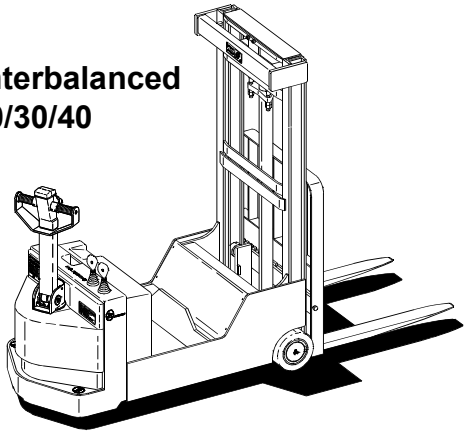
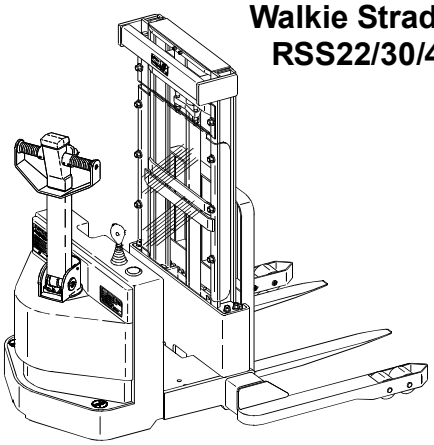
RAYMOND

Maintenance Manual

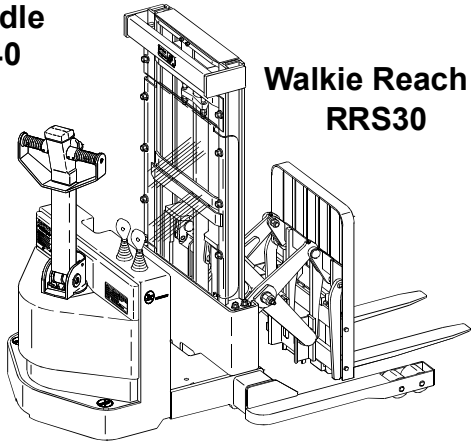
Walkie Counterbalanced
RCS20/30/40



Walkie Straddle
RSS22/30/40



Walkie Reach
RRS30



Model	Serial Numbers
RCS20/30/40 RSS22/30/40 RRS30	01000 - Up

Publication: #1010298-2 Issued: 22 Dec 2006

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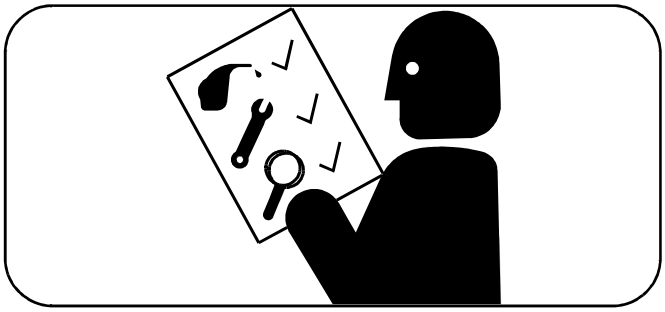
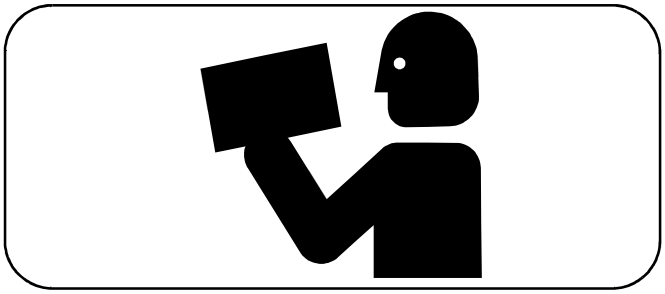
Follow the scheduled lubrication, maintenance, and inspection steps.

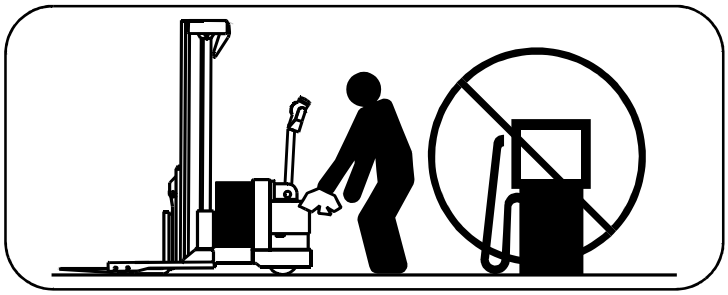


Follow exactly the safety and repair instructions in this manual. Do **NOT** take “shortcuts”.

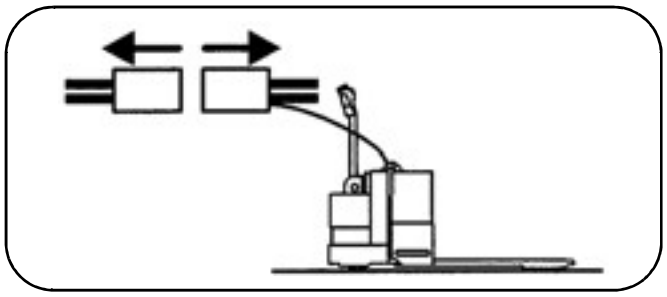


Do **NOT** Use an open flame near the truck.

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



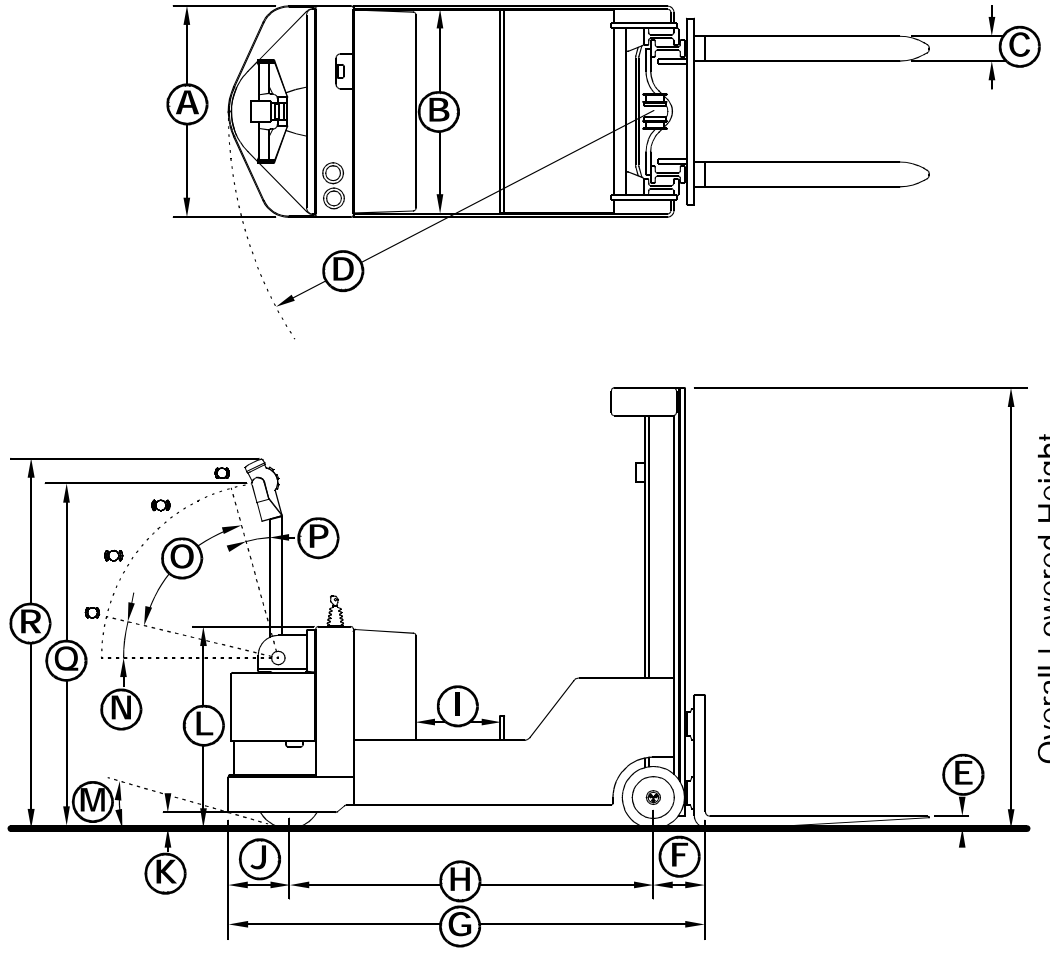
- Attach the ground cable as close to the weld area as possible.



- Disconnect all electrical cards before any type of electric resistance welding is done.
- Do not perform any welding operations near the electrical components.
- Only trained, qualified, and authorized personnel should weld on the truck.
- If welding must be done near the battery compartment, remove the battery from the truck.
- When welding is completed, perform all ground tests and electrical inspections before the truck is operated.

