Brakes

Section 05-02-01

Komatsu has made every effort to make this manual as accurate as possible based on the information available at the time of publication and printing. Continuous improvement and advancement of product design may cause changes to machines, which may not have been included in this publication. Komatsu reserves the right to make changes and improvements at any time. To ensure the most current information, please contact your service center.

Table of Contents

List of Figures

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Scope of This Publication

This “BRAKES” publication is provided to assist service technicians with the inspection and maintenance of the service and parking brakes.

This publication does not provide instructions for disassembly of the L/D-950/L-1150 brake canister (actuator). That information is available in the manufacturer’s publication appended to this publication.

Safety

To prevent serious injury, the following Safety, Warnings and Cautions as well as all other pertinent safety procedures, cautions or warnings must be adhered to ANYTIME service brakes are inspected or maintenance, repair, or service procedures are performed.

Listed below are the signal words and symbols that precede these instructions and their meanings:

⚠ DANGER

The danger label indicates a hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING

The warning label indicates a hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION

The caution label, used with the safety alert symbol indicates a hazardous situation which, if not avoided, could result in minor or moderate injury (includes the safety alert symbol ⚠).

CAUTION

The caution label (without safety alert symbol) is used to address practices not related to personal injury only equipment damage.

NOTICE

The NOTICE graphic is to indicate areas of importance to the reader that are not related to personal injury or machine damage.

Safety, Warnings, and Cautions

⚠ WARNING

CRUSH HAZARD

- **Crush hazards exist from leaving the cab without setting the park brakes, which could result in unplanned and uncontrolled movement of the machine. The operator should never leave the cab with the park brake released. Set the park brake before leaving the cab. Leaving the cab without setting the park brake could cause a crush hazard from unexpected machine movement, resulting in property damage, serious injury or death.**
- **Crush hazards exist if the machine is started or moved while work processes are being performed on the machine. Place bucket flat and level on the ground. Place frame lock in the locked position and lock out the machine's starting capability before performing any work process. Follow all applicable lockout procedures and local rules and regulations for performing work processes. ANYONE performing inspections or service procedures to the machine should be familiar with ALL instructions and procedures contained in the machine's SERVICE MANUAL. Crush hazard could occur if the machine is started or moves while any type of work process is being conducted on the machine, resulting in serious injury or death.**
- **Crush hazards exist in machine pivot area and area between the tires. Do not enter these areas unless it is verified that the operator has control over the steering and that personnel locking the frame lock have good communication with the operator. Entering the pivot area and area between the tires while the machine is moving or pivoting (articulating) could cause crush hazards resulting in serious injury or death.**
- **Crush hazards exist if all personnel are not cleared from the bucket and lift arm area before using the hydraulic hoist and bucket hydraulic pressure bleed down valves to relieve pressure from the hoist and bucket circuit. Assembly must be used only when the engine is NOT running. Before using the Manual Bleed Valve Assembly, refer to "HYDRAULIC AND GREASE SYSTEMS", "MANUAL BLEED VALVE ASSEMBLY", in Section 04 of the Service Manual for additional operational and safety information. Operating the manual bleed valve may cause the lift arms and bucket to descend rapidly. All personnel around the bucket and lift arms area shall be removed from the area before operating hydraulic hoist and bucket hydraulic pressure bleed down valves. Using the hydraulic bleed down valves could result in movement of the lift arms and bucket which could cause a crush hazard resulting serious injury or death.**
- **Crush hazards exist if the machine is started or moved while work processes are being performed on the machine. Be sure all personnel are secure and in safe positions prior to doing any testing. Place signs to alert other personnel to keep a safe distance from the machine. Place bucket flat and level on the ground. Place frame lock in the locked position and lock out the machine's starting capability before performing any work process. Follow all applicable lockout procedures and local rules and regulations for performing work processes. ANYONE performing inspections or service procedures to the machine should be familiar with ALL instructions and procedures contained in the machine's SERVICE MANUAL. Crush hazard could occur if the machine is started or moves while any type of work process is being conducted on the machine, resulting in serious injury or death.**

CRUSH HAZARD AND PINCH POINT HAZARD

- **Crush hazard and pinch point hazard exists when procedures are being performed on the brake cylinders. Brake cylinders are under compressed spring force. Sudden spring release is possible. Maintenance and repairs should be performed in full accordance with safe working procedures. Use of a suitable press is required for servicing, disassembly, and reassembly of the brake caliper assemblies. Failure to follow safe work procedures could cause crush hazard or pinch point hazard resulting in serious injury or death.**
- **Crush hazard and pinch point hazard exists when procedures are being performed on the brake cylinders. NEVER attempt to disassemble the brake cylinders while mounted on the motor. Never remove cylinders without following appropriate procedures to ensure the air system pressure is**

completely relieved. Brake cylinders are under compressed spring force. Sudden spring release is possible. Maintenance and repairs should be performed in full accordance with safe working procedures. Use of a suitable press is required for servicing, disassembly, and reassembly of the brake caliper assemblies. Failure to follow safe work procedures could cause crush hazard or pinch point hazard resulting in serious injury or death.

CRUSH, SHOCK, OR OTHER HAZARDS

- **Crush, shock, or other hazards exist if stored energy is not removed or isolated prior to working on the machine. Stored energy (hydraulic, electrical, pneumatic, mechanical, etc.) may be present if not isolated or released prior to working on the machine. Do not work on the machine without removing this stored energy (suspended loads, electrical power, air pressure, etc.). Risk of crushing, shock, or other physical injury exists if stored energy is not removed or isolated prior to working on the machine which could result in serious injury or death.**

STRUCK-BY OR STRUCK AGAINST HAZARDS

- **Struck-by or struck against hazards exist if the jack rod is not bottomed into threaded recess in cylinder rod. Use flat on jack rod to tighten and keep it from screwing out of rod when turned counterclockwise. Failure to bottom jack rod in bottom of threaded recess and preventing it from turning during the process can cause struck-by or struck against hazards resulting in serious injury or death.**
- **Struck-by or struck against hazards exist when assembling or disassembling brake cylinders. Install safety plates to press before using press for disassembly or assembly of brake cylinder. Brake cylinders are under compressed spring force. Releasing the tension on the brakes must be done with the use of the jack bolt and nut assembly (P/N 423-9175 and 423-9176) or shop air at a minimum of 10 psi greater than brake release pressure of the machine. Minimum air pressure of 105 psi (7.2 bar) must be maintained on the brake cylinder. The brakes will begin to set at 95 psi (6.6 bar). If air is used to release the brake, ensure the supply is an uninterruptible source so the brake doesn't set quickly, possibly causing serious injury (refer to instructions "QUICK CHANGE BRAKE CALIPER ASSEMBLY ADJUSTMENT INSTRUCTIONS (earlier in this section). Failure to install safety plates could cause struck-by or struck against hazards resulting in serious injury or death.**
- **Struck-by or struck against hazards exist before releasing hydraulic pressure. Spring pressure is still present in rear cylinder until it is manually released. Failure to release hydraulic pressure can cause a struck-by or struck against hazard resulting in serious injury or death.**

STRUCK-BY OR PINCH POINT HAZARD

- **Struck-by or pinch point hazards exist when releasing tension on the brakes. Brake cylinders are under compressed spring force. Releasing the tension on the brakes must be done with the use of the jack bolt and nut assembly (P/N 423-9175 and 423-9176) or shop air at a minimum of 10 psi greater than brake release pressure of the machine. Minimum air pressure of 105 psi (7.2 bar) must be maintained on the brake cylinder. The brakes will begin to set at 95 psi (6.6 bar). If air is used to release the brake, ensure the supply is an uninterruptible source so the brake doesn't set quickly, possibly causing serious injury (refer to illustration "JACK ROD INSTALLATION FOR RELEASING BRAKE' later in this section). Failure to use the jack bolt and nut assembly or an uninterruptable air supply can cause struck-by or pinch point hazards resulting in injury.**

ELECTRICAL SHOCK HAZARD

- **Electrical shock hazard exists inside the axle if axle access panel on either axle is removed without locking out the electrical system. Always verify the absence of bus voltage before removing the axle access panels or touching any electrified component inside the axle. Failure to lockout the electrical system, or touching electrified components inside the axle could cause electrical shock which might result in serious injury or death.**
- **Risk of fatal electrical shock or injury by contact in the electrical cabinet is possible if the engine is running, the LINCS software indicates voltage on the bus, or the red bus LED's in the electrical cabinet are illuminated. All Generation II SR equipment has the ability to produce voltage at low throttle. Even with the engine off, there may be a residual of 12-15VDC on the bus. Do not enter**

the electrical cabinet or touch any components in the electrical cabinet without performing the Bus Discharge Verification Procedure. Failure to do so may result in fatal electrical shock or other injury.

- **High voltage may be present. Risk of shock or equipment damage by use of an improperly rated meter is possible. Use a CAT III 1000V rated volt meter to take voltage readings.**
- **Electrical shock hazard exists inside the axle if axle access panel on either axle is removed without locking out the electrical system. Always verify the absence of bus voltage before removing the axle access panels and touching any electrified component inside the axle. Do NOT touch the electrical cable connections inside the axle when the key switch is ON, or the generator is primed, or until five minutes after the engine has been shut down and the absence of bus voltage is verified. to lockout the electrical system, and touching electrified components inside the axle could cause electrical shock which might result in serious injury or death.**

ADDITIONAL HAZARDS

- **ALWAYS wear all necessary or required Personal Protective Equipment (PPE) when performing repair, maintenance, or service procedures on the equipment. Failure to do so can result in severe injury or death.**
- **Stuck-by or struck against hazards exist if loosening or tightening a hose or line connection or removing a plug that is under pressure. NEVER loosen or tighten a hose or line or remove a plug that is under pressure. Always verify the hose, line, or plug is not pressurized before loosening or tightening connections. Failure to verify the absence of hose or line pressure can cause struck-by or struck against hazards resulting in serious injury or death.**

Theory of Operation

Three brake systems are used on the wheel loaders. They are:

- Parking: a spring applied, air released brake.
- Service: an air applied, spring released brake.
- Dynamic: an electrical brake that is automatic and will bring the machine to a stop during normal operation.

CAUTION

It is natural for operators to equate stopping the machine with stopping a highway vehicle, which requires depressing the brake pedal to stop. Therefore, it is essential to train operators in the function and capability of the machine's dynamic braking system, to avoid accelerated wear of the brake pads and discs.

⚠ WARNING

Crush hazards exist from leaving the cab without setting the park brakes, which could result in unplanned and uncontrolled movement of the machine. The operator should never leave the cab with the park brake released. Set the park brake before leaving the cab. Leaving the cab without setting the park brake could cause a crush hazard from unexpected machine movement, resulting in property damage, serious injury or death.

NOTICE

The instructions contained herein cover only the inspection and servicing of the brake caliper assemblies. For additional information, refer to the Compressed Air System schematic (Brake Control Diagram) in the Parts Manual.

Parking Brake

The function of the park brake is to hold the machine while parked. The park brake is applied with the console-mounted switch. When the park brake is set, the drive system is inhibited. The park brake must be set before the LINCS™ control system will allow the engine to be cranked. The service and park brakes on the machine are air-operated disc brakes attached to each drive motor armature shaft. The park brakes are spring-applied air-released brakes. The compressed air system provides air pressure for brake operation.

Service Brake

The primary function of the service brakes is to hold the machine while on grades or when in close proximity to material hauling vehicles or for emergency stops. The service brakes are NOT intended to stop the machine routinely during material handling operations. Using the service brakes to stop the machine routinely during material handling operations will result in rapid wear of the brake pads and discs.

Dynamic Braking

The dynamic brake uses the machines' kinetic energy to generate electricity. This electrical energy is used to speed up the engine and to be used by the hydraulic pump drive. If the amount of electricity generated is more than what the engine and hydraulic pump drive can use, the excessive amount is directed to the braking grids on the back of the machine. In these braking grids the electricity is converted to heat and dissipated.

During normal machine operation, dynamic braking will do most of the braking work. Service brake application should only be used to hold the machine on a grade, or when additional braking greater than dynamic braking is needed.

Component Description L-1350/L-1850/L-2350

⚠ WARNING

Electrical shock hazard exists inside the axle if axle access panel on either axle is removed without locking out the electrical system. Always verify the absence of bus voltage before removing the axle access panels or touching any electrified component inside the axle. Failure to lockout the electrical system, or touching electrified components inside the axle could cause electrical shock which might result in serious injury or death.

Spring/Air Actuator

Refer to illustration “CYLINDER OPERATION POSITIONS” (below) for following explanations of brake operations. The Service Air Brake System has one caliper assembly and spring/air cylinder per wheel. Operation of the spring/air cylinder is as follows:

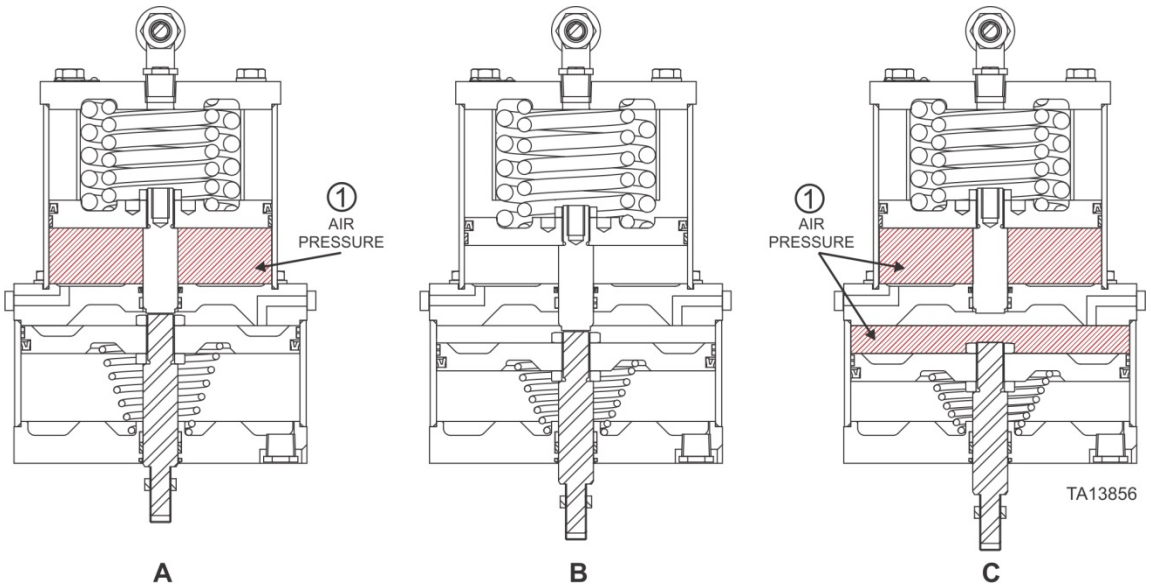
a. Normal operation:

1. Parking brake: Air pressure is applied to the spring causing it to compress. This releases the brake pads from the brake disk.

2. Service brake: The service brake is held in the released position by a different spring.

b. Service brake application: Air is supplied to the service brake diaphragm/piston. As air pressure increases the diaphragm/piston causes a push rod to apply pressure on the brake pads. the push rod is positioned through the piston or parking portion of the brake assembly

c. Park/emergency brake application: The park brake is applied by spring pressure. To release the park brake, air pressure must be applied to the piston causing the spring to compress. Any loss of air pressure (<85 psi) will cause the park brakes to start to set.



