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BRAKE SYSTEM TROUBLESHOOTING

Main Category:	Mechanical Engineering
Sub Category:	-
Course #:	MEC-157
Course Content:	20 pgs
PDH/CE Hours:	2

OFFICIAL COURSE/EXAM

(SEE INSTRUCTIONS ON NEXT PAGE)

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MEC-157 EXAM PREVIEW

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Exam Preview:

1. According to the reference material, the most common cause for a soft or spongy brake pedal will be air trapped in the hydraulic lines.
    a. True
    b. False
2. The purpose of air braking systems is to enable the operator to apply sufficient braking action to the wheels of larger and heavier trucks and construction equipment. Considerable force is available for braking since the operating pressure is as high as ___ pounds per square inch.
    a. 90
    b. 100
    c. 110
    d. 120
3. According to the reference material, diesel engines create too much vacuum to actuate the vacuum power brake booster. The alternative is a hydraulic-assisted power brake booster or hydroboost.
    a. True
    b. False
4. According to the reference material, if it takes longer than __ minutes to bring the air pressure from 0 to 60 psi, in an air brake system, check the system for leaks, and check the air compressor and relief valves.
    a. 10
    b. 8
    c. 6
    d. 5

5. According to the reference material, when you test parking brakes, stop the vehicle on a road graded at about 30 percent. Set the parking brake and release the service brakes. The vehicle should maintain its position and not roll or inch backwards.
    a. True
    b. False
6. Using Table 6-1.-Troubleshooting Chart for Hydraulic Brakes (Standard), which of the following malfunctions may have probable causes such as: master cylinder piston not returning or wheel cylinder pistons sticking?
    a. Excessive pedal pressure required to stop car
    b. Pulsating brake pedal
    c. Rear brakes drag
    d. Brake pedal travel decreasing
7. Using Table 6-2. —Troubleshooting Chart for Vacuum-Assisted Hydraulic Brakes (Power), which of the following probable causes corresponds to the brakes failing to release?
    a. Vacuum failure
    b. Blocked passage in power piston
    c. Defective diaphragm
    d. Cracking master cylinder casing
8. According to the reference material, when brakes are too sensitive this problem may be the result of grease or brake fluid on the lining, pedal linkage binding, a faulty master cylinder, or glazed brake linings.
    a. True
    b. False
9. Using Figure 6-1.-Stopping distances from different speeds with good brakes. Which of the following vehicle braking distances corresponds to a vehicle with good brakes travelling at 60 MPH?
    a. 128 ft
    b. 186 ft
    c. 171 ft
    d. 233 ft
10. According to the Hydroboost troubleshooting section of the reference material, which problem may be caused by fluid contamination, pedal linkage binding, or a bad hydroboost unit?
    a. Slow pedal return
    b. Hard pedal at an idle
    c. Pedal pulsation
    d. High pedal and steering effort

INSPECTING AND TROUBLESHOOTING BRAKE SYSTEMS

Braking systems are usually inspected yearly, or every 12,000 miles to ensure safe operation, to comply with state and local regulations, and to keep personnel and equipment safe. Many accidents caused by defective brakes might have been avoided by frequent and thorough brake inspections. These brake inspections must be done more frequently when vehicles are used in sand, mud, or constant fording.

WARNING

Without a reliable braking system, CESE does not leave the shop. If the problem is discovered in the field, the next stop for that equipment (towed) should be the CM maintenance shop. CESE shall not be operated nor will it be placed in operation with faulty brakes.

Regulations for testing and inspecting brakes are about the same all over. One requirement is that the brakes must stop the vehicle within a prescribed distance, at a given speed, with a minimum of effort, and without deviating the vehicle from a straight line (controlled stop).

The stopping distances for all vehicles depend on the distance the driver can see and think before he or she presses the brake pedal. Figure 6-1 shows some stopping distances from different speeds with good brakes. These stopping distances came from actual tests.

INSPECTING AND TROUBLESHOOTING HYDRAULIC BRAKE SYSTEMS

Hydraulic brakes should be inspected for the external condition of the hoses and tubing, especially for leakage or seepage at the couplings. Hose or tubing worn or weakened by rubbing against other parts of the vehicle must be replaced.

CAUTION

Under no circumstances should steel brake tubing be replaced with copper tubing.

Test for leakage by holding the brake pedal depressed for at least 1 minute. If the pedal does not hold, there is a leak in the system. If you find a leak, repair it, even if you have to pull all the wheels to examine the wheel cylinders. Then fill the master cylinder with fluid and bleed the brakes.

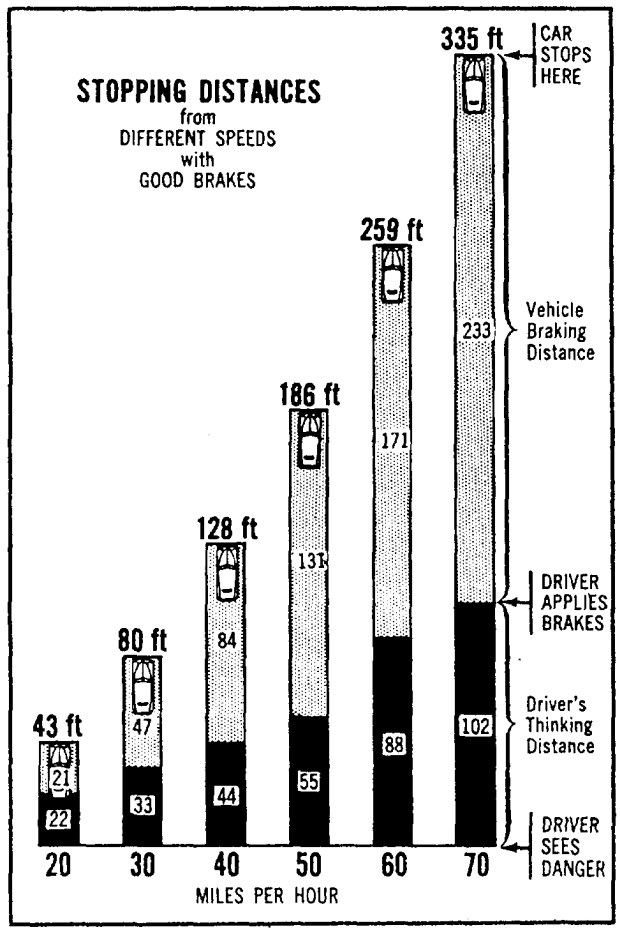

Figure 6-1.-Stopping distances from different speeds with good brakes.

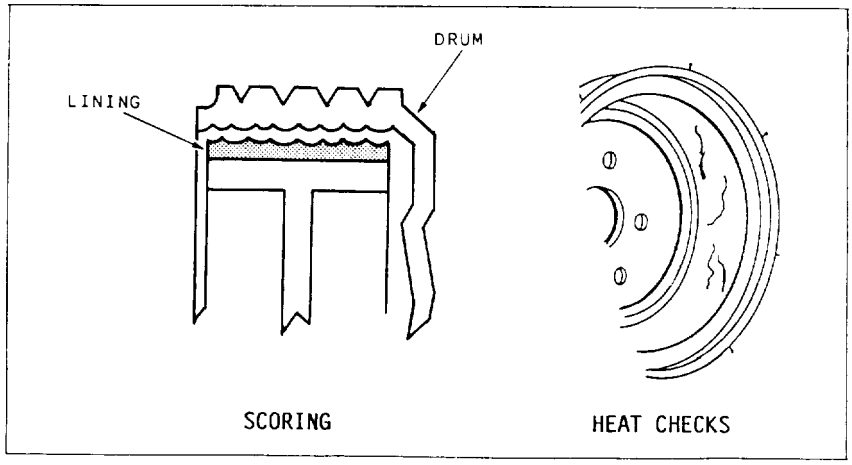

Figure 6-2.-Drum wear patterns.

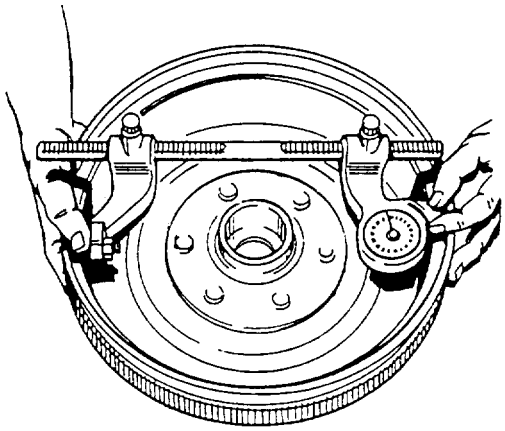

Figure 6-3.-Using a drum micrometer to measure the drum.

