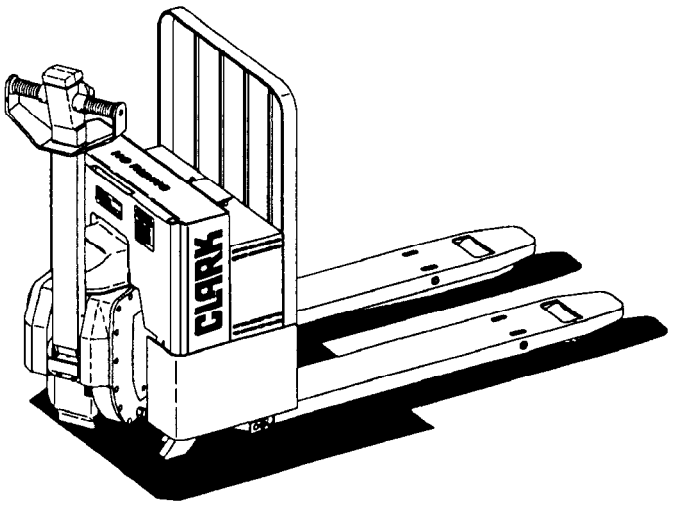
Service Manual

SM 611



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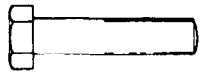
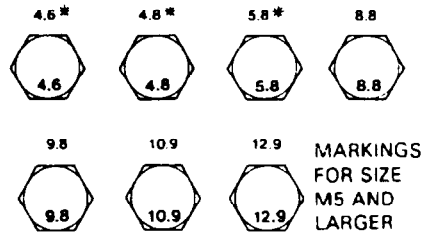
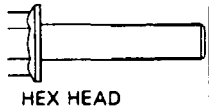
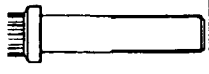
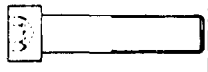
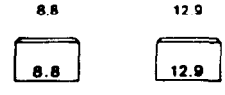
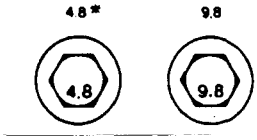
STRENGTH IDENTIFICATION

The most common property classes for metric fasteners are 8.8 and 10.9. The property class is marked with a number on the head of the capscrew or on a nut. Property classes less then 8.8 are often not marked. Grades for inch bolts go from 2 to 8. Grade 2 fasteners normally do not have marks. The following tables show the marks that identify the grades and property classes for different fasteners.

⚠WARNING When fasteners must be replaced, the new fasteners must be of the same strength or greater then the original fasteners. The new fasteners must also be the correct size.

NOTE: IDENTIFICATION MARKS ARE ACCORDING TO BOLT STRENGTH. THE HIGHER THE NUMBER OR THE INCREASE IN THE NUMBER OF MARKS INDICATES INCREASED BOLT STRENGTH.

TABLE 1 - BOLTS AND SCREWS

TYPE OF FASTENER	INCH FASTENERS. STRENGTH LEVELS: SAE GRADES * MARKINGS NOT REQUIRED	METRIC FASTENERS. STRENGTH LEVELS: PROPERTY CLASSES * MARKINGS NOT REQUIRED
 HEX HEAD BOLTS & CAPSCREWS		
 HEX HEAD FLANGE SCREWS		SAME AS ABOVE
 12-POINT FLANGE SCREWS		
 HEX SOCKET HEAD CAPSCREWS	MARKINGS NOT REQUIRED	
 SEMS		

0.4.3 Planned Maintenance Procedures

This section describes how to perform the services listed in the Schedule of Planned Maintenance Operations. As with the "Schedule" this section is sub-divided into service intervals.

Services to be performed daily or at each 8 hour operating shift:

The daily inspection is to be made by the operator prior to each operating shift. It is the operator's responsibility to report any defects to the proper authorities and the truck should not be operated until it has been inspected and repaired by a qualified technician. The operator is ultimately responsible for the safe operation of this pallet truck.

Battery -

The battery should be charged when it reaches the 80% discharged level. This is indicated on the optional Battery Discharge Indicator when the single red LED bar on the far left is illuminated. A warning will be given at the 70% discharged level by means of the two red LED bars flashing alternately on and off. If the truck is equipped with the optional Lift Interrupt then lift lockout will occur at the 80% discharged level. If the optional Battery Discharge Indicator is not mounted then the battery should be charged after 6 to 8 operating hours.

