SYSTEMS OPERATION
TESTING AND ADJUSTING

920 St 930 WHEEL LOADER
AIR SYSTEM AND BRAKES

SERIAL NUMBERS

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INTRODUCTION

This publication has instructions and procedures for the subject on the front cover. The information, specifications, and illustrations in this publication are on the basis of information that was current at the time this issue was written.

Correct operation, maintenance, test and repair procedures will give this product a long service life. Before starting a test, repair or rebuild job, the serviceman must read the respective sections of the Service Manual, and know all the components he will work on.

Your safety, and the safety of others, is at all times very important. When you see this symbol or this symbol in the manual, you must know that caution is needed for the procedure next to it. The symbols are warnings. To work safely, you must understand the job you do. Read all instructions to know what is safe and what is not safe.

It is very important to know the weight of parts. Do not lift heavy parts by hand. Use a hoist. Make sure heavy parts have a good stability on the ground. A sudden fall can cause an accident. When lifting part of a machine, make sure the machine has blocks at front and rear. Never let the machine hang on a hoist, put blocks or stands under the weight.

When using a hoist, follow the recommendation in the manual. Use correct lift tools as shown in illustrations to get the correct balance of the component you lift. This makes your work safer at all times.

NOTE: The "C" is an indication of a change from the former issue.
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## SPECIFICATIONS

NOTE: For Specifications with illustrations, make reference to SPECIFICATIONS FOR 920 & 930 AIR SYSTEM AND BRAKES, Form No. SENR7413. If the Specifications in Form SENR7413 are not the same as in the Systems Operation and the Testing and Adjusting, look at the printing date on the back cover of each book. Use the Specifications in the book with the latest date.
AIR SYSTEM AND BRAKES

The engine driven air compressor delivers air to the reservoir with the pressure controlled by the air compressor governor. The governor is mounted on the compressor and causes the compressor to cut-in and cut-out as air is required. An electric warning system informs the operator of low air pressure, and an emergency brake system applies the emergency brake if the air pressure becomes dangerously low.

Compressed air provides only the power to actuate the hydraulic system of the hydraulic disc brakes. When the service brakes are applied, the air chamber rods extend pushing against the hydraulic master cylinder pistons. Oil flows from the master cylinders and applies the service brakes.

AIR FLOW

Compressed air flows from the reservoir (9) to the two service brake control valves, (4) and (7). Air flows directly through the lower chamber of the left control valve (4) to the horn valve (5). Air flows through the lower portion of the right control valve (7) to the emergency and parking brake control valve (18). With the air pressure in the normal operating range and the emergency and parking brake control valve in the RELEASED (pushed in) position, air will flow through the valve to the emergency and parking brake chamber (22) where the air pressure compresses the spring and releases the emergency and parking brake. If the control valve is in the APPLIED (pulled out) position, the line to the emergency and parking
The hydraulic disc brake for each axle consists of the hydraulic master cylinders (15) and (17), connecting lines, and the brake assemblies (3). The hydraulic brake fluid reservoir is an integral part of each master cylinder. Each reservoir fluid level must be maintained separately on machines 62K1 thru 62K2778 and 41K1 thru 41K1827. On machines 62K2779-Up and 41K1828-Up the hydraulic brake fluid reservoirs for the master cylinders (15) and (17) are connected to reservoir (23). To prevent an air lock from developing in the master cylinders, the fluid must always be visible in the reservoir (23). When the brake pedal is pushed, the air chamber rod extends and pushes the master cylinder piston. Piston movement creates brake line pressure which is transmitted to the disc brake pistons causing them to push the friction pads against the disc.

Releasing the brake pedal relieves the air pressure acting against the master cylinder. The master cylinder piston retracts and relieves hydraulic pressure from the brake pistons. The pistons and pads are not spring returned, but merely release their grip on the disc. The pads remain very close to the disc. Since the pads move only far enough away from the discs to release, no adjustment is required to compensate for pad wear. Due to the close running clearance, the pads keep the discs clean.

