

**Model: JP100SSC  
Electric Towbarless Tug**



01/2018 – Rev. 05

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01	10/2014	Original Release
02	03/2015	Major revision
03	03/2016	Modified Parts Lists
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05	01/2018	Modified Parts Lists

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This product can not be modified without the written approval of Tronair, Inc. Any modifications done without written approval voids all warranties and releases Tronair, Inc., its suppliers, distributors, employees, or financial institutions from any liability from consequences that may occur. Only Tronair OEM replacement parts shall be used.

## 1.0 PRODUCT INFORMATION

### 1.1 DESCRIPTION

Electric towbarless tug with towing capacity of 100,000 lbs

### 1.2 MODEL & SERIAL NUMBER

Reference nameplate on unit

### 1.3 MANUFACTURER

**TRONAIR, Inc.**

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Website: www.tronair.com

## 2.0 SPECIFICATIONS

### 2.1 DIMENSIONS

Weight: 7000 lbs (3175 kg)

Length: 208 in (528 cm)

Height: 40 3/16 in (102 cm)

Width: 70 in (107 cm)

Ground Clearance: 5 1/2 in (10 cm)

Deck Height: 24 in (48 cm)

Cradle Depth, Usable: 24 in (61 cm)

Cradle Width, Inside: 34.25 in (87 cm)

Cradle Lift Height: 15° tilt, lifting NLG tires approximately 2-3 inches off ground

Cradle Capacity: 10,000 lbs (4,536 kg)

Aircraft Tire Range: Captures dual tires 17.5 in. O.D. to 24 in. O.D. (does not capture single wheel NLG)

Steering Axle Tire Size: (2) 4.80 x 8", 16" OD

Drive Tire Size: (2) 21 x 9 x 15

### 2.2 DRIVE SYSTEM

Traction Motor: Two 10HP Continuous Duty, 48 volt D.C., Separately Exited electric motors

Motor Controller: Two Sep-ex type DC motor controllers. Each rated at 500 amps 1 minute, 180 amps continuous.

Gear Reduction: Two 36:1 heavy duty gear reduction torque hubs

Empty Speed: 6.5 mph (10.5 kph)

Full Load Speed: 3 mph (5 kph)

Throttle type: Hall-Effect foot throttle

Battery Type: Deep Cycle 6 Volt (16 Total)

Battery Capacity: 430 Ah (20 hr rate) x 2

Charge Time: 8 hours, average, from full discharge

### 2.3 STEERING SYSTEM

PSM Proportional Steering Module (PSM) controls throttle proportion to each motor controller

Power steering Utilizes steering valve and rotary actuator to provide 5th wheel type steering with leaf spring suspension.  
Steers 87° in each direction

### 2.4 BRAKE SYSTEM

Regenerative The main dynamic braking system is programmable, regenerative braking provided by the motor controllers.

Foot Brake The back-up dynamic system is a foot operated, hydraulic over-ride on the parking brake.

Parking Brake The parking brake consists of two multiple disc, enclosed type, wet brakes. Maximum holding torque on the parking brake is 1273 in-lbs per side on the input side of the gear reduction hubs. Pressing the throttle and/or cradle movement releases parking brake.

### 2.5 OTHER STANDARD EQUIPMENT

Battery Charge Indicator with Hourmeter

Fire Extinguisher

Powder Coated Frame

Side Marker Lights

Front and Rear Facing LED Headlights

Cradle LED Headlight

Strobe Light

### 3.0 SAFETY

#### 3.1 USAGE AND SAFETY INFORMATION

To insure safe operations please read the following statements and understand their meaning. Also refer to your equipment manufacturer's manual for other important safety information. This manual contains safety precautions which are explained below. Please read carefully.



**WARNING!** — Warning is used to indicate the presence of a hazard that **can cause severe personal injury, death, or substantial property damage** if the warning notice is ignored.

**CAUTION!** — Caution is used to indicate the presence of a hazard that **will or can cause minor personal injury or property damage** if the caution notice is ignored.

#### 3.2 SAFETY SWITCHES (TUG)

1. The operator's seat switch (SW4) and proximity sensor 4 (SEN4) must both make contact to enable normal driving speed or move the aircraft. This means that the driver must be sitting and the cradle must be up.
2. The switch built into the throttle pedal (PED1) controls the parking brake release and the SRO input (Static Return to OFF) to the motor controllers. The switch changes state with very slight throttle movement.
3. The "Start" function of the key switch turns on all functions of the controller and causes Controller 2 to pull in K6 relay, which in turn pulls in K1 relay and line contactor (CONT1). If the key switch is turned to "Off" while in motion, the regenerative electric braking will bring the tug to a stop.
4. The E-Stop button at the driver's console turns off all control power. If the E-stop is pressed while in motion, the regenerative braking is turned off and the tug is brought to a stop by the parking brake.
5. If the E-stop at the left front fender is pressed, the regenerative braking will take effect.
6. The battery charger door, when open, shuts everything off with the exception of headlights and strobe. It does this by shutting off all power to the controllers causing K1 relay and the line contactor to be de-energized.
7. The aircraft selector switch sets the overload and oversteer protection levels for the aircraft chosen.

#### 3.3 SAFETY SWITCHES (CRADLE)

1. Proximity sensor 1 (SEN1) stops the Cradle Down movement when the cradle roller touches the ground.
2. While the JP100SSC is in "Creep Speed" for aircraft capture, the cradle safety bar shuts off the forward throttle when pressed by the NLG. This is accomplished through proximity sensor 2 (SEN2).
3. Proximity sensor 3 (SEN3) releases the parking brake any time a cradle movement button is pushed and the cradle arms are open less than 45°. This allows the tug to roll, as needed, to reduce load on the NLG during capture and release.
4. The cradle down sensor (SEN4), limits the tug to "Creep Speed" when the cradle is lowered.
5. Proximity sensor 5 (SEN5) in conjunction with SEN3, stops forward and reverse direction input when the cradle is open more than 45° but not fully open. This prevents attempted capture or release when the cradle is only partially open.

#### 3.4 DRIVING SAFETY

1. The JETporter, like any piece of machinery, should be operated by responsible personnel who are alert, attentive and aware of the potential for serious injury or death. Operators should not be under the influence of intoxicants, drugs or any substance that would alter or impair their actions or ability to make responsible and prudent judgments. No person should be allowed to operate the JETporter without reading and understanding this operator manual.
2. Operators are expected to know and observe all normal safety procedures for working around aircraft. The operator's knowledge of these general aviation safety procedures is a basic assumption for this manual. The omission of general aircraft safety procedures from the *JETporter* Operator's Manual is no excuse for the operator's failure to apply them.
3. Proper attire should be worn while operating *JETporter*. Loose fitting clothing should be avoided. Appropriate outdoor work shoes should be worn at all times.
4. Do not leave the JETporter until the parking brake is set.
5. Do not leave the JETporter unattended when children are present.
6. The JETporter is normally stopped by slowly releasing the accelerator pedal. If the pedal is released very slowly while on an incline, the tug will be reduced to a slow crawl instead of a complete stop. Using the foot brake will complete the stop. Holding the foot brake for 3 seconds with the tug at a complete stop will set the parking brake.
7. For the smoothest transition while towing an aircraft, the tug should be brought to a stop before changing direction on the F-N-R switch.
8. Always accelerate and brake as smoothly as possible to prevent possible aircraft damage.
9. For moving aircraft up or down inclines/slopes, a qualified operator should be in the aircraft cockpit to utilize the aircraft's brakes for safety/backup.
10. When moving in reverse direction, look both ways and clear the area of other traffic and obstacles.
11. Always wear seatbelt.

### 3.4 DRIVING SAFETY *(continued)*



#### WARNING

**Do not allow anyone to sit or ride on the diamond plate or front fenders of the JETporter while in motion.**

### 3.5 BATTERY SAFETY

1. The diamond plate over the batteries should be open when charging the batteries. During the charging cycle, explosive hydrogen gas is expelled. Open flame or sparks must be avoided. Do not smoke near the batteries while charging.
2. **Important!** All switches need to be turned off before plugging in the JETporter for charging.
3. Eye protection and rubber gloves should be worn when adding water or working with the batteries. Remember that the current capability of the batteries is extremely high.
4. Read SECTION 7.0 Battery Care and understand safety procedures for working around batteries.

### 3.6 MOVING DISABLED TUG

1. The JETporter is equipped with a mechanical parking brake that is set when there is no hydraulic power. If the JETporter needs to be towed, the torque hubs must be unlocked as shown. Unlocking the hubs allows the drive wheels to turn without turning the brake or motor.
2. If the hydraulic pump does not run, the tug can still be maneuvered with the steering wheel. Move the steering wheel slowly (it will be hard to turn) as the tug is rolling.



To unlock hub, remove two bolts and reverse plate so rounded "nub" faces inboard. Replace and snug bolts.

#### WARNING



**When the torque hubs are unlocked, the JETporter does not have brakes. Move the JETporter slowly. Wheel chocks must be used for stopping.**

## 4.0 TRAINING

### 4.1 TRAINING REQUIREMENTS

The employer of the operator is responsible for providing a training program sufficient for the safe operation of the unit.

### 4.2 OPERATOR TRAINING

The operator training should provide the required training for safe operation of the unit.

**NOTE: Maintenance and Trouble Shooting are to be performed by a skilled and trained technician.**

## 5.0 OPERATING INSTRUCTIONS



#### WARNING

**Do not make sharp turns while moving rapidly. Always look behind you before backing up.**

### 5.1 GENERAL INSTRUCTIONS

1. To start, the E-stop button on the driver's console must be in the released position, the E-stop button on the left front fender must be in the released position, and the charger plug door must be closed. To release E-stops, turn clockwise and release.
2. Sit down in the operator's seat. Turn the "Off- On-Start" switch to "Start" and hold for one second. You will hear the hydraulic pump run as the accumulator charges. Release switch to "On" position.
3. Make sure the cradle is completely closed and completely up before moving. This is accomplished by pressing the "Cradle Closed" rocker switch until movement stops, and pressing the "Cradle Up" rocker switch until movement stops.
4. This tug is NOT designed to coast. Accelerating, braking, and maintaining a constant speed, are all very dependent on foot pedal position. This results in a tug that is very easy to drive and extremely easy to control on inclines. Push the throttle pedal to accelerate, slowly release the throttle to brake. Hold the throttle steady for a steady speed.
5. The switch located under the driver's seat and the proximity switch for the "Cradle Up" position must both make contact before the Jetporter will drive at normal speed (approximately 5.5 MPH). It will otherwise be limited to "Creep Speed".
6. The Forward-Neutral-Reverse (F-N-R) toggle switch is on the center console. When initially starting the JETporter, move the F-N-R switch to the Neutral position before choosing a direction. Any time the JETporter is turned off and re-started, the F-N-R switch must be returned to the Neutral position.
7. To set the parking brake, press and hold the foot service brake for 3 seconds without touching the accelerator pedal, then release. The parking brake will also set when the key is turned off or when the E-Stop button is pressed. (Either of the latter two actions will cause the hydraulic accumulator to discharge.)

5.1 General instructions continued on following page.

## 5.1 GENERAL INSTRUCTIONS *(continued)*

### WARNING



Turning the “Off-ON-Start” switch to “Off” while driving will result in a regenerative braking stop. Pressing the Emergency-Stop button on the left front fender will result in a regenerative braking stop. Pressing the Emergency-Stop button on the driver’s console will cut all control power and the JETporter will be brought to a stop by the parking brake.

8. The JETporter steers very easily. Turning the steering wheel 3-1/4 turns from center will result in turning the steering tires approximately 88°. During a sharp turn, both motors will slow down and the inside motor will slow to a stop. The JETporter is designed to be very maneuverable at slow speeds in tight places, NEVER enter into a turn at high speed. Loss of control will cause personal injury and property damage. Do not move your JETporter any faster than is necessary.
9. The JP100SSC is intended to be driven while standing for capture and release. The steering console can be fully raised to allow the driver to stand for positioning the tug at the aircraft nose wheel. While the driver is in the standing position, the JETporter will be limited to “Creep Speed”. This provides better throttle control for capture and release. To protect both the driver and the aircraft, the JETporter will not have sufficient power to move an aircraft while in “Creep Speed”. Care needs to be taken while driving the tug from a standing position. Do not apply any sudden throttle or brake that may cause loss of balance. Never drive while standing except for very slow final positioning. Do not allow anyone in the passenger compartment to stand while the tug is in motion. The steering console is raised by pulling the lever on the right hand side of the console and lifting upward.

### WARNING



Do not make sharp turns while moving rapidly. Always look behind you before backing up.

## 5.2 CAPTURE OF THE NOSE LANDING GEAR (NLG)

### WARNING



Be extra careful when moving aircraft on inclines as aircraft or tug may move unexpectedly. Make sure no personnel are in the direct path of the aircraft or tug.

### WARNING



Pay close attention to scissor location, whether connected or disconnected. Be certain that scissors are not damaged as cradle is closed and raised.

- a. Move the aircraft selector switch to the proper position for the aircraft being moved. The aircraft selector switch is extremely important for the protection of the aircraft. The selector switch sets the overload protection and oversteer protection for the aircraft chosen.
- b. Approach the aircraft while making best attempt to align with the NLG. The reflectors on the top of the JETporter and inside the cradle can be used to aid in alignment.
- c. Stop 2-3 feet short of the NLG.
- d. Stand while capturing aircraft. Raise the steering console to the full up position (must use sliding release lever on right hand side of console).
- e. The JETporter will now be limited to “creep-speed”.
- f. Push the “Cradle Down” button until movement stops.
- g. To open the cradle, push the “Cradle Down” and “Cradle Open” button simultaneously. Hold both buttons until cradle movement stops.
- h. Drive toward the NLG while centering the white rollers with the NLG tires.
- i. If the NLG is not aligned with the aircraft body, align the JETporter with the angle of the NLG.
- j. When the cradle bar contacts the NLG tires, the throttle will disengage.
- k. Push the “Cradle Close” button until movement stops. If the aircraft has the brakes set, do not use the JETporter foot brake during capture. The JETporter will roll, if needed, during the capture process to prevent horizontal force on the NLG.
- l. Push the “Cradle Up” button until movement stops. The cradle MUST be in the full up position to move the aircraft.
- m. Lower the steering console and sit in the driver’s seat. With the cradle up and the driver sitting in the seat, the JETporter will have power available for pushing or towing.

## 5.3 MOVING THE AIRCRAFT

Move the aircraft by choosing the direction of desired travel and slowly pressing the foot throttle.





## 5.0 OPERATING INSTRUCTIONS *(continued)*

### 5.4 RELEASE OF THE NOSE LANDING GEAR (NLG)

- a. Stand while releasing aircraft. Raise the steering console to full up position (must use sliding release lever on right hand side of console).
- b. To release the aircraft, push the “Cradle Down” button until movement stops. Do not use the JETporter foot brake during release. The Jetporter will roll, if needed, during the release process to prevent horizontal force on the NLG.
- c. To open cradle, push the “Cradle Down” and “Cradle Open” button simultaneously. Hold both buttons until cradle movement stops.
- d. Back straight away from the aircraft. Do not attempt to turn the JETporter until the cradle is completely clear of the aircraft tires.
- e. When clear of the aircraft, push the “Cradle Close” button until movement stops.
- f. Push the “Cradle Up” button until movement stops.
- g. Lower the steering console and sit in the driver seat.
- h. Full power is available when the cradle is up and the driver is in the seat.

### 5.5 BRAKING

The JP100SSC has two separate braking systems. The main braking system is the regenerative braking provided by the drive motors. As the throttle is let up the motors begin braking. The motors act like generators trying to force a charge back into the batteries.

**Note: This tug is designed NOT to coast**

Holding the throttle steady will result in a steady speed. “Pumping” the throttle will result in speed fluctuations (the same as accelerating and braking). Regenerative braking, as currently programmed, will provide approximately 1800 ft-lbs of torque at the drive wheels.

The parking/foot brake consists of two “multiple disc type” brakes, one on each drive motor. These are located between the motor and the gear reduction hub. The brakes are spring set and will provide approximately 7630 ft-lbs of torque at the drive wheels. The brake is hydraulically opened when the throttle pedal is used. When the throttle is let up the brake valves will activate in 2 seconds (programmable) if there is no regenerative braking taking place. After the valves shift the hydraulic fluid bleeds through an orifice adding another second before the brakes reach full potential. If sitting on an incline hold the foot brake for 3 seconds before leaving the tug with the key on.

The foot brake overrides the hydraulics that release the parking brake. The foot brake can be used when needed and should be used when coming to a stop on a slope.

**Note: the parking brake will not set if the tug is rolling enough to cause regenerative braking current.**

The foot brake may also be needed during cradle movement if the tug is on an incline (the parking brake will release during cradle movement) but should not be used while closing the cradle gates of lifting or lowering an aircraft that has the MLG brakes set. In this situation the JP100SSC need to be able to roll to the aircraft position.

### 5.6 BATTERY CHARGE INDICATION

The batteries should be recharged when the state of charge indicator has declined to 30-40% (two yellow lights on).

## 6.0 BATTERY CARE

This section provides general instructions for good battery care. Please refer to Appendix in this section for additional information on battery care.

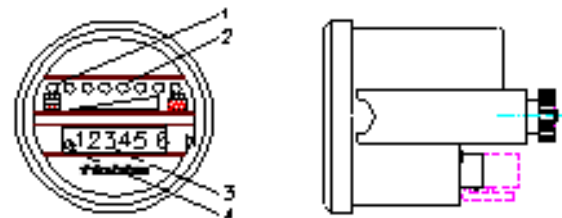
### 6.1 WATER

1. Add approved water only to a fully charged battery. You can use local tap water as long as it is not high in mineral deposits or other hard deposits.
2. Keep electrolyte water level above separator protectors.
3. Keep battery cells filled to proper level. Low water can cause permanent damage to batteries.
4. Check water level once a week. Replace water lost to evaporation. Never add water to a discharged battery.
5. Never add sulfuric acid to a battery.
6. Do not transfer acid from one cell to another.
7. Never allow the batteries to stand in an uncharged state. Plate damage will occur.

### 6.2 CHARGING

1. Keep battery compartment open during charging to ensure proper ventilation.
2. The batteries should be recharged when the state of charge indicator has declined to 30-40% (two yellow lights on).
3. Keep flame and metal away from the battery tops to prevent battery gasses from exploding.
4. Cool before charging or operating, if battery is above 115° F.

6.0 Battery care continued on following page.



- 1 = red LED „Charge battery now (BATTERY BELOW 25%)  
 2 = yellow multi LED bar display for residual capacity of battery (RECOMMEND CHARGING WHEN TWO YELLOW LIGHTS REMAIN)  
 3 = LC display for hour counter  
 4 = operation indication for hour counter

**6.0 BATTERY CARE** *(continued)***6.3 PRECAUTIONS**

1. Keep battery tops clean and dry.
2. Be sure battery caps are on and secure for spark protection.
3. Check specific gravity levels on a regular pre-determined schedule, after charging, but not directly after service watering. The specific gravity of a fully charged cell should be at least 1.235 and show less than 50 points difference between high and low cells in the same battery.
4. Do not overcharge batteries. Allow several hours use between charges.

**6.4 SAFETY**

1. Always wear eye protection and rubber gloves when working with batteries.
2. Never wear jewelry, watches or rings while working around batteries.
3. When working on *JETporter*, always remove all power leads from batteries. The battery pack is capable of extremely high currents and could cause serious damage or injury if short-circuited.
4. If battery acid is accidentally spilled on the skin, immediately flush the area with large amounts of water. **Electrolyte splashed in the eyes is extremely dangerous!** If this should happen, force the eye open and flood it with cool, clean water for approximately fifteen minutes. A doctor should be called immediately when the accident occurs.
5. If you have any doubts or questions, contact Tronair, Inc.
6. The tug charging location should have good ventilation to the outside air. Signs should be posted for "Explosive Gases", "No Smoking", "No Sparks", "No Open Flames". Check for additional local ordinances concerning battery-charging safety.

**7.0 UNDERSTANDING SYSTEM FUNCTIONS FOR TROUBLE SHOOTING****7.1 JP100SSC DRIVE TRAIN SYSTEM**

The JP100SSC is powered by two 10HP continuous rated separately excited 48 volt DC motors. The motors are connected directly in-line with the brakes and torque hubs for maximum mechanical efficiency. The maximum combined torque capability for break-away, at the gear hub output (36:1), without programmed limits, is 6500 ft-lbs.

The motors are driven by two separate motor controllers; each is rated at 500 amps for 1 minute and 180 amps continuous. The controllers are linked together through a PSM. The PSM delivers the throttle signal to each controller. The signal is based on foot throttle position and steering wheel position.

The maximum loaded driving speed is approximately 3 MPH. The maximum empty driving speed is approximately 6.5 mph. Acceleration and deceleration rates are programmed for smooth starts and stops thereby limiting the load applied to the NLG.

**7.2 OVER-LOAD SYSTEM**

The output torque, and thereby drawbar pull, is controlled by programming maximum amperage limits for a given input. The input signal is provided by a three position selector switch, used as an aircraft type selector. The present limits are set for draw-bar pulls of 3700 lbs. (low), 5400 lbs. (medium) and 7000 lbs. (high). If a situation is encountered that requires higher amperage than the pre-set limit, the JP100SSC will come to a stall.

**7.3 BRAKE DESCRIPTION**

The JP100SSC has two separate braking systems. The main (dynamic) braking system is the regenerative braking provided by the drive motors. As the operator reduces pressure or force on the foot throttle, the motors begin braking. The Tronair JP100SSC TLTV is designed to NOT coast. Holding the throttle steady will result in a steady speed. Releasing the throttle will apply programmed regenerative braking. Regenerative braking, as currently programmed, will provide approximately 1800 ft.-lbs. of torque at the drive wheels.

The parking/foot brake consists of two "multiple disc type" wet brakes, one on each drive motor. These are located between the motor and the gear reduction hub. The brakes are spring set, and will provide approximately 7630 ft.-lbs. of torque at the drive wheels as a parking brake. The brake is hydraulically opened when the throttle pedal is used. When the throttle is let up, the brake valves will activate in 2 seconds if there is no regenerative braking taking place (no significant movement). After the parking brake valves shift, the hydraulic fluid bleeds off through an orifice adding another second before the brakes reach full potential. If sitting on an incline, hold the foot brake 3 seconds for the parking brake to set before leaving the tug with the key on.

The foot brake overrides the hydraulics that release (open) the parking brake. The foot brake can be used when needed, and should be used when coming to a complete stop on a slope. Note: the parking brake will not set if the TLTV is rolling enough to cause regenerative braking current. The foot brake may also be used during cradle movement if the tug is on an incline but must not be used while closing the cradle gates or lifting or lowering an aircraft that has the MLG brakes set. In this situation the tug needs to be able to roll to the aircraft position. The foot brake is an entirely manual system (no power assist).

**7.0 UNDERSTANDING SYSTEM FUNCTIONS FOR TROUBLE SHOOTING** *(continued)***7.4 CRADLE SYSTEM**

The cradle system is a capture type that makes contact with the NLG tires only. When the cradle is down, the tires sit between 45° plates at the front and rear of the cradle. When the cradle is raised, it is tilted back at a 15° angle. The tilt puts the rear plate of the cradle at 30° and the front plates at 60°. At this time, the aircraft tires are 2-3 inches off the ground.

Capacity of the cradle is 10,000 lbs. vertical lift (tilt). Draw bar capacity is 7000 lbs. Capture range is from 17.5 inch O.D. tires to 24 inch O.D. tires (dual only).

The driver of the Tronair JP100SSC drives the TLTV to within 2-3 feet of the NLG. The driver makes an attempt to center the TLTV with the NLG on the initial approach. The driver then stops and lifts the steering console of the TLTV for stand-up driving.

The driver lowers the cradle, by holding the “cradle down” switch, until cradle motion stops. This is done from either the stand-up driver’s position or the front fender position. The cradle stops its downward motion when a bottom roller causes a proximity switch to trip. The act of lowering the cradle automatically puts the TLTV in “creep speed” for approaching the aircraft.

The driver then opens the cradle by holding both the “cradle down” and the “cradle open” switch at the same time. Both switches are held until cradle motion stops. Motion is stopped when the side cradle cylinders reach the end of their stroke.

The driver proceeds to drive the TLTV forward and aligns the upper rollers with the ribs of the NLG tire tread. This is an accurate centering method. When NLG tires make contact with the “rear cradle bar”, the forward throttle shuts off.

The driver then presses and holds the “cradle close” switch until cradle motion stops. When the cradle gates swing past the 45° position, the parking brake on the TLTV is released. This allows the TLTV to roll in relation to the aircraft to avoid horizontal loads on the NLG. The gates continue to close until hydraulic fluid flows over a pre-set relief valve, causing cradle motion to stop. The relief valve is set at 450 PSI. The effective area is 2.35 in<sup>2</sup>. The pulling force or preload on each swing gate becomes 1050 lbs. The cylinders are locked in place with individual P.O. check valves mounted on each cylinder.

The driver then presses the “cradle up” switch until cradle motion stops. The cradle tilts to a 15° angle. Between 13° and 15°, the cradle makes contact with a proximity switch. Also, the upper hold-down arms lock in place between 13° and 15°. The driver lowers the console to allow driving in the sitting position. The combination of the driver sitting in the seat, and the cradle fully raised, take the TLTV out of “creep speed”.

To unload the aircraft, the driver stops and raises the steering console for the standing position. The driver presses the cradle down button until cradle movement stops. The start of the downward movement (between 13° and 15°) releases the upper hold-down arms. With the cradle down, the TLTV is restricted to “creep speed”. The driver fully opens the cradle until cradle motion stops, then backs straight away from the aircraft without turning the steering wheel until the NLG is clear. There is a proximity switch on the top of the cradle that prevents backing away from the aircraft with the gates in a partially open condition.

The cradle must be raised and the driver must be sitting before the TLTV can be driven above creep speed. There is a seat switch to prevent the operator from moving the aircraft from a non-seated position.

An adjustment for the height of the hold down rollers must be made if the aircraft strut has a cant (angle) of 5° or more.

**7.5 HYDRAULIC SYSTEM AND STEERING**

The hydraulic system is used for parking brake release, all cradle motion, and steering. See INS-2162 hydraulic schematic.

**7.6 RELAY AND SENSOR FUNCTION (ELECTRICAL TROUBLE SHOOTING)**

- K1 is a 3PDT relay activated by the momentary switch KS2 and held by a latching circuit (pos.) and input from Controller 2 (neg.). K1 makes the connection for all 24VDC and 48VDC control circuits requiring the activation from the “OFF ON START” switch.
- K2 relay is activated and held in by the use of ANY cradle control rocker switch. K2 is also energized by the pressure sensor when hydraulic pressure drops below 1000 PSI and until hydraulic pressure reaches 1500 PSI. K2 makes a 48VDC connection to Contactor 2 (starts hydraulic pump).
- K3 completes the SRO (deadman) input connection.
- K5 is a 4PDT low amperage relay. The purpose of this relay is to switch the accelerator circuit from normal acceleration to “Creep” speed. When activated, the relay allows normal acceleration. Activation of this relay requires:
  - a. Seat Switch SW4 must be closed.
  - b. The cradle must be in the full-up position for contact with SEN 4 proximity sensor.When K5 is deactivated, the accelerator circuit is routed through VR1 and reduced to “Creep Speed”.