1) Air pressure

Figure 1. Cylinder operation positions

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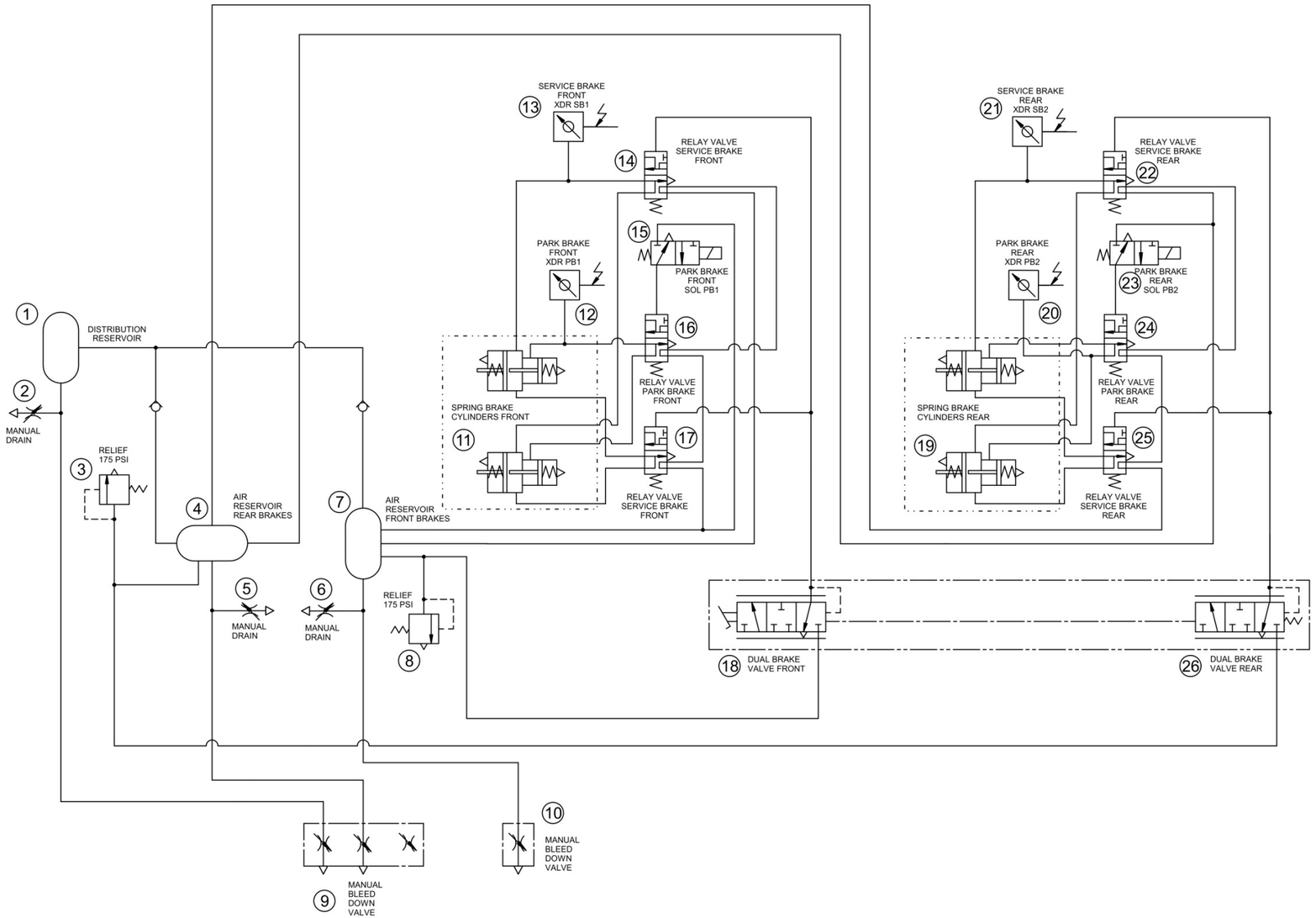
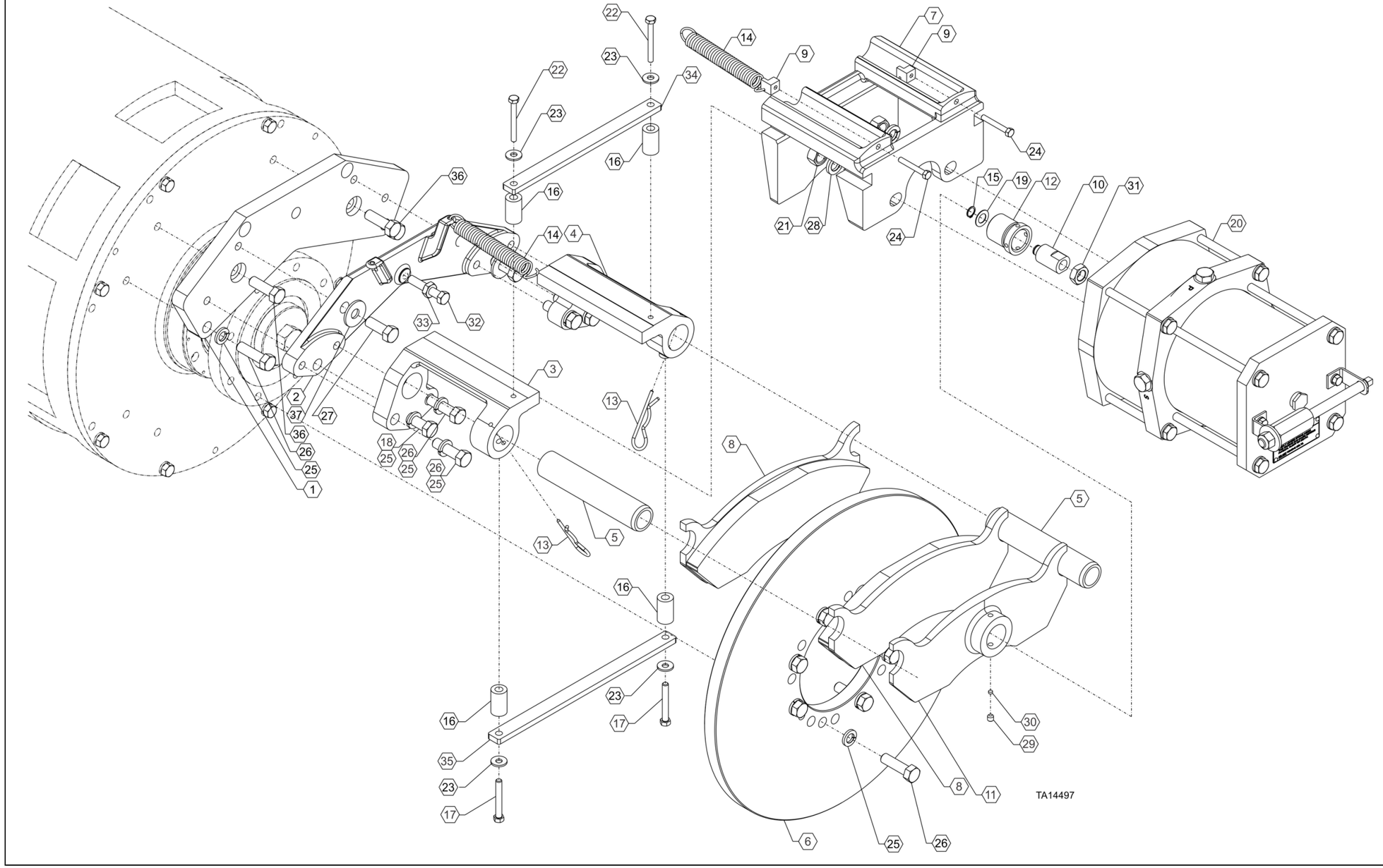
Circuit Description L-1350/L-1850/L-2350



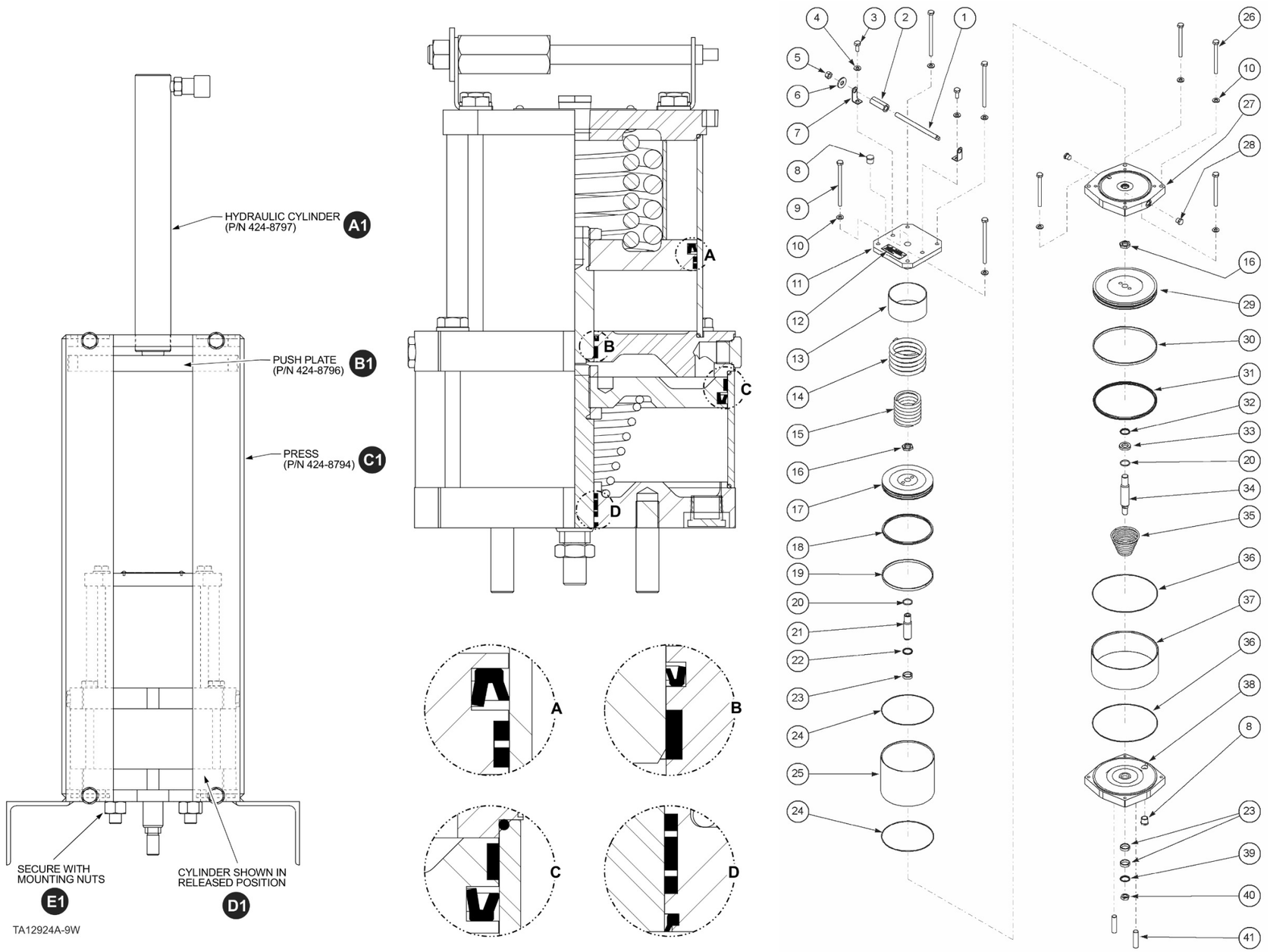
1. Distribution reservoir	**6.** Manual drain	**11.** Front spring brake cylinders	**16.** Front relay valve park brake	**21.** Rear service brake XDR SB2
2. Manual drain	**7.** Air reservoir front brakes	**12.** Park brake front XDR PB1	**17.** Front relay valve service brake	**22.** Rear relay valve service brake
3. Relief 175 psi (12 bar)	**8.** Relief 175 psi (12 bar)	**13.** Service brake front XDR SB1	**18.** Front dual brake valve	**23.** Rear park brake SOL PB2
4. Air reservoir rear brakes	**9.** Manual bleed down valve assy	**14.** Front relay valve service brake	**19.** Rear spring brake cylinders	**24.** Rear relay valve park brake
5. Manual drain	**10.** Manual bleed down valve	**15.** Front park brake SOL PB1	**20.** Rear park brake XDR PB2	**25.** Rear relay valve service brake
				26. Rear dual brake valve

Figure 2. L-1350/L-1850/L-2350 brake circuit diagram



1	Caliper mount adapter
2	Caliper mount
3	Torque tube- right
4	Torque tube- left
5	Guide pin
6	Brake disc
7	Brake actuator
8	Carrier and lining assy
9	Spring adjusting clevis
10	Swivel boss
11	Clamp plate
12	Adjusting sleeve
13	Cotter pin
14	Spring
15	Retaining ring
16	Tube spacer
17	Bolt
18	Bolt
19	Flat washer
20	Brake cylinder
21	Nut
22	Bolt
23	Washer
24	Bolt**
25	Washer
26	Bolt
27	Bolt
28	Lock washer
29	Set screw
30	Thread lock insert
31	Jam nut
32	Bolt
33	Jam nut
34	Short bar
35	Long bar
36	Bolt
37	Washer

Figure 3. L-1350/L-1850/L-2350 brake caliper assembly (1 of 2)



A1) Hydraulic cylinder, **B1)** Push plate, **C1)** Press, **D1)** Cylinder shown in released position, **E1)** Secure with mounting nuts

Figure 4. L-1350/L-1850/L-2350 brake cylinder assembly (2 of 2)

1	Rod, jack
2	Nut, jack
3	Bolt
4	Lockwasher
5	Nut
6	Flatwasher
7	Bracket, mount
8	Breather
9	Bolt
10	Flatwasher
11	End cap
12	Plate, safety - brake spring
13	Tube, stop (spacer)
14	Spring, heavy
15	Spring, boost
16	Jamnut
17	Piston
18	Seal, piston
19	Ring, wear - piston
20	O-Ring
21	Rod, cylinder - rear
22	Seal, rod
23	Ring, wear - rod
24	O-Ring
25	Tube, housing
26	Bolt
27	Plate, support - middle
28	Plug
29	Piston
30	Ring, wear - piston
31	Seal, piston
32	O-Ring
33	Spacer, stop
34	Rod, cylinder - front
35	Spring, return
36	O-Ring
37	Tube, housing
38	End cap, 10"
39	Wiper, rod
40	Jamnut
41	Stud, mounting

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Settings and Adjustments L-1350/L-1850/L-2350

Inspection and Adjustment of Brake Caliper Assemblies

⚠ WARNING

Electrical shock hazard exists inside the axle if axle access panel on either axle is removed without locking out the electrical system. Always verify the absence of bus voltage before removing the axle access panels or touching any electrified component inside the axle. Failure to lockout the electrical system, or touching electrified components inside the axle could cause electrical shock which might result in serious injury or death.

⚠ WARNING

Crush hazard and pinch point hazard exists when procedures are being performed on the brake cylinders. Brake cylinders are under compressed spring force. Sudden spring release is possible. Maintenance and repairs should be performed in full accordance with safe working procedures. Use of a suitable press is required for servicing, disassembly, and reassembly of the brake caliper assemblies. Failure to follow safe work procedures could cause crush hazard or pinch point hazard resulting in serious injury or death.

⚠ CAUTION

Crush hazards or pinch point hazards exists if air pressure drops below operating pressure while inspecting the brakes. The brakes will set automatically if the air pressure drops below operating pressure. This could occur suddenly and unexpectedly. During brake inspection, a technician should be stationed in the operator's cab to monitor the air pressure and be in direct communication with the person accessing the axles. Inspecting the brakes while the air pressure is not at operating pressure could cause crush hazards or pinch point hazards resulting in serious injury.

NOTICE

Never remove actuator before following appropriate procedures for relieving pressure from the air system.

The brakes should be checked every 500-hours of operation for normal wear condition. Inspect the brakes as follows:

Safety Preparations

⚠ WARNING

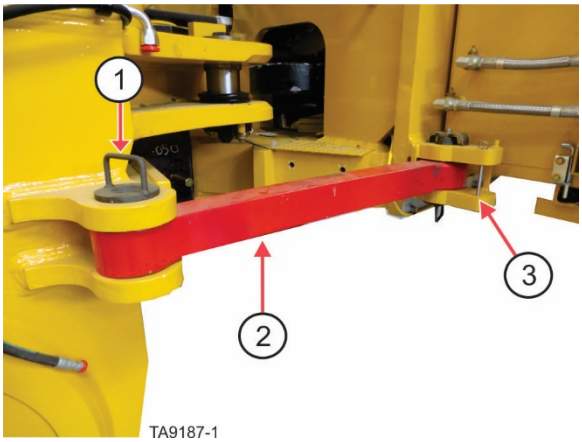
Crush hazards exist if the machine is started or moved while work processes are being performed on the machine. Place bucket flat and level on the ground. Place frame lock in the locked position and lock out the machine's starting capability before performing any work process. Follow all applicable lockout procedures and local rules and regulations for performing work processes. ANYONE performing inspections or service procedures to the machine should be familiar with ALL instructions and procedures contained in the machine's SERVICE MANUAL. Crush hazard could occur if the machine is started or moves while any type of work process is being conducted on the machine, resulting in serious injury or death.

⚠ WARNING

Crush hazard and pinch point hazard exists when procedures are being performed on the brake cylinders. Brake cylinders are under compressed spring force. Sudden spring release is possible. Maintenance and repairs should be performed in full accordance with safe working procedures. Use of a suitable press is required for servicing, disassembly, and reassembly of the brake caliper assemblies. Failure to follow safe work procedures could cause crush hazard or pinch point hazard resulting in serious injury or death.

a. Stop the wheel loader on flat level ground.

b. Move the frame lock to the locked position so that the frame cannot be steered.



1) Retaining pin for locked position, **2)** Frame lock – shown in locked position, **3)** Retaining pin bracket for un-locked position

Shown in locked position

Figure 5. Frame Lock

c. Set bucket flat and level on the ground.

d. Place wheel chocks in front and behind each wheel.

- Chocking against motion must be done using chocks rated for the equipment being chocked. Heavy mobile equipment must be chocked with appropriate chocks. Factors such as machine weight, size, wheel diameter, ground grade and others must be considered when selecting chocks

⚠WARNING

Crush hazard is possible if the frame lock is not locked to prevent machine articulation while personnel are in the machine articulation area. Do not enter this area unless you have verified that the operator has control over the steering and that you have good communication with the operator. Crush hazard is possible if personnel are in this area while the machine is articulated, which could result in serious injury or death.

e. Set the parking brakes.

Discharging the KESS should be done before shutting the machine down by performing the following steps:

Figure 6. Operators Screen – KESS at 60%

f. Ensure Park Brake is SET
g. Place machine at LO Throttle
h. Select Main Menu button
i. Select Data Logging
j. Select Logging/Monitoring
k. Select Energy Storage Data Link
l. Move ESD 1 Mst:Motor (RPM) and ESD 2 Mst:Motor (RPM) to right column by clicking and dragging

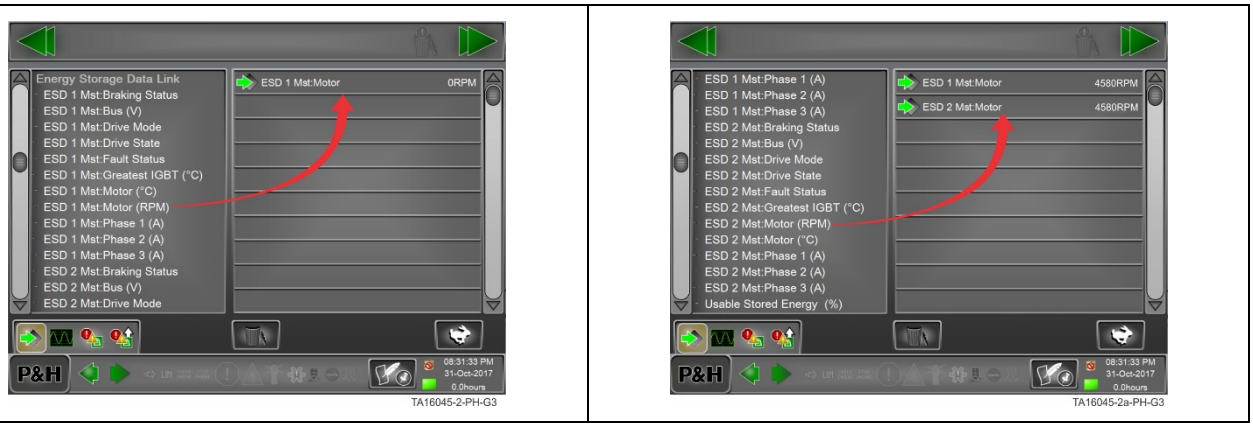


Figure 7. ESD Motor Channel Select

m. Press the Drive Enable Switch

Figure 8. Drive Enable Switch

n. The ESD Mst: Motor RPM will start to decline and will reach 0 RPM in approximately 35 seconds.

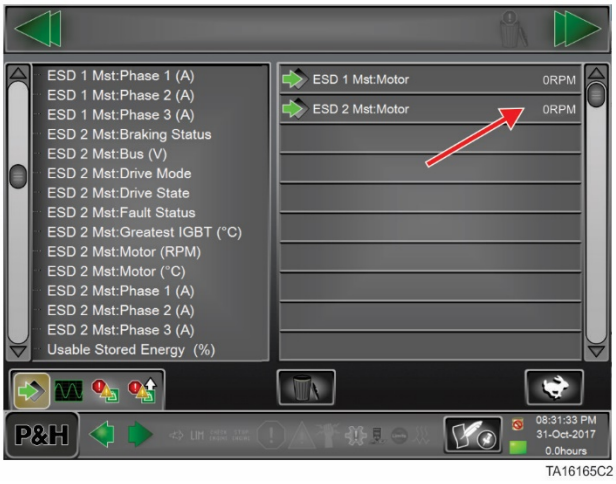


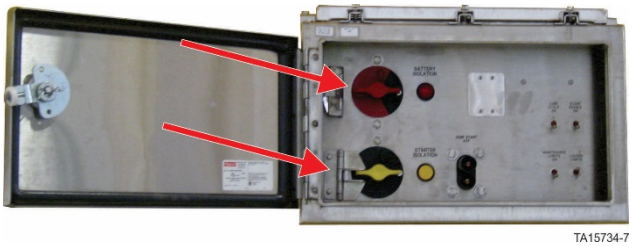
Figure 9. ESD Motor RPM

⚠ WARNING

Crush, shock, or other hazards exist if stored energy is not removed or isolated prior to working on the machine. Stored energy (hydraulic, electrical, pneumatic, mechanical, etc.) may be present if not isolated or released prior to working on the machine. Do not work on the machine without removing this stored energy (suspended loads, electrical power, air pressure, etc.). Risk of crushing, shock, or other physical injury exists if stored energy is not removed or isolated prior to working on the machine which could result in serious injury or death.

o. Shut off the engine.

