

Maintenance Manual MM-99100

Wheel Equipment

Disc Wheel Hubs

Brake Drum Failure Analysis

Revised 09-12



Supersedes Dayton Walther's Disc Wheel Hubs Safety,
Installation and Maintenance Manual for Class 6, 7 and 8 Trucks and Trailers

Service Notes

About This Manual

This manual provides maintenance and service instructions for Meritor's disc wheel hubs, as well as brake drum inspection and failure analysis information.

Before You Begin

1. Read and understand all instructions and procedures before you begin to service components.
2. Read and observe all Warning and Caution hazard alert messages in this publication. They provide information that can help prevent serious personal injury, damage to components, or both.
3. Follow your company's maintenance and service, installation, and diagnostics guidelines.
4. Use special tools when required to help avoid serious personal injury and damage to components.


Hazard Alert Messages and Torque Symbols

WARNING

A Warning alerts you to an instruction or procedure that you must follow exactly to avoid serious personal injury and damage to components.

CAUTION

A Caution alerts you to an instruction or procedure that you must follow exactly to avoid damage to components.

 This symbol alerts you to tighten fasteners to a specified torque value.

How to Obtain Additional Maintenance, Service and Product Information

Visit Literature on Demand at meritor.com to access and order additional information.

Contact the OnTrac Customer Service Center at 866-668-7221 (United States and Canada); 001-800-889-1834 (Mexico); or email OnTrac@meritor.com.

If Tools and Supplies are Specified in This Manual

Contact Meritor's Commercial Vehicle Aftermarket at 888-725-9355.

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Asbestos and Non-Asbestos Fibers

ASBESTOS FIBERS WARNING

The following procedures for servicing brakes are recommended to reduce exposure to asbestos fiber dust, a cancer and lung disease hazard. Material Safety Data Sheets are available from Meritor.

Hazard Summary

Because some brake linings contain asbestos, workers who service brakes must understand the potential hazards of asbestos and precautions for reducing risks. Exposure to airborne asbestos dust can cause serious and possibly fatal diseases, including asbestosis (a chronic lung disease) and cancer, principally lung cancer and mesothelioma (a cancer of the lining of the chest or abdominal cavities). Some studies show that the risk of lung cancer among persons who smoke and who are exposed to asbestos is much greater than the risk for non-smokers. Symptoms of these diseases may not become apparent for 15, 20 or more years after the first exposure to asbestos.

Accordingly, workers must use caution to avoid creating and breathing dust when servicing brakes. Specific recommended work practices for reducing exposure to asbestos dust follow. Consult your employer for more details.

Recommended Work Practices

1. Separate Work Areas. Whenever feasible, service brakes in a separate area away from other operations to reduce risks to unprotected persons. OSHA has set a maximum allowable level of exposure for asbestos of 0.1 f/cc as an 8-hour time-weighted average and 1.0 f/cc averaged over a 30-minute period. Scientists disagree, however, to what extent adherence to the maximum allowable exposure levels will eliminate the risk of disease that can result from inhaling asbestos dust. OSHA requires that the following sign be posted at the entrance to areas where exposures exceed either of the maximum allowable levels:

**DANGER: ASBESTOS
CANCER AND LUNG DISEASE HAZARD
AUTHORIZED PERSONNEL ONLY
RESPIRATORS AND PROTECTIVE CLOTHING
ARE REQUIRED IN THIS AREA.**

2. Respiratory Protection. Wear a respirator equipped with a high-efficiency (HEPA) filter approved by NIOSH or MSHA for use with asbestos at all times when servicing brakes, beginning with the removal of the wheels.
3. Procedures for Servicing Brakes.
- Enclose the brake assembly within a negative pressure enclosure. The enclosure should be equipped with a HEPA vacuum and worker arm sleeves. With the enclosure in place, use the HEPA vacuum to loosen and vacuum residue from the brake parts.
 - As an alternative procedure, use a catch basin with water and a biodegradable, non-phosphate, water-based detergent to wash the brake drum or rotor and other brake parts. The solution should be applied with low pressure to prevent dust from becoming airborne. Allow the solution to flow between the brake drum and the brake support or the brake rotor and caliper. The wheel hub and brake assembly components should be thoroughly wetted to suppress dust before the brake shoes or brake pads are removed. Wipe the brake parts clean with a cloth.
 - If an enclosed vacuum system or brake washing equipment is not available, employers may adopt their own written procedures for servicing brakes, provided that the exposure levels associated with the employer's procedures do not exceed the levels associated with the enclosed vacuum system or brake washing equipment. Consult OSHA regulations for more details.
 - Wear a respirator equipped with a HEPA filter approved by NIOSH or MSHA for use with asbestos when grinding or machining brake linings. In addition, do such work in an area with a local exhaust ventilation system equipped with a HEPA filter.
 - NEVER** use compressed air by itself, dry brushing, or a vacuum not equipped with a HEPA filter when cleaning brake parts or assemblies. **NEVER** use carcinogenic solvents, flammable solvents, or solvents that can damage brake components as wetting agents.
4. Cleaning Work Areas. Clean work areas with a vacuum equipped with a HEPA filter or by wet wiping. **NEVER** use compressed air or dry sweeping to clean work areas. When you empty vacuum cleaners and handle used rags, wear a respirator equipped with a HEPA filter approved by NIOSH or MSHA for use with asbestos. When you replace a HEPA filter, wet the filter with a fine mist of water and dispose of the used filter with care.
5. Worker Clean-Up. After servicing brakes, wash your hands before you eat, drink or smoke. Shower after work. Do not wear work clothes home. Use a vacuum equipped with a HEPA filter to vacuum work clothes after they are worn. Launder them separately. Do not shake or use compressed air to remove dust from work clothes.
6. Waste Disposal. Dispose of discarded linings, used rags, cloths and HEPA filters with care, such as in sealed plastic bags. Consult applicable EPA, state and local regulations on waste disposal.

Regulatory Guidance

References to OSHA, NIOSH, MSHA, and EPA, which are regulatory agencies in the United States, are made to provide further guidance to employers and workers employed within the United States. Employers and workers employed outside of the United States should consult the regulations that apply to them for further guidance.

NON-ASBESTOS FIBERS WARNING

The following procedures for servicing brakes are recommended to reduce exposure to non-asbestos fiber dust, a cancer and lung disease hazard. Material Safety Data Sheets are available from Meritor.

Hazard Summary

Most recently manufactured brake linings do not contain asbestos fibers. These brake linings may contain one or more of a variety of ingredients, including glass fibers, mineral wool, aramid fibers, ceramic fibers and silica that can present health risks if inhaled. Scientists disagree on the extent of the risks from exposure to these substances. Nonetheless, exposure to silica dust can cause silicosis, a non-cancerous lung disease. Silicosis gradually reduces lung capacity and efficiency and can result in serious breathing difficulty. Some scientists believe other types of non-asbestos fibers, when inhaled, can cause similar diseases of the lung. In addition, silica dust and ceramic fiber dust are known to the State of California to cause lung cancer. U.S. and international agencies have also determined that dust from mineral wool, ceramic fibers and silica are potential causes of cancer.

Accordingly, workers must use caution to avoid creating and breathing dust when servicing brakes. Specific recommended work practices for reducing exposure to non-asbestos dust follow. Consult your employer for more details.

Recommended Work Practices

1. Separate Work Areas. Whenever feasible, service brakes in a separate area away from other operations to reduce risks to unprotected persons.
2. Respiratory Protection. OSHA has set a maximum allowable level of exposure for silica of 0.1 mg/m³ as an 8-hour time-weighted average. Some manufacturers of non-asbestos brake linings recommend that exposures to other ingredients found in non-asbestos brake linings be kept below 1.0 f/cc as an 8-hour time-weighted average. Scientists disagree, however, to what extent adherence to these maximum allowable exposure levels will eliminate the risk of disease that can result from inhaling non-asbestos dust.

Therefore, wear respiratory protection at all times during brake servicing, beginning with the removal of the wheels. Wear a respirator equipped with a high-efficiency (HEPA) filter approved by NIOSH or MSHA, if the exposure levels may exceed OSHA or manufacturers' recommended maximum levels. Even when exposures are expected to be within the maximum allowable levels, wearing such a respirator at all times during brake servicing will help minimize exposure.

3. Procedures for Servicing Brakes.
- Enclose the brake assembly within a negative pressure enclosure. The enclosure should be equipped with a HEPA vacuum and worker arm sleeves. With the enclosure in place, use the HEPA vacuum to loosen and vacuum residue from the brake parts.
 - As an alternative procedure, use a catch basin with water and a biodegradable, non-phosphate, water-based detergent to wash the brake drum or rotor and other brake parts. The solution should be applied with low pressure to prevent dust from becoming airborne. Allow the solution to flow between the brake drum and the brake support or the brake rotor and caliper. The wheel hub and brake assembly components should be thoroughly wetted to suppress dust before the brake shoes or brake pads are removed. Wipe the brake parts clean with a cloth.
 - If an enclosed vacuum system or brake washing equipment is not available, carefully clean the brake parts in the open air. Wet the parts with a solution applied with a pump-spray bottle that creates a fine mist. Use a solution containing water, and, if available, a biodegradable, non-phosphate, water-based detergent. The wheel hub and brake assembly components should be thoroughly wetted to suppress dust before the brake shoes or brake pads are removed. Wipe the brake parts clean with a cloth.
 - Wear a respirator equipped with a HEPA filter approved by NIOSH or MSHA when grinding or machining brake linings. In addition, do such work in an area with a local exhaust ventilation system equipped with a HEPA filter.
 - NEVER** use compressed air by itself, dry brushing, or a vacuum not equipped with a HEPA filter when cleaning brake parts or assemblies. **NEVER** use carcinogenic solvents, flammable solvents, or solvents that can damage brake components as wetting agents.
4. Cleaning Work Areas. Clean work areas with a vacuum equipped with a HEPA filter or by wet wiping. **NEVER** use compressed air or dry sweeping to clean work areas. When you empty vacuum cleaners and handle used rags, wear a respirator equipped with a HEPA filter approved by NIOSH or MSHA, to minimize exposure. When you replace a HEPA filter, wet the filter with a fine mist of water and dispose of the used filter with care.
5. Worker Clean-Up. After servicing brakes, wash your hands before you eat, drink or smoke. Shower after work. Do not wear work clothes home. Use a vacuum equipped with a HEPA filter to vacuum work clothes after they are worn. Launder them separately. Do not shake or use compressed air to remove dust from work clothes.
6. Waste Disposal. Dispose of discarded linings, used rags, cloths and HEPA filters with care, such as in sealed plastic bags. Consult applicable EPA, state and local regulations on waste disposal.

Regulatory Guidance

References to OSHA, NIOSH, MSHA, and EPA, which are regulatory agencies in the United States, are made to provide further guidance to employers and workers employed within the United States. Employers and workers employed outside of the United States should consult the regulations that apply to them for further guidance.

About This Manual

This manual supersedes the Dayton Walther manual, Disc Wheel Hubs Safety, Installation and Maintenance, and provides information on the following procedures for disc wheel hubs.

Mounting and Installation

Section 2, Section 3 and Section 4 provide information on the differences in hub and disc wheel systems, as well as correct mounting and installation procedures for disc wheel hubs and related components.

Maintenance

Section 5 presents warnings before maintenance procedures to alert you to stud and nut conditions that can affect your safety and the integrity of the vehicle and its components.

Carefully read all of the warnings before you install the disc wheel hubs.

Brake Drum Inspection and Failure Analysis

Section 6 includes a Brake Drum Failure Analysis section that provides information on brake drum wear conditions, conditions that can affect brake drum wear, a troubleshooting chart, maintenance procedures, replacing a brake drum and preventive maintenance tips.

This failure analysis information is also available in VHS format. To obtain a copy of the video, Brake Drum Failure Analysis, call the OnTrac Customer Service Center at 866-OnTrac1 (668-7221) and request item number T99105V.

Fasteners Used on a New Brake Drum Assembly for Shipping

An original equipment manufacturer will use one of the methods listed below to secure a new OUTBOARD brake drum assembly during shipping.

- Two hexagon nuts secure the assembly. Discard these nuts at removal. Do not use these nuts to attach disc wheels to the hub and drum assembly.
- Two ball seat or two flange nuts, depending on the disc wheel system, secure the assembly. After you remove these nuts, use them with the additional nuts required for the system.
- Eight or 10 ball seat or flange nuts, depending on the disc wheel system, secure the assembly. After you remove these nuts, use them to attach the disc wheels to the hub and drum assembly.

2 Disc Wheel Hub Mounting Variations

Rotor Assemblies

Hub- and Hat-Shaped

In Figure 2.1 both the front and rear hub and rotor assemblies have the rotor attached to the hub with separate capscrews or bolts. Rotors used in these assemblies are usually referred to as hat-shaped.

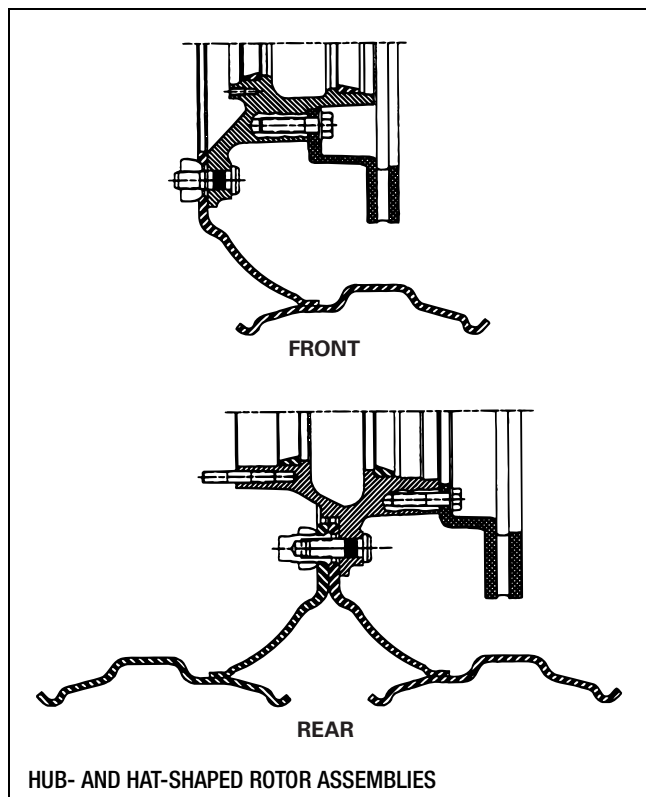


Figure 2.1

Usually the capscrews or bolts are treated with a locking substance to prevent loosening. If it is necessary, to remove fasteners treated with a locking substance, apply heat up to a maximum of 400°F (205°C) to the bolt heads to loosen the thread bond.

