

SECTION 10: FRONT AXLE

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Section 10: FRONT AXLE

1. FRONT AXLE

1.1 DESCRIPTION

The Dana Spicer S84U front axle is of the "Reverse Elliot" type manufactured by Dana Spicer Europe. The front axle consists of a girder section axle bed or beam with stub axles. Each stub axle is carried on a taper kingpin, with a plain phosphor bronze bushing at the top and at the bottom. The unitized hub bearings used on the NDS range of axles, are non-serviceable items. Bearings are pre-adjusted, lubricated and have seals fitted as part of the manufacturing process. The bearings are greased for life and there is no need or facility for re-lubrication. Brakes are manufactured by KNORR-BREMSE. Steering ball joints with hardened balls and rubbing pads incorporate compression springs which automatically take up any wear.

The tie rod simplifies toe-in adjustment. The maximum turning angle is set through stop screws installed on the inner side of the knuckle.

Steering stabilizer (damper) and steering drag link which are mounted on the front axle are described in Section 14; "Steering" of this manual.

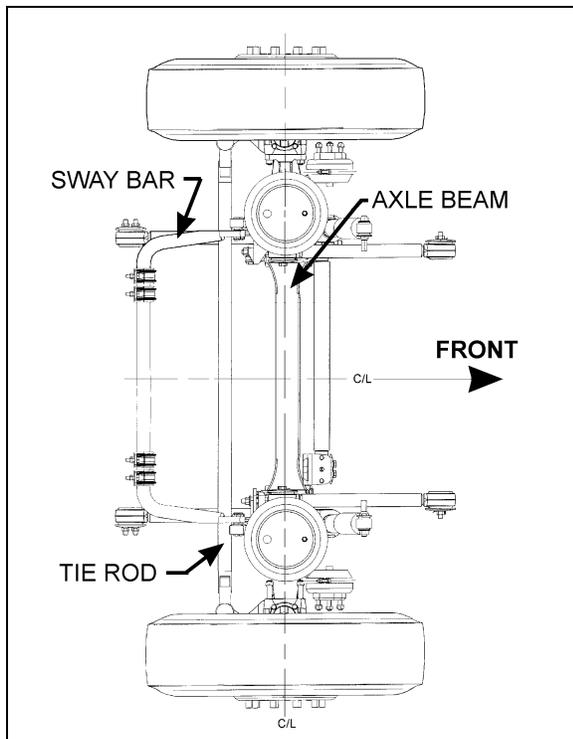


FIGURE 1: FRONT AXLE ASSEMBLY

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2. LUBRICATION



MAINTENANCE

Knuckle pins are provided with grease fittings for pressure lubrication. These grease fittings should be serviced every 6,250 miles (10 000 km) or every six months whichever comes first.

Good quality lithium-base roller bearing mineral grease NLGI No.1 and 2 like Shell Retinax LX are recommended.

