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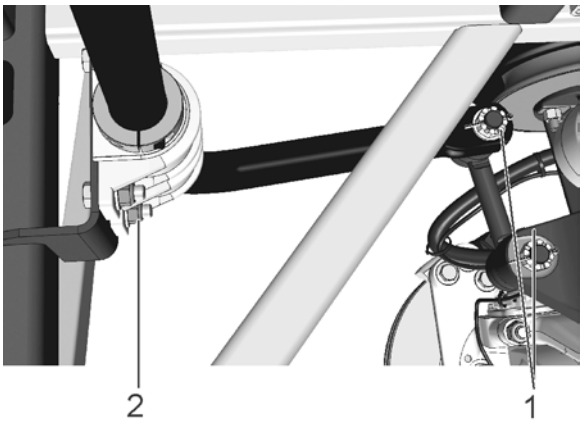
1 TORQUE TABLES

1.1 FRONT I-BEAM AXLE AND RELATED COMPONENTS



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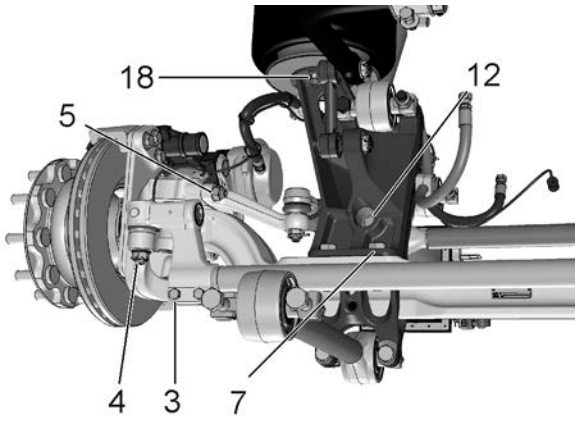

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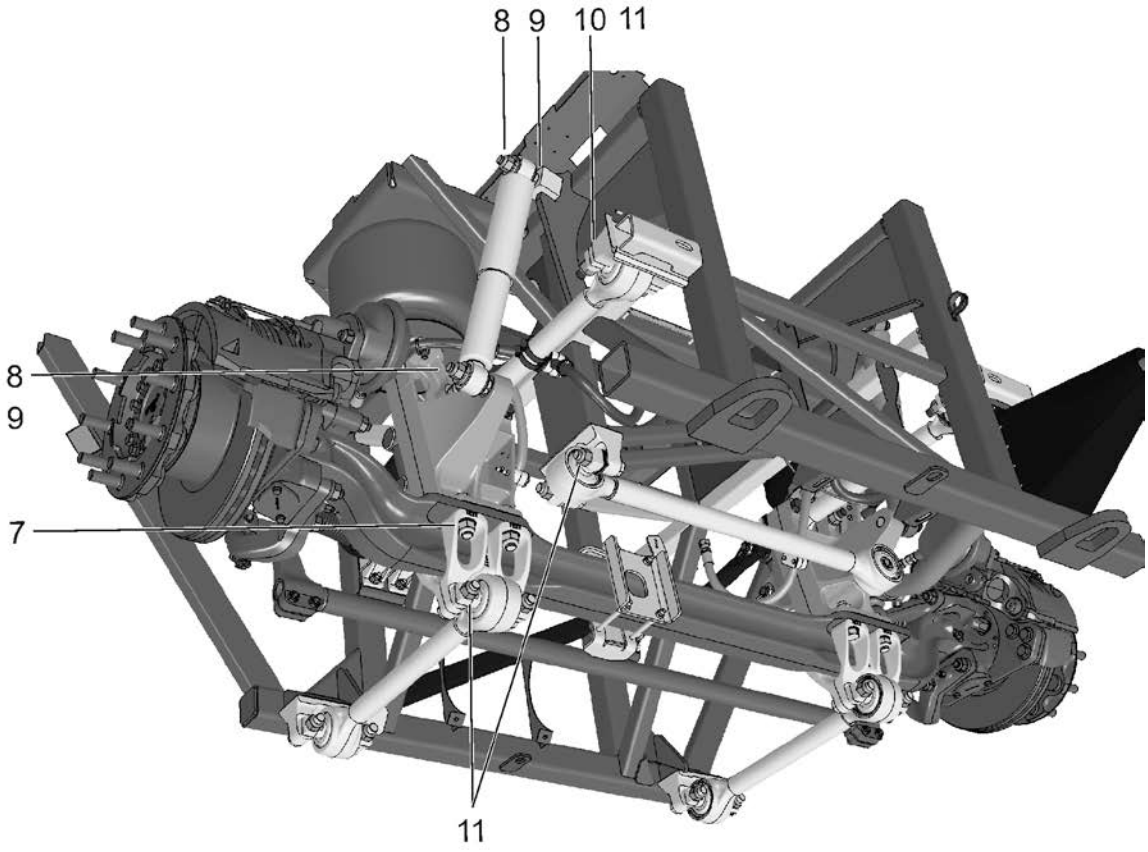

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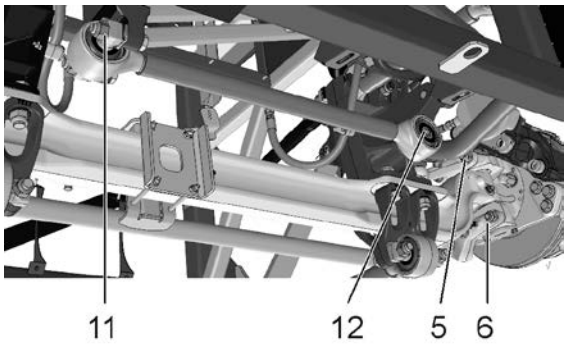

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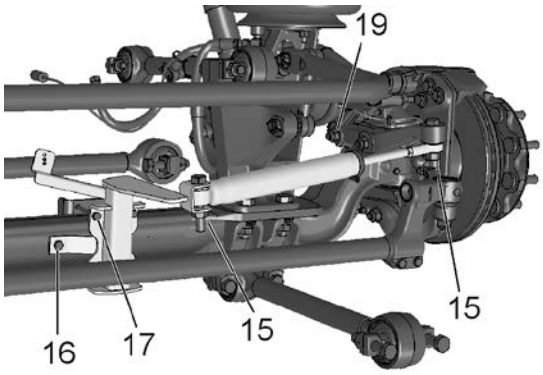

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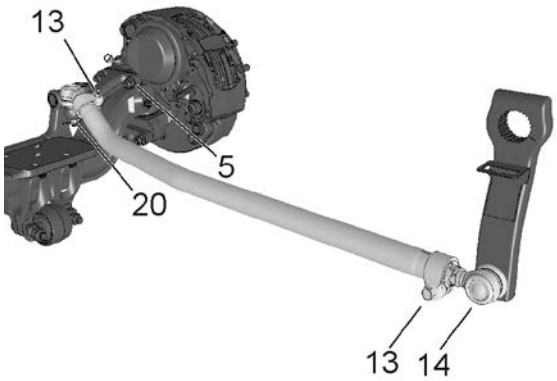
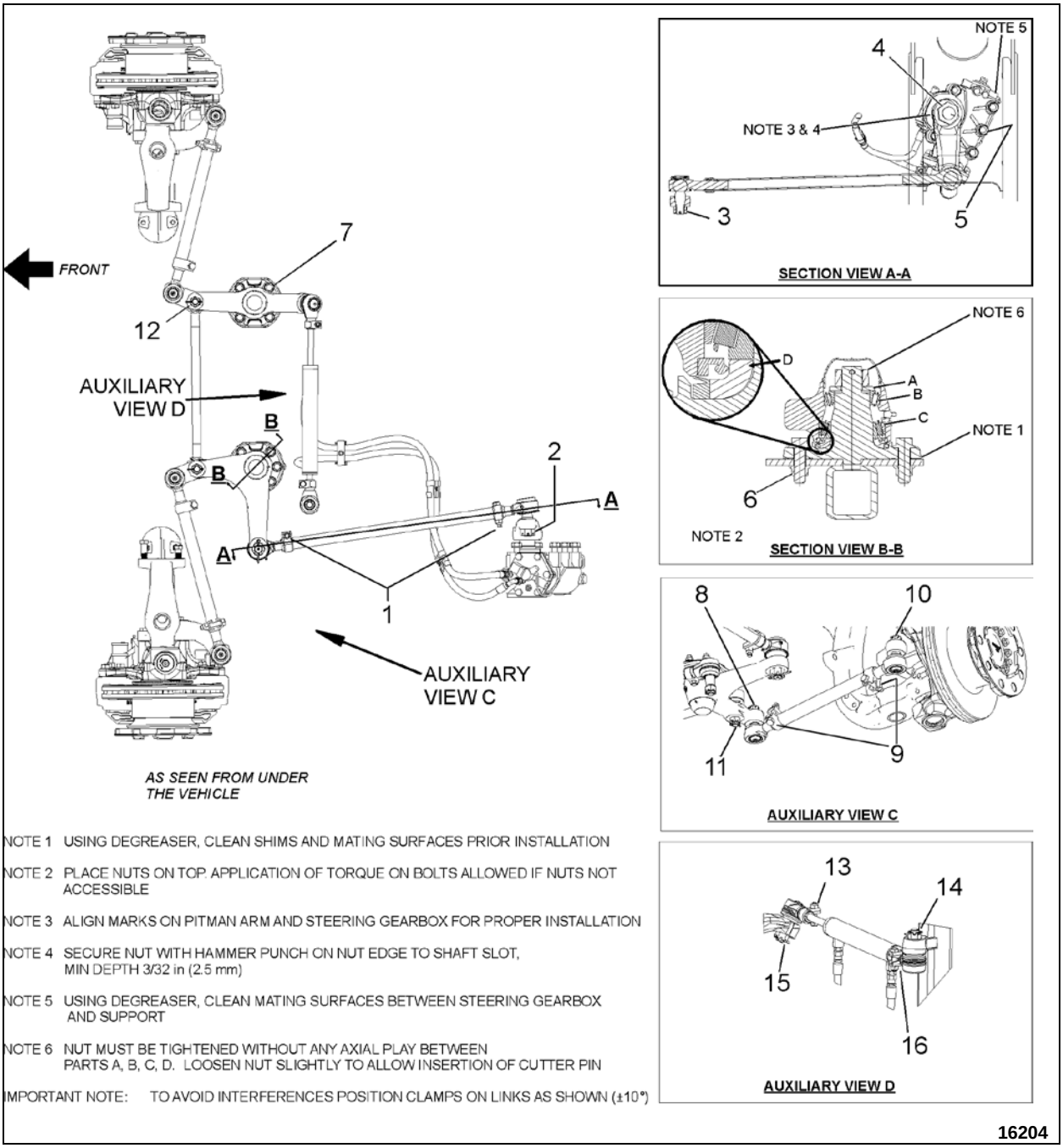


16194_1

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 bolts	4	65-75 lb-ft (88-102 Nm)
4	Tie rod end ball pin nuts	2	150-200 lb-ft (203-271 Nm)
5	Steering arm stud nuts	2	285-315 lb-ft (386-427 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)
13	Drag link clamp bolts	2	118-133 lb-ft (160-180 Nm)
14	Drag link ball joint stud nut, fore	1	165-236 lb-ft (224-320 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)
20	Drag link ball joint stud nut, aft	1	140-200 lb-ft (190-271 Nm)

1.2 INDEPENDENT FRONT SUSPENSION



NOTE 1 USING DEGREASER, CLEAN SHIMS AND MATING SURFACES PRIOR INSTALLATION

NOTE 2 PLACE NUTS ON TOP. APPLICATION OF TORQUE ON BOLTS ALLOWED IF NUTS NOT ACCESSIBLE

NOTE 3 ALIGN MARKS ON PITMAN ARM AND STEERING GEARBOX FOR PROPER INSTALLATION

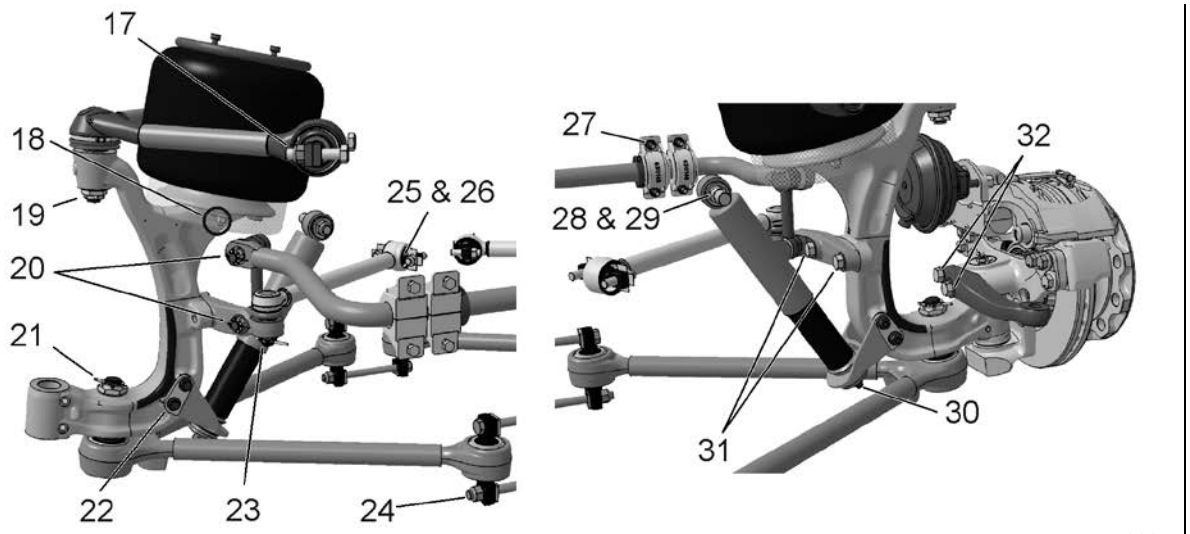
NOTE 4 SECURE NUT WITH HAMMER PUNCH ON NUT EDGE TO SHAFT SLOT, MIN DEPTH 3/32 in (2.5 mm)

NOTE 5 USING DEGREASER, CLEAN MATING SURFACES BETWEEN STEERING GEARBOX AND SUPPORT

NOTE 6 NUT MUST BE TIGHTENED WITHOUT ANY AXIAL PLAY BETWEEN PARTS A, B, C, D. LOOSEN NUT SLIGHTLY TO ALLOW INSERTION OF CUTTER PIN

IMPORTANT NOTE: TO AVOID INTERFERENCES POSITION CLAMPS ON LINKS AS SHOWN (±10°)

16204



16205

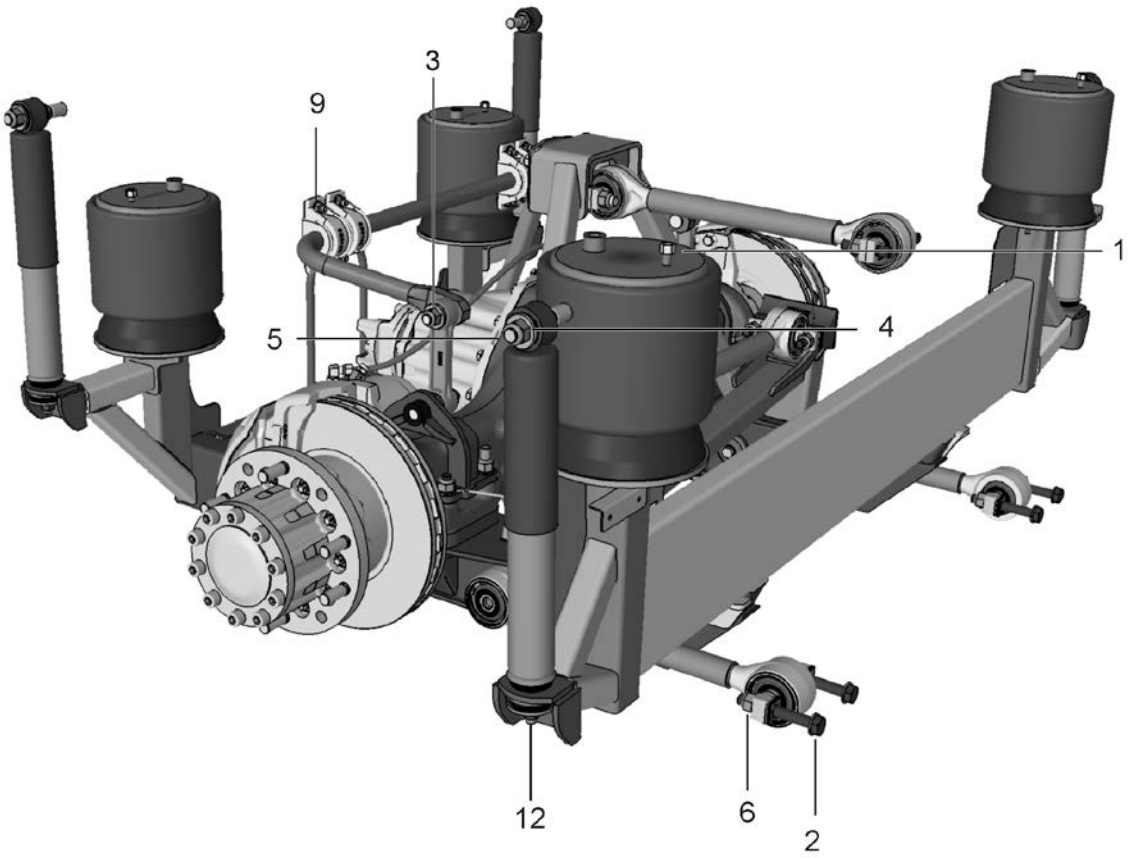
INDEPENDENT FRONT SUSPENSION			
No	DESCRIPTION	QTY	TORQUE (dry)
1	Drag link socket end clamp pinch bolt	2	50-60 lb-ft (68-81 Nm)
2	Drag link ball stud nut to pitman arm	1	245-270 lb-ft (332-366 Nm)
3	Drag link ball stud nut to bell crank	1	245-270 lb-ft (332-366 Nm)
4	Pitman arm to steering gear fixing nut	1	470-570 lb-ft (637-773 Nm)
5	Steering gearbox to mounting bracket bolt	5	365-405 lb-ft (495-549 Nm)
6	Bell crank spindle mounting nut	6	208-254 lb-ft (282-344 Nm)
7	Idler arm spindle mounting nut	6	208-254 lb-ft (282-344 Nm)
8	Tie rod end ball stud nut to idler arm or bell crank	2	150-200 lb-ft (203-271 Nm)
9	Tie rod end clamp pinch bolt	4	50-60 lb-ft (68-81 Nm)
10	Tie rod end ball stud nut to steering arm stud *****	2	150-200 lb-ft (203-271 Nm)
11	Relay rod stud nut to bell crank *****	1	150-200 lb-ft (203-271 Nm)
12	Relay rod stud nut to idler arm *****	1	150-200 lb-ft (203-271 Nm)
13	Hydraulic power cylinder end clamp pinch bolt	1	50-60 lb-ft (68-81 Nm)
14	Hydraulic power cylinder to bracket stud nut*****	1	150-200 lb-ft (203-271 Nm)
15	Hydraulic power cylinder to idler arm stud nut*****	1	150-200 lb-ft (203-271 Nm)
16	Hydraulic power cylinder end clamp pinch bolt	1	50-60 lb-ft (68-81 Nm)
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)