*7.6 Relay and sensor function (electrical trouble shooting) continued on following page.*

7.6 RELAY AND SENSOR FUNCTION (ELECTRICAL TROUBLE SHOOTING) *(continued)*

- K6 is activated when Controller 2 Pin 14 [C2 P14] receives a signal from the “OFF ON START” switch. The controller provides the negative connection [C2 P18] to the coil of K6. The purpose of K6 is to provide the negative connection to K1, K16, and Contactor 1 via output from Controller 2 Pin 18.
- K7- Horn relay.
- K8 is activated when K11 is de-activated and the “Cradle Down” button is pressed (roller touching ground). This allows the “Cradle Open” motion. K8 must be deactivated for “Cradle Up”.
- K9 is best explained in the following manner. The solid state switch at the top of the accelerator pedal puts out a 5 volt signal. This signal, via solid state relay K15, sends a 24VDC signal to Controller 1 Pin 14 [C1 P14]. The input at pin 14 gives a negative output at Controller 1 Pin 18 [C1 P18] to activate K9. The purpose of K9 is to release the parking brake and send the SRO (dead-man) signal to Controllers 1 and 2.
- K10 is to shut off forward throttle when the cradle bar comes in contact with the NLG while in “Creep” mode. K10 is activated by proximity switch SEN 2.
- K11 is activated by SEN 1 until the cradle roller touches the ground. K11 allows “Cradle down” motion anytime the cradle roller is off the ground and the “Cradle Down” button is pressed.
- K12 receives power from K17 to release the parking brake anytime a cradle control rocker switch is pressed and the cradle arms are closed past mid swing (approximately 45°).
- K13 cuts the signal to the Forward / Reverse switch when SEN 5 is energized (cradle not fully open) AND K18 is de-energized.
- K15 is a solid state relay that sends a 24 volt signal to Pin 14 of Controller 1 as the accelerator pedal is lightly pushed. It operates on 5 volts initially supplied to the accelerator pedal by the Proportional Steering Module (PSM) and is switched on by the initial movement of the accelerator pedal. Input to Controller 1 Pin 14 causes a negative output at Pin 18 which releases the parking brake.
- K16 is to turn off the 24 volt to the connection to the battery when the 48 volt connection is lost. K16, K1, and Contactor 1 are all turned on by K6.
- K17, when energized, supplies the negative for the coils of K12 and K18. K17 is energized by SEN3 while cradle arms are closed and to approximately 45° open.
- K18 cuts the signal to the Forward / Reverse switch when SEN 3 is de-energized (cradle partially swung open) AND K13 is energized.
- K20 adds a redundant feature to the cradle open circuit. The cradle will not open in the full up position if SEN4 sensor is made.
- VR1 adjusts creep speed. Move in small increments.
- Proximity Sensor 1 (SEN1) stops cradle down movement by energizing K11.
- Proximity Sensor 2 (SEN2) stops forward throttle in Creep Speed by de-energizing K10 when the cradle safety bar contacts the NLG.
- Proximity Sensor 3 (SEN3) releases the parking brake during cradle movement if the cradle arms are open less than 45°. SEN3 energizes K17 to release brakes.
- Proximity Sensor 4 (SEN4) de-energizes K5 to limit the tug to Creep Speed when the cradle is down.
- Proximity Sensor 5 (SEN5) stops forward and reverse direction input through K13 if the cradle gates are not fully open.

7.7 PRELIMINARY TROUBLE SHOOTING

Won't Start	Is the E-stop at the driver's panel pressed?	E-stop must be released. Turn clockwise to release
	Is the charger plug door open?	Door must be closed to contact limit switch
	Was the On switch held in the Start position?	May have to hold in Start position 1-2 seconds
	Is the battery dead?	Check battery charge
	Has the battery been unplugged from the vehicle?	Check under the passenger's side battery cover to see that the battery is plugged into the vehicle
Won't Move (no forward or reverse) Normal Speed	Is the E-stop on the front left fender pressed?	E-stop must be released. Turn clockwise to release
	Is the cradle up all of the way?	The cradle must be up to contact the “cradle up” sensor
	Is the driver sitting in the seat?	Switch in seat must make contact
	Is the seat against the rear support frame?	Seat must be clear of frame for switch to make contact.
	Is the cradle partially open?	Movement of tug requires that the cradle be completely open or more than 45° closed
Will Move at Normal Speed but Won't Move at Creep Speed	Is the forward cradle safety bar pressed? (will not move forward)	If pressed, or stuck in the pressed position, the forward cradle safety bar will shut off the forward throttle
	Is the creep speed adjusted too slow?	Potentiometer VR1 adjusts creep speed (inside driver's console)

## 8.0 MAINTENANCE SCHEDULE

### WARNING



All work on the *JETporter* tug should be performed by competent repair personnel. Before performing maintenance, review all safety procedures.

### WARNING



Be certain the *JETporter* is turned off (including driver's E-stop switch) before performing any maintenance. Unplug the battery from the *JETporter* when working with or near electrical connections. The hydraulic accumulator can hold pressures up to 2500 PSI while the power is turned on. The accumulator will dump system pressure through valve SV4 when the power is turned off. This release of pressurized fluid into the reservoir can be heard every time the *JETporter* is turned off may take as long as 15 seconds.



### WARNING

Battery acid is corrosive. Wear gloves and eye protection when servicing batteries.

### 8.1 DAILY OPERATOR CHECKS (BEFORE FIRST USE)

#### 8.1.1 Headlights

1. Check all headlights for proper function, forward facing, rear facing, and cradle light.

#### 8.1.2 Battery Cover

1. Check the battery cover (deck lid) hold down straps/latches. They must be latched and not damaged.

#### 8.1.3 Check The Cradle For Proper Function

2. Lower cradle to ground until movement stops.
3. Fully open the cradle (must hold "Cradle Down and "Cradle Open" buttons).
4. Fully close the cradle.
5. Fully raise (tilt) the cradle.

#### 8.1.4 Upper Arm Locking Function

1. With the cradle fully raised, lift each roller arm to check the locking mechanism. The arm will have some play but should be locked in position.
2. Lower the cradle enough to expose 1 inch of the cylinder rod. Lift each roller arm. The arms should move freely up and come down under their own weight.

#### 8.1.5 Check For "Creep Speed" Function

1. Raise the steering cowl and stand in the driver's position. Press the accelerator pedal to test the "creep speed" function.

**NOTE: Inform maintenance personnel if any problems are found.**

### 8.2 WEEKLY MAINTENANCE CHECKS

#### 8.2.1 Check Brake Reservoir

Remove reservoir cover. Collapse diaphragm; fill to level indicated on reservoir. Loss of fluid in the reservoir is an indication of external leakage.

#### 8.2.2 Perform Battery Maintenance

See section 6.0 on battery care.

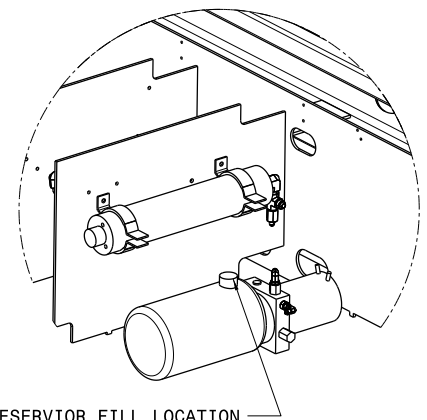
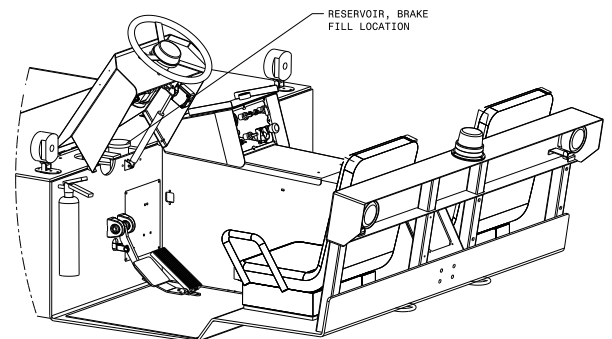
### 8.3 MONTHLY MAINTENANCE CHECKS

#### 8.3.1 Reservoir Level

Check main hydraulic reservoir fluid level. Cradle must be in full up position with gates fully closed. All power must be turned off so that the accumulator discharges all fluid into the reservoir. Remove the reservoir cap and check the fluid level. Level should be maintained at approximately 1 inch from the top of the reservoir. Fill with Mobil DTE 10 Excel 32. Loss of fluid in the reservoir is an indication of external leakage.

#### 5.3.2 Repeat Daily Check

Run through the Daily Operator Check sequence.



8.0 Maintenance schedule continued on following page.

HYDRAULIC RESERVIOR FILL LOCATION

**8.0 MAINTENANCE SCHEDULE** *(continued)***8.4 THREE MONTHS OR 125 HOURS MAINTENANCE CHECKS****8.4.1 Torque Hubs**

1. Check the gear lube level in the torque hubs. Turn the front drive wheels so that the plugs in the torque hubs are at 12:00 and 3:00. Remove the plug at the 12:00 position and check for excessive metallic debris on the magnet. If excessive debris is present, or if moisture is present, the hub should be drained. Turn the wheel so that one of the plugs is at the 6:00 position. Remove both plugs and drain the fluid.
2. Turn the wheel until the plugs are at 3:00 and 12:00. Fill with 80W/90 gear oil through the 12:00 position until fluid flows out the 3:00 position. Clean and re-install plugs.
3. If the fluid does not need to be drained, loosen the plug at the 3:00 position to check the fluid level. If the fluid level is not up to the 3:00 position, add 80W/90 gear oil at the 12:00 position until fluid flows from the 3:00 position. Re-install plugs.

**8.4.2 Battery Cable And Hydraulic Hose Routing**

1. Open both battery covers (deck lids). Unplug the battery from the JETporter tug. Remove the front motor covers (two center panels).
2. Trace all cable routing through the frame openings. Check for chaffing or other damage on cables. Check cable ends for loose connections. Check battery cable ends for corrosion. Clean corroded cables with baking soda. Coat the terminals of the batteries with acid neutralizing coating when necessary. If battery acid should spill into the battery box or on metal parts, flush with water and baking soda.
3. Trace all hydraulic hoses through the frame openings. Check for chaffing or other damage on hoses. Check for leaks at hose ends. If hoses need to be tightened, do not allow them to twist during the tightening process. Hydraulic hoses should never be twisted.

**8.4.3 Steering**

1. Raise the steering console. Check to make sure that the hydraulic hoses are not being pulled when the console is lifted and that no chaffing is occurring.
2. Lower the steering console. Look under the JETporter at the rear steering plate. Make sure that all hoses are clear from the path of the steering plate as it turns through its 175° rotation.
3. Check hose ends for leaks.
4. Visually look at the leaf spring and axle assembly. Check to see that all spring mounting hardware, including U-bolts, tie plates, and rear links, are visibly intact and tight.
5. The JETporter, while unloaded, should sit level with the ground or with the rear slightly elevated. A JETporter that sits with the rear of the frame lower than the front might indicate a problem with the rear springs or axle.

**8.4.4 Steering Console Gas Strut**

Pull the lift lever on the steering console (right hand outside of console), and lift the steering console all the way up. The steering console should stay up without drifting down. If the strut drifts down, or if the console is difficult to lift, the upper attachment point of the strut may need adjustment. The nut on the rod at the attachment point can be loosened so that the rod can be turned by hand. Adjust the rod so that the pin in the end (release valve) is not at all depressed when the lift lever is released, but depresses far enough to not restrict movement when the lift lever is pulled. If the strut cannot be properly adjusted, it may be damaged or otherwise defective.

**8.4.5 Motors And Controllers**

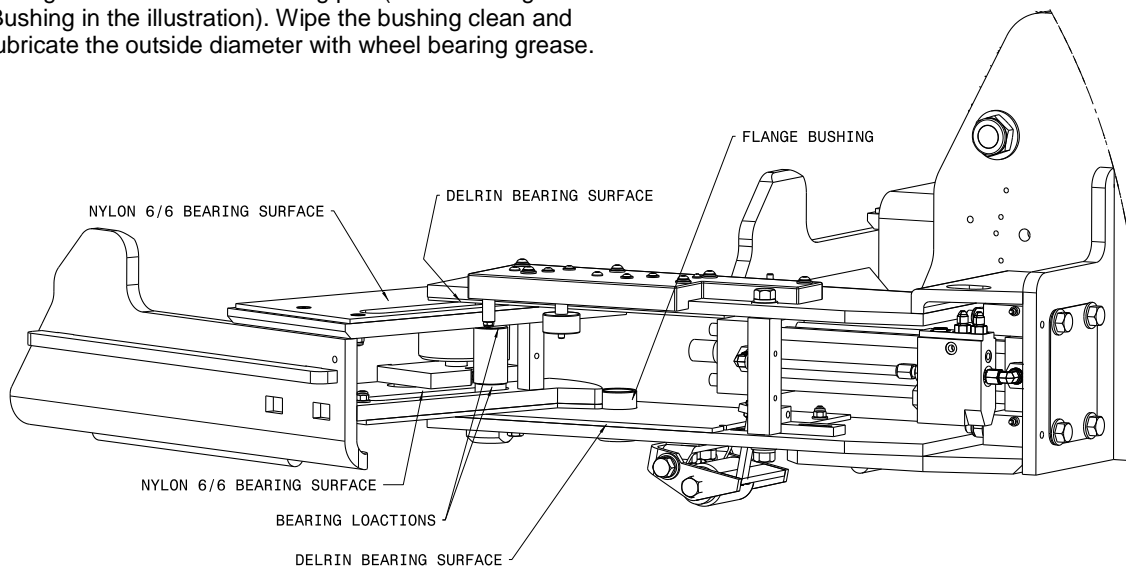
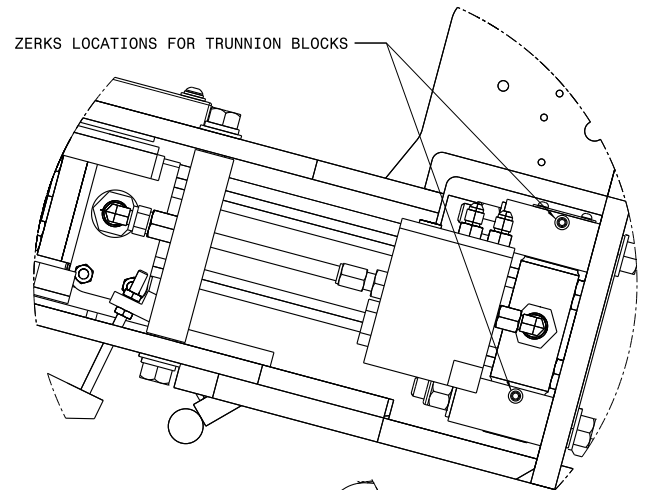
1. Test drive the JETporter. Any problems in the performance character should be noted and addressed. A bad or loose steering potentiometer might have symptoms such as periodic slow down, picking up speed when beginning a turn, or the feel that one drive wheel is trying to apply braking.
2. If problems are suspected, jack the drive wheels off the floor in the following manner: With the cradle fully closed and partially tilted, place 4x4 boards under the bottom edge of the front cradle gates. Lower the cradle onto the 4x4s until the front drive wheels are 1 ½ to 2 inches off the floor.
3. Now turn the steering wheel until the steering tires are aimed straight forward. Set the direction toggle to Forward. Press the accelerator pedal to run at approximately ½ throttle. The wheels should both turn at the same speed with the steering tires pointed straight ahead. Slowly turn the steering wheel to the left. Both drive tires should slow down. The left tire should slow to a stop. Now slowly turn the steering wheel for a full right turn. As you pass center both wheels should run at the same speed. As you approach the right, both wheels will slow down and the right wheel will slow to a stop.

Different results are an indication of a problem. Consult Tronair to aid with trouble shooting.

## 8.4 THREE MONTHS OR 125 HOURS MAINTENANCE CHECKS *(continued)*

### 8.4.6 Cradle Lubrication

1. Remove the side panels from the capture cradle (two on each side).
2. Use a grease gun to lubricate the rear trunnion mount blocks. There will be one grease zerk on the outside of each block, two blocks per side. See illustration for location
3. Open the cradle all the way. Use compressed air to blow out excessive dirt when possible. Visually look at the lower Delrin (plastic) bearing pads (lowest bearing pad on each side). They will visibly be scuffed, scratched and gouged; this is normal. Look for any wear that has resulted in actual deep dishing of the material. If wear points become significantly thinner than the surrounding material, the bearing pad should be changed before failure occurs. Notify Tronair if this type of wear is found.
4. With the cradle open, find the bushing that comes up through the lower Delrin bearing pad (labeled Flange Bushing in the illustration). Wipe the bushing clean and lubricate the outside diameter with wheel bearing grease.



### 8.4.7 Tire Wear

Check wear on the drive and steering tires. Check for un-even wear. Check for tire cracking. The shallow tread pattern in the center of the tires may wear away in the range of 300 to 400 hours of use, depending on factors such as towing weight and pavement porosity. There is no determined depth at which the tires are worn out. The tires need to be in good condition (even wear and no cracks) and be suitable for the environment they are being used in. In extreme wear cases, ground clearance will be reduced. It will be necessary to establish a "life span" in hours, for both drive and steering tires, so that plans can be made for replacement. For reference, the drive tires are 21" O.D. at the center when new. The steering tires are 16" O.D. at the center when new.

### 8.4.8 Brake Testing

The brake and be tested for full release and full set in the following manner:

#### Full Release:

1. Lower the cradle fully closed, use a 4 x 4 under the full front edges of both cradle gates. Lower the cradle onto the 4 x 4 until the drive wheels are 1 ½ to 2 inches off the ground.
2. Turn the Forward/Neutral/Reverse switch to Neutral.
3. This step will take two people. Have one person press the accelerator pedal (with FNR switch in Neutral) while the other person attempts to turn the drive wheel by hand. The wheel will turn hard due to the 36:1 drive ratio. Grab the tire by the tread, lean into it and turn it. If the brakes are fully released, it will turn.
4. If the unit fails this test, notify Tronair for trouble shooting.

*8.4.8 Brake testing continued on following page.*

## 8.4.8 Brake Testing (continued)

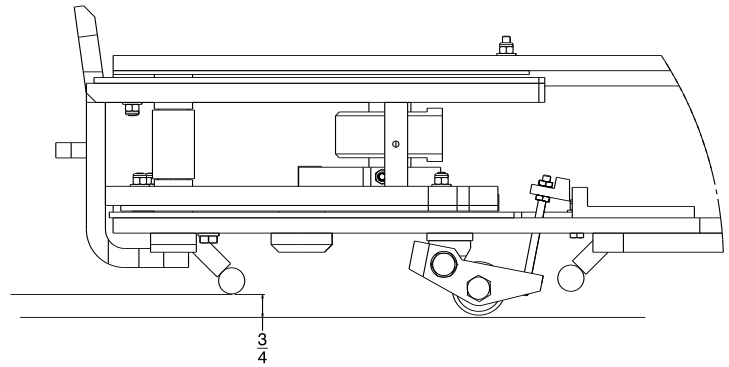
Full Set:

1. Lower the cradle fully closed, use a 4 x 4 under the full front edges of both cradle gates. Lower the cradle onto the 4 x 4 until the drive wheels are 1 ½ to 2 inches off the ground.
2. Open the battery cover on the driver's side to expose the hydraulic valve manifold.
3. Remove the connector plugs (gray) from valves SV3 and SV5. Be sure to write down the wire numbers for re-installation.
4. Turn the Forward/Neutral/Reverse switch to Forward.
5. Press the accelerator pedal for a count of 3 seconds and release. Do not press for more than 3 seconds. The parking brake should be tight enough to prevent wheel spin under full load conditions. **Caution: this procedure applies full amperage to the motor in a locked rotor condition. Do not test twice without a significant cooling period in between.**
6. If the unit fails this test, notify Tronair for trouble shooting.

## 8.4.9 Cradle Ground Clearance

The proximity of the cradle to the ground at the time of capture is important to get the best capture and best lift on the NLG. The stopping distance from the ground is adjustable at the roller switch on the driver's side of the cradle.

1. Find the flattest available area of concrete to park the tug and make this adjustment.
2. With the cradle full retracted (Cradle In) and fully lowered (Cradle Down) measure the distance from the lowest part of the cradle gates to the ground. For best performance this distance should be maintained at ½ to ¾ inches from the ground. For consistency measure at the inside edge of the gate, closest to center.
3. If adjustments need to be made, remove the sheet metal side plates (2) from the driver's side of the cradle exposing the cylinder and roller switch area.
4. Adjustments can be made to the height of the steel block on the ¼ - 20 studs and to the position of the aluminum mounting block housing the proximity sensor.
5. Recent parts released (K-5157) consisting of a new proximity sensor mounting block (J-6291) and shims (S-2989-01) will allow increased adjustment of the mounting block position.



## 8.5 TWELVE MONTHS OR 500 HOURS MAINTENANCE CHECKS

### 8.5.1 Wheel Bearings

Repack steering axle wheel bearings. If repair is needed, the hub, bearings, grease seal, and dust cap can be purchased as a set.

### 8.5.2 Filter Element

Change filter element in Hydraulic System Filter. Filter kit number is on filter label. This element is oversized enough that clogging should not be an issue; however, as silt collects in a filter element, sifting can occur as the element is shaken. Removing the silt by changing the element and cleaning the filter bowl is advised.



8.0 MAINTENANCE SCHEDULE (continued)

8.6 MAINTENANCE SCHEDULE CHART

Serial or I.D. Number								
Maintenance	Section	Inspected By/ Date	Inspected By/ Date	Inspected By/ Date	Inspected By/ Date	Inspected By/ Date	Inspected By/ Date	Inspected By/ Date
<b>Daily Checks</b>								
Headlights	8.1.1							
Battery Cover Tie Down/Latch	8.1.2							
Cradle Function	8.1.3							
Upper Arm Locking	8.1.4							
Creep Speed	8.1.5							
<b>Weekly Checks</b>								
Brake Reservoir Fill	8.2.1							
Battery Care	8.2.2, 6.0							
<b>Monthly Checks</b>								
Hydraulic Reservoir Fill	8.3.1							
Repeat Daily Check	8.3.2							
<b>Monthly Torque Specs</b>								
Drive Wheel Lug Nuts – 240 ft lbs								
Rear Wheel Lug Nuts – 90 ft lbs								
<b>3 Month or Every 125 Hours Checks</b>								
Torque Hubs	8.4.1							
Battery Cable and Hose Routing	8.4.0							
Steering	8.4.3							
Steering Console Gas Strut	8.4.4							
Motors and Controllers/Test Drive	8.4.5							
Cradle Lubrication	8.4.6							
Tire Wear Check	8.4.7							
Cradle Ground Clearance Check	8.4.9							
<b>12 Month or Every 500 Hours Checks</b>								
Steer Axle Wheel Bearings	8.5.1							
Hydraulic Filter Element	8.5.2							

## 9.0 PROVISION OF SPARES

### 9.1 SOURCE OF SPARE PARTS

Spare parts may be obtained from the manufacturer:

**TRONAIR**, Inc.

1 Swanton Cargo Pkwy East  
Swanton, Ohio 43558 USA

Telephone: (419) 866-6301 or 800-426-6301

Fax: (419) 867-0634

E-mail: sales@tronair.com

Website: www.tronair.com

### 9.2 RECOMMENDED SPARE PARTS LISTS

Reference the following page(s) for Replacement Parts and Kits available.

## 10.0 IN SERVICE SUPPORT

Contact Tronair, Inc. for technical services and information. See Section 1.3 – Manufacturer.

## 11.0 GUARANTEES/LIMITATION OF LIABILITY

Tronair products are warranted to be free of manufacturing or material defects for a period of one year after shipment to the original customer. This is solely limited to the repair or replacement of defective components. This warranty does not cover the following items:

- a) Parts required for normal maintenance
- b) Parts covered by a component manufacturers warranty
- c) Replacement parts have a 90-day warranty from date of shipment

If you have a problem that may require service, contact Tronair immediately. Do not attempt to repair or disassemble a product without first contacting Tronair, any action may affect warranty coverage. When you contact Tronair be prepared to provide the following information:

- a) Product Model Number
- b) Product Serial Number
- c) Description of the problem

If warranty coverage is approved, either replacement parts will be sent or the product will have to be returned to Tronair for repairs. If the product is to be returned, a Return Material Authorization (RMA) number will be issued for reference purposes on any shipping documents. Failure to obtain a RMA in advance of returning an item will result in a service fee. A decision on the extent of warranty coverage on returned products is reserved pending inspection at Tronair. Any shipments to Tronair must be shipped freight prepaid. Freight costs on shipments to customers will be paid by Tronair on any warranty claims only. Any unauthorized modification of the Tronair products or use of the Tronair products in violation of cautions and warnings in any manual (including updates) or safety bulletins published or delivered by Tronair will immediately void any warranty, express or implied.