**ELECTRIC WARNING SYSTEM**

A buzzer and a visible indicator warn of low air pressure. The buzzer and indicator switches sense pressure in the line from the emergency and parking brake control valve to the emergency and parking brake chamber. The pressure switch (20) for the buzzer is closed (current flows and the buzzer sounds) when the pressure is below 70 to 80 psi (480 to 550 kPa). The indicator pressure switch (21) is closed (current flows and the indicator appears green) when the pressure is above 70 to 80 psi (480 to 550 kPa). The low pressure indicator is mounted on the dash and shows the red side of a magnetic ball when the pressure is low. When the pressure is high enough for safe operation, the switch is closed and current flows to the indicator. The current flow energizes an electromagnet and causes the ball to turn and expose the green side.

Since the pressure switches are mounted downstream from the emergency brake control valve, the buzzer will sound and the indicator will show red, regardless of system air pressure, whenever the emergency brake control valve is in the APPLIED (pulled out) position. However, with the valve pushed in and the pressure descending, the buzzer sounds and the indicator shows red before the emergency and parking brake applies. This is due to the control valve’s lower actuating pressure.

**SYSTEM COMPONENTS**

**Air Compressor and Reservoir**

The air compressor is mounted on the engine and driven by the engine timing gears. The air compressor governor controls operating pressure. It is mounted on the compressor and can be adjusted to raise or lower the compressor operating range.
A safety relief valve prevents damage to the air system if the compressor governor should fail. The safety relief valve is mounted on the reservoir and opens when air pressure reaches 150 psi (1030 kPa).

Brake Control Valve

Two brake control valves are used in the braking system. The operation is the same for each valve.

When the brake control valve treadle is depressed, a force is exerted on seat (1). The force compresses rubber spring (2) and moves piston assembly (3) downward. The exhaust valve seat (7) contacts and closes exhaust port (12) in valve (9). Continued downward movement of the piston assembly pushes the valve (9) off inlet valve seat (8). Pressure air from inlet port (13) passes around the valve and out through outlet port (5). Air travels to the double check valve, air chamber and transmission neutralizer control valve when the left brake treadle is depressed, or the double check valve and air chamber when the right brake treadle is depressed.

When the air pressure below piston assembly (3) becomes greater than the force exerted above the piston, the piston lifts sufficiently to permit valve (9) to move upward and seat. This blocks off further supply of pressure air. Piston assembly (3) remains seated against valve (9), preventing any loss of air pressure through exhaust port (12). Thus, the brake control valve is in a balanced position and air pressure is held in the lines and air chambers.

If the treadle is partially raised, mechanical force above piston assembly (3) is decreased. The greater force below the piston assembly, exerted by pressure air and spring (6), lifts the piston assembly, unseating it from valve (9). Pressure air in the lines and air chambers is permitted to escape past exhaust diaphragm (14) until forces above and below the piston are balanced. When the treadle is completely raised, piston assembly (3) will remain unseated from valve (9), exhausting all pressure air to atmosphere and releasing the brakes. Valve (9) is held in its seat by valve spring (11).

Double Check Valve

The double check valve prevents air delivered by one service brake control valve from entering the
delivery circuit of the other control valve.

Air from the right service brake control valve passes into one side of the double check valve and air from the left service brake control valve passes into the other side. Air entering from either control valve passes out through one delivery port.

Applying the left control valve sends air to the transmission neutralizer and into the double check valve. Air pushes the shuttle against the port leading to the right control valve, sealing that port, and flows to the air chambers.

Applying the right brake moves the shuttle against the left port, blocking air flow to the transmission neutralizer valve and allows the air to flow only to air chambers.

**Air Chambers and Hydraulic Master Cylinders**

The two air chambers actuate the pistons of the hydraulic brake master cylinders. Compressed air in the brake chamber acts against the diaphragm and extends the rod. When the rod extends, it pushes the hydraulic master cylinder piston. A spring returns the diaphragm when the air pressure is released.

