Drum Brakes

39

OBJECTIVES

◆ Explain how drum brakes operate. ◆ Identify the major components of a typical drum brake and describe their functions. ◆ Explain the difference between duo-servo and nonservo drum brakes. ◆ Perform a cleaning and inspection of a drum brake assembly. ◆ Recognize conditions that adversely affect the performance of drums, shoes, linings, and related hardware. ◆ Reassemble a drum brake after servicing. ◆ Explain how typical drum parking brakes operate. ◆ Adjust a typical drum parking brake.

For many years, drum brakes were used on all four wheels on virtually every vehicle on the road. Today, disc brakes have replaced drum brakes on the front wheels of most vehicles, and some models are equipped with both front and rear disc brakes. One reason for their continued use is that drum brakes can easily handle the 20 to 40 percent of total braking load placed on the rear wheels. Another is that drum brakes can also be built with a simple parking brake mechanism.

DRUM BRAKE OPERATION

Drum brake operation is fairly simple. The most important fact contributing to the effectiveness of the braking force supplied by the drum brake is the brake shoe pressure or force directed against the drum (Figure 39–1). With the vehicle moving in either the forward or reverse direction with the brakes on, the applied force of the brake shoe pressing against the brake drum increasingly multiplies itself. This is because the brake's anchor pin acts as a brake shoe stop and prohibits the brake shoe from its tendency to follow the movement of the rotating drum. The result is a wedging action between the brake shoe and brake drum. The wedging action combined with the applied brake force creates a self-multiplied brake force.

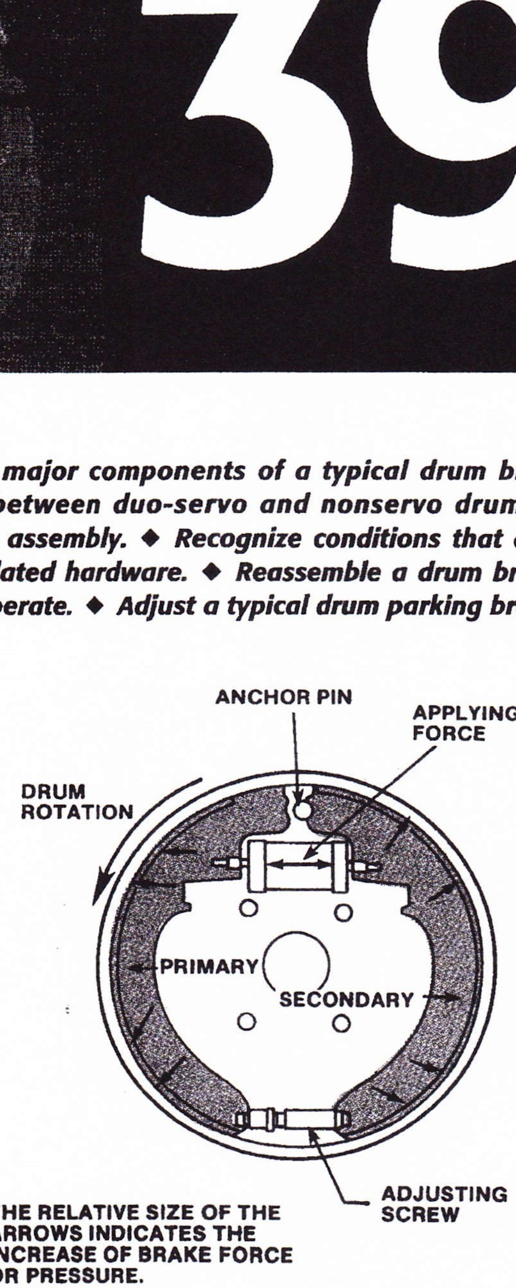


FIGURE 39–1 The wheel cylinder pushes the primary and secondary shoes against the inside surface of the rotating brake drum.

DRUM BRAKE COMPONENTS

The major components of a typical drum brake are shown in Figure 39–2. The **backing plate** provides a foundation for the brake shoes and associated hardware. The plate is secured and bolted to the axle flange or spindle. The wheel cylinder, under hydraulic pressure, forces the brake's shoes against the drum. There are also two linked brake shoes attached to the backing plate. Brake shoes are the backbone of a drum brake. The shoes must support the lining and carry it into the drum so the pressure is distributed across the lining surface during brake application. Shoe return springs and shoe hold-down

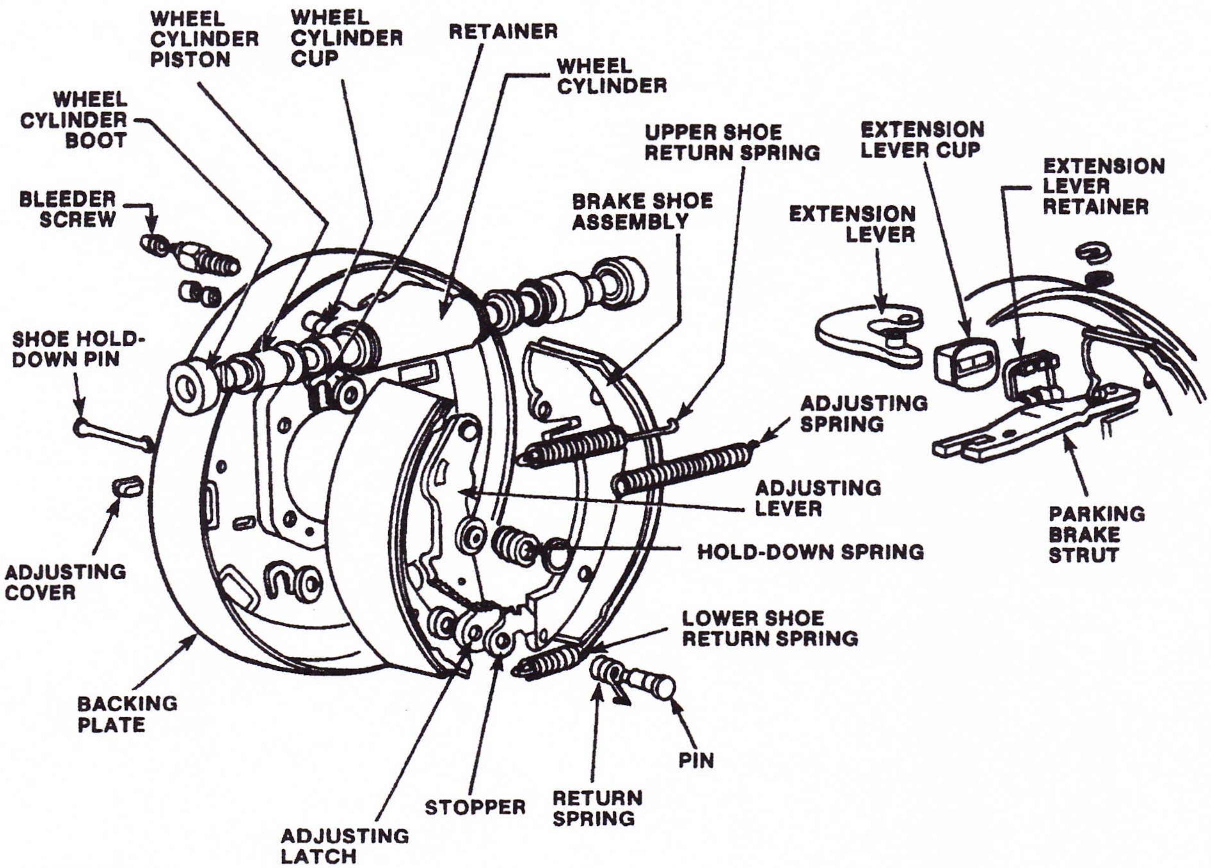


FIGURE 39–2 Components of a typical rear-wheel drum brake.

parts maintain the correct shoe position and clearance. Some drum brakes are self-adjusting. Others require manual adjustment mechanisms. Brake drums provide the rubbing surface area for the linings. Drums must withstand high pressures without excessive flexing and must also dissipate large quantities of heat generated during brake application. Finally, the rear drum brakes on most vehicles include the parking brakes.

Wheel Cylinders

Wheel cylinders convert hydraulic pressure supplied by the master cylinder into a mechanical force at the wheel brakes. The space in the wheel cylinder bore between the cups is filled with fluid. When the brake pedal is depressed, additional brake fluid is forced into the cylinder bore. The additional fluid, which is under pressure, moves the cups and pistons outward in the bore. This piston movement forces the shoe links and brake shoes outward to contact the drum and thus apply the brakes.

Brake Shoes and Linings

The workhorse of the drum brake is the brake shoe. In the same brake sizes, there can be differences in **web** thickness, shape of web cutouts, and positions of any reinforcements.

The shoe rim is welded to the web to provide a stable surface for the lining. The web thickness might differ to provide the stiffness or flexibility needed for a specific application. Many shoes have nibs or indented places along the edge of the rim. These nibs rest against shoe support ledges on the backing plate and keep the shoe from hanging up.

Each drum in the drum braking system contains a set of shoes. The **primary shoe** (or leading shoe) is the one that is toward the front of the vehicle. The friction between the primary shoe and the brake drum forces the primary shoe to shift slightly in the direction that the drum is turning (an **anchor pin** permits just limited movement). The shifting of the primary shoe forces it against the bottom of the secondary shoe, which causes the secondary shoe to contact the drum. The **secondary shoe** (or trailing shoe) is the one that is toward the rear of the vehicle. It comes into contact as a result of the movement and pressure from the primary shoe and wheel cylinder piston and increases the braking action.

The brake shoe lining provides friction against the drum to stop the car. It contains heat-resistant fibers. The lining is molded with a high-temperature synthetic bonding agent.

The two general methods of attaching the lining to the shoe are riveting and bonding. Regardless of the method of attachment, brake shoes are usually held in a position by spring tension. They are either held against the anchor by the shoe return springs or against the support plate pads by shoe **hold-down springs**. The shoe webs are linked together at the end opposite the anchor by an adjuster and a spring. The adjuster holds them apart. The spring holds them against the adjuster ends.

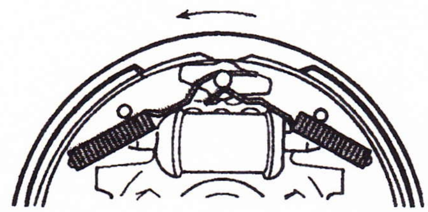
Mechanical Components

In the unapplied position, the shoes are held against the anchor pin by the return springs. The shoes are held to the backing plate by hold-down springs or spring clips. Opposite the anchor pin, a star wheel adjuster links the shoe webs and provides a threaded adjustment that permits the shoes to be expanded or contracted. The shoes are held against the star wheel by a spring.

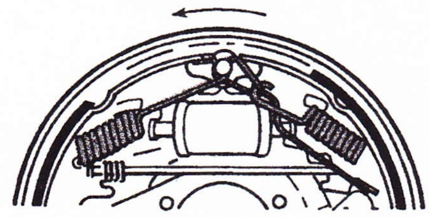
Shoe Return Springs

Return springs can be separately hooked into a link or a guide (Figure 39–3) or strung between the shoes. Springs are normally installed on the anchor in the order shown under each category listed in Figure 39–4.

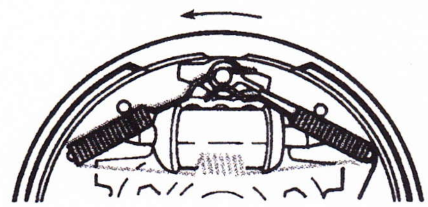
While shoe brake springs look the same, they are usually not interchangeable. Sometimes to help distinguish between them, they are color coded. Pay close attention to the colors and the way they are hooked up.



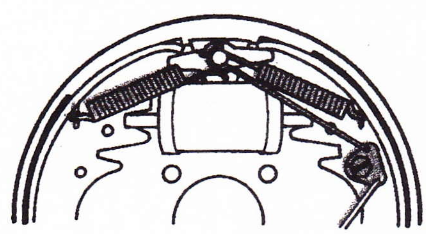
WITH MANUAL ADJUSTER



WITH GM LEVER AUTOMATIC ADJUSTER

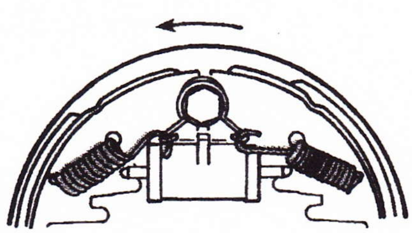


WITH CABLE AUTOMATIC ADJUSTER; WITH AUXILIARY (THIRD) SPRING

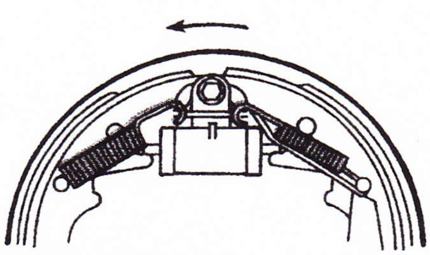


WITH CRANK AUTOMATIC ADJUSTER

FIGURE 39–4 Typical brake shoe return spring anchoring points.



SEPARATE SPRING LINK



SEPARATE SPRING GUIDE

FIGURE 39–3 Typical brake shoe return spring alignments.

Shoe Hold-Downs

Various shoe hold-downs are illustrated in Figure 39–5. To unlock or lock the straight pin hold-downs, depress the locking cup and coil spring or the spring clip, and rotate the pin or lock 90 degrees. On General Motors' lever adjusters, the inner (bottom) cup has a sleeve that aligns the adjuster lever.

Shoe Anchors

As shown in Figure 39–6 there are various types of **shoe anchors** such as the fixed nonadjustable type; self-centering shoe sliding type; or, on some earlier models, adjustable fixed type providing either an eccentric or a slotted adjustment. On some front brakes, fixed anchors are threaded into or are bolted through the steering knuckle and also support the wheel cylinder.

On adjustable anchors, when it is necessary to recenter the shoes in the drum or drum gauge, loosen

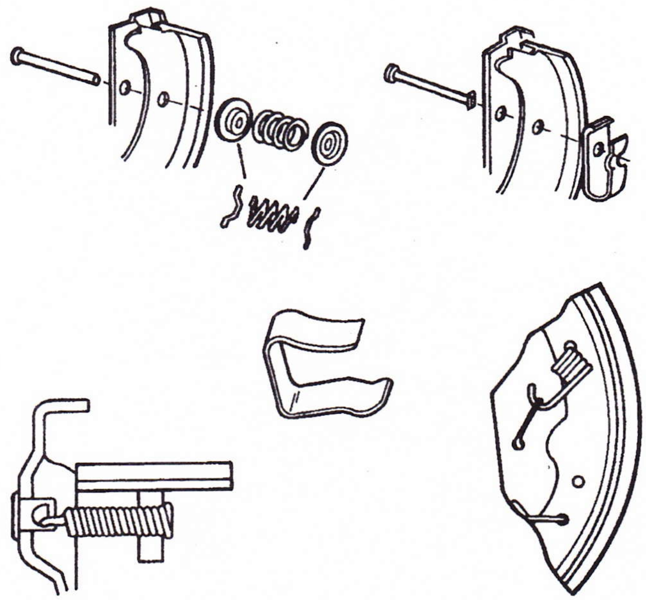


FIGURE 39–5 Types of brake shoe hold-downs.