ATTENTION

CESO Maintenance Bulletin No. 75 directs the Naval Construction Force to use silicone brake fluid. Silicone brake fluid will not mix with glycol brake fluid and no adverse effects will occur to brake parts if it is combined accidently in small quantities. Some of the advantages of silicone brake fluid are that it will not damage painted surfaces, it has excellent dielectric properties, it will not deteriorate during long periods of system storage or climatic exposure, and it will not absorb or retain moisture.

To comply with requirements for testing brakes, you must see that at least one of the wheels is removed to check the brake lining and drum/rotor. Some

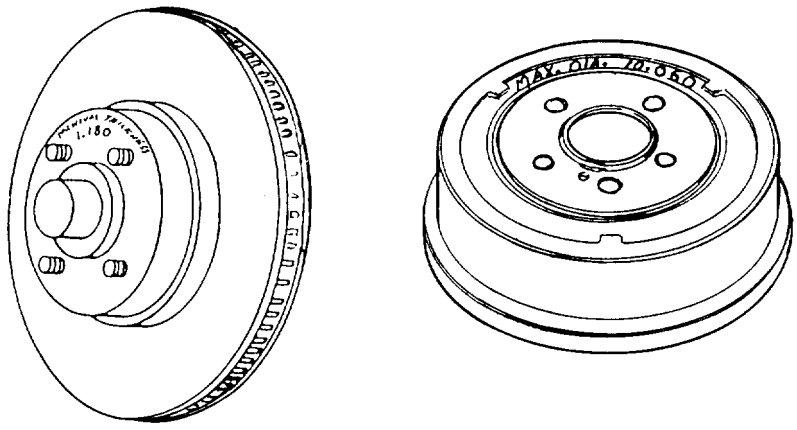

Figure 6-4.-Examples of specifications cast into brake drums.

manufacturers recommend pulling two wheels-one on each side. Look for loose or broken brake shoe retracting springs, worn clevis and cotter pins in the brake operating mechanisms, and grease or oil leaks at the wheel bearing grease retainer. Check for any signs of brake fluid leakage around the wheel cylinders or caliper operating pistons.

Brake linings that pass inspection for wear must be securely fastened to the brake shins and free from grease and oil. Small grease or oil spots can be removed from the lining with a nonoil base solvent. Linings saturated with grease or oil should be replaced only after the source of contamination has been repaired.

Badly worn or scored brake drums/rotors (fig. 6-2) should be machined smooth and true on a lathe or replaced. Cracked brake drums (fig. 6-3), or brake drums that have been machined beyond their maximum allowable diameter should be discarded. Brake drums and discs have the maximum or discard diameters cast into their outer surfaces (fig. 6-4).

Brake shoe and drum trouble not immediately evident when the wheels are pulled, yet that is detected during road tests, may be caused by the wrong kind of lining, ill-fitting brake shoes, or brake drums slightly out of round. The clue to these troubles may be chattering, spongy, or grabbing brakes.

CAUTION

Before troubleshooting brake systems by road testing, be sure that the vehicle is mechanically sound. Different size tires, low tire pressures, faulty shock absorbers, loose wheel bearings, and worn front-end parts may each indicate brake problems where there are none.

Navy vehicles seldom have the wrong kind of brake lining. However, an inexperienced mechanic may reverse the primary and secondary shoe on one of the wheels or interchange them between wheels so that the shoes are not exactly mated with the drums against which they expand. If you replace shoes or machine the drum/rotor on one side, do the same to the opposite side to prevent pull or loss of control.

The preceding paragraphs apply to most braking systems but do not list all of the problems you will have. For other probable causes of trouble and their remedies in standard hydraulic brake systems, refer to table 6-1.

PEDAL GOES TO THE FLOOR (LOW PEDAL)

Pedal reserve (fig. 6-5) is the distance from the brake pedal to the floorboard with the brakes applied. Low or no pedal reserve indicates brake problems. When there is no pedal reserve or an unlikely occurrence with a dual master cylinder, it could mean anything from a lack of brake fluid, to worn brake linings, a faulty master cylinder, or only a simple brake adjustment. Each of these conditions demands that you closely inspect the brake system.

BRAKES DRAG

Dragging brakes are caused by the following: one or more sets of shoes being adjusted too tightly, broken or weak return springs, a wheel cylinder piston that is stuck, drums that are out of round, defective lining material, loose anchor pins, or clogged lines or hoses. When both rear wheels drag, the cause may be the parking cable linkage being adjusted too tightly or a frozen parking brake cable. All wheels dragging can be the result of a stuck master cylinder pedal linkage or a defective power booster.

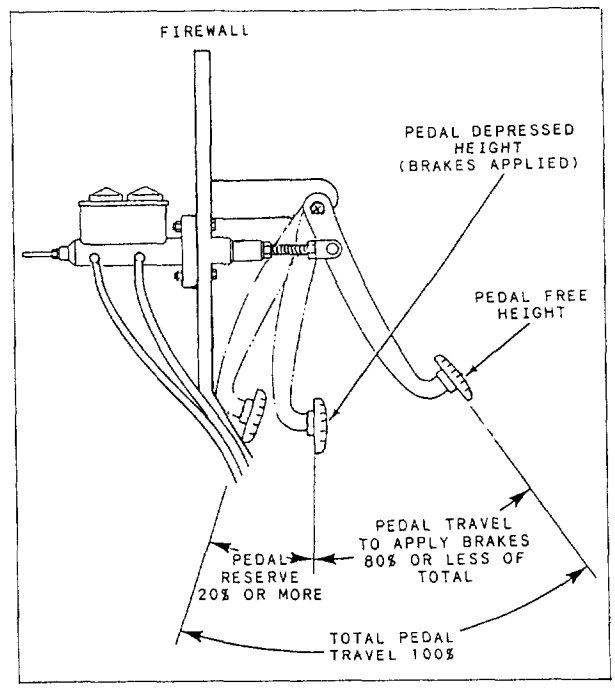

Figure 6-5.-Example of pedal reserve.

Table 6-1.-Troubleshooting Chart for Hydraulic Brakes (Standard)

MALFUNCTION	PROBABLE CAUSE	POSSIBLE REMEDY
A. Low pedal or pedal goes to toeboard.	1. Excessive clearance between linings and drum.	1. Adjust brakes.
	2. Automatic adjusters not working.	2. Make forward and reverse stops. If pedal stays low, repair faulty adjusters.
	3. Weak brake hose.	3. Replace hose.
	4. Leaking brake pipe.	4. Repair or replace faulty parts.
	5. Leaking wheel cylinder.	5. Clean and rebuild.
	6. Leaking master cylinder.	6. Clean and rebuild.
	7. Leaking master cylinder check valve.	7. Replace valve.
	8. Leaking stop light switch.	8. Replace switch.
	9. Air in system.	9. Bleed system.
	10. Plugged master cylinder filler cap.	10. Clean filler cap vent holes; bleed system.
	11. Improper brake fluid.	11. Flush system and replace with correct fluid.
	12. Low fluid level.	12. Fill reservoir; bleed system.
B. Springy, spongy pedal.	1. Air trapped in hydraulic system.	1. Remove air by bleeding.
	2. Improper brake fluid.	2. Flush and bleed system.
	3. Anchor pin adjustment incorrect.	3. Adjust anchor pin.
	4. Improper lining thickness or location.	4. Install specified lining or replace shoe and lining.
	5. Drums worn too thin.	5. Replace drums.
	6. Master cylinder filler vent clogged.	6. Clean vent or replace cap; bleed brakes.
	7. Weak hose.	7. Replace hose.
C. Excessive pedal pressure required to stop car.	1. Brake adjustment not correct.	1. Adjust brakes or repair self adjuster.
	2. Incorrect lining.	2. Install specified lining.
	3. Grease or fluid soaked lining.	3. Repair grease seal, or wheel cylinder. Install new linings.
	4. Improper fluid.	4. Flush out system; fill with correct type fluid.
	5. Frozen master or wheel cylinder pistons.	5. Rebuild or replace.

