Group Index, Alphabetical

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Front Axle Wheel Hubs and Wheel Bearings	33.01
Front Axle Oil or Grease Seal	refer to 33.01

Front Axle Wheel Alignment 33.00

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General Information

Correct front axle wheel alignment is needed to ensure long tire life, ease of handling, and steering stability.

Three factors are involved in wheel alignment: camber angle, caster angle, and wheel toe-in.

Camber angle **(Fig. 1)** is the vertical tilt of the wheel as viewed from the front of the vehicle. Camber angle is measured in degrees, and is not adjustable. Positive camber is the outward tilt of the wheel at the top. Excessive positive camber in one wheel causes the vehicle to pull in the opposite direction, rapidly wearing the outboard side of the tire tread. Negative camber is the inward tilt of the wheel at the top. Excessive negative camber in one wheel causes the vehicle to pull in the same direction that the negative-camber wheel is on, wearing the inboard side of the tire tread. If camber angles are not correct, the tires will wear smooth around the edge on one side. **See Fig. 2.**

Caster angle **(Fig. 3)** is the tilt of the knuckle pin (or kingpin) as viewed from the side. Caster angle is measured in degrees and it is adjustable. A positive caster angle is the tilt of the top of the knuckle pin toward the rear of the vehicle. A negative caster angle is the tilt of

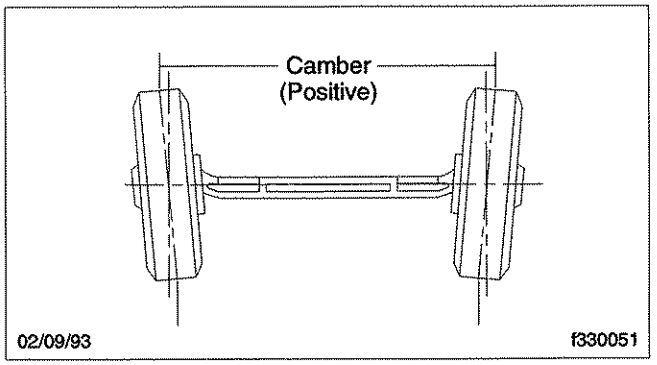


Fig. 1, Camber Angle

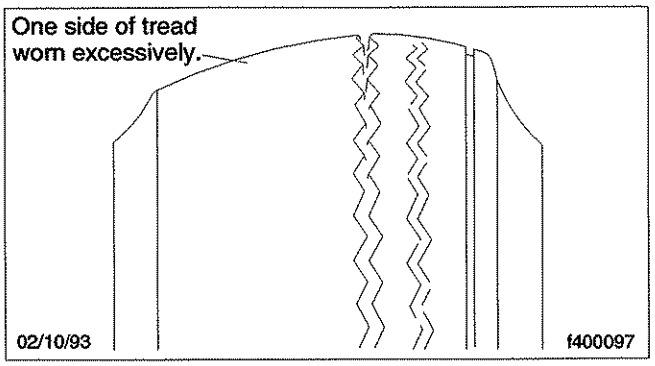


Fig. 2, Tire Damage Due to Excessive Camber

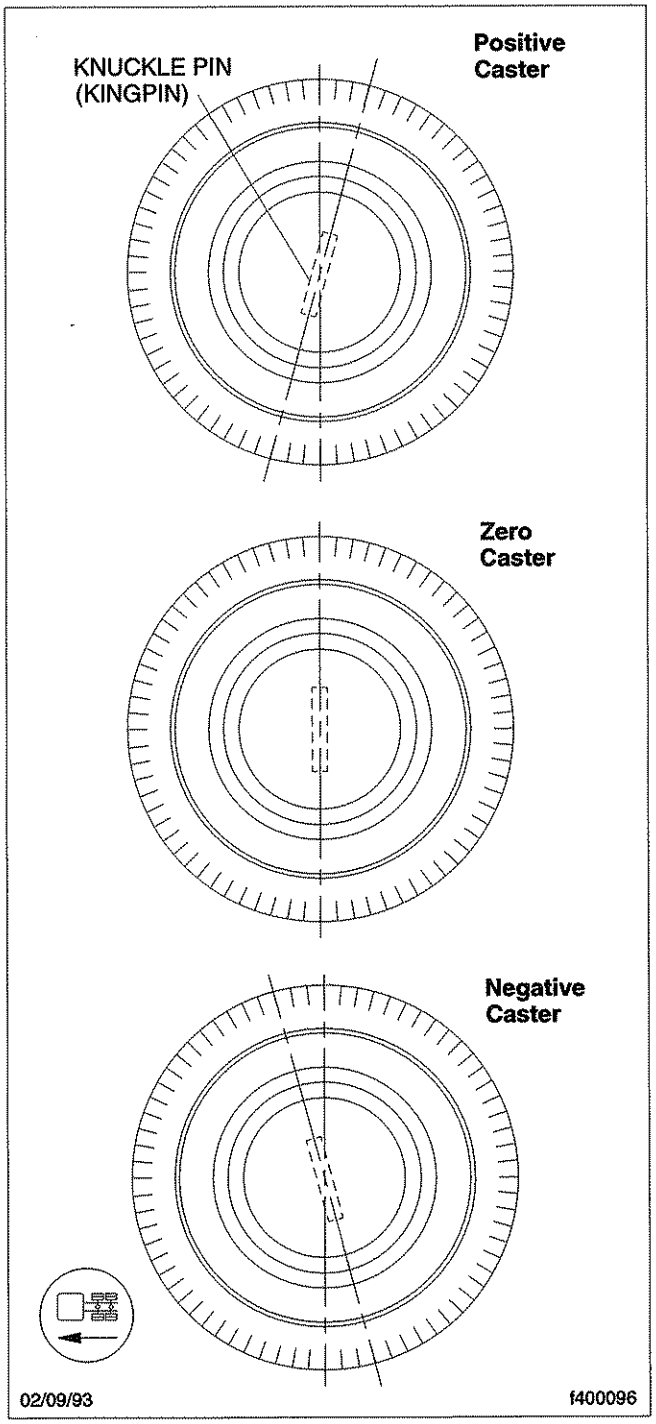


Fig. 3, Caster Angle

General Information

the top of the knuckle pin toward the front of the vehicle. Caster angles are based on the design load of the vehicle. An incorrect caster angle does not cause tire wear. However, a positive caster angle that exceeds specifications could cause vehicle shimmy, road shock, and an increased steering effort. A negative caster angle that does not meet specifications could cause unstable steering. The vehicle may wander and weave, and extra steering effort may be necessary. After leaving a turn, the tendency to return to and maintain a straight-ahead position is reduced. Too much or too little caster in one wheel can cause erratic steering when the service brakes are applied to stop the vehicle.

Wheel toe-in **(Fig. 4)** is the distance in inches that the front of the wheels are closer together than the rear of the wheels, as viewed from the top. Wheel toe-in is adjustable. If it is not adjusted correctly, the vehicle could pull to one side while driving. Wheel shimmy and cupped tire treads (indentations on the road contact surface of the treads) could occur. Also, rapid or severe tire wear on the steering axle could occur, usually in a feather-edged pattern. **See Fig. 5.**

Advanced wear patterns can be seen, but less severe wear patterns are detected only by rubbing the palm of your hand flat across the tire tread.

Feather-edging more often affects the front tire on the passenger's side of the vehicle, and is usually more apparent on the outside grooves of the tire.

If any of the conditions listed above occur, the vehicle could need a front end wheel alignment, and possibly, drive axle alignment. However, in some cases these conditions are not wheel alignment related: **refer to "Troubleshooting, 300"** for other possible causes.

If excessive tire tread wear has resulted from incorrect wheel alignment, replace the damaged tires. For minimum tread wear specifications, refer to the wheels and tires group of the vehicle maintenance manual.

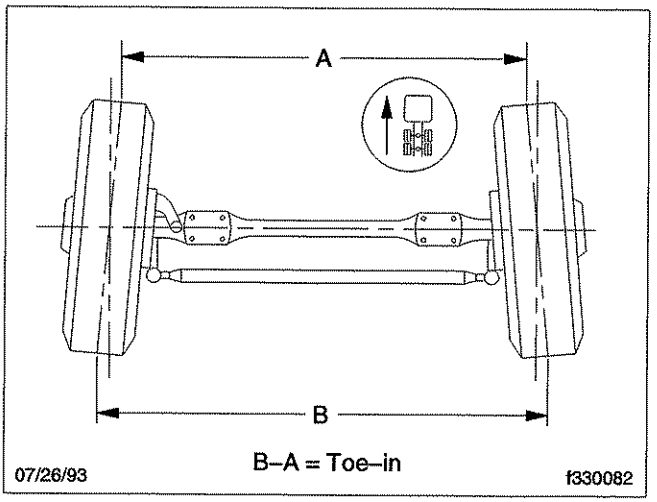


Fig. 4, Wheel Toe-In (Overhead View)

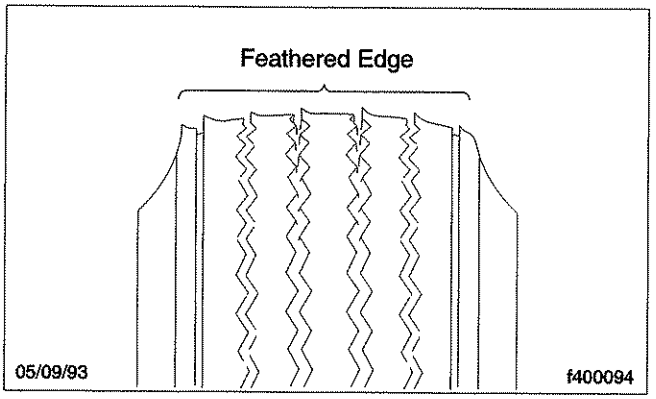


Fig. 5, Tire Damage Due to Excessive Toe-In or Incorrect Drive Axle Alignment

Preliminary Checks

Precision instruments and equipment are needed for accurately measuring and adjusting wheel alignment. Refer to the operating instructions provided by the wheel alignment equipment manufacturer.

Before checking or correcting wheel alignment, make sure the vehicle is at curb weight. Curb weight is the weight of the unloaded vehicle complete with accessories and full fuel tanks.

If a road test is necessary, the route should be one that allows full left and right turns and full stops. It should also include a length of straight, level road to check the steering wheel position during straight-ahead driving.

During the road test, note any steering effort and possible roughness. Check for looseness, too much wheel play, any tendency for the vehicle to lead in one direction, and for pull during stopping.

Note the position of the steering wheel while driving on a straight, level road. When the steering gear is centered, the steering wheel spokes should be within 10 degrees of the 4 and 8 o'clock positions. **See Fig. 1.**

NOTE: These steering wheel location specifications are for reference and apply only for the conditions of this road test. Variations outside of these specifications may occur later when the vehicle is placed in service.

If there are any problems, **refer to "Troubleshooting, 300."**

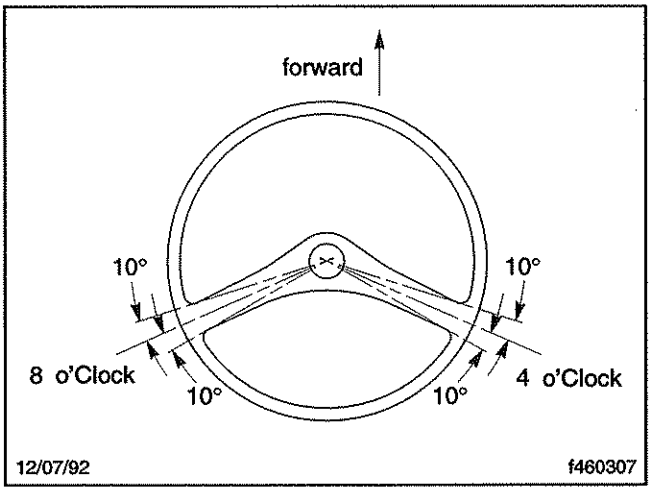


Fig. 1, Steering Wheel Position

1. Steering axle wheel assemblies should be balanced, especially for vehicles that travel at sustained speeds of more than 80 km/h (50 mph). Off-balance wheel assemblies cause vibrations that result in severely shortened life for tires, and steering suspension parts.
2. Do not mix tires of different size, type, or weight. Tire wear should be even and not worn to limits exceeding government specifications. **Refer to the wheels and tires group** in this manual and the vehicle maintenance manual, for more information. Replace any tire that is excessively worn.
3. Check the inflation pressure of the tires. **Refer to the wheels and tires group** in this manual for recommended pressures. An underinflated tire causes tread wear completely around both tire shoulders. An overinflated tire causes tread wear in the center of the tire. **Refer to Fig. 2.**
4. Check for out-of-round wheels, rims, or wheel stud holes. Replace the wheel if any of these conditions exist.
5. On each side of the vehicle, check the height of the chassis above the ground. Sagging, fatigued, or broken suspension springs create a lopsided vehicle appearance. This causes an unbalanced weight distribution. Anything that changes the ratio of weight on the springs affects the alignment angles and also the tire tread contact area. Replace damaged springs as instructed **in the suspension group.**
6. Inspect the front axle beam (also called the axle center) for bends or twists. If the axle beam is bent or twisted over 1/2 degree, replace it before aligning the front axle wheels.
7. Check for damaged, worn, or bent steering gear or linkage parts. Make sure the steering gear is centered. Replace damaged components, and adjust the steering gear, using the instructions **in the steering group.**
8. Check the steering angle, and adjust the axle steering stops, as needed. **Refer to "Steering Angle Checking and Adjusting, 110."**

Preliminary Checks

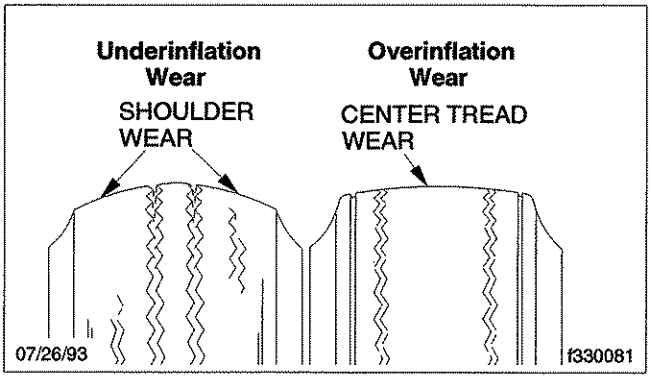


Fig. 2, Tire Damage Due to Underinflated or Overinflated Tires

Checking and Adjusting

Steering (or turning) angle is the degree of front wheel movement from a straight-ahead position to either an extreme right or left position. Although front wheel movement can be limited by the amount of internal travel in the steering gear, it generally depends on how much clearance there is between chassis components and the tire and wheel assemblies. All axles have adjustable stopscrew-and locknut-type axle stops (**Fig. 1**), which are located on the rear side of each front axle spindle.

IMPORTANT: For vehicle alignment to be accurate, the shop floor must be level in every direction. The turn plates for the front wheels must rotate freely without friction, and the alignment equipment must be calibrated every three months by a qualified technician from the equipment manufacturer. Freightliner dealers must have proof of this calibration history.

1. Make sure the steering gear is in the center of travel when the wheels are in a straight-ahead position. Center the gear, using the instructions in the steering gear section in the **steering group**. Bottoming of the steering gear must not occur when making an extreme right or left turn.
2. If using stationary turn-plates or turntables (**Fig. 2**), drive the vehicle on the plates; the tires must be exactly straight ahead. Apply the parking brakes.

   If using portable gauges, apply the parking brakes, chock the rear tires, and raise the front of the vehicle. Place a turn-plate or turntable under each tire. With the tires exactly straight ahead, lower the vehicle so that the tires rest on the center of the gauges.
3. Remove the lockpins from the gauges, and adjust the dials so that the pointers on both gauges read zero.
4. With the brakes fully applied, turn the steering wheel clockwise to the end of travel. Have someone check both sides of the vehicle for interference at the tires and wheels. There must be at least 0.50 inch (13 mm) clearance from any fixed object, and 0.75 inch (19 mm) from any moving object.

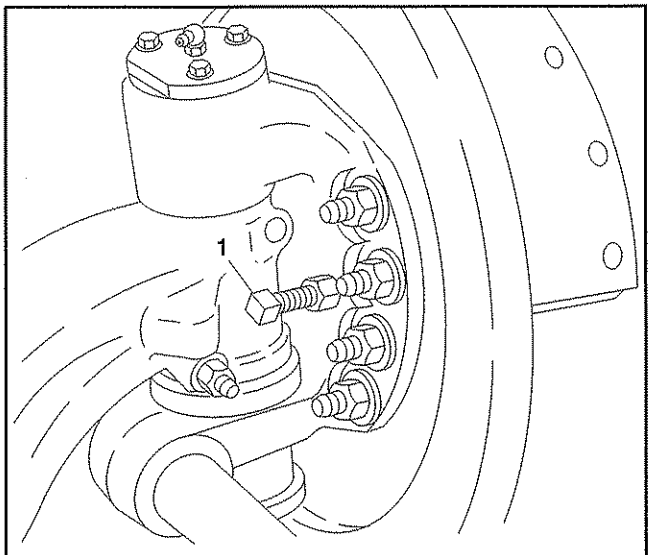
   If necessary, loosen the stopscrew locknut; adjust the stopscrew to contact the axle when the maximum turning angle of the wheels is determined.

   Tighten the locknut to the value in the torque table in **Specifications, 400.**

   Repeat the step with the steering wheel turned counterclockwise. Adjust the axle stop, as needed.

NOTE: The turning angle may not be the same on both sides.

5. Adjust the steering gear so that pressure is released ahead of the axle stop. This will prevent possible damage to the steering or axle components. For poppet valve adjustment instructions, refer to the steering gear section in the **steering group**.
6. Drive the vehicle off the turn-plates or turntables, or remove them from under the tires and lower the vehicle.



