

RAYMOND



Maintenance Manual Model 4100 and 4200

Stand-Up Counterbalanced Lift Truck
With *The ACR System™*



Models

4100
4200

Serial Numbers

00001 and Up

1060345B
Replaces 1060345A

Re-issued: 01 Jul 2010
Issued: 27 Aug 2007

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Manual Design

This manual is designed with the following objectives in mind:

- provide technical coverage for expected levels of user expertise
- anticipate your needs and reduce your decisions regarding maintenance
- reduce page flipping through a “one-stop shopping” approach

The two-line running page header at the top of each page tells you:

- Name of the manual
(*Model 4100/4200 Maintenance Manual*)
- Current Section Title
(for example, this page; *Section 1. How to Use This Manual*)
- Current topic
(for example, this page; *Manual Design*)

This manual consists of the following sections:

- **Section 1. How to Use This Manual** explains the manual format and design as well as abbreviations and symbols used.
- **Section 2. Safety** explains warning and caution notes and general safety rules, as well as safety rules for batteries, static, jacking, towing, and welding.
- **Section 3. Systems Overview** includes lift truck specification plate, programming instructions, and configuration menu.
- **Section 4. Scheduled Maintenance** outlines the recommended schedule of preventive services to keep the lift truck working most efficiently.
- **Section 5. Troubleshooting** guides the user from fault symptoms to a specific sequence of tests in order to isolate a failing component.
- **Section 6. Messages, Codes, and Tests** lists the electrical fault codes and procedures for running firmware-based electrical tests.

- **Section 7. Component Procedures** gives step-by-step procedures for testing, removing, replacing, and servicing individual lift truck components. Components are grouped by lift truck system. To find a component procedure, you may use one of three methods:
 - Look up the component name in the List of **Component Procedures**.
 - Look up the component name in the maintenance manual **Index**.
- **Section 8. Theory of Operation** 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.
- **Section A. Appendix** contains reference information such as torque values, lubricants, and standard/metric conversions.
- **Index** lists subjects alphabetically.



Static Precautions

Electronic circuit boards can contain Electrostatic Discharge Sensitive (ESDS) devices.

Static charges can accumulate from standard operation of the lift truck as well as movement or contact between non-conductive materials such as plastic bags, synthetic clothing, synthetic soles on shoes, and styrofoam coffee cups.

Accumulated static electricity can be discharged to a circuit board or component by touching the parts. Electrostatic Discharge (ESD) is also possible through the air when a charged object is placed close to another surface at a different electrical potential. *Static discharge can occur without seeing or feeling it.*

Whenever working on or near ESDS devices, follow these precautions:

- Wear an ESD wrist strap. The wrist strap should be equipped with a 1 megohm resistor to protect against shock hazard. If the resistor is open, replace the strap.
- Connect the wrist strap plug to the ground jack on the lift truck. See [Figure 2-1](#). If you cannot use the ground jack, connect the ground clip to an unpainted, grounded surface on the lift truck frame.

Figure 2-1. Ground Jack Location

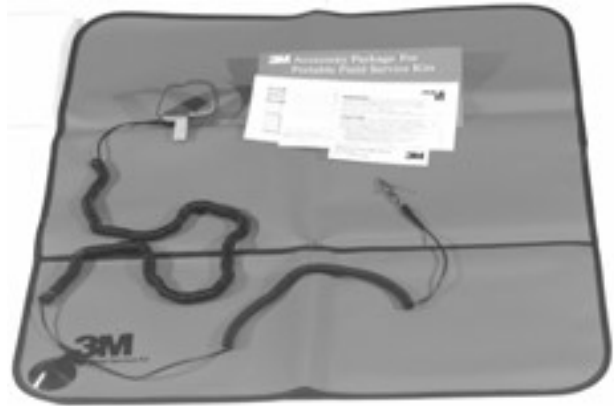


- Handle circuit boards by the edges only. Avoid touching the edge connectors.
- If you are removing or installing static-sensitive components, place them on a correctly grounded antistatic mat.
- To transport static sensitive components, including failed components being returned, place the components in an antistatic bag or box (available from your local authorized Raymond dealer).

Test the wrist strap and related accessories before each use to make sure they are working correctly.

[Figure 2-2](#) shows the components of the Raymond antistatic field service kit P/N 1-187-059.

Figure 2-2. Anti-Static Kit with Wrist Strap and Mat



The kit includes a wrist strap, ground cord, and static-dissipative work surface (mat). Follow the instructions packaged with the kit.

Wrist straps (P/N 1-187-058/001) are available in quantities of 25. A wrist strap tester (P/N 1-187-060) is also available.

Contact your local authorized Raymond dealer for information.

To Change an Option Setting:

The list box in the middle of the Truck Setup screen shows the Truck Options.

To enable an option, check the adjacent check box. To disable an option, uncheck the check box. See [Figure 3-4](#). When the options are correctly configured, click the “SEND Changes to Truck” button.

NOTE: Options displayed in red require authorization codes. When these options are selected, a pop up window appears requesting the authorization code. Contact your local Raymond dealer for the correct forms and procedure for obtaining the authorization code.

Options include (but are not limited to):

- **Electronic Key*** - requires operator to enter a code prior to operating the vehicle
- **Weight** - enables weight of load to be displayed on Operator Display
- **High Speed Limit** - reduces top travel speed based on mast mounted switch placement
- **Travel Alarm** - enables alarm to sound when truck is moving
- **Aux Attachments** - configuration dependant
- **HSA2 Enabled*** - used to select between two high speed auxiliary functions
- **Lift Limit w/Bypass** - limits lift height based on mast mounted switch placement
- **EE Truck*** - must be checked for EE configured trucks
- **Bottlers Tilt*** - enables reduced speed and/or forward tilt based on mast mounted switch(es)
- **Quad Mast*** - enables correct weight sensor calibration for trucks with a Quad Mast installed
- **2 Speed Tilt*** - enables reduced tilt speed on trucks equipped with a Quad mast, based on placement of mast switch

- **Operator Compartment Sensor** - enables option that requires the operator compartment threshold to remain unblocked
- **Ambient Temp Sensor** - sensor used to determine if handle heater assembly should remain ON even with key switch OFF
- **Battery Gates*** - enables option requiring both battery gates to be installed to allow travel
- **Breakaway QD*** - enables breakaway quick disconnect option
- **iPort Basic*** - used to select *iPort* Basic
- **iAlert*** - used to select *iAlert* as part of the *iPort* Premium package
- **iControl*** - used to select *iControl* as part of the *iPort* Premium package
- **4200 Handle Type*** - used to identify type of handle installed on truck (standard, optional, lever controls)

*These options require a passkey to be enabled. To obtain a passkey, a Form S-207, Field Modification Request Form, must be submitted.

Vehicle Manager Software

The Vehicle Manager Software dialog box is used to load/upload VM software. See [Figure 3-5](#).

Figure 3-5. VM Software Dialog Box





Table 3-3. Maintenance Mode Menu

Initial or Default Value	Text Displayed/Description	Selections/Parameters
Quit	Exit Maintenance Mode	
Learn	Enter the Learn Mode	Enter (See Table 3-4) Quit
_ 2 _ _ _ _ _	Enter New Maintenance Password. (Default is _ 2 _ _ _ _ _)	_ 2 _ _ _ _ _
D Inputs	See Digital Input Tests beginning on page 6-29.	
A Inputs	See Analog Tests beginning on page 6-47.	
Outputs	See Output Tests beginning on page 6-81.	
Active Maintenance	Select Active Maintenance Display Active Maintenance Do Not Display Active Maintenance	On Off
# of Errors Logged	Error Codes Logged System Will Store Up To 20 Error Codes Exit Error Log Menu If not zero, Press to Scroll Through Logged Error Codes Press ENTER key to Clear all errors from log	0-20 Quit Enter Clear
S/S	Select sideshift speed. This is used to adjust sideshift speed between 3 and 4.5 seconds (the higher the percentage, the faster the sideshift speed). It is also used to set the correct speed of an attachment that has a second AUX function. Changing this setting affects tilt speed as well.	60% to 90%

Table 3-4. Learn Mode Menu

Item	Values	Text Displayed/Action
Enter	Quit Weight Travel Lift Tilt Sideshift	See Learn in Table 3-3, Maintenance Mode Menu Exit Learn Mode Learn the Weight Sensor (Optional) Return Control to Neutral, then Press Enter Return Control to Neutral, then Press Enter Return Control to Neutral, then Press Enter (Optional handle only) Return Control to Neutral, then Press Enter (Optional handle only)



Maintenance Minder™ Tool

Maintenance Minder Tool is a feature that allows a customer to be prompted when the truck is due for scheduled maintenance.