Table 6-1.—Troubleshooting Chart for Hydraulic Brakes (Standard)-Continued

MALFUNCTION	PROBABLE CAUSE	POSSIBLE REMEDY
C. Excessive pedal pressure required to stop car–Continued.	6. Brake pedal binding on shaft.	6. Lubricate or replace.
	7. Linings installed on wrong shoes.	7. Install primary and secondary linings correctly.
	8. Glazed linings.	8. Sand surface of linings.
D. Light pedal pressure. Brakes too severe.	1. Brake adjustment not correct.	1. Adjust the brakes or repair self adjusters.
	2. Loose backing plate on front axle.	2. Tighten plates.
	3. A small amount of grease or fluid on linings.	3. Replace the linings.
	4. Glazed linings.	4. Sand the surfaces of the linings.
	5. Incorrect lining.	5. Install factory specified linings.
	6. Wheel bearings loose.	6. Adjust wheel bearings.
	7. Lining loose on shoe.	7. Replace lining or shoe and lining.
	8. Excessive dust and dirt in drums.	8. Clean and sand drums and linings.
	9. Bad drum.	9. Turn drums in pairs or replace.
E. Brake pedal travel decreasing.	1. Master cylinder compensating port plugged.	1. Open with compressed air or replace.
	2. Swollen cap in master cylinder.	2. Replace rubber parts; flush system.
	3. Master cylinder piston not returning.	3. Rebuild master cylinder.
	4. Weak shoe retracting springs.	4. Replace springs.
	5. Wheel cylinder pistons sticking.	5. Clean cylinder bores and parts. Replace bad parts.
F. Pulsating brake pedal.	1. Drums out of round.	1. Refinish drums to specifications.
	2. Loose brake drum on hub.	2. Tighten.
	3. Worn or loose wheel bearings.	3. Replace or adjust.
	4. Bent rear axle.	4. Replace axle.

Table 6-1.—Troubleshooting Chart for Hydraulic Brakes (Standard)-Continued

MALFUNCTION	PROBABLE CAUSE	POSSIBLE REMEDY
G. *Brake Fade.	1. Incorrect lining.	1. Replace lining with lining recommended by factory.
	2. Thin drum.	2. Replace drums.
	3. Dragging brakes.	3. Adjust or correct cause.
H. All brakes drag when adjustment is known to be correct.	1. Pedal does not return to stop.	1. Lubricate the pedal.
	2. Improper fluid.	2. Replace rubber parts and refill.
	3. Compensating or bypass part of master cylinder closed.	3. Open with compressed air or replace.
I. One wheel drags.	1. Weak or broken shoe retracting springs.	1. Replace the defective brake shoe springs and lubricate the brake shoe ledges.
	2. Brake shoe to drum clearance too small or the brake shoe eccentric is not adjusted properly.	2. Adjust.
	3. Loose wheel bearings.	3. Adjust wheel bearings.
	4. Wheel cylinder piston cups swollen and distorted or the piston stuck.	4. Rebuild cylinders.
	5. Pistons sticking in wheel cylinder.	5. Clean or replace pistons; clean cylinder bore.
	6. Drum out of round.	6. Grind or turn front or rear drums.
	7. Obstruction in line.	7. Clean out or replace.
	8. Loose anchor pin.	8. Adjust and tighten lock-nut.
	9. Distorted shoe.	9. Replace.
	10. Defective lining.	10. Replace with specified lining.
	11. Parking brake cable frozen.	11. Lubricate.
J. Rear brakes drag.	1. Maladjustment.	1. Adjust brake shoes and parking brake mechanism.
	2. Parking brake cables frozen.	2. Lubricate.
K. Vehicle pulls to one side.	1. Grease or fluid soaked lining.	1. Replace with new linings.
	2. Anchor pin adjustment not correct.	2. Major brake adjustment.

*Fade is a temporary reduction of brake effectiveneess resulting from heat.

Table 6-1.—Troubleshooting Chart for Hydraulic Brakes (Standard)—Continued

MALFUNCTION	PROBABLE CAUSE	POSSIBLE REMEDY
K. Vehicle pulls to one side–Continued	3. Loose wheel bearings; loose backing plate on rear axle or front axle or loose spring bolts.	3. Adjust the wheel bearing; tighten the backing plate on the rear axles and tighten spring bolts.
	4. Linings not of specified kind or primary and secondary shoes reversed.	4. Install specified linings.
	5. Tires not properly inflated or unequal wear of tread. Different tread nonskid design.	5. Inflate the tires to recommended pressures. Rearrange the tires so that a pair of nonskid tread surfaces of similar design and equal wear will be installed on the front wheels and another pair with the tread will be installed on the rear wheels.
	6. Linings glazed.	6. Sand the surfaces of the linings.
	7. Water, mud, etc., in brakes.	7. Remove any foreign materials from all of the brake parts and the inside of the drums. Lubricate the shoe ledges and the rear brake cable ramps.
	8. Wheel cylinder sticking.	8. Repair or replace wheel cylinder.
	9. Weak or broken retracting springs.	9. Check springs. Replace bent, open-coiled or cracked springs.
	10. Out-of-round drums.	10. Re-surface or replace drums in left and right hand pairs (both front and both rear).
	11. Brake dragging.	11. Check for loose lining. Adjust.
	12. Weak chassis springs, loose U–bolts, loose steering gear, etc.	12. Replace spring, tighten U–bolts, adjust steering gear, etc.
	13. Loose steering.	13. Repair and adjust.
	14. Unequal camber.	14. Adjust to spec.
	15. Bad drum.	15. Refinish drums in pairs.
L. One wheel locks.	1. Gummy lining.	1. Reline.
	2. Tire tread slick.	2. Match up tire tread side to side.
	3. Faulty anchor adjustment.	3. Adjust.

Table 6-1.—Troubleshooting Chart for Hydraulic Brakes (Standard)–Continued

MALFUNCTION	PROBABLE CAUSE	POSSIBLE REMEDY
M. Wet weather, brakes grab or won't hold.	1. Linings sensitive to water.	1. Reline.
	2. Dirty brakes.	2. Clean out.
	3. Bent backing plate-opening.	3. Straighten or replace.
	4. Scored drums.	4. Grind or turn in pairs.
N. Brakes squeak.	1. Backing plate bent or shoes twisted.	1. Straighten or replace damaged parts.
	2. Metallic particles or dust embedded in lining.	2. Sand linings and drums. Remove all particles of metal in surface of linings.
	3. Lining rivets loose or lining not held tightly against the shoe at the ends.	3. Replace rivets and/or tighten lining by reriveting.
	4. Drums not square or distorted.	4. Turn or grind or replace drums.
	5. Incorrect lining.	5. Replace lining per factory specs.
	6. Shoes scraping on backing plate ledges.	6. Lube ledges. Replace with new shoe and linings, if distorted.
	7. Weak or broken hold down springs.	7. Replace defective parts.
	8. Loose wheel bearings.	8. Tighten to proper setting.
	9. Loose backing plate, anchor, drum wheel cylinder.	9. Tighten.
	10. Loose shoe links.	10. Tighten.
	11. Linings located wrong on shoes.	11. Install linings correctly.
O. Brakes chatter.	1. Incorrrect lining to drum clearance.	1. Readjust to recommended clearances.
	2. Loose backing plate.	2. Tighten securely.
	3. Grease, fluid, road dust on lining.	3. Clean or reline.
	4. Weak or broken retractor spring.	4. Replace.
	5. Loose wheel bearing.	5. Readjust.
	6. Drums out of round.	6. Grind or turn drums in pairs.
	7. Distorted shoes.	7. Replace shoes.
P. Grinding noise.	1. Shoe hits drum.	1. Switch drums or grind drums.
	2. Foreign material in lining.	2. Remove or replace lining.
	3. Rivets or shoe rubbing drum.	3. Reline. Refinish drums.
	4. Rough drum surface.	4. Refinish drums.

CAR PULLS TO ONE SIDE

Be sure all other parts related to the front end are in good working order before placing blame on the brakes. Loose anchor pins or backing plates, improper lining, wrong adjustment, broken return springs, drums out of round, defective wheel cylinder, a binding disc caliper piston, or a clogged or crimped hydraulic line can all cause a vehicle to pull to one side during braking.

