Maintenance Manual

Serial Numbers: 872-17-00100 and Up

Publication: 1236462, Issued: 18 Jan 2018

Manual Design

This manual is designed to give personnel, with an expected level of expertise, the technical information necessary to maintain, troubleshoot, and repair a *Raymond* product.

The two-line header at the top of each page contains the name of the manual, the title of the current section, and the topic of the page.

This manual includes the following sections:

- **1. How to Use This Manual** explains the manual format and design as well as abbreviations and symbols used.
- **2. Safety** explains warning and caution notes, gives general safety rules and (as applicable) safety rules for batteries, jacking, static electricity, towing, transport, and welding.
- **3. Systems Overview** includes general lift truck specifications, modes of operation, and setup/configuration information.
- **4. Scheduled Maintenance** identifies the recommended maintenance tasks and intervals necessary to keep the lift truck working most efficiently.
- **5. Troubleshooting** provides information used to isolate a problem or failing component based on the lift truck's symptoms.
- **6. Messages, Codes, and Tests** gives (as applicable) operator messages, fault codes, and procedures for running diagnostic tests.
- **7. Component Procedures** contains component locator photos and step-by-step information for the testing, removal, installation, and adjustment of individual lift truck components. Components are grouped by system. A detailed List of Component Procedures can be found at the beginning of the section.
- **8. Theory of Operations** explains signal flow within the electrical and hydraulic systems for various conditions of lift truck operation. This section also contains a detailed connection point table (Pinout Matrix) designed to assist in testing and troubleshooting the truck.
- **Appendix** contains reference information such as torque values, lubricants, and standard/metric conversions.
- **Index** alphabetically lists subject matter with applicable page references.

Battery Safety

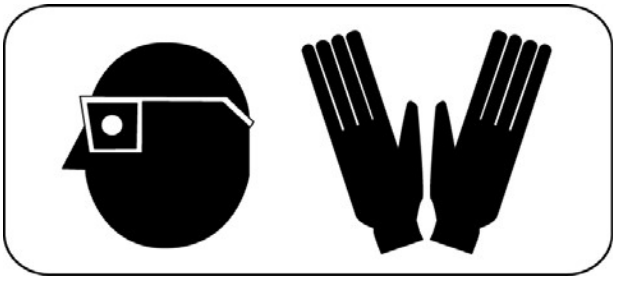
⚠ WARNING

As a battery is being charged, an explosive gas mixture forms within and around each cell. If the area is not correctly ventilated, this explosive gas can remain in or around the battery for several hours after charging. Make sure there are no open flames or sparks in the charging area. An open flame or spark can ignite this gas, resulting in serious damage or injury.

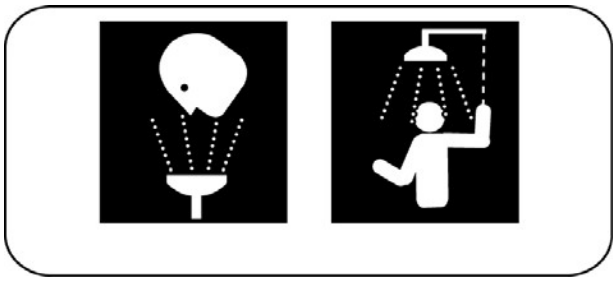
⚠ WARNING

Battery electrolyte is a solution of sulfuric acid and water. Battery electrolyte causes burns. If any electrolyte comes in contact with your clothing or skin, flush the area immediately with cold water. If the solution gets on your face or in your eyes, flush the area with cold water and get medical help immediately.

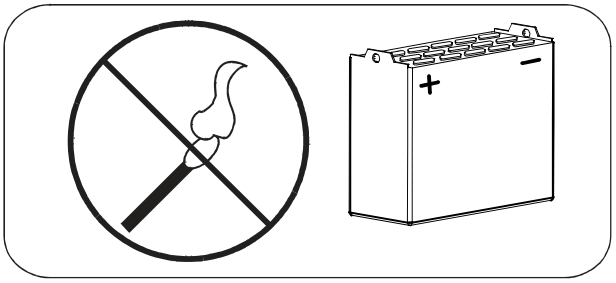
Wear personal protective equipment to protect eyes, face, and skin when checking, handling, or filling batteries. This equipment includes goggles or face shield, rubber gloves (with or without arm shields), and a rubber apron.



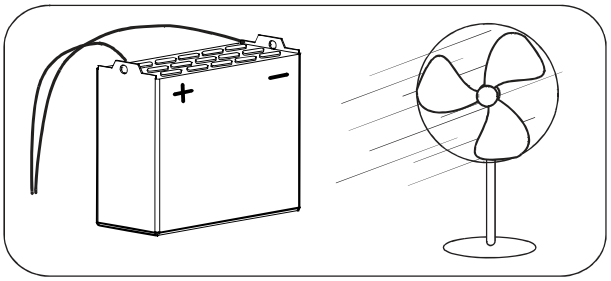
Make sure a shower and eyewash station are nearby in case there is an accident.



A battery gives off explosive gases. *Never* smoke, use an open flame, or use anything that gives off sparks near a battery.



Keep the charging area well-ventilated to avoid hydrogen gas concentration.



Introduction

This manual provides information for maintenance and repair of the Raymond 2nd level orderpicker.

This manual contains the most current and accurate procedures, drawings, and photographs available at the time of publication. Subsequent releases of this product may differ slightly from that shown here. Accordingly, some changes in parts, layout, or procedures may not be reflected in this manual.

For the latest information on your *Raymond* lift truck, contact your local authorized Raymond Sales and Service Center.

7. Press the horn button again to confirm the new PIN-key code value. The parameter control indicator on the display stops flashing.
8. To enable additional operators; rotate the directional/speed control in the fork-first direction to roll over to the 2nd operator, and stop at parameter 10. The default value of "0" is displayed. Follow the previous steps for the desired number of different PIN-key codes you want to set up. There are a total of ten operators.

NOTE: Disabling all operators (all PIN-key code values = 0) prohibits truck operation without the service key.

NOTE: Use unique PIN-key codes to avoid confusion. If two operators have the same PIN-key code, the higher number operator's parameters are used. For example if the 1st and 2nd operator PIN-key code is 1111, and the 1st operator's max speed is 80% and the 2nd operator's max speed is 90%, when someone logs in with 1111 the max speed used is 90%.

Table 3-2. Service Parameters

Parameter	Name	Range (Step)	Default	Description
10	PIN-key code (optional keypad only)	0 to 9999 (1)	1	Capability to assign up to 10 PIN-key codes (for 10 different operators). Service Key needed to access and view this parameter.
11	Floor Mat Option	0 to 3 (1)	0	0: Order Picker 1: Order Picker 2: Travel Restricted 3: Order Picker with No Lift/Lower **NOTE:** For settings 0, 1, and 3, the steering angle is limited to 25 degrees with the floor switch open. Travel is restricted when the steering request is greater than 55 degrees. **NOTE:** In the travel restricted mode, the truck will not move or lift/lower when the floor switch is open. If the floor switch opens while traveling, the truck will plug to a stop.
12	Throttle Map	20 to 80% (5%)	50%	Sets a response curve to the throttle request. 50% is a linear throttle response. > 50% is more rapid response at lower throttle request < 50% is slower increase in speed at lower throttle request Maximum speed is attained at full throttle for all response curves.
13	Plugging Rate	1 to 5 (1)	3	Selects from a table for deceleration rate. A higher number results in a less aggressive deceleration. 1 = hardest feel, 5 = gentlest feel.
14	Display Hour Meter at Run-Time (option)	0 to 1 (1)	0	0: Hour Meter displayed briefly at power-up, then BSOC percent displayed during run-time 1: BSOC displayed briefly at power-up, then Hour Meter displayed during run-time **NOTE:** A setting of "1" is useful for trucks with fuel cells.

Digital Inputs From VM Control Sensors

The third most significant numerical field figure active (marked with arrow).

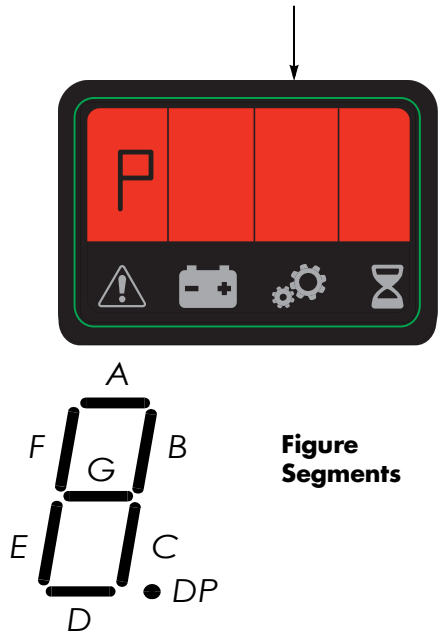


Figure Segments

Figure Segment	Function
A	
B	
C	
D	Lift Forks
E	Lower Forks
F	Platform Lift
G	Platform Lower
DP	VM Input: Horn

Digital Inputs From VM Control Sensors

The fourth most significant numerical field figure active (marked with arrow).

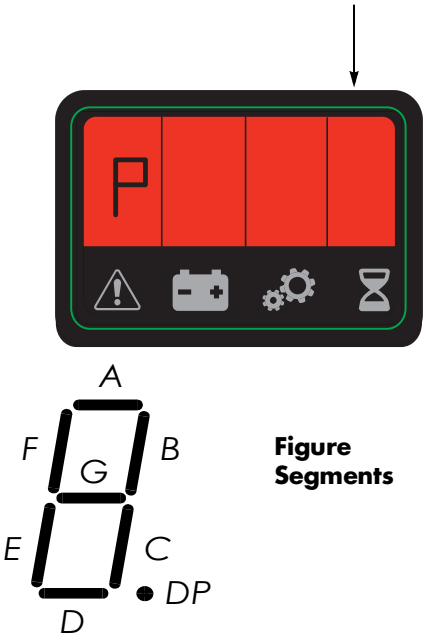


Figure Segments

Figure Segment	Function
A	
B	Left-Hand Jog Button Control
C	
D	
E	Right-Hand Jog Button Control
F	
G	
DP	

Every 180 Days or 500 Deadman Hours

NOTE: For Severe or Extreme operating condition service intervals, refer to page 4-2.

