BRAKE SYSTEM

GENERAL

This section has a description and the repair procedures for the parts of the hydraulic brake system. These parts include the brake booster, master cylinder and brake shoe assemblies.

DESCRIPTION AND OPERATION

The master cylinder is actuated by a brake booster on the S3.50-5.50XL (S70-120XL) and H3.50-5.00XL (H70-110XL) lift trucks. The brake booster is a hydraulic valve actuated by the brake pedal. The brake booster uses the oil that flows from the steering control unit to multiply the force of the brake pedal. The system allows braking without hydraulic pressure at the brake booster.

Lift trucks of the E3.50-5.50XL (E70-120XL, E70-120XL$_3$) series have a different master cylinder that is not actuated by a brake booster.

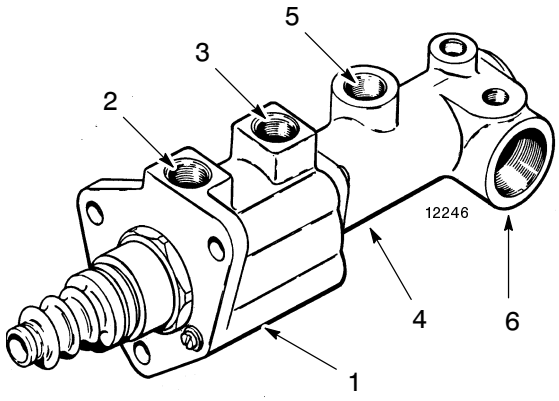
BRAKE BOOSTER AND MASTER CYLINDER (See FIGURE 1. and FIGURE 2.)

These parts are for the S3.50-5.50XL (S70-120XL) and H3.50-5.00XL (H70-110XL) models. The operation of the parts is described in FIGURE 2.

MASTER CYLINDER (See FIGURE 3.)

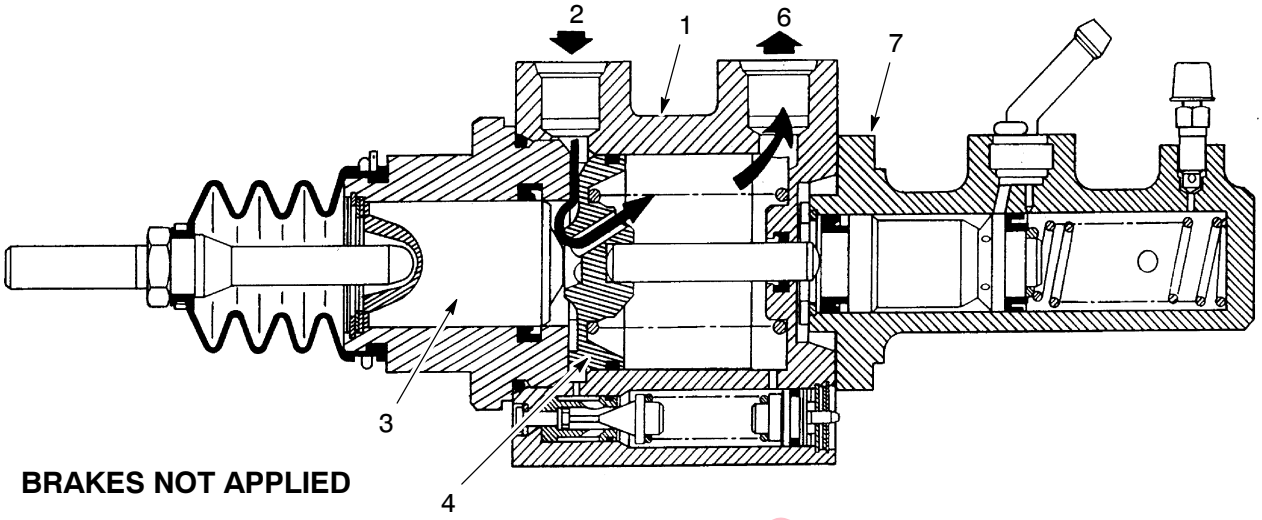
This master cylinder is for the E3.50-5.50XL (E70-120XL, E70-120XL$_3$) models. The master cylinder has a housing and a piston assembly. The housing (3) has two ports between the bore for the piston and the reservoir for the fluid. The compensator port (7) in front of the piston is open when the piston is fully retracted. The compensator port lets fluid move to or from the brake system when the temperature changes. Another port (6) keeps fluid in the cavity around the piston. The piston (10) moves in the housing when the operator pushes the brake pedal. A small movement of the piston closes the compensator port (7). Hydraulic pressure actuates the wheel cylinders as the piston pushes fluid through the check valve (13). A return spring pushes the piston (10) back to the stop plate (9) when the pedal is released. Fluid can flow through passages in the piston and past the primary cup (11) as the piston returns. Fluid flows across the piston to prevent a vacuum while fluid returns through the check valve (13). When the piston passes the compensator port (7), excess fluid from the system can return to the reservoir. The check valve keeps a very small amount of pressure in the brake system. The pressure helps to keep the system effectively sealed.

