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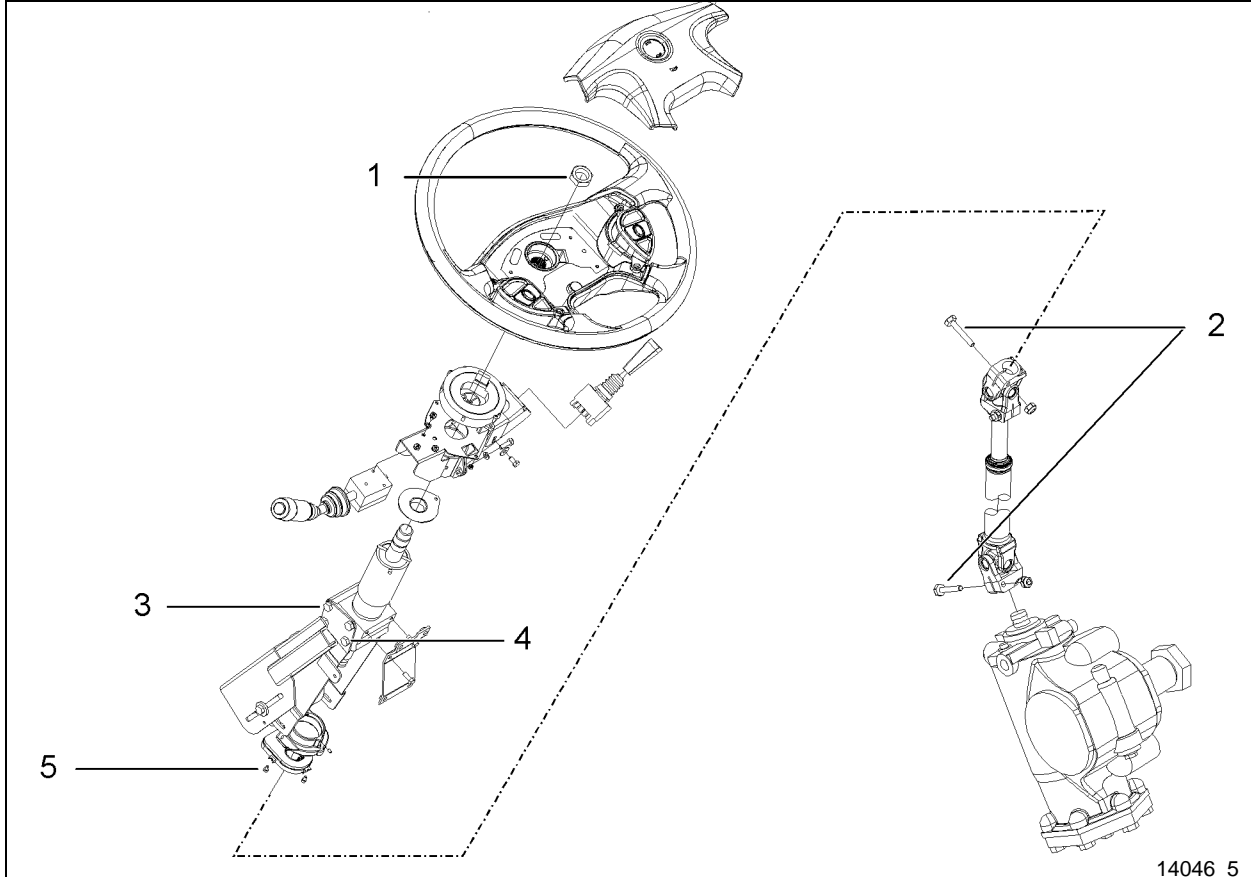
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SECTION CHANGE LOG

DESCRIPTION		DATE
1	New paragraphs added: 13.1 Power Steering Fluid Condition; 13.1.1 Power Steering Fluid Visual Inspection	Nov. 2017
2	Updated tie rod on I-beam axle	October 2018
3		
4		
5		
6		

1. TORQUE TABLES

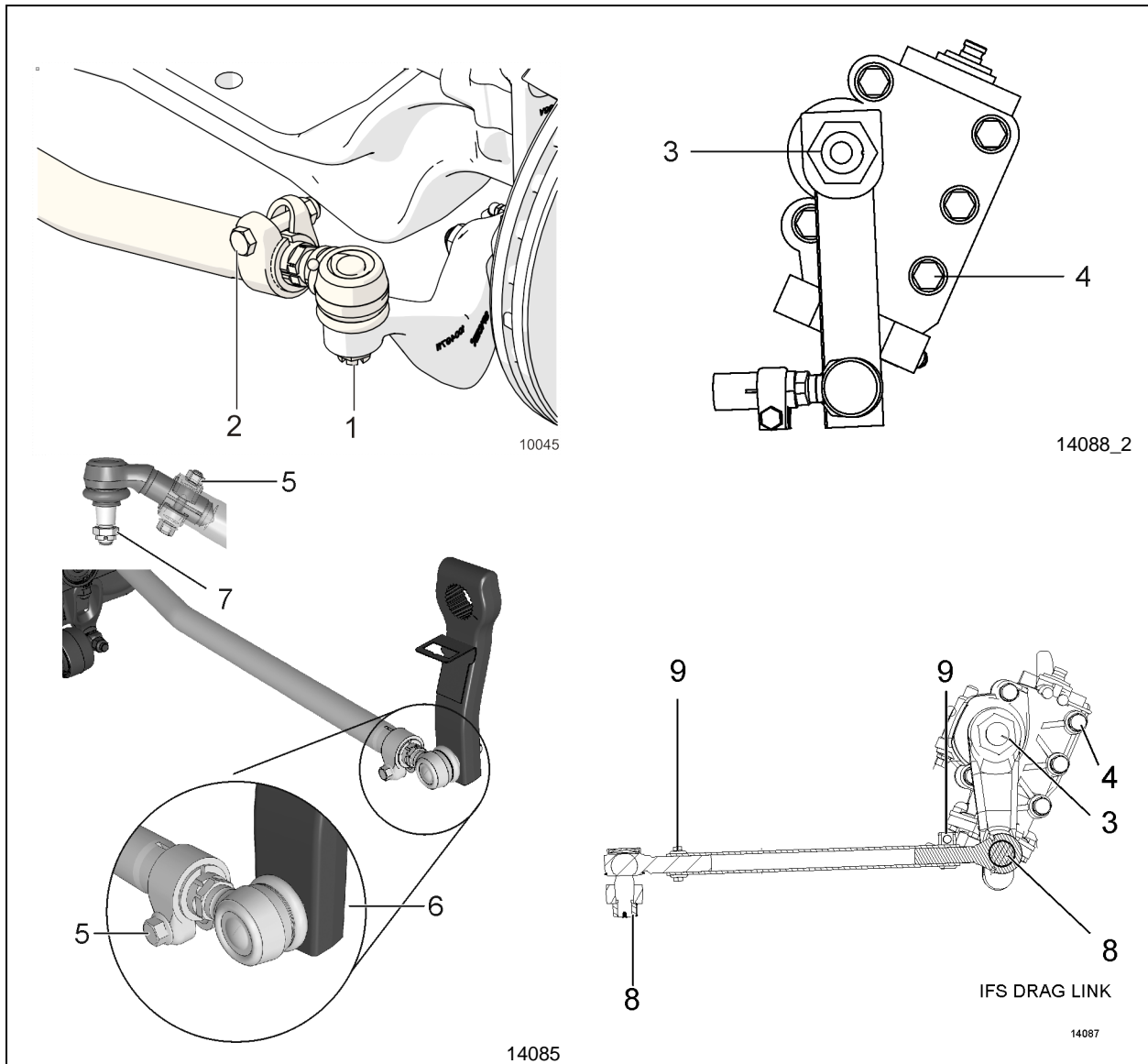
1.1 STEERING COLUMN



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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)

1.2 MISCELLANEOUS TORQUES



MISCELLANEOUS		
No	DESCRIPTION	TORQUE
1	Tie rod end ball pin nuts - I-Beam Axle	155-170 lb-ft (210-230 Nm)
2	Tie rod end clamp bolts - I-Beam Axle	107-129 lb-ft (145-175 Nm)
3	Pitman Arm Fixing Nut	470-570 lb-ft (637-773 Nm)
4	Steering Gear Mounting Bolts	365-405 lb-ft (495-549 Nm)
5	Drag Link Clamp Bolts - I-Beam Axle	118-133 lb-ft (160-180 Nm)
6	Drag Link Ball Joint Stud Nut (Fore) - I-Beam	165-236 lb-ft (224-320 Nm)
7	Drag Link Ball Joint Stud Nut (Aft) - I-Beam	140-200 lb-ft (190-271 Nm)
8	Drag Link Ball Joint Stud Nut - IFS	245-270 lb-ft (332-366 Nm)
9	Draglink Clamp Bolt - IFS	50-60 lb-ft (68-81 Nm)

2. STEERING SYSTEM

2.1 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 gearbox 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.

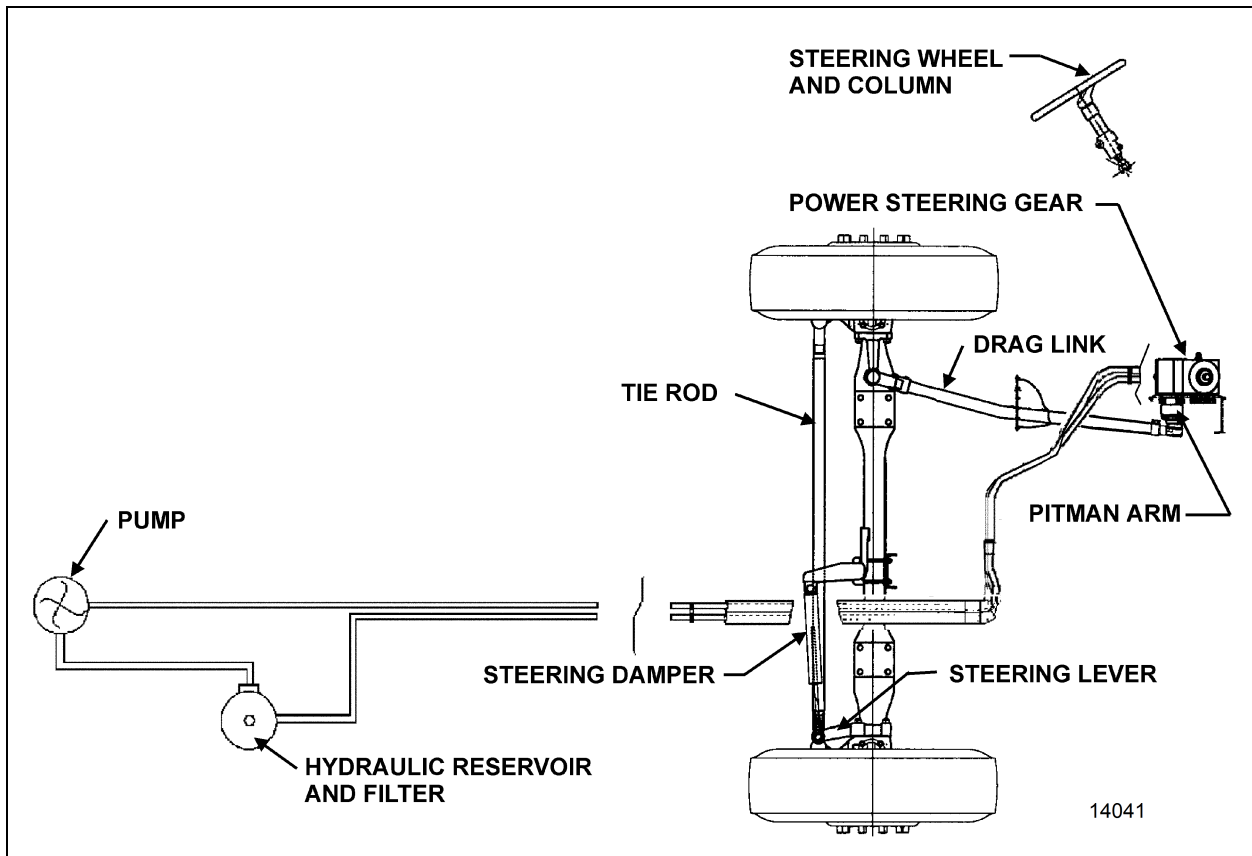


FIGURE 1: I-BEAM AXLE STEERING SYSTEM SETUP

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2.2 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 (Figure 2). 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.

