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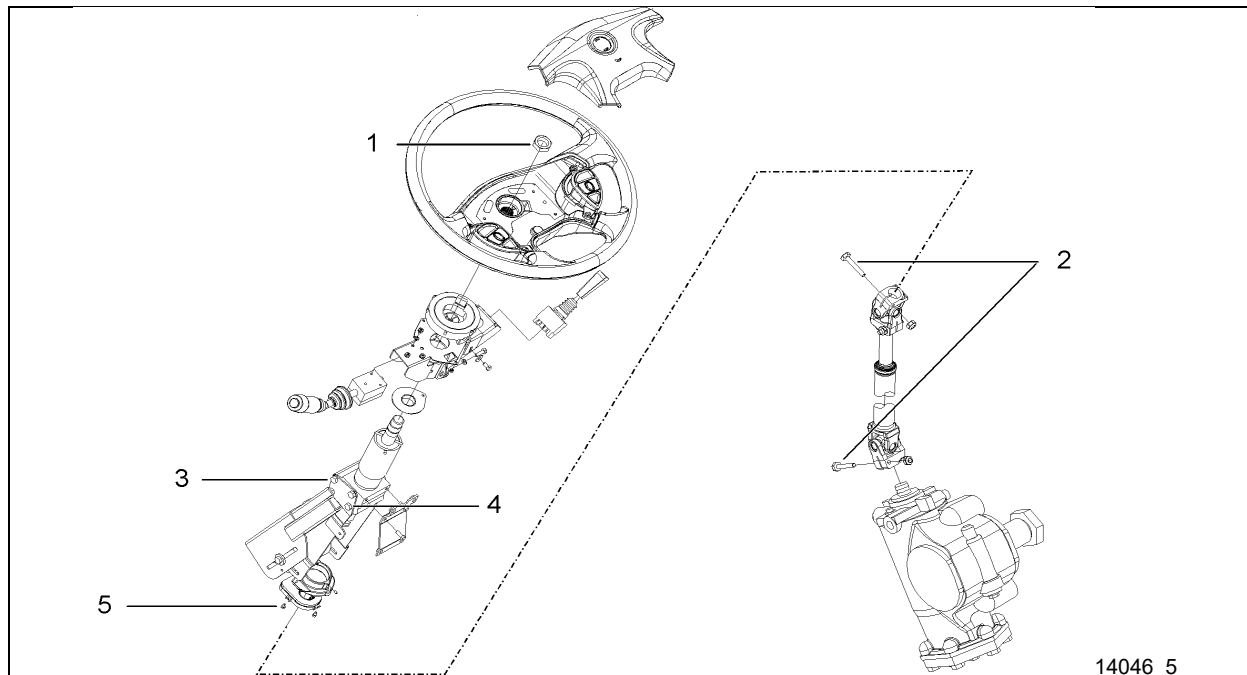


1. SECTION CHANGE LOG

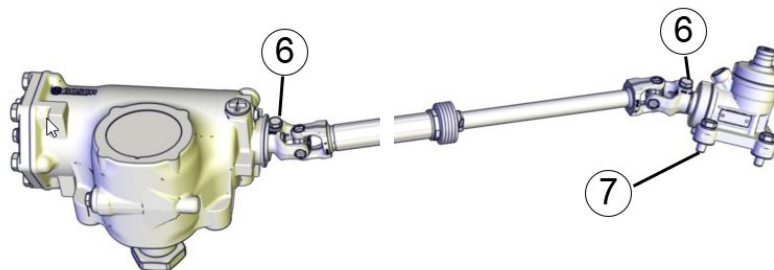
DESCRIPTION		DATE
1	Updated for new IFS design	March 2025
2		
3		
4		
5		
6		

2. TORQUE TABLES

2.1 STEERING COLUMN



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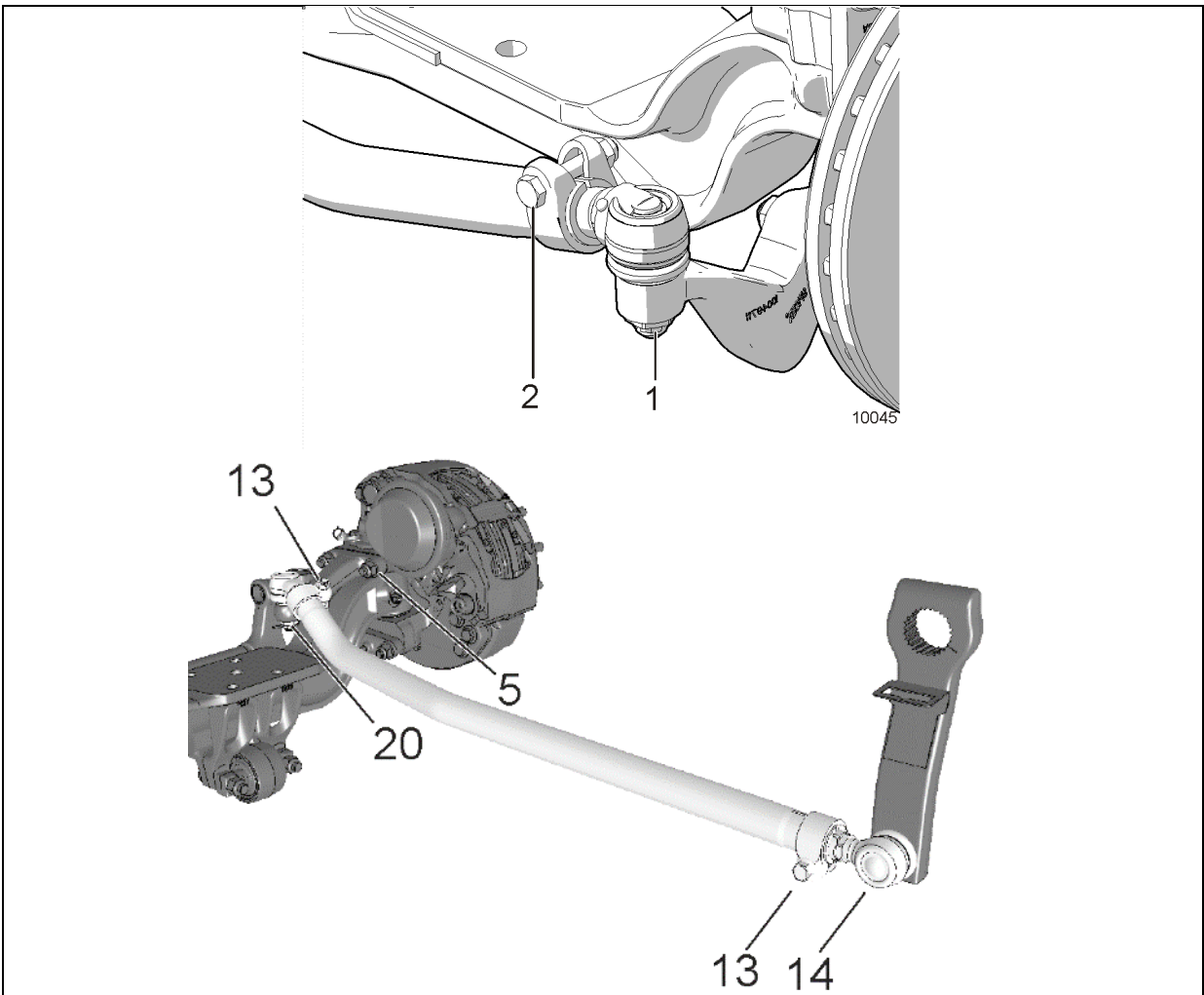


new IFS design

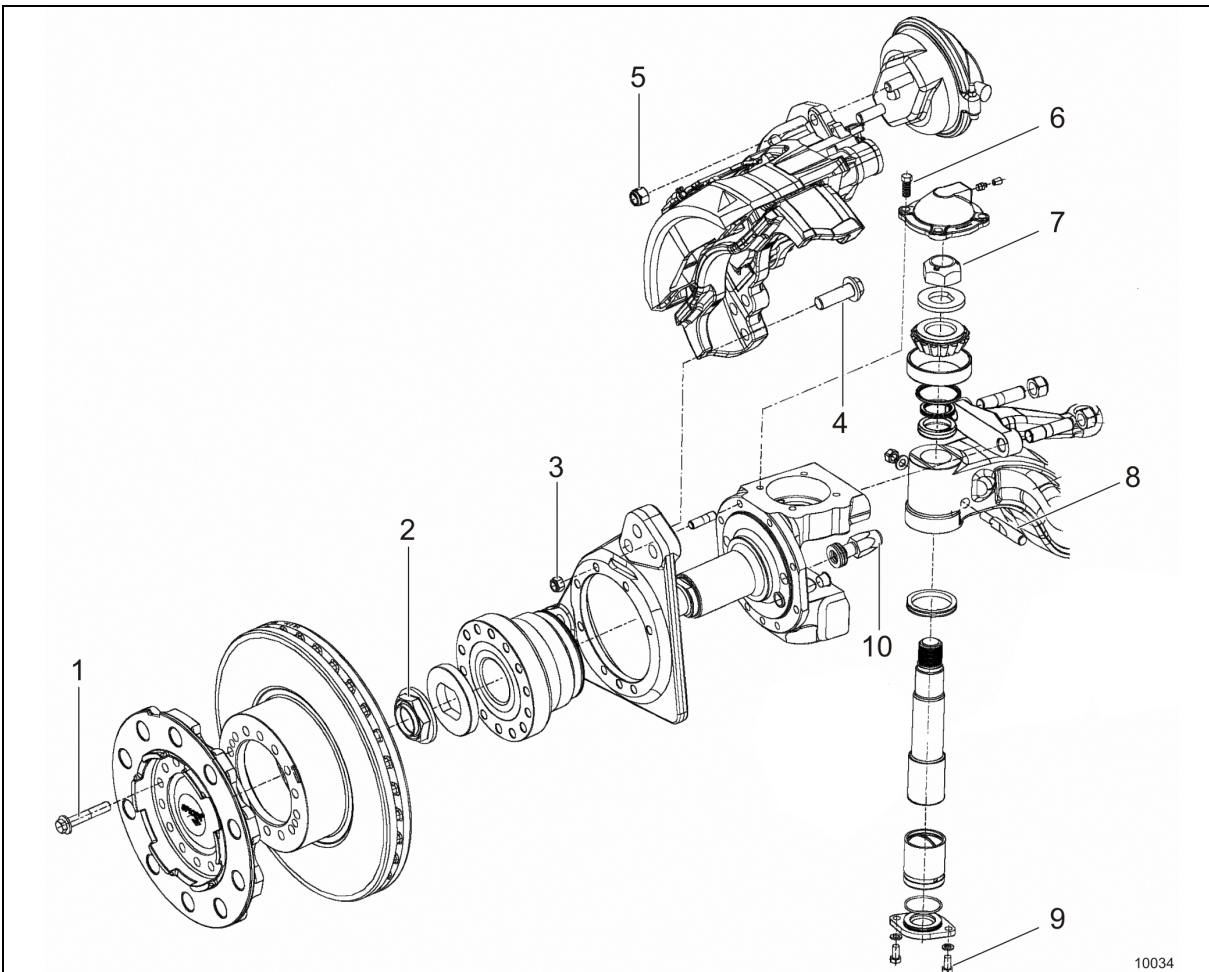
**STEERING COLUMN**

No	DESCRIPTION	TORQUE
1	Steering wheel nut	35-45 lb-ft (47-61 Nm)
2	U-joint clamp nut	48 lb-ft (65 Nm)
3	Column support fore bolts	11-13 lb-ft (15-18 Nm)
4	Column support aft bolts	15-19 lb-ft (20-26 Nm)
5	Steering angle sensor mounting screws	9-12 lb-in (1.02-1.36 Nm)
6	U-joint clamp nut – new IFS design	44 lb-ft (60 Nm)
7	90-degree gearbox mounting bolt (4x)	82 lb-ft (111 Nm)

2.2 FRONT I-BEAM AXLE



MISCELLANEOUS		
No	DESCRIPTION	TORQUE
1	Tie rod end ball pin self locking nuts - I-Beam Axle	155-170 lb-ft (210-230 Nm)
2	Tie rod end clamp bolts - I-Beam Axle	118-133 lb-ft (160-180 Nm)
5	Steering arm stud nuts	285-315 lb-ft (386-427 Nm)
13	Drag Link Clamp Bolts - I-Beam Axle	118-133 lb-ft (160-180 Nm)
14	Drag Link Ball Joint Stud Nut (Fore) - I-Beam	165-236 lb-ft (224-320 Nm)
20	Drag Link Ball Joint Stud Nut (Aft) - I-Beam	140-200 lb-ft (190-271 Nm)

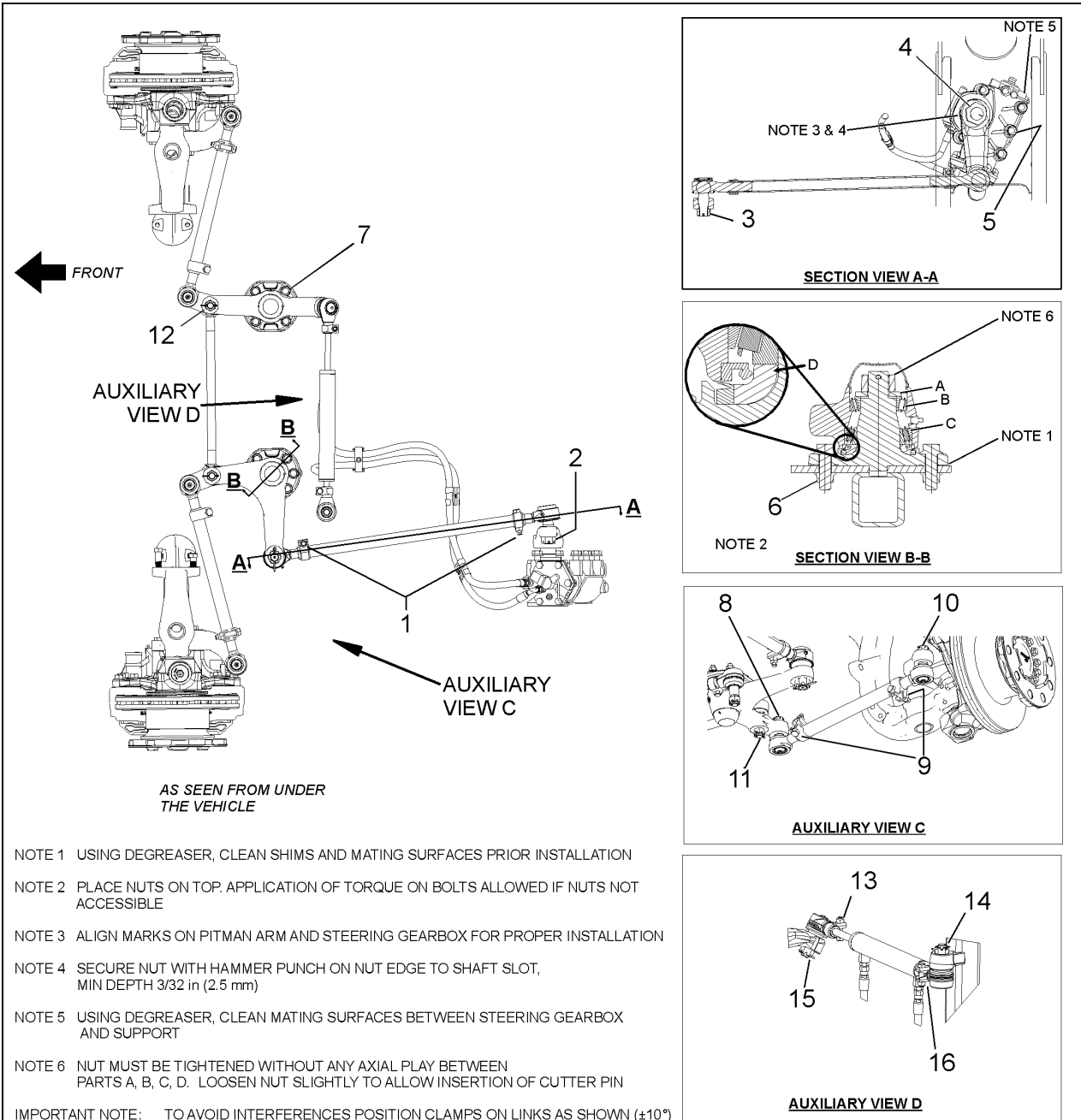


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**HUB, ROTOR AND BRAKE**

No	DESCRIPTION	QTY	TORQUE (dry)
1	Refer to Section 13: Wheels, Hubs and Tires		-
2	Refer to Section 13: Wheels, Hubs and Tires		-
3	Caliper Bracket Nut – Self Lock	16	85-103 lb-ft (115-140 Nm)
4	Refer to Section 12: Brake & Air System		-
5	Refer to Section 12: Brake & Air System		-
6	Kingpin cover Screw	8	51-62 lb-ft (69-84 Nm)
7	Kingpin Nut – Self Lock	2	500-700 lb-ft (678-949 Nm)
8	Draw key, Nut	2	51-62 lb-ft (69-84 Nm)
9	Kingpin lower cover Screw	4	26-32 lb-ft (35-43 Nm)
10	Back & Front Lock - Stop Bolt	3	85-103 lb-ft (115-140 Nm)

2.3 INDEPENDENT FRONT SUSPENSION (IFS) – PREVIOUS DESIGN



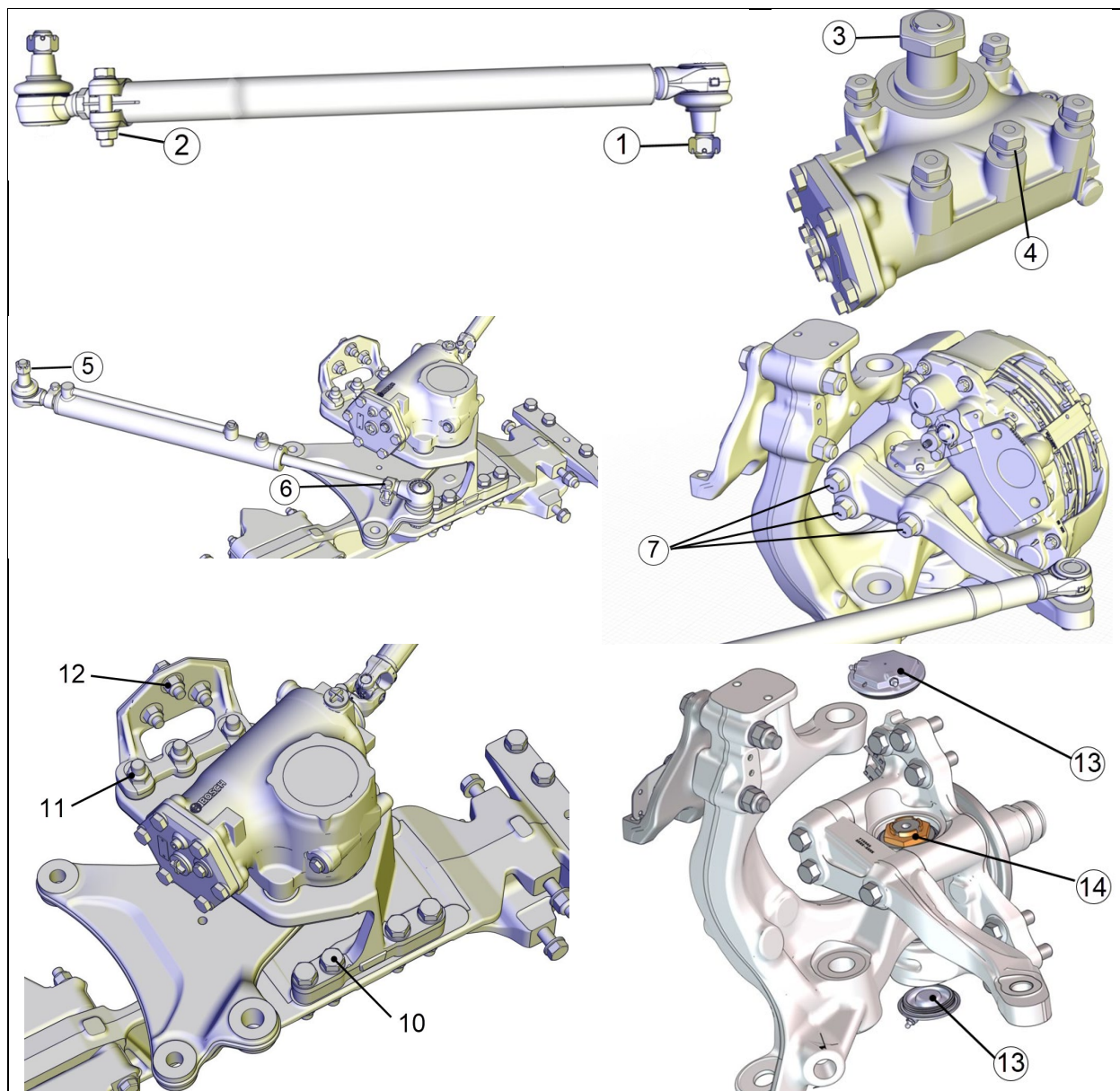
INDEPENDENT FRONT SUSPENSION			
No	DESCRIPTION	QTY	TORQUE (dry)
1	Drag link socket end clamp pinch bolt	2	50-60 lb-ft (68-81 Nm)
2	Drag link ball stud nut to pitman arm	1	245-270 lb-ft (332-366 Nm)
3	Drag link ball stud nut to bell crank	1	245-270 lb-ft (332-366 Nm)
4	Pitman arm to steering gear fixing nut	1	470-570 lb-ft (637-773 Nm)

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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)

\* Tighten the nut to the prescribed torque and then move forward to the next alignment cotter pin slot and install a new cotter pin.

2.4 INDEPENDENT FRONT SUSPENSION (IFS) – NEW DESIGN



MISCELLANEOUS

No	DESCRIPTION	TORQUE
1	Steering tie rod end stud castellated nut (2x) – new IFS design	154 lb-ft (209 Nm)
2	Steering tie rod end clamp pinch bolt – new IFS design	118-132 lb-ft (160-179 Nm)
3	Steering gear sector shaft nut	470-570 lb-ft (637-773 Nm)
4	Steering gear mounting bolts (5x)	365-405 lb-ft (495-549 Nm)
5	Hydraulic power cylinder stud nut – new IFS design	39 lb-ft (53 Nm)
6	Hydraulic power cylinder end clamp pinch bolt – new IFS design	52-66 lb-ft (71-89 Nm)
7	Steering arm bolt (3x) – new IFS design	516 lb-ft (700 Nm)

## SECTION 14: STEERING

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10	Pedestal bolts (7x) – new IFS design	387 lb-ft (525 Nm)
11	Pedestal side bracket M20 bolts (3x) – new IFS design	387 lb-ft (525 Nm)
12	Pedestal side bracket M16 bolts (3x) – new IFS design	198 lb-ft (268 Nm)
13	Upper & lower king pin covers	53-65 lb-ft (72-88 Nm)
14	King pin bearing nut	564-690 lb-ft (765-936 Nm)



### 3. STEERING SYSTEM

#### 3.1 FRONT I-BEAM AXLE STEERING SYSTEM DESCRIPTION

The steering system consists of the steering wheel and column assembly, a vane-type hydraulic pump, reservoir, filter, interconnecting system lines and hoses, integral power steering gear, linkage and steering damper (Figure 1). The steering linkage includes the pitman arm, drag link, steering arm, tie rod arms and tie rod.

Hydraulic components are added to transmit, increase and regulate steering control forces.

These elements are:

1. Steering stabilizer (damper);
2. A vane type hydraulic pump;
3. Hydraulic reservoir and hoses.

The steering stabilizer reduces road shocks and vibrations in the system. The steering gear is self-powered and provides movement with power assistance to the left wheel.

Steering stability and tire wear are influenced by wheels, hubs, tires, air suspension, brakes, front suspension and front end alignment which are all covered in their respective sections in this manual.

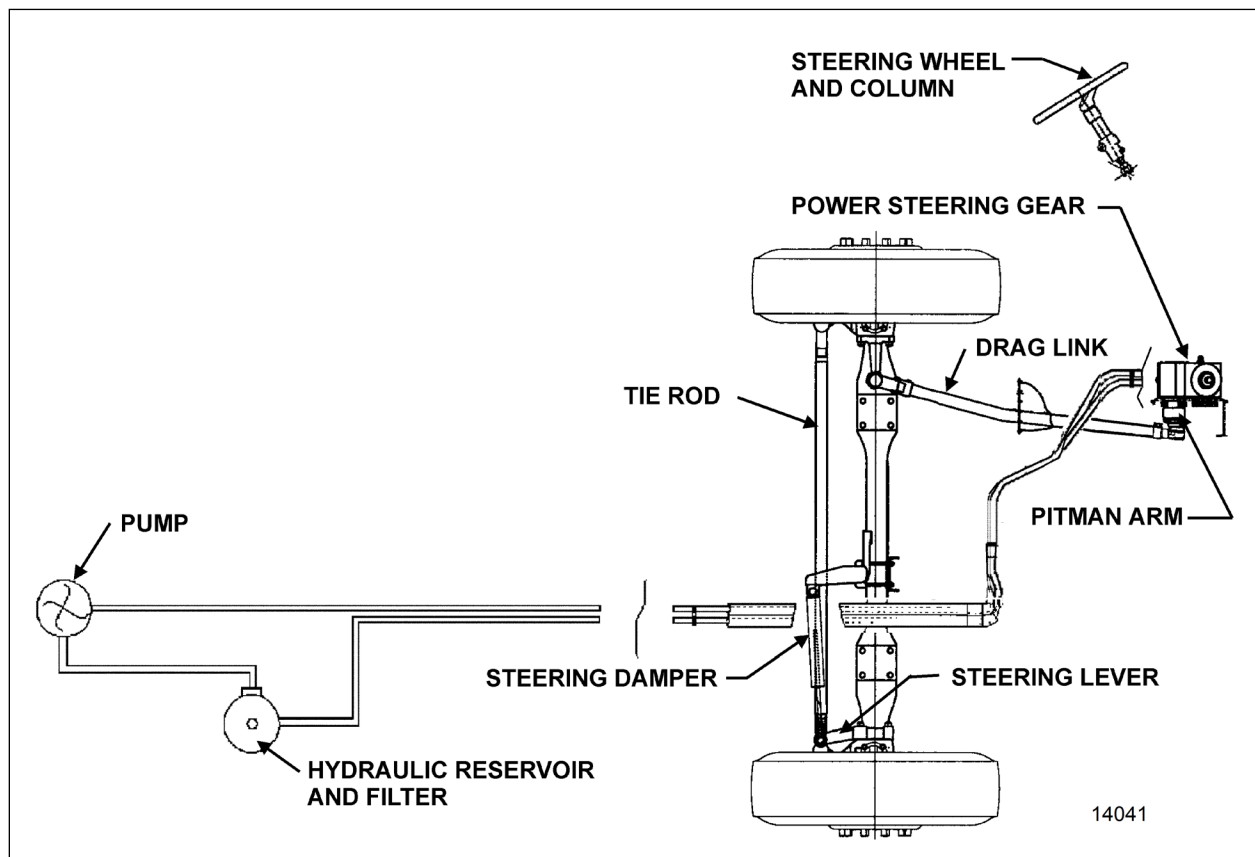


FIGURE 1: I-BEAM AXLE STEERING SYSTEM SETUP 14041

### 3.2 INDEPENDENT FRONT SUSPENSION STEERING SYSTEM DESCRIPTION

The steering system consists of the steering wheel and column assembly, a vane-type hydraulic pump, reservoir, filter, interconnecting system lines and hoses, integral power steering gear and linkage.

Hydraulic components are added to transmit, increase and regulate steering control forces.

These elements are:

1. A vane type hydraulic pump;
2. Hydraulic reservoir and hoses;
3. Hydraulic power cylinder (VIP).

#### **NOTE**

*VIP vehicles and bus shells are equipped with a hydraulic power cylinder. The hydraulic power cylinder provides an added source of assistance and makes it such that the total steering forces are produced with minimal stress on mechanical linkages.*

Steering stability and tire wear are influenced by wheels, hubs, tires, air suspension, brakes, front suspension and front end alignment which are all covered in their respective sections in this manual.

