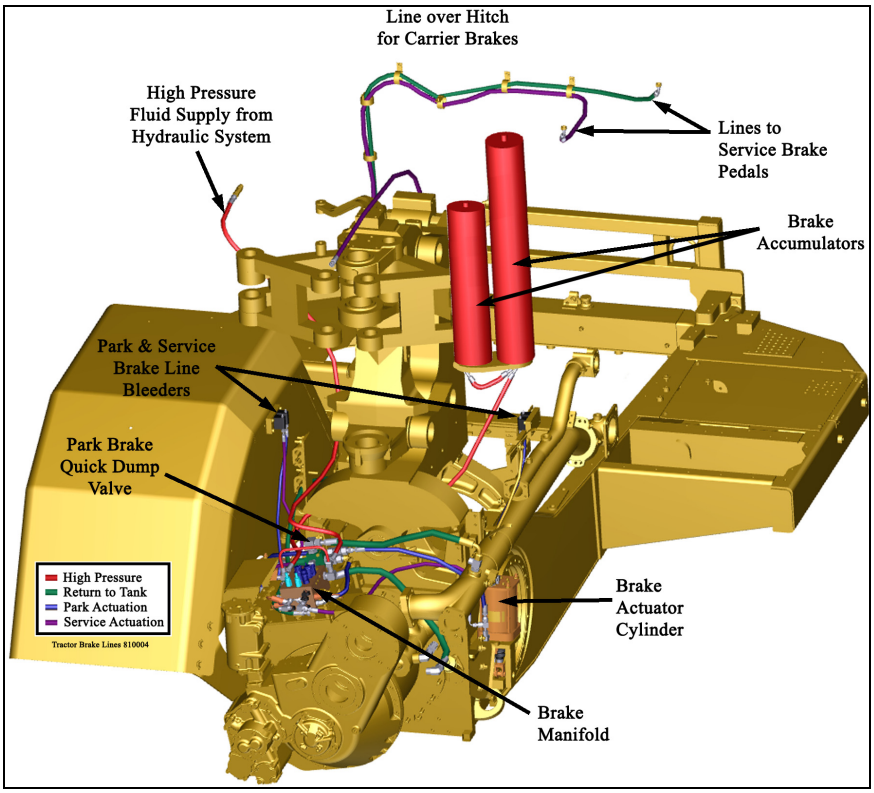
BRAKE SYSTEM, HYDRAULICALLY ACTUATED - 631G TRACTOR 194139

631 Cat Tractors with standard shoe/drum brakes

Kress Corporation modifies the Caterpillar tractor air actuated shoe brake system to a hydraulically actuated system. This eliminates the need for an air system on the vehicle. The hydraulic system eliminates the cold weather operating problem of air lines becoming clogged with frozen moisture condensation. The air components are all replaced with hydraulic components. The mechanical portion of the shoe brake remains the same having the same slack adjuster and linkage. Retaining these same components keeps the service and adjustment procedures of the tractor brakes very similar to the standard Cat tractors.

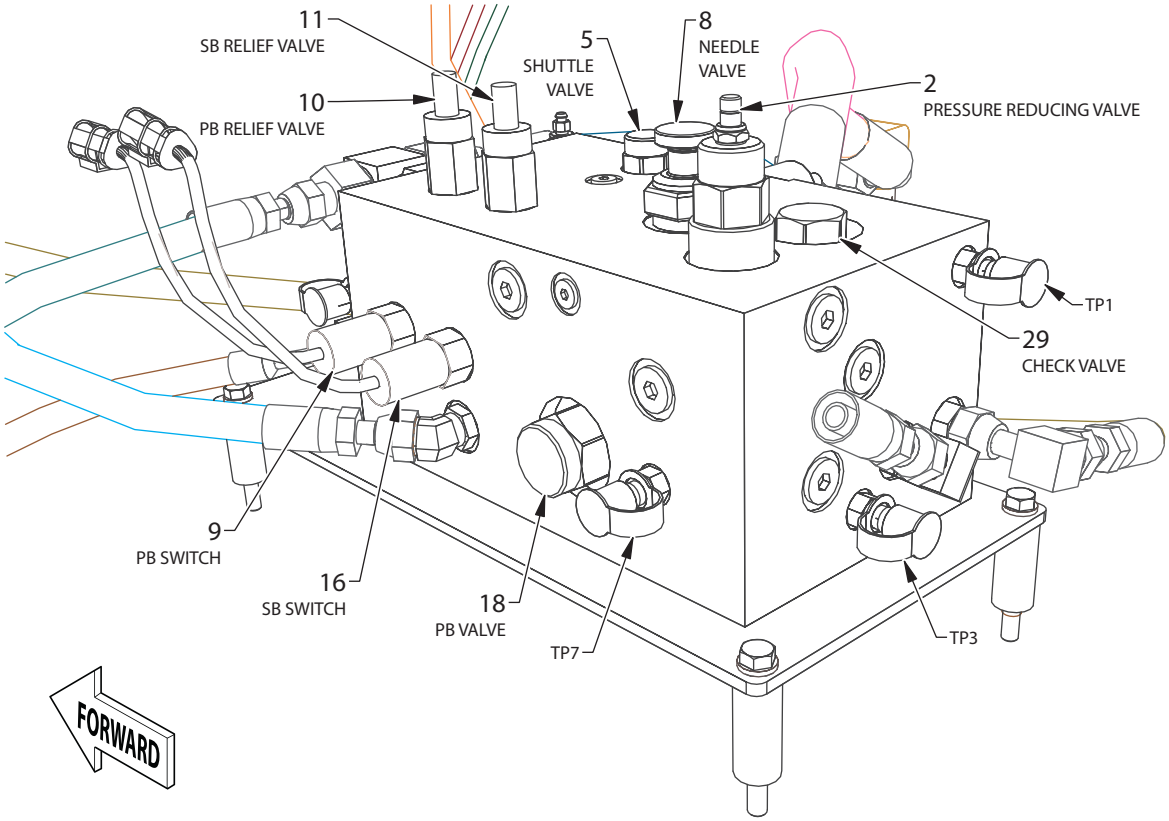
MAJOR COMPONENTS OF THE HYDRAULICALLY ACTUATED TRACTOR BRAKE CIRCUIT

Note: The numbers in parenthesis correlate to image on the next page and also on the foldout schematic page at the rear of this document.