The hydraulic brake fluid reservoir is an integral part of each master cylinder. With the master cylinder piston retracted, oil flows from the reservoir into the cylinder. When the piston moves it covers the port from the reservoirs and traps the fluid in the cylinder. The trapped oil is pushed out of the cylinder and into the brake lines.

The brake fluid displaced by the master cylinder piston causes the brake pistons to extend and apply the brakes. When the apply force is released, a spring returns the master cylinder piston and the brake fluid returns to the reservoir.

**CAUTION:** Always bleed air from the hydraulic brake system when a line has been disconnected.

**Wheel Brake and Head Assembly**

**DISC BRAKE COMPONENTS**

Hydraulic pressure in the head assembly acts on pistons to force friction pads against discs to provide wheel braking. The discs revolve with the wheel hubs and the head is mounted on the axle flange. The head assembly for each wheel on the 930 Wheel Loader has one friction pad assembly and two pistons on each side of each disc. The head assembly for each wheel on the 920 Wheel Loader has one friction pad assembly and one piston on each side of each disc. The friction pads are bonded to a metal backing. The friction pad assemblies are held in place by anchor pins.

CAUTION: To prevent damage to pistons and seals, do not apply brakes when brake pads are removed.

When the brakes are applied, hydraulic pressure forces the pistons against the pads. The pads move out against the discs to produce braking for the machine.

When the brakes are applied, the hydraulic pressure balances the pistons and the force exerted on each side of the disc is equal. The pistons do not have return springs.

The pads may be replaced without removing the head by removing the anchor pin and sliding the pad out.

CAUTION: Do not apply brakes with pads removed. The pistons must not be allowed to extend out of their bores with the pads removed. Open the bleed valves on the head to relieve any pressure acting on the pistons. If the pistons should extend and expose the seals, head removal will be required to reinstall the pistons.

Two bleed valves on each head are used to bleed air from the hydraulic brake system. Bleed the brakes whenever a line is disconnected in the hydraulic brake circuit.

Emergency and Parking Brake

WARNING: The emergency and parking brake prevents only the drive shaft from turning. Therefore, differential action will allow the machine to articulate with the parking brake applied. Always place the safety bar in LOCKED POSITION before working beneath machine.

The emergency and parking brake prevents the drive shaft from turning whenever air pressure to
the emergency brake chamber is below a safe operating level. A brake drum with expanding shoes is mounted on the drive shaft.

The air brake chamber actuates the expanding shoes. The brakes are spring applied and air released. The spring force retracts the brake chamber rod pulling the brake lever UP to APPLY the brake. Air pressure acts on the diaphragm to compress the spring, extend the brake chamber rod, and push the brake lever DOWN to RELEASE the brake.

Emergency and Parking Brake Control Valve

The dash-mounted emergency and parking brake valve controls the supply of air to the emergency and parking brake chamber. With the valve pulled out, the line to the emergency parking brake chamber is vented to atmosphere. With the valve pushed in, air flows from the reservoir into the emergency and parking brake chamber and releases the brake.

FLOW OF AIR WITH PARKING BRAKES APPLIED

With the air reservoir discharged, the emergency and parking brake control valve will be in the APPLIED position. [Knob (1) pulled out.] Valve (8) will be seated against upper face of valve body (2) sealing off pressure air supply to outlet port (5), and exhaust port (7). Air pressure in the reservoir is allowed to build to the operating range.

When the air pressure gauge registers in the operating range, the operator must push in and hold knob (1) on the emergency and parking brake control valve to release the parking brake. Pressure air from the reservoir enters the valve through inlet port (6), passes through orifice (4), and outlet port (5) to the brake chamber, releasing the parking brake. Air pressure then holds valve (8) seated over exhaust port (7).

FLOW OF AIR WITH PARKING BRAKES RELEASED

In the event of an air system failure or if the pressure drops below 40 + 5 psi (280 ± 35 kPa) spring (3) will unseat valve (8) exhausting pressure air to the atmosphere and will apply the emergency and parking brake.

