

RAYMOND

Maintenance Manual

**Model 9600 and 9700 *Swing-Reach*[®] Lift Truck
With *The ACR System*[™]**



**Model
9600
9700**

**Serial Numbers
960-09-00001 and Up
970-09-00001 and Up**

**1089040B
Replaces 1089040A**

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This publication, 1089040B, applies to the Model 9600 and 9700 *Swing-Reach*® Lift Truck With *The ACR System*, Model 9600, S/N 960-09-00001 and up, Model 9700, S/N 970-09-00001 and up, and to all subsequent releases of this product until otherwise indicated in new editions or bulletins. Changes occur periodically to the information in this publication.

For revision information, see “[Page Revision Record](#)” on page v.

If you need assistance with your lift truck, or to order additional copies of this manual, contact your local authorized Raymond dealer.

To locate your local authorized Raymond dealer, go to www.raymondcorp.com.

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Page Revision Record

This section is a record of all revised pages in this manual. Whenever a page is revised, this section is updated and included in the revision package.

Pages are revised due to technical and non-technical changes described as follows:

- Technical changes – These changes are identified by a vertical line (change bar) in the left margin next to the change. Pages affected by technical changes are identified with “Page Revised: dd/mmm/yyyy” in the footer. These pages are also available on the *Raymond* iNet.
- Non-technical changes – These changes consist of typographical and grammatical corrections, paragraph renumbering, repagination, etc. Non-technical changes are not identified with a change bar, however, affected pages are identified with “Revised: dd/mmm/yyyy” in the footer.

Document Revision History

1089040A Original Issue 01 Sep 2009
1089040B Re-issue 15 Jun 2010
(technical changes identified by change bars)

Service Bulletin List

The following Service Bulletins have been incorporated into this manual.

Use the blank rows below to log Service Bulletins when they are added to this manual.

Document Number	Subject	Date

Product Improvement Notice List

The following Product Improvement Notices have been incorporated into this manual.

Use the blank rows below to log Product Improvement Notices when they are added to this manual.

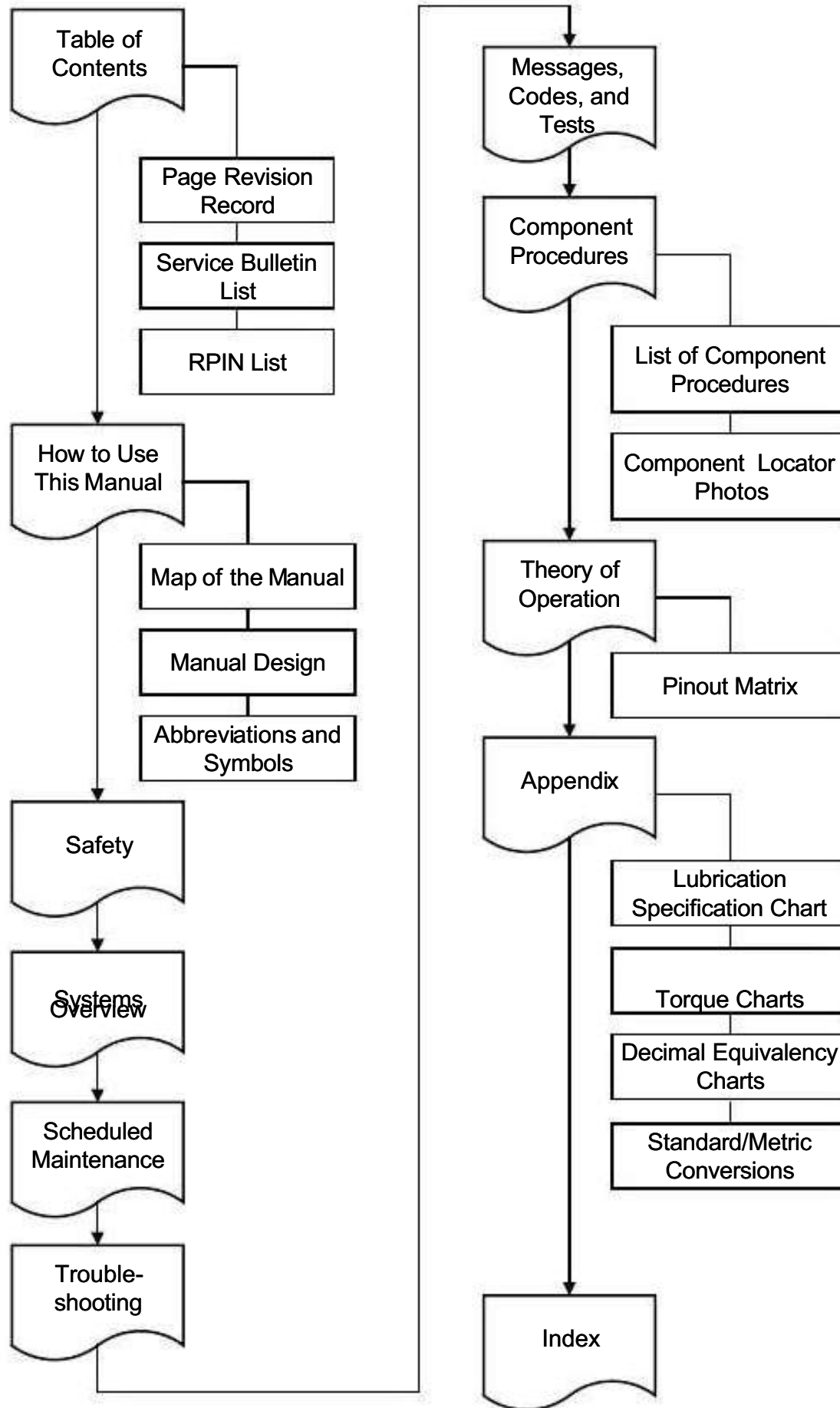
Document Number	Subject	Date
SWR-09-R003	Power Amplifier Cooling Fan Kit Available	21 Dec 2009
SWR-10-R001	TM S/W V2.2 and CM S/W V1.8	26 Jan 2010

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Section 1. How to Use This Manual

Map of the Manual

Map of the Manual



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:

- the name of the manual
(Model 9600/9700 Swing-Reach® Maintenance Manual)
- the current section title
(for example, this page *How to Use This Manual*)
- the 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, general safety rules, and safety rules for batteries, static, jacking, and welding.
- **Section 3: Systems Overview** includes general lift truck specifications, installation, FlashWare, Modes of Operation, and configuration information.
- **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 specific checks and tests in order to isolate a bad component.
- **Section 6: Messages, Codes, and Tests** lists fault codes and firmware-based inputs and electrical tests designed to diagnose problems and repair the truck.

- **Section 7: Component Procedures** gives step-by-step procedures to remove, install, and adjust serviceable components. Components are grouped by truck system. To find a component procedure, you may use one of two methods:

- Look up the component name in the **List of Component Procedures** on page 7-2.
- Look up the component name in the **Index** (page I-1).
- **Section 8: Theory of Operation** explains signal flow within the electrical and hydraulic systems for various conditions of 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** lists subjects alphabetically.

Abbreviations and Symbols

Abbreviations and Symbols

These abbreviations, acronyms, and symbols are used in this manual.

Term/Symbol	Definition	Term/Symbol	Definition
A	Ampere	E	UL Electric Truck Type Certification Rating with safeguards against inherent fire and electrical shock hazards
AC	Alternating Current	EE	UL Electric Truck Type Certification Rating where electrical equipment is completely enclosed
AGND	Analog Ground	Elev. Ht.	Elevated Height
AH	hours on Load Handler	Emerg	Emergency
amp	Ampere or amplifier	EOA	End-of-Aisle
ANSI	American National Standards Institute	EPO	Emergency Power Off
API	American Petroleum Institute	ESD	Electrostatic Discharge
approx.	approximately	ESDS	Electrostatic Discharge Sensitive
assy	assembly	F	Fahrenheit
aux	auxiliary	FF	Forks First
AWG	American Wire Gauge	ft.	foot or feet
BSOC	Battery State-of-Charge	ft. lb.	foot pound(s)
C	Celsius or Centigrade	FU	Fuse
CAN	Controller Area Network	GA	gauge
CB	Counterbalance valve	gal.	gallon or gallons
CCW	Counterclockwise	GM	Guidance Manager
cfg	configuration	gm	gram(s)
CM	Carriage Manager	Gnd	ground
CMB	Carriage Manager Boot Block	HA	Heading Angle or hours on Load Handler
cm	centimeter	HD	hours with Deadman switch activated
COP	Computer Operating Properly	HL	hours lifting
CS	Cold Storage	HT	hours traveling
CV	Check Valve	Ht	Height
CW	Clockwise	HTR	Heater
CYL	Cylinder	IC	Integrated Circuit
DC	Direct Current	in.	inch or inches
DdManH	Deadman Pedal Hours	in. lb.	inch pound(s)
DFW	Distance From Wire	JP	jack and pin connector
DGND	Digital Ground		
diam.	diameter		
Dir	Direction		
DMM	Digital MultiMeter		
DOT	US Department of Transportation		
DVM	Digital Voltmeter		

Abbreviations and Symbols

Term/Symbol	Definition	Term/Symbol	Definition
K	thousand	P	pump or lift contactor
KH	hours with key switch ON	PAL	Lift Power Amp Software
kg	kilogram(s)	PALB	Lift Power Amp Boot Block
km/cm ²	kilograms per square centimeter	PALVCL	Lift Power Amp Vehicle Control Language
km/h	kilometers per hour	PAT	Traction Power Amp Software
kPa	kiloPascal(s)	PATB	Traction Power Amp Boot Block
l	liter(s)	PATVCL	Traction Power Amp Vehicle Control Language
lb.	pound or pounds	pot	Potentiometer
LPA	Lift Power Amplifier	Press	Pressure
LED	Light Emitting Diode	Prop	Proportional
LiftH	Lift Hours	Prox	Proximity
LH	Load Handler or Left-Hand	psi	pounds per square inch
LHC	Load Handler Contactor	PWM	Pulse Width Modulation
L/L	lift/lower	P/N	Part Number
LHM	Load Handler Motor		
LM	Lift Motor	qt.	quart
LME	Lift Motor Encoder	qty.	quantity
LMT	Lift Motor Temperature sensor		
LPA	Lift Power Amplifier	RAM	Random Access Memory
LPC	Lift Power Contactor	RCH	Reach
LR	LPA precharge resistor	REL	relief
LWR	Lower	RF	Radio Frequency
		ROM	Read Only Memory
m	meter(s)	RPIN	<i>Raymond</i> Product Improvement Notice
mA	milliamper	rpm	revolutions per minute
mm	millimeter	R/R	reach/retract
MM	<i>Maintenance Minder</i> ™	RSB	<i>Raymond</i> Service Bulletin
mph	miles per hour		
MS	steer motor	S	Switch
N/A	Not Applicable or Not Available	SA	Steer Amplifier
N/C	Normally Closed	SAE	Society of Automotive Engineers
NLGI	National Lubricating Grease Institute	S/N	Serial Number
Nm	Newton Meter	SOL	Solenoid
N/O	Normally Open	spec	specification
NVM	Non-Volatile Memory	SPL	Splice
OACH	Overall Collapsed Height	STR	Steer Contactor
OD	Operator Display	SWM	Supplier Wireless Module
OSHA	Occupational Safety and Health Association		
OTM	over-the-mast		
oz.	ounce(s)		

Abbreviations and Symbols

Term/Symbol	Definition
TA	Traction Power Amplifier
temp	temperature
TF	Tractor First
TM	Tractor Manager, Traction Motor, or Total distance traveled
TMB	Tractor Manager Boot Block
TME	Traction Motor Encoder
TMT	Traction Motor Temperature sensor
TP	Tie Point
TPA	Traction Power Amplifier
TPC	Traction Power Contactor
TS	Terminal Strip
UL	Underwriters Laboratories
UNC	Unified Coarse thread
UNF	Unified Fine thread
V	Volts
VDC	Volts Direct Current
ver.	version
VR	variable resistor
wrt	with respect to
Xducer	Transducer
@	at
TM	trademark
©	copyright
+	plus or positive
-	minus or negative
±	plus or minus
°	degrees
°F	degrees Fahrenheit
°C	degrees Celsius
<	less than
>	greater than
%	percent
=	equals

Section 2. Safety

Definitions

Definitions

Throughout this manual, you will see two kinds of safety reminders:

▲ WARNING

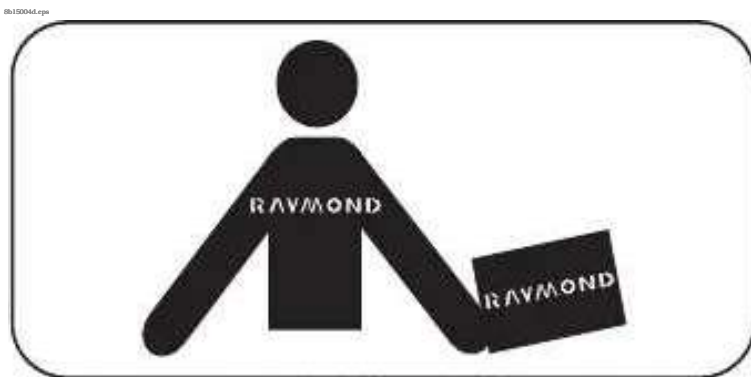
Warning means a potentially hazardous situation exists which, if not avoided, could result in death or serious injury.

▲ CAUTION

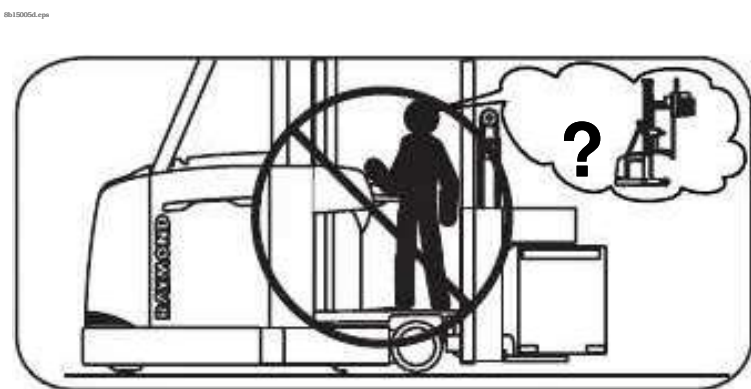
Caution means a potentially hazardous situation exists which, if not avoided, could result in minor or moderate injury or in damage to the lift truck or nearby objects. It can also be used to alert against unsafe practices.

General Safety

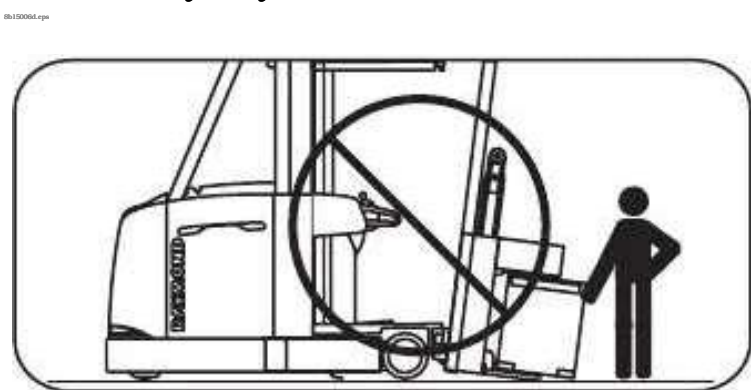
Do *not* operate or work on this lift truck unless you are trained, qualified, and authorized to do so, and you have read the Owner Manual and the Operator Manual.



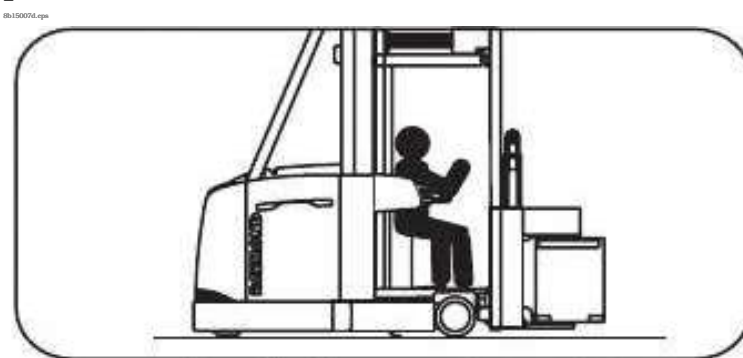
Know the lift truck's controls and what they do.



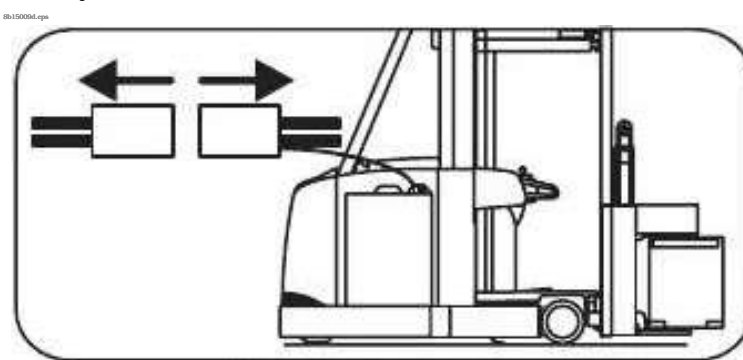
Do *not* operate this lift truck if it needs repair or if it is in any way unsafe.



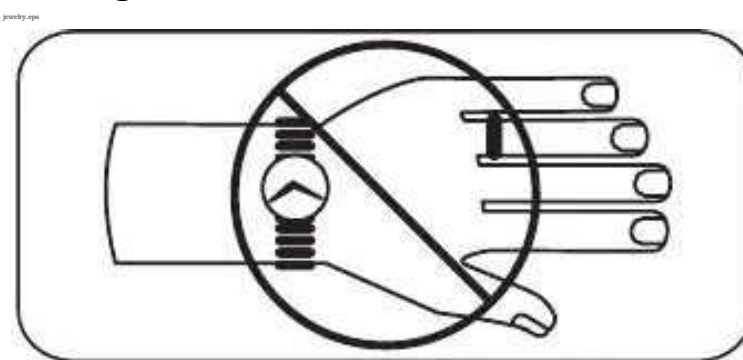
Operate this lift truck only from the operator's position.



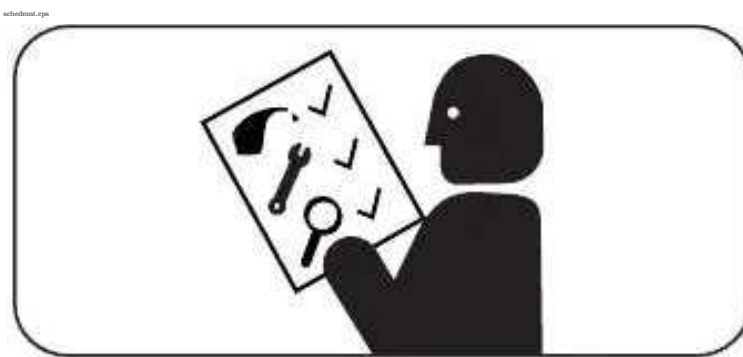
Before working on this lift truck, always turn the key switch to OFF and disconnect the lift truck's battery connector (unless this manual tells you otherwise).



Do *not* wear watches, rings, or jewelry when working on the lift truck.



Follow the scheduled lubrication, maintenance, and inspection steps.



General Safety

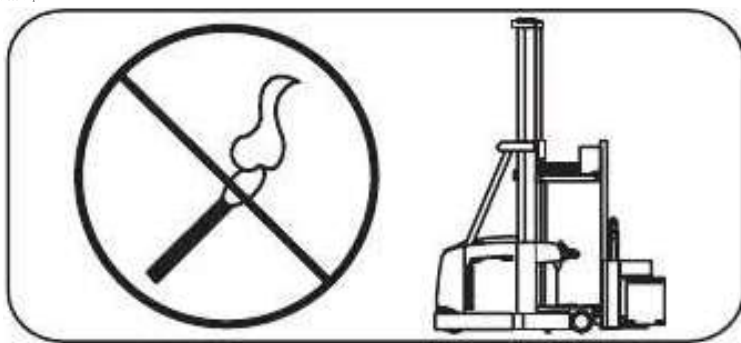
Follow exactly the safety and repair instructions in this manual. Do *not* take “shortcuts.”



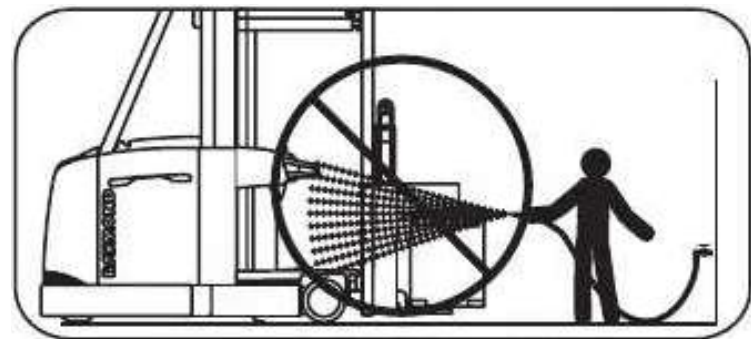
Always operate and park this lift truck indoors.



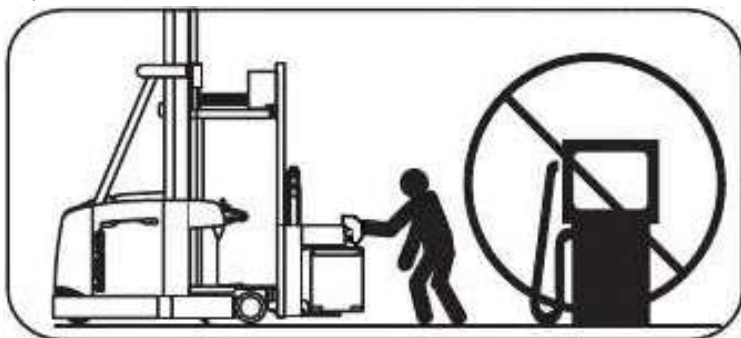
Do *not* use an open flame near the lift truck.



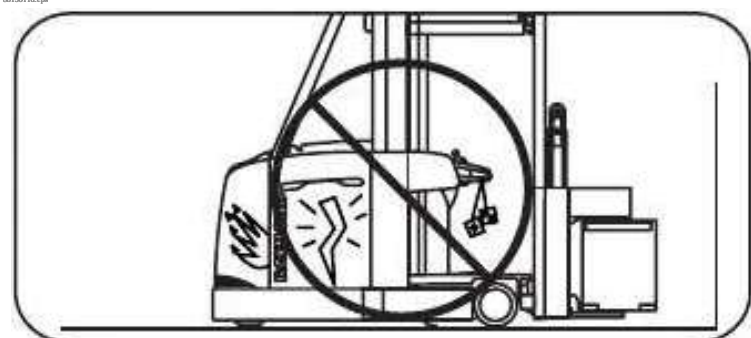
Do *not* wash this lift truck with a hose.



Do *not* use gasoline or other flammable liquids for cleaning parts.



Do *not* add to or modify this lift truck until you contact your local Raymond dealer to receive written manufacturer approval.



Clean up any hydraulic fluid, oil, or grease that has leaked or spilled on the floor.



Battery Safety

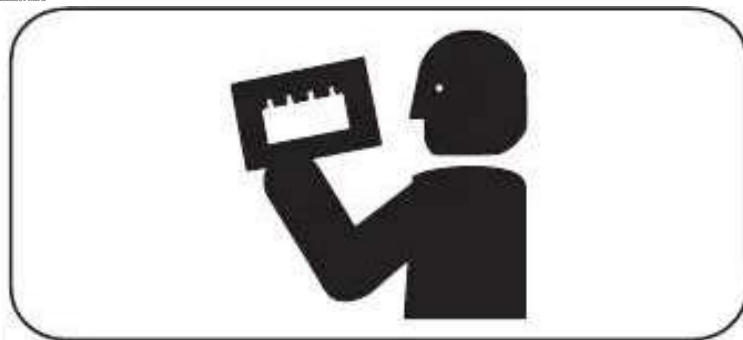
⚠ WARNING

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.

⚠ CAUTION

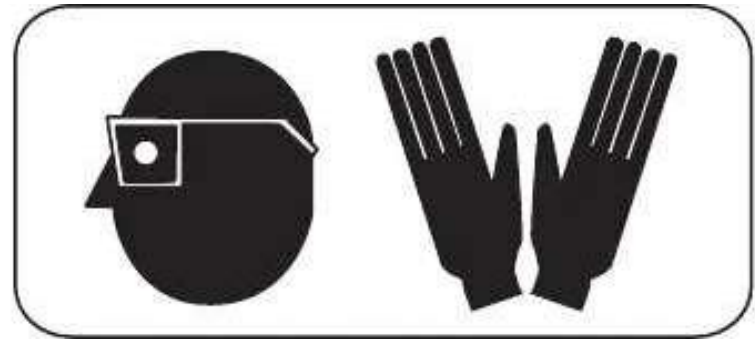
Battery electrolyte is a solution of sulfuric acid and water. Battery acid causes burns. If any electrolyte comes in contact with your clothing or skin, flush the area immediately with cold water. If the solution gets on your face or in your eyes, flush the area with cold water and get medical help immediately.

Read, understand, and follow procedures, recommendations, and specifications in the battery and battery charger manufacturer's manuals.

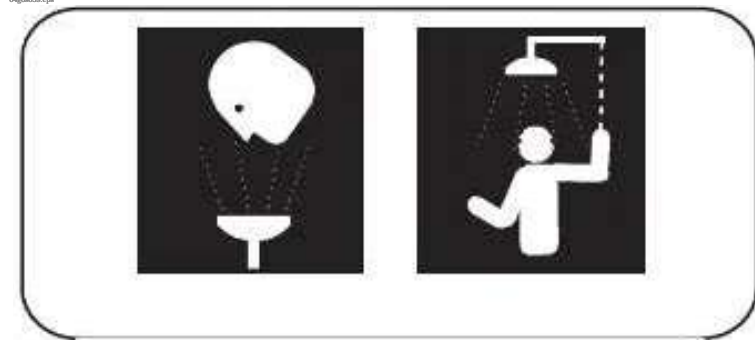


Wear personal protective equipment to protect eyes, face, and skin when checking, handling, or filling batteries. This equipment includes

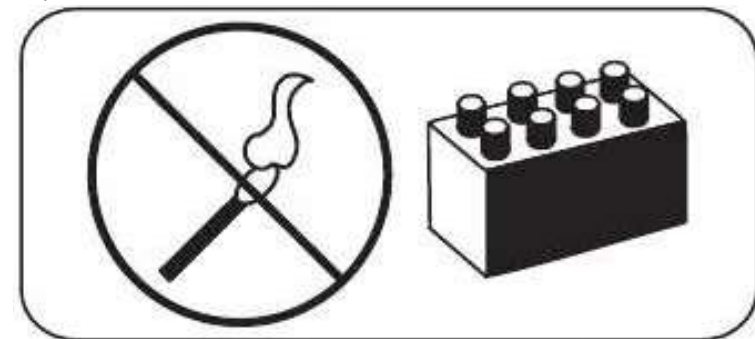
goggles or face shield, rubber gloves (with or without arm shields), and a rubber apron.



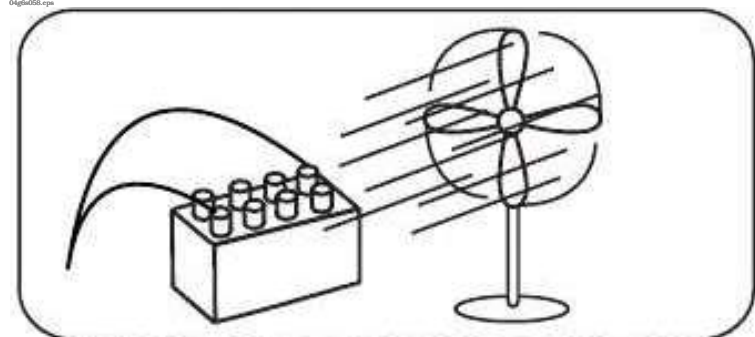
Make sure that a shower and eyewash station are nearby in case of an accident.



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

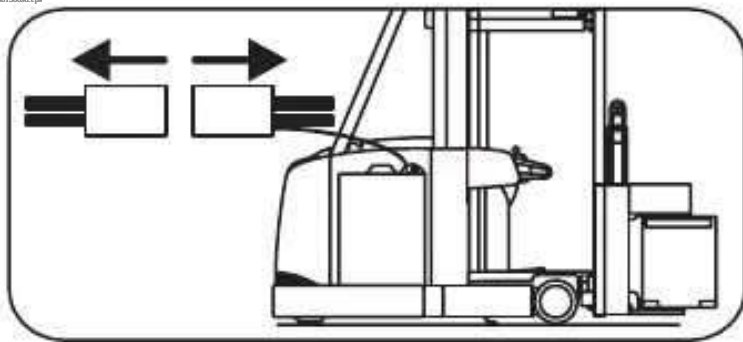


Keep the charging area well-ventilated to avoid hydrogen gas concentration.

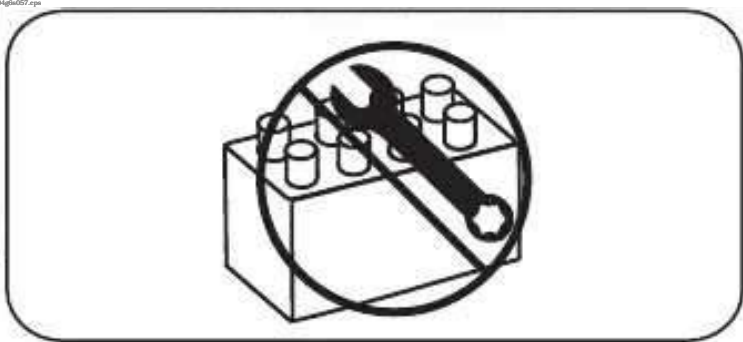


Battery Safety

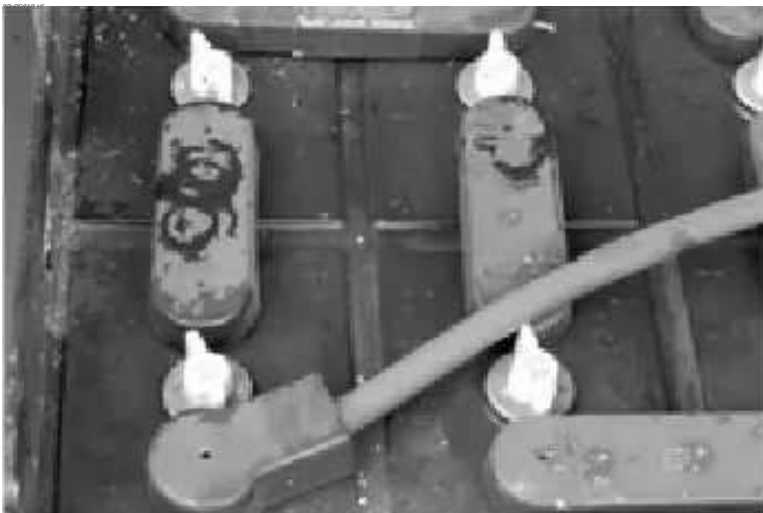
Turn the key switch OFF *before* disconnecting the battery from the lift truck at the battery connector. *Do not* break live circuits at the battery terminals. A spark often occurs at the point where a live circuit is broken.



Do *not* lay tools or metal objects on top of the battery. A short circuit or explosion could result.



Keep batteries clean. Corrosion causes shorts to the frame and the possibility of sparks.



Keep plugs, terminals, cables, and receptacles in good condition to avoid shorts and sparks.



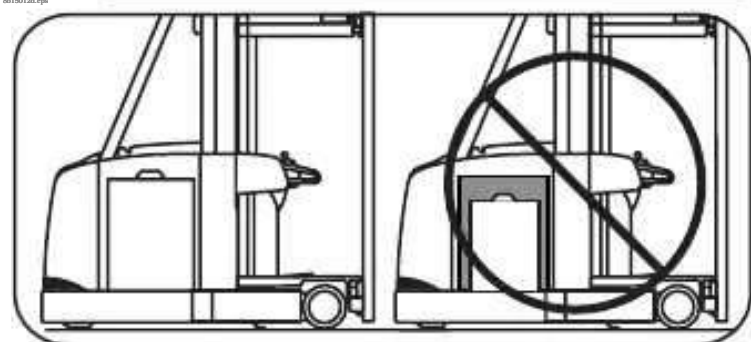
Keep filler plugs firmly in place at all times except when checking the electrolyte level, when adding water to the cells, or when checking the specific gravity.

Make sure the vent holes in the filler plugs are open to permit the gas to escape from the cells.

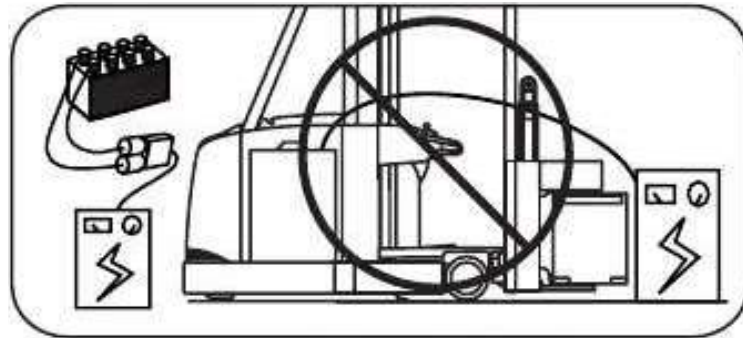


Do *not* permit cleaning solution, dirt, or any foreign matter to enter the cells.

Make sure you install the correct size battery. A smaller or lighter weight battery could seriously affect lift truck stability. See the lift truck's specification plate for more information.



Never plug a battery charger into the lift truck's battery connector. Plug the battery charger only into the battery connector from the battery.



Static Precautions

Static Precautions

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

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

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 dissipate static charges slowly.
- Connect the wrist strap plug to the ground jack on the lift truck. See [Figure 2-1](#) and [Figure 2-2](#). If you cannot use the ground jack, connect the ground clip to an unpainted, grounded surface on the lift truck frame.

Figure 2-1. ESD Ground Jack - Electrical Compartment



Figure 2-2. ESD Ground - Operator Compartment



- 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 anti-static mat.
- To transport static sensitive components, including failed components being returned, place the components in an anti-static 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 2-3](#) shows the components of the Raymond anti-static field service kit, P/N 1-187-059. The kit includes a wrist strap, ground cord, and static-dissipative work surface (mat). Follow the instructions packaged with the kit.

Figure 2-3. Anti-Static Kit with Wrist Strap and Mat



Wrist straps (P/N 1-187-058/001) are available in quantities of 25.

A wrist strap tester (P/N 1-187-060/100) is also available.

Contact your local Raymond dealer for information.

Jacking Safety

Jacking Safety

Some maintenance procedures require the lift truck to be jacked up. To safely jack the truck:

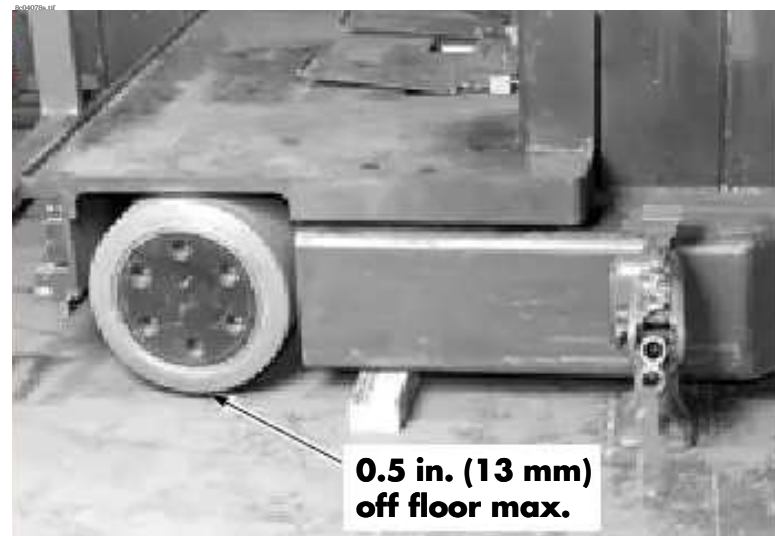
1. Lower the carriage and forks completely to the floor. Remove any load.
2. Place all controls in neutral.
3. Block the wheels to prevent movement of the vehicle.
4. Turn the key switch OFF and disconnect the battery connector.
5. If possible, stabilize the top of the mast with an overhead chain hoist.
6. Place the jack under the designated jacking points. See [Figure 2-4](#) and [Figure 2-5](#).

⚠ WARNING

Use extreme care when the lift truck is jacked up. Never block the lift truck between the carriage and the floor. 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 to support the lift truck.

7. *To jack the baseleg:* Place the jack in the designated jacking position. See [Figure 2-4](#). Jack the lift truck up just high enough to raise the load wheel off the floor, no more than 0.5 in. (13 mm). Place a block under the baseleg as shown.

Figure 2-4. Jacking and Blocking Baseleg



8. *To jack the tractor:* Place the jack in the designated jacking position. Do not jack under the removable bumper. See [Figure 2-5](#). Jack one side of the lift truck so that the drive tire is off the floor no more than 2 in. (50 mm). Block that side of the lift truck in place. Then jack up the other side of the lift truck in the same manner. Block that side in place.

Figure 2-5. Jacking and Blocking Tractor



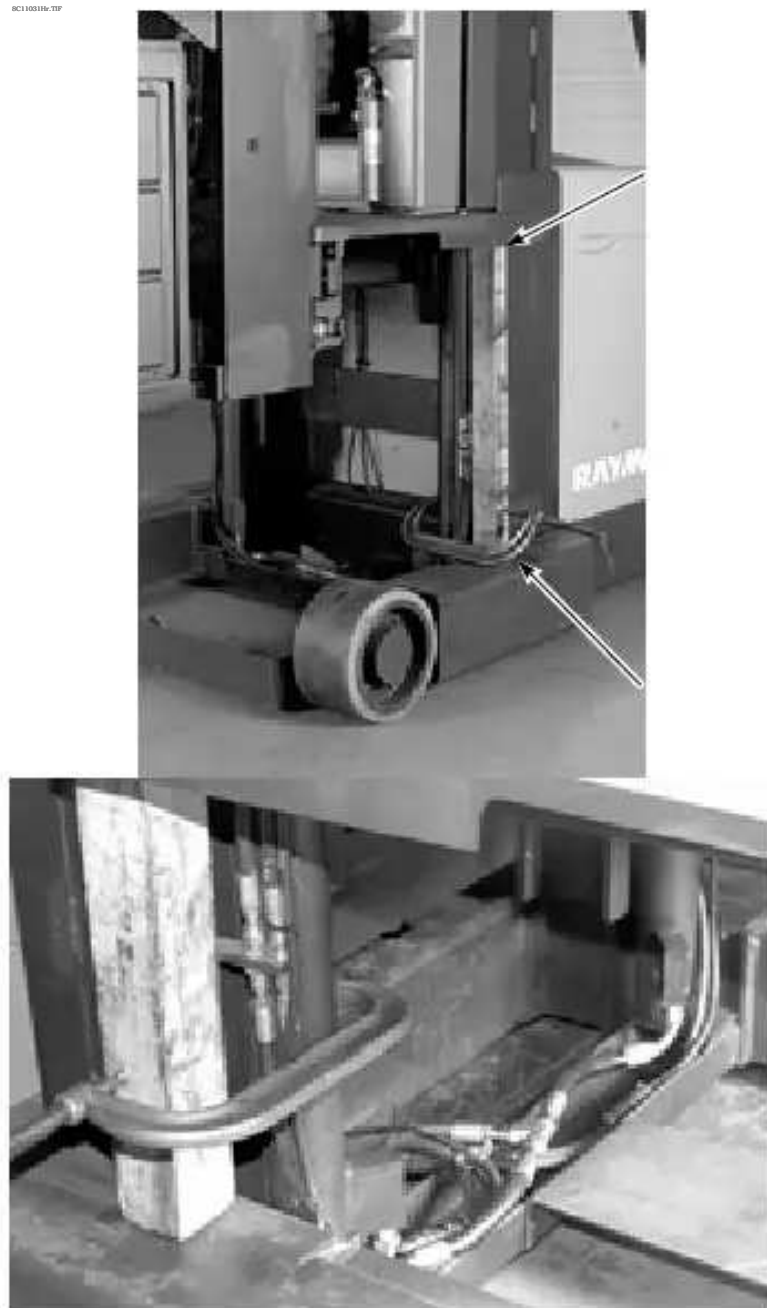
Blocking and Lifting Safety

Blocking the Carriage

⚠ CAUTION

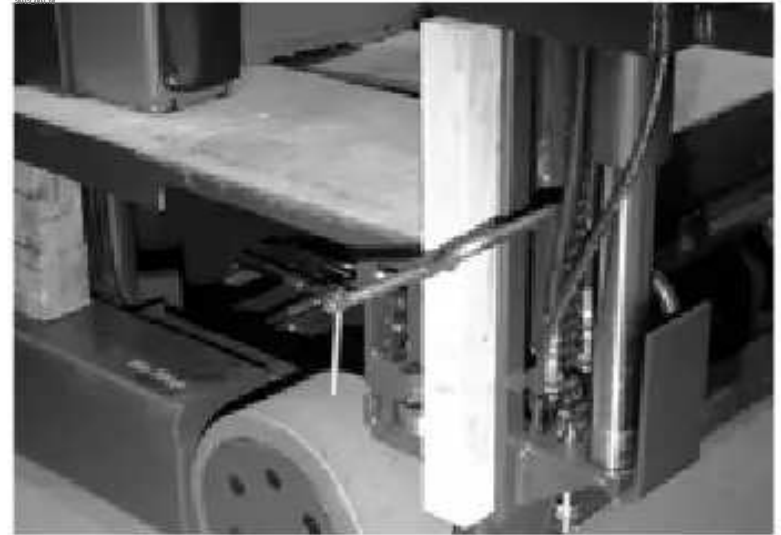
Do not block against the platform floor; use the edge of the platform. Do not block the carriage against the floor.

Figure 2-6. Blocking Carriage



Blocking Load Handler

Figure 2-7. Blocking Load Handler



Lifting Motors

Secure a hoist to the traction motor with 2 straps cross-wrapped as shown in Figure 2-8.

Figure 2-8. Lifting Traction Motor



Welding Safety

Welding Safety

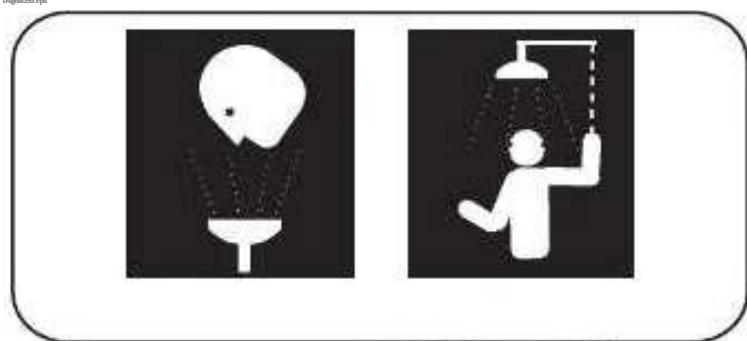
⚠ WARNING

Flame cutting or welding on painted surfaces can produce potentially harmful fumes, smoke, and vapors. Before doing flame cutting or welding, remove the coating from the area where the operation(s) will occur.

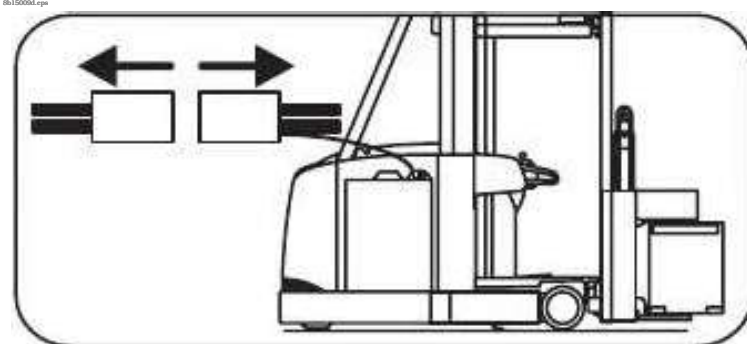
Coating removal can occur by mechanical methods, chemical methods, or a combination of methods. Do flame cutting and/or welding operations only in well-ventilated areas, using local exhaust if necessary.

Before working on this lift truck, make sure:

- Fire protection equipment is nearby.
- You know where the nearest eyewash station is.

**⚠ CAUTION**

Disconnect the battery before you attempt to inspect, service, or repair the lift truck.



- Check for shorts to frame as described on [page 5-3](#). If you detect any shorts, correct them before you weld.
- Clean the area to be welded.
- Protect all lift truck components from heat, weld spatter, and debris.
- Attach the ground cable as close to the weld area as possible.
- Do not weld near electrical components.
- If you must weld near the battery compartment, remove the battery from the lift truck.
- Disconnect all electrical circuit cards before welding. When you are finished welding, reconnect all circuit cards and do ground tests and electrical inspections before operating the lift truck.

Section 3. Systems Overview

Introduction

Introduction

This manual provides information for maintenance and repair of the *Model 9600/9700 Swing-Reach*[®] lift truck by Raymond.

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 dealer.

Lift Truck Specifications

This lift truck is rated for performance by load center, load weight, and load height with forks and/or platform elevated.

Review the specification plate located on the lift truck's left mast upright for detailed load capacity and load center information. See [Figure 3-1](#).

Due to continuous product improvement, specifications are subject to change without notice or obligation.

Figure 3-1. Lift Truck Specification Plate

SPECTAG WMP 412-852, C.EPS

Serial number

Raymond model

Approximate weight of lift truck with battery installed, minus load and operator

Approximate weight of lift truck minus battery, load, and operator

Maximum load capacity for this lift truck

Nominal battery voltage

Nominal battery width

Maximum battery weight for this lift truck

Power rating of battery

Hour rating of battery

Minimum battery weight for this lift truck

Battery weight must be between the minimum and maximum weight

Truck Weight (lb./kg)		Battery Weight (lb./kg)		Battery Max. Rated Capacity (A.H.)	
Without Battery	With Maximum Battery	Minimum	Maximum	Hour Rate	Attachment

CAPACITY				CAPACITY			
MAXIMUM CAPACITY	DIM. A	DIM. C	DIM. D	MAXIMUM CAPACITY	DIM. A	DIM. C	DIM. D
lb.	in.	in.	in.	kg	mm	mm	mm

HORIZONTAL MOTION OF BATTERY MUST NOT EXCEED 0.5 INCHES/12.7MM. ATTACHMENT RESTRAINT TO BATTERY COMPARTMENT AS REQUIRED.

MANUFACTURED TO COMPLY WITH MANDATORY REQUIREMENTS OF ANSI/ITSDF B56.1 PART III EFFECTIVE ON THE DATE OF MANUFACTURE FOR TYPE E INDUSTRIAL TRUCKS WHEN EQUIPPED WITH TYPE EO BATTERY. GIVE MODEL AND SERIAL NUMBER IN ALL CORRESPONDENCE.