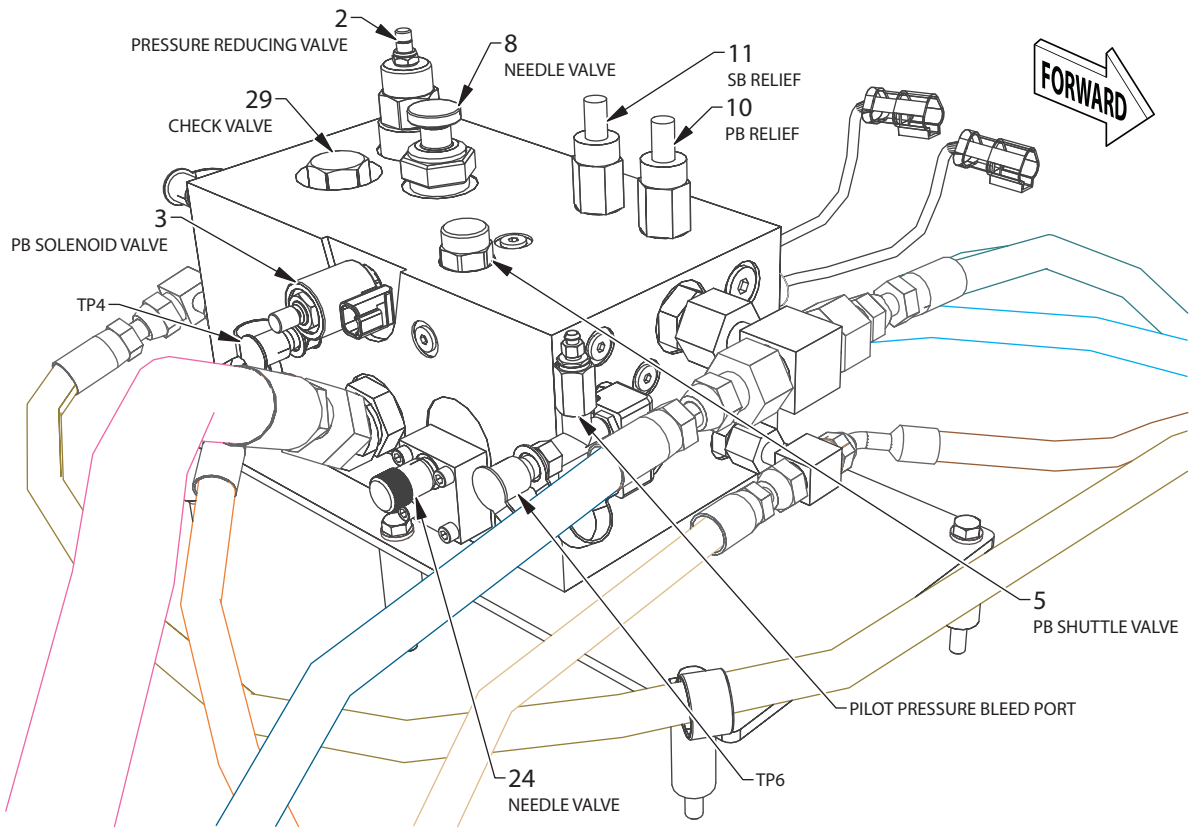


- Constant Pressure Piston Pump (cushion hitch pump set at approx. 2300 PSI [15858 kPa)])
- Filter (1) (3 micron)
- Service Brake Valve, Front (20)
- Service Brake Valve, Rear (19)
- Brake Accumulator (25) (pre-charged to 720 PSI - dry nitrogen [N_2])
- Tractor Park/Service Brake Actuator (13)
- Tractor Park/Service Brakes (14)
- Carrier Service Brakes (17)
- Brake Light Pressure Switch (18) (175 PSI actuation)
- Pump Outlet Pressure Transducer (21)
- Brake Manifold
    1. High pressure filter 3 micron absolute, full flow bypass and reverse flow.
    2. Pressure reducing/relieving valve 225 PSI (1550 kPa).
    3. Park brake pilot valve (controlled by the park brake switch located on the side dash board).
    4. Test port 7 used to measure/check the pressure reducing valve setting.
    5. Park brake shuttle valve. This valve is used to release the park brake when the service brakes are applied.
    6. Test port 6 used to measure/check the park brake pilot pressure (this port is also connected to a bleeder).
    7. Test port 4 used to measure the park brake pressure upstream of the needle valve.
    8. Needle valve (open for normal operation-used to lock the park brakes in the OFF position and to check the pressure reducing valve setting).
    9. Park brake pressure switch (175 PSI, 1207 kPa activation).
    10. Park brake pressure relief valve set at 300 PSI (2070 kPa).

11. Service brake pressure relief valve set at 1000 PSI (6900 kPa).
12. Test port 5 used to measure the park brake pressure and check the relief valve setting.
13. Brake actuator.
14. Drum brake assembly.
15. Test port 2 used to measure/check service brake pressure.
16. Service brake switch (175 PSI, 1207 kPa activation).
17. Service brake cylinders.
18. Park brake valve (controls the flow to and from the park brakes).
19. Rear service brake valve (pedal assembly).
20. Front service brake valve (pedal assembly).
21. Pressure transducer.
22. Shuttle valve.
23. Shuttle valve.
24. Brake Accumulator bleed-down valve. (Blow).
25. Brake accumulator 4 gallon, 720 PSI precharge (15 liter, 4900 kPa precharge).
26. Brake accumulator, 2.5 gallon, 720 PSI precharge (9.5 liter, 4900 kPa precharge).
27. Test port 1 used to check pump discharge and accumulator pressure.
28. Test port 3 used to check the park brake accumulator pressure in wet disc brakes systems (the park brakes and the service brakes have separate accumulators in wet disc brake systems).
29. Test port used to measure the service brake pressure at the carrier brakes.
30. Check valve.



BACKSIDE OF BRAKE MANIFOLD
LOCATED ON TOP OF TRANSMISSION



FRONTSIDE OF BRAKE MANIFOLD
LOCATED ON TOP OF TRANSMISSION

OPERATION

The explanation of the hydraulically operated 631G tractor brakes will be covered in three key areas of operation.