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 & Bus Shells)

NOTE
VIP vehicles and Bus Shells are also equipped with a hydraulic power cylinder. The hydraulic power cylinder provides an added source of assistance and being connected to the R.H. wheel, makes it such that the total steering forces are produced with minimal stress on mechanical linkages.

The steering gearbox 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.

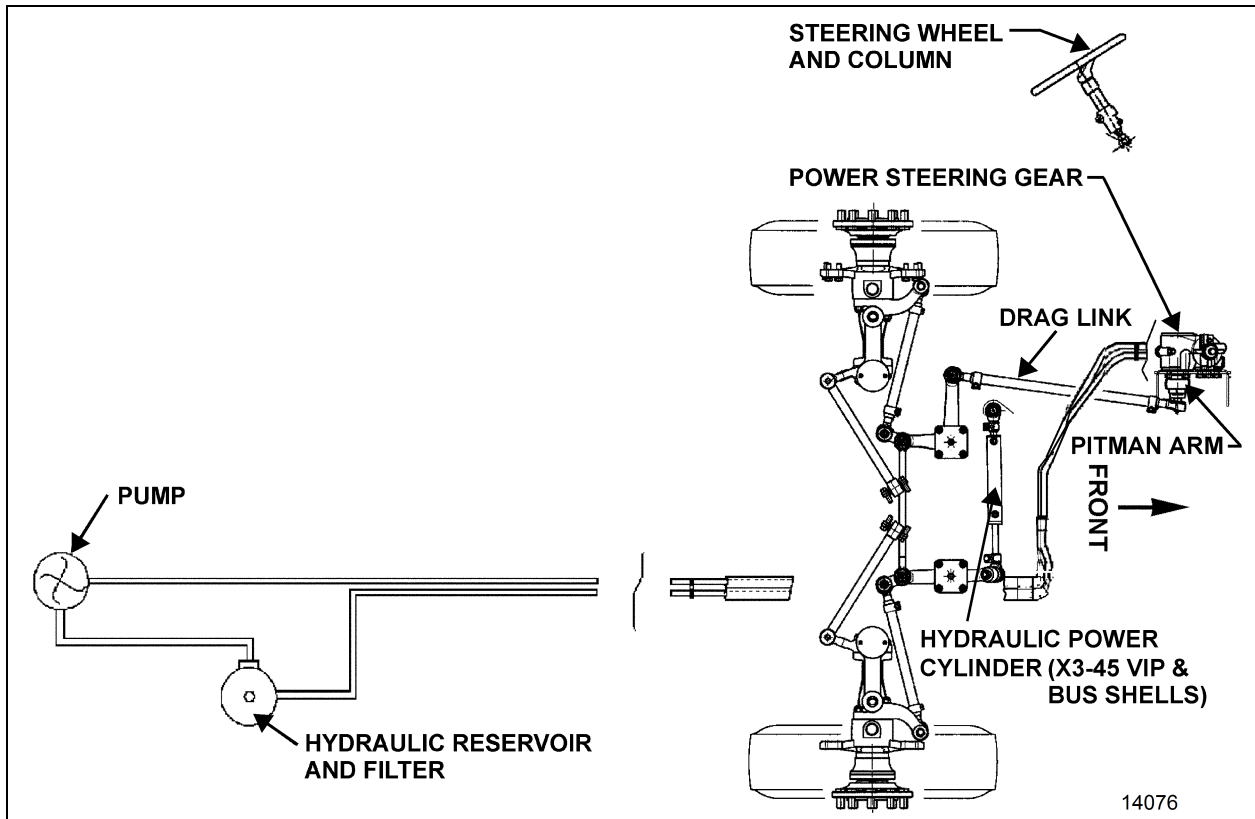


FIGURE 2: IFS STEERING SYSTEM SETUP

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3. POWER STEERING GEAR

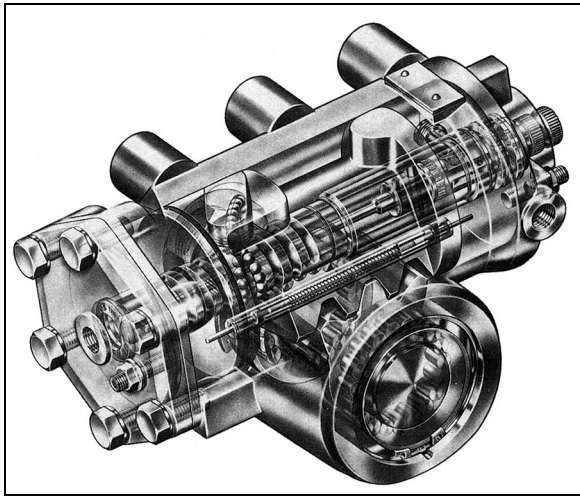


FIGURE 3: POWER STEERING GEAR

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3.1 DESCRIPTION

The power steering gear is located in the lower part of front service compartment (Figs. 3 & 4). The housing of the ZF/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.

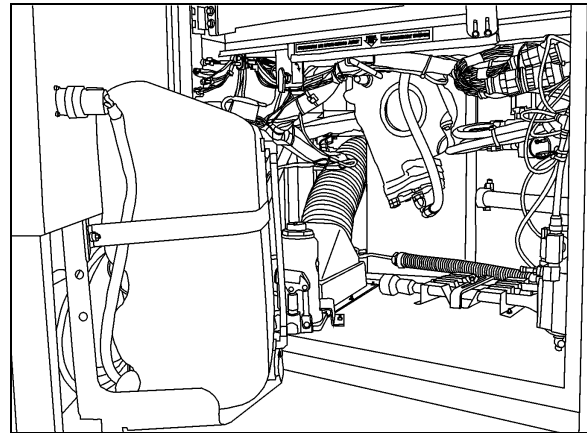


FIGURE 4: FRONT SERVICE COMPARTMENT

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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 your Technical Publications USB flash drive, for the functional aspects and maintenance procedure of the steering gear.

3.2 POWER STEERING GEAR REMOVAL

3.4 TROUBLESHOOTING

WARNING

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

Perform troubleshooting of the steering gear as outlined in the "ZF-SERVOCOM Repair Manual" and "RB Robert Bosch Servocom - Service Manual (8090)" found on your Technical Publications USB flash drive.

1. 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.
2. Mark both the pitman arm and sector shaft with a line, then remove pitman arm. Refer to "11.1 Pitman Arm Removal" procedure.
3. Mark both the steering shaft universal joint yoke and steering gear input shaft with a line, then disconnect universal joint.
4. Unscrew and remove the power steering gear.

3.3 POWER STEERING GEAR INSTALLATION

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 4 (Bleeding power steering hydraulic system).

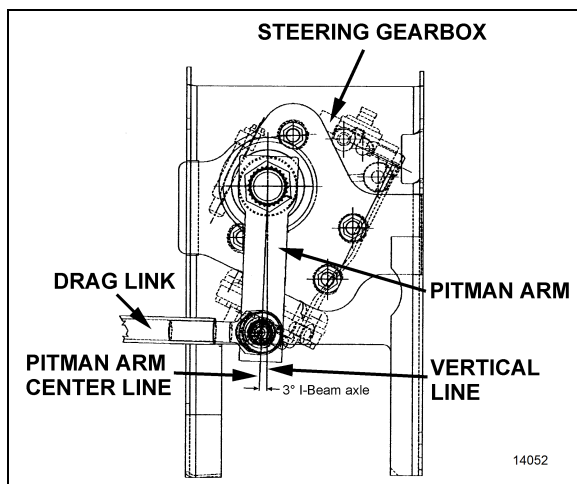


FIGURE 5: PITMAN ARM ADJUSTMENT

4. 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".

5. 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.

6. POWER STEERING HYDRAULIC PUMP

6.1 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.

6.2 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.

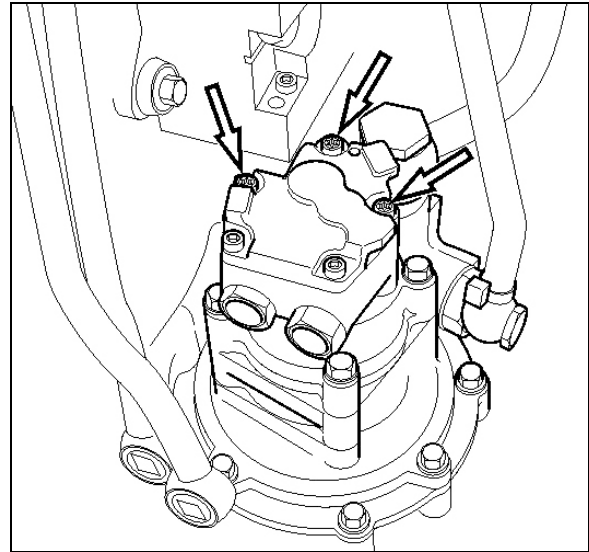


FIGURE 6: FUEL PUMP REMOVAL



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.

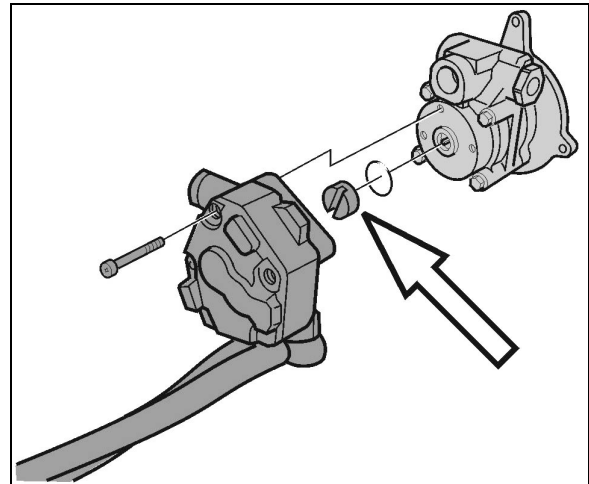


FIGURE 7: FUEL PUMP DRIVE AXLE

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.