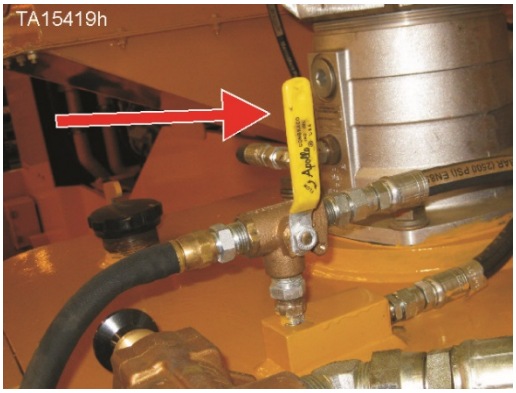
p. Turn the battery and engine isolation switches to the off position and install locks on the battery isolation switch. Lock out the machine's starting capability before performing any cleaning, inspections, or installation and repair procedure.



Isolation and Control switches assembly – Battery isolation switch in OFF position with locks in place

q. Release the air from the hydraulic reservoir by using the hydraulic reservoir air valve (ball valve) on top of the reservoir. The supply line from main air system will be blocked and reservoir air will vent out the hose that runs down the outside of the hydraulic reservoir.

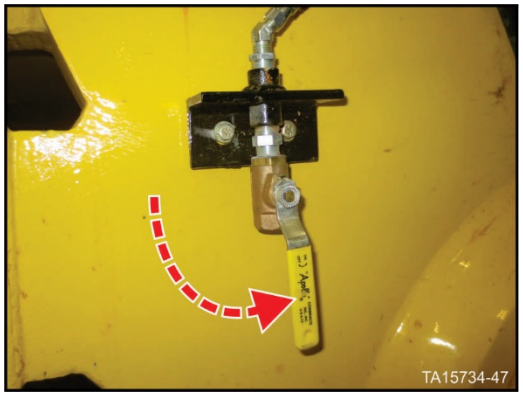
r. Turn the handle to the up position as shown.



Hydraulic reservoir air valve handle UP

s. Release the air from the various air storage reservoirs by opening all of the air bleed valves.

Three valves on right side of rear frame under hydraulic reservoir
One valve on right side of front frame near hoist cylinder ball cap



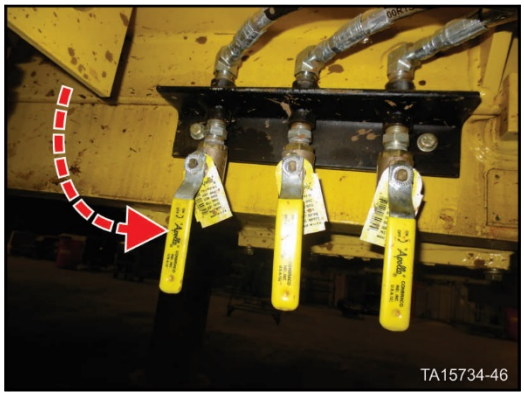


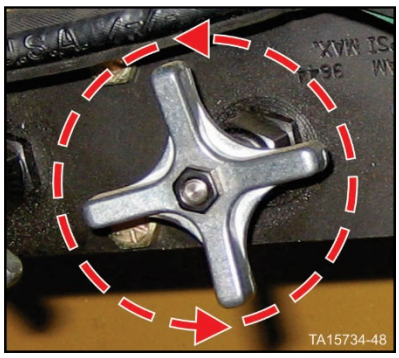
Figure 10. Open air reservoir bleed valves

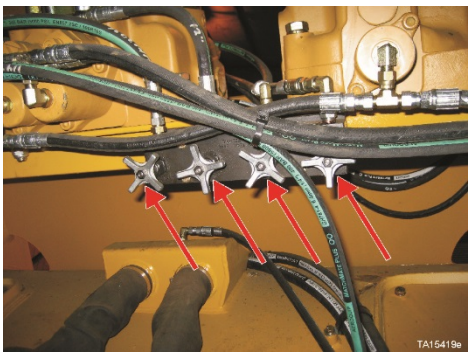
⚠ WARNING

Crush hazard exists by the lift arms or bucket if all personnel are not cleared from the bucket and lift arm area before using the hydraulic hoist and bucket pilot pressure bleed down valves to relieve pressure from the hoist and bucket pilot circuit. Clear all personnel from the area around the bucket and lift arms before operating hydraulic hoist and bucket pilot pressure bleed down valves. Using the hydraulic bleed down valves could result in some movement of the lift arms and bucket which could cause injury or death.

t. Use the hydraulic pressure bleed down valves located in the front frame underneath the Husco valves to bleed any stored pressure in the hoist and bucket circuit.

- Turn each valve slowly counterclockwise as shown below and allow the pressure to bleed down.
- Open the valve completely and leave it open during repairs.





u. Drain the hydraulic reservoir if applicable to the procedure being performed.

Converter Bus Voltage

⚠ WARNING

Risk of fatal shock or injury by contact in the electrical cabinet is possible if the engine is running, the LINCS software indicates voltage on the bus, or the red bus LED's in the electrical cabinet are illuminated. All SR equipment has the ability to produce voltage at low throttle. Even with the engine off, there may be a residual of 12-15VDC on the bus. Do not enter the electrical cabinet or touch any components in the electrical cabinet without performing the Bus Discharge Verification Procedure. Failure to do so may result in fatal electrical shock or other injury.

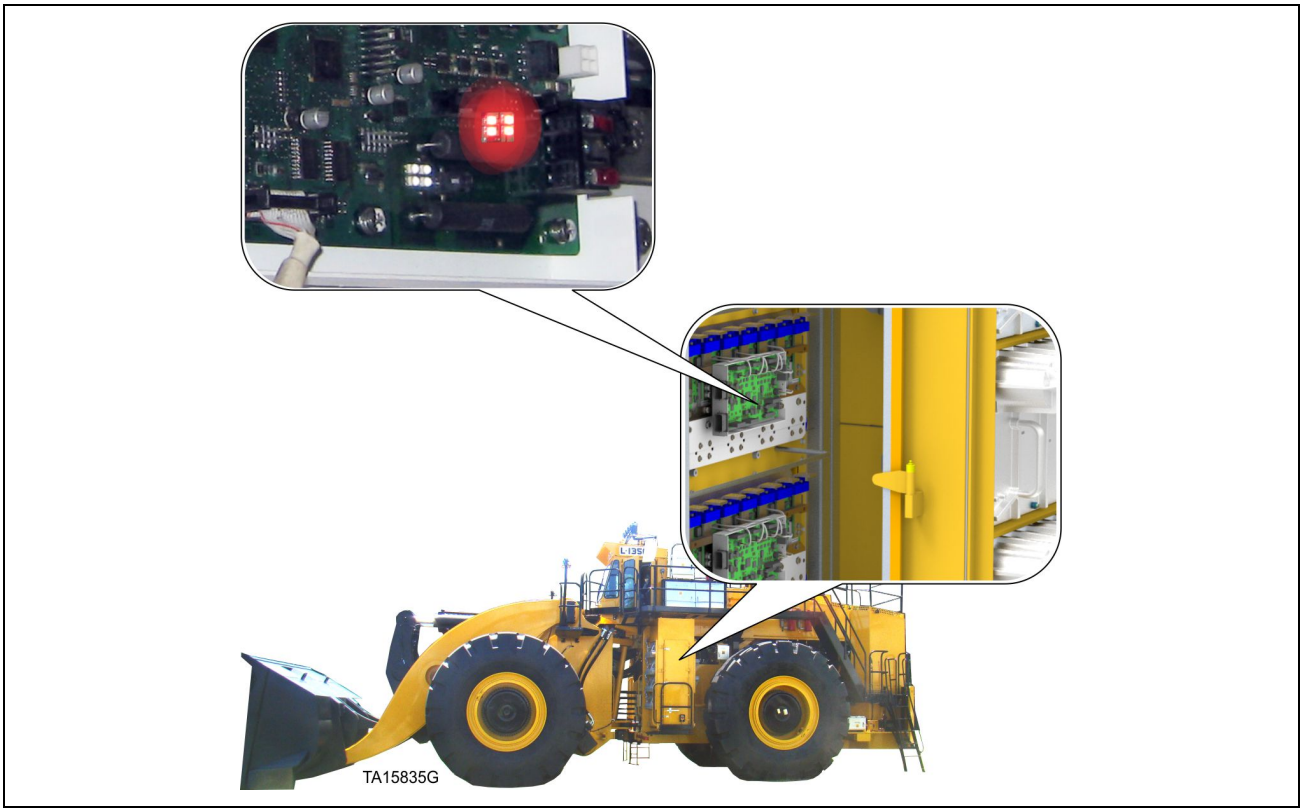


Figure 11. Converter assembly bus LED's

There are three different methods that are combined to verify when it is safe to enter the electrical cabinet.

1. LINCS II display in cab
2. visual indication in electrical cabinet
3. physical measurement

All of these steps are required in order to assure that the system is properly discharged.

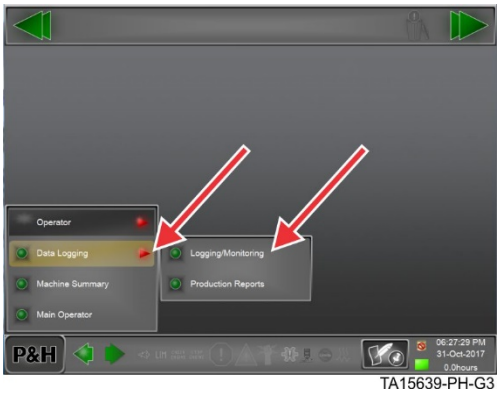
In Cab Verification Using LINCS II Display

a. Make sure that the LINCS II system is booted (key switch ON) with the engine NOT running and the park brake SET.

b. As shown in the following figure, on the touch panel in the dash, press the Main Menu button in the lower left corner, then select Data Logging then Logging/Monitoring.

TA15638-PH-G3

Main Menu Button

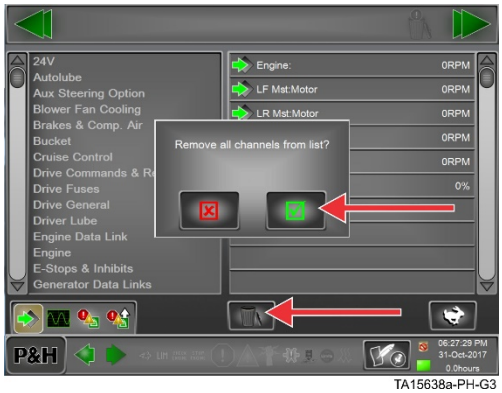


TA15639-PH-G3

Data Logging & Logging/Monitoring

Figure 12. LINCS logging/monitoring menu access

c. Select the Trash Can icon and then select the Check Mark to clear any selection on the right hand side of the screen (if applicable).



TA15638a-PH-G3

Figure 13. Remove channels

d. Scroll down the left hand list until Drive Fuses is displayed.

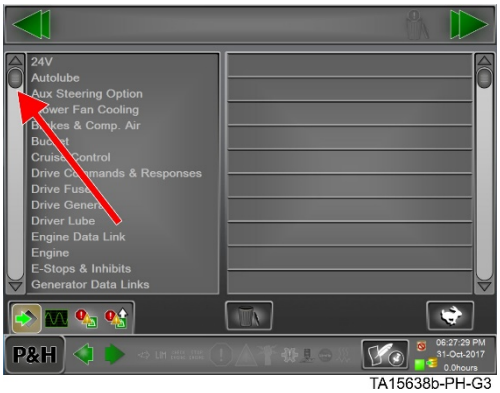


Figure 14. Left hand scroll

e. Drag the Drive Fuses category to the right hand side of the screen, all of the bus voltage channels should now be visible.

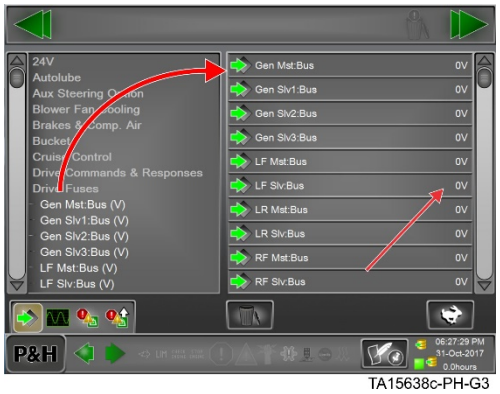


Figure 15. Bus voltage indication

f. Verify bus voltage is less than 24VDC.

NOTICE

Should any voltage (greater than 24VDC) be present on any of the DC busses, allow the system to discharge for a period of no less than 10 minutes. Re-test the bus voltages prior to continuing.

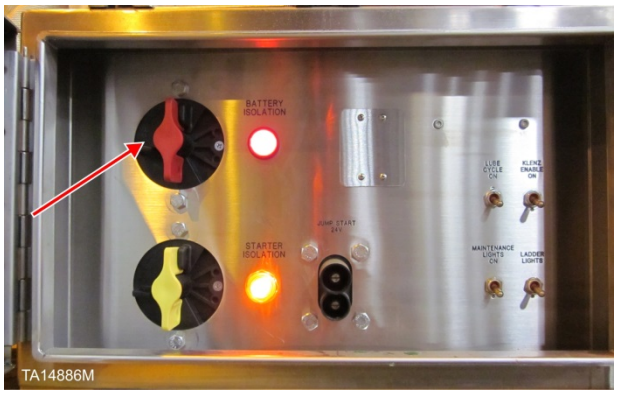
g. Turn the key switch to the OFF position and proceed to the next step in the verification process.

Verification by Visual Indication

Following the verification by LINCS II software, the next step is to verify the existence of bus voltage by the array of four LED indicators located on the main SR control board on each converter assembly.

To conduct this test, ensure that:

- The 24V DC power is isolated at the battery disconnect (turned off and locked out) per site requirements.



Isolate the battery and lockout the machine

Figure 16. Isolation and control switch assembly

- The SR electrical converter cabinet door should now be opened.
- DO NOT enter the cabinet at this time.

View the LED arrays on each of the converter assemblies and verify the LED's are not illuminated. The LED's will be illuminated when a potential of greater than approximately 35VDC is present on the DC bus connections on the converter assemblies. The light intensity varies with voltage and a greater intensity indicates a higher bus voltage.

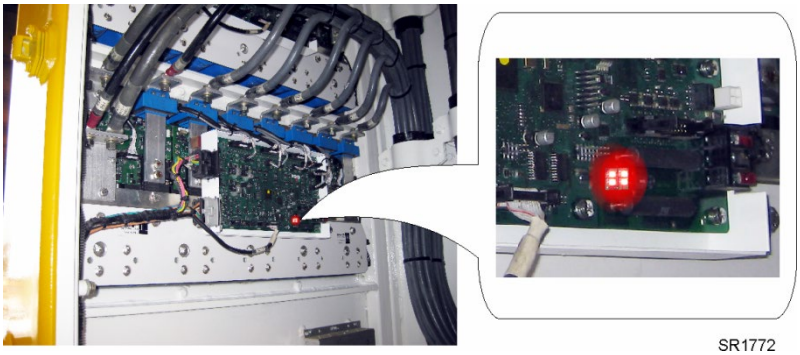


Figure 17. Bus voltage LED array on SR control board

Once verified that the LED's are NOT illuminated, proceed with Verification by Physical Measurement of the main bus bars.

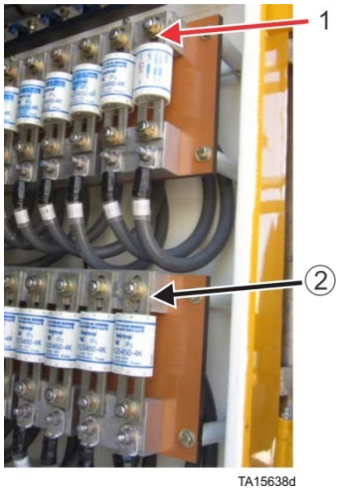
Verification by Physical Measurement Main Bus Bars

Once the visual indicators have been verified, the bus voltage should be physically measured. The bus voltage should be fully discharged based on the previous checks.

a. Measure between the positive and negative bus bars using a voltmeter rated for 1000V. The potential voltage on a bus that has not discharged could be over 700VDC. A properly discharged bus should be less than 24VDC as verified by the completion of LINCS system verification.

⚠ WARNING

Risk of shock or equipment damage by use of an improperly rated meter is possible. Use a CAT III 1000V rated volt meter to take voltage readings. Shock or other injury may result from using improperly rated test equipment.



1) Positive bus bar, **2)** Negative bus bar

Figure 18. Main bus bars

Converter Assembly Bus Connections

The final point of verification is the bus connections to each individual converter assembly. The bus voltage can be measured at the two bus tabs located adjacent to the electrical converter cabinet door.

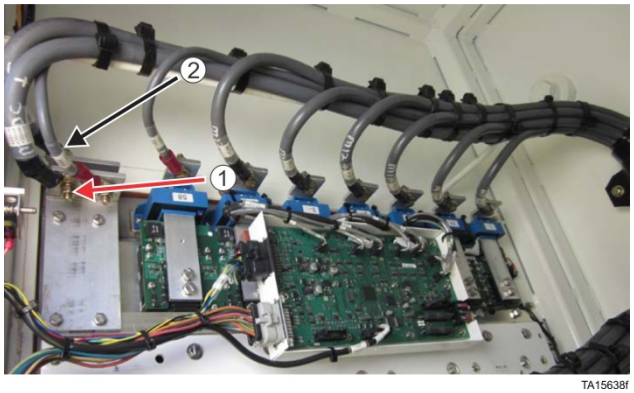
NOTICE

The converter assemblies on the rear of the cabinet are inverted in comparison to those mounted on the front. Similarly, the positive and negative bus connections will be inverted.

Connect a voltmeter across the two bus connection points. Bus voltage should be less than 24VDC following the completion of the previous checks. Once the check has been completed, the entire drive system has been verified as discharged.