#### 3.2.1 Previous IFS Design

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 (Figure 2).

#### 3.2.2 New IFS Design

The steering linkage consists of steering tie rods connected to the steering arms and T-Arm which is mounted to the steering gear (Figure 3) sector shaft.

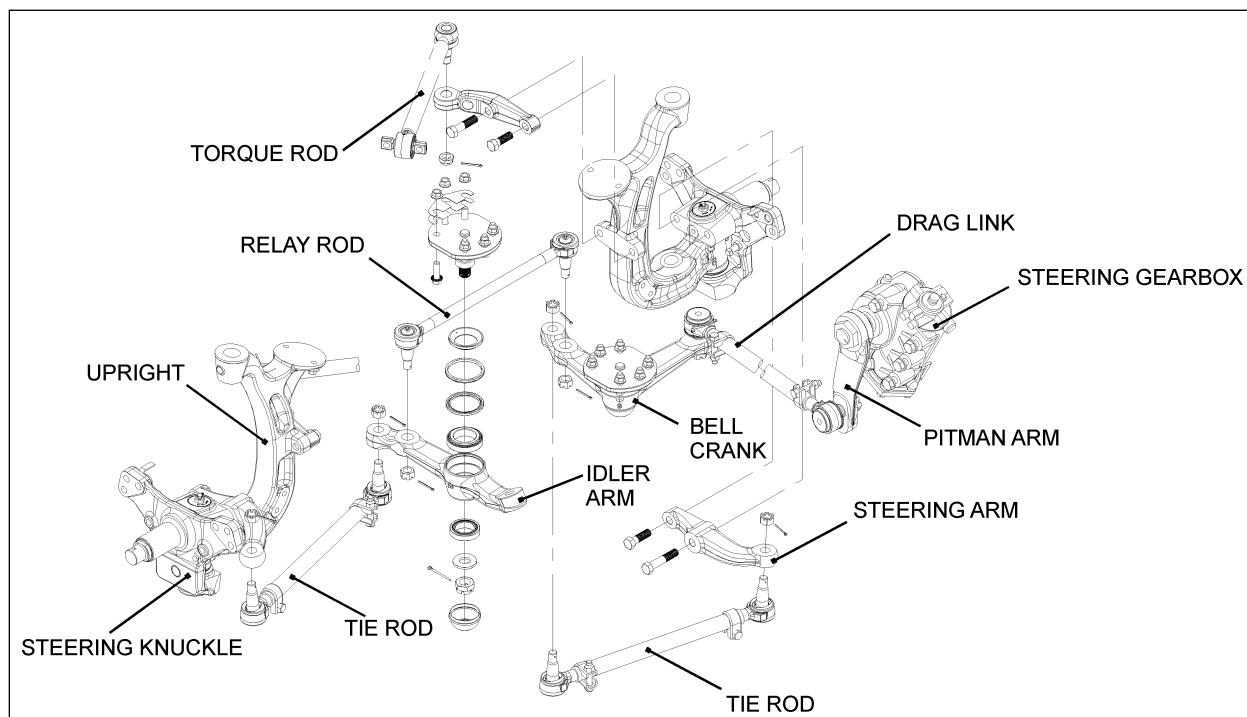


FIGURE 2: PREVIOUS IFS STEERING SYSTEM SETUP

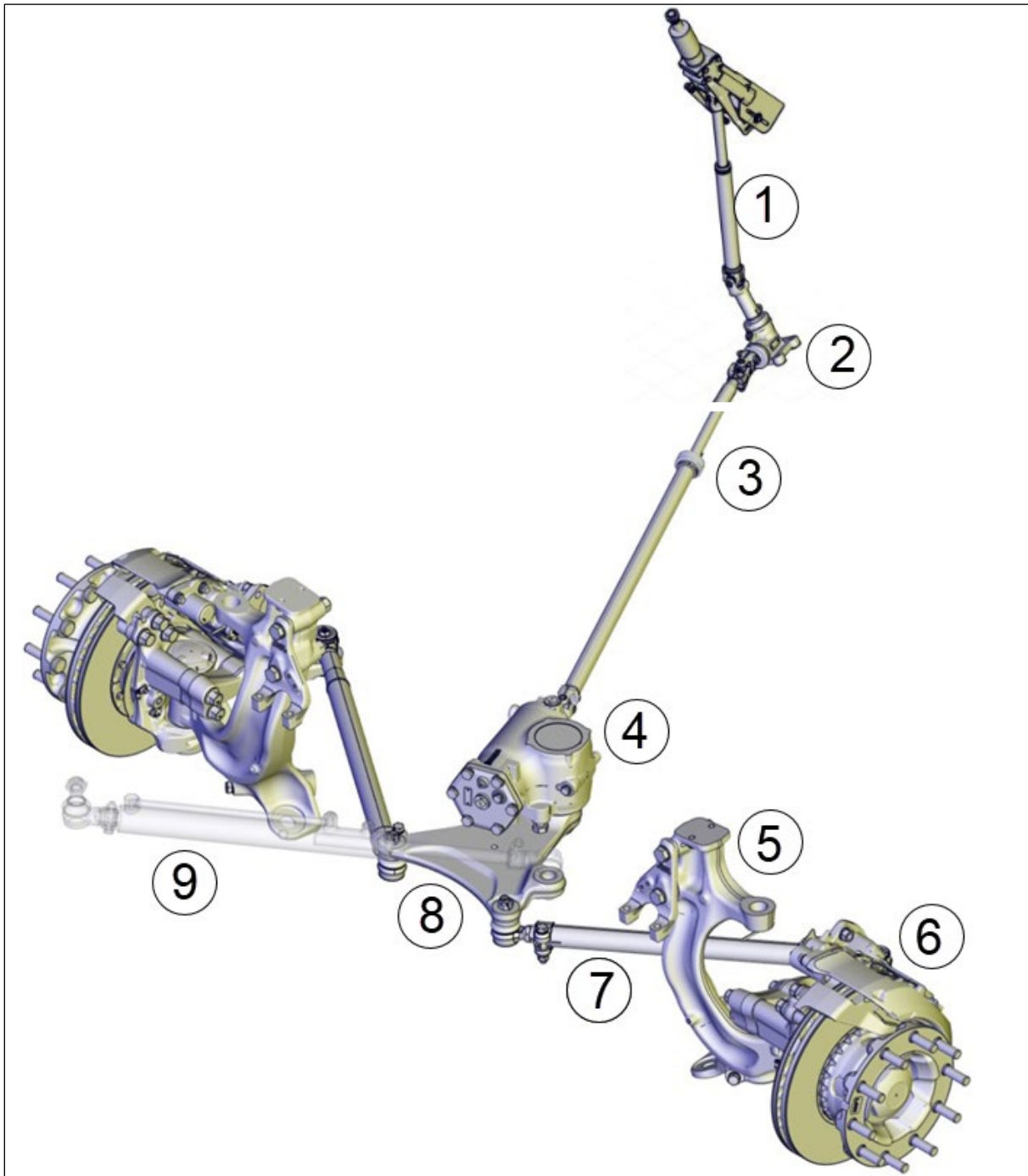


FIGURE 3: NEW IFS DESIGN STEERING SYSTEM SETUP

- |                      |                             |
|----------------------|-----------------------------|
| 1. Steering column   | 6. Disc brake assembly      |
| 2. 90-degree gearbox | 7. Steering tie rod         |
| 3. Steering shaft    | 8. T-arm                    |
| 4. Steering gear     | 9. Hydraulic power cylinder |
| 5. Upright           |                             |

## 4. POWER STEERING GEAR

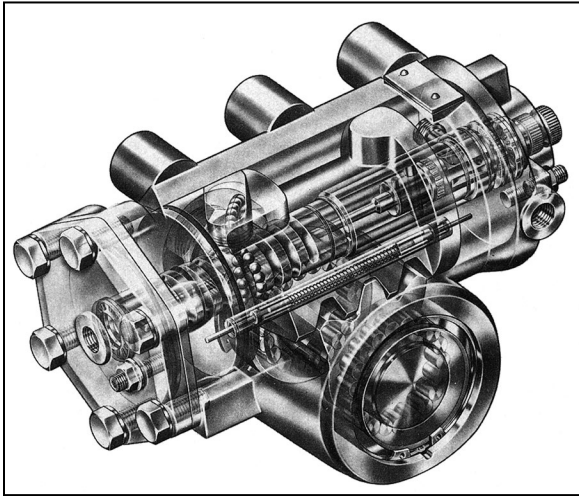


FIGURE 4: POWER STEERING GEAR

### 4.1 DESCRIPTION

The power steering gear is located in the lower part of front service compartment. The housing of the Robert Bosch-Servocom contains a control valve, working cylinder and a complete mechanical steering gear. The pressure oil for the steering is delivered by a motor-driven oil pump which is supplied with oil from an oil tank.

The housing is designed as a cylinder for the piston, which converts the rotation of the steering shaft and the worm into an axial movement and transfers this to the steering worm sector shaft. The serration of the sector shaft is straight cut with a high surface quality in such a way that it is only possible to set a unique setting without play on installation in the straight-ahead driving area by means of the two eccentrically designed lateral housing covers.

The piston and worm are connected via a ball chain. When the worm is turned, the balls are collected by a circulating pipe at one end of the chain and fed in again at the other end, thus producing an endless ball chain.

The control valve consists of the valve slide in a needle bearing in the worm, with six control grooves on the circumference and the control sleeve on the worm, which also has six control grooves. The valve slide, designed with steering shaft connection, turns together with the worm as the steering wheel is turned.

A torsion bar, which is pinned with the valve slide and the worm, keeps the control valve in the neutral position as long as no opposing force is applied to the steering wheel. The steering housing contains a pressure relief valve, which limits the discharge pressure of the oil pump to the maximum value required. A replenishing valve can also be used, through which oil is sucked from the return if steering is not hydraulically boosted.

Compared with constant ratio, steering versions with variable ratio are more directly designed in the center area than outside the center area. The resulting smaller steering corrections benefit steering behavior in straight-ahead driving. At the same time, the indirect transmission means that there is a higher hydraulic torque available at the steering arm in parking movement. If the hydraulic assistance fails, the operating forces on the steering wheel are correspondingly lower in this area. This is achieved through a piston/steering worm sector shaft serration with differing modulus and angle of pressure.

Upon transfer of a torque from the steering shaft to the worm, or vice versa, the torsion bar is deformed in the elastic area so that there is torsion between the valve slide and the control sleeve. When the steering wheel is released, the torsion bar ensures that the valve is returned to the neutral position.

**Refer to the "ZF-SERVOCOM Repair Manual" and "RB Robert Bosch Servocom - Service Manual (8090)", found on the Technical Publications site for the functional aspects and maintenance procedure of the steering gear.**

### 4.2 POWER STEERING GEAR REMOVAL



#### WARNING

The steering gear weighs approximately 100 lbs (45 kg) dry. Exercise caution when handling.

#### 4.2.1 All except new IFS design

1. Make sure that the front wheels are in straight ahead position.
2. Thoroughly clean the steering gear and its immediate surroundings, particularly the pipe connections.

3. Attach the steering wheel to **prevent any rotation**.
4. Take a note of the pressure and return lines position.
5. Put a container into place, and then disconnect both the inlet and outlet hoses from the power steering gear. Cover fittings to prevent fluid contamination.
6. Mark both the pitman arm and sector shaft with a line, then remove pitman arm to ensure correct alignment at reassembly.
7. Mark both the steering shaft universal joint yoke and steering gear input shaft with a line.
8. Disconnect the steering shaft yoke from the steering gear input shaft.
9. Unscrew and remove the power steering gear.

**NOTE**

The steering wheel must not be rotated.

#### 4.2.2 New IFS Design

To remove the steering gear, you will need a chain block hoist, a suitable sling to support the steering gear assembly and a tube or beam to support the chain block.

1. Make sure that the front wheels are in straight ahead position.
2. Thoroughly clean the steering gear and its immediate surroundings, in particular the pipe connections.
3. Attach the steering wheel to **prevent any rotation**.
4. Identify the pressure and return hoses.

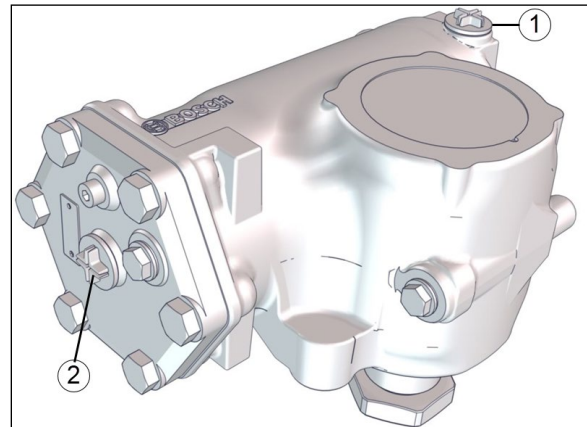


FIGURE 5: (1) PRESSURE LINE PORT, FROM PUMP (2) RETURN LINE PORT, TO POWER STEERING FLUID TANK

5. Put a container into place, and then disconnect both the inlet and outlet hoses from the power steering gear. Cover fittings to prevent fluid contamination.
6. Mark both the steering shaft universal joint yoke and steering gear input shaft with a line to ensure correct alignment at reassembly.
7. Disconnect the steering shaft yoke from the steering gear input shaft (Figure 6). See paragraph **10.4 t-arm**

**NOTE**

The steering shaft and steering wheel must not be rotated.

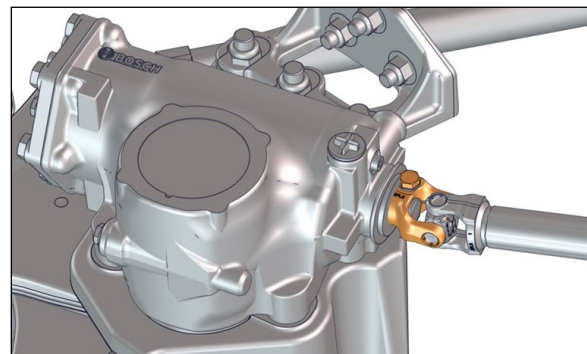


FIGURE 6

8. Remove the split pin, the castellated nut and then disconnect the power cylinder from the T-Arm (Figure 7). TOOL: puller.



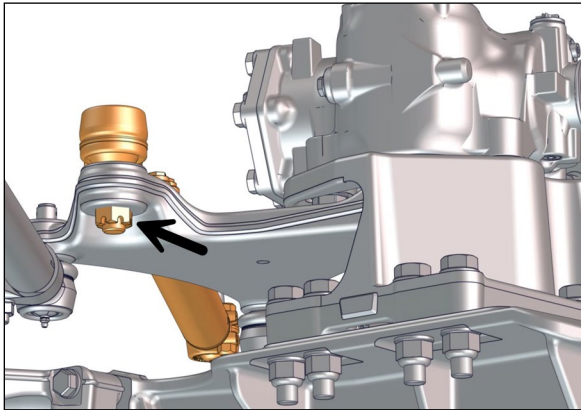


FIGURE 7

9. Disconnect both steering tie rods from the T-arm. TOOL: puller.
10. Unscrew seven (7x) bolts fastening the pedestal to the backbone (Figure 8 & Figure 9).

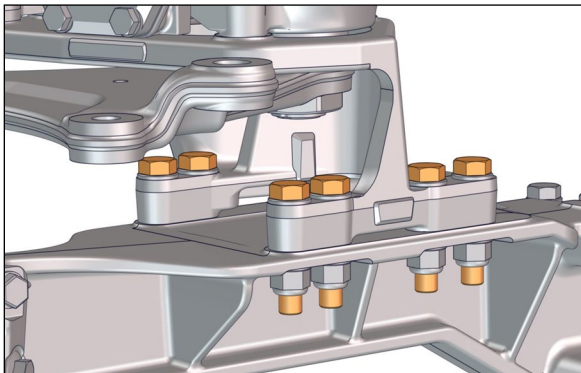


FIGURE 8

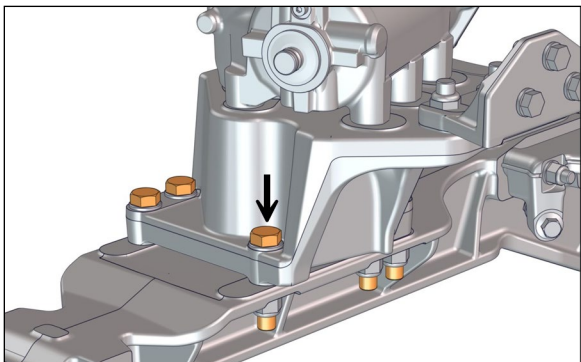


FIGURE 9

11. Install the chain block.
12. Install the chain block sling to support the steering gear assembly, i.e. the steering gear, the pedestal and the T-arm.
13. Unscrew six (6x) bolts fastening the pedestal to the side bracket (Figure 10). Remove the side bracket.

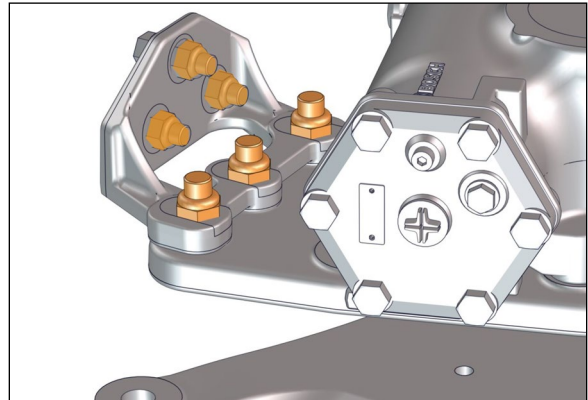


FIGURE 10: SIDE BRACKET

14. Using the chain block, from the curb side, lower the steering gear, the pedestal and the T-arm as a complete unit. You will have to swing the assembly from side to side to clear the lower control arm and the backbone. **CAUTION, the assembly weighs about 180 lbs.**
15. Add additional reference marks to the T-arm and sector shaft if necessary to ensure correct alignment at reassembly.
16. Using a cold chisel, undo punch mark that locks the steering gear sector shaft nut (Figure 11).

**NOTE**

*Never reuse a sector shaft nut that was previously punched.*

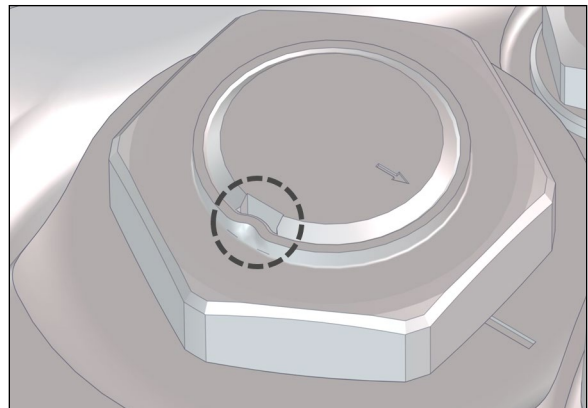


FIGURE 11

17. Remove sector shaft nut.
18. Use a suitable puller to separate the T-arm from the steering gear sector shaft.
19. If necessary, remove five (5) bolts to separate the steering gear from the pedestal.

4.3 POWER STEERING GEAR INSTALLATION

4.3.1 All except new IFS design

Reverse "Power Steering Gear Removal" procedure paying particular attention to the following:

1. Tighten fasteners as recommended according to TORQUE TABLES.
2. Bleed air from the system as per paragraph 14 BLEEDING POWER STEERING HYDRAULIC SYSTEM.

4.3.2 New IFS Design

Reverse "Power Steering Gear Removal" procedure paying particular attention to the following:

1. Tighten fasteners as recommended according to TORQUE TABLES.
2. Bleed air from the system as per paragraph 14 BLEEDING POWER STEERING HYDRAULIC SYSTEM.

4.4 STEERING GEAR SECTOR SHAFT NUT

1. To unscrew and remove the steering gear sector shaft nut, first, using a cold chisel, undo punch mark that locks the sector shaft nut (Figure 12).

**NOTE**  
Never reuse a sector shaft nut that was previously punched.

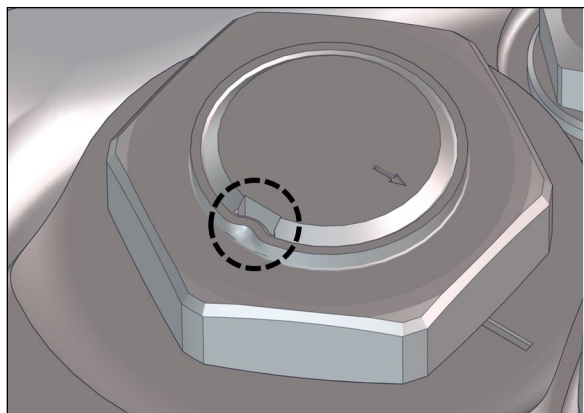


FIGURE 12

2. At all times, prior installation of the steering sector shaft nut, make sure the mark on the sector shaft is in line (coinciding) with the mark on the pitman arm (FIGURE 13) or the T-arm (Figure 14).

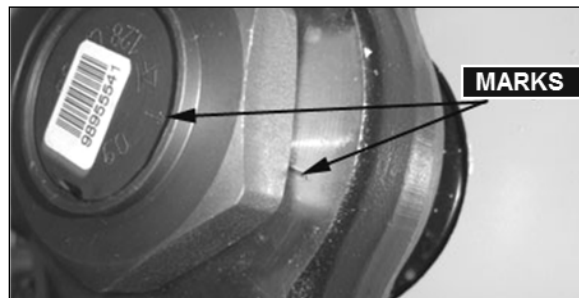


FIGURE 13: STEERING GEAR SECTOR SHAFT AND PITMAN ARM MARKS ALIGNED

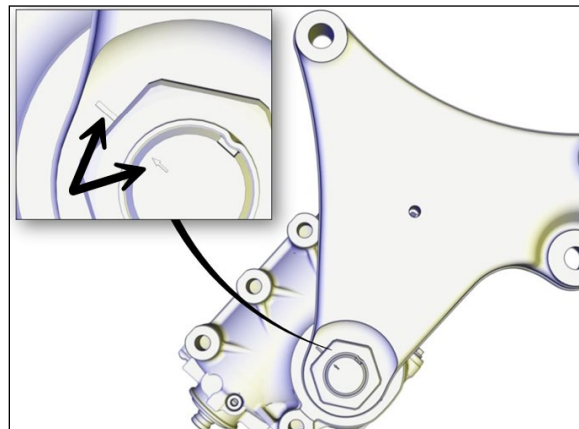


FIGURE 14: MARKINGS ON T-ARM AND STEERING GEAR SECTOR SHAFT SHOWING POSITION WHEN DRIVING STRAIGHT AHEAD MUST BE COINCIDING

3. Once a steering gear sector shaft nut is installed and torque tighten, using a punch,peen the nut as shown on (Figure 15).

**CAUTION**  
Lock nut with sector shaft using a punch mark into the groove, minimum depth 3/32 inch (2.5mm) (Figure 15).

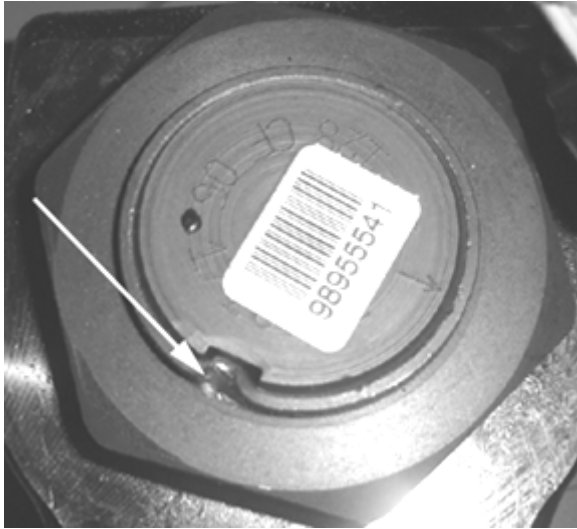


FIGURE 15: FIXING NUT PUNCH MARK

- b) New screws (20 and 128) were fitted to the automatically adjusting steering limitation or
- c) Alterations to or adjustments of the front axle were carried out.

**Find the end limiter adjustment procedure in *Maintenance Information MI20-12* available on [Prevost Technical Publications site](#).**

Also, see **Setting the hydraulic steering limitation** in the following manual:

***RB Robert Bosch Servocom - Service Manual (8090)***

#### 4.5 TROUBLESHOOTING

Perform troubleshooting of the steering gear as outlined in the "*ZF-SERVOCOM Repair Manual*" and "***RB Robert Bosch Servocom - Service Manual (8090)***" found on [Prevost Technical Publications site](#).

#### 4.6 STEERING GEAR HYDRAULIC END LIMITER ADJUSTMENT

Refer to the following technical information when experiencing steering jerking, wheels hard to turn and noisy gear when wheels are turned all the way.

Two potential failure modes could cause the problems described above:

- 1) Air in the system – Need to bleed the air in the system (refer to *RB Robert Bosch Servocom - Service Manual (8090)*, available on the [Prevost Technical Publications site](#)).
- 2) Pressure relief limiter screws not set correctly. **Replace the limiter screws** on the steering gear when setting the alignment that could have changed the mechanical end lock position of the vehicle or if the maintenance technician took the steering gear to a full lock position without having all the steering mechanical connections installed or linked.

A setting of the steering limitation is necessary if or when:


- a) A new or repaired steering gear is fitted or





## 5. PITMAN ARM

### 5.1 PITMAN ARM REMOVAL

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

	<b>WARNING</b>
Always wear approved eye protection when operating pullers.	

	<b>CAUTION</b>
Do not drive (hammer in) pitman arm on or off as this can damage the steering gear sector shaft.	

	<b>CAUTION</b>
Heating of components to aid in disassembly is not allowed because it has a detrimental effect on axle components and steering linkages.	

3. Using a cold chisel, undo punch mark that locks the steering gear sector shaft nut. Refer to **4.4 Steering gear sector shaft nut**.
4. Remove the steering gear sector shaft nut.
5. Check the radial position of the pitman arm in relation to the sector shaft prior to removal of pitman arm.
6. Add reference marks to the pitman arm and sector shaft if necessary to ensure correct alignment at reassembly.
7. Use a suitable puller and remove pitman arm.


### 5.2 INSTALLATION

1. Position pitman arm on sector gear shaft with reference marks aligned.

<b>NOTE</b>
-------------

<i>Use a new nut if the previously removed nut was punched.</i>
---

2. Install the sector shaft nut.
3. Lock nut with sector shaft using a punch mark into the groove. Refer to **4.4 Steering gear sector shaft nut**.
4. Connect drag link to pitman arm while ensuring that rubber stabilizer is in place on the rod end. Install washers. Tighten nut and install a new cotter pin. Depending on axle type, select the appropriate torque.

	<b>CAUTION</b>
Input shaft marks must be aligned before adjusting pitman arm.	

### 5.3 PITMAN ARM ADJUSTMENT

1. Disconnect the drag link from pitman arm. Center steering wheel by dividing the total number of steering wheel turns in two. Scribe a reference mark on steering gear at the center previously determined.
2. Using a protractor, check the angle of the pitman arm (Figure 16).
3. The pitman arm should be adjusted with reference marks aligned or to an angle of 2.5° towards front of vehicle (I-Beam axle) or 0° (Independent Front Suspension) in relation with the vertical axis. If not, unscrew and remove fixing nut. Remove the pitman arm according to the procedure outlined under previous heading **5.1 PITMAN ARM REMOVAL**. Adjust to the proper angle.
4. When adjustment is achieved, install the steering gear sector shaft nut.