Maintenance Minder, when configured and enabled, monitors the Hours on Deadman (HD) meter. When the time interval for scheduled maintenance is exceeded, the operator is informed in the following ways:

- One of two messages scrolls on the Operator Display for at least 30 seconds following the Daily Checklist message:
 - *Scheduled Maintenance Due*
 - *Lift Cutout, Scheduled Maintenance Due*
- A wrench icon flashes.
- The audible alarm sounds the high-low tone for approx. five seconds.

Lift Cutout, when active, does not disable the lift function until power to the control circuits is cycled (key switch OFF or battery disconnected).

When the control circuit power is cycled, lift is disabled until *Maintenance Minder* is reset or disabled, or the lift cutout option is turned OFF.

Enabling

Once installed in the configuration options, *MAINTENANCE MINDER* appears in the Configure Mode menu. The default factory setting is *DISABLE*. To enable the feature, enter Configure Mode.

NOTE: For instructions on selecting Modes of Operation, see [Modes of Operation on page 3-12](#).

With Configuration Mode selected, scroll to display *MAINTENANCE MINDER* and press ENTER. When entered from a disabled state, *Maintenance Minder* offers a sub-menu with the options *QUIT MM* and *ENABLE*. Scroll to *ENABLE* and press ENTER.

Setting Time Interval and Action Option

The first time you enter the time interval menu, the Factory Suggested setting, followed by the letters FS, is displayed. Subsequently, when you enter the time interval menu, the last used setting is displayed. Values from 50 to 500 hours, in increments of 50, are available. Scroll to the desired time interval and press ENTER.

Scroll to the desired action option and press ENTER.

- *MSG ONLY* causes the Operator Display to show *SCHEDULED MAINTENANCE DUE* when the scheduled maintenance time interval is exceeded.
- *L CUTOUT* causes the Operator Display to show *LIFT CUT OUT, SCHEDULED MAINTENANCE DUE* when the scheduled maintenance time interval is exceeded. Lift is disabled the next time the power circuits are cycled.

Scroll to *QUIT MM* from the sub-menu. If the status has changed, you are prompted to save changes. Press ENTER.

From the Config Menu, exit by selecting *QUIT CFG*. You will not be prompted again to save changes, but any changes saved when you *QUIT MM* are retained.

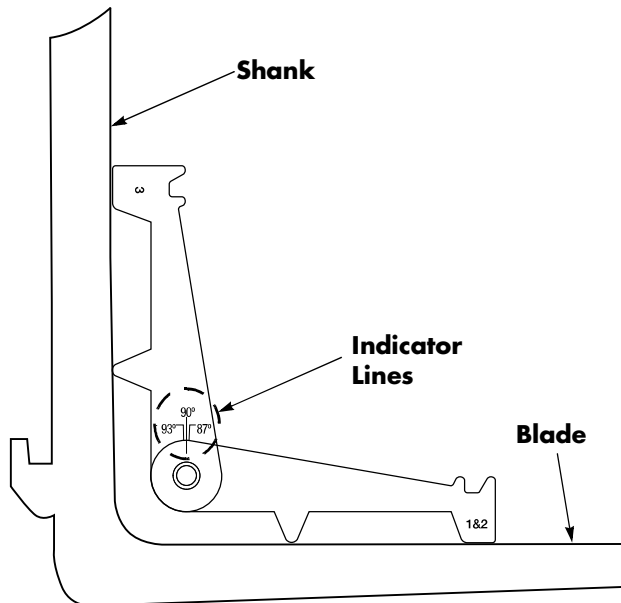
Changing Time Interval or Action Option

When *Maintenance Minder* is active and you want to change the time interval or action option, enter Configure Mode.

With Configuration Mode selected, scroll to *MNT MIND* and press ENTER. When entered from an enabled state, *Maintenance Minder* offers a sub-menu with the options *QUIT MM*, *RESET*, *DISABLE*, and *SETUP*. Scroll to *SETUP*, then press ENTER. The current time interval is displayed (hours). Proceed as described under Setting Time Interval and Action Option.

Fork Tip Height

Figure 4-5. Fork Angle



3. When all four extruded points are in contact with the fork, gently remove the caliper and note the reading on the indicator line, located right above the hinge pin. See Figure 4-5.
4. If the deviation is greater than 3° of the original angle, remove the fork from service.

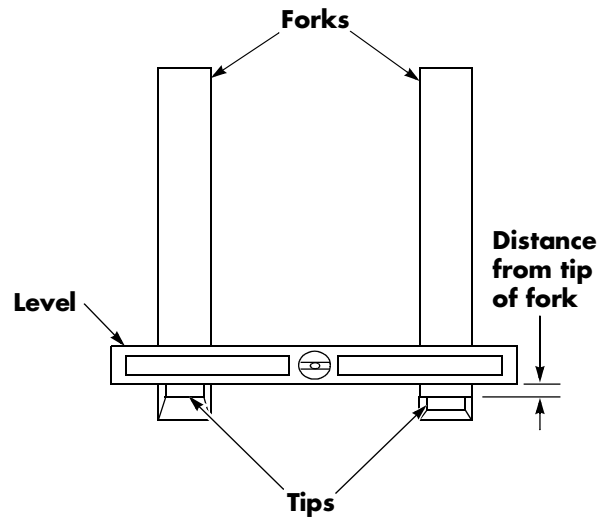
NOTE: Most forks are manufactured with a 90° angle; therefore, a reading greater than 93° or less than 87° is unacceptable. However, there are some forks that are purposely manufactured to angles greater than or less than 90°.

Fork Tip Height

1. With forks on the carriage, measure the length of the blade. See Figure 4-3.
 - For forks 42 in. (106.7 cm) or less, max. deviation is 0.25 in. (6.3 mm).
 - If length of fork is >42 in. (106.7 cm), multiply length of blade by 3%.
 $\text{Blade length } _____ \text{ in.} \times 3\% = _____ \text{ in.}$
 This is the maximum deviation.
2. Elevate forks approx. 4 ft. (1.2 m) off the floor.
3. Place a 4 ft. level across the tips of the forks. See Figure 4-6.

4. Raise one end of the level to make it level. See Figure 4-6.
5. Measure the distance from the tip of the fork. See Figure 4-6.

Figure 4-6. Measuring Fork Tip Height



6. Compare this measurement to the maximum deviation.
7. If the maximum deviation number is exceeded, remove the fork from service.

Wear

Fork Blade and Shank

1. Remove the forks from the carriage.
2. Approx. half way up the shank, set the front teeth of the jaws of the caliper on the shank. Make sure the caliper is held square across the shank to get an accurate reading. The caliper is now set to measure fork blade wear. Carefully remove the caliper from the shank. See Figure 4-7.

Electrical Troubleshooting

Condition	Probable Cause	Commutator Surface
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-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-Small Bright Spots	Related to overloaded machines and low brush pressure. Due to sparking under brush, that gives rise to spots being of a random distribution. If not corrected, results in scored commutator.	

Open Circuit Motor Test

An open circuit is an electrical circuit within the motor that is broken. This can be caused by:

- bad brushes or brush springs
- a broken wire in the field or armature winding
- loose or bad connections

Refer to Figures 5-1 and 5-2 while performing the following procedure:

1. Isolate the motor from the lift truck circuit by removing the power cables. Use two wrenches to avoid twisting the terminal stud.
2. With the motor at room temperature, connect the leads of a digital ohmmeter between the individual circuits in the motor.
3. Observe the following measurements:

DC Motor	Probe Points	Resistance
Lift	A to S	<1 ohm
	A to Frame	>100,000 ohms
Steer	MS+ or MS- to Frame	>100,000 ohms

4. If the meter indicates high resistance in the armature, check the condition of the brushes before replacing the motor.

5. If you find an open circuit in a series-wound motor, the motor must be disassembled by a motor rebuilding facility to isolate the problem to the field or armature circuit.

Grounded Motor Test

In a grounded motor, an electrical circuit exists between the current-carrying conductors and the motor housing. This can be caused either by direct contact or through conductive foreign material.

The ground may be caused by:

- insulation breakdown
- brush leads touching the motor housing
- build-up of carbon dust or other materials

Isolate the motor from the lift truck circuit by removing the power cables. Use two wrenches to avoid twisting the terminal studs.

Attach one lead of a megohm meter or a digital ohmmeter to a motor terminal and the other lead to an unpainted surface of the motor housing. Set the ohmmeter to the highest scale.

If the ohmmeter reads resistance of <100,000 ohms, the motor is grounded. Clean, repair, or replace the motor as necessary.