1) Positive bus bar, **2)** Negative bus bar

Figure 19. Converter assembly bus connections (rear of cabinet)



1) Positive bus bar, **2)** Negative bus bar

Figure 20. Converter assembly bus connections (front of cabinet)

Once verified that bus voltage does not exist, entry into the electrical cabinet, axels, and grid area are permissible.

Inspection

The brakes should be checked every 500 hours of operation for normal wear condition. Inspect the brakes as follows:

⚠ WARNING

Electrical shock hazard exists inside the axle if axle access panel on either axle is removed without locking out the electrical system. Always verify the absence of bus voltage before removing the axle access panels or touching any electrified component inside the axle. Failure to lockout the electrical system, or touching electrified components inside the axle could cause electrical shock which might result in serious injury or death.

Electrical shock hazard exists inside the axle if axle access panel on either axle is removed without locking out the electrical system. Always verify the absence of bus voltage before removing the axle access panels and touching any electrified component inside the axle. Do NOT touch the electrical cable connections inside the axle when the key switch is ON, or the generator is primed, or until five minutes after the engine has been shut down and the absence of bus voltage is verified. to lockout the electrical system, and touching electrified components inside the axle could cause electrical shock which might result in serious injury or death.

a. Remove the axle housing access covers.

b. Inspect brake for loose or missing bolts, nuts, return springs, cotter pins, retaining rings or other attachments. Secure or replace as required.

c. Inspect carrier and lining (pads) assemblies for wear, scars or breaks.

NOTICE

Grooves are machined into the linings to indicate wear. If the grooves are worn away, the pads should be replaced. Replace the brake pads if lining is less than 1/8” thick.

d. Inspect brake disc. Minimum allowable thickness is: 0.75" (19.05 mm)

Adjustment

Numbers in parenthesis refer to illustration “L-1350/L-1850/L-2350 BRAKE CALIPER ASSEMBLY (1 of 2).

⚠ WARNING

Electrical shock hazard exists inside the axle if axle access panel on either axle is removed without locking out the electrical system. Always verify the absence of bus voltage before removing the axle access panels or touching any electrified component inside the axle. Failure to lockout the electrical system, or touching electrified components inside the axle could cause electrical shock which might result in serious injury or death.

NOTICE

The brake disc pads are adjusted at the factory for a combined clearance of .030” to .060” (0.762 to 1.524 mm) (.015” to .030” [0.381 to 0.762 mm] each side of brake disc). It should not be necessary to readjust the brake disc pads at replacement unless the caliper is disassembled for other repair. Disassembly of the caliper is not necessary for brake disc pad replacement.

⚠ CAUTION

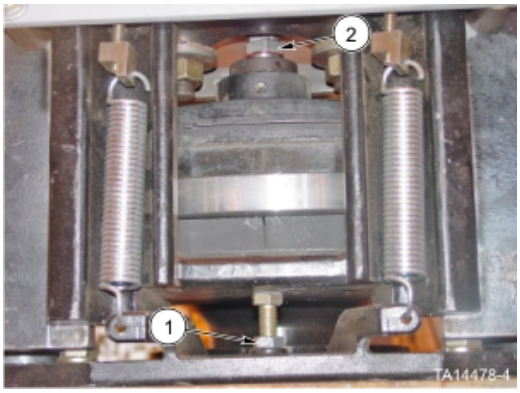
Struck-by or pinch point hazards exist when releasing tension on the brakes. Brake cylinders are under compressed spring force. Releasing the tension on the brakes must be done with the use of the jack bolt and nut assembly (P/N 423-9175 and 423-9176) or shop air at a minimum of 10 psi greater than brake release pressure of the machine. Minimum air pressure of 105 psi (7.2 bar) must be maintained on the brake cylinder. The brakes will begin to set at 95 psi (6.6 bar). If air is used to release the brake, ensure the supply is an uninterruptible source so the brake doesn’t set quickly, possibly causing serious injury (refer to illustration “JACK ROD INSTALLATION FOR RELEASING BRAKE’ later in this section). Failure to use the jack bolt and nut assembly or an uninterruptable air supply can cause struck-by or pinch point hazards resulting in injury.

If adjustment is required, the brakes must be released. Use the supplied jack bolt or shop air to bring the air pressure to a sufficient level to release the brakes and keep them released.

Numbers in parenthesis refer to illustration “L-1350/L-1850/L-2350 BRAKE CALIPER ASSEMBLY (1 of 2).

a. Loosen the jam nut (33) and adjust the adjustment bolt (32) to achieve a .015” to .030” (0.381 to 0.762 mm) clearance between the floating brake pad (1), (pad farthest from the brake cylinder [20]) and the disc (6), measured at the center of the pad’s I.D. Tighten the jam nut (33).

b. Loosen the setscrew 1/4 turn (29) and rotate the adjusting sleeve (12) (use an Allen wrench or spanner wrench LET P/N 403-4209 or Williams equivalent #472) to achieve a .015” to .030” (0.381 to 0.762 mm) clearance between the piston actuated pad (8), (pad closest to cylinder) and the disc (6) measured at the center of the pad’s I.D. Tighten the setscrew (29) to lock the adjustment.



1) Jam nut and adjustment bolt, **2)** Jam nut and adjustment sleeve

Figure 21. Brake pad adjustment points top side view

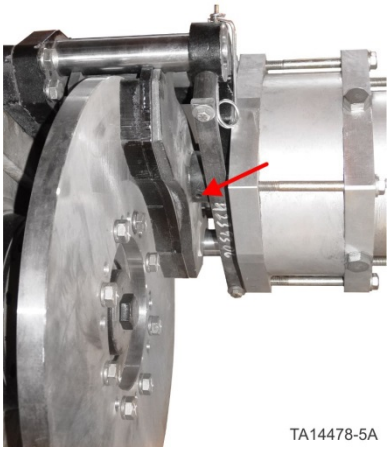


Figure 22. Set screw for locking cylinder side brake pad adjustment

NOTICE

When finished with the procedure, follow all local rules and regulations to return the machine to operating condition.

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Removal and Installation L-1350/L-1850/L-2350

Disc Pad Replacement

Numbers in parenthesis refer to illustration “L-1350/L-1850/L-2350 BRAKE CALIPER ASSEMBLY (1 of 2)”.

NOTICE

The brake disc pads are adjusted at the factory for a combined clearance of .030” to .060” (0.762 to 1.524 mm) (.015” to .030” [0.381 to 0.762 mm] each side of brake disc). It should not be necessary to readjust the brake disc pads at replacement unless the caliper is disassembled for other repair. Disassembly of the caliper is not necessary for brake disc pad replacement.

If brake pads or other parts need replacement, remove the brake pads as follows:

Safety Preparations

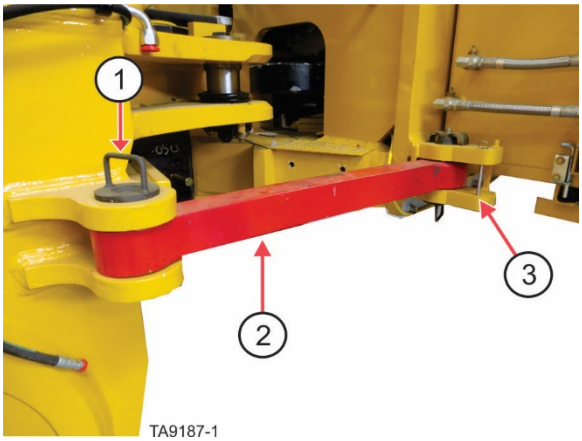
⚠ WARNING

Crush hazards exist if the machine is started or moved while work processes are being performed on the machine. Place bucket flat and level on the ground. Place frame lock in the locked position and lock out the machine’s starting capability before performing any work process. Follow all applicable lockout procedures and local rules and regulations for performing work processes. ANYONE performing inspections or service procedures to the machine should be familiar with ALL instructions and procedures contained in the machine’s SERVICE MANUAL. Crush hazard could occur if the machine is started or moves while any type of work process is being conducted on the machine, resulting in serious injury or death.

⚠ WARNING

Crush hazard and pinch point hazard exists when procedures are being performed on the brake cylinders. Brake cylinders are under compressed spring force. Sudden spring release is possible. Maintenance and repairs should be performed in full accordance with safe working procedures. Use of a suitable press is required for servicing, disassembly, and reassembly of the brake caliper assemblies. Failure to follow safe work procedures could cause crush hazard or pinch point hazard resulting in serious injury or death.

a. Stop the wheel loader on flat level ground.
b. Move the frame lock to the locked position so that the frame cannot be steered.



1) Retaining pin for locked position**, 2)** Frame lock – shown in locked position,
3) Retaining pin bracket for un-locked position

Shown in locked position

Frame Lock

c. Set bucket flat and level on the ground.

d. Place wheel chocks in front and behind each wheel.

- Chocking against motion must be done using chocks rated for the equipment being chocked. Heavy mobile equipment must be chocked with appropriate chocks. Factors such as machine weight, size, wheel diameter, ground grade and others must be considered when selecting chocks

⚠WARNING

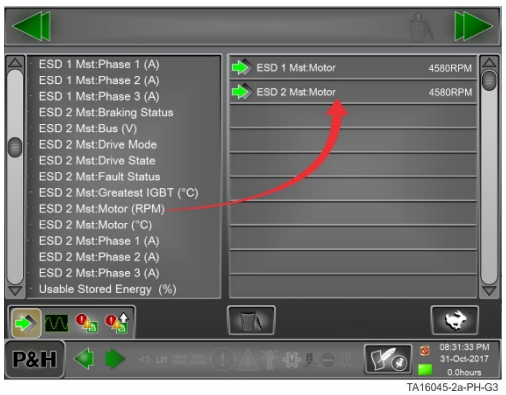
Crush hazard is possible if the frame lock is not locked to prevent machine articulation while personnel are in the machine articulation area. Do not enter this area unless you have verified that the operator has control over the steering and that you have good communication with the operator. Crush hazard is possible if personnel are in this area while the machine is articulated, which could result in serious injury or death.

e. Set the parking brakes.

Discharging the KESS should be done before shutting the machine down by performing the following steps:

Operators Screen – KESS at 60%

f. Ensure Park Brake is SET
g. Place machine at LO Throttle
h. Select Main Menu button
i. Select Data Logging
j. Select Logging/Monitoring
k. Select Energy Storage Data Link
l. Move ESD 1 Mst:Motor (RPM) and ESD 2 Mst:Motor (RPM) to right column by clicking and dragging

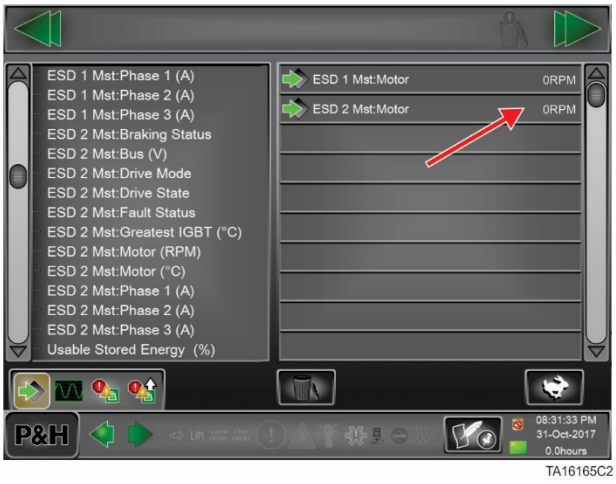


ESD Motor Channel Select

m. Press the Drive Enable Switch

Drive Enable Switch

n. The ESD Mst: Motor RPM will start to decline and will reach 0 RPM in approximately 35 seconds.



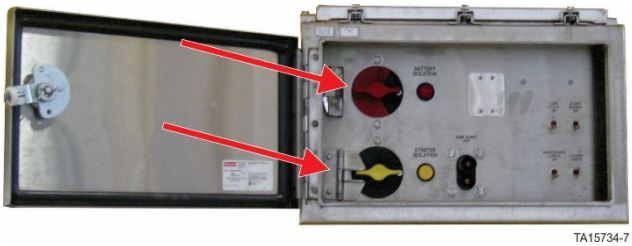
ESD Motor RPM

⚠ WARNING

Crush, shock, or other hazards exist if stored energy is not removed or isolated prior to working on the machine. Stored energy (hydraulic, electrical, pneumatic, mechanical, etc.) may be present if not isolated or released prior to working on the machine. Do not work on the machine without removing this stored energy (suspended loads, electrical power, air pressure, etc.). Risk of crushing, shock, or other physical injury exists if stored energy is not removed or isolated prior to working on the machine which could result in serious injury or death.

o. Shut off the engine.

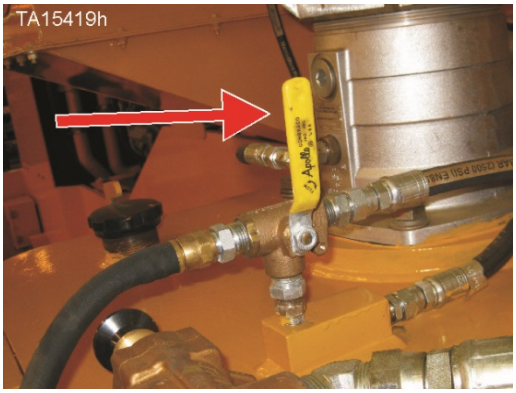
p. Turn the battery and engine isolation switches to the off position and install locks on the battery isolation switch. Lock out the machine's starting capability before performing any cleaning, inspections, or installation and repair procedure.



Isolation and Control switches assembly – Battery isolation switch in OFF position with locks in place

q. Release the air from the hydraulic reservoir by using the hydraulic reservoir air valve (ball valve) on top of the reservoir. The supply line from main air system will be blocked and reservoir air will vent out the hose that runs down the outside of the hydraulic reservoir.

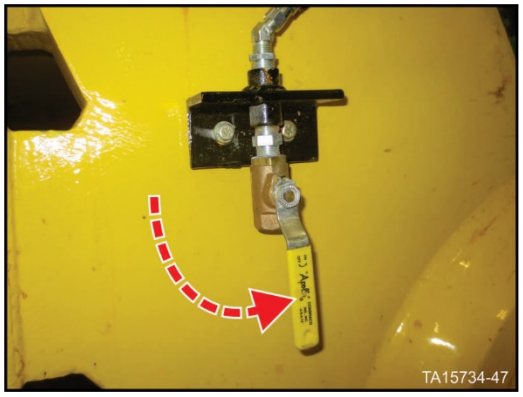
r. Turn the handle to the up position as shown.

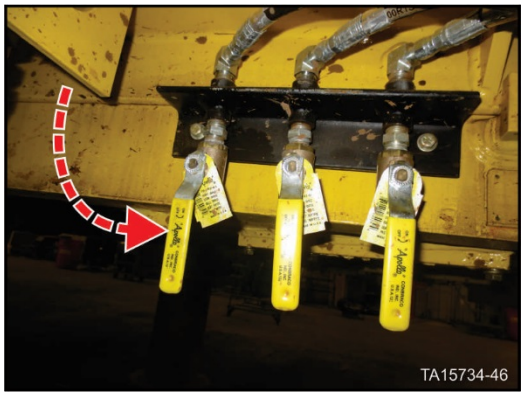


Hydraulic reservoir air valve handle UP

s. Release the air from the various air storage reservoirs by opening all of the air bleed valves.

Three valves on right side of rear frame under hydraulic reservoir
One valve on right side of front frame near hoist cylinder ball cap





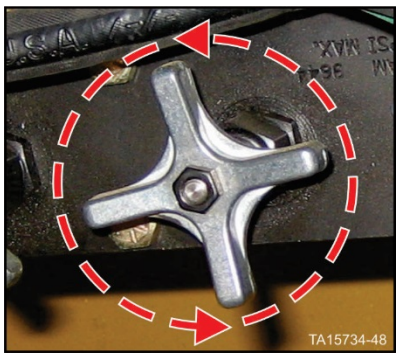
Open air reservoir bleed valves

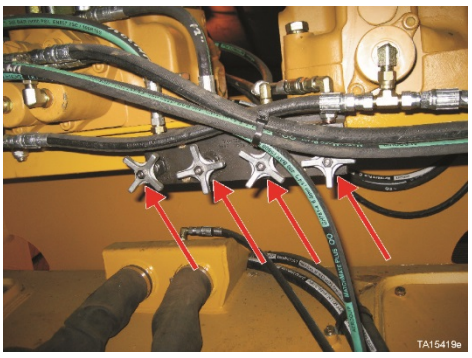
⚠ WARNING

Crush hazard exists by the lift arms or bucket if all personnel are not cleared from the bucket and lift arm area before using the hydraulic hoist and bucket pilot pressure bleed down valves to relieve pressure from the hoist and bucket pilot circuit. Clear all personnel from the area around the bucket and lift arms before operating hydraulic hoist and bucket pilot pressure bleed down valves. Using the hydraulic bleed down valves could result in some movement of the lift arms and bucket which could cause injury or death.

t. Use the hydraulic pressure bleed down valves located in the front frame underneath the Husco valves to bleed any stored pressure in the hoist and bucket circuit.

- Turn each valve slowly counterclockwise as shown below and allow the pressure to bleed down.
- Open the valve completely and leave it open during repairs.