<b>NOTE</b>
<i>Use a new nut if the previously removed nut was punched.</i>

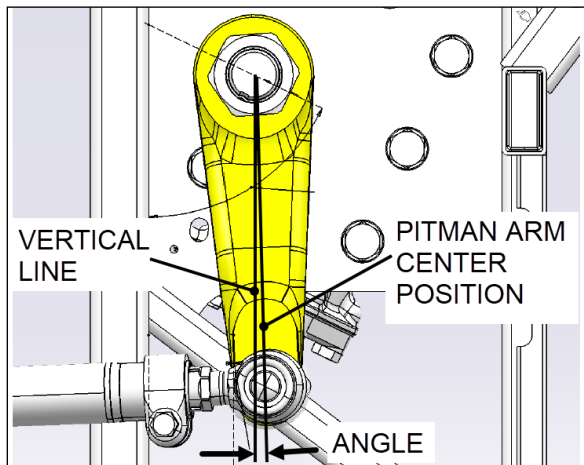


FIGURE 16: PITMAN ARM ADJUSTMENT

front axle type	pitman arm center position angle in reference to vertical line
H3 I-beam	2.5°
H3 IFS	0°
X3 I-beam	2.4°
X3 IFS	0°

#### 5.4 TAG AXLE UNLOADING SWITCH ADJUSTMENT (OPTIONAL)

1. Make sure vehicle wheels are straight and facing forward.
2. Line up switch lever with reference to the bracket center.

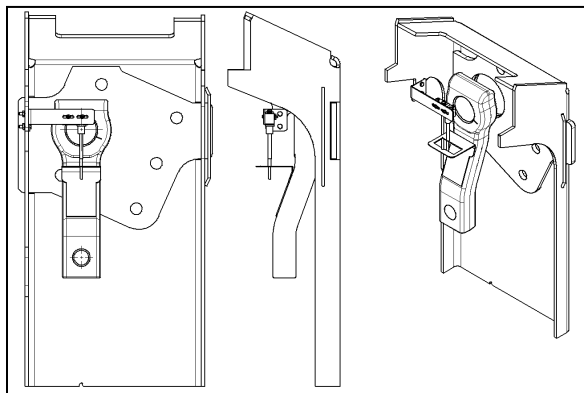


FIGURE 17: TAG AXLE UNLOADING SWITCH ADJUSTMENT  
14061

#### 6. DRAG LINK (I-BEAM AXLE)

The draglink on your vehicle connects the steering gear pitman arm to the front axle's steering arm.

For additional details please refer to ZF assembly instructions LMN404-3 and Lemförder service information leaflet for the fine adjustment system.

### PINCH HAZARD

Keep hands and fingers clear of pinch zones around pitman arm.

Pinch zones are between pitman arm and clamp, and between front of pitman arm and vehicle structure.

PINCH ZONES 14079

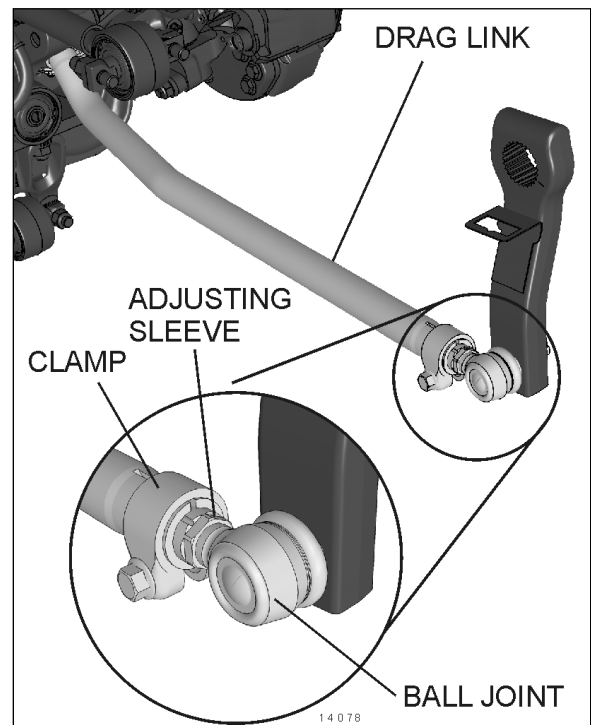


FIGURE 18: DRAG LINK  
14 078

### 6.1 LENGTH ADJUSTMENT

The drag link fore end is provided with an adjusting sleeve which has internal and external left and right threads. Turning this sleeve allows fine adjustments to the length of the draglink.

Apply a small amount anti-seize compound on the threads for corrosion protection. Be sure to avoid smearing the ball joint boot.

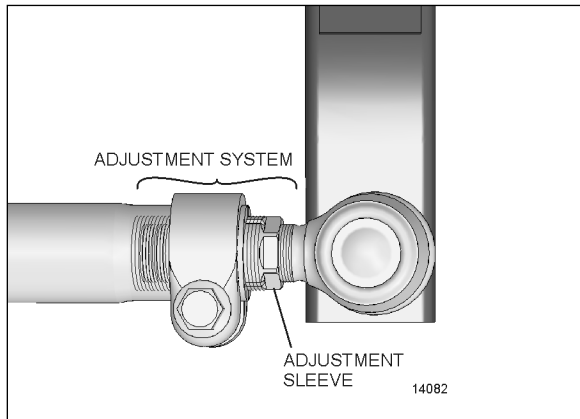


FIGURE 19: DRAG LINK ADJUSTMENT SYSTEM

	<b>CAUTION</b>
<p>Too little pressure on the clamp can destroy the threaded adjustment system sleeve.</p> <p>Apply the recommended torque for clamp nut.</p>	

Fine adjustment of the drag link length should be performed exclusively by turning the adjuster sleeve.

Refer to maintenance information [MI19-05](#) for detailed draglink length adjustment instructions.

#### 6.1.1 Adjustment System Thread Lengths

When assembling the adjuster sleeve or ball joint, be sure to assemble the parts within the following prescribed thread lengths and values.

Lengths V and W should be measured prior to removal to restore the steering system to its original state.

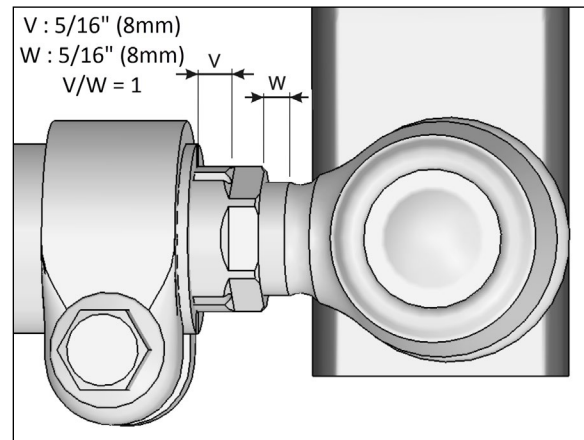


FIGURE 20: DRAG LINK ADJUSTMENT SYSTEM

- Dimension V and W should be equal:  $V/W = 1$
- Dimension V: 5/16" (8mm)
- Dimension W: 5/16" (8mm)

	<b>WARNING</b>
<p>To preserve the integrity of the adjusting system, length V and W should <i>never</i> exceed 5/8"(16mm) ± 1 thread pitch.</p> <p>Length V and W should be equal within ± 1mm</p>	

## 7. DRAG LINK - PREVIOUS IFS DESIGN

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 may be equipped with lubrication fittings and should be lubricated as directed in **21 MAINTENANCE - LUBRICATION FITTINGS ON IFS** 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.*

### 7.1 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 disconnect the stud from drag link at bell crank.
4. Locate centerline of vehicle and center of relay rod.
5. 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.*

6. 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.
7. 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.*

## 8. FRONT I-BEAM AXLE - STEERING KNUCKLE KING PIN INSPECTION

Check permissible slackness in the kingpins as follows:

Aspects to be considered are:

- **Lateral slackness**
- **Vertical slackness**

### NOTE

*Before commencing checks, apply parking brake, raise wheels off ground and support axle on stands.*

### 8.1 CHECKING LATERAL SLACKNESS

Following regular and thorough greasing practices will maximise bushing life. This procedure measures the upper bearing & lower bushing wear due to side and vertical loading. While this is being carried out, the brake must be applied.

1. Place a set-square with its stock on ground and its blade against tire wall.
2. Place a mark on the ground to indicate position of stock end.
3. Insert a lever through bottom cut-out of wheel and lever it upwards thus moving set-square outboard.
4. Mark the changed position of the stock end.

5. Maximum allowable stock displacement (for 22.5" wheels) is **0.315 in (8mm)**.
6. If displacement exceeds stated allowance then need for bushing / bearing attention and possible renewal, is in evidence.

**NOTE**

*To avoid inaccurate measurements, be careful not to let the knuckle turn while moving assembly in and out. Applying brakes will help lock wheel assembly.*

2. Place a jack against underside of knuckle and, while applying a lifting force, observe any movement on indicator dial.
3. **If vertical movement is evident and it exceeds 0.030" (0.76mm)** then readjustment of knuckle is required by adjusting thickness of bearing adjusting shims. In this case, refer to:

***Dana Parts & Service Instructions S84U Steer Axle KING PIN REWORK\_ Manual NO 1985 B iss A.***

## 8.2 CHECKING VERTICAL SLACKNESS

1. This is measured by a dial indicator anchored to axle beam and having its pointer placed vertical against knuckle top.

## 9. INDEPENDENT FRONT SUSPENSION – PREVIOUS DESIGN

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

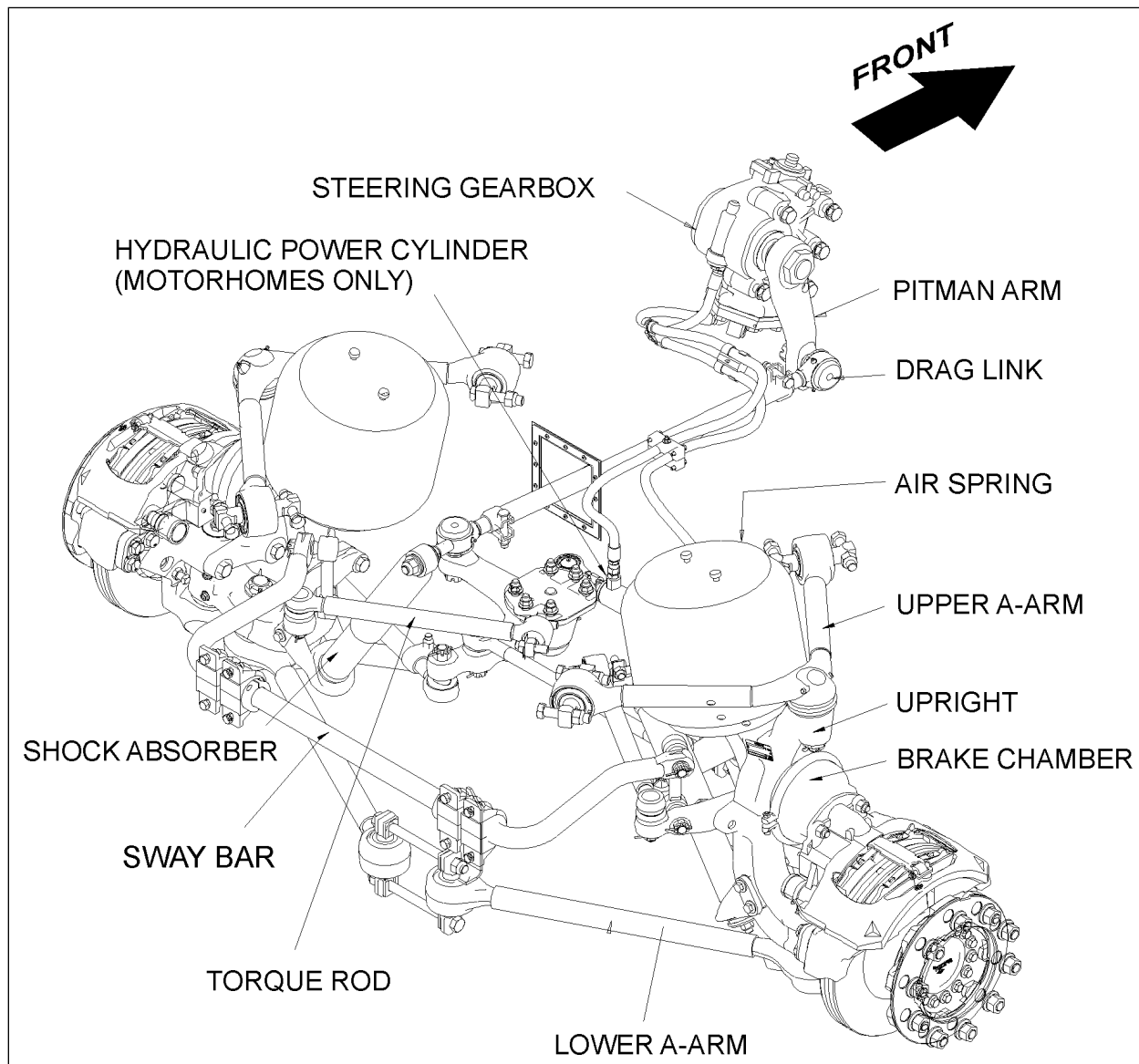


FIGURE 21: INDEPENDENT FRONT SUSPENSION

### 9.1 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 control arms (A-arm) 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.

### 9.1.1 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:  $49.5^{\circ} \pm 0.5^{\circ}$

Interior:  $58^{\circ} \pm 0.5^{\circ}$

Before checking the turning angle, be sure the front end is properly aligned.

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 26 & FIGURE 27 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.

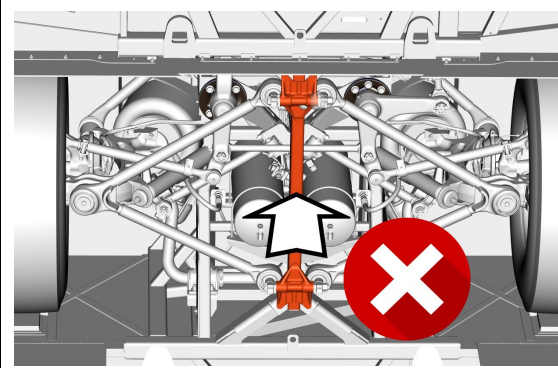
4. If necessary, readjust hydraulic steering limiter. Refer to **4.6 STEERING gear HYDRAULIC END LIMITER ADJUSTMENT**.

### NOTE

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

### CAUTION

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





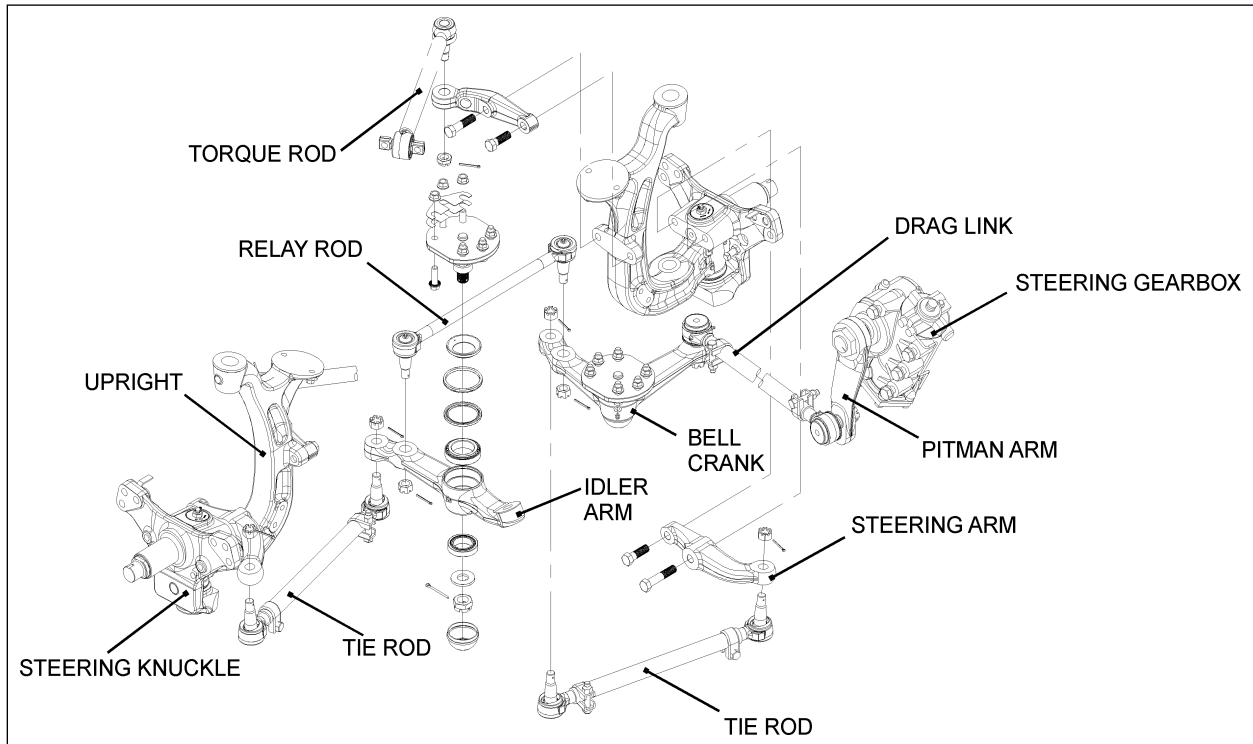


FIGURE 22: IFS STEERING LINKAGE OVERVIEW



### STEERING LINKAGE NOMINAL LENGTHS

LINKAGE NOMINAL LENGTH IS GIVEN ONLY FOR PRELIMINARY ADJUSTMENT. ALL LENGTHS MEASURED FROM CENTER TO CENTER OF BALL SOCKET.

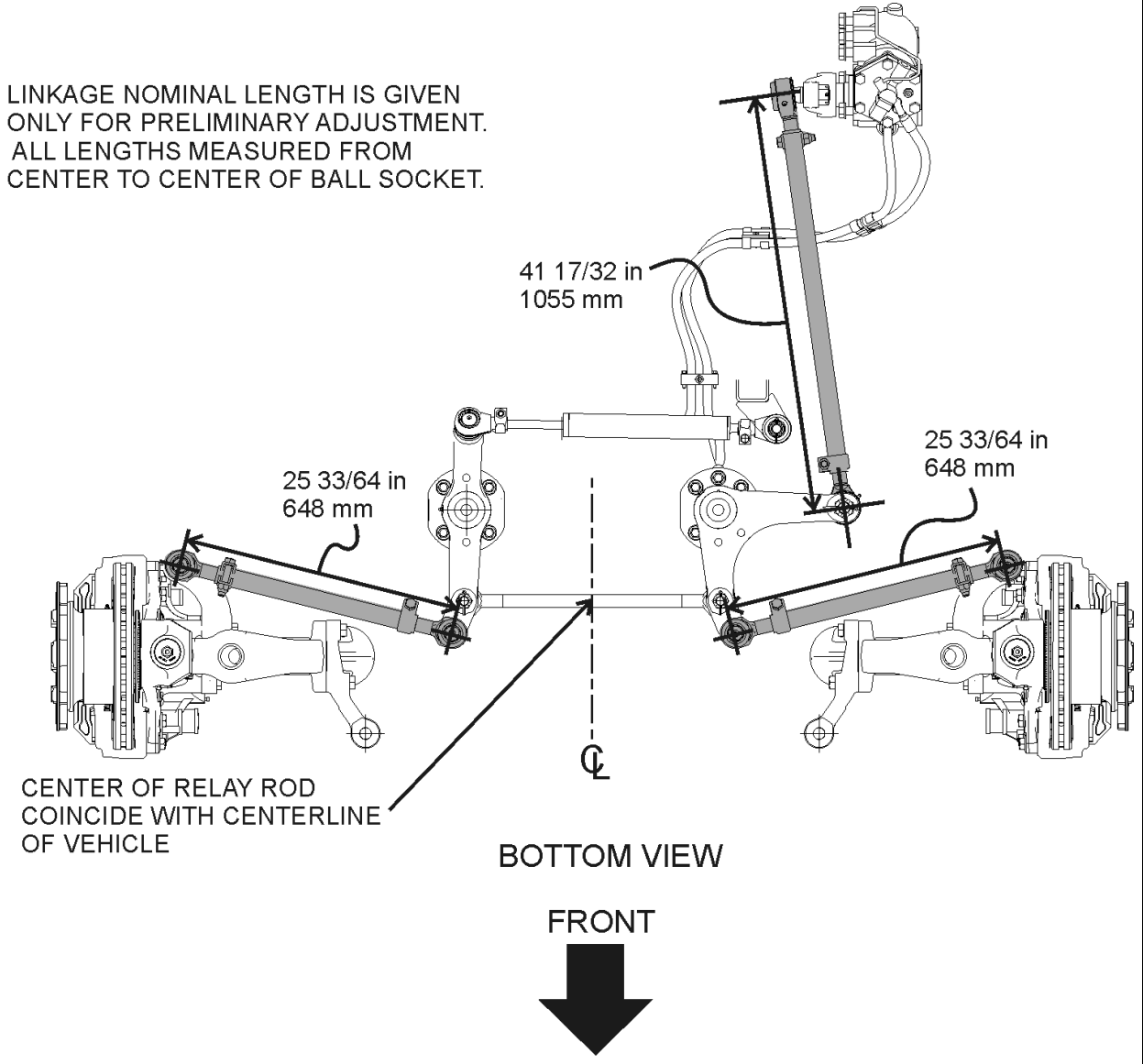


FIGURE 23: STEERING LINKAGE NOMINAL LENGTHS

## 9.2 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 gear input shaft marks.
3. Afterwards, the pitman arm should be adjusted with sector shaft and pitman arm reference marks aligned.

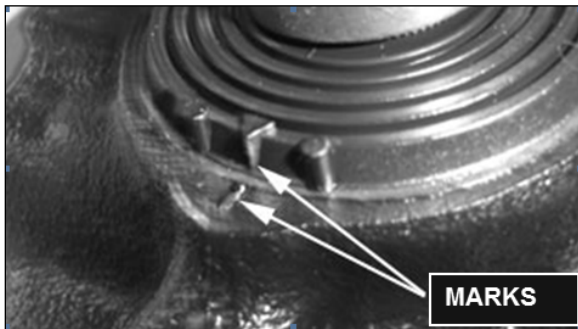


FIGURE 24: STEERING GEAR INPUT SHAFT MARKS

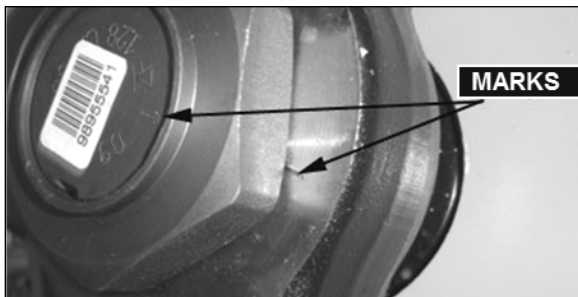


FIGURE 25: STEERING GEAR SECTOR SHAFT AND PITMAN ARM MARKS ALIGNED

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.

## 9.3 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 interchangeable 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 paragraph 21 MAINTENANCE - LUBRICATION FITTINGS ON IFS.

### 9.3.1 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

### 9.3.2 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 . 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.

**CAUTION**  
Reinstall tie rod clamp as per FIGURE 26 & FIGURE 27 as they might interfere with other components.

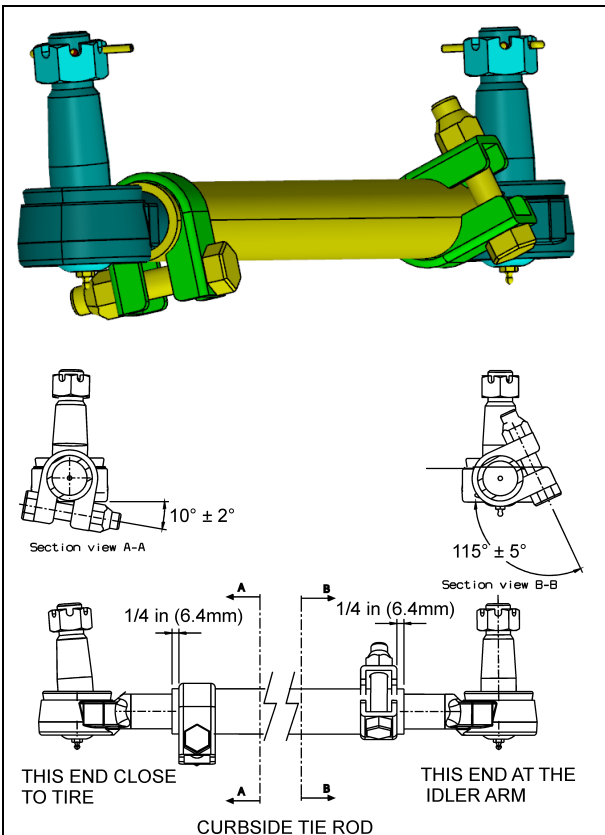


FIGURE 26: CURBSIDE TIE ROD - CLAMPS POSITION 16199

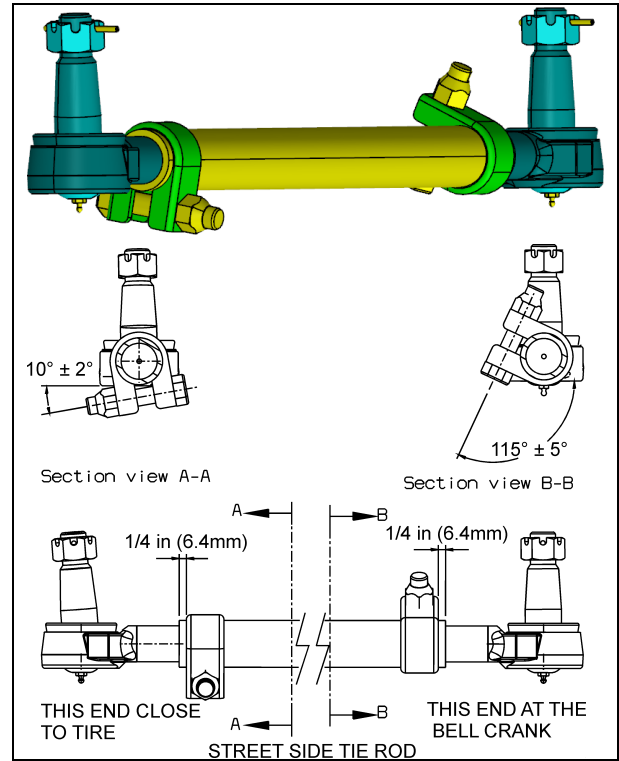


FIGURE 27: STREET SIDE TIE ROD - CLAMPS POSITION 16200

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

## 9.4 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.

### 9.4.1 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.

## 9.4.2 Installation

1. Install steering arm onto steering knuckle.
2. Torque steering arm to steering knuckle fixing bolts. Torque bolt to prescribed torque.
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. 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.

## 9.5 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.

## 9.5.1 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.

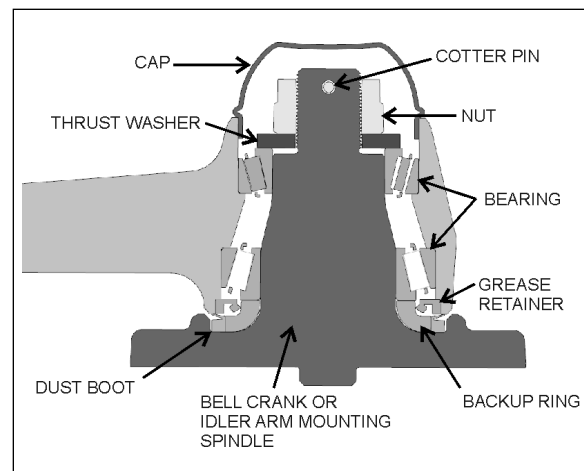


FIGURE 28: BELL CRANK OR IDLER ARM HUB

## 9.5.2 Bell crank or Idler Arm Hub Disassembly

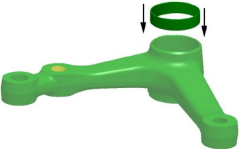
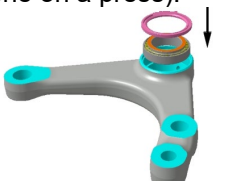
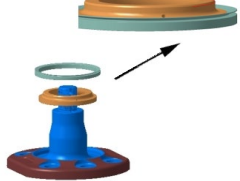
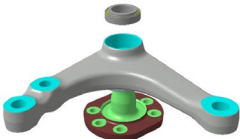
1. Remove adjacent link assemblies from bell crank or idler arm as previously described.
2. Remove the cap (Figure 28).
3. Remove the cotter pin, nut and thrust washer. Remove bearings, grease retainer, backup ring and the bell crank or idler arm from its mounting spindle (Figure 28).

