



WARNING

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



ASBESTOS AND NON-ASBESTOS FIBERS 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. **Figures 6.1 and 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 6.1

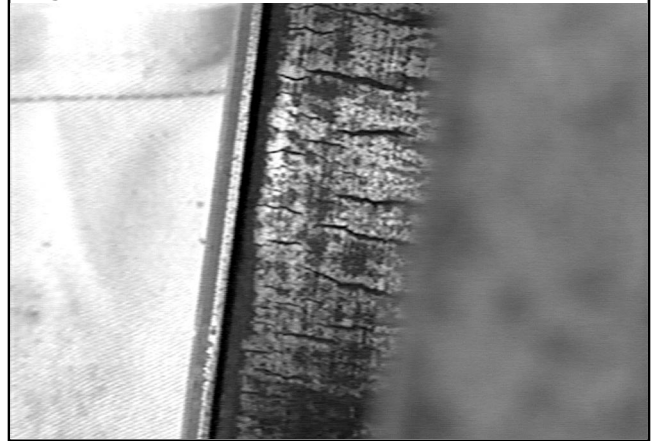


Figure 6.2

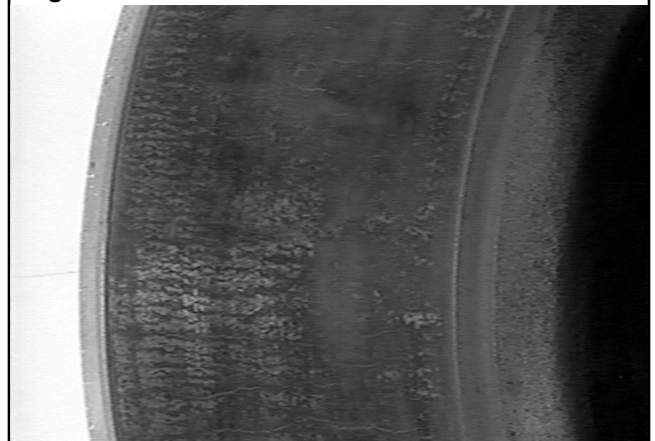
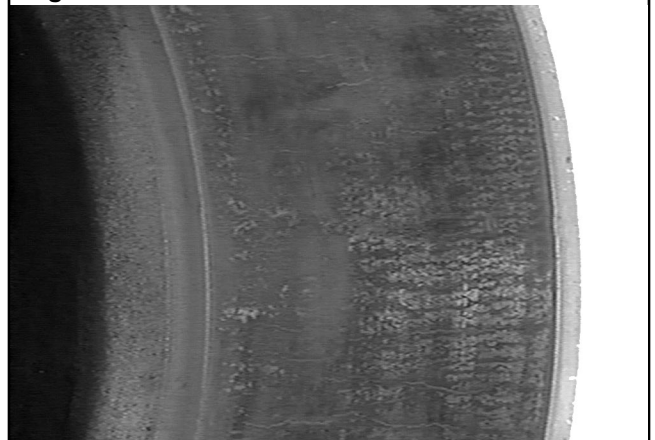


Figure 6.3



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Brake Drum Failure Analysis

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 one to two inches or more are usually deep and require that you replace the drum. **Figure 6.4.**

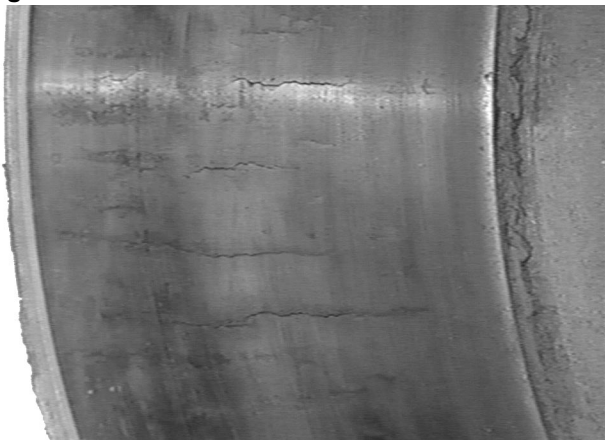
Heat Checking Only on One Side of the Drum

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 6.4



Figure 6.5



Hot Spotting (Black Spots)

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

1. Over the entire surface (uniform). **Figure 6.6.**
2. On one side only. **Figure 6.7.**
3. In three equally distant places. **Figure 6.8.**
4. Replace the brake drum.