412-852

Installation Instructions

Installation Instructions

Inspect the units as received for damage in transit. You should have the following:

- Mast assembly and diagonal support arms on a pair of skids
- Tractor assembly, with 2 battery gates, glass mast guard (if so equipped), side covers, and parts carton on a skid
- Full body harness and tether
- Cable clamps
- Miscellaneous hardware
- Lift Reference Prox switch and bracket

Equipment Required

In addition to normal tools, you should have the following available at the installation site:

- A hoist or crane with a capacity of 5 tons (4540 kg) for a Model 9600 mast, or 10 tons (9000 kg) for a Model 9700 mast. Ceiling clearance must be greater than the lift truck's collapsed height dimension. If erecting a Model 9700 mast by means of two lift trucks and a structural tubing lifting bar, the lift trucks should have a capacity of 8000 lbs. (3632 kg) each.
- A 3000 lb. (1362 kg) capacity lift truck for handling the tractor
- Hoist slings of suitable capacity
- Three lengths of heavy chain of suitable capacity
- Two wooden support blocks 3.5 in. (9 cm) wide by 2 in. (5 cm) high by 12 in. (30 cm) to 20 in. (51 cm) long for placement under baselegs

Assembly Procedure



- **Perform this procedure with a minimum of two technicians. Do not permit observers to stand nearby.**
 - **Do not allow distractions during setup of the lift truck.**
 - **Wear gloves, safety glasses, steel-toed safety boots, and a safety helmet (hard hat).**
 - **Place the mast and tractor skids in an open area where it is safe to work.**
 - **Unassembled lift truck components are heavy, unstable, and difficult to handle. Use extreme caution when lifting and assembling the lift truck. Do not stand the mast up if the mini-mast is not centered side-to-side in the main carriage.**
 - **Do not remove the steel banding securing the main carriage or the mini-mast, nor the wood stringers in the lower traverse rack, until the main mast is upright.**
1. Cut and discard the banding on the tractor. Carefully set aside the tractor side covers, glass mast guard (if so equipped), and parts carton. Remove forks from tractor skid.
 2. Remove diagonal support arms from the mast skid.
 3. Static straps might have been removed prior to shipment or might have been repositioned so as not to protrude below the mast. If they are not already installed, install two static straps at the base of the mast. Position static straps at a 45° angle to the floor.
 4. Cut and discard the banding securing the mast to its skid(s). *Do not remove banding securing the mini-mast or the banding securing the carriage to the mast until the mast is standing upright.*

5. Cut and discard the cable ties securing the over-the-mast hoses and cables. *Do not cut the cable ties securing the hose and cable slap pads to the hoses and cable on the outboard side of the cylinders.* These remain on the lift truck.
6. Use two lift trucks of suitable capacity to lift the mast off the skid(s). Remove and discard skid(s). Carefully lower mast to floor.
7. Model 9600: Attach two 5-ton hoist straps around the main mast and telescopic crossties.

NOTE: Model 9600 alternate method: Position the lifting truck as shown in [Figure 3-2](#) and secure a heavy chain around the fork carriage of the lifting truck and the mast crosstie. Slowly and carefully raise the mast erect. See [Figure 3-3](#). Lift very slowly at the point where the weight of the mast goes forward of the pivot point.

Figure 3-2. 9600 Mast Erection, Alternate Method



Figure 3-3. 9600 Mast Erection Using Lift Truck



8. Model 9700: Attach two 10-ton hoist straps around the second main mast and telescopic crossties. See [Figure 3-4](#).

Figure 3-4. 9700 Mast Strapped to Hoist



CAUTION

On a Model 9700 mast, do not wrap hoist strap around the uppermost crosstie, only the main mast and telescopic crossties.

NOTE: Model 9700 alternate method: Insert a length of suitable structural tubing through the 6 in. (15 cm) hole in the lifting flange. This flange is a part of the Model 9700 mast lower crosstie. See

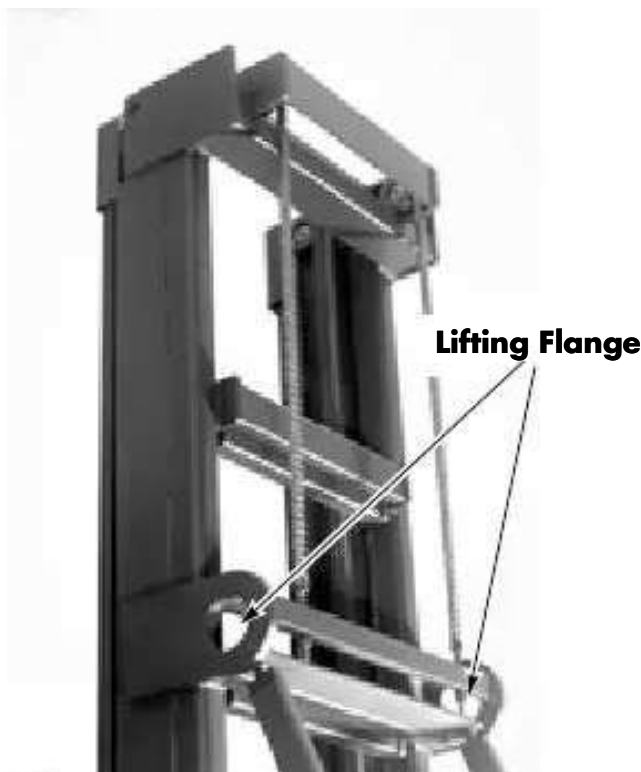
Installation Instructions

Figure 3-5. If you are using two lift trucks to erect the mast, a 160 in. (407 cm) length is recommended for the tubing. See **Table 3-1** for specifications on structural tubing.

Table 3-1. Structural Tubing Specifications

Structural Tubing Type	OD/ Size	Wall Thickness	ASTM
5 in. Round Type ERW	5 in.	0.5 in.	A500 Grade B or C
5 in. Round Schedule 160	5.6 in. nominal	0.62 in. nominal	A53 Type E Grade B
5 in. XXS Round		0.75 in. nominal	A53 Type A Grade A or B
Square	4x4 in.	0.5 in.	A500 Grade B or C

Figure 3-5. 9700 Mast Lifting Flange



Attach and secure 10-ton hoist straps around the structural tubing on both sides of the mast.

If you are lifting the mast with lift trucks instead of a hoist, chain or clamp the

structural tubing to the fork carriage of the lift trucks.

9. Raise the mast and carriage section erect and hold in a level position. Block the back edge of the mast with wooden blocks. See **Figure 3-6**.

Figure 3-6. Mast Blocked



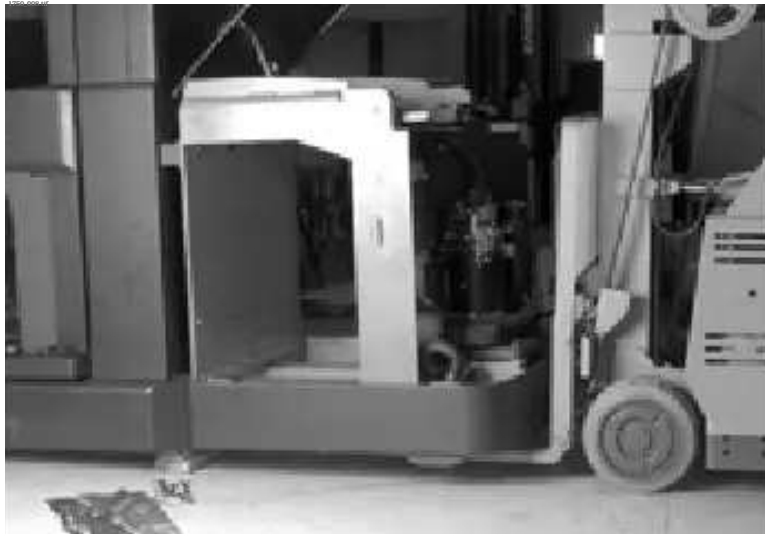
10. Pull hydraulic hoses and wire guidance cable (if so equipped) out the hole near the left side of the base of the mast. Pull over-the-mast cables out the hole in the top of the base of the mast near the right side. Pull Model 9600 work light cable (if so equipped) out the cutout in the back of the mast approx. 4 ft. (1.2 m) from the floor on the right side.

Figure 3-7. Pulling Hydraulic Hoses Through Mast



11. Install Lift Reference Prox switch and bracket.
12. Using a lift truck, position the tractor in alignment with the mast. See [Figure 3-8](#).

Figure 3-8. Mating Tractor to Mast



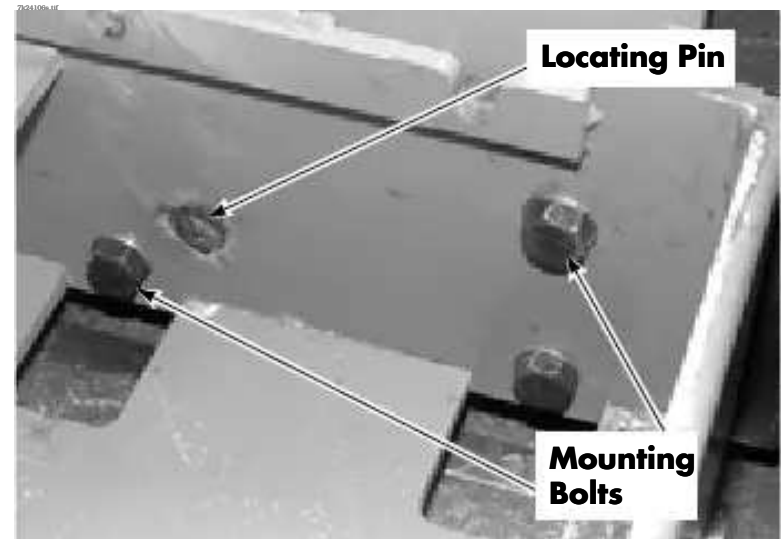
13. Connect the over-the-mast cable connectors to the correct tractor cable connectors at the mast-to-tractor cable connection panel. See [Figure 3-9](#).

Figure 3-9. Mast to Tractor Cable Connections



14. Mate the tractor to the mast, engaging the locating pins in the tractor with the holes in the mast frame.
15. From the battery compartment, thread 4 mounting bolts and washers through the top of the tractor frame into the mast. Thread 7 mounting bolts and washers into the bottom of the tractor frame into the mast. Using a torque wrench, torque to 350 ft. lb. (475 Nm). See [Figure 3-10](#).

Figure 3-10. Mast-Tractor Mounting Bolts, Lower



CAUTION

Diagonal support arms weigh approx. 60 lb. (27 kg)

16. Install the diagonal support arms. Secure clevis pins with snap rings, flat side of the ring to the inside of the tractor. See [Figure 3-11](#).

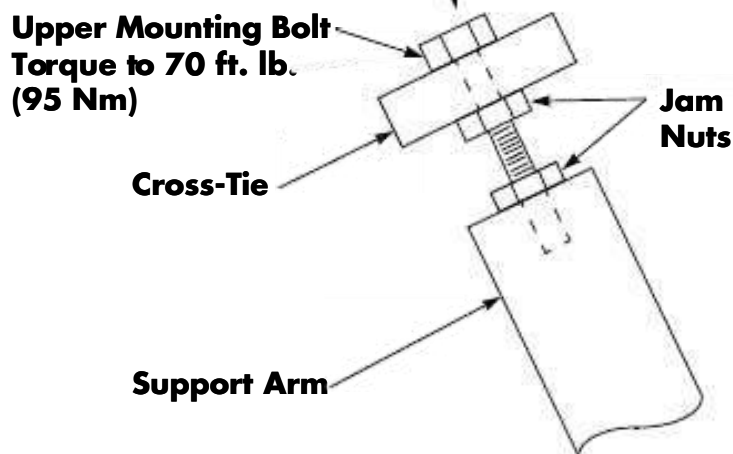
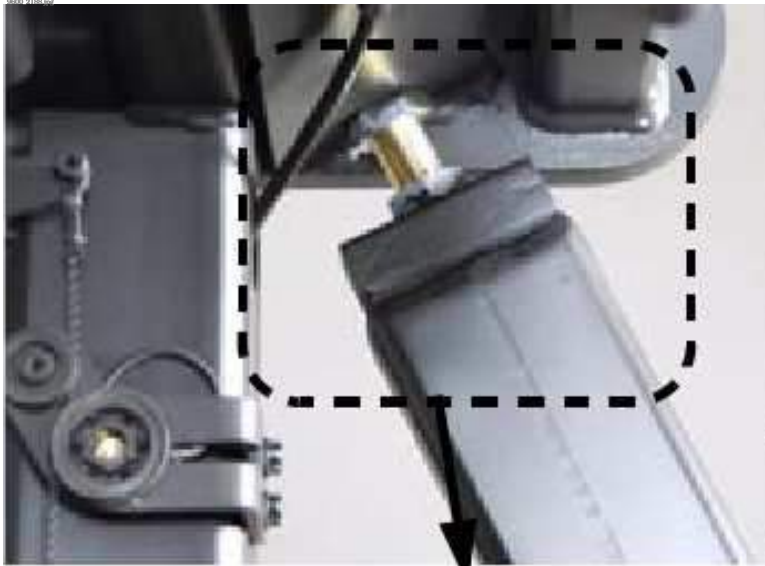
Figure 3-11. Support Arm Installation to Tractor



17. Apply thread-locking compound (P/N 990-571) to upper mounting bolt threads. Thread the upper mounting bolt, tighten, and torque to 70 ft. lb. (95 Nm). Tighten jam nuts against cross-tie and support arm. See [Figure 3-12](#).

Installation Instructions

Figure 3-12. Support Arm Installation to Mast



18. Install the battery spacer, if used.
19. Remove hoist strap.
20. Cut and discard the steel banding securing the carriage to the mast. Remove the bolt securing the mini-mast. Cut and discard the cable ties and wooden stringers that center the mini-mast in the lower traverse rack. Remove the blocking between mini-mast and mini-mast lift cylinder.

CAUTION

Use correct electrostatic discharge precautions. See "Static Precautions" on page 2-8.

21. Feed the electrical cables, and cables for the travel light (if so equipped), end-of-aisle sensor (if so equipped), and wire guidance sensor (if so equipped) from the mast through the tractor opening and connect to the Tractor Manager and Wire

Guidance Filter Card at JW1 (if so equipped). Connect standard cables to interconnection points.

22. Connect the hydraulic hoses at the bottom of the battery compartment. Make sure the O-ring is in place on the male fitting. See

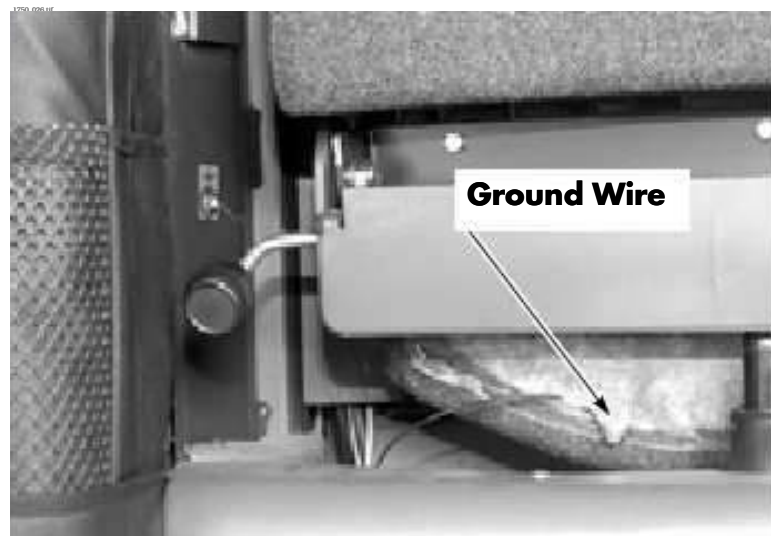
Figure 3-13.

Figure 3-13. Hydraulic Hose Connection



23. If they are not already in place, install battery rollers. Install a fully charged battery, using a suitable battery installation device. Install battery gates.
24. Make sure the ground wire to the bottom of the seat is installed. See **Figure 3-14.**

Figure 3-14. Operator Seat Ground Wire



25. Install the glass mast guard, if so equipped. Make sure brackets are installed with mounting screws on the tractor side of the glass, so that the glass lines up with the back of the operator compartment, without any "ledge" or "jog."

This is important for the mounting of the Supplemental Operator Display.

26. Install the Supplemental Operator Display on the glass or mesh mast guard.
27. Remove plastic wrapping from control handles and arms.
28. Bleed the hydraulic system. See [“Bleeding the Hydraulic System”](#) on page 7-74.
29. Grease steering ring gear.
30. Grease the traverse racks and areas on the top and bottom of the carriage where the sliders ride.
31. Install the forks.
32. Install covers.
33. Run Wire Guidance Learn. Refer to page 3-34.
34. Perform [Test O62 – Lower Sol \[Lower Solenoid \(SOL1\)\]](#) (page 6-153).
35. Install optional equipment such as lights, fan, and so on. If so equipped, set Lift Limit with Bypass heights per customer requirements. See [“Configuration and Truck Setup Options”](#) on page 3-12.

FlashWare

FlashWare

Overview

FlashWare is used on many different model trucks with different “Manager” configurations. The 9600/9700 uses the same “Vehicle Manager” for the Tractor and Carriage Manager. Unique software is loaded into the device and a harness/jumper configuration is used to identify the component. Refer to [“Schematics” on page A-19](#).

FlashWare allows you to update software, view, and configure options on the lift truck through the following features:

- Update Vehicle (Tractor) Manager Software
- Clear Primary Memory (truck identification data from CM)
- Reset Factory Default Settings
- BSOC Calibration
- Clear Managers (Tractor and Carriage)
- View/Update Carriage Manager Software
- View/Install/Update Power Amp Software
- Update Carriage Manager Software
- Install Cleared (New) Manager

For more detailed FlashWare information, click on Help and select **Help Topics** from the menu bar.

FlashWare can be installed on any IBM-compatible PC. The PC communicates with the truck software via a serial (9 pin) or USB port.

Installing FlashWare on PC

If you are a customer service technician, obtain FlashWare from your Raymond dealer.

If you are a Raymond dealer technician, obtain FlashWare from the iNet software download site.

To install FlashWare on the PC, double-click the installation file and follow the instructions on

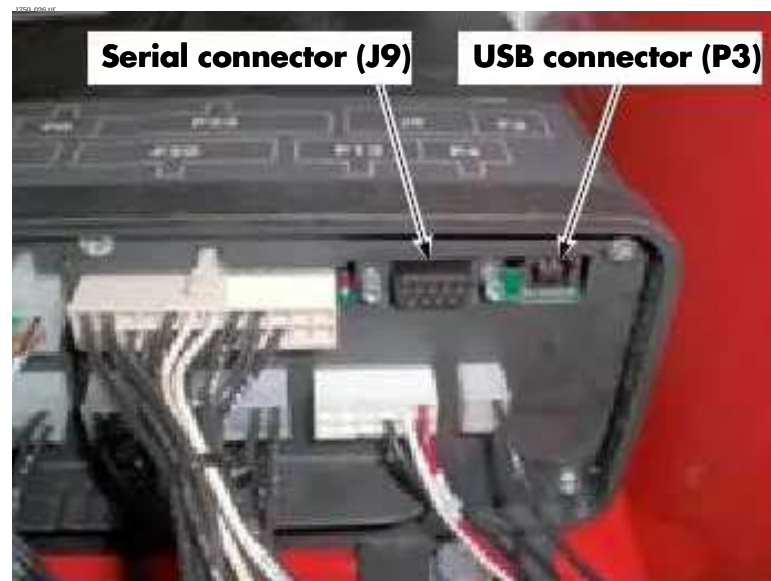
the screen. The software package is a self-extracting executable file. Read the “Readme” file in the software package for the latest detailed installation instructions.

Connecting PC to Truck

There are two methods available to connect the PC to a manager:

- **USB to USB** - this method requires the correct drivers to be installed on the PC. Typically, this type of connection is much faster than a serial connection. With the key switch OFF, connect cable P/N 610-809/210 to a USB port on the PC and the P3 connector on the manager. See [Figure 3-15](#).
- **Serial to Serial** - this method requires a surge protector (P/N 154-010-801) to be connected in series with the cable to protect the PC. With the key switch OFF, connect a standard 9-pin serial cable to a serial port on the PC and the J9 connector on the manager. See [Figure 3-15](#).

Figure 3-15. Truck FlashWare Connections



Manager Connection

The Tractor Manager is the primary FlashWare connection point. However, when it is necessary to communicate with or clear a Carriage Manager, the PC must be connected directly to the Carriage Manager.

Tractor Manager

Connect FlashWare to the Tractor Manager to:

- enable/disable options
- update TM, CM, LPA, and TPA software
- clear manager
- reset factory defaults
- install TM software into a blank manager

Carriage Manager

Connect FlashWare directly to the Carriage Manager to:

- install CM software into a blank manager
- clear CM

Starting FlashWare

1. With the key switch ON, double-click the FlashWare icon on the main desktop screen or navigate via Start > Programs > FlashWare. The truck opening screen appears. See [Figure 3-16](#).

Figure 3-16. Truck Opening Screen



NOTE: When entering or using FlashWare, it is normal for Code 57 to display.

2. From the menu bar, click “Communications”, then select the applicable connection type:
 - COMx (9-pin Serial)
 - COMx (USB)

NOTE: “x” numbers will vary depending on the computer configuration.

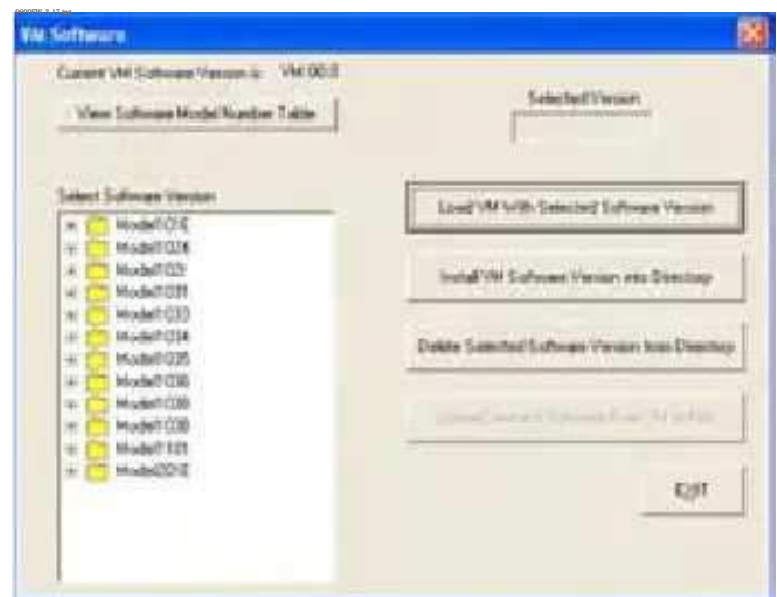
3. From the menu bar, click “Connect to Truck”, then select “All Other Trucks”. The Truck Setup screen is displayed.
 - If the PC is connected to a correctly functioning Tractor Manager, the Truck Setup screen is displayed.

Figure 3-17. Truck Setup Screen



- If the PC is connected to a correctly functioning Carriage Manager or a blank manager, the VM Software screen is displayed. See [Figure 3-18](#).

Figure 3-18. VM Software Screen



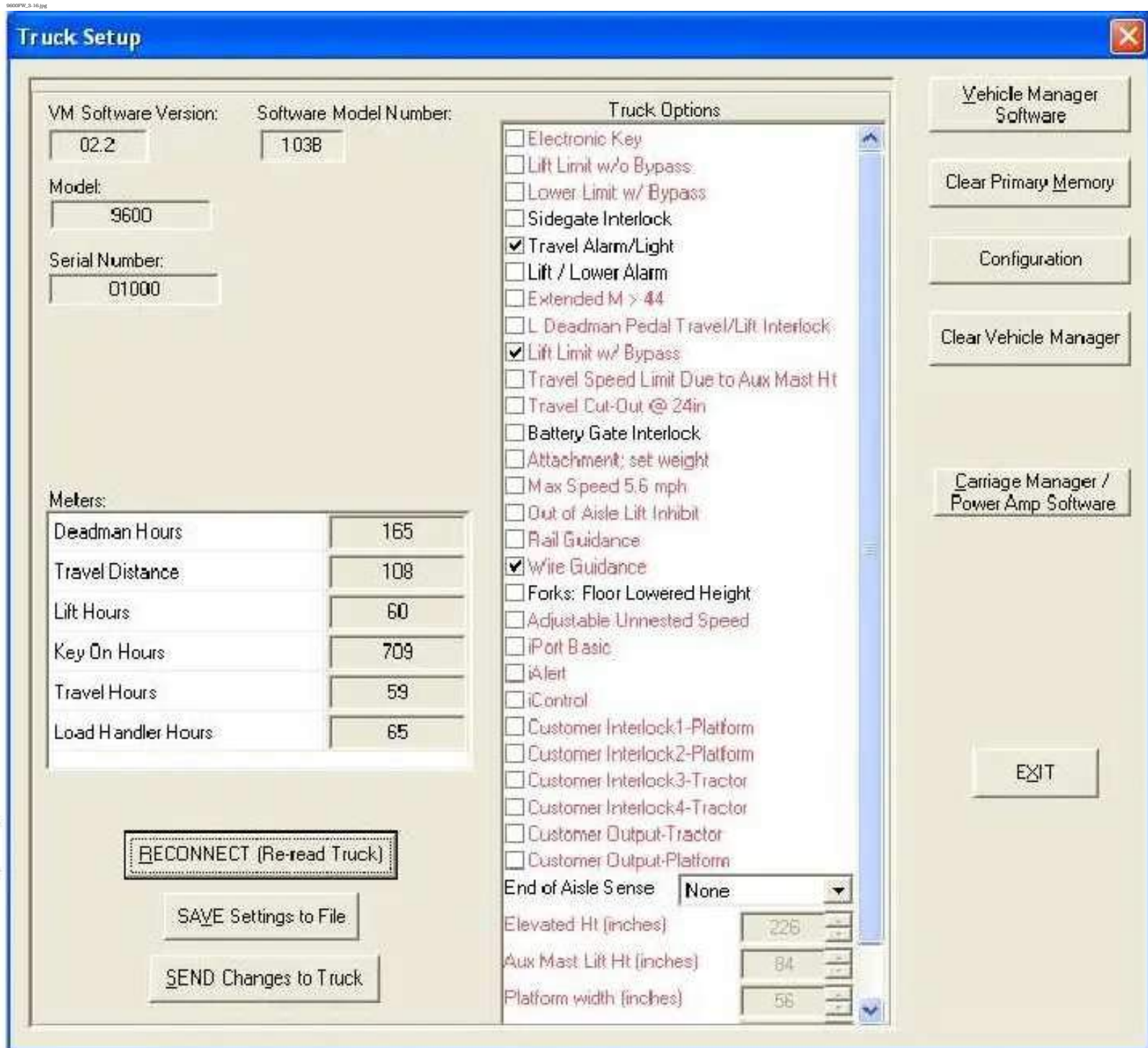
FlashWare

Configuration and Truck Setup Options

The Truck Setup Screen allows you to:

- enable options that were added to the truck since shipment from the factory
- check the serial number, model number, software model number, Elevated Ht, Vehicle Manager version, and hour meters of the truck. See [Figure 3-19](#).

Figure 3-19. Truck Setup Screen



To Change an Option Setting:

The list box near the middle of the window shows the Truck Options.

Select the required check box. To disable an option, deselect the check box. See [Figure 3-19](#). 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):

NOTE: Unless otherwise specified, all options require an authorization code.

Electronic Key - requires the operator to enter a code before operation is allowed.

Lift Limit w/o Bypass - limits lift height without a bypass switch.

Lower Limit w/Bypass - limits lower height and is equipped with a bypass switch.

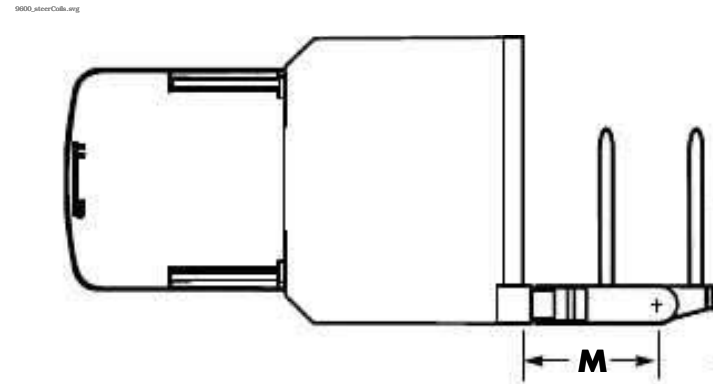
Sidegate Interlock - requires both sidegates to be lowered to allow travel and lift/lower functions. *Authorization Code not required.*

Travel Alarm/Light - allows the alarm or light to function when the lift truck is moving as configured. *Authorization Code not required.*

Lift/Lower Alarm - allows the alarm to function when the lift truck is lifting/lowering as configured. *Authorization Code not required.*

Extended M >44 - Refer to [Figure 3-20](#). Used when dimension “M” exceeds 44 in. (112 cm).

Figure 3-20. Extended M Dimension



L Deadman Pedal Travel/Lift Interlock - used when the customer wants to have both deadman pedals depressed prior to allowing travel or lift/lower.

Lift Limit w/Bypass - limits lift at up to 4 programmable lift heights and is equipped with a bypass switch.

Travel Speed Limited due to Aux Mast Ht. - used to interrupt travel when the mini-mast is raised above the programmed height.

Travel Cut-Out @24 in. - used to interrupt travel when the vehicle's elevated height is above 24 in. (51 cm).

Battery Gate Interlock - used to interrupt travel until the battery gate is correctly installed. *Authorization Code not required.*

Attachment, set weight - used when an optional attachment has been installed.

Max Speed 5.6 mph - used to limit maximum travel speed to 5.6 mph (9.0 km/h).

Out-of-Aisle Lift Inhibit - used to interrupt main lift and limit travel speed when the truck is not located in a rail or wire guided aisle.

Rail Guidance - allows the rail guidance function to operate when the vehicle is correctly equipped.

Wire Guidance - allows the wire guidance function to operate when the vehicle is correctly equipped.

FlashWare

Forks: Floor Lowered Height - used when truck has a floor lowered height to adjust the height display correctly. *Authorization Code not required.*

Adjustable Unnested Speed - used to select what speed (0, 0.5, or 1 mph (0, 0.8, or 1.6 km/h)) is allowed when the load handler is not nested.

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.

Customer Interlock 1-Platform - used for optional inputs (see [Table 3-2](#)).

Customer Interlock 2-Platform - used for optional inputs (see [Table 3-2](#)).

Customer Interlock 3-Tractor - used for optional inputs (see [Table 3-2](#)).

Customer Interlock 4-Tractor - used for optional inputs (see [Table 3-2](#)).

Customer Output-Tractor - used for optional customer outputs (see [“Configuration” on page 3-15](#)).

Customer Output-Platform - used for optional customer outputs (see [“Configuration” on page 3-15](#)).

End of Aisle Sense - used to select the type of magnet system that has been installed into the floor for the End-of-Aisle system. *Authorization Code not required.*

Elevated Height (inches) - used to set the forks maximum elevated height.

Aux Mast Lift Ht (inches) - used to set the height of the Aux (mini) mast.

Platform Width (inches) - used to set the platform width.

Attachment Weight (lbs) - used to set the attachment weight after the *Attachment, set weight* option has been enabled.

Vehicle (Tractor) Manager Software

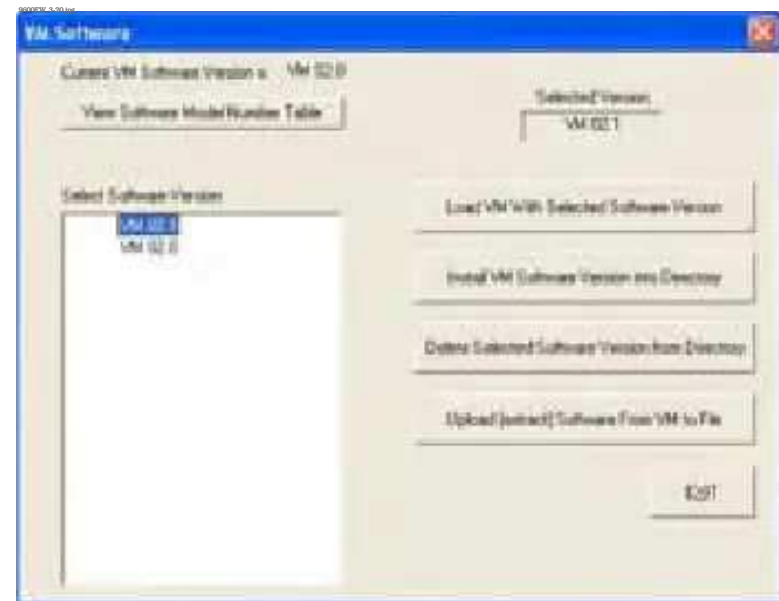
Tractor Manager software management can be performed in the VM Software dialog box:

- Identify the current version of software installed in the truck
- Update the current version of software with a newer version
- Upload the currently installed version of software

NOTE: If installing a new or cleared manager, refer to [“Install Cleared \(New\) Manager” on page 3-19](#).

1. Click the **Vehicle Manager Software** button on Truck Setup Screen.
2. Select the software version to load. See [Figure 3-21](#).

Figure 3-21. VM Software Dialog Box



3. Click the **Load VM With Selected Software Version** button. The new software is then installed in the truck.
4. To display software versions in the truck, see [“Version” under “Program Mode” on page 3-22](#).
5. Load updates to FlashWare and install software to the truck as needed to make sure a matching set of TM/CM software is installed.

NOTE: Check the software model number table in FlashWare Help for the current matching set.

- When the installation is complete, click **EXIT** to return to the Truck Setup screen.

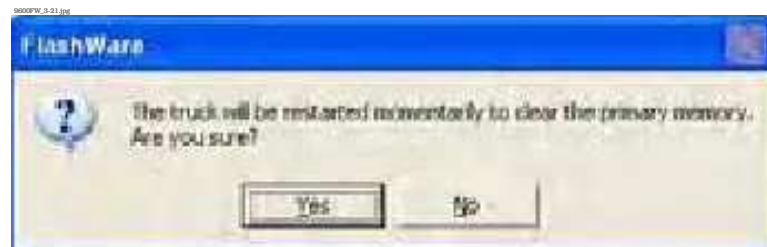
Clear Primary Memory

On this truck, the Clear Primary Memory feature removes truck specific information from the Carriage Manager.

NOTE: The Carriage Manager can be replaced without losing truck identity. A copy of the truck identity is stored in both the Tractor Manager and Traction Power Amplifier. If two of the three memory storage locations agree, the truck assumes that identity. If all three memory locations disagree, a code AV is displayed and a programmed Carriage Manager and Tractor Manager must be installed.

- Click the **Clear Primary Memory** on the Truck Setup screen.
- After selecting this feature, the Clear Primary Memory dialog box appears. See [Figure 3-22](#).

Figure 3-22. Clear Primary Memory Dialog Box



- If **No** is selected, the action is cancelled. If **Yes** is selected, a new dialog box appears. See [Figure 3-23](#). Click OK.

Figure 3-23. Remove Cleared Memory Dialog Box



CAUTION

Do not cycle the key switch, or the primary memory will be restored to the current truck configuration.

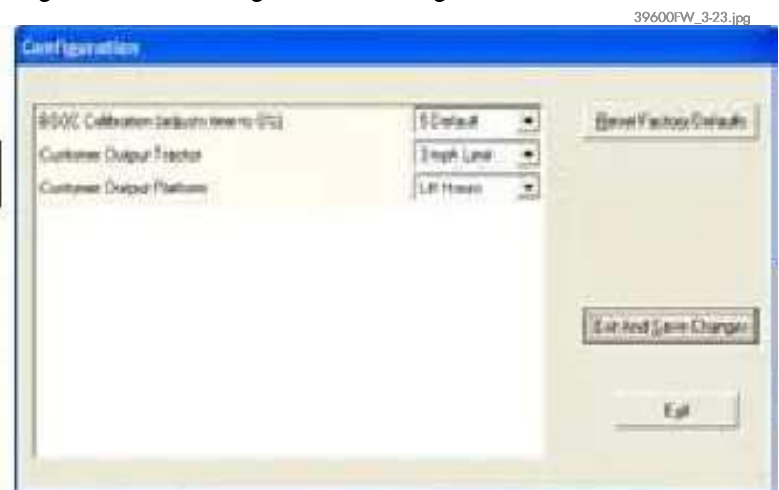
- Remove the Carriage Manager.

Configuration

Truck configuration can be reviewed in the Configuration window.

Click **Configuration** on the main Truck Setup screen. See [Figure 3-19](#). The Configuration dialog box appears. See [Figure 3-24](#).

Figure 3-24. Configuration Dialog Box

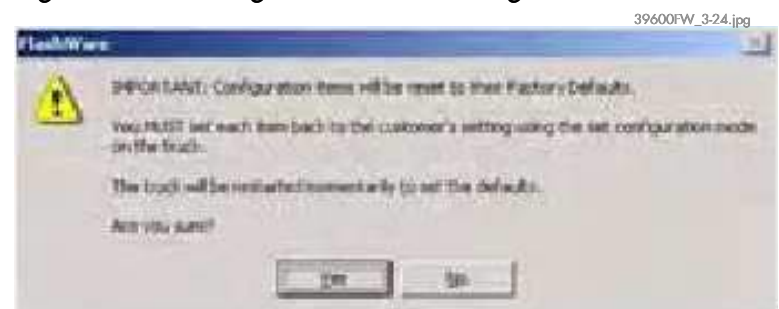


Reset Factory Defaults

Use this feature to reset vehicle configuration, including Superword and Password.

NOTE: Record customer-specific configurations; e.g. speed, acceleration, lift, and coast from the Truck Config screens *before* resetting defaults.

Figure 3-25. Configuration Reset Dialog Box



FlashWare

BSOC Calibration

5 is the factory default and specifies the average voltage that is considered as 0% BSOC.

Making this number smaller (down to 1) lowers the average voltage considered as 0% BSOC, resulting in increasing the time to reach 0% BSOC, by using more battery capacity.

Making this number higher (up to 9) increases the average voltage considered as 0% BSOC, resulting in decreasing the time to reach 0% BSOC, by using less battery capacity.

CAUTION

If BSOC is lowered such that the battery is depleted to below Specific Gravity 1.120, the battery can be permanently damaged.

Customer Outputs - Tractor and Platform

This option controls the 48V output available at the Tractor and Platform Customer Output connectors (PCO1 and 2). Functionality is enabled by selecting one of the following Customer options.

- *None*
- *3 mph Limit* - activates an external device when travel speed is <3 mph in the tractor-first direction and at 0 mph. This setting is designed to activate an optional camera.
- *Lift Hours* - can be used to capture lift hours when using a wired third party warehouse management system. This setting records lift/lower hours.
- *Wire Guidance Status* - can be used to record when the system is in the auto or manual guidance mode.

Clear Vehicle Manager (Tractor Manager)

The Clear Vehicle Manager feature provides the ability to purge existing memory and software from the manager so that it may be used in a different model truck.

1. Click the **Clear Vehicle Manager** button on the right side of the Truck Setup screen. See [Figure 3-19](#).
2. The Erase Vehicle Manager Software dialog box is displayed. See [Figure 3-26](#).

Figure 3-26. Erase Vehicle Manager Software Dialog Box



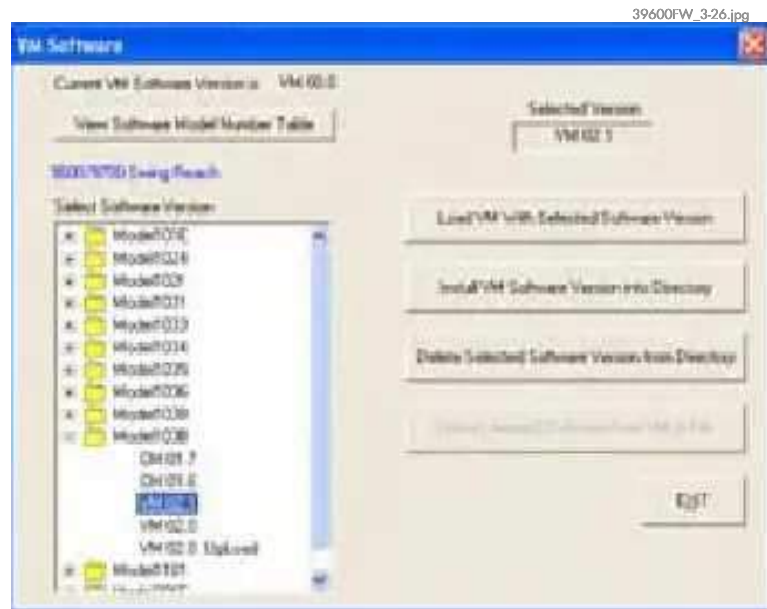
3. Click **ERASE**. Memory is cleared and the manager can now be programmed as a Tractor Manager or a Carriage Manager.

Clear Carriage Manager

NOTE: To clear a Carriage Manager, it must first be programmed as a Tractor Manager.

1. Connect directly to the Carriage Manager and start FlashWare. See [“Starting FlashWare” on page 3-11](#).
2. At the VM Software screen, click to open the Model103B folder and select VM software to be loaded. See [Figure 3-27](#).

Figure 3-27. VM Software Screen - Folder Selection



This feature is used to view/update Carriage Manager software and view/install/update Power Amplifier software.

NOTE: If installing a new or cleared manager, refer to “Install Cleared (New) Manager” on page 3-19.

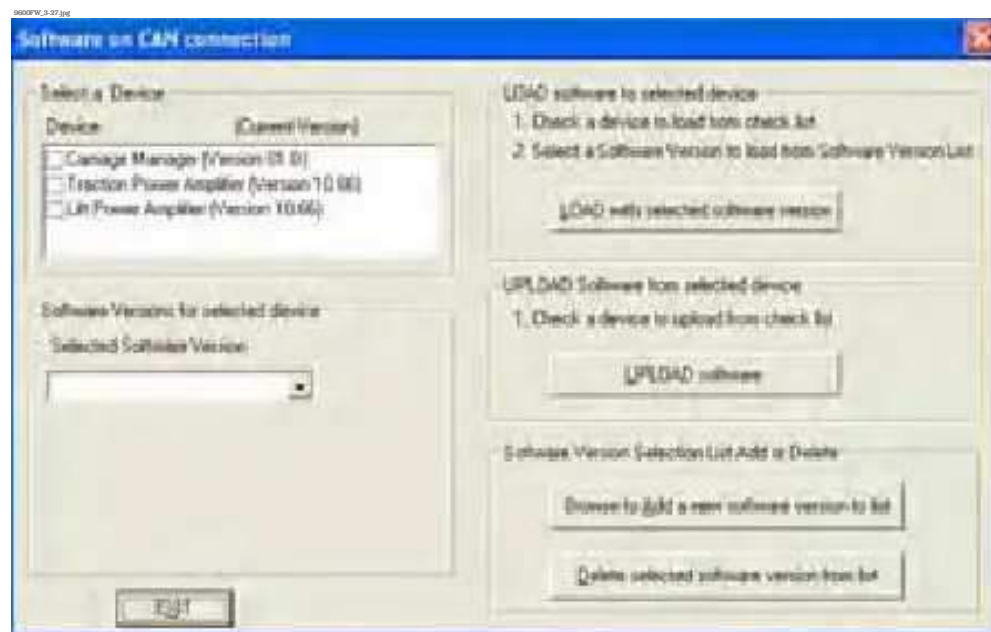
1. Click **Carriage Manager/Power Amp Software** button in the main Truck Setup screen.
2. When the Carriage Manager/Power Amp Screen appears, follow prompts on the screen to Load/Upload software. See [Figure 3-28](#).

3. Click the **Load VM With Selected Software Version** button. When load is complete, the Truck Setup screen is displayed.
4. From the Truck Setup screen, select **Clear Vehicle Manager** and follow the prompts.

Carriage Manager/Power Amp Software

NOTE: Refer to the Software Release Reference Guide posted on iNet for current software version information.

Figure 3-28. Software on CAN connection Screen

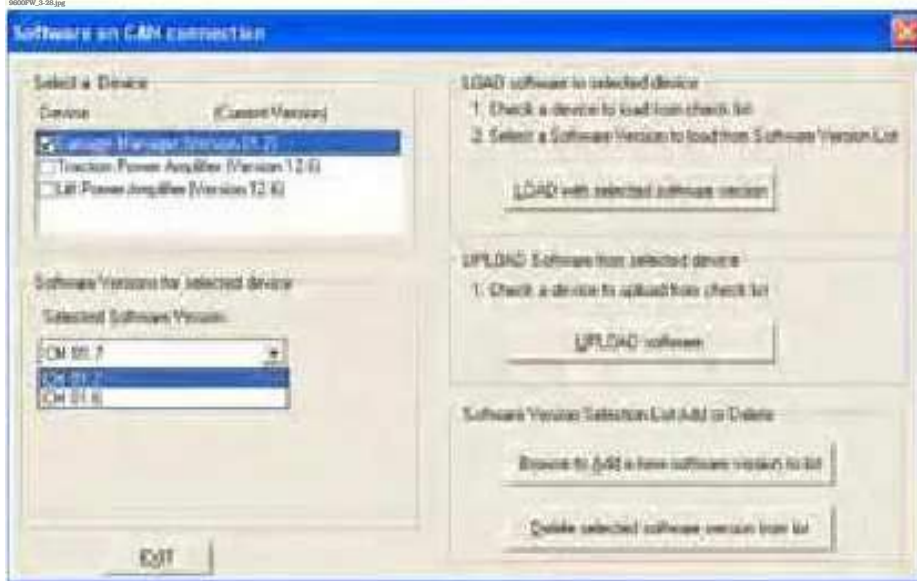


FlashWare

Programming the Carriage Manager

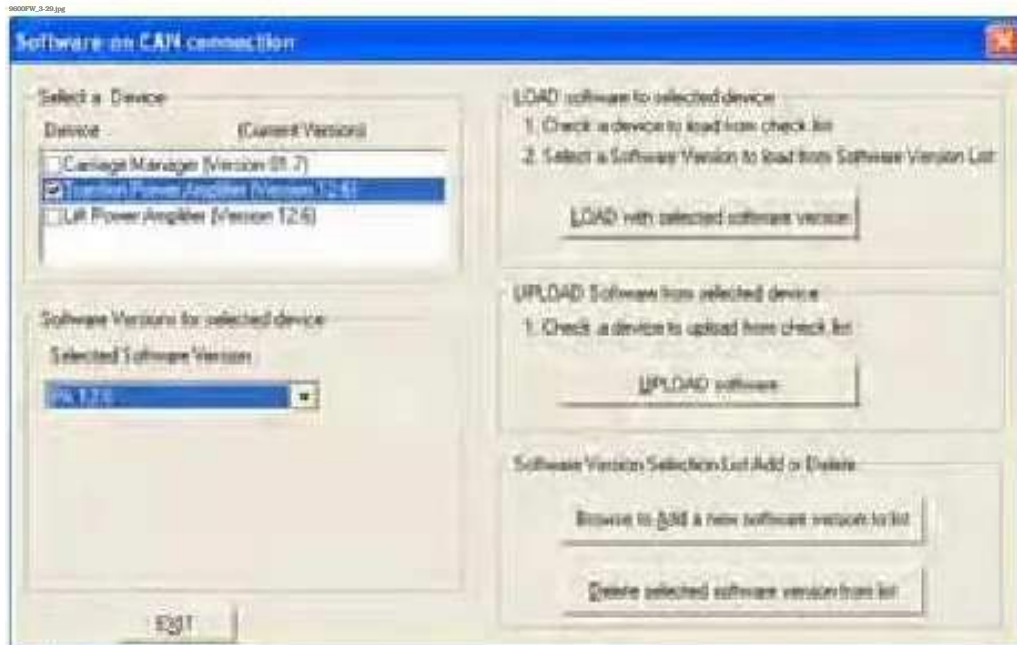
Select Carriage Manager in the device window, then select desired software version in the software window. Click **LOAD with selected software version**. See Figure 3-29.

