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DATE: 1981 May 29

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DOCUMENT DESCRIPTION: Memo - EPA/OSHA Asbestos Exposure Program for Brake Mechanics with Industry Warning Information Attached



Inter Office

Ford Parts and Service Division

May 29, 1981

Mr. M. E. Hamburg

cc Mr. G. G. Clickard ✓  
Mr. E. J. Riley

Subject: EPA/OSHA Asbestos Exposure Program for Brake Mechanics

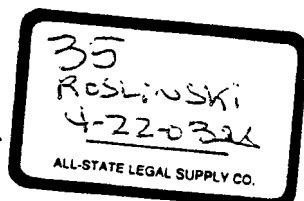
Ref: 1. EPA letter of 4/27/81  
2. A. B. M. Houston letter of 5/21/81

We have reviewed the EPA letter and attachments and also Mr. Houston's letter and offer the following comments:

1. The Training and Publications Dept. has published warnings in the brake section of the Car and Truck Shop Manuals regarding the health hazard of air blowing asbestos dust and recommended the use of proper equipment for dust removal. Copies of this information are attached for your use.
2. The Training and Publications Dept. has had no brake training programs in recent years because there has been no new technology on brake service requirements. Accordingly, we have not published training information on asbestos dangers and handling procedures.

*E. F. Priebe*  
E. F. Priebe

Attachments



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## REMOVAL AND INSTALLATION

### BRAKE DRUM

#### VEHICLES THRU 9000 SERIES

Use the following service procedures for both hydraulic and air brakes.

#### FRONT BRAKE DRUM

1. Raise the vehicle until the tire clears the floor and remove the wheel and tire from the hub. Loosen the brake shoe adjusting screw until the shoes no longer touch the brake drum. Remove the grease cap and the gasket (if equipped) from the hub.
2. On vehicles with 9,000 lb front axles and hydraulic brakes, remove the locknut, locking ring, dimpled washer and adjusting nut. On all other axles, remove the cotter pin, adjusting nut and flat washer from the spindle.
3. Remove the outer bearing cone and roller assembly. Pull the hub and drum assembly off the wheel spindle.
4. Remove the front wheel-to-hub retaining nuts (or rim and tire attaching nuts). Remove the wheel (or rim and tire) from the hub and drum.
5. Remove the brake drum retainers and attaching bolts, screws or bolts and nuts.
6. Remove the brake drum from the hub.
7. Check the drum for damage or wear, and repair or replace if necessary. If a new drum will be installed, be sure to remove the protective coating with degreaser.

Install new grease retainer seals whenever a wheel and hub is removed.

8. Place the brake drum to the hub and install the retainers and retaining bolts, screws, or bolts and nuts.
9. Install the hub and drum on the wheel spindle. Keep the hub centered on the spindle to prevent damage to the grease retainer or the spindle threads.
10. On vehicles with 9,000 lb front axles and hydraulic brakes install the outer bearing cone and roller assembly, and the bearing adjusting nut. On all other axles, install the outer bearing cone and roller and flat washer on the spindle. Install the adjusting nut.
11. Install the wheel and tire on the hub. Then install the clamps (if applicable) and the wheel stud nuts.
12. While rotating the wheel, tighten the adjusting nut to specification. Adjust wheel bearings as described in Group 11.
13. On vehicles with 9000 lb front axle and hydraulic brakes, install the dimpled washer with the dimple indexed in one of the holes in the adjusting nut. Install the locking ring lock nut and tighten to specification (refer to Group 11). Bend the locking ring over a flat of the lock nut.
14. Install the gasket (if equipped) and the grease cap, and tighten the wheel stud nuts to specification (refer to Group 11). Install the hub cap (if equipped), and adjust the brakes as described in this Part.

## OVERHAUL

Removal of dust and dirt from brake assemblies should be done by using the Rotunda Brake Vacuum (340009) or equivalent or Rotunda brake parts washer (model 650016) or equivalent. Brake assembly dust and dirt should not be removed by either blowing off with an air gun or vacuuming with a standard industrial vacuum because a health hazard from breathing asbestos dust may develop. Also, any machining done on brake linings or pads should be done using properly exhaust ventilated equipment.

### BRAKE DRUM REFINISHING

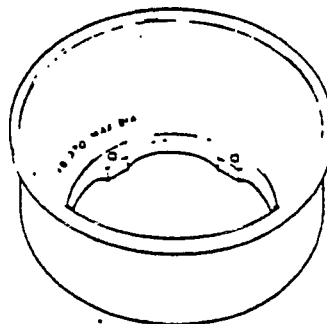
Minor scores on a brake drum can be removed with fine emery cloth, provided the emery is thoroughly cleaned off the drum after the operation.

### BRAKE DRUM REFINISHING

Minor scores on a brake drum can be removed with fine emery cloth, provided the emery is thoroughly cleaned off the drum after the operation.

A badly scored, rough, or out-of-round drum should be ground or turned on a drum lathe. Do not remove any more material from the drum than is necessary to provide a smooth surface for the brake shoe contact.

Brake drum maximum braking surface diameter is shown on each brake drum (Fig. 10). Brake drums which exceed the maximum braking surface diameter shown on the brake drum, either through wear or refinishing, must be replaced.