Perform the following maintenance tasks every 180 days or 500 HD, whichever comes first.	
Component	**Task**
Battery	Check the weight stamped on the battery in the pallet truck against the minimum and maximum allowable weights on the spec tag for the pallet truck. Report any pallet trucks that are running with batteries under the minimum or over the maximum allowable weight. Inspect all battery connectors and leads for damage and cuts in protective coatings. Make sure the battery gates are in position and not damaged. Make sure the battery has no more than 0.5 inch (13 mm) free play in any direction.
Brakes	In an open area, measure stopping distance. Traveling at walking speed or less with the no load, apply the brake by turning the truck OFF; the empty pallet truck should stop within 2 to 4 feet (0.6 to 1.2 m). During normal operation, with a rated load and traveling at top speed, the pallet truck should stop within approximately one and one-half truck lengths. Stopping distance depends on the load, floor, and tire condition. Examine for signs of oil on the upper and lower plate or rotor. If oil is present, disassemble brake, clean the upper and lower plate, and replace the rotor. Check brake gap, replace brake pad if the pad gap exceeds 0.015 in. (.38 mm). Failure to keep brakes adjusted causes premature upper and lower plate and rotor wear and excessive motor heat. See “Brake” on page 7-61.
Caster Wheels	Examine for bond failure, chunking, and excessive or uneven wear. Inspect bearings for binding or excessive play. Check adjustment of caster wheels. See “Caster Height Adjustment” on page 7-58.
Contactor	Inspect contactor tips for burnt or pitted surfaces. Failure to replace the tips may prevent the contactor from opening or closing, causing unscheduled downtime. With the truck OFF and the battery disconnected, check the plunger for smooth operation with no binding. If binding occurs, the pallet truck may malfunction or exhibit intermittent fault codes. See “Contactor Tip Inspection” on page 4-8.
Control Handle Assembly	Make sure steering function is smooth and responsive, without binding or excess play. Verify lift/lower function is smooth and controllable. Verify travel function is smooth and responsive through full range of acceleration and braking. Verify no codes on display. Verify function of all switches.
Brake Switch	Verify the actuator is within 1.5 to 3 mm of the switch with the handle in the travel position (switch closed).
Drive Unit	Check fluid level. Inspect for leaks. Make sure O-ring is present on the dipstick. Check drive unit axle for play.
Electrical Cables	Inspect all power cables for nicks or cuts. Give special attention to those cables that are not stationary, for example, cables to the traction motor. Replace any cable that is damaged or shows signs of excessive heat. Failure to do so will cause intermittent system shutdowns and/or electronic failures.

Electrical Troubleshooting Guidelines

General

⚠ WARNING

Block the lift truck so that the drive tire is off the floor whenever a troubleshooting procedure requires turning the truck ON. This prevents accidents caused by unexpected lift truck travel.

Use extreme care when the truck is jacked up for any reason. Keep hands and feet clear while jacking the lift truck. After the lift truck is jacked, place solid blocks or jack stands beneath it to support it. *Do not* rely on the jack alone. See "Jacking Safety" on page 2-9.

⚠CAUTION

Unless otherwise directed, disconnect the battery connector when you check electrical circuits or components.

Before removing a power amplifier, discharge the amplifier's internal capacitor by jumpering the + and – terminals with a 100 ohm 25W resistor.

Many problems are caused by a faulty or dirty battery. Make sure the battery is clean. See "Battery Exterior Cleaning" on page 7-67.

Save time and trouble by looking for simple causes first.

Visually inspect all wiring and electrical components for:

- Loose connections or connectors
- Loose or broken terminals
- Damaged terminals, blocks, or strips
- Broken wiring and shorted conditions (especially those that are close to metal edges or surfaces)

Use a Digital MultiMeter (DMM) such as a Fluke meter for all measurements. Analog meters can give inaccurate readings and load down sensitive electronic circuits enough to cause failure. Make sure meter cables are connected to the correct meter jacks and that the correct function and scale are selected.

When measuring voltage, connect the positive meter lead to the connector or probe point marked (+) in the test. Connect the negative meter lead to the connector or probe point marked (–).

Whenever measuring resistance, turn the truck OFF and disconnect the battery connector. Battery current can damage an ohmmeter. Isolate the component from the circuit.

Before replacing an electrical component, disconnect and clean all jack/pin connectors on the component(s) with contact cleaner (P/N 996-600/CC2). Reconnect and retest truck.

For troubleshooting DC electric motors, see "DC Electric Motors" on page 5-8.

For troubleshooting AC electric motors, see "AC Electric Motors" on page 5-13.

For information on fuses, see "Fuses" on page 5-7.

For information on pin, connector, and harness connections, see "Wiring Harness" on page 7-73, and "AMP Harness Connector (TPA, TIM, PIM)" on page 7-78.

For information on functions and normal voltages of terminals and harness connector pins, refer to the Pinout Matrix beginning on page 8-13.

Short-Circuited Winding

A short-circuited winding is one where the insulation on the field or armature has broken down at two or more points. The breakdown creates a low resistance path, permitting current to flow from one turn of the coil to another adjacent coil turn, without actually flowing through the coil wire. The result is a decrease in total resistance of the motor winding and an increase in the current flow. The severity of the short circuit depends on its location.

A shorted motor may be indicated by:

- Slow or sluggish operation
- Running faster than normal
- Overheating
- Blowing a power fuse
- Severe burning or discoloration on one or two commutator segments every 90° of rotation

These symptoms can also be caused by problems other than the motor itself, such as:

- Brake too tight or dragging
- Wheel bearings too tight
- Faulty transmission
- Binding in an attached pump

Testing a motor for short-circuited windings requires special equipment at a motor rebuilding facility.

No Travel, Lift/Lower OK. Main Contactor Does Close. TPA Amber LED is Flashing Once Every 2 Seconds

Possible Cause	Action
Bad or Misadjusted Mast Proximity Switch	Check the LED indicator on each Mast switch and verify that each is ON when fully lowered. If an LED is not ON, try activating it with a flat piece of metal, such as a flat screwdriver. Verify the digital input test for the failed switch functions correctly. See "Traction Power Amplifier Inputs" on page 3-21. If the test fails, troubleshoot the switch, wiring, and connections. If OK, replace the TPA.
Platform elevated but travel at height option not activated	Verify that the travel at height option is activated.
Bad Directional/Speed Control Switch	Verify the digital input test for the failed switch functions correctly. See "Traction Power Amplifier Inputs" on page 3-21. If the test fails, troubleshoot the switch, wiring, and connections. If OK, replace the TPA.

No Travel, No Lift/Lower. TPA Flash Code 1,3. Operator Display Indicates Error Code E202

Possible Cause	Action
Bad wiring between TPA and traction motor	With the truck OFF and the battery disconnected, disconnect cables W, V, and U from TPA and traction motor. Check for continuity and shorts between cables and truck frame.
Bad TPA	With the truck OFF and the battery disconnected, disconnect the cables at the TPA. Reconnect the battery and turn the truck ON. If code 1,3 is still displayed, replace the TPA. If code 1,3 is not displayed, replace the traction motor.

No Travel, No Lift/Lower. TPA Flash Code 1,2. Operator Display Indicates Error Code E201

Possible Cause	Action
Bad wiring between TPA and traction motor	With the truck OFF and the battery disconnected, disconnect cables W, V, and U from TPA and traction motor. Measure for continuity and shorts between cables and to truck frame.
Bad TPA	With the truck OFF and the battery disconnected, disconnect motor cables at TPA. Reconnect the battery and turn the truck ON. If code is still displayed, replace the TPA. If code goes away, replace the traction motor.

Code C27

Code Title	Lower Switch Stuck
Operator Display	C27
System Response	System ignores the stuck input. Turns off Lower Solenoid. Stuck switch is disabled. If truck is equipped with an alternate switch, the alternate switch is still active. Lower solenoid responds to input from alternate switch if equipped.
Reason	Lower request ON longer than time out value (10 seconds). Lower switch is jammed or the operator is holding the switch for longer than is required to lower the forks.
Tests to Run	Examine for stuck switch or shorted wiring harness. See "Pinout Matrix" on page 8-13.
How to Clear	Release Lower switch. Investigate the wiring harness for the cause of the short. Repair or replace as needed. Replace the switch.

Code C33

Code Title	Horn Switch Stuck
Operator Display	C33
System Response	Ignores stuck input. Turns off Horn. Horn responds to input from alternate source if equipped (this includes the second horn switch on the control handle).
Reason	Horn request ON longer than time out value (10 seconds). Stuck switch is disabled; if equipped with an alternate switch, the alternate switch is still active.
Tests to Run	Examine horn switch and related wiring. Examine rear control module switches if provided. See "Pinout Matrix" on page 8-13.
How to Clear	Release or repair Horn switch.

Code C35

Code Title	Brake Switch Error
Operator Display	C35
System Response	Normal travel controls are disabled. The truck responds only if the traction motor is rotating in tractor-first direction.
Reason	The brake switch is out of adjustment or damaged giving a false indication that the brake is engaged. At the same time the traction motor is detected rotating.
Tests to Run	See "Pinout Matrix" on page 8-13.
How to Clear	Apply brake and have the switch adjusted or replaced.

Code C75

Code Title	Steer Unit Bus Voltage too Low (less than 12V)
Operator Display	C75
System Response	No steering. Truck plugged to stop. No Travel. Brake applied at 0 mph.
Reason	Bad wiring or contactor, blown fuse(s). Error is delayed by 1 second to prevent false tripping when the battery cable is unplugged when the key switch is in the ON position.
Tests to Run	Inspect contactor, check fuses FU6, FU8, and FU9 and wiring to PSU. Check battery voltage,
How to Clear	Cycle the truck OFF/ON. If still not clear, replace the Steer Amplifier.

Code C76

Code Title	Steer Unit Bus Voltage too High (greater than 39 volts)
Operator Display	C76
System Response	No steering. Truck plugged to stop. No Travel. Brake applied at 0 mph.
Reason	Continuous or momentary open circuit to battery during travel regen, bad contactor, fuse, or cable or possibly bad steer unit.
Tests to Run	Check battery voltage to the PSU.
How to Clear	Make sure the correct voltage battery is installed. Error automatically cleared if possible when truck goes idle. If not, cycle the truck OFF/ON. Replace the Steer Amplifier.

Code C77

Code Title	Steer Sensor 5V Power Supply Out-of-Range
Operator Display	C77
System Response	No steering. Truck plugged to stop. No Travel. Brake applied at 0 mph.
Reason	Short in wiring. Either short to ground or battery.
Tests to Run	Disconnect power steer sensor and check wiring for shorts.
How to Clear	Error automatically cleared if possible when truck goes idle. If not, cycle the truck OFF/ON. Run Learn Steer. If the code does not clear, replace the Steer Amplifier.

Code C387

Code Title	Platform Proximity Switches out of Sequence
Operator Display	C387
System Response	Travel limited to 1 mph (1.6 km/h).
Reason	Proximity switch or its wiring has failed.
Tests to Run	Check the proximity switches and wiring.
How to Clear	The code clears when the problem is resolved.

Code C430

Code Title	TIM DOUT2 Open or Shorted to B– (Platform Blocking Valve Fault)
Operator Display	C430 TIM Flash Code “4,2”
System Response	Platform lift and forks lift not available. Platform lower may not be available.
Reason	Platform blocking valve open or shorted.
Tests to Run	Check platform blocking solenoid and wiring.
How to Clear	Investigate cause of open or short. Repair or replace as needed. Cycle the truck OFF/ON.

Code C431

Code Title	TIM DOUT3 Open or Shorted to B– (Platform Blocking Valve Overcurrent)
Operator Display	C431 TIM Flash Code “3,2”
System Response	Platform lift not available. Platform lower may not be available.
Reason	Platform blocking valve shorted causing overcurrent condition.
Tests to Run	Check platform blocking solenoid and wiring.
How to Clear	Investigate cause of short. Repair or replace as needed.