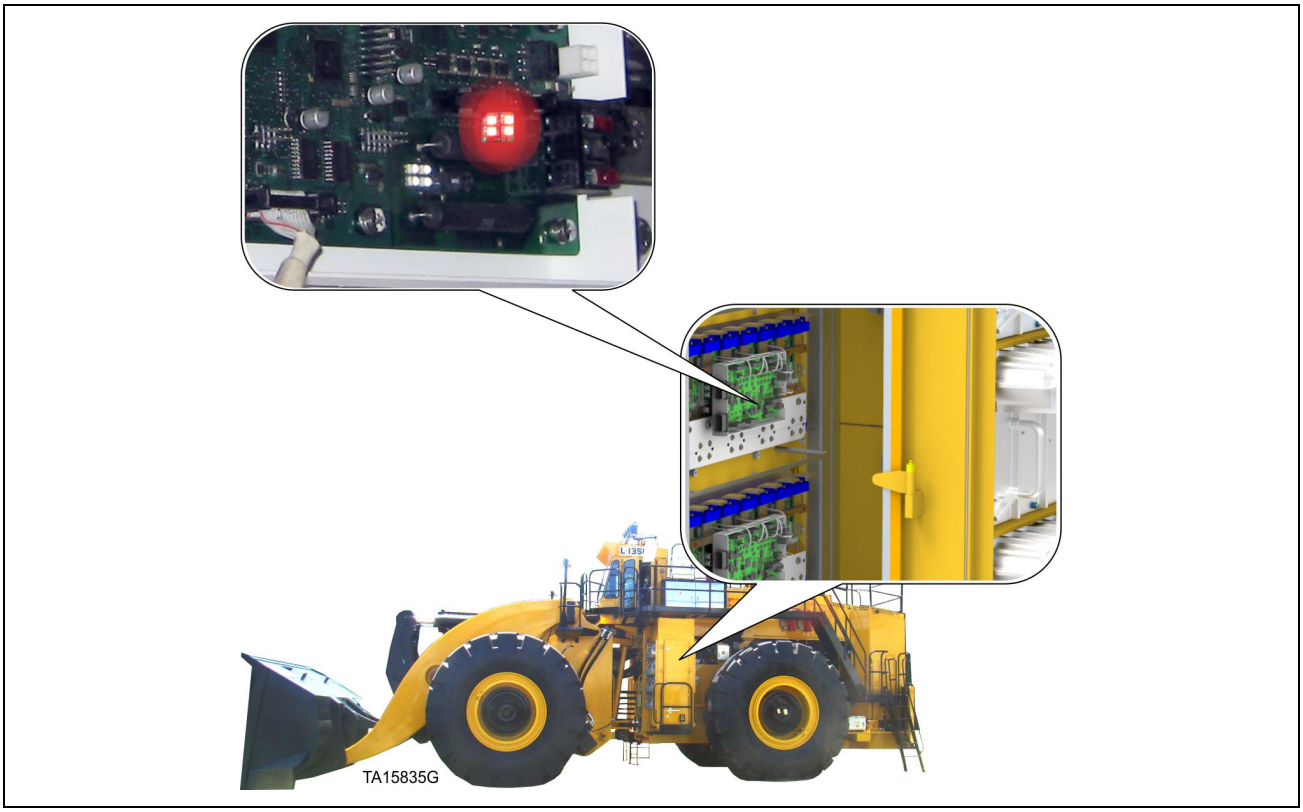


u. Drain the hydraulic reservoir if applicable to the procedure being performed.

Converter Bus Voltage

⚠ WARNING

Risk of fatal shock or injury by contact in the electrical cabinet is possible if the engine is running, the LINCS software indicates voltage on the bus, or the red bus LED's in the electrical cabinet are illuminated. All SR equipment has the ability to produce voltage at low throttle. Even with the engine off, there may be a residual of 12-15VDC on the bus. Do not enter the electrical cabinet or touch any components in the electrical cabinet without performing the Bus Discharge Verification Procedure. Failure to do so may result in fatal electrical shock or other injury.



Converter assembly bus LED's

There are three different methods that are combined to verify when it is safe to enter the electrical cabinet.

1. LINCS II display in cab
2. visual indication in electrical cabinet
3. physical measurement

All of these steps are required in order to assure that the system is properly discharged.

In Cab Verification Using LINCS II Display

a. Make sure that the LINCS II system is booted (key switch ON) with the engine NOT running and the park brake SET.

b. As shown in the following figure, on the touch panel in the dash, press the Main Menu button in the lower left corner, then select Data Logging then Logging/Monitoring.

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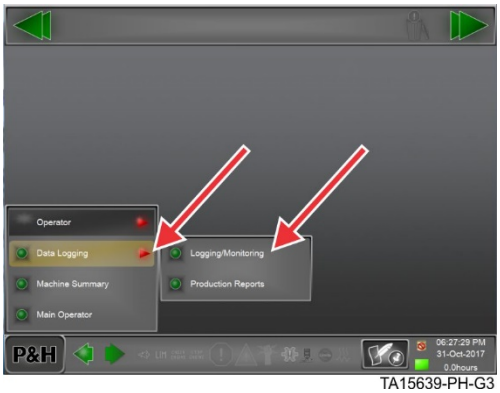
Main Menu Button

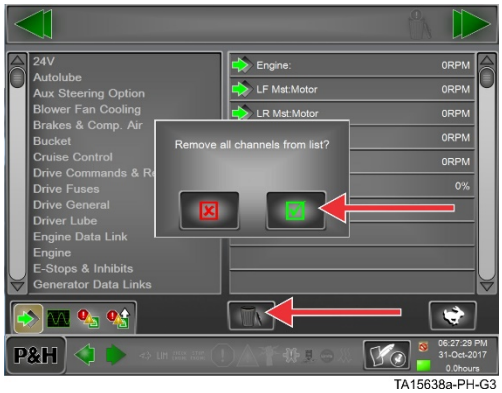


TA15639-PH-G3

Data Logging & Logging/Monitoring

LINCS logging/monitoring menu access

c. Select the Trash Can icon and then select the Check Mark to clear any selection on the right hand side of the screen (if applicable).



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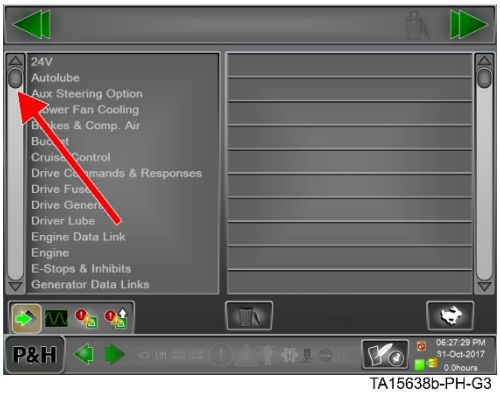
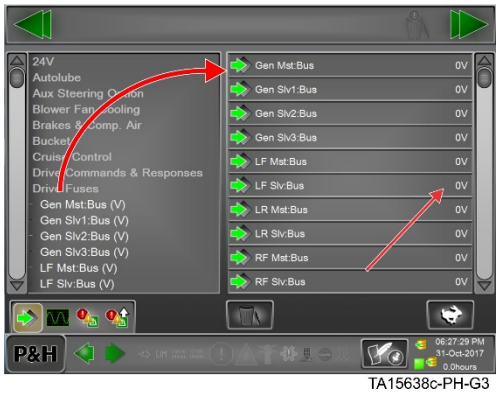
Remove channels

d. Scroll down the left hand list until Drive Fuses is displayed.



Left hand scroll

e. Drag the Drive Fuses category to the right hand side of the screen, all of the bus voltage channels should now be visible.



Bus voltage indication

f. Verify bus voltage is less than 24VDC.

NOTICE

Should any voltage (greater than 24VDC) be present on any of the DC busses, allow the system to discharge for a period of no less than 10 minutes. Re-test the bus voltages prior to continuing.

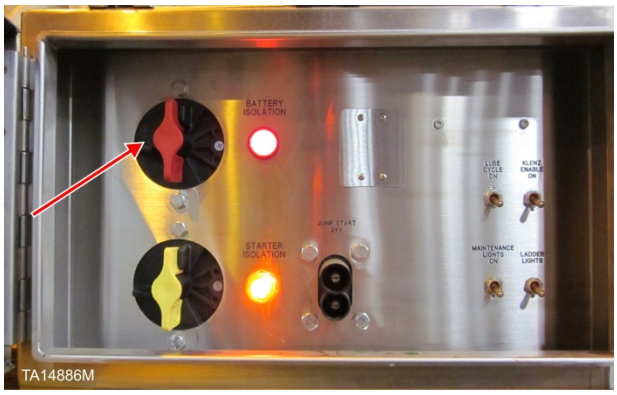
g. Turn the key switch to the OFF position and proceed to the next step in the verification process.

Verification by Visual Indication

Following the verification by LINCS II software, the next step is to verify the existence of bus voltage by the array of four LED indicators located on the main SR control board on each converter assembly.

To conduct this test, ensure that:

- The 24V DC power is isolated at the battery disconnect (turned off and locked out) per site requirements.

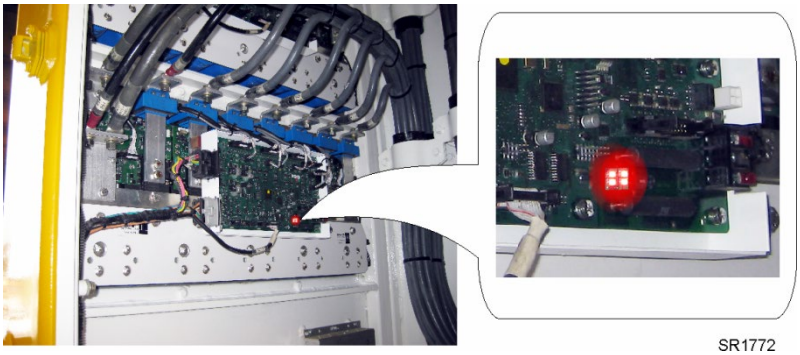


Isolate the battery and lockout the machine

Isolation and control switch assembly

- The SR electrical converter cabinet door should now be opened.
- DO NOT enter the cabinet at this time.

View the LED arrays on each of the converter assemblies and verify the LED's are not illuminated. The LED's will be illuminated when a potential of greater than approximately 35VDC is present on the DC bus connections on the converter assemblies. The light intensity varies with voltage and a greater intensity indicates a higher bus voltage.



Bus voltage LED array on SR control board

Once verified that the LED's are NOT illuminated, proceed with Verification by Physical Measurement of the main bus bars.

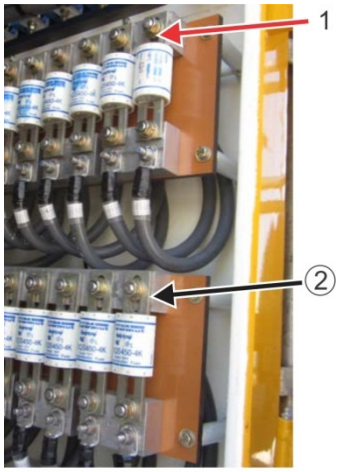
Verification by Physical Measurement Main Bus Bars

Once the visual indicators have been verified, the bus voltage should be physically measured. The bus voltage should be fully discharged based on the previous checks.

a. Measure between the positive and negative bus bars using a voltmeter rated for 1000V. The potential voltage on a bus that has not discharged could be over 700VDC. A properly discharged bus should be less than 24VDC as verified by the completion of LINCS system verification.

⚠ WARNING

Risk of shock or equipment damage by use of an improperly rated meter is possible. Use a CAT III 1000V rated volt meter to take voltage readings. Shock or other injury may result from using improperly rated test equipment.



1) Positive bus bar, **2)** Negative bus bar

Main bus bars

Converter Assembly Bus Connections

The final point of verification is the bus connections to each individual converter assembly. The bus voltage can be measured at the two bus tabs located adjacent to the electrical converter cabinet door.

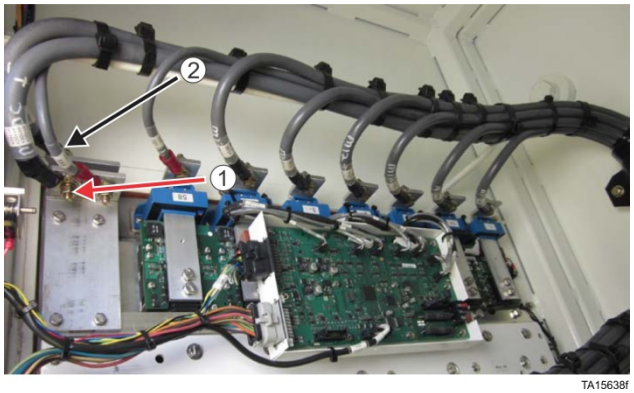
NOTICE

The converter assemblies on the rear of the cabinet are inverted in comparison to those mounted on the front. Similarly, the positive and negative bus connections will be inverted.

Connect a voltmeter across the two bus connection points. Bus voltage should be less than 24VDC following the completion of the previous checks. Once the check has been completed, the entire drive system has been verified as discharged.

1) Positive bus bar, **2)** Negative bus bar

Converter assembly bus connections (rear of cabinet)



1) Positive bus bar, **2)** Negative bus bar

Converter assembly bus connections (front of cabinet)

Once verified that bus voltage does not exist, entry into the electrical cabinet, axels, and grid area are permissible.

Removal and Replacement

⚠ WARNING

Crush hazard and pinch point hazard exists when procedures are being performed on the brake cylinders. Brake cylinders are under compressed spring force. Sudden spring release is possible. Maintenance and repairs should be performed in full accordance with safe working procedures. Use of a suitable press is required for servicing, disassembly, and reassembly of the brake caliper assemblies. Failure to follow safe work procedures could cause crush hazard or pinch point hazard resulting in serious injury or death.

⚠ WARNING

Crush hazards exist if the machine is started or moved while work processes are being performed on the machine. Be sure all personnel are secure and in safe positions prior to doing any testing. Place signs to alert other personnel to keep a safe distance from the machine. Place bucket flat and level on the ground. Place frame lock in the locked position and lock out the machine's starting capability before performing any work process. Follow all applicable lockout procedures and local rules and regulations for performing work processes. ANYONE performing inspections or service procedures to the machine should be familiar with ALL instructions and procedures contained in the machine's SERVICE MANUAL. Crush hazard could occur if the machine is started or moves while any type of work process is being conducted on the machine, resulting in serious injury or death.

⚠ WARNING

Electrical shock hazard exists inside the axle if axle access panel on either axle is removed without locking out the electrical system. Always verify the absence of bus voltage before removing the axle access panels and touching any electrified component inside the axle. Do NOT touch the electrical cable connections inside the axle when the key switch is ON, or the generator is primed, or until five minutes after the engine has been shut down and the absence of bus voltage is verified. to lockout the electrical system, and touching electrified components inside the axle could cause electrical shock which might result in serious injury or death.

a. Remove the axle housing access covers. DO NOT remove the axle housing access covers while the machine is energized. Refer to "Safety Preparations".

b. Remove one cotter pin (13) from the guide pin (5). There are two cotter pins on each caliper assembly. Either pin can be removed.

c. Hold the brake disc pads (8) in position.

d. Remove the guide pin by sliding it outward from the torque tube (3 or 4).

e. Remove the disc pads (8).

f. Inspect the brake disc (6). If it is badly grooved or scored, remove it (first, remove the entire brake caliper assembly) to have it resurfaced or replaced.

g. Position the new pads and install the guide pin by sliding it back into the torque tube.

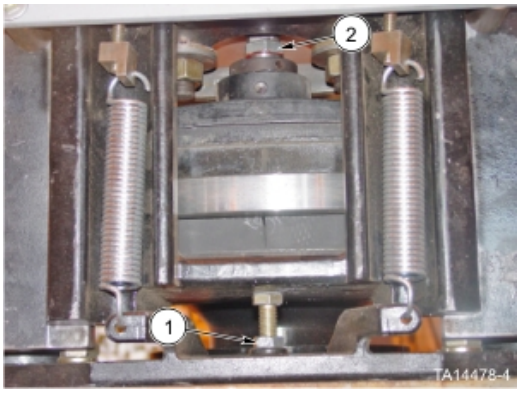
h. Install the cotter pin back into the guide pin.

i. Check the clearance between the brake pads and the disc. The clearance should not require adjustment unless the brake caliper was disassembled.

j. To adjust the brakes:

- Loosen the jam nut (33) and screw the adjustment bolt (32) out until the clearance between the floating pad (1) pad farthest from the brake cylinder(20) and the disc is .015" to .030” (0.381 to 0.762 mm) measured at the center of the pad. Tighten the jam nut.

- Loosen the setscrew (29) 1/4 turn and turn the adjusting sleeve (12) (use a spanner wrench LET P/N 403-4209 or Williams equivalent #472) until the piston-actuated pad (pad closest to actuator) has clearance of .015" to .030” (0.381 to 0.762 mm) between it and the rotor. Tighten the setscrew.



1) Jam nut and adjustment bolt **2)** Jam nut and adjustment sleeve

Figure 23. Brake pad adjustment points top side view

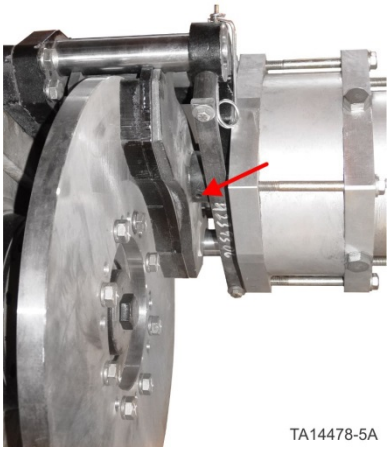


Figure 24. Set screw for locking cylinder side brake pad adjustment

NOTICE

If excessive wear is observed on the brake disc pads, the brake rotor run-out should be checked. This should be done at the time new carrier linings are installed.

- **To check the run-out tolerance while the caliper assembly is removed, place a dial indicator on the rotor assembly and rotate the rotor by hand one revolution. If run-out exceeds .005” (0.127 mm), it will be necessary to check rotor installation.**

k. Activate the brakes and check for proper movement of the caliper and actuator rod.

l. Install the axle housing access covers.

NOTICE

Caliper mount plates must be square to the disk surface. Angular pad wear indicates the plates are not square and rapid pad wear will result. Refer to "QUICK CHANGE BRAKE CALIPER ASSEMBLY ADJUSTMENT INSTRUCTIONS" should it be necessary to disassemble the brake caliper assembly during service operations.

NOTICE

If excessive wear is observed on the brake disc pads, the brake disc run out should be checked. This should be done at the time new carrier linings are installed.

To check the run out tolerance while the caliper assembly is removed, place a dial indicator on the caliber assembly and rotate the disc by hand one revolution. If run out exceeds .005 of an inch, it will be necessary to check disc installation.

m. Move frame lock to the unlocked position.

n. Follow all lockout tag out rules, local rules, and local regulations to return the machine back to service.

Adjustment

This procedure ensures proper alignment and clearance for the brake caliper and actuator and must be followed any time the brakes have been fully dismantled or should premature wear of the brake disc pads occur. This procedure is performed once the brake assembly has been removed from the machine.

NOTICE

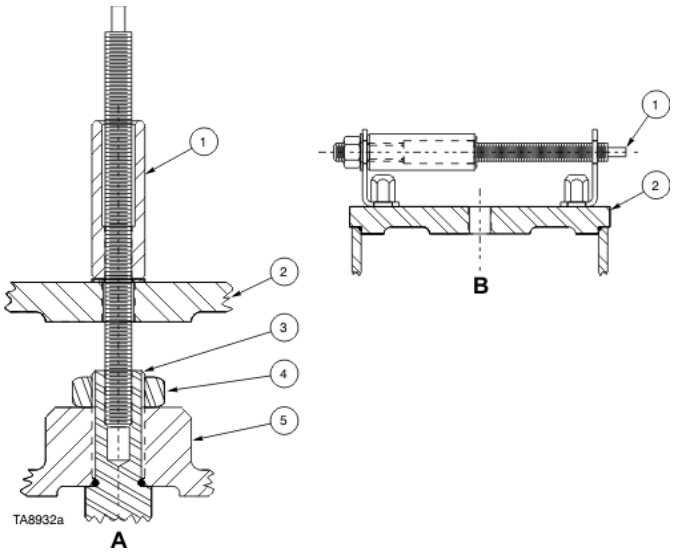
For illustrative purposes, the following procedure shows a typical generic type of brake cylinder mounted on a motor that has been removed from the machine axle. The brake caliper assembly in the illustrations is the same as used on L-950 and L-1150 machines.