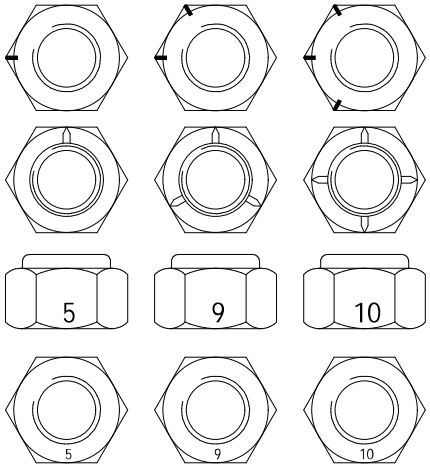
1.5. RCS30 Dimensions

The following diagram shows external dimensions for the **RCS30** truck in its standard design.



A	34.1 in. (886 mm)	J	9.7 in. (246 mm)
B	32.3 in. (820 mm)	K	2.1 in. (53 mm)
C	4 in. (101 mm)	L	32.5 in. (8.25 mm)
D	62 in. (1574 mm)	M	16.2°
E	2 in. (50 mm)	N	10.5°
F	8.1 in. (205 mm)	O	67°
G	70.1 in. (1780 mm)	P	12.5°
H	52.3 in. (1328 mm)	Q	55.6 in. (1412 mm)
I	13.3 in. (337 mm)	R	59.5 in. (1511 mm)

Inch (SAE) and Metric Fasteners



1. Introduction

Threaded fasteners such as bolts, nuts, cap screws, and studs are made to specifications that describe mechanical strength and hardness of fastener. A fastener used in a design application is selected in accordance with its specifications. Parts used on this truck are purchased from many countries. Many fasteners are similar but cannot be used as direct replacements.

Service technicians must use replacement fasteners that have the same specifications. Fasteners made to each specification have identification marks for that specification. This specification is commonly called "grade" for SAE standards and "property" for metric standards. This section describes identification of some common fasteners.

The metric system used is described as SI (International System of Units, also called SI in all languages). The SI system of measurement is described in ISO Standard 1000, 1973.

Temperature					
Multiply	**By**	**To Get**	**Multiply**	**By**	**To Get**
(Fahrenheit -32)	0.56	Celsius (C)	(Celsius x 1.8)	+32	Fahrenheit (F)
Torque					
Multiply	**By**	**To Get**	**Multiply**	**By**	**To Get**
inch pound	0.113	Newton meter (N•m)	Newton meter	8.851	inch pounds in-lb
feet pound	1.356	Newton meter (N•m)	Newton meter	0.738	foot pounds ft-lbs
Velocity					
Multiply	**By**	**To Get**	**Multiply**	**By**	**To Get**
miles/hour	1.609	kilometer/hour (km/h)	kilometer/hour	0.621	miles/hour (mph)
Volume					
Multiply	**By**	**To Get**	**Multiply**	**By**	**To Get**
inches^3	16.387	centimeters^3 (cm^3)	centimeters^3	0.061	inches^3 (in^3)
inches^3	0.016	liters	liters	61.024	inches^3 (in^3)
quarts, U.S.	0.946	liters	liters	1.057	quarts, U.S. (qt)
quarts, U.S.	0.83	quarts, Imp. (qt)	quarts, Imp.	1.205	quarts, U.S. (qt)
gallons, U.S.	3.785	liters	liters	0.264	gallons, U.S. (gal)
gallons, U.S.	0.83	gallons, Imp. (gal)	gallons, Imp.	1.205	gallons, U.S. (gal)
ounces	29.57	milliliters (ml)	milliliters	0.034	ounces (oz)

2. Lubricants

2.1. Standard Conditioning

The standard truck conditioning is designed for operation in temperatures down to 32 degrees F (0 degrees C).

2.2. Corrosion Conditioning

The corrosion conditioning specification is designed for operation in environments with standing water, high humidity, limited brine or salt solution exposure, food processing, or frequent wash downs.

- Hydraulic Fittings - a rust inhibitor coating is applied
- Screws - a rust inhibitor coating is applied
- Lift chains - coated with rust inhibiting chain protectant
- Component protective coating - coated with corrosion inhibiting protective coating where appropriate
- Sealed components (switches, push/pull cables, sensors) - used where appropriate
- Lubrication points - grease fittings provided on axle and other pivot points where necessary
- Plated components - plated pins, shafts, and linkage where required
- Electrical connections - protected with a silicone compound or rust inhibitor coating where appropriate
- Corrosion preventative - components (adjustable features, bearing races, etc.) coated with Antiseize where necessary

2.4.2. Hydraulic System

Inspect for leaks around the lift cylinder. Any sign of oil on the floor under the truck is an indication that the truck may be leaking hydraulic oil or transmission fluid. Report any problems to the appropriate personnel. DO NOT operate the truck until it has been inspected and repaired by a trained, qualified, and authorized technician.

2.4.3. Lifting Devices

Check lift cylinders for proper mounting. Lubricate pivot points on cylinder mounting pins that do not have grease fittings. Lubricate non-greasable wear points with a drip oil can using 10 weight machine oil. On WRX, check reach mechanism for damage and cracks, proper reach stroke and timing, and retract bumpers.

2.5. Services Performed Semi-Annually or Every 720 Operating Hours

The semi-annually planned maintenance service should be performed by a trained, qualified, and authorized technician.

2.5.1. Frame

Check frame for crack formation and damage. Check cover screws and secure as necessary.

2.5.2. Drive Gear

⚠ WARNING When using compressed air, wear effective chip-guarding and personal protective equipment. Compressed air used for cleaning **MUST** be reduced to less than 30 psi (207 kPa).

Check for oil leakage on the drive gear. Clean motor of dirt and dust. Check torque of motor bolts.

2.5.3. Brakes

Check correct clearance of brake shoes.

2.5.4. Steering Arm Handle

Check fasteners on steering arm handle. Check ease of steering.

Contents, Section S

1. Service Instructions

NO	FUNCTION GROUP	C-CODE
0	CHASSIS	0000
1	MOTORS	1000
2	DRIVE GEAR / TRANSMISSION	2000
3	BRAKE / WHEEL SYSTEM	3000
4	STEERING SYSTEM	4000
5	ELECTRICAL / PNEUMATIC SYSTEM	5000
6	HYDRAULIC SYSTEM	6000
7	LIFTING MAST / CYLINDERS	7000
8	PERIPHERAL / INSTALLATION EQUIPMENT	8000
9	OPTIONS / ATTACHMENTS	9000
10	TOOLS	10000

Item No.	Description	Item No.	Description
1	Console	8	Latch
2	Bumper, door	9	Screw, locking
3	Latch	10	Plate, latch
4	Screw, flat socket head	11	Screw, cap
5	Panel, kick	12	Plate
6	Screw, socket	13	Screw
7	Door		

Operator Controls

1. Theory of Operation

The one spool hydraulic control manual valve is used to control the lift and lower functions. The two spool hydraulic control manual valve is used to control the tilt and sideshifter functions.

Travel speeds, lift/lower controls, horn and reverse controls are located on the control handle.

2. Maintenance

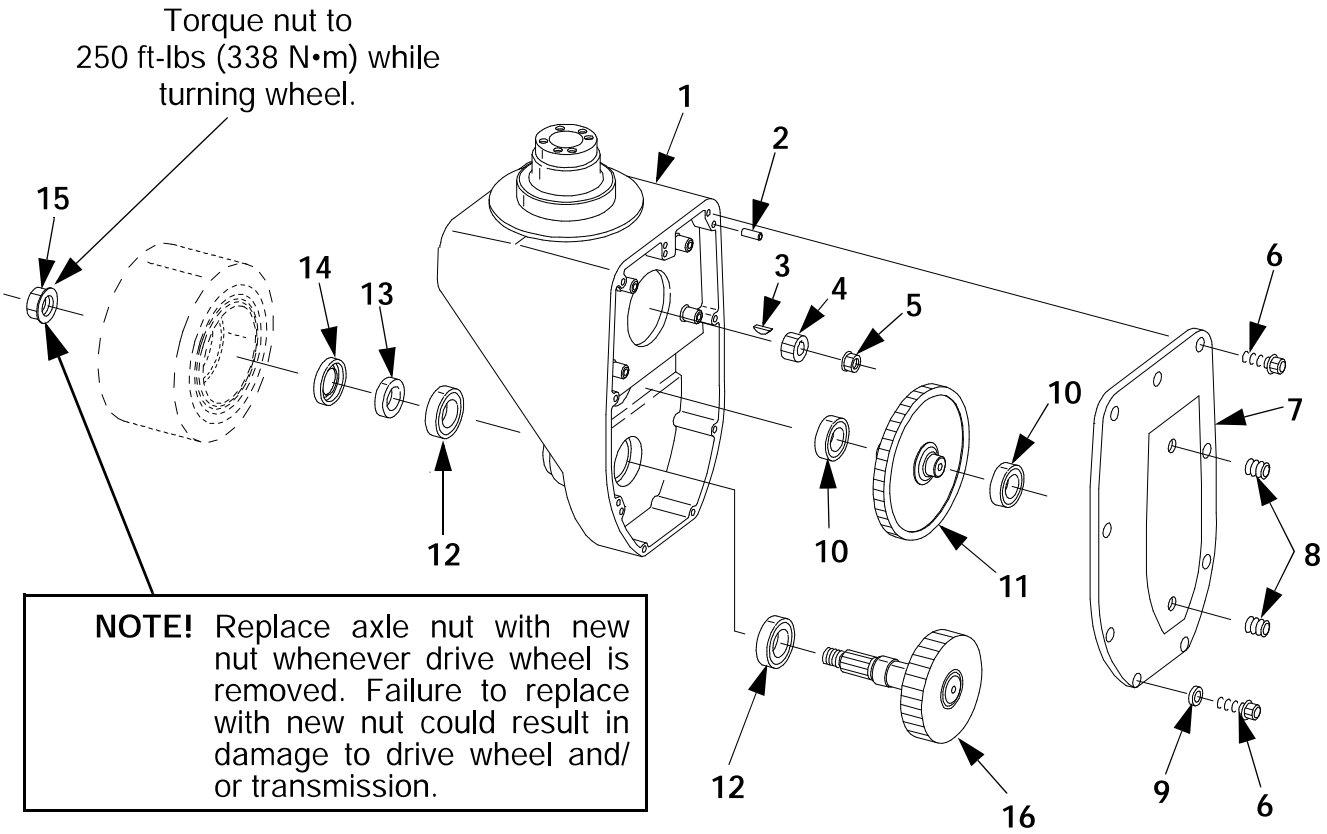
See "Planned Maintenance Schedule" on page 71.