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1. Stopscrew and Locknut

Fig. 1

Steering Angle Checking and Adjusting

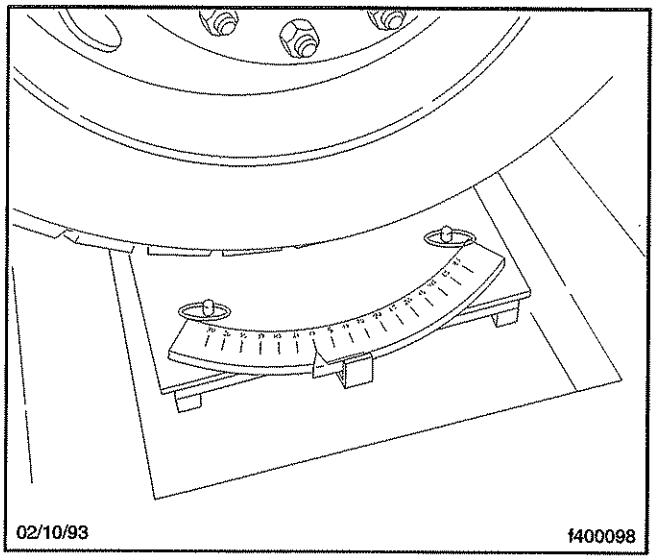


Fig. 2, Turn-Plate (Turntable), Stationary Type

Checking (See Fig. 1)

IMPORTANT: For vehicle alignment to be accurate, the shop floor must be level in every direction. The turn plates for the front wheels must rotate freely without friction, and the alignment equipment must be calibrated every three months by a qualified technician from the equipment manufacturer. Freightliner dealers must have proof of this calibration history.

1. Apply the parking brakes and chock the rear tires.
2. Raise the front of the vehicle until the tires clear the ground. Place safety stands under the axle; make sure the stands will support the weight of the cab, frame, and front axle.
3. Before measuring camber, check the front wheel bearings for wear and incorrect adjustment. Try moving the wheel on the axle spindle (steering knuckle) either by grasping the front tire on the top and bottom, or by using a bar for leverage. If movement between the brake drum and the backing plate or other axle-mounted reference point is 0.05 inch (1 mm) or more, the bearings may be worn or incorrectly adjusted. Inspect the wheel bearings for damage using the instructions in the front axle group of the vehicle maintenance manual. If needed, replace or adjust the bearings using the instructions in **Section 33.01** of this manual.
4. Remove the safety stands, and lower the vehicle to the ground.
5. Using the alignment equipment manufacturer's instructions, measure the front wheel camber.
6. Compare the camber angles with those shown in the applicable table in **Specifications, 400.** Differences between the measurements taken in this subject and the angles in the applicable table in **Specifications, 400** are caused by damaged (bent) axle components.

   Incorrect camber angles could be caused by damage in one or more of the following front axle components: the knuckle pin, the knuckle pin bushings, the axle spindle, or the axle beam. Replace twisted or otherwise damaged components. Don't try to straighten twisted or bent components; replace them with new components. If a bent or twisted front axle knuckle pin, axle spindle, or axle beam has been straightened, the axle warranty will be voided.

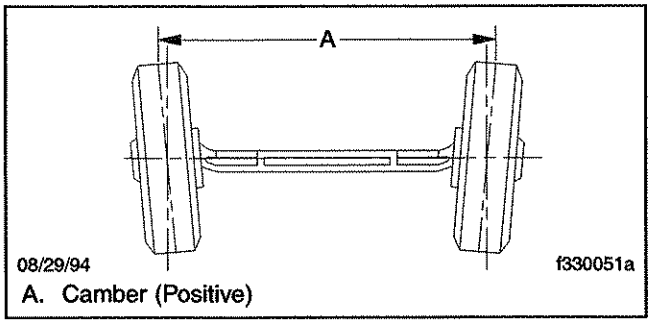


Fig. 1, Camber Angle

⚠ WARNING

WARNING: Trying to straighten a twisted or bent front axle component can crack or weaken it. A cracked or weakened axle component could result in a collapsed front axle or the loss of a wheel, which could cause serious personal injury.

7. Remove the chocks from the tires.

Caster Angle Checking and Adjusting

Checking and Adjusting (See Fig. 1)

IMPORTANT: For vehicle alignment to be accurate, the shop floor must be level in every direction. The turn plates for the front wheels must rotate freely without friction, and the alignment equipment must be calibrated every three months by a qualified technician from the equipment manufacturer. Freightliner dealers must have proof of this calibration history.

Using the alignment equipment manufacturer's operating instructions, measure the front wheel caster.

Compare the caster angles with those shown in the applicable table in **Specifications, 400**. If needed, adjust the caster angle by placing wedge-shaped shims between the axle spacer and the axle beam, as follows (**see Fig. 2**):

IMPORTANT: Extreme angle shims cannot be used to correct caster angles that vary by more than 2 degrees from the values in the table in **Specifications, 400**. Weak or broken leaf springs, or worn shackle bushings, can cause extreme deviations to caster angles. Replace damaged parts before doing caster adjustments.

1. Apply the parking brakes and chock the front and rear tires.
2. Back off the U-bolt high nuts from the U-bolts on one side of the front axle. **See Fig. 2.**
3. Raise the spring away from the axle enough to allow removal of the front caster shim.
4. Remove the shim, and install one that will provide the correct caster angle, as specified in the table in **Specifications, 400**. Install the dowel pin and check penetration.

IMPORTANT: Place front caster shims between the axle beam and the axle spacer. **See Fig. 2.**

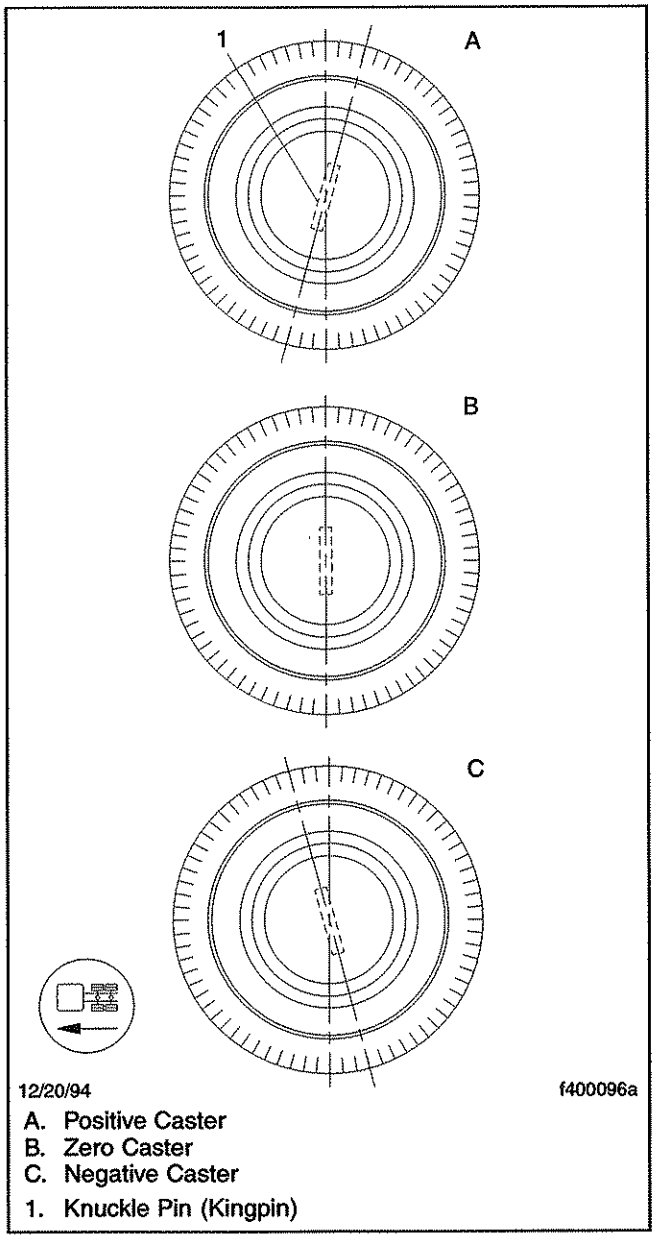
5. Lower the vehicle onto the axle.
6. Coat the threaded ends of the U-bolts with chassis lube or an antiseize compound, such as Loctite® 242. Tighten the U-bolt nuts to the value in the torque table in **Specifications, 400**.

   U-bolt high nuts need periodic retightening. Refer to the suspension group in the vehicle maintenance manual for recommended intervals.

⚠ CAUTION

CAUTION: Failure to periodically retighten the U-bolt high nuts could result in spring breakage and abnormal tire wear.

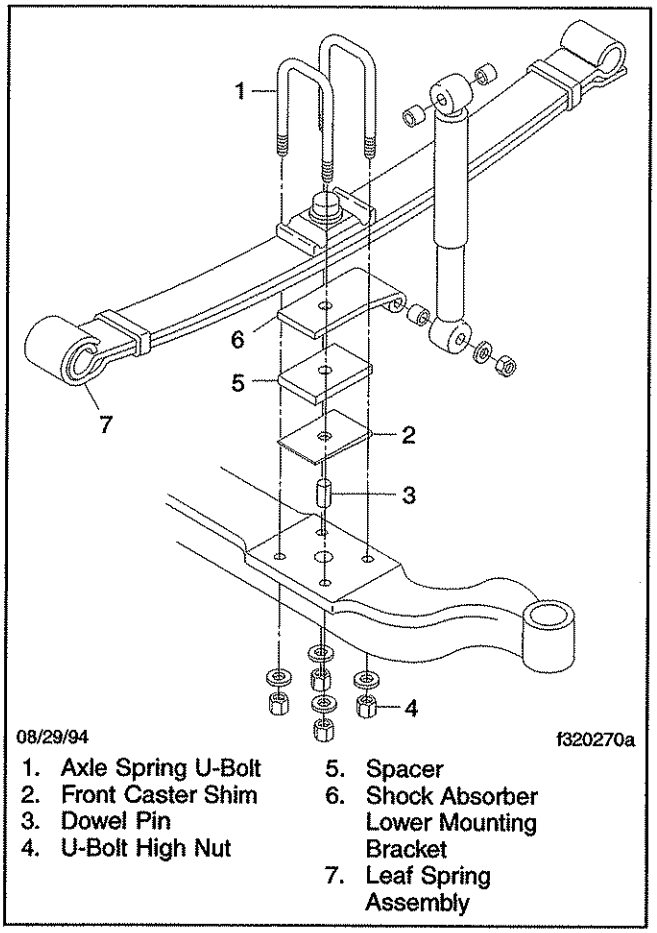
7. Using the steps above, replace the shim on the other side of the axle.



A. Positive Caster
B. Zero Caster
C. Negative Caster
1. Knuckle Pin (Kingpin)

Fig. 1, Caster Angle

Caster Angle Checking and Adjusting



1. Axle Spring U-Bolt
2. Front Caster Shim
3. Dowel Pin
4. U-Bolt High Nut
5. Spacer
6. Shock Absorber Lower Mounting Bracket
7. Leaf Spring Assembly

Fig. 2

8. Remove the chocks from the tires. Do a final caster angle check.

Wheel Toe-In Checking and Adjusting

Checking and Adjusting (See Fig. 1)

NOTE: If using electronic alignment equipment, measure the wheel toe-in following the manufacturer's operating instructions. Compare the measurement with that shown in the table in **Specifications, 400.** If corrections are needed, go to the step in this subject which describes loosening the tie rod clamp nuts, and proceed.

If electronic alignment equipment is not available, do all the steps.

IMPORTANT: For vehicle alignment to be accurate, the shop floor must be level in every direction. The turn plates for the front wheels must rotate freely without friction, and the alignment equipment must be calibrated every three months by a qualified technician from the equipment manufacturer. Freightliner dealers must have proof of this calibration history.

1. Apply the parking brakes and chock the rear tires.
2. Raise the front of the vehicle until the tires clear the ground. Place safety stands under the axle. Make sure the stands will support the weight of the cab, axle, and frame.
3. Using spray paint or a piece of chalk, mark the entire center rib of each front tire.
4. Place a scribe or pointed instrument against the marked center rib of each tire, and turn the tires. The scribes must be held firmly in place so that a single straight line is scribed all the way around each tire.
5. Place a turn-plate or turntable under each tire. Remove the safety stands from under the axle, then lower the vehicle. Remove the lockpins from the gauges; make sure the tires are exactly straight ahead.
6. Place the trammel bar at the rear of the front tires; locate the trammel pointers at spindle height, and adjust the pointers to line up with the scribe lines. Lock in place. Make sure that the scale is set on zero.

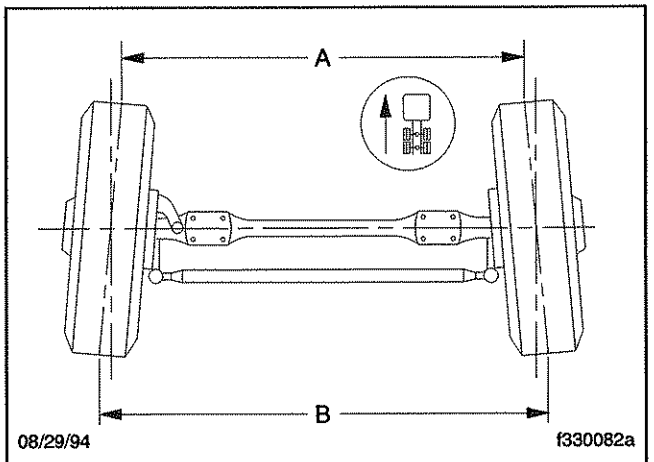
NOTE: If turn-plates or turntables are not available, lower the vehicle. Remove the chocks from the rear tires and release the parking brakes. Move the vehicle backward and then forward about two meters (six feet).

7. Place the trammel bar at the front of the tires as shown in **Fig. 2.** Adjust the scale end so that the pointers line up with the scribe lines. **See Fig. 3.**
8. Read the toe-in from the scale. Compare the toe-in with the value in the table in **Specifications, 400.** Make corrections if necessary.
9. Loosen the tie rod (cross tube) clamp nuts, and turn the tie rod as needed.

   If the vehicle is not on turn-plates or turntables, move the vehicle backward and then forward about two meters (six feet). This is important when setting the toe-in on vehicles equipped with radial tires.

   Do a final wheel toe-in check to make sure that it is correct.

   Tighten the clamp nuts to the values in the table in **Specifications, 400.**
10. If not already done, remove the chocks from the rear tires. Road test the vehicle.



NOTE: B minus A equals Toe-In.

Fig. 1, Wheel Toe-In (Overhead View)

Wheel Toe-In Checking and Adjusting

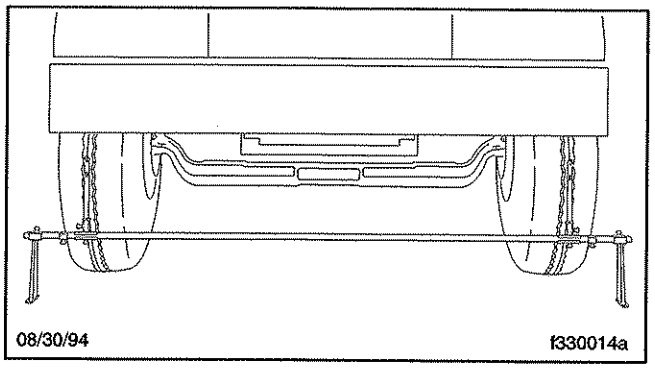


Fig. 2, Trammel Bar Positioning

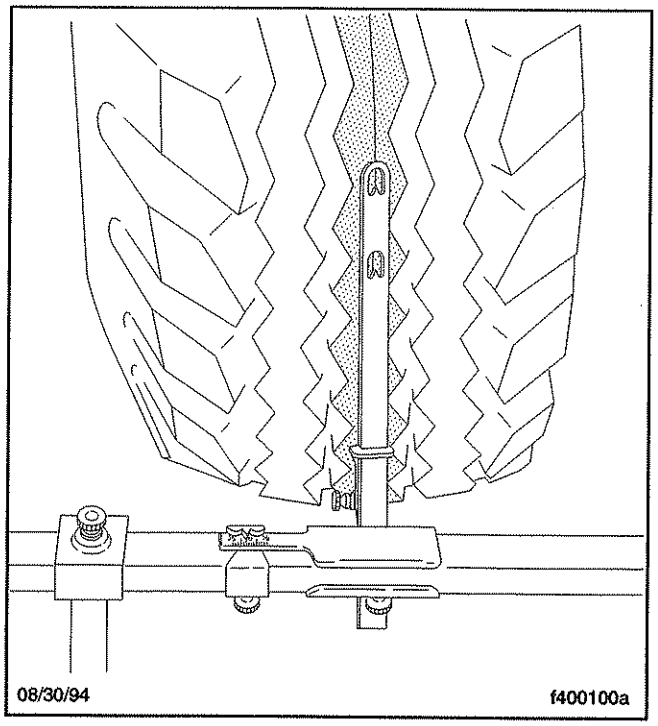


Fig. 3, Calculating Wheel Toe-In

Troubleshooting

Service instructions for most of the remedies below are found by referring to the index in the back of this manual. For axles, refer to the service literature provided by either Rockwell or Eaton Corporation. For tire inflation pressures, refer to the wheels and tires section in this manual. For more steering system troubleshooting information, refer to the steering section in this manual.

Problem - Hard Steering

Problem - Hard Steering	
Possible Cause	**Remedy**
Tire pressure is low in one or both front tires.	Inflate tires to the correct pressure.
Binding in the steering gear due to a lack of lubrication.	Lubricate the steering gear. For instructions, refer to the vehicle maintenance manual.
Too much caster angle in the front wheels.	Check the caster angle and adjust as needed
The front suspension is sagging due to a damaged spring.	Repair or replace the spring as needed. For instructions, refer to the suspension section in this manual.
The axle spindle is bent.	Replace the spindle.
The frame is misaligned.	Check the frame alignment; correct, as needed.
Low pressure in the power steering system.	Repair the power steering system.
Steering gear is not assembled correctly.	Assemble the steering gear correctly.
King pins are binding.	Replace the king pins.
Steering arm geometry is incorrect.	Service the steering system as necessary.
Tie rod ends are hard to move.	Replace the tie rod ends.
Thrust bearing is worn.	Replace the thrust bearing.

