CAT® Lift Trucks

Service Manual

GE SX Controls

EC15K, EC18K, EC18KL

A3EC1-10200-up

A3EC1-20200-up

A3EC1-30200-up

A3EC1-40200-up

EC20K, EC25K

A3EC2-10200-up

A3EC2-20200-up

A3EC2-30200-up

A3EC2-40200-up

A3EC2-80200-up

EC25KE, EC25KL, EC30K

A3EC3-10200-up

A3EC3-20200-up

A3EC3-30200-up

A3EC2-40200-up

A3EC3-80200-up

EC30KL

A3EC4-40200-up

99759-84120

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Recommended Lubrication of Pins and Sockets Prior to Installation

WARNING: Before conducting maintenance on the vehicle, jack up the drive wheels, disconnect the battery and discharge the capacitors. To discharge the capacitors, connect a 150 ohm, 25 watt resistor (Part No. 358280) between the positive and negative terminals on the control panel for at least 20 seconds.

Cleaner and lubricant are provided in the terminal maintenance kit SE000003.

Fretting occurs during microscopic movement at the contact points of the connection. This movement exposes the base metal of the connector pin which, when oxygen is present, allows oxidation to occur. Sufficient build up of the oxidation can cause intermittent contact and intermittent vehicle operation. This can occur at any similar type of connection, whether at the control or in any associated vehicle wiring, and the resultant intermittent contact can provide the same fault indication as actual component failure.

The addition of lubricant will prevent the oxidation process by eliminating the access of oxygen to the contact point. Add this lubricant to the 12 pin and 23 pin plugs of all new SX controls at the time of their installation into a vehicle

When servicing existing vehicles exhibiting symptoms of intermittent mis-operation or shutdown by the control, add this lubricant to all 12 and 23 pin plugs, after proper cleaning of the connectors, as a preventative measure to insure fretting is not an issue before control replacement. Also, for long term reliable control operation, the plug terminals must be maintained per these instructions with the recommended contact cleaner and lubricant which provides a high degree of environmental and fretting protection.

New and re-manufactured control plugs are cleaned and lubricated prior to shipment from the factory. However, in applications where severe vibration or high temperature cycling and excessive humidity, such as freezers are present, it is recommended that the plug terminals be cleaned and lubricated every year, per these instructions. In normal applications, plug maintenance should be performed every two years, unless intermittent problems arise with the plugs, requiring more immediate attention.
Warning: Do not use any other cleaners or lubricants other than the ones specified.

1. **Disconnect** plug from controller or mating plug.

2. **Locate** the plug that contains the socket (female) terminals. Maintenance needs only to be per formed on the plug containing the socket (female) type terminals. Reconnecting the plugs will lubricate the pin (male) terminals.

3. **Clean** each terminal using contact cleaner as shown in Figure 1.



Figure 1

4. **Lubricate** each terminal using lubricant as shown in figure 2. Apply enough lubricant to each terminal opening to completely fill each opening to a depth of .125" minimum.



Figure 2

5. **Reconnect** plugs.

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The primary method of diagnosing SX Control System faults is to use the diagnostic features of the display and handset. These, along with the preceding fault code tables, aid in the resolution of the majority of faults encountered. If a problem is readily identified through the built-in diagnostics feature, use the following tables as a secondary guide to aid in the identification of the fault.

1st Check is for Shorts to frame. Voltage on frame may cause many problems and codes.

2nd Checks are always loose/dirty connections at controller and harness connections.

TABLE ONE
Failures that Cause Reduced or No Motor Torque

NOTE

Conduct all testing with drive wheels raised off the floor.