Code E159

Code Title	CAN Bus Overrun Error
Operator Display	E159
System Response	No truck function active
Reason	TPA did not reply to CAN messages.
Tests to Run	See "Troubleshooting the CAN Bus" on page 5-3. Examine VM, TPA, and related wiring.
How to Clear	Repair or replace as needed.

Code E201

Code Title	Overcurrent Fault
Operator Display	E201 TPA Flash Code "1,2"
System Response	No truck function active
Reason	TPA faulty or motor short circuit. External short of U, V, or W traction motor connections.
Tests to Run	See "No Travel, No Lift/Lower. TPA Flash Code 1,2. Operator Display Indicates Error Code E201" on page 5-22. See "Service Input/Output Displays" on page 3-20.
How to Clear	Investigate cause of apparent short. Start with cables, then replace TPA and/or traction motor until problem is isolated.

Code E202

Code Title	TPA Current Sensor Error
Operator Display	E202 TPA Flash Code "1,3"
System Response	No truck function active
Reason	Phase current sensor fault.
Tests to Run	See "No Travel, No Lift/Lower. TPA Flash Code 1,3. Operator Display Indicates Error Code E202" on page 5-22. See "Service Input/Output Displays" on page 3-20.
How to Clear	Investigate cause of apparent short. Start with cables, then replace TPA and/or traction motor until problem is isolated.

Code E712

Code Title	PIM Write to Flash Memory Fault
Operator Display	E712 PIM Flash Code “1,6”
System Response	No truck functions active.
Reason	PIM failed to write to flash memory.
Tests to Run	None
How to Clear	Cycle the truck OFF/ON. If code persists, replace the PIM.

Code E713

Code Title	PIM Overvoltage
Operator Display	E713 PIM Flash Code “2,1”
System Response	No truck functions active.
Reason	PIM voltage is greater than 35 volts.
Tests to Run	Check the voltage at JPPIM-1 with respect to JPPIM-2. Check the wiring and connections.
How to Clear	If voltage is OK, replace the PIM.

Code E714

Code Title	PIM Undervoltage
Operator Display	E714 PIM Flash Code “2,2”
System Response	No truck functions active.
Reason	PIM voltage is less than 12 volts.
Tests to Run	Check the voltage at JPPIM-1 with respect to JPPIM-2. Check the wiring and connections.
How to Clear	If voltage is OK, replace the PIM.

Component Locator Photos

Figure 7-2.

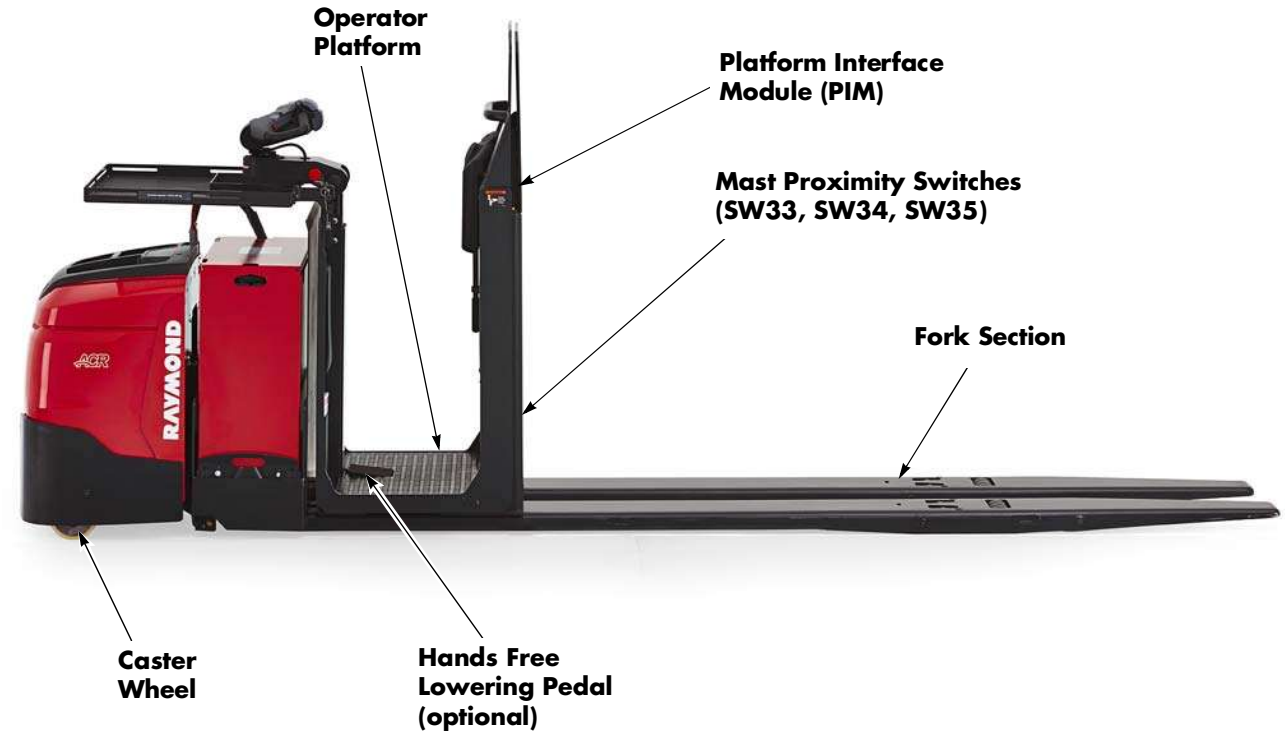
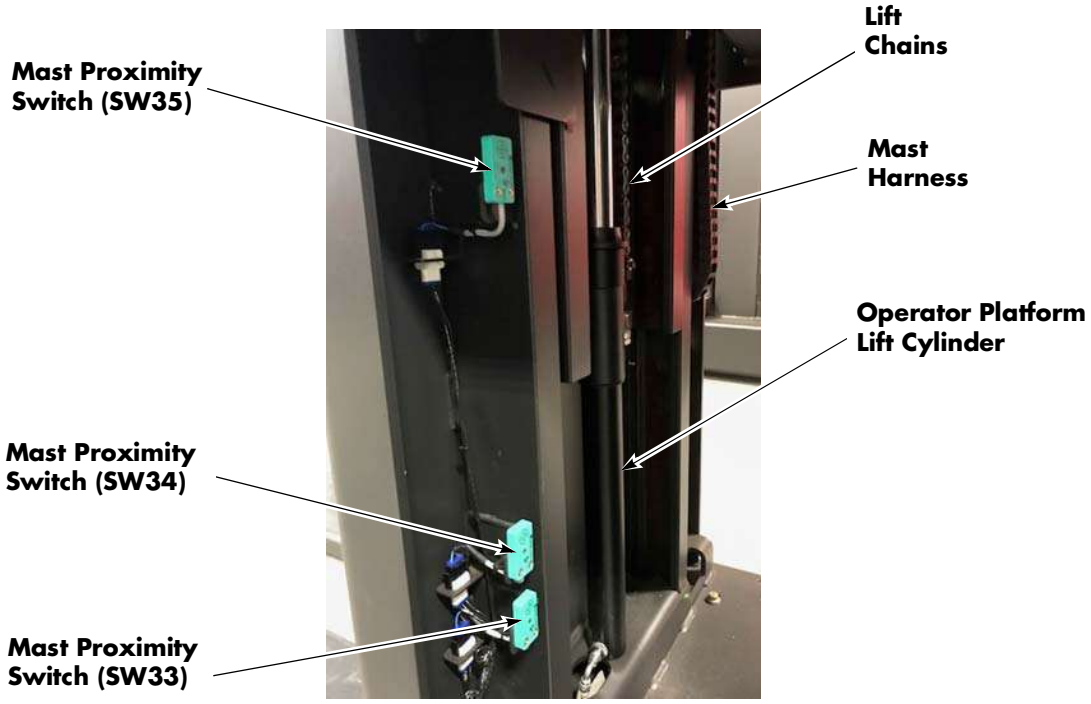


Figure 7-3. Mast Components (Operator Platform Side)



four screws [20] securing the PSU housing to the drive unit steering bearing and the screw securing the PSU to the tractor frame. Adjust the backlash to 0.002 to 0.010 in. (0.05 to 0.25 mm).

10. Apply thread-locking compound (P/N 1013829) to the four screws [20]. Torque to 28 to 32 ft. lb. (38 to 43 Nm).
11. Tighten the screw through the tractor frame finger tight. Torque the nuts to 36 to 40 ft. lb. (49 to 54 Nm).
12. Recheck the backlash.
13. Lubricate the gears using Texaco Starflak-PM (P/N 1012992) or approved equivalent.
14. Connect connector JP9 to the Power Steering unit [32].
15. Install the tractor cover.
16. Reconnect the battery connector and turn the truck ON.
17. Re-learn the handle. See "Learn Steer" on page 7-17.

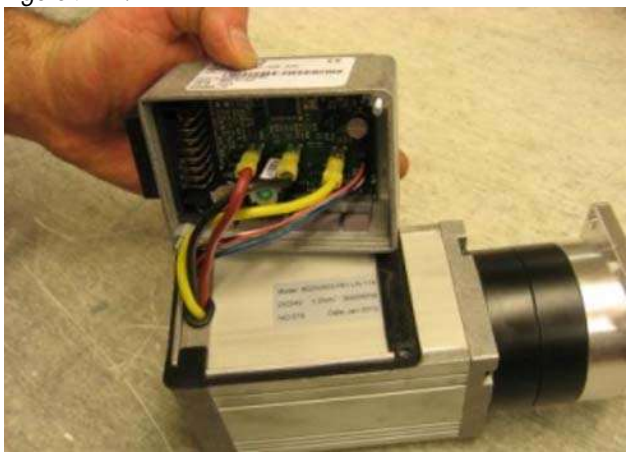
Steer Amplifier Replacement

1. Remove the PSU from the truck.
2. Place the PSU on a static mat. Put the wrist strap on and connect the ground cord to the mat. See "Static Precautions" on page 2-12.
3. Remove the two screws connecting the Steer Amplifier to the motor.
4. Hold the casing with a bare hand to avoid potential electrical differences between your body and the unit.

NOTE: Do not wear gloves.

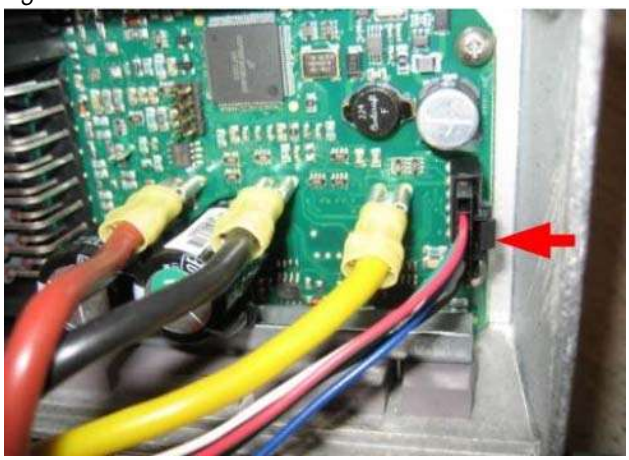
5. Carefully lift the Steer Amplifier slightly and turn it 90 degrees (see Figure 7-12). Connect the ground cord to the housing of the Steer Amplifier before performing the next step. See Figure 7-12.