Hub- and U-Shaped

In Figure 2.2 both the front and rear hub and rotor assemblies have the rotor attached to the hub with the same bolts used to secure the disc wheels to the hub. Rotors used in these assemblies are usually referred to as U-shaped. Attachment of these rotors is identical to inboard-mounted brake drums as shown in Figure 2.3, Figure 2.4, Figure 2.7 and Figure 2.8.

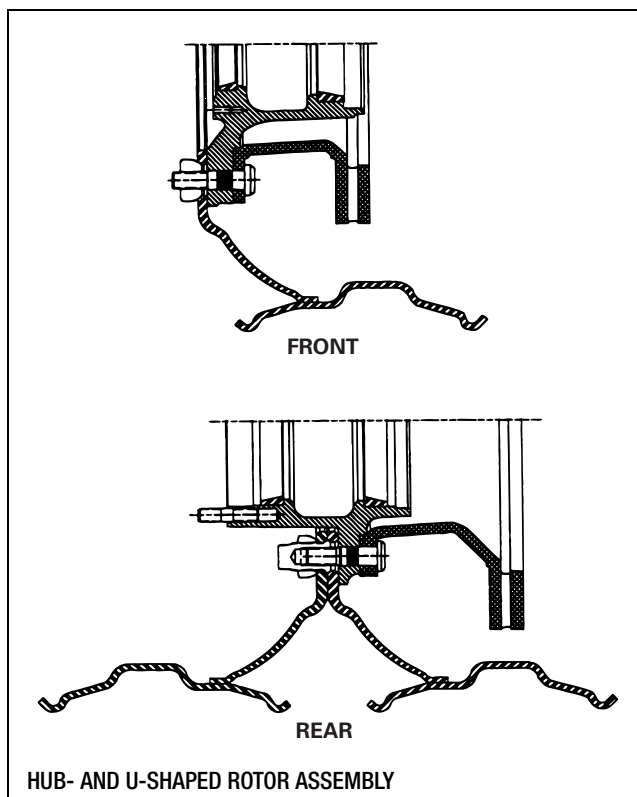


Figure 2.2

Hub and Drum Assemblies

Hub and Drum Configurations

- Inboard- or outboard-mounted
- Stud- or hub-piloted
- Front or rear assembly

Stud-Piloted Front Hub with Inboard-Mounted Drum

Figure 2.3 is a stud-piloted front hub and drum assembly. Ball-seat nuts center the disc wheel to the studs. The drum is mounted inboard of the hub flange.

2 Disc Wheel Hub Mounting Variations

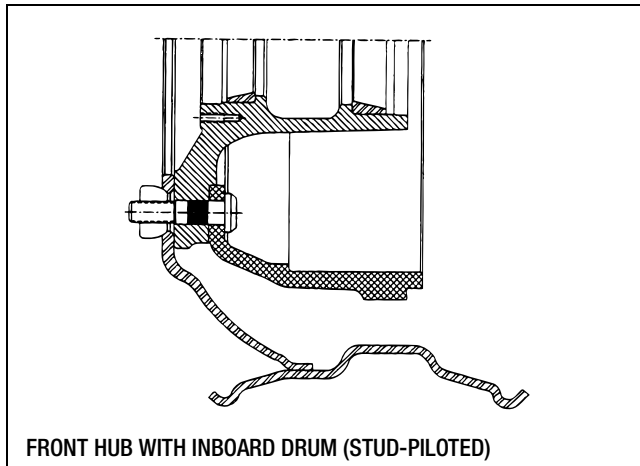


Figure 2.3

Stud-Piloted Rear Hub with Inboard-Mounted Drum

Figure 2.4 is a stud-piloted rear assembly with the brake drum mounted inboard of the hub flange. Ball-seat cap nuts center the inner disc wheel to the studs and the outer disc wheel to the inner dual cap nut. Drive flange studs identify it as a rear-dual drive hub for a truck.

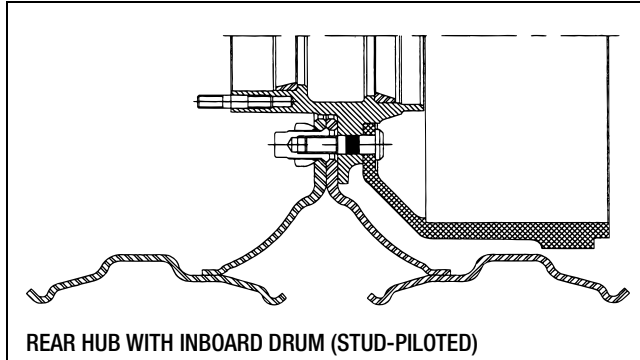


Figure 2.4

Stud-Piloted Front Hub with Outboard-Mounted Drum

Figure 2.5 is a stud-piloted front hub and drum assembly with the brake drum mounted outboard of the hub flange. Ball-seat nuts center the disc wheel to the studs.

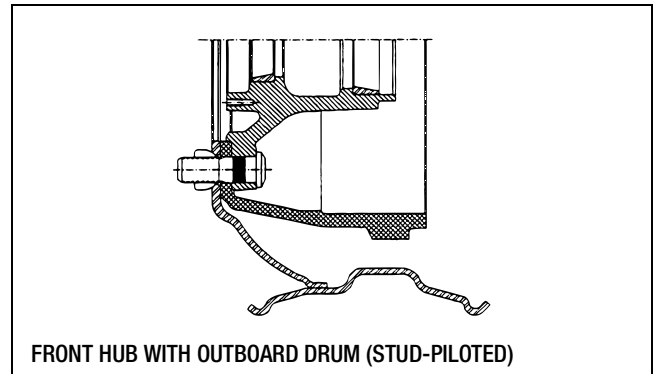


Figure 2.5

Stud-Piloted Dual-Rear Hub with Outboard-Mounted Drum

In Figure 2.6 the brake drum is mounted outboard of the hub flange. Ball-seat cap nuts center the outer disc wheel to the inner dual cap nut. It is a stud-piloted dual-rear assembly for trailers, because only hubcap bolt holes are present.

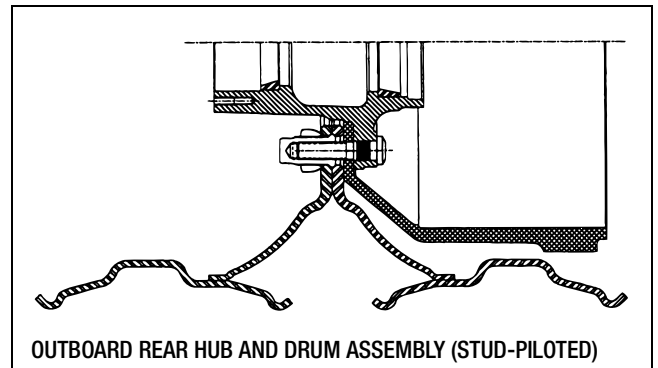


Figure 2.6

Hub-Piloted Front Hub with Inboard-Mounted Drum

Figure 2.7 is a hub-piloted front assembly with the brake drum mounted inboard of the hub flange. Because the disc wheel is hub-piloted, studs do not center the disc wheel.

2 Disc Wheel Hub Mounting Variations

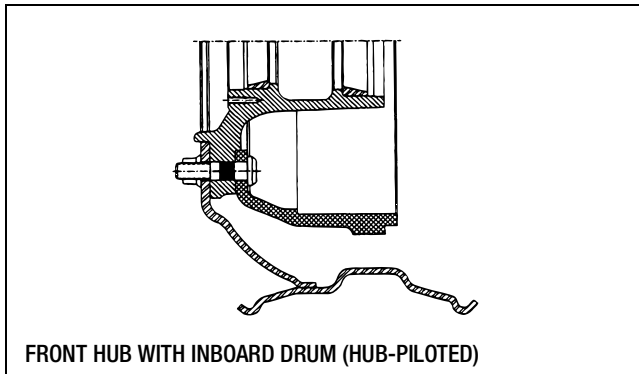


Figure 2.7

Hub-Piloted Dual-Rear Hub with Inboard-Mounted Drum

Figure 2.8 is a dual-rear assembly with the brake drum mounted inboard of the hub flange. Because the disc wheels are hub-piloted, studs do not center the disc wheels. Drive flange studs identify it as a rear-dual drive hub for a truck.

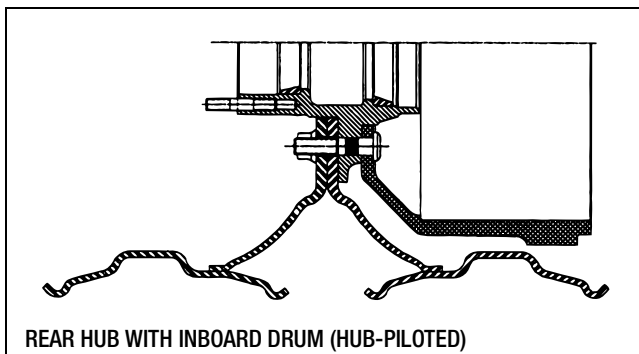


Figure 2.8

Hub-Piloted Front Hub with Outboard-Mounted Drum

Figure 2.9 is a hub-piloted front assembly with the brake drum mounted outboard of the hub flange. Because the disc wheel is hub-piloted, studs do not center the disc wheel.

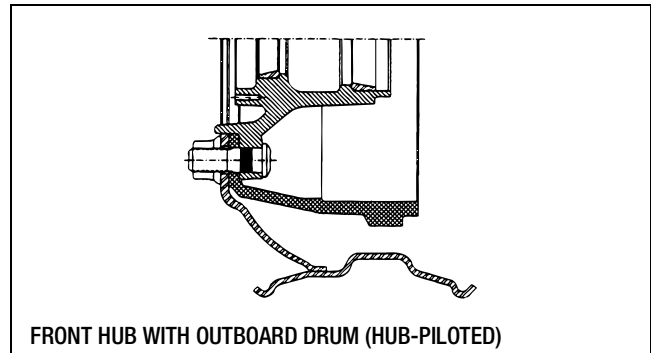


Figure 2.9

Hub-Piloted Dual-Rear Hub with Outboard-Mounted Drum

In Figure 2.10 the brake drum is mounted outboard of the hub flange. Because the disc wheels are hub-piloted, studs do not center the disc wheels. It is a dual-rear assembly for trailers, because only the hubcap bolt holes are present.

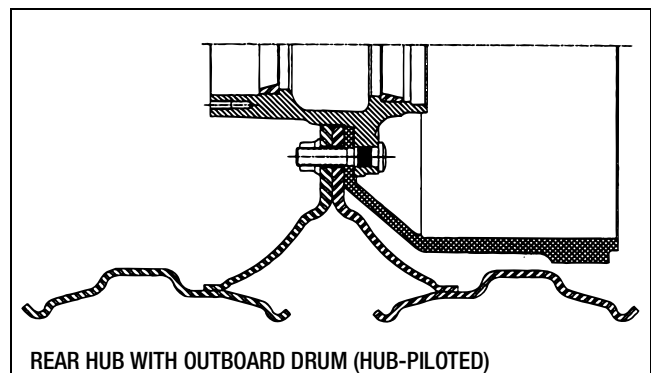
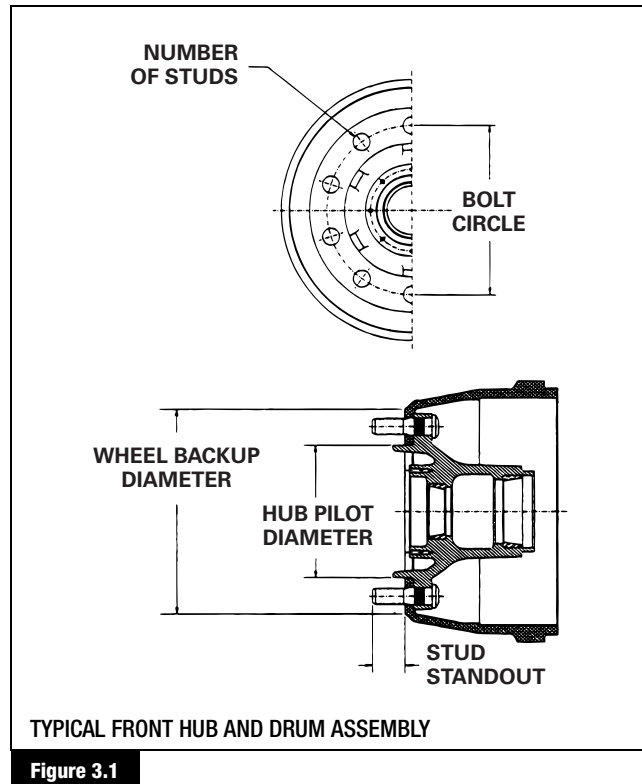


Figure 2.10

Disc Wheel Systems

Table A shows eight of the most popular disc wheel systems used in North America. The parameters for each system are the same whether the assembly has an inboard- or an outboard-mounted brake drum.

The descriptions on the left-hand side of Table A are defined in Figure 3.1 and below.