SOFT PEDAL

The most common cause for a soft or spongy brake pedal will be air trapped in the hydraulic lines. This problem may also be caused by a brake drum being cut too thin when it is being resurfaced, and by weak or old flexible brake lines.

BRAKES TOO HARD TO APPLY

his problem may be the result of grease or brake fluid on the lining, pedal linkage binding, a faulty master cylinder, or glazed brake linings.

BRAKES TOO SENSITIVE

Incorrect brake adjustment or brake lines or brake lining fouled with grease or brake fluid maybe the cause of sensitive brakes.

BRAKE NOISE

Before you determine a noise to be coming from the brakes, eliminate all other possible sources, such as body noise, loose front-end parts, loose lug nuts, and so forth. Brake noise may be coming from shoes scraping the backing plate, and also, loose brake lining (riveted), loose anchor pins, loose or weak return springs, and loose backing plates can all cause some sort of brake noise.

BRAKE FLUID LOSS

Brake fluid loss is a serious problem caused by loose fittings, leaking wheel cylinders, master cylinder, brake lines, and hydraulic hoses.

BRAKES DO NOT SELF-ADJUST

The brake drum must be removed to check the self-adjust mechanism. Worn or frozen star wheels, broken or dislodged adjusting cable, or broken hold-down clips will all cause the self-adjuster to malfunction. See figure 6-6 for an illustration of an automatic adjuster components list.

BRAKE WARNING LAMP WILL NOT GO OUT

If the brake failure warning lamp comes on, it is a signal that one of the two hydraulic circuits has malfunctioned. Check the entire system and after you

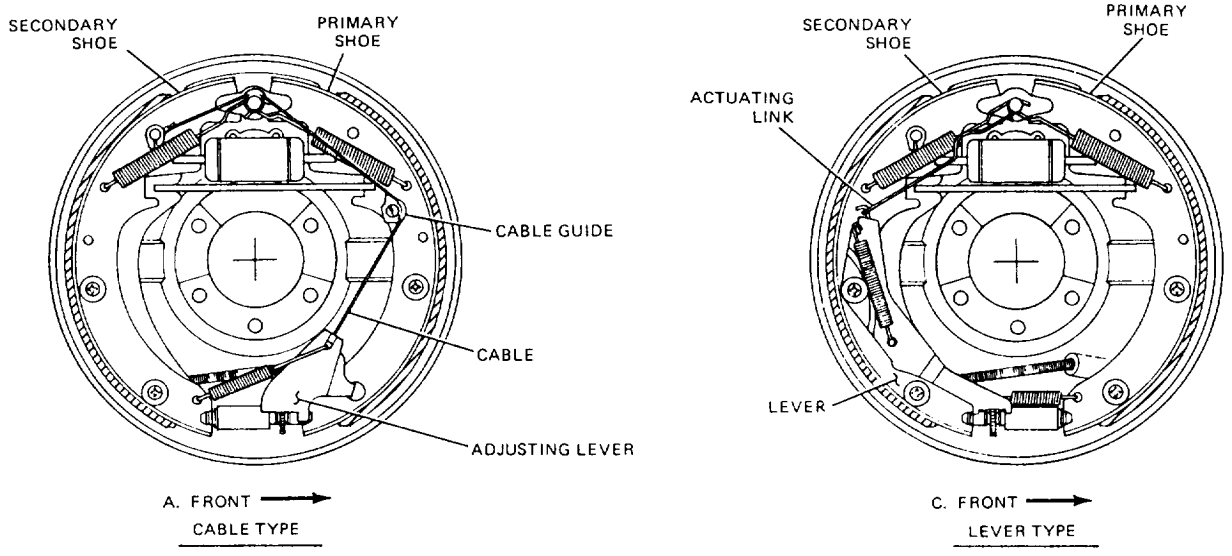

Figure 6-6.—Self-adjusting brake mechanisms.

make any repairs, reset the brake failure warning lamp switch (fig. 6-7).

See table 6-1 for a complete listing of possible brake problems and repairs.

TROUBLESHOOTING VACUUM-ASSISTED HYDRAULIC BRAKES (POWER) SYSTEMS

Aside from the vacuum booster, the same basic inspection procedures given in the hydraulic brake section apply to the vacuum-assisted hydraulic brake system. When you check this system for a source of trouble, refer to the chart for the standard hydraulic brake system (table 6-1). After you isolate possible causes by consulting this chart, check for causes in the troubleshooting chart of table 6-2.

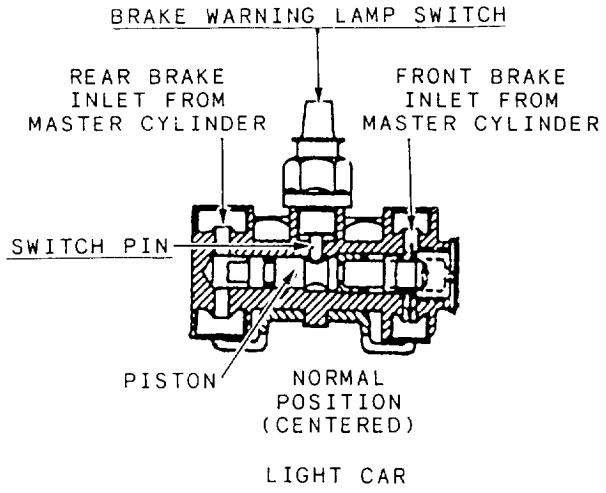

Figure 6-7.—Pressure differential valve with brake tamp warning switch.

NOTE

Conduct the following test BEFORE you check the cause of a hard pedal. With the engine stopped, depress the brake pedal several times to eliminate all vacuum from the system. Apply the brakes, and while holding the foot pressure on the brake pedal, start the engine. If the unit is operating correctly, the brake pedal will move forward when the engine vacuum power is added to the pedal pressure. If this test shows the power unit is not operating, check the probable causes of vacuum failure in table 6-2.

HARD PEDAL

A "hard pedal" means the booster is inoperative and you should suspect and check the following as the cause: collapsed vacuum hoses, faulty vacuum check valves, internal damage to the power booster, or a broken plunger stem.

GRABBY BRAKES

Uncontrolled stopping is a problem that may be caused by grabbing or oversensitive brakes. This symptom may result from a faulty power booster, a damaged vacuum check valve, leaky or incorrectly connected vacuum lines, or a broken plunger stem.

BRAKES FAIL TO RELEASE

When you apply the brakes and they fail to release, the following could be the problem–a broken power booster return spring, a sticking valve plunger in the booster, or a jammed power piston.

LOSS OF FLUID

Loss of brake fluid may occur through the rear seal of the master cylinder past the piston stop plate and into the power booster. The leak is not visible on the backing plates, the wheels, or the frame because the fluid collects in the power booster. Some of the fluid may be drawn through the vacuum lines and burned in the engine. The end result is that you do not see the leak. For a more complete listing of vacuum booster hydraulic brake problems and remedies, see table 6-2. Always consult the specific manufacturer's manual whenever you replace or repair any vacuum power booster.

HYDROBOOST POWER BRAKE SYSTEMS

Diesel engines do not create enough useable vacuum to actuate the vacuum power brake booster. The alternative is a hydraulic-assisted power brake booster or hydrobcmst. This system is currently found in the 1 1/4-ton CUCV and the 3/4-ton CUCV Blazer, both powered by the 366 cubic inch V8 General Motors diesel engine. Both units are found throughout the NCF and at some public works stations. The hydroboost uses hydraulic pressure developed by the power steering

Table 6-2.—Troubleshootiug Chart for Vacuum-Assisted Hydraulic Brakes (Power)

MALFUNCTION	PROBABLE CAUSE	POSSIBLE REMEDY
A. *Hard pedal.	1. Broken or damaged hydraulic brake lines.	1. Inspect and replace as necessary.
	2. Vacuum failure.	2. Check for: a. Faulty vacuum check valve or grommet–replace. b. Collapsed or damaged vacuum hose–replace. c. Plugged or loose vacuum fitting–repair. d. Faulty air valve seal or support place seal–replace. e. Damaged floating control valve–replace. f. Bad stud welds on front or rear housing of power head–replace unless easily repaired.
	3. Defective diaphragm.	3. Replace.
	4. Restricted air filter element.	4. Replace.
	5. Worn or badly distorted reaction disc. (tandem diaphragm).	5. Replace reaction disc.
	6. Cracked or broken power pistons or retainer.	6. Replace power pistons and piston rod retainer.
	7. Incorrect selective reaction piston (tandem diaphragm only).	7. Gauge reaction piston and replace with correct piston.
B. Grabby brakes. (Apparent off-and-on condition).	1. Broken or damaged hydraulic brake lines.	1. Inspect and replace as necessary.
	2. Insufficient fluid in master cylinder.	2. Fill reservoirs with approved brake fluid and check for leaks.
	3. Defective master cylinder seals.	3. Repair or replace as necessary.
	4. Cracking master cylinder casting.	4. Replace.
	5. Air in hydraulic system.	5. Bleed system.
C. Brakes fail to release.	1. Blocked passage in power piston.	1. Inspect and replace as necessary.
	2. Air valve sticking shut.	2. Check for proper lubrication of air valve O ring.
	3. Broken piston return spring.	3. Replace.
	4. Broken air valve spring.	4. Replace.
	5. Tight pedal linkage.	5. Repair or replace as necessary.