- High Pressure Fluid Circuit
- Park Brake Circuit
- Service Brake Circuit

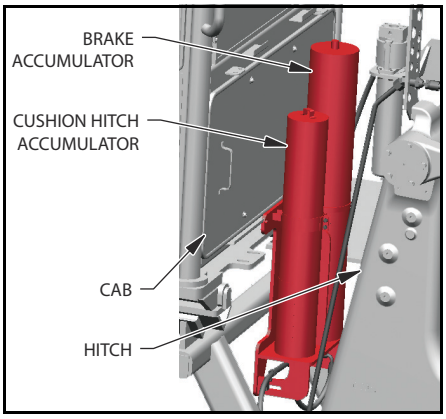
HIGH PRESSURE FLUID CIRCUIT

Upon engine startup, the constant pressure piston pump (same as cushion hitch pump) flows fluid to the Pall filter (1) at the rate of 9 gpm. This pump is normally set to approximately 2300 PSI (15858 kPa). The Pall filter has a 50 PSI bypass valve if the 3 micron element becomes clogged. Fluid from the filter flows to the Brake Manifold that is mounted on top of the transmission.

NOTE The fluid from the constant pressure pump can also go to additional circuits besides the brake circuit. These circuits could be cushion hitch circuit, pot lock circuit, carry arm circuit and other optional circuits depending on vehicle model and configuration.

The Brake Manifold disperses fluid to several hydraulic components including the brake accumulators (25 & 26), the pressure relieving needle valve (24), the park brake pressure reducing valve (2), the 3000 PSI pressure transducer (21) and the service brake pedals (19 & 20) in the operator's cab.

BRAKE ACCUMULATOR

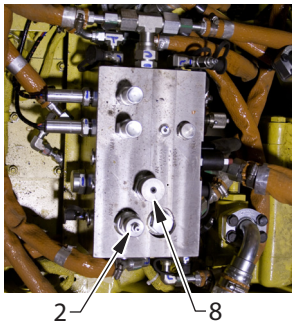


The 2½ & 4 gallon hydraulic brake accumulators are used to store fluid under pressure to ensure adequate operating fluid for the park and service brake circuits. These accumulators, which are mounted either on the left side of the hitch or directly behind the cab, will also help protect the circuit from pressure spikes if they were to occur. Precharge this accumulator with dry nitrogen (N_2) to 720 PSI (4964 kPa) with all hydraulic pressure relieved by opening the relieving needle valve (24).

ACCUMULATOR TESTING

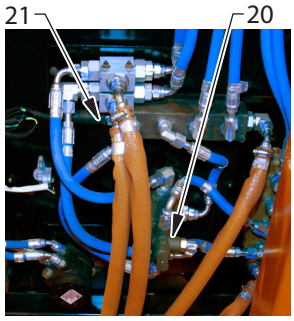
- Before testing the accumulator first ensure the nitrogen precharge is correct as stated above.
- Start the engine to build maximum accumulator hydraulic pressure. Check the pressure at Test Port 1 or 3 (26 or 27). Should be approx. 2300 PSI.
- Shut off the engine, release the park brake and repeatedly apply the service brakes. The service brakes should apply a minimum of 6 times with a minimum of 800 PSI remaining in the accumulator circuit. If this cannot be obtained determine the cause and repair as necessary.

PARK BRAKE PRESSURE REDUCING VALVE



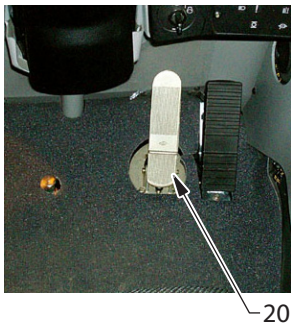
The park brake pressure reducing valve (2) receives approximately 2300 PSI fluid and reduces it to 225 PSI (1551 kPa) for use in the Park Brake circuit. This valve is adjustable. To check the output pressure of this valve attach a pressure gauge to test port TP4 (7) and close the needle valve (8) in the park brake circuit. Actuate the Park Brake control to release the Park Brakes and check the reading on the test gauge. Adjust as necessary to obtain a 225 PSI (1551 kPa) reading. Lock the adjustment screw and open the needle valve (8). Remove the test gauge.

3000 PSI PRESSURE TRANSDUCER



The pressure transducer (21) converts the input fluid pressure to an electrical signal that can be understood by the vehicle's electrical system so the pressure can be read on the screen in the cab. The transducer is shown at the right. It is screwed into the small manifold located under the cab by the front brake pedal (20).

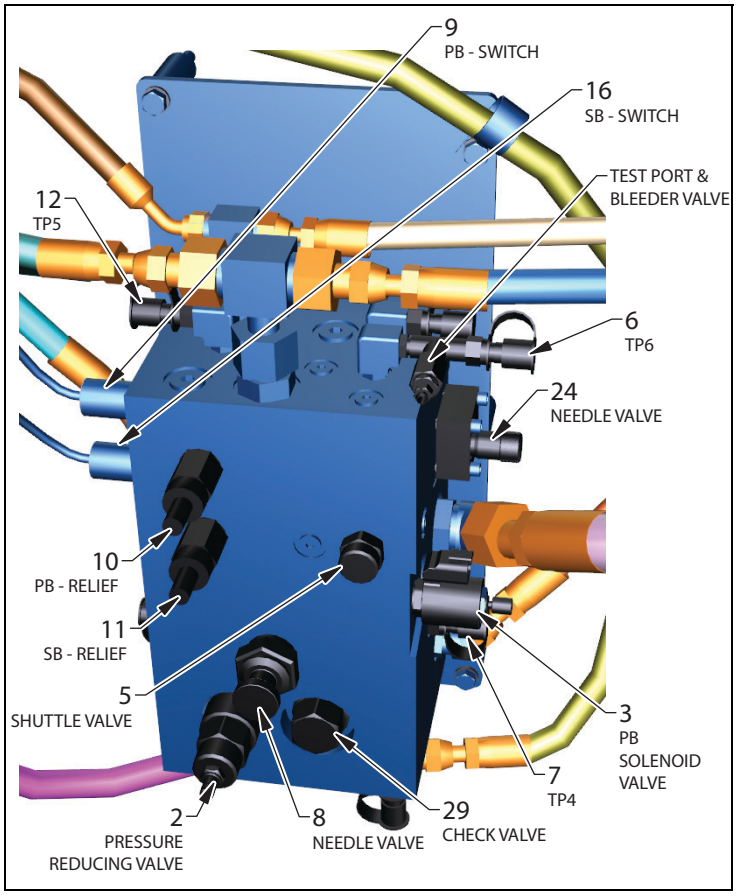
BRAKE PEDALS



The hydraulic brake pedals are located in the cab floor just to the right of the steering column (shown at right). The hydraulic valve portion of the brake pedal is below floor level where hoses can be connected outside the cabin as shown at right with the front brake pedal valve (20).