Symptom Tables: Hydraulic Functions

Unable to Pick Up a Load

Possible Cause	Action
Battery problems	Adjust lift cutout as necessary. Replace battery with fully-charged battery. Test battery for bad cells. See Battery Procedures on page 7-42.
Incorrect lift pressure adjustment	Check and adjust lift pressure setting.
Bad lift pump	Test system pressure.
Bad lift motor	4100 DC Lift Trucks: Test lift motor. See DC Motors on page 5-5. Check amp draw. 4200 AC Lift Trucks: Run "Test O28 - Ramp Lift Motor (AC Lift)" and/or "Test I20 - Lift RPM (AC Lift only)".
Binding in the mast	Inspect mast and bearings for signs of binding.

Lower Function**Slow Lower**

Possible Cause	Action
Binding proportional valve	Check valve operation. Run "Test O12 - Lift/Lower Solenoid (SOL2)".
Binding in the mast	Inspect the mast and bearings for signs of binding.
Plugged or malfunctioning flow control valve	Check for contamination in hydraulic fluid. If contamination is present, flush, fill, and bleed the hydraulic system. If no contamination is found, replace the flow control valves in the main lift cylinders.

Intermittent Lower

Possible Cause	Action
Bad load hold solenoid	Run "Test O11 - Load Hold Solenoid (SOL1)".
Binding proportional valve	Check valve operation. Run "Test O12 - Lift/Lower Solenoid (SOL2)".
Plugged or malfunctioning flow control valve	If still slow, remove and inspect. Check for contamination in hydraulic fluid. If contamination is present, flush, fill, and bleed the hydraulic system. If no contamination is found, replace the flow control valves in the main lift cylinders.

Load Drifting/Settling

Possible Cause	Action
Load holding solenoid	Run "Test O11 - Load Hold Solenoid (SOL1)". Check for contamination in hydraulic fluid. If contamination is present, inspect and clean the relief valve. Flush, fill, and bleed the hydraulic system.



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Messages and Codes

Message Displayed: CODE 2X Inform Service

Icon	Code Title/Reason	Tests to Run	Notes/Corrective Action
	Code 2X: Left TPA Out-of-Range The power supply output in the left TPA is less than 4.5V, greater than 5.5V, or too much current is being drawn by an external component.	None	Travel restricted to 1 mph (1.6 km/h). Cycle key switch to clear. Disconnect (+) wire to temp and speed sensors. If code changes, troubleshoot wires and sensors. If not OK, replace TPA. The VM cannot cause this code.

Message Displayed: CODE 2Y Inform Service

Icon	Code Title/Reason	Tests to Run	Notes/Corrective Action
	Code 2Y: Incorrect TPA Installed Incorrect power amp installed. Should be 500A, 400A was installed.	None	Replace with correct TPA. Travel is limited to 2.5 mph (4.0 km/h).

Message Displayed: CODE 42 Inform Service

Icon	Code Title/Reason	Tests to Run	Notes/Corrective Action
	Code 42: LPC Detected Closed When Commanded Open <i>AC Lift</i> - the LPA has detected an incorrect voltage at the B+ terminal on the amplifier. <i>DC Lift</i> - the VM has detected an incorrect voltage at JPC22-20.	"Test I13 - Lift Contactor (DC Lift)" "Test O02 - Lift Contactor (LPC)"	Lift is disabled. Cycle key switch to clear.

Message Displayed: CODE 43 Inform Service

Icon	Code Title/Reason	Tests to Run	Notes/Corrective Action
	Code 43: LPC Detected Open When Commanded Closed <i>AC Lift</i> - the LPA has detected an incorrect voltage at the B+ terminal on the amplifier. <i>DC Lift</i> - the VM has detected an incorrect voltage at JPC22-20.	"Test I13 - Lift Contactor (DC Lift)" "Test O02 - Lift Contactor (LPC)"	Cycle key switch to clear.

Message Displayed: CODE 4B Inform Service

Icon	Code Title/Reason	Tests to Run	Notes/Corrective Action
	Code 4B: Steer Contactor Detected Closed When Commanded Open The VM measured greater than +10VDC at JPC22-19 when the STR coil was de-energized.	"Test I14 - Steer Contactor" "Test O01 - Steer Contactor (STR)"	Check for incorrect voltage at JPC22-19. Reference "Pinout Matrix" on page 8-13. Cycle key switch to clear.



Messages and Codes

Message Displayed: CODE AG Inform Service

Icon	Code Title/Reason	Tests to Run	Notes/Corrective Action
	Code AG: Communications To/From Operator Display Failed Operator Display communications failure detected by VM.	None	Cycle key switch to clear. Check cable to display. If code does not clear, replace OD.

Message Displayed: CODE AH Inform Service

Icon	Code Title/Reason	Tests to Run	Notes/Corrective Action
	Code AH: Bad Operator Display Checksum	None	Cycle key switch to clear. If code does not clear, replace OD.

Message Displayed: CODE AL Inform Service

Icon	Code Title/Reason	Tests to Run	Notes/Corrective Action
	Code AL: VM Battery Backed Up RAM Failed	None	Cycle key switch to clear. If code does not clear, replace VM.

Message Displayed: CODE AP Inform Service

Icon	Code Title/Reason	Tests to Run	Notes/Corrective Action
	Code AP: Left TPA Software Fault	None	Travel disabled. Cycle key switch to clear. If code does not clear, Flash TPA with latest software.

Message Displayed: CODE AT Inform Service

Icon	Code Title/Reason	Tests to Run	Notes/Corrective Action
	Code AT: LPA Software Fault <i>AC lift only.</i>	None	Lift disabled. Cycle key switch to clear. If code does not clear, Flash LPA with latest software.

Message Displayed: CODE EC Inform Service

Icon	Code Title/Reason	Tests to Run	Notes/Corrective Action
	Code EC: COP Not Enabled	None	Cycle key switch to clear. If code does not clear, replace VM.

Test I13 - Lift Contactor (DC Lift)

This test reports the absence or presence of B+ on the load side of the LPC contactor.

It is necessary to manually activate the contactor in order to see the transition or perform test in Active Maintenance mode.



Energizing the Lift Contactor causes the Lift Motor to run.

Run test:

When the test is run, observe the following results:

LPC Contactor	Value Displayed
Open	Out
Closed	In

If these results are not observed, the test has failed. Check fuse FU3 and the LPC Contactor tips.

Diagnosis and Repair

Step	Action/ Meter Setting	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	Remove FU3/ Ohms	FU1+	FU1-	0 Ohms	Perform step 2	Replace fuse
2	DCV	JPC22-20	TP4	Tips open: <0.5V; Tips closed: B+	Replace VM	T/S wiring & connections. Check contactor tips. Check for shorts to frame.



Test I82 - Right Traction RPM

This test displays the output from the speed encoder on the right Traction Motor as seen by the right Traction Power Amplifier.

CAUTION

Do this test in an area free of obstructions with ample room for maneuvering.

NOTE: For best results, run this test in Active Maintenance Mode.

For more information on how to use Maintenance Mode, refer to [page 3-16](#).

Run test:

The Operator Display should show a linear increase to maximum RPM.

Diagnosis and Repair

Step	Action/ Meter Setting	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	DCV	JPTR1-26	JPTR1-7	4.5 - 5.5V	Perform step 2	Replace TPA
2		JPTR2-1	JPTR2-4		Perform step 3	R/R harness
3		JPTR1-31	JPTR1-7; after JPTR1-7 is tested for B-, use TP4 for easier access	Stationary: >3.5V or <0.5V Running: approx. 2V	Perform step 4	Perform step 5
4		JPTR1-32			Replace TPA	Perform step 6
5		JPTR2-3			R/R harness	Replace Motor Encoder
6		JPTR2-2				



Analog Tests

Test A11 - Left Traction Current

Test A11 - Left Traction Current

This test displays the current in the left Traction Motor power circuit.

Limits:

- Above 266°F (130°C) current is reduced linearly
- Maximum current up to 540A when deadman pedal is released, unaffected and unreduced by temperature

NOTE: For best results, run this test in Active Maintenance Mode.

For more information on how to use Maintenance Mode, refer to [page 3-16](#).

Run test:

The Operator Display shows the current that the traction power amplifier reads from the traction motor.

System Condition	Value Displayed
Static at Rest	<20A
Travel at Full Speed	<150A

NOTE: Because Test A11 measures only one phase, the test may not always reveal a current problem.

Diagnosis and Repair

NOTE: Check all motor and power amplifier connections for tightness and corrosion.

Check individual phase currents with a clamping ammeter. The current should ramp evenly as the lift truck accelerates and decelerates. Phase currents must be approximately equal. Gross differences indicate a problem.