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FIG. 10 Brake Drum Maximum Braking Surface Diameter Marking Location—Typical Medium—Heavy Truck Shown

On all medium and heavy trucks, the maximum braking surface diameter specification, which is shown on each brake drum, allows for 0.060-inch machining cut over the original nominal drum diameter, plus 0.030-inch additional wear before the drum must be replaced. After refinishing the brake surface runout must not exceed 0.070-inch total indicator reading, measured from the bearing cup.

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(complete axle set) on front wheels as required. The rubber caliper insulators and the plastic sleeves must be replaced when linings are replaced.

3. Visually check the caliper. If the caliper housing is leaking, it should be replaced. If a seal is leaking, the caliper must be disassembled and new seals installed. If a piston is seized in the bore, a new caliper housing is required.

Refer to Part 12-20 for disc brake rotor resurfacing procedure.

#### Service Precautions

1. Grease or any other foreign material must be kept off the lining surfaces of the rotor and external surfaces of the hub during service operations. In handling the rotor and caliper assemblies, avoid deformation of the brake rotor and nicking or scratching of brake linings.
2. If a caliper piston is removed for any reason, the piston seal must be replaced.
3. During removal and installation of a wheel assembly, exercise care not to interfere with the caliper splash shield or the bleeder screw fitting.
4. Front wheel bearing end play is critical and must be within specifications.
5. To avoid bending or damaging the rotor splash shield on full right or left wheel turns, be sure the vehicle is centered on the hoist before servicing any front end components.
6. Riding of the brake pedal (common on left-foot applications) must be avoided during vehicle operation.
7. The wheel and tire must be removed separately from the brake rotor, unlike drum brakes where the wheel, tire, and drum can be removed as a unit.
8. Do not attempt to clean or restore any oil or grease-soaked brake linings. When contaminated linings are found, they must be replaced in complete axle sets.
9. Always replace rubber caliper insulators and plastic sleeves when replacing linings. Do not lubricate the slide pins.
10. Caliper slide pins must be hand started into spindle before tightening. This is to insure that the large diameter of pin is through outer shoe holes to prevent binding or bending.

#### Drum Brakes

1. Remove the wheel from the drum, and remove the drum, Part 12-02.

Removal of dust and dirt from brake assemblies should be done by using the Rotunda brake vacuum (model 340009) or Rotunda brake parts washer (model 650016) or equivalent. Brake assembly dust and dirt should not be removed by blowing off with an air gun because a health

hazard from breathing asbestos dust may develop.

3. Inspect the brake shoes for excessive lining wear or shoe damage. If the lining is worn within 1/32 inch of the rivet heads or if the shoes are damaged, they must be replaced. Replace any lining that has been contaminated with oil, grease, or brake fluid. Replace lining in axle sets. Prior to replacement of lining, the drum diameter should be checked to determine that the brake drum braking surface diameter is within specification by using the Rotunda brake drum micrometer (model 100010) or equivalent. If the braking surface diameter exceeds specification, the drum must be replaced.
4. Check the condition of brake shoes, retracting springs, hold-down springs, and drum for signs of overheating. If the shoes have a slight blue coloring, indicating overheating, the retracting and hold-down springs should be replaced. Overheated springs lose their pull and could cause the new lining to wear prematurely, if not replaced. If the brake drums are heat spotted, indicating an overheated condition, they should be replaced.
5. Inspect all other brake parts, and replace any that are worn or damaged.
6. Inspect the brake drum and, if necessary, refinish. Refer to Rotunda Catalog Wheel Service, for a description of the various types of brake lathes available. The maximum inside braking surface diameter is shown on each brake drum (Fig. 21). If the maximum inside braking surface diameter shown on the drum is exceeded either by wear or refinishing, the drum must be replaced. Refer to Part 12-02 for refinishing.

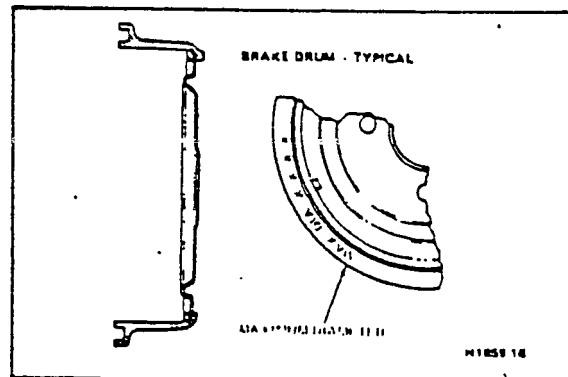


FIG. 21 Location of Brake Drum Maximum Inside Surface Markings

#### Brake Booster

Check the booster operation as noted under Power Brake Functional Test. If the brake booster is damaged or inoperative, replace it with a new booster. The brake booster is serviced only as an assembly, including the check valve.