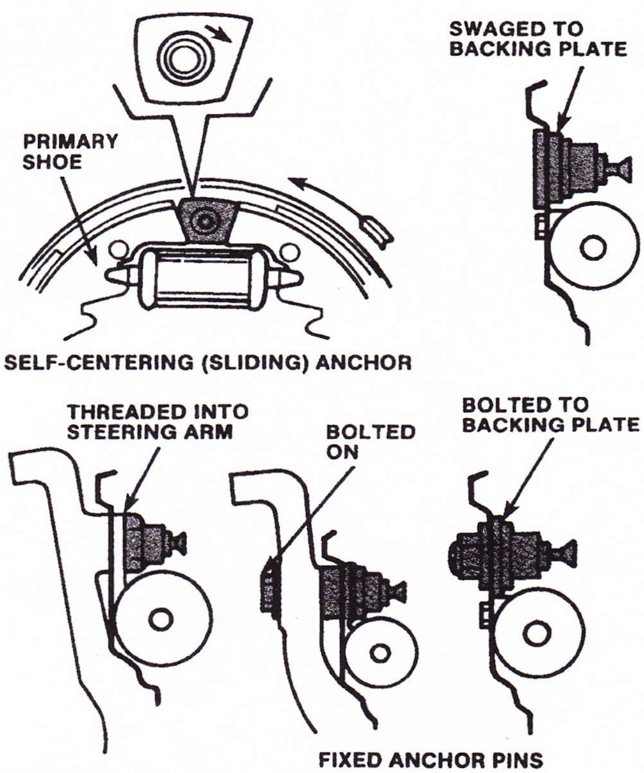


FIGURE 39–6 Types of brake shoe anchors.

the locknut enough to permit the anchor to slip but not so much that it can tilt.

On eccentric anchors, tighten the star wheel to heavy brake drag (Figure 39–7). Rotate the eccentric anchor in the direction that frees the brake until drag is again encountered. Return the eccentric to the position between the two points of drag where the

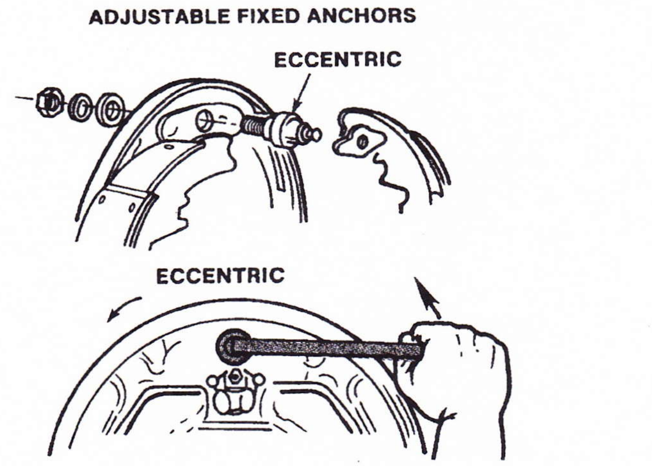


FIGURE 39–7 Eccentric anchor adjustment.

drum rotates freely. Repeat this sequence until drag cannot be relieved. Tighten the anchor nut. Back off the star wheel to a normal manual adjustment.

On the slotted type anchor, tighten the star wheel to heavy drag. Tap the support plate until the anchor moves and frees the brake. Repeat this sequence until drag cannot be relieved. Tighten the lock nut to 100 to 200 foot-pounds torque. Back off the star wheel to a normal manual adjustment.

Drums

Modern automotive brake drums are made of heavy cast iron (some are aluminum with an iron or steel sleeve or liner) with a machined surface inside against which the linings on the brake shoes generate friction when the brakes are applied. This results in the creation of a great deal of heat. The inability of drums to dissipate as much heat as disc brakes is one of the main reasons discs have replaced drums at the front of all late-model cars and light trucks, and at the rear of some sports and luxury cars.

Sometimes the rear drums of FWD cars are integral with the hub and cannot be removed without disassembling the wheel bearing. The rear drums of other FWD and most RWD cars are held in place by the wheel lugs, so they can be removed without tampering with the wheel bearings.

DRUM BRAKE DESIGNS

There are two brake designs in common use. They are **duo-servo** (or self-energizing) drum brakes and **nonservo** (or leading-trailing) drum brakes.

Most large American cars use the duo-servo design of brake. However, the nonservo type has become popular as the size of cars have become smaller. Because the smaller cars are lighter, this type of brake helps reduce rear brake lockup without reducing breaking ability.

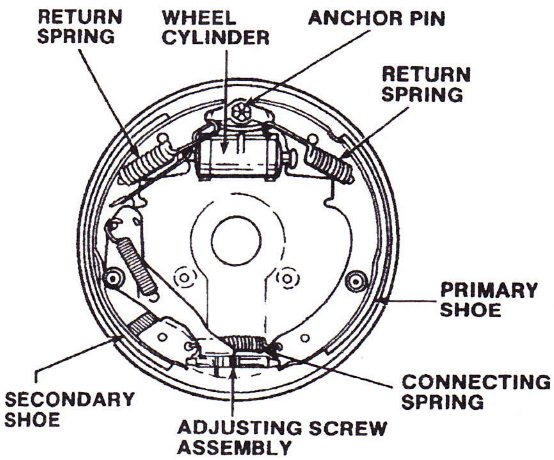


FIGURE 39–8 Typical duo-servo drum brake.

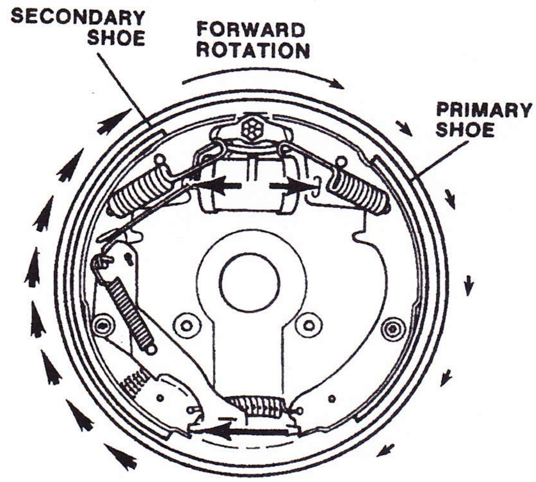


FIGURE 39–10 Duo-servo braking forces.

Duo-Servo Drum Brakes

The name duo-servo brake drum is derived from the fact that the **self-energizing** force is transferred from one shoe to the other with the wheel rotating in either direction. Both the primary (front) and secondary (rear) brake shoes are actuated by a double-piston wheel cylinder (Figure 39–8). The upper end of each shoe is held against a single anchor by a heavy coil return spring. An adjusting screw assembly and spring connect the lower ends of the shoes.

The wheel cylinder is mounted on the backing plate at the top of the brake. When the brakes are applied, hydraulic pressure behind the wheel cylinder cups forces both pistons outward causing the brakes to be applied. Some wheel cylinders have extensions on the pistons that contact the brake shoes, while others have separate links (Figure 39–9).

When the brake shoes contact the rotating drum in either direction of rotation, they tend to move with the drum until one shoe contacts the anchor and the other shoe is stopped by the star wheel adjuster link (Figure 39–10). With forward rotation, frictional forces between the lining and the drum of the primary shoe result in a force acting on the adjuster link to apply the secondary shoe. This adjuster link force into the secondary shoe is many times greater than the wheel cylinder input force acting on the primary shoe. The force of the adjuster link into the secondary shoe is again multiplied by the frictional forces between the secondary lining and rotating drum, and all of the resultant force is taken on the anchor pin. In normal forward braking, the friction developed by the secondary lining is greater than the primary lining. Therefore, the secondary brake lining is usually thicker and has more surface area. The roles of the primary and secondary linings are reversed in braking the vehicle when backing up.

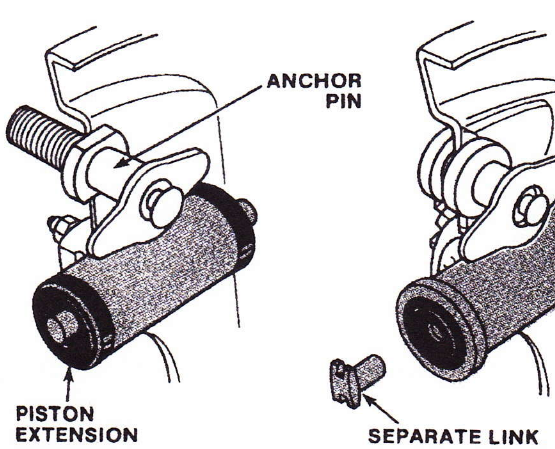


FIGURE 39–9 Wheel cylinder designs.

Automatically Adjusted Servo Brakes

Since the early 1960s, automatic drum brake adjusters have been used on all American and most import vehicles. There are several variations of automatic adjusters used with servo brakes. The more common types available follow.

BASIC CABLE Figure 39–11 shows a typical automatic adjusting system. Adjusters, whether cable,

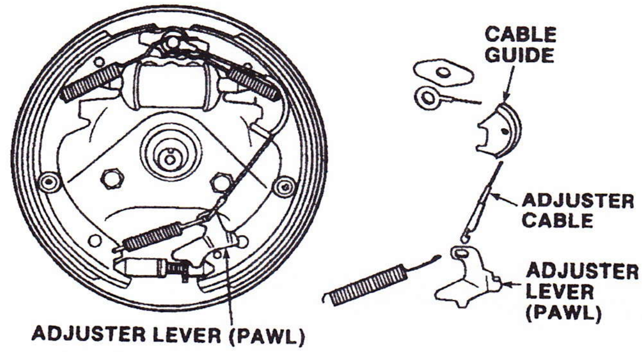


FIGURE 39–11 Cable self-adjusters.

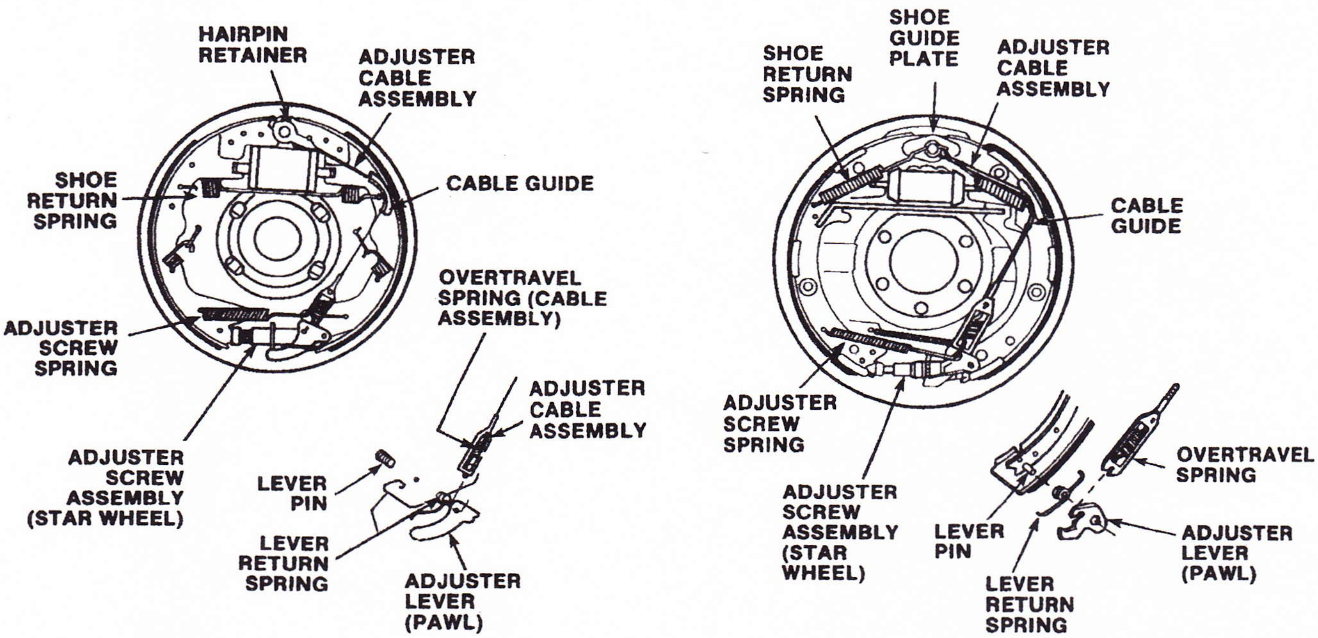


FIGURE 39–12 Cable automatic adjustment with overtravel springs.

crank, or lever, are installed on one shoe and operated whenever the shoe moves away from its anchor. The upper link, or cable eye, is attached to the anchor. As the shoe moves, the cable pulls over a guide mounted on the shoe web (the crank or lever pivots on the shoe web) and operates a lever (pawl), which is attached to the shoe so it engages a star wheel tooth. The pawl is located on the outer side of the star wheel and, on different styles, slightly above or below the wheel centerline so it serves as a ratchet lock, which prevents the adjustment from backing off. However, whenever lining wears enough to permit sufficient shoe movement, brake application pulls the pawl high enough to engage the next tooth. As the brake is released, the adjuster spring returns the pawl, thus advancing the star wheel one notch.

On most vehicles, the adjuster system is installed on the secondary shoe and operates when the brakes are applied as the vehicle is backing up. On a few models, it is located on the primary shoe and operates when the brakes are applied as the vehicle is moving forward. Left-hand and right-hand threaded star wheels are used on opposite sides of the car, so parts should be kept separated. If the wrong star wheel thread is installed, the system does not adjust at all.

Another system uses a cable and pawl, with the left brake having right-hand threads and the right brake left-hand threads. The first cable guide is usually retained on the shoe web by the secondary shoe return spring, and the lever-pawl engages a hole in the shoe web. The adjuster operates in either direction of vehicle movement.

CABLE WITH OVERTRAVEL SPRING Figure 39–12 shows a system with an upstroke pawl advance. The left brake has left-hand threads, and the right brake has right-hand threads. The lever (pawl) is installed on a web pin with an additional pawl return mousetrap spring. The cable is hooked to the lever (pawl) by means of an **overtravel spring** installed in the cable hook. The overtravel spring dampens movements and prevents unnecessary adjustment should sudden hard braking cause excessive drum deflection and shoe movement.

LEVER WITH OVERRIDE The system illustrated in Figure 39–13 uses a downstroke pawl advance. The left brake has right-hand threads, and the right brake has left-hand threads.

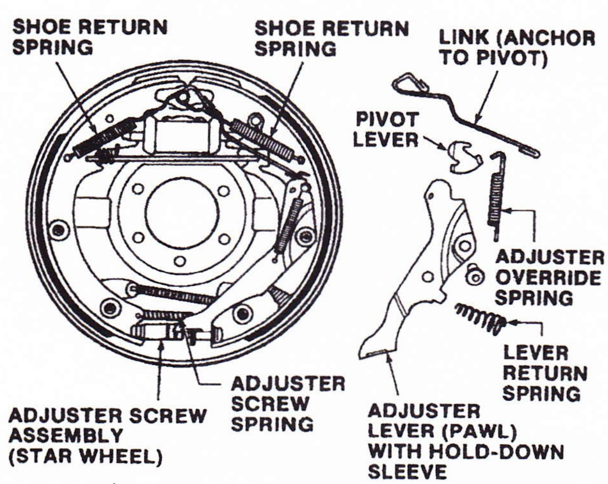


FIGURE 39–13 Adjusting lever with pivot and override spring.

The lever (pawl) is mounted on a shoe hold-down, pivoting on a cup sleeve. It has a separate lever-pawl return spring located between the lever and the shoe table. A pivot lever and an override spring assembled to the upper end of the main lever dampen movement, preventing unnecessary adjustment in the event of excessive drum deflection.

LEVER AND PAWL The system illustrated in Figure 39–14 uses a downstroke pawl advance. The left brake has right-hand threads, and the right break has left-hand threads. The lever is mounted on a shoe hold-down, pivoting on a cup sleeve, and engages the pawl. A separate pawl return spring is located between the pawl and the shoe.