*Hard pedal is excessive pedal pressure required to apply the brakes.

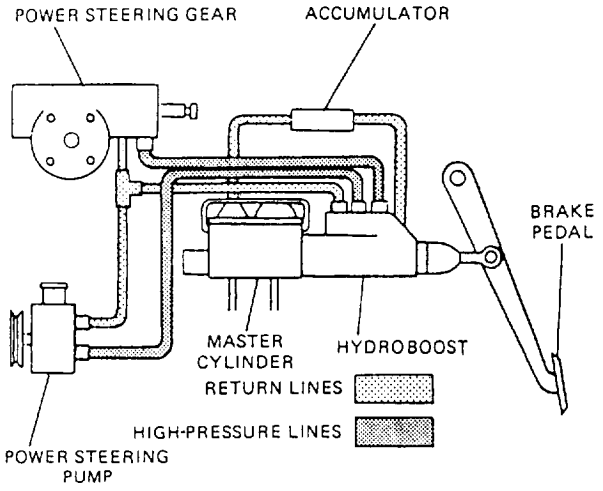

Figure 6-8.—Hydrauiic power booster system.

pump (fig. 6-8) rather than vacuum from the engine. The booster unit contains a spool valve that has an open center that controls the pump pressure as braking occurs. A lever assembly has control over the valve position and the boost piston provides the necessary force that operates the master cylinder. See figure 6-9 for a parts breakdown of the booster assembly.

In the event of hydraulic pressure loss, a spring-loaded accumulator is provided on the unit. This will provide for at least two power brake applications. The brakes will operate without the power assist unit, but the pedal pressure will be noticeably higher. AVOID DRIVING IN THIS CONDITION.

HYDROBOOST TROUBLESHOOTING

Hard Pedal (at an idle):

This problem may be caused by fluid contamination, pedal linkage binding, or a bad hydroboost unit.

High Pedal and Steering Effort:

A loose or broken power steering belt, low pump fluid level, low engine idle, a restriction in one or more hydraulic lines, or a defective power steering pump will cause these symptoms.

Slow Pedal Return:

Slow pedal return can be caused by pedal linkage binding, a restricted booster hydraulic line, or an internal problem with the hydroboost unit.

Pedal Pulsation:

Pedal chatter/pulsation is caused by a loose or slipping drive belt, low power steering fluid level, a defective power steering pump, or a defective hydroboost unit.

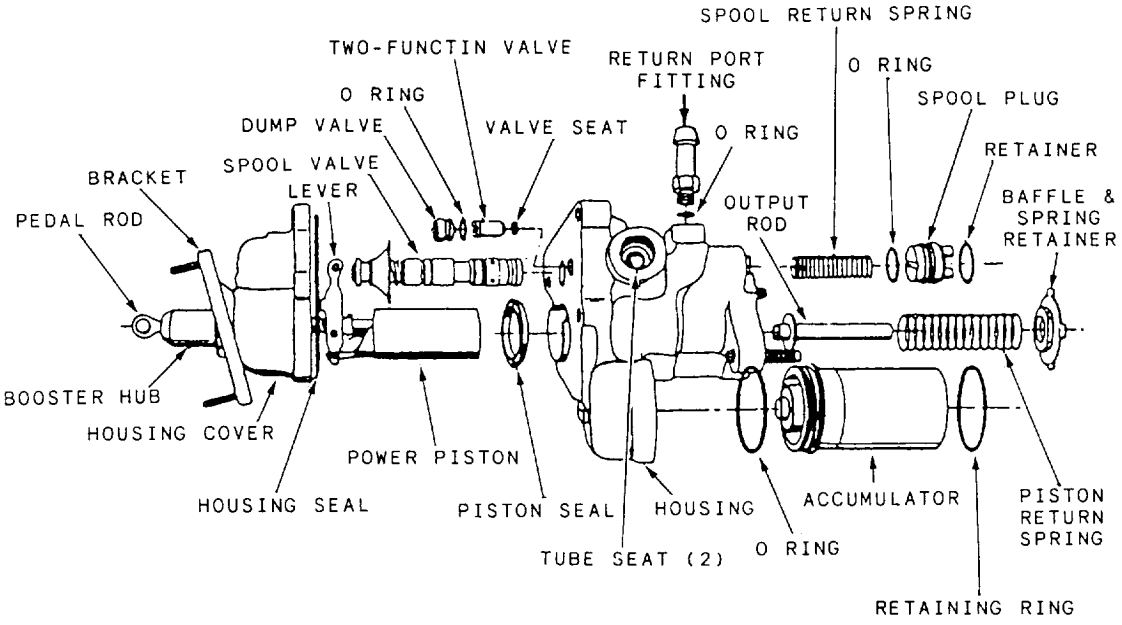

Figure 6-9.—Hydraulic power booster assembly.

Brakes Too Sensitive:

Pedal linkage binding or a defective hydroboost unit will cause this to happen.

Excessive Noise:

Excessive noise originating in the hydroboost unit is an indication of the following problems: low power steering fluid, air in the power steering fluid, a loose power steering belt, or a restriction in the hydraulic hoses.

WARNING

The interchanging of parts between hydroboost units of different makes of CESE is not recommended. Tolerances of parts and pressure differentials may be different, causing a jerry-rigged hydroboost unit to exceed the normal 1,400 psi accumulator pressure. INJURY TO PERSONNEL AND DAMAGE TO THE VEHICLE COULD BE THE RESULT. PROTECT YOURSELF. USE THE MANUFACTURER' S SPECIFICATIONS WHEN YOU WORK ON THESE UNITS.

The manufacturer recommends that this unit not be rebuilt or overhauled. If the problem is in the booster, replace the booster.

TROUBLESHOOTING AIR BRAKE SYSTEMS

The purpose of air braking systems (fig. 6-10) is to enable the operator to apply sufficient braking action to the wheels of larger and heavier trucks and construction equipment. Considerable force is available for braking since the operating pressure is as high as 110 pounds per square inch. More often, stopping distances will be much greater than those shown in figure 6-1, primarily because of the increased weight of the equipment and load. General information concerning air braking systems can be found in chapter 10 of the *Construction Mechanic 3&2,* NAVEDTRA 10644-G1 .

When you are troubleshooting, first make a visual inspection and check all the obvious things-open air drain cocks, off-track compressor belt, broken air lines, and so forth. Next, perform an air buildup test and an air leakage test.