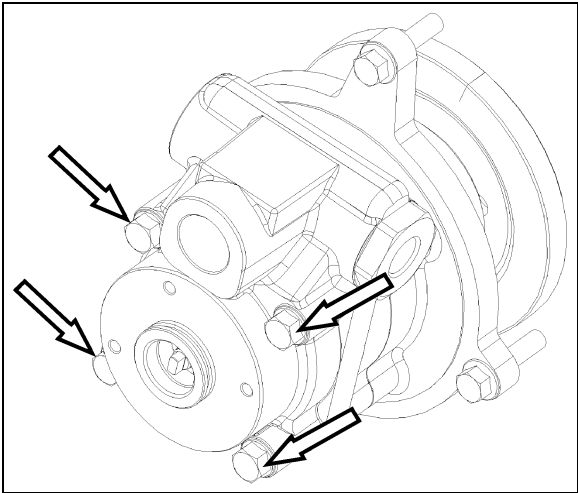


FIGURE 8: POWER STEERING PUMP REMOVAL

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

NOTE
<i>Use a new gasket.</i>

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

NOTE
<i>Use a new sealing ring. Check that the fuel pump drive axle sits correctly in the power steering pump.</i>

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

7. STEERING COLUMN

7.1 REMOVAL

To disassemble the steering column from system, refer to Figure 9 & Figure 10. 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:

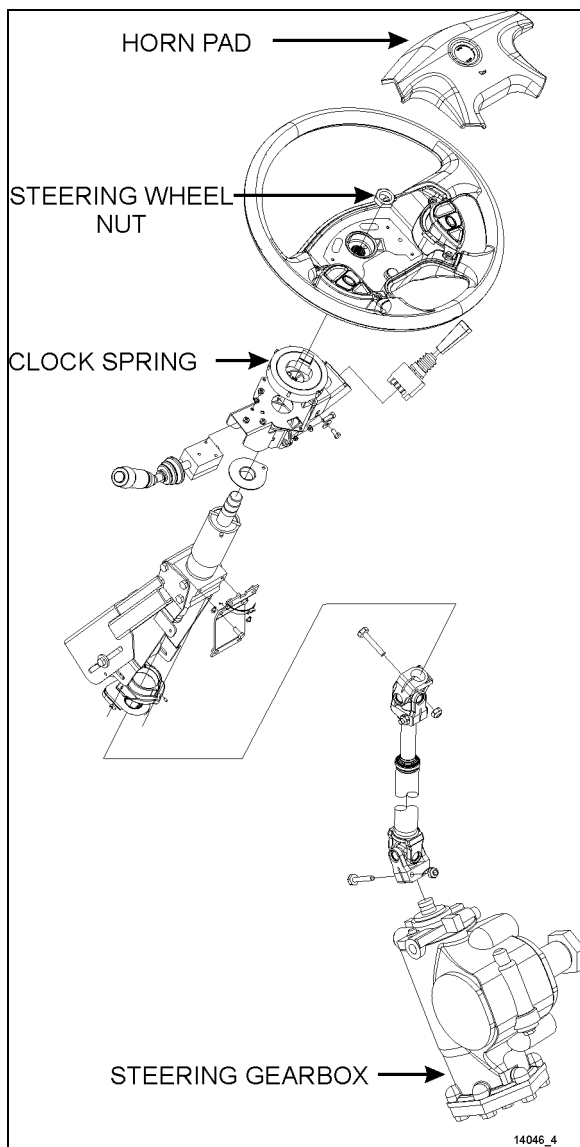


FIGURE 9: STEERING COLUMN

1. From the front driver's compartment area, remove the three plastic fasteners on steering

column lower cover. Remove the lower cover (Figure 10).

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.

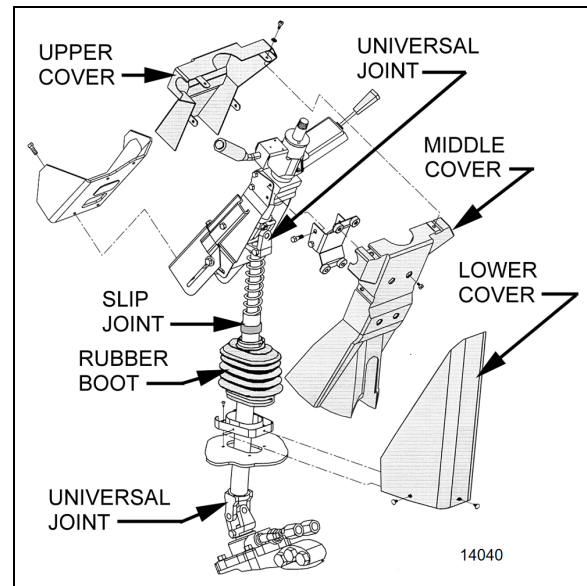


FIGURE 10: STEERING COLUMN COVERS

8. STEERING WHEEL

8.1 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 11).
3. Disconnect the horn wire (white) connected to the horn pad and the steering wheel harness 4-pin connector.

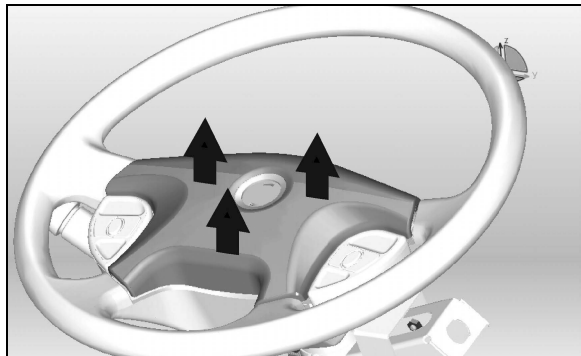


FIGURE 11: REMOVING THE HORN PAD

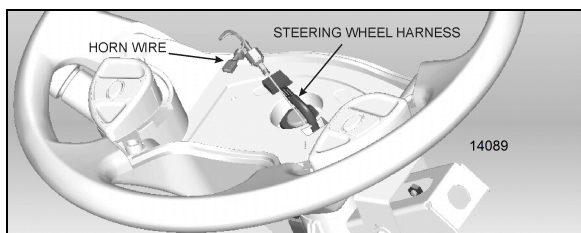


FIGURE 12: STEERING HARNESS & HORN WIRE

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 13).

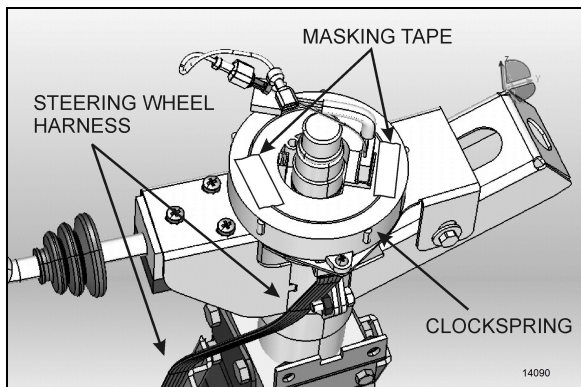


FIGURE 13: LOCKING THE CLOCKSPRING IN PLACE

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.

8.2 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.

TORQUE : 35-45 lb-ft (47-61 Nm)
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.

8.3 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 14). If necessary, remove the steering column covers.
3. Route the new clockspring harness through the opening in the clockspring support (Figure 14). Plug the connector at the base of the steering wheel column and fix harness along the steering wheel column.

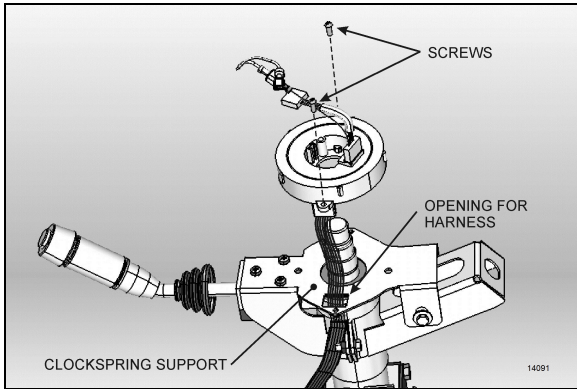


FIGURE 14: CLOCKSPRING INSTALLATION

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 15). This step is necessary for the installation of the steering wheel.

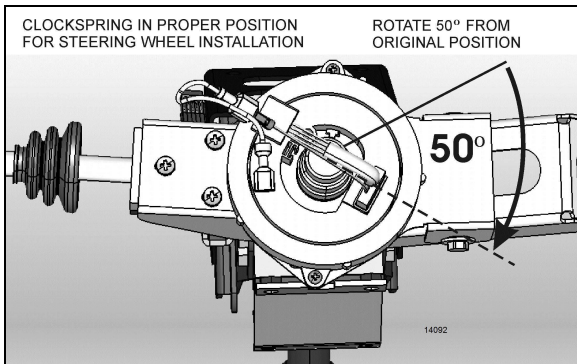


FIGURE 15: PROPER CLOCKSPRING POSITION

6. Reinstall the steering wheel.

9. 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. Refer to section 10 "Front Axle" under heading "6.4 Turning Angle Adjustment".

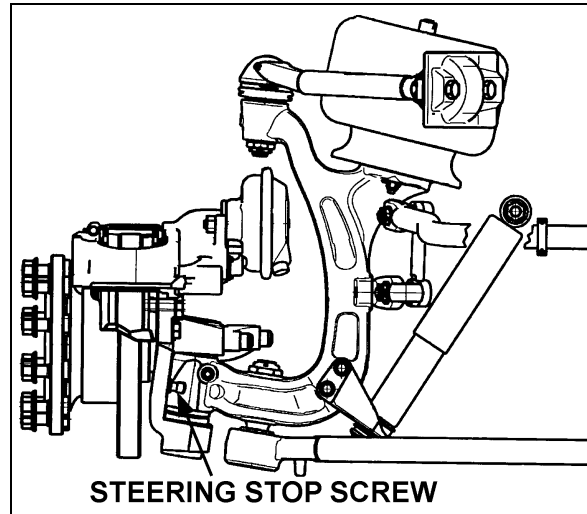


FIGURE 16: STEERING STOP SCREW ON IFS

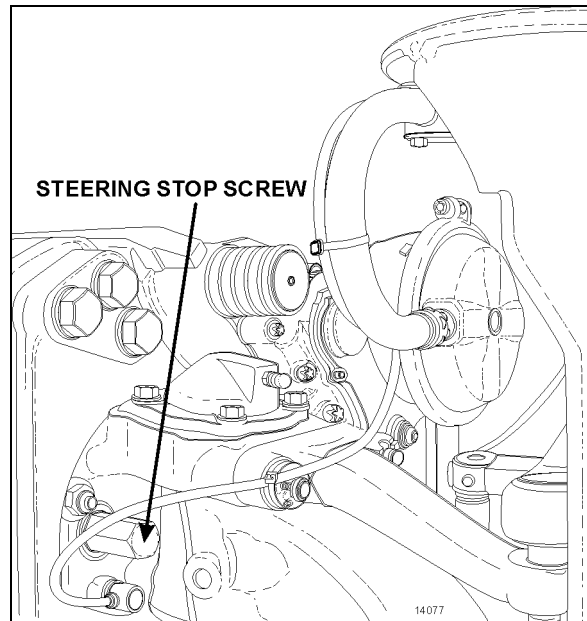


FIGURE 17: STEERING STOP SCREW ON I-BEAM AXLE



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 13.5 "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").

**CAUTION**

Front wheel alignment should be checked and adjusted if necessary, any time a component of the steering system is repaired, disassembled or adjusted. Refer to section 16 "Suspension" under heading: "Front End Alignment".

10. STEERING LINKAGE ADJUSTMENT

Steering linkage pivot points should be checked each time they are lubricated. Looseness can be visually detected while rotating the steering wheel in both directions. Replace defective parts.

10.1 COACHES

The steering linkage includes the pitman arm, drag link, steering arm, tie rod arms and tie rod.

**CAUTION**

Front wheel alignment should be checked and adjusted if necessary, any time a component of the steering system is repaired, disassembled or adjusted. Refer to section 10 "Front Axle" under heading 6. "Front Wheel Alignment".


10.2 VIP & BUS SHELLS


The steering linkage consists of tie rods connected to the bell crank and the steering arm at the left side of the bus shell, and to the idler arm and steering arm at the right side of the bus shell.


11. PITMAN ARM

11.1 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).

	<h2>WARNING</h2>
<p>Always wear approved eye protection when operating pullers.</p>	

	<h2>CAUTION</h2>
<p>Do not drive (hammer in) pitman arm on or off pitman shaft as this can damage the steering gear.</p>	

	<h2>CAUTION</h2>
<p>Heating of components to aid in disassembly is not allowed because it has a detrimental effect on axle components and steering linkages.</p>	

3. Using a cold chisel, undo punch mark that locks fixing nut to the pitman arm.
4. Remove pitman arm fixing nut.
5. Check the radial position of the pitman arm in relation to the sector shaft prior to removal of pitman arm.