⚠ WARNING

Crush hazard and pinch point hazard exists when procedures are being performed on the brake cylinders. Brake cylinders are under compressed spring force. Sudden spring release is possible. Maintenance and repairs should be performed in full accordance with safe working procedures. Use of a suitable press is required for servicing, disassembly, and reassembly of the brake caliper assemblies. Failure to follow safe work procedures could cause crush hazard or pinch point hazard resulting in serious injury or death.

Numbers in parenthesis refer to “L-1350/L-1850/L-2350 BRAKE CALIPER ASSEMBLY (1 of 2)” (above).

a. Ensure the brakes are fully released and caged using the jack rod supplied with the brakes.



A View with jack rod installed
B View with jack rod stored on actuator top plate

1. Special tool P/N 423-9175 & 423-9176
2. Actuator top plate
3. Cylinder rod
4. Jam nut
5. Piston

⚠ WARNING

Struck-by or struck against hazards exist if the jack rod is not bottomed into threaded recess in cylinder rod. Use flat on jack rod to tighten and keep it from screwing out of rod when turned counterclockwise. Failure to bottom jack rod in bottom of threaded recess and preventing it from turning during the process can cause struck-by or struck against hazards resulting in serious injury or death.

Figure 25. Jack rod installation for releasing brake

Figure 26. View of jack rod installed in brake cylinder

b. Remove the cotter pins (13), guide pins (5) and brake pads (8).

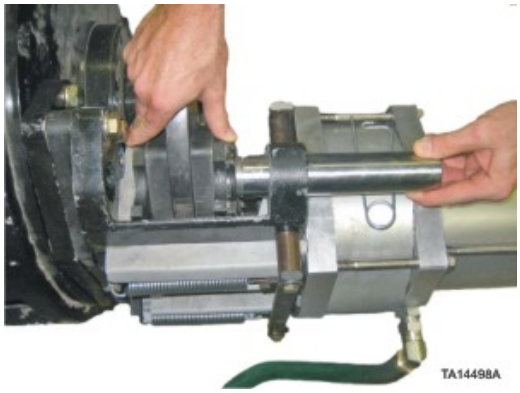


Figure 27. Removal of cotter pins and guide pins

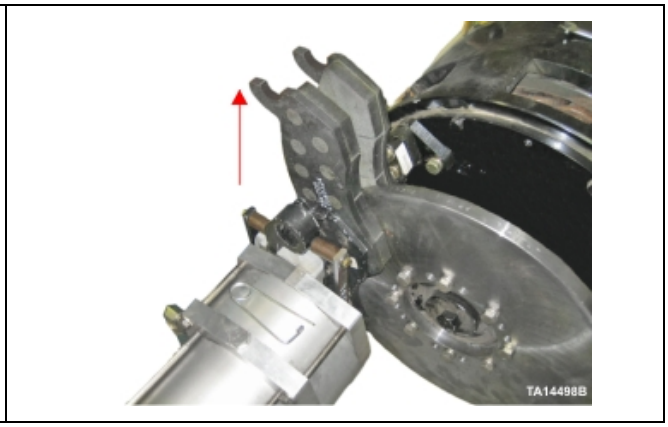


Figure 28. Removal of brake pads

c. Carefully measure the distance between the torque tube pin bores on one of the torque tubes (3 or 4 as chosen) and the brake disc (6). Loosen the retaining bolts (18 and 26) and check the torque tube to ensure both bore surfaces are square to the brake disc.

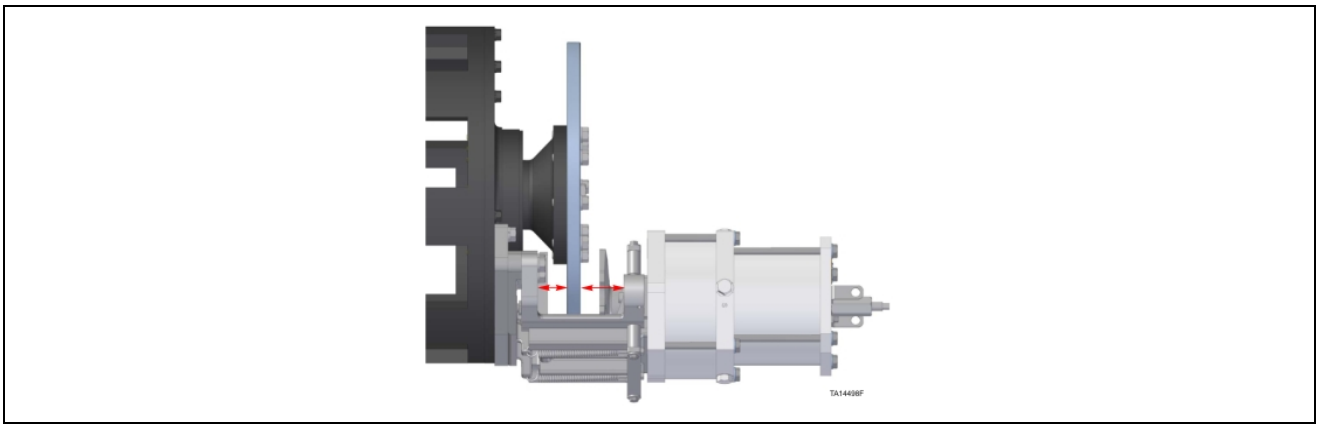


Figure 29. Location of torque tube guide pin bore surfaces which must square to the brake disc

d. Mount a magnetic-base dial indicator to the motor end bell or reference torque tube with the probe touching the brake actuator structure (7) and zero the dial indicator.

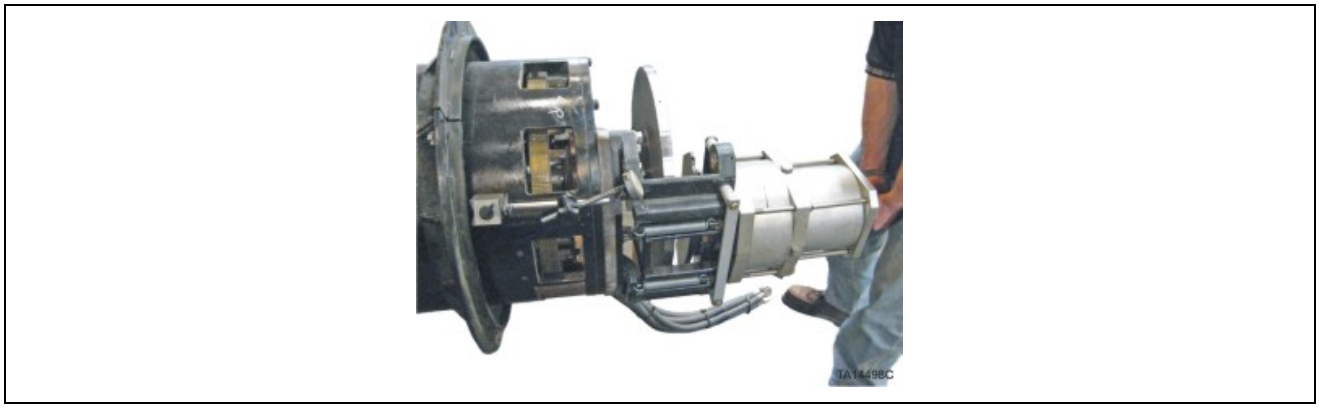


Figure 30. Placement of dial indicator and lifting brake cylinder to check movement

e. Grasp the jack rod used to release the brakes and forcefully lift the brake cylinder (20).

f. Check the dial indicator for the amount of movement between the brake actuator (7) and reference torque tube (3 or 4 as chosen). Allowable movement is .003” to .006” (.0762 to .1524 mm).

g. Loosen the bolts (18 and 26) securing the other torque tube (3 or 4 as chosen) and bolts (17 and 22) securing both retainer bars (34 and 35).

h. Use a brass or plastic hammer to tap on the torque tube to ensure that it is not in a bind and can be moved for adjustment.

Figure 31. Tapping on torque tube to ensure it is not in a bind prior to adjustment

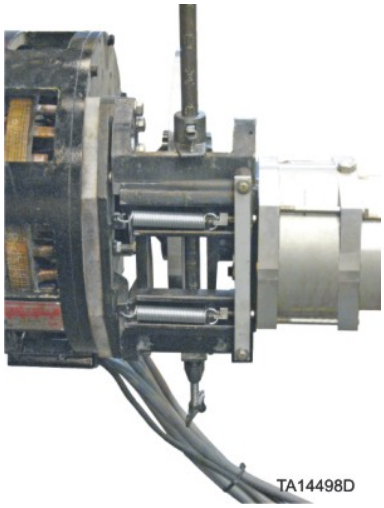


Figure 32. Positioning of pipe clamp for adjustment of torque tube

i. Place a suitable clamping device, such as the ¾” pipe clamp shown in illustration “POSITIONING OF PIPE CLAMP FOR ADJUSTMENT OF TORQUE TUBE”, across the center of both torque tubes (3 and 4).

j. Tighten the clamp. This will adjust the other torque tube to obtain uniform fit from inboard to outboard ends of the torque tube to brake actuator (7).

k. Tighten the retaining bar bolts and torque tube bolts.

l. Remove the clamp and check movement again on both torque tubes. This will require repositioning the dial indicator.

m. Should movement not be within allowable tolerances, it will be necessary to loosen the reference torque tube for additional dimension.

n. Once movement on both torque tubes is within allowable tolerances, tighten all bolts to the amount shown on the CAPSCREW TORQUE CHART, located in the machine’s Service Manual.

o. Install brake pads and check for proper adjustment. With new pads the clearance between the pad and rotor should be .015” to .030” (0.381 to 0.762 mm) on either side of the brake disc.

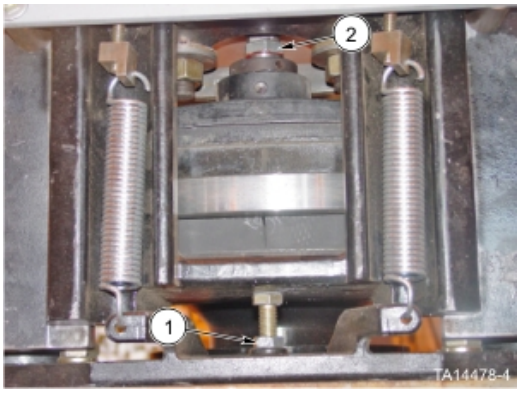
p. If adjustment is required, the brakes must be released. Use an uninterruptible air source with a minimum of 95 psi (6.6 bar) to release the brakes and keep them released. Use the following procedure to obtain the required clearance between the brake pads and the brake disc.

NOTICE

The brake disc pads are adjusted at the factory for a combined clearance of .030” to .060” (0.762 to 1.524 mm) (.015” to .030” [0.381 to 0.762 mm] each side of brake disc). Disassembly of the caliper is not necessary for brake disc pad replacement. When brake pads are worn to 1/8” material remaining they must be replaced, but adjustment should not be required.

q. Refer to illustration “L-1350/L-1850/L-2350 BRAKE CALIPER ASSEMBLY (1 of 2)” within this section. Loosen the jam nut (33) and adjust the adjustment bolt (32) to achieve a .015” to .030” (0.381 to 0.762 mm) clearance between the floating brake pad (pad farthest from cylinder [1]) and the disc, measured at the center of the pad’s I.D. Tighten the jam nut.

r. Loosen the set screw (29) and screw the adjusting sleeve (12) (use a spanner wrench LET P/N 403-4209 or Williams equivalent #472) to achieve a .015” to .030” (0.381 to 0.762 mm) clearance between the piston actuated pad (pad closest to cylinder [8]) and the disc, again, measured at the center of the pad’s I.D. Tighten the set screw to lock the adjustment.



1) Jam nut and adjustment bolt **2)** Jam nut and adjustment sleeve

Figure 33. Brake pad adjustment points top side view

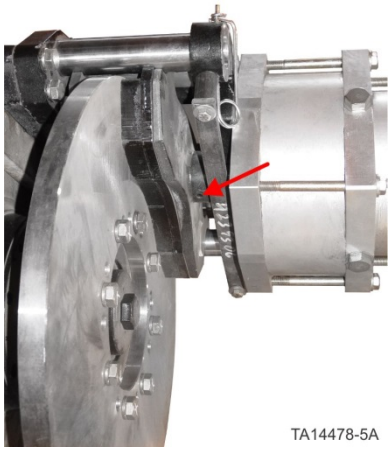


Figure 34. Set screw for locking cylinder side brake pad adjustment

NOTICE

Brakes are now set per factory specification. When brake pads are worn to 1/8” (3.175 mm) material remaining they must be replaced, but adjustment should not be required.

Installation of Seal Kit in Brake Cylinder

⚠ WARNING

Crush hazard and pinch point hazard exists when procedures are being performed on the brake cylinders. NEVER attempt to disassemble the brake cylinders while mounted on the motor. Never remove cylinders without following appropriate procedures to ensure the air system pressure is completely relieved. Brake cylinders are under compressed spring force. Sudden spring release is possible. Maintenance and repairs should be performed in full accordance with safe working procedures. Use of a suitable press is required for servicing, disassembly, and reassembly of the brake caliper assemblies. Failure to follow safe work procedures could cause crush hazard or pinch point hazard resulting in serious injury or death.

⚠ WARNING

Struck-by or struck against hazards exist when assembling or disassembling brake cylinders. Install safety plates to press before using press for disassembly or assembly of brake cylinder. Brake cylinders are under compressed spring force. Releasing the tension on the brakes must be done with the use of the jack bolt and nut assembly (P/N 423-9175 and 423-9176) or shop air at a minimum of 10 psi greater than brake release pressure of the machine. Minimum air pressure of 105 psi (7.2 bar) must be maintained on the brake cylinder. The brakes will begin to set at 95 psi (6.6 bar). If air is used to release the brake, ensure the supply is an uninterruptible source so the brake doesn't set quickly, possibly causing serious injury (refer to instructions "QUICK CHANGE BRAKE CALIPER ASSEMBLY ADJUSTMENT INSTRUCTIONS (earlier in this section). Failure to install safety plates could cause struck-by or struck against hazards resulting in serious injury or death.

Safety Preparations

⚠ WARNING

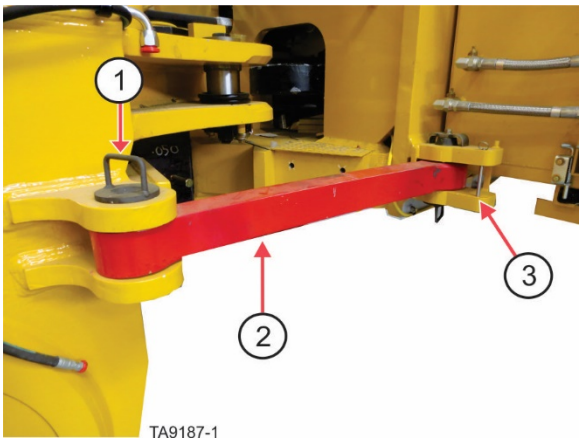
Crush hazards exist if the machine is started or moved while work processes are being performed on the machine. Place bucket flat and level on the ground. Place frame lock in the locked position and lock out the machine's starting capability before performing any work process. Follow all applicable lockout procedures and local rules and regulations for performing work processes. ANYONE performing inspections or service procedures to the machine should be familiar with ALL instructions and procedures contained in the machine's SERVICE MANUAL. Crush hazard could occur if the machine is started or moves while any type of work process is being conducted on the machine, resulting in serious injury or death.

⚠ WARNING

Crush hazard and pinch point hazard exists when procedures are being performed on the brake cylinders. Brake cylinders are under compressed spring force. Sudden spring release is possible. Maintenance and repairs should be performed in full accordance with safe working procedures. Use of a suitable press is required for servicing, disassembly, and reassembly of the brake caliper assemblies. Failure to follow safe work procedures could cause crush hazard or pinch point hazard resulting in serious injury or death.

a. Stop the wheel loader on flat level ground.

b. Move the frame lock to the locked position so that the frame cannot be steered.



1) Retaining pin for locked position**, 2)** Frame lock – shown in locked position,
3) Retaining pin bracket for un-locked position

Shown in locked position

Frame Lock

c. Set bucket flat and level on the ground.

d. Place wheel chocks in front and behind each wheel.

- Chocking against motion must be done using chocks rated for the equipment being chocked. Heavy mobile equipment must be chocked with appropriate chocks. Factors such as machine weight, size, wheel diameter, ground grade and others must be considered when selecting chocks

⚠WARNING

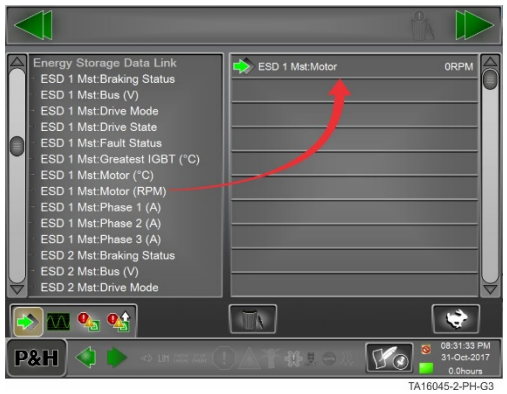
Crush hazard is possible if the frame lock is not locked to prevent machine articulation while personnel are in the machine articulation area. Do not enter this area unless you have verified that the operator has control over the steering and that you have good communication with the operator. Crush hazard is possible if personnel are in this area while the machine is articulated, which could result in serious injury or death.

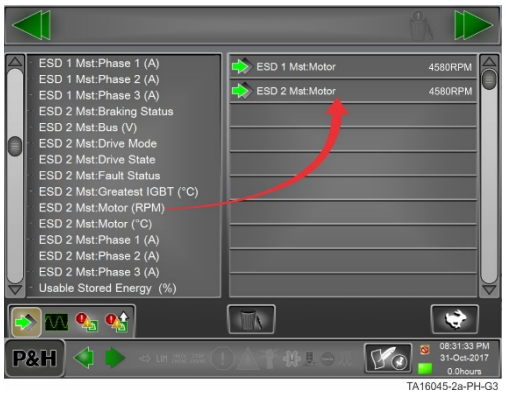
e. Set the parking brakes.