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Ford Parts and Service Division

Inter Office

June 1, 1981

Mr. M. H. Hamberg

Subject: EPA/OSHA Asbestos Exposure Program

As requested, we have reviewed the attached slide-tape script and (2) brochures regarding asbestos poisoning and make the following comments:

- There is an inconsistency between the two brochures in the mention of brake vacuums. In the slide-tape script, pages 10, 11 and 12 refer to using a industrial or shop vacuum. Further emphasis for a shop vacuum designed for asbestos usage or a efficient filtering and disposal system, like that mentioned in the larger brochure would be appropriate.
- One popular brake cleaning method the program does not address is the coffee can method. This method is simply using a coffee can filled with parts cleaner solvent from the parts washer and brushing off the brake assembly holding the can under it. Because technicians are paid by the job (flat rate), cleaning a brake with a vacuum is not always done, even if the garage has the equipment; it becomes awkward, time consuming and costly. Brake washers are fine, but they are a fairly new product and there are few in use in the field. The coffee can method is used by technicians who are aware of asbestos poisoning but don't have the sophisticated equipment or take the time to use it. This paper should address this method and its' safety impact in areas such as solvent disposal (Do you pour down the drain or put it back in the parts washer?).
- Consider suggesting to Mr. Guimond that the brochure and slide-tape refer to people who work on cars as technicians, rather than mechanics. This is a practice adopted by Ford and G.M. which technicians prefer.
- In the area of program effectiveness, the brochure suggests (pg. 74) displaying a poster to remind people of the dangers of asbestos poisoning. Because it is not readily available, the EPA might consider making a poster available and including it with the distribution of brochures. A poster hung in the garage area might prove to be the most effective reminder of the dangers of asbestos poisoning.

There are currently (4) four class action suits pending against Ford Motor Company for asbestos poisoning by former Ford dealer technicians. I suggest you review this material and your prepared response to EPA/OSHA with Wanda Jones (x42476) to assure it does not adversely effect those lawsuits.

  
D. E. Schwenk

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8. Remove the line and inspect the flare for cracks or poor flare form. If the flare is not correct, cut it off and repeat the process.

The finished flare must be square with the line, free of cracks and have a smooth mating surface to ensure a leakproof connection.

#### Flaring a Line (Flaring-Bar Type)

Refer to Figs. 15 and 17.

1. Cut off and straighten the required length of line. (A line cutting tool will simplify making a clean and square cut).
2. Square off the ends of the line with a file, and chamfer the end of the line to be flared.
3. Insert the line through its appropriate ribbed hole in the bar assembly until the end of the line sticks out about as far as the thickness of the adaptor above the bar, or even with the bar, depending on the tool used.
4. Fit the adaptor onto the line and slide the bar into the yoke. Lock the bar in position with the line beneath the yoke screw.
5. Form the single flare by tightening the yoke screw securely.
6. Release the screw and remove the adaptor.
7. Form the double flare by tightening the yoke screw again, with second adaptor fitted, depending on the tool used.
8. Release the screw bar, and flared line. Inspect the flare for cracks or poor flare form, and repeat the process if the flare is not correct.
9. Repeat Steps 3 through 6 at the opposite wheel cylinder.

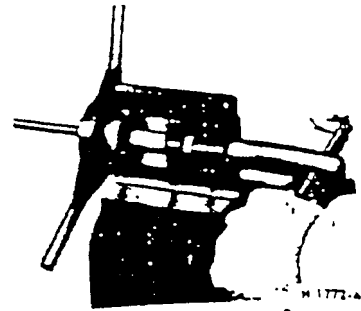


FIG. 17 Line Flaring (Flaring Bar Type)

#### BRAKE HOSE

Replace a flexible brake hose if it shows signs of softening, cracking or other damage.

When installing a new brake hose, position the hose to avoid contact with other vehicle parts.

## REMOVAL AND INSTALLATION

### BRAKE DRUM

#### All Vehicles thru 9000 Series

Use the following service procedures for both hydraulic and air brakes. Since the F-100 thru F-350, E-100-E-350 and Bronco rear drums, and the P-500 (front and rear) procedures apply to hydraulic brakes only, they are covered in Part 12-02.

#### FRONT BRAKE DRUM

1. Raise the vehicle until the tire clears the floor and remove the wheel and tire from the hub. Loosen the brake shoe adjusting screw until the shoes no longer touch the brake drum. Remove the grease cap and the gasket (if equipped) from the hub.
2. On vehicles with 9,000 lb front axles and hydraulic brakes, remove the locknut, locking ring, dimpled washer and adjusting nut. On all other axles, remove the cotter pin, adjusting nut and flat washer from the spindle.
3. Remove the outer bearing cone and roller assembly. Pull the hub and drum assembly off the wheel spindle.

4. Remove the front wheel-to-hub retaining nuts (or rim and tire attaching nuts). Remove the wheel (or rim and tire) from the hub and drum.
5. Remove the brake drum retainers and attaching bolts, screws or bolts and nuts.
6. Remove the brake drum from the hub.
7. Check the drum for damage or wear, and repair or replace if necessary. If a new drum will be installed, be sure to remove the protective coating with degreaser.  
Install new grease retainer seals whenever a wheel and hub is removed.
8. Place the brake drum to the hub and install the retainers and retaining bolts, screws, or bolts and nuts.
9. Install the hub and drum on the wheel spindle. Keep the hub centered on the spindle to prevent damage to the grease retainer or the spindle threads.
10. On vehicles with 9,000 lb front axles and hydraulic brakes install the outer

bearing cone and roller assembly, and the bearing adjusting nut. On all other axles, install the outer bearing cone and roller and flat washer on the spindle. Install the adjusting nut.