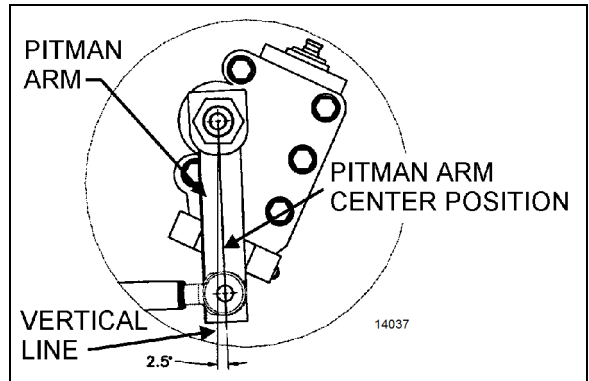


FIGURE 18: I-BEAM FRONT AXLE PITMAN ARM ADJUSTMENT

6. Add reference marks to the arm and shaft if necessary to ensure correct alignment at reassembly.

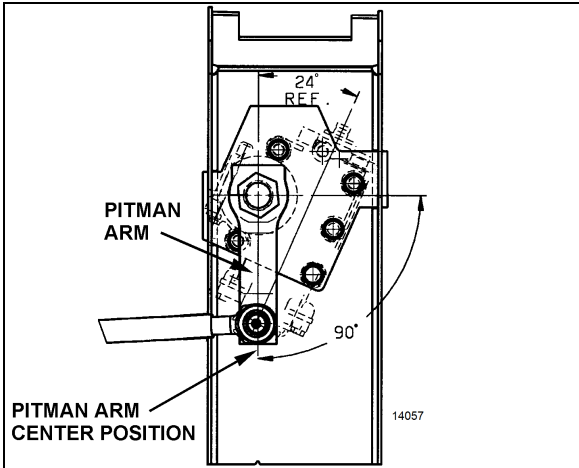


FIGURE 19: IFS PITMAN ARM ADJUSTMENT

7. Use a suitable puller and remove pitman arm.

11.2 INSTALLATION

1. Position pitman arm on sector gear shaft with reference marks aligned.
2. Install fixing nut.

TORQUE: 470-570 lb-ft (637-773 Nm)

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

3. Lock nut with sector shaft using a punch mark into the groove (Refer to Figure 20).



FIGURE 20: FIXING NUT PUNCH MARK

16098

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,

IFS, TORQUE: 245-270 lb-ft (332-366 Nm)

I-BEAM, TORQUE: 165-236 lb-ft (224-320 Nm)



CAUTION

Input shaft marks must be aligned before adjusting pitman arm.

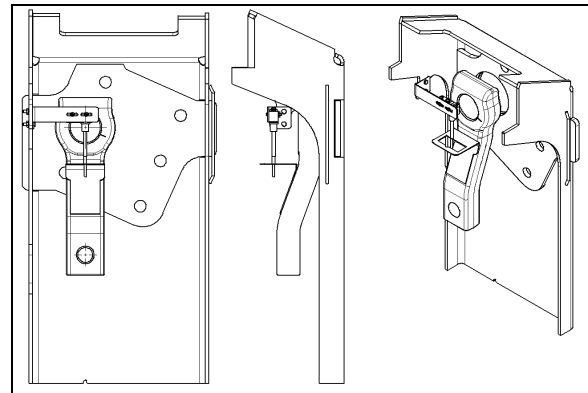


FIGURE 21: TAG AXLE UNLOADING SWITCH ADJUSTMENT

14061

11.3 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 gearbox at the center previously determined.
2. Using a protractor, check the angle of the pitman arm (refer to Figure 18 & Figure 19 for details).
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 "*Pitman arm removal*". Adjust to the proper angle.
4. When adjustment is achieved, replace fixing nut and tighten

TORQUE: 470-570 lb-ft (637-773 Nm)


11.4 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 (Refer to Figure 21).

12. DRAG LINK (I-BEAM AXLE)

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

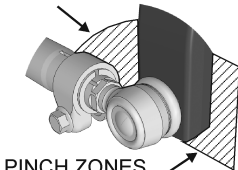
For additional details please refer to ZF assembly instructions LMN404-3 and Lemförder service information leaflet for the fine adjustment system.



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

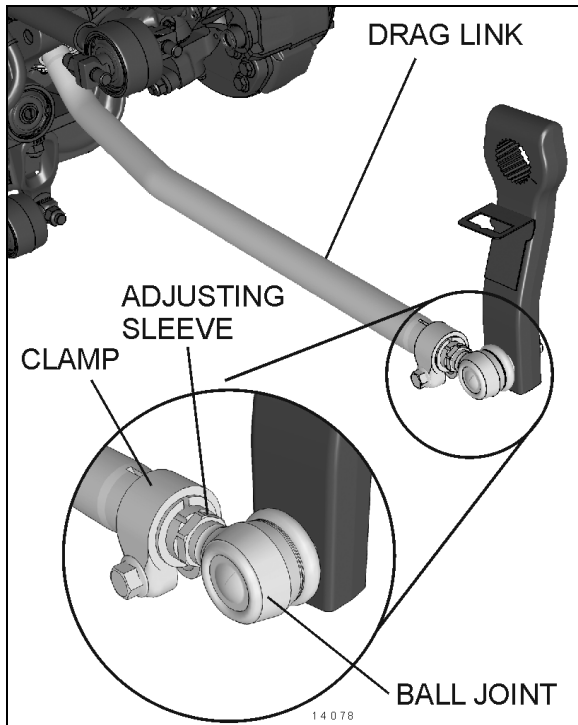


FIGURE 22: DRAG LINK

12.1 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.

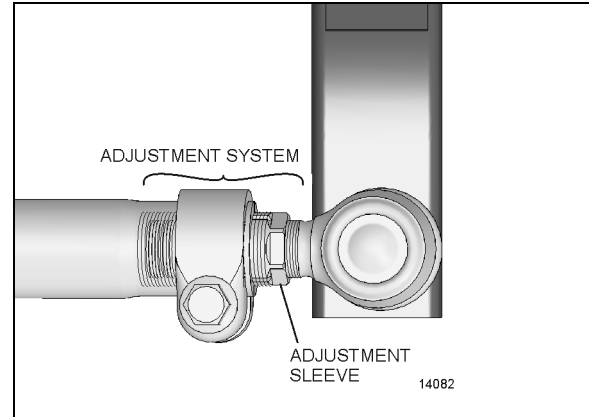



FIGURE 23: DRAG LINK ADJUSTMENT SYSTEM



CAUTION

Too little pressure on the clamp can destroy the threaded adjustment system sleeve.

Apply the recommended torque for clamp nut.

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

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.

12.1.1 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.

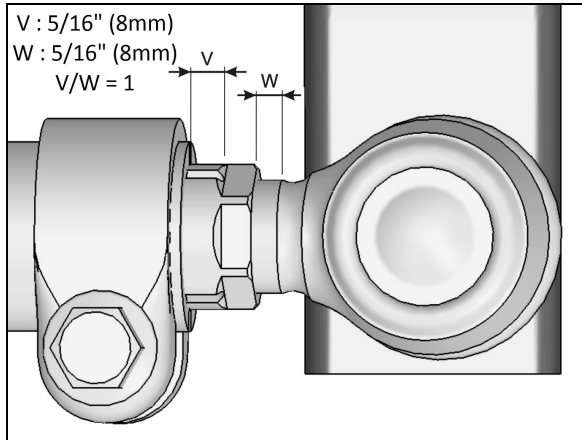


FIGURE 24: DRAG LINK ADJUSTMENT SYSTEM

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



WARNING

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

13. 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 4: *"BLEEDING POWER STEERING HYDRAULIC SYSTEM"*.

	<p>CAUTION</p>
<p>Do not operate the pump without fluid in the power steering fluid reservoir.</p>	

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. Refer to section 10 *"FRONT AXLE"* under heading 6: *"FRONT WHEEL ALIGNMENT"*.

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"* in Section 24 of this manual. The intervals given in the schedule are recommended for normal service. More frequent intervals may be required under severe operating conditions.

13.1 POWER STEERING FLUID CONDITION



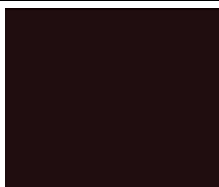
The power steering fluid reservoir is filled with Automatic Transmission Fluid (ATF) (refer to **FLUIDS & LUBRICANTS TABLE** in Section 24: *Lubrication & Servicing*). A periodic power steering fluid change is not required. Change the power steering fluid only if the steering gear unit was repaired,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


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

13.1.1 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.

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



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. Prior to pulling out the oil dipstick on the power steering fluid reservoir (Figure 25), thoroughly clean the reservoir and its immediate vicinity to protect the fluid from being soiled by impurities.
4. Unscrew and remove the dipstick located on top of reservoir and wipe with a clean rag.
5. Insert dipstick in reservoir. Remove it again to check fluid level.
6. Top up level to "FULL" mark using proper dipstick side depending on fluid temperature.
7. Reinsert and tighten the dipstick.

13.2 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.

The power steering fluid reservoir is equipped with a **magnetic drain plug**. When replacing the power steering fluid, check for trapped metal particle and clean the drain plug before refilling with new power steering fluid. Replace the filter element simultaneously with the fluid change.

13.3 POWER STEERING FLUID LEVEL CHECK

The power steering reservoir is located on R.H. side of engine compartment, on front wall and accessible through the engine compartment R.H. side door.

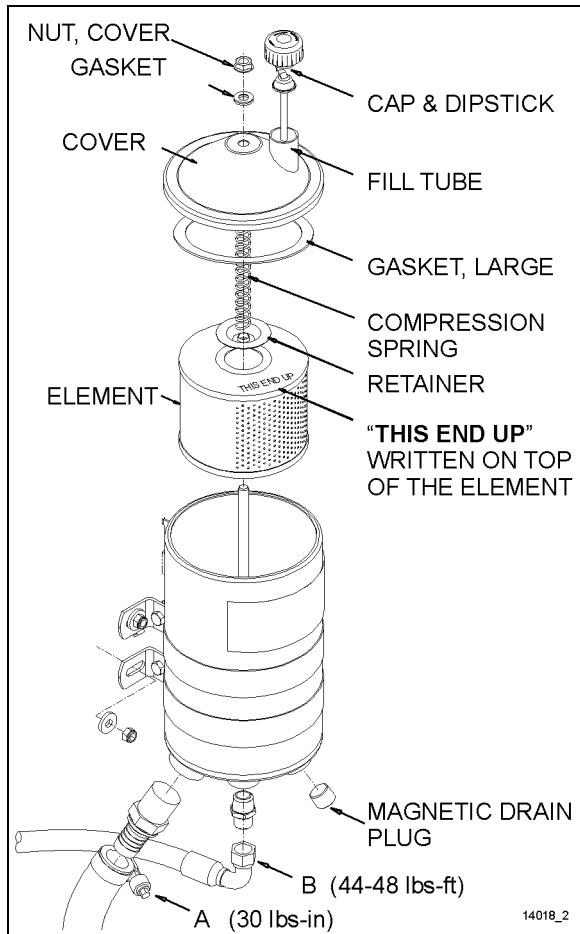


FIGURE 25: POWER STEERING FLUID RESERVOIR

13.3.1 Filter Element Replacement

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

1. Place an appropriate container under the drain plug and unscrew the **drain plug**. Drain the reservoir.
2. To protect the fluid from being soiled by particles dripping from the old filter element, loosen clamp **A** and disconnect suction hose. Use the container to recover the fluid that will flow through the fitting.
3. Disconnect fitting **B** and allow the fluid to drip in the container.
4. Remove the reservoir cover and the gasket (Figure 25). Remove the retaining spring and the element retainer.
5. Remove the old filter element very carefully. Allow the reservoir to drain completely.



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.

6. Clean the large gasket and the mating surfaces on the cover and reservoir.
7. Clean the magnetic drain plug and reinstall (apply Loctite 567 sealant on threads).
8. Connect fitting **B** (44-48 lbs-ft).
9. Reinstall the suction hose and tighten clamp **A** (30 lbs-inch).
10. Fit a new filter element.
11. Pass the reservoir threaded rod through the element and install the element with the element's writing "THIS END UP" on top.
12. Pass the reservoir threaded rod through the retainer and rest the retainer on top of the element, followed by the compression spring.
13. Properly place the large gasket in the cover. Install the cover, making sure the gasket is properly placed.
14. Clean the small gasket and install with the rubber side against the cover. Screw and tighten the nut as necessary to prevent leaks.
15. Top up with fresh power steering fluid through the fill tube to "FULL" mark on proper dipstick side depending on fluid temperature.