Nonservo Drum Brakes

The nonservo (or as it is better known today as the leading-trailing shoe) drum brake is often used on small cars. The basic difference between this type and the duo-servo brake is that both brake shoes are held against a fixed anchor at the bottom by a retaining spring (Figure 39–15). Nonservo brakes have no servo action.

On a forward brake application, the forward (leading) shoe friction forces are developed by wheel cylinder fluid pressure forcing the lining into contact with the rotating brake drum. The shoe's friction forces work against the anchor pin at the bottom of the shoe. The trailing shoe is also actuated by wheel cylinder pressure but can only support a friction force equal to the wheel cylinder piston forces. The trailing shoe anchor pin supports no friction load. The leading shoe in this brake is energized and does most of the braking in comparison to the nonenergized trailing shoe. In reverse braking, the leading and trailing brake shoes switch functions.

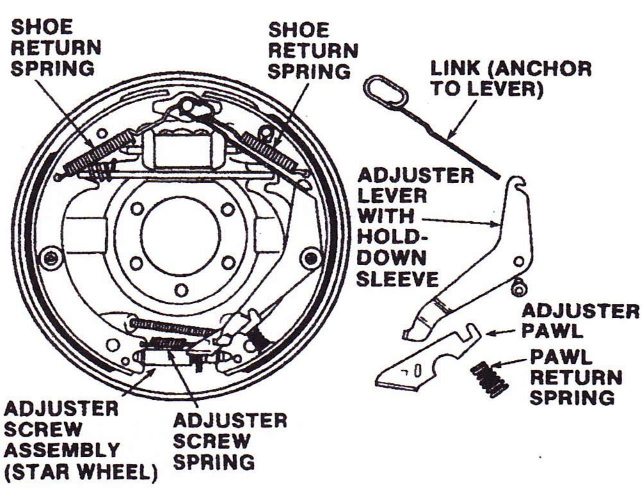


FIGURE 39–14 Lever and pawl automatic adjustment.

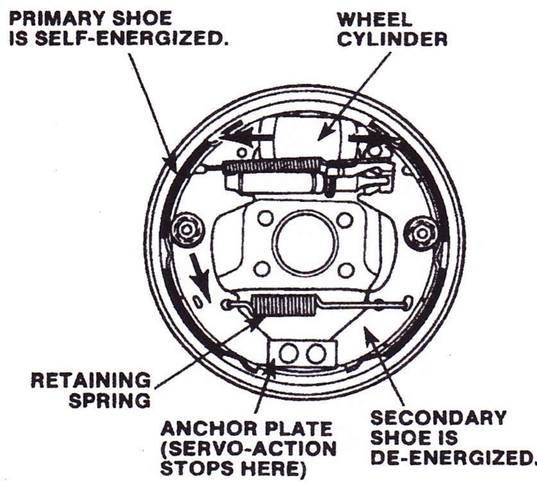


FIGURE 39–15 Typical nonservo drum brake.

SHOP TALK

It is important for the technician to remember that on nonservo drum systems the forward shoe is called the leading shoe and the rear one is known as the trailing shoe (when the vehicle is moving in the forward direction). On duo-servo designs, the forward shoe is the primary, and the rear is the secondary. ■

Nonservo, or leading-trailing shoe, drum brakes can be either manually adjusted or can have an automatic adjustment feature.

Manually Adjusted Nonservo Drum Brakes

There are several types of manually adjusted nonservo drum brake designs available. The two most common are lockheed manual and adjustable strut adjusters.

LOCKHEED MANUAL ADJUSTER This is a very simple brake system. The shoes are located on the top and bottom rather than the sides. The shoes are held tightly against the wheel cylinder and the adjusters by two retracting springs. Each shoe has to be adjusted individually by tightening it against the drum and then backing it off until the drum turns freely.

Depending upon what car this type of brake is used on, there will be differences in the brake shoes, adjusters, anchors, wheel cylinders, or parking brake linkage. It is best to work on one wheel at a time and use the other for reference.

ADJUSTABLE STRUT ADJUSTER On this design (Figure 39–16) the bottoms of the leading and trailing shoes are held against the anchor plate by shoe-to-anchor retaining springs. The top webs engage the wheel cylinder pistons and are straddled by a specially designed adjuster screw assembly. Return springs

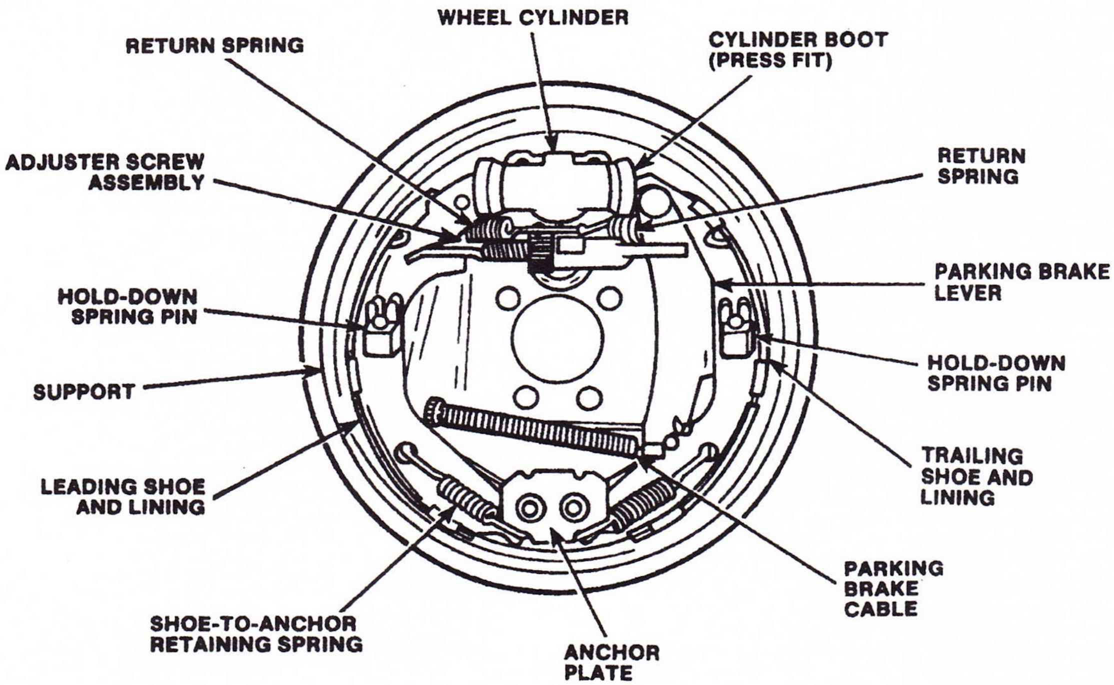


FIGURE 39–16 Nonservo manually adjusted brake.

attached to the adjuster hole in the backing plate hold the shoes in against the adjuster screw assembly. One end engages the trailing shoe web and parking brake lever and the other end engages the leading shoe web.

The upper end of the parking brake lever is pinned to the upper end of the trailing shoe and the lower end is attached to the parking brake cable. When the cable is pulled, force is transmitted through the special adjuster assembly to the leading shoe. Shoe adjustment is done manually by inserting a thin bladed screwdriver through the hole in the backing plate and rotating the adjuster screw to spread the shoes.

Automatically Adjusted Nonservo Brakes

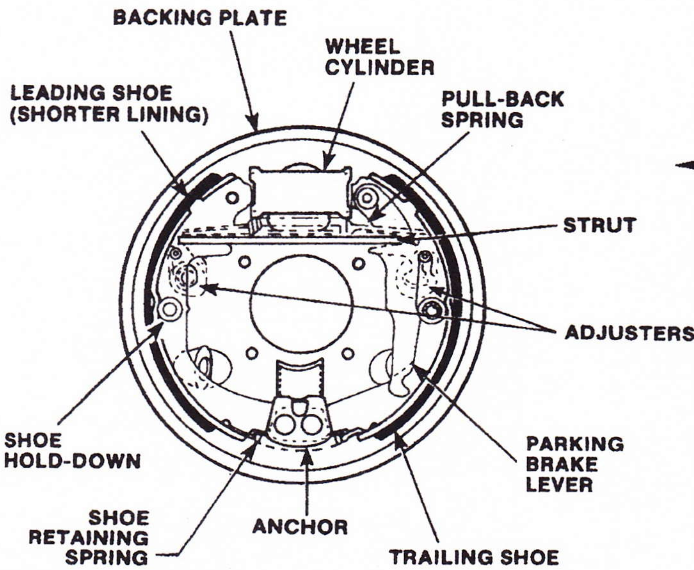
While some standard automatic adjusters similar to the one already discussed are employed on small cars, some of the automatic adjuster mechanisms are unique and varied, using expanding struts between the shoes, or special ratchet adjusting mechanisms. Among the more common of these designs are automatic cam, ratchet automatic, and semiautomatic adjusters.

AUTOMATIC CAM ADJUSTERS This rear nonservo drum brake is for use with front disc brakes and has one forward acting (leading) and one reverse acting (trailing) shoe. Shoes rest against the wheel cylinder pistons at the top and are held against the anchor plate by a shoe-to-shoe pull-back spring. The anchor plate and retaining plate are riveted to the backing plate. Adjustment of the brake shoes takes place automatically as needed when the brakes are applied. The automatic cam adjusters are attached to each shoe by a pin through a slot in the shoe webbing. As the shoes move outward during application, the pin in the slot moves the cam adjuster, rotating it outward. Shoes always return enough to provide proper clearance because the pin diameter is smaller than the width of the slot (Figure 39–17).

RATCHET AUTOMATIC ADJUSTER These popular brakes are a leading-trailing shoe design with a ratchet self-adjusting mechanism. The shoes are held to the backing plate by spring and pin hold-downs, and are held against the anchors at the top by a shoe-to-shoe spring. At the bottom, the shoe webs are held against the wheel cylinder piston ends by a return spring (Figure 39–18).

The self-adjusting mechanism consists of a spacer strut and a pair of toothed ratchets attached to the secondary brake shoe. The parking brake actuating lever is pivoted on the spacer strut.

The self-adjusting mechanism automatically senses the correct lining-to-drum clearance. As the linings wear, the clearance is adjusted by increasing the effective length of the spacer strut. This strut has projections to engage the inner edge of the secondary shoe via the hand brake lever and the inner edge of the large ratchet on the secondary shoe. As wear on the linings increases, the movement of the shoes to bring them in contact with the drums becomes greater than the gap. The spacer strut, bearing on the shoe web, is moved together with the primary shoe to



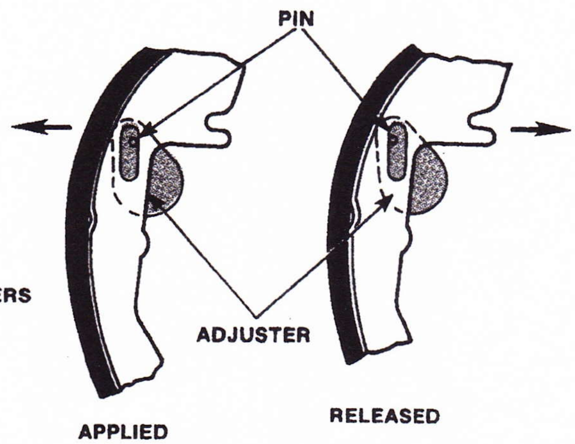


FIGURE 39–17 Nonservo drum brake with automatic cam adjusters.

close the gap. Further movement causes the large ratchet behind the secondary shoe to rotate inward against the spring-loaded small ratchet, and the serrations on the mating edges maintain this new setting until further wear on the shoe results in another adjustment. On releasing brake pedal pressure, the return springs cause the shoes to move into contact with the shoulders of the spacer strut/hand brake actuating lever. This restores the clearance between the linings and the drum proportionate to the gap.

SEMIAUTOMATIC ADJUSTER This brake was designed to be used only as a rear wheel drum for a small car with front disc brakes (Figure 39–19). It has one forward-acting and one reverse-acting shoe. A hold-down clip has replaced the hold-down spring, cup, and pin. A specially designed parking brake strut and rod assembly straddles the shoe webs just below the wheel cylinder. A shoe-to-shoe spring at the top and another at the bottom under the anchor plate hold the shoes in place.

The strut and rod assembly for the parking brake has the strut part on the forward shoe and the rod part connected to a hole in the reverse shoe. When the parking brake is applied, rear brake shoe adjustment is made. The strut and rod spread the shoes enough to pass the spring locks mounted in the assembly. The shoes are prevented from returning to their original position. Pressure on the brake shoes is released when the rod is relaxed, providing enough clearance for the wheels to turn.

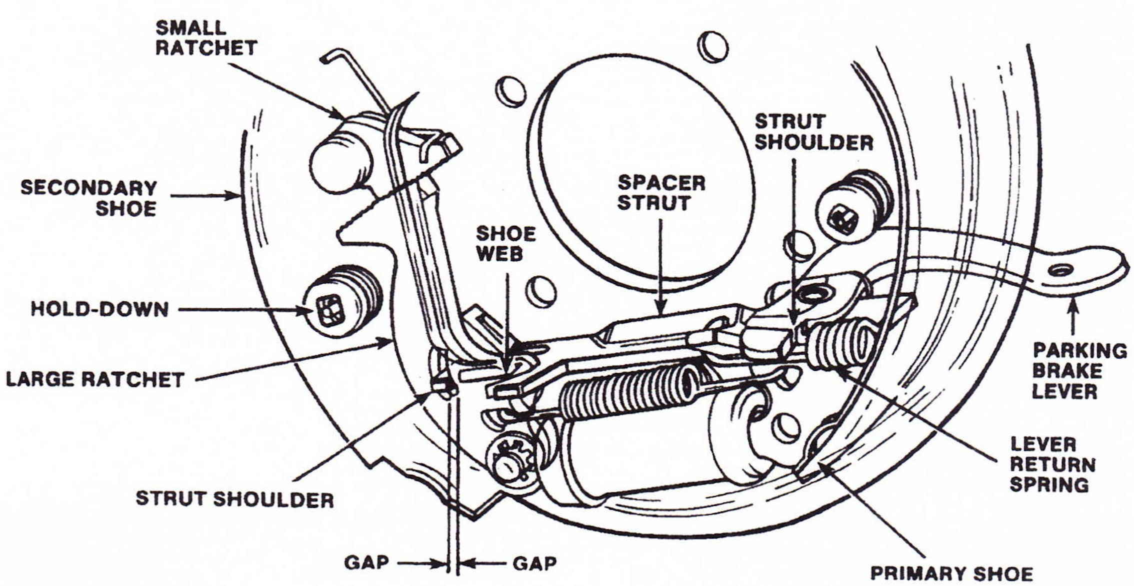


FIGURE 39–18 Typical nonservo self-adjusting mechanism.

