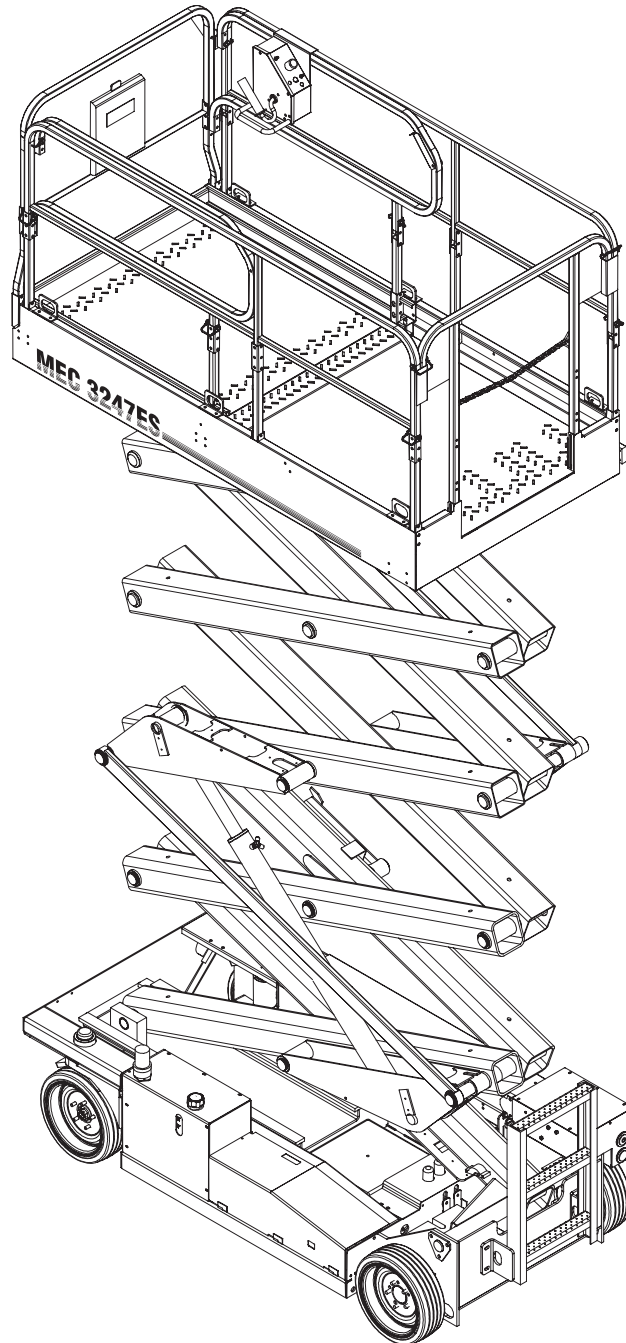




# CE SERVICE AND PARTS MANUAL

## 2047ES / 2647ES / 3247ES



### Serial Number Range

2047ES:	9801000 - Present
2647ES:	9901000 - Present
3247ES:	10001000 - Present

Part # 90972 R2  
March 2008



## **Aerial Platform Sales Corp.**

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# Table of Contents

## Service Manual

<b>INTRODUCTION .....</b>	<b>I</b>
<b>General Safety Tips .....</b>	<b>III</b>
Hydraulic System .....	IV
Electrical System .....	IV
Total System .....	IV
<b>Machine Specifications .....</b>	<b>V</b>
<b>Primary Machine Components .....</b>	<b>VII</b>
<b>Lubrication .....</b>	<b>VIII</b>

### SECTION 1:

<b>HYDRAULIC SYSTEM .....</b>	<b>1-1</b>
Hydraulic Fluid .....	1-2
Hydraulic System Components .....	1-4
Parking Brake and Towing Circuit .....	1-6
Emergency Systems And Procedures .....	1-6
Steering Circuit .....	1-8
Platform Lift Circuit .....	1-9
Cylinder Repair .....	1-10
Hydraulic Manifold .....	1-13

### SECTION 2:

<b>ELECTRICAL SYSTEM .....</b>	<b>2-1</b>
Electrical System - General .....	2-2
Deutsch Connectors .....	2-3
Batteries .....	2-4
Alarms and Switches .....	2-8
Continuity Checks .....	2-11
Diode Board .....	2-12
Sevcon Motor Speed Controller .....	2-13
Load Sensing System .....	2-14



# Table of Contents

## SECTION 3

<b>PLATFORM OVERLOAD SYSTEM .....</b>	<b>3-1</b>
<b>General Description .....</b>	<b>3-2</b>
<b>Electrical Connections .....</b>	<b>3-3</b>
<b>Troubleshooting .....</b>	<b>3-4</b>
GP102 - EZcal Help Messages .....	3-4
GP102 LED Flash Codes .....	3-7
<b>Calibration .....</b>	<b>3-8</b>
CALIBRATION TROUBLESHOOTING; Failure Messages .....	3-11
CALIBRATION TROUBLESHOOTING; Information Messages .....	3-16

## SECTION 4:

<b>MECHANICAL COMPONENTS .....</b>	<b>4-1</b>
<b>Torque Specifications .....</b>	<b>4-2</b>
<b>Mechanical Components .....</b>	<b>4-3</b>
Base / Undercarriage .....	4-3
Hoses and Cables .....	4-3
Raising the Machine .....	4-4
Tires/Wheels .....	4-5
Front Drive Motors .....	4-6
Rear Wheel Brakes .....	4-7
Steer Cylinder .....	4-8
Pothole Circuit .....	4-9
Platform Removal .....	4-10
Lift Cylinder Removal and Installation .....	4-11
Scissor Beam Assembly .....	4-12



# Table of Contents

## SECTION 5:

<b>TROUBLESHOOTING .....</b>	<b>5-1</b>
General Troubleshooting Tips .....	5-2
Hydraulic Pressure Adjustment Procedures .....	5-4
Troubleshooting .....	5-6
Sevcon Motor Speed Controller .....	5-14
LED Diagnostics Definitions (Flash Codes) .....	5-15
Sevcon Motor Speed Controller - Connections .....	5-17
Troubleshooting Battery Charger .....	5-19

## SECTION 6:

<b>SCHEMATICS .....</b>	<b>6-1</b>
Hydraulic Schematics .....	6-2
2047ES - Serial # 9801000 - 9801099	
2647ES - Serial # 9901000 - 9901199	
3247ES - Serial # 10001000 - 10001199 .....	6-2
2047ES - Serial # 9801100 - CURRENT	
2647ES - Serial # 9901200 - CURRENT	
3247ES - Serial # 10001200 - CURRENT .....	6-4
Electric Schematics .....	6-9
2047ES - Serial # 9801000 - 9801099	
2647ES - Serial # 9901000 - 9901199	
3247ES - Serial # 10001000 - 10001199 .....	6-10
2047ES - Serial # 9801100 - CURRENT	
2647ES - Serial # 9901200 - CURRENT	
3247ES - Serial # 10001200 - CURRENT .....	6-12



# **Table of Contents**

## **Parts Manual**

**SECTION A: CONTROL BOXES**

**SECTION B: PLATFORM AND RAILS**

**SECTION C: SCISSORS**

**SECTION D: HYDRAULICS**

**SECTION E: BASE**

**SECTION F: DECALS**



## SECTION 1:

# HYDRAULIC SYSTEM

Hydraulic Fluid .....	1-2
Hydraulic System Components .....	1-4
Parking Brake and Towing Circuit .....	1-6
Emergency Systems And Procedures .....	1-6
Steering Circuit .....	1-8
Platform Lift Circuit .....	1-9
Cylinder Repair .....	1-10
Hydraulic Manifold .....	1-13

# HYDRAULIC FLUID

## Handling Precautions



**PERSONS IN REGULAR CONTACT WITH MINERAL-BASED HYDRAULIC FLUID NEED TO BE AWARE OF THE IMPORTANCE OF THOROUGH HYGIENE, AND THE PROPER METHODS FOR HANDLING MINERAL OILS IN ORDER TO AVOID POTENTIAL HAZARDS TO HEALTH.**

If mineral-based hydraulic fluid is **SPLASHED INTO THE EYES**, it must be **WASHED OUT THOROUGHLY** using abundant quantities of water. If irritation persists, medical advice should be sought.



**HYDRAULIC FLUID UNDER PRESSURE CAN PENETRATE AND BURN SKIN, DAMAGE EYES, AND MAY CAUSE SERIOUS INJURY OR BLINDNESS.**

**FLUID LEAKS UNDER PRESSURE MAY NOT ALWAYS BE VISIBLE.**

## Fluid Recommendations

MEC recommends the use of ISO Grade 32 hydraulic fluid. A 150SSU EQUIVALENT substitute can be used if absolutely necessary. Mineral-based hydraulic fluids produced by different companies will **USUALLY** mix with each other satisfactorily, but this **IS NOT RECOMMENDED**. When in doubt, consult with your supplier.

ISO Grade 32 has proven to be suitable for use in all climates. For continued operation in temperatures below 32 °F (0 °C), use of an ATF hydraulic fluid is satisfactory.

The only exception to the above is to drain and fill the system with ATF fluid or its equivalent. This will also start up at temperatures down to -20 °F (-29 °C). However, use of this fluid will give poor performance at temperatures above 120 °F (49 °C).

## System Flushing Procedure

1. With platform fully down, drain hydraulic fluid from hydraulic reservoir into an, empty container.
2. When the hydraulic reservoir is empty, remove suction strainer and hoses.
3. Remove return line on the hydraulic reservoir.
4. Remove the bypass filter and hose.
5. Flush the hoses with clean hydraulic fluid.
6. Discard old bypass filter element and replace.
7. Flush out the tank with hoses removed from the hydraulic reservoir.
8. Reinstall all hoses in the previous steps.
9. Fill hydraulic reservoir with filtered, fresh hydraulic fluid (refer to Lubrication Chart).
10. Loosen output hose fittings at pump to flood with hydraulic fluid. Tighten fittings.
11. Briefly operate all functions. Two or three lift cycles may be necessary to purge all air from lift cylinder(s).
12. When the above procedures have been completed, fill hydraulic reservoir to full mark on sight gauge.
13. Check all leaks and correct as necessary. Machine is now ready to be placed back into operation.

**NOTE:** Avoid mixing petroleum and synthetic base fluids. It is not advisable to mix fluids of different brands or types, except as recommended.

# HYDRAULIC SYSTEM COMPONENTS

## Hydraulic Fluid Reservoir

This consists of the tank, a filler cap with breather, a drain plug, and a bypass filler with a 10 micron filter element.

Perform the following steps weekly:

- Check tank for signs of leakage.
- Inspect tank securing bolts for tightness.

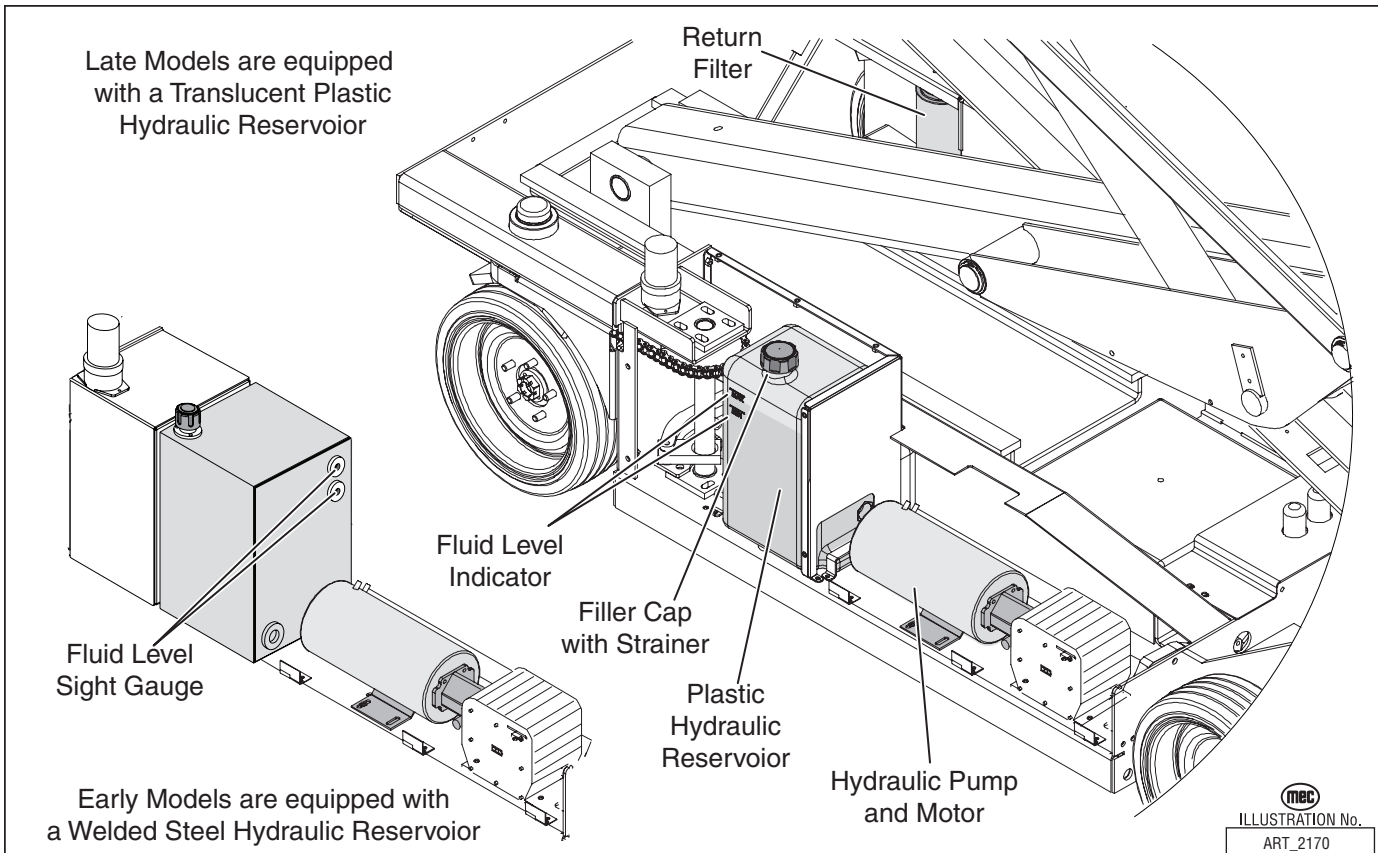
## Hydraulic Filter

All machines are produced with a filter. It is a 10 micron spin-on, bypassing filter. When the filter is clogged, hydraulic flow bypasses the filter element. The filter element must be changed every 6 months or 500 hours. Extremely dirty conditions may require that the filter be replaced more often.

Beware of hot fluid. Contact with hot fluid may cause burns.

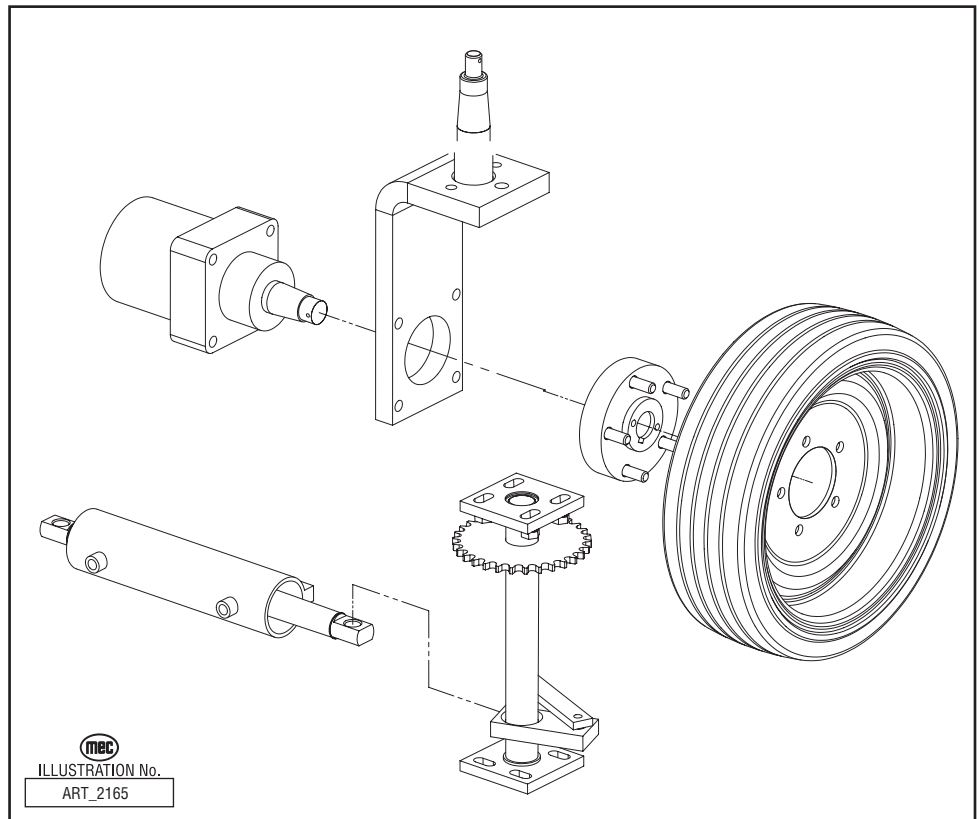
## Hydraulic Pump

An electric motor drives the fixed displacement, gear pump. The pump provides hydraulic fluid flow to operate the machine functions at 3 g.p.m. There are no adjustments on the pump. The pump provides power for the lift, drive, brake and steering functions.



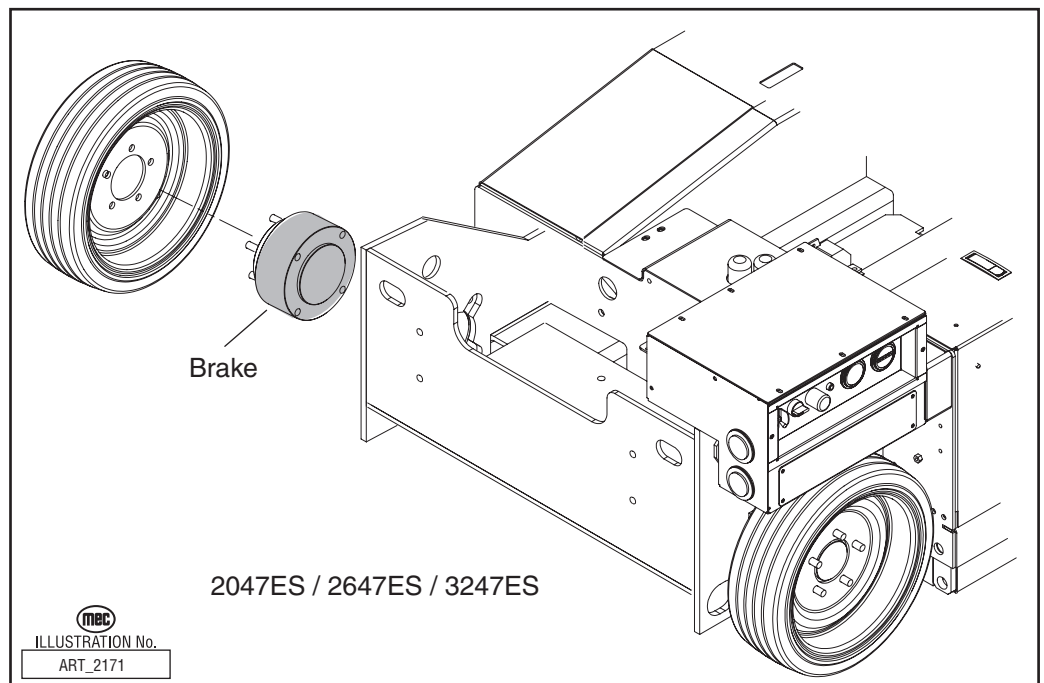
## Wheel Drive Circuit

There are two (2) hydraulic, fixed-displacement gear wheel motors to provide power to two (2) front wheels.



## Braking Circuit

Rear brakes are released whenever the machine is commanded to drive.



# PARKING BRAKE AND TOWING CIRCUIT

**Note:** Refer to *Parts Section E* for hose routing.

Machine can be winched or moved short distances in case of power failure at speeds not to exceed 5 m.p.h. (8.05 km/h).



**PRIOR TO MANUALLY RELEASING BRAKES, INSURE WHEELS ARE CHOCKED TO PREVENT MACHINE FROM MOVING.**

Release Brakes Before Towing:

- Open the tow valve by turning counter-clockwise.
- Push in the manual Brake Release valve located on the main manifold.
- Using the hand pump on the manifold, pump valve until pressure is built.
- Machine is now ready for towing.



**AFTER RELEASING THE BRAKES, THERE IS NOTHING TO STOP THE MACHINE'S TRAVEL. MACHINE WILL ROLL FREELY ON SLOPES. BE ON GUARD AGAINST RUNAWAY.**

To Reset Brakes:

- Close the tow valve by turning clockwise.
- Brakes will reset when drive function is activated or reset by pulling on manual brake release valve.

## EMERGENCY SYSTEMS AND PROCEDURES



**IF THE CONTROL SYSTEM FAILS WHILE THE PLATFORM IS ELEVATED, HAVE AN EXPERIENCED OPERATOR USE THE EMERGENCY LOWERING PROCEDURE TO SAFELY LOWER THE PLATFORM.**

**DO NOT ATTEMPT TO CLIMB DOWN SCISSOR ASSEMBLY.**

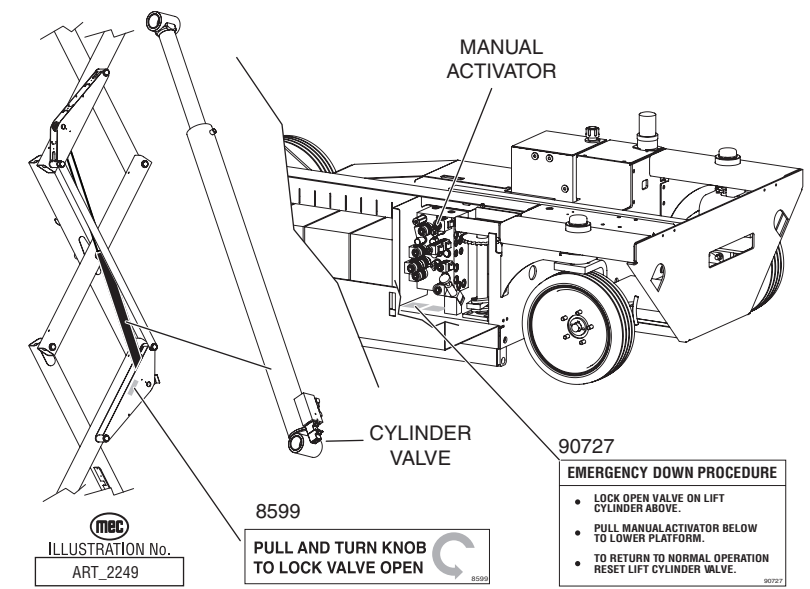
**BEFORE LOWERING PLATFORM, RETRACT THE DECK EXTENSION.**



## Emergency Lowering - 2047ES and 2647ES (early models)

The Emergency Down System is used to lower the platform in case of power or valve failure. To lower the platform, perform the following steps:

1. Pull and turn knurled knob on lift cylinder counterclockwise to lock the valve in open position.
2. Pull manual activator (override valve) on main manifold to lower platform to desired height.
3. To return to normal operation, turn knurled knob on lift cylinder clockwise. Valve will automatically lock.



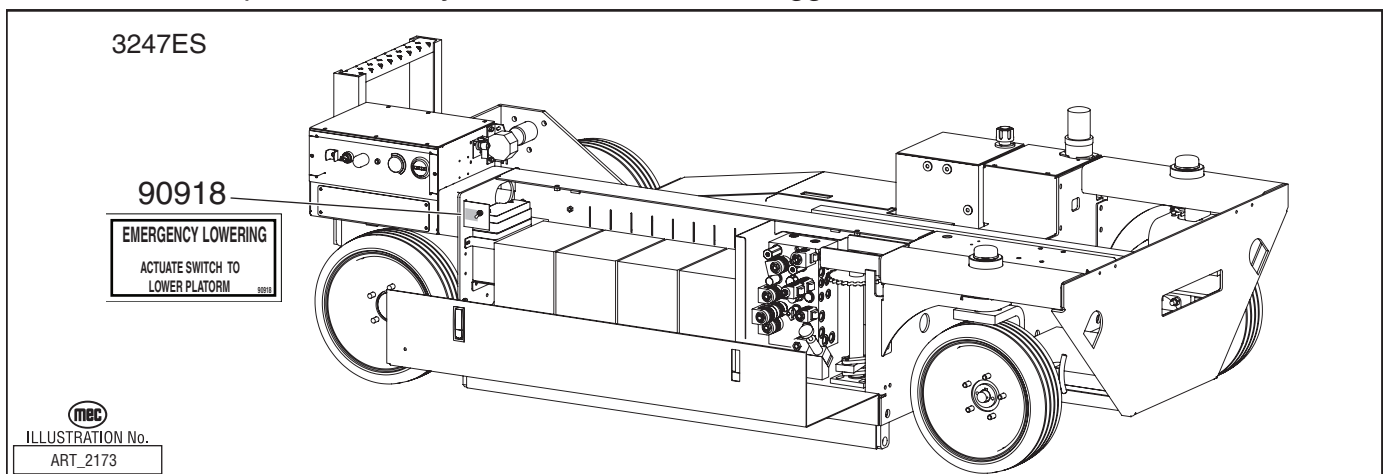
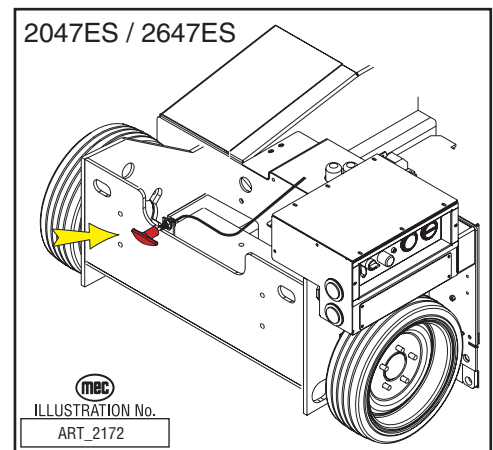
## Emergency Lowering - 2047ES and 2647ES (current models)

Emergency Down system is used to lower the platform in case of power or valve failure. To lower the platform, pull the red "T" handle located at the rear of the machine. Lowering stops when you release the "T" handle.

## Emergency Lowering - 3247ES (all models)

The Emergency Down System is used to lower the platform in case of power or valve failure. To lower the platform, perform the following steps:

1. Push down on the toggle switch and hold it to lower the platform to the desired height.
2. Once the platform is fully lowered, release the toggle switch to close the valve



# STEERING CIRCUIT

**Note:** Refer to *Hydraulic Manifold and Relief Pressure Adjustment Procedure*.  
Refer to *Section 3* for Remove and Replace instructions.  
Refer to *Parts Section E* for hose routing.

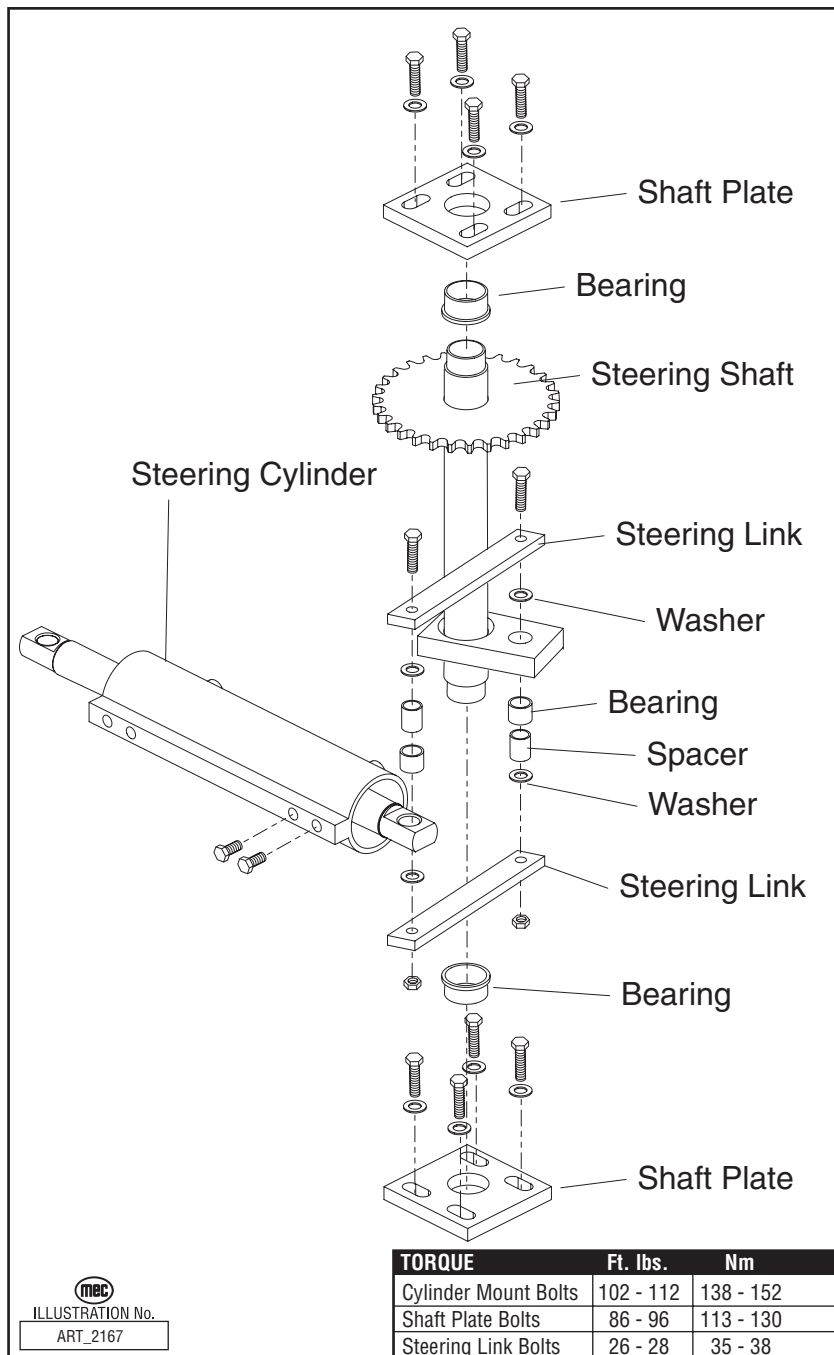
## The steering system consists of the following components:

- Each wheel motor housings has a pivot and chain sprocket on the top.
- A hydraulic steering cylinder is mechanically linked via tie rods to two (2) chain-and-sprocket assemblies (one [1] for each motor housing).
- Steering is accomplished hydraulically by using one (1) double-acting cylinder, and a 4-way 3-position solenoid-operated, hydraulic directional control cartridge valve.

## Steer Cylinder

There is one (1) cylinder utilized in the steering system. This cylinder is a double acting double sided type which requires fluid flow to operate the cylinder rod in both directions. Directing fluid forces the piston to travel to one side or the other, thereby extending one rod end and retracting the other.

Refer to the Mechanical Section of this manual for cylinder disassembly, or replacement.



# PLATFORM LIFT CIRCUIT

**Note:** Refer to *Hydraulic Manifold* and *Relief Pressure Adjustment Procedure*.  
Refer to *Section 3* for Remove and Replace instructions.

- The lift system uses the hydraulic pump to obtain proportional lifting function controlled by the lift valve and pump speed.
- Lowering is single speed controlled by the holding valves on the lift cylinder(s) and regulated by a fixed orifice located on the lift cylinder(s).
- Platform capacity is limited by a hydraulic relief valve in the lift circuit. (Refer to Machine Specifications or the Hydraulic Schematic for proper setting).

## Lift Cylinder

**Note:** Refer to *Cylinder Repair*.

### 2047ES / 2647ES

One (1) single acting type hydraulic cylinder.

The cylinder has an integrated 2-position, 2-way solenoid operated platform lower valve for holding the platform in position.

The valve is also externally actuated for manually lowering the platform. Early models use a pull-to-release knob at the cylinder, while current models use a cable release with a pull handle located near the ladder (see *Emergency Systems and Procedures*).

### 3247ES

Two (2) single acting type hydraulic cylinders.

Each cylinder has an integrated 2-position, 2-way solenoid operated platform lower valve for holding the platform in position (see *Emergency Systems and Procedures*).

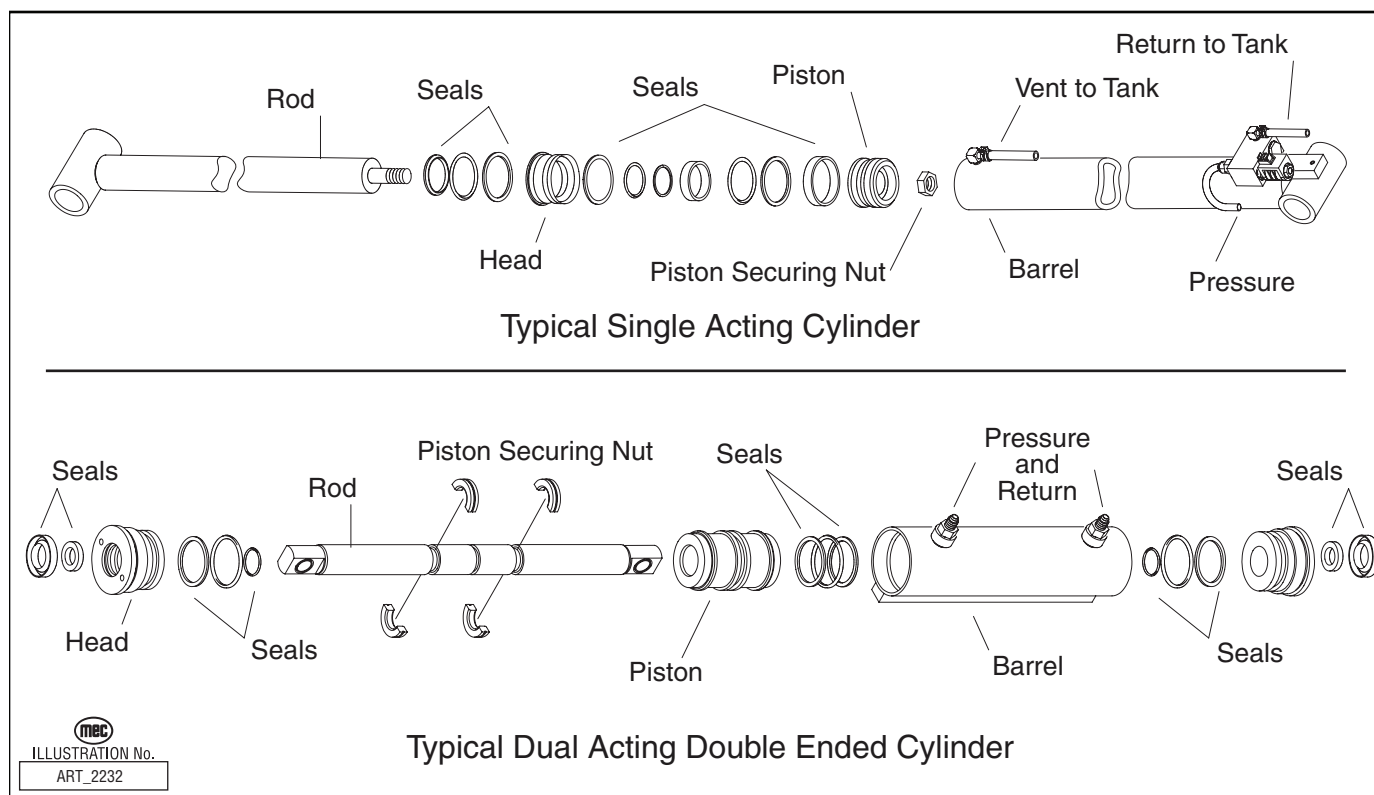
The valves are also externally actuated via a toggle switch for manually lowering the platform.

The normally closed holding valve prevents retraction of the cylinder rod should a hydraulic line rupture or a leak develop between the cylinder and its related control valve.

# CYLINDER REPAIR



**CYLINDERS ARE HEAVY. SUPPORT CYLINDERS BEFORE REMOVING HARDWARE THAT SECURES THE CYLINDER TO THE MACHINE.**



## Removal

**Note:** Refer to *Section 3* for Remove and Replace instructions, and the *Parts Section* for a list of hardware specific to the cylinder being repaired.

1. Tag hoses for proper reassembly.
2. Disconnect hoses and IMMEDIATELY cap the openings to prevent contamination.
3. Remove cylinder from the machine as described in *Section 3*.

## Preparation



**Take care not to damage rod surface and guard against dirt or other foreign objects entering system.**

1. Drain all fluid from cylinder.
2. Clean all dirt and grit from outside of cylinder.
3. Insert cylinder into vise.

## Cylinder Disassembly

1. Remove the head from the cylinder body.
2. Remove the shaft assembly from the barrel, pulling in a straight line, so as not to scar the internal parts.
3. Insert shaft into a **soft jawed** vise so that the head and piston can be removed. Be sure the shaft and vise are both clean before using.
4. Remove nut at the end of the shaft and pull head and piston off of the rod.
5. Remove all seals from the head and piston using a non-sharp seal tool. These tools are available from various seal suppliers.
9. Clean all fluid and debris off of the head, piston, shaft, collar and barrel using solvent, rags, and an air hose.
10. Inspect parts for scratches, pits or polishing. Check seal grooves and sealing surfaces.
  - a. Scratches or pits deep enough to catch the fingernail are unacceptable; replace the cylinder.
  - b. Polishing is a sign of uneven loading. Check for roundness. If a polished surface is not round within .007 in (0.18 mm) replace the cylinder.

## Cylinder Assembly

### CAUTION:

- To insure a quality repair, cylinder parts must be thoroughly cleaned, dry, and free of solvents, and assembly must be performed in a clean area free of dust and contamination.
- 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 restore to their original shape before assembling the cylinder.
- Torque all hardware according to the *Hydraulic Components Torque Table* unless otherwise specified.

1. Lubricate all components with clean hydraulic fluid.
2. Install new seal kit components. Install all seals on the head and piston using the non-sharp seal tool.
3. Place a small amount of fluid on the inside seals of the head and reinstall it on the shaft, by slipping head over the piston end of the shaft being very careful not to damage the inside seals.
4. Place a small amount of fluid on the inside seals of the piston and reinstall it on the shaft by slowly twisting the piston on over the threads of the shaft being very careful not to damage the inside seals.
5. Reinstall the shaft nut; torque 1 ½" nut to 160 ft.-lbs.
6. Grease the outside seals of the head and piston.
7. Reinstall the shaft into the barrel of the cylinder and push in until groove of the head lines up with the slot in the barrel.
17. Reinstall the cylinder retainer. Installation is reverse of removal.
18. Cycle the cylinder using air to check for proper operation.

**NOTE:** It is very important to keep all parts clean when working with hydraulic cylinders, even one small piece of dirt or grit can damage the cylinder.

# HYDRAULIC MANIFOLD

**Note:** Refer to *Section 3* for Remove and Replace instructions, and the *Parts Section* for a list of hardware.  
Tag all components as they are removed so as not to confuse their location during reassembly.

## Hydraulic Manifold Removal

1. Disconnect the negative battery terminal.
2. Tag and disconnect the solenoid valve leads.
3. Tag and disconnect hydraulic hoses, and IMMEDIATELY cap the openings to prevent contamination.
4. Remove the bolts that hold the manifold to the mounting bracket.
5. Remove the manifold block.

## Disassembly

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 defective parts and O-rings.

## Assembly

**Note:** Lubricate all O-rings before installation to prevent damage to the O-ring. Seat 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 #424 or equivalent thread locker on each screw-in orifice.
2. Install valves.

## Installation

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









## SECTION 2:

# ELECTRICAL SYSTEM

Electrical System - General .....	2-2
Deutsch Connectors .....	2-3
Batteries .....	2-4
Alarms and Switches .....	2-8
Continuity Checks .....	2-11
Diode Board .....	2-12
Sevcon Motor Speed Controller .....	2-13
Load Sensing System .....	2-14

# ELECTRICAL SYSTEM - GENERAL

The electrical control system consists of a lower control box and a upper control box.

## Lower Control box

The ground station, when enabled via the Base/Platform Selector Switch, disables the upper station and provides control for a fixed speed Lift UP/DOWN functionality.

## Upper Control box

The upper station consists of a joystick controller with enable switch (trigger), Lift/Drive Mode (Forward/Down, Reverse/Up and accelerator demand), Steer (Right/Left). A torque mode switch causes both hydraulic motors to operate in parallel rather than in series for speed control mode (normal).

# DEUTSCH CONNECTORS

Deutsch connectors used on MEC equipment is designed so that individual parts may be replaced without replacing the entire component. Special tools and detailed instructions are provided in Deutsch Connector field kits, MEC part number 84091.

## Male Plug Connector

- Use the flat end of the Removal Tool or a flat blade screwdriver to pry the locking wedge from the connector, taking care not to damage the Sealing Gasket.
- Inspect and replace damaged parts.
- Replace or re-crimp wires and contacts.

## Female receptacle Connector

- Use the notched end of the removal tool or a wire hook to pull the locking wedge from the connector
- Replace worn or damaged parts
- Replace or re-crimp wires and contacts.

## Locking Fingers

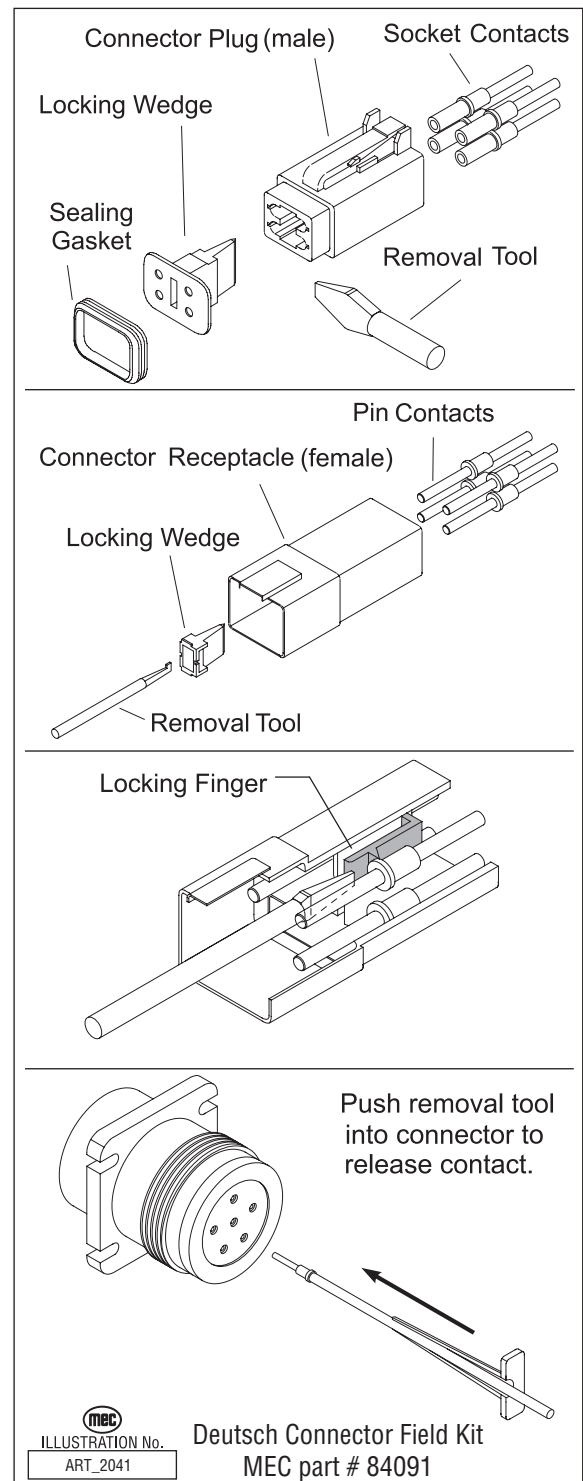
- Remove the locking wedge as outlined above.
- Using the removal tool or a flat blade screwdriver, push the Locking Fingers aside to release the contact.
- Pull the wire and contact out of the connector.

## Heavy Duty Plug

- Slide the removal tool along the wire to be replaced and push into the connector to release the contact.
- Pull the wire and contact out of the plug.

## Crimping

- Strip 1/4 in (6 mm) insulation from the wire.
- Insert the contact into the crimping tool and insert the stripped wire into the contact making sure no wires are outside the contact barrel.
- Close the handles of the crimping tool, then release the handles to remove the crimped contact.



# BATTERIES



**CHARGING BATTERIES CREATE EXPLOSIVE HYDROGEN GAS. KEEP SPARKS, FLAMES AND SMOKING MATERIALS AWAY FROM BATTERIES.**

**ALWAYS WEAR SAFETY GLASSES WHEN WORKING WITH BATTERIES.**

**BATTERY FLUID IS CORROSIVE. THOROUGHLY RINSE SPILLED FLUID WITH CLEAN WATER.**

**REPLACE WITH MANUFACTURER APPROVED BATTERIES.**

**BEFORE DISCONNECTING THE BATTERY NEGATIVE (–) LEAD, MAKE SURE THAT ALL SWITCHES ARE OFF. IF ON, A SPARK WILL OCCUR AT THE GROUND TERMINAL THAT COULD IGNITE HYDROGEN GAS OR FUEL VAPORS.**

Four (4), 6 volt batteries supply the 24 volt electrical power required to operate the electrical circuits.

One (1) 12 volt battery supplies power to operate the Emergency Lowering circuit for the 3247ES.

## **Battery Maintenance (in storage)**

Follow these procedures for maintenance of battery on a machine not in use:

- Keep battery clean. Electrolyte of “wet” batteries should be checked regularly and kept at proper level.
- Never stack one battery directly on top of another because post or container damage can result. If batteries are stored individually, place supporting boards between layers. Rotate stock so that oldest batteries are used first.
- “Wet” batteries should be kept fully charged. A “wet” battery, while in storage, should be recharged to full charge at recommended intervals. Leaving the MEC charger connected during prolonged storage will maintain battery voltage automatically.

A battery fully (100 %) charged at 80 °F (26.6 °C)

- drops to 65 % at 32 °F (0 °C)

- drops to 40 % at 0 °F (–32 °C)

## **Recommended Intervals**

### **If Stored At:**

Below 40 °F (4 °C)

Above 60 °F (15 °C)

40 ° - 60 °F (4 ° - 15 °C)

### **Recharge:**

None required

Every month

Every 2 months

## Battery Maintenance (in use)

Check battery and surrounding area for signs of damage or corrosion.

Check battery terminals for:

- Corrosion: Regularly clean connections and apply a nonmetallic grease or protective spray to retard corrosion.
- Loose connections: Be sure all cable connections are tightly secured, and that good contact is made with terminals.
- Broken or Frayed cables: Be sure all connections are good and that no loose or broken wires are exposed. Replace as necessary.

Check battery electrolyte level. Replenish the electrolyte, if necessary. Remove vent caps before filling, and USE ONLY DISTILLED WATER. DO NOT OVERFILL. Fill to level indicator (or 1/2 inch over the top of separators, if there is no level indicator). Fill after charging to prevent overflow of acid due to expansion. Do not use a hose to add water to batteries.

Allowing the electrolyte level to drop below the top of the separators will lead to shortened battery life.

Excessive water usage can indicate that a battery has been overcharged, has been subjected to excessively high temperatures, or is nearing the end of its service life.

## Battery Preventative Maintenance:

Every 15 hours (after battery has been charged), spot-check the specific gravity of two or more cells. A fully charged battery should indicate 1.28 specific gravity. If low readings are noted, check the following:

- Check terminals for corrosion, loose connections and broken or frayed cables.
- Check all cells with a hydrometer for variance in specific gravity. A variation of 0.03 points or more between cells is a cause for concern. Mark the low cells.

Recheck specific gravity of all cells after recharging. Wash the top of the battery, making sure all vents are in place. Do not allow cleaning water or other foreign matter to enter the cells. Use a solution of bicarbonate of soda (5 tsp of baking soda per quart of warm water) and water to wash the battery if there is an accumulation of acid.

### Battery Specific Gravity and Voltage Table

SPECIFIC GRAVITY		VOLTS DC		
EACH CELL		PER CELL	6V BATTERY	12V BATTERY
Fully Charged	1.280	2.10	6.30	12.60
Fully Discharged	1.130	1.75	5.19	10.50

## Battery Charging

### Main Electrical Power






**The use of an improper extension cord could result in a risk of fire or electric shock.**

The use of long extension cords with the charger should be minimized. If an extension cord is used, ensure that it has three conductors with a ground and that the wire size and length meet your electrical code for the voltages and currents of the Electrical Specifications table. Locate all cords so that they will not be driven over, stepped on, tripped over, or otherwise subjected to damage or stress.

Connect the power supply cord to a properly grounded 100 volt / 50 or 60 Hz, 115 v/ 60 Hz, or 230 volt / 50 or 60 Hz socket. This charger automatically senses and adjusts to the AC input voltage range.

The charger will start automatically within four to six seconds. The charger will start even with severely discharged batteries (down to 1 volt terminal voltage). Once charging starts, the LEDs indicate the charging progress as described in the following Charging State table. If all 3 LEDs blink together there is a problem. Take proper action according to the trouble shooting guide found in *Section 4: Troubleshooting*. The charger goes into an equalizing charge mode after the batteries are charged and all 3 LEDs are ON. The charger will continue to charge at a low current then shut-off automatically when complete.

		50 %	75 %	100 %
Charging State	LED			
0 to 50 % charged		Blinking	OFF	OFF
50 % to 75 % charged		ON	Blinking	OFF
75 % to 100 % charged		ON	ON	Blinking
100 % charged		ON	ON	ON
Abnormal Cycle		OFF	OFF	Blinking

### Emergency Lowering System - 3247ES

Battery charging current is regulated by a diode in the charger supply cable. Refer to the illustration on the following page.

## Battery Replacement



**BEFORE REMOVING THE BATTERIES FROM THE MACHINE, TURN OFF THE SELECTOR/KEY SWITCH. THERE SHOULD BE NO POWER.**



**Prevent damage to battery and/or electrical system;**

- **Always disconnect the negative battery cable first.**
- **Always connect the positive battery cable first.**

### Main Electrical Power

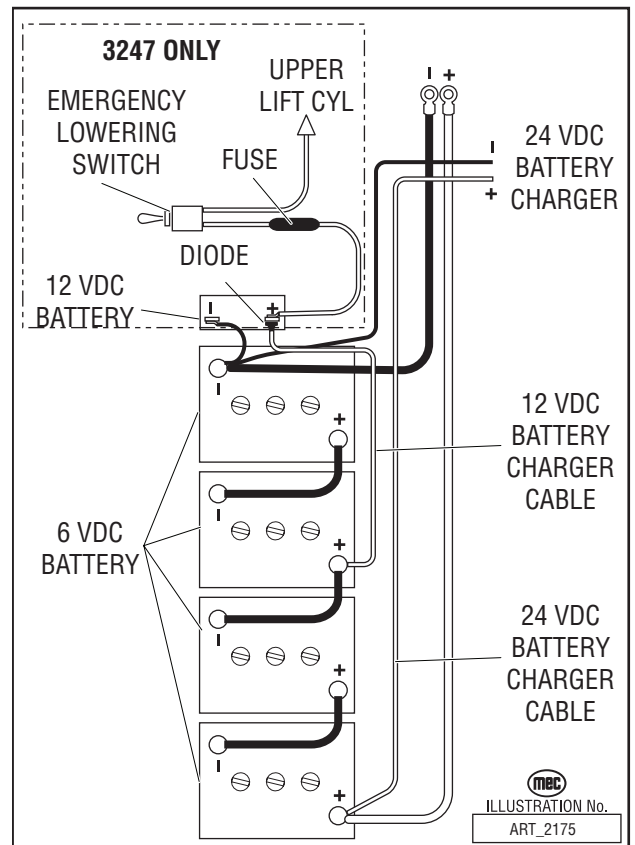
To remove batteries, follow these procedures.

Batteries are located in the side compartment of the machine.

**Always disconnect the negative battery cable first.**

Remove bolts holding battery. Lift the battery from the compartment. Put the battery to the side and dispose of properly.

To install the battery, reverse the process by positioning the battery in the compartment securely with hold down bolts. Connect battery cables.



# ALARMS AND SWITCHES

## Emergency Stop Button

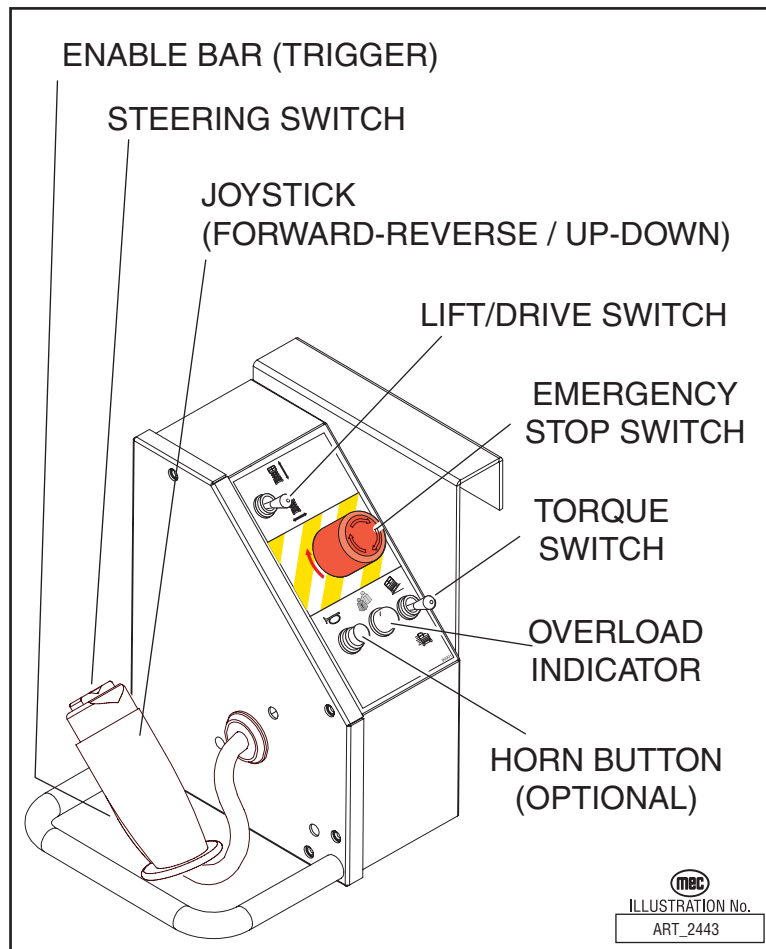
There are two red emergency stop buttons: one located on the upper controls and the other on the lower control panel.

This stop button, when in the ON (OUT) position, provides power to the desired control box. Also, the stop button, in the event of an emergency can be used to turn off the power by pushing IN. All functions stop immediately when depressed.

Turn button clockwise to reset.

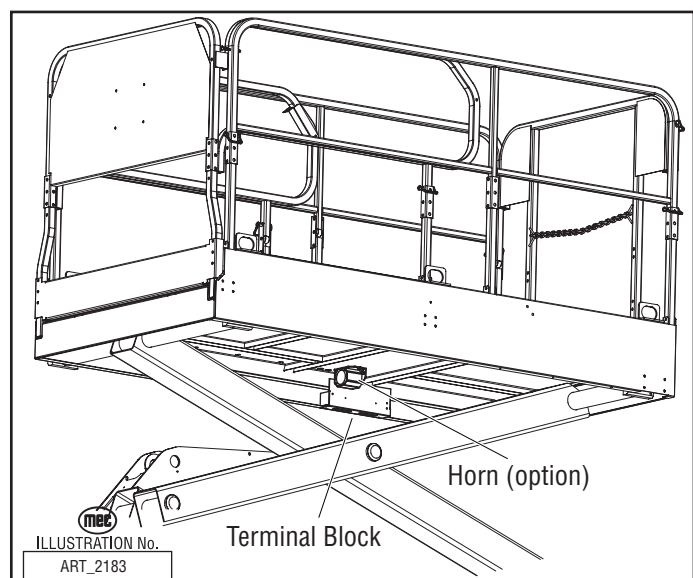
**NOTE:** As a safety feature, selecting and operating the lower controls will override the upper controls emergency stop button.

The lower control box emergency stop button will stop machine operations, even if the selector switch is switched to upper controls.



## Horn

It is activated at the upper controls and sounds at the ground alerting personnel to clear the machine's path to avoid hazards or unsafe conditions.





## Selector Switch

Machine can be operated from the lower or upper controls. Activation of one or the other is achieved with this switch.

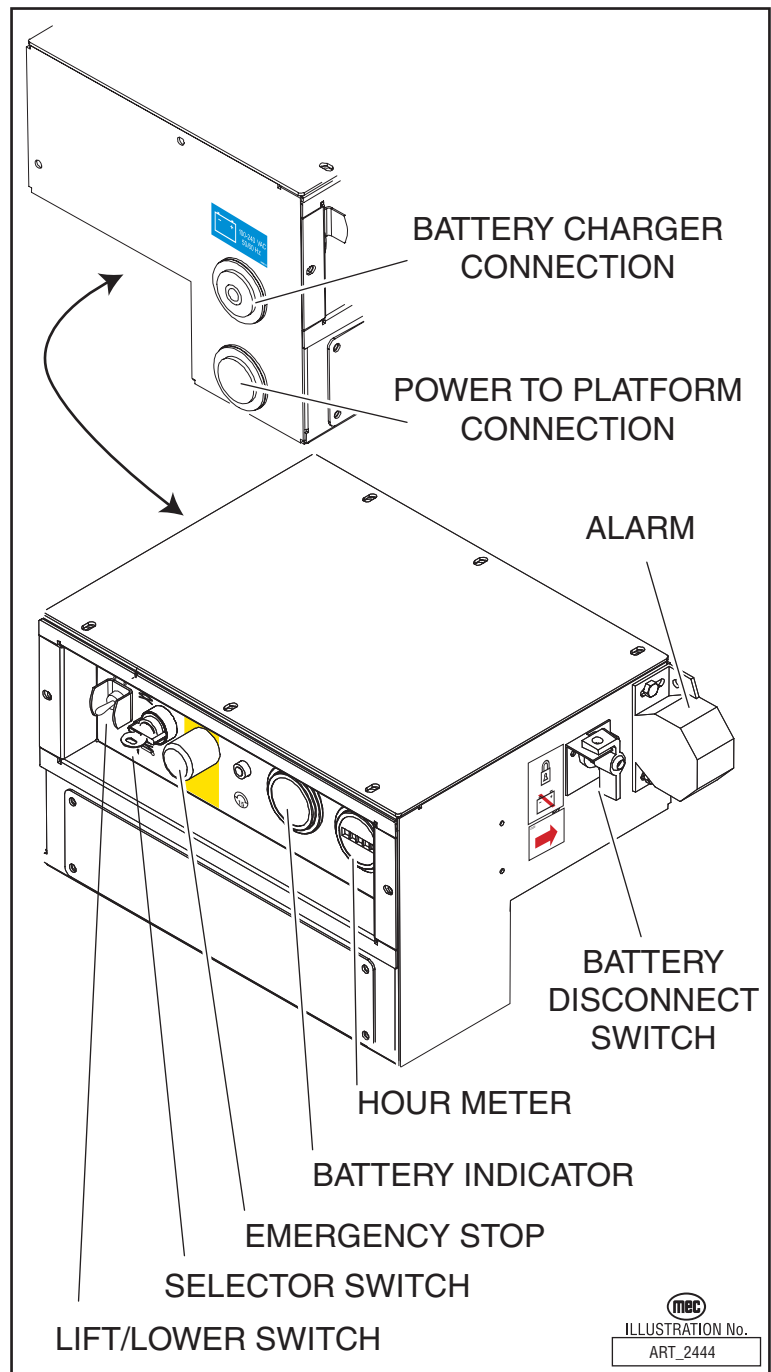
With the upper controls selected, from the lower control panel, if the platform up/lower function is operated there should be NO movement. Similarly, with the lower controls selected, from the upper controls if any machine function is operated, there should be NO movement.

## Master Disconnect Switch

The switch is used primarily to shut off control circuit. The battery disconnect is provided to facilitate servicing and also to prevent unauthorized use of the vehicle by using a padlock (to provide security).

## Movement Alarm

This alarm is activated as soon as the upper control box joystick (controller) lever is moved off the center "Neutral" position.



**THE MOVEMENT ALARM IS PROVIDED FOR YOUR PROTECTION, AND PROTECTION OF PERSONS WORKING IN THE IMMEDIATE AREA. DISABLING THIS IMPORTANT SAFETY DEVICE MAY RESULT IN SERIOUS INJURY OR DEATH.**

## Limit Switch

There is a limit switch to prevent driving in high speed. When the platform is raised above approximately 7 feet (2.3 meters), the machine will be in the slow speed mode.

## Pothole Switch

When the platform is elevated above 7 feet (2.3 meters), the pothole switch activators raise, activating the two (2) pothole switches and causing the pothole bars to extend.

When the platform is lowered, the pothole switch activators lower, depressing the two (2) switches and causing the pothole bars to retract.

## Height / Angle Switch

The height sensor calculates the height of the platform by measuring the angle of the bottom scissor beam. The data is used by the load sensing system to ensure safe machine operation.

## Overload / Pressure Switch

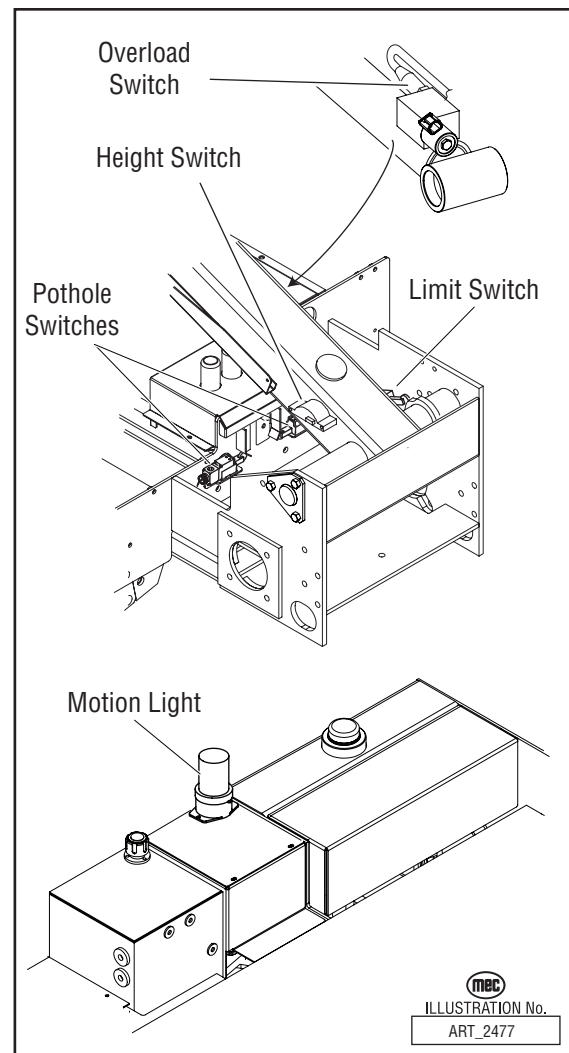
The overload switch measures the pressure at the lift cylinder to calculate platform load. The data is used by the load sensing system to prevent operation when the platform is overloaded.

## Tilt Alarm

An alarm provided on the platform control box will sound at 10 Hz when the machine is on an unsafe slope, and elevated above the limit switch. If the alarm sounds, use extreme caution and lower the platform. Reposition the machine on a firm level surface before elevating again.

## Tilt Alarm Test

The slope rating is shown on the machine Serial Plate or in the *Specifications* section of this manual. Identify a suitable location where the slope is outside the specified range using an inclinometer. Lower the platform fully before driving onto this slope. Exit the platform and switch selector to Base Controls. Elevate the platform to approximately 2.5 m. An alarm should sound at Upper Control station. If it does not, review *Section 3* for troubleshooting of the Platform Overload Sensing System.



# CONTINUITY CHECKS

## Check Toggle Switch

- Disconnect wires and connect one probe of ohm meter to the connection on toggle switch and the other probe on the other connection.
- When toggle is open, there should be no reading, and when closed there should be a low reading.

## Check Selector Switch

- Disconnect wires and connect one probe of ohm meter to common and the other to normally open terminal.
- With the switch flipped, there should be a low resistance.

## Check Emergency Stop Button

- Disconnect wires and connect one probe of ohm meter to connection on button and other probe on other connection.
- There should be no reading with the button pressed and a low resistance with it reset.

## Check Limit Switch Operation

- Disconnect wires.
- With one probe of ohm meter to common and other probe to open contact, move limit switch arm. Low resistance should be seen.
- With one probe of ohm meter to common and other probe to closed contact, low resistance should be seen. Move limit switch arm and no resistance should be seen.

# DIODE BOARD

The diode board is located inside the lower control box.

The diagram shows a diode board layout. At the top is a 14-pin connector J1 with pins numbered 14, 7, 8, and 1. Below it is a terminal block TB1. Various diodes (D1-D15) and resistors (R1-R4) are shown with their respective wire connections. A MEC 8601 component is at the bottom center.

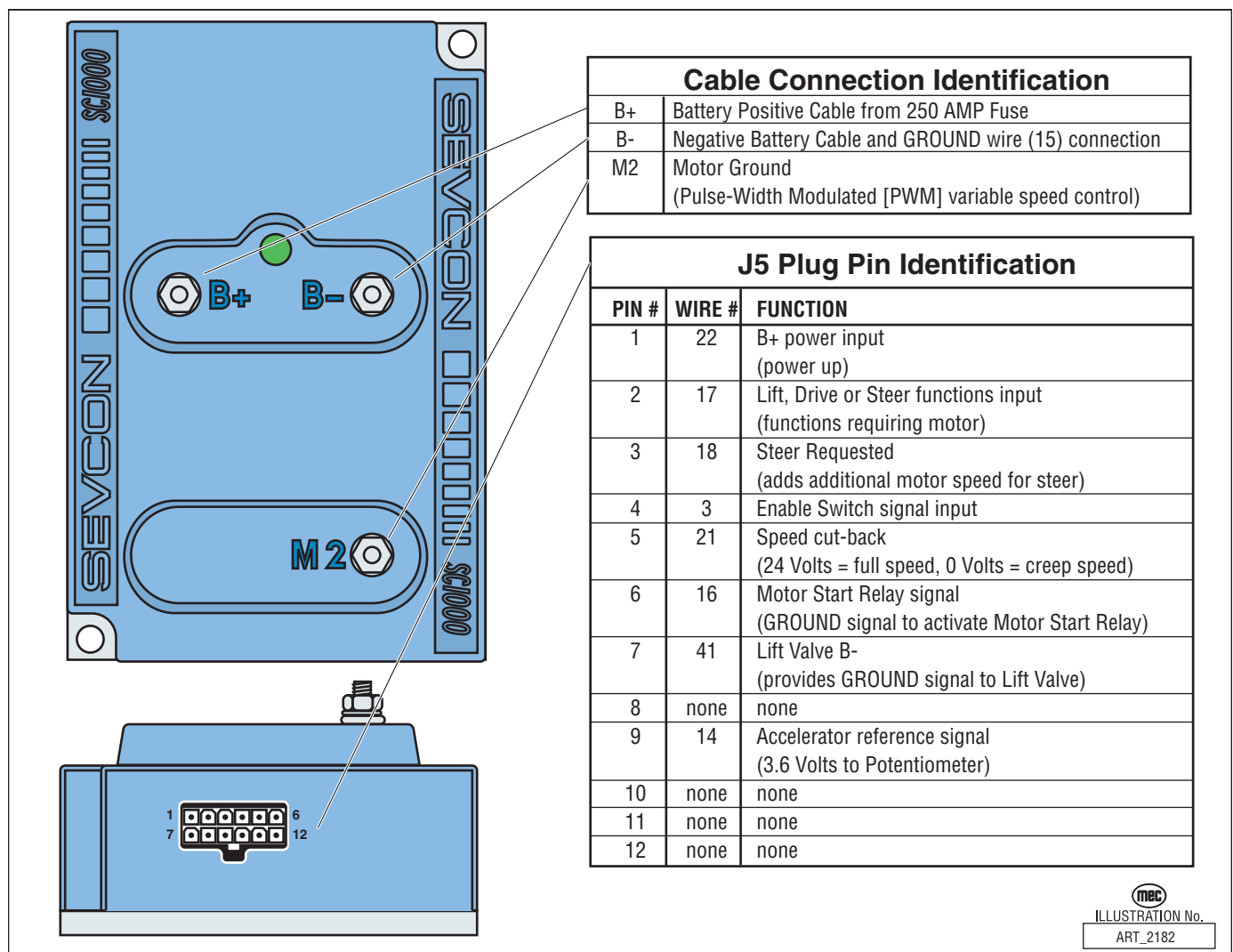
J1 Plug Pin Identification			
PIN #	WIRE #	SIGNAL	FUNCTION
1	10	INPUT	Drive Reverse
2	11	INPUT	Drive Forward
3	19	OUTPUT	Brake, Decel Valve signal
4	8	INPUT	Steer Left
5	18	OUTPUT	Steer signal to Sevcon
6	5	INPUT	Down signal
7	20	OUTPUT	Signal to Motion Alarm(s) (optional)
8	17	OUTPUT	Sevcon & Hour Meter (motor function requested)
9	15	INPUT	Battery Negative
10	7	INPUT	Steer Right
11	4	INPUT	Lift Up
12	2	INPUT	Limit Switch (24V = platform down)
13	3	OUTPUT	Enable, from lower Lift switch
14	21	OUTPUT	To Sevcon (for speed cutback)

ILLUSTRATION No.  
ART\_2181

# SEVCON MOTOR SPEED CONTROLLER

The Sevcon Motor Speed Controller located in the lower control box, is a microprocessor designed with the express purpose of operating the D/C electric motor at varying speeds. The controller uses Pulse-width Modulation (PWM) technology on the Ground side of the motor to control motor speed. Out of concern for operator safety and to prevent short-circuiting, the Controller monitors certain circuits for potential abnormalities. When the controller senses a problem it errs to the side of safety and stops all motor operation. The green LED will flash a code indicating the reason for the shutdown.