11. Install the wheel and tire on the hub. Then install the clamps (if applicable) and the wheel stud nuts.
12. While rotating the wheel, tighten the adjusting nut to specification. Adjust wheel bearings as described in Group 11.
13. On vehicles with 9000 lb front axle and hydraulic brakes, install the dimpled washer with the dimple indexed in one of the holes in the adjusting nut. Install the locking ring lock nut and tighten to specification. Bend the locking ring over a flat of the lock nut.
14. Install the gasket (if equipped) and the grease cap, and tighten the wheel stud nuts to specification. Install the hub cap (if equipped), and adjust the brakes as described in this Part.

## OVERHAUL

An industrial type vacuum cleaner in place of compressed air, is recommended to remove any dust and dirt present on brake linings, pads, rotors and drums etc, when performing wheel brake repairs. Also, any machining done on brake linings or pads should be done using properly exhaust ventilated equipment.

### BRAKE DRUM REFINISHING

#### E-100—E-350, F-100—F-350, U-100

Minor scores on a brake drum can be removed with fine emery cloth, provided the emery is thoroughly cleaned off the drum after the operation.

A badly scored, rough, or out-of-round drum should be ground or turned

on a drum lathe. Do not remove any more material from the drum than is necessary to provide a smooth surface for the brake shoe contact. Brake drum maximum braking surface diameter is shown on each brake drum (Fig. 19). Brake drums which exceed the maximum braking surface diameter shown on the

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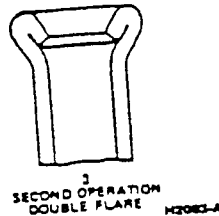
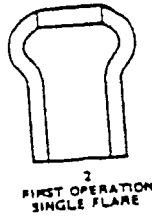
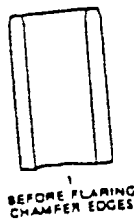


FIG. 15 Line Flaring Sequence

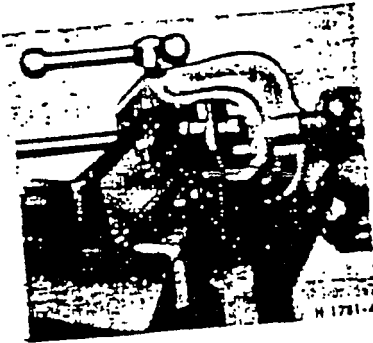


FIG. 16 Line Flaring (Split Die Type)

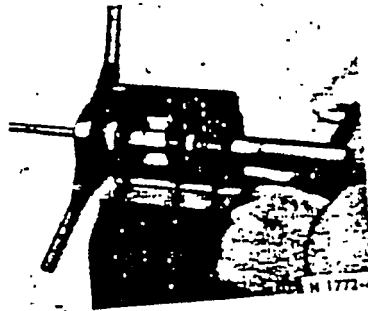


FIG. 17 Line Flaring (Flaring Bar Type)

7. Form the double flare by tightening the yoke screw again, with second adaptor fitted, depending on the tool used.
8. Release the screw bar, and flared line. Inspect the flare for cracks or poor flare form, and repeat the process if the flare is not correct.
9. Repeat Steps 3 through 6 at the opposite wheel cylinder.

**BRAKE HOSE**

Replace a flexible brake hose if it shows signs of softening, cracking or other damage.

When installing a new brake hose, position the hose to avoid contact with other vehicle parts.

**REMOVAL AND INSTALLATION****BRAKE DRUM****All Vehicles thru 9000 Series**

Use the following service procedures for both hydraulic and air brakes. Since the F-100 thru F-350, E-100-E-350 and Bronco rear drums, procedures apply to hydraulic brakes only, they are covered in Part 12-02.

**FRONT BRAKE DRUM**

1. Raise the vehicle until the tire clears the floor and remove the wheel and tire from the hub. Loosen the brake shoe adjusting screw until the shoes no longer touch the brake drum. Remove the grease cap and the gasket (if equipped) from the hub.
2. On vehicles with 9,000 lb front axles and hydraulic brakes, remove the locknut, locking ring, dimpled washer and adjusting nut. On all other axles, remove the cotter pin, adjusting nut and flat washer from the spindle.
3. Remove the outer bearing cone and roller assembly. Pull the hub and drum assembly off the wheel spindle.

4. Remove the front wheel-to-hub retaining nuts (or rim and tire attaching nuts). Remove the wheel (or rim and tire) from the hub and drum.
5. Remove the brake drum retainers and attaching bolts, screws or bolts and nuts.
6. Remove the brake drum from the hub.
7. Check the drum for damage or wear, and repair or replace if necessary. If a new drum will be installed, be sure to remove the protective coating with degreaser.

Install new grease retainer seals whenever a wheel and hub is removed.

8. Place the brake drum to the hub and install the retainers and retaining bolts, screws, or bolts and nuts.
9. Install the hub and drum on the wheel spindle. Keep the hub centered on the spindle to prevent damage to the grease retainer or the spindle threads.
10. On vehicles with 9,000 lb front axles and hydraulic brakes install the outer bearing cone and roller assembly, and

the bearing adjusting nut. On all other axles, install the outer bearing cone and roller and flat washer on the spindle. Install the adjusting nut.