Problem - Erratic Steering When the Brakes are Applied

Problem - Erratic Steering When the Brakes are Applied	
Possible Cause	**Remedy**
Tire pressure is low in one or both front tires.	Inflate the tires to the correct pressure.
One or more front axle spring U-bolt nuts are loose.	Check the U-bolt nuts for looseness. If loose, check the U-bolt for damage. Replace damaged parts; tighten loose nuts.
The brakes are not adjusted evenly.	Adjust the brakes on all axles. Also, check the operation of the slack adjusters.
Grease or oil contamination of the brake linings is reducing brake effectiveness.	Replace the brake linings and clean the drums. Find and correct the cause of grease or oil contamination.
The caster angle is wrong.	Check, and adjust as needed.
An axle spindle is bent.	Replace the axle spindle.
The front axle wheel bearings are worn or were incorrectly adjusted.	Check the bearings for wear or damage; replace as needed.

Troubleshooting

Problem - Vehicle Pulls to One Side During Operation

Problem - Vehicle Pulls to One Side During Operation	
Possible Cause	**Remedy**
Tire pressure is low in one or both front tires.	Inflate the tires to the correct pressure.
One or more of the alignment measurements are incorrect.	Check all the alignment measurements. Correct as needed.
The wheels or tires are out-of-round.	Inspect the wheels and tires. Replace out-of-round parts.
The front axle wheel bearings are too tightly adjusted.	Check the bearings for wear or other damage. Replace the bearings if needed.
The front suspension is sagging due to a damaged spring.	Repair or replace the spring as needed. For instructions, refer to the suspension section in this manual.
The axle spindle is bent.	Replace the spindle.
The frame is misaligned.	Check the frame alignment; correct as needed.
The rear axle(s) is out of alignment.	Check, and if needed, adjust the rear axle alignment.

Problem - Front Wheel Wander

Problem - Front Wheel Wander	
Possible Cause	**Remedy**
One or more wheels or brake drums are out-of-balance.	Balance the wheels. Check for out-of-round brake drums; correct as needed.
One of the front springs is weak or broken.	Repair or replace the spring as needed. For instructions, refer to the suspension section in this manual.

Problem - Front Wheel Shimmy

Problem - Front Wheel Shimmy	
Possible Cause	**Remedy**
Tire pressure is low in one or both front tires.	Inflate the tires to the correct pressure.
One or more wheels or brake drums are out-of-balance.	Balance the wheels. Check for out-of-round brake drums, correct or replace as needed.
One or more tires are out-of-round or bulged.	Replace the tire.
The front axle wheel bearings are worn or were incorrectly adjusted.	Check the bearings for wear or other damage. Replace the bearings if needed.
Parts of the steering gear or linkage are worn.	Test for play in the steering gear and linkage with the front tires off the ground. Replace parts as needed.
The axle spindle is bent.	Replace the spindle.
One or more of the alignment measurements are incorrect.	Check all alignment measurements and correct as needed.
The knuckle pin is loose due to worn bushings.	Inspect the knuckle pin and bushings for damage. Replace worn or damaged parts as needed.

Problem - Front Wheel Shimmy	
Possible Cause	**Remedy**
Shock absorbers are worn or damaged.	Check the shock absorbers and replace if needed.
Caster is out of adjustment.	Adjust the caster.

Problem - Vehicle Wanders

Problem - Vehicle Wanders	
Possible Cause	**Remedy**
Tire pressure is low in one or both front tires.	Inflate the tires to the correct pressure.
One or more of the alignment measurements are incorrect.	Check all of the alignment measurements; correct as needed.
The rear axle(s) is out of alignment.	Check the rear axle alignment and adjust as needed.
Parts of the steering gear or linkage are worn.	Test for play in the steering gear and linkage with the front tires off the ground. Replace parts as needed.
A knuckle pin is loose due to worn bushings.	Inspect the knuckle pin and bushings for damage. Replace worn or damaged parts.
The axle spindle is bent.	Replace the spindle.

Problem - Cupped Tires

Problem - Cupped Tires	
Possible Cause	**Remedy**
Tire pressure is too low or too high in one or both front tires.	Inflate or deflate the tires to the correct pressure.
One or more wheels or brake drums are out-of-balance.	Balance the wheels. Check for eccentric brake drums; correct or replace as needed.
The wheel toe-in is not correct.	Adjust the wheel toe-in.
The brakes are not adjusted evenly.	Adjust the brakes on all axles. Also, check the operation of the slack adjusters.
The front axle wheel bearings are worn or were not adjusted correctly.	Check the bearings for wear or other damage; replace them if needed.
The camber angle is not within specifications.	Check the front wheel camber angle. If not correct, find and replace the damaged axle component.

Problem - Steering Wheel Spokes Do Not Point at the 4 and 8 O'clock Positions

Problem - Steering Wheel Spokes Do Not Point at the 4 and 8 O'clock Positions	
Possible Cause	**Remedy**
The steering gear is not centered.	Center the steering gear.
If adjustable, the drag link is out of adjustment.	Adjust the drag link.

Troubleshooting

Problem - Steering Wheel Spokes Do Not Point at the 4 and 8 O'clock Positions	
Possible Cause	**Remedy**
The steering wheel was not installed (positioned) correctly on the steering column.	Reposition the steering wheel on the steering column.
The pitman arm is not correctly aligned with the timing mark on the steering gear output shaft.	Reposition the pitman arm on the steering gear output shaft. For instructions, refer to the steering section in this manual.

Problem - Tires Wear Out Quickly or Have Uneven Tire Tread Wear

Problem - Tires Wear Out Quickly or Have Uneven Tire Tread Wear	
Possible Cause	**Remedy**
Tires have incorrect air pressure.	Inflate or deflate the tires to the correct pressure.
Tires are out of balance.	Balance or replace the tires.
Tandem axle alignment is incorrect.	Align the tandem axles.
Toe-in setting is incorrect.	Adjust toe-in to the specified setting.
Steering arm geometry is incorrect.	Service the steering arm as necessary.

Problem - Ends of the Cross Tube are Worn

Problem - Ends of the Cross Tube are Worn	
Possible Cause	**Remedy**
Ends of the cross tube need lubrication.	Lubricate the ends of the cross tube. Make sure lubrication schedule is followed.
Vehicle is operated in severe conditions.	Operate the vehicle correctly.
Boot on end of cross tube is damaged.	Replace the boot.
Add-on type of power steering cylinders are not installed correctly.	Install the power steering cylinders correctly.

Problem - Bent or Broken Cross Tube, Ball Stud, Steering Arm or Cross Tube Arm

Problem - Bent or Broken Cross Tube, Ball Stud, Steering Arm or Cross Tube Arm	
Possible Cause	**Remedy**
Too much pressure in the power steering system.	Adjust the power steering system to the specified pressure.
Cut-off pressure in the power steering system is out of adjustment.	Adjust the power steering system to the specified pressure.
Vehicle is not operated correctly.	Make sure vehicle is operated correctly.
Add-on type power steering system is not installed correctly.	Install the add-on power steering system correctly.

Problem - Worn or Broken Steering Ball Stud

Problem - Worn or Broken Steering Ball Stud	
Possible Cause	**Remedy**
Drag link fasteners are tightened past specified torque.	Tighten the drag link fasteners to the specified torque.
Lack of lubrication, or lubricant is incorrect.	Lubricate the linkage with specified lubricant.
Power steering stops are out of adjustment.	Adjust the stops to specified dimension.

Problem - Worn King Pins and Knuckle Bushings

Problem - Worn King Pins and Knuckle Bushings	
Possible Cause	**Remedy**
Seals and gaskets are worn or missing.	Replace the seals and gaskets.
Lubricant is incorrect.	Lubricate the axle with specified lubricant.
Axle is not lubricated at scheduled frequency.	Lubricate the axle at scheduled frequency.
Lubrication procedures are incorrect.	Use the correct lubrication procedures.
Lubrication schedule does not match the operating conditions.	Change the lubrication schedule to match the operating conditions.

Specifications

IMPORTANT: When aligning the front axle, it is essential that the rear axle(s) be checked for correct alignment at the same time. Alignment of the rear axle(s) has a direct impact on how the vehicle tracks. See **Section 35.01**, Specifications.

Camber and Toe-In					
Axle Manufacturer	**Axle Model**	**Left Camber (deg)**	**Right Camber (deg)**	**Toe-In Limits in (mm)**	**Toe-In Target in (mm)**
Meritor	FF–943 FF–961 FG–941 FL–941	Axles built before September 1992:* +1/2 ± 7/16 Axles built from September 1, 1992:* 0 ± 7/16	0 ± 7/16	0 to +1/8† (0 to +3.2)	+1/16 (+1.6)
Freightliner	FK–120	+1/2 ± 1/4	+1/2 ± 1/4	0 to +1/8 (0 to +3.2)	+1/16 (+1.6)
Dana Spicer	EFA–12F4	+7/16 ± 7/16	+7/16 ± 7/16	0 to +1/8 (0 to +3.2)	+1/16 (+1.6)

* A manufacturer's code tag is riveted to the front of the axle beam for identification. Tags with no date code, or with a date code followed by the letter "P" (for example "24592P"), were manufactured before September 1, 1992.

† If adjustment is required, set the toe-in as close as possible to +1/16 inch.

Table 1, Camber and Toe-In

Caster					
Axle Model	**Beissbarth (deg)**	**Bee Line**		**Hunter (deg)**	**Target, All Models (deg)**
		Except LC 4000 (deg)	**LC 4000 (deg)**		
Meritor, Freightliner, and Dana Spicer	+3 to +6-1/2	+3 to +6-1/2	+2-1/4 to +4-3/4	+1-1/2 to +5	Left +3-1/2; Right +4
IMPORTANT: Caster settings for the left and right sides *must* be within 1/2 degree of each other. It is necessary for only one side to be within the specifications given in this table.					

Table 2, Caster

Tie Rod Clamp Nut Torque Values				
Axle Manufacturer	**Axle Model**	**Tie Rod Clamp Nut Size**	**Plain Nut Torque* lbf·ft (N·m)**	**Locknut Torque* lbf·ft (N·m)**
Meritor	FF–943, FF–961, FG–941, FL–941	5/8–11	40–60 (54–81)	40–60 (54–81)
Meritor	FF–943, FF–961, FG–941, FL–941	5/8–18	40–60 (54–81)	40–55 (54–75)
Freightliner	FK–120	7/16–14	—	46–50 (62–68)
Dana Spicer	EFA–12F4	1/2–13	—	45–60 (61–81)

* All torque values in this table apply to parts lightly coated with rust-preventive type oil.

Table 3, Tie Rod Clamp Nut Torque Values

Specifications

Miscellaneous Torque Values	
Description	**Torque lbf.ft (N.m)**
U-Bolt Nuts 7/8–14	400 (542)
Meritor Stopscrew Locknut	50–65 (68–88)
Freightliner Stopscrew Locknut	80–85 (108–115)
Dana Spicer Stopscrew Locknut	90–120 (122–163)

Table 4, Miscellaneous Torque Values

Front Axle Wheel Hubs and Wheel Bearings 33.01

Contents

Subject	Subject Number
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Hub Assembly Removal and Installation, Spoke Wheels	102
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Wheel Bearing Cup Removal and Installation, Ferrous Hubs	120
Wheel Stud Replacement, Disc Wheels	130
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General Information

The front axle full-floating wheel hub assembly is made up of four major components: tapered wheel bearings, the wheel hub, wheel studs, and the brake drum or rotor. **See Fig. 1.**

TAPERED WHEEL BEARINGS

A typical tapered wheel bearing assembly consists of a cone, tapered rollers, a roller cage, and a separate cup that is press-fit in the hub. **See Fig. 2.** All components carry the load, with the exception of the cage, which spaces the rollers around the cone.

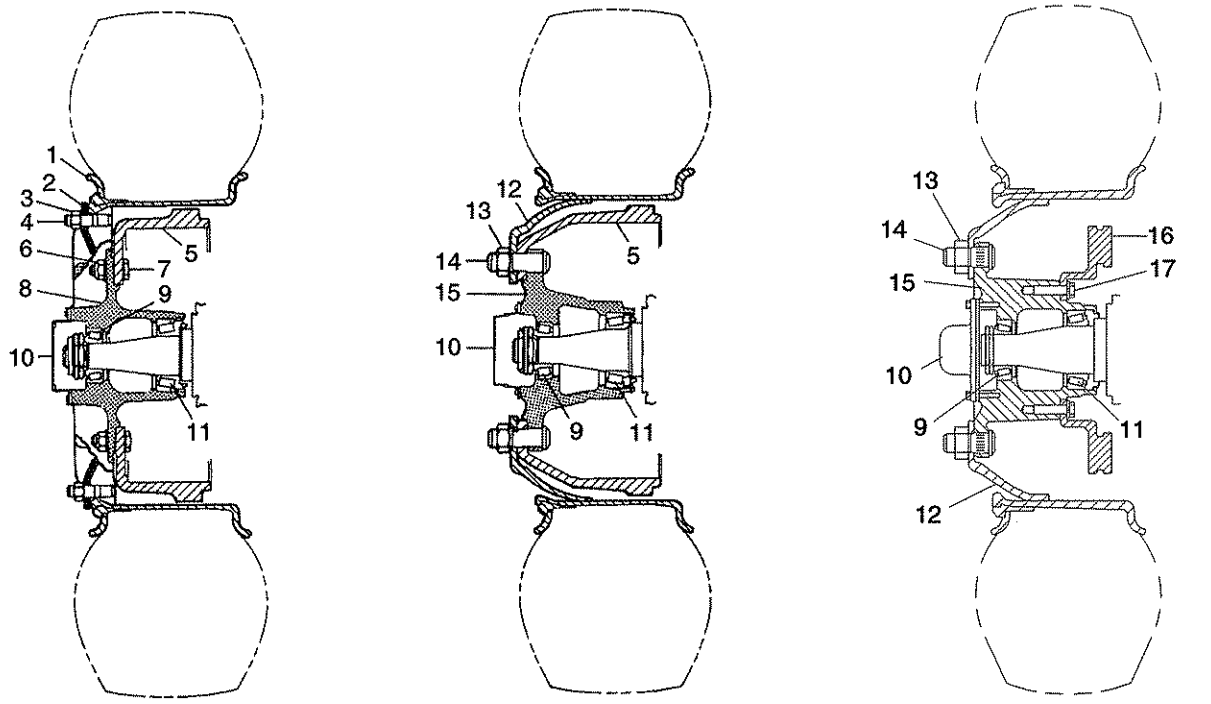
Each hub has a set of inner and outer tapered wheel bearing assemblies. The bearing setting is locked in place on the axle spindle (steering knuckle) by an adjusting nut and jam nut. **See Fig. 3.**

WHEEL HUB

The wheel and the brake drum or rotor are mounted on a steel or iron wheel hub **(Fig. 4).**

Both the inner and outer wheel bearing cups and the wheel studs are press-fit in the hub.

Spoke wheels combine the wheel and hub into a single unit.



Spoke Wheel Assembly with Drum Brakes

Disc Wheel Assembly with Drum Brakes

Disc Wheel Assembly with Disc Brakes

1. Rim
2. Rim Clamp
3. Rim Stud Nut
4. Rim Stud
5. Brake Drum
6. Brake Drum Nut
7. Brake Drum Bolt
8. Spoke Wheel
9. Outer Wheel Bearing
10. Hub Cap
11. Inner Wheel Bearing
12. Disc Wheel
13. Wheel Nut
14. Wheel Stud
15. Hub
16. Brake Rotor
17. Rotor Bolt

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Fig. 1

General Information

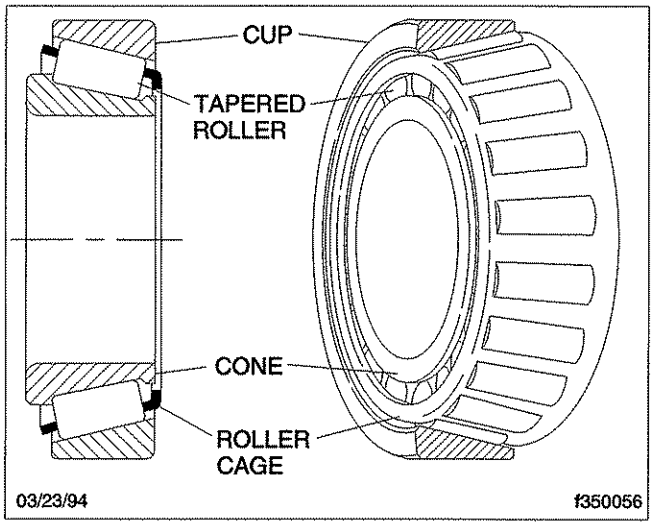


Fig. 2

WHEEL STUDS

A headed wheel stud **(Fig. 5)** is used on front axle disc wheel hub assemblies and has serrations on the stud body to prevent the stud from turning in the wheel hub.

The end of the stud that faces away from the vehicle is stamped with an "L" or "R," depending on which side of the vehicle the stud is installed. Studs stamped with an "L" are left-hand threaded and are installed on the driver's side of the vehicle. Studs stamped with an "R" are right-hand threaded and are installed on the passenger's side of the vehicle.

Spoke wheels have rim studs. Rim studs are threaded on both ends, with a nonthreaded section midway along the shaft of the stud. The studs are coated with an anaerobic locking compound.

