

Service Manual

MX15 and MX19 Work Platform

Serial Numbers 20600 - Current

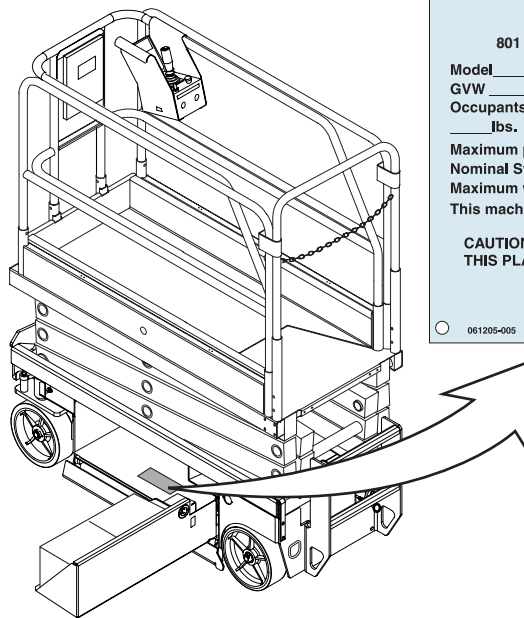
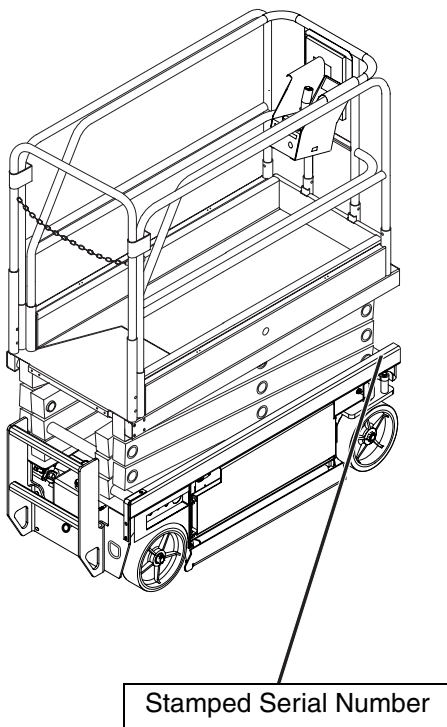
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UpRight

MX15 / MX19

Serial Number 20600 – Current

When contacting UpRight for service or parts information, be sure to include the MODEL and SERIAL NUMBERS from the equipment nameplate. Should the nameplate be missing, the SERIAL NUMBER is also stamped on top of the chassis above the front axle pivot.



UpRight Inc.	
801 S. PINE ST. MADERA CALIFORNIA 93637 USA	
Model _____	Serial number: _____
GVW _____ lbs.	Mfg. date: _____
Occupants and equipment must not exceed the rated workload _____ lbs. Rated number of occupants: _____	
Maximum platform height: _____ ft.	
Nominal System Voltage: _____ vdc	
Maximum wheel and/or outrigger load: _____ lbs.	
This machine is manufactured to comply with ANSI A92.6-1999.	
CAUTION: CONSULT OPERATOR'S MANUAL BEFORE USE. THIS PLATFORM IS NOT ELECTRICALLY INSULATED.	
061205-005	

UpRight, Inc.

801 South Pine Street
Madera, California 93637

TEL: 559-662-3900

FAX: 559-673-6184

PARTS: 1-888-UR-PARTS

PARTS FAX: 1-800-669-9884

UpRight

Call Toll Free in U.S.A.

1-800-926-LIFT

UpRight

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FOREWORD

This manual contains instructions for the maintenance of the machine. Referring to the Operator Manual will aid in understanding the operation and function of the various components and systems of the machine, and help in diagnosing and repair of the machine.

All information contained in this manual is based on the latest product information available at the time of printing. We reserve the right to make changes at any time without notice. No part of this publication may be reproduced, stored in retrieval system, or transmitted, in any form by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of the publisher. This includes text, figures and tables.

This manual consists of five (5) parts.

OPERATOR MANUAL

A copy of the Operator Manual that is stored on every UpRight Aerial Work Platform.

SECTION 1 - GENERAL INFORMATION

Contains generic information relevant to all UpRight Aerial Work Platforms.

SECTION 2 - SERVICE AND REPAIR

Detailed information specific to this UpRight Aerial Work Platform.

SECTION 3 - TROUBLESHOOTING

Causes and solutions to typical problems.

SECTION 4 - SCHEMATICS

Electric and Hydraulic schematics.

NOTES:

OPERATOR MANUAL

WARNING

All personnel shall carefully read, understand and follow all safety rules, operating instructions, and the Scaffold Industry Association's MANUAL OF RESPONSIBILITIES of ANSI A92.6-1999 before performing maintenance on or operating any UpRight Aerial Work Platform.

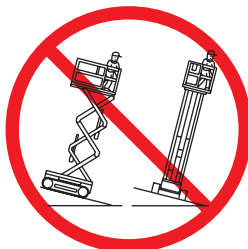
Safety Rules

Electrocution Hazard



NEVER operate the machine within ten (10) feet of power lines.
THIS MACHINE IS NOT INSULATED.

Tip Over Hazard



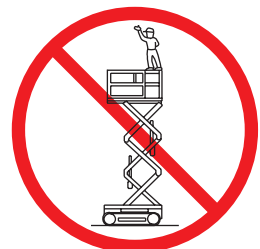
NEVER operate or drive with the platform elevated unless on firm, level surface.

Collision Hazard



NEVER position the platform without first checking for overhead obstructions or other hazards.

Fall Hazard



NEVER climb, stand or sit on the platform guardrails or midrail.

- **NEVER** operate the machine without first surveying the work area for surface hazards such as holes, drop-offs, bumps, curbs, or debris.
- **NEVER** operate the machine if all guardrails are not properly in place and secured with all fasteners properly torqued.
- **ALWAYS** close and secure the entrance after entering the platform.
- **NEVER** use ladders or scaffolding on the platform.
- **NEVER** exceed the maximum platform load. See "Specifications" on page 16.
- **NEVER** attach overhanging loads or increase platform size.
- **LOOK** up, down and around for overhead obstructions and electrical conductors.
- **DISTRIBUTE** all platform loads evenly on the platform.
- **NEVER** use damaged equipment. (Contact UpRight for instructions. See toll free phone number on inside back cover.)
- **NEVER** change operating or safety systems.
- **INSPECT** the machine thoroughly for cracked welds, loose or missing hardware, hydraulic leaks, damaged cables or hoses, loose wire connections, and wheel bolts.
- **NEVER** climb down elevating assembly when the platform is elevated.
- **IF ALARM SOUNDS** while the platform is elevated, **STOP**, carefully lower the platform. Move the machine to a firm, level surface.
- **IN CASE OF EMERGENCY** push the Emergency Stop button to cut power to all machine functions.
- **NEVER** perform service on the machine while the platform is elevated without blocking the elevating assembly.
- **NEVER** recharge batteries near sparks or open flame; batteries that are being charged emit explosive hydrogen gas.
- **NEVER** replace any component or part with anything other than original UpRight replacement parts without the manufacturer's written consent.
- **VERIFY** that all labels are in place and legible before using.
- **NEVER** tow the machine. Transport by truck or trailer only.
- **AFTER USE**, secure the machine against unauthorized use by turning the Chassis Key Switch OFF and removing the key.

California Proposition 65 Warning.

Battery Posts, terminals and related accessories contain lead compounds, chemicals known to the State of California to cause cancer and reproductive harm. Wash hands after handling.

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INTRODUCTION

This manual covers the application of the MX15 and MX19 Aerial Work Platforms. **This manual must be stored on the machine at all times.**

Read, understand and follow all safety rules and operating instructions before attempting to operate the machine.

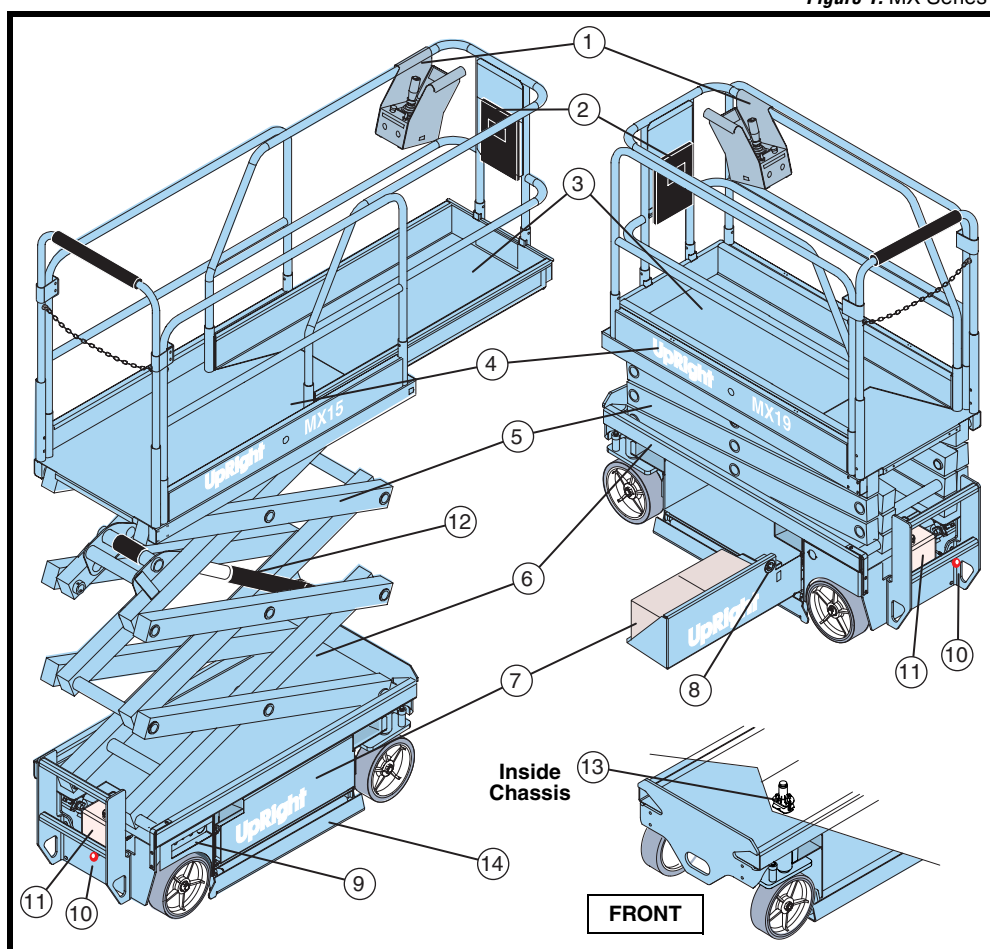
GENERAL DESCRIPTION

⚠ WARNING ⚠

DO NOT use the machine if all guardrails are not properly in place and secured.

Figure 1: MX Series

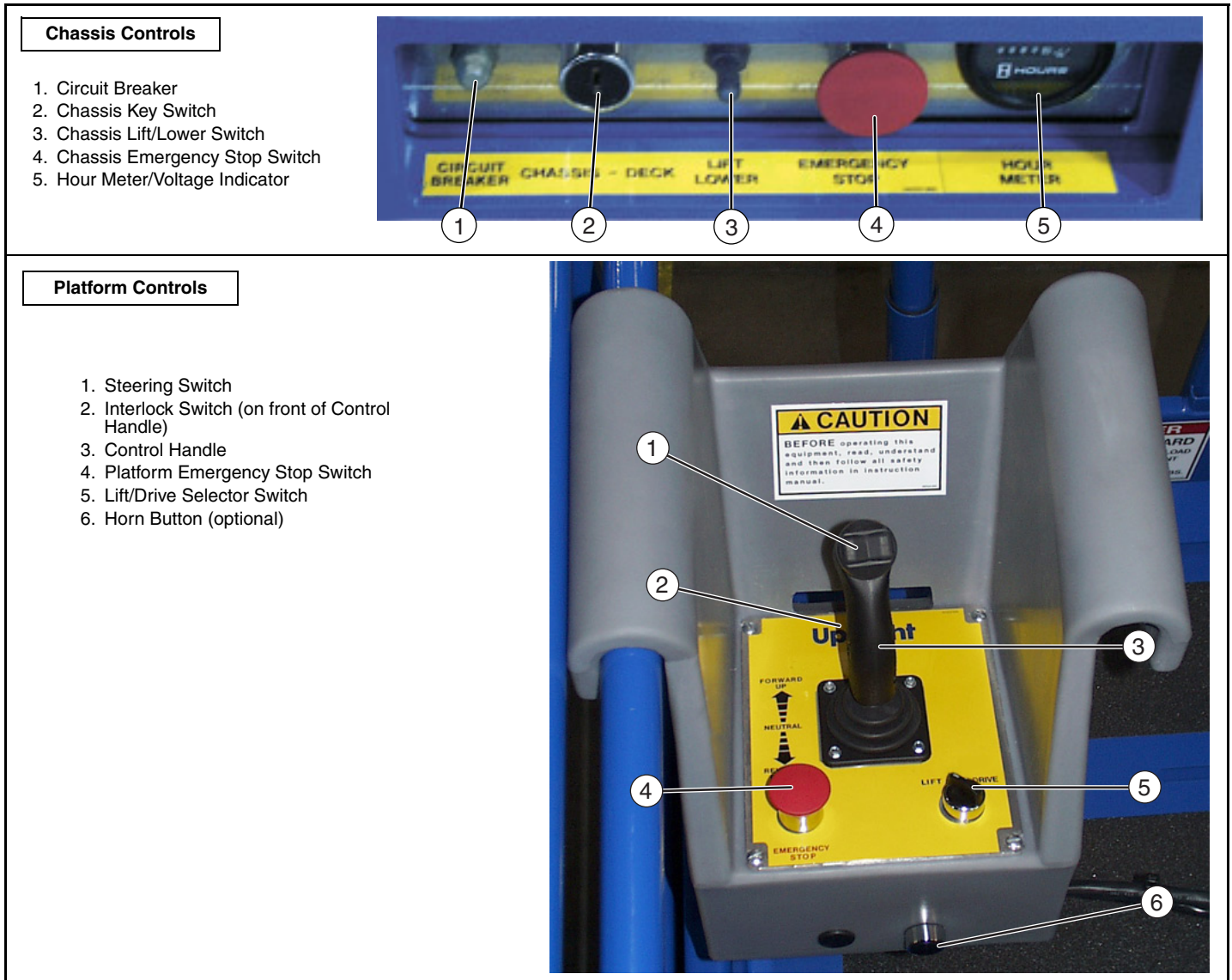
1. Platform Controls
2. Manual Case
3. Deck Extension
4. Platform
5. Elevating Assembly
6. Chassis
7. Batteries
8. Charger Outlet Plug
9. Chassis Controls
10. Emergency Lowering Valve Knob
11. Hydraulic Fluid Reservoir
12. Lift Cylinder
13. Level Sensor (inside chassis)
14. Depression Mechanism Support



CONTROLS AND INDICATORS

The operator shall know the location of each control and indicator and have a thorough knowledge of the function and operation of each before attempting to operate the unit.

Figure 2: Controls and Indicators



PRE-OPERATION SAFETY INSPECTION

NOTE: Carefully read, understand and follow all safety rules, operating instructions, labels, and the Scaffold Industry Association's **MANUAL OF RESPONSIBILITIES** of ANSI A92.6-1999. Perform the following steps each day before use.

1. Open modules and inspect for damage, fluid leaks or missing parts.
2. Check the level of the hydraulic fluid with the platform fully lowered. See "Hydraulic Fluid" on page 11. Add recommended hydraulic fluid if necessary. See "Specifications" on page 16.
3. Check that fluid level in the batteries is correct. See "Battery Maintenance" on page 11.
4. Verify that the batteries are charged.
5. Check that the A.C. extension cord has been disconnected from the charger plug.
6. Check that all guardrails are properly in place and secured.
7. Inspect the machine thoroughly for cracked welds, loose or missing hardware, hydraulic leaks, damaged cables or hoses, loose wire connections and wheel bolts.

SYSTEM FUNCTION INSPECTION

Refer to Figure 1 and Figure 2 for the locations of various controls and indicators.



STAND CLEAR of the machine while performing the following checks.

Before operating the machine, survey the work area for surface hazards such as holes, drop-offs, bumps, curbs, or debris.

LOOK up, down and around for overhead obstructions and electrical conductors.

Protect the control cable from possible damage while performing checks.

1. Move the machine, if necessary, to an unobstructed area to allow for full elevation.
2. Turn the Chassis and Platform Emergency Stop Switches ON by pulling the buttons out.
3. Turn and hold the Chassis Key Switch to CHASSIS.
4. Push the Chassis Lift/Lower Switch to the LIFT position and elevate the platform approximately 2,1 m (7 ft.).
5. Install the Elevating Assembly Brace as described on page 10.
6. Visually inspect the elevating assembly, lift cylinder, cables, and hoses for cracked welds and structural damage, loose hardware, hydraulic leaks, and loose wire connections. Check for missing or loose parts.
7. Verify that the Depression Mechanism Supports have rotated into position under the machine.
8. Check Level Sensor operation (refer to "Level Sensor" on page 10).
9. Remove the Elevating Assembly Brace as described on page 10.
10. Turn and hold the Chassis Key Switch to CHASSIS.
11. Push the Chassis Lift/Lower Switch to the LIFT position and fully elevate the platform.
 - Check for erratic operation.
12. Partially lower the platform by pushing Chassis Lift/Lower Switch to LOWER, and check for proper operation of the audible lowering alarm.
13. Check the Emergency Lowering Valve for proper operation (refer to "Emergency Lowering" on page 7).
14. Lower the platform.
15. Push the Chassis Emergency Stop Switch to check for proper operation. All machine functions should be disabled. Pull out the Chassis Emergency Stop Switch to resume.
16. Turn the Chassis Key Switch to DECK.
17. Check that the route is clear of surface hazards such as holes, drop-offs, bumps, curbs, or debris, and is level and capable of supporting the wheel loads.
18. Mount the platform and properly close and secure the entrance.
19. Turn the Lift/Drive Switch to DRIVE.
20. Check for speed and directional control.
 - While engaging the Interlock Switch, slowly position the Control Handle to FORWARD then REVERSE. The farther you push or pull the Control Handle from center the faster the machine will travel.
21. Push the Steering Switch RIGHT, then LEFT, to check for steering control. Check clearances above, below, and to the sides of machine.
22. Turn the Lift/Drive Switch to LIFT to check platform lift controls.
 - While engaging the Interlock Switch, move the Control Handle to UP to raise the platform.
 - While engaging the Interlock Switch, move the Control Handle to DOWN to lower the platform. The platform should descend and the audible lowering alarm should sound.
23. Push the Platform Emergency Stop Switch to check for proper operation. All machine functions should be disabled. Pull out the Platform Emergency Stop Switch to resume.

OPERATION

Before operating the machine, ensure that the Pre-Operation Safety Inspection and System Function Inspection has been completed and that any deficiencies have been corrected. **Never operate a damaged or malfunctioning machine.** The operator must be thoroughly trained on this machine.

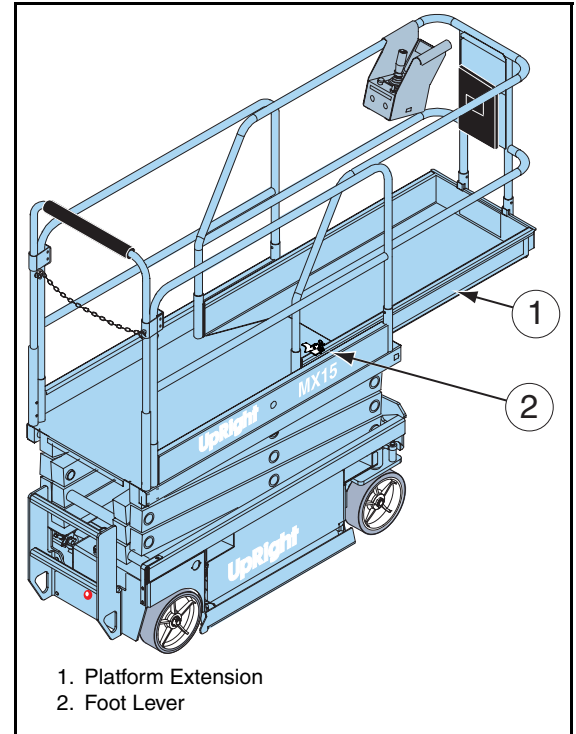
PLATFORM EXTENSION

1. Mount the platform and properly close and secure the entrance.
2. Depress the foot lever located at the rear of the platform extension. Push the platform extension forward until the pin engages the front stop.
3. To retract the platform extension, depress the foot lever and pull the platform extension toward the rear of the machine until the pin engages the rear stop.

TRAVEL WITH THE PLATFORM LOWERED

1. Check that the route is clear of surface hazards such as holes, drop-offs, bumps, curbs, or debris.
2. Check that the route is level, and is capable of supporting the wheel loads.
3. Verify that the Chassis Key Switch is turned to DECK and Chassis Emergency Stop Switch is ON (pulled out).
4. Mount the platform and properly close the entrance.
5. Check clearances above, below, and to the sides of platform.
6. Pull the Platform Emergency Stop Switch out to the ON position.
7. Turn the Lift/Drive Switch to DRIVE.
8. Engage the Interlock Switch and move the Control Handle to FORWARD or REVERSE to travel in the desired direction. The speed of the machine will vary depending on how far from center the Control Handle is moved.

Figure 3: Platform Extension



STEERING

1. Turn the Lift/Drive Switch to DRIVE.
2. While engaging the Interlock Switch, push the Steering Switch to RIGHT or LEFT to turn the wheels in the desired direction. Observe the tires while maneuvering the machine to ensure proper direction.

NOTE: Steering is not self-centering. Wheels must be returned to the straight ahead position by operating the Steering Switch.

ELEVATING THE PLATFORM

1. Locate a firm, level surface.
2. Check clearances above, below, and to the sides of platform.
3. Turn the Lift/Drive Switch to LIFT.
4. While engaging the Interlock Switch, push the Control Handle FORWARD.
5. If the machine is not level the level sensor alarm will sound and the machine will not lift or drive. **If the level sensor alarm sounds the platform must be lowered and the machine moved to a firm, level surface before attempting to elevate the platform.**

NOTE: Depression Mechanism Supports will deploy automatically as the platform elevates and will retract after the platform has been lowered completely and driven.

TRAVEL WITH THE PLATFORM ELEVATED

NOTE: The machine will travel at reduced speed when the platform is elevated.

1. Check that the route is clear of surface hazards such as holes, drop-offs, bumps, curbs, or debris.
2. Check that the route is level, and is capable of supporting the wheel loads.
3. Check clearances above, below, and to the sides of platform.
4. Turn the Lift/Drive Switch to DRIVE.
5. Engage the Interlock Switch and move the Control Handle to FORWARD or REVERSE to travel in the desired direction. The speed of the machine will vary depending on how far from center the Control Handle is moved.
6. If the machine is not level the level sensor alarm will sound and the machine will not lift or drive. **If the level sensor alarm sounds the platform must be lowered and the machine moved to a firm, level surface before attempting to elevate the platform.**

LOWERING THE PLATFORM

1. Turn the Lift/Drive Switch to LIFT.
2. Check around the base of the platform to ensure that no one is in contact with the machine. Engage the Interlock Switch and pull back on the Control Handle to lower the platform.

EMERGENCY LOWERING

The Emergency Lowering Valve Knob is located beside the ladder at the rear of the machine.

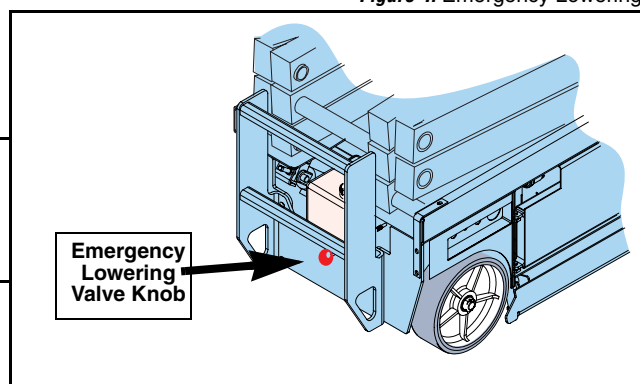


If the platform should fail to lower, NEVER climb down the elevating assembly.

Stand clear of the elevating assembly while operating the Emergency Lowering Valve Knob.

1. Open the Emergency Lowering Valve by pulling and holding the knob.
2. To close, release the knob. The platform will not elevate if the Emergency Lowering Valve is open.

Figure 4: Emergency Lowering



PARKING BRAKE RELEASE

Perform the following only when the machine will not operate under its own power and it is necessary to move the machine or when winching onto a transport vehicle (refer to “Transporting the Machine” on page 9).

IMPORTANT: *Do Not* release the parking brakes if the machine is on a slope.



Never winch or move the machine faster than 0,3 m/sec. (1 ft./sec.).

Never operate the machine with the parking brakes released. Serious injury or damage could result.

The parking brakes are integral to the drive motors. Each drive motor has two brake release nuts. Release and engage the parking brakes one wheel at a time. Turn the brake release nuts in stages ($\frac{1}{2}$ turn at a time) to prevent possible binding of the brake mechanism.

RELEASE THE PARKING BRAKE

The front wheel motors each have two brake release nuts.

IMPORTANT: Turn the nuts alternately in $\frac{1}{2}$ turn increments to insure uniform adjustment and prevent binding.

1. Chock the rear wheels to prevent the machine from rolling.
2. Using a 13 mm socket wrench, turn the brake release nuts clockwise until they contact the motor body.
3. Alternately turn each nut clockwise in $\frac{1}{2}$ turn increments until resistance is felt (approximately two turns).
4. The brake is released.

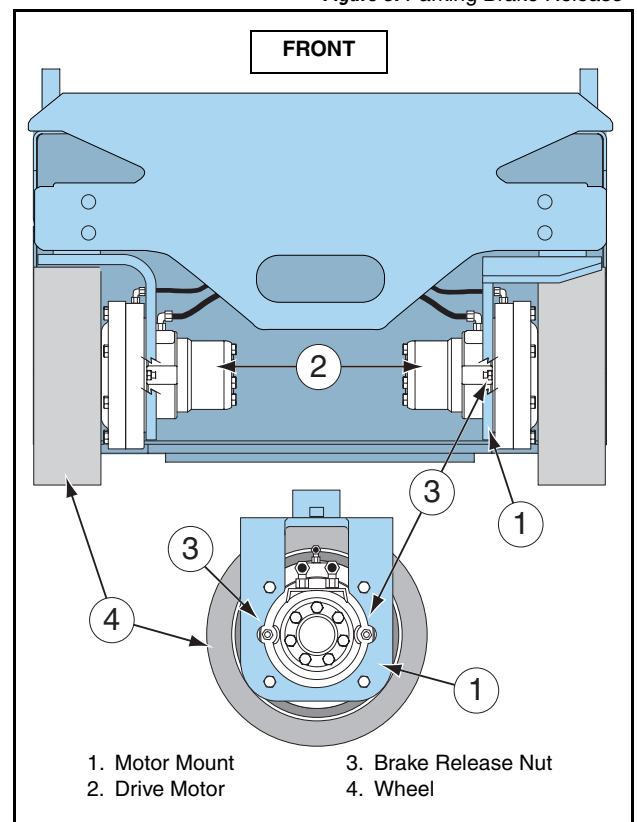
ENGAGE THE PARKING BRAKE

1. Chock the rear wheels to prevent the machine from rolling.
2. Using a 13 mm socket wrench, alternately turn the brake release nuts counter-clockwise in $\frac{1}{2}$ turn increments.
 - Repeat until there is approximately 3.2 mm ($\frac{1}{8}$ in.) between the brake release nuts and the drive motor body.
3. Verify that the brakes have fully engaged before operating the machine by testing their ability to hold the machine on a 14.5° (26%) grade.

AFTER USE EACH DAY

1. Ensure that the platform is fully lowered.
2. Park the machine on a firm level surface, preferably under cover, secure against vandals, children and unauthorized operation.
3. Turn the Chassis Key Switch to OFF and remove the key to prevent unauthorized operation.

Figure 5: Parking Brake Release



TRANSPORTING THE MACHINE

Always use a transport vehicle when moving a machine to a work site. Towing the machine over long distances will damage the machine and void the warranty.

⚠ DANGER ⚠

See specifications for the weight of the machine and be certain that the crane or forklift is of adequate capacity to lift the machine.

LIFTING BY CRANE

Secure straps to chassis tie down/lifting points only (refer to Figure 6).

MOVING BY FORKLIFT

IMPORTANT: Forklifting is for transport only.

Both the MX15 and MX19 may be forklifted from the rear end of the machine between the wheels. They may also be forklifted from the side using the forklift pockets shown in Figure 6.

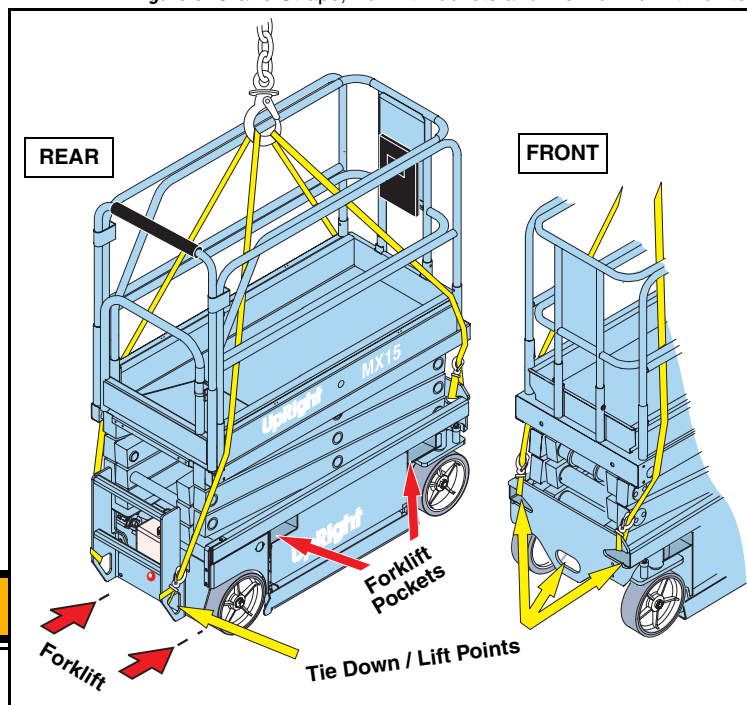
DRIVING OR WINCHING ONTO A TRUCK OR TRAILER

⚠ WARNING ⚠

Never winch faster than 0,3 m/sec.
(1 ft./sec.).

Never operate the machine with the parking brakes released. Serious injury or damage could result.

Figure 6: Crane Straps, Forklift Pockets and Tie Down / Lift Points



1. Loading the machine onto the truck or trailer;
 - A. To **Drive** the machine onto the transport vehicle:
 - a. Turn the Lift/Drive Switch to DRIVE and drive the machine up the ramp and into transport position.
 - b. Set the wheels straight and turn off the machine.
 - c. Chock the wheels.
 - B. To **Winch** the machine onto the transport vehicle:
 - a. Drive the machine up to the ramp.
 - b. Attach the winch cable to the tie down/lifting points.
 - c. Release the parking brakes (refer to "Parking Brake Release" on page 8).
 - d. Winch the machine into transport position.
 - e. Chock the wheels.
 - f. Engage the parking brakes.
2. Secure the machine to the transport vehicle with chains or straps of adequate load capacity attached to the chassis tie down/lifting points (refer to Figure 6).

CAUTION

Overtightening chains or straps attached to the Tie Down/Lift Points may result in damage to the machine.

MAINTENANCE

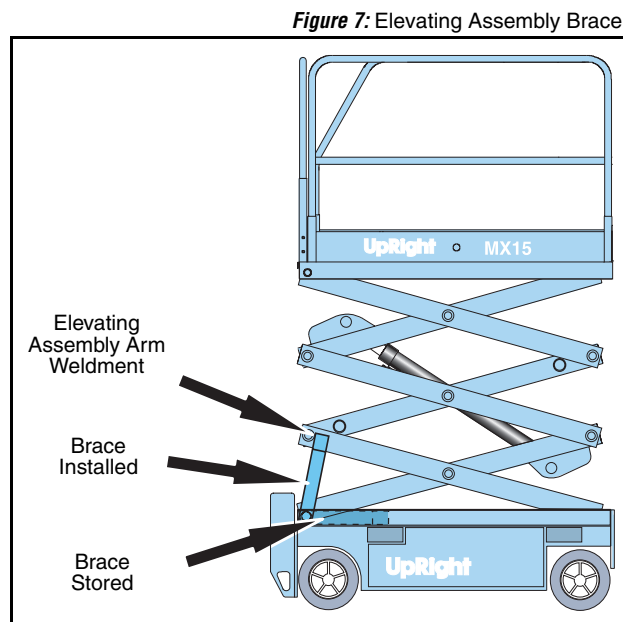
⚠ WARNING ⚠

Never perform service while the platform is elevated without first blocking the elevating assembly.
DO NOT stand in the elevating assembly area while deploying or storing the brace.