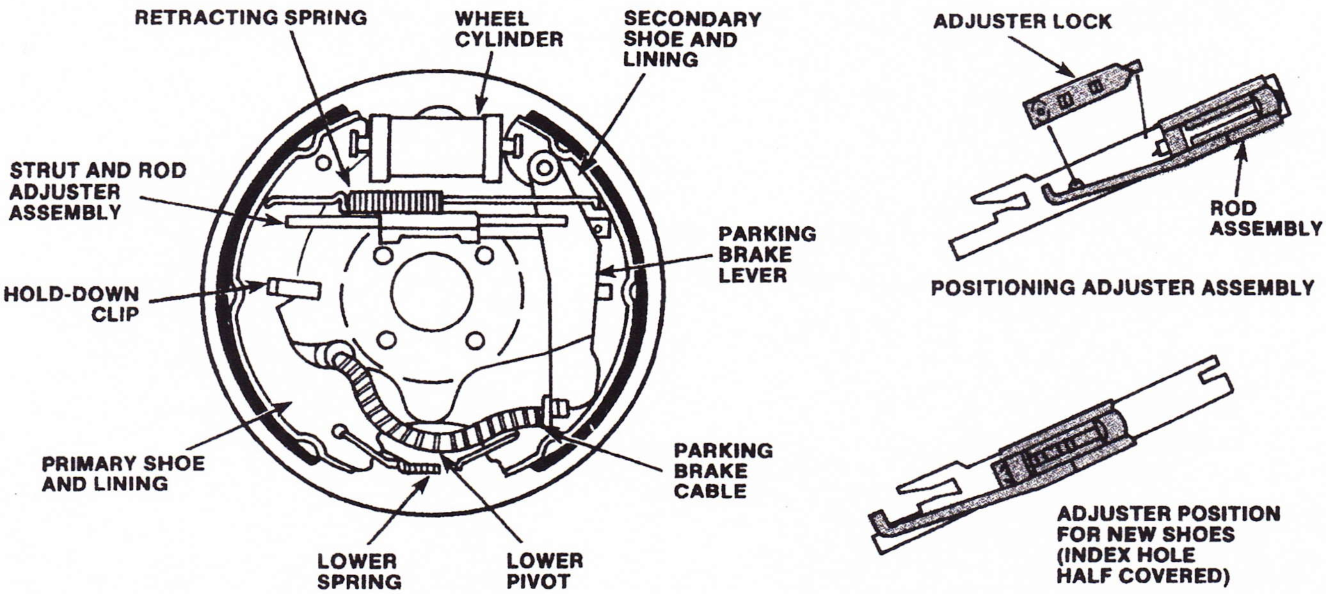


FIGURE 39–19 Nonservo drum brake featuring semiautomatic adjustments.

Inspection and Service

The first rule of quality brake service is to perform a complete job. For example, if new linings are installed without regard to the condition of the hydraulic system, the presence of a leaking wheel cylinder quickly ruins the new linings. Braking power and safety are also compromised.

Problems such as spongy pedal, excessive pedal travel, pedal pulsation, poor braking ability, brake drag, lock, or pulling to one side, and braking noises can be caused by trouble in the hydraulic system or the mechanical components of the brake assembly. To aid in doing a complete inspection and diagnosis, a form like the one shown in Figure 39–20 is very helpful. Working with such a form helps the technician avoid missing any brake test and components that may cause problems.

Brake Noise

All customer complaints related to brake performance must be carefully considered. The number one customer complaint is brake noise. Noise is often the first indication of wear or problems within the braking system, particularly in the mechanical components. Rattles, clicking, grinding, and hammering from the wheels when the brake is in the unapplied position should be carefully investigated. Be sure the noise is not caused by the bearings or various suspension parts. If the noise is coming from the brake assembly, it is most likely caused by worn, damaged, or missing brake hardware, or the poor fastening or mounting of brake components. Grinding noises usually occur when a stone or other object becomes trapped between the lining material and the rotor or drum.

When the brakes are applied, a clicking noise usually indicates play or hardware failure in the attachment of the pad or shoe. On recent systems, the noise could be caused by the lining tracking cutting tool marks in the rotor or drum. A nondirectional finish on rotors eliminates this and so does a less pointed tip on the cutting tool used to refinish drums.

Grinding noises on application can mean metal-to-metal contact, either from badly worn pads or shoes, or from a serious misalignment of the caliper, rotor, wheel cylinder, or backing plate. Wheel cylinders and calipers that are frozen due to internal corrosion can also cause grinding or squealing noises.

Other noise problems and their solutions are covered later in this chapter.

ROAD TESTING BRAKES

Road testing allows the brake technician to evaluate brake performance under actual driving conditions. Whenever practical, perform the road test before beginning any work on the brake system. In every case, road test the vehicle after any brake work to make sure the brake system is working safely and properly.

WARNING!

Before test driving any car, first check the fluid level in the master cylinder. Depress the brake pedal to be sure there is adequate pedal reserve. Make a series of low-speed stops to be sure the brakes are safe for road testing. Always make a preliminary inspection of the brake system in the shop before taking the vehicle on the road. ■

PREBRAKE JOB INSPECTION CHECKLIST

Owner ____________ (LAST) ____________ (FIRST) Phone ____________ Date ___/___/___

Address ______________________ License No. ____________

Make ________ Model ________ Mileage ________ Serial No. ________ Year ________

Special Key for Hubcaps/Wheels Location ____________ Owner Use Parking Brake Yes ☐ No ☐

4 Drum ☐ 4 Disc ☐ Disc/Drum ☐ P/B No ☐ Yes ☐ Vacuum ☐ Hydro ☐ ABS ☐

Owner Comments ______________________

1. CHECKS BEFORE ROAD TEST	Safe	Unsafe
Stoplight Operation		
Brake Warning Light Operation		
Master Cylinder Checks		
Fluid Level		
Fluid Contamination		
Under Hood Fluid Leaks		
Under Dash Fluid Leaks (No Power)		
Bypassing		

BRAKE PEDAL HEIGHT AND FEEL

Check One		Check One		
Low		Spongy		
Med		Firm		
High				

Power Brake Unit Checks

VACUUM	Safe	Unsafe	HYDRO	Safe	Unsafe
Vacuum Unit			Hydro Unit		
Engine Vacuum			P/S Fluid		
Vacuum Hose			P/S Belt Tension		
Unit Check Valve			P/S Belt Condition		
Reserve Braking			P/S Fluid Leaks		
			Reserve Braking		

Tire Pressure Specs	Front	Rear
Record Pressure Found		
RF ____ LF ____ RR ____ LR ____		
Tire Condition		
RF ____ LF ____ RR ____ LR ____		

2. ROAD TEST	Yes	No	RF	LF	RR	LR
Brake Pull						
Brake Clunk						
Brake Scraping						
Brake Squeal						
Brake Grabby						
Brakes Lock Prematurely						
Wheel Bearing Noise						
Vehicle Vibrates						

STEERING WHEEL MOVEMENT WHEN STOPPING FROM 2-3 MPH YES/NO/RGT/LFT

Does ABS Work	YES	NO
Pedal Pulsation when Braking	YES	NO
Steering Wheel Oscillation when Braking	YES	NO
No Stopping Power	YES	NO
Warning Light Comes on when Braking	YES	NO
Difference in Pedal Height after Cornering	YES	NO
Nose Dive	YES	NO

3. In Shop Checks On Hoist	Yes	No	RF	LF	RR	LR
Brake Drag						
Intermittent Brake Drag						
Brake Pedal Linkage Binding						
Wheel Bearing Looseness						
Missing or Broken Wheel Fasteners						
Suspension Looseness						

	Front					Rear				
	Right			Left		Right			Left	
Mark Wheels and Remove										
Caliper/Piston Stuck RF LF RR LR										
Mark Drums and Remove	Spec	Safe	Unsafe	Safe	Unsafe	Spec	Safe	Unsafe	Safe	Unsafe
Measure Rotor Thickness or Drum Diameter.										
Measure Rotor Thickness Variation.										
Measure Rotor Runout.										
Lining Thickness										
Tubes and Hoses										
Fluid Leaks										
Broken Bleeders										
Leaky Seals										
Self-Adjuster Operation										
									Safe	Unsafe
Parking Brake Cables and Linkage										

FIGURE 39–20 Sample of prebrake job inspection checklist. *Courtesy of Hennessy Industries, Inc.*

Brakes should be road tested on a dry, clean, reasonably smooth, and level roadway. A true test of brake performance cannot be made if the roadway is wet, greasy, or covered with loose dirt. All tires do not grip the road equally. Testing is also adversely affected if the roadway is crowned so as to throw the weight of the vehicle toward the wheels on one side, or if the roadway is so rough that wheels tend to bounce.

Test brakes at different speeds with both light and heavy pedal pressure. Avoid locking the wheels and sliding the tires on the roadway. There are external conditions that affect brake road-test perfor-

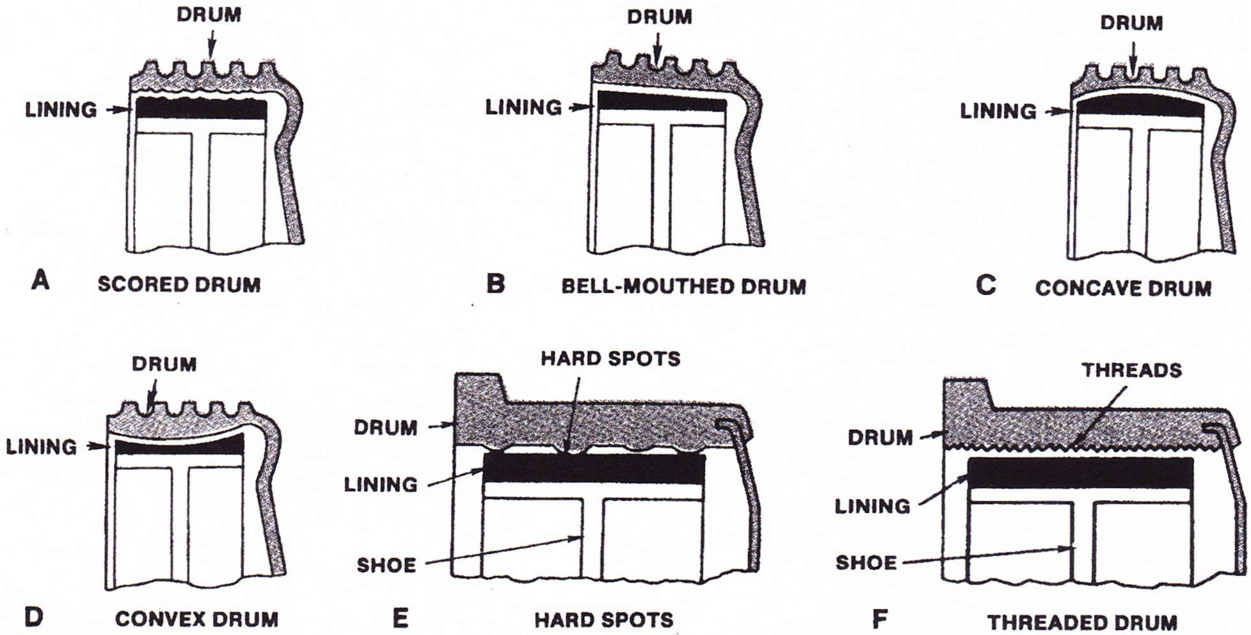


FIGURE 39–24 Drum conditions that require servicing or replacement of the drum.

HEAT CHECKS **Heat checks** are visible, unlike hard spots that do not appear until the machining of the drum (Figure 39–25A). Extreme operating temperatures are the major cause. The drum might also show a bluish/gold tint, which is a sign of high temperatures. Hardened carbide lathe bits or special grinding attachments are available through lathe manufacturers to service these conditions. Excessive damage by heat checks or hard spots requires drum replacement.

CRACKED DRUM Cracks in the cast-iron drum are caused by excessive stress (Figure 39–25B). They can be anywhere but usually are in the vicinity of the bolt circle or at the outside of the flange. Fine cracks in the drums are often hard to see and, unfortunately, often do not show up until after machining. Nevertheless, should any cracks appear, no matter how small, the drum must be replaced (Figure 39–25C).

OUT-OF-ROUND DRUMS Drums with eccentric distortion might appear good to the eye but cause pulling, grabbing, and pedal vibration or pulsation. An out-of-round or egg-shaped condition (Figure 39–26) is often caused by heating and cooling during normal brake operation. Out-of-round drums can be detected before the drum is removed by adjusting the brake to a light drag and feeling the rotation of the drum by hand. After removing the drum, gauge it to determine the amount of eccentric distortion. Drums with this defect should be machined or replaced.

Drum Measurements

Measure every drum with a drum micrometer (Figure 39–27) even if the drum passed a visual inspection to make sure that it is within the safe oversize limits. If the drum is within safe limits, even though the surface appears smooth, it should be turned to assure a true drum surface and to remove any possible contamination in the surface from previous brake linings, road dust, etc. Remember that if too much metal is removed from a drum, unsafe conditions can result.

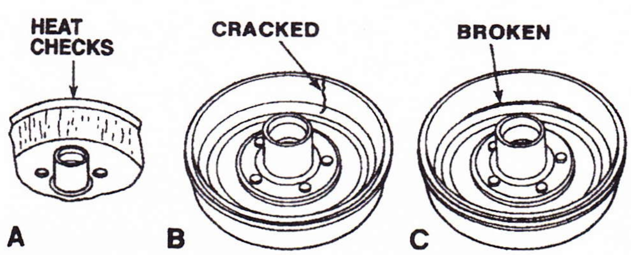


FIGURE 39–25 (A) Heat checks, (B) cracks, and (C) broken areas. The latter two conditions require replacement.

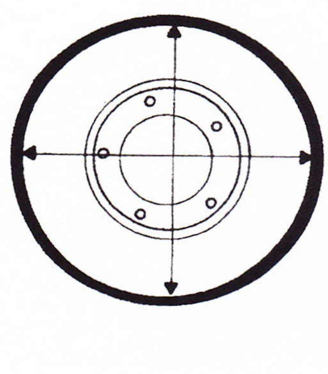


FIGURE 39–26 Measure the inside diameter of the drum in several spots to determine out-of-roundness.

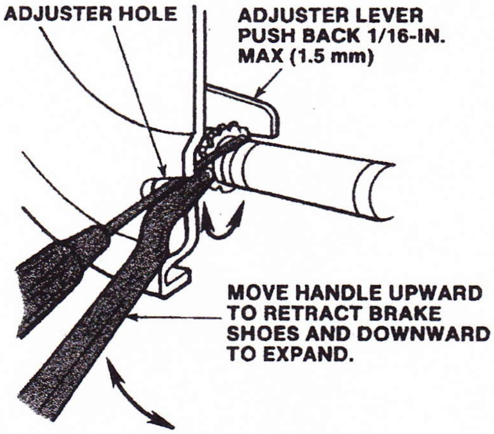


FIGURE 39–22 Removing brake drums equipped with self-adjusters.

slot in the drum is not open, knock out the center of the slot-shaped lanced area with a punch or chisel.

Be sure to inspect the rear wheel axle gaskets and wheel seals for leaks. Replace worn components as needed.

Drum Inspection

One of the most important safety inspections to be made is that of the brake drum (Figure 39–23). First, visually inspect the brake shoes, as installed on the car. Their condition can, many times, reveal defects in the drums. If the linings on one wheel are worn more than the others, it might indicate a rough drum. Uneven wear from side to side on any one set of shoes can be caused by a tapered drum. If some linings are worn badly at the toe or heel, it might indicate an out-of-round drum.

Thoroughly clean the drums with a water-dampened cloth or a water-based solution. Equipment for washing brake parts is commercially available. Wet cleaning methods must be used to prevent asbestos fibers from becoming airborne. If the drums have been exposed to leaking oil or grease, thoroughly clean them with a non-oil-based solvent after washing to remove dust and dirt. It is important to determine the source of the oil or grease leak and correct the problem before reinstalling the drums.

FIGURE 39–23 Checking the condition of the drum.

Brake drums act as a heat sink. They absorb heat and dissipate it into the air. As drums wear from normal use or are machined, their cooling surface area is reduced and their operating temperatures increase. Structural strength also reduces. This leads to over-distortion, which causes some of the drum conditions covered here.

SCORED DRUM SURFACE Figure 39–24A shows a scored drum surface. The most common cause of this condition is buildup of brake dust and dirt between the brake lining and drum. A glazed brake lining, hardened by high heat or in some cases by very hard inferior grade brake lining, can also groove the drum surface. Excessive lining wear that exposes the rivet head or shoe steel will score the drum surface. If the grooves are not too deep, the drum can be turned.