ORIFICE CHECK VALVES

The check valves are used in the air lines between the left brake control valve and double check valves. The check valves allow the transmission to engage before the brakes fully release. The brake release delay is caused by the restricting orifice in the valve (4).

CHECK VALVE CONSTRUCTION
Tools Needed: 8M2885 0 to 200 psi (0.0 to 1380 kPa) Pressure Gauge, 5P3100 Pump Group, and 8F24 Hose Assembly.

WARNING: The emergency and parking brake prevents only the drive shaft from turning. The differential will allow the machine to articulate with the parking brake applied. Always place the safety bar in LOCKED POSITION before working beneath machine.

CAUTION: To prevent damage to pistons and seals, do not apply brakes when brake pads are removed.

PRESSURE GAUGE INSTALLATION

Exhaust the air pressure from reservoir by depressing the cap on the bleed valve.

Remove the bleed valve and install the pressure gauge and hose. Leave the gauge installed for all pressure tests.

AIR COMPRESSOR GOVERNOR

Start the engine and allow the air pressure to build up to governor cutout pressure. Note the pressure reading on the test gauge.

If the cutout pressure (on 920) is not 122 ± 2 psi (840 ± 14 kPa) or, if the cutout pressure (on 930) is not 105 ± 2 psi (725 ± 14 kPa), adjust the air compressor governor as follows:

Loosen the locknut of the adjusting screw. Turn the adjusting screw as required. One clockwise turn of the adjusting screw raises the cutout pressure approximately 20 psi (140 kPa).

NOTE: Cut-in pressure is automatic after the cutout adjustment is made.

NOTE: On earlier machines, remove the panel on the side of the engine compartment and the cover on bottom side of the governor.

SAFETY RELIEF VALVE

Exhaust air pressure from the reservoir and remove the safety relief valve. Connect valve to a 5P3100 Pump Group. Apply the pressure on the
valve. The valve should open at 150 psi (1030 kPa). Adjust the valve by loosening the locknut and turning the adjusting screw.

**SAFETY RELIEF VALVE**

**EMERGENCY AND PARKING BRAKE CONTROL VALVE**

Start the engine and allow the air pressure to build up to cutout pressure. Push the emergency brake in to release the emergency and parking brake. Shutoff the engine and relieve the air pressure by repeatedly applying the service brakes. Look at the test gauge pressure reading to make sure the emergency and parking brake control knob moves to the APPLIED (pulled out) position at 40 ± 5 psi (280 ± 35 kPa). If not, recondition the valve.

**EMERGENCY AND PARKING BRAKE ADJUSTMENT**

With the emergency and parking brake control in the brake APPLIED position, start the engine and engage the transmission in second gear. If the emergency and parking brake does not prevent machine movement at engine full-load speed, make an adjustment as follows. Stop the engine and move the emergency and parking brake control knob to the OFF position. Remove pin (4), loosen locknut (1), turn yoke (2) to shorten the rod assembly. Check brake operation and, if necessary, make an adjustment to the parking brake.

**WARNING:** If the buzzer begins to sound while the linkage is being adjusted, stop the adjustment and start the engine to build the air pressure back up. The buzzer begins sounding at 70 to 80 psi (480 to 550 kPa). If the system pressure were to continue to bleed down to approximately 45 psi (310 kPa), the brake will apply.

Block the wheels and stop the engine. Measure the movement of rod assembly (3) when the emergency brake control knob is moved from the APPLIED position to the OFF position. Rod assembly movement should be .75 in. (19 mm) minimum.

**BRAKE CONTROL VALVE**

Start the engine and allow the air pressure to build up. Depress either brake treadle and hold the treadle in the depressed position.

Release the brake treadle and depress the other treadle. The service brake should function the same. Failure of front and/or rear service brakes to release indicates faulty brake control valves.