3. Troubleshooting

For electrical problems on the truck see page 206. For hydraulic problems on the truck see page 293.

5. Remove blocks. Connect the battery connector to the truck.
6. Turn master control on/off switch ON and turn key switch ON. Test truck for proper operation before returning to service.

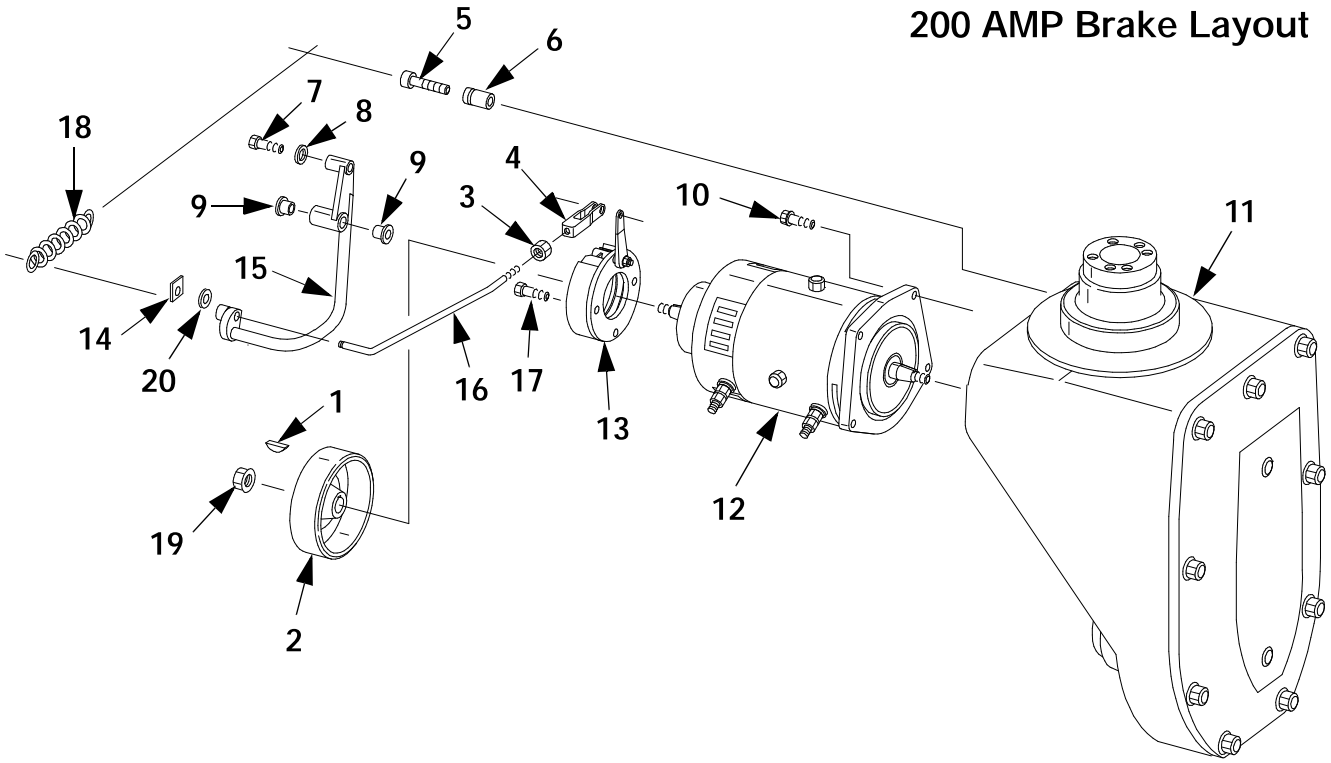
Item No.	Description	Item No.	Description
1	Motor assembly, drive	10	Band, head
2	Kit, field coil	11	Armature
3	Kit, lead assembly	12	Fan
4	Brush	13	Ring, retainer
5	Spring	14	Bearing
6	Plate, brush	15	Endhead, drive
7	Bearing	16	Seal
8	Washer, wave	K	Kit, "EE" cover band
9	Endhead, commutator		



Item No.	Description	Item No.	Description
1	Case, gear	9	Washer, sealing
2	Pin, dowel	10	Bearing, ball
3	Key	11	Gear, idler
4	Gear, pinion	12	Bearing
5	Nut, flanged	13	Ring
6	Screw, socket head	14	Seal
7	Cover, gear case	15	Nut, flanged
8	Plug, drain/fill pipe	16	Gear, drive