11. Install the wheel and tire on the hub. Then install the clamps (if applicable) and the wheel stud nuts.
12. While rotating the wheel, tighten the adjusting nut to specification. Adjust wheel bearings as described in Group 11.
13. On vehicles with 9000 lb front axle and hydraulic brakes, install the dimpled washer with the dimple indexed in one of the holes in the adjusting nut. Install the locking ring lock nut and tighten to specification. Bend the locking ring over a flat of the lock nut.
14. Install the gasket (if equipped) and the grease cap, and tighten the wheel stud nuts to specification. Install the hub cap (if equipped), and adjust the brakes as described in this Part.

**OVERHAUL**

An industrial type vacuum cleaner in place of compressed air, is recommended to remove any dust and dirt present on

brake linings, pads, rotors and drums ect. when performing wheel brake repairs. Also, any machining done on brake

linings or pads should be done using properly exhaust ventilated equipment.

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5. Form the single flare by tightening the yoke screw securely.
6. Release the screw and remove the adaptor.
7. Form the double flare by tightening the yoke screw again, with second adaptor fitted, depending on the tool used.
8. Release the screw bar, and flared line. Inspect the flare for cracks or poor flare form, and repeat the process if the flare is not correct.
9. Repeat Steps 3 through 6 at the opposite wheel cylinder.

### BRAKE HOSE

Replace a flexible brake hose if it shows signs of softening, cracking or other damage.

When installing a new brake hose, position the hose to avoid contact with other vehicle parts.

### OVERHAUL

Removal of dust and dirt from brake assemblies should be done by using the Rotunda brake vacuum (model 34-0009) or Rotunda brake parts washer (model 650016) or an equivalent. Brake assembly dust and dirt should not be removed by either blowing off with an air gun or vacuuming with a standard industrial vacuum cleaner because a health hazard from breathing in asbestos dust may develop. Also, any machining done on brake linings or pads should be done using properly exhaust ventilated equipment. Also, any machining done on brake linings or pads should be done using properly exhaust ventilated equipment.

### BRAKE DRUM REFINISHING

Minor scores on a brake drum can be removed with fine emery cloth, provided the emery is thoroughly cleaned off the drum after the operation.

A badly scored, rough, or out-of-round drum should be ground or turned on a drum lathe. (Refer to the lathe manufacturers instructions.) Do not remove any more material from the drum than is necessary to provide a smooth surface for the brake shoe contact. Brake drum maximum braking surface diameter is shown on each brake drum (Fig. 13). Brake drums which exceed the maximum braking surface diameter shown on the brake drum, either through wear or refinishing, must be replaced. The maximum braking surface diameter specification, which is shown on each brake drum (Fig. 13), allows for a 1.52mm (0.060 inch) machining cut over the original nominal drum diameter plus .762mm (0.030 inch) additional wear before reaching the drum-discard diameter.

### FRONT DISC BRAKES

1. Remove the shoe and linings as described in Part 12-24 Disc Brakes—Light and Heavy Duty—Sliding Caliper.
2. Measure the thickness of the brake lining. If the lining thickness at any point on the assembly is less than .794mm (1/32 inch) above the backing plate or rivets, or if the lining shows evidence of brake fluid or oil contamination that is causing a brake pull, replace all four shoe and lining assemblies.
3. To check rotor runout, first eliminate the wheel bearing end play by tightening the adjusting nut. Then check to be sure the rotor can still be rotated.
4. Clamp a dial indicator to the spindle so the stylus contacts the rotor approximately one inch from the outer edge. Rotate the rotor and take an indicator

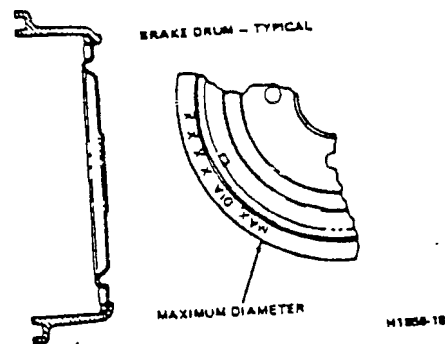


FIG. 13 Rear Brake Drum Maximum Inside Braking Surface Diameter Marking Location—E-100—E-350, Bronco, and F-100—F-350

reading. If the reading exceeds .254mm (0.010 inch) total lateral runout within a six inch radius on the indicator, replace or re-surface the disc brake rotor. The following requirements must be met when re-surfacing disc brake rotors.

Use a disc brake lathe to re-finish the disc brake rotors. (Follow the manufacturers instructions.)

No more than .508mm (0.020 inch) of material may be machined equally off each surface (A and B, Fig. 14). If rotor thickness falls below the minimum shown on each rotor, it must be replaced.

The finished braking surfaces of the rotor must be flat and parallel within 0.025mm (0.001-inch); lateral runout must not exceed 0.076mm (0.003 inch) total indicator reading, and the surface finish of the braking surfaces must be 16 to 80 micro inches.

When the runout check is finished, adjust the bearings as described in Part 11-10, Wheel Hubs and Bearings—Front (except Front Wheel Drive) to prevent bearing failure.

