FILE NAME: Ford (FD)

DATE: 1970-1983

DOC#: FD149

DOCUMENT DESCRIPTION: Industry Warning Information with 1983 Report - Industrial Hygiene Audit of Ohio Truck Plant

WARNINGS IN SHOP MANUALS
(Asbestos Cases)

The following is a review of Ford Motor Company car and truck shop manuals from 1950 to 1982 directed to any warnings in the manuals about asbestos dust in brake repairs. Since much of the language is repeated from year to year and within the various shop manuals issued in any given year, samples of each type of warning (or lack thereof) are attached as exhibits A through I. Reference will be made to a particular exhibit and the language contained therein.

1970	Car	Volume 1	12-01-08	A
1974	Car	Volume 1	12-01-12	A
1975	Car	Volume 1	12-01-23	A
1975/76	Car	Volume 1	12-01-24	A
1977	Car	Volume 1	12-01-29	B
1977	Truck	Volume 1	12-01-22	C
1978	Car	Volume 1	12-01-32	D
1978	Truck	Volume 1	12-01-22	C
1979	Car	Volume 1	12-01-31	D
1980	Light Truck	BCE*	12-01-20	E
1980	Medium/Heavy Truck	BCE	12-01-20	E
1980	Fairmont/Zephyr T-Bird/Cougar	BCE	12-01-22	D
1980	Pinto/Bobcat Mustang/Capri Granada/Monarch/ Versailles	BCE	12-01-28	D
1980	Ford/Mercury Lincoln Continental/ Continental/Mark VI	BCE	12-01-20	E
1981	Lincoln	BCE	12-01-22	E
1981	Escort/Lynx	BCE	12-01-27	F
1981	Light Truck	BCE	12-01-18	E
1981	Medium/Heavy Truck	BCE	12-01-24	E
1981	Courier	BCE	12-01-6	A

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1982	Lincoln Town/Mark VI Ford/Mercury	BCE	12-01-22	E
1982	Lincoln Continental T-Bird/XR-7 Fairmont/Zephyr Granada/Cougar Mustang/Capri	BCE	12-01-25	E
1982	Escort/Lynx	BCE	12-01-25	I
1982	Light Truck	BCE	12-01-	H
1982	Medium/Truck	BCE	12-10-6	G
1982	Courier	BCE	12-01-05	A

*BCE - Body, Chassis, Electrical

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be inspected for wear or damage.

9. On floating caliper type disc brakes, the caliper assembly must be removed from the spindle prior to removal of the shoe and lining assemblies.

10. On floating caliper type disc brakes the calipers must not be interchanged from one side to the other. When the caliper is installed on its proper anchor plate and spindle, the bleeder screw will point to the rear of the vehicle. If a caliper is installed on the wrong side of the vehicle, it is not possible to bleed the system properly.

11. 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.

DRUM BRAKES

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

2. Brush all dust from the backing plates and interior of the brake drums.

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 had 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 if oversize linings must be installed.

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, replacement of the retracting and hold-down springs is strongly recommended. Overheated springs lose their pull and could cause the new lining to wear prematurely, if they are not replaced. If the brake drums are heat spotted, indicating a overheated condition, they should be replaced.

5. If the vehicle has 30,000 or more miles of operation on the brake linings or signs of overheating are present when relining brakes, the wheel cylinders should be disassembled and inspected for wear and entrance of dirt into the cylinder. The cylinder cups should be replaced, thus avoiding future problems.

6. Inspect all other brake parts and replace any that are worn or damaged.

7. Inspect the brake drum and, if necessary, refinish. Refer to Part 12-02 for refinishing.

BRAKE BOOSTER

Check the booster operation as noted in Part 12-01, 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.

HYDRAULIC LINES

Steel tubing is used throughout the brake system with the exception of the flexible hoses at the front wheels and at the rear axle housing, brake tube connection.

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

BRAKE TUBING

If a section of the 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 underbody or rear axle contours, be careful not to kink or crack the tube.

All brake tubing should be double flared properly to provide good leakproof connections. Clean the 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 Milbar Tool 1112-144 or equivalent.

BRAKE HOSE

A flexible brake hose should be replaced if it shows signs of softening, cracking, or other damage.

When installing a new front brake hose, position the hose to avoid contact with other chassis parts. Place a new copper gasket over the hose fitting and thread the hose assembly into the front wheel cylinder. Engage the opposite end of the hose to the bracket on the frame. Install the horseshoe-type retaining clip, and connect the tube to the hose with the tube fitting nut.

A rear brake hose should be installed so that it does not touch the muffler outlet pipe or shock absorber. Thread the hose into the rear brake tube connector. Engage the front end of the hose to the bracket on the frame. Install the horseshoe-type retaining clip, and connect the tube to the hose with the tube fitting nut.

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1970 Car Shop Manual Vol. 1 p. 12-01-08

6. Clean all parts in clean isopropyl alcohol, and inspect the parts for chipping, excessive wear or damage. When using a master cylinder repair kit, install all the parts supplied.
7. Be sure that all recesses, openings and internal passages are open and clean. Place all parts on a clean pan or paper.
8. Inspect the master cylinder bore for signs of etching, pitting, scoring or rust. If necessary to hone the master cylinder bore to repair damage, do not exceed allowable hone specifications.

Assembly

1. Dip all parts except the master cylinder body in clean brake fluid (ESA-M6C25-A) Ford Part No. C6AZ-19542-A or DOT-3 equivalent.
2. Carefully insert the complete secondary piston and return spring assembly in the master cylinder bore (Fig. 23).
3. Install the primary piston assembly in the master cylinder bore.
4. Depress the primary piston and install the snap ring in the cylinder bore groove.
5. Install the push rod, boot and retainer on the push rod, if so equipped. Install the push rod assembly into the primary piston. Make sure the retainer is properly seated and holding the push rod securely.
6. Position the inner end of the push rod boot (if so equipped) in the master cylinder body retaining groove.
7. Install the secondary piston stop bolt, if used, with an O-ring if screw is on bottom outside of master cylinder casting.
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. 23. 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.