Refer to *Section 5: Troubleshooting* for diagnostic codes.



# LOAD SENSING SYSTEM

The GP102 control module prevents scissor vehicle operation when its platform is overloaded, and provides a warning alarm for tilted condition. Troubleshooting and calibration of the load sense system are covered in *Section 3*.

## GP-102 Load Sense Control Module Connections

### J1 (P1)

PIN #	WIRE #	FUNCTION
1	EZ-Cal	DIAGNOSTIC
2	EZ-Cal	AND
3	EZ-Cal	CALIBRATION
4	EZ-Cal	

### J2 (P2)

PIN #	WIRE #	FUNCTION
1	—	No Connection
2	—	No Connection
3	4	UP valve (B+ when UP requested)
4	5	DOWN valve (B- when DOWN requested)
5	—	No Connection
6	—	No Connection
7	20A	PCB #7 (B+ for any movement)
8	—	No Connection
9	—	No Connection
10	2	Platform Elevated indication (B+ when platform stowed)
11	15	Supply Negative (connected to B-)
12	22	Supply Positive (connected to B+)

### J3 (P3)

PIN #	WIRE #	FUNCTION
1	20	Base Alarm (A8)
2	6	Platform Alarm (A10)
3	12	Overload Light (A1) Normally OFF   ON indicates overload
4	44	Overload Relay Output (8) (B+ when not overloaded)
5	45	Overload Relay (7) (B-) (internally linked to P2-11)
6	—	No Connection

### J4 (P4)

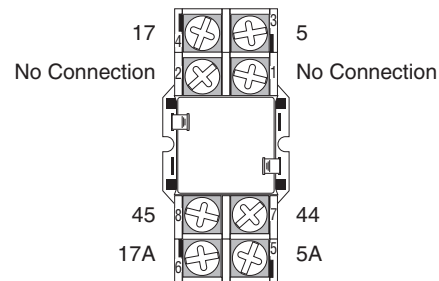
PIN #	WIRE #	FUNCTION
1	—	No Connection
2	42	Overload Sensor
3	43	Height sensor
4	—	No Connection
5	—	No Connection
6	46	Overload Sensor (B+ protected supplies)
7	47	Overload Sensor (B-)
8	48	Height Sensor (B+ protected supplies)
9	49	Height Sensor (B-)

## Overload Cutout Relay Connections

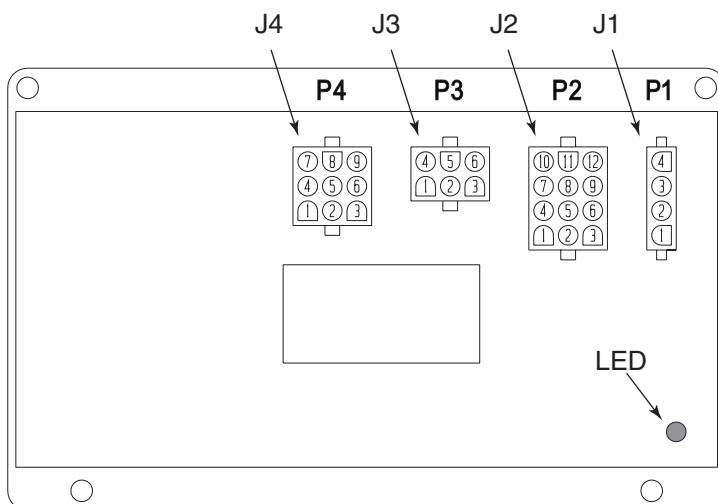
### RL1

PIN #	WIRE #	FUNCTION
1	—	No Connection
2	—	No Connection
3	5	DOWN requested
4	17	LIFT, DRIVE, or STEER requested
5	5A	Signal to Down Valve Coils
6	17A	Signal to Motor Controller (LIFT, DRIVE, STEER)
7	44	Cutout Relay (B-)
8	45	Cutout Relay (B+ when not overloaded)

### RL1 Overload Cutout Relay



### GP-102 Load Sense Control Module





## SECTION 3

# PLATFORM OVERLOAD SYSTEM

<b>General Description .....</b>	<b>3-2</b>
<b>Electrical Connections .....</b>	<b>3-3</b>
<b>Troubleshooting .....</b>	<b>3-4</b>
GP102 - EZcal Help Messages .....	3-4
GP102 LED Flash Codes .....	3-7
<b>Calibration .....</b>	<b>3-8</b>
CALIBRATION TROUBLESHOOTING; Failure Messages .....	3-11
CALIBRATION TROUBLESHOOTING; Information Messages .....	3-16







# GENERAL DESCRIPTION

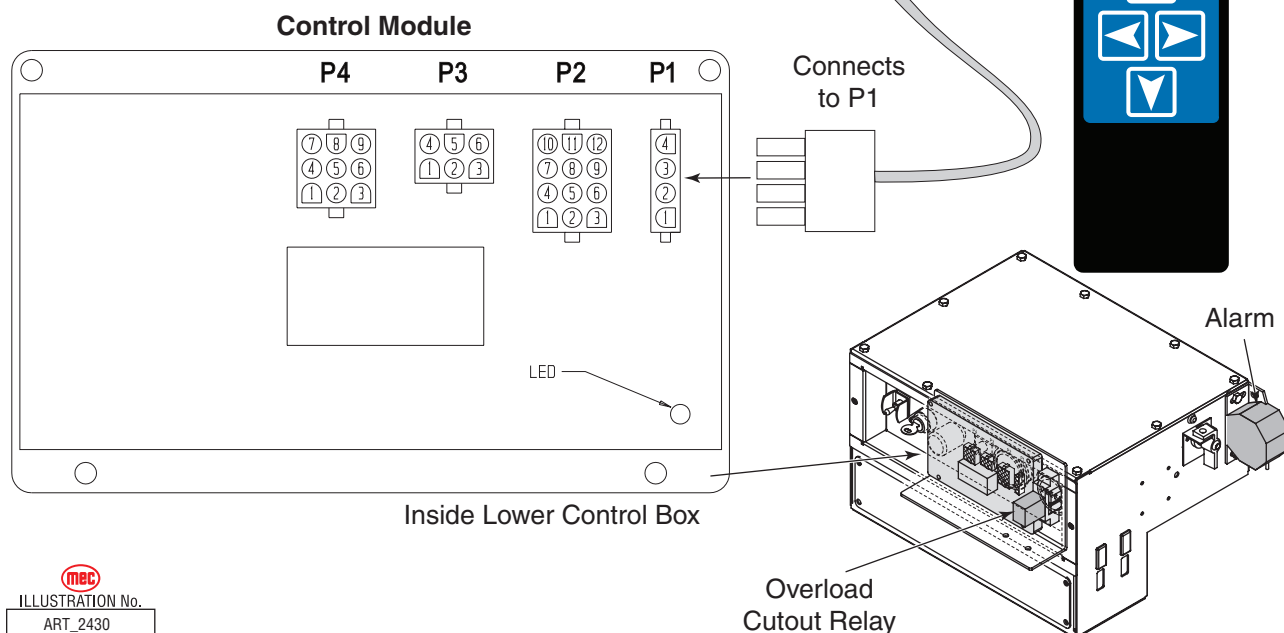
In combination with a height sensor to measure platform height and a pressure sensor to measure lift cylinder load, the GP102 control module calculates an estimate of load and prevents scissor vehicle operation when its platform is overloaded. The system also includes an integrated tilt sensor that provides a warning alarm for tilted condition. In addition the automatic armguard cutout and descent alarm are controlled by this system. To access the control module for troubleshooting and calibration, the **EZcal** hand held device is required. These are available from MEC Aerial Platform Sales Corp.



**ONLY TRAINED AND AUTHORIZED PERSONNEL SHALL BE PERMITTED TO CALIBRATE THE PLATFORM OVERLOAD SENSING SYSTEM.**

**READ ALL INSTRUCTIONS CLOSELY BEFORE ATTEMPTING EACH STEP OF THE CALIBRATION PROCEDURE.**

SYMBOL	KEY FUNCTIONS
 	<b>ESC/ENTER BUTTONS</b> To move back and forth between menu and sub-menu
 	<b>LEFT/RIGHT BUTTONS</b> Select menus and setting to be adjusted
 	<b>UP/DOWN BUTTONS</b> Adjust steering values





# ELECTRICAL CONNECTIONS

**P1 (J1) Connects to EZcal hand-held device for diagnostics and calibration.**

**P2 (J2) Connects to power supply & function switches:**

	(J) P2-1	no connect
	(J) P2-2	no connect
RED/BLU 304	(J) P2-3	"UP" valve (B+ when UP requested)
YEL/BLU 105	(J) P2-4	"DOWN" valve (B+ when DOWN requested)
	(J) P2-5	no connect
	(J) P2-6	no connect
GRY/RED 111	(J) P2-7	"FWD" Valve (B+ when Forward commanded)
GRY/BLK 110	(J) P2-8	"REV" Valve (B+ when Reverse commanded)
	(J) P2-9	no connect
TAN/ORG 2	(J) P2-10	"PLATFORM ELEVATED" indication (B+ when platform stowed)
BLK 15	(J) P2-11	SUPPLY NEGATIVE (connected to B-)
RED/WHT 201	(J) P2-12	SUPPLY POSITIVE (connected to B+)

**P3 (J3) Provides outputs for cutout Alarms, lamp, and relay**

TAN 12	(J) P3-1	Tilt Sensor to Lower Control Box (B+ when not tilted)
BLU/WHT 72	(J) P3-2	Platform and Base Alarm
BLK/RED 74	(J) P3-3	OVERLOAD LAMP output (off normally, turns on to indicate overload)
RED/BLK 44	(J) P3-4	Cutout Relay output (B+ when not overloaded)
BLK 15	(J) P3-5	Cutout Relay B- (internally linked to P2-11)
	(J) P3-6	no connect

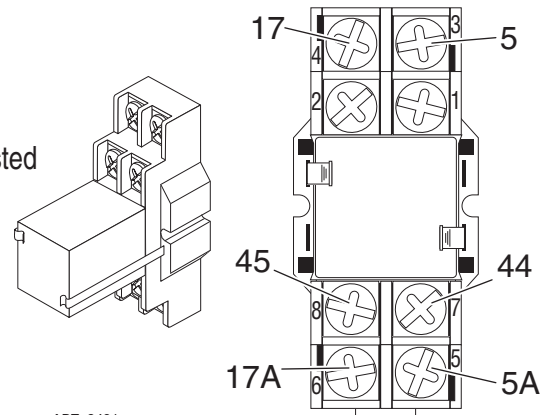
**P4 (J4) Connects to lift cylinder pressure sensor and height sensor:**

	(J) P4-1	no connect
ORG/GRN 42	(J) P4-2	pressure sensor (0.5V...4.5V analog)
ORG/RED 43	(J) P4-3	height sensor (1V...4V analog)
	(J) P4-4	no connect
	(J) P4-5	no connect
GRY 46	(J) P4-6	B+ protected supplies for pressure sensor
BLK 15	(J) P4-7	B- for pressure sensor
BLK 15	(J) P4-8	B- protected supplies for height sensor
BRN/YEL 49	(J) P4-9	B+ for height sensor

(J)= plug identification as it corresponds to the electrical schematic diagram.

**(RL1) Cutout Relay Connections:**

	RL1-1	no connect
	RL1-2	no connect
Wire 5	RL1-3	down function requested
Wire 17	RL1-4	Lift, Drive, or Steer Function requested
Wire 5A	RL1-5	signal to down valve coils
Wire 17A	RL1-6	signal to motor controller allowing
Lift, Drive, or Steer Function		
Wire 45	RL1-7	Cutout Relay B-
Wire 44	RL1-8	Cutout Relay input
(B+ when platform not overloaded)		



ART\_2431



# TROUBLESHOOTING

## GP102 - EZcal Help Messages

When the **EZcal** hand-held device is connected to the **GP102** control module, the first menu available is "HELP" - just press the **ENTER** button to see a message describing the current status of the **GP102**; this will provide the best information when troubleshooting the load sense system. When an **EZcal** is unavailable, an LED on the **GP102** flashes to provide limited diagnostics. Refer to **GP102 LED Flash Codes** in this section.

The following messages may be displayed on the Ezcal display.

### EVERYTHING OK

The **GP102** detects no problems.

If problems are being experienced with the system, use the **DIAGNOSTICS** menus to check for faulty sensors and/or switches. LED on steady.

### ARMGUARD ACTIVE!

The **GP102** has stopped descent at the Armguard height, and is delaying for 5 seconds to "give the operator the opportunity to see whether persons ... could be injured" (per EN 280 5.4.4). Vehicle movement will continue to be stopped after the delay until all functions are released. LED flash code 4.

### B+ SUPPLY TOO LOW

The **GP102** is designed for use on 12V and 24V battery powered vehicles; it cannot operate with a supply below about 9V. The "BATTERY" voltage can be checked in the "SENSORS" menu (available in the "DIAGNOSTICS" menu). LED flash code 7.

### DRIVE/LIFT SELECT INPUTS FAULTY!

Neither the drive select (P2-7) nor the lift select (P2-8) input is active, or both are active - the **GP102** cannot determine the vehicle use.

All vehicle operation will be prevented until the problem is corrected. LED flash code 2.

### ELEVATION SWITCH SHIFTED?

The **GP102** uses the elevation switch in combination with the height sensor to ensure correct functionality of both; any of the following faults may be detected:

- The elevation switch should change state near the point at which it did during load calibration. All vehicle operation will be prevented until the problem is corrected. LED flash code 4.

### ELEVATION SWITCH STUCK?

The **GP102** uses the elevation switch in combination with the height sensor to ensure correct functionality of both; any of the following faults may be detected:

- When the platform is elevated, the measured height should be above that stored during load calibration
- When the platform is not elevated, the measured height should be below that stored during load calibration

All vehicle operation will be prevented until the problem is corrected. LED flash code 4.

**FACTORY OVERRIDE**

To allow vehicle movement during manufacture, the **GP102** is delivered in a "FACTORY OVERRIDE" state which disables all functionality. The first load calibration (even if not completed) will terminate this state. LED flash code 15.

**FAULT: BAD TILT SENSOR**

The **GP102** has detected that its integral tilt sensor is faulty - the module may need to be replaced. IMPORTANT: If the **GP102** is installed incorrectly, this fault may occur erroneously. LED flash code 8.

**HEIGHT NOT CALIBRATED**

During the first phase of load calibration ("DYNAMIC"), the **GP102** calibrates the minimum and maximum output of the height sensor so that platform height can be determined. This calibration must be successfully completed! LED flash code 1.

**IDLE TIMEOUT ACTIVE!**

If configured, the **GP102** will turn off all its outputs after a set time with no vehicle functions operated; this saves battery power and silences any alarm still sounding when the vehicle was left. Any vehicle function will end the idle timeout and restore normal operation of the **GP102** outputs. LED stays off.

**INVALID HEIGHT - CHECK SENSORS**

There is a problem that prevents the vehicle height being determined; there may be a fault with the height sensor, or the vehicle may have been modified or damaged since the last calibration occurred. All vehicle operation will be prevented until the problem is corrected. LED flash code 9.

**INVALID LOAD - CHECK SENSORS**

There is a problem which prevents the estimated load being determined; there may be a fault with the height sensor or the load sensor, or the vehicle may have been modified or damaged since the last calibration occurred. All vehicle operation will be prevented until the problem is corrected. LED flash code 6.

**LOAD NOT CALIBRATED**

During the second and third phases of load calibration ("LOADED" and "EMPTY"), the **GP102** calibrates the lift cylinder pressure at various heights corresponding to a fully loaded and unloaded platform. This calibration must be successfully completed! LED flash code 1.

**NO LAST CALDATE!**

At the end of load calibration, the **GP102** prompts for entry of the current date to aid in vehicle maintenance. A non-zero date must be entered! When load (re)calibration is begun, the last CALDATE is erased and cannot be reentered until calibration is completed; this ensures that a partly calibrated vehicle cannot be operated. LED flash code 1.

**P3-4 SHORT TO 0V?**

The **GP102** start-up tests detected that something is overloading the output on P3-4. All vehicle operation will be prevented until the problem is corrected. LED flash code 5.

**P3-4 SHORT TO SUPPLY?**

The **GP102** start-up tests (or the continuous monitoring during any prevention of vehicle movement) detected that something is providing a permanent supply on P3-4 (defeating the internal cutout). All vehicle operation will be prevented until the problem is corrected. LED flash code 3.

**TESTING HWFS**

When the **GP102** is powered up, it carries out various tests to ensure that it is functioning safely.



### **TOO HIGH - DRIVE PREVENTED**

A drive function has been selected but the platform is raised above the "MAX DRIVE" setting (if enabled). The drive function will be prevented until the platform is lowered. LED flash code 8.

### **TOO HIGH - LIFT UP PREVENTED**

The lift/up function has been selected but the platform is raised above the "MAX LIFT" setting (if enabled). The lift/up function will be prevented until the platform is lowered. LED flash code 8.

### **UP/DOWN SELECT INPUTS ACTIVE TOGETHER!**

The up select (P2-3 and/or P2-5) and the down select (P2-4 and/or P2-6) are active together - the **GP102** cannot determine the vehicle use. All vehicle operation will be prevented until the problem is corrected. LED flash code 2.

### **VEHICLE OVERLOADED**

The estimated load in the platform exceeds the "OVERLOAD AT" setting in the "ADJUSTMENTS" "LOAD" menu. The **GP102** will activate the cutout to prevent vehicle operation until the platform load is reduced. LED flash code 8.

### **VEHICLE TILTED**

Either the "X" or "Y" tilt (measured by the **GP102** integral tilt sensor) exceeds the "X TRIP" or "Y TRIP" setting in the "ADJUSTMENTS" "TILT" menu. LED flash code 8.

### **WAITING FOR B+ ON P2-12**

The supply on P2-12 provides power for the outputs P3-1/2/3/4. The **GP102** cannot function if the supply is not present. Since the supply on P2-12 is switched to P3-4, vehicle operation will be prevented. LED flash code 7.

### **WAITING FOR NEUTRAL**

When the **GP102** is powered up, all controls must be in neutral to allow safe testing of the fail-safe output; no functions are allowed until testing is complete. LED flash code 2.

## GP102 LED Flash Codes

The **GP102** has a built-in LED to provide simple diagnostics when no **EZcal** is available. Please note that the use of an **EZcal** provides significantly better diagnostics through the HELP messages. An **EZcal** is also necessary to calibrate a **GP102**.

### LED on steady

This indicates no fault with the **GP102**

### LED off always

This indicates no power to the **GP102**, or idle timeout (if enabled - activate a lift or drive function to cancel the idle timeout)

### LED flash code 1

This indicates the **GP102** has not been properly calibrated.

### LED flash code 2

This indicates a fault with the switch inputs to the **GP102**. Check wiring to connector P2.

### LED flash code 3

This indicates a fault with the shutdown outputs of the **GP102** - a short to the supply has been detected. Check wiring from pins P3-4.

### LED flash code 4

This indicates that armguard is active, or that there is a fault with the elevation switch - the **GP102** verifies correct opening and closing of the elevation switch against the height sensor. Checking the elevation switch on P2-10. If the height sensor has been adjusted or replaced, repeat the CALIBRATE HEIGHT procedure.

### LED flash code 5

This indicates a fault with the shutdown outputs of the **GP102** - a short to 0V (ground) has been detected. Check wiring from pins P3-4.

### LED flash code 6

This indicates a fault with the load measurement - check the pressure sensor and wiring from it to connector P4.

### LED flash code 7

This indicates a fault with the supply to the **GP102** - check battery supply at least 8V on pin P2-12; also check that there is not a short to 0V (ground) on pin P4-1.

### LED flash code 8

This is not a fault - it indicates the **GP102** has prevented a function; functions can be prevented if the platform is overloaded, if the machine is tilted too far, or if the platform is too high.

### LED flash code 9

This indicates a fault with the height measurement - check the height sensor and wiring from it to connector P4.

### LED flash code 10

This indicates the **GP102** is carrying out start-up tests.

### LED flash code 15

This indicates the **GP102** is in "FACTORY OVERRIDE" and overload functions are disabled - this aids manufacture by allowing vehicle movement before the machine is built sufficiently to be calibrated. 15 flash will be present whenever a *new* circuit board is installed previous to calibration.

# CALIBRATION

Before attempting the calibration procedure, the batteries must be fully charged and battery terminals clean and tight. Move machine to an area that is perfectly level as measured by a spirit level or other leveling device. An Ezcal hand-held device (MEC part # 90888) is required to carry out all calibration procedures on the **GP102** Load sense control module.

## Tilt Sensor Calibration

The integral tilt sensor of the **GP102** control module must be leveled to compensate for variations due to installation and vehicle construction. This procedure must be done if the lower control box is ever removed or repositioned, or if the **GP102** module is ever repositioned or replaced.

- a.] Drive machine to level ground.
- b.] Plug **EZcal** into connector P1 on load sense control module.
  - Display reads HELP: PRESS ENTER.
- c.] Press right arrow to ACCESS LEVEL 3, Press Enter.
  - Display reads CODE 0000.
- d.] Press up and right arrow to enter code 1775, Press Enter.
  - Display reads ACCESS LEVEL 2.
- e.] Right arrow to SETUPS, Press Enter.
  - Display reads CHANGE DEFAULTS.
- f.] Right arrow to TILT SETUPS, Press Enter.
  - Display reads CALIBRATE LEVEL.
- g.] Press Enter.
  - Display reads CALIBRATE LEVEL: YES:ENTER,NO:ESC.
- h.] Press Enter.
  - Display reads TILT 0.0',0.0' i. Press ESC, ESC, ESC j. Disconnect **EZcal** from the load sense module.

## Platform Load Calibration

Platform load calibration must be done if there are ever any significant repairs to the scissor assembly or if the lift cylinder is removed and serviced or replaced. Also, if any of the components of the Platform Load Sense System are replaced, the system will need re-calibration. During the calibration procedure the vehicle platform is fully raised and lowered three times:

1. "DYNAMIC" calibration – fully loaded platform raised & lowered in one continuous movement. DYNAMIC measurements are taken.
2. "LOADED" calibration – fully loaded platform raised & lowered with stops to take measurements. STATIC measurements are taken.
3. "EMPTY" calibration – unloaded platform raised & lowered with stops to take measurements. STATIC measurements are taken.

The following procedure must be followed **COMPLETELY** to calibrate the **GP102**; throughout the procedure various checks are made – if any problem is detected the procedure stops and displays a FLASHING failure message. Explanations of each message and suggested corrections can be found in the section of this manual following the calibration procedure.

**NOTE:** If the calibration procedure is interrupted, completed phases do not need to be repeated. A “REDO” prompt will appear – answer “NO” if there is no reason to repeat the phase, or “YES” if the phase must be repeated (for example because the wrong platform load was used on the previous phase).

- a.] Drive machine to level ground, in area where it can reach full elevation.
- b.] Place rated load in platform.
- c.] Turn selector switch to Base controls.
- d.] Remove top cover off of lower control station box, and plug **EZcal** into connector P1 on load sense control module.

**EZcal** display reads HELP: PRESS ENTER

- e.] Press right arrow to ACCESS LEVEL 3, Press Enter.
  - Display reads CODE 0000
- f.] Press up and right arrow to enter code 1775, Press Enter.
  - Display reads ACCESS LEVEL 2.
- g.] Press Right Arrow to SETUPS, Press Enter.
  - Display reads CHANGE DEFAULTS
- h.] Press Enter to verify machine type. Press up and down arrows to change if necessary.
  - Display reads 1=1532, 2=1932, 3=2033 ...etc. Select appropriate model.
- i.] Press Enter. Press Esc. Press Right Arrow to LOAD SETUPS. Press Enter.
  - Display reads CALIBRATE LOAD
- j.] Press Enter.
  - Display reads PLATFORM DOWN? Verify that platform is fully lowered.
- k.] Press Enter.
  - Display reads PLATFORM LOADED? Verify that rated load is in platform.
- l.] Press Enter.
  - Display reads PLEASE LIFT. Hold lower controls switch in the up position until machine is fully elevated, then release switch.
  - Display reads PLEASE LOWER. Hold switch in down position until platform is in the fully lowered position. Release switch. Display reads PLATFORM LOADED?
- m.] Press Enter.
  - Display reads PLEASE LIFT. Hold lower controls switch in the up position until machine is fully elevated, then release switch.

**NOTE:** The platform will lift incrementally during this phase of the calibration. Every third lift cycle the platform will fail to lift even though the circuit is initiated. When this occurs, release the lift switch for 1 second (or more) then reapply. The platform should then rise normally for another two cycles.

- Display reads TOTAL DATA #XX, then PLEASE LOWER. Hold switch in down position until platform is in the fully lowered position. Note: The platform will lower incrementally during this phase on the calibration. Do not release the switch until fully lowered. Release switch.
- Display reads TOTAL DATA #XX, then PLATFORM EMPTY?



**NOTE:** At this time the load in the platform must be removed. It is best to remove it without moving the machine. If you must switch to platform controls to move the machine, steps a.] through g.] must be repeated. Steps j.] through m.] will generate the REDO prompt. Answer NO. If machine was not moved, proceed to step n.].

n.] Press Enter.

- Display reads PLEASE LIFT. Hold lower controls switch in the up position until machine is fully elevated, then release switch.

**NOTE:** The platform will lift incrementally during this phase of the calibration. Every third lift cycle the platform will fail to lift even though the circuit is initiated. When this occurs, release the lift switch for 1 second (or more) then reapply. The platform should then rise normally for two cycles.

- Display reads TOTAL DATA #XX, then PLEASE LOWER. Hold switch in down position until platform is in the fully lowered position.

**NOTE:** The platform will lower incrementally during this phase on the calibration. Do not release the switch until fully lowered. Once fully lowered, release switch.

- Display reads TOTAL DATA #XX, then BUILDING TABLES, then CALDATE mm/dd/yy.

o.] Enter current date using Up, Down and Right Arrows.

- Display reads FINISHED.

p.] Disconnect **EZcal** from the load sense control module. The Platform Overload Sensing System is now calibrated.

## Height Calibration

The height sensor must be calibrated if the height limit switch (LS-1 on electrical schematic) is ever replaced or adjusted. It is not necessary to redo the load calibration if the limit switch is all that was serviced. For this procedure it is not necessary to place any load in the platform.

a.] Drive machine to level ground, in area where it can reach full elevation.

b.] Turn selector switch to Base controls.

c.] Remove top cover off of lower control station box, and plug **EZcal** into connector P1 on load sense control module. **EZcal** display reads HELP: PRESS ENTER

d.] Press right arrow to ACCESS LEVEL 3, Press Enter.

- Display reads CODE 0000

e.] Press Up and Right Arrow to enter code 1775, Press Enter.

- Display reads ACCESS LEVEL 2.

f.] Press Right Arrow to SETUPS, Press Enter.

- Display reads CHANGE DEFAULTS

g.] Press Right Arrow to HEIGHT SETUPS, Press Enter.

- Display reads CALIBRATE HEIGHT

h.] Press Enter.

- Display reads PLATFORM DOWN? Verify that platform is fully lowered.

i.] Press Enter.

- Display reads PLEASE LIFT. Hold lower controls switch in the up position until machine is fully elevated, then release switch. Display reads PLEASE LOWER. Hold switch in down position until platform is in the fully lowered position. Release switch. Display reads FINISHED.



## CALIBRATION TROUBLESHOOTING; Failure Messages

During calibration, various problems can be detected by the that prevent successful calibration. These problems are reported with a flashing message including an "F" code. The following descriptions are helpful in solving the problem:

<b>F01:CHECK HWFS</b>	<p>This message is given if the start-up tests have not completed.</p> <p>Check HELP message for more information.</p>
<b>F02:NOT GROUND MODE</b>	<p>This message is given if the machine is not in ground mode (P2-2 must be high). Calibration can only be carried out in ground mode.</p>
<b>F03:NOT STOPPED</b>	<p>This message is given if any function switch is closed. Check DIAGNOSTICS / SWITCHES to see which function switch is closed.</p>
<b>F04:TILTED</b>	<p>This message is given if the machine is tilted. Calibration must be carried out with the machine level. If the machine is level, perform the Tilt Calibration procedure above.</p>
<b>F05:BAD HEIGHT</b>	<p>This message is given if the height sensor output (P4-3) is out of range at the start of calibration. The height sensor output must be between 1.0V and 4.0V. Check DIAGNOSTICS / SENSORS to see the output. A reading of 0V or 5V is probably due to a wiring problem.</p>
<b>F06:CHECK ELEV</b>	<p>This message is given if the elevation switch (P2-10) is open at the start of calibration, when the operator has confirmed the "PLATFORM DOWN?" question.</p> <p>If the platform is down, check the elevation switch wiring.</p>
<b>F08:CHECK ELEV</b>	<p>This message is given if the elevation switch (P2-10) is closed at the end of the DYNAMIC lift, when the platform should be fully raised.</p> <p>This message would occur if the UP switch was accidentally opened near the start of the DYNAMIC lift.</p> <p>If the platform is fully raised, check the elevation switch wiring.</p>
<b>F09:BAD HEIGHT</b>	<p>This message is given if the height sensor output (P4-3) is out of range at the start of the DYNAMIC lift. The height sensor output must be between 1.0V and 4.0V. Check DIAGNOSTICS / SENSORS to see the output. This is usually due to a wiring problem.</p>
<b>F10:BAD HEIGHT</b>	<p>This message is given if the height sensor output (P4-3) is out of range at the end of the DYNAMIC lift. The height sensor output must be between 1.0V and 4.0V. Check DIAGNOSTICS / SENSORS to see the output. A reading of 0V or 5V is probably due to a wiring problem.</p>

<b>F11:NOT UP</b>	This message occurs at the start of the DYNAMIC lift if the operator selects a function other than UP.
<b>F12:TOO MANY</b>	<p>This message occurs if the DYNAMIC lift takes too long.</p> <p>This message could occur if the UP switch was not released at the end of the dynamic lift.</p>
<b>F13:LOW HEIGHT RANGE</b>	<p>This message occurs at the end of the DYNAMIC lift if the height sensor output did not change sufficiently to give a reasonably accurate platform height estimate. DIAGNOSTICS / SENSORS can be used to check the height sensor output (P4-3) when the platform is fully lowered and fully raised; a difference of at least 1V is to be expected.</p> <p>This message could occur if the UP switch was accidentally opened too early (when the platform is not fully raised).</p>
<b>F14:BAD HEIGHT</b>	This message occurs if the height sensor output (P4-3) is out of range during the DYNAMIC lift. The height sensor output must be between 1.0V and 4.0V. Check DIAGNOSTICS / SENSORS to see the output. A reading of 0V or 5V is probably due to a wiring problem.
<b>F15:CHECK ELEV</b>	<p>This message is given if the elevation switch (P2-10) is open when the platform has been fully lowered after the DYNAMIC lift.</p> <p>This message would occur if the DOWN switch was accidentally opened before the platform was fully lowered.</p> <p>If the platform is fully lowered, check the elevation switch.</p>
<b>F16:LOW ELEV.OPEN</b>	This message is given if the elevation switch (P2-10) opened during lift at a too low height (below 5%). Check CALIBRATIONS / HEIGHT CALS; the "ElevUp" value shows the recorded height where the switch opened.
<b>F17:HIGH ELEV.OPEN</b>	<p>This message is given if the elevation switch (P2-10) opened during lift at a too high height (above 25%).</p> <p>Check CALIBRATIONS / HEIGHT CALS; the "ElevUp" value shows the recorded height where the switch opened.</p>
<b>F18:LOW ELEV.CLOSE</b>	<p>This message is given if the elevation switch (P2-10) closed during lower at a too low height (below 5%).</p> <p>Check CALIBRATIONS / HEIGHT CALS; the "ElevDown" value shows the recorded height where the switch opened.</p>

<b>F19:HIGH ELEV.CLOSE</b>	<p>This message is given if the elevation switch (P2-10) closed during lower at a too high height (above 25%).</p> <p>Check CALIBRATIONS / HEIGHT CALS; the "ElevUp" value shows the recorded height where the switch opened.</p>
<b>F20:HEIGHT&lt;&gt;0%</b> <b>F21:HEIGHT&lt;&gt;0%</b>	<p>This message occurs if the platform height is not 0% after the platform has been fully lowered at the end of a calibration step. The platform must return to the same height each time it is fully lowered.</p> <p>Check DIAGNOSTICS / SYSTEM to check the height.</p>
<b>F22:HEIGHT&lt;&gt;100%</b> <b>F23:HEIGHT&lt;&gt;100%</b>	<p>This message occurs if the platform height is not 100% after the platform has been fully raised during a calibration step. The platform must return to the same height each time it is fully raised. Check DIAGNOSTICS / SYSTEM to check the height.</p>
<b>F24:TOO MANY</b>	<p>This message occurs if too many static measurements are taken during a calibration step. In the rare event that this occurs, please call MEC for assistance.</p>
<b>F25:CHECK ELEV</b> <b>F26:CHECK ELEV</b>	<p>This message indicates a problem with the elevation switch (P2-10) during the STATIC phases.</p> <p>The switch is either staying closed to a higher height, or staying open to a lower height, than that recorded during the DYNAMIC phase.</p>
<b>F27:BAD HEIGHT</b>	<p>This message indicates a problem with the height sensor output (P4-3) during the STATIC calibration phases.</p> <p>The height sensor output must be between 1.0V and 4.0V at all times.</p> <p>Check DIAGNOSTICS / SENSORS to see the output. A reading of 0V or 5V is probably due to a wiring problem.</p>
<b>F30:BAD HEIGHTS</b>	<p>This message indicates that the recorded heights are not increasing during either STATIC lift, or are not decreasing during either STATIC lower.</p> <p>It may be possible to cause this problem by repeatedly opening and closing the UP or DOWN switch during the STATIC phases.</p>

**F31:REJECT CURVE**

The DYNAMIC pressure curve is unacceptable.

An initial pressure peak when the platform lifted cannot be found between 0% and 15% height.

Check the pressure sensor and lift cylinder hydraulics.

**F32:REJECT CURVE**

The DYNAMIC pressure curve is unacceptable.

There should be a lowest pressure about halfway through the lift (ie: near 50% height); the lowest pressure measured is at too low a height.

Check the pressure sensor and lift cylinder hydraulics.

**F33:REJECT CURVE**

The DYNAMIC pressure curve is unacceptable.

There should be a lowest pressure about halfway through the lift (ie: near 50% height); the lowest pressure measured is at too high a height.

Check the pressure sensor and lift cylinder hydraulics.

**F34:REJECT CURVE**

The DYNAMIC pressure curve is unacceptable.

There is not enough difference between the initial pressure peak and the minimum pressure.

Check the pressure sensor and lift cylinder hydraulics.

**F40:REJECT DELTA**

This message indicates that there is not enough difference between the loaded & empty pressure.

This message could occur if the platform were not properly loaded during the STATIC LOADED phase, or if the platform were not properly empty during the STATIC EMPTY phase.

This message could also occur if the wrong pressure sensor was fitted (eg: a 5000psi sensor when a 2000psi one is needed).

Check CALIBRATIONS / HEIGHT CALS; the "Height" indicates the first height at which there was insufficient difference and the "Up" and "Down" values show the loaded pressure (first) and the difference between loaded and empty pressure (second).

**F42:LOW PRESSURE**

This message indicates that the pressure is too low (0.5V or less) when the elevation switch opens during the DYNAMIC lift.

This message would occur if the pressure sensor was disconnected, or if there were some other wiring error.

Check DIAGNOSTICS / SENSORS to check the pressure.

**F43:HIGH PRESSURE**

This message indicates that the pressure is too high (4.5V or more) when the elevation switch opens during the DYNAMIC lift.

This message would occur if the wrong pressure sensor was fitted, or if there were some other wiring error.

Check DIAGNOSTICS / SENSORS to check the pressure.

**F44:LOW PRESSURE**

This message indicates that the pressure is too low (0.5V or less) at a STATIC measurement point.

This message would occur if the pressure sensor was disconnected, or if there were some other wiring error.

Check DIAGNOSTICS / SENSORS to check the pressure.

**F45:HIGH PRESSURE**

This message indicates that the pressure is too high (4.5V or more) at a STATIC measurement point.

This message would occur if the wrong pressure sensor was fitted, or if there were some other wiring error.

Check DIAGNOSTICS / SENSORS to check the pressure.

**F46:CHECK ELEV**

This message indicates that the elevation switch opened more than once during the DYNAMIC lift.

**F47:CHECK ELEV**

This message indicates that the elevation switch closed more than once during the DYNAMIC lower.

**F48:BAD PRESSURE**

This message is given if the pressure sensor output (P4-2) is out of range at the start of calibration.

The height sensor output must be between 0.5V and 4.5V.

Check DIAGNOSTICS / SENSORS to see the output. A reading of 0V or 5V is probably due to a wiring problem.

## CALIBRATION TROUBLESHOOTING; Information Messages

During calibration the following messages may be displayed:

<b>BUILDING TABLES</b>	This message indicates that the STATIC measurements are being used to build calibration data - the process should take no more than 5s.
<b>CALDATE:</b>	<p>This message is prompting for the date to be entered; it is stored to identify when the machine was calibrated.</p> <p>The last calibrate date can be viewed in DIAGNOSTICS / LOG.</p> <p>Press LEFT &amp; RIGHT to select the flashing digits.</p> <p>Press UP &amp; DOWN to change the flashing digits.</p> <p>Press ENTER when the entry is complete.</p> <p>IMPORTANT: The date 00/00/00 is not allowed!</p>
<b>FINISHED</b>	This message confirms that calibration is complete and successful.
<b>GO DOWN MORE!</b>	This message occurs if the DOWN switch is released during either STATIC lowering phase, when more measurements are needed (before the platform is fully lowered).
<b>GO UP MORE!</b>	This message occurs if the UP switch is released during either STATIC lifting phase, when more measurements are needed (before the platform is fully raised).
<b>LIFT EMPTY</b>	This message is displayed during the STATIC empty phase while the platform is being raised to the next measurement height.
<b>LIFT LOADED</b>	This message is displayed during the STATIC loaded phase while the platform is being raised to the next measurement height.
<b>LIFTING</b>	This message is displayed during the DYNAMIC phase while the platform is being raised.
<b>LOWER EMPTY</b>	This message is displayed during the STATIC empty phase while the platform is being lowered to the next measurement height.
<b>LOWER LOADED</b>	This message is displayed during the STATIC loaded phase while the platform is being lowered to the next measurement height.
<b>LOWERING</b>	This message is displayed during the DYNAMIC phase while the platform is being lowered.

<b>MEASURING #</b>	<p>This message is displayed when the platform is stopped during either STATIC phase, when the takes a measurement.</p> <p>There will be a short delay while the machine is allowed to stabilize after movement is stopped.</p>
<b>MUST GO DOWN!</b>	<p>This message occurs if the wrong switch is closed when the is waiting for the platform to be lowered.</p>
<b>MUST GO UP!</b>	<p>This message occurs if the wrong switch is closed when the is waiting for the platform to be raised.</p>
<b>PLATFORM DOWN?</b>	<p>This message is prompting for confirmation that the platform is fully lowered. If necessary the DOWN switch can be activated to lower the platform.</p> <p>Press ENTER to confirm when the platform is fully lowered.</p>
<b>PLATFORM EMPTY?</b>	<p>This message is prompting for confirmation that the platform is completely empty.</p> <p>Press ENTER to confirm when the platform is empty.</p>
<b>PLATFORM LOADED?</b>	<p>This message is prompting for confirmation that the platform is loaded to rated load (this will be 100% for the ).</p> <p>Press ENTER to confirm when the platform is loaded.</p>
<b>PLEASE LIFT ...</b>	<p>This message is prompting for the platform to be raised.</p> <p>The UP switch should be closed.</p>
<b>PLEASE LOWER ...</b>	<p>This message is prompting for the platform to be lowered.</p> <p>The DOWN switch should be closed.</p>
<b>PLEASE WAIT</b>	<p>This message indicates that the is busy; the delay will be short (no more than 5s).</p>
<b>REDO DYNAMIC:</b>	<p>This message is displayed if the DYNAMIC phase of load calibration has previously been completed.</p> <p>Press ENTER when "NO" is displayed if there is no need to redo the DYNAMIC phase.</p> <p>Press UP or DOWN to display "YES" then press ENTER if it is necessary to redo the DYNAMIC phase.</p> <p>If the previous DYNAMIC calibration was in error, or if the height or pressure sensor is replaced, it will be necessary to redo the DYNAMIC phase.</p>

**REDO EMPTY:**

This message is displayed if the EMPTY phase of load calibration has previously been completed.

Press ENTER when "NO" is displayed if there is no need to redo the EMPTY phase.

Press UP or DOWN to display "YES" then press ENTER if it is necessary to redo the EMPTY phase.

If the previous EMPTY calibration was in error, or if the pressure sensor is replaced, it will be necessary to redo the EMPTY phase.

**REDO LOADED:**

This message is displayed if the LOADED phase of load calibration has previously been completed.

Press ENTER when "NO" is displayed if there is no need to redo the LOADED phase.

Press UP or DOWN to display "YES" then press ENTER if it is necessary to redo the LOADED phase.

If the previous LOADED calibration was in error, or if the pressure sensor is replaced, it will be necessary to redo the LOADED phase.





## SECTION 4:







# MECHANICAL COMPONENTS

<b>Torque Specifications .....</b>	<b>4-2</b>
<b>Mechanical Components .....</b>	<b>4-3</b>
Base / Undercarriage .....	4-3
Hoses and Cables .....	4-3
Raising the Machine .....	4-4
Tires/Wheels .....	4-5
Front Drive Motors .....	4-6
Rear Wheel Brakes .....	4-7
Steer Cylinder .....	4-8
Pothole Circuit .....	4-9
Platform Removal .....	4-10
Lift Cylinder Removal and Installation .....	4-11
Scissor Beam Assembly .....	4-12

# TORQUE SPECIFICATIONS

## Fasteners

Use the following values to apply torque unless a specific torque value is called out for the part being used.

AMERICAN STANDARD CAP SCREWS									METRIC CAP SCREWS								
SAE GRADE	5				8				METRIC GRADE	8.8				10.9			
CAP SCREW SIZE - inches -									CAP SCREW SIZE - millimeters -	 				 			
	TORQUE				TORQUE					TORQUE				TORQUE			
	FT. LBS		Nm		FT. LBS		Nm			FT. LBS		Nm		FT. LBS		Nm	
	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX		MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
1/4 - 20	6.25	7.25	8.5	10	8.25	9.5	11	13	M6 X 1.00	6	8	8	11	9	11	12	15
1/4 - 28	8	9	11	12	10.5	12	14	16	M8 X 1.25	16	20	21.5	27	23	27	31	36.5
5/16 - 18	14	15	19	20	18.5	20	25	27	M10 X 1.50	29	35	39	47	42	52	57	70
5/16 - 24	17.5	19	23	26	23	25	31	34	M12 X 1.75	52	62	70	84	75	91	102	123
3/8 - 16	26	28	35	38	35	37	47.5	50	M14 X 2.00	85	103	115	139	120	146	163	198
3/8 - 24	31	34	42	46	41	45	55.5	61	M16 X 2.50	130	158	176	214	176	216	238	293
7/16 - 14	41	45	55.5	61	55	60	74.5	81	M18 X 2.50	172	210	233	284	240	294	325	398
7/16 - 20	51	55	69	74.5	68	75	92	102	M20 X 2.50	247	301	335	408	343	426	465	577
1/2 - 13	65	72	88	97.5	86	96	116	130	M22 X 2.50	332	404	450	547	472	576	639	780
1/2 - 20	76	84	103	114	102	112	138	152	M24 X 3.00	423	517	573	700	599	732	812	992
9/16 - 12	95	105	129	142	127	140	172	190	M27 X 3.00	637	779	863	1055	898	1098	1217	1488
9/16 - 18	111	123	150	167	148	164	200	222	M3 X 3.00	872	1066	1181	1444	1224	1496	1658	2027
5/8 - 11	126	139	171	188	168	185	228	251	<p>Torque values apply to fasteners as received from the supplier, dry or when lubricated with normal engine oil.</p> <p>If special graphite grease, molydisulphide grease, or other extreme pressure lubricants are used, these torque values <b>do not apply</b>.</p>								
5/8 - 18	152	168	206	228	203	224	275	304									
3/4 - 10	238	262	322	255	318	350	431	474									
3/4 - 16	274	302	371	409	365	402	495	544									
7/8 - 9	350	386	474	523	466	515	631	698									
7/8 - 14	407	448	551	607	543	597	736	809									
1 - 8	537	592	728	802	716	790	970	1070									
1 - 14	670	740	908	1003	894	987	1211	1137									

## Hydraulic Components

Use the following values to apply torque to hydraulic components. Always lubricate threads with clean hydraulic oil prior to installation.

TYPE: SAE PORT SERIES	FITTINGS		HOSES	
	FT. LBS.	Nm	FT. LBS.	Nm
#4	9 - 11	12 - 15	16 - 18	22 - 24
#6	19 - 24	25 - 32	28 - 32	38 - 43
#8	39 - 42	53 - 57	38 - 42	52 - 57
#10	58 - 62	78 - 84	58 - 62	79 - 84
#12	79 - 85	107 - 115	83 - 87	113 - 118
#16	136-144	184 - 195	100 - 110	136 - 149

# MECHANICAL COMPONENTS

Following is a description of the major mechanical components of the scissors lift.

## Base / Undercarriage



**When cleaning the base/undercarriage, cover electrical components to prevent water penetration.**

Steam clean the chassis as necessary, and inspect all welds and brackets. Check for cylinder pins that turn in their mounting, which will indicate sheared retaining pins.

## Hoses and Cables

**Note:** Refer to *Parts Section E* for detailed hydraulic hose diagrams.

Inspect all hoses and electrical cables for security and damage. Hoses and cables should be examined for rubbing and chafing.

Check for leaks at fittings. Replace any damaged hose or cable.

1. Tag hoses for proper reassembly.
2. Disconnect hoses and IMMEDIATELY cap the openings to prevent contamination.
3. Torque hose fittings according to the Hydraulic Torque Specification Table.

## Raising the Machine



**THE USE OF SUBSTANDARD LIFTING DEVICES AND/OR JACK STANDS MAY CAUSE THE MACHINE TO FALL RESULTING IN DEATH OR SERIOUS PERSONAL INJURY.**

The following are needed to safely raise and support the machine;

- a jack with a lifting capacity of two (2) tons or more.
- jack stands with a rating of one (1) ton or more.

### To raise the machine

1. Move machine to a firm level surface capable of supporting the weight of the machine.
2. Chock tires on one end of machine and raise the other end of machine.
3. Position a jack at the end of the machine to be lifted, under a solid lifting point in the center of the frame.
4. Raise the machine and place two (2) suitable jack stands under solid support points at the outer ends of the frame.
5. Lower the machine to rest on the jack stands and inspect for stability.

### To lower the machine

1. Raise machine slightly and remove jack stands.
2. Lower the machine and remove the jack.
3. Remove chocks.

## Tires/Wheels

Tires are solid non marking rubber permanently mounted on a steel wheel. Inspect for cuts, chunking, side-wall damage, or abnormal wear. Any tire faults **MUST BE CORRECTED** before further machine operation. Refer to Parts Section for replacements.



**FAILURE TO USE APPROVED PARTS MAY CAUSE DEATH OR SERIOUS PERSONAL INJURY.**

**NOTE:** Replace tires/wheels with the correct parts to maintain the rating of this equipment.

### Changing Tires/Wheels



**ALWAYS BLOCK THE MACHINE BEFORE RAISING THE MACHINE.**

When a tire / wheel change is necessary, follow these tips:

1. While the machine is on the ground, loosen but **do not remove** lug nuts.

**NOTE:** Wheels may spin when attempting to loosen lug nuts without the weight of the machine on the wheels. Loosen lug nuts enough to break free, but leave them tight for safety.

2. Raise and support the machine (see *Raising the Machine*).
3. Remove lug nuts and pull the wheel off.
4. Install the replacement wheel and tighten the lug nuts.
5. Lower the machine to the ground and remove the chocks.
6. Torque lug nuts to 75 to 85 ft.-lbs. (102 to 115 Nm).

## Front Drive Motors

There are two (2) hydraulic motors on the front axle. These can be damaged or leaks may occur; repair or replace as necessary. Refer to *Section 1 - Hydraulics* for motor service and repair procedure.

### CAUTION:

- Clean all fittings before disconnecting hoses.
- Tag hoses for proper reassembly.
- Plug all openings to prevent contamination.

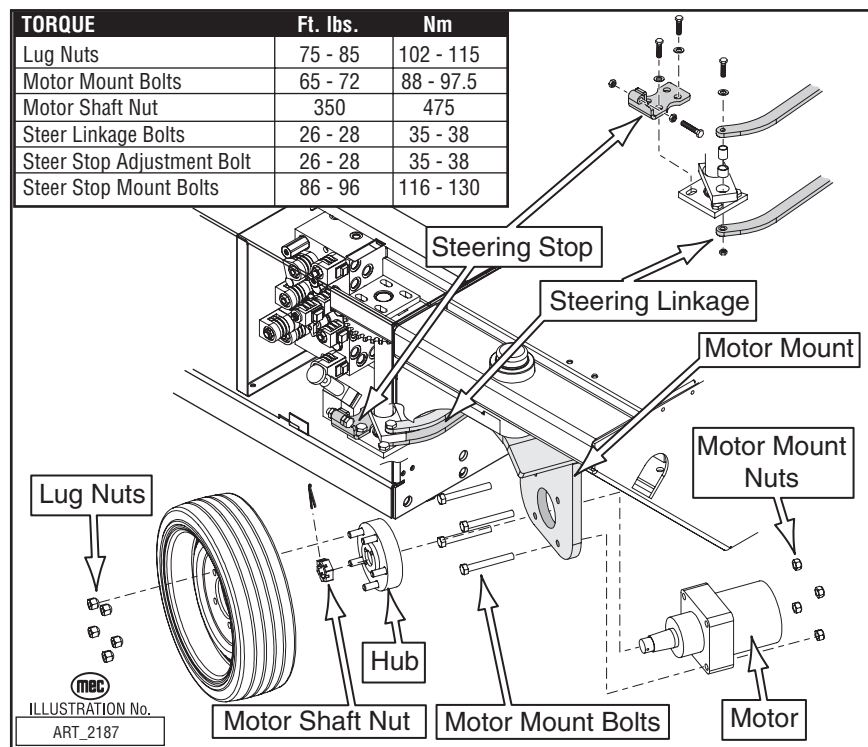
### Front Drive Motors

#### Remove.

1. Loosen the lug nuts.
2. Raise and support the front end of machine (see *Raising the Machine*).
3. Remove the wheel and tire assembly to access drive motor.
4. Disconnect the Steering Linkage (refer to illustration).
5. Remove the steering stop (refer to illustration).
6. Remove the cotter key, motor shaft nut, and hub from the drive motor shaft.
7. Turn the motor housing to gain access to the motor and hose assemblies.
8. Disconnect hose assemblies from drive motor.
9. Remove the cap screws and remove the drive motor.

#### Replace

Installation is reverse of removal.



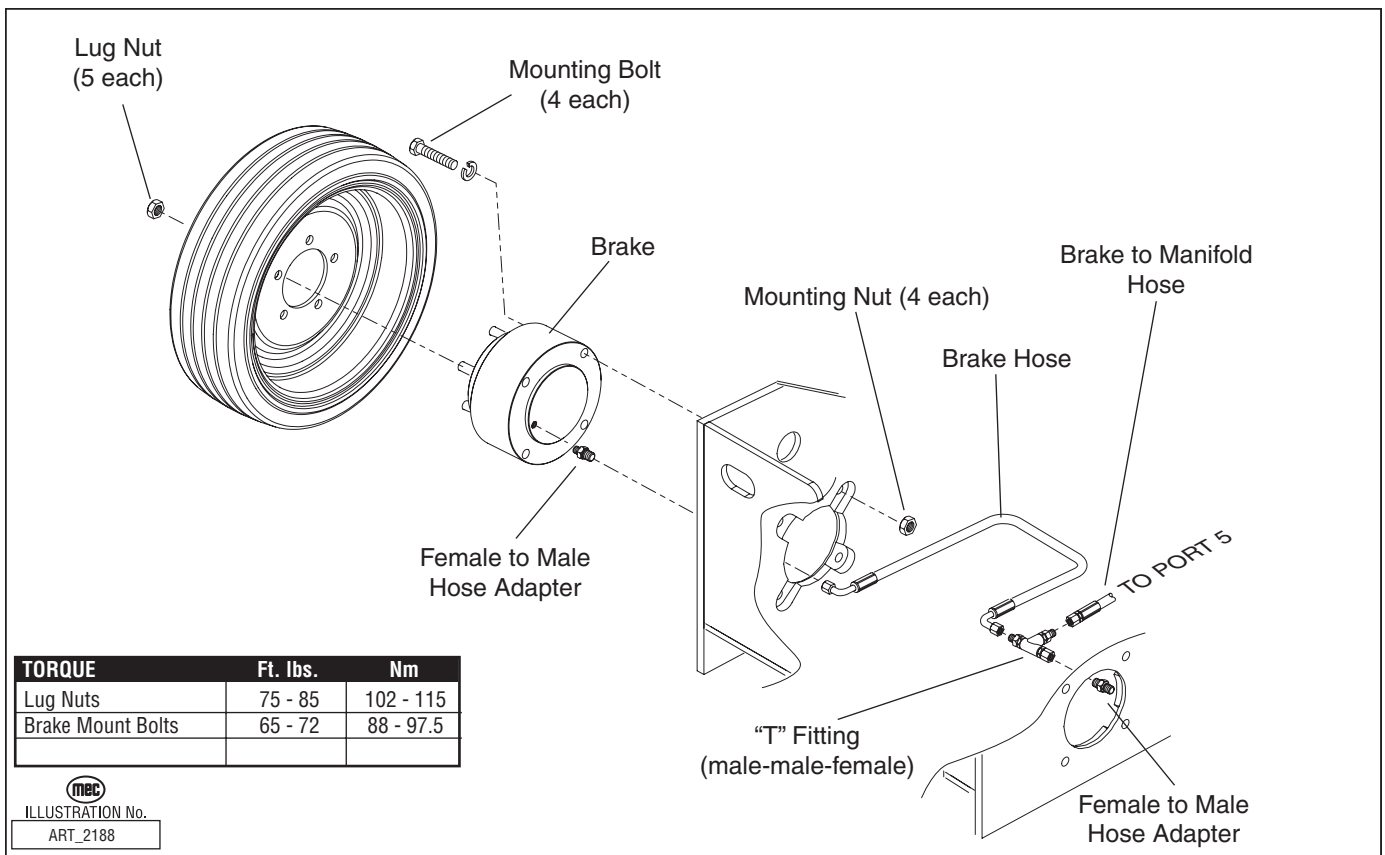
## Rear Wheel Brakes

### Remove

1. Raise and support the rear end of machine (see *Raising the Machine*).
2. Remove the wheel and tire assembly to access brake.
3. Disconnect hose assemblies from the brake.
4. Remove the relief valve.
5. Remove the cap screws and remove the brake from the housing.

### Replace

Installation is reverse of removal.



## Steer Cylinder

There is one (1) double acting type steer cylinder on this machine. During operation, cylinder should not leak, but a slight damping at the rod seal is acceptable.

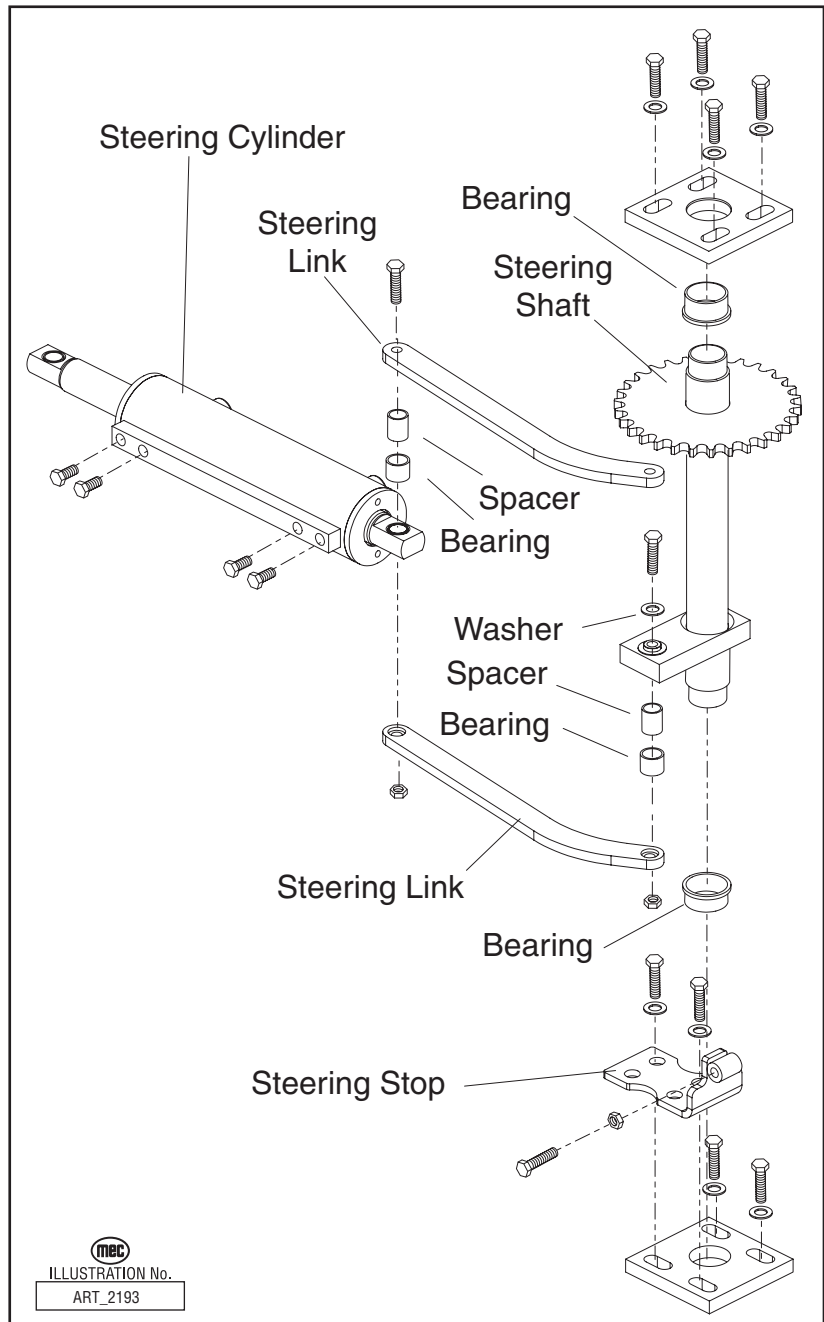
### To replace steer cylinder:

- CAUTION:**
- Clean all fittings before disconnecting hoses.
  - Tag hoses for proper reassembly.
  - Plug all openings to prevent contamination.

1. Raise and support the front end of machine (see *Raising the Machine*).
2. Disconnect hydraulic hoses and cap them.
3. Remove the bolts holding the steering cylinder to the steering links and move the steering links away from the cylinder.
4. Remove the steer cylinder mounting bolts.
5. Carefully remove the steer cylinder.
6. Position the new steer cylinder and install the mounting bolts.
7. Move the steering links into position and install the hardware.
8. Connect hydraulic hoses.
9. To purge air from cylinder;
  - place a suitable container beneath the hose connections to catch spilled oil,
  - loosen hose fittings slightly,
  - actuate steer function,
  - when all air is purged, tighten hose connections.

### Steer Cylinder Seal Replacement

Refer to *Section 1* for seal replacement instructions.



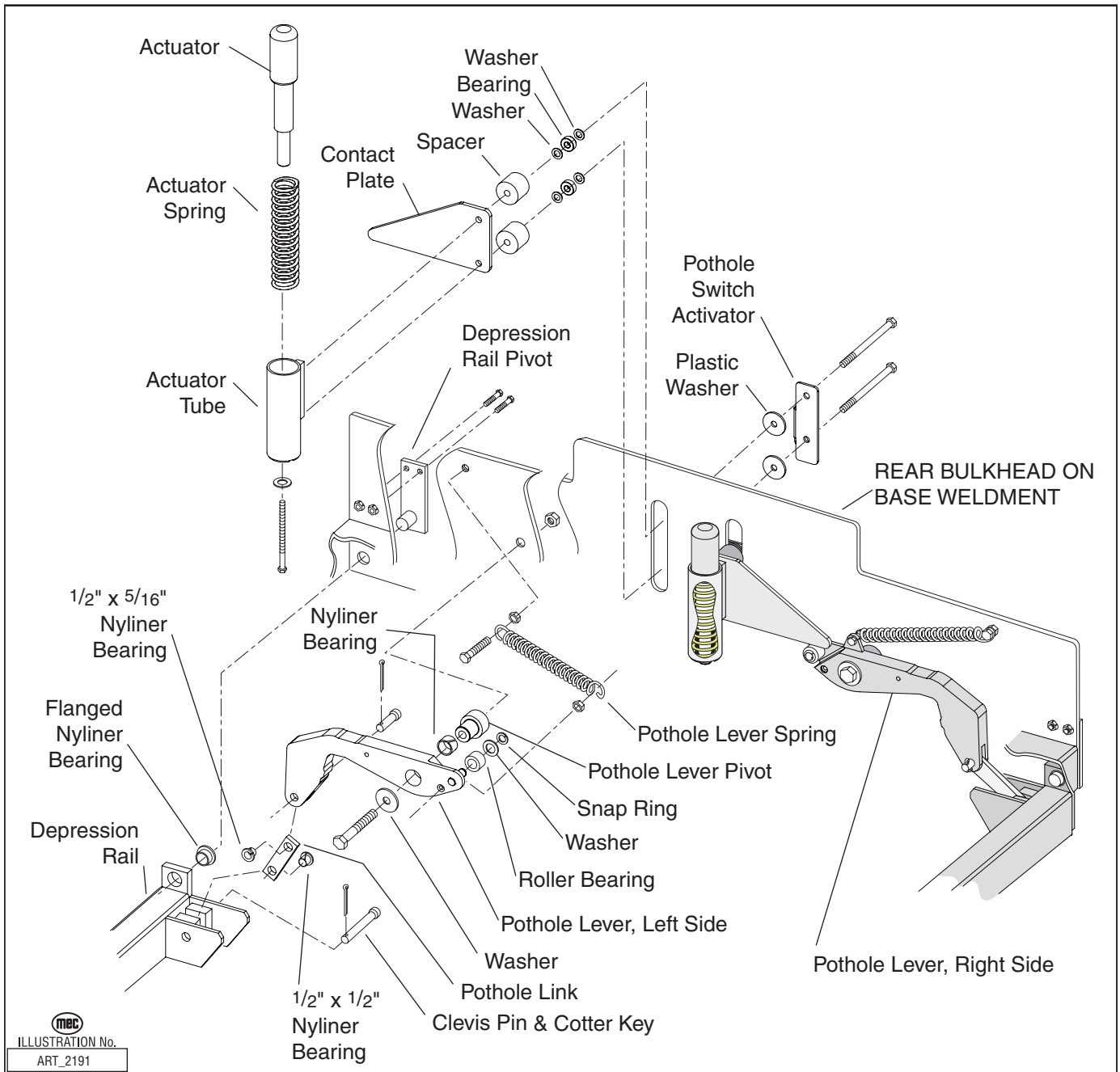


## Pothole Circuit

The Pothole Depression Rails are raised and lowered mechanically. When the platform is elevated, the depression rails are pulled into position by spring tension. When the platform is lowered, the bottom fixed beam in the scissor stack presses downward on the pothole actuator and raises the depression rails.

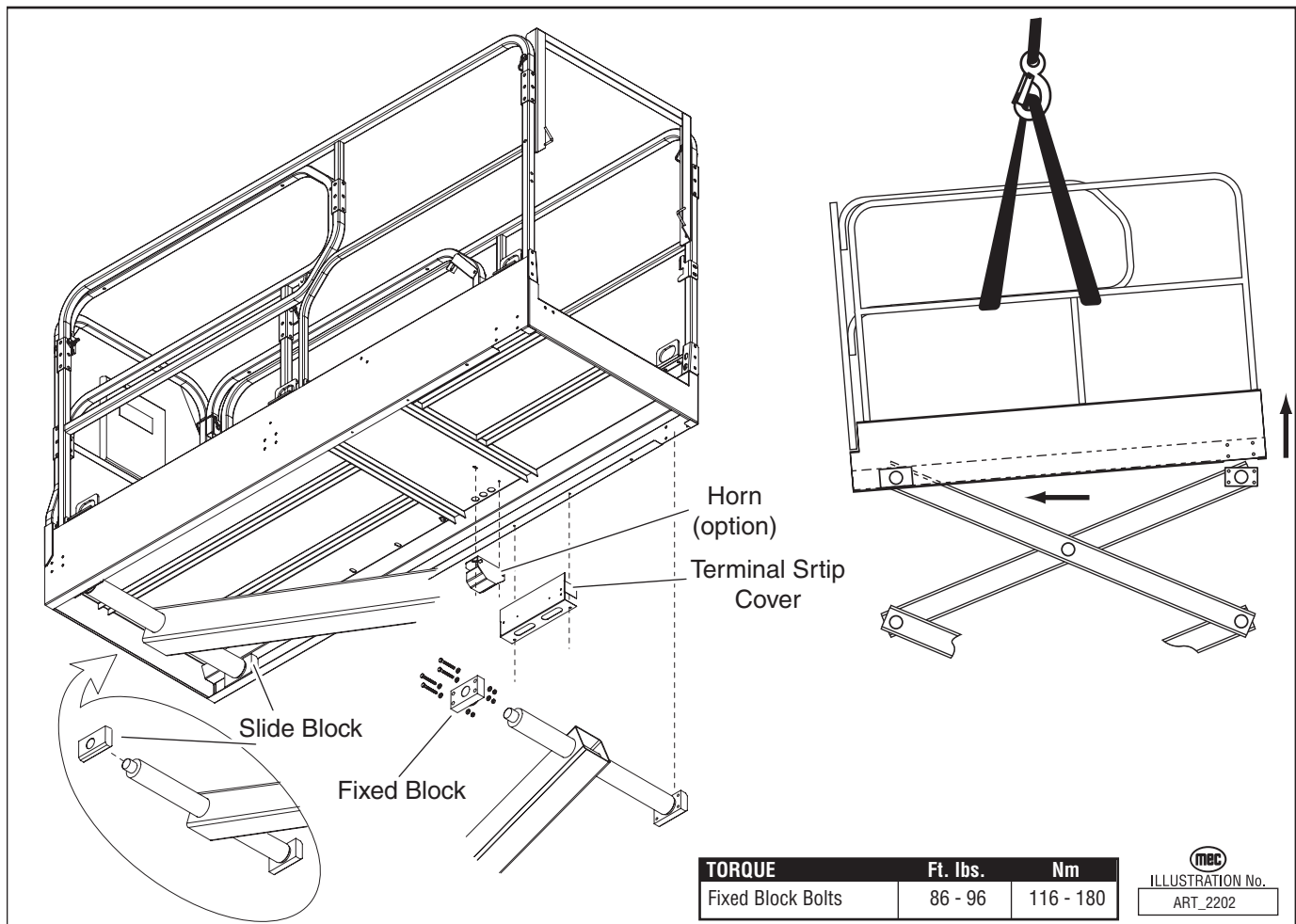
### Repair:

1. Raise the scissor arm assembly and support using the maintenance lock.
2. Refer to the illustration and *Parts Section E*.



## Platform Removal

1. Raise platform and support with the maintenance lock (see *General Safety Tips*).
2. Connect overhead crane by appropriate lifting device to platform.
3. Remove the terminal strip cover and disconnect all platform wires. Remove any components that will obstruct the scissor slide path.
4. Remove the bolts from both fixed blocks at the rear of the platform.
5. Lift the rear of the platform until the fixed blocks are clear.
6. Slide the platform assembly forward until the slide blocks align with the slide track opening at the rear of the platform.
7. Remove the platform assembly.
8. Installation is reverse of removal.



## Lift Cylinder Removal and Installation

**Note:** Refer to *Section 1* for seal replacement instructions.  
Refer to *Parts Section C* for detailed parts list and illustration.

**CAUTION:**

- Clean all fittings before disconnecting hoses.
- Tag hoses for proper reassembly.
- Plug all openings to prevent contamination.

1. Raise the scissor arm assembly and support using the maintenance lock.
2. Remove the support beam.
  - Remove the upper and lower retaining rings.
  - Remove the upper and lower nylon washers.

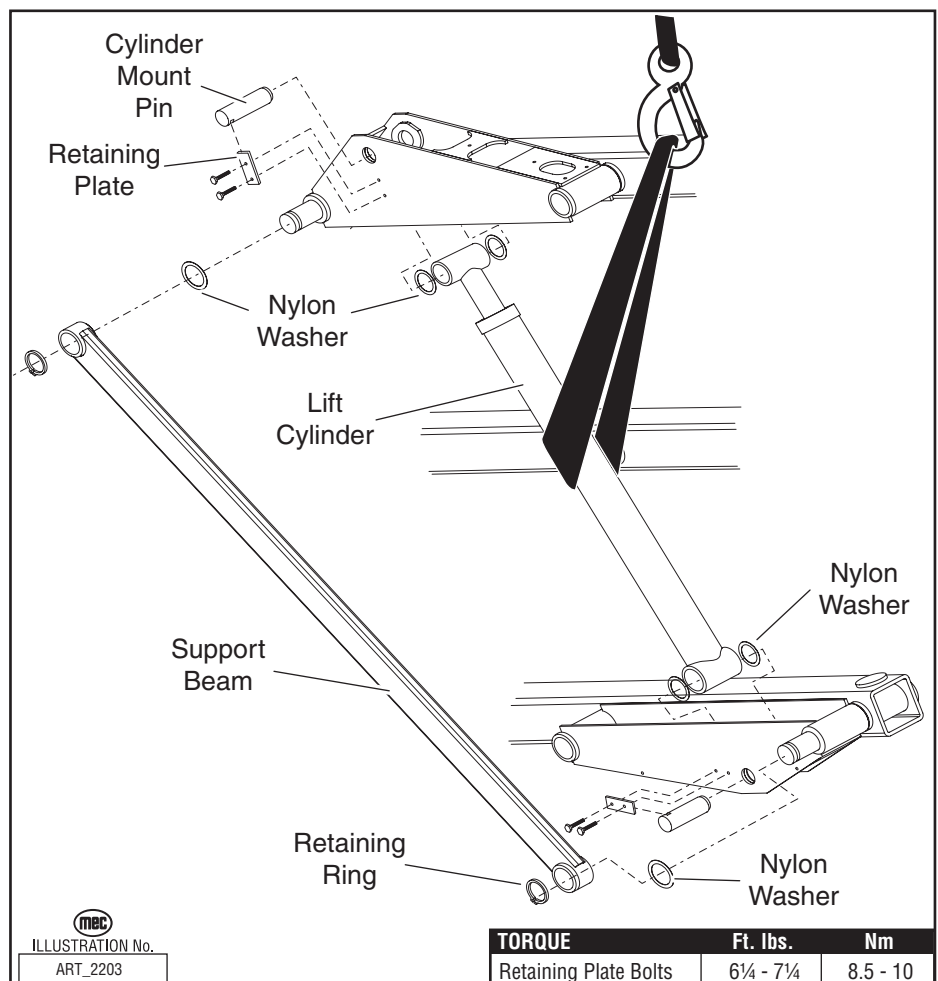
3. Disconnect hoses and wires and cables from the lift cylinder(s).
4. Use a suitable lifting device to support the lift cylinder.