Figure 6.6

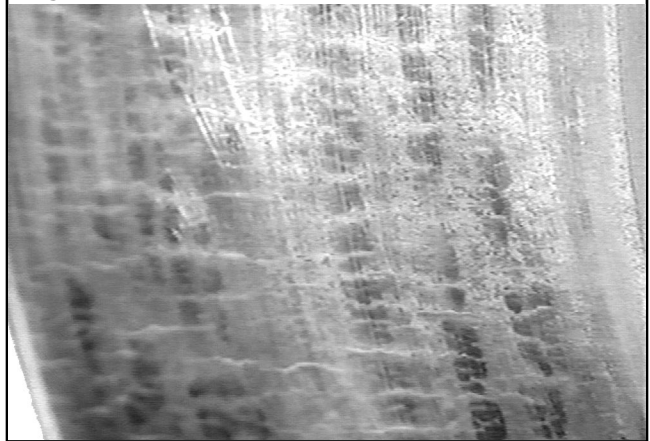


Figure 6.7

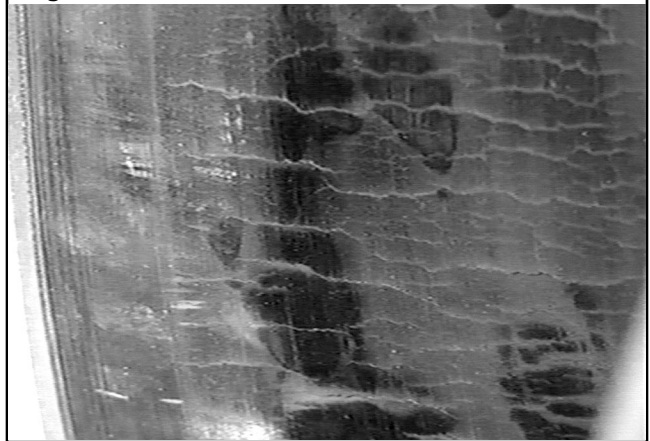


Figure 6.8

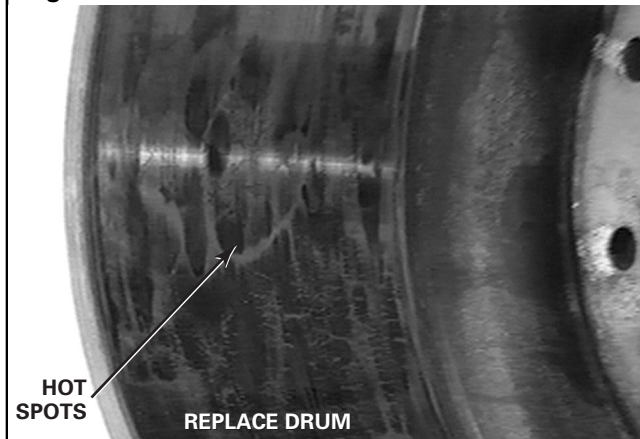
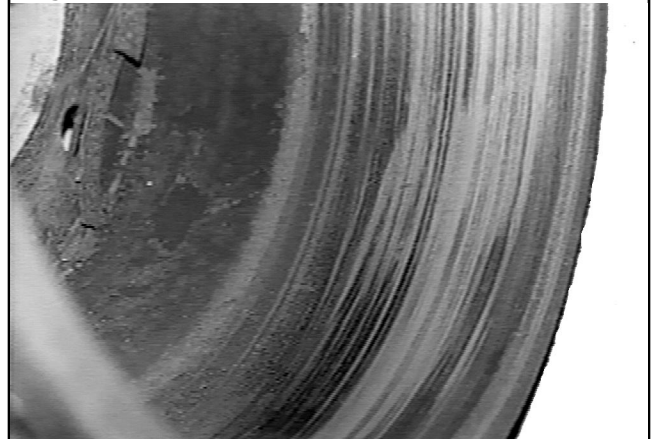


Figure 6.10



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.**

Scoring (Grooving)

Scoring (grooving) are depressions in the drum's circumference that are deeper than 0.10-inch and wider than 0.030-inch. Replace the drum and linings. **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.**

Figure 6.11

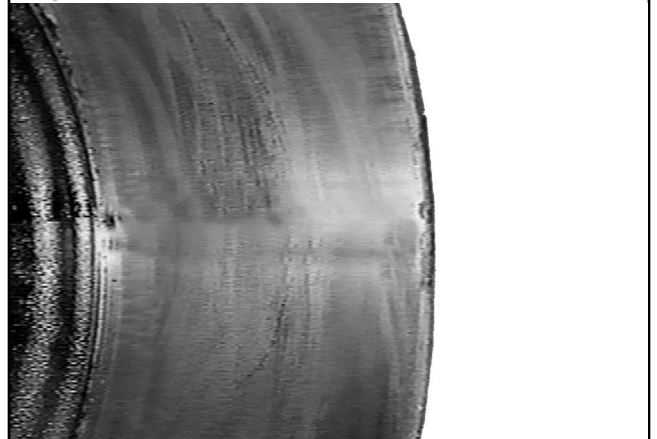


Figure 6.9



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Brake Drum Failure Analysis

Broken Bolt Flange (Brake Surface Not Cracked)

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

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.**

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.