PARK BRAKE CIRCUIT

The Park Brake circuit receives operating fluid via the Pressure Reducing Valve which reduces the 2300 PSI (15858 kPa) pump supply to 225 PSI (1551 kPa) for use in the park brake circuit. This 225 PSI is used to overcome the spring force in the park brake assembly to release the park brake for vehicle operation.



The 225 PSI fluid supply is distributed within the brake manifold to the park brake valve (18) and the Normally Closed (NC) Park Brake Solenoid Valve (3). It then is routed to the Needle valve (8) where it is routed to each Park Brake chamber.

WARNING Before servicing the park brakes or disconnecting any lines in the park brake circuit, first shut down the engine and open the PB solenoid valve (3) to relieve any pressure in the circuit to the hydraulic tank.

SHUTTLE VALVE

The Shuttle Valve (5) is used to ensure that the Park Brakes are not applied at the same time that the Service Brakes are applied which could cause mechanical damage to the brake components.

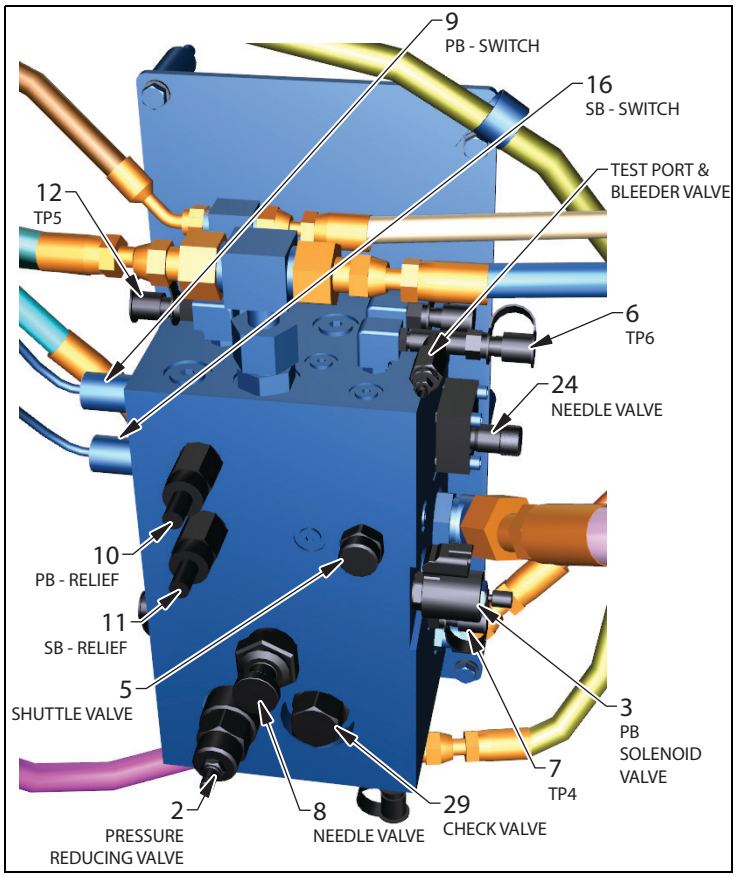
The Shuttle Valve is hydraulically actuated by a signal from the Service Brake circuit. When the park brakes are applied and no service brake pressure signal is being received by the directional valve, the directional valve spool is spring centered allowing the PB actuator to directly return to tank. This allows the springs in the park brake assembly to apply the park brake. Park brake pressure supply fluid 225 PSI (1551 kPa) is blocked by the shuttle valve. When the Service Brakes are applied a pressure signal to the shuttle valve shifts the park brake valve spool (18) and the 225 PSI park brake fluid is allowed to continue on to the park brake assembly to overcome spring force and release the park brakes at the same time the service brake fluid is applying the service brakes.

PARK BRAKE SOLENOID VALVE

The 3 way park brake solenoid valve (3) provides pilot pressure to the shuttle valve (5) which in turn actuates the park brake valve (18) by providing the required pilot pressure for the valve to shift. In the de-energized position the park brake is on, while in the energized position the park brake is off. The hydraulic fluid is provided directly from the brake accumulator.

PARK BRAKE SHUTOFF NEEDLE VALVE

The park brake shutoff needle valve (8) is to be open (turned fully counterclockwise) during normal vehicle operation to allow fluid to flow to and from the brake assemblies.



To check the park brake circuit pressure close the brake shutoff valve (turned fully clockwise), attach a pressure gauge to test port TP4 (7) and actuate the cab control to release the park brake. A reading of 225 PSI (1551 kPa) should be seen when the engine is running. If not, adjust the pressure reducing valve (2) to obtain this pressure.

If the vehicle is disabled and the park brake needs to be released, actuate the park brake solenoid valve (3) override knob by pushing it in then turning it counterclockwise until it pops out. Close the needle valve (8) to lock the pressurized fluid into the park brake actuator. The park brakes are now released. Alternatively, instead of using the override knob, the park brake can be released by applying the service brakes, then closing the needle valve (8). The disadvantage of this method is that it cannot be performed by a single operator.

The park brake will not release unless the accumulator contains enough fluid to perform this procedure.

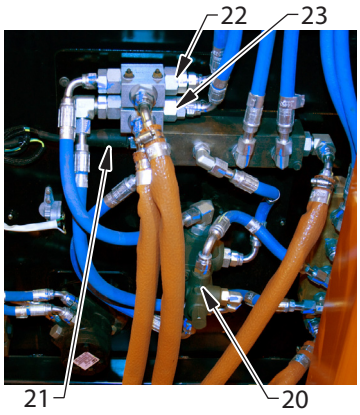
NOTE The Park Brake Relief Valve (10) is in the circuit to protect overpressuring of the brake components. This relief valve is factory set at 300 PSI (2068 kPa).

PARK BRAKE PRESSURE SWITCH

The Park Brake Pressure Switch (9) is factory set to actuate at 175 PSI (1207 kPa). When 200 PSI (1379 kPa) pressure is present in the park brake circuit to release the park brakes, the switch contacts will be open. When the pressure is relieved in the park brake circuit to apply the park brakes, the switch contacts will be closed and the indicator light in the cab dash will be illuminated to alert the operator.