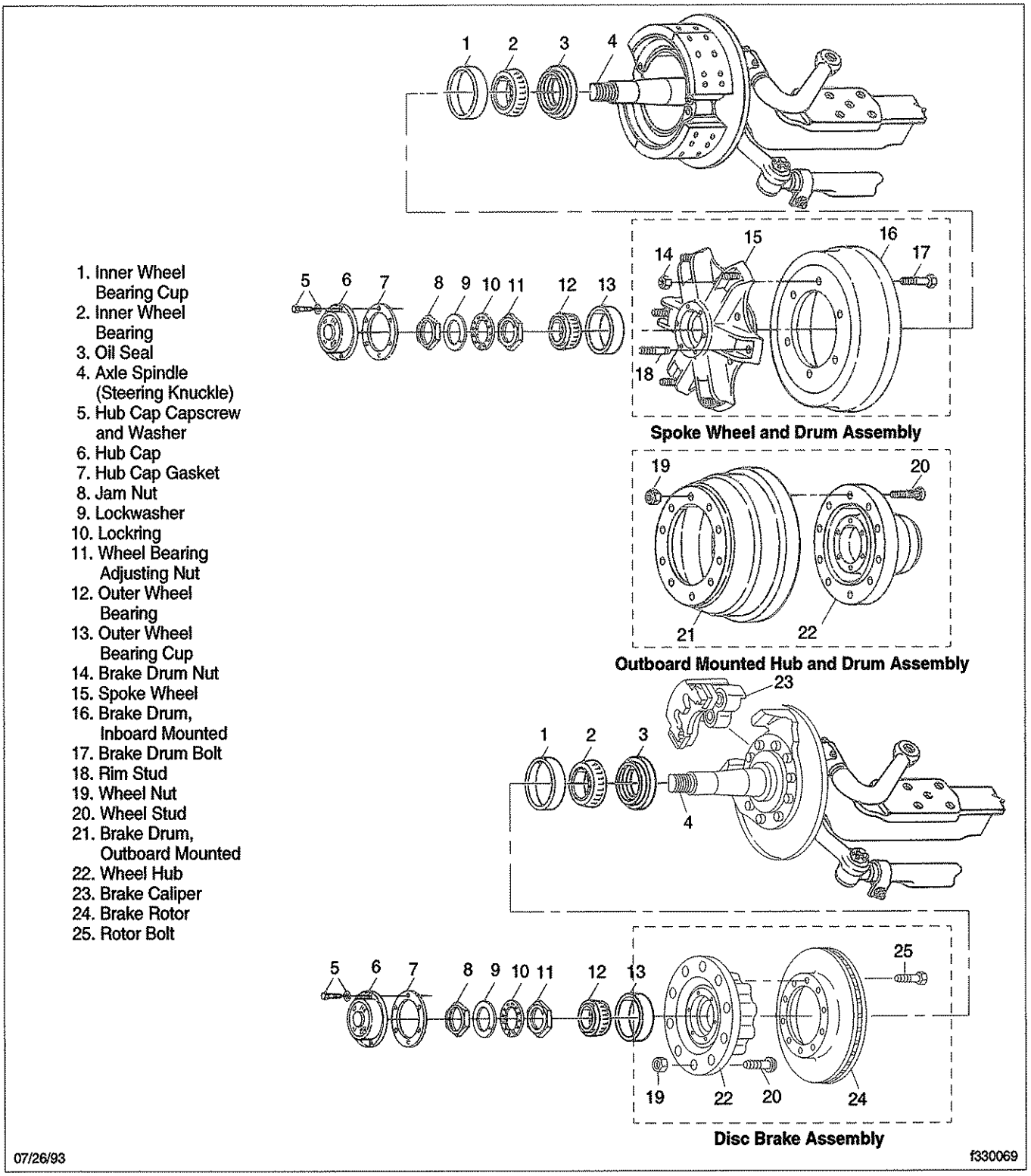

1. Inner Wheel Bearing Cup
2. Inner Wheel Bearing
3. Oil Seal
4. Axle Spindle (Steering Knuckle)
5. Hub Cap Capscrew and Washer
6. Hub Cap
7. Hub Cap Gasket
8. Jam Nut
9. Lockwasher
10. Lockring
11. Wheel Bearing Adjusting Nut
12. Outer Wheel Bearing
13. Outer Wheel Bearing Cup
14. Brake Drum Nut
15. Spoke Wheel
16. Brake Drum, Inboard Mounted
17. Brake Drum Bolt
18. Rim Stud
19. Wheel Nut
20. Wheel Stud
21. Brake Drum, Outboard Mounted
22. Wheel Hub
23. Brake Caliper
24. Brake Rotor
25. Rotor Bolt
Spoke Wheel and Drum Assembly
Outboard Mounted Hub and Drum Assembly
Disc Brake Assembly
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Fig. 3

General Information

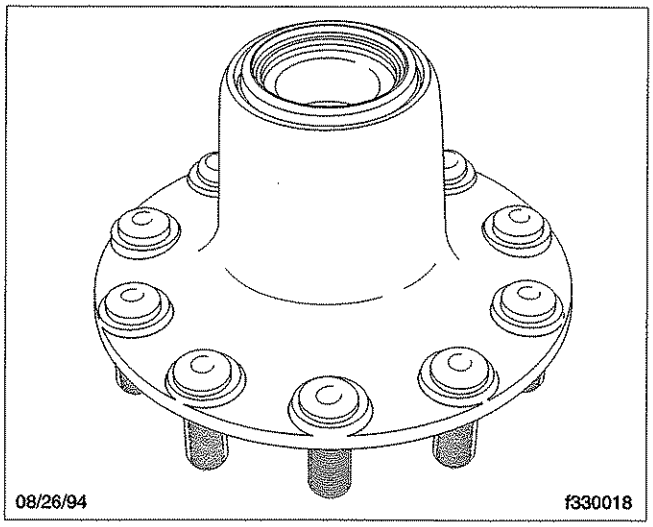


Fig. 4, Front Axle Wheel Hub

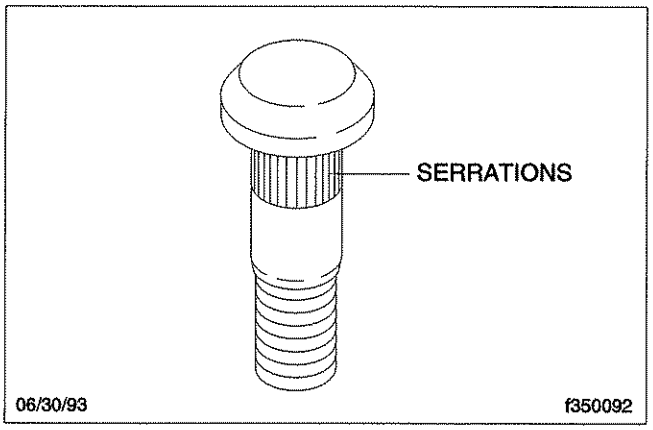
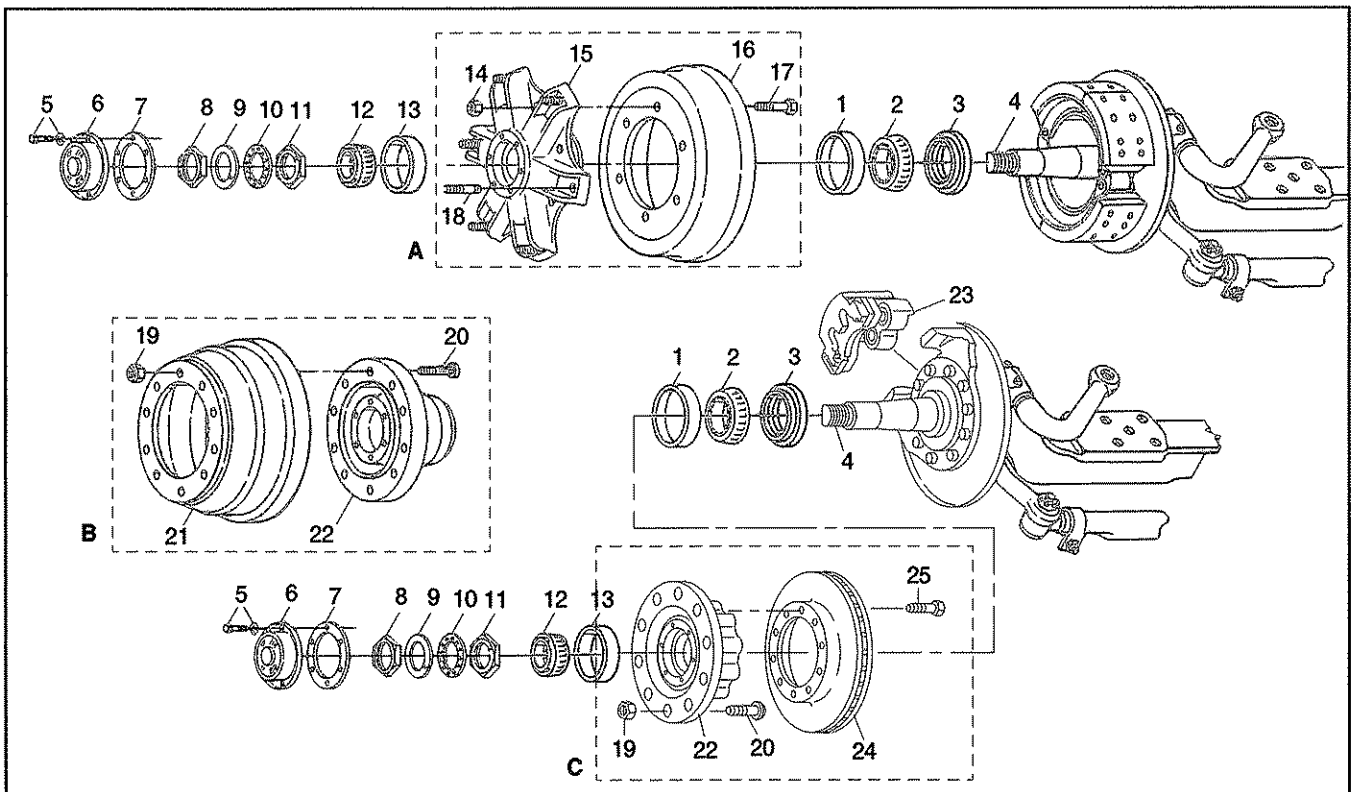


Fig. 5

Hub Assembly Removal and Installation, Disc Wheels

Removal (See Fig. 1)

1. Apply the parking brakes, and chock the rear tires to prevent vehicle movement.
2. Raise the front of the vehicle until the tires clear the ground. Then place safety stands under the axle.
3. On vehicles equipped with air brakes, back off the slack adjuster to release the front axle brake shoes. For instructions, see the applicable slack adjuster section in **Group 42.**
4. Remove the wheel and tire assembly. See **Group 40** for instructions.



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A. Spoke Wheel and Inboard-Mounted Drum Assembly
B. Disc Wheel, Hub, and Outboard-Mounted Drum Assembly
C. Disc Brake Assembly

1. Inner Wheel Bearing Cup
2. Inner Wheel Bearing
3. Oil Seal
4. Axle Spindle (Steering Knuckle)
5. Hub Cap Capscrew and Washer
6. Hub Cap
7. Hub Cap Gasket
8. Jam Nut
9. Lockwasher
10. Lockring
11. Wheel Bearing Adjusting Nut
12. Outer Wheel Bearing
13. Outer Wheel Bearing Cup
14. Brake Drum Nut
15. Spoke Wheel
16. Brake Drum, Inboard-Mounted
17. Brake Drum Bolt
18. Rim Stud
19. Wheel Nut
20. Wheel Stud
21. Brake Drum, Outboard-Mounted
22. Wheel Hub
23. Brake Caliper
24. Brake Rotor
25. Rotor Bolt

Fig. 1, Typical Front Axle Assembly

Hub Assembly Removal and Installation, Disc Wheels

⚠ WARNING

Breathing brake lining dust (asbestos or non-asbestos) could cause lung cancer or lung disease. OSHA has set maximum levels of exposure and requires workers to wear an air purifying respirator approved by MSHA or NIOSH. Wear a respirator at all times when servicing the brakes, starting with removal of the wheels and continuing through assembly.

5. To minimize the possibility of creating airborne brake lining dust, clean the dust from the brake drum, brake backing plate, and brake assembly, using an industrial-type vacuum cleaner equipped with a high-efficiency filter system. Then, using a rag soaked in water and wrung until nearly dry, remove any remaining dust. Don't use compressed air or dry brushing to clean the brake assembly.
6. Remove the brake drum (air brakes) or brake caliper (hydraulic brakes). For instructions, see **Group 42.**

NOTE: On vehicles equipped with oil-lubricated bearings, oil will spill as the hub cap and wheel hub are removed. Place a suitable container under the axle spindle to catch any spilled oil. Dispose of the oil safely.

7. Remove the capscrews, washers, and hub cap. Remove and discard the hub cap gasket.
8. Remove the axle spindle (steering knuckle) jam nut, lockwasher, and lockring or cotter pin. See **Fig. 2** or **Fig. 3.**
9. Back off the wheel bearing adjusting nut about two turns, or enough to allow the weight of the hub to be lifted from the wheel bearings.
10. Lift the hub until all weight is removed from the wheel bearings; remove the adjusting nut.

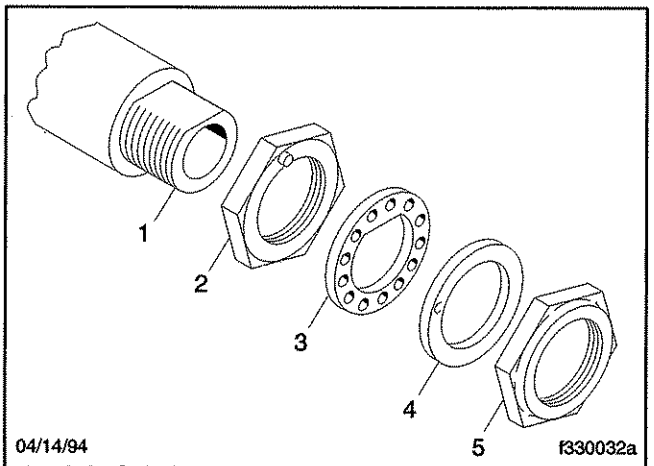
⚠ CAUTION

When moving the hub, be careful not to let the outer wheel bearing drop from the axle spindle. If the wheel bearing is dropped, cage warpage or roller damage can occur.

11. Move the hub about 13 mm (1/2 inch) to jar loose the outer wheel bearing (allow the hub-only assembly to rest on the axle spindle; be careful not to damage the axle spindle threads).
12. Carefully remove the outer wheel bearing. Handle the bearing assembly with clean, dry hands; wrap all bearing assembly parts in clean oil-proof paper or lint-free rags.

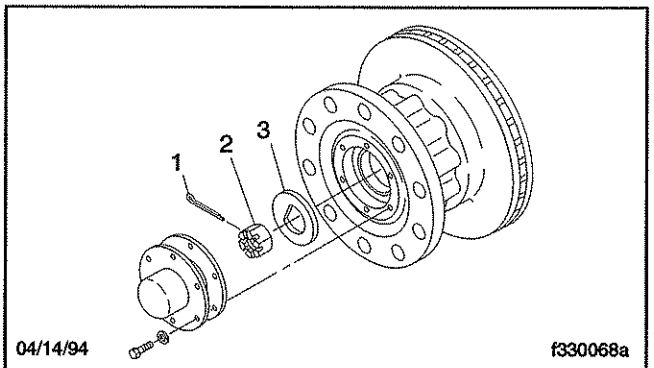
⚠ CAUTION

Don't spin the bearing rollers at any time. Dirt or grit can scratch their surfaces and cause rapid wear of the bearing assembly. Treat used bearings as carefully as new ones.



1. Axle Spindle
2. Adjusting Nut
3. Lockring
4. Lockwasher
5. Jam Nut

Fig. 2, Axle With Jam Nut and Lockring



1. Cotter Pin
2. Adjusting Nut
3. Thrustwasher ("D" Washer)

Fig. 3, Single Nut Adjustment Hub Assembly, With Disc Brakes Shown

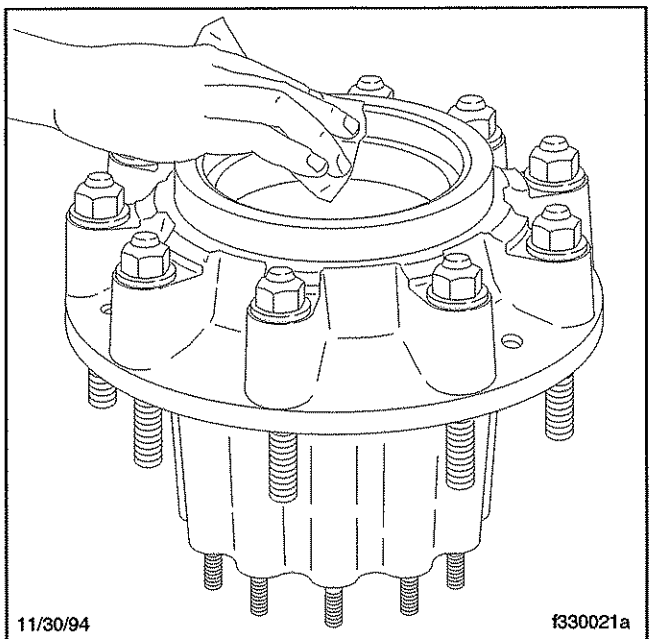
13. Remove the hub from the axle spindle. Be careful not to damage the axle spindle threads as the assembly is removed.
14. Remove the oil or grease seal from the hub with a seal removal tool.
15. Remove the inner wheel bearing from the hub. Handle the bearing assembly with clean, dry hands.

    If the bearing isn't easy to remove, place a protective cushion to catch it. Then, use a hardwood drift and a light hammer to gently tap the bearing (and seal, if needed) out of the cup. Wrap all bearing assembly parts in clean, oil-proof paper or lint-free rags.

IMPORTANT: Use extreme care in cleaning the wheel hub cavity and axle spindle. Dirt, metal filings, or other debris can scratch the bearing roller surfaces, and cause premature wear of the bearing assembly.