Figure 3-29. Carriage Manager Software Selection

**Programming the Traction Power Amplifier**

Select Traction Power Amplifier in the device window, then select desired software version in the software window. Click **LOAD with selected software version**. See Figure 3-29.

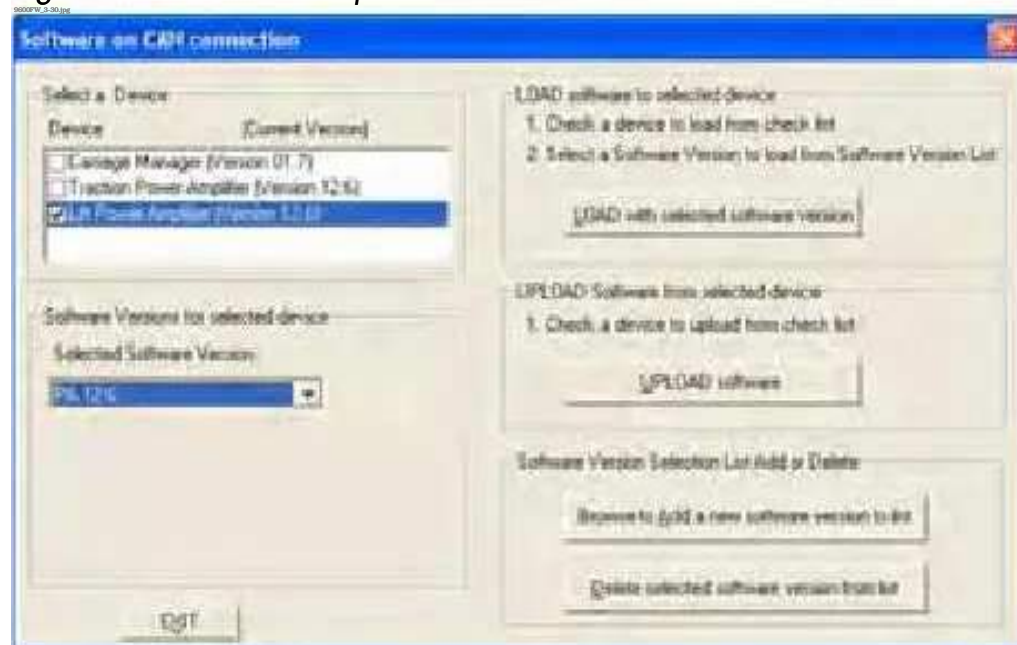
Figure 3-30. Traction Power Amplifier Software Selection



Programming the Lift Power Amplifier

Select **Lift Power Amplifier** in the device window, then select desired software version in the software window. Click **LOAD with selected software version**. See [Figure 3-29](#).

Figure 3-31. Lift Power Amplifier Software Selection



RECONNECT (Re-read Truck)

This feature is used to re-establish communication with the vehicle.

SAVE Settings to File

This feature is used to store the vehicle's current configuration for future reference.

SEND Changes to Truck

This feature is used to transmit desired option and height-related changes to the vehicle.

Install Cleared (New) Manager

This feature is used to load Tractor Manager or Carriage Manager software in a cleared (new) manager.

1. Connect directly to the manager being installed and start FlashWare. See ["Starting FlashWare"](#) on page 3-11.

NOTE: If FlashWare cannot communicate with the manager, verify B+ and B- to the manager. Verify FlashWare program and cables are functioning properly by testing on another manager. If you are still unable to communicate with the manager, replace it.

2. At the VM Software screen, click to open the Model103B folder and select the correct software to be loaded.
3. Click the **Load VM With Selected Software Version** button. When load is complete, the Truck Setup screen is displayed.
4. Exit FlashWare. Cycle key switch and run Learn. See ["Learn"](#) on page 3-23.

Operator Displays

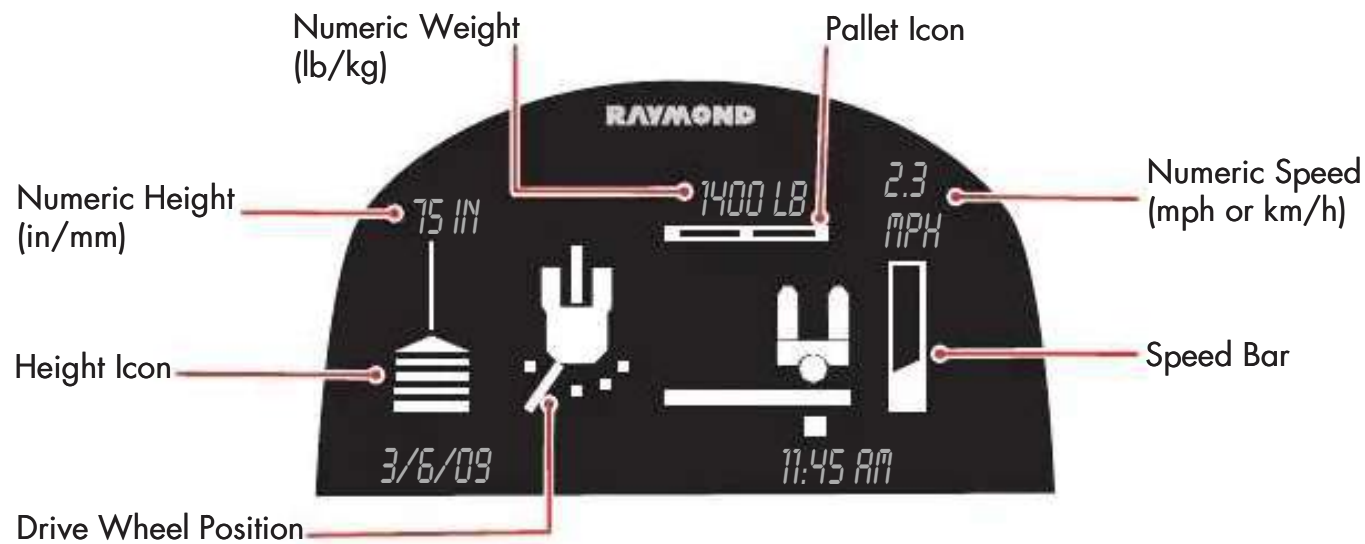
Operator Displays

The lift truck has two Operator Displays. The Primary Operator Display is in the right control arm, as viewed by the operator when seated.

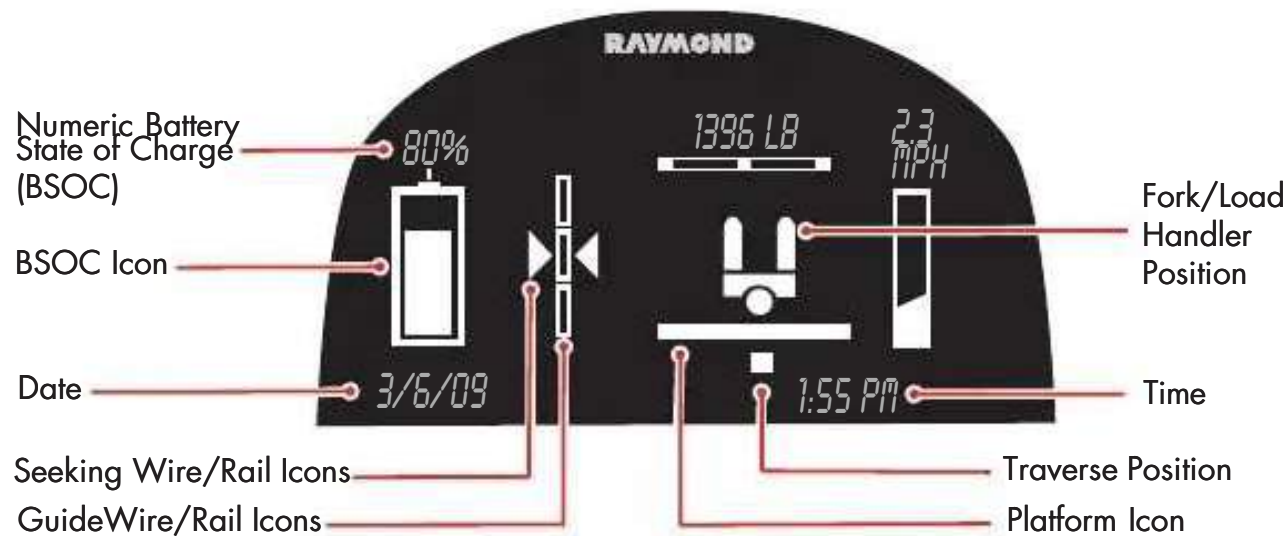
See [Figure 3-32](#). The Supplemental Display is located on the left side of the mast guard, as viewed by the operator when facing the tractor to drive standing up. See [Figure 3-33](#).

Operator Display

Figure 3-32. Operator Display



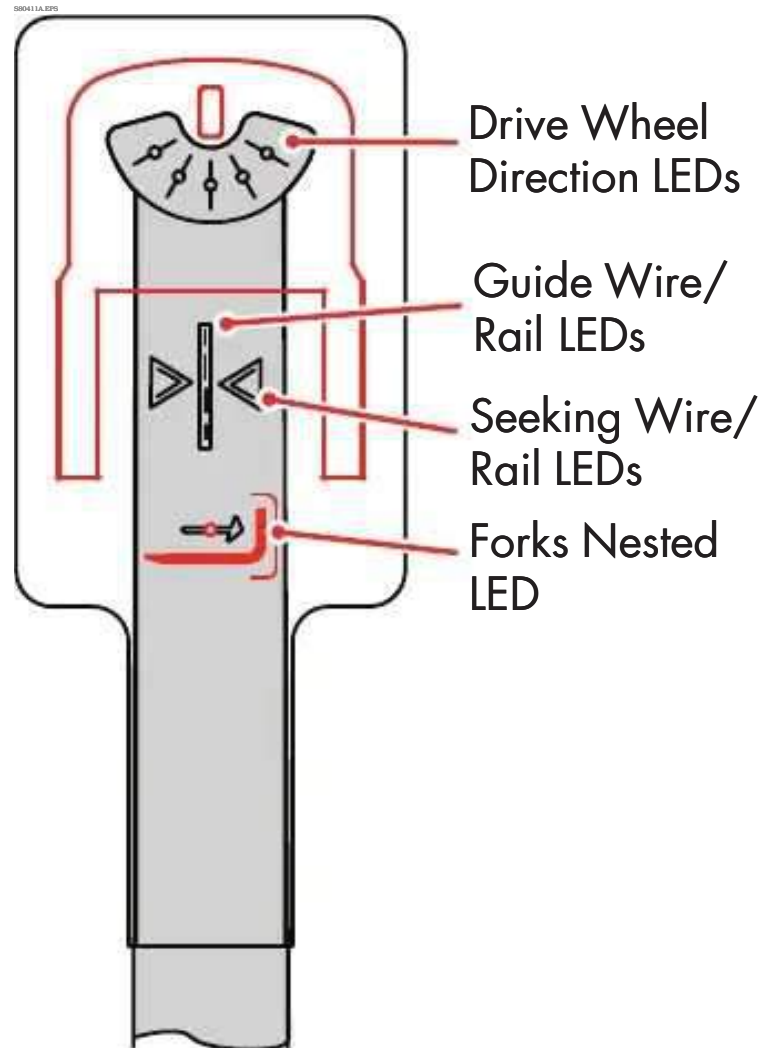
Primary Display
Truck Lifting and Manual Steering Selected



Primary Display
Truck Traveling and with Automatic Steering
(Wire Guided Mode) Selected

Supplemental Display

Figure 3-33. Supplemental Display



Modes of Operation

Modes of Operation

Overview of Modes

This lift truck has several modes of operation.

The main distinction is between Run Mode and Program Mode. Run Mode is the normal working mode for the lift truck. Program Mode permits configuration, calibration, and diagnostic testing.

Run Mode

When you power the lift truck on normally, the on-board firmware performs a number of internal self-tests and enters the default mode of operation, Run Mode. Run Mode is the normal working mode. In Run Mode, the Operator Display shows the default display.

Program Mode

Use Program Mode for configuration, calibration, and diagnostic testing on the lift truck. You need a password in order to enter Program Mode. See [“Passwords” on page 3-24](#).

Program Mode is divided into six categories:

- Serial #
- Version
- Hr Mtrs
- Config
- Learn *(Superword required)*
- Maint *(Superword required)*

When Program Mode is exited, the electronic key prompt is displayed (if enabled) or the truck performs Selftest and enters Run Mode.

Serial

The serial number displayed must match the serial number on the tractor and mast specification plates. This field cannot be changed from Program Mode.

Version

The version of software resident in the following devices is displayed:

- CM - Carriage Manager software
- CMB - Carriage Manager Boot Block***
- TM - Tractor Manager software
- TMB - Tractor Manager Boot Block***
- GM - Guidance Manager*
- PAT - Traction Power Amp software
- PATB - Traction Power Amp Boot Block***
- PATVCL - Traction Power Amp VCL**
- PAL - Lift Power Amp software
- PALB - Lift Power Amp Boot Block***
- PALVCL - Lift Power Amp VCL**

*Guidance Manager change requires firmware chip to be replaced to change version.

**VCL = Vehicle Control Language. This is Raymond specific software for the amp.

***Boot Block software cannot be changed in the field.

NOTE: When using FlashWare, the amp VCL file and software are located in the same file.

Hour Meters and Distance Indicator

The Operator Display shows the following accumulated totals:

- **KH:** Total hours the key switch has been turned ON
- **HD:** Total hours on deadman
- **HL:** Total hours spent lifting and lowering
- **TM:** Total distance traveled (miles or kilometers, depending on Units specified in Config)
- **HT:** Total hours spent traveling
- **HA:** Total hours on Load Handler

Config

Use Configure Mode to adjust various lift truck performance parameters to specific customer requirements. To enter Configure Mode, you must enter the Password or Superword.

NOTE: Some items in Configure Mode appear only if Superword is entered and/or the option has been enabled.

For detailed description, see [“Using Configure Mode” on page 3-26.](#)

Learn

Use Learn Mode to calibrate the lift truck for correct operation. You can select the following sub-categories for calibration:

- Controls (travel, traverse, lift/lower, rotate)
- Load Handler (Ld Hndlr)
- Weight
- Guidance

To enter Learn Mode, you must enter the Superword.

For detailed description, see [“Using Learn Mode” on page 3-33.](#)

Maint

Maintenance Mode allows service technicians to check/test individual circuits within the system. Maintenance Mode is accessed through Program Mode after the Superword is entered. Refer to [“Using Maintenance Mode” on page 3-37](#) to access Maintenance Mode.

NOTE: If the input/test does not appear in the Maintenance Mode menu for an option when you think it should, either that option is not enabled (via FlashWare) or the truck does not have the latest software.

NOTE: If you need to enter Maint several times to resolve a problem, it may save time if Superword is temporarily changed to a single digit code. Remember to re-enter the correct Superword when you are done.

⚠ CAUTION

Disconnecting wires or connectors to integrated circuits with power ON can result in premature failure of those or other components. Always disconnect the battery before making or breaking any connections.

⚠ WARNING

During Maintenance Output Tests, always jack the drive tire off the floor and open the Emergency Lowering Valve.

Use extreme care when the truck is jacked up for any reason. Never block the lift truck between the carriage and the floor. 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 2-10.](#)

Follow all instructions contained in this manual for each test. If you are unsure how to conduct a test while in Maintenance Mode, do not proceed with the test.

Active Maintenance Mode

Active Maintenance Mode (ActMaint), when enabled in Config, permits testing of various systems on the truck. In Active Maintenance, all Analog and Digital inputs can be selected with the results displayed while operating the truck in Run Mode. Refer to [“Using Active Maintenance Mode \(ActMaint\)” on page 3-39.](#)

Passwords

Electronic Operator Key

Electronic Operator Key is a feature that allows the customer to assign up to 20 operator electronic keys (passwords). With Operator Key

Modes of Operation

enabled, the operator is prompted to enter his/her electronic key when the key switch is turned ON. Truck operation is not allowed unless the correct electronic key or *Superword* is entered.

Password

Password permits access to Configure Mode only. It is intended for customer use in setting performance parameters within those features purchased with the lift truck.

Superword

Superword permits access to all Program Modes. Superword is intended to limit service access to qualified and trained service technicians.

We *strongly* recommend that, during installation, you change the Superword from the factory default to a code known only to the dealer and/or owner so that access to Diagnostic Mode is limited to qualified personnel. Make sure to record the new Superword in a safe place. If this code is lost or forgotten, a technician must reset the lift truck to factory default settings. This makes it necessary to reconfigure all variable settings.

Run Mode Tones

Tone 1. A single tone that indicates:

- A key on the Operator Keypad (Up/Down/Left/Right/Enter) is depressed
- Maximum steer request is reached

Tone 2. Two tones (high/low) that indicate the TPC and LPC contactors are disabled (opened). Travel, steering, and lift/lower are disabled and the brake is applied until the problem is corrected.

Tone 3. Three tones (high/medium/low) that indicate:

- A travel performance limitation - travel speed is limited to 1 mph (1.6 km/h). Lift, lower, steering, and horn functions operate normally.

- A traction system shutdown - travel is not allowed. Lift, lower, steering, and horn functions operate normally.
- A shutdown in the lift/lower system - lift and lower are not allowed. Travel, horn, and steering functions operate normally.
- Load Handler shutdown

Tone 4. A continuous tone with deadman pedal pressed and Auto/Manual switch in Manual indicates the truck is over the guide wire.

Tone 5. Tone ramps up then repeats, indicating the truck is seeking and aligning over the guide wire. The tone continues until the truck is locked on the guide wire or the Auto/Manual switch is changed to Manual.

Tone 6. Descending tone (bomb drop) that indicates an incorrect Password or Electronic Passkey was entered.

The tones described do not repeat continuously. A fault code and associated message scroll across the Operator's Display. The message repeats continuously until the key switch is turned OFF.

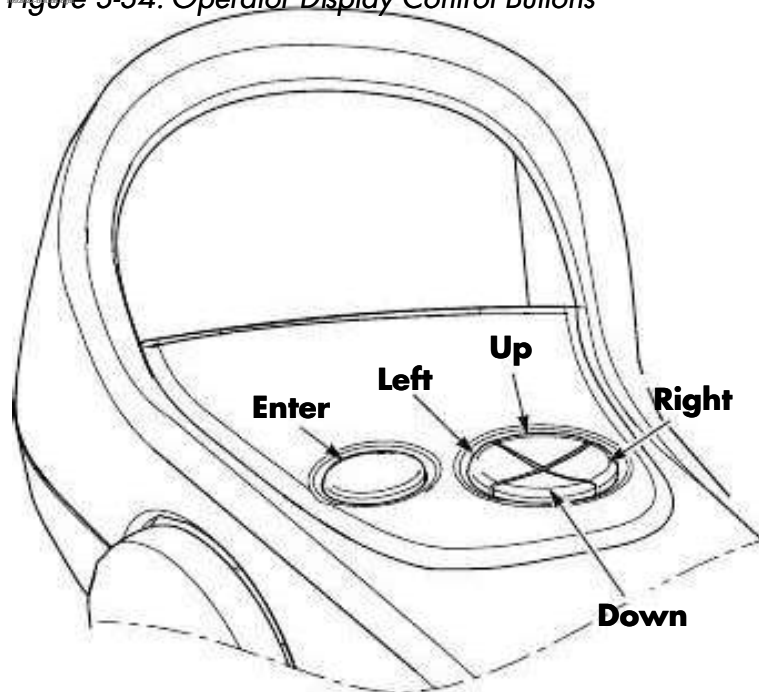
Using Program Mode

⚠ WARNING

By entering Program Mode, safety circuits associated with the ACR System are disabled. Follow all instructions in this manual for each test. If you are unsure how to conduct a test while in Program Mode, STOP: do not proceed with the test. Contact an authorized Raymond dealer.

To enter Program Mode, use the right button to obtain the cursor prompt. Using the **up/down** buttons to scroll to the desired number and the **left/right** buttons to move to a different character position, enter the Password or Superword, then press **Enter**.

Figure 3-34. Operator Display Control Buttons



Entering Electronic Operator Key, Password, or Superword

An Electronic Operator Key, Password, or Superword can be one to eight characters in length, having any combination of letters, numbers, and/or spaces (indicated by an underscore). A password of all spaces is not permitted.

1. When the password prompt displays, an eight character field of underscores

appears. Initially, the left-most character position is flashing, showing it is the currently selected position.

2. Use the **left/right** buttons to select a different character position.
3. Once the character position is selected, use the **up/down** buttons to select the desired number, letter, or space. The character set wraps between “z” and “_” (space). To go quickly from the letter “z” to the number “0,” press the down button twice.

**_0123456789ABCDEFGHIJKLMNOPQR
STUVWXYZ**

4. Repeat steps 2 and 3 for the remaining Electronic Operator Key, Password, or Superword characters.
5. When all characters in the Electronic Operator Key, Password, or Superword are entered, press the **Enter** button once.
6. If an invalid Electronic Operator Key, Password, or Superword is entered, a tone sounds and **Invalid Password** is displayed before returning to the password prompt screen.
7. If a mistake is made entering a character, repeat steps 2 thru 5.

When a correct *Electronic Operator Key* is entered, the truck completes SelfTest and enters Run Mode.

When the correct *Password or Superword* is entered, one of the following is displayed for 3 seconds:

- a. If Password is entered, the following is displayed:
 - Quit
 - Serial #
 - Version
 - Hr Meter
 - Config

Modes of Operation

b. If Superword is entered, the following is displayed:

- Quit
- Serial #
- Version
- Hr Meter
- Config
- Learn
- Maint

To exit Program Mode, select Quit and press **Enter**.

Using Configure Mode

Configure Mode can be accessed with Superword or Password, however some items in **Config** will only appear if Superword is entered.

Table 3-2 outlines all menus and submenus available in Config.

Quit Cfg is first displayed when **Config** is selected. Use the **Up/Down** buttons until the desired selection is displayed. Press **Enter**. This will take you into the submenu for that item.

Current values of configurable items or the ability to enable/disable an option appear in the submenu. To change the value, press the **Up/Down** button. When the desired value appears, press **Enter**.

All possible truck configurations and options are listed in these instructions. Only the options associated with that particular truck are displayed on the OD.

To save changes, select **Quit Cfg** from the **Config** menu and press **Enter**. Select **Save? Y** to save the changes made and exit **Config**.

To disregard changes made in **Config**, select **Save? N**. **Config** exits without saving changes.

Default Settings

NOTE: Once defaults are reset (Reset? Y) the previous settings cannot be recalled.

To reinstate factory default settings:

1. Select **Defaults** from the main menu and press **Enter**. Select **Reset? Y**.
2. Select **Quit Cfg**.

Changing Password or Superwrđ

Both Password and Superwrđ can be changed to any combination of letters and/or numbers. Blank spaces are not allowed [spaces are represented by a **down** bar (_)].

If Program Mode is entered with a password, only **Password** can be changed. If Program Mode is entered with a superword, both **Password** and **Superwrđ** be changed.

The minimum number of characters is one, the maximum is eight.

To change **Password** or **Superwrđ**:

1. Enter **Config** using the current password or superword.
2. Select **Password** or **Superwrđ** (as applicable) from the **Config** menu and press **Enter**.
3. Enter the new code using the **Up/Down** and **Enter** buttons.
4. When the new code is displayed, press **Enter**. The display returns to the main menu.

Table 3-2. Configure Mode Menu

CONFIGURE MODE MENU			
Can be entered with Password unless Superword is specified			
Menu	Item	Selection	Description
Quit Cfg		Save? Y Save? N	Exits Configure Mode Save changes and leave Configure Mode Abandon changes and leave Configure Mode
Defaults		Reset? Y Reset? N (<i>default</i>)	Restore Factory Defaults - see “Default Settings” on page 3-26. Restore Factory Defaults Do not restore Factory Defaults CAUTION: The previous settings cannot be recalled once defaults are reset (Reset? Y).

Modes of Operation

CONFIGURE MODE MENU			
Can be entered with Password unless Superword is specified			
Menu	Item	Selection	Description
Travel	Speed	Max Speed (<i>default</i>)	Set Max Travel Speed 0.0 or 1.0 to 6.0 mph (0.1 mph increments)
	T Accel	Hard Medium (<i>default</i>) Soft	Set Travel Acceleration
	Coast	Long Medium (<i>default</i>) Short	Set Coast
	Spd/Hgt-1	Height1 Speed1	Set Max Travel Speed above a given height Height 1 (1 in. increments) Speed 1 (0.1 mph increments)
	Spd/Hgt-2	Height2 Speed2	Set Max Travel Speed above a given height Height 2 (1 in. increments) Speed 2 (0.1 mph increments)
	OOA Spd (<i>Superword only</i>)	Max Speed (<i>default</i>)	Out-of-Aisle Speed: Set Max Travel Speed when truck is not located in a rail or wire guided aisle - enabled with FlashWare. 0.0 or 1.0 to 6.0 mph (0.1 mph increments)
	UnNestSp (<i>Superword only</i>)	1 mph (<i>default</i>)	Set Max Travel Speed when Load Handler is Unnested - enabled with FlashWare. 0 to 1.0 mph (0.5 mph increments)
	AlarmT (<i>Superword only</i>)	None Both (<i>default</i>) Fork Ld Fork Trl	Set Alarm for Traction - enabled with FlashWare. Choose one of following: Off On in both directions On when forks leading On when forks trailing
	EOASpeed	1.0 mph (<i>default</i>)	Set End-of-Aisle Speed - enabled with FlashWare. 0.0 or 1.0 to 6.0 mph (0.1 mph increments)
	AuxSpd/Ht (<i>Superword only</i>)	Max Speed Max Height	Set Max Travel Speed when mini-mast is above a given height - enabled with FlashWare. Speed (0.1 mph increments) Height (1 in. increments) Note: "Travel Speed Limited due to Aux Mast Ht" must be enabled in FlashWare.

CONFIGURE MODE MENU			
Can be entered with Password unless Superword is specified			
Menu	Item	Selection	Description
Lift	LftAccel	Hard Medium (<i>default</i>) Soft	Set Lift/Lower Start/Stop Acceleration
	LwrDecel	2 (<i>default</i>)	Set Lower Deceleration Rate: 0-5 0 = quickest, 5 = slowest Note: This setting affects the height that decel begins.
	LftLimit (<i>Superword only</i>)	Enable	Enter a height between 0 and maximum elevated height. If option is enabled with FlashWare, lift is disabled above the configured height. Enable Height Disable
	Lft Byps (<i>Superword only</i>)	Disable Enable (<i>default</i>) Height1 - lowest Height2 Height3 Height4	Set Lift Bypass height - enabled with FlashWare. Note: Up to 4 different bypass heights can be programmed. The default is the maximum height programmed using FlashWare.
	AlarmL (<i>Superword only</i>)	None BOTH (<i>default</i>) Lift Lower	Set Alarm for Lift/lower - enabled with FlashWare. Off ON in both directions ON when lifting ON when lowering
	Lwr Byps (<i>Superword only</i>)	Disable Enable 10 inches	Set Lower Bypass Height - enabled with FlashWare. 0.0 to 48 in. (1 in. increments) Note: Setting the height to 0.0 is the same as not having a Lower Bypass
Ld Hndlr	LH Accel	Hard Medium (<i>default</i>) Soft	Set Load Handler Acceleration for Traverse and Rotate
	Trvse Sp (<i>Superword only</i>)	Slow (<i>default</i>) Medium Fast	Set Traverse Speed

Modes of Operation

CONFIGURE MODE MENU			
Can be entered with Password unless Superword is specified			
Menu	Item	Selection	Description
BSOC <i>(Superword only)</i>	Reset	75 <i>(default)</i>	Battery State-of-Charge Reset Variable from 55 to 100 in increments of 1
	Cut Out	20 <i>(default)</i>	Select Battery Cutout Voltage Variable from 0 to 50 in increments of 1
Units		English <i>(default)</i> Metric	Select English or Metric units of measure.
Guidance	Type	Wire Rail None	Select between Wire, Rail Guidance, or None (only appears if the option is installed on the truck and enabled in FlashWare).
	Set Heading Angle and Distance From Wire		
	HA SLOW	1.6 deg <i>(default)</i>	0.6 to 2.0° in 0.2° increments
	HA STOP	3.0 deg <i>(default)</i>	2.0 to 4.0° in 0.2° increments
	DFW SLOW	1.6 in. <i>(default)</i>	0.6 to 1.6 in. in 0.2 in. increments
	DFW STOP	3.0 in <i>(default)</i>	1.6 to 3.0 in. in 0.2 in. increments
	AcquirSpd	1.0 mph <i>(default)</i>	Set Acquire Speed (tractor-first only) 1.0 to full speed in 0.1 mph increments Note: Forks-first acquire speed is fixed at 1.0 mph.
	FreeSpeed	Max Speed <i>(default)</i>	Set top speed of truck when not in wire guidance mode (Auto/Manual switch in Manual) and the wire is not sensed. 1.0 to max speed (0.1 mph increments)
	SensCreep	Enable (1.0 mph max) Disable	Set Sense Creep Speed. When enabled, Auto/Manual switch in Manual, and wire is sensed, truck soft plugs to 1 mph and remains speed limited until wire is no longer sensed or Auto/Manual switch is set to Auto.
	Language		English <i>(default)</i> Spanish French
PassWord	Password	1 _ _ _ _ _ <i>(factory setting)</i>	Enter New Password Display Current Password
	Superwrđ <i>(Superword only)</i>	2 _ _ _ _ _ <i>(factory setting)</i>	Enter New Superword Display Current Superword
	Elec Key	3 _ _ _ _ _ <i>(factory setting)</i>	Enter New Electronic Keys (up to 20) - enabled with FlashWare Display Current Elec Key

CONFIGURE MODE MENU			
Can be entered with Password unless Superword is specified			
Menu	Item	Selection	Description
Mnt Mind	Enab\Dis Reset Setup	Disable Enable 300 Hrs (<i>default</i>) Msg Only (<i>default</i>)	Set parameters for <i>Maintenance Minder</i> Turn <i>Maintenance Minder</i> ON/OFF Reset #hours (deadman) until next reminder Set #hours between reminders Choose between Lift CutOut or Message Only For more information, refer to " Maintenance Minder™ Tool " on page 4-3)
Clock	Time Date 24-Hour	HH:MM:SS -AM -PM MM/DD/YY Disable Enable	Set Time/Date Set time of day (AM or PM) Set date Turn 24 hour clock ON/OFF
Auto Off		Disable (<i>default</i>) 10 Min 5 Min 4 Min 3 Min 2 Min 1 Min	Set idle time for automatic shut-off. Truck turns off after the programmed setting with no activity while off the deadman.
ActMaint (<i>Superword only</i>)		Enable (<i>default</i>) Disable	Set Active Maintenance
Brighten		Up Down Default	Set brightness of Operator Display
CustInt1 (<i>Superword only</i>)	CI Speed CI Lift CI LH	0.0 mph (<i>default</i>) Enable Disable (<i>default</i>) Enable Disable (<i>default</i>)	Customer Interlock Input 1 - Platform: enabled with FlashWare 0.1 mph increments This option can disable lift and load handler functions, and also limit the truck's speed based on the state of the input to the CM.
CustInt2 (<i>Superword only</i>)	CI Speed CI Lift CI LH	0.0 mph (<i>default</i>) Enable Disable (<i>default</i>) Enable Disable (<i>default</i>)	Customer Interlock Input 2 - Platform: enabled with FlashWare 0.1 mph increments This option can disable lift and load handler functions, and also limit the truck's speed based on the state of the input to the CM.

Modes of Operation

CONFIGURE MODE MENU			
Can be entered with Password unless Superword is specified			
Menu	Item	Selection	Description
CustInt3 (<i>Superword only</i>)	CI Speed	0.0 mph (<i>default</i>)	Customer Interlock Input 3 - Tractor: enabled with FlashWare 0.1 mph increments
	CI Lift	Enable Disable (<i>default</i>)	This option can disable lift and load handler functions, and also limit the truck's speed based on the state of the input to the TM.
	CI LH	Enable Disable (<i>default</i>)	
CustInt4 (<i>Superword only</i>)	CI Speed	0.0 mph (<i>default</i>)	Customer Interlock Input 4 - Tractor: enabled with FlashWare 0.1 mph increments
	CI Lift	Enable Disable (<i>default</i>)	This option can disable lift and load handler functions, and also limit the truck's speed based on the state of the input to the TM.
	CI LH	Enable Disable (<i>default</i>)	
iPort	Init Spd	MAX SPEED (<i>default</i>)	Set max travel speed after key switched ON and before the 3rd party unit sends a speed request. 0.1 mph increments
	Err Spd	MAX SPEED (<i>default</i>)	Set max travel speed after communication is lost with the 3rd party unit. 0.1 mph increments
iP Lim (<i>View only</i>)	TF MAX SPD	6.0 mph	Max TF travel speed setting
	FF MAX SPD	6.0 mph	Max FF travel speed setting
	Mast Vel DN	100%	Percentage of max lower speed setting
	Mast Vel UP	100%	Percentage of max lift speed setting
	T Accel	Medium	Travel acceleration profile setting
	L Accel	Hard	Lift acceleration profile setting

Using Learn Mode

To place the lift truck in Learn Mode:

1. Enter Superword.
2. From the Program Mode Superword Level menu, use the **up/down** buttons to select **Learn**, then press the **Enter** button. The selected menu item is indicated by an arrow to the left of the selection.
3. The Learn Mode menu is displayed:
 - Controls
 - Ld Hndlr (Load Handler)
 - Weight
 - Wire Guidance
 - Rail Guidance

Use the **up/down** and/or **left/right** buttons to select the category desired.

Learn Controls

With **Controls** selected at the Learn Mode menu, press **Enter**.

During Learn Controls, the Carriage Manager control circuits are calibrated to the output voltage of the Rotate (VR3) and Traverse/Reach (VR4) pots.

The Carriage Manager also communicates the status of the Travel (VR1) and Lift (VR2) pots to the Tractor Manager for calibration.

This determines the neutral position for the command pots. The maximum and minimum positions are calculated during Run Mode and adjusted as necessary to compensate for component wear.

Learn Ld Hndlr (Load Handler)

Use Learn Load Handler to determine the extreme positions of the Rotate Position Feedback (VR6) and Traverse Position Feedback (VR5) pots, and opening points for the proportional valves (SOL7 and SOL8) by the Carriage Manager.

CAUTION

Make sure there is sufficient room for the Load Handler to traverse and rotate completely in both directions.

The fork carriage can be in any position at the start of Learn. However, for best results, start from the Load Handler nested right position.

With **LD Hndlr** selected at the Learn Mode menu, press **Enter**.

The Load Handler traverses and rotates with no control inputs once Learn is selected and both Deadman pedals are depressed.

The Load Handler first rotates clockwise to the stop, then counterclockwise to the stop. The Load Handler hits the stops harder than when

in Run Mode. The Load Handler should then rotate clockwise and counterclockwise again, slowing down just before reaching the stops.

The Load Handler then traverses left to the stop, pause, then traverse right to the stop. The Load Handler hits the stops harder than when in Run Mode. The Load Handler should then traverse left and right again, slowing down just before reaching the stops.

Learn Weight

Learn Weight is used to calibrate the weight displayed. The Main Lift Pressure transducer is used with the main lift cylinders and the Mini Lift Pressure transducer is used with the mini-mast lift cylinder.

CAUTION

Make sure there is sufficient lifting height to elevate both the main and mini-masts.

1. With **Weight** selected at the Learn Mode menu, press **Enter**. The following message should be displayed.

Lift main mast at least 4 inches with the forks empty, then press Enter

Modes of Operation

NOTE: If mast will not lift the required 4 in., check Lift Bypass (Lft Bypss) setting in Configure mode (refer to Table 3-2 on page 3-27).

- Elevate the truck as instructed.

**LEARNING
PASSED**

should display.

- Lift mini mast at least 4 inches with the forks empty, then press Enter

should display.

- Elevate the truck as instructed.

**LEARNING
PASSED**

should display.

Learn Wire Guidance

The following information is for a correctly functioning wire guidance system. If problems are encountered while trying to perform these procedures, refer to “Bad Coil Values” on page 5-21.

Learn Guidance is a six step process:

- Initial Learn Frequency and Signal Strength
- Initial Learn Offset Between Antennas
- Initial Learn Steer Zero Position
- Final Learn Frequency and Signal Strength
- Final Offset Between Antennas
- Final Learn Steer Zero Position

Before performing the following procedures:

- Verify the line driver is adjusted to the correct frequency and amplitude.
- Center the truck over the guide wire within 0.5 in. (13 mm).

NOTE: It is easier to center the load antenna first, then center the tractor antenna.

- Place the truck in an area that allows tractor-first travel for upcoming steps.

With **Wire Guidance** selected at the Learn Mode menu, press **Enter**.

Step 1 - Initial Learn Frequency and Signal Strength

Step 1 learns the frequency and field strength of the floor signal. The guidance system actually “searches” for the frequency generated by the floor signal as well as the field strength.

Center on wire. LLL

**Press ENTER. @LLL
LL=58 LN=103 LR=64
TL=71 TN=98 TR=65**

When the **Enter** button is pressed, the numbers on the display change, indicating the system is switching between multiple frequencies and strengths. The Guidance Manager determines what frequency and field strength the floor signal is generating.

Busy learning wire..

**LL= 58 LN=103 LR= 64
TL= 71 TN= 98 TR= 65**

The numbers cycle from 1 to 199 until the system is able to calibrate itself to the floor signal. If the message **Learn wire failed, Press Enter to retry** is displayed, refer to “Bad Coil Values” on page 5-21.

Step 2 - Initial Learn Offset Between Antennas

Step 2 learns the Offsets for the antennas. Following the screen message, **Must lock onto wire**, press the Auto/Manual switch to AUTO,

Must lock onto wire..

Guide Tractor First. is displayed. The display also shows **Trac Ant = +x.xx"** which is the distance from the wire as calculated by the

Tractor Antenna. The display also shows **+x.x mph**. Drive tractor-first at 1.5 to 2 mph (2.4 to 3.2 km/h) for a distance of approx. 20 ft. (6m).

Guide tractor first.

Trac Ant = +0.09"
+ x.x mph

Gently coast to a stop, and hit ENTER is displayed. Return the throttle to neutral and allow the truck to coast to a stop. After the truck has come to a complete stop, press **Enter**. The Trac Ant value should be 0.00 ±0.40.

Gently coast to a stop, and hit ENTER.

Trac Ant = x.xx"
+x.x mph

Step 3 - Initial Learn Steer Zero Position

Step 3 learns the Steer Zero Position. **Guide both ways to minimize, hit ENTER.** is displayed. The display also shows **Wire Dist: +x.xx"** and **+x.x mph**.

Guide both ways to minimize, hit ENTER.
Wire Dist: +0.09"
+1.2 mph Done=None

NOTE: While performing this portion of Learn, the truck must travel at least 1.5 mph (2.4 km/h) and not be aggressively accelerating. A rotating spinner in the upper right corner of the display indicates a valid Learn is in process.

Travel in both directions a minimum of 100 ft. (30.5m) (shorter aisles require multiple runs) until the numbers for **Wire Dist** are consistently within ±0.25 in. in both directions. Press **Enter**. Learn Wire Guidance exits and the Learn Mode menu is displayed.

NOTE: If, after several attempts, the truck does not consistently track within ±0.25 in., press **Enter** to exit. Re-enter Guidance and repeat steps 1 thru 3.

Step 4 - Final Learn Frequency and Signal Strength

Re-enter Wire Guidance Learn.

Step 4 learns the frequency and field strength of the floor signal.

Center on wire. LLL

Press ENTER. @LLL
LL=58 LN=103 LR=64
TL=71 TN=98 TR=65

When the **Enter** button is pressed, the numbers on the display change, indicating the system is switching between multiple frequencies and strengths. The Guidance Manager determines what frequency and field strength the floor signal is generating.

Busy learning wire..

LL= 58 LN=103 LR= 64
TL= 71 TN= 98 TR= 65

The numbers cycle from 1 to 199 until the system is able to calibrate itself to the floor signal.

Step 5 - Final Learn Offset Between Antennas

Step 5 learns the Offsets for the antennas.

Following the screen message **Must lock onto wire**, press the Auto/Manual switch to AUTO,

Must lock onto wire..

Guide Tractor First. is displayed. The display also shows **Trac Ant = +x.xx"** which is the distance from the wire as calculated by the Tractor Antenna. The display also shows **+x.x mph**. Drive tractor-first at 1.5 to 2 mph (2.4 to 3.2 km/h) for a distance of approx. 20 ft. (6m).

Modes of Operation

Guide tractor first.

Trac Ant = +0.09"
+ x.x mph

Gently coast to a stop, and hit ENTER is displayed. Return the throttle to neutral and allow the truck to coast to a stop. After the truck has come to a complete stop, press **Enter**. The Trac Ant value should be 0.00 ±0.10.

**Gently coast to a stop,
and hit ENTER.**

Trac Ant = x.xx"
+x.x mph

Step 6 - Final Learn Steer Zero Position

Step 6 learns the final Steer Zero Position. **Guide both ways to minimize, hit ENTER.** is displayed. The display also shows **Wire Dist:** **+x.xx"** and **+x.x mph**.

**Guide both ways to
minimize, hit ENTER.**
Wire Dist: +0.09"
+1.2 mph Done=None

NOTE: While performing this portion of Learn, the truck must travel at least 1.5 mph (2.4 km/h) and not be aggressively accelerating. A rotating spinner in the upper right corner of the display indicates a valid Learn is in process.

Travel in both directions a minimum of 100 ft. (30.5m) (shorter aisles require multiple runs). The display indicates when it has successfully learned each direction by displaying **Fork**, **Trac** or **Both** (when both directions are learned).

Continue to drive the truck in both directions until **Done=Both** is displayed.

Learn Rail Guidance

Perform Learn Rail Guidance to adjust the center position of the drive unit so that the truck tracks straight while in the aisle.

1. Place the truck in an area where there is a straight line at least 20 ft. (6m) in length that can be used as a reference (such as wire guidance groove, yellow aisle marker, or rail).
2. Select *Manual* (ON) on the Auto/Manual switch. The truck is now in "seeking mode" and can be driven with manual steering.
3. Position the truck so that it drives parallel to the reference line. Make small corrections with the steer tiller until the truck tracks 10 ft. (3m) without deviating more than 1/2 in. (13 mm) from the straight line.
4. Manually activate and secure the rail switch to simulate the truck is in a rail guided aisle.
5. With **Rail Guidance** selected at the Learn Mode menu, press **Enter**. The display shows "Rail Offset: +/- X.X" where X.X is a number between -5.0 and +5.0. This is the steer proximity offset from dead center in degrees. Rail Detect and Auto/Manual switch status is also displayed.

Rail Offsets +X.X
Rail Detect Sw: ON/OFF
Auto/Manual Sw: ON/OFF

6. Select *Auto* on the Auto/Manual switch (OFF). The steer unit centers and manual steer is disabled.
7. Drive forward 10 ft. (3m). Measure deviation from the reference line. Deviation should be <1 in. (25.4 mm). If deviation is >1 in. (25.4 mm), proceed to the next step. If deviation is <1 in. (25.4 mm), proceed to step 11.
8. Drive the truck back to the original position.
9. Use the **up/down** buttons to adjust the value on the display. More negative numbers cause the truck to drive to the right when driven tractor-first. Changing the value by 0.1 corresponds to a deviation of approx. 0.25 in. (6 mm) over 10 ft. (3m).
10. Repeat steps 7 thru 9 until a deviation of 1 in. (25.4 mm) or less over 10 ft. (3m) is achieved.

11. To save the value, press the **Enter** button. Select **Save? Y** and press **Enter**.
12. Learn Rail Guidance is complete.

Using Maintenance Mode

To place the lift truck in Maintenance Mode:

1. Enter Superword.
2. From the Program Mode Superword Level menu, use the **up/down** buttons to select **Maint**, then press the **Enter** button. The selected menu item is indicated by an arrow to the left of the selection.
3. The Maintenance Mode menu is displayed:
 - Analog
 - Input
 - Output
 - Wire Guidance
 - EvtLog
 - Quit Mnt

Use the **up/down** buttons to select the category desired, then press the **Enter** button.

Analog (Inputs)

When Analog is selected, Analog inputs are displayed in numerical sequence. Use the **up/down** and **left/right** buttons to scroll to the desired input.

To display the selected input, press the **Enter** button. The Operator Display shows the input number and its status. To return to the Analog menu, press the **left** or **right** button.

Refer to “[Analog Inputs](#)” on page 6-35.

Input (Digital)

When Input is selected, Digital inputs are displayed in numerical sequence. Use the **up/down** buttons to scroll to the desired input.

To display the selected input, press the **Enter** button. The Operator Display shows the input

number and its status. To return to the Input menu, press the **left** or **right** button.

Refer to “[Digital Inputs](#)” on page 6-35.

Output Tests

When Output is selected, Output Tests are displayed in numerical sequence. Use the **up/down** and **left/right** buttons to scroll to the desired test.

WARNING

When performing an output test, elevate the drive tire off the floor. See “[Jacking Safety](#)” on page 2-10. Open the Emergency Lowering Valve. See “[Main Manifold](#)” on page 7-70.

To “run” a selected test, press the **Enter** button. The Operator Display prompts you to jack the drive wheel off the floor and to open the Emergency Lowering Valve. The Operator Display shows the test number and its results. To return to the Output menu, press the **left** or **right** button.

Refer to “[Output Tests](#)” on page 6-36.

Wire Guidance

Wire Guidance Maintenance Mode can be used to examine system tracking (**Tracking Values**), view individual antenna coil inputs (**Coil Values**), and clear the EEPROM on the Guidance Manager card (**Clear WG EEPROM**). The system can function at several different frequencies and strengths. The Wire Guidance floor signal strength must be consistent throughout the warehouse. Refer to Publication PDSS-0051 for floor adjustment, troubleshooting, and additional information.

Tracking Values

Use Tracking Values to monitor the Wire Guidance calculated position and record Tractor First (TF) and Forks First (FF) position values. When centered over the wire, near-wire coil signal strength is typically about 100%.