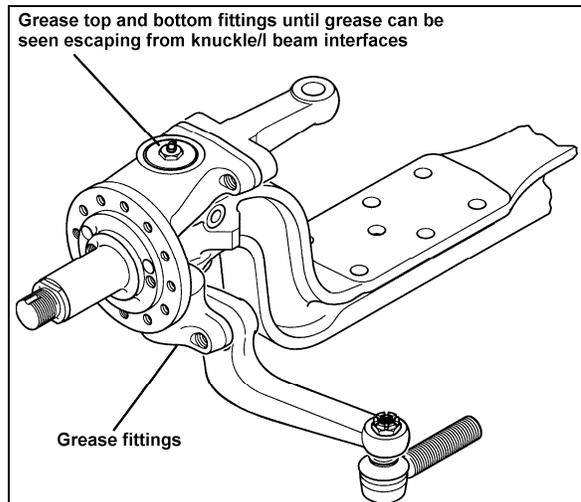
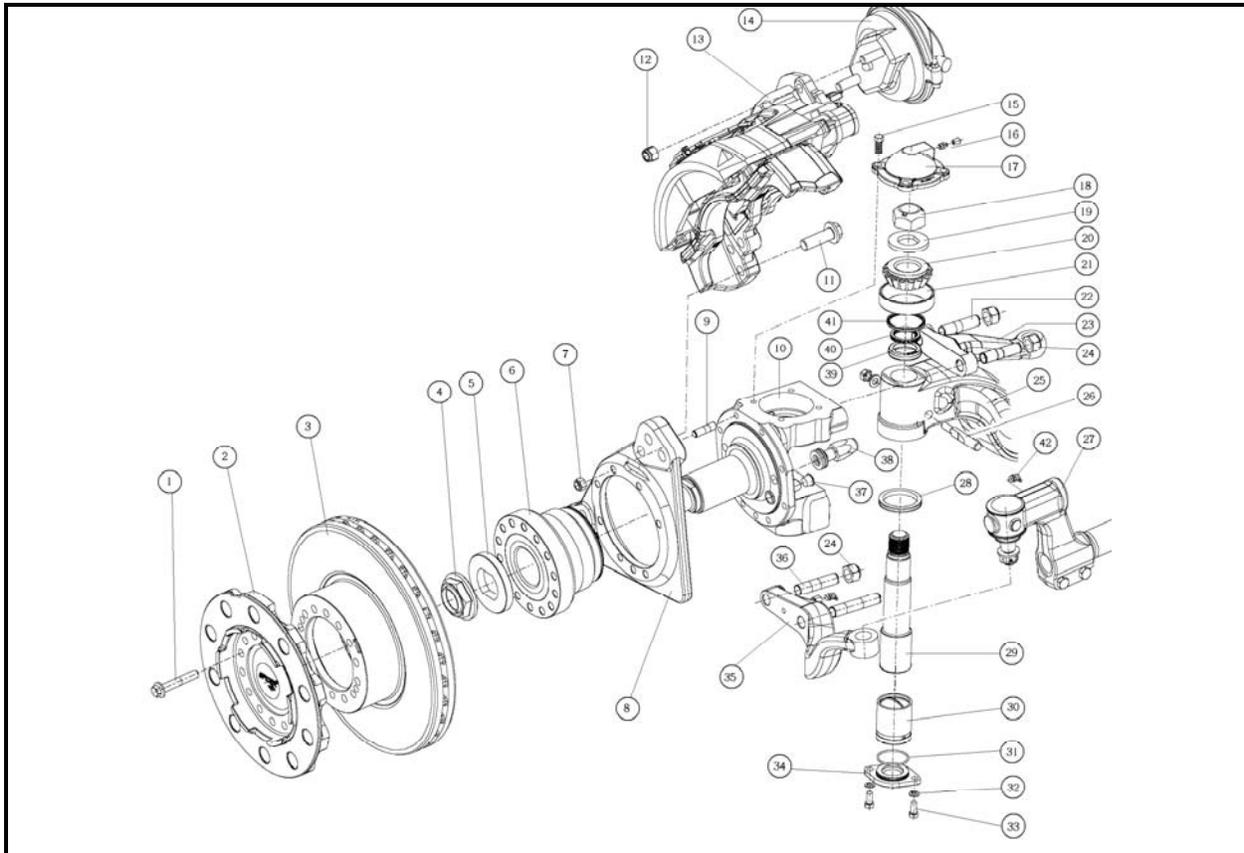


FIGURE 2: FRONT AXLE GREASING POINTS

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TYPICAL S84U AXLE

ITEM	DESCRIPTION	QTY	ITEM	DESCRIPTION	QTY		
1	Flanged Bolt	161-197 lbf-ft	28	26	Draw key, Nut, Washer	51-62 lbf-ft	2
2	Hub		2	27	Tie Rod End		2
3	Brake Disc		2	28	V" Ring Seal		2
4	Stake Hub Nut	563-687 lbf-ft	2	29	Kingpin		2
5	Collet Washer		2	30	Kingpin - Bushing		2
6	Hub Bearing		2	31	O-Ring Seal		2
7	Nut – Self Lock	85-103 lbf-ft	16	32	Washer		4
8	Brake Mounting Bracket		2	33	Screw	26-32 lbf-ft	4
9	Stud		16	34	Cap - Knuckle Bottom		2
10	Knuckle		2	35	Bottom Steering Lever		2
11	Brake Fixing – Bolt	325-375 lbf-ft	12	36	Bottom Steering Lever - Stud		4
12	Nut – Self Lock	133-155 lbf-ft	4	37	Abs Sensor - Bush		2
13	Brake		1	38	Back Lock - Stop Bolt	85-103 lbf-ft	2
14	Brake Chamber		2		Front Lock - Stop Bolt	85-103 lbf-ft	1
15	Screw	51-62 lbf-ft	8	39	Sleeve - Knuckle Bearing		2
16	Grease Fitting		4	40	Shim .005"		8
17	Cap - Knuckle Top		2		Shim .010"		8
18	Nut – Self Lock	500-700 lbf-ft	2		Shim .015"		8
19	Washer		2		Shim .008"		4
20	Bearing Cone		2		Shim .006"		2
21	Bearing Cup		2	41	Oil Seal		2
22	Steering Lever - Stud		4	42	Grease Fitting		2
23	Steering Lever		2				
24	Nut - Self Lock		4				
25	Axle, I-Beam		1				

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

3. MAINTENANCE

A periodic inspection of the front axle assembly should be made to check that all bolts are tight, and that no damage and distortion have taken place. Suspension support stud nuts, U-bolt nuts, tie rod arms, steering arm nuts and stop screws should be checked and tightened, as required, to the torque specifications given at the end of this section. Also check the condition of the steering knuckle pins and bushings. In case of excessive looseness, the bushings and pins should be replaced.