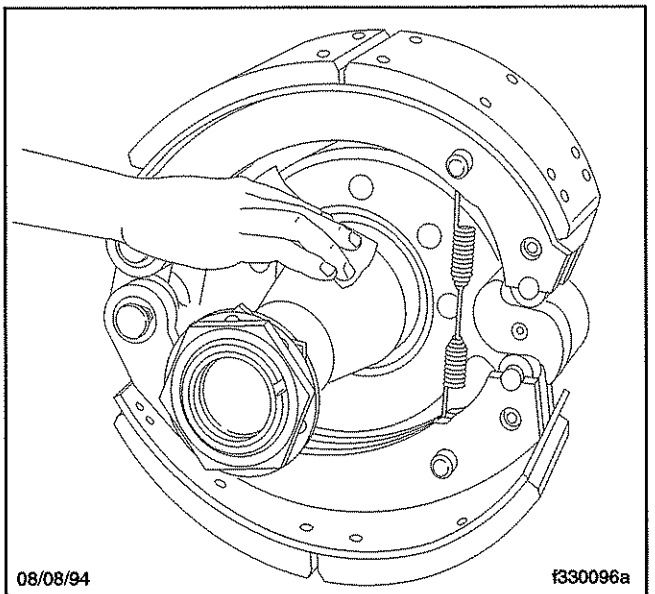
16. Using an emery cloth or file, remove all burrs from the hub shoulder. See **Fig. 4** or **Fig. 5**.

    Clean any metal filings from the parts. For instructions, see **Subject 110**.



NOTE: Typical application.

Fig. 4, Clean the Hub Shoulder



NOTE: Typical application.

Fig. 5, Clean the Spindle

Installation

⚠ WARNING

Breathing brake lining dust (asbestos or non-asbestos) could cause lung cancer or lung disease. OSHA has set maximum levels of exposure and requires workers to wear an air purifying respirator approved by MSHA or NIOSH. Wear a respirator at all times when servicing the brakes, continuing through installation of the wheels.

1. Using clean solvent, remove the old oil or grease from the axle spindle (steering knuckle) and the disassembled parts. Allow the parts to dry, or dry them with a clean, absorbent, and lint-free cloth or paper.
2. Wrap a protective layer of friction tape on the axle spindle threads.

Hub Assembly Removal and Installation, Disc Wheels

⚠ CAUTION

When coating the bearing assemblies with oil or grease, don't use old lube, which could be contaminated with dirt or water. Both are corrosives, and could damage the wheel bearings and hub.

3. If the axle is equipped with oil-lubricated bearings, coat them with fresh oil; if equipped with greased bearings, pack them using a pressure packer, if possible. If a packer is not available, pack the bearing by hand. Starting from the large end of the cone, force lithium-based wheel bearing grease into the cavities between the rollers and the cage. For lubricant specifications, see **Specifications, 400**.

   Install the inner wheel bearing and oil or grease seal. Handle the bearing assembly with clean, dry hands.

4. Depending on the type of bearing lubricant used on the axle, wipe a film of axle oil or grease on the axle spindle, to prevent rust from forming behind the inner wheel bearing.

5. Install the new oil or grease seals.

   5.1 Seat the small outer diameter of the seal in the recess of the tool adaptor. See **Fig. 6**. The correct adaptor is identified on the box.

   5.2 Insert the centering plug of the tool in the bore of the inner bearing cone. See **Fig. 7**. The plug prevents cocking of the seal in the bore.

   5.3 Hold the tool handle firmly, and strike it until the sound of the impact changes as the seal bottoms out. See **Fig. 8**. Hold the tool firmly to avoid bounce or unseating of the seal from the adaptor.

   5.4 After the seal is bottomed in the bore, check for freedom of movement by manually moving the interior rubber part of the seal back and forth. A slight movement indicates a damage-free installation.

6. Carefully mount the hub and inner wheel bearing assembly on the axle spindle. Be careful not to unseat the inner wheel bearing or seal.

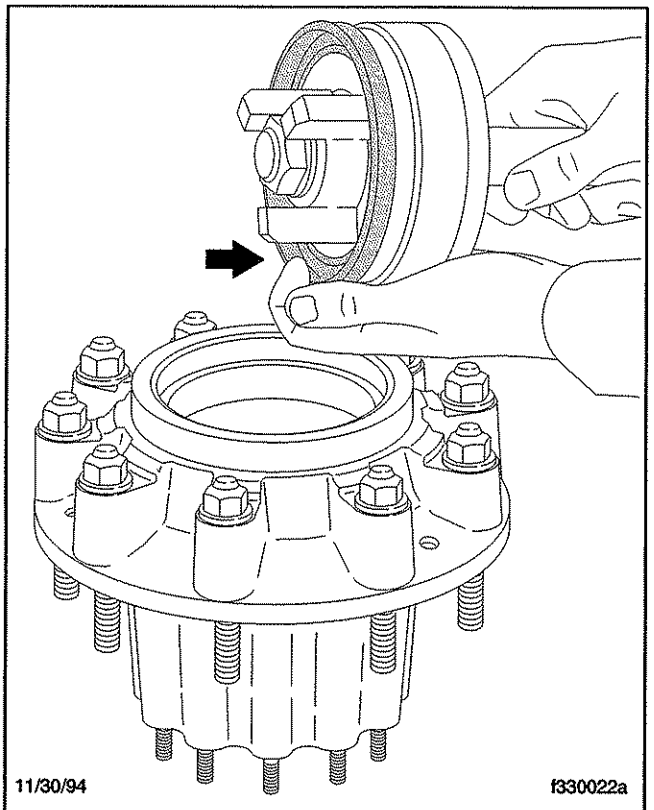
7. If the axle is equipped with oil-lubricated bearings, fill the hub cavity with oil; if equipped with greased bearings, pack the hub between the bearing cups with lubricant to the level of the smallest diameter of the cups. See **Fig. 9**.

   Install the outer wheel bearing. Handle the bearing assembly with clean, dry hands. Use care not to damage the bearing while seating it in the cup. Remove the friction tape from the axle spindle threads.

8. Install the wheel bearing adjusting nut. Tighten the nut finger-tight. Adjust the bearings (see **Fig. 2** or **Fig. 3**).

   IMPORTANT: Be sure there is sufficient clearance between the brake shoe and the brake drum, so brake shoe drag will not interfere with bearing adjustment.

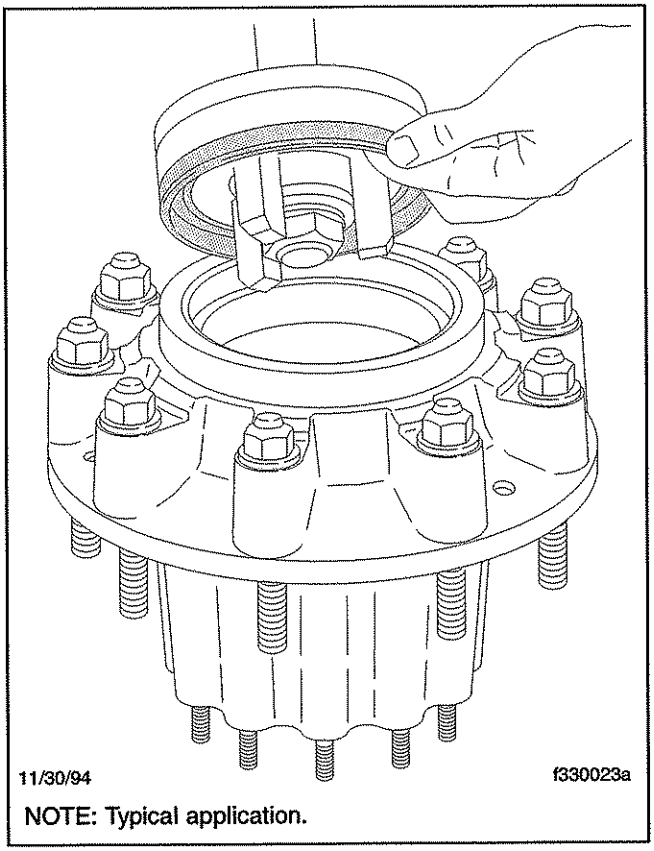
   8.1 After the wheel hub and bearings are assembled on the spindle, tighten the inner (adjusting) nut 271 N·m (200 lbf·ft) while rotating the wheel hub assembly.



NOTE: Typical application.

Fig. 6, Seat the Seal in the Tool

Hub Assembly Removal and Installation, Disc Wheels



NOTE: Typical application.

Fig. 7, Insert the Tool

8.2 Back off the inner nut one full turn.

8.3 Tighten the inner nut 68 N·m (50 lbf·ft) while rotating the wheel hub assembly.

8.4 Back off the inner nut one half turn.

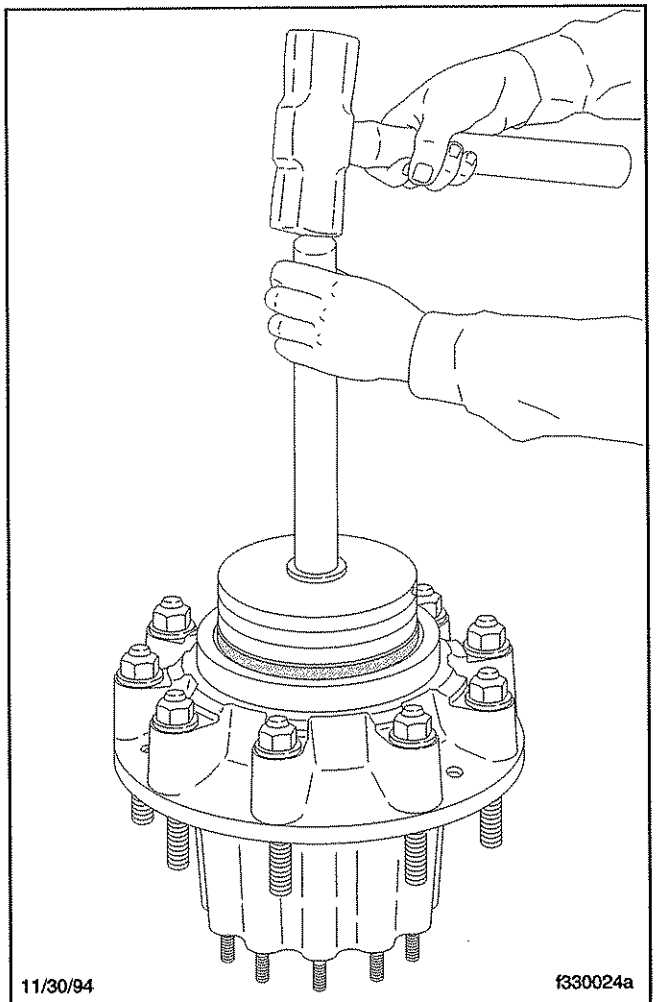
8.5 On applicable assemblies, install a new cotter pin (see **Fig. 3**), or install the jam nut and locking device as follows.

NOTE: If you're securing the wheel bearings with a pierced lockring and no hole in the lockring aligns with the dowel on the adjusting nut, remove the lockring, turn it over and install it, again. If a hole still doesn't align with the dowel, loosen the adjusting nut, but only enough to align the dowel with a hole in the lockring.

8.6 Install the locking device:

- Tanged nut-lock
- Lockring
- Lockwasher *and* a lockring
- Nut-lock *and* a lockring

Then install the jam nut, and tighten it to the applicable torque in **Table 1**.



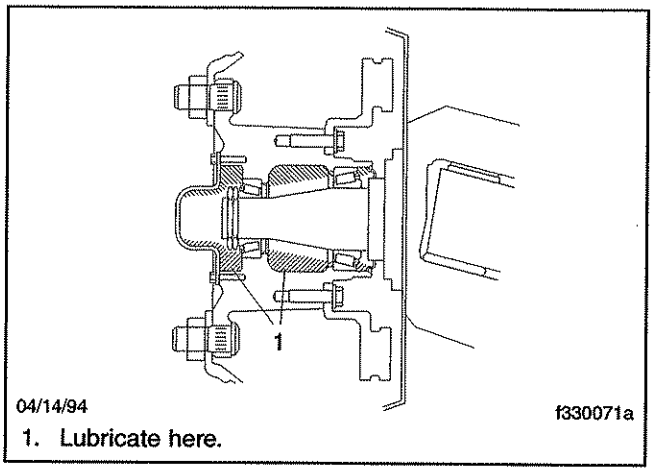
NOTE: Typical application.

Fig. 8, Strike the Tool

IMPORTANT: Do not adjust the wheel bearings with the wheel mounted on the hub. You cannot accurately adjust or measure bearing end play with the wheel mounted on the hub.

8.7 With the jam nut installed and tightened, attach a dial indicator to the hub and set the point of the indicator in line with the end of the axle spindle.

Hub Assembly Removal and Installation, Disc Wheels



1. Lubricate here.

Fig. 9, Lubricate the Bearings

If using aluminum hubs, you may have to install the brake drum on the hub to provide a steel base for the magnet of the dial indicator. Mount the drum on the hub's drum pilot, then adjust the brake or have someone apply the brakes to hold the drum securely while you secure the drum using the stud at the 12 o'clock position, then the studs at about the 4 o'clock and 8 o'clock positions.

NOTE: If using a stud-piloted hub and a steel drum, install 1–1/4 inch washers between the nuts and the drum.

8.8 Release the brakes if you used them to hold the drum while installing it.

Grip the sides of the hub at the three o'clock and nine o'clock positions, then push the hub (and drum, if applicable), to seat the inboard bearing set. Zero the dial indicator.

Grip the sides of the hub at the three o'clock and nine o'clock positions, then pull the hub (and drum, if applicable). Read the dial indicator, and note the end play.

Push the hub back in to confirm that the needle of the dial indicator returns to zero.

The end play must be between 0.025 and 0.127 mm (0.001 and 0.005 inch).

9. If the end play is not within this range, remove the jam nut and locking device, and back off or tighten the inner (adjusting) nut to adjust the end play. Keep the following in mind:

   If you're using a nut-lock: turning the inner nut 1/4 turn will change the end play about 0.355 mm (0.014 inch).

   If you're using a lockring: turning the inner nut one lockring hole will change the end play about 0.127 mm (0.005 inch). If you take the lockring off and reverse it, then turn the inner nut to the next hole, this will change the end play about 0.0635 mm (0.0025 inch).

   Install the locking device and jam nut as described earlier, and measure the end play. If the end play is not between 0.025 and 0.127 mm (0.001 and 0.005 inch), adjust the inner (adjusting) nut, again.

10. Once the end play is correct, bend the nut-lock or lockwasher as applicable to lock the jam nut and/or adjusting nut in place.

11. Rotate the wheel in both directions. It should turn freely with no dragging or binding.

12. If the axle is equipped with grease-packed bearings, pack the hub between the bearing cups with lithium-based wheel bearing grease to the level of the smallest diameter of the cups (see **Fig. 9**).

13. Place the hub cap and a new gasket in position, then install the washers and capscrews. Tighten the capscrews to the torque value in the torque table in **Specifications, 400**.

    If the axle is equipped with oil-lubricated bearings, add fresh oil to the wheel hub to the level shown on the hub cap. Refer to **Specifications, 400** for recommended axle lubricants.

Locking Device	Torque: lbf.ft (N.m)	
	1-1/8 to 2-1/2 Inch Jam Nuts	2-5/8 Inch or Larger Jam Nuts
Tanged Nut-Lock	200–300 (271–407)	
Lockring		

Hub Assembly Removal and Installation, Disc Wheels

Locking Device	Torque: lbf·ft (N·m)	
	1-1/8 to 2-1/2 Inch Jam Nuts	2-5/8 Inch or Larger Jam Nuts
Tanged Nut-Lock and Lockring	200–300 (271–407)	250–400 (339–542)
Lockwasher and Lockring		

Table 1, Jam Nut Torques

⚠ WARNING

Failure to add oil to the wheel hub after the hub has been serviced will cause the wheel bearings to overheat and seize during vehicle operation. See Fig. 10. Seized bearing rollers can cause sudden damage to the tire or axle, possibly resulting in personal injury due to loss of vehicle control.

14. Install the brake drum or caliper on the wheel hub. See **Group 42** for instructions.
15. Install the wheel and tire assembly. See **Group 40** for instructions.

⚠ WARNING

If the wheel nuts cannot be tightened to minimum torque values, the wheel studs have lost their locking action, and the wheel hub flange is probably damaged. In this case, replace it with a new wheel hub assembly. Failure to replace the wheel hub assembly when these conditions exist could result in the loss of a wheel or loss of vehicle control, and possible personal injury.