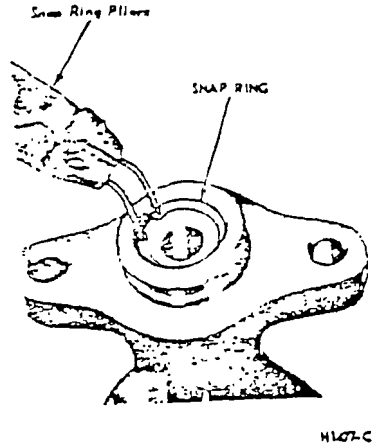


FIG. 24 Removing Snap Ring—Typical

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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 (4) shoe and lining assemblies (complete axle set) on front or rear wheels as appropriate.
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.
4. Front wheel bearing end play is critical and must be within specifications.
5. Be sure the vehicle is centered on the hoist before servicing any front end components, to avoid bending or damaging the rotor splash shield on full right or left wheel turns.
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 oil or grease-soaked brake linings. When contaminated linings are found, brake linings must be replaced in complete axle sets.

DISC BRAKE SERVICE PRECAUTIONS

1. Grease or any other foreign material must be kept off the linings 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.

DRUM BRAKES

1. Remove the wheel from the drum, and remove the drum as outlined in Part 12-02.
2. Use an industrial type vacuum cleaner to remove all dust from the backing plates and interior of the brake drums.
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 had 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. 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. The maximum inside braking surface diameter is shown on each brake drum (Fig. 23). 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.

1977 Car Shop Manual Vol. 1 p. 12-01-29

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 tighening 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.

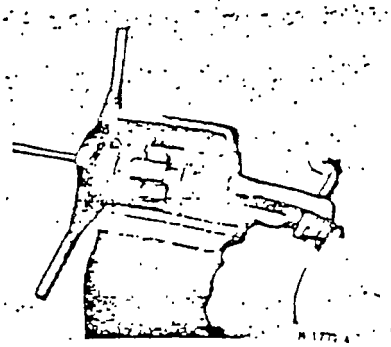


FIG. 17 Line Flaring (Flaring Bar Type)

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 ect, 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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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.

DISC BRAKE SERVICE PRECAUTIONS

1. Grease or any other foreign material must be kept off the linings 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. Be sure the vehicle is centered on the hoist before servicing any front end components, to avoid bending or damaging the rotor splash shield on full right or left wheel turns.
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 oil or grease-soaked brake linings. When contaminated linings are found, brake linings must be replaced in complete axle sets.
9. On Fairmont/Zephyr only, always replace rubber caliper insulators and plastic sleeves when replacing linings. Do not lubricate the slide pins.

DRUM BRAKES

1. Remove the wheel from the drum, and remove the drum as outlined in Part 12-02.
2. Use an industrial vacuum cleaner to remove all dust from the backing plates and interior of the brake drums.
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. 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. The maximum inside braking surface diameter is shown on each brake drum (Fig. 33). 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.

BRAKE TUBING

If a section of the 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 underbody or rear axle contours, be careful not to kink or crack the tube.

HYDRAULIC LINES

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

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

All brake tubing should be double flared properly to provide good leakproof connections. Clean the 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 Milbar Tool 1112-144 or equivalent.

BRAKE HOSE

A flexible brake hose should be replaced if it shows signs of softening, cracking, or other damage.

When installing a new front brake hose, position the hose to avoid contact with other chassis parts. On all vehicles except Fairmont/Zephyr, place a new copper gasket over the hose fitting and thread the hose assembly into the front wheel cylinder or caliper. Fairmont/Zephyr front hose does not require a copper gasket and is reusable. Engage the opposite end of the hose to the bracket on the frame. The white stripe on the hose should show no evidence of twisting. Install the horseshoe-type retaining clip, and connect the tube to the hose with the tube fitting nut.

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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.

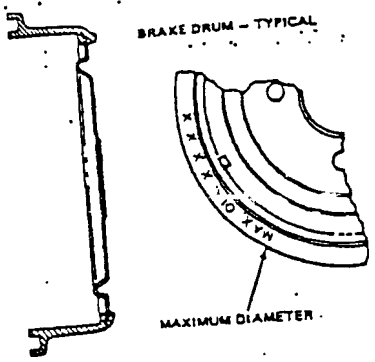


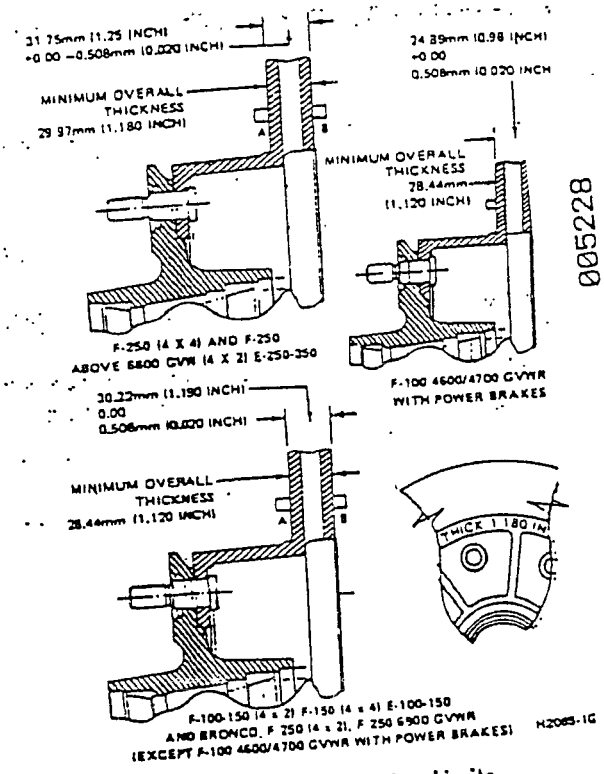
FIG. 13 Rear Brake Drum Maximum Inside Braking Surface Diameter Marking Location—E-100—E-350, Bronco, and F-100—F-350

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 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.



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FIG. 14 Disc Brake Rotor Service Limits

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.

1980 Light Truck Shop Manual Body Chassis Elec. p 12-01-20

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 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 specification, drum must be replaced.

4. Check condition of brake shoes, retracting spring, holddown springs, and drum for signs of overheating. If shoes have a slight blue coloring, indicating overheating, retracting and holddown 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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REMOVAL AND INSTALLATION

The following apply to vehicles equipped with either air or hydraulic brakes.

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.

CAST SPOKE WHEELS

Removal

1. Raise the vehicle until the tire clears the floor and install safety stands. Remove the tire and rim assembly by removing the clamps and nut.
2. Remove the cast spoke wheel and drum assembly from the front or rear axle.
3. Remove the drum from the cast spoke wheel by removing the nuts, bolts and washers.
4. Check the drum for damage or wear and repair or replace if necessary. If a new drum will be installed, remove the protective coating with a degreaser.

NOTE: Replace the drum with the same type and size. Failure to do so will affect vehicle performance. Replace cast drums with cast drums. Replace centrifuse drums only with centrifuse drums.