Any looseness in the steering linkage, under normal steering loads, is sufficient cause to immediately check all pivot points for wear, regardless of accumulated mileage. Steering linkage pivot points should be checked each time the front axle assembly is lubricated. Any looseness can be visually detected while rotating the steering wheel in both directions.

Steering knuckles, knuckle pins and bushings can be overhauled or replaced without removing the axle from the vehicle. However, if extensive overhaul work is necessary, the axle assembly should be removed.



CAUTION

Should removal of a locking device be required when undergoing repairs, disassembly or adjustments, always replace with a new one.

4. REMOVAL AND REPLACEMENT

The following procedure deals with the removal of the front axle assembly. The method used to support the axle assembly and suspension components during removal and disassembly depends upon local conditions and available equipment.

4.1 REMOVAL

1. Raise the vehicle by its jacking points on the body (see Section 18, "Body" under heading 34; Vehicle Jacking Points) until vehicle body is approximately 20 inches (508 mm) from the floor. Place jack stands under frame. Remove the wheels (if required, refer to Section 13, "Wheels, Hubs and Tires").



CAUTION

Use only the recommended jacking points as outlined in section 18 "Body".

2. Exhaust compressed air from the air supply system by opening the drain valve of each reservoir.
3. Install jacks under axle jacking points to support the axle weight.



WARNING

To help prevent injury caused by the axle rolling off the jacks, these should be equipped with U-adapters, or similar precautions must be taken.

4. Disconnect the steering drag link from the steering arm.
5. Remove the ABS sensors from their location in hubs (if applicable).
6. Disconnect the height control valve link from its support on the axle.
7. Disconnect air lines from front brake chambers, and cover line ends and fittings to prevent the entry of foreign matter.



CAUTION

Position the air lines and electric wires so they will not be damaged while removing the front axle assembly.

8. Proceed with steps a, b and c, while referring to Section 16: "SUSPENSION".
 - a) Disconnect sway bar links from axle brackets.
 - b) Remove shock absorbers.
 - c) Disconnect five radius rods: one transversal and two longitudinal from subframe, and two upper rods from axle.
9. Remove the bolts and nuts fixing the axle to the left-hand and right-hand side air bellows mounting supports.
10. Using the jacks, slowly lower the axle assembly, and carefully pull away from underneath vehicle.

4.2 REPLACEMENT

Reverse front axle "Removal" procedure. Ensure cleanliness of air bellows support mounting plates.

NOTE

Refer to Section 16, "Suspension", Section 14, "Steering" and to paragraph 8 "Specifications" at the end of this section for applicable checks and recommended tightening torques.

5. SERVICE INSTRUCTIONS FOR STEER AXLE

5.1 STEERING KNUCKLE (KING) PIN INSPECTION



MAINTENANCE

An inspection should be made at intervals of 30,000 miles (48 000 km) or twice a year whichever comes first.

Aspects to be considered are:

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

NOTE

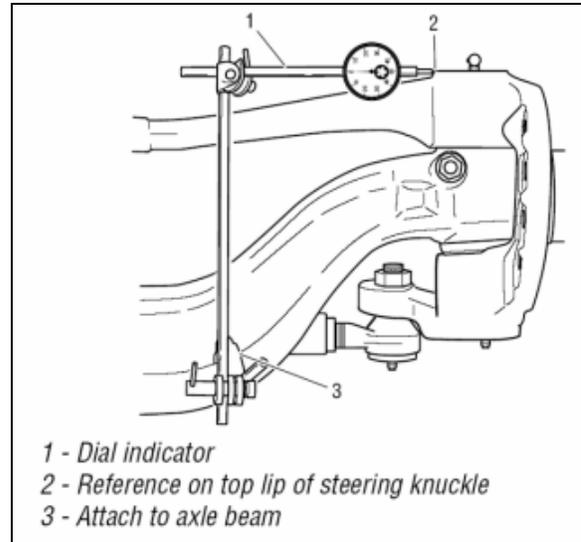
Before commencing checks, apply parking brake, raise wheels off ground and support axle on stands.