BELL-MOUTHED DRUM Figure 39–24B shows a distortion due to extreme heat and braking pressure. It occurs mostly on wide drums and is caused by poor support at the outside of the drum. Full drum-to-lining contact cannot be achieved and fading can be expected. Drums must be turned.

CONCAVE DRUM Figure 39–24C shows an excessive wear pattern in the center area of the drum brake surface. Extreme braking pressure can distort the shoe platform so braking pressure is concentrated at the center of the drum.

CONVEX DRUM This wear pattern is greater at the closed end of the drum (Figure 39–24D). It is the result of excessive heat or an oversized drum, which allows the open end of the drum to distort.

HARD SPOTS ON THE DRUM This condition in the cast-iron surface (Figure 39–24E), sometimes called chisel spots or islands of steel, results from a change in metallurgy caused by braking heat. Chatter, pulling, rapid wear, hard pedal, and noise occur. These spots can be removed by grinding. However, only the raised surfaces are removed, and they can reappear when heat is applied. The drum must be replaced.

THREADED DRUM SURFACE An extremely sharp or chipped tool bit or a lathe that turns too fast can result in a threaded drum surface (Figure 39–24F). This condition can cause a snapping sound during brake application as the shoes ride outward on the thread, then snap back. To avoid this, recondition drums using a rounded tool and proper lathe speed. Check the edge of the drum surface around the mounting flange side for tool marks indicating a previous rebore. If the drum has been rebored, it might have worn too thin for use. Check the diameter.

mance. Tires having unequal contact and grip on the road cause unequal braking. Tires must be equally inflated, and the tread pattern of right and left tires must be approximately equal. When the vehicle has unequal loading, the most heavily loaded wheels require more braking power than others and a heavily loaded vehicle requires more braking effort. A loose front-wheel bearing permits the drum and wheel to tilt and have spotty contact with the brake linings, causing erratic brake action. Misalignment of the front end causes the brakes to pull to one side. Also, a loose front-wheel bearing could permit the disc to tilt and have spotty contact with brake shoe linings, causing pulsations when the brakes are applied. Faulty shock absorbers that do not prevent the car from bouncing on quick stops can give the erroneous impression that the brakes are too severe.

DRUM BRAKE INSPECTION

Before inspecting drum brakes, place the vehicle in neutral, release the parking brake, and raise the vehicle on the hoist. Once the vehicle is raised, mark the wheel-to-drum and drum-to-axle positions so the components can be accurately reassembled. Relieve all tension from the parking brake cable by loosening or removing the adjusting nut at the equalizer. To access the drum brake assembly, remove the lug nuts and pull the wheel off the hub.

CAUTION:

When servicing wheel brake parts, do not create dust by cleaning with a dry brush or with compressed air. Asbestos fibers can become airborne if dust is created during servicing. Breathing dust containing asbestos fibers can cause serious bodily harm. To clean away asbestos from brake surfaces, use an OSHA-approved washer (Figure 39–21). Follow manufacturer's instructions when using the washer. ■

Shoe and Lining Removal

Several different methods are used to mount the drum to the wheel hub flange. It can be fastened with rivets or by swaging the piloting shoulders of the wheel studs, or with speed nut fasteners installed over the threads of the wheel studs.

The most common mounting method is to use the tire rim and lug nuts. The drum is a slip fit over the axle flange and studs. Speed nuts are installed at the vehicle manufacturing plant for temporary retention of the drum on the assembly line until the wheel is installed.

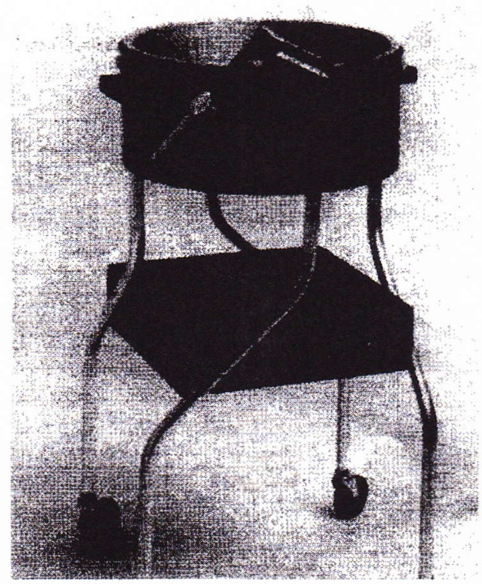


FIGURE 39–21 Washer used to safely remove asbestos fibers from brake surfaces.

A **floating drum** can be retained by a nut and cotter pin. The drum can also be secured to the axle flange by one or two bolts. Some import applications have two additional holes threaded into the drum face so bolts can be used to press the drum from the hub or flange.

After removing the retaining devices that hold the drum to the axle flange or hub, the drum can be removed for servicing. If the brake drum is rusted or corroded to the axle flange and cannot be removed, lightly tap the axle flange to the drum mounting surface with a plastic mallet. Remember that if the drum is worn, the brake shoe adjustment has to be backed off for the drums to clear the brake shoes. Do not force the drum or distort it. Do not allow the drum to drop.

If the brake shoes have expanded too tightly against the drum or have cut into the friction surface of the drum brake, the drums might be too tight for removal. In such a case, the shoes must be adjusted inward before the brake drum is removed. On most cars with self-adjusting mechanisms, reach through the adjusting slot with a thin screwdriver (or similar tool) and carefully push the self-adjusting lever away from the star wheel a maximum of 1/16 inch (Figure 39–22). While holding the lever back, insert a brake adjusting tool into the slot and turn the star wheel in the proper direction until the brake drum can be removed.

On cars that have the adjusting slot in the drum rather than in the backing plate, reach through the slot with a thin wire hook and pull the adjuster lever away from the star wheel slackening the adjustment. If the

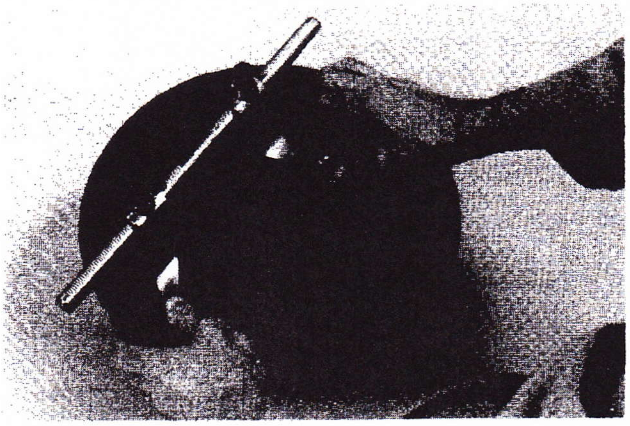


FIGURE 39–27 Measuring the inside diameter with a drum micrometer.

Take measurements at the open and closed edges of the friction surface and at right angles to each other. Drums with taper or out-of-roundness exceeding 0.006 inch are unfit for service and should be turned or replaced. If the maximum diameter reading (measured from the bottom of any grooves that might be present) exceeds the new drum diameter by more than 0.060 inch, the drum cannot be reworked. If the drums are smooth and true but exceed the new diameter by 0.090 inch or more, they must be replaced.

If the drums are true, smooth up any slight scores by polishing with fine emery cloth. If deep scores or grooves are present that cannot be removed by this method, the drum must be turned or replaced.

Drum Refinishing

Brake drums can be refinished by either turning or grinding on a **brake lathe** (Figure 39–28).

Only enough metal should be removed to obtain a true, smooth friction surface. When one drum must be machined to remove defects, the other drum on the same axle set must also be machined in the same manner and to the same diameter so braking is equal.

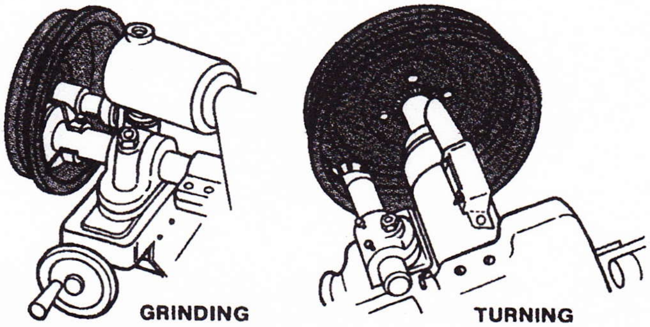


FIGURE 39–28 Brake drums can be remachined by grinding or turning on a brake lathe.

FIGURE 39–29 The drum's discard diameter is stamped on the drum.

Brake drums are stamped with a discard dimension (Figure 39–29). This is the allowable wear dimension and not the allowable machining dimension. There must be 0.030 inch left for wear after turning the drums. Some states have laws about measuring the limits of a brake drum.

Machining or grinding brake drums increases the inside diameter of the drum and changes the lining-to-drum fit. When remachining a drum, follow the equipment instructions for the specific tool you are using.

Cleaning Newly Refaced Drums

The friction surface of a newly refaced drum contains millions of tiny metal particles. These particles not only remain free on the surface, they always lodge themselves in the open pores of the newly machined surface. If the metal particles are allowed to remain in the drum, they become imbedded in the brake lining. Once the brake lining gets contaminated in this manner, it acts as a fine grinding stone and scores the drum.

These metal particles must be removed by washing or cleaning the drum. Do not blow out the drum with air pressure. Either of the following methods is recommended to clean a newly refaced brake drum. The first method involves washing the brake drum thoroughly with hot water and wiping with a lint-free rag. Then, use the air pressure to thoroughly dry it. If the front hub and drums are being cleaned, be very careful to avoid contaminating the wheel bearing grease. Or, completely remove all the old grease, then regrease and repack the wheel bearing after the drum has been cleaned and dried. The wheel bearings and the grease seals must be removed from the drum before cleaning. The second method involves wiping the inside of the brake drum (especially the newly machined surface) with a lint-free white cloth dipped in one of the many available brake cleaning solvents that do not leave a residue. This operation should be repeated until dirt is no longer apparent on the wiping cloth. Allow the drum to dry before reinstalling it on the vehicle.

Both of these procedures are also good for cleaning disc brake rotors.

PROCEDURES
Mechanical Component Service of Duo-Servo Drum Brakes

1. Disconnect the cable from the parking brake lever.
2. If required, install wheel cylinder clamps on the wheel cylinders to prevent fluid leakage or air from getting into the system while the shoes are removed. Some brakes have wheel cylinder stops; therefore, wheel cylinder clamps are not required. Regardless of whether or not the clamps are needed, do not press down on the brake pedal after shoe return springs have been removed. To prevent this, block up the brake pedal so it cannot be depressed.

SHOP TALK

Keep the adjusting screws and automatic adjuster parts for left and right brakes separate. These parts usually are different. For example, on many automatic adjusters, the adjusting screws on the right brakes have left-hand threads and the adjusting screws on the left brakes have right-hand threads. ■

3. Remove the brake shoe return springs. Use a brake spring removal and installation tool to unhook the springs from the anchor pin or anchor plate (Figure 39–30). In some cases, the return springs might not be attached directly to the anchor pin. One spring might be hooked over the adjusting mechanism link, which is in turn installed over the anchor pin. Or, both springs can be hooked onto an anchor plate. Regardless of how springs are attached, carefully note the location, position, and color of all springs before removing any so they can be reinstalled properly.

WARNING!

Do not use the brake spring tool to remove the adjusting link from the anchor pin or anchor plate. ■

4. Remove the shoe retaining or hold-down cups and springs. Special tools are available, but the hold-down springs can be removed by using pliers to compress the spring and rotating the cup with relation to the pin.
5. Self-adjuster parts can now be removed. Lift off the actuating link, lever and pivot assembly, sleeve (through lever), and return spring. No advantage is gained by disassembling the lever and pivot assembly unless one of the parts is damaged.
6. Spread the shoes slightly to free the parking brake strut and remove the strut with its spring. Disconnect the parking brake lever from the secondary shoe. It can be attached with a retaining clip, bolt, or simply hooked into the shoe.
7. Slip the anchor plate off the pin. No advantage is gained by removing the plate if it is bolted on or riveted. Spread the anchor ends of the shoes and disengage from the wheel cylinder links, if used. Remove the shoes connected at the bottom by the adjusting screw and spring, as an assembly.
8. Overlap the anchor end of the shoes to relieve spring tension. Unhook the adjusting screw spring, and remove the adjusting screw assembly.

PROCEDURES
Disassembling Nonservo or Leading-Trailing Brakes

1. Install the wheel cylinder clamp. Then unhook the adjuster spring from the parking brake strut and reverse shoe.
2. Unhook the upper shoe-to-shoe spring from the shoes and unhook the antinoise spring from the spring bracket.
3. Remove the parking brake strut and disengage the shoe webs from the flat, clamp shoe hold-down clips. *(continued)*

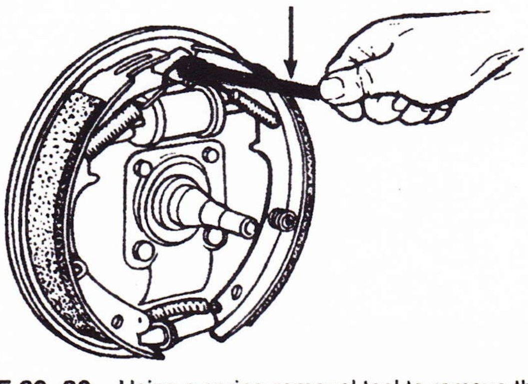


FIGURE 39–30 Using a spring removal tool to remove the return springs.

4. Unhook the lower shoe-to-shoe spring and remove the forward shoe. Disconnect the parking brake cable, then remove the reserve shoe.
5. Remove the shoe hold-down clips from the backing plate.
6. Press off the C-shaped retainers from the pins and remove the parking brake lever, automatic adjuster lever, and adjuster latch.

SHOP TALK

Mark the shoe positions if shoe and linings are to be reused. When disassembling an unfamiliar brake assembly, work on one wheel at a time and use the other wheel as a reference. ■

7. Remove the parking brake lever.

Cleaning, Inspecting, and Lubricating Brake Parts

CAUTION:

When servicing wheel brake parts, do not create dust by cleaning with a dry brush or compressed air. ■

PROCEDURES

Cleaning and Inspecting Brake Parts

1. Clean the backing plates, struts, levers, and other metal parts to be reused using a water-dampened cloth or a water-based solution. Equipment is commercially available to perform washing functions of brake parts. Wet cleaning methods must be used to prevent asbestos fibers from becoming airborne.
2. Carefully examine the raised shoe pads on the backing plate to make sure they are free from corrosion or other surface defects that might prevent the shoes from sliding freely. Use fine emery cloth to remove surface defects, if necessary. Clean them thoroughly.
3. At the rear wheels, look for evidence of oil or grease leakage past the wheel bearing seals. Such leakage could cause brake failure and indicates the need for additional service work.
4. Check that the backing plates are not cracked or bent. If so, they must be replaced. Make sure backing plate bolts and bolted-on anchor pins are torqued to specifications.
5. If replacement of the wheel cylinder is needed, it should be done at this time. To determine wheel cylinder condition, carefully inspect the boots. If they are cut, torn, heat-cracked, or show evidence of excessive leakage, the wheel cylinders should be replaced. On cylinders with external boots, carefully pull back the lower edge of the boot. If more than a drop of fluid spills out, leakage is excessive and indicates that replacement is necessary. If the wheel cylinders have internal boots, carefully remove one of the wheel cylinder connecting links to check for leakage.

SHOP TALK

A slight amount of fluid behind the boot is normal. This lubricates the piston. However, if enough fluid is present to run or spill out, this indicates excessive leakage. ■

6. Disassemble the adjusting screw assembly (Figure 39-31) and clean the parts in a suitable solvent. Make sure the adjusting screw threads into the pivot nut over its complete length without sticking or binding. Check that none of the adjusting screw teeth are damaged, particularly on self-adjusting brakes. Lubricate the adjusting screw threads with brake lubricant, being careful not to get any on the adjusting teeth, and reassemble. Most adjusting screw assemblies use a thrust washer between the adjusting screw and socket. Some might also have the antinoise spring washer. Thread the adjusting screw in as far as it goes.