Modes of Operation

When the Auto/Manual switch transitions from Manual to Auto, the stored values are cleared. When the Auto/Manual switch transitions from Auto to Manual after tracking the wire, the following values are displayed (see [Figure 3-35](#)):

- Truck speed (**X.X**) in upper left corner
- Distance From the Wire (**DFW**) in inches
- Heading Angle (**HA**) in degrees
- Near Wire signal as a percentage (**NW%**)

Figure 3-35. Wire Guidance Tracking Values



Term	Meaning
Now	Present calculated reading of coils
MaxT	Max. calculated reading of tractor coil pair
MinT	Min. calculated reading of tractor coil pair
MaxF	Max. calculated reading of fork coil pair
MinF	Min. calculated reading of fork coil pair

NOTE: Coil NW% can range from 0 to 199%.

When traveling TF, the NW% coil readings are from the tractor end antenna coils. When traveling FF, the NW% coil readings are from the load end antenna coils. The display alternates automatically, depending on direction of travel. Use the **Up/Down** buttons to obtain differences between the TF and FF tracking information when the truck is not over the guide wire and tracking.

Procedure: Enter Wire Guidance/Maintenance Mode/Tracking Values. Lock the truck onto the wire (if presently locked onto the wire, cycle the Auto/Man switch to clear existing values) and travel in both directions. Drive the truck the full length of the aisle. As the truck travels on the

wire, minimum and maximum tracking values are automatically recorded. The following table lists acceptable values.

	DFW	NW%
MaxT and MaxF	0.00 to +1.00	90 to 130%
MinT and MinF	0.00 to -1.00	70 to 110%

If the values displayed are not within these limits, re-Learn the Wire Guidance system and check again. See [“Learn Wire Guidance” on page 3-34](#).

Coil Values

Use Coil Values to monitor what the Guidance Manager is sensing from the individual antenna coils for multiple frequencies. The readings can be used to aid in troubleshooting the system. The **Now**, **Min**, and **Max** coil strengths can be selected for display. When the truck is centered over the wire, the inner (near wire) coil signal strength is typically about 100%. Outer (left and right) coil signal strength is approx. 60% to 70%. These values are affected by truck position relative to the wire and wire depth in the floor. For more information, refer to [“Wire Guidance Troubleshooting” on page 5-21](#).

Clear WG EEPROM

This is used to clear the EEPROM on the Guidance Manager card. When this occurs, learn Wire Guidance must be performed. See

[“Learn Wire Guidance” on page 3-34](#).

1. Select **Clear WG EEPROM** from Wire Guidance sub-menu.
2. **Reset? N** is displayed. Press the **right** button.
3. **Reset? Y** is displayed. Press **Enter**. The wire guidance EEPROM is cleared.

Evt Log

When Event Log is selected, the last twenty error codes recorded are displayed. Each entry shows the code and the date and time of occurrence.

- Use the **up/down** buttons to switch between pages 1 and 2 of the log.
 - Use the **left/right** buttons to exit the log back to the Maintenance Mode menu.
 - If the log displays the message “Error Log is empty” no error codes were recorded since the log was last cleared.
 - To clear and reset the Event Log, select **Clear** and press **Enter**. On the Clear menu, select **Yes** with the **down** button, then press the **Enter** button. The log is cleared and the display returns to the Maintenance Mode menu.
6. The Operator Display then shows in large letters:
Configuration Download in Progress
 7. Wait for the download to complete (approx. 45 seconds to 1 minute). When the download has completed, the Operator Display shows:
Configuration Download Complete
 8. Step off both deadman pedals. Turn the key switch OFF.
 9. Turn the key switch ON. The lift truck should go through normal SelfTest.

Using Active Maintenance Mode (ActMaint)

Active Maintenance Mode allows inputs to be displayed while the truck is in Run mode.

ActMaint is enabled in Configure Mode. Refer to “Using Configure Mode” on page 3-26.

1. While in Run Mode (while time and date are displayed), use the **up/down** buttons to scroll to either Analog or Input and press **Enter**.
2. Use the **up/down** buttons to scroll to the desired item. Refer to “Analog Inputs” and “Digital Inputs” on page 6-35.

Graphics Database Download

Perform a graphics database download:

- if the Operator Display shows Code 57 and the truck is operational
- the Display Interface Card is replaced
- anytime the truck software is updated

To do this:

1. Turn the key switch OFF.
2. Press and hold the lift select button.
3. Step on and hold both deadman pedals.
4. Turn the key switch ON.
5. Press and release the lift select button three times.



Section 4. Scheduled Maintenance

Scheduled Maintenance Guidelines

Scheduled Maintenance Guidelines

Following a regularly scheduled maintenance program:

- promotes maximum truck performance
- prolongs truck life
- reduces costly down time
- avoids unnecessary repairs

Scheduled maintenance includes:

- Lubrication
- Cleaning
- Inspection
- Service

Perform all of the scheduled checks and maintenance during the suggested intervals. The time intervals given in this guide are based on Deadman Hours (HD) under normal operating conditions.

When operating under Severe or Extreme conditions, perform these services more often as indicated in the following table.

Operating Conditions	Working Environment	Service Frequency
Light to Moderate	An eight hour shift of basic material handling	180 days or 500 hours, whichever comes first
Severe	<ul style="list-style-type: none"> • Extended heavy duty operation • Freezer operation • Sudden temperature changes such as going from freezer to room temperature 	250 hours
Extreme	<ul style="list-style-type: none"> • All UL Type EE rated lift trucks • Dusty or sandy conditions such as in cement plants, lumber or flour mills, coal dust or stone-crushing areas • High temperature areas such as in steel mills, foundries, enclosed (Type EE) applications • Corrosive atmosphere such as in chlorine or salt-sea air environments 	100 hours

Hour Meters

To display the lift truck hour meters, turn the key switch OFF. Press and hold the horn button while turning the key switch ON. The Operator Display lists the accumulated totals in the following lift truck hour meters:

- **KH**: Total hours the key switch has been turned ON
- **HD**: Total hours on deadman
- **HL**: Total hours spent lifting and lowering

- **TM**: Total distance traveled (miles or kilometers, depending on Units specified in Config)
- **HT**: Total hours spent traveling
- **HA**: Total hours on Load Handler

To exit, press and release both deadman pedals.

Maintenance Minder™ Tool

Maintenance Minder Tool is a feature that permits prompting of a customer when the lift truck is due for scheduled maintenance.

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

- One of two messages appears on the Operator Display following the “Daily Checklist” message.
 - “Scheduled Maintenance Due”
 - “Lift Cutout, Scheduled Maintenance Due”
- The audible alarm sounds a high pitch tone every 5 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 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, *Maintenance Minder* appears in the Configure Mode menu. The initial factory setting is “Disable.” To enable the feature, enter Configure Mode.

NOTE: For instructions on selecting Modes of Operation, see “Overview of Modes” on page 3-22.

With Configuration Mode selected, use the **down** button to display the “Mnt Mind” item. Press the **right** button. With “Enab/Dis” highlighted, press the **right** button. Use the **down** button to select “Enable.” Press the **Enter** button. *Maintenance Minder* is enabled with the last stored time interval and action option.

Exit Program Mode.

Setting or Changing Time Interval and Action Option

With Configuration Mode selected, use the **down** button to display the “Mnt Mind” item. Press the **right** button. Use the **down** button to select “Setup.” Press the **right** button.

The first time the Setup menu is entered, the Factory default setting is displayed. Afterward, when the Setup menu is entered, the setting last used is displayed. Values from 50 to 500 deadman pedal hours are available. Use the **up/down** buttons to scroll to the desired time interval. With the selected value displayed, press the **Enter** button.

Next, select one of the following options:

- “Msg Only” causes the Operator Display to show “Scheduled Maintenance Due” when the scheduled maintenance time interval is exceeded.
- “L Cut Out” 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.

Use the **up/down** buttons to select the option you want, then press the **Enter** button. Exit Program Mode.

Resetting Maintenance Minder

If you want to reset the reminder prompt when *Maintenance Minder* is active and you have done scheduled maintenance, enter Configure Mode.

With Configuration Mode selected, use the **down** button to display the “Mnt Mind” item. Press the **right** button. Use the **down** button to select “Reset”. Press the **Enter** button. Exit Program Mode.

Disabling

When *Maintenance Minder* is active and you want to disable it, enter Configure Mode.

Maintenance Minder™ Tool

With Configuration Mode selected, use the **down** button to display the “Mnt Mind” item. Press the **right** button. With “Enab/Dis” highlighted, press the **right** button. Use the **up** button to select “Disable.” Press the **Enter** button. Exit Program Mode.

Exiting Program Mode

1. Use the **left** button to back out of the menus.
2. The Operator Display shows:
Restore
Save
3. Use the **down** button to select Save. Press the **Enter** button. Your new values are saved.

NOTE: You cannot exit to the main menu until you have selected either **Restore** or **Save** and pressed the **Enter** button.

4. Use the **up/down** buttons to select **Quit**. Press the **Enter** button. The truck goes through reset, then enters Run Mode.

Initial 90 Day/250 Deadman Hour (HD) Maintenance

Perform the following maintenance tasks 90 days or 250 HD after the truck was put into service, whichever comes first.

Component	Task
Drive Unit	Break mounting bolts free and reapply thread-locking compound (P/N 990-544). Re-torque mounting bolts to 350 ft. lb. (475 Nm). Change fluid.
Hydraulic Tank	Change fluid and filter.
Power Amplifiers	Torque power cable terminal nuts to 11 ft. lb. (15 Nm).

Every 180 days or 500 Deadman Hours (HD)

Every 180 days or 500 Deadman Hours (HD)

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 lift truck against the minimum and maximum allowable weights on the spec tag for the lift truck. Report any lift 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 place and not damaged. Make sure the battery has no more than 0.5 in. (13 mm) free play in any direction.
Brakes	In an open area, measure stopping distance. Traveling to 2 to 3 mph (3.2 to 4.8 km/h) empty, push the EPO switch; the empty lift 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 lift 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 pads or rotor. If oil is present, disassemble brake, clean rotor, and replace pads. Measure for correct air gap between armature and armature plate: 0.040 in. (1.0 mm) max. See Figure 7-43 on page 7-36 .
Contactors	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 key switch OFF and the battery disconnected, check the plunger for smooth operation with no binding. If binding occurs, the lift truck may malfunction or exhibit intermittent fault codes.
Control Handle(s)	Verify: <ul style="list-style-type: none"> • lift/lower function is smooth and controllable • travel function is smooth and responsive through full range of motion • rotate function is smooth and controllable • traverse function is smooth and responsive through full range of motion Check for play in the center position of all pots; repair/replace control handle if necessary. Verify function of all switches.
Deadman Pedals	Check for smooth operation with no binding through full range of pedal stroke. Test correct operation of the deadman switch by the pedal.
Drain Holes	Beneath deadman pedal and in battery compartment - make sure the drain holes are not blocked by any debris.
Drive Unit	Check fluid level. Inspect for leaks. Make sure O-ring is present on the dipstick. Check drive axle for play. Examine for drive unit radial ring wear. See "Radial Ring Inspection" on page 7-32 .
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 drive motor. Replace any cable that is damaged or shows signs of excessive heat. Failure to do so causes intermittent system shutdowns and/or electronic failures. Check the tension of the over-the-mast cables. Set tension so the cables just stay on the pulleys. Higher tension causes premature failure. Maximum spring tension is 5 to 7 lb. (2.2 to 3.2 kg).
Fans	Check for correct operation. Run Test O23 – Fans (page 6-133) .

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Section 4. Scheduled Maintenance

Every 180 days or 500 Deadman Hours (HD)

Perform the following maintenance tasks every 180 days or 500 HD, whichever comes first.	
Component	Task
Forks	Check fork mounting surfaces for wear. Make sure fork positioning lock is working correctly. Examine for excessive wear, bends, cracks, welding arcs, excessive heat, or unauthorized modifications. Replace if found. Measure fork thickness (Tool P/N 922-369). See “Fork Inspection” on page 4-15 .
Frame and Baseleg Checks	General visual inspection of structural members for cracks, including but not limited to baselegs, main frame, and tractor.
Hardware	Check bolt torque of major components (motors, pumps, brake, drive unit, manifolds, mast-to-tractor mounting bolts). Tighten any loose hardware. Replace any broken or missing hardware. See “Component Specific Service/Torque Chart” on page A-4 .
Horn	Check that horn sounds when activated. Check mounting bracket insulators.
Hydraulic Hoses	Inspect all hydraulic hoses for leaks, nicks, cut, chafing, and bulges. Replace damaged hoses as soon as possible. Inspect all fittings for leaks. Repair any leaks immediately. Inspect over-the-mast hoses for correct tension. Make sure over-the-mast pulleys spin freely and show no signs of wear.
Hydraulic Tank	Check fluid level.
Lift Chains	Check adjustment. See “Chain Maintenance” on page 4-14 . Inspect for excessive stretch or wear (tool P/N 950-350/CG). Lubricate. See “Lubrication Specification Chart” on page A-2 .
Lower Solenoid	Run Test O62 – Lower Sol [Lower Solenoid (SOL1)] (page 6-153) .
Lubrication	Lubricate all grease points. See “Lubrication Points” on page 4-11 .
Mast	Examine mast bearings. Inspect mast and carriage stops for tightness and wear. Inspect the outside of the main frame for wear. Inspect rails for abnormal wear, metal flakes, or shavings. Repair any grooves worn in the mast deeper than 1/8 in. (3 mm). <i>9600 Only</i> - Wipe old grease off mast uprights and apply new grease.
Mini-Mast	Traverse - Inspect the traverse rack and gears for wear. Check wear pad adjustment. Check traverse stop mounting bolt torque. Make sure traverse roller bearings are not binding or damaged. Make sure hose and cable guards are not damaged. Remove and clean Load Handler manifold filter. See “Load Handler Manifold” on page 7-71 . Apply a thin coat of grease where the pucks contact the Mini-Mast lift cylinder.

Section 4. Scheduled Maintenance

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Every 180 days or 500 Deadman Hours (HD)

Perform the following maintenance tasks every 180 days or 500 HD, whichever comes first.	
Component	Task
Motors	AC - Check the cable lugs to make sure they are tight to the terminal studs. Verify the inside and outside nut are torqued to the values listed. Replace any cable that shows signs of excessive heat. Check sensor wires for sound connection and condition. Blow out the inside of the motor with compressed air.
	DC - Visually inspect brushes for excessive heat (discoloration of the pigtails). If excessive heat is evident, inspect the armature circuit for loose connections. Check condition of commutator per photos on page 5-6 . Find the shortest brush in the holder. Remove the brush and check overall dimension. See Table 7-6 on page 7-54 . Inspect the brush for even wear over the full surface of the brush. If the brush is not contacting the complete surface, replace the brushes. Inspect the brush rigging for damage or loose brush holders. Make sure the connections on the brush leads are tight. Check brush spring tension. Blow out the inside of the motor with compressed air. Check the cable lugs to make sure they are tight to the terminal studs. Verify both the inside and outside nut are torqued to the values listed. Replace any cable that shows signs of excessive heat. Check sensor wires for sound connection and condition.
Overhead Guard	Inspect guard for physical damage. If structurally damaged, replace carriage.
Power Amplifiers	Check torque on power amplifier connections.
Pump Coupling	Separate lift pump and motor. Apply Molybdenum Anti-Seize Compound (P/N 990-638) to the splines. See "Pump Maintenance" on page 7-68 .
Safety Belt or Harness and Tether	Check for signs of wear, fraying, or damage. Check anchor points on overhead guard for damage.
Shorts to Frame	Check for electrical shorts to frame. See "Shorts to Frame Test" on page 5-3 . Wipe compartments clean.
Side Gates and Barrier	Check for correct operation and/or damage.
Stability Pads	Check stability pad clearance to floor. Replace if clearance is >0.75 in. (19.05 mm).
Static Straps	Make sure static straps are not worn or broken. Clean debris from straps. Check resistance of resistor in standoff. EE Labeled lift trucks require a phosphor bronze static strap; do not use steel braided cable on EE labeled lift trucks.
Steering	Check that steering system function is smooth and responsive. Inspect the teeth on the steering gear and drive unit for wear. Check gap on Home Steering Proximity Sensor.
Switches	Check all switches for correct operation and adjust as needed.
Travel Alarm(s)	If equipped, check for correct operation.
Ventilation Slots	Make sure ventilation slots in the tractor frame/cover are clear of obstructions and debris.
Warning Decals	Replace any illegible or damaged decals.
Warning Lights	Check for correct operation.
Wheels and Tires	Examine for bond failure, chunking, and excessive or uneven wear. Inspect load wheel bearings for binding or excessive play.

Every 180 days or 500 Deadman Hours (HD)

Perform the following maintenance tasks every 180 days or 500 HD, whichever comes first.	
Component	Task
Wire Guidance	Check sensor assemblies for damage and mounting hardware for tightness. Verify the lift truck acquires and tracks the guide wire correctly. Verify the brake is applied when truck loses wire signal.

Every 360 Days

Every 360 Days

Perform the following maintenance tasks every 360 days.	
Component	Task
Drive Unit	Change fluid.
Hydraulic Tank	Change hydraulic fluid and filter.
Pump Coupling	Separate load handler pump and motor. Apply Molybdenum Anti-Seize Compound (P/N 990-638) to the splines.

Lubrication Points

Fluids

See “Lubrication Specification Chart” on page A-2.

Hydraulic Fluid

Reservoir capacity is 15 gal. (57 l), *not including* fluid in cylinders and hoses.

Drive Unit

Drive unit capacity is 7.12 qt. (6.75 l).

Lubrication Point Locator Photos

Figure 4-1. Lubrication Points, Fork Carriage Fittings

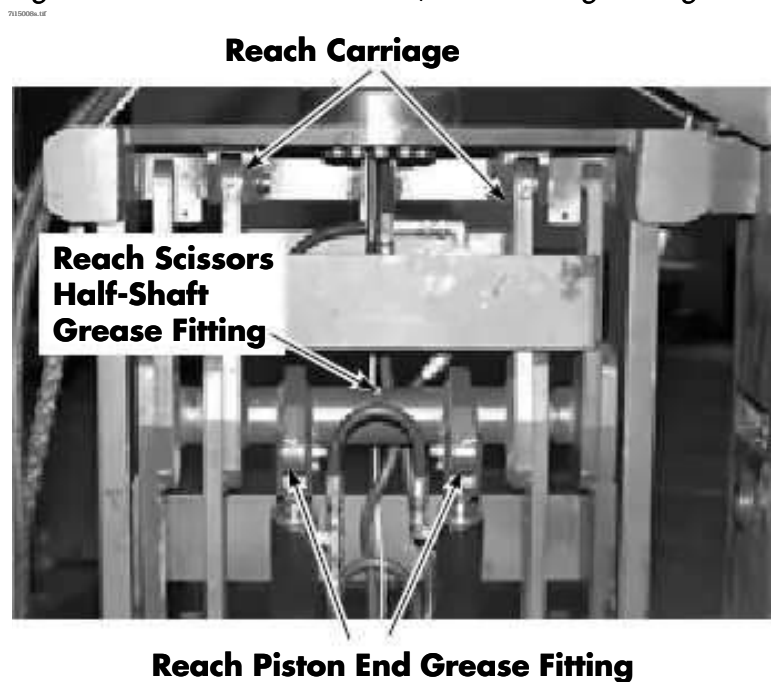
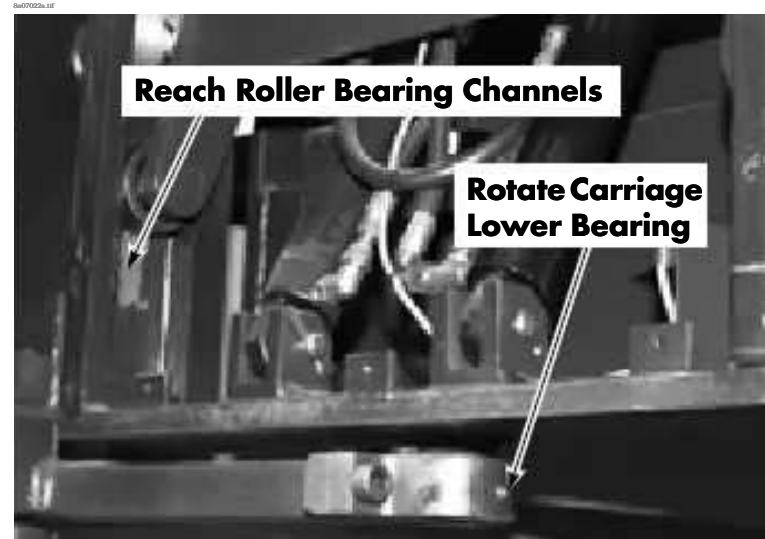


Figure 4-2. Lubrication Points, Fork Carriage Bearings



Section 4. Scheduled Maintenance

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Lubrication Points

Figure 4-3. Mini Mast and Load Handler

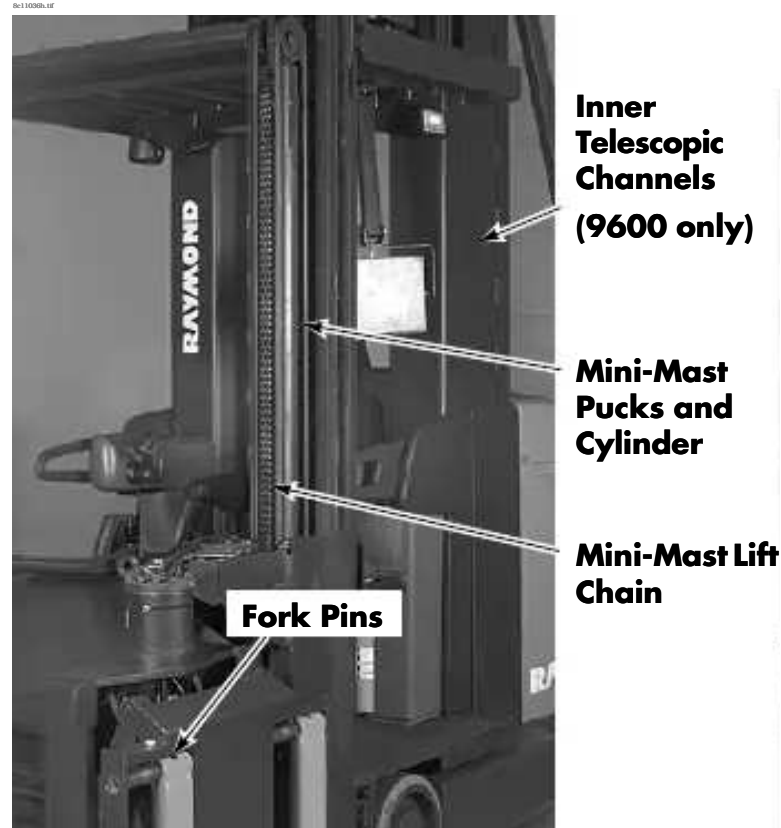


Figure 4-4. Traverse Rack

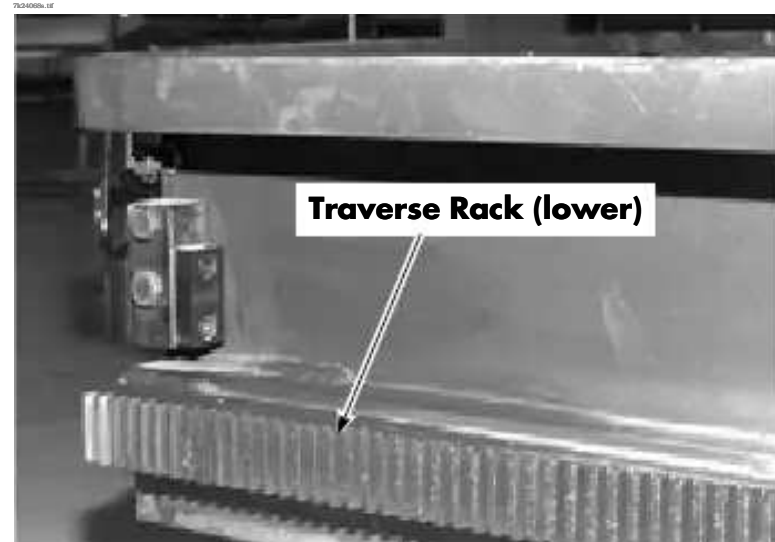


Figure 4-5. Lower Traverse Gears and Bearings

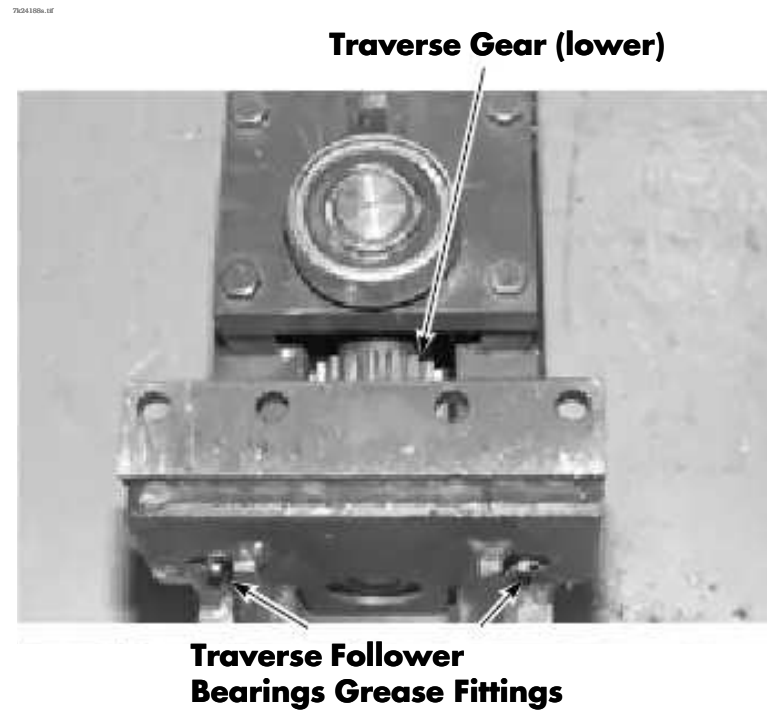


Figure 4-6. Upper Traverse Gears and Bearings

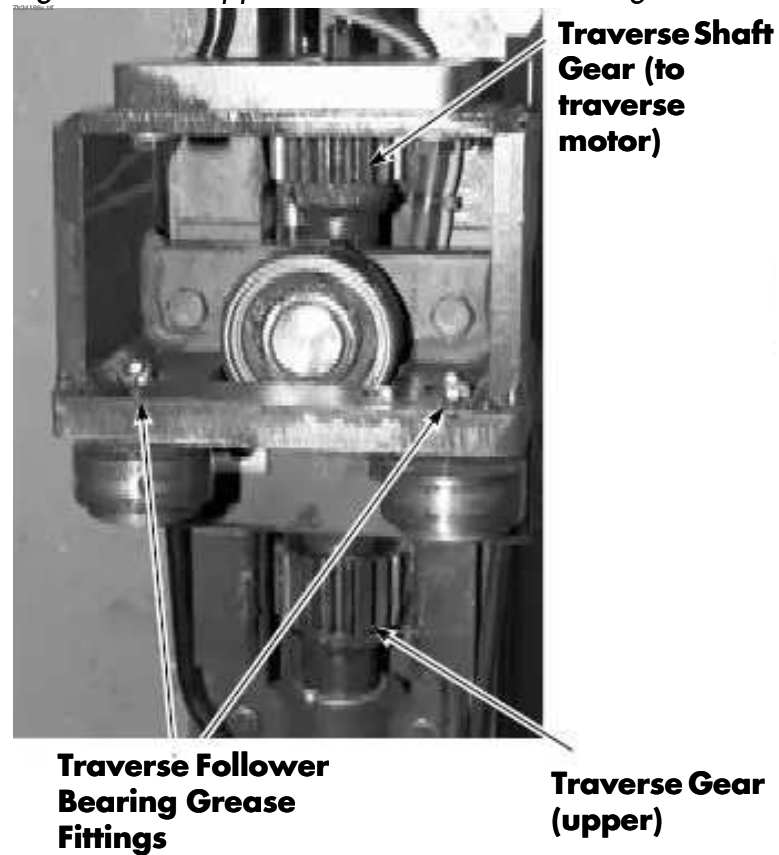
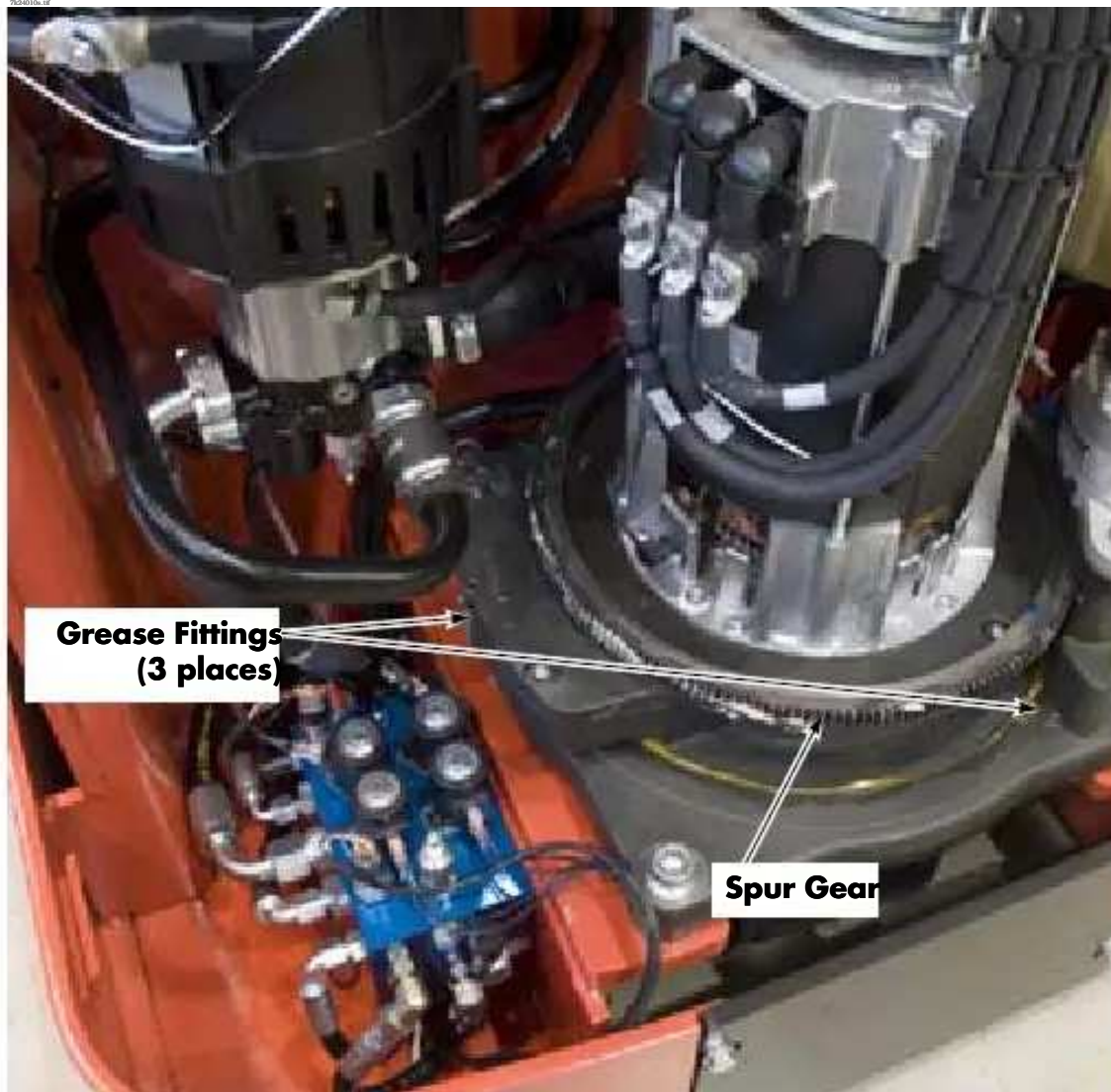


Figure 4-7. Lubrication Points, Drive Unit



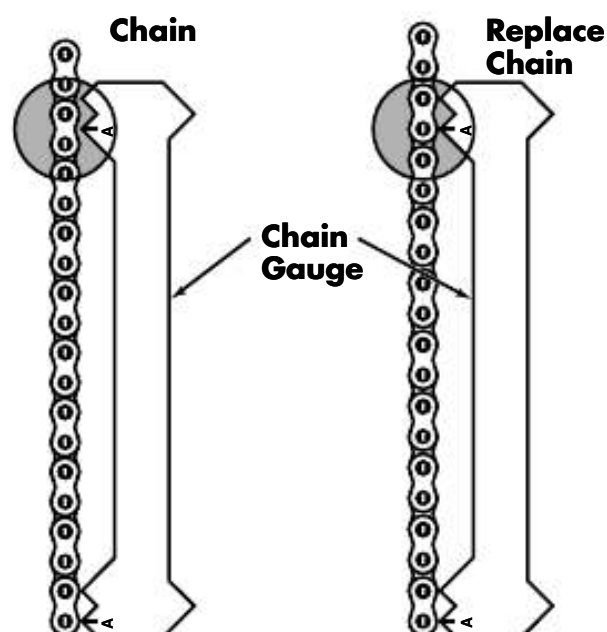
Chain Maintenance

Chain Maintenance

Inspection

Make sure chains are not damaged. Check the chain for wear using a Chain Gauge (P/N 950-350/CG). See [Figure 4-8](#).

Figure 4-8. Chain Gauge



Problem	Cause	Maintenance Procedure
Chain Elongation	Wear	Use a chain gauge or lay the chain on a flat surface and push it together. Measure and mark a 12 in. (305 mm) length that has operated over the pulley sheave. Stretch the chain; if more than 5/16 in. (8 mm) play is detected, replace the chain.
	Lack of oil	
Rust and Corrosion	Steam cleaning or degreasing new truck chains.	Oil chain frequently. Refer to Scheduled Maintenance.
Cracked Plates	Infrequent Oiling	Replace the chain.
	Rust	
	Corrosion	
	Chain Fatigue	
Tight Joints	Bent pins or plates	Replace the chain.
	Rusty joints or peened plate edges	Replace the chain.
Chain Side Wear	Chain misalignment	Realign the chain on the pulleys.

Chain Adjustment

See “Main Lift Chains (9600)” on page 7-92, “Main Lift Chains (9700)” on page 7-94, and “Fork Height and Lift Chain Adjustment” on page 7-115.

Fork Inspection

The following tools are required to perform fork inspection:

- Fork Wear Caliper (P/N 922-369)
- Tape Measure or Ruler
- 24 in. Framing Square
- 4 ft. Level

Do the following when performing Scheduled Maintenance.

Surface Inspection

Remove the forks from the carriage. Visually inspect all fork surfaces for signs of damage, including, but not limited to:

- cracks
- excessive wear
- excessive heat
- deformation
- unauthorized modifications

Pay special attention to the heel and welds attaching mounting components. If any damage is found, remove the fork from service.

Straightness of Blade and Shank

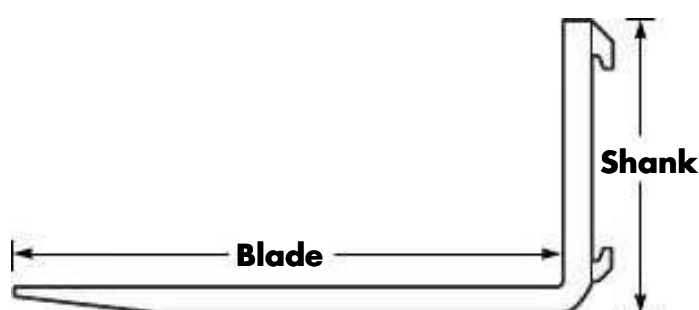
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N : This measurement can be done with the forks on or removed from the carriage.

1. Measure the length of the blade and the height of the shank. See Figure 4-9.

Figure 4-9. Measuring Fork Blade and Shank

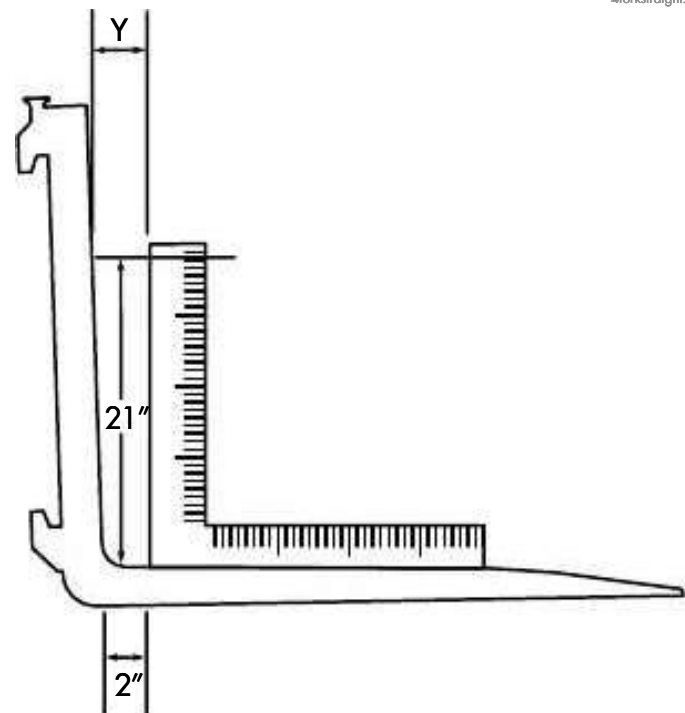
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2. Multiply these numbers by 0.5%. The smallest number is your maximum deviation.
 - Length of blade ____ x 0.5% = ____
 - Height of shank ____ x 0.5% = ____
3. Place a 24 in. framing square on the blade of the fork, 2 in. away from the heel of the fork. See Figure 4-10.
4. At 21 in., measure the distance between the face of the shank and the framing square. See Figure 4-10.

Figure 4-10. Fork Measurement with Framing Square

4forkstraight.svg



5. Compare this measurement, minus 2 in., to the smallest maximum deviation number determined in step 2.
6. If the maximum deviation number is exceeded, remove the fork from service.

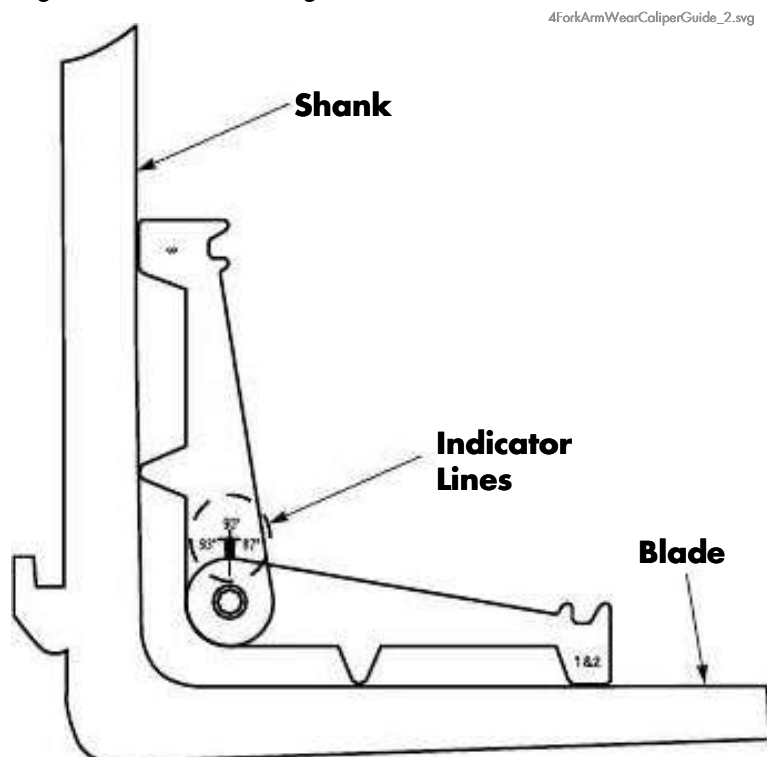
Fork Angle

NOTE: This measurement can be done with the forks on or removed from the carriage.

1. Place the fork caliper on the blade. Make sure that the two extruded points are touching the blade of the fork. See Figure 4-11.
2. Now open and move the caliper so the two extruded points are touching the shank. See Figure 4-11.

Fork Inspection

Figure 4-11. 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 4-11.
4. If the deviation is greater than 3° of the original angle, remove the fork from service.

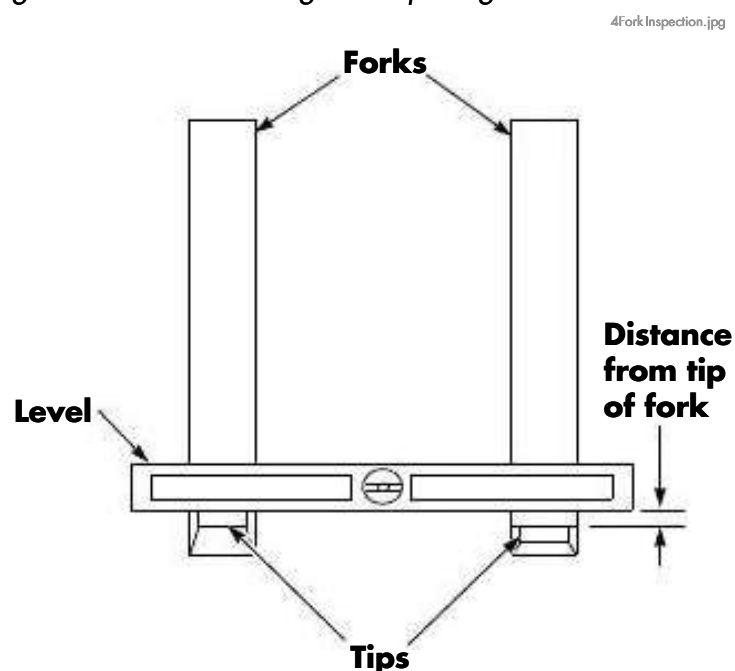
NOTE: Most forks are manufactured with a 90° angle; therefore, a reading greater than 93° or less than 87° is unacceptable. However, there are some forks that are purposely manufactured to angles greater than or less than 90°.

Fork Tip Height

1. With forks on the carriage, measure the length of the blade. See Figure 4-9.
 - 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%.
 $\text{Blade length } \underline{\hspace{1cm}} \text{ in.} \times 3\% = \underline{\hspace{1cm}} \text{ in.}$
 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 4-12.

4. Raise one end of the level to make it level. See Figure 4-12.
5. Measure the distance from the tip of the fork. See Figure 4-12.

Figure 4-12. Measuring Fork Tip Height



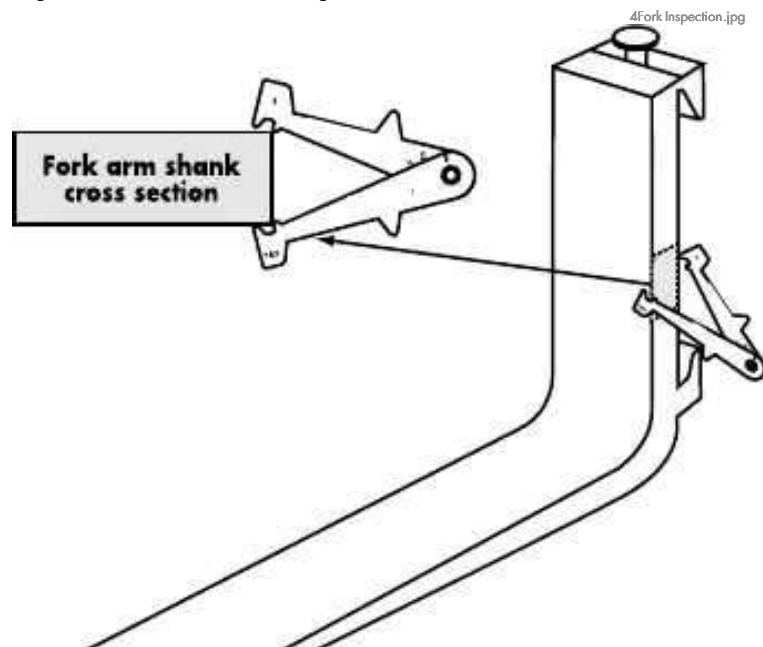
6. Compare this measurement to the maximum deviation.
7. If the maximum deviation number is exceeded, remove the fork from service.

Wear

Fork Blade and Shank

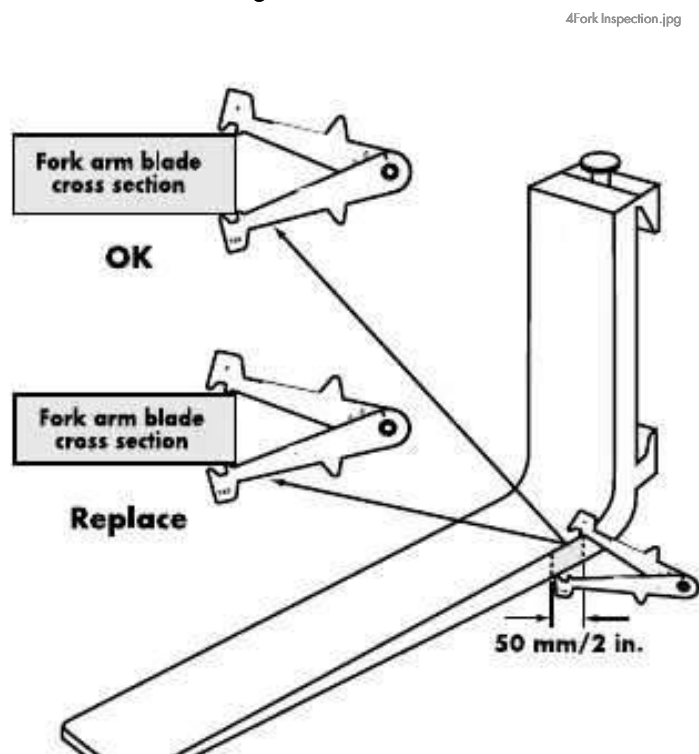
1. Remove the forks from the carriage.
2. Approx. halfway up the shank, set the front teeth of the jaws of the caliper on the shank. Make sure the caliper is held square across the shank to get an accurate reading. The caliper is now set to measure fork blade wear. Carefully remove the caliper from the shank. See Figure 4-13.

Figure 4-13. Measuring Fork Shank



3. Measure 2 in. (50 mm) out from the heel of the fork.
4. Place the caliper over the flanks of the fork arm blade at this 2 in. (50 mm) point. See Figure 4-14.

Figure 4-14. Measuring Fork Blade Wear



5. If the inside teeth of the caliper hit the fork, there is <10% wear. If the inside teeth pass freely over the fork arm, there is >10% wear and the fork must be removed from service.

CAUTION

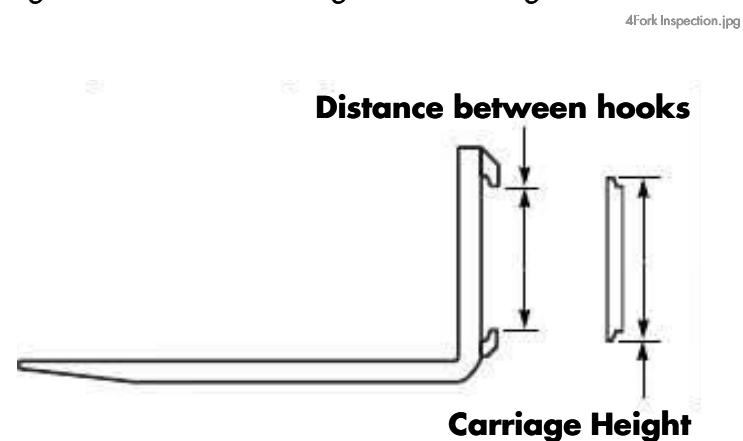
If there is greater than 10% wear of the fork arm, the fork has at least a 20% reduction in capacity.