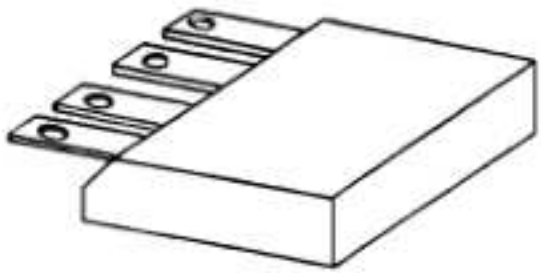
Symptom	Probable Cause
1a. Line Contactor does not pick up. No control voltage from positive to negative.	• Check power and control fuses. • Check battery for low specific gravity and connections for looseness or broken connector.

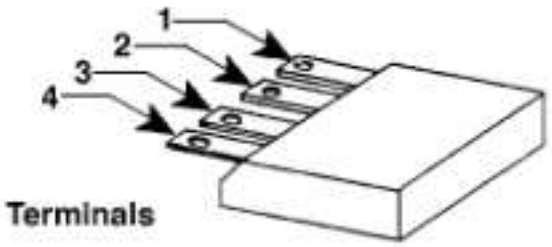
1b. Line Contactor does not pick up. with control voltage positive to negative	• Check PTC (Positive Temperature Coefficient) for heating. If hot to touch, check for proper battery polarity to control panel.
	• Plug in the battery with the key switch OFF. Voltage on should be battery volts at P1-1.
	• Close key switch and check volts at P1-2; voltage should be battery volts. If not check control fuse FU2
	• With key switch and seat switch closed, check for battery volts at P1-6. If zero, check control fuse, wiring or faulty key switch. If low check for volt drop across circuit from battery pos to P1-6.
	• With key switch and seat switch closed, check for battery volts at P1-2. If zero, check control wire #10 between key switch and seat switch and control card or fault seat switch. If low check for volt drop across circuit to P1-2.
	• Check for positive at line contact coil. P10-2 connection. If not battery volts check line coil for open or possible loose connections.
	• *Static Return to Off Fault.* If monitoring system warning light on display (!) comes on, once the key switch and seat switch are closed:
	  • Check for fault in directional control switch.
	  • Check for fault in wiring to directional control switch

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Pump Time Delay

FUNCTION: Controls the power supply to the pump driver according to the control signal input.



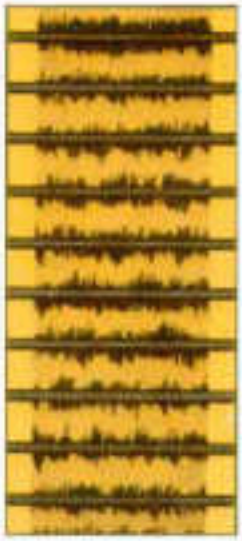


TERMINAL #	TRUCK WIRE HARNESS #	CONTACTOR PANEL HARNESS #	DESCRIPTION	CONDITION	VOLTAGE ON TERMINAL
1	NA	52	Control Signal Output	Not Activated Activated	0V 5V
2	13	13	Battery Negative	Always	0V
3	52	53	Control Card Input to Delay	Contactor Not Activated Contactor Activated	12V 11V
4	10	10	Battery Positive	Key On	BV BV

BV = Battery Volt

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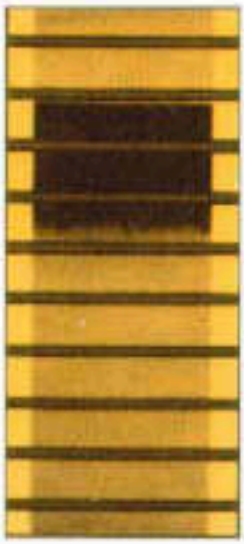
Commutator Surfaces



UNSATISFACTORY CONDITION

EXAMPLE OF POOR COMMUTATOR MACHINING

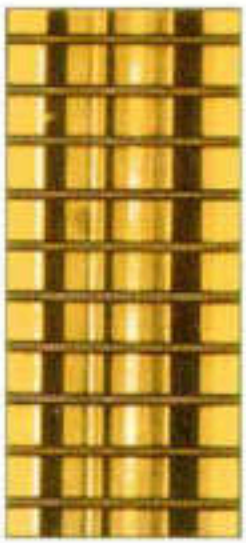
Bars are low in the middle giving rise to the brushes riding on entry and leaving bar edges. This and the previous illustration indicate the need for better maintenance.