Installation

1. Assemble the drum to the cast spoke spider. Tighten the nuts to 299-352 N·m (220-260 ft-lbs).
2. Assemble the cast spoke spider and drum assembly to the front or rear axle. Adjust the wheel bearings and the axle shaft installation, if necessary, per the appropriate Section in Group 11.
3. Install the tire and wheel assembly on the cast spoke wheel. Refer to Section 11-01, Wheels, Rims and Tires for the procedure.
4. Tighten the front and rear wheel clamps to 299-352 N·m (220-260 ft-lbs).

DISC WHEELS—OUTBOARD MOUNTED DRUMS

Removal

1. Raise the vehicle until the tire clears the floor and install safety stands. Remove the nuts retaining the tire and wheel assembly to the hub (Fig. 6).
2. Remove the drum from the hub.
3. Check the drum for damage or wear and repair or replace as necessary. If a new drum is installed, be sure to remove the protective coating with degreaser.

NOTE: Replace drums with drums of the same type. Failure to do so will affect vehicle track and performance. Replace cast drums only with cast drums. Replace centrifuse drums only with centrifuse drums.

Check wheel grease seals for leakage. If the hub is removed from the axle, install new wheel grease seals.

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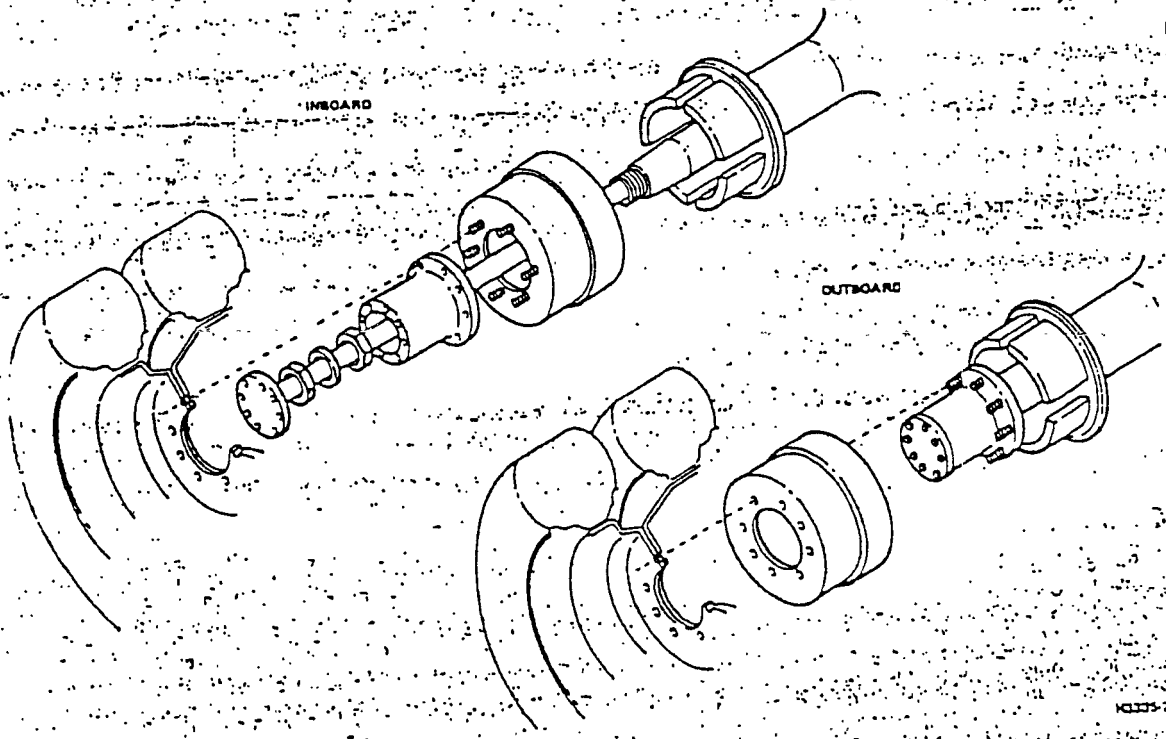


FIG. 6 Brake Drum Mountings

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2. 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 adapter above the bar, or even with the bar, depending on the tool used.
3. Fit the adapter onto the line and slide the bar into the yoke. Lock the bar in position with the line beneath the yoke screw.
4. Form the single flare by tightening the yoke screw securely.
5. Release the screw and remove the adaptor.
6. Form the double flare by tighening 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

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.

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.

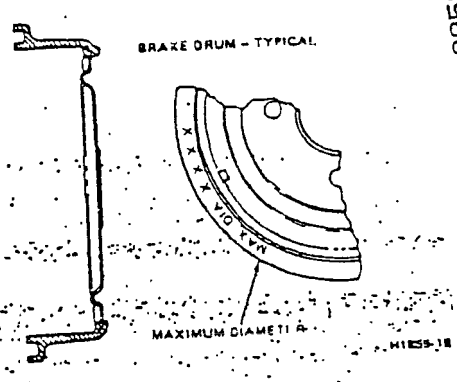


FIG. 13 Rear Brake Drum Maximum Inside Braking Surface Diameter Marking Location—E-100—E-350, Bronco, and F-100—F-350

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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.