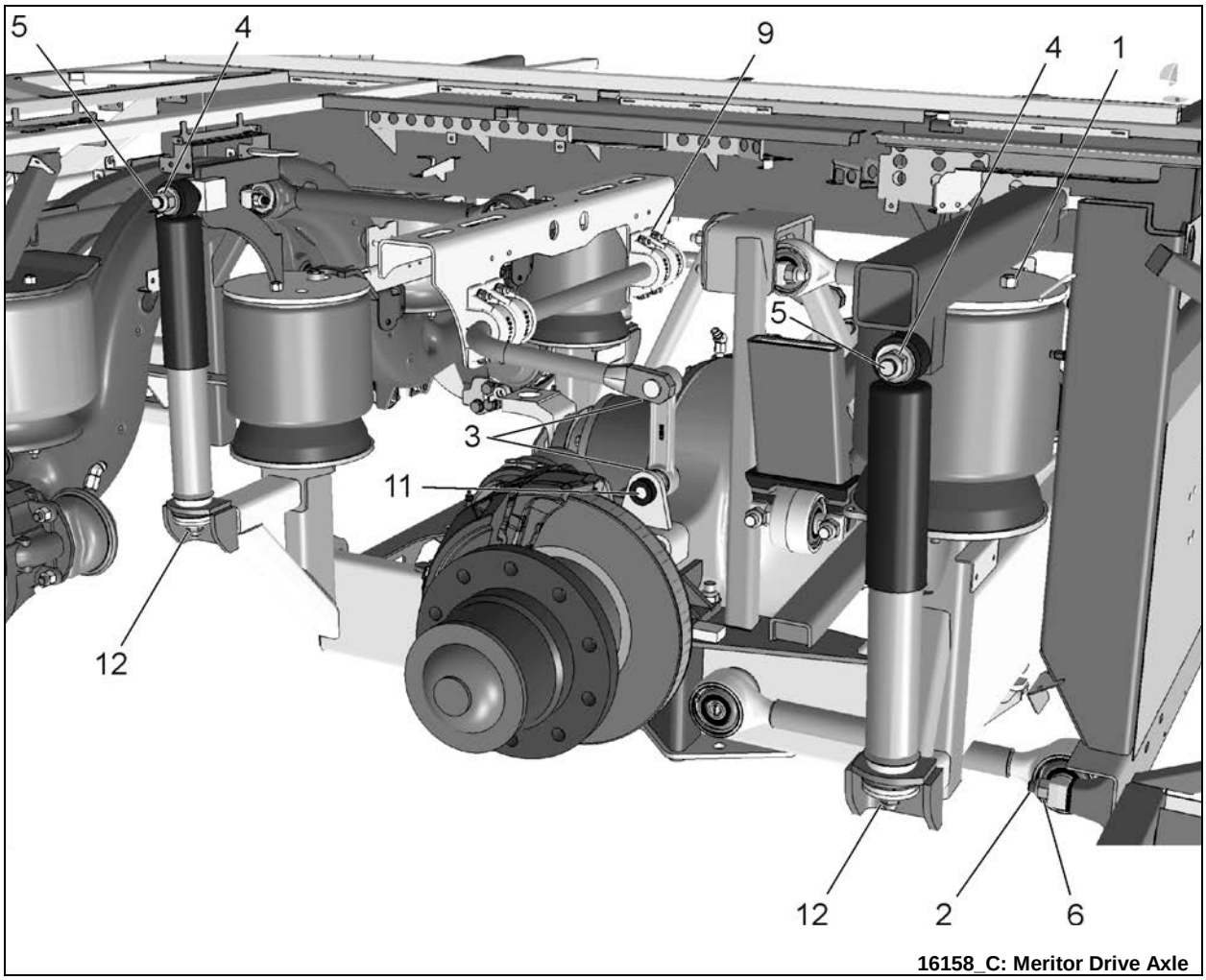
* Tighten nut to specified torque, then advance to next aligning cotter pin slot and install a new cotter pin.

NOTE
Apply corrosion-protective compound on exposed threads.

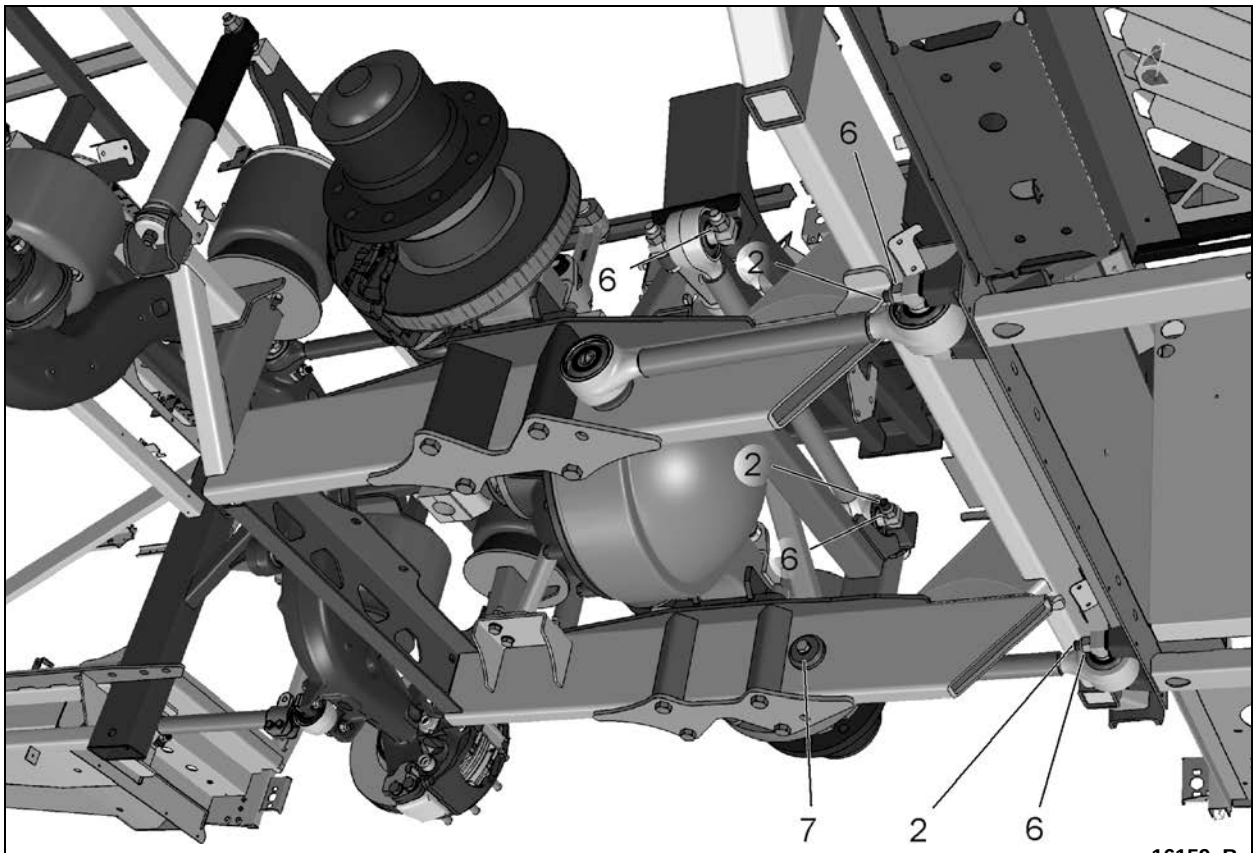
1.3 REAR SUSPENSION



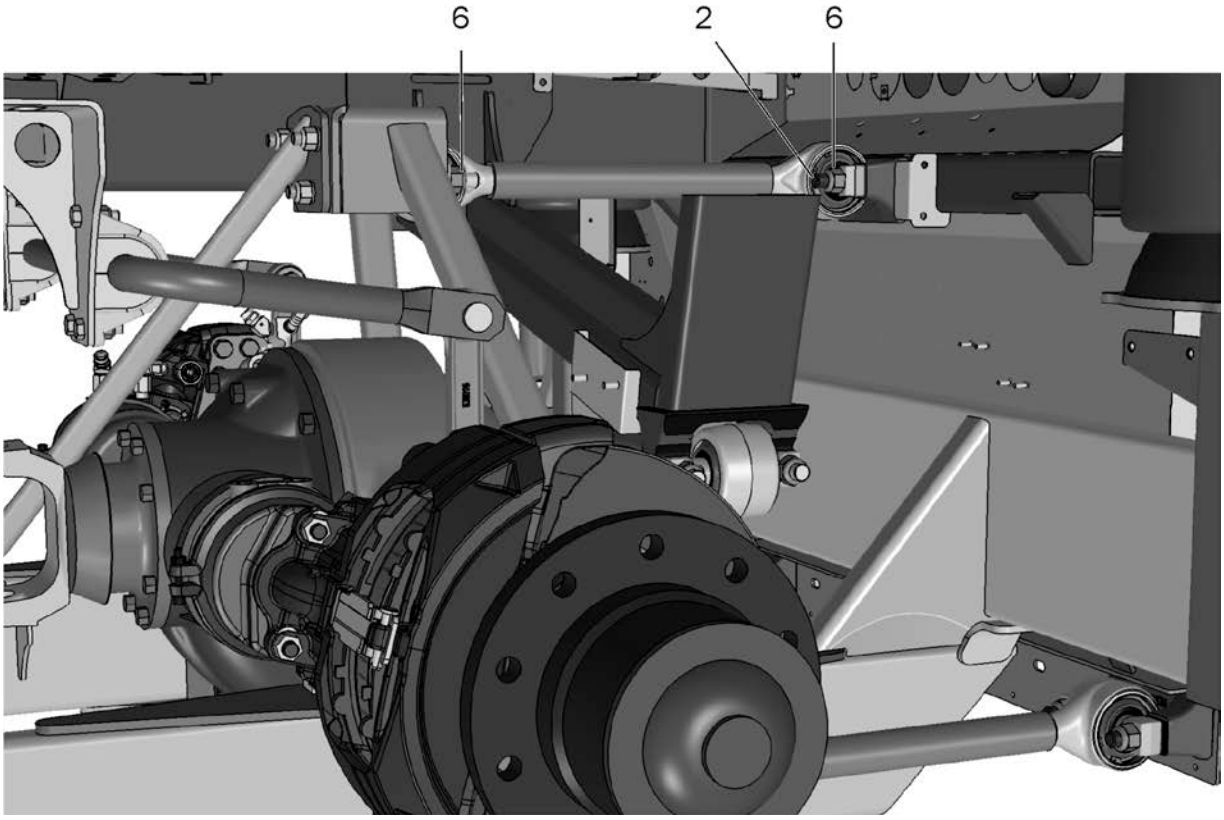
16206:
ZF drive axle



16158_C: Meritor Drive Axle



16159_B



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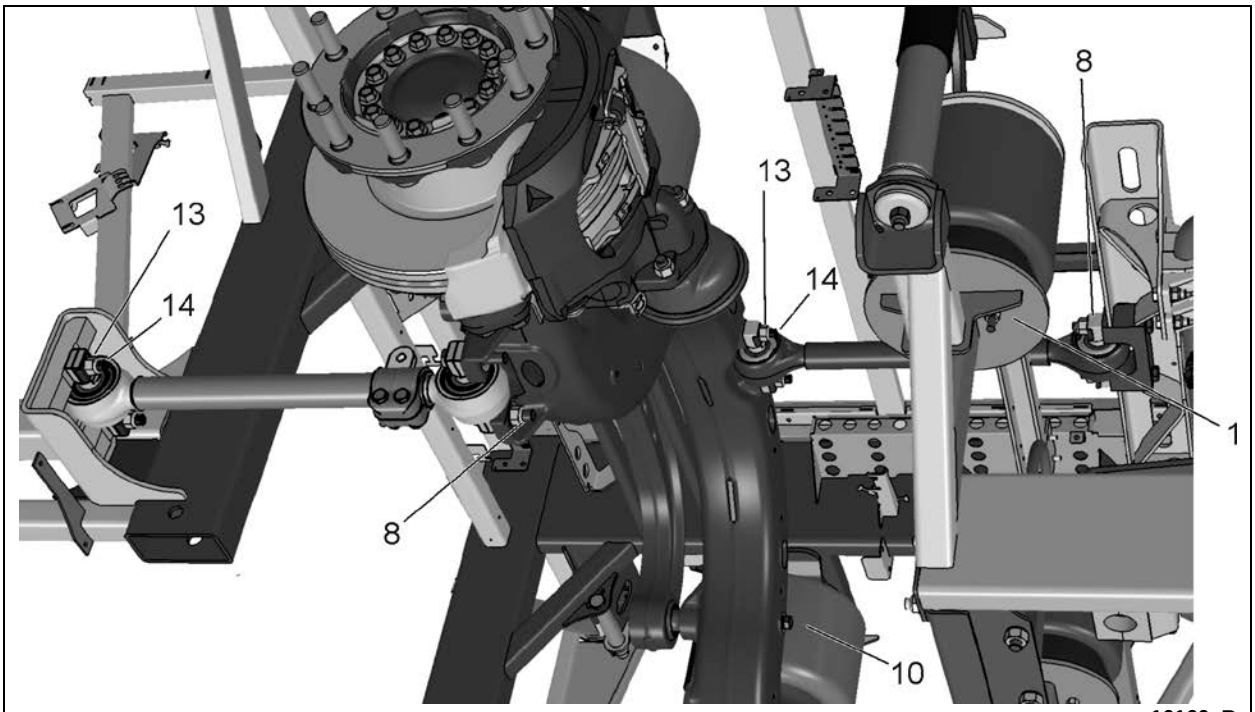

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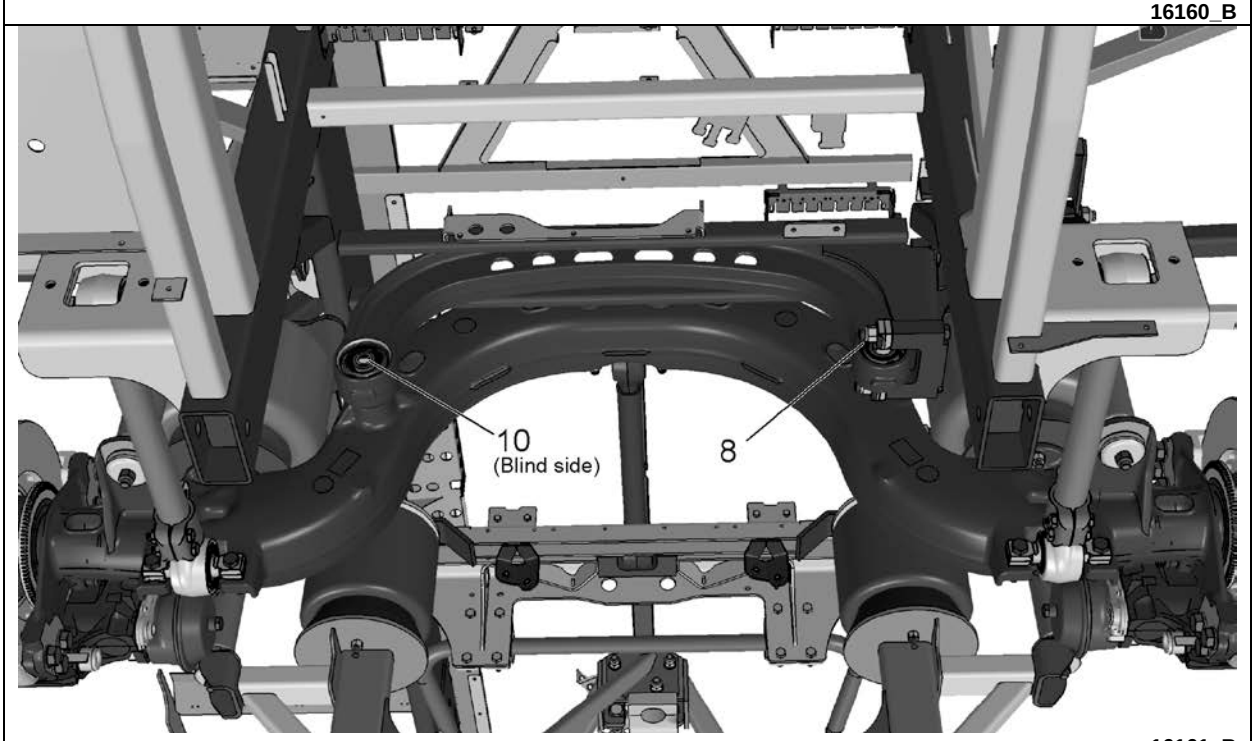


16161_B

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.

2 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

3 FRONT I-BEAM AXLE SUSPENSION

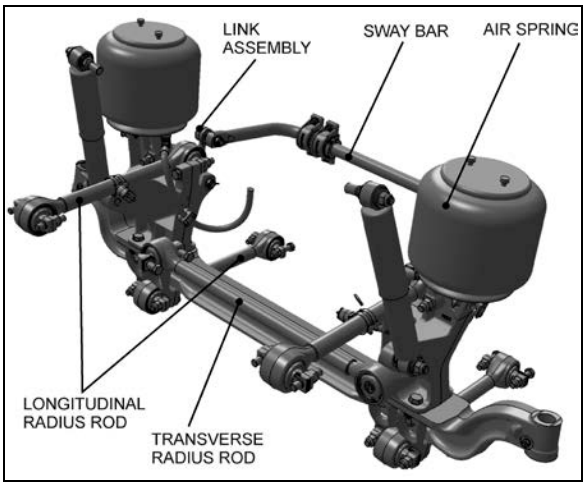


FIGURE 1: FRONT I-BEAM AXLE SUSPENSION 16105

3.1 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.

3.1.1 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.

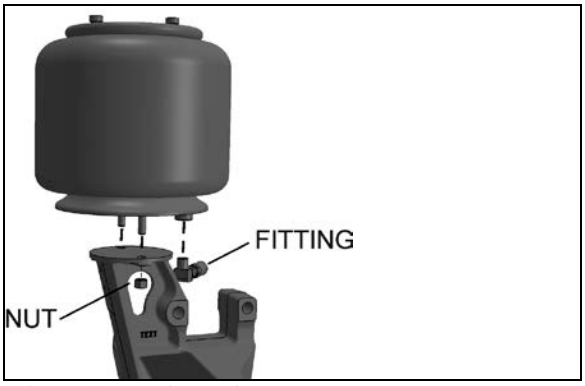


FIGURE 2: AIR SPRING 16052

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.

3.1.2 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.

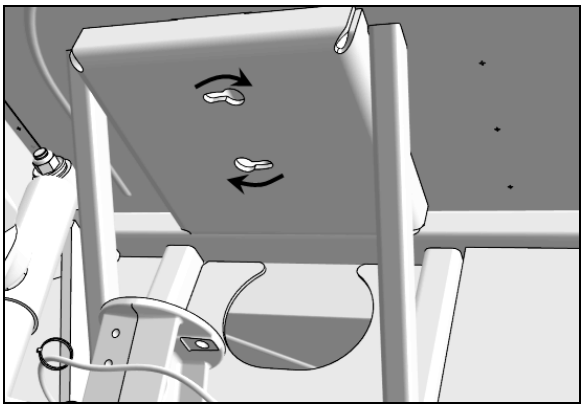


FIGURE 3: AIR SPRING UPPER MOUNTING PLATE

3.1.3 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.

3.2 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.

3.2.1 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.

3.2.2 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.

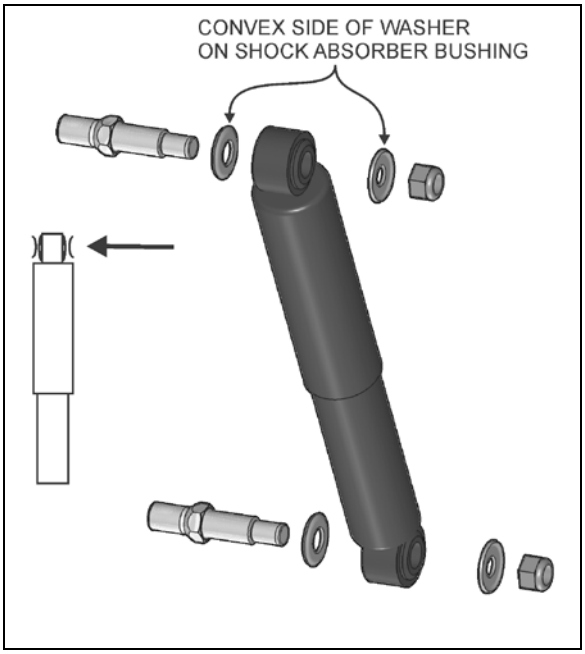


FIGURE 4: SHOCK ABSORBER 16008

3.2.3 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.

3.3 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.