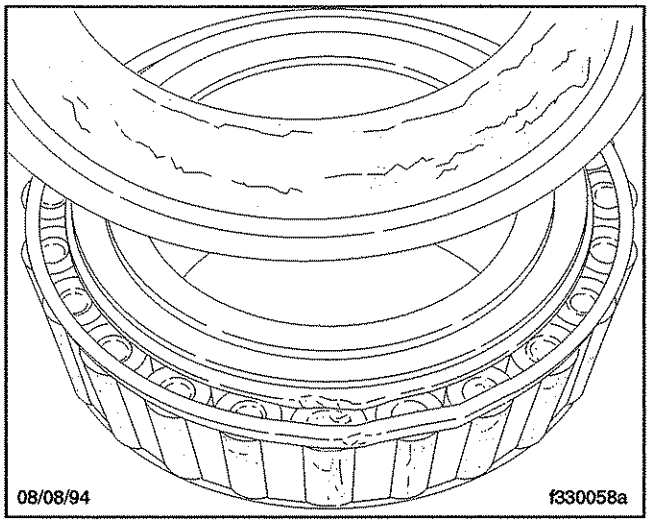


Fig. 10, Bearing Damage Resulting from Inadequate Lubrication

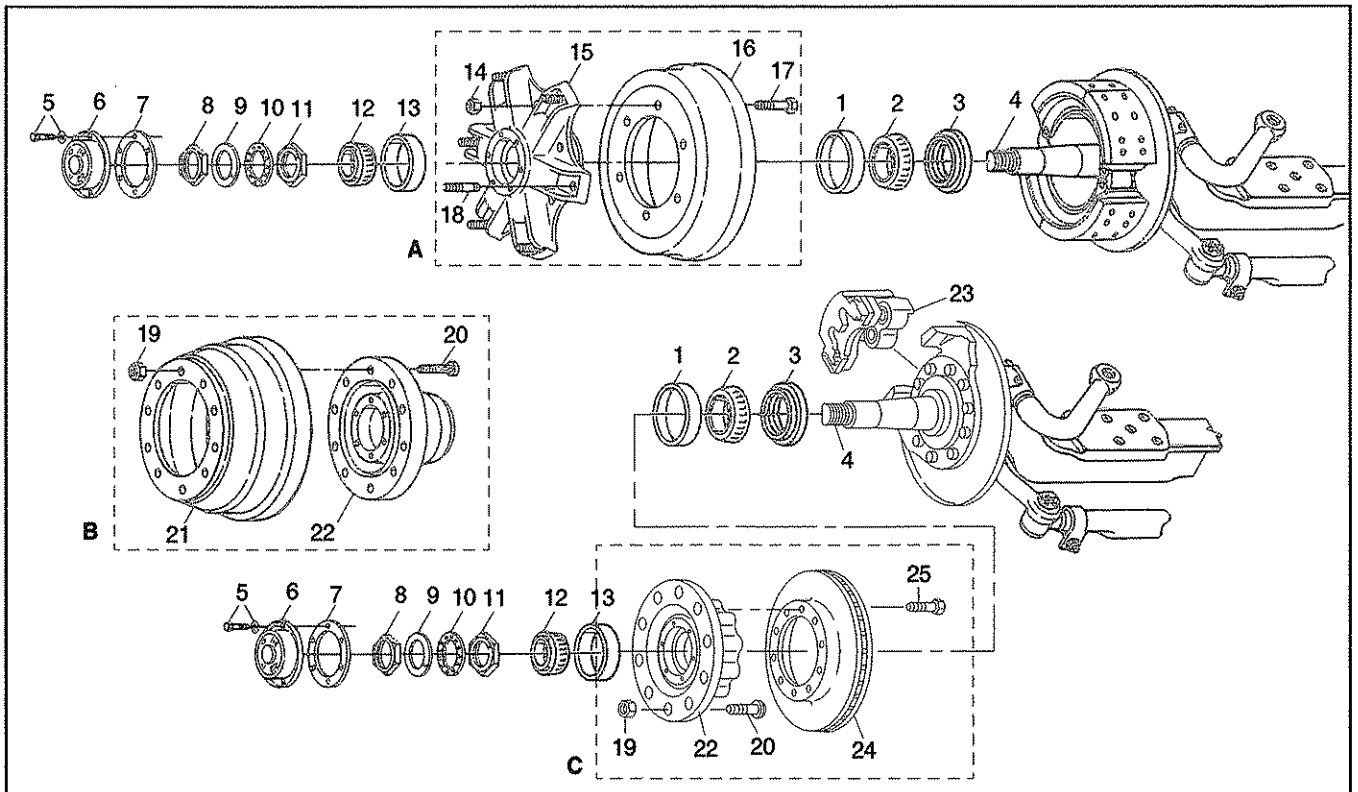
16. Adjust the front axle brakes. For instructions, see **Group 42** of the *Business Class Trucks Maintenance Manual.*
17. Remove the safety stands from under the axle; lower the vehicle.
18. Remove the chocks from the rear tires.

Hub Assembly Removal and Installation, Spoke Wheels

Removal (See Fig. 1)

1. Apply the parking brakes, and chock the rear tires to prevent vehicle movement.
2. Raise the front of the vehicle until the tires clear the ground; place safety stands under the axle. Position a jack or wheel-and-tire dolly under the tire.
3. On vehicles equipped with air brakes, back off the slack adjuster to release the front axle brake shoes. For instructions, see the applicable slack adjuster section in **Group 42.**
4. Remove the rim and tire assembly. See **Group 40** for instructions.

NOTE: On axles equipped with oil-lubricated bearings, oil will spill as the hub cap is removed. Place a suitable



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A. Spoke Wheel and Inboard-Mounted Drum Assembly
B. Disc Wheel, Hub, and Outboard-Mounted Drum Assembly
C. Disc Brake Assembly

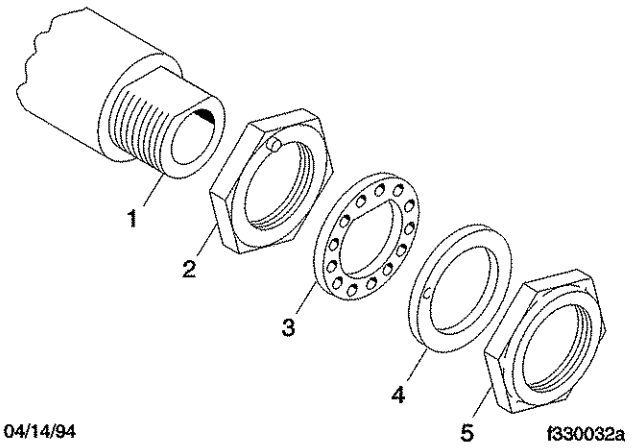
1. Inner Wheel Bearing Cup
2. Inner Wheel Bearing
3. Oil Seal
4. Axle Spindle (Steering Knuckle)
5. Hub Cap Capscrew and Washer
6. Hub Cap
7. Hub Cap Gasket
8. Jam Nut
9. Lockwasher
10. Lockring
11. Wheel Bearing Adjusting Nut
12. Outer Wheel Bearing
13. Outer Wheel Bearing Cup
14. Brake Drum Nut
15. Spoke Wheel
16. Brake Drum, Inboard-Mounted
17. Brake Drum Bolt
18. Rim Stud
19. Wheel Nut
20. Wheel Stud
21. Brake Drum, Outboard-Mounted
22. Wheel Hub
23. Brake Caliper
24. Brake Rotor
25. Rotor Bolt

Fig. 1, Typical Front Axle Assembly

Hub Assembly Removal and Installation, Spoke Wheels

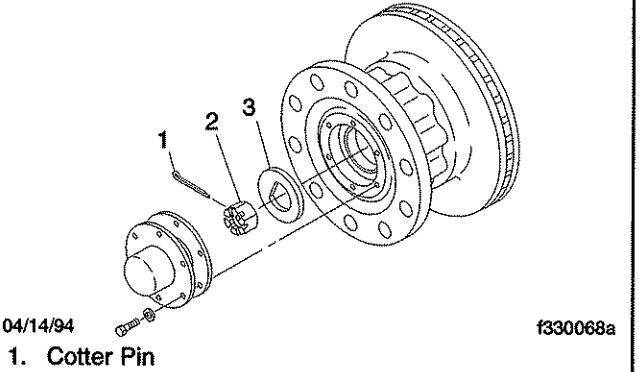
container under the wheel to catch any spilled oil. Dispose of the oil safely.

5. Remove the capscrews, washers, and hub cap. Remove and discard the hub cap gasket and oil.
6. Remove the axle spindle (steering knuckle) jam nut, lockwasher, and lockring or cotter pin. See **Fig. 2** or **Fig. 3**.
7. Back off the wheel bearing adjusting nut about two turns, or enough to allow the weight of the wheel and drum assembly to be lifted from the wheel bearings.



1. Axle Spindle
2. Adjusting Nut
3. Lockring
4. Lockwasher
5. Jam Nut

Fig. 2, Axle With Jam Nut and Lockring



1. Cotter Pin
2. Adjusting Nut
3. Thrustwasher ("D" Washer)

Fig. 3, Single Nut Adjustment Hub Assembly, With Disc Brakes Shown

8. Using an adjustable wheeled support, raise the wheel and drum assembly until all weight is removed from the bearings. Remove the adjusting nut.
9. Carefully remove the outer wheel bearing. Handle the bearing assembly with clean, dry hands. If the bearing hasn't loosened from the cup, move the wheel assembly about 13 mm (1/2 inch) to jar loose the outer wheel bearing. Be careful to not drop the bearing. Wrap all bearing assembly parts in clean oil-proof paper or lint-free rags.

⚠ CAUTION

Don't spin the bearing rollers at any time. Dirt or grit can scratch their surfaces and cause rapid wear of the bearing assembly. Treat used bearings as carefully as new ones.

10. Using the wheeled support, pull the wheel assembly away from the vehicle. Be careful not to damage the axle spindle threads as the assembly is removed.

⚠ WARNING

Breathing brake lining dust (asbestos or non-asbestos) could cause lung cancer or lung disease. OSHA has set maximum levels of exposure and requires workers to wear an air purifying respirator approved by MSHA or NIOSH. Wear a respirator at all times when servicing the brakes, starting with removal of the wheels and continuing through assembly.

11. To minimize the possibility of creating airborne brake lining dust, clean the dust from the brake drum, brake backing plate, and brake assembly, using an industrial-type vacuum cleaner equipped with a high-efficiency filter system. Then, using a rag soaked in water and wrung until nearly dry, remove any remaining dust. Don't use compressed air or dry brushing to clean the brake assembly.
12. Remove the brake drum or rotor nuts (**Fig. 1**) and detach the brake drum or rotor from the wheel.
13. Remove the oil or grease seal using a seal removal tool.

Hub Assembly Removal and Installation, Spoke Wheels

14. Remove the inner wheel bearing from the hub. Handle the bearing assembly with clean, dry hands.

    If the bearing isn't easy to remove, place a protective cushion to catch it. Then, use a hardwood drift and a light hammer to gently tap the bearing (and seal, if needed) out of the cup. Wrap all bearing assembly parts in clean, oil-proof paper or lint-free rags.

IMPORTANT: Use extreme care in cleaning the wheel hub cavity and axle spindle. Dirt, metal filings, or other debris can scratch the bearing roller surfaces, and cause premature wear of the bearing assembly.

15. Using an emery cloth or file, remove all burrs from the hub shoulder. See **Fig. 4** or **Fig. 5**.

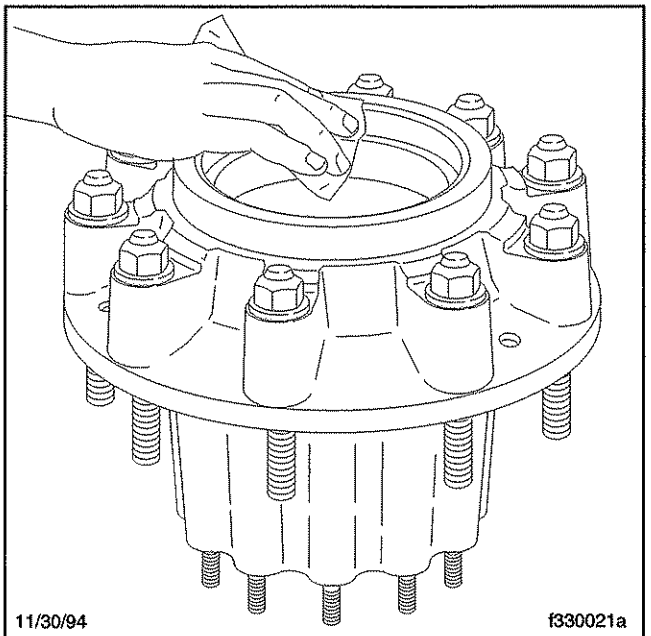
    Clean any metal filings from the parts. For instructions, see **Subject 110**.

Installation

⚠ WARNING

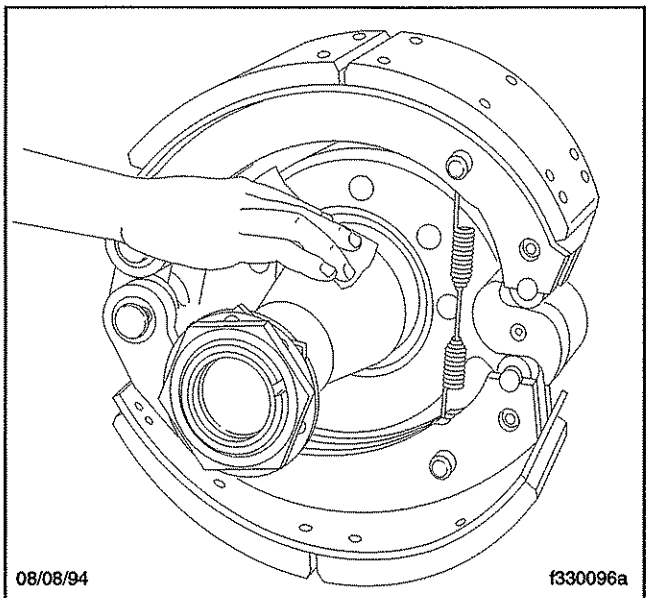
Breathing brake lining dust (asbestos or non-asbestos) could cause lung cancer or lung disease. OSHA has set maximum levels of exposure and requires workers to wear an air purifying respirator approved by MSHA or NIOSH. Wear a respirator at all times when servicing the brakes, starting with removal of the wheels and continuing through assembly.

1. Using clean solvent, remove the old oil or grease from the axle spindle (steering knuckle) and the disassembled parts. Inspect and clean the wheel hub cavity and the wheel bearings as instructed under **Subject 110**. Allow the parts to dry, or dry them with a clean, absorbent, and lint-free cloth or paper.
2. Wrap a protective layer of friction tape on the axle spindle threads.
3. If it was removed, attach the brake drum or rotor to the hub. Install the bolts and nuts, then tighten the nuts 325 N·m (240 lbf·ft) for drum brakes and 175 N·m (130 lbf·ft) for disc brakes.
4. If the axle is equipped with oil-lubricated bearings, coat them with fresh oil; If equipped with greased bearings, pack them using a pressure packer, if possible. If a packer is not available, pack the bearing by hand. Starting from the large end of the cone, force lithium-based wheel bearing grease



NOTE: Typical application.

Fig. 4, Clean the Hub Shoulder



NOTE: Typical application.

Fig. 5, Clean the Spindle

Hub Assembly Removal and Installation, Spoke Wheels

into the cavities between the rollers and the cage. For lubricant specifications, see **Specifications, 400.**

Install the inner wheel bearing. Handle the bearing assembly with clean, dry hands.

5. Install the new oil or grease seals.

   5.1 Seat the small outer diameter of the seal in the recess of the tool adaptor. See **Fig. 6.** The correct adaptor is identified on the box.

   5.2 Insert the centering plug of the tool in the bore of the inner bearing cone. See **Fig. 7.** The plug prevents cocking of the seal in the bore.

   5.3 Hold the tool handle firmly, and strike it until the sound of the impact changes as the seal bottoms out. See **Fig. 8.** Hold the tool firmly to avoid bounce or unseating of the seal from the adaptor.

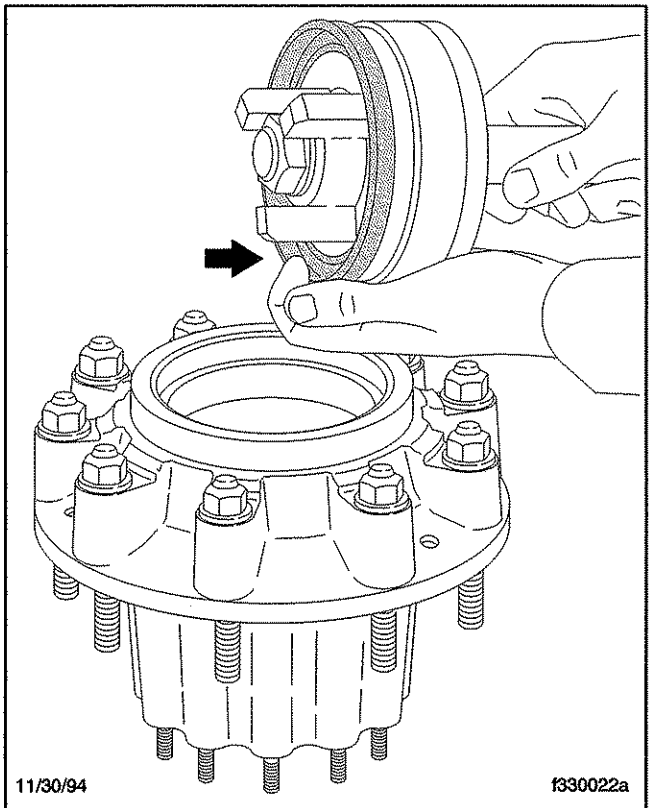
   5.4 After the seal is bottomed in the bore, check for freedom of movement by manually moving the interior rubber part of the seal back and forth. A slight movement indicates a damage-free installation.

6. Depending on the type of bearing lubricant used on the axle, wipe a film of axle oil or grease on the axle spindle, to prevent rust from forming behind the inner wheel bearing.

7. Using a wheeled support, mount the wheel and drum assembly on the axle spindle; be careful not to unseat the bearing or seal.

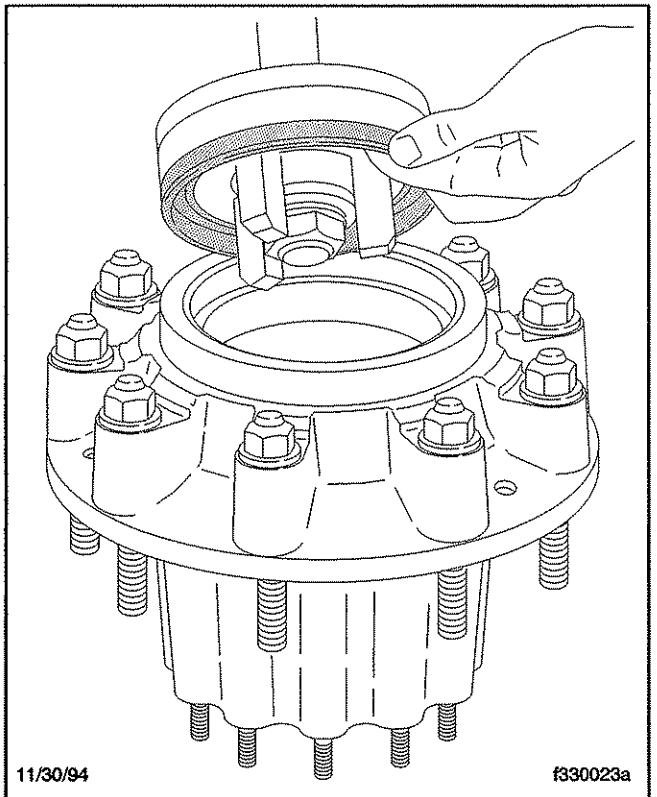
8. If the axle is equipped with oil-lubricated bearings, fill the hub cavity with oil; if equipped with greased bearings, pack the hub between the bearing cups with lubricant to the level of the smallest diameter of the cups. See **Fig. 9.**

   Install the outer wheel bearing. Handle the bearing assembly with clean, dry hands. Use care not to



NOTE: Typical application.