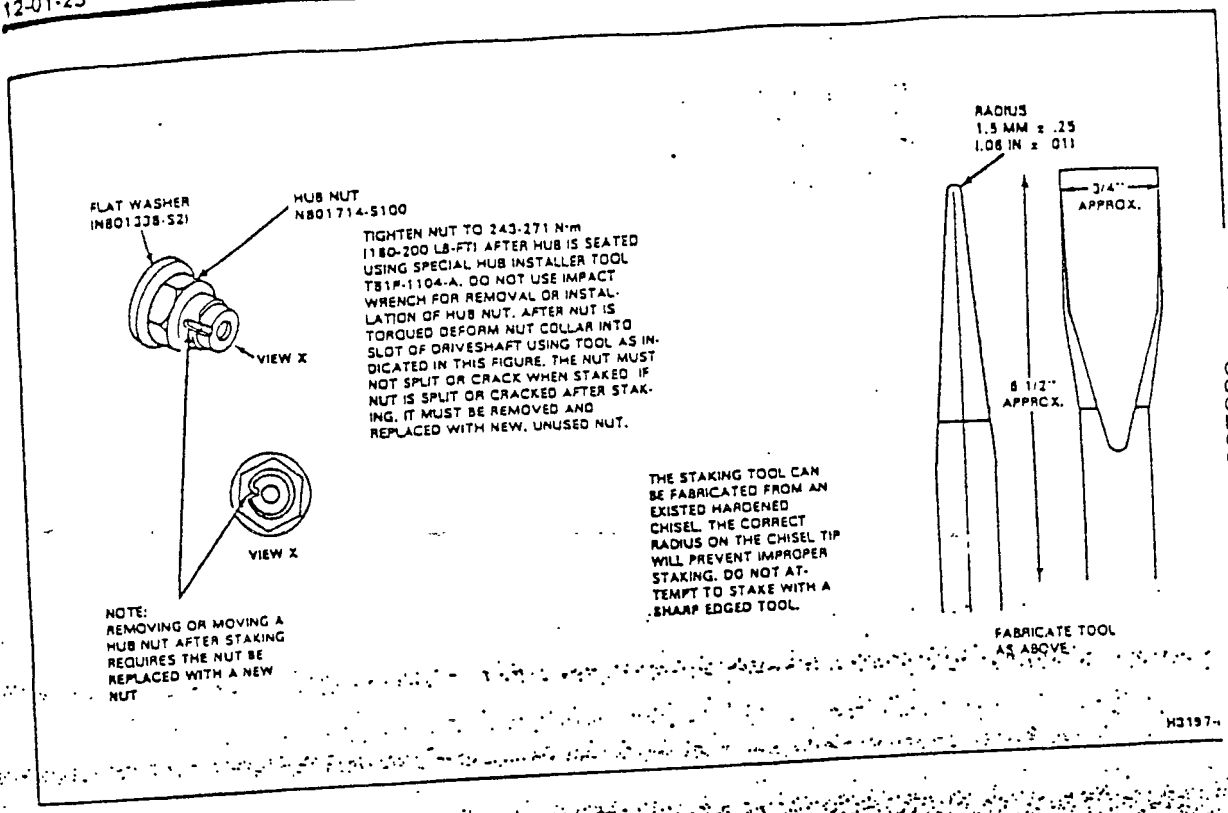
FRONT DISC BRAKES

1. Remove the shoe and linings as described in Section 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 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.

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FIG. 11 Hub Nut Installation

Refer to Section 11-12, Front Hubs for nut tightening procedure.

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.

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 and tire assembly and drum assembly from spindle.

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

WARNING: Dust and dirt conditions present on wheel brake assemblies and rotors and drums, may contain asbestos fibers that can represent a potential health hazard when made airborne by cleaning with compressed air.

All wheel brake assemblies should therefore be cleaned only with a vacuum cleaner suitable for use with asbestos fibers. This type of vacuum cleaner is available through the Rotunda Dealer Equipment Catalog. Dust and dirt from the vacuum cleaner should be disposed of in a manner that prevents dust exposure.

Any service done on brake linings, pads, rotors and drums, should be done using properly exhaust ventilated equipment.

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be inspected for wear or damage.

9. On floating caliper type disc brakes, the caliper assembly must be removed from the spindle prior to removal of the shoe and lining assemblies.

10. On floating caliper type disc brakes the calipers must not be interchanged from one side to the other. When the caliper is installed on its proper anchor plate and spindle, the bleeder screw will point to the rear of the vehicle. If a caliper is installed on the wrong side of the vehicle, it is not possible to bleed the system properly.

11. 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..

DRUM BRAKES

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

2. Brush all dust from the backing plates and interior of the brake drums..

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 had 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 if oversize linings must be installed.

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, replacement of the retracting and hold-down springs is strongly recommended. Overheated springs lose their pull and could cause the new lining to wear prematurely, if they are not replaced. If the brake drums are heat spotted, indicating a overheated condition, they should be replaced.

5. If the vehicle has 30,000 or more miles of operation on the brake linings or signs of overheating are present when relining brakes, the wheel cylinders should be disassembled and inspected for wear and entrance of dirt into the cylinder. The cylinder cups should be replaced, thus avoiding future problems.

6. Inspect all other brake parts and replace any that are worn or damaged.

7. Inspect the brake drum and, if necessary, refinish. Refer to Part 12-02 for refinishing.

BRAKE BOOSTER

Check the booster operation as noted in Part 12-01, 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.

HYDRAULIC LINES

Steel tubing is used throughout the brake system with the exception of the flexible hoses at the front wheels and at the rear axle housing brake tube connection.

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

BRAKE TUBING

If a section of the 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 underbody or rear axle contours, be careful not to kink or crack the tube.

All brake tubing should be double flared properly to provide good leakproof connections. Clean the 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 Milbar Tool 1112-144 or equivalent.

BRAKE HOSE

A flexible brake hose should be replaced if it shows signs of softening, cracking, or other damage.

When installing a new front brake hose, position the hose to avoid contact with other chassis parts. Place a new copper gasket over the hose fitting and thread the hose assembly into the front wheel cylinder. Engage the opposite end of the hose to the bracket on the frame. Install the horseshoe-type retaining clip, and connect the tube to the hose with the tube fitting nut.

A rear brake hose should be installed so that it does not touch the muffler outlet pipe or shock absorber. Thread the hose into the rear brake tube connector. Engage the front end of the hose to the bracket on the frame. Install the horseshoe-type retaining clip, and connect the tube to the hose with the tube fitting nut.

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6. Clean all parts in clean isopropyl alcohol, and inspect the parts for chipping, excessive wear or damage. When using a master cylinder repair kit, install all the parts supplied.
7. Be sure that all recesses, openings and internal passages are open and clean. Place all parts on a clean pan or paper.
8. Inspect the master cylinder bore for signs of etching, pitting, scoring or rust. If necessary to hone the master cylinder bore to repair damage, do not exceed allowable hone specifications.

Assembly

1. Dip all parts except the master cylinder body in clean brake fluid (ESA-M6C25-A) Ford Part No. C6AZ-19542-A or DOT-3 equivalent.
2. Carefully insert the complete secondary piston and return spring assembly in the master cylinder bore (Fig. 23).
3. Install the primary piston assembly in the master cylinder bore.
4. Depress the primary piston and install the snap ring in the cylinder bore groove.
5. Install the push rod, boot and retainer on the push rod, if so equipped. Install the push rod assembly into the primary piston. Make sure the retainer is properly seated and holding the push rod securely.
6. Position the inner end of the push rod boot (if so equipped) in the master cylinder body retaining groove.
7. Install the secondary piston stop bolt, if used, with an O-ring if screw is on bottom outside of master cylinder casting.
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. 23. 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.