BLOCKING THE ELEVATING ASSEMBLY

ELEVATING ASSEMBLY BRACE INSTALLATION

1. Park the machine on a firm, level surface. Completely unload the platform before deploying the Elevating Assembly Brace.
2. Verify that the Chassis and Platform Emergency Stop Switches are ON by pulling each button out.
3. Turn and hold the Chassis Key Switch to CHASSIS. Push the Chassis Lift/Lower Switch to UP and elevate the platform approximately 2,1 m (7 ft.).
4. Rotate the Elevating Assembly Brace to a vertical position.
5. Carefully lower the platform until the end of the Elevating Assembly Arm Weldment rests on the Brace.



ELEVATING ASSEMBLY BRACE STORAGE

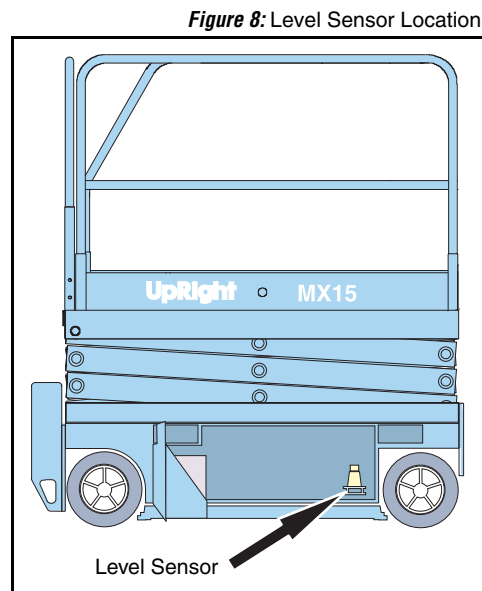
1. While holding the Brace, slowly raise the platform using the Chassis Controls until the end of the Elevating Assembly Arm Weldment clears the Elevating Assembly Brace.
2. Rotate the Elevating Assembly Brace forward to rest on the Chassis.
3. Push the Chassis Lift/Lower Switch to LOWER and completely lower the platform.

LEVEL SENSOR

The Level Sensor is located inside the chassis. To verify the sensor is working properly there are two LED's under the sensor; green indicates the sensor is ON (has power), red indicates the sensor is LEVEL.

TESTING THE LEVEL SENSOR

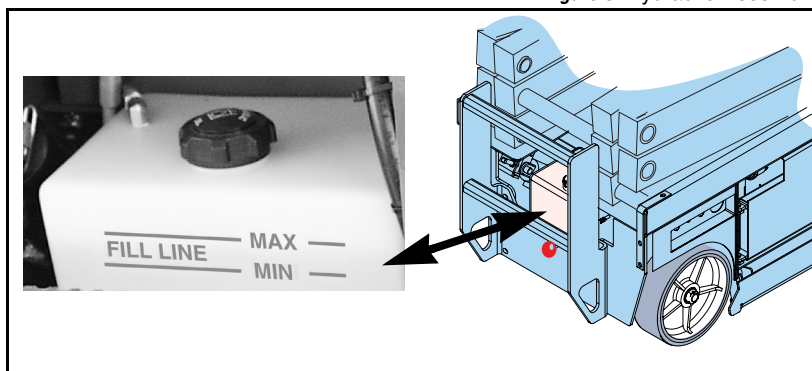
1. Place machine on firm level surface.
2. Open the door.
3. Push and hold the sensor off of level.
4. Push the Chassis Lift Switch to the UP position.
 - The alarm should sound, and the platform should not lift.
5. Close and latch the door.



HYDRAULIC FLUID

Check the level of the hydraulic fluid with the platform fully lowered. The hydraulic reservoir is located at the rear of the machine. The fluid level should be visible through the side of the reservoir, and must be between the MIN and MAX lines (see Figure 9). Add hydraulic fluid if necessary.

Figure 9: Hydraulic Reservoir



BATTERY MAINTENANCE

⚠ WARNING ⚠

Hazard of explosive gas mixture. Keep sparks, flame, and smoking material away from batteries.

Always wear safety glasses when working near batteries.

Battery fluid is highly corrosive. Thoroughly rinse away any spilled fluid with clean water.

Always replace batteries with UpRight batteries or manufacturer approved replacements weighing 26,3 kg (58 lbs.) each.

- Check the battery fluid level daily, especially if the machine is being used in a warm, dry climate.
- If electrolyte level is lower than 10 mm ($\frac{3}{8}$ in.) above the plates add distilled water only. DO NOT use tap water with high mineral content, as it will shorten battery life.
- Keep the terminals and tops of the batteries clean.
- Refer to the Service Manual to extend battery life and for complete service instructions.

BATTERY CHARGING

Charge the batteries at the end of each work shift or sooner if the batteries have been discharged.

WARNING

Charge the batteries in a well ventilated area.

Do not charge the batteries when the machine is near a source of sparks or flames.

Permanent damage to the batteries will result if the batteries are not immediately recharged after discharging.

Never leave the battery charger operating for more than two days.

Never disconnect the cables from the batteries when the charger is operating.

Keep the charger dry.

1. Check the battery fluid level. If the battery fluid level is lower than 10 mm ($\frac{3}{8}$ in.) above the plates add distilled water only.
2. Connect an extension cord (1,5 mm² [12 gauge] minimum conductor diameter; 15 m (50 ft.) maximum length) to the charger plug located at the left side of the chassis.
3. The charger turns on automatically after a short delay. Look through the charge indicator cutout to check the state of charge.
 - 0 - 50% charge:
 - First Light -BLINKING-
 - Second and Third Light -OFF-
 - 50% - 75% Charge:
 - First Light -ON-
 - Second Light -BLINKING-
 - Third Light -OFF-
 - 75% - 100% Charge:
 - First and Second Light -ON-
 - Third Light - BLINKING-
 - Charge Complete
 - All Lights -ON-
 - The charger automatically shuts down to low current after charging is complete and all lights turn ON.
 - The charger continues at low current (equalizing charge) for three to four hours, then charging current shuts off completely.
 - Lights remain ON until the AC power supply is disconnected.

NOTE: The battery charger circuit must be used with a GFI (Ground Fault Interrupt) outlet.

NOTE: DO NOT operate the machine while the charger is plugged in.

Figure 10: Battery Charger

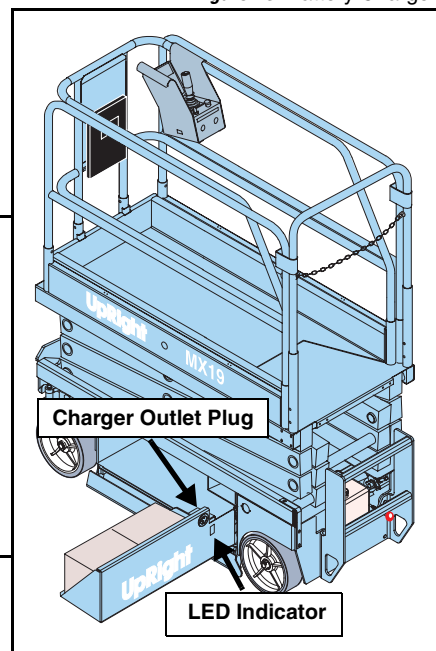
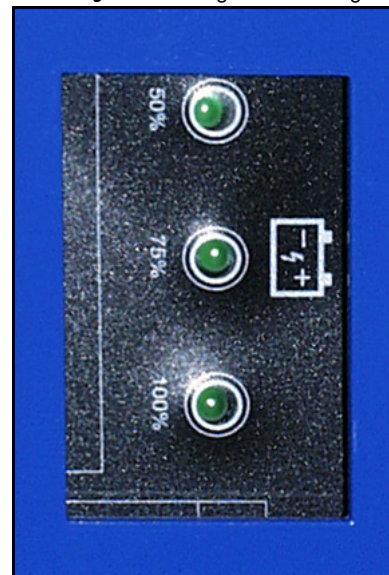


Figure 11: Charge Indicator Lights



DAILY INSPECTION AND MAINTENANCE SCHEDULE

The Complete Inspection consists of periodic visual and operational checks, along with periodic minor adjustments that assure proper performance. Daily inspection will prevent abnormal wear and prolong the life of all systems. Perform the inspection and maintenance items daily. Inspection and maintenance shall be performed by personnel who are trained and familiar with mechanical and electrical procedures.

! WARNING !

Before performing preventative maintenance, familiarize yourself with the operation of the machine.

Always block the elevating assembly whenever it is necessary to perform maintenance while the platform is elevated.

The daily preventative maintenance checklist has been designed for machine service and maintenance. Please photocopy the Daily Preventative Maintenance Checklist and use the checklist when inspecting the machine.

DAILY PREVENTATIVE MAINTENANCE CHECKLIST

MAINTENANCE TABLE KEY

Y = Yes/Acceptable

N = No/Not Acceptable

R = Repaired/Acceptable

PREVENTATIVE MAINTENANCE REPORT

Date: _____

Owner: _____

Model No: _____

Serial No: _____

Serviced By: _____

COMPONENT	INSPECTION OR SERVICES	Y	N	R
Battery	Check electrolyte level.			
	Check battery cable condition.			
Chassis	Check hoses for pinch or rubbing points.			
	Check welds for cracks.			
Control Cable	Check the exterior of the cable for pinching, binding or wear.			
Controller	Check switch operation.			
Drive Motors	Check for operation and leaks.			
Elevating Assembly	Inspect for structural cracks.			
Emergency Lowering System	Operate the emergency lowering valve and check for serviceability.			

COMPONENT	INSPECTION OR SERVICES	Y	N	R
Entire Unit	Check for and repair collision damage.			
Hydraulic Fluid	Check fluid level.			
Hydraulic Pump	Check for hose fitting leaks.			
Hydraulic System	Check for leaks.			
Labels	Check for peeling, missing, or unreadable labels & replace.			
Platform Deck and Rails	Check welds for cracks.			
	Check condition of deck.			
Tires	Check for damage.			

LABELS

These labels shall be present and in good condition before operating the machine. Be sure to read, understand and follow these labels when operating the machine.

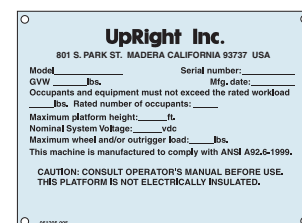
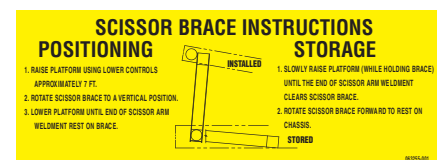
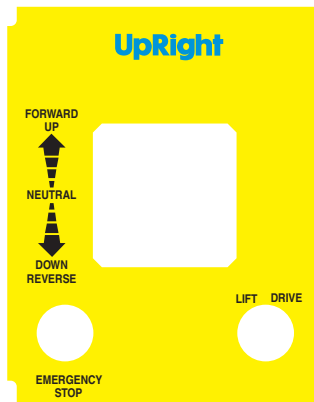
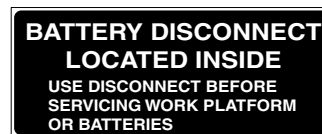
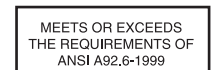
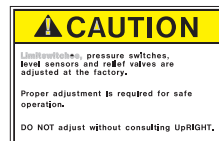
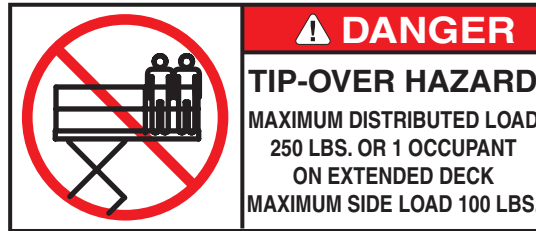
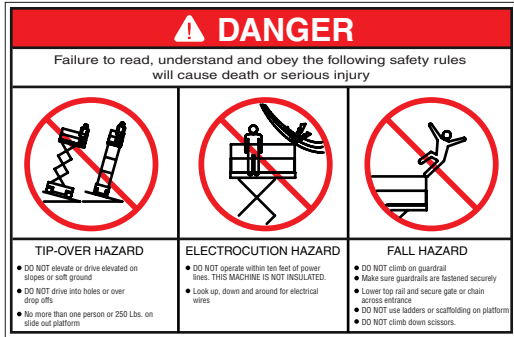
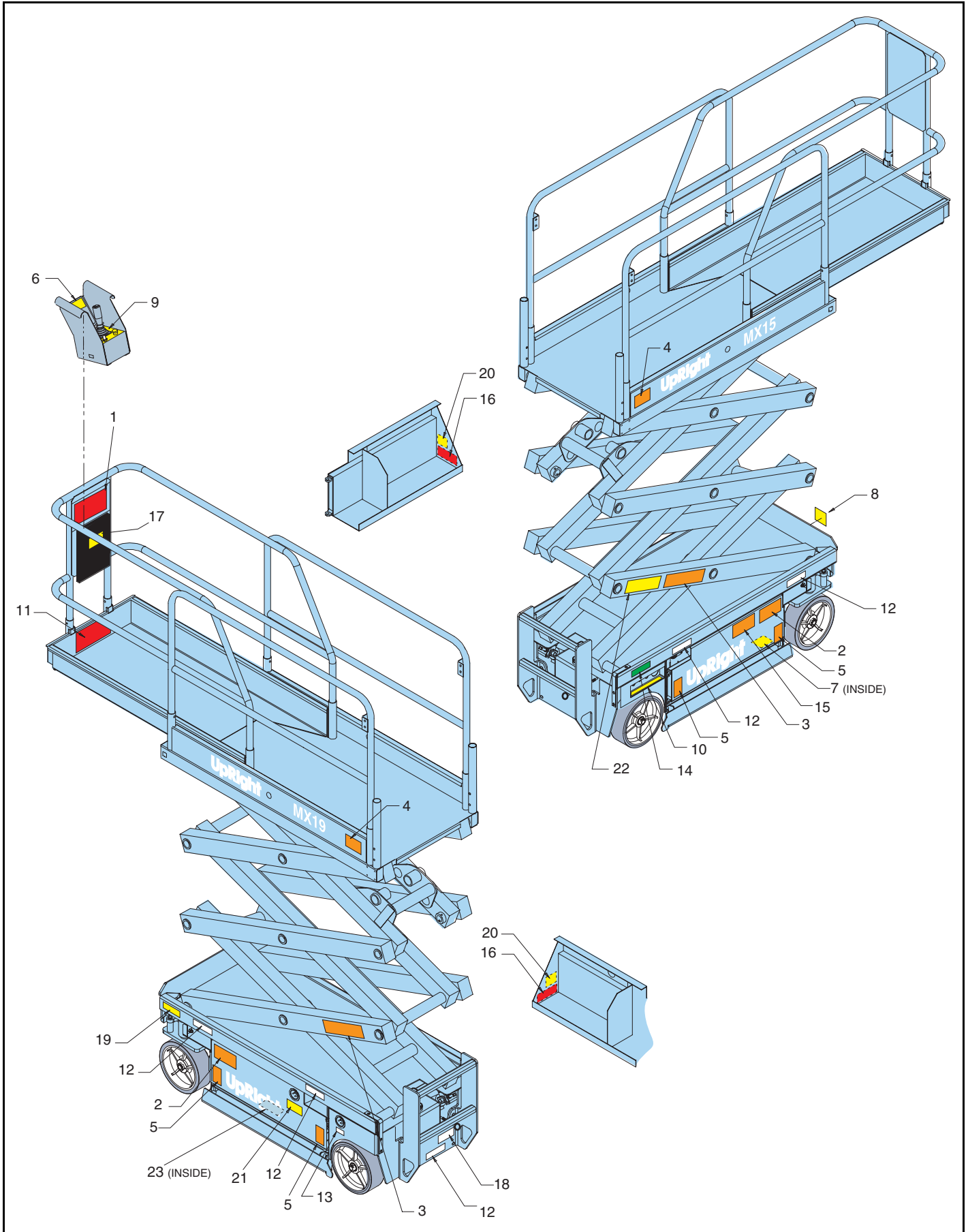


Figure 12: Safety Labels Locations



SPECIFICATIONS

ITEM	MX15	MX19
Gross Vehicle Weight (machine + rated load)	1,592 kg (3510 lbs.)	1692 kg (3730 lbs.)
Maximum Wheel Load	315 kg (1050 lbs.)	345 kg (1150 lbs.)
Platform Size (Inside minimum)	0,72 m x 2,5 m (28.5 in. x 100 in.)	
Maximum Platform Capacity	250 kg (550 lbs.)	227 kg (500 lbs.)
Maximum Number of Occupants	2 People	
Standard w/Deck Extension	1 Person	
Height		
Working Height	6,57 m (21 ft.)	7,79 m (25 ft.)
Maximum Platform Height	4,57 m (15 ft.)	5,79 m (19 ft.)
Minimum Platform Height	0,90 m (35.5 in.)	1,02 m (40.25 in.)
Dimensions		
Weight	1343 kg (2960 lbs.)	1465 kg (3230 lbs.)
Overall Width	0,76 m (30 in.)	0,76 m (30 in.)
Overall Height (Lowered)	1,89 m (74.5 in.)	2,01 m (79.25 in.)
Overall Length (Deck in)	1,75 m (68.75 in.)	1,75 m (68.75 in.)
Overall Length (Deck extended)	2,71 m (106.5 in.)	2,71 m (106.5 in.)
Drivable Height	4,57 m (15 ft.)	5,79 m (19 ft.)
Drive Speed	3,7 km/h (2.3 mph)	
Platform Lowered	1,0 km/h (0.62 mph)	
Platform Raised		
Energy Source	24 Volt Battery Pack (four 220 A hour, 6 Volt batteries, min. wt. 26,3 kg [58 lbs.] each)	
Motor	24 Volt 4 Horse Power DC Electric Motor	
System Voltage	24 V DC	
Battery Charger	20 A, 110/220 VAC	
Hydraulic Reservoir Capacity	12,9 L (3.4 US gal.)	
Maximum Hydraulic System Pressure	207 bar (3000 psi)	
Hydraulic Fluid	ISO #32	
Normal above 32° F [0° C]	ISO #32	
Low Temp. below 32° F [0° C]	ISO #15	
below 0° F [-17° C]		
Lift System	One Single Stage Lift Cylinder	
Lift Speed	Lift, 19 sec. Lower, 20 sec.	Lift, 19 sec. Lower, 18 sec.
Control System	<ul style="list-style-type: none"> • Proportional Control Handle with Interlock Switch • Rotary Lift/Drive Switch • Red Mushroom Emergency Stop Switch 	
Drive System	Dual Front Wheel Hydraulic Motors	
Tires	305 mm (12 in.) diameter solid rubber, Non-marking	
Parking Brake	Dual, Spring Applied, Hydraulic Release	
Turning Radius	Inside: 152 mm (6 in.) Outside: 1,6 m (64 in.)	
Maximum Gradeability	29% (16°)	
Wheel Base	1,24 m (49 in.)	
Guardrails	1,10 m (43 in.)	
Toeboard	152 mm (6 in.)	
Ground Clearance	9 cm (3.5 in.)	

*Specifications are subject to change without notice. Hot weather or heavy use may affect performance.

Refer to the Parts Manual and the Service Manual for complete parts and service information.

The MX15 / MX19 meets or exceeds all applicable requirements of OSHA and ANSI A92.6-1999.

GENERAL INFORMATION

This section contains generic instructions for the repair and maintenance of UpRight Aerial Work Platforms. Referring to the Operator Manual will aid in understanding the operation and function of the various components and systems of the machine, and help in diagnosing and repair of the machine.

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1-1 HAZARD INDICATORS



Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.



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



Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.



Indicates a potentially hazardous situation which, if not avoided, may result in damage to the machine.

1-2 WORKSHOP PROCEDURES

Detailed descriptions of standard workshop procedures, safety principles and service operations are not included. Please note that this manual does contain warnings and cautions against some specific service methods which could cause personal injury, or could damage a machine or make it unsafe. Please understand that these warnings cannot cover all conceivable ways in which service, whether or not recommended by UpRight, Inc., might be done, or of the possible hazardous consequences of each conceivable way, nor could UpRight Inc. investigate all such ways. Anyone using service procedures or tools, whether or not recommended by UpRight Inc., must satisfy themselves thoroughly that neither personal safety nor machine safety will be jeopardized.



Be sure to read, understand and follow all safety rules, operating instructions, and the Scaffold Industry Association's MANUAL OF RESPONSIBILITIES of ANSI A92.6-1999 before performing maintenance on or operating any UpRight Aerial Work Platform.



Never perform service on the machine in the elevating assembly area while platform is elevated without first blocking the elevating assembly.

DO NOT stand in elevating assembly area while deploying or storing brace.

Refer to the Operator Manual for elevating assembly blocking instructions.

1-3 TORQUE SPECIFICATIONS

HYDRAULIC COMPONENTS

NOTE: Always lubricate threads with clean hydraulic fluid prior to installation

Use the following values to torque hydraulic components used on UpRight Aerial Work Platforms.

Table 1-1: Torque Specifications for Hydraulic Components

Type: SAE Port Series	Cartridge Poppet		Fittings		Hoses	
	Ft/Lbs	Nm	Ft/Lbs	Nm	In/Lbs	Nm
#4	N/A	N/A	N/A	N/A	135-145	15-16
#6	N/A	N/A	10-20	14-27	215-245	24-28
#8	25-30	34-41	25-30	34-41	430-470	49-53
#10	35-40	47-54	35-40	47-54	680-750	77-85
#12	85-90	115-122	85-90	115-122	950-1050	107-119
#16	130-140	176-190	130-140	176-190	1300-1368	147-155

FASTENERS

This standard applies to the preloading of fasteners measured by installation torque.

NOTE: For other preloading methods or fasteners consult UpRight Engineering Department.

This general standard applies to all SAE and Metric fasteners unless otherwise specified.

THREAD CONDITION

- For lubricated or zinc plated fasteners use $K = .15$
- For dry unplated fasteners use $K = .20$

TORQUE TABLES

Table 1-2: Torque Specifications for SAE Fasteners



		 SAE J429 Grade 5			 SAE J429 Grade 8		
Nominal Thread Size		Clamp Load	Tightening Torque		Clamp Load	Tightening Torque	
			$K = .15$	$K = .20$		$K = .15$	$K = .20$
		lbs.	in-lbs.	in-lbs.	lbs.	in-lbs.	in-lbs.
Unified Coarse Thread Series	1/4 -20	2,000	75	100	2850	107	143
	5/16 -18	3,350	157	210	4700	220	305
		lbs.	ft-lbs.	ft-lbs.	lbs.	ft-lbs.	ft-lbs.
	3/8-16	4,950	23	31	6950	32.5	44
	7/16-14	6,800	37	50	9600	53	70
	1/2-13	9,050	57	75	12800	80	107
	9/16-12	11,600	82	109	16400	115	154
	5/8-11	14,500	113	151	20300	159	211
	3/4-10	21,300	200	266	30100	282	376
	7/8-9	29,435	321	430	41550	454	606
	1-8	38,600	483	640	54540	680	900
Nominal Thread Size		Clamp Load	Tightening Torque		Clamp Load	Tightening Torque	
			$K = .15$	$K = .20$		$K = .15$	$K = .20$
		lbs.	in-lbs.	in-lbs.	lbs.	in-lbs.	in-lbs.
Unified Fine Thread Series	1/4 -28	2,300	85	115	3250	120	163
	5/16-24	3,700	173	230	5200	245	325
		lbs.	ft-lbs.	ft-lbs.	lbs.	ft-lbs.	ft-lbs.
	3/8-24	5,600	26	35	7900	37	50
	7/16-20	7,550	42	55	10700	59	78
	1/2-20	10,200	64	85	14400	90	120
	9/16-18	13,000	92	122	18300	129	172
	5/8-18	16,300	128	170	23000	180	240
	3/4-16	23,800	223	298	33600	315	420
	7/8-14	32,480	355	473	45855	500	668
	1-12	42,270	528	704	59670	745	995

Table 1-3: Torque Specifications for Metric Fasteners, U.S. Customary Units

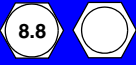
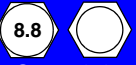
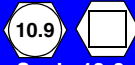

Nominal Thread Size	 Grade 8.8			 Grade 10.9			 Grade 12.9		
	Clamp Load	Tightening Torque		Clamp Load	Tightening Torque		Clamp Load	Tightening Torque	
		K =,15	K =,20		K =,15	K =,20		K =,15	K =,20
mm	lbs.	in-lbs.	in-lbs.	lbs.	in-lbs.	in-lbs.	lbs.	in-lbs.	in-lbs.
3	-	-	-	-	-	-	823	14.6	19.5
3.5	-	-	-	-	-	-	1,109	22.9	30.5
4	-	-	-	-	-	-	1,436	33.9	45.2
5	1,389	41.0	54.7	1,987	58.7	78.2	2,322	68.6	91.2
6	1,966	69.7	92.9	2,813	100.0	132.8	3,287	116.8	155.8
7	2,826	116.8	155.8	4,044	167.3	223.0	4,727	195.6	260.2
		ft-lbs.	ft-lbs.		ft-lbs.	ft-lbs.		ft-lbs.	ft-lbs.
8	3,579	14.1	18.8	5,122	20.1	26.9	5,986	23.6	31.4
10	11,742	27.9	37.2	8,117	39.9	53.3	9,486	46.7	62.3
12	8,244	48.7	64.9	11,797	69.7	92.2	13,787	81.1	108.4
14	11,246	77.4	103.3	16,093	110.6	147.5	18,808	129.1	172.6
16	15,883	125.4	166.7	21,971	173.3	230.9	25,677	202.1	269.2
18	19,424	171.9	229.4	26,869	238.2	317.2	31,401	278.1	371.0
20	2,304	243.4	325.3	34,286	337.8	449.9	40,070	394.6	525.9
22	30,653	331.9	442.5	42,403	458.8	612.2	49,556	536.2	715.4
24	35,711	420.4	562.0	49,400	583.4	778.1	57,733	682.2	909.4
27	46,435	617.3	84.8	64,235	853.4	1138.1	75,069	997.2	1329.8
30	56,753	837.9	1117.4	78,509	1159.4	1545.2	91,751	1354.9	1807.0
33	70,208	1140.3	1520.1	97,121	1576.9	2102.8	113,503	1843.9	2457.5
36	82,651	1464.1	1952.3	114,334	2025.3	2700.9	133,620	2367.6	3156.0

Table 1-4: Torque Specifications for Metric Fasteners, SI Units

Nominal Thread Size	 Grade 8.8			 Grade 10.9			 Grade 12.9		
	Clamp Load	Tightening Torque		Clamp Load	Tightening Torque		Clamp Load	Tightening Torque	
		K =,15	K =,20		K =,15	K =,20		K =,15	K =,20
mm	N	N-m	N-m	N	N-m	N-m	N	N-m	N-m
3	-	-	-	-	-	-	3660	1,65	2,2
3.5	-	-	-	-	-	-	4932	2,59	3,45
4	-	-	-	-	-	-	6387	3,83	5,11
5	6177	4,63	6,18	8840	6,63	8,84	10330	7,75	10,3
6	8743	7,87	10,5	12512	11,3	15	14623	13,2	17,6
7	12570	13,2	17,6	17990	18,9	25,2	21025	22,1	29,4
8	15921	19,1	25,5	22784	27,3	36,5	26626	32	42,6
10	52230	37,8	50,5	36105	54,1	72,2	42195	63,3	84,4
12	36670	66	88	52475	94,5	125	61328	110	147
14	50025	105	140	71587	150	200	83663	175	234
16	70650	170	226	97732	235	313	114218	274	365
18	86400	233	311	119520	323	430	139680	377	503
20	10250	330	441	152513	458	610	178238	535	713
22	136350	450	600	188618	622	830	220433	727	970
24	158850	570	762	219743	791	1055	256808	925	1233
27	206550	837	115	285728	1157	1543	333923	1352	1803
30	252450	1136	1515	349223	1572	2095	408128	1837	2450
33	312300	1546	2061	432015	2138	2851	504885	2500	3332
36	367650	1985	2647	508582	2746	3662	594368	3210	4279

1-4 DATE CODE IDENTIFICATION ON HOSES

GATES uses an eight digit code: Plant, Month, Day, Year.
i.e.: XX 01 07 01 - means Plant XX January 07 2001.

PARKER uses a 4 digit code indicating Quarter and Year.
i.e.: 2Q01 - means Second Quarter of 2001.

DAYCO stamps month, day and year on each hose.

1-5 SPECIAL TOOLS

The following is a list of special tools which may be required to perform certain maintenance procedures on the machine.

- 0-69 bar (**0-1000 psi**) Hydraulic Pressure Gauge with Adapter Fittings
- 0-207 bar (**0-3000 psi**) Hydraulic Pressure Gauge with Adapter Fittings
- 0-414 bar (**0-6000 psi**) Hydraulic Pressure Gauge with Adapter Fittings
- Small UpRight Connector Field Kit (UpRight P/N 030899-000)
- Large UpRight Connector Field Kit (UpRight P/N 030898-000)
- Inclinator (UpRight P/N 010199-000-00)
- MOS90 Calibrator (UpRight P/N 057128-000)
- Optimizer with adapter (UpRight P/N 100329-000)
- Flow Meter Kit (UpRight P/N 067040-000)
- Quadragauge with fitting (UpRight P/N 063971-000)
- 0-25 kg (**0-50 Lbs.**) Chain Tension Scale (UpRight P/N 107078-000)

UPRIGHT LIFT TOOL LIST

- Gland Nut Wrench (UpRight P/N 062521-000)
- Strap Wrench (UpRight P/N 062482-000)
- Tierod Tensioner (2 required) (UpRight P/N 062738-000)
- Tensioner Bracket (2 required) (UpRight P/N 062739-000)

1-6 UPRIGHT CONNECTORS

UpRight connectors are designed so that connector parts, contacts or electrical cables may be replaced without replacing the entire connector.

Figure 1-1: UpRight Connector Kits



Small Kit

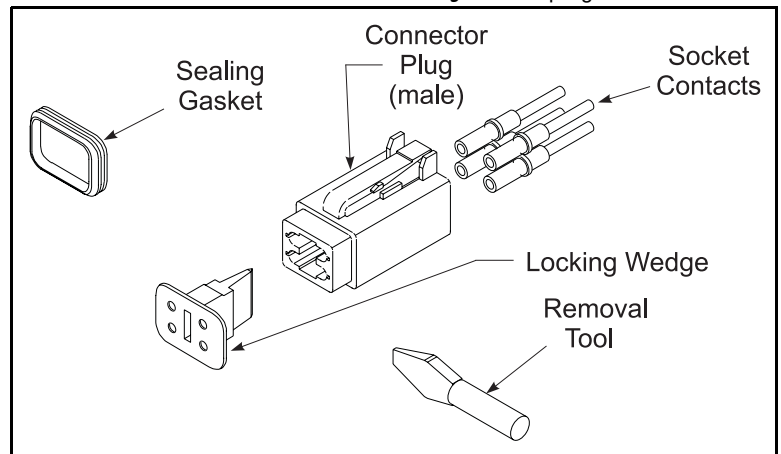


Large Kit

MALE CONNECTOR (PLUG)

1. Disconnect the male connector (plug) from the female connector (receptacle).
2. Using the flat end of the Removal Tool (or flat blade screwdriver), pry the Locking Wedge from the Male Connector. Care should be taken that the Sealing Gasket is not damaged during this procedure.
3. Check all parts for damage. Replace all parts which are damaged or worn.
4. Replace or re-crimp the wires and contacts. Refer to "Crimping" procedure.