5. Check the rotor for scoring. Remove minor scores with a fine emery cloth. If the rotor is excessively scored, re-finish or replace the rotor if necessary.
6. Check the caliper. If it is cracked or shows any signs of leakage, replace it. If the caliper is leaking around the dust boot, remove and repair it.
7. Check brake hoses for signs of cracking, leaks or abrasion. Replace them, if necessary.

5. Be sure vehicle is centered on hoist before servicing any front end components, to avoid bending or damaging rotor splash shield on full right or left wheel turns.

6. Riding of brake pedal (common on left-front applications) must be avoided during vehicle operation.

7. The wheel and tire must be removed separately from the brake rotor, unlike drum brakes where the wheel, tire and drum can be removed as a unit.

8. Do not attempt to clean or restore oil or grease-soaked brake linings. When contaminated linings are found, brake linings must be replaced in complete axle sets and the rotor braking surfaces wiped clean.

9. Do not lubricate caliper slide pins.

10. Calipers must be installed with bleed screws in an upward position for proper bleeding of air from brake system.

### Drum Brakes

1. Remove wheel, tire and drum assembly from spindle.

2. Use an industrial vacuum cleaner to remove all dust from backing plates and interior of the brake drums.

**WARNING: Never inhale dust from brake linings. Asbestos dust when inhaled can be injurious to health. Do not blow out dust with an air line. A vacuum cleaner equipped for this purpose, brush or rag should be carefully used to remove any dust. Any dust should be contained in a sealed bag for disposal.**

3. Inspect brake shoes for excessive lining wear or shoe damage. If lining is damaged or worn within 1/32 inch of the rivet heads on riveted linings or within 0.060 inch of the shoe on bonded linings, they must be replaced. Replace any lining that has been contaminated with oil, grease, or brake fluid. Replace lining in axle sets. Prior to replacement of lining, drum diameter should be checked to determine that brake drum braking surface diameter is within specifications. If braking surface diameter exceeds specifications, drum must be replaced.

4. Check condition of brake shoes, retracting spring, hold-down springs, and drum for signs of overheating. If shoes have a slight blue coloring, indicating overheating, retracting and hold-down springs should be replaced. Overheated springs lose their pull and could cause new lining to wear prematurely, if not replaced. If brake drums are heat spotted, indicating an overheated condition, they should be replaced.

5. Refer to part 11-15, for hub nut tightening procedure.

### Brake Booster

Check booster operation as noted under Power Brake Functional Test. If brake booster is damaged or inoperative, replace it with a new booster. The brake booster is serviced only as an assembly, including the check valve.

### Brake Tubing

If a section of brake tubing becomes damaged, the entire section should be replaced with tubing of the same type, size, shape and length. Copper tubing should not be used in a hydraulic system. When bending brake tubing to fit body contours, be careful not to kink or crack tube.

### Hydraulic Lines

Double wall steel tubing is used throughout the brake system with the exception of the flexible hoses at the front and rear wheels.

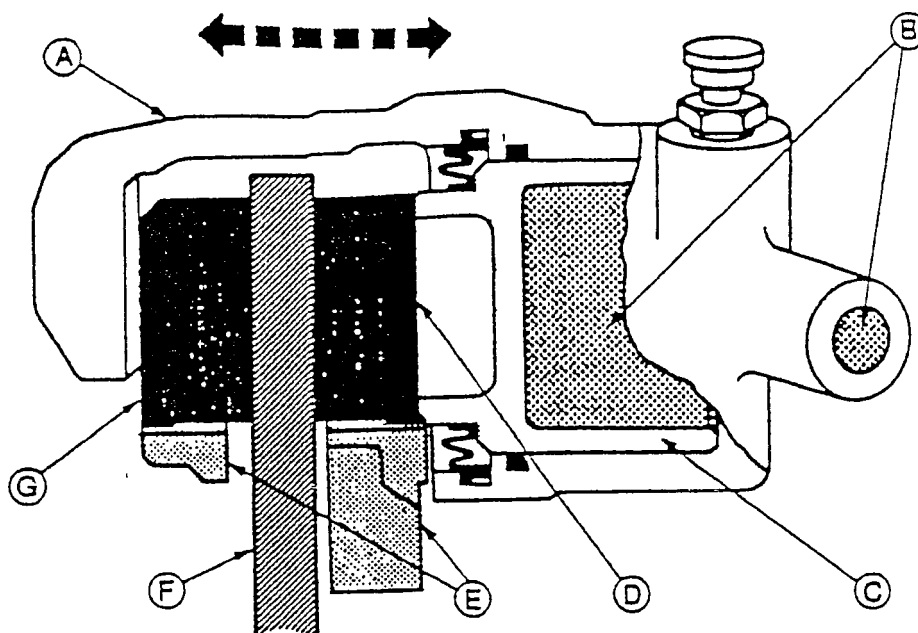
Always bleed applicable primary or secondary brake system after primary or secondary brake system hose or line replacement. Centralize pressure differential valve after bleeding system.

All brake tubing should be properly double flared to provide good leakproof connections. Clean brake tubing by flushing with clean brake fluid before installation.

When connecting a tube to a hose, tube connector, or brake cylinder, tighten the tube fitting nut to specified torque with the D81L-600-A inch-pound torque wrench.