4. Repair and Rebuild

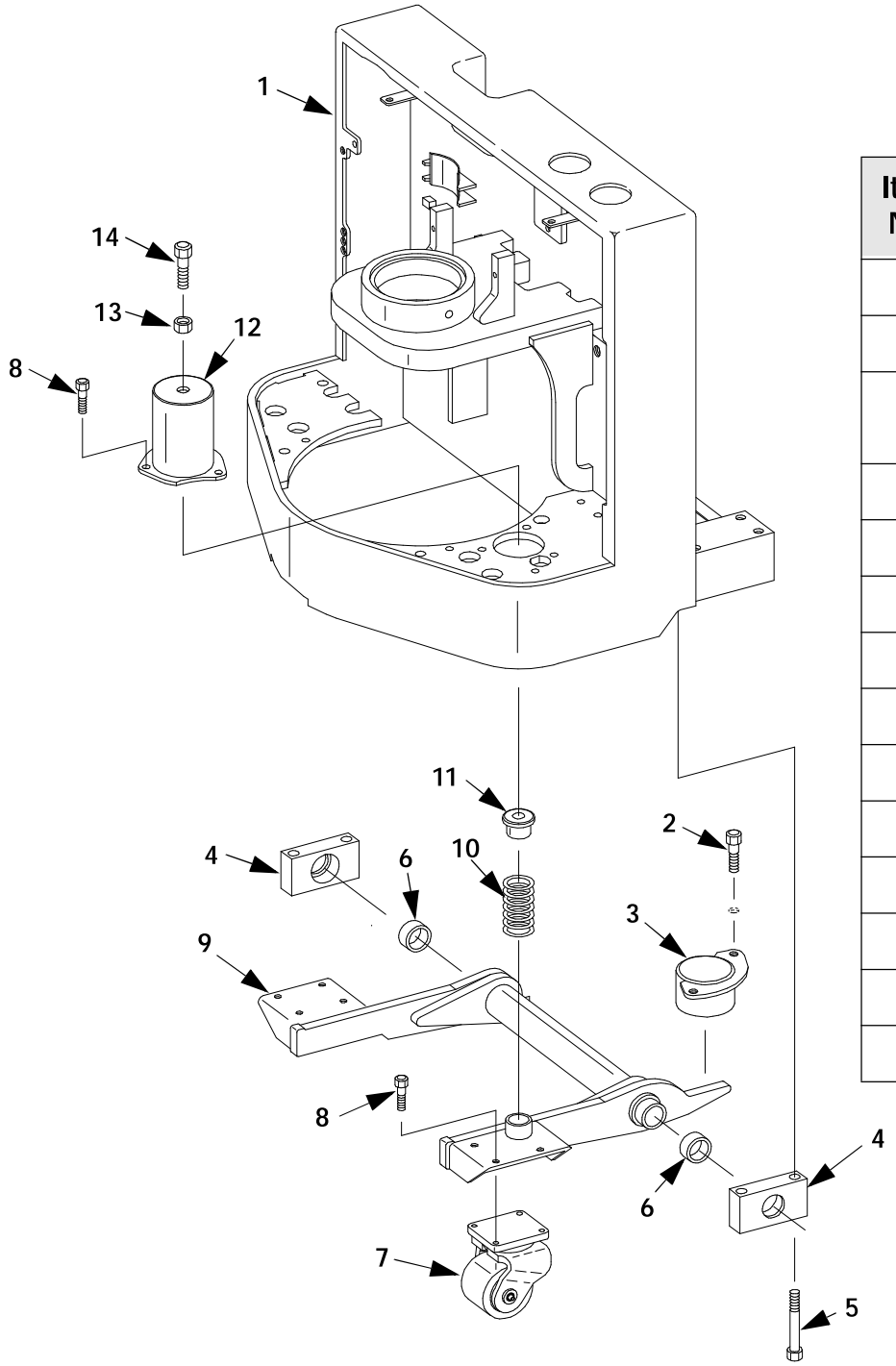
200 AMP Brake Layout



Item No.	Description	Item No.	Description
1	Key	11	Transmission assembly
2	Drum, brake	12	Drive motor assembly
3	Nut	13	Brake assembly
4	Yoke assembly	14	Retainer
5	Screw, socket head	15	Linkage, brake
6	Anchor, spring	16	Rod, push
7	Screw, cap	17	Screw, socket head
8	Bearing, handle	18	Spring
9	Bushing	19	Nut, flanged
10	Screw, socket head	20	Washer

4. Repair and Rebuild

RCS/RRS



Item No.	Description
1	Frame, carrier
2	Screw, cap
3	Compensator cylinder assembly
4	Pivot
5	Screw, cap
6	Bushing
7	Caster assembly
8	Screw, cap
9	Bar, torsion
10	Spring
11	Retainer, spring
12	Base, spring
13	Nut
14	Screw, cap

Caster Assembly

1. Theory of Operation

The casters are mounted on the torsion bar to provide maximum stability in turning.

2. Maintenance

Normal maintenance includes lubricating grease fittings on the caster periodically. (See "Planned Maintenance Schedule" on page 71.)

2.1. Inspection

1. Park truck on level surface and apply brake.
2. Turn key switch OFF and depress master control on/off switch OFF.
3. Disconnect the battery connector from the truck.

⚠ WARNING When using compressed air, wear effective chip-guarding and personal protective equipment. Compressed air used for cleaning **MUST** be reduced to less than 30 psi (207 kPa).

NOTE! **CLEANLINESS!** Perform procedures in a clean environment. Make sure all parts are cleaned before disassembly and kept clean during assembly.

4. Thoroughly clean all parts and remove all nicks and burrs with emery cloth.
5. Inspect all bearings and replace as needed.
6. Inspect wheel(s) for flat spots or pieces of material missing from tire.
7. Inspect axle shaft for scoring or rust. If it cannot be removed with emery cloth, replace axle.

Removal

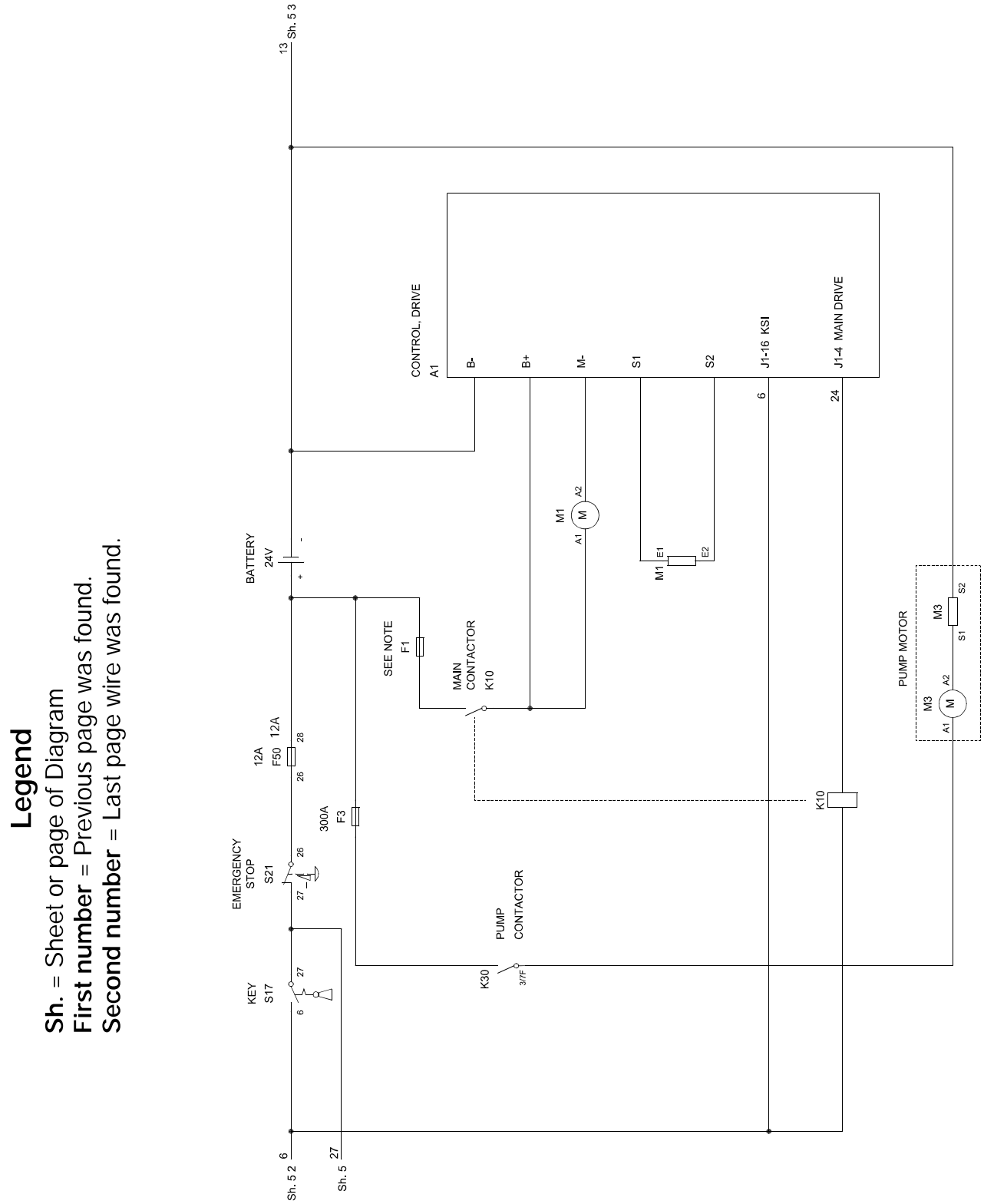
WARNING Block all wheels to prevent truck from rolling.

1. Park truck on a level surface and make sure parking brake is applied.
2. Release pressure in hydraulic system by pressing the lowering button on the steering control handle.
3. Turn key switch OFF and depress master control on/off switch OFF.
4. Disconnect the battery connector from the truck.

NOTE! **Do not** remove center screw (1) and nut (3).

5. Remove screws (1) from outer edge of switch cover (5).
6. Lift switch cover (5) assembly plate off assembly and lay to one side.
7. Remove two socket screws (11) from inside the head securing the head and handle stem together.
8. Lift the entire head assembly from the control stem and disconnect wiring harness plug. The head assembly is free to be disassembled on a bench.

Electrical Schematic 1(5)



2.1.1. Definitions

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

Open Circuit. A lack of a continuous path between two or more electrical connections. Generally, when such a circuit is tested, it will have a resistance greater than 10 megohms.

Pulse Width Modulation. Pulse Width Modulation (PWM), also called "chopping," controls the speed of the motor by switching the battery voltage to the motor on and off very quickly.

Overtemperature (Power Amplifier). Overtemperature of the motor power amplifier is from 185°F (85°C) and above. At overtemperature the drive current limit is linearly decreased from full set current down to zero. Plug current is not reduced to provide full vehicle braking under all thermal conditions.

Undertemperature. When the power amplifier is operating at less than –13°F (–25°C), the current limit is cut back resulting in reduced travel speed.

Short Circuit or "Short". A short circuit is an unspecified path in a circuit that provides unwanted full or partial continuity between two or more locations in an electrical circuit.

Example: Two insulated wires are physically next to each other and the insulation has been worn off each of the wires. Because the conductors inside each wire are now touching each other, there is a short circuit.

Example: A power cable from the battery to a junction post in truck has had the insulation worn away. Because the wire conductors are touching the chassis frame, there is a short circuit of the battery cable.

B. Negative side of S15, wire number 3.

   Adjust or replace S15.

C. Plug J1-11, wire number 3, A1.

   Repair open wire number 3 between S15 and A1.

D. Power circuit breaker positive side of F1.

   Repair power cable between battery positive and F1.

E. Power circuit breaker negative side of F1.

   Replace F1.

F. Power circuit positive side of K10.

   Repair power cable between F1 and K10.

G. Power circuit negative side of K10.

   If **battery voltage** is **NOT** measured here, verify line contactor operation; and replace line contactor.