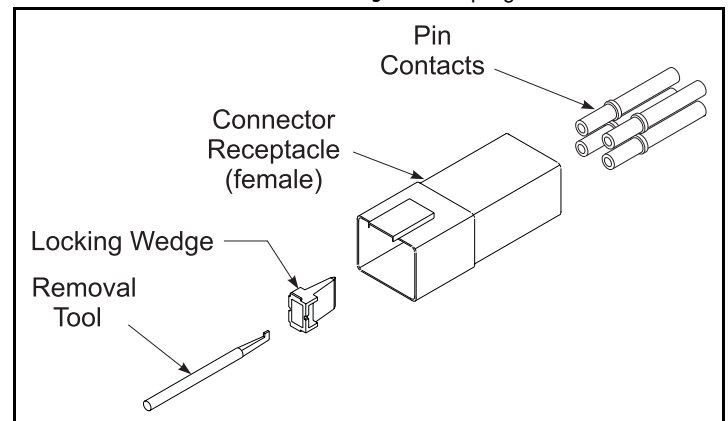
Figure 1-2: UpRight Male Connector



FEMALE CONNECTOR (RECEPTACLE)

1. Disconnect the male connector (plug) from the female connector (receptacle).
2. Using the notched end of the Removal Tool (or a wire hook), pull the Locking Wedge from the Female Connector.
3. Check all parts for damage. Replace all parts which are damaged or worn.
4. Replace or re-crimp the wires and contacts. Refer to "Crimping" procedure.

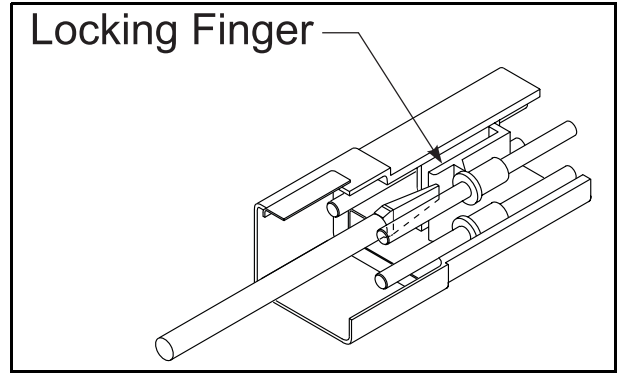
Figure 1-3: UpRight Female Connector



RELEASING LOCKING FINGERS

1. The Locking Fingers can be released following the removal of the Locking Wedge of either the male or female connector.
2. Use the removal tool (or flat bladed screwdriver) to push the Locking Fingers aside. This will release the grip on the contact.
3. Pull the wire and contact out of the connector.

Figure 1-4: Locking Finger, UpRight Connector



CRIMPING

1. Strip 6 mm ($\frac{1}{4}$ in.) from the wire.

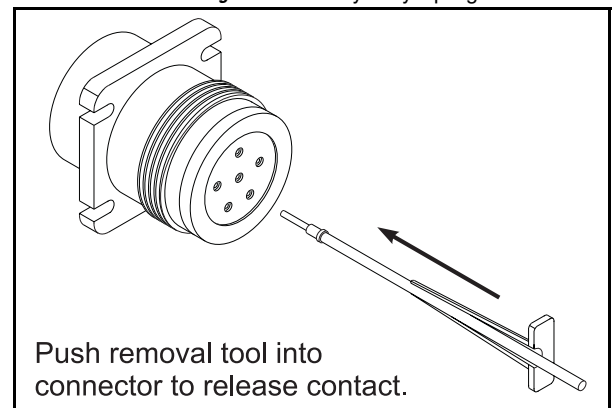
NOTE: Complete crimping instructions are included in each Field Kit.

2. Insert the contact into the crimping tool.
3. Insert the stripped wire into the contact. Copper strands should be visible in the bleed hole of the contact and no copper strands should be loose (outside) of the contact barrel.
4. Completely close the handles of the crimping tool. Release the handles of the crimping tool and remove the crimped contact.
5. Inspect the crimped contact to ensure that all strands are secure in the crimp barrel.

REMOVING CONTACT FROM HEAVY DUTY PLUG

1. Slip the removal tool along the wire to be replaced.
2. Push the removal tool into the connector until the contact is released.
3. Pull the wire and contact out of the plug.

Figure 1-5: Heavy Duty UpRight Connector



1-7 HYDRAULIC MANIFOLD REPAIR

REMOVAL

Refer to the *Service and Repair* section for model specific information.

1. Disconnect the battery.
2. Tag and disconnect the solenoid valve leads.
3. Tag, disconnect, and plug hydraulic hoses.
4. Remove the bolts that hold the manifold to the mounting bracket.
5. Remove the manifold block.

DISASSEMBLY

NOTE: Mark all components as they are removed so as not to confuse their location during assembly.

1. Remove coils from solenoid valves.
2. Remove valves.
3. Remove fittings, plugs, springs, balls, and orifices.

CLEANING AND INSPECTION

1. Wash the manifold in cleaning solvent to remove built-up contaminants, then blow out all passages with clean compressed air.
2. Inspect the manifold for cracks, thread damage and scoring where O-rings seal against internal and external surfaces.
3. Wash and dry each component and check for thread damage, torn or cracked O-rings, and proper operation.
4. Replace parts and O-rings found unserviceable.

ASSEMBLY

Refer to the *Service and Repair* section for assembly drawings, and the *Parts Manual* for illustrated parts breakdowns.

NOTE: Lubricate all O-rings before installation to prevent damage to O-rings. Seat all balls in manifold block by lightly tapping on the ball with a brass drift punch.

1. Install fittings, plugs, springs, balls, and orifices. Use one drop of Loctite #242 on each screw-in orifice.
2. Install valves.

INSTALLATION

Refer to the *Service and Repair* section for model specific information.

1. Attach manifold assembly to mounting plate with bolts.
2. Connect solenoid leads (as previously tagged).
3. Connect hydraulic hoses. Be certain to tighten hoses to manifold.
4. Reconnect the battery.
5. Operate each hydraulic function and check for proper operation and leaks.
6. Adjust valve pressures according to the *Service and Repair* section.

1-8 CYLINDER REPAIR



Cylinders may be very heavy. Support heavy cylinders before removing pins which secure the cylinder to the machine.

REMOVAL

NOTE: Refer to the *Service and Repair* section for the location of cylinders, and the *Parts Manual* for a list of parts which secure the cylinders.

1. Mark and disconnect hoses and IMMEDIATELY cap the openings to prevent contamination.
2. Remove the cylinder from the machine as described in the *Service and Repair* section.

DISASSEMBLY

1. Remove the head from the cylinder body.
2. Carefully slide the rod assembly out of the cylinder.
3. Remove the seal kit components (wipers, rod seals, o-rings and backup rings) from the head and piston.
4. Inspect parts for scratches, pits or polishing. Check seal grooves and sealing surfaces. Scratches or pits deep enough to catch the fingernail are unacceptable; replace the cylinder. Polishing is a sign of uneven loading. When this occurs, the surface should be checked for roundness. Cylinders not round within 0,18 mm (.007 in.) should be replaced.

ASSEMBLY

Refer to the *Service and Repair* section for seal-kit assembly drawings, and the *Parts Manual* for illustrated parts breakdowns.

NOTE: To avoid cutting the seals, do not use sharp edged tools during seal replacement. After installing seals allow at least one hour for the seals to elastically restore to their original shape before assembling the cylinder.

NOTE: Torque all hardware to torques according to Table 1-1, "Torque Specifications for Hydraulic Components," on Page 1-3 unless otherwise specified.

1. Lubricate all components with clean hydraulic fluid.
2. Install new seal kit components.
3. Lubricate the rod wiper and seal with hydraulic fluid and slide the head onto the rod.
4. Lubricate the seals on the piston and head.
5. Carefully slide the rod assembly into the cylinder.
6. Secure the head into the cylinder.

INSTALLATION

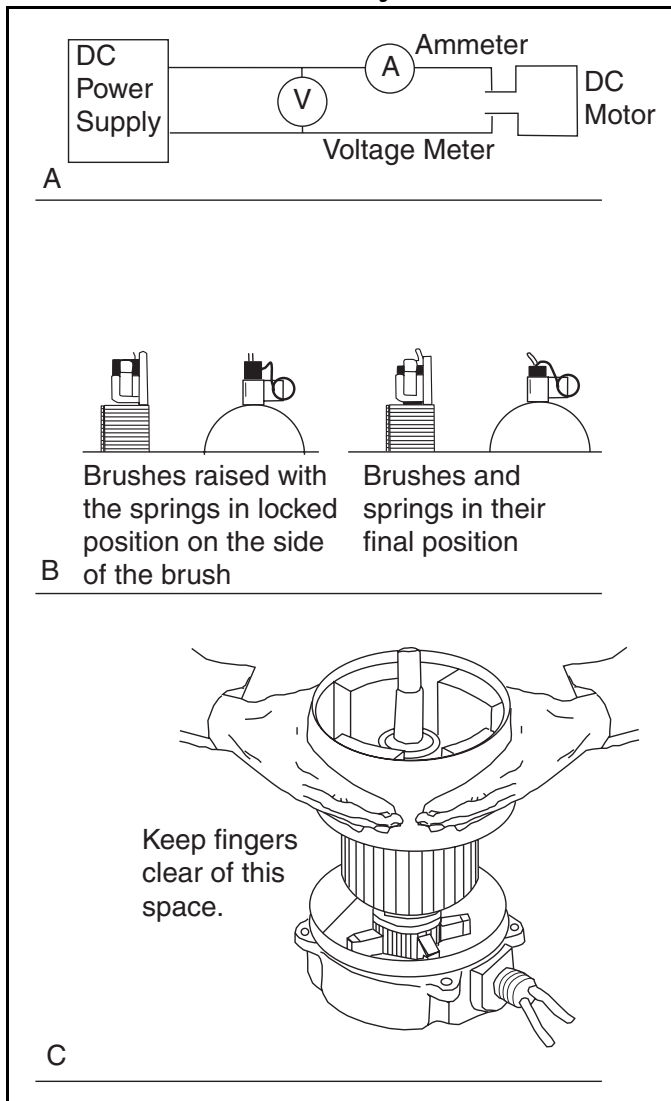
1. Installation is reverse of removal.
2. Carefully remove the elevating assembly support.
3. Slowly cycle the cylinder several times to remove air from the hydraulic system.
4. Check for proper cylinder operation. Check hydraulic connections for leaks.

1-9 ELECTRIC MOTORS

TROUBLESHOOTING

1. Read the nameplate to become familiar with the motor, especially the rated voltage.
2. Try to turn the shaft by hand. Keep motor leads separated while doing this. If the shaft turns freely go to Step 3. If the shaft won't turn, proceed to Step A.
- A. The shaft could be tight for a number of reasons, this check is to determine if the tightness is of a temporary nature only.
 - a. Obtain power to produce the nameplate voltage. **Do not Make a Permanent Connection.**
 - b. First touch the motor leads quickly to the power supply just long enough to observe if the shaft turns.
 - c. If it does turn, then hold the motor leads on the power supply for a longer time. If the motor sounds normal, go to Step 3.
 - d. If the motor sounds noisy, it should be taken apart as described in the disassembly section.
3. If the motor turned freely, connect an ammeter in the circuit as shown in Figure 1-6A. With rated voltage applied and the shaft running free, the ammeter should read less than 20% of the nameplate full load current. If the motor meets the above conditions, then it can be assumed that the original problem is external to the motor.

Figure 1-6: Electric Motor Service



DISASSEMBLY

1. Remove the through bolts.
2. Remove the pulley end cover.
3. Pull the armature out of the assembly in one swift motion.
4. Remove the commutator end cover.

NOTE: Do not place the stator ring in any mechanical holding device during the disassembly or assembly operation. Permanent distortion or other damage will result.

INSPECTION

Once the motor has been disassembled, go through the following check-list steps to determine where the problem lies.

1. Bearings should spin smoothly and easily and have ample lubrication and be free of corrosion.
2. The armature should be checked for grounds and shorted turns. Re-finish the commutator surface if it is pitted or excessively worn. (This procedure should be performed by a qualified electric motor shop.)
3. Brushes should be checked for wear and to ensure that they are free in the brush holders.

NOTE: Observe how the brushes are assembled in the brush holders, and the position of the brush lead. New brushes must be installed in the same manner. Brushes should be removed as follows:

- a. Remove the brush spring clip from its mounting on the brush assembly.
 - b. Lift the brush assembly from the brush holder.
 - c. Disconnect the brush assembly lead.
 - d. Install the new brush assembly by reversing the above procedure.
4. Inspect the wire harness and all connections for signs of damage due to overheating.
 5. Check the stator to see if it is securely mounted.

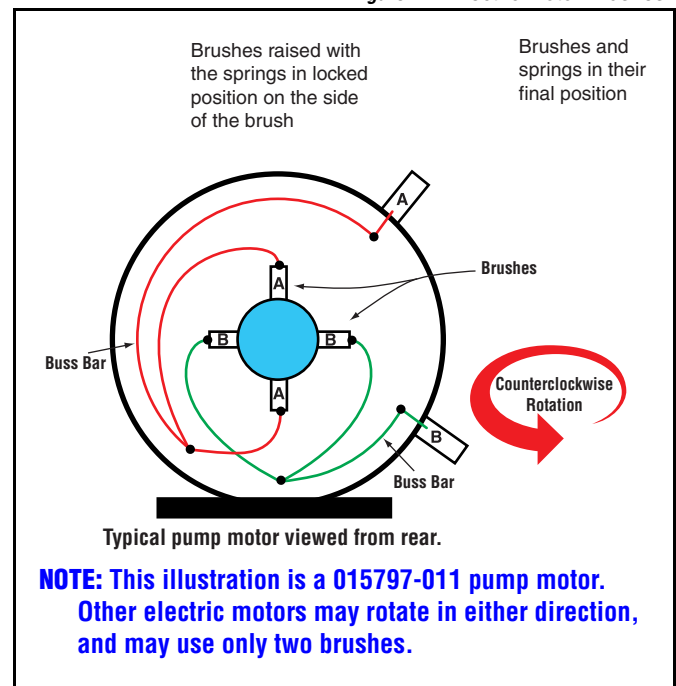
REASSEMBLY

1. Install new brushes and be sure they are free in the holder. Install the brush with the lead wires positioned as when received. Raise all brushes to the locked position. (See Figure 1-7 and **Inspection** Step 3).
2. Place the commutator cover on a work bench with the brush assembly facing upward.
3. Place the bearing spring into the bearing bore.
4. Take a complete armature assembly, including bearings, and insert the commutator end bearing into the bearing bore.

NOTE: Do not re-use bearings which have been removed from the armature shaft. Keep the assembly in a vertical position. Use extreme care not to damage the armature with bearing pullers. New bearings should be installed by pressing the inner race of the bearing onto proper position on the armature shaft.

5. Set the brushes into their final position as shown in Figure 1-7.
6. Place the complete stator down over the vertical armature, and into position on the commutator cover.
7. The stator assembly must be placed in a definite relationship with the commutator covers in order to obtain a neutral brush setting. There is a match-mark on both items. These two marks must line up exactly. Rotate until they do.
8. Assemble the pulley end cover in the proper relationship. Insert the mounting bolts and tighten alternately to ensure a good mechanical alignment.
9. Spin the shaft by hand to see if it is free. Be sure motor leads (if used) are not touching together. If the leads are touching, a generator action will give the effect of friction in the motor. A no-load test can now be performed. At the rated voltage, observe the no-load current. It should be less than 20% of the name-plate full load current. Anything higher indicates:
 - Brushes are not on neutral setting (check match-marks for exact alignment).
 - Faulty armature.

Figure 1-7: Electric Motor Brushes



1-10 BATTERY MAINTENANCE

CAUTION

If battery water level is not maintained, batteries will not fully charge, creating a low discharge rate.

⚠ WARNING ⚠

Hazard of explosive gas mixture. Keep sparks, flame and smoking materials away from batteries.

Always wear safety glasses when working with batteries.

Battery fluid is highly corrosive. Thoroughly rinse away any spilled fluid with clean water.

Always replace batteries with UpRight batteries or manufacturer approved replacements.

Before disconnecting the battery negative (-) lead, make sure all switches are OFF. If ON, a spark will occur at the ground terminal which could cause an explosion if hydrogen gas or fuel vapors are present.

- Check battery fluid level daily.
- If electrolyte level is lower than 10 mm (**3/8 in.**) above plates, add distilled water only.
DO NOT use tap water with high mineral content. It will shorten battery life.
DO NOT overfill. Battery acid expands during charging and can overflow.
- Keep terminals and tops of batteries clean.
- The battery and cables should be inspected regularly for signs of cracks in the case, electrolyte leakage and corrosion of the terminals. Inspect the cables for worn spots or breaks in the insulation and for broken cable terminals.
- Clean batteries whenever there are signs of corrosion at the terminals, or when electrolyte has overflowed during charging. Use a baking soda solution to clean batteries, taking care not to get the solution inside the cells. Rinse thoroughly with clean water.
- Clean battery and cable contact surfaces to a bright metal finish whenever a cable is removed.

BATTERY CHECK

Electric UpRight Aerial Work Platforms use deep cycle batteries. If poor service life is experienced, batteries should be checked for bad cells. Fully charge batteries for 14 hours minimum, ensuring that the charger has completed its cycle (see "Battery Charging" on page 1-14).

Deep cycle batteries do not have their full potential until they have been through 50 charge/discharge cycles. Normal 5-day weeks, charging batteries every day, equals 50 cycles in ten weeks.

If bad cells are found in any battery in a battery pack more than two years old, all batteries in the pack should be replaced for balance.

BATTERY CELL EQUALIZATION

The specific gravity of the electrolyte in the battery cells should be equalized monthly. To do this, charge batteries as outlined in "Battery Charging" on page 1-14. After this initial charge, recheck the electrolyte level in all cells and add distilled water as necessary. Then, turn on the charger for an additional eight hours.

SPECIFIC GRAVITY

Check the specific gravity of all cells with a hydrometer. The temperature corrected specific gravity of a fully charged battery should be 1.260. If any corrected readings are below 1.230, the batteries containing such cells should be replaced.

Do not check the specific gravity in a cell to which water has just been added. If there is not enough electrolyte in a fully charged cell to obtain a sample for the hydrometer, add water and complete a discharge/charge cycle before checking.

Table 1-5: Specific Gravity and Battery Voltage

SPECIFIC GRAVITY		VOLTS DC				
	Each Cell	Per Cell	6V Battery	12V Battery	24V Battery Pack	48V Battery Pack
Fully Charged	1.270	2.10	6.30	12.60	25.20	50.40
Fully Discharged	1.130	1.75	5.25	10.50	21	42

LOAD TESTING BATTERY PACKS

1. Fully charge the battery pack.
2. With the battery pack at rest and under full load, perform steps 3 and 4.
 - a. To put the battery pack under full load,
 - Activate the steering switch to turn the wheels fully in either direction.
 - Continue to hold the steering switch while performing steps 3 and 4.
3. Measure the potential across each battery.
4. Measure the potential across the entire battery pack.
5. Compare the measured results

Any battery that measures 10% lower voltage than the others has a bad cell and should be replaced.

BATTERY CHARGING

CAUTION

Permanent damage will result if the battery is not immediately recharged after discharging.

WARNING

Charge batteries only in a well ventilated area.

DO NOT charge batteries when sparks or open flames are present.

Never leave the connected charger unattended for more than two days.

Never disconnect the cables from the battery when the charger is operating.

Keep the charger dry.




- Charge batteries at the end of each work shift or sooner if the batteries have been discharged.
- Discharging a deep cycle battery to less than 1.75 Volts per cell can cause permanent damage.

NOTE: Do not operate the machine when the battery charger is plugged in.

When night temperatures fall below 65°F (18°C), batteries charged in unheated areas should be charged as soon after use as possible. Under such conditions a four hour charge cycle once a week in the early afternoon will improve the state of charge and battery life.

1. Check the battery fluid level. If electrolyte level is lower than 10 mm (**3/8 in.**) above plates, add distilled water only.
2. Check the charger to determine the AC charging current. If equipped, set the AC voltage selector switch to match the AC power source.
3. Connect an extension cord that meets or exceeds the charger AC current onto the charger plug.
4. Connect the other end of the extension cord to a grounded AC outlet of proper current, voltage and frequency rating.
5. The charger turns on automatically after a short delay. Table 1-6 illustrates charging indicators.

Table 1-6: Battery Charging, UpRight Electric and BiEnergy Machines

Charger Display	AC Charging Current		Charging Indicator	Charger Shutdown
	068574-000	8 Amp - 115 VAC	Ammeter <ul style="list-style-type: none"> • Charging current is displayed on ammeter. • Current drops off as batteries charge. 	<ul style="list-style-type: none"> • Charger shuts off automatically. • Ammeter shows "0" current.
	069112-000	4 Amp - 230 VAC		
	063944-001	7 Amp - 115 VAC	Green Light <ul style="list-style-type: none"> • ON during charging cycle. • Blinking at charge completion. 	<ul style="list-style-type: none"> • Charger automatically shuts down to 1 amp trickle charge. • Green Light continues to blink.
	063948-003	4 Amp - 230 VAC		
	069199-000 & 069199-001 Dual Voltage	8 Amp - 115 VAC 4 Amp - 230 VAC	Three Lights <ul style="list-style-type: none"> • 0 - 50% charge: First Light -Blinking- Second and Third Light -OFF- • 50% - 75% Charge: First Light -ON- Second Light -Blinking- Third Light -OFF- • 75% - 100% Charge: First and Second Light -ON- Third Light - Blinking- • Charge Complete All Lights -ON- 	<ul style="list-style-type: none"> • Charger automatically shuts down to low current after charging is complete and all Lights turn ON. • Charger continues at low current (equalizing charge) for 3-4 hours, then charging current shuts off completely. • Lights remain ON until the AC power supply is disconnected.

BATTERY CHARGER TROUBLESHOOTING

CAUTION

Ensure that battery chargers with voltage selector switches are set on the correct AC line voltage before placing chargers in service to avoid charger failure.

Connect battery leads in correct polarity to avoid charger damage.

WARNING




Remove all power before working on electrical parts to avoid shock.

Shock hazard can exist if AC plugs are wired incorrectly.

The battery charger troubleshooting procedure is outlined in Table 1-7. The table shows various conditions for each charger type with the problem to be investigated. Follow the table from the top down when troubleshooting. If the problem is not resolved after going through the entire table, the charger should be replaced.

NOTE: The majority of chargers returned to UpRight as “failed” test good. Please follow the troubleshooting procedures carefully.

Table 1-7: Battery Charger Troubleshooting

				
Problem	068574-000(115V) 069112-000(110/230V)	063944-001 (115V) 063948-003 (110/230V)	069199-000 & 069199-001 (115/230V auto)	Solution
Battery voltage is below 18 Volts (too low to allow the charger to turn on).	<ul style="list-style-type: none"> Ammeter does not move. No hum from charger. 	<ul style="list-style-type: none"> No green Light. No hum from charger. 	<ul style="list-style-type: none"> Not Applicable. Charger turns on even with very low battery voltage. 	Charge batteries to at least 24 Volts with an external charger, then disconnect the external charger and plug in the internal charger.
The charger has been plugged into an AC outlet with different voltage than the AC switch setting on the charger.	<ul style="list-style-type: none"> Ammeter does not move. No hum from charger. 	<ul style="list-style-type: none"> No green Light. No hum from charger. 	<ul style="list-style-type: none"> Not Applicable. Charger automatically adjusts to the incoming AC current. 	063944-001 ONLY <ul style="list-style-type: none"> Check the fuse inside the switch box - replace if bad. If the fuse is good, the charger has failed. All Others <ul style="list-style-type: none"> Check the AC main circuit breaker and reset if necessary. Set the voltage selector switch to the proper voltage.
Fuse visible on front of charger has failed.	<ul style="list-style-type: none"> Ammeter does not move. No hum from charger. 	<ul style="list-style-type: none"> Not Applicable. 	<ul style="list-style-type: none"> Not Applicable. 	Check for DC output short circuit and replace the fuse.
AC power problem.	<ul style="list-style-type: none"> Ammeter does not move. No hum from charger. 	<ul style="list-style-type: none"> No green Light. No hum from charger. 	<ul style="list-style-type: none"> No Lights ON. No Lights blinking. 	<ul style="list-style-type: none"> AC outlet is bad. Extension cord is bad Plug is bad or wired wrong. AC wire is broken. Check and repair as necessary.
DC connection to batteries.	<ul style="list-style-type: none"> Ammeter does not move. No hum from charger. 	<ul style="list-style-type: none"> No green Light. No hum from charger. 	<ul style="list-style-type: none"> All three Lights blink once. 	Connection to battery; <ul style="list-style-type: none"> missing. corroded. wrong polarity. DC wire broken. Check and repair as necessary, and check Fuse.
One or more batteries is bad.	<ul style="list-style-type: none"> Ammeter never shuts off, even after 14 hours of charging. 	<ul style="list-style-type: none"> Green Light ON but never starts blinking, even after 14 hours of charging. 	<ul style="list-style-type: none"> Lights one and two are ON or blinking, but all three Lights ON never occurs, even after 14 hours of charging. 	<ul style="list-style-type: none"> Check water level. Check for shorted cells. Replace bad batteries.
AC input voltage too high.	<ul style="list-style-type: none"> Not Applicable. 	<ul style="list-style-type: none"> Not Applicable. 	<ul style="list-style-type: none"> All three Lights blink two times. 	Check and correct AC source.
Overheated charger.	<ul style="list-style-type: none"> Not Applicable. 	<ul style="list-style-type: none"> Not Applicable. 	<ul style="list-style-type: none"> All three Lights blink three times. 	Move the machine to a cooler area. Allow the machine to cool before connecting to AC source.
High current in DC charging output.	<ul style="list-style-type: none"> Not Applicable. 	<ul style="list-style-type: none"> Not Applicable. 	<ul style="list-style-type: none"> All three Lights blink four times. 	<ul style="list-style-type: none"> Check for shorted DC output wires. Check for bad batteries.

1-11 HYDRAULIC FLUID

FLUID LEVEL

With the platform fully lowered, check the hydraulic fluid level. If the fluid is NOT in operating range, add hydraulic fluid until the fluid level is in operating range.

- DO NOT fill above operating range.
- DO NOT add fluid when the platform is elevated.

RECOMMENDED HYDRAULIC FLUID

CAUTION

Unless recommended by UpRight, do not mix hydraulic fluids of different brands or types. The required additives and fluid viscosities may vary.

If the use of hydraulic fluids other than listed below is desired please contact UpRight Product Support.

MOBILFLUID 424

- Viscosity Grade: ISO 46 High V.I. (similar to SAE 10W-30).
- Viscosity index: 152.
- Operating Range: -10° C to +96° C (+15° F to +205° F) Reservoir Temperature.
- Ambient Conditions*: Above -10° C (+15° F).

MOBIL DTE 13 M

- Viscosity Grade: ISO 32 High V.I. (similar to SAE 5W-20).
- Viscosity index: 140.
- Operating Range: -18° C to +80° C (-4° F to +176° F) Reservoir Temperature.
- Ambient Conditions*: -18° C to +30° C (-4° F to +86° F).

MOBIL DTE 11 M

- Viscosity Grade: ISO 15.
- Viscosity index: 140.
- Operating Range: -35° C to +45° C (-30° F to +115° F) Reservoir Temperature.
- Ambient Conditions*: -35° C to +20° C (-30° F to +70° F).

MOBIL EAL ENVIROSYN 46 H

For use where a *biodegradable non-toxic hydraulic fluid is required*.

- Viscosity Grade: ISO 46 High V.I. (similar to SAE 10W-20).
- Viscosity Index: 153.
- Operating Range: -14° C to +90° C (+6° F to +195° F) Reservoir Temperature.
- Ambient Conditions*: -14° C to +41° C (+6° F to +105° F).
- Synthetic Ester Base.

The anti-wear quality of hydraulic fluid must meet or exceed API Service Classification GL-3. The chemical stability of the hydraulic fluid must be sufficient for mobile hydraulic system service.

*Ambient Conditions are for reference only and may vary by model. Refer to operating temperature for final determination of correct fluid.

1-12 FLOOR LOADING

Floor Loading is defined as pressure imposed onto load-bearing surfaces, and can be measured as **Localized Pressure** or **Occupied Pressure**. To calculate Floor Loading, find the Total Weight of the machine.

TOTAL WEIGHT = MACHINE WEIGHT + MAXIMUM PLATFORM CAPACITY.

Refer to the machine specifications or contact UpRight or your UpRight dealer.

LOCALIZED PRESSURE

KG/CM² OR PSI

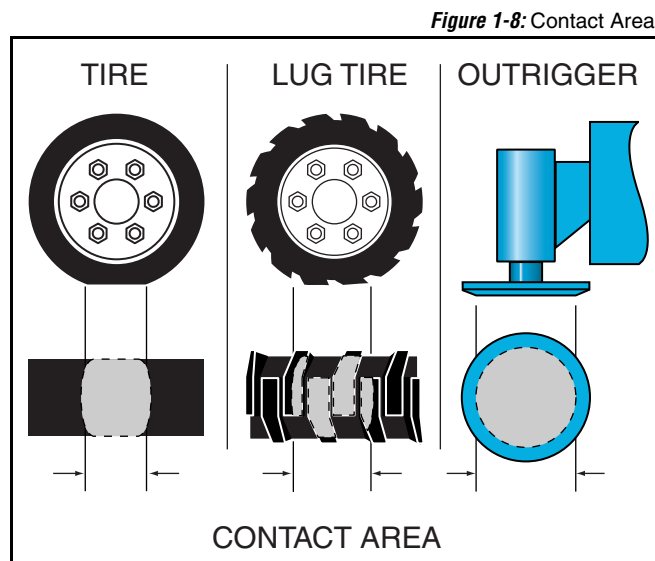
Localized Pressure is measured in *kilograms per square centimeter* or *pounds per square inch*. It is the pressure exerted onto a small area (contact area). Each tire and/or outrigger imposes Localized Pressure which can cause damage to the load-bearing surface.

NOTE: The formulas shown here are for vertical lift machines. Applying these formulas to machines with extending platforms will yield average pressures for machines in stowed position. Extending a platform causes increased localized pressure in the direction of extension, and decreased localized pressure at the opposite end.

MEASURE THE CONTACT AREA

Measure the contact area of the contacting surface (tire or outrigger).

The tire contact area can be determined by placing the loaded tire on a clean surface. The tire will leave an imprint from which an area can be determined.



CALCULATE THE LOCALIZED PRESSURE

Find the pressure exerted at each contacting surface.

NOTE: The wheel load can usually be found on a label on the machine, or on the serial plate.

If you know the wheel load, use this formula:

LOCALIZED PRESSURE = WHEEL LOAD ÷ CONTACT AREA

If you do not know the wheel load, use this formula:

LOCALIZED PRESSURE = (TOTAL WEIGHT ÷ 4) ÷ CONTACT AREA

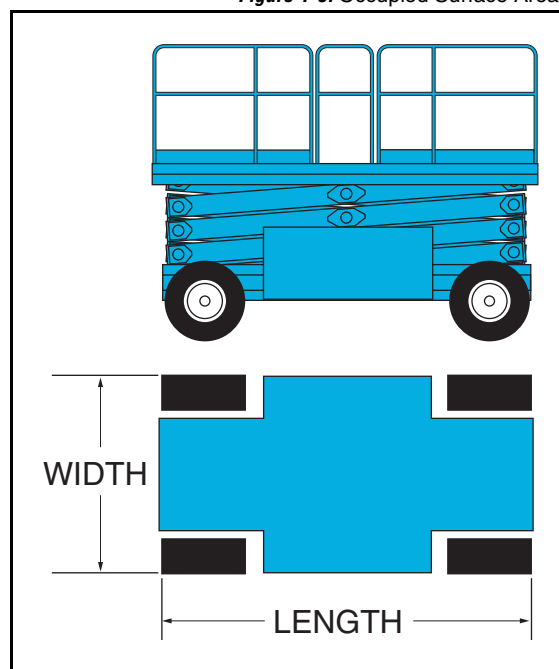
OCCUPIED PRESSURE

KPA OR PSF

Occupied Pressure is measured in *kilopascals* or *pounds per square foot*. It is the total pressure imposed onto the work surface over the area of the machine (occupied surface area). This is especially important when the work surface is supported by beams. The Occupied Pressure *must not exceed* the maximum load that the surface can support.