Discharging the KESS should be done before shutting the machine down by performing the following steps:

Operators Screen – KESS at 60%

f. Ensure Park Brake is SET
g. Place machine at LO Throttle
h. Select Main Menu button
i. Select Data Logging
j. Select Logging/Monitoring
k. Select Energy Storage Data Link
l. Move ESD 1 Mst:Motor (RPM) and ESD 2 Mst:Motor (RPM) to right column by clicking and dragging



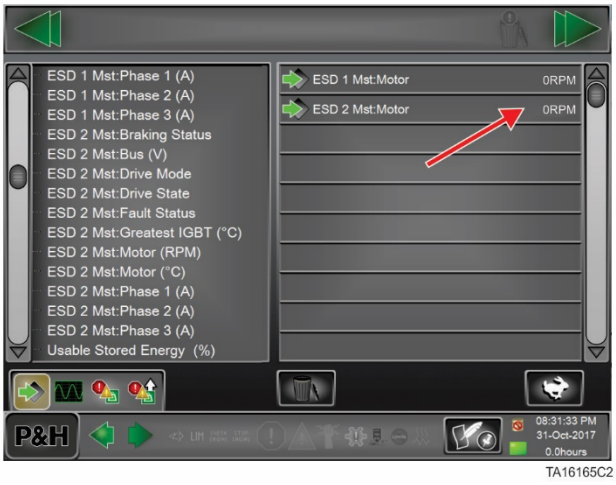


ESD Motor Channel Select

m. Press the Drive Enable Switch

Drive Enable Switch

n. The ESD Mst:Motor RPM will start to decline and will reach 0 RPM in approximately 35 seconds.



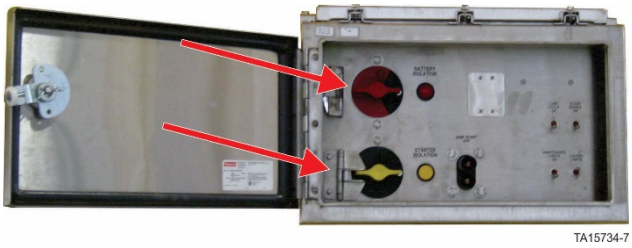
ESD Motor RPM

⚠ WARNING

Crush, shock, or other hazards exist if stored energy is not removed or isolated prior to working on the machine. Stored energy (hydraulic, electrical, pneumatic, mechanical, etc.) may be present if not isolated or released prior to working on the machine. Do not work on the machine without removing this stored energy (suspended loads, electrical power, air pressure, etc.). Risk of crushing, shock, or other physical injury exists if stored energy is not removed or isolated prior to working on the machine which could result in serious injury or death.

o. Shut off the engine.

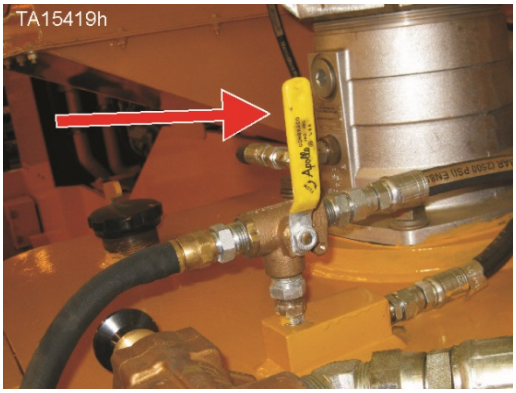
p. Turn the battery and engine isolation switches to the off position and install locks on the battery isolation switch. Lock out the machine's starting capability before performing any cleaning, inspections, or installation and repair procedure.



Isolation and Control switches assembly – Battery isolation switch in OFF position with locks in place

q. Release the air from the hydraulic reservoir by using the hydraulic reservoir air valve (ball valve) on top of the reservoir. The supply line from main air system will be blocked and reservoir air will vent out the hose that runs down the outside of the hydraulic reservoir.

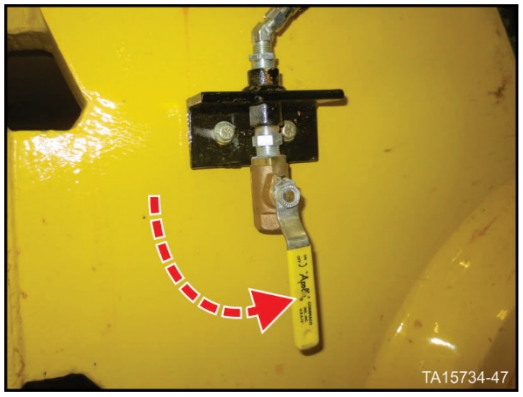
r. Turn the handle to the up position as shown.

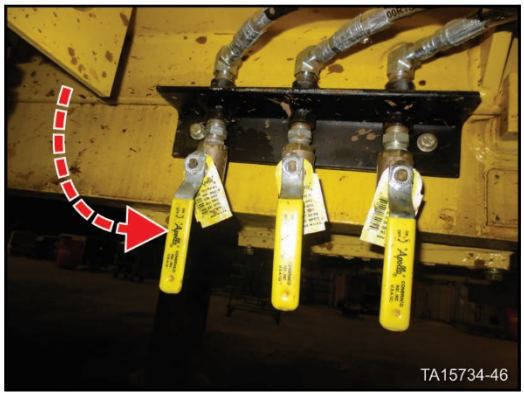


Hydraulic reservoir air valve handle UP

s. Release the air from the various air storage reservoirs by opening all of the air bleed valves.

Three valves on right side of rear frame under hydraulic reservoir
One valve on right side of front frame near hoist cylinder ball cap





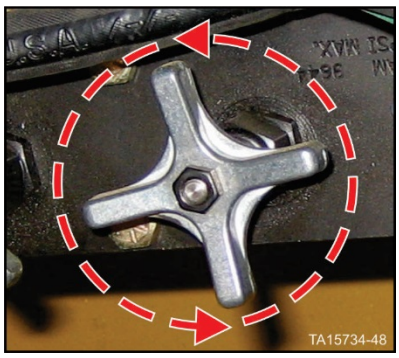
Open air reservoir bleed valves

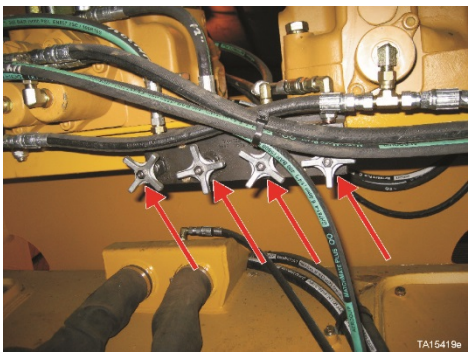
⚠ WARNING

Crush hazard exists by the lift arms or bucket if all personnel are not cleared from the bucket and lift arm area before using the hydraulic hoist and bucket pilot pressure bleed down valves to relieve pressure from the hoist and bucket pilot circuit. Clear all personnel from the area around the bucket and lift arms before operating hydraulic hoist and bucket pilot pressure bleed down valves. Using the hydraulic bleed down valves could result in some movement of the lift arms and bucket which could cause injury or death.

t. Use the hydraulic pressure bleed down valves located in the front frame underneath the Husco valves to bleed any stored pressure in the hoist and bucket circuit.

- Turn each valve slowly counterclockwise as shown below and allow the pressure to bleed down.
- Open the valve completely and leave it open during repairs.



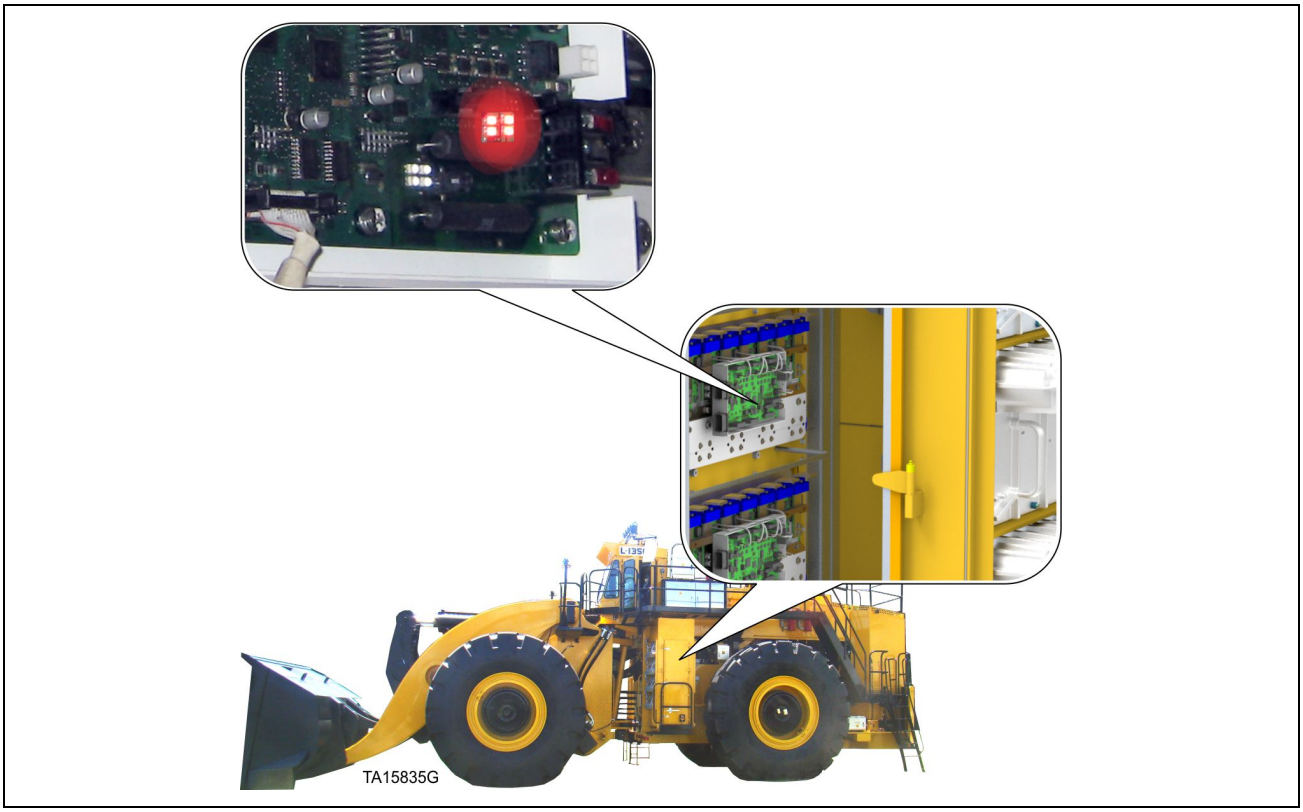


u. Drain the hydraulic reservoir if applicable to the procedure being performed.

Converter Bus Voltage

⚠ WARNING

Risk of fatal shock or injury by contact in the electrical cabinet is possible if the engine is running, the LINCS software indicates voltage on the bus, or the red bus LED's in the electrical cabinet are illuminated. All SR equipment has the ability to produce voltage at low throttle. Even with the engine off, there may be a residual of 12-15VDC on the bus. Do not enter the electrical cabinet or touch any components in the electrical cabinet without performing the Bus Discharge Verification Procedure. Failure to do so may result in fatal electrical shock or other injury.



Converter assembly bus LED's

There are three different methods that are combined to verify when it is safe to enter the electrical cabinet.

1. LINCS II display in cab
2. visual indication in electrical cabinet
3. physical measurement

All of these steps are required in order to assure that the system is properly discharged.

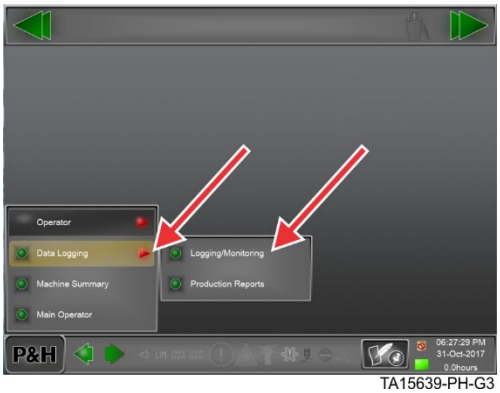
In Cab Verification Using LINCS II Display

a. Make sure that the LINCS II system is booted (key switch ON) with the engine NOT running and the park brake SET.

b. As shown in the following figure, on the touch panel in the dash, press the Main Menu button in the lower left corner, then select Data Logging then Logging/Monitoring.

TA15638-PH-G3

Main Menu Button

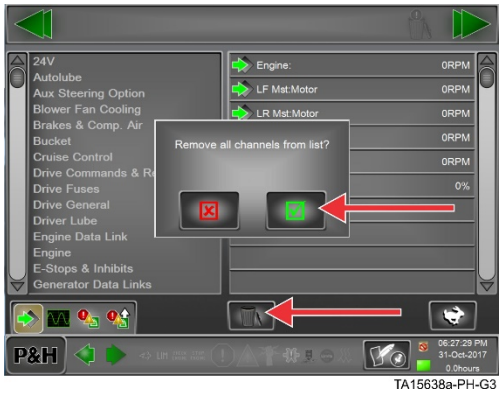


TA15639-PH-G3

Data Logging & Logging/Monitoring

LINCS logging/monitoring menu access

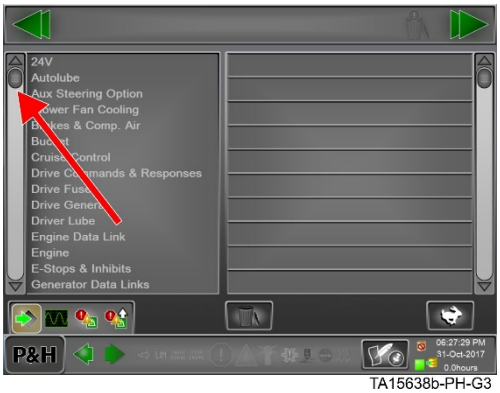
c. Select the Trash Can icon and then select the Check Mark to clear any selection on the right hand side of the screen (if applicable).



TA15638a-PH-G3

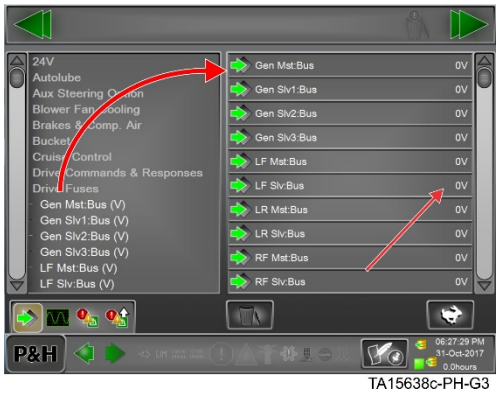
Remove channels

d. Scroll down the left hand list until Drive Fuses is displayed.



Left hand scroll

e. Drag the Drive Fuses category to the right hand side of the screen, all of the bus voltage channels should now be visible.



Bus voltage indication

f. Verify bus voltage is less than 24VDC.

NOTICE

Should any voltage (greater than 24VDC) be present on any of the DC busses, allow the system to discharge for a period of no less than 10 minutes. Re-test the bus voltages prior to continuing.

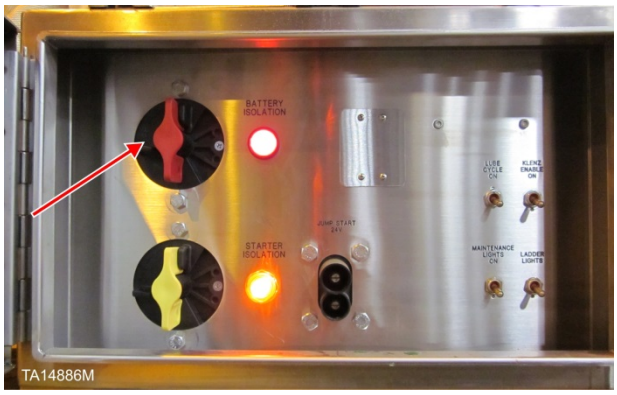
g. Turn the key switch to the OFF position and proceed to the next step in the verification process.

Verification by Visual Indication

Following the verification by LINCS II software, the next step is to verify the existence of bus voltage by the array of four LED indicators located on the main SR control board on each converter assembly.

To conduct this test, ensure that:

- The 24V DC power is isolated at the battery disconnect (turned off and locked out) per site requirements.

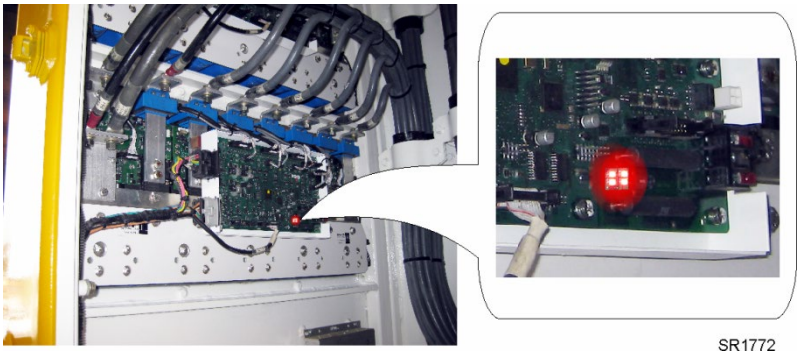


Isolate the battery and lockout the machine

Isolation and control switch assembly

- The SR electrical converter cabinet door should now be opened.
- DO NOT enter the cabinet at this time.

View the LED arrays on each of the converter assemblies and verify the LED's are not illuminated. The LED's will be illuminated when a potential of greater than approximately 35VDC is present on the DC bus connections on the converter assemblies. The light intensity varies with voltage and a greater intensity indicates a higher bus voltage.



Bus voltage LED array on SR control board

Once verified that the LED's are NOT illuminated, proceed with Verification by Physical Measurement of the main bus bars.

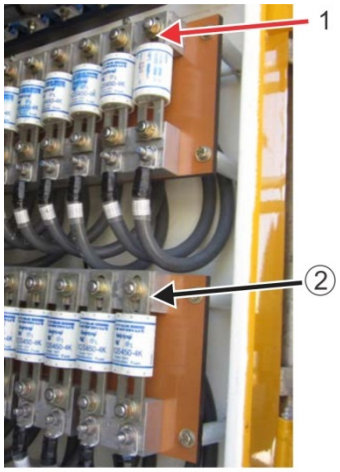
Verification by Physical Measurement Main Bus Bars

Once the visual indicators have been verified, the bus voltage should be physically measured. The bus voltage should be fully discharged based on the previous checks.

a. Measure between the positive and negative bus bars using a voltmeter rated for 1000V. The potential voltage on a bus that has not discharged could be over 700VDC. A properly discharged bus should be less than 24VDC as verified by the completion of LINCS system verification.

⚠ WARNING

Risk of shock or equipment damage by use of an improperly rated meter is possible. Use a CAT III 1000V rated volt meter to take voltage readings. Shock or other injury may result from using improperly rated test equipment.