NOTE: The caliper is designed to measure forks up to 4 in. (100 mm). It is not to be used on full or lumber tapered forks. For these forks, you must know the original fork blade thickness and take a measurement of the fork arm thickness. If the difference in the measurement exceeds 10% of the original thickness, the fork must be removed from service.

Fork Hooks

1. Remove the forks from the carriage.
2. Determine the fork mounting class.
 - a. Measure the height of the carriage or the distance between the hooks. See Figure 4-15.

Figure 4-15. Determining Fork Mounting Class



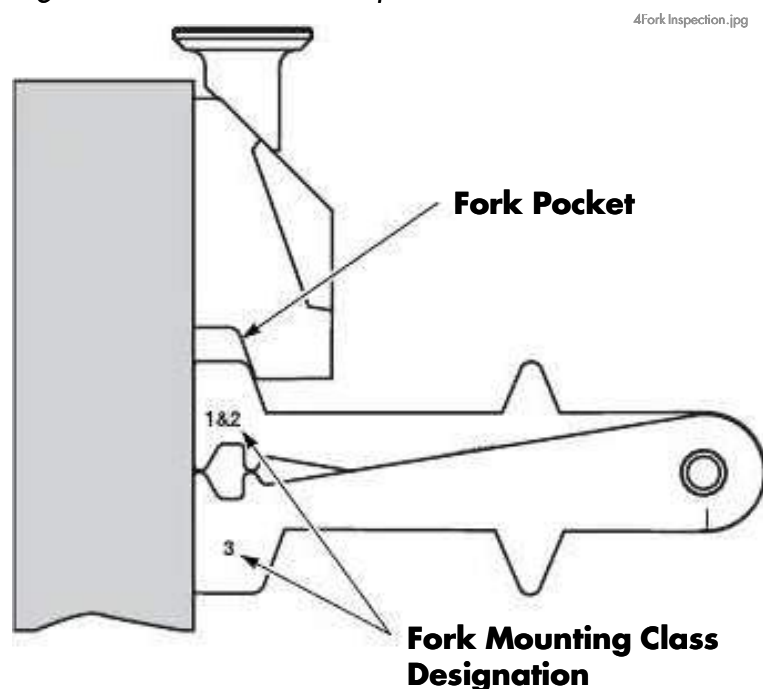
- b. Compare this measurement to the table below.

Fork Mounting Class	Distance Between Hooks in. (mm)	Carriage Height in. (mm)
1	12.05 (306)	13 (331)
2	15.04 (382)	16 (407)
3	18.78 (477)	20 (508)

Fork Inspection

3. Locate the correct extruded edge on the caliper for the fork mounting class. See [Figure 4-16](#).
4. Slide the extruded edge up into the hook pocket. See [Figure 4-16](#).
5. If the caliper's extruded edge *completely slides up into the fork pocket*, remove the fork from service. See [Figure 4-16](#).

Figure 4-16. Fork Hook Inspection



Markings

Make sure the fork's marking (individual load rating) is legible (typically located on side of fork). If fork marking is not legible, remove the fork from service.

Section 5. Troubleshooting

Electrical Troubleshooting

Electrical Troubleshooting

General



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

Use extreme care when the truck is jacked up for any reason. Never block the lift truck between the carriage and the floor. 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 2-10.

Unless otherwise directed, disconnect the battery connector when you check electrical circuits or components with an ohmmeter. Electrical current can damage an ohmmeter.

Before removing a power amplifier, discharge the amplifier's internal

capacitor by jumpering the + and - terminals with a 100 ohm 25W resistor.

- Many problems can be caused by a dirty battery. Make sure the battery is clean.
- Save time and trouble by looking for simple causes first.
- 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.

- Printed circuit boards are conformal coated. Make sure meter leads make a good electrical connection with test points.
- 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 key switch OFF and disconnect the battery connector. Battery current can damage an ohmmeter. Isolate the component from the circuit.

Shorts to Frame

Shorts to frame is an industry term for unintentional current leakage paths between normally isolated electrical circuits and their metal enclosures.

Shorts to frame may be metallic connections, such as a wire conductor contacting metal through worn insulation. More often, shorts to frame are resistive "leakage" paths caused by contamination and/or moisture.

These leakage paths can result in unwanted electrical noise on the metallic lift truck structure and can cause incorrect operation.

Shorts to frame are caused by:

- Accumulation of dirt
- Battery electrolyte leakage
- Motor brush dust
- Motor brush leads touching the housing
- Breakdown in insulation
- Bare wires
- Pinched wiring harness
- Incorrect mounting of circuit cards

Shorts to frame can occur at numerous locations on a lift truck, including:

- Batteries
- Motors
- Cables, wiring, and harnesses
- Heatsinks

- Bus bars
- Solenoids
- Contactors
- Terminal strips
- Switches
- Power panel insulation
- Circuit card mounts

Shorts to Frame Test

1. Turn the key switch OFF and disconnect the battery connector.
2. To test the battery for shorts to case, connect a 12V test light to the battery case from battery B+, and then to the battery case from battery B-. If the light illuminates at all, even momentarily, there is a serious problem with the battery, either external contamination or internal damage. Do not continue until this condition is corrected. The meter may be damaged if you proceed before correcting this condition.

Install another battery in the truck and repeat this procedure from Step 1.

If the test light does not illuminate, continue to the next step.

3. Use a DMM set on the ampere function to measure the current leakage from the battery case to battery B+ and from the battery case to battery B-. Begin measuring at the highest ampere scale and work toward the lowest. A reading of more than 0.001A (1mA) indicates a serious short. Do not continue until this condition is corrected. The meter may be damaged if you proceed before correcting this condition.

Install another battery in the lift truck and repeat this procedure from Step 1.

If the current is $<0.0002A$ (0.2mA), go to Step 4. If the current is $>0.0002A$ (0.2mA) and $<0.001A$ (1mA), remove the battery

from the truck, then continue with Step 4. Make sure the battery case does not touch

the truck frame during the remaining tests.

4. With the battery disconnected (or removed and disconnected) from the truck, use a DMM to measure the resistance from lift truck frame to truck B+, to truck B- (not battery B+ and B-), and to all fuses and motors. A reading of <1000 ohms indicates a serious short. Do not continue until this condition is corrected. The meter may be damaged if you proceed before correcting this condition.
 - a. To identify the cause of the short to frame, disconnect circuit components until the low resistance condition disappears. Do not reconnect components one at a time, but leave them disconnected until the low resistance reading disappears. Prevent disconnected terminals or connectors from touching the lift truck frame or other conductive surfaces.
 - b. The most likely areas to check are:
 - Motors
 - Heatsinks
 - Power cables
 - Power circuit components
 - Control circuit components
 - c. Repair or replace the component causing the low resistance condition. Repeat Step 4.
 - d. Reconnect all other components previously disconnected, one at a time, measuring resistance between steps. If a reading is <1000 ohms when reconnecting a component, that component or its wiring is faulty; repair or replace as appropriate.
 - e. When, after all components are reconnected, you get readings >1000 ohms, continue with the next step.
5. Reconnect the battery connector and turn the key switch ON. If the battery was previously removed, make sure the battery case does not touch the lift truck frame.

Section 5. Troubleshooting

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Electrical Troubleshooting

NOTE: The functions being checked must be energized. Example: to check for shorts to frame in the travel circuit, travel must be requested.

6. Use a DVM set to the current function to

measure current leakage to the truck frame from B+, B-, and all fuses and motor terminals. Begin measuring at the highest ampere scale and work toward the lowest. If the current is <0.001A (1mA), go to step 7. If the current is more than 0.001A (1mA), continue with the following steps.

a. To identify the cause of the short to frame, disconnect circuit components until the leakage current reads <0.001A (1mA). Do not reconnect components one at a time, but leave them disconnected until the leakage current reads <0.001A (1mA). Prevent disconnected terminals or connectors from touching the lift truck frame or other conductive surfaces.

b. The most likely areas to check are:

- Motors
- Heatsinks
- Power cables
- Power circuit components

- Control circuit components
- c. Repair or replace the component(s) causing the leakage current. Repeat Step 6.

d. Reconnect all other components previously disconnected, measuring current between steps. If a reading is more than 0.001A (1mA) when reconnecting a component, that component or its wiring is bad. Repair or replace as appropriate.

7. When, after all components are reconnected, you get a reading <0.001A (1mA) there is no short to frame condition with the truck or the battery. If you previously removed the battery from the truck, re-install the battery.

Fuses

Test/Inspection

Examine the fuse for signs of overheating, discoloration, cracking, or other physical damage. Replace as necessary.

To test a fuse, remove it from the lift truck. The resistance should be <1 ohm.

Table 5-1. Fuse Chart

Fuse	Amps	Location	Function
FU1	100	Contactora/Fuse Panel	Power fuse for steering
FU2	500	Contactora/Fuse Panel	Power fuse for traction
FU3	675	Contactora/Fuse Panel	Power fuse for lift
FU4	200	Contactora/Fuse Panel	Power fuse for Load Handler Motor
FU5	15	Fuse/Relay Card	B+ Control fuse for Key switch and EPO
FU6	15	Fuse/Relay Card	B- Control fuse for Tractor and Carriage Manager
FU7	15/5	Fuse/Relay Card	B+ Control fuse for options
FU8	15/5	Fuse/Relay Card	B- Control fuse for options
FU11	70	Contactora/Fuse Panel	Power fuse for Aux option
F101	2	Light/Fan Package	Fans/Lights
F102	2		
F103	2		
F104	2		

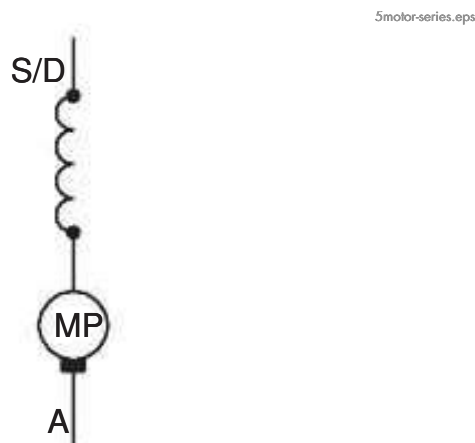
DC Motors

Types of DC Motors

There are two primary types of DC Motors:

- A series-wound motor has only two external connections because the armature and field windings are connected internally.

Figure 5-1. Series-Wound Motor Circuit



- A permanent magnet motor has two external connections. The field is produced by an internal magnet.

Figure 5-2. Permanent Magnet Motor Circuit



NOTE: Field connections may be labeled A or S. Series wound motor field connections may be labeled D.

Inspection

Inspect commutator for surface condition and high mica. Most armatures have the mica undercut. If the armature on your motor does not, do not attempt to cut it.

The commutator must be smooth and clean to provide maximum brush wear. When

commutators are not correctly maintained, carbon dust can collect in the grooves between

the segments. This can lead to a short circuit in the armature.

Good commutation is indicated by a dark brown polished commutator and an evenly polished brush wearing surface. See Table 5-2, "Commutator Surfaces."

If the commutator appears rough, pitted, or has signs of burning or heavy arcing between the commutator bars, remove the motor for service.

Service

If the commutator requires service, you must remove the armature from the motor.

Do not use a stone to even out high and low spots on the commutator.

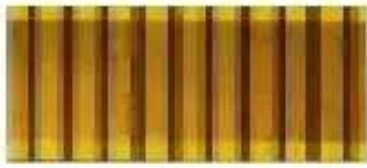

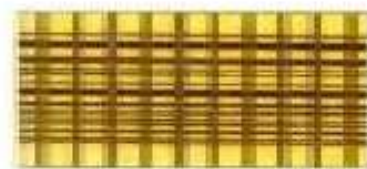

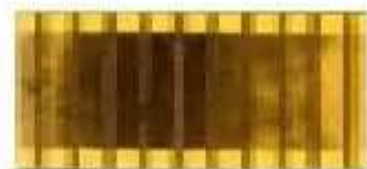




Service a motor for an abnormal commutator surface condition and high mica or mica undercutting requires special equipment at a motor rebuilding facility.

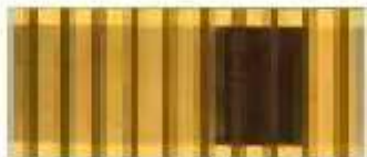


Section 5. Troubleshooting

Model 9600/9700 Swing-Reach® Maintenance Manual

Electrical Troubleshooting

Table 5-2. Commutator Surfaces

Condition	Probable Cause	Commutator Surface
Good Condition-Light Film	Uniform coloring indicates satisfactory operation of machine and brushes. Film color is largely an effect of thickness; therefore, provided the film is uniform, it is perfectly acceptable.	
Satisfactory Condition-Light and Dark Pattern	This is not a good condition, however, machines having this pattern have operated with satisfactory results for long periods of time. This condition can appear in alternating bars as shown or every 3rd or 4th bar. This is related to the winding design of the armature or difficulty caused from split windings crossing in the same slot.	
Unsatisfactory Condition-Streaky Film with No Commutator Wear	Frequently due to under-loaded operation, machine grossly over-brushed, or brush grade incorrect for particular machine application. Atmosphere and environmental conditions can contribute.	
Unsatisfactory Condition-Uneven Film	Patchy colors of varying densities and shape. Due to unclean operating conditions or incorrect physical condition of commutator.	
Unsatisfactory Condition-Film with Dark Areas	These areas can be isolated or regular. Commutator out-of-round. This can be caused by vibration or mechanical deficiencies in equipment operation, bearings, couplings, and so forth.	
Unsatisfactory Condition-Example of Poor Commutator Machining	Bars are low on entry and leaving edges giving rise to the brushes riding on the middle of the bars.	
Unsatisfactory Condition-Example of Poor Commutator Machining	Bars are low in the middle giving rise to the brushes riding on entry and leaving bar edges. This and the previous illustration indicate the need for better maintenance.	
Unsatisfactory Condition-Streaky Film with Commutator Wear	This is a further development of the third example. Brush grade, machine applications, and working environment are all suspect. Earlier corrective action should have been taken.	
Unsatisfactory Condition-Double Pole Pitch	Darkening of commutator in sequences two pole pitches apart is due to armature fault, bad coil, riser bars, or equalizer connections.	

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
Load Handler	LHM-A1 to LHM-S1	<1 ohm
	LHM-A1 or LHM-S1 to Frame	>100,000 ohms
Steer	MSA1 to MSA2	<1 ohm
	MSA1 or MSA2 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.

Electrical Troubleshooting

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

Short Circuited Armature or Field

Winding

A short circuited winding is one that the insulation on the field or armature has broken down at two or more points. The breakdown creates a low resistance path, allowing 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 usual (suggests a short in the field)
- Overheating
- Blowing a power fuse
- Burning of brush wires
- Severe burning or discoloration on armature coil
- Severe burning or discoloration on one or two commutator segments every 90° of rotation.

These symptoms can be caused by problems other than the motor itself, such as binding in a related pump, hose, or solenoid valve.

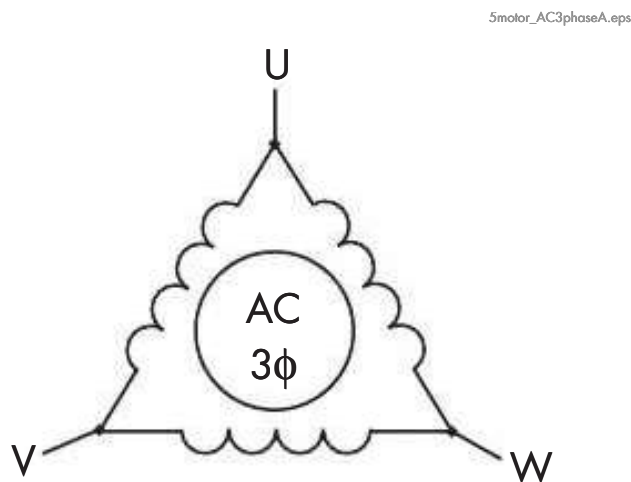
Testing a motor for short circuited windings requires special equipment at a motor rebuilding facility.

AC Motors

AC motors used on this lift truck are brushless, 3-phase, internally delta-connected, variable speed motors.

The AC motor has a rotor (in place of the DC armature) and a stator (in place of the DC field). There is no electrical connection to the rotor; current is induced in the rotor. The stator has three windings staggered 120° apart, and three external connections labeled U, V, and W. See [Figure 5-3](#).

Figure 5-3. Traction Motor Circuits



Open Winding

If the AC motor fails with an open winding, the motor moves erratically, as if hunting, and there is a ticking sound. Rotation is much slower than usual.

Using a clamping ammeter, measure current in each of the motor power cables. The open phase reads significantly lower than the other two phases.

Shorted Winding

If the AC motor fails with a shorted winding, the motor moves erratically, as if hunting, and there is a high-pitched sound.

Using a clamping ammeter, measure current in each of the motor power cables. The shorted phase reads significantly higher than the other two phases.

Electrical Troubleshooting

Battery State-of-Charge

Battery State-of-Charge (BSOC) is a feature that monitors and remembers the charge level of the battery connected to the lift truck and helps to prevent excessive discharging of the battery. Operating a lift truck using a discharged battery can damage both the battery and the electrical components of the lift truck.

At power-up, BSOC tests the battery voltage to determine if it is the same as it was at power-down. If the voltage is the same, BSOC assumes it is the same battery and continues to monitor the battery for discharge and updates the Operator Display as required.

If a different battery voltage is detected, BSOC assumes a different battery is installed and tests to determine the state-of-charge of the replacement battery. The replacement battery must meet one of the following criteria before the display resets and lift is restored.

- The replacement battery must have a charge level at least 50% different from the previously installed battery,
- The charge value of the replacement battery must be greater than the configured BSOC setting.

The criteria are determined in this way:

- BSOC compares the charge of the battery that was connected to the lift truck with the replacement battery's charge. A charge difference of at least 50% between the two batteries resets BSOC to show the state-of-charge of the replacement battery, that is, the measured state-of-charge of the replacement battery minus the remembered state-of-charge of the old battery must equal or exceed 50%. This reset can be higher or lower than the old battery.
- BSOC looks at the configured reset point. BSOC reset is programmable from 55% to 100% of total battery charge and can be changed by entering the Configure Mode using the Superword. The replacement

battery must be greater than the configured percent of charge before BSOC changes. Example - BSOC configured at

95%. Plugging in a battery at anything below 95% charge will not change the Operator Display. Older batteries or applications providing inadequate charging time could require a lower configured value for BSOC since older batteries might be unable to reach a higher percent charge. Therefore, some batteries could require BSOC configured as low as 55% before lift cutout resets and the Operator Display shows the charge of the replacement battery.

Setting Battery State-of-Charge Cutout

1. Fill, charge, and install a battery that is typical of the batteries normally used in this application.
2. Have a customer operator use the lift truck in normal application until cutout occurs.
3. Allow the battery to cool and stabilize for at least two hours.
4. Before filling the battery, either take specific gravity readings or measure open circuit voltage of the battery cells.
5. Compare the measurements with the battery manufacturer's recommendations for maximum discharge.
6. Adjust the cutout value as needed and repeat the previous steps until battery cutout occurs at the desired discharge level.

Electrical Connector Locator Chart

Terminology

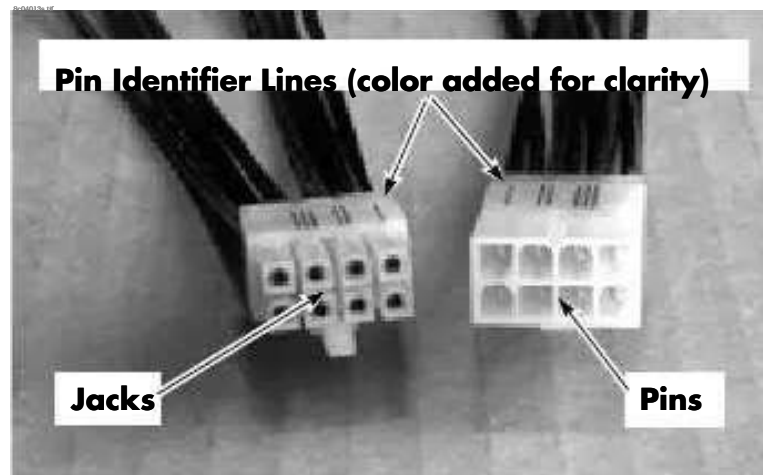
The term “connector JPx” means a mated connector consisting of two connector halves. One half contains male connectors, or pins (P); the other half contains female connectors, or jacks (J).

When you disconnect a mated JP connector, you will have two connector halves. The individual connector halves are designated by “Jx” and “Px.” If you cannot locate a connector designated “Jx” or “Px,” look for “JPx,” and vice versa.

Molex connectors have ridges on the sides to help locate pin number 1. The short side has a

single ridge at pin number 1. The long side has 1, 2, and 3 raised ridges at pin numbers 1, 2, and 3. See [Figure 5-4](#).

Figure 5-4. Molex Jack and Pin Connector



Use [Table 5-3](#) (or the graphics beginning on [page 5-15](#)) to locate electrical connectors on the lift truck.

Table 5-3. Electrical Connector Locator Chart

Connector	Location	Function/Destination
J1	Near Tractor Manager	Lift/Lower pendant
JP1L	Under Platform	Wire guidance load sensor antenna
JP1T	Behind Front Bumper	Wire guidance tractor sensor antenna
JP2	Load Handler	Mini-mast height prox
JP3	Near Reach Scissors	Reach prox
JP4	Near Rotate Pot	Rotate pot
JP5	Turret - underside	Mini power supply
JP10	Top Tractor Cover	Warning/strobe light
JP12	Mast Crosstie	Travel light
JP18	Under Seat	OTM cable
JP19	Under seat - left side	
JP20	Right side of Seat	Load handler solenoid intermediate connector
JP21	Top of Mini-Mast	
JP27	Left Control Handle	Left-hand deadman
JP46	Main Manifold	Mini-Mast lift pressure transducer
JPA1	Supplemental Display	Supplemental Operator Display
JPA7	Drive Unit - right side	Home steer prox

Section 5. Troubleshooting

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Electrical Connector Locator Chart

Connector	Location	Function/Destination
JPB-	Battery	B- cable
JPB+		B+ cable
JPBR	Top of Traction Motor	Brake coil
JPBSEN1	Above Main Manifold	Battery gate prox 1
JPBSEN2	Underneath Horn	Battery gate prox 2
JPC4	Carriage Manager	Refer to “Schematics” on page A-19.
JPC6		
JPC10		
JPC12		
JPC14		
JPC18		
JPC22		
JPC24		
JPD1	Display Interface Card	Display screen
JPD2		Menu switches
JPD3		CAN Bus+ power
JPD4		Horn (sounder)
JPD5		CAN baud rate
JPE1	Under Left Control Handle	Steer Encoder
JPE2		
JPE4	Steer Motor	Steer motor feedback encoder
JPE5	Tractor Bulkhead Panel	Main lift height encoder intermediate connector
JPE5A	Top of Mast	Main lift height encoder
JPF1	Fuse/Relay Card	Refer to “Schematics” on page A-19.
JPF2		
JPF3		
JPF4		
JPK2	Top of Mini-Mast	Traverse Feedback Pot
JPKP	Right Control Handle	Operator display control switches
JPL1	Left Control Handle	Left control handle inputs to CM
JPL2	Inside Left Control Handle	5V supply to VR3 and VR4
JPL19	Right side of Seat	Light/Fan harness intermediate connector

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Electrical Connector Locator Chart

Connector	Location	Function/Destination
JPLA1	Lift Power Amp	LPA connector
JPLA2	Near Lift Motor	Lift motor encoder
JPLA3		Lift motor temperature sensor
JPOM1	Top of Mini-Mast	Over the mini-mast cable
JPOM2	Turret - underside	
JPOM3	Top of Mini-Mast	
JPOM4	Turret - underside	
JPFAN1	Near Load Handler pump	Load handler cooling fan
JPFAN2	Top cover	Top cover cooling fan (optional)
JPFAN3		
JPR1	Right Control Handle	Right control handle
JPR2	Inside Right Control Handle	5V supply to VR1 and VR2
JPRDP	Supplier Wireless Module	<i>iWarehouse</i>
JPLHA1	Below Left Control Handle	Left control handle - intermediate connector
JPLHA2		Left control handle heater option - intermediate connector
JPRHA1	Below Right Control Handle	Right controls (handle, EPO, key switch) - intermediate connector
JPRHA2		Display, lights, and fan switches - intermediate connector
JPRHA3	Near Carriage Manager	Right control handle heater option - intermediate connector
JPS1	Contactor Panel	Contactor panel interface
JPS2		
JPS3	Tractor Bulkhead Panel	Slack Chain Switch 1
JPS4	Guidance Manager	Guidance Manager
JPS5	Tractor Bulkhead Panel	Slack Chain Switch 2
JPS6	Guidance Manager	Guidance Manager
JPS7	Behind Fuse/Relay Card	Top cover cooling fan (optional)
JPS8	Tractor Bulkhead Panel	Lift reference prox switch
JPS25		OTM cable
JPS26		
JPS27	Right side of Seat	Over the mini-mast cable
JPS44	Near Guidance Manager	Travel light - intermediate connector
JPS45		Travel alarm - intermediate connector

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Electrical Connector Locator Chart

Connector	Location	Function/Destination
JPS50	Main Manifold	Main lift pressure transducer
JPS54	Behind Fuse/Relay Card	Aisle detect sensors - intermediate connector
JPS55	Near Steer Motor	Rail guidance switch
JPT2	Tractor Manager	Refer to "Schematics" on page A-19.
JPT4		
JPT6		
JPT9		
JPT10		
JPT12		
JPT14		
JPT18		
JPT20		
JPT22		
JPT24		
JPTA1	Traction Power Amplifier	TPA connector
JPTA2	Traction Motor	Traction motor encoder
JPTA3		Traction motor temperature sensor
JPTA4	Harness above Traction Motor	Traction motor encoder/temp sensor intermediate connector
JPW1	Filter Card	Load sensor antenna connector
JPW2		Tractor sensor antenna connector
JPW7	Right Control Handle	Control handle heater, right side - optional
JPW8	Left Control Handle	Control handle heater, left side - optional
JPZ	Near Load Handler Fan	Load Handler Motor temperature sensor

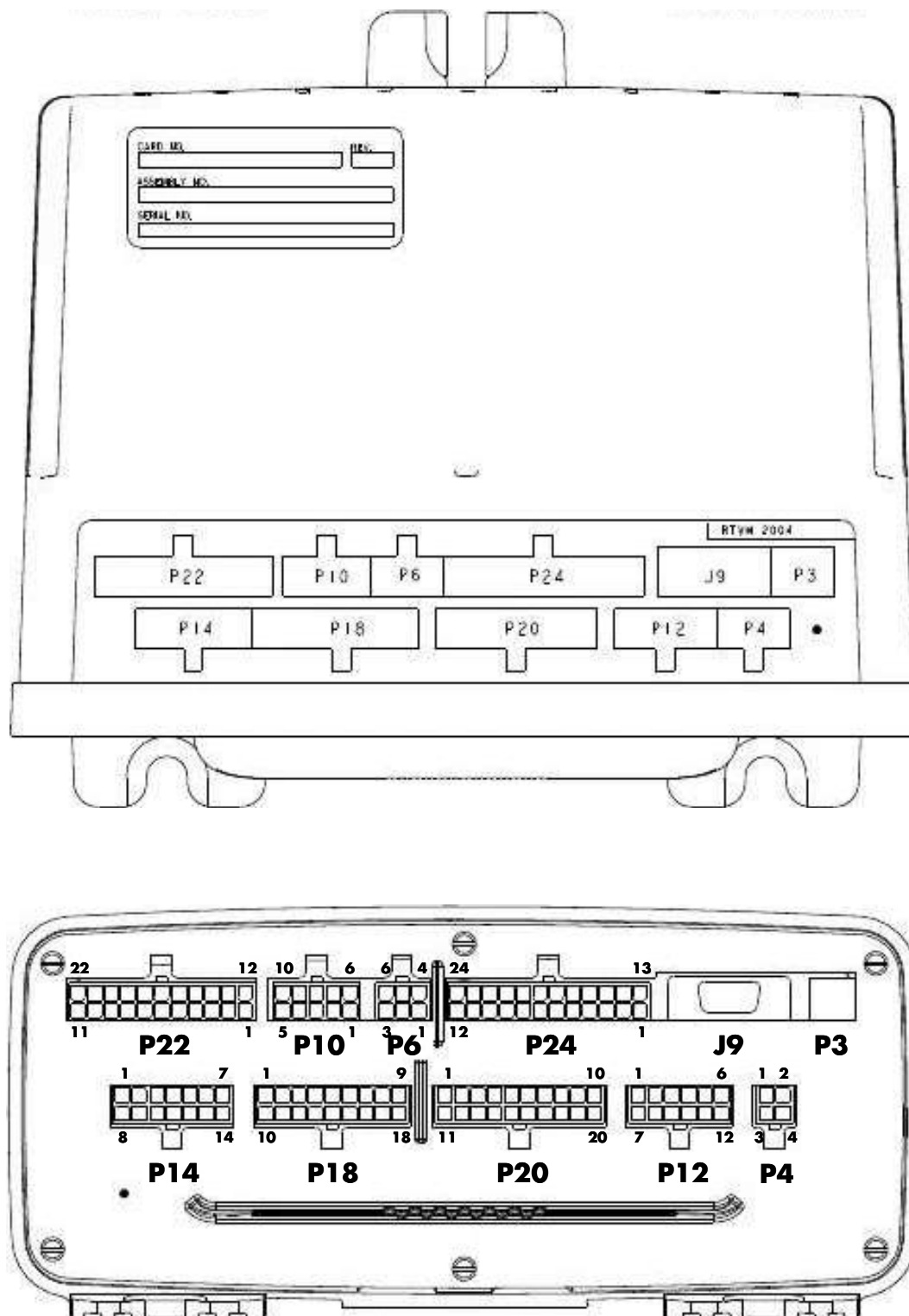
Circuit Card Connectors

Refer to the following figures for circuit card connector and pin locations.

Tractor and Carriage Manager

Figure 5-5. Tractor/Carriage Manager Connectors

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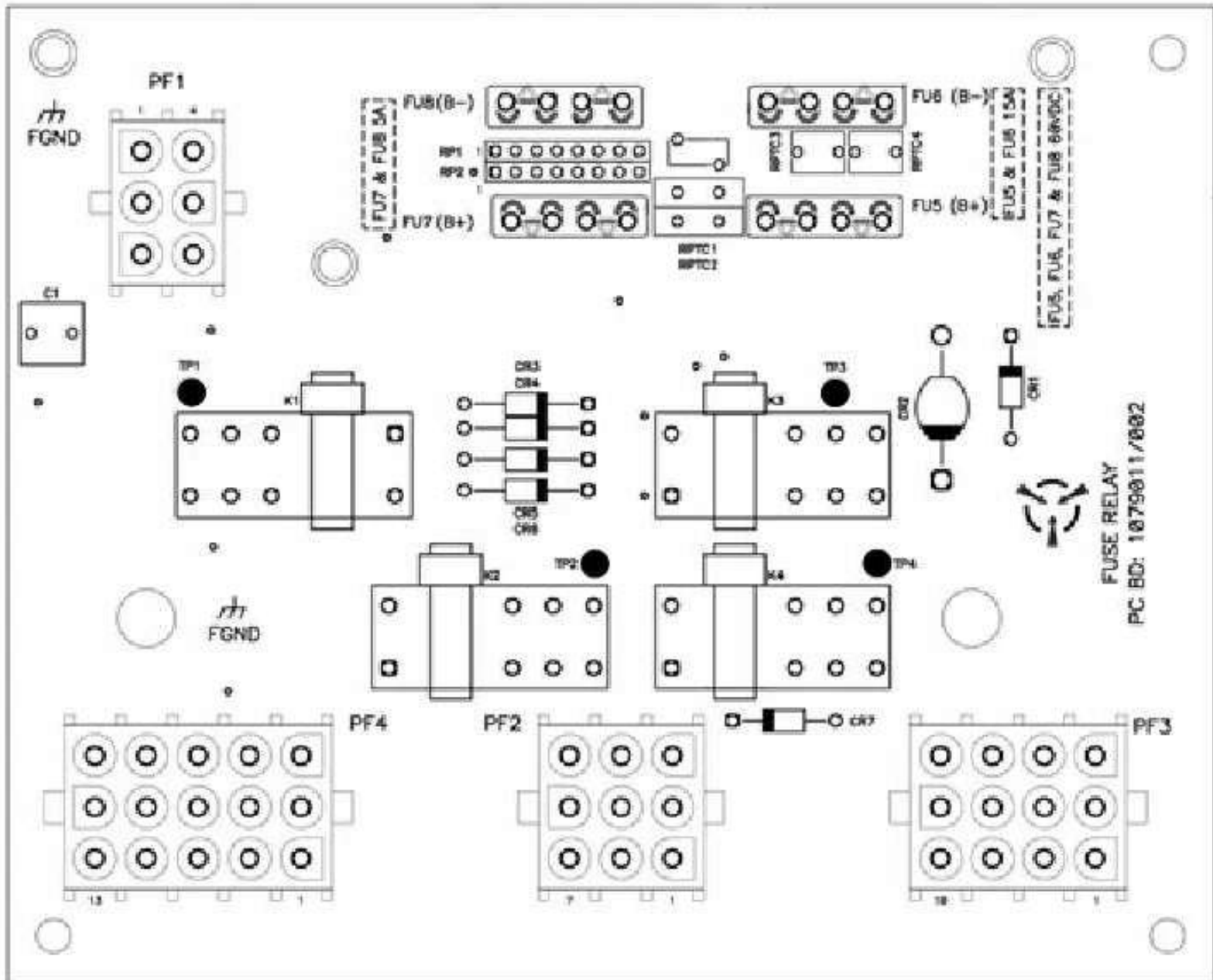
Section 5. Troubleshooting

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Circuit Card Connectors

Fuse/Relay Card

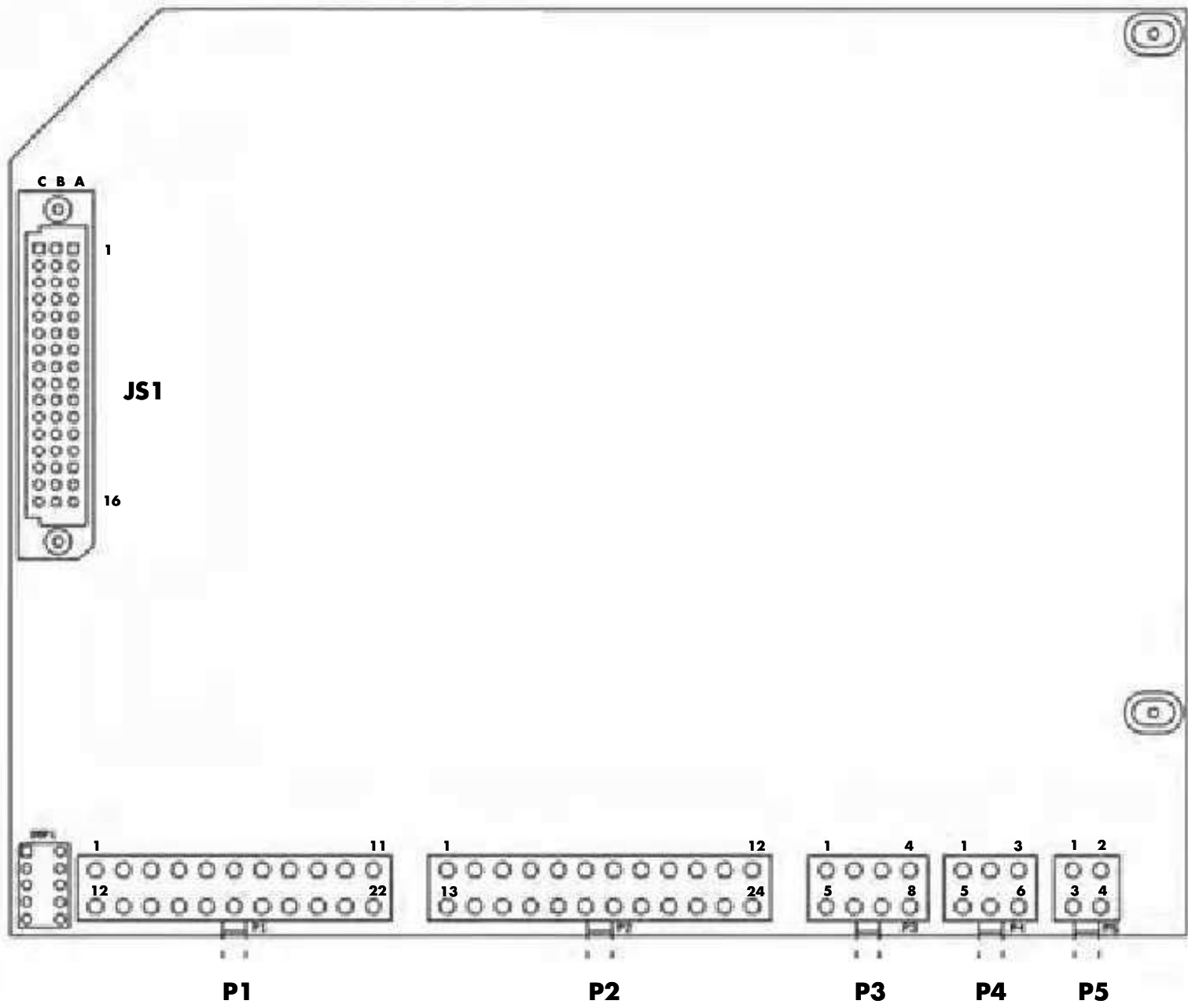
Figure 5-6. Fuse/Relay Card Connectors



Guidance Manager

Figure 5-7. Guidance Manager Connectors

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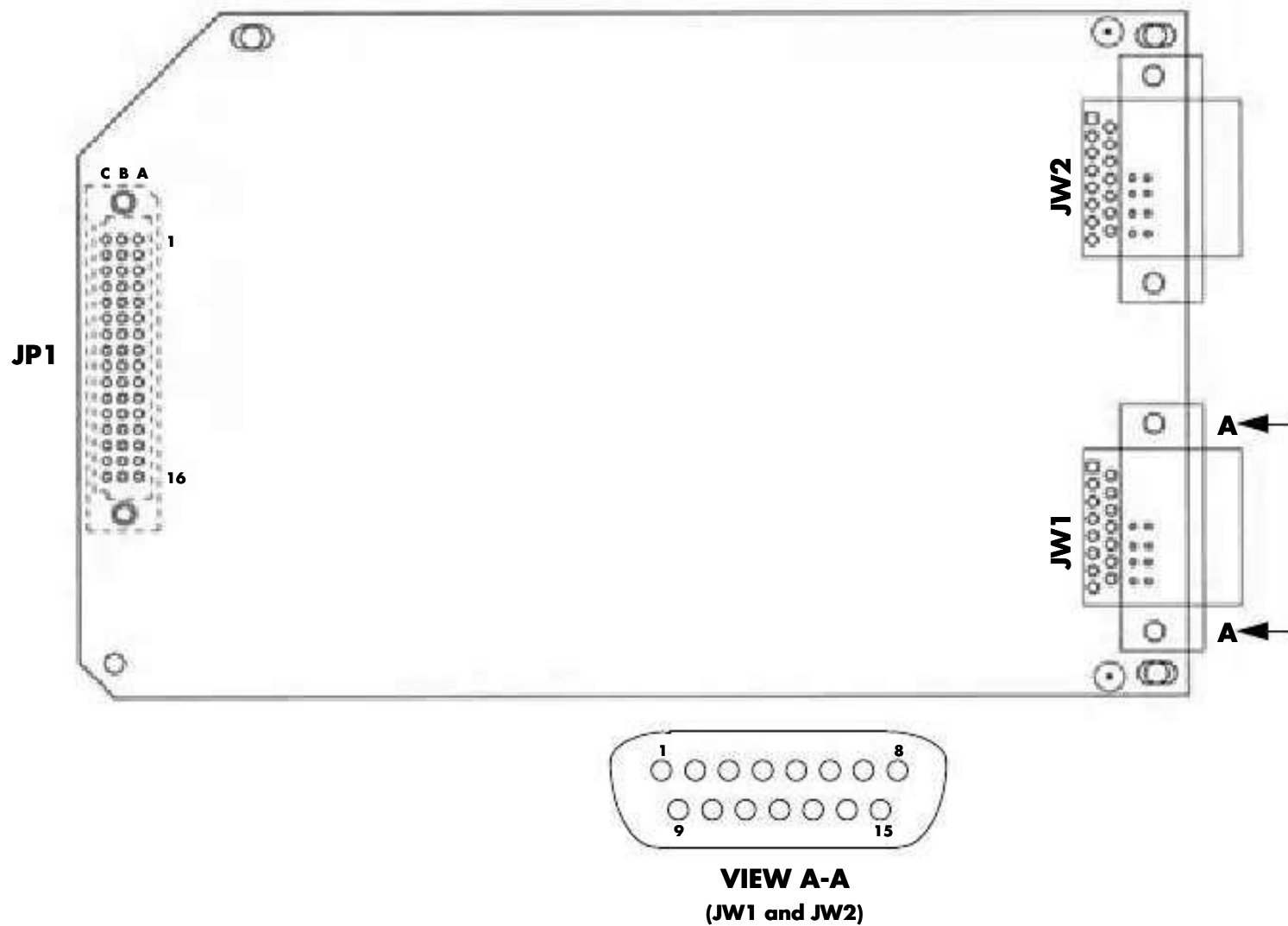


Circuit Card Connectors

Wire Guidance Filter Card

Figure 5-8. Wire Guidance Filter Card connectors

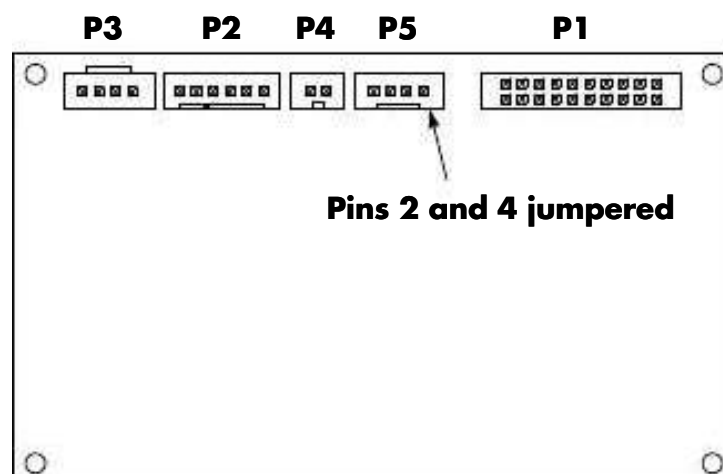
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Display Interface Card

Figure 5-9. Display Interface Card Connectors

6-00008a.tif



Troubleshooting Communication Error Codes (5x Series)

Troubleshooting Intermittent Communication Error Codes

If a Code 50, 51, 55, 56, 57, 59, 5A, 5E, 5G, or 5J is intermittently displayed, determine if there is a particular pattern that repeats itself. The following table lists possible causes and actions to perform.

Scenario	Action
Code is displayed while traveling	Check static straps. Refer to “Component Specific Service/Torque Chart” on page A-4 .
Code is displayed while lifting	Check over-the-mast cable.
Codes are randomly displayed	Refer to Shorts to Frame Test (page 5-3) . Check static straps. Refer to “Component Specific Service/Torque Chart” on page A-4 . Check wiring harness for loose connections in CAN Bus splices. Unplug and inspect associated CAN Bus jacks and pins.
Code is displayed while steering	Check cables and wiring to the Traction Motor. Cable ties should not be too tight. Make sure cable and wire insulation is not damaged.

If the above checks are performed and the code is still displayed, replace the Tractor Manager.

Troubleshooting Code 51

If Code 51 is displayed during SelfTest:

1. Check for correct jumper installation at the Carriage Manager between JPC22-22 and JPC24-4.
2. Check connections at JPC14-4 and JPC14-11.
3. Connect FlashWare directly to the Carriage Manager to verify manager is able to communicate. Refer to [“Install Cleared \(New\) Manager” on page 3-19](#).

Troubleshooting Communication Error Codes (5x Series)

Troubleshooting Code 57

Code 57 is displayed when the Display Interface Card is unable to communicate with the Tractor Manager. The appearance of this code (much

larger scale numbers) differs from any other displayed code. Inputs and Output tests are not accessible when this code is displayed and a 5Q is registered in the error log.

NOTE: This code is displayed if the K2 relay tips are welded when the key switch is turned OFF.

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	Key ON/ DCV	JPT14-12	JPT14-1	Approx. 48V	Perform step 4	Perform step 2
2			TP4		Perform step 3	T/S OTM cable, key switch, fuse circuit, and wiring
3	DCV	TP1	JPT14-1		Perform step 1	T/S fuse circuit and wiring
4	Key ON/ DCV	JPC14-5	JPC14-2	Approx. 12V	Perform step 5	Unplug all connectors from CM except JC14 and check voltage again. If 12V is present, T/S the circuit that is pulling it down. If not OK, replace the CM.
5	Connect FlashWare to the truck and check TM software version. If a valid software version appears, the test is a success.				T/S Bus1 wiring from the TM to the Display Interface Card. Check jumper at JPD5.	Attempt to load a valid software version into the TM. If unable to load software, replace TM. If S/W load was successful, check for shorts to frame, static straps, and repair as necessary.

Wire Guidance Troubleshooting

Intermittent Codes or Learn Problems

If Wire Guidance related codes are displayed intermittently or problems running Learn Wire Guidance occur, check for the following:

- bad radial rings
- dirty antennas
- worn load wheels or drive tire
- bad spur (steering) gear
- bad steer motor
- damaged cables
- bad line driver
- shorts to frame

Refer to Publication PDSS-0051 for floor related issues.

Bad Coil Values

If a Code 93, 94, 9J, or 9K is displayed or problems performing Step 1 of the Learn Wire Guidance process are encountered, perform the following procedure.

1. Verify line driver frequency/output.

NOTE

N : Most line drivers are equipped with a decal on the inside of the access door that identifies the frequency.

NOTE: Antenna signal strength can be influenced by several factors that are floor related and not truck related. If the value displayed varies at the same location (such as an expansion joint) every time, this may indicate a problem in the floor. For more information, refer to Publication PDSS-0051.

CAUTION

If it is necessary to interrupt the floor signal, notify all personnel that may be using the guideway.

2. Position the truck over the guidewire to within 0.5 in. (13 mm) of center (it is easier to center the load antenna first).
3. Enter Maint/Wire Guidance/Coil Values. Refer to “Coil Values” on page 3-38.

NOTE: If truck is locked on the wire when Coil Values is entered, cycle the Auto/Man switch.

4. Using the **right** button, cycle to the frequency of the line driver determined in step 1.
5. Observe coil readings. See Figures 5-10 and 5-11. If all are low (less than 10%), refer to Diagnosis and Repair. Figure 5-10 shows a good Load Antenna and a bad Tractor Antenna.