13.4 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 (44mm) 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.

13.5 STEERING STABILIZER CYLINDER (DAMPER)

The steering damper is located on R.H. side, aft of front axle (Figure 26).

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.

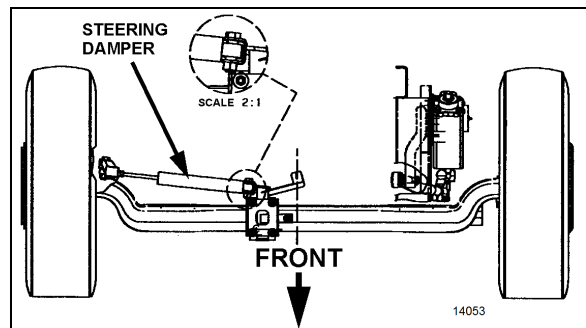


FIGURE 26: STEERING STABILIZER (DAMPER)

13.6 DRAG LINK MAINTENANCE

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

13.6.1 IFS Drag Link

Lubrication Fittings

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

Re-charge ball joint until grease can be seen escaping from socket. On ball joints fitted with a rubber boot, do not add 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 27 shows approximate location of steering lubrication fittings.



MAINTENANCE

Drag Link (with Independent Front Suspension)

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.



MAINTENANCE

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

The lubrication fittings (see Figure 27) 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 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).

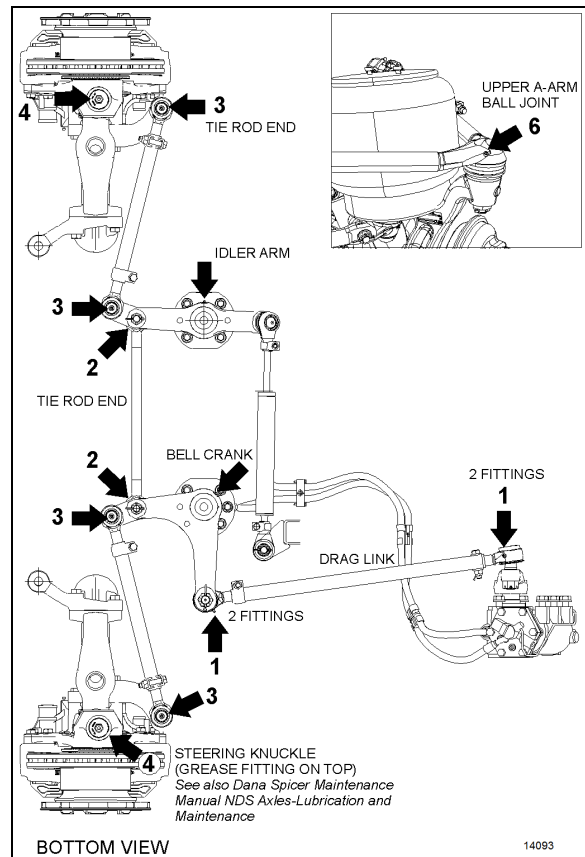


FIGURE 27: LUBRICATION FITTINGS LOCATION

13.6.2 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.

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.

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.

CAUTION

Do not re-use clamp hardware.

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

REPLACE NUT AND BOLT
EACH TIME THEY ARE UNSCREWED

14083

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

FIGURE 28: I-BEAM FRONT AXLE DRAG LINK

13.7 FRONT I-BEAM AXLE TIE ROD

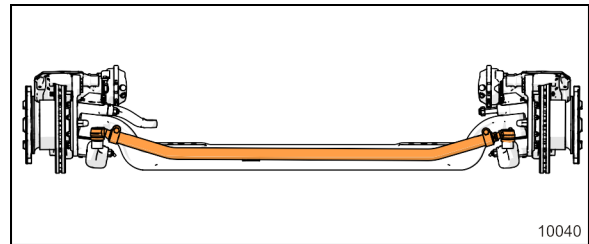


FIGURE 29: TIE ROD

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

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

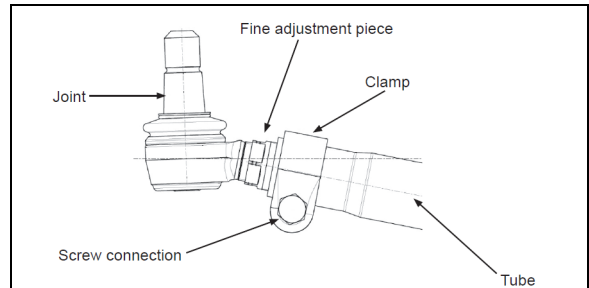


FIGURE 30: TIE ROD COMPONENTS

For additional details, refer to supplier information:

TRW_Front_Axle_Steering_Bar_Service_Information_XSZ143

MAINTENANCE

Inspect tie rod once a year.

13.7.1 Tube inspection

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

13.7.2 Ball joint inspection

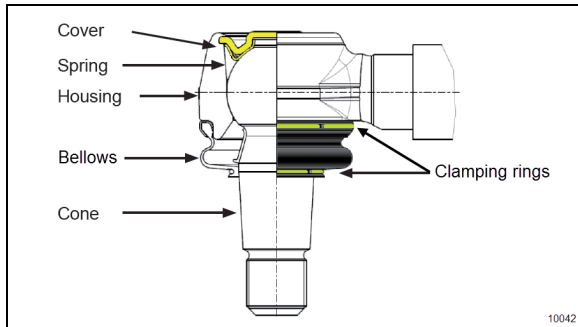


FIGURE 31 TIE ROD BALL JOINT

To inspect joint wear and play, turn the wheels alternately left and right until the wheels move. Perform this with the axle loaded normally. Replace the joint if the movement of the ball stud exceeds **0.5mm axially** in the housing . In doubt, measure the distance with a caliper (Figure 32).

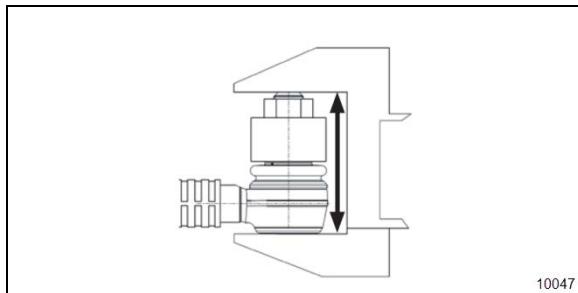


FIGURE 32: MEASURING AXIAL PLAY, TIE ROD JOINTS

13.7.3 Fine adjustment sleeve inspection

Turn the wheels alternately left and right while keeping a finger on the threads to feel any movement in the threads. (Figure 33). If there is too much play in the sleeve, replace the tie rod.

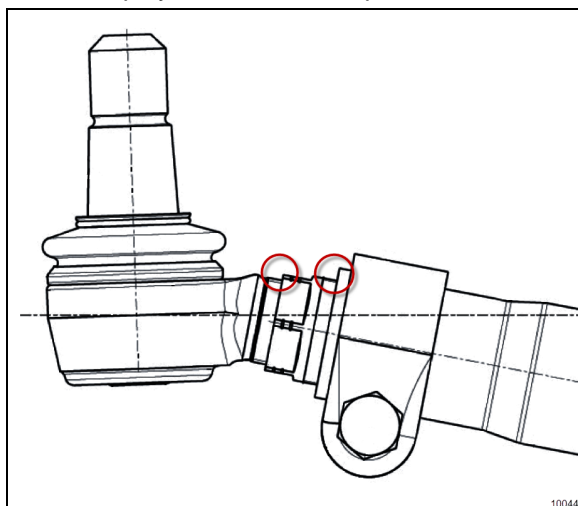


FIGURE 33:

13.7.4 Tie rod ball joint inspection for corrosion

MAINTENANCE

Inspect tie rod ball joints for corrosion once a year.

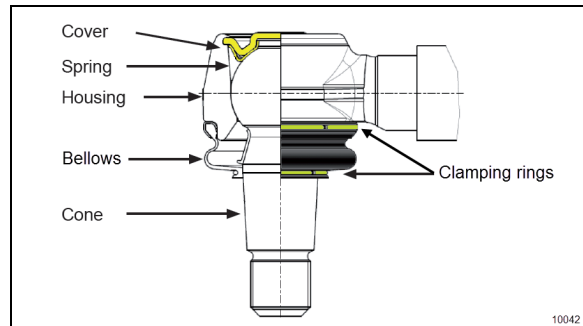


FIGURE 34: TIE ROD BALL JOINT CONSTRUCTION

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.

13.8 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.



MAINTENANCE

Inspect drag link joints for corrosion once a year.

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.

13.9 STRAIGHT BODY TYPE BALL JOINT

This type includes ball joints where the threaded shank is slightly bent like those that are found on the tie rod and draglink.

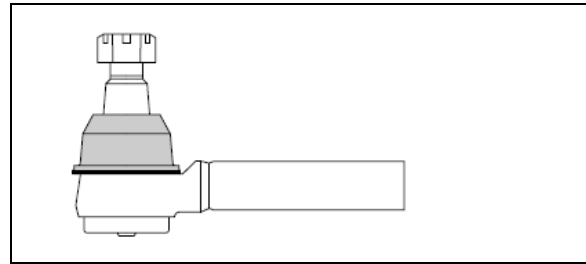


FIGURE 35: STRAIGHT BODY TYPE BALL JOINT

13.9.1 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.

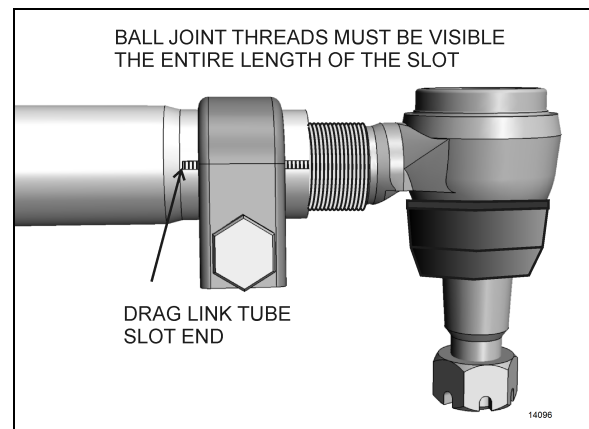


FIGURE 36: ADEQUATE CLAMPING CONDITION

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.

13.9.2 Straight Body Type Ball Joint End Play and Looseness

What creates movement in sockets?

SECTION 14: STEERING

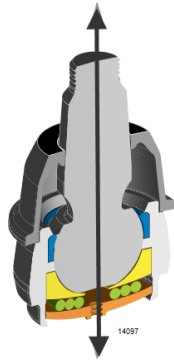
In each straight body type ball joints, the compressive force of the spring creates resistive torque by applying a constant load on the bearing and stud.

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.




CAUTION

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.

14. 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 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>

15. FRONT WHEEL ALIGNMENT


15.1 INDEPENDENT FRONT SUSPENSION ALIGNMENT

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

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

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

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

	<h3>WARNING</h3>
<p>During alignment, both camber and caster among other angles are adjusted. When adjusting these, we install or remove shims at the IFS lower A-arms. After performing alignment, make sure that the following is done:</p> <ul style="list-style-type: none"> • Installing a new lock nut after all shims are finalized. • Torque replaced nuts as per Torque Table. • 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. 	

15.1.1 Alignment Terminology

Wheel Camber: Camber is the number of degrees the top of the wheel is tilted inward or outward from a true vertical (Figure 38).

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 38).

Kingpin Inclination: The inclination of the kingpin from vertical toward the center of the vehicle at the top and outward at the bottom (B, Figure 38).