If readings are not within reference limits, the test has failed.

1. If any one phase differs significantly from the other two, check power cable continuity. Replace cables as necessary. See [“Power Cable Terminals” on page 7-46](#).
 - If power cable continuity is OK, T/S the traction motor. See [“AC Motors” on page 5-8](#).
 - If all phases give high readings, the drive unit may be binding. Check drive unit.
2. The power amplifier may be bad. Run [“Test O29 - Ramp Traction Motors” on page 6-96](#).



Test A36 - Ambient Temperature

This test displays the ambient temperature of the area around the lift truck.

Run test:

The Operator Display should display the room temperature where the lift truck is located.

If not, the test has failed.

Diagnosis and Repair

Step	Action/ Meter Setting	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	JPA Disconnected/ DCV	JPC24-23	JPC24-11	Approx. 5V	Perform step 2	Replace VM
2	Ohms	JPC24-23	JPA-1	0 ohms	Replace temp sensor	T/S wires as indicated by test
3		JPC24-11	JPA-2			



Test A75 - Attach Fcn 1 (S4)

This test displays the voltage at the Attachment Function 1 switch (S4) on a standard control handle.

Run test:

Acceptable values are:

State	Value Displayed
Neutral	Approx. 5V
Function Activated	Approx. 0.0V

If the voltage is outside these limits or does not change, the test has failed.

Diagnosis and Repair

Step	Action/ Meter Setting	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
Note: A breakout cable or box is required to measure control handle voltages.						
1	DCV	JPC12-4	TP4	De-activated: approx. 5V Activated: less than 1V	Replace VM	Repair or replace control handle, cable, or S4 (in handle)



Test 001 - Steer Contactor (STR)

This test toggles the Steer Power Contactor (STR) ON and OFF.

Run test:

Acceptable values are:

PC Contactor	Value Displayed
Closed	ON
Open	OFF

The test is a success if the STR Contactor tracks the On/Off shown on the display. If these results are not observed, the test has failed.

Diagnosis and Repair

Step	Action/ Meter Setting	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	JPC18 & JPF2 Disconnected/ Ohms	JPC18-11	JPF2-1	Approx. 38 ohms	Perform step 2	T/S wires, connections, & contactor coil for opens or shorts
2	DCV	STR-X	TP4	B+	Perform step 3	T/S wire & connections (including SPL9 & JPF2-1)
3		TP1 or STR-X	STR-Y	Test ON: approx. 23V Test OFF: 0V	Check for binding	Replace VM

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Test O20 - Travel Alarm

This test verifies the operation of the optional Travel Alarm.

A successful test proves the wiring and related circuitry in the VM are functioning correctly.

NOTE: In order to test the output portion of the Vehicle Manager, a device is needed that will load down the circuit. The Load Holding Coil on the hydraulic manifold can be used for that purpose. Remove the Load Holding Coil and carefully connect its wires into the circuit.

CAUTION

Use extreme caution to prevent its wires from shorting to any components.

Run test:

Connect a voltmeter between JPF2-2 and JPC18-18.

Voltage Output	Value Displayed
0.0 to 1.0V	OFF
22.0V	ON

When the display shows ON, the travel alarm must be activated. If these results are not observed, the test has failed.

Diagnosis and Repair

Step	Action/ Meter Setting	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	Test Activated/ DCV	H-1	H-2	B+	Replace alarm	Perform step 2
2			TP4		Perform step 3	T/S wiring back to horn and SPL9
3		JPC18-18	Less than 1V	R/R wire to H-2	Perform step 4	
4	Connect load holding coil & activate test/DCV	TP1	JPC18-18	B+	Replace alarm	Replace VM

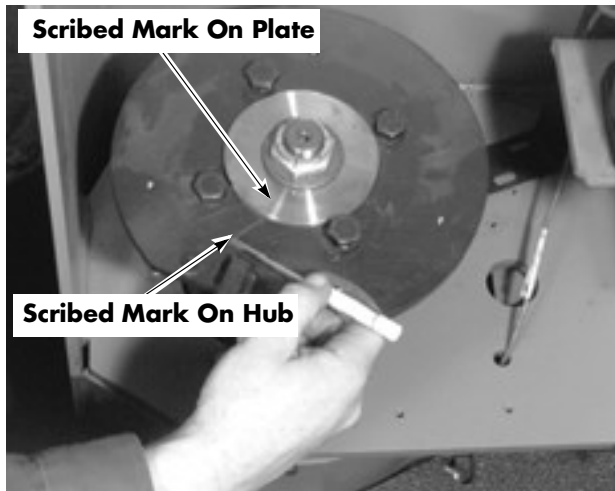


Section 7. Component Procedures

Steerable Wheel Assembly

Steering and Controls

Figure 7-8. Scribing a Mark from Hub to Steer Plate



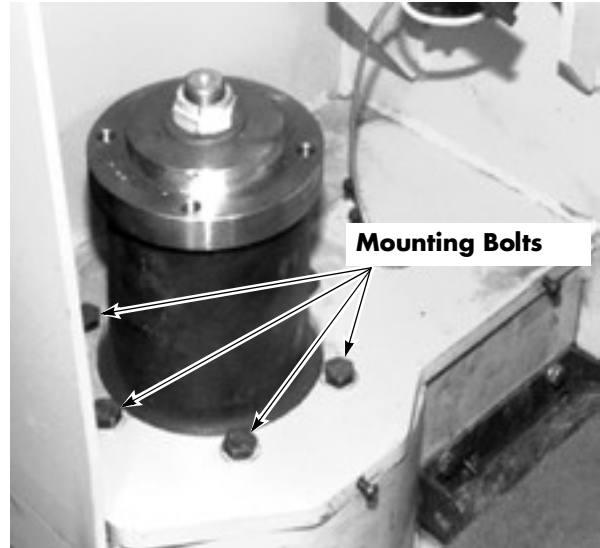
8. Remove the four bolts that hold the steer plate in place, then remove the steer plate. See Figure 7-9.

Figure 7-9. Removing Steering Plate Bolts



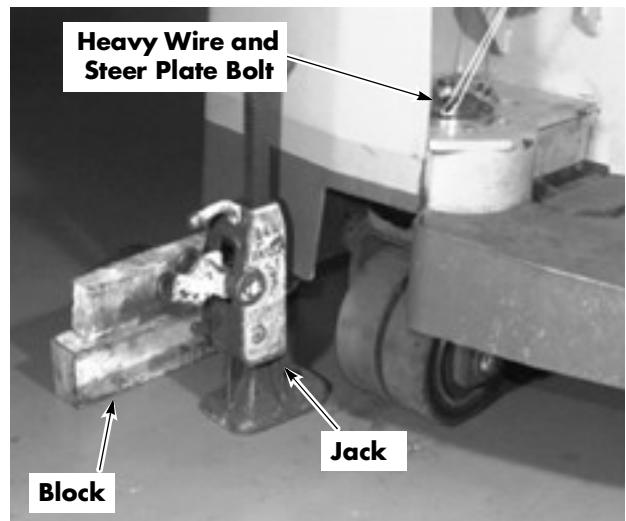
9. Remove the six mounting bolts holding the steerable wheel assembly to the lift truck frame. See Figure 7-10.

Figure 7-10. Steering Wheel Mounting Bolts



10. Place chocks in front of the drive wheels.
11. Reinstall one of the steer plate bolts. Wrap a piece of heavy wire around this screw to use as a temporary support. You will use this temporary support to lower the steer assembly to the floor when the lift truck is jacked up. See Figure 7-11.

Figure 7-11. Temporary Support for Steerable Wheel



12. Remove the wheel from the steer assembly to reduce jacking height and for ease of removal.



Control Handle - Optional

Steering and Controls

8. Install the five remaining socket head screws in the handle. Torque all socket head screws to 15 to 20 in. lb. (1.7 to 2.25 Nm).
9. Rotate the lift/lower potentiometer shaft so the flat on the shaft is parallel to the return spring pin on the potentiometer bracket. If the potentiometer shaft has no flat, rotate the shaft to the center of its travel.
10. Install the lift/lower knob. The pin on the knob must fit between the ears of the potentiometer return spring.
11. Install and tighten set screw and nylon plug in the knob. Check the potentiometer for correct rotation and spring return to neutral. Correct any binding.

Installation

1. Install the control handle on to the pivot.
2. Apply thread-locking compound (P/N 990-536) to the control handle set screw.
3. Install the set screw and tighten.
4. Form a loop in the control handle cable harness as it leaves the handle. Do not route through or under any components. Route the cable to the VM and connect JPC12.
5. Make sure that all other wires are tied back and away from the handle harness service loop.
6. Test the motion of the service loop by rotating the handle. The entire length of the loop should absorb the twist. Make sure the loop does not hang up on nearby wires, cable ties, or structures.
7. Install covers.