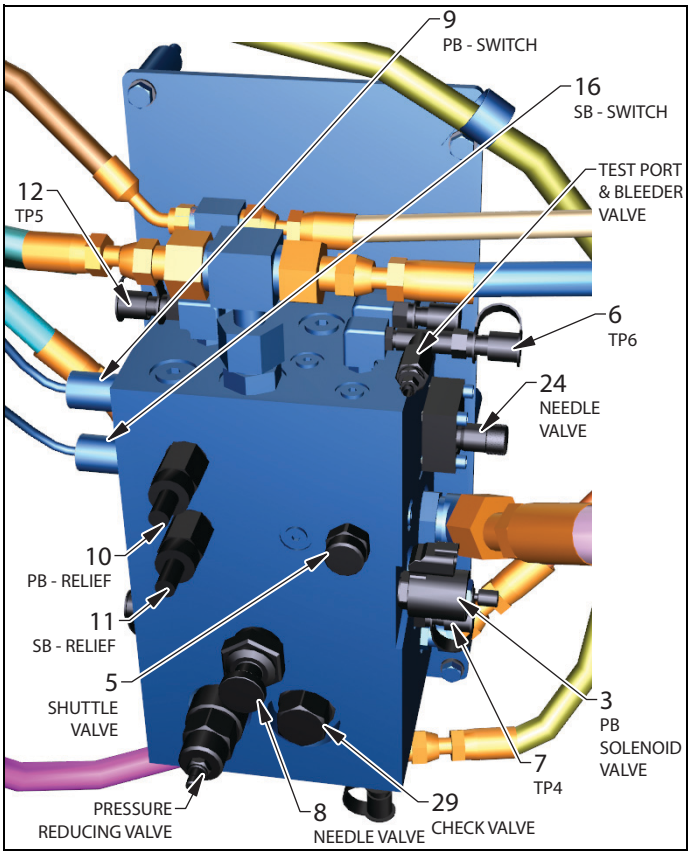
SERVICE BRAKE CIRCUITS

The Service Brake circuit receives operating fluid via the Cab Brake Pedal Valves (19, 20) which proportionally reduce the 2300 PSI (15858 kPa) pump supply to 535 PSI (3689 kPa) for use in the tractor service brake circuit and to 1810 PSI (12480 kPa) for use in the carrier service brake circuit. Two different pressures are needed because the tractor brakes use a cylinder to actuate the shoe brakes and the carrier brakes are calipers clamping onto a rotor. The brake pedal valves have dual chambers actuated simultaneously so the front and rear brakes will apply simultaneously.



The service brake pressure switch (16) and the retarder pressure switch (if the machine has a retarder) are in series and go into the Transmission/Chassis ECM. The switch tells the ECM when the service brakes are being applied. The ECM uses these inputs for throttle lock and control throttle shifting functions, among other things.

The park brake pressure switch (9) goes into the Transmission/Chassis ECM also. It splits and goes two places: the carrier park brake pressure switch input and the tractor park brake pressure switch input. The ECM uses these inputs to control the park brake solenoid.



On a standard air brake tractor, there are 3 air pressure sensors (dry tank, wet tank, and pilot tank). These air pressure sensors are used to tell the Transmission/Chassis ECM what the actual air pressure is at those 3 places. Based on those values, the following occurs:

- at around 120 PSI, brake indicator OK
- at around 70 PSI, the EMS service brake indicator will sound
- at around 43 PSI, the Transmission/Chassis ECM will apply the park brakes

Since the modified Kress tractors do not have air brake systems, a hydraulic pressure transducer (21) is used to read the brake supply pressure. That signal is sent into the IQAN which converts to the 4-20mA signal into a pressure (0-3000 PSI). A PWM signal is then generated at the appropriate level to approximate the 0 to 120 PSI PWM signal that the ECM is seeking. Three values are sent:

- at greater than 1200 PSI hydraulic pressure, the Transmission ECM is told that there is 120 PSI (everything is OK)
- at 900 to 1200 PSI hydraulic pressure, the Transmission ECM is told that there is 70 PSI (the EMS brake indicator will alarm)

- at less than 900 PSI hydraulic pressure, the Transmission ECM is told that there is 40 PSI (the Transmission ECM will apply the park brake)

WARNING Before servicing the brake pedals or disconnecting any lines to the brake pedals, first shut down the engine and open the Relieving Needle Valve (24) to relieve any pressure in the circuit to the hydraulic tank.

Front Service Brake Circuit

When the service brake pedal is depressed a maximum of 535 PSI (3689 kPa) fluid is delivered to the front shuttle valve (22). The shuttle valve will then direct the fluid on to the front service brake circuit. This shuttle is connected to both the front brake pedal (20) and the rear brake pedal (19) so whichever pedal is being used will actuate the service brakes. Check application pressure at TP2 on the brake manifold.

The fluid travels to the PB valve (18), the Service Brake Relief Valve (11), the Service Brake Pressure Switch (16) and to the Service Brake assemblies (13).

Park Brake Valve

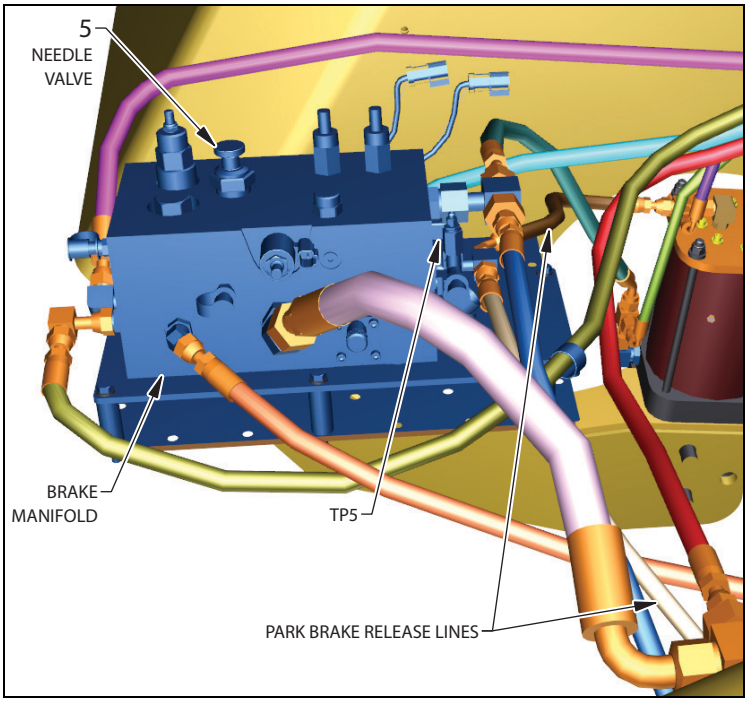
The fluid to the PB valve (18) located on the brake manifold under TP1 provides signal pressure to actuate the valve to release the Park Brake if it is not already released. This prevents component damage resulting from both the Park and Service brakes being applied at the same time.