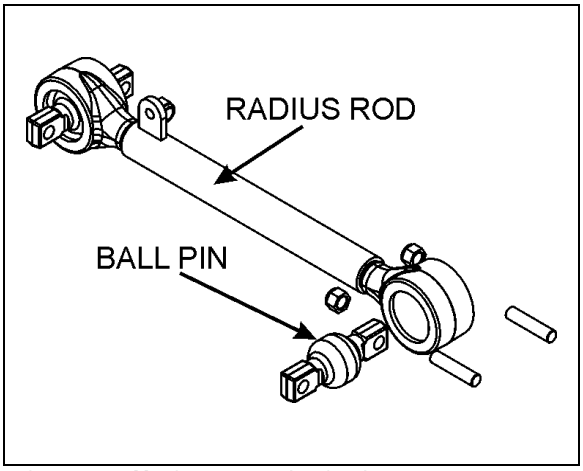


FIGURE 5: TYPICAL RADIUS ROD SETUP 16010

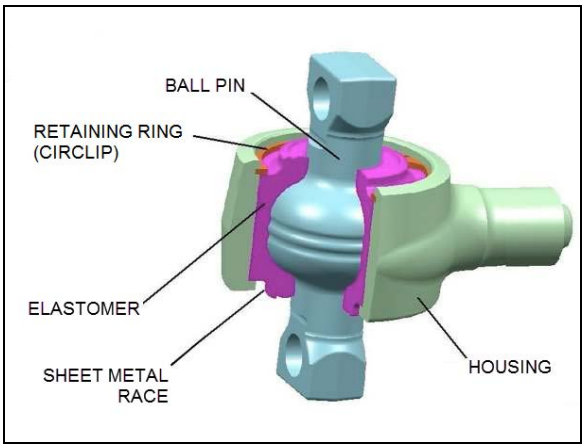


FIGURE 6: BALL PIN JOINT CONSTRUCTION 16186

3.3.1 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.

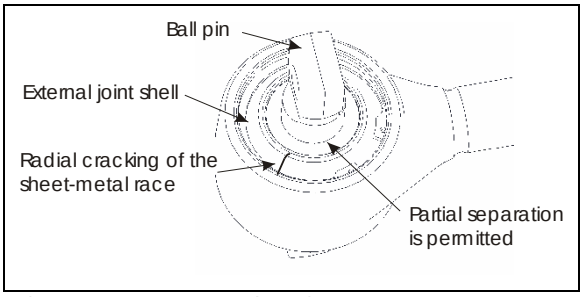


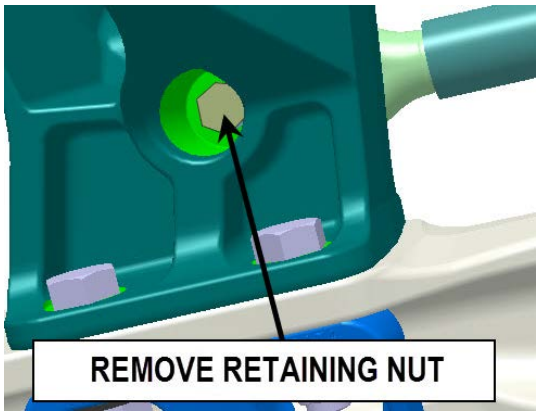
FIGURE 7: BALL PIN BUSHING

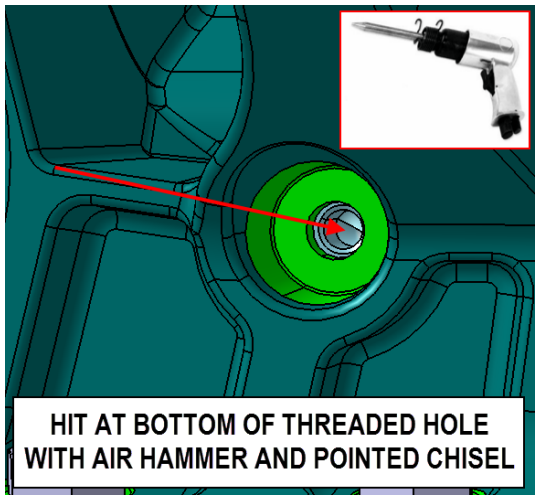
3.3.2 Radius Rod Removal

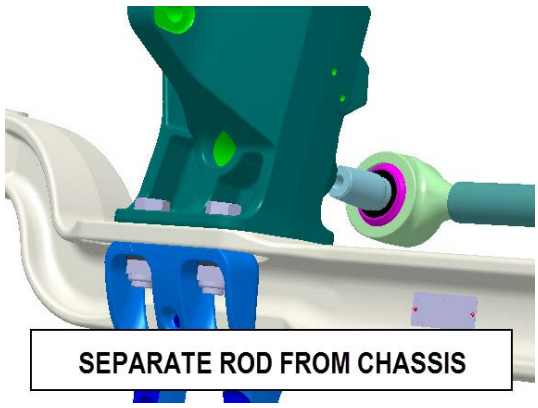
1. Unscrew the nuts (or bolts) at each extremity of the radius rod.
2. Remove the radius rod.

NOTE

One end of the transversal radius rod is fitted with a conical (tapper) 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 tapper radius rods; this could lead to cracking and/or deformations of the cast parts.

3.3.3 Stripping Down

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

Clean out housing bore and Circlip groove.

3.3.4 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.

3.3.5 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.

3.4 SWAY BAR

A sway bar is connected to the front axle to increase vehicle stability. It controls lateral motion (swaying movement) of the vehicle (Figure 8).

3.4.1 Removal

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

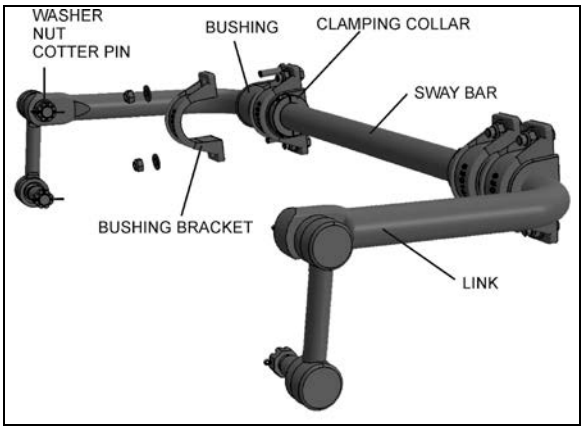


FIGURE 8: SWAY BAR 16028

NOTE
Sway bar bushings are slit to ease their removal.

3.4.2 Installation

1. Loosely install the sway bar.
2. Tighten the eight bushing brackets nuts according to Torque Table 1 under heading Torque Specifications.
3. Tighten sway bar link upper nuts and lower nuts according to Torque Table 1 under heading Torque Specifications.
4. Install a cotter pin on each nut and bend.

4 INDEPENDENT FRONT SUSPENSION (IFS)

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

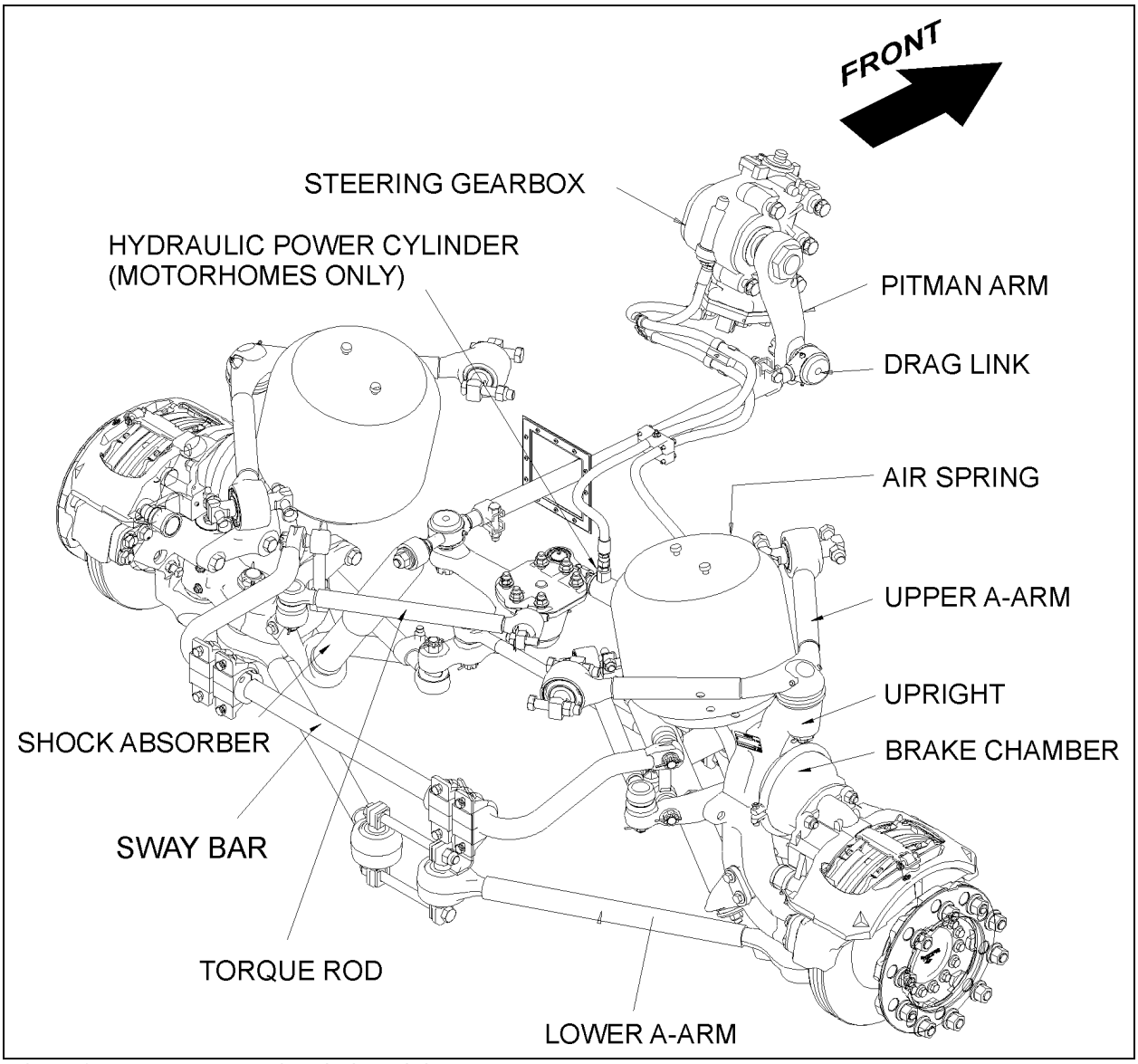


FIGURE 9: INDEPENDENT FRONT SUSPENSION 16124

4.1 STEERING LINKAGE

Turning motion of the steering wheel is transferred by the steering gear and steering linkage to the steering arms at the right and left front wheels. The steering linkage consists of tie rods connected to the bell crank and the steering arm at the left side of the coach, and to the idler arm and steering arm at the right side of the coach. The bell crank and idler arm are connected by a relay rod. A drag link connected to the bell crank and the pitman arm, which is mounted to the steering gear, transfers the turning motion of the steering wheel to the steering arms. On VIP series, a hydraulic power cylinder connected to the R.H. wheel provides an added source of assistance and ensures that the

total steering forces are produced with minimal stress on mechanical linkages.

Lower and upper A-arms are widely spaced. They are mounted on ball joints. Torque rods prevent rotation of the uprights around the lower and upper ball joints.

If the steering linkage is bent, twisted or worn, steering action of the coach will be seriously affected. Any time steering linkage components are replaced or adjusted, steering geometry and front wheel alignment must be checked as explained in this section.

Turning Angle

The maximum turning angle is set mechanically through the two steering stop screws installed on the swivel assembly. The turning angle mechanical stop is factory adjusted to accommodate the chassis design, and therefore, does not require adjustment on new vehicles.

However, turning angle should be checked and hydraulically adjusted, if necessary, any time a component of the steering system is repaired, disassembled or adjusted.

Turning angles are as follows:

Exterior: 49.5° ± 0.5°

Interior: 58° ± 0.5°

Before checking the turning angle, be sure the front end is properly aligned as described under paragraph FRONT END ALIGNMENT in this section.

To check steering maximum turning angle, proceed with the following method:

1. Lift the vehicle using the axles lifting points. Suspension must be at normal ride height.

2. Check if front tires rub against the frame or if the steering gear has been serviced.

3. While performing a full left and right turn, check for proper position of the tie rod end clamp bolt and nut and drag link end clamps in order to avoid clamps interfering with close parts. Refer to FIGURE 17 & FIGURE 18 for location and positioning of clamp bolts and nuts. Reposition if required.

CAUTION

Clamp bolts are either in a vertical or horizontal position. Reinstall clamp bolts exactly as they were before removal as they might interfere with other components.

4. If necessary readjust hydraulic steering limiter. Refer to these manuals annexed to the Maintenance Manual, Section 14: STEERING:

   - ZF-SERVOCOM Types 8090-8099 Single and Dual-Circuit Versions Repair Manual.
   - ZF-SERVOCOM Types 8090, 8095, 8097 and 8098 Design, Operation' Maintenance, Inspection.

NOTE

Prior to hydraulic steering limiter adjustment, verify vehicle wheel alignment, and ensure that oil level is adequate and that air bleeding is done.

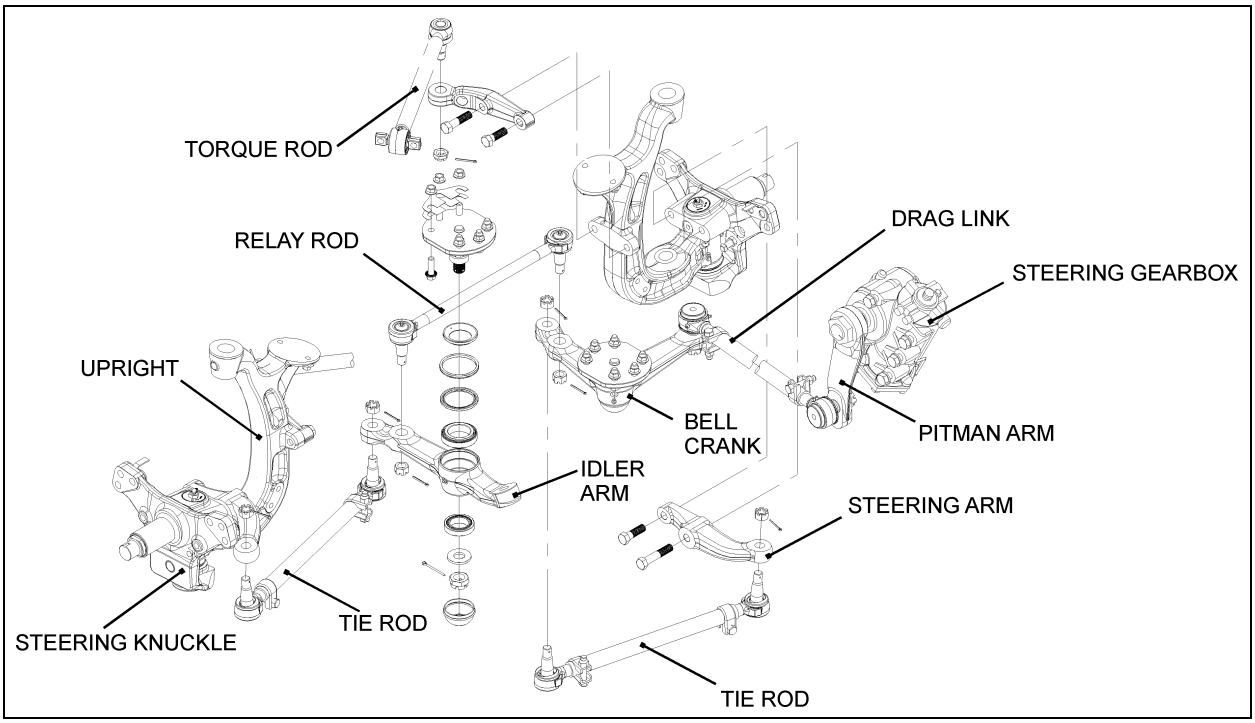


FIGURE 10: IFS STEERING LINKAGE OVERVIEW

4.2 STEERING LINKAGE INSTALLATION SEQUENCE

NOTE
Whenever a steering linkage component has been removed and replaced, check steering geometry and front end alignment as directed in this Section. Check to insure that all stud nuts and mounting bolts and nuts have been tightened to prescribed torque.

1. Position front wheels in straight ahead position.
2. Align the steering gearbox input shaft marks.
3. Afterwards, the pitman arm should be adjusted with output shaft and pitman arm reference marks aligned (for proper tightening torque, refer to Torque Table 2).

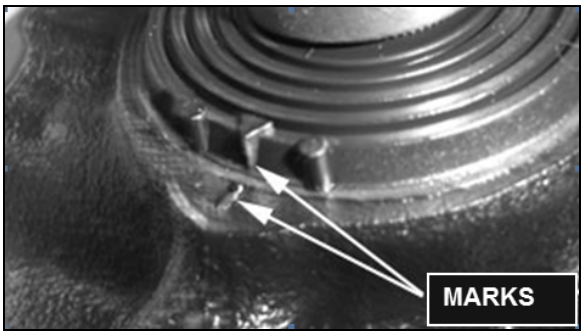


FIGURE 11: STEERING GEARBOX INPUT SHAFT MARKS

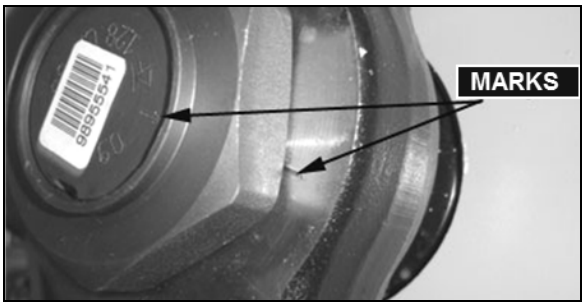


FIGURE 12: STEERING GEARBOX OUTPUT SHAFT AND PITMAN ARM MARKS ALIGNED

4. Locate centerline of vehicle then install relay rod in boss at steering bell crank and idler arm. Align center of relay rod with centerline of vehicle.
5. Install drag link to pitman arm and adjust opposite end of drag link to fit ball stud hole in bell crank.
6. Install tie rods then adjust toe-in as described in "Front End Alignment" in this section (for proper tightening torque, refer to Torque Table 2).

4.3 PITMAN ARM

4.3.1 Removal

1. Remove cotter pin, nut and washer from drag link ball stud at pitman arm.
2. Disconnect drag link from pitman arm, using jaw style pullers (pressure screw type).

WARNING

Always wear approved eye protection when operating pullers.

CAUTION

Do not drive pitman arm on or off sector gear shaft as this can damage the steering gear.

CAUTION

Heating of components to aid in disassembly is not allowed because it has a detrimental effect on axle components and steering linkage.

3. Remove pitman arm hold down nut.
4. Check the radial position of the pitman arm in relation to the sector shaft prior removal of pitman arm.
5. Locate the reference marks to the arm and shaft to ensure correct alignment at reassembly.
6. Use a puller to remove pitman arm.

4.3.2 Installation

1. Position pitman arm on sector gear shaft with reference marks aligned.
2. Install hold down nut. Tighten nut (dry) as per Torque Table 2.

NOTE
Use a new nut if the previously removed nut was punched.

CAUTION

Lock nut with sector shaft using a punch mark into the groove, minimum depth 3/32 inch (2.5mm) (see Figure 13).

FIGURE 13: FIXING NUT PUNCH MARK 16098

3. Connect drag link to pitman arm. Ball stud and taper bore must be clean and free of grease. Install washers. Tighten nut (dry) as per Torque Table 2. Advance nut to next alignment cotter pin slot and install a new cotter pin.

4.4 DRAG LINK

Drag link assembly consists of three parts; a drag link and two end assemblies. Both end assemblies are identical and they are retained on the drag link with a clamp bolt and nut.