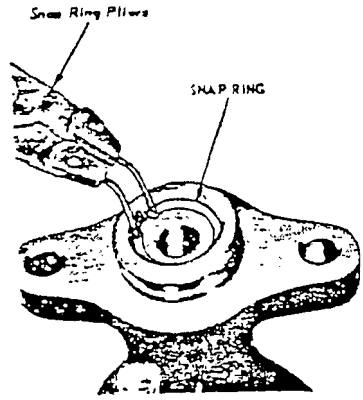


FIG. 24 Removing Snap Ring—Typical

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 (4) shoe and lining assemblies (complete axle set) on front or rear wheels as appropriate.
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.

DISC BRAKE SERVICE PRECAUTIONS

1. Grease or any other foreign material must be kept off the linings 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. Be sure the vehicle is centered on the hoist before servicing any front end components, to avoid bending or damaging the rotor splash shield on full right or left wheel turns.
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 oil or grease-soaked brake linings. When contaminated linings are found, brake linings must be replaced in complete axle sets.

DRUM BRAKES

1. Remove the wheel from the drum, and remove the drum as outlined in Part 12-02.
2. Use an industrial type vacuum cleaner to remove all dust from the backing plates and interior of the brake drums.
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. 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. The maximum inside braking surface diameter is shown on each brake drum (Fig. 23). 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.

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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 tighening 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.

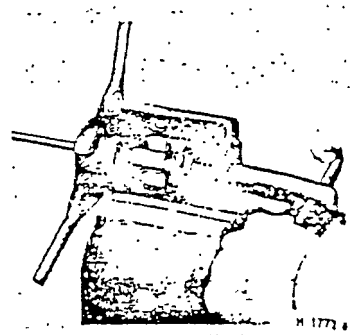


FIG. 17 Line Flaring (Flaring Bar Type)

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 ect, 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

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.

DISC BRAKE SERVICE PRECAUTIONS

1. Grease or any other foreign material must be kept off the linings 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. Be sure the vehicle is centered on the hoist before servicing any front end components, to avoid bending or damaging the rotor splash shield on full right or left wheel turns.
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 oil or grease soaked brake linings. When contaminated linings are found, brake linings must be replaced in complete axle sets.
9. On Fairmont/Zephyr only, always replace rubber caliper insulators and plastic sleeves when replacing linings. **Do not lubricate the slide pins.**

DRUM BRAKES

1. Remove the wheel from the drum, and remove the drum as outlined in Part 12-02.
2. Use an industrial vacuum cleaner to remove all dust from the backing plates and interior of the brake drums.
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. 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. The maximum inside braking surface diameter is shown on each brake drum (Fig. 33). 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.**

BRAKE TUBING

If a section of the 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 underbody or rear axle contours, be careful not to kink or crack the tube.

HYDRAULIC LINES

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

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

All brake tubing should be double flared properly to provide good leakproof connections. Clean the 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 Milbar Tool 1112-144 or equivalent.

BRAKE HOSE

A flexible brake hose should be replaced if it shows signs of softening, cracking, or other damage.

When installing a new front brake hose, position the hose to avoid contact with other chassis parts. On all vehicles except Fairmont/Zephyr, place a new copper gasket over the hose fitting and thread the hose assembly into the front wheel cylinder or caliper. Fairmont/Zephyr front hose does not require a copper gasket and is reusable. Engage the opposite end of the hose to the bracket on the frame. The white stripe on the hose should show no evidence of twisting. Install the horseshoe-type retaining clip, and connect the tube to the hose with the tube fitting nut.

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.

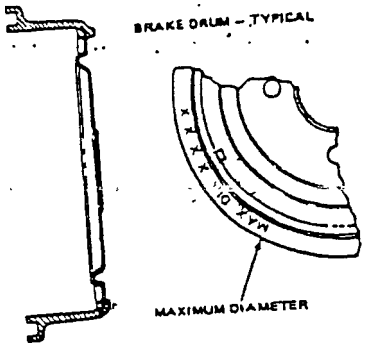


FIG. 13 Rear Brake Drum Maximum Inside Braking Surface Diameter Marking Location—E-100—E-350, Bronco, and F-100—F-350

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 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.

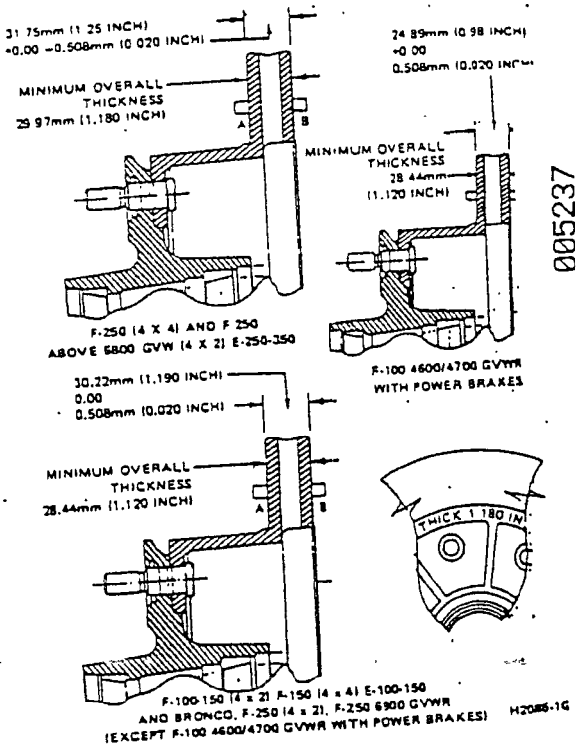


FIG. 14 Disc Brake Rotor Service Limits

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.

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 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 specification, drum must be replaced.

4. Check condition of brake shoes, retracting spring, holddown springs, and drum for signs of overheating. If shoes have a slight blue coloring, indicating overheating, retracting and holddown 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.

REMOVAL AND INSTALLATION

The following apply to vehicles equipped with either air or hydraulic brakes.

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.

CAST SPOKE WHEELS

Removal

1. Raise the vehicle until the tire clears the floor and install safety stands. Remove the tire and rim assembly by removing the clamps and nut.
2. Remove the cast spoke wheel and drum assembly from the front or rear axle.
3. Remove the drum from the cast spoke wheel by removing the nuts, bolts and washers.
4. Check the drum for damage or wear and repair or replace if necessary. If a new drum will be installed, remove the protective coating with a degreaser.

   NOTE: Replace the drum with the same type and size. Failure to do so will affect vehicle performance. Replace cast drums with cast drums. Replace centrifuse drums only with centrifuse drums.