Service Brake Relief Valve

The fluid also goes to the Service Brake Relief Valve (11) which will relieve pressure in the front service brake circuit above 1050 PSI (7239 kPa) to protect the brake components.

Service Brake Pressure Switch

The Brake Pressure Switch (16) is factory set to actuate at 175 PSI (1207 kPa) fluid pressure. This switch provides a signal to the electrical system when the service brakes are applied.



Test Port TP2

Test port TP2 (15) located on the brake manifold can be used to check the application pressure of the tractor service brakes. Attach a test gauge to this port and apply the service brakes with the engine running. There should be a reading of 535 PSI (3689 kPa) when the service brake pedal is fully depressed.

Towing

If accumulators are charged: twist and turn the manual override of the park brake solenoid valve (3). Close the needle valve

(8). OR: step on the service brake pedal and while the pedal is depressed, close the needle valve (8).

Without accumulator pressure: see slack adjuster procedure (page 10).

If an external power supply is used to release the PB, connect the supply to TP5 and close the needle valve.

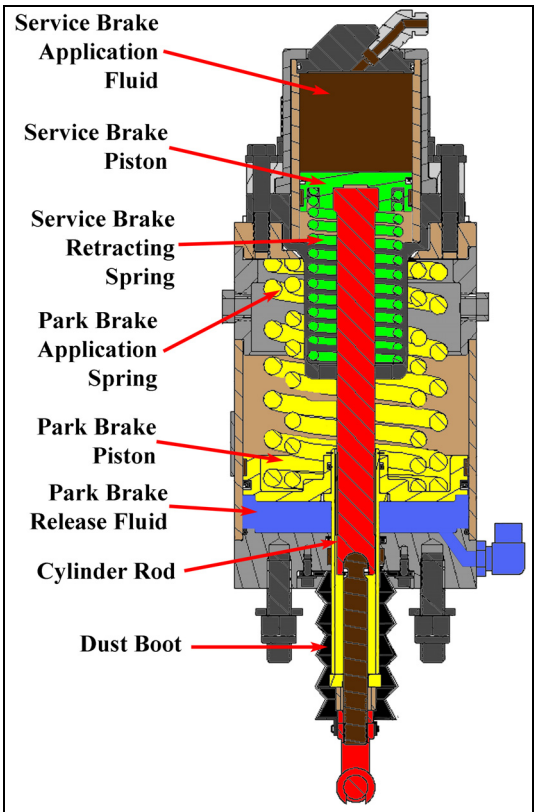
Once the system is pressurized the connection at TP5 will need to stay until the brakes can be de-pressurized after towing is complete.

If none of the above methods will release the PB, then adjust the Slack adjusters until the yole pins are loose.

BRAKE ACTUATOR CYLINDER

The brake actuator cylinder shown at right performs the functions of both the Park Brake and the Service Brake.

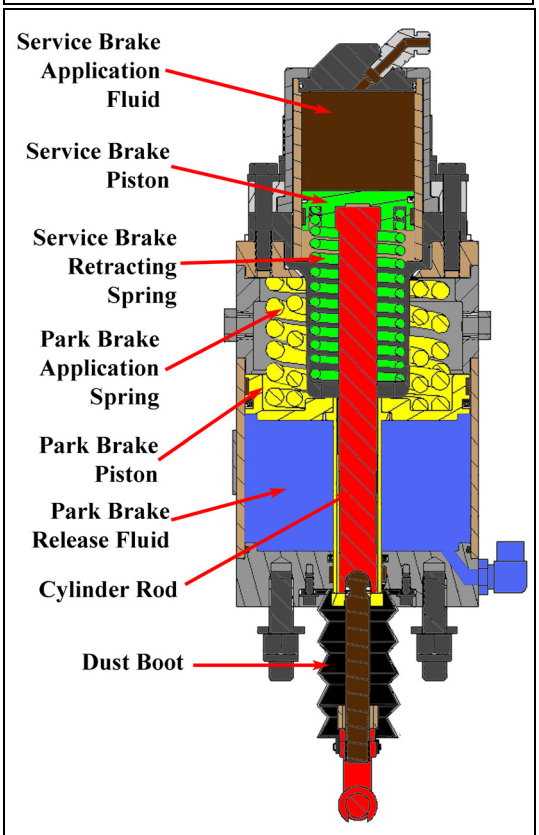
The Park Brake Piston (yellow) and associated tube (also yellow) around the cylinder rod are pushed downward by the Park Brake Application Spring (yellow) which pushes the cylinder rod down to apply the tractor's shoe brakes. (see Figure 1 at the right)



Park Brake Applied
Figure 1

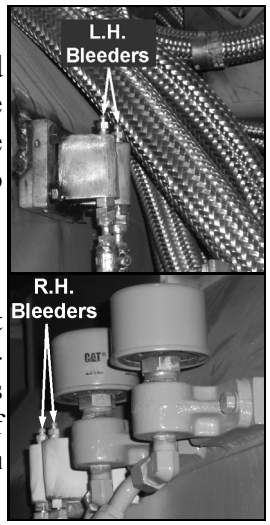
To release the Park Brake, fluid (blue) is introduced under the park brake piston which forces the piston up compressing the park brake spring. At the same time the Service Brake Retracting spring is forced up which pushes the Service Brake Piston and attached cylinder rod to release the tractor's shoe brakes.

To apply the Service Brakes, fluid (brown) is introduced on top of the service brake piston (green) which forces the piston down and the attached cylinder rod to apply the tractor's shoe brakes. (see Figure 2 below)



Service Brake Applied
Figure 2

When the service brake actuation fluid pressure is released, the service brake spring (green) pushes the service brake piston and attached cylinder rod up to release the tractor's shoe brakes.



BRAKE BLEEDERS

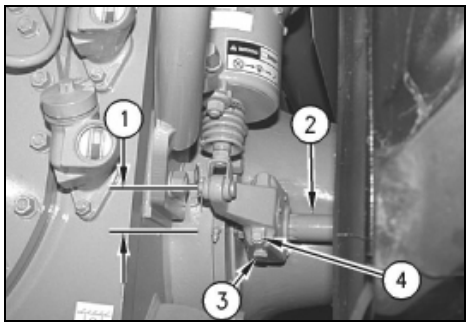
Bleeders are provided to bleed any air that might be present in the lines to the park/service actuator cylinders. These bleeders (shown at right) are located on the inside of the RH and LH tractor fenders. (**Park** toward **front**; **Service** toward **rear**)

Release the Park Brake and open each park brake bleeder until an air free stream of fluid is seen and then close the bleeder.