The obligations of Tronair expressly stated herein are in lieu of all other warranties or conditions expressed or implied. **Any unauthorized modification of the Tronair products or use of the Tronair products in violations of cautions and warnings in any manual (including updates) or safety bulletins published or delivered by Tronair will immediately void any warranty, express or implied and Tronair disclaims any and all liability for injury (WITHOUT LIMITATION and including DEATH), loss or damage arising from or relating to such misuse.**

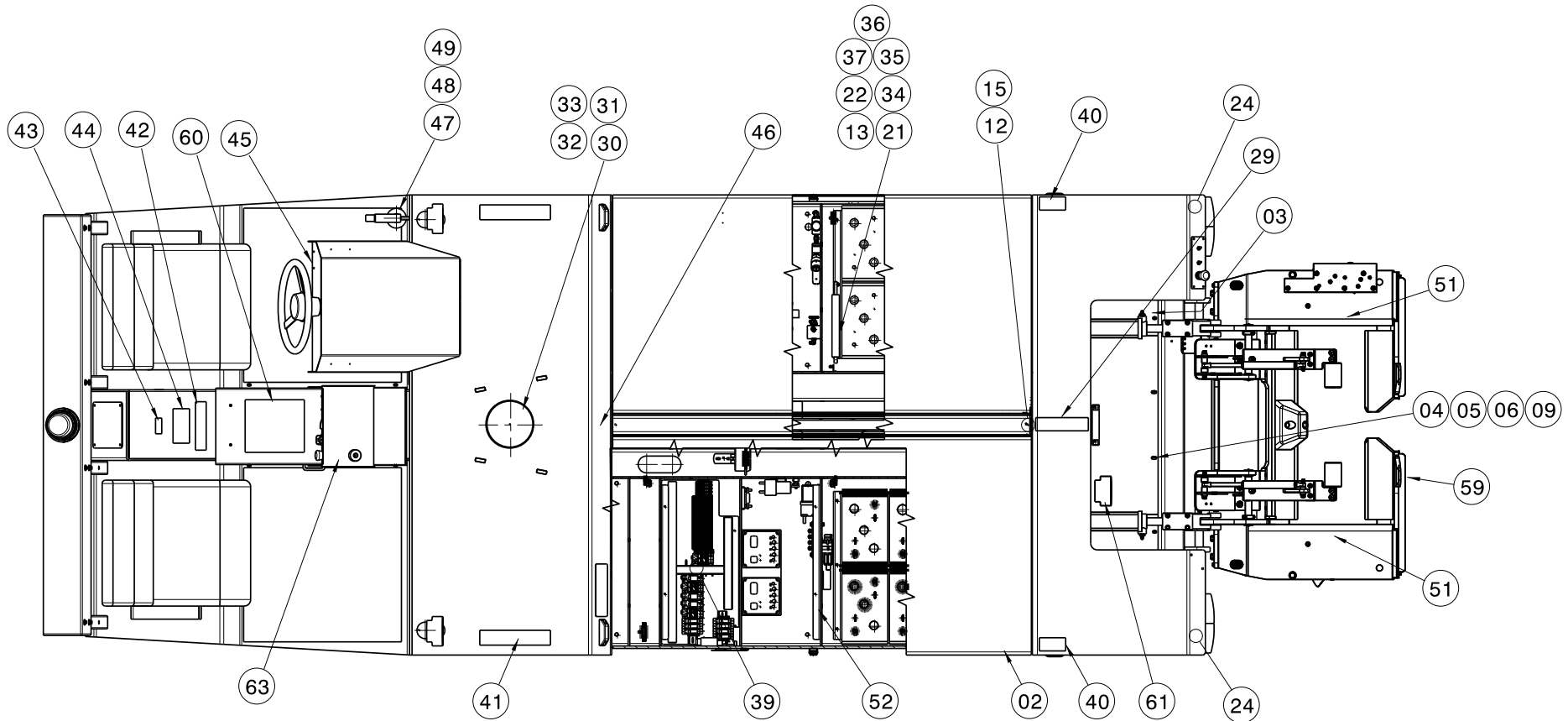
## 12.0 APPENDICES

APPENDIX I	Wiring Diagram
APPENDIX II	Hydraulic Schematic
APPENDIX III	Remote Actuator Installation and Service Instructions
APPENDIX IV	Mobile DTE 10 Excel 32 SDS
APPENDIX V	Deep Cycle Battery Handling, Maintenance and Test Procedures & Battery Mate 80 and Battery Charger Controller
APPENDIX VI	NAPA Prem Perf Gear Oil SAE 80W-90 SDS
APPENDIX VII	Declaration of Conformity

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## Parts List

When ordering replacement parts/kits, please specify model, serial number and color of your unit.



Item	Part Number	Description	Qty
2	Z-6348-01	Assembly, Battery Covers	1
3	J-3872	Plate, Motor Cover	2
4	G-1475-107010	Screw, 3/8 - 16 SOC BUT HD CAP	6
5	G-1503-1070N	Flatwasher	6
6	G-1502-1070R	Lockwasher, 3/8 Regular	6
9	J-5768-01	Plate, Motor Cover	Ref
12	G-1503-1050N	Flatwasher, 1/4 Narrow SS	6
13	G-1503-1030N	#10 Flatwasher, SS	8
15	G-1476-105006	Screw, 1/4 - 20 SOC BUT HD CAP	6

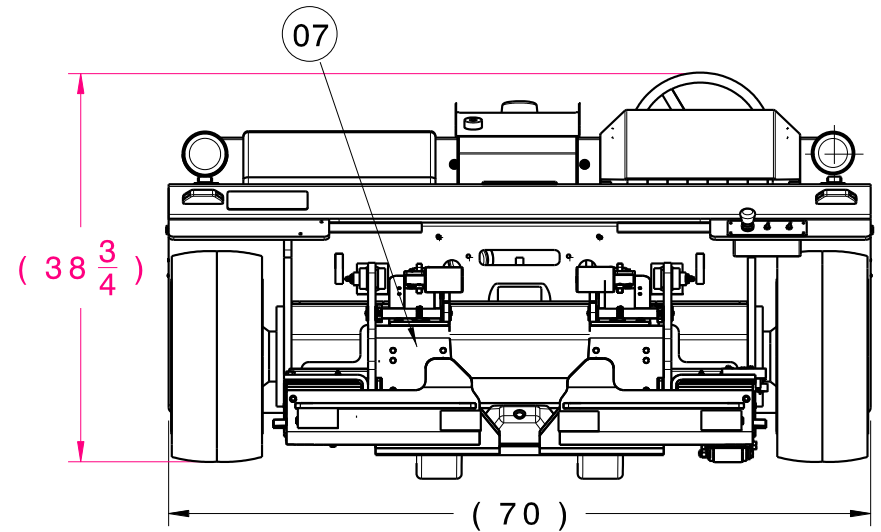
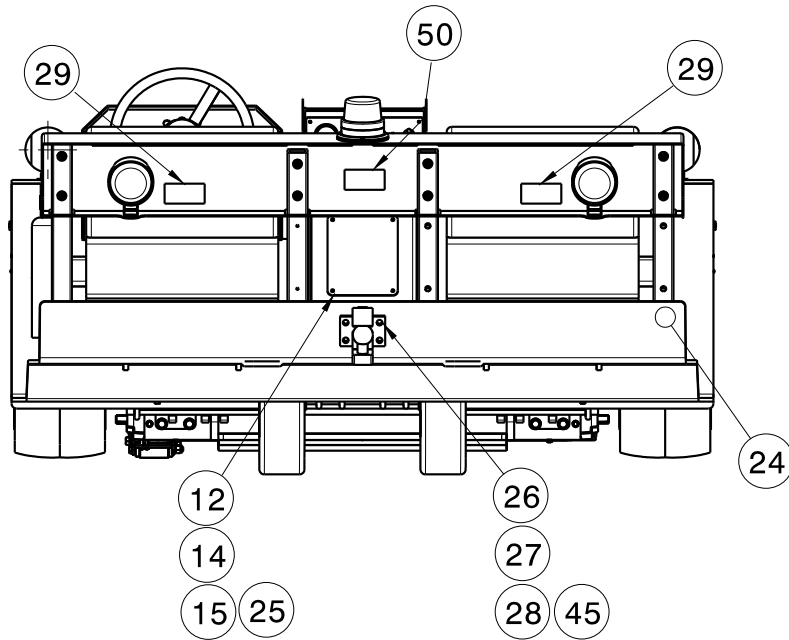
### Parts List

When ordering replacement parts/kits, please specify model, serial number and color of your unit.

Item	Part Number	Description	Qty
21	G-1476-103106	Screw, 10 - 32 SOC BUT HD CAP	8
22	G-1202-1035	ESN, #10 – 32	8
24	H-2899	Reflector, White	8 in
29	H-2806	Reflector, Amber	24
30	R-2237-01	Plate, Cover	Ref
31	J-4225	Plate, Center Arm	1
32	G-1476-105010	Screw, ¼ - 20 SOC BUT HD CAP	1
33	G-1476-106012	Screw, 5/16 - 18 SOC BUT HD CAP	1
34	JP-235	Gas Struts	4
35	JP-236	Gas Strut Mounting Bracket	8
36	G-1152-103206	Screw, SOC FLT HD 82° CAP	8
37	G-1501-1030	ESN, 10 – 24 SS	8
39	V-1050	ISO Electric	2
40	V-2194	Label, Sit Down	2
41	V-1814	Label, Warning, Keep 5 ft	2
42	V-2343	Label, Back Away	1
43	V-1001	Label, Made In USA	1
44	V-2191	Label, Caution Hands/Feet	1
45	V-2247	Label, Driving Instructions	1
46	V-2268-02	Label, Tronair, Inc.	1
47	H-3075	Extinguisher, Fire	1
48	G-1159-103506	Screw, 10 – 32 RD HD CRS REC	2
49	H-3076	Bracket, Extinguisher	1
51	V-2331-02	Label, Softcapture 9 in	2
52	H-1204-06*120	Tape, Neoprene Foam Seal	1
59	Z-7898 (see pgs 62-66)	Assembly, Cradle Sheetmetal	Ref
60	V-2421	Label, Loading and Unloading	1
61	EC-2455	Light, Work Flood LED	1
63	Z-8502	Assembly, Control Console	1

## Parts List

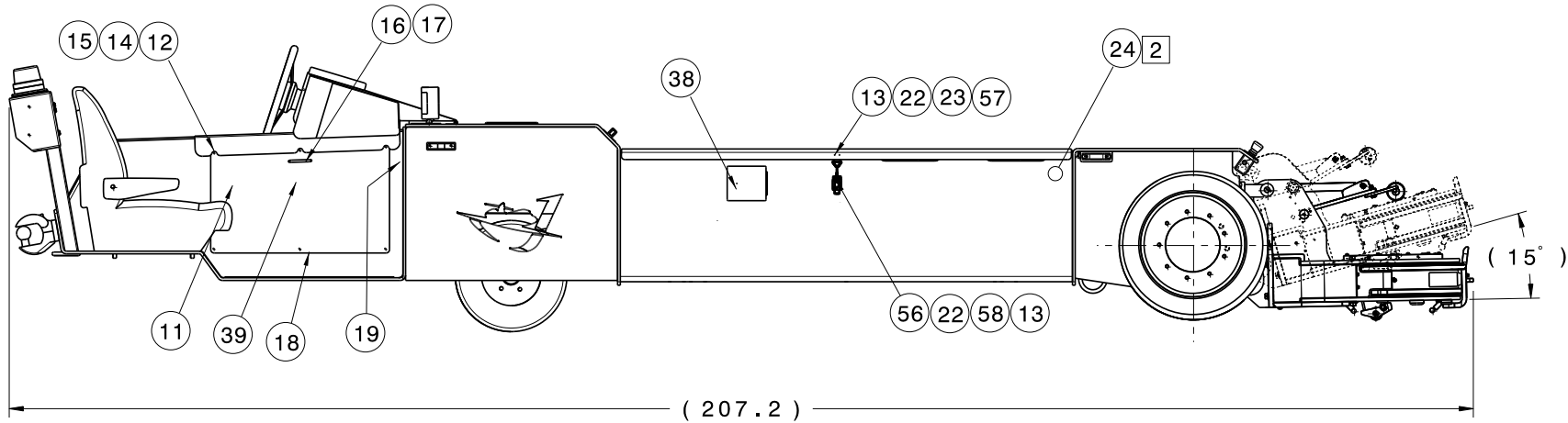
When ordering replacement parts/kits, please specify model, serial number and color of your unit.



Item	Part Number	Description	Qty
12	G-1503-1050N	Flatwasher, ¼ Narrow SS	4
13	Z-8631-01	Weldment, Backrest	1
14	G-1502-1050R	Lockwasher, ¼ Regular SS	4
15	G-1476-105006	Screw, ¼ - 20 SOC BUT HD CAP	4
25	S-2119-01	Console Rear Cover	Ref
26	G-1112-109016	Bolt, ½ - 13 HH SS	4
27	G-1503-1090N	Flatwasher, ½	4
28	G-1202-1090	ESN, ½ - 13	4
29	H-2806	Reflector, Amber (4 in long)	8 in
45	Jp-241	Combo Pintle Hitch	1
50	V-2118	Label, Serial Number	1

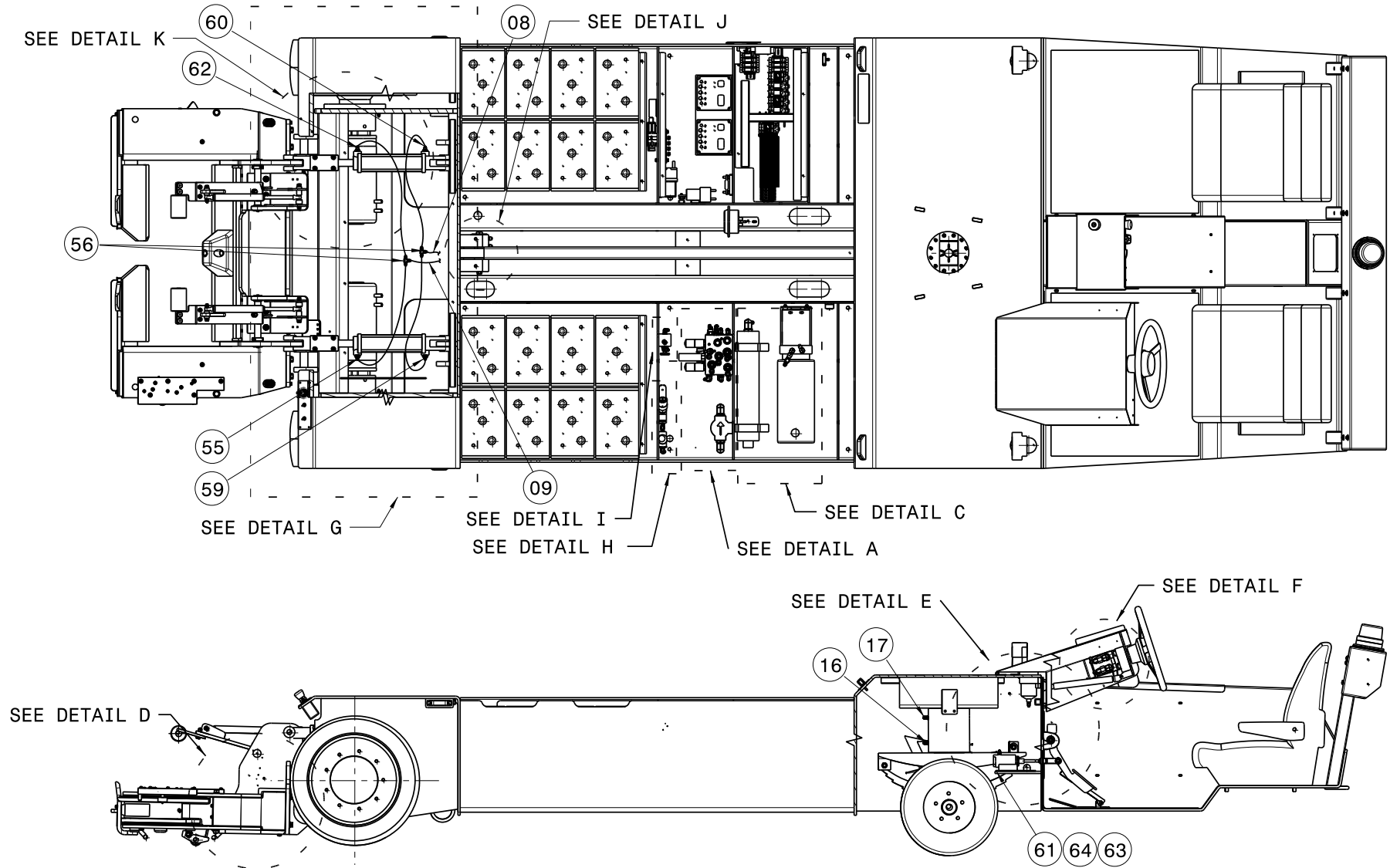
### Parts List

When ordering replacement parts/kits, please specify model, serial number and color of your unit.



Item	Part Number	Description	Qty
11	S-2600-01	Cover, Console Side	Ref
12	G-1503-1050N	Flatwasher, ¼ Narrow SS	4
13	G-1503-1030N	#10 Flatwasher, SS	8
14	G-1502-1050R	Lockwasher, ¼ Regular SS	4
15	G-1476-105006	Screw, ¼ - 20 SOC BUT HD CAP	4
16	G-1476-102006	Screw, #8 - 32 SOC BUT HD CAP	2
17	14074	Handle, Drawer	1
18	H-1204-06*82.0	Tape, Neoprene Foam Seal	1
19	V-2249	Label, Fasten Seat Belt	1
21	G-1476-103106	Screw, 10 - 32 SOC BUT HD CAP	8
22	G-1202-1035	ESN, #10 - 32	8
23	H-3627	Latch, Draw Adjustable	2
38	V-2146	Label, Battery Charger Plug In	1
39	V-1050	ISO Electric	2
46	V-2298-02	Label, Tronair	3
56	G-1159-103714	Screw, 10-32 RD HD CRS REC	2
57	G-1152-107206	Screw, SOC FLT HD 82° CAP	4
58	J-5354	Spacer, Latch	2
Not Shown	V-2525-01/02	Label, JETporter	2

**Parts List Illustration**





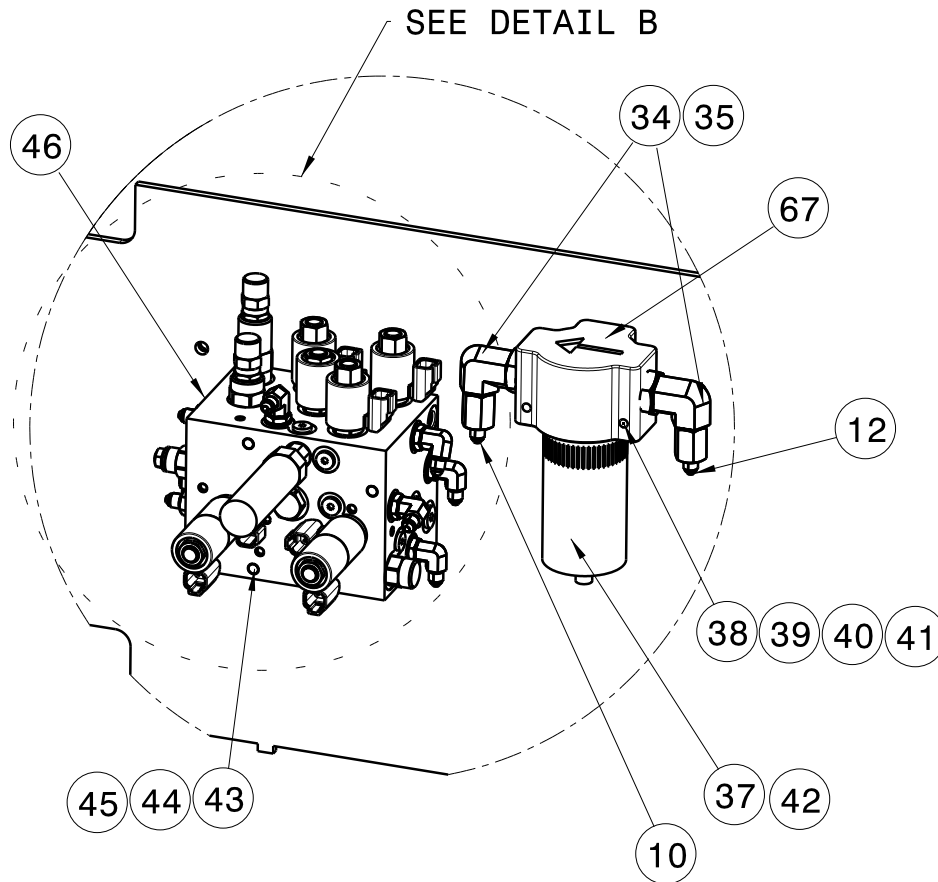
**Parts List**

When ordering replacement parts/kits, please specify model, serial number and color of your unit.

Item	Part Number	Description	Qty
8	JP-299-04	Hose, Blind End Tee of Up/Down Cradle Cylinder to Needle Valve Block (80" STR to STR)	1
9	JP-299-04	Hose, Rod End Tee of Up/Down Cradle Cylinder to Needle Valve Block (80" STR to STR)	1
16	JP-299-10	Hose, Steering Valve Block Port L to Rotary Actuator Bottom Port (52" STR to STR)	1
17	JP-299-10	Hose, Steering Valve Block Port R to Rotary Actuator Top Port (52" STR to STR)	1
55	JP-299-05	Hose, Cylinder Cradle Up Driver Side to Tee (21" STR to 90° Short Elbow)	8
56	N-2012-03-S	Tee, Union	4
59	JP-299-11	Hose, Cylinder Down Driver Side to Tee (19" STR to 90° Short Elbow)	1
60	JP-299-19	Hose, Cylinder Down Passenger Side to Tee (33" STR to 90° Short Elbow)	1
61	G-1100-105012	Bolt, ¼ - 20 HEX HD GR5	4
62	JP-299-20	Hose, Cylinder Cradle Up Passenger Side to Tee (35" STR to 90° Short Elbow)	8
63	G-1202-1050	ESN, ¼ - 20	4

**Parts List**

When ordering replacement parts/kits, please specify model, serial number and color of your unit.

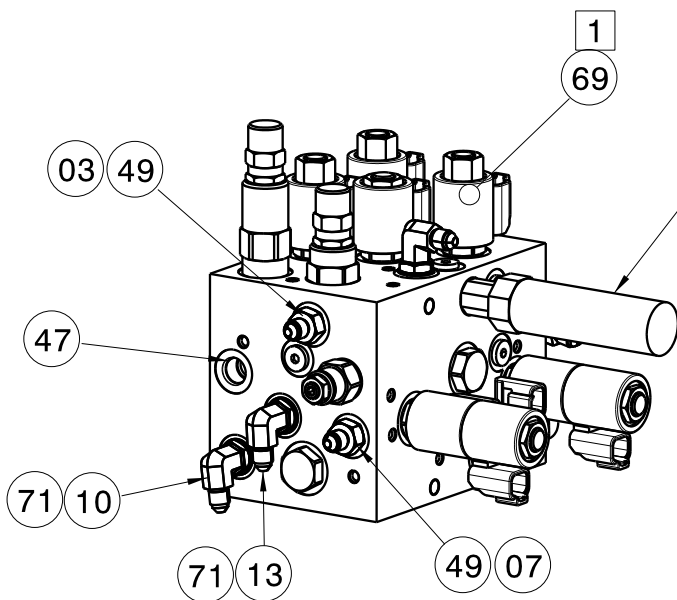


**DETAIL A  
VALVE BLOCK & FILTER**

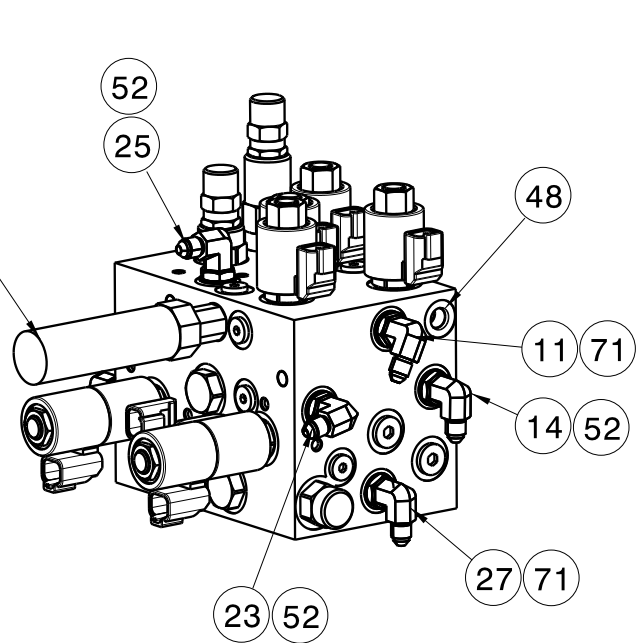
Item	Part Number	Description	Qty
10	JP-299-09	Hose, Filter Outlet to Main Valve Block Port P (25" STR to STR)	1
12	JP-299-17	Hose, Pump Pressure to Filter Inlet (40" STR to STR)	1
34	N-2001-14-S-B	Elbow, Male	2
35	N-2020-03-S	8-6 Reducer	2
37	HC-1244	Body, Filter -4	1
38	G-1250-1050N	Flatwasher, ¼ Narrow	4
39	G-1202-1055	ESN, ¼ - 28	2
40	G-1100-105544	Bolt, ¼ - 28 HH GR5	2
41	TR377-03*001.63	TBG, SST .50 OD .49 W	2
42	K-4225	Element, Filter (M.B.)	1
43	G-1100-106054	Bolt, 5/16 - 18 HH GR5	3
44	G-1250-1060N	Flatwasher, 5/16 Narrow	6
45	G-1202-1060	ESN, 5/16 - 18	3
46	HC-2373	Valve Manifold (Block and Valves Complete)	1
67	V-2231	Label, Filter Element Replacement, K-4225	1

## Parts List

When ordering replacement parts/kits, please specify model, serial number and color of your unit.



DETAIL B  
MAIN VALVE BLOCK

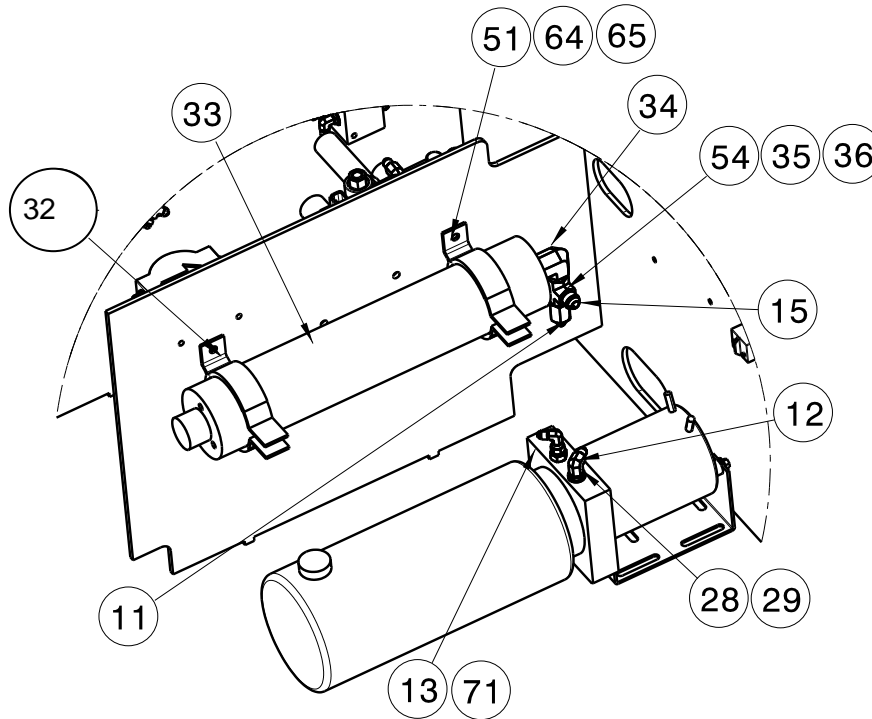


DETAIL B  
MAIN VALVE BLOCK

Item	Part Number	Description	Qty
3	JP-299-12	Hose, Valve Port P10 to bottom Brake Tee (73" STR to STR)	1
7	JP-299-01	Hose, Needle Valve Block to Main Block Valve Port P3 (21" STR to STR)	1
10	JP-299-09	Hose, Filter Outlet to Main Valve Block Port P (25" STR to STR)	1
11	JP-299-18	Hose, Valve Block Port P8 to Accumulator (34" STR to STR)	1
13	JP-299-16	Hose, Pump Return to Valve Block Port T (27" STR to STR)	1
14	JP-299-14	Hose, Valve Block Port P11 to Steering Valve Block Port T (112" STR to STR)	1
23	JP-299-03	Hose, Rotary Valve Port 1 to Main Valve Block P5 (30" STR to STR)	1
25	JP-299-01	Hose, Needle valve Block to Main Block Valve Port P4 (21" STR to STR)	1
27	JP-299-06	Hose, Main Valve Block Port P6 to Flow Combiner Port 3 (76" STR to STR)	1
47	N-2053-05-S-B	Plug, Hex HD w/O-Ring	1
48	N-2053-03-S-B	Plug, Hex HD w/O-Ring	1
49	N-2007-05-S-B	Connector, Straight Thread	2
52	N-2001-05-S-B	Elbow, Straight Thread	3
66	EC-2204	Switch, Pressure	1
69	HC-2389	Disc, Orifice	1
71	N-2001-08-S-B	Elbow, Straight Thread #6	4
72	N-2846-02	Conversion, Adapter	1
73	EC-2205	Cable Sensor, Pressure	1

## Parts List

When ordering replacement parts/kits, please specify model, serial number and color of your unit.