5.1.1 Checking Lateral Slackness

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

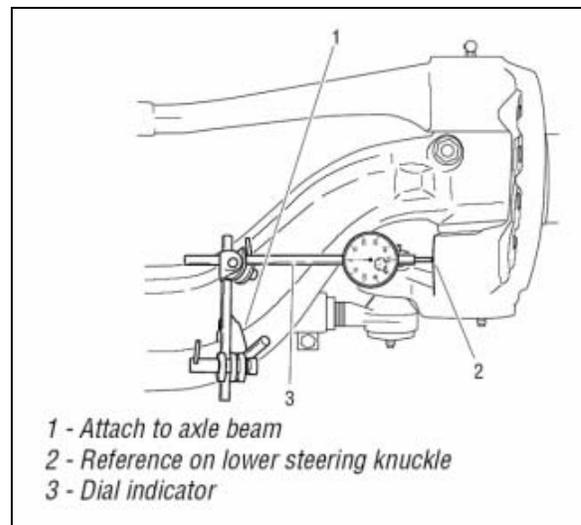
Upper Bushing Lateral Inspection

1. Mount dial indicator on the axle. Reference the upper part of the steering knuckle.
2. Move the tire and wheel assembly in and out with a push/pull motion and have an assistant record the dial indicator reading.
3. Replace the upper bushing if readings are in excess of 0.020" (0.5mm).
4. If displacement exceeds stated allowance then need for bush / bearing attention and possible renewal, is in evidence.



Lower Bushing Lateral Inspection

1. Mount dial indicator on the axle. Reference the base of the lower arm on the steering knuckle.
2. Move the tire and wheel assembly in and out with a push/pull motion and have an assistant record the dial indicator reading.
3. Replace the upper bushing if readings are in excess of 0.020" (0.5mm).
4. If displacement exceeds stated allowance then need for bush / bearing attention and possible renewal, is in evidence.



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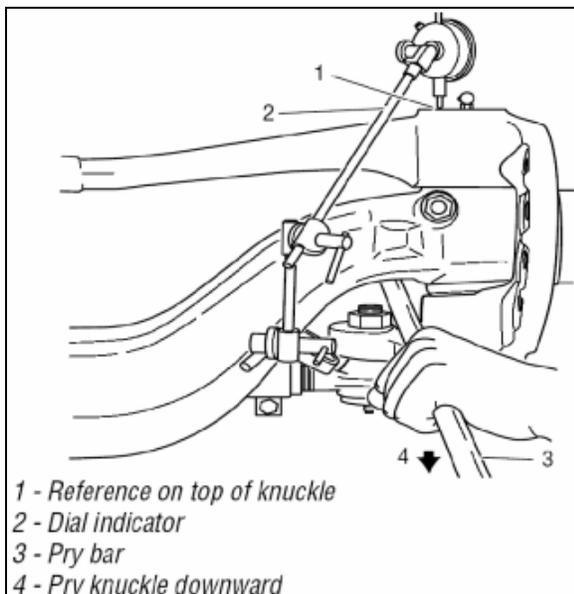
NOTE

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

Locate indicator on a smooth, flat surface for best reading.

5.1.2 Checking Vertical Slackness

1. This is measured by a dial indicator anchored to axle beam and having its pointer placed vertical against swivel top.
2. Place a jack against underside of swivel and, while applying a lifting force, observe any movement on indicator dial.
3. **If vertical movement is evident and it exceeds 0.040" (1.02mm) then readjustment of swivel is required by adjusting thickness of bearing adjusting washers.**



6. 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**.

6.1 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.

6.2 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 6.1, "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.

6.3 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 6.1, "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 6.5 "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.

6.4 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 :

6.4.1 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 section 14 "Steering").

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.

6.4.2 L.H. Turn Adjustment

1. Turn steering wheel to the left until the boss on the axle center touches the left stop screw.
1. Verify the nearest point of contact of the ball socket body with the air bellows support assembly. Measure the distance between those two points.
2. 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.

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- 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.

NOTE

If steering angle stoppers are changed, a special procedure is required for readjusting gearbox steering limiter. See paragraph 6.5 "Hydraulic Stop" in this section.

6.5 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' annexed at the end of Section 14 "Steering" under heading 'Setting and Functional Test'.

6.6 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 (Fig. 4).

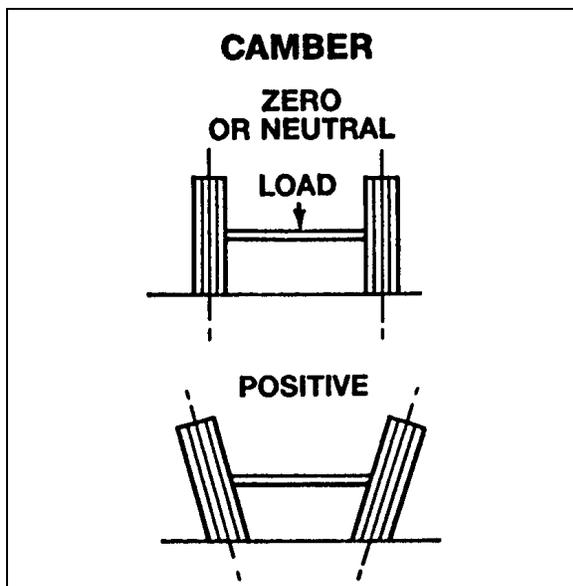


FIGURE 3: CAMBER

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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.