Hydraulic System -

Inspect the entire truck for leaks; especially around the hydraulic pump assembly and the lift cylinder. Any sign of oil on the floor under the truck is an indication that the truck may be leaking hydraulic oil or transmission fluid. Report any problems to the proper authorities and do not operate the truck until it has been inspected and repaired by a qualified technician.

Frame/Sheet Metal -

Inspect the truck for loose, damaged or missing parts. All shields must be in place and functional. Report any problems to the proper authorities and do not operate the truck until it has been inspected and repaired by a qualified technician.

Wheels/Tires -

Inspect wheels and tires for wear and damage. Trash wrapped around wheels and axles will cause premature tire wear and bearing damage. Any trash should be removed before operating the truck and the floors should be kept clear of trash to prevent damage to the wheels and tires.

Functions/Operations -

Test the truck for the proper operation of all functions; including the travel controls, lift and lower functions, the brakes and the emergency reverser button. Safety devices must be operational. Report any problems to the proper authorities and do not operate the truck until it has been inspected and repaired by a qualified technician.

4. Install transmission assembly through transmission mounting bracket. Install smaller bearing cone and felt seal.

5. Use Loctite Thread Lock 42 on nut and install nut on transmission pivot tube. The nut should be tightened until all end play is removed from pivot bearing.

6. Lower truck and connect battery, turn key switch "ON" and test operation of truck.

7. Grease pivot bearings while slowly rotating transmission.

8. Install sheet metal cover and plastic cover on truck.

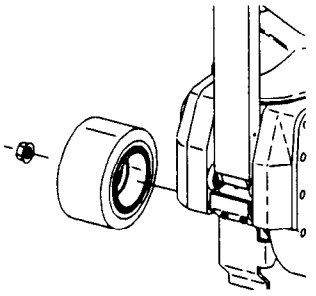
1.6.2 DRIVE WHEEL REMOVAL AND INSTALLATION

REMOVAL

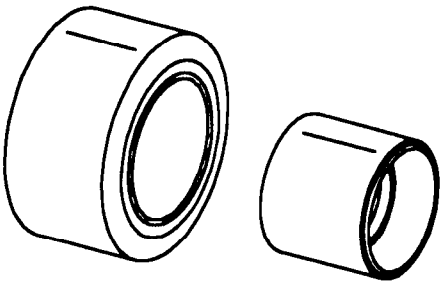
The drive wheel can be removed without removing the transmission by following these steps:

1. Disconnect the battery, block truck with drive tire off floor (about 1 inch).

2. Remove drive tire by hand or if wheel is stubborn use three bolts from side cover over drive tire and thread in hub to push drive tire off drive axle.



3. Press drive tire from wheel hub.



ITEM #	DESCRIPTION
1	PANEL ASSEMBLY
2	MOTOR
3	PUMP, LIFT
4	WIRE ASSEMBLY
5	WIRE ASSEMBLY
6	SCREW, THREAD FORM
7	
8	SCREW, SOCKET FLAT HEAD
9	SCREW, THREAD FORM
10	SWITCH, KEY
11	SWITCH, EMERGENCY KILL
12	MOUNT
13	HARNESS
14	SWITCH
*	HOURMETER
*	BATTERY DISCHARGE INDICATOR/HOURMETER

- **Curtis PMC controller power circuits.**

When either the forward or reverse contactors are closed current will flow from the battery positive terminal through the battery cable, through the 110 amp circuit breaker, through the line contactor to the B+ terminal on the Curtis PMC controller. From the B+ terminal through the drive motor armature, A1 to A2, through the normally open (now closed) contacts of the chosen direction contactor; through the drive motor field coils (S1 to S2 or S2 to S1 depending on direction), through the normally closed contacts of the opposite direction contactor, to the M- terminal of the Curtis PMC controller.

The current flowing into the M- terminal will be connected internally in the Curtis PMC controller to the B- terminal which is connected directly to the battery negative terminal.

Inside the Curtis PMC controller a high power semi-conductor switch, consisting of an array of paralleled power MOSFET transistors, controls the current through the drive motor. The transistors are turned on and off at the rate of 15,000 times per second by the control circuitry, while the ratio of the on and off times is regulated by the input of the accelerator potentiometer. This is called Pulse Width Modulation. When the transistors are on, current flows through the drive motor and builds up energy in the motor's magnetic field. When the transistors turn off, this stored energy continues to flow in the drive motor through the freewheel, or flyback diode. Thus, the average motor current is greater then the average battery current and smooth, stepless control of the power delivered to the drive motor is achieved with very little power loss in the control components.