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A—Piston Housing  
B—Brake Fluid  
C—Piston

D—Inner Brake Pad  
E—Pad Housing (Anchor Bracket)  
F—Brake Disc  
G—Outer Brake Pad

FIG. 5 Sectional View of Front Caliper

Simultaneously, the transverse cable is placed in tension by the equalizer causing the actuating lever on the right hand brake assembly to activate the brake shoes (Fig. 10).

### BRAKE SERVO

The Brake Servo, if installed, is of the suspended vacuum type. With the engine running, vacuum is supplied to the Servo unit through a non-return valve. Both sides of the chamber diaphragm in the Servo are subjected to equal vacuum. Initial movement of the brake pedal admits atmospheric pressure to the rear of the diaphragm, resulting in a pressure difference which causes the diaphragm to move forward.

The brake pedal effort is assisted and reduced by the movement of the diaphragm.

### GENERAL NOTE

Every 60,000 km (36,000 miles), brake cylinder seals, flexible hoses and hydraulic fluid should be replaced.

Brake system components must be kept clean of any foreign matter. If necessary, any hydraulic components should be washed in clean brake fluid, industrial alcohol or methylated spirits to remove any

foreign matter and dried with a clean non-fluffy cloth. Do not use a mineral base fluid such as petrol or paraffin.

Brake fluid must not be allowed to come into contact with brake pads/shoes or with disc or drum surfaces. Due to the complexity of braking systems, when replacing or overhauling components, care must be taken to ensure that only correct parts are installed.

Any brake fluid accidentally spilled onto a painted surface must be cleaned off immediately using cold water to prevent damage to paint-work.

**WARNING:** Care should be taken to avoid inhaling dust from brake linings. Asbestos dust when inhaled may be injurious to health. Do not blow out dust with an air line. A vacuum cleaner equipped for this purpose, brush, or rag should be carefully used to remove any dust. Any dust should be contained in a sealed bag for disposal.

### JACKING THE VEHICLE

Before commencing any repairs that involve jacking the vehicle it is essential that the vehicle jacking instructions contained in Section 11, General Description, are followed.

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8. Install the bleed screw (if so equipped). Install the gasket (diaphragm) in the master cylinder filler cover. Position the gasket as shown in Fig. 17. **Make sure the gasket is securely seated.**
9. Install the cover and gasket on the master cylinder and secure the cover into position with the retainer.

linings are found, brake linings must be replaced in complete axle sets.

9. Always replace rubber caliper insulators and plastic sleeves when replacing linings. Do not lubricate the slide pins.

## CLEANING AND INSPECTION

### Disc Brakes

1. Remove the wheel and tire from the hub and rotor.
2. Inspect brake shoes and lining for wear. If the lining is worn to within 1/8 inch of the shoe, replace all (four) shoe and lining assemblies (complete axle set) on front or rear wheels as required. The rubber caliper insulators and the plastic sleeves must be replaced when linings are replaced.
3. Visually check the caliper. If the caliper housing is leaking, it should be replaced. If a seal is leaking, the caliper must be disassembled and new seals installed. If a piston is seized in the bore, a new caliper housing is required.

Refer to Part 12-20 for disc brake rotor resurfacing procedure.

### Service Precautions

1. Grease or any other foreign material must be kept off the lining surfaces of the rotor and external surfaces of the hub during service operations. In handling the rotor and caliper assemblies, avoid deformation of the brake rotor and nicking or scratching of brake linings.
2. If a caliper piston is removed for any reason, the piston seal must be replaced.
3. During removal and installation of a wheel assembly, exercise care not to interfere with and damage the caliper splash shield or the bleeder screw fitting.
4. Front wheel bearing end play is critical and must be within specifications.
5. To avoid bending or damaging the rotor splash shield on full right or left wheel turns, be sure the vehicle is centered on the hoist before servicing any front end components.
6. Riding of the brake pedal (common on left-foot applications) must be avoided during vehicle operation.
7. The wheel and tire must be removed separately from the brake rotor, unlike drum brakes where the wheel, tire, and drum can be removed as a unit.
8. Do not attempt to clean or restore any oil or grease-soaked brake linings. When contaminated

### Drum Brakes

1. Remove the wheel from the drum, and remove the drum, Part 12-02.
2. Removal of dust and dirt from brake assemblies should be done by using the Rotunda brake vacuum (model 340009) or Rotunda brake parts washer (model 650016) or equivalent. Brake assembly dust and dirt should not be removed by blowing off with an air gun because a health hazard from breathing asbestos dust may develop
3. Inspect the brake shoes for excessive lining wear or shoe damage. If the lining is worn within 1/32 inch of the rivet heads or if the shoes are damaged, they must be replaced. Replace any lining that has been contaminated with oil, grease or brake fluid. Replace lining in axle sets. Prior to replacement of lining, the drum diameter should be checked to determine that the brake drum braking surface diameter is within specification using the Rotunda brake drum micrometer (model 100010) or equivalent. If the braking surface diameter exceeds specification, the drum must be replaced.
4. Check the condition of brake shoes, retracting springs, hold-down springs, and drum for signs of overheating. If the shoes have a slight blue coloring, indicating overheating, the retracting and hold-down springs should be replaced.  
  