6.6.1 Camber Check

For camber specifications, refer to paragraph 8: "SPECIFICATIONS" 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" annexed at the end of this section.
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).

6.7 FRONT AXLE CASTER

For caster specifications, refer to paragraph 8: "SPECIFICATIONS" 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 (Fig. 5). 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).

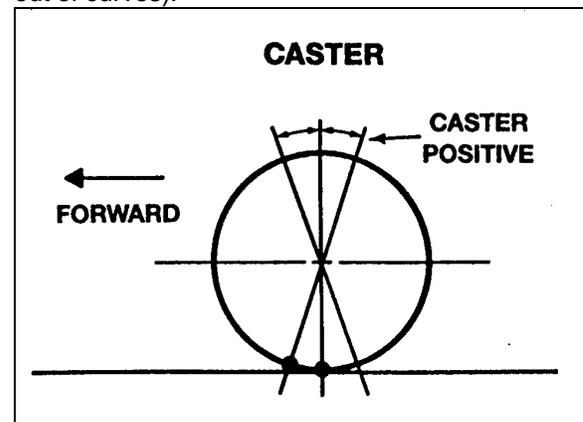


FIGURE 4: CASTER

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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.

6.8 FRONT WHEEL TOE-IN

Wheel toe-in is the degree (usually expressed in fractions of an inch) to which 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 fig. 6).

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.

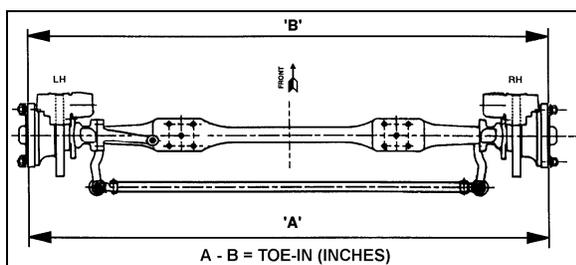


FIGURE 5: TOE-IN MEASUREMENT

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For toe-in specifications, refer to paragraph 8 "Specifications" 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.

6.8.1 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 nuts and bolts on each tie rod end.
 - b. Turn the tie rod until the specified toe-in measurement is obtained.
 - c. Tighten the pinch bolt nuts alternately and progressively to 65-75 lbf-ft (88-102 Nm), thus securing all tie rod joints.

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FRONT WHEEL ALIGNMENT SPECIFICATIONS			
Front Wheel Alignment	Minimal	Nominal	Maximal
Camber, (degrees) R.H. and L.H. *	-0.250	0.125	0.375
Caster, (degrees) R.H. and L.H.	2	2.75	3.5
Toe-in (A minus B), (degrees)	0.04	0.06	0.08

Refer to Section 16: Suspension for front wheel alignment with independent front suspension

NOTE

Camber angle changes with loading. The given numbers are for an empty vehicle.

7. 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. Kingpins 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 kingpins. 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 stud.	<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.