H. B+ terminal on A1

   Repair open power cable between K10 and B+ at the transistor controller.

I. A1 terminal on drive motor.

   Repair open A1 cable between K10 and M1.

J. M- terminal on A1: Voltage should be battery voltage in neutral and decrease with throttle input down to approximately 1 volt.

K. A2 terminal on drive motor voltage should be battery voltage in neutral and decrease with throttle input down to approximately 1 volt.

L. Test with handset.

M. Replace A1.

4. **No forward travel** (tractor-first). Line contactor closes when control handle is pulled down to operating position. Rearward travel and the lift, lower, and horn function.

   Conditions for testing:

Repair open wire number 16A between S35 and S111.

F. Negative side of S111, wire number 18

Replace S111.

G. Positive side of Y16, wire number 18.

Repair open wire number 18 between S111 and Y16.

H. Negative side of YI 6, wire number 12.

Special Instructions:

If battery voltage **IS** measured here, then check position of S111. Replace S111 and/or repair open wire number 18 and/or wire number 13 between Y16 and battery negative.

If battery voltage is NOT measured here, then check operation of Y16 by holding a screwdriver next to coil. If screwdriver is magnetically attracted to coil, the problem is likely hydraulic contamination preventing valve from operating. If screwdriver is not magnetically attracted to coil, then problem is likely a failed lowering valve coil. Replace valve and/or coil as necessary.

12. **Reach function** does not operate with **two switches** in the auxiliary valve lever knob. Lift works.

Conditions for testing:

Truck blocked to prevent it from rolling.

Battery fully charged and connected to truck.

S21 in the "run" position.

S17 turned "on".

Auxiliary lever operated to dose S35.

Test for battery voltage at:

A. Positive side of S35, wire number 6.

Repair open wire number 6 between S17 and S35.

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4. Repair and Rebuild

Contact your local battery supplier for replacements or rebuilds of industrial batteries.

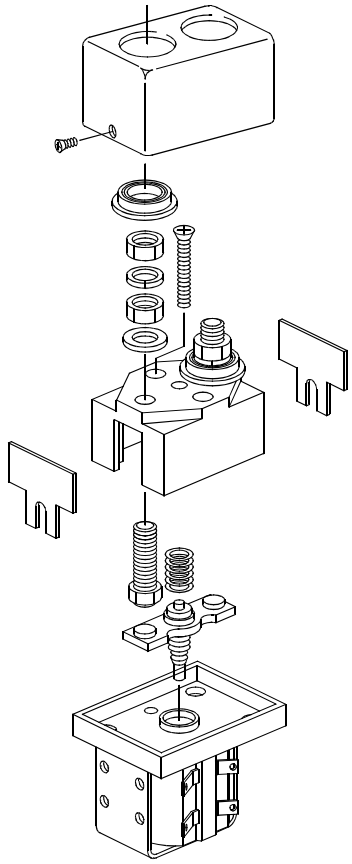
Removal

⚠ WARNING Block all wheels to prevent truck from rolling.

1. Park truck on a level surface and make sure load wheels are blocked to prevent accidental movement.
2. Turn key switch OFF and depress master control on/off switch to OFF.
3. Disconnect the battery connector from the truck.
4. Position battery replacement device in accordance with the manufacturer's recommendations.
5. On RSS trucks, remove battery cover (see page 106.)
6. Remove battery from truck onto suitable battery table or battery lifting device.

Installation

1. With a fully charged and tested battery on the lifting device, position lifting device at the truck according to the manufacturer's recommendations.
2. Move the battery in the compartment. Be sure the battery has no more than 1/2 inch (13 mm) of "free play" movement in the battery compartment.
3. On RSS trucks, install the battery cover.
4. Move lifting device from the area.
5. Remove blocks. Connect the battery connector to the truck.
6. Turn master control on/off switch ON and turn key switch ON. Test truck for proper operation before returning to service.



200/300 Amp “EE” (RCS/RSS)

4.1. Removal/Replacement of Contact Tips

NOTE! Before attempting to disassemble a contactor to install a new contact tip set, carefully observe location and orientation of each part.

1. Park truck on a level surface and make sure load wheels are blocked to prevent accidental movement.
2. Turn key switch to OFF and depress master control on/off switch OFF.
3. Disconnect the battery connector from the truck.
4. Open compartment access door and remove console (see page 96.)
5. Disconnect cable wires.
6. Remove contactor from truck.

2. Repeat procedure with voltmeter's positive lead on pin 5 and its negative lead on battery negative terminal. Load battery and record measured.
3. Add two voltage readings. This total should be less than 1 percent of the nominal battery voltage. Voltage higher than this will cause the instrument to calculate battery state-of-charge from incorrect readings.

LEDs Do Not Light

The battery discharge indicator LEDs are illuminated by keyswitch battery positive input at pin 2. Verify battery voltage is present across pin 2 and pin 5. If voltage is present and LEDs do not light, the instrument is bad or worn.

3.2. Hourmeter

No Display

The LCD of hourmeter will light when power is applied at pin 7 and pin 5. If battery voltage is measured across the pins and LCD does not turn on, instrument is bad or worn.

Hourmeter Glass Icon Does Not Flash

If icon does not flash, the hourmeter is not accumulating time. The key switch pin 2 must be on at B+, pin 7 must be connected to B+, and one or both of the hourmeter lines must be active. If the key switch is on, one or both inputs are correct, and the hourmeter icon does not flash, the instrument is bad or worn.

Hourmeter Glass Icon Always Flashes

When the icon is flashing, the hourmeter is accumulating time. Turn truck key switch off. This should remove voltage from pin 2 of the instrument. If the voltage is not present at pin 2 and the hourmeter's icon continues to flash, the instrument is bad or worn.

Speed Controls

1. Theory of Operation

The accelerator potentiometer is accessible inside the steering control handle. The potentiometer operates off a gear toothed shaft (rack) that is moved when the travel controls are twisted.

The rearward and forward switches are mounted in the switch housing on the handle head assembly. The switches in the handle are molded in the switch bar so the switch bar and switch will be replaced together as a single part. It will be necessary to remove the handle cover to change the switches.

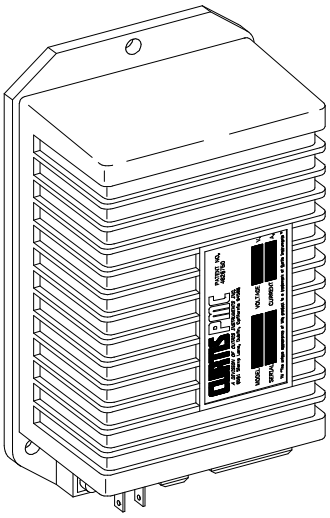
2. Maintenance

See "Planned Maintenance Schedule" on page 71.

2.1. Potentiometer Adjustment

1. Park truck on a level surface and make sure load wheels are blocked to prevent accidental movement.
2. Turn key switch OFF and depress master control on/off switch OFF.
3. Disconnect the battery connector from the truck.
4. Remove outside screws securing the raise/lower/horn switch plate to the control handle head. Do not remove center screws on the switch plate. Remove switch plate and lay it over to one side.
5. Disconnect potentiometer leads from the controller before connecting an ohmmeter for adjusting. Disconnect wire number 9 and number 19 from the controller. Connect ohmmeter leads to the potentiometer leads.
6. In neutral, the ohmmeter reading should be 5500 ohms and will reduce to below 50 ohms as the speed controls are operated to high speed.
7. A second method is as follows:

Transistor Controller



1. Theory of Operation

The transistor controller is a microprocessor based, programmable motor controller designed for separately excited motors. It is capable of four distinct operating modes or personalities and is programmable with a programmer. In addition to programming the controller, it has diagnostic and test modes to display error codes and display the status of the controller's inputs and outputs.

1.1. Basics of Circuit Operation

The transistor controller includes an armature controller and a field controller. These both regulate the voltage and current applied to the motor according to a preprogrammed motor control algorithm. This allows the user to select programmable speed and torque profiles that can be tailored to almost any material handling vehicle traction system. The polarity and magnitude of the field current is also controlled to provide solid state, contactor-less direction control and plug braking.

The transistor controller is energized by applying power to the key switch input, pin number 16. The controller is powered up and performs an internal self test. The controller becomes active by applying power to the brake input, pin number 15. At that time, the following start-up checks are performed:

- A short between M- and Ground. Insures the M- output or power MOSFETs are not shorted.
- Continuity in the field coil. Occurs each time forward or rearward is selected.
- Main contactor coil has actually closed when commanded, by checking for battery voltage at the B+ terminal.
- Throttle is below 25 percent.
- Continuity in the emergency reverse wiring. The controller applies a brief pulse from the reverse check output, pin number 10. This pulse is read by the reverse input, pin number 13. If the pulse is not present, there is an open circuit and the controller

3.3. Troubleshooting Chart

The transistor controller has a Status LED built into the controller that is visible through a window in the label. This LED displays fault codes whenever there is a problem with the controller or the inputs to controller. During normal operation with no faults present, the Status LED will flash steadily on and off. If the controller detects a fault a 2 digit code (see table below) is flashed continuously until the fault is corrected.