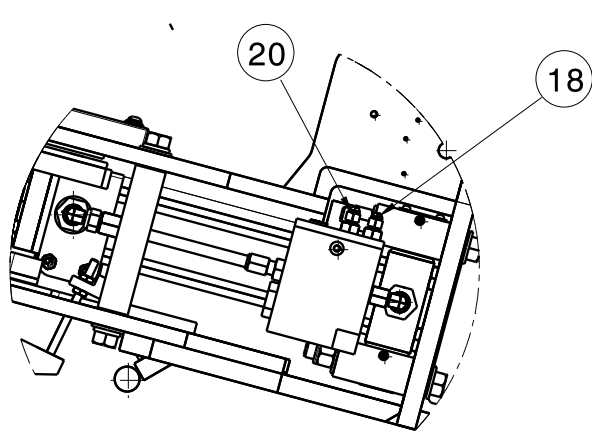


DETAIL C  
PUMP & ACCUMULATOR

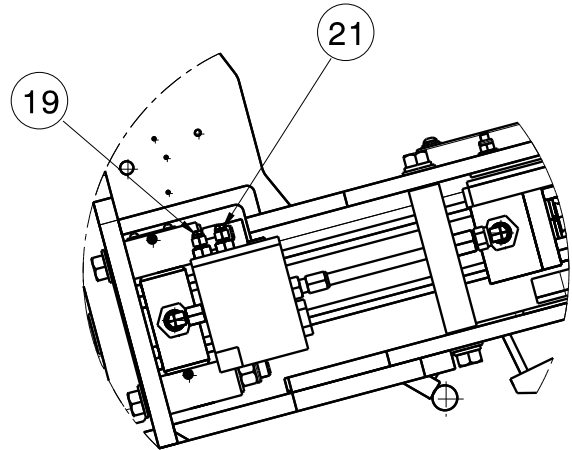
Item	Part Number	Description	Qty
11	JP-299-18	Hose, Valve Block Port P8 to Accumulator (34" STR to STR)	1
12	JP-299-17	Hose, Pump Pressure to Filter Inlet (40" STR to STR)	1
13	JP-299-16	Hose, Pump Return to Valve Block Port T (27" STR to STR)	1
15	JP-299-13	Hose, Accumulator Tee to Steering Valve Block Port P (95" STR to 90° Short Elbow)	1
28	N-2002-05-S	Elbow, Swivel Nut	1
29	N-2007-08-S-B	Connector, Straight Thread	1
32	H-3074-04	Bracket, Accumulator	2
33	HC-2375	Accumulator	1
34	N-2001-14-S	Elbow, Male	3
35	N-2020-03-S	8-6 Reducer	1
36	N-2000-06-S	Nut, #8 Tube	1
51	G-1100-107010	Bolt, 3/8 - 16 HEX HD GR5	4
54	N-2016-08-S	Tee, Run Swivel Nut	1
64	G-1250-1070N	Flatwasher, 3/8 Narrow	8
65	G-1202-1070	ESN, 3/8 - 16	4
71	N-2001-08-S-B	Elbow, Straight Thread #6	1

## Parts List

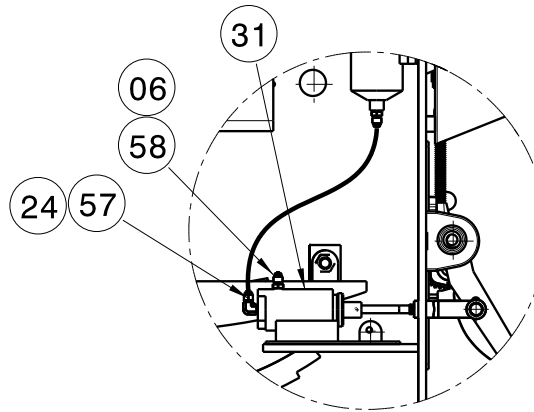
When ordering replacement parts/kits, please specify model, serial number and color of your unit.



DETAIL D (Z-8175)  
CRADLE LEFT SIDE



DETAIL D (Z-8175)  
CRADLE RIGHT SIDE

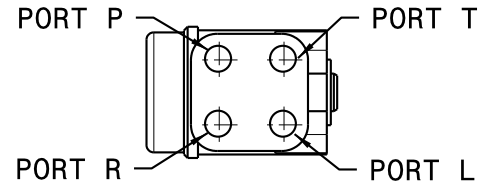
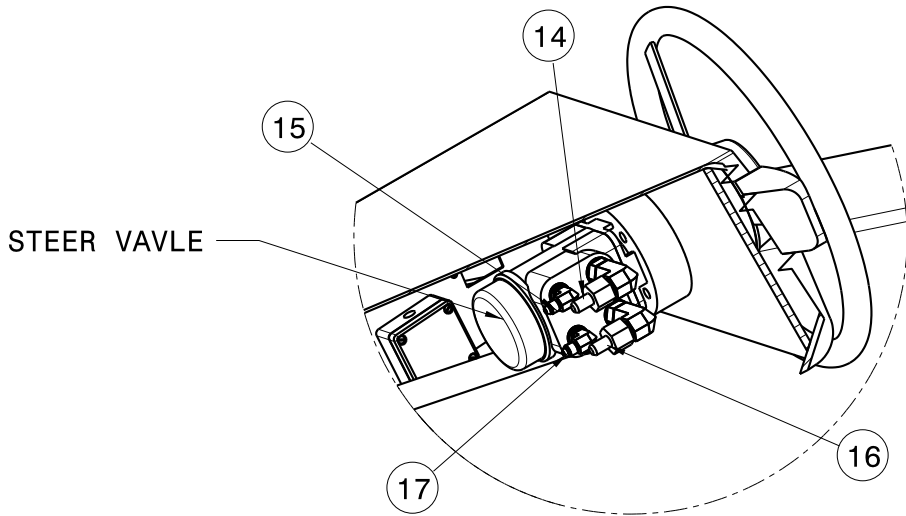


DETAIL E  
MASTER CYLINDER

Item	Part Number	Description	Qty
6	JP-299-15	Hose, Tee Top of Brake to Master Cylinder (140" STR to STR)	1
18	JP-299-06	Hose, Left Side of Cradle Assembly Check Valve Block To Block Manifold in Battery Box (at front center) (76" STR to STR)	1
19	JP-299-06	Hose, Right Side of Cradle Assembly Check Valve Block To Block Manifold in Battery Box (at front center) (76" STR to STR)	1
20	JP-299-06	Hose, Left Side of Cradle Assembly Check Valve Block To Flow Divider Block in Battery Box (at front center) (76" STR to STR)	1
21	JP-299-06	Hose, Right Side of Cradle Assembly Check Valve Block To Flow Divider Block in Battery Box (at front center) (76" STR to STR)	1
24	JP-299-07	Hose, Brake Reservoir To Brake Actuator Inlet (22" STR to STR)	1
31	Z-6358	Assembly, Hydraulic Actuator	1
57	N-2005-03-S	Elbow, Male	1
58	N-2009-03-S	Connector, Male	1

**Parts List**

When ordering replacement parts/kits, please specify model, serial number and color of your unit.



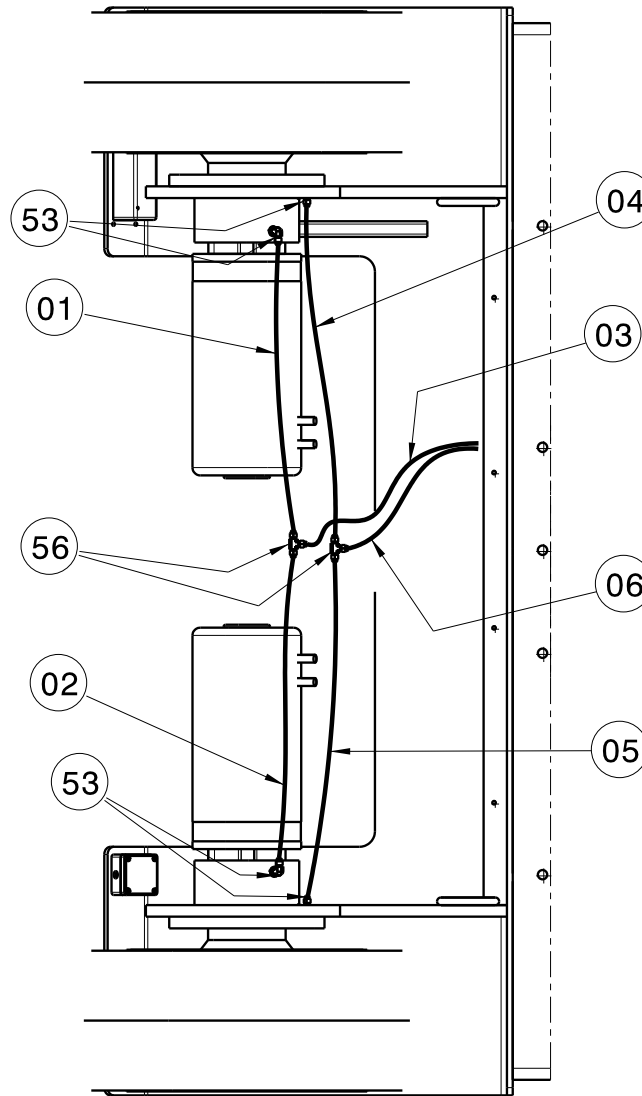
DETAIL STEER VALVE  
PORT LOCATION  
SCALE 1:4

DETAIL F  
STEER VALVE HOSES

Item	Part Number	Description	Qty
14	JP-299-14	Hose, Valve Block Port P11 to Steering Valve Block Port T (112" STR to STR)	1
15	JP-299-13	Hose, Accumulator Tee to Steering Valve Block Port P (95" STR to 90° Short Elbow)	1
16	JP-299-10	Hose, Steering Valve Block Port L to Rotary Actuator Bottom Port (52" STR to STR)	1
17	JP-299-10	Hose, Steering Valve Block Port R to Rotary Actuator Top Port (52" STR to STR)	1

**Parts List**

When ordering replacement parts/kits, please specify model, serial number and color of your unit.

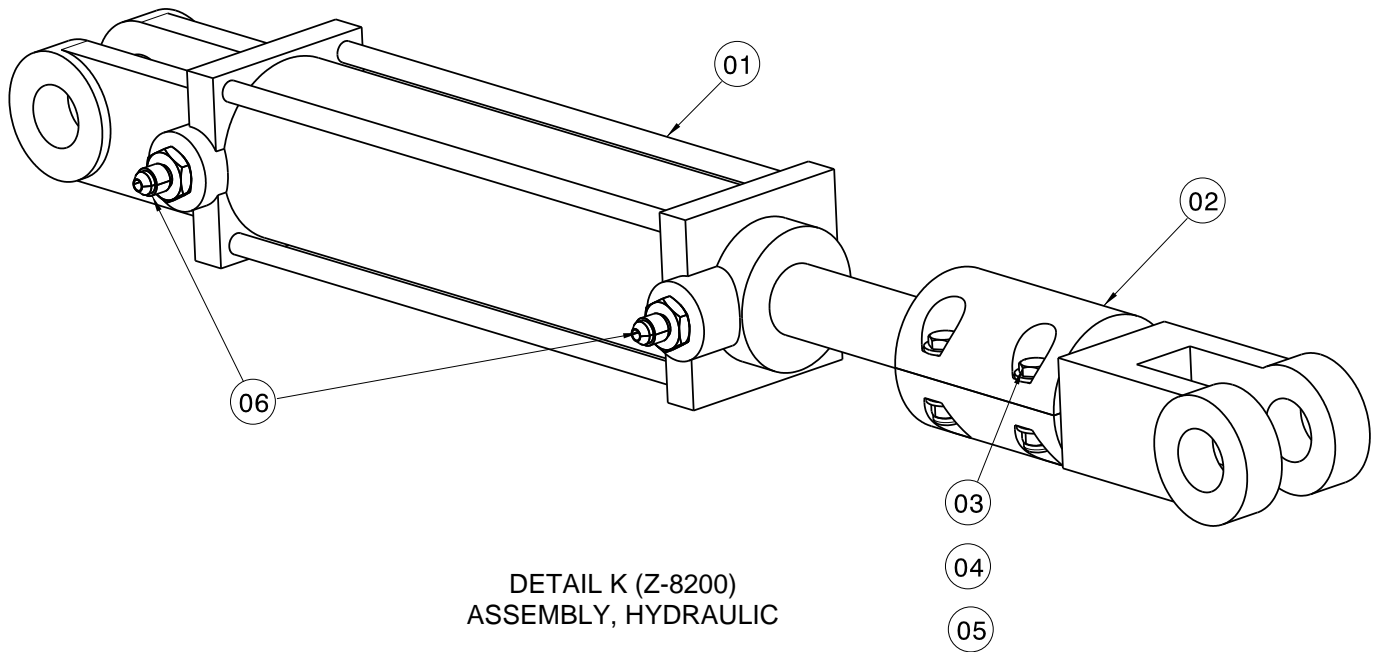


**DETAIL G  
BOTTOM VIEW BRAKE HOSES**

Item	Part Number	Description	Qty
1	JP-299-07	Hose, Bottom of Brake on Drivers' Side to Tee (22" STR to STR)	1
2	JP-299-07	Hose, Bottom of Brake on Passenger Side to Tee (22" STR to STR)	1
3	JP-299-12	Hose, Valve Port P10 to Bottom Brake Tee (73" STR to STR)	1
4	JP-299-08	Hose, Top of Brake on Driver Side to Tee (26" STR to STR)	1
5	JP-299-08	Hose, Top of Brake on Passenger Side to Tee (26" STR to STR)	1
6	JP-299-15	Hose, Master Cylinder to Top Brake Tee (140" STR to STR)	1
53	N-2001-03-S-B	Elbow, Straight Thread	4
56	N-2012-03-S	Tee, Union	2

**Parts List**

When ordering replacement parts/kits, please specify model, serial number and color of your unit.

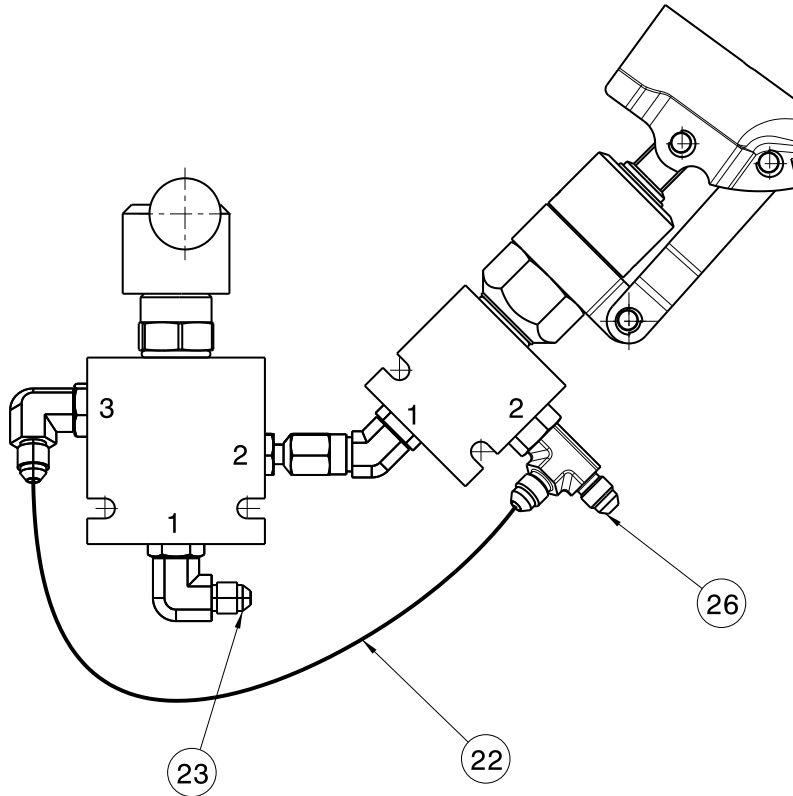


Item	Part Number	Description	Qty
1	JP-219	Cylinder, Left Cradle	1
2	R-3055-01	Cylinder, Stop	1
3	G-1100-105512	Bolt, HH GR 5, 1/4 - 28 x 1 1/4 Long	4
4	G-1250-1050N	Flatwasher, 1/4 ID Narrow	8
5	G-1100-105512	ESN, 1/4 - 20	4
6	N-2009-37-S	Connector, Straight Thread	2



**Parts List**

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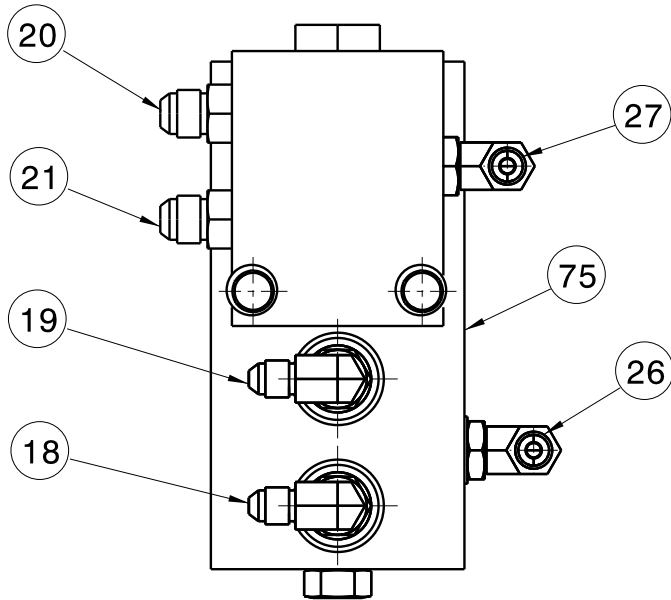


DETAIL I (Z-7890)  
HAND PUMP

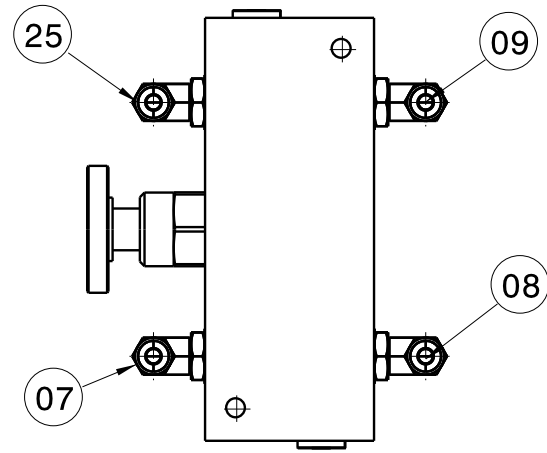
Item	Part Number	Description	Qty
22	JP-299-02	Hose, Assy. Manual Pump Port 2 tee to Rotary Valve Port 3 (76" STR to STR)	1
23	JP-299-03	Hose, Assy. Manual Pump Arms Opening Port 3 to Main Valve Block P5 (30" STR to STR)	1
26	JP-299-06	Hose, Main Valve Block Port P6 to Block Tee in Battery Box (15" STR to STR)	1

**Parts List**

When ordering replacement parts/kits, please specify model, serial number and color of your unit.



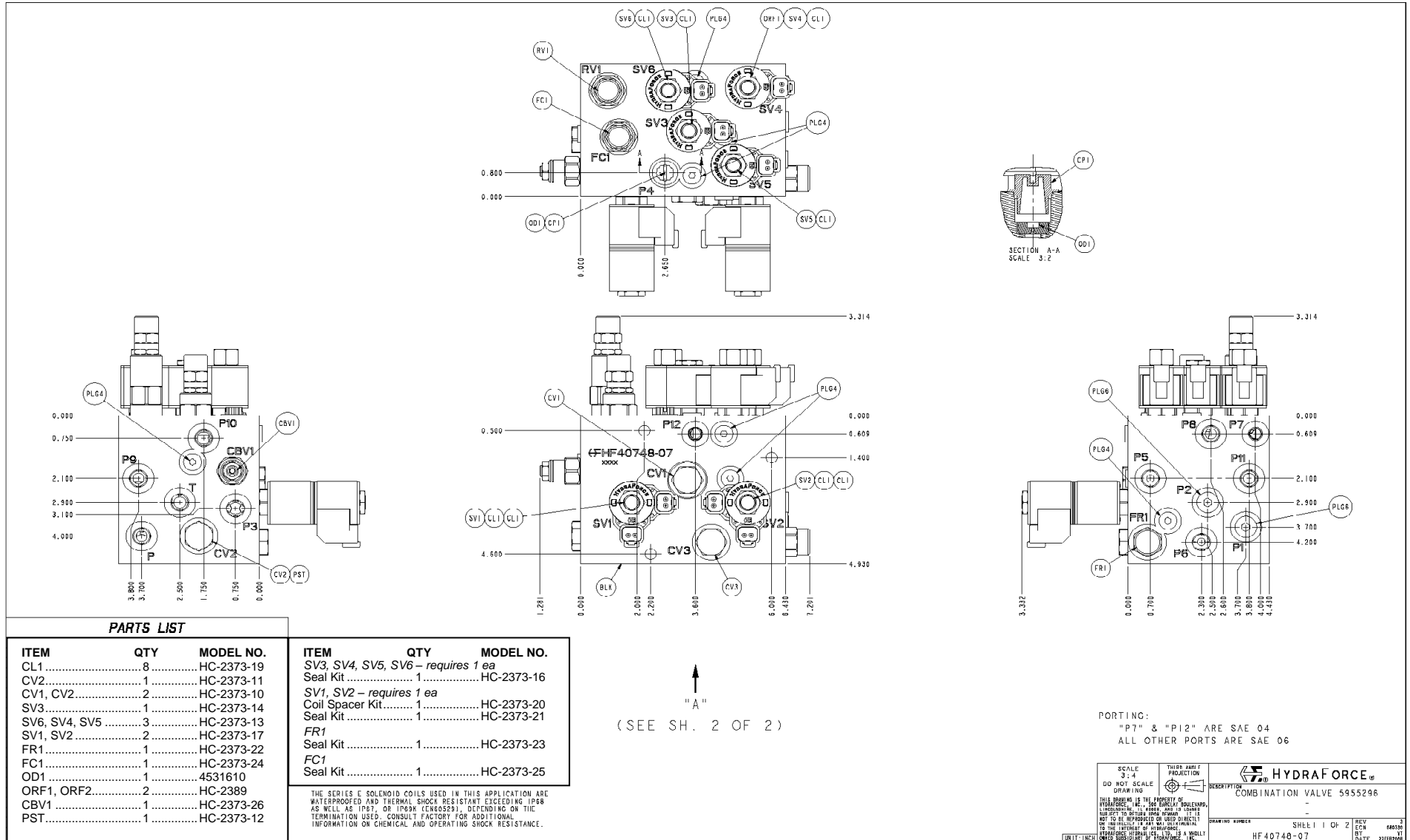
DETAIL J (Z-8017)  
FLOW COMBINER



DETAIL K (Z-7889)  
MANUAL CYLINDER  
NEEDLE VALVE

Item	Part Number	Description	Qty
7	JP-299-01	Hose, Needle Valve Block to Main Block Valve Port P3 (21" STR to STR)	1
8	JP-299-04	Hose, Blind End of Up/Down Cradle Cylinder to Needle Valve Block (80" STR to STR)	1
9	JP-299-04	Hose, Rod End of Up/Down Cradle Cylinder to Needle Valve Block (80" STR to STR)	1
18	JP-299-06	Hose, Left Side of Cradle Assembly Check Valve Block to Block Tee in Battery Box (76" STR to STR)	1
19	JP-299-06	Hose, Right Side of Cradle Assembly check Valve Block to Block Tee in Battery Box (76" STR to STR)	1
20	JP-299-06	Hose, Left Side of Cradle Assembly Check Valve Block to Flow Combiner/ Divider Port 4 (76" STR to STR)	1
21	JP-299-06	Hose, Right Side of Cradle Assembly Check Valve Block to Flow Combiner/ Divider Port 2 (76" STR to STR)	1
25	JP-299-01	Hose, Needle Valve Block to Main Block Valve Port P4 (21" STR to STR)	1
26	JP-299-06	Hose, Hand Pump Tee Port 2 to Block Tee in Battery Box (76" STR to STR)	1
27	JP-299-06	Hose, Main Valve Block Port P6 to Flow Combiner/Divider Port 3 (76" STR to STR)	1
75	Z-8017	Machine, Block Manifold	1

## Main Block



### PARTS LIST

ITEM	QTY	MODEL NO.	ITEM	QTY	MODEL NO.
CL1	8	HC-2373-19	SV3, SV4, SV5, SV6	requires 1 ea	
CV2	1	HC-2373-11	Seal Kit	1	HC-2373-16
CV1, CV2	2	HC-2373-10	SV1, SV2	requires 1 ea	
SV3	1	HC-2373-14	Coil Spacer Kit	1	HC-2373-20
SV6, SV4, SV5	3	HC-2373-13	Seal Kit	1	HC-2373-21
SV1, SV2	2	HC-2373-17	FR1	1	HC-2373-22
FR1	1	HC-2373-22	Seal Kit	1	HC-2373-23
FC1	1	HC-2373-24	FC1	1	HC-2373-24
OD1	1	4531610	Seal Kit	1	HC-2373-25
ORF1, ORF2	2	HC-2389			
CBV1	1	HC-2373-26			
PST	1	HC-2373-12			

THE SERIES E SOLENOID COILS USED IN THIS APPLICATION ARE WATERPROOFED AND THERMAL SHOCK RESISTANT EXCEEDING IP68 AS WELL AS IP97, OR IP99X (ENCLOSURE), DEPENDING ON THE TERMINATION USED. CONSULT FACTORY FOR ADDITIONAL INFORMATION ON CHEMICAL AND OPERATING SHOCK RESISTANCE.