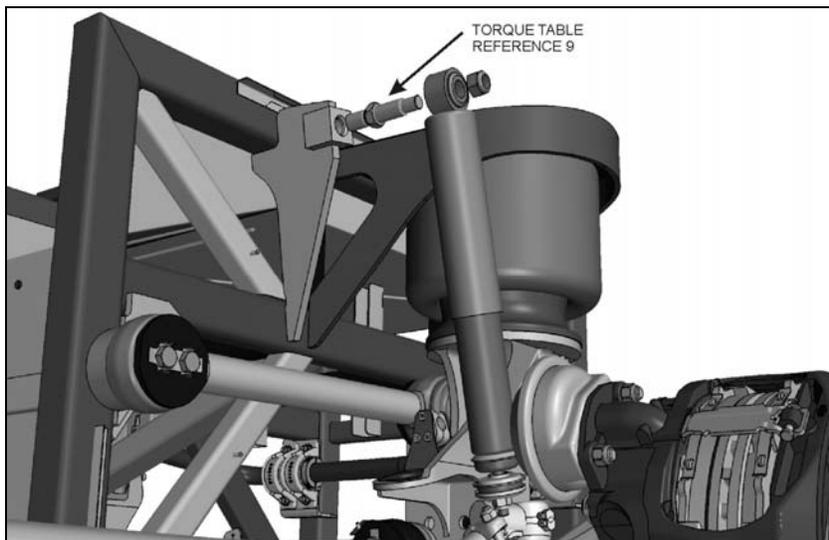
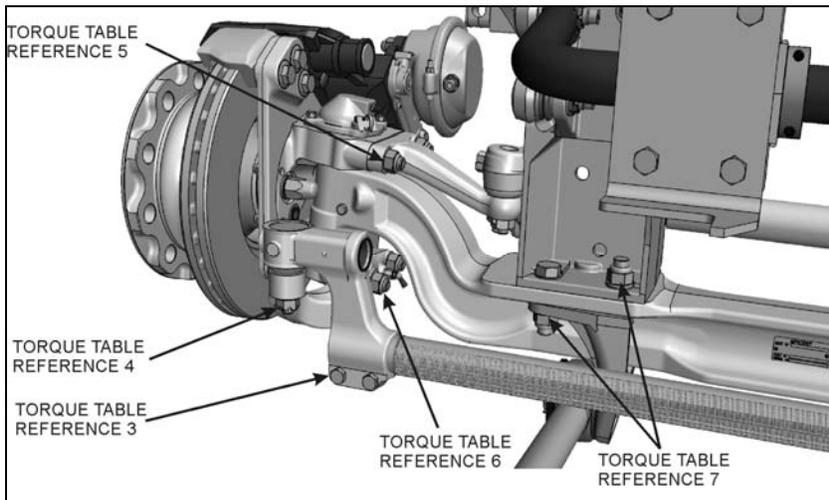
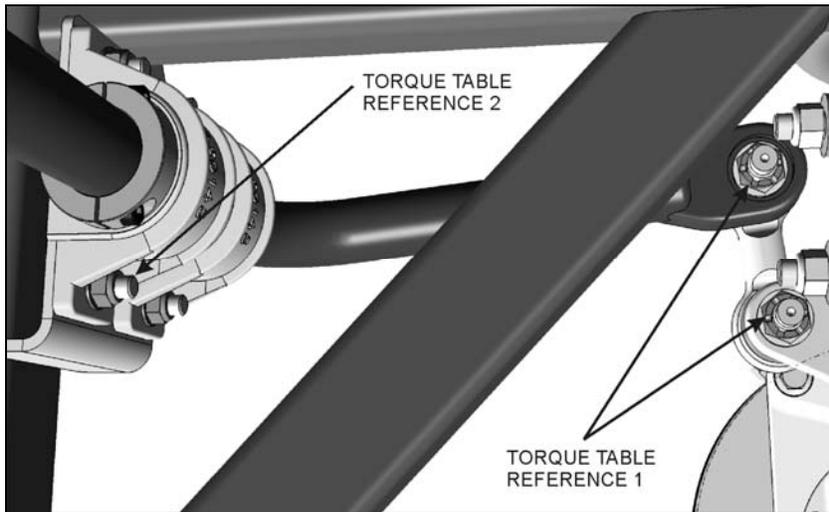
8. SPECIFICATIONS