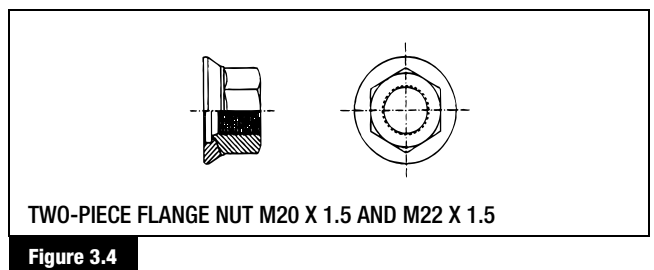
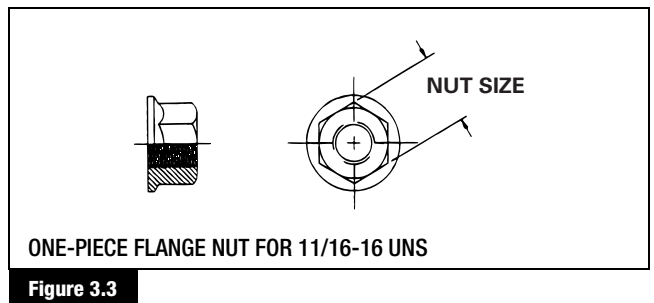
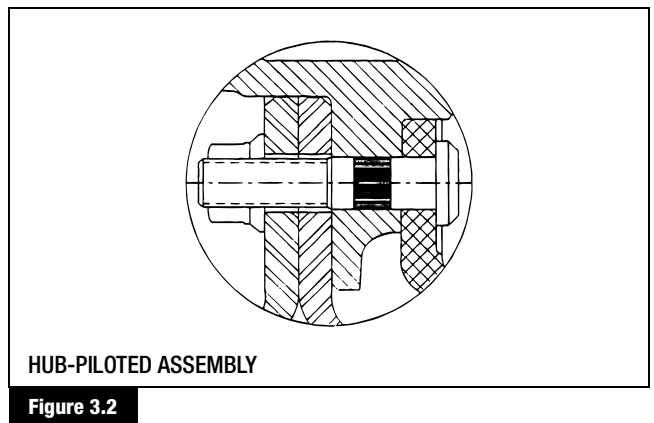


Hub-Piloted Assembly

A hub-piloted assembly centers the disc wheel by using the close fit between the disc wheel center bore and the precision-machined hub intermittent pilot or continuous pilot. Figure 3.2.

- Most hub pilots are intermittent to minimize the freezing of the disc wheels to the hubs.
- The function of the hub pilots is to center the wheels during installation. Therefore, they do not carry a radial load after you correctly tighten fasteners to specification.
- Flange nuts attach steel or aluminum hub-piloted disc wheels to the hub and drum assembly. All fasteners are right-hand only, and disc wheel bolt holes do not have centering ball seats. Figure 3.3 and Figure 3.4.

- Meritor 285.75 mm bolt circle 10 hole hubs made for hub-piloting disc wheels can be modified for stud-piloting disc wheels by changing the 22 mm studs to 0.75-inch studs. Figure 3.5 shows a stud that has the same size shank as a 22 mm stud, but the threaded portion is 0.75-inch.
- The holes in the hubs and brake drums for rear axle applications are the same, because the studs have the same diameter shank size.



3 Typical Disc Wheel Systems

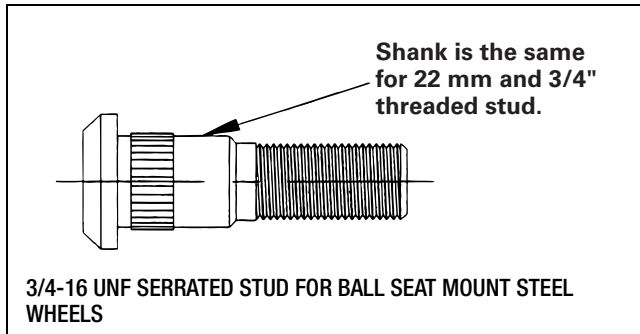


Figure 3.5

Stud-Pilot Assembly

- The stud-piloted assembly uses centering fasteners, ball seats, to pilot the disc wheels, which have mating spherical nut seats. Figure 3.6.

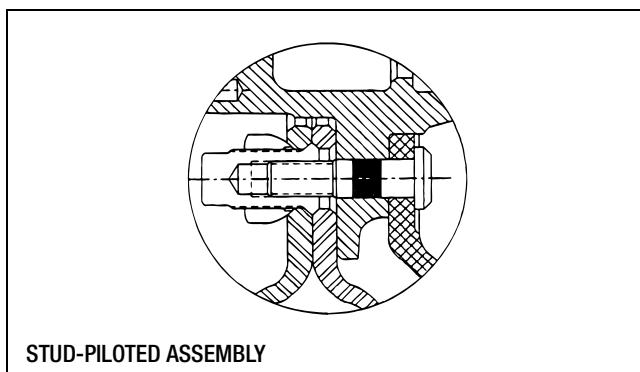


Figure 3.6

- Because ball seat fasteners do not produce as much clamp load as two-piece flange nuts to hold the disc wheels in place, right- and left-hand fasteners are required to prevent the fasteners from loosening.
- The ball seat system requires an INNER and OUTER nut for the dual wheels. Figure 3.7 and Figure 3.8.

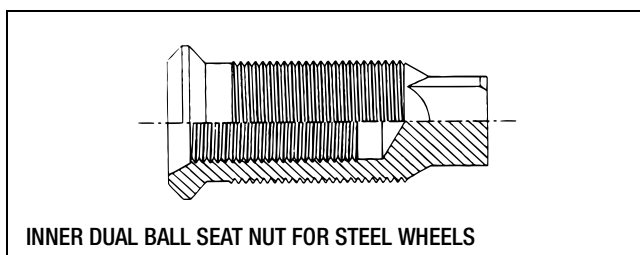


Figure 3.7

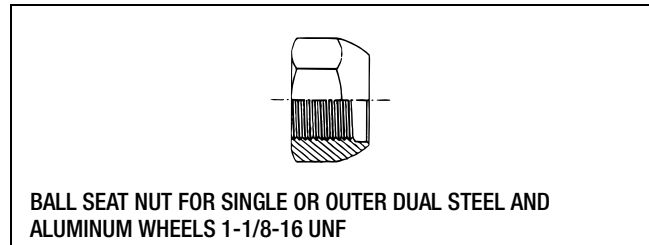


Figure 3.8

- Most dual-wheel applications use 3/4-16 UNF threaded studs. A front assembly can use either a 3/4-16 UNF or 1-1/8-16 UNF stud.
- If a 1-1/8-16 UNF stud is on the front hub, use an outer dual nut.
- If a 3/4-16 UNF stud is on the front hub, use a nut with the same 1.5-inch hexagon, but with a 0.75-inch thread. Figure 3.9.

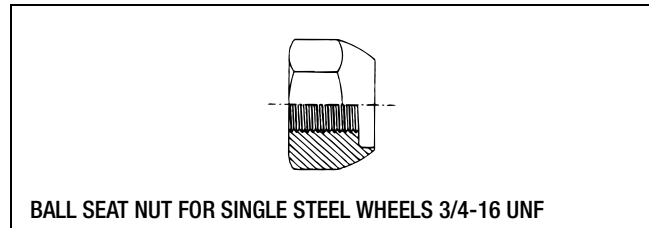


Figure 3.9

Aluminum Disc Wheel

Hub-Piloted Assembly

- A hub-piloted assembly requires longer studs for aluminum wheels than for steel disc wheels. The two-piece flange nuts are the same for aluminum and steel disc wheels.
- All hub-piloted hubs have extended pilots, so you can use them for either aluminum or steel disc wheels. Only the wheel studs have different lengths.

Dual Stud-Piloted Assembly

- A dual stud-piloted assembly uses the same studs for aluminum and steel disc wheels. Use Alcoa 5988R and 5988L cap nuts designed specifically for aluminum disc wheels. Figure 3.10.

3 Typical Disc Wheel Systems

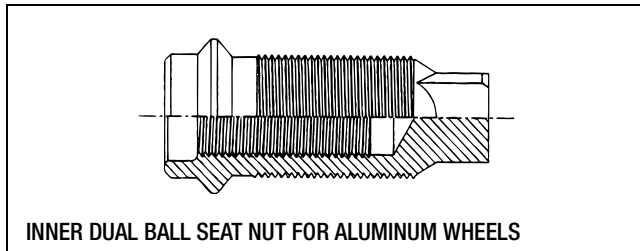


Figure 3.10

- The 1-1/8-16 UNF stud on front hubs uses the same nut as used on rear outer wheels. However, the 3/4-16 UNF front stud requires an Alcoa 5995R and 5995L nut. Figure 3.11 and Figure 3.12.

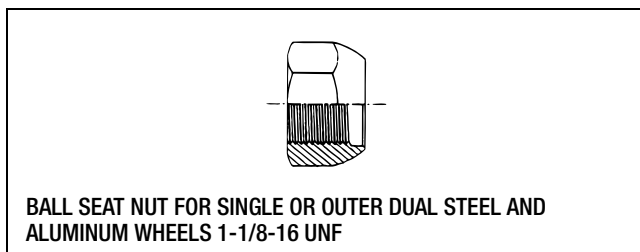


Figure 3.11

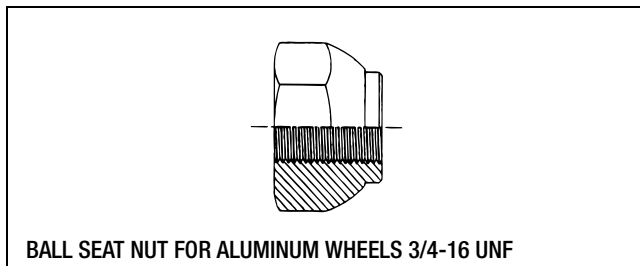


Figure 3.12

- Front hubs can have either 0.75-inch or 1.125-inch studs.

4 Disc Wheel Hub Installation

Hazard Alert Messages

Read and observe all Warning and Caution hazard alert messages in this publication. They provide information that can help prevent serious personal injury, damage to components, or both.

⚠ WARNING

To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

Park the vehicle on a level surface. Block the wheels to prevent the vehicle from moving. Support the vehicle with safety stands. Do not work under a vehicle supported only by jacks. Jacks can slip and fall over. Serious personal injury can result.

Disc Wheel Hub-to-Axle Installation

Before You Install the Hub

1. Wear safe eye protection. Park the vehicle on a level surface. Block the wheels to prevent the vehicle from moving.
2. Raise the vehicle, so that the area you will service is off the ground. Support the vehicle with safety stands.
3. Verify that the hub cavity is clean and free from debris and contaminants, which can cause a bearing to fail and a seal to leak.

⚠ CAUTION

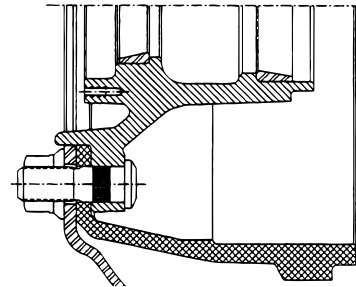
Use an emery cloth to remove fine nicks or dents from the seal bore on the hub and the seal entry chamfer, radius. If you cannot remove the nicks and dents, the seal can leak. Replace the hub to prevent damage to components.

4. Inspect the seal bore on the hub, the seal entry chamfer, radius and the axle where the seal will fit after assembly for nicks or dents.
 - **If you find nicks or dents:** Use an emery cloth to remove the nicks or dents. Replace the parts if the nicks or dents are too deep to remove, which can cause a seal to leak.

⚠ WARNING

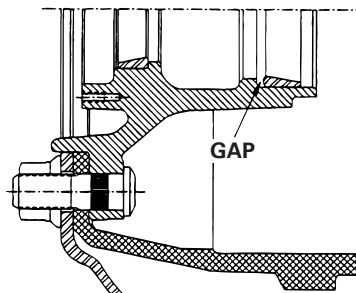
Check that the bearing cups are seated flush against the bearing cup shoulder in the hub. A bearing cup that is not seated correctly will seat under load and increase end play, which can cause the bearings to loosen or fail. The entire wheel end can separate from the vehicle. Serious personal injury and damage to components can result.

5. Check that the bearing cups are seated flush against the bearing cup shoulder in the hub. Figure 4.1. A bearing cup that is not seated correctly will seat under load and increase end play. Figure 4.2.



CORRECTLY SEATED BEARING CUP

Figure 4.1



INCORRECTLY SEATED BEARING CUP

Figure 4.2

4 Disc Wheel Hub Installation

WARNING

Ensure that you assemble the correct bearing cup and cone. Check the numbers on the cup and cone and compare them to the application. If the cup and cone are not correct, the spindle locking nuts will not fit correctly or secure the hub to axle correctly. Damage to the bearing can result, which can cause the bearing to loosen and fail. The entire wheel end can separate from the vehicle. Serious personal injury and damage to components can result.

6. Check the numbers on the cup and cone and compare them to the catalog application to ensure that you are assembling the correct bearing cup and cone. Some bearings are identical except for corner radii, and can be easily confused. Figure 4.3 and Figure 4.4. If you mix cups and cones, the spindle locking nuts will not fit correctly, and the hub will not be secured to the axle.