Figure 7-38. Lower Pinion Bearing Removal



2. Press the bearing from the pinion gear shaft.



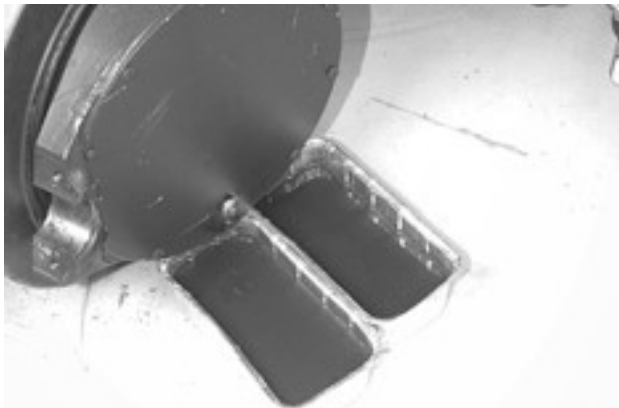
Electrical Components

Traction Motors

Removal

1. Turn the key switch OFF and disconnect the battery connector.
2. Remove the three front covers.
3. Remove the mast.
4. Remove the brake assembly.
5. Remove the friction plate retaining nut.
6. Remove the friction plate.
7. Disconnect the three power cables from the terminals on the traction motor and label for later installation. Use two wrenches to avoid twisting the terminal studs.
8. Disconnect JPTL2 (left) or JPTR2 (right) and JPTL3 (left) or JPTR3 (right).
9. Place a drain pan beneath the drive unit. Remove the drain plug and drain approx. two pints (one liter) of drive unit oil. This prevents oil from spilling when the traction motor is removed. [See Figure 7-56.](#)

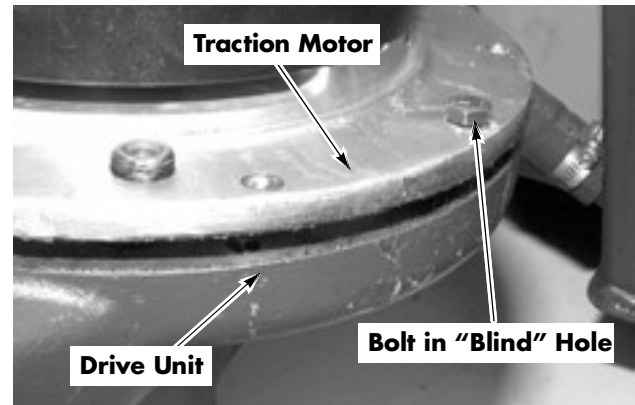
Figure 7-56. Drive Unit Drain Plug



10. Remove the four bolts that attach the traction motor to the top of the drive unit.
11. To break the seal between the traction motor and drive unit:
 - a. Install two of the bolts you removed in step 10 into the two “blind” holes on the traction motor mounting flange.
 - b. Evenly turn each bolt clockwise.

- c. As you turn the bolts, the traction motor pushes upward, breaking its seal to the drive unit. [See Figure 7-57.](#)

Figure 7-57. Traction Motor Removal, Breaking Seal



CAUTION

The traction motor is heavy. Use a suitable lifting device to move it if necessary.

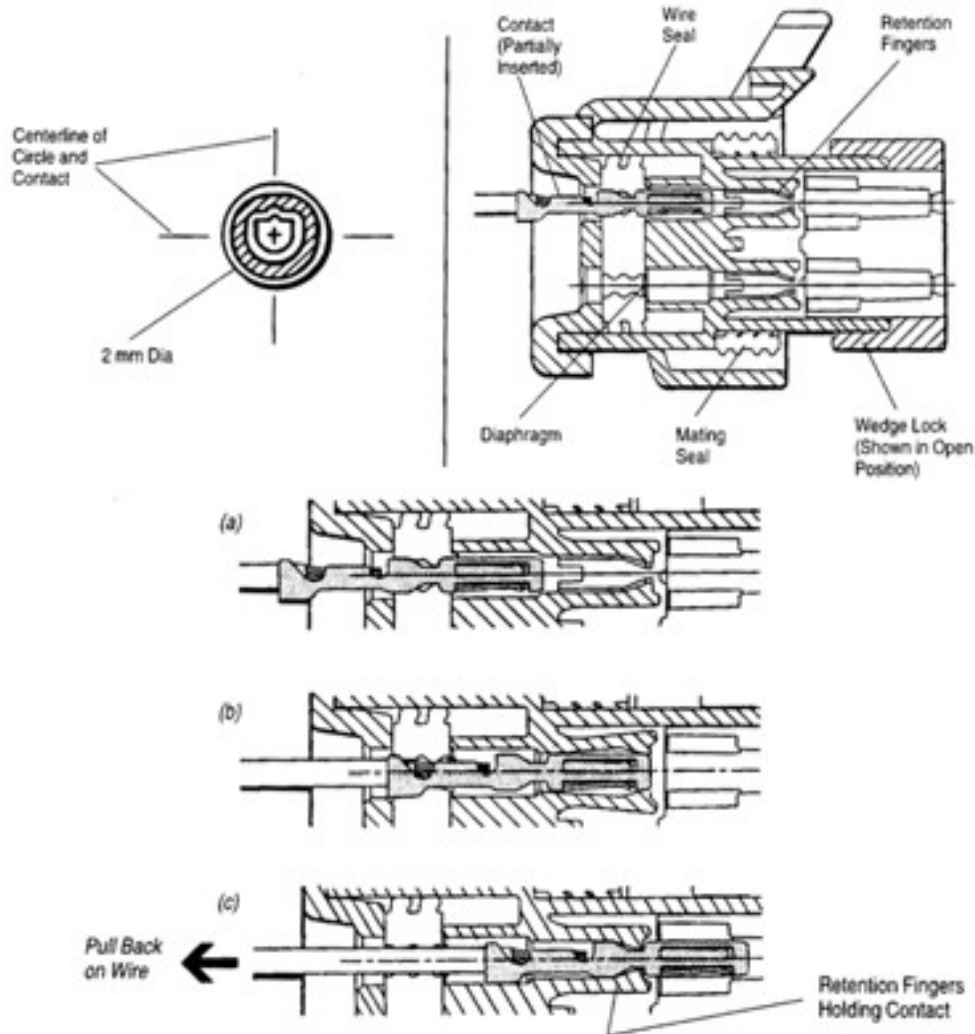
12. Lift the traction motor off the drive unit.
13. If you are not reinstalling a traction motor, use plastic film and masking tape to seal the opening for the traction motor so that no debris can fall into the drive unit.
14. Remove the pinion gear from the traction motor shaft.

Installation

1. Thoroughly clean the mating areas on the traction motor shaft and pinion gear.
2. Correctly install the pinion gear on the traction motor shaft (taper correctly oriented). Apply thread-locking compound (P/N 990-536) and install nut. Torque to 45 ft. lb. (61 Nm).
3. Thoroughly clean the mating areas on the top of the drive unit and the bottom of the traction motor mounting flange.
4. Apply a coat of gasket cement (P/N 990 556) to the mating surface on the top of the drive unit. A gasket (P/N 828 013-978) may be used instead of the gasket cement.

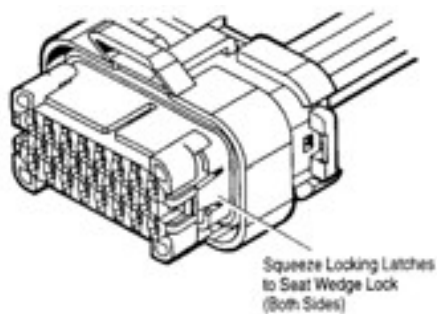


Figure 7-69. Contact Insertion



3. After all contacts are inserted, the wedge lock must be closed to its locked position. Release the locking latches by squeezing them inward. See Figure 7-70.

Figure 7-70. Wedge Lock Latches



CAUTION

Be very careful when putting the wedge lock in the locked position. Forcing the wedge lock can cause damage to the connector. Make sure the wedge lock is aligned correctly. If resistance is felt, slightly adjust the wedge lock until it slides in freely.

4. Slide the wedge lock into the housing until it is flush with the housing. See Figure 7-71.

Cylinder Service

Main or Free Lift Cylinders - Model 4200

1. Remove the cylinder from the mast. [See TF and TT Mast Service - Model 4200 on page 7-77.](#)
2. Use a spanner wrench to remove the retainer.
3. Remove the plunger/piston assembly from the shell. To remove the piston, refer to [Piston Removal](#).
4. Remove the Hydraulic Fuse or fitting as equipped.
5. Inspect all components for nicks or burrs. Minor nicks or burrs can be removed with 400-grit emery cloth.