Figure 5-10. Coil Readings - Bad Tractor Antenna

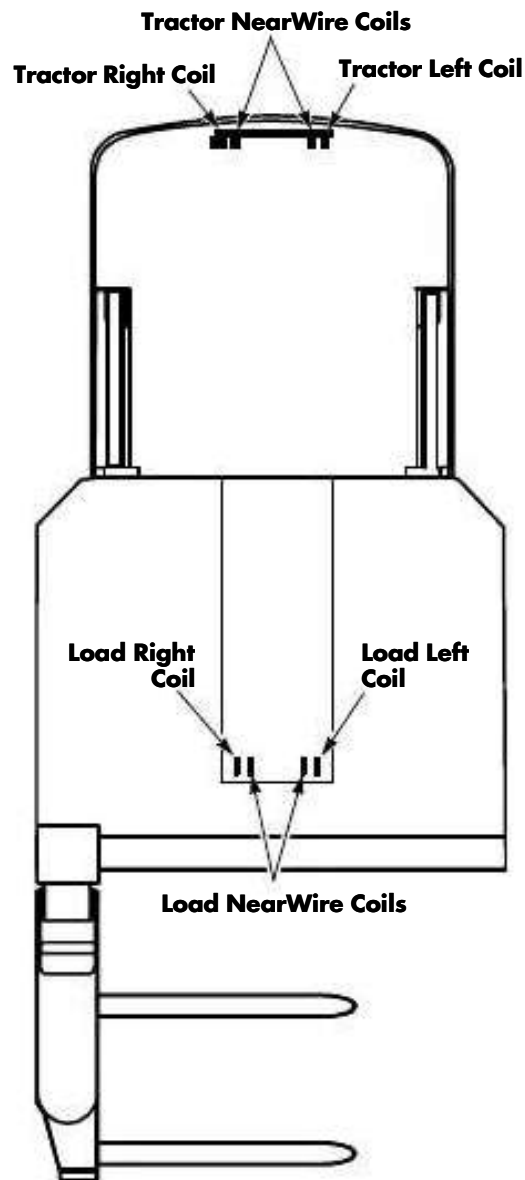


Section 5. Troubleshooting

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Wire Guidance Troubleshooting

Figure 5-11. Coil Locations



6. If one or more coil readings are low, turn the key switch OFF, disconnect the battery, and swap the JPW1 (Load) and JPW2 (Trac) connectors at the Filter Card.
 - If the problem follows the antenna and cable, troubleshoot the cable and antenna.
 - If the readings do not change, refer to Diagnosis and Repair.

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	Disconnect Antenna Cables at JPW1 and JPW2/DCV	JW1-15	JW1-14	10.5 to 13V	Perform step 2	Perform step 3
2		JW2-15	JW2-14		Replace Filter Card	Perform step 3
3	Remove Filter Card/DCV	JA1-B1	JPS6-24 (Backprobe connection)		Replace Filter Card. Recheck coil values. If correct results are still not obtained, replace GM	Replace the GM

Troubleshooting Steering Fault Codes (G Series)

If Code G2, G3, or G4 is displayed *before* the truck is operated, refer to “Code Displayed After Deadman Pedal Is Depressed”. If code is displayed *during* operation, refer to “Intermittent Steering Related Error Codes”.

Code Displayed After Deadman Pedal Is Depressed

If a code is displayed after the deadman pedal is depressed, observe the reaction in the steering system and refer to the following table:

Scenario	Action
Truck steers and does not contact mechanical stops.	Refer to Input I25 – Str Encdr [Steer Motor Encoder] (page 6-84) and Input I39 – Neut Pulse [Neutral Pulses] (page 6-91) . Run Test O44 – Steer Mtr [Steer Motor] (page 6-140) .
Truck steers in one direction only and contacts mechanical stop.	Check home steer prox sensor adjustment. Refer to Input I24 – Str Home [Home Steer Proximity Sensor] (page 6-83) and Input I25 – Str Encdr [Steer Motor Encoder] (page 6-84) . Run Test O44 – Steer Mtr [Steer Motor] (page 6-140) .
No movement in steering. Mechanical issue, worn radial ring.	Run Test O44 – Steer Mtr [Steer Motor] (page 6-140) .

Intermittent Steering Related Error Codes

If the truck has intermittent error codes, determine if there is a particular pattern that repeats itself. The following table lists possible causes and actions to perform.

Possible Cause	Action
Noise, shorts to frame	Refer to Shorts to Frame Test (page 5-3) . Check static straps. Refer to “ Component Specific Service/Torque Chart ” on page A-4 .
Calculated position of the drive unit bad	Check adjustment of home steer prox. Check home steer prox sensor sense rail for damage.
Large correction to steering prior to braking	Steer Motor Encoder, Steer Amplifier (SA), or TM may be bad. Check home steer prox adjustment.
Mechanical issue, worn radial ring	Refer to Input A37 – Str Curr [Steer Motor Current] (page 6-58) to determine if excessive current is required by the steer motor. Repair or replace as necessary.

Hydraulic Troubleshooting Guidelines

Hydraulic Troubleshooting Guidelines

CAUTION

After elevating or reaching the carriage for troubleshooting, use blocks to secure the carriage. Never remove a block when it is supporting the mast.

Lower the carriage fully and retract the reach mechanism fully.

When you check voltage at solenoids, make sure hydraulic lines and components are fully installed.

Whenever possible, keep the key switch OFF, the battery connector disconnected, and the Emergency Lowering Valve open.

Cap open hydraulic lines to prevent contamination.

Symptom Tables: Hydraulic System

Load Handler Functions Traverse - Erratic Operation

Possible Cause	Action
Bad Traverse Position Feedback Pot or wiring	Refer to Input A86 – Trv Posn [Traverse Position Feedback Pot (VR5)] (page 6-64).
Contamination in hydraulic system	Inspect mesh screen in Load Handler manifold, Traverse Solenoids 9A/B and CV4 for contamination. If found, flush and refill system.
Bad Traverse Directional Solenoid	Run Test O56 – Sol9A DirA [Traverse DIR A (SOL9A)] (page 6-147) and Test O57 – Sol9B DirB [Traverse DIR B (SOL9B)] (page 6-148).
Traverse Relief Valve	Check REL-3 pressure setting. Refer to “Traverse Pressure Adjustment” on page 7-78.
Bad Traverse PWM Solenoid	Run Test O58 – Traverse PWM [Traverse PWM (SOL7)] (page 6-149).
Mechanical binding in Rack assembly	Refer to “Shimming the Mini-Mast” on page 7-105.
Binding or excessive play in Traverse Motor	Replace Traverse Motor.

Traverse - Intermittent Operation

Possible Cause	Action
Bad Traverse Feedback Pot	Refer to Input A86 – Trv Posn [Traverse Position Feedback Pot (VR5)] (page 6-64).
Contamination in hydraulic system	Inspect mesh screen in Load Handler manifold, Traverse Solenoids 9A/B and CV4 for contamination. If found, flush and refill system.
Bad Traverse Directional Solenoid	Run Test O56 – Sol9A DirA [Traverse DIR A (SOL9A)] (page 6-147) and Test O57 – Sol9B DirB [Traverse DIR B (SOL9B)] (page 6-148).
Bad Traverse PWM Solenoid	Run Test O58 – Traverse PWM [Traverse PWM (SOL7)] (page 6-149).
Traverse Relief Valve	Check REL-3 pressure setting. Refer to “Traverse Pressure Adjustment” on page 7-78.
Binding or deformed Traverse Rack	Refer to “Shimming the Mini-Mast” on page 7-105.

Section 5. Troubleshooting

Model 9600/9700 Swing-Reach® Maintenance Manual

Symptom Tables: Hydraulic System

Possible Cause	Action
Binding Traverse Motor	Replace Traverse Motor.

Traverse - Noisy

Possible Cause	Action
Misaligned, damaged, or worn Rack assembly	Refer to “Shimming the Mini-Mast” on page 7-105.
Worn Traverse Shaft Gear	See “Traverse Gear Shaft” on page 7-110.
Worn Traverse Follower Bearings	Replace bearings. See “Traverse Gear Shaft” on page 7-110.

Traverse - Slow Operation

Possible Cause	Action
Contamination in hydraulic system	Inspect Traverse Solenoids 9A/B for contamination. If found, flush and refill system.
Incorrect Load Handler pressure relief setting	Adjust pressure. See “Load Handler Pressure Adjustment” on page 7-77.
Bad Load Handler Pump	Check pressure. See “Load Handler Pressure Adjustment” on page 7-77.
Bad Traverse Directional Solenoid	Replace or swap valves and see if symptoms change. If so, original solenoid valve is bad. See “Load Handler Manifold” on page 7-71.
Bad Traverse Pot	Refer to Input A85 – Trv Pot [Traverse/Reach Pot (VR4)] (page 6-63).
Mechanical binding in Traverse Rack or Motor	Refer to “Shimming the Mini-Mast” on page 7-105.
Traverse Relief Valve	Check REL-3 pressure setting. Refer to “Traverse Pressure Adjustment” on page 7-78.

Traverse - One Direction Only

Possible Cause	Action
Bad Traverse Directional Solenoid	Run Test O56 – Sol9A DirA [Traverse DIR A (SOL9A)] (page 6-147) and Test O57 – Sol9B DirB [Traverse DIR B (SOL9B)] (page 6-148).

Rotate - Erratic Operation

Possible Cause	Action
Bad Rotate Position Feedback Pot or wiring	Refer to Input A88 – Rot Posn [Rotate Position Feedback Pot (VR6)] (page 6-66).

Symptom Tables: Hydraulic System

Possible Cause	Action
Contamination in hydraulic system	Inspect Rotate Direction Solenoids 10A/B for contamination. If found, flush and refill system.
Bad Reach Prox or wiring	Refer to Input I04 – Bypass S7 [Lift/Lower Inhibit Bypass Switch (S7)] (page 6-76) . Tap lightly on the sensor to see if condition changes.
Bad Fork Control Solenoids	Run Test O53 – Sol10A DrA [Reach/Rotate DIR A (SOL10A)] (page 6-144) and Test O54 – Sol10B DrB [Reach/Rotate DIR B (SOL10B)] (page 6-145) .
Bad Traverse PWM Solenoid	Run Test O58 – Traverse PWM [Traverse PWM (SOL7)] (page 6-149) .
Bad Reach/Rotate PWM Solenoid	Run Test O55 – Rch/Rot PWM [Reach/Rotate PWM (SOL8)] (page 6-146) .
Mechanical binding in Rotate Actuator	Check the Rotate Actuator and replace if necessary.
Incorrect or missing orifices in Rotate Actuator elbow fittings	Examine. Replace as necessary.

Rotate - Intermittent Operation

Possible Cause	Action
Bad Fork Control Solenoids	Run Test O53 – Sol10A DrA [Reach/Rotate DIR A (SOL10A)] (page 6-144) and Test O54 – Sol10B DrB [Reach/Rotate DIR B (SOL10B)] (page 6-145) . Monitor current flow while tapping on coil body.
Bad Reach Prox or wiring	Refer to Input I04 – Bypass S7 [Lift/Lower Inhibit Bypass Switch (S7)] (page 6-76) . Tap lightly on the sensor to see if condition changes.
Mechanical binding in Rotate Actuator	Replace Rotate Actuator.

Rotate - Slow Operation

Possible Cause	Action
Bad Load Handler Pump	Check pressure. See “Load Handler Pressure Adjustment” on page 7-77 .
Contamination in hydraulic system	Inspect Fork Control Solenoids 10A/B for contamination. If found, flush and refill system.
Bad Fork Control Solenoid Valves	Replace or swap valves and see if symptoms change. If so, original solenoid valve is bad. See “Load Handler Manifold” on page 7-71 .
Bad Traverse PWM Solenoid	Run Test O58 – Traverse PWM [Traverse PWM (SOL7)] (page 6-149) .

Section 5. Troubleshooting

Model 9600/9700 Swing-Reach® Maintenance Manual

Symptom Tables: Hydraulic System

Possible Cause	Action
Incorrect Load Handler pressure relief setting. Note: Incorrect pressure relief would likely also affect reach and traverse functions.	Adjust pressure. See “Load Handler Pressure Adjustment” on page 7-77.
Mechanical binding in Load Handler	Replace parts as necessary.

Rotate - Noisy Operation

Possible Cause	Action
Worn, damaged, or misaligned Rotate Carriage Lower Bearing	Replace bearing.
Bad Rotate Actuator	Replace Rotate Actuator.

Rotate - One Direction Only

Possible Cause	Action
Bad Fork Control Solenoids	Run Test O53 – Sol10A DrA [Reach/Rotate DIR A (SOL10A)] (page 6-144) and Test O54 – Sol10B DrB [Reach/Rotate DIR B (SOL10B)] (page 6-145).
Mechanical binding or bad Rotate Actuator	Replace Rotate Actuator.

Reach - Erratic Operation

Possible Cause	Action
Bad Rotate Position Feedback Pot or wiring	Refer to Input A88 – Rot Posn [Rotate Position Feedback Pot (VR6)] (page 6-66).
Damaged or worn Reach Cylinder	Replace Reach Cylinder.
Worn Scissors Bearings or deformed Scissors Assembly	Replace bearings or repair/replace scissors assembly.
Bad Traverse PWM Solenoid	Run Test O58 – Traverse PWM [Traverse PWM (SOL7)] (page 6-149).
Bad Reach/Rotate PWM Solenoid	Run Test O55 – Rch/Rot PWM [Reach/Rotate PWM (SOL8)] (page 6-146).
Bad Reach Solenoid	Run Test O06 – Sol11 Rch [Reach Select Solenoid (SOL11)] (page 6-128).
Bad Fork Control Solenoids	Run Test O53 – Sol10A DrA [Reach/Rotate DIR A (SOL10A)] (page 6-144) and Test O54 – Sol10B DrB [Reach/Rotate DIR B (SOL10B)] (page 6-145).

Reach - Intermittent Operation

Possible Cause	Action
Bad Rotate Position Feedback Pot or wiring	Refer to Input A88 – Rot Posn [Rotate Position Feedback Pot (VR6)] (page 6-66)
Bad Reach Solenoid	Run Test O06 – Sol11Rch [Reach Select Solenoid (SOL11)] (page 6-128) .
Bad Traverse PWM Solenoid	Run Test O58 – Traverse PWM [Traverse PWM (SOL7)] (page 6-149) .
Bad Fork Control Solenoids	Run Test O53 – Sol10A DrA [Reach/Rotate DIR A (SOL10A)] (page 6-144) and Test O54 – Sol10B DrB [Reach/Rotate DIR B (SOL10B)] (page 6-145) .
Bad Reach/Rotate PWM Solenoid	Run Test O55 – Rch/Rot PWM [Reach/Rotate PWM (SOL8)] (page 6-146) .
Excessive play in the Reach Mechanism, due to mechanical wear/deformation	Repair/replace components as necessary.
Contamination in hydraulic system	Inspect Reach Solenoid SOL11 for contamination. If found, flush and refill system.

Reach - Noisy or Slow Operation

Possible Cause	Action
Worn Scissors Bearings or deformed Scissors Assembly	Replace bearings or repair/replace scissors assembly.
Contamination in hydraulic system	Inspect Reach Solenoid (SOL11) for contamination. If found, flush and refill system.
Damaged or worn Reach Cylinder	Replace Reach Cylinder.
Bad Reach/Rotate PWM Solenoid	Run Test O55 – Rch/Rot PWM [Reach/Rotate PWM (SOL8)] (page 6-146) .
Bad Traverse PWM Solenoid	Run Test O58 – Traverse PWM [Traverse PWM (SOL7)] (page 6-149) .
Bad Fork Control Solenoids	Run Test O53 – Sol10A DrA [Reach/Rotate DIR A (SOL10A)] (page 6-144) and Test O54 – Sol10B DrB [Reach/Rotate DIR B (SOL10B)] (page 6-145) .
Bad Reach Solenoid Valve	Run Test O06 – Sol11Rch [Reach Select Solenoid (SOL11)] (page 6-128) .

Section 5. Troubleshooting

Model 9600/9700 Swing-Reach® Maintenance Manual

Symptom Tables: Hydraulic System

Auto Traverse and Rotate and/or Auto Center Nest Does Not Function

Possible Cause	Action
Traverse and rotate do not function correctly independently.	Verify proper operation of the traverse and rotate. Verify the display shows the load handler in the nested position when it should.
Function being activated with rotate or traverse outside the allowable start positions. Allowable start positions may vary slightly between trucks and platform widths.	Place the load handler in the nested position and retry.
Switch S5 not functioning correctly. Rotate will operate but no traverse. Traverse will only operate with the traverse command pot.	Refer to Input I110 – Attach S5 [Attachment (S5)].

Lift/Lower System**Slow Lift**

Possible Cause	Action
Bad Lift Motor Encoder	Refer to Input I20 – Lift RPM [Lift Motor RPM] (page 6-80) .
Incorrect lift pressure adjustment	Check and adjust lift pressure setting. See “Lift Pressure Adjustment” on page 7-76 .
Bad Lift Pump	Check pressure. See “Lift Pressure Adjustment” on page 7-76 .
Bad Lift Motor	Run Test O28 – Lift RPM [Ramp Lift Motor] (page 6-134) .
Battery problems	Replace battery with fully-charged good battery.
Bad Flow Limiters	Replace the Flow Limiters. See “Flow Limiters” on page 7-84 .
Contamination in hydraulic system	Inspect valves for contamination. If found, flush and refill system.
Bad Lower Solenoid	Run Test O11 – Sol1 Lwr [Lower Solenoid (SOL1)] (page 6-129) .
LPA overtemperature	Refer to Input A19 - LA Temp [LPA Temp] (page 6-52) .

Intermittent Lift

Possible Cause	Action
If problem occurs only with Main Mast, Main Lift Select Solenoid may be intermittent.	Run Test O52 – Sol4 ManSl [Main Lift Select (SOL4)] (page 6-143) . Flex harness while running test to check for intermittent wires.
If problem occurs only with Mini-Mast, Mini Lift Select Solenoid may be intermittent.	Run Test O50 – Sol6 MinSl [Mini Lift Select (SOL6)] (page 6-143) . Flex harness while running test to check for intermittent wires.

Slow Lower

Possible Cause	Action
Bad Lift Motor Encoder	Refer to Input I20 – Lift RPM [Lift Motor RPM] (page 6-80).
Lower Solenoid may be intermittent/bad	Run Test O62 – Lower Sol [Lower Solenoid (SOL1)] (page 6-153).
If problem occurs only with Mini-Mast, Mini Load Hold Solenoid may be intermittent.	Run Test O43 – Sol5 MinLH [Mini Load Hold (SOL5)] (page 6-139). Flex harness while running test to check for intermittent wires.
If problem occurs only with Main Mast, Main Load Hold Solenoid may be intermittent.	Run Test O51 – Sol3 ManLH [Main Load Hold (SOL3)] (page 6-142). Flex harness while running test to check for intermittent wires.
Mechanical binding in Bearings or Telescopic	Adjust or replace bearings.
Bad Flow Limiter	Replace the Flow Control valves. See “Flow Limiters” on page 7-84.

Intermittent Lower

Possible Cause	Action
If problem occurs only with Main Mast, Main Load Hold Solenoid may be intermittent.	Run Test O51 – Sol3 ManLH [Main Load Hold (SOL3)] (page 6-142). Flex harness while running test to check for intermittent wires.
Mechanical binding in bearings or telescopic	Adjust or replace bearings.
If problem occurs only with Mini-Mast, Mini Load Hold Solenoid may be intermittent.	Run Test O43 – Sol5 MinLH [Mini Load Hold (SOL5)] (page 6-139). Flex harness while running test to check for intermittent wires.

Load Drifting/Settling

Possible Cause	Action
Leaking or contaminated Emergency Lower Valve	Make sure the handle is not bottoming out before the valve is seated. Inspect, clean, flush, or replace as needed.
Lower Solenoid may be intermittent/bad	Run Test O62 – Lower Sol [Lower Solenoid (SOL1)] (page 6-153).

Bouncing Lower

Possible Cause	Action
Air in lift cylinders	Bleed cylinders. See “Bleeding the Hydraulic System” on page 7-74.
Main Mast bearing pucks binding	Lubricate/adjust pucks as necessary. See “Main Mast Lateral Bearing Adjustment (9600)” on page 7-99.

Symptom Tables: Travel Problems

Symptom Tables: Travel Problems

Slow or Sluggish Acceleration or Travel

Possible Cause	Action
Configuration set to soft acceleration	In Config Mode, set Travel Accel to Medium or Hard. Refer to “Using Configure Mode” on page 3-26 and Table 3-2, “Configure Mode Menu,” on page 3-27 .
Note: Determine if problem is configuration settings, mechanical, or electrical:	In Config Mode, set Coast to Long. Drive and coast to a stop. Compare coasting distance with a normally operating lift truck, if possible. If coasting distance is short, problem is mechanical.
Mechanical:	
Binding Drive Unit	Check amp draw. Refer to Input A11 - Dr Curr [Traction Motor Current] (page 6-45).
Worn Load Wheel Bearings	Replace load wheel bearings.
Dragging brake	See “Brake” on page 7-36 .
Electrical:	
Low battery	Install a fully charged battery.
Bad Traction Motor (might test OK with no load, but fail under load)	Run Test O29 – Traction RPM [Ramp Traction Motor] (page 6-135).
Speed is limited due to Traction Motor or TPA overtemperature or bad Temperature Sensor	Refer to Input A08 - Dr Mr Tmp [Traction Motor Temp] (page 6-42) and Input A10 - TA Temp [TPA Temp] (page 6-44).
Bad Traction Motor Encoder (TME)	Refer to Input I19 – Trac RPM [Traction Motor RPM] (page 6-79).
Throttle Pot problem	Refer to Input A04 – Thr1 Pot [Throttle Pot (VR1)] (page 6-40) and Input A22 – Thr1 % [Travel Request] (page 6-54).

Uneven Travel Speed

Possible Cause	Action
Note: First determine if the problem is mechanical or electrical.	In Config Mode, set Coast to Long. Drive to 4 mph (6.5 km/h) and coast to a stop. If the lift truck deceleration is not smooth or lift truck drags as it coasts, the problem is mechanical.
Mechanical:	
Binding Drive Unit	Replace Drive Unit.
Electrical:	
Bad Traction Motor	Run Test O29 – Traction RPM [Ramp Traction Motor] (page 6-135).
Bad Throttle Pot	Refer to Input A04 – Thrtl Pot [Throttle Pot (VR1)] (page 6-40).
Bad Traction Motor Encoder (TME)	Refer to Input I19 – Trac RPM [Traction Motor RPM] (page 6-79).

Symptom Tables: Electrical Problems

Symptom Tables: Electrical Problems

Motor Overheating

Possible Cause	Action
Fans	Run Test O23 – Fans (page 6-133) .
Wrong motor for lift truck	Verify correct motor for lift truck.
Application exceeds designed workload -- short runs with plugging/acceleration or heavy-duty lifting cycles	Refer to service manager for evaluation.
Bad Battery	Check voltage, both open circuit and under load. Replace if necessary with fully-charged, good battery.
Corroded or damaged Battery Connector Tips	Inspect battery connector. See “Battery Connector/Cables” on page 7-40 .
Incorrect BSOC Cutout value	Check battery specific gravity at cutout, after battery has stabilized. Compare to battery manufacturer specifications for discharged battery. Adjust BSOC Cutout as needed. Refer to Table 3-2, “Configure Mode Menu,” on page 3-27 .
Heat stressed cables: Look for discolored terminals, drawn insulation, and hard spots and bulges.	Replace power cables.
Drive Motor Current problem	Refer to Input A11 - Dr Curr [Traction Motor Current] (page 6-45) .
Binding Gearbox or Pump	Check gearbox or pump for binding. Clean, repair, or replace as necessary.
Dragging Brake	Check gap. See “Brake” on page 7-36 .
Incorrectly adjusted steer centering on a rail guided lift truck	Run “Learn Rail Guidance” on page 3-36 .

Motor Arcing (Load Handler Motor)

Possible Cause	Action
Worn Brushes or incorrect Brush Tension	Replace brushes and/or brush springs. See “Motor Brushes” on page 7-52 and “Motor Brush Spring Tension” on page 7-53 .
Rough or pitted Motor Commutator	Refer to motor rebuild facility. Replace motor.

BSOC Reset or Cutout Does Not Occur

Possible Cause	Action
Incorrect BSOC Cutout value	Check battery specific gravity at cutout, after battery has stabilized. Compare to battery manufacturer specifications for discharged battery. Adjust BSOC Cutout as needed. See "Setting Battery State-of-Charge Cutout" on page 5-10.

Scrambled or Intermittent Display

Possible Cause	Action
Loose Harness or Card Connectors	Reseat cards and harness connections.
Intermittent wires or connectors in harness	Test for continuity while flexing harness. If discontinuity is found, replace wiring harness.
Bad Display Module	Run Test O39 – Display Test [Cycle Display] (page 6-138).

Operator Display Dark or Inoperative, Truck Runs

Possible Cause	Action
<i>Travel Speed Not Limited</i> - Bad Operator Display Module or Display Interface Card	Check JPD1 connection. If OK, replace Display Module.
<i>Travel Speed Limited</i> - Bad Display Interface Card or wiring	Check wiring. If OK, replace Display Interface Card.

Display is Dark; Lift Truck is not Operational

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	Key switch ON/DCV	JPC14-12	JPC14-1	Approx. 48V	Perform step 4	Perform step 2
2			TP4		Perform step 3	T/S battery, OTM cable, key switch, fuse circuit, and wiring
3	DCV	TP1	JPC14-1		Perform step 1	T/S OTM cable, fuse circuit, and wiring
4	Key switch ON/DCV	JPC14-5	JPC14-2	Approx. 12V	Perform step 5	Extract JC14-2 and unplug all connectors except JC14. Check again. If 12V is present, T/S the circuit that is pulling it down. If not OK, replace CM.
5		JPD3-3	JPD3-4			

Section 5. Troubleshooting

Model 9600/9700 *Swing-Reach*[®] Maintenance Manual

Symptom Tables: Electrical Problems

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Section 6. Messages, Codes, and Tests

Messages and Codes Summary List

Messages and Codes Summary List

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Messages and Codes

Message: Battery low, no lift

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Battery Low, No Lift Lift interrupt has occurred due to the battery state-of-charge.	If charging or changing the battery does not clear the message, refer to "Input A15 – BattVolt [Battery Voltage]" (page 6-49)	Charge/change battery.

Message: Check battery gates

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Check Battery Gates	"Input I87 – BG Lt S57 [Left Battery Gate Switch (S57)]" (page 6-101), "Input I88 – BG Rt S58 [Right Battery Gate Switch (S58)]" (page 6-102)	Check battery gates for correct installation. Cycle key switch to clear.

Message: Deadman?

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Deadman? Deadman switch(es) activated while truck is attempting to perform SelfTest or control handle inputs detected and deadman pedal(s) not depressed.	"Input I00 – Dman S23 [Carriage Deadman Switch (S23)]" (page 6-74), "Input I32 – Dman S2 [Brake Deadman Switch (S2)]" (page 6-86), "Input I02 – Lift S11 [Lift Reference Prox (S11)]" (page 6-75)	<p><i>Message displayed during SelfTest</i> - release deadman(s), resume operation. If message does not clear, refer to the inputs listed.</p> <p><i>Message displayed after SelfTest</i> - depress deadman pedal(s). If message does not go away, refer to Inputs listed.</p>

Message: EPO depressed

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
EPO Depressed EPO depressed. CM senses the EPO switch is open (IN).	"Input A41 - CM EPO [CM EPO Sense]" (page 6-60)	Lift EPO Button and cycle key switch to clear.

Section 6. Messages, Codes, and Tests Model 9600/9700 Swing-Reach® Maintenance Manual

Messages and Codes

Message: Learn timed out

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Learn Timed Out One or all deadman switches were open longer than 2.8 consecutive minutes during Learn Load Handler process.	"Input I00 – Dman S23 [Carriage Deadman Switch (S23)]" (page 6-74), "Input I32 – Dman S2 [Brake Deadman Switch (S2)]" (page 6-86), "Input I102 – LdDm S9 [Load Handler Deadman (S9)]" (page 6-105)	Restart Learn and step on both deadman pedals.

Message: Lift cut-out pending ... low battery

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Lift Cut-Out Pending ... Low Battery Battery low.	None	Message is displayed for five minutes, then lift is disabled. Change Battery.

Message: Lift cut-out, scheduled maintenance due

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Lift Cut-Out, Scheduled Maintenance Due Displayed when Mnt Mind is enabled in Configure Mode menu.	None	Reset or disable Mnt Mind in Configure Mode menu.

Message: Lift limited

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Lift Limited An option that inhibits lift in certain situations has been activated.	None	If truck is equipped with the Out-of-Aisle Lift Inhibit option, enter aisle to allow lift. If truck is equipped with the Lift Limit w/o Bypass option, lower the carriage below the height set in Config Mode to allow lift.

Message: Lift speed limited

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Lift Speed Limited LPA is not receiving encoder pulses.	"Input I20 – Lift RPM [Lift Motor RPM]" (page 6-80)	Cycle key switch to clear.

Message: Load handler overheated, allow time to cool

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Load Handler Overheated, Allow Time To Cool The system has detected an over temperature condition exists.	"Input A65 - LH Mr Tmp [Load Handler Motor Temp]" (page 6-62), "Test O23 - Fans" (page 6-133)	Allow time for truck to cool.

Message: Load handler stalled

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Load Handler Stalled No change in Load Handler position detected when a traverse or rotate command is present.	Traverse: "Input A86 - Trv Posn [Traverse Position Feedback Pot (VR5)]" (page 6-64), "Test O56 - Sol9A DirA [Traverse DIR A (SOL9A)]" (page 6-147), "Test O57 - Sol9B DirB [Traverse DIR B (SOL9B)]" (page 6-148), "Test O58 - Traverse PWM [Traverse PWM (SOL7)]" (page 6-149) Rotate: "Input A88 - Rot Posn [Rotate Position Feedback Pot (VR6)]" (page 6-66), "Test O53 - Sol10A DrA [Reach/Rotate DIR A (SOL10A)]" (page 6-144), "Test O54 - Sol10B DrB [Reach/Rotate DIR B (SOL10B)]" (page 6-145), "Test O55 - Rch/Rot PWM [Reach/Rotate PWM (SOL8)]" (page 6-146)	Refer to applicable inputs/perform applicable tests.

Message: Lower disabled, use emergency lower valve to resume lowering

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Lower Disabled	"Test O62 - Lower Sol [Lower Solenoid (SOL1)]" (page 6-153)	Run test listed.

Section 6. Messages, Codes, and Tests Model 9600/9700 Swing-Reach® Maintenance Manual

Messages and Codes

Message: Lower sidegates to resume operation

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
<p>Lower Sidegates To Resume Operation One or both sidegates are raised while attempting to operate the truck. (Optional)</p>	<p>"Input I67 – SG Rt S60 [Right Sidegate Switch (S60)]" (page 6-96), "Input I83 – SG Lt S61 [Left Sidegate Switch (S61)]" (page 6-100)</p>	<p>Lower Sidegate(s) and resume operation.</p>

Message: Mismatched software versions

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
<p>Mismatched Software Versions</p>	<p>None</p>	<p>Verify/install correct TM and CM software in FlashWare. Cycle key switch to clear.</p>

Message: Overheated, allow time to cool

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
<p>Overheated, Allow Time To Cool Truck Overheated. The system has detected that an over-temperature condition exists.</p>	<p>"Input A08 - Dr Mr Tmp [Traction Motor Temp]" (page 6-42), "Input A09 - Lft Mr Tmp [Lift Motor Temp]" (page 6-43)</p>	<p>Allow time for truck to cool. If Traction Motor is overheated, traction is inhibited. If Lift motor is overheated, lift is inhibited.</p>

Message: Press bypass switch to continue lifting

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
<p>Press Bypass Switch To Continue Lifting Calculated height of mast position has reached the point that lift interrupt should occur.</p>	<p>"Input I04 – Bypass S7 [Lift/Lower Inhibit Bypass Switch (S7)]" (page 6-76)</p>	<p>Activate bypass switch to continue to lift. Check height settings in Configure Mode.</p>

Message: Press bypass switch to continue lowering

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
<p>Press Bypass Switch To Continue Lowering Calculated height of mast position has reached the point that lower interrupt should occur.</p>	<p>"Input I04 – Bypass S7 [Lift/Lower Inhibit Bypass Switch (S7)]" (page 6-76)</p>	<p>Activate bypass switch to continue to lower. Check height settings in Configure Mode.</p>

Message: Reach not nested

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
<p>Reach Not Nested During Learn Load Handler, the Carriage Manager did not see the expected values for Reach Prox.</p>	<p>"Input I04 – Bypass S7 [Lift/Lower Inhibit Bypass Switch (S7)]" (page 6-76)</p>	<p>Verify the reach is fully retracted.</p>

Message: Release buttons

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Release Buttons The TM detects a Lift/Lower Pendant button(s) was depressed at Startup.	"Input A17 – Lift Pnd [Lift Pendant]" (page 6-50), "Input A18 – Lwer Pnd [Lower Pendant]" (page 6-51).	Cycle key switch to clear. Note: If message appears when the pendant is connected and no switches are depressed, the pendant is bad.

Message: Release bypass switch to continue lifting

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Release Bypass Switch to Continue Lifting Lift/lower bypass switch (S7) has been activated for an extended period of time or was depressed at Startup.	"Input I04 – Bypass S7 [Lift/Lower Inhibit Bypass Switch (S7)]" (page 6-76)	Release switch.

Message: Release lift select button to resume operation...Main lower is enabled

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Release Lift Select Button to Resume Operation...Main Lower is Enabled The TM detects the Lift Select Switch was depressed at Startup.	"Input I109 – LftSel S6 [Lift Select (S6)]" (page 6-112)	Release switch.

Message: Release lift to resume operation

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Release Lift To Resume Operation Control handle (VR2) was moved before deadman pedal was depressed at Startup.	"Input A05 – L/L Pot [Lift/Lower Pot (VR2)]" (page 6-41)	Release lift, step on deadman, resume operation. Note: After this message is displayed three times, "CODE 8F Inform Service" (page 6-25) is displayed.

Message: Release rotate to resume operation

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Release Rotate To Resume Operation Rotate pot (VR3) was moved before deadman pedal was depressed at Startup.	"Input A87 – Rot Pot [Rotate Command Pot (VR3)]" (page 6-65)	Release rotate pot, step on deadman, resume operation. Note: After this message is displayed three times, "CODE 8V Inform Service" (page 6-25) is displayed.

Section 6. Messages, Codes, and Tests Model 9600/9700 Swing-Reach® Maintenance Manual

Messages and Codes

Message: Release traction handle to resume operation

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
<p>Release Traction Handle To Resume Operation Control handle (VR1) was moved before deadman pedal was depressed.</p>	<p>"Input A04 – Thr1l Pot [Throttle Pot (VR1)]" (page 6-40)</p>	<p>Release throttle, step on deadman, resume travel. Note: After this message is displayed three times, "CODE 83 Inform Service" (page 6-24) is displayed.</p>

Message: Release traverse handle to resume operation

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
<p>Release Traverse Handle To Resume Operation Traverse handle (VR4) was moved before deadman pedal was depressed at Startup.</p>	<p>"Input A85 – Trv Pot [Traverse/Reach Pot (VR4)]" (page 6-63)</p>	<p>Release Traverse handle, step on deadman, resume operation. Note: After this message is displayed three times, "CODE 8X Inform Service" (page 6-25) is displayed.</p>

Message: Retract reach for full speed travel

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
<p>Retract Reach for Full Speed Travel Traverse handle (VR4) was moved before deadman pedal was depressed at Startup.</p>	<p>"Input I04 – Bypass S7 [Lift/Lower Inhibit Bypass Switch (S7)]" (page 6-76)</p>	<p>Retract forks to allow full speed travel.</p>

Message: Rotate failed

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
<p>Rotate Failed During the Learn Load Handler process, the Carriage Manager did not see the expected values for Rotate.</p>	<p>"Input A88 – Rot Posn [Rotate Position Feedback Pot (VR6)]" (page 6-66), "Test O53 – Sol10A DrA [Reach/Rotate DIR A (SOL10A)]" (page 6-144), "Test O54 – Sol10B DrB [Reach/Rotate DIR B (SOL10B)]" (page 6-145), "Test O55 – Rch/Rot PWM [Reach/Rotate PWM (SOL8)]" (page 6-146)</p>	<p>During Learn, the values saved are the feedback pot voltages at both ends of the function and the current required by the proportional valves to make the functions begin to move and obtain the desired speeds.</p>

Message: Rotate and traverse failed

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
<p>Rotate and Traverse Failed During the Learn Load Handler process, the Carriage Manager did not see the expected values for both Rotate and Traverse.</p>	<p>Traverse: "Input A86 – Trv Posn [Traverse Position Feedback Pot (VR5)]" (page 6-64), "Test O56 – Sol9A DirA [Traverse DIR A (SOL9A)]" (page 6-147), "Test O57 – Sol9B DirB [Traverse DIR B (SOL9B)]" (page 6-148), "Test O58 – Traverse PWM [Traverse PWM (SOL7)]" (page 6-149) Rotate: "Input A88 – Rot Posn [Rotate Position Feedback Pot (VR6)]" (page 6-66), "Test O53 – Sol10A DrA [Reach/Rotate DIR A (SOL10A)]" (page 6-144), "Test O54 – Sol10B DrB [Reach/Rotate DIR B (SOL10B)]" (page 6-145), "Test O55 – Rch/Rot PWM [Reach/Rotate PWM (SOL8)]" (page 6-146)</p>	<p>During Learn, the values saved are the feedback pot voltages at both ends of the functions and the current required by the proportional valves to make the functions begin to move and obtain the desired speeds.</p>

Message: Scheduled maintenance due

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
<p>Scheduled Maintenance Due Displayed when Mnt Mind is enabled in Configure Mode menu.</p>	None	Reset or disable Mnt Mind in Configure Mode menu.

Message: Speed limited due to load handler

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
<p>Speed Limited Due To Load Handler Load handler is not nested.</p>	<p>"Input A86 – Trv Posn [Traverse Position Feedback Pot (VR5)]" (page 6-64), "Input A88 – Rot Posn [Rotate Position Feedback Pot (VR6)]" (page 6-66),</p>	Return load handler to the nested position to allow full speed travel.

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Message: Speed limited due to unknown main height... lower main mast to floor then raise to cross reference switch

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Speed Limited Due To Unknown Main Height	"Input I02 – Lift S11 [Lift Reference Prox (S11)]" (page 6-75), "Input I26 – Main Ht Ct [Main Lift Height Encoder]" (page 6-85)	Refer to display. If message does not go away, refer to Inputs listed.

Message: Speed limited due to unknown mini height... completely lower mini mast, then lift to reset height

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Speed Limited Due To Unknown Mini Height	"Input I105 – Mini Ht Ct [Mini-Mast Height Count]" (page 6-108)	Refer to display. If message does not go away, refer to Input listed.

Message: Stalled, release control handle to resume operation

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Stalled, Release Control Handle To Resume Operation No encoder pulses are received by Power Amplifier.	Travel speed limited - "Input I19 – Trac RPM [Traction Motor RPM]" (page 6-79) Lift speed limited - "Input I20 – Lift RPM [Lift Motor RPM]" (page 6-80)	Travel speed or lift speed is limited when the corresponding power amp is not receiving encoder pulses. Cycle key switch OFF/ON to clear.

Message: Step on deadman

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Step on Deadman One or all of the deadman switches are open during the Learn Load Handler process.	"Input I00 – Dman S23 [Carriage Deadman Switch (S23)]" (page 6-74), "Input I32 – Dman S2 [Brake Deadman Switch (S2)]" (page 6-86), "Input I102 – LdDm S9 [Load Handler Deadman (S9)]" (page 6-105)	Depress both Deadman pedals for Learn to continue.

Message: Travel cut-out

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Travel Cut-Out "Travel Cut-Out @ 24in," option is enabled and fork height is above 24 in.	None	Lower forks below 24 in.

Message: Traverse failed

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Traverse Failed During the Learn Load Handler process, the Carriage Manager did not see the expected values for Traverse.	"Input A86 – Trv Posn [Traverse Position Feedback Pot (VR5)]" (page 6-64), "Test O56 – Sol9A DirA [Traverse DIR A (SOL9A)]" (page 6-147), "Test O57 – Sol9B DirB [Traverse DIR B (SOL9B)]" (page 6-148), "Test O58 – Traverse PWM [Traverse PWM (SOL7)]" (page 6-149)	During Learn, the values saved are the feedback pot voltages at both ends of the function and the current required by the proportional valves to make the functions begin to move and obtain the desired speeds.

Message: Waiting for download command

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Waiting For Download Command Display Interface Card does not contain a valid Graphic Database Download.	None	Perform Graphics Database Download. Refer to " Graphics Database Download " on page 3-39. If unable to perform, check communications between TM and CM using FlashWare. If OK, replace Display Interface Card.

CODE 1H Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 1H: TPA Out-of-Range The TPA has reported its internal temperature is less than -40°F (-40°C) or greater than +203°F (+95°C).	"Input A10 - TA Temp [TPA Temp]" (page 6-44)	Cycle key switch to clear after TPA has cooled.

CODE 1K Platform Hung Lift Slowly

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 1K: Platform Hung Lift Slowly Slack chain switch has transitioned during operation.	"Input I45 – Slk Ch S50 [Slack Chain 1 Switch (S50)]" (page 6-92), "Input I46 – Slk Ch S51 [Slack Chain 2 Switch (S51)]" (page 6-93)	Lift platform if it is hung up to clear.

CODE 2A Overheated, Allow time to cool

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 2A: Traction Motor Approaching Overtemp The TPA senses the traction motor is approaching overtemperature.	"Input A08 - Dr Mr Tmp [Traction Motor Temp]" (page 6-42)	Travel speed is linearly de-rated starting at 284°F (140°C). Travel speed is limited to 1 mph at 311°F (155°C).

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Messages and Codes

CODE 2E Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
<p>Code 2E: Traction Motor Temp Sensor Out-of-Range The traction motor temperature sensor is open or shorted.</p>	<p>"Input A08 - Dr Mr Tmp [Traction Motor Temp]" (page 6-42)</p>	<p>Clears when reason for fault is corrected.</p>

CODE 2G Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
<p>Code 2G: Phase Open on Traction Motor The TPA detects no current draw in one of the three phases of the motor.</p>	<p>"Test O29 - Traction RPM [Ramp Traction Motor]" (page 6-135)</p>	<p>Cycle key switch to clear.</p>

CODE 2H Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
<p>Code 2H: Failure Detected in Traction Motor Speed Sensor</p>	<p>"Input I19 - Trac RPM [Traction Motor RPM]" (page 6-79)</p>	<p>If a single channel is bad, this code is displayed during Run. If one or both channels are bad at SelfTest, STALLED is displayed. Cycle key switch to clear.</p>

CODE 2M Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
<p>Code 2M: TPA Pre-Charge Failed TPA failed to precharge correctly.</p>	<p>None</p>	<p>Check for B+ at TPA+. Cycle key switch to clear. If code does not clear, replace TPA. Note: The TM cannot cause this code.</p>

CODE 2T Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
<p>Code 2T: TPA Current Calibration Error The TPA has sensed a current calibration error.</p>	<p>None</p>	<p>Cycle key switch to clear. If code does not clear, replace TPA. Note: The TM cannot cause this code.</p>

CODE 2U Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
<p>Code 2U: TPA Overcurrent or Short Circuit The TPA has sensed current in excess of 450A.</p>	<p>"Test O29 - Traction RPM [Ramp Traction Motor]" (page 6-135)</p>	<p>Cycle key switch to clear. Check for shorted traction motor power cables. If code does not clear, replace TPA. Note: The TM cannot cause this code.</p>

CODE 2V Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 2V: TPA High DC BUS Voltage The TPA detects an overvoltage condition at the + terminal.	"Input A15 – BattVolt [Battery Voltage]" (page 6-49)	If the problem is intermittent and only occurs during plugging, it indicates a bad battery or possible loose connection in the power circuit connections for the traction system. Check all associated power cables for correct torque and contactor tips for excessive wear. If the error is a hard code, re-flash the TPA. If the code persists, replace the TPA. Note: The TM cannot cause this code.

CODE 2W Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 2W: TPA Internal Fault TPA internal circuitry has malfunctioned.	None	Cycle key switch to clear. Re-flash TPA. If code does not clear, replace TPA.

CODE 2X Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 2X: TPA Power Supply Out-of-Range The power supply output in the TPA is less than 4.5V, greater than 5.5V, or too much current is being drawn by an external component.	None	Cycle key switch to clear. Disconnect (+) wire to temperature and speed sensors. Cycle key switch. If code changes, troubleshoot wires and sensors. If not OK, replace TPA. Note: The TM cannot cause this code.

CODE 42 Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 42: LPC Detected Closed When Commanded Open LPA detected an incorrect voltage at LPA+ during SelfTest.	"Test 002 – LPC Ctr [Lift Power Contactor]" (page 6-126)	Cycle key switch to clear. Note: Low battery voltage can contribute to burnt tips. If contactor tips are welded or burnt, check the BSOC setting in Config Mode menu. Note: The TM cannot cause this code.

CODE 43 Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 43: LPC Detected Open When Commanded Closed LPA detected <12VDC at LPA+ after the LPC coil was energized.	"Test 002 – LPC Ctr [Lift Power Contactor]" (page 6-126)	Cycle key switch to clear. Check contactor for mechanical binding. Note: The TM cannot cause this code.

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CODE 49 Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 49: Load Handler Contactor Detected Closed When Commanded Open	"Input I112 – FU4 sense [FU4 Sense]" (page 6-115), "Test O03 – LHC Ctr [Load Handler Contactor]" (page 6-127)	Cycle key switch to clear.

CODE 4A Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 4A: Load Handler Contactor Detected Open When Commanded Closed	"Input I112 – FU4 sense [FU4 Sense]" (page 6-115), "Test O03 – LHC Ctr [Load Handler Contactor]" (page 6-127)	Cycle key switch to clear.

CODE 4B Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 4B: Steer Contactor Detected Closed At Start-Up	"Input I14 – FU1 Sense" (page 6-77), "Test O01 – STR Ctr [Steer Power Contactor]" (page 6-125)	Cycle key switch to clear. Check contactor for mechanical binding.

CODE 4C Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 4C: FU1 Sense Validation Steer contactor detected open when commanded closed.	"Input I14 – FU1 Sense" (page 6-77), "Test O01 – STR Ctr [Steer Power Contactor]" (page 6-125)	Check FU1, FU1 Sense line (JPT22-19). If FU1 opens during Run Mode, Code G4 is displayed. Cycle key switch to clear.

CODE 4F Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 4F: TPC Detected Closed When Commanded Open The TPA detects an incorrect voltage at the B+ terminal on the amplifier.	"Test O00 – TPC Ctr [Traction Power Contactor]" (page 6-124)	Cycle key switch to clear. Check contactor for mechanical binding.

CODE 4G Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 4G: TPC Detected Open After Power-Up The TPA detects the TPC open after power-up.	"Test 000 – TPC Ctr [Traction Power Contactor]" (page 6-124)	Cycle key switch to clear.