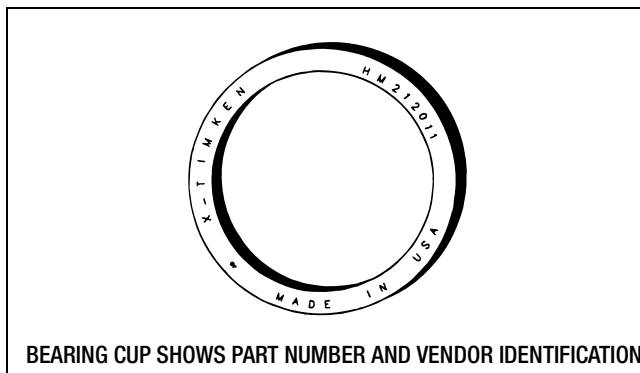


Figure 4.3

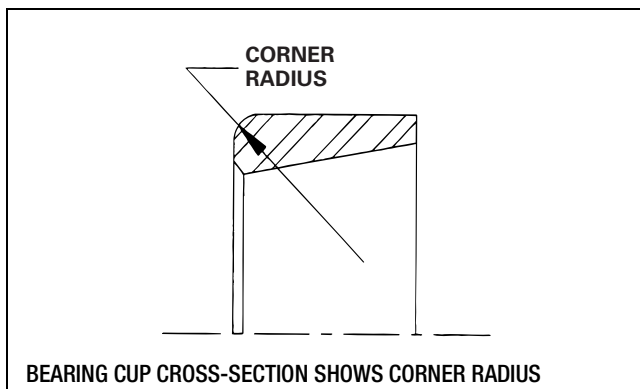


Figure 4.4

7. Install the seal. Follow the axle and seal manufacturer's instructions.

8. Ensure that all parts are thoroughly cleaned before you assemble them onto the axle.

WARNING

Before you perform assembly procedures, thoroughly clean mounting surfaces to remove paint and contaminants, which can loosen fasteners and cause wheels to separate from the vehicle. Serious personal injury and damage to components can result.

9. Check that there is no paint on the mounting surfaces of the hub, brake drum, studs or nuts. Figure 4.5.
 - If you find paint on the mounting surfaces: Remove the paint before you install the hub onto the axle.

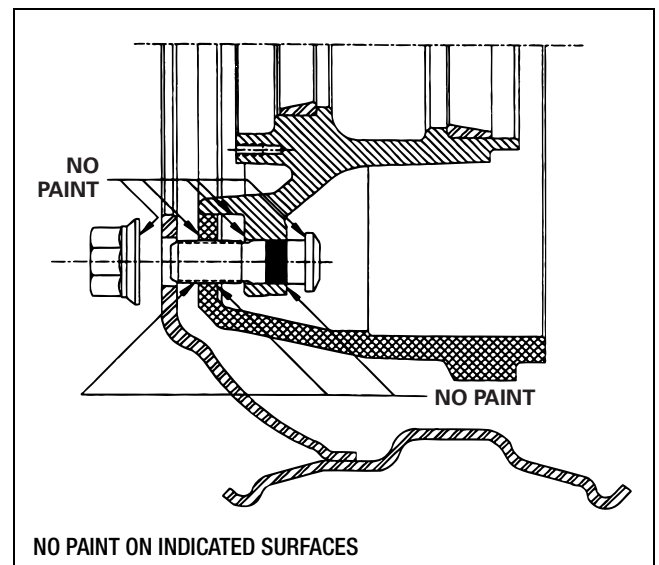


Figure 4.5

4 Disc Wheel Hub Installation

Install the Disc Wheel Hub onto the Axle

1. Install the disc wheel hub onto the axle. Follow the axle manufacturer's instructions.

WARNING

Fill the oil reservoir to the correct level. If the oil reservoir is low, damage to the bearings can result, which can cause a fire in the wheel-end assembly, or the assembly can separate from the vehicle. Serious personal injury and damage to components will result.

2. If you check the oil level in a hub, such as a front or trailer hub, and the oil is low, fill the reservoir with oil to the specified level. Figure 4.6.

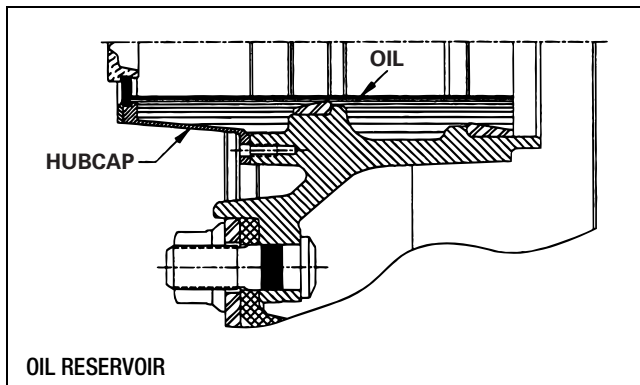


Figure 4.6

WARNING

You must lift an OUTBOARD-mounted brake drum into place on the pilot to correctly seat the drum before you tighten the fasteners. Do not seat a drum by only tightening the fasteners. An incorrectly seated drum can wear away the pilot ledge, which can loosen the drum and the entire assembly. Serious personal injury and damage to components can result.

Always replace serrated bolts with new ones. Discard used serrated bolts, which can turn in the holes during tightening and cause wheels to separate from the vehicle. Serious personal injury and damage to components can result.

NOTE: The brake drum fits tighter on its pilot than the disc wheel does on the wheel pilot.

3. You must lift an outboard-mounted brake drum into place on the wheel pilot to correctly seat the drum. Position the hub so that one of the intermittent pilots is located at the TOP position. Just tightening will not force the drum onto the pilot. Ensure that the drum is seated correctly and the flange has not dropped onto the pilot. Figure 4.7.

- If you replace an inboard-mounted brake drum: Ensure that the drum is seated correctly on the pilot and flush against the hub flange. Refer to Section 2 for figures of inboard-mounted brake drums.

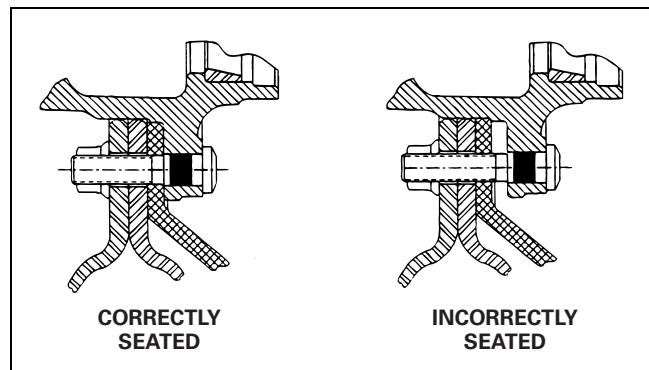


Figure 4.7

4. Tighten the fasteners to the correct torque specification. Refer to Table A in this section.

Disc Wheel-to-Hub Installation

Before You Install a Disc Wheel onto a Hub

WARNING

Take care that you do not damage stud bolt threads. Studs with damaged threads can strip or cross-thread, which will reduce clamp load, loosen studs and cause a wheel to separate from the vehicle. Serious personal injury and damage to components can result.

1. Ensure that the disc wheels match the hub mounting system. It is possible to install wheels that are not designed for the hub system. An example of this type of installation is to assemble ball seat 11.25-inch bolt circle wheels on ISO 285.75 mm bolt circle hubs.

4 Disc Wheel Hub Installation

2. Position the hub so the studs will align with the disc wheel bolt circle holes before you install the disc wheel and tire assembly onto the hub.
 - **If the assembly is hub-piloted:** Position the hub so that one of the intermittent pilots is located at the TOP position. Ensure that the disc wheel is high enough to easily slide onto the studs and pilots, if present.

WARNING

Verify that the disc wheel and rim assembly does not interfere with the brake drum or the balance weights on the brake drum, which can affect wheel and drum performance. Serious personal injury and damage to components can result.

3. Check that the disc wheel and rim assembly does not interfere with the brake drum, especially the balance weights on the drum, when you seat the disc. Interference will damage the wheel and brake drum.

CAUTION

Verify that the valve stem does not touch the brake drum or the balance weight on the brake drum, which can cause the valve stem to overheat. Damage to components can result.

4. Verify that the valve stem does not touch the brake drum. The valve stem can overheat and can cause a flat tire.

WARNING

Tighten fasteners to the correct torque specification. Do not over-tighten or under-tighten fasteners, which can cause the wheels to separate from the vehicle. Serious personal injury and damage to components can result.

5. Carefully follow procedures when you tighten and retighten fasteners on each type of disc wheel system. Ensure that you use the correct tightening sequence. Always use a calibrated torque wrench. Refer to Table A in this section for the correct torque specifications and Figure 4.8 for the tightening sequence.

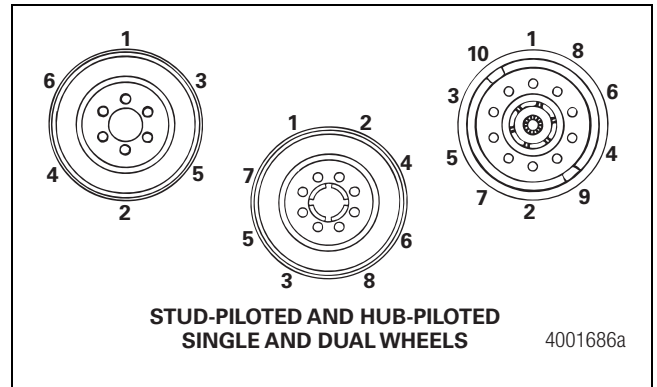


Figure 4.8

4 Disc Wheel Hub Installation

Install the Disc Wheel onto the Hub

Follow the disc wheel manufacturer's installation procedures.

Table A: Inboard and Outboard Mounting Systems

Systems Features	ISO 275 mm BC (8) 20 mm Studs	¹ 275 mm BC (8) 22 mm Studs	² ISO 285.75 mm BC (10) 22 mm Studs	³ ISO 335 mm BC (10) 22 mm Studs	8.75" BC (6) Studs	8.75" BC (10) Studs	8.75" BC (10) Studs	⁴ 11.25" BC (10) Studs
Type of Pilot	Hub	Hub	Hub	Hub	Stud	Hub	Stud	Stud
Bolt Circle (BC) Diameter	10.827" 275 mm	10.827" 275 mm	11.25" 285.75 mm	13.189" 335 mm	8.75" 222.25 mm	8.75" 222.25 mm	8.75" 222.25 mm	11.25" 285.75 mm
Number of Studs in Bolt Circle (BC)	8	8	10	10	6	10	10	10
Stud Thread Size	M20 x 1.5	M22 x 1.5	M22 x 1.5	M22 x 1.5	0.75-16 UNF and 1.125-16 UN	0.6875-16 UN	0.75-16 UNF and 1.125-16 UN	0.75-16 UNF and 1.125-16 UN
Nut Type	2-Piece Flange	2-Piece Flange	2-Piece Flange	2-Piece Flange	Ball Seat	1-Piece Flange	Ball Seat	Ball Seat
Hub Pilot Diameter	8.693/8.685" 220.8/220.6 mm	8.693/8.685" 220.8/220.6 mm	8.654/8.646" 219.8/219.6 mm	11.06/11.05" 280.8/280.6 mm	6.45" max, Clearance Diameter	6.250/6.242" 158.8/158.5 mm	6.45" max, Clearance Diameter	8.720" max, Clearance Diameter
Stud Stand Out/Single Steel Wheels/ Minimum	1.65" 42 mm	1.93" 49 mm	1.89" 48 mm	1.89" 48 mm	1.25" 31.8 mm	1.59" 40.4 mm	1.25" 31.8 mm	1.32" 33.5 mm
Stud Stand Out/Single Aluminum Wheels/ Minimum	2.17" 55 mm	2.40" 61 mm	2.36" 60 mm	2.36" 60 mm	1.50" 38.1 mm			1.80" 45.7 mm
Stud Stand Out/Dual Steel Wheels/ Minimum	2.17" 55 mm	2.48" 63 mm	2.44" 62 mm	2.44" 62 mm	1.31/1.44" 33.3/36.6 mm	2.09" 53.1 mm	1.31/1.44" 33.3/36.6 mm	1.31/1.44" 33.3/36.6 mm
Stud Stand Out/Dual Aluminum Wheels/ Minimum	3.15" 80 mm	3.39" 86 mm	3.35" 85 mm	3.35" 85 mm	1.31/1.44" 33.3/36.6 mm			1.31/1.44" 33.3/36.6 mm

4 Disc Wheel Hub Installation

Systems Features	ISO 275 mm BC (8) 20 mm Studs	¹ 275 mm BC (8) 22 mm Studs	² ISO 285.75 mm BC (10) 22 mm Studs	³ ISO 335 mm BC (10) 22 mm Studs	8.75" BC (6) Studs	8.75" BC (10) Studs	8.75" BC (10) Studs	⁴ 11.25" BC (10) Studs
Nut Size Across the Flats, Wrench Size	1.18" 30 mm	1.5" 38.1 mm	1.30" 33 mm	1.30" 33 mm	1.5/0.813" 38.1/20.7 mm	1.125" 28.6 mm	1.5/0.813" 38.1/20.7 mm	1.5/0.813" 38.1/20.7 mm
Wheel Backup Diameter	12.60/12.40" 320/315 mm	13.50/13.15" 343/334 mm	13.39/13.19" 340/335 mm	15.16/14.96" 385/380 mm	11.25/11.00" 285.8/279.4 mm	11.25/11.00" 285.8/279.4 mm	11.25/11.00" 285.8/279.4 mm	13.50/13.18" 342.9/334.8 mm
Nut Torque (lb-ft)	280/310	450/500	450/500	390/500	450/500	300/350	450/500	450/500
Right- or Left-Handed	Right	Right	Right	Right	Right and Left	Right	Right and Left	Right and Left

¹ WHD-8 or CentroMount-8

² Also known as AccuMount, UniMount-10, CentroMount-10

³ Also known as UltraMount

⁴ Also known as Ball Seat mount

5 Maintenance

Maintenance

Clean the Mounting Surfaces

WARNING

To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

Before you perform assembly procedures, thoroughly clean mounting surfaces to remove paint and contaminants, which can loosen fasteners and cause the wheels to separate from the vehicle. Serious personal injury and damage to components can result.