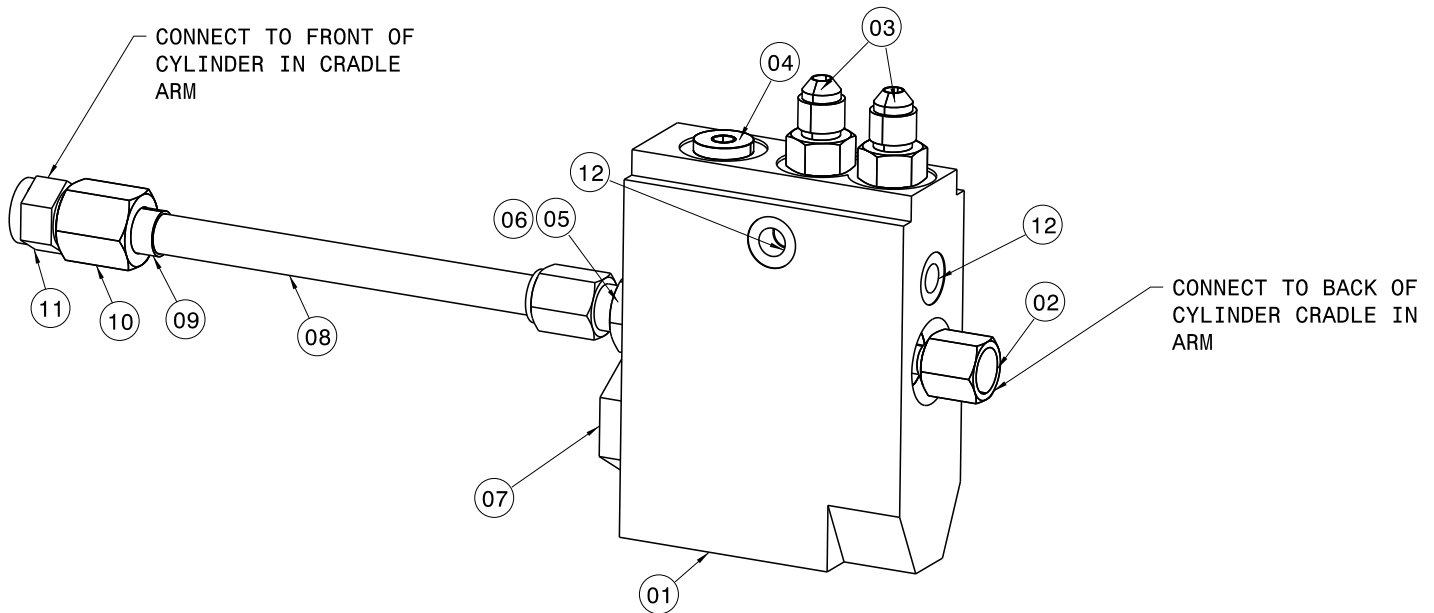
↑  
"A"  
(SEE SH. 2 OF 2)

PORTING:  
"P7" & "P12" ARE SAE 04  
ALL OTHER PORTS ARE SAE 06

SCALE 3:4 DO NOT SCALE DRAWING	THIS IS A PRODUCTION DRAWING	HYDRAFORCE® COMBINATION VALVE 5955296
<small>THIS DRAWING IS THE PROPERTY OF HYDRAFORCE, INC. - SEE WORKING AGREEMENT, SECTION 10. THIS DRAWING IS TO BE RETURNED TO HYDRAFORCE, INC. UPON THE COMPLETION OF THE PROJECT OR AS OTHERWISE AGREED TO BY THE PARTIES.</small>		DRAWING NUMBER: HF40740-07 SHEET 1 OF 2 DATE: 2/18/2018

## Parts List

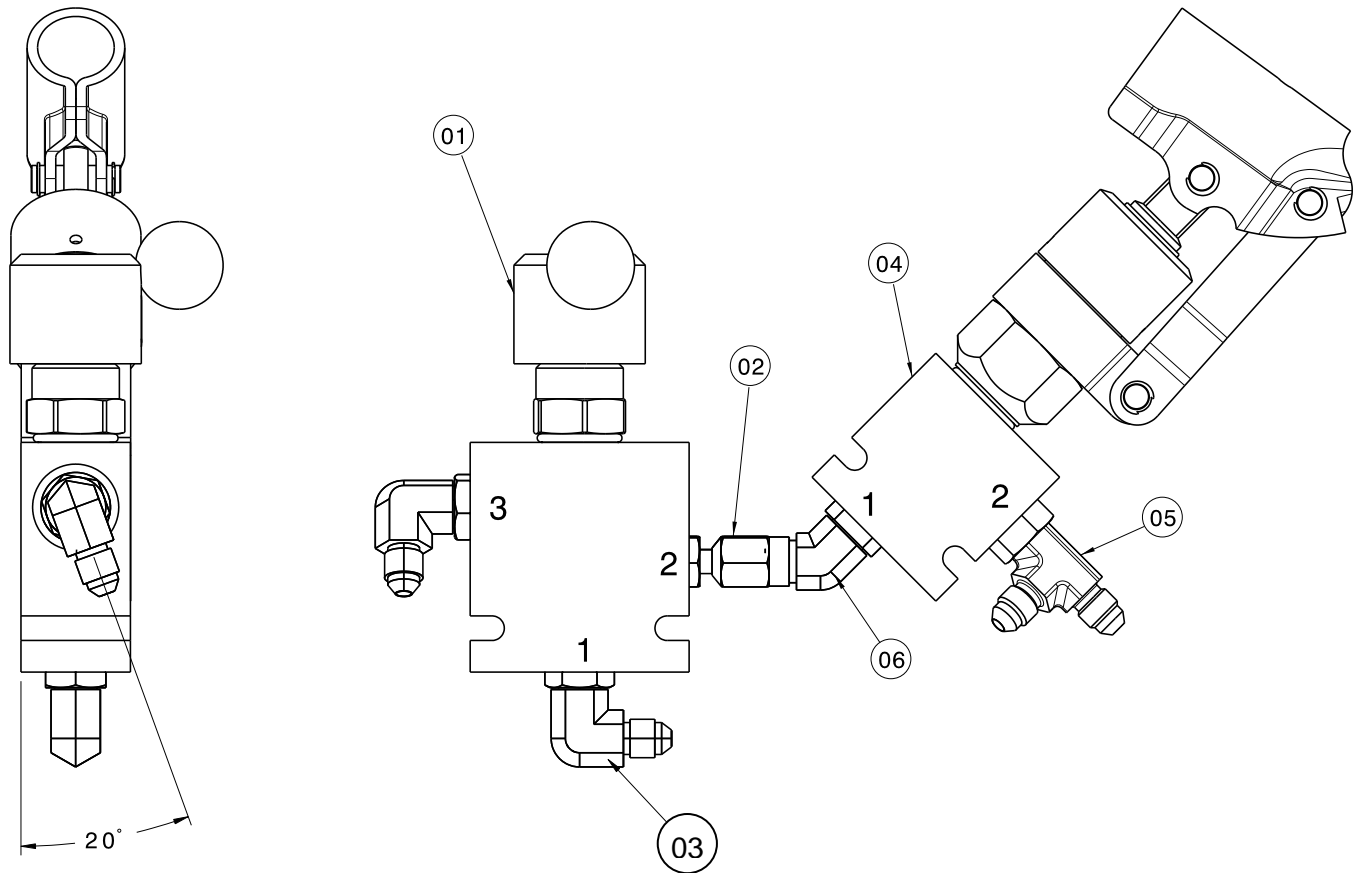
When ordering replacement parts/kits, please specify model, serial number and color of your unit.



Item	Part Number	Description	Qty
1	HC-2580	Block Flow	1
2	N-2036-01-S-B	Swivel, 37° Female	1
3	N-2007-03-S-B	Connector, Straight Thread	2
4	N-2066-04-S-B	Plug, Hollow Hex w/O-Ring	1
5	N-2678-23-S-B	Connector, Straight Thread	1
6	N-2407-05-SS	Ferrule, 3/8	1
7	HC-2433-12	Valve	1
8	TR375-05-006-56	TBG, SST .38 OD - .049 W 6.56 LG	1
9	N-2019-05-S	Sleeve, 3/8 Tube #6	1
10	N-2000-05-S	Nut, #6 JIC x 37°	1
11	N-2052-06	Expander, Tube	1
12	H-1362	Plug, MB Series	2

## Parts List

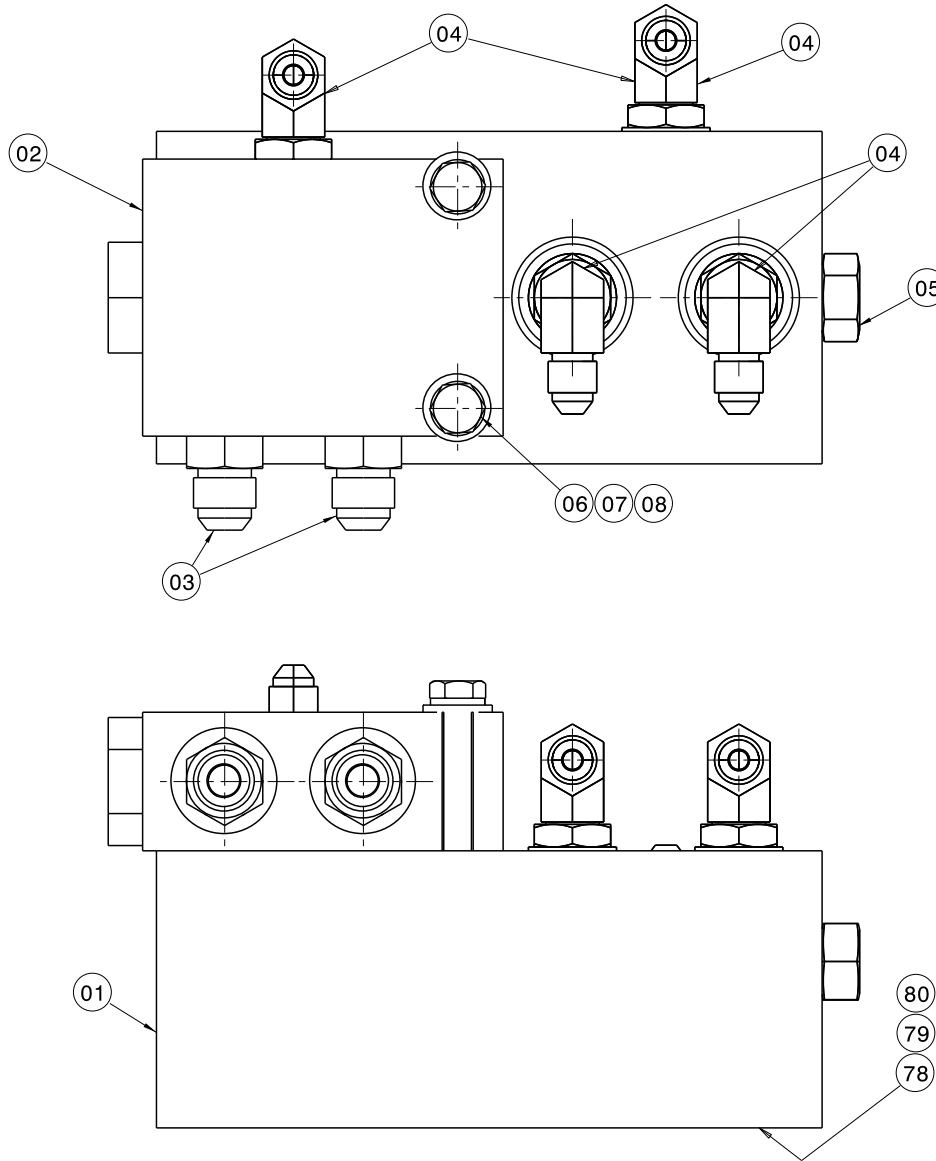
When ordering replacement parts/kits, please specify model, serial number and color of your unit.



Item	Part Number	Description	Qty
1	HC-2504	Valve, Rotary	1
2	N-2036-03-S-B	Swivel, 37° Female	1
3	N-2001-05-S-B	Elbow, Straight Thread	2
4	HC-2503	Pump, Hand	1
5	N-2015-05-S-B	Tee, Run Straight Thread	1
6	N-2042-05-S-B	Elbow, 45° Straight Thread	1

**Parts List**

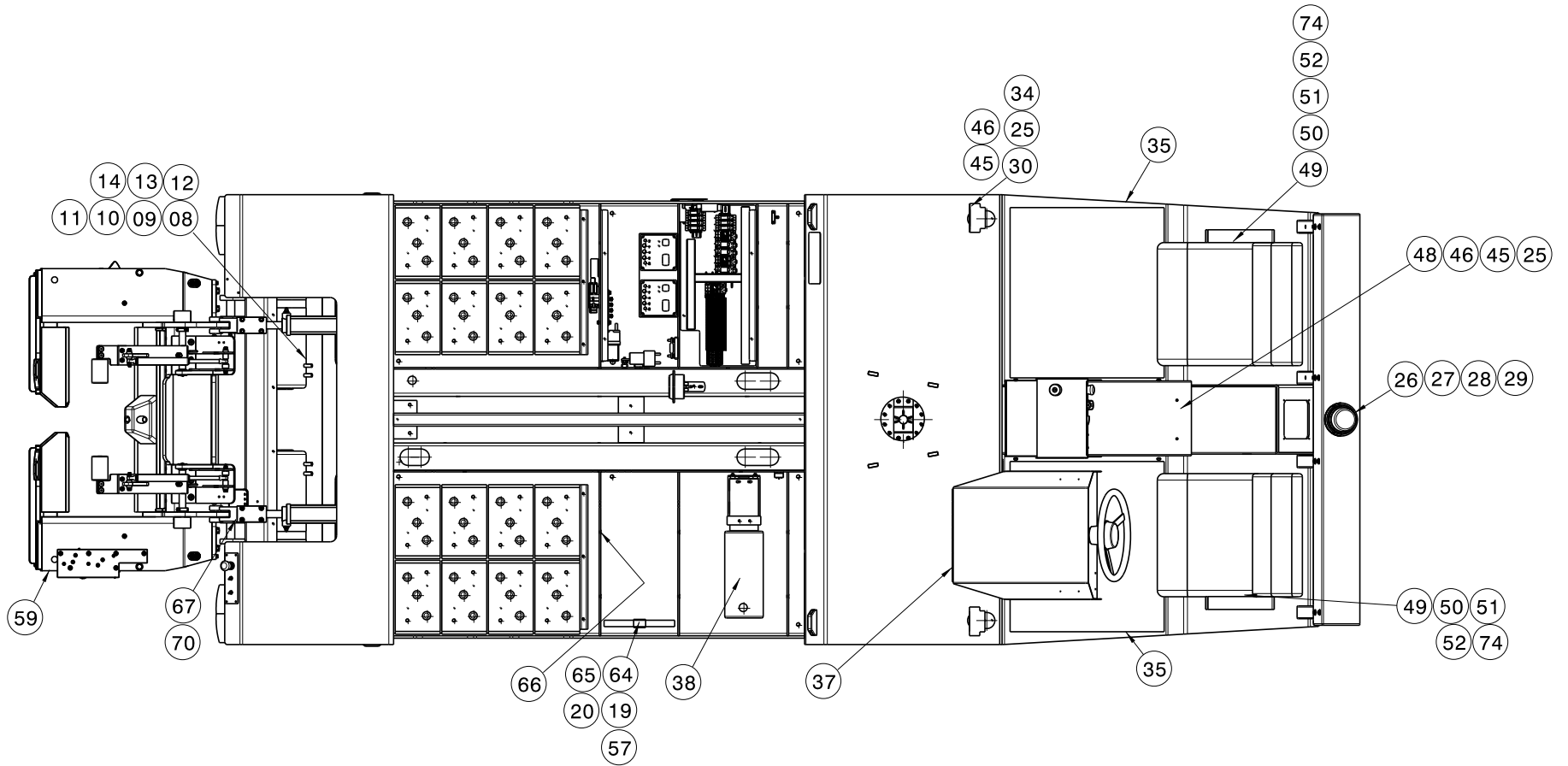
When ordering replacement parts/kits, please specify model, serial number and color of your unit.



Item	Part Number	Description	Qty
1	HC-2499	Machine, Block Manifold	1
2	HC-2497	Block, Flow Divider	1
3	N-2007-05-S-B	Connector, Straight Thread	2
4	N-2001-05-S-B	Elbow, Straight Thread	4
5	N-2053-05-S-B	Plug, Hex w/O-Ring	1
6	G-1250-1050N	Flatwasher, ¼ Narrow	2
7	G-1251-1050R	Lockwasher, ¼ Regular	2
8	G-1100-105020	Bolt, ¼ - 20 HH GR5	2
78	G-1100-110012	Bolt, ⅝ - 11 HH GR5	2
79	G-1250-1100N	Flatwasher, ⅝ Narrow	2
80	G-1251-1100R	Lockwasher, ⅝ Regular	2

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**Parts List Illustration**



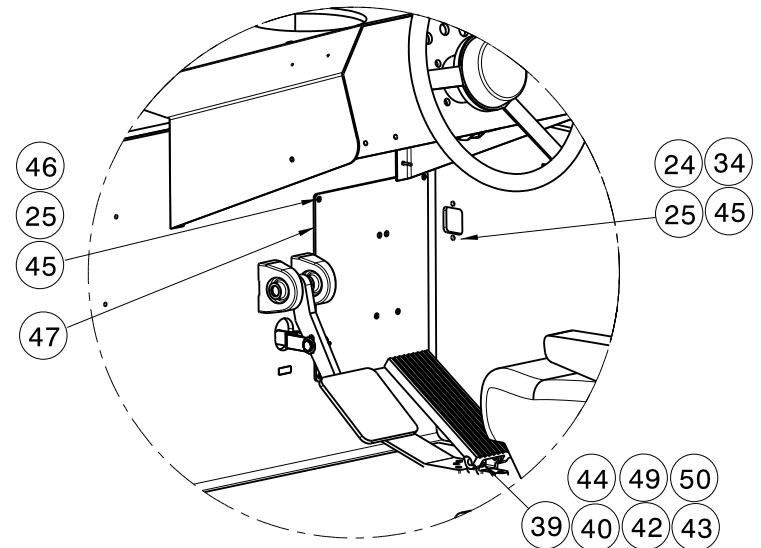
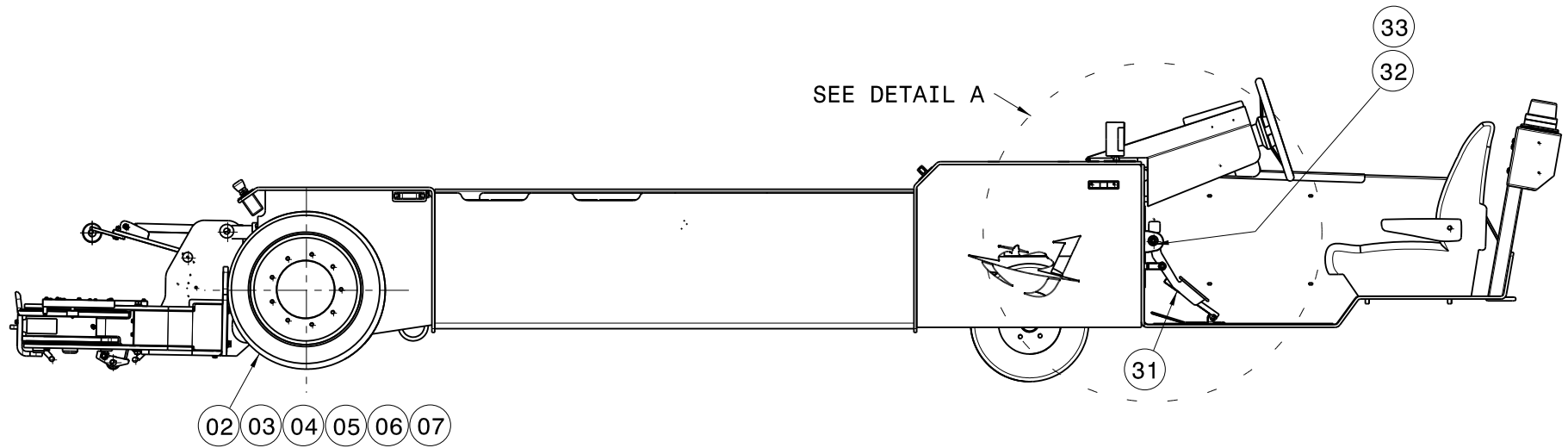


### Parts List

When ordering replacement parts/kits, please specify model, serial number and color of your unit.

Item	Part Number	Description	Qty
7	HC-2000-045	O-Ring, Series 2	2
8	G-1420-109050	Bolt, HH ½ - 13 x 5 LG	4
9	G-1251-1090R	Lockwasher, ½ Regular	4
10	G-1251-1070R	Lockwasher, ⅜ Regular	4
11	G-1420-107010	Bolt, HH ⅝ - 16 x 1 LG	4
12	HC-2413	Hydraulic Brake	2
13	EC-2031	10 HP Motor, Separately Excited	2
14	HC-2007-228	O-Ring	2
16	Z-8463	Assembly, Center Console	1
19	G-1202-1035	Stopnut, #10-32 Elastic	5
20	G-1503-1030N	Flatwasher, #10	6
25	G-1503-1050N	Flatwasher, ¼ Narrow	4
26	JP-118	Strobe Light	1
27	G-1497-102004	Screw, 8 – 32 x ½ Round Head	3
28	G-1503-1020N	#8 Washer	3
29	JP-118	Cover, Lens	1
30	EC-2456	Light, Work Spot LED	2
34	S-2597-01	Plate, Cover	Ref
35	H-3616	Mat, Platform	2
37	Z-7859	Assembly, Steering	1
38	V-2295	Label, Use AW32 Oil	2 gal
45	G-1476-105010	Screw, ¼ - 20 SOC BUT HD CAP	4
46	G-1502-1050R	Lockwasher, ¼ Regular	4
48	Z-8502	Assembly, Accelerator Frame	1
49	G-1501-1060	ESN, 5/16 – 18 SS	8
50	G-1503-1060N	Flatwasher, 5/16 Narrow SS	8
51	JP-227	Seat	2
52	JP-228	Arm Rest	1 set
57	G-1476-103106	Screw, #10-32 Socket Button Cap	1
59	Z-7896	Assembly, Cradle Hydraulic	Ref
64	H-1438-02	Holder, Spring Clip	1
65	R-2691	Handle, Pump	1
66	V-2423	Label, Electrical	1
67	G-1320-01	Linch, Pin	8
70	Z-8200	Assembly, Cylinder	2
74	JP-229	Belt, Seat	2

**Parts List Illustration**



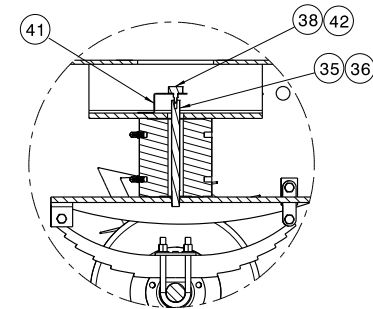
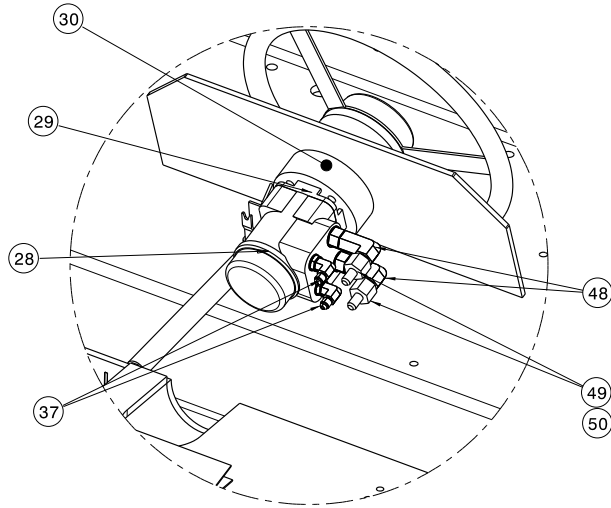
**DETAIL A  
SUSPENDED PEDAL**

### Parts List

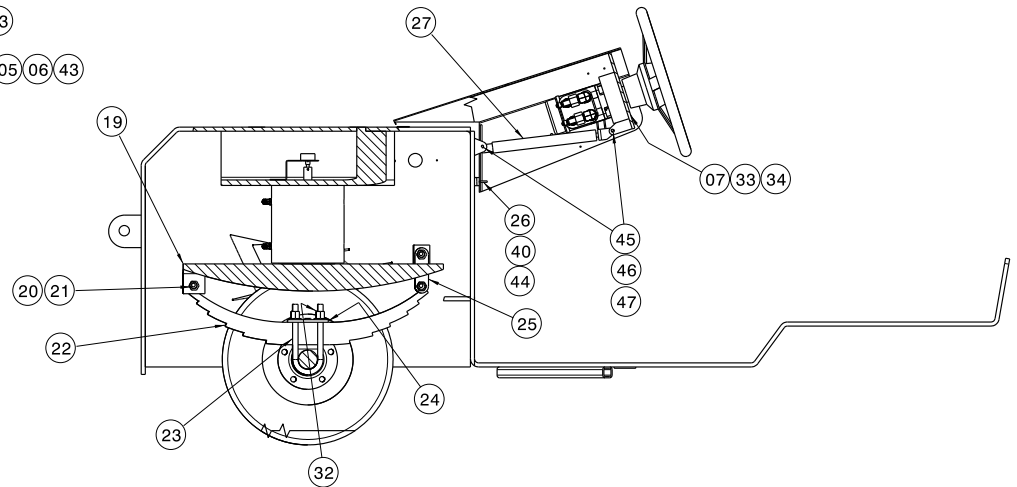
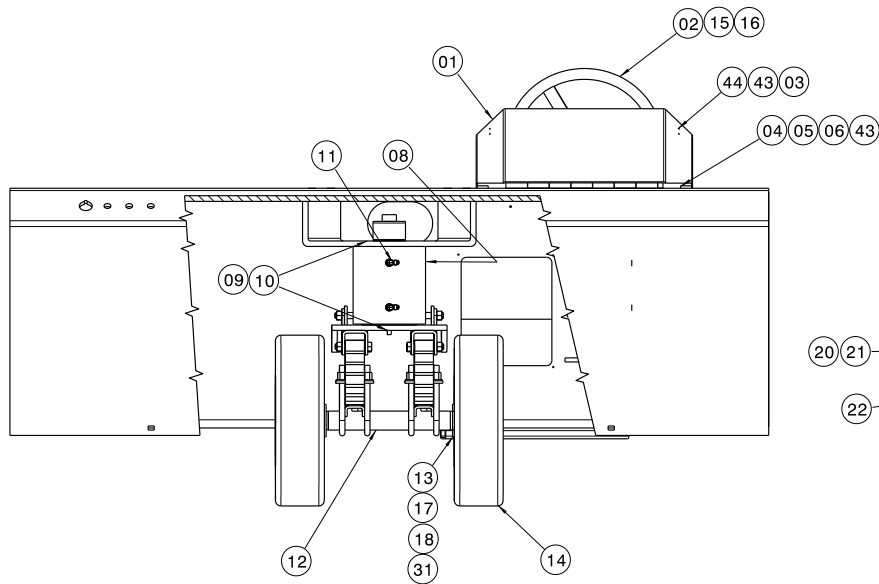
When ordering replacement parts/kits, please specify model, serial number and color of your unit.