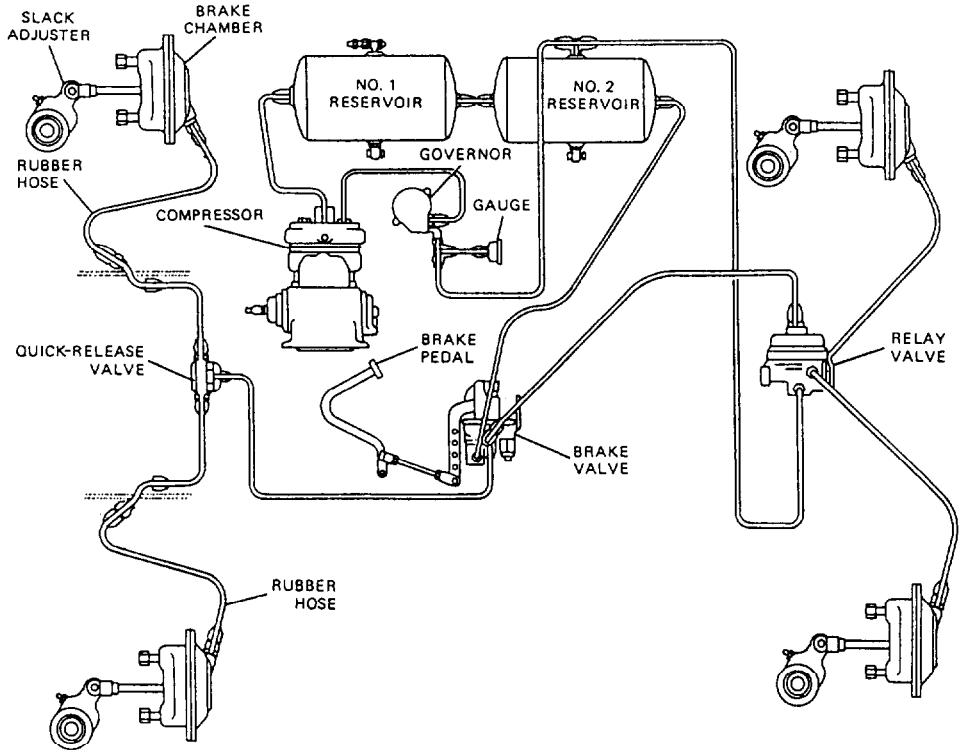

Figure 6-10.—typical air brake system.

Perform the air buildup test in the following sequence:

1. Before starting the engine, open the air drain cocks and release the air pressure from the system.

2. Close the air reservoir air drain cocks (fig. 6- 11).

3. Start the engine and watch the air pressure gauge to see how long it takes to build up to safe operating pressure. If it takes longer than 10 minutes to bring the air pressure from 0 to 60 psi, check the system for leaks, and check the air compressor and relief valves.

Conduct the air leakage test with the air brake system at normal operating pressure and the engine turned off. Hold the air brakes in the maximum applied position and watch the air pressure gauge on the dashboard of the vehicle. The air pressure should not drop more than 3 pounds in 1 minute after the brakes are applied and 2 pounds in 1 minute with the brakes released. If the indicated air pressure drops more rapidly than the times specified here, there is an air leak in the system. Trace the air lines to determine the exact source of the leak. Since air leaks normally make a distinct hissing sound, when you find the source of the noise and you have found the leak. Smaller leaks are not as audible and are harder to detect; however, you can detect these leaks by brushing the hose or tubing connections of the air brake system with a solution of soapy water. Air bubbles indicate a leak.

Air brakes on trailers get an external brake inspection as part of the inspetion required on a truck-trailer combination. They are also tested for holding as if the trailer were suddenly disconnected from the tractor. To conduct this test, first make sure the air lines between the tractor and trailer are coupled properly. Then, after you start the engine so both tractor and trailer air reservoirs are charged, quickly and simultaneously disconnect both air line couplings. The trailer or semitrailer brakes should be automatically applied. Trailer brakes are designed to stop the trailer when it is accidentally disconnected from the towing vehicle. All states require automatic application of trailer brakes in an emergency. Some states go even further for trailers having a chassis and body weight of 1,000 pounds or over; such trailers must be equipped with adequate brakes that will also hold the vehicle for at least 15 minutes after application.

If these inspections and tests do not disclose the fault, consult the troubleshooting chart of table 6-3.

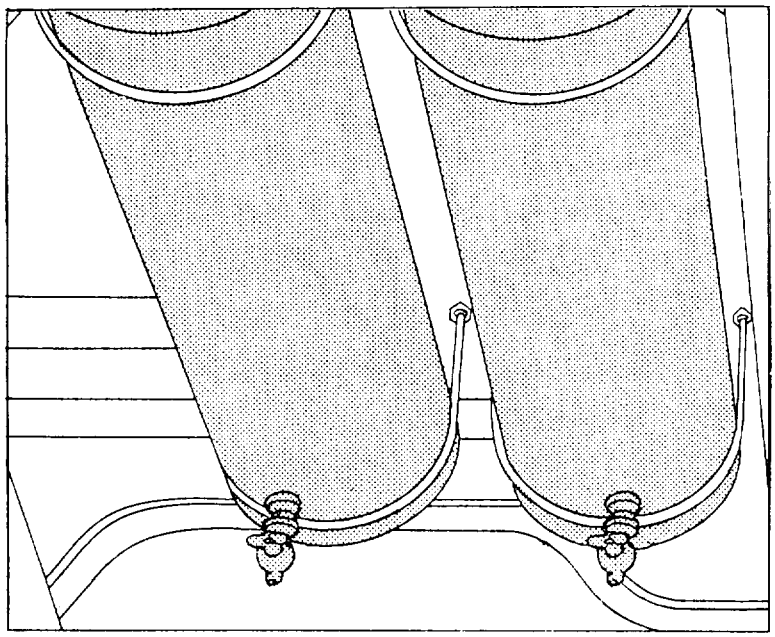

Figure 6-11.—Air reservoir with air drain cock.

Table 6-3.—Air Brake System Troubleshooting Chart

IMPROPER AIR PRESSURE	
PROBABLE CAUSE	POSSIBLE REMEDY
Air pressure in system is above normal.	Check governor settings. Adjust air compressor unloading valves. Replace governor if necessary.
Air reservoir damaged.	Inspect air reservoir and replace if necessary.
CARRIER HAND BRAKE DOES NOT HOLD WHEN APPLIED	
PROBABLE CAUSE	POSSIBLE REMEDY
Hand brake linkage out of adjustment.	Adjust linkage.
CARRIER HAS NO BRAKE ACTION, INSUFFICIENT ACTION OR BRAKES APPLY SLOWLY	
PROBABLE CAUSE	POSSIBLE REMEDY
Improper brake shoe adjustment.	Adjust brake shoes.
Blocked, bent, or broken tubing or hose.	Remove obstruction in line or replace faulty tubing.
Brake valve delivery pressure below normal.	If brake valve is defective, replace unit.
No air pressure.	Replace or repair air compressor.
BRAKES RELEASE TOO SLOWLY WITH PEDAL RELEASED	
PROBABLE CAUSE	POSSIBLE REMEDY
Insufficient brake shoe clearance.	Adjust brake shoes if clearance is insufficient.
Weak or broken valve diaphragm return spring.	Replace brake valve.
Defective quick-release valve.	Replace quick-release valve.
ONE BRAKE DRAGS WITH PEDAL RELEASED	
PROBABLE CAUSE	POSSIBLE REMEDY
Insufficient brake shoe clearance.	Adjust brake shoe clearance.
Blocked or defective quick-release valve.	Clean or replace faulty unit.
Weak or broken brake shoe return spring.	Replace faulty spring.
Brake shoe binds on anchor pin.	Remove shoe; clean and lubricate anchor pins.
BRAKES GRAB WHEN PEDAL IS DEPRESSED	
PROBABLE CAUSE	POSSIBLE REMEDY
Brake shoe clearance too great.	Adjust clearance.
Grease or oil on linings.	Clean linings or replace brake shoes or linings.
Drums out-of-round.	Replace drum.
Defective brake valve.	Replace faulty unit.
Brakes need relining.	Replace brake shoes.
Brake chamber diaphragm leaks.	Tighten all fittings. If caused by broken or faulty unit, replace brake chamber.

AIR-OVER-HYDRAULIC

On vehicles equipped with air-over-hydraulic brakes (fig. 6-12), do a good visual inspection of the air compressor, the air reservoir, the air lines, the brake pedal and linkage, the wheel brakes, the master cylinder, and the hydraulic line from the master cylinder to the air-hydraulic-power cylinder and from the air-hydraulic power cylinder to the wheel brakes.

Operating troubles resulting from malfunction of the air-over-hydraulic power cylinder are hard pedal (excessive pedal pressure required to apply the brakes) and dragging brakes (power cylinder fails to return to released position when the brake pedal is released).

To test a sluggish or inoperative power cylinder, first install an air pressure gauge in the control valve housing and a hydraulic gauge at both the hydraulic fluid inlet line and the hydraulic brake line output port. Then slowly depress the brake pedal and observe the gauges. When the air control pressure gauge shows between 1 and 5 psi, the hydraulic pressure at the hydraulic inlet should not exceed 40 psi. Excessive hydraulic pressure indicates a sticking relay piston (caused by swollen or damaged piston scaling cups or a corroded or damaged relay piston sleeve) or sticking control valve poppets (caused by corrosion of the poppets, poppet seats, or damaged poppets).