**CAUTION:** **Attach the lifting device to the cylinder body.**  
Lifting by the rod end will cause the cylinder to extend.

5. Remove the upper retaining plate, cylinder mount pin, and two (2) nylon washers.
6. Remove the lower retaining plate.
7. While supporting the cylinder, carefully remove the cylinder mount pin and two (2) nylon washers.

**CAUTION:** The cylinder may shift suddenly when the pin is removed.

8. Lift the cylinder from the scissor assembly using a suitable lifting device.
9. Clean all parts before reassembly. Replace worn or damaged parts with new parts.
10. Installation is reverse of removal.



## Scissor Beam Assembly

**Note:** Refer to *Parts Section C* for detailed parts list and illustration.

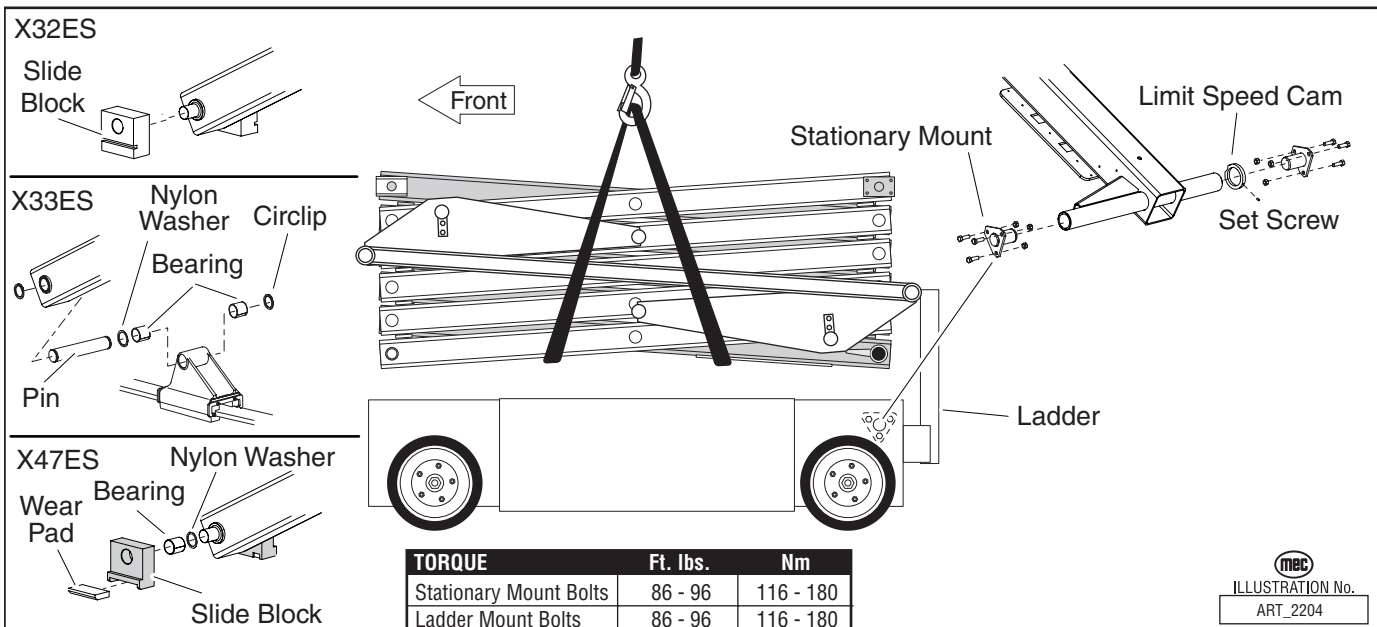
Clean the beams once a year or as necessary and inspect along the beam's surface, especially welds and brackets.

### Scissor Beam Removal

1. Remove the platform and ladder.
2. Attach a suitable lifting device to the scissor assembly.
3. Remove the stationary mounts.
4. Carefully lift until the rear of the scissor is clear and remove the limit speed cam.
5. Slide the scissor assembly to the rear until the slide block reaches the end of slide channel and lift the scissor assembly.

**CAUTION:** The scissor assembly may shift suddenly upon clearing the slide channel.

6. Remove slide blocks and wear pads.
7. Clean all parts before installation. Replace worn or damaged parts with new parts.
8. Installation is reverse of removal.





## SECTION 5:

# TROUBLESHOOTING

<b>General Troubleshooting Tips .....</b>	<b>5-2</b>
<b>Hydraulic Pressure Adjustment Procedures .....</b>	<b>5-4</b>
<b>Troubleshooting .....</b>	<b>5-6</b>
<b>Sevcon Motor Speed Controller .....</b>	<b>5-14</b>
LED Diagnostics Definitions (Flash Codes) .....	5-15
Sevcon Motor Speed Controller - Connections .....	5-17
<b>Troubleshooting Battery Charger .....</b>	<b>5-19</b>

# GENERAL TROUBLESHOOTING TIPS

The ES series Aerial Work Platform operates on a "Motor Control" theory in which fluid flow volume is controlled by varying the speed of the DC electric motor. 100% of the fluid produced by the pump goes to the selected function.

The ES series is designed for easier troubleshooting. There is a terminal strip located under the platform for checking signals to and from upper controls. There is also an LED's located on the Motor Control Unit located inside the lower control box, that will help in the event the DC electric motor fails to operate (see Motor Controller Flash Codes in this section for troubleshooting with flash codes). It is important to note that not all failures will cause a flash code on the motor controller. Before you begin troubleshooting this model, check the battery state of charge and inspect the battery connections for looseness or corrosion. A fully charged battery set on a 24 V DC system will have a nominal voltage of 25.6 V DC.

Before investigating a malfunction, check the following items:

- ◆ Check that battery connections are secure and battery is fully charged.
- ◆ Check that the emergency stop button is released (UP/OUT position).
- ◆ Check that the hydraulic fluid is at the correct level.
- ◆ Check that the brake release valve is open.
- ◆ Check that the circuit breaker is in the ON position.

## Common Causes of Hydraulic System Malfunctions:

- ◆ Incompatible hydraulic fluids mixed, destroying the additives and causing varnish buildup, resulting in the valves sticking.
- ◆ Water in the hydraulic fluid due to a damp climate.
- ◆ Improper hydraulic fluid used. Viscosity too high in cold climates. Viscosity too low in warm climates.

**NOTES:** Contamination always causes failure in any hydraulic system. It is very important to be careful not to introduce any contamination into your hydraulic system during the assembly procedures. Make sure all ports and cavities of the manifold and cylinders are properly covered while other work is performed.

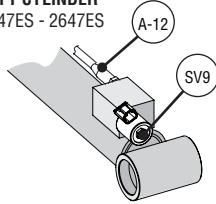
## Early Model vs. Current Model

Current model hydraulics are modified in the following ways;

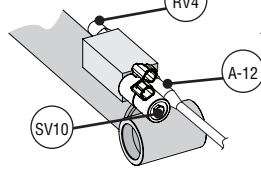
- ◆ Electrical components use Deutsch style connectors.
- ◆ The brake release hand pump is on the main manifold.
- ◆ Valve **CV1** is eliminated.
- ◆ Valve **SV7** is eliminated.
- ◆ Valve **SV8** is eliminated.
- ◆ Steering flow control valve **PFC1** and relief valve **RV3** are replaced by a single valve **FRR1**.

Refer to the accompanying illustrations when using the Troubleshooting Guide.

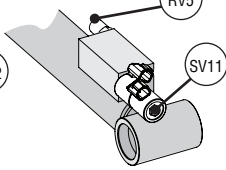
**LIFT CYLINDER**  
2047ES - 2647ES



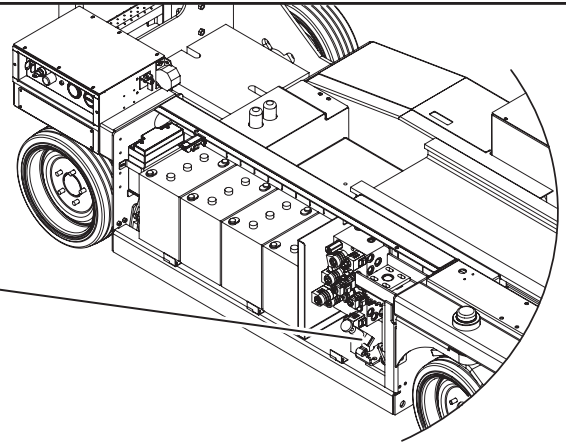
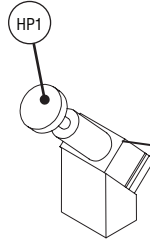
**LOWER LIFT CYLINDER**  
3247ES



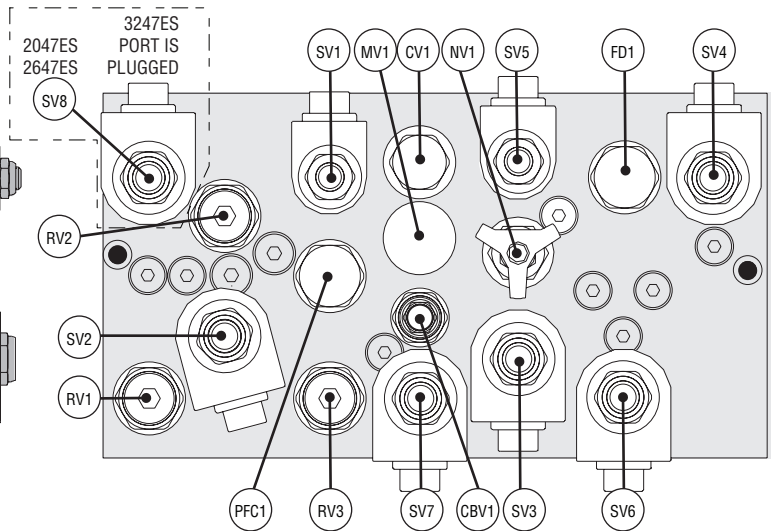
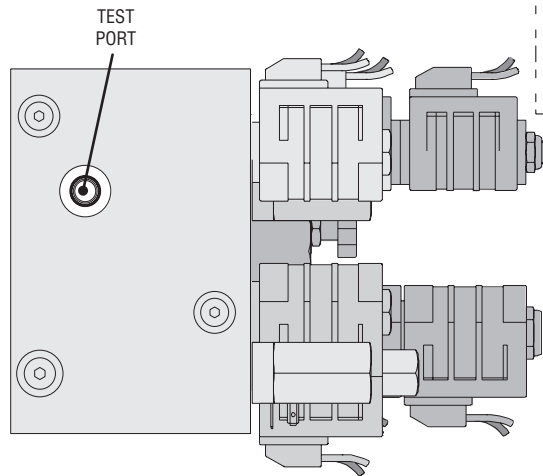
**UPPER LIFT CYLINDER**  
3247ES



**BRAKE RELEASE  
HAND PUMP**  
2047ES - 2647ES  
(Early Models)



**MAIN MANIFOLD**  
(Early Models)



**MAIN MANIFOLD**  
(Current Models)

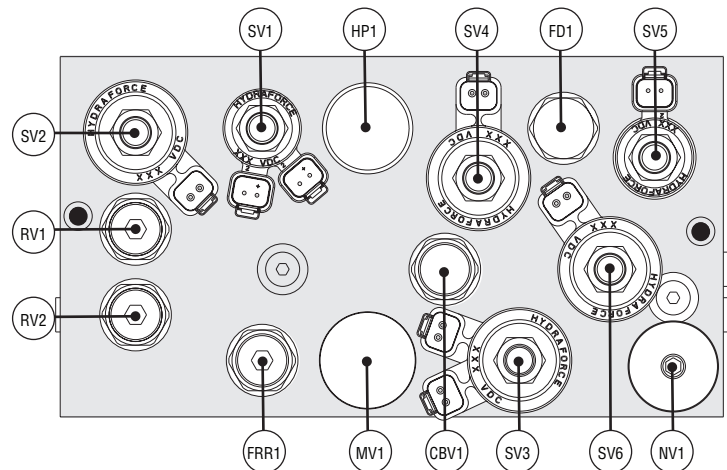
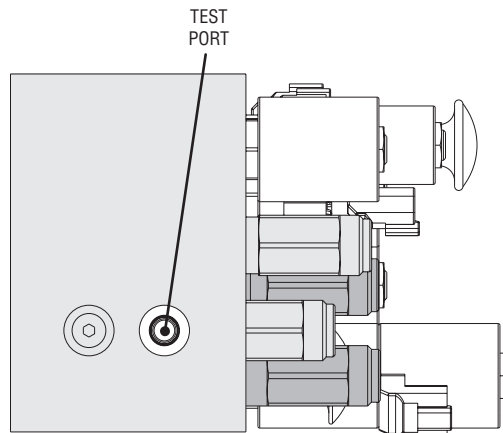


ILLUSTRATION No.  
ART\_2484

Hydraulic Valve Locations, 2047ES - 2647ES - 3247ES, CE





# HYDRAULIC PRESSURE ADJUSTMENT PROCEDURES

- ◆ Before attempting to check and/or adjust pressure relief valves, operate the machine for 15 minutes or long enough to sufficiently warm the hydraulic fluid.
- ◆ Insert a 0-240 bar (0-3500 psi) gauge onto the pressure test port on the valve manifold using gauge adapter fitting MEC part no. 8434

Pressure Adjustment Table

MODEL	MAIN	LIFT	STEER	COUNTERBALANCE PRESSURE
2047ES	2750 PSI 190 bar	2500 PSI 172 bar	1100 PSI 76 bar	550 PSI 38 bar
2647ES	3000 PSI 207 bar	2500 PSI 172 bar	1100 PSI 76 bar	550 PSI 38 bar
3247ES	3000 PSI 207 bar	2045 PSI 141 bar	1100 PSI 76 bar	550 PSI 38 bar

## Check and Adjust Pressure (except counterbalance)

If adjustment is required, set pressure to the correct setting as follows:

- ◆ Connect pressure gauge (0-240 bar) with a female quick disconnect to the main test port.

### Main/System

- ◆ Disconnect forward or reverse coil of drive valve.
- ◆ Energize drive function by moving joystick (lever) in the direction of the already disconnected coil.
- ◆ Hold the switch for 10 seconds to get an accurate reading on the pressure gauge.

### Lift

- ◆ Energize the platform to full extension with **no load on platform**.
- ◆ Hold the switch for 10 seconds to get an accurate reading on the pressure gauge.

### Steering

- ◆ Energize the steering to full left.
- ◆ Hold the switch for 10 seconds to get an accurate reading on the pressure gauge.

### Early Models

Early models do not have a tamper proof cap.

- ◆ Turn adjustment screw "IN" to increase the pressure.
- ◆ Turn adjustment screw "OUT" to decrease the pressure.

### Current Models

- ◆ Remove the tamper proof cap.
- ◆ Turn adjustment screw "IN" to increase the pressure.
- ◆ Turn adjustment screw "OUT" to decrease the pressure.
- ◆ When correct pressure is obtained replace tamper proof cap with a new one.

**CAUTION: Do not operate pump with tamper proof cap removed as fluid will emit under pressure.**



## Setting Counterbalance Valves

- ◆ Before attempting to check and/or adjust counterbalance valves, operate the machine for 15 minutes or long enough to sufficiently warm the hydraulic fluid.
- ◆ Insert a 0-70 bar (0-1000 psi) gauge onto the pressure test port on the valve manifold using gauge adapter fitting MEC part no. 8434

## Check and Adjust Pressure (counterbalance)

If adjustment is required, set pressure to the correct setting as follows:

- ◆ Open the freewheel valve (NV1) completely.
- ◆ Operate drive in either direction.
- ◆ Hold the switch for 10 seconds to get an accurate reading on the pressure gauge.

### Early Models

- ◆ Loosen the jam nut.
- ◆ Turn “counterclockwise” to increase the pressure.
- ◆ Turn “clockwise” to decrease the pressure.

### Current Models

- ◆ Using pliers or other gripping tool, **carefully** remove the tamper proof cap.
- ◆ Turn adjustment screw “IN” to increase the pressure.
- ◆ Turn adjustment screw “OUT” to decrease the pressure.
- ◆ When correct pressure is obtained replace tamper proof cap with a new one.

# TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSE	REMEDY/SOLUTION
<b>GENERAL LOSS OF POWER</b>		
<b>No operation from upper or lower control station</b>	<p>Main battery switch turned off</p> <p>Emergency switch pushed in or Base-Platform switch turned off</p> <p>Circuit breaker tripped</p> <p>Damaged upper control box harness</p> <p>Batteries discharged</p> <p>Check for motor controller flash codes</p>	<p>Located on of lower control box</p> <p>Pull upper and lower emergency stop switches to initiate power</p> <p>Check for short circuits and Reset Located in lower control box panel</p> <p>Inspect from harness plug to terminal strip under platform</p> <p>Look for a 7 or 9 flash code while attempting function. Check battery voltage under load</p> <p>See "Sevcon Motor Speed Controller" in this section for troubleshooting flash codes.</p>
<b>Functions from lower controls but not from upper controls</b>	<p>Upper Emergency Stop switch pushed in</p> <p>Interlock switch (joystick)</p> <p>Damaged harnesses</p>	<p>Pull upper emergency stop switch</p> <p>Check power to red wire (power to switch) and power to purple wire (power out of switch) at joystick plug</p> <p>Check scissor and upper box harness for damage</p>
<b>LIFT</b>		
<b>Partial or intermittent lift from either control station</b>	<p>Low battery voltage, at 18 volts operating</p> <p>Platform overloaded</p> <p>Lift relief valve RV1 out of adjustment</p> <p>Lowering valve SV9 pulled out or emergency down cable (if equipped) sticking</p> <p>6- flash code at motor controller</p>	<p>Lift will stop, a 9-flash code will be displayed on the motor controller while attempting to lift</p> <p>Check platform load and compare with posted Maximum Weight labels, reduce load</p> <p>Adjust relief valve to rated capacity</p> <p>Inspect lowering valve, located on lift cylinder Check cable adjustment/operation (if equipped)</p> <p>Test potentiometer POT1 for open circuit Located in upper control box, replace</p>

## Troubleshooting (continued)

PROBLEM	POSSIBLE CAUSE	REMEDY/SOLUTION
<b>LIFT (CONTINUED)</b>		
<b>No lift from either control station - Pump motor runs</b>	Lift Valve SV2 not energized	Check lift circuit on wire # 4 from control box to lift valve SV2
	Main system pressure inadequate	Check main relief RV2 adjustment, Check pump output pressure using a flow meter
<b>No lift from either control station - Pump motor <i>NOT</i> operating while attempting lift</b>	Micro-switch S7 inoperative	Check operation of micro-switch located in upper control box on joystick
	Mode Selector Switch S6 faulty	Check power through S6 on wire 10
	Damaged wiring or poor plug connection	Check wire 10 through plug connections from upper control box to Diode Board
	Failed diode in diode board	Test diodes on diode board, replace diode board
<b>LOWER</b>		
<b>Platform will not lower</b>	Maintenance lock in maintenance position	Elevate platform slightly and return maintenance lock to the stowed position
	Lowering valve/s not energized SV9 (SV8)	Check lowering circuit wire # 5 from control box to lowering valve, located on lift cylinder On earlier units, check valve SV8 also
	Lowering valve/s not shifting	Clean debris, replace
	Lowering orifice ORF3 plugged	Clean orifice - located under fitting at lift cylinder
<b>Lowers but not completely (3247ES only)</b>	Down valve on one cylinder inoperative	Check valves and coils located on cylinders
<b>Emergency lowering not working  3247ES only</b>	E-down cable frayed (later models only)	Replace e-down cable
	Lowering valve not shifting	Clean debris, replace
	E-down battery discharged - should charge during normal battery charge cycle	Check charge diode D18 located at positive terminal of battery, check charge wire connection
	Valve coil failed on either cylinder	Test, replace
<b>Lowers but not completely - 3247ES only</b>	Down valve on one cylinder inoperative	Check valve coils, wiring

## Troubleshooting (continued)

PROBLEM	POSSIBLE CAUSE	REMEDY/SOLUTION
<b>DRIVE</b>		
<b>No drive either direction Pump motor runs while attempting to drive LOW pressure indicated at Test Port TP-1</b>	Freewheel Valve NV1 open  Brake valve SV5 not shifting   Brake valve SV5 not shifting -no power on wire 19	Turn counter-clockwise to close  Check power to SV5 Remove SV5 and check for contamination Replace SV5  Check power back to diode board term 3
<b>No drive either direction Pump motor runs while attempting to drive HIGH pressure indicated at Test Port TP-1</b>	Drive valve SV3 not shifting   Drive valve SV3 not shifting - no ground to valve coils on wire # 151  Counterbalance Valve CBV1 failure	Check power to SV3 Remove SV3 and check for contamination Replace SV3  Check Limit Switch LS1 for sticking or failure Loosen up with lubricant Replace  Replace CBV1
<b>Reduced, slow or sluggish drive either direction Torque switch OFF</b>	Freewheel Valve NV1 partially open  Torque valve/s SV4 & or SV6 sticking  Decel valve SV7 inoperative - earlier units only  One or both Wheel motors WM1 & WM2 internal bi-pass  Limit Switch LS1 inoperative  6- flash code at motor controller	Turn counter-clockwise to close  Inspect torque valves SV4 & SV6, replace  Check for power to SV7 while driving Check valve for contamination Replace valve  Test wheel motors Replace wheel motors  Check power on wire 22 and 2 in limit switch with platform below 6 feet.  Test potentiometer POT1 for open circuit Located in upper control box Replace
<b>Reduced, slow or sluggish drive either direction Torque switch ON</b>	One Torque valve SV4 or SV6 not shifting  One or both Wheel motors WM1 & WM2 internal bi-pass	Check voltage on wire #13 while driving Check valves for contamination, replace SV4 or SV6  Test wheel motors Replace wheel motors

## Troubleshooting (continued)

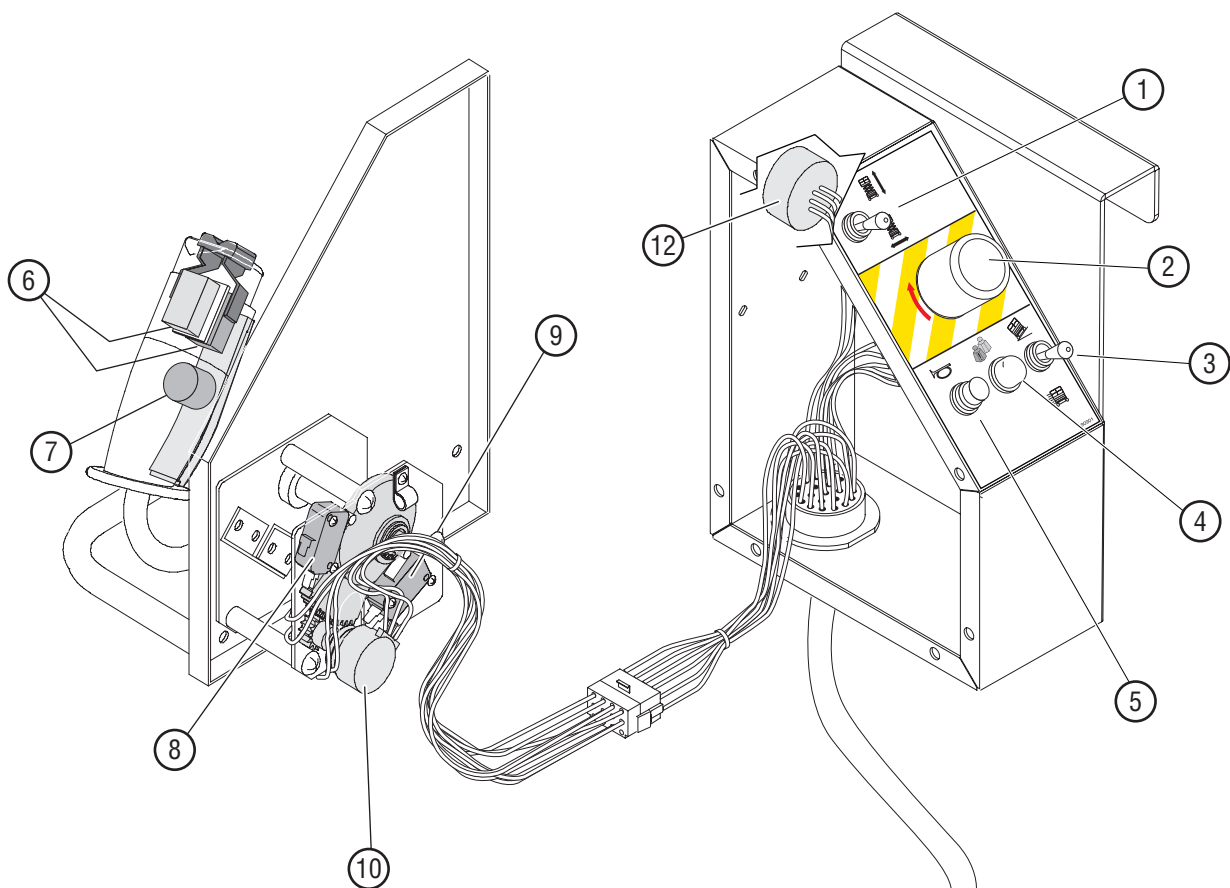
PROBLEM	POSSIBLE CAUSE	REMEDY/SOLUTION
<b>DRIVE (CONTINUED)</b>		
<b>No Drive in <i>REVERSE</i> only Pump motor <i>NOT</i> operating while attempting to drive</b>	Micro-switch S7 inoperative  Mode Selector Switch S6 faulty  Damaged wiring or poor plug connection  Failed diode in diode board	Check operation of micro-switch Located in upper control box on joystick  Check power through S6 on wire 10  Check wire 10 through plug connections from upper control box to Diode Board  Test diodes on diode board Replace diode board
<b>No Drive in <i>FORWARD</i> only Pump motor <i>NOT</i> operating while attempting to drive</b>	Micro-switch S8 inoperative  Mode Selector Switch S6 faulty  Damaged wiring or poor plug connection  Failed diode in diode board	Check operation of micro-switch Located in upper control box on joystick  Check power through S6 on wire 11  Check wire 11 through plug connections from upper control box to Diode Board  Test diodes on diode board Replace diode board
<b>No Drive in <i>REVERSE</i> only Pump motor <i>OPERATES</i> while attempting to drive</b>	Drive valve SV3 not shifting	Check power to SV3, remove SV3 Check for contamination Replace SV3
<b>No Drive in <i>FORWARD</i> only Pump motor <i>OPERATES</i> while attempting to drive</b>	Drive valve SV3 not shifting	Check power to SV3, remove SV3 Check for contamination Replace SV3
<b>Drives in one direction regardless of direction operated</b>	Drive valve SV3 sticking  Drive valve SV3 powered in one direction	Check SV3 for contamination Replace SV3  Short in wiring, faulty diode board.

## Troubleshooting (continued)

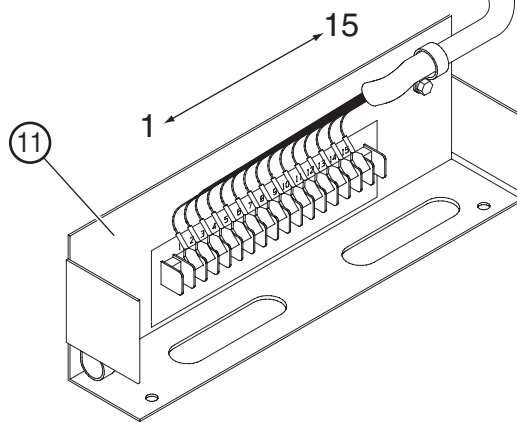
PROBLEM	POSSIBLE CAUSE	REMEDY/SOLUTION
<b>DRIVE</b> (CONTINUED)		
<b>No Drive above limit switch</b> <b>HIGH pressure indicated at Test Port TP-1</b>	Pothole system not deployed  Pothole limit switch/s LS2 & LS3 inoperative	Clear debris from under pothole bars Check pothole linkage operation  Check switch/es for presence of Ground on wire 151 when pothole bars completely deployed
<b>No Drive above limit switch</b> <b>LOW pressure indicated at Test Port TP-1</b>	Decel valve SV7 inoperative - earlier units only  Pump output reduced due to wear	Check for power to SV7 while driving Check valve for contamination Replace valve  Test pump with a flow meter Replace
<b>Speed uncontrollable while descending a hill</b>	Counterbalance Valve CBV1 out of adjustment	See " <i>Setting Counterbalance Valves</i> " in this section Replace valve
<b>STEER</b>		
<b>No Steer</b> <b>Either direction</b> <b>Pump motor OPERATES while attempting to steer</b>	Steer valve SV1 not shifting  Steering linkage binding No power to SV1  Steering Cylinder internal failure	Check power to SV1, remove SV1 and check for contamination Replace SV1  Inspect - lube linkage, replace as necessary  Check for broken wires between lower control box and SV1 valve  Inspect, replace seals
<b>No Steer</b> <b>Either direction</b> <b>Pump motor NOT operating while attempting to steer</b>	Selector switch S6 inoperative  Broken wire in joystick handle	Check for power on wire 3 and 3a when steer attempted  Check for broken Blue wire in joystick handle
<b>No Steer</b> <b>Right only</b> <b>Pump motor NOT operating while attempting to steer</b>	Micro-switch S4 inoperative  Damaged wiring or poor plug connection  Failed diode in diode board	Check operation of micro-switch located in upper control box in joystick handle  Check wire 7 through plug connections from upper control box to Diode Board  Test diodes on diode board Replace diode board

## Troubleshooting (continued)

PROBLEM	POSSIBLE CAUSE	REMEDY/SOLUTION
<b>DRIVE (CONTINUED)</b>		
<b>No Steer Left only Pump motor NOT operating while attempting to steer</b>	Micro-switch S5 inoperative  Damaged wiring or poor plug connection  Failed diode in diode board	Check operation of micro-switch located in upper control box in joystick handle  Check wire 8 through plug connections from upper control box to Diode Board  Test diodes on diode board Replace diode board
<b>No Steer Right only Pump motor OPERATES while attempting to steer</b>	Steer valve SV1 not shifting  Steering linkage binding Steering Cylinder internal seal failure	Check power to SV1 Remove SV1 and check for contamination Replace SV1  Inspect - lube linkage, replace as necessary Inspect, replace seals
<b>No Steer Left only Pump motor OPERATES while attempting to steer</b>	Steer valve SV1 not shifting  Steering linkage binding Steering Cylinder internal seal failure	Check power to SV1 Remove SV1 and check for contamination Replace SV1  Inspect - lube linkage, replace as necessary Inspect, replace seals
<b>Drives in one direction regardless of direction request</b>	Steer valve SV1 sticking  Drive valve SV1 powered in one direction	Inspect SV1 valve for debris Replace SV1  Short in wiring, faulty diode board.

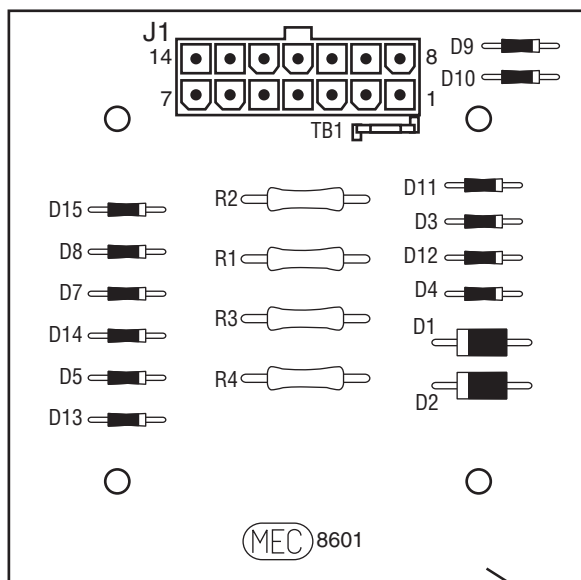


- 1] Lift/Drive Selector Switch
- 2] Emergency Stop Switch
- 3] Torque Switch
- 4] Overload Warning Light (Red)
- 5] Horn Button (option)
- 6] Steering Micro-Switches
- 7] Drive Enable Switch
- 8] Reverse/Down Rocker Switch
- 9] Forward/Up Rocker Switch
- 10] Potentiometer
- 11] Terminal Strip
- 12] Control Box Alarm



**mec**  
ILLUSTRATION No.  
ART\_2429

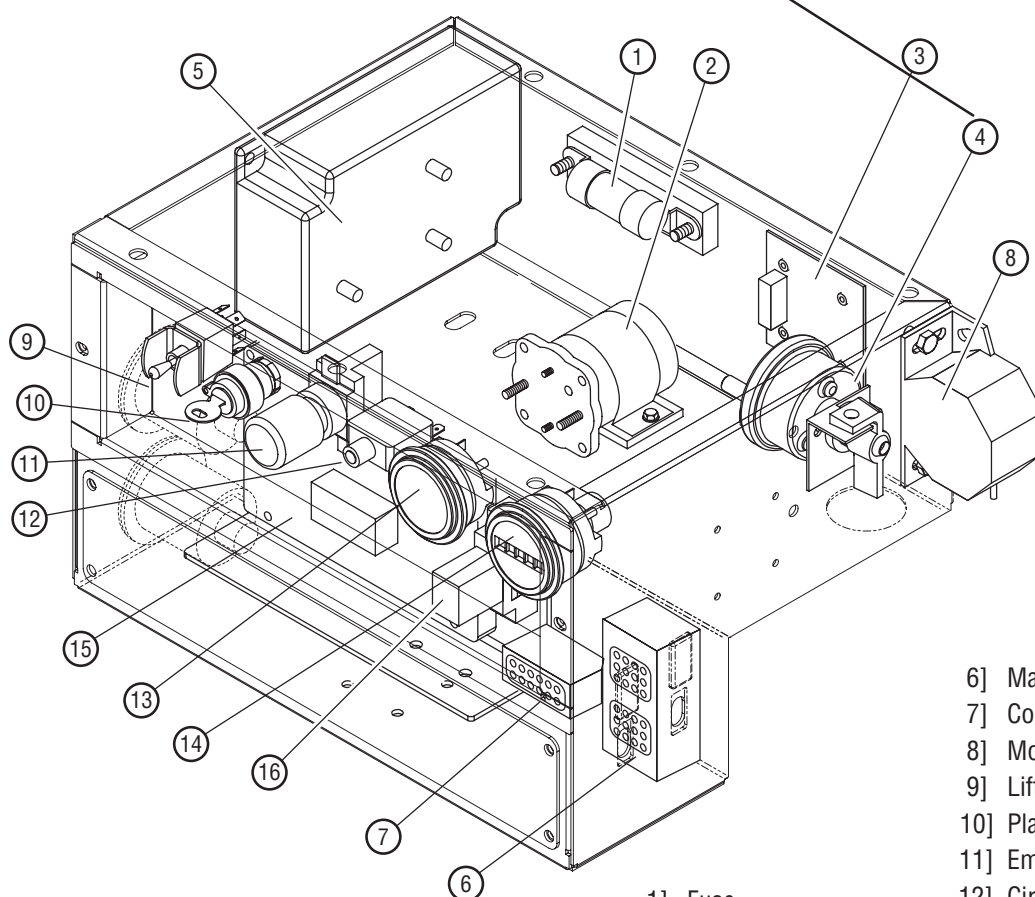




## J1 Plug Pin Identification

PIN #	WIRE #	SIGNAL	FUNCTION
1	10	INPUT	Drive Reverse
2	11	INPUT	Drive Forward
3	19	OUTPUT	Brake, Decel Valve signal
4	8	INPUT	Steer Left
5	18	OUTPUT	Steer signal to Sevcon
6	5	INPUT	Down signal
7	20	OUTPUT	Signal to Motion Alarm(s) (optional)
8	17	OUTPUT	Sevcon & Hour Meter (motor function requested)
9	15	INPUT	Battery Negative
10	7	INPUT	Steer Right
11	4	INPUT	Lift Up
12	2	INPUT	Limit Switch (24V = platform down)
13	3	OUTPUT	Enable, from lower Lift switch
14	21	OUTPUT	To Sevcon (for speed cutback)

ILLUSTRATION No.  
ART\_2181



- 1] Fuse
- 2] Contactor
- 3] Circuit (Diode) Board
- 4] Battery Cutoff Switch
- 5] MotorControl Unit
- 6] Main Harness Connection
- 7] Control Cable Connection
- 8] Motion Alarm (option)
- 9] Lift/Lower Switch
- 10] Platform-Base Selector
- 11] Emergency Stop Switch
- 12] Circuit Breaker
- 13] Battery Gauge
- 14] Hour Meter
- 15] GP102 Load Sense Module
- 16] Overload Cutout Relay

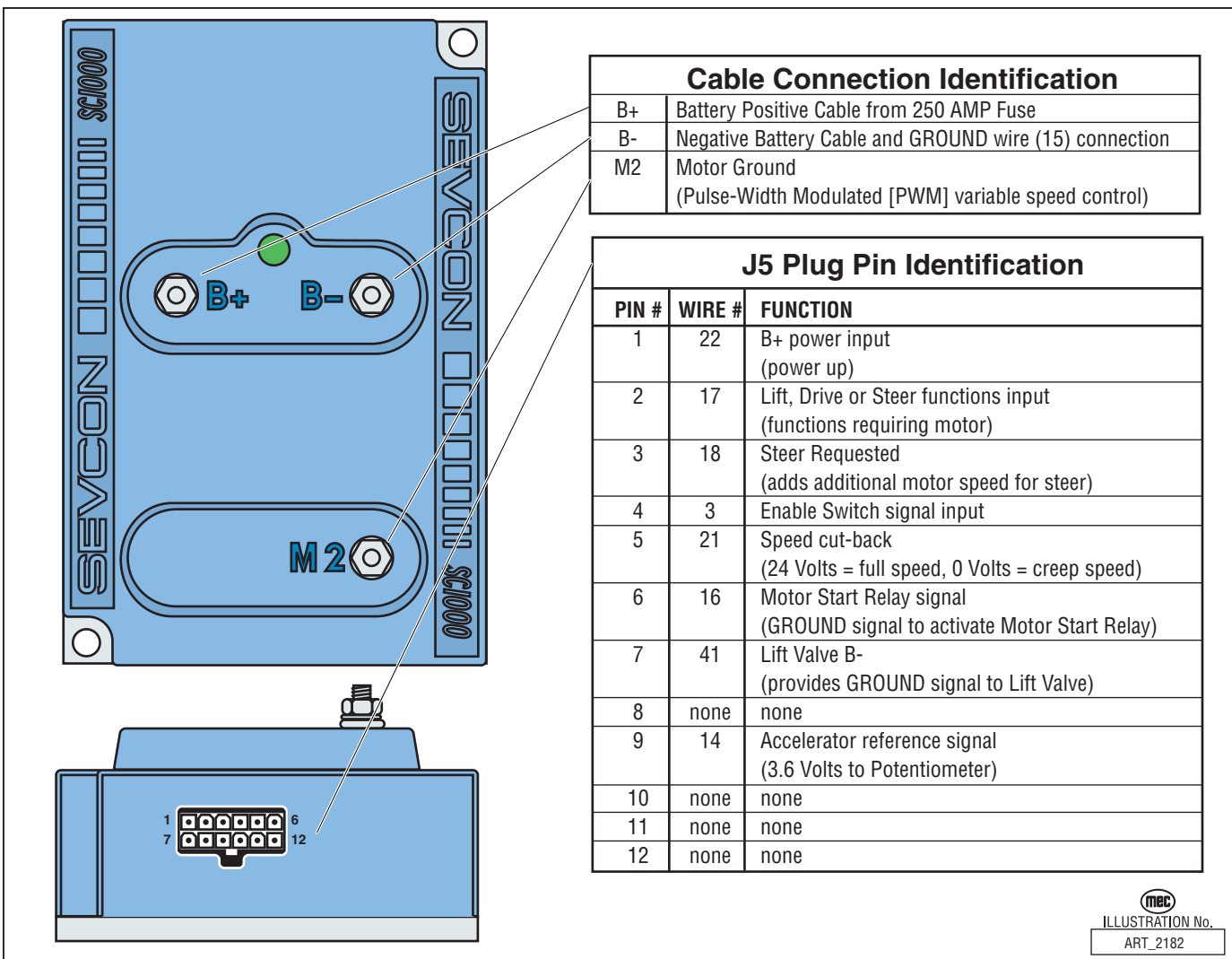
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ART\_2428



# SEVCON MOTOR SPEED CONTROLLER

The Sevcon Motor Speed Controller (MC-1) is a microprocessor designed with the express purpose of operating the D/C electric motor at varying speeds. The controller uses Pulse-Width Modulation (PWM) technology on the Ground side of the motor to control motor speed. Out of concern for operator safety and to prevent short-circuiting, the Controller monitors certain circuits for potential abnormalities. When the controller senses a problem it errs to the side of safety and stops all motor operation. The green LED will flash a code indicating the reason for the shutdown.

Refer to the *LED Diagnostics Definitions* and *Sevcon Motor Speed Controller - Connections* on the following pages.



## LED Diagnostics Definitions (Flash Codes)

LED READING	DIAGNOSIS
<b>LED Steady On</b>	Controller is operational and detects no irregularities on monitored circuits.
<b>LED Off</b>	<b>No power-up</b> <ul style="list-style-type: none"> <li>No power to pin # 1.</li> <li>No ground to B- post.</li> <li>LED failure or internal controller fault.</li> </ul>
<b>2 Flashes</b>	<b>Procedure fault.</b> <ul style="list-style-type: none"> <li>Enable depressed at power up.</li> <li>Enable depressed for more then 15 seconds without function request.</li> <li>No signal on wire 17 pin # 2 when function requested.</li> <li>No B- to diode board.</li> <li>Failed diode/s.</li> <li>Damaged wire harness.</li> <li>Internal controller fault.</li> </ul>
<b>3 Flashes</b>	<b>Motor circuit low.</b> Set with unit at rest and is the result of the voltage at M-2 dropping to approximately 4 volts or lower. Possible causes: <ul style="list-style-type: none"> <li>Short to ground in the motor circuit between the motor contactor and the M-2 terminal.</li> </ul>
<b>4 Flashes</b>	<b>Motor circuit high.</b> Set with the unit at rest and is the result of the voltage at M-2 terminal rising above 21 volts. Possible causes: <ul style="list-style-type: none"> <li>Motor contactor points are welded shut</li> </ul>
<b>5 Flashes</b>	<b>Motor contactor circuit open.</b> Set when a function is requested but no current can flow through the motor circuit to the M-2 terminal. Possible causes: <ul style="list-style-type: none"> <li>Blown 200 amp fuse</li> <li>Malfunctioning motor contactor</li> <li>Worn motor brushes</li> <li>Incomplete circuit to the Sevcon pin #6</li> </ul> If the motor and contactor circuits are diagnosed as working properly: <ul style="list-style-type: none"> <li>Sevcon internal fault</li> </ul>

continued...

## LED Diagnostics Definitions (continued)

LED READING	DIAGNOSIS
<b>6 Flashes</b>	<p><b>Accelerator fault.</b></p> <p>Set with unit at rest, a 6 flash will result in an 80% cutback of motor speed. The Accelerator is the proportional control circuitry for the Sevcon. It works in conjunction with the potentiometer located in the upper control box, which is connected to the joystick handle through a gear arrangement.</p> <p><b>Measure voltage at terminals 14 and 15 on the platform terminal strip or at the potentiometer plug connection.</b></p> <ul style="list-style-type: none"><li>• With the joystick handle in neutral, 3.6 volts should be measured on the accelerator circuit (wire #14).</li><li>• Voltage proportionally decreases with the travel of the joystick, with 0 volts at full stroke.</li><li>• With the joystick centered, voltages lower than 3.1 or higher than 3.9 will trigger a (6 flash) code.</li></ul>
<b>7 Flashes</b>	<p><b>Battery voltage fault.</b></p> <ul style="list-style-type: none"><li>• This includes battery voltage below 12 volts or above 45 volts as measured on pin #1.</li><li>• This code will disable all functions.</li></ul>
<b>8 Flashes</b>	<p><b>Thermal cutback.</b></p> <ul style="list-style-type: none"><li>• Sevcon internal temperatures above 176 degrees F.</li><li>• Will limit motor speed in comparison with over temperature.</li><li>• Resets when cooled.</li></ul>
<b>9 Flashes</b>	<p><b>Battery voltage at or below 18 volts</b></p> <ul style="list-style-type: none"><li>• As measured on pin #1.</li><li>• This code will interrupt or prevent lift function but will allow drive and steer functions.</li></ul> <p>When lift is interrupted due to a 9 flash, the electric motor will still run.</p>

## Sevcon Motor Speed Controller - Connections

The following two pages describe the connections to the Sevcon Motor Speed Controller with a brief description of their function and the voltage measurements under normal conditions.

**Important: Batteries must be fully charged before troubleshooting!**  
**A fully charged battery set on a 24 V DC system will have a nominal voltage of 25.6 V DC**

FUNCTION	VOLTAGE READING
<b>PIN 1 – WIRE 22</b> (WIRE 9 ON EARLY UNITS)	
<b>Battery Positive Input</b>	Switched <b>5% less than battery voltage</b> <ul style="list-style-type: none"> <li>Controller power-up and reference point for battery state-of-charge.</li> <li>Green LED indicates controller power-up.</li> <li>Power travels through the upper emergency-stop switch with upper controls selected.</li> <li>7-Flash code and 9-flash code indicate low voltage at this terminal.</li> </ul>
<b>Pin 2 Wire 17</b>	
<b>Lift, Drive or Steer functions requested</b>	Motorized function is requested <b>15%-18% less than battery voltage</b> <ul style="list-style-type: none"> <li>Controller begins the motor run sequence with this signal but still requires a signal on pin 4 and a change on pin 9 before the motor will operate.</li> </ul>
<b>Pin 3 Wire 18</b>	
<b>Steer Function Requested</b>	When steering is operated <b>15%-18% less than battery voltage</b> <ul style="list-style-type: none"> <li>Adds motor speed to compensate for addition of steer requirement during drive operation.</li> <li>Provides a minimum motor speed for steer requirement when only steer is operated.</li> </ul>
<b>Pin 4 Wire 3</b>	
<b>Enable signal input</b>	When joystick trigger pulled <b>5% less than battery voltage.</b> <ul style="list-style-type: none"> <li>Motor will not start without this input</li> <li>A signal here longer then 15 seconds without a signal on pin-2 or pin-3 will result in a 2-flash code failure.</li> </ul>
<b>Pin 5 Wire 21</b>	
<b>Speed cutback signal from limit switch or Lift circuit</b>	Full speed: <b>24 V DC</b> Creep speed: <b>0 V DC.</b> <ul style="list-style-type: none"> <li>Speed cutback is the elevated drive speed.</li> </ul>

## Sevcon Motor Speed Controller - Connections (continued)

FUNCTION	VOLTAGE READING
<b>PIN 6 – WIRE 16</b>	
<b>Motor Start Relay ground signal</b>	<p>Idle: <b>24 V DC</b></p> <p>When function requested: <b>0 V DC</b>.</p> <ul style="list-style-type: none"> <li>• This is how the Controller maintains control over the motor circuit.</li> <li>• Sevcon controls the Motor Start Relay function ground signal.</li> <li>• Will not operate the motor start relay when 2, 3, 4 &amp; 7 flash codes occur.</li> </ul>
<b>PIN 7 – WIRE 41</b>	
<b>Ground signal to Lift solenoid valve</b>	<p><b>0 volts</b></p> <p>No ground presence until lift is requested.</p> <ul style="list-style-type: none"> <li>• By providing the ground signal, lift function can be prevented anytime battery voltage falls below 18 volts. This will result in a 9 flash code.</li> </ul>
<b>PIN 9 – WIRE 14</b>	
<b>Accelerator reference signal to the potentiometer (upper control box)</b>	<p>From <b>3.5 V DC</b> with joystick in the neutral to <b>0 V DC</b> at full stroke.</p> <ul style="list-style-type: none"> <li>• Controller uses this circuit to monitor joystick input after pins 2 &amp; 4 energize.</li> <li>• Controls motor speed in reference to the voltage on this circuit.</li> <li>• Voltages above 4.0 V DC or below 3.0 V DC will result in a 6 flash code.</li> </ul>
<b>POST B+</b>	
<b>Battery positive cable from 200 amp fuse</b>	<p>Full battery voltage.</p> <ul style="list-style-type: none"> <li>• No real diagnostic value.</li> </ul>
<b>POST B–</b>	
<b>Battery positive cable from 200 amp fuse</b>	<p>Battery ground cable connection</p> <p>Ground path for motor operation</p> <ul style="list-style-type: none"> <li>• All system ground wires (wire #s 15 &amp; 15A) terminate here.</li> <li>• Best place to connect ground lead from multimeter while troubleshooting.</li> </ul>
<b>POST M-2</b>	
<b>PWM controlled motor ground</b>	<p>Idle: <b>12 V DC – 13 V DC</b></p> <p>During operation, between <b>5 V DC &amp; 24 V DC</b>.</p> <ul style="list-style-type: none"> <li>• 12 – 13 volts is reference voltage used by the controller to monitor motor circuit irregularities at idle.</li> <li>• 0 volts at idle = 3 flash code</li> <li>• Above 20 volts at idle = 4 flash code</li> <li>• No voltage change after Motor Start Relay signal = 5 flash code.</li> </ul>

# TROUBLESHOOTING BATTERY CHARGER

To be able to use the trouble shooting guide safely and effectively, it is important to read through this guide before beginning any tests.



**Do not disassemble charger. Return to MEC when service or repair is required.**



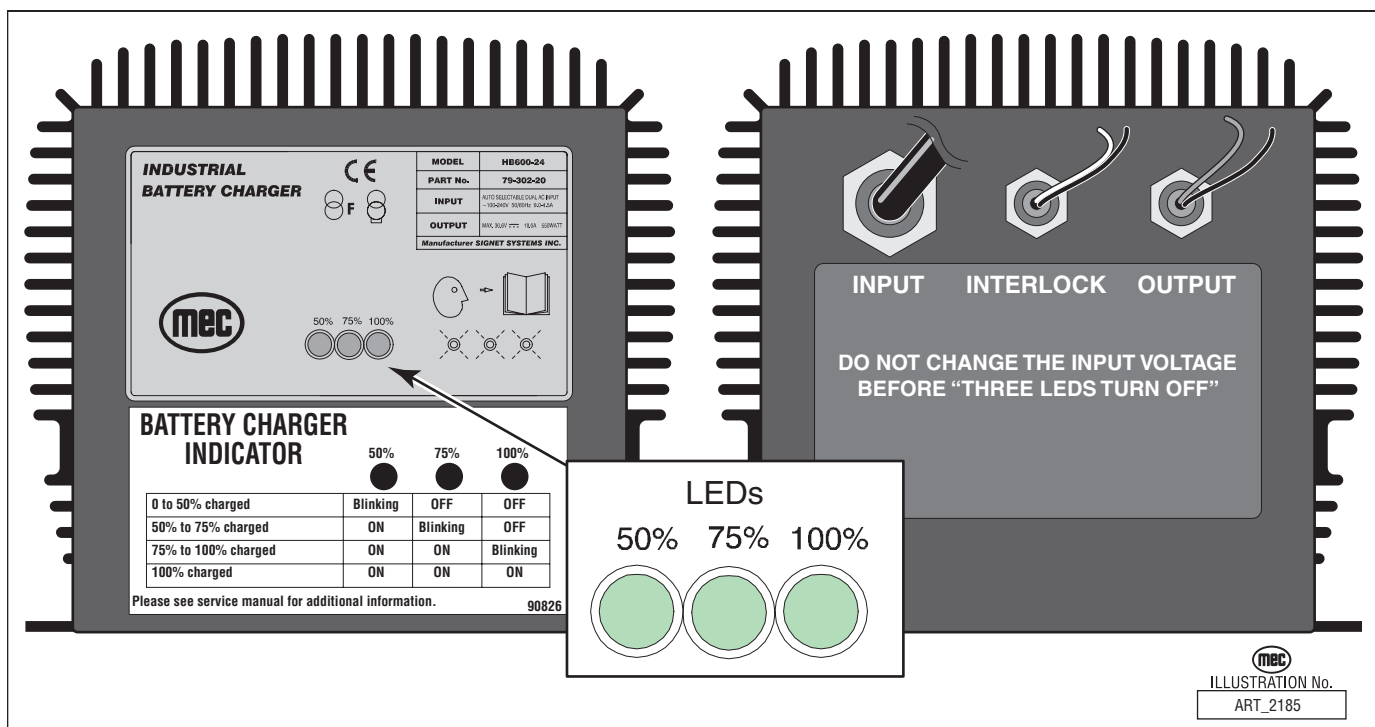
**TO REDUCE THE RISK OF ELECTRIC SHOCK, ALWAYS DISCONNECT BOTH THE POWER SUPPLY CORD AND THE OUTPUT WIRES BEFORE ATTEMPTING MAINTENANCE.**



**DO NOT OPERATE THE CHARGER IF IT IS MALFUNCTIONING. PERSONAL INJURY OR PROPERTY DAMAGE MAY RESULT.**

Incorrect assembly may result in a risk of electric shock or fire. The following procedures are intended only to determine if a malfunction may exist in the charger. Most returned chargers test good, it is very important that this procedure is followed and that other problems are corrected before assuming the charger has failed.

The MEC battery charger is a fully automatic type with a maintenance feature that will maintain battery voltage indefinitely when connected to an AC power source. The battery charger should be plugged into an unswitched AC source if stored for long periods of time.



	LED Status	Description
Fault	All 3 LED lamps blink once simultaneously.	Output is open or short, or output voltage is over a limit. Otherwise, output terminals are reversed.
	All 3 LED lamps blink twice simultaneously.	Input voltage is out of the range
	All 3 LED lamps blink three times simultaneously.	The internal temperature of the charger exceeds a limit.
	All 3 LED lamps blink four times simultaneously.	Output current exceeds a limit.
Warning	100% LED lamp blinks.	Battery pack has a bad cell.

To determine if a charger is malfunctioning, identify the problem from the following list and refer to the appropriate section for detailed instructions.

- 1.) Charger does not turn on
- 2.) All 3 LEDs blink simultaneously
- 3.) 100% LED blinks while 50% and 75% LEDs are "OFF"
- 4.) Batteries do not fully charge
- 5.) The AC supply circuit breaker or fuse is blown

If the problem is not listed above, refer the problem to a qualified service agent for additional trouble shooting procedures.



## Troubleshooting Battery Charger (continued)

PROBLEM	DIAGNOSIS
<b>Charger does not turn ON</b>	<p><b>The AC plug must be disconnected and reconnected to start the charger once it has turned-off from a charge cycle.</b></p> <ul style="list-style-type: none"> <li>• Connect the AC supply cord securely to a live AC outlet.</li> <li>• Double check the outlet to ensure it is working by connecting a known good piece of equipment with the outlet.</li> <li>• Inspect the DC output wires and connections to be sure they are in good working condition.</li> <li>• Refer to LED Flash Codes below if all 3 LEDs are flashing.</li> <li>• Replace charger if everything else is correct.</li> </ul>
<b>All 3 LEDs blink <i>ONCE</i> simultaneously</b>	<p><b>Output connection error.</b></p> <ul style="list-style-type: none"> <li>• Check the battery and charger connection and correct</li> <li>• The output may not be connected to the batteries</li> <li>• The connections to the batteries may have corroded or loosened.</li> <li>• The output may be shorted due to improper connection to the batteries or pinched wires.</li> <li>• The output may be connected in reverse polarity to the batteries.</li> </ul> <p>The charger will not be damaged by any of these problems.</p>
<b>All 3 LEDs blink <i>TWICE</i> simultaneously</b>	<p><b>AC input voltage tolerance beyond limit.</b></p> <ul style="list-style-type: none"> <li>• Check the AC input voltage. The charger is indicating the AC voltage is too low or too high.</li> </ul> <p>This is an unusual problem and would most likely occur with a very poorly regulated engine-generator set providing the AC voltage to the charger.</p>
<b>All 3 LEDs blink <i>THREE TIMES</i> simultaneously</b>	<p><b>Charger is overheated.</b></p> <ul style="list-style-type: none"> <li>• No action required. When the charger cools, charging will restart automatically.</li> <li>• Check and correct for dirt or other debris on charger that may be reducing cooling.</li> </ul>
<b>All 3 LEDs blink <i>FOUR TIMES</i> simultaneously</b>	<p><b>Input or output over current.</b></p> <ul style="list-style-type: none"> <li>• No action required, charger will correct and restart automatically.</li> </ul>
<b>100% LED blinks while 50% and 75% LEDs are "OFF"</b>	<p><b>The 18 hour timer has elapsed and stopped charging. Batteries are unable to complete constant current and constant voltage charge cycle.</b></p> <ul style="list-style-type: none"> <li>• Batteries are weak, old, or have one or more bad cells. Batteries will still charge but capacity will be reduced. Replace batteries.</li> <li>• Battery pack too large for charger. Use higher output charger or unplug then plug-in charger to restart charge cycle to complete charging.</li> </ul>

## Troubleshooting Battery Charger (continued)

PROBLEM	DIAGNOSIS
<b>Batteries do not fully charge</b>	<p><b>If the batteries are charged overnight, make sure the AC supply is not being switched-off at night with other building items.</b></p> <ul style="list-style-type: none"><li>• Check battery condition following the battery supplier's instructions.</li><li>• Check for dead cells or reduced capacity.</li><li>• Replace charger only if other problems are not found.</li></ul>
<b>The AC line circuit breaker or fuse is blown</b>	<p><b>A defective circuit breaker or fuse, overloaded circuit, or a charger problem can cause this condition.</b></p> <ul style="list-style-type: none"><li>• Connect the charger to a different AC outlet (on a different circuit) in the building.</li><li>• If the charger operates properly on other AC outlets, a qualified Person should correct the AC outlet problem.</li><li>• If the AC supply checks good, the charger should be replaced.</li></ul>



## SECTION 6:

# SCHEMATICS

<b>Hydraulic Schematics .....</b>	<b>6-2</b>
2047ES - Serial # 9801000 - 9801099	
2647ES - Serial # 9901000 - 9901199	
3247ES - Serial # 10001000 - 10001199 .....	6-2
2047ES - Serial # 9801100 - CURRENT	
2647ES - Serial # 9901200 - CURRENT	
3247ES - Serial # 10001200 - CURRENT .....	6-4
<b>Electric Schematics .....</b>	<b>6-9</b>
2047ES - Serial # 9801000 - 9801099	
2647ES - Serial # 9901000 - 9901199	
3247ES - Serial # 10001000 - 10001199 .....	6-10
2047ES - Serial # 9801100 - CURRENT	
2647ES - Serial # 9901200 - CURRENT	
3247ES - Serial # 10001200 - CURRENT .....	6-12

# HYDRAULIC SCHEMATICS

**2047ES - Serial # 9801000 - 9801099**

**2647ES - Serial # 9901000 - 9901199**

**3247ES - Serial # 10001000 - 10001199**

ITEM	DESCRIPTION	Location
CBV1	Counterbalance Valve	Main Manifold (MA-1)
CYL1	Steering Cylinder	Machine Base, Front
CYL2	Lift Cylinder, 2047, 2647	Scissor Assembly
CYL3	Lift Cylinder, Lower, 3247	Scissor Assembly
CYL4	Lift Cylinder, Upper, 3247	Scissor Assembly
FD1	Flow Divider	Main Manifold (MA-1)
FRR1		
HP1	Hand Pump, Brakes	Brake Release Manifold (MA-2)
MA-1	Main Manifold Assembly	Machine Base, Battery Compartment
MA-2	Brake Release Manifold	Battery Compartment
MA-3	Manifold Assembly	Lift Cylinder, 2047ES and 2647ES only
MA-4	Manifold Assembly	Lower Lift Cylinder, 3247ES only
MA-5	Manifold Assembly	Upper Lift Cylinder, 3247ES only
MP1	Manual Pump	Main Manifold (MA-1)
NV1	Needle Valve	Main Manifold
ORF1	Orifice Plug, Wheel Motors	Main Manifold (MA-1)
ORF3	Orifice, Down Valve	Lift Cylinder Manifold (MA-3), 2047ES and 2647ES only
ORF4	Orifice, Down Valve	Lower Lift Cylinder Manifold (MA-4), 3247ES only
ORF5	Orifice, Down Valve	Upper Lift Cylinder Manifold (MA-5), 3247ES only
P1	Pump	Pump Compartment
PCF1	Steering Relief Flow Control	Main Manifold (MA-1)
RV1	Relief Valve, Lift Relief	Main Manifold (MA-1)
RV2	Relief Valve, Main Relief	Main Manifold (MA-1)
RV3	Relief Valve, Steering	Main Manifold (MA-1)
RV4	Relief Valve, Lift Cylinder	Lower Lift Cylinder Manifold (MA-4), 3247ES only
RV5	Relief Valve, Lift Cylinder	Upper Lift Cylinder Manifold (MA-5), 3247ES only
SV1	Spool Valve, Steering	Main Manifold (MA-1)
SV2	Spool Valve, Lift	Main Manifold (MA-1)
SV3	Spool Valve, Drive	Main Manifold (MA-1)
SV4	Spool Valve, Decel	Main Manifold (MA-1)
SV5	Spool Valve, Torque	Main Manifold (MA-1)
SV6	Spool Valve, Torque	Main Manifold (MA-1)
SV7	Spool Valve, Brakes	Main Manifold (MA-1)
SV8	Poppet Valve, Down	Main Manifold (MA-1), 2047ES and 2647ES only
SV9	Spool Valve, Down	Lift Cylinder Manifold (MA-3), 2047ES and 2647ES only
SV10	Spool Valve, Down	Lower Lift Cylinder Manifold (MA-4), 3247ES only
SV11	Spool Valve, Down	Upper Lift Cylinder Manifold (MA-5), 3247ES only
TP1	Test Port	Main Manifold (MA-1)
WB1	Wheel Brake	Drive Wheel
WB2	Wheel Brake	Drive Wheel
WM1	Wheel Motor, Right Side	Machine Base
WM2	Wheel Motor, Left Side	Machine Base



# HYDRAULIC SCHEMATIC

Model: / Serial #

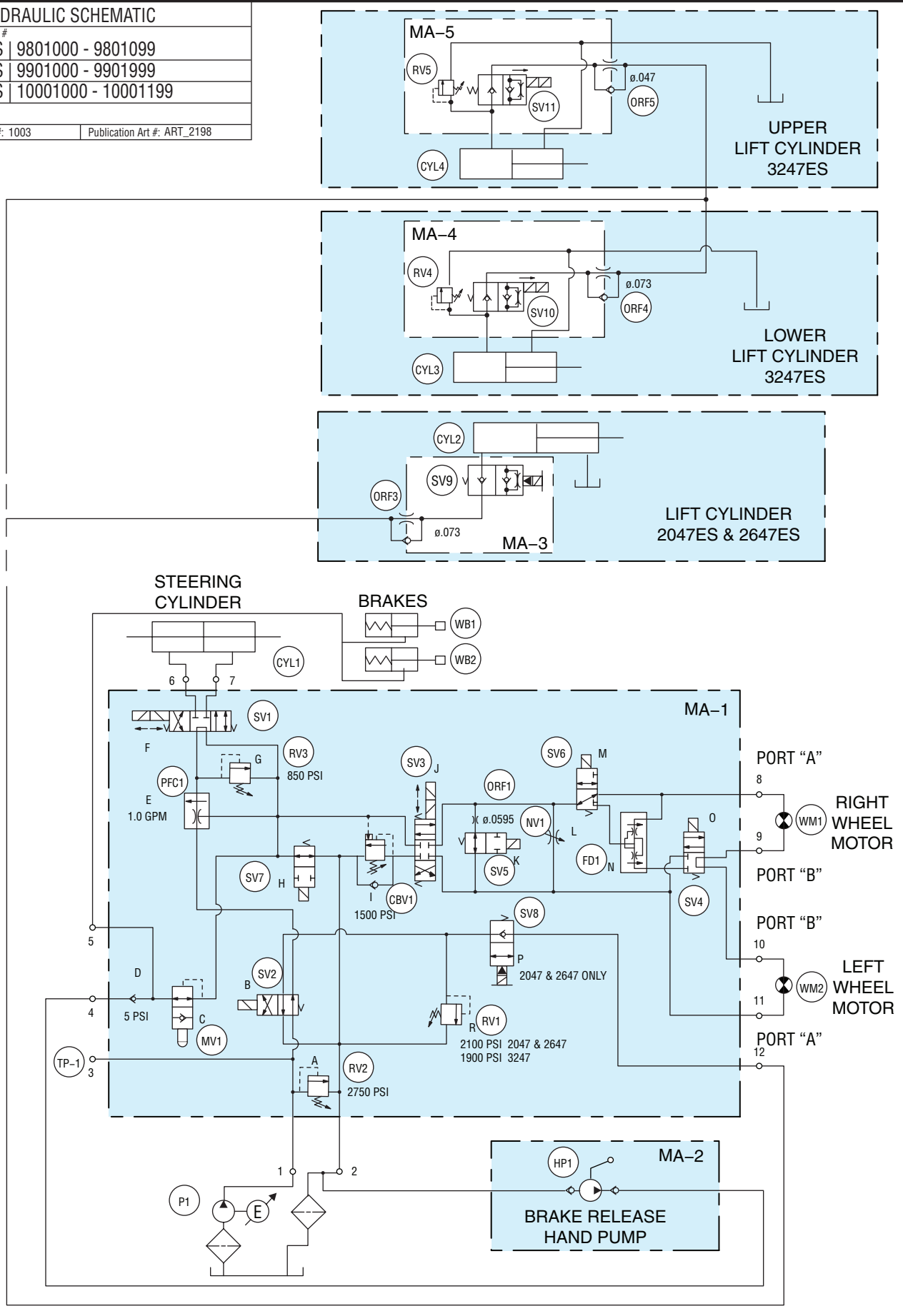
2047ES | 9801000 - 9801099

2647ES | 9901000 - 9901999

3247ES | 10001000 - 10001199

Reference Art #: 1003

Publication Art #: ART\_2198



**2047ES - Serial # 9801100 - CURRENT**

**2647ES - Serial # 9901200 - CURRENT**

**3247ES - Serial # 10001200 - CURRENT**

ITEM	DESCRIPTION	Location
CBV1	Counterbalance Valve	Main manifold (MA-1)
CYL1	Steering Cylinder	Machine Base, Front
CYL2	Lift Cylinder, 2047, 2647	Scissor Assembly
CYL3	Lift Cylinder, Lower, 3247	Scissor Assembly
CYL4	Lift Cylinder, Upper, 3247	Scissor Assembly
FD1	Flow Divider	Main manifold (MA-1)
FRR1	Steering Relief Flow Control	Main manifold (MA-1)
HP1	Hand Pump, Brakes	Main manifold (MA-1)
MA-1	Main Manifold Assembly	Machine Base, Battery Compartment
MA-3	Manifold Assembly	Lift Cylinder, 2047ES and 2647ES only
MA-4	Manifold Assembly	Lower Lift Cylinder, 3247ES only
MA-5	Manifold Assembly	Upper Lift Cylinder, 3247ES only
MP1	Manual Pump	Main manifold (MA-1)
NV1	Needle Valve	Main manifold (MA-1)
ORF1	Orifice Plug, Wheel Motors	Main manifold (MA-1)
ORF2	Orifice Disc, Brake Release	Main manifold (MA-1)
ORF3	Orifice, Down Valve	Lift Cylinder Manifold (MA-3), 2047ES and 2647ES only
ORF4	Orifice, Down Valve	Lower Lift Cylinder Manifold (MA-4), 3247ES only
ORF5	Orifice, Down Valve	Upper Lift Cylinder Manifold (MA-5), 3247ES only
P1	Pump	Pump Compartment
RV1	Relief Valve, Lift Relief	Main manifold (MA-1)
RV2	Relief Valve, Main Relief	Main manifold (MA-1)
RV4	Relief Valve, Lift Cylinder	Lower Lift Cylinder Manifold (MA-4), 3247ES only
RV5	Relief Valve, Lift Cylinder	Upper Lift Cylinder Manifold (MA-5), 3247ES only
SV1	Spool Valve, Steering	Main manifold (MA-1)
SV2	Spool Valve, Lift	Main manifold (MA-1)
SV3	Spool Valve, Drive	Main manifold (MA-1)
SV4	Spool Valve, Brake/Decel	Main manifold (MA-1)
SV5	Spool Valve, Torque	Main manifold (MA-1)
SV6	Spool Valve, Torque	Main manifold (MA-1)
SV9	Spool Valve, Down	Lift Cylinder Manifold (MA-3), 2047, 2647
SV10	Spool Valve, Down	Lower Lift Cylinder Manifold (MA-4), 3247
SV11	Spool Valve, Down	Upper Lift Cylinder Manifold (MA-5), 3247
WB1	Wheel Brake	Drive Wheel
WB2	Wheel Brake	Drive Wheel
WM1	Wheel Motor, Right Side	Machine Base
WM2	Wheel Motor, Left Side	Machine Base