Repeat this procedure with the other two bleeders by actuating the service brakes to purge the air from the lines. Also, when bleeding the service brakes open the bleeder on the Brake Manifold to bleed any air from those passages.

Perform this bleeding procedure during the monthly testing of these brakes if they have slower than normal response time.

Slack Adjusters



The slack adjusters that the brake actuator cylinders connect to are standard Caterpillar components and are to be adjusted as stated in the Caterpillar Service Manual for this tractor. The following was taken from the Caterpillar 631G Service manual.

- Measure movement (1) of the slack adjuster at the pin when the brakes are applied. If the movement is 64 mm (2.5 inch) or more, adjust the brake.
- Loosen lock bolt (4). Turn adjusting shaft (3) so that shaft (2) turns in the braking direction. Adjust the shaft in order to limit movement (1) to 41.1 mm (1.62 inch).
- Tighten lock bolt (4).

Adjustable Components of the Brake System

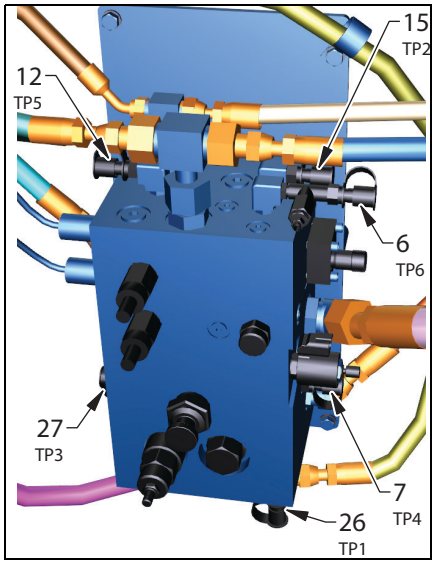
- Park Brake Pressure Reducing Valve (2): 225 PSI (1551 kPa)
- Accumulator (25) Nitrogen (N_2) Precharge: 720 PSI (4964 kPa)
- Cushion Hitch CP Piston Pump: 2300 PSI (15858 kPa)

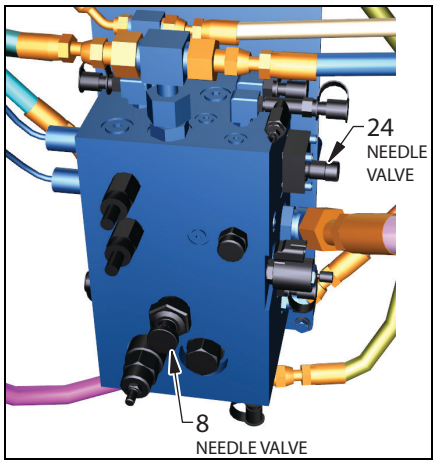
Non-Adjustable Components of the Brake System

- Park Brake Relief Valve (10) *(factory set)*
- Service Brake Relief Valve (11) *(factory set)*
- Brake Pedal Valves (19, 20) *(factory set)*

Ports to Test Pressures

- TP1 (26) (pump supply pressure to system)
- TP2 (15) (Service delivery pressure)
- TP3 (27) (pump supply pressure to system)
- TP4 (7) (Park Brake PSI between solenoid valves (4, 5) and Park Brake Shutoff Needle Valve (8)
- TP5 (12) (Park Brake PSI between Park Brakes (13, 14) and Park Brake Shutoff Needle Valve (8)





Pressure Transducer

- 3000 PSI Pressure Transducer (21)

PRESSURE SWITCHES

- Brake Light Switch (18) (175 PSI) *(optional)*
- Service Brake Pressure Switch (16) (175 PSI)
- Park Brake Pressure Switch (9) (175 PSI)

MANIFOLD NEEDLE VALVES

- Park Brake Shutoff Needle Valve (8) (To be **open** during normal operation. During maintenance it can be closed to check and/or set the park brake PSI reducing valve.)
- Accumulator Pressure Relieving Needle Valve (24) (To be **closed** during normal operation. During maintenance it can be opened to relieve pump & accumulator pressure for servicing the manifold and circuit.)

TROUBLESHOOTING INFORMATION

The chart below will provide troubleshooting information **only for the modified Caterpillar 631 hydraulic tractor brake circuits** by giving problem symptoms, areas to check and possible solutions to the problems. The numbers in parenthesis (4) are shown in the illustrations on the previous pages and also in the schematic at the end of this document. Information on carrier brakes is in separate documents.

NOTE The fluid from the constant pressure pump can also go to additional circuits besides the brake circuit. These circuits could be cushion hitch circuit, pot lock circuit, carry arm circuit and other optional circuits depending on vehicle model and configuration. If pressure loss is being experienced, ensure the other circuits from the CP pump are functioning properly also.

SYMPTOMS	DIAGNOSTIC CHECKS	SOLUTION
Park Brakes		
PARK BRAKE WILL NOT RELEASE	**A.** Does test port TP1 show 2300 PSI (15858 kPa) when engine is running?	**If yes**, this indicates the pump is working so go to next check. **If no**, check for possible leaks, or repair or replace the pump and retest.
	B. Does test port TP5 (12) show 225 PSI (1551 kPa) when the park brake switch is actuated in the cab?	**If yes**, go to next check. **If no**, then check for line leaks to the tractor brake cylinders, mechanical failures in the valves and the actuator cylinders and proper adjustment of the slack adjusters.
	C. Is the shutoff needle valve (8) closed (turned fully clockwise)? It should be open.	**If yes**, then open the valve and retest. **If no**, then go to next check.
	D. Is the PB solenoid (3) receiving a 24 volt signal when the park brake switch is actuated?	**If yes**, go to next check. **If no**, determine the cause, repair as necessary and retest.
	E. Close the shutoff needle valve (8) and check at test port TP4 (7) to see if 225 PSI (1551 kPa) when the park brake switch is actuated in the cab	**If yes**, go to next check. **If no**, then check the park brake relief valve (10) to see if the valve relieves below 300 PSI. Trobleshoot and repair the pressure relief valve.