9.5.3 Bell Crank or Idler Arm Hub Reassembly

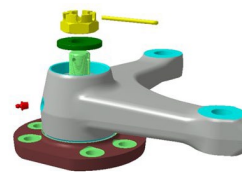
**NOTE**  
For bearing installation use tool Prevost # 110684.

**NOTE**  
Install grease retainer according to Figure 28. 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.

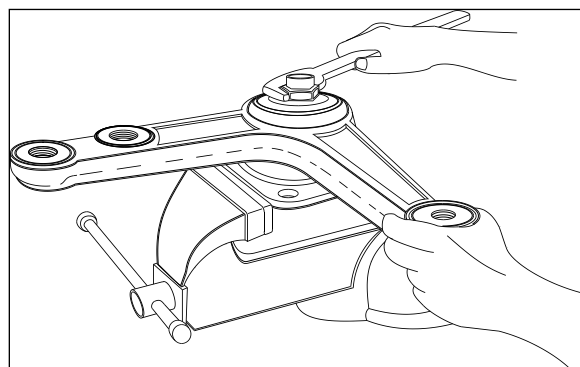


FIGURE 29: BELL CRANK

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 30.
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.

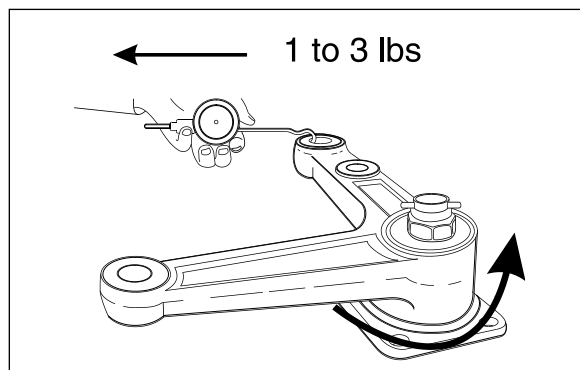


FIGURE 30: BELL CRANK

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.

## 9.6 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.*

### 9.6.1 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.
4. Remove stud nuts then remove relay rod.
5. 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.
6. Install stud nuts. Tighten nuts to prescribed torque. Align cotter pin slot (tighten) and install a new cotter pin.

## 10. INDEPENDENT FRONT SUSPENSION - NEW DESIGN

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

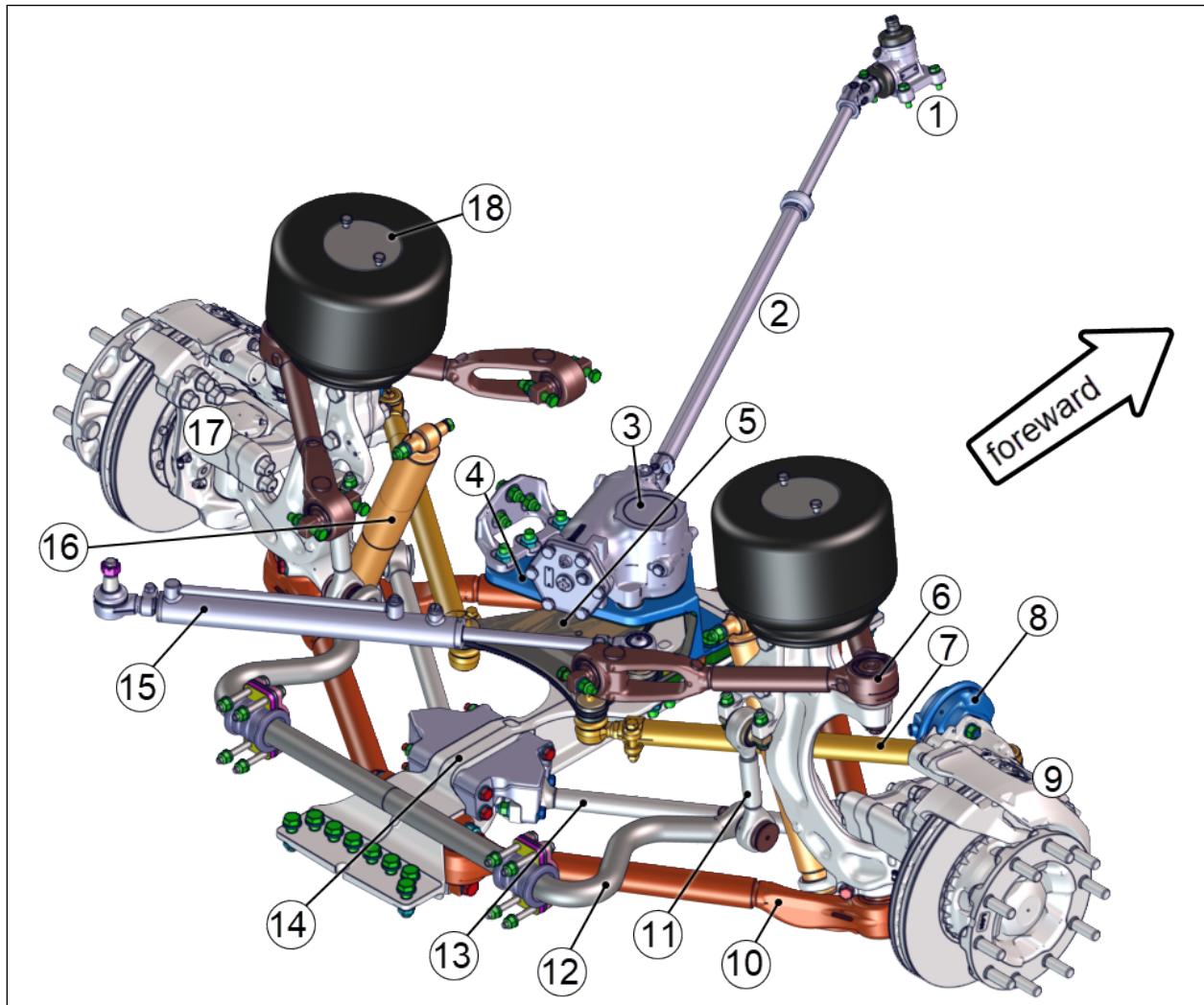


FIGURE 31: NEW INDEPENDENT FRONT SUSPENSION DESIGN – SUSPENSION & STEERING SYSTEM SHOWN

- |                        |                              |
|------------------------|------------------------------|
| 1. 90 angle gearbox    | 10. Lower control arm        |
| 2. Steering shaft      | 11. Sway bar link            |
| 3. Steering gearbox    | 12. Sway bar                 |
| 4. Pedestal            | 13. Reaction rod             |
| 5. T-arm               | 14. Backbone                 |
| 6. Upper control arm   | 15. Hydraulic power cylinder |
| 7. Steering tie rod    | 16. Shock absorber           |
| 8. Brake chamber       | 17. Steering knuckle         |
| 9. Disc brake assembly | 18. Air spring               |



## 10.1 STEERING LINKAGE

Turning motion of the steering wheel is transferred by the steering gear to the T-arm which transfers the turning motion to the steering tie rods and then to the steering arms and knuckles.

A hydraulic power cylinder connected to the T-arm provides an added source of assistance and ensures that the total steering forces are produced.

Lower and upper control arms are widely spaced. They are mounted on rubber bushings. Reaction 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 vehicle 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.

### 10.1.1 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:

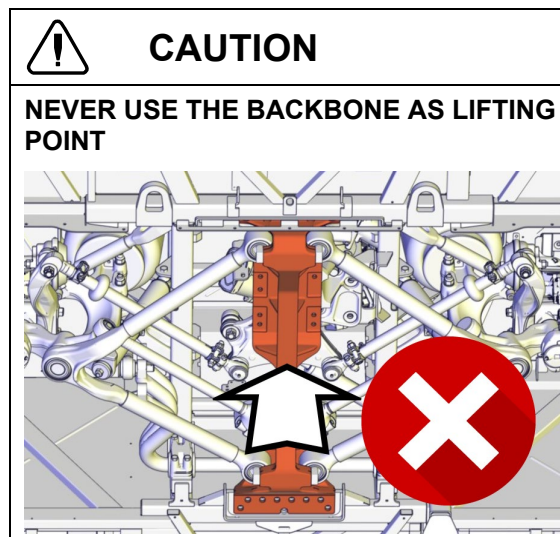
Exterior:  $49.5^\circ \pm 0.5^\circ$

Interior:  $58^\circ \pm 0.5^\circ$

Before checking the turning angle, be sure the front end is properly aligned.

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 steering tie rod end clamp bolt and nut to avoid clamps interfering with close parts.
- If necessary, readjust hydraulic steering limiter. Refer to **4.6 STEERING gear HYDRAULIC END LIMITER ADJUSTMENT**.

#### NOTE

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



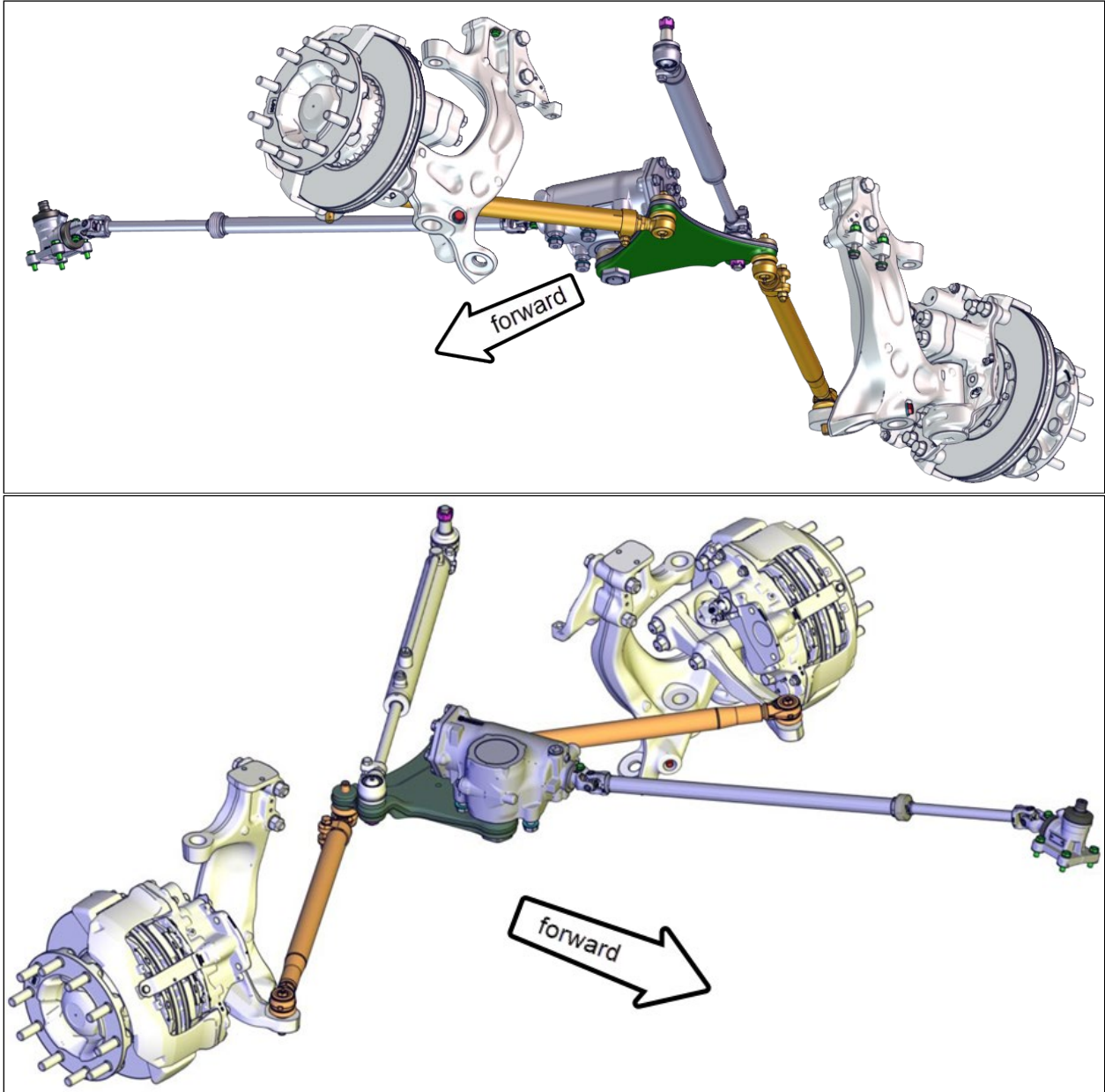


FIGURE 32: NEW IFS DESIGN STEERING LINKAGE OVERVIEW

## 10.2 STEERING LINKAGE INSTALLATION SEQUENCE

### NOTE

Whenever a steering linkage component has been removed and replaced, check steering geometry and front end alignment. 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 gear input shaft marks (Figure 38).
3. Afterwards, the T-arm should be installed with steering gear sector shaft and T-arm reference marks aligned (Figure 37).
4. Install the steering tie rods to link the steering arms to the T-arm.
5. Then adjust toe-in as described in paragraph **26 ALIGNMENT – independent front suspension**.

## 10.3 STEERING TIE RODS

Steering tie rod ends are connected to the T-arm and the steering arms. Each steering tie rod assembly consists of three parts: a tube and two socket end assemblies. Both steering tie rod ends is threaded into the tube and secured with clamp bolt to ease toe-in adjustment.

The steering tie rod ends require periodic inspection to check 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 steering tie rod for bent condition and inspect tube for damaged threads. If steering tie rod is bent or threads are damaged, replace the assembly.

### NOTE

The steering tie rods nominal length is **814 mm** measured from the center of one ball socket to the other. Nominal length is given only for preliminary adjustment.

### 10.3.1 Steering Tie Rod Length Adjustment

On the tie rod, you will find an adjustment sleeve which has internal and external left and right threads.

Fine adjustment of the tie rod length if required should be performed exclusively by turning the adjustment sleeve while preventing the tube and joint from rotating.

The only part rotating should be the sleeve

- To extend, turn the sleeve clockwise.
- To retract, turn counterclockwise.

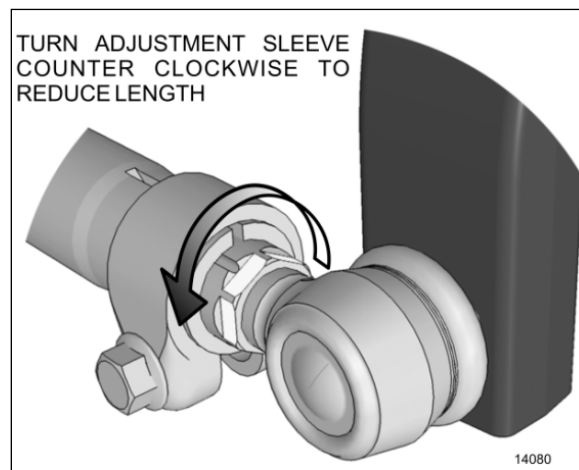


FIGURE 33

When assembling the adjuster sleeve or ball joint, be sure to assemble the parts within the following prescribed thread lengths and values.

Lengths V and W should be measured prior to removal to restore the steering system to its original state.

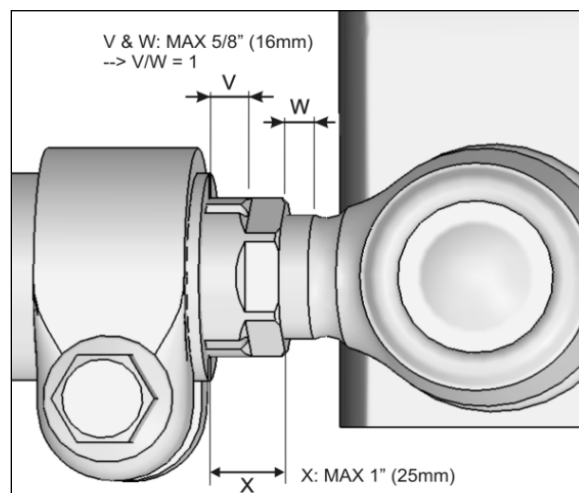



FIGURE 34

- Dimension V and W should be equal:  
 $V/W = 1$
- Dimension V: 5/8" (16 mm) **MAX**
- Dimension W: 5/8" (16 mm) **MAX**

To preserve the integrity of the adjusting system, length V and W should *never* exceed 5/8"(16mm) ± 1 thread pitch.  
Length V and W should be equal within ± 1mm

 **WARNING**

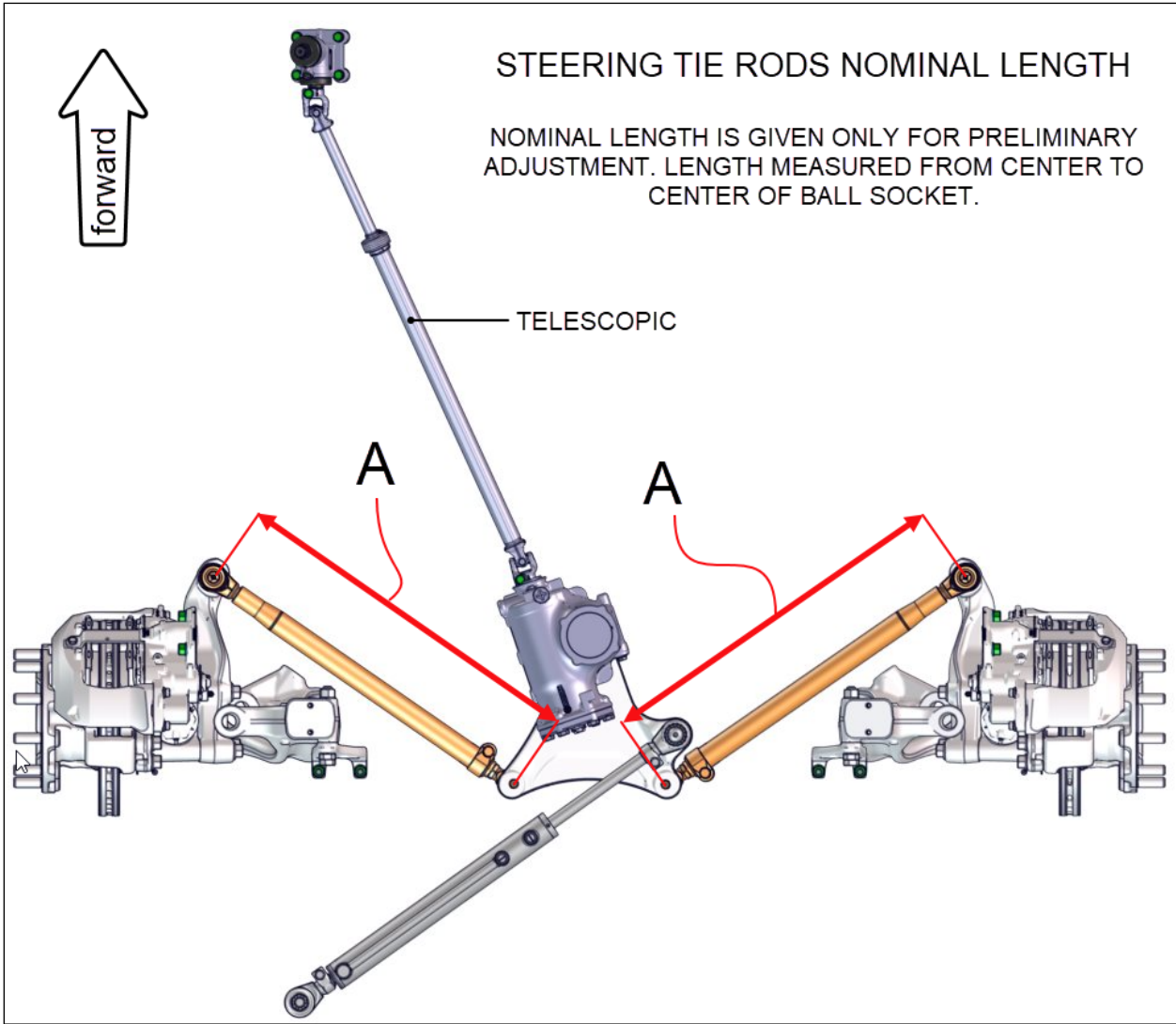


FIGURE 35: STEERING TIE RODS NOMINAL LENGTH, A=814 MILLIMETER

10.3.2 Removal

1. Remove cotter pins and stud nuts which attach the steering tie rod socket ends to the T-arm and left/right steering arm.

2. Remove steering tie rod ball stud by tapping on steering arm and the T-arm with brass hammer, while using a sledgehammer to absorb shocks. If available, use a puller tool.

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

10.3.3 Installation

1. Make sure threads on stud and stud nut are clean and not damaged.
2. Position ball studs (socket ends of steering tie rod) in holes in steering arm and T- arm. Ball stud and taper bore must be clean and free of grease. Install a ball stud nut on each stud and tighten firmly.
3. Torque stud nuts to prescribed torque. 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.*

4. Make sure steering tie rod ends are properly aligned with ball studs, and then torque steering tie rod end clamp bolts to prescribed torque.

10.4 T-ARM

The T-arm transfers rotation movement from the steering gear to the steering tie rods which connect to the knuckle steering arms.

An hydraulic power cylinder supply power assistance to the T-arm.

The marking on the T-arm casting is a reference for the straight-ahead driving position and must be in line (coinciding) with the marking on the steering gear sector shaft (Figure 37).

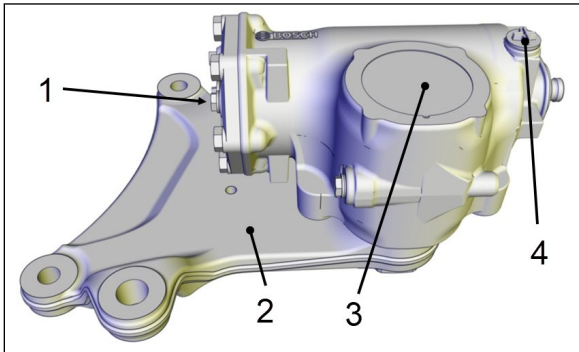


FIGURE 36: (1) RETURN LINE PORT TO OIL TANK, (2) T-ARM, (3) STEERING GEAR, (4) PRESSURE LINE PORT FROM PUMP

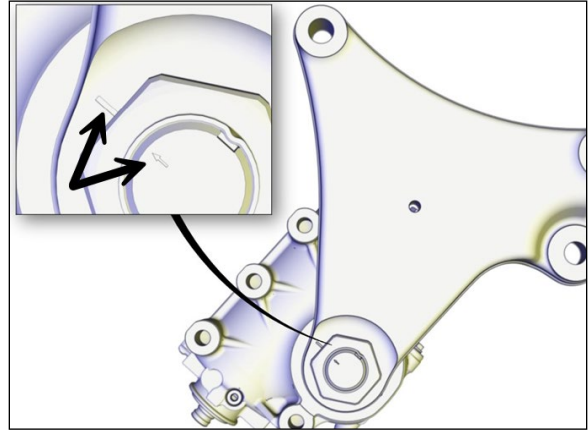


FIGURE 37: MARKINGS ON T-ARM AND STEERING GEAR SECTOR SHAFT SHOWING POSITION WHEN DRIVING STRAIGHT AHEAD MUST BE COINCIDING

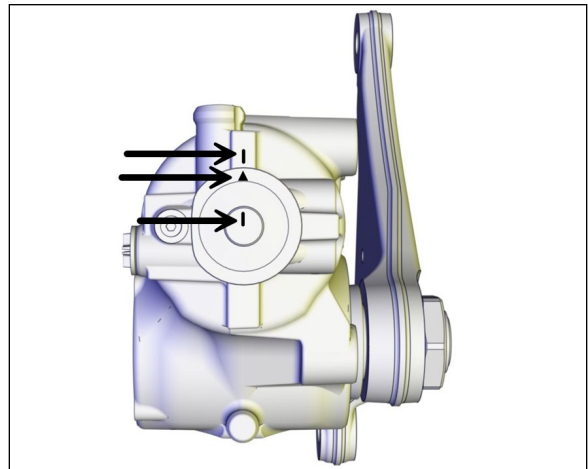


FIGURE 38: MARKS ON THE INPUT SHAFT, THE PROTECTIVE CAP & THE HOUSING

10.5 STEERING ARMS

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

10.5.1 Removal

1. Remove wheel as directed in **Section 13, Wheel, Hubs and Tires**.
2. Remove cotter pin and nut from stud securing steering tie rod to steering arm. Remove ball stud from steering arm using a puller tool or by tapping on arm with a brass hammer, placing a sledgehammer underneath steering arm to absorb shocks.



- Remove the three (3x) bolts securing steering arm to steering knuckle assembly. Remove steering arm from steering knuckle.

### 10.5.2 Installation

- Install steering arm onto steering knuckle.
- Torque steering arm to fixing bolts. Torque bolt to prescribed torque.
- Position steering 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. Tighten nut to nearest cotter pin slot and install a new cotter pin.
- Proceed similarly to connect the steering tie rod to the T-arm.
- Install wheel as directed in Section 13, "Wheel, Hubs and Tires" under paragraph "Installation" of the maintenance manual.

### 10.6 90 ANGLE GEARBOX

The 90 angle gearbox transfers rotation movement from the steering gear column to the steering shaft which is connected to the steering gear.

Markings on the casting are references for the straight ahead driving position.

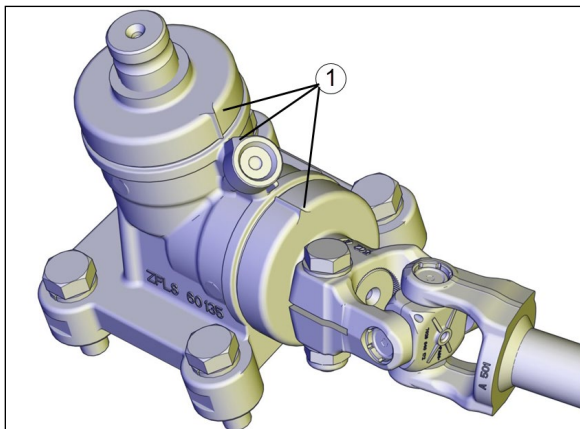


FIGURE 39: 90 ANGLE GEARBOX. (1) STRAIGHT AHEAD MARKINGS

### 10.7 KING PIN

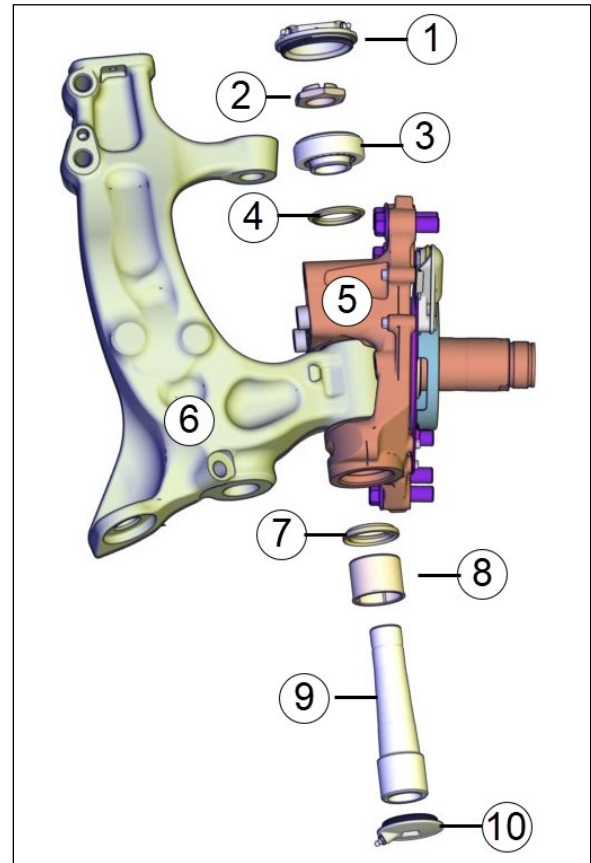


FIGURE 40: KNUCKLE & KING PIN

- Upper cover (with 2 grease fittings)
- Retainer nut
- Bearing
- Seal
- Knuckle
- Upright
- Seal
- Bushing, lower (Teflon)
- King pin
- Lower cover (with 1 grease fitting)

#### 10.7.1 Measuring the radial and axial play of the king pin

NOTE: Illustrations may differ from the actual design of the vehicle. The illustrations shown are only used to visually represent the procedure.