UNSATISFACTORY CONDITION

BRUSH CONTACT MARK

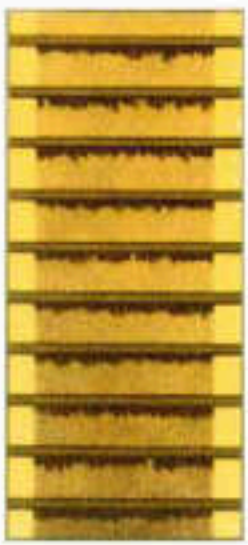
Storage of machines, for lengthy periods, with brushes in position. This can also result from operation of machine in prolonged stall conditions.



UNSATISFACTORY CONDITION

STREAKY FILM WITH COMMUTATOR WEAR

This is a further development of the third example, previous page. Brush grade, machine applications and working environment all suspect. Earlier corrective action should have been taken.



UNSATISFACTORY CONDITION

BAR EDGE BURNING CAUSE HIGH MICA

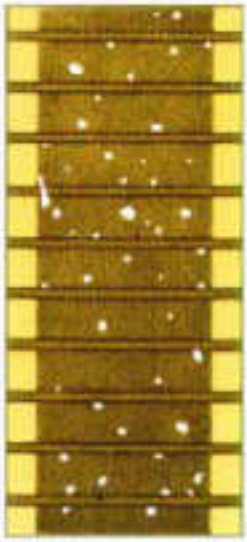
Illustration shows high mica in every slot. Same effect can occur on one bar only. Similar conditions can be caused by a high or low bar.



UNSATISFACTORY CONDITION

DOUBLE POLE PITCH

Darkening of commutator in sequences two pole pitches apart is due to armature fault, defective coil, riser bars or equalizer connections.



UNSATISFACTORY CONDITION

SMALL BRIGHT SPOTS

Related to over-loaded machines and low brush pressure. Due to sparking under brush which gives rise to spots being of a random distribution. If not corrected, will result in scored commutator.

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Application of Thermal Compound

Due to the minute differences in the control mounting surface and the vehicle mounting surface, small pockets of air will be created. These air pockets will add to the overall thermal resistance of the interface. To avoid these air pockets and improve thermal conductivity, thermal compound must be applied between the control base plate and the vehicle mounting surface. The function of this compound is to conform to surface discrepancies, filling gaps and optimizing the metal-to-metal contact of the control and the vehicle.

a) Prepare the two mounting surfaces (control and vehicle) as indicated above.
b) Using a triangular notched trowel of 3/32" (.09" +/- .01), apply the grease to the vehicle mounting surface.
c) Use straight, non-crossing strokes of the trowel to apply the compound.
d) Make multiple vertical passes until a uniform consistency is achieved.