NOTE: Minor nicks are those that do not bypass oil when under pressure. If they cannot be removed with emery cloth, replace the part.

6. Replace the retainer and piston seals, back-up rings, O-rings, and bearing. Lubricate the new seals with petroleum jelly prior to installation.

NOTE: Observe correct seal direction. The cylinder will not operate correctly if the seals are installed backwards.

NOTE: When replacing the piston check valve O-ring, make sure the check valve is reinstalled with the arrow pointed in the correct direction.

7. *Main Lift Cylinder* - Install the plunger retainer on the plunger. Install the plunger/piston assembly into the cylinder shell. Using the claw spanner wrench and a strap wrench, tighten the retainer to:
 - *TF Mast* - 225 to 250 ft. lb. (305 to 339 Nm)
 - *TT Mast* - 180 to 200 ft. lb. (244 to 271 Nm)
 - *Quad Mast* - 95 to 125 ft. lb. (129 to 169 Nm)

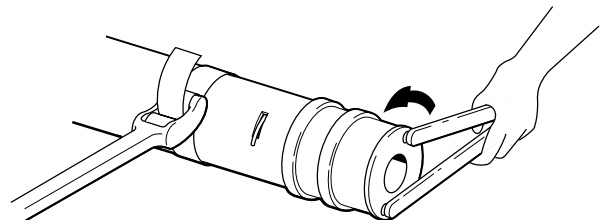
Free Lift Cylinder - Install the plunger retainer on the plunger. Install the plunger/piston assembly into the cylinder shell.

- *TF/TT Masts* - Pour 25 to 30 cc hydraulic oil into the cylinder cavity between the shell and rod. Tighten the retainer to 280 to 300 ft. lb. (380 to 407 Nm) using the claw spanner wrench and a strap wrench.
- *Quad Masts* - Pour 120 cc hydraulic oil into the cylinder cavity between the shell and rod. Tighten the retainer to 95 to 125 ft. lb. (129 to 169 Nm) using the claw spanner wrench and a strap wrench.

Piston Removal

1. Remove the plunger/piston assembly from the cylinder shell.
2. Use a strap wrench and 400-grit emery cloth to secure the plunger while turning the piston with a pin type spanner wrench. [See Figure 7-78.](#)

Figure 7-78. Piston Removal



3. Turn the piston until the snap wire end is visible through the hole. Use a screwdriver to start the wire end out the hole. Turn the piston to feed the wire out.
4. Pull the piston from the plunger.
5. For reassembly, reverse the removal procedure. Install a new snap wire when installing the piston.



Carriage - Model 4200 TF and TT Masts

NOTE: On *TT Mast* carriages, make sure the retainer bolts are torqued to at least 84 in. lb. (9.5 Nm). If retainer bolts or plate are damaged, replace them.

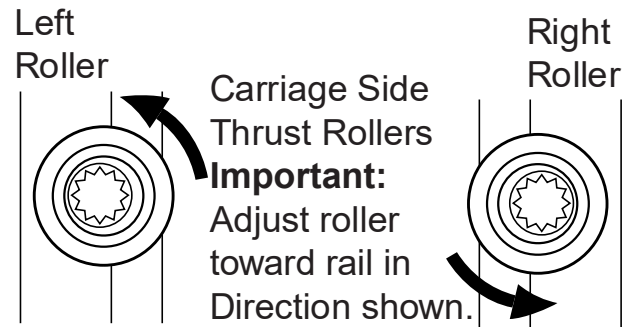
Carriage Removal

1. Remove mast from truck. [See Mast Service on page 7-74.](#)
2. Remove chain anchor nuts.

NOTE: Install new self-locking chain anchor nuts during reassembly.

3. Remove the chain anchors.
4. Disconnect the internal reeving hoses for the carriage fittings. Plug the hose ends.
5. Roll the carriage to the bottom of the mast.
6. Attach an overhead hoist to the carriage fork bars. Remove the carriage through the bottom of the mast.
7. Note the number of shims located behind each load roller for reassembly.

Figure 7-85. Carriage Side Thrust Rollers



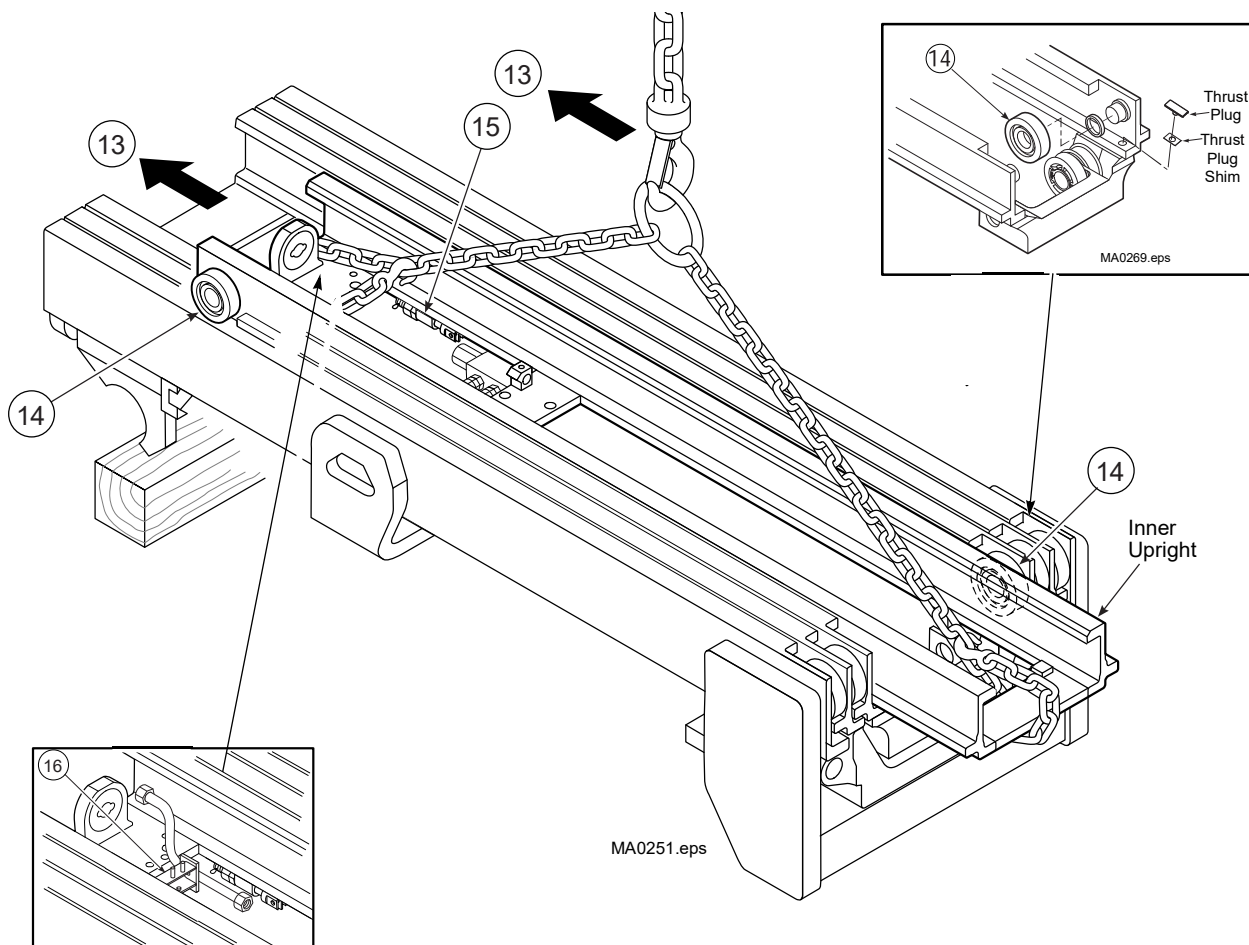
Carriage Installation

Reverse the removal procedure and do the following:

- Inspect the carriage.
- Lubricate the inner upright rails. Refer to [Lubrication Specification Chart on page A-2.](#)
- Assemble shims and load rollers on the carriage stub shafts. The shims should be installed to provide a total side to side clearance no looser than 0.06 in. (1.5 mm) at the tightest point throughout the travel of the carriage. Use an equal amount of shims on each side.
- *TT Masts* - Adjust the carriage side thrust rollers for unrestricted clearance along the travel of the carriage. Turn the eccentric mount base of each roller toward the upright rail to decrease clearance. [See Figure 7-85.](#) Torque the cap screws to 63 to 70 ft. lb. (85 to 95 Nm).
- Check and adjust the free lift chains. [See Lift Chains on page 7-98.](#)