- RADIAL PLAY.** Lift the vehicle at the axles lifting points so that the tires loose contact with the ground. Refer to maintenance

instruction *MI18-18 General Hoisting and Towing Procedures*.

2. While a coworker applies the service brakes to eliminate any play in the wheel bearing, check the clearance in the king pin bushing/bearing by using a crowbar as a lever to lift in one of the rim holes.
3. Place a support, e.g. a set-square, against the side of the tire.

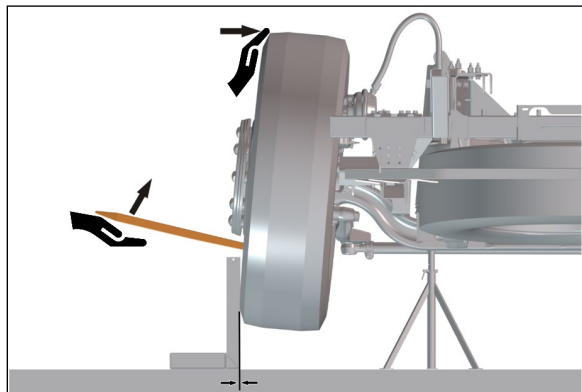


FIGURE 41

4. Push the crowbar downwards. At the same time, accurately measure the distance between the support and the tire wall. Record the value and carry on to the next steps of this procedure for axial play.

**NOTE**

*The measured radial clearance at the point of measurement will be considerably greater than the maximum permitted radial clearance in the bushing, because of the distance between the bushing and the tire wall.*

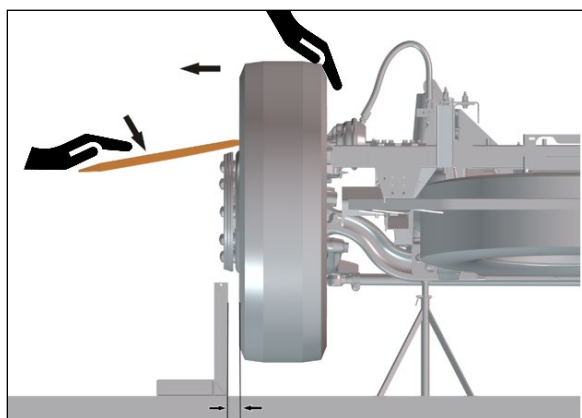


FIGURE 42

5. **AXIAL PLAY.** Use a feeler gauge to measure the clearance between the steering knuckle

and the upright. Record the value of the axial play.

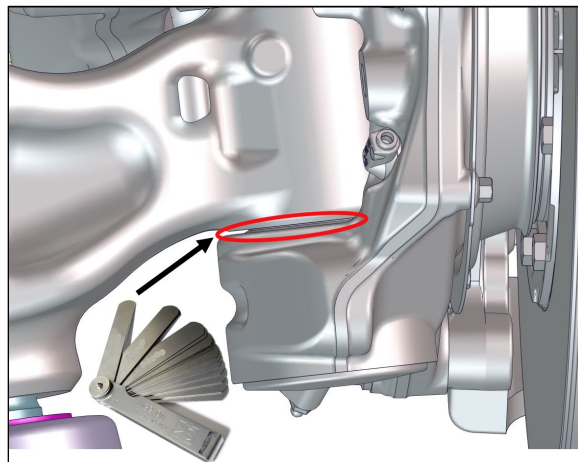


FIGURE 43



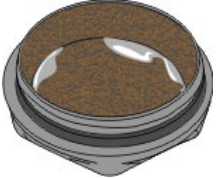
6. See the following table for possible actions to take depending on the amount of radial and axial play.

RADIAL PLAY (mm)	ACTION
> 3.0	Overhaul the steering knuckle.
1.5–3.0	Check the lower king pin cover. If cover is OK, tighten the king pin.  See “10.7.1.1 <i>Play discovered during inspection</i> ” in this section.  If the cover is not OK, overhaul the steering knuckle.
1.0–1.5	If no complaints are received regarding steering wheel vibration, wait until the next yearly service.  Otherwise, tighten the king pin as in “10.7.1.2 <i>Play discovered due to steering wheel vibration</i> ”
0–1.0	Wait until the next yearly service.  This play can be expected on new vehicles. See further information for a description of the steering knuckle in “Steering knuckle” on Impact.
AXIAL PLAY (mm)	ACTION
0–0.15	If the lower king pin cover is OK, tighten the king pin.  See instructions “10.7.1.1 <i>Play discovered during inspection</i> ” in this section.

If the lower king pin cover is not OK, overhaul the steering knuckle.

10.7.1.1 Play discovered during inspection

1. Lift the vehicle at the axles lifting points so that the tires loose contact with the ground. Refer to maintenance instruction MI18-18 General Hoisting and Towing Procedures.
2. Clean the surfaces and parts around the upper and lower king pin covers.
3. Remove the king pin lower cover.
4. Check the inside of the bottom cover and take the appropriate action based on the cover's appearance.

<p>Clean cover</p> 	<p>OK – no action needed</p>
<p>Thin layer of dust</p> 	<p>OK – no action needed</p>
<p>Water, dirt</p> 	<p>Check the condition of the cover.</p> <p>If water has entered via the cover, replace the cover.</p> <p>If the cover is OK but there is water in the cover and corrosion around the king pin, water has entered via the bearing. The steering knuckle must then be overhauled!</p>


<p>Some deposits</p> 	<p>Steering knuckle overhaul required!</p>
---	--

TABLE 1: KING PIN COVER APPEARANCE

5. Remove the upper protective cover and torque tighten the upper nut on the king pin (refer to TORQUE TABLES).
6. Clean the inside and sealing surface of the cover. Smear the sealing surface with silicon sealant. Clean the sealing surface on the steering knuckle.
7. Fit the upper and lower cover on the steering knuckle. Tighten to appropriate torque (refer to TORQUE TABLES).

10.7.1.2 Play discovered due to steering wheel vibration

1. Lift the vehicle at the axles lifting points so that the tires loose contact with the ground. Refer to maintenance instruction MI18-18 General Hoisting and Towing Procedures.
2. Check that the wheel is round and balanced and that the vibration is not caused by this, before retightening the king pin.
3. Remove the king pin lower cover.
4. Check the inside of the bottom cover and take the appropriate action based on the cover's appearance (refer to TABLE 1: king pin cover appearance).
5. Remove the upper protective cover and torque tighten the upper nut on the king pin (refer to TORQUE TABLES) (see 1 on Figure 44).
6. Angle-tighten the upper nut  $30 \pm 5$  degrees ( $\frac{1}{2}$  spanner flat). Mark one of the nut corners in relation to the king pin (see 2 Figure 44).



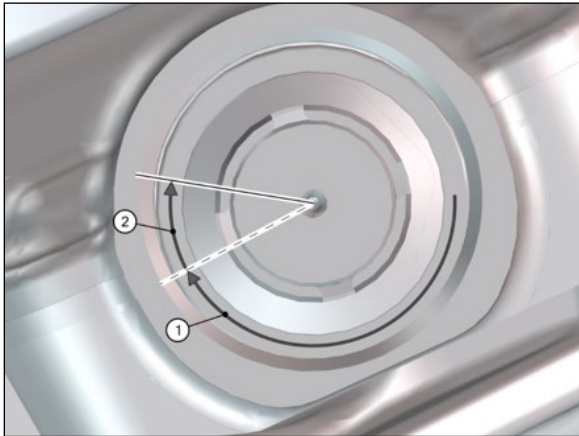


FIGURE 44

7. Clean the inside and sealing surface of the cover. Smear the sealing surface with silicon sealant. Clean the sealing surface on the steering knuckle.
8. Fit the upper cover on the steering knuckle. Tighten to appropriate torque (refer to TORQUE TABLES).

#### 10.8 STEERING KNUCKLE OVERHAUL

Refer to **6105-2 Steering knuckle, overhaul** available on the *Supplier Publications* tab on the Prevest Technical Publications site. In the Title field, type *6105* then click on *Search*.

[https://techpub\\_prevostcar.com/en/download?id=622&type=publications&mode=view](https://techpub_prevostcar.com/en/download?id=622&type=publications&mode=view)

## 11. STEERING COLUMN

### 11.1 REMOVAL

To disassemble the steering column from system, refer to Figure 45 & Figure 46. The steering column has no lubrication points. The lower steering column U-joint is easily accessible through the front service compartment. The upper steering column U-joint and the steering slip joint are accessible from the front driver's area. To access these joints, proceed as follows:

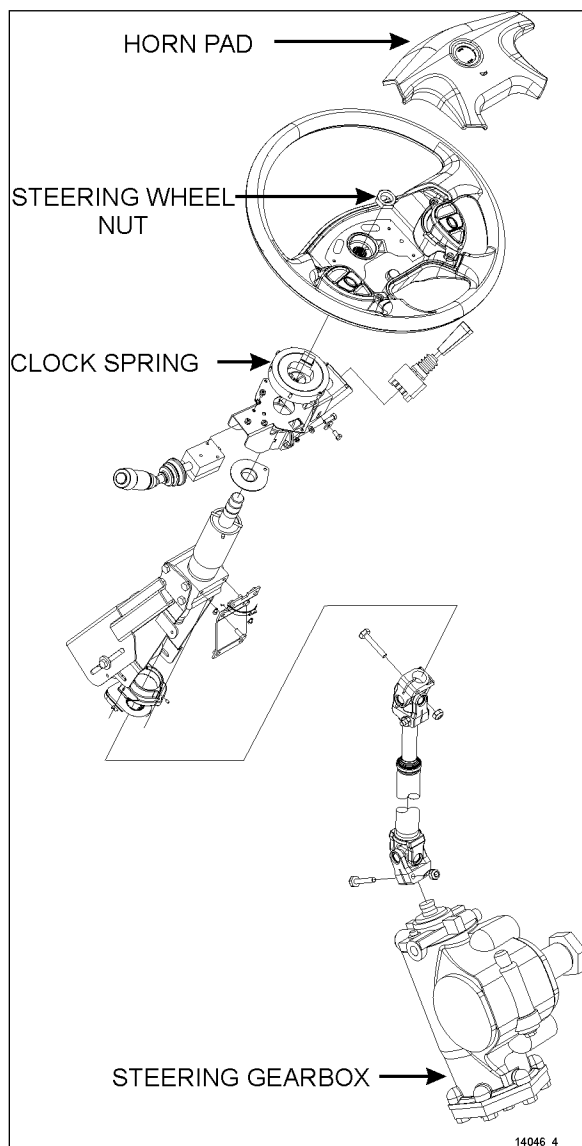


FIGURE 45: STEERING COLUMN

1. From the front driver's compartment area, remove the three plastic fasteners on steering column lower cover. Remove the lower cover (Figure 46).
2. Unscrew the four retaining screws on steering column middle cover.
3. Unscrew the four retaining screws fixing steering column upper cover to middle cover. Remove the steering column middle and upper covers.
4. Position the steering wheel in order to gain access to the joints.

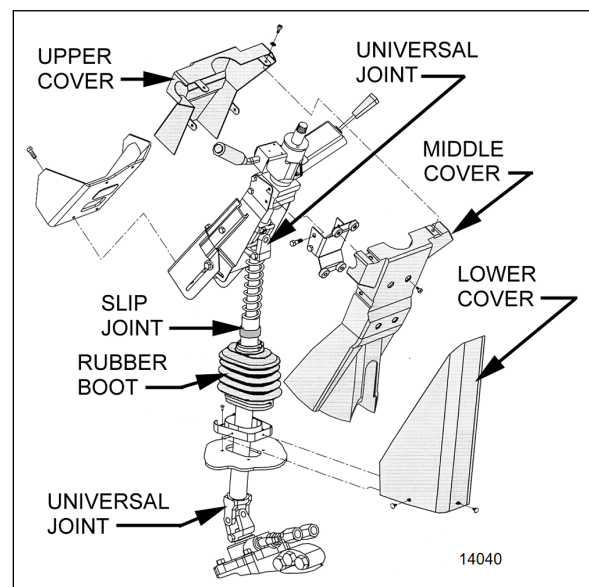


FIGURE 46: STEERING COLUMN COVERS

## 12. STEERING WHEEL

### 12.1 REMOVAL

#### NOTE

Before undertaking the steering wheel removal, assure that the front wheels are pointing straight ahead, aligned with the vehicle.

1. Set the battery master switch located in the rear electrical compartment to the "OFF" position.
2. Pull the horn pad straight up gently to detach it from the steering wheel (Figure 47).
3. Disconnect the horn wire (white) connected to the horn pad and the steering wheel harness 4-pin connector.

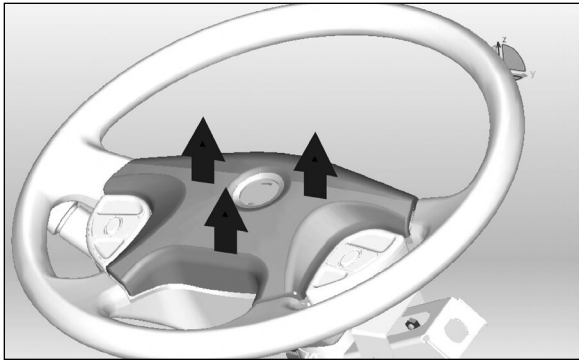


FIGURE 47: REMOVING THE HORN PAD

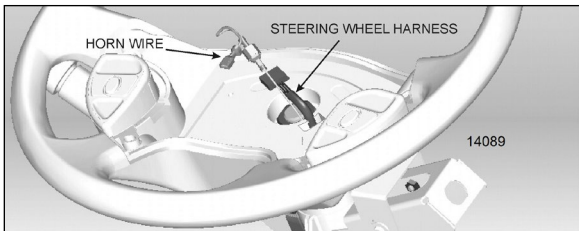


FIGURE 48: STEERING HARNESS & HORN WIRE

4. Unscrew the steering wheel nut. To simplify installation and ensure steering wheel alignment, mark the relationship of the spline shaft to the steering wheel hub (if marks don't already exist or don't line up).
5. Using an appropriate puller, separate the steering wheel from the spline shaft.
6. From behind the steering wheel, pull gently on the electrical wires passing through the rectangular opening in the steering wheel to finish removal of the steering wheel.

7. Once the steering wheel is removed, it is important to block any rotating movement of the clockspring in order to prevent it from losing its neutral position. Use two pieces of masking tape to lock it in place (Figure 49).

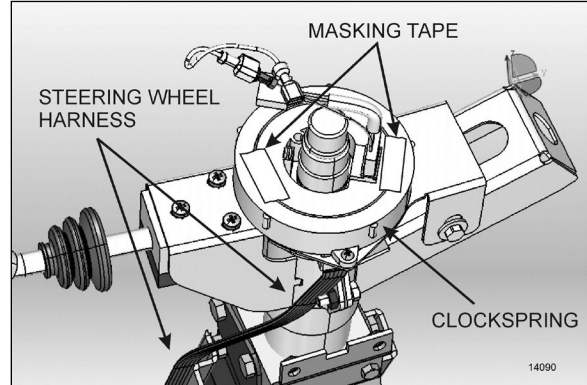


FIGURE 49: LOCKING THE CLOCKSPRING IN PLACE

#### NOTE

The clockspring mechanism permits a certain number of turns in each direction. At the moment of reinstalling the steering wheel, if the clockspring is not at its neutral position, the number of available turns will be reduced. This may damage the clockspring if the steering wheel is turned to its maximum amplitude.

### 12.2 INSTALLATION

1. Route the white horn wire and the 4-pin connector through the opening on the steering wheel.
2. Align the mark on the steering wheel hub with the mark on the spline shaft and slide the wheel onto the shaft.
3. Tighten steering wheel retaining nut.
4. Plug the 4-pin connector and connect the white horn wire to the center pad.
5. Reinstall the center pad and test for proper horn functioning.

### 12.3 CLOCKSPRING REPLACEMENT

1. Remove the steering wheel.
2. Remove the 2 clockspring mounting screws and then remove the clockspring. You will

have to disconnect the clockspring harness connector located lower along the steering wheel column (Figure 50). If necessary, remove the steering column covers.

3. Route the new clockspring harness through the opening in the clockspring support (Figure 50). Plug the connector at the base of the steering wheel column and fix harness along the steering wheel column.

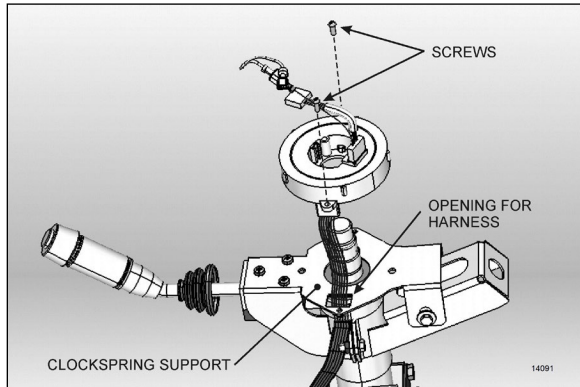


FIGURE 50: CLOCKSPRING INSTALLATION

4. Mount the clockspring in place with 2 screws.
5. Break the paper seal and rotate the center part of the clockspring about 50° clockwise (Figure 51). This step is necessary for the installation of the steering wheel.

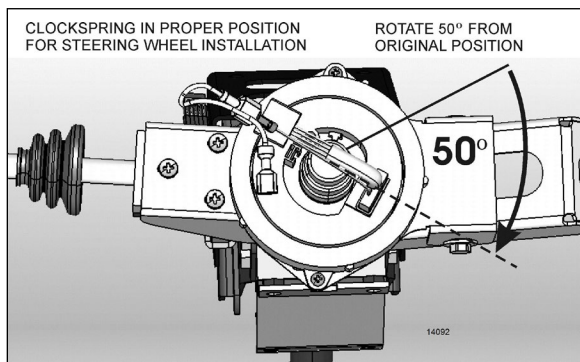


FIGURE 51: PROPER CLOCKSPRING POSITION

6. Reinstall the steering wheel.

### 13. TURNING ANGLE ADJUSTMENT

The maximum turning angle is set through two (2) steering stop screws installed on the knuckles, above the ABS wheel sensors. Steering stop screws are factory adjusted to accommodate the chassis design, and therefore, do not require adjustment on new vehicles. However, these should be checked and adjusted if necessary, any time a steering system component is repaired, disassembled or adjusted.

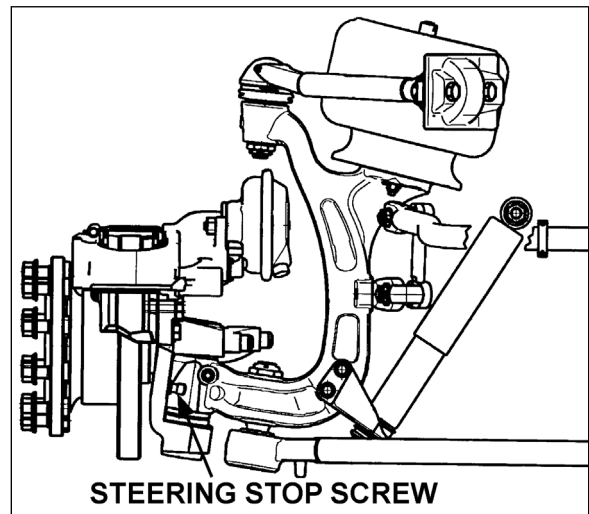


FIGURE 52: STEERING STOP SCREW ON IFS

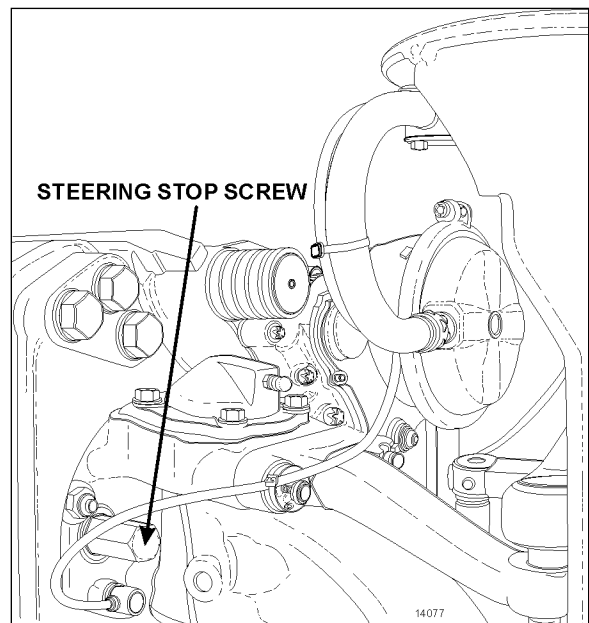


FIGURE 53: STEERING STOP SCREW ON I-BEAM AXLE



**CAUTION**

To prevent the steering damper from interfering with the adjustment of turning angles on vehicles equipped with I-Beam axle, make sure its fixing bracket is at correct location on the axle (refer to paragraph **20** maintenance - STEERING STABILIZER CYLINDER (DAMPER)).



**CAUTION**

Never maintain the relief pressure for more than 5 seconds, since damage to the power steering pump may occur.



**CAUTION**

*Reduce or shut off the power steering hydraulic pressure before the boss on the knuckle touches the stop screw. If not, the components of the front axle will be damaged (refer to "ZF-SERVOCOM Repair Manual" and "RB Robert Bosch Servocom - Service Manual (8090)", found on your Technical Publications USB flash drive, under heading "Setting The Steering Limiter" or "Setting the hydraulic steering limitation").*

**14. BLEEDING POWER STEERING HYDRAULIC SYSTEM**

To bleed the power steering hydraulic system, refer to "RB Robert Bosch Servocom - Service Manual (8090)", found on your Technical Publications USB flash drive, under heading "Setting and Functional Test".

**15. HYDRAULIC PRESSURE TEST**

Perform a pressure test as outlined in the "ZF-SERVOCOM Repair Manual" annexed to this section under heading "Setting and Functional Test".

**NOTE**

*For vehicles equipped with ZF-SERVOCOMTRONIC (speed sensitive) unit, refer to the supplement to the repair manual ZF-SERVOCOM.*

**16. POWER STEERING HYDRAULIC PUMP**

**16.1 DESCRIPTION**

The power steering pump is a gear driven hydraulic unit which supplies hydraulic pressure for the operation of the steering gear. The pump is mounted on the engine, at the flywheel end and is also used for driving the fuel pump.

**16.2 REMOVAL AND INSTALLATION**

The pump is accessible through the engine compartment R.H. access door.

To remove the pump, proceed as follows:

1. You must first remove the fuel feed pump.
2. Clean around the fuel pump and fuel lines. Position a container to catch any fuel that might drain from the pump or lines.
3. Remove the fuel pump.

**NOTE**

*Only unfasten the bolts marked with arrows.*

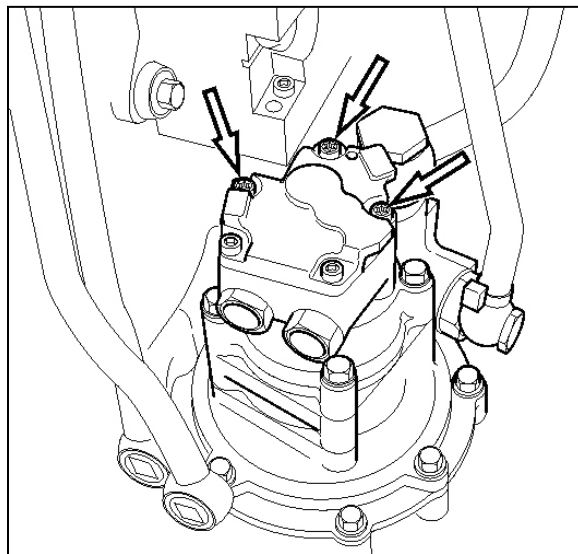


FIGURE 54: FUEL PUMP REMOVAL



**CAUTION**

Ensure to clean around the head of the bolts. Debris will prevent the tool from fitting properly and cause damage to the fasteners.

4. Check that the adapter and fuel pump drive axle are not damaged.



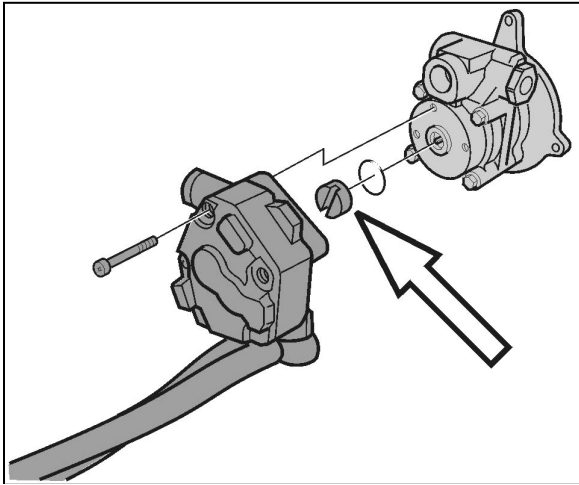


FIGURE 55: FUEL PUMP DRIVE AXLE

5. Set the fuel pump aside.
6. Clean around the power steering pump and loosen the steering lines. Position a container to catch any hydraulic fluid that might drain from the pump or lines.
7. Unfasten the power steering pump bolts.

**NOTE**

Only unfasten the bolts marked with arrows.

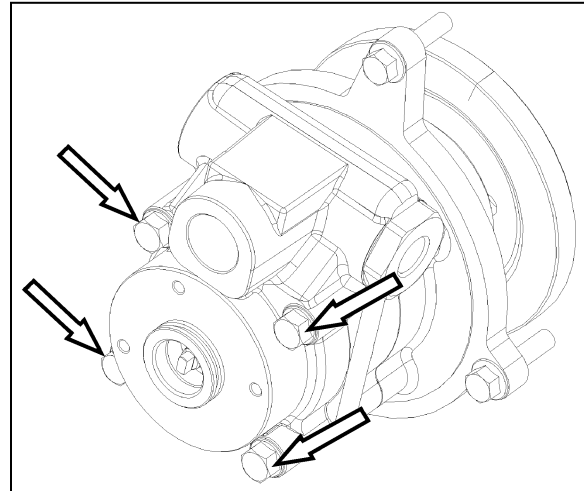


FIGURE 56: POWER STEERING PUMP REMOVAL

8. Install the new power steering pump. Torque-tighten bolts to specification.

**NOTE**

Use a new gasket.

9. Connect the hydraulic lines to the power steering pump.
10. Install the fuel pump. Torque-tighten bolts to specification.

**NOTE**

Use a new sealing ring. Check that the fuel pump drive axle sits correctly in the power steering pump.

11. Start the engine and let run for 5 minutes. Make sure that there are no leaks.

## 17. MAINTENANCE

The power steering system requires little maintenance. However, the system should be kept clean to ensure maximum operating performance and trouble-free service. Periodic inspections should also be made to check for leakage and all parts for damage or distortion.

When the slightest evidence of dirt, sludge or water is discovered in the system, disconnect fluid lines at the power steering gear to drain the system. Drain and refill the system with appropriate power steering fluid.

Air in the hydraulic system will cause spongy action and noisy operation. When a hose has been

disconnected or when fluid has been lost for any reason, the system must be bled. Bleed system as outlined under paragraph **14 BLEEDING POWER STEERING HYDRAULIC SYSTEM**.

**CAUTION**

Do not operate the pump without fluid in the power steering fluid reservoir.

If the steering linkage between the steering gear and the two front wheels is not properly adjusted, or if it is bent, twisted or worn, the steering of the vehicle will be seriously impaired. Whenever a steering linkage part is repaired, replaced or adjusted, steering geometry and front wheel alignment must be checked and necessary corrections made.


At regular lubrication intervals, the steering linkage should be thoroughly inspected for worn or loose components.

After the vehicle has been operated continually and high mileage figures have been reached, overhaul of the various steering units will be required. General overhaul procedure normally requires removal of the entire assembly, cleaning and inspection of all parts and final assembly. Careful inspection of all parts during overhaul is very important and must not be neglected.