OCCUPIED PRESSURE = TOTAL WEIGHT ÷ (LENGTH X WIDTH)

Figure 1-9: Occupied Surface Area



FLOOR LOADING SPECIFICATIONS

Personnel Lift Machines

MODEL	Installed Outrigger Area (Length X Width)		Unit Weight				Platform Capacity		Occupied Floor Area		Occupied Floor Pressure (uniform)		Outrigger Pad Area		Maximun Localized Pressure (each pad.)		
			AC Units		DC Units												
	in.	cm	lbs.	kg	lbs.	kg	lbs.	kg	in.²	m²	psf	kPa	in.²	cm²	psi	kPa	kg/cm²
UL25	59 x 56	105 x 142	770	349	810	367	350	159	3304	2,13	50	2,39	12.57	81	23	1,62	159
UL32	81 x 78	206 x 198	920	417	960	435	300	136	6318	4,08	29	1,39	12.57	81	25	1,76	172
UL40	92 x 89	234 x 226	990	449	1030	467	300	136	8188	5,69	23	1,1	12.57	81	26	1,83	179

Small Slab Machines

MODEL	Chassis Length (excluding Ladder)		Vehicle Width		Vehicle Weight		Platform Capacity		Occupied Floor Area		Occupied Floor Pressure (uniform)			Maximum Tire Load (including rated load)		Maximum Axle Load (including rated load)		Tire Width		Tire Contact Area		Maximum Localized Pressure (each tire, platform extended)		
	in.	m	in.	m	lbs.	kg	lbs.	kg	in. ²	m ²	psf	kPa	kg/cm ²	lbs.	kg	lbs.	kg	in.	cm	in. ²	cm ²	psi	kPa	kg/cm ²
TM12	53.5	1,36	30.0	0,75	2209	1002	500	227	1602	1,03	243	11,63	0,118	677	307	1354	614	2,75	7	7,9	50,3	85,7	591	6,03
MX15	68.8	1,74	30.0	0,75	2961	1343	550	250	2063	1,33	245	11,73	0,119	968	439	1936	878	4	10	10,2	65,8	94,9	654	6,67
MX19	68.8	1,74	30.0	0,75	3100	1406	500	227	2063	1,33	251	12,01	0,122	1050	476	2100	953	4	10	10,2	65,8	102,9	709	7,23
SL20	92.5	2,35	33.0	0,84	3100	1406	750	340	3053	1,97	181	8,66	0,088	1150	522	2300	1044	4.5	11,4	13,1	84,5	87,7	605	6,17
X20N	92.5	2,35	32.5	0,82	3828	1736	750	340	3006	1,94	219	10,48	0,106	1400	635	2800	1270	4.5	11,4	11,8	76,1	118,6	818	8,34
X20W	92.5	2,35	48.0	1,22	4273	1938	1000	454	4440	2,86	149	7,13	0,072	1600	726	3200	1452	4.5	11,4	15,6	101	102,6	707	7,21
X26N	92.5	2,35	48.0	1,22	4747	2153	1000	454	4440	2,86	171	8,19	0,083	1750	794	3500	1588	4.5	11,4	16,1	104	108,7	749	7,64
X26UN	92.5	2,35	32.5	0,82	5200	2358	500	227	3006	1,94	273	13,07	1,133	1750	794	3500	1588	4.5	11,4	16,1	104	108,7	749	7,64
X31N	92.5	2,35	48.0	1,22	5480	2485	700	317	4440	2,86	200	9,58	0,097	1850	839	3700	1678	4.5	11,4	16,3	105	113,5	783	7,98
X32N	92.5	2,35	48.0	1,22	5480	2485	700	317	4440	2,86	200	9,58	0,097	1850	839	3700	1678	4.5	11,4	16,3	105	113,5	783	7,98

1-13 LONG TERM STORAGE

NOTE: Do not drain the hydraulic system prior to long term storage.

If the machine is to be placed in long term storage, follow these recommended preservation procedures.

PRESERVATION

1. Clean painted surfaces. If paint is damaged, repaint.
2. Fill the hydraulic reservoir to operating level.

IMPORTANT: Do not fill the hydraulic reservoir while the platform is elevated.

3. Coat exposed portions of cylinder rods with a preservative such as multipurpose grease and wrap with a barrier material.
4. Coat all exposed unpainted metal surfaces with preservative.
5. **Internal Combustion Models:** Service the engine according to the manufacturers recommendations.
6. **Electric And BiEnergy Models:** Remove the batteries and place them in alternative service.

SERVICE AND REPAIR

This section contains instructions for the maintenance of the machine. Refer to the General Information section for information relevant to all UpRight work platforms. Referring to the Operator Manual will aid in understanding the operation and function of the various components and systems of the machine, and help in diagnosing and repair of the machine.

WARNING

Be sure to read, understand and follow all information in the Operation Section of this manual before attempting to operate or perform service on any Aerial Work Platform.

WARNING

Never perform service on the machine in the elevating assembly area while platform is elevated without first blocking the elevating assembly.

DO NOT stand in elevating assembly area while deploying or storing brace.

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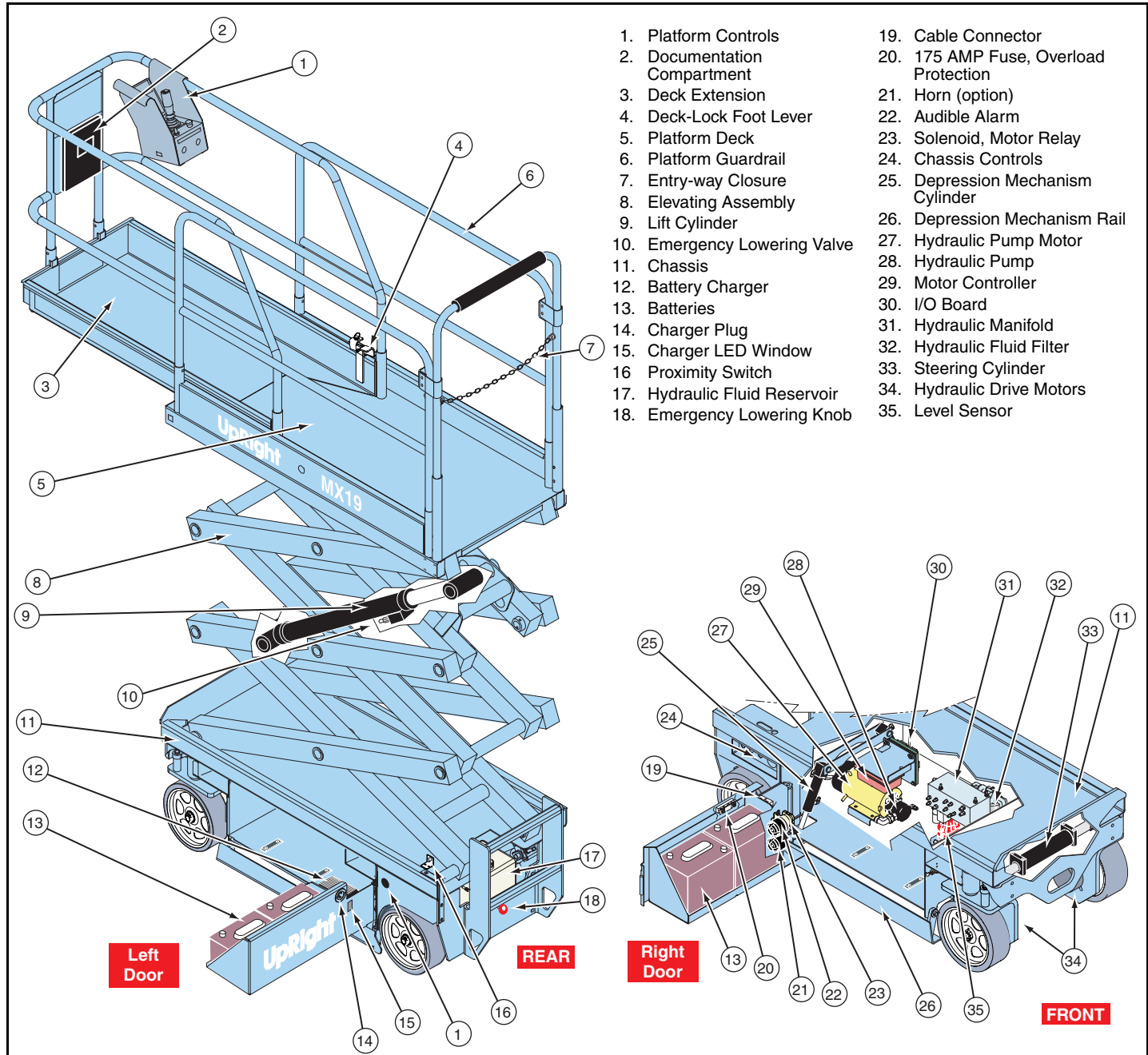
2-1 GENERAL DESCRIPTION

The MX15 and MX19 are self-propelled aerial work platforms designed to provide mobility with the platform elevated or lowered. The elevating function shall only be used when the platform is on a firm, level surface. Travel with the platform elevated is limited to the low speed range. The machine is intended to be self-propelled only when in relatively close proximity to the work area.

⚠ WARNING ⚠

DO NOT use the machine without guardrails properly assembled and in place.

Figure 2-1: MX15 / MX19 Work Platform



2-2 PREVENTATIVE MAINTENANCE

The complete inspection consists of periodic visual and operational checks, along with periodic minor adjustments to assure proper performance. Daily inspection will prevent abnormal wear and prolong the life of all systems. The inspection and maintenance schedule is to be performed at regular intervals. Inspection and maintenance shall be performed by personnel who are trained and familiar with mechanical and electrical procedures.



Before performing preventative maintenance, familiarize yourself with the operation of the machine.

Always block the elevating assembly whenever it is necessary to enter the scissor assembly to perform maintenance while the platform is elevated.

The preventative maintenance table has been designed for machine service and maintenance repair. Please photocopy the **Preventative Maintenance Check List** and use the table when inspecting the machine for service.

PREVENTATIVE MAINTENANCE CHECK LIST

MAINTENANCE TABLE KEY

Interval

Daily=each shift or every day

50h/30d=every 50 hours or 30 days

250h/6m=every 250 hours or 6 months

1000h/2y=every 1000 hours or 2 years

Y=Yes/Acceptable

N=No/Not Acceptable

R=Repaired/Acceptable

PREVENTATIVE MAINTENANCE REPORT

Date: _____

Owner: _____

Model No: _____

Serial No: _____

Serviced By: _____

Service Interval: _____

COMPONENT	INSPECTION OR SERVICES	INTERVAL	Y	N	R
Battery	Check electrolyte level	Daily			
	Check battery cable condition	Daily			
	Clean exterior	3m			
	Check specific gravity	6m			
	Clean terminals	6m			
Hydraulic Oil	Check oil level	Daily			
	Change filter	6m			
	Drain and replace oil	2y			
Hydraulic System	Check for leaks	Daily			
	Check hose connections	30d			
	Check hoses for exterior wear	30d			
Emergency Hydraulic System	Operate the emergency lowering valve and check for serviceability	Daily			
Controller	Check switch operation	Daily			
Control Cable	Check the exterior of the cable for pinching, binding or wear	Daily			
Platform Deck and Rails	Check fasteners for proper torque	6m			
	Check welds for cracks	Daily			
	Check condition of deck	Daily			
Tires	Check for damage	Daily			
	Check lug nuts (torque to 108 Nm [80 ft. lbs.])	6m			
Hydraulic Pump	Wipe clean	30d			
	Check for leaks at mating surfaces	30d			
	Check for hose fitting leaks	Daily			
	Check mounting bolts for proper torque	6m			

COMPONENT	INSPECTION OR SERVICES	INTERVAL	Y	N	R
Drive Motors	Check for operation and leaks	Daily			
Steering System	Check hardware & fittings for proper torque	6m			
	Grease pivot pins	30d			
	Oil king pins	30d			
	Check steering cylinder for leaks	30d			
Elevating Assembly	Inspect for structural cracks	Daily			
	Check pivot points for wear	6m			
	Check mounting pin pivot bolts for proper torque	6m			
	Check elevating arms for bending	6m			
Chassis	Check hoses for pinch or rubbing points	Daily			
	Check component mounting for proper torque	6m			
	Check welds for cracks	Daily			
Lift Cylinder	Check the cylinder rod for wear	30d			
	Check mounting pin pivot bolts for proper torque	6m			
	Check seals for leaks	30d			
	Inspect pivot points for wear	6m			
	Check fittings for proper torque	6m			
Entire Unit	Check for and repair collision damage	Daily			
	Check fasteners for proper torque	6m			
	Check for corrosion-remove and repaint	6m			
	Lubricate	30d			
Labels	Check for peeling, missing, or unreadable labels & replace	Daily			

2-3 BLOCKING THE ELEVATING ASSEMBLY

⚠ WARNING ⚠

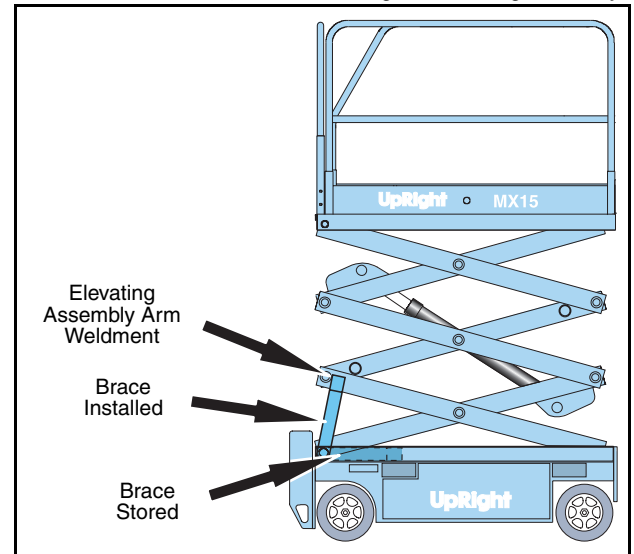
Never perform service on the machine in the elevating assembly area while platform is elevated without first blocking the elevating assembly.

DO NOT stand in elevating assembly area while deploying or storing brace.

ELEVATING ASSEMBLY BRACE INSTALLATION

1. Park the machine on a firm, level surface. Completely unload the platform before deploying the elevating assembly brace.
2. Verify that the Chassis and Platform Emergency Stop Switches are ON by pulling each button out.
3. Turn and hold the Chassis Key Switch to CHASSIS. Push the Chassis Lift/Lower Switch to UP and elevate the platform;
 - MX15 - approximately 2,1 m (7 ft.).
 - MX19 - approximately 2,7 m (9 ft.).
4. Rotate the elevating assembly brace towards the rear, holding it perpendicular to the assembly arm weldment.
5. Carefully lower the platform until the end of the elevating assembly arm weldment rests on the brace.

Figure 2-2: Blocking the Elevating Assembly



ELEVATING ASSEMBLY BRACE STORAGE

1. While holding the brace, slowly raise the platform using the chassis controls until the end of the elevating assembly arm weldment clears the elevating assembly brace.
2. Rotate the elevating assembly brace forward to rest on the chassis.
3. Push the Chassis Lift/Lower Switch to DOWN and completely lower the platform.

2-4 BATTERIES

Electrical Energy for the motor is supplied by four 6 volt batteries wired in series for 24 volts DC. Proper care and maintenance of the batteries and motor will ensure maximum performance from the machine.

BATTERY MAINTENANCE

Check the electrolyte level daily. Clean the battery exterior and terminals every 125 hours or three months.

Refer to *Section 1: General Information* for complete battery maintenance instructions.

Refer to the *Operator Manual* included in this Service Manual for specific maintenance and charging instructions.

NOTE: If system voltage drops below 17 volts (on a 24 volt system), the charger will not recharge the batteries. If this extreme voltage drop occurs, disconnect and recharge each battery separately using a 6 volt charger to bring the voltage in each up to at least 4 1/2 volts.

CAUTION

If battery water level is not maintained, batteries will not fully charge, creating a low discharge rate.

⚠ WARNING ⚠

Hazard of explosive gas mixture. Keep sparks, flame and smoking materials away from batteries.

Always wear safety glasses when working with batteries.

Battery fluid is highly corrosive. Thoroughly rinse away any spilled fluid with clean water.

Always replace batteries with UpRight batteries or manufacturer approved replacements.

Before disconnecting the battery negative (–) lead, make sure all switches are OFF. If ON, a spark will occur at the ground terminal which could cause an explosion if hydrogen gas or fuel vapors are present.

BATTERY REPLACEMENT

There are two batteries located in each door. The four 6 volt batteries are wired in series for 24 volts DC. Battery cables must be installed as shown in the Battery Cable Installation Diagram.

REMOVAL

1. Turn the Chassis Key Switch to the OFF position and push the Chassis and Platform Emergency Stop Switches down to the OFF position.

NOTE: If switches are ON, a spark may occur at the negative lead which could cause an explosion if hydrogen gas or fuel vapors are present.

2. Open the right-side door and disconnect the battery pack connector.
3. Open the left-side door and disconnect the battery negative (-) lead on battery #1.

IMPORTANT: Disconnect the battery negative (-) lead on battery #1 first.

4. Disconnect the remaining battery leads.
5. Lift the batteries out of the doors.

INSTALLATION

NOTE: Replacement batteries must be equal to or greater than the weight of the originals to maintain stability when the platform is elevated. Always replace batteries with UpRight batteries or manufacturer approved replacements weighing 26,3 kg (58 lb.) each.

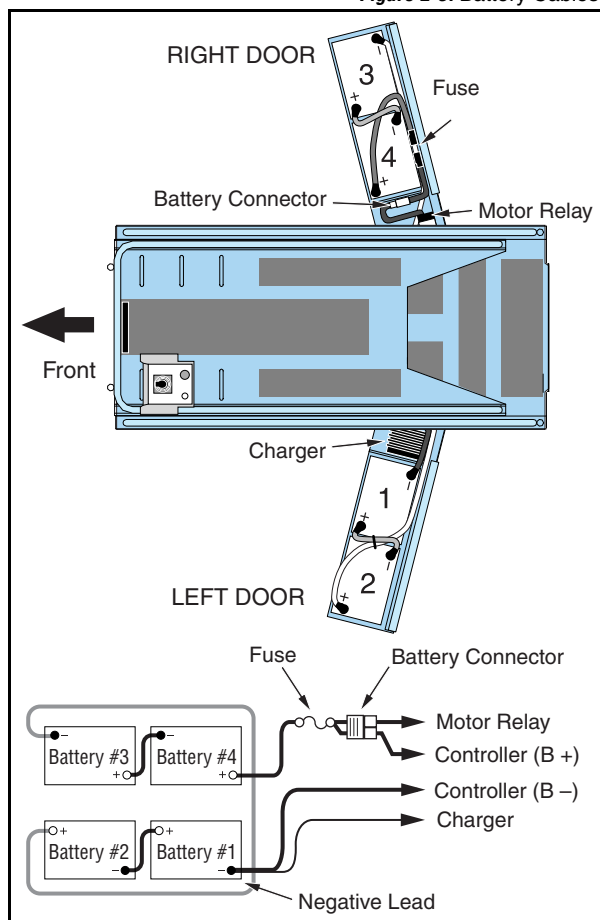
Battery cables must be installed as shown in Figure 2-3.

1. Verify that the Chassis Key Switch and the Chassis and Platform Emergency Stop Switches are in the OFF position.
2. Place the batteries into the doors as shown in Figure 2-3.
3. Connect the battery to battery leads.

IMPORTANT: Connect the battery negative (-) lead on battery #1 last.

4. Connect the battery pack connector.

Figure 2-3: Battery Cables



2-5 SWITCH ADJUSTMENTS



Always use the elevating assembly brace whenever it is necessary to enter the elevating assembly when the platform is elevated.

LEVEL SENSOR

INTRODUCTION

The Level Sensor has three wires: red-power (24V in), black-ground, white-output (24V out). To verify that the sensor is working properly, there is one LED under the sensor that indicates the sensor is off level.

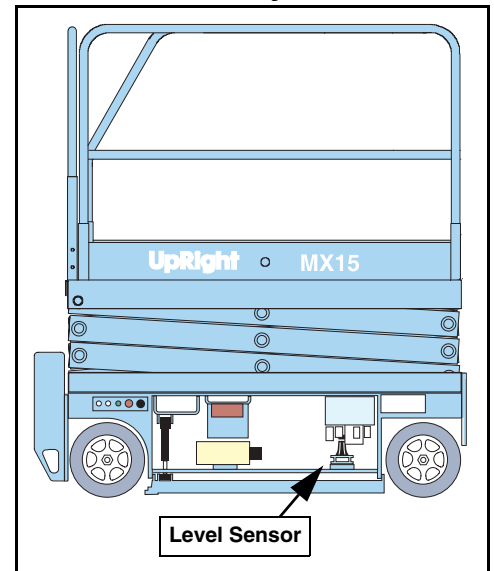
Figure 2-4: Level Sensor

ADJUSTMENT

1. Place machine on firm, level surface.
2. Use an Inclinometer (P/N: 10119-000-00) to ensure that the Chassis is level from front to rear and side to side.
3. Open the right door to access the Level Sensor.
4. Adjust the three leveling locknuts until the bubble is centered in the circle on the attached bubble level.

TEST

1. Open the right door.
2. Push and hold the sensor off of level while pushing the Chassis Lift Switch to the UP position.
 - The alarm should sound, and the platform should not lift.
3. Close and latch the door.



PROXIMITY SWITCH

Refer to Figure 2-5.

The Proximity Switch is a magnetically activated switch located near the rear of the chassis on the left side. Its function is determined by the location of the lower elevating assembly tube.

PROXIMITY SWITCH FUNCTION

A red LED at the rear of the switch should be ON when the elevating assembly tube is next to the switch (the platform is lowered). The Proximity Switch controls the machine operation based upon the proximity of the elevating assembly tube to the Proximity Switch.

When Elevating:

- The Level Sensor is enabled.
- The Depression Mechanism is enabled.
- Power to the High Speed Circuit is cut, preventing the machine from travel faster than 1,0 km/h (0.62 mph).

When Completely Lowered:

- Power is supplied to the High Speed Circuit, allowing the machine to travel up to 3,7 km/h (2.3 mph).

TEST THE PROXIMITY SWITCH



Never perform service while the platform is elevated without first blocking the elevating assembly. DO NOT stand in the elevating assembly area while deploying or storing the maintenance brace.

1. Turn the Chassis Key Switch ON.
 - The red LED should be ON. If not, the Proximity Switch may be out of adjustment.
2. Elevate the platform until the elevating assembly tube is clear of the Proximity Switch.
 - The red LED should turn OFF.
3. Deploy the Maintenance Brace.
4. Place a piece of steel next to the Proximity Switch.
 - The red LED should turn ON. If it was OFF in Step 1, the Proximity Switch requires adjustment.
 - If the red LED remains OFF, replace the Proximity Switch.

TEST HIGH SPEED CIRCUIT

1. Elevate the platform 30 cm (12 in.).
2. Turn the Lift/Drive Switch to DRIVE and attempt to drive the machine.
 - If the machine will drive faster than 1,0 km/h (0.62 mph), adjust or replace the switch.

REMOVAL AND INSTALLATION

1. Deploy the maintenance brace (see “Blocking the Elevating Assembly” on page 2-6).
2. Disconnect the switch leads.
3. Remove the defective switch and install a new one.
4. Adjust the switch-to elevating assembly tube clearance (see “Proximity Switch Adjustment” on page 2-11).
5. Connect the switch leads.
6. Store the maintenance brace and lower the platform.

PROXIMITY SWITCH ADJUSTMENT

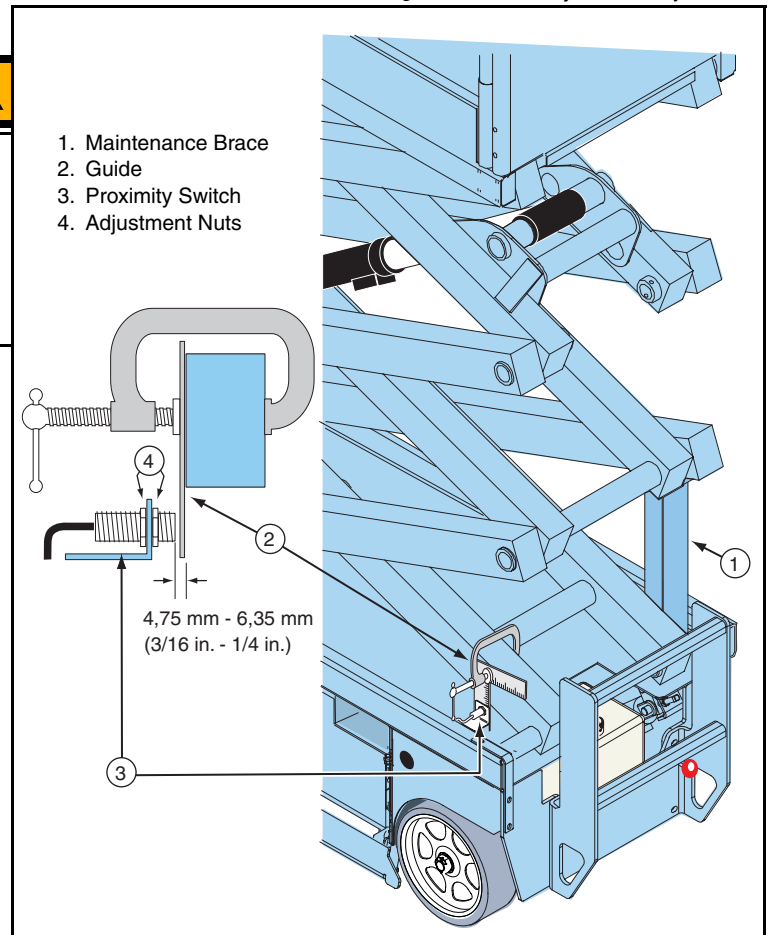
Figure 2-5: Proximity Switch Adjustment

⚠ WARNING ⚠

Never perform service while the platform is elevated without first blocking the elevating assembly.

DO NOT stand in the elevating assembly area while deploying or storing the maintenance brace.

1. Deploy the maintenance brace (see "Blocking the Elevating Assembly" on page 2-6).
2. Use a clamp to attach a straight guide to the elevating assembly tube.
3. Measure the gap between the face of the Proximity Switch and the side of the guide that faces the elevating assembly tube.
4. Turn the adjusting nuts on the Proximity Switch to set the gap to within 4,76 mm to 6,35 mm (3/16 to 1/4 in.).
5. Remove the clamp and guide and repeat the test.
 - If the test fails, the Proximity Switch is defective and must be replaced.



PLATFORM CONTROLS

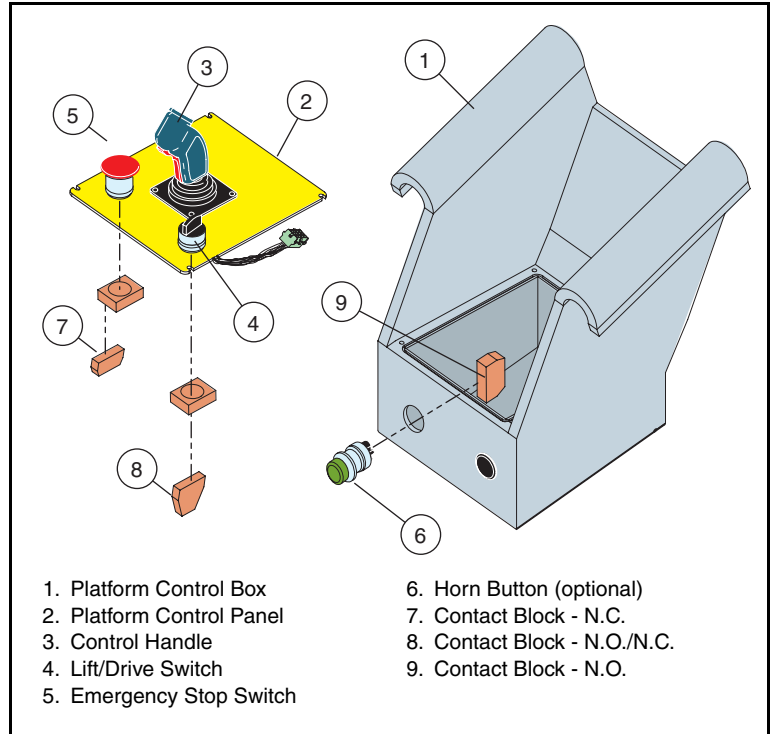
Refer to *Section 4 - Schematics* for wiring diagrams.

Refer to the *Parts Manual* for replacement part numbers.

ACCESS TO SWITCHES

1. Remove the four screws from the control panel and lift the assembly from the Platform Control box.
2. Unplug the Control Handle wiring harness.

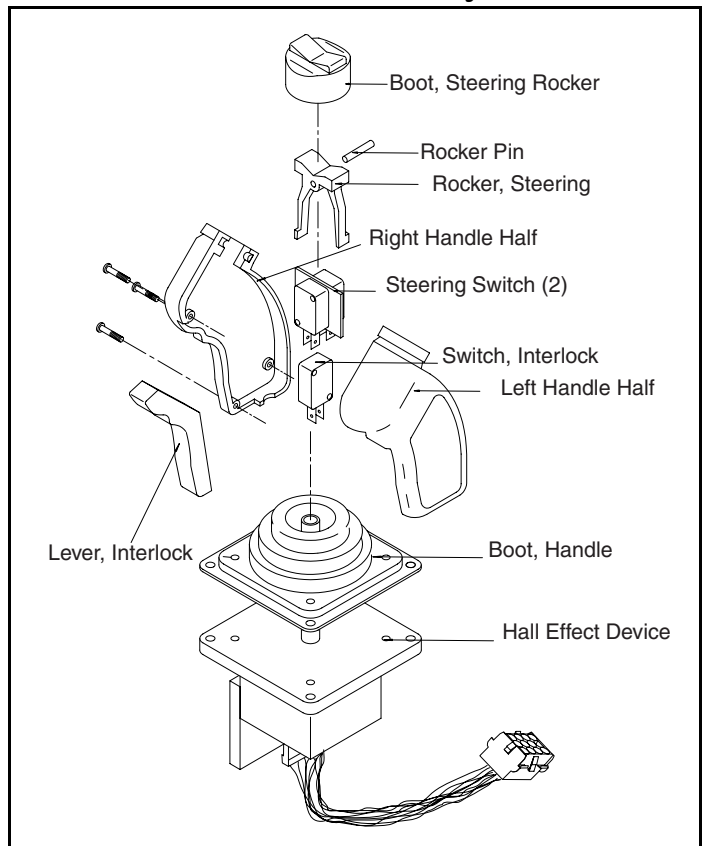
Figure 2-6: Platform Controls



CONTROL HANDLE

1. Remove the Control Handle, if necessary, from Platform Control box.
 - a. Remove the control panel.
 - b. Unplug the control handle wiring harness.
 - c. Remove the four screws from the control handle mounting plate.
 - d. Lower the control handle through the control panel.
2. Remove and replace defective parts. Refer to the *Parts Manual* for repair parts numbers.

Figure 2-7: Control Handle



CHASSIS CONTROLS

Refer to *Section 4 - Schematics* for wiring diagrams.

Refer to the *Parts Manual* for replacement part numbers.

To access the switches and components for repair or replacement;

1. Disconnect the cable from J4 on the I/O board.
2. Remove three capscrews and nuts to remove the controller/wheel cover assembly, and take the assembly to a workbench.
3. Loosen the cable connector. Remove four screws to remove the cover.
 - Be careful not to damage the wires as you push the cable through the cover.

Installation is reverse of removal.

MOTOR CONTROLLER AND I/O BOARD DIP SWITCH SETTINGS

Refer to *Section 3 - Troubleshooting* for motor controller and I/O board dip switch settings.