# HYDRAULIC SCHEMATIC

Model: / Serial #

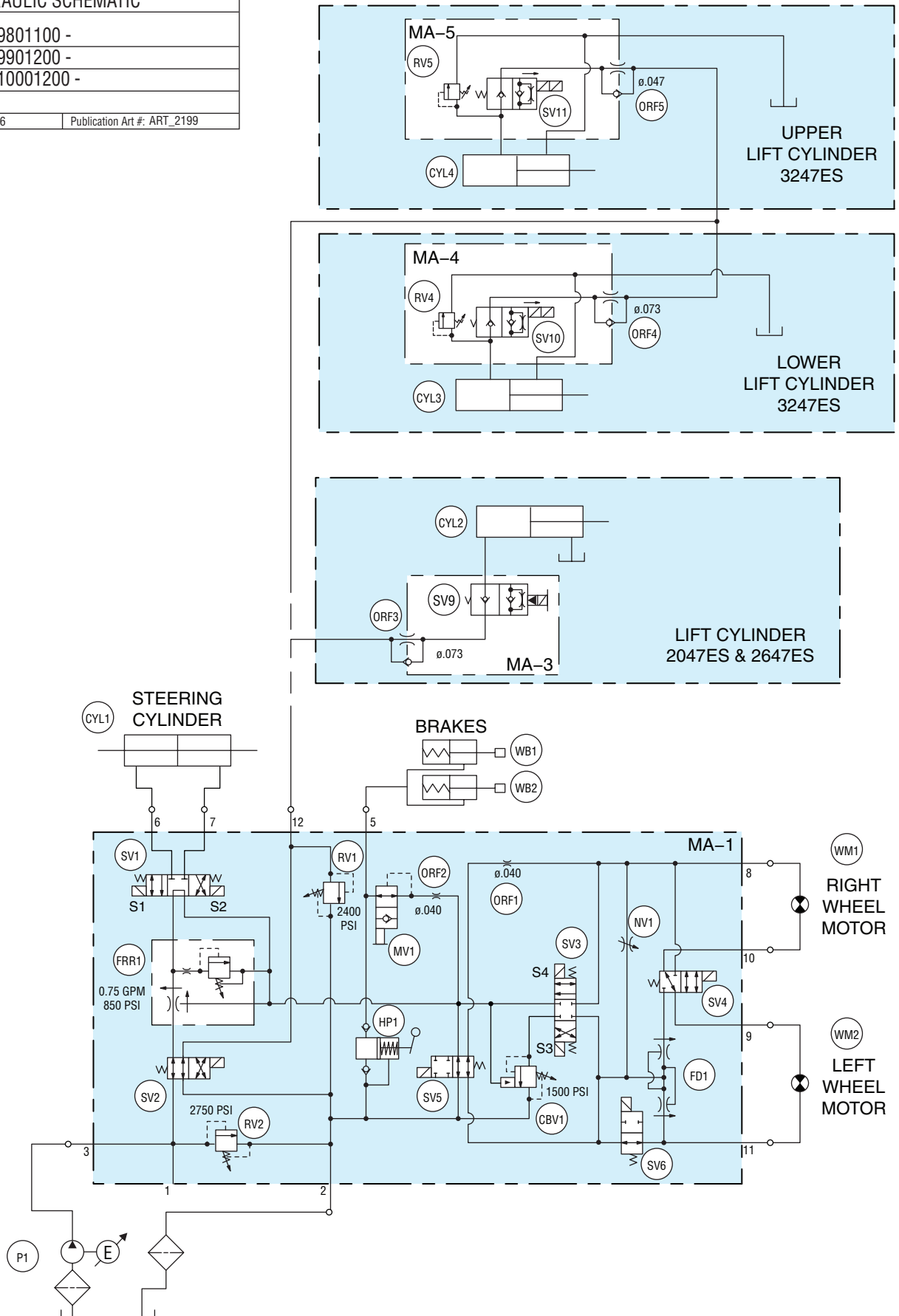
2047ES | 9801100 -

2647ES | 9901200 -

3247ES | 10001200 -

Reference Art #: 966

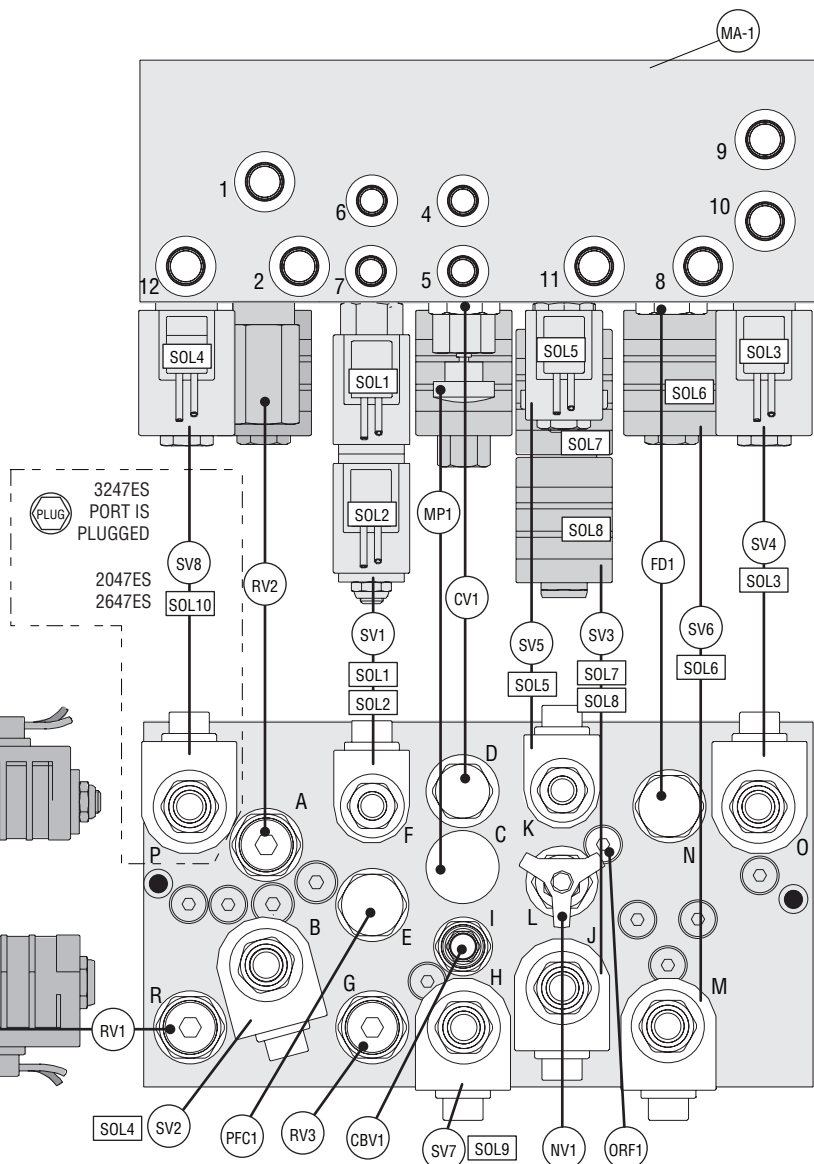
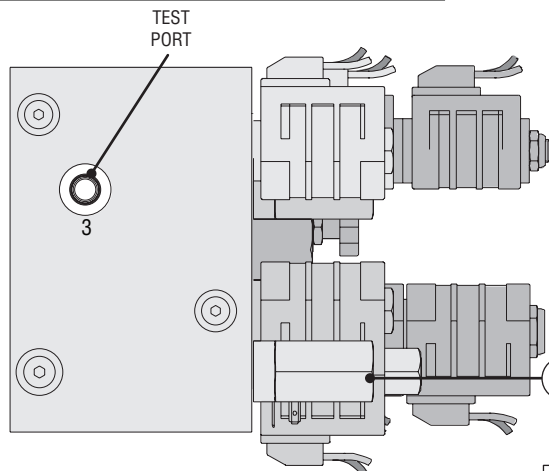
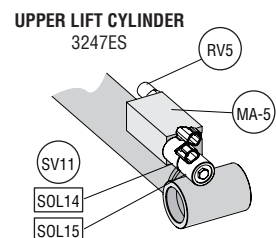
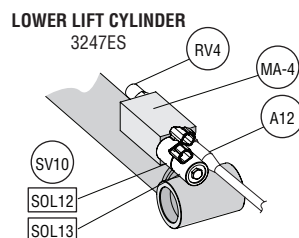
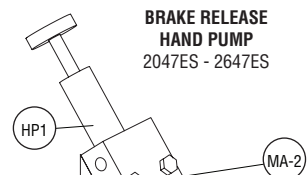
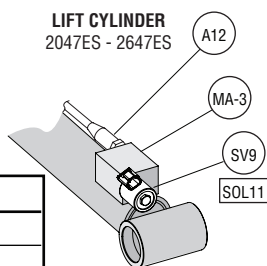
Publication Art #: ART\_2199



<b>Hydraulic Manifold - early style</b>
Model: / Serial #
2047ES CE   2647ES CE   3247ES CE
Reference Art #: none
Publication Art #: ART_2468

NOTE: Early style manifold. Refer to Hydraulic Schematic for serial # break

MA1	COMPONENTS		FUNCTION	PORTS	
	CBV1	Relief Valve	Counter Balance	1	PUMP
	CV1	Check Valve	Flow Control, Brakes	2	TANK
	SOL1	Coil (SV1)	Steer Right	3	TEST PORT
	SOL2	Coil (SV1)	Steer Left	4	BRAKE RELEASE
	SOL3	Coil (SV5)	Drive/Decel	5	BRAKE
	SOL4	Coil (SV2)	Lift	6	STEER
	SOL5	Coil (SV4)	Torque	7	STEER
	SOL6	Coil (SV6)	Torque	8	RIGHT A
	SOL7	Coil (SV3)	Drive Forward	9	RIGHT B
	SOL8	Coil (SV3)	Drive Reverse	10	LEFT B
	SOL9	Coil (SV7)	Brakes	11	LEFT A
	SOL10	Coil (SV8)	Down	12	LIFT
	FD1	Flow Divider			
	MP1	Manual Pump	Brake Release		
	NV1	Needle Valve	Freewheel		
	ORF1	Orifice Plug			
	PFC1	Flow Control	Steer Relief		
	RV1	Relief Valve	Lift Relief		
	RV2	Relief Valve	Main Relief		
	RV3	Relief Valve	Steering Relief		
	SV1	Spool Valve	Steering Control		
	SV2	Spool Valve	Lift Control		
	SV3	Spool Valve	Direction Control		
	SV4	Spool Valve	Torque		
	SV5	Spool Valve	Drive Dump/Decel		
	SV6	Spool Valve	Torque		
	SV7	Spool Valve	Brakes		
	SV8	Poppet Valve	Down		
MA2	HP1	Hand Pump	Brake Release		
MA3	SOL11	Coil (SV9)	Down, Lift Cylinder		
	SV9	Spool Valve	Down, Lift Cylinder		
	RV4	Relief Valve	Lift Cylinder Relief		
MA4	SOL12	Coil (SV10)	Down, Lift Cylinder		
	SOL13	Coil (SV10)	Down, Lift Cylinder		
	SV10	Spool Valve	Down, Lift Cylinder		
	A12	Pressure Sensor	Overload		
	RV5	Relief Valve	Lift Cylinder Relief		
MA5	SOL14	Coil (SV11)	Down, Lift Cylinder		
	SOL15	Coil (SV11)	Down, Lift Cylinder		
	SV11	Spool Valve	Down, Lift Cylinder		





# Hydraulic Manifold - current style

Model: / Serial #

2047ES CE | 2647ES CE | 3247ES CE

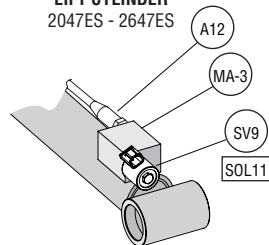
Reference Art #: none

Publication Art #: ART\_2469

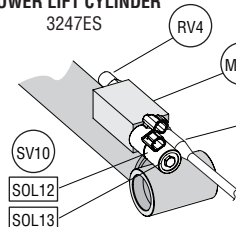
NOTE: Current style manifold. Refer to Hydraulic Schematic for serial # break

	COMPONENTS		FUNCTION		PORTS	
MA1	CBV1	Relief Valve	Counter Balance		1	PUMP
	SOL1	Coil (SV1)	Steer ?RIGHT?		2	TANK
	SOL2	Coil (SV1)	Steer ?LEFT?		3	TEST PORT
	SOL3	Coil (SV5)	Brake/Decel		4	N/A
	SOL4	Coil (SV2)	Lift		5	BRAKE
	SOL5	Coil (SV4)	Torque		6	STEER
	SOL6	Coil (SV6)	Torque		7	STEER
	SOL7	Coil (SV3)	Drive Forward		8	RIGHT B
	SOL8	Coil (SV3)	Drive Reverse		9	LEFT A
	FD1	Flow Divider			10	RIGHT A
	FRR1	Flow Control	Steer Relief		11	LEFT B
	HP1	Hand Pump	Brake Pump		12	LIFT
	MP1	Manual Pump	Brake Release			
	NV1	Needle Valve	Freewheel			
	ORF1	Orifice Plug	Flow Restriction			
	ORF2	Orifice Disc	Flow Restriction			
	PP1	Pilot Piston	Counter Balance			
	RV1	Relief Valve	Lift Relief			
	RV2	Relief Valve	Main Relief			
	SV1	Spool Valve	Steering Control			
	SV2	Spool Valve	Lift Control			
	SV3	Spool Valve	Direction Control			
	SV4	Spool Valve	Torque			
	SV5	Spool Valve	Drive Dump/Decel			
	SV6	Spool Valve	Torque			
MA3	SOL11	Coil (SV9)	Down, Lift Cylinder			
	SV9	Spool Valve	Down, Lift Cylinder			
MA4	RV4	Relief Valve	Lift Cylinder Relief			
	SOL12	Coil (SV10)	Down, Lift Cylinder			
	SOL13	Coil (SV10)	Down, Lift Cylinder			
	SV10	Spool Valve	Down, Lift Cylinder			
MA5	A12	Pressure Sensor	Overload			
	RV5	Relief Valve	Lift Cylinder Relief			
	SOL14	Coil (SV11)	Down, Lift Cylinder			
	SOL15	Coil (SV11)	Down, Lift Cylinder			
	SV11	Spool Valve	Down, Lift Cylinder			

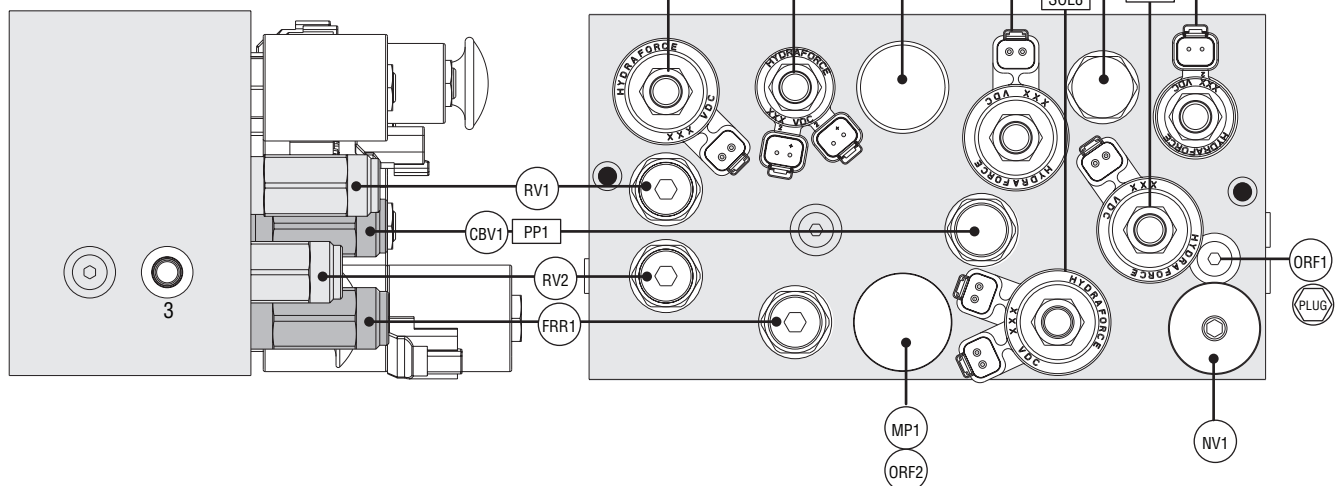
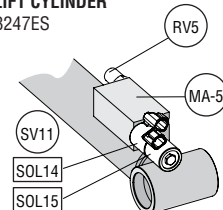
LIFT CYLINDER  
2047ES - 2647ES



LOWER LIFT CYLINDER  
3247ES



UPPER LIFT CYLINDER  
3247ES



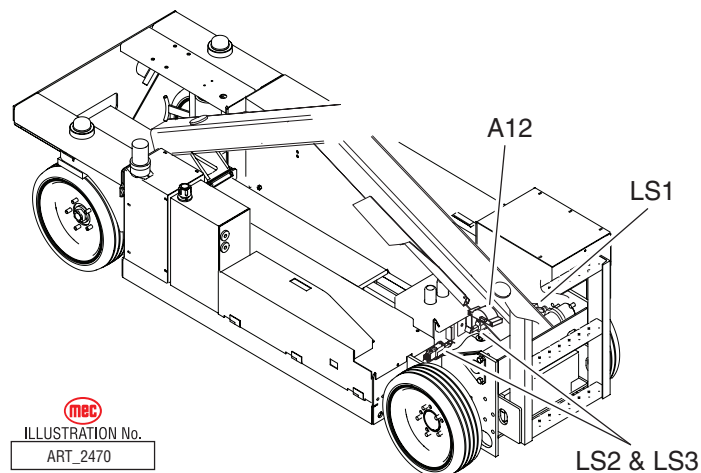
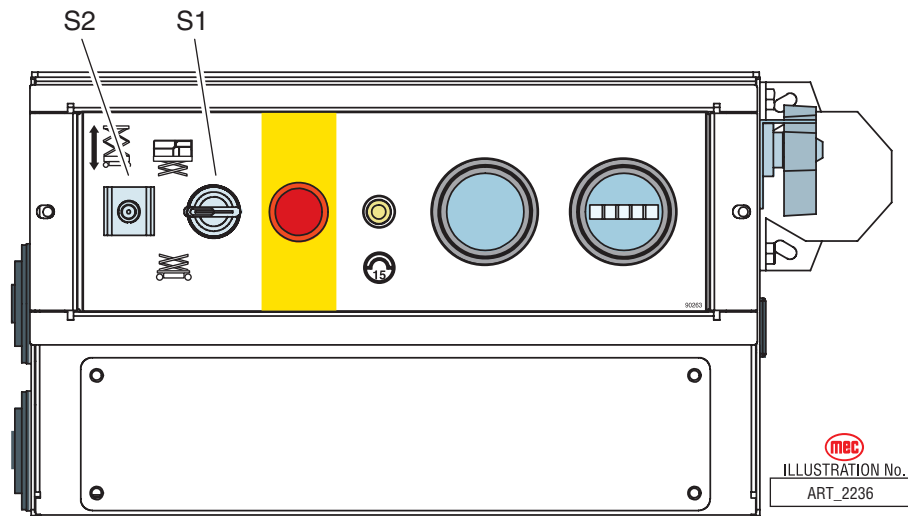
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# ELECTRIC SCHEMATICS

**NOTES:** (Unless otherwise specified)

1. Switch **S1 BASE/PLATFORM** makes contact from the CENTER to the LEFT position when placed in **BASE**.
2. Switch **S2 UP/DOWN** makes contact from the CENTER to the LEFT position when the switch is held in the CONTACT position and automatically returns to the CENTER position when released.
3. Switch **LS1** breaks the N/C set of contacts and makes the N/O set of contacts when the platform reaches approximately 7 feet.
4. Switch **LS2 and LS3** makes the N/C set of contacts when the Pothole Bars are down and locked in place.



**2047ES - Serial # 9801000 - 9801099**  
**2647ES - Serial # 9901000 - 9901199**  
**3247ES - Serial # 10001000 - 10001199**

ITEM	DESCRIPTION	FUNCTION	LOCATION
A1	OverloadLight, 28V	Warn when Machine is Overloaded	Upper Control Box
A5	Push-Button Switch	Activates Horn	On Upper Control Box
A6	Horn, 12V - 48V (option)	Activated by Operator	Under Platform
A7	Overload/Motion Alarm (option)	Warn of Movement	Outside Lower Control Box
A8	Motion Light (option)	Warn of Movement	Front Left Corner of Machine
A9	Hour Meter	Record Machine Usage Time	Lower Control Panel
A10	Platform Alarm	Warn of Platform Overload and Tilt	Upper Control Box
A12	Pressure Transducer	Measure Lift Cyl Pressure for Load Sense	Lift Cylinder Manifold
A13	Angle Transducer (Height Sensor)	Measure Scissor Angle for Load Sense	Lowest Scissor Beam
A11	Battery Indicator	Show Battery Status	Lower Control Panel
B1-4	6-V Deep Cycle Battery	Power for Motor And Control Circuit	Inside Battery Compartment
B5	12-V Battery	Power for Emergency Down Circuit	Battery Compartment, 3247ES ONLY
BD1	Battery Disconnect Switch	Disconnect All Electrical Power	Lower Control Box
CB1	Circuit Breaker, 15AMP Manual	Control Circuit Protection	Lower Control Panel
CH1	Battery Charger	Recharges 24-VDC Battery Pack	Machine Base, Rear
CHRL1	Charger Relay	Disconnect Electric when Charger ON	Inside Charger
D1 - D15	Circuit Board Diodes	Directs Signal to Proper Location	Inside Lower Control Box
D17	Diode w/Ring Terminals	Suppression Diode	Across Contactor Coil
D19	Diode w/Stud Base 10-32UNF-2A	Emergency Down Battery Charger	Battery Compartment
ED1	Switch, Emergency Down	Actuates Emergency Down Valves	Battery Compartment, 3247ES ONLY
ES1	Switch, Emergency Stop	Shut down All Moving Functions	Lower Control Panel
ES2	Switch, Emergency Stop	Shut down All Platform Functions	Upper Control Box
F1	Fuse, 200AMP	Main Line Fuse	Inside Lower Control Box
F2	Fuse, 8AMP	Emergency Down Fuse	Battery Compartment, 3247ES ONLY
LS1	Limit Switch, Double Pole	Enable Drive and High Speed	Right Rear Corner of Machine
LS2	Limit Switch, Single Pole	Drive Enable if Pothole Deployed	On pothole Linkage
LS3	Limit Switch, Single Pole	Enable Drive if Pothole Deployed	On Pothole Linkage
M1	Motor, 24V, 2HP	Turn the Hydraulic Pump	Pump Compartment
MC1	24-V Contactor	Connects Battery (+) to Motor	Inside Lower Control Box
PWM	Controller, DC 250AMP	Changes the Motor Speed	Inside Lower Control Box
POT1	Potentiometer, 20K Ohms	Senses Operator Input	Upper Control Box
R1 - R4	Circuit Board Resistors		Inside Lower Control Box
RL1	Load Sense Relay	Disable Functions if Platform Overloaded	Lower Control Box
S1	Key Switch, N/O Contact Block	Select Lower or Upper Controls	Lower Control Panel
S2	Switch, Toggle	Lift/Lower at Lower Controls	Lower Control Panel
S3	Switch, Push Button	Enable Other Functions at Platform	Upper Control Box Handle
S4	Switch, Micro	Right Turn Switch	Upper Control Box Handle
S5	Switch, Micro	Left Turn Switch	Upper Control Box Handle
S6	Switch, Toggle	Select LIFT or DRIVE	Upper Control Box
S7	Switch, Micro	Reverse or Lift Switch	Upper Control Box
S8	Switch, Micro	Forward or Down Switch	Upper Control Box
S9	Switch, Toggle	TORQUE Switch	Upper Control Box
SOL1	Coil, Turn Right Solenoid	Activate Turn Right Valve (SV1)	Main Manifold
SOL2	Coil, Turn Left Solenoid	Activate Turn Left Valve (SV1)	Main Manifold
SOL3	Coil, Decel Solenoid	Activate Decel Valve (SV5)	Main Manifold
SOL4	Coil, Lift Solenoid	Activate Lift Valve (SV2)	Main Manifold
SOL5-6	Coil, Torque Solenoid	Activate Torque Valves (SV4) (SV6)	Main Manifold
SOL7	Coil, Reverse Solenoid	Activate Reverse Valve (SV3)	Main Manifold
SOL8	Coil, Forward Solenoid	Activate Forward Valve (SV3)	Main Manifold
SOL9	Coil, Brake Solenoid	Activate Brake Valve (SV7)	Main Manifold
SOL10	Coil, Down Solenoid	Activate Down Valve (SV8)	Main Manifold
SOL11	Coil, Down Solenoid	Activate Down Valve (SV9)	Lift Cylinder, 2047/2647 ONLY
SOL12	Coil, Down Solenoid	Activate Down Valve (SV10)	Lower Lift Cylinder, 3247 ONLY
SOL13	Coil, E-Down Solenoid	Activate Emergency Down Valve (SV10)	Lower Lift Cylinder, 3247 ONLY
SOL14	Coil, Down Solenoid	Activate Down Valve (SV11)	Upper Lift Cylinder, 3247 ONLY
SOL15	Coil, E-Down Solenoid	Activate Emergency Down Valve (SV11)	Lower Lift Cylinder, 3247 ONLY



# ELECTRIC SCHEMATIC

Model / Serial #

2047ES CE | 9801000 - 9801099

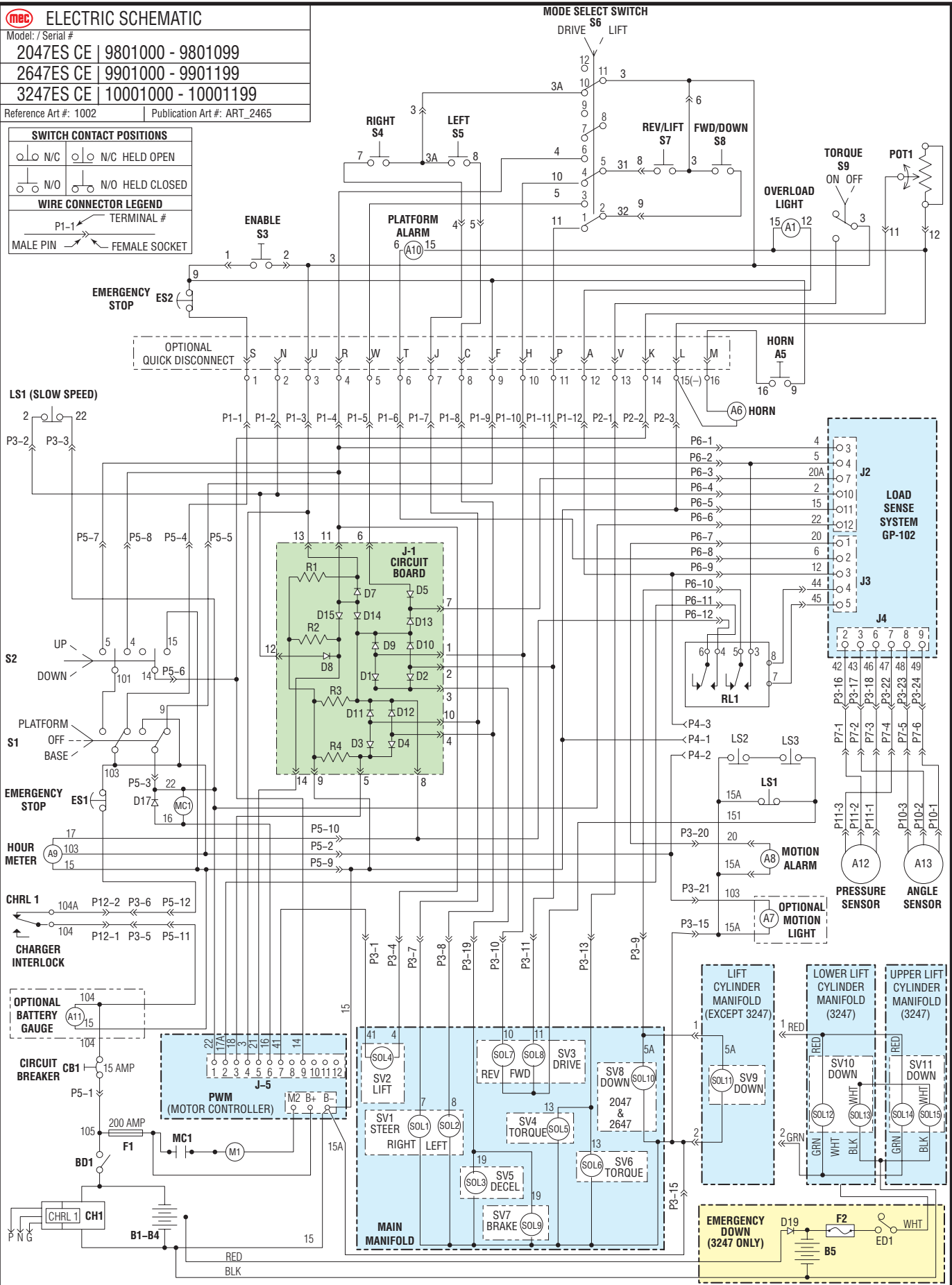
2647ES CE | 9901000 - 9901199

3247ES CE | 10001000 - 10001199

Reference Art #: 1002

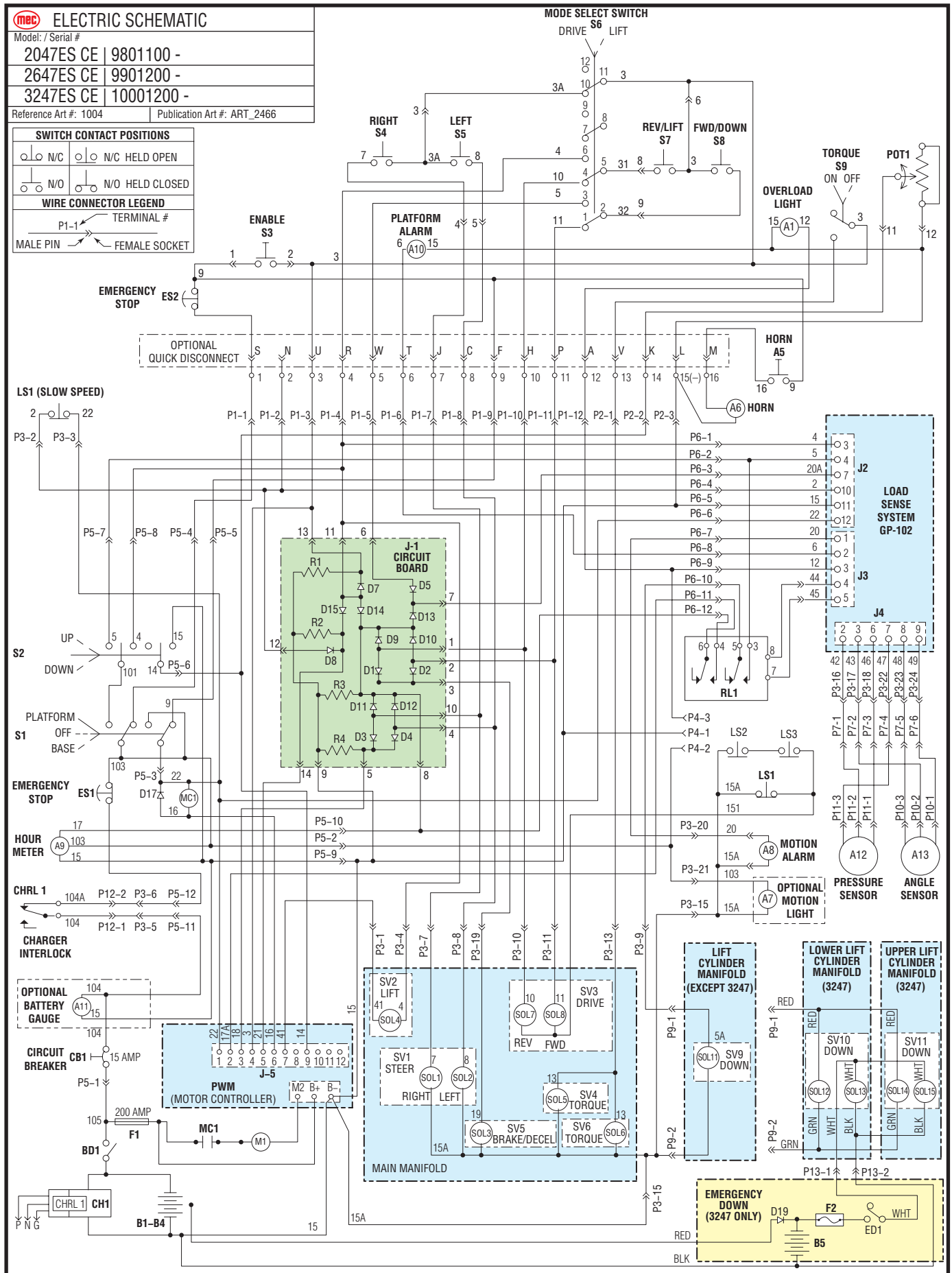
Publication Art #: ART\_2465

SWITCH CONTACT POSITIONS	
	N/C
	N/C HELD OPEN
	N/O
	N/O HELD CLOSED
WIRE CONNECTOR LEGEND	
	TERMINAL #
	MALE PIN
	FEMALE SOCKET



**2047ES - Serial # 9801100 - CURRENT**  
**2647ES - Serial # 9901200 - CURRENT**  
**3247ES - Serial # 10001200 - CURRENT**

ITEM	DESCRIPTION	FUNCTION	LOCATION
A1	Tilt Light, 28V	Warn when Machine is Tilted	Upper Control Box
A5	Push-Button Switch	Activates Horn	On Upper Control Box
A6	Horn, 12V - 48V (option)	Activated by Operator	Under Platform
A7	Overload/Motion Alarm (option)	Warn of Movement	Outside Lower Control Box
A8	Motion Light (option)	Warn of Movement	Front Left Corner of Machine
A9	Hour Meter	Record Machine Usage Time	Lower Control Panel
A10	Platform Alarm	Warn of Platform Overload and Tilt	Upper Control Box
A12	Pressure Transducer	Measure Lift Cyl Pressure for Load Sense	Lift Cylinder Manifold
A13	Angle Transducer (Height Sensor)	Measure Scissor Angle for Load Sense	Lowest Scissor Beam
A11	Battery Indicator	Show Battery Status	Lower Control Panel
B1-4	6-V Deep Cycle Battery	Power for Motor And Control Circuit	Inside Battery Compartment
B5	12-V Battery	Power for Emergency Down Circuit	Battery Compartment, 3247ES ONLY
BD1	Battery Disconnect Switch	Disconnect All Electrical Power	Lower Control Box
CB1	Circuit Breaker, 15AMP Manual	Control Circuit Protection	Lower Control Panel
CH1	Battery Charger	Recharges 24-VDC Battery Pack	Machine Base, Rear
CHRL1	Charger Relay	Disconnect Electric when Charger ON	Inside Charger
D1 - D15	Circuit Board Diodes	Directs Signal to Proper Location	Inside Lower Control Box
D17	Diode w/Ring Terminals	Suppression Diode	Across Contactor Coil
D19	Diode w/Stud Base 10-32UNF-2A	Emergency Down Battery Charger	Battery Compartment
ED1	Switch, Emergency Down	Actuates Emergency Down Valves	Battery Compartment, 3247ES ONLY
ES1	Switch, Emergency Stop	Shut down All Moving Functions	Lower Control Panel
ES2	Switch, Emergency Stop	Shut down All Platform Functions	Upper Control Box
F1	Fuse, 200AMP	Main Line Fuse	Inside Lower Control Box
F2	Fuse, 8AMP	Emergency Down Fuse	Battery Compartment, 3247ES ONLY
LS1	Limit Switch, Double Pole	Enable Drive and High Speed	Right Rear Corner of Machine
LS2	Limit Switch, Single Pole	Drive Enable if Pothole Deployed	On pothole Linkage
LS3	Limit Switch, Single Pole	Enable Drive if Pothole Deployed	On Pothole Linkage
M1	Motor, 24V, 2HP	Turn the Hydraulic Pump	Pump Compartment
MC1	24-V Contactor	Connects Battery (+) to Motor	Inside Lower Control Box
PWM	Controller, DC 250AMP	Changes the Motor Speed	Inside Lower Control Box
POT1	Potentiometer, 20K Ohms	Senses Operator Input	Upper Control Box
R1 - R4	Circuit Board Resistors		Inside Lower Control Box
RL1	Load Sense Relay	Disable Functions if Platform Overloaded	Lower Control Box
S1	Key Switch, N/O Contact Block	Select Lower or Upper Controls	Lower Control Panel
S2	Switch, Toggle	Lift/Lower at Lower Controls	Lower Control Panel
S3	Switch, Push Button	Enable Other Functions at Platform	Upper Control Box Handle
S4	Switch, Micro	Right Turn Switch	Upper Control Box Handle
S5	Switch, Micro	Left Turn Switch	Upper Control Box Handle
S6	Switch, Toggle	Select LIFT or DRIVE	Upper Control Box
S7	Switch, Micro	Reverse or Lift Switch	Upper Control Box
S8	Switch, Micro	Forward or Down Switch	Upper Control Box
S9	Switch, Toggle	TORQUE Switch	Upper Control Box
SOL1	Coil, Turn Right Solenoid	Activate Turn Right Valve (SV1)	Main Manifold
SOL2	Coil, Turn Left Solenoid	Activate Turn Left Valve (SV1)	Main Manifold
SOL3	Coil, Decel/Brake Solenoid	Activate Decel/Brake Valve (SV5)	Main Manifold
SOL4	Coil, Lift Solenoid	Activate Lift Valve (SV2)	Main Manifold
SOL5-6	Coil, Torque Solenoid	Activate Torque Valves (SV5)(SV6)	Main Manifold
SOL7	Coil, Reverse Solenoid	Activate Reverse Valve (SV3)	Main Manifold
SOL8	Coil, Forward Solenoid	Activate Forward Valve (SV3)	Main Manifold
SOL11	Coil, Down Solenoid	Activate Down Valve (SV9)	Lift Cylinder, 2047/2647 ONLY
SOL12	Coil, Down Solenoid	Activate Down Valve (SV10)	Lower Lift Cylinder, 3247 ONLY
SOL13	Coil, E-Down Solenoid	Activate Emergency Down Valve (SV10)	Lower Lift Cylinder, 3247 ONLY
SOL14	Coil, Down Solenoid	Activate Down Valve (SV11)	Upper Lift Cylinder, 3247 ONLY
SOL15	Coil, E-Down Solenoid	Activate emergency Down Valve (SV11)	Upper Lift Cylinder, 3247 ONLY





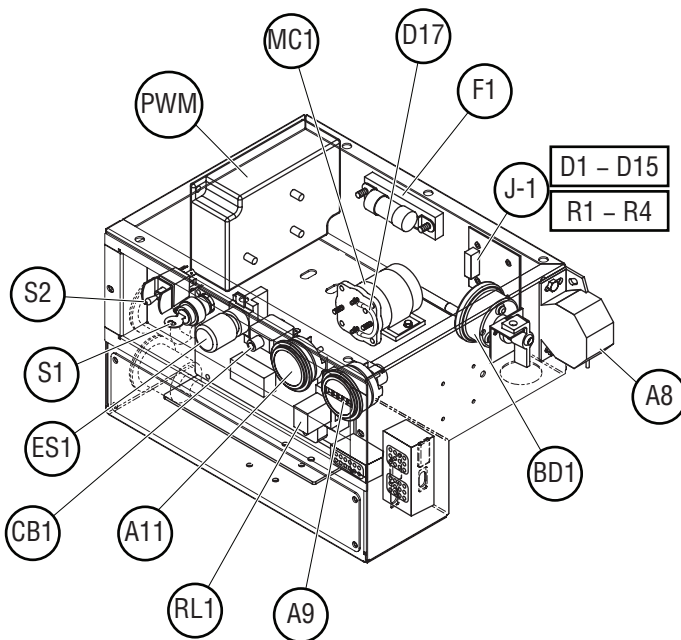
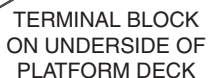
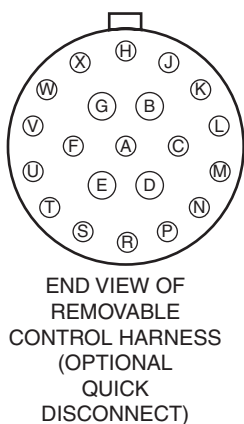
Model: / Serial #  
ES Models: all CE

Publication Art #: 2445

The diagram illustrates the wiring for the control panel, showing the following components and their connections:

- OVERLOAD ALARM:** A terminal block with terminals 15A and 20. Wires are connected: BLK to 15A, BLK to the alarm symbol, and RED to 20.
- LIFT/DRIVE:** A terminal block with terminals 32, 31, 3A, and 3. Wires are connected: 32 to 1, 31 to 4, 3A to 7, and 3 to 10.
- E-STOP:** A switch with terminals 1 and 2. Wires are connected: 1 to the switch and 2 to the switch.
- TORQUE:** A switch with terminals 13, 1, 2, and 2. Wires are connected: 13 to 1, 1 to 2, and 2 to 2.
- OVERLOAD/TILT:** A switch with terminals 15 and 12. Wires are connected: BLK to 15 and 12 to the switch.
- HORN BUTTON:** A button with terminals 15 and 6. Wires are connected: BLK to 15 and 6 to the button.
- Other components:** A10 (alarm), S6 (stop), ES2 (emergency stop), S9 (torque), A1 (overload/tilt), A5 (horn button), S7 (stop), S8 (stop), and POT1 (potentiometer).

PIN #	WIRE #
S	1
F	9
W	5
R	4
V	13
A	12
H	10
P	11
U	3
T	6
J	7
N	2
C	8
K	14
M	16 (GND)
L	15







## Component Locations

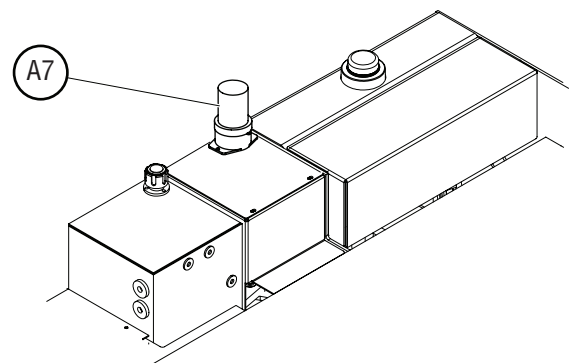
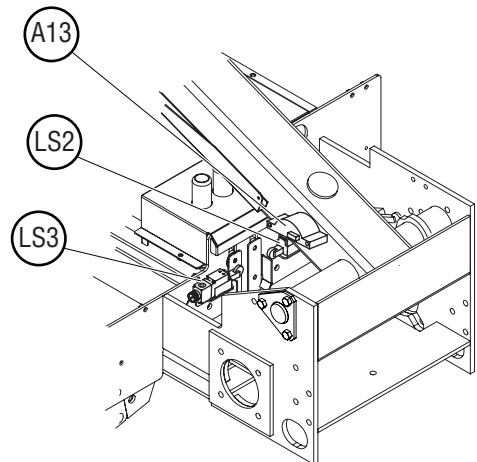
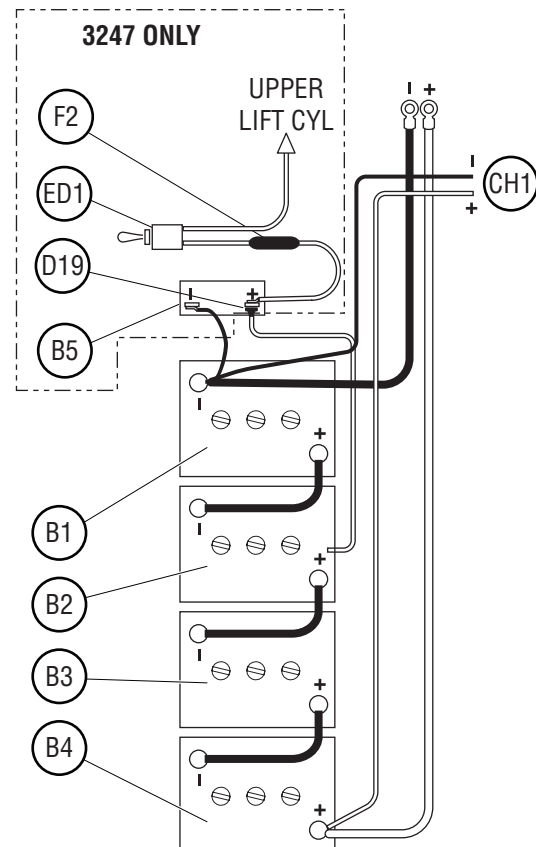
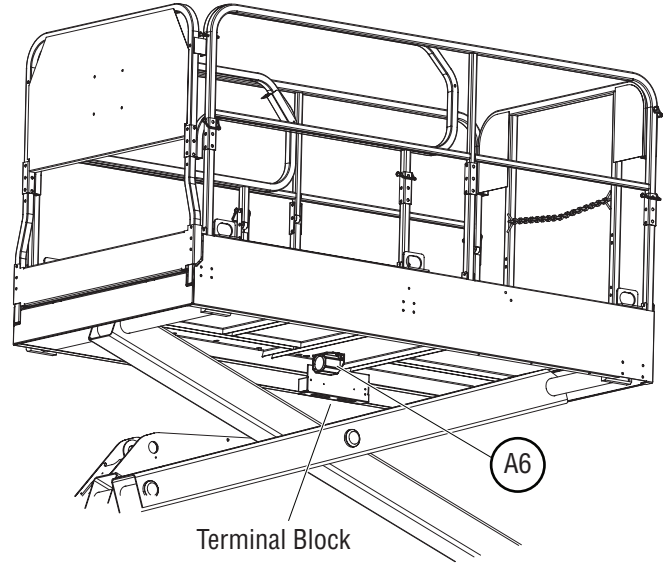
Model: / Serial #

2047ES - 2647ES - 3247ES: all CE

Reference Art #: none

Publication Art #: 2471

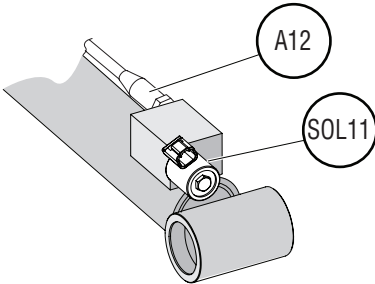
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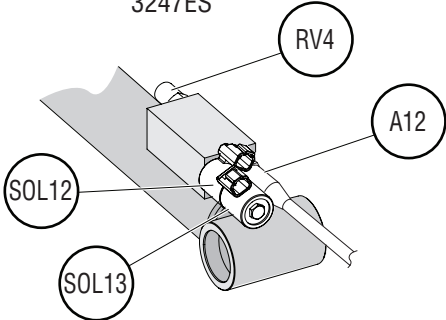
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Model: / Serial #	
ES Models: X47 CE	
Reference Art #: none	Publication Art #: ART_2472

REFER TO  
ELECTRIC SCHEMATIC

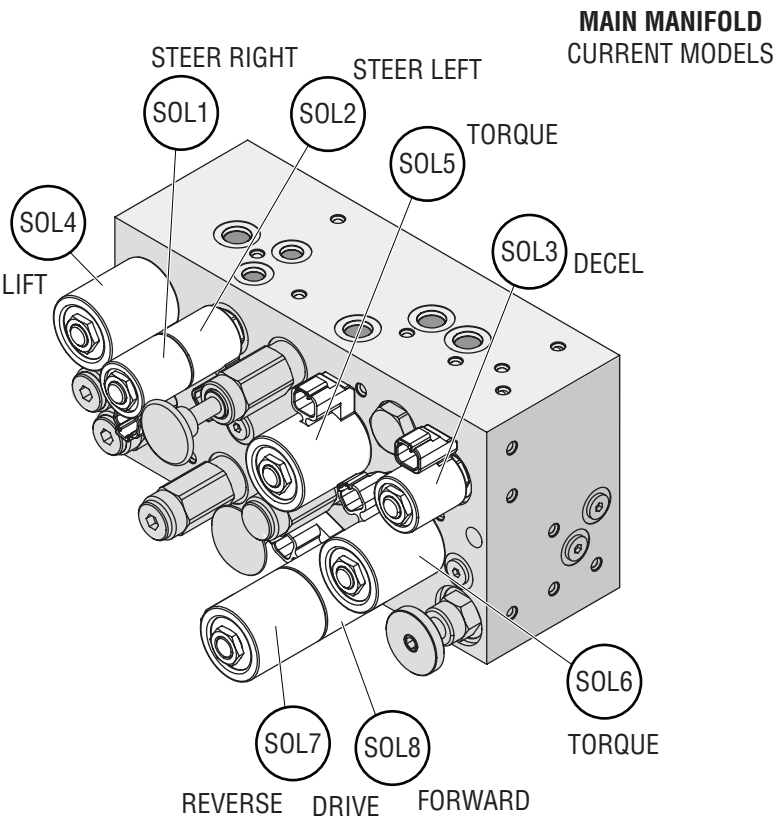
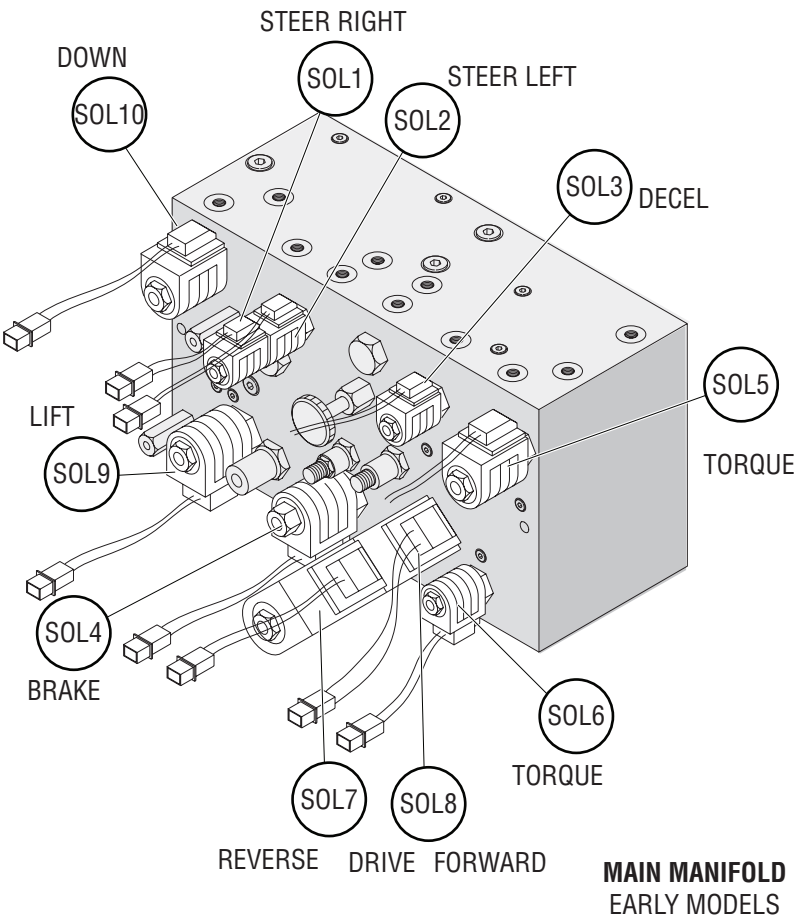
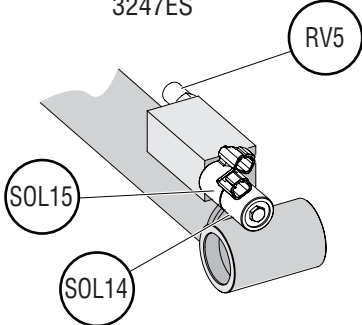
LIFT CYLINDER  
2047ES - 2647ES



LOWER LIFT CYLINDER  
3247ES



UPPER LIFT CYLINDER  
3247ES



**Controller Plug Pin Identification**

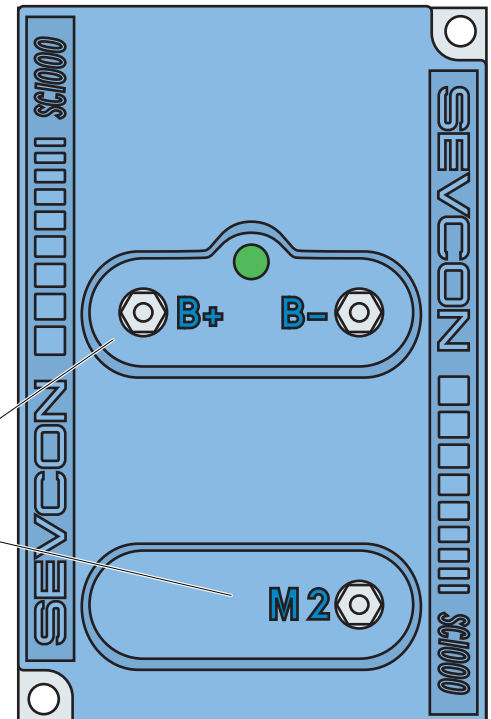
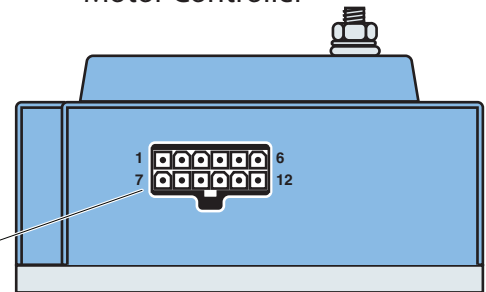
Model: / Serial #  
ES Models : all

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Reference Art #: none      Publication Art #: 2217

**REFER TO  
ELECTRIC SCHEMATIC**

## PWM Motor Controller



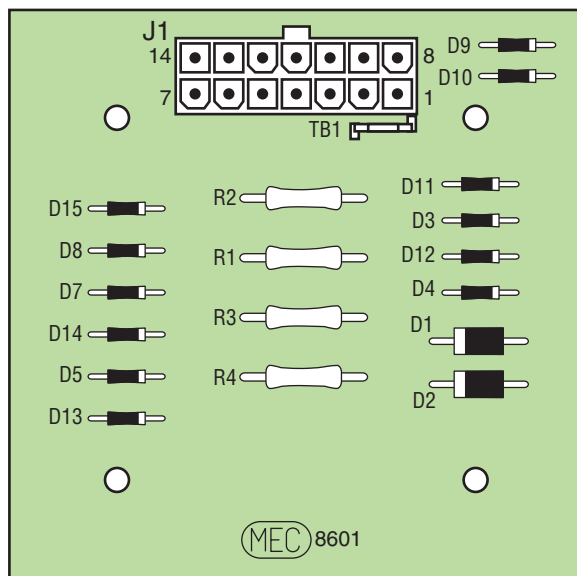
## J5 Pin Identification

PIN #	WIRE #	FUNCTION
1	22	B+ power input (power up)
2	17	Lift, Drive or Steer functions requested (functions requiring motor)
3	18	Steer Requested (adds additional motor speed for steer)
4	3	Enable signal input
5	21	Speed cut-back (24 Volts = full speed, 0 Volts = creep speed)
6	16	Motor Start Relay signal (GROUND signal to activate Motor Start Relay)
7	41	Lift Valve B- (provides GROUND signal to Lift Valve)
8	none	none
9	14	Accelerator reference signal (3.6 Volts to Potentiometer)
10	none	none
11	none	none
12	none	none

## Terminal Identification

POST	FUNCTION
B+	Battery Positive Cable from 200 AMP Fuse
B-	Negative Battery Cable and GROUND wire (15) connection
M2	Motor Ground (Pulse-Width Modulated [PWM] variable speed control)

## Circuit Board



## J1 Plug Pin Identification

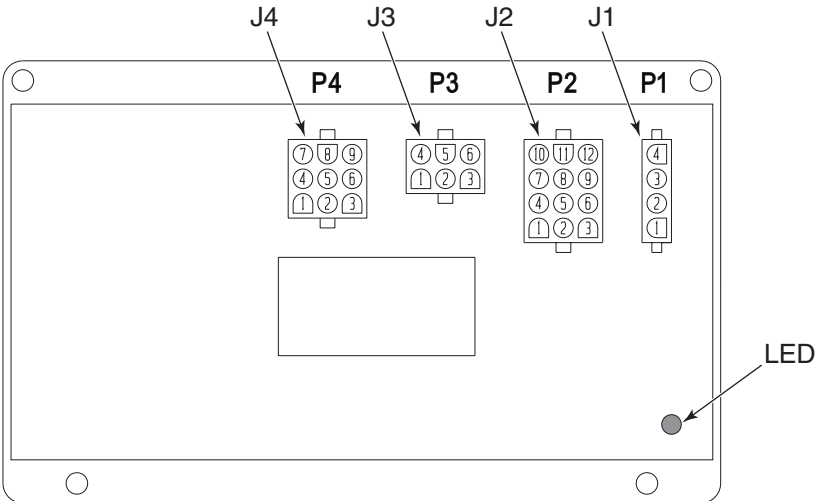
PIN #	WIRE #	SIGNAL	FUNCTION
1	10	INPUT	Drive Reverse
2	11	INPUT	Drive Forward
3	19	OUTPUT	Brake, Decel Valve signal
4	8	INPUT	Steer Left
5	18	OUTPUT	Steer signal to Sevcon
6	5	INPUT	Down signal
7	20	OUTPUT	Signal to Motion Alarm(s) (optional)
8	17	OUTPUT	Sevcon & Hour Meter (motor function requested)
9	15	INPUT	Battery Negative
10	7	INPUT	Steer Right
11	4	INPUT	Lift Up
12	2	INPUT	Limit Switch (24V = platform down)
13	3	OUTPUT	Enable, from lower Lift switch
14	21	OUTPUT	To Sevcon (for speed cutback)



GP-102 Load Sense Control Module Connections

J1 (P1)			J2 (P2)			J3 (P3)			J4 (P4)		
PIN #	WIRE #	CONNECTION	PIN #	WIRE #	CONNECTION	PIN #	WIRE #	CONNECTION	PIN #	WIRE #	CONNECTION
1	EZ-Cal	DIAGNOSTIC AND PROGRAMMING	1	—	No Connection	1	20	Motion Alarm (A8)	1	—	No Connection
2	EZ-Cal		2	—	No Connection	2	6	Alarm (A10)	2	42	Overload Sensor
3	EZ-Cal		3	4	P6-1	3	12	Overload Light (A1)	3	43	Height sensor
4	EZ-Cal		4	5	P6-2	4	44	Overload Relay (8)	4	—	No Connection
			5	—	No Connection	5	45	Overload Relay (7)	6	46	Overload Sensor
			6	—	No Connection	6	—		7	47	Overload Sensor
			7	20A	P6-3				8	48	Height Sensor
			8	—	No Connection				9	49	Height Sensor
			9	—	No Connection						
			10	2	P6-4						
			11	15	P6-5						
			12	22	P6-6						

GP-102 Load Sense Control Module

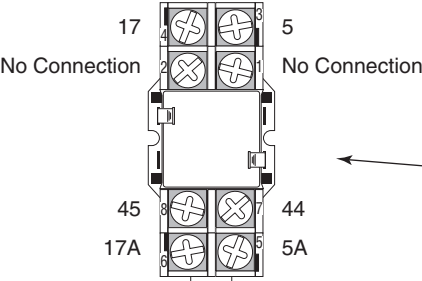


Inside Lower Control Box

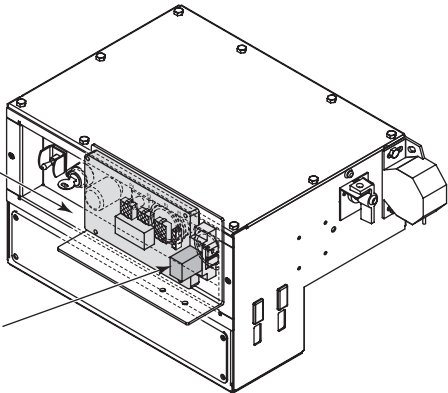
Overload Cutout Relay Connections

RL1		
PIN #	WIRE #	CONNECTION
1	—	No Connection
2	—	No Connection
3	5	GP-102 (J2 - Pin 4)
4	17	P6-12
5	5A	P6-10
6	17A	P6-12
7	44	GP-102 (J3 - Pin 4)
8	45	GP-102 (J3 - Pin 5)

RL1 Overload Cutout Relay



Overload Cutout Relay



# Parts Section Table of Contents

## SECTION A: CONTROL BOXES

REMOVABLE CONTROL BOX ASSEMBLY, CE .....	A-3
REMOVABLE CONTROL BOX ASSEMBLY .....	A-3
FIXED CONTROL BOX ASSEMBLY, CE .....	A-5
FIXED CONTROL BOX ASSEMBLY .....	A-5
UPPER CONTROL BOX COVER ASSEMBLY .....	A-7
JOYSTICK .....	A-9
CONTROL PANEL, BASE .....	A-11
CONTROL BOX, BASE .....	A-13
CONTROL BOX, BASE .....	A-13
WIRE HARNESSES, LOWER CONTROLS .....	A-15
WIRE HARNESSES, COMMUNICATION CABLE (EARLY MODELS) .....	A-17
WIRE HARNESSES, UPPER CONTROLS (EARLY MODELS) .....	A-17
WIRE HARNESSES, OTHER (EARLY MODELS) .....	A-17
WIRE HARNESSES, COMMUNICATION CABLE (CURRENT MODELS) .....	A-19
WIRE HARNESSES, UPPER CONTROLS (CURRENT MODELS) .....	A-19
WIRE HARNESSES, OTHER (CURRENT MODELS) .....	A-19

## SECTION B: PLATFORM AND RAILS

PLATFORM AND RAILS .....	B-3
ROLLOUT DECK AND RAILS .....	B-5
ENTRY .....	B-7
SWING GATE .....	B-9
ROLLOUT DECK LOCK .....	B-11
ROLLOUT DECK ROLLER .....	B-13
TERMINAL BLOCK .....	B-15
OPERATOR HORN (OPTION) .....	B-15
AIRLINE TO PLATFORM (OPTION) .....	B-15
POWER TO PLATFORM .....	B-17

## SECTION C: SCISSORS

BEAM ASSEMBLY- 2047ES .....	C-3
BEAM ASSEMBLY- 2647ES .....	C-5
BEAM ASSEMBLY - 3247ES .....	C-7
SLIDE BLOCK ASSEMBLY .....	C-9
LIFT CYLINDER MOUNT .....	C-11
LIFT CYLINDER - 2047ES / 2647ES, EARLY MODELS .....	C-13
LIFT CYLINDER - 2047ES / 2647ES, LATE MODELS .....	C-15
UPPER LIFT CYLINDER - 3247ES, EARLY MODELS .....	C-17
UPPER LIFT CYLINDER - 3247ES, LATE MODELS .....	C-19
LOWER LIFT CYLINDER - 3247ES, EARLY MODELS .....	C-21
LOWER LIFT CYLINDER - 3247ES, LATE MODELS .....	C-23
EMERGENCY LOWERING CABLE .....	C-25



# Parts Section Table of Contents

## SECTION D: HYDRAULICS

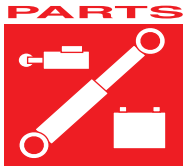
BRAKE RELEASE MANIFOLD, EARLY MODELS .....	D-3
MAIN MANIFOLD ASSEMBLY, 2047ES-2647ES, EARLY MODELS .....	D-5
MAIN MANIFOLD ASSEMBLY - 3247ES, EARLY MODELS .....	D-9
MAIN MANIFOLD ASSEMBLY, LATE MODELS .....	D-13
HYDRAULIC RESERVOIR, STEEL .....	D-15
HYDRAULIC RESERVOIR, PLASTIC .....	D-17
HYDRAULIC HOSES, 2047ES - 2647ES .....	D-19
HYDRAULIC HOSES, 3247ES .....	D-21

## SECTION E: BASE

LADDER .....	E-3
EMERGENCY LOWERING SWITCH - 3247ES .....	E-5
BASE COVERS (STEEL HYDRAULIC FLUID RESERVOIR) .....	E-7
BASE COVERS (PLASTIC HYDRAULIC FLUID RESERVOIR) .....	E-9
BALLAST .....	E-11
MOTION ALARM .....	E-13
MOTION LIGHT (OPTION) .....	E-13
POWER CONVERTER (OPTION) .....	E-13
BRAKE ASSEMBLY .....	E-15
FRONT AXLE .....	E-17
STEERING COMPONENTS .....	E-21
HYDRAULIC PUMP ASSEMBLY .....	E-23
POTHOLE ASSEMBLY .....	E-25
WHEEL MOTOR .....	E-29
BATTERY INSTALLATION .....	E-31
POTHOLE LIMIT SWITCH .....	E-33
DRIVE LIMIT SWITCH .....	E-33
BATTERY CHARGER .....	E-35

## SECTION F: DECALS

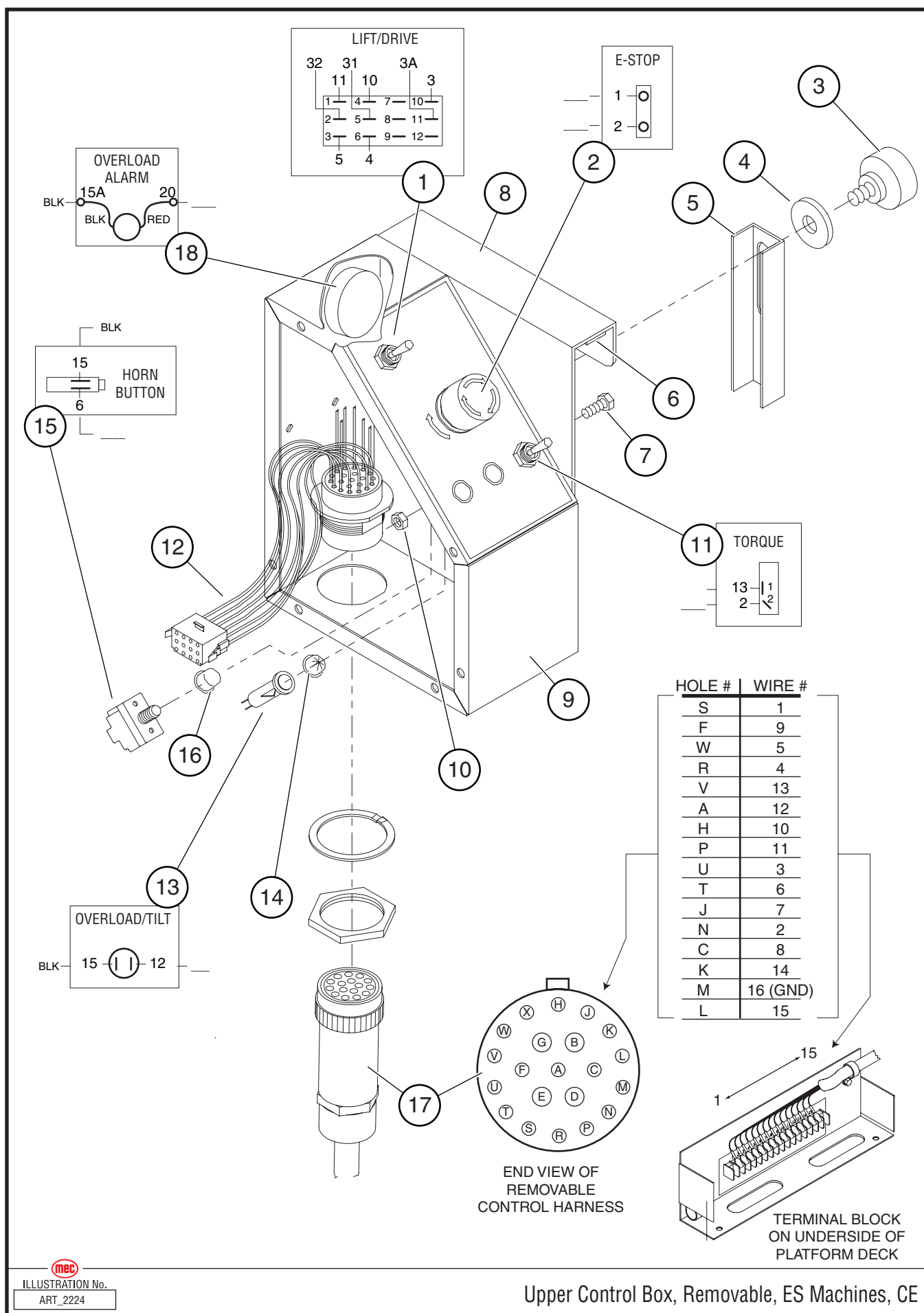
DECALS: CONTROLS .....	F-3
DECALS, 2047ES - 2647ES - 3247ES CONTROLS .....	F-3
DECALS, 2047ES - 2647ES - 3247ES BASE .....	F-5
DECALS: BASE, 2047ES - 2647ES - 3247ES .....	F-5
DECALS: SCISSORS, 2047ES - 2647ES - 3247ES .....	F-7
DECALS, 22047ES - 2647ES - 3247ES SCISSORS .....	F-7
DECALS: PLATFORM, 2047ES - 2647ES - 3247ES .....	F-9
DECALS, 2047ES - 2647ES - 3247ES PLATFORM .....	F-9