Item	Part Number	Description	Qty
2	JP-261	Tire Mounting Front	2
3	JP-245	Torque Hub	2
4	G-1100-110016	Bolt, HH 5/8 - 11 x 1 3/4 LG	12
5	G-1251-1100R	Lockwasher, 5/8 N8	12
6	G-1248-1105	, 5/8 - 18 Flange Hex	18
7	HC-2000-045	O-Ring, Series 2	2
24	G-1202-1050	ESN, 1/4 - 20	4
25	G-1503-1050N	Flatwasher, 1/4 Narrow	4
31	Z-7771-01	Weldment, Brake Pedal	Ref
32	JP-226	Pillow Block, Brake Pedal	2
33	G-1154-107210	Screw, 3/8 - 16 x 1 LG SOC HD CAP	4
34	S-2597-01	Plate, Cover	Ref
39	EC-2766	Foot Pedal	1
40	G-1420-106012	Bolt, 5/16 - 18 Hex Head GR 8	2
41	G-1250-1050N	Flatwasher, 1/4 Narrow	8
42	4002-36	Contact, Socket	8
43	EC-2102	Wedge, 6 Pin Secondary Locking	1
44	EC-2103	DT Connector 6 Pin	1
45	G-1476-105010	Screw, 1/4 - 20 SOC BUT HD CAP	4
46	G-1502-1050R	Lockwasher, 1/4 Regular	4
47	J-5179	Panel, Access	Ref
49	G-1501-1060	ESN, 5/16 - 18 SS	2
50	G-1503-1060N	Flatwasher, 5/16 Narrow SS	4

**Parts List Illustration**



Front view[10]  
Scale: 1:8



### Parts List

When ordering replacement parts/kits, please specify model, serial number and color of your unit.

Item	Part Number	Description	Qty
1	JP-271	Lever, Steering Cowl	1
2	H-3068	Wheel, Steering	1
3	G-1201-1031	ESN, #10 – 32 SS	4
4	Z-6342-01	Weldment, Steer Cowl	Ref
5	G-1100-107012	Bolt, HH 3/8 - 16 x 1 1/4 LG	2
6	G-1202-1070	ESN, 3/8 - 16	2
7	G-1251-1070R	Lockwasher, 3/8	4
8	HC-2372	Actuator, Steering	1
9	G-1100-109012	Bolt, HH 1/2 - 13 x 1 1/4 LG	24
10	G-1251-1090R	Lockwasher, 1/2	24
11	N-2001-35-S-B	Elbow, Straight Thread 6-4	2
12	Z-2717-01	Weldment, Axle	1
13	JP-021	Hub, 3500	2
14	U-1128	Wheel, Solid	2
15	EC-2040	Button, Horn	1
16	H-3069	Nut, Steering Wheel	1
17	G-1230-01	Nut, Axle 1-14	2
18	G-1283	Washer, Spindle, 1"	2
19	Z-6716-01	Weldment, Bottom Steering Plate	Ref
20	G-1129	Bolt, Shackle 9/16 – 18 x 3 LG	6
21	G-1240	Nut, Shackle 9/16 – 18	6
22	H-3066	Spring, 7 Leaf	2
23	H-3073	U-Bolt, 1.75 Axle 5.75 LG	4
24	H-3070	Plate, Tie 1.75 Axle, 1.75 Spring	2
25	J-4185	Link, Rear Shackle	Ref
26	JP-242	Bumper	2
27	H-3665	Cylinder, Block-A-Lift	1
28	HC-2371	Valve, Steering	1
29	H-3067	Steering Column	1
30	R-2319	Spacer	1

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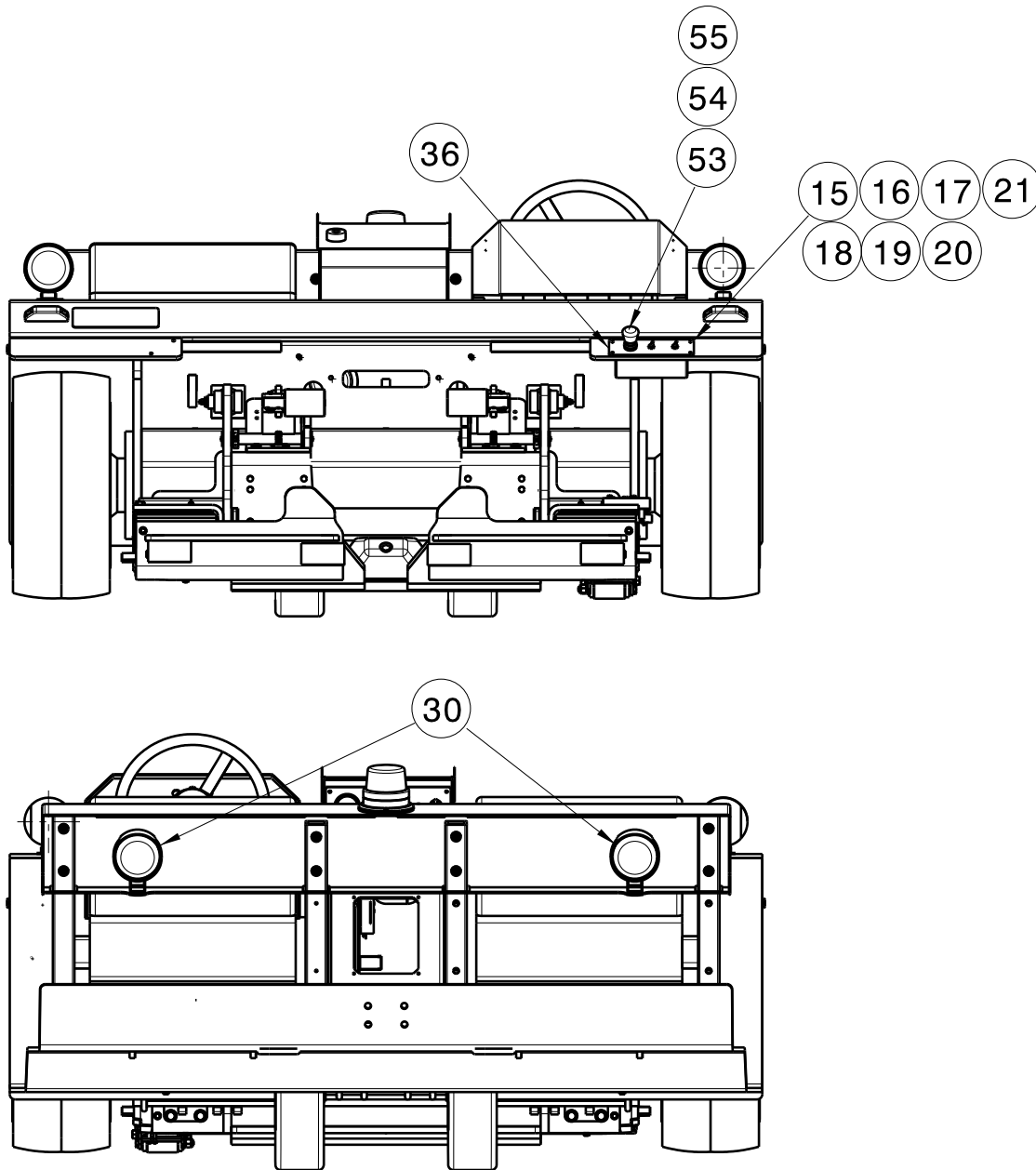
### Parts List

When ordering replacement parts/kits, please specify model, serial number and color of your unit.

Item	Part Number	Description	Qty
31	G-1301-11	Pin, Cotter, 3/16 x 1 1/2	2
32	H-3071	Nut with Washer (fits H-3073 U-Bolt)	8
33	G-1100-107030	Bolt, HH 3/8 - 16 x 3 LG	4
34	G-12501-1070N	Flatwasher, 3/8	8
35	G-1151-103212	Screw, 10 – 24 HEX SOC HD CAP	2
36	R-2320	Extension	1
37	N-2001-09-S-B	Elbow, Straight Thread 6-8	2
40	G-1202-1035	ESN, #10 – 32	6
41	S-2525-01	Bracket	1
43	G-149-103106	Screw, 10 – 32 x 3/4 RD HD PH SS	4
44	G-1503-1030N	Flatwasher, #10 Narrow SS	14
45	G-1250-1060N	Flatwasher, 5/16 Narrow	4
46	G-1202-1065	ESN, 5/16 - 24	2
47	G-1100-106514	Bolt, HH 5/16 – 24 x 1 1/2 LG	2
48	N-2706-03-S-B	Elbow, Straight Thread	2
49	N-2020-03-S	Reducer, Tube End Thread	2
50	N-2000-06-S	Nut, #8 JIC 37°	2

## Parts List

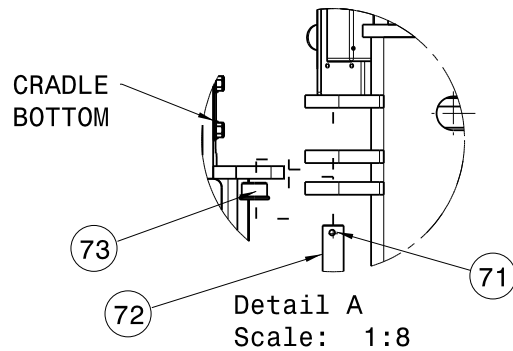
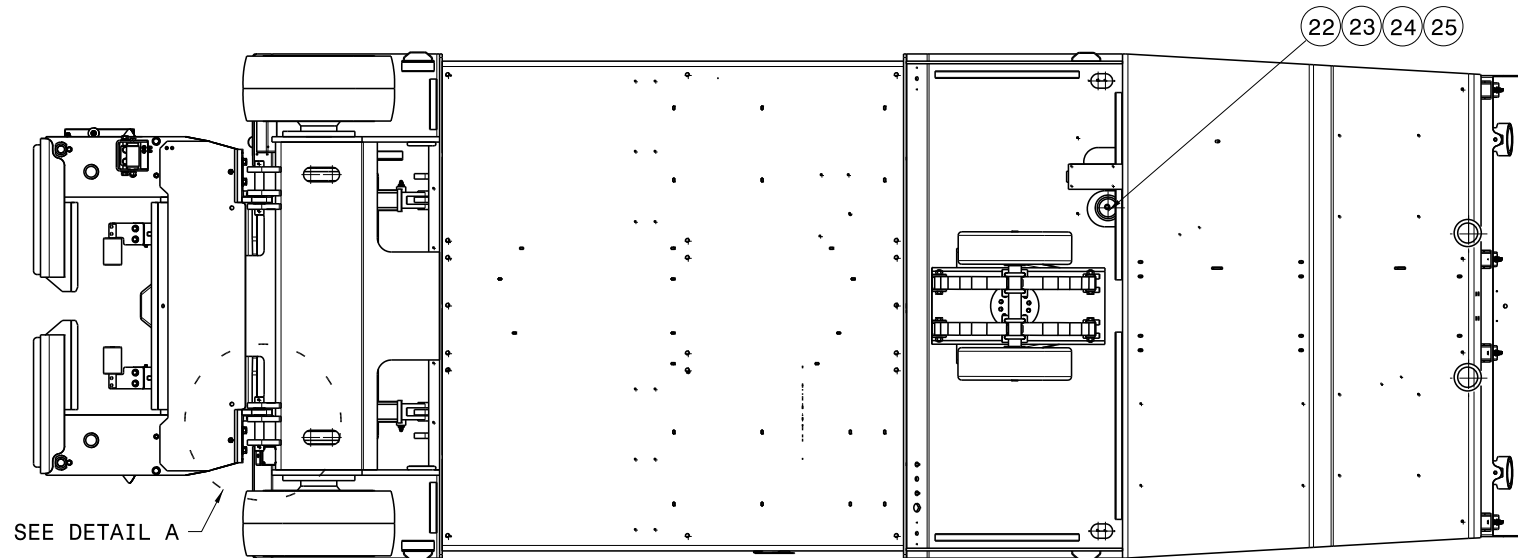
When ordering replacement parts/kits, please specify model, serial number and color of your unit.



Item	Part Number	Description	Qty
15	S-2680-01	Plate, Rocker Switch	Ref
18	G-1476-103110	Screw, 10-32 SOC BUT HD CAP	4
19	G-1202-1035	ESN, 10-32	4
20	G-1503-1030N	Flatwasher, #10	4
21	JP-108	Cord Grip	1
30	EC-2456	Light, Work Spot LED	2
53	14132	Switch, Emergency Stop	Ref

## Parts List

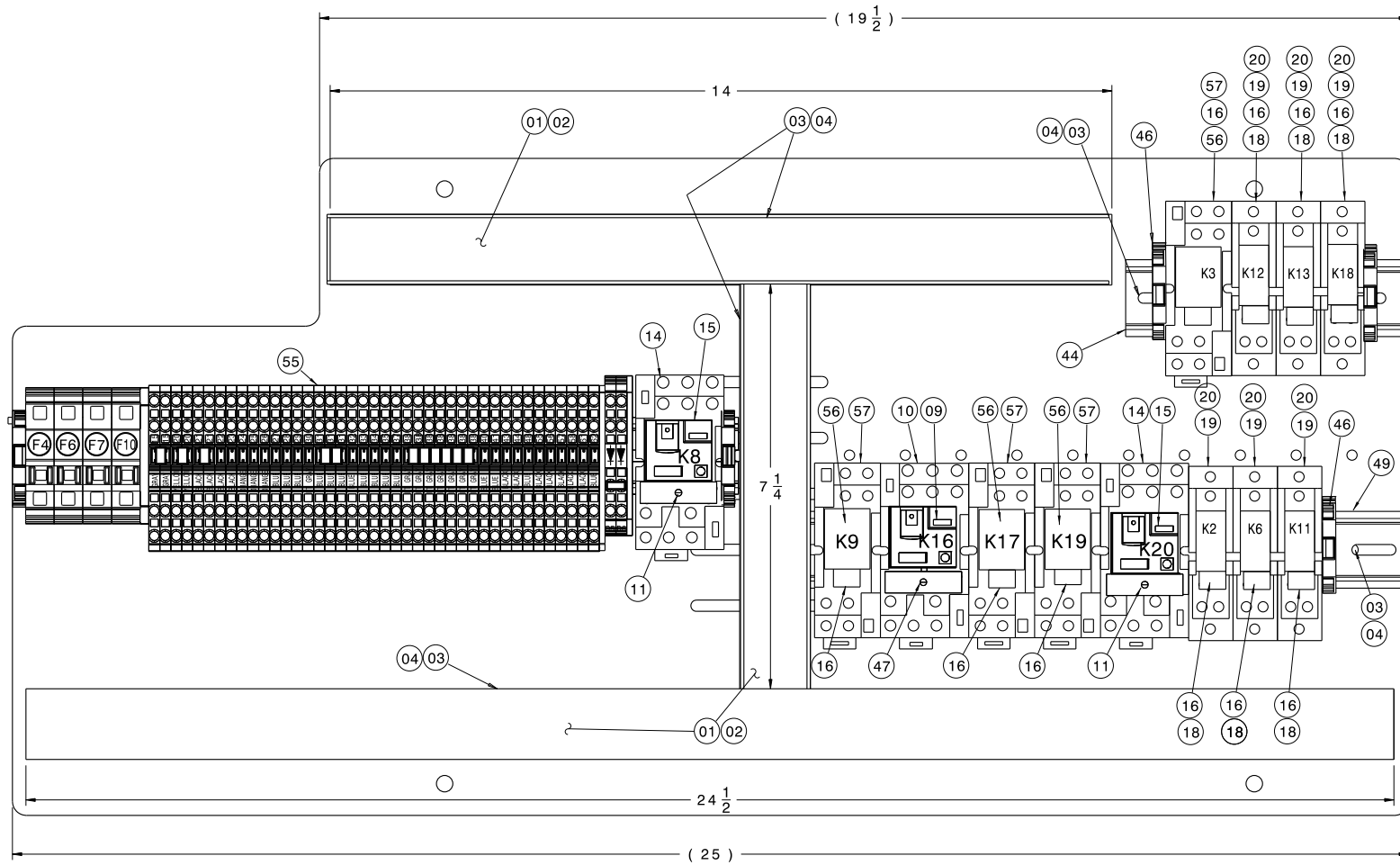
When ordering replacement parts/kits, please specify model, serial number and color of your unit.



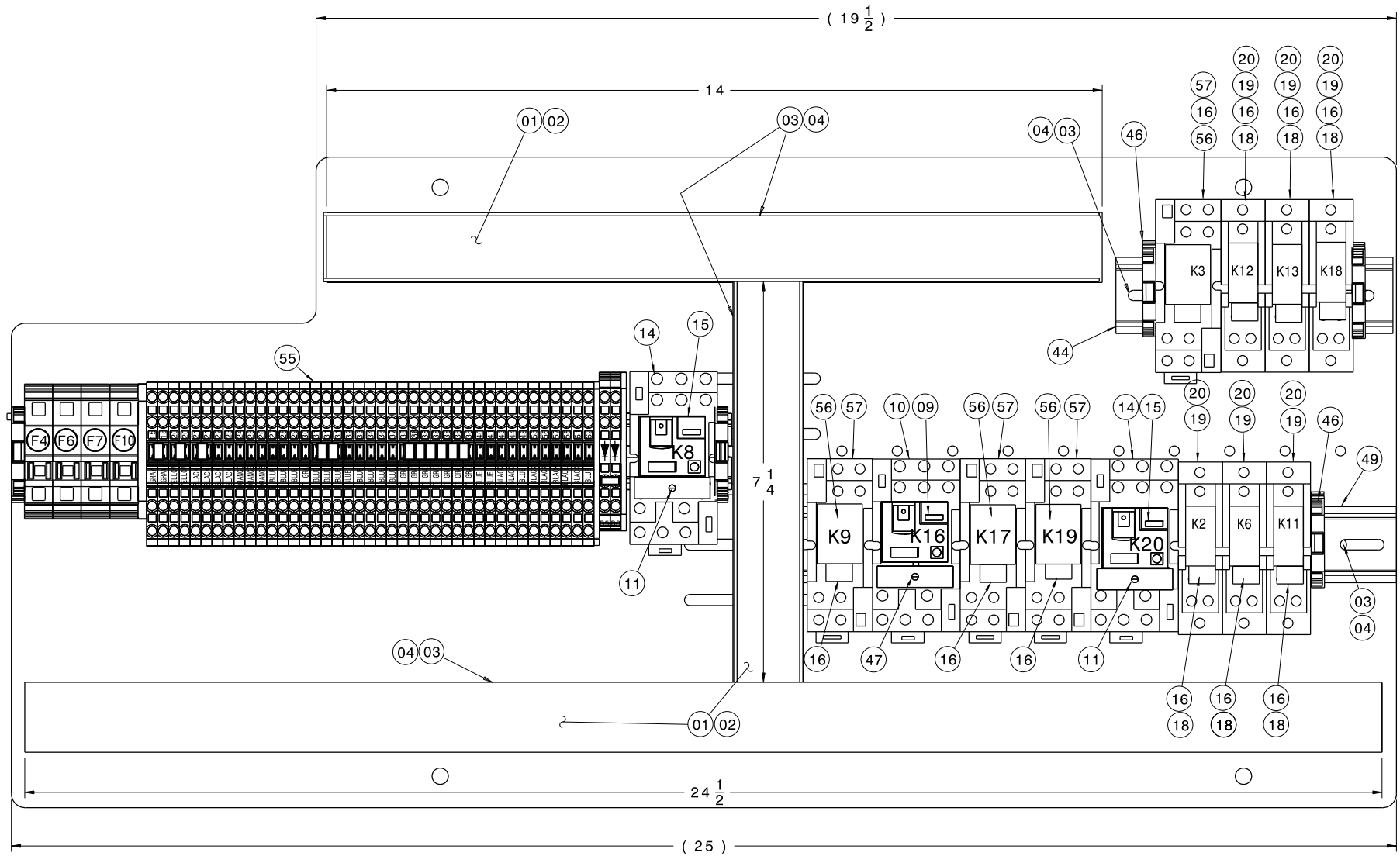
Item	Part Number	Description	Qty
22	JP-223	Reservoir, Brake	1
23	G-1100-105010	Bolt, HH, ¼ - 20 x 1	2
24	G-1202-1050	ESN, ¼ - 20	2
25	G-1503-1050N	Flatwasher, ¼ Narrow	2
71	JP-114	Linch, Pin	4
72	R-2740	Rod, Cradle	2
73	H-3689	Bearing, Flanged	2



**Parts List Illustration**



**Parts List Illustration**



### Parts List

When ordering replacement parts/kits, please specify model, serial number and color of your unit.

Item	Part Number	Description	Qty
1	EC-1711-03	Cover, Wiring Duct, two 26" LG	72 in
2	EC-1710-10	Duct, Cover	72 in
3	G-1159-103504	Screw, #10 – 32 CRS REC	26
4	G-1202-1035	Stopnut, 10-32 Elastic	26
8	EC-2682	Assembly, Terminal Block	1
9	EC-2806	Relay, Plug-In (DPDT)	1
10	EC-2807	Socket, Relay	2
11	EC-2075	Diode, Plug-In 11 Pin Socket	3
12	EC-2252	Socket, 3 Amp	1
13	EC-2253	Relay, Socket	1
14	13074	Socket, Relay (TPDT)	3
15	13064	Relay, Compact 24VDC (TPDT)	3
16	EC-2060	Diode, Plug-In 8 Pin Socket	14
17	EC-2837	Relay, Solid State 3 – 32 VDC	1
18	EC-2260	Relay, Clip	8
19	EC-2258	Relay, Ice Cube (SPDT) 20 AMP	8
20	EC-2259	Socket, 20 AMP 300 Volts	8
21	EC-2332	Relay, Latching (DPDT)	1
22	EC-2012	Relay, High Capacity (Horn)	1
23	S-2713-01	Panel, Din Rail	1
37	EC-2461	Receptacle, 12 Way In-Line (Plug by Cradle)	1
38	EC-2462	Plug, 12 Way In-Line (Plug by Cradle)	1
39	EC-2463	Wedgelock, Receptacle 12 Way In-Line (Plug by Cradle)	1
40	EC-2464	Wedge, Plug 12 Way In-Line 9 (Plug by Cradle)	1
44	13072*005.00	Rail, Din	1
46	13070	Anchor, Din Rail	2
47	EC-2808	Diode, Surge Suppressor, 6-200 VDC	1
49	13072*011.0	Rail, Din	1
55	EC-2684	Assembly, Terminal Block	1

Continued on following page

### Parts List

When ordering replacement parts/kits, please specify model, serial number and color of your unit.

Item	Part Number	Description	Qty
56	13063	Relay, Compact 24VDC (DPDT)	4
57	13073	Socket, Relay 8 Pin	4
73	EC-2275	Potentiometer	1
74	G-1251-1080R	Lockwasher, ¼ Regular	6
75	G-1250-1050N	Flatwasher, ¼ Narrow	8
76	G-1251-1030R	Lockwasher, #10 Regular	25
77	TR377-03*001.12	TGB, SST .50 OD .49 W	2
78	G-1100-105016	Bolt, Hex Head FR 5 ¼ - 20 x 1.75 Long	2
79	G-1100-105010	Bolt, Hex Head FR 5 ¼ - 20 x 1Long	5
80	G-1202-1050	Stopnut, ¼ - 20 Elastic	1
Not Shown	EC-2113-5.00	Fuse, 5 AMP Fast Acting	3
Not Shown	EC-2113-10.0	Fuse, 10 AMP Fast Acting	4
Not Shown	V-2314	Label, Components	1
Not Shown	EC-2117	Wire, 18 GA MTW White	190 in
Not Shown	EC-2116	Wire, 18 GA MTW Green	1,441 in
Not Shown	EC-2115	Wire, 18 GA MTW Black	190 in
Not Shown	EC-2114	Wire, 18 GA MTW Blue	3,393 in
Not Shown	17156	Wire, 20 AWG Yellow	50 in
Not Shown	17155	Wire, 20 AWG MTW Blue	50 in
Not Shown	17152	Wire, 16 AWG MTW Blue	120 in
Not Shown	17151	Wire, 16 AWG MTW Black	54 in
Not Shown	17150	Wire, 16 AWG MTW Green	18 in
Not Shown	17110	Terminal, #8 Reg Ring	4
Not Shown	17102	Wire, 20 AWG MTW Green	50 in
Not Shown	17096	Wire, 20 AWG MTW Black	50 in
Not Shown	EC-2049	Plug, 2 Socket, DT (by Pump Block)	9
Not Shown	EC-2050	Wedge, 2 Pin Secondary Locking (by Pump Block)	9
Not Shown	4002-36	Contact, Socket 16 AWG	36
Not Shown	JP-142	Blocking Diodes, Large	5

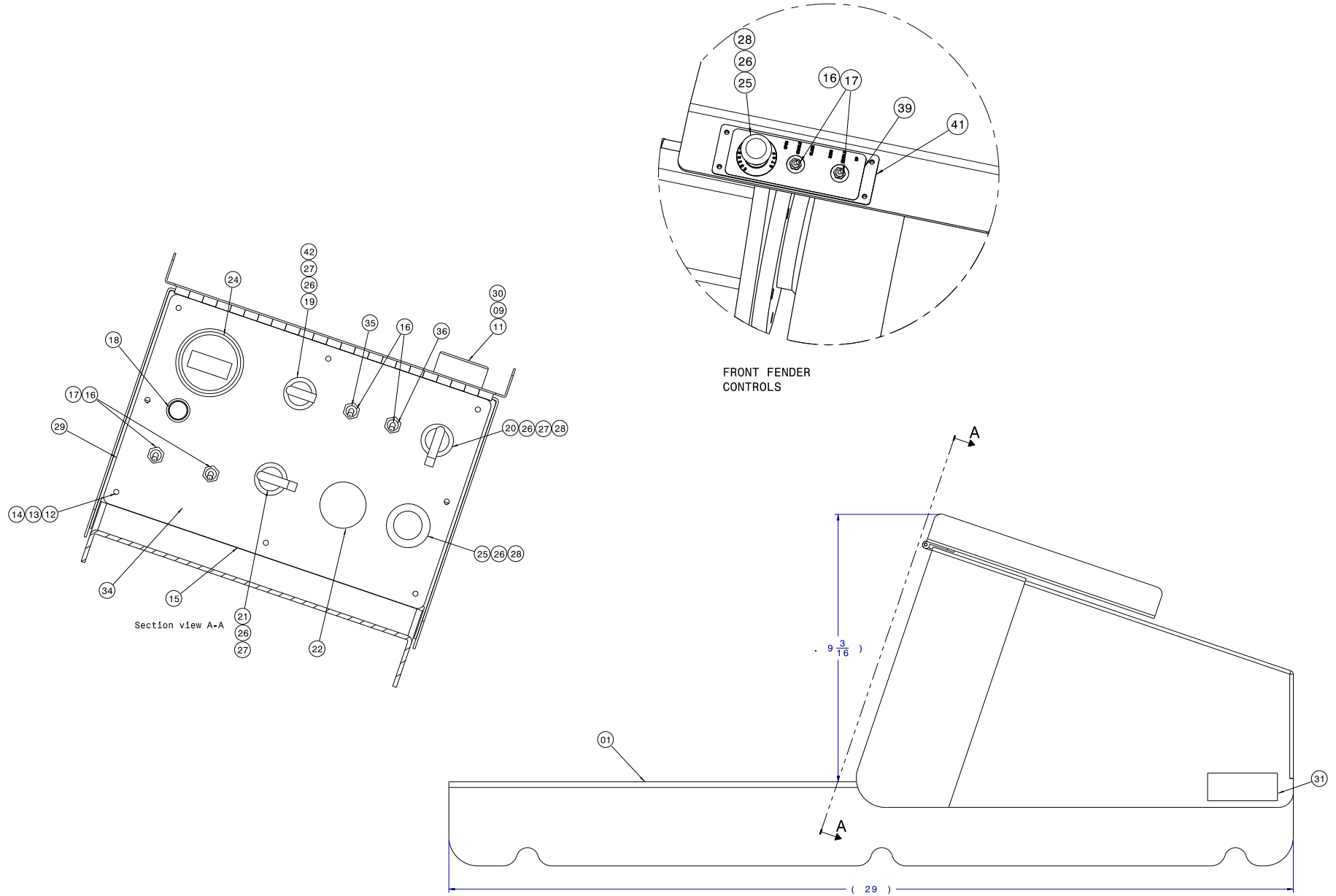
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**Parts List**