WARNING!

Do not use ordinary grease to lubricate drum brake parts. It does not hold up under high temperatures. ■

7. Apply a thin film of a brake lubricant to the raised shoe pads on the backing plate lands. Check that there are no burrs on the edges of the replacement shoes where they contact the pads. On the rear brakes, lubricate the parking brake lever pivot point.

SHOP TALK

Antiseize lubrication works very well as brake lubricant. ■

8. Examine the shoe anchor, support plate, and small parts for signs of looseness, wear, or damage that could cause faulty shoe alignment. Check springs for spread or collapsed coils, twisted or nicked shanks, and severe discoloration. Operate star wheel automatic adjusters by prying the shoe lightly away from its anchor or by pulling the cable to make sure the adjuster advances easily, one notch at a time. Adjuster cables tend to stretch, and star wheels and pawls become blunted after a long period of use. For rear-axle parking brakes, pull on the cable and shoe linkage to make sure no binding condition is present that could cause the shoes to drag when the parking brake is released.

SHOP TALK

Some brake technicians check brake spring tension by the drop method. This method is not overly scientific and the results are not always correct. Drop the brake spring on a clean concrete floor. If it bounces with a chunky sound, it is good. If the bounced spring gives off a tinny sound, it is tired and should be replaced. ■

To complete the drum brake inspection, examine wheel bearings and hub grease seals for signs of damage. Service or replace, if necessary.

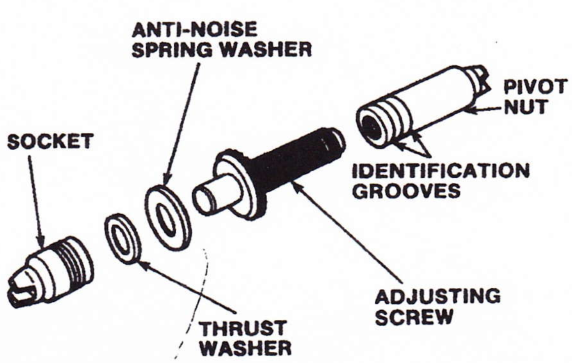


FIGURE 39–31 Exploded view of adjusting screw assembly.

BRAKE SHOES AND LININGS

Lining materials influence braking operation. The use of a lining with a friction value that is too high can result in a severe grabbing condition. A friction value that is too low can make stopping difficult because of a hard pedal.

Overheating a lining accelerates wear and can result in dangerous lining heat fade—a friction-reducing condition that hardens the pedal and lengthens the stopping distance. Continual overheating eventually pushes the lining beyond the point of recovery into a permanent fade condition. In addition to fade, overheating can cause squeal.

Overheating is indicated by a lining that is charred or has a glass-hard glazed surface, or if severe, random cracking of the surface is present.

CAUTION:

Automotive friction materials often contain substantial amounts of asbestos. Studies indicate that exposure to excessive amounts of asbestos dust can be a potential health hazard. It is important that anyone handling brake linings understands this and takes the necessary precautions to avoid injury. ■

Inspect the linings for uneven wear, imbedded foreign material, loose rivets, and to see if they are oil soaked. If linings are oil soaked, replace them.

If linings are otherwise serviceable, tighten or replace loose rivets, remove imbedded foreign material, and clean the rivet counterbores.

If linings at any wheel show a spotty wear pattern or an uneven contact with the brake drum, it is an indication that the linings are not centered in the drums. Linings should be circle ground to provide better contact with the drum.

Brake Relining

Brake linings that are worn to within 1/32 inch of a rivet head or that have been contaminated with brake fluid, grease, or oil must be replaced (Figure 39–32). Failure to replace worn linings results in a scored drum. When it is necessary to replace brake shoes, they must also be replaced on the wheel on the opposite side of the vehicle. Inspect brake shoes for distortion, cracks, or looseness. If these conditions exist, the shoe must be discarded.

Do not let brake fluid, oil, or grease touch the brake lining. If a brake lining kit is used to replace the linings, follow the instructions in the kit and install all the parts provided.

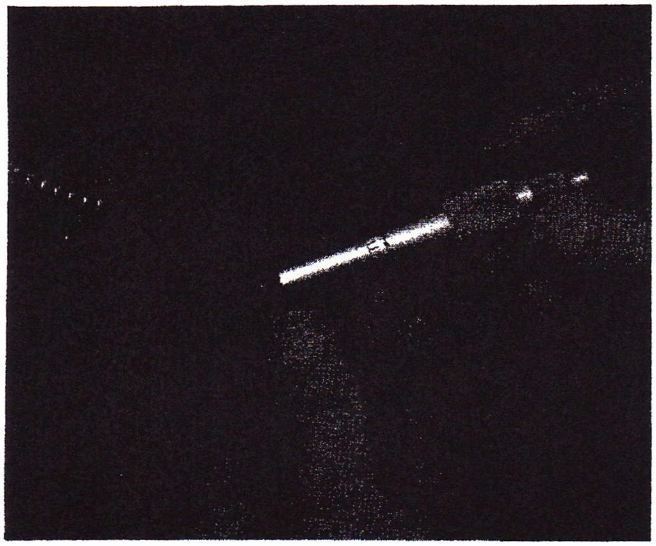


FIGURE 39–32 Checking drum brake lining thickness using a depth gauge.

The two general methods of attaching the linings to the brake shoes are bonding and riveting (Figure 39-33). The **bonded linings** are fastened with a special adhesive to the shoe, clamped in place, then cured in an oven. Instead of using an adhesive, some linings are riveted to the shoe. Riveted linings allow for better heat transfer than bonded linings.

Sizing New Linings

Modern brake shoes are usually supplied with what is known as cam, offset, contour, or eccentric shape (Figure 39–34), which is ground in at the factory. That is, the full thickness of the lining is present at the middle of the shoe, but is ground down slightly at the heel and toe. The diameter of the circle the shoes make is slightly smaller than that of the drum. This compensates for the minor tolerance variations of drums and brake mountings and promotes proper wearing-in of the linings to match the drum.

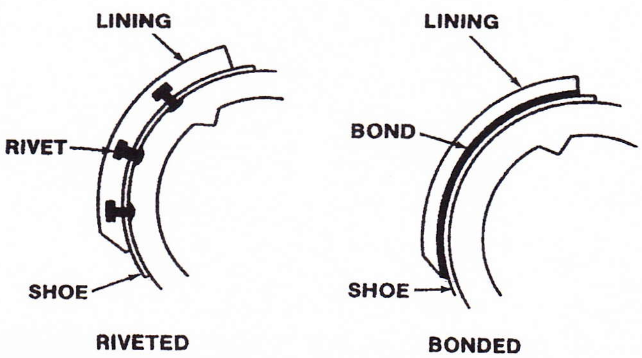


FIGURE 39–33 Examples of riveted and bonded brake shoe linings.

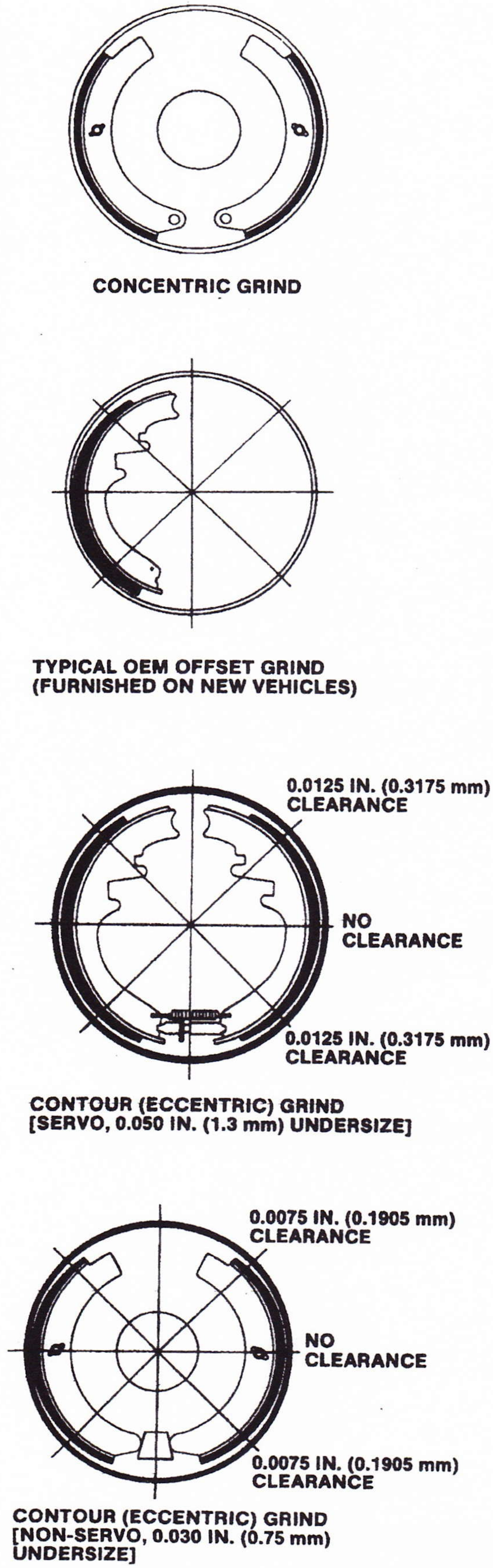


FIGURE 39–34 Various types of brake shoe lining grinds.

SHOP TALK

On duo-servo shoe designs, the forward shoe is the primary and the rear, the secondary. The secondary shoe lining is longer. ■

Lining Adjustment

New **eccentric-ground** linings tolerate a closer new lining clearance adjustment than concentric ground linings. With manual adjusters, the shoes should be expanded into the drums until the linings are at the point of drag but not dragging heavily against the drum. With star wheel automatic adjusters, a drum/shoe gauge provides a convenient means of making the preliminary adjustment. This type of gauge, when set at actual drum diameter, automatically provides the working clearance of the shoes. If new linings have been concentrically ground, the initial clearance adjustment must be backed off an amount that provides sufficient working clearance.

Many technicians take pride in showing the customer a high pedal, but it should be remembered that with new linings an extremely high pedal indicates tight clearances and can cause seating problems.

Drum Shoe and Brake Installation

Before installing the shoes, be sure to sand or stone the inner edge of the shoe to dress down any slight lining or metal nicks and burrs that could interfere with the sliding upon the support pads.

A support (backing) plate must be tight on its mount and not bent. Stone the shoe support pads brightly and dress down any burrs or grooves that could cause the shoes to bind or hang up.

Using an approved lubricant, lightly coat the support pads and the threads of servo star wheel adjusters. On rear axle parking brakes, lubricate any point of potential binding in the linkage and the cable. Do not lubricate nonservo brake adjusters other than to free a frozen adjuster with penetrating oil.

Reassemble the brakes in the reverse order of disassembly. Make sure all parts are in their proper locations and that both brake shoes are properly positioned in either end of the adjuster. Also, both brake shoes should correctly engage the wheel cylinder pushrods and parking brake links. They should be centered on the backing plate. Parking brake links and levers should be in place on the rear brakes. With all of the parts in place, try the fit of the brake drum over the new shoes. If not slightly snug, pull it off and turn the star wheel until a slight drag is felt when sliding on the drum. A brake preset gauge makes this job easy and final brake adjustment simple. Then install the brake drum, wheel bearings, spindle nuts, cotter pins, dust caps, and wheel/tire assemblies, and make the final brake adjustments as specified in individual instructions in the vehicle's service manual. Torque the spindle and lug nuts to specifications.

WHEEL CYLINDER INSPECTION AND SERVICING

Wheel cylinders might need replacement when the brake shoes are replaced or when they begin to leak.

Inspecting and Cleaning Wheel Cylinders

Wheel cylinder leaks reveal themselves in several ways: (1) fluid can be found when the dust boot is peeled back; (2) the cylinder, linings, and backing plate, or the inside of a tire might be wet; or (3) there might be a drop in the level of fluid in the master cylinder reservoir.

Such leaks can cause the brakes to grab or fail and should be immediately corrected. Note the amount of fluid present when the dust boot is pulled back. A small amount of fluid seepage dampening the interior of the boot is normal. A dripping boot is not.

WARNING!

Hydraulic system parts should not be allowed to come in contact with oil or grease. They should not be handled with greasy hands. Even a trace of any petroleum-based product is sufficient to cause damage to the rubber parts. ■

Cylinder binding can be caused by rust deposits, swollen cups due to fluid contamination, or by a cup wedged into an excessive piston clearance. If the clearance between the pistons and the bore wall exceeds allowable values, a condition called heel drag might exist. It can result in rapid cup wear and can cause the piston to retract very slowly when the brakes are released.

Evidence of a scored, pitted, or corroded cylinder bore is a ring of hard, crystal-like substance. This substance is sometimes noticed in the cylinder bore where the piston rests after the brakes are released.

Light roughness or deposits can be removed with crocus cloth or an approved cylinder hone. While honing lightly, brake fluid can be used as a lubricant. If the bore cannot be cleaned up readily, the cylinder must be replaced.

PROCEDURES

Replacing a Wheel Cylinder

1. Since brake hoses are an important link in the hydraulic system, it is recommended they be replaced when a new cylinder is to be installed or when the old cylinder is to be reconditioned. Remove the brake shoe assemblies from the backing plate before proceeding. The smallest amount of brake fluid contaminates the friction surface of the brake lining.
2. Using two appropriate wrenches, disconnect the hydraulic hose from the steel line located on the chassis. On solid rear axles, use the appropriate tubing wrench and disconnect the hydraulic line where it enters the wheel cylinder. Care must be exercised in removing this steel line. It might be bent at this point and be difficult to install once new wheel cylinders are mounted to the backing plate.
3. Remove the plates, shims, and bolts that hold the wheel cylinder to the backing plate (Figure 39–35). Some later designed wheel cylinders are held to the backing plate with a retaining ring (Figure 39–36) that can be removed with two small picks.
4. Remove the wheel cylinder from the backing plate and clean the area with a proper cleaning solvent.

Care must be taken when installing new or reconditioned wheel cylinders on cars equipped with wheel cylinder piston stops. The rubber dust boots and the pistons must be squeezed into the cylinder before it is tightened to the backing plate. If this is not done, the pistons jam against the stops causing hydraulic fluid leaks and erratic brake performance.

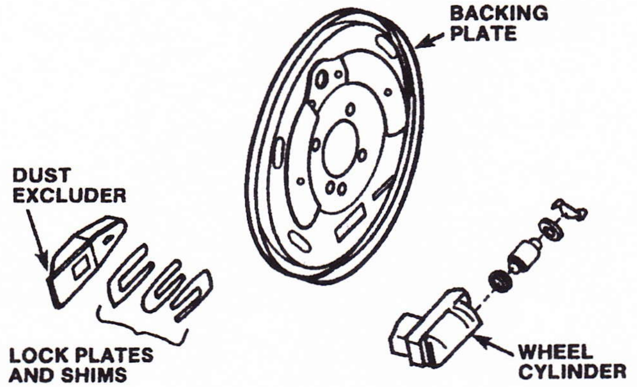


FIGURE 39–35 Lock plates and shims can be used to hold the wheel cylinder to the backing plate.

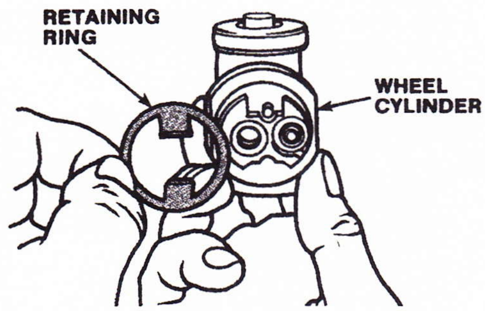


FIGURE 39–36 Example of a wheel cylinder retaining ring.