Overheated springs lose their pull and could cause the new lining to wear prematurely, if not replaced. If the brake drums are heat spotted, indicating an overheated condition, they should be replaced.
5. Inspect all other brake parts and replace any that are worn or damaged.
6. Inspect the brake drum and, if necessary, refinish. Refer to the Rotunda Catalog Wheel Service, for a description of the various types of brake lathes available. The maximum inside braking surface diameter is shown on each brake drum (Fig. 19). If the maximum inside braking surface diameter shown on the drum is exceeded either by wear or refinishing, the drum must be replaced. Refer to Part 12-02 for refinishing.

### Brake Booster

Check the booster operation as noted under Power Brake Functional Test. If the brake booster is damaged or inoperative, replace it with a new booster. The brake booster is serviced only as an assembly, including the check valve.

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## OVERHAUL

Removal of dust and dirt from brake assemblies should be done by using the Rotunda Brake Vacuum (340009) or equivalent or Rotunda brake parts washer (model 650016) or equivalent. Brake assembly dust and dirt should not be removed by either blowing off with an air gun or vacuuming with a standard industrial vacuum because a health hazard from breathing asbestos dust may develop. Also, any machining done on brake linings or pads should be done using properly exhaust ventilated equipment.

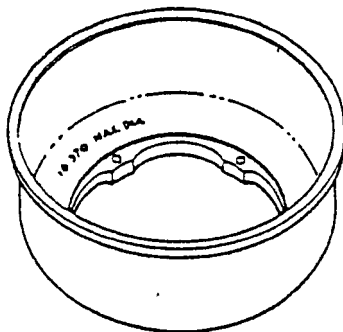
### BRAKE DRUM REFINISHING

Minor scores on a brake drum can be removed with fine emery cloth, provided the emery is thoroughly cleaned off the drum after the operation.

### BRAKE DRUM REFINISHING

Minor scores on a brake drum can be removed with fine emery cloth, provided the emery is thoroughly cleaned off the drum after the operation.

A badly scored, rough, or out-of-round drum should be ground or turned on a drum lathe. Do not remove any more material from the drum than is necessary to provide a smooth surface for the brake shoe contact. Brake drum maximum braking surface diameter is shown on each brake drum (Fig. 9). Brake drums which exceed the maximum braking surface diameter shown on the brake drum, either through wear or refinishing, must be replaced.



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FIG. 9 Brake Drum Maximum Braking Surface Diameter Marking Location—Typical Medium—Heavy Truck Shown

On all medium and heavy trucks, the maximum braking surface diameter specifications, which is shown on each brake drum, allows for 1.52mm (0.060 inch) machining cut over the original drum diameter, plus 0.762mm (0.030 inch) additional wear before the drum must be replaced. After refinishing the brake surface runout must not exceed 1.77mm (0.070 inch) total indicator reading, measured from the bearing cup.

On medium and heavy trucks, if the drum diameter is less than 0.762mm (0.030 inch) oversize after refinishing, install standard linings on the brake assemblies. If the diameter is over 0.762mm (0.030 inch), install oversize or shimmed linings.

### BRAKE SHOE AND PARKING BRAKE BAND RELINING

1. Remove the rivets holding the old lining and remove the lining.
2. Clean the shoe or band thoroughly with cleaning fluid, especially the rim surface. Wipe the shoe or band dry and remove all burrs or rough spots from the shoe. Do not use shoes with elongated rivet holes, a bent or worn shoe web or rim.
3. On service brake, check the inside diameter of the brake drum.
4. Position a new lining on the shoe or band. The primary and secondary linings are marked. Install new rivets, beginning with the rivet holes near the center of the shoe. On some vehicles, the primary lining is shorter than the secondary lining. If this condition exists, position the shorter (primary) lining in line with the heel end of the shoe. Do not let brake fluid, oil, or grease touch the brake lining. If a brake lining kit is used to replace the worn linings, follow the instructions in the kit and install all the parts provided.
5. Check the clearance between the lining and shoe rim. The lining must seat snugly against the rim with not more than 0.127mm (0.005 inch) separation between any two rivets. If only the linings are replaced on duo-servo single anchor brakes with fixed anchor pins, the brake linings must be cam ground 0.25mm (0.010 inch) at the ends after the linings are riveted to the brake shoe.

### BRAKE CYLINDER

1. Clean all brake cylinder parts in clean isopropyl alcohol or the Rotunda brake parts washer (model 650016) or equivalent. Inspect all parts for wear or damage. Check the cylinder bore for rust, scores, or other damage. Be sure the bleeder screw passage is clean and open. Replace all parts that are worn or damaged.
2. If dirt is found in any part of the hydraulic system, flush the entire system with clean isopropyl alcohol.

### MASTER CYLINDER

1. Clean all master cylinder parts in clean isopropyl alcohol or the Rotunda brake parts washer (model 650016) or equivalent, and inspect the parts for wear or damage. Replace them if required. When a master cylinder repair kit is used, follow the instructions in the kit and install all of the parts provided.
2. Make sure that all ports and vents in the master cylinder are open and free of foreign matter.
3. On a single brake system master cylinder, check the spring valve (riveted to the front end of the piston). If it is loose or has moved so the piston ports are open, replace the piston.
4. Inspect the cylinder walls for scores or rust. Remove scores and rust or obtain a smooth wall surface by honing the cylinder walls, but not more than 0.076mm (0.003 inch) of material. Remove any

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