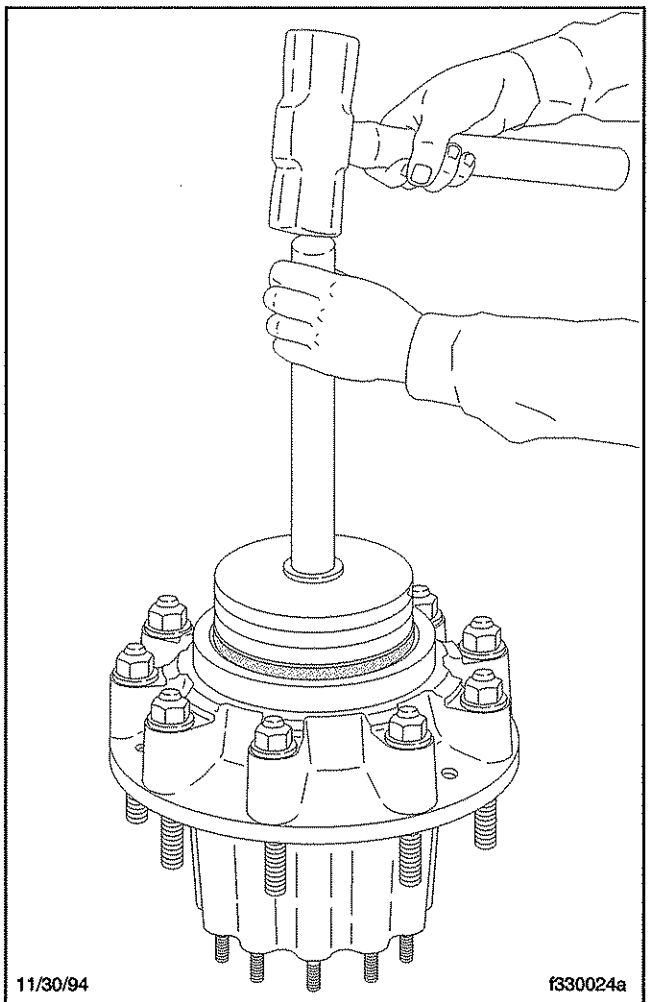
Fig. 6, Seat the Seal in the Tool



NOTE: Typical application.

Fig. 7, Insert the Seal in the Tool

Hub Assembly Removal and Installation, Spoke Wheels



NOTE: Typical application.

Fig. 8, Strike the Tool

damage the bearing while seating it in the cup. Remove the friction tape from the axle spindle threads.

9. Install the wheel bearing adjusting nut. Tighten the nut finger-tight. Adjust the bearings (see **Fig. 2** or **Fig. 3**).

   IMPORTANT: Be sure there is sufficient clearance between the brake shoe and the brake drum, so brake shoe drag won't interfere with bearing adjustment.

   9.1 After the wheel hub and bearings are assembled on the spindle, tighten the inner (adjusting) nut 271 N·m (200 lbf·ft) while rotating the wheel hub assembly.

   9.2 Back off the inner nut one full turn.

   9.3 Tighten the inner nut 68 N·m (50 lbf·ft) while rotating the wheel hub assembly.

   9.4 Back off the inner nut one half turn.

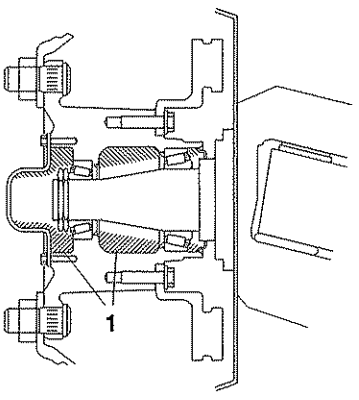
   9.5 On applicable assemblies, install a new cotter pin (see **Fig. 3**), or install the jam nut and locking device as follows.

   NOTE: If you're securing the wheel bearings with a pierced lockring and no hole in the lockring aligns with the dowel on the adjusting nut, remove the lockring, turn it over and install it, again. If a hole still doesn't align with the dowel, loosen the adjusting nut, but only enough to align the dowel with a hole in the lockring.

   9.6 Install the locking device:

   - Tanged nut-lock
   - Lockring
   - Lockwasher *and* a lockring
   - Nut-lock *and* a lockring

   Then install the jam nut, and tighten it to the applicable torque in **Table 1**.



1. Lubricate here.

Fig. 9, Lubricate the Bearings

Hub Assembly Removal and Installation, Spoke Wheels

Locking Device	Torque: lbf·ft (N·m)	
	1-1/8 to 2-1/2 Inch Jam Nuts	2-5/8 Inch or Larger Jam Nuts
Tanged Nut-Lock	200–300 (271–407)	
Lockring		
Tanged Nut-Lock and Lockring	200–300 (271–407)	250–400 (339–542)
Lockwasher and Lockring		

Table 1, Jam Nut Torques

IMPORTANT: Do not adjust the wheel bearings with the wheel mounted on the hub. You cannot accurately adjust or measure bearing end play with the wheel mounted on the hub.

9.7 With the jam nut installed and tightened, attach a dial indicator to the hub and set the point of the indicator in line with the end of the axle spindle.

If using aluminum hubs, you may have to install the brake drum on the hub to provide a steel base for the magnet of the dial indicator. Mount the drum on the hub's drum pilot, then adjust the brake or have someone apply the brakes to hold the drum securely while you secure the drum using the stud at the 12 o'clock position, then the studs at about the 4 o'clock and 8 o'clock positions.

NOTE: If using a stud-piloted hub and a steel drum, install 1–1/4 inch washers between the nuts and the drum.

9.8 Release the brakes if you used them to hold the drum while installing it.

Grip the sides of the hub at the three o'clock and nine o'clock positions, then push the hub (and drum, if applicable), to seat the inboard bearing set. Zero the dial indicator.

Grip the sides of the hub at the three o'clock and nine o'clock positions, then pull the hub (and drum, if applicable). Read the dial indicator, and note the end play.

Push the hub back in to confirm that the needle of the dial indicator returns to zero.

The end play must be between 0.025 and 0.127 mm (0.001 and 0.005 inch).

10. If the end play is not within this range, remove the jam nut and locking device, and back off or tighten the inner (adjusting) nut to adjust the end play. Keep the following in mind:

If you're using a nut-lock: turning the inner nut 1/4 turn will change the end play about 0.355 mm (0.014 inch).

If you're using a lockring: turning the inner nut one lockring hole will change the end play about 0.127 mm (0.005 inch). If you take the lockring off and reverse it, then turn the inner nut to the next hole, this will change the end play about 0.0635 mm (0.0025 inch).

Install the locking device and jam nut as described earlier, and measure the end play. If the end play is not between 0.025 and 0.127 mm (0.001 and 0.005 inch), adjust the inner (adjusting) nut, again.

11. Once the end play is correct, bend the nut-lock or lockwasher as applicable to lock the jam nut and/or adjusting nut in place.

12. Rotate the wheel in both directions. It should turn freely with no dragging or binding.

13. If the axle is equipped with grease-packed bearings, pack the hub between the bearing cups with lithium-based wheel bearing grease to the level of the smallest diameter of the cups (see **Fig. 9**).

14. Place the hub cap and a new gasket in position, then install the washers and capscrews. Tighten the capscrews to the torque value in the torque table in **Specifications, 400**.

15. Install the rim and tire assembly. See **Group 40** for instructions.

Hub Assembly Removal and Installation, Spoke Wheels

⚠ WARNING

If the rim nuts cannot be tightened to minimum torque values, the rim studs have lost their locking ability, and the wheel hub flange is probably damaged. In this case, replace it with a new wheel. Failure to replace the wheel when these conditions exist could result in loss of a wheel or loss of vehicle control, and possible personal injury.

16. Lower and remove the jack or wheel-and-tire dolly from under the tires.
17. If the axle is equipped with oil-lubricated bearings, add fresh oil to the wheel hub to the level shown on the hub cap. See **Specifications, 400** for recommended axle lubricants.

⚠ WARNING

Failure to add oil to the wheel hub after the hub has been serviced will cause the wheel bearings to overheat and seize during vehicle operation. See Fig. 10. Seized bearing rollers can cause sudden damage to the tire or axle, possibly resulting in personal injury due to loss of vehicle control.

18. Adjust the front axle brakes. For instructions, see **Group 42.**
19. Remove the safety stands from under the axle; lower the vehicle.

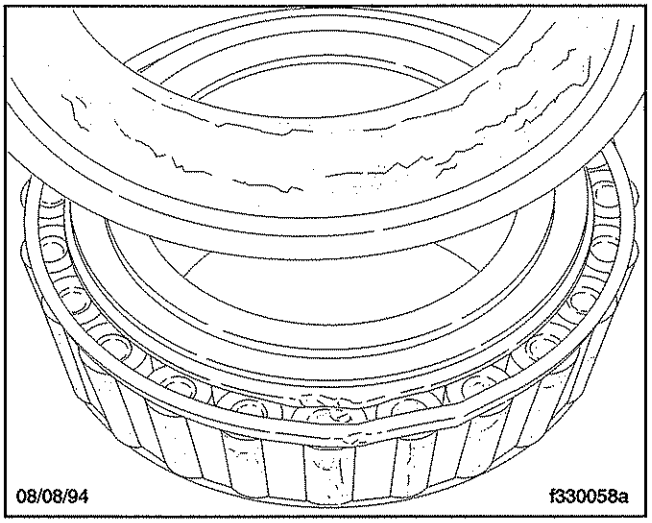


Fig. 10, Bearing Damage Resulting from Inadequate Lubrication

20. Remove the chocks from the rear tires.

Wheel Hub Assembly Inspection

1. Inspect the wheel hub mounting flange. A loose wheel assembly will cause the flange to be worn, jagged, or warped. **See Fig. 1.** Replace the wheel hub if any of these conditions exist.

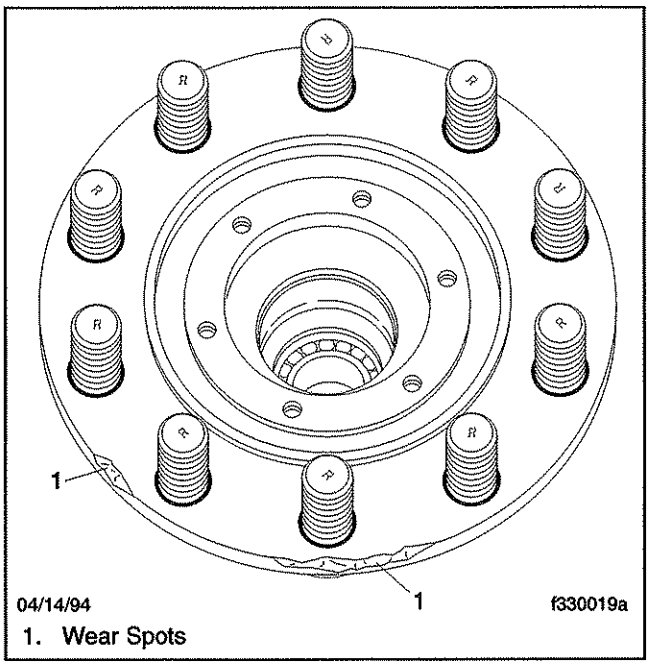
   Inspect the flange surface around the wheel studs. Improperly torqued wheel nuts will cause worn or cracked stud grooves on the hub. **See Fig. 2.** If wear spots or cracks appear anywhere on the hub, or if the hub is otherwise damaged, replace it with a new one.

2. Remove all the old oil or grease from the spoke wheel or hub cavity. Inspect the inner surface of the wheel or hub for cracks, dents, wear, or other damage. Replace the wheel or hub if damaged.

3. Remove all the old grease or oil from the surfaces of the wheel bearing cups. Inspect the cups for cracks, wear, spalling, or flaking. **See Fig. 3.** Replace the cups if damaged in any way. Refer to **Subject 120.**

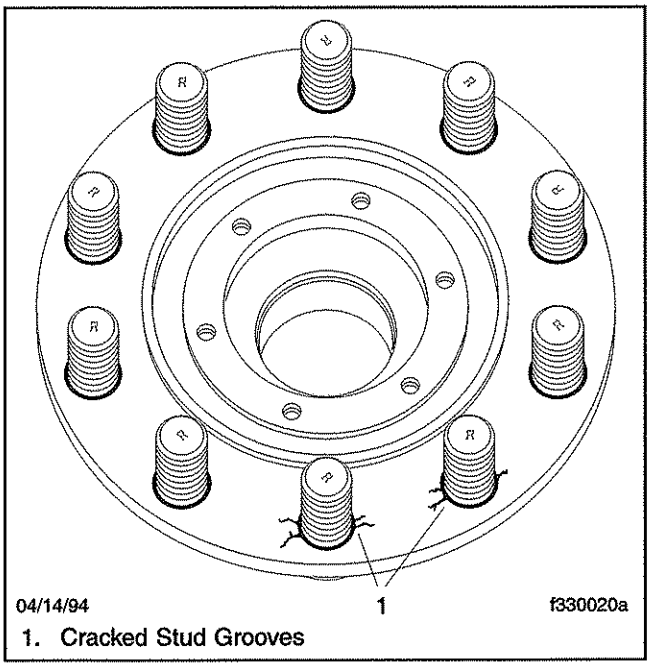
4. Inspect the wheel nuts on disc wheel installations, or the rim nuts on spoke-wheel installations. Damaged nuts (**Fig. 4**), usually caused by inadequate tightening, must be replaced with new ones.

5. Inspect the wheel studs or rim studs. Replace studs that are stripped, broken, bent, or otherwise damaged. Refer to **Subject 130** or **Subject 140.**



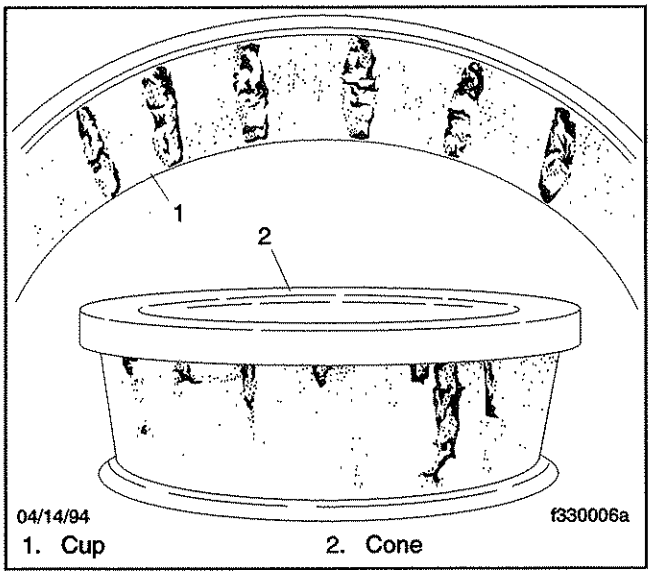
1. Wear Spots

Fig. 1, Damaged Front Axle Wheel Hub



1. Cracked Stud Grooves

Fig. 2, Damaged Front Axle Wheel Hub



1. Cup 2. Cone

Fig. 3, Spalling (Flaking) of Wheel Bearing Assembly

Axle Components Cleaning and Inspection

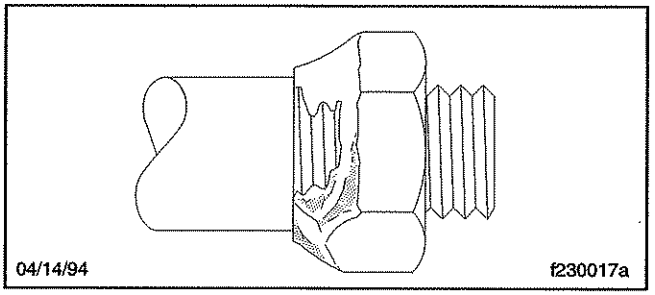


Fig. 4, Damaged Wheel Stud Nut

Wheel Bearing Cleaning and Inspection

CLEANING

⚠ WARNING

WARNING: To prevent skin irritation, wear chemical resistant gloves when working with diesel fuel or kerosene. Also, don't expose these fluids to flames or heat exceeding 38°C (100°F); both are combustible, and could cause personal injury if ignited.

⚠ CAUTION

CAUTION: Don't spin the bearing rollers at any time. Dirt or grit can scratch the roller surface and cause premature wear of the bearing assembly. Treat a used bearing as carefully as a new one.

Wheel bearings should be very closely inspected at the time of disassembly. The best inspection conditions are possible only after the bearings have been thoroughly cleaned using kerosene or diesel fuel oil, and a stiff brush (**see Fig. 5**). Before inspecting, clean the bearings, as described below.

1. Clean all old oil or grease from the bearings and hub cavities, with kerosene or diesel fuel and a stiff brush. **See Fig. 5.** Don't use gasoline or heated solvent.
2. Allow the cleaned parts to dry, or dry them with a clean absorbent cloth or paper.

   Clean and dry your hands and all tools used in the maintenance operation. Oil will not stick to a surface that is wet with kerosene or diesel fuel, and the kerosene or diesel fuel may dilute the lubricant.

INSPECTION

After the bearings are cleaned, inspect the assemblies, which include the rollers, cones, cups, and cages. If any of the conditions below exist, replace the bearing assemblies.