S3.50-5.50XL (S70-120XL)
H3.50-5.00XL (H70-110XL)



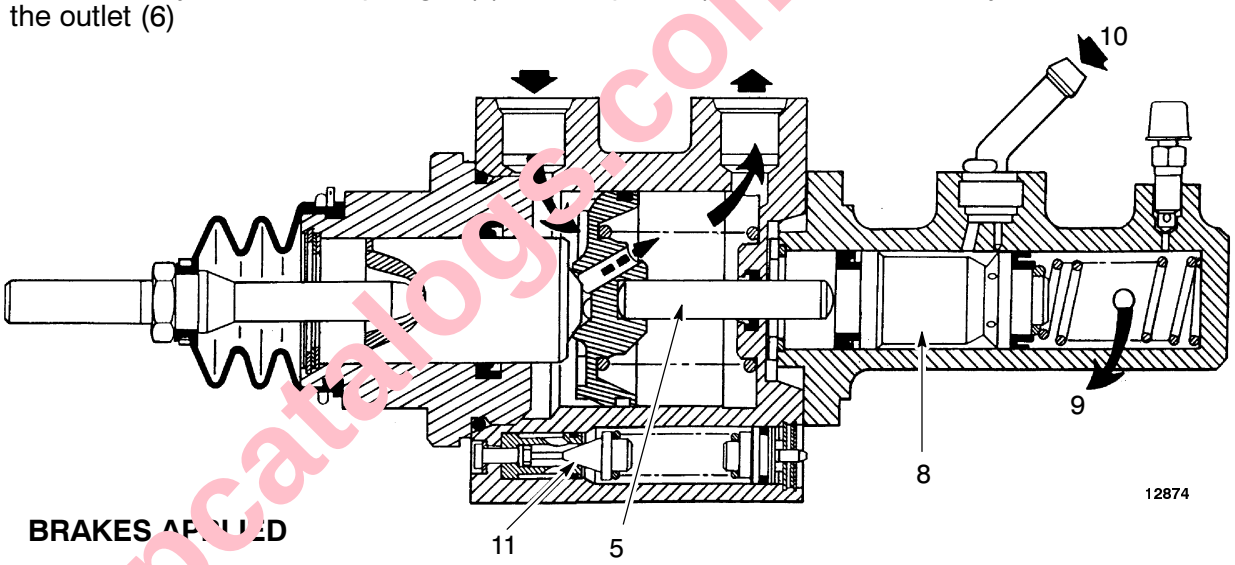
1. BRAKE BOOSTER
2. INLET FROM STEERING CONTROL UNIT
3. OUTLET TO HYDRAULIC TANK
4. MASTER CYLINDER
5. INLET FROM RESERVOIR
6. OUTLET TO WHEEL CYLINDERS

FIGURE 1. BRAKE BOOSTER AND MASTER CYLINDER



BRAKES NOT APPLIED

Hydraulic oil flows from the steering control unit to the inlet (2) of the brake valve. The hydraulic oil flows freely between the plunger (3) and the piston (4) and returns to the hydraulic tank from the outlet (6)



BRAKES APPLIED

When the brakes are applied and the engine is not running, the plunger (3) pushes against the piston (4). The piston and piston rod (5) push against the piston in the master cylinder to actuate the brakes.

When the engine is running, there is hydraulic oil flowing through the brake valve.

The movement of the plunger (3) makes a restriction in the flow of oil between the plunger (3) and the piston (4). The hydraulic pressure behind the piston increases and pushes on the piston (4) and piston rod (5) to move the piston in the master cylinder. The oil pressure behind the piston decreases the effort at the brake pedal to apply the brakes. As the piston (8) for the master cylinder moves, brake fluid flows from the outlet (9) to the wheel cylinders. The relief valve (11) gives a 2300 kPa (332 psi) limit to the hydraulic pressure in the brake valve.