**Leakage Check**

Depress either brake pedal and hold it in the
depressed position. Coat air line connections at the air chambers with soap suds and check for air leakage. Release the brake pedal. Coat the exhaust port of each brake control valve with soap suds. Leakage must not exceed a 1 in. (25.4 mm) soap bubble in one minute. Correct any air leaks that may exist.

DOUBLE CHECK VALVE

Test the double check valve with the engine running, the powershift transmission in 3rd speed forward, and the machine moving. Depress the right service brake control valve and the engine rpm should decrease. Depress the left service brake control valve and the engine rpm should increase due to the action of the transmission neutralizer. If the transmission neutralizes when the right service brake control valve is depressed, the double check valve is defective. Install a new valve.

NOTE: Before beginning any test of the electric warning system, check all electrical connections and grounds to assure good contact.

Start the diesel engine and allow the air system pressure to build up to cutout pressure. Push the emergency and parking brake control valve in. Shut off the diesel engine. Turn the disconnect switch ON.

Slowly exhaust the air pressure by depressing the service brake pedal. Note the air pressure reading on the test gauge at which the buzzer begins to sound and the low air pressure indicator changes from green to red. Both should act between 70 and 80 psi (480 to 550 kPa).

**Indicator**

**ELECTRIC WARNING SYSTEM**


**SCHEMATIC OF ELECTRIC WARNING SYSTEM**

**BRAKE CONTROLS**

1. Indicator. 2. Emergency and parking brake control valve. 3. Left brake control valve. 4. Right brake control valve.

**WARNING SYSTEM PRESSURE SWITCHES**

2. Emergency and parking brake control valve. 5. Line to emergency and parking brake chamber. 6. Buzzer switch. 7. Indicator switch.
The low air pressure indicator switch should open and the indicator should appear red. If the low pressure indicator remains green, the indicator may be sticking or the switch may not be opening. If current flows to the indicator, install a new switch. If no current flows and the indicator continues to show green, install a new indicator.

**Buzzer**

If the buzzer does not begin to sound in the correct pressure range, check continuity of the normally closed pressure switch. The switch should be closed. If the switch is good, check the buzzer. If either is defective install a new component.

**HYDRAULIC BRAKE SYSTEM SERVICING**

Use heavy duty hydraulic brake fluids meeting SAE J1703c specifications only. Other fluids may cause rubber parts to deteriorate or swell.

Avoid brake fluid contamination when servicing the hydraulic brake system. Most commercial parts cleaners may be used to clean master cylinder and wheel cylinders if the parts are then thoroughly rinsed with denatured alcohol or brake fluid to remove all traces of the solvent. After removing solvent, dry parts and protect from dust until cylinders are reassembled. Wash the rubber parts in clean denatured alcohol or brake fluid.

CAUTION: Do not use mineral base cleaning solvent such as gasoline, kerosene, distillant, carbon tetrachloride, acetone, paint thinner, etc. These solvents deteriorate rubber parts causing them to become soft, tacky and swollen.

**Brake Adjustment**

Hydraulic disc brakes require no adjustment. There is no return mechanism to force the lining assembly away from the discs; therefore, the lining assemblies remain in slight contact with the discs to keep them clean.

Check for minimum permissible thickness in area where disc (1) and lining assembly (2) make contact. Apply service brake and hold in the engaged position. Inspect discs and lining assemblies for wear. Minimum permissible thickness of disc (1) is .450 in. (11.43 mm). New disc thickness is .500 in. (12.7 mm). Minimum permissible thickness of lining (2) is .125 in. (3.18 mm). New lining thickness is .625 in. (15.88 mm). If the lining thickness is measured across the complete carrier and lining assembly, the minimum total thickness is .375 in. (9.53 mm).

**Bleeding The Brakes**

Whenever air has entered the hydraulic brake system, or a master cylinder has become dry, the system must be bled. This can be done manually or by using a pressure hydraulic system bleeder.
NOTE: To prevent an air lock from developing in the master cylinders, fluid must always be visible in the reservoir while the system is being bled.

2. Attach a hose to the bleed valve. Place loose end of hose into a jar containing enough fluid to submerge the end of the hose.