With the brake pedal completely depressed in the fully applied position, the air control pressure gauge should show 90 psi and the hydraulic output pressure gauge should show full power (runout) pressure of 1,400 to 1,600 psi. Low pressure or no pressure on the air pressure gauge indicates air leakage or an inoperative control valve. Low hydraulic output pressure indicates hydraulic fluid leakage, a sticking hydraulic piston, or an inoperative check valve (in the hydraulic piston), or a residual line check valve.

To test for internal and external air leakage or hydraulic leakage, fast depress the brake pedal and apply soapsuds at the air control line and its connections, the double check valve (if so equipped), and the cylinder body and end plate. Bubbles appearing at any of these points indicate external air leaks. While the pedal is depressed, check for hydraulic fluid leakage at the outlet fitting cap and around the jam nut on the slave cylinder housing. Internal air leakage is indicated by a pressure drop in excess of 2 psi in 15 seconds. The trouble is a worn or damaged piston packing, a scored cylinder body, or leakage at the poppets in the control valve. Internal hydraulic pressure leakage can also be indicated by hydraulic pressure drop at both hydraulic pressure gauges while the brake pedal is depressed.

Dragging brakes can be tested by releasing the brake pedal and observing the air pressure gauge and the two

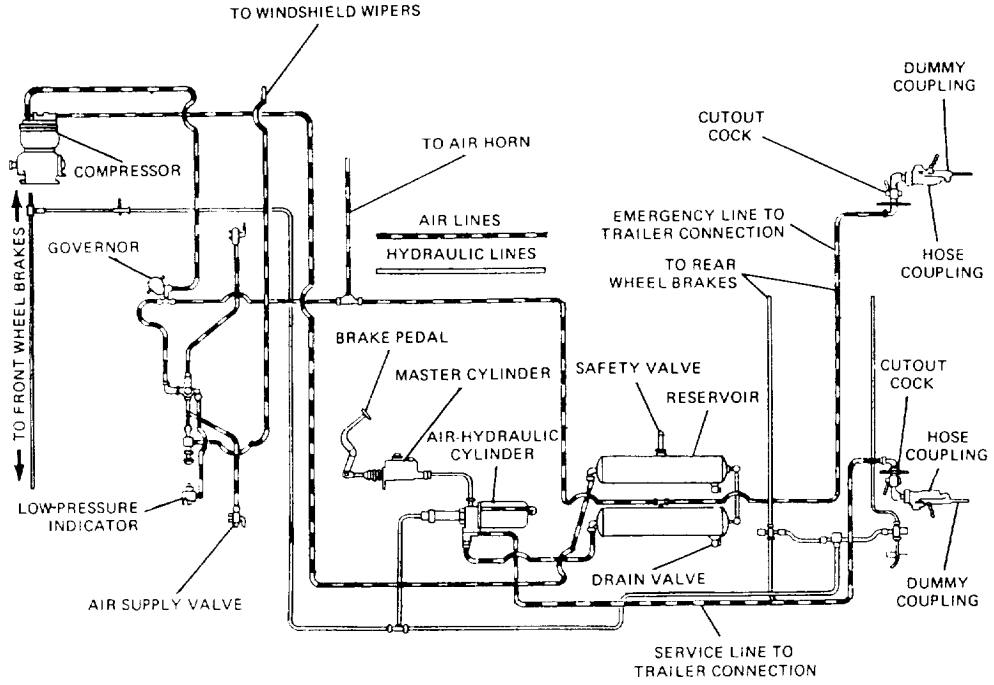

Figure 6-12.—Air-over-hydraulic brake system.

hydraulic pressure gauges. All gauges should register zero without lagging. When pressure is noted at the air pressure gauge, a sticking relay piston, damaged or corroded control valve poppet, or a ruptured control valve diaphragm exists. Pressure at the hydraulic pressure gauges indicates a sticking hydraulic piston, a sticking power piston, or a weak or broken piston return spring. If the hydraulic pressure gauges show a slow pressure drop, it indicates a defective check valve (in the hydraulic piston) or a defective residual line check valve.

If the tests indicate external air leakage, tighten the control line connections, and or replace a damaged control line, control line gasket, or double check the valve. For internal air leakage you must remove the unit to replace worn or damaged power piston packing or end plate gasket, and repair or replace the cylinder body or end plate.

If the tests indicate hydraulic fluid leakage, an inoperative control valve, sticking power piston, relay piston, or hydraulic piston, remove the unit for disassembly and repair or replace the worn or damaged parts.

PARKING/EMERGENCY BRAKES

Serviceable parking/emergency brakes are essential to the safe operation of any piece of automotive or construction equipment. Several types of these brakes are manufactured, such as the external contraction, drum, and disk types (fig. 6-13). These are drive line brakes common to heavy construction equipment. These

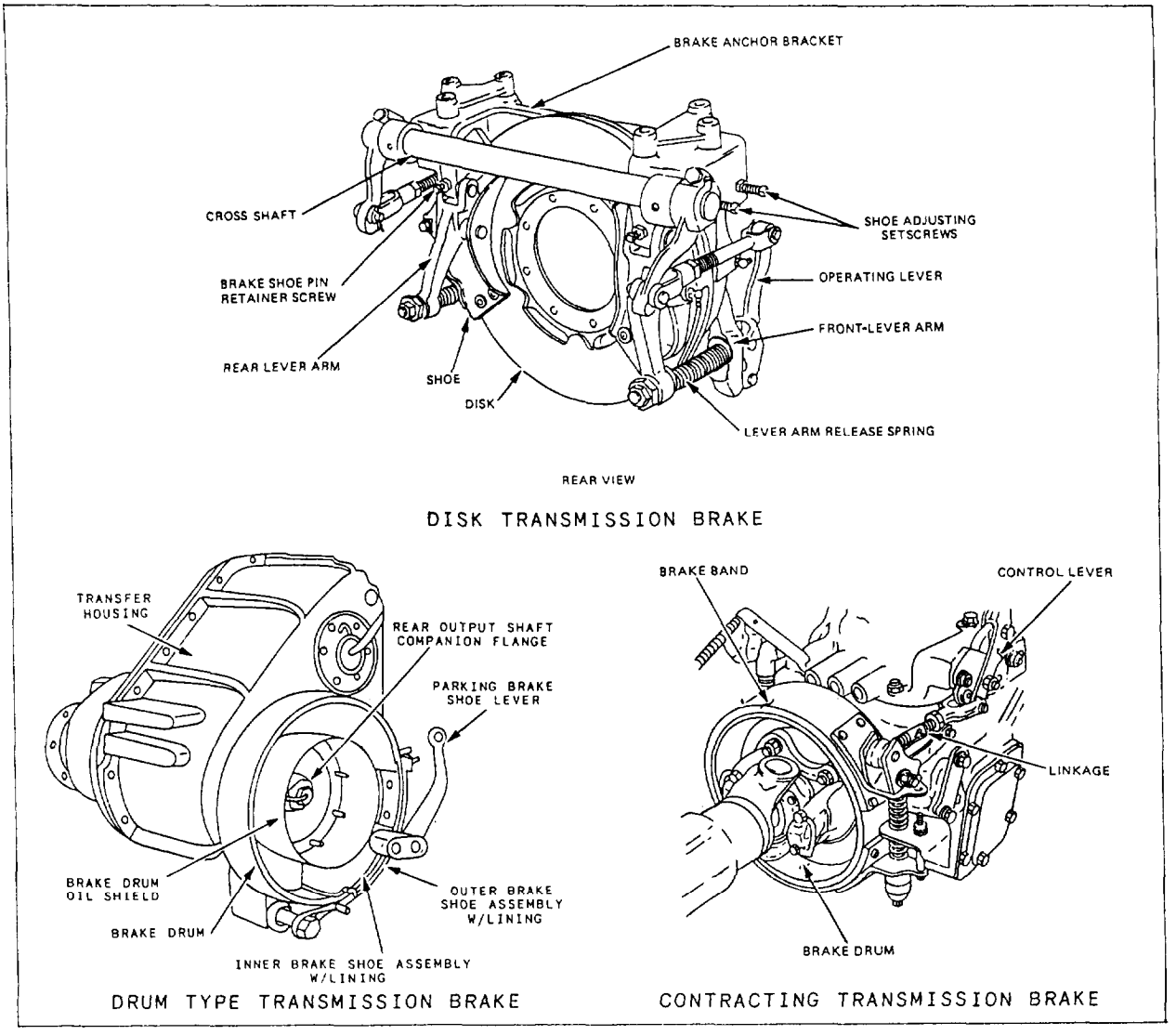

Figure 6-13.—Examples of drive line emergency/parking brakes, transmission mounted.