Stud nuts at the pitman arm and bell crank ends of the drag link must be kept tight or hole at ball stud end of drag link and hole in pitman arm may become enlarged as a result of excessive looseness. Subsequent tightening of stud nuts may draw studs too far into holes and dust cover parts may become damaged which can result in component failure.

Drag link end sockets are equipped with lubrication fittings and should be lubricated as directed in "Lubrication Fittings" in this section.

NOTE

The drag link nominal length is 41 17/32 inch (1055 mm) measured from the center of one ball socket to the other. Nominal length is given only for preliminary adjustment.

4.4.1 Adjustment

It should not be necessary to alter the length of the drag link except when a new link is installed or when removable end assembly has been replaced. If drag link adjustment is necessary, proceed as follows:

1. Position front wheels in straight ahead position.
2. Center steering gear as previously explained in "Steering Linkage Installation Sequence".
3. Remove cotter pin, nut and stud from drag link at bell crank. Locate centerline of vehicle and center of relay rod. With center of relay rod aligned with centerline of vehicle, loosen clamp bolt at socket end (bell crank end) of drag link and adjust length of socket end assembly to fit in boss of bell crank.

NOTE

Do not change position of pitman arm.

4. Install stud with nut and torque to proper torque. Ball stud and taper bore must be clean and free of grease. Align nut with cotter pin slot (tighten) and install a new cotter pin.
5. Torque mounting clamp bolt nut to prescribed torque, then test the adjustment. Front wheels should turn from full right to full left end of stroke without noticeable binding at drag link ends.

CAUTION

Clamp bolts are either in a vertical or horizontal position. Reinstall clamp bolts exactly as they were before removal as they might interfere with other components.

4.5 BELL CRANK AND IDLER ARM

Bell crank and idler arm are equipped with one lubrication fitting and should be lubricated as directed in "Lubrication Fittings" in this section.

4.5.1 Bell Crank or Idler Arm Removal

NOTE

Use a piece of wire to support loosen end of relay rod and tie rod in order to prevent placing an excessive load on opposite socket end.

Bell crank: Disconnect drag link, tie rod and relay rod from bell crank by removing cotter pins and nuts from ball studs. Separate socket assemblies from the bell crank.

Idler arm: Remove cotter pins and nuts from ball studs connecting relay rod, tie rod and hydraulic power cylinder to idler arm. Separate socket assemblies from idler arm.

Remove nuts from bolts attaching bell crank or idler arm mounting spindle to vehicle subframe. Remove bell crank or idler arm mounting spindle.

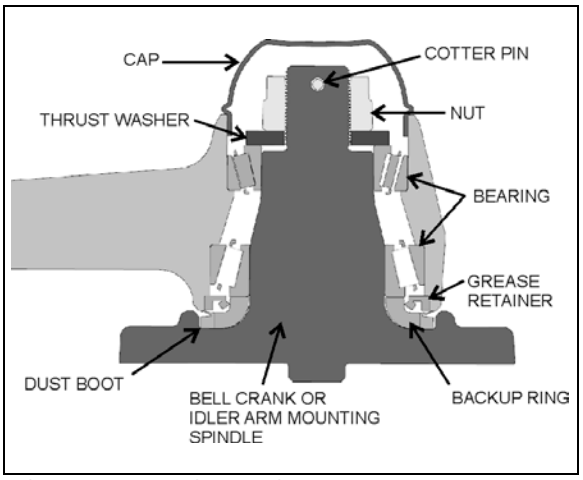


FIGURE 14: BELL CRANK OR IDLER ARM HUB

4.5.2 Bell crank or Idler Arm Hub Disassembly

1. Remove adjacent link assemblies from bell crank or idler arm as previously described.
2. Remove the cap (Figure 14).
3. Remove the cotter pin, nut and thrust washer. Remove bearings, grease retainer, backup ring and the bell crank or idler arm from its mounting spindle (Figure 14).

4.5.3 Bell Crank or Idler Arm Hub Reassembly

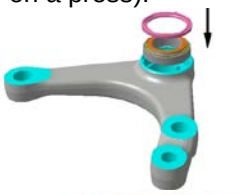
NOTE
For bearing installation use tool Prevost # 110684.

NOTE
Install grease retainer according to Figure 14. Grease must be able to exit the bell crank or idler arm mechanism. For grease retainer installation use tool Prevost # 110683.

NOTE
Apply grease on bearings before installation.

1. Clean parts thoroughly with degreaser.
2. Insert the small bearing outer race into appropriate bore (done on a press).

3. Insert the large bearing outer race into appropriate bore (done on a press).
4. Insert the large bearing into outer race and then, add grease retainer.



5. Apply good quality lithium grease (#680752) on backup ring and dust boot.

6. Install backup ring and dust boot on bell crank or idler arm spindle.
7. Apply a thin layer of grease on spindle shaft.
8. Install bell crank or idler arm onto its mounting spindle, while holding the bell crank or idler arm, slide on the small bearing assembly, thrust washer and secure using nut.

9. Tighten nut.

TORQUE:130 lb-ft (176 Nm)

10. Rotate assembly 3 turns in each direction.

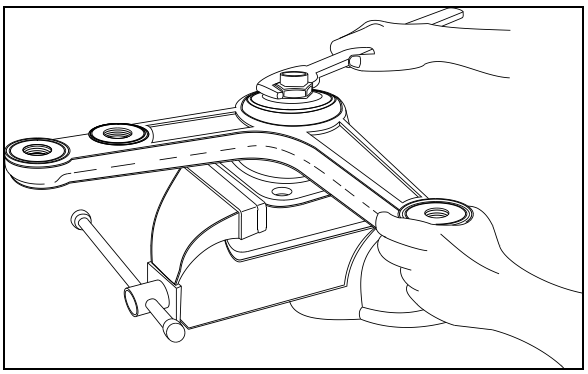


FIGURE 15: BELL CRANK 16044

11. Unscrew nut until bell crank or idler arm starts to turn with the application of 1 to 3 lbs force load as shown on Figure 16.
12. Check for loose bearings by applying an up and down load on bell crank or idler lever. The lever is not supposed to move in the vertical axis direction.

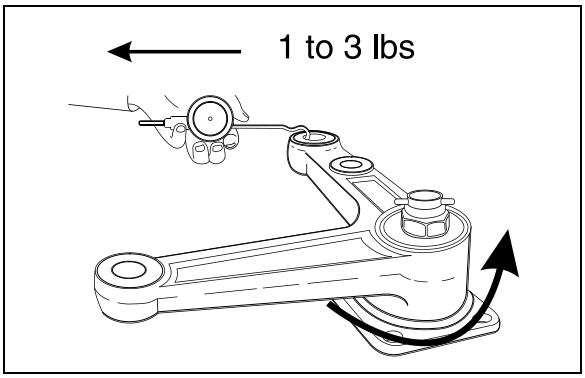


FIGURE 16: BELL CRANK 16045

13. Align nut with cotter pin slot (tighten) and install a new cotter pin.

NOTE
Bend cotter pin around the nut. Do not bend the cotter pin in the direction of the cap as it may interfere with the cap.

14. Install the cap.
15. **Bell crank:** Install drag link, tie rod and relay rod as directed herein under each specific subject.
16. **Idler arm:** Install hydraulic power cylinder, tie rod and relay rod as directed herein under each specific subject.
17. Adjust turning angle as previously directed under paragraph "**Turning Angle**" and check front end alignment as specified under heading “Front End Alignment".

4.6 RELAY ROD

Relay rod ends are equipped with lubrication fittings and should be lubricated as directed in “Lubrication Fittings” in this section.

NOTE
The relay rod is crimped in place and it is not possible to remove and replace the ball joint socket end assemblies.

4.6.1 Replacement

1. Remove cotter pins from bell crank and idler arm end of relay rod. Loosen nuts flush with end of studs.
2. Use a puller or place a sledge hammer behind the adjacent part to absorb shocks. Strike the studs with a brass hammer to loosen end assemblies.
3. Remove stud nuts then remove relay rod.
4. Position new relay rod studs into bell crank and idler arm then tap stud ends with a brass hammer to seat tapered surfaces. Ball stud and taper bore must be clean and free of grease.
5. Install stud nuts. Tighten nuts to prescribed torque (refer to Torque Table 2). Align cotter pin slot (tighten) and install a new cotter pin.

4.7 TIE RODS

Tie rod ends are connected to the bell crank and left steering arm, and to the idler arm and right steering arm. Each tie rod assembly consists of three parts; a tube and two socket end assemblies. The tie rod ends are threaded into the tube and secured with clamp bolts. Right and left hand threads are provided to ease toe-in adjustment. Tie rod assemblies are inter-changeable from the right to the left side of the coach.

Tie rod end sockets require periodic lubrication and inspection to see that ball studs are tight. Replace socket ends when there is excessive up and down motion, lost motion or end play at ball end of stud.

1. Periodically check bolt nut for tightness.
2. Inspect tie rod for bent condition and inspect tube for damaged threads. If tie rod is bent or threads are damaged, replace the assembly.
3. Lubricate tie rod end fittings as directed in "Lubrication Fittings" in this section.

4.7.1 Removal

1. Remove cotter pins and stud nuts which attach tie rod socket ends to bell crank and left steering arm (or idler arm) and right steering arm.

2. Remove tie rod ball stud by tapping on steering arm and bell crank or idler arm with brass hammer, while using a sledge hammer to absorb shocks.

NOTE
If tie rod end assemblies are damaged in any way, they must be replaced

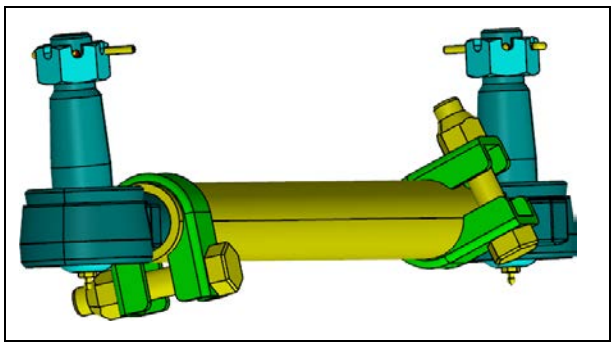
4.7.2 Installation

1. Install socket end assemblies on tie rod. Be sure both ends are threaded an equal distance into the tube.
2. Make sure threads on stud and in stud nut are clean and not damaged.
3. Position ball studs (socket ends of tie rod) in holes in steering arm and bell crank or idler arm. Ball stud and taper bore must be clean and free of grease. Install a ball stud nut on each stud and tighten firmly.
4. Torque stud nuts to prescribed torque (refer to Torque Table 2). Align cotter pin slot (tighten) and install a new cotter pin.

NOTE
Adjust toe-in as directed under heading "Toe-In Adjustment" in this section.

5. Make sure tie rod ends are properly aligned with ball studs, and then torque tie rod end clamp bolts to prescribed torque (refer to Torque Table 2).

CAUTION
Reinstall tie rod clamp as per FIGURE 17 & FIGURE 18 as they might interfere with other components.



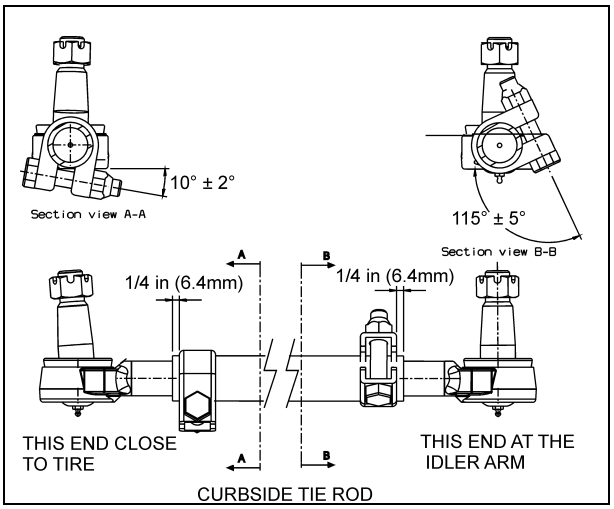


FIGURE 17: CURBSIDE TIE ROD - CLAMPS POSITION
16199

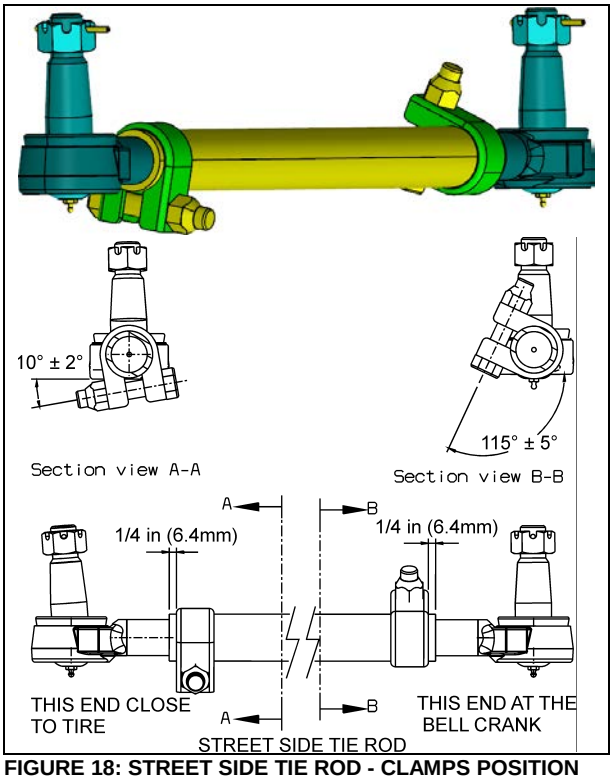


FIGURE 18: STREET SIDE TIE ROD - CLAMPS POSITION
16200

NOTE
If tie rod is not properly aligned with stud, binding will result.

4.8 STEERING ARMS

The left and right wheel steering arms are secured to a steering knuckle at one end and to a tie rod at the other end.

4.8.1 Removal

1. Remove wheel as directed in Section 13, "Wheel, Hubs and Tires" of the maintenance manual.
2. Remove cotter pin and nut from stud securing tie rod to steering arm. Remove ball stud from steering arm by tapping on arm with a hammer, placing a sledge hammer underneath steering arm to absorb shocks.
3. Remove bolts securing steering arm to steering knuckle assembly. Remove steering arm from steering knuckle.

4.8.2 Installation

1. Install steering arm onto steering knuckle.
2. Torque steering arm to steering knuckle fixing bolts. Torque bolt to prescribed torque (refer to Torque Table 2).
3. Position tie rod ball stud in steering arm and tap with a brass hammer to seat ball stud in steering arm. Ball stud and taper bore must be clean and free of grease. Install nut on stud. Torque nut to prescribed torque (refer to Torque Table 2. Tighten nut to nearest cotter pin slot and install a new cotter pin.
4. Install wheel as directed in Section 13, "Wheel, Hubs and Tires" under paragraph "Installation" of the maintenance manual.

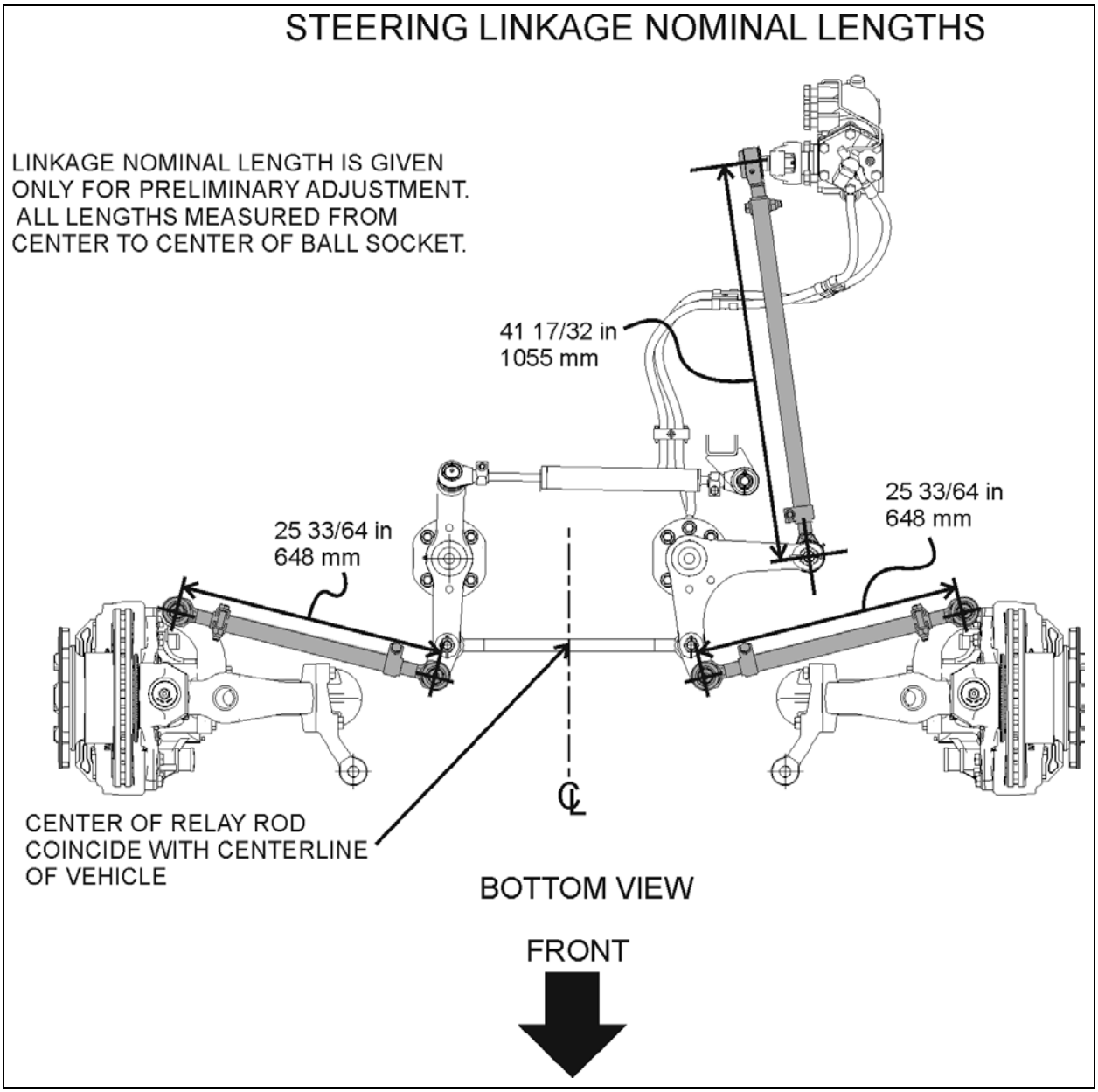


FIGURE 19: STEERING LINKAGE NOMINAL LENGTHS 16202

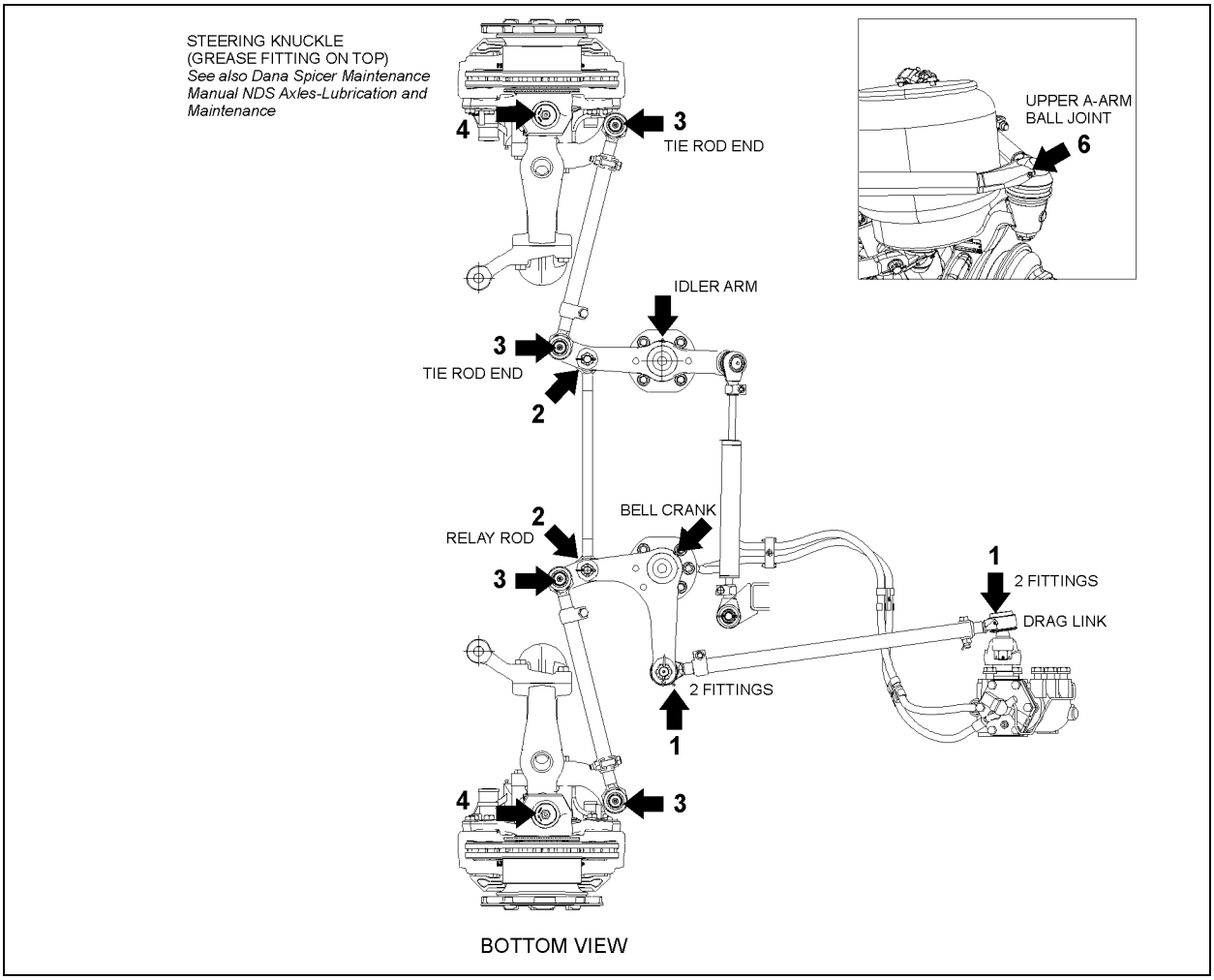


FIGURE 20: LUBRICATION FITTINGS LOCATION 16046

4.9 LUBRICATION FITTINGS

All lubrication fittings must be clean before applying lubricant. Also, always be sure equipment used in applying lubricant is clean. Every precaution should be taken to prevent entry of dirt, grit, lint or other foreign matter into lubricant containers. Replace fitting when become broken or damaged.