1. Always thoroughly clean the hub mounting surfaces where the outboard brake drum mounts.
2. Always thoroughly clean the brake drum's outside flange, which is the mounting surface for the disc wheels.
3. Remove dirt and contaminants from mounting surfaces before you perform assembly procedures. Do not apply paint to mounting surfaces, studs or nuts. Paint decreases a fastener assembly's capability to maintain clamp load.
4. If the assembly has an inboard-mounted brake drum, clean the hub flange areas where the disc wheels mount. Refer to Section 2.
5. If the entire assembly is off the axle spindle and you will replace the brake drum, clean the hub mounting surfaces where the brake drum mounts.

WARNING

Replace a worn or damaged hub assembly or disc, which can cause excessive runout. A wheel can separate from the vehicle. Serious personal injury and damage to components can result.

6. Check the following areas for wear, which can be caused by a wheel that runs loose on the hub.
 - The pilot on a hub-piloted assembly
 - The mounting surfaces of all hub types
 - Outboard drum mounting surfaces

NOTE: Use a calibrated torque wrench with right- and left-hand capabilities to tighten ball seat mounts.

7. Ensure that fasteners are tightened in the correct tightening sequence and to the correct torque specifications. Use a torque wrench to tighten the fasteners. Figure 5.1.

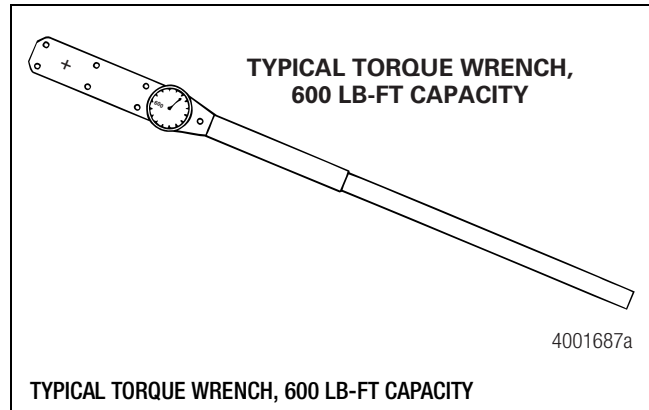


Figure 5.1

8. If wheels have run loose on the hub, the pilot on hub-piloted assemblies and the mounting faces of all types of hubs, or outboard brake drum mounting faces will show wear.
 - A. Replace the entire hub assembly, including the nuts. A worn pilot or brake drum mounting surface will cause fatigue damage to the studs, and the hub or outboard brake drum mounting surface will not provide a flat support for the disc wheels.
 - B. Replace the disc wheels.

Studs and Nuts

The following warnings are to alert you to stud and nut conditions and maintenance procedures that can affect your safety and the integrity of the vehicle and its components.

Carefully read the warnings before you install the disc wheels.

WARNING

Replace bent, loose, broken or stripped studs. When you replace a stripped stud, always replace the stud on each side of the stripped stud as well. Even if the adjoining studs are not cracked, they have sustained fatigue damage, which can cause the wheels to loosen and separate from the vehicle. Serious personal injury and damage to components can result.

Always replace a serrated stud or bolt with a new one. Do not reuse a serrated stud, which will not tighten correctly and can cause the wheels to loosen and separate from the vehicle. Serious personal injury and damage to components can result.

Do not apply paint to mounting surfaces, studs or nuts. Paint decreases a fastener assembly's capability to maintain clamp load, which can cause wheels to loosen and separate from the vehicle. Serious personal injury and damage to components can result.

Ensure that you do not damage stud threads. Damaged threads will not allow the stud to provide the required clamp load to support the wheel retention system. The wheels can loosen and separate from the vehicle. Serious personal injury and damage to components can result.

Check that stud standout is correct for stud-piloted wheels. If standout exceeds specifications even though the correct torque is used, the cap nut can bottom against the hub stud and loosen both wheels and the brake drum, which will cause the wheels to separate from the vehicle. If standout is too short, the cap nut will overload and crack, causing the inner and dual wheels to separate from the vehicle. Serious personal injury and damage to components can result.

Install right-hand studs onto the right side of the vehicle and left-hand studs onto the left side of the vehicle. Studs that are not installed correctly can loosen, which can cause the wheels to loosen and separate from the vehicle. Serious personal injury and damage to components can result.

If the wheel studs are being reused, apply two drops of oil to the last two or three threads at the end of each stud. Do not over lubricate the studs or nut threads. Over lubricating the fasteners can cause excessive clamp load. The studs can break and cause the wheels to loosen and separate from the vehicle. Serious personal injury and damage to components can result.

Do not install 1-1/2-inch hex two-piece flange nuts onto M22 x 1.5 serrated studs when 33 mm two-piece hex nuts are used on the CentroMount-8™ system. Wheels can crack, loosen and separate from the vehicle. Serious personal injury and damage to components can result.

Install aluminum wheel nuts onto an aluminum disc wheel. Do not install steel wheel nuts. Steel wheel nuts can damage an aluminum wheel or cause dual wheels to loosen and separate from the vehicle. Serious personal injury and damage to components can result.

Install steel wheel nuts onto steel wheels. Do not install aluminum wheel nuts. The extension on an aluminum wheel nut can bottom against the hub flange or brake drum before the disc wheel is clamped correctly, which can cause wheels to separate from the vehicle. Serious personal injury and damage to components can result.

Install nuts with the correct thread size onto the studs. A nut with an incorrect thread size will not turn freely on the stud or will fit loosely on the stud. The thread can strip, which can cause loss of clamp load. The wheels can loosen and separate from the vehicle. Serious personal injury and damage to components can result.

Install the correct wheel system components for the application. Do not mix wheel system components. The wheels can loosen and separate from the vehicle. Serious personal injury and damage to components can result.

Apply two drops of oil between the nut flange and the hex portion of the swivel area at each installation if you reinstall the two-piece flange nuts that have been in service. Without lubricant, the fasteners may not produce adequate clamp load, and a wheel can loosen and separate from the vehicle. Serious personal injury and damage to components can result.

Lightly lubricate the hub pilots to ease wheel installation and removal. Do not lubricate the mounting face of the drum or wheel. Lubricant on the drum or wheel mating surfaces can reduce friction and cause the components to slip during operation. Serious personal injury and damage to components can result.

1. Check the studs. Repair or replace loose, bent, stripped or broken studs.
2. Check for correct serrated stud standout.
 - A. Figure 5.2 shows correct standout.

5 Maintenance

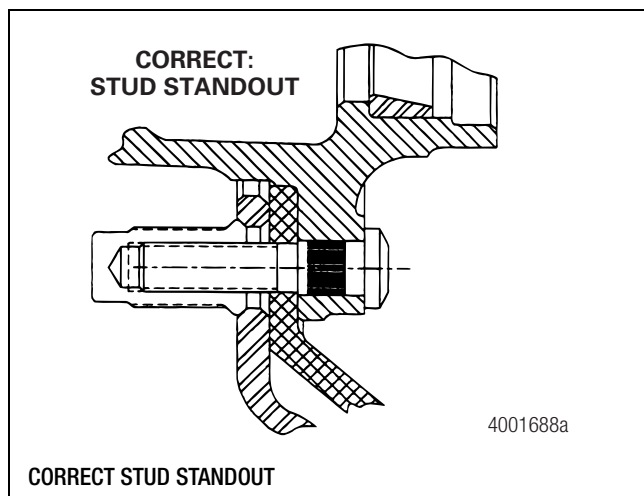


Figure 5.2

B. Figure 5.3 and Figure 5.4 show incorrect standout.

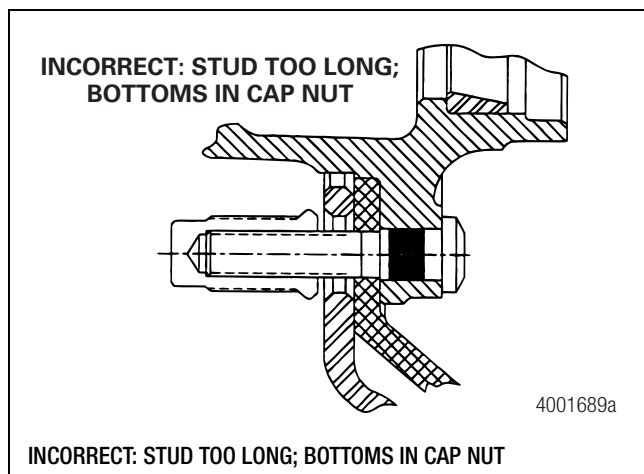


Figure 5.3

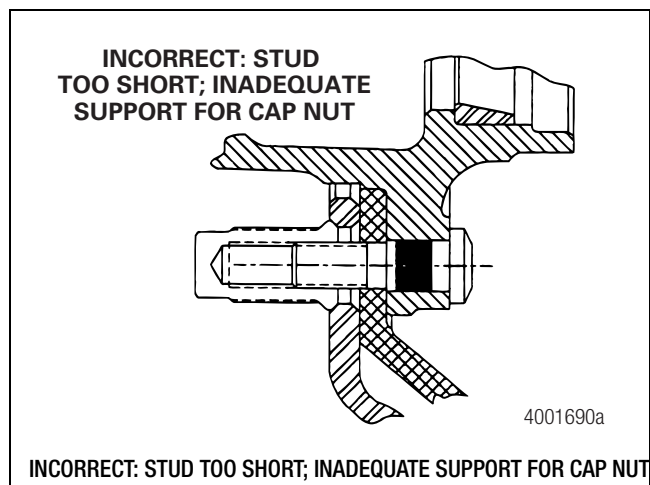


Figure 5.4

- C. Serrated studs do not usually interchange with those in various hub part numbers. Check the application in Table A. Call the OnTrac Customer Service Center at 866-OnTrac1 (668-7221) for more information.
3. Check for **R** and **L** stamped in the end of the stud. Figure 5.5. Install right-hand studs on the right side of the vehicle, and left-hand studs on the left side of the vehicle.

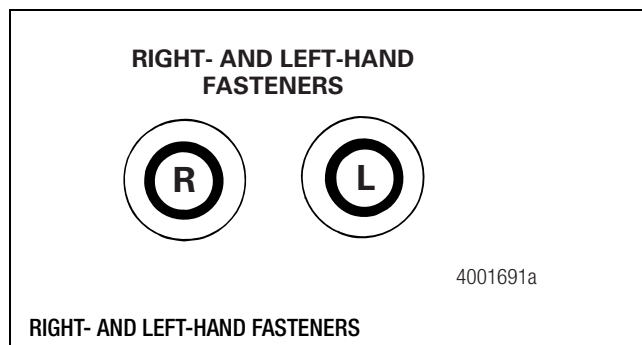
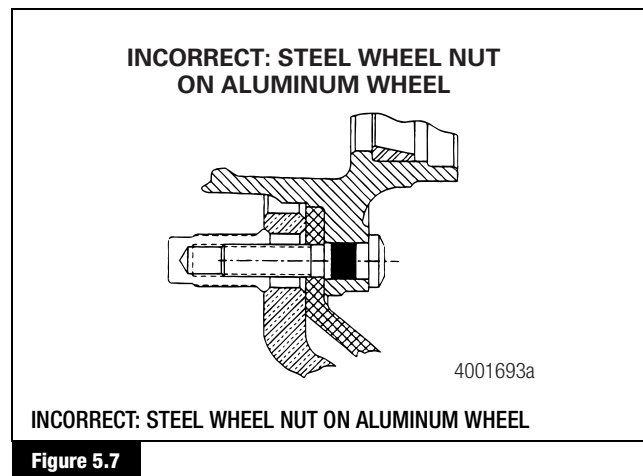
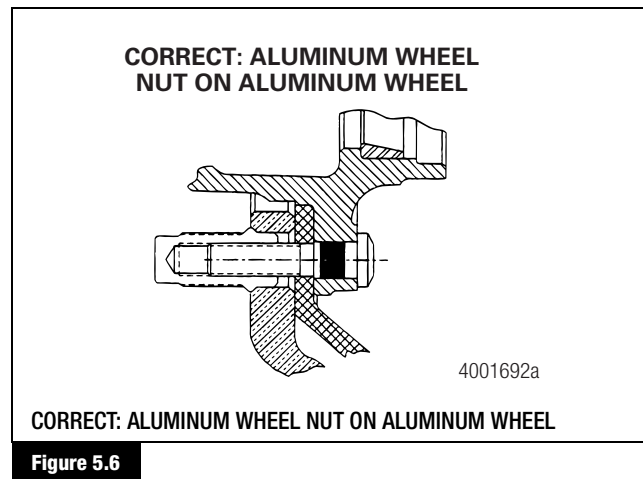


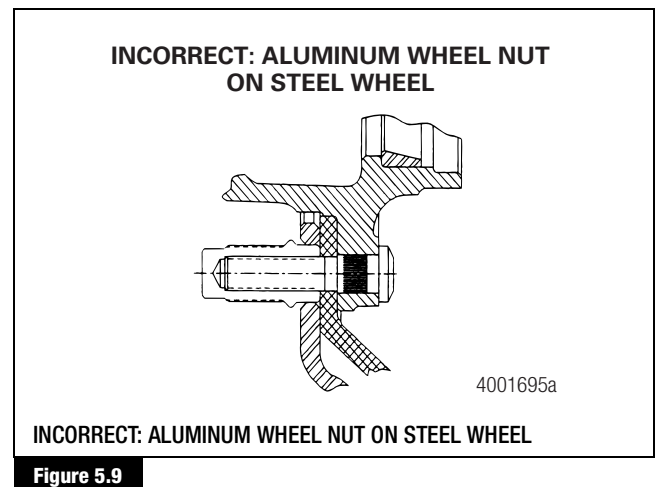
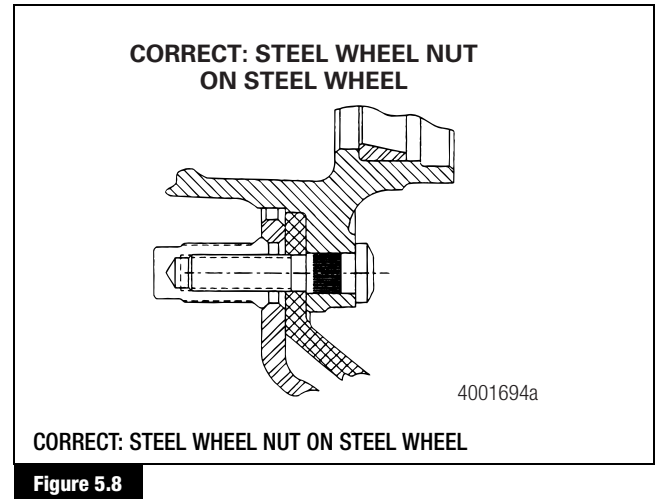
Figure 5.5

4. Some manufacturers color code the studs. Check the manufacturer's instructions to verify the color code used.
5. Install the correct nut in all applications. Refer to Table A. Do not install rusty, galled or worn nuts. Ensure that you use the correct nuts in the following installations.
 - Install 33 mm hex two-piece flange nuts into ISO 285.75 mm bolt circle diameter (BC) and ISO 335 mm BC systems.