Example, Code "3.2" • main contactor welded • appears as:

◎◎◎ ◎◎ ◎◎◎ ◎◎ ◎◎◎ ◎◎

(3,2) (3,2) (3,2)

LED Codes		Programmer LCD Display	Fault Category	Explanation	Possible Cause
	LED off				1. No power or bad controller.
	Solid on				1. Controller or microprocessor fault.
0,1	◎	No known faults	0		1. Controller operational; no fault.
1,1	◎ ◎	Current shunt fault	1	Current sensor error	1. Controller bad.
1,2	◎ ◎◎	HW fail-safe	1	Hardware fail-safe fault	1. Controller bad.
1,3	◎ ◎◎◎	M- shorted	1	Internal M- short to B-	1. Controller bad.
1,4	◎ ◎◎◎◎	SRO	3	SRO fault	1. Improper sequence of KSI, brake and direction inputs. 2. Wrong SRO type selected. 3. Brake or direction switch open. 4. Sequencing delay too short.
2,1	◎◎	Throttle fault 1	2	Wiper fault	1. Throttle input wire open. 2. Throttle input wire shorted to B+ or B-. 3. Throttle pot bad. 4. Wrong throttle type selected.
2,2	◎◎ ◎◎	E/R wiring check	3	Emergency reverse wiring fault	1. Emergency reverse wire open. 2. Emergency reverse check wire open.

2. Maintenance

2.1. Adjustments

The only adjustment to the hydraulic system is the pressure relief setting. (See "Hydraulic Pump" on page 297.) To perform adjustment, remove screw cap (20) on pressure relief valve and turn screw (22) to make the adjustment. Turning screw clockwise, will increase the pressure relief setting.

2.1. Hydraulic Fluid Check

WARNING **DO NOT** use your hands to check for hydraulic leakage. Use a piece of cardboard or paper to search for leaks. Escaping fluid under pressure can penetrate the skin causing serious injury. Relieve pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure. Keep hands and body away from pinholes and nozzles which eject fluids under high pressure.

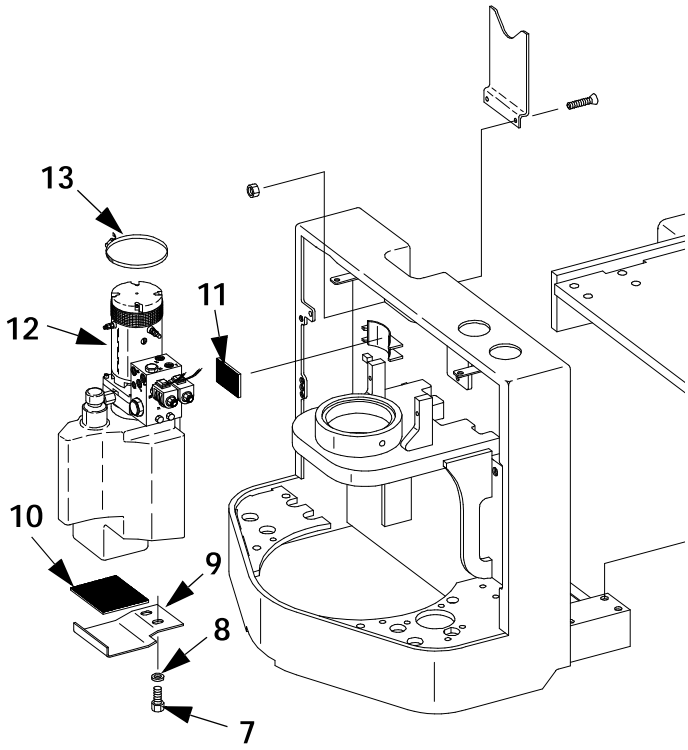
The hydraulic fluid level must be checked periodically. (See "Planned Maintenance Schedule" on page 71.) If the reservoir regularly requires the addition of oil to maintain the proper level, then a leak is indicated and must be repaired.

When scheduled, the reservoir should be removed and drained for cleaning and filled with new oil. After refilling, check the lift, lower, and other hydraulic functions for proper operation. If the truck will not lift a full load, then the pressure relief setting should be checked and adjusted. During normal operation, the pressure relief setting will not change. As the pump wears with age, some loss of performance may be experienced. If loss becomes severe, the pump should be replaced.

2.2. Changing Hydraulic System Fluid

Before adding or changing hydraulic fluid, determine the environment and usage of truck. To make proper oil/lubricant selection see page 84.

Hydraulic Reservoir Mounting



Item No.	Description	Item No.	Description
7	Screw, cap	11	Cushion
8	Washer, flat	12	Pump Assembly
9	Support	13	Clamp
10	Cushion		

Spool Control Valves

1. Theory of Operation

1.1. Lift (Mechanical Valve)

When the lever on the chassis is operated, a switch closes and the pump starts. The oil flows through the pump, solenoid valve, and mechanical valve to the lift cylinders. The increase in speed is regulated by the movement of the lever.

1.2. Lower (Mechanical Valve)

When the lowering valve is operated by the lever on the chassis, it opens to let oil in the pressure line return to the oil tank. The lowering speed is regulated by the movement of the lever.

2. Maintenance

Inspect all moving parts for wear. Inspect o rings for wear and cracks, and replace as necessary.

3. Troubleshooting

3.1. Spool Valve Leaks

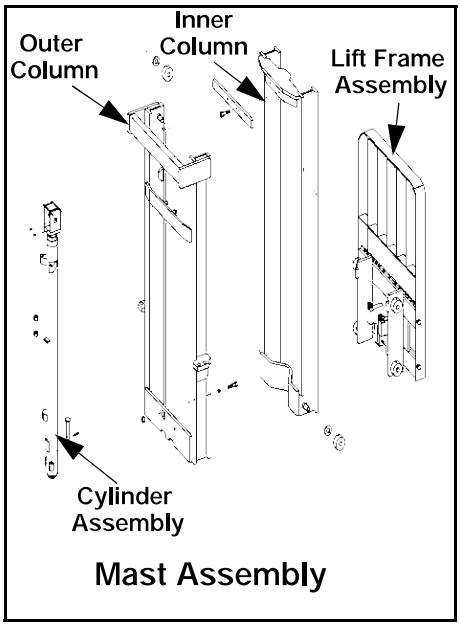
Replace O ring seals in spool valve.

3.2. Mast Drifts

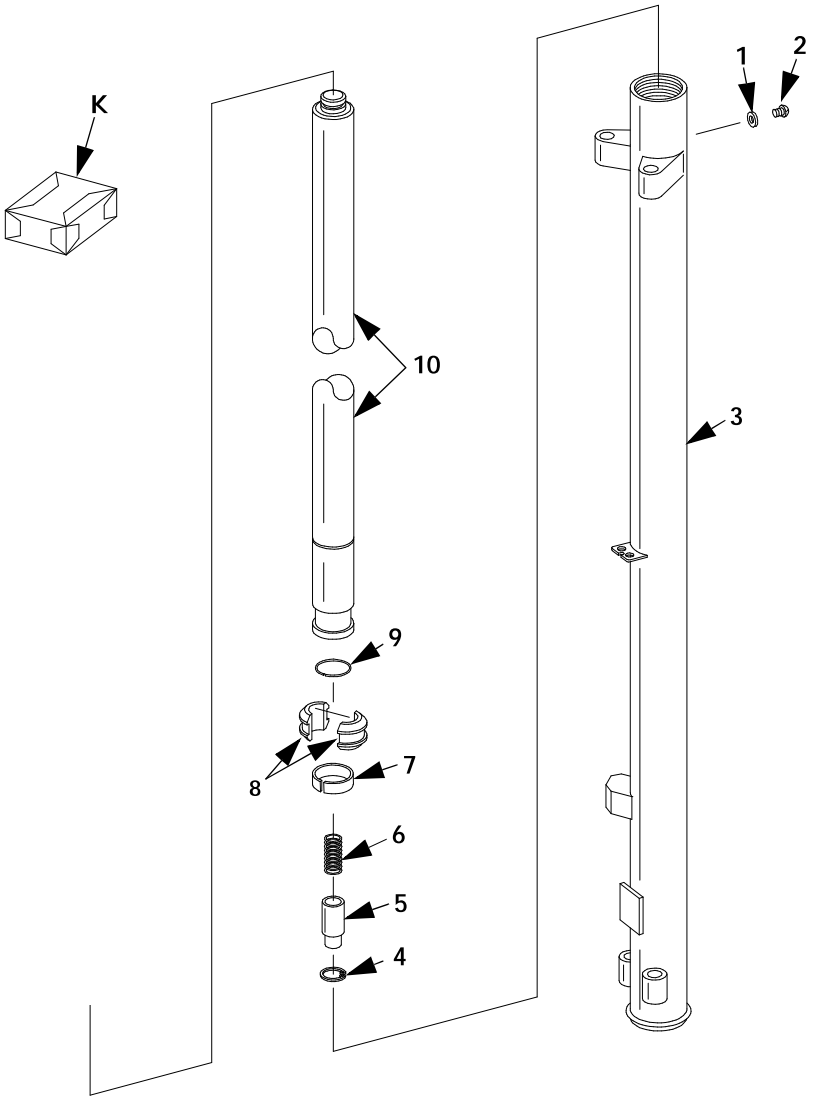
Spool valve not returning to center. Repair or replace valve and or linkage.