Re-charge ball joint until grease can be seen escaping from socket. On ball joints fitted with a rubber boot, do not add to much grease as the rubber boot might expand and rupture.

Intervals of application given in the following paragraphs are recommended for normal service. More frequent intervals may be applied under severe operating conditions. In selecting proper lubricants, supplier reputation must be considered. The supplier must be responsible for product quality. Figure 20 shows approximate location of steering lubrication fittings.

MAINTENANCE

(1) **Drag Link Ends:** Lubricate at four fittings, two at each end of link, every 6,250 miles (10 000 km) with good quality lithium-base grease NLGI No. 2 (Shell Retinax LX or equivalent).

(2) **Relay Rod Ends:** Lubricate at two fittings, one at each end of rod, every 6,250 miles (10 000 km) with good quality lithium-base grease NLGI No. 2 (Shell Retinax LX or equivalent).

(3) **Tie Rod Ends:** Lubricate at four fittings, one at each end of both tie rods, every 6,250 miles (10 000 km) with good quality lithium-base grease NLGI No. 2 (Shell Retinax LX or equivalent).

(4) **Steering Knuckle (swivel assembly):** Refer to DANA SPICER MAINTENANCE MANUAL NDS AXLES Lubrication and Maintenance" annexed at the end of section 10.

(5) **Idler Arm and Bell Crank:** Lubricate at two fittings, one on the idler arm and the other on the crank bell, every 6,250 miles (10 000 km) with good quality lithium-base grease NLGI No. 2 (Shell Retinax LX or equivalent). Apply grease gun pressure to the fitting until lubricant appears at the top seal.

(6) **Upper A-Arm Ball Joint:** Lubricate at fitting until you see some grease on the relief valve nearby, every 6,250 miles (10 000 km) with good quality lithium-base grease NLGI No. 2 (Shell Retinax LX or equivalent).

4.10 BALL JOINTS – GENERAL RECOMMENDATIONS

Visual Inspection

- Visually inspect for missing or damages grease fittings and replace if required.
- Check ball joint connection for missing cotter pins.
- Check for looseness in the ball/socket assembly.

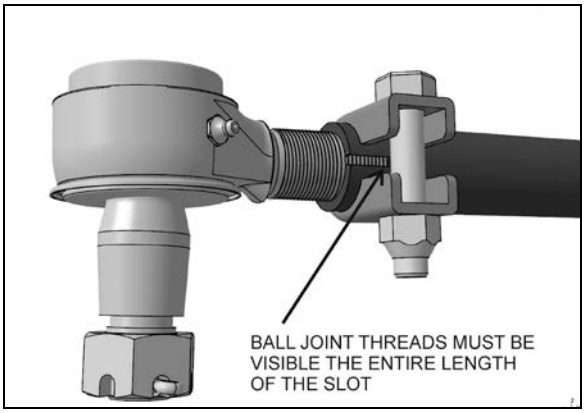


FIGURE 21: ADEQUATE CLAMPING CONDITION

For adequate clamping, the ball joint threads must be visible the entire length of the tube slot. If not, the drag link must be adjusted or replaced. It is either the wrong size, or improper adjustment was used to compensate for another problem (e.g. bent steering arm).

Damaged sealing boots, salt and climatic conditions can cause loss of the corrosion protection coating applied at time of manufacturing. To prevent corrosion from forming around the ball pin, remove the old grease bead and assure sufficient grease is applied to purge the old grease and fill the joint and dust seal (if applicable).

Good quality lithium-base mineral grease NLGI No. 2 like Shell Retinax LX is recommended.

4.11 FRONT-END ALIGNMENT

Proper front end alignment must be maintained to insure ease of steering and provide satisfactory tire life. When making front end alignment inspections, the vehicle must be level and empty with the full weight of the vehicle on the wheels.

Front end alignment inspections fall into two groups: regular service inspections performed at periodic intervals, and inspections to determine the extent of damage after a collision or severe service.

Regular service inspections concern toe-in, camber and caster.

Any variation from the specified alignment will indicate either a need for adjustment or a more thorough inspection to determine if parts replacement is required.

WARNING

During alignment, both camber and caster among other angles are adjusted. When adjusting these, install or remove shims at the IFS lower A-arms. After performing alignment, make sure that the following is done:

- Installing a new lock nut after all shims are finalized.
- Torque replaced nuts as per Torque Table 2.
- Install longer bolt if less than 2 threads are remaining after the nut.
- Using torque seal paint, leave a mark on the nut for future visual inspection.

4.11.1 Alignment Terminology

Wheel Camber: Camber is the number of degrees the top of the wheel is tilted inward or outward from a true vertical (Figure 26).

Wheel Toe-In: a slight forward convergence given to the wheels of motor vehicles to improve steering and equalize tire wear
(D minus E, Figure 26).

Kingpin Inclination: The inclination of the kingpin from vertical toward the center of the vehicle at the top and outward at the bottom
(B, Figure 26).

Front Axle Caster: The inclination of the kingpin from vertical in the fore and aft direction
(C, Figure 26).

4.11.2 Front End Inspection

Before checking front end alignment, make the following inspection:

1. Check that the vehicle is at normal ride height (see paragraph "8. Suspension Height Adjustment").
2. Check the tires for proper inflation.
3. Check wheel installation and run-out.
4. Check wheel bearing adjustment.
5. Check tie rods and drag link ends for looseness.
6. Check kingpins for looseness.
7. Check if the length of the torque rod is 21 17/64" (540 mm) (FIGURE 19). Check if the length of the relay rod is 23 19/64" (592 mm).

4.11.3 Front Wheel Camber

Positive camber is the outward inclination of the wheels at the top, negative or reverse camber is the inward inclination of the wheels at the top. Camber variations may be caused by wear at the wheel bearings, wheel spindle bushings, or bent suspension parts.

Check camber, with an accurate gauge. If camber is incorrect, check suspension parts for wear and replace worn parts. If wear is not perceptible, suspension parts may be bent or lower A-arm may be improperly shimmed.

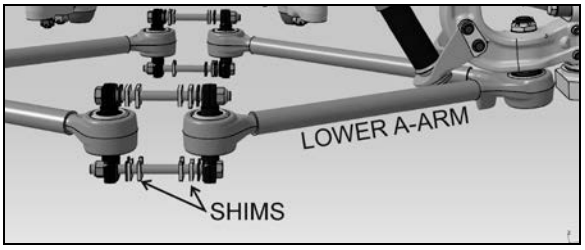


FIGURE 22: SHIMS AT THE LOWER A-ARMS

Check kingpin inclination. If kingpin inclination is incorrect, readjust the camber and check kingpin inclination again.

NOTE
Camber is more important than kingpin inclination, so adjust camber and verify kingpin inclination.

Shim the lower A-arm to adjust camber (Figure 22 & FIGURE 25). If the kingpin inclination is incorrect, the wheel kingpin assembly may be bent and therefore should be replaced.

Excessive positive camber results in irregular wear of the tires at the outer shoulders. Negative or reverse camber causes wear at the inner shoulders.

NOTE
Shim only the lower suspension arm to adjust the front wheel camber.

CAUTION
Once the perfect shim combination is achieved, always install new Stover nuts because the self-locking effect is lost after tightening and loosening of the nut. It is recommended to punch marks to detect loosening of the nuts during future visual inspections.

4.11.4 Front Wheel Toe-In

Toe-in is measured from the center of the tire treads. Measurements at the front and rear of the tires must be made at the same height from the floor. Incorrect toe-in results in excessive tire wear and steering instability with a tendency to wander.

Toe-In Check

1. Check the camber adjustment and adjust if necessary.
2. Hoist the front of the vehicle and spin the wheels marking the centerline of the tire treads.
3. Place the wheels in the straight ahead position and lower the vehicle to rest on the floor.
4. Roll the vehicle ahead several feet. This removes any slack caused by looseness in the wheel bearings or steering connections.

5. Check the distance between the tire centerlines at the front and rear of the front tires. These two measurements must be made at the same height above the floor. The front measurement must be 3/32 ±1/32 of an inch less than the rear measurement.

Toe-In Adjustment

1. Loosen the tie rod clamp bolts.
2. Using a pipe wrench, turn the tie rod tubes to obtain the toe-in measurement specified in step 5 under paragraph "Toe-in Check" (Figure 26).
3. Tighten the tie rod clamp bolts and recheck toe-in.
4. Check that the angular relationship of the pitman arm to the steering gear is as shown in Figure 23.

NOTE
Use only tie rods to adjust toe-in.

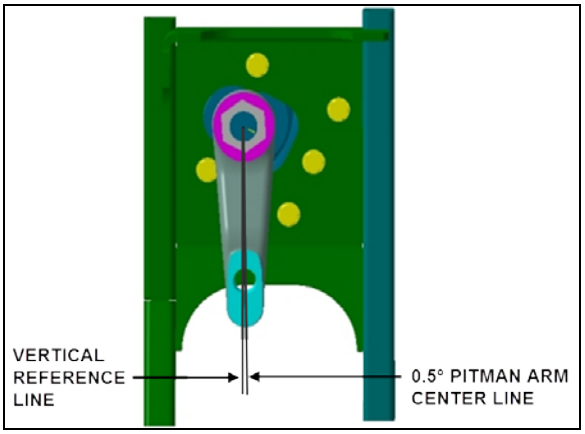


FIGURE 23: IFS PITMAN ARM ALIGNMENT 14056

4.11.5 Front Wheel Caster

Positive caster is the inclination of the top of the kingpins toward the rear of the vehicle. Negative or reverse caster is the inclination of the kingpins toward the front of the vehicle. This vehicle is designed with positive caster. The purpose of caster is to provide steering stability by keeping the wheels in a straight ahead position.

Caster variations may be caused by bent upper suspension A-arm, lower suspension A-arm, or kingpin housing. Caster should be adjusted with shims. Precision instruments should be used to measure caster. Shim bell crank and idler arm to adjust caster (Figure 26).

Variations from the specified caster will affect steering stability, cause wandering, wheel shimmy, and reduce steer re-centering when pulling out of curves.

4.11.6 Major Damage

If the suspension has sustained major damage, it may be necessary to shim the bell crank and the idler arm to avoid the bump steer or roll steer. Moreover refer to paragraph "Front End Alignment".

4.11.7 Alignment Specifications

See FIGURE 25 & Figure 26.

NOTE
On Independent Front Suspension, caster on right wheel must be equal or greater than caster on left wheel, with a maximum difference of 0.3°.

Use static wheel alignment systems which work with angle measurements only, such as Josam or Hunter systems.

H3-45 VIP
INDEPENDENT FRONT SUSPENSION

Load	Minimum value		Nominal value		Maximum value	
	Non-converted	Converted	Non-converted	Converted	Non-converted	Converted
Right camber	0.20°	-0.20°	0.30°	0°	0.50°	0.20°
Left camber	0.20°	-0.20°	0.30°	0°	0.50°	0.20°
Right caster	2.55°		2.8°		3.05°	
Left caster	2.55°		2.8°		3.05°	
Total toe	0.02°	0.04°	0.04°	0.06°	0.06°	0.08°

H3-45 Coaches
WITH INDEPENDENT FRONT SUSPENSION

	Minimum value	Nominal value	Maximum value
Right camber	0.0°	0.150°	0.30°
Left camber	0.0°	0.150°	0.30°
Right caster	2.35°	2.6°	2.85°
Left caster	2.35°	2.6°	2.85°
Total toe-in	0.04°	0.06°	0.08°

X3-45 Coaches
WITH INDEPENDENT FRONT SUSPENSION

	Minimum value	Nominal value	Maximum value
Right camber	0.0°	0.150°	0.30°
Left camber	0.0°	0.150°	0.30°
Right caster	2.35°	2.6°	2.85°
Left caster	2.35°	2.6°	2.85°
Total toe-in	0.04°	0.06°	0.08°

X3-45 VIP
INDEPENDENT FRONT SUSPENSION

Load	Minimum value		Nominal value		Maximum value	
	Non-converted	Converted	Non-converted	Converted	Non-converted	Converted
Right camber	**0.20°**	**-0.20°**	**0.30°**	**0°**	**0.50°**	**0.20°**
Left camber	**0.20°**	**-0.20°**	**0.30°**	**0°**	**0.50°**	**0.20°**
Right caster	**2.55°**		**2.8°**		**3.05°**	
Left caster	**2.55°**		**2.8°**		**3.05°**	
Total toe	**0.02°**	**0.04°**	**0.04°**	**0.06°**	**0.06°**	**0.08°**