- **Accelerator Potentiometer Circuits**

The accelerator potentiometer is used to signal the Curtis PMC controller of the desired motor speed. By controlling the position of the accelerator potentiometer the operator can control the travel speed of the truck.

The accelerator potentiometer is connected between terminals 2 and 3 on the Curtis PMC controller. When in neutral the resistance through the accelerator potentiometer is high, approximately 5000 ohms. As the truck controls are operated to a higher travel speed the resistance through the accelerator potentiometer decreases. The resistance should decrease to below 50 ohms at full speed.

The resistance of the accelerator potentiometer is used to regulate the voltage potential on terminals 2 and 3 of the Curtis PMC controller. In neutral with a high resistance through the accelerator potentiometer the voltage potential, with respect to battery negative will be 1.85 volts +/- 10% on terminal 3 and 5.20 volts +/- 10% on terminal 2. When the controls are operated to high speed and the resistance through the accelerator potentiometer is at a minimum the voltage potential, with respect to battery negative, will equalize at 4.3 volts +/- 10% on both terminals 2 and 3.

- **Lower pallet forks**

When the lowering switch bar is pushed the lowering switch closes and positive battery voltage is supplied to the lowering solenoid valve coil. The other side of the coil is connected directly to battery negative via wire #13 and so the solenoid valve energizes to release the oil in the lift cylinders, and the pallet forks lower.

The first steps of any troubleshooting procedure are to:

1. Inspect the truck for physical damage or mechanical malfunction. Contactors must be free to move and the tips must not be welded or burnt.

2. Check for ground faults from the electrical system to the frame with on ohmmeter. A minimum of 20,000 ohms resistance from the frame to any and all wiring is acceptable.

3. Check that the battery is fully charged and connected.

4. Operate the truck in all modes to determine the exact symptoms. Do not forget that these systems are equipped with safety circuits that prevent operation in the event of improper operating procedures.

NOTE: There are two series of tests for the accelerator potentiometer circuits. The first series will test the resistance through the potentiometer circuit and the second series will test the control voltages on the transistor controller.

Resistance testing

Conditions for testing:

- Battery disconnected from truck.
- Truck blocked to prevent it from rolling.
- Wires #9 and #10 removed from transistor controller.

Test Procedure:

Connect an ohmmeter with at least a 10K ohm scale to wires #9 and #10 that were removed from transistor controller. The purpose is to test the resistance through the accelerator potentiometer as the travel controls are operated through their full range in both directions. Operate travel controls slowly and smoothly to full speed in both directions: read ohmmeter.

Test Results:

In neutral the resistance should be approximately 5000 ohms through the accelerator potentiometer circuit. As the controls are operated to high speed the resistance through the accelerator potentiometer circuit should drop smoothly to about zero (0) ohms.

Recommended Action:

If the test indicates an open circuit between wires #9 and #10 then repair the broken wire #9 or #10 or replace the accelerator potentiometer as necessary.

If the test indicates zero (0) ohms resistance between wires #9 and #10 repair the short circuit or replace the accelerator potentiometer as necessary.

If the test indicates improper potentiometer function in both directions then adjust or replace accelerator potentiometer. If the test indicates improper potentiometer function in only one direction then the problem is mechanical and can be found in the control linkage.

2.5.14 No reverse travel (forks leading). Line contactor closes when control handle is pulled down to operating position. Forward travel and the lift, lower, and horn functions work okay.

Conditions for testing:

- Truck raised and blocked with drive tire off ground.
- Battery fully charged and connected to truck.
- Emergency disconnect pushbutton switch pulled out to the "run" position.
- Key switch turned "on".
- Control handle pulled down to operating position with brakes released and brake interlock switch closed.
- Travel controls operated to travel in the reverse direction (forks leading).

Test for battery voltage at:

A. Positive side of reverse direction control switch, wire #7.

Repair open wire #7 between brake interlock switch and reverse direction control switch.

B. Negative side of reverse direction control switch, wire #3.

Adjust or replace reverse direction control switch.

C. Plug PZ-7, wire #3, on transistor controller.

Repair open wire #3 between reverse direction control switch and transistor controller.