Two Stage Mast with LFL Lift Cylinder RCS/RSS/RRS

Lift Cylinder Assembly Range
71/100 inch (1803/2540 mm)
83/124 inch (2108/3150 mm)
95/150 inch (2413/3810 mm)



Mast Assembly



Item No.	Description	Item No.	Description
1	Washer, seal	10	Cylinder, rod
2	Screw	11K	O ring
3	Cylinder, tube	12K	Ring, backup
4	Ring, retainer	13	Bearing
5	Plunger assembly	14K	Ring, guide
6	Spring	15K	Seal
7K	Ring, guide	16K	Wiper
8	Piston	K	Kit, seal (items marked with "K")
9	Ring, retainer		

Item No.	Description	Item No.	Description
1	Screw	10	Piston
2	Washer, seal	11	Ring, retainer
3	Cylinder, tube	12	Rod, cylinder
4	Cylinder, tube	13	O ring
5	Plunger assembly	14	Bearing
6	Spring	15K	Seal, rod
7K	Plug	16K	Wiper
8	O ring	K	Kit, seal (items marked with "K")
9K	Ring, wear		

Removal

DANGER	HOT OIL under pressure may be present. Be certain truck is safely blocked and pressure is released. Some spillage of hydraulic oil may occur.

1. Park truck on a level surface and apply brake.
2. Fully extend the staging cylinders to inspect the cylinder rods for gouges or pits. If gouges or pits are detected, remove cylinder for repair.

DANGER	Securely block mast columns to reduce risk of lowering when working on or near mast. If not blocked, unexpected movement could occur resulting in personal injury or death.

3. Raise mast until approximately 12 inches (305 mm) of the staging cylinder rods are extended out of the cylinder tubes.
4. Using a chain (minimum 2,000 pounds [907 kg] rated capacity), route the chain over the top of the upper tie bar on the outer mast column. Continue routing the chain around the lower tie bar on the intermediate mast column. Secure the chain to prevent the intermediate column from lowering.
5. Lower mast assembly until the weight of the intermediate mast column, and the reach assembly are supported by the chain.

4. Carefully slide bearing assembly onto cylinder rod. Be sure the rod end does not cut or nick the wiper or seal upon installation.
5. Install cylinder rod into cylinder tube). Be careful not to nick or cut piston seals on the edge of the cylinder tube or when sliding them over the groove within the tube.
6. Install bearing assembly into cylinder tube. Use care so seals are not nicked or cut upon installation.
7. Check installation by making sure piston rod assembly moves smoothly within tube assembly without binding.
8. Install bearing retainer.

Installation

1. Connect the battery connector to the truck.
2. Turn key switch OFF and depress master control on/off switch OFF.
3. Raise reach to full freelift height. Install reach cylinder and front and rear mounting pins. Secure mounting pins with roll pins.
4. Connect correct hydraulic hoses to reach cylinders.
5. Connect positive control wire to lift pump contactor.
6. Remove hoist strap and chain.
7. Fill hydraulic reservoir with new clean oil.
8. Connect the battery connector to the truck.
9. Turn master control on/off switch ON and turn key switch ON.

3. Put trunnion end of cylinder in a vise equipped with soft jaws.
4. Remove bearing retainer (13) and cylinder bearing (7) from the cylinder tube.
5. Remove bearing assembly, seals, rings, rod (10), and piston seals.
6. Remove and discard all seals and rod wiper (5, 6, 8, 9, 11, and 12).
7. Inspect mounting bushings (2) located at both ends of the cylinder. It will not be necessary to remove bushings unless they are found to be unfit for further service.

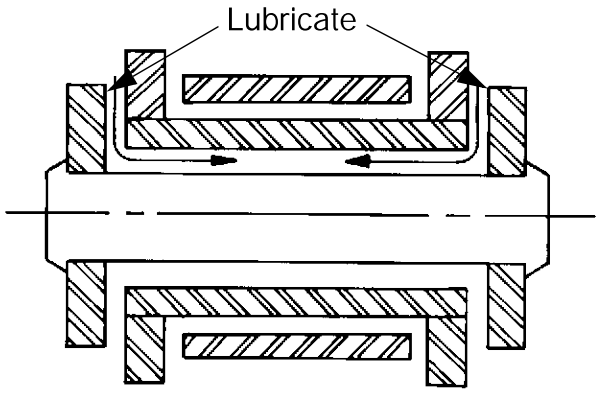
NOTE! Orifices are located in the control valve supply ports to restrict oil flow.

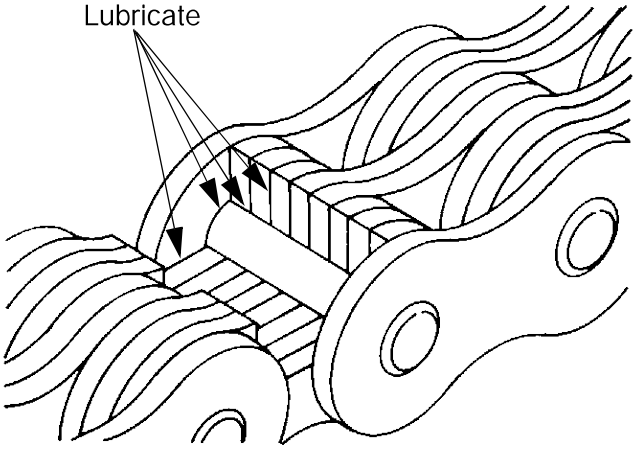
Inspection

⚠ WARNING When using compressed air, wear effective chip-guarding and personal protective equipment. Compressed air used for cleaning **MUST** be reduced to less than 30 psi (207 kPa).

1. Carefully clean all parts in a cleaning solution and position on a clean work surface
2. Check cylinder rod for damage. Look for gouges, scratches, corrosion or evidence of unusual wear. Minor surface damage can be repaired by use of fine abrasion cloth or stoning. Be extremely careful to not remove chrome plating. Deeper damage will require replacement of cylinder rod assembly. Make sure threads on rod are free of damage.
3. Check cylinder bore for any damage. Parts with deep gouges or pitted surfaces will require replacement.
4. Check threaded section of cylinder tube to be sure threads have not been damaged.

The oil must penetrate the chain joint to prevent wear. Applying oil to the external surface will prevent rust, but oil must flow into the live bearing surface for maximum wear life.





Apply oil to chains with a narrow paint brush. A plastic liquid detergent bottle makes a handy lube applicator. Flood the chain with oil over its entire length.

The best estimate of lube period is 100 hours (or 4 weeks) actual operating truck time. Trucks in severe service (or parked outside) may require more frequent relube to maintain an oil film on all chain surfaces.

Mast, Three Stage

1. Theory of Operation

The mast, and associated components, provide the lifting function in the trucks. These components consist of the mast columns, lift cylinders, lift chains, chain rollers, and carriage assembly. The hydraulic system provides the necessary force and controls to do the work. When lifting, the lift cylinders extend as hydraulic pressure and volume is applied.

On a three-stage, full-freelift mast, the freelift cylinder extends before the staging cylinders, due to the physics involved with the weight of the carriage and mast column. The freelift cylinder extends pushing the mast chain rollers up. Lift chains, attached to inner column and routed over the chain rollers, pull carriage assembly up. When the freelift cylinder has fully extended, the staging cylinders will begin to extend. The staging cylinders, working in parallel, push the intermediate column up. Staging lift chains, attached to the top of the outer column and routed over the chain rollers on the intermediate column, pull the inner column and carriage assembly up. Lifting stops when no more volume of hydraulic fluid is put into the lift cylinder, either by stopping the pump or by extending the lift cylinders to their maximum height.

Refer to the hydraulic section (page 283) for further information.

2. Maintenance

See “Maintenance” on page 353.

3. Troubleshooting

See “Troubleshooting” on page 360.

4. Repair and Rebuild

Replace bearings and chains as necessary. The mast columns cannot be rebuilt. **DO NOT WELD ON MAST. DO NOT REPAIR BROKEN MAST COLUMNS.** Replace mast as necessary.

Removal

> **WARNING** Block all wheels to prevent truck from rolling. Park the truck on a level surface and make sure all wheels are blocked to prevent accidental movement.

1. Park truck on a level surface and apply brake.

> **DANGER** When blocking mast columns to reduce risk of lowering when working on or near mast, always block both sides of column. If both sides are not blocked, unexpected movement could occur resulting in personal injury or death.