Figure 7-12.



6. Remove the connector by pressing the locking device to the left. Remove the three flat pin connectors (to the left in the picture) using a pair of tweezers. Do NOT pull the motor cables directly! See Figure 7-13.

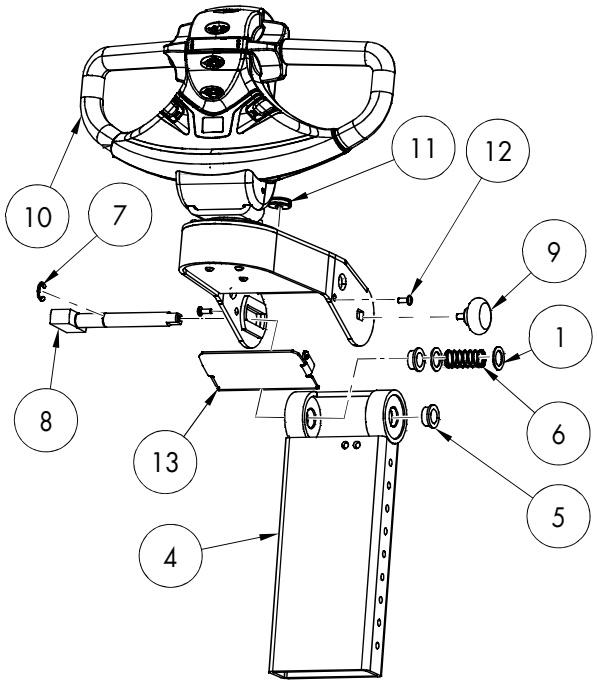
Figure 7-13.



7. Inspect the gasket. If damaged, install a new one.
8. Remove the new Steer Amplifier from its packaging. Connect the ground cord to the housing.
9. Reconnect the wires as shown in Figure 7-13. From left to right, the three wire colors are Red, Black, and Yellow. Connect the small wires. Make sure the locking tab engages.
10. Place the Steer Amplifier onto the motor. Make sure no cables are pinched between the housing and motor. Apply a drop of thread-locking compound (P/N 1013829)

Control Handle and Arm Removal

Figure 7-27.



Refer to Figure 7-27 for location of numbers in brackets [ ].

1. Turn the truck OFF and disconnect the battery connector.
2. Press the handle pivot latch [9] and rotate the control arm assembly to the vertical position.
3. Remove the fasteners [12] and access cover plate [13] at the base of the control arm.

⚠CAUTION

Note the position of cable ties holding harnesses and cables. When reassembling, attach new cable ties in the same locations.

4. Remove the battery, if required.
5. Disconnect the control head harness from the platform wiring harness at JPCH1 and JPCH2. Disconnect the key switch harness at SW1. Disconnect the EPO switch harness at SW26. Cut the cable ties holding the harness to the frame.

⚠CAUTION

Use correct lifting procedures when lifting the control handle assembly. The handle weighs approximately 46 lbs. (21 kg).

6. Support the control handle/arm assembly.
7. Remove the knob [9] and retaining E-ring [7] on the handle arm pivot shaft [8]. See Figure 7-27.
8. Carefully remove the pivot shaft [8], making sure not to lose the washers [1], spring [6], and bushings [5] down the post.
9. Lift the control handle/arm assembly from the post. Carefully thread the wiring harness out through the handle.

Control Handle and Arm Installation

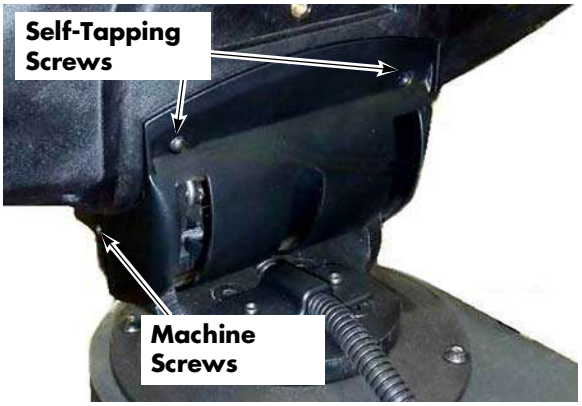
Refer to Figure 7-27 for location of numbers in brackets [ ].

1. Thread the wiring harness up through the handle.
2. Insert handle pivot shaft [8] partially through post and arm weldment. Install bushing [5], flat washer [1], spring [6], flat washer [1], and bushing [5], on the pivot shaft, then complete pivot shaft insertion.
3. Install retaining E-ring [7] and knob [9].
4. Connect the control head harness to the platform wiring harness at JPCH1 and JPCH2. Connect the key switch harness at SW1. Connect the EPO switch harness at SW26.
5. Install the cable ties on the control head harness and key switch harness, in their original locations.
6. Install the battery, if previously removed.
7. Install the access cover plate [13] and fasteners [12] at the base of the control arm.

25. Install the handle assembly onto the hinge assembly. Install the hinge assembly covers using (2) screws in the face of the cover and (2) screws on the side of the cover.

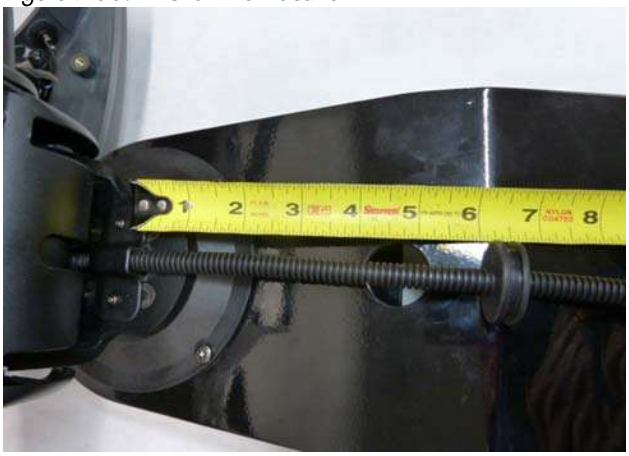
NOTE: The screws in the plastic on the face are self-tapping screws. The screws in the side are machine screws. Do not use thread-locking compound on any of these screws.

Figure 7-52.



26. Install the grommet on the harness at 6 inches (152 mm) edge-to-edge from the steering potentiometer cover to the grommet.

Figure 7-53. Grommet Location



27. Feed the connectors down through the arm weldment. gently push the grommet in place using a flat head screwdriver.

Figure 7-54.

28. When fully installed, the harness should rise approximately 2 inches (50 mm) above the arm weldment with the handle centered and in the up position.

Figure 7-55.

29. Connect the control head harness from the platform wiring harness at JPCH1 and JPCH2.
30. Connect the key switch harness at SW1.

Drive Unit

Removing the Drive Unit

1. Lower the forks and operator platform completely. Turn the truck OFF. Disconnect the battery connector.

⚠ WARNING

Use extreme care whenever the truck is jacked up. Keep hands and feet clear from vehicle while jacking the truck. After the truck is jacked, put solid blocks beneath it to hold it. Do *not* rely on the jack alone to hold the truck. For details, see "Jacking Safety" on page 2-9.

2. Jack the truck and block the frame.
3. Remove the tractor cover.
4. Remove the drive unit fill plug (Figure 7-73) and drain plug (Figure 7-74). Permit the gear oil to drain.

Figure 7-73. Drive Unit Fill Plug

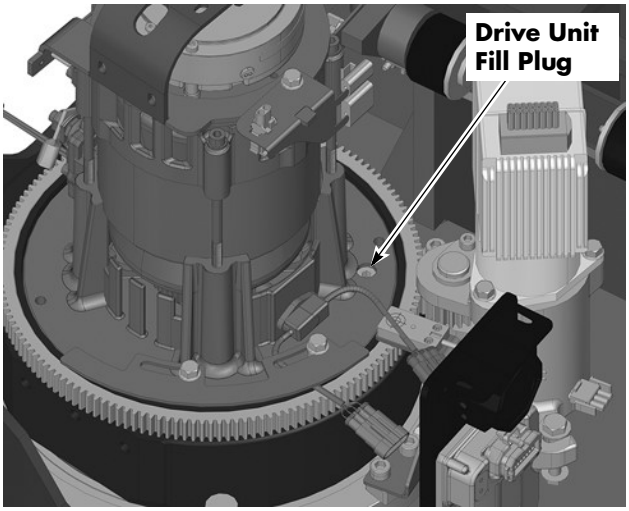
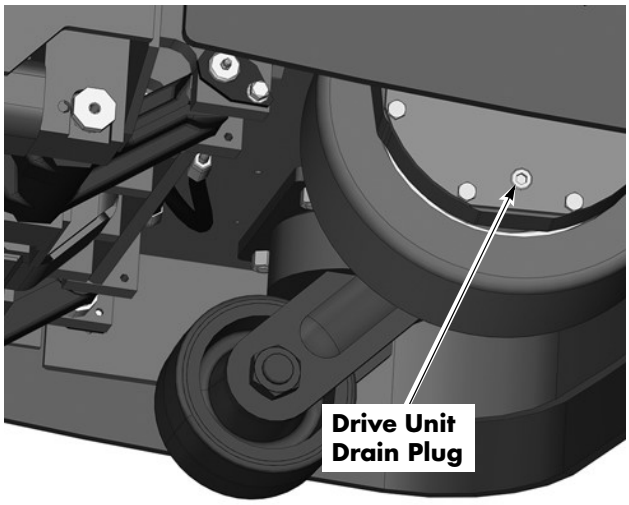


Figure 7-74. Drive Unit Drain Plug



5. Remove the power steering unit. See "Replacing the Entire Power Steer Unit" on page 7-15 (steps 1 through 5).
6. Remove the traction motor. See "Traction Motor" on page 7-96.
7. Remove the twelve socket head cap screws that secure the drive unit (through the steering bearing) to the tractor frame. See Figure 7-75.

Figure 7-75. Drive Unit Mounting (Traction Motor Removed)

8. Secure hoisting straps to the drive unit. Remove the drive unit using a hoist with at least one-ton capacity.
9. To remove steering bearing, see "Removing the Steering Bearing" on page 7-48. To disassemble the entire drive unit, see "Disassembling the Drive Unit" on page 7-49.