Lubrication fittings must all be cleaned before applying lubricant. Moreover, always be sure the 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 fittings that have become broken or damaged. Lubrication intervals, as well as the recommended lubricants for the steering components, are given in the *Lubrication And Servicing Schedule*. The intervals given in the schedule are recommended for normal service. More frequent intervals may be required under severe operating conditions.

**18. MAINTENANCE - POWER STEERING FLUID CONDITION**

The power steering fluid reservoir is filled with Automatic Transmission Fluid (ATF) (refer to FLUIDS & LUBRICANTS TABLE in Section 24: Lubrication & Servicing). A periodic power steering fluid change is not required. Change the power steering fluid only if the steering gear unit was repaired, replaced or if the visual inspection of the fluid shows that a change is necessary.

	<p><b>MAINTENANCE</b></p>
<p>Check power steering fluid condition at the intervals specified by the Lubrication And Servicing Schedule in Section 24: LUBRICATION &amp; SERVICING</p>	

**18.1 POWER STEERING FLUID VISUAL INSPECTION**

The color of the power steering fluid can give you an idea of the fluid's condition and tell you that it needs to be changed. ATF gets darker with age, this process doesn't necessarily indicate a problem. If the fluid has darkened significantly, it may indicate that the power steering system is running hotter than normal and the fluid is overheating. Troubleshoot the overheating and have the fluid changed.

Get a sample of power steering fluid using the gauge located on top of the reservoir. Wipe it on a clean white rag. Check the fluid color, smell and consistency. Use the color chart below to determine if the power steering fluid needs to be changed.

<p><b>POWER STEERING FLUID CONDITION COLOR CHART</b></p>
--



	Translucent red <b>New fluid</b>
	Semi-translucent dark red/light brown, thick oily consistency, relatively odorless <b>Normal fluid</b>
	Opaque dark brown, appears to be thin <b>Dirty, change fluid</b>
	Dark brown/black with burnt smell <b>Bad condition</b> <i>(internal damage may have already occurred)</i>

18.2 POWER STEERING FLUID CHANGE

Please, refer to **Oil Change and Bleeding** in “*RB Robert Bosch Servocom - Service Manual (8090)*” found on your Technical Publications USB flash drive.

Replace the filter element simultaneously with the fluid change. See 18.5 Filter Element Replacement.

18.3 POWER STEERING FLUID RESERVOIR

The power steering reservoir is located on the R.H. side of the engine compartment. On H series vehicles it is fixed on the main power compartment wall, accessible by the R.H. compressor door.

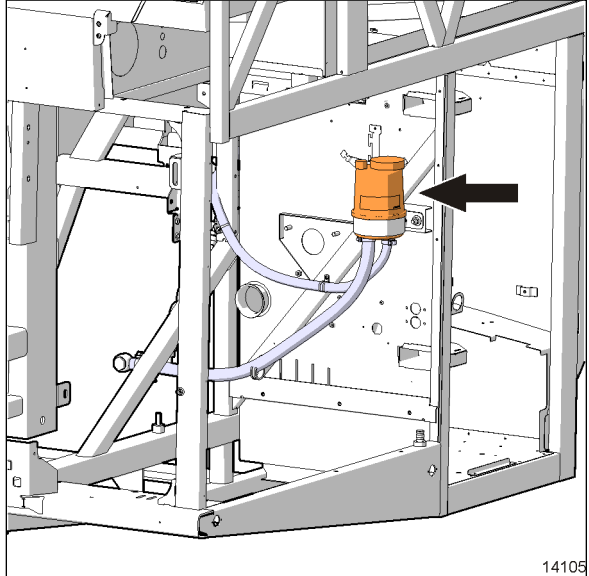


FIGURE 57: H SERIES POWER STEERING RESERVOIR

On X series vehicles it is located at the upper right side of the engine compartment, accessible by the engine compartment door.

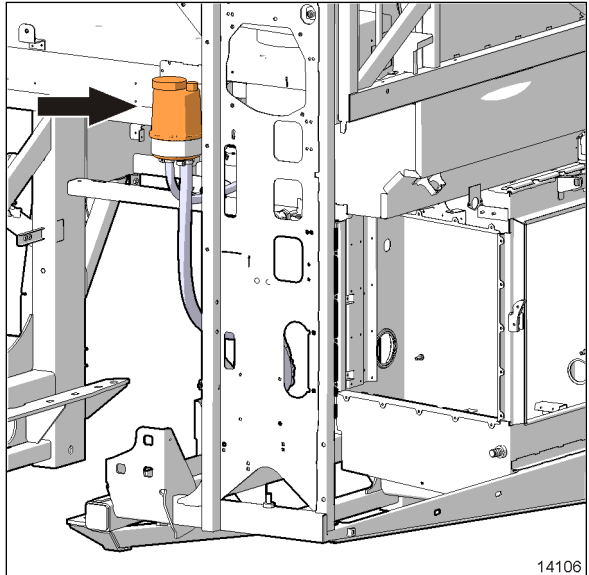


FIGURE 58: X SERIES POWER STEERING RESERVOIR

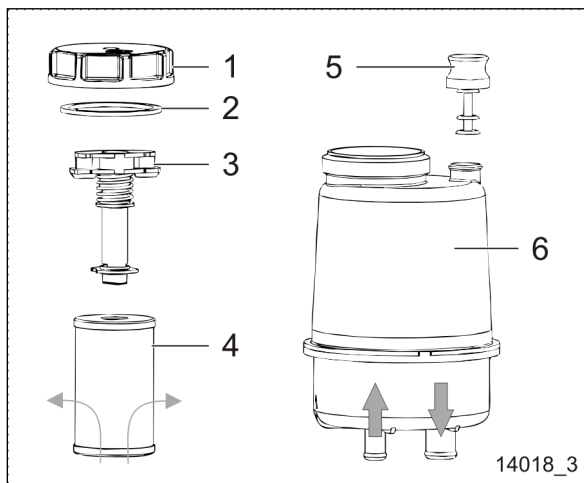


FIGURE 59: POWER STEERING FLUID RESERVOIR

- 1) Cap
- 2) Gasket
- 3) Filter screw
- 4) Filter
- 5) Breather cap
- 6) Reservoir

#### 18.4 FLUID LEVEL CHECK



### MAINTENANCE

At regular intervals, fluid level should be checked in the reservoir and filter assembly. Furthermore, the oil filter element in the power steering reservoir should be replaced at the intervals specified by the Lubrication And Servicing Schedule in Section 24: LUBRICATION & SERVICING.

1. Stop the engine.
2. Open the engine compartment R.H. side door.
3. Thoroughly clean the reservoir and its immediate vicinity to protect the fluid from being soiled by impurities.
4. Check fluid level.
5. Open the cap and top up level to "FULL" mark.
6. Close the cap.

#### 18.5 FILTER ELEMENT REPLACEMENT

##### NOTE

*Note: Before taking the power steering fluid reservoir cover off, thoroughly clean the reservoir and caps to prevent the ingress of impurities into the hydraulic fluid.*

*When cleaning, avoid contact with isopropyl alcohol and brake cleaner. Do not clean with a rag that may contain brake fluid.*

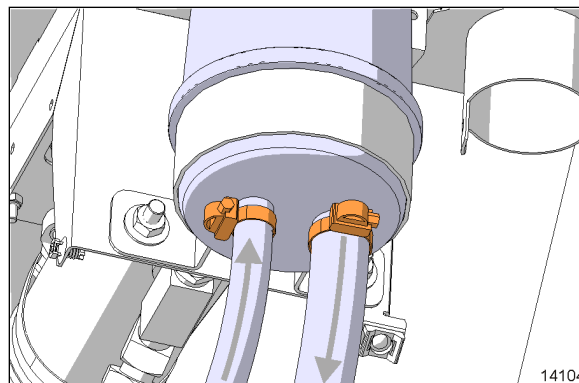


FIGURE 60: HOSE CLAMPS



FIGURE 61: FILTER REMOVAL

1. Remove the cap
2. Prepare an appropriate container.
3. Disconnect the larger suction hose first.
4. Disconnect the inlet hose.
5. Drain all fluid from the reservoir.
6. Press down and unscrew the filter.

7. Lift up the old filter and keep one finger under the filter's center hole, to prevent the impurities from the filter from entering the oil reservoir.
8. Drain any remaining oil.
9. Clean reservoir.
10. Transfer the screw to the new filter and insert it into the oil reservoir.
11. Check that the filter is positioned correctly and is locked in place securely.
12. Reconnect the hoses.  
Tighten the clamps to **30 lb-ft (41 Nm)**
13. Top up with fresh oil to the MAX marking.
14. Double check cleanliness of cap and install.
15. Discard the oil collected during the filter change.



## CAUTION

### Protect the fluid from being soiled by impurities

When removing the old filter element, make sure that power steering fluid doesn't flush back particles into the reservoir. If this situation occurs, contaminated fluid must be drained and the reservoir must be cleaned.

## 19. MAINTENANCE - STEERING SYSTEM PLAY INSPECTION

Basically, the steering system play is checked with the engine running and the front wheels in the straight ahead driving position. The steering wheel is slowly turned in one direction until there is a perceptible movement of a front wheel. If a point on the steering wheel rim moves more than the value indicated below before perceptible return movement of the wheel under observation, there is excessive free play in the steering system.

### Steering wheel travel covered:

**Maximum 1.732 inch (44 mm) with Prevost 18-inch steering wheel**

### NOTE

The full procedure is described under paragraph **Checking the Steering Gear Play** in *RB Robert Bosch Servocom - Service Manual (8090 manual)*.

**Take note that the maximum travel covered value specified in the Servocom manual doesn't apply to the Prevost design which uses a 18-inch steering wheel.**

If the maximum value is exceeded, the steering system should be thoroughly inspected for worn or loose components, beginning with the steering linkage. If the steering linkage is in good condition, then the steering column and the steering gear should be inspected.



## MAINTENANCE

### I-BEAM FRONT AXLE

Perform the steering play inspection every 185 000 miles (300 000 km) or once a year whichever comes first.



## MAINTENANCE


### INDEPENDENT FRONT SUSPENSION (Private use only)

Perform the steering play inspection every 48 months.

## 20. MAINTENANCE - STEERING STABILIZER CYLINDER (DAMPER)

The steering damper is located on R.H. side, aft of front axle (Figure 62).

The cylinder is non-adjustable and non-repairable. Check for oil leaks or lack of resistance. Disconnect the cylinder from axle, and then carefully attempt to extend and collapse it manually.



### MAINTENANCE

Steering damper ball joint (rod end) is provided with grease fitting for pressure lubrication. Under normal conditions, it should be serviced at the intervals specified by the Lubrication And Servicing Schedule in Section 24: LUBRICATION & SERVICING.

Check the ball joint for wear, and replace if necessary. Good quality lithium-base grease NLGI No. 2 like Shell Retinax LX is recommended.

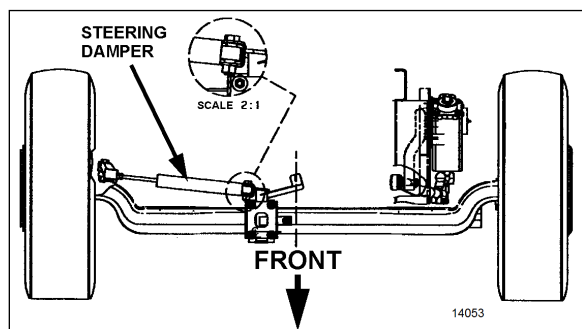


FIGURE 62: STEERING STABILIZER (DAMPER)

## 21. MAINTENANCE - LUBRICATION FITTINGS ON IFS


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 too much grease as the rubber boot might expand and rupture.

In selecting proper lubricants, supplier reputation must be considered. The supplier must be responsible for product quality. Figure 63 & Figure 64 show approximate location of steering lubrication fittings.

### 21.1 NEW IFS DESIGN

Lubricate at three fittings, two at the top of the steering knuckle and one at the bottom (Figure 63) with good quality lithium-base grease NLGI No. 2 (Shell Retinax LX or equivalent).



### MAINTENANCE

**Steering Knuckle (swivel assembly) king pin**

Apply grease as per the *Lubrication and Servicing* schedule intervals.

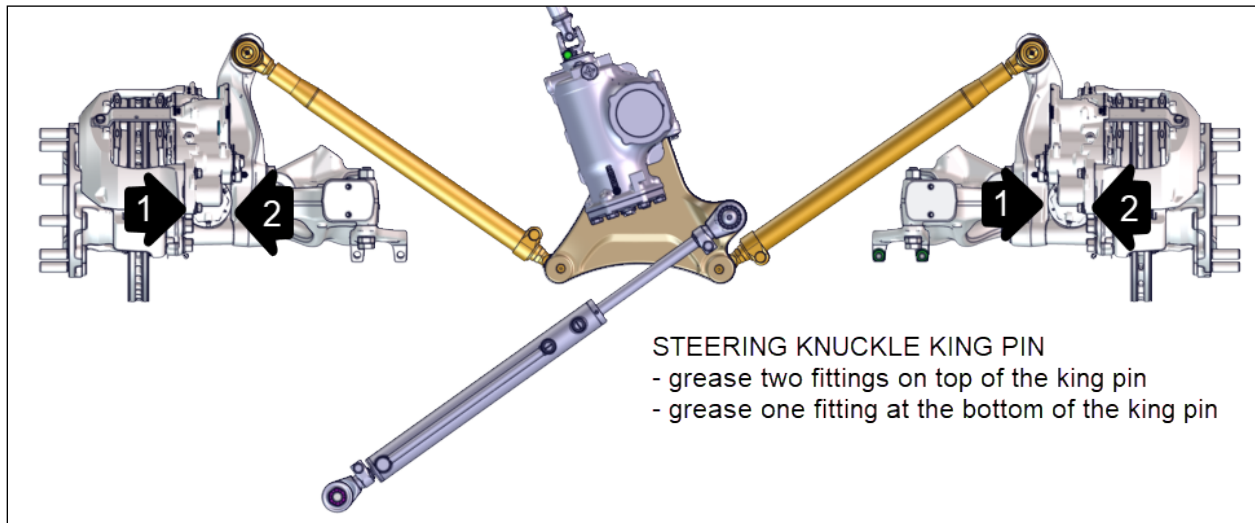


FIGURE 63: KING PIN LUBRICATION FITTINGS LOCATION ON THE STEERING KNUCKLE

## 21.2 PREVIOUS IFS DESIGN



### MAINTENANCE

Intervals below are recommended for normal service. More frequent intervals may be applied under severe operating conditions.

The lubrication fittings (see Figure 64 ) should be serviced at the intervals specified by the Lubrication And Servicing Schedule in Section 24: LUBRICATION & SERVICING.

- (1) **Drag Link Ends:** Lubricate at four fittings, two at each end of link 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 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, 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" for more details.
- (5) **Idler Arm and Bell Crank:** Lubricate at two fittings, one on the idler arm and the other on the crank bell, 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 control arm (A-arm) Ball Joint:** Lubricate at fitting until you see some grease on the relief valve nearby, with good quality lithium-base grease NLGI No. 2 (Shell Retinax LX or equivalent).

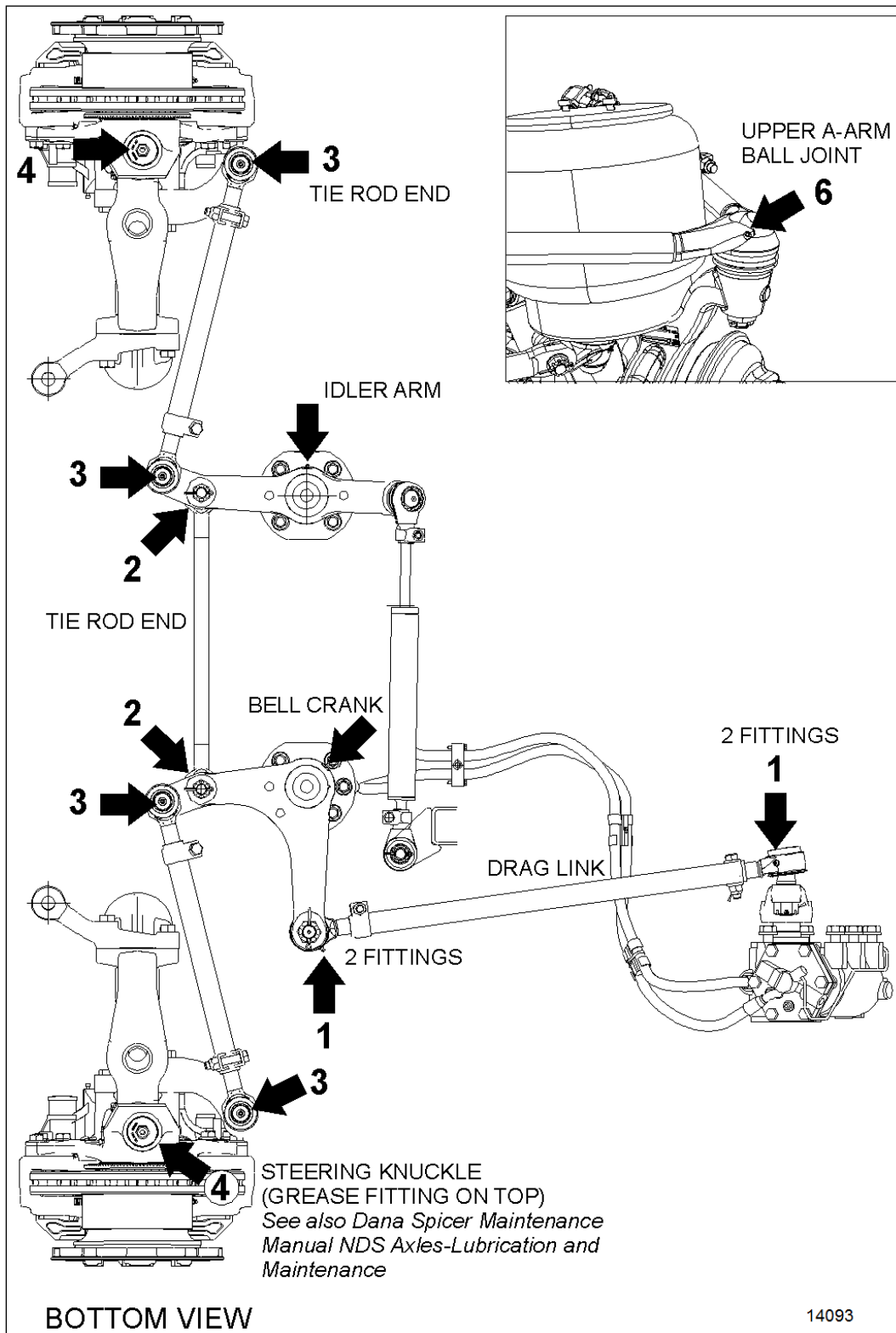



FIGURE 64: LUBRICATION FITTINGS LOCATION ON PREVIOUS IF5 DESIGN

## 22. MAINTENANCE - DRAG LINK

Visually inspect drag link components for broken, corroded or deformed clamps, loose, bent or corroded nuts and gauges on tube from rubbing parts.

### 22.1 DRAG LINK BALL JOINT INSPECTION FOR CORROSION

Inspection of ball joints is important. Damaged sealing boots, salt and climatic conditions can cause loss of the corrosion protection coating applied at time of manufacturing.

 <h3 style="margin: 0;">MAINTENANCE</h3>
<p>Inspect drag link joints for corrosion once a year.</p>

1. Carefully clean the sealing boot or dirt seal contact area to ensure that no contaminants can get under the sealing boot or dirt seal during the inspection procedure. Do not use cleaning agents or solvents, only use dry cloth or cotton wool.
2. Use an appropriate inspection tool (e.g. spatula with cut out) to push up (sealing boot) or down (dirt seal) the seal (without damaging it) until ball pin surface is visible. Degrease the ball pin surface and inspect carefully.
3. If there is corrosion of the ball pin or the sealing boot has deteriorated through ageing or is damaged, replace the ball joint.
4. If there is corrosion of the steering arm or tie rod arm area which is in contact with the sealing boot or dirt seal, clean and eliminate all surface irregularities.
5. If there is no corrosion or damage to the sealing boot or dirt seal, smear the steering arm with Lithium grease and push seal back into its properly seated position.

When dismantling the drag link, ensure that no damage is caused to the sealing boots, dirt seals or ball joint housings.

### 22.2 IFS DRAG LINK – PREVIOUS DESIGN ONLY

Drag link ends (ball joint) are provided with grease fittings for pressure lubrication.

To prevent corrosion from forming around the ball pin (particularly the drop type ball joint as it is exposed to dirt and water), remove the old grease bead and assure sufficient grease is applied to purge the old grease and fill the joint and dust seal.

### 22.3 FRONT I-BEAM AXLE DRAG LINK

On vehicles equipped with I-beam front axle, the drag link features **lubricated for life** ball joints and a compact fine adjustment system.

Although the ball joints do not require greasing, they do require regular inspection, refer to the following sections for ball joint maintenance.

#### 22.3.1 Adjustment System Visual inspection

Inspect the adjustment system to ensure the threads are firmly seated. Also, a visual inspection should be carried-out looking for damage or corrosion to the adjustment system components. Replace any part showing corrosion or damage.

#### 22.3.2 Adjustment System Functional inspection

Clean the adjustment system with a brush and compressed air prior to inspection, if required.

With the engine running and the vehicle on the ground (with a load on the axle) turn the steering wheel left and right.

To verify that the threads are tight and do not present any play, use one of the following methods:

- Visual inspection
- Place a finger on the separation line from the adjuster sleeve to the threaded ball joint shaft. **Keep fingers clear of pinch zones.**
- Use a dial gage clamped to the tube and feelers aligned on the ball joint to indicate any play

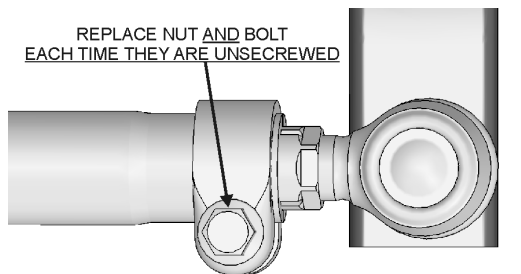
*When play is discovered in the adjusting system, replace the complete drag link.*

 <h3 style="margin: 0;">CAUTION</h3>
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**Do not re-use clamp hardware.**

Bolt and nut should be replaced every time they are unscrewed.



While assembling the clamp, make sure the bolt does not touch the draglink tube.

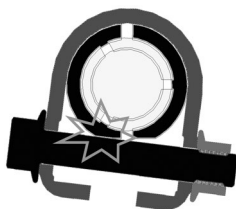


FIGURE 65: I-BEAM FRONT AXLE DRAG LINK

**23. FRONT I-BEAM AXLE TIE ROD**

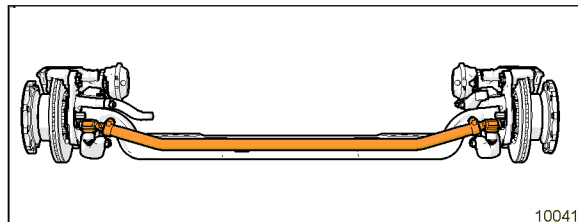


FIGURE 66: I BEAM AXLE TIE ROD

The tie rod includes a fine adjustment sleeve on one side.

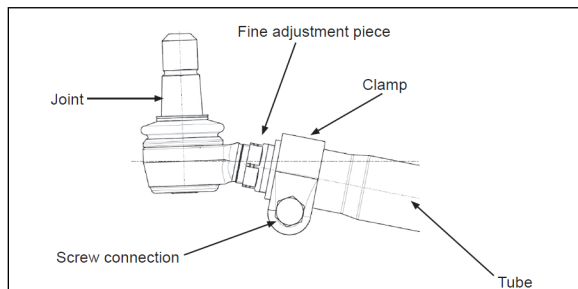


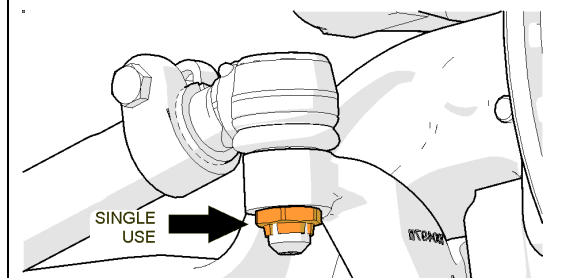
FIGURE 67: TIE ROD COMPONENTS



**CAUTION**

**Do not re-use tie rod joint nut.**

Joint nuts should be replaced every time they are unscrewed.




For additional details, refer to supplier information:

**TRW Front Axle Steering Bar Service Information XSZ143**

**23.1 TIE ROD INSPECTION PROCEDURE**

The steering tie rod assembly requires several visual and functional inspections. If any of the described conditions are found, a complete replacement of the tie rod assembly or individual ball joints may be required.



## MAINTENANCE

Inspect tie rod once a year.

### 23.1.1 Tube inspection

Check the tube for damage. If there are signs of deformation, replace the tie rod assembly.

### 23.1.2 Ball joint play inspection

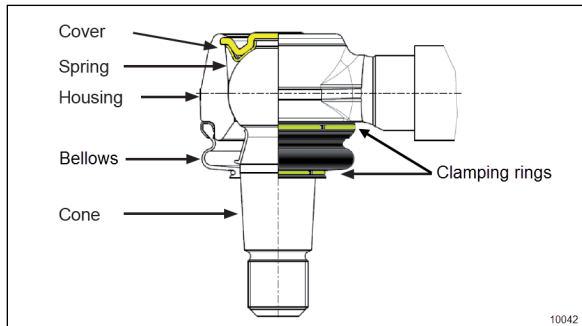


FIGURE 68 TIE ROD BALL JOINT

To inspect joint wear and play, turn the wheels alternately left and right until the wheels move. Perform this with the axle loaded normally. During this process, the spring deflection of the ball pivot against the housing should not exceed **0.020" (0.5 mm)** axially. Replace the joint if the movement of the ball stud exceeds **0.020" (0.5 mm)** axially in the housing.

Measure the distance with a caliper (Figure 69).

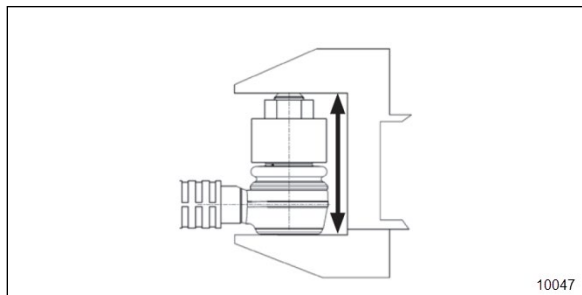


FIGURE 69: MEASURING AXIAL PLAY, TIE ROD JOINTS

### 23.1.3 Fine adjustment sleeve play inspection

Turn the wheels alternately left and right while keeping a finger on the threads to feel any movement in the threads. (Figure 70). If there is too much play in the sleeve, replace the tie rod.

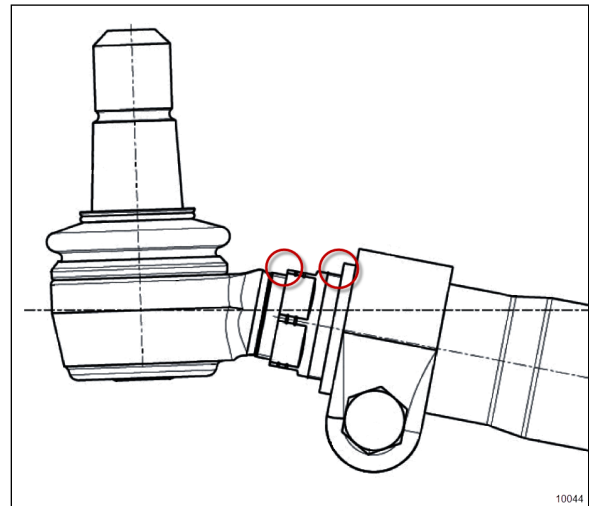



FIGURE 70:

## 23.2 TIE ROD BALL JOINT INSPECTION FOR CORROSION



## MAINTENANCE

Inspect tie rod ball joints for corrosion once a year.