D. Special Instructions:

For this test only!! Remove only the power cable from the "P" terminal on transistor controller. Reconnect wire #29 to "P" terminal.

⚠WARNING Disconnect battery and discharge capacitor before removing or connecting any electrical wiring. Discharge capacitor by connecting a 50 ohm resistor across "P" and "N" terminals on transistor controller for several seconds.

Test for battery voltage on power cable that was removed from "P" terminal on transistor controller.

If battery voltage is NOT measured here then verify line contactor operation and replace line contactor, or repair open power cable from line contactor.

If battery voltage IS measured here then reconnect power cable to "P" terminal on transistor controller and continue with test E.

E. A1 terminal on transistor controller.

Replace transistor controller.

C. Inspect internally for loose or discolored connections and wires damaged due to overheating.

D. Inspect transformer coils for obvious discrepancies.

E. Inspect the charger internal AC power fuse - should be 10 amp rated.

NOTE: IF THE AC POWER FUSE IS BLOWN IT COULD INDICATE A SHORTED DIODE ON THE DC OUTPUT CIRCUIT.

III. Testing the DC output circuit.

NOTE: IF THE AC POWER FUSE BLOWS OR THE DC 1 x CIRCUIT BREAKER TRIPS CHECK FOR REVERSE POLARITY OF THE BATTERY CONNECTION.

A. Open circuit voltage test.

With the batteries disconnected and the charger turned on, the DC output voltage should be 1 1/2 times the rated DC voltage.

*See chart III on page

B. Short circuit amperage test.

With the charger output battery connector short circuited (positive to negative jumper connector plugged into charger output connector), and the charger turned on, the DC output amps should be 80% of the normal DC amps.

*See chart IV on page

1. With the charger in the "off" position connect AC power cord to appropriate AC power supply, connect with the + to - loop to the charger.

2. Turn on the battery charger and note the amp gauge reading. It should be as stated on the chart IV on page . Leave the charger on for five minutes while watching the amp gauge. The amp gauge should remain steady. This verifies the condition of the circuit breaker and any loose connections.

3. Turn the charger off before disconnecting the jumper connector.

IV Testing components

⚠WARNING Before checking components disconnect AC power supply, unplug batteries, and discharge capacitor with an insulated screwdriver. All tests should be made with the charger disconnected unless otherwise stated. Use extreme caution when a test calls for the power to be "on" at the charger.

A. Diodes

1. A quick test for shorted diodes may be made by connecting the leads of the ohmmeter to the charger battery connector terminals and testing for continuity in each direction. If the test shows open, the DC circuit breaker may be open. To bypass an open DC circuit breaker connect the test leads to the positive and negative lugs behind the circuit breaker, reverse the ohmmeter probes. A

INDICATIONS	IMMEDIATE CAUSES	PRIMARY FAULTS
Chattering or Noisy	Commutator surface condition Looseness in machine Faulty machine adjustment High friction Wrong brush grade	See specific surface fault in evidence 15-16-17 10-11 6-43-45-49-52-58-59 55-58-59

INDICATIONS APPEARING AT COMMUTATOR SURFACE

INDICATIONS	IMMEDIATE CAUSES	PRIMARY FAULTS
Brush Chipping or Breakage	Commutator surface condition Looseness in machine Vibration Chattering Sluggish brush movement	See specific surface fault in evidence 15-16-17 52 See "Chattering or Noisy Brushes" 14
Rough or Uneven Surface		1-2-3-4-17
Dull or Dirty Surface		5-44-60
Eccentric Surface		1-19-22-52
High Commutator Bar	Sparking	17
Low Commutator Bar Streaking or Threading of Surface	Sparking Copper or foreign material in brush face Glowing	2-25 43-44-45-46-49-59 2-3-46-47-48-61 See "Glowing at Brush Face"
Bar Etching or Burning	Sparking Flashover	2-3-7-12-30-31-32-33 5-11-14-35-38-39-41-53
Bar Marking at Pole Pitch Spacing	Sparking	25-37
Bar Marking at Slot Pitch Spacing	Sparking	7-12-30-57-60
Flat Spot	Sparking Flashover Lack of attention	19-23-25-41-53 5-11-14-35-38-39-41-53 1-5-11
Discoloration of Surface	High temperature Atmospheric condition Wrong brush grade	See "Heating at Commutator" 44-46 60

3.1 COMPONENT IDENTIFICATION