1. BRAKE VALVE (BOOSTER)
2. INLET
3. PLUNGER
4. PISTON (BRAKE VALVE)
5. PISTON ROD
6. OUTLET TO HYDRAULIC TANK
7. MASTER CYLINDER
8. PISTON (MASTER CYLINDER)
9. OUTLET TO WHEEL CYLINDERS
10. INLET FROM BRAKE RESERVOIR
11. RELIEF VALVE

FIGURE 2. OPERATION OF THE BRAKE BOOSTER AND THE MASTER CYLINDER

E3.50-5.50XL (E70-120XL, E70-120XL$_3$)

1. FILLER PLUG
2. GASKET
3. HOUSING
4. PUSH ROD
5. BOOT
6. INTAKE PORT
7. COMPENSATOR PORT
8. LOCK WIRE
9. PISTON STOP PLATE
10. PISTON ASSEMBLY
11. PRIMARY CUP
12. RETURN SPRING
13. CHECK VALVE

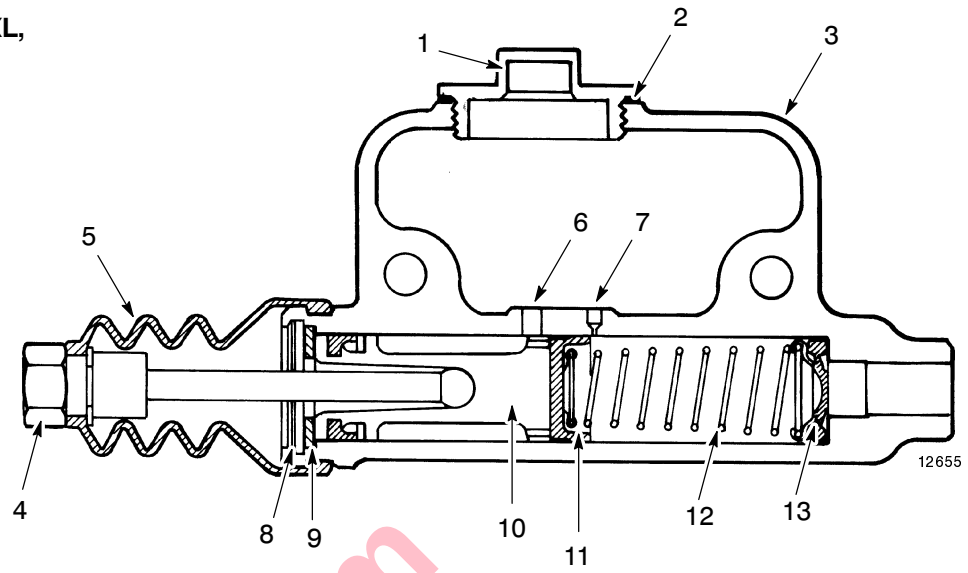
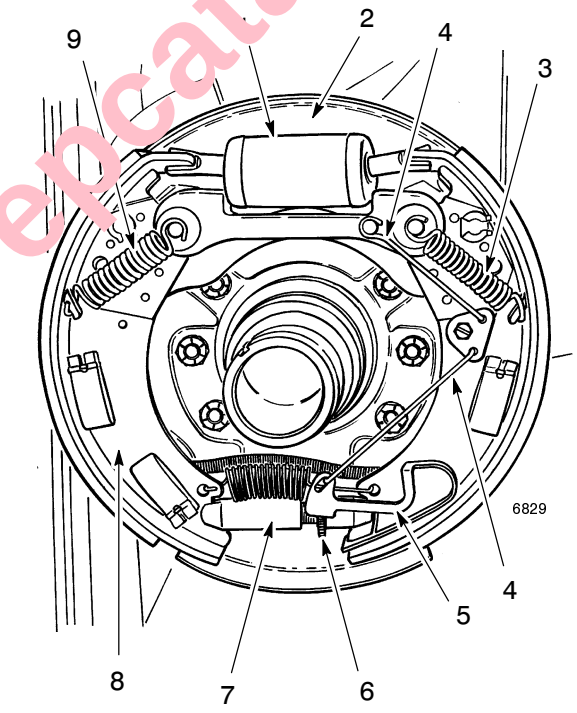


FIGURE 3. THE MASTER CYLINDER

SERVICE BRAKE ASSEMBLY (See FIGURE 4.)