Drive Wheel

Removing the Drive Wheel

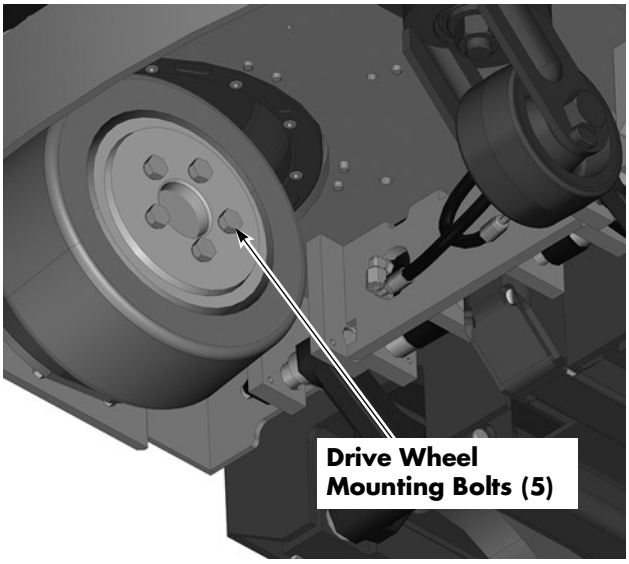
1. Turn the truck OFF and disconnect the battery connector.

⚠ WARNING

Use extreme care whenever the truck is jacked up. Keep hands and feet clear from vehicle while jacking the truck. After the truck is jacked, put solid blocks beneath it to hold it. Do *not* rely on the jack alone to hold the truck. For details, see "Jacking Safety" on page 2-9.

2. Jack and block the truck below the tractor frame.
3. Remove the drive wheel mounting bolts. See Figure 7-83.

Figure 7-83. Drive Wheel and Tire



4. Remove the drive wheel.

Cushion Tire Replacement

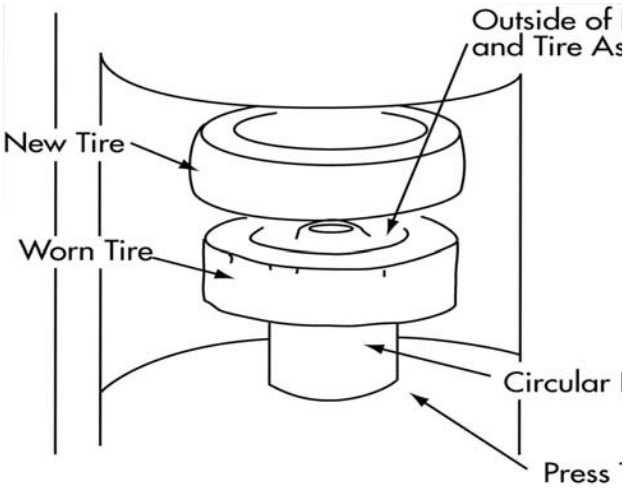
Any misalignment of the tire and hub while the tire is being pressed on the hub can cause damage to the hub. For this reason, chamfers are provided on the outside edge of the hub and on the end of the inside diameter of the tire's metal insert. The chamfers help to center the hub and tire during pressing and to reduce the possibility of misalignment.

⚠CAUTION

To prevent damage, install the hub on the circular ram with the chamfered side up.

1. Check the inside surface of the metal insert on the new tire. Remove any scaling or rust with sandpaper. Clean the inside of the metal insert.
2. Position a circular ram on the press table. See Figure 7-84.

Figure 7-84. Cushion Tire Replacement



NOTE: The length of the ram must be longer than the width of the old tire to permit complete removal of the old tire. The outside diameter of the ram must be small enough to fit loosely in the insert of the tire but large enough to rest squarely on the flat surface on the outer edge of the hub.

Battery

⚠CAUTION

Before working on the battery, see "Battery Safety" on page 2-6. Batteries may weigh more than 1,000 pounds (454 kg). Use extreme care during replacement. Use a suitable battery replacement device or hoist for lifting. Do *not* extend a battery more than 1/3 of its length outside the battery compartment without being attached to a battery-moving device.

Raymond pallet trucks may be equipped with optional battery rollers and battery side gates for ease of battery removal and replacement.

Trucks With Battery Gates and Rollers (Optional)

Battery Removal

1. Turn the truck OFF.
2. Disconnect the battery connector installed at the top of the tractor cover.
3. Position the battery replacement device in accordance with the manufacturer's recommendations.
4. Remove the battery gate by lifting straight up.
5. Remove the battery with the battery replacement device.

Battery Installation

1. With a fully charged and tested battery on the removal device, position the device in accordance with the manufacturer's recommendations.

NOTE: Make sure the battery connector and cable is positioned so that it does not get damaged when installing the battery in the truck.

2. Position the battery in the compartment. Make sure the battery has no more than 0.50 in. (13 mm) of "free play" movement in any direction in the battery compartment.
3. Install the battery gate. Move the removal device from the area.
4. Reconnect the battery connector, turn the truck ON, and test the operation of the truck.

Trucks Without Battery Gates and Rollers

Battery Removal

1. Turn the truck OFF.
2. Disconnect the battery connector installed at the top of tractor cover.
3. Press the handle release knob on the arm/tiller assembly and rotate the control handle/arm assembly to a vertical position to allow access to the battery.
4. If the truck is equipped with a storage shelf, remove the quick release pins and rotate the storage shelf to a vertical position and secure with the quick release pins to allow access to the battery.
5. Position the battery hoist above the battery and attach to the battery manufacturer's designated lift points.
6. Remove the battery by lifting straight up.

Battery Installation

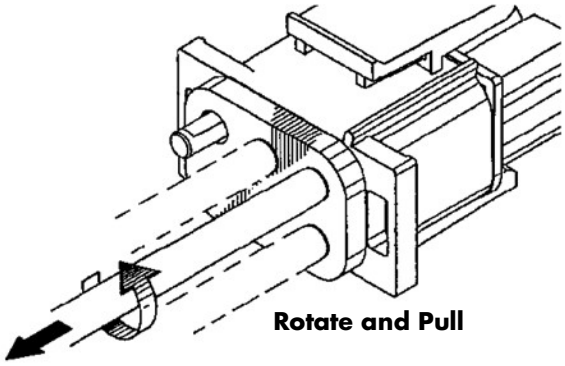
1. With a fully charged and tested battery on the hoist, position the battery above the battery compartment.

NOTE: Make sure the battery connector and cable is positioned so that it does not get damaged when installing the battery in the truck.

2. Lower the battery and position it in the compartment. Make sure the battery has no more than 0.50 in. (13 mm) of "free play" movement in the battery compartment.
3. Move the hoist from the area.

3. Holding the wire seal and connector housing together, rotate the wire while pulling it through the wire seal. This prevents damage to the seal. See Figure 7-104.

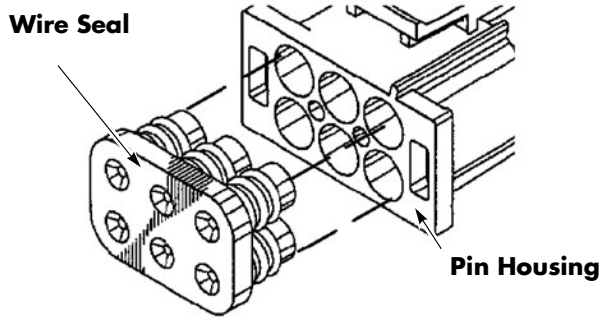
Figure 7-104. Removing Wire



AMP Connector Pin Insertion

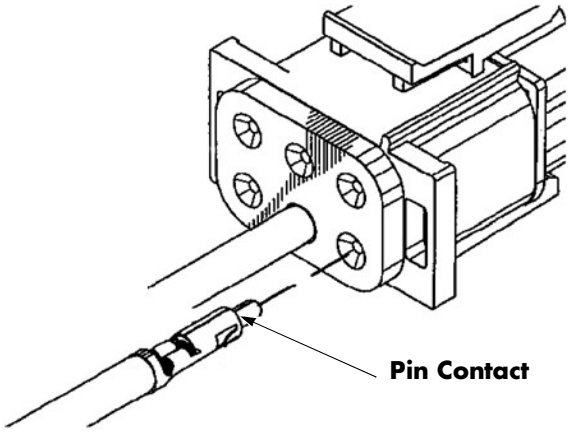
1. Make sure the connector has a wire seal attached to the connector back. See Figure 7-105.

Figure 7-105. Wire Seal



2. If re-inserting a wire previously removed, check the pin contact locking lances to make sure they are extended to their original position.
3. Grasp the wire close behind the contact insulation barrel and push the wire straight through the wire seal into the socket until it clicks. Pull back gently to make sure the contact is locked in place. See Figure 7-106.

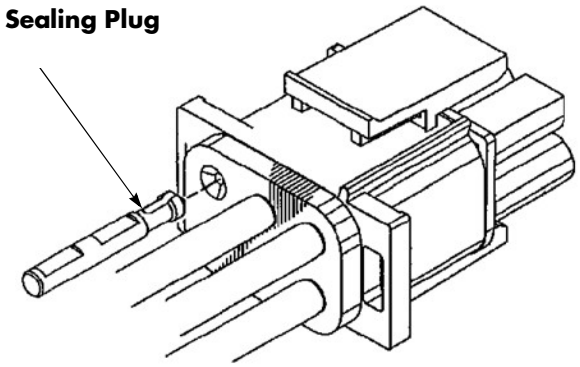
Figure 7-106. Wire Insertion



AMP Connector Seals

1. Use a wire seal at the back (wire end) of each connector half. See Figure 7-105.
2. Plug unused pin positions with sealing plugs. See Figure 7-107.

Figure 7-107. Sealing Plug



3. Align the split tapered end of the sealing plug with the unused opening in the wire seal. Push the plug through the wire seal into the connector until it snaps into position.
4. Remove sealing plugs by pulling with needle-nose pliers while grasping the wire seal and connector.
5. Use an interface seal between pin and jack halves of the connector. To prevent damage to the seal, use the matching connector cap to slide the interface seal over the contact silos on the pin housing. See Figure 7-108.

Hands Free Lowering Pedal Sensor

The Hands Free Lowering Pedal option allows an operator to lower the operator platform using a foot pedal instead of the hand lowering controls on the control handle.

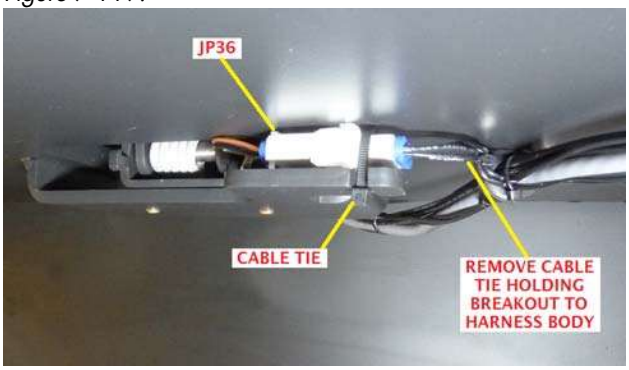
Adjustment

⚠ WARNING

Use extreme care whenever the truck is jacked up. Keep hands and feet clear from vehicle while jacking the truck. After the truck is jacked, put solid blocks beneath it to hold it. Do *not* rely on the jack alone to hold the truck. For details, see "Jacking Safety" on page 2-9.