## SECTION A:

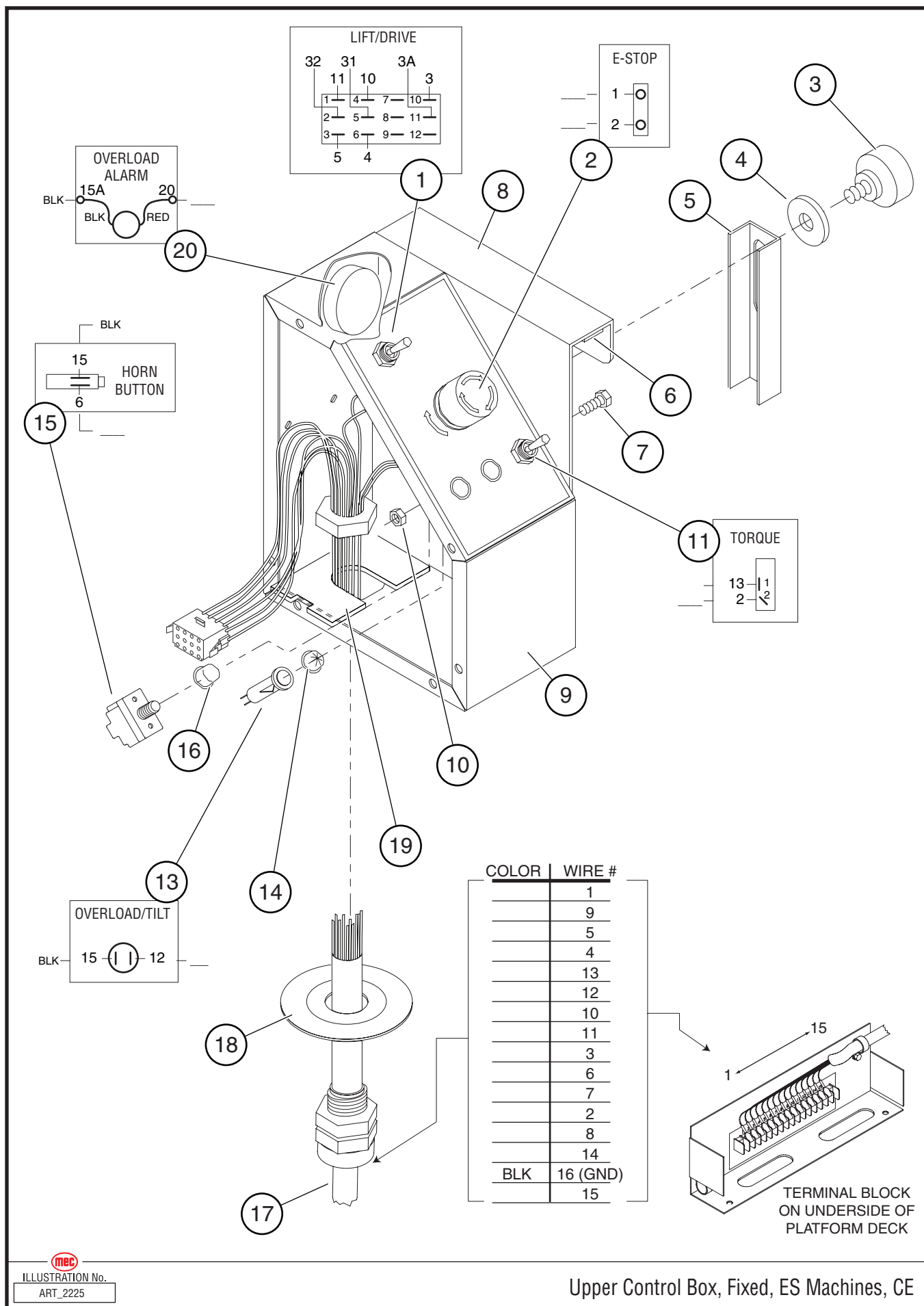
# CONTROL BOXES

REMOVABLE CONTROL BOX ASSEMBLY .....	A-3
FIXED CONTROL BOX ASSEMBLY .....	A-5
UPPER CONTROL BOX COVER ASSEMBLY .....	A-7
JOYSTICK .....	A-9
CONTROL PANEL, BASE .....	A-11
CONTROL BOX, BASE .....	A-13
WIRE HARNESSSES, LOWER CONTROLS .....	A-15
WIRE HARNESSSES, COMMUNICATION CABLE (EARLY MODELS) .....	A-17
WIRE HARNESSSES, UPPER CONTROLS (EARLY MODELS) .....	A-17
WIRE HARNESSSES, OTHER (EARLY MODELS) .....	A-17
WIRE HARNESSSES, COMMUNICATION CABLE (CURRENT MODELS) .....	A-19
WIRE HARNESSSES, UPPER CONTROLS (CURRENT MODELS) .....	A-19
WIRE HARNESSSES, OTHER (CURRENT MODELS) .....	A-19

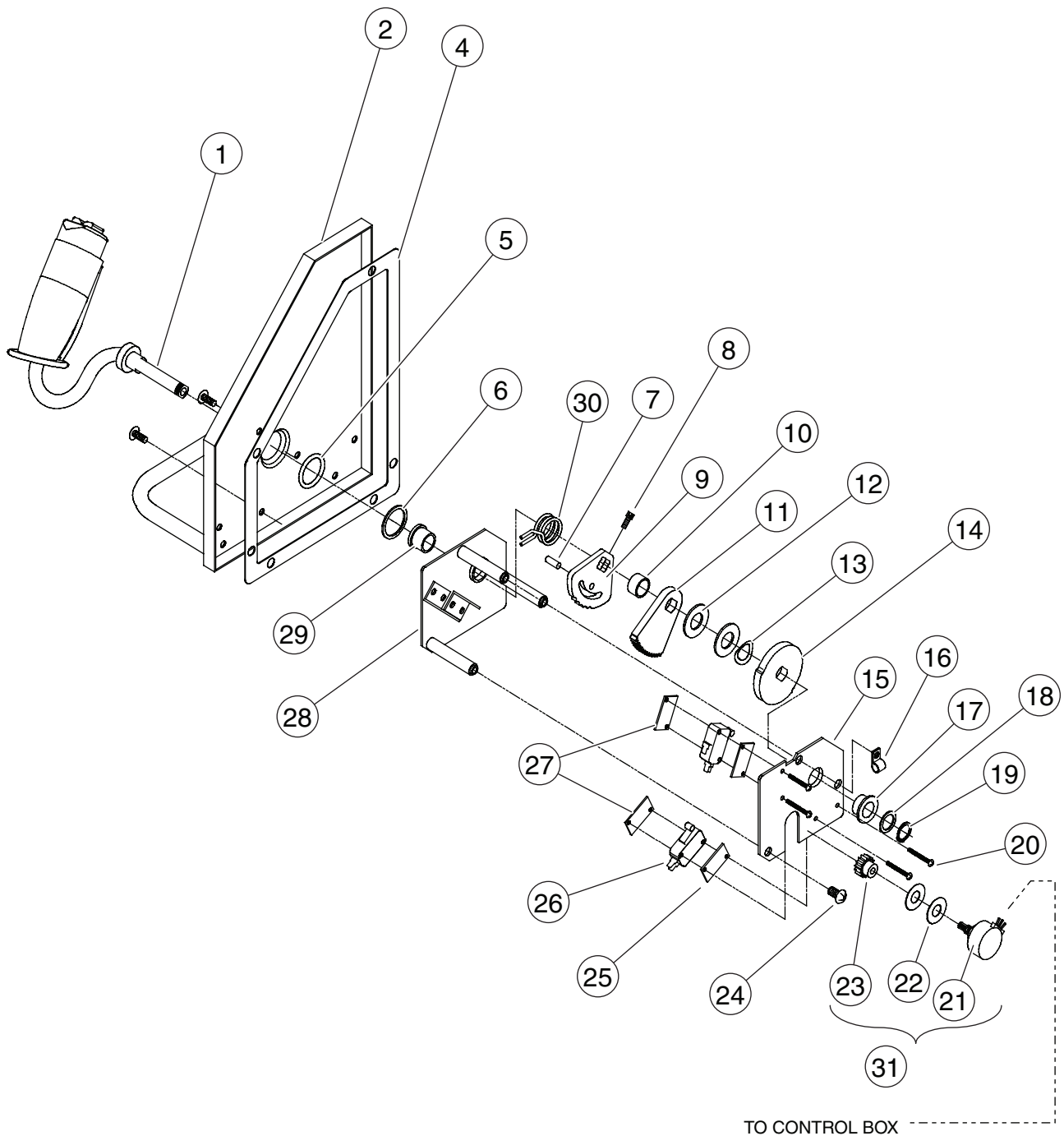




ITEM	PART NO.	QTY	DESCRIPTION
			<b>REMOVABLE CONTROL Box ASSEMBLY, CE</b>
	90875		REMOVABLE CONTROL BOX ASSEMBLY (OPTION)
1	8638	1	SWITCH, TOGGLE, 2 POSITION, 4 POLE
2	7800	1	EMERGENCY STOP SWITCH ASSEMBLY
	9345	1	BLOCK-CONTACT N.C.
3	8826	1	THUMBSCREW, 5/16" - 18, FLOWER
4	HDW8294	1	WASHER, FLAT
5	13864	1	LOCK, CONTROL ARM BRACKET
6	6350	.5	TAPE, FOAM
7	HDW5724	1	SCREW, 5/16" - 18, 3/4" LG
8	13865	1	BRACKET, CONTROL BOX HOLDER
9	13867	1	WRAPPER, CONTROL BOX
10	HDW7120	1	NUT, 5/16" - 18
11	5630	1	SWITCH, TOGGLE, TORQUE
12	REF	1	WIRE HARNESS, W/CONNECTOR CONTROL BOX (SEE WIRE HARNESS)
13	9179	1	SOCKET, LIGHT
14	9183	1	LENS, RED
	9182	1	LIGHT, BAYONET, 28 VOLT
15	8044	1	SWITCH, (MANUAL HORN) (OPTION)
16	8819	1	BOOT (OPTION)
17	REF 6318	1	CABLE, UPPER CONTROL (SEE WIRE HARNESS) PIN REPAIR KIT FOR CABLE
18	7553	1	CONTROL BOX ALARM



ITEM	PART NO.	QTY	DESCRIPTION
			<b>FIXED CONTROL Box ASSEMBLY, CE</b>
1	90874 8638	1	CONTROL BOX ASSEMBLY SWITCH, TOGGLE, 2 POSITION, 4 POLE
2	7800 9345	1 1	EMERGENCY STOP SWITCH ASSEMBLY BLOCK-CONTACT N.C.
3	8826	1	THUMBSCREW, 5/16" - 18, FLOWER
4	HDW8294	1	WASHER, FLAT
5	13864	1	LOCK, CONTROL ARM BRACKET
6	6350	.5	TAPE, FOAM
7	HDW5724	1	SCREW, 5/16" - 18, 3/4" LG
8	13865	1	BRACKET, CONTROL BOX HOLDER
9	13867	1	WRAPPER, CONTROL BOX
10	HDW7120	1	NUT, 5/16" - 18
11	5630	1	SWITCH, TOGGLE, TORQUE
13	9179	1	SOCKET, LIGHT
14	9183	1	LENS, RED
	9182	1	LIGHT, BAYONET, 28 VOLT
15	8044	1	SWITCH, (MANUAL HORN) (OPTION)
16	8819	1	BOOT (OPTION)
17	REF	1	CONTROL CABLE (SEE WIRE HARNESS)
18	16079	1	STRAIN RELIEF WASHER
19	16120	1	MOUNTING PLATE
20	7553	1	CONTROL BOX ALARM



ITEM	PART NO.	QTY	DESCRIPTION
			<b>UPPER CONTROL BOX COVER ASSEMBLY</b>
	13868		CONTROL BOX COVER ASSEMBLY
1	13647	1	CONTROL ARM
2	3772	1	COVER
4	7875	1	GASKET
5	7882	1	O-RING, 7/8" ID X 1 1/8" OD
6	HDW3768	1	WASHER, FLAT
7	100/8348	1	PIN, HOLD DOWN
8	HDW7887	1	SCREW, #6-32, 1/2" LG
9	13502	1	BRACKET, CENTERING
10	3763	1	SPACER, STEP
11	13402	1	GEAR, LARGE
12	HDW8531	2	WASHER, FLAT
13	HDW7881	1	WASHER, BEVEL
14	3782	1	CAM. DIRECTIONAL
15	13403	1	PLATE, BOTTOM
16	6917	1	CLAMP, CABLE 1/4"
17	7818	1	BEARING, BRONZE, FLANGED
18	HDW3771	1	WASHER, FLAT
19	5736	1	RING, RETAINING, 1/2"
20	HDW8399	4	SCREW, #4 - 40, 5/8" LG
21	8383	1	POTENTIOMETER
22	HDW8567	2	WASHER, FLAT
23	8389	1	GEAR, SPUR
24	HDW7888	12	SCREW, #10 - 32, 1/2" LG
25	3764	2	PLATE, SPACER
26	8696	2	SWITCH, LIMIT, MICRO V7
27	3765	2	PLATE, STRAP
28	3766	1	PLATE, TOP
29	7819	1	BEARING, BRONZE, FLANGED
30	8435	1	SPRING, JOYSTICK, CENTERING
31	13527	1	POTENTIOMETER ASSEMBLY (INCLUDES 21, 22, & 23)

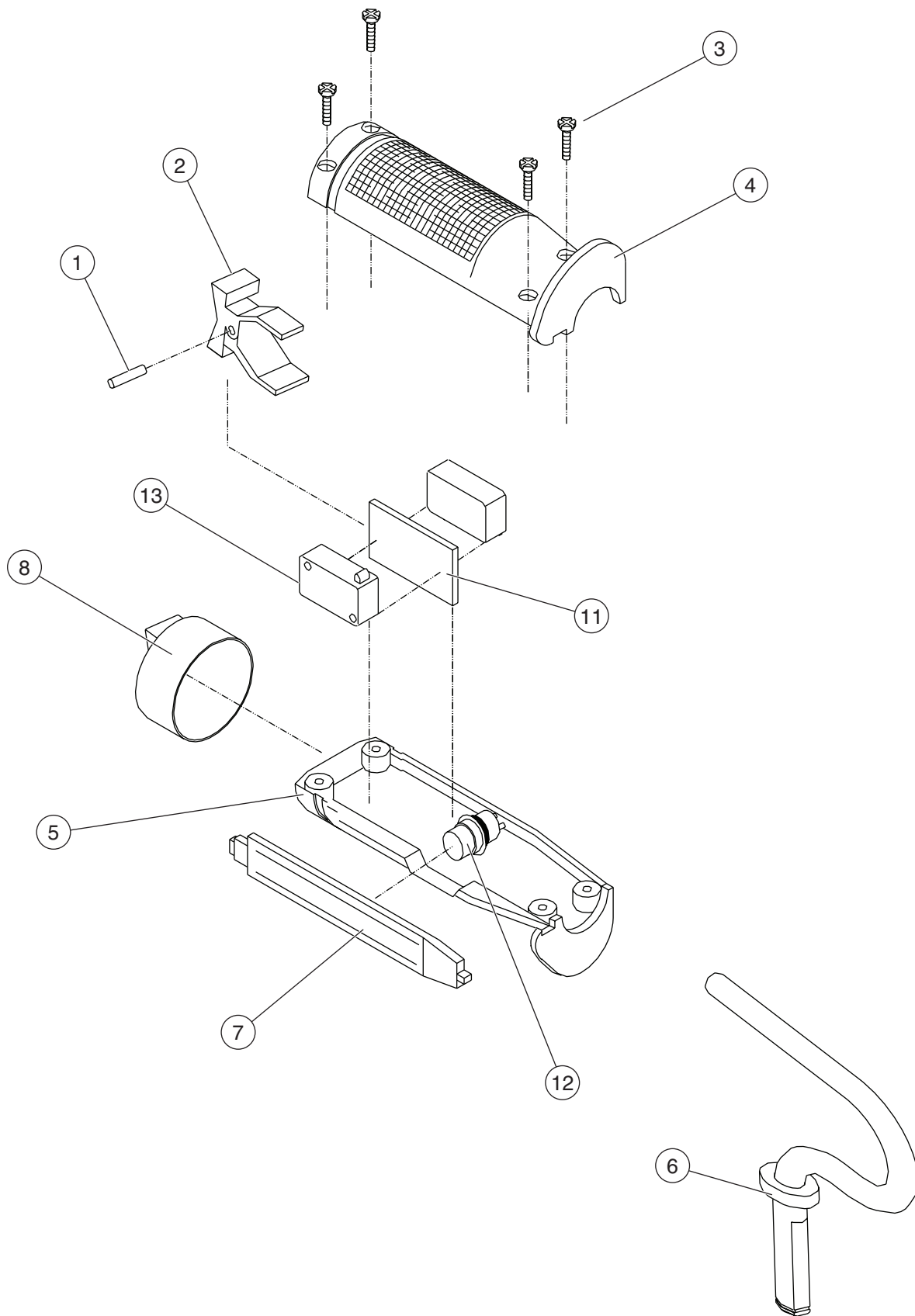


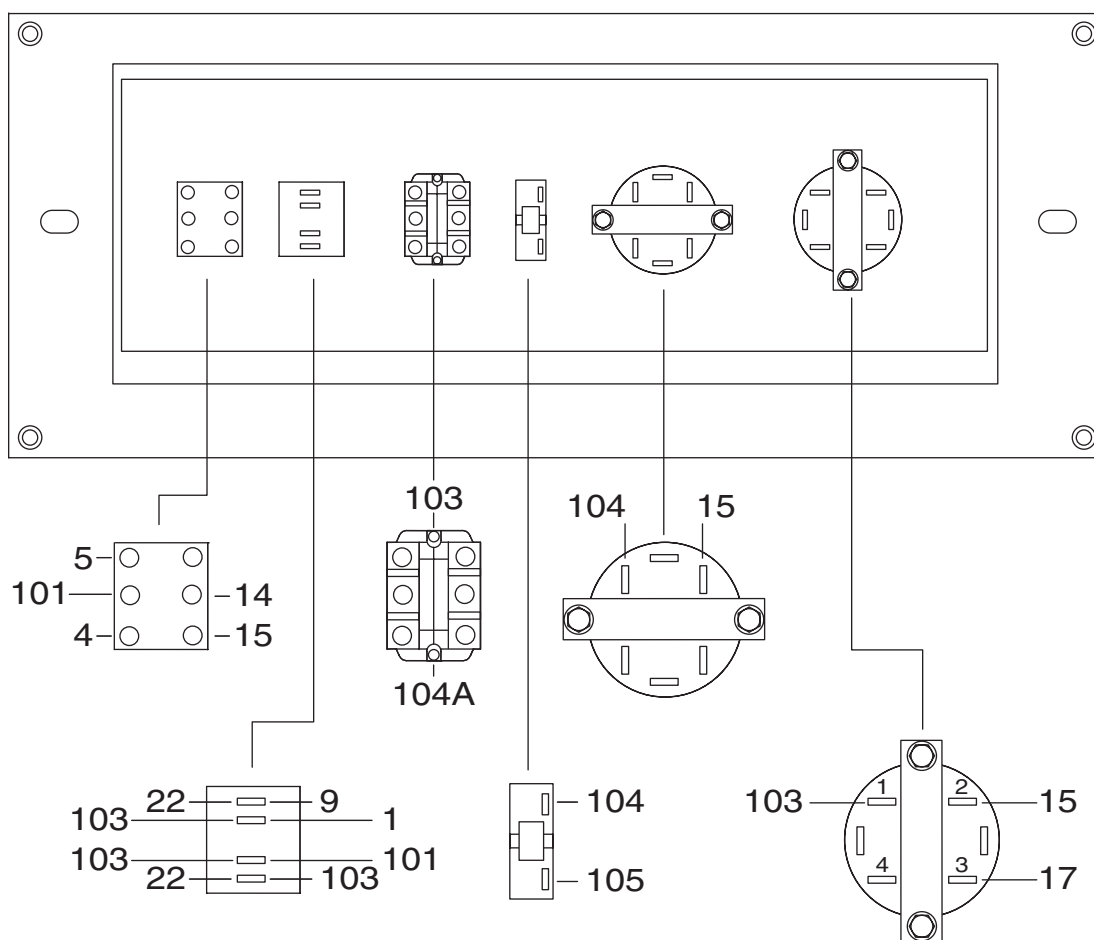
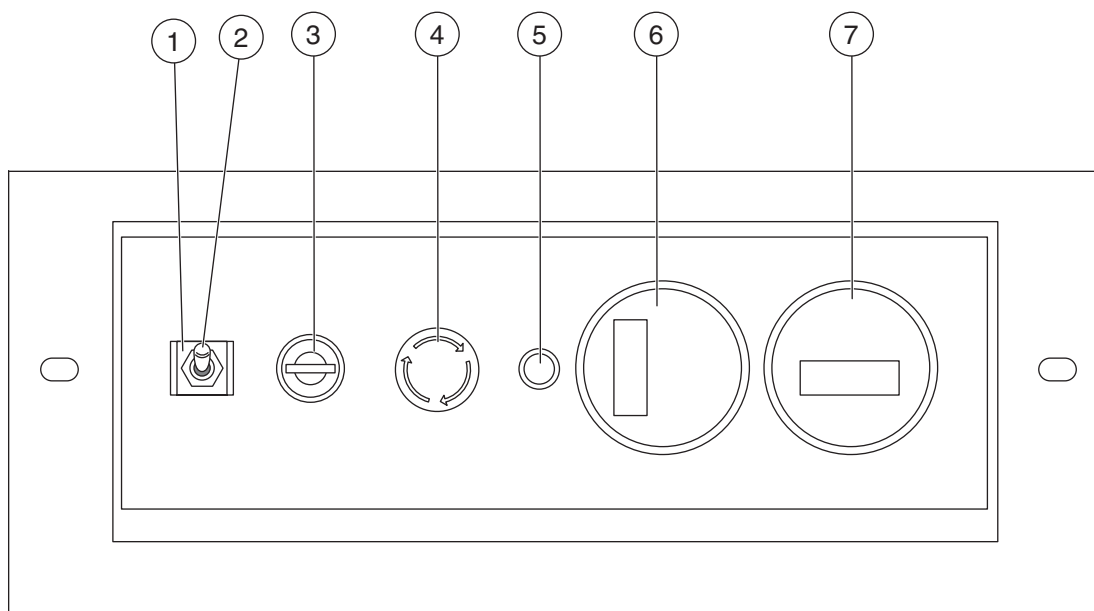
ILLUSTRATION No.  
ART\_2221

Reference: ART\_188

Control Arm (Joystick)



ITEM	PART NO.	QTY	DESCRIPTION
			JOYSTICK
1	13647 8750	1	CONTROL ARM ASSEMBLY PIN (SERVICE ONLY)
2	8453	1	SWITCH ACTUATOR (SERVICE ONLY)
3	HDW8455	4	SCREW, 6-1/2" LG (SERVICE ONLY)
4	8752	1	GRIP-TOP HALF (SERVICE ONLY)
5	8751	1	GRIP-BOTTOM HALF (SERVICE ONLY)
6	13638	1	CONTROL ARM WITHOUT WIRE
7	8748	1	TRIGGER (SERVICE ONLY)
8	8456	1	ROCKER BOOT (SERVICE ONLY)
	7476	5	AMP PINS
	8630 8761	1	HANDLE, GRIP SWITCH ASSEMBLY (NOT SHOWN)
	8089	1'	WIRE, BLK 18GA 300 V
	7777	2	TERMINAL, PUSH ON, 3/16"
11	8447	1	SWITCH SEPARATOR (SERVICE ONLY)
12	8753	1	MOTION SWITCH, ON-OFF (SERVICE ONLY)
13	8448	2	SWITCH (SERVICE ONLY)







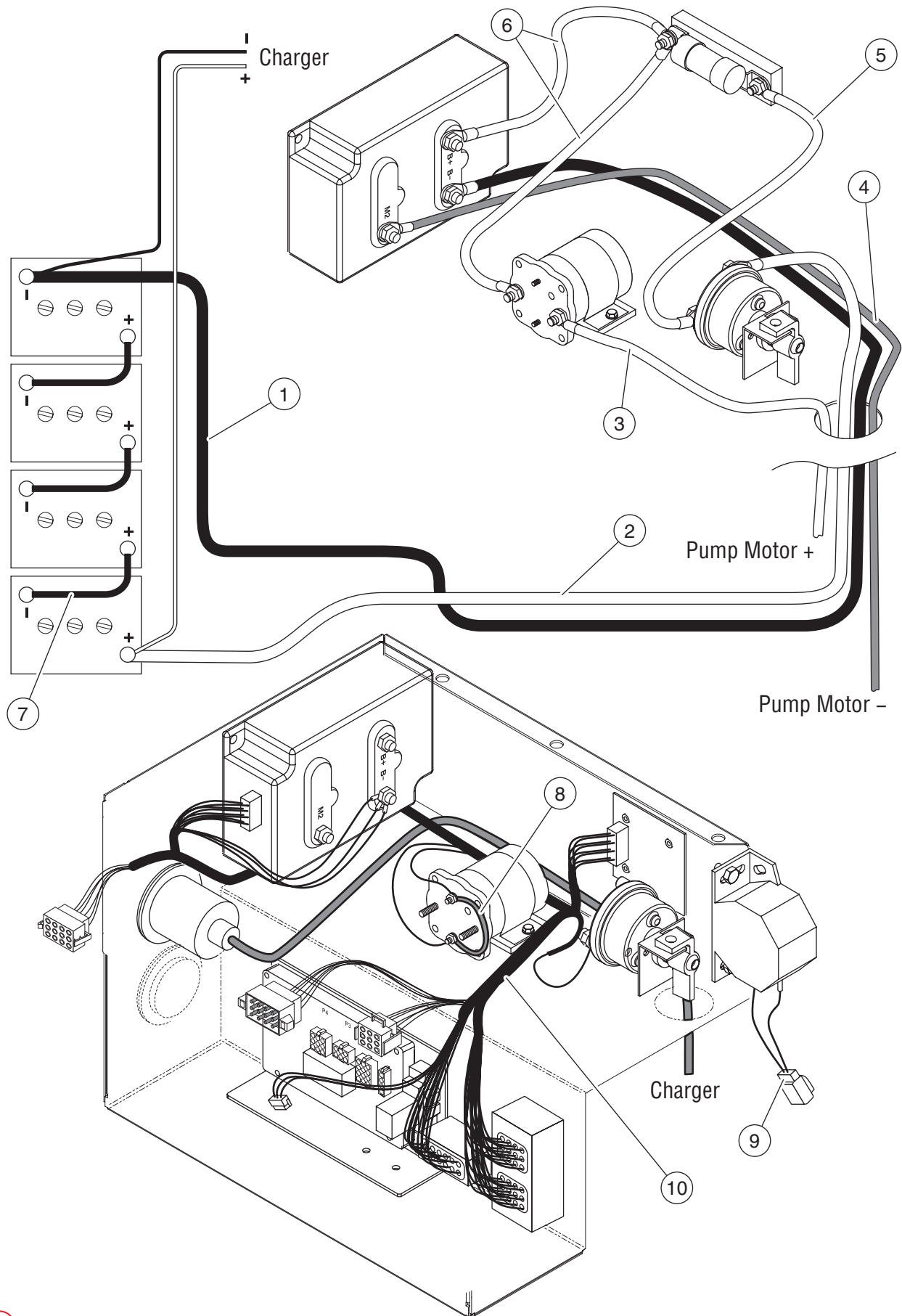


March 2008  
Page A-12

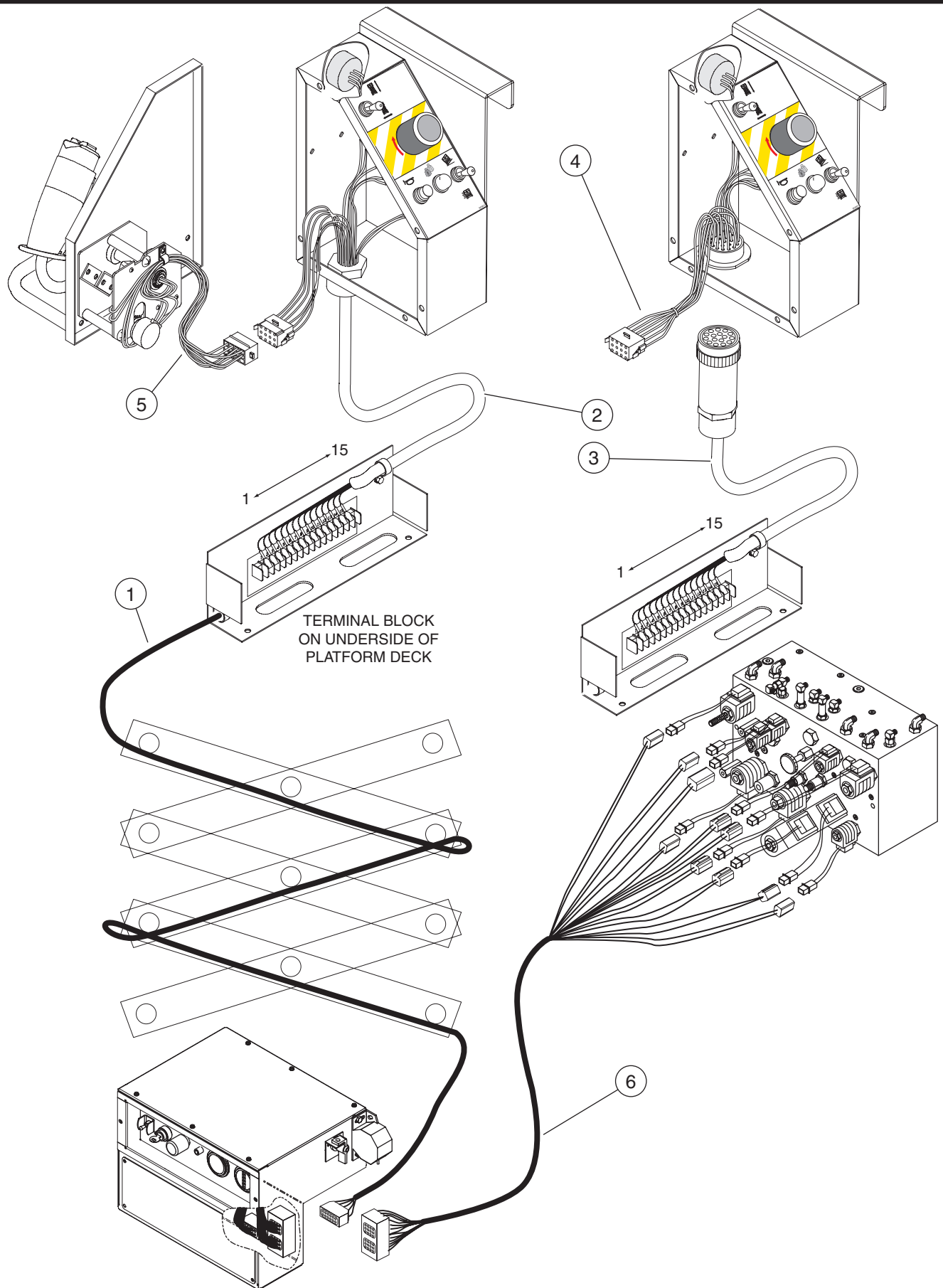
"2047ES - 2647ES - 3247ES" Service &amp; Parts Manual - CE Specifications



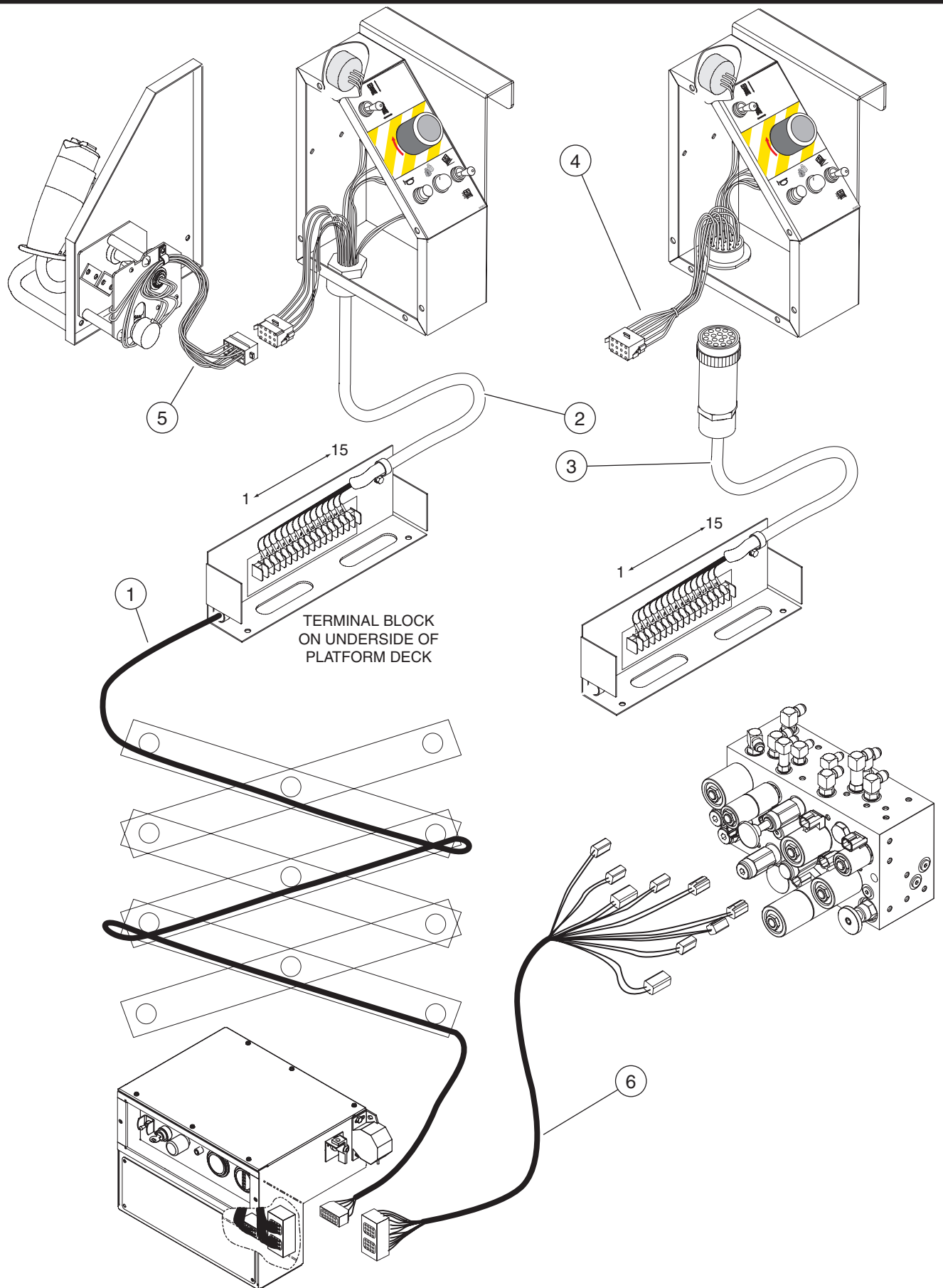
ITEM	PART NO.	QTY	DESCRIPTION
			<b>CONTROL Box, BASE</b>
1	16609	1	WELDMENT, BASE CONTROL BOX
2	16608	1	COVER, ACCESS PANEL
3	16053	1	CONTROL PANEL
4	15118	1	COVER, ACCESS PANEL TOP
5	5863	1	GROMMET
6	9454	3 FT.	GASKET STRIP
8	HDW5276	4	NUT, 1/4" - 20
9	HDW6455	14	SCREW, 1/4 -20 X 1/2"
10	HDW90879	2	SCREW, #6 - 32 X 1 1/4"
11	HDW90880	4	SCREW, #10 - 32 X 1"
12	HDW90803	4	LOCKNUT, #10 - 32
13	90814	4	SPACERS, NYLON
14	8698	1	ALARM, BASE (OPTION)
15	8841	1	SWITCH, MASTER DISCONNECT
17	HDW8364	12	NUT #6 - 32
18	HDW6461	2	LOCKNUT, 1/4" - 20
20	HDW90833	10	SCREW, #6 - 32 X 3/4" LG
21	8601	1	CIRCUIT BOARD
23	5967	1	CONTACTOR, 24 V
24	8344	1	FUSE, 200A
25	8345	1	FUSE HOLDER
26	HDW90929	2	SCREW, 1/4" - 20, 1" LG
27	90991	1	MOTOR CONTROLLER
28	HDW90288	2	SCREW, 1/4" - 20, 3" LG
29	90532	1	CHARGER CORD, STRAIN RELIEF
30	90925	2	ADAPTER, RECEPTACLE HOLE
31	7115	1	HOLE PLUG
32	90927	1	RELAY, SPDT 24VDC
33	90871	1	RELAY, BASE
34	90923	1	RELAY, CLIP
35	16064	1	BRACKET, LOAD SENSE
36	90843	1	GP102 LOAD SENSE MODULE



ITEM	PART NO.	QTY	DESCRIPTION
			<b>WIRE HARNESSES, LOWER CONTROLS</b>
1	90962	1	BATTERY CABLE, BLACK
2	9062	1	BATTERY CABLE, RED
3	8836	1	BATTERY CABLE, RED
4	9243	1	BATTERY CABLE, BLACK
5	8837	1	BATTERY CABLE, RED
6	8426	2	BATTERY CABLE, RED
7	6208	3	BATTERY CABLE, BLACK
8	8368	1	DIODE
9	8782	1	HARNESS, BASE ALARM (OPTION)
10	90905	1	HARNESS, E-DOWN CHARGE WIRE W/DIODE (3247ES)
11	91072	1	HARNESS, E-DOWN TO BATTERIES (3247ES)
-	9441	45'	WIRE, 14 GA, CE COLORS
NS	90156	AS REQ	TERMINAL, PUSH ON, 1/4" MALE FI, 22-18
NS	9356	2	CLAMP, NYLON
NS	90781	1	FORK TERMINAL 12 GA
			<b>2047ES - SERIAL # 9801000 - 9801099</b>
			<b>2647ES - SERIAL # 9901000 - 9901199</b>
			<b>3247ES - SERIAL # 10001000 - 10001199</b>
12	90810	1	HARNESS, INSTRUMENTS
			<b>2047ES - SERIAL # 9801100 - UP</b>
			<b>2647ES - SERIAL # 9901200 - UP</b>
			<b>3247ES - SERIAL # 10001200 - UP</b>
12	90877	1	HARNESS, INSTRUMENTS



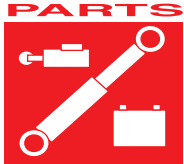
ITEM	PART NO.	QTY	DESCRIPTION
1	90847		<b>WIRE HARNESSES, COMMUNICATION CABLE (EARLY MODELS)</b> 2047ES COMMUNICATION CABLE
1	90848		2647ES COMMUNICATION CABLE
1	90849		3247ES COMMUNICATION CABLE
			<b>WIRE HARNESSES, UPPER CONTROLS (EARLY MODELS)</b>
2	90817	1	CONTROLLER CABLE, FIXED
3	7656	1	CONTROLLER CABLE, REMOVABLE (OPTION)
4	90100		CONTROL HARNESS (USED WITH REMOVABLE CABLE)
5	8346	1	JOYSTICK HARNESS
			<b>2047ES - SERIAL # 9801000 - 9801099</b> <b>2647ES - SERIAL # 9901000 - 9901199</b>
6	90684	1	<b>3247ES - SERIAL # 10001000 - 10001199</b> BASE / MANIFOLD HARNESS
NS	90683	1	LIFT CYLINDER HARNESS (2047ES/2647ES)
NS	90955	1	LIFT CYLINDER HARNESS - LOWER CYL (3247ES)
NS	90956	1	LIFT CYLINDER HARNESS - UPPER CYL (3247ES)
NS	90686		<b>WIRE HARNESSES, OTHER (EARLY MODELS)</b> LIMIT SWITCH HARNESS
NS	90685	1	POTHOLE SWITCH HARNESS
NS	—	1	HORN (OPTION) SEE SECTION B
NS	—		MOTION LIGHT (OPTION) SEE SECTION E, OPTIONS
NS	—		POWER CONVERTER (OPTION) SEE SECTION E, OPTIONS
NS	90870	1	HARNESS, LOAD SENSE BOARD
NS	90878	1	HARNESS, LOAD SENSE TRANSDUCERS





ITEM	PART NO.	QTY	DESCRIPTION
1	90847		<b>WIRE HARNESES, COMMUNICATION CABLE (CURRENT MODELS)</b> 2047ES COMMUNICATION CABLE
1	90848		2647ES COMMUNICATION CABLE
1	90849		3247ES COMMUNICATION CABLE
			<b>WIRE HARNESES, UPPER CONTROLS (CURRENT MODELS)</b>
2	90817	1	CONTROLLER CABLE, FIXED
3	7656	1	CONTROLLER CABLE, REMOVABLE (OPTION)
4	90100		CONTROL HARNESS (USED WITH REMOVABLE CABLE)
5	8346	1	JOYSTICK HARNESS
			<b>2047ES - SERIAL # 9801100 - UP</b>
			<b>2647ES - SERIAL # 9901200 - UP</b> <b>3247ES - SERIAL # 10001200 - UP</b>
6	91066	1	BASE / MANIFOLD HARNESS
NS	91069	1	LIFT CYLINDER HARNESS (2047ES/2647ES)
NS	91085	1	<b>LOWER LIFT CYLINDER HARNESS (3247ES)</b> <b>EXCEPT SERIAL # 10001211 - #10001217</b>
NS	90955	1	<b>LOWER LIFT CYLINDER HARNESS (3247ES)</b> <b>SERIAL # 10001211 - #10001217</b>
NS	91086	1	<b>UPPER LIFT CYLINDER HARNESS (3247ES)</b> <b>EXCEPT SERIAL # 10001211 - #10001217</b>
NS	90956	1	<b>UPPER LIFT CYLINDER HARNESS (3247ES)</b> <b>SERIAL # 10001211 - #10001217</b>
			<b>WIRE HARNESES, OTHER (CURRENT MODELS)</b>
NS	NOT USED		LIMIT SWITCH HARNESS
NS	91066	1	POTHOLE SWITCH HARNESS
NS	—	1	HORN (OPTION) SEE SECTION B
NS	—		MOTION LIGHT (OPTION) SEE SECTION E, OPTIONS
NS	—		POWER CONVERTER (OPTION) SEE SECTION E, OPTIONS
NS	90870	1	HARNESS LOAD SENSE BOARD
NS	90878	1	HARNESS LOAD SENSE TRANSDUCERS





# SECTION B:

## PLATFORM AND RAILS

PLATFORM AND RAILS .....	B-3
ROLLOUT DECK AND RAILS.....	B-5
ENTRY .....	B-7
SWING GATE .....	B-9
ROLLOUT DECK LOCK .....	B-11
ROLLOUT DECK ROLLER .....	B-13
TERMINAL BLOCK .....	B-15
OPERATOR HORN (OPTION) .....	B-15
AIRLINE To PLATFORM (OPTION) .....	B-15
POWER To PLATFORM .....	B-17

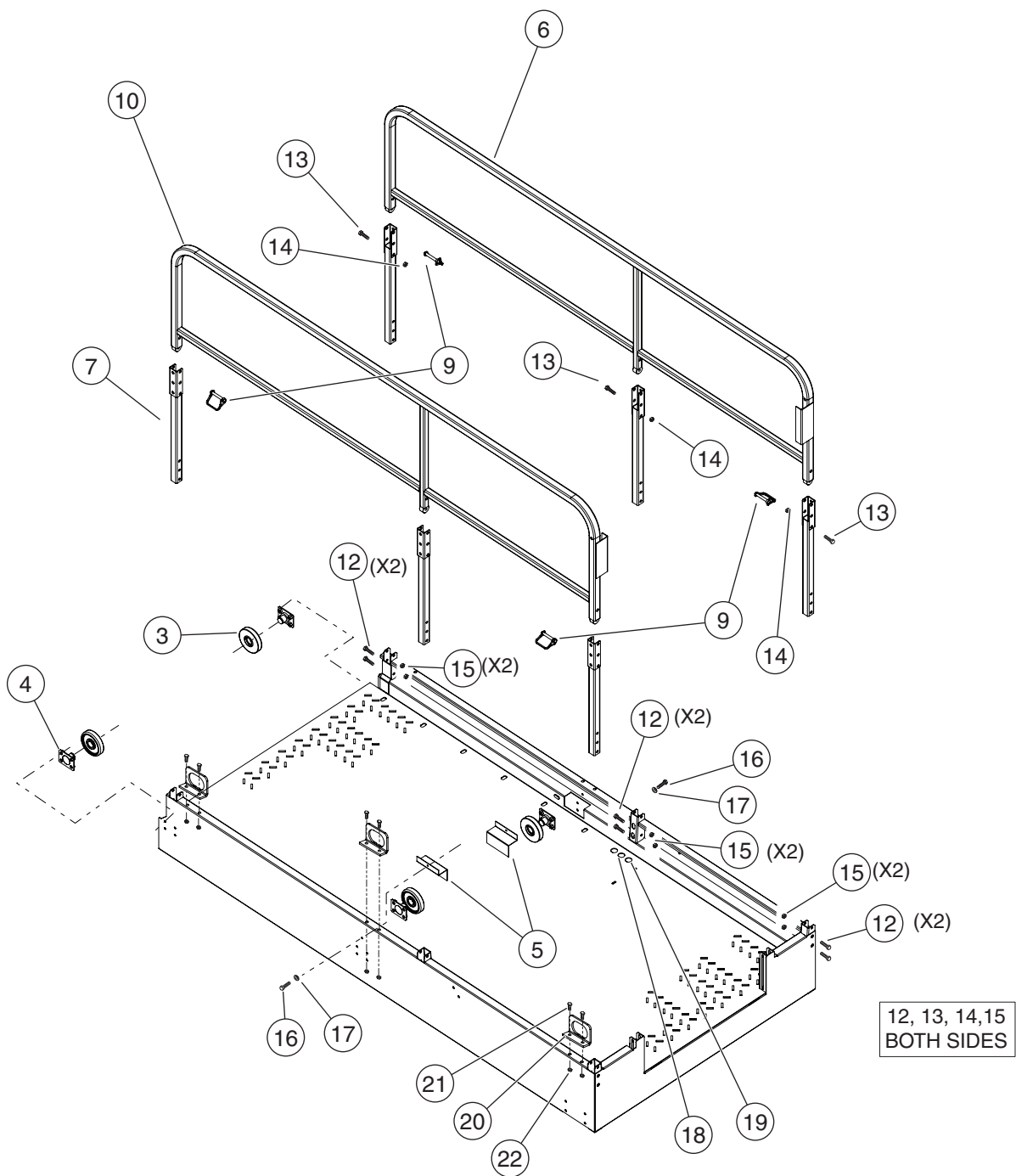
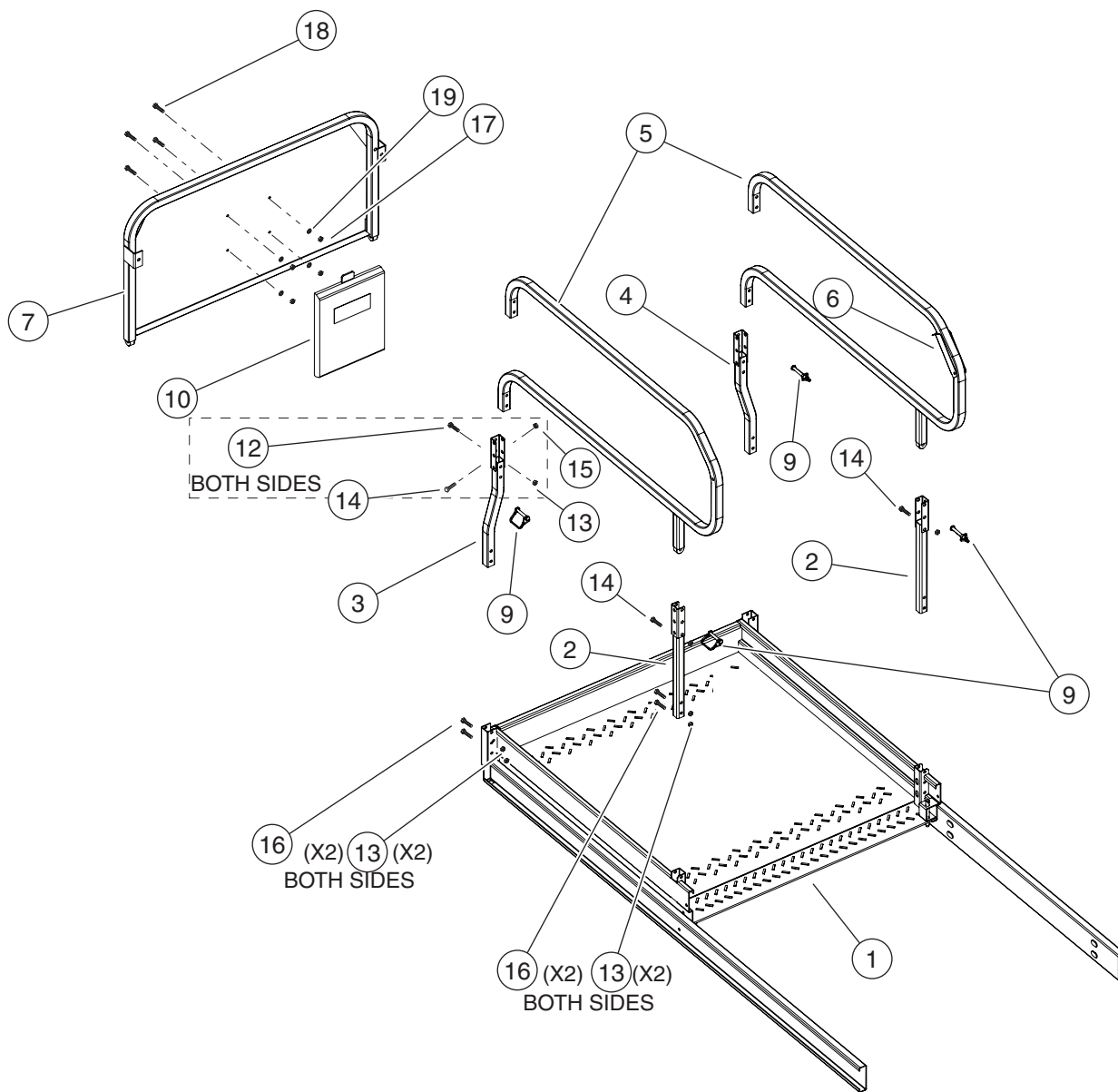


ILLUSTRATION No.  
ART\_2485

Main Deck and Rails, X47ES, CE



ITEM	PART NO.	QTY	DESCRIPTION
			<b>PLATFORM AND RAILS</b>
1	16516	1	MAIN PLATFORM
2	13777	2	BLOCK, FIXED PLATFORM
3	13230	4	ROLLER
4	13267	4	PLATE ROLLER WELDMENT
5	13637	2	BRACKET, ROLLER COVER
6	16634	1	RAIL WELD MAIN UPPER RH
7	16564	6	RAIL WELD EXT LOWER
9	HDW91057	4	PIN WIRE LOCK 3/8" X 2.25 W/CHAIN
10	16573	1	RAIL WELD MAIN UPPER LH
12	HDW8303	12	SCREW, 5/16" - 18, 2" LG
13	HDW6434	6	SCREW 3/8"-16 X 2.00
14	HDW5039	6	LOCK NUT 3/8"-16
15	HDW8304	12	NUT 5/16"-18
16	HDW6455	2	SCREW, HEX HEAD, 1/4" - 20 X 1/2"
17	HDW5217	2	FLAT WASHER, 11/32" ID
18	90208	2	CAP, STEEL 1.0" DIA HOLE
19	8479	1	BUSHING, 3/4" ID
20	3923	6	BRKT, ATTACHMENT POINT
21	HDW6432	12	SCREW, 3/8" - 16, 3/4" LG
22	HDW5039	12	LOCK NUT, 3/8" - 16



ITEM	PART NO.	QTY	DESCRIPTION
			<b>ROLLOUT DECK AND RAILS</b>
1	16523	1	PLATFORM EXTENSION
2	15089	2	RAIL WELD EXT REAR LOWER
3	16580	1	RAIL WELD EXT LOWER FRONT LH
4	16579	1	RAIL WELD EXT LOWER FRONT RH
5	15085	2	RAIL WELD EXT SIDE
6	13814	1	HANDLE R/O PLATFORM
7	16566	1	RAIL WELD EXT FRONT UPPER
9	HDW91057	4	PIN WIRE LOCK 3/8" X 2.25 W/CHAIN
10	8909	1	ENCLOSURE SERVICE MANUAL
12	HDW7471	2	SCREW 5/16"-18 X 3.00
13	HDW8304	10	NUT 5/16"-18
14	HDW6434	4	HEX CAP SCREW 3/8"-16 X 2.00
15	HDW5039	4	LOCKNUT 3/8"-16
16	HDW8303	8	HEX CAP SCREW 5/16"-18 X 2"
17	HDW6461	4	LOCK NUT 1/4"-20
18	HDW5904	4	HEX CAP SCREW 1/4"-20 X 3/4"
19	HDW5217	4	FLAT WASHER 11/32" ID

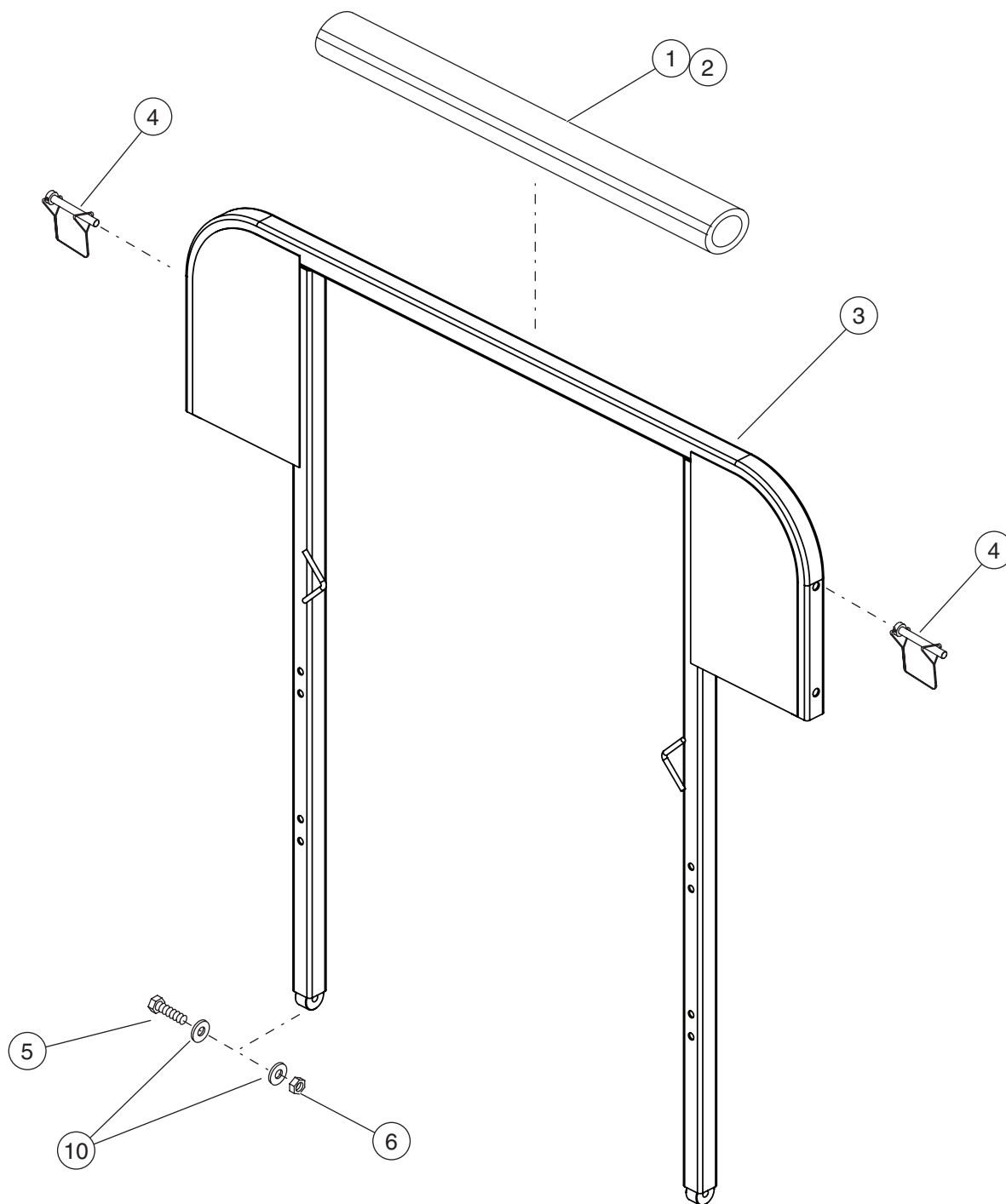


ILLUSTRATION No.  
ART\_2486

Entry and Top Rail, X47ES, CE







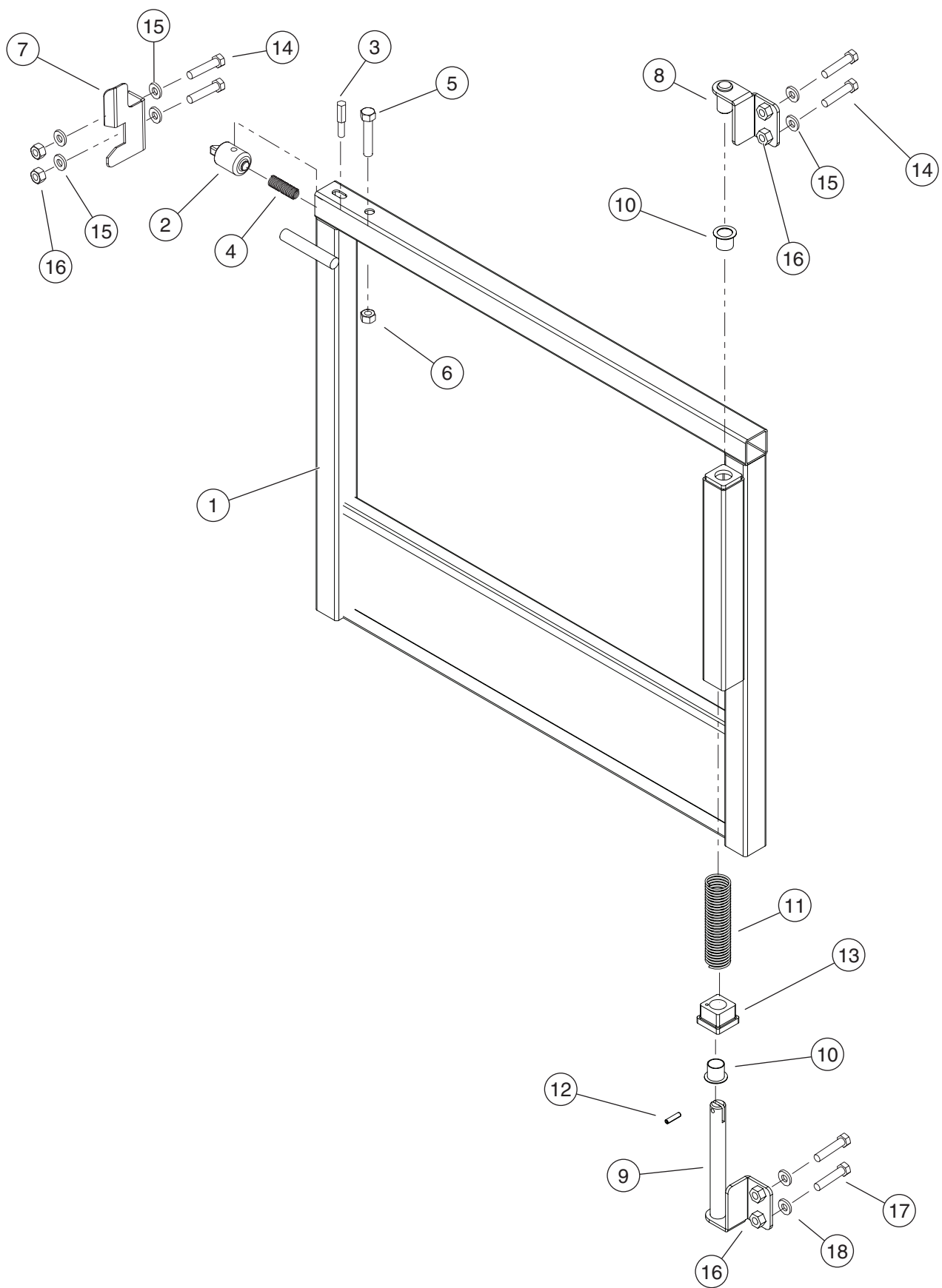


ILLUSTRATION No.  
ART\_2259

Reference: ART\_

Swing Gate, X47ES



ITEM	PART NO.	QTY	DESCRIPTION
			<b>SWING GATE</b>
1	16635	1	SWING GATE WELDMENT
2	40003	1	PIN, LATCH
3	40006	1	ROD, LATCH LEVER
4	7055	1	SPRING, LATCH
5	HDW8277	1	SCREW, 3/8" - 16, 1 3/4" LG
6	HDW6281	1	NUT, 3/8" - 16
7	25615	1	BRKT STRIKER SWING GATE
8	40014	1	SWING GATE MOUNT WELD UPPER
9	40015	1	SWING GATE MOUNT WELD LOWER
10	8187	2	BEARING, NYLINER, FLANGED
11	8300	1	SPRING, TORSION, 1" OD, 4" LG
12	HDW7455	1	PIN, SLOTTED SPRING, 3/16" DIA X 3/4" LG
13	13272	1	BLOCK, PIVOT
14	HDW7119	4	HEX CAP SCREW 5/16"-18 X 2.25"
15	HDW8294	8	FLAT WASHER 0.328 ID
16	HDW8304	6	LOCNUT 5/16"-18
17	HDW5724	2	HEX CAP SCREW 5/16"-18 X 3/4"
18	HDW5217	2	FLAT WASHER 11/32" ID

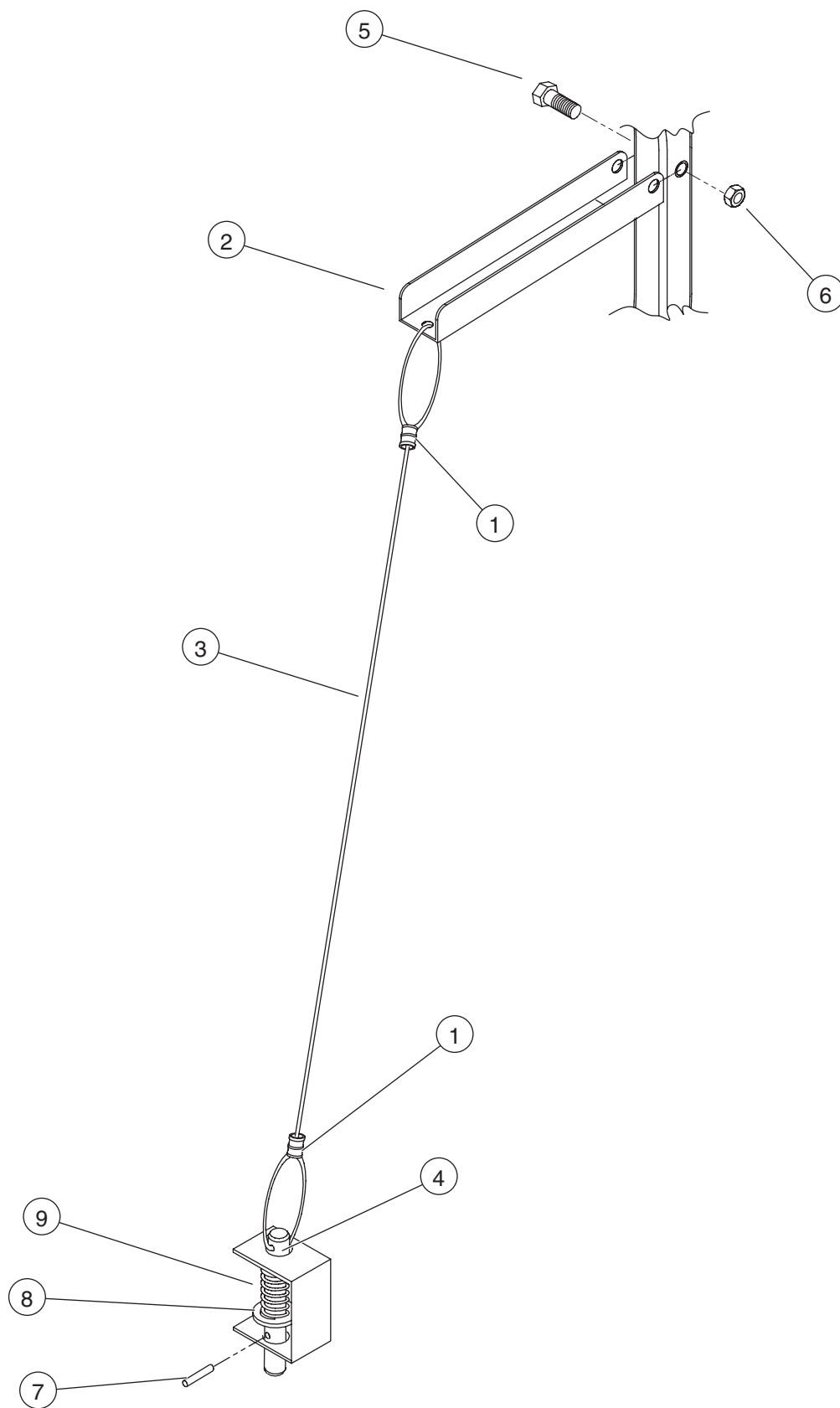


ILLUSTRATION No.  
ART\_2174

Reference ART\_686

Roll-out Deck Lock Pin Assembly





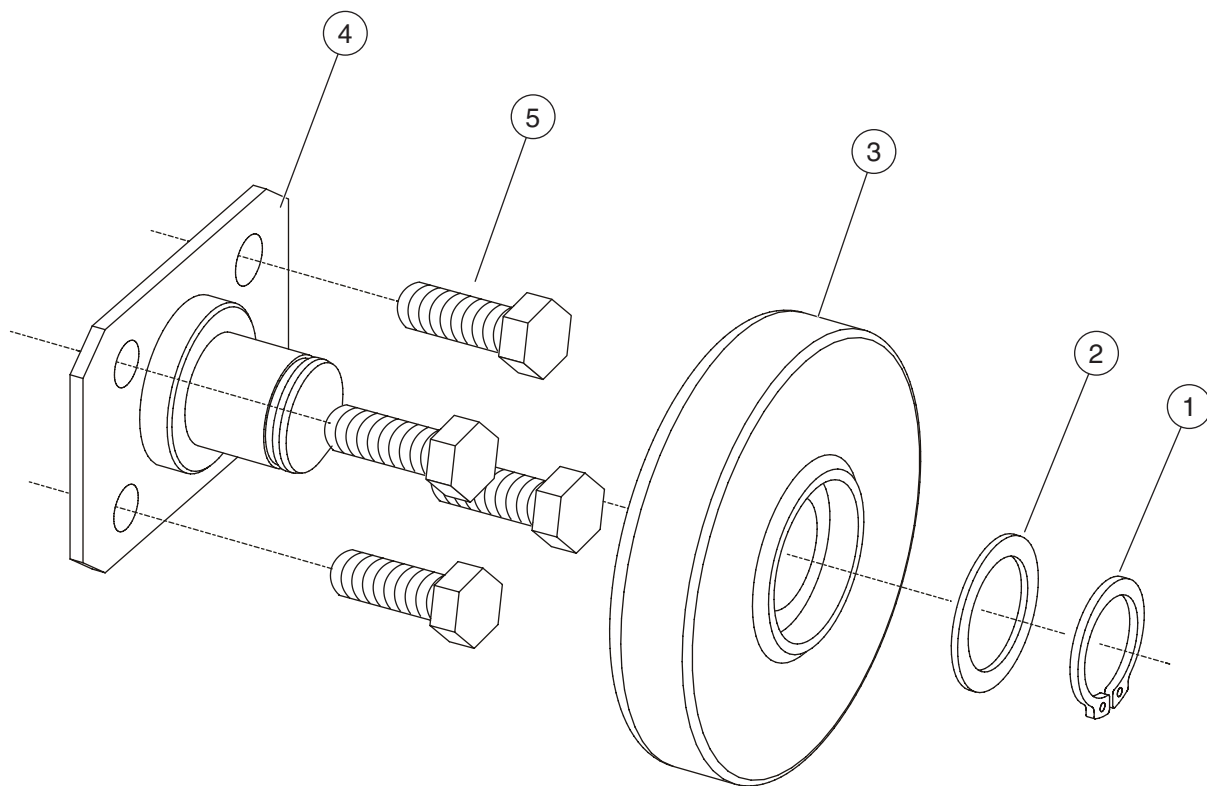


ILLUSTRATION No.  
ART\_2095

Reference: ART\_687

Roll-out Deck Roller





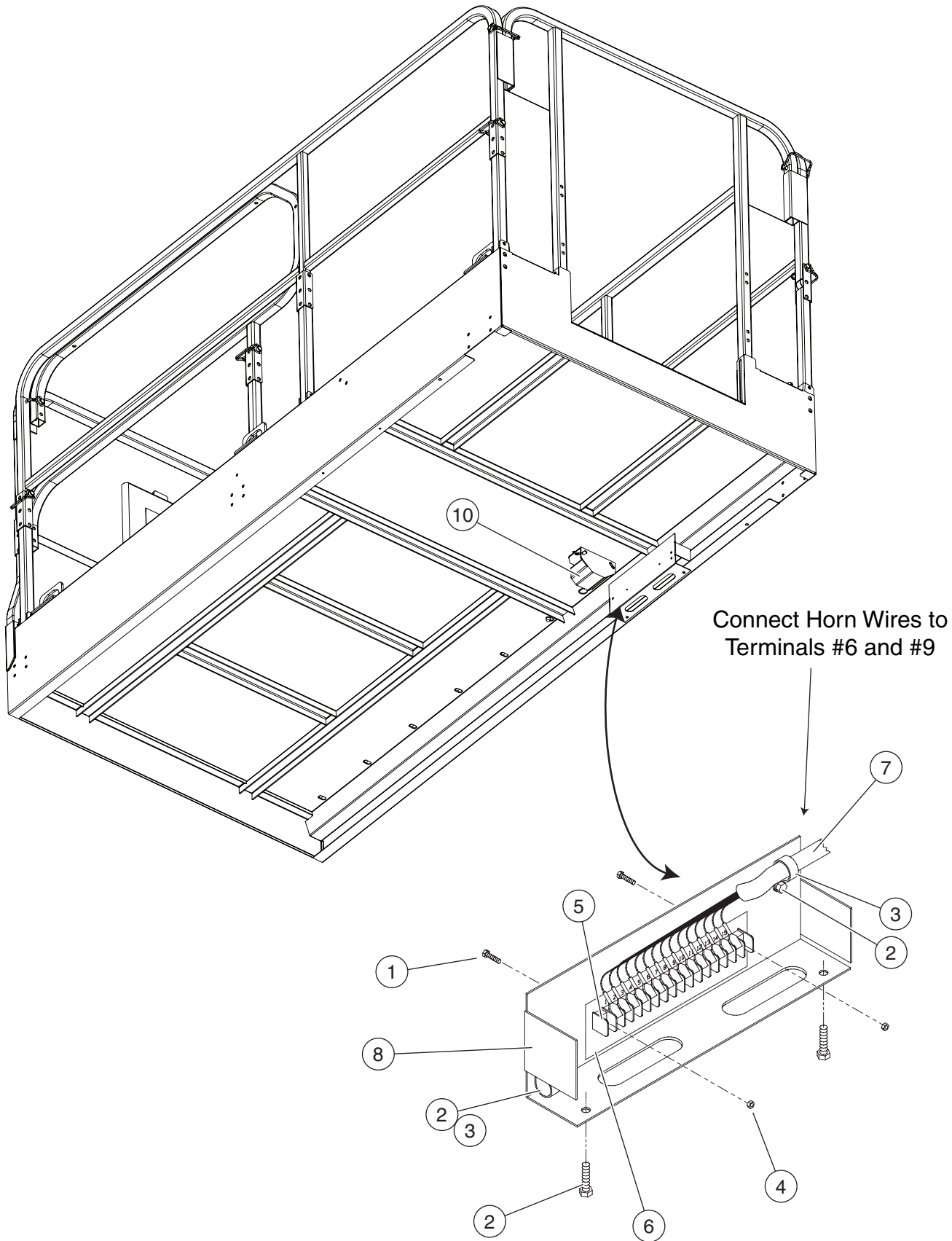


ILLUSTRATION No.  
ART\_2227

Terminal Block Installation, ES





ITEM	PART NO.	QTY	DESCRIPTION
			<b>TERMINAL BLOCK</b>
1	HDW5363	2	SCREW, 6-32, 1" LG
2	HDW6455	4	SCREW, 1/4" - 20, 1/2" LG
3	5882	2	CABLE CLAMP
4	HDW5364	2	NUT, 6-32
5	5991	1	TERMINAL BLOCK
6	7817	1	STRIP, BACKING, 15 POSITION
7	REF	1	WIRE HARNESS, UPPER CONTROLS
8	25526	1	TERMINAL STRIP COVER
10	9716	1	<b>OPERATOR HORN (OPTION)</b> HORN, 12-48 VOLT ELECTRONIC
	HDW5723	2	SCREW, 1/4" - 20, 3/4" LG
	HDW5276	2	NUT, 1/4" - 20
	HDW5217	2	WASHER, FLAT
			<b>AIRLINE To PLATFORM (OPTION)</b>
	5351	1	<b>NOT SHOWN</b> CABLE TIE
	8543	*	HOSE, 1/4" AIRLINE * 2047ES = 34 FT.
			* 2647ES = 41 FT. 6 IN. * 3247ES = 49 FT.
	8559	2	CLAMP, HOSE
	HDW5052	2	FITTING, 1/4" MALE, MALE HOSE BARB