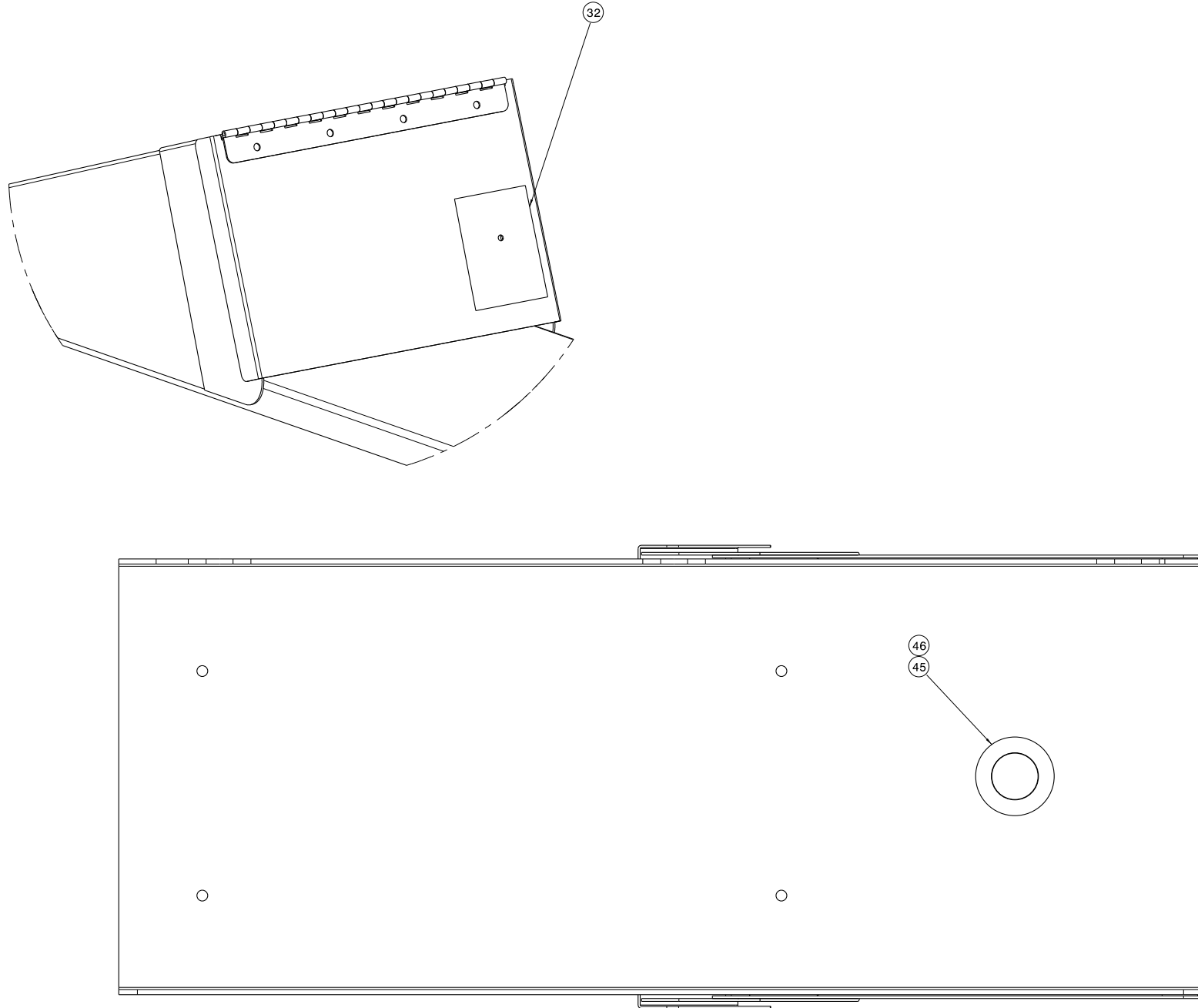
When ordering replacement parts/kits, please specify model, serial number and color of your unit.

Item	Part Number	Description	Qty
Not Shown	EC-2051	Connector, Compact 5 Conductor	5
Not Shown	17160	Terminal, 5/16 Yellow Ring	5
Not Shown	EC-1327-01	Tab, Male	16
Not Shown	EC-1326-01	Disconnect, Female	56
Not Shown	EC-2077	Card, Making Terminal Block	1
Not Shown	EC-2078	Card, Making Terminal Block	1
Not Shown	EC-2079	Card, Making Terminal Block	1
Not Shown	EC-2453	Card, Making Terminal Block	1
Not Shown	EC-2454	Card, Making Terminal Block	1
Not Shown	EC-2679	Card, Making Terminal Block	1
Not Shown	4002-31	Contact, Pin 16 AWG	12
Not Shown	12095	3 Pin Connector, DT06-3S	2
Not Shown	12099	Plug, Wedge Lock, W3S	2

**Parts List Illustration**



**Parts List Illustration**



### Parts List

When ordering replacement parts/kits, please specify model, serial number and color of your unit.

Item	Part Number	Description	Qty
1	Z-8456-01/SP	Weldment, Console	<i>Ref</i>
2	V-2343	Label, Back Away	1
3	V-2421	Label, Loading and Unloading	1
4	V-2513	Label, E-Stop and Reset Instruction	1
5	G-1476-105004	Screw, Socket Button Head Cap, ¼ - 20	4
6	G-1503-1050N	Flatwasher, ¼ SST	4
7	G-1502-1050R	Lockwasher, ¼	4
8	G-1658-13	Washer, w/Neoprene ¼	4
9	G-1476-103006	Screw, Socket Button Head Cap, 10-24	1
11	G-1671-01	Nut, Non-Removable 10-24	1
12	G-1476-103106	Screw, Socket Button Head Cap, #10 – 30	8
13	G-1502-1030R	Lockwasher, #10	8
14	G-1658-04	Washer, w/Neoprene #10	8
15	S-2674-01	Panel, Control	1
16	EC-2744	Rubber, Switch Boots	6
17	EC-2745	Switch, Toggle 3 Position (DPDT)	4
18	EC-2693	Lamp, Panel LED (White)	1
19	EC-2739	Switch, 4 Position Maintained	1
20	EC-2740	Switch, 3 Position Spring R/1	1
21	EC-2741	Switch, 3 Position Maintained w/Level	1
22	EC-2812	Hole, Plug Black Plastic	1
24	EC-2096	Battery, Controller Hour Meter	1
25	14132	Switch, Emergency Stop	2
26	14142	Flange, Latch	5
27	14143	Block, Contact (Green)	6
28	14144	Block, Contact (Red)	8
29	H-3752	Seal, Silicone Rubber	38.38 in
30	J-5692	Spacer, E-Stop	1
31	V-1001	Label, Made In USA	1

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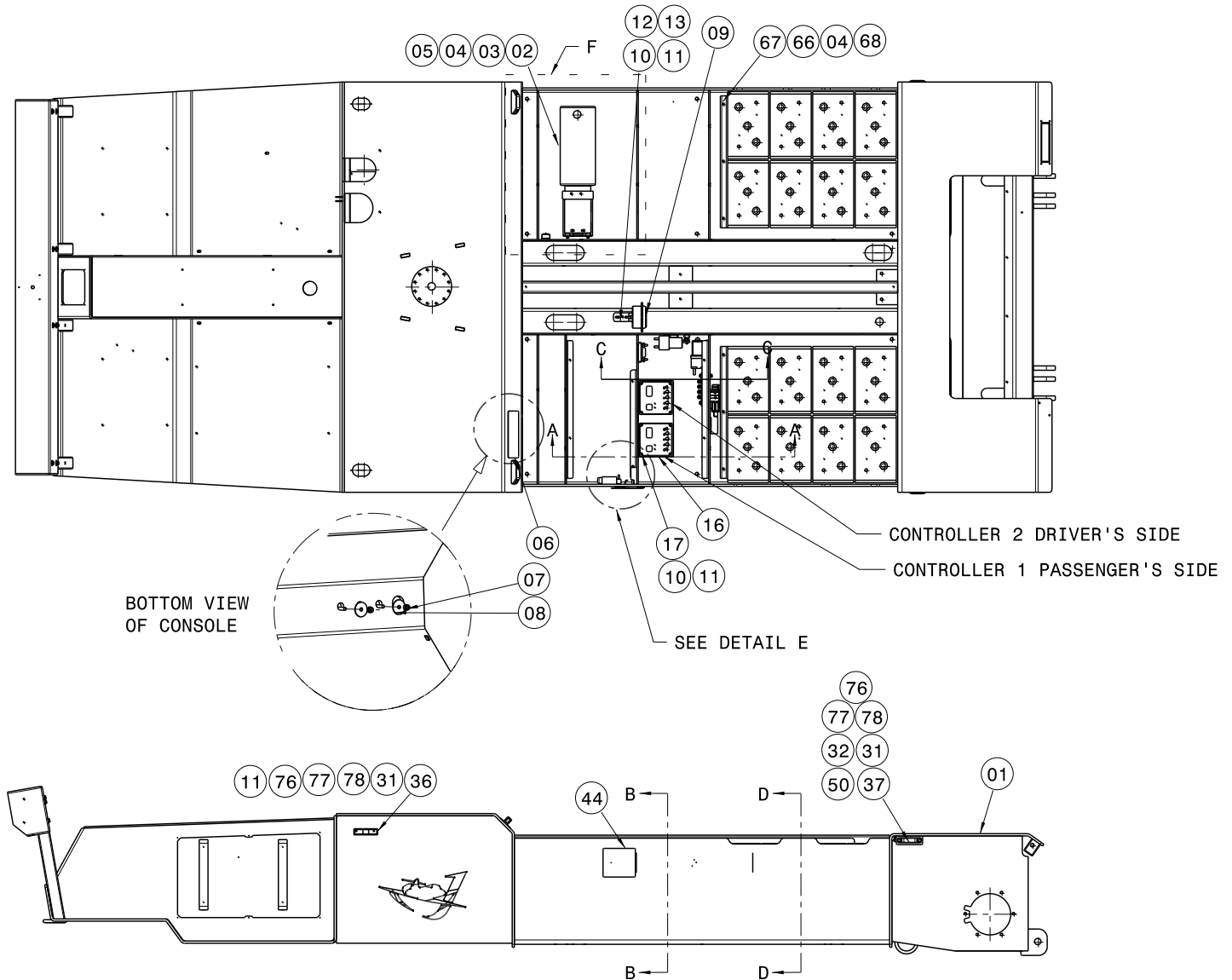
### Parts List

When ordering replacement parts/kits, please specify model, serial number and color of your unit.

Item	Part Number	Description	Qty
32	V-2514	Label, E-Stop Cover	1
34	V-2574	Label, Center Control	1
35	EC-2747	Switch, Toggle 2 Position (DPDT)	1
36	EC-2746	Switch, Toggle 2 Position (DPDT)	1
39	V-2515	Label, Fender Switch	1
41	S-2680-01	Plate, Fender Switch	1
45	EC-1175-25-A	Connector, Power Cable 1 ¼	1
46	EC-1176-05	Locknut, Conduit	1
<i>Not Shown</i>	V-2191	Label, Caution Hands/Feet	1
<i>Not Shown</i>	EC-2674	Block, Contact NCEB SP-CLP	2

## Parts List

When ordering replacement parts/kits, please specify model, serial number and color of your unit.



Item	Part Number	Description	Qty
1	Z-6339-01	Weldment, JP100S	Ref
2	HC-2537	Pump, Hydraulic	1
3	G-1100-107012	Bolt, HH GR5, 3/8 - 24 x 1 1/4 LG	2
4	G-1250-1070N	Flatwasher, 3/8 Narrow	14
5	G-1251-1070R	Lockwasher, 3/8 Regular	2
6	S-2332-01	Cover, Socket	Ref
7	G-1202-1050	ESN, 1/4 - 20	14
8	G-1254-09	Washer, 1/4 Fender	2
9	EC-2011	Horn	1
10	G-1251-1050R	Lockwasher, 1/4 Regular	10
11	G-1250-1050N	Flatwasher, 1/4 Narrow	10
12	G-1440-1050-S	Nutsert, 1/4 - 20 Open End	2
13	G-1100-105006	Bolt, HH, 1/4 - 20 x 3/4 LG	2
16	EC-2090	Controller	2
17	G-1154-105206	Screw, 1/4 - 20 SOC BUT HD CAP	8

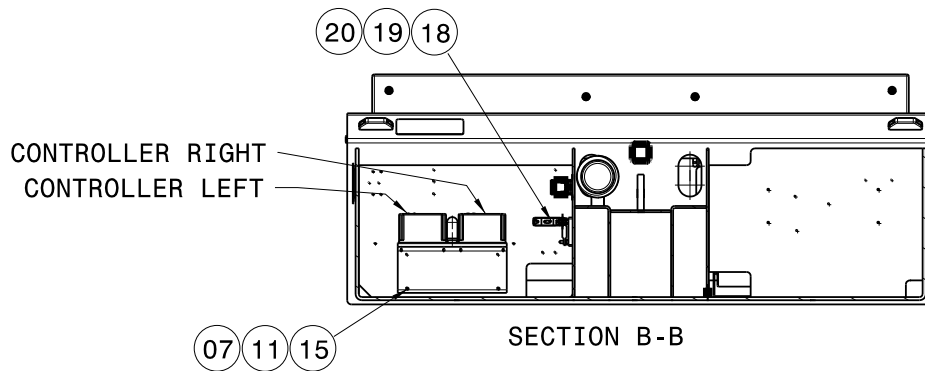
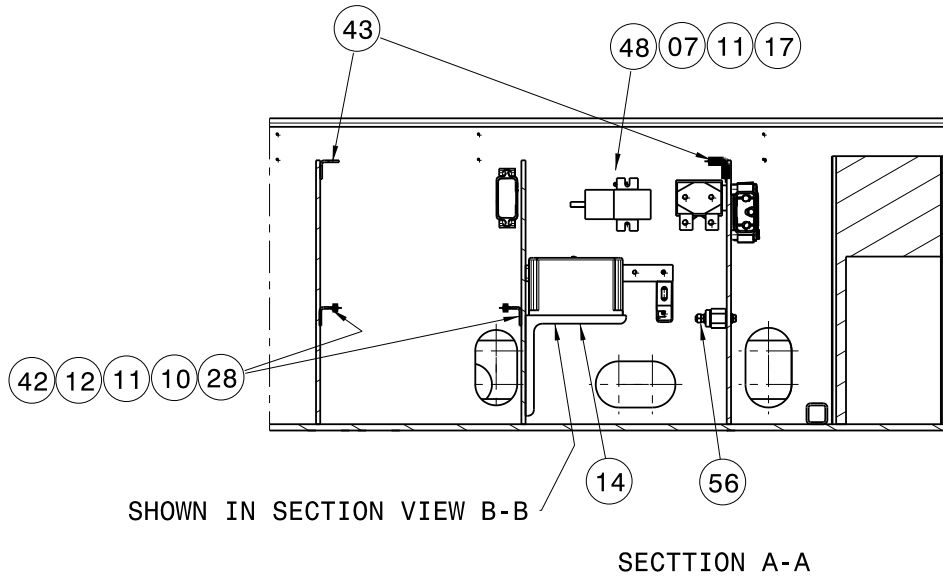
**Parts List**

When ordering replacement parts/kits, please specify model, serial number and color of your unit.

Item	Part Number	Description	Qty
31	G-1476-103110	Screw, #10 – 32 Socket Button Head Cap	12
32	G-1250-1030N	Flatwasher, #10 Narrow	4
36	EC-2846	LED, 24V Red	2
37	EC-2847	LED, 24V Amber	4
44	Z-7952	Assembly, Charger Door	1
50	G-1202-1035	Stopnut, #10 – 32 Elastic	6
66	G-1100-107022	Bolt, HH GR5, 3/8 - 16 x 2 1/4 LG	6
67	TS-2439-01	Tube, Stop	Ref
68	G-1202-1070	ESN, 3/8 - 16	6
76	EC-1326-01	Disconnect, Female Red 1/4 F/I	12
77	EC-1327-01	Disconnect, Male Red 1/4 F/I	12
78	EC-2709	Base, Black for 169 LED Light	6

## Parts List

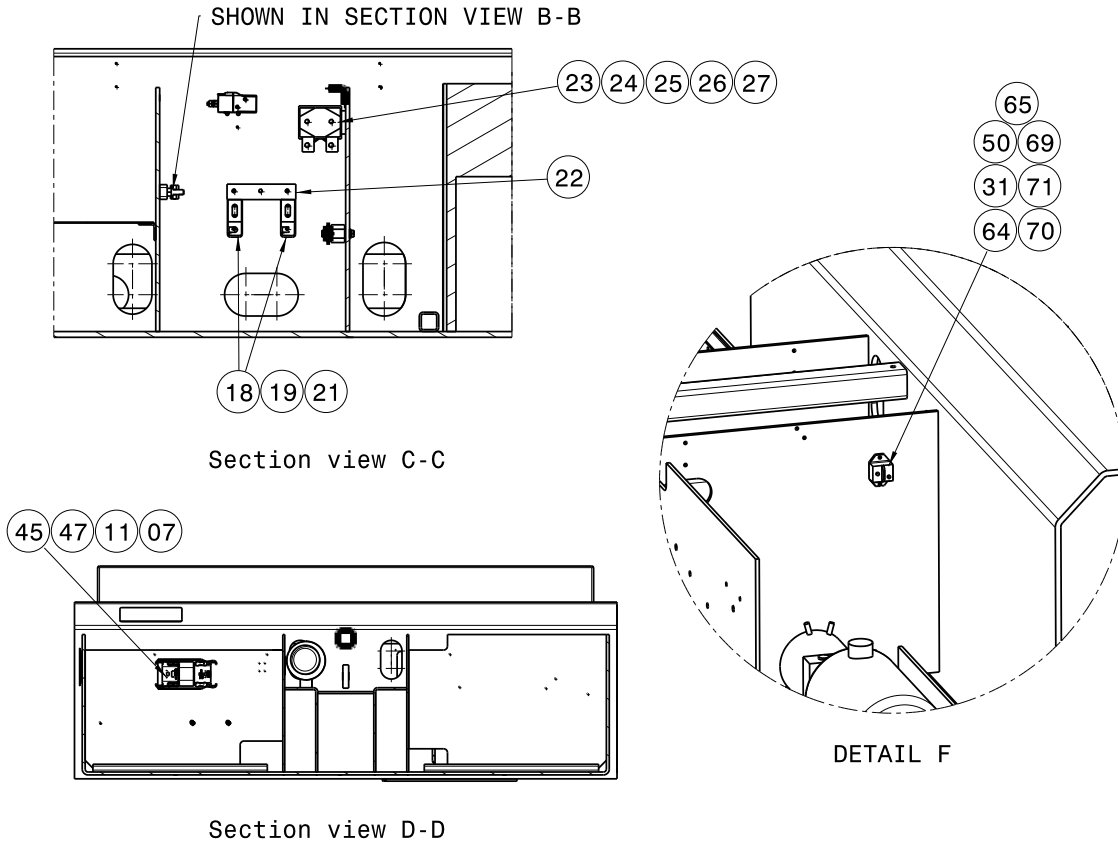
When ordering replacement parts/kits, please specify model, serial number and color of your unit.



Item	Part Number	Description	Qty
7	G-1202-1050	ESN, ¼ - 20	16
10	G-1251-1050R	Lockwasher, ¼ Regular	8
11	G-1250-1050N	Flatwasher, ¼ Narrow	20
12	G-1440-1050-S	Nutsert, ¼ - 20 Open End	8
14	A-1280	Angle, Mounting	1
15	G-1100-105012	Bolt, HH GR5, ¼ - 20 x 1 ¼ LG	4
17	G-1151-105010	Screw, ¼ - 20 Hex Head Cap	10
18	G-1152-103706	Screw, 82" SOC Flat HD CAP	2
19	EC-1618	Holder, Fuse	1
20	EC-1619-04	Fuse, Low Voltage Limiter (60 AMP)	1
28	G-1100-105010	Bolt, HH GR5, ¼ - 20 x 1 LG	6
31	G-1250-1030N	Flatwasher, #10 Narrow	8
42	J-5182-01/-02	Bracket	Ref
43	J-4505-01/-02	Bracket	Ref
48	EC-2842	Contactora, 15 A (SPST)	1
49	H-3526	Bracket, Mounting	1
50	G-1202-1035	ESN, #10 - 32	2
51	G-1497-103106	Screw, RD HD PH SS, 10 - 32 x ¾	2
56	Z-7949	Assembly, Negative Buss Bar	1

## Parts List

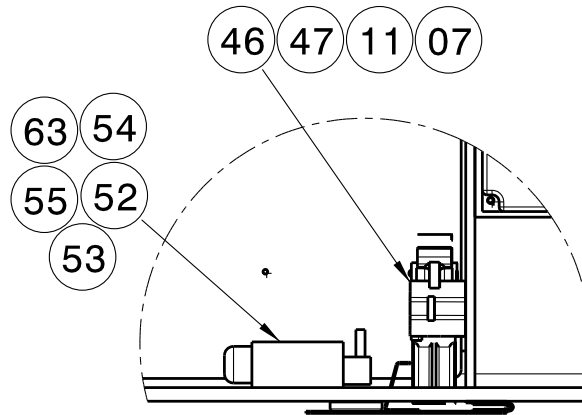
When ordering replacement parts/kits, please specify model, serial number and color of your unit.



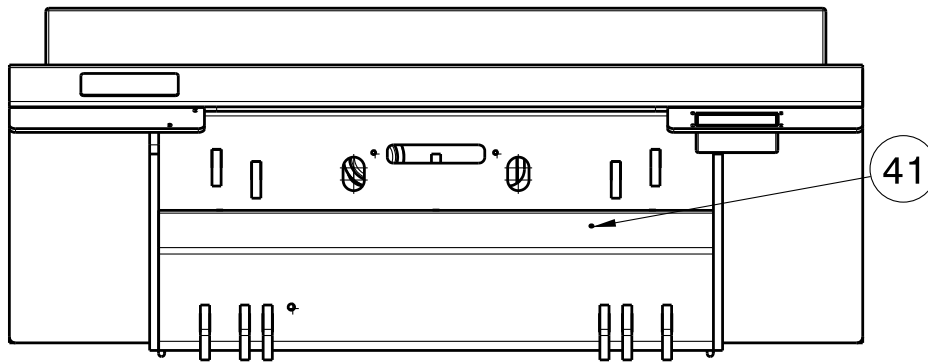
Item	Part Number	Description	Qty
7	G-1202-1050	ESN, ¼ - 20	4
11	G-1250-1050N	Flatwasher, ¼ Narrow	8
18	G-1152-103706	Screw, 82" SOC Flat HD CAP	4
19	EC-1618	Holder, Fuse	3
21	EC-1619-18	Fuse, Low Voltage Limiter (400 AMP)	2
22	J-5189	Bar, Buss	1
23	EC-2452	Contactora	1
24	J-4268	Plate, Contactora	1
25	G-1515-M50	Flatwasher, Metric M5	4
26	G-1514-M50R	Lockwasher, Split	4
27	G-1114-050025	Bolt, Class 8.8 Metric	4
31	G-1250-1030N	Flatwasher, #10 Narrow	8
45	EC-2446-01	EVC Connector, A32 Female	1
47	G-1100-105024	Bolt, HH GR5, ¼ - 20	4
50	G-1202-1035	ESN, #10 - 32	4
64	EC-2663	Modual, Power Diode (100 Amp)	1
65	G-1159-103510	Screw, #10-32 RD HD CRS REC	2
69	EC-1185-08	Cable, Welding #6	36 in
70	EC-1034-01	Terminal, Ring	2
71	EC-1034-03	Terminal, Ring	2