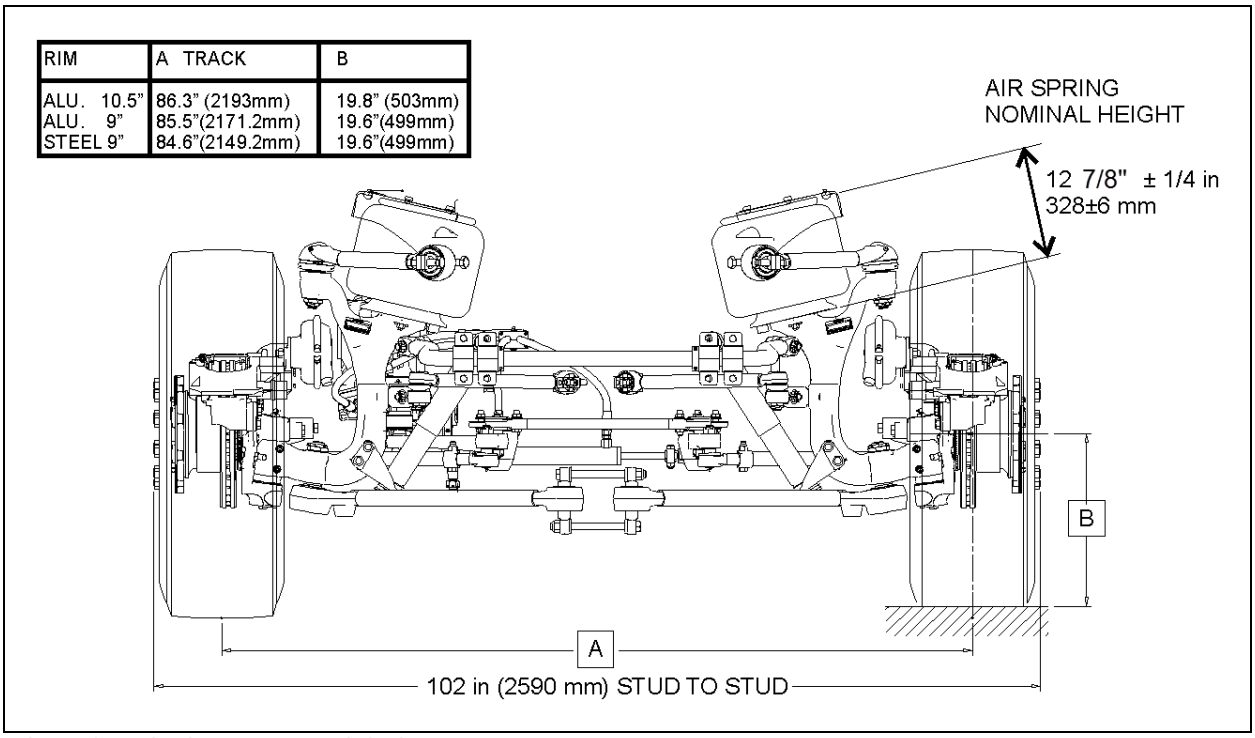


FIGURE 24: IFS NOMINAL DIMENSIONS

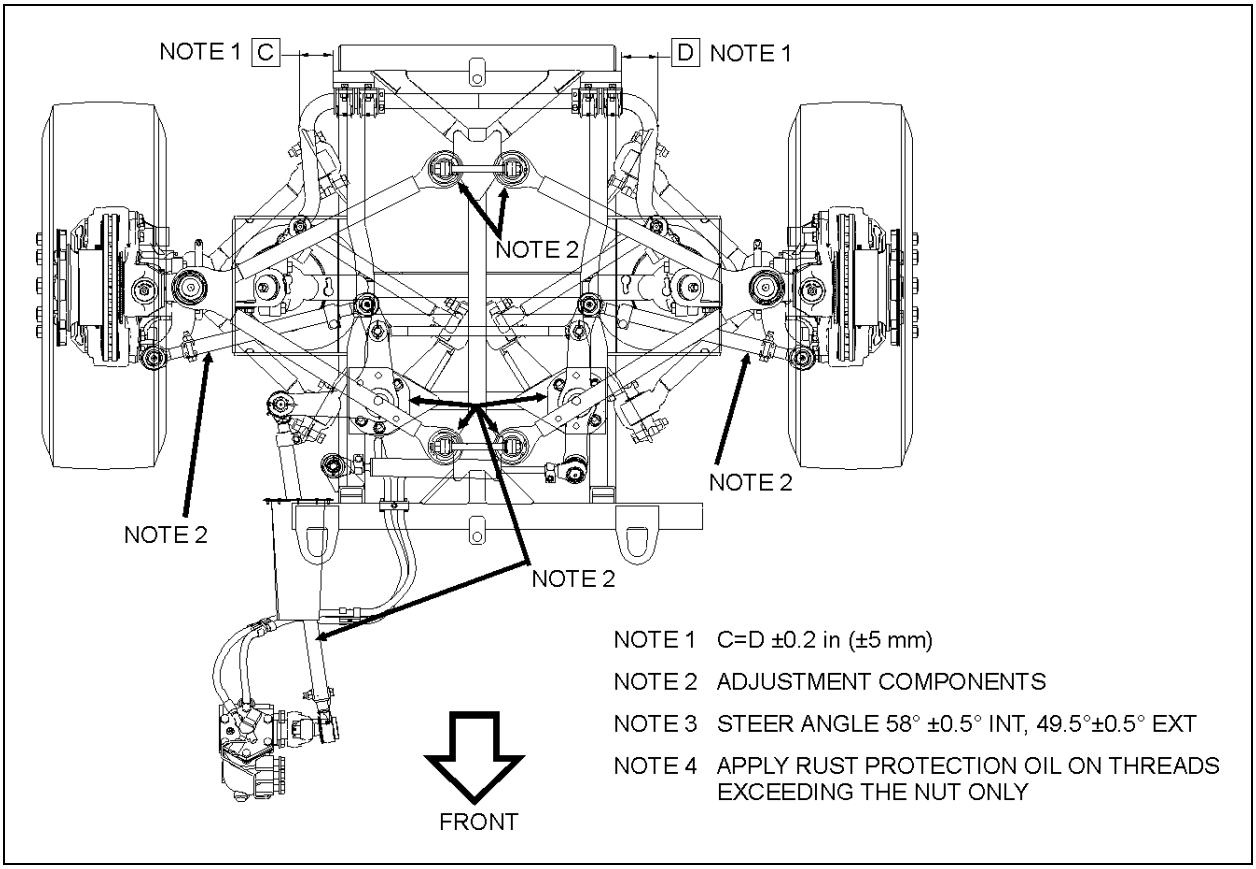
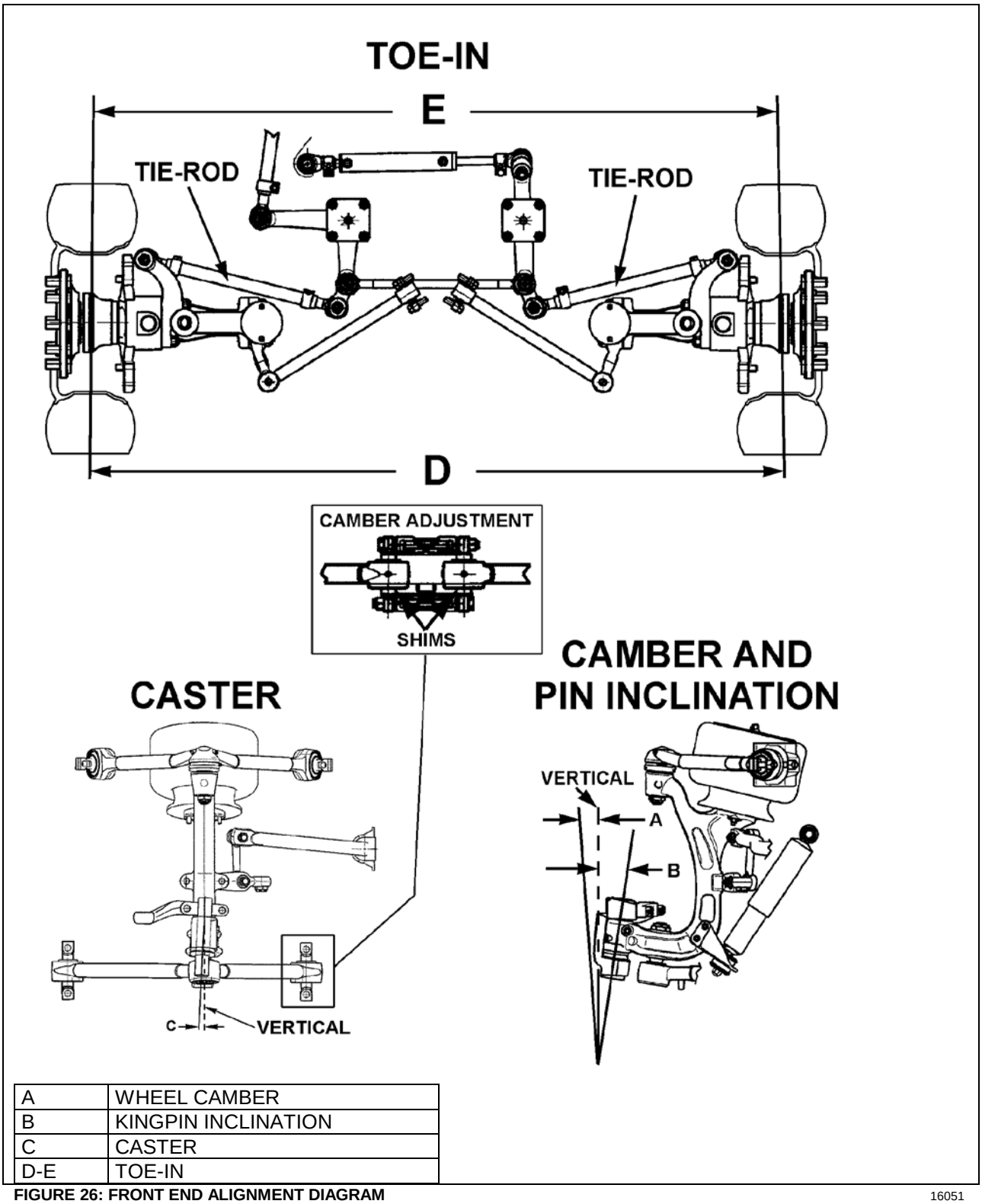


FIGURE 25: IFS ADJUSTMENT

Note 2 indicates where adjustment may be performed if needed when proceeding to IFS ALIGNMENT



A	WHEEL CAMBER
B	KINGPIN INCLINATION
C	CASTER
D-E	TOE-IN

FIGURE 26: FRONT END ALIGNMENT DIAGRAM 16051

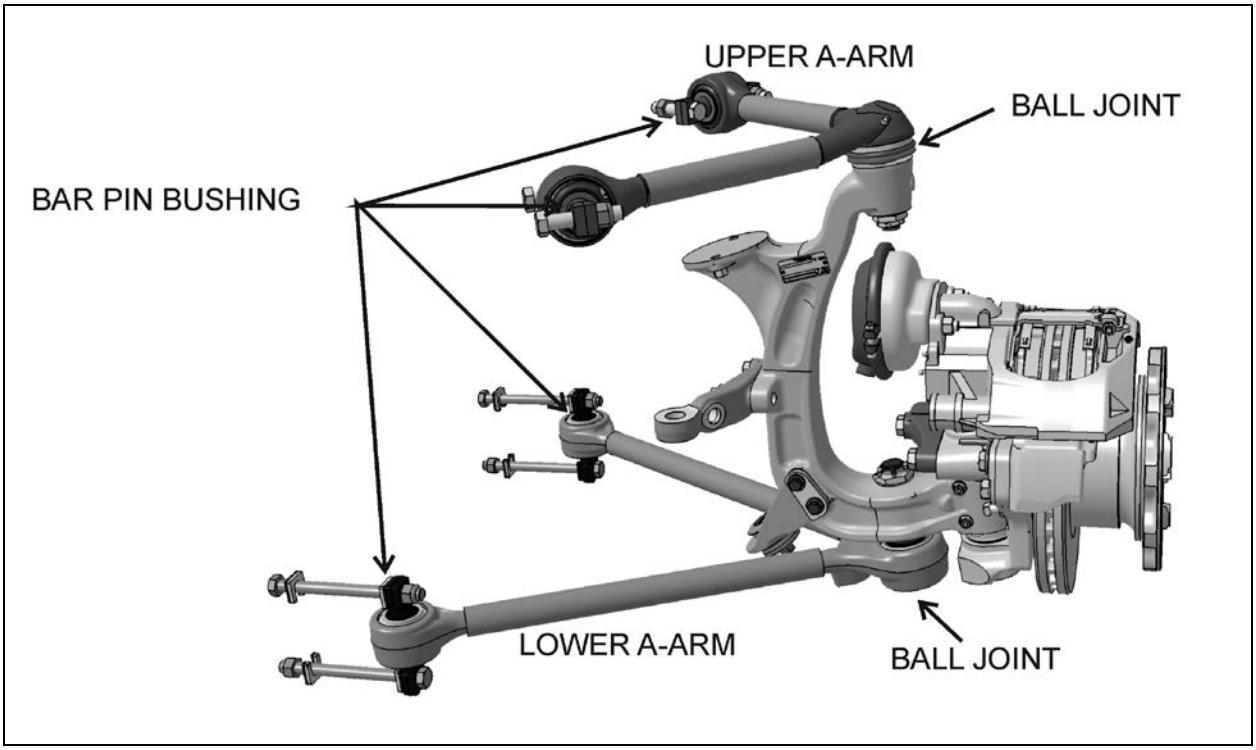


FIGURE 27: A-ARM JOINT IDENTIFICATION

4.12 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.

4.12.1 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.

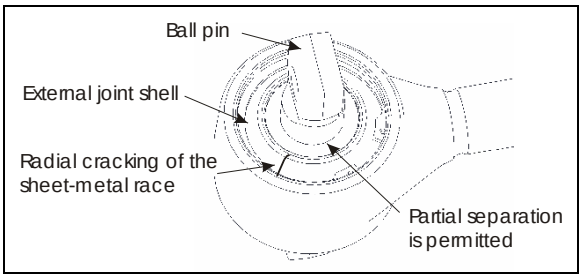


FIGURE 28: BALL PIN BUSHING

4.12.2 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.

4.12.3 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.

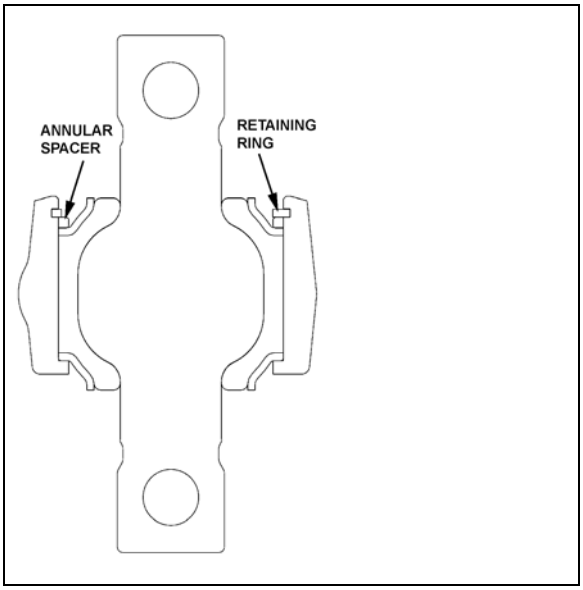


FIGURE 29: LOWER A-ARM BALL PIN BUSHING 16047

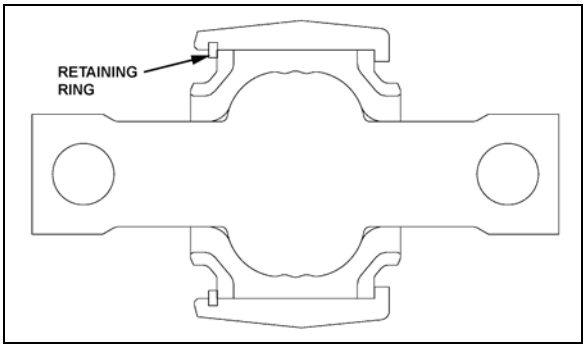


FIGURE 30: UPPER A-ARM BALL PIN BUSHING

4.13 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.

4.13.1 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

4.13.2 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.

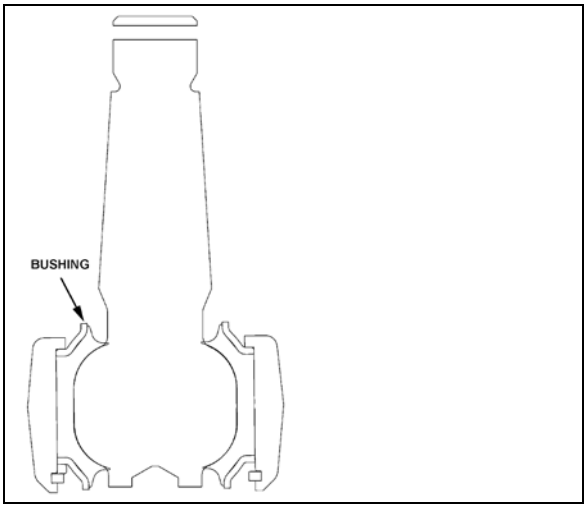


FIGURE 31: LOWER A-ARM BALL JOINT

4.14 UPPER A-ARM BALL JOINT

4.14.1 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.

4.14.2 Play Measurement

1. Raise the vehicle and support through axle jacking points.
2. Using a caliper, measure dimension “A” on Figure 32.
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.

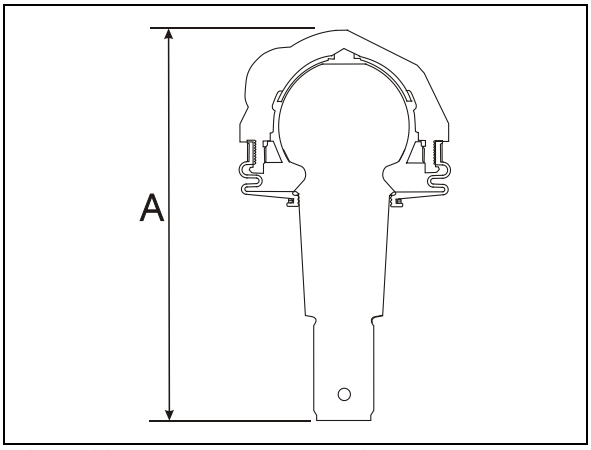


FIGURE 32: UPPER A-ARM BALL JOINT 16116

4.15 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.

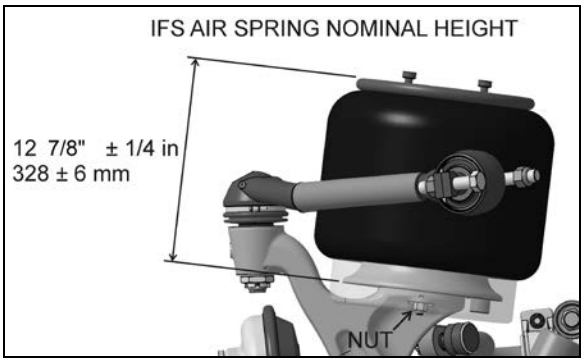


FIGURE 33: AIR SPRINGS 16052

4.15.1 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.

4.15.2 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.

4.15.3 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.

4.16 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).

4.16.1 Shock Absorber Removal

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

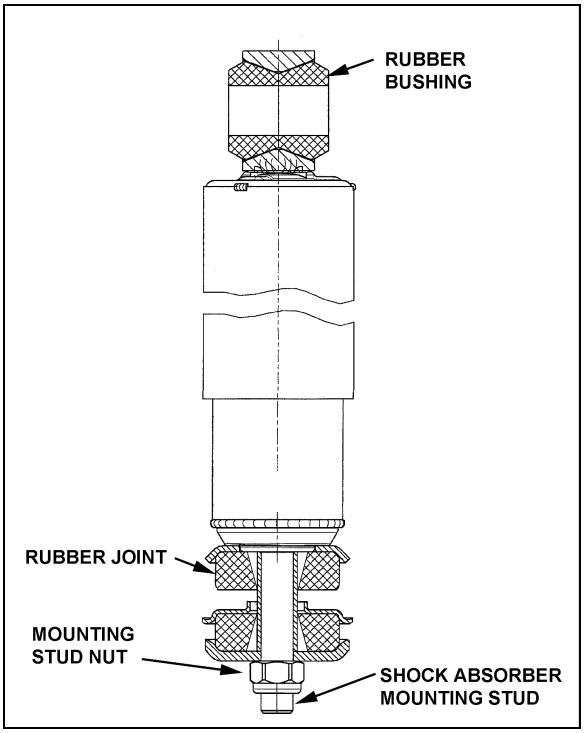


FIGURE 34: SHOCK ABSORBER 16112

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.

4.16.2 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 35.

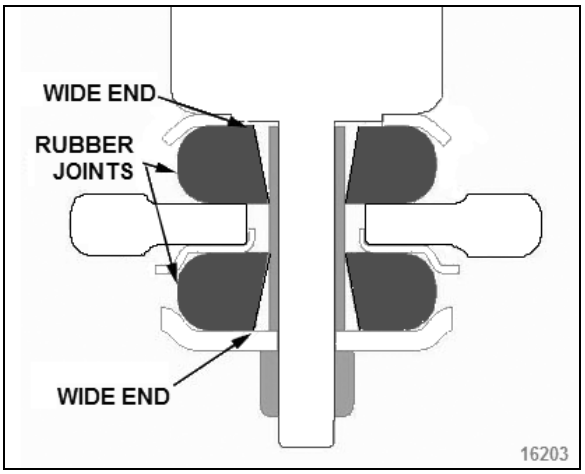


FIGURE 35: LOWER SHOCK MOUNTING BUSHINGS

5. Install the shock absorber as shown in Figure 34 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.

4.17 SWAY BAR

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

4.17.1 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.