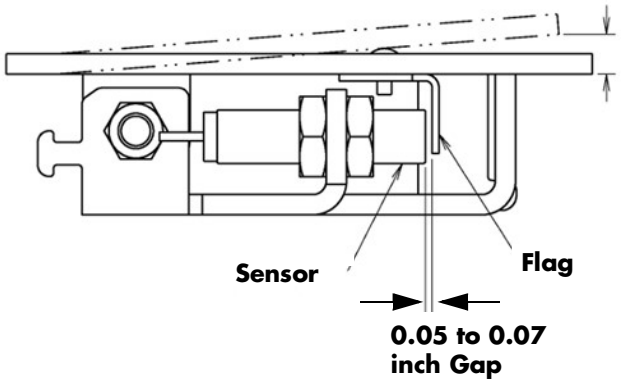
1. Raise the operator platform approximately 30 inches (762 mm) to access the sensor connector (JP36). Block the operator platform.

Figure 7-119.



2. Turn the truck OFF and disconnect the battery connector.
3. Adjust the hands free lowering proximity switch so there is a gap of 0.05 to 0.07 in. between the sensor and the flag.

Figure 7-120.



4. Reconnect the battery connector and turn the truck ON.
5. Raise the operator platform to remove the blocks.
6. Test the operation of the truck.

Replacement

⚠ WARNING

Use extreme care whenever the truck is jacked up. Keep hands and feet clear from vehicle while jacking the truck. After the truck is jacked, put solid blocks beneath it to hold it. Do *not* rely on the jack alone to hold the truck. For details, see "Jacking Safety" on page 2-9.

1. Raise the operator platform approximately 30 inches (762 mm) to access the switch connector (JP36). Block the operator platform.
2. Turn the truck OFF and disconnect the battery connector.
3. Disconnect the switch connector (JP36).
4. Remove the two screws [5] securing the pedal cover [3] to the pedal [2].

Traction Motor

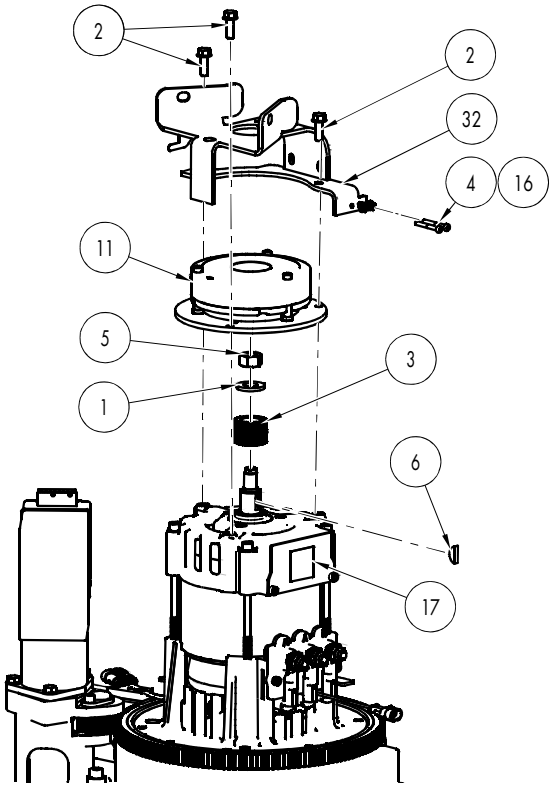
Removing the Traction Motor

1. Turn the truck OFF and disconnect the battery connector.
2. Remove the tractor cover.
3. Disconnect JPBR and JP9.

NOTE: Note the position of cable ties holding harnesses and cables. When reassembling, attach new cable ties in the same locations.

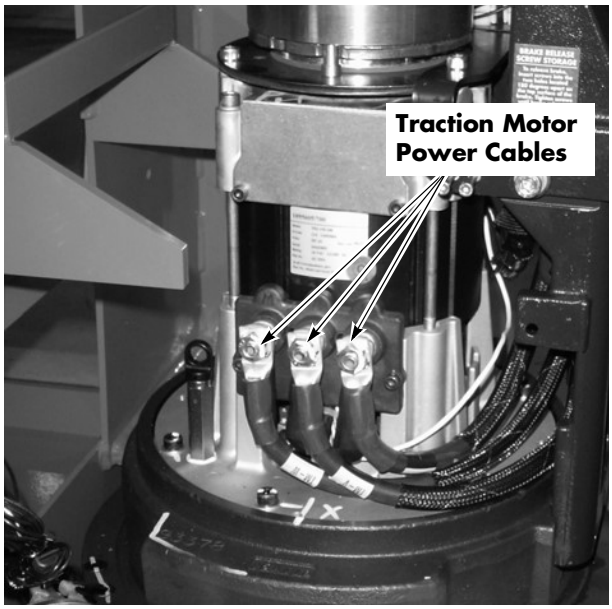
4. Remove the three screws securing the brake assembly and transmission cable bracket to the traction motor. See Figure 7-132.

Figure 7-132. Brake and Bracket Mounting Screws



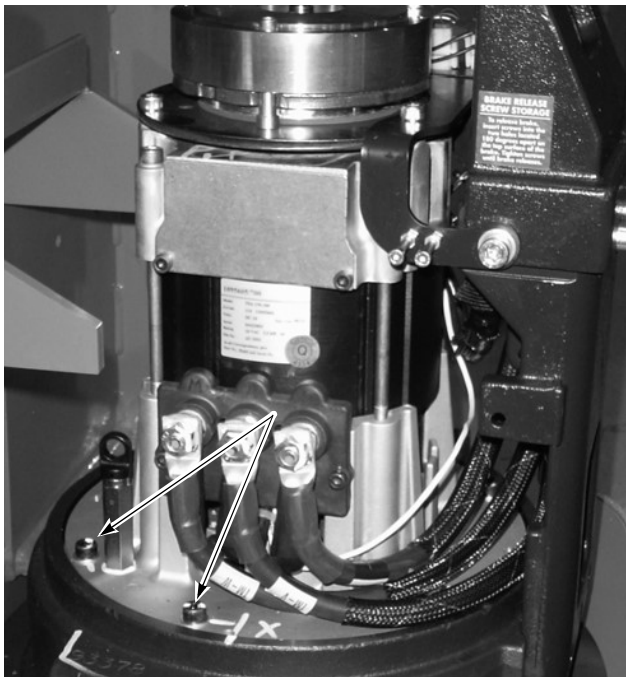
5. Remove the brake. See "Brake Removal" on page 7-61.
6. Disconnect the U, V, and W power cables from the motor. See Figure 7-133.

Figure 7-133. Traction Motor Power Cables



7. Remove the six socket head cap screws and flat washers that secure the traction motor to the drive unit housing. See Figure 7-134.

Figure 7-134. Traction Motor Removal



8. Remove the traction motor with a suitable lifting device.

Lift Motor

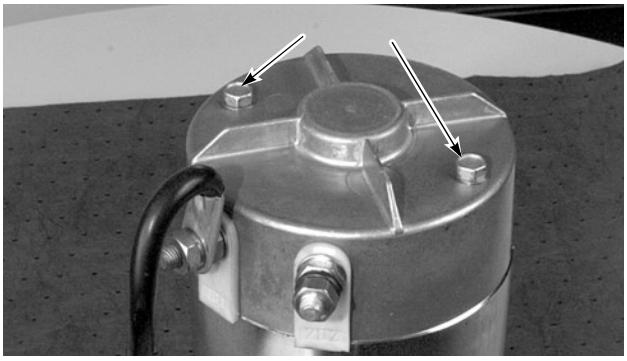
General Data

Lubrication	None required. Sealed bearings are used at the two ends of the motor.
Armature Test	These armatures have standard winding connections. Test on a growler using a metal strip to find shorted windings.
Commutator	Replace armature when commutator is worn to minimum diameter of 40.8 mm.
Brush Replacement	Replace brushes when worn to minimum length of 10 mm.
Spring Tension	Adjust the spring tension of new brushes to 32 to 40 oz. (908.8 to 1136 grams).

Removing the Lift Motor

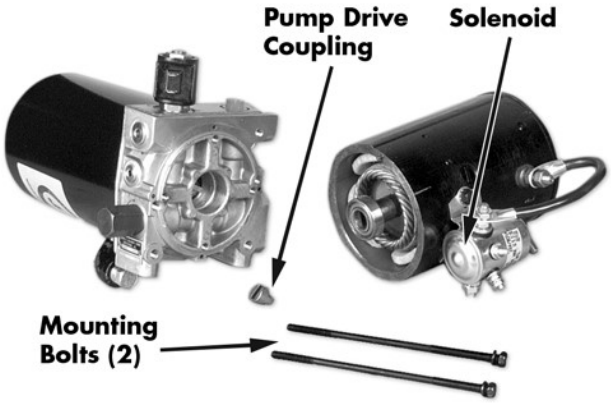
1. Remove the hydraulic unit from the truck. See “Hydraulic Unit” on page 7-112.
2. Remove the two bolts from the end plate that attach the motor to the adapter housing. See Figure 7-166.

Figure 7-166. Bolts Securing Motor To Adapter



3. Separate the motor from the adapter housing. See Figure 7-167.

Figure 7-167. Separated Reservoir and Motor (typical)



4. Remove the solenoid from the side of the motor housing to be reused. See Figure 7-167.

Installing the Lift Motor

1. Stand the pump assembly on end, with the adapter body facing up.
2. Set aside the pump drive coupling to be reused. See Figure 7-167.

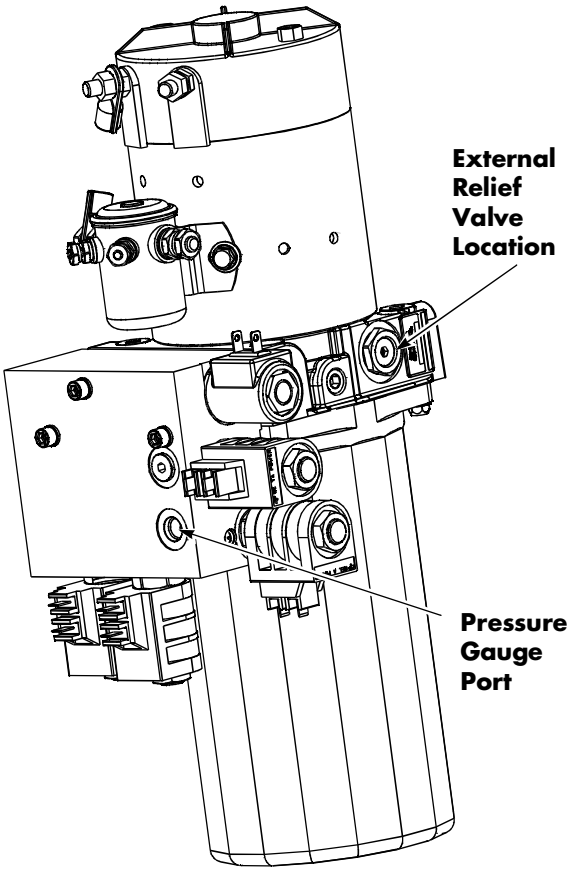
NOTE: The coupling is the mechanical connection between the pump shaft and the electric motor armature shaft. It may have been removed with the motor.