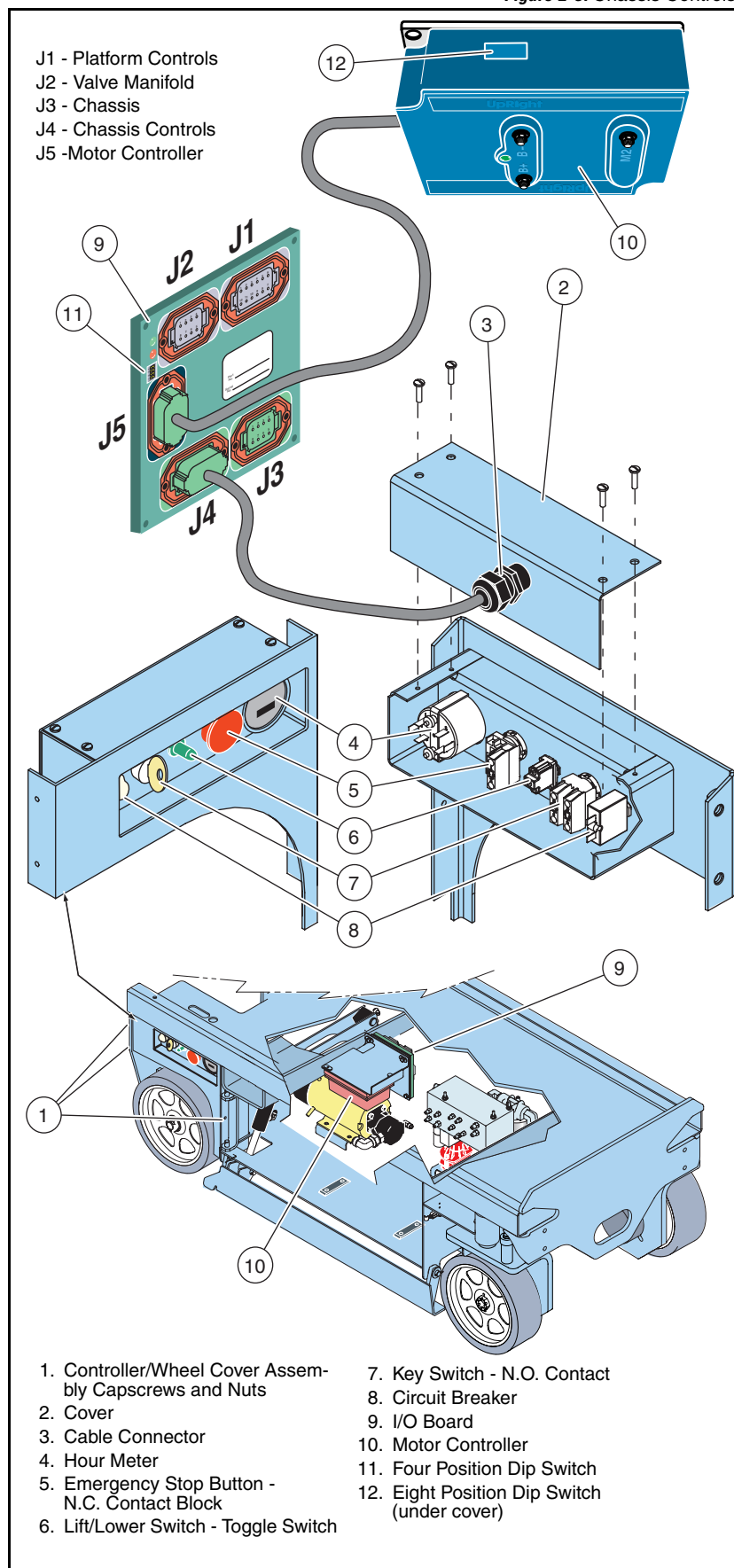
MOTOR CONTROLLER

To access the motor controller dip switches, open the right door.

I/O BOARD

To access the I/O board dip switches, open the left door.

Figure 2-8: Chassis Controls



EMERGENCY LOWERING VALVE

⚠ WARNING ⚠

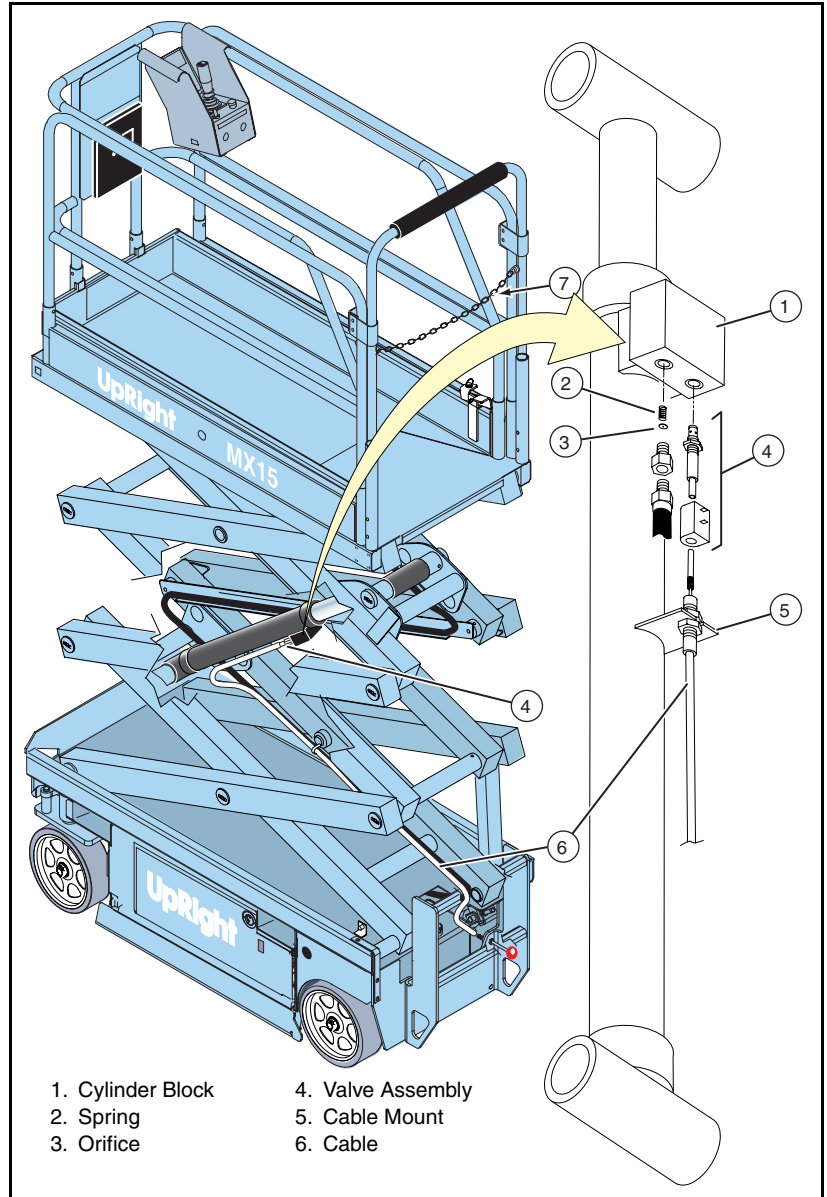
Never perform service while the platform is elevated without first blocking the elevating assembly.
DO NOT stand in the elevating assembly area while deploying or storing the maintenance brace.

The Emergency Lowering Valve is mounted on the lift cylinder. The cable is routed with the power cable along the elevating assembly tubes.

REPAIR

1. Deploy the maintenance brace (see "Blocking the Elevating Assembly" on page 2-6).
2. Inspect the cable. Replace if damaged.
3. Inspect the valve. Replace if damaged.
4. Check for and clear any blockage in the orifice. Install the orifice with the beveled side toward the cylinder block.
5. Adjust the valve.
 - At the cable mount, adjust the cable cover to stop the inner cable when the valve is fully open.
6. Store the maintenance brace and lower the platform.

Figure 2-9: Emergency Lowering Valve



2-6 HYDRAULIC FLUID RESERVOIR AND FILTER

FLUID LEVEL

With the platform **fully lowered**, check the fluid level through the side of the reservoir. The level should be between the MAX (maximum) and MIN (minimum) lines.

Figure 2-10: Hydraulic Fluid Reservoir

RESERVOIR BREATHER/CAP

Clean the breather/cap at the same time that the fluid filter is replaced. Use cleaning solvent and blow dry with clean dry compressed air.

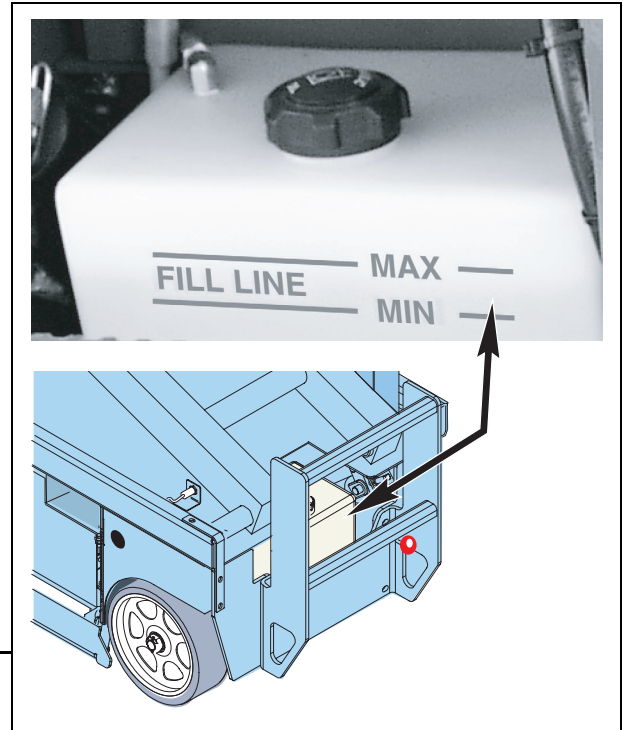
FLUID AND FILTER REPLACEMENT

Drain Hydraulic Fluid

1. Operate the machine for 10-15 minutes to bring the hydraulic fluid up to normal operating temperature.
2. Completely lower the platform and turn the Chassis Key Switch to the OFF position.



The hydraulic fluid may be of sufficient temperature to cause burns. Wear safety gloves and safety glasses when handling hot fluid.



3. Provide a suitable container to catch the drained fluid. The hydraulic reservoir has a 12,9 liter (3.4 US gal) capacity.
4. Remove the breather/cap and use a pump to remove all hydraulic fluid.

IMPORTANT: Dispose of hydraulic fluid properly - contact your local recycler.

Filter Replacement

5. Unscrew the filter from the filter assembly (located on the left side of the valve block).
6. Apply a thin film of clean hydraulic fluid to the gasket of the replacement filter.
7. Screw the replacement filter onto the filter head until the gasket makes contact, then rotate the filter $\frac{3}{4}$ of a turn further.

Check Fluid Outlet Screen

8. Disconnect the outlet hose from the reservoir and plug the hose to prevent foreign material from entering.
9. Remove the outlet screen. Clean or replace as necessary.

Replenish Hydraulic Fluid

10. Fill the hydraulic reservoir with hydraulic fluid until the fluid level is between the MIN and MAX lines on the reservoir. Do not fill above the MAX line on the reservoir. The hydraulic reservoir has a capacity of 12.9 liter (3.4 US gal).
11. Operate all machine functions and recheck the fluid level. Add fluid if necessary.

2-7 HYDRAULIC PRESSURE SETTINGS

Check the hydraulic pressures whenever the pump, manifold, or relief valves have been serviced or replaced.

WARNING

The hydraulic fluid may be of sufficient temperature to cause burns. Wear safety gloves and safety glasses when handling hot fluid.

The fluid in the hydraulic system is under very high pressure which can easily cause severe cuts. Obtain medical assistance immediately if cut by hydraulic fluid.

MAIN RELIEF VALVE

1. Operate the hydraulic system 10-15 minutes to warm the fluid.
2. Slowly drive the machine to within 8 cm (**3 in.**) of a solid, immovable brick wall. Ease the machine forward until the front of the chassis is in solid contact with the wall.
3. Remove the test port cap and install a pressure gauge capable of reading up to 250 bar (**3500 psi**) onto the test port.
4. Remove the protective end-cap on the Main Relief Valve and turn the adjusting screw counterclockwise two full turns.
5. Unhook the Platform Controls from the guardrail so that the machine may be operated from the ground. Slowly push the Control Handle in the direction of the wall.
6. Slowly turn the Main Relief Valve adjusting screw clockwise to increase the pressure until the gauge reads 207 bar (**3000 psi**).
7. Replace the protective end-cap on the Main Relief Valve.
8. Remove the pressure gauge and replace the test port cap.

LIFT RELIEF VALVE

1. Operate the hydraulic system 10-15 minutes to warm the fluid.
2. Remove the protective end-cap on the Lift Relief Valve and turn the adjusting screw counterclockwise two full turns.
3. Place the maximum rated load on the platform (see the Specifications Table in the *Operator Manual*).
4. Turn and hold the Chassis Key Switch to CHASSIS. Push the Chassis Lift Switch to the UP position and hold it there.
5. Slowly turn the Lift Relief Valve adjusting screw clockwise to increase the pressure until the platform just begins to rise.
6. Release the Chassis Lift Switch. Replace the protective end-cap on the Lift Relief Valve.

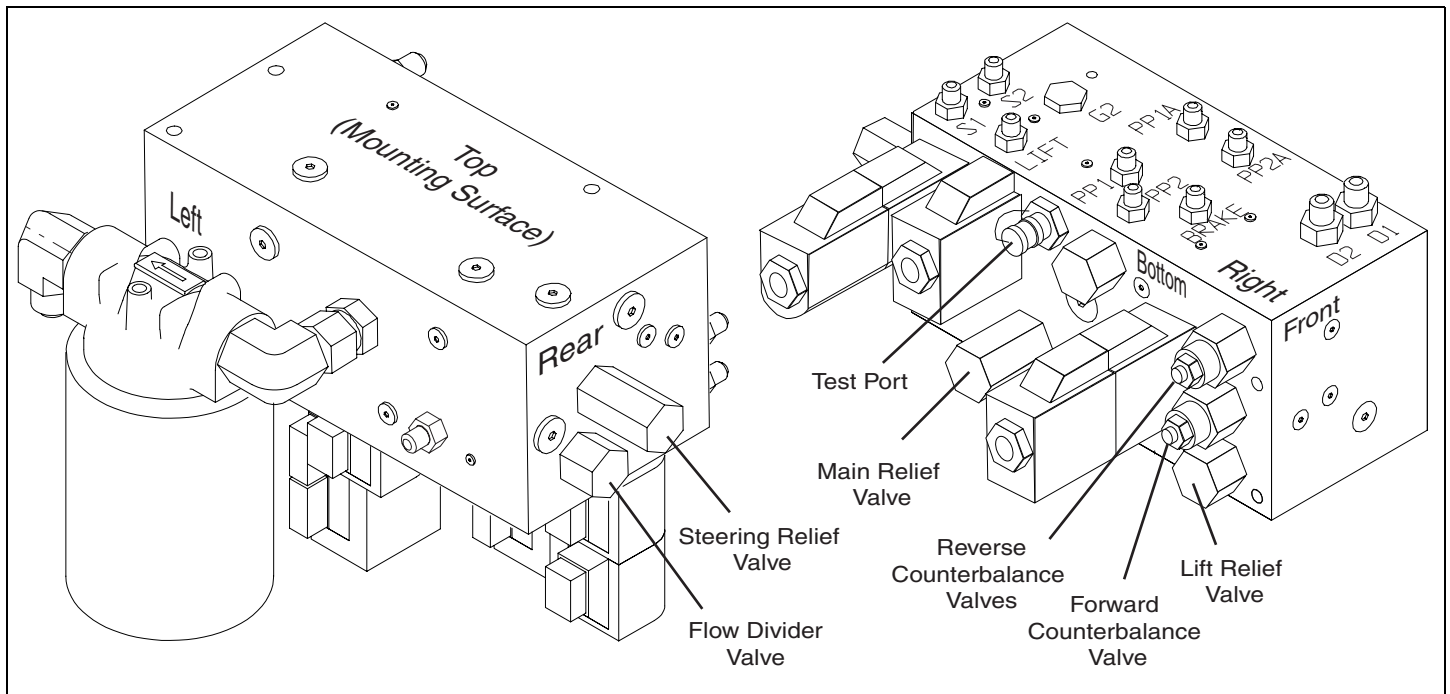
STEERING RELIEF VALVE

1. Operate the machine for 10-15 minutes to bring the hydraulic fluid up to normal operating temperature.
2. Remove the test port cap and install a pressure gauge capable of reading up to 250 bar (**3500 psi**) onto the test port.
3. Remove the protective end-cap on the Steering Relief Valve and turn the adjusting screw counterclockwise two full turns.
4. While one person holds the Steering Switch to steer to the right or left, slowly turn the Steering Relief Valve adjusting screw clockwise to increase the pressure until the gauge reads 82,7 bar (**1200 psi**).
5. Replace the protective end-cap on the Steering Relief Valve cover.
6. Remove the pressure gauge and replace the test port cap.

COUNTERBALANCE VALVES

1. Operate the machine for 10-15 minutes to bring the hydraulic fluid up to normal operating temperature.
2. Remove the test port cap and install a pressure gauge capable of reading up to 250 bar (**3500 psi**) onto the test port.
3. Lift the machine and support the chassis with jackstands so that the drive wheels are off the ground.
4. Loosen the locknuts on Counterbalance Valves.
5. With the Chassis Key Switch on DECK and the Drive/Lift Switch in DRIVE depress the Interlock Lever and slowly pull the Control Handle to REVERSE to drive the wheels.
6. Adjust the Forward Counterbalance Valve by turning the adjustment screw until the pressure gauge indicates 55 bar (**800 psi**).
7. Slowly push the Control Handle to FORWARD to drive the wheels.
8. Adjust the Reverse Counterbalance Valve by turning the adjustment screw until the pressure gauge indicates 55 bar (**800 psi**).
9. Check the settings by slowly moving the Control Handle FORWARD, then REVERSE, checking the gauge to ensure that the pressures are properly set. Readjust as needed.
10. Tighten the locknuts on the valves to 8 N-m (**6 ft./lbs.**).
11. Remove the pressure gauge and replace the test port cap.
12. Remove the blocks and lower the machine to the ground.
13. Check for proper operation of the drive system.

Figure 2-11: Hydraulic Manifold Test Ports, from right side



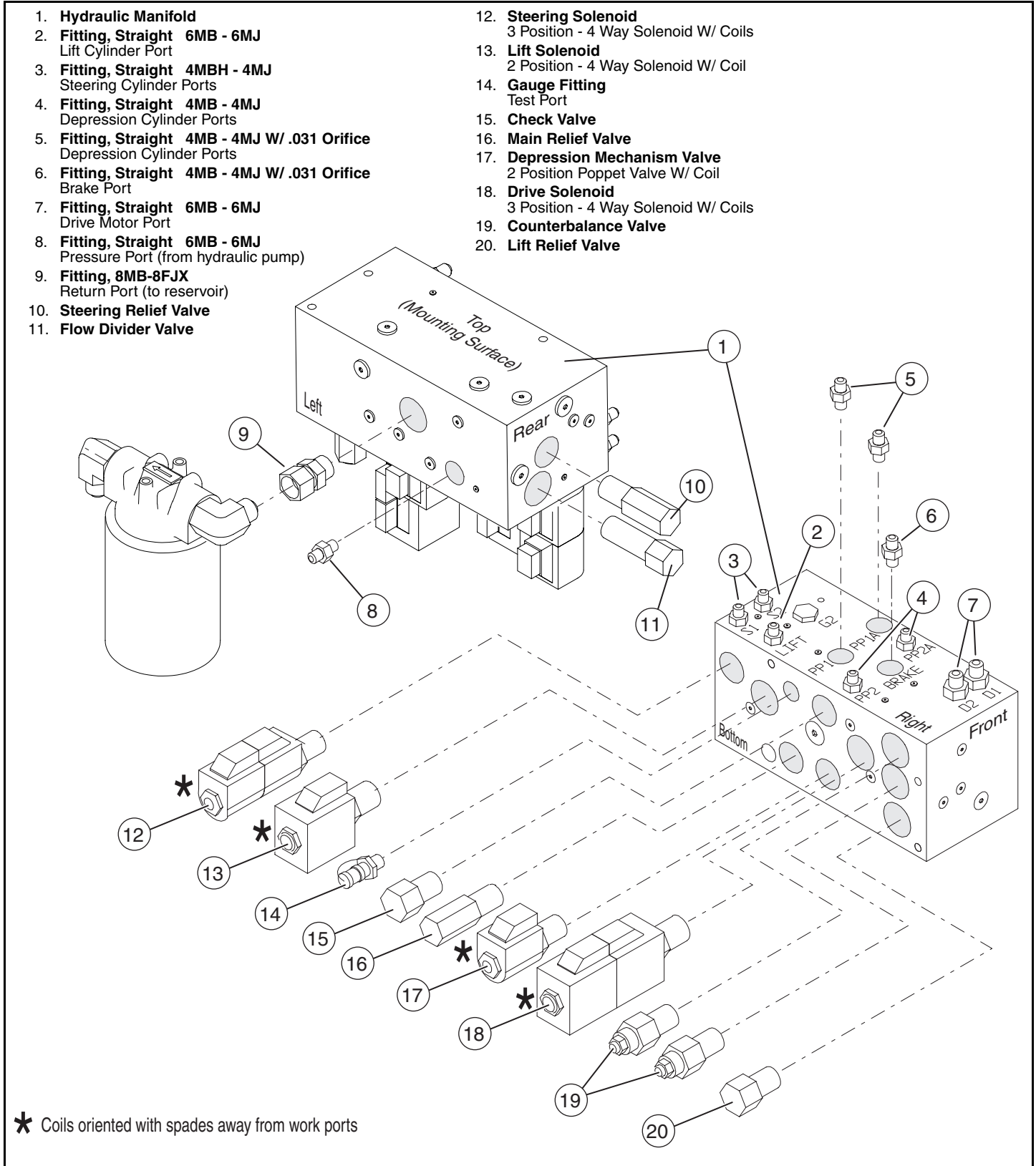
2-8 HYDRAULIC MANIFOLD

It is not necessary to remove the manifold to perform all maintenance procedures. Decide beforehand as to whether or not the manifold should be removed before maintenance procedures begin.

REMOVAL, REPAIR AND INSTALLATION

Refer to *Section 1 - General Information* for removal, repair and installation instructions.

Figure 2-12: Hydraulic Manifold



2-9 HYDRAULIC PUMP

REMOVAL

NOTE: If the hydraulic reservoir has not been drained, suitable means for plugging hoses should be provided to prevent excessive fluid loss.

⚠ WARNING ⚠

Before disconnecting the battery negative (–) lead, make sure all switches are OFF. If ON, a spark will occur at the ground terminal which could cause an explosion if hydrogen gas or fuel vapors are present.

1. Open the right door and disconnect the battery connector.
2. Open the left door and disconnect the negative (–) lead on the number 1 battery.
3. Mark, disconnect and plug the hose assemblies.

NOTE: It may not be necessary to remove the motor to service or remove the pump.

4. Disconnect the power supply from the motor.
5. Remove the four cap screws from the vibration mounts and lift the motor and pump assembly.
6. Loosen the capscrews and remove the pump assembly from the motor.

INSTALLATION

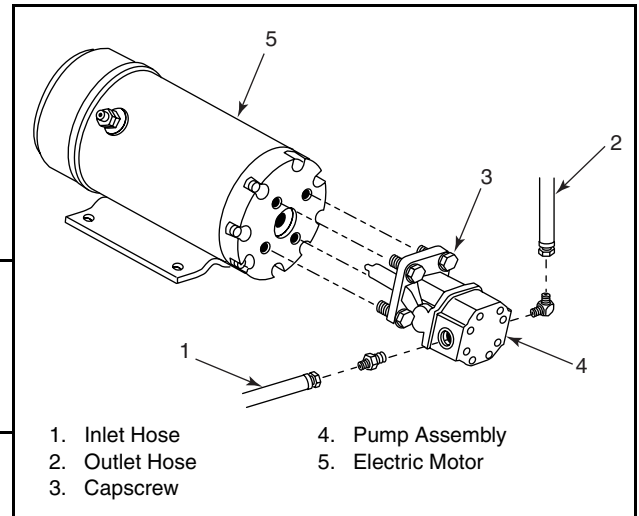
Pump to Motor

1. Lubricate the pump shaft with general purpose grease and attach the motor with the capscrews.
2. Using a crisscross pattern, torque each capscrew a little at a time until all capscrews are torqued to 27 N-m (20 ft./lbs.).

Pump and Motor Assembly to Chassis

3. Position the motor and vibration mounts into the chassis.
4. Put a drop of Loctite® 242 thread lock on each capscrew as you install the capscrew and lock washer.
5. Tighten the motor mount nuts to 24 N-m (18 ft./lbs.).
6. Unplug and connect the hydraulic hoses.
7. Connect the power supply to the motor.
8. Connect the battery negative (–) lead.
9. Connect the battery pack connector.
10. Check the fluid level in the hydraulic reservoir before operating the machine.

Figure 2-13: Hydraulic Pump



2-10 HYDRAULIC DRIVE MOTORS

DRIVE MOTORS

Figure 2-14: Drive Motor

REMOVAL

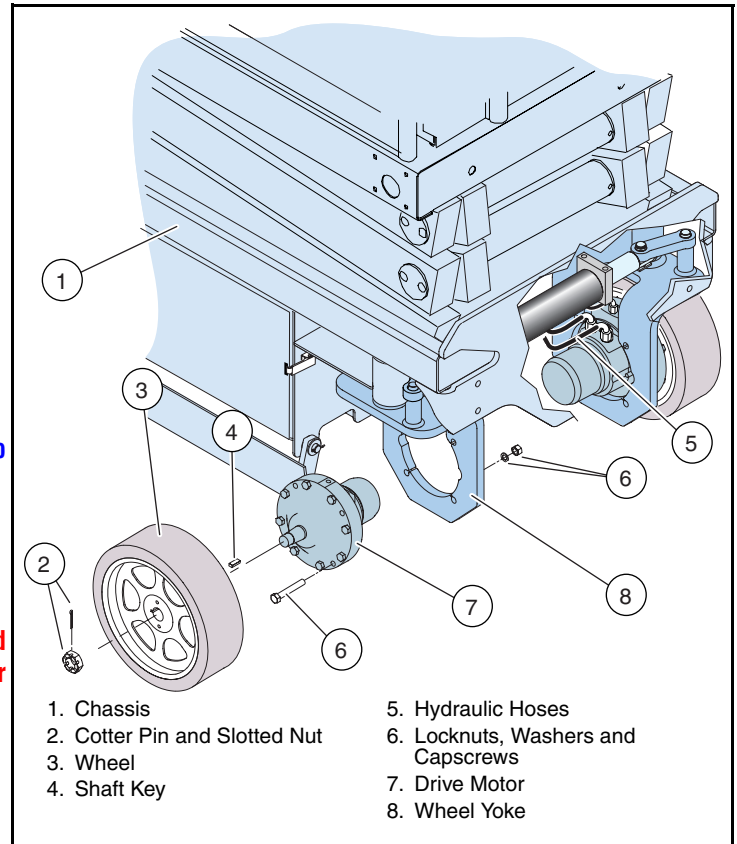
1. Chock the rear wheels to prevent the machine from rolling.
 - Use a 1000 Kg (1 ton) capacity jack to raise the front of the machine.
 - Place two 1000 Kg (1 ton) jackstands beneath the machine for support.
 - Remove the jack.
2. Remove the cotter pin and slotted nut.
3. Remove the wheel.

NOTE: It may be necessary to use a wheel puller to remove the wheel.

4. Remove the shaft key.

IMPORTANT: Before disconnecting any hoses, thoroughly clean off all the outside dirt around the fittings. IMMEDIATELY plug the holes after disconnecting the hoses and before removing the motor from the machine.

5. Tag, disconnect and plug the hose assemblies to prevent foreign material from entering.
6. Remove the locknuts, washers and capscrews.
7. Remove the drive motor.



INSTALLATION

1. Position the drive motor into the wheel yoke and secure it with capscrews and locknuts.
2. Torque the locknuts to 95 N-m (70 ft./lbs.).
3. Remove the plugs from the hose assemblies and connect them to the drive motor.
4. Clean the motor shaft and hub bore and lubricate the slotted nut face and threads.
5. Install the shaft key, wheel, and slotted nut. Torque the slotted nut to 95-108 N-m (70-80 ft./lbs.).
6. Install a new cotter pin. DO NOT back-off the nut to install the cotter pin.
7. Remove the jackstands and lower the machine to the ground.
8. Check the fluid level in the hydraulic reservoir before operating the machine.
9. Operate the drive system and check for leaks.

BRAKE SERVICE

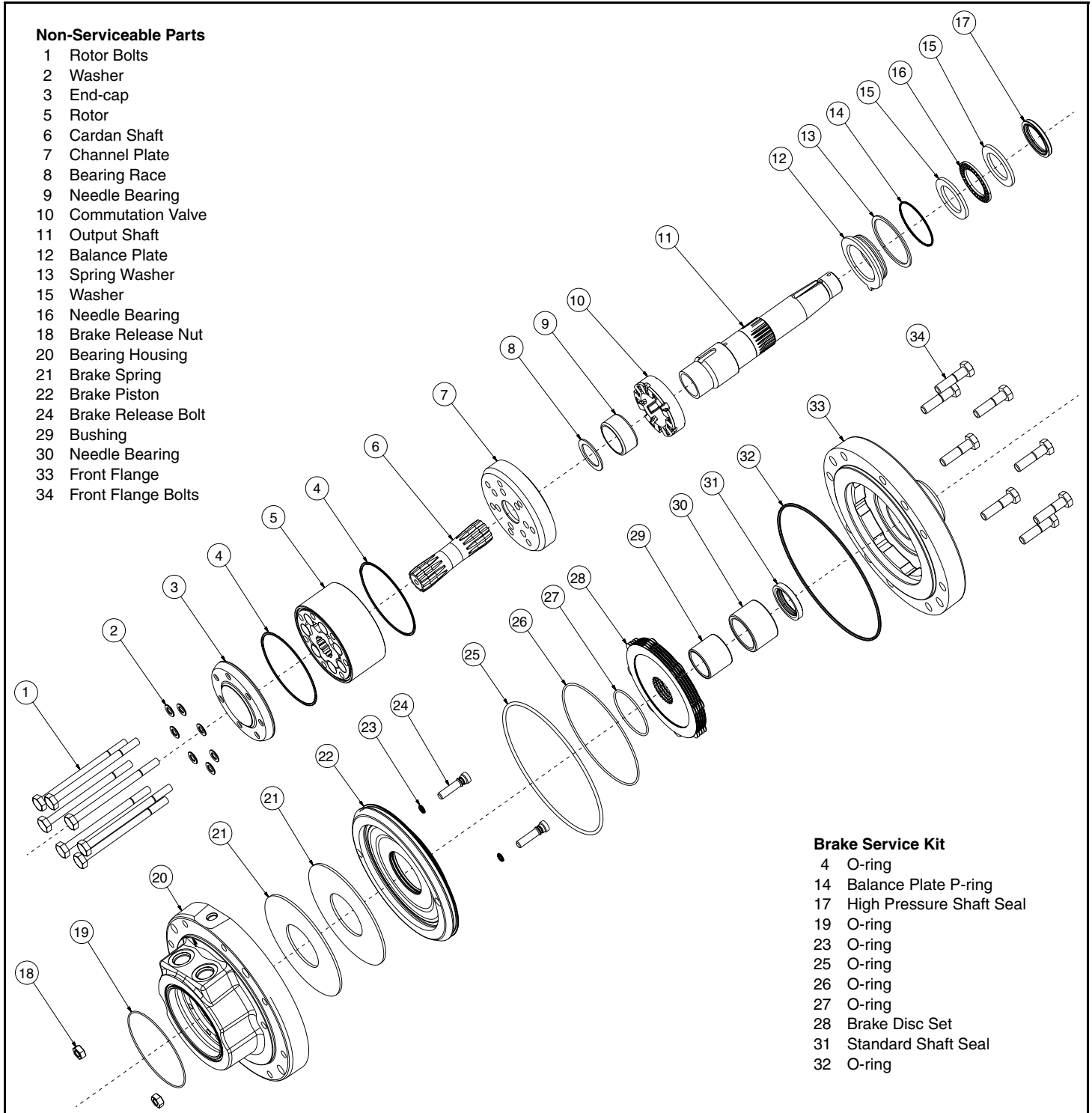
If brake service or repair is required, replace all serviceable parts. Refer to the *Parts Manual* for the brake service kit part number. Refer to Figure 2-15 when assembling the motor.

Torque the rotor bolts [1] and the front flange bolts [34] to 54 N-m (40 ft.lbs.).

Brake Adjustment

1. Using a 13 mm socket wrench, alternately turn the brake release nuts counter-clockwise in $\frac{1}{2}$ turn increments. Repeat until there is approximately 3.2 mm ($\frac{1}{8}$ in.) between the brake release nuts and the drive motor body.
2. After installing the motors, verify that the brakes have fully engaged before operating the machine. Refer to the *Operator Manual*.