DRUM PARKING BRAKES

The parking brake keeps a vehicle from rolling while it is parked. It is important to remember that the parking brake is not part of the vehicle's hydraulic braking system. It works mechanically, using a lever assembly connected through a cable system to the rear drum service brakes.

Types of Parking Brake Systems

Parking brakes can be either hand or foot operated. In general, downsized cars and light trucks use hand-operated self-adjusting lever systems (Figure 39–37). Full-size vehicles normally use a foot-operated park-

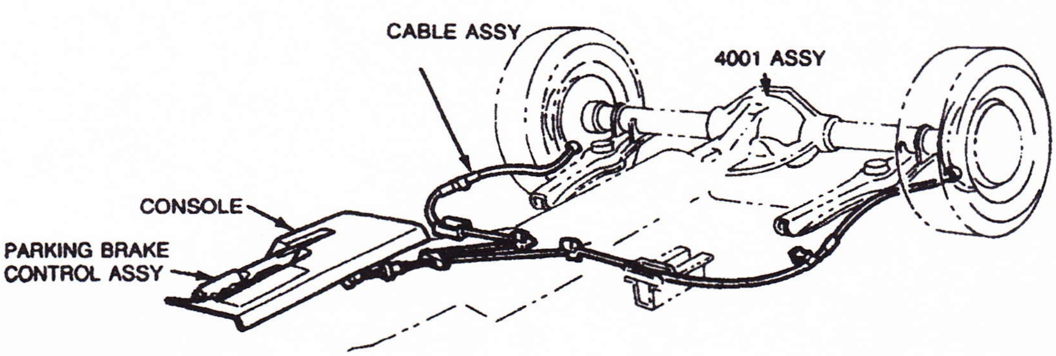
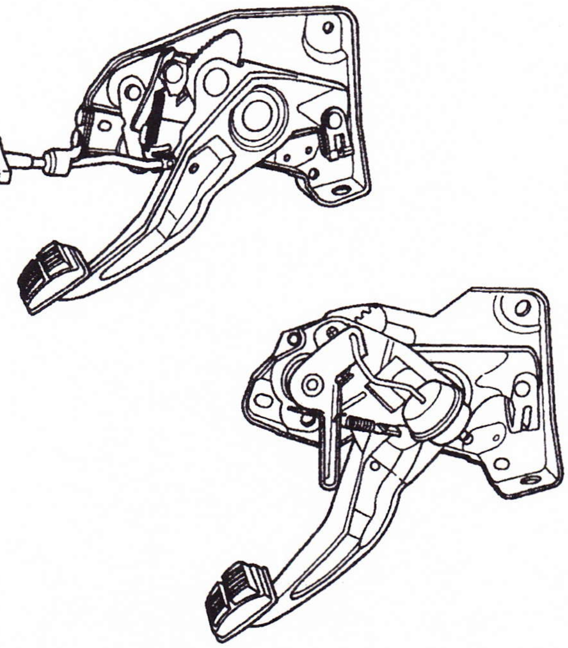


FIGURE 39–37 Typical center-mounted hand-operated parking brake.



A

B

FIGURE 39–38 Typical pedal-operated parking brakes: (A) mechanical release and (B) vacuum release.

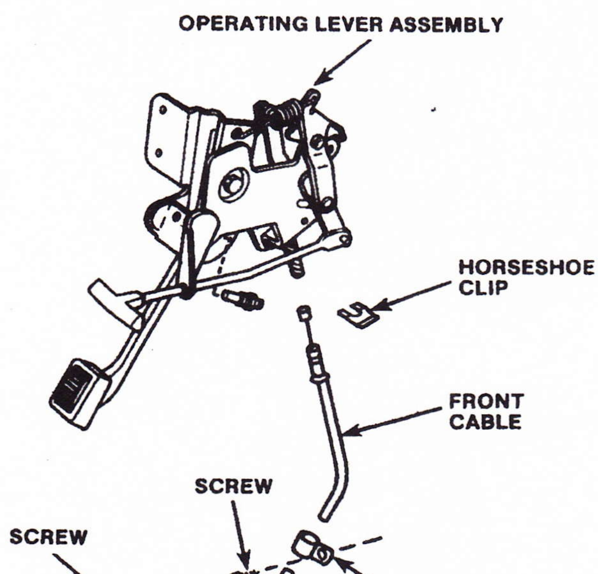
ing brake pedal (Figure 39–38A). The pedal or lever assembly is designed to latch into an applied position and is released by pulling a brake release handle or pushing a release button.

On some vehicles, a vacuum power unit (Figure 39-38B) is connected by a rod to the upper end of the release lever. The vacuum motor is actuated to release the parking brake whenever the engine is running and the transmission is in forward driving gear. The lower end of the release lever extends down for alternate manual release in the event of vacuum power failure or for optional manual release at any time. Hoses connect the power unit and the engine manifold to a vacuum release valve on the steering column.

The starting point of a typical parking brake cable and lever system is the foot pedal (Figure 39–39) or hand lever. This assembly is a variable ratio lever mechanism that converts input effort of the operator and pedal/lever travel into output force with less travel. In the system shown in Figure 39–39, as the pedal is being depressed, the attached front cable assembly tightens increasingly as it moves a short distance (by comparison to the pedal's travel distance). Tensile force from the front cable is transmitted through the car's brake cable system to the rear brakes. This tension pulls the flexible steel cables attached to each of the rear brakes. It serves to operate the internal lever and strut mechanism of each rear brake, expanding the brake shoes against the drum. Springs return the shoes to the unapplied position when the parking brake pedal is released and tensile forces in the cable system are relaxed.

CUSTOMER CARE

Drivers of vehicles equipped with an automatic transmission may sometimes develop the bad habit of resting their left foot on the brake pedal. The effect of this slight pressure is constant braking action that can quickly wear out components. Wear normally occurs in the brake assembly where the



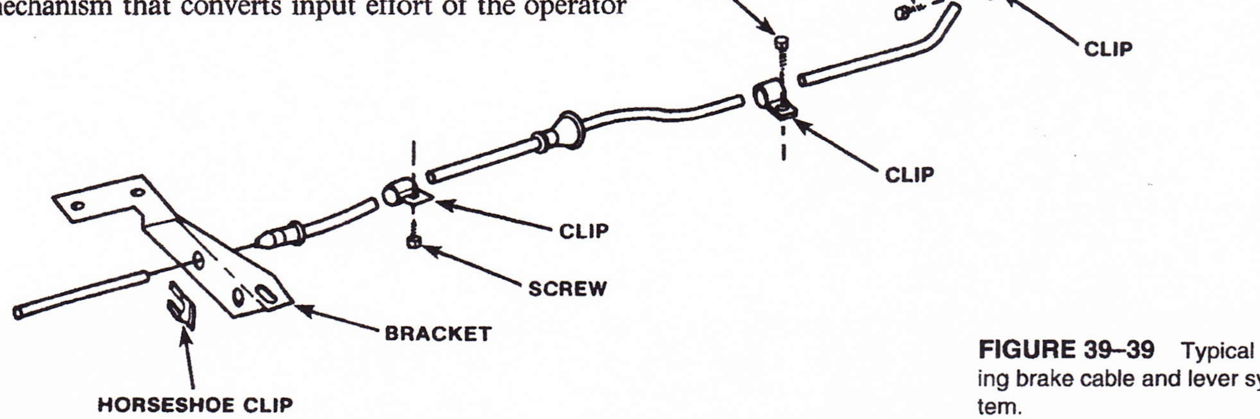


FIGURE 39–39 Typical parking brake cable and lever system.

return springs, seals, and pistons have slightly less mechanical resistance than the other three wheels. In effect, this brake is constantly applied.

On vehicles driven in stop-and-go traffic only, the weak brake assembly may be affected. In vehicles driven at constant highway speeds, all four assemblies may quickly become worn and burnt. The true danger involved is that excessive heat may lead to hydraulic fluid evaporation and brake failure.

Suspect this problem when signs of accelerated wear are present. Ask the customer how often the braking system requires service. Inspect the brake pedal for signs of wear. If the left foot brake condition is apparent, let the customer know that the cause of the problem is not the quality of the replacement parts or service. ■

An electronic switch, triggered when the brake pedal is applied, lights the brake indicator in the instrument panel when the ignition is turned on. The light goes out when either the pedal or control is released or the ignition is turned off.

The cable/lever routing system in a typical parking brake arrangement (Figure 39–40) employs a three lever setup to multiply the physical effort of the operator. First is the pedal assembly or hand grip. When moved, it multiplies the operator's effect and pulls the front cable. The front cable, in turn, pulls the equalizer lever.

The **equalizer lever** multiplies the effort of the pedal assembly, or hand grip, and pulls the rear cables. This pulling effort passes through an equalizer, which ensures equal pull on both rear cables. The equalizer functions by allowing the rear brake cables to slip slightly to balance out small differences in cable length or adjustment. Typical equalizer arrangements are shown in Figure 39–41.

USING SERVICE MANUALS

Service manuals list the standard brake drum inside diameter along with the discard dimension. They also state the standard and minimum lining thickness. Manual illustrations should be used to accurately identify all components plus the disassemble/reassembly procedure. Tightening torques for backing plate nuts and other components should always be followed. ■

The rear cables pull the parking brake levers in the drum brake assembly (Figure 39–42). As for the parking brakes themselves, there are several types in use. The integral or conventional rear drum parking brake is part of the vehicle's ordinary rear drum system. It utilizes the same friction elements as the hydraulic brakes. The transmission or drive shaft parking brake system operates independently of the rear wheel brakes. These parking brakes are known in the trade as drive shaft brakes.

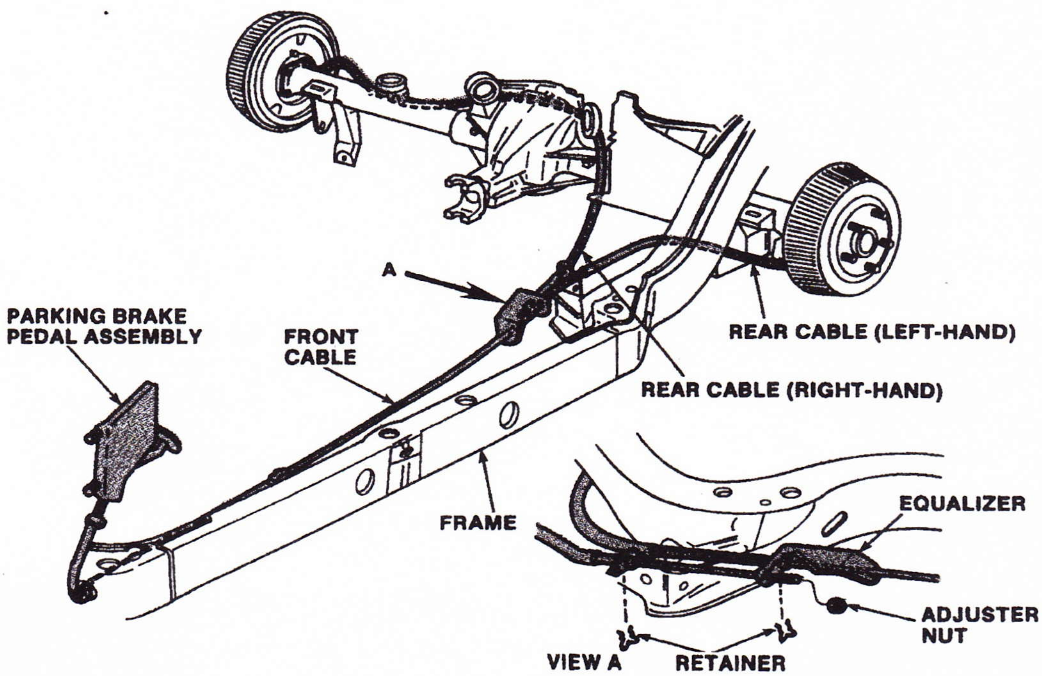


FIGURE 39–40 Typical parking brake routing to the rear drum brakes.

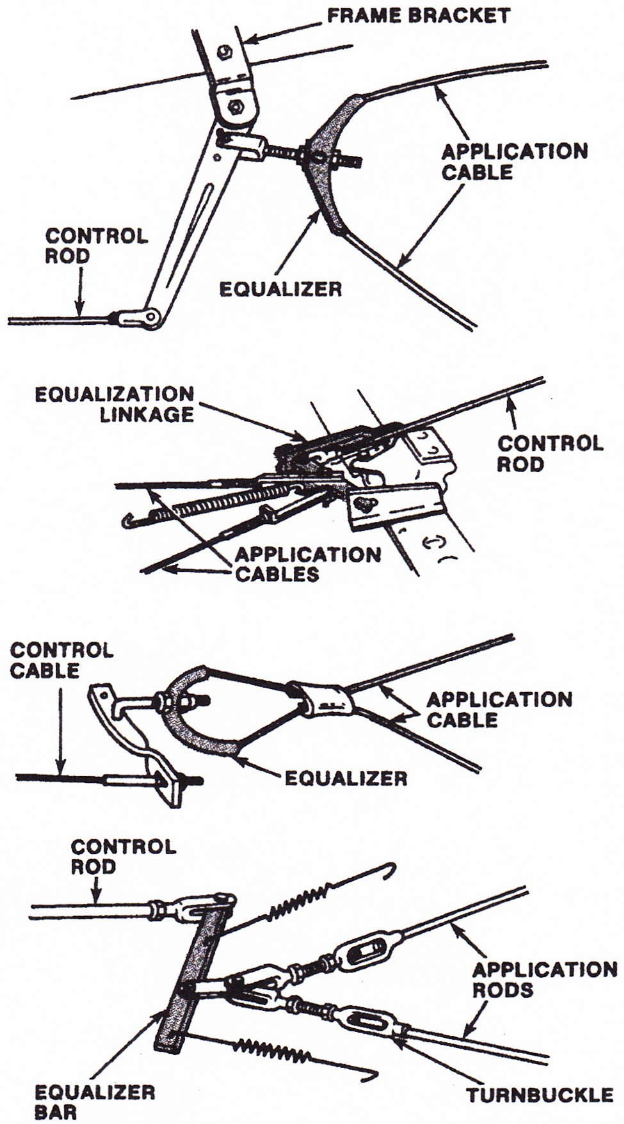


FIGURE 39–41 Types of equalizers used to apply even application force to each rear brake.

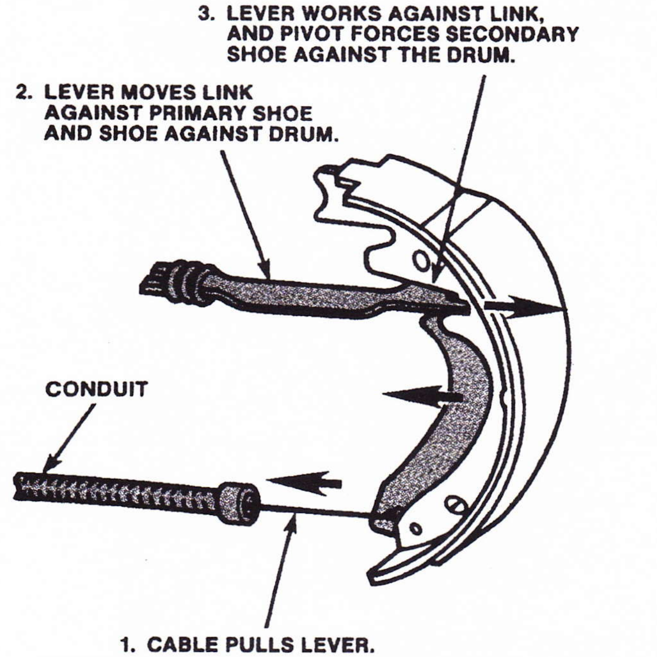


FIGURE 39–42 Integral drum brake parking brake operation.