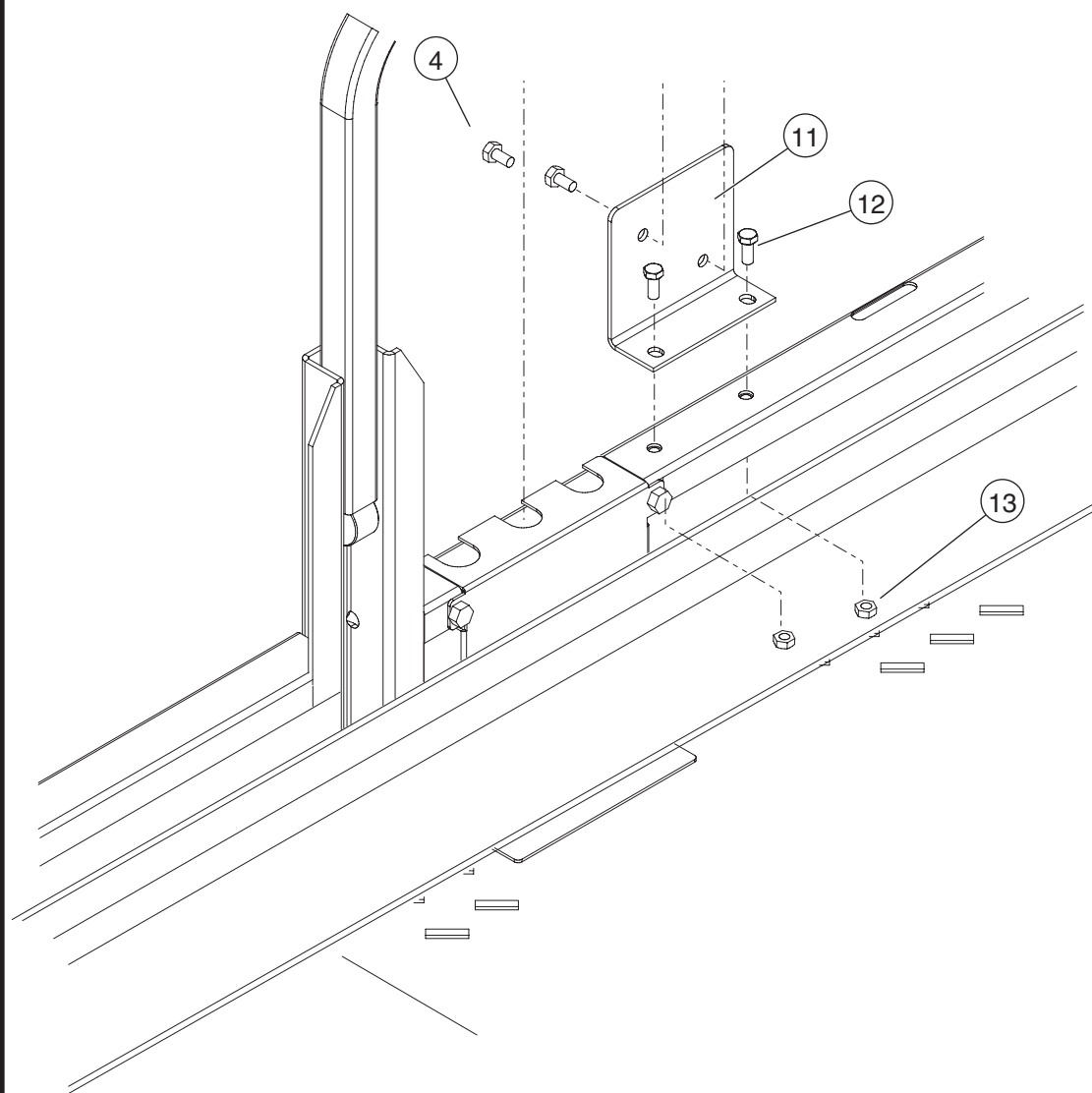


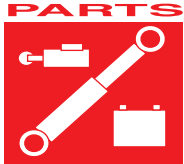
ILLUSTRATION No.  
ART\_2228

Power to Platform Outlet Installation









## SECTION C:

# SCISSORS

BEAM ASSEMBLY- 2047ES .....	C-3
BEAM ASSEMBLY- 2647ES .....	C-5
BEAM ASSEMBLY - 3247ES .....	C-7
SLIDE BLOCK ASSEMBLY .....	C-9
LIFT CYLINDER MOUNT .....	C-11
LIFT CYLINDER - 2047ES / 2647ES, EARLY MODELS .....	C-13
LIFT CYLINDER - 2047ES / 2647ES, LATE MODELS .....	C-15
UPPER LIFT CYLINDER - 3247ES, EARLY MODELS .....	C-17
UPPER LIFT CYLINDER - 3247ES, LATE MODELS .....	C-19
LOWER LIFT CYLINDER - 3247ES, EARLY MODELS .....	C-21
LOWER LIFT CYLINDER - 3247ES, LATE MODELS .....	C-23
EMERGENCY LOWERING CABLE .....	C-25

↓ DENOTES LOCATION OF  
HDW13175

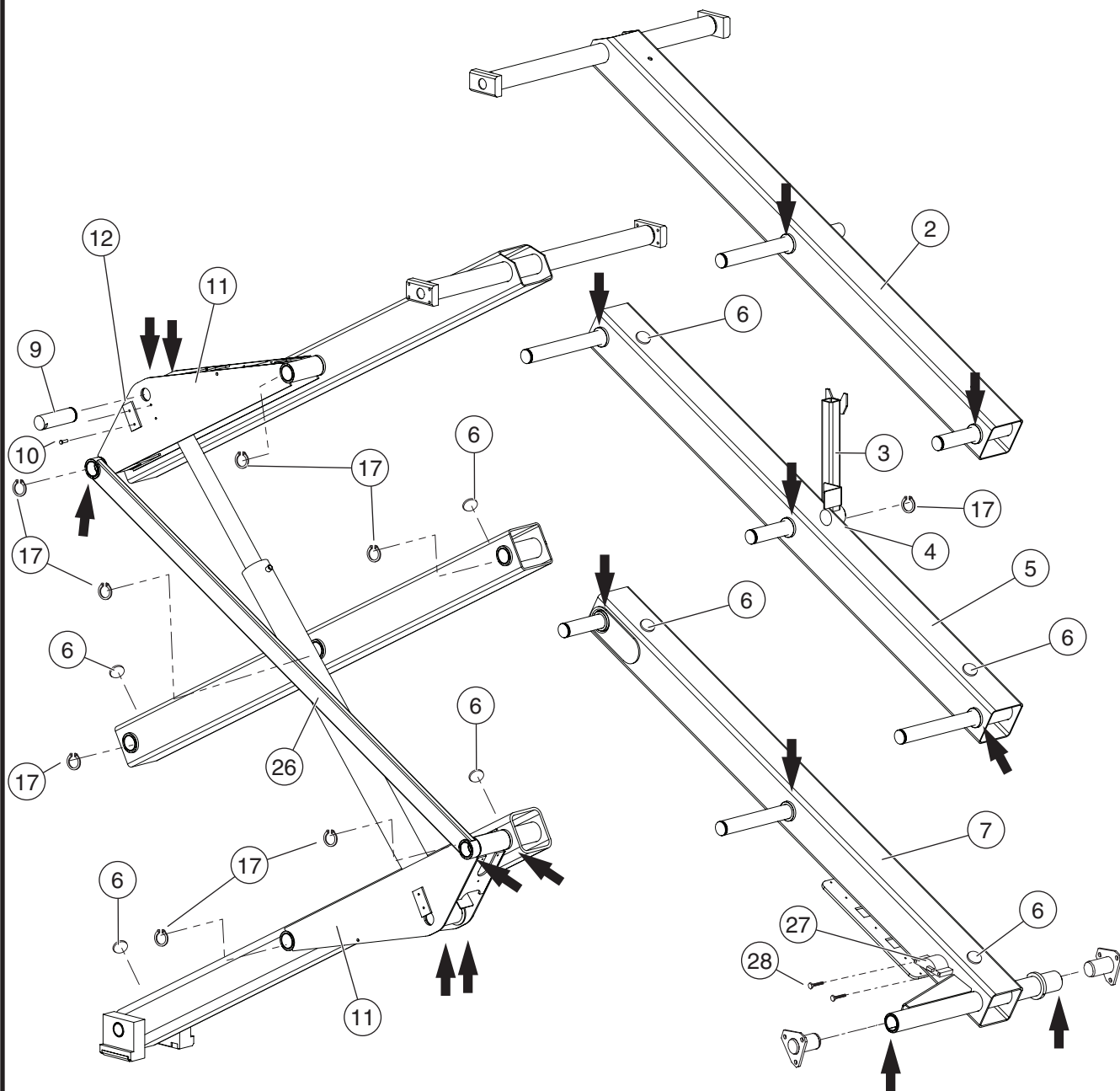


ILLUSTRATION No.  
ART\_2487

Scissor Assembly, 2047ES, CE



ITEM	PART NO.	QTY	DESCRIPTION
			<b>BEAM ASSEMBLY- 2047ES</b>
2	16607	1	BEAM, WITH PINS
3	30518	1	MAINTENANCE LOCK
4	8675	2	BEARING, 2 2/4" X 2" X 1 1/2" LG
5	16606	1	BEAM, WITH PINS
6	25429	8	SPACER BLOCK
7	16598	1	BEAM, WITH PINS
8	HDW8899	4	RETAINING RINGS
9	14537	2	PIN, CYLINDER MOUNT
10	HDW6455	4	SCREW, 1/4" - 20, 1/2" LG
11	16512	2	CYLINDER MOUNT
12	14538	2	BRACKET, CYLINDER RETAINING
15	16500	1	BEAM, WITH BEARINGS
	6669	4	BEARING, 32DU32
16	16603	1	BEAM, WITH BEARINGS
	6669	6	BEARING, 32DU32
17	6701	8	RING, RETAINING, 2" SHAFT
19	16511	1	BEAM, WITH BEARINGS
	6669	4	BEARING, 32DU32
25	REF	1	CYLINDER, LIFT (SEE END OF THIS SECTION)
26	16585	1	SUPPORT, BEAM, 1X3
27	90844	1	ANGLE SENSOR
28	HDW6831	2	SCREW, 1/4" - 20 X 2

↓ DENOTES LOCATION OF  
HDW13175

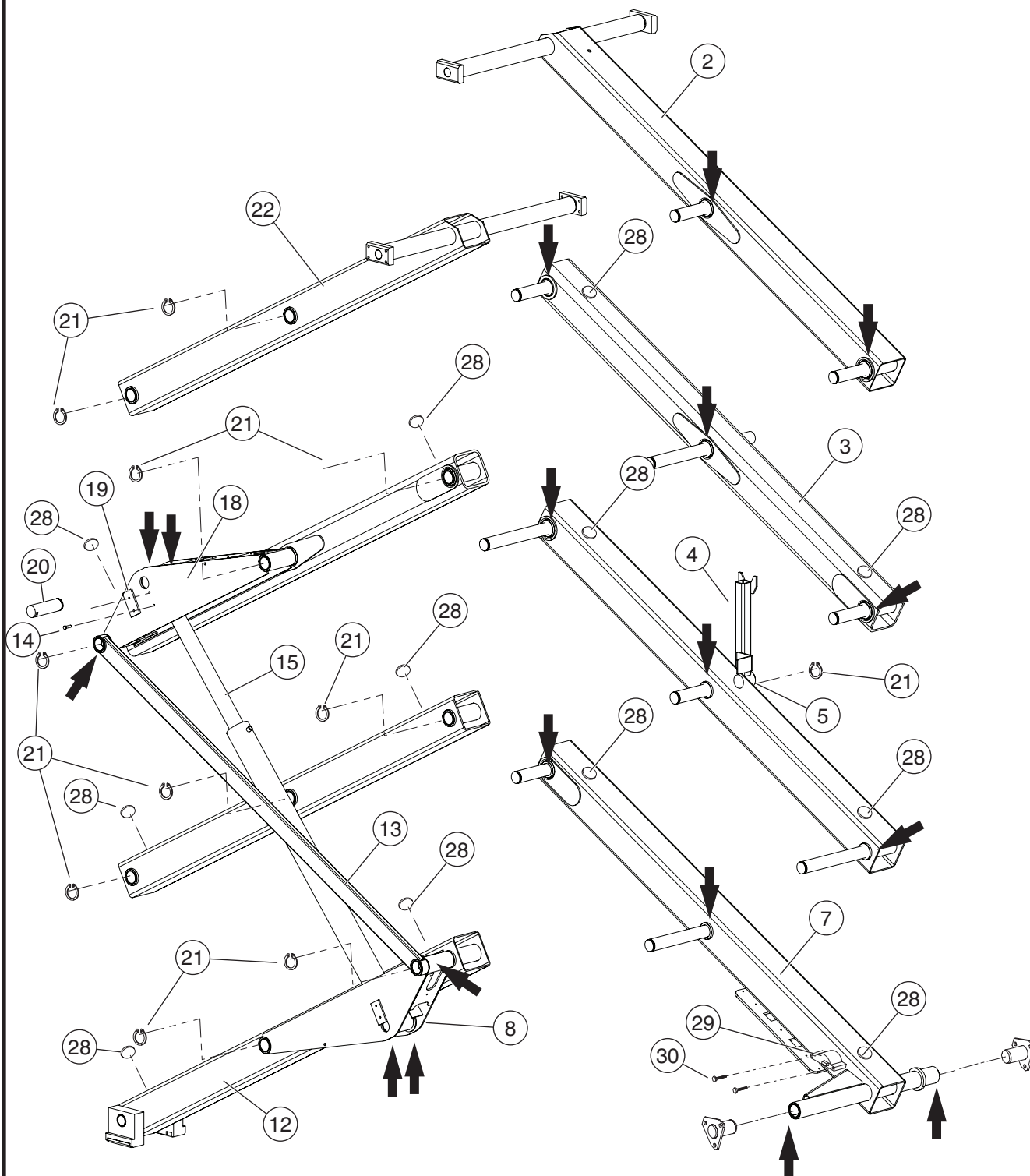


ILLUSTRATION No.  
ART\_2488

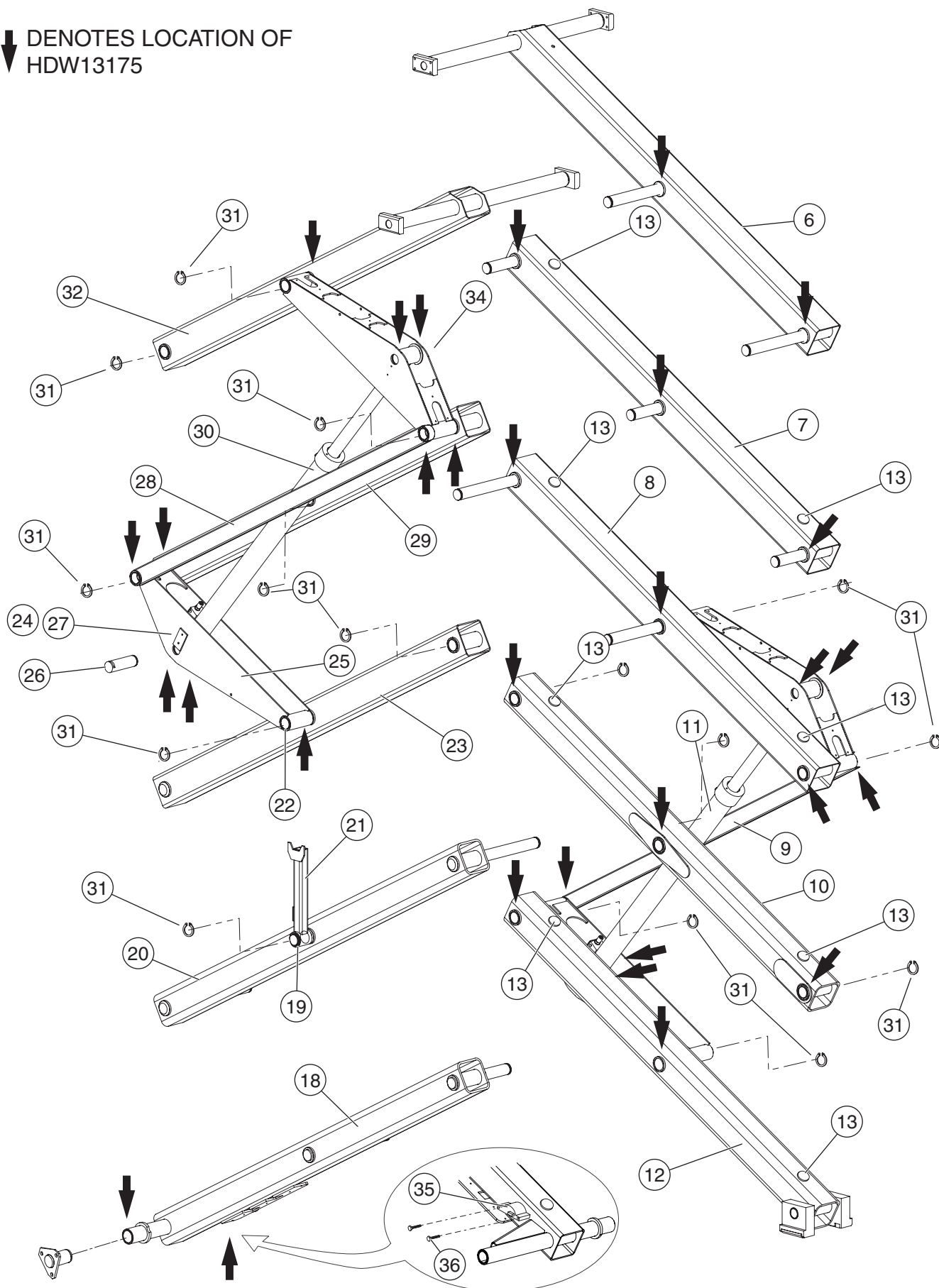
Scissor Assembly, 2647ES, CE





ITEM	PART NO.	QTY	DESCRIPTION
			<b>BEAM ASSEMBLY- 2647ES</b>
2	16601	1	BEAM, WITH PINS
3	16599	1	BEAM, WITH PINS
4	30518	1	MAINTENANCE LOCK
5	8675	2	BEARING, 2 2/4" X 2" X 1 1/2" LG
6	16600	1	BEAM, WITH PINS
7	16598	1	BEAM, WITH PINS
8	HDW8899	4	RETAINING RINGS
12	16602	1	BEAM, WITH BEARINGS
	6669	4	BEARING, 32DU32
13	13931	1	SUPPORT, BEAM, 1X3
14	HDW6455	4	SCREW, 1/4" - 20, 1/2" LG
15	REF	1	CYLINDER, LIFT (SEE END OF THIS SECTION)
16	16603	1	BEAM, WITH BEARINGS
	6669	6	BEARING, 32DU32
17	16502	1	BEAM, WITH BEARINGS
	6669	6	BEARING, 32DU32
18	16512	2	CYLINDER MOUNT
19	14538	2	BRACKET, CYLINDER RETAINING
20	14537	2	PIN, CYLINDER MOUNT
21	6701	11	RING, RETAINING, 2" SHAFT
22	16605	1	BEAM, WITH PINS
28	25429	12	SPACER BLOCK
29	90844	1	ANGLE SENSOR
30	HDW6831	2	SCREW, 1/4" - 20 X 2

↓ DENOTES LOCATION OF  
HDW13175



Scissor Assembly, 3247ES

ILLUSTRATI N No.  
ART\_2489

ITEM	PART NO.	QTY	DESCRIPTION
			<b>BEAM ASSEMBLY - 3247ES</b>
6	16506	1	BEAM, WITH PINS
7	16505	1	BEAM, WITH PINS
8	16503	1	BEAM, WITH BEARINGS
	6669	4	BEARING, 32DU32
9	13931	1	SUPPORT, BEAM, 1X3, LOWER
10	16502	1	BEAM, WITH BEARINGS
	6669	6	BEARING, 32DU32
11	REF	1	CYLINDER, LIFT
12	16500	1	BEAM, WITH BEARINGS
	6669	4	BEARING, 32DU32
13	25429	16	SPACER BLOCK
18	16507	1	BEAM, WITH PINS
19	8675	2	BEARING, 2 1/4" X 2" X 1 1/2"
20	16508	1	BEAM, WITH PINS
21	30518	1	MAINTENANCE LOCK
22	30407	1	PIN, 2"
23	16509	1	BEAM, WITH PINS
24	14538	4	BRACKET, CYLINDER RETAINING
25	16512	4	CYLINDER MOUNT
26	14537	4	PIN, CYLINDER MOUNT
27	HDW6455	8	SCREW, 1/4" - 20, 1/2" LG
28	16585	1	SUPPORT, BEAM, 1X3, UPPER
29	16510	1	BEAM, WITH BEARINGS
	6669	6	BEARING, 32DU32
30	REF	1	CYLINDER, LIFT
31	6701	15	RING, RETAINING, 2" SHAFT
32	16511	1	BEAM, WITH BEARINGS
	6669	4	BEARING, 32DU32
33	14488	2	BLOCK, SLIDE, PLATFORM
34	HDW8899	8	RING, RETAINING
35	90844	1	ANGLE SENSOR
36	HDW6831	2	SCREW, 1/4" - 20 X 2

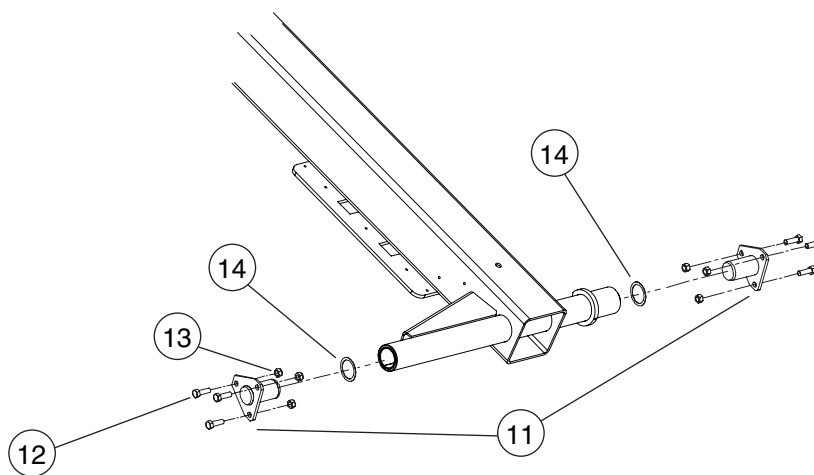
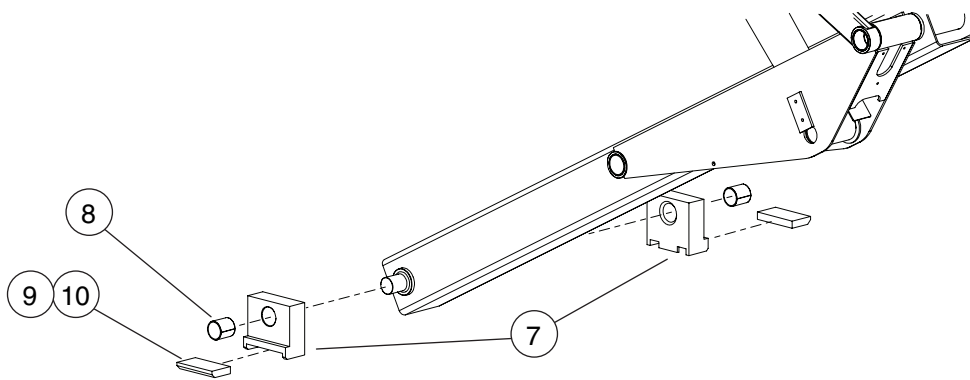
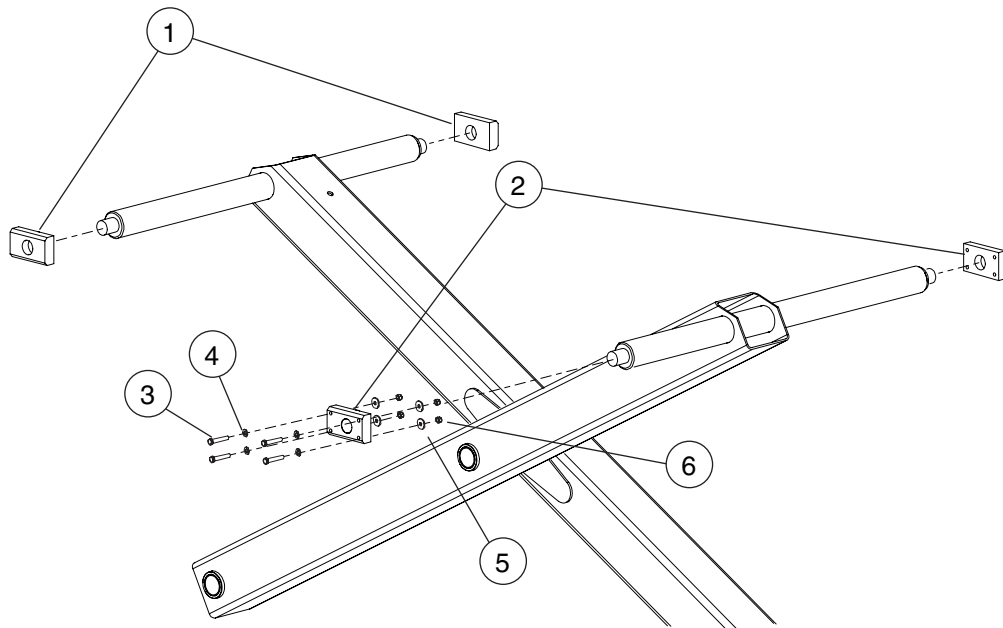


ILLUSTRATION No.  
ART\_2264

Reference: ART\_

Scissor Mounting Detail, X47ES





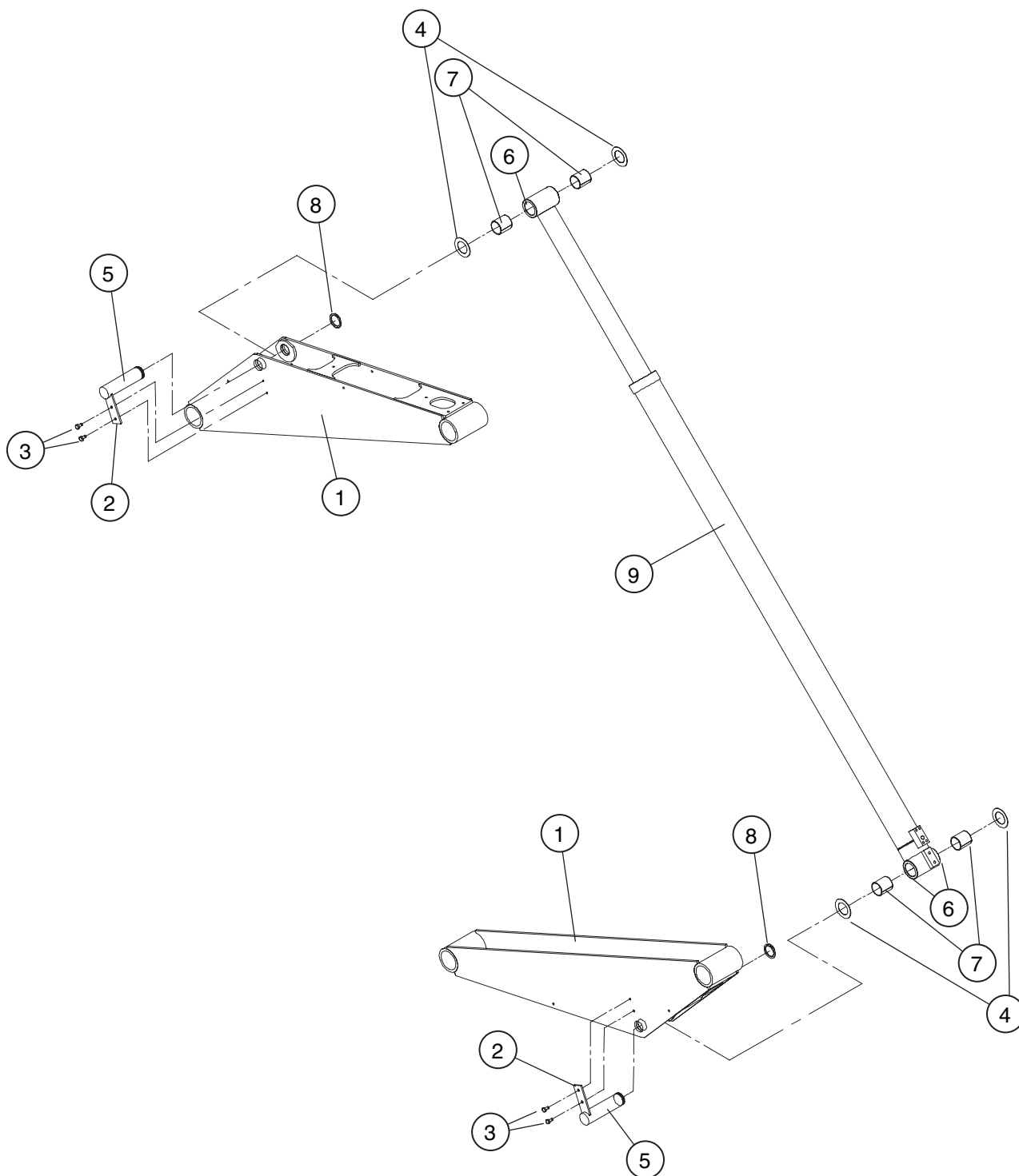


ILLUSTRATION No.  
ART\_2265

Reference: ART\_

Cylinder Mounting Detail, ES





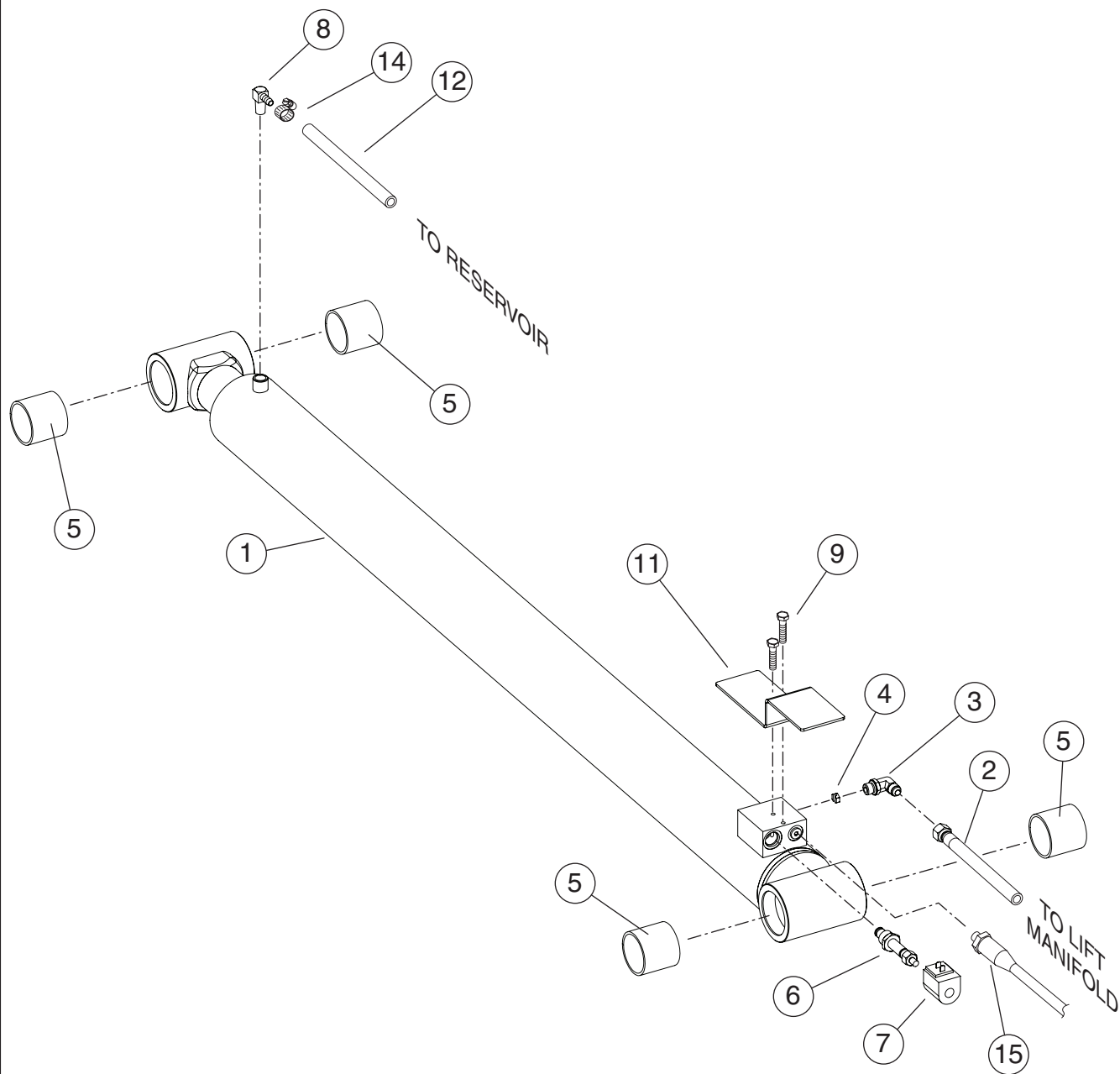


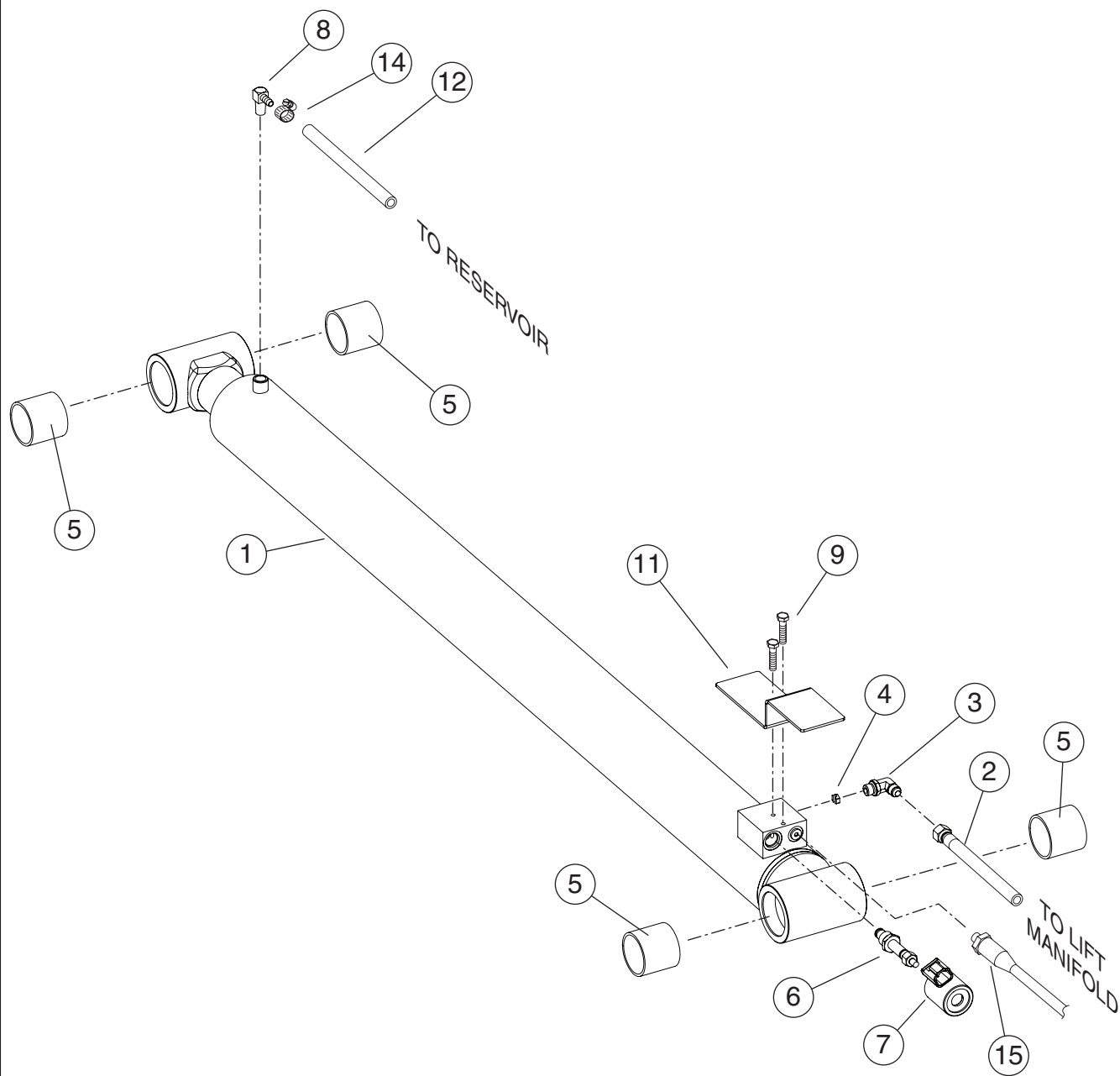
ILLUSTRATION No.  
ART\_2279

90834 Hydraulic Cylinder

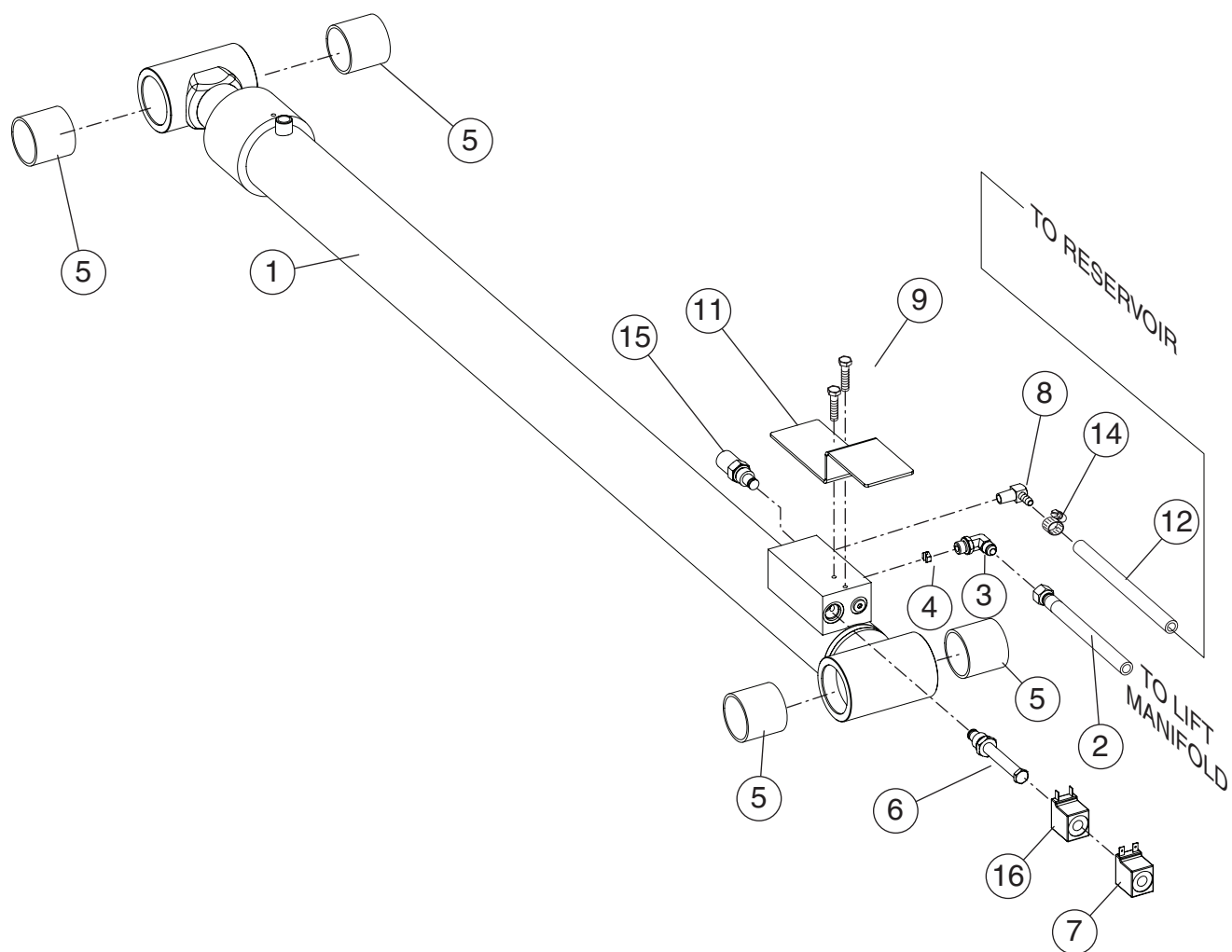




ITEM	PART NO.	QTY	DESCRIPTION
			<b>LIFT CYLINDER - 2047ES / 2647ES, EARLY MODELS</b>
			<b>2047ES - SERIAL #9801000 TO # 9801099</b> <b>2647ES - SERIAL #9901000 TO # 9901199</b>
1	90834	1	CYLINDER, LIFT
2	REF	1	HOSE ASSY (SEE SECTION D)
3	HDW7601	1	FITTING, ELBOW ADAPTOR
4	90361	1	ORIFICE
5	90993	4	BEARING, BRONZE, 2" ID X 2" LG
6	90815	1	VALVE, 2 WAY, N.C. W/MANUAL LOCK
7	90816	1	COIL, 24 VOLT, DOUBLE SPADE W/DIODE
8	HDW6727	1	FITTING, PIPE 90°, MALE BARB
9	HDW8152	2	SCREW, 1/4" - 20 X 3/4" LG
10	90986	1	KIT, SEAL-LIFT CYLINDER (SERVICE) (NOT SHOWN)
11	16062	1	BRACKET, LIFT CYLINDER VALVE GUARD
12	REF	21 FT	HOSE, RETURN LINE (SEE SECTION D)
14	7788	1	CLAMP, HOSE
15	90845	1	PRESSURE SENSOR, 3000 PSI (OPTION)
NS	REF	1	HARNESS, WIRE DOWN, VALVE (SEE PARTS SECTION A)



ITEM	PART NO.	QTY	DESCRIPTION
			<b>LIFT CYLINDER - 2047ES / 2647ES, LATE MODELS</b>
			<b>2047ES - SERIAL # 9801100 - 9801024</b> <b>2647ES - SERIAL # 9901200 - 9901245</b>
1	91052	1	CYLINDER, LIFT
2	REF	1	HOSE ASSY (SEE SECTION D)
3	HDW7601	1	FITTING, ELBOW ADAPTOR
4	90361	1	ORIFICE
5	90993	4	BEARING, BRONZE, 2" ID X 2" LG
6	91051	1	VALVE, 2 WAY, N.C. W/MANUAL LOCK
7	91001	1	COIL
8	HDW6727	1	FITTING, PIPE 90°, MALE BARB
9	HDW8152	2	SCREW, 1/4" - 20 X 3/4" LG
10	90986	1	KIT, SEAL-LIFT CYLINDER (SERVICE) (NOT SHOWN)
11	16062	1	BRACKET, LIFT CYLINDER VALVE GUARD
12	REF	21 FT	HOSE, RETURN LINE (SEE SECTION D)
14	7788	1	CLAMP, HOSE
15	90845	1	PRESSURE SENSOR, 3000 PSI
NS	REF	1	HARNESS, WIRE DOWN, VALVE (SEE PARTS SECTION A)



ITEM	PART NO.	QTY	DESCRIPTION
			<b>UPPER LIFT CYLINDER - 3247ES, EARLY MODELS</b>
			<b>SERIAL # 10001000 # 10001199</b>
1	90835	1	CYLINDER, LIFT
2	REF	1	HOSE ASSY (SEE SECTION D)
3	HDW7601	1	FITTING, ELBOW ADAPTOR
4	90439	1	ORIFICE
5	90993	4	BEARING, BRONZE, 2" ID X 2" LG
6	90968	1	VALVE, 2 WAY, N.C.
7	90957	1	COIL, 24 VOLT, DOUBLE SPADE W/DIODE
8	HDW6727	1	FITTING, PIPE 90°, MALE BARB
9	HDW8152	2	SCREW, 1/4" - 20 X 3/4" LG
10	90987	1	KIT, SEAL-LIFT CYLINDER (SERVICE) (NOT SHOWN)
11	16062	1	BRACKET, LIFT CYLINDER VALVE GUARD
12	REF	40 FT	HOSE, RETURN LINE (SEE SECTION D)
14	7788	1	CLAMP, HOSE
15	90969	1	RELIEF VALVE
16	90958	1	COIL, 12 VOLT, DOUBLE SPADE W/DIODE
NS	REF	1	HARNESS, WIRE DOWN, VALVE (SEE PARTS SECTION A)

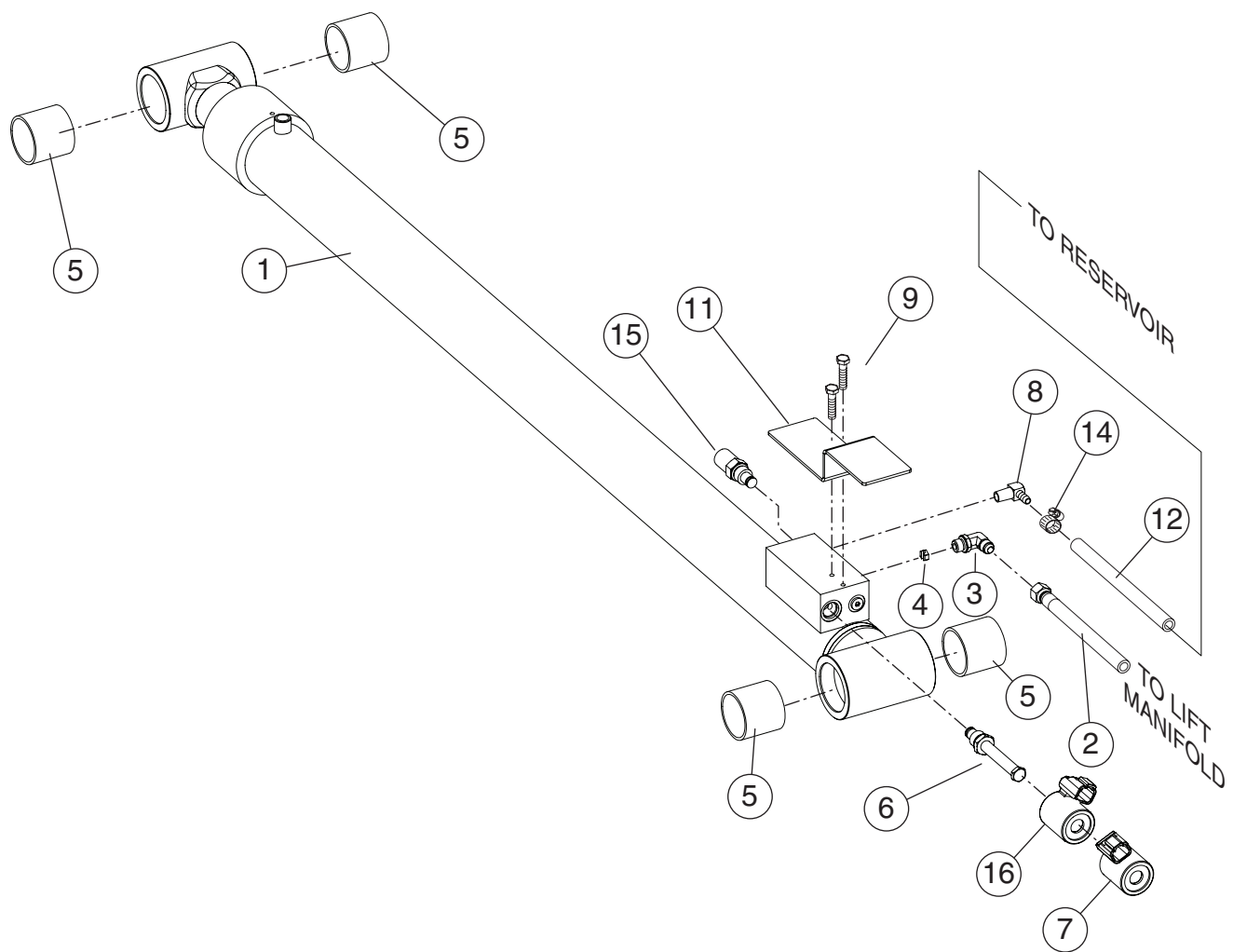


ILLUSTRATION No.  
ART\_2282

91053 Hydraulic Cylinder



ITEM	PART NO.	QTY	DESCRIPTION
			<b>UPPER LIFT CYLINDER - 3247ES, LATE MODELS</b>
			<b>SERIAL # 10001200 UP</b>
1	91053	1	CYLINDER, LIFT
2	REF	1	HOSE ASSY (SEE SECTION D)
3	HDW7601	1	FITTING, ELBOW ADAPTOR
4	90439	1	ORIFICE
5	90993	4	BEARING, BRONZE, 2" ID X 2" LG
6	90968	1	VALVE, 2 WAY, N.C.
7	91048	1	COIL, 20 VOLT <b>EXCEPT SERIAL # 10001211 - #10001217</b>
7	90957	1	COIL, 24 VOLT <b>SERIAL # 10001211 - #10001217</b>
8	HDW6727	1	FITTING, PIPE 90°, MALE BARB
9	HDW8152	2	SCREW, 1/4" - 20 X 3/4" LG
10	90987	1	KIT, SEAL-LIFT CYLINDER (SERVICE) (NOT SHOWN)
11	16062	1	BRACKET, LIFT CYLINDER VALVE GUARD
12	REF	40 FT	HOSE, RETURN LINE (SEE SECTION D)
14	7788	1	CLAMP, HOSE
15	90969	1	RELIEF VALVE
16	91049	1	COIL, 10 VOLT <b>EXCEPT SERIAL # 10001211 - #10001217</b>
16	90958	1	COIL, 12 VOLT <b>SERIAL # 10001211 - #10001217</b>
NS	REF	1	HARNESS, WIRE DOWN, VALVE (SEE PARTS SECTION A)

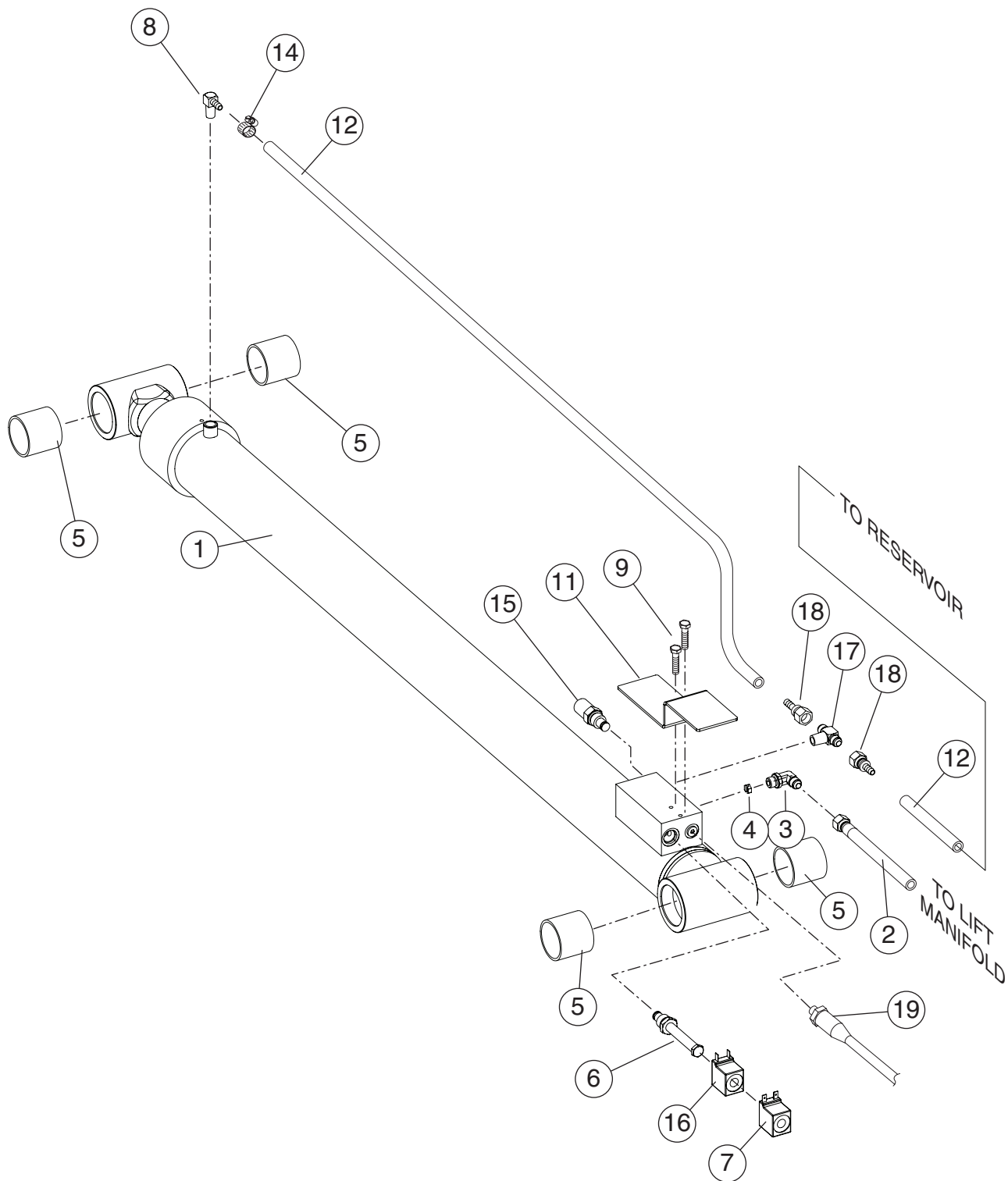


ILLUSTRATION No.  
ART\_2283

90836 Hydraulic Cylinder





ITEM	PART NO.	QTY	DESCRIPTION
			<b>LOWER LIFT CYLINDER - 3247ES, EARLY MODELS</b>
			<b>3247ES - SERIAL # 10001000 # 10001199</b>
1	90836	1	CYLINDER, LIFT (3247ES - LOWER)
2	REF	1	HOSE ASSY (SEE SECTION D)
3	HDW7601	1	FITTING, ELBOW ADAPTOR
4	90361	1	ORIFICE
5	90993	4	BEARING, BRONZE, 2" ID X 2" LG
6	90968	1	VALVE, 2 WAY, N.C.
7	90957	1	COIL, 24 VOLT, DOUBLE SPADE W/DIODE
8	HDW6727	1	FITTING, PIPE 90°, MALE BARB
9	HDW8152	2	SCREW, 1/4" - 20 X 3/4" LG
10	90988	1	KIT, SEAL-LIFT CYLINDER (SERVICE) (NOT SHOWN)
11	16062	1	BRACKET, LIFT CYLINDER VALVE GUARD
12	REF	21 FT	HOSE, RETURN LINE (SEE SECTION D)
14	7788	1	CLAMP, HOSE
15	90969	1	RELIEF VALVE
16	90958	1	COIL, 12 VOLT, DOUBLE SPADE W/DIODE
17	HDW90943	1	FITTING, TEE ADAPTOR
18	HDW90945	2	FITTING, FEMALE SWIVEL
19	90845	1	PRESSURE SENSOR, 3000 PSI
NS	REF	1	HARNESS, WIRE DOWN, VALVE (SEE PARTS SECTION A)

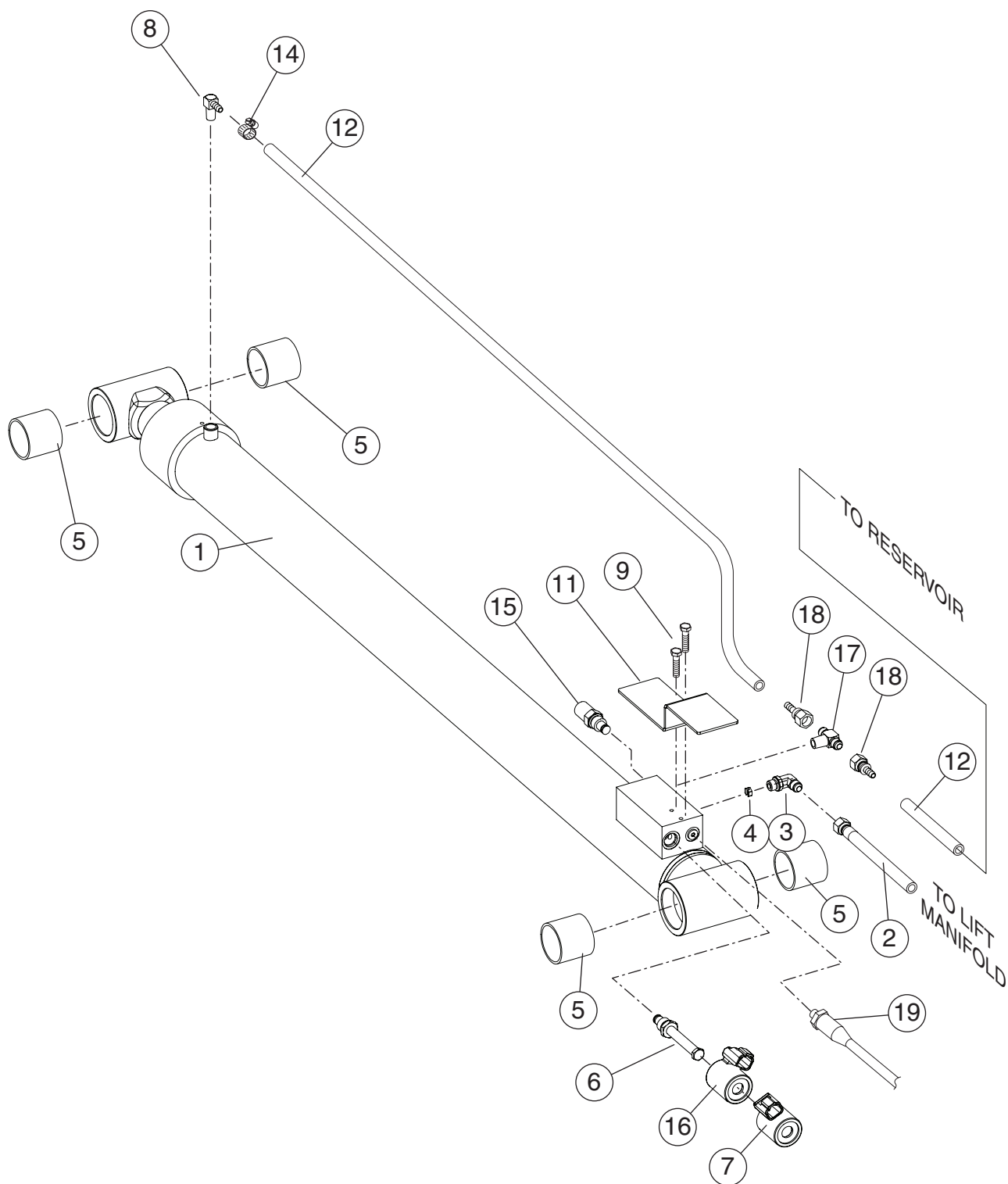


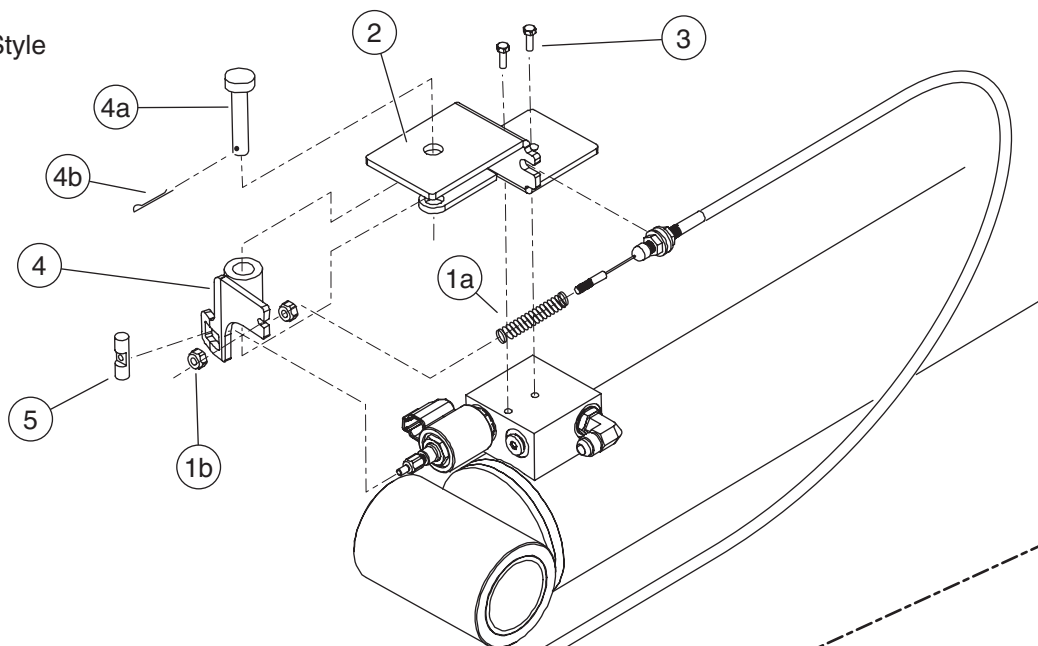
ILLUSTRATION No.  
ART\_2284

91054 Hydraulic Cylinder



ITEM	PART NO.	QTY	DESCRIPTION
			<b>LOWER LIFT CYLINDER - 3247ES, LATE MODELS</b>
			<b>3247ES - SERIAL # 10001200 UP</b>
1	91054	1	CYLINDER, LIFT (3247ES - LOWER)
2	REF	1	HOSE ASSY (SEE SECTION D)
3	HDW7601	1	FITTING, ELBOW ADAPTOR
4	90361	1	ORIFICE
5	90993	4	BEARING, BRONZE, 2" ID X 2" LG
6	90968	1	VALVE, 2 WAY, N.C.
7	91048	1	COIL, 20 VOLT <b>EXCEPT SERIAL # 10001211 - #10001217</b>
7	90957	1	COIL, 24 VOLT <b>SERIAL # 10001211 - #10001217</b>
8	HDW6727	1	FITTING, PIPE 90°, MALE BARB
9	HDW8152	2	SCREW, 1/4" - 20 X 3/4" LG
10	90988	1	KIT, SEAL-LIFT CYLINDER (SERVICE) (NOT SHOWN)
11	16062	1	BRACKET, LIFT CYLINDER VALVE GUARD
12	REF	21 FT	HOSE, RETURN LINE (SEE SECTION D)
14	7788	1	CLAMP, HOSE
15	90969	1	RELIEF VALVE
16	91049	1	COIL, 10 VOLT <b>EXCEPT SERIAL # 10001211 - #10001217</b>
16	90958	1	COIL, 12 VOLT <b>SERIAL # 10001211 - #10001217</b>
17	HDW90943	1	FITTING, TEE ADAPTOR
18	HDW90945	2	FITTING, FEMALE SWIVEL
19	90845	1	PRESSURE SENSOR, 3000 PSI
NS	REF	1	HARNESS, WIRE DOWN, VALVE (SEE PARTS SECTION A)

# Early Style



# Current Style

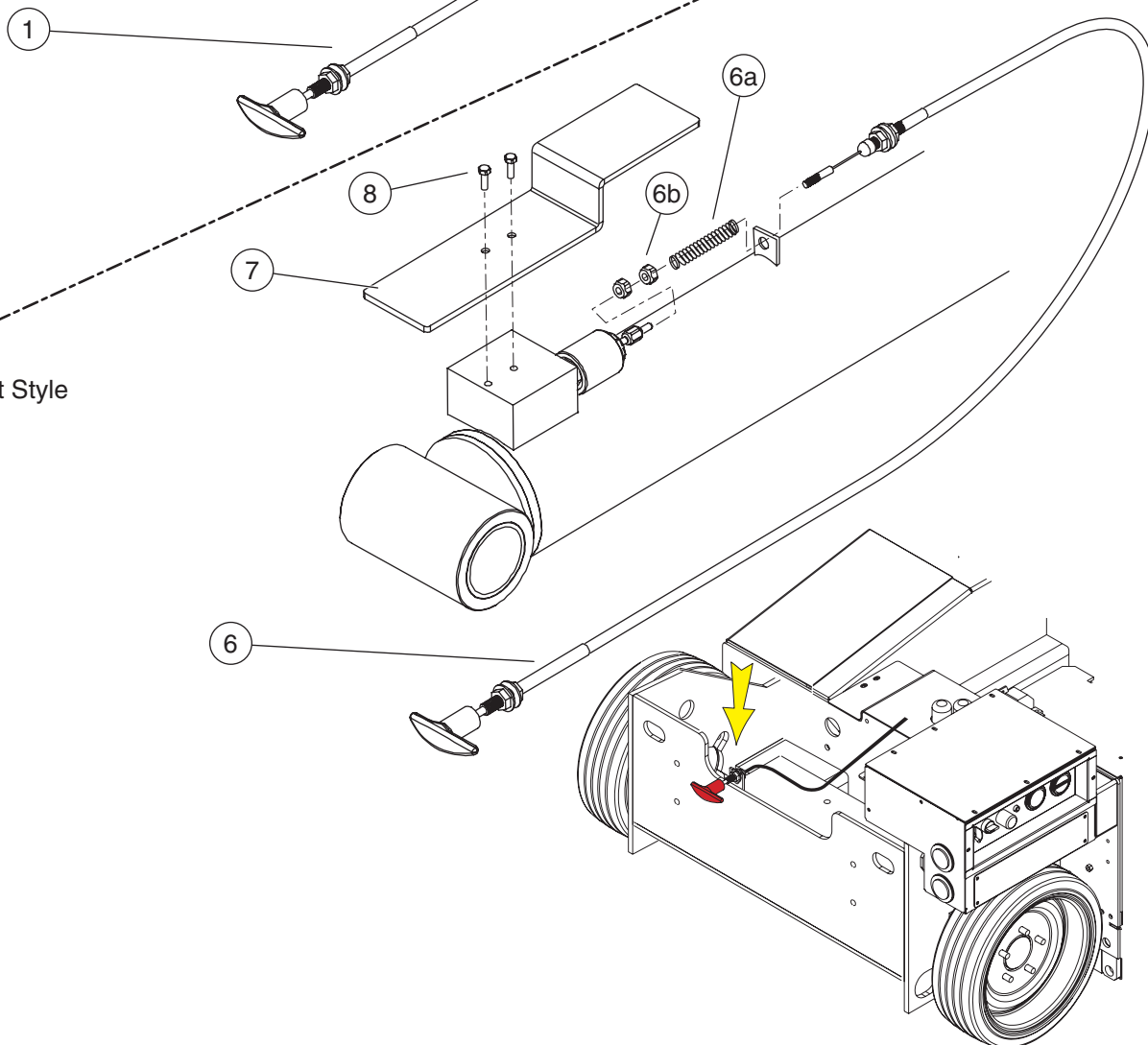


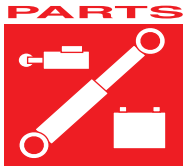
ILLUSTRATION No.  
ART\_2270

Emergency Lowering Cable - 2047ES-2647ES



ITEM	PART NO.	QTY	DESCRIPTION
			<b>EMERGENCY LOWERING CABLE</b>
			<b>2047ES - SERIAL # 9801000 - #9801024</b> <b>2647ES - SERIAL # 9901000 - #9901245</b>
			<b>3247ES - NOT USED</b>
1	91104	1	CABLE, 80 IN (2047ES)
1	91082	1	CABLE, 100 IN (2647ES)
1a	—	1	SPRING
1b	—	1	CAP LUG
2	16117	1	WELDMENT, CABLE MOUNT ATTACHMENT
3	8152	2	BOLT
4	16121	1	BELL CRANK
4a	—	1	CLEVIS PIN
4b	—	1	COTTER PIN
5	16134	1	E-DOWN PIVOT NUT
			<b>2047ES - SERIAL # 9801025 UP</b>
			<b>2647ES - SERIAL # 9901246 UP</b> <b>3247ES - NOT USED</b>
6	91104	1	CABLE, 80 IN (2047ES)
6	91082	1	CABLE, 100 IN (2647ES)
6a	—	1	SPRING
6b	—	1	CAP LUG
7	16062	1	BRACKET, LIFT CYLINDER VALVE GUARD
8	8152	2	BOLT