Figure 2-15: Drive Motor Exploded View



REAR WHEELS

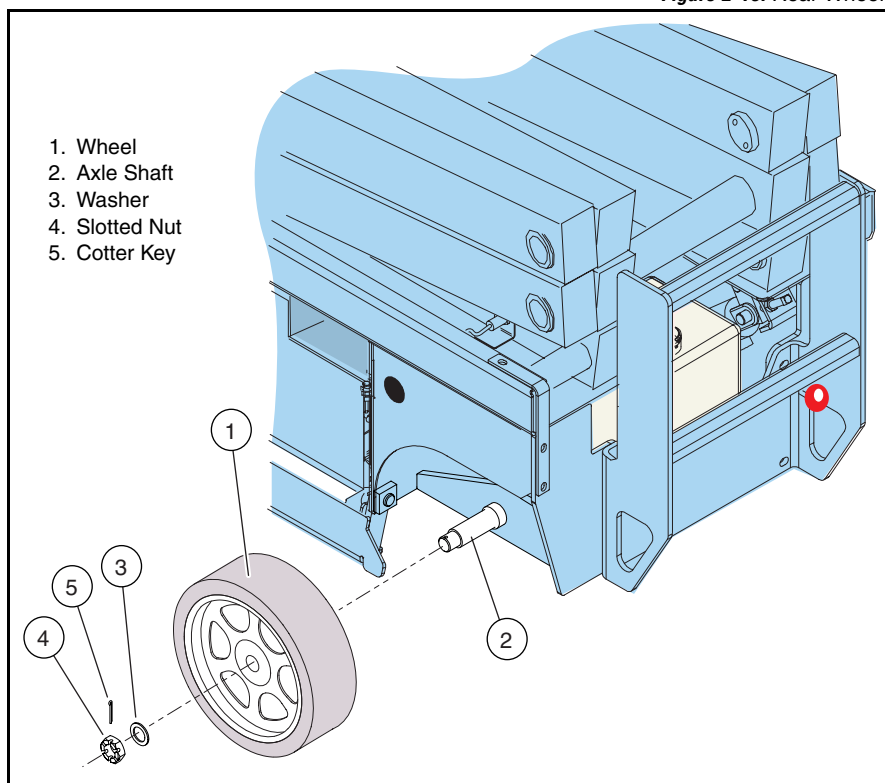
Figure 2-16: Rear Wheel

REMOVAL

1. Chock the front wheels to prevent the machine from rolling.
 - Use a 1000 Kg (1 U.S. ton) capacity jack to raise the rear of the machine.
 - Place two 1000 Kg (1 U.S. ton) jackstands beneath the machine for support.
 - Remove the jack.
2. Remove the cotter pin and slotted nut.
3. Remove the wheel.

INSTALLATION

NOTE: If you are installing a new wheel, it may be necessary to ream the hub bore.



1. Clean the axle shaft and hub bore.
2. Lubricate the slotted nut face and threads.
3. Position the wheel onto the axle shaft.
4. Tighten slotted nut until it is snug, then back-off until the wheel turns freely and install a new cotter pin.
5. Remove the jackstands and lower the machine to the ground.

2-11 STEERING CYLINDER

REMOVAL

1. Turn the wheels to the straight position.

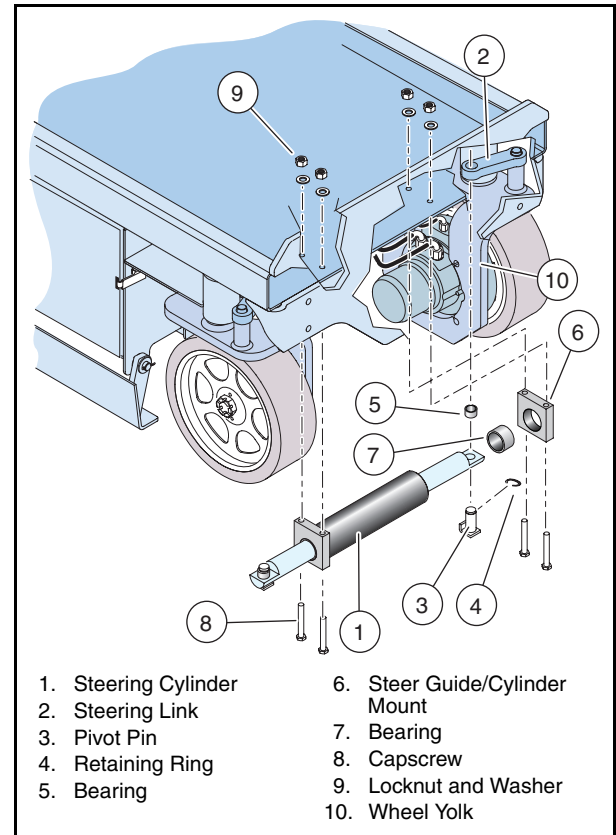
IMPORTANT: Before disconnecting any hoses, thoroughly clean off all the outside dirt around the fittings. IMMEDIATELY plug the holes after disconnecting the hoses and before removing the cylinder from the machine.

2. Elevate the platform and block the elevating assembly with the brace (see "Blocking the Elevating Assembly" on page 2-6).
3. Tag and disconnect the hose assemblies from the cylinder fittings and immediately cap the openings to prevent foreign material from entering.
4. Remove the retaining rings from the pivot pins.
5. While supporting the cylinder, remove the lock-nuts, washers, and capscrews.
6. Remove the cylinder.

REPAIR

Refer to *Section 1 - General Information* for disassembly, cleaning and inspection, and assembly instructions.

Figure 2-17: Steering Cylinder Installation



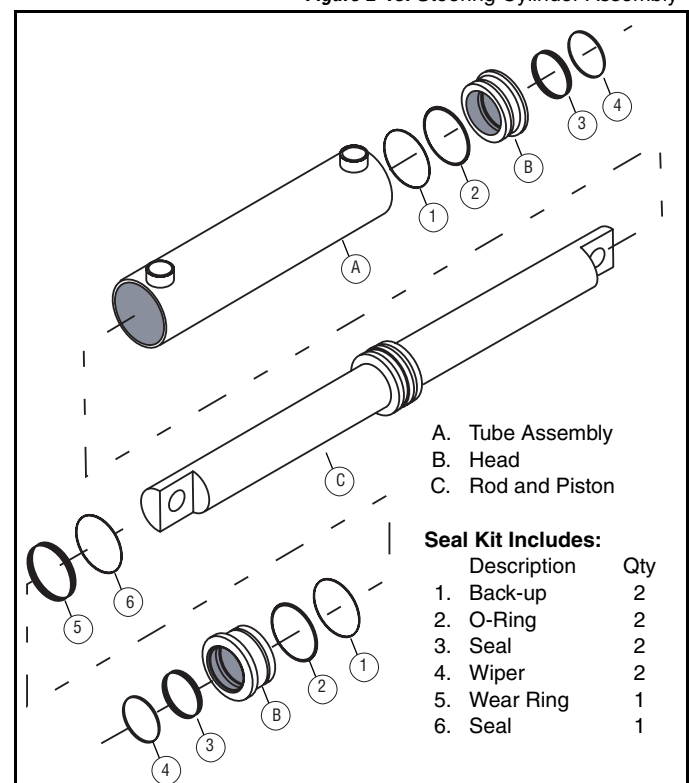
INSTALLATION

1. Position the cylinder assembly in the chassis.
2. Insert the capscrews into the steer guide/cylinder mounts, up through the chassis, and secure with washers and locknuts.

IMPORTANT: If capscrews are inserted down through the chassis the ends of the capscrews will protrude through the bottom of the steer guide/cylinder mount and may rub and cut the hydraulic hoses.

3. Insert pivot pins and secure with retaining rings.
4. Connect the hose assemblies to the fittings.
5. Operate the steering circuit several times throughout its entire range of travel to expel trapped air, then check for leaks.

Figure 2-18: Steering Cylinder Assembly



Seal Kit Includes:		
Description	Qty	
1. Back-up	2	
2. O-Ring	2	
3. Seal	2	
4. Wiper	2	
5. Wear Ring	1	
6. Seal	1	

2-12 DEPRESSION MECHANISM CYLINDER

REMOVAL

1. Open the module door to access the cylinder.
2. Tag and disconnect the hose assemblies from the cylinder fittings and immediately cap the openings to prevent foreign material from entering.
3. Remove the cotter rue ring from the upper pivot pin.
4. Remove the cotter pin from the lower pivot pin.
5. While supporting the cylinder, remove pivot pins and lift the cylinder out.

REPAIR

Refer to *Section 1 - General Information* for disassembly, cleaning and inspection, and assembly instructions.

INSTALLATION

1. Position the cylinder assembly in the chassis. Insert the pivot pins and secure with new cotter pins.
2. Connect the hose assemblies to the fittings.
3. Operate the steering circuit several times throughout its entire range of travel to expel trapped air, then check for leaks.

Figure 2-19: Depression Mechanism Cylinder

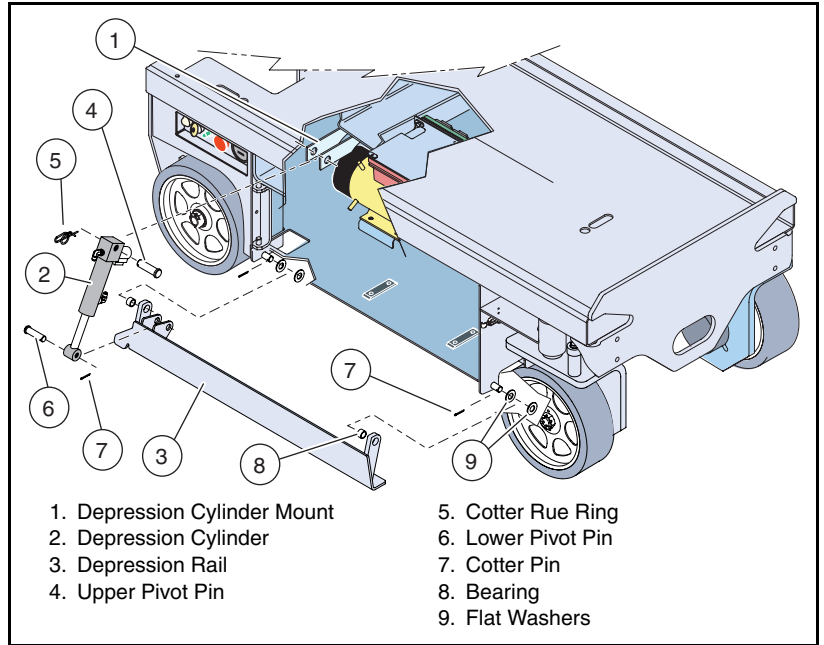
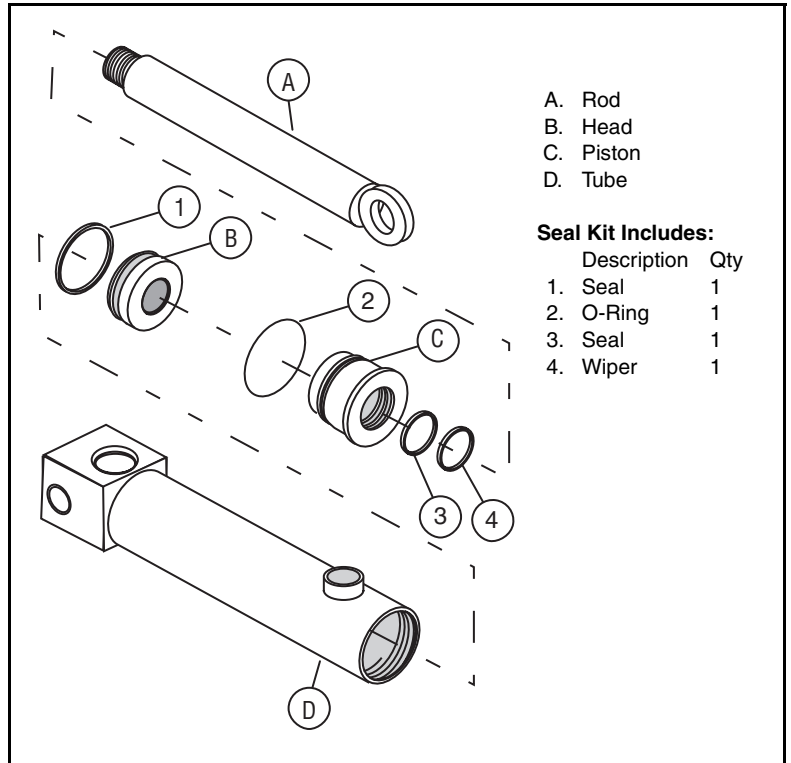


Figure 2-20: Depression Mechanism Cylinder



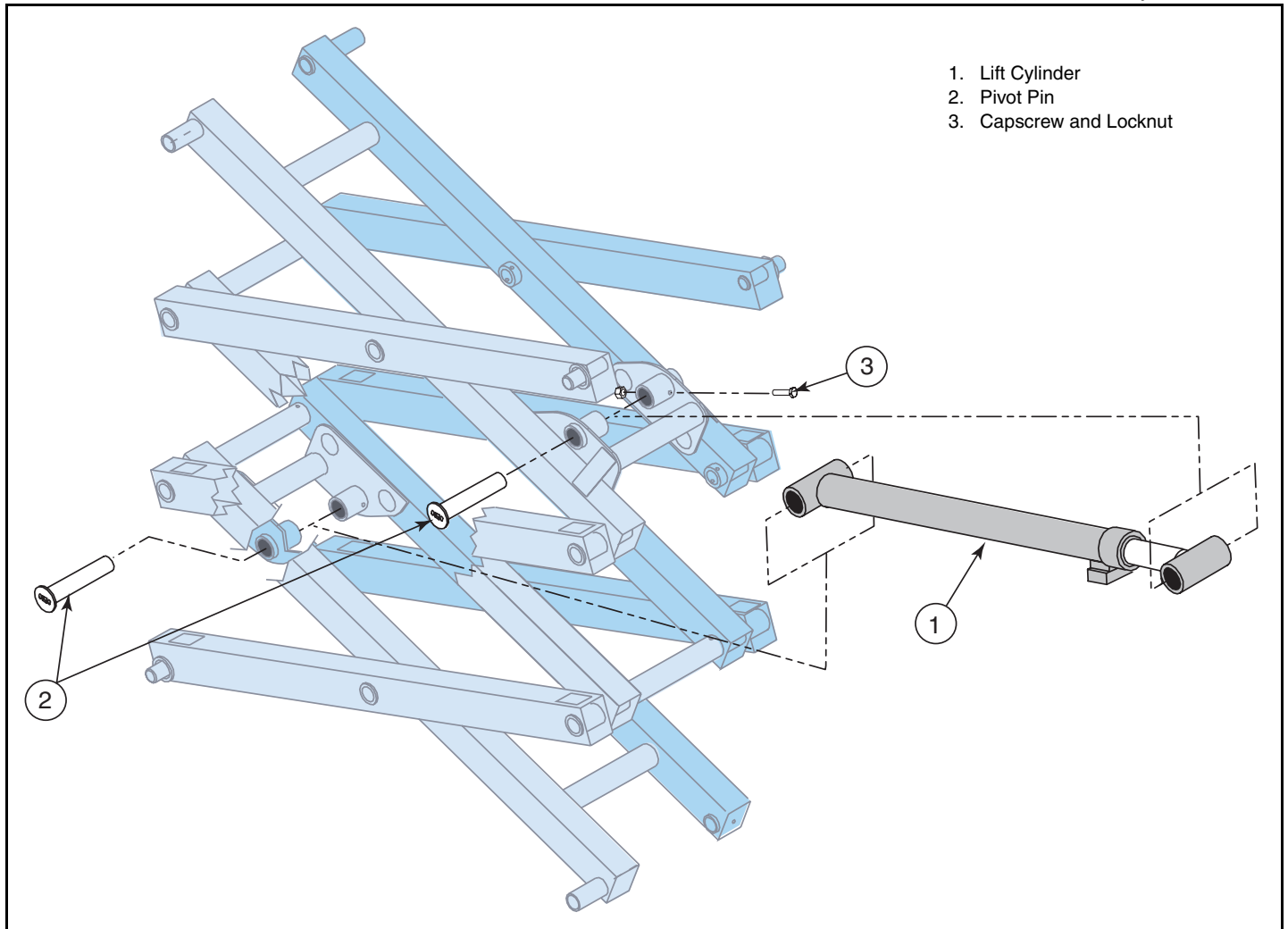
2-13 LIFT CYLINDER

REMOVAL

Refer to Figure 2-21.

1. Elevate the platform and deploy the maintenance brace (see “Blocking the Elevating Assembly” on page 2-6).
2. Provide a suitable container to catch the hydraulic fluid, then disconnect the hydraulic hoses. Immediately plug hoses to prevent foreign material from entering.
3. Remove emergency lowering valve cable and down valve wires from the emergency lowering (down) valve.
4. Remove the cable bracket from the lift cylinder.
5. Remove capscrews and locknuts securing lift cylinder pivot pins.
6. Remove lower pivot pin and lower cylinder to rest on chassis.
7. Attach a suitable hoisting device and sling to the cylinder, and remove upper pivot pin.
8. Carefully remove cylinder.

Figure 2-21: Lift Cylinder Location



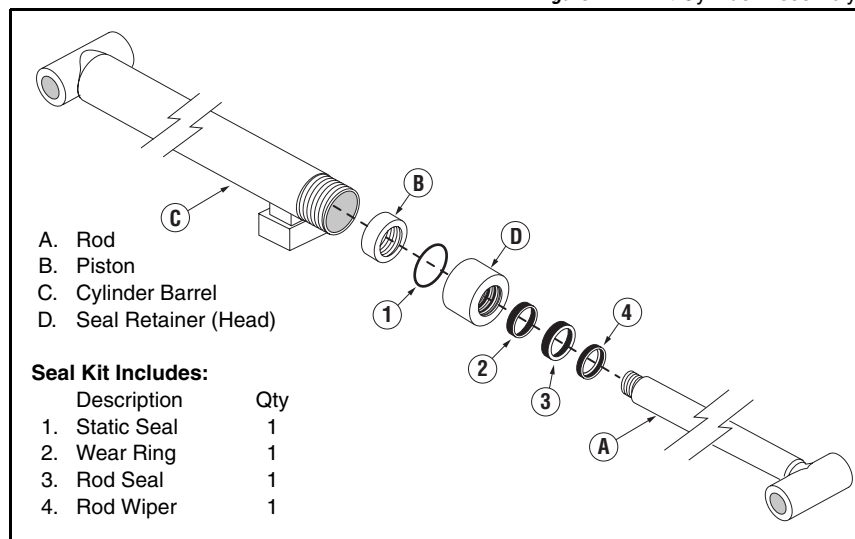
REPAIR

Refer to *Section 1 - General Information* for disassembly, cleaning and inspection, and assembly instructions.

INSTALLATION

1. Coat both pivot pins with anti-seize compound.
2. Attach a suitable hoisting device and sling to the cylinder. Carefully position cylinder in the elevating assembly, and install the upper pivot pin.
3. Install the capscrew and locknut securing the upper pivot pin.
4. Carefully lift the cylinder and align the lower mount, and install the pivot pin.
5. Install the capscrew and locknut securing the lower pivot pin.
6. Connect the emergency lowering valve cable and down valve wires.
7. Unplug hydraulic hoses and attach to the cylinder.
8. Replace hydraulic fluid removed from lift cylinder.
9. Test with weight at rated platform load to check system operation.
10. Check for leaks
11. Check level of hydraulic fluid.

Figure 2-22: Lift Cylinder Assembly



TROUBLESHOOTING

This section contains troubleshooting Truth Tables.

Careful inspection and accurate analysis of the symptoms listed in the Troubleshooting Guide will localize the trouble more quickly than any other method. This manual cannot cover all possible problems that may occur. If a specific problem is not covered in this manual, call our toll free number for service assistance.

Referring to the Operator Manual and the Schematics section will aid in understanding the operation and function of the various components and systems of the machine and help in diagnosing and repair of the machine.

W A R N I N G

When troubleshooting, ensure that the machine is resting on a firm, level surface.

When performing any service which requires the platform to be raised, the Elevating Assembly must be blocked.

Disconnect the battery when replacing or testing the continuity of any electrical component.

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3-1 TECHNICAL SUPPORT

Technical Support is available by telephone or FAX.

**UPRIGHT
USA**

Tel: 1-800-926-5438
FAX: 1-559-662-4785

**UPRIGHT
EUROPE**

Tel: +353-1-620-9300
FAX: +353-1-620-9301

3-2 GENERAL PROCEDURE

Thoroughly study hydraulic and electric schematics in *Section 3 - Schematics*. Check for loose connections and short circuits. Check/repair/replace each component in the Truth Table which is listed under each machine function which does not operate properly.

Determine whether the problem is mechanical (interference), electrical or hydraulic. Some functions require power at more than one solenoid.

Use the charts on the following pages to help determine the cause of a fault in your UpRight Aerial Work Platform.

NOTE: Spike protection diodes at components have been left out of the charts to eliminate confusion.

3-3 TROUBLESHOOTING PROCEDURES

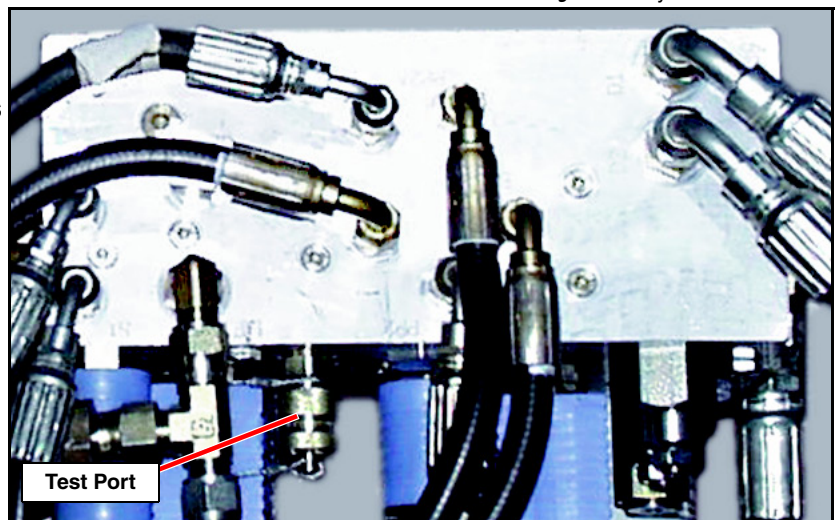
1. *Verify your problem.* Do a full function test from both platform controls and chassis controls and note all functions that are not operating correctly.
2. *Narrow the possible causes of the malfunction.* Use the troubleshooting guide to determine which components are common to all circuits that are not functioning correctly. To aid in troubleshooting, the letters following the component on the table are the same as the component's designation on the schematics.
3. *Identify the problem component.* Test components that are common to all circuits that are not functioning correctly. Remember to check wires and terminals between suspect components. Be sure to check connections to battery negative.
4. *Repair or replace component found to be faulty.*
5. *Verify that repair is complete.* Do a full function test from both the platform and chassis controls to verify that all functions are operating correctly and that the machine is performing according to specifications.

ADJUSTMENT PROCEDURES

- Hydraulic settings must be checked whenever a component is repaired or replaced.
- Remove counterbalance valves and "bench test" them if they are suspect.
- Connect a pressure gauge of appropriate range to the test port located on the hydraulic manifold.

NOTE: Correct pressure settings are listed in the hydraulic schematic.

Figure 3-1: Hydraulic Test Port



3-4 MOTOR CONTROLLER DIP SWITCH SETTINGS

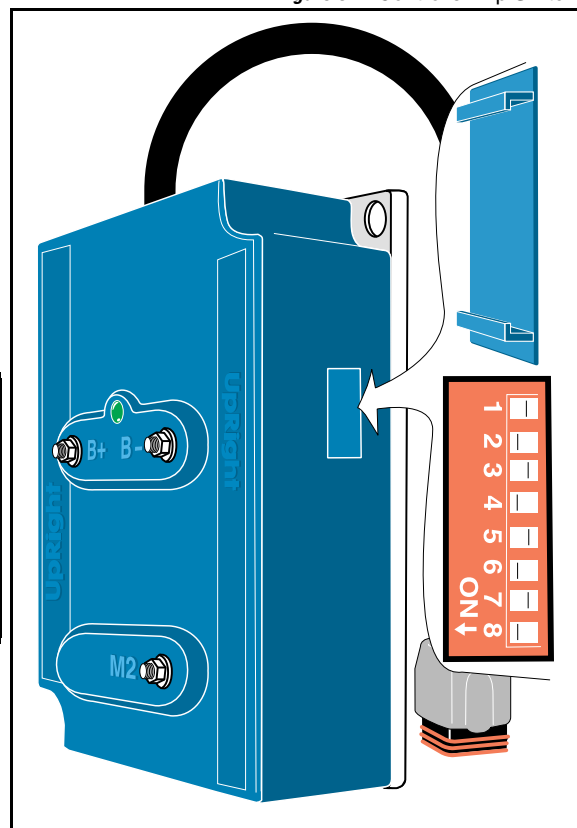
The Dip Switch is located behind a snap-out cover on the side of the Motor Controller. Slide your fingernail or a small screw driver under the edge of the cover at the middle and pry it off.

DEFAULT DIP SWITCH SETTINGS

The table shows the default dip switch settings on the controller box when the machine leaves the factory.

	1	2	3	4	5	6	7	8
MX15/19	OFF	OFF	OFF	ON	OFF	ON	OFF	ON
SL20	ON	OFF	OFF	ON	OFF	ON	OFF	ON
TM12	OFF	OFF	OFF	ON	OFF	ON	OFF	ON
X20N	ON	OFF	OFF	ON	OFF	ON	OFF	ON
X20W	ON	OFF	OFF	ON	OFF	ON	OFF	ON
X26UN	ON	ON	OFF	OFF	OFF	ON	OFF	ON
X26/32	ON	ON	OFF	ON	OFF	OFF	OFF	ON

Figure 3-2: Controller Dip Switch



ADJUSTED DIP SWITCH SETTINGS

The following adjustments may be made to the dip switch settings.

CREEP SPEED

Switches 3 & 4 determine the elevated “creep” speed. If the machine does not operate at the specified speed at the default settings, use the following table to adjust the dip switch settings.

Creep Speed	3	4
1 (slowest)	OFF	OFF
2 (slow)	ON	OFF
3 (default)	OFF	ON
4 (fastest)	ON	ON

DECELERATION TIME

Switches 5 & 6 determine the deceleration time.

- Switch 5 determines the deceleration rate while the platform is lowered.
- Switch 6 determines the deceleration rate while the platform is elevated.

DECEL	5	6
0.24 sec.	OFF	OFF
1.27 sec.	ON	ON

3-5 I/O BOARD DIP SWITCH SETTINGS

DEFAULT SETTINGS

The table shows the default dip switch settings on the I/O board when the machine leaves the factory.

	1	2	3	4
MX15/19	OFF	OFF	OFF	OFF
SL20	OFF	OFF	OFF	OFF
TM12	OFF	OFF	OFF	OFF
X20N	OFF	OFF	OFF	OFF
X20W	OFF	OFF	OFF	OFF
X26UN	OFF	OFF	OFF	OFF
X26/32	OFF	OFF	OFF	OFF

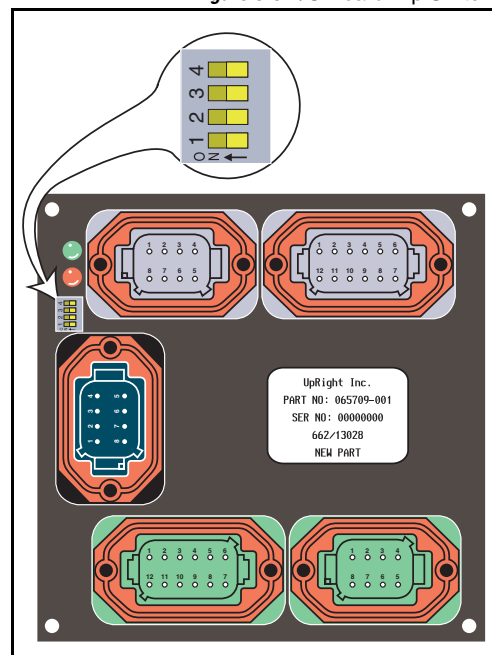
OPTIONAL SETTINGS

The table shows the result of each switch setting on the I/O board Dip Switch.

Switches 3 & 4 work together to determine the optional alarm settings.

1	2	3	4	RESULT
ON	—	—	—	Two Speed Mode (not used)
OFF	—	—	—	Proportional Control
—	ON	—	—	not used
—	OFF	—	—	Depression Mechanism extends when platform is raised
—	—	OFF	OFF	Down alarm only
—	—	ON	OFF	Down and Reverse alarm
—	—	OFF	ON	Drive and Down alarm
—	—	ON	ON	All Motion alarm

Figure 3-3: I/O Board Dip Switch

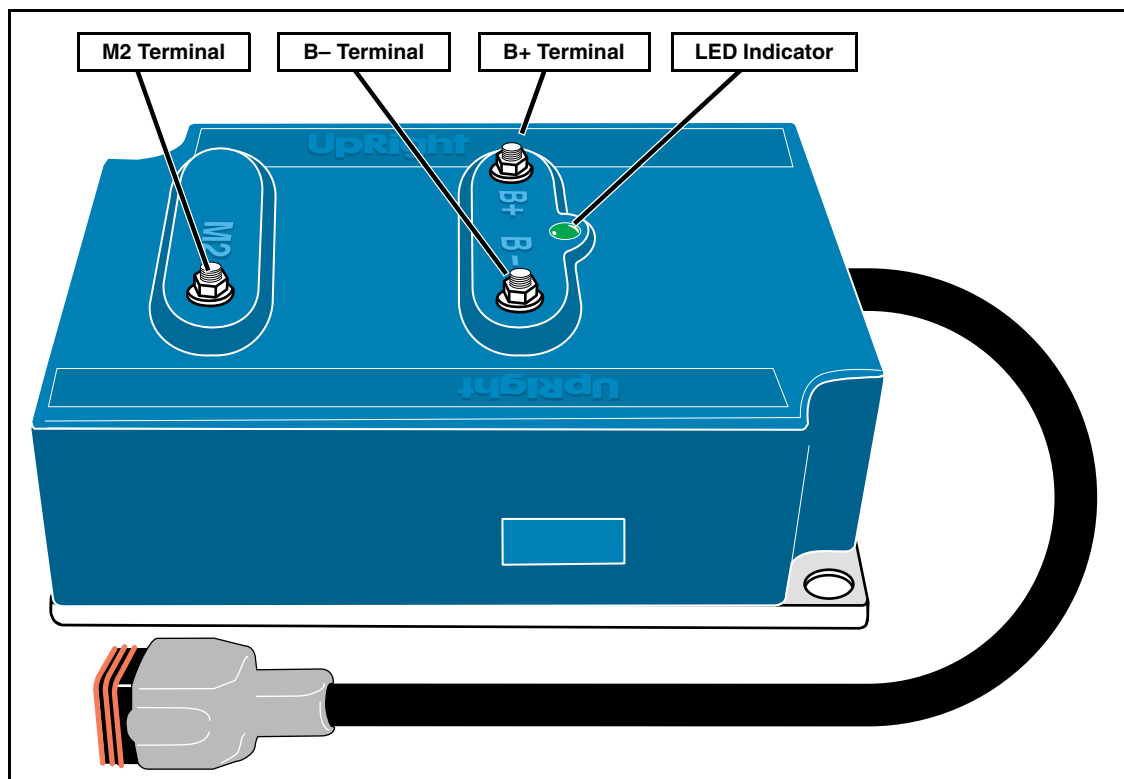


3-6 LED FAULT CODES

Batteries must be fully charged before troubleshooting.

Check/Repair all connections before replacing any components

Figure 3-4: Motor Controller Connections



NOTE: Before dip switch settings will take effect, power must be disconnected or Emergency Stop switches must be depressed.