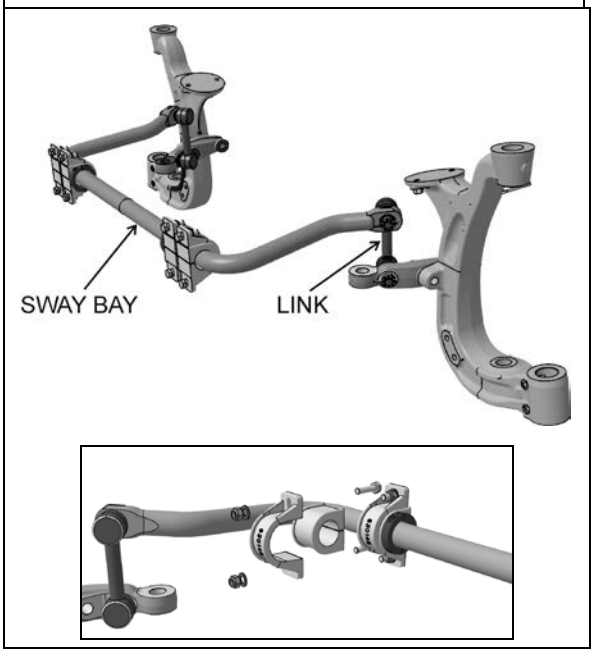


FIGURE 36: SWAY BAR (INDEPENDENT FRONT SUSPENSION) 16138_C

4.17.2 Installation

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

5 REAR SUSPENSION

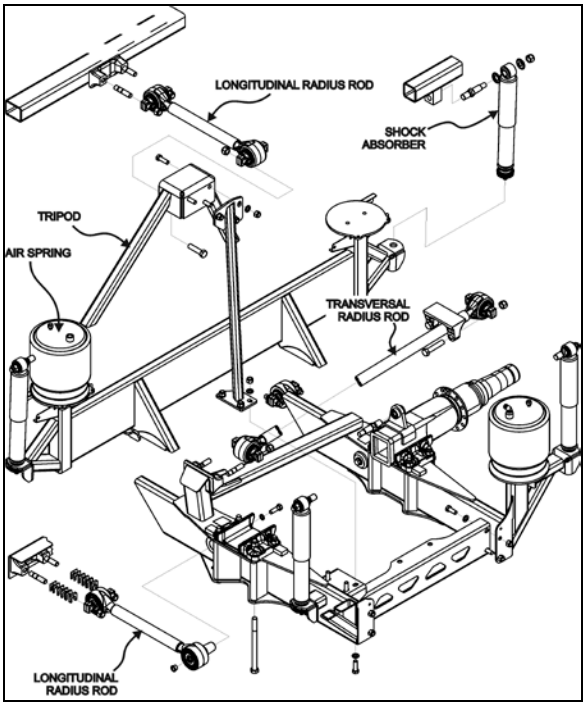


FIGURE 37: DRIVE AXLE, DETAILS OF REAR SUSPENSION 16106

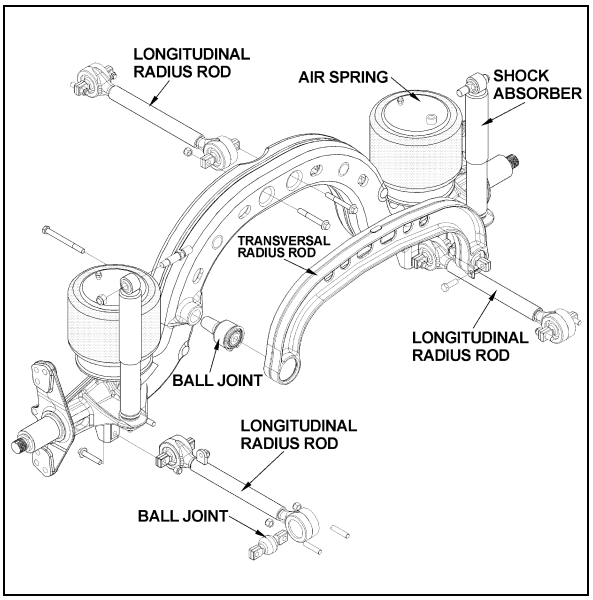


FIGURE 38: TAG AXLE SUSPENSION

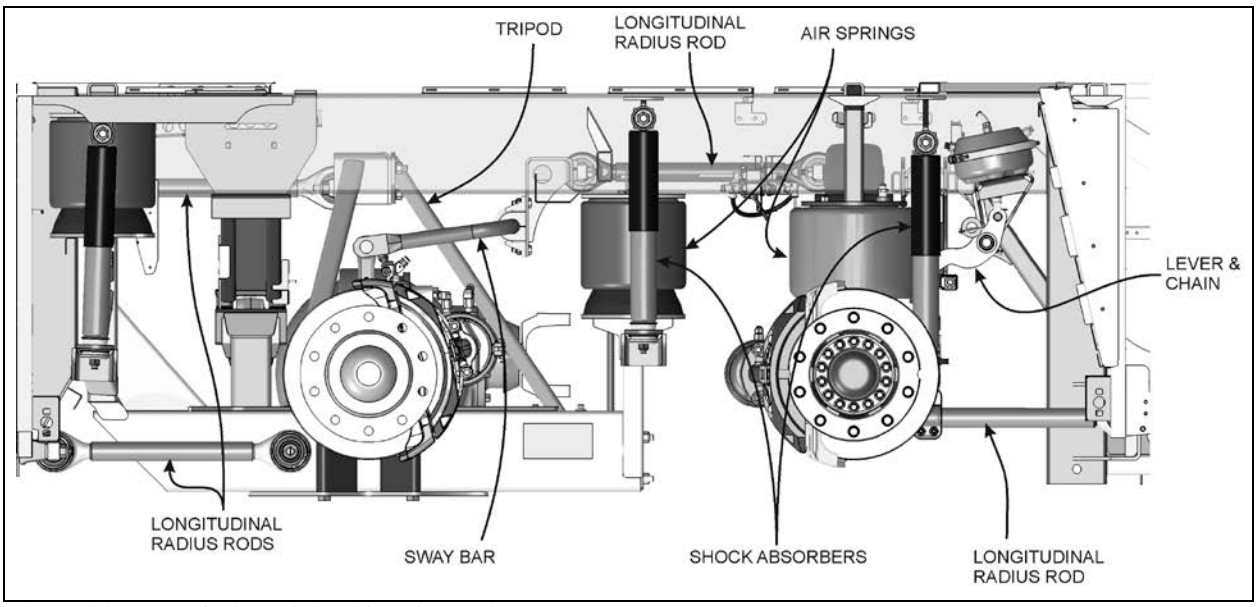


FIGURE 39: REAR SUSPENSION COMPONENTS 16003

5.1 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.

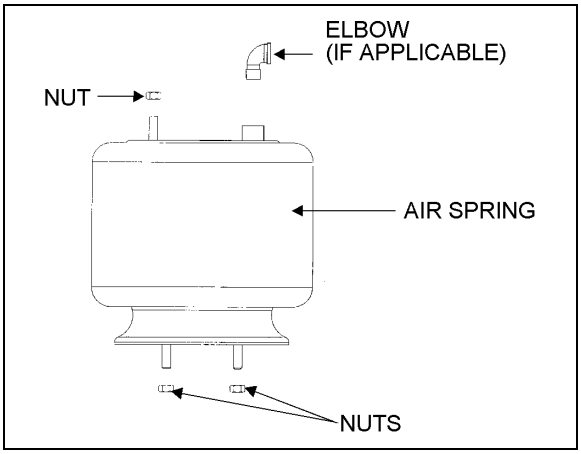


FIGURE 40: AIR SPRING 16052

5.1.1 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.

5.1.2 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.

5.1.3 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.

5.2 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 41).

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.

5.2.1 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.

5.2.2 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.

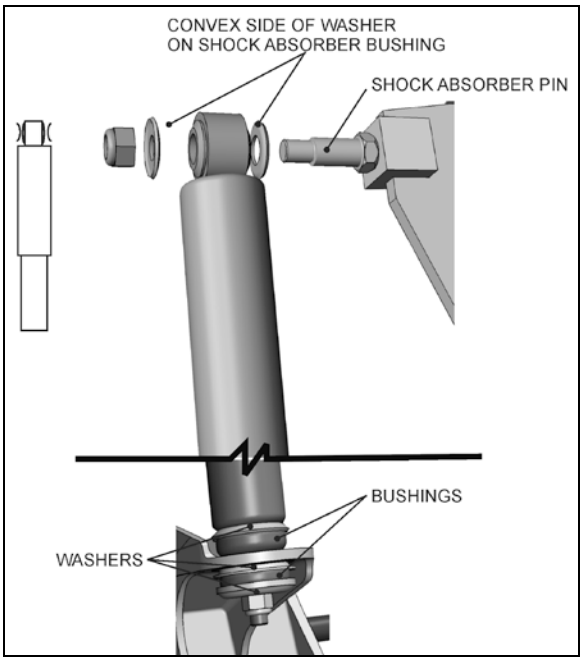


FIGURE 41: TYPICAL SHOCK ABSORBER SETUP 16009

5.2.3 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 42.

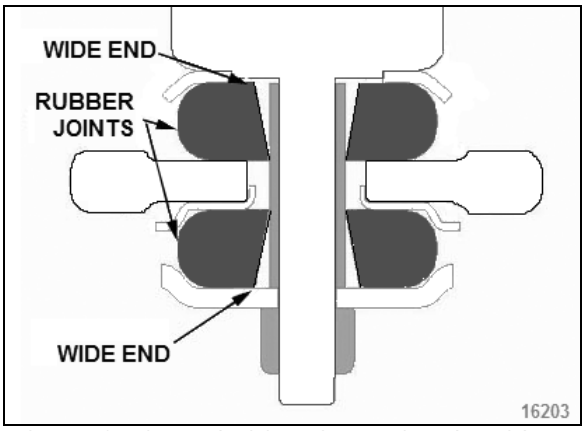


FIGURE 42: LOWER SHOCK MOUNTING BUSHINGS

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.

5.3 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.

6 SUSPENSION AIR SYSTEM

The suspension air system has its own air reservoir (accessory tank) which is located 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 located 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.

6.1 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.

6.2 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.

7 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.

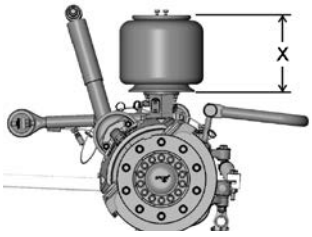
To adjust suspension height, refer to Maintenance Information MI16-14 SUSPENSION HEIGHT ADJUSTMENT USING HEIGHT CONTROL VALVES included after Section 16 in this Maintenance Manual.

7.1 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)

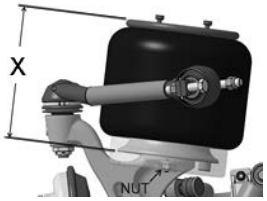
2 air springs



X = 11 ¾ ± ¼ inch (297 ± 6 mm)

INDEPENDENT FRONT SUSPENSION (IFS)

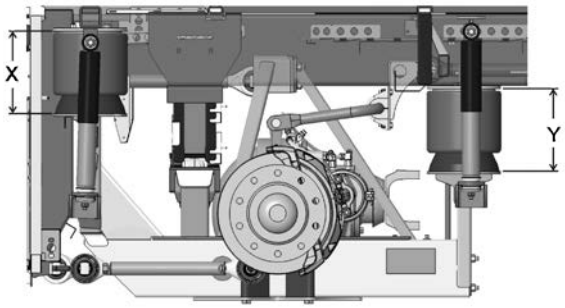
2 air springs



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)

7.2 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.

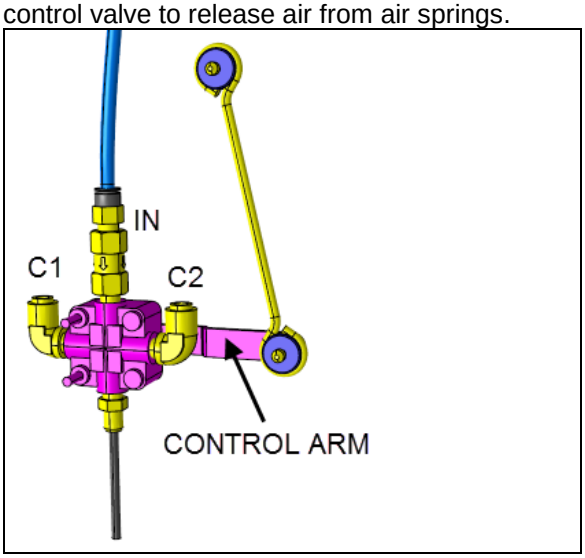


FIGURE 43: HEIGHT CONTROL VALVE 16093

7.3 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.

7.3.1 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.

7.3.2 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.

8 "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.

8.1 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.

8.2 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”*.

9 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.

9.1 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.

9.2 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".*

9.3 AIR SPRING CONTROL SOLENOID VALVES

9.3.1 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.

10 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.

10.1 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.

10.2 MAINTENANCE

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

10.3 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).

10.3.1 Adjustment

1. Before turning on system air pressure, release jam nut (2, Figure 44) 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 44) to lock pressure setting.

10.3.2 Disassembly

1. Shut off inlet pressure and reduce pressure in inlet and outlet lines to zero. Turn regulator adjustment handle (1, Figure 44) 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)**

10.3.3 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.

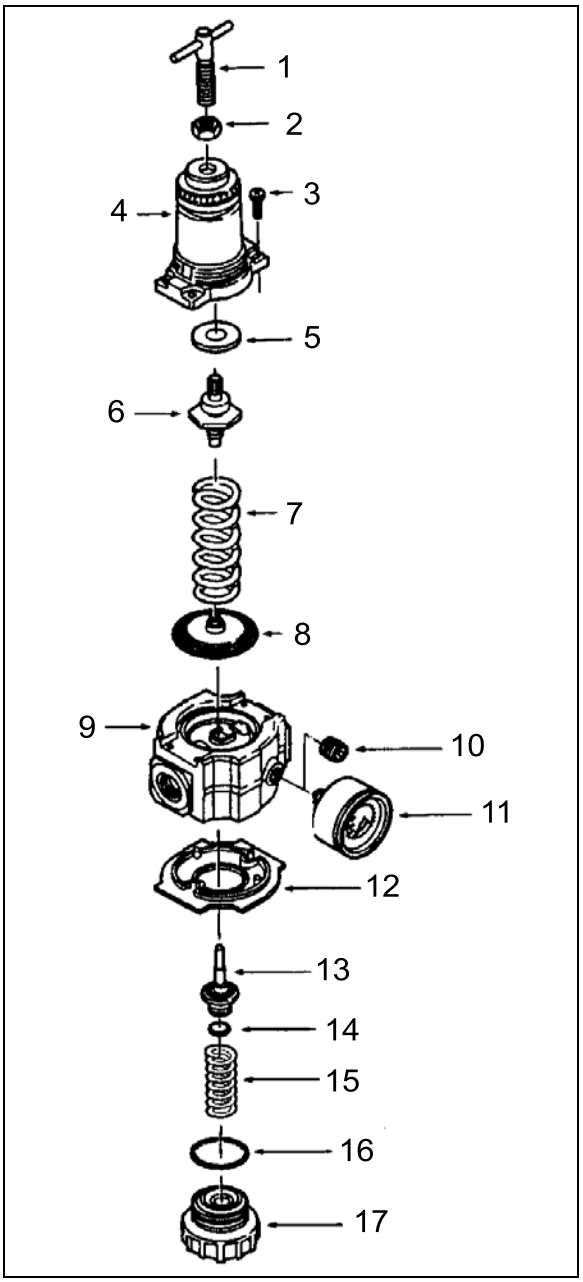


FIGURE 44: AIR PRESSURE REGULATOR 16035

10.3.4 Reassembly

1. Lubricate O-ring (14 and 16, Figure 44), 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.

11 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.

11.1 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.

11.2 MAINTENANCE

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

12 AIR SYSTEM

The basic air system consists of an air compressor, tanks, valves, filters and interconnecting lines and hoses (refer to Section 12, "Brake and Air System" for complete information). It provides a means for braking, operating controls and accessories, and suspension.

The air coming from the air dryer is first directed to the wet air tank, then to the primary (for the primary brake system), secondary (for the secondary brake system), and accessory (for the pneumatic accessories) air tanks (Figure 45).

In addition, an expansion air tank is installed in series with each air spring.

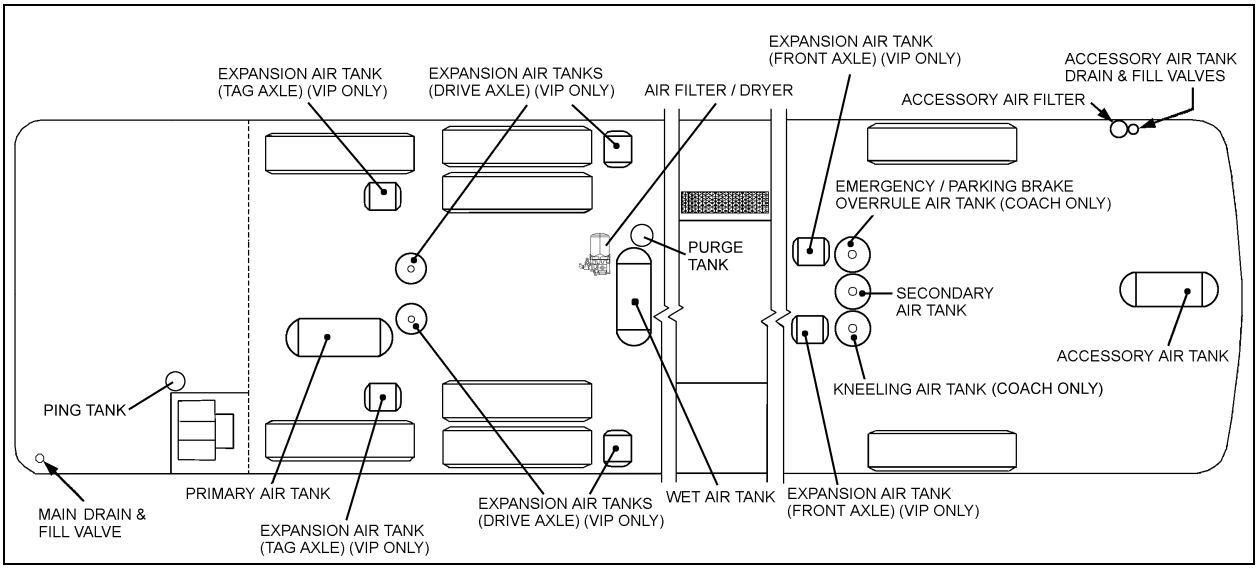


FIGURE 45: LOCATION OF AIR TANKS

12195

12.1 AIR TANK MAINTENANCE

Ensure that the accessory air tank is purged during pre-starting inspection. A good practice is to purge this tank at the end of every driving day by the remote air tank drain valve located in the service compartment (Figure 48).

Moreover, purge all tanks by their bottom drain valves at specified intervals.

12.1.1 Wet Air Tank

This tank is installed in front of and above drive axle in the rear wheel housing and is provided with a bottom drain valve.

MAINTENANCE

It is recommended to **purge** the wet air tank by its bottom drain valve every 12,500 miles (20 000 km), or once a year, whichever comes first.

A remote valve located in engine compartment and accessible through engine R.H. side door is used to **purge daily** (Figure 46).

12.1.2 Primary Air Tank

The primary air tank is located above tag axle.

This tank is also provided with a bottom drain valve.

MAINTENANCE

It is recommended to **purge** the primary air tank by its bottom drain valve every 12,500 miles (20 000 km), or once a year, whichever comes first.

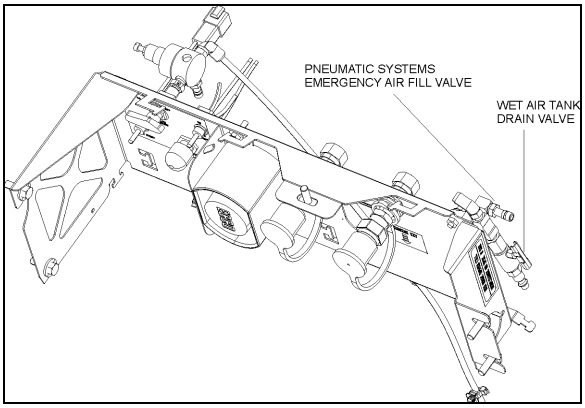


FIGURE 46: REAR VALVE LOCATION ON H3 SERIES

12162

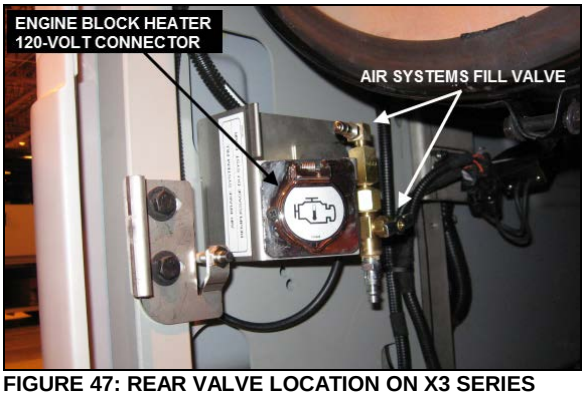


FIGURE 47: REAR VALVE LOCATION ON X3 SERIES

12.1.3 Secondary Air Tank

This tank is located in front wheel housing. The tank is installed vertically and is provided with a bottom drain valve.

MAINTENANCE

It is recommended to **purge** the secondary air tank by its bottom drain valve every 12,500 miles (20 000 km), or once a year, whichever comes first.

12.1.4 Accessory Air Tank

On H3 vehicles, the accessory air tank is installed at the ceiling of spare wheel compartment. On X3 series, it is installed next to the secondary air tank (the tank may be installed vertically depending on type of front suspension). The tank is provided with a bottom drain valve.

MAINTENANCE

It is recommended to **purge** the accessory air tank by its bottom drain valve every 12,500 miles (20 000 km), or once a year, whichever comes first.

A remote drain valve is located in front service compartment. Refer to Section 12, paragraph "5. Accessory Air Filter" of the maintenance manual for daily purge procedure.