- Install 1.5-inch hex two-piece flange nuts into a 275 mm system with M22 x 1.5 serrated studs. Do not install 1.5-inch hex two-piece flange nuts onto M22 x 1.5 serrated studs when 33 mm two-piece hex nuts are used on the CentroMount-8™ system.
6. Install aluminum wheel nuts onto aluminum wheels. Do not install steel wheel nuts. An aluminum wheel nut has an extension to accommodate the thickness of the aluminum. Figure 5.6 and Figure 5.7.



7. Install steel wheel nuts onto steel wheels. Do not install aluminum wheel nuts. The extension of the aluminum wheel nut can bottom against the hub flange or brake drum before the disc is clamped correctly. Figure 5.8 and Figure 5.9.



8. Install nuts with the correct thread size onto the studs. A correct thread size enables the nut to turn freely on the stud. An incorrect nut will fit very loosely on the stud thread, which can cause the thread to strip.
9. Check the extension of the stud through the nut after you tighten the nut to the specified torque. Refer to Table A.
- **If less than two threads extend through the nut, or more than 0.375-inch (9.5 mm) of the stud extends through the nut:** Check all parts to verify that they are correct for the wheel system you will install on the vehicle.

5 Maintenance

10. Ensure that the nut and wheel mate correctly. Ensure that you install the correct components onto the wheel systems.
Figure 5.10 and Figure 5.11.

- **If the wheel has a ball seat bolt hole pattern:** The nut must have a spherical surface that seats in the ball seat.
- **If the wheel has a cylindrical bolt hole pattern:** The nut must have a flat surface that seats against the wheel.

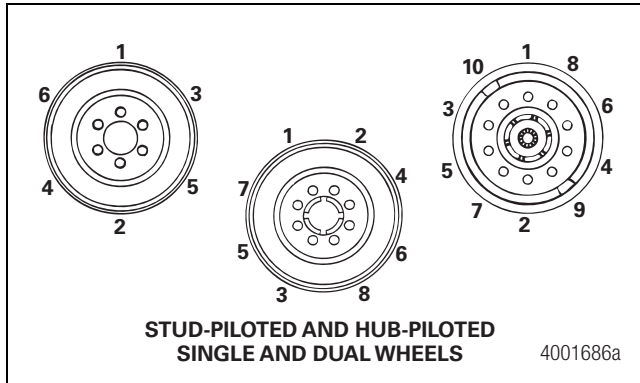


Figure 5.10

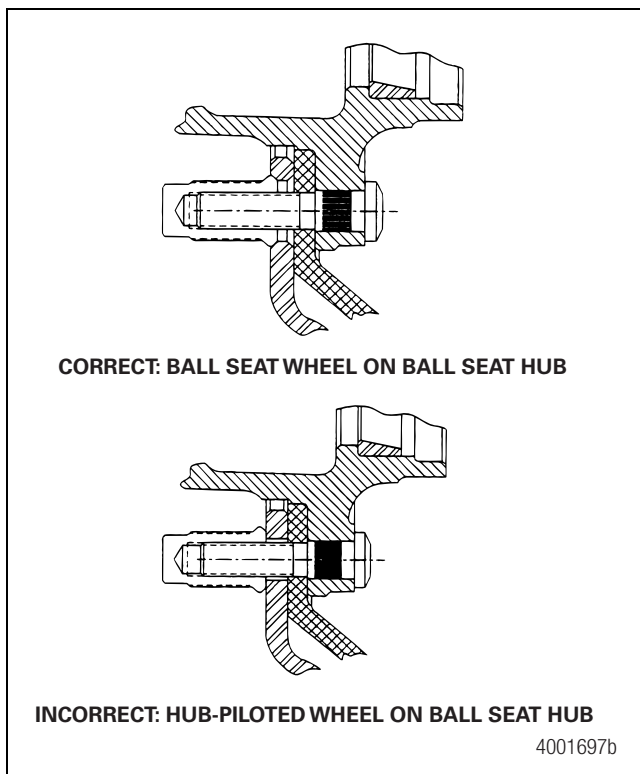


Figure 5.11

11. Follow the disc wheel manufacturer's fastener tightening sequence when you install fasteners to help ensure a higher and more uniform clamp load. Figure 5.12. Always check fasteners at the wheel manufacturer's recommended service intervals.

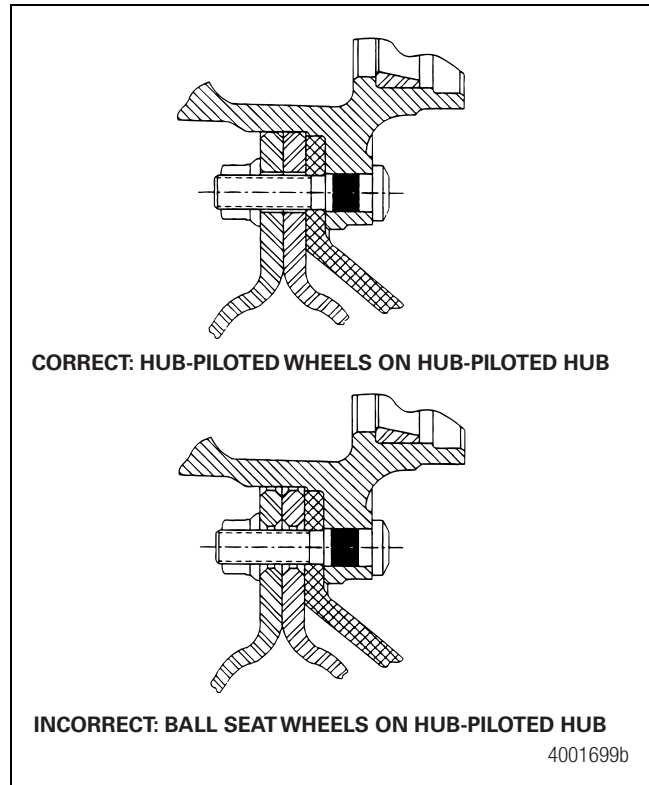


Figure 5.12

⚠ WARNING

Apply two drops of oil between the nut flange and the hex portion of the swivel area at each installation if you reinstall the two-piece flange nuts that have been in service. Without lubricant, the fasteners may not produce adequate clamp load, and a wheel can loosen and separate from the vehicle. Serious personal injury and damage to components can result.

12. Apply two drops of oil between the nut flange and the hex portion of the swivel area at each installation if you reinstall the two-piece flange nuts that have been in service.
13. Apply two drops of oil to the last two or three threads at the end of each stud.

WARNING

Lightly lubricate the hub pilots to ease wheel installation and removal. Do not lubricate the mounting face of the drum or wheel. Lubricant on the drum or wheel mating surfaces can reduce friction and cause the components to slip during operation. Serious personal injury and damage to components can result.

14. Lightly lubricate the hub pilots to ease wheel installation and removal. Do not lubricate the mounting face of the drum or wheel
15. Retighten all wheel nuts on all systems at 50-100 miles (80-160 km) to the correct torque specifications. Refer to Table A.
16. Use the correct installation tools. Refer to Table A.
17. Ensure that the gross weight does not exceed gross vehicle weight (GVW). Ensure that the axle loads do not exceed gross axle weight ratings (GAWR).

6 Brake Drum Failure Analysis

Hazard Alert Messages

Read and observe all Warning and Caution hazard alert messages in this publication. They provide information that can help prevent serious personal injury, damage to components, or both.

WARNING

To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

WARNING

Some brake linings contain asbestos fibers, a cancer and lung disease hazard. Some brake linings contain non-asbestos fibers, whose long-term effects to health are unknown. You must use caution when you handle both asbestos and non-asbestos materials. Refer to page 1 in this manual for hazard summaries and recommended work practices.

Brake Drum Wear Conditions

Most of the following wear conditions that affect a brake drum require that you replace the drum. Refer to Table B for possible causes of, and corrective actions for, the following wear conditions.

What is Normal Wear?

Brake drums wear evenly under normal operating conditions. Use fleet history, if available, to determine the approximate wear rate of tractor drums. Normal wear is the most common reason to remove a brake drum from service.

What is Deep or Excessive Wear?

It is important to inspect a brake drum for the following excessive wear conditions, which require you to replace the drum.

Deep, Uniform Wear

Deep, uniform wear at the edge of the drum where the lining rub path starts can result from brake drag, brake imbalance and dirt embedded in the brake lining. Figure 6.1 and Figure 6.2.

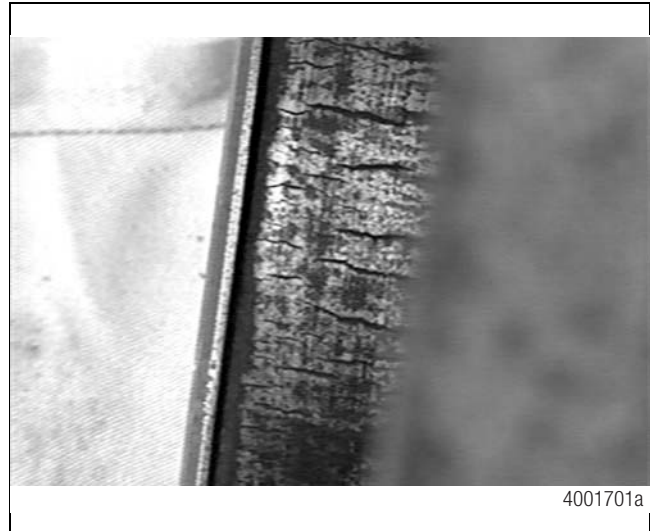


Figure 6.1

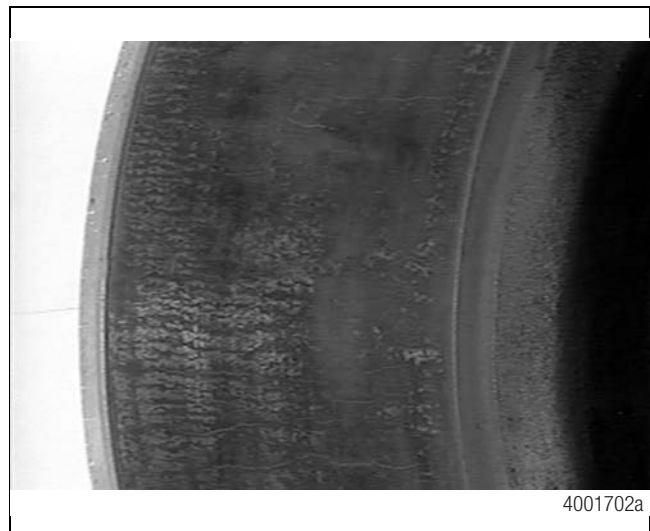


Figure 6.2

Deep Wear on One Side of the Drum Only

Deep wear only on one side of the drum indicates that the drum is not concentric with the bearing center line of the hub. No evidence of hot spotting may be evident. Figure 6.3.



Figure 6.3

Uniform Heat Checking

Heat checking is fine cracks on the drum's surface. This is a normal condition that results from continuous heating and cooling of the friction surface. Cracks that are 1-2-inches or more are usually deep and require that you replace the drum. Figure 6.4.



Figure 6.4

Heat Checking Only on One Side of the Drum

Heat checking that appears only on one side of the drum results when a drum is not concentric to the linings. Hot spotting may or may not be evident. However, you may also notice deep wear on the same side of the drum. Replace the drum. Figure 6.5.

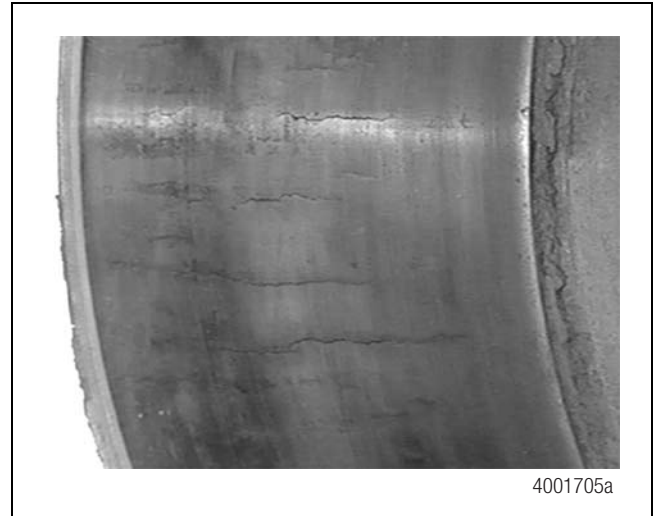


Figure 6.5

Hot Spotting or Black Spots

Hot spotting is black spots on a drum's surface that can appear in the following ways.