Adhesive spreader model SE000049



Vehicle surface after proper grease application

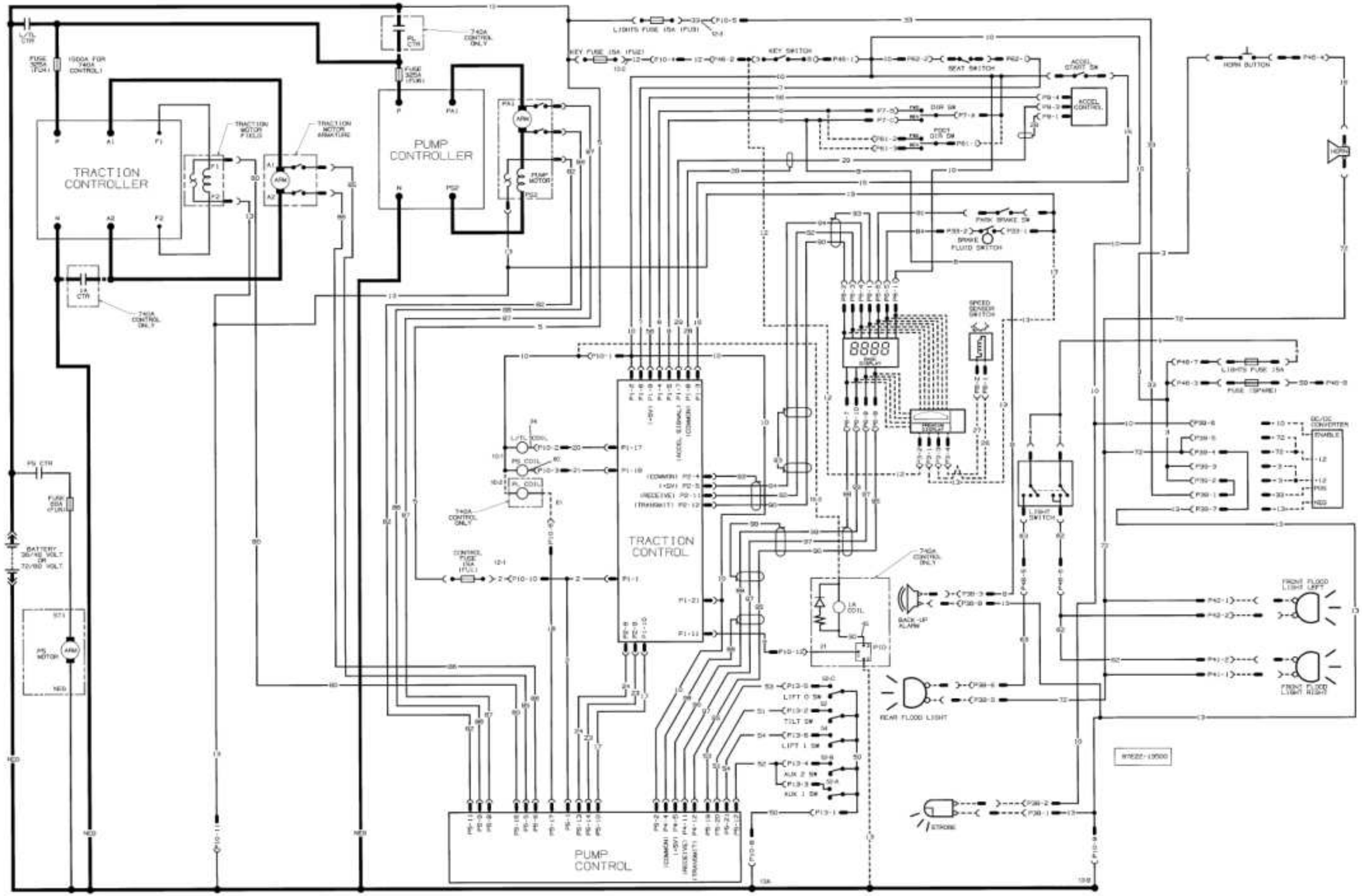
Mounting the Control

a) After control mounting surface is prepared with heat sink grease, place the copper heat conducting pad on heat sink grease and align holes as positioned.
b) After placing the copper pad, apply heat sink grease to the exposed side of the pad using the same method as before.
c) Prepare mounting surface of truck.
d) Place the control unit with desired orientation on mounting surface of truck with mounting holes aligned.
e) Move the control slightly in all directions to eliminate voids and enhance the distribution of the thermal compound.
f) Insert all of the mounting hardware (6 or 8 bolts, M6, necessary for the mounting of the respective control).
g) Tighten these bolts (as per sequence shown in diagrams below) to half of the nominal torque value (4 ft-lb).
h) Lastly, tighten the bolts to the nominal torque value (8 ft-lb), following the same sequence.



Calibrated torque wrench for hardware installation

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Traction Bypass with Pump Control

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