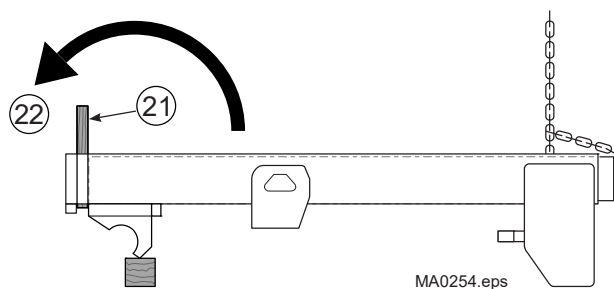
Figure 7-96. Inner Upright Installation



17. Install the free lift chain anchors (short anchors) and chains to the inner upright center cross member.
18. Install the free lift cylinder supply hose to the free lift cylinder tube. Leave the tubing clamp loose.
19. Install the carriage. See [Installation - Mast on Floor on page 7-92](#).
20. Install the free lift cylinder. See [Free Lift Cylinder Installation - Mast on Floor on page 7-93](#). Connect the tube to the cylinder fitting and tighten the tubing clamp.
21. Place a 2 x 4 in. (5 x 10 cm) wood block between the outer and outer intermediate lower cross members to prevent upright movement.
22. Turn the mast over (face down), rotating it on its lower end. Make sure the mast is

re-blocked in a level position. See [Figure 7-97](#).

Figure 7-97. Blocking Uprights Before Turning Mast Over



23. Install main lift cylinders. See [Main Lift Cylinder Installation - Mast on Floor on page 7-93](#).
24. Install the Mast. Refer to [Mast Installation on page 7-75](#).



Section 8. Theory of Operation



Lift/Lower System Theory

When the lift contactor coil is energized, the contactor tips close, allowing B+ to the power side of the LPA. The LPA supplies voltage to the lift motor. The motor turns at a speed predetermined by software.

SOL4 receives oil flow at port 1 that flows through the valve and out port 3 to SOL6, the directional solenoid. When energized, SOL6 reverses the direction of the Aux functions.

Oil flow then goes to solenoid 9R or 9L. Solenoid 9R and 9L must be energized for Sideshift to work in either direction. From SOL9, the oil flows through the over-the-mast hoses to the Sideshift cylinders.

From the Maintenance Menu, the user can establish sideshift speed. See [Table 3-3, "Maintenance Mode Menu,"](#) on page 3-17.

This is used to adjust sideshift speed between 3 and 4.5 seconds. It is also used to set the correct speed of an attachment that has a second AUX function. Changing this setting affects tilt speed as well. The VM varies the voltage to SOL4 in order to create the differing sideshift speeds.

Tilt

With the key switch ON and the deadman pedal depressed, the following occurs to activate the Tilt function.

Moving the Tilt control forward or back varies the output voltage of the Tilt pot (optional handle). This voltage goes to the VM at JPC12-8. The VM sees a voltage change and sends a request to the lift amplifier via BUS+/- (JPC14-11 and JPC14-4 to JPL1-23 and JPL1-35).

The lift power amplifier internally supplies B- to the lift contactor coil (LPC) at JPL1-6, closing the normally open contactor tips.

When the lift contactor coil is energized, the contactor tips close, allowing B+ to be supplied to the power side of the lift power amplifier. This supplies voltage to the lift motor to make it

rotate. The motor turns at a speed predetermined by software.

SOL4 receives oil flow at port 1, that flows through the valve and out port 3 to SOL6, the directional solenoid. When energized, SOL6 reverses the direction of the Aux functions.

Oil flow then goes to SOL10. SOL10 must be energized for Tilt to work in either direction.

From SOL10, the oil flows through CB-1 or 2, depending on the requested tilt direction. The oil then flows through the hoses to the Tilt cylinders.

During a lift and aux function at the same time, SOL4 becomes energized to allow the correct oil flow to the Aux functions.

Bottler's Tilt (Optional)

Bottler's Tilt allows additional forward mast tilt while in free lift, and may limit the lift height depending on the tilt position.

To accomplish this, there are modifications to the lift truck and the option must be enabled in FlashWare. See [Table 3-1, "Configure Mode Menu,"](#) on page 3-14.

When the mast is fully lowered and vertical, the High Speed Limit Switch (SW11) and Mast Tilt Switch (SW18) are normally closed.

When tilt is requested, greater than 3° tilt forward is possible.

When the lift truck is elevated above free lift, SW11 opens, causing a change in state to be seen at the VM.

The VM does not allow tilt forward to go more than 3° as seen by SW18.

When the mast is tilted more than 3° while in free lift, and lift is requested, lift stops when switch SW11 is deactivated.



Pinout Matrix

Item	Connector	Functional Description	Theory of Operation	Normal Level	Signal Source	Signal User
117	JPF2-4	B+K4	Supply input to the VM that allows the VM to remain powered up with the Key Switch OFF. This is used in cold storage applications to allow the handle heater circuit to work based on input from the ambient temperature sensor.	K4 energized: B+	K4 tips	VM
118	JPF2-5	B+K2	B+ from the K2 relay to the Left Brake Coil.	K2 energized: B+	K2 tips	Left Brake Coil
119	JPF2-6	B+K2	B+ from the K2 relay to VM.	K2 energized: B+	K2 tips	VM
120	JPF2-7	B+K2	B+ from the K2 relay to VM.	K2 energized: B+	K2 tips	VM
121	JPF2-8	B+K2	B+ Supply from the K2 relay to SOL1, 3, 7R, 7C, 9R, 9L, and optional SOL11.	K2 energized: B+	K2 tips	SOL1, 3, 7R, 7C, 9R, 9L, & SOL11
122	JPF2-9	B+Key	B+ from the K1 relay to be used for accessory power after the Key Switch is activated.	K1 energized: B+	K1 tips	TS1-5 & 6
123	JPF3-1	B-	B- for FU6 that provides B- to the VM.	<0.5V	TP4	VM
124	JPF3-2	B-	B- for FU6 that provides B- to the VM.	<0.5V	TP4	VM
125	JPF3-3	DGND	B-F for DGND on the VM.	<0.5V	FU6	VM
126	JPF3-4	DGND	B-F for DGND on the VM.	<0.5V	FU6	VM
127	JPF3-5	B-F	B-F for the VM.	<0.5V	FU6	VM
128	JPF3-6	B-F	B-F for the VM.	<0.5V	FU6	VM
129	JPF3-7	B-F	B-F for the VM.	<0.5V	FU6	VM
130	JPF4-1	B+	B+ from TP1 to FU5 to supply K4 coil and the K2, K4 relay tips. Also supplies Battery_Sense_In to the VM.	B+	TP1	VM
131	JPF4-2	B+	B+ from TP1 to FU5 to supply the K4 coil and the K2, K4 relay tips. Also supplies Battery_Sense_In to the VM.	B+	TP1	VM
132	JPF4-3	B+	B+ from TP1 to FU7 and K1 tips to supply Accessory Power option.	B+	TP1	FU7 & Accessory Power Option
133	JPF4-4	B+	B+ from TP1 to FU7 and K1 tips to supply Accessory Power option.	B+	TP1	FU7 and Accessory Power Option



Torque Chart - Standard (Ferrous)