A service brake assembly is installed at each end of the housing for the drive axle. Each service brake assembly has a single wheel cylinder at the top of each back plate. The support plate has an anchor for each shoe. When the wheel cylinder is actuated by fluid pressure from the master cylinder, the shoes touch the drum. The primary shoe starts to turn with the drum. This action pushes the secondary shoe tight against the drum and the anchor. This servo action increases the force applied to the brake drums. When the lift truck is traveling in reverse, the primary shoe is pushed against the anchor and the drum by the secondary shoe.



1. WHEEL CYLINDER
2. BACK PLATE
3. RETURN SPRING - GREEN
4. ADJUSTER LINKS
5. ADJUSTER SPRING LEVER
6. ADJUSTER SCREW WHEEL (RIGHT HAND THREAD)
7. ADJUSTER SCREW NUT
8. FRONT BRAKE SHOE
9. RETURN SPRING - BLACK

LEFT SIDE SHOWN

FIGURE 4. SERVICE BRAKES

The automatic adjusting linkage turns the adjuster screw wheel to adjust the clearance between the brake shoes and the brake drum. The secondary shoe and the links move with the drum during a stop when the truck is traveling in reverse. The links permit the adjuster spring lever to rotate the adjuster screw wheel. The adjuster screw wheel only can turn when there is clearance between the lining and the brake drum. The adjuster screw wheel can be turned manually through a slot in the back plate.

PARKING BRAKE (See FIGURE 5.)

The parking brake uses the service brake shoes. Additional linkage pushes the shoes apart when the hand lever pulls the cables. On units with a powershift transmission and a MONOTROL® pedal, the hand lever also actuates a switch (2). The switch deenergizes the circuit for the MONOTROL pedal and the forward and reverse solenoids when the parking brake is applied. The action of the switch puts the transmission in Neutral and makes the Start circuit complete. See FIGURE 7.1 for the parking brake arrangement for the S3.50-5.50XL (E70-120XL, E70-120XL$_3$).

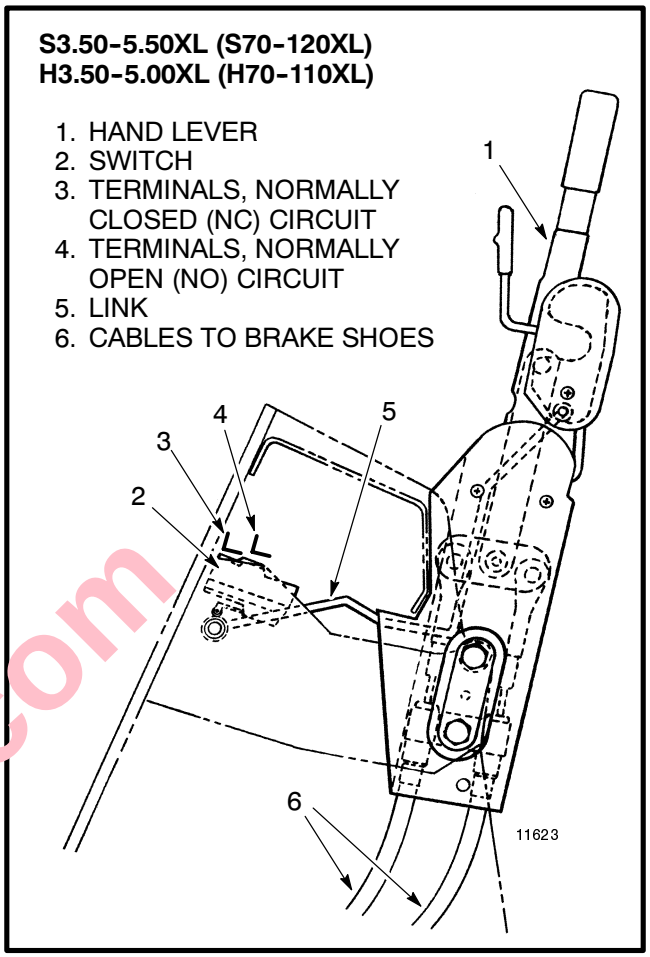


FIGURE 5. PARKING BRAKE ARRANGEMENT

REPAIRS

BRAKE SHOE ASSEMBLIES

Removal and Disassembly (See FIGURE 4. and FIGURE 6.)