2. Lift carriage/reach approximately 6 inches (152 mm). Securely block carriage/reach to prevent lowering.
3. Lower freelift cylinder so chains, hoses, and electric cables are loose.
4. Turn key switch OFF and depress master control on/off switch OFF.
5. Disconnect the battery connector from the truck.
6. Remove chains, hoses, and electric cables from crosshead sheaves (6).
7. Loosen set screw (9) at the base of sheave head (7).
8. Lift crosshead assembly off the freelift cylinder rod. Clean crosshead.

Disassembly

1. Remove retaining ring (2) from one end of the crosshead assembly.
2. Slide shim (3), bearing roller (5) and race (4), chain sheave (6) and the second shim (3) off the shaft (9).
3. Repeat steps 1 and 2 for the opposite side.

3. Sufficiently raise forks to create a work space.
4. Remove fork stop bolt (7) from sideshifter carriage.
5. Flip release tabs on forks. Slide both forks towards the center of the carriage.
6. Remove screws (28).

> **CAUTION** Use caution when bolts (6) and screws (8) are removed. Parts will fall out and could cause injury to personnel.

7. Loosen lower hook mounting bolts (6) and screws (8) until lower hooks are completely lowered.
8. Lift lower part of sideshifter carriage away from fork carriage (leave top of sideshifter attached to fork carriage).
9. Securely block sideshifter carriage away from fork carriage with a 3 inch (76 mm) spacer.
10. Remove lower pads (12) using a screwdriver.
11. Lubricate lower pads with grease, then place new pads into lower hook (11), making sure they are seated.
12. Remove blocking spacer and lower sideshifter carriage to fork carriage.
13. Lift lower hook (11), bringing plastic pad (12) in contact with the underside of lift truck carriage. Torque securing bolts (6) to 65 ft-lbs (88 N•m).
14. Tighten screw (8) to 21 ft-lbs (28 N•m) torque.
15. Install screw (28) into the hole with screw (8). Torque screw to 70 ft-lbs (95 N•m).
16. Slide forks into position. Install fork stop bolt (7) with washer (9 and 10) into lower bar of sideshifter carriage.
17. Sideshift unit several times to insure there are no leaks. Check sideshifter unit for smooth operation with no interference.

NOTE! Call-outs in the following procedures refer to illustration on page 397.

4.1. Reach

NOTE! The reach can be repaired without being removed from the mast.

1. Remove forks (see page 407.)
2. Remove load backrest (see page 409.)
3. Jack truck up (see page 68.)
4. Extend reach approximately half way. Securely block reach so it will not retract.

⚠ WARNING Block all wheels to prevent truck from rolling. Park the truck on a level surface and make sure all wheels are blocked to prevent accidental movement.

5. Park truck on a level surface.
6. Turn key switch OFF and master control on/off switch OFF.
7. Disconnect the battery connector from the truck. Remove battery from truck.

4.2. Forward Frame

Removal

1. Disconnect hydraulic hoses from tilt and sideshift cylinders from the input side of junction block. Cap hoses with plugs to prevent contamination.

NOTE! Secure front frame with a hoist to prevent movement before removing cap screw (1) and pins (25).

2. Remove cap screw (1) at the forward frame (17).
3. Drive pins (25) to the outside by hitting with a soft hammer.

Load Backrest

1. Theory of Operation

The removal load backrest is available on the truck as an option.

2. Maintenance

Inspect backrest for wear. TIghten fasteners as necessary.

3. Troubleshooting

Inspect backrest for proper installation

4. Repair and Rebuild

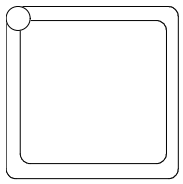
Removal

1. Park truck on a level surface.
2. Turn key switch OFF and depress master control on/off switch OFF.
3. Disconnect the battery connector from the truck.
4. Use a 3/4 inch (19 mm) socket to remove four screws (2), two on each side.
5. Lift backrest off the front fork frame.

Installation

1. Place load backrest on the front fork frame.
2. Insert mounting screws (2) and tighten.
3. Repeat steps 2 and 3 for the opposite side.
4. Connect the battery connector to the truck.
5. Return truck to service.

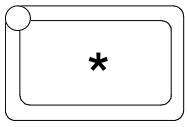
NOTE!	Some items may not be available on all models.



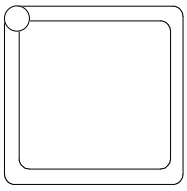
DIAGNOSTICS

In the **Diagnostics** mode, accessed by pressing the **DIAGNOSTICS** key, currently active faults detected by the controller are displayed.

The **MORE INFO** key, when used in the Diagnostics mode, causes additional information to be displayed about the selected item. For a list of the abbreviations used in the Diagnostics display see page 277.



MORE INFO



PROGRAM

The **Special Program** mode allows a variety of tasks, most of which are self-explanatory. Through the Special Program Menu, revert to earlier settings, save controller settings into the handset memory, load the controller settings from the handset into a controller, clear the controller's diagnostic history, adjust the contrast of the handset's LCD display, select the language to be displayed by the handset, and display basic information (model number, etc.) about the controller and the handset.

To access the Special Program mode, first press the **MORE INFO** key. Then, while continuing to hold the **MORE INFO** key, press the **PROGRAM** key. The LED on the **PROGRAM** key will light, when the handset is in Program mode. To distinguish between the Program and Special Program modes, look at the menu items in the display.

CONTROLLER CLONING

Two of the Special Program Menu items, **Save Controller Settings in Handset and Load Handset Settings into Controller**, allows "clone" controllers. To complete this function, program one controller to the desired settings. Save these settings in the handset and load into other similar (same model number) controllers, thus creating a family of controllers with identical settings.

The **MORE INFO** key is used initially to access the Special Program mode. Once within the Special Program mode, it performs the desired tasks. To adjust the contrast in the

the programmer in the Menu "Functions > Settings". Then, select "Get Settings From Controller". This will upload the data from a unit into the handheld programmer or "Write Settings To Controller" to download the present data stored in the handheld programmer to the unit. **THIS PROCESS WILL WORK BETWEEN IDENTICAL MODELS.**

Restore the original settings of the unit can easily be accomplished. Each time the programmer is connected to a unit, it uploads the present data and stores it in a "Temporary Achieve" memory. Revert back the original settings any time during the programming session by selecting the Menu "Functions > Settings > Reset All Settings".

Any unintentional change of parameters can be undone using this procedure, even if the previous settings are not remembered (**AS LONG AS THE PROGRAMMER HAS NOT BEEN UNPLUGGED AND POWER HAS NOT BEEN REMOVED FROM THE CONTROLLER**).

Information Displays

Beside the parameters, values and fault history, each handheld programmer contains a small file describing the basic revision level of the product under the information Menu. To review the product information, use the Menu Navigation Key to select "Information" in the Main Menu (press the right arrow to select a Menu). A screen will show the available information. Press the left arrow to exit.

Programmer SetUp

The handheld programmer can be viewed, setup and customized to the user's preference. Select "Programmer Setup > Program > LCD Contrast" to allow the user to set the desired contrast level for best viewing. Select "Programmer Setup > Information" to show the current revision level of the programmer.

RAYMOND SERVICE INFORMATION

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

RSI MUL-15-006
June 29, 2015

Model
Multi Product

SUBJECT: Updated Torque Check Procedures

GENERAL INFORMATION: Updates are being made to the procedures for checking bolt torque during scheduled maintenance.

SERVICE INFORMATION: When a fastener requires a torque check after the initial 90 day/250 HD Maintenance, there are now two procedures that can be used.

- If the fastener ***was previously marked*** with a paint pen when torqued, look at the markings to verify the fastener has not moved. If the fastener has moved or is in question, remove the fastener, clean the threads, and apply the appropriate thread locker. Install the fastener and torque to the proper value, turning it in the tightening direction. Use a paint pen and mark the fastener for future inspections.
- If the fastener ***was not previously marked*** with a paint pen, determine the proper torque value. Set the torque wrench to 85% of the required torque value and check the torque of the fastener, turning it in the tightening direction. If the fastener does not move, use a paint pen and mark the fastener for future inspections. If the fastener moves, remove the fastener, clean the threads, and apply the appropriate thread locker. Install the fastener and torque to the proper value. Use a paint pen and mark the fastener for future inspections.

PARTS AVAILABILITY: N/A

FILING INSTRUCTIONS: File this notice in all Maintenance Manuals next to the 180 day or 500 HD Scheduled Maintenance chart.

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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

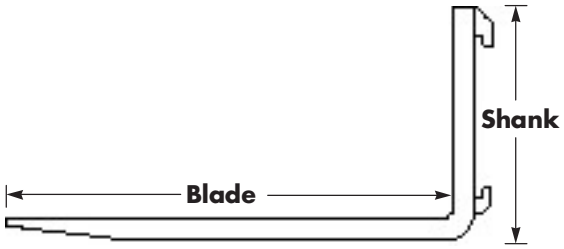
Pay special attention to the heel and welds attaching mounting components. If any damage is found, remove the fork from service.

Straightness of Blade and Shank

Note: 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 1-1.

Figure 1-1. Measuring Fork Blade and Shank



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 1-2.

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