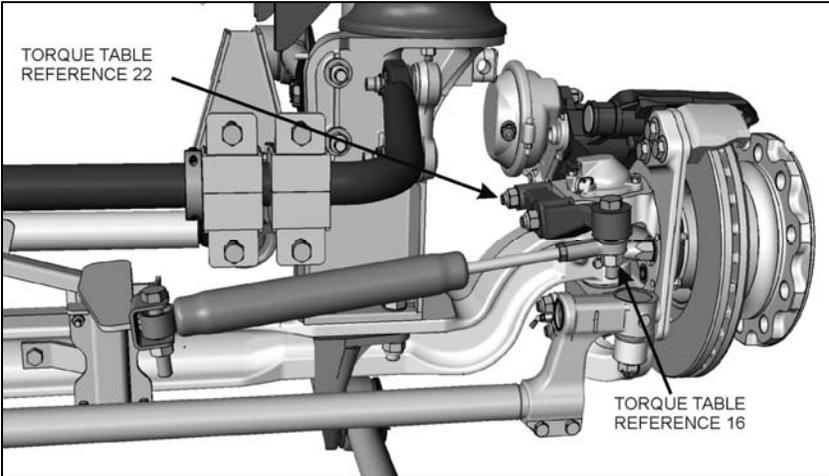
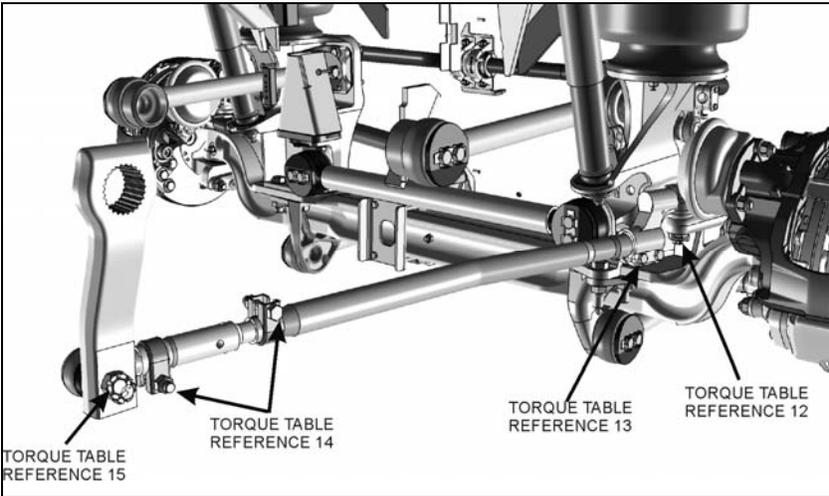
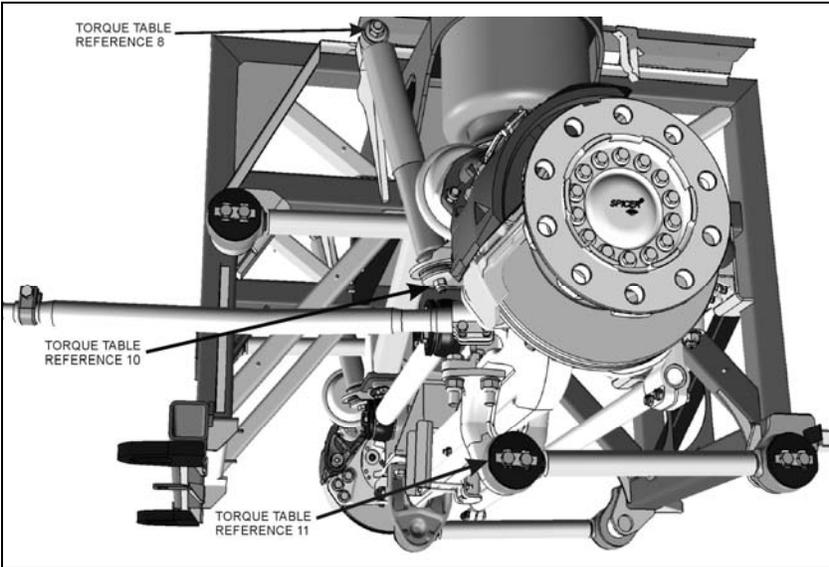
Front Axle