Table 3-1: LED Fault Codes

Flash Code	Meaning	Status	Corrective Action
LED on	Power to the controller and the controller is operational.	<ul style="list-style-type: none"> System is functional 	<ul style="list-style-type: none"> None.
LED off	No power to the controller, or internal fault in the controller.	<ul style="list-style-type: none"> Battery cables not connected properly Failed controller 	<ul style="list-style-type: none"> Check battery cable connections. Replace the controller.
2 Flash	Procedural fault.	<ul style="list-style-type: none"> Lift, drive, or steer switch is engaged at start-up Drive/Lift switch rotated while operating 	<ul style="list-style-type: none"> Cycle the Control Handle through neutral to clear fault.
3 Flash	Controller senses B- at the M2 terminal.	<ul style="list-style-type: none"> Short circuit at the motor M2 cable in contact with B- cable Short circuit within controller 	<ul style="list-style-type: none"> Check cable routing and connections. Test terminals for source of B-. Replace the controller
4 Flash	Controller senses B+ at the M2 terminal before engaging the Motor Start relay.	<ul style="list-style-type: none"> B+ cable routed incorrectly M2 cable making contact with B+ cable Motor Start relay contacts welded closed. 	<ul style="list-style-type: none"> Check cable routing and connections. Test terminals for source of B+. Replace the Motor Start relay.
5 Flash	Controller senses open circuit at M2 after engaging the Motor Start terminal.	<ul style="list-style-type: none"> Cables loose or not connected Faulty Motor Start relay 	<ul style="list-style-type: none"> Check the cable routing and connections. Check the signal from Motor Controller to relay. Check/replace the Motor Start relay.
6 Flash	Faulty signal from Control Handle or I/O board.	<ul style="list-style-type: none"> Faulty Control Handle Wiring error 	<ul style="list-style-type: none"> If Platform Controls are affected, check/replace the Control Handle. If Chassis Controls are affected, check/replace the I/O board.
7 Flash	Battery voltage below 12V or above 45V.	<ul style="list-style-type: none"> Dead batteries Bad cable connections 	<ul style="list-style-type: none"> Check batteries and cable connections.
8 Flash	Thermal cut-off.	<ul style="list-style-type: none"> Controller is overheated due to overuse or other failure 	<ul style="list-style-type: none"> Allow system to cool. Locate and repair other source of overheat.

3-7 LEDs AT I/O BOARD

GREEN LED ON

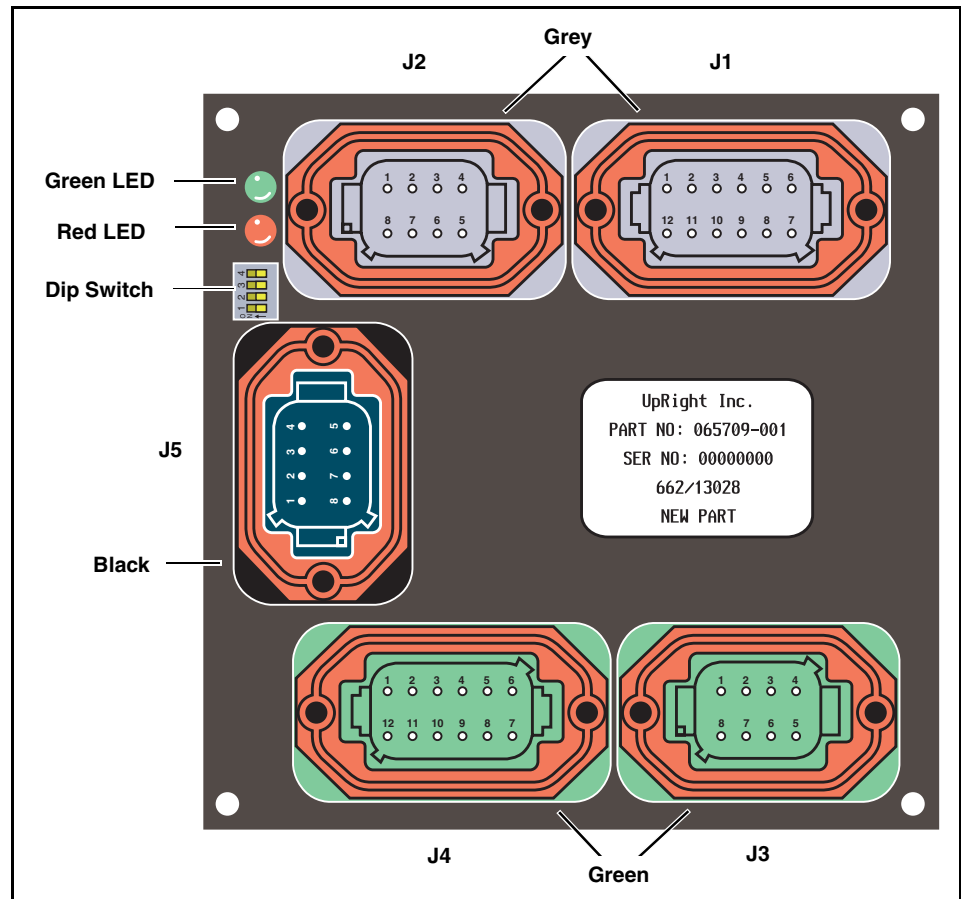
The Green LED indicates that power is present at the board.

RED LED ON

The Red LED indicates a short in the system. To locate the problem;

1. Push both E-Stop switches to the OFF position.
2. Turn the Keyswitch to the OFF position, then to either Platform or Chassis.
3. Pull both E-Stop switches to the ON position.
 - The Green LED should be ON.
 - The Red LED should be OFF.
4. Perform all machine functions until the Red LED is ON. Determine which function activated the Red LED and check all components that are active for that function.

Figure 3-5: I/O Board Connections



3-8 I/O BOARD INPUTS AND OUTPUTS

Refer to Figure Figure 3-5: "I/O Board Connections," on page 3-7.

PERFORM TESTS WITH FULLY CHARGED BATTERIES

Battery state of charge will affect readings.

BV = BATTERY VOLTAGE

Readings within a few volts of current battery state of charge will be called BV.

ØV

ØV is generally Ø up to 1 volt.

VOLTAGE READINGS FOR ELECTRONICS ARE RARELY EXACT

Many factors can affect readings, such as state of charge, voltage drops through switches (mechanical or electrical), and wires.

Be sure that both the Platform and Chassis Emergency Stop Switches are pulled out to the ON position.

All voltages are measured between the component and the B– terminal on the Motor Controller.

NOTE: For the I/O board to be powered up (Green LED illuminated), both E-Stops must be closed and either Platform Controls or Chassis Controls selected by the Keyswitch.

Table 3-2: Connector J1 – Platform Controls

PIN	PIN DESCRIPTION	CONDITION	VOLTAGE	CONTINUOUS TO PIN
J1-1	Lift input from Lift/Drive selector switch	Lift selected	BV	—
		Lift not selected	ØV	
J1-2	Not Used	—	—	—
J1-3	Drive input from Lift/Drive selector switch	Drive selected	BV	—
		Drive not selected	ØV	
J1-4	Lower E-Stop activation (output from I/O board when lower E-Stop is closed)	Lower E-Stop closed	BV	J4-9
		Lower E-Stop open	ØV	
J1-5	Upper E-Stop activation (output to I/O board when upper E-Stop is closed)	Upper E-Stop closed	BV	J4-2
		Upper E-Stop open	ØV	
J1-6	Power to Platform Controls when selected by Keyswitch	Platform Controls selected	BV	J4-10
		Platform Controls not selected	ØV	
J1-7	Not Used	—	—	—
J1-8	Controller direction "A" (up/forward)	Control Handle pushed forward	20-22V	—
J1-9	Controller direction "B" (down/reverse)	Control Handle pushed forward	20-22V	—
J1-10	Speed signal from Control Handle	Signal starts high and drops proportionally as Control Handle is moved in either direction	4.3V dropping to 0.2V	—
J1-11	Steer Left input from Steering switch	Steer Left selected	23V	—
		Steer Left not selected	ØV	
J1-12	Steer Right input from Steering switch	Steer Right selected	23V	—
		Steer Right not selected	ØV	

Table 3-3: Connector J2 – Valve Manifold

PIN	PIN DESCRIPTION	CONDITION	VOLTAGE	CONTINUOUS TO PIN
J2-1	Depression mechanism activation (extend)	Lift Up requested	0V	—
		Lift Up not requested	BV	
J2-2	Not Used	—	—	—
J2-3	24 Volt supply for solenoids	Upper & Lower E-Stops closed	BV	J4-5 & J3-3
		Upper or Lower E-Stop open	0V	
J2-4	Forward solenoid activation	Forward requested	0V	—
		Forward not requested	BV	
J2-5	Reverse solenoid activation	Reverse requested	0V	—
		Reverse not requested	BV	
J2-6	Up solenoid activation	Up requested	0V	—
		Up not requested	BV	
J2-7	Steer Left solenoid activation	Steer Left requested	0V	—
		Steer Left not requested	BV	
J2-8	Steer Right solenoid activation	Steer Right requested	0V	—
		Steer Right not requested	BV	

Table 3-4: Connector J3 – Chassis

PIN	PIN DESCRIPTION	CONDITION	VOLTAGE	CONTINUOUS TO PIN
J3-1	Alarm activation	Alarm sounding (out of level unit lowering, etc.)	†	—
† If the alarm is sounding because the unit is out of level, BV will drop to 0V as long as the alarm is sounding. If the alarm is sounding because the unit is lowering, there will be alternating high and low voltages (the voltages will vary).				
J3-2	Level Sensor output signal	Unit within Level Sensor angle	BV	—
		Unit outside Level Sensor angle	0V	
J3-3	24 Volt supply for Alarm, Level Sensor and solenoids,	Upper & Lower E-Stops closed	BV	J2-3 & J4-5
		Upper or Lower E-Stop open	0V	
J3-4	Input from platform down Proximity Switch	Above Proximity switch	0V	—
		Below Proximity switch	BV	
J3-5	Down solenoid activation	Down requested	0V	—
		Down not requested	BV	
J3-6	Depression mechanism activation (retract)	Drive requested	0V	—
		Drive not requested	BV	
J3-7	Not Used	—	—	—
J3-8	Battery negative supply for Level sensor and Proximity switch	—	B–	J4-11

Table 3-5: Connector J4 – Chassis Controls

PIN	PIN DESCRIPTION	CONDITION	VOLTAGE	CONTINUOUS TO PIN
J4-1	Motor Start relay and Hourmeter activation	Drive, Lift or Steer requested	0V	—
		Drive, Lift or Steer not requested	BV	
J4-2	24 Volt supply to Keyswitch	Upper & Lower E-Stops closed	BV	—
		Upper or Lower E-Stop open	0V	
J4-3	Chassis Controls selected from Keyswitch	Chassis Controls selected	BV	—
		Chassis Controls not selected	0V	
J4-4	24 Volt supply to chassis Up/Down switch	—	‡	—
‡ Keyswitch must be held to Chassis Controls position to measure BV				
J4-5	24 Volt supply to Keyswitch	Upper & Lower E-Stops closed	BV	J2-3 & J3-3
		Upper or Lower E-Stop open	0V	
J4-6	Not Used	—	—	—
J4-7	Up signal from Chassis Controls	Up requested from Chassis Controls	BV	—
		Up not requested from Chassis Controls	0V	
J4-8	Down signal from Chassis Controls	Down requested from Chassis Controls	BV	—
		Down not requested from Chassis Controls	0V	
J4-9	Lower E-Stop activation (input to I/O board when E-Stop is closed)	Lower E-Stop closed	BV	J1-4
		Lower E-Stop open	0V	
J4-10	Power output to Platform Controls	Platform selected at Keyswitch	BV	J1-6
		Platform not selected at Keyswitch	0V	
J4-11	Battery negative supply to I/O Board	—	B–	—
J4-12	24 Volt supply to Hourmeter and Line Contactor coil	Upper & Lower E-Stops closed and Platform Controls or Chassis Controls selected	BV	—

Table 3-6: Connector J5 - Motor Controller

PIN	PIN DESCRIPTION	CONDITION	VOLTAGE	CONTINUOUS TO PIN
J5-1	24 Volt supply to EMC motor controller	Upper & Lower E-Stops closed and Platform Controls or Chassis Controls selected	BV	—
J5-2	Drive signal to EMC motor controller	Forward/Reverse requested	15V	—
		Forward/Reverse not requested	0V	
J5-3	Steer signal to EMC motor controller	Steer Right/Steer Left requested	15V	—
		Steer Right/Steer Left not requested	0V	
J5-4	Up signal to EMC motor controller	Up requested	15V	—
		Up not requested	0V	
J5-5	Speed Reduction signal to EMC motor controller	Below Proximity switch	15V - 17V	—
		Above Proximity switch	0V	
J5-6	Line Contactor activation signal	Drive, Lift or Steer requested	0V	—
		Drive, Lift or Steer not requested	BV	
J5-7	Direction enable	Forward/Reverse requested	0V	—
		Forward/Reverse not requested	4.0V - 4.3V	
J5-8	Speed signal to EMC motor controller	Signal starts high and drops proportionally as Control Handle is moved in either direction	4.3V dropping to 0.2V	—

3-9 ELECTRIC

Table 3-7: Electrical Troubleshooting Table

Component		Function	Lower Controls	Upper Controls	Drive Forward	Drive Reverse	High Speed/Creep	Raise Platform	Lower Platform	Steer Left	Steer Right	Depression Mechanism Extend	Depression Mechanism Retract	Brakes	Level Alarm	Down Alarm	Battery Charge
ALM1	Alarm														X	X	
BAT	Batteries		X	X	X	X	X	X	X	X	X	X	X	X	X	X	
CHG	Battery Charger																X
F1	5 AMP Circuit Breaker		X	X	X	X	X	X	X	X	X	X	X	X	X	X	
F2	175 AMP Fuse		X	X	X	X	X	X	X	X	X	X	X	X			
HM	Hour Meter/low Voltage Indicator																
I/O	I/O Board		X	X	X	X	X	X	X	X	X	X	X	X	X	X	
MC	Motor Control		X	X	X	X	X	X	X	X	X	X	X	X			
MOT	Motor				X	X	X	X	X	X	X	X	X	X			
R1	Motor Relay				X	X	X	X	X	X	X	X	X	X			
S1	Chassis Emergency Stop Switch		X	X	X	X	X	X	X	X	X	X	X	X	X	X	
S2	Chassis Lift Switch							X	X								
S3	Chassis Key Switch		X	X	X	X	X	X	X	X	X	X	X	X	X	X	
S4	Lift/Drive Selector Switch			X	X	X		X	X								
S5	Proximity Switch						X										
S7	Platform Emergency Stop Switch		X	X	X	X	X	X	X	X	X	X	X	X	X	X	
S8	Interlock Switch			X	X	X	X	X	X	X	X						
S9	Control Handle			X	X	X		X	X								
S10	Platform Steering Switch									X	X						
SNSR	Level Sensor		X	X	X	X	X	X	X	X	X	X	X	X	X	X	
SOL1A	Steering Solenoid (right)										X						
SOL1B	Steering Solenoid (left)									X							
SOL2A	Platform Lift Solenoid							X									
SOL2B	Down Solenoid (Emergency Lowering)								X								
SOL3A	Depression Mechanism Extension Solenoid											X					
SOL3B	Depression Mechanism Retraction Solenoid (2)												X				
SOL4A	Reverse Solenoid					X											
SOL4B	Forward Solenoid				X												

3-10 HYDRAULIC

Table 3-8: Hydraulic Troubleshooting Table

Component		Function	Lift Platform	Lower Platform	Steer Right	Steer Left	Drive Forward	Drive Reverse	Creep	Depression Mechanism Extend	Depression Mechanism Retract	Brakes
CV	Check Valve									X	X	
CYL1	Steering Cylinder			X	X							
CYL2	Lift Cylinder	X										
CYL3	Depression Mechanism Cylinder (2)									X	X	
DVDR	Priority Flow Divider	X		X	X	X	X	X	X	X	X	X
DVR2	Series Parallel Flow Divider						X	X	X			
FL1	Suction Strainer	X		X	X	X	X	X	X	X	X	
FL2	Return Filter	X		X	X	X	X	X	X	X	X	
MOT	Drive Motors (2)						X	X				X
OR1	Lift Cylinder Orifice	X	X									
OR2	Depression Mechanism Orifice (2)									X	X	
OR3	Brake Orifice						X	X	X			X
PMP	Pump	X		X	X	X	X	X	X	X	X	
RES	Reservoir	X	X	X	X	X	X	X	X	X	X	X
RV1	Steering Relief Valve			X	X							
RV2	Lift Relief Valve	X										
RV3	Main Relief Valve	X					X	X	X	X	X	X
V1	Steering Right/Left Valve			X	X							
V2A	Lift Valve	X										
V2B	Down/Emergency Lowering Valve		X									
V3A	Depression Mechanism Extend Valve									X		
V3B	Depression Mechanism Retract Valve (2)										X	
V4	Forward/Reverse Valve						X	X				
V5	Series Parallel Valve (2)						X	X	X			
V6	Counterbalance Valve (2)						X	X	X			X

SCHEMATICS

This section contains electrical and hydraulic power schematics and associated information for maintenance purposes.

The diagrams are to be used in conjunction with the *Troubleshooting Truth Tables* in *Section 3*. They allow understanding of the makeup and functions of the systems for checking, tracing, and faultfinding during troubleshooting analysis.

The components that comprise the electrical and hydraulic systems are given a reference designation and are explained as to function and location in the following tables.

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4-1 ELECTRIC

Legend: Electrical Schematic 065616-027

Reference Number	Name	Function	Location
ALM1	Alarm	Provides warning sound	Control Module
ALM2	Horn (option)	Provides warning sound	Power Module
BAT	Battery Pack	Power source for the machine	Power Module
CHG	Battery Charger	Charges the battery pack	Power Module
F1	5 AMP Circuit Breaker	Electrical overload protection	Chassis Controls
F2	175 AMP Fuse	Overload protection for the electric motor	Control Module
HM	Hour Meter	Shows how many hours the machine has been in use	Chassis Controls
I/O	I/O Board (Circuit Board)	Connection point for machine function wiring	Control Module
MC	Motor Control	Controls the speed of the electric motor	Control Module
MOT	Motor	Provides power to the hydraulic pump	Control Module
R1	Motor Relay	Controls the speed of the electric motor	Control Module
S1	Chassis Emergency Stop Switch	Shuts down all machine functions	Chassis Controls
S2	Chassis Lift Switch	Elevates platform	Chassis Controls
S3	Chassis Key Switch	Allows some machine functions to be initiated from ground level	Chassis Controls
S4	Lift/Drive Selector Switch	Activates lift or drive functions, and high and low speed drive	Platform Controls
S5	Proximity Switch (Limit Switch)	Stops lift assembly at lower limit, cuts out high speed drive when platform is elevated	Chassis, Front
S7	Platform Emergency Stop Switch	Shuts down all machine functions	Platform Controls
S8	Interlock Switch (Trigger)	Safety mechanism for control handle	Platform Controls
S9	Control Handle	Proportionally controls the drive and lift functions	Platform Controls
S10	Platform Steering Switch	Control left and right steering solenoids	Platform Controls
S12	Horn Button (option)	Provides power to horn	Platform Controls
SNSR	Level Sensor	Activates level sensor alarm and disables all machine functions except platform lower when the machine is more than 2° out of level	Chassis, Front
SOL1A	Steering Solenoid (right)	Shifts steering valve to the left	Hydraulic Manifold
SOL1B	Steering Solenoid (left)	Shifts steering valve to the right	Hydraulic Manifold
SOL2A	Platform Lift Solenoid	Elevates platform	Hydraulic Manifold
SOL2B	Down Solenoid (Emergency Lower)	Lowers platform	Lift Cylinder
SOL3A	Depression Mechanism Extension Solenoid	Extends depression mechanism bars	Hydraulic Manifold
SOL3B	Depression Mechanism Retraction Solenoid (2)	Retracts depression mechanism bars	Depression Mechanism cylinders
SOL4A	Reverse Solenoid	Shifts forward/reverse valve to reverse	Hydraulic Manifold
SOL4B	Forward Solenoid	Shifts forward/reverse valve to forward	Hydraulic Manifold