NOTE: Disc brakes have two bleed valves for each wheel. Both valves must be opened to remove all of the air from the brake system.

3. Repeatedly depress the brake pedal until the brake fluid escaping through the bleed line contains no air bubbles.

4. Hold the brake pedal down and observe the stroke indicator rod.

5. Open the bleed valve and observe the brake fluid escaping from the bleed line. Close the bleed valve when the stroke indicator rod is extended 1.44 in. (36.6 mm).

6. Repeat Steps 3, 4, and 5 until the brake fluid escaping through the bleed line contains no air bubbles.

7. Refill the reservoir to within .5 in. (12 mm) from the top of the reservoir.

8. Repeat the procedure for the other wheel brakes if necessary.

Pressure Hydraulic System Bleeder Method

A commercially available pressure hydraulic system bleeder can be used. Before using the pressure hydraulic system bleeder, be sure tank (5) contains a sufficient quantity of brake fluid of the recommended type and grade. Maintain a pressure of 45 to 60 psi (310 to 415 kPa) in the tank while bleeding the system.

On earlier machines each system is pressure bled separately. Bleed one brake system by pressurizing master cylinder (1) and then repeat the procedure for the other brake system by pressurizing master cylinder (6). Either system may be bled first.

On later machines equipped with the reservoirs connected to both master cylinders, both systems can be pressurized at the same time by connecting the adapter (2) to the reservoir filler opening.

1. Remove the plug from the master cylinder reservoir and install adapter (2).

2. Attach the hose (3) to the adapter and open the valve (4).

3. Attach a bleed hose to the bleed valve on the wheel brake head. Insert the other end of the hose into a jar containing enough brake fluid to submerge the end of the hose, and open the bleed valve approximately one-half turn.

4. When the fluid flows into the jar without air bubbles, close the bleed valve and remove the hose.
5. Bleed the cylinder on the other wheel.

6. Disconnect the pressure hydraulic system bleeder from the master cylinder, remove the adapter, and install the plug.

7. Repeat procedure for other brake system.

C AIR IN THE HYDRAULIC BRAKE SYSTEM

Air in the hydraulic brake system cannot be detected by brake pedal "feel." However, a stroke indicator from the air chambers on each master cylinder will provide a means of detecting a "soft" pedal condition which will cause increased master cylinder piston movement. If the movement of stroke indicators (1) is too much, check for hydraulic leaks or air in the system. See BRAKE CONTROL VALVE, LEAKAGE TEST.

NOTE: If the leak results from a damaged cup or seal, the hydraulic brake system may be contaminated. Drain the brake fluid and flush the system with denatured alcohol. If the system is free of leaks, check for air. Bleed each hydraulic brake system. See BLEEDING THE BRAKES.

C BRAKE SYSTEM TEST

Check of Operation

The stroke indicator (1) will give an indication when brake repair is needed. With the brake pedal pushed down, make note of the stroke of the rod (1) on each master cylinder. Brake repair is needed when the stroke indicator moves more than 1.00 in. (25.4 mm) from the air chamber of the master cylinder.

1. Start the diesel engine and let the air pressure in the reservoir go up to cutout pressure.

2. Push the brake pedal down and keep it in that position.

3. Look at the stroke indicator.
   a. Slow movement of the stroke indicator after it has stopped once, is an indication that there is leakage in the hydraulic section of the brake system or that the cup is cut.
   b. Extra travel of the stroke indicator (with brake linings in contact with discs) is an indication that air is in the hydraulic section of the system.

4. Release the brake pedal.
   a. If either one or both of the stroke indicators do not retract, this is an indication that a bypass opening in one of the master cylinders is closed by dirt, corrosion or the primary cup has become too large.

NOTE: A primary cup which has become too large is an indication of wrong or dirty hydraulic fluid in the system. If hydraulic fluid is dirty, remove and repair all components in the hydraulic system of the brakes. Flush the brake lines with clean hydraulic fluid.