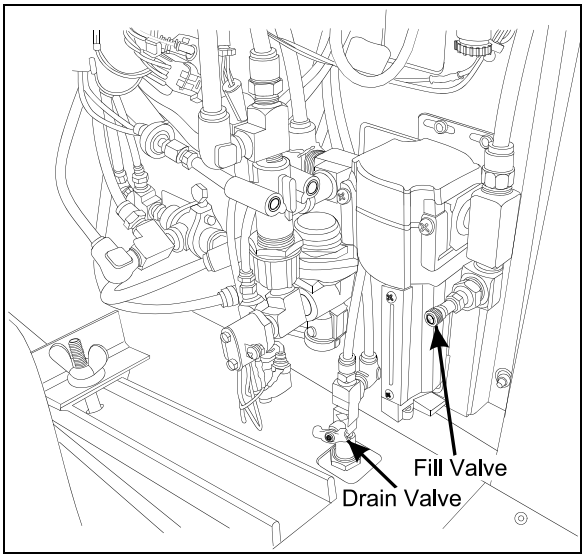


FIGURE 48: FRONT VALVE LOCATION ON H3 SERIES
12144

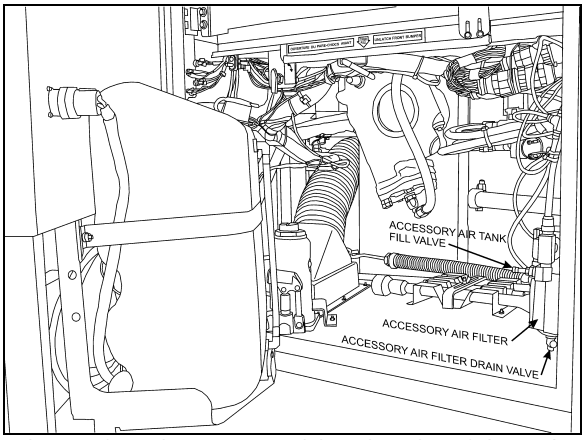


FIGURE 49: FRONT VALVE LOCATION ON X3 SERIES
12210

12.1.5 Expansion Air Tank

Two expansion tanks are located in front wheel housing. These air tanks are located behind secondary air tank. Also, six expansion tanks are located near rear air springs (Figure 45). Expansion tanks are connected in series with air springs. Expansion tanks are used to lower the stiffness of the air spring. They are provided with a bottom drain valve.

MAINTENANCE

It is recommended to **purge** the expansion air tanks every 12,500 miles (20 000 km), or once a year, whichever comes first.

12.2 EMERGENCY FILL VALVES

The vehicle is equipped with two air system emergency fill valves to supplement the air system when air pressure is low and engine cannot be operated.

The rear valve is located in engine compartment and accessible from engine R.H. side door (Figure 46).

CAUTION

No other point should be used to supply air system. The maximum allowable air pressure is 125 psi (860 kPa).

The front valve is located in the front service compartment close to accessory air filter (Figure 48).

These two air valves are fitted with the same valve stems as standard tires, and can be filled by any standard external air supply line.

The rear valve will supply air for all systems (brakes, suspension and accessories) while the front valve will supply air for accessories only.

CAUTION

Air filled through these two points will pass through the standard air filtering system provided by Prevost. Do not fill air through any other points.

NOTE

Apply corrosion-protective compound on exposed threads.

13 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.

14 SPECIFICATIONS

Independent Front Suspension Air Springs

Make..... Goodyear Tire and Rubber
Model……..1400
Type ..... Mae West
Diameter..... 14 inches
Air Inlet ..... 1/2''-14 NPTF AIR INLET

Front I-Beam axle air springs and tag axle air springs

Make..... Goodyear Tire and Rubber
Model……..1200
Type ..... Mae West
Nominal diameter ..... 12” (304 mm)

Drive axle air springs

Make..... Goodyear Tire and Rubber
Type ..... Double Flare
Nominal diameter ..... 11.5” (279 mm)

Independent Front Suspension - Shock Absorbers (Coaches)

Make.....Arvin
Color..... Black
Piston Diam. ..... 1 5/8 inch
Collapsed length..... 14.16 inches
Extended length……22.44 inches

Front I-Beam axle shock absorbers

Make..... Sachs
Color..... Black
Ext. Diam. ..... 75 mm
Collapsed length..... 15.51” (394 mm)
Extended length ..... 24.37” (619 mm)

Drive and tag axle shock absorbers

Make..... Sachs
Color..... Black
Ext. Diam. ..... 75 mm
Collapsed length..... 15.51” (394 mm)
Extended length ..... 24.37” (619 mm)

Height control valve (IFS)

Quantity used 1

Prevost number..... Refer to Parts Manual

Height control valve (coach, all axles & VIP, rear only)

Quantity ..... 2 or 3

Prevost number..... Refer to Parts Manual

Bellows control and exhaust solenoid valve assembly

Make..... Norgren

Coil

Voltage ..... 24 V DC

Current draw..... 29 amperes

Valve (3-way, 2 positions)

Type ..... N/C

Type ..... N/O

Radius rod bushing

Make..... Prevost

Prevost number..... Refer to Parts Manual

Sway bar bushing (Independent Front Suspension

Make..... Prevost

Prevost number..... Refer to Parts Manual

Sway bar bushing (Front Axle)

Make..... Prevost

Prevost number..... Refer to Parts Manual

Sway bar bushing (Drive Axle)

Make..... Prevost

Prevost number..... Refer to Parts Manual

Sway bar link bushings

Prevost number..... Refer to Parts Manual

Shock absorber bushings

Prevost number..... Refer to Parts Manual

High-Buoy Pressure regulator

Recommended pressure setting ..... 90 psi (621 kPa)

Prevost number..... Refer to Parts Manual

MAINTENANCE INFORMATION

MI16-14

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

APPLICATION

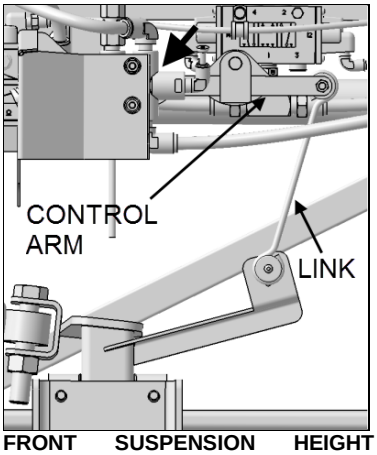
Model	
All models Model Year : From 2014	

DESCRIPTION

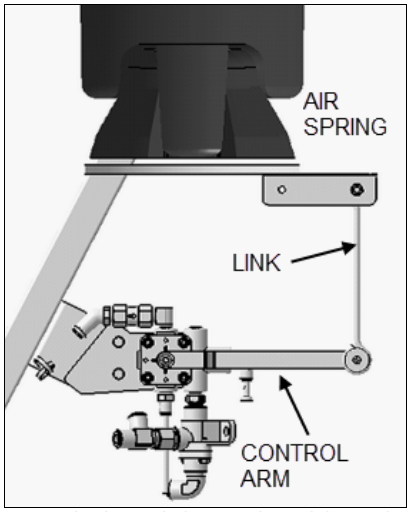
Use this procedure when a suspension height check or adjustment must be performed.

HEIGHT CONTROL VALVES

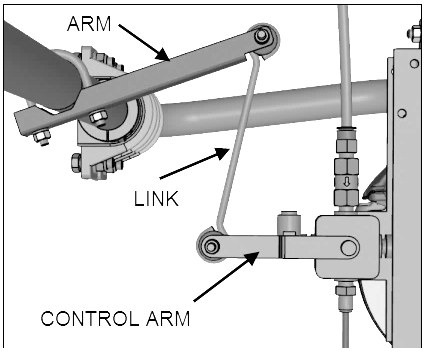
Three height control valves automatically control air volume in the suspension air springs at three separate locations to maintain a constant vehicle height regardless of load or load distribution.



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.

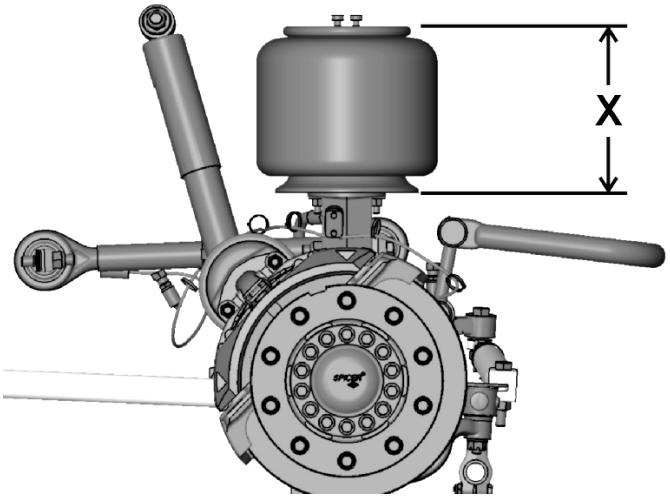
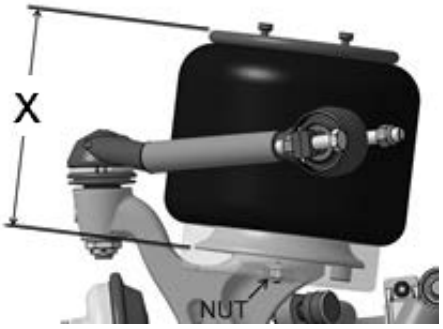
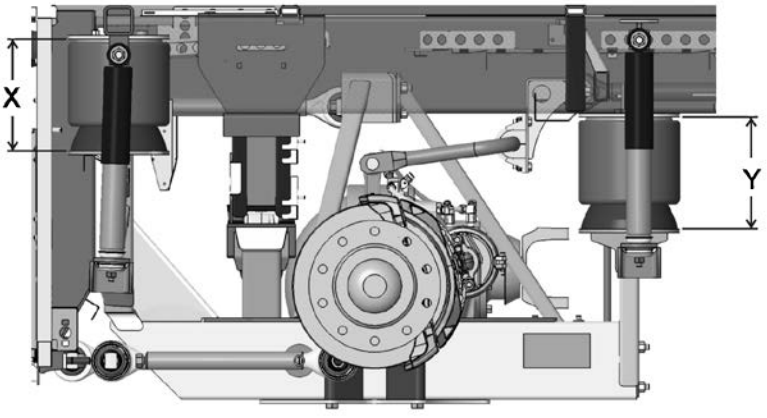
The appropriate vehicle body height is checked by measuring the clearance of all the air springs installed on the front and rear suspension. The tag axle, by its nature, doesn't need to be adjusted.

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

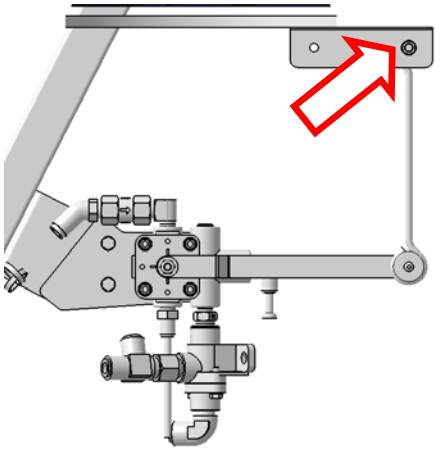
Measurement

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

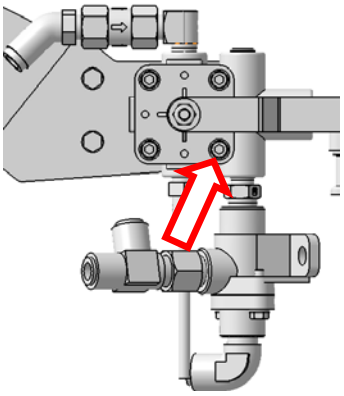
While proceeding with one side of the vehicle at a time, adjust the air springs clearance with the height control valve

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.



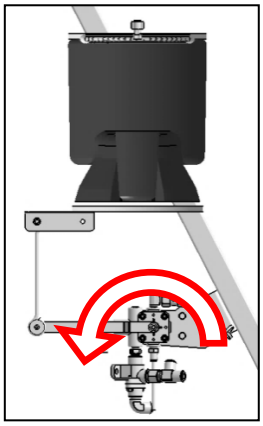
5. Loosen the lower mounting bolt shown.

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

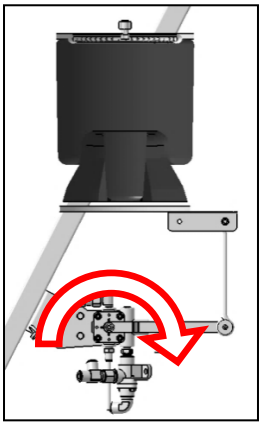


6. Rotate the valve body to increase or decrease the clearance as shown (the mounting bracket has a slotted hole).
7. Allow 15 minutes to the air system to settle before measuring the resulting clearance. Repeat previous step if necessary.
8. Tighten the lower mounting bolt once adjustment is done.
9.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

INCREASING CLEARANCE

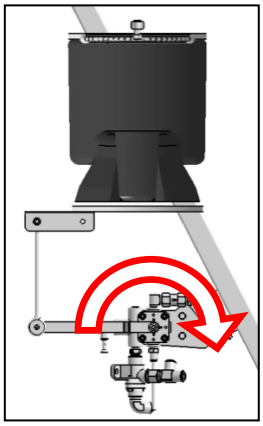


STREET SIDE

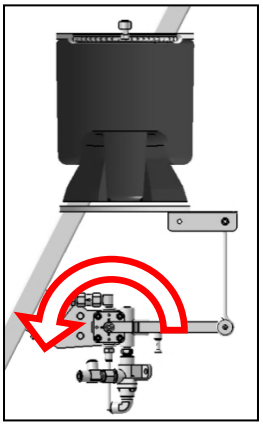


CURB SIDE

DECREASING CLEARANCE



STREET SIDE



CURB SIDE

FRONT SUSPENSION AIR SPRINGS ADJUSTMENT (I-BEAM AXLE)

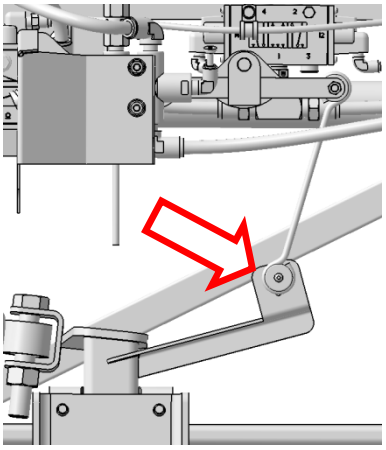
Measurement

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

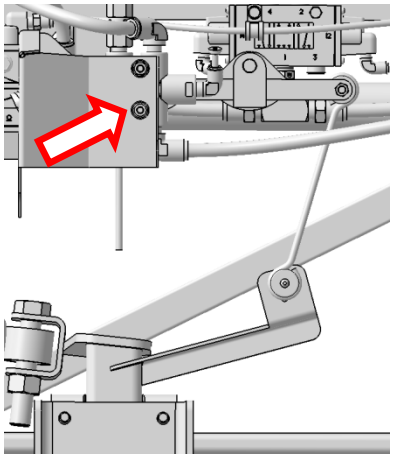
Adjust the air springs clearance with the height control valve

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.



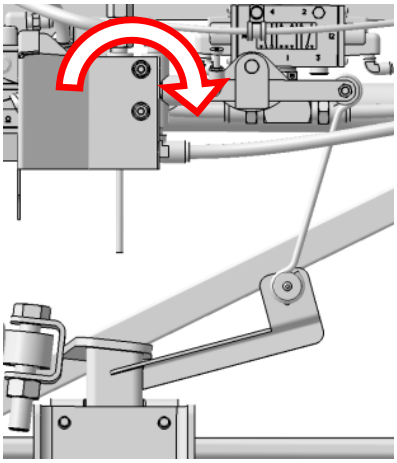
5. Loosen the lower mounting bolt shown.

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

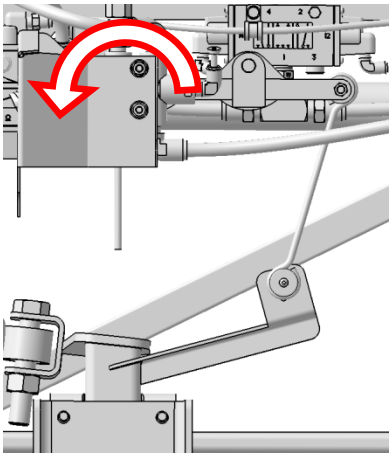


6. Rotate the valve body to increase or decrease the clearance as shown (the mounting bracket has a slotted hole).
7. Allow 15 minutes to the air system to settle before measuring the resulting clearance. Repeat previous step if necessary.

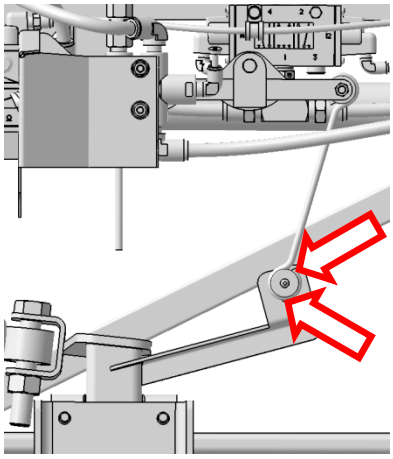
INCREASING CLEARANCE



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.

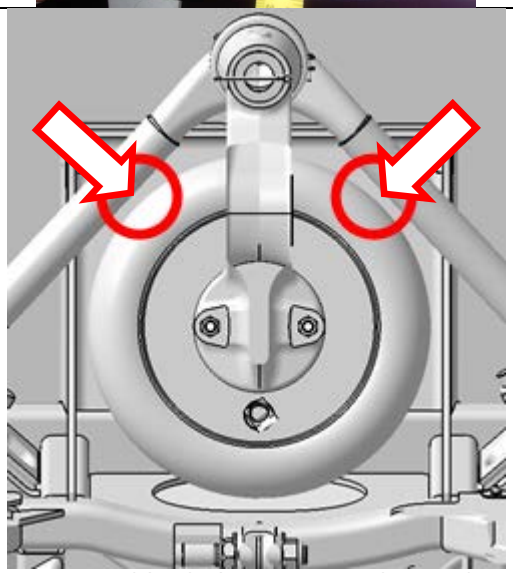


INDEPENDENT FRONT SUSPENSION ADJUSTMENT

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.

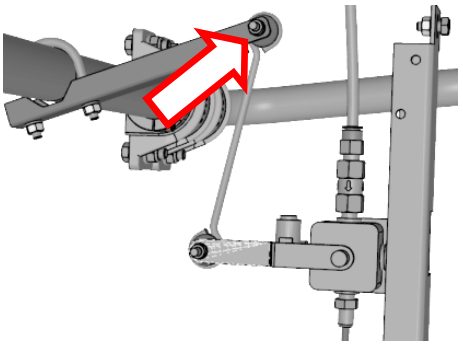
4. Take the measurement where indicated on the image preferably.



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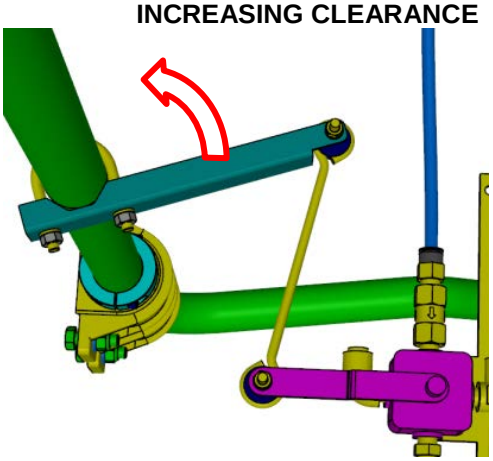
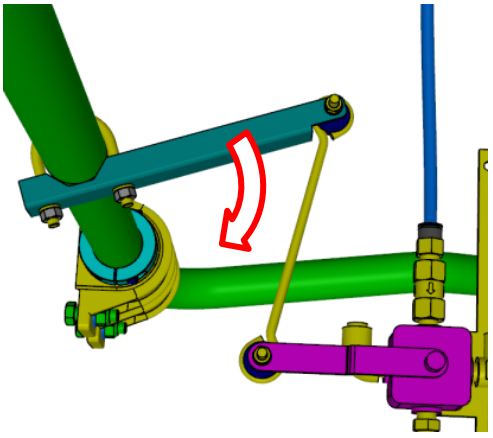
6. Using a hammer, tap gently on the arm secured to the sway bar. Even if the fasteners are properly tightened, it will rotate around the sway bar. Rotate the arm secured to the sway bar to increase or decrease the clearance as shown.
7. Allow 15 minutes to the air system to settle then measure the new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

INCREASING CLEARANCE



DECREASING CLEARANCE



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*E-mail us at **technicalpublications_prev@volvo.com** and type “ADD” in the subject to receive our warranty bulletins by e-mail.*