Front Axle Caster: The inclination of the kingpin from vertical in the fore and aft direction (C, Figure 38).

15.1.2 Front End Inspection

Before checking front end alignment, make the following inspection:

1. Check that the vehicle is at normal ride height (see paragraph 3.18 "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 kingpins for looseness.
7. 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).

15.1.3 Front Wheel Camber

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

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

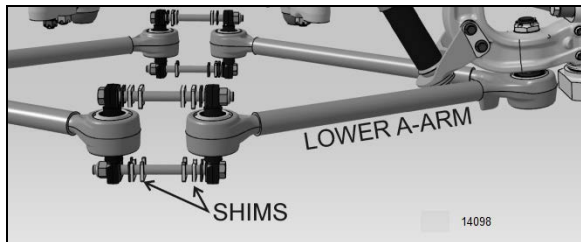


FIGURE 37: SHIMS AT THE LOWER A-ARMS

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

NOTE

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

Shim the lower A-arm to adjust camber (Figure 34). If the kingpin inclination is incorrect, the wheel kingpin assembly may be bent and therefore should be replaced.

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

NOTE

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



CAUTION

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

15.1.4 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 measurement specified in step 5 under paragraph "Toe-in Check".
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 35.

NOTE

Use only tie rods to adjust toe-in.

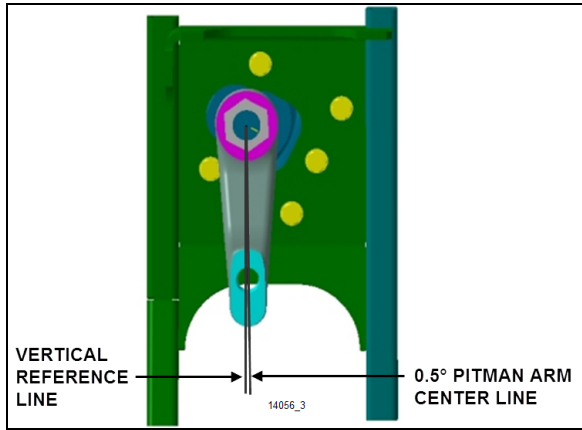


FIGURE 38: IFS PITMAN ARM ALIGNMENT

15.1.5 Front Wheel Caster

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

Caster variations may be caused by bent upper suspension A-arm, lower suspension A-arm, or kingpin housing. Caster should be adjusted with shims. Precision instruments should be used to measure caster. Shim bell crank and idler arm to adjust caster (Figure 38).

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°.

15.1.6 Major Damage

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

15.1.7 Alignment Specifications

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°.

X3-45 VIP INDEPENDENT FRONT SUSPENSION						
Load	Minimum value		Nominal value		Maximum value	
	Non-converted	Converted	Non-converted	Converted	Non-converted	Converted
Right camber	0.20°	-0.20°	0.30°	0°	0.50°	0.20°
Left camber	0.20°	-0.20°	0.30°	0°	0.50°	0.20°
Right caster	2.55°		2.8°		3.05°	
Left caster	2.55°		2.8°		3.05°	
Total toe	0.02°	0.04°	0.04°	0.06°	0.06°	0.08°

SECTION 14: STEERING

X3-45 Coaches WITH INDEPENDENT FRONT SUSPENSION			
	Minimum value	Nominal value	Maximum value
Right camber	0.0°	0.150°	0.30°
Left camber	0.0°	0.150°	0.30°
Right caster	2.35°	2.6°	2.85°
Left caster	2.35°	2.6°	2.85°
Total toe-in	0.04°	0.06°	0.08°