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.

Figure 6.13



Figure 6.14

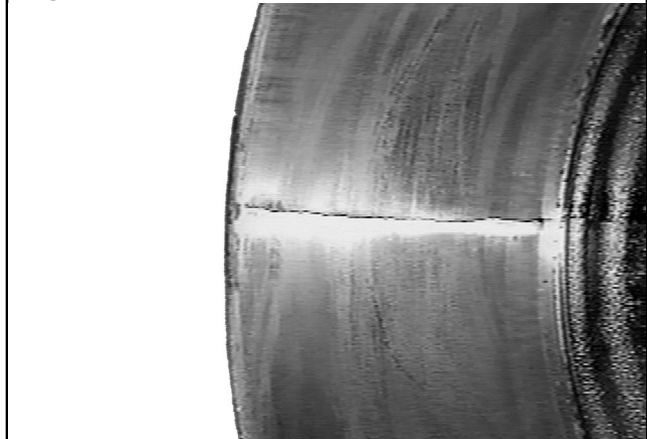


Figure 6.12



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.**

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.**

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.

Figure 6.16

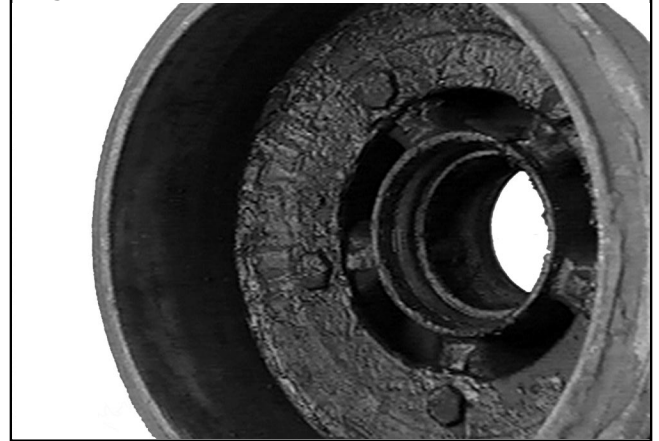


Figure 6.15



Section 6

Brake Drum Failure Analysis



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 (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 centerline of the hub

Heavy Braking

- Inadequate braking system for operation
- Linings not OEM-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 OEM-approved
- Incorrect brake power (AL Factor)
- Imbalanced “apply” and “release” threshold pressures

Table B: Troubleshooting Brake Drum Wear

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

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Brake Drum Failure Analysis



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 OEM-approved	Check for dirt embedded in the lining. Install 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 OEM-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.



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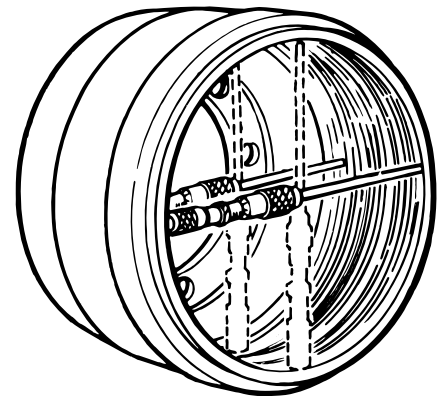
Inspect for Brake Drum Wear

Inspect 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.

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.

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.

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Brake Drum Failure Analysis



Replace a Brake Drum



WARNING

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.

When you work on a spring chamber, carefully follow the service instructions of the chamber manufacturer. Sudden release of a compressed spring can cause serious personal injury.

1. Park the vehicle on a level surface. Block the wheels.
2. Raise the vehicle. Support the vehicle with jack stands.

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 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 locknuts onto the bolts. Tighten to the correct torque specification. Refer to the following table.

Drum Locknut Sizes	Torque
Drum Replacements:	
5/8" diameter	95-130 lb-ft (129.2-176.8 N•m)
3/4" diameter	200-250 lb-ft (272-340 N•m)
Blind Tapped Holes:	
5/8" diameter	153-207 lb-ft (208.1-281.5 N•m)
3/4" 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 or greater snubs to break in new linings, rather than light dragging stops.
- Ensure that 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 one to two inches or more on the surface.
- Use OEM-approved replacement linings. Vehicles are usually certified to pass FMVSS 121 original equipment only.