3. Insert the pump drive coupling on the end of the pump shaft and fill coupling cavity with anti-seize compound (P/N 990-638). See Figure 7-168.

Adjusting Hydraulic Pump Relief Valve Pressure

The hydraulic system is protected by an external relief valve installed in the adapter body. See Figure 7-179. The external relief valve has a tamper-proof mark.

Figure 7-179. Checking Relief Valve Pressure



The relief valve is set by the manufacturer to open at a specified pressure.

The correct relief valve setting (measured at port G) is: 3,650 to 3,750 PSI (25,165 to 25,855 kPa).

Checking Relief Valve Setting

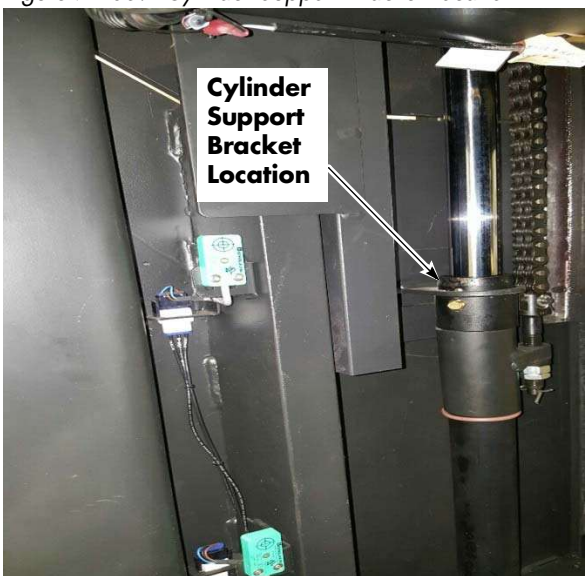
NOTE: Make sure that a full-sized battery is installed.

1. Put the rated load on pallet(s). Make sure the load is evenly distributed.
2. Turn the adjusting screw counter clockwise until the load does not elevate.
3. Turn the screw clockwise until the load elevates without any audible bypass. When you have found this position, turn the screw inward 1/4 turn more.
4. Lift the load one more time to verify that this is the correct pressure setting. Re-adjust if necessary.
5. Retract the lift cylinders completely. Turn the truck OFF.
6. To check the pressure, disconnect one of the lift hoses from the tee to the left of the fill plug. See Figure 7-179. Install a female run tee and a 1/8 in. NPT 0 to 4,000 psi (0 to 27,579 kPa) pressure gauge. Reinstall the lift hose on the female run tee.
7. Turn the truck ON. Leave the control handle in the neutral (vertical) position.
8. Press the lift button and observe the pressure gauge indicator. When the forks reach the upper lift-limit, the pump makes a high pitched squeal indicating that the relief valve is opening.
9. If the relief valve opens at a lower or higher pressure than the specified pressure, adjust the relief valve:
   a. Remove the protective cap on the relief valve.
   b. Loosen the lock nut on the relief valve adjustment screw. See Figure 7-179.
   c. As you press the lift button, turn the adjusting screw *inward* to increase the pressure setting or *outward* to decrease the pressure setting.
   d. Monitor the pressure gauge indicator. After the relief valve is correctly set, release the lift button. Pressure should not exceed 3,700 psi (25,510 kPa).

Figure 7-202.

7. Disconnect the hose at the base of the cylinder. Cap and plug the hose and fitting.
8. Unbolt the cylinder retaining bracket, taking care to support the cylinder.

Figure 7-203. Cylinder Support Bracket Location



9. Remove the cylinder and set aside.
10. Install the cylinder retaining bracket. Extend the cylinder to the pulley bracket.
11. Replace with a new cylinder, rest the cylinder base on the base of the mast frame and centering the top of the cylinder against the center of the mast.
12. Connect the hose at the base of the cylinder.
13. Unblock and lower the platform. Make sure the pulley sheave bracket aligns with the top of the cylinder rod.
14. Reblock the operator platform.
15. Tighten the set screw in the pulley sheave bracket assembly to secure the cylinder rod.

NOTE: There is no need to bleed the lift cylinder. There is a breather at the top of the cylinder, but no bleed screw.

16. Pull the lift chain over the pulley. Install the pin to secure the chain to the chain anchor. Install a new cotter pin to secure the chain.
17. Adjust the chain anchor so that there is slight tension in the chain when the operator platform is fully lowered and resting on the operator platform bumpers.
18. Check the hydraulic reservoir fluid level. If necessary, add fluid; fill to the bottom of the breather cap elbow. See "Lubrication Equivalency Chart" on page A-2.
19. Connect the battery connector and turn the truck ON.
20. After truck has passed SelfTest, lift the operator platform using the lift button. Remove the blocks and fully lower the operator platform.
21. Install the access cover and load backrest.
22. Test the truck for correct operation and return the truck to service.

Pallet Entry Sliders

Slider Replacement

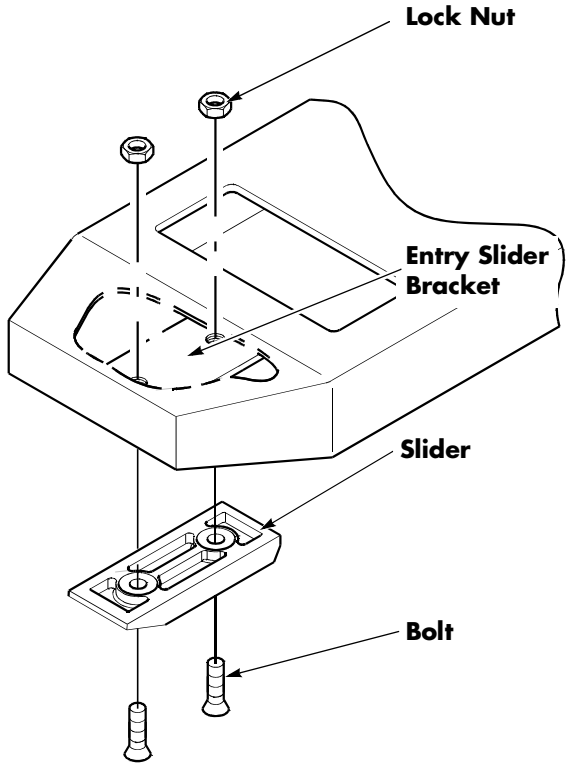
Pallet entry sliders are only available on fork lengths of 60 inches and below.

⚠ WARNING

Use extreme care when the truck is jacked up. Keep hands and feet clear from the vehicle while jacking the truck. After the truck is jacked, put solid blocks beneath it to hold it. Do *not* rely on the jack alone to hold the truck. For details, see "Jacking Safety" on page 2-9.

1. Raise the forks and block them in the raised position. See "Jacking Safety" on page 2-9.
2. Turn the truck OFF and disconnect the battery connector.
3. Remove the two lock nuts and bolts from the bottom of the entry slider bracket. See Figure 7-220.

Figure 7-220. Replacing Pallet Entry Slider



4. Replace the slider.
5. Insert the two 1/4-20 bolts through the entry slider bracket and slider. Secure each bolt with a lock nut. See Figure 7-220.
6. Verify the clearance from the floor to the slider is 0.125 in. (3.18 mm).
7. Connect the battery connector and turn the truck ON.
8. Raise the fork section and remove the blocking.
9. Test the truck for correct operation and return the truck to service.

Inner Telescopic

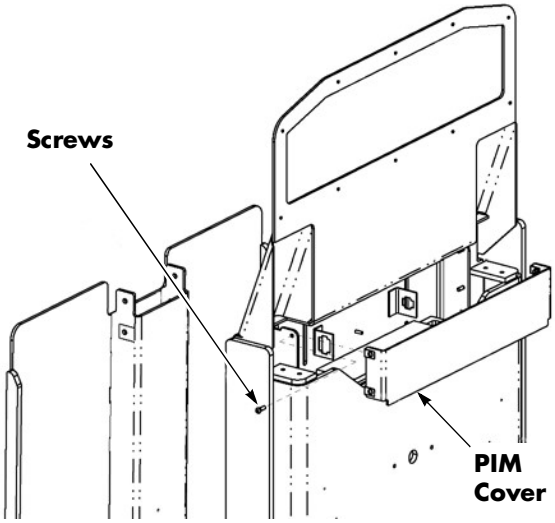
⚠ WARNING

Use extreme care whenever the lift truck is jacked up. Keep hands and feet clear from the vehicle while jacking the lift truck. After the lift truck is jacked, place solid blocks beneath it to support it. Do not rely on the jack alone to support the lift truck. **See "Jacking Safety" on page 2-9.**

Inner Telescopic Removal

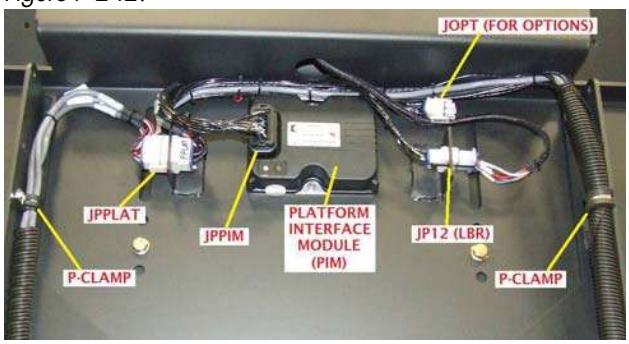
1. Remove the operator platform from the lift truck. See "Operator Platform Removal" on page 7-143.
2. Remove the four screws securing the protective cover over the PIM.

Figure 7-241.



3. Disconnect the JPPIM, JPPLAT, and JP12 connectors.

Figure 7-242.

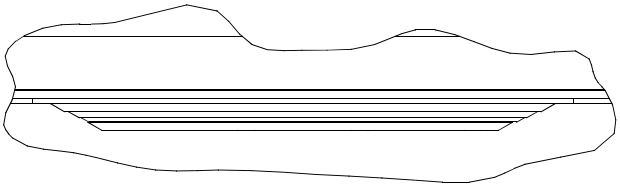


4. Remove the two screws securing the PIM to the mast cover.
5. Remove the P-Clamps securing the cables to the mast cover.
6. Remove the set screw at the base of the pulley sheave bracket.
7. Attach a hoist to the inner telescopic.
8. Remove the cotter pin securing the chain to the chain anchor on the lift cylinder sleeve bracket. Feed the chain over the pulley sheave.
9. Using a suitable hoist, lift the inner telescopic out of the operator platform.

Part Selection

Battery spacers are to be installed on the inside surface of the battery compartment to reduce the battery's fore-aft movement to 0.188 inches or less. The kit is designed with a lead-in for efficient battery installation and removal (see Figure 7-255). Take note to stack the spacers to maintain a consistent and continuous lead-in for all configurations.

Figure 7-255. Full Spacer Kit Designed Lead-in



Use Table 7-9 to select the appropriate spacer thicknesses and fastener lengths for the measured battery gap. Unused parts should be stored in case spacing requirements change.