Installation

1. Assemble the drum to the cast spoke spider. Tighten the nuts to 299-352 N·m (220-260 ft-lbs).
2. Assemble the cast spoke spider and drum assembly to the front or rear axle. Adjust the wheel bearings and the axle shaft installation, if necessary, per the appropriate Section in Group 11.
3. Install the tire and wheel assembly on the cast spoke wheel. Refer to Section 11-01, Wheels, Rims and Tires for the procedure.
4. Tighten the front and rear wheel clamps to 299-352 N·m (220-260 ft-lbs).

DISC WHEELS—OUTBOARD MOUNTED DRUMS

Removal

1. Raise the vehicle until the tire clears the floor and install safety stands. Remove the nuts retaining the tire and wheel assembly to the hub (Fig. 6).
2. Remove the drum from the hub.
3. Check the drum for damage or wear and repair or replace as necessary. If a new drum is installed, be sure to remove the protective coating with degreaser.

   NOTE: Replace drums with drums of the same type. Failure to do so will affect vehicle track and performance. Replace cast drums only with cast drums. Replace centrifuse drums only with centrifuse drums.

   Check wheel grease seals for leakage. If the hub is removed from the axle, install new wheel grease seals.

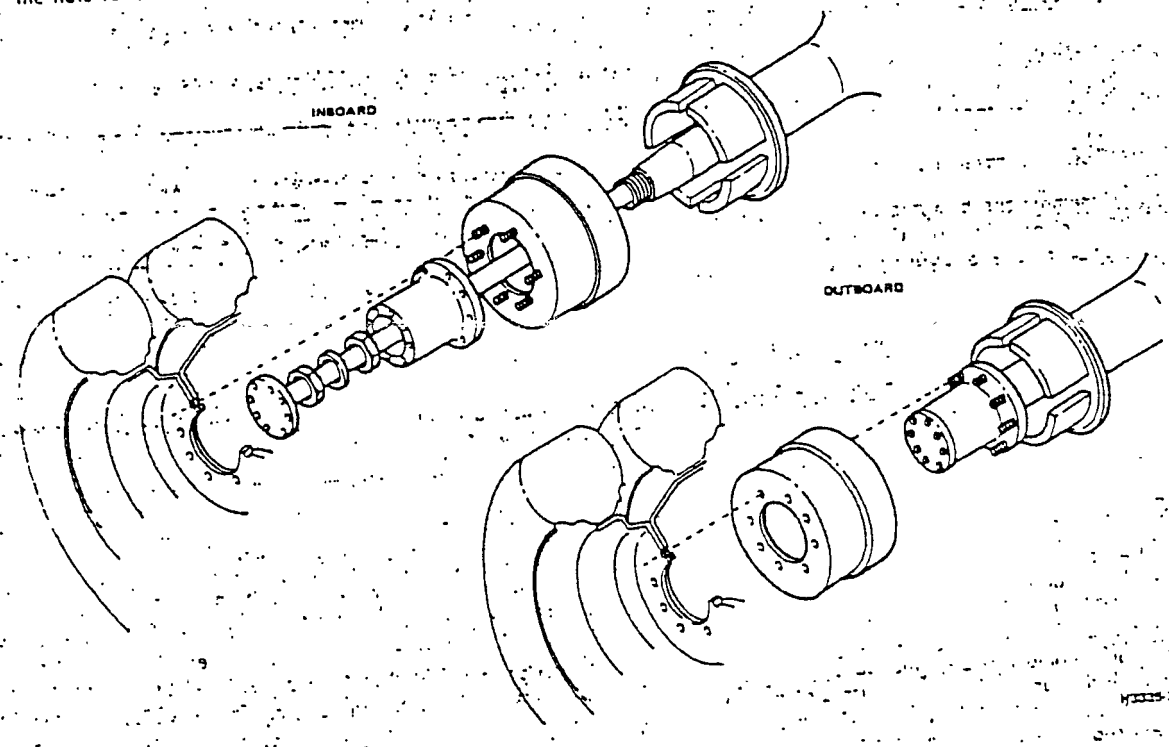


FIG. 6 Brake Drum Mountings

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 adapter above the bar, or even with the bar, depending on the tool used.
4. Fit the adapter 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 tighening 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

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.

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 Section 12-24 Disc Brakes—Light and Heavy Duty—Sliding Caliper.

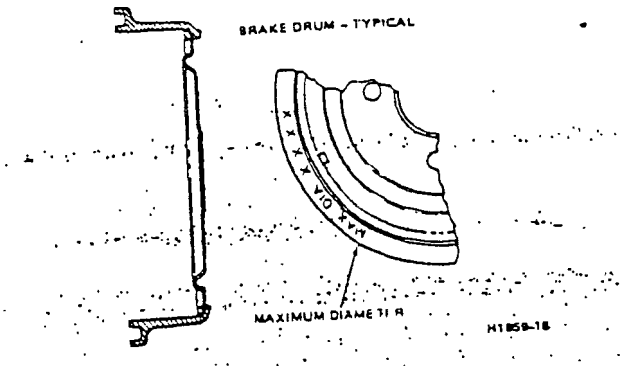


FIG. 13 Rear Brake Drum Maximum Inside Braking Surface Diameter Marking Location—E-100—E-350, Bronco, and F-100—F-350

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 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.