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

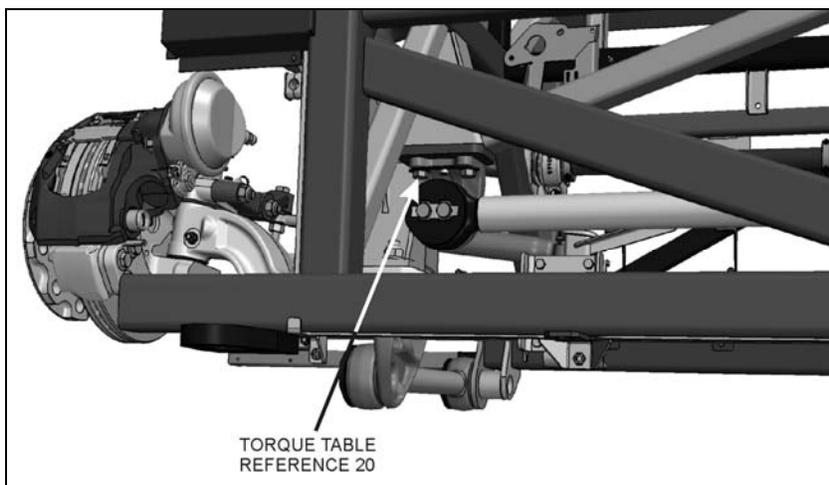
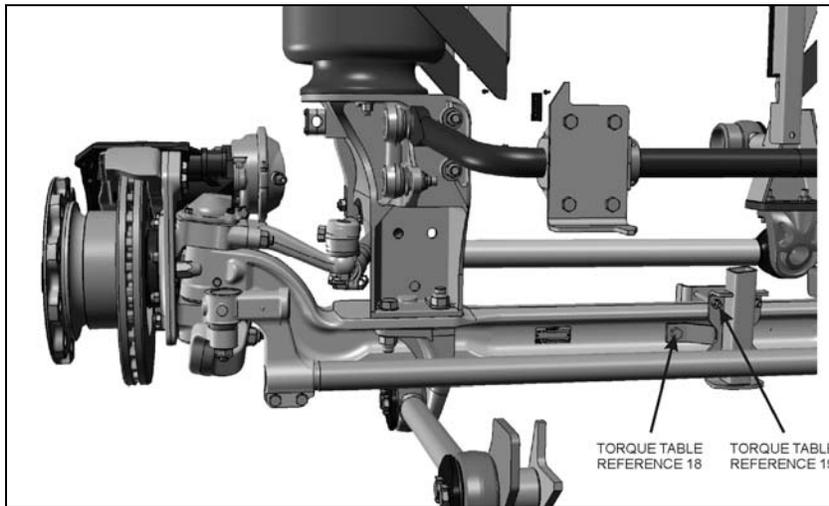
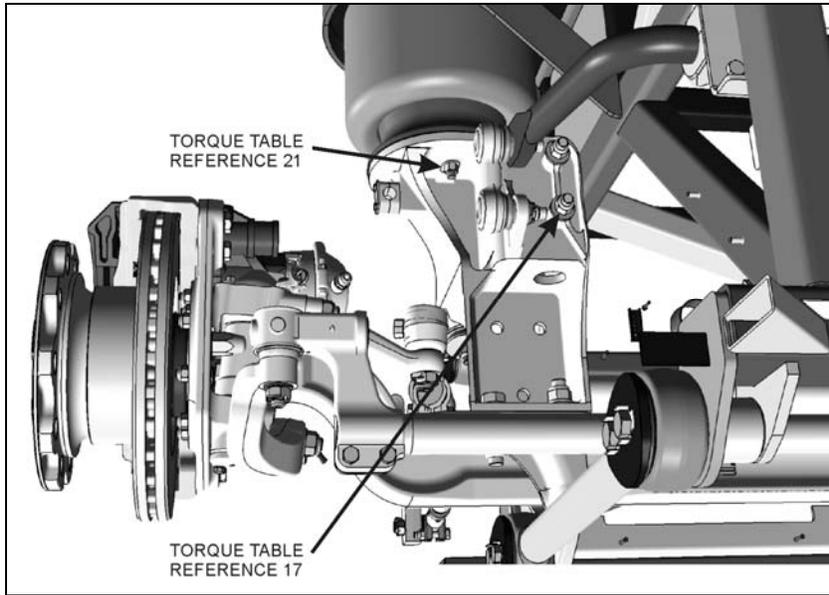
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9. TORQUE SPECIFICATIONS





Section 10: FRONT AXLE



Section 10: FRONT AXLE

The following table lists the tightening torques which do require a specific torque value. When no torque specifications are indicated, use the Standard Torque Specifications table found in Section 00: General Information of the Maintenance Manual.

SPECIFIC TORQUE TABLE 1 – FRONT I-BEAM AXLE SUSPENSION & STEERING				
DESCRIPTION	QTY	REFERENCE	TORQUE DRY (lbf-ft / Nm) <i>threads must be free of oil or other lubricant</i>	
SWAY BAR LINK UPPER AND LOWER NUTS	4	1	165-200	224-271
SWAY BAR BUSHING COLLAR (FRONT SUSPENSION)	8	2	80-100	108-136
TIE ROD END CLAMP PINCH BOLT	4	3	65-75	88-102
TIE ROD END BALL STUD NUT	2	4	150-200	203-271
STEERING ARM STUD NUT	2	5	520-575	705-780
TIE ROD ARM STUD NUT	4	6	520-575	705-780
I-BEAM AXLE MOUNT	8	7	230-280	311-378
SHOCK ABSORBER UPPER MOUNTING PIN STUD NUT	2	8	99-121	134-164
SHOCK ABSORBER PIN	2	9	350-400	475-545
SHOCK ABSORBER LOWER MOUNTING PIN NUT	2	10	60-75	81-102
RADIUS ROD RETAINING BOLT	20	11	140-155	190-210
DRAG LINK BALL STUD NUT	1	12	150-200	203-271
DRAG LINK CLAMP BOLT NUT	2	13	65-75	88-102
DRAG LINK SOCKET END CLAMP PINCH BOLT	2	14	50-60	68-81
DRAG LINK TO PITMAN ARM STUD NUT	1	15	150-200	203-271
STEERING DAMPER	2	16	100-120	135-160
RADIUS ROD SUPPORT	4	17	228-252	309-342
STEERING DAMPER BRACKET	1	18	39-45	53-61
STEERING DAMPER BRACKET	4	19	30-36	41-49
RADIUS ROD SUPPORT	2	20	200-220	271-298
AIR SPRING NUT	6	21	31-38	42-52
STEERING DAMPER ARM NUTS	2	22	285-315	386-427

For more torque specifications, see 'Dana Spicer Maintenance Manual NDS Axles and Maintenance Manual Model NDS' annexed at the end of this section.