A. The large ends of the rollers are worn flush to the recess; the radii at the large ends of the rollers are worn sharp. These are signs of advanced wear. **See Fig. 6.**

B. Visible step wear, especially at the small end of the roller track, or deep indentations, cracks, or breaks in the cone surfaces. **See Fig. 7.**

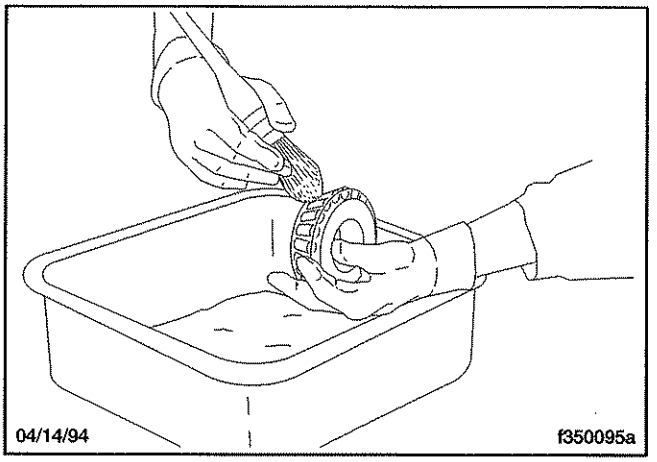
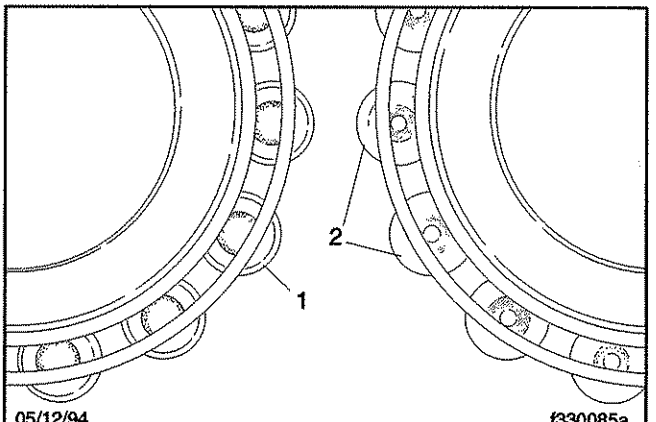


Fig. 5, Wheel Bearing Cleaning



1. New Bearing
2. Worn Bearing Rollers

Fig. 6, Wheel Bearing Roller Wear

C. Bright rubbing marks on the dark phosphate surfaces of the bearing cage. **See Fig. 8.**

D. Water etch on any bearing surface. Water etch appears as gray or black stains on the steel surface, and it greatly weakens the affected area. If water etch is present, check the bearing seal sealing surfaces.

E. Etching or pitting on functioning surfaces. **See Fig. 9.**

F. Spalling (flaking) of the bearing cup, roller, or cone surfaces. **See Fig. 3.**

After inspection, pack the bearings with fresh axle lubricant. If a packer is not available, pack the bearing by hand. Starting from the large end of the cone, force lithium-based wheel bearing grease into the cavities between the rollers and the cage. For installation, refer to **Subject 100** or **Subject 102.**

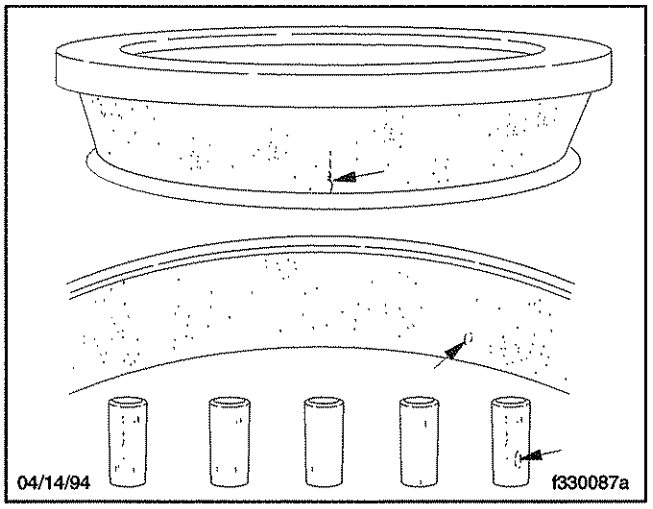


Fig. 7, Indentations, Cracks, or Breaks in Bearing Surfaces

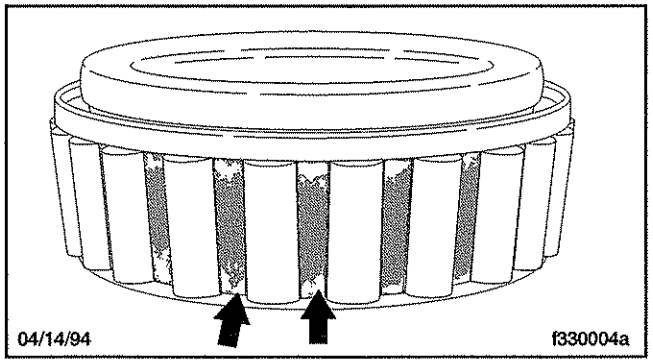


Fig. 8, Rubbing Marks on Bearing Cage

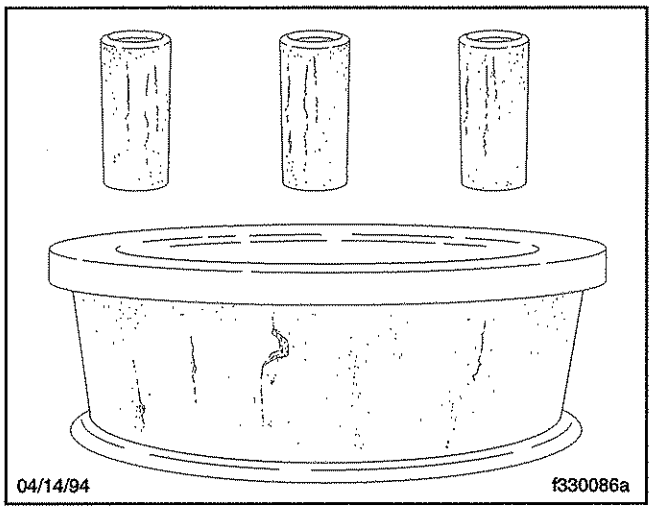


Fig. 9, Etching (Pitting) on Bearing Surfaces

Wheel Bearing Cup Removal and Installation, Ferrous Hubs

Removal

Wheel bearing cups in ferrous hubs are removed by driving them out; there is no need to first heat the hubs.

⚠ WARNING

WARNING: Commercial cleaning solvents are toxic, can cause severe skin irritation, and may be fire hazards. When using solvents, follow the safety precautions recommended by the solvent manufacturer.

1. Using a solvent, completely remove all grease, oil, and other debris from the outer and inner surfaces of the wheel hub assembly.
2. Using a mild-steel rod through the opposite end of the hub, drive against the inner edge of the bearing cup. Alternately drive on opposite sides of the cup to avoid cocking the cup and damaging the inside of the hub.

Installation

Wheel bearing cups are installed in ferrous hubs by pressing them in; there is no need to first heat the hubs.

⚠ WARNING

WARNING: Commercial cleaning solvents are toxic, can cause severe skin irritation, and may be fire hazards. When using solvents, follow the safety precautions recommended by the solvent manufacturer.

1. Using a solvent, completely remove all grease, oil, and other debris from the outer and inner surfaces of the wheel hub assembly, including the bearing cup bores.
2. Inspect the bearing cup bores of the hub for warpage or uneven surfaces. If a bearing cup bore is damaged, replace the wheel hub assembly.
3. Coat the hub-contact surface of the replacement bearing cup with a film of grease.
4. Position the cup in the hub and press it into place, using a suitable driving tool. Cups must seat against the shoulder in the hub.

⚠ WARNING

WARNING: To prevent skin irritation, wear chemical resistant gloves when working with diesel fuel or kerosene. Also, don't expose these fluids to flames or heat exceeding 38°C (100°F); both are combustible, and could cause personal injury if ignited.

5. Wipe off the accumulation of grease left after the bearing cup has been seated. Then, using a clean lint-free cloth dampened with kerosene or diesel fuel oil, clean the inner surface of the bearing cup. Wipe the surface dry using a clean, absorbent, and lint-free cloth or paper.

Wheel Stud Replacement, Disc Wheels

Replacement

⚠ WARNING

WARNING: If a wheel stud breaks, the remaining studs are subjected to undue strain and could fail due to fatigue. When a broken stud is replaced, replace the stud on each side of it. See Fig. 1. If more than one stud is broken, replace all of the studs. Failure to replace the studs could result in the loss of a wheel or loss of vehicle control, possibly resulting in personal injury.

1. Remove the wheel hub from the axle. For instructions, **refer to "Hub Assembly Removal and Installation, Disc Wheels, 100."**
2. If a bent portion of a wheel stud will have to pass through the wheel stud bore, cut off the bent portion before removing the wheel stud.
3. Place the wheel hub on a suitable press; make sure the hub flange is evenly supported around and next to the stud being removed. With steady movement, press the damaged stud out of the hub.

⚠ CAUTION

CAUTION: Don't use a drift and hammer or concentrated heat for removing and installing the wheel studs. Constant, smooth movement of the wheel stud is needed to ensure the least amount of metal removal from the wheel stud bore. Concentrated heat will damage the hub. If the hub is damaged during wheel stud removal or installation, replace it.

4. Apply a coat of clean axle grease to the entire shaft on headed studs.
5. With the hub on a suitable press, make sure the hub flange is evenly supported around and next to the stud being installed.
6. Position the stud in its hole.

⚠ CAUTION

CAUTION: Position the teeth of the serrated portion in the notches carved by the original wheel studs during factory installation. If additional metal is scraped from the wheel stud bores, the locking action provided by the serrations will be greatly weakened. Loss of locking action will prevent achieving final torque of the wheel nuts during wheel installation. If final wheel nut torques cannot be achieved, replace the wheel hub assembly.

IMPORTANT: If the driver's side of the vehicle is being serviced, the replacement wheel stud must be stamped with an "L" (left-hand threaded), and the nut's face must be stamped "Left." If the passenger's side of the vehicle is being serviced, the replacement stud

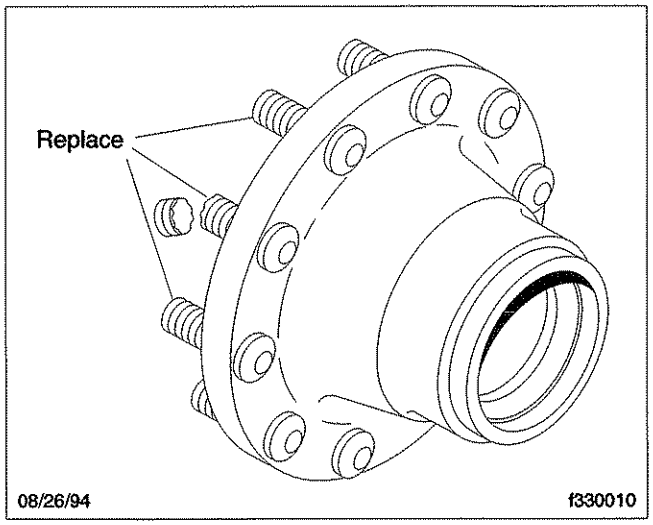


Fig. 1

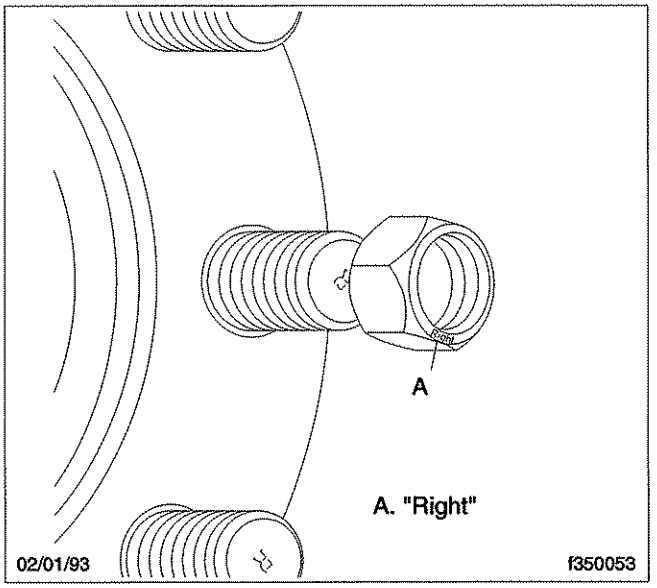


Fig. 2

Wheel Stud Replacement, Disc Wheels

must be stamped with an "R" (right-hand threaded), and the nut's face must be stamped "Right" **(Fig. 2).**

7. With steady movement, press the new stud all the way into the hub.
8. Make sure the stud is fully seated and that its head (flange) is not embedded in the hub. If the head of the stud is embedded in the hub, replace the hub.
9. Wipe off any grease on the wheel studs and hub. Install wheel nuts on dry wheel studs only.
10. Install the wheel hub on the axle. For instructions, **refer to "Hub Assembly Removal and Installation, Disc Wheels, 100."**

Rim Stud Replacement, Spoke Wheels

Replacement

1. Remove the rim and tire assembly from the spoked wheel. For instructions, **refer to the wheels and tires group.**
2. If enough threads remain on the damaged stud, remove it by double-nutting the stud. Turn the inner nut with a wrench in order to remove the stud. Then, go to the step for tapping out the rim stud hole.

   If the rim stud is broken near the surface of the wheel, the stud should be center-drilled using a high-speed drill, and then removed with an easy-out tool. If needed, grind off a flat surface on the damaged stud, then centerpunch the surface as starting point for drilling. Remove the stud.

   2.1 Determine the correct drill diameter by referring to the easy-out tool manufacturer's guidelines. At no time should it be large enough to penetrate the threads of the stud; if the stud threads in the wheel are damaged, replace the wheel.

   2.2 Don't drill more than 32 mm (1-1/4 inches) into the broken stud, as measured at the stud's entrance into the wheel. Drilling through the bottom of the rim stud could damage the wheel. If the wheel is drilled into, replace it.

   2.3 While drilling, keep the cutting surfaces of the drill well lubricated with oil, which acts as a coolant. Allow the drill and drill bit to cool frequently.
3. After the damaged stud is removed, tap out the rim stud hole in the wheel to rid the threads of old stud-locking compound. Use an appropriate tap size, depending on the original rim stud installation size.
4. Be sure the threads of the new stud are clean and dry. Then, coat the insertion end of the rim stud with an anaerobic thread-lock compound.
5. Using double nuts on the fine thread portion of the stud, install the new stud. Seat the rim stud using the torques values in the torque table in **"Specifications, 400."**
6. Allow enough time for the thread-lock compound to set, as suggested by the manufacturer.
7. Install the rim and tire assembly. For instructions, **refer to the wheels and tires group.**

Troubleshooting

- Noisy Bearings or Excessive Bearing Replacement Intervals
- Broken Wheel or Rim Studs
- Damaged Hub
- Loss of Lubricant from the Wheel Hubs
- Vehicle Doesn't Slow Down Quickly Enough When the Brakes Are Applied

Problem—Noisy Bearings or Excessive Bearing Replacement Intervals

Possible Cause	Remedy
Not enough oil or grease was used on the bearings, or the wrong type of oil or grease was used.	Clean then inspect the bearings for wear. Replace worn seals. Coat the bearing assemblies with fresh oil or grease. For lubricant specification, **refer to "Specifications, 400."**
Foreign matter or corrosive agents entered the bearing assembly. Dirt or metallic debris from the bearings was not removed.	Clean then inspect the bearings for wear. Replace worn seals. Also clean the wheel hub, the axle spindle, and any other part in contact with the bearing lubricant.
An incorrect adjustment of the wheel bearings is causing noise and wear.	Adjust the wheel bearings following the instructions in **Subject 100** and **Subject 102** in this section.
Flat spots or dents on the roller surface were caused by skidding of the roller or improper handling of the wheel bearing during installation.	Clean then inspect the bearing rollers. Replace the bearing if damaged. Coat the replacement bearings with fresh oil. For lubricant specifications, **refer to "Specifications, 400."**

Problem—Broken Wheel or Rim Studs

Possible Cause	Remedy
The wheel or rim nuts were overtightened.	Replace the wheel or rim studs. **Refer to the wheels and tires group** for the wheel or rim nut tightening sequence.
An incorrect nut tightening sequence was used.	
The vehicle is being overloaded.	Don't exceed the maximum load-carrying capacity of the vehicle.

Problem—Damaged Hub

Possible Cause	Remedy
(Bent flange) Incorrect installation of the wheel studs, such as using a hammer and drift, or the hub flange was not fully supported on the press during wheel stud replacement.	Replace the hub assembly. Replace the wheel studs as instructed under **"Wheel Stud Replacement, Disc Wheels, 130."**
Insufficient tightening of the wheel nuts to the wheel hub.	Replace the hub assembly and tighten the wheel nuts to the values in the torque table in **"Specifications, 400."**

Problem—Loss of Lubricant from the Wheel Hubs

Possible Cause	Remedy
The seals or gaskets are worn or damaged.	Replace worn or damaged parts.

Troubleshooting

Problem—Vehicle Doesn't Slow Down Quickly Enough When the Brakes Are Applied

Possible Cause	Remedy
The brake drums are worn, heat-checked, or cracked.	Install new brake drums.

Specifications

This subject contains the following tables:

- Torque Values
- Rockwell Axles With Oil-Lubricated Bearings
- Rockwell Axles With Grease-Lubricated Bearings

Application	Size (grade 8)	Torque N·m (lbf·ft)
Hub Cap Capscrews	5/16-18	20 (15)
Spoke-Wheel Brake Drum Nuts	3/4-10	325 (240)
Spoke-Wheel Rim Studs	3/4-10	325 (240)
Rotor Capscrews	9/16-12	175 (130)

Table 1, Torque Values

Lubricant Type	Viscosity Grade By Ambient Temperature	
Hypoid Gear Oil	0-76-A/SAE 85-140:	-12°C (+10°F) and up
	0-76-B/SAE 80W-140:	-26°C (-15°F) and up
API Service Classifications GL-5	0-76-D/SAE 80W-90:	-26°C (-15°F) and up
	0-76-E/SAE 75W-90:	-40°C (-40°F) and up
	0-76-J/SAE 75W:	-40°C (-40°F) to +2°C (+35°F)
	0-76-L/SAE 75W-140:	-40°C (-40°F) and up

Table 2, Rockwell Axles With Oil-Lubricated Bearings

Lubricant Type	Grease Specification
Lithium-Based Wheel Bearing Grease	Standard: 0-617A or equivalent
	Optional: 0-617B or equivalent

Table 3, Rockwell Axles With Grease-Lubricated Bearings