1. Uniformly over the entire surface. Figure 6.6.

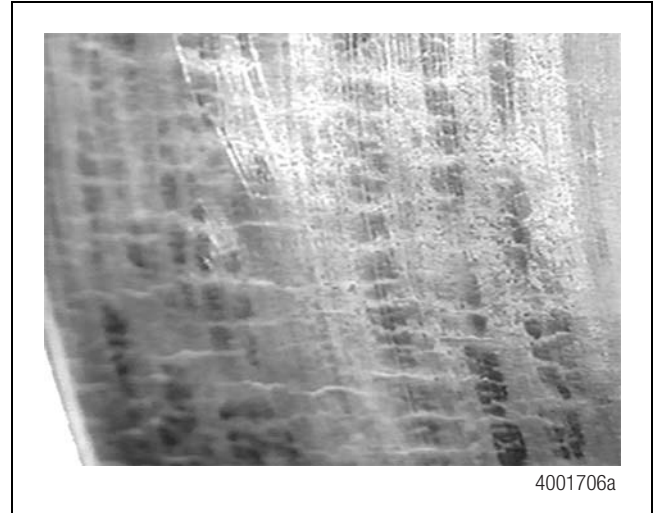


Figure 6.6

2. On one side only. Figure 6.7.

6 Brake Drum Failure Analysis

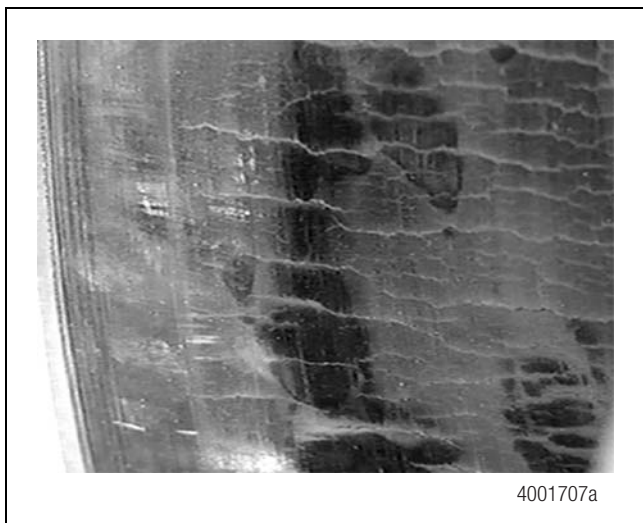


Figure 6.7

3. In three equally distant places. Figure 6.8.

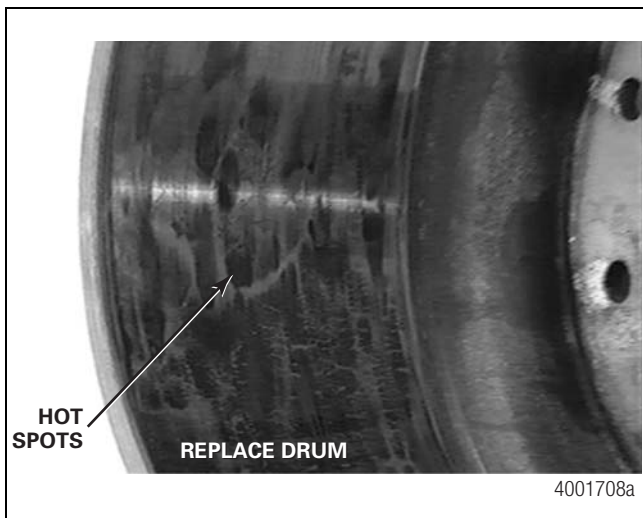


Figure 6.8

4. Replace the brake drum.

Polished or Glazed Drum

A polished or glazed drum has a mirror-like finish on the friction surface. This condition occurs with some non-asbestos linings. Figure 6.9.



Figure 6.9

Scoring or Grooving

Scoring or grooving are depressions in the drum's circumference that are deeper than 0.10-inch (2.54 mm) and wider than 0.030-inch (0.762 mm). Replace the drum and linings. Figure 6.10.

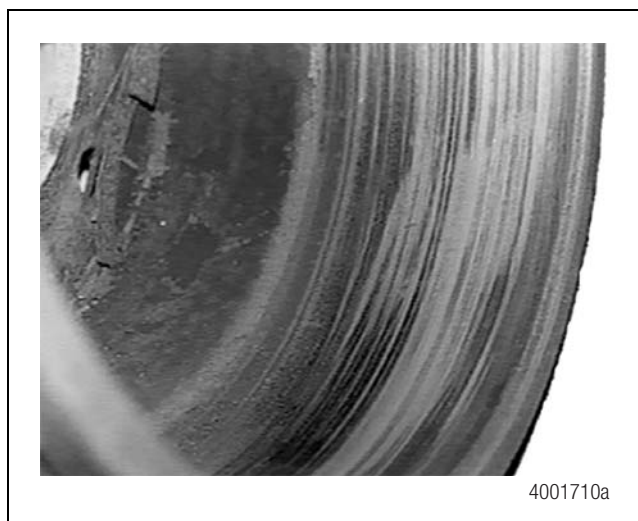


Figure 6.10

Blue Drum

The inside of the brake drum has a blue tint, and components can be damaged or deformed. These conditions indicate that extremely high temperatures occurred during operation. Replace the drum. Figure 6.11.

6 Brake Drum Failure Analysis



4001711a

Figure 6.11

Broken Bolt Flange, Brake Surface Not Cracked

NOTE: Allowable brake drum pilot clearance is 0.001-0.007-inch (0.0254-0.1778 mm).

The bolting flange is broken, but the brake's surface may not have cracked. Figure 6.12. This is a rare condition that usually has been caused by an assembly interference. For example, an incorrect drum was assembled onto a hub or spoke wheel. When the fasteners were tightened, the clamping load cracked the flange.



4001712a

Figure 6.12

Broken flanges can also occur if both brake shoes do not simultaneously contact the drum.

Broken Bolt Flange, Cracked Brake Surface

The expanding brake shoes separated the bolt flange from the brake drum, but the flange remained intact. Figure 6.13.

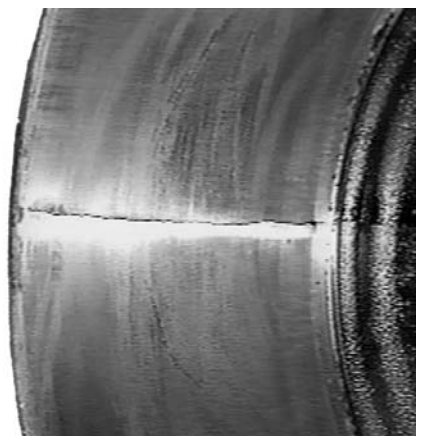


4001713a

Figure 6.13

Cracked Drum

The drum has cracked, but may not show signs of wear, heat checking or hot spots. Figure 6.14. A drum can crack when the parking brake is set while the brakes are extremely hot. The cooling drum contracted on the brake shoes with enough force to crack the drum.



4001714a

Figure 6.14

6 Brake Drum Failure Analysis

Brake drum pilot interference with the hub or wheel pilot can also cause the entire cross-section of the drum to crack, if the drum was forced onto the pilot while interference is present.

Worn Brake Drum Bolt Holes

The brake drum bolt holes are worn, usually because the bolts were not tightened to the correct torque specification. Drum pilots may also be worn, and runout in the brake drum may have occurred. The mating hub or wheel pilots may be extensively damaged. Replace both the hub and drum. Figure 6.15.



Figure 6.15

Oil or Grease Has Penetrated the Drum's Surface; the Drum is Discolored

The brake system has been contaminated with oil or grease when the following conditions are evident. It is difficult to reverse this type of damage, because oil and grease can actually penetrate iron. Figure 6.16.

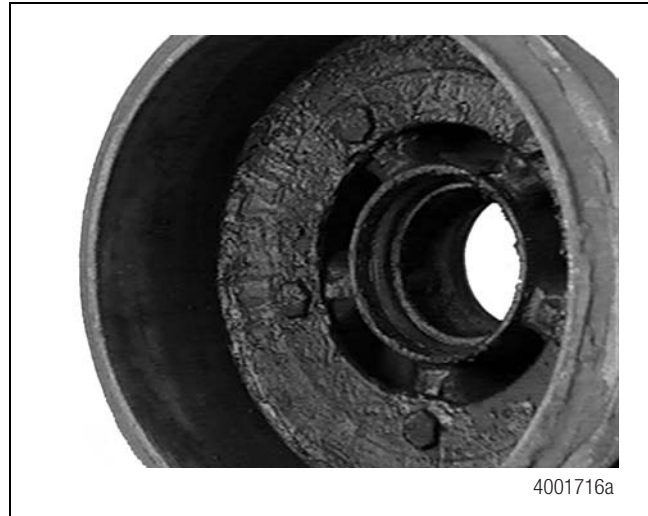


Figure 6.16

1. Oil and grease spots have penetrated the drum's surface.
2. The brake drum is discolored.
3. Oil and grease spots are evident on components, which resulted from wheel or hub oil seals that leaked.
4. Replace the drum.

Conditions That Can Affect Brake Drum Wear

Brake Drag

- Worn camshaft bushings
- Relay valves do not work correctly
- Automatic slack adjuster does not work correctly
- Manual slack adjuster set too tight
- Bent air chamber push rods
- Weak or broken air chamber or shoe return springs
- Swelling and growth of new linings
- Total vehicle air brake system imbalance
- Clogged air exhaust ports
- Restricted or pinched air hoses or tubing
- Imbalanced apply and release threshold pressures

Too Much Drum-to-Pilot End Play or Gap

- Mating hub- or wheel-pilot machined under size
- Hub or wheel pilots not concentric to bearing bores

- Brake drum assembled on contaminated or corroded hub pilots
- Drum incorrectly assembled onto pilot
- Drum not concentric to lining

Drum Seats Incorrectly on the Hub or Pilot Wheel

- Corroded mounting surfaces
- Corroded aluminum hub and drum assembly
- Iron or aluminum hub pilot not cleaned correctly prior to installation

Both Shoes Do Not Simultaneously Contact the Drum

- Brake drum not concentric with the bearing center line of the hub

Heavy Braking

- Inadequate braking system for operation
- Linings not original equipment manufacturer-approved
- Poor driver technique
- High-temperature applications, such as city and construction driving
- Brake imbalance
- Bent spiders; or bent shoes that do not uniformly contact the brake surface

Brake Imbalance

- Pneumatic imbalance between axles
- Relay valves do not work correctly
- Linings are not original equipment manufacturer-approved
- Incorrect brake power, AL Factor
- Imbalanced apply and release threshold pressures

6 Brake Drum Failure Analysis

Table B: Troubleshooting Brake Drum Wear

Condition	Possible Cause	Corrective Action
Deep, uniform drum wear	Brake drag	Replace the drum. Install the dust shields. If dust shields are installed, remove the shields and try operating the vehicle without them.
	Brake imbalance	
	Dirt and contaminants imbedded in the brake lining	
	Incorrect driving technique	
	Engine retarder not installed	
	Braking with hand valve	
	Not downshifting on steep grades	
Deep drum wear on one side only	Exceeding vehicle's brake capacity	Replace the drum.
Worn brake drum bolt holes	Brake drum dropped, bent or machined out-of-round	Replace the drum.
	Drum-to-pilot fit has too much end play or gap	
Uniform heat checking, fine cracks	Incorrect torque applied to bolt, which also causes hub- and drum-pilots to wear. Runout also occurs.	Replace the drum.
Heat checking on one side only	Heavy braking	Replace the drum.
Uniform hot spotting or black spots on the drum's surface	Drum dropped, bent or machined out-of-round	Replace the drum.
	Fine cracks on drum's surface from normal operation	
	Drum-to-pilot fit has too much play or gap	
	Brake lining and drum mating surfaces burnished too slowly	
Hot spotting or black spots on one side only	Brake drag	Replace the drum.
	Extremely hard linings	
	Lining swell from poor-quality linings	
	Brake drum not concentric to the lining	
Hot spotting or black spots on three equally-distant places	Drum dropped, bent or machined out-of-round	Replace the drum.
	Drum-to-pilot fit has too much play or gap	
	Brake lining and drum mating surfaces burnished too slowly	
	Braking with light, dragging stops	
	Linings not original equipment manufacturer-approved	
Polished or glazed drums, mirror-like shine	Uneven brake surface contour caused by incorrect manufacturing process	Replace the drum.
	Brake drag	
	Low-pressure braking	
	Linings not aggressive enough or not original equipment manufacturer-approved	

Table C: Troubleshooting Brake Drum Wear

Condition	Possible Cause	Corrective Action
Scoring, Grooving Deep grooves in the drum's surface that exceed the drum's maximum diameter. Drum can appear to be in good condition.	Dirt or contaminants in the brake system Linings worn to the rivets or not original equipment manufacturer-approved	Check for dirt embedded in the lining. Install the dust shields. If dust shields are installed, remove the shields and try operating the vehicle without them.
Blue Drum Inside of the brake drum has blue tint from excessive heat. Components can be deformed or damaged.	Braking generates extremely high temperatures caused by axle-wheel end imbalance Poor driver techniques Linings not original equipment manufacturer-approved Brake system incorrectly spec'd for the application Brake drag	Replace the drum.
Cracked Drum Drum has cracked, but may not show signs of wear, heat checking or hot spotting.	The parking brake is set while the brakes are extremely hot. The cooling drum contracts on the brake shoes with enough force to crack the drum. Brake drum pilot interference with the hub or wheel pilot Drum cracked prior to assembly	Replace the drum.
Broken Bolt Flange, brake surface not cracked	The brake drum pilot interferes with the hub or wheel pilot. Drum cracks at installation. High temperatures cause expanding brake shoes to separate the bolt flange from the drum Incorrect drum assembly on a spoke wheel Brake drum not seated correctly on the hub or pilot wheel Both brake shoes do not contact the drum simultaneously	Replace the drum.
Broken Bolt Flange, cracked brake surface	Excessive wear, heat checking or hot spotting Any combination of the above	Replace the drum.
Oil or grease has penetrated the drum's surface; the drum is discolored Oil and grease spots have penetrated the drum's surface and are evident on components. Discolored drum	Wheel or hub oil seals leak	Attempt to remove oil and grease spots from the drum. If you cannot completely remove the oil and grease spots, you must replace the drum.