Figure 4-1: Electric Components Location

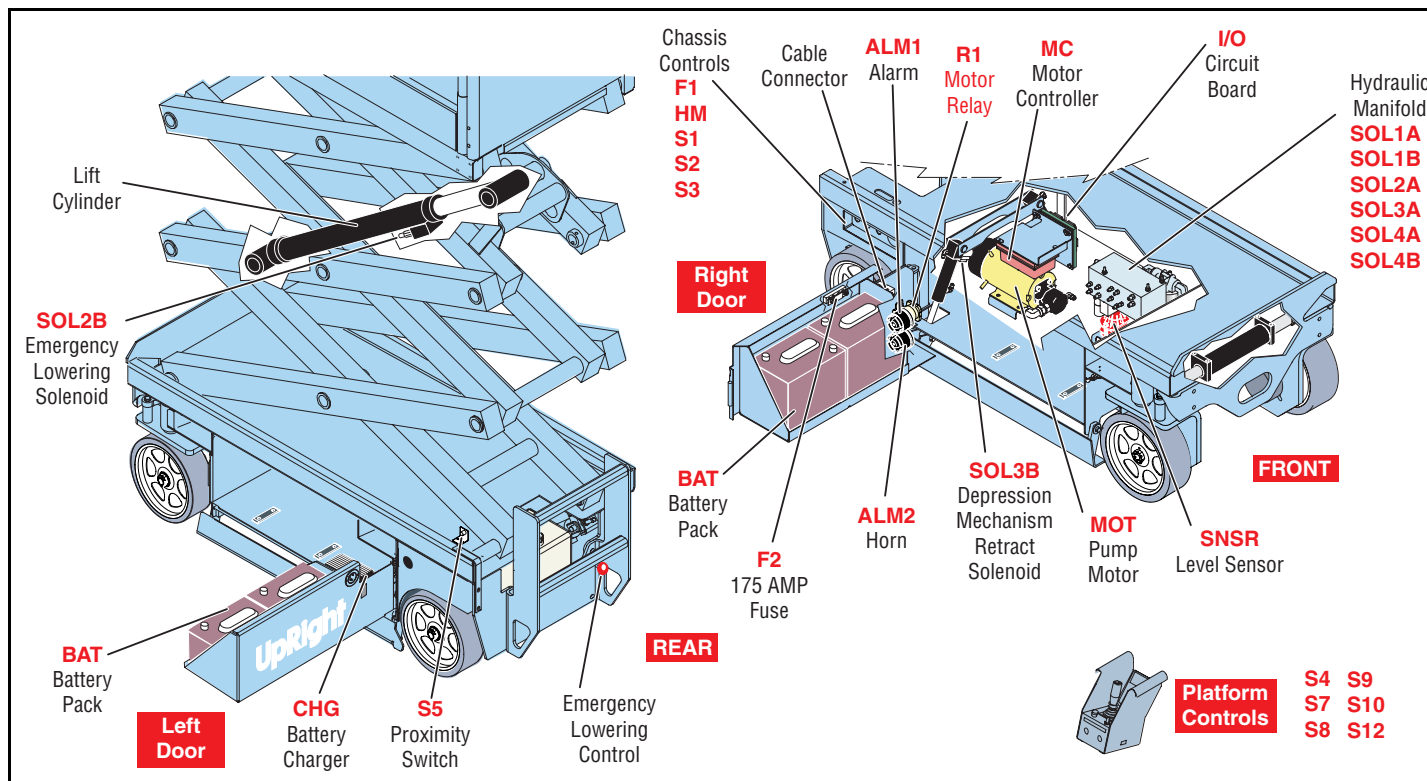


Figure 4-2: Electrical Schematic

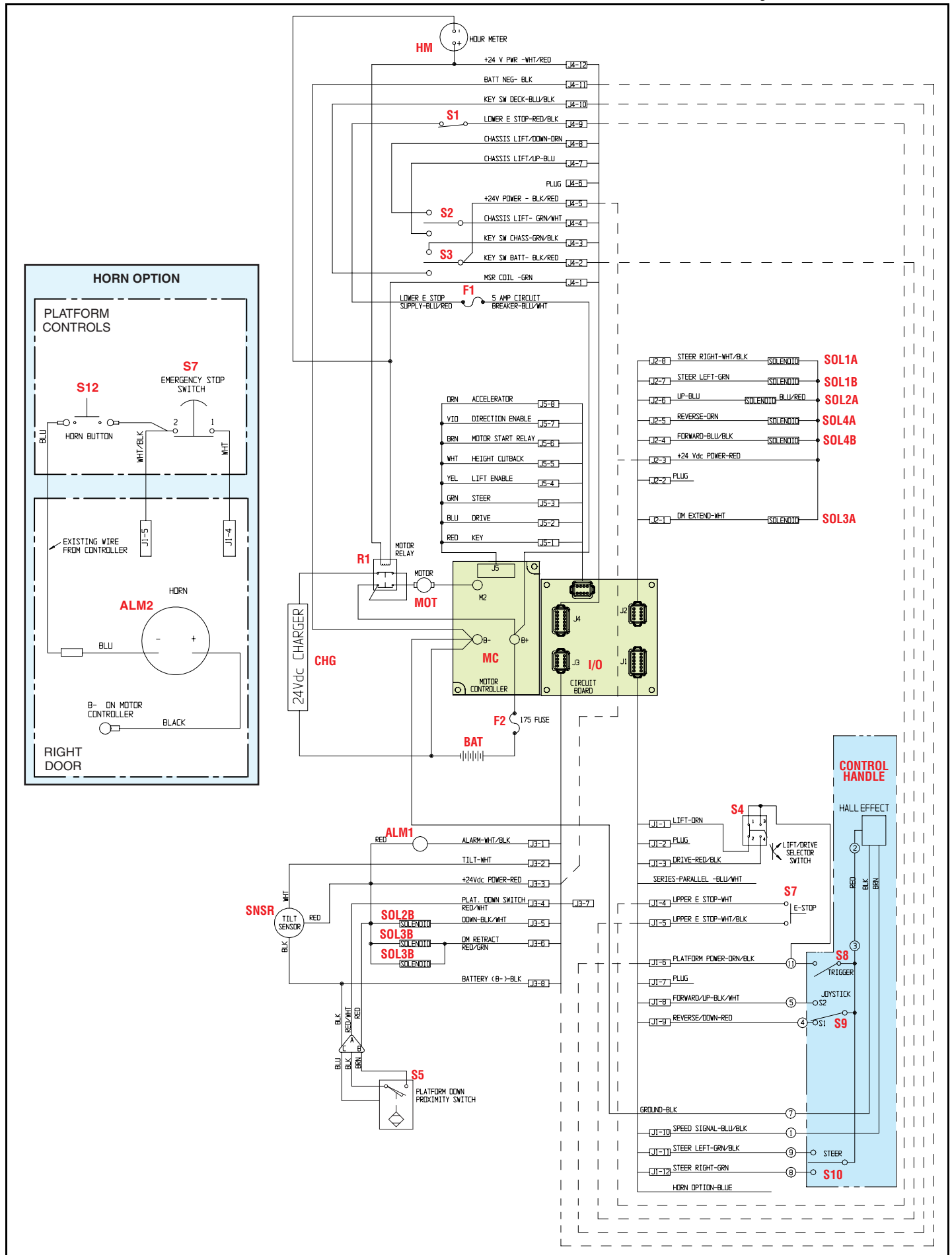


Figure 4-3: Electrical Wire Routing

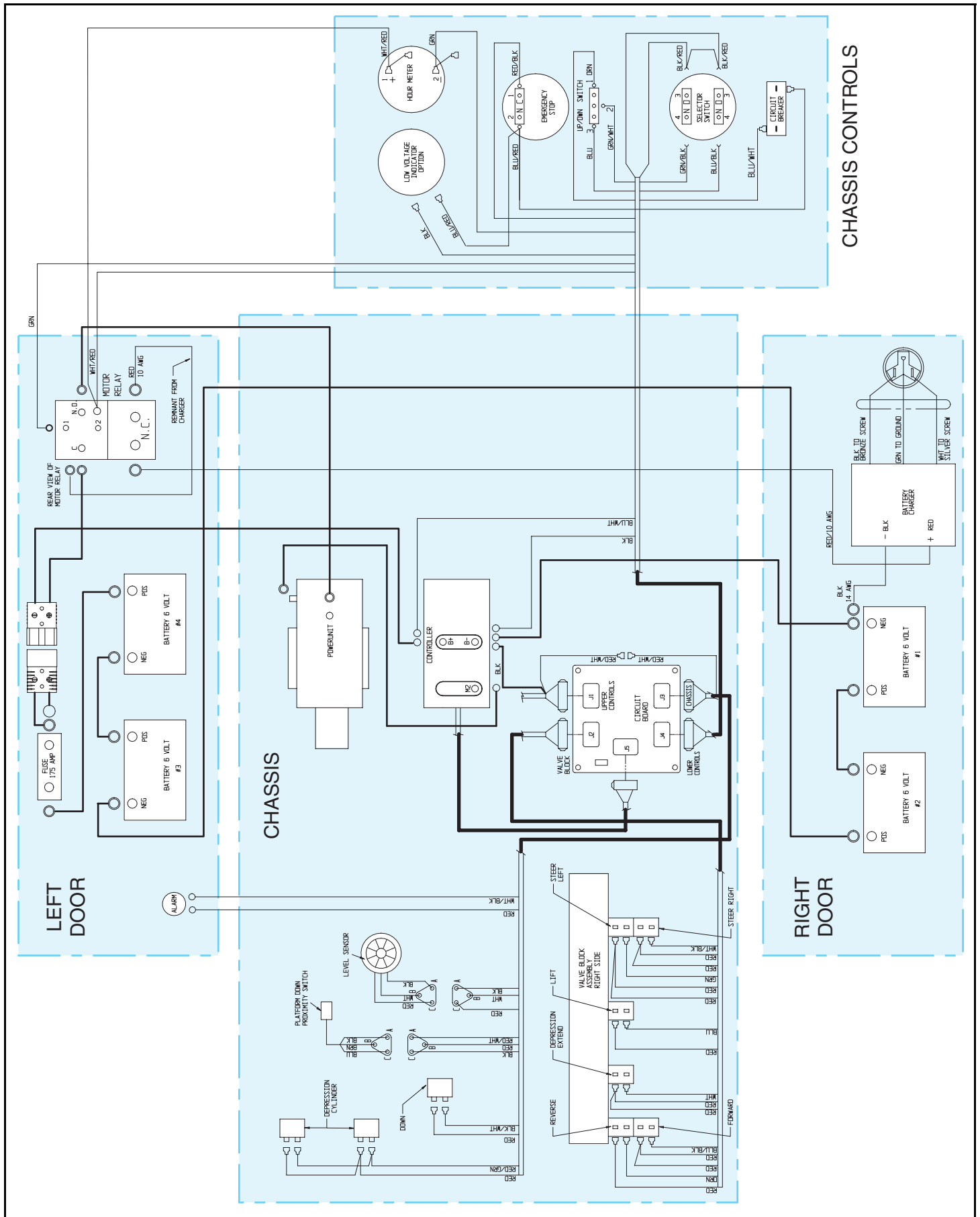


Figure 4-4: Lower Controls Components

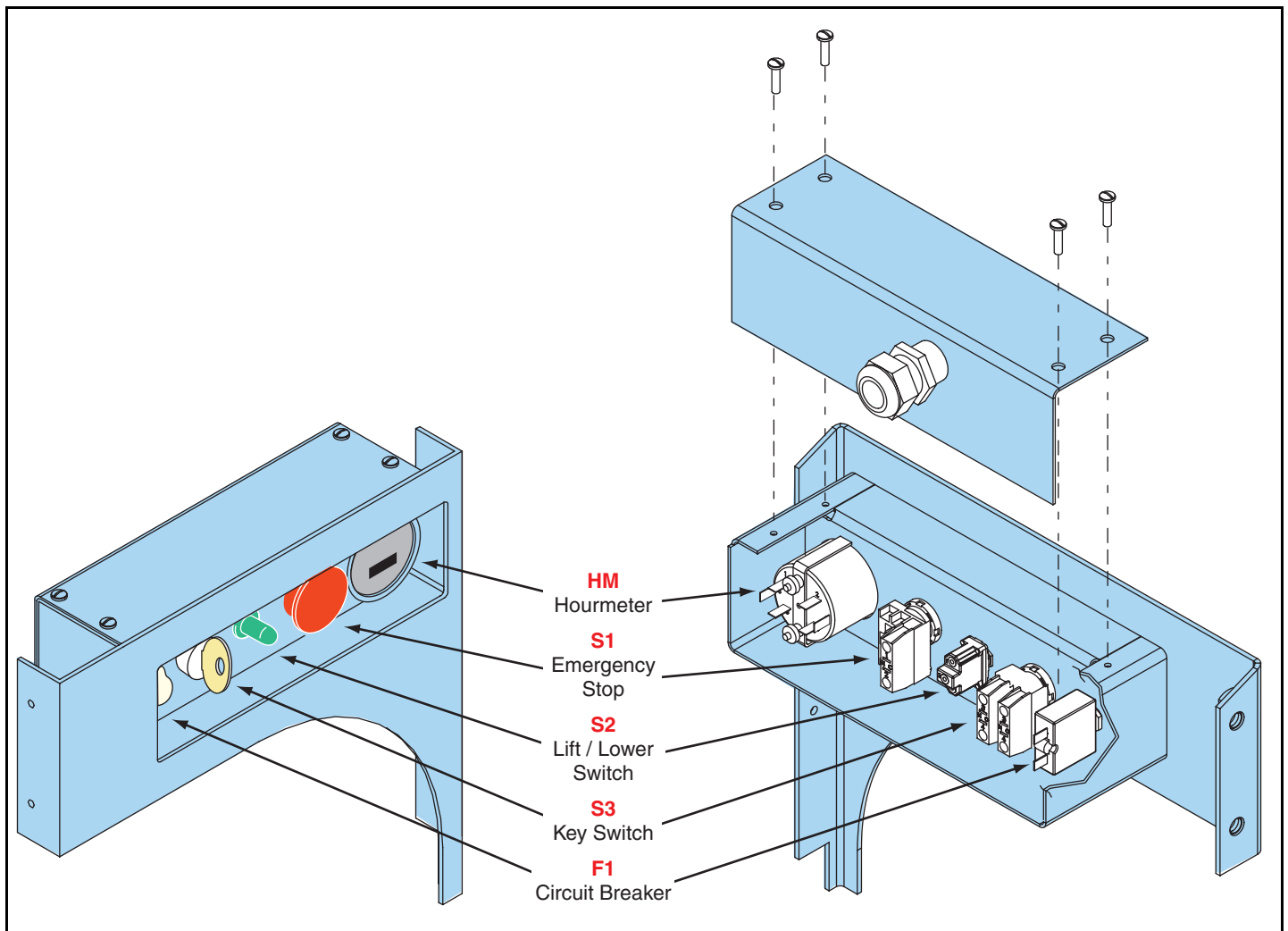


Figure 4-5: Upper Controls Components

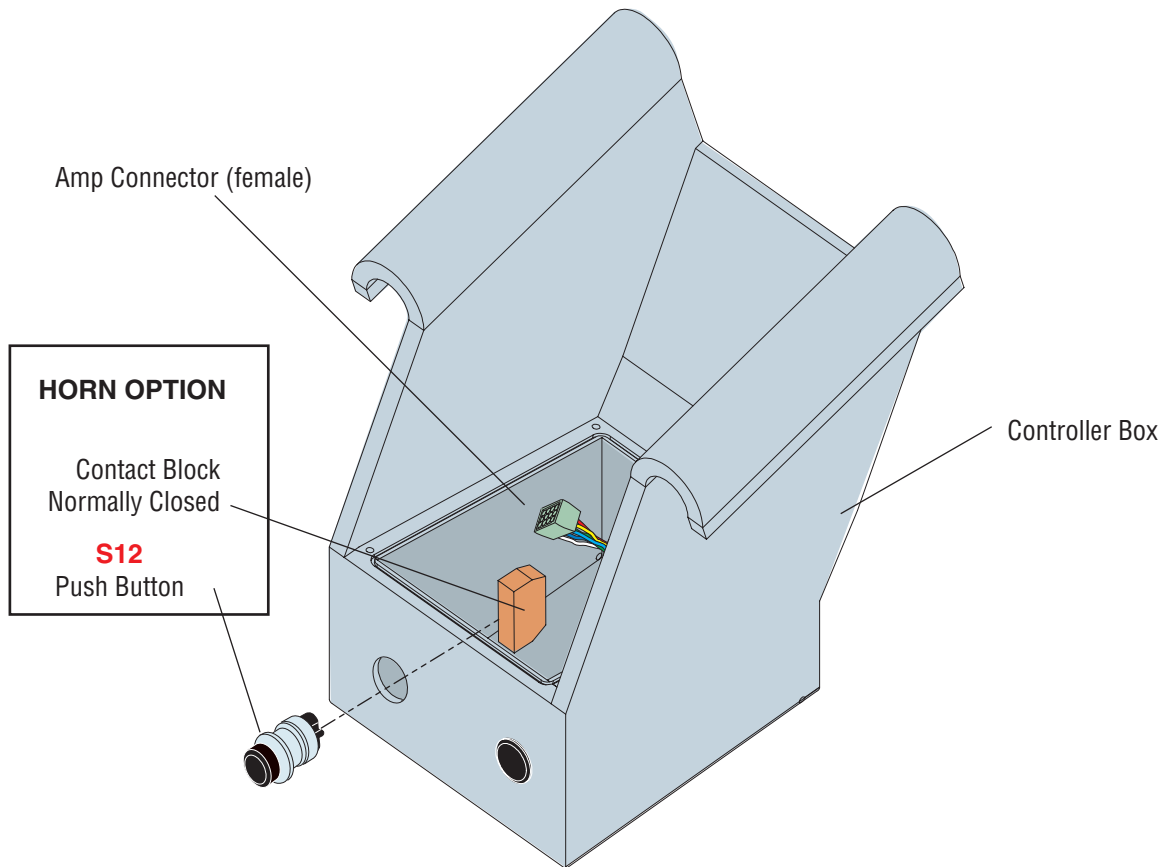
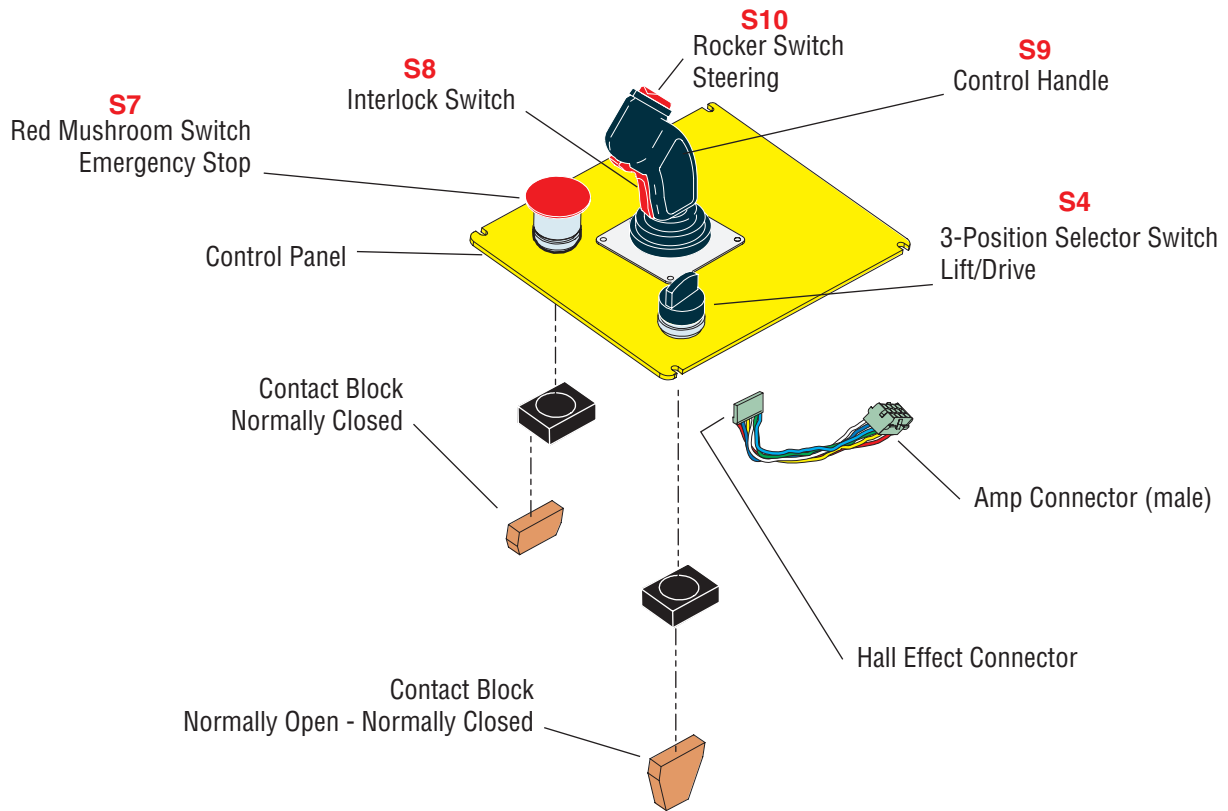
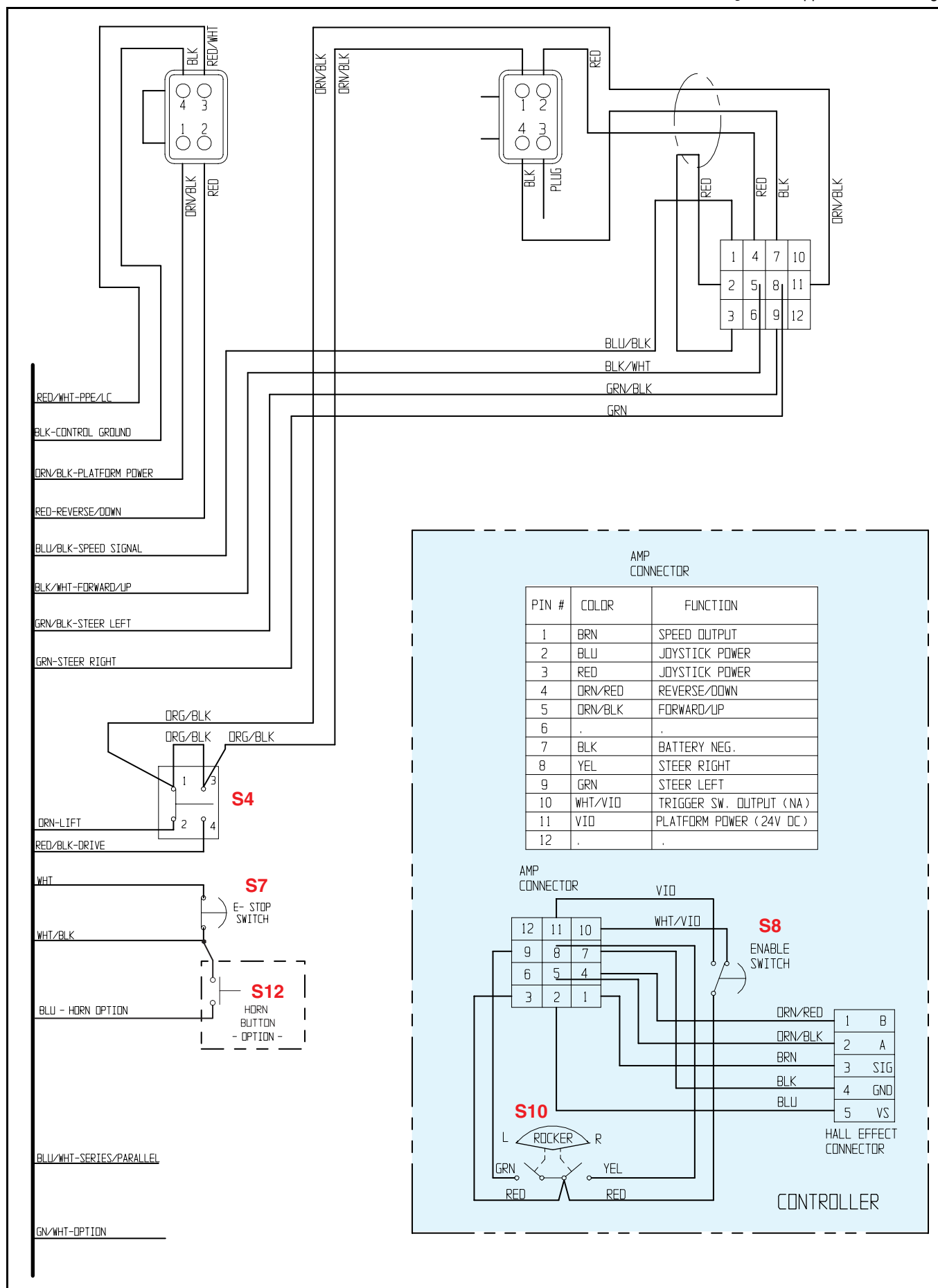


Figure 4-6: Upper Controls Wiring



4-2 HYDRAULIC

Legend: Hydraulic Schematic 065615-023

Reference number	Name	Function	Location
CV	Check Valve	Allows depression mechanism to retract in drive mode	Hydraulic Manifold
CYL1	Steering Cylinder	Provides force to turn front wheels	Front of Chassis above drive motors
CYL2	Lift Cylinder	Provides force to lift platform	Elevating Assembly
CYL3	Depression Mechanism Cylinder (2)	Extends or retracts depression mechanism bar	Front of hydraulic reservoir
DVDR	Priority Flow Divider	Provides priority fluid flow to steering	Hydraulic Manifold
FL1	Suction Strainer	Traps particles in hydraulic reservoir	Inside hydraulic reservoir at outlet
FL2	Return Filter	Filters fluid returning to reservoir	Back of hydraulic reservoir
MOT	Drive Motors (2)	Provides tractive effort to move platform	Front motor mounts
OR1	Orifice	Controls the fluid flow rate of the lift cylinder	Lift Cylinder
OR2	Orifice	Controls the fluid flow rate of the depression mechanism cylinders	Hydraulic Manifold
OR3	Orifice	Controls the fluid flow rate of the brakes	Hydraulic Manifold
PMP	Pump	Provides hydraulic pressure for all functions	On Electric Motor between Battery Modules
RV1	Steering Relief	Provides pressure protection to pump and steering components when steering	Hydraulic Manifold
RV2	Lift Relief Valve	Provides pressure protection to lift system	Hydraulic Manifold
RV3	Main Relief Valve	Provides pressure protection to hydraulic system	Hydraulic Manifold
RES	Reservoir	Holds hydraulic fluid	Rear end of Chassis
V1	Steering Right/Left Valve	Provides directional control for steering	Hydraulic Manifold
V2A	Lift Valve	Provides fluid control for drive or lift functions	Hydraulic Manifold
V2B	Down/Emergency Lowering Valve	Allows fluid to return to reservoir; manually operated for emergency lowering	Lift Cylinder
V3A	Depression Mechanism Extend Valve	Provides fluid control for depression mechanism bar	Hydraulic Manifold
V3B	Depression Mechanism Retract Valve (2)	Provides fluid control for Depression Mechanism bar	Depression Mechanism Cylinder
V4	Forward/Reverse Valve	Provides fluid control for drive or lift functions	Hydraulic Manifold
V5	Counterbalance Valve (2)	Provides dynamic braking	Hydraulic Manifold

Figure 4-7: Hydraulic Components Location

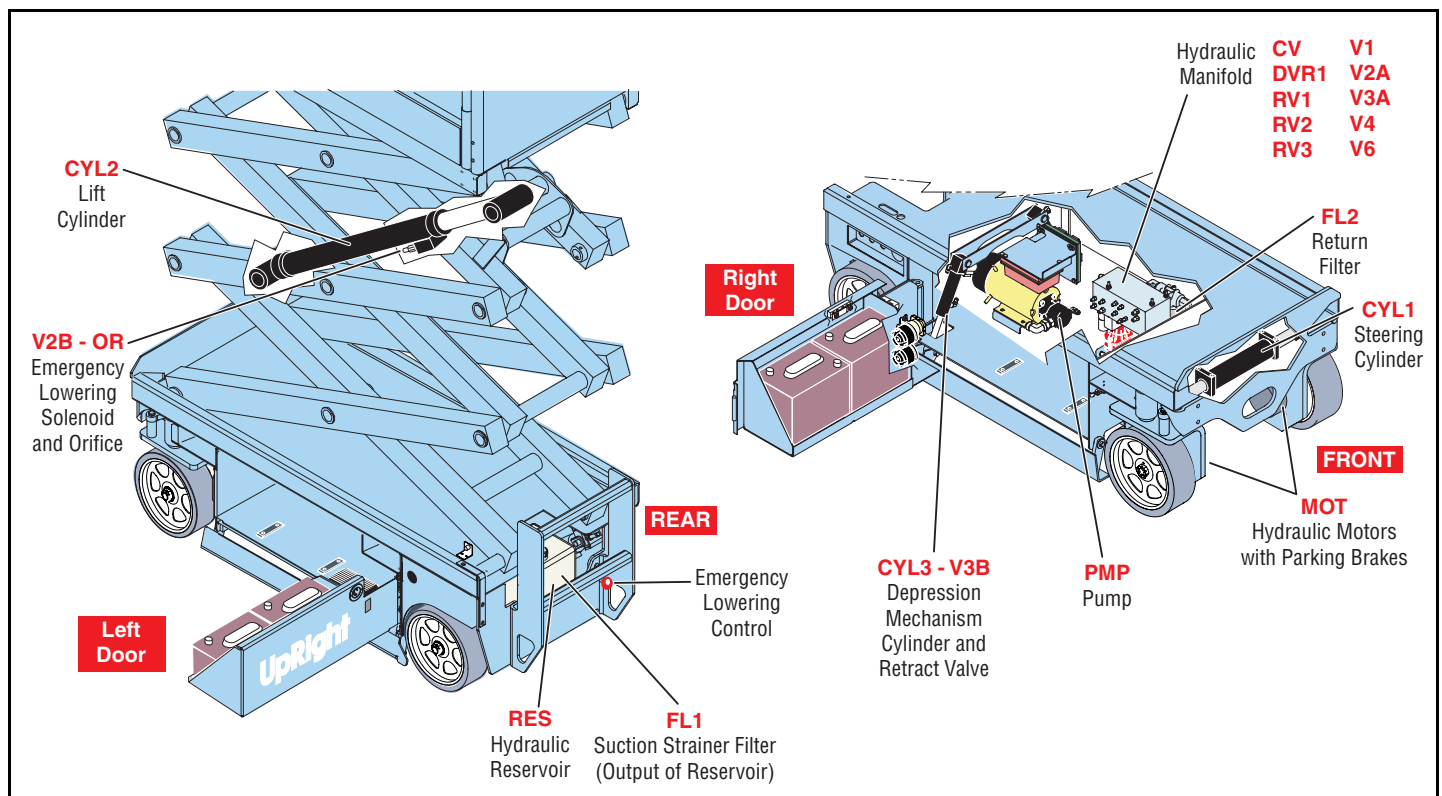


Figure 4-8: Hydraulic Schematic

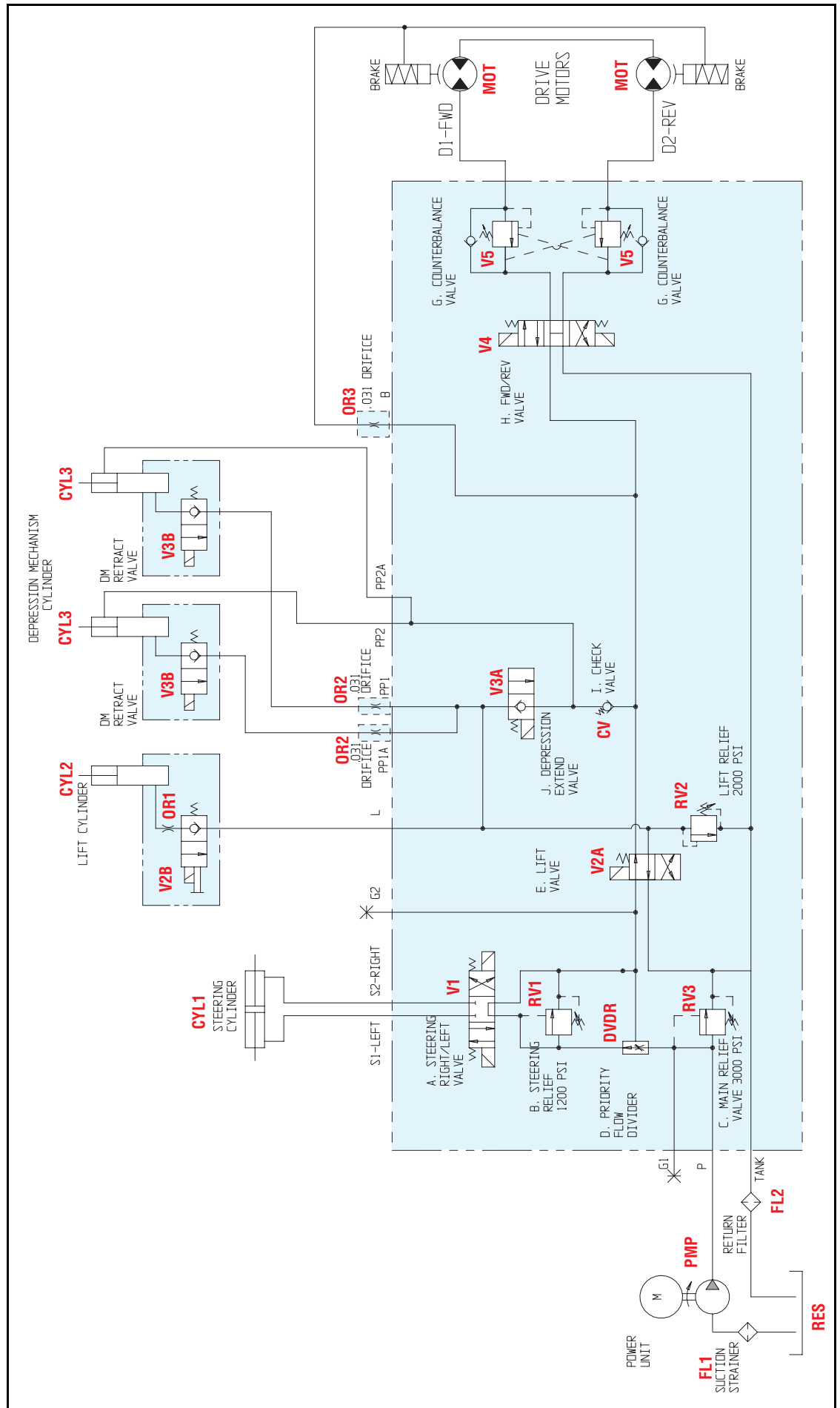


Figure 4-9: Hose Routing

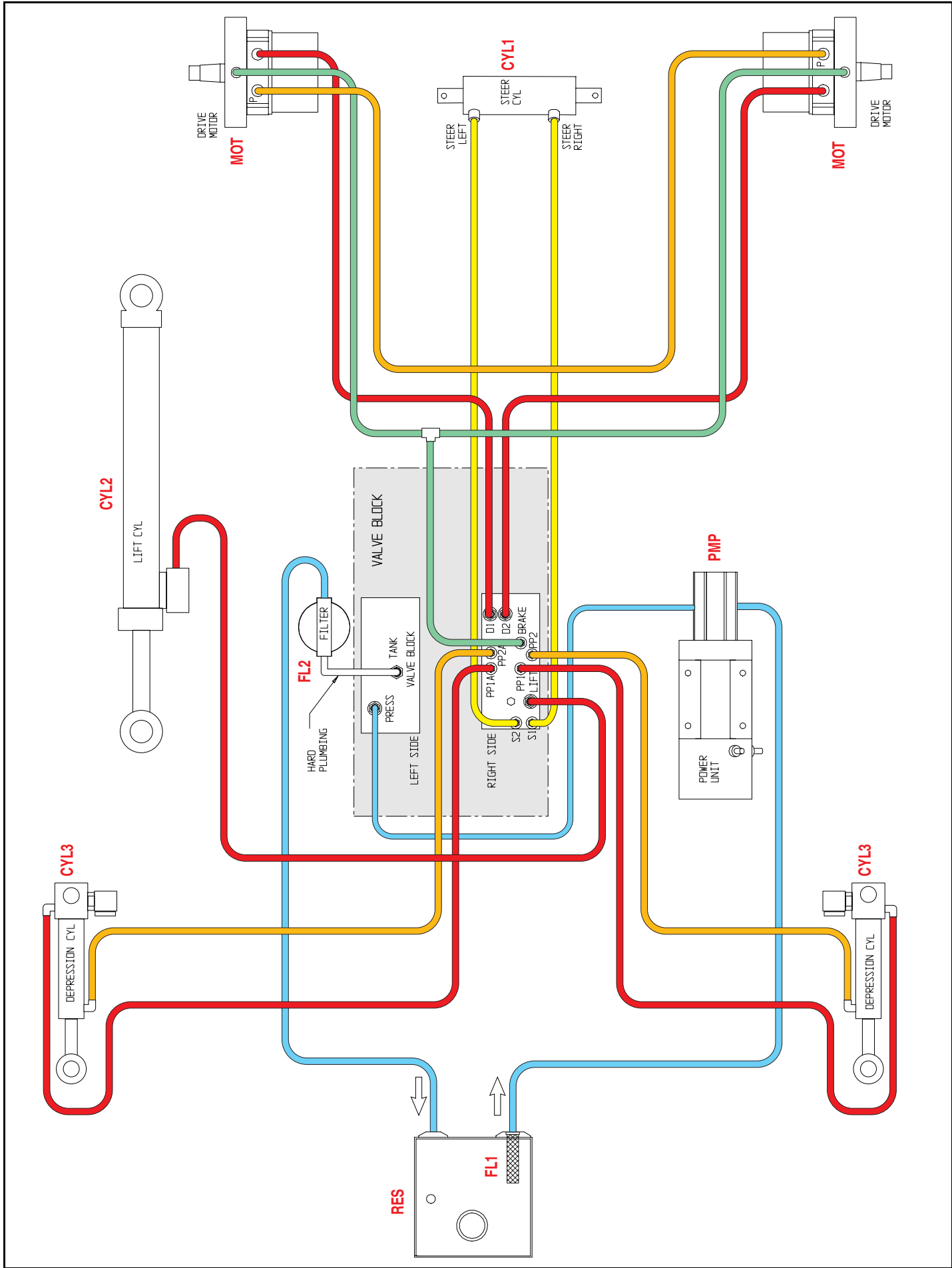


Figure 4-10: Valve Diagram

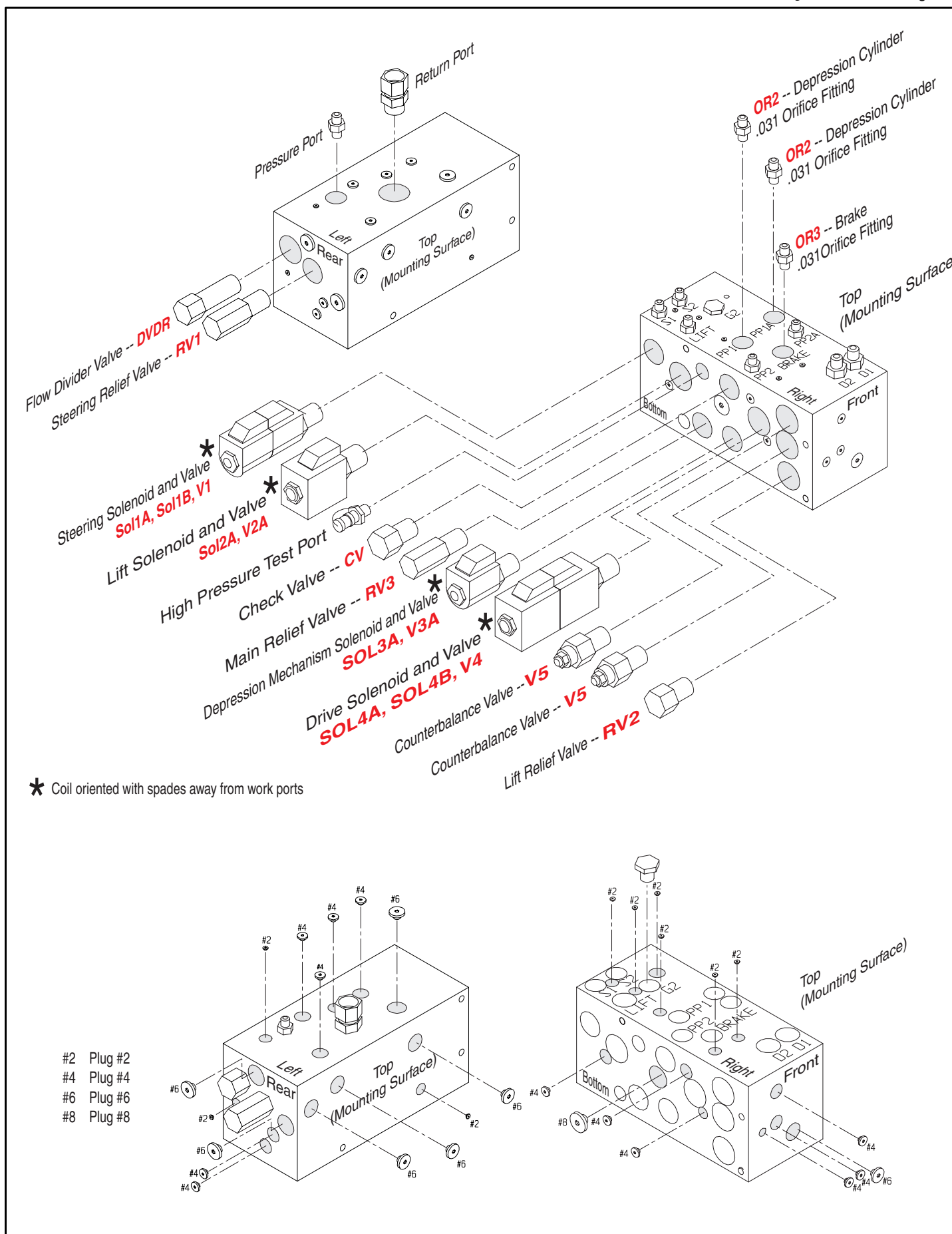
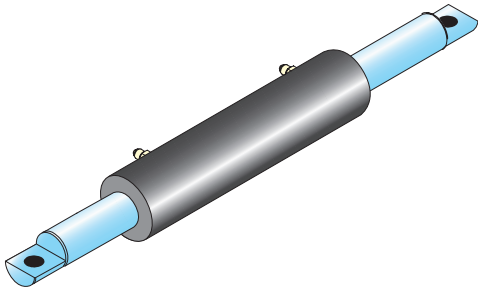
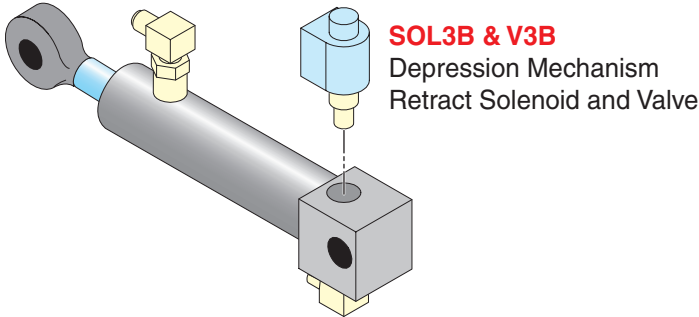


Figure 4-11: Cylinders

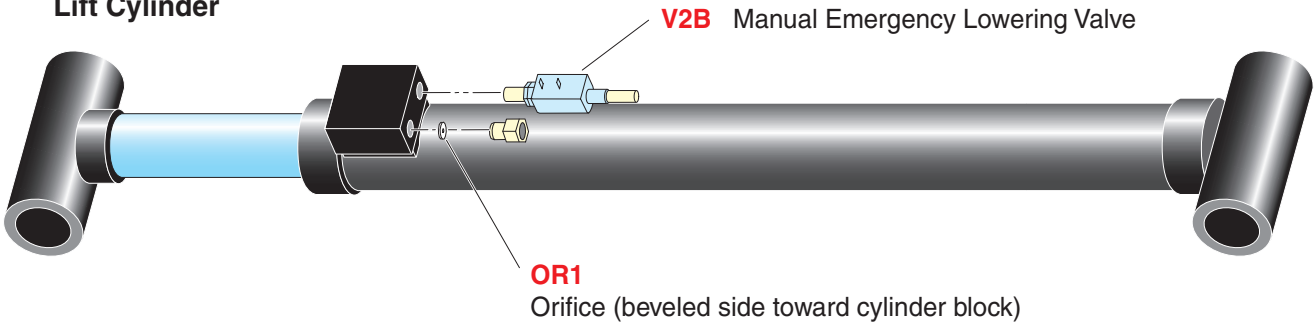
Steering Cylinder



Depression Mechanism Cylinder



Lift Cylinder



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