INTEGRAL PARKING BRAKES

Integral parking brakes are for vehicles with rear wheel drum brakes. Figure 39–43 shows a typical integral parking brake. When the parking brake pedal is applied, the cables and equalizer exert a balanced pull on the parking brake levers of both rear brakes. The levers and the parking brake struts move the shoes outward against the brake drums. The shoes are held in this position until the parking brake pedal is released. The portion of the parking brake from the equalizer on back to the rear wheel drum brake is shown in Figure 39–43. Also, the parking brake components are shown removed from the wheel brake for identification.

The rear cable enters each rear brake through a conduit (Figure 39–44). The cable end engages the lower end of the parking brake lever. This lever is hinged to the web of the secondary shoe and linked with the primary shoe by means of a strut. The lever and strut expand both shoes away from the anchor and wheel cylinder and into contact with the drum as the cable and lever are drawn forward. The shoe return springs reposition the shoes when the cable is slacked.

To remove and replace the rear brake shoes, it might be necessary to relieve the parking brake cable tension by backing off the adjusting check nuts at the equalizer. Count the turns backed off in order to restore the nuts to their original position.

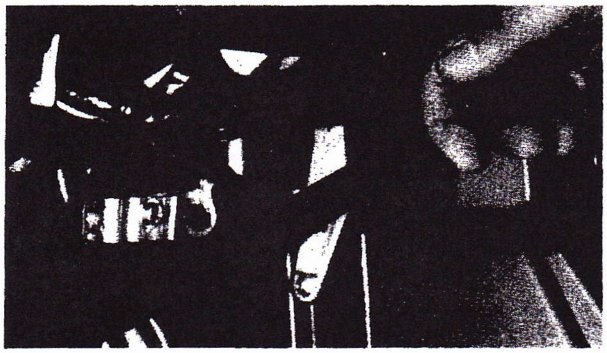
Adjusting and Replacing Parking Brakes

Regular wheel brake service should be completed before adjusting the parking brake. Then, check the parking brake for free movement of the parking brake cables in the conduits. If necessary, apply a lubricant to free the cables. Check for worn equalizer and linkage parts. Replace any defective parts. Finally, check for broken strands in the cables. Replace any cable that has broken strands or shows signs of wear.

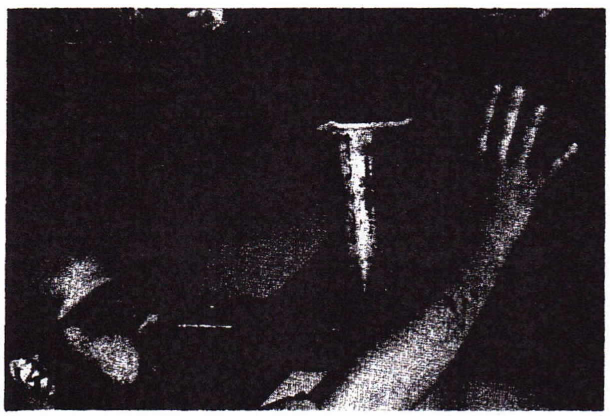
TESTING Test the parking brake by parking the vehicle facing up on an incline of 30 degrees or less. Set the parking brake fully and place the transmission in neutral. The vehicle should hold steady. Reverse the vehicle position so it is facing down the incline and repeat the test. If the vehicle creeps or rolls in either case, the parking brake requires adjustment. A typical adjustment procedure is shown in Photo Sequence 28.

PHOTO SEQUENCE 28

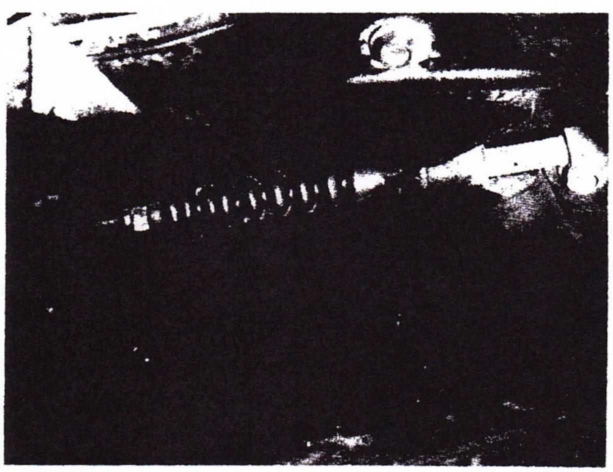
ADJUSTING REAR DRUM PARKING BRAKE



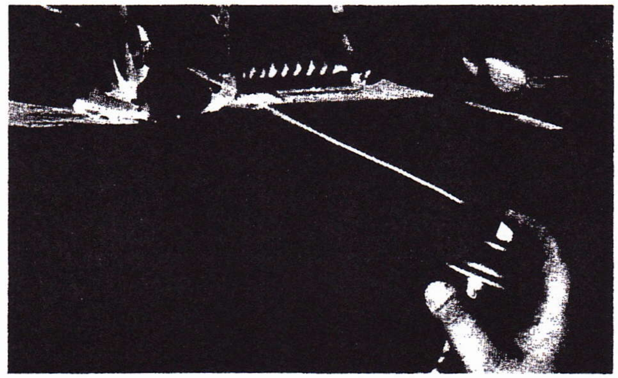
P28–1 Proper adjustment of the parking brake begins with setting the parking brake to a near full on position.



P28–2 Raise the car. Make sure it is safe to work under and that you will be able to rotate the wheels. (If the parking brake is adjusted and working properly, you should be unable to rotate the wheels.)



P28–3 Carefully inspect the entire length of the parking brake cable. Look for signs of fraying, breakage, and deterioration.

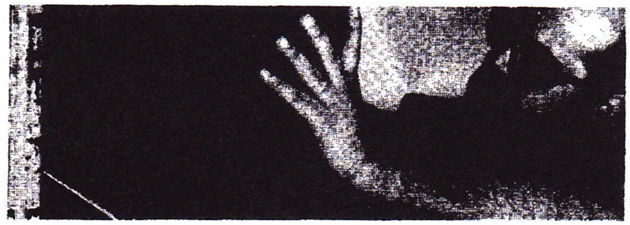


P28–4 Spray all exposed metal areas of the cable assembly with a penetrating oil. This will ensure a free-moving system.

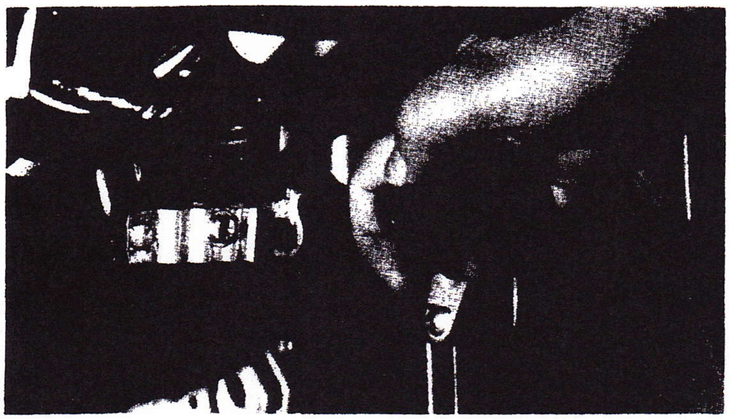
P28–5 Inspect the adjustment mechanism. Clean off the threaded areas and make sure the tightening nuts are not damaged.

P28–6 Loosen the adjustment lock nut. Adjust the parking brake.

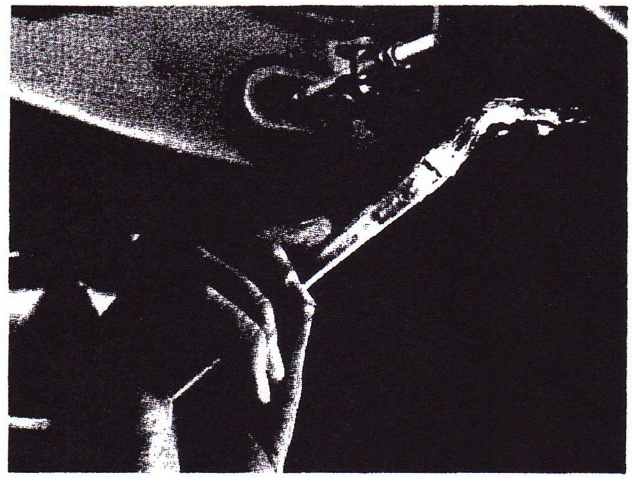
P28–7 When the wheels are unable to be turned, stop tightening the adjusting nut.



P28–9 Raise the vehicle and rotate the wheels. If the wheels turn with only a slight drag, the parking brake is properly adjusted.



P28–8 Lower the vehicle and release the parking brake lever.



P28–10 After proper adjustment is made, tighten the adjustment lock nut. Apply a coat of white grease to all contacting surfaces of the adjustment assembly.

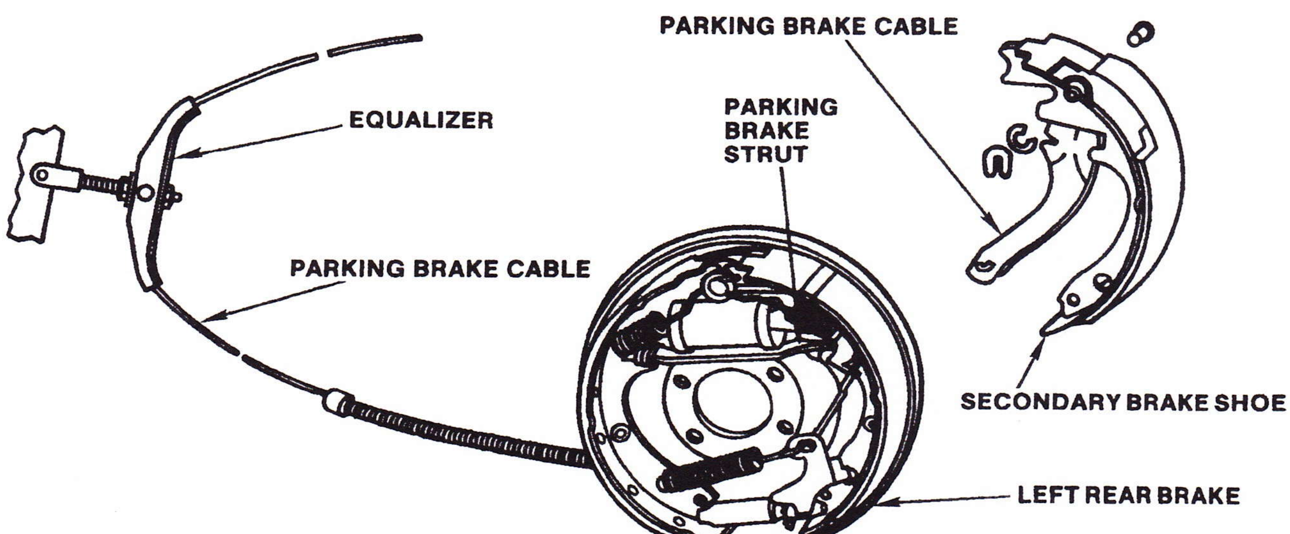


FIGURE 39–43 Integral parking brake components.

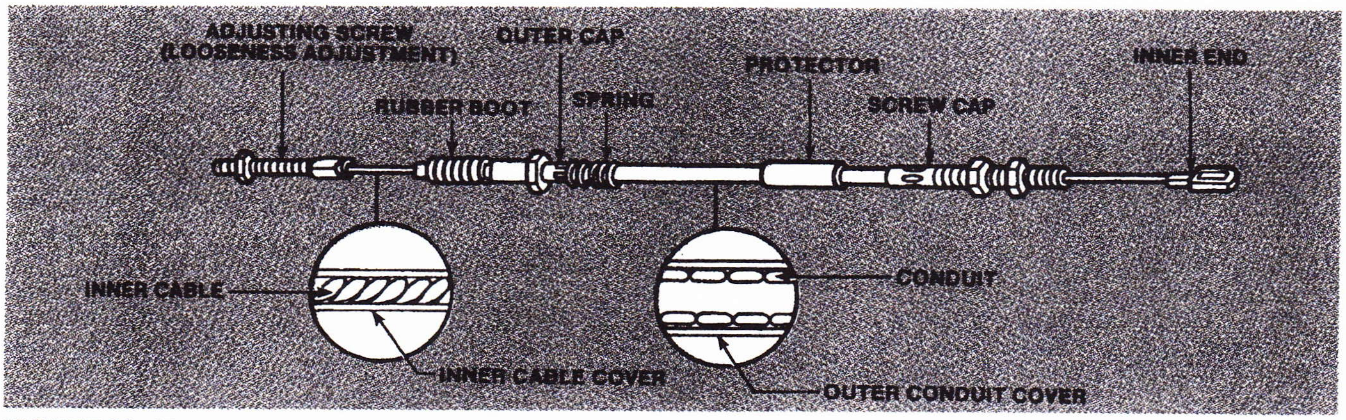


FIGURE 39–44 Rear cable and conduit details.

CASE STUDY

Shortly after new brake shoes and hardware were installed on a vehicle, it is returned to the shop on the rear of a tow truck. An extremely irate and distressed customer is heard throughout the entire service bay area. It seems when the customer applied the brakes while traveling at a high speed, there was a sudden loss of braking power and fine metallic grinding noise was heard. Luckily, the customer was able to control the vehicle and avoid an accident, but the situation was potentially disastrous.

The vehicle is immediately placed on a hoist and the drum brakes are disassembled. Although all the parts are new, they had failed. The shoes are pulled away from the backing plate and the hold-down pins and retainers are broken.

The technician replaces all broken components with new parts from the shop's parts department. Everything appears to be installed correctly and in good working order.

The technician is reluctant to release the vehicle to the owner without uncovering the cause of the first failure. Inspecting the assembly, the technician compares the new shoes with the failed shoes. He notices the hold-down pin bores on the defective shoes do not line up perfectly with the pins. More comparisons between the new and failed parts uncover slight differences. The shoes and hardware that had failed were the wrong parts for the vehicle. Although similar in many ways, these slight differences were enough to cause a major failure. The technician who had performed the original replacement should have visually compared the new parts with the old parts.

KEY TERMS

Anchor pin	Hold-down spring
Backing plate	Nonservo
Bonded linings	Overtravel spring
Brake lathe	Primary shoe
Duo-servo	Return spring
Eccentric-ground	Secondary shoe
Equalizer lever	Self-energizing
Floating drum	Shoe anchor
Heat checks	Web

SUMMARY

- Drum brakes are still used on the rear wheels of many cars and light trucks.
- The drum is mounted to the wheel hub. When the brakes are applied, a wheel cylinder uses hydraulic power to press two brake shoes against the inside surface of the drum. The resulting friction between the shoe's lining and drum slows the drum and wheel.
- The brake's anchor pin acts as a brake shoe stop, keeping the shoes from following the rotating drum. This creates a wedging action that multiplies braking force.
- The shoes and wheel cylinder are mounted on a backing plate. Hardware, such as shoe return springs, hold-down parts, and linkages are also mounted on the backing plate.
- The primary or leading shoe is toward the front of the vehicle while the secondary or trailing shoe is toward the rear of the vehicle.
- Brake lining can be attached to the shoes by riveting or a special adhesive bonding process.
- Brake drums act as a heat sink to dissipate the heat of braking friction. Drums can be refinished on a brake lathe provided the inside diameter is not increased above a safe limit (discard dimension).