SECTION 04-101.01
ZF FRONT AXLE

GENERAL DESCRIPTION

See Figures 1 and 2.

The ZF RL-85 A is a forged steel I-beam type front axle. The axle is equipped with disk brakes and ball joints for the installation of the steering system tie rods.

The axle assembly is made up of the following main components: the pneumatic disk brakes, the hubs, the steering knuckles, the steering knuckle carriers, the tie rod, and the supports for the front shock absorbers and for the upper and lower radius rods.

NOTE:
See section 04-701: RADIUS RODS and section 04-301: SHOCK ABSORBERS for additional details on these components.

The identification plate is located in the front on the central part of the axle. It contains useful information, which, combined with the information found in the traceability report and the parts manual, facilitates the order of replacement parts.

MAINTENANCE

GENERAL INSPECTION

The following inspections must be performed at regular intervals, which is determined by the conditions under which the bus operates.

It is very important that all axle components be carefully inspected before they are reinstalled. Make sure that parts are not worn or damaged. If they are, replace them. Immediate replacement of worn or damaged parts will prevent premature failure of the axle.

CAUTION:

If play is noticed in any one of the parts of the steering mechanism, check the entire lubricated mechanism.

Parts can be removed from the axle without removing the axle from the bus. When general maintenance is necessary, the axle may be removed for convenience, even though components are accessible for maintenance with the axle in place.

Figure 1 - Front Axle, Ready for Installation on the Bus
Figure 2 - Exploded View of the ZF RL-85 A Front Axle
1. Examine the pneumatic suspension, including the air springs (7) and their components. If the air springs are damaged, they must be replaced. For additional information, see section 04: AIR SPRINGS AND FRONT SUSPENSION in this manual.

2. Verify if the radius rods (2 and 3) are worn or damaged and replace them if necessary. For additional information, see section 04: RADIUS RODS of this manual.

3. Verify if the drag link ball joints are worn or damaged, and replace if necessary.

4. Verify the amount of play in the drag link ball joints and replace if excessive. Measure the torque necessary to turn the ball joint stud and if this is less than 5 lb-in (0.56 N•m), replace the joint.

5. Examine all the nuts, the bolted assemblies, the axle installation, as well as the complete steering system. Ensure that all torque values are according to specifications.

6. If it is difficult to turn the steering or if there is noticeably abnormal wear of the tires, verify the front axle geometry according to the procedure indicated in section 04: AXLE ALIGNMENT of this manual.

7. Check the settings of the stop bolts and adjust them if necessary, according to the procedure described under the STOP BOLTS SETTINGS heading in section 04: AXLE ALIGNMENT, ZF of this manual.

8. Lubricate the front axle components as indicated in section 19: LUBRICATION in this manual.

9. When greasing the front axle components, verify the condition of the waterproof seals on the steering knuckle carriers (see the ZF RL-85 A Front Axle manual), of the radius rods (2 and 3) and of the drag links. Replace the seals if they are damaged or missing.

10. Examine the steering knuckle carriers and the swivel axis periodically to ensure that all settings from top to bottom are within the tolerance limits prescribed by the manufacturer. See Figure 3. This will prevent excessive knocking and eventual damage to the thrust bearing.

11. Inspect the I-beam section (central section) of the axle body for any cracks.

**STEERING KNUCKLE ASSEMBLY**

*NOTE:

The king pin should be solid in the axle beam. If there is movement between the king pin and axle beam, the axle beam must be changed. The steering knuckle pivots on the king pin with needle bearing on the top and a bronze bush on the bottom. It is most likely the bronze bush would wear first. Therefore, direct attention to the bottom connection point.

The steering knuckle is shimmed to the axle beam and the up and down movement of the steering knuckle should be between 0.001968 in. (0.05 mm) and 0.005905 in. (0.15 mm).

For more details, see Figure 3 and the ZF FRONT/TRAILING AXLE RL-85 A manual.

**LUBRICATION**

*NOTE:

See section 19: FLUIDS AND LUBRICANTS and the ZF FRONT/TRAILING AXLE RL-85 A manual for the greasing intervals and the recommended lubricant type.
HUB ASSEMBLY

NOTE:
See Figure 4 and the ZF FRONT/TRAILING AXLE RL-85 A manual.

BRAKE ASSEMBLY

NOTE:
See Figure 5 and the ZF REPAIR MANUAL - PNEUMATIC DISK BRAKE.
For adjustment of the linkage, see the ZF MAINTENANCE AND SERVICING MANUAL 410 X 220 Z-G.

LUBRICATION

NOTE:
See section 19: FLUIDS AND LUBRICANTS and the ZF FRONT/TRAILING AXLE RL-85 A manual for the greasing intervals and the recommended lubricant type.

TIE ROD

The tie rod is made of three parts: one tube and two end sockets. The tube has a straight thread at one end and a left-handed thread at the other end. Each end of the tie rod has a thread matching the one located on the end of the tube. Therefore, they are not interchangeable. The tie rod ends are secured to the tube by a clamping bolt, a nut and a clamp.