6 Brake Drum Failure Analysis

Hazard Alert Messages

Read and observe all Warning and Caution hazard alert messages in this publication. They provide information that can help prevent serious personal injury, damage to components, or both.

WARNING

To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

Park the vehicle on a level surface. Block the wheels to prevent the vehicle from moving. Support the vehicle with safety stands. Do not work under a vehicle supported only by jacks. Jacks can slip and fall over. Serious personal injury and damage to components can result.

Inspect for Brake Drum Wear

Inspect the brake drums when you perform maintenance and service procedures. Refer to Brake Drum Wear Conditions in this section and Table B to identify the types, possible causes and corrective actions for brake drum wear.

1. Closely check wear patterns on the friction surface inside the drum.
2. The maximum allowable brake drum diameter is stamped or cast into the outer edge of the drum. Place a brake drum diameter gauge inside the drum. Take several measurements within 90 degrees of each other at the open and closed edges of the drum's friction surface.
 - If any of these measurements are **0.120-inch (3.048 mm) over nominal diameter**: Replace the brake drum. Figure 6.17.
 - If a brake drum is **out-of-round**: Replace the drum.

Table D

Nominal Diameter	Discard Drum at:
16.5"	16.620"
15"	15.120"

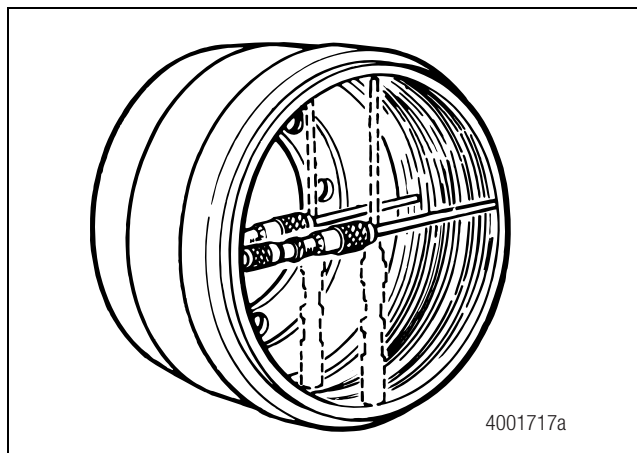


Figure 6.17

3. Check that the brake drum surface is concentric to the bearings within 0.015-inch (0.381 mm) total indicator runout (TIR). Excessive end play can result when the drum's surface is not concentric to the bearings, which can result in deep drum wear on one side only.
4. Inspect all components for corrosion before assembly, especially the brake drum pilot and mating hub and bolt flanges. Corroded parts can cause excessive end play, which can result in deep drum wear on one side only.

Check Runout on an Assembled Brake Drum

NOTE: You should always check runout on an assembled brake drum. Do not disassemble the wheel and tire assembly, or any other components. Do not remove the wheel and tire assembly from the vehicle, which will change the original position of the assembled components and affect the accuracy of the runout reading.

Perform the following procedure with the wheel and tire assembly installed to obtain an accurate in-service runout reading.

1. Wear safe eye protection. Park the vehicle on a level surface. Block the wheels to prevent the vehicle from moving.
2. Raise the axle you will inspect and support it with safety stands.

6 Brake Drum Failure Analysis

WARNING

Fully open the hood and ensure it is engaged in the safety catch according to the vehicle manufacturer's instructions. Do not work under a hood that is unsecured. The hood can fall unexpectedly, resulting in serious personal injury.

3. If you are working on a steer axle wheel end, open the hood and secure it correctly.
4. Remove the dust shields, if equipped, to obtain access to the drum friction surface.
5. Mount the base of the dial indicator onto the axle, steering knuckle or other flat surface near the wheel end.
 - **If a flat surface is not available:** Use a pair of clamps and flat piece of stock to create a flat surface for mounting the dial indicator. Ensure the dial indicator base is correctly secured.
 - **If there is movement in the base:** Relocate it to a more secure position. In some vehicle configurations, a lateral runout gauge or small style dial indicator may be required in order to obtain correct clearance. Figure 6.18 and Figure 6.19.

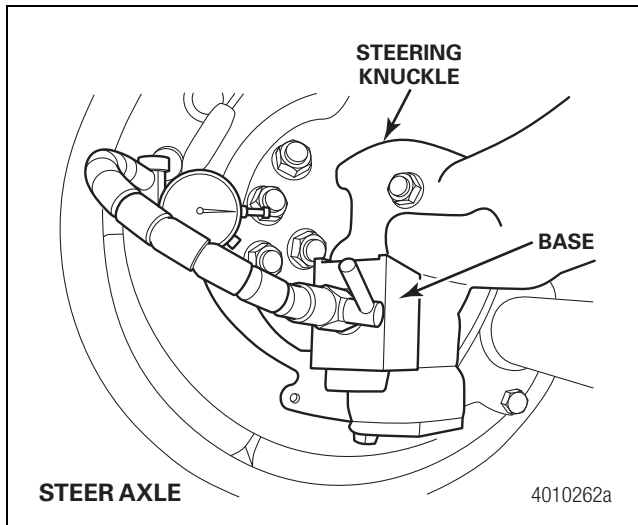


Figure 6.18

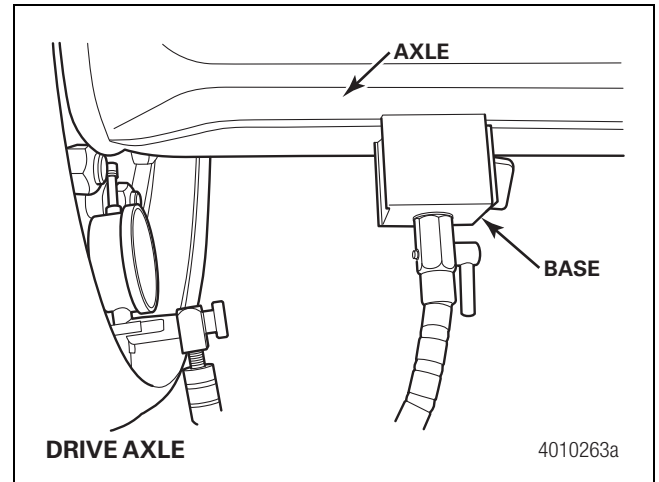


Figure 6.19

6. Align the dial indicator to contact the drum friction surface. Ensure the dial indicator tip is perpendicular to the drum friction surface to obtain an accurate reading. Figure 6.20 and Figure 6.21.

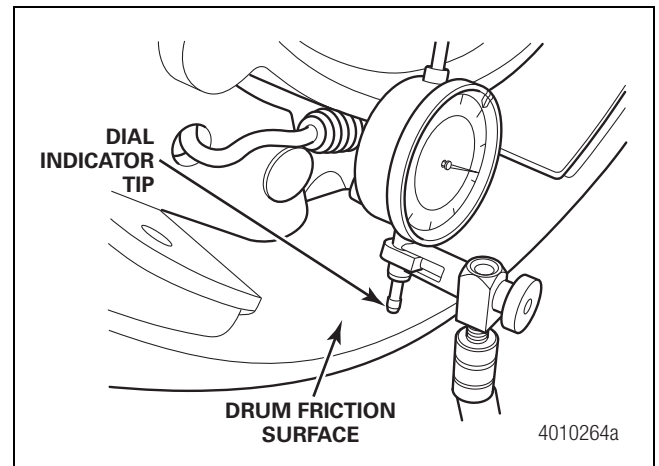


Figure 6.20

6 Brake Drum Failure Analysis

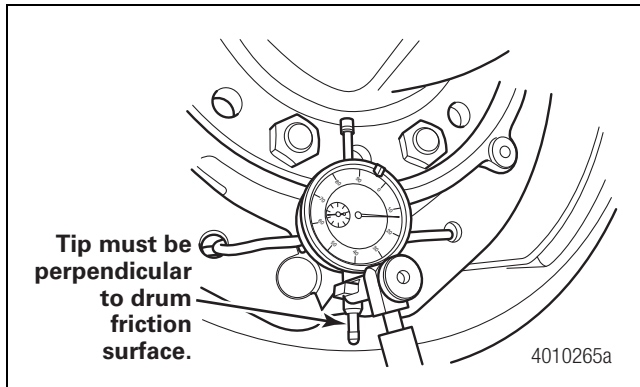


Figure 6.21

7. Set the dial indicator to ZERO. Figure 6.22.

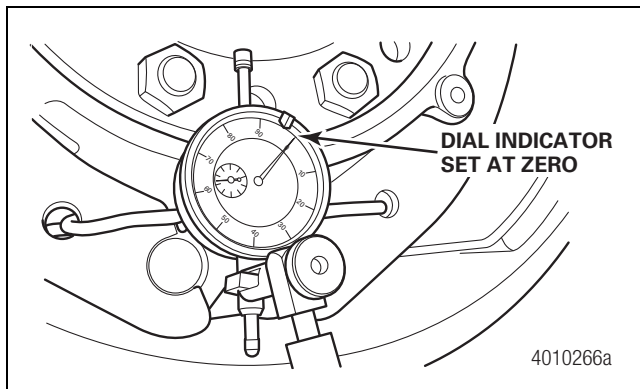


Figure 6.22

8. Rotate the wheel and tire assembly 360 degrees, one complete revolution. As you rotate the wheel, watch the gauge as it moves left to right. Note the area with the highest runout reading.
9. Rotate the drum to the highest runout reading and zero the dial indicator.
10. Rotate the drum 360 degrees again. As you rotate the wheel, watch the gauge and note the maximum reading. This is the total indicator runout (TIR), which should not exceed 0.015-inch (0.381 mm).
 - **If runout is less than 0.015-inch (0.381 mm):** Return the vehicle to service.
 - **If runout exceeds 0.015-inch (0.381 mm):** Remove the drum and inspect the hub-to-drum mating surfaces for damage. A mismatch of the drum pilot to the hub pilot can damage the chamfer surfaces and possibly not allow the drum to position correctly onto the hub pilot.

No Damage is Found

1. Reinstall the brake drum onto the hub by rotating the drum 180 degrees from its original position.
2. Install two nuts 180 degrees apart to keep the drum seated against the hub. Remeasure runout.
 - **If runout is less than 0.015-inch (0.381 mm):** Keep the drum in its new position. Remove the nuts, reassemble the wheel, and return the vehicle to service.
 - **If runout exceeds 0.015-inch (0.381 mm):** Replace the drum.

Damage is Found

Replace the necessary components.

Maintenance Procedures

How to Clean a Brake Drum

NOTE: Use a wet cleaning method to prevent fibers from the friction material from becoming airborne.

Use the following procedure to clean drums during maintenance and service, and after machining.

1. Clean the brake drum with a cloth dampened with water or a water-base solution.
2. If a drum has been exposed to leaking oil or grease, perform Step 1. Then clean the drum with a non-oil base solvent.

Replace a Brake Drum

⚠ WARNING

Before you service a spring chamber, carefully follow the manufacturer's instructions to compress and lock the spring to completely release the brake. Verify that no air pressure remains in the service chamber before you proceed. Sudden release of compressed air can cause serious personal injury and damage to components.

1. Wear safe eye protection. Park the vehicle on a level surface. Block the wheels.
2. Raise the vehicle. Support the vehicle with safety stands.

6 Brake Drum Failure Analysis

NOTE: Before you remove the wheel and brake drum, it may be necessary to de-adjust the slack adjuster to provide clearance between the brake linings and drum.

3. Remove the wheel lug nuts. Remove the wheel assembly.
4. Loosen the drum from the hub mounting bolts. Remove the drum.
 - **If the drum is rusted or corroded:** Treat the bolts. Apply pressure to one side of the drum. Pull the drum from the hub.
5. Clean brake drum surfaces to remove dirt and contaminants.
6. Measure the replacement drum in several places to ensure that the dimensions are correct.
7. Clean debris from the drum.

NOTE: At installation, take care that wheel bearing grease does not contaminate the drum.

8. Clean the drum and hub pilots with a wire brush.
9. Align the drum with the hub bolts. Install the drum onto the hub. Ensure that the drum seats flat against the face of the hub.
10. Install the lock nuts onto the bolts. Tighten to the correct torque specification. Refer to Table E.

Table E

Drum Lock Nut Sizes	Torque
Drum Replacements:	
0.625" diameter	95-130 lb-ft (129.2-176.8 N•m)
0.75" diameter	200-250 lb-ft (272-340 N•m)
Blind Tapped Holes:	
0.625" diameter	153-207 lb-ft (208.1-281.5 N•m)
0.75" diameter	273-367 lb-ft (371.3-499.1 N•m)

Preventive Maintenance Tips

- Use heavier brake drums to ensure braking capacity. Specify X-10 drums to avoid various types of hot spotting.
- Use 20 psi (138 kPa) or greater snubs to break in new linings, rather than light dragging stops.
- Ensure that the brake drum surface is concentric to the bearings within 0.015-inch (0.381 mm) total indicator runout (TIR).

- Thoroughly clean all parts prior to assembly, especially the drum and hub pilots, and the mating hub and bolt flanges. Because these parts fit closely together, dirt, rust or paint can cause runout, which can shorten drum and lining life.
- Discard a brake drum with heat checks of 1-2-inches or more on the surface.
- Use original equipment manufacturer-approved replacement linings. Vehicles are usually certified to pass FMVSS 121 original equipment only.

Meritor Heavy Vehicle Systems, LLC

2135 West Maple Road
Troy, MI 48084 USA
866-OnTrac1 (668-7221)
meritor.com

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Printed in USA

Revised 09-12
Maintenance Manual MM-99100 (16579)