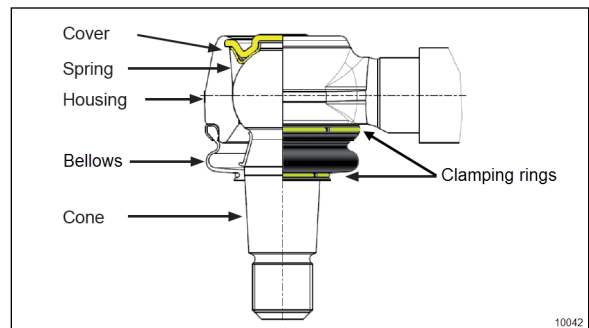


FIGURE 71: TIE ROD BALL JOINT CONSTRUCTION

1. Carefully clean the sealing boot contact area to ensure that no contaminants can get under the sealing bellows during the inspection procedure. Do not use cleaning agents or solvents, only use dry cloth or cotton wool.
2. **Housing:** The housing must not show any signs of deep rusting (depth of no more than approx. 1mm). Pay particular attention to the roll edge and cover, they must be rust free.  
  
Clean corrosion on the axle steering lever contact faces also.
3. **Bellows:** They must be in perfect condition to protect from corrosion. Squeeze the bellows

by hand and make sure no grease is expelled from the opening. Make sure the bellows is in good condition, without any holes, tears, scratches or chafing marks. Replace the joint if inspection result is not OK.

Tension rings and clamping rings must be well seated in their groove.

It must always be possible to turn the bellows on the housing by hand (do not use any tools). Hold the bellows in the area of the clamping ring and turn with a lot of manual force. Replace the tie rod if the result is not OK.

## 24. BALL JOINTS – GENERAL RECOMMENDATIONS

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.

### 24.1 VISUAL INSPECTION

- Visually inspect for missing or damaged grease fittings and replace if required.
- Damaged sealing boot or improper sealing requires seal replacement or complete replacement.
- Check ball joint connection for missing cotter pins.
- Check for looseness in the ball/socket assembly.

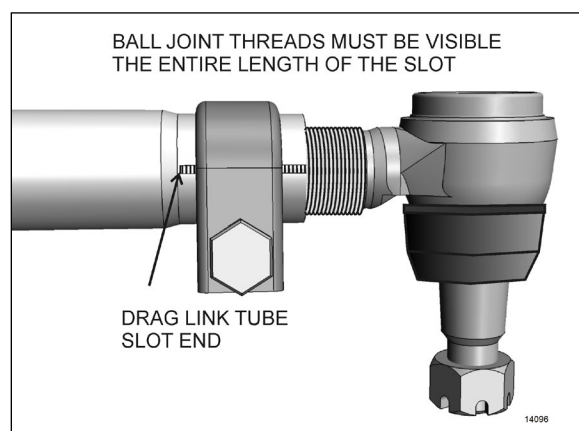


FIGURE 72: ADEQUATE CLAMPING CONDITION

For adequate clamping, the ball joint threads must be visible the entire length of the tube slot. If not, the tube 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 components).

No heavy corrosion is accepted for the clamps or screws.

Nuts and screws must be firmly in place.

## 24.2 STRAIGHT BODY TYPE BALL JOINT END PLAY AND LOOSENESS

### What creates movement in sockets?

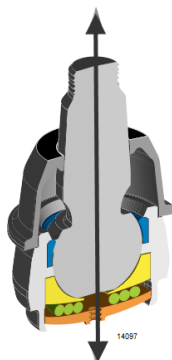
In each straight body type ball joints, the compressive force of the spring creates resistive torque by applying a constant load on the bearing and stud.

As wear occurs on the components, the spring creates less resistive torque. With less torque, you no longer have the precise joint needed for optimum steering, but you do still have a safe linkage. **When all compression is lost, it's time to replace the linkage.** This wear can be caused by impact, lack of lubrication and normal wear.

1. With vehicle engine on, lightly rock the steering wheel while checking for looseness in any threaded joint. Observe any looseness in the two mating tapers or any movement of the ball pin nut. Any looseness requires further inspection. If either of the mating tapered parts shows distortion or wear, both parts must be replaced.


2. With the engine off and wheels straight ahead and no force is being exerted on the linkage by the steering gear, push and pull the ball joint in and out by hand (approximately 100 lbs. force) in the direction of the ball pin. If no movement is detected, the ball joint is safe. **Any movement detected by hand will require the replacement of the ball joint.**

Inspect for movement along vertical axis only.




service brakes are applied (wheel locking will oppose the effect of steering geometry which tends to make the front wheels rotate in opposite directions).

Persisting in turning, or maintaining the steering wheel with an extra effort, could make the hydraulic system work at the relief pressure, and consequently, cause the hydraulic fluid to become overheated.

	<h3>CAUTION</h3>
<p>Never maintain the hydraulic system at the relief pressure for longer than 5/10 seconds to avoid damaging the power steering pump.</p>	

<p><i>NOTE</i></p>
<p><i>Unequal or low tire pressure, oversize tires, and vehicle overloading are some of the causes that may increase steering effort.</i></p>

	<h3>CAUTION</h3>
<p>Do not use a wrench or other object to apply leverage when inspecting ball joint. Applying leverage with tools can give distorted results and damage components.</p>	

## 25. DRIVING TIPS

In order to maximize power steering pump service life, do not attempt to turn the steering wheel when the vehicle is stationary, and especially when

## 26. ALIGNMENT – INDEPENDENT FRONT SUSPENSION

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.

### NOTE

*On the new IFS design, addition or removal of shims on the lower control arms to perform the alignment is not recommended.*

*Add or remove shims on the upper control arms only. Doing so will prevent undesirable adjustments at the reaction rods. Moreover, the lower control arms are secured with the same bolts. Loosening the attachment of a control arm on one side will impact the adjustment on the opposite control arm.*



### WARNING

During alignment, both camber and caster among other angles are adjusted. When adjusting these, shims are installed or removed at:

- ▷ **The IFS lower control arm (A-arm) (previous IFS design).**
- ▷ **The IFS upper control arms (new IFS design).**

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 TABLES.
- Installing a longer bolt if less than 2 threads are remaining after the nut.
- Using a torque seal, leave a mark on the nut for future visual inspection.

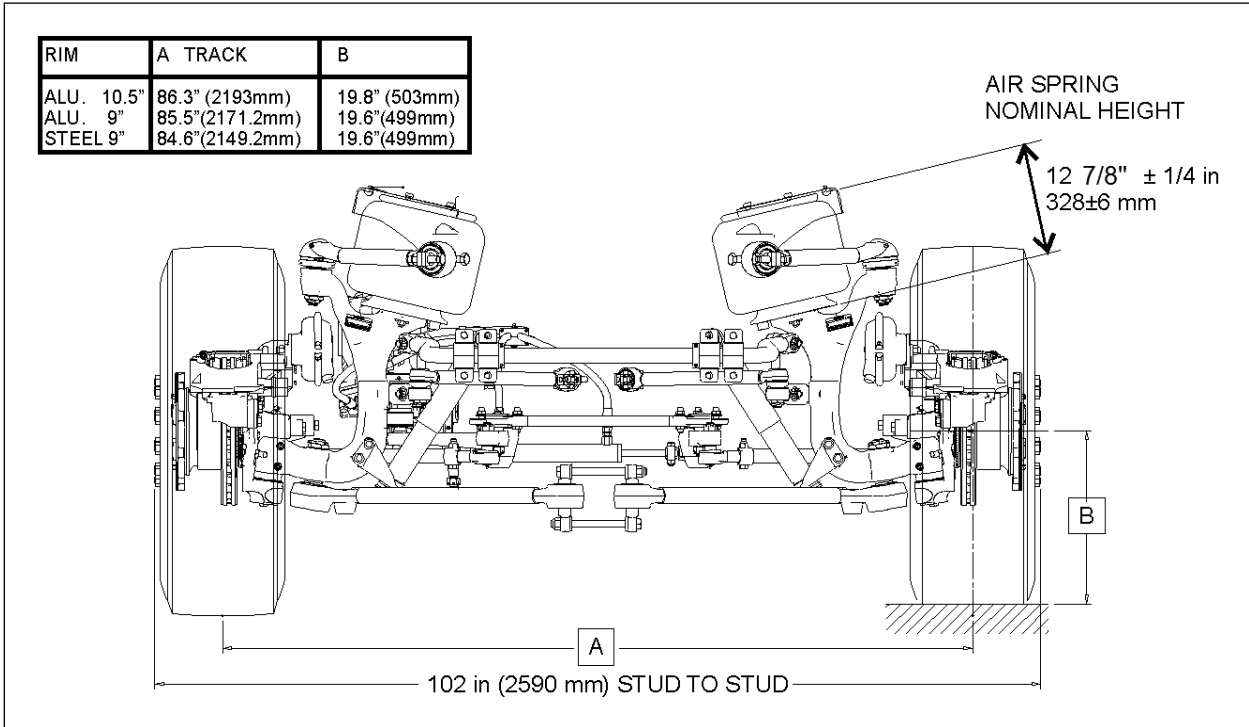


FIGURE 73: PREVIOUS IFS DESIGN NOMINAL DIMENSIONS

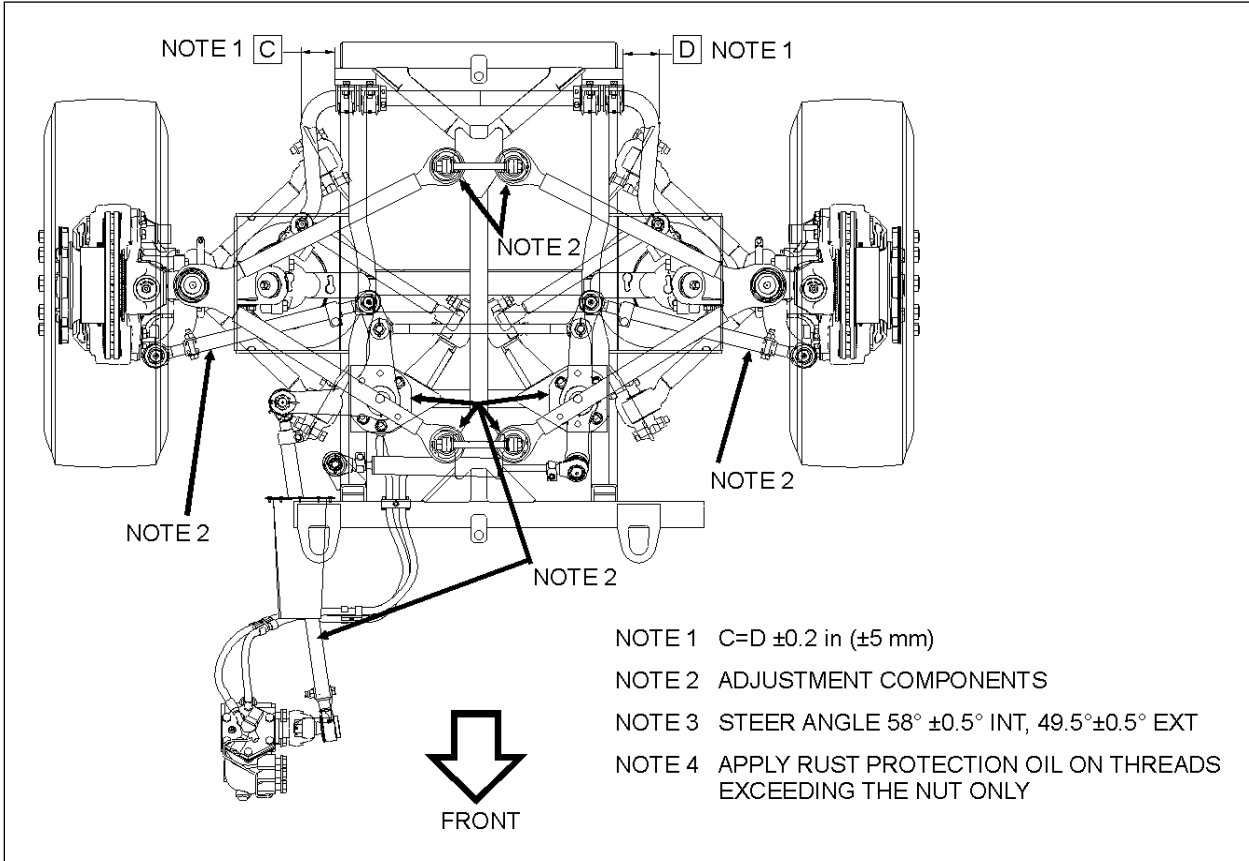


FIGURE 74: PREVIOUS IFS DESIGN ADJUSTMENT

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

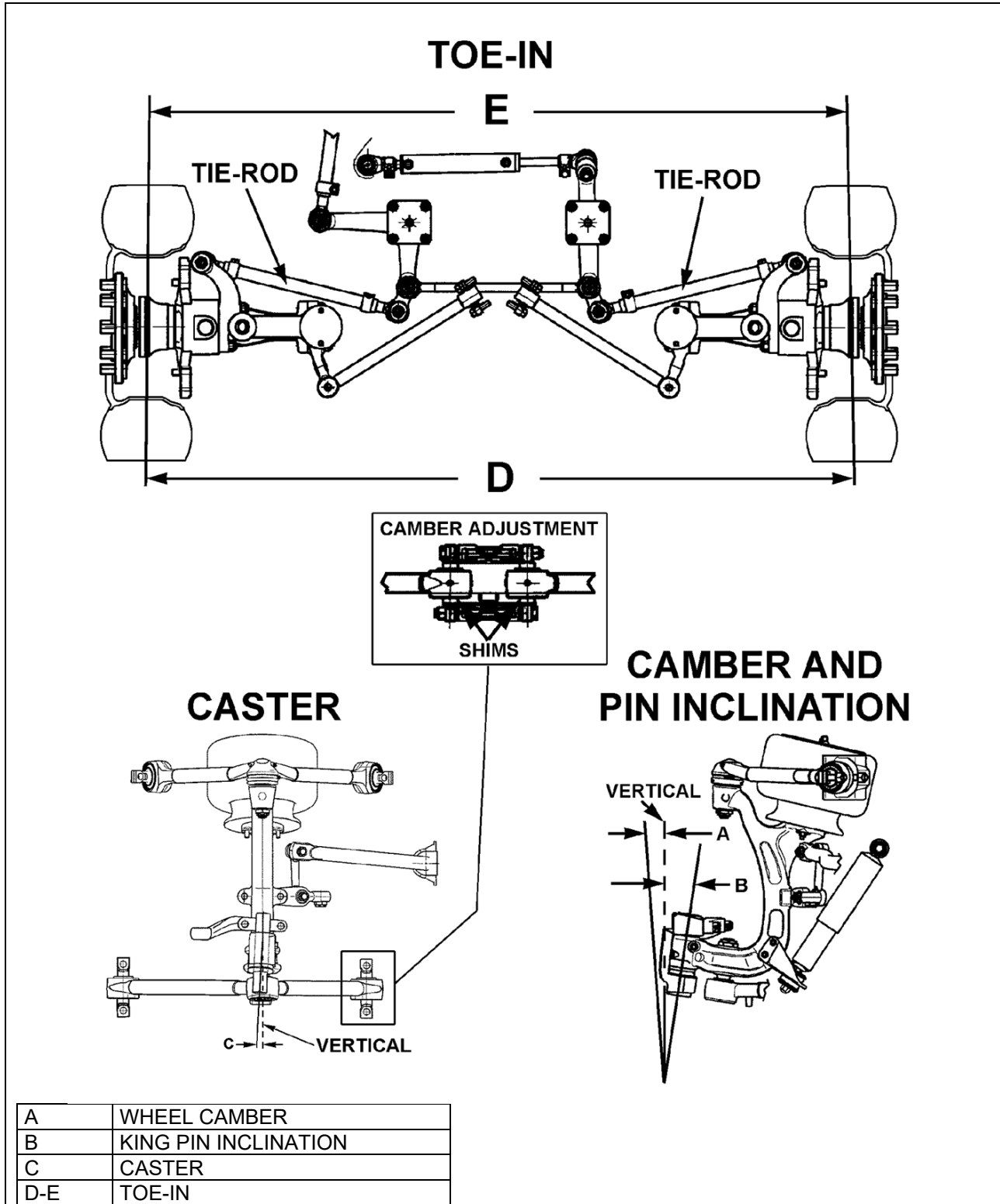


FIGURE 75: FRONT END ALIGNMENT DIAGRAM

16051



## 26.1 ALIGNMENT TERMINOLOGY

### 26.1.1 Wheel Camber

Camber is the number of degrees the top of the wheel is tilted inward or outward from a true vertical (FIGURE 75).

### 26.1.2 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 75).

### 26.1.3 Front Axle Caster

The inclination of the king pin from vertical in the fore and aft direction (C, FIGURE 75).

## 26.2 FRONT END INSPECTION

Before checking alignment, make the following inspection:

1. Check that the vehicle is at normal ride height (see *Suspension Height Adjustment* in Section 16: Suspension).
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 king pins for looseness.
7. **Previous IFS design:** Check that the length of the torque rod is 21 17/64" (540 mm) and the length of the relay rod is 23 19/64" (592 mm).

### 26.3 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 the control arms may be improperly shimmed.

On the **previous IFS design**, shim the lower control arms (A-arm) to adjust camber (Figure 76).

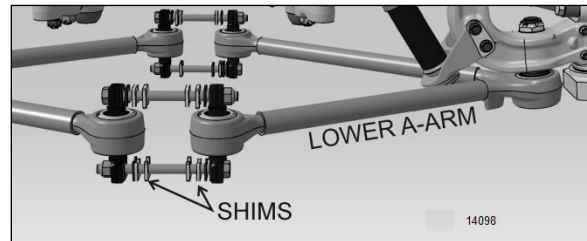


FIGURE 76: SHIMS AT THE LOWER CONTROL ARMS (A-ARM) - PREVIOUS IFS DESIGN

On the **new IFS design**, shim the upper control arms to adjust camber (Figure 77).

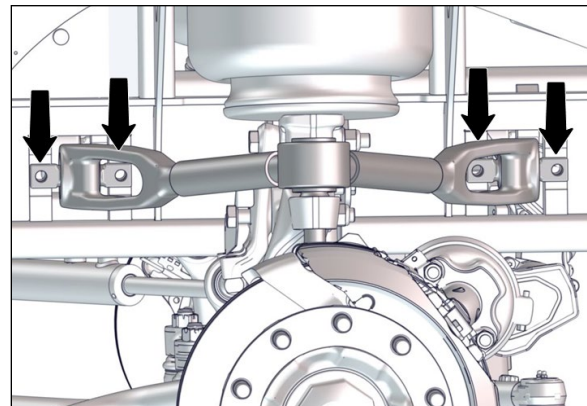


FIGURE 77: SHIMS LOCATION AT THE UPPER CONTROL ARMS - NEW IFS DESIGN

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



### 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.

## 26.4 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  $3/32 \pm 1/32$  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 specification.
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 16.

#### **NOTE**

*Use only the steering tie rods to adjust toe-in.*

## 26.5 FRONT WHEEL CASTER

Positive caster is the inclination of the top of the king pins toward the rear of the vehicle. Negative or reverse caster is the inclination of the king pins 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 control arms or king pin 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 75**).

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

#### **NOTE**

*On Independent Front Suspension, caster on right wheel must be equal or greater than caster on left wheel, without exceeding  $0.3^\circ$ .*

## 26.6 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. Refer to section 16 "Suspension" for additional information.

## 26.7 HYDRAULIC END LIMITER ADJUSTMENT AFTER WHEEL ALIGNMENT

#### **NOTE**

*Before steering limiter readjustment, verify vehicle wheel alignment and ensure that oil level is checked and that air bleeding is done.*

A setting of the steering limitation is necessary if or when:

- a) A new or repaired steering gear is fitted or
- b) New screws (see MI20-12, items 20 and 128,) were fitted to the automatically adjusting steering limitation or
- c) Alterations to or adjustments of the front axle were carried out.

**Find the end limiter adjustment procedure in Maintenance Information MI20-12 available on Prevest Technical Publications site.**

26.8 FRONT WHEELS ALIGNMENT SPECIFICATIONS – IFS (PREVIOUS AND NEW DESIGN)

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

**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°.*

<b>ALL VIP CONVERSION SHELLS INDEPENDENT FRONT SUSPENSION</b>						
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°

<b>ALL COACHES WITH INDEPENDENT FRONT SUSPENSION</b>			
	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°

## 27. ALIGNMENT - I-BEAM AXLE FRONT WHEEL

Correct front wheel alignment must be maintained for steering comfort and satisfactory tire life. Road shocks and vibrations, as well as normal stress and strains on the front-end system can, under normal operating conditions, result in loss of front wheel alignment.

Check the front wheel alignment when the following occurs:

1. Every 200,000 miles (320 000 km) or 24 months (normal maintenance);
2. When the vehicle does not steer correctly; or
3. To correct a tire wear condition.

There are two types of front wheel alignment: minor alignment and major alignment.

### 27.1 INSPECTION BEFORE ALIGNMENT

Check the following before doing a front wheel alignment:

1. Ensure that the vehicle is at normal riding height. See Section 16, "Suspension" under heading 7: "Suspension Height Adjustment".
2. Ensure that front wheels are not the cause of the problem. See Section 13, "Wheels, Hubs and Tires". Inspect the tires for wear patterns indicating suspension damage or misalignment.
  - a. Make sure the tires are inflated to the specified pressure.
  - b. Make sure the front tires are the same size and type.
  - c. Make sure the wheels are balanced.
  - d. Check wheel installation and straightness.
3. Check the wheel bearing adjustment. See Section 13, "Wheels, Hubs and Tires".
4. Check steering linkage for bending and pivot points for looseness.
5. Check knuckle pins for evidence of excessive wear.

6. Check radius rods for bending and rubber bushings for evidence of excessive wear.
7. Make sure all fasteners are tightened to the specified torque. Use a torque wrench for verification. As soon as the fastener starts to move, record the torque. Correct if necessary. Replace any worn or damaged fasteners.

### 27.2 MINOR FRONT WHEEL ALIGNMENT

Perform a minor front wheel alignment for all normal maintenance conditions.

Perform the minor front wheel alignment in the following sequence:

1. Inspect all the systems that affect the wheel alignment. See paragraph 27.1, "Inspection Before Alignment" in this section.
2. Check the hub bearings. See section 13, "Wheels, hubs and Tires" under heading 8: Front and Tag Axle Wheel Hubs.
3. Check and adjust the toe-in.

### 27.3 MAJOR FRONT WHEEL ALIGNMENT

Perform a major front wheel alignment to correct steering and tire wear conditions.

Perform the major front wheel alignment in the following sequence:

1. Inspect all systems affecting the wheel alignment. See paragraph 27.1, "Inspection Before Alignment" in this section.
2. Check the hub bearings. See section 13, "Wheels, hubs and Tires" under heading 8: Front and Tag Axle Wheel Hubs.

#### **NOTE**

*If steering angle stoppers are changed, a special procedure is required for readjusting gear steering limiter. See paragraph 27.4 Hydraulic End Limiter Adjustment After Wheel Alignment in this section.*

3. Check and adjust the turning angle adjustment.
4. Check the camber angle.
5. Check and adjust the caster angle.

6. Check and adjust the toe-in.

27.4 HYDRAULIC END LIMITER  
ADJUSTMENT AFTER WHEEL  
ALIGNMENT

**NOTE**  
*Before steering limiter readjustment, verify vehicle wheel alignment and ensure that oil level is checked and that air bleeding is done.*

A setting of the steering limitation is necessary if or when:

- d) A new or repaired steering gear is fitted or
- e) New screws (items 20 and 128, see MI20-12) were fitted to the automatically adjusting steering limitation or
- f) Alterations to or adjustments of the front axle were carried out.

**Find the end limiter adjustment procedure in Maintenance Information MI20-12 available on Prevost Technical Publications site.**


27.5 TURNING ANGLE ADJUSTMENT

The maximum turning angle is set through the two steering stop screws installed on the axle center. The turning angle is factory adjusted to accommodate the chassis design, and therefore, does not require adjustment on new vehicles. However, it should be checked and adjusted any time any component of the steering system is repaired, disassembled or adjusted.

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

Proceed with the following method to check the steering maximum turning angle:

27.6 R.H. TURN ADJUSTMENT

 **CAUTION**  
To prevent the steering damper from interfering with the adjustment of turning angles, make sure its fixing bracket is at the correct location on the axle center (refer to paragraph 20).

1. Turn steering wheel to the right until the boss on the axle center touches the right stop screw.
2. Verify the nearest point of contact of the ball socket body with the air bellows support assembly. Measure the distance between those two points.
3. The distance between these two points should be approximately 1/8 inch (3 mm). If not, the steering stop screws must be readjusted.
4. Verify the nearest point of contact of the drag link with the tire. Measure the distance between those two points.
5. The distance should be 1 inch (25 mm) or more. If not, the steering stop screws must be readjusted.
6. This must be done for a full right turn.
7. If readjustment is required:
  - a. Remove the swivel stop screw.
  - b. Add to the stop screw the required number of washers to obtain the proper measure, tighten the stop screw afterwards. Two washers of different thickness are available: 1/16 inch and 3/16 inch.

27.7 L.H. TURN ADJUSTMENT

1. Turn steering wheel to the left until the boss on the axle center touches the left stop screw.
2. Verify the nearest point of contact of the ball socket body with the air bellows support assembly. Measure the distance between those two points.
3. The distance between these two points should be approximately 1/8 inch (3 mm). If not, the steering stop screws must be readjusted.
4. Check the stroke of the steering stabilizer cylinder (damper). It should not exceed 12.59 inches (320 mm).
5. The steering stopper screw must be in contact before the steering stabilizer reaches the end of the stroke.
6. This must be done for a full left turn.
7. If readjustment is required:
  - a. Remove the swivel stop screw.

- b. Add to the stop screw the required number of washers to obtain the proper measure, tighten the stop screw afterwards. Two washers of different thickness are available: 1/16 inch and 3/16 inch.

## 27.8 FRONT WHEEL CAMBER

Wheel camber is the number of degrees the top of the wheel tilts outward (positive) or inward (negative) from a vertical angle (Figure 78).

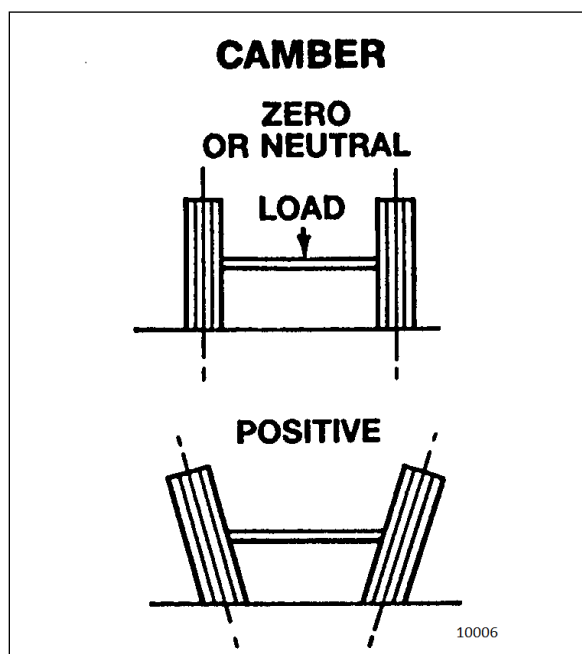


FIGURE 78: CAMBER

The camber angle is not adjustable. Camber variations may be caused by wear at the wheel bearings, steering knuckle pins or by a bent knuckle or sagging axle center. Steering effort is affected by improper camber, and uneven tire wear will result. Excessive positive camber causes an irregular wear of tire at the outer shoulder and excessive negative camber causes wear at the inner shoulder.

## 27.9 CAMBER CHECK

1. Use an alignment machine to check the camber angle.
2. If camber reading is not in the specifications, adjust the wheel bearings and repeat the check. If the reading is still not within

specifications, verify the steering knuckle pins and axle center.

3. See instructions in “DANA SPICER Maintenance Manual Model NDS and Maintenance Manual NDS Axles”.
4. Check the wheel lateral distortion as instructed in Section 13, “Wheels, Hubs and Tires” under heading, “Checking for Distorted Wheel on Vehicle”. If distortion is excessive, straighten or replace wheel(s).