REMOVAL
1. Position the wheels in a straight-line position.
2. Loosen the clamps at both ends of the tie rod.
3. Disconnect the tie rod from the assembly.

INSTALLATION
1. Install the collar, the bolt and the locknut at each extremity of the rod.
2. Rotate the center of the tube of the tie rod until the proper toe-in measurements are reached. See section 04: AXLE ALIGNMENT of this manual.
3. Tighten the bolt of each collar until a torque value of 58 ± 3 lb-ft (79 ± 4 N•m) is reached.

MAINTENANCE
Curved, twisted or misadjusted parts in the linkage between the power steering gearbox and the front end badly affect the operation of the steering system. Whenever repairing, replacing or adjusting the steering linkage, check the steering alignment and the front wheel adjustment as indicated in section 04: AXLE ALIGNMENT of this manual.

TIE ROD ENDS

INSPECTION
1. Make sure the boot completely covers the ball joint of the socket end with no cracks or tears. If the boot is damaged, the entire socket end must be replaced. See Figure 6.
2. Make sure the slotted nut is sufficiently tightened and the cotter pin is correctly installed. If the cotter pin is missing, the slotted nut could become loose and the steering will suffer.

A = 45 MM, DISK THICKNESS IN NEW CONDITION.
B = 37 MM, DISK THICKNESS WORN TO THE MINIMUM THICKNESS; THE DISK MUST BE REPLACED.
C = 30 MM, OVERALL THICKNESS OF NEW PAD.
D = 9 MM, THICKNESS OF BACKPLATE.
E = 2 MM, MINIMUM THICKNESS OF FRICTION MATERIAL; REPLACEMENT REQUIRED.
F = 11 MM, MAXIMUM ALLOWED THICKNESS IN WORN CONDITION FOR BACKPLATE AND FRICTION MATERIAL, REPLACEMENT OF PADS IS NECESSARY.

Figure 5 - Disk and Pad Wear Limits
7. If the cross tubes or clamps are bent, cracked or damaged, replacement is necessary. Do not attempt to repair a cross tube as this could result in damage to the axle.

MAINTENANCE

The tie rod ends are self-adjusting. A certain amount of vertical play is normal and does not indicate undue wear. Lateral play, however, can be an indication of worn parts.

The normal surface wear of the tie rod end sockets leads to an increase in the total height of the assembly. In case of excessive play, the tie rod ends should be replaced.

The slotted nuts of the tie rod should remain tightened. Excessive play could enlarge the ball holes of both the steering and the pitman arm. Overtightening these nuts can drive the balls into the steering or pitman arm, resulting in damage to the dust shields during sharp turns.

Inspect at regular intervals to verify whether the ball pivots are worn or need lubrication.

LUBRICATION

Lubricate the ends of the tie-rod according to the following procedure:
1. Make sure the tires touch the ground.
2. Use a grease gun to lubricate the assembly. Apply the lubricant through grease fittings on assembly.
3. Apply the lubricant until new lubricant comes from the boot.

NOTE:
See section 19: Fluids and lubricants for the recommended intervals.

REPLACEMENT

1. Disconnect the tie rod ends.
2. If the cross tube is being replaced, count the number of exposed threads on the tie rod ends.
3. Loosen the clamp nut and unscrew the tie rod ends.
4. Install new tie rod end or anew cross tube.

NOTE:
Cross tube has right-hand and left-hand threads for corresponding sides of the vehicle.

5. Thread the tie rod end into the cross tube past the tube split. The number of threads exposed from the tube should be equal on both left and right tie rod ends.
6. Tighten the bolt of each collar until a torque value of 58 ±3 lb-ft (79 ±4 N•m) is reached.
7. Install the tie rod end into the knuckles on the steering arm and the pitman arm. Secure with a slotted nut and tighten.
8. Install the cotter pin in the slotted nut and bend the ends to secure. If necessary, tighten the nut until the holes align.
9. Adjust the toe-in.

**NOTE:**

On rods with a rotating clamp, position the clamp with fastener away from the beam.

**AXLE LUBRICATION**

**NOTE:**

See section 19: FLUIDS AND LUBRICANTS and the ZF FRONT/TRAILING AXLE RL-85 A manual for the recommended greasing intervals and lubricant types and for additional details on axle lubrication.

**LUBRICATING THE HUB WITH OIL**

(EARLY MODELS)

**NOTE:**

See Figure 8 and the ZF manual: ZF front axle /3 Axle RL-85 A.

**LUBRICATING THE HUB WITH GREASE**

See Figure 8.

**NOTE:**

The grease must be changed every two years.

1. Raise and secure the bus using the procedures in section 18: HOISTING AND TOWING in this manual.
2. Remove the hub.

**NOTE:**

When removing the hub for greasing, only remove the interior rings (3 and 8) from the steering knuckle carrier. The exterior rings must remain in their position.