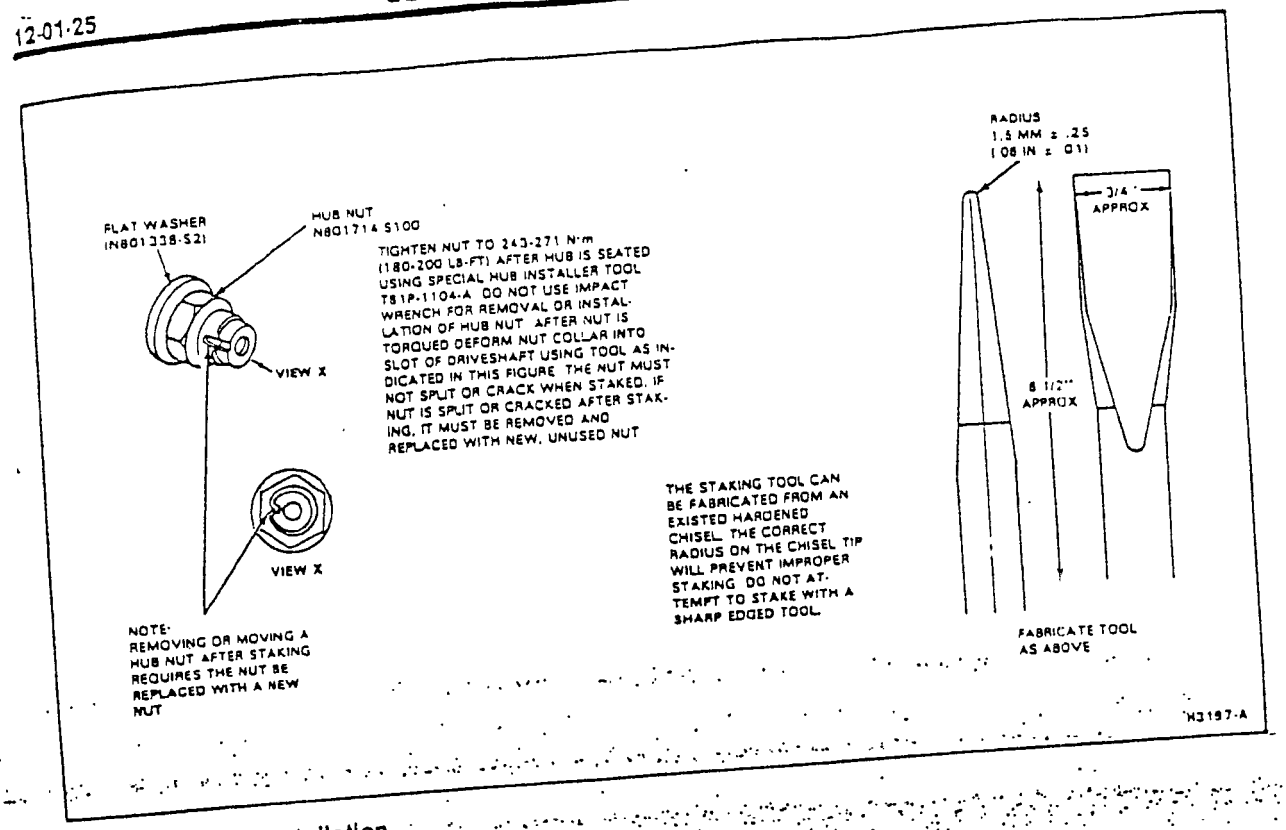


FIG. 11 Hub Nut Installation

Refer to Section 11-12, Front Hubs for nut tightening procedure.

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.

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 and tire assembly and drum assembly from spindle.

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

WARNING: Dust and dirt conditions present on wheel brake assemblies and rotors and drums, may contain asbestos fibers that can represent a potential health hazard when made airborne by cleaning with compressed air.

All wheel brake assemblies should therefore be cleaned only with a vacuum cleaner suitable for use with asbestos fibers. This type of vacuum cleaner is available through the Rotunda Dealer Equipment Catalog. Dust and dirt from the vacuum cleaner should be disposed of in a manner that prevents dust exposure.

Any service done on brake linings, pads, rotors and drums, should be done using properly exhaust ventilated equipment.

LIBERTY MUTUAL

21040 Greenfield Road, Detroit, Michigan 48237 • Tel. (313) 666-2525

December 29, 1975

Ford Dealer Development
Dealership Presidents

Exposure to Asbestos Dust

Brake linings, pads and clutch assemblies are made of asbestos, which has long been recognized as a material producing a hazard to the health of those who inhale its dust in excessive amounts over a long period of time. During the last few years, however, attention has been focused on the development of cancer of the lung and other body areas following exposure to asbestos dust.

An alert concerning the potential health hazard for persons exposed to asbestos during the servicing of motor vehicle brake and clutch assemblies was issued by the National Institute for Occupational Safety and Health on August 8, 1975. It cited four cases of rare mesothelial tumors in persons who were employed in jobs involving brake servicing. This rare type of cancer in the membrane around the lung or stomach causes 1 in 10,000 deaths in the general populace. But one study of 632 asbestos workers found that 32 (1 out of 20) had died of this type of cancer. Asbestos also causes lung cancer; and an asbestos worker who smokes is 50 times more likely to get lung cancer.

The full extent of asbestos-related disease in brake servicing personnel is not known because this group has never before been systematically studied. Excessive dust concentrations measured at operations, such as blow-out of automobile drum brake assemblies, grinding of used truck brake linings, bevelling of new truck brake linings, and arcing of new auto brake linings, together with mesothelial tumors in persons so employed, affirms the necessity for effectively controlling the exposure.

At present we do not have complete information on how much exposure, if any, can be tolerated; and so it is important to eliminate exposures whenever possible and minimize those which cannot be eliminated. Recommended practices are listed below.

Wear Respirator:

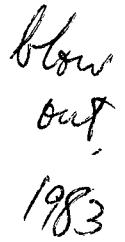
1. During brake servicing, an air purifying respirator, either single use or with replaceable particulate filters(s), as approved by the National Institute for Occupational Safety and Health (NIOSH) should be worn during all procedures starting with the removal of the wheels and including reassembly. During manual clutch servicing, such a respirator should be worn during removal and cleaning of the clutch, pressure plate and housing assembly and during installation of the new clutch assembly. This should also include any arcing or riveting operations.

EXHIBIT
23 Rosynski
4-22-03 SS
PENCAD-Bayonne, N. J.

002809

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The sticky note shown below was written by Barry Castleman and attached to the page immediately following this one along the right margin at the spot marked on the next page with an X



INDUSTRIAL HYGIENE AUDIT OF OHIO TRUCK PLANT

6 - 8 June 1983

An industrial hygiene audit was conducted at Ohio Truck Plant on June 6-8, 1983. The purpose of this audit was to evaluate environmental conditions, work practices, and processes in the plant that could adversely affect employee health or contribute to worker discomfort. Mrs. Nancy Lutz, Plant Safety Engineer, very cooperatively assisted during this audit.

Elements of the audit included appraisal of general plant and process ventilation, chemical handling practices, air quality, hearing conservation, respiratory protection, corrosive chemical vision conservation practices, illumination, skin protection practices, sanitation, and heat stress protection.

Overall, the plant's industrial hygiene programs are excellent. Noteworthy are the local exhaust ventilation systems and control of employee exposures to airborne contaminants. Exposures to overspray mist and solvent vapors in paint booths were controlled as was exposure to fine-wire welding fume and gases.

Deficiencies in some industrial hygiene programs were noted, however, and should receive attention.