SYMPTOMS	DIAGNOSTIC CHECKS	SOLUTION
PARK BRAKE WILL NOT RELEASE (continued)	**G**. Is the PB valve (18) allowing fluid to flow to the solenoid valves (4, 5)? Check this first to ensure the accumulator is charged at TP1 with the engine shut off. Then with the engine off, open the park relieving needle valve (3) and listen for fluid flowing back through the needle valve. Is the sound of fluid flowing back to tank present at the pressure reducing valve with the needle valve open?	**If yes**, then check, repair, adjust or replace the pressure reducing valve (2). **If no**, then check, repair or replace the solenoid valves (3) or shuttle valve (5).
PARK BRAKE WILL NOT APPLY	**A**. Do the service brakes function properly?	**If yes**, go to next check. **If no**, then check the slack adjusters for proper adjustment.
	B. Is the shutoff needle valve (8) closed? It should be open.	**If yes**, then fully open it by turning fully counter-clockwise and retest. **If no**, then go to next check.
	C. With the engine shut off, did the park brakes apply?	**If no or applied slowly**, then check the PB valve (18), and shuttle valves (3,5) as it may be stuck in the actuated position allowing park brake fluid to the actuation cylinders. **If yes,** repair or replace as necessary.
Service Brakes		
SERVICE BRAKES WILL NOT APPLY	**A.** Does test port TP1 show 2300 PSI (15858 kPa) when engine is running?	**If yes**, this indicates the pump is working so go to next check. **If no**, then check to ensure the relieving needle valve (24) is closed before repairing or replacing the pump. If the needle valve was open, close it and retest.
	B. Does one of the brake pedals (front or rear) work, but not the other?	**If yes**, then check the service shuttle valve (22) and the non-functioning brake pedal valve for damage and/or contamination. Repair or replace as necessary. **If neither pedal functions**, then go to next check.
	C. Do the service brakes on the carrier work, but not the tractor with one of the pedals?	**If yes**, then repair or replace the pedal valve (19, 20) that is not functioning. **If no**, neither pedal will actuate the tractor brakes, then go to the next check.

SYMPTOMS	DIAGNOSTIC CHECKS	SOLUTION
SERVICE BRAKES WILL NOT APPLY (continued)	**D**. With one of the brake pedals fully depressed, is approximately 535 PSI (3689 kPa) present at test port TP2 (15)?	**If yes**, then check for mechanical damage to the brake actuator cylinders and proper slack adjuster adjustment. Repair as necessary. **If no**, then check the service brake relief valve (11) for damages. Repair, replace or adjust as necessary and retest.
SERVICE BRAKES WILL NOT RELEASE	**A**. Is the Park Brake switch in the actuated position?	**No**, then go to next check. **Yes**, then deactuate the Park Brakes and retest.
	B. Is hydraulic pressure present at test port TP2 (15)?	**If no**, then check for proper slack adjuster adjustment and if that is correct, the check the actuator cylinders for damages. Repair or replace as necessary. **If yes**, then one of the brake pedals is not fully returning or its valve is damaged and letting fluid bypass. Repair or replace as necessary.

Front Park/Service Brakes

PARK BRAKE DOES NOT RELEASE	**A.** Is the needle valve closed?	Verify needle valve is open. open if required
	B. Is the park brake relief valve set too low or stuck open?	Measure pressure at TP5 and reset or replace park brake relief valve as required.
	C. The PBV does not have enough pilot pressure to shift.	Install pressure gauge at TP6 and step on the service brake. If pressure is zero or too low, install a second gauge at TP2 and measure pressure. If pressure at TP2 is within normal range, replace the shuttle valve. If not, troubleshoot the service brake valves. actuate the manual override of the park brake solenoid valve. If the pressure at TP6 is still zero or low, replace the solenoid valve body. If the pressure is normal troubleshoot the wiring and the solenoid and replace parts as necessary. If the PBV has enough pilot pressure to shift BU the park brake does not release, repleace the PBV.
	D. Is the pressure reducing valve set too low or stuck open?	Reset or replace the pressure reducing valve as required, following the instrucitons given in the setting and adjustments section.
	E. Is the blow down valve open?	Verify the blow down valve is closed. closed if required.
PARK BRAKE IS SLOW TO COME ON/OFF	**A**. Is the needle valve not opened fully.	Verify needle valve is fully opened. Open if required

SYMPTOMS	DIAGNOSTIC CHECKS	SOLUTION
	B. The PBV is not shifting properly.	Verify the PBV pilot pressure is within range by using the procedure above. If pilot pressure is within range, replace the PBV.
	C. The pressure reducing valve is set incorrectly or not functioning.	Check the pressure reducing valve setting and replace if necessary.
PARK BRAKE IS SLOW TO COME ON/OFF (continued)	**D**. Park Brake Relief Valve is Bypassing.	The park brake relief valve PPRV set at 300PSI. Measure with a pressure gauge at TP5. This valve should be adjusted at zero flow (cracking pressure) from the factory to the Kress specifications. If it is found to be out of tolerance, or if it is replaced with a valve that has not been pre-set, the following steps should be followed: - Install the valve in a test block (manufactured or purchased from Sun Hydraulics with a T-3A cavity) - Connect the bottom port of the valve (block) to the pressure port of a hand or power hydraulic unit equipped with a pressure gauge, and the side port of the valve (block) to tank. - Remove protective cap, and turn the valve adjustment screw all the way in. - Using the hand or power portable unit, pressurize the bottom port of the valve. - If using a hand pump, build the pressure up until the gauge reads 300PSI and turn the adjustment screw counterclockwise until the relief valve cracks open. - If using a power unit, set the output pressure to 300PSI, turn the unit ON and after the set pressure has bean reached turn the adjustment screw counterclockwise until the relief valve cracks open. - Remove the relief valve and assemble into the brake manifold.

SYMPTOMS	DIAGNOSTIC CHECKS	SOLUTION
ACCUMULATORS DO NOT CHARGE OR CHARGE SLOWLY	**A**. Are the service brake valves leaking?	Verify the blowdown valve is closed.
	B. Opened blowdown valve.	Troubleshoot and repair the service brake valves as required.
	C. Is the pressure reducing valve is stuck open?	Adjust the pressure reducing valve as described in the previous section. Replace the pressure reducing if necessary.
SOFT SERVICE BRAKE PEDAL FEEL OR WEAK SERVICE BRAKES	**A**. Is the service brake relief valve incorrectly set or defective?	Set the relief valve as described in the previous section. Replace if required.