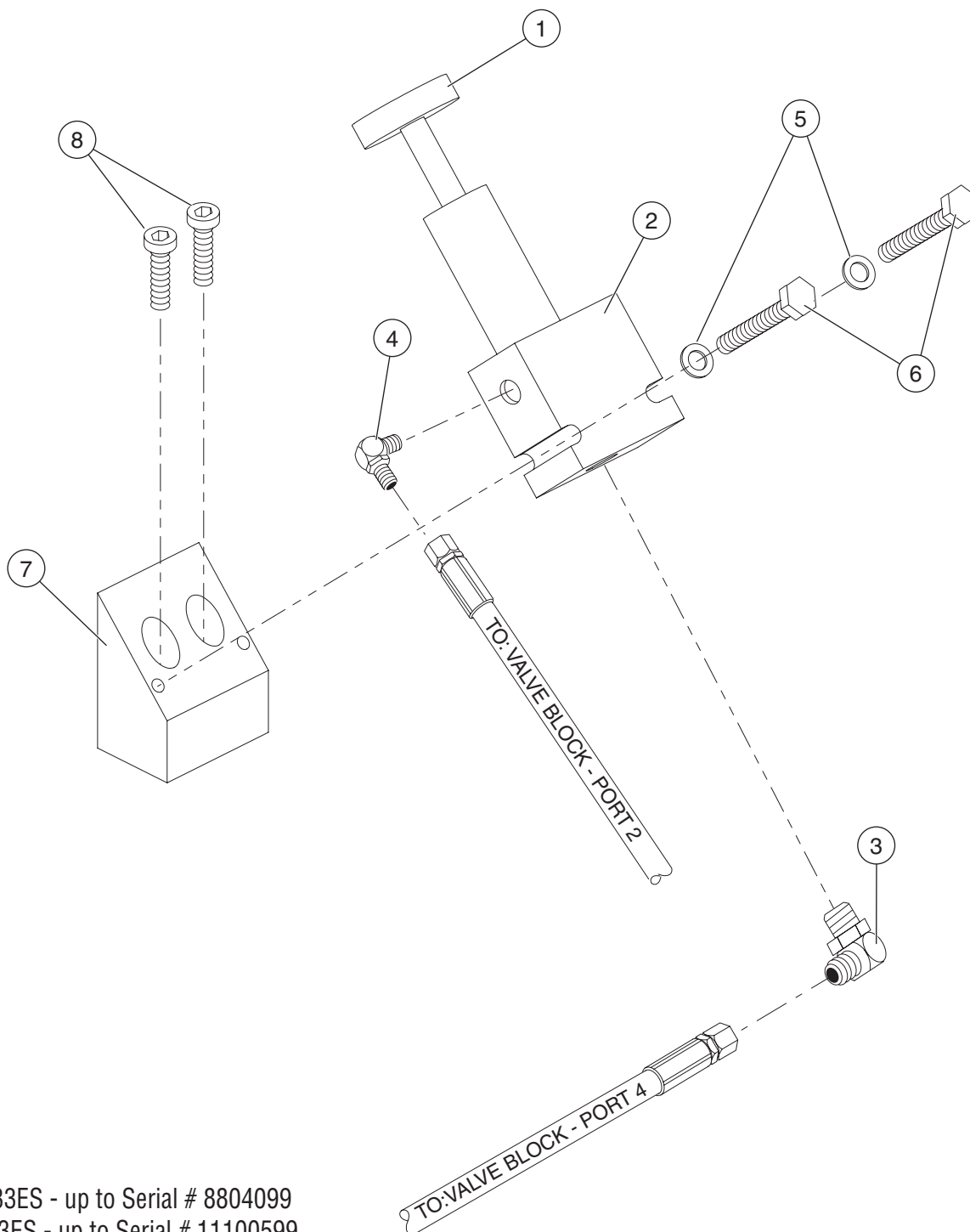




## SECTION D:

# HYDRAULICS

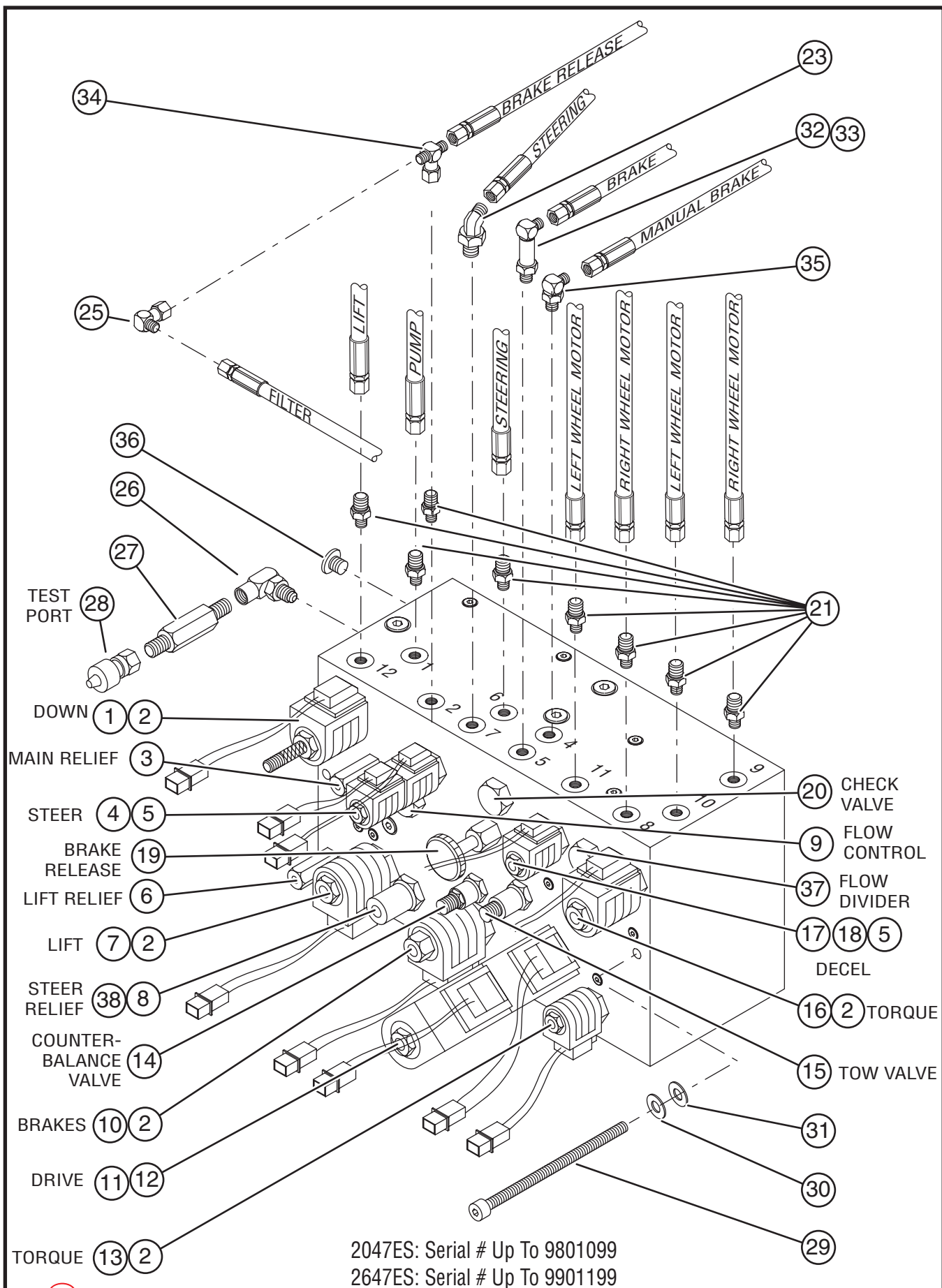
BRAKE RELEASE MANIFOLD, EARLY MODELS .....	D-3
MAIN MANIFOLD ASSEMBLY, 2047ES-2647ES, EARLY MODELS .....	D-5
MAIN MANIFOLD ASSEMBLY - 3247ES, EARLY MODELS .....	D-9
MAIN MANIFOLD ASSEMBLY, LATE MODELS .....	D-13
HYDRAULIC RESERVOIR, STEEL .....	D-15
HYDRAULIC RESERVOIR, PLASTIC .....	D-17
HYDRAULIC HOSES, 2047ES - 2647ES .....	D-19
HYDRAULIC HOSES, 3247ES .....	D-21



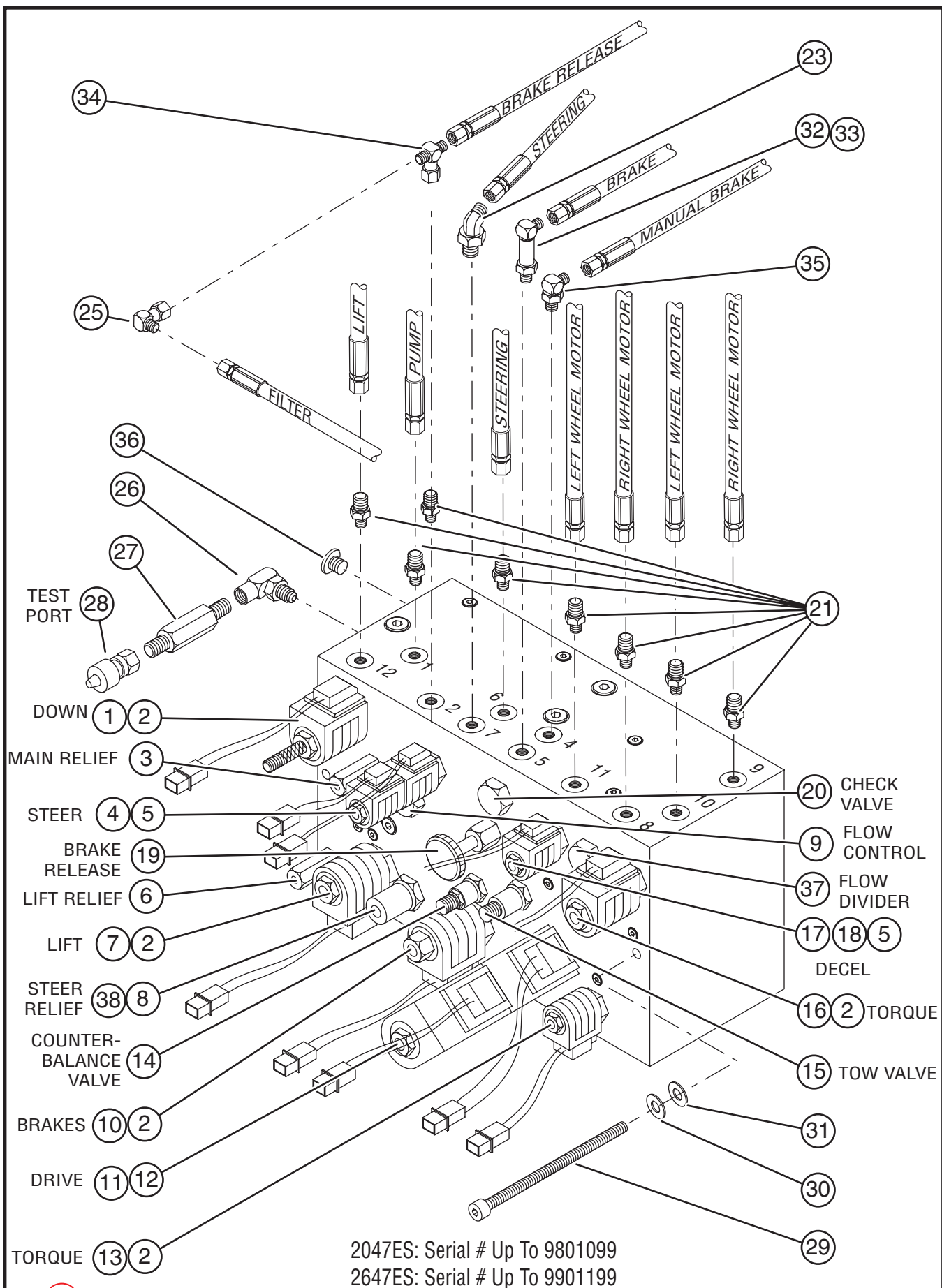
2033ES - up to Serial # 8804099  
 2633ES - up to Serial # 11100599  
 2047ES - up to Serial # 9801100  
 2647ES - up to Serial # 9901200  
 3247ES - NOT USED



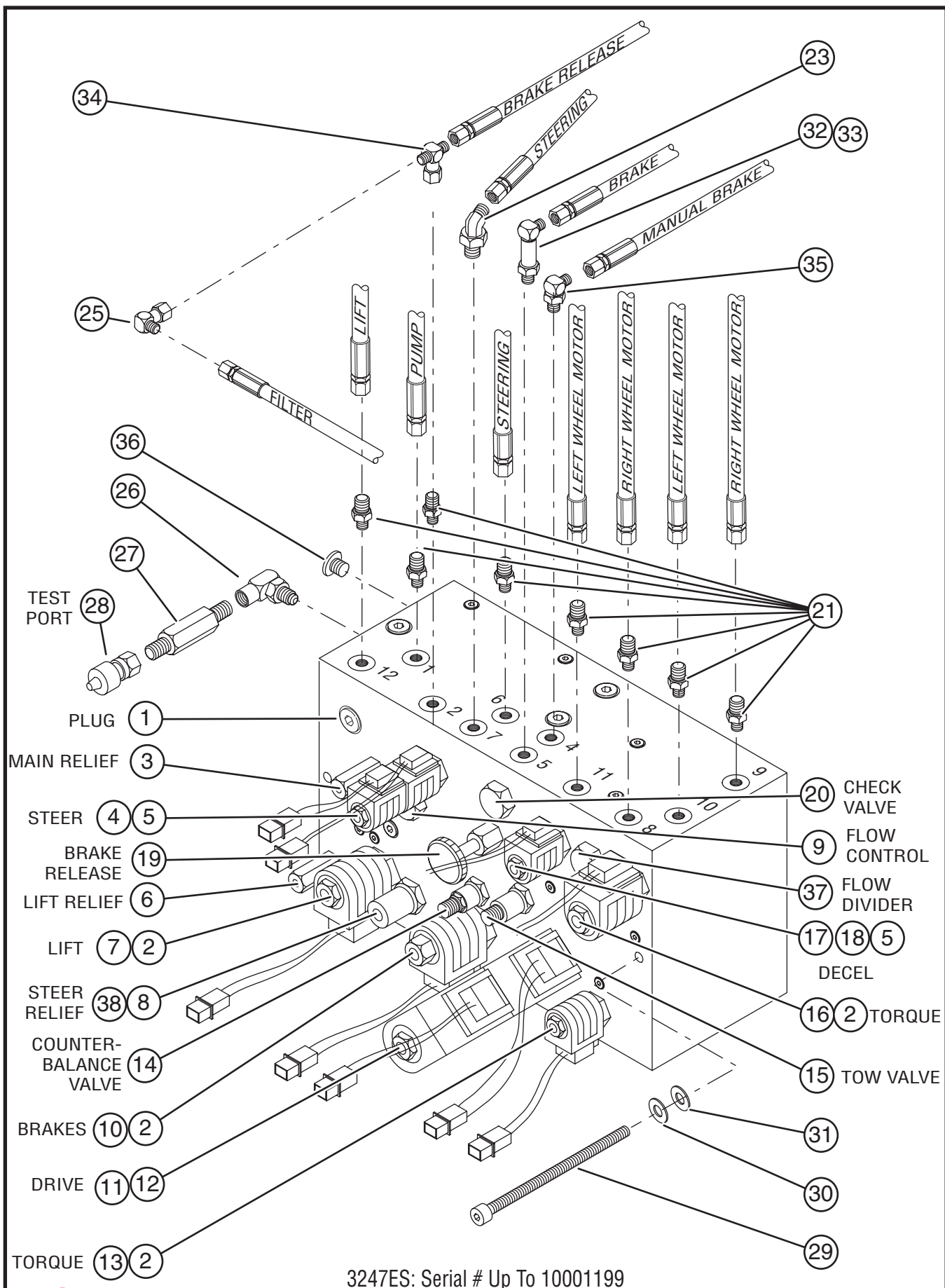




ITEM	PART NO.	QTY	DESCRIPTION
			<b>MAIN MANIFOLD ASSEMBLY, 2047ES-2647ES, EARLY MODELS</b>
			<b>2047ES - SERIAL #9801000 - # 9801099</b> <b>2647ES - SERIAL #9901000 - # 9901199</b>
	90667		MAIN MANIFOLD ASSEMBLY
1	8343	1	VALVE, SPOOL, POP, 2 WAY, N.C. W/MAN OVERRIDE
2	9996	5	COIL, 24 VOLT (2047ES, 2647ES)
3	9992	1	VALVE, RELIEF
4	9986	1	VALVE, SPOOL, 4 WAY, 3 POSITION (STEERING)
5	9988	3	COIL, 24 VOLT
6	9993	1	VALVE, RELIEF
7	9982	1	VALVE, SPOOL, 4 WAY
8	9984	1	VALVE, RELIEF
9	5954	1	VALVE, PRIORITY FLOW CONTROL
10	6975	1	VALVE, SPOOL, N.O.
11	9995	1	VALVE, SPOOL, 4 WAY, 3 POSITION (DRIVE)
12	9997	2	COIL, 24 VOLT
13	6976	1	VALVE, SPOOL, 3 WAY
14	9669	1	VALVE, COUNTER BALANCE
15	90378	1	VALVE NEEDLE (TOW VALVE)
16	8373	1	VALVE, SPOOL, 4 WAY
17	9985	1	VALVE, SPOOL, N.O.
18	9998	1	ORIFICE 0.040 DIA.
19	9665	1	VALVE, MANUAL (BRAKE RELEASE)
20	9990	1	VALVE, CHECK
			(CONTINUED ON NEXT PAGE)



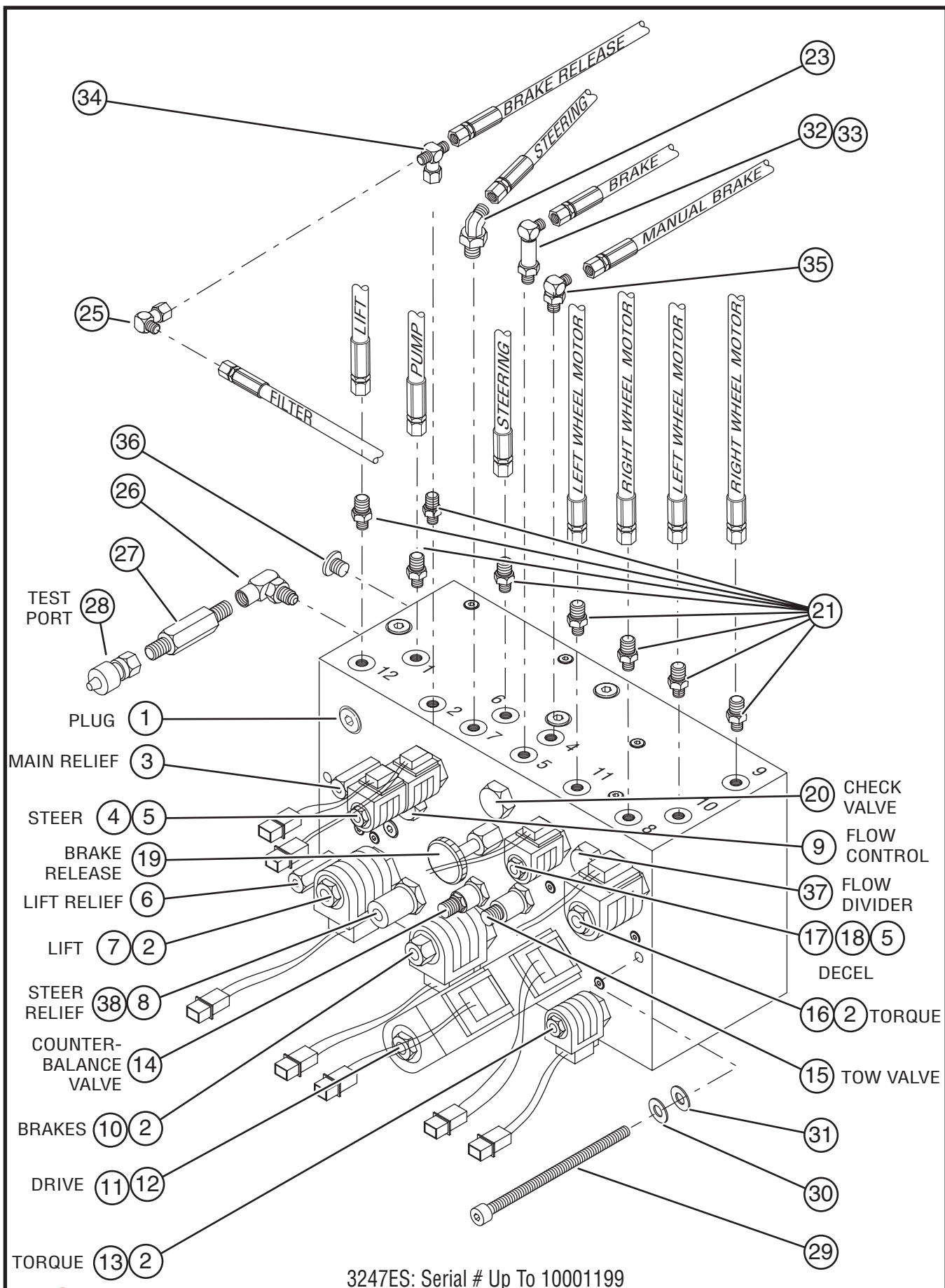
ITEM	PART NO.	QTY	DESCRIPTION
			<b>MAIN MANIFOLD ASSEMBLY, 2047ES-2647ES, EARLY MODELS</b> (CONTINUED)
			<b>2047ES - SERIAL #TO # 9801099</b> <b>2647ES - SERIAL #TO # 9901199</b>
21	HDW7389	8	ADAPTER, MALE 3/8", MALE 3/8" O-RING
23	HDW90364	1	FITTING, 45° 6MB-6MJ
25	HDW90299	1	FITTING, 90° ELBW, MALE 3/8", FML 3/8", MALE 3/8"
26	9980	1	FITTING, 90° ELBW, MALE 3/8" O-RING, FML 1/4" NPT
27	HDW90301	1	UNION, MALE 1/4" NPT, MALE 1/4" NPT, 3" LG
28	HDW7971	1	DISCONNECT, MALE 1/4"
29	HDW90287	2	SCREW, 1/4" - 20, 4.5" LG
30	HDW5277	2	WASHER, LOCK
31	HDW5217	2	WASHER, FLAT
32	HDW90327	1	FITTING, 90° ELBW, MALE 1/4", MALE 3/8" O-RING
33	2974	1	PLUG, METERING
34	HDW90285	1	FITTING, MALE 3/8" TEE
35	HDW90329	1	FITTING, 90° ELBW, MALE 1/4", MALE 3/8" O-RING
37	91014	1	FLOW DIVIDER
38	9971	3	RELIEF VALVE TAMPER PROOF CAP
	REF		SEE HYDRAULIC HOSES, THIS SECTION



3247ES: Serial # Up To 10001199

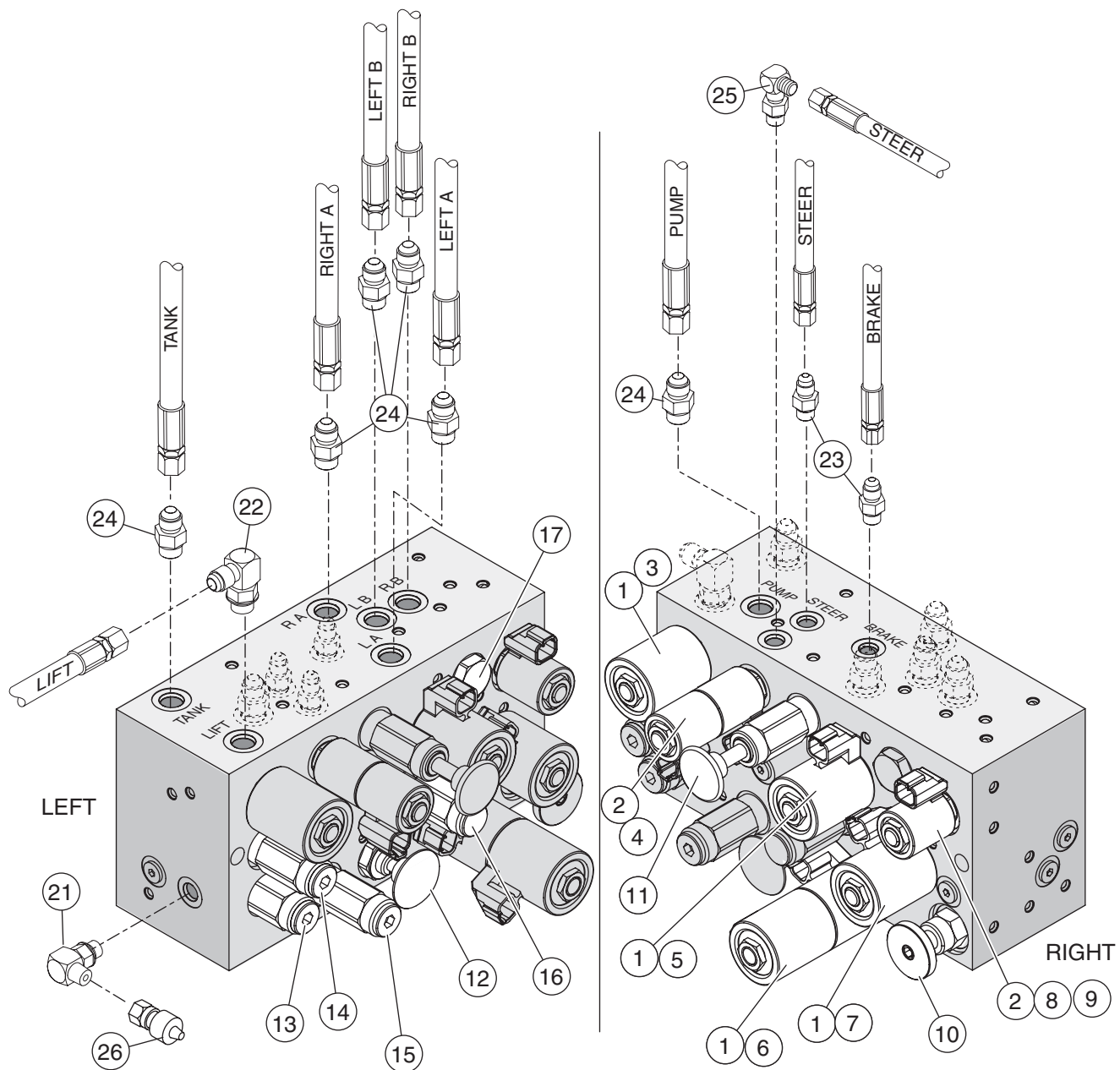
ITEM	PART NO.	QTY	DESCRIPTION
			<b>MAIN MANIFOLD ASSEMBLY - 3247ES, EARLY MODELS</b>
			<b>SERIAL #10001000 # 10001199</b>
1	90667 HDW90952	1	MAIN MANIFOLD ASSEMBLY PLUG (3247ES ONLY)
2	9996	4	COIL, 24 VOLT(3247ES)
3	9992	1	VALVE, RELIEF
4	9986	1	VALVE, SPOOL, 4 WAY, 3 POSITION (STEERING)
5	9988	3	COIL, 24 VOLT
6	9993	1	VALVE, RELIEF
7	9982	1	VALVE, SPOOL, 4 WAY
8	9984	1	VALVE, RELIEF
9	5954	1	VALVE, PRIORITY FLOW CONTROL
10	6975	1	VALVE, SPOOL, N.O.
11	9995	1	VALVE, SPOOL, 4 WAY, 3 POSITION (DRIVE)
12	9997	2	COIL, 24 VOLT
13	6976	1	VALVE, SPOOL, 3 WAY
14	9669	1	VALVE, COUNTER BALANCE
15	90378	1	VALVE NEEDLE (TOW VALVE)
16	8373	1	VALVE, SPOOL, 4 WAY
17	9985	1	VALVE, SPOOL, N.O.
18	9998	1	ORIFICE 0.040 DIA.
19	9665	1	VALVE, MANUAL (BRAKE RELEASE)
20	9990	1	VALVE, CHECK
			(CONTINUED ON NEXT PAGE)







ITEM	PART NO.	QTY	DESCRIPTION
			<b>MAIN MANIFOLD ASSEMBLY - 3247ES, EARLY MODELS (CONTINUED)</b>
			<b>3247ES - SERIAL #10001000 # 10001199</b>
21	HDW7389	8	ADAPTER, MALE 3/8", MALE 3/8" O-RING
23	HDW90364	1	FITTING, 45° 6MB-6MJ
25	HDW90299	1	FITTING, 90° ELBW, MALE 3/8", FML 3/8", MALE 3/8"
26	9980	1	FITTING, 90° ELBW, MALE 3/8" O-RING, FML 1/4" NPT
27	HDW90301	1	UNION, MALE 1/4" NPT, MALE 1/4" NPT,3" LG
28	HDW7971	1	DISCONNECT, MALE 1/4"
29	HDW90287	2	SCREW, 1/4" - 20, 4.5" LG
30	HDW5277	2	WASHER, LOCK
31	HDW5217	2	WASHER, FLAT
32	HDW90327	1	FITTING, 90° ELBW, MALE 1/4", MALE 3/8" O-RING
33	2974	1	PLUG, METERING
34	HDW90285	1	FITTING, MALE 3/8" TEE
35	HDW90329	1	FITTING, 90° ELBW, MALE 1/4", MALE 3/8" O-RING
37	91014	1	FLOW DIVIDER
38	9971	3	RELIEF VALVE TAMPER PROOF CAP
			SEE HYDRAULIC HOSES, THIS SECTION



2033ES: Serial # 8804100- UP  
 2633ES: Serial # 11100600- UP

2047ES: Serial # 9801100- UP  
 2647ES: Serial # 9901200- UP

3247ES: Serial # 10001200- UP

ILLUSTRATION No.  
 ART\_2293

91000, Hydraulic Manifold Assembly, X33ES and X47ES

ITEM	PART NO.	QTY	DESCRIPTION
			<b>MAIN MANIFOLD ASSEMBLY, LATE MODELS</b>
			<b>2047ES - SERIAL # 9801100 - UP</b>
			<b>2647ES - SERIAL # 9901200 - UP</b>
			<b>3247ES - SERIAL # 10001200 - UP</b>
1	91002	5	COIL
2	91001	3	COIL
3	91003	1	VALVE, SPOOL 4 WAY 2 POSITION (LIFT)
4	91004	1	VALVE, SPOOL 4 WAY 3 POSITION (STEERING)
5	91005	1	VALVE, SPOOL 4 WAY 2 POSITION (TORQUE)
6	91008	1	VALVE, SPOOL 4 WAY 3 POSITION (DRIVE)
7	91007	1	VALVE, SPOOL 2 WAY N.O. (TORQUE)
8	91006	1	VALVE, SPOOL 4 WAY 2 POSITION (DRIVE DUMP/DECEL)
9	9998	1	ORIFICE 0.040
10	91016	1	VALVE, NEEDLE (TOW/FREEWHEEL)
11	91015	1	PUMP, MANUAL (BRAKE)
12	91012	1	VALVE, MANUAL (BRAKE RELEASE)
13	91010	1	VALVE, RELIEF (MAIN)
14	91009	1	VALVE, RELIEF (LIFT)
15	91011	1	VALVE, RELIEF (STEER/PRIORITY FLOW CONTROL)
16	91013	1	VALVE, RELIEF (COUNTERBALANCE WITH PISTON)
17	91014	1	VALVE, CHECK (FLOW DIVIDER)
21	HDW91080	1	FITTING, 90° ELBOW, ¼" MALE O-RING × ¼" MALE NPT
22	HDW7601	1	FITTING, 90° ELBOW, 3/8" MALE O-RING × 3/8" MALE JIC
23	HDW8881	3	FITTING, ¼" MALE O-RING × ¼" MALE JIC
24	HDW7438	6	FITTING, 3/8" MALE O-RING × 3/8" MALE JIC
25	HDW8877	1	FITTING, 90° ELBOW, ¼" MALE O-RING × ¼" MALE JIC
26	HDW7971	1	DISCONNECT, MALE 1/4"
			SEE HYDRAULIC HOSES, THIS SECTION

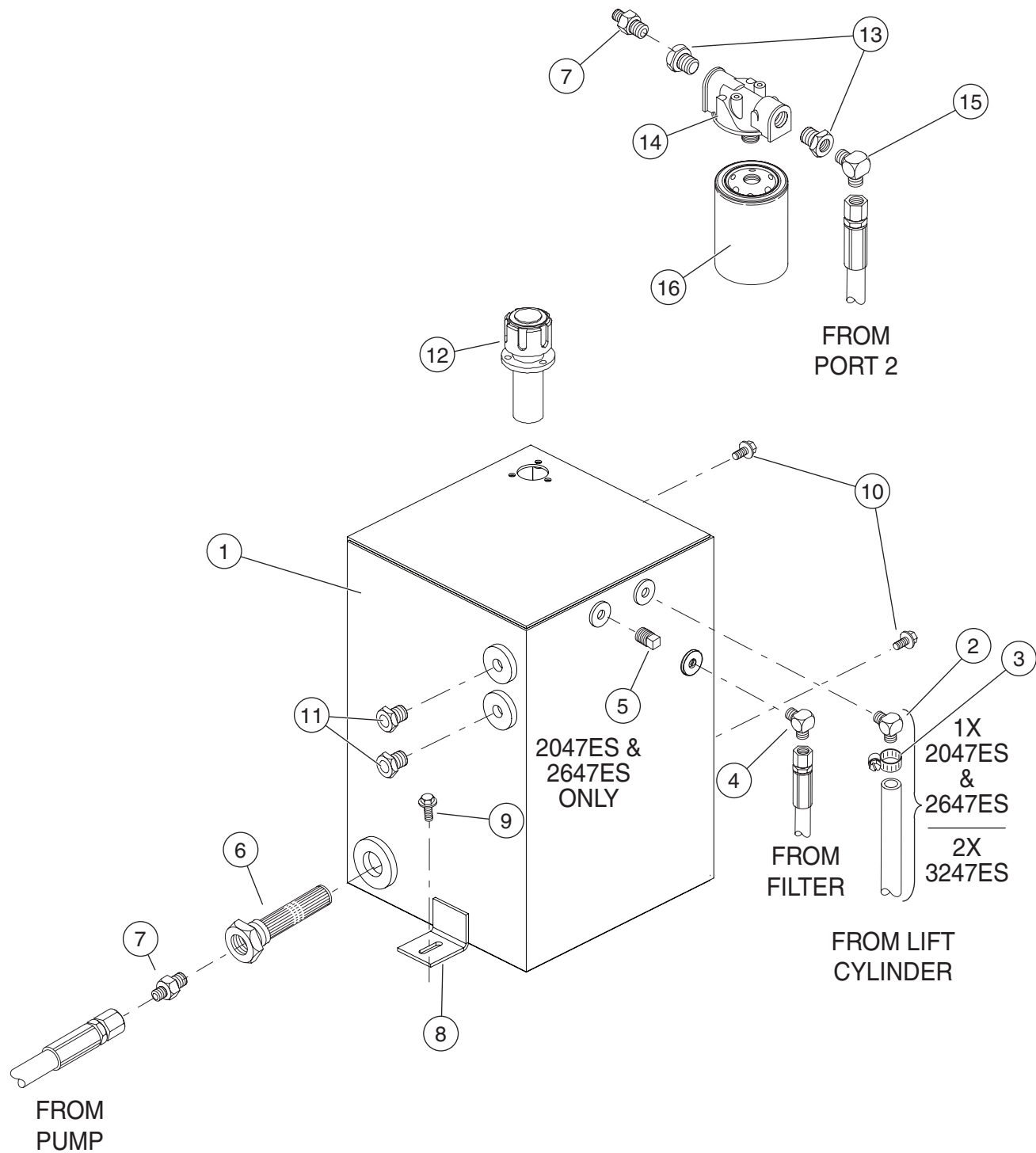
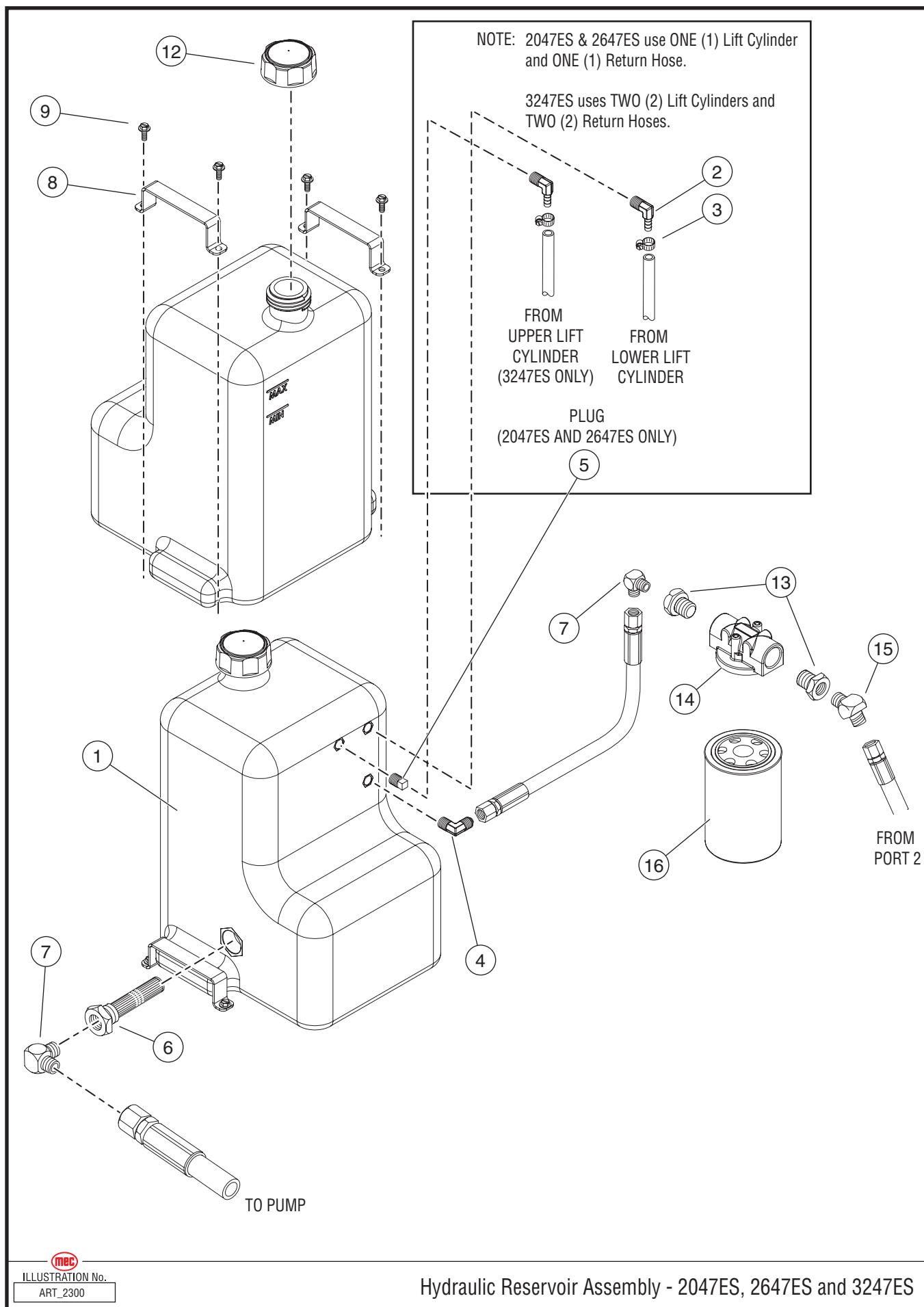


ILLUSTRATION No.  
ART\_2299

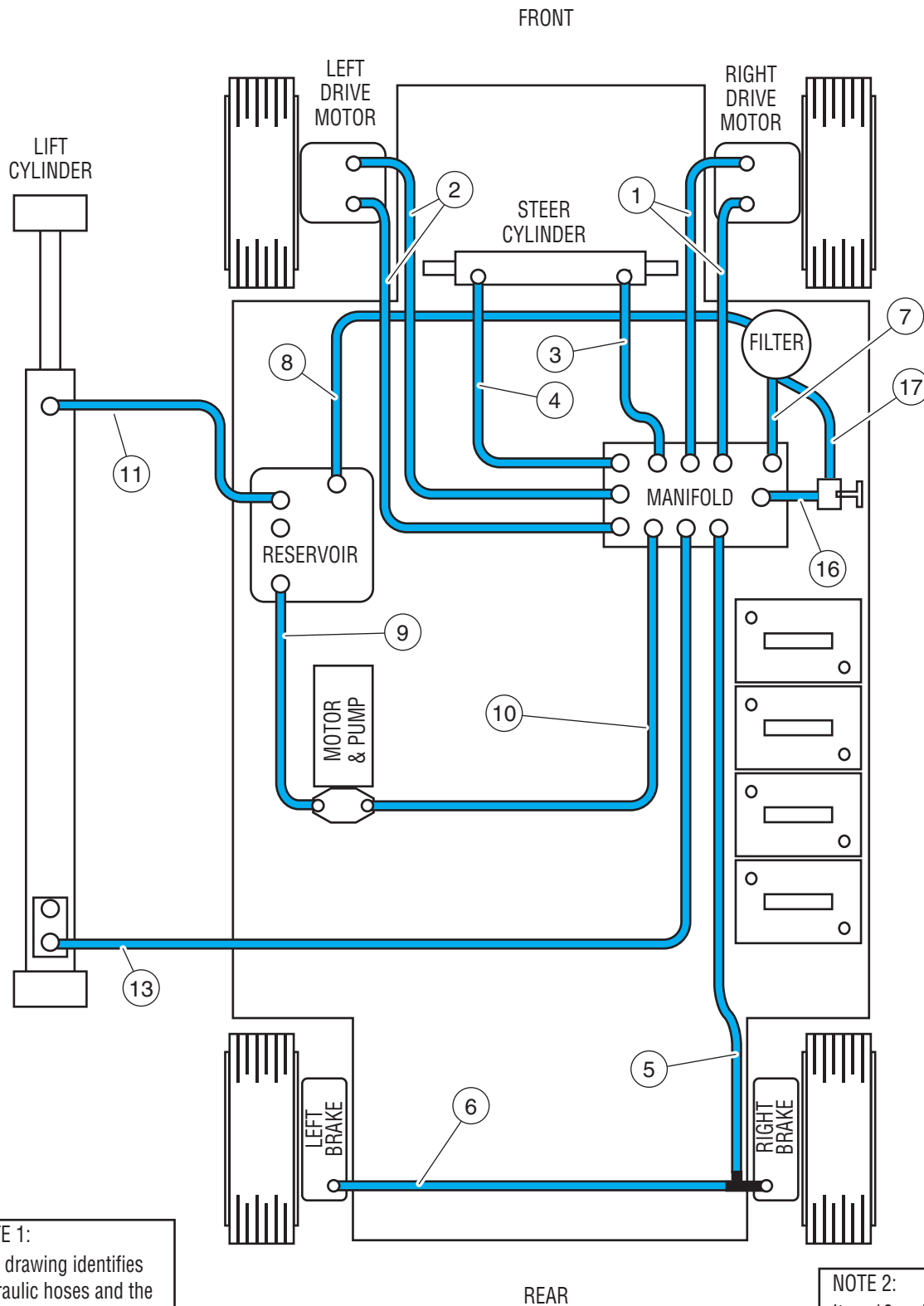
# Hydraulic Reservoir Assembly, Steel - 2047ES, 2647ES and 3247ES



ITEM	PART NO.	QTY	DESCRIPTION
			HYDRAULIC RESERVOIR, STEEL 2047ES - SERIAL NOT USED
			2647ES - SERIAL #9901000 - #9901199 3247ES - SERIAL #10001000 - #10001269
1	16544	1	HYDRAULIC RESERVIOR WELDMENT
2	HDW6727	*	FITTING, ELBOW 90°, MALE 1/4", MALE BARB 1/4"
3	7788	*	CLAMP, HOSE
*	—	1	2047ES AND 2647ES
*	—	2	3247ES
4	HDW7500	1	FITTING, ELBOW 90°, MALE 1/4" NPT, MALE 3/8" JIC
5	HDW9200	1	PLUG (2047ES, 2647ES ONLY)
6	8412	1	SUCTION STRAINER - 1"
7	HDW90917	2	FITTING, ADAPTER, MALE 1/2" NPT, MALE 1/2" JIC
8	15133	1	BRACKET, RESERVOIR MOUNTING
9	HDW5723	1	SCREW, SELF-TAP & FORM HEX HD 1/4" - 20 - .75" LG
10	HDW6455	2	SCREW, 1/4" - 20 - .5" LG
11	HDW5938	2	FITTING, SIGHT GAUGE
12	90127	1	BREATHER VENT ASSY
13	HDW6752	2	ADAPTER, MALE 3/4", FML 1/2"
14	6714	1	FILTER, HEAD
15	HDW90300	1	FITTING, ELBOW 90°, MALE 3/8", MALE 1/2"
16	6156	1	FILTER, OIL CARTRIDGE
NS	5292	6	US GALHYDRAULIC FLUID, ISO32 OR EQUIVALENT
			SEE HYDRAULIC HOSES, THIS SECTION



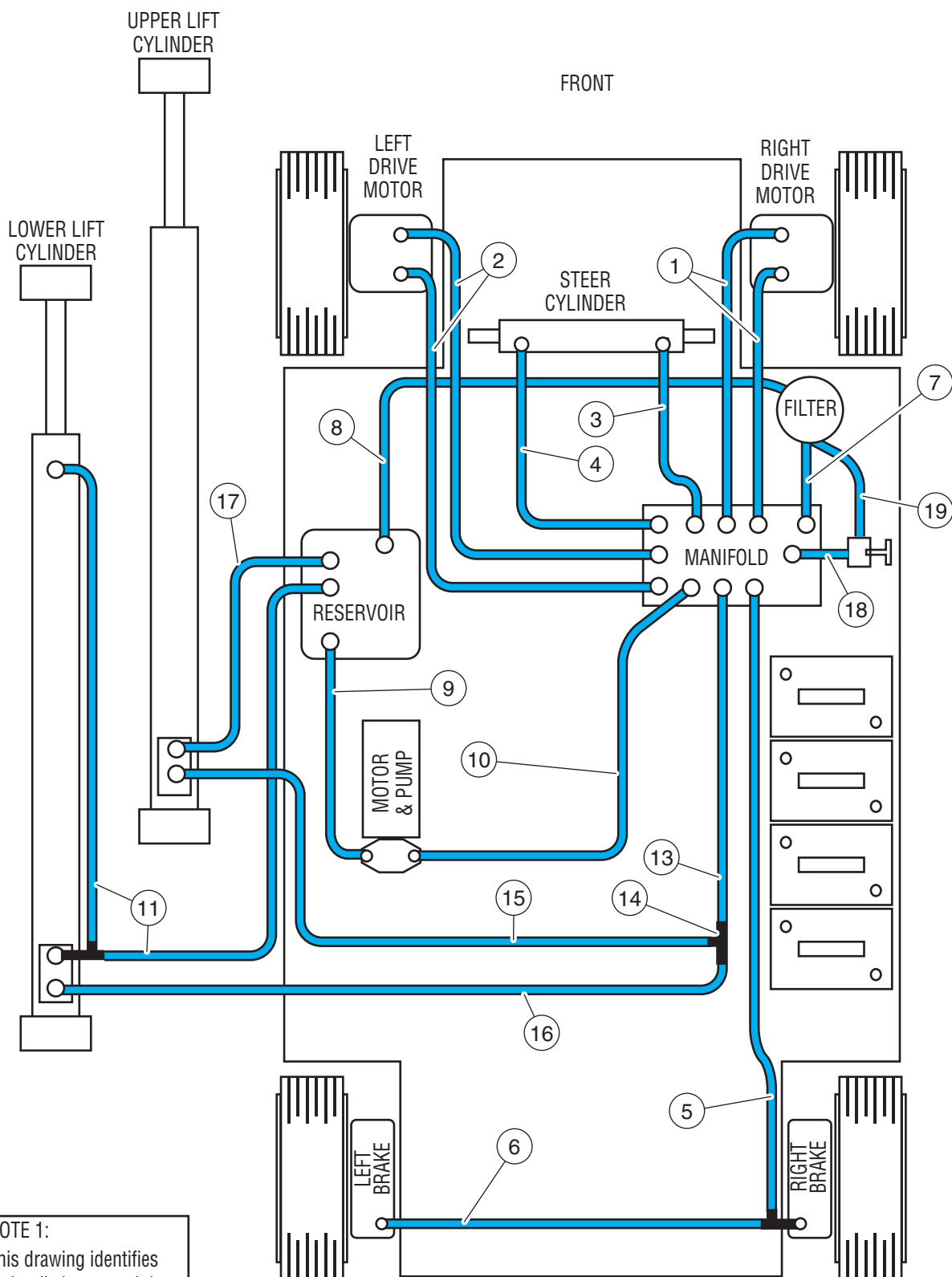
ITEM	PART NO.	QTY	DESCRIPTION
			HYDRAULIC RESERVOIR, PLASTIC 2047ES - SERIAL #9801000 - UP
			2647ES - SERIAL #9901200 - UP 3247ES - SERIAL #10001270 - UP
1	16127	1	HYDRAULIC RESERVIOR, PLASTIC
2	HDW6727	*	FITTING, ELBOW 90°, MALE 1/4", MALE BARB 1/4"
3	7788	*	CLAMP, HOSE
*	—	1	2047ES AND 2647ES
*	—	2	3247ES
4	HDW7500	1	FITTING, ELBOW 90°, MALE 1/4" NPT, MALE 3/8" JIC
5	HDW9200	1	PLUG (2047ES, 2647ES ONLY)
6	8412	1	SUCTION STRAINER - 1"
7	HDW90917	2	FITTING, ADAPTER, MALE 1/2" NPT, MALE 1/2" JIC
8	16128	1	BRACKET, RESERVOIR MOUNTING
9	HDW5723	1	SCREW, SELF-TAP & FORM HEX HD 1/4" - 20 - .75" LG
12	91091	1	BREATHING CAP
13	HDW6752	2	ADAPTER, MALE 3/4", FML 1/2"
14	6714	1	FILTER, HEAD
15	HDW90300	1	FITTING, ELBOW 90°, MALE 3/8", MALE 1/2"
16	6156	1	FILTER, OIL CARTRIDGE
NS	5292	6	US GALHYDRAULIC FLUID, ISO32 OR EQUIVALENT
			SEE HYDRAULIC HOSES, THIS SECTION



Hydraulic Hoses, 2047ES - 2647ES



ITEM	PART NO.	QTY	DESCRIPTION
			<b>HYDRAULIC HOSES, 2047ES - 2647ES</b>
1	90672	2	HOSE ASSEMBLY, DRIVE MOTOR, RIGHT
2	90286	2	HOSE ASSEMBLY, DRIVE MOTOR, LEFT
3	90883	1	HOSE ASSEMBLY, STEER CYLINDER
4	90882	1	HOSE ASSEMBLY, STEER CYLINDER
5	90762	1	HOSE ASSEMBLY, BRAKE TO MANIFOLD
6	9754	1	HOSE ASSEMBLY, BRAKE TO BRAKE
7	7598	1	HOSE ASSEMBLY, MANIFOLD TO FILTER
8	9029	1	HOSE ASSEMBLY, FILTER TO TANK
9	90899	1	HOSE ASSEMBLY, SUCTION
10	90884	1	HOSE ASSEMBLY, PRESSURE
11	6458	21 FT	HOSE ASSEMBLY, LIFT CYLINDER TO TANK
13	90985	1	HOSE ASSEMBLY, LIFT CYLINDER
			<b>2047ES - SERIAL #9801000 # 9801099</b>
			<b>2647ES - SERIAL #9801000 # 9901199</b>
16	90275	1	HOSE ASSEMBLY, HAND PUMP
17	90763	1	HOSE ASSEMBLY, HAND PUMP RETURN
			<b>2047ES - SERIAL # 9801100 - UP</b>
			<b>2647ES - SERIAL # 9901200 - UP</b>
16	—	—	NOT USED
17	—	—	NOT USED

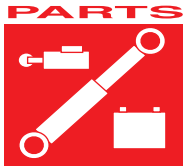


**NOTE 1:**  
This drawing identifies hydraulic hoses and the component that they connect to, and NOT the actual hose positions on the machine.

**NOTE 2:**  
Item 18 and item 19 are used up to Serial #10001099

ITEM	PART NO.	QTY	DESCRIPTION
			<b>HYDRAULIC HOSES, 3247ES</b>
1	90672	2	HOSE ASSEMBLY, DRIVE MOTOR, RIGHT
2	90286	2	HOSE ASSEMBLY, DRIVE MOTOR, LEFT
3	90883	1	HOSE ASSEMBLY, STEER CYLINDER
4	90882	1	HOSE ASSEMBLY, STEER CYLINDER
5	90762	1	HOSE ASSEMBLY, BRAKE TO MANIFOLD
6	9754	1	HOSE ASSEMBLY, BRAKE TO BRAKE
7	7598	1	HOSE ASSEMBLY, MANIFOLD TO FILTER
8	9029	1	HOSE ASSEMBLY, FILTER TO TANK
9	90899	1	HOSE ASSEMBLY, SUCTION
10	90884	1	HOSE ASSEMBLY, PRESSURE
11	6458 REF	21 FT	HOSE ASSEMBLY, LOWER LIFT CYLINDER RETURN TEE FITTING (SEE <i>SECTION 3</i> FOR HARDWARE)
13	90924	1	HOSE ASSEMBLY, LIFT CYLINDERS
14	HDW7391	1	TEE FITTING
15	90885	1	HOSE ASSEMBLY, UPPER LIFT CYLINDER
16	9039	1	HOSE ASSEMBLY, LOWER LIFT CYLINDER
17	6458	40 FT	HOSE ASSEMBLY, UPPER LIFT CYLINDER RETURN
			<b>SERIAL #10001000 # 10001199</b>
18	90275	1	HOSE ASSEMBLY, HAND PUMP
19	90763	1	HOSE ASSEMBLY, HAND PUMP RETURN
			<b>SERIAL # 10001200 - UP</b>
18	—	—	NOT USED
19	—	—	NOT USED





## SECTION E:

### BASE

LADDER .....	E-3
EMERGENCY LOWERING SWITCH - 3247ES .....	E-5
BASE COVERS .....	E-7
BALLAST .....	E-9
MOTION ALARM .....	E-11
MOTION LIGHT (OPTION) .....	E-11
POWER CONVERTER (OPTION) .....	E-11
BRAKE ASSEMBLY .....	E-13
FRONT AXLE .....	E-15
STEERING COMPONENTS .....	E-19
HYDRAULIC PUMP ASSEMBLY .....	E-21
POTHOLE ASSEMBLY .....	E-23
WHEEL MOTOR .....	E-27
BATTERY INSTALLATION .....	E-29
POTHOLE LIMIT SWITCH .....	E-31
DRIVE LIMIT SWITCH .....	E-31
BATTERY CHARGER .....	E-33

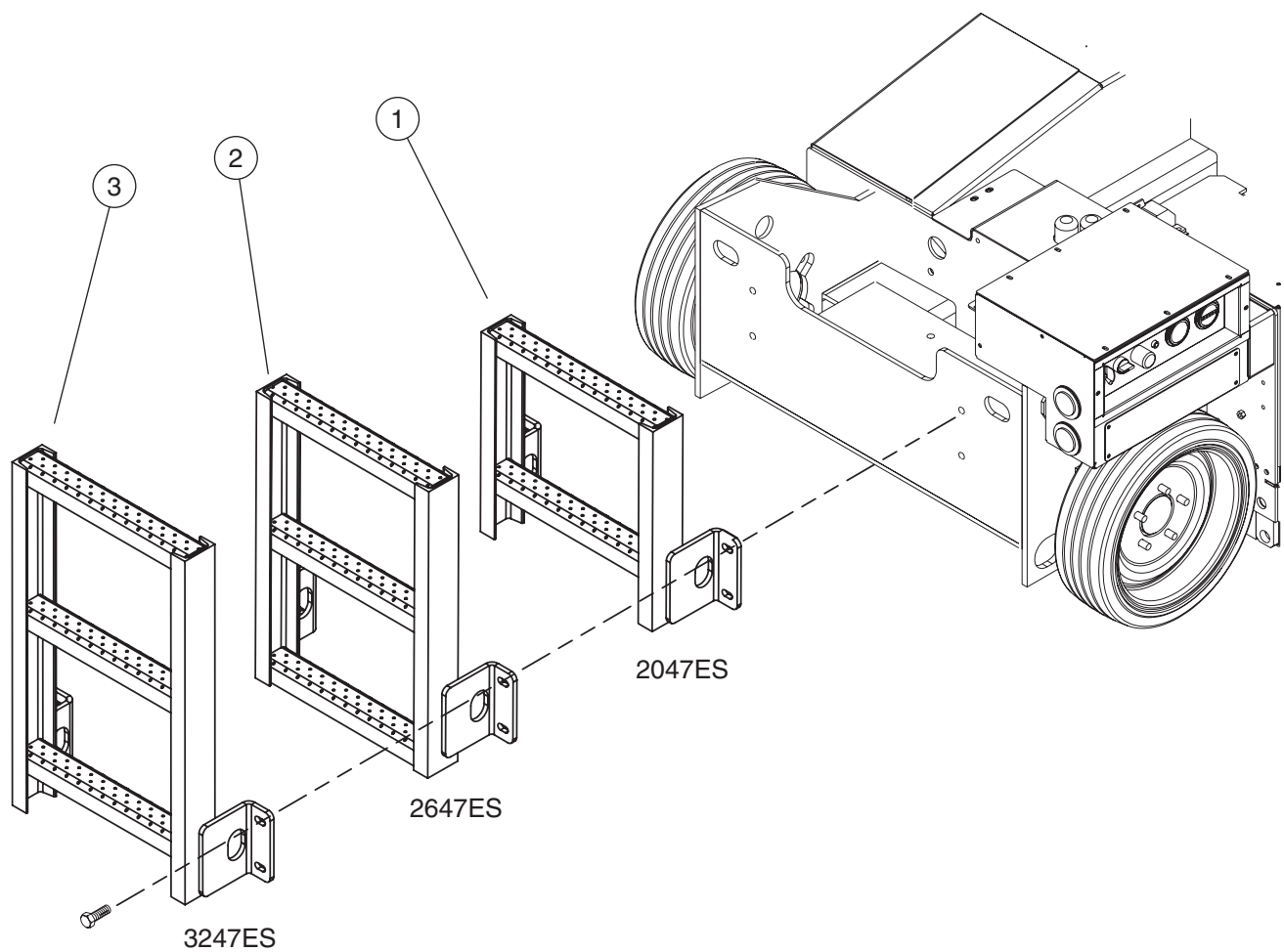


ILLUSTRATION No.  
ART\_2303

Ladder Installation, 2047ES - 2647ES - 3247ES





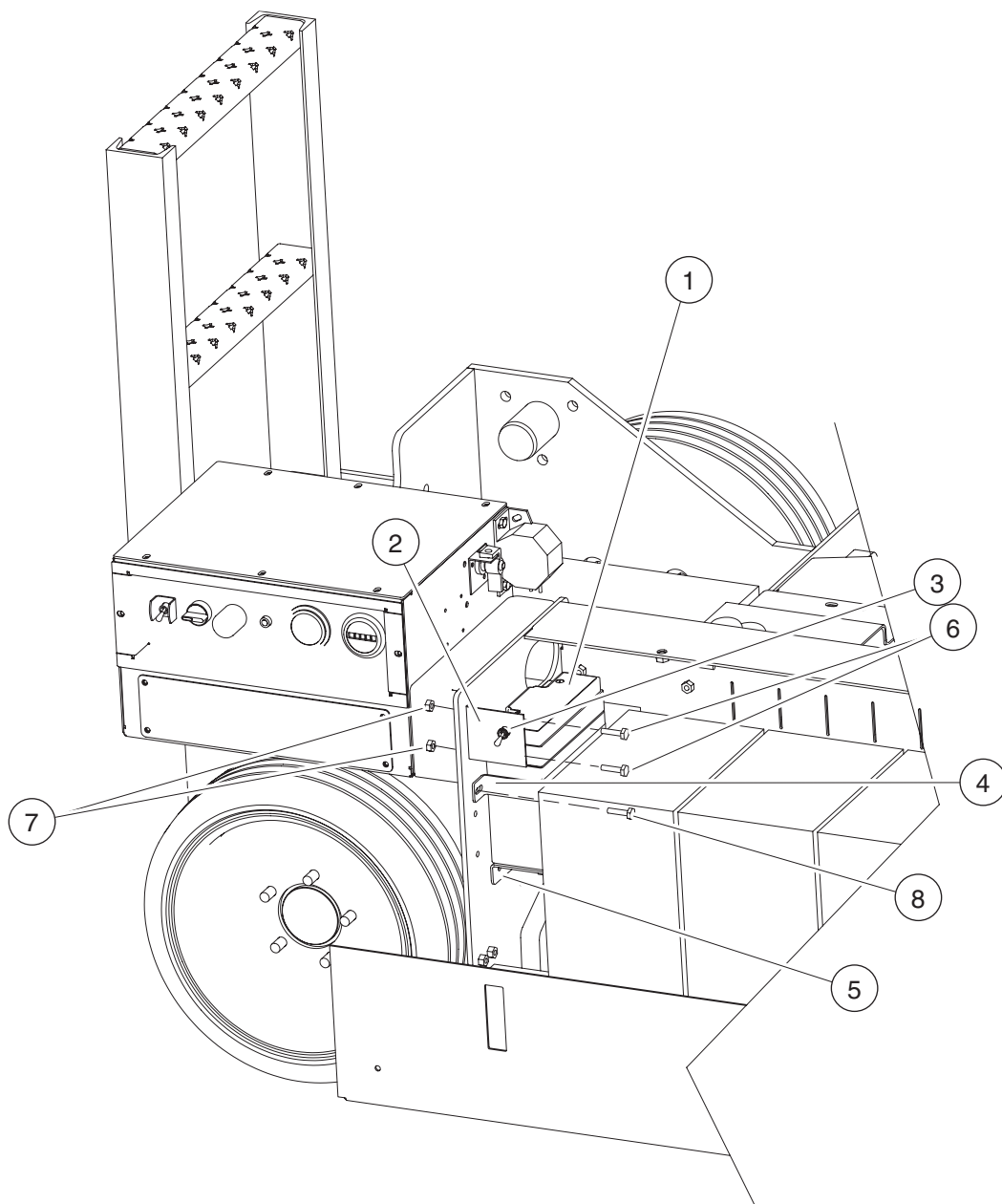


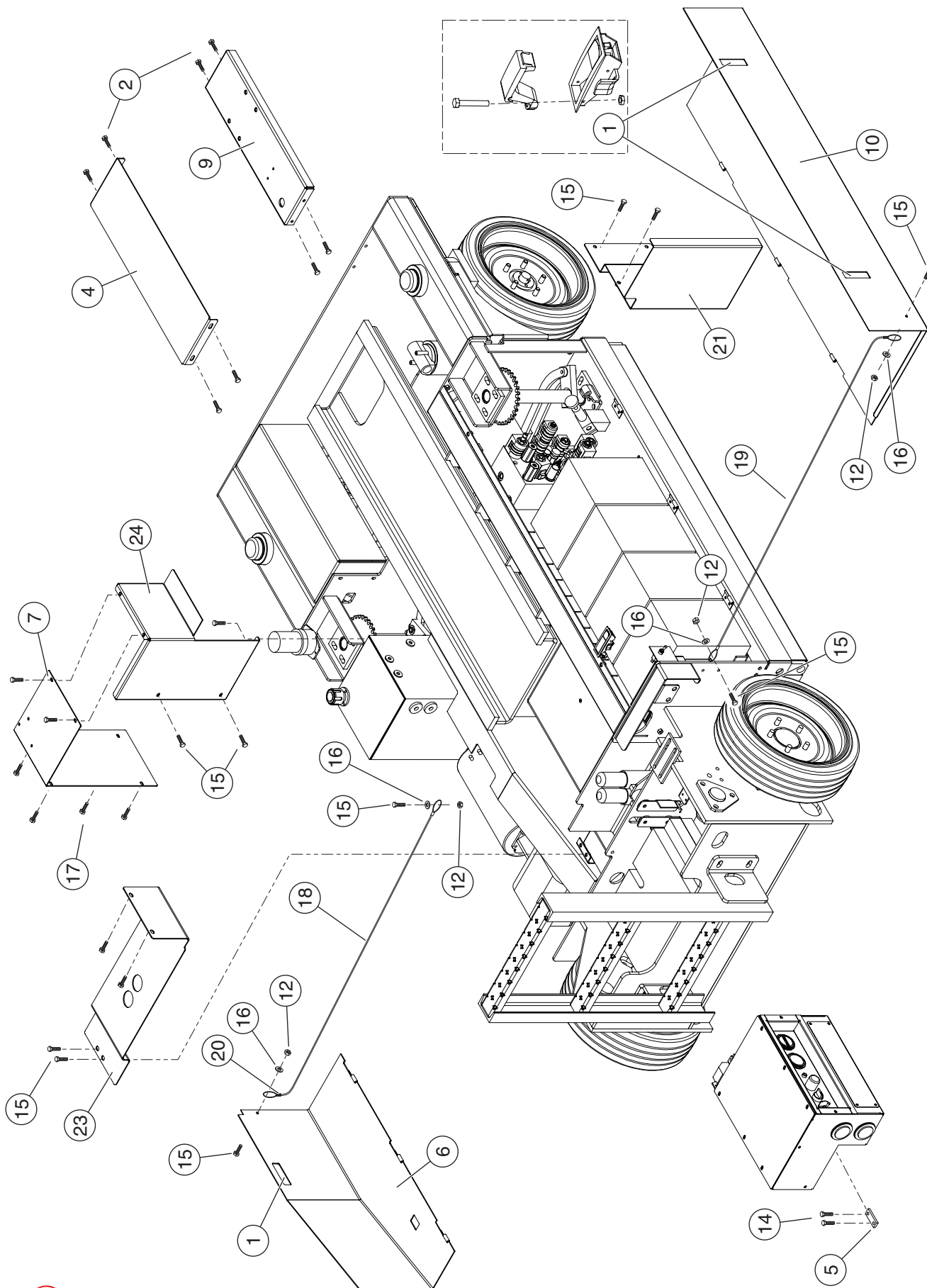
ILLUSTRATION No.  
ART\_2328

Emergency Lowering Switch and Battery, 3247ES









ITEM	PART NO.	QTY	DESCRIPTION
			<b>BASE COVERS (STEEL HYDRAULIC FLUID RESERVOIR)</b>
1	8386	3	LATCH
2	HDW6455	8	SCREW, 1/4"-20, 1/2" LG
3	16540	1	BASE WELDMENT
4	16554	1	WEBBING COVER PLATE
5	16629	1	MOUNTING BLOCK LOWER CONTROL BOX
6	16616	1	COVER, PUMP MOTOR CHARGER
7	16553	1	TOP COVER, FRONT LH STEERING
9	15143	1	BRACKET MOUNT OIL FILTER
10	16071	1	COVER, BATTERY CABINET
11	90752	6	HINGE SLIP, MALE HALF LH W/ HOLES
12	HDW5276	4	NUT, 1/4"
14	HDW6433	4	SCREW, 3/8"-16, 1" LG
15	HDW5904	20	SCREW, 1/4"-20, 3/4" LG
16	HDW5217	4	FLAT WASHER
17	HDW5723	6	MACHINE SCREW, SELF TAPPING, 1/4"-20, 3/4"LG
18	7184	18"	WIRE CABLE, COATED & ROLLED
19	7184	21"	WIRE CABLE, COATED & ROLLED
20	8814	4	SLEEVE, OVAL ALUMINUM
21	15124	1	BULKHEAD MANIFOLD CABINET
23	16632	1	COVER POTHOLE PLUNGER
24	16551	1	STEERING CABINET
25	HDW6432	2	SCREW, 3/8"-16, 3/4" LG