1) Positive bus bar, **2)** Negative bus bar

Main bus bars

Converter Assembly Bus Connections

The final point of verification is the bus connections to each individual converter assembly. The bus voltage can be measured at the two bus tabs located adjacent to the electrical converter cabinet door.

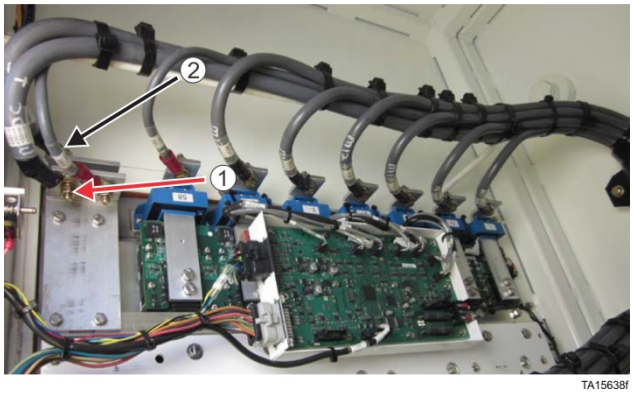
NOTICE

The converter assemblies on the rear of the cabinet are inverted in comparison to those mounted on the front. Similarly, the positive and negative bus connections will be inverted.

Connect a voltmeter across the two bus connection points. Bus voltage should be less than 24VDC following the completion of the previous checks. Once the check has been completed, the entire drive system has been verified as discharged.

1) Positive bus bar, **2)** Negative bus bar

Converter assembly bus connections (rear of cabinet)



1) Positive bus bar, **2)** Negative bus bar

Converter assembly bus connections (front of cabinet)

Once verified that bus voltage does not exist, entry into the electrical cabinet, axels, and grid area are permissible.

Converter Assembly Bus Connections

The final point of verification is the bus connections to each individual converter assembly. The bus voltage can be measured at the two bus tabs located adjacent to the electrical converter cabinet door.

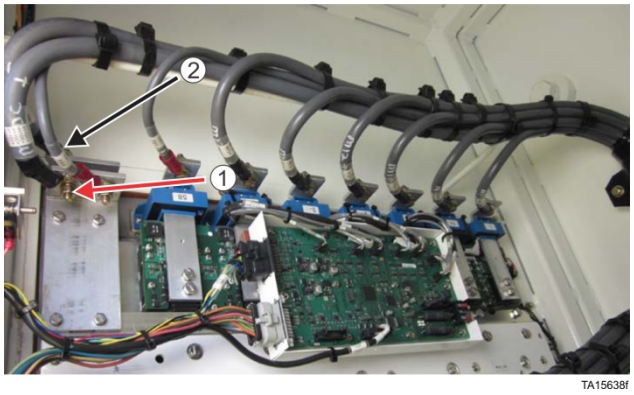
NOTICE

The converter assemblies on the rear of the cabinet are inverted in comparison to those mounted on the front. Similarly, the positive and negative bus connections will be inverted.

Connect a voltmeter across the two bus connection points. Bus voltage should be less than 24VDC following the completion of the previous checks. Once the check has been completed, the entire drive system has been verified as discharged.

1) Positive bus bar, **2)** Negative bus bar

Converter assembly bus connections (rear of cabinet)



1) Positive bus bar, **2)** Negative bus bar

Converter assembly bus connections (front of cabinet)

Once verified that bus voltage does not exist, entry into the electrical cabinet, axels, and grid area are permissible.

Removal of Brake Caliper Assembly

Numbers in parenthesis refer to illustration "L-1350/L-1850/L-2350 BRAKE CALIPER ASSEMBLY (1 of 2)" earlier in this section.

⚠ WARNING

Electrical shock hazard exists inside the axle if axle access panel on either axle is removed without locking out the electrical system. Always verify the absence of bus voltage before removing the axle access panels and touching any electrified component inside the axle. Do NOT touch the electrical cable connections inside the axle when the key switch is ON, or the generator is primed, or until five minutes after the engine has been shut down and the absence of bus voltage is verified. to lockout the electrical system, and touching electrified components inside the axle could cause electrical shock which might result in serious injury or death.

a. Follow appropriate procedures to ensure air system pressure is completely relieved; then remove air line from brake cylinder.

b. Use the jack bolt assembly, externally mounted on the brake cylinder, or shop air of 105-psi minimum to release tension on the brake. Refer to illustration "JACK ROD INSTALLATION FOR RELEASING BRAKE" for use of jack bolt. Also refer to illustration "VIEW OF JACK ROD INSTALLED IN BRAKE CYLINDER". Attach shop air to the inlet port of the cylinder if that is your chosen method.

c. Remove cotter pin (13).

d. Remove one guide pin (5).

e. Remove disc pads (8).

f. Remove mount (2).

g. Unbolt the brake cylinder (20) and take it to suitable workbench.

Disassembly of Brake Cylinder

Numbers in parenthesis refer to illustration "L-1350/L-1850/L-2350 BRAKE CALIPER ASSEMBLY (2 of 2)" earlier in this section. This procedure is only performed after the cylinder has been removed from the machine.

a. Remove breather plug (8) and jack bolt assembly (1 - 7).

b. Place the brake actuator into brake actuator press (hydraulic cylinder P/N 424-8797, press structure P/N 424-8794, press plate P/N 424-8796) with the studs protruding through the bottom of the press's base plate. Secure with mounting nuts.

c. Place press plate on top of the end cap (11).

Figure 35. Placing press plate into press

d. Bolt the two safety plates to the front of the press.

e. Power the press ram down until it seats firmly against the press plate. Use suitable spacers as required.

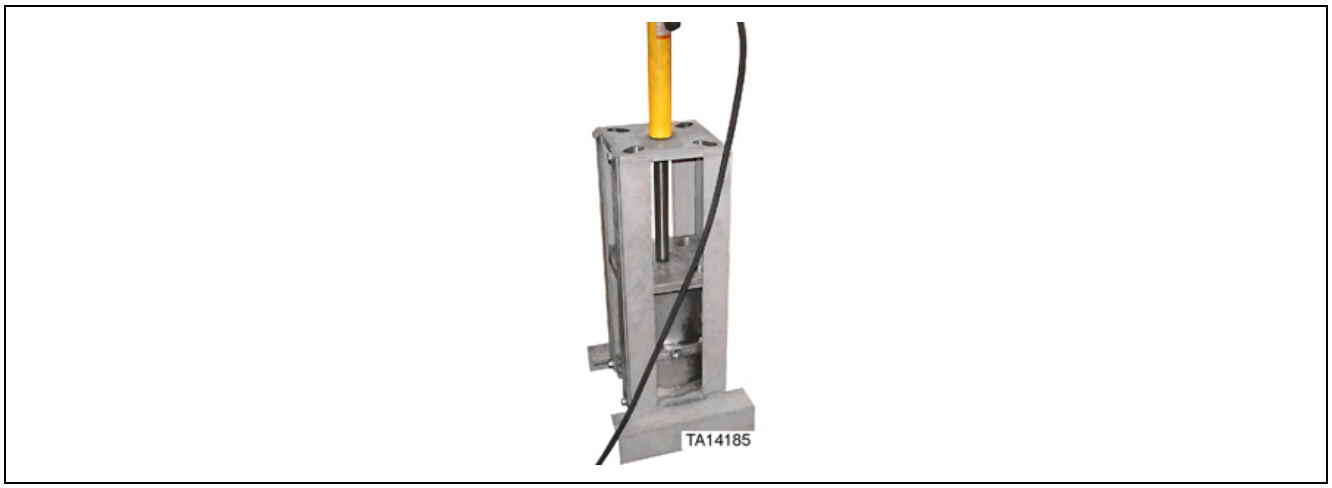


Figure 36. Press ram seated against press plate

f. Remove the four bolts (9) securing the end cap (11).

Figure 37. Removal of bolts securing end cap (1 of 2)

Figure 38. Removal of bolts securing end cap (2 of 2)

⚠ WARNING

Struck-by or struck against hazards exist before releasing hydraulic pressure. Spring pressure is still present in rear cylinder until it is manually released. Failure to release hydraulic pressure can cause a struck-by or struck against hazard resulting in serious injury or death.

g. Slowly release hydraulic pressure. The spring force against the inside of the end cap will allow the end cap internal components of the actuator to be safely removed after the ram is backed off sufficiently.

Figure 39. Disassembly of outer side components (1 of 2)

h. Remove the springs (14 and 15), spacer (13) and O-rings (24).

i. Remove the tube housing (25), piston assembly (17-23) and O-rings (24).

Figure 40. Disassembly of outer side components (2 of 2)

j. Repeat the above procedure to remove the rear tube housing (37), piston assembly (29-34) and O-rings (36).

Figure 41. Removal of inner spring and piston

k. Remove seals and wear rings from pistons and end caps.

Figure 42. Removal of seals and wear rings (1 of 2)

Figure 43. Removal of seals and wear rings (2 of 2)

I. Thoroughly clean all components with solvent.

Inspections upon Disassembly

Numbers in parenthesis refer to illustration "L-1350/L-1850/L-2350 BRAKE CYLINDER ASSEMBLY (2 of 2)" (earlier in this section). This procedure is only followed after the cylinder has been removed from the machine.

a. Check actuator cylinder(s) bore surface (25 and 37) for scoring and dents.

b. Inspect the cylinder rods (21 and 34) and pistons (17 & 29). Remove any nicks and scratches. If it is observed that the cylinder rod and piston are corroded, scored, or notched, then they should be replaced.

c. Thoroughly clean the springs (14, 15 & 35) and coat with a light rust preventative lubricant.

d. Check breathers (8) for cleanliness and proper air flow.

e. Check the wiper and seals as shown in details A, B, C, and D on illustration "L-1350/L-1850/L-2350 BRAKE CYLINDER ASSEMBLY (2 of 2)".

NOTICE

If mounting studs are removed from housing, use LOCTITE thread locking compound to reassemble.
If piston is removed from cylinder rod, use LOCTITE thread compound on retaining nut.

Assembly

Numbers and letters in parenthesis refer to illustration "L-1350/L-1850/L-2350 BRAKE CYLINDER ASSEMBLY (2 of 2)" (illustrated earlier in this section). This procedure is only followed after the cylinder has been removed from the machine.

a. Install O-ring seals (18 and 31) .and wear rings (19 and 30) to pistons (17 and 29). Note proper orientation of the seal as shown in Views A and C of illustration "L-1350/L-1850/L-2350 BRAKE CYLINDER ASSEMBLY (2 of 2)".

Figure 44. Installation of seal and wear ring to piston

b. Install rod seals (22) and rod wear rings (23) onto end cap (27) and support plate (38). Note proper orientation of seals.

Figure 45. Installation of O-ring to end cap

c. Place end cap (38) into press and lubricate O-ring seal mounting area of end cap (27) and support plate (38) with lubricant P/N 425-6386.

NOTICE

It is essential to use lubricant P/N 425-6386 as other lubricants do not perform well in low ambient temperatures.

Figure 46. Lubrication of inner end cap for installation of O-ring

d. Install the O-ring (36).

Figure 47. Installation of O-ring on inner end cap

e. Lubricate the seal and wear ring (30 and 31) with lubricant P/N 425-6386.

Figure 48. Lubrication of seal and wear ring

f. Lubricate the inside of the tube housing (37) with lubricant P/N 425-6386.

Figure 49. Lubrication of inner housing

g. Place the piston assembly (29, 32, 33, 20, 34) into the tube housing (37) and push it down by hand to approximately 1-inch (25.4 mm) from the bottom of the housing.

Figure 50. Installation of piston into inner housing

h. Lubricate the perimeter of the underside of the piston with a liberal amount of lubricant.

Figure 51. Lubrication of piston in inner housing

i. Lubricate the O-ring mounting surface of end cap (27).

Figure 52. Lubrication of top end cap for inner housing for installation of O-ring

j. Install O-ring (36) to end cap.

Figure 53. Installation of O-ring on top end of end cap of inner housing

k. Place spring (35) onto the plate (38).

Figure 54. Installation of spring onto inner end cap

l. Place the piston assembly and tube housing on top of the spring.

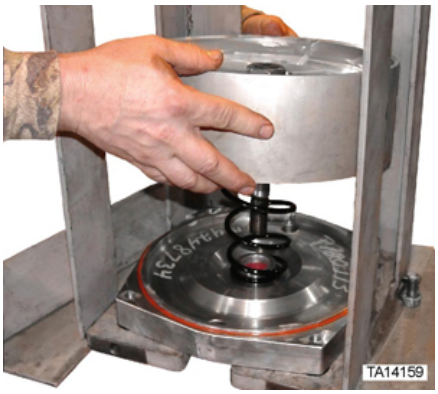


Figure 55. Installation of inner housing and piston

m. Place support plate (27) in mounting position on tube housing.

Figure 56. Positioning of top side inner end cap for pressing

n. Place press plate on top of the support plate (27).

Figure 57. Placement of press plate into press for final assembly of inner actuator

o. Install safety plates to the front of the press.

Figure 58. Installation of safety plates prior to final assembly of inner canister

p. Place suitable spacers on top of the press plate.

Figure 59. Pressing inner canister for final assembly (1 of 2)

q. Press the piston (29) and tube housing (37) down against the spring (35) pressure. Stop approximately 1/8-inch (3.175 mm) before the O-ring (36) contacts the tube housing (37). Carefully examine the O-ring and tube housing to ensure the housing is correctly oriented to be pressed into position without the O-ring being damaged. It may be necessary to use a soft hammer to tap the end cap to gain the proper orientation on the seal.

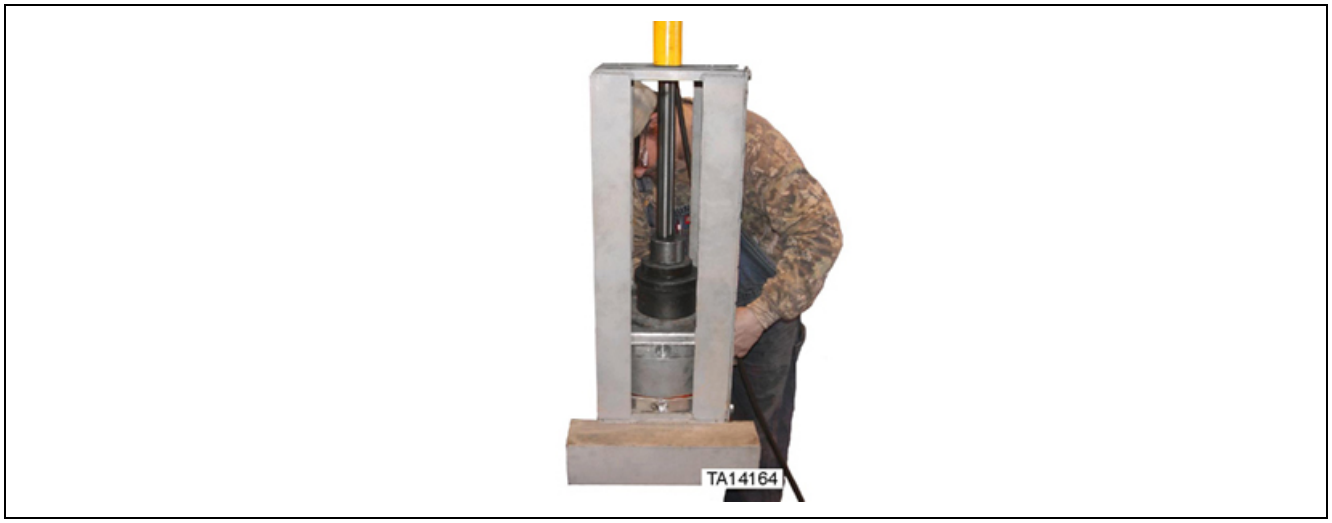


Figure 60. Pressing inner canister for final assembly (2 of 2)

r. Continue to press the end cap and housing down onto the end cap (38). Stop approximately 1/8-inch (3.175 mm) before the tube housing (37) contacts the end cap (38) and examine the positioning of the tube housing and O-ring to ensure that when the housing is pressed onto the end cap, the O-ring is not damaged. Use a soft hammer to position the end cap as necessary.

s. Press the support plate (27) piston assembly (29, 32, 33, 20, 34) and tube housing (37) into position on the end cap (38). Ensure the assembly is pressed; down completely.

t. Install the four bolts (26) and torque to 60 ft. lbs. **NOTE: These bolts are installed dry. Do not lubricate them with oil or grease.**

Figure 61. Installation of bolts securing inner canister components

u. Lubricate the piston, seal and wear ring (17, 18, & 19) as previously done for inner side.

Figure 62. Lubrication of seal and wear ring

v. Lubricate the inside of the tube housing (25), as was previously done with the inside housing (37).

Figure 63. Lubrication of inner housing

w. Lubricate the O-ring seal mounting surface of the end cap (11) and install O-ring (24).

Figure 64. Lubrication of end cap installation of O-ring

x. Lubricate the O-ring mounting area and rod bore on the support plate (27). Install O-ring (24) to support plate (27).

Figure 65. Lubrication of inner end cap for installation of O-ring

y. Place the piston assembly (16 - 22) onto the support plate (27). Place tube housing (25) onto support plate (27) in press.

Figure 66. Installation of outer housing

Figure 67. Outer housing in position in press

z. Install spring assembly and spacer tube (14, 15, & 16).

Figure 68. Installation of spring assembly into housing

aa. Place end cap (11) into mounting position in press. Place plate into position on end cap.

Figure 69. Compression of outer housing components

bb. Install safety plates to the press.

cc. Slowly press the end cap down against the spring assembly. Stop several inches above the tube housing.

dd. Use a soft hammer to tap the end cap at each side to ensure equal spacing with the press plate. This will center the O-ring as it enters the tube housing to ensure no damage is done to the O-ring.

ee. Continue to press the assembly into position, stopping approximately 1/8-inch (3.175 mm) above the tube housing. Closely examine the positioning of the O-ring to ensure that it enters the tube housing and no damage is done. Reposition the end cap as necessary by tapping it with the soft hammer.

ff. Press the assembly down completely and install the four retaining bolts. Torque the bolts to 60 ft. lbs. **NOTE: These bolts are installed dry. Do not lubricate them with oil or grease.**

Figure 70. Installation of bolts securing outer housing

gg. Bench test the cylinder with 120 to 130 psi pressure. Check for proper operation and air leaks.

Figure 71. Bench testing actuator

hh. Install the breather plug (8) and jack bolt assembly (1 - 7)

ii. Use the jack bolt assembly to release the park brake and check for proper cylinder operation.

Figure 72. Use of jack bolt to release park brake to test actuator operation

jj. Re-install the brake cylinder to the machine.

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Troubleshooting L-1350/L-1850/L-2350

The LINCS control system can be used to identify air leaks within the braking system. Refer to Section 05-01-06 of the Service Manual for information on charting the air pressures within the system.

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