Table 7-9. Battery Spacer Assembly Configurations

Battery Gap Measurement (in inches)	Countersunk Spacer (0.229 in.)	Spacer (0.229 in.)	Spacer (0.179 in.)	Spacer (0.119 in.)	Fastener Length in. (mm):
Below 0.382	x	–	–	–	0.63 (16)
From 0.382 up to 0.442	x	–	–	x	0.63 (16)
From 0.442 up to 0.502	x	–	x	–	0.79 (20)
From 0.502 up to 0.569	x	x	–	–	0.79 (20)
From 0.569 up to 0.629	x	–	x	x	0.98 (25)
From 0.629 up to 0.689	x	x	–	x	0.98 (25)
From 0.689 up to 0.824	x	x	x	–	0.98 (25)
Above 0.824	x	x	x	x	1.18 (30)

To restrict fore-aft battery movement to no more than 0.188 inches:

1. Measure battery gap with one face of the battery pressed against the opposing battery compartment wall.
2. Install spacers with a consistent and continuous lead-in for simplified battery installation and removal.

Definitions

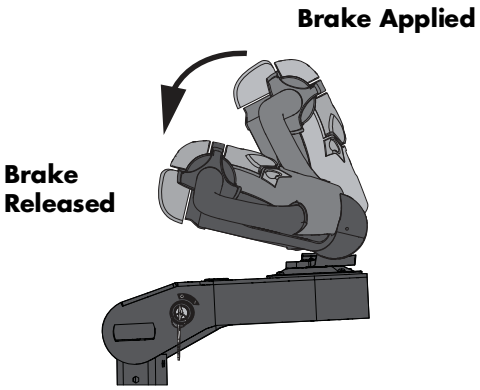
Acceleration Rate

The process where the truck's acceleration characteristic is determined when the truck starts from a stop. This is a truck (Operator) parameter (03 - Performance Settings). The range is from 1 to 5 in increments of 1. Default is 3. A lower number gives less aggressive acceleration. See "Programming Operator Parameters" on page 3-9.

Brake Switch

The brake switch in the 2nd level orderpicker truck must be activated to permit truck travel. It is activated by the control handle position. The handle must be fully lowered for the brake switch to close, permitting travel. See Figure 8-1.

Figure 8-1. Brake Switch and Brake Actuation



Continuity

A continuous and uninterrupted path between two or more locations in an electrical circuit, typically having a resistance of less than 1 ohm.

Controller Area Network (CAN)

Motor control functions performed by the electronic circuitry [Vehicle Manager (VM), Traction Power Amplifier (TPA), Power Steering Unit (PSU), Platform Interface Module (PIM), and Tractor Interface Module (TIM)] are communicated in the truck through this network.

Current Limiting

A protective function that prevents excessive current levels from damaging components by cutting back or eliminating current.

Fault Codes

The VM provides fault information by displaying fault codes on the LED display built into the control handle head. The Traction Power Amplifier (TPA), Platform Interface Module (PIM), and Tractor Interface Module (TIM) provide fault information by flashing fault codes through two status LED indicators built into the TPA cover. See "Traction Power Amplifier Flash Codes" on page 6-6.

High Pedal Disable (HPD)

The HPD feature prevents the truck from traveling while the throttle is prematurely applied. The system is programmed to give the HPD warning if there is a throttle request before the key is turned ON or brake release input. Refer to "Code 'HPd' (C20)" on page 6-12.

Neutral Braking Deceleration (Plugging)

A truck feature that provides some plugging effect when the throttle is returned to the neutral position. This is a truck (Operator) parameter (04 - Performance Settings). The range is from 0 to 6 in increments of 1. Default is 5. A lower number gives more aggressive plugging. A 0 setting sets the plugging rate to the same rate that is set in Parameter 13 as long as Parameter 13 setting is not lower than 4. If Parameter 13 is set lower than 4, then the

PICK2PALLET™ LED Light System

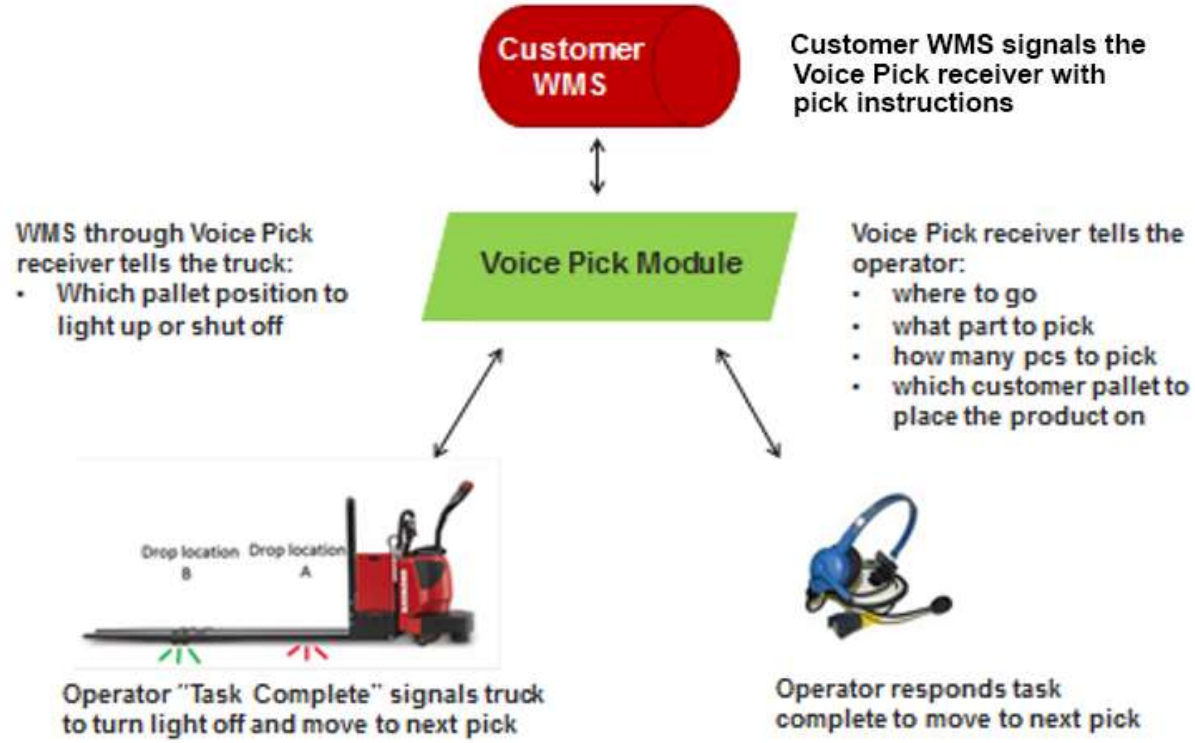
The PICK2PALLET™ LED Light System option is available for Model 8720 2nd level orderpicker trucks with 84 or 96" double fork lengths, and 144" triple fork lengths.

In order picking applications that use double and triple pallet trucks, the PICK2PALLET™ LED Light system option uses lights mounted on the sides of the forks. These lights shine on the floor next to the pallet to identify the correct pallet for an operator to place the picked product. This is called a put-to-light system and is used to reduce pick errors when two or three customer orders are being picked at the same time and being placed on separate pallets.

The PICK2PALLET™ LED Light system is used in applications that use third party Voice Picking systems. Voice Picking systems use wireless computers connected real-time via RF to the customer's Warehouse Management System (WMS). The computer translates the information from the WMS into voice commands that are given to the operator. There is no change in the operation of the voice commands to the operator. Through the voice pick equipment, the WMS tells the operator what location to go to, what product to pick, the quantity needed, and the customer that ordered the product. The voice pick equipment is connected to the truck light system LED Control Module. It communicates (real-time) with the truck's LED Control Module through an RS-232 port, identifying the pallet position to turn the lights on or off. This lighting up of LED lights directs the operator where to place the product.

When power is applied to the pallet truck, the lights should flash three times. If this does not happen, there could be an issue with power to the unit, a controller malfunction, or an issue with the light or its associated wiring. The controller runs off 24 VDC.

Figure 8-2.



Component Specific Service/Torque Chart

Table A-2. Component Specific Service/Torque Chart

Component	Sub-Component(s)	Thread-Locking Compound P/N	Torque to: /Notes
Brake	Attachment to mounting plate screws (3)	Not Required	5.8 ft. lb. / 69 in. lb. (7.8 Nm)
Brake Switch	Not Applicable	Not Applicable	2 mm gap when closed
Contactor	Mounting lock nuts (brass)	Not Required	70 to 84 in. lbs. (8 to 9.5 Nm)
Contactor	Terminals	Not Required	70 to 84 in. lbs. (8 to 9.5 Nm)
Drive Unit	Axle nut (to seat bearings) (1)	Not Required	18 ft. lbs (25 Nm)
Drive Unit	Final assembly of axle nut (1)	thread-locking compound 990-669	40 in. lb. (4.5 Nm)
Drive Unit	Axle nut clamp screw (1)	thread-locking compound 1013829	128 in. lb. (14.4 Nm)
Drive Unit	Cover plate mounting cap screws (8)	Not Required	17 ft. lb. (23 Nm)
Drive Unit	Mounting (through steer bearing) to truck frame (8 or 12)	thread-locking compound 1013829	36 to 40 ft. lbs. (49 to 54 Nm)
Drive Unit	Pinion shaft (1)	thread-locking compound 990-669	Not Applicable
Drive Unit	Original pinion gear lock nut (to seat the bearings that support the pinion shaft) (1)	Not Required	35 ft. lb. (48 Nm)
Drive Unit	New pinion gear lock nut (1)	Not Required	23 ft. lb. (31 Nm)
Drive Unit	Pinion shaft lock nut locking screw (1)	thread-locking compound 1013829	128 in. lb. (14.4 Nm)
Drive Unit	Upper gear housing to lower gear housing (11)	thread-locking compound 1013829	28 ft. lb. (38 Nm)
Drive Wheel	Mounting bolts (5)	Not Required	100 ft. lbs. (135 Nm)
Hydraulic Reservoir	Screws mounting reservoir to adaptor housing (4)	Not Required	125 to 145 in. lbs. (14 to 16 Nm).

Torque Chart - Straight Thread Face Seal O-Rings

Table A-4. Torque Chart - Straight Thread Face Seal O-Rings

SAE Dash Size	Tube Side Thread Size	ft. lbs.	Nm
-4	9/16-18	18 ±1	25
-6	11/16-18	27 ±2	40
-8	13/16-16	40 ±2	55
-10	1-14	63 ±3	80
-12	1 3/16-12	90 ±4	115
-14	1 5/16-32	95	130
-16	1 7/16-12	120 ±8	150
-20	1 11/16-12	140 ±8	190
-24	2-12	165 ±8	245
-32	2 1/2-12	360	490

RAYMOND

Main Harness Routing

1. After connecting controller harness to P2P controller and LED harnesses, route the power wires for M1-1 and TA– to the traction power amplifier following the main harness.
   Note: The Controller harnesses are designed to fit all truck configurations. Coil the excess harness length under the traction power amplifier before terminating at M1-1 and TA–.