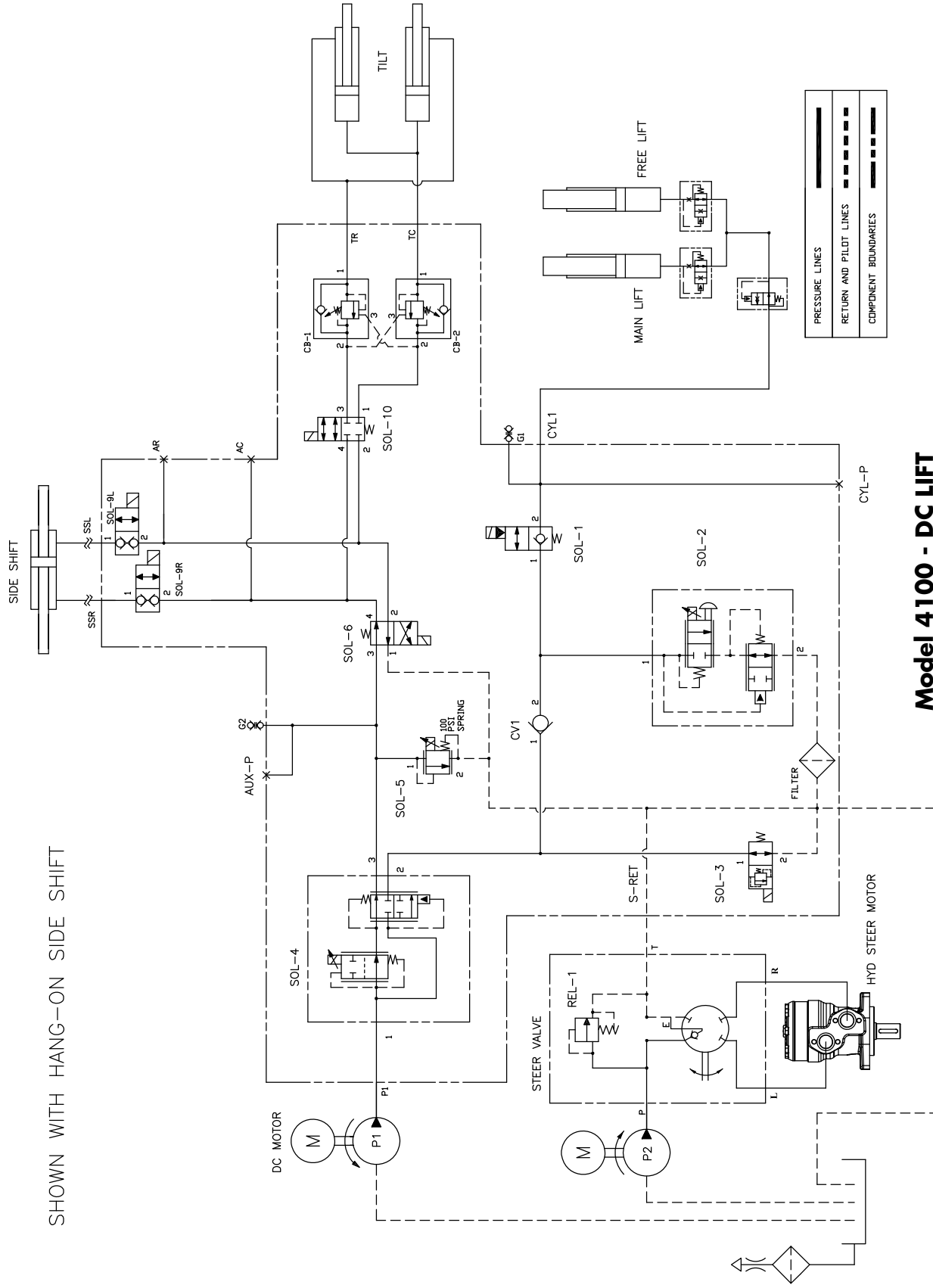
**Torque Chart - Standard
(Ferrous)**

Grade Identification Marking	None					
	SAE Grade 2 Bolts Tightening Torque		SAE Grade 5 Bolts Tightening Torque		SAE Grade 8 Bolts Tightening Torque	
	Dry	Oiled	Dry	Oiled	Dry	Oiled
Size	in. lb.	in. lb.	in. lb.	in. lb.	in. lb.	in. lb.
4-40	5	4	8	6	12	9
4-48	6	5	9	7	13	10
6-32	10	8	16	12	23	17
8-32	19	14	30	22	41	31
8-36	20	15	31	23	43	32
10-24	27	21	43	32	60	45
10-32	31	23	49	36	68	51
1/4-20	66	49	96	75	144	108
1/4-28	78	56	120	86	168	120
	ft. lb.	ft. lb.	ft. lb.	ft. lb.	ft. lb.	ft. lb.
5/16-18	11	8	17	13	25	18
5/16-24	12	9	19	14	25	20
3/8-16	20	15	30	23	45	35
3/8-24	23	17	35	25	50	35
7/16-14	30	24	50	35	70	55
7/16-20	35	25	55	40	80	60
1/2-13	50	35	75	55	110	80
1/2-20	55	40	90	65	120	90
9/16-12	65	50	110	80	150	110
9/16-18	75	55	120	90	170	130
5/8-11	90	70	150	110	220	170
5/8-18	110	85	180	130	240	180
3/4-10	160	120	260	200	380	280
3/4-16	180	140	300	220	420	320
7/8-9	140	110	400	300	600	460
7/8-14	155	120	440	320	660	500
1-8	220	160	580	440	900	680
1-12	240	170	640	480	1000	740
1 1/8-7	300	220	800	600	1280	960
1 1/8-12	340	260	880	660	1440	1080
1 1/4-7	420	320	1120	840	1820	1360
1 1/4-12	460	360	1240	920	2000	1500
1 3/8-6	560	420	1460	1100	2380	1780
1 3/8-12	640	460	1680	1260	2720	2040
1 1/2-6	740	560	1940	1460	3160	2360
1 1/2-12	840	620	2200	1640	3560	2660

Note: Use "oiled" values for bolts with thread-locking compound.



Figure 1-7. Hydraulic Schematic - Model 4100 - DC Lift (Sheet 2 of 3)



SHOWN WITH HANG-ON SIDE SHIFT

Model 4100 - DC LIFT

	PRESSURE LINES
	RETURN AND PILOT LINES
	COMPONENT BOUNDARIES

RAYMOND SERVICE INFORMATION

The Raymond Corporation
 Corporate Headquarters
 P O Box 130
 Greene, New York 13778-0130



RSI CTB-18-006
October 22, 2018

Models
4100/4150/4200/4250

SUBJECT: New Brake Assembly

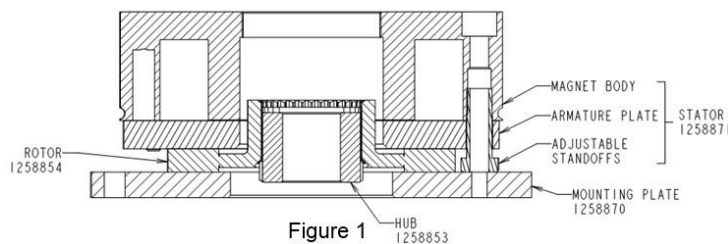
GENERAL INFORMATION: Brake assembly (P/N 1252130) is now available. The new brake is available along with all necessary installation components as kit P/N 1252130/Kit.

NOTE: Brake P/N 1094113/003 remains available for Reach Model 7200.

SERVICE INFORMATION: Both brakes must be replaced at the same time; therefore, *2 kits are required for each truck*. Order 2 kits per truck and perform the following procedure to remove the old brake assemblies and install the new brake assemblies.

Brake Assy Installation Kit P/N 1252130/Kit (2 required per truck)				
Item	Description (see Figure 1)	P/N	Qty.	Replaces P/N
1	Brake Assembly (includes:)	1252130	1	1043541, 1094113/003, or 1094113/004
2	Hub	1258853		
3	Rotor	1258854		
4	Mounting Plate	1258870		
5	Stator	1258871		
6	Brake Release Bolts	7-710-006-060	2	7-710-006-050
7	Mounting Screw	5-001-509	3	5-002-575
8	Nyloc Flange Nut	1259902/006	1	5-015/008 or 1169843/006
9	Mounting Screw	5-002-086	3	Not applicable

Table 1



RAYMOND SERVICE INFORMATION

The Raymond Corporation
Corporate Headquarters
P O Box 130
Greene, New York 13778-0130



RSI CTB-15-008
October 29, 2015

Models
4100, 4150, 4200, 4250

SUBJECT: New Brake Assembly Available

GENERAL INFORMATION: A new replacement brake assembly (P/N 1094113/004) is now available. The new brake is available along with all necessary components as one of the following kits:

- Kit P/N 1043541/K01 – for all trucks *except* C50 with a plastic reservoir
- Kit P/N 1043541/K02 – for C50 with a plastic reservoir

SERVICE INFORMATION: Order the correct Brake Replacement Kit for the truck model as specified above and install per the following instructions.

NOTE: It *is not* necessary to replace both brakes at the same time.

Brake Kits P/N 1043541/* include:

Item	*/K01	*/K02	Part Number	Qty.
Brake Assembly	X	X	1094113/004	1
Mounting Bolts	X	X	5-002-575 (precoated)	3
Brake Release Bolts	X	X	7-710-006/050	2
Bracket		X	1222584	1



- C50 models with a plastic reservoir require bracket P/N 1189483 to be replaced with bracket P/N 1222584 to allow clearance for the new brake.
- C50 models require the removal of the tilt cylinder to provide the necessary clearance during installation.
- Unless otherwise specified, torque all hardware per the torque chart in the Maintenance Manual Appendix.

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