## 27.10 FRONT AXLE CASTER

Positive caster is the rearward tilt from the vertical axis of the knuckle pin. Negative caster is the forward tilt from the vertical axis of the knuckle pin (Figure 79). This vehicle is designed with a positive caster. The purpose of the caster angle is to give a trailing effect. This results in stabilized steering and a tendency for the wheels to return to the straight-ahead position after taking a turn.

Excessive caster results in hard steering around corners. A shimmy may also develop when returning to the straight ahead position (pulling out of curves).

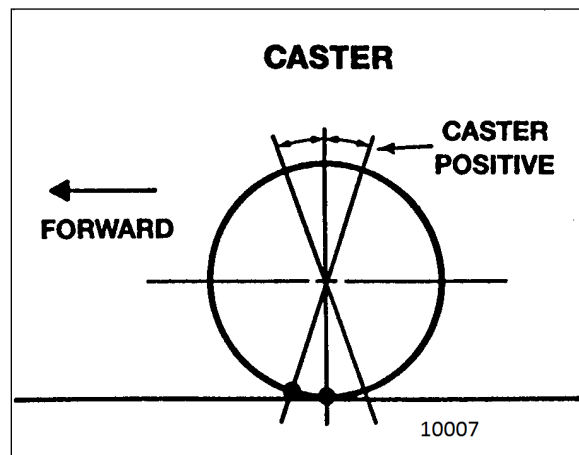


FIGURE 79: CASTER

Insufficient caster will cause wandering and steering instability. Caster variations may be caused by a bent axle, tilting or distortion of the side suspension supports, damaged radius rod bushings, or unequal tightening of the front and rear suspension support bolts. Incorrect caster must be corrected by replacing the damaged suspension parts. A precision instrument should be used to measure the caster.

**NOTE**



The caster of this vehicle is factory set and is not adjustable. However, if after replacing damaged parts or in case of improper caster due to irregular setting, the front axle caster needs adjustment; it can be adjusted by means of shims (Prevost #110663) on the left-hand side upper radius rod support in order to obtain minor adjustment.

### 27.11 FRONT WHEEL TOE-IN

Wheel toe-in is the degree (usually expressed in fractions of an inch) where the forward part of the vehicle front wheels are closer together than the rear part, measured at wheel centerline height with the wheels in the normal "straight-ahead" position of the steering gear.

Incorrect toe-in results in excessive tire wear caused by side slippage and also steering instability with a tendency to wander. Toe-in may be measured from the center of tire tread or from the inside of the tires. Take measurements at both front and rear of axle (see "A" and "B" in Figure 80).

When setting toe-in adjustment, the front suspension must be neutralized; that is, all component parts must be in the same relative position when making the adjustment as they will be when in operation.

To neutralize the suspension, the vehicle must be rolled forward, approximately ten feet.

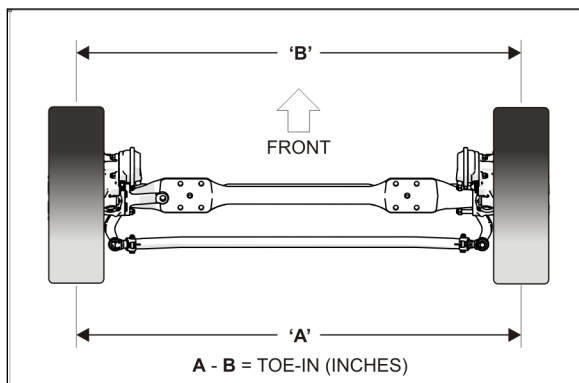


FIGURE 80: TOE-IN MEASUREMENT

### 27.12 NEUTRALIZING THE FRONT SUSPENSION BEFORE ALIGNMENT

By rolling the vehicle forward, all tolerances in the front suspension are taken up and the suspension is then in its normal operating position. Neutralizing the front suspension is extremely important, especially if the vehicle has been jacked up in order to mark the tires. Otherwise, the front wheels will not return to their normal operating position due to the tires gripping the floor surface when the vehicle jack is lowered.

#### NOTE

"Toe-in" measurements must be taken at the horizontal axis of the wheel centerline.

### 27.13 INSPECTION AND ADJUSTMENT

Before checking front wheel toe-in, first check the camber angles and make the necessary corrections.

1. Measure the toe-in.
2. If the toe-in measurement is not within the specified tolerance, carry out the following procedure :
  - a. Loosen the pinch bolt on the right hand (curb side) tie rod end where the adjuster sleeve is located.
  - b. Turn the adjuster sleeve (Figure 81) until the specified toe-in measurement is obtained.
  - c. Tighten the pinch bolt nuts

**TORQUE:** 118-133 lb-ft (160-180 Nm)

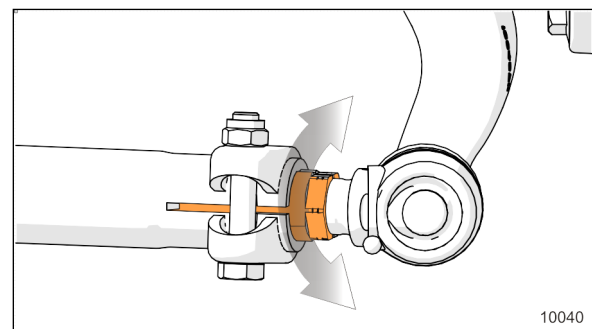


FIGURE 81: FINE ADJUSTER SLEEVE ON TIE ROD



## 27.14 FRONT WHEELS ALIGNMENT SPECIFICATIONS – I-BEAM AXLE

Use static wheel alignment systems which work with angle measurements only, such as Josam or Hunter systems. Static alignment specifications are listed in the following tables:

<b>FRONT WHEELS ALIGNMENT SPECIFICATIONS FOR I-BEAM AXLE</b>			
<b>Front Wheel Alignment</b>	<b>Minimal</b>	<b>Nominal</b>	<b>Maximal</b>
Camber R.H. and L.H. * (degrees)	-0.250	0.125	0.375
Caster R.H. and L.H. (degrees)	2	2.75	3.5
Total toe (A minus B) (degrees)	0.04	0.06	0.08

## 28. TROUBLESHOOTING

CONDITION	CAUSE	CORRECTION
Tires wear out quickly or have uneven tire tread wear.	<ol style="list-style-type: none"> <li>1. Tires have incorrect air pressure.</li> <li>2. Tires out-of-balance.</li> <li>3. Incorrect tag axle alignment.</li> <li>4. Incorrect toe-in setting.</li> <li>5. Incorrect steering arm geometry.</li> </ol>	<ol style="list-style-type: none"> <li>1. Put specified air pressure in tires.</li> <li>2. Balance or replace tires.</li> <li>3. Align tag axle.</li> <li>4. Adjust toe-in specified setting.</li> <li>5. Service steering system as necessary.</li> </ol>
Vehicle is hard to steer.	<ol style="list-style-type: none"> <li>1. Low pressure in the power steering system.</li> <li>2. Steering gear not assembled correctly.</li> <li>3. Steering linkage needs lubrication.</li> <li>4. King pins binding.</li> <li>5. Incorrect steering arm geometry.</li> <li>6. Caster improperly adjusted.</li> <li>7. Tie rod ends hard to move.</li> <li>8. Worn thrust bearing.</li> </ol>	<ol style="list-style-type: none"> <li>1. Repair power steering system.</li> <li>2. Assemble steering gear correctly.</li> <li>3. Lubricate steering linkage.</li> <li>4. Replace king pins.</li> <li>5. Service steering system as necessary.</li> <li>6. Adjust caster as necessary.</li> <li>7. Replace tie rod ends.</li> <li>8. Replace thrust bearing.</li> </ol>
Bent or broken steering arm, steering top lever or tie rod assembly.	<ol style="list-style-type: none"> <li>1. Too much pressure in the power steering system.</li> <li>2. Cut-off pressure of the power steering system improperly adjusted.</li> <li>3. Vehicle not powered on correctly.</li> <li>4. Power steering system not installed correctly.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace damaged part(s), adjust power steering system to specified pressure.</li> <li>2. Make sure vehicle is powered on correctly.</li> <li>3. Correctly install the power steering system.</li> <li>4. Correctly install the power steering system.</li> </ol>
Worn or broken steering ball pin.	<ol style="list-style-type: none"> <li>1. Drag link fasteners tightened past specified torque.</li> <li>2. Lack of lubrication or incorrect lubricant.</li> <li>3. Power steering stops improperly adjusted.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace damaged part(s), tighten drag link fasteners to specified torque.</li> <li>2. Lubricate linkage with specified lubricant.</li> <li>3. Adjust stops to specified dimension.</li> </ol>
Worn king pins and knuckle bushings.	<ol style="list-style-type: none"> <li>1. Worn or missing seals and gaskets.</li> <li>2. Incorrect lubricant.</li> <li>3. Axle not lubricated at scheduled frequency.</li> <li>4. Incorrect lubrication procedures.</li> <li>5. Lubrication schedule does not match operating conditions.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace damaged part(s), replace seals and gaskets.</li> <li>2. Lubricate axle with specified lubricant.</li> <li>3. Lubricate axle at scheduled frequency.</li> <li>4. Use correct lubrication schedule to match operating conditions.</li> <li>5. Change lubrication schedule to match operating conditions.</li> </ol>
Vibration or shimmy of front axle during operation.	<ol style="list-style-type: none"> <li>1. Caster not adjusted properly.</li> <li>2. Wheels and/or tires out of balance.</li> <li>3. Worn steering stabilizer cylinder.</li> </ol>	<ol style="list-style-type: none"> <li>1. Adjust caster.</li> <li>2. Balance or replace wheels and/or tires.</li> <li>3. Replace steering stabilizer cylinder.</li> </ol>

**29. SPECIFICATIONS****Power Steering Gear**

Make .....	ZF/ROBERT BOSCH-SERVOCOMTRONIC
Type .....	Speed Sensitive
F.E.W. ....	16,600 lbs (7 545 kg)
Pressure rating .....	2,175 psi (150 Bar)
Gear ratio (center) .....	22.2 : 1
Gear ratio (extremities) .....	26.2 : 1
Minimum pump flow for 1.5 hwt/sec .....	4.22 gpm (16 lpm)

**Power Steering Gear**

Make .....	ZF/ROBERT BOSCH--SERVOCOM
F.E.W. ....	16,600 lbs (7 545 kg)
Pressure rating .....	2,175 psi (150 Bar)
Gear ratio (center) .....	22.2 : 1
Gear ratio (extremities) .....	26.2 : 1
Minimum pump flow for 1.5 hwt/sec .....	4.22 gpm (16 lpm)

**Power Steering Gear (previous IFS design)**

Make .....	ZF/ROBERT BOSCH -SERVOCOM
Type .....	8098
F.E.W. ....	19,000 lbs (8 618 kg)
Pressure rating .....	2,320 psi (160 Bar)

**Power Steering Gear (new IFS design)**

Make .....	ZF/ROBERT BOSCH -SERVOCOM
Type .....	8098 with automatic bleeder
F.E.W. ....	19,000 lbs (8 618 kg)
Pressure rating .....	2465 psi (170 Bar)

**Power Steering Reservoir**

Oil capacity .....	4 US qts (3.7 liters)
Make .....	Nelson Muffler

**Steering Stabilizer Cylinder (Damper)**

Extended length .....	32.73±0.12"
Collapsed length.....	20.26±0.12"
Stroke.....	12.47±0.12"

**Front I-Beam Axle**

Make .....	DANA SPICER EUROPE
Model .....	S84U
Front Track .....	84.4 inches (2 145 mm)
Rated load capacity.....	16,500 lbs (7 500 kg)



**MAINTENANCE  
INFORMATION**

**MI19-05A**

DATE :	February 2019	SECTION :	14 STEERING
SUBJECT :	<b>660865, 660699 DRAGLINK ADJUSTMENT</b>		

Revision: A


Added X3-45 commuter & US built vehicles

2019-02-28

***IMPORTANT NOTICE***

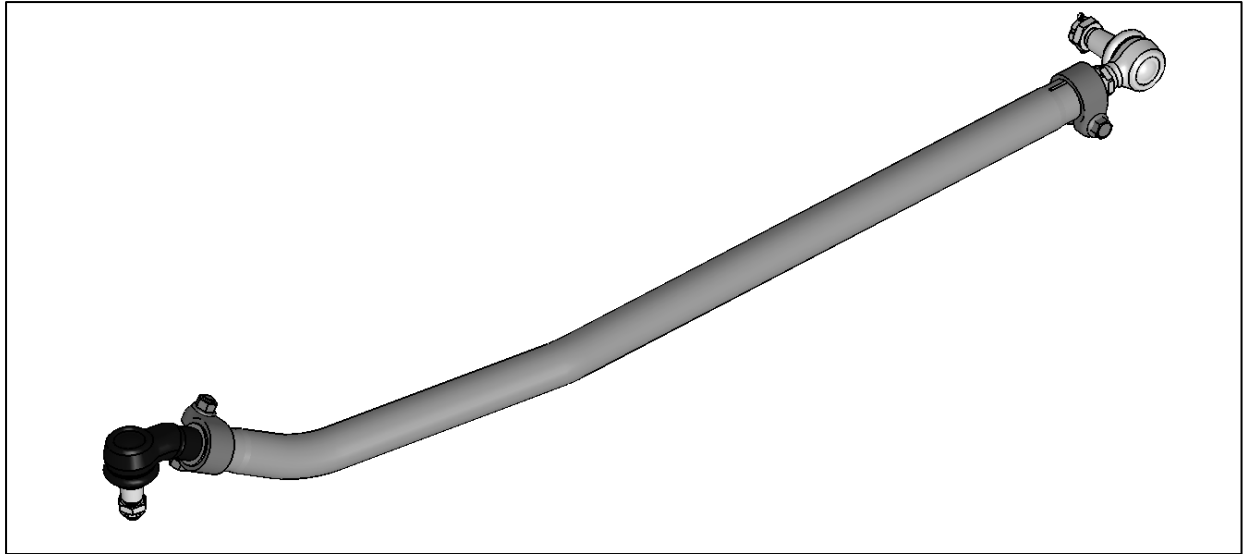
*This modification is recommended by PrevoSt to increase your vehicle's performance. Note that no reimbursement will be awarded for carrying out this modification.*

**APPLICATION**

Model	VIN	
H3-41, H3-45 coaches Model Year : 2014 -	From 2PCH3349X <b>EC712505</b> up to ...	
X3-45 coaches Model Year : 2014 -	US built from: 4RKG33495 <b>F9737000</b> up to ...	
	Canadian built from: 2PCG33497 <b>EC735526</b> up to ...	
X3-45 Commuter Model Year : 2017 -	US built from: 4RKJ33498 <b>H9737386</b> up to ...	
	Canadian built from: 2PCJ33493 <b>JC736317</b> up to ...	

**DESCRIPTION**

For vehicles equipped with I-beam axles, follow these instructions to adjust the length of the draglink. This applies to model year 2014 and onward.



## MATERIAL

H series

Part No.	Description	Qty
660865	DRAG LINK ASSEMBLY, H SERIES	1
502104	COTTER PIN 5/32 X 2	1

X series

Part No.	Description	Qty
660699	DRAG LINK ASSEMBLY, X SERIES	1
502104	COTTER PIN 5/32 X 2	1

Other parts that may be required, depending on condition

Part No.	Description	Qty
660018	COLLAR ASSY / W/BOLT & NUT	2

### NOTE

*Material can be obtained through regular channels.*

## PROCEDURE



### CAUTION

CONFORM TO THE PRESCRIBED TORQUES AND FOLLOW ASSEMBLY GUIDELINES TO ENSURE VEHICLE SAFETY.



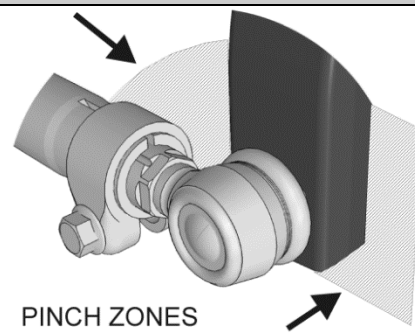
Park vehicle safely, apply parking brake, stop engine and set battery master switch(es) to the OFF position prior to working on the vehicle.



## PINCH HAZARD

Keep hands and fingers clear of pinch zones around pitman arm.

Pinch zones are between pitman arm and clamp, and between front of pitman arm and vehicle structure.



## REMOVAL OF EXISTING DRAG LINK



### CAUTION

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



### CAUTION

Do not drive (hammer in) pitman arm on or off pitman shaft as this can damage the steering gear.

1. Raise the vehicle by the wheels using mobile column lifts. Doing so will prevent a change in direction of the knuckles and preserve the relative positions of the steering components involved i.e. the steering arm and the pitman arm.
2. Remove cotter pin and nut from drag link ball joint stud at pitman arm.
3. Disconnect drag link from pitman arm, using jaw style pullers (pressure screw type).
4. Remove cotter pin and nut from drag link ball joint stud at the steering arm (near knuckle) and then disconnect the drag link.

## ADJUSTING THE DRAG LINK TO PROPER LENGTH - ELBOW BALL JOINT (KNUCKLE SIDE)

- Adjust the length of the draglink. To do so, try to install it between the steering arm and the pitman arm. If the length is not adequate, it must be adjusted to the required length. Use dimension "A" and steps below to adjust the length of the replacement drag link or you may use the replaced drag link for length reference.

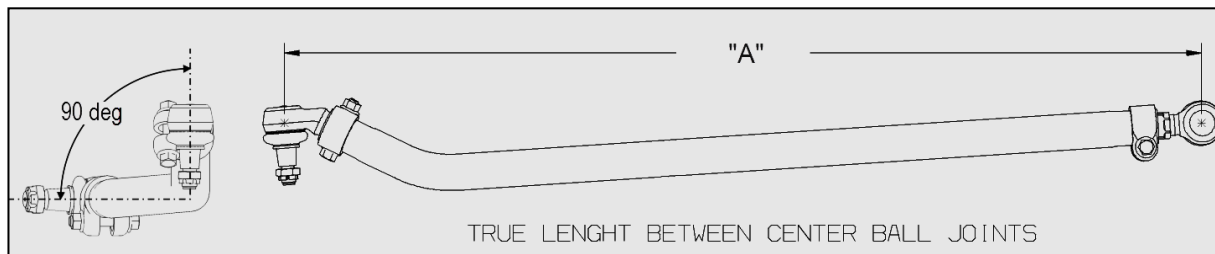


FIGURE 1: HSERIES LENGTH

H Series: Length A = 55" 7/8" ± 1/16" (1420mm ± 2mm)

X Series: Length A = 53" 3/8" ± 1/16" (1356mm ± 2mm)

- Screw the drag link elbow ball joint (knuckle side) fully in drag link tube.



FIGURE 2

- Unscrew the *drag link elbow* ball joint by (**not more than 1 turn**) so the tapered shank *points down* as shown on FIGURE 3. This will be the *initial / reference* position for next step.



FIGURE 3



8. Next, unscrew the *drag link elbow* ball joint back out.

H Series: **Five (5) full turn** from the *initial / reference* position.

X Series: **One (1) full turn** from the *initial / reference* position.

The tapered shank must point down as shown on (FIGURE 4).

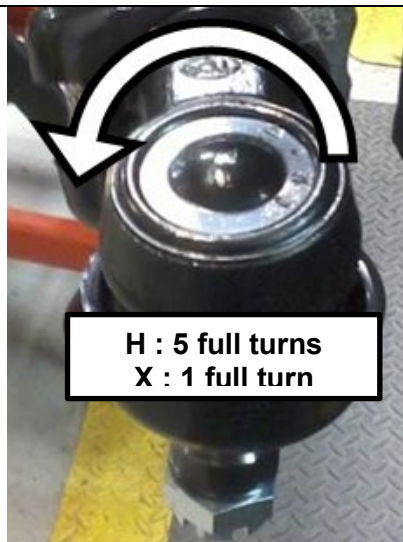


FIGURE 4

9. To prevent interference between the ball joint clamp bolts and other components of the steering system, the clamp bolt must be positioned vertically as shown on FIGURE 6. **Tighten the clamp nut to 118-133 lbf-ft.**



**CAUTION**

**Do not re-use clamp hardware.**

Bolt and nut should be replaced every time they are unscrewed. While assembling the clamp, make sure the bolt does not touch the drag link tube.

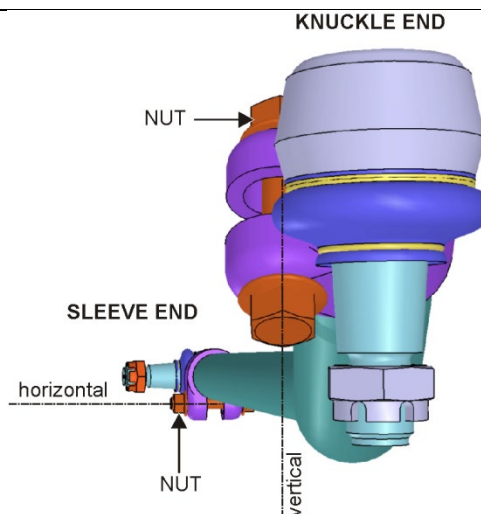
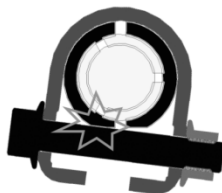


FIGURE 5: NOTE THE VERTICAL ORIENTATION OF THE CLAMP BOLT AT THE KNUCKLE END AND ON WHICH SIDE THE NUT MUST BE POSITIONED

**SLEEVE ADJUSTMENT PARAMETERS**

10. On the drag link front end you will find an adjustment sleeve which has internal and external left and right threads.

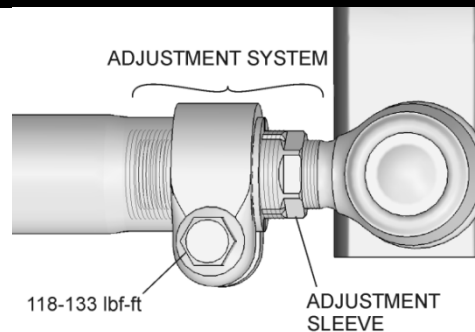


FIGURE 6

11. Fine adjustment of the drag link length if required should be performed exclusively by turning the adjustment sleeve while preventing the tube and joint from rotating.

***The only part rotating should be the sleeve***

- To extend, turn the sleeve clockwise.
- To retract, turn counter clockwise.

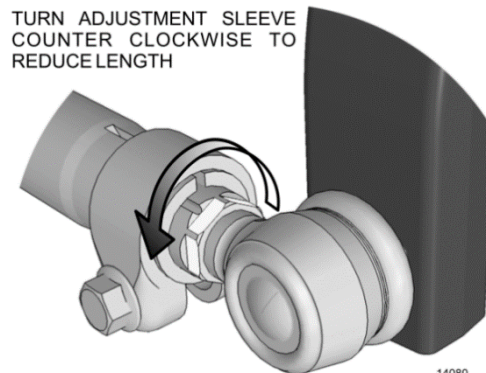


FIGURE 7

#### GENERAL LIMITATIONS OF THE ADJUSTMENT SLEEVE

Do not exceed the following maximum thread lengths and values.

- Max dimension **V** : 5/8" (16mm)  $\pm$  1 thread pitch
- Max dimension **W** : 5/8" (16mm)  $\pm$  1 thread pitch
- Max dimension **X** : 1" (25mm)
- Dimension **V** and **W** should be equal ( $V/W = 1$ )

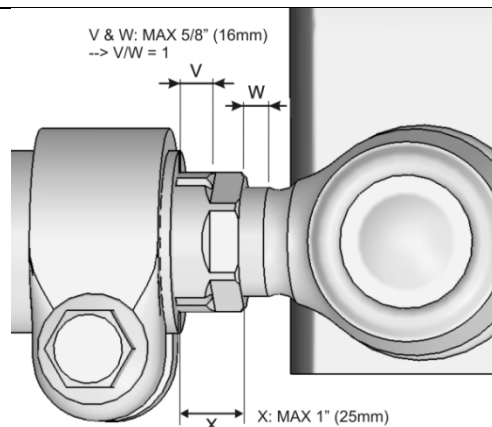


FIGURE 8

## SLEEVE ADJUSTMENT

12. Adjust sleeve to the values of FIGURE 10.

10/32"=8mm

13. Once the proper length adjustment is done, tighten the sleeve end ball joint clamp. To prevent interference between the ball joint clamp bolts with other components of the steering system, the clamp bolt must be positioned horizontally as shown on FIGURE 11. **Tighten the clamp nut to 118-133 lbf-ft.**



### CAUTION

**Do not re-use clamp hardware.**

Bolt and nut should be replaced every time they are unscrewed. While assembling the clamp, make sure the bolt does not touch the drag link tube.

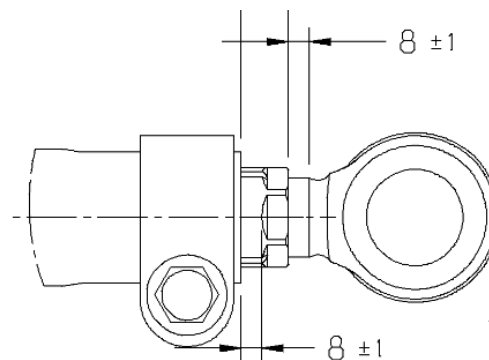
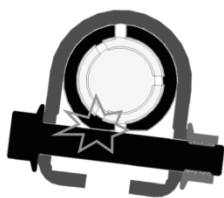


FIGURE 9

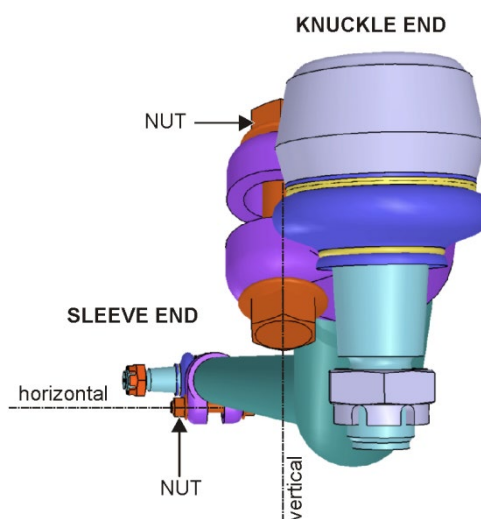


FIGURE 10: NOTE THE HORIZONTAL ORIENTATION OF THE CLAMP BOLT AT THE SLEEVE END AND ON WHICH SIDE THE NUT MUST BE POSITIONED

## DRAG LINK INSTALLATION

14. Install the drag link.
15. Ball joint castellated nut on both ends should be tightened to **150-200 lbf-ft**.
16. Install cotter pin **p/n 502104** and bend to lock bolt in place (see an example of a correct installation of a cotter pin on the image below).
17. Apply a small amount of anti-seize compound on all exposed threads for corrosion protection. Be sure to avoid smearing the ball joint boot.

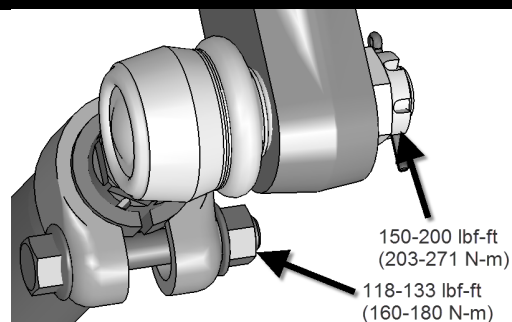
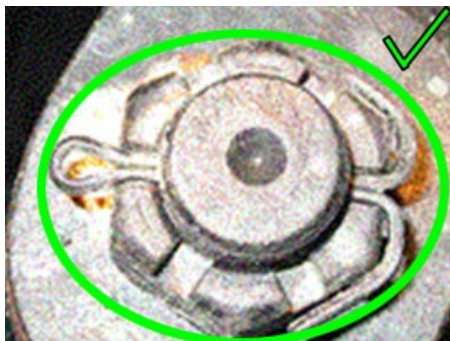


FIGURE 11



18. Make sure there is no binding or interference of the draglink with the vehicle structure by turning wheels fully in each direction. Min gap: 1/4" (6mm)
19. Inspect the gap between *tire* and *draglink* turning wheels *right*: Min gap 3/8" (9.5mm).

## PARTS / WASTE DISPOSAL

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