⚠ WARNING

Brake linings can contain dangerous fibers. Breathing the dust from these brake linings is a cancer or lung disease hazard. Do not create dust! Do not clean brake parts with compressed air or by brushing. Use vacuum equipment approved for brake dust or follow the cleaning procedure in this section. When the brake drums are removed, do not create dust.

Do not sand, grind, chisel, hammer or change linings in any way that will create dust. Any changes to linings must be done in a restricted area with special ventilation. Protective clothing and a respirator must be used.

1. Tilt the mast back and put blocks under the outer mast weldment. Tilt the mast forward to raise the tires from the floor.

⚠ WARNING

Completely remove the air from the tires before removing them from the lift truck. Air pressure in the tires can cause the tire and wheel parts to explode, causing serious injury or death.

2. The wheels, hub and brake drum can be removed as an assembly. Make sure that you remove all the air pressure from the tires before you remove the wheels from the hub.

3. Remove the capscrews that the hold the axle shaft to the hub. Remove the axle shaft.

4. Remove the lock nut, lock plate and bearing adjustment nut from the axle housing. Remove the outer bearing cone. Remove the wheels, hub and brake drum as an

assembly. Remove the inner seals and bearing cone from the hub.

⚠ WARNING

When the brake shoes are removed do not create dust in the air. See the cleaning procedures in this section.

5. To loosen the brake shoes, turn the adjuster screw. Disconnect the anchor link and the actuator link. Remove the adjuster spring lever.

6. Use spring pliers to remove the shoe return springs.

7. Remove the three spring clips.

8. Remove the brake shoes from the wheel cylinder rods. Remove the adjuster screw spring. Remove the adjuster screw assembly.

⚠ CAUTION

The adjuster screw assemblies are not the same. Make sure that each assembly has identification for installation on the correct side of the axle.

9. Remove the parking brake cable from the lever. Remove the lever from the primary shoe.

10. Disconnect and put a cap on the line to the wheel cylinder. Remove the support flange and back plate. Remove the two cap screws that hold the wheel cylinder to the back plate. Remove the cable clamp and pull the cable through the back plate.

Cleaning and Inspection

Cleaning Procedures:

a. Do not release brake lining dust from the brake linings into the air when the brake drum is removed.

b. Use a solvent approved for cleaning of brake parts to wet the brake lining dust. Follow the instructions and cautions of the manufacturer for the use of the solvent. If a solvent spray is used, do not create dust with the spray.

3. When the dust is wet, clean the parts. Put any cloth or towels in a plastic bag or an airtight container while they are still wet. Put a "DANGEROUS FIBERS"s warning label on the plastic bag or airtight container.

d. Any cleaning cloths that will be washed must be cleaned so that fibers are not released into the air.

⚠ CAUTION

Do not use an oil solvent to clean the wheel cylinder. Use a solvent approved for cleaning of brake parts. Do not permit oil or grease in the brake fluid or on the brake linings.

Inspection procedures:

⚠ WARNING

Cleaning solvents can be flammable and toxic, and can cause skin irritation. When using cleaning solvents, always follow the recommendations of the manufacturer.

a. Clean all metal parts except the linings and the wheel cylinder with solvent.

b. Check the bore of the wheel cylinder for holes or scratches. Replace the wheel cylinder if there is any damage.

c. Check the return springs for damage. Inspect the back plate for wear where the brake shoes touch the back plate.

⚠ WARNING

The brake shoes on both wheels must be replaced if any shoe is damaged. The brake performance on both ends of an axle must be equal or the lift truck can be difficult to steer when the brakes are applied.

d. Inspect the brake shoes for cracks or damage. If the linings or shoes are worn or damaged, replace the brake shoes. It is recommended that brake shoes be replaced in complete sets.

e. Check the adjuster screw wheel for wear. Make sure the adjuster screw turns. Check for bent or broken adjuster links.

NOTE: If the brake drums require grinding, do not grind more than 1.5 mm (0.060 in) from the diameter. The maximum inside diameter of the brake drum, including wear, is 319.25 mm (12.57 in). If the brake drum is larger than this, replace the brake drum.

f. Inspect the brake drums for cracks or damage. Use sandpaper on the surface for the brake shoes.