3. Remove all the grease in the hub (1) from the bearings, the steering knuckle carrier (6) and on the seals. Clean these components.
4. Check the state and conditions of each bearings.
5. Properly charge each bearing with approximately 2 oz (60 g) of grease.
6. Fill the empty spaces of the hub with approximately 2.5 oz (80 g) of grease.
7. Change the seals (11 and 12) and if necessary the O-ring (13) before replacing the hub, according to the procedures found in the ZF manual.
CLEANING OF PARTS

Use a solvent to clean the polished or machined surfaces. Kerosene or diesel oil may be used.

NOTE:
Do NOT use solvents, hot solutions or alkali solutions carelessly for the cleaning of the components. Serious accidents can occur. To prevent such situations, always refer to the manufacturer’s instructions. Never use gasoline to clean parts, because it may ignite or explode.

Do not clean parts that have polished or machined surfaces in a hot solution containing water, steam, or a strong alkali solution. These solutions may corrode the parts.

Parts having unfinished surfaces can be cleaned with machined parts. These parts can be cleaned in a hot bath containing a weak alkali solution. The parts must stay in the solution until all traces of dirt have been removed.

Parts cleaned in this manner must be dried immediately. Use paper, a rag or compressed air. Never use compressed air to dry bearing components. Do not get any oil on the parts to be reinstalled. Do not get any oil on the drums or brake shoes.

If the parts are to be stored, apply a rust inhibitor on all surfaces. Do not get any on the drums or brake shoes. Wrap parts so that they are protected from rust.

FRONT AXLE REPLACEMENT

REMOVAL

NOTE:
Ensure that nothing interferes with the front axle during the removal process.

See Figure 2.

1. Raise the bus.

NOTE:
See section 18: HOISTING AND TOWING. Follow your internal safety procedure. Use appropriate safety equipment for your protection.

2. Remove the stud support (44) and the stem of the air spring-leveling valve while removing the studs. Pull on the leveling valve stem to empty the air from the air spring (7).

NOTE:
For added security, it is important to empty the air from the air springs before starting any work on the axle.

3. Place supports under the bus in the appropriate places. See section 18: HOISTING AND TOWING in this manual.

4. Disconnect the front brake hoses that pass directly through the bulkhead of the two front sides of the structure.

5. Disconnect the front axle automatic lubrication system hoses up to the injection block, fixed to the structure, near the battery tray.

6. Disconnect the drag link from the axle. See section 07: STEERING MECHANISM in this manual. Ensure that the automatic lubrication system hoses have been completely disconnected.

7. Disconnect the ABS brake sensors, located on the connector in the front suspension valve box. Remove the attachments that affix the hoses of those sensors to the structure.

8. Remove the bolt (22) and washer (21) that attach each of the air springs (7) and hoses to the axle. This is in preparation for the complete removal of the air springs assembly (7, 8, 9 and 10). See section 04: AIR SPRINGS AND FRONT SUSPENSION, in this manual.

9. Disconnect the end of each radius rod (2 and 3) attached to the structure of the bus. See section 04: RADIUS RODS for more details.

10. Disconnect the end of each shock absorber (1) attached to the axle suspension posts (51). See section 04: SHOCK ABSORBERS, SACHS in this manual.

11. Lower the axle until the air springs and the plate assemblies (8 and 9) completely clear the suspension posts (51) and the axle itself clears the structure of the bus. Carefully remove the axle from underneath the bus.

CAUTION:
Unless indicated otherwise, all torque values are indicated in Figure 9, at the end of this section.

INSTALLATION

Perform the REMOVAL procedure mentioned above, but in the reverse order. Respect the following precautions:


**CAUTION:**

Unless indicated otherwise, all torque values are indicated in Figure 9, at the end of this section.

1. Clean all contact surfaces, all connections and all supports. Apply anti-seize grease on each part that has to be tightened prior to installation.

2. Following installation of the axle, ensure that all hoses, tubing, wires, etc. are tightly secured and do not interfere with any moving parts of the axle.

3. If this is a new axle installation, ensure that the wheel rim is correctly fitted at the time of the installation. On request, Nova Bus can provide the necessary specifications for the gauge. It is also important that all cavities and lubrication components are filled with grease, because the automatic lubrication system cannot fulfill this function completely.

4. Verify all air components in order to ensure that there are no leaks.

5. During removal, the radius rods are only disconnected from the structure of the bus. During reinstallation, even if the radius rods and the air springs are positioned correctly, only apply the proper torque values once the axle has been completely installed.

6. At the time of removal of the axle, take note of the location of each radius rod washer, to maintain proper alignment when the axle is being re-installed. Also, see the alignment procedure in section 04: **ZF AXLE ALIGNMENT** for additional information on installation of the axle.

7. It is very important to always ensure correct leveling of the bus after the installation of an axle. See section 04: **AIR SPRINGS AND FRONT SUSPENSION**, in this manual.

8. If necessary, perform the adjustment of the axle stops and the steering valve. See section 04: **ZF AXLE ALIGNMENT** for more information.

9. Test the brakes in a safe location to ensure that they are working correctly, before performing a full road test.

---

**NOTE:**

If, during the road test, the front axle floats or vibrates, check the alignment, the balancing of the wheels/tires and the condition of the shock absorbers.
Figure 9 - Torque Values for the ZF RL-85 A Front Axle