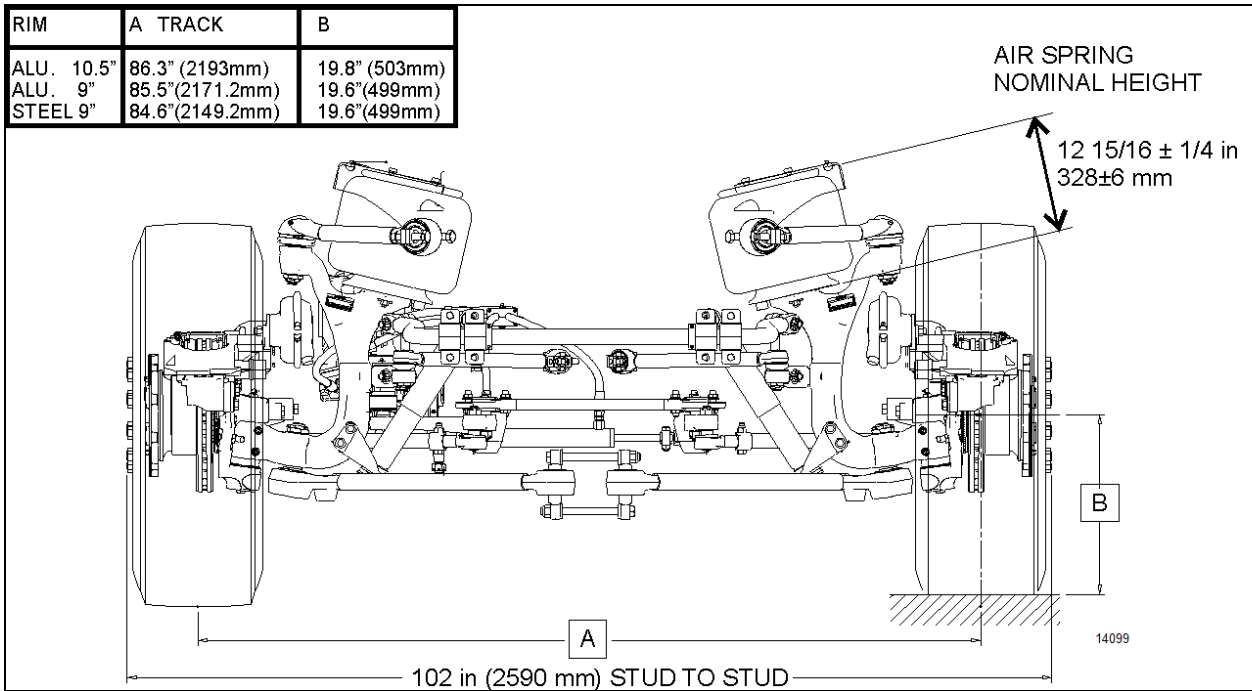


FIGURE 39: IFS NOMINAL DIMENSIONS

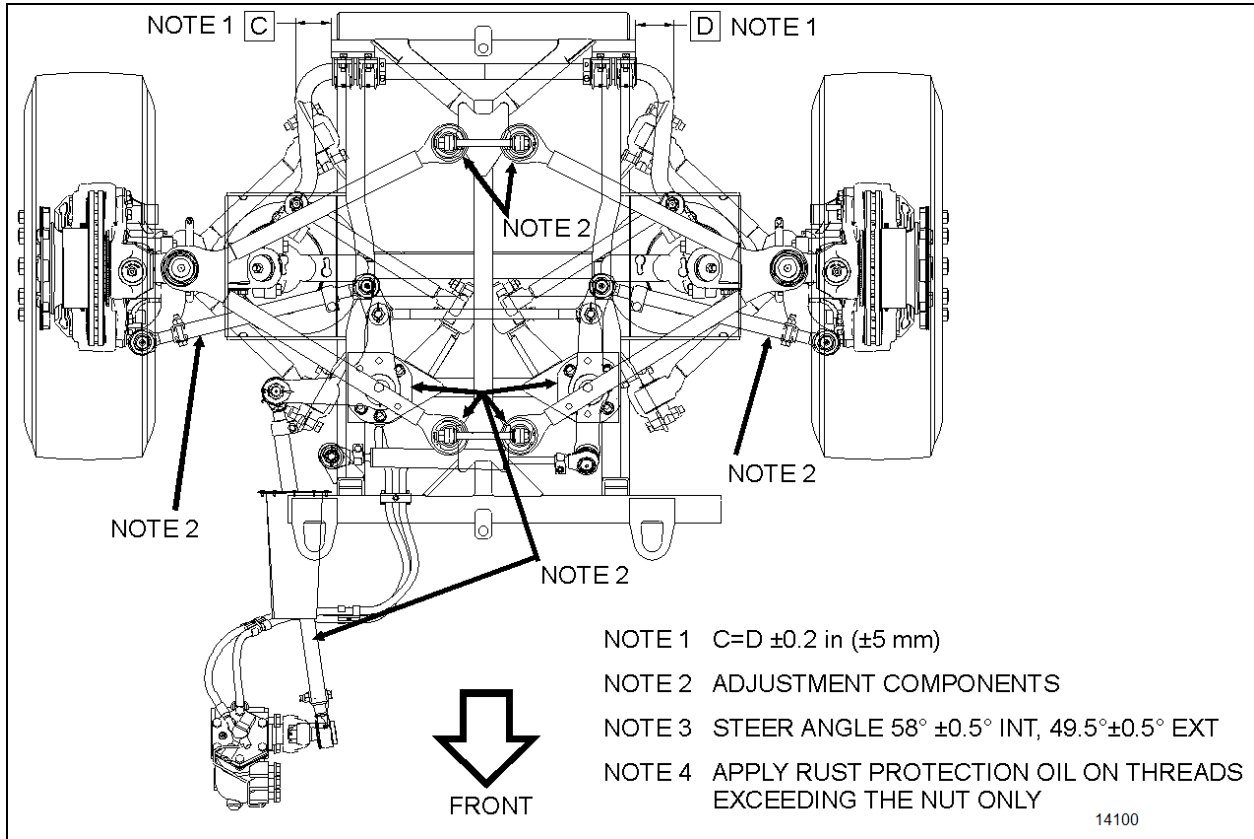


FIGURE 40: NOTE 2 INDICATES WHERE ADJUSTMENT MAY BE PERFORMED AT IFS ALIGNMENT

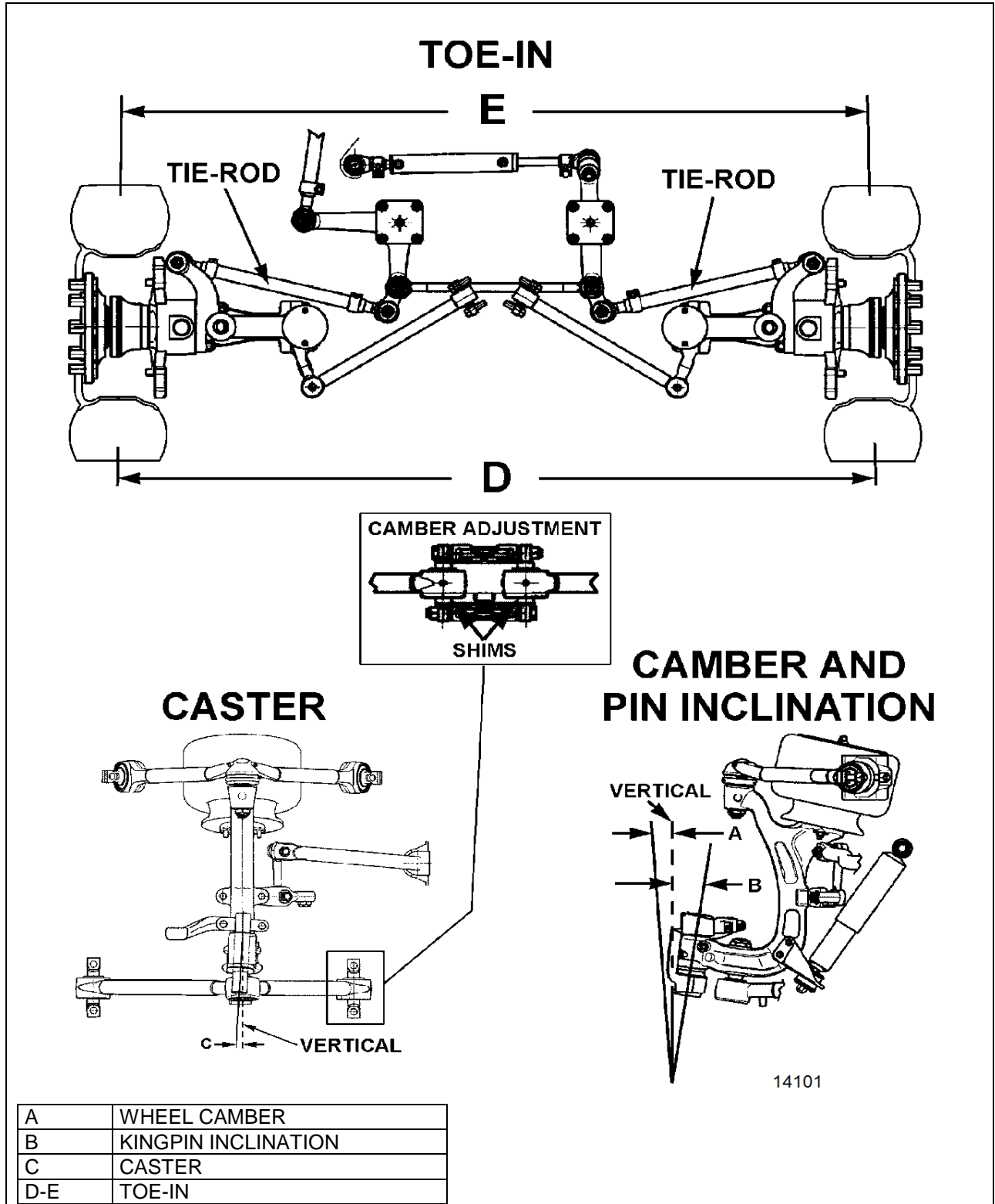


FIGURE 41: FRONT END ALIGNMENT DIAGRAM

16051

15.2 I-BEAM AXLE - FRONT WHEEL ALIGNMENT

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.

15.2.1 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.

15.2.2 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 15.2.1, "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.

15.2.3 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 15.2.1, "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 gearbox steering limiter. See paragraph 15.2.7 "Hydraulic Stop" 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.

15.2.4 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:

15.2.5 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 13.5)

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.

15.2.6 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.

15.2.7 Hydraulic Stop

NOTE

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

Refer to "ZF-SERVOCOM Repair Manual" found on your Technical Publications USB flash drive, under heading *Setting and Functional Test*

15.2.8 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 39).

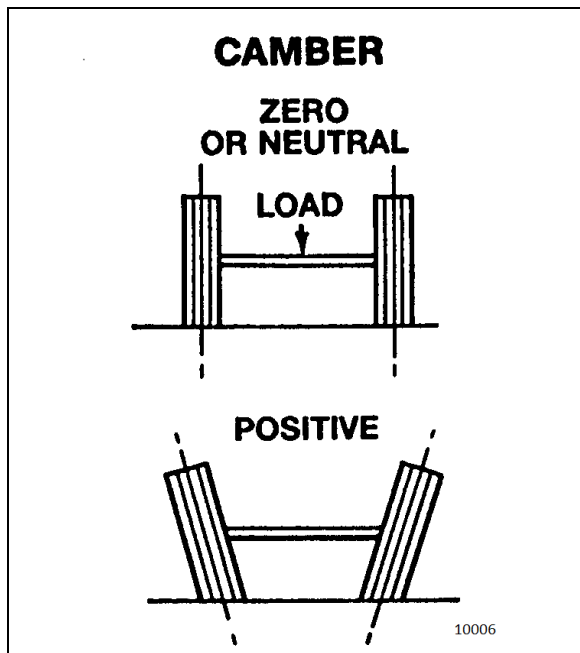


FIGURE 42: CAMBER

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.

15.3 CAMBER CHECK

For camber specifications, refer to paragraph 15.3.3 in this section

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).

15.3.1 Front Axle Caster

For caster specifications, refer to paragraph 15.3.3 in this section.

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 40). 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).

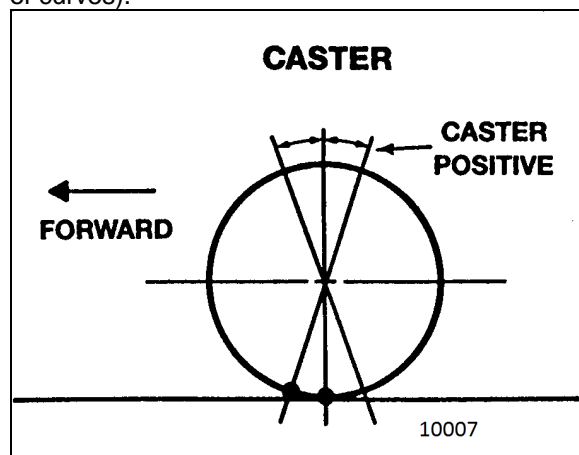


FIGURE 43: CASTER

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.

15.4 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 5).

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

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

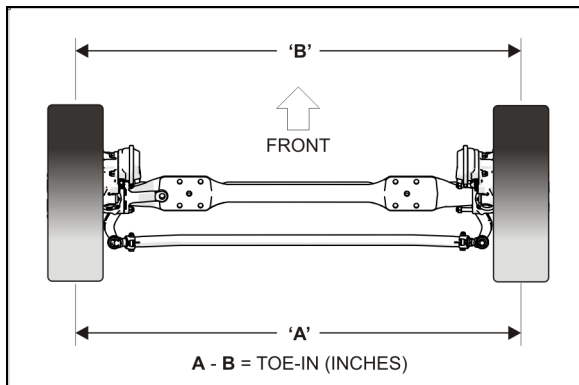


FIGURE 44: TOE-IN MEASUREMENT

For toe-in specifications, refer to the FRONT WHEEL ALIGNMENT SPECIFICATIONS table in this section.

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.

15.4.1 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 8) until the specified toe-in measurement is obtained.
 - c. Tighten the pinch bolt nuts

TORQUE: 107-129 lb-ft (145-175 Nm)

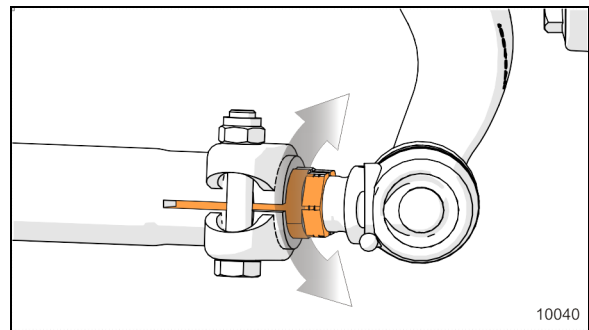


FIGURE 45: FINE ADJUSTER SLEEVE ON TIE ROD

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:

FRONT WHEEL ALIGNMENT SPECIFICATIONS WITH I-BEAM AXLE			
Front Wheel Alignment	Minimal	Nominal	Maximal
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

16. TROUBLESHOOTING

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

17. TORQUE SPECIFICATIONS

The torque specifications applicable to the front axle steering are grouped with information regarding the front suspension. Please refer to Section 16: SUSPENSION of this manual.

18. SPECIFICATIONS**Power Steering Gear**

MakeZF/ROBERT BOSCH-SERVOCOMTRONIC
 TypeSpeed Sensitive
 F.E.W..... 16,600 lbs (7 545 kg)
 Pressure rating2,175 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

MakeZF/ROBERT BOSCH--SERVOCOM
 F.E.W..... 16,600 lbs (7 545 kg)
 Pressure rating2,175 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 (with IFS)

MakeZF/ROBERT BOSCH -SERVOCOM
 Type..... 8098
 F.E.W..... 19,000 lbs (8 618 kg)
 Pressure rating2,320 psi (160 Bar)

Power Steering Reservoir

Oil capacity4 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)



PREVOST

**INFORMATION
DE
MAINTENANCE**

IM19-05A

DATE :	Février 2019	SECTION :	14 DIRECTION
SUJET :	Ajustement de la barre de direction 660865 et 660699		

Révision: A

Ajout des autocars de banlieue et véh. construits aux É-U 2019-02-28

REMARQUE IMPORTANTE

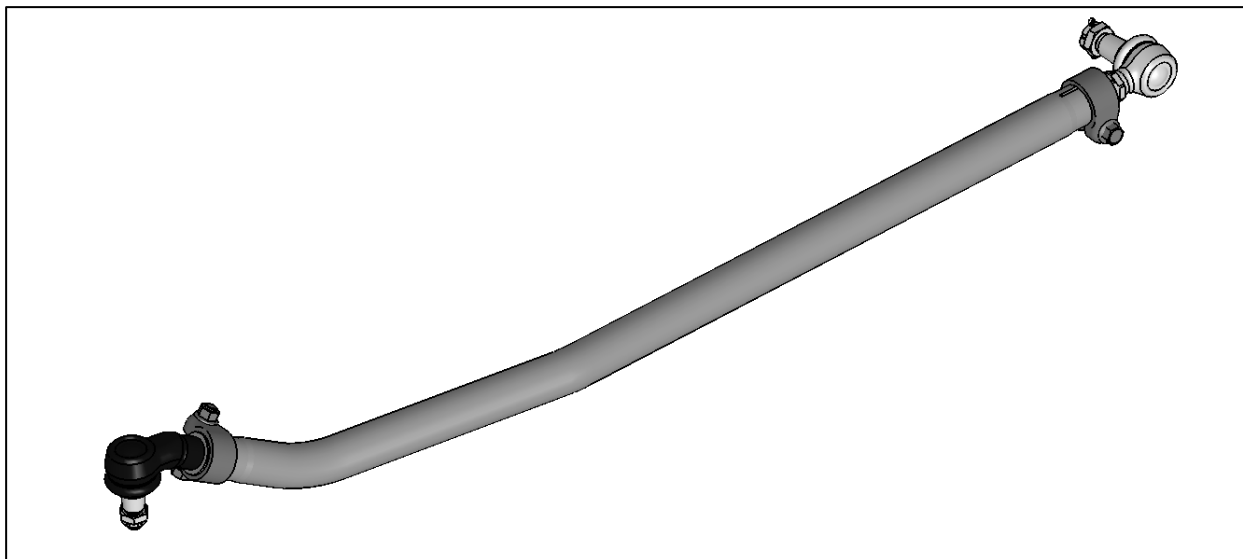
Cette modification est recommandée par PrevoSt dans le but d'améliorer les performances de votre véhicule. Notez qu'aucun remboursement ne sera accordé pour l'exécution de cette modification.

APPLICATION

Modèle	VIN	
Autocars H3-41, H3-45 Année modèle : 2014 -	Du 2PCH3349X <u>EC712505</u> jusqu'au	
Autocars X3-45 Année modèle : 2014 -	Construit aux États-Unis : du 4RKG33495 <u>F9737000</u> jusqu'au	
	Construit au Canada : du 2PCG33497 <u>EC735526</u> jusqu'au ...	
Autocars de banlieue X3-45 Année modèle : 2017 -	Construit aux États-Unis : du 4RKJ33498 <u>H9737386</u> jusqu'au	
	Construit au Canada : du 2PCJ33493 <u>JC736317</u> jusqu'au ...	

DESCRIPTION

Pour les autocars de la série H équipés d'essieux rigides, suivre ces instructions pour ajuster la longueur de la barre de direction. Valide pour les années-modèle 2014 et suivantes.



MATÉRIEL

Série H :

Pièce No	Description	Qté
660865	Barre de direction, Série H	1
502104	Goupille fendue 5/32 X 2	1

Série X :

Pièce No	Description	Qté
660699	Barre de direction, Série H	1
502104	Goupille fendue 5/32 X 2	1

Commandez les pièces suivantes :

Pièce No	Description	Qté
660018	Bride avec vis et écrou	1

REMARQUE

Le matériel peut être commandé selon la pratique habituelle.