CODE 4H Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 4H: TPA, TPC Contactor Coil or Coil Driver Open or Shorted	"Test 000 – TPC Ctr [Traction Power Contactor]" (page 6-124)	Cycle key switch to clear.

CODE 4K Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 4K: LPA, LPC Contactor Coil or Coil Driver Open or Shorted	"Test 002 – LPC Ctr [Lift Power Contactor]" (page 6-126)	Cycle key switch to clear.

CODE 50 Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 50: No TM Communications Received by CM The Carriage Manager has not received correct communications from the TM.	"Input I23 – Can Bus [CAN Communication]" (page 6-81)	See "Troubleshooting Communication Error Codes (5x Series)" on page 5-19. Cycle key switch to clear.

CODE 51 Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 51: No CM Communications Received by TM The Tractor Manager has not received correct communications from the CM.	Refer to "Troubleshooting Code 51" on page 5-19.	Cycle key switch to clear.

CODE 55 Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 55: CAN Bus 1 Transmission Buffer Error The Tractor Manager has detected a CAN transmission buffer error on CAN Bus 1.	"Input I23 – Can Bus [CAN Communication]" (page 6-81) If intermittent, refer to "Troubleshooting Codes (5x Series)" on page 5-19.	Cycle key switch to clear.

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Messages and Codes

CODE 56 Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
<p>Code 56: CAN Bus 1 Error Overflow CAN BUS error overflow detected by TM on CAN Bus 1.</p>	<p>"Input I23 – Can Bus [CAN Communication]" (page 6-81) If intermittent, refer to "Troubleshooting Communication Error Codes (5x Series)" on page 5-19.</p>	<p>Cycle key switch to clear.</p>

CODE 57 Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
<p>Code 57: No Communications Received by Display Interface Card</p>	<p>Refer to "Troubleshooting Code 57" on page 5-20.</p>	<p>Cycle key switch to clear. Note: This code is displayed when FlashWare is connected to truck.</p>

CODE 59 Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
<p>Code 59: CAN Bus 0 Transmission Buffer Error The Tractor Manager has detected a CAN transmission buffer error on CAN Bus 0.</p>	<p>"Input I23 – Can Bus [CAN Communication]" (page 6-81) If intermittent, refer to "Troubleshooting Communication Error Codes (5x Series)" on page 5-19.</p>	<p>Cycle key switch to clear.</p>

CODE 5A Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
<p>Code 5A: CAN Bus 0 Error Overflow CAN BUS error overflow detected by TM on CAN Bus 0.</p>	<p>"Input I23 – Can Bus [CAN Communication]" (page 6-81) If intermittent, refer to "Troubleshooting Communication Error Codes (5x Series)" on page 5-19.</p>	<p>Cycle key switch to clear.</p>

CODE 5E Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
<p>Code 5E: No Guidance Manager CAN Communications Received by TM</p>	<p>"Input I23 – Can Bus [CAN Communication]" (page 6-81) If intermittent, refer to "Troubleshooting Communication Error Codes (5x Series)" on page 5-19.</p>	<p>Travel disabled in AUTO mode. Travel allowed in MANUAL mode. Cycle key switch to clear.</p>

CODE 5G Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 5G: No Communications Received by TM from TPA The Tractor Manager has not received CAN communications from the TPA.	"Input I23 – Can Bus [CAN Communication]" (page 6-81) If intermittent, refer to "Troubleshooting Communication Error Codes (5x Series)" on page 5-19.	Cycle key switch to clear.

CODE 5J Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 5J: No communications Received by TM from LPA The Tractor Manager has not received CAN communications from the LPA.	"Input I23 – Can Bus [CAN Communication]" (page 6-81) If intermittent, refer to "Troubleshooting Communication Error Codes (5x Series)" on page 5-19.	Cycle key switch to clear.

CODE 5M Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 5M: TPA Start Timeout Occurs 1 minute after TPA is powered ON if TM does not send a message. This code is not likely to show on the truck display if there is truly a broken line between the TM and the TPA.	None	Re-Flash TPA software via FlashWare. If code does not clear, replace TPA.

CODE 5P Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 5P: LPA Start Timeout Occurs 1 minute after LPA is powered ON if TM does not send a message. This code is not likely to show on the truck display if there is truly a broken line between the TM and the LPA.	None	Re-Flash LPA software via FlashWare. If code does not clear, replace LPA.

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Messages and Codes

CODE 5Q Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
<p>Code 5Q: Display Interface Card Not Responding The TM is not receiving communication from the Display Interface Card. This code appears in the error log but not on the Operator Display.</p>	<p>Refer to "Troubleshooting Code 57" on page 5-20.</p>	<p>Note: Code 5Q is recorded in the error log. The Operator Display will most likely display Code 57.</p>

CODE 64 Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
<p>Code 64: Main Mast Height System Error While lifting or lowering at >500 rpm, no pulses or missing pulses are seen from the mast height encoder.</p>	<p>"Input I26 – Main Ht Ct [Main Lift Height Encoder]" (page 6-85)</p>	<p>Cycle key switch to clear.</p>

CODE 65 Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
<p>Code 65: Mini-Mast Height System Error While lifting or lowering at >300 rpm, no pulses or missing pulses are seen from the mini height prox switches or calculated height does not match.</p>	<p>"Input I105 – Mini Ht Ct [Mini-Mast Height Count]" (page 6-108)</p>	<p>Cycle key switch to clear.</p>

CODE 67 Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
<p>Code 67: Main Mast Count Error Calculated height does not match at main mast reference switch when lowering.</p>	<p>"Input I02 – Lift S1 1 [Lift Reference Prox (S1 1)]" (page 6-75), "Input I26 – Main Ht Ct [Main Lift Height Encoder]" (page 6-85)</p>	<p>Cycle key switch to clear.</p>

CODE 6D Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
<p>Code 6D: Main Lift Pressure Sensor Out-of-Range The Tractor Manager has determined that the pressure sensor voltage is out-of-range.</p>	<p>"Input A13 – MainPres [Main Lift Pressure Sensor]" (page 6-47)</p>	<p>Cycle key switch to clear.</p>

CODE 6E Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 6E: Mini Lift Pressure Sensor Out-of-Range The Tractor Manager has determined that the pressure sensor voltage is out-of-range.	"Input A89 – MiniPres [Mini-Mast Pressure Sensor]" (page 6-67)	Cycle key switch to clear.

CODE 6F Overheated, Allow Time To Cool

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 6F: Lift Motor Overheated Lift motor temperature has exceeded 311°F (155°C).	"Input A09 - Lft Mr Tmp [Lift Motor Temp]" (page 6-43)	Allow time to cool. Cycle key switch to clear. Note: The TM cannot cause this code.

CODE 78 Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 78: Lower Continues After Request is Removed	"Input A23 – L/L % [Lift/Lower Request]" (page 6-55), "Input I20 – Lift RPM [Lift Motor RPM]" (page 6-80), "Test O62 – Lower Sol [Lower Solenoid (SOL1)]" (page 6-153)	Cycle key switch to clear. Note: This code appears in the error log only.

CODE 79 Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 79: Regen Lower Fault	"Input A23 – L/L % [Lift/Lower Request]" (page 6-55), "Input I20 – Lift RPM [Lift Motor RPM]" (page 6-80), "Test O62 – Lower Sol [Lower Solenoid (SOL1)]" (page 6-153)	Cycle key switch to clear. If code occurs after lift pump replacement, make sure correct pump was installed.

CODE 7E Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 7E: Lift Motor Temperature Sensor Out-of-Range Lift motor temperature sensor voltage is out-of-range.	"Input A09 - Lft Mr Tmp [Lift Motor Temp]" (page 6-43)	Cycle key switch to clear. Note: The TM cannot cause this code.

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CODE 7F Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 7F: LPA Temp Out-of-Range The LPA temperature is less than -40°F (-40°C) or greater than +203°F (+95°C).	"Input A19 - LA Temp [LPA Temp]" (page 6-52)	Cycle key switch to clear. Note: The TM cannot cause this code.

CODE 7G Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 7G: LPA Motor Phase Open The LPA detects no current draw in one of the three phases of the motor.	"Test O28 - Lift RPM [Ramp Lift Motor]" (page 6-134)	Cycle key switch to clear. Note: The TM cannot cause this code.

CODE 7H Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 7H: Lift Motor Speed Sensor Failure Detected The LPA detects incorrect pulses from the lift motor speed sensor.	"Input I20 - Lift RPM [Lift Motor RPM]" (page 6-80)	Cycle key switch to clear. Note: The TM cannot cause this code.

CODE 7M Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 7M: LPA Failed to Precharge The LPA failed to precharge.	"Test O03 - LHC Ctr [Load Handler Contactor]" (page 6-127)	Check for B+ at TPA+ or welded LHC tips. Cycle key switch to clear. If code will not clear, replace LPA. Note: The TM cannot cause this code.

CODE 7T Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 7T: LPA Current Sensor Fault Internal LPA circuitry detects a fault.	None	If cycling the key switch does not clear this code, replace the LPA. Note: The TM cannot cause this code.

CODE 7U Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 7U: LPA Overcurrent or Short Circuit The LPA senses current in excess of 650A.	"Test O28 - Lift RPM [Ramp Lift Motor]" (page 6-134)	Check for shorted lift motor power cables. Cycle key switch to clear. Note: The TM cannot cause this code.

CODE 7V Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 7V: LPA High Voltage on DC BUS The LPA detects an overvoltage condition at the + terminal.	None	If the problem is intermittent and only occurs while lowering the main mast, it indicates a bad battery or possible loose connection in the power circuit connections for the lift/lower system. Check all associated power cables for correct torque and contactor tips for excessive wear. If the error is a hard code, re-flash the LPA. If the code persists, replace the LPA. Note: The TM cannot cause this code.

CODE 7W Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 7W: LPA Internal Fault Internal malfunction.	None	Cycle key switch to clear. Re-flash the LPA. If code does not clear, replace LPA. Note: The TM cannot cause this code.

CODE 7X Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 7X: LPA Power Supply Out-of-Range The power supply output in the LPA is less than 4.5V, greater than 5.5V, or too much current is being drawn by an external component.	None	Cycle key switch to clear. Disconnect (+) wire to LPA temperature and speed sensors. If code changes, troubleshoot wires and sensors. If code does not change, replace LPA. Note: The TM cannot cause this code.

CODE 80 Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 80: Throttle Pot Voltage Out-of-Range VR1 voltage at pin JPC12-3 out-of-range.	"Input A04 – Thr1 Pot [Throttle Pot (VR1)]" (page 6-40)	Cycle key switch to clear.

CODE 81 Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 81: Lift/Lower Pot Voltage Out-of-Range VR2 voltage at pin JPC12-2 out-of-range.	"Input A05 – L/L Pot [Lift/Lower Pot (VR2)]" (page 6-41)	Cycle key switch to clear.

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Messages and Codes

CODE 83 Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 83: Throttle Pot Out-of-Neutral VR1 out of learned neutral value during SelfTest.	"Input A04 – Thrfl Pot [Throttle Pot (VR1)]" (page 6-40)	Cycle key switch to clear. Check throttle pot spring for excessive play. Note: This code is displayed if the Throttle is out-of-neutral and the "Release handle" message has scrolled three times.

CODE 84 Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 84: Brake Inoperable - Not Applied The traction motor speed sensor indicated movement during Selftest.	"Test O30 – Brake" (page 6-136)	Make sure brake release bolts are removed from brake assembly. Cycle key switch to clear.

CODE 88 Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 88: +5V Power Supply Out-of-Range Control handle +5V power supply located in Carriage Manager out-of-range.	"Input A26 - CM 5V PS [+5VDC Pot Supply]" (page 6-56)	Cycle key switch to clear.

CODE 8A Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 8A: Rotate Pot Voltage Out-of-Range VR3 voltage at JPC12-5 out-of-range.	"Input A87 – Rot Pot [Rotate Command Pot (VR3)]" (page 6-65)	Cycle key switch to clear.

CODE 8B Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 8B: Traverse Pot Voltage Out-of-Range VR4 voltage at JPC4-4 out-of-range.	"Input A85 – Trv Pot [Traverse/Reach Pot (VR4)]" (page 6-63)	Cycle key switch to clear.

CODE 8C Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 8C: Deadman Pedal Switch Error Signals do not agree from the Deadman pedals (S2 and S23).	"Input I00 – Dman S23 [Carriage Deadman Switch (S23)]" (page 6-74), [Brake Deadman Switch (S2)]" (page 6-86)	Check for debris under deadman pedals. Cycle key switch to clear.

Messages and Codes

CODE 8F Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 8F: Lift/Lower Pot Out-of-Neutral VR2 out of learned neutral value during SelfTest.	"Input A05 – L/L Pot [Lift/Lower Pot (VR2)]" (page 6-41)	Check lift/lower pot spring for excessive play. Cycle key switch to clear. Note: This code is displayed if the Lift pot is out-of-neutral and the "Release handle" message has scrolled three times.

CODE 8L Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 8L: Brake Feedback Current Out-of-Range The TM senses brake coil current is incorrect.	"Input A35 - BrkSense [Brake Voltage]" (page 6-57)	Cycle key switch to clear.

CODE 8M Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 8M: Mini Power Supply Voltage Out-of-Range Mini power supply voltage on load handler is <9.0 or >20.0V	"Test 063 – MiniPwrSup [Mini Power Supply]" (page 6-154), "Input A40 - MiniSply [Mini Power Supply]" (page 6-59)	Cycle key switch to clear.

CODE 8V Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 8V: Rotate Pot Out-of-Neutral VR3 out of learned neutral value during SelfTest.	"Input A87 – Rot Pot [Rotate Command Pot (VR3)]" (page 6-65)	Check rotate pot spring for excessive play. Cycle key switch to clear. Note: This code is displayed if the Rotate pot is out-of-neutral and the "Release handle" message has scrolled three times.

CODE 8X Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 8X: Traverse Pot Out-of-Neutral VR4 out of learned neutral value during SelfTest.	"Input A85 – Trv Pot [Traverse/Reach Pot (VR4)]" (page 6-63)	Check traverse pot spring for excessive play. Cycle key switch to clear. Note: This code is displayed if the Traverse pot is out of neutral and the "Release handle" message has scrolled three times.

Section 6. Messages, Codes, and Tests Model 9600/9700 Swing-Reach® Maintenance Manual

Messages and Codes

CODE 91 Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 91: Drive Unit Turned >10° While On Wire	"Input I24 – Str Home [Home Steer Proximity Sensor]" (page 6-83), "Input I25 – Str Encdr [Steer Motor Encoder]" (page 6-84)	Cycle key switch to clear.

CODE 92 Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 92: Tracking Limits Exceeded	None	Run Wire Guidance Learn. See "Learn Wire Guidance" on page 3-34. Cycle key switch to clear.

CODE 93 Lost TCP Lost Wire

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 93: Not Near Wire - Tractor Coil Pair	None	Refer to "Wire Guidance Troubleshooting" on page 5-21.

CODE 94 Lost LCP Lost Wire

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 94: Not Near Wire - Load Coil Pair	None	Refer to "Wire Guidance Troubleshooting" on page 5-21.

CODE 9A Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 9A: Bad WG Learn Procedure	None	Run Wire Guidance Learn. See "Learn Wire Guidance" on page 3-34.

CODE 9B Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 9B: Incorrect Firmware in Guidance Manager Version of firmware installed in Guidance Manager is not compatible with TM software.	None	Install correct TM software via FlashWare or correct firmware in Guidance Manager. Cycle key switch to clear.

CODE 9E Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 9E: Track and Hold Signal Failed The truck is moving on the wire and the guidance signals are not fluctuating.	Check for shorts to frame. Refer to "Shorts to Frame Test" on page 5-3.	Check static straps. AUTO/MAN switch to Manual. Cycle key switch to clear. Replace Guidance Manager.

CODE 9F Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 9F: Filter Card Not Connected to Guidance Manager AUTO/MAN switch is switched to Auto and the Guidance Manager does not sense the Filter Card.	None	Cycle key switch to clear. Check connection between Filter Card and Guidance Manager. Replace Filter Card first, then Guidance Manager.

CODE 9G Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 9G: No Signal - Load Antenna	None	Cycle key switch to clear. Line driver output interrupted. Refer to “Wire Guidance Troubleshooting” on page 5-21.

CODE 9H Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 9H: No Signal - Tractor Antenna	None	Cycle key switch to clear. Line driver output interrupted. Refer to “Wire Guidance Troubleshooting” on page 5-21.

CODE 9J Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 9J: Load Antenna Input Too High	None	AUTO/MAN switch to Manual. Cycle key switch to clear.

CODE 9K Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code 9K: Tractor Antenna Input Too High	None	Refer to “Wire Guidance Troubleshooting” on page 5-21.

CODE A0 Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code A0: Incorrect Software Incorrect Tractor Manager installed in truck or Flashed with incorrect software.	None	Travel, lift, and lower disabled. Cycle key switch to clear. If this code appears, upgrade the software in the truck using FlashWare.

CODE A2 Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code A2: Software Compatibility Issue with TM and TPA	None	Upgrade software via FlashWare. Cycle key switch to clear.

Section 6. Messages, Codes, and Tests Model 9600/9700 Swing-Reach® Maintenance Manual

Messages and Codes

CODE A4 Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code A4: Software Compatibility Issue with TM and LPA	None	Upgrade software via FlashWare. Cycle key switch to clear.

CODE AP Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code AP: TPA Software Fault	None	Cycle key switch to clear. If code does not clear, upgrade TPA software via FlashWare.

CODE AT Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code AT: LPA Software Fault	None	Cycle key switch to clear. If code does not clear, upgrade LPA software via FlashWare.

CODE AV Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code AV: Primary Memory Mismatch The three primary memory locations do not agree.	None	Cycle key switch to clear. Install a pre-programmed TM and CM.

CODE B0 Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code B0: Rotate Position Feedback Pot Out-of-Range	"Input A88 – Rot Posn [Rotate Position Feedback Pot (VR6)]" (page 6-66)	Cycle key switch to clear.

CODE B1 Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code B1: Traverse Position Feedback Pot Out-of-Range	"Input A86 – Trv Posn [Traverse Position Feedback Pot (VR5)]" (page 6-64)	Cycle key switch to clear.

CODE FE Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code FE: Internal TM Circuit for BSOC Not Calibrated	None	Code is displayed for 30 seconds. Replace TM.

CODE FG Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code FG: TM Power Supply Out-of-Range	"Input A14 - TM +12 [TM +12VDC Power Supply]" (page 6-48)	Cycle key switch to clear.

CODE FH Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code FH: Battery Voltage Out-of-Range Wrong voltage battery or voltage out-of-range.	"Input A15 - BattVolt [Battery Voltage]" (page 6-49)	Cycle key switch to clear.

CODE FK Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code FK: CM Power Supply Out-of-Range	"Input A12 - CM +12 [CM +12VDC Power Supply]" (page 6-46)	Cycle key switch to clear.

CODE FN Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code FN: Relays Did Not Open at Power Off	"Test O32 - Relay Tog [Toggle Relay Enable]" (page 6-137)	Cycle key switch to clear.

CODE FP Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code FP: TM In-Circuit Hardware Failure	None	If code is displayed at Startup, replace TM. If intermittent, check static straps and for shorts to frame. Refer to " Shorts to Frame " (page 5-2). Cycle key switch to clear.

CODE FT Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code FT: TM Internal Software Error	None	Cycle key switch to clear. If code does not clear, upgrade TM software via FlashWare.

CODE FX Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code FX: CM In-Circuit Hardware Failure	None	If code is displayed at Startup, replace CM. If intermittent, check static straps and for shorts to frame. Refer to " Shorts to Frame " (page 5-2). Cycle key switch to clear.

Section 6. Messages, Codes, and Tests Model 9600/9700 Swing-Reach® Maintenance Manual

Messages and Codes

CODE FY Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code FY: CM Internal Software Error	None	Cycle key switch to clear. If code does not clear, upgrade CM software via FlashWare.

CODE G0 Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code G0: Steer Tiller Encoder 1 Bad	"Input I35 – Str Enc 1 [Steering Encoder Channel E1]" (page 6-89)	Cycle key switch to clear.

CODE G2 Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
<p>Code G2: Auto Steer Center Failed</p> <ol style="list-style-type: none"> Home switch is >10° from the initial value saved during a successful Auto Steer Center. Auto Steer Center time-out >2 seconds. No encoder pulses sensed during Auto Steer Center. 	Refer to "Troubleshooting Steering Fault Codes (G Series)" on page 5-23.	Step off, then back on the deadman pedal to allow travel again. Cycle key switch to clear.

CODE G3 Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code G3: Home Prox Switch Not Functioning Correctly	Refer to "Troubleshooting Steering Fault Codes (G Series)" on page 5-23.	All steer indicator lights will flash. Cycle key switch to clear.

CODE G4 Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
<p>Code G4: Open Detected in Steer Control Circuit</p> <p>No neutral pulses detected when the truck is not moving and the deadman pedal is depressed.</p>	Refer to "Troubleshooting Steering Fault Codes (G Series)" on page 5-23.	Step off, then back on the deadman pedal to allow travel again. Cycle key switch to clear.

CODE G5 Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code G5: Short Detected In Steer Power Circuit No command and steer motor encoder pulses detected.	"Input A37 - Str Curr [Steer Motor Current]" (page 6-58), "Input I25 - Str Encdr [Steer Motor Encoder]" (page 6-84), "Test O44 - Steer Mtr [Steer Motor]" (page 6-140)	Step off, then back on the deadman pedal to allow travel again. Cycle key switch to clear.

CODE G7 Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code G7: Steer Tiller Encoder 2 Bad	"Input I36 - Str Enc2 [Steering Encoder Channel E2]" (page 6-90)	Cycle key switch to clear.

CODE GD Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code GD: No Steer Motor Encoder Pulses Seen No steer motor encoder pulses seen when requesting a steer correction, travel is >0.1 mph, or during Auto Steer Center.	"Input I25 - Str Encdr [Steer Motor Encoder]" (page 6-84)	Cycle key switch to clear.

CODE GE Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code GE: Both Steer Tiller Encoders Bad The connect detect circuit senses both steer tiller encoders are bad.	"Input I35 - Str Enc1 [Steering Encoder Channel E1]" (page 6-89), "Input I36 - Str Enc2 [Steering Encoder Channel E2]" (page 6-90)	Cycle key switch to clear.

CODE GF Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
Code GF: Wire Guidance Position Out-of-Range	None	Run Wire Guidance Learn. See "Learn Wire Guidance" on page 3-34. Cycle key switch to clear.

Section 6. Messages, Codes, and Tests Model 9600/9700 Swing-Reach® Maintenance Manual

Messages and Codes

CODE J2 Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
<p>Code J2: Aisle Exit Error Only one magnet was sensed when the aisle was exited.</p>	<p>"Input I72 – EOA1, Right [End-of-Aisle Sensor 1 (Right Side)]" (page 6-98), "Input I73 – EOA2, Left [End-of-Aisle Sensor 2 (Left Side)]" (page 6-99), "Input I117 – EOA1 Inner [Alternate Sensor 2]" (page 6-121), "Input I118 – EOA2 Outer [Alternate Sensor 1]" (page 6-122)</p>	<p>While out of the aisle, switch the AUTO/MAN switch to Manual. Turn the drive unit >10° and travel until the code clears. Note: Inputs displayed are dependant on EOA selection in FlashWare.</p>

CODE J4 Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
<p>Code J4: End-of-Aisle Sensor Fault The connect/detect circuit senses one or both sensors are bad.</p>	<p>"Input I100 – EOA1 On [End-of-Aisle Connect Detect 1 (Right Side)]" (page 6-103), "Input I101 – EOA2 On [End-of-Aisle Connect Detect 2 (Left Side)]" (page 6-104)</p>	<p>Check sensor wiring. Cycle key switch to clear.</p>

CODE T4 Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
<p>Code T4: Traverse Proportional Valve Solenoid Open</p>	<p>"Test O58 – Traverse PWM [Traverse PWM (SOL7)]" (page 6-149)</p>	<p>Cycle key switch to clear.</p>

CODE T5 Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
<p>Code T5: Rotate/Reach Proportional Valve Solenoid Open</p>	<p>"Test O55 – Rch/Rot PWM [Reach/Rotate PWM (SOL8)]" (page 6-146)</p>	<p>Cycle key switch to clear.</p>

CODE TE Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
<p>Code TE: Load Handler Motor Temp Sensor Out-of-Range</p>	<p>"Input A65 - LH Mr Tmp [Load Handler Motor Temp]" (page 6-62)</p>	<p>Cycle key switch to clear.</p>

Model 9600/9700 Swing-Reach® Maintenance Manual Section 6. Messages, Codes, and Tests

Messages and Codes

CODE TF Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
<p>Code TF: Load Handler Motor Overtemp</p>	<p>"Input A65 - LH Mr Tmp [Load Handler Motor Temp]" (page 6-62). Test Oils Fans (page 6-133)</p>	<p>Self-resetting after motor allowed to cool.</p>

CODE X6 Inform Service

Code Title/Reason	Inputs/Tests to Run	Notes/Corrective Action
<p>Code X6: EPO Mismatch Reading at JPT22-21 does not agree with reading at JPC22-21 regarding EPO position.</p>	<p>"Input A41 - CM EPO [CM EPO Sense]" (page 6-60) "Input A42 - TM EPO [TM EPO Sense]" (page 6-61)</p>	<p>Cycle key switch to clear.</p>

Section 6. Messages, Codes, and Tests Model 9600/9700 Swing-Reach® Maintenance Manual

Messages and Codes

RAYMOND

Electrical Inputs/Test Summary List

Electrical Inputs/Test Summary List**Analog Inputs**

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Electrical Inputs/Test Summary List

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Section 6. Electrical Tests

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Electrical Inputs/Test Summary List

RAYMOND

Analog Inputs

Analog Inputs

A Diagnosis and Repair table is provided for most inputs. If an input is not within the specified limits, refer to the Diagnosis and Repair table.

Through the process of elimination, these tables provide a step-by-step approach to diagnose a problem and provide the necessary corrective action. See the example below.

Example Diagnosis and Repair Table

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
Do the testing in this order.	<p>This column identifies any actions required before testing the circuit, such as disconnecting certain connectors. If no instructions are given, all circuits should be connected.</p> <p>Note: If something was disconnected in the prior step, reconnect it before performing the next step.</p> <p>This column also identifies the required setting on the meter for this step.</p>	Probe point for the positive (+) meter lead.	Probe point for the negative (-) meter lead.	The reading required to consider the step a success.	The next action to perform if the Expected Results are met.	The next action to perform if the Expected Results are <i>not</i> met.

Input A04 – Thrtl Pot [Throttle Pot (VR1)]

Input A04 – Thrtl Pot [Throttle Pot (VR1)]

The voltage the Carriage Manager (CM) reads from the throttle pot (VR1) is displayed.

NOTE: Run Learn after you replace, repair, or adjust the throttle pot. [Refer to Learn Controls on page 3-33.](#)

If a message to “Release Traction handle to resume operation” is displayed during SelfTest, check the handle for excessive play. The handle should not have movement that allows it to go beyond the values listed while in the neutral position.

Move the throttle pot from full Forks-First (FF) through neutral to full Tractor First (TF), observing the Operator Display.

The input is good if the value displayed is within these limits:

Throttle Position	Voltage Displayed
Full FF	<4.4V
Neutral	2.25 to 2.75V
Full TF	>0.4

Voltage fluctuation indicates a bad cable or pot. If the displayed voltages are outside these limits or do not change in a smooth, linear fashion, refer to Diagnosis and Repair.

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	Disconnect JPR1/DCV	JR1-9	JR1-12	>4V	Perform step 2	T/S wiring
2	Disconnect JPR1 and JPC12/Ohms	JR1-11	JC12-3	0 Ohms	Perform step 3	T/S wiring
3	Disconnect JPC12. <1V should be displayed with A04 selected. If not, replace CM. If OK, connect a jumper (at the CM) between JC12-3 and JC12-1. The display should read >4 with A04 selected. If not, replace the CM. If the correct values are displayed, verify wiring to VR1. If OK, replace pot.					

Input A05 – L/L Pot [Lift/Lower Pot (VR2)]

Input A05 – L/L Pot [Lift/Lower Pot (VR2)]

The voltage the CM reads from the lift/lower pot (VR2) is displayed.

NOTE: Run Learn after you replace, repair, or adjust the lift/lower pot. [Refer to Learn Controls on page 3-33.](#)

If message “Release Lift to resume operation” is displayed during SelfTest, check the handle for excessive play. The handle should not have movement that allows it to go beyond the values listed while in the neutral position.

Move the lift/lower pot from full lift through neutral to full lower, observing the Operator

Display.

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	Disconnect JPR1/DCV	JR1-9	JR1-13	>4V	Perform step 2	T/S wiring
2	Disconnect JPR1 and JPC12/Ohms	JR1-10	JC12-2	0 Ohms	Perform step 3	T/S wiring
3	Disconnect JPC12. <1V should be displayed with A05 selected. If not, replace CM. If OK, connect a jumper (at the CM) between JC12-2 and JC12-1. The display should read >4 with A05 selected. If not, replace the CM. If the correct values are displayed, verify wiring to VR2. If OK, replace pot.					

The input is good if the value displayed is within these limits:

Throttle Position	Voltage Displayed
Full Lift	>0.4
Neutral	2.25 to 2.75V
Full Lower	<4.4V

Voltage fluctuation indicates a bad cable or pot. If the voltage is outside these limits or does not change in a smooth, linear fashion, refer to [Diagnosis and Repair](#).

Input A08 - Dr Mr Tmp [Traction Motor Temp]

Input A08 - Dr Mr Tmp [Traction Motor Temp]

the temperatures are not within several degrees, refer to Diagnosis and Repair.

Traction Motor temperature is displayed.

While operating, the TM continuously monitors traction motor temperature. If the temperature gets too high, performance is reduced until the motor cools down.

- Normal operation: ambient to 284°F (140°C)
- Travel speed reduced linearly between 285°F (141°C) and 310°F (154°C)
- Code 2A is displayed between 311°F (155°C) and 373°F (189°C) and speed is reduced to 1.0 mph
- Code 2E is displayed and travel is limited to 1.0 mph at 374°F (190°C)

With the lift truck at rest and at ambient temperature, compare the temperature displayed to the actual ambient temperature. If

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	Disconnect JPTA3/ Ohms	JTA3-2	JTA3-1	<1200 ohms if Traction Motor	Perform step 2	Replace Traction Motor Temp
2	Disconnect JPTA1/ Ohms	JTA1-8 (on connector)	JTA1-7	is cool to the touch. >1200 ohms if hot to the touch	Replace TPA	Sensor T/S Traction Motor Temp Sensor wires

Input A09 - Lft Mr Tmp [Lift Motor Temp]

Input A09 - Lft Mr Tmp [Lift Motor Temp]

Lift Motor temperature is displayed.

While operating, the TM continuously monitors lift motor temperature. If the temperature gets too high, performance is reduced until the motor cools down.

- Normal operation: ambient to 310°F (154°C)
- Code 6F displayed at 311°F (155°C) and lift is disabled. Lower is allowed
- Code 7E displayed at 320°F (160°C) and lift continues to be disabled. Lower is allowed

With the lift truck at rest and at ambient temperature, compare the temperature displayed to the actual ambient temperature. If the temperatures are not within several degrees, refer to Diagnosis and Repair.

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	Disconnect JPLA3/ Ohms	JLA3-2	JLA3-1	<1200 ohms if Traction Motor is cool to the touch. >1200 ohms if hot to the touch	Perform step 2	Replace Traction Motor Temp Sensor
2	Disconnect JPLA1/ Ohms	JLA1-8	JLA1-7		Replace TPA	T/S Traction Motor Temp Sensor wires

NOTE: For extreme operating conditions where trucks are subjected to repetitive lift/lower cycles, short runs and/or repetitive plugging cycles without time for the amplifiers to cool, a cooling fan kit is available through the parts distribution center. Refer to the parts manual.

Input A10 - TA Temp [TPA Temp]

Traction Power Amplifier (TPA) temperature is displayed.

While operating, the TPA continuously monitors its internal heatsink temperature. If the temperature gets too high, performance is reduced until the TPA cools down.

- Normal operation: ambient to 175°F (79°C)
- At 185°F (85°C), torque is linearly reduced by the TPA
- Code 1H is displayed when temperature exceeds 203°F (95°C) or falls below -40°F (-40°C)

As the truck is operated, the TPA temperature should increase evenly over time. If not, refer to Diagnosis and Repair.

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	Is TPA hot to touch?	N/A	N/A	Hot to touch	Perform step 2	If not hot, replace TPA
2	Allow time to cool			Not hot to touch/no code	Return to service	Replace TPA

NOTE: For extreme operating conditions where trucks are subjected to repetitive lift/lower cycles, short runs, and/or repetitive plugging cycles without time for the amplifiers to cool, a cooling fan kit is available through the Parts Distribution Center. Refer to the parts manual.

Input A11 - Dr Curr [Traction Motor Current]

Input A11 - Dr Curr [Traction Motor Current]

The current the TPA reads from one phase of the traction motor is displayed.

- Maximum current: 450A

The input is good if the value displayed is within these limits:

System Condition	Current Displayed
Static (at rest)	<20A
Travel at Full Speed	<150A

NOTE: Because Input A11 measures only one phase, the value displayed may not always reveal a current problem.

Check the current on each phase (U, V, and W) with a AC clamp-on ammeter.

- The current should ramp evenly as the truck accelerates and decelerates.
- Current should be approx. equal for each phase. Gross differences indicate a problem.

Diagnosis and Repair

If readings are not within specified limits,

perform the following steps.

1. If any one phase differs significantly from the other two, check power cable continuity. Replace cables as necessary. [Refer to Power Cable Terminals on page 7-52.](#)
 - If power cable continuity is OK, troubleshoot the Traction Motor. [Refer to AC Motors on page 5-9.](#)
 - If all phases give high readings, the drive unit may be binding. Check drive unit.

2. The TPA may be bad. Run [Test O29 – Traction RPM](#) <https://www.towclift.com/pdfmanuals.com/> [Motor](#) (page 6-135).

Input A12 - CM +12 [CM +12VDC Power Supply]

Output of the Carriage Manager's internal +12VDC power supply is displayed.

With the truck at rest, the value displayed should be 10.1 to 13.0V.

If the reading fluctuates by more than 0.8V in 10 seconds, refer to Diagnosis and Repair.

Diagnosis and Repair

Unplug all connectors supplying 12V from the CM. Measure 10.1 to 13VDC between JC24-13 and JC10-9. If not OK, replace the CM. If OK, plug in connectors one at a time. Troubleshoot the circuit that pulls the +12V down.

Input A13 – MainPres [Main Lift Pressure Sensor]

Input A13 – MainPres [Main Lift Pressure Sensor]

Voltage from the main lift pressure sensor is displayed.

The input is good if the value displayed is within these limits:

Load Weight	Voltage Displayed
0 lb. (no load) - platform raised 4 in. (102 mm)	Approx. 2.2V

The voltage displayed should increase and decrease linearly as the load weight is increased or decreased. If it does not, refer to Diagnosis and Repair.

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	DCV	JPT20-5	JPT24-10	10.5 to 13V	Perform step 2	Replace TM
2		JPS50-1			Perform step 3	T/S harness
3	Attach pressure gauge to G1/DCV	JPS50-2	JPS50-3	1V at 0 psi. 1V increase per 1000 psi	Perform step 4	Replace Pressure Transducer
4		JPT24-18	JPT24-10		Replace TM	T/S harness

Input A14 - TM +12 [TM +12VDC Power Supply]

Output of the Tractor Manager's (TM) internal +12VDC power supply is displayed.

With the truck at rest, the value displayed should be 10.1 to 13.0V.

If the reading fluctuates by more than 0.8V in 10 seconds, refer to Diagnosis and Repair.

Diagnosis and Repair

Unplug all connectors supplying 12V from the TM. Measure 10.1 to 13VDC between JPT14-5 and TP4. If not OK, replace the TM. If OK, plug in connectors one at a time. Troubleshoot the circuit that pulls the +12V down.

Input A15 – BattVolt [Battery Voltage]

Input A15 – BattVolt [Battery Voltage]

The voltage the TM reads from BATTERY_SENSE_IN at JPT24-24 is displayed.

NOTE: This voltage is used by the TM to calculate Battery State-of-Charge (BSOC).

The input is good if the value displayed is within these limits:

Nominal Battery Voltage	Voltage Displayed (while stationary)
48V	44 to 52V

If the voltage displayed is not within the correct range or the reading fluctuates by more than 0.8V in 10 seconds with the truck not moving or lifting, refer to Diagnosis and Repair.

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	DCV	TP1	TP4	44 to 52V	Perform step 2	Check battery water level and specific gravity. Replace battery. T/S battery cables
2		JPF4-1			Perform step 3	T/S harness from TP1 to JPF4-1
3		JPF4-7			Perform step 4	Replace Fuse/Relay Card
4		JPT24-24			Replace TM	T/S harness from Fuse/Relay Card to TM

Input A17 – Lift Pnd [Lift Pendant]

The voltage to the Lift Pendant from the Tractor Manager is displayed.

NOTE: The display should read approx. 5.0V with the pendant disconnected.

If the voltage reads approx. 5V, refer to Input A18. If the display reads <1V at startup, refer to Diagnosis and Repair.

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	DCV (pendant disconnected)	J1-4	J1-9	Approx. 5V	Replace TM	Perform step 2
2	Extract JT12-5 from connector/DCV (pendant disconnected)	PT12-5	JPT12-12		T/S wiring	Replace TM

Input A18 – Lwer Pnd [Lower Pendant]

Input A18 – Lwer Pnd [Lower Pendant]

The voltage to the Lower Pendant from the Tractor Manager is displayed.

NOTE: The display should read approx. 5.0V with the pendant disconnected.

If the voltage reads approx. 5V, refer to Input A17. If the display reads <1V at startup, refer to Diagnosis and Repair.

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	DCV (pendant disconnected)	J1-3	J1-9	Approx. 5V	Replace TM	Perform step 2
2	Extract JT12-6 from connector/DCV (pendant disconnected)	PT12-6	JPT12-12		T/S wiring	Replace TM

Input A19 - LA Temp [LPA Temp]

Lift Power Amplifier (LPA) temperature is displayed.

While operating, the LPA continuously monitors its internal heatsink temperature. If the temperature gets too high, performance is reduced until the LPA cools down.

- Normal operation: ambient to 175°F (79°C)
- At 185°F (85°C), speed is linearly reduced to 0 fpm at 239°F (115°C), when lift is disabled
- Code 7F is displayed when temperature exceeds 203°F (95°C) or falls below -40°F (-40°C)

As lift is operated, the LPA temperature should increase evenly over time. If not, refer to Diagnosis and Repair.

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	Is LPA hot to touch?	N/A	N/A	Hot to touch	Perform step 2	If not hot, replace LPA
2	Allow time to cool. Does code clear?			Not hot to touch/no code	Return to service	Replace LPA if code does not clear

NOTE: For extreme operating conditions where trucks are subjected to repetitive lift/lower cycles, short runs, and/or repetitive plugging cycles without time for the amplifiers to cool, a cooling fan kit is available through the Parts Distribution Center. Refer to the parts manual.

Input A20 - Lft Curr [Lift Motor Current]

Input A20 - Lft Curr [Lift Motor Current]

The current the LPA reads from one phase of the lift motor is displayed.

- Maximum current: 650A

The input is good if the value displayed is within these limits:

System Condition	Current Displayed
Static (at rest)	<20A
Full Lift	Approx. 460A

NOTE: Because Input A20 measures only one phase, the value displayed may not always reveal a current problem.

Check the current on each phase (U, V, and W) with a AC clamp-on ammeter.

- The current should ramp evenly as the truck lifts.
- Current should be approx. equal for each phase. Gross differences indicate a problem.

Diagnosis and Repair

If readings are not within specified limits,

perform the following steps.

1. If any one phase differs significantly from the other two, check power cable continuity. Replace cables as necessary. [Refer to Power Cable Terminals on page 7-52.](#)
 - If power cable continuity is OK, troubleshoot the Lift Motor. [Refer to AC Motors on page 5-9.](#)
 - If all phases give high readings, the lift pump may be binding. Check lift pump.
2. The LPA may be bad. Run [Test O28 – Lift RPM \[Ramp Lift Motor\] \(page 6-134\).](#)

Input A22 – Thrtl % [Travel Request]

The percentage of throttle request the TM sends to the IPA is displayed. This value is based on VR1 position as calculated by the TM.

NOTE: Run Learn after you replace, repair, or adjust the throttle pot. [Refer to Learn Controls on page 3-33.](#)

The input is good if the value displayed is within these limits:

Throttle Position	Percentage Displayed
Full TF	0 to +100
Neutral	0
Full FF	0 to -100

The values should change smoothly and evenly as the handle moves from Full Tractor-First to Full Forks-First. If these results are not observed, refer to Diagnosis and Repair.

Diagnosis and Repair

Refer to [Input A04 – Thrtl Pot \[Throttle Pot \(VR1\)\] \(page 6-40\)](#).

Compare Input A04 with Input A22. Maximum throw should show maximum values. If so, replace the IPA. If not, check traction system for speed limitations due to motor temperature, limit switches, or configured speed.

Input A23 – L/L % [Lift/Lower Request]

Input A23 – L/L % [Lift/Lower Request]

The percentage of lift/lower request the TM sends to the EPA is displayed. This value is based on VR2 position as calculated by the TM.

NOTE: Run Learn after you replace, repair, or adjust the lift/lower pot. [Refer to Learn Controls on page 3-33.](#)

The input is good if the value displayed is within these limits:

Throttle Position	Percentage Displayed
Full Lower	0 to -100
Neutral	0
Full Lift	0 to +100

The values should change smoothly and evenly as the pot is moved from Full Lower to Full Lift. If these results are not observed, refer to [Diagnosis and Repair](#).

Diagnosis and Repair

Refer to [Input A05 – L/L Pot \[Lift/Lower Pot \(VR2\)\]](#) (page 6-41).

Compare Input A05 with Input A23. Maximum throw should show maximum values. If so, replace the LPA. If not, check lift system for limitations due to motor temperature or switches.

Input A26 - CM 5V PS [+5VDC Pot Supply]

Output of the Carriage Manager's internal +5VDC power supply is displayed. This voltage is used for control handle pots.

With the truck at rest, the value displayed should be $5 \pm 0.25V$.

If the reading fluctuates by more than 0.25V in 10 seconds, refer to Diagnosis and Repair.

Diagnosis and Repair

Disconnect JPC12 and JPC4. Measure $5 \pm 0.25VDC$ between PC12-1 and PC12-12. If

not OK, replace the CM. If OK, plug in connectors, one at a time. Troubleshoot the circuit that pulls the +5V down.

Input A35 - BrkSense [Brake Voltage]

Input A35 - BrkSense [Brake Voltage]

The brake is activated by an internal TM coil driver. The voltage measured at JPT20-14 is displayed.

The input is good if the value displayed is within these limits:

State of Brake	Voltage Displayed
Deactivated	B+
Deadman Pedal Depressed/Travel Requested	7 to 11V for approx. 1 sec, increasing to 15 to 28V

If these results are not observed, refer to [Diagnosis and Repair for Test C30 - Brake \(Page 6-136\)](#).

Input A37 - Str Curr [Steer Motor Current]

The current the steer motor is drawing is displayed.

The input is good if the value displayed is within these limits:

State of Motor	Current Displayed
At rest	<2A
Clockwise (CW) Steering	-30A to -50A
Counterclockwise (CCW) Steering	30A to 50A
Note: CW and CCW is drive unit direction. Open in wire at JPT6-3 equals -199A.	

If these results are not observed, refer to Diagnosis and Repair.

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	DCV	JPT6-3	JPT6-4	At rest: approx. 2.5V Steering CCW: <V at rest Steering CW: >V at rest	Replace TM	Replace Steer Amplifier

Input A40 - MiniSply [Mini Power Supply]

Input A40 - MiniSply [Mini Power Supply]

Output of the Carriage Manager's internal power supply is displayed. This voltage is used to power the mini power supply located on the mini-mast.

With the truck at rest, the value displayed should be 8.5 to 11V.

The readings associated with this input vary depending on the load that is currently on connection JPC12-7. If the voltage displayed is not within the correct range, refer to [Test O63 – MiniPwrSup \[Mini Power Supply\]](#) (page 6-154).

Input A41 - CM EPO [CM EPO Sense]

The status of the Emergency Power Off (EPO) switch (S21), as sensed by the CM, is displayed.

The input is good if the value displayed is within these limits:

State of Switch	Voltage Displayed
Up (closed)	B+
Down (open)	<0.5V

Code X6 is displayed when the truck cannot determine EPO switch status. If the above results are observed, refer to [Input A42 - TM](#)

[EPO \[TM EPO Sense\] \(page 6-61\)](#).

If these results are not observed, refer to [Diagnosis and Repair](#).

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	DCV	JPC22-21	JPC14-10	Switch closed: B+ Switch open: <0.5V	Replace CM	T/S wiring, switch, and connections

Input A42 - TM EPO [TM EPO Sense]

Input A42 - TM EPO [TM EPO Sense]

The status of the Emergency Power Off (EPO) switch (S21), as sensed by the TM, is displayed.

The input is good if the value displayed is within these limits:

State of Switch	Voltage Displayed
Up (closed)	B+
Down (open)	<0.5V

If these results are observed, the TM EPO circuit from S21, the Over-the-Mast (OTM) cable, the Fuse/Relay Card, and the wiring to the TM are good.

Code X6 is displayed when the truck cannot determine EPO switch status. If the above results are observed, refer to [Input A41 - CM EPO \[CM EPO Sense\] \(page 6-60\)](#).

If these results are not observed, refer to Diagnosis and Repair.

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	With EPO switch raised, disconnect JPF4/Ohms	JF4-8	JF4-5	Approx. 0 ohms	Perform step 2	T/S OTM cable and connections
2	DCV	JPT22-21	TP4	Switch closed: B+ Switch open: <0.5V	Replace TM	T/S wiring and connections

Input A65 - LH Mr Tmp [Load Handler Motor

Temp]

Load Handler Motor (LHM) temperature is displayed.

While operating, the TM continuously monitors the load handler motor temperature. If the temperature gets too high, the fan circuit is activated by the TM. Fan activation should occur at 120°F (49°C).

- Normal operation: ambient to 259°F (126°C)
- Out-of-range code TE
- Code TF displayed at 260°F (127°C) and load handler functions are disabled

With the lift truck at rest and at ambient temperature, compare the temperature displayed to the actual ambient temperature. If the temperatures are not within several degrees, refer to Diagnosis and Repair.

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
Run Test O23 – Fans (page 6-133) to verify fans are functional.						
1	JPZ disconnected/ Ohms	PZ-1	PZ-2	<1200 ohms if LHM is cool to the touch. >1200 ohms if hot to the touch	Perform step 2	Replace LHM Temp Sensor
2	JPT24 disconnected/ Ohms	JT24-23	JT24-11		Replace TM	T/S LHM Temp Sensor wires

Input A85 – Trv Pot [Traverse/Reach Pot (VR4)]

Input A85 – Trv Pot [Traverse/Reach Pot

(VR4)]

The voltage the CM reads from the traverse/reach pot (VR4) is displayed.

NOTE: Run Learn after you replace, repair, or adjust the traverse/reach pot. [Refer to Learn Controls on page 3-33.](#)

If code 8X is displayed during SelfTest, check the handle for excessive play. The handle should not have movement that allows it to go beyond the values listed while in the neutral position.