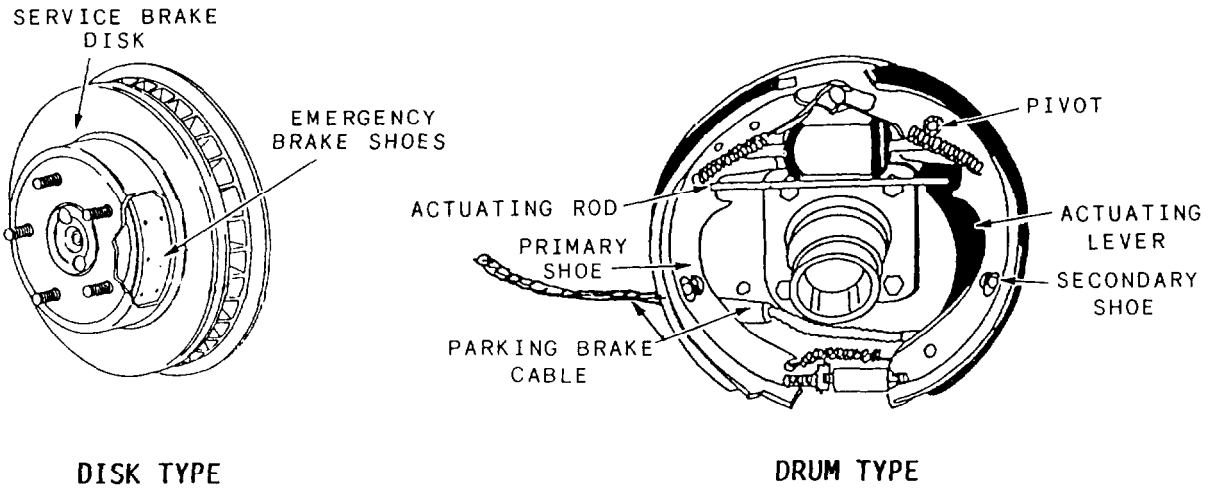

Figure 6-14.—Automotive type emergency/parking brake axle mounted.

are usually mounted on the output shaft of the transmission or transfer case directly in the drive line. Theoretically, this type of system is preferred for heavy equipment because the braking force is multiplied through the drive line by the final drive ratio and the braking action is equalized perfectly through the differential. Drawbacks are that severe strain is placed on the power transmission system, and also that the vehicle may move while it is being lifted since the differential is not locked out.

Parking brakes interconnected with service brakes are usually found on automotive types of equipment (fig. 6-14). This type of emergency/parking brake is actuated by a foot pedal or a dash mounted handle assembly and is connected through linkage to an equalizer lever (fig. 6-15), rod assembly, and cables connected to the emergency/parking brake mechanism within the drums/discs (fig. 6-14) at the rear wheels.

When you test parking brakes, stop the vehicle on a road graded at about 30 percent. Set the parking brake and release the service brakes. The vehicle should maintain its position and not roll or inch backwards. Repeat the test in the opposite direction. Again, the vehicle should hold its position. If there is no hill close by, you may test parking brakes by setting the brake, placing the vehicle in first gear (low), and slowly releasing the clutch with the engine idling (do not rev the engine while doing this exercise). This action should stall the engine of the vehicle you are testing. In the case of an automatic transmission, the vehicle should not move in any gear. In either of these tests, if the vehicle does move, it is an indication that there is a parking brake malfunction.

Once you determine there is a problem, proceed as follows. First, inspect the condition of the emergency brake linings and contact surfaces just as you would for service brakes and just as carefully. Pay attention to the ratchet and paw] or any other automatic locking device that holds the brake in the applied position to make sure it is operating properly. In addition, when inspecting the drive line type brake, examine the universal joints and splines for loose bolts and grease leaks. Loose bolts are not uncommon for vehicles having brakes mounted in the drive line.

The emergency brake must hold the vehicle on any grade. This requirement covers both passenger and commercial motor vehicles equipped with either the enclosed type of emergency brake at each rear wheel or a single emergency brake mounted on the drive line. The

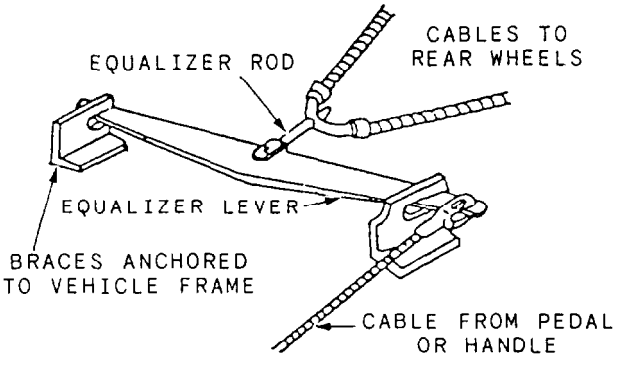

Figure 6-15.—Equalizer linkage.

Federal Motor Carrier Safety Regulations Pocketbook, par. 393-52, lists emergency brake requirements.

ANTILOCK BRAKES

The first antilock brake systems (ABSs) were developed and used in aircraft in the early 1950s. Certain automobiles had the systems in the experimental stages in the mid 1950s and in the production stages in the early 1970s. The ABSs are common today in many production cars and trucks.

Why wc use ABS is simple, CONTROL. A high percentage of vehicle accidents on the highway are caused by skidding. Since braking is most effective and steering is not lost when the wheels are still rotating, the antilock brake system prevents skidding by allowing the wheels to continue turning during maximum braking effort. On wet pavement, hydroplaning of the tires is cut to a minimum. One final benefit is that of extended tire wear by the elimination of flat spots caused by brake lockup during panic stops.

All ABS (either two wheel or four wheel) operate on the same principle. That is, the system is monitored by an electronic control module for the rate of reduction of vehicle wheel speed during brake system operation. If the system feels that lockup is about to occur at one or more wheels, modulated hydraulic pressure is fed to that brake caliper by a hydraulic control unit or an electro-hydraulic valve. In this way, even if hydraulic pressure is not the same at each wheel, maximum tire adhesion to the road surface is maintained. Once again, the way the modulated hydraulic pressure is maintained is different with each manufacturer. Before going any further, get a copy of the manufacturer's maintenance and repair manual of the vehicle that you are working on.

While these systems are not yet common in the Naval Construction Force, the first equipment you arc most likely to see the system used on is automotive type CESE. Very little should malfunction on the system. If the ABS is in need of repair, you should take the following precautions before working on it:

1. Repressurize the system before attempting to make repairs.
2. Do not work on an antilock brake system with the ignition turned on. (Damage to the system computer can result.)
3. Do not substitute parts. Use parts that are approved for the system you are working on.
4. Keep the correct size tires on your vehicle. Mismatched tire sizes will give the computer false readings.
5. Check the speed sensors for cleanliness. A dirty speed sensor will give the computer a false, or zero reading.
6. Wheel lugs must be torqued to the correct foot pounds and in proper sequence. Your failure to do so may distort the wheel and sensor, thus sending incorrect readings to the antilockbrake system computer.
7. An incorrect air gap on the wheel sensors will lead to false input to the antilock brake system computer.
8. DO NOT USE SILICONE BRAKE FLUID in a vehicle equipped with an antilock brake system.
9. If electric arc welding must be done to the vehicle you are working on, disconnect the antilock brake system computer first.
10. A low battery caused by a faulty charging system will cause the antilock brake system to malfunction.
11. Antennas for transmitting type radios should not be located near the computer of antilock brake system.

CAUTION

Using an improper test method on these systems can lead to damage to the system or personal injury to yourself or to the personnel working for you.

CAUTION

All antilock brake systems have special system bleeding instructions. Your failure to follow these instructions will lead to an inoperative or a faulty system.

For further reading concerning antilock braking systems, consult your manufacturer's service and repair manual of the vehicle you are working on.

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