Ventilation

Whereas overall plant ventilation is excellent, a slight negative pressure condition exists. While insignificant during warm months when large doors are open, this could be a problem during winter leading to breathing zone air quality problems. Plant engineering should assure provision of sufficient makeup air to balance all supply and exhaust systems to within ten percent of each other.

Sodium hydroxide mist was extremely irritating to eyes and respiratory tract on the catwalk in the Caustic Building. The two side draft local exhaust systems were inoperative at the lye tank. These should be repaired and the caustic tank enclosure immediately designated a respiratory protection area. All employees in this enclosure must wear respirators approved for alkaline mists and must be included in a comprehensive respiratory protection program in compliance with OSHA standards and Company guidelines. The enclosure must be appropriately posted.

Asbestos/Silica

Sand blasting of brake drums at the Trailer Maintenance Building presents potential exposures to airborne asbestos fiber and respirable silica dust. Steel shot or glass beads should be considered as substitutes for silica to eliminate risk of silicosis. An air-supplied abrasive blasting helmet must be provided to control exposure to asbestos fiber and dust. A vacuum sweeper approved for asbestos fiber should be purchased to remove residual asbestos from truck trailer brake drums before new brake shoes are installed. This vacuum sweeper should be made available to maintenance personnel who repair and install new brakes in the hi-lo and fork truck vehicle maintenance area. Employees must be instructed not to use compressed air wands to blow residual asbestos dust and fiber off brake shoes and drums. Wet methods, vacuuming, respiratory protection, and ventilation must be used to control exposure to asbestos. Brake maintenance employees should be on the asbestos medical surveillance program.

Illumination

Illumination was marginally acceptable in several areas in the north end of the plant. Much daytime illumination in this area comes from skylights. Illumination is considerably less on the night shift. Steps should be initiated to clean and maintain existing lighting fixtures and to consider installation of additional luminaires.

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The area behind the lye tanks in the Caustic Building was poorly illuminated. Since there are tripping hazards here and employees must periodically enter this area of corrosive and slippery chemicals, better illumination is indicated.

Sanitation

Overall plant sanitation and hygiene is excellent. No deficiencies other than minor housekeeping were noted in cafeterias, food preparation areas, canteens, locker rooms, and washrooms/toilets. The nuisance odor condition associated with cigarette butts, food, waste, and oil discarded into trenches around production equipment should be addressed by a periodic maintenance cleaning schedule. At the least, this condition is visually unaesthetic and is an employee concern as expressed by the UAW Health and Safety Representative. The food storage refrigerator in the Power House should be relocated away from the chemical storage area. Free-standing water in the Trailer Maintenance Building should be controlled to eliminate a slipping hazard and harborage for mosquito and insect larvae. Flying insects in the plant were not a problem, and we see no compelling need for installation of more electronic bug killers.

Hearing Conservation

There was inconsistent use of hearing protectors in designated hearing conservation areas. All employees must consistently wear approved muffs or plugs at these locations. A variety of protectors should be made available including an approved earmuff and at least two types of earplugs. The Power House generator area should be designated a hearing conservation area and appropriately posted. Some metal finishers at F-26, for example, were not wearing protection. They must constantly use hearing protection equipment. The paint pot block house must be made a mandatory hearing conservation area and so posted. Although exposures are brief in this area, the noise intensity is extreme and poses a risk of noise-induced hearing loss. Generally, hearing conservation areas should be more clearly posted and designated.

Respiratory Protection

Employees use appropriate and approved respirators for air contaminants to which they are exposed; however, a serious deficiency exists because many do not use both straps on the half mask respirators. This prevents an effective face-to-mask seal. This should be corrected by management enforcement and education and training sessions. The paint residue removal area at the Caustic Building lye tanks must be designated as "Respiratory Protection Required". Written programs must be established for all respiratory protection areas in compliance with OSHA standards. Paint sprayers leave their respirators on work surfaces adjacent to the booths. This must be corrected by providing an hygienic storage area for each painter's respirator.

Vision Conservation

Employees use inappropriate eye protection when handling or working near corrosive chemicals. Eye protection of choice is the chemical splash goggle which is superior to a face shield for vision conservation. Employees must be instructed to wear goggles where splashing of corrosive chemicals could occur. These areas should be so designated. The chemical eyewash fountain and shower in the Caustic Building must be relocated on the catwalk midway between both lye tanks. Consideration should be given to installing an emergency eyewash fountain near BB-21, A-22 or A-21. It must be emphasized that eyewash fountains are secondary to consistent use of splash goggles in vision conservation areas. Employees who handle strong acids, alkalies, oxidizers, corrosion inhibitors, microbiocides, and scale removers must wear splash goggles. We see little need for face shields in chemical handling areas at Ohio Truck Plant.

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Air Quality

Other than caustic mist at the lye tanks, no obvious air quality problems were noticed. It is advisable, however, to document exposures to solvent vapors in the paint kitchen. Arrangements will be made to have plant personnel conduct this monitoring this winter when doors are closed. Air sampling is also recommended to document solvent vapor exposures of maintenance employees who clean paint sludge filters in the basement at C-37.

Skin Protection

There is no evidence of excessive dermatitis at Ohio Truck Plant in spite of potential contact with a wide variety of dermal irritants and sensitizers. Several paint sprayers complained, however, that even two pairs of green gloves do not prevent paint from penetrating through to their skin. As a result, they wash their hands with paint thinner at the end of the shift. They believe that white cotton gloves which had been provided to them previously are superior to the present gloves. The plant should select a glove to assure that painters do not have to resort to the use of solvents to clean their hands. Non-silicone based barrier creams should also be considered. Although the solvent they use is not appreciably skin absorbed, it can dissolve protective oils and lipids from the skin and pave the way for an industrial dermatosis.

Chemical Storage

Greater attention by means of educating and training lift truck operators is required to assure that incompatible chemicals are not stored together. For example, drums of concentrated sulfuric acid were stored next to drums of aqueous ammonia. Drums of sodium nitrite, a strong oxidizer, were stored next to readily oxidizable materials. Inadvertent drum rupture as might occur during a fire or from impaling by or dropping from a fork truck could produce a chemical emission emergency.

Ergonomics

The BAO ergonomics task force should consider the potential for chronic hand/wrist musculoskeletal and neurological trauma in sealer application employees.

Heat Stress

No significant heat stressful work environmental conditions were observed.

The Industrial Hygiene Services Section will, as requested, assist in implementing these recommended industrial hygiene programs at Ohio Truck Plant.

Roger Wabeke

Roger Wabeke, Supervisor
Industrial Hygiene & Toxicology Department
Employee Health Services

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