MARCHE À SUIVRE



AVERTISSEMENT

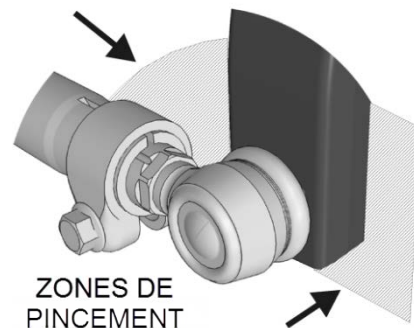
RESPECTER LES VALEURS DE COUPLE INDIQUÉES ET SUIVRE LES INDICATIONS D'ASSEMBLAGE POUR ASSURER LA SÉCURITÉ DU VÉHICULE.



DANGER DE PINCEMENT

Les mains et les doigts doivent rester à l'écart des zones de pincement autour de la bielle pendante.

Les zones de pincement sont situées entre la bielle pendante et le collier de serrage, et entre l'avant de la bielle pendante et la structure du véhicule.



ENLÈVEMENT DE LA BARRE DE DIRECTION EXISTANTE



ATTENTION

Le chauffage des organes pour contribuer au démontage n'est pas autorisé cela peut endommager les organes d'essieu et les tringleries de direction.



ATTENTION

Ne pas frapper (marteler) la bielle pendante sur l'arbre pendant l'installation ou le retrait, car ceci risque d'endommager le boîtier de direction.

1. Soulever le véhicule par les roues en utilisant des élévateurs à colonnes mobiles. Cette méthode préviendra un changement de l'orientation des joints et permettra de conserver les positions relatives des différentes composantes de la direction, c'est à dire la bielle pendante et le levier de direction.
2. Enlever la goupille fendue et l'écrou de la rotule de barre de direction à la bielle pendante.
3. Démontez la barre de direction de la bielle pendante en utilisant des extracteurs à mâchoire type vis de pression.
4. Enlever la goupille fendue et l'écrou de la rotule coudée de la barre de direction au levier de direction puis démonter la direction

AJUSTEMENT DE LA LONGUEUR DE LA BARRE DE DIRECTION AU JOINT COUDÉ.

5. Ajuster la longueur de la barre de direction. La placer entre la bielle pendante et le levier de direction. Si la longueur n'est pas adéquate, elle doit être ajustée. Ajuster la longueur de la barre de direction en utilisant la dimension « A » et les instructions ci-dessous ou utiliser la barre de direction retirée comme référence.



FIGURE 1

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

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

6. Visser le joint coudé complètement dans la barre de direction.



FIGURE 2

7. Dévisser le joint coudé mais pas plus d'un tour afin d'orienter la tige conique vers le bas tel qu'indiqué à la (FIGURE 3).

Ce sera la position de référence pour la prochaine étape.



FIGURE 3

8. Ensuite, dévisser le joint coudé.

Série H : de **cinq (5)** tours à partir de la position de référence.


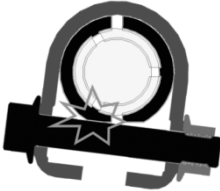
Série X : de **un (1)** tour à partir de la position de référence.

La tige conique doit pointer vers le bas tel qu'indiqué à la (FIGURE 4).



FIGURE 4

9. Pour prévenir des interférences entre les vis de colliers de serrage et les autres composantes de la direction, la vis doit être orientée tel qu'indiqué à la FIGURE 6. **Serrer l'écrou à 118-133 lb-pi.**

	ATTENTION
Ne pas réutiliser la quincaillerie du collier de serrage.	
Le boulon <u>et</u> l'écrou doivent être remplacés chaque fois qu'ils sont dévissés. En montant le collier de serrage, s'assurer que le boulon <u>ne touche pas</u> le tube de la barre de direction.	
	

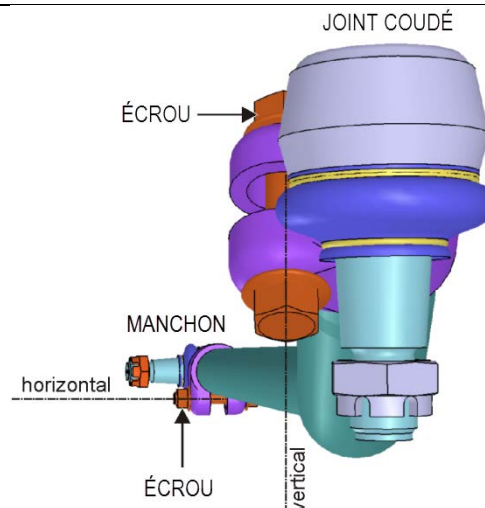


FIGURE 5: NOTEZ L'ORIENTATION VERTICALE DE LA VIS AU JOINT COUDÉ ET DE QUEL CÔTÉ EST PLACÉ L'ÉCROU.

PARAMÈTRES D'AJUSTEMENT DU MANCHON DE RÉGLAGE

10. L'extrémité avant de la barre de direction est équipée d'un manchon de réglage qui possède des filetages interne et externe à droite et à gauche.

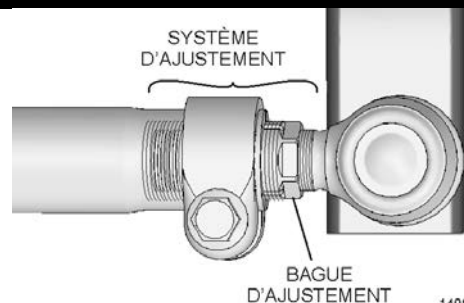


FIGURE 6

11. Le réglage fin de la longueur de la barre de direction doit être réalisé exclusivement en faisant tourner le manchon de réglage en empêchant la rotation du tube.

Le manchon devrait être la seule pièce qui tourne.

- Pour allonger, tourner le manchon dans le sens horaire.
- Pour raccourcir, tourner en sens anti horaire.

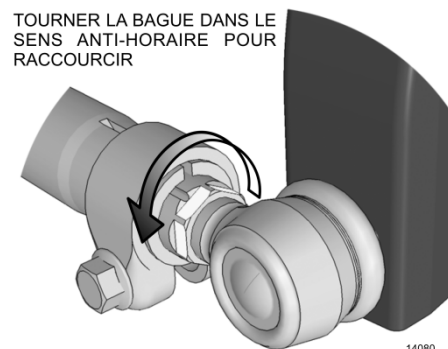


FIGURE 7

LIMITES GÉNÉRALES DU MANCHON DE RÉGLAGE

Ne pas dépasser les longueurs de filet et valeurs maximales indiquées.

- Dimension **V** max: 5/8" (16mm) ± 1 pas de filetage
- Dimension **W** max: 5/8" (16mm) ± 1 pas de filetage
- Dimension **X** max: 1" (25 mm)
- Les dimensions **V** et **W** doivent être égales : $V/W = 1$

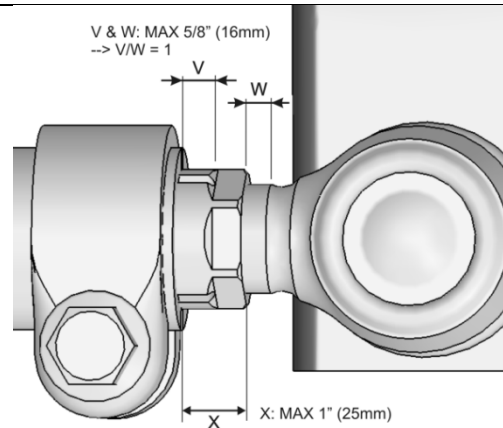


FIGURE 8

AJUSTEMENT DU MANCHON

12. Ajuster le manchon aux valeurs de la FIGURE 10.

$$10/32" = 8\text{mm}$$

13. Lorsque l'ajustement est complété, serrer le collet. Pour prévenir des interférences entre les vis de colliers de serrage et les autres composantes de la direction, la vis doit être orientée tel qu'indiqué à la FIGURE 11. **Serrer l'écrou à 118-133 lb-pi.**

ATTENTION

Ne pas réutiliser la quincaillerie du collier de serrage.

Le boulon et l'écrou doivent être remplacés chaque fois qu'ils sont dévissés. En montant le collier de serrage, s'assurer que le boulon ne touche pas le tube de la barre de direction.

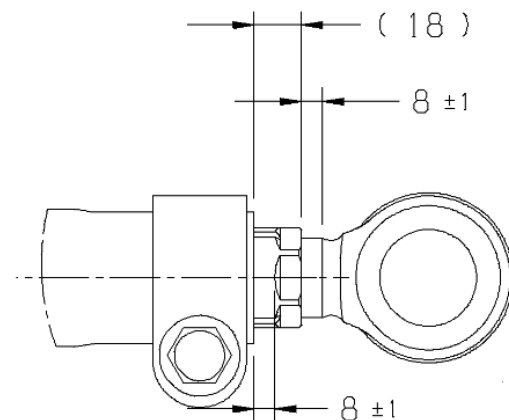


FIGURE 9

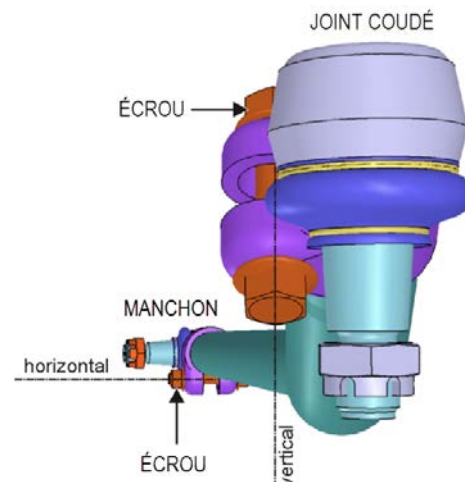
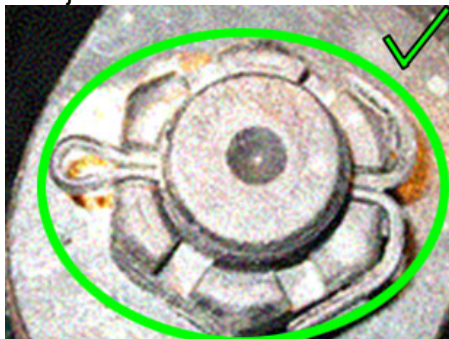
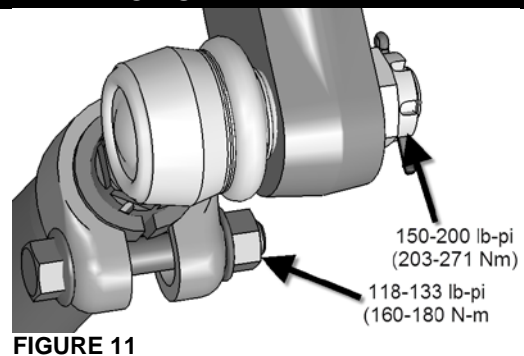


FIGURE 10: NOTEZ L'ORIENTATION VERTICALE DE LA VIS AU JOINT COUDÉ ET DE QUEL COTÉ EST PLACÉ L'ÉCROU.

INSTALLATION DE LA BARRE DE DIRECTION

14. Installer la barre de direction.
15. Serrer les écrous à créneaux aux deux extrémités à **150-200 lb-pi**.
16. Installer la goupille fendue No 502104 et la plier pour fixer l'écrou (Voir l'exemple ci-dessous).
17. Appliquer une petite quantité de composé antigrippant sur les filets exposés en guise de protection antirouille. Éviter d'en mettre sur le soufflet de joint à rotule.



18. S'assurer qu'il n'y a pas de coincement ou d'interférence avec la structure du véhicule en tournant les roues d'un extrême à l'autre. Jeu minimal : 1/4" (6mm)
19. Vérifier le jeu entre le pneu et la barre de direction en tournant les roues vers la droite. Jeu minimal : 3/8" (9.5mm).

DISPOSITION DES PIÈCES

Rebuter selon les règlements environnementaux applicables (mun./prov./féd.).

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