Move the traverse/reach pot from full traverse right through neutral to full traverse left, observing the Operator Display.

The input is good if the value displayed is within these limits:

Position	Voltage Displayed
Traverse Right (handle pulled back)	<4.4V
Neutral	2.25 to 2.75V
Traverse Left (handle pushed forward)	>0.4

Voltage fluctuation indicates a bad cable or pot. If the voltage is outside these limits or does not change in a smooth, linear fashion, refer to [Diagnosis and Repair](#).

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	Disconnect JPL1/DCV	JL1-9	JL1-12	>4V	Perform step 2	T/S wiring
2	Disconnect JPL1 and JPC4/Ohms	JL1-11	JC4-4	0 Ohms	Perform step 3	T/S wiring
3	Disconnect JPC4. <1V should be displayed with A85 selected. If not, replace CM. If OK, connect a jumper (at the CM) between JC4-2 and JC4-4. The display should read >4 with A85 selected. If not, replace the CM. If the correct values are displayed, verify wiring to VR4. If OK, replace pot.					

Input A86 – Trv Posn [Traverse Position

Feedback Pot (VR5)]

The voltage the CM reads from the traverse position feedback pot (VR5) is displayed.

NOTE: Run Learn after you replace, repair, or adjust the traverse position feedback pot. [Refer to Learn Controls on page 3-33.](#)

Traverse the mini-mast from full right to full left, observing the Operator Display.

The input is good if the value displayed is within these limits:

Mini-Mast Position	Voltage Displayed
Fully Left	>0.2V
Center	2.25 to 2.75V
Fully Right	<4.8V

Voltage fluctuation indicates a bad cable or pot. If the voltage is outside these limits or does not change in a smooth, linear fashion, refer to Diagnosis and Repair.

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	Disconnect VR5/DCV	JK2-1	JK2-3	Approx. 5V	Perform step 2	T/S wiring
2	Disconnect JPC24 and JPK-2/Ohms	JC24-18	JK2-2	0 ohms	Perform step 3	T/S wiring
3	Disconnect JPS27. <1V should be displayed with A86 selected. If not, replace CM. If OK, connect a jumper between JS27-14 and JPC4-1. The display should read >4 with A86 selected. If not, replace the CM. If the correct values are displayed, replace pot.					

Input A87 – Rot Pot [Rotate Command Pot (VR3)]

Input A87 – Rot Pot [Rotate Command Pot

(VR3)]

The voltage the CM reads from the rotate command pot (VR3) is displayed.

NOTE: Run Learn after you replace, repair, or adjust the rotate pot. [Refer to Learn Controls on page 3-33.](#)

If code 8V is displayed during SelfTest, check the knob for excessive play. The knob should not have movement that allows it to go beyond the values listed while in the neutral position.

Move the rotate pot from full clockwise through neutral to full counterclockwise, observing the Operator Display.

The input is good if the value displayed is within these limits:

Rotate Position	Voltage Displayed
Full Clockwise	>0.4
Neutral	2.25 to 2.75V
Full Counterclockwise	<4.4V

Voltage fluctuation indicates a bad cable or pot. If the voltage is outside these limits or does not change in a smooth, linear fashion, refer to Diagnosis and Repair.

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	Disconnect JPL1/DCV	JL1-9	JL1-13	>4V	Perform step 2	T/S wiring
2	Disconnect JPL1 and JPC12/Ohms	JL1-10	JC12-5	0 ohms	Perform step 3	T/S wiring
	Disconnect JPC12 and https://www.forkliftpdfmanuals.com/ selected. If not, replace CM. If OK, connect a jumper (at the CM) between PC12-5 and PC4-2. The display should read <1V with A87					

3	selected. If not, replace the CM. If the correct values are displayed, verify wiring to VR3. If OK, replace pot.
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Input A88 – Rot Posn [Rotate Position

Feedback Pot (VR6)]

The voltage the CM reads from the rotate position feedback pot (VR6) is displayed.

NOTE: Run Learn after you replace, repair, or adjust the rotate position feedback pot.
[Refer to Learn Controls on page 3-33.](#)

Rotate the load handler from full clockwise to full counterclockwise, observing the Operator Display.

The input is good if the value displayed is within these limits:

Rotate Position	Voltage Displayed
Full Clockwise	<4.5V
Straight Ahead	2.25 to 2.75V
Full Counterclockwise	>0.5V

Voltage fluctuation indicates a bad cable or pot. If the voltage is outside these limits or does not change in a smooth, linear fashion, refer to Diagnosis and Repair.

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	Disconnect JP4/DCV	J4-1	J4-3	>4V	Perform step 2	T/S wiring
2	Disconnect JP4 and JPC24/Ohms	J4-2	JC24-15	0 Ohms	Perform step 3	T/S wiring
3	Disconnect JPS27 and JPC12. <1V should be displayed with A88 selected. If not, replace CM. If OK, connect a jumper (at the CM) between JC24-15 and JC12-1. The display should read >4 with A88 selected. If not, replace the CM. If the correct values are displayed, replace VR6.					

Input A89 – MiniPres [Mini-Mast Pressure Sensor]

Input A89 – MiniPres [Mini-Mast Pressure

Sensor]

Voltage from the mini-mast pressure sensor is displayed.

The input is good if the value displayed is within these limits:

Load Weight	Voltage Displayed
0 lb. (no load) - Load Handler raised 4 in. (102 mm)	Approx. 1.5V

The voltage displayed should increase and decrease linearly as the load weight is increased or decreased. If it does not, refer to Diagnosis and Repair.

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	DCV	JPT20-4	JPT20-6	10.5 to 13V	Perform step 2	Replace TM
2		JP46-1	JP46-3		Perform step 3	T/S harness
3	Attach pressure gauge to G1/DCV	JP46-2		JPT24-6	1V at 0 psi. 1V increase per 1000 psi	Perform step 4
4		JPT24-19	Replace TM			T/S harness

Input A90 – TM B+Key

The voltage the TM is reading at JPT14-12 is displayed.

The input is good if the value displayed is within these limits:

Nominal Battery Voltage	Voltage Displayed
48V	44.0 to 52.0V

Input A91 – CM B+Key

Input A91 – CM B+Key

The voltage the CM is reading at JPC14-12 is displayed.

The input is good if the value displayed is within these limits:

Nominal Battery Voltage	Voltage Displayed
48V	44.0 to 52.0V

Input A94 - Trv Curr [Traverse Solenoid

(SOL7)]

The current the traverse solenoid (SOL7) is drawing, as read by the CM, is displayed in milliamps.

The input is good if the value displayed is within these limits:

State	Current Displayed (mA)
Neutral	0 to 4
Traverse Requested	up to 650

If these results are not observed, refer to Diagnosis and Repair.

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	Disconnect JPC20/Ohms	JC20-20	JC20-17	Approx. 30 ohms	Perform step 2	T/S wiring, connections, and solenoid coil
2	DCV	SOL7-1	JPC14-1	B+	Perform step 3	T/S wiring, connections, and Fuse/Relay Card
3		JC20-20		Ramp from B+ (OFF) to approx. 31V (ON)	Check SOL7 for mechanical binding.	T/S B+K2. If OK, replace CM

Input A95 - Rot Curr [Rotate Solenoid (SOL8)]

Input A95 - Rot Curr [Rotate Solenoid (SOL8)]

The current the rotate solenoid (SOL8) is drawing, as read by the CM, is displayed in milliamps.

The input is good if the value displayed is within these limits:

State	Current Displayed (mA)
Neutral	0 to 4
Traverse Requested	up to 550

If these results are not observed, refer to Diagnosis and Repair.

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	Disconnect JPC20/Ohms	JC20-16	JC20-13	Approx. 30 ohms	Perform step 2	T/S wiring, connections, and solenoid coil
2	DCV	SOL8-1	JPC14-1	B+	Perform step 3	T/S wiring, connections, and Fuse/Relay Card
3		JPC20-16		Ramp from B+ (OFF) to approx. 32V (ON)	Check SOL8 for mechanical binding.	T/S B+K2. If OK, replace CM

Section 6. Electrical Tests

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Input A95 - Rot Curr [Rotate Solenoid (SOL8)]

RAYMOND

Digital Inputs

Digital Inputs

A Diagnosis and Repair table is provided for most inputs. If an input is not within the specified limits, refer to the Diagnosis and Repair table.

Through the process of elimination, these tables provide a step-by-step approach to diagnose a problem and provide the necessary corrective action. See the example below.

Example Diagnosis and Repair Table

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
Do the testing in this order.	<p>This column identifies any actions required before testing the circuit, such as disconnecting certain connectors. If no instructions are given, all circuits should be connected.</p> <p>Note: If something was disconnected in the prior step, reconnect it before performing the next step.</p> <p>This column also identifies the required setting on the meter for this step.</p>	Probe point for the positive (+) meter lead.	Probe point for the negative (-) meter lead.	The reading required to consider the step a success.	The next action to perform if the Expected Results are met.	The next action to perform if the Expected Results are <i>not</i> met.

Input I00 – Dman S23 [Carriage Deadman

Switch (S23)]

The status of the Carriage Deadman Switch (S23), as seen by the CM, is displayed.

The input is good if these values are displayed:

Pedal Position	Value Displayed
Up	Off
Down	On

If these values are not displayed, refer to Diagnosis and Repair.

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	Disconnect S23/DCV	S23-1	S23-3	Approx. 12V	Perform step 2	T/S wiring
2	DCV	JPC22-7	JPC22-11	Pedal Up: Approx. 5V Pedal Down: <1V	Replace CM	T/S switch, wiring, and connections

Input I02 – Lift S11 [Lift Reference Prox (S11)]

Input I02 – Lift S11 [Lift Reference Prox (S11)]

The status of the Lift Reference Prox (S11), as seen by the TM, is displayed.

The display should indicate S11 is below (Belw) when near the mast crosstie and above (Abve) when the telescopic is raised above the switch.

Verify clearance between the switch and telescopic is 0.19 ±0.06 in. (4.8 ±1.5 mm).

The input is good if these values are displayed:

Switch State	Value Displayed
Near metal	Belw
Away from metal	Abve

If these values are not displayed, refer to Diagnosis and Repair.

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	Disconnect JPS8/DCV	PS8-1	PS8-3	Approx. 12V	Perform step 2	T/S wiring
2	DCV	JPT22-7	JPF3-11	Above: Approx. 5V Below: <1V	Replace TM	T/S switch, wiring, and connections

Input I04 – Bypass S7 [Lift/Lower Inhibit

Bypass Switch (S7)]

The status of the Lift/Lower Inhibit Bypass Switch (S7), as seen by the CM, is displayed.

The input is good if these values are displayed:

Switch State	Value Displayed
Closed	In
Open	Out

If these values are not displayed, refer to Diagnosis and Repair.

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	Disconnect JPC12 and JPC4/Ohms	JC12-8	JC4-2	Switch depressed: 0 ohms	Replace CM	T/S switch, wiring, and connections

Input I14 – FU1 Sense

Input I14 – FU1 Sense

The absence or presence of B+ to the load side of the STR contactor is displayed.

The input is good if these values are displayed:

STR State	Value Displayed
Open	<4V*
Closed	B+

*Allow approx. 7 minutes for voltage to drop below 4V after STR contactor opens.

If these values are not displayed, refer to Diagnosis and Repair.

Code 4B

- If >4V is displayed with the contactor open, check for shorts to frame. Remove the sense wire from JPT22-19. If the voltage goes away, locate the cause of the short. If the voltage remains >4V with the sense lead disconnected, replace the TM.

Code 4C - Check FU1 and the STR contactor tips.

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	STR Contactor pushed in	JPT22-19	TP4	B+	Replace TM	T/S wiring, connections, and contactor

Input I15 – Horn S3 [Horn Switch (S3)]

The status of the Horn Switch (S3), as seen by the CM, is displayed.

The input is good if these values are displayed:

Switch State	Value Displayed
Out	Out
Depressed	In

If these values are not displayed, refer to Diagnosis and Repair.

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	Disconnect JPC12/Ohms	JC12-10	JC12-12	Switch depressed: 0 ohms Switch not depressed: open	Replace CM	T/S switch, wiring, and connections

Input I19 – Trac RPM [Traction Motor RPM]

Input I19 – Trac RPM [Traction Motor RPM]

The output from the Traction Motor Encoder (TME), as seen by the TPA, is displayed.

The Display shows rpm as measured by the TPA. The RPM reading should show a linear increase to maximum RPM.

If these values are not displayed, refer to Diagnosis and Repair.

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	Disconnect JPTA4/DCV	JPTA1-26	JPTA1-7	4.5 to 5.5V	Perform step 2	Replace TPA
2	DCV	JPTA2-1	JPTA2-4		Perform step 3	T/S harness
3		JPTA1-31			Perform step 4	
4		JPTA1-32	JPTA1-7	Stationary: >3.5V or <0.5V Running: Approx. 2V	Replace TPA	T/S wiring. If OK, replace TME
5						

Input I20 – Lift RPM [Lift Motor RPM]

The output from the Lift Motor Encoder (LME), as seen by the LPA, is displayed.

The Display shows rpm as measured by the LPA. The RPM reading should show a linear increase to maximum RPM.

If these values are not displayed, refer to Diagnosis and Repair.

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	Disconnect JPLA2/DCV	JPLA1-26	JPLA1-7	4.5 to 5.5V	Perform step 2	Replace LPA
2	DCV	JPLA2-1	JPLA2-4		Perform step 3	T/S harness
3		JPLA1-32			JPLA1-7	
4		JPLA1-31	Stationary: >3.5V or <0.5V Running: Approx. 2V	Perform step 5	T/S wire connections. If OK, replace LME	
5				Replace LPA		

Input I23 – Can Bus [CAN Communication]

Input I23 – Can Bus [CAN Communication]

Verification that the TM is communicating with the CM, TPA, LPA, Display Interface Card, and GM is displayed.

The information below is for a truck that displays a code during SelfTest. If the code is displayed after a successful SelfTest, refer to “[Troubleshooting Communication Error Codes \(5x Series\)](#)” on page 5-19.

The input is good if these values (letters) are displayed:

- **C** - CM is communicating with the TM
- **D** - Display Interface Card is communicating with the TM
- **L** - LPA is communicating with the TM
- **T** - TPA is communicating with the TM
- **W** - Guidance Manager is communicating with the TM (wire guidance only).

If these values are not displayed, refer to Diagnosis and Repair.

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
L is missing						
1	DCV	JPLA1-1	B- (on amp)	B+	Perform step 2	T/S B+ from K2 Relay
2	JPLA1 and JPT14 disconnected /Ohms	JLA1-35	JT14-4	0 ohms	Perform step 3	Repair/replace harness
3		JLA1-23	JT14-11		Replace LPA	
T is missing						
1	DCV	JPTA1-1	B- (on amp)	B+	Perform step 2	T/S B+ from K2 Relay
2	JPTA1 and JPT14 disconnected	JTA1-35	JT14-4	0 ohms	Perform step 3	Repair/replace harness

3	disconnected /Ohms	JTA1-23	JT14-11		Replace TPA	harness
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Input I23 – Can Bus [CAN Communication]

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
W is missing						
1	DCV	JPS6-11	JPS6-24	B+	Perform step 2	T/S B+ from K2 Relay
2	JPS4 and JPT14 disconnected /Ohms	PS4-5	JT14-4	0 ohms	Perform step 3	Repair/replace harness
3		PS4-6	JT14-11		Perform step 4	
4	Disconnect JPW1 and JPW2. If the “ W ” appears with the cables disconnected, troubleshoot wiring and antenna coils to determine which sensor/cable is dragging the GM down. If the “ W ” still does not display, inspect the GM firmware for correct installation. See “Guidance Manager Firmware Replacement” on page 7-56 . If correctly installed, replace GM.					

Input I24 – Str Home [Home Steer Proximity Sensor]

Input I24 – Str Home [Home Steer Proximity

Sensor]

The state of the Home Steer Proximity Sensor, as seen by the TM, is displayed.

The input is good if these values are displayed:

Steer Prox	Value Displayed	LED (on sensor)
Over metal	On	On
Not over metal	Off	Off

If these values are not displayed, refer to

Diagnosis and Repair.

NOTE: If the input is bad, pass a screwdriver or metal ruler under the sensor to activate it. If this produces desired results, adjust switch gap to 0.19 ±0.06 in. (4.8 ±1.5 mm).

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	DCV	JPA7-3	JPA7-2	10.5 to 13V	Perform step 3	Perform step 2
2		JPT20-9	JPT22-11		Replace/replace harness	Replace TM
3		JPA7-1	JPA7-2	Sensor over metal: <1V	Perform Step 4	Adjust/replace sensor
4		JPT22-3	JPT20-11	Sensor not over metal: Approx. 5V	Replace TM	Repair/replace harness

Input I25 – Str Encdr [Steer Motor Encoder]

The Steer Motor feedback Encoder input (counts) to the TM is displayed.

A three digit number is displayed, representing the number of steer motor encoder counts. When the count exceeds 255, it starts over at 0. If the count goes below 0, it starts over at 255.

If these values are not displayed, refer to Diagnosis and Repair.

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	DCV	JPE4-1	JPE4-4	10.5 to 13V Stationary: >4V or <0.5V Turning: Approx. 2.5V	Perform step 2	Perform step 6
2		JPE4-3			Perform step 3	Replace Steer Motor Encoder
3		JPE4-2			Perform step 4	
4		JPT22-9	JPT10-9	Perform step 5	Repair/replace harness	
5		JPT22-10		Replace TM		
6		JPT20-7		10.5 to 13V	Repair/replace harness	Replace TM

Input I26 – Main Ht Ct [Main Lift Height Encoder]

Input I26 – Main Ht Ct [Main Lift Height

Encoder]

The Main Lift Height Encoder input to the TM is displayed.

A three digit number is displayed, representing the number of pulses counted. The count should increase during lower and decrease during lift. When the count exceeds 255, it starts over at 0. If the count goes below 0, it starts over at 255.

If these values are not displayed, refer to Diagnosis and Repair.

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	DCV	JPE5A-1	JPE5A-4	10.5 to 13V	Perform step 2	Repair/replace wiring
2		JPE5A-3 (Channel A)	JPE5A-4	Not lifting or lowering main mast: Approx. 5 or <1V Lifting or lowering main mast: Approx. 2.3V	Perform step 3	Replace Height Encoder
3		JPE5A-2 (Channel B)			Perform step 4	
4		JPT22-5 (Channel A)	JPT10-4		Perform step 5	Repair/replace wiring
5		JPT22-12 (Channel B)			Replace TM	

Input I32 – Dman S2 [Brake Deadman Switch

(S2)]

The state of the Brake Deadman Switch (S2), as seen by the TM (via over-the-mast cable), is displayed.

The input is good if these values are displayed:

Pedal Position	Value Displayed
Up	Up
Down	Down

If these values are not displayed, refer to Diagnosis and Repair.

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	Disconnect S2/DCV	S2-1 at cable	S2-3 at cable	10.1 to 13V	Perform step 2	Perform step 4
2	Disconnect S2/DCV	S2-2 at cable		Approx. 4.5V	Perform step 3	Perform step 5
3	DCV	JPT22-8	JPT14-3	Deadman up: approx. 5V Deadman down: <1V	Replace TM	Replace S2
4	Disconnect S2/Ohms	S2-1 at cable	JPT14-5	Approx. 1 ohm	Perform step 5	Repair/replace wiring
5		S2-3 at cable	JPT14-3		Perform step 6	
6		S2-2 at cable	JPT22-8		Perform step 3	

Input I33 – Str Enc 1 On [Steering Encoder Connect Detect 1]

Input I33 – Str Enc 1 On [Steering Encoder

Connect Detect 1]

Verification that the E1 channel of the Steering Encoder is connected is displayed.

The input is good if these values are displayed:

Steering Encoder	Value Displayed
Connected	Yes
Not Connected	No

If these values are not displayed, refer to Diagnosis and Repair.

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	DCV	JPC10-7	JPC18-5	JPE1 connected: Approx. 10V JPE1 disconnected: Approx. 12V	Replace CM	Check wiring. If OK, replace steering encoder

Input I34 – Str Enc2On [Steering Encoder

Connect Detect 2]

Verification that the E2 channel of the Steering Encoder is connected is displayed.

The input is good if these values are displayed:

Steering Encoder	Value Displayed
Connected	Yes
Not Connected	No

If these values are not displayed, refer to Diagnosis and Repair.

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	DCV	JPC10-6	JPC18-6	JPE2 connected: approx. 10V JPE2 disconnected: approx. 12V	Replace CM	Check wiring. If OK, replace steering encoder

Input I35 – Str Enc 1 [Steering Encoder Channel E1]

Input I35 – Str Enc 1 [Steering Encoder

Channel E1]

The input from the Steering Encoder Channel E1 to the CM is displayed.

The TM uses the input from the CM to determine the rate and direction of steering request. The number displayed varies between 0 and 255. The displayed value should change as the steer tiller rotates.

If the number displayed does not vary or only changes from 0 to 1 or 0 to 255, refer to Diagnosis and Repair.

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	DCV	JPC10-7	JPC18-5	Approx. 9V	Perform step 2	Disconnect JPE1 and JPE2. If voltage goes to 12V, check wiring. If OK, replace steering encoder
2		JPC22-12 (Ch B)		Tiller stationary: approx. 0 or 4.75V	Perform step 3	Check wiring. If OK, replace steering encoder
3		JPC22-5 (Ch A)		Tiller moving: approx. 2.5V	Replace CM	Check wiring. If OK, replace steering encoder

Input I36 – Str Enc2 [Steering Encoder

Channel E2]

The input from the Steering Encoder Channel E2 to the CM is displayed.

The TM uses the input from the CM to determine the rate and direction of steering request. The number displayed varies between 0 and 255. The displayed value should change as the steer tiller rotates.

If the number displayed does not vary or only changes from 0 to 1 or 0 to 255, refer to Diagnosis and Repair.

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	DCV	JPC10-6	JPC18-6	Approx. 9V Tiller stationary: approx. 0 or 4.75V Tiller moving: approx. 2.5V	Perform step 2	Disconnect JPE1 and JPE2. If voltage goes to 12V, check wiring. If OK, replace steering encoder
2		JPC22-14 (Ch B)				Perform step 3
3		JPC22-13 (Ch A)			Replace CM	Check wiring. If OK, replace steering encoder.

Input I39 – Neut Pulse [Neutral Pulses]

Input I39 – Neut Pulse [Neutral Pulses]

The neutral pulses seen by the TM from the Steer Amplifier (SA) are displayed.

Run [Test O44 – Steer Mtr \[Steer Motor\]](#) (page 6-140) to check the power portion of the steering system.

The input is good if these values are displayed:

Deadman	Value Displayed
Off	Steady ON or OFF
ON	Quickly toggles between ON and OFF

NOTE: ON/OFF continues to toggle after deadman is released until STR contactor opens.

If these values are not displayed, refer to Diagnosis and Repair.

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	DCV	JPT6-6	JPT6-4	10.5 to 13V	Perform step 2	Replace TM
2		JPT6-1		Deadman pedal down: approx. 2.5V	Replace TM	Repair wiring/ replace SA

Input I45 – Slk Ch S50 [Slack Chain 1 Switch

(S50)]

The state of the Slack Chain Switch 1 (S50 located on seated operator left side), as seen by the TM, is displayed.

The input is good if these values are displayed:

Switch	Value Displayed
Activated	In
Deactivated	Out

If these values are not displayed, refer to Diagnosis and Repair.

Diagnosis and Repair

Check lift chain tension. Make sure the switch is activated and both main cylinder lift chains are at the same tension. Inspect the compression spring washers. Refer to [“Main Lift Chains \(9600\)” on page 7-92](#) or [“Main Lift Chains \(9700\)” on page 7-94](#). Also, the main lift cylinders may require bleeding. See [“Bleeding the Hydraulic System” on page 7-74](#).

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	Disconnect JPT22 and JPF3/Ohms	JT22-1	JF3-10	0 Ohms	Perform step 2	Repair/replace wiring/switch
2		PT22-1	PF3-10	Approx. 5V	Replace TM	Check wiring and Fuse/Relay Card. Make sure JPF3-10 is at B-

Input I46 – Slk Ch S51 [Slack Chain 2 Switch (S51)]

Input I46 – Slk Ch S51 [Slack Chain 2 Switch

(S51)]

The state of the Slack Chain Switch 2 (S51 located on seated operator right side), as seen by the TM, is displayed.

The input is good if these values are displayed:

Switch	Value Displayed
Activated	In
Deactivated	Out

If these values are not displayed, refer to Diagnosis and Repair.

Diagnosis and Repair

Check lift chain tension. Make sure the switch is activated and both main cylinder lift chains are at the same tension. Inspect the compression spring washers. Refer to [“Main Lift Chains \(9600\)” on page 7-92](#) or [“Main Lift Chains \(9700\)” on page 7-94](#). Also, the main lift cylinders may require bleeding. See [“Bleeding the Hydraulic System” on page 7-74](#).

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	Disconnect JPT22 and JPT4/Ohms	JT22-2	JT4-2	0 Ohms	Replace TM	Repair/replace wiring/switch

Input I65 – Rail Sense [Rail Guidance Switch

(S15)]

The state of the optional Rail Guidance Switch (S15), as seen by the TM, is displayed.

The input is good if these values are displayed:

Switch	Value Displayed
Depressed	In
Released	Out

If these values are not displayed, refer to Diagnosis and Repair.

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	Disconnect JPT22 and JPT24/Ohms	JT22-4	JT24-5	Switch depressed: 0 Ohms Switch released: Open	Replace TM	Repair/replace wiring/switch

Input I66 – Auto/Man [Auto/Manual Switch (S4)]

Input I66 – Auto/Man [Auto/Manual Switch

(S4)]

The state of the optional Auto/Manual Switch (S4), as seen by the CM, is displayed.

The input is good if these values are displayed:

Switch	Value Displayed
O (open)	Auto
(closed)	Manu

If these values are not displayed, refer to Diagnosis and Repair.

NOTE: If the wire between the AUTO/MANUAL switch and the CM is disconnected, the system defaults to AUTO.

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	Disconnect JPC12/Ohms	JC12-11	JC12-12	Auto: open circuit Manual: 0 ohms	Replace CM	T/S wiring and switch

Input I67 – SG Rt S60 [Right Sidegate Switch

(S60)]

The state of the optional Sidegate Right Switch (S60), as seen by the CM, is displayed.

The input is good if these values are displayed:

Sidegate	Value Displayed
Up	Up
Down	Down

If these values are not displayed, refer to Diagnosis and Repair.

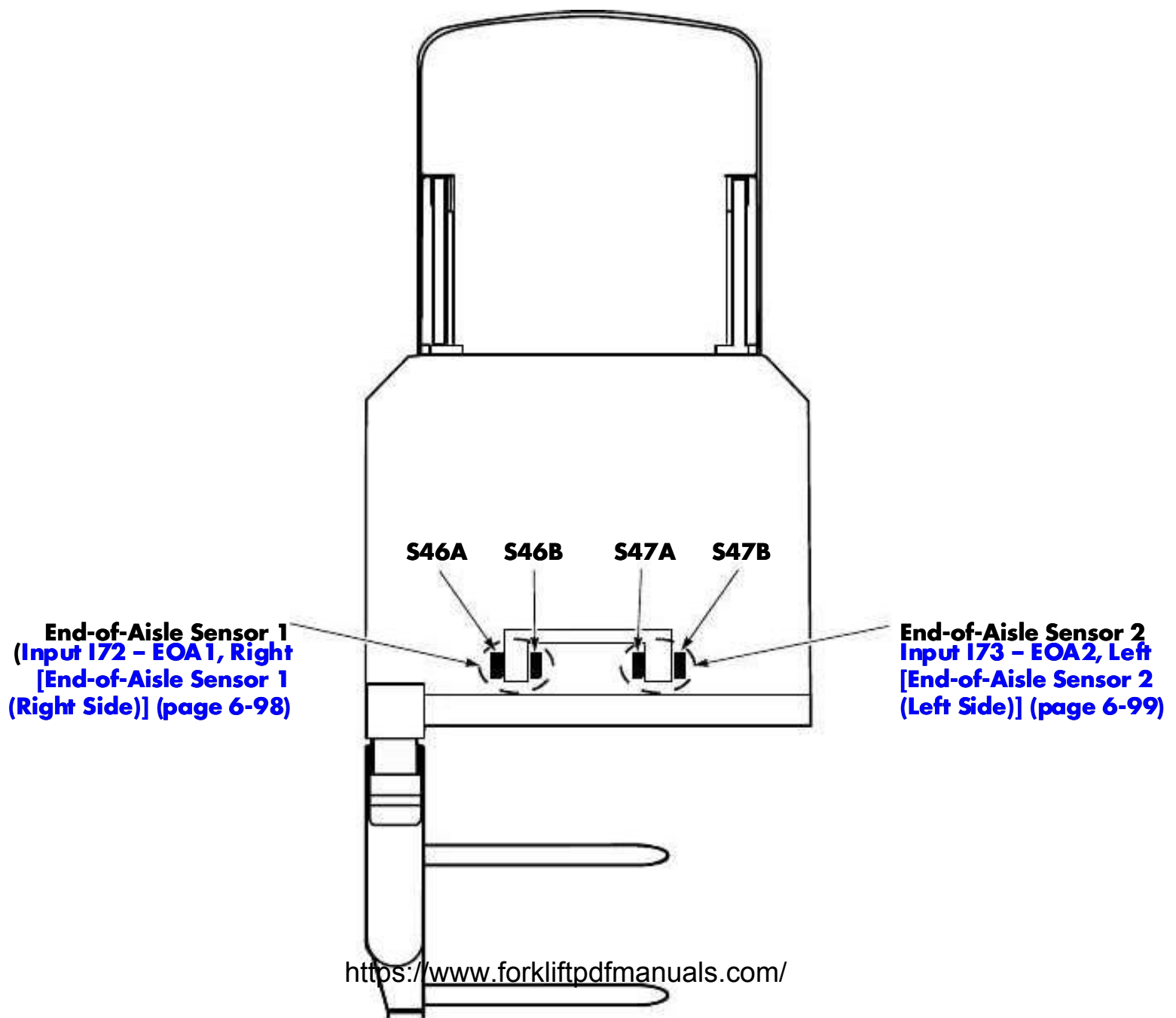
Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	Disconnect S60/DCV	S60-1	S60-3	Approx. 12V	Perform step 2	T/S wiring
2	DCV	JPC22-4	JPC18-7	Sidegate up: 5V Sidegate down: <1V	Replace CM	T/S switch, wiring, and connections

Raymond EOA Sensor Location

Raymond EOA Sensor Location

Figure 6-1. Location of Raymond End-of-Aisle Sensors and Related Inputs



Input I72 – EOA1, Right [End-of-Aisle Sensor 1

(Right Side)]

The input from the optional End-of-Aisle Sensor 1 (S46A and B), as seen by the TM is displayed (refer to [Figure 6-1 on page 6-97](#)).

NOTE: This input is displayed when Raymond EOA is selected in FlashWare.

While observing the display, drive the truck so the sensor passes over a floor magnet. The display should change from “OFF” to “ON”,

If these values are not displayed, refer to Diagnosis and Repair.

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	Disconnect JPT10/DCV	PT10-6	PT24-8	Approx. 12V	Perform step 2	Replace TM
2	DCV	JPT10-6 (Backprobe)	JPT24-8 (Backprobe)	Approx. 8V	Perform step 3	T/S harness for opens and shorts. If OK, replace sensor S46A or S46B
3	Disconnect JPT12 and JPT24/DCV	PT12-10	PT24-8	Approx. 5V	Perform step 4	Replace TM
4	DCV	JPT12-10 (Backprobe)	JPT24-8 (Backprobe)	S46A or S46B Closed (sees magnet): <1V Open (no magnet): Approx. 5V	Replace TM	T/S harness for opens or shorts. If OK, replace bad sensor

Input I73 – EOA2, Left [End-of-Aisle Sensor 2 (Left Side)]

Input I73 – EOA2, Left [End-of-Aisle Sensor 2 (Left Side)]

The input from the optional End-of-Aisle Sensor 2 (S47A and B), as seen by the TM is displayed (refer to Figure 6-1 on page 6-97).

NOTE: This input is displayed when Raymond EOA is selected in FlashWare.

While observing the display, drive the truck so the sensor passes over a floor magnet. The display should change from “OFF” to “ON”.

If these values are not displayed, refer to Diagnosis and Repair.

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	Disconnect JPT10/DCV	PT10-7	PT24-9	Approx. 12V	Perform step 2	Replace TM
2	DCV	JPT10-7 (Backprobe)	JPT24-9 (Backprobe)	Approx. 8V	Perform step 3	T/S harness for opens and shorts. If OK, replace sensor S47A or S47B
3	Disconnect JPT10 and JPT24/DCV	PT24-17	PT24-9	Approx. 5V	Perform step 4	Replace TM
4	DCV	JPT24-17 (Backprobe)	JPT24-9 (Backprobe)	S47A or S47B Closed (sees magnet): <1V Open (no magnet): Approx. 5V	Replace TM	T/S harness for opens or shorts. If OK, replace bad sensor

Input I83 – SG Lt S61 [Left Sidegate Switch

(S61)]

The state of the optional Sidegate Left Switch (S61), as seen by the CM, is displayed.

The input is good if these values are displayed:

Sidegate	Value Displayed
Up	Up
Down	Down

If these values are not displayed, refer to Diagnosis and Repair.

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	Disconnect S61/DCV	S61-1	S61-3	Approx. 12V	Perform step 2	T/S wiring
2	DCV	JPC22-6	JPC24-10	Sidegate up: 5V Sidegate down: <1V	Replace CM	T/S switch, wiring, and connections

Input I87 – BG Lt S57 [Left Battery Gate Switch (S57)]

Input I87 – BG Lt S57 [Left Battery Gate Switch (S57)]

The state of the optional Left Battery Gate Switch (S57), as seen by the TM, is displayed.

The input is good if these values are displayed:

Battery Gate	Value Displayed
Removed	Out
Installed	In

If these values are not displayed, refer to Diagnosis and Repair.

Diagnosis and Repair

Check for correct switch clearance. The sensor should extend 0.23 in. (5.8 mm) beyond the switch mounting plate.

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	Disconnect JPBSEN1/DCV	PBSEN1-2	PBSEN1-3	Approx. 12V	Perform step 2	T/S wiring
2	DCV	JPT22-6	JPT18-5	Gate removed: 5V Gate installed: <1V	Replace TM	T/S switch, wiring, and connections

Input I88 – BG Rt S58 [Right Battery Gate

Switch (S58)]

The state of the optional Right Battery Gate Switch (S58), as seen by the TM, is displayed.

The input is good if these values are displayed:

Battery Gate	Value Displayed
Removed	Out
Installed	In

If these values are not displayed, refer to Diagnosis and Repair.

Diagnosis and Repair

Check for correct switch clearance. The sensor should extend 0.23 in. (5.8 mm) beyond the switch mounting plate.

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	Disconnect JPBSEN2/DCV	PBSEN2-2	PBSEN2-3	Approx. 12V	Perform step 2	T/S wiring
2	DCV	JPT24-20	JPT18-5	Gate removed: 5V Gate installed: <1V	Replace TM	T/S switch, wiring, and connections

Input I100 – EOA1 On [End-of-Aisle Connect Detect 1 (Right Side)]

Input I100 – EOA1 On [End-of-Aisle Connect

Detect 1 (Right Side)]

Verification that the Sensor 1 End-of-Aisle switches (S46A and B) are connected is displayed.

NOTE: S46A and B are located on the right side of the Antenna Card bracket as you stand on the platform facing the tractor.

The input is good if these values are displayed:

Sensor 1 Switches	Value Displayed
Connected	Yes
Not Connected	No

If these values are not displayed, refer to [Input I72 – EOA1, Right \[End-of-Aisle Sensor 1 \(Right Side\)\]](#) (page 6-98) Diagnosis and Repair.

Input I101 – EOA2 On [End-of-Aisle Connect

Detect 2 (Left Side)]

Verification that the Sensor 2 End-of-Aisle switches (S47A and B) are connected is displayed.

NOTE: S47A and B are located on the left side of the Antenna Card bracket as you stand on the platform facing the tractor.

The input is good if these values are displayed:

Sensor 2 Switches	Value Displayed
Connected	Yes
Not Connected	No

If these values are not displayed, refer to [Input I73 – EOA2, Left \[End-of-Aisle Sensor 2 \(Left Side\)\] \(page 6-99\)](#) Diagnosis and Repair.

Input I102 – LdDm S9 [Load Handler Deadman (S9)]

Input I102 – LdDm S9 [Load Handler Deadman (S9)]

The state of the Load Handler Deadman Switch (S9), as seen by the CM, is displayed.

The input is good if these values are displayed:

Switch	Value Displayed
Open	Off
Closed	On

If these values are not displayed, refer to Diagnosis and Repair.

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	Disconnect S9/DCV	S9-1	S9-3	Approx. 12V	Perform step 2	T/S wiring
2	DCV	JPC22-2	JPC10-9	Pedal up: 5V Pedal down: <1V	Replace CM	T/S switch, wiring, and connections

Input I103 – LeftHndDM [Left Hand Deadman

(S26)]

The state of the optional Left Hand Deadman Switch (S26), as seen by the CM, is displayed.

The input is good if these values are displayed:

Switch	Value Displayed
Open	Off
Closed	On

If these values are not displayed, refer to Diagnosis and Repair.

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	DCV	JPC12-6	JPC4-2	Switch open: 5V Switch closed: <1V	Replace CM	T/S switch, wiring and connections

Input I104 – ReachProx [Reach Proximity Sensor]

Input I104 – ReachProx [Reach Proximity

Sensor]

The state of the Reach Proximity Sensor, as seen by the CM, is displayed.

The input is good if these values are displayed:

Reach Prox	Value Displayed	LED (on sensor)
Over metal	On	On
Away from metal	Off	Off

If these values are not displayed, refer to [Diagnosis and Repair](#).

NOTE: If the input is bad, pass a screwdriver or metal ruler under the sensor to activate it. If this produces desired results, adjust the switch gap to 0.09 ±0.03 in. (2.3 ±0.7 mm).

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	Disconnect JP3/DCV	JPC12-7	JPC10-4	8.5 to 11V	Perform step 2	T/S wiring. If OK, run Test O63 – MiniPwrSup [Mini Power Supply] (page 6-154)
2	Disconnect all wires/DCV	JPC22-1		Sensor over metal: approx. <1V Sensor not over metal: approx. 5V	Replace CM	T/S wiring. If OK, replace sensor

Input I105 – Mini Ht Ct [Mini-Mast Height Count]

The mini-mast height count, calculated by the TM, is displayed. The displayed height should increase during lift and decrease during lower.

The mini-mast height count is determined by the height proximity sensor inputs. When the mini-mast is fully lowered, Height Prox A (“[Input I106 – Mini Sw A \[Mini-Mast Height Prox A\]](#)”), Height Prox B (“[Input I107 – Mini Sw B \[Mini-Mast Height Prox B\]](#)”), and Height Prox C (“[Input I108 – Mini Sw C \[Mini-Mast Height Prox C\]](#)”) are all ON. While lifting or lowering, if all three inputs are present at the same time, a fault code occurs. Also, if one of the inputs does not change state while lifting or lowering, a fault code occurs.

Navigate to the input menu and scroll until I06, I07, and I08 are all displayed. Observe the status of each input while lifting or lowering.

If one of the inputs remains ON, it may indicate a shorted mast cable or wiring. If one of the three inputs does not change from ON to OFF while lifting/lowering, refer to the input for the switch that is not changing state.

Input I106 – Mini Sw A [Mini-Mast Height Prox A]

Input I106 – Mini Sw A [Mini-Mast Height

Prox A]

The state of the Prox A channel of the mini-mast height proximity sensor, as seen by the CM, is displayed.

The input is good if these values are displayed:

Reach Prox	Value Displayed
Over metal	On
Not over metal	Off

The value displayed should change as the mini-mast is raised and lowered. If these results are not observed, refer to Diagnosis and Repair.

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	DCV	JP5-3	JPC10-4	Approx. 5V	Perform step 2	Run Test O63 – MiniPwrSup [Mini Power Supply] (page 6-154)
2		JP2-1			Perform step 3	
3	JP2 and JPC22 disconnected/ Ohms	JC22-9	P2-2	0 Ohms	Perform step 4	T/S wiring
4	DCV	JPC22-9	JPC10-4	Near metal: 0.6V Not near metal: approx. 3.2V	Replace CM	Replace mini-mast Height Prox Sensor

Input I107 – Mini Sw B [Mini-Mast Height

Prox B]

The state of the Prox B channel of the mini-mast height proximity sensor, as seen by the CM, is displayed.

The input is good if these values are displayed:

Reach Prox	Value Displayed
Over metal	On
Away from metal	Off

The value displayed should change as the mini-mast is raised and lowered. If these results are not observed, refer to Diagnosis and Repair.

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	DCV	JP5-3	JPC10-4	Approx. 5V	Perform step 2	Run Test O63 – MiniPwrSup [Mini Power Supply] (page 6-154)
2		JP2-1			Perform step 3	
3	JP2 and JPC22 disconnected /Ohms	JC22-10	P2-3	0 Ohms	Perform step 4	T/S wiring
4	DCV	JPC22-10	JPC10-4	Near metal: 0.6V Not near metal: approx. 3.2V	Replace CM	Replace mini-mast Height Prox Sensor

Input I108 – Mini Sw C [Mini-Mast Height Prox C]

Input I108 – Mini Sw C [Mini-Mast Height

Prox C]

The state of the Prox C channel of the mini-mast height proximity sensor, as seen by the CM, is displayed.

The input is good if these values are displayed:

Reach Prox	Value Displayed
Over metal	On
Away from metal	Off

The value displayed should change as the mini-mast is raised and lowered. If these results are not observed, refer to Diagnosis and Repair.

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	DCV	JP5-3	JPC10-4	Approx. 5V	Perform step 2	Run Test O63 – MiniPwrSup [Mini Power Supply] (page 6-154)
2		JP2-1			Perform step 3	
3	JP2 and JPC22 disconnected /Ohms	JC24-20	P2-4	0 Ohms	Perform step 4	T/S wiring
4	DCV	JPC24-20	JPC10-4	Near metal: 0.6V Not near metal: approx. 3.2V	Replace CM	Replace mini-mast Height Prox Sensor

Input I109 – LftSel S6 [Lift Select (S6)]

The state of the Lift Select Switch (S6), as seen by the CM, is displayed.

The input is good if these values are displayed:

Switch Position	Value Displayed
Out	Off
Depressed	On

If these values are not displayed, refer to Diagnosis and Repair.

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	JPC12 and JPC4 disconnected/Ohms	JC12-4	JC4-2	Depressed: 0 ohms Not depressed: open	Replace CM	T/S switch, wiring, and connections

Input I1 10 – Attach S5 [Attachment (S5)]

Input I1 10 – Attach S5 [Attachment (S5)]

The state of the optional Attachment Switch (S5), as seen by the CM, is displayed.

The input is good if these values are displayed:

Switch Position	Value Displayed
Out	Off
Depressed	On

If these values are not displayed, refer to Diagnosis and Repair.

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	JPC12/Ohms	JC12-9	JPC12-12	Depressed: 0 ohms Not depressed: open	Replace CM	T/S switch, wiring, and connections

Input I111 – In Aisle

This test displays the End-of-Aisle status in the truck's memory.

The display shows either **IN** or **OUT**.

If these values are not displayed, refer to [Input I72 – EOA1, Right \[End-of-Aisle Sensor 1 \(Right Side\)\] \(page 6-98\)](#) or [Input I117 – EOA1 Inner \[Alternate Sensor 2\] \(page 6-121\)](#) and [Input I73 – EOA2, Left \[End-of-Aisle Sensor 2 \(Left Side\)\] \(page 6-99\)](#) or [Input I118 – EOA2 Outer \[Alternate Sensor 1\] \(page 6-122\)](#).

Input I112 – FU4 sense [FU4 Sense]

Input I112 – FU4 sense [FU4 Sense]

The absence or presence of B+ to the load side of the Load Handler Contactor (LHC) is displayed.

NOTE: Manually activate the contactor to see the transition.

The input is good if these values are displayed:

STR State	Value Displayed
Open	Out
Closed	In

If these values are not displayed, refer to Diagnosis and Repair.

Code 49 - If >4V is displayed with the contactor open, check for shorts to frame. Remove the sense wire from JPT22-20. If the voltage goes away, locate the cause of the short. If the voltage remains >4V with the sense lead disconnected, replace the TM.

Code 4A - Check FU4 and the LHC contactor tips.

Diagnosis and Repair

Step	Action/ Meter Scale	(+) Lead	(-) Lead	Expected Results	Step Passed	Step Failed
1	LPC and LHC Contactor pushed in	JPT22-20	TP4	B+	Replace TM	T/S wiring, connections, and contactor

Input I113 – CustomIn1 [Custom Input 1 (CM)]

This option must be enabled in FlashWare. It is designed to support “Custom” inputs. This input displays the status of the associated circuit to the CM.

NOTE: Refer to the attached device manufacturer’s documentation for specific troubleshooting information regarding that device.

Refer to [Table 3-2, “Configure Mode Menu,” on page 3-27.](#)

The input is good if these values are displayed:

JPC10-8 to JPC24-8	Value Displayed
0 ohms	On
Open	OUT

If these results are not observed, refer to Diagnosis and Repair.

Diagnosis and Repair

Carefully complete the circuit between JPC10-8 and JPC24-8. If “ON” is displayed, troubleshoot the attached device and associated wiring. If

“ON” is *not* displayed, replace the CM.

Input I1 14 – CustomIn2 [Custom Input 2 (CM)]

Input I1 14 – CustomIn2 [Custom Input 2 (CM)]

This option must be enabled in FlashWare. It is designed to support “Custom” inputs. This input displays the status of the associated circuit to the CM.

NOTE: Refer to the attached device manufacturer’s documentation for specific troubleshooting information regarding that device.

Refer to [Table 3-2, “Configure Mode Menu,” on page 3-27.](#)

The input is good if these values are displayed:

JPC10-2 to JPC24-9	Value Displayed
0 ohms	ON
Open	OUT

If these results are not observed, refer to Diagnosis and Repair.

Diagnosis and Repair

Carefully complete the circuit between JPC10-2 and JPC24-9. If “ON” is displayed, troubleshoot the attached device and associated wiring. If

“ON” is *not* displayed, replace the CM.

Input I115 – CustomIn3 [Custom Input 3 (TM)]

This option must be enabled in FlashWare. It is designed to support “Custom” inputs. This input displays the status of the associated circuit to the TM.

NOTE: Refer to the attached device manufacturer’s documentation for specific troubleshooting information regarding that device.

Refer to [Table 3-2, “Configure Mode Menu,” on page 3-27.](#)

The input is good if these values are displayed:

JPT10-8 to JPT24-3	Value Displayed
0 ohms	ON
Open	OUT

If these results are not observed, refer to [Diagnosis and Repair.](#)

Diagnosis and Repair

Carefully complete the circuit between JPT10-8 and JPT24-3. If “ON” is displayed, troubleshoot the attached device and associated wiring. If

“ON” is *not* displayed, replace the TM.