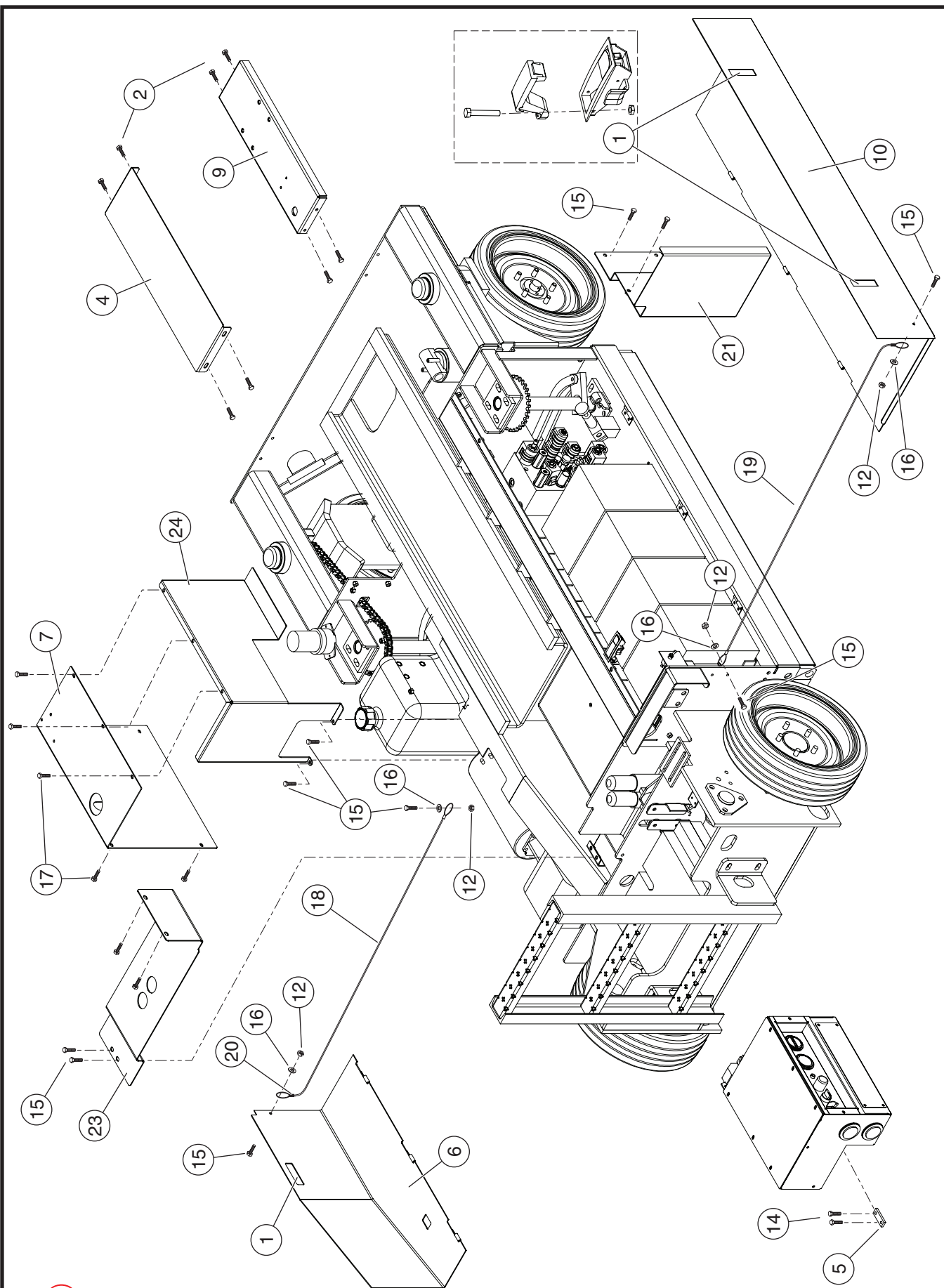


ILLUSTRATION No.  
ART\_2395

with Plastic Hydraulic Fluid Reservoir

Base and Covers, 2047ES - 2647ES - 3247ES



ITEM	PART NO.	QTY	DESCRIPTION
			<b>BASE COVERS (PLASTIC HYDRAULIC FLUID RESERVOIR)</b>
1	8386	3	LATCH
2	HDW6455	8	SCREW, 1/4"-20, 1/2" LG
3	16540	1	BASE WELDMENT
4	16554	1	WEBBING COVER PLATE
5	16629	1	MOUNTING BLOCK LOWER CONTROL BOX
6	16616	1	COVER, PUMP MOTOR CHARGER
7	16183	1	TOP COVER, FRONT LH STEERING
9	15143	1	BRACKET MOUNT OIL FILTER
10	16071	1	COVER, BATTERY CABINET
11	90752	6	HINGE SLIP, MALE HALF LH W/ HOLES
12	HDW5276	4	NUT, 1/4"
14	HDW6433	4	SCREW, 3/8"-16, 1" LG
15	HDW5904	20	SCREW, 1/4"-20, 3/4" LG
16	HDW5217	4	FLAT WASHER
17	HDW5723	7	MACHINE SCREW, SELF TAPPING, 1/4"-20, 3/4"LG
18	7184	18"	WIRE CABLE, COATED & ROLLED
19	7184	21"	WIRE CABLE, COATED & ROLLED
20	8814	4	SLEEVE, OVAL ALUMINUM
21	15124	1	BULKHEAD MANIFOLD CABINET
23	16632	1	COVER POTHOLE PLUNGER
24	16182	1	STEERING CABINET
25	HDW6432	2	SCREW, 3/8"-16, 3/4" LG

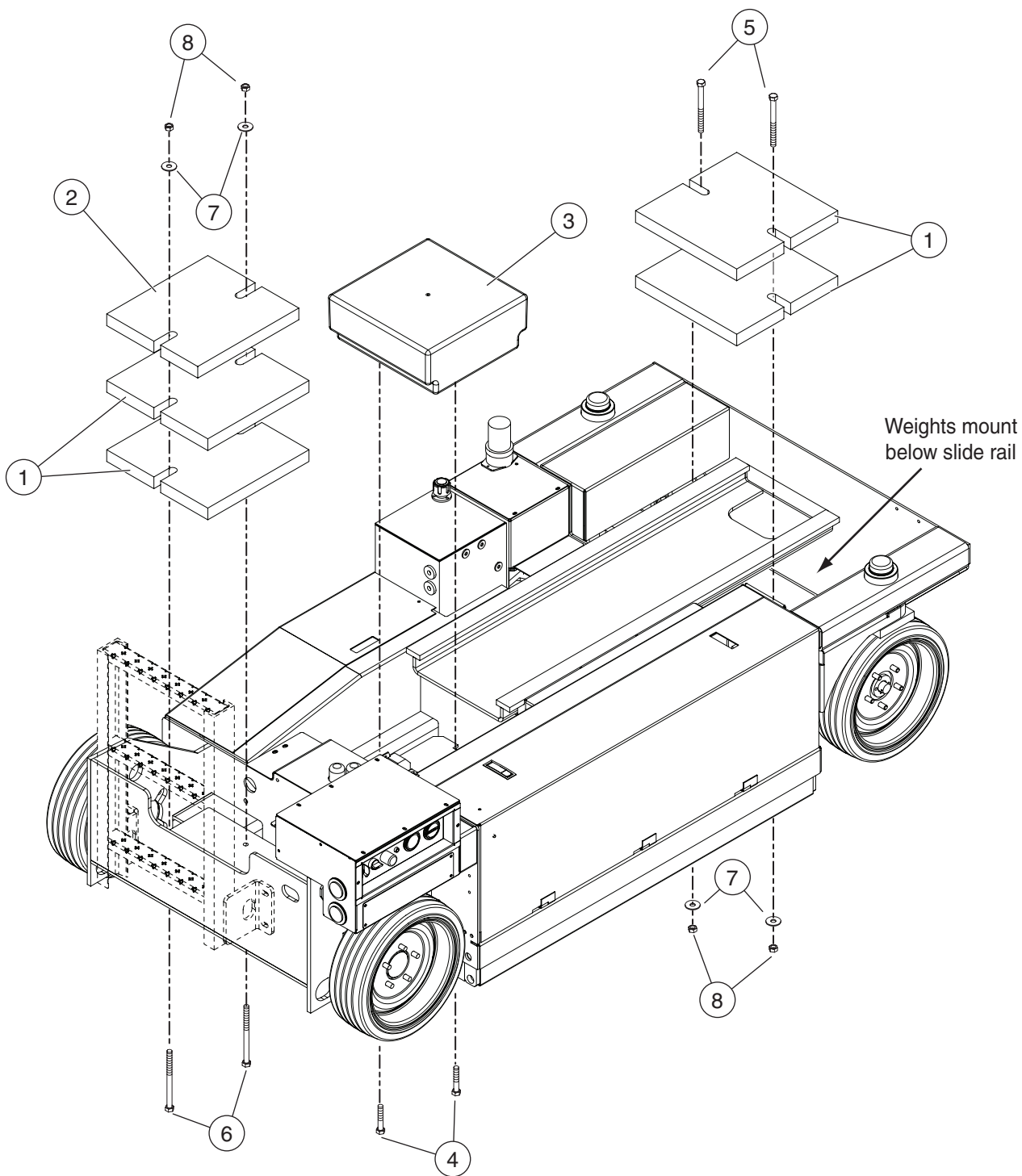
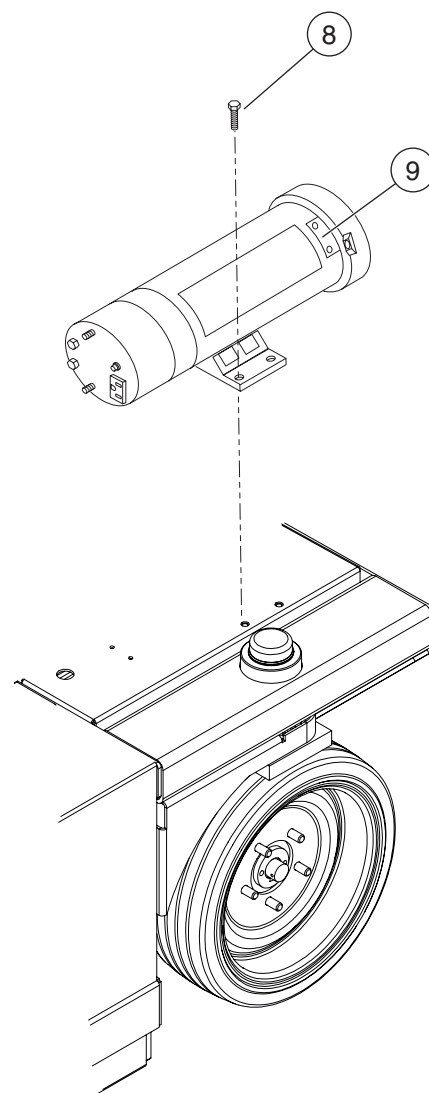
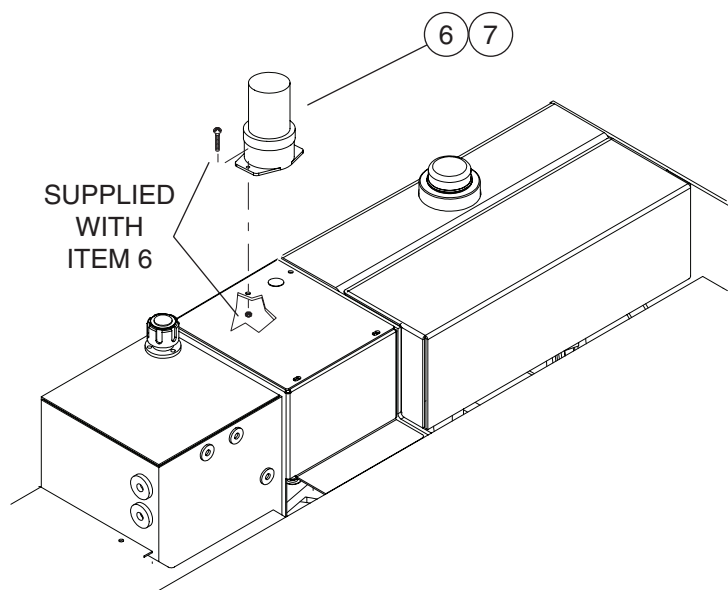
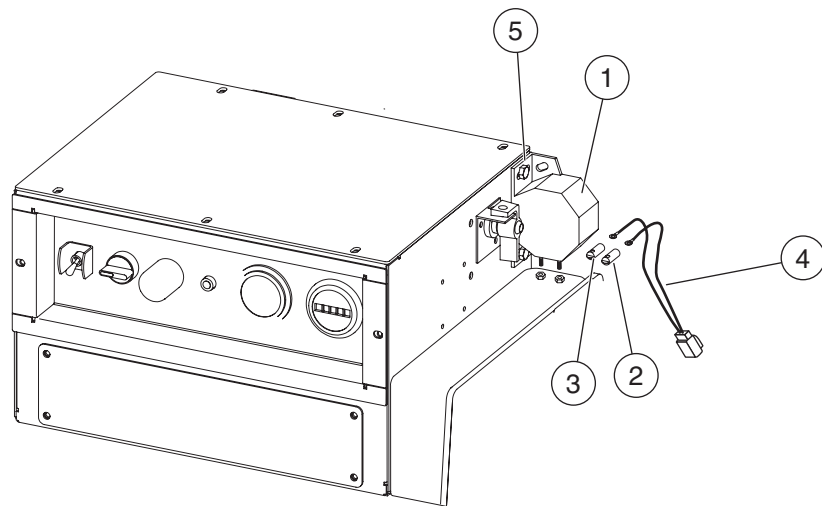


ILLUSTRATION No.  
ART\_2325

Machine Ballase, 2047ES - 2647ES - 3247ES









ITEM	PART NO.	QTY	DESCRIPTION
			<b>MOTION ALARM</b>
1	8698	1	ALARM, MOTION 12-48 VOLTS
2	8709	1	INSULATOR, TERMINAL, RED
3	8710	1	INSULATOR, TERMINAL, BLACK
4	8782	1	HARNESS, MOTION ALARM
5	HDW6455	2	SCREW, 1/4" - 20, 1/2" LG
			<b>MOTION LIGHT (OPTION)</b>
6	90164	1	LIGHT, STROBE
7	90776	1	TUBE REPLACEMENT
	7476	2	TERMINAL, AMP CONNECTOR PIN
	7640	1	CONNECTOR, AMP 2 PIN
			<b>POWER CONVERTER (OPTION)</b>
8	HDW5204	4	SCREW, 5/16" - 18, 1" LG
9	7103	1	CONVERTER
	7109	1	BOOT INSULATOR, BLACK
	7110	1	BOOT INSULATOR, RED
	7111	1	CABLE, POWER SUPPLY
	7112	1	CABLE, POWER SUPPLY
	7130	1	CAPACITOR

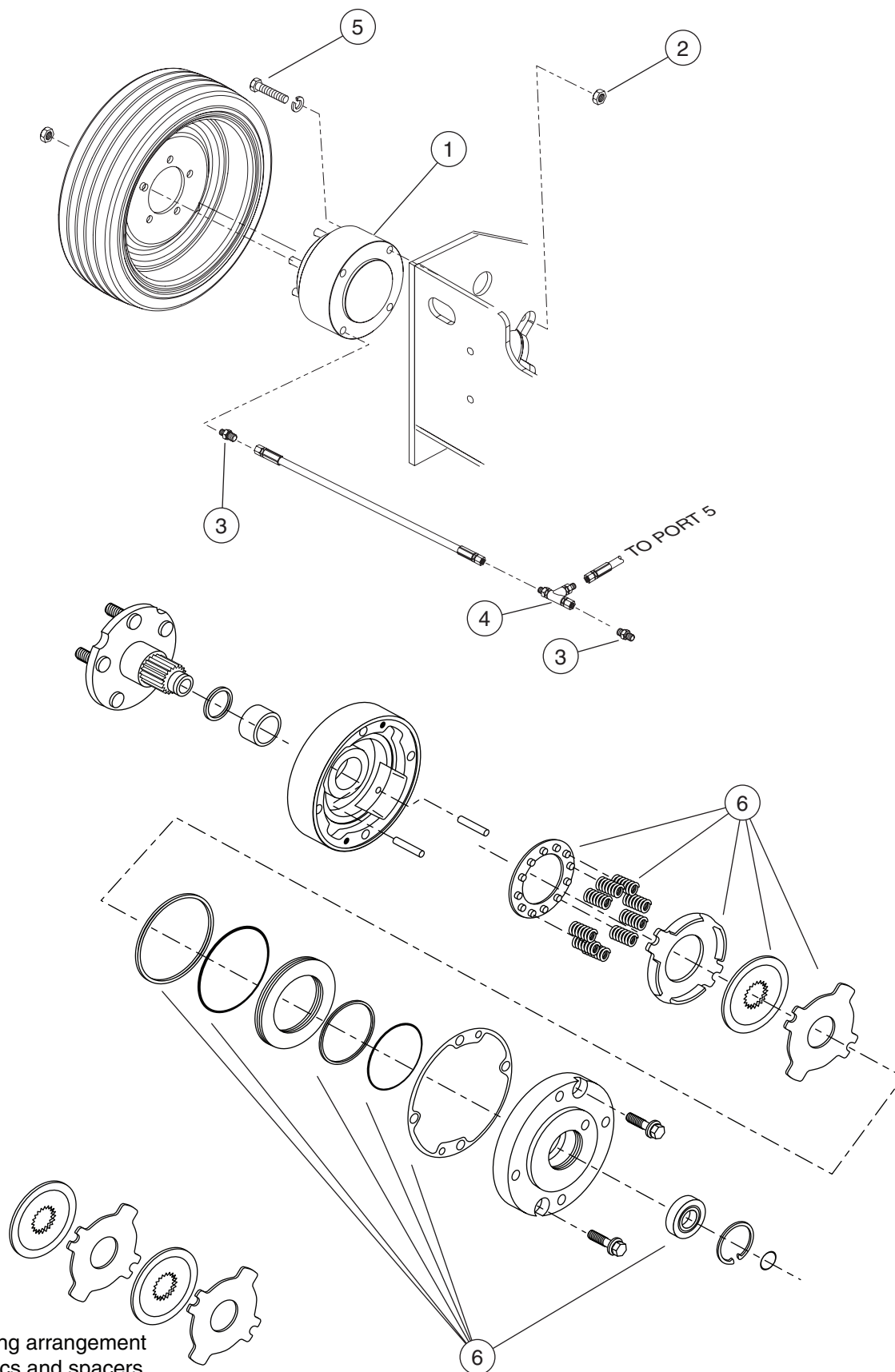
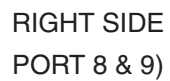


ILLUSTRATION No.  
ART\_2309

Brake Installation, ES







ITEM	PART NO.	QTY	DESCRIPTION
			<b>FRONT AXLE</b>
1	7719	2	CAP, GREASE
2	HDW5738	2	COTTER PIN HAMMER LOCK .18Ø 1.50
3	HDW5737	2	NUT, SLOTTED HEX, .750-16 UNC
4	HDW3801	2	FLAT WASHER, .765 ID X 2.024 OD X .127 THK
5	7715	2	BEARING, TAPERED ROLL - 1.25" ID
6	7717	2	RACE, BEARING TAPERED
7	7716	2	RACE, BEARING TAPERED
8	7714	2	BEARING, TAPERED ROLL - 1.5" ID
9	8159	2	SEAL, GREASE 1-3/4" SHAFT
10	8173	2	CHAIN ROLLER #50, 74 LINKS
	6541		CHAIN LINK CONNECTOR #50 (REPLACEMENT PART)
11	13724	2	WHEEL MOTOR BRACKET WELDMENT
			<b>2047ES - SERIAL #9801000 - #9801019</b>
			<b>2647ES - SERIAL #9901000 - #9901218</b>
			<b>3247ES - SERIAL #10001000 #10001275</b>
11	16115	2	WHEEL MOTOR BRACKET WELDMENT
			<b>2047ES - SERIAL #9801020 UP</b>
			<b>2647ES - SERIAL #9901219 UP</b>
			<b>3247ES - SERIAL #10001276 UP</b>
			(CONTINUED)



ITEM	PART NO.	QTY	DESCRIPTION
			<b>FRONT AXLE (CONTINUED)</b>
13	REF	2	HOSE ASSY
14	REF	2	HOSE ASSY
15	90846	2	HYDRAULIC WHEEL MOTOR
16	HDW8457	8	HEX TOP LOCK NUT .500-13
17	HDW8498	8	SCREW, CAP, .500 -13, 4" LG GRADE 5
18	15131	2	FRONT HUB ASSEMBLY
19	HDW8568	2	SLOTTED HEX NUT 1 1/8" - 18
20	HDW5290	2	COTTER PIN HAMMER LOCK .16Ø 1.75
21	HDW6677	10	HEX LUG NUT .500-20
22	91065	2	WHEEL
23	13436	1	CYLINDER, DOUBLE END, HYDRAULIC ASSY
24	HDW7438	1	FITTING, MALE 3/8", MALE 3/8" O-RING
25	HDW90299	1	FITTING, 90° MALE 3/8", FEMALE 3/8"
26	HDW7601	1	FITTING, 90° MALE 3/8", MALE 3/8" O-RING
27	REF	1	HOSE ASSY
28	REF	1	HOSE ASSY
29	13422	2	STEER IDLER SHAFT WELDMENT
NS	90765	3'	CABLE WRAP
	REF		SEE HYDRAULIC HOSES (PARTS SECTION D)

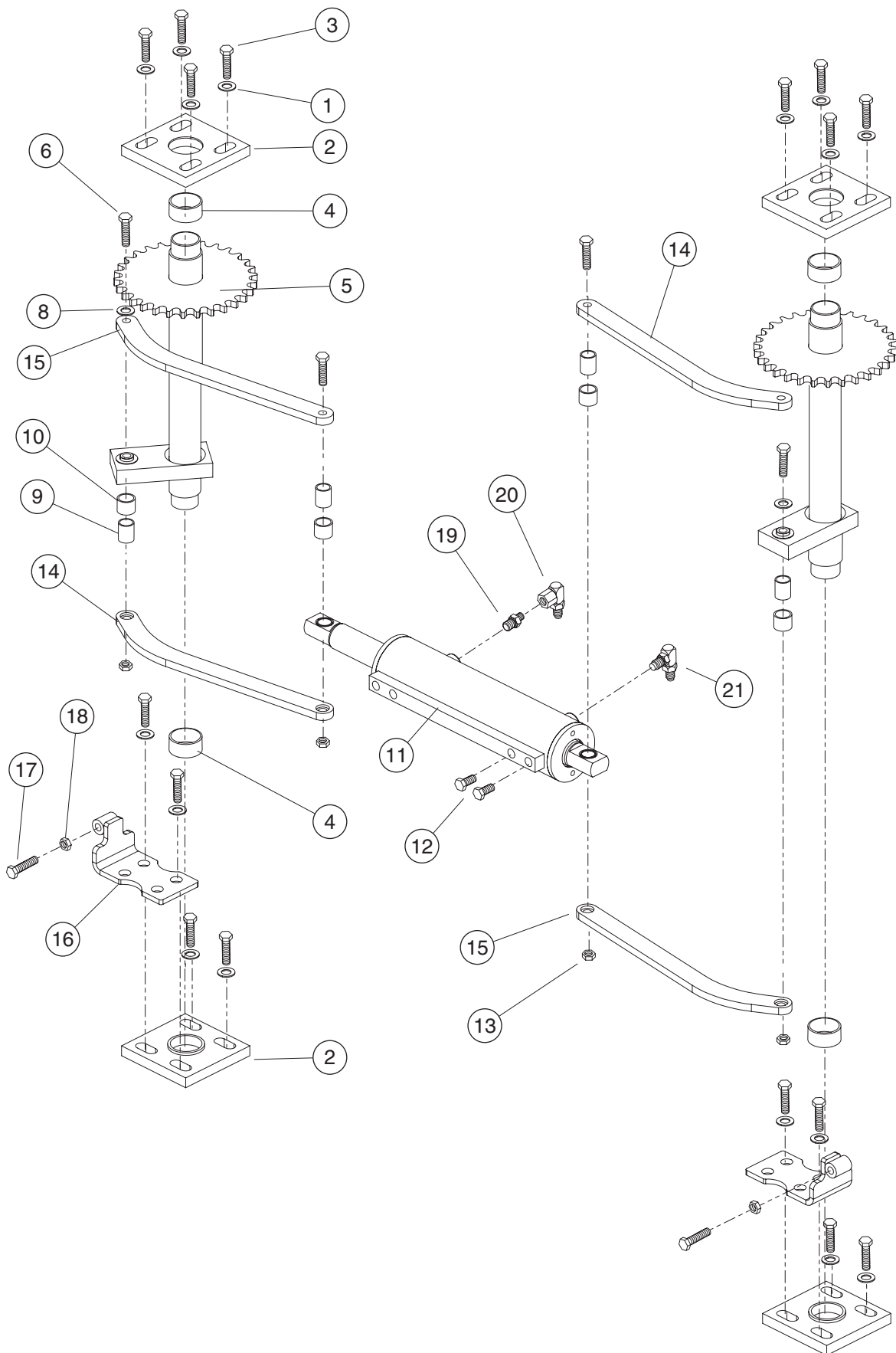


ILLUSTRATION No.  
ART\_2312

## Steering Assembly Installation, 2047ES - 2647ES - 3247ES





ITEM	PART NO.	QTY	DESCRIPTION
			<b>STEERING COMPONENTS</b>
1	HDW90784	16	WASHER, FLAT, .531 ID, 1.063 OD, .0104 THK
2	13251	4	PLATE, LOWER ADJUST IDLET SHAFT
3	HDW8283	16	BOLT, CAP, HEX HD, 1/2-13 X 1.50 GRADE 8
4	8248	4	BEARING, OILITE, 1.25 X 5
5	13422	2	STEER IDLER SHAFT WELDMENT
6	HDW6434	4	SCREW, CAP, HEX HEAD, 3/8-16 X 2.00 GRADE 5
8	HDW13423	2	WASHER, FLAT, .632 ID, 1.008 OD, .030 THK, NYLON
9	13421	4	SPACER
10	8433	4	BEARING, 10DU12
11	13436	1	CYLINDER, DOUBLE END, HYDRAULIC ASSY
12	HDW8287	4	BOLT, CAP, HEX HD, 1/2-20 X .75, GRADE 8
13	HDW5039	4	LOCKNUT, 3/8-16
14	16622	2	LINK, INTERMEDIATE STEERING
15	16621	2	LINK, INTERMEDIATE STEERING
16	16646	2	STEERING ADJUSTER
17	HDW8494	2	SCREW, 3/8"-16 X 2" LG
18	HDW90994	4	JAM NUT, 3/8"-16
19	HDW7438	1	FITTING, MALE 3/8", MALE 3/8" O-RING
20	HDW90299	1	FITTING, 90° MALE 3/8", FEMALE 3/8"
21	HDW7601	1	FITTING, 90° MALE 3/8", MALE 3/8" O-RING

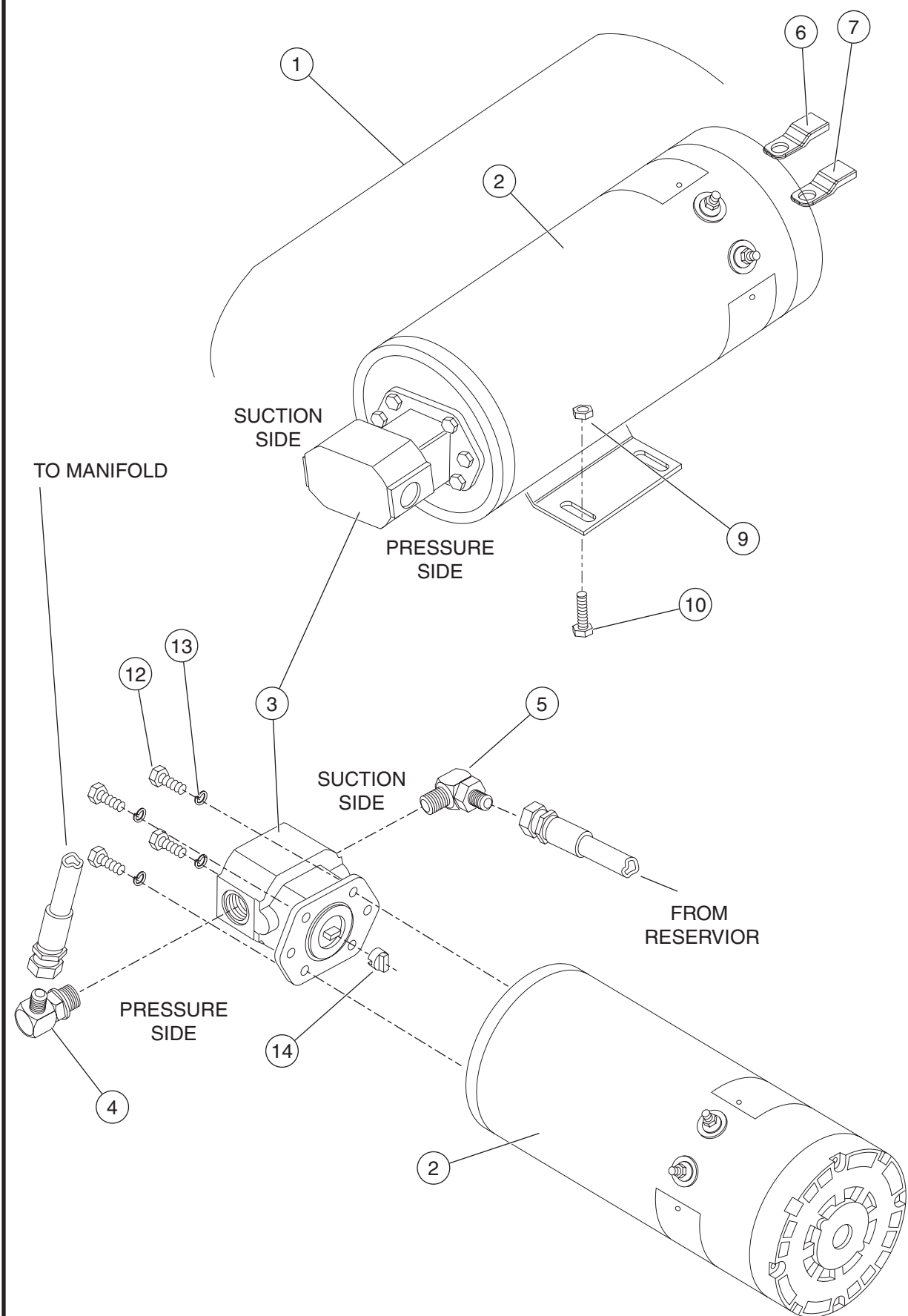


  
 ILLUSTRATION No.  
 ART\_2314

Electric Motor & Pump, X33ES - X47ES

ITEM	PART NO.	QTY	DESCRIPTION
			<b>HYDRAULIC PUMP ASSEMBLY</b>
			<b>2047ES: S/N# 9801000 TO 9801007</b> <b>2647ES: S/N# 9901000 TO 9901035</b>
2	8544	1	MOTOR, 24 VDC, 2 HP
3	8546	1	PUMP
14	6314	1	COUPLER
			<b>2047ES: S/N# 9801008 TO CURRENT</b> <b>2647ES: S/N# 9901036 TO CURRENT</b>
			<b>3247ES: S/N# 10001000 TO CURRENT</b>
1	90970	1	POWER UNIT ASSEMBLY
2	90997	1	MOTOR, 24 VDC, 2 HP
	91226	1	BRUSHES
3	90998	1	PUMP
14	90999	1	COUPLER
4	HDW8081	1	FITTING, 90° ELBW, MALE 1/2" O-RING, MALE 3/8" SIZE: 37
5	HDW90967	1	FITTING, 90° ELBW, MALE 3/8" O-RING, MALE 1/2" SIZE: 50
6	REF	1	BATTERY CABLE, RED (SEE HARNESSES, PARTS SEC A)
-	7172	1	BOOT TERMINAL INSULATOR RED (NOT SHOWN)
7	REF	1	BATTERY CABLE, BLACK, (SEE HARNESSES, PARTS SEC A)
-	7172	1	BOOT TERMINAL INSULATOR BLACK (NOT SHOWN)
9	HDW5005	4	NUT, 5/16" - 18
10	HDW5204	4	SCREW, 5/16" - 18, 1" LG
12	HDW5724	4	SCREW, 5/16"-18, 3/4" LG
13	HDW5006	4	LOCKWASHER, 5/16"
			SEE HYDRAULIC HOSES (SECTION D)

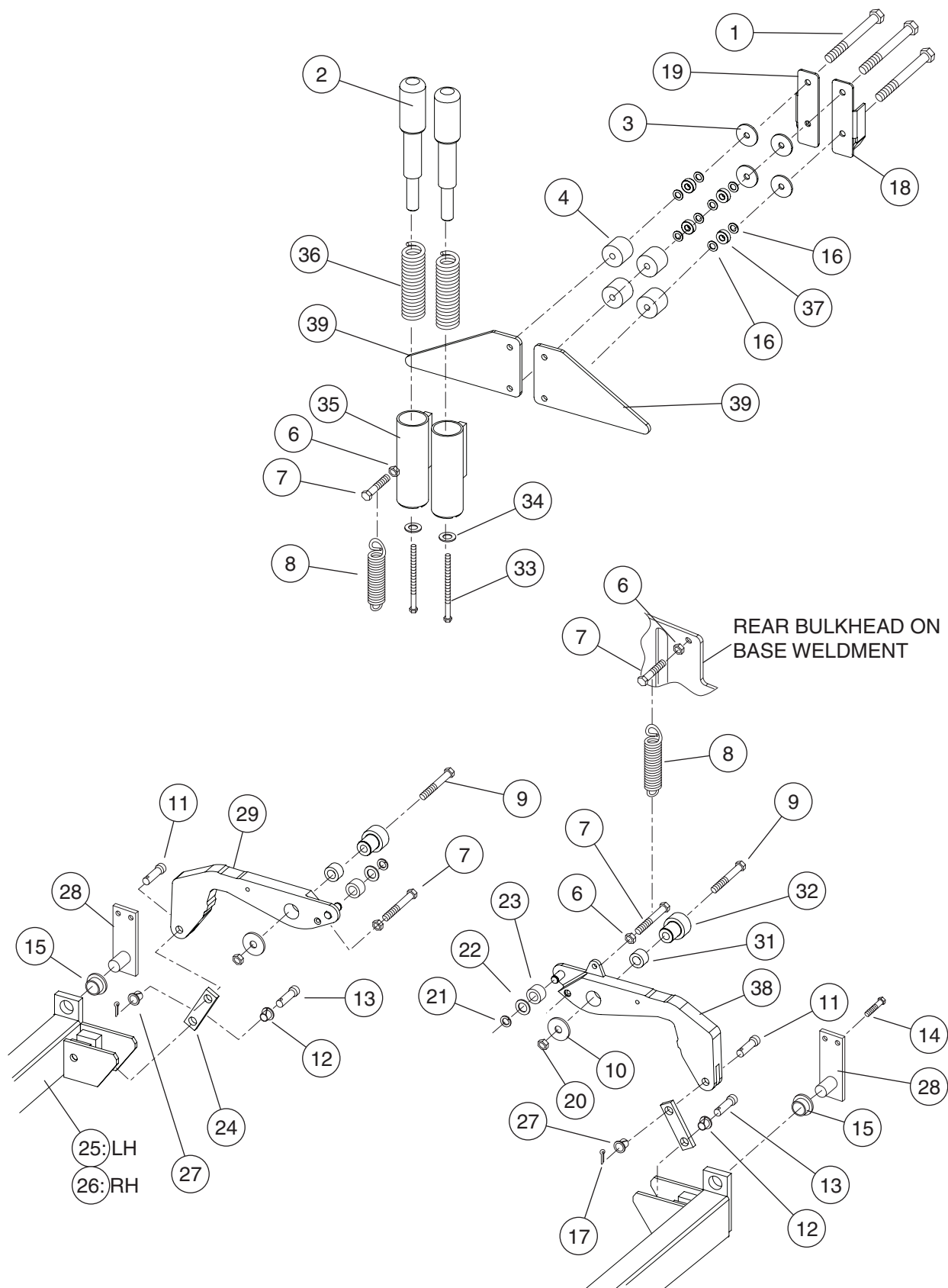
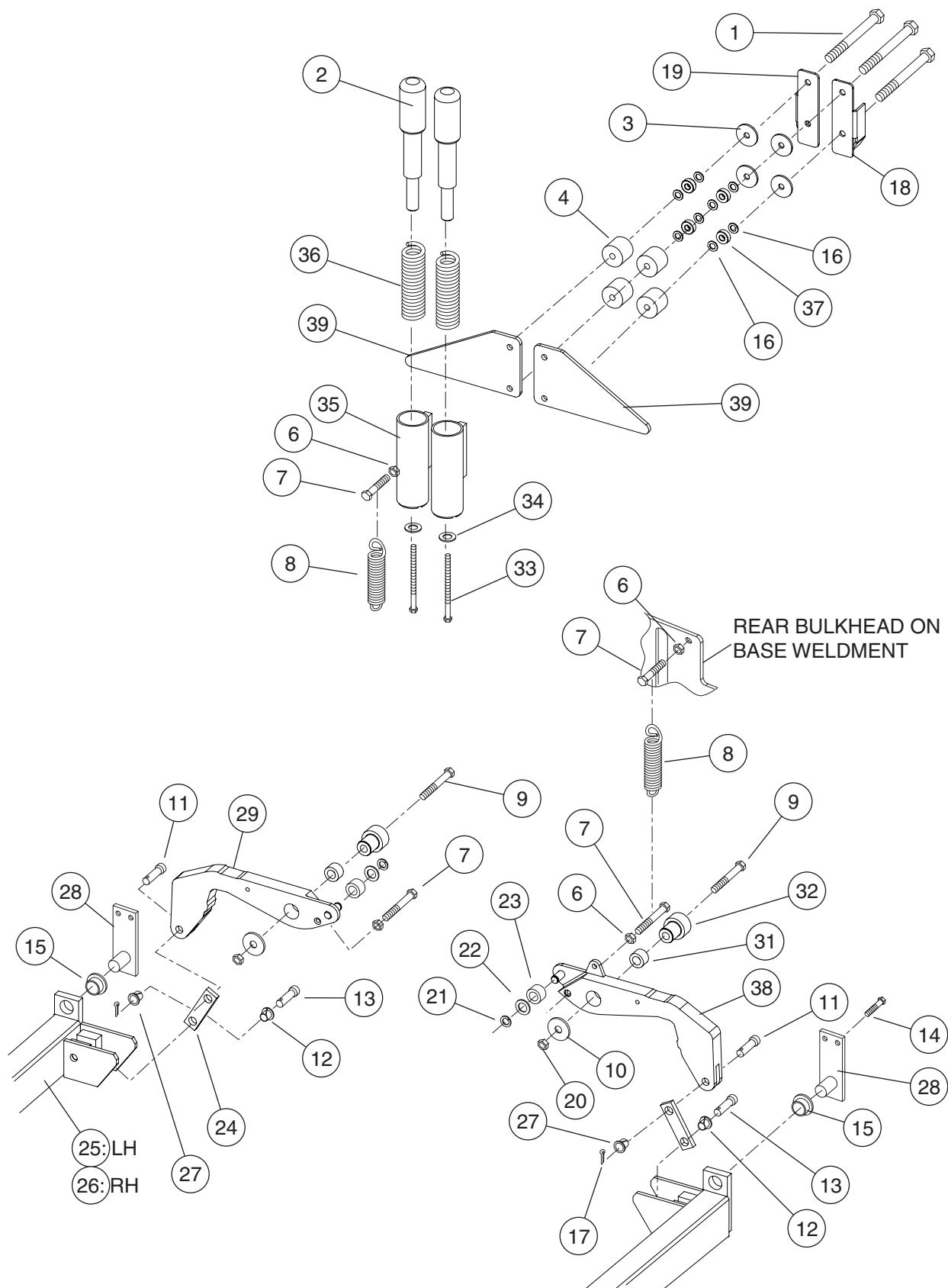


ILLUSTRATION No.  
ART\_2317

Pothole Assembly, 2047ES - 2647ES - 3247ES



ITEM	PART NO.	QTY	DESCRIPTION
			<b>POTHOLE ASSEMBLY</b>
1	HDW8279	4	BOLT, CAP HEX HD, 3/8" -16, 2.50" LG, GRADE 5, ZI/CL
2	16587	2	ROD, ACTUATOR SPRING TUBE
3	HDW13556	4	WASHER, FLAT, PLASTIC, ID .391", OD 1.5", .125" THK
4	16624	4	SPACER, STEPPED, PVC
6	HDW8312	4	NUT, HEX, 5/16"-18, CLASS 5, ZI/CL
7	HDW8310	4	BOLT, CAP, HEX HD, 1/2"-13, 3.00" LG, GRADE 5, ZI/CL
8	8226	2	SPRING, TENSION, .75" X .564" X 5", K9.3+3.5
9	HDW7018	2	BOLT, CAP, HEX HD, 1/2"-13, 3.00" LG, GRADE 5, ZI/CL
10	HDW13195	2	WASHER, FLAT, ID .515", OD 1.512", .098" THK, ZI/YEL
11	HDW90770	1	PIN, CLEVIS, 1/2" X 1.375" LG, ZI/CL
12	7200	2	BEARING, 1/2" ID X 1/2" LG, NYLINER
13	HDW8179	2	PIN, CLEVIS, 1/2" X 2.62" LG, ZI/YEL
14	HDW8273	8	BOLT, CAP, HEX HD, 1/4"-20, 1.00" LG, GRADE 5, ZI/CL
15	7015	4	BEARING, FLANGED, NYLINER
16	HDW16625	8	THRUST WASHER
17	HDW5920	4	PIN, COTTER, HAMMERLOCK, 1/8" X 1.00", ZI/CL
18	13842	1	BRACKET, POTHOLE SWITCH ACTIVATOR, RH
19	13839	1	BRACKET, POTHOLE SWITCH ACTIVATOR, LH
20	HDW8457	2	NUT, LOC, HEX HD, 1/2"-13, CLASS B, ZI/CL
21	5736	2	RING, RETAINING, EXTERNAL, 1/2" SHAFT
22	HDW7031	2	WASHER, FLAT, ID .5", OD .875", .074 THK, ZI/YEL
23	4542	2	ROLLER
24	13770	2	LINK, POTHOLE
25	13766	1	BAR, POTHOLE, LH
26	13767	1	BAR, POTHOLE, RH
27	8181	2	BEARING, 1/2" X 5/16", NYLINER
28	13178	4	WELDMENT, PIVOT PIN
29	15039	1	WELDMENT, LEVER
			(CONTINUED)



REAR BULKHEAD ON  
BASE WELDMENT



ILLUSTRATION No.  
ART\_2317

Pothole Assembly, 2047ES - 2647ES - 3247ES











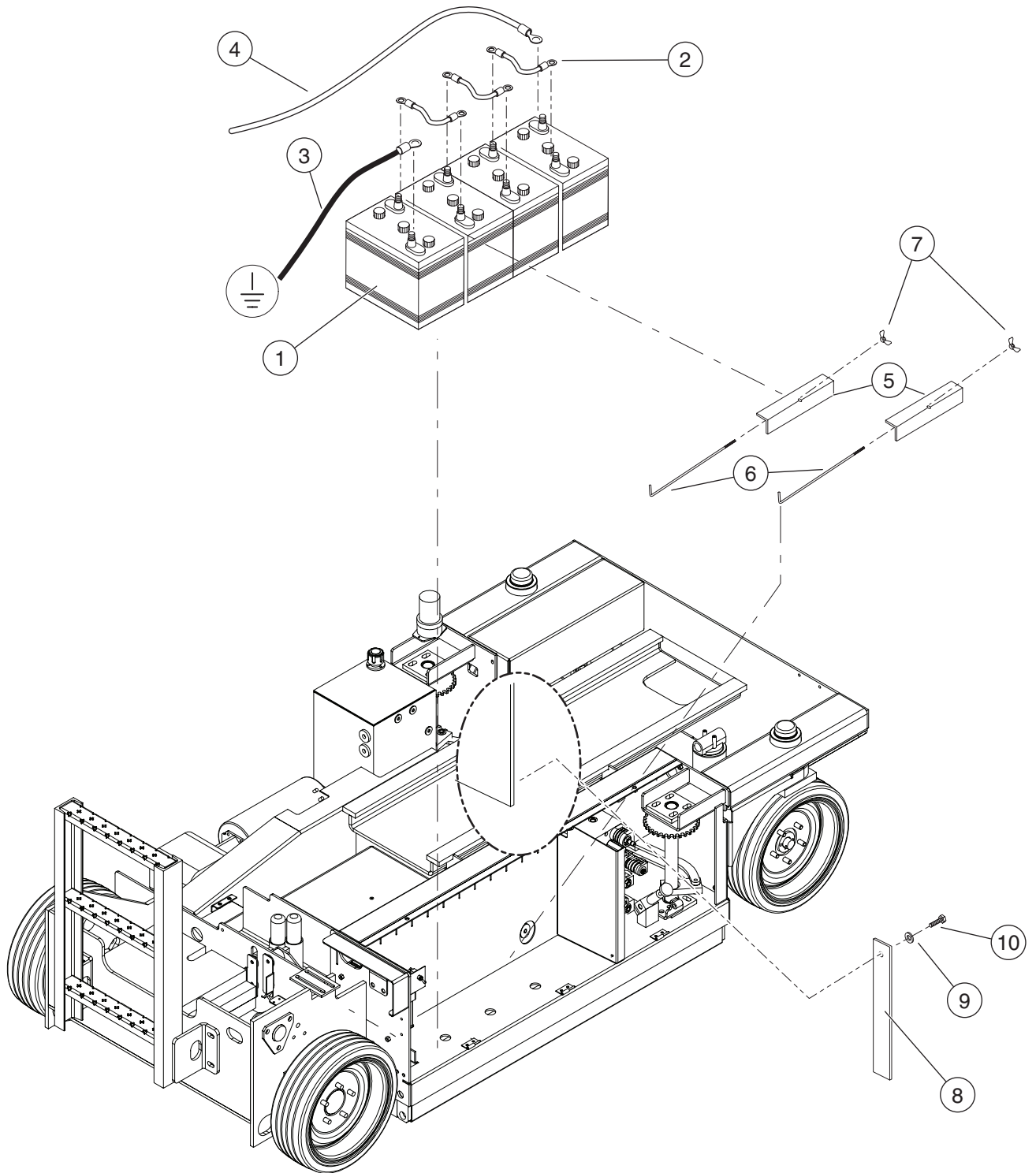


ILLUSTRATION No.  
ART\_2321

Battery Installation, 2047ES - 2647ES - 3247ES





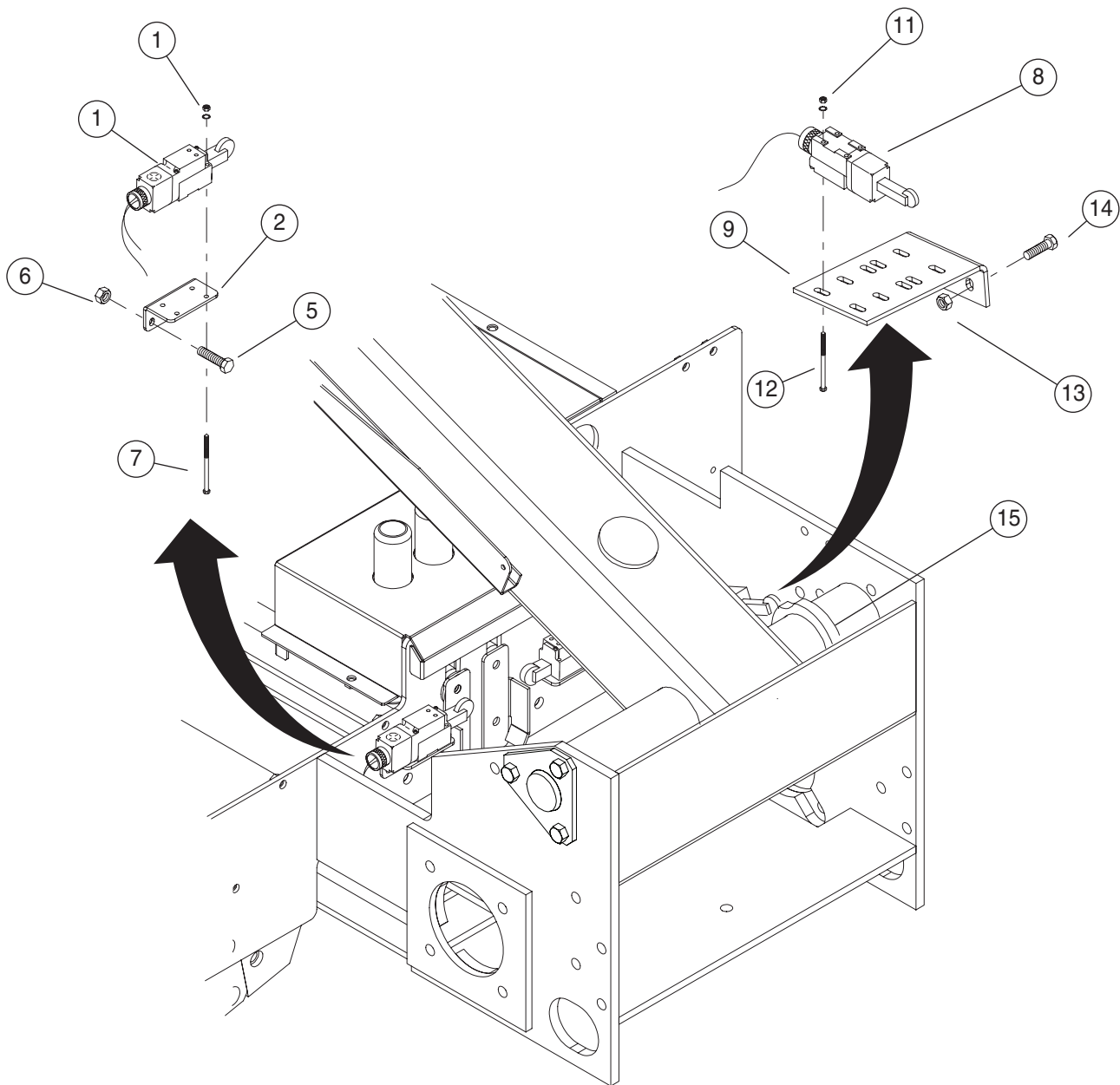
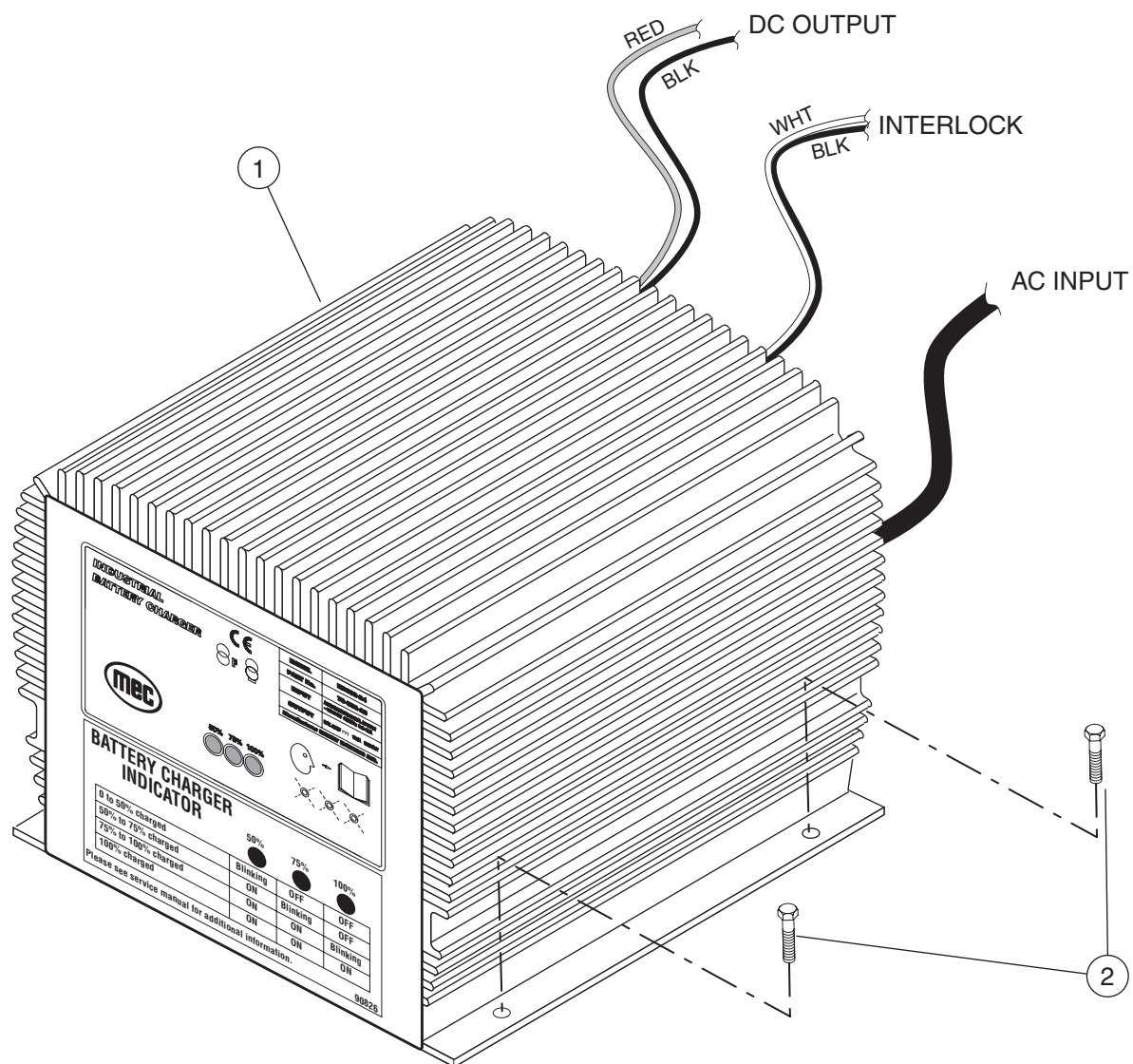


ILLUSTRATION No.  
ART\_2327

Limit Switches Installation, X33ES - X47ES



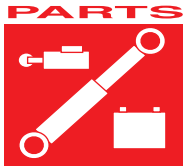
ITEM	PART NO.	QTY	DESCRIPTION
			<b>POTHOLE LIMIT SWITCH</b>
1	90531	2	SWITCH, POTHOLE
2	13840	2	BRACKET, POTHOLE SWITCH MOUNT
3	90685	1	POTHOLE SWITCH HARNESS
4	HDW5251	2	NUT #8
5	HDW8273	2	SCREW, CAP, HEX HD, 1/4" X 1" LG
6	HDW5276	2	NUT, 1/4"
7	HDW8482	2	SCREW, MACHINE, #8 X 1.5" LG
			<b>DRIVE LIMIT SWITCH</b>
8	8932	2	SWITCH, LIMIT SPEED, HONEYWELL BRAND
8	90996	2	SWITCH, LIMIT SPEED, TELEMECANIQUE BRAND
9	13838	1	BRKT, LIMIT SWITCH MOUNT
10	90686	1	SAFETY SWITCH HARNESS
11	HDW5251	2	NUT, #8 - 32
12	HDW8273	2	SCREW, 1/4" - 20, 1" LG
13	HDW5276	2	NUT 1/4" - 20
14	HDW8482	2	#8 - 32, 1 1/2" LG
15	13837	1	CAM, LIMIT SPEED
	HDW8870	1	SET SCREW
NS	6064	2	HOSE CLAMP, PLASTIC MOLDED
NS	HDW5217	2	WASHER
NS	HDW6502	1	SCREW, 1/4"-20 X 2 1/2" LG







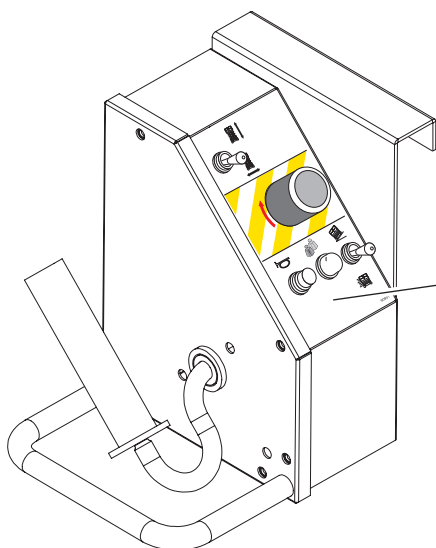




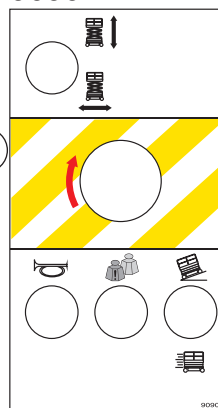
# SECTION F:

## DECALS

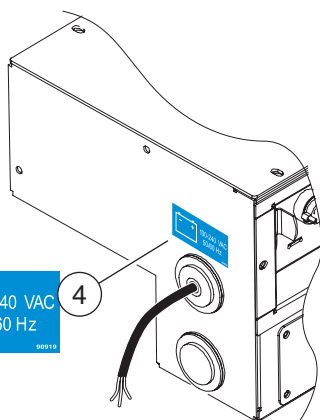
DECALS, 2047ES - 2647ES - 3247ES CONTROLS .....	F-3
DECALS, 2047ES - 2647ES - 3247ES BASE .....	F-5
DECALS, 22047ES - 2647ES - 3247ES SCISSORS .....	F-7
DECALS, 2047ES - 2647ES - 3247ES PLATFORM .....	F-9



90901



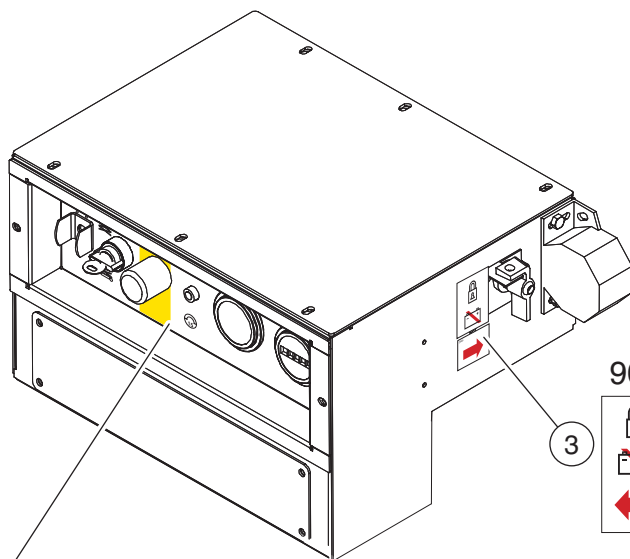
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90919



4

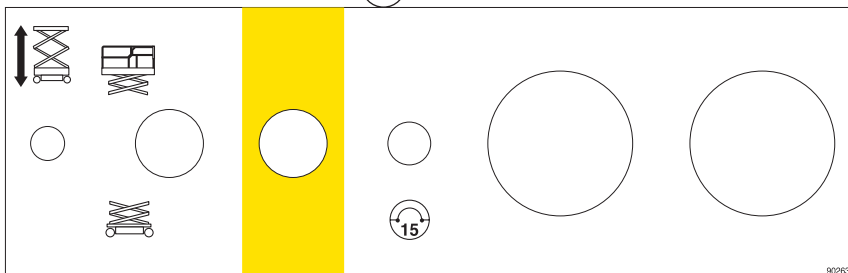


9052



3

90263



2

90263




ILLUSTRATION No.  
ART\_2433

Decals - Controls: All Models - CE

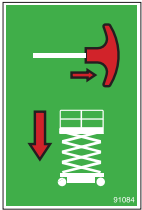




90982

 MEC AERIAL PLATFORM SALES CORP. 10000 SHELLEY BLVD. #11 BOSTON, MA 02124		CE 2007	2007	2007	2007
MAX. PLATFORM CAPACITY (2047ES/2647ES) 1710 lbs. / 776 kg	MAX. PLATFORM HEIGHT 20.9 ft. / 6.37 m	MAX. ALLOWABLE WIND SPEED (2047ES/2647ES) 15 mph / 24 km/h	MAX. ALLOWABLE WIND SPEED (3247ES) 20 mph / 32 km/h	MAX. ALLOWABLE WIND SPEED (2047ES/2647ES) 15 mph / 24 km/h	MAX. ALLOWABLE WIND SPEED (3247ES) 20 mph / 32 km/h
MAX. ALLOWABLE PLATFORM WEIGHT 1500 lbs. / 680 kg	MAX. ALLOWABLE PLATFORM WEIGHT 1500 lbs. / 680 kg	MAX. ALLOWABLE PLATFORM WEIGHT 1500 lbs. / 680 kg	MAX. ALLOWABLE PLATFORM WEIGHT 1500 lbs. / 680 kg	MAX. ALLOWABLE PLATFORM WEIGHT 1500 lbs. / 680 kg	MAX. ALLOWABLE PLATFORM WEIGHT 1500 lbs. / 680 kg
MAX. ALLOWABLE PLATFORM WEIGHT 1500 lbs. / 680 kg	MAX. ALLOWABLE PLATFORM WEIGHT 1500 lbs. / 680 kg	MAX. ALLOWABLE PLATFORM WEIGHT 1500 lbs. / 680 kg	MAX. ALLOWABLE PLATFORM WEIGHT 1500 lbs. / 680 kg	MAX. ALLOWABLE PLATFORM WEIGHT 1500 lbs. / 680 kg	MAX. ALLOWABLE PLATFORM WEIGHT 1500 lbs. / 680 kg

91084  
(2047ES & 2647ES)

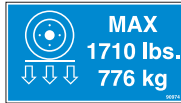


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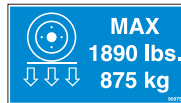
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2

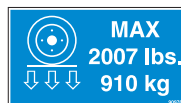
90974 (2047ES)



90975 (2647ES)



90976 (3247ES)



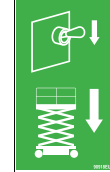
2

90930



4

90918EUR  
(3247ES only)



5

ITEM	PART NO.	QTY	DESCRIPTION
			<b>DECALS: BASE, 2047ES - 2647ES - 3247ES</b>
			<b>2047ES</b>
1	90982	1	SERIAL PLATE
2	90974	4	DECAL, WHEEL PRESSURE
3	91084	1	DECAL, EMERGENCY LOWERING
4	90930	2	DECAL, FORK LIFT POCKETS
			<b>2647ES</b>
1	90982	1	SERIAL PLATE
2	90975	4	DECAL, WHEEL PRESSURE
3	91084	1	DECAL, EMERGENCY LOWERING
4	90930	2	DECAL, FORK LIFT POCKETS
			<b>3247ES</b>
1	90982	1	SERIAL PLATE
2	90976	4	DECAL, WHEEL PRESSURE
3	90918EUR	1	DECAL, EMERGENCY LOWERING
4	90930	2	DECAL, FORK LIFT POCKETS

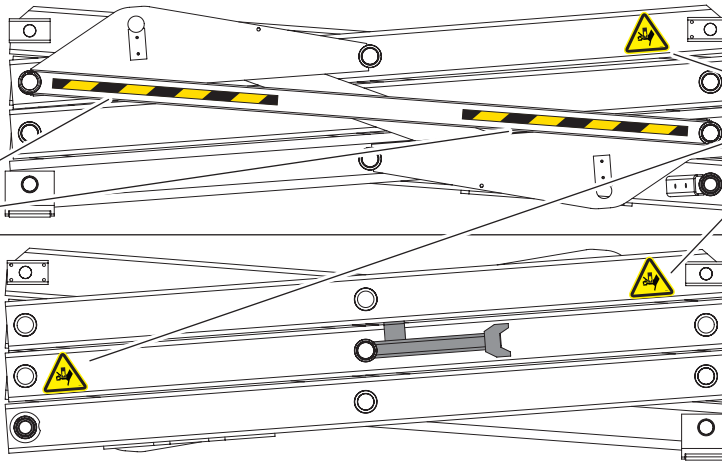
2047ES

7982(2X)

2

9910(3X)

1



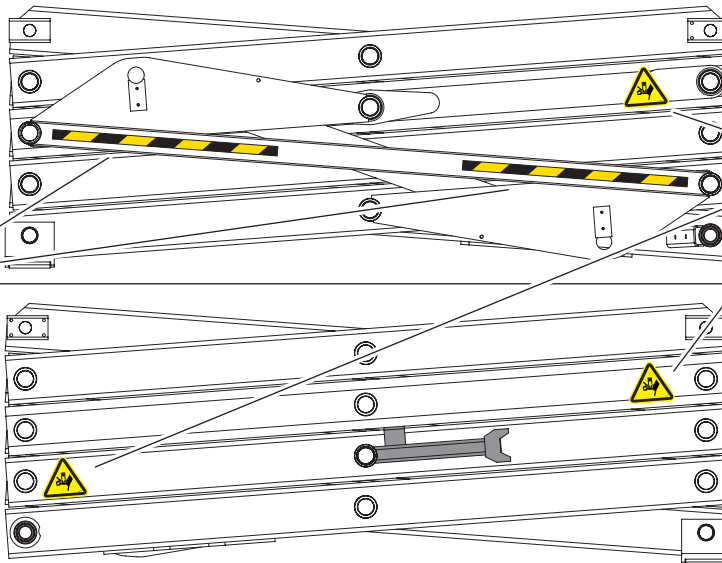
2647ES

7982 (2X)

2

9910(3X)

1



3247ES

7982 (4X)

2

9910(3X)

1

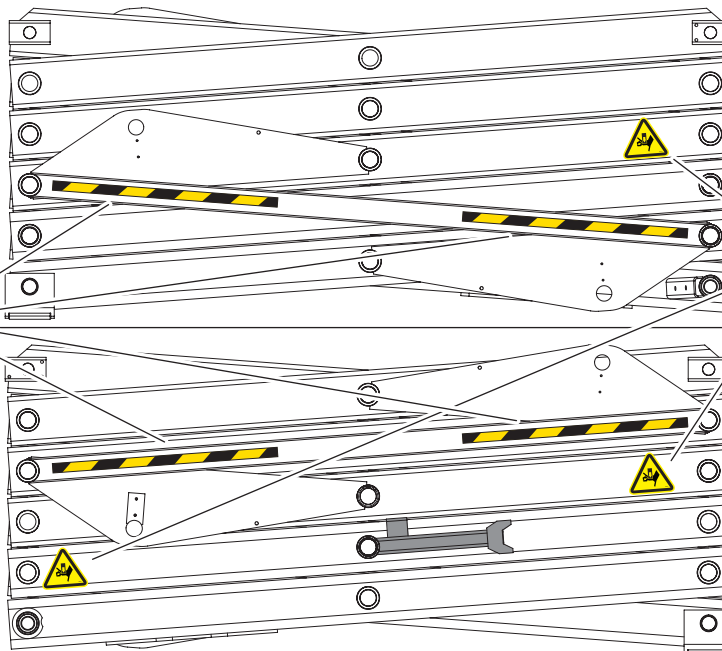


ILLUSTRATION No.  
ART\_2441

Decals - Scissors: 2047ES / 2647ES / 3247ES - CE









ITEM	PART NO.	QTY	DESCRIPTION
			<b>DECALS: PLATFORM, 2047ES - 2647ES - 3247ES</b>
			<b>2047ES</b>
1	90719	1	DECAL, MEC LOGO
2	9623	2	DECAL, MEC 2047ES
3	8402	2	DECAL, RAIL STRIPE
4	7982	3	DECAL, SAFETY STRIPE
5	8911	1	DECAL, MANUALS INSIDE
6	90979	2	DECAL, PLATFORM CAPACITY
7	90739	1	DECAL, MADE IN USA
			<b>2647ES</b>
1	90719	1	DECAL, MEC LOGO
2	9624	2	DECAL, MEC 2647ES
3	8402	2	DECAL, RAIL STRIPE
4	7982	3	DECAL, SAFETY STRIPE
5	8911	1	DECAL, MANUALS INSIDE
6	91230	2	DECAL, PLATFORM CAPACITY
7	90739	1	DECAL, MADE IN USA
			<b>3247ES</b>
1	90719	1	DECAL, MEC LOGO
2	9625	2	DECAL, MEC 3247ES
3	8402	2	DECAL, RAIL STRIPE
4	7982	3	DECAL, SAFETY STRIPE
5	8911	1	DECAL, MANUALS INSIDE
6	91229	2	DECAL, PLATFORM CAPACITY
7	90739	1	DECAL, MADE IN USA





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\*\*Fed Ex shipments require Fed Ex account number

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## Limited Owner Warranty

MEC Aerial Platform Sales Corp. warrants its equipment to the original purchaser against defects in material and/or workmanship under normal use and service for one (1) year from date of registered sale or date the unit left the factory if not registered. MEC Aerial Platform Sales Corp. further warrants the structural weldments of the main frame and scissor arms to be free from defects in material or workmanship for five (5) years from date of registered sale or date unit left the factory if not registered. Excluded from such warranty is the battery(s) which carries a ninety (90) day warranty from described purchase date. Warranty claims within such warranty period shall be limited to repair or replacement, MEC Aerial Platform Sales Corp's option, of the defective part in question and labor to perform the necessary repair or replacement based on MEC Aerial Platform Sales Corp's then current flat rate, provided the defective part in question is shipped prepaid to MEC Aerial Platform Sales Corp. and is found upon inspection by MEC Aerial Platform Sales Corp. to be defective in material and/or workmanship. MEC Aerial Platform Sales Corp. shall not be liable for any consequential, incidental or contingent damages whatsoever. Use of other than factory authorized parts; misuse, improper maintenance, or modification of the equipment voids this warranty. The foregoing warranty is exclusive and in lieu of all other warranties, express or implied. All such other warranties, including implied warranties of merchantability and of fitness for a particular purpose, are hereby excluded. No Dealer, Sales Representative, or other person purporting to act on behalf of MEC Aerial Platform Sales Corp. is authorized to alter the terms of this warranty, or in any manner assume on behalf of MEC Aerial Platform Sales Corp. any liability or obligation which exceeds MEC Aerial Platform Sales Corp's obligations under this warranty.



## **Aerial Platform Sales Corp.**

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