**Parts List**

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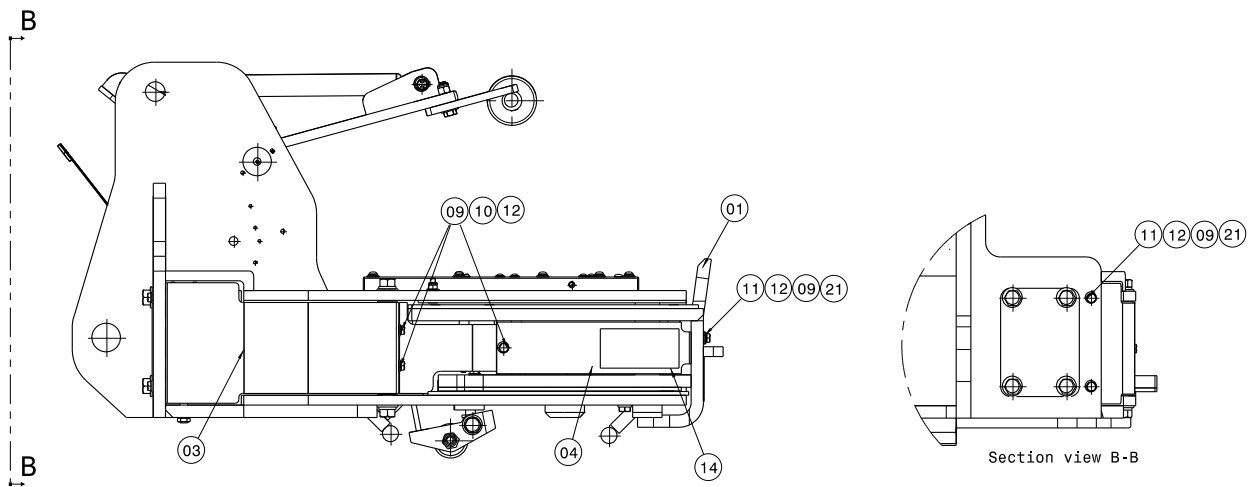
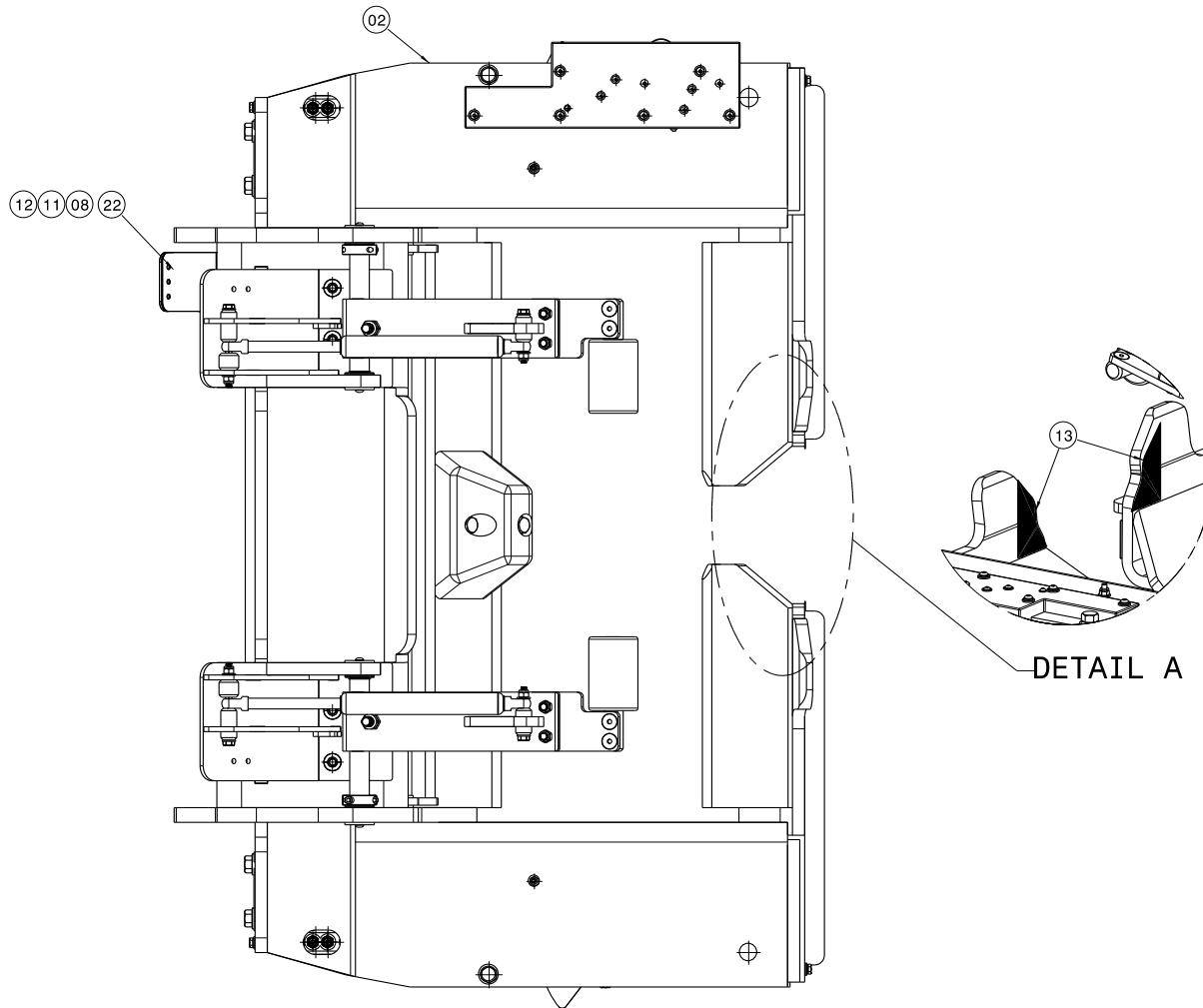
**DETAIL E  
CHARGE DOOR**



Item	Part Number	Description	Qty
7	G-1202-1050	ESN, ¼ - 20	4
11	G-1250-1050N	Flatwasher, ¼ Narrow	8
41	EC-2250	Proximity, Switch	1
46	EC-2447-01	EBC Connector, A32 Male	1
47	G-1100-105024	Bolt, HH GR5, ¼ - 20	4
52	JP-205	Switch, Batt CMP/Steer Limit	1
53	G-1157-103512	Screw, #10 – 32 PAN HD CRS REC	2
54	G-1251-1030R	Lockwasher, #10 Regular	2
55	G-1503-1020N	Flatwasher, #8 Narrow	2
63	G-1202-1020	Stopnut, #8 – 32 RD HD CRS REC	2

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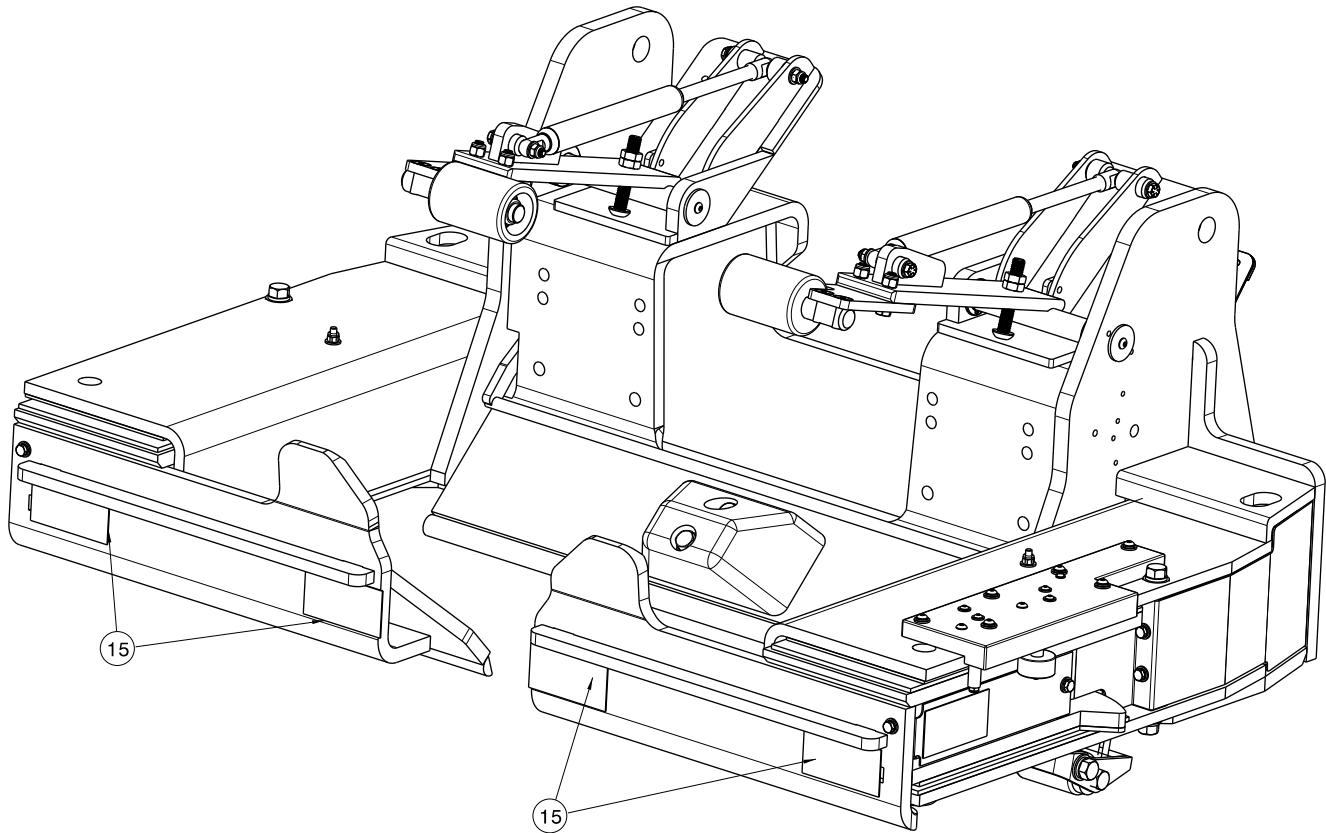
**Parts List Illustration**





## Parts List

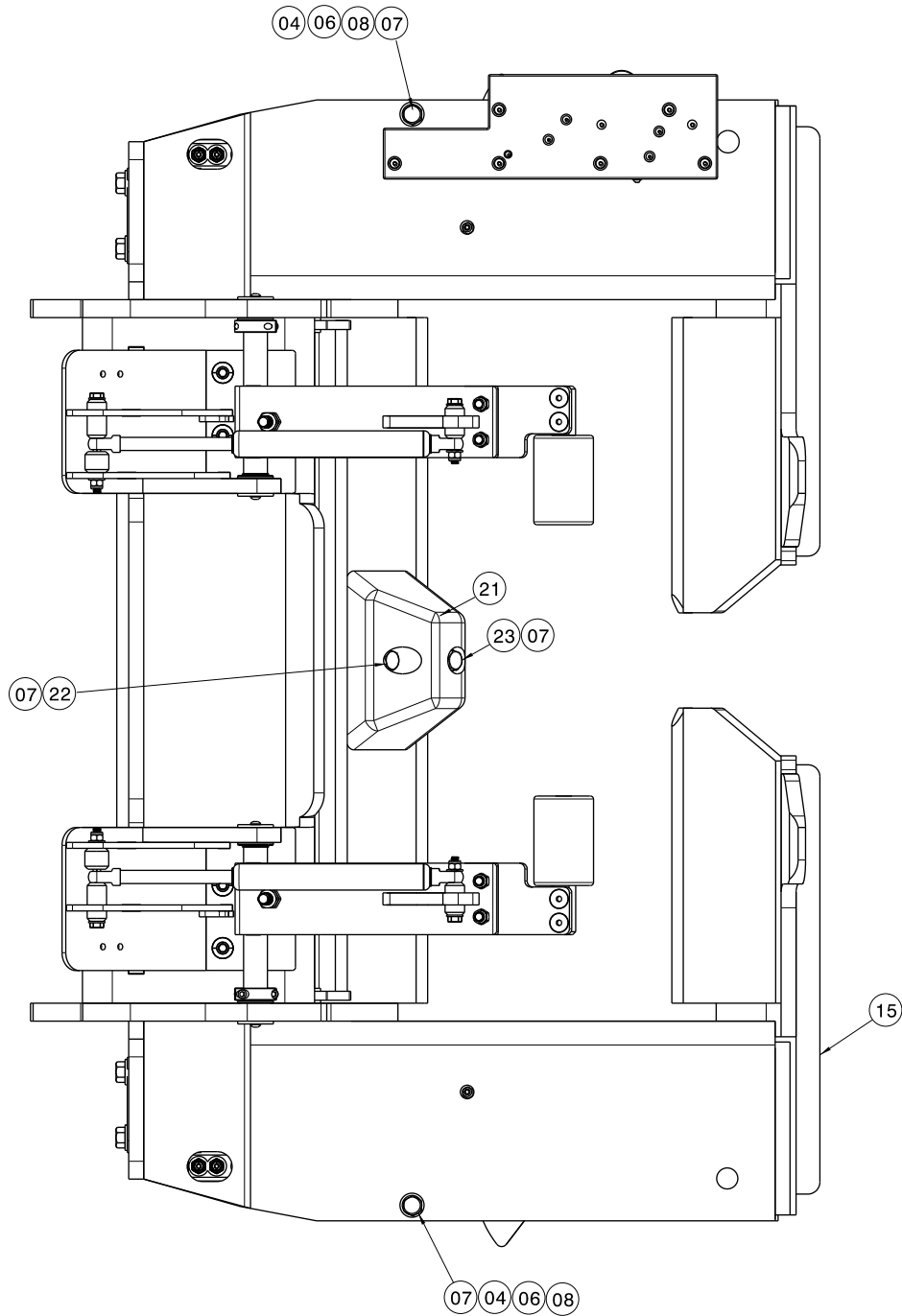
When ordering replacement parts/kits, please specify model, serial number and color of your unit.



Item	Part Number	Description	Qty
1	Z-7896	Assembly, Hydraulic	Ref
2	S-2618-01	Guard, Side Long Left	1
3	S-2619-01	Guard, Side Long Right	1
4	S-2389-01	Guard, Side Short Front	2
8	G-1202-1050	Stopnut, ¼ - 20 Elastic	1
9	G-1502-050R	Lockwasher, ¼ ID Narrow	12
10	G-1112-105006	Bolt, HH GR5, ¼ - 20 x ¾ LG	10
11	G-1112-105012	Bolt, HH GR5, ¼ - 20 x 1 ¼ LG	8
12	G-1503-1050N	Flatwasher, ¼ ID Narrow	16
13	H-2807	Reflector, Red	12.38 in
14	H-2806	Reflector, Yellow	8 in
15	H-2899	Reflector, White	16 in
21	G-1439-1050-S	Nutsert, ¼ - 20 Open End	6
22	Z-9119-01	Sensor, Tab	1
Not Shown	Z-8172-SP	Capture Metal Package	Ref

## Parts List

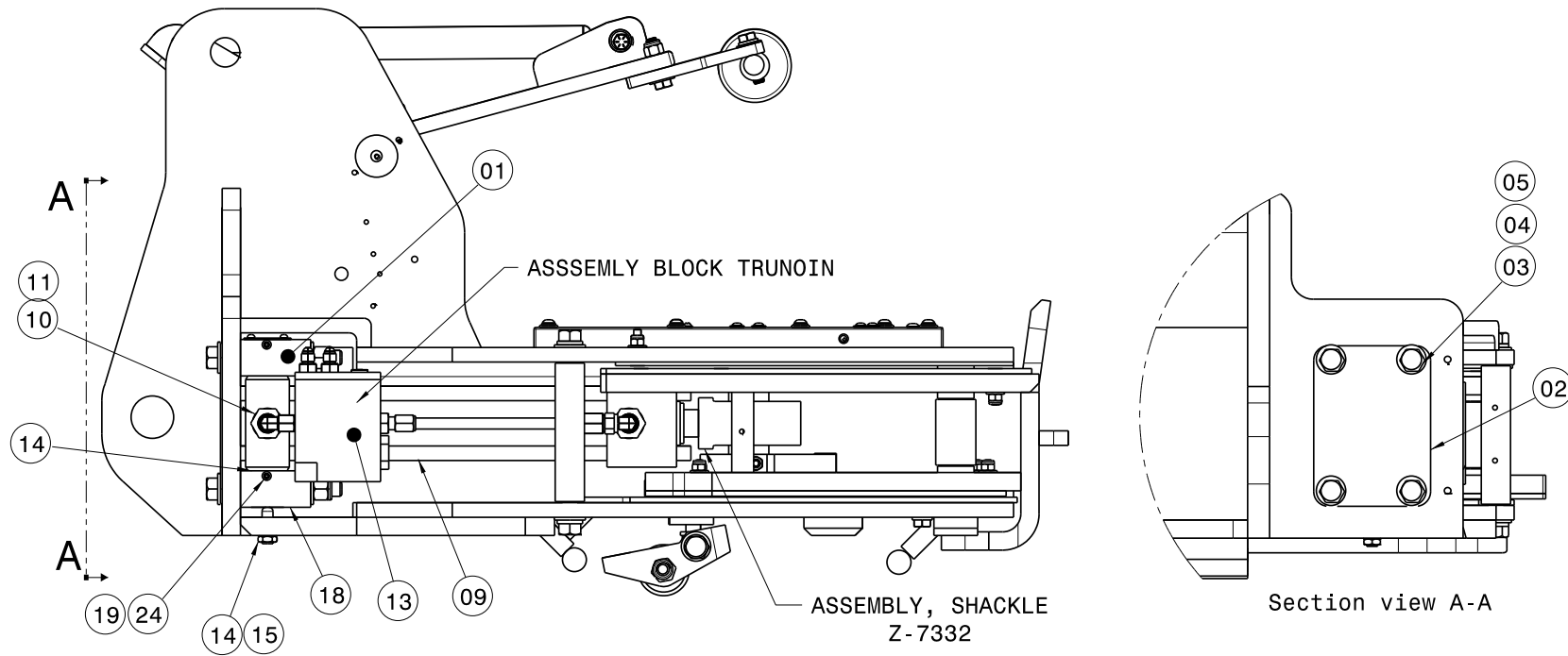
When ordering replacement parts/kits, please specify model, serial number and color of your unit.



Item	Part Number	Description	Qty
4	G-1250-1090R	Flatwasher, ½ Regular	4
6	J-4795	Pin, Support	2
7	G-1251-1090R	Lockwasher, ½ Regular	6
8	G-1100-109514	Bolt, HH GR5, ½ - 20 x 1 ½ LG	4
15	Z-7895	Assembly, Cradle	1
21	J-5687	Center Wedge	1
22	G-1100-109016	Bolt, HH GR5, ½ - 13 x 1 ¼ LG	1
23	G-1100-109030	Bolt, HH GR5, ½ - 13 x 3 LG	1

### Parts List

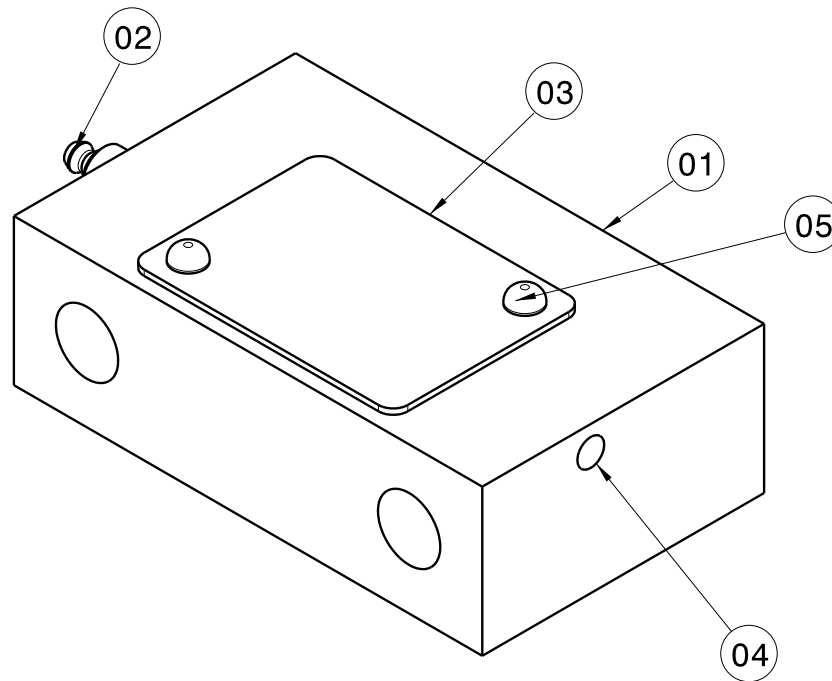
When ordering replacement parts/kits, please specify model, serial number and color of your unit.



Item	Part Number	Description	Qty
1	Z-7931	Block, Trunnoin	2
2	S-2363-01	Plate, Cover	2
3	G-1100-109042	Bolt, HH GR5, 1/2 - 13 x 4 1/4 LG	8
4	G-1250-1090R	Flatwasher, 1/2 Regular	16
5	G-1202-1090	ESN, 1/2 - 13	8
9	HC-2598	Cylinder, Hydraulic	2
10	N-2463-36-S-B	Fitting, Reducer Expander, 10-4	4
11	N-2001-03-S-B	Elbow, Straight Thread	4
13	Z-8175	Assembly, Block Flow	2
14	G-1677-107512	Screw, Set, Oval Point, 3/8 - 24 x 1 1/4 Long	2
15	G-1203-1075	Jamnut, 3/8 - 24 Elastic	2
18	J-4770	Block, Trunnoin	2
19	G-1163-01	Screw, Hex CAP PT SET, 1/4 - 28	2
24	N-2411-02	Zerk, Grease 1/4 - 28	2

**Parts List**

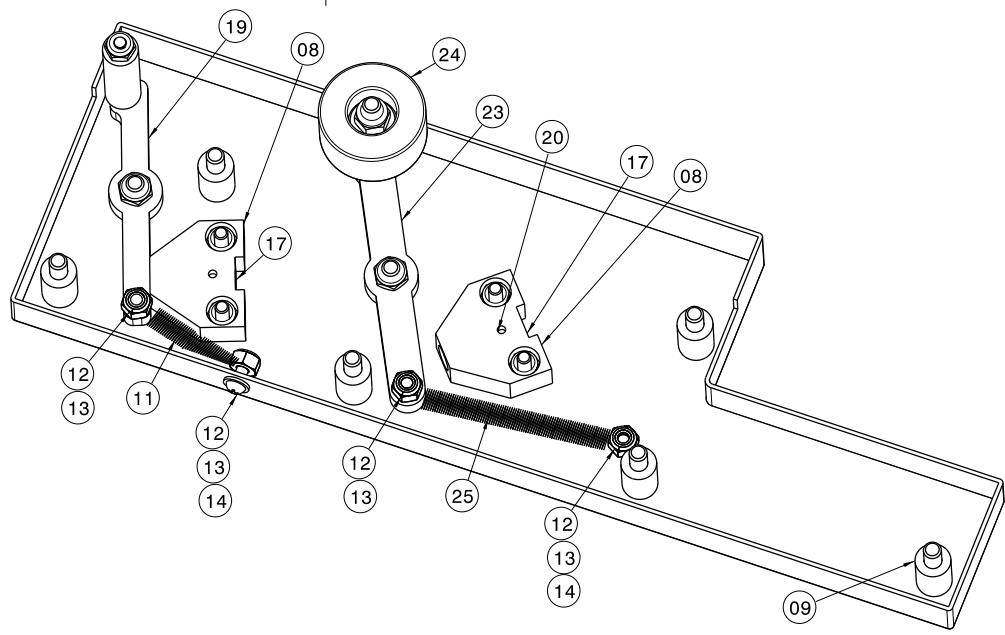
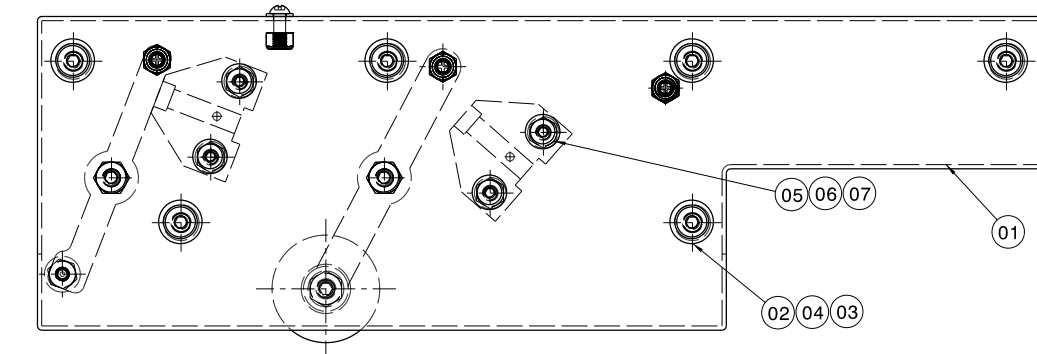
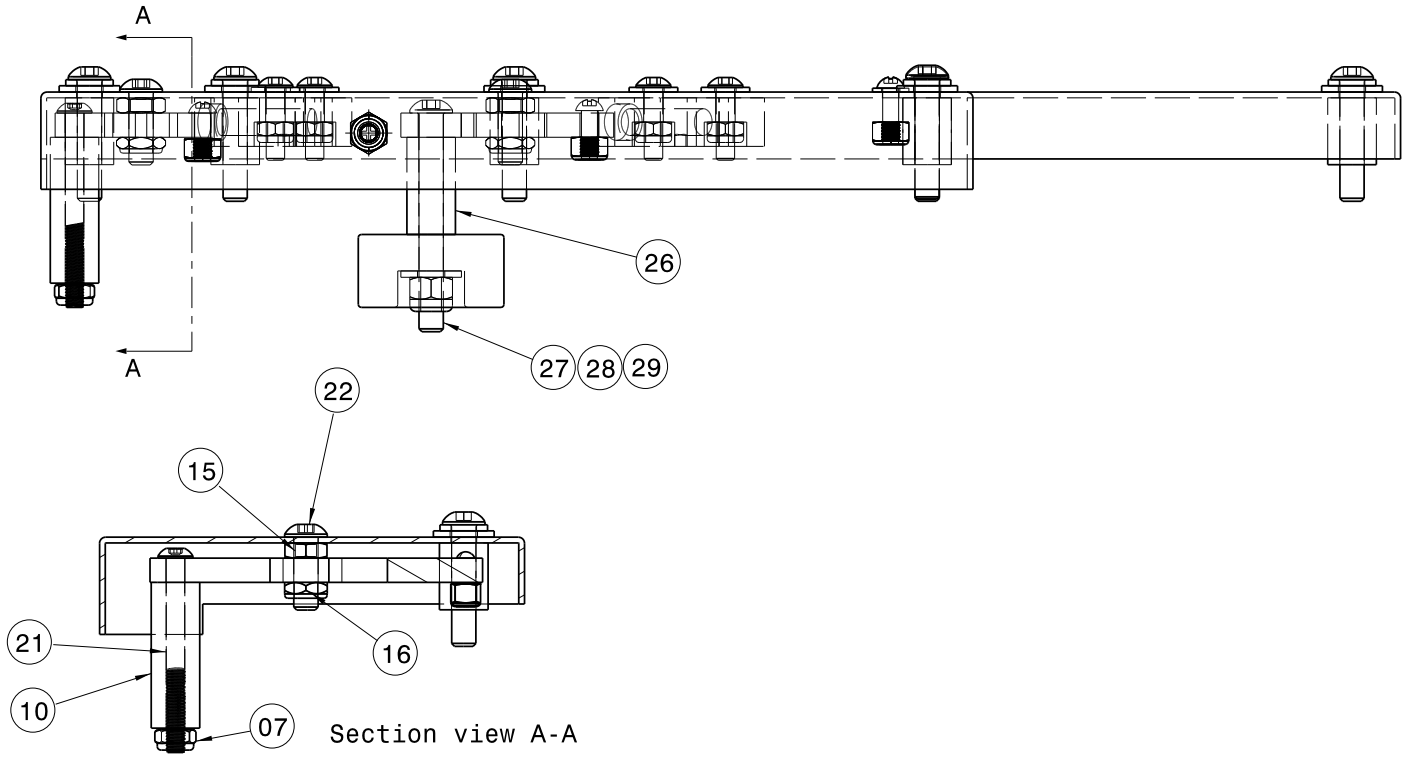
When ordering replacement parts/kits, please specify model, serial number and color of your unit.



Item	Part Number	Description	Qty
1	J-4770	Block, Trunnoin	1
2	N-2411-02	Zerk, Grease ¼ - 28	1
3	S-2540-01	Cover, Trunnoin	1
4	G-1163-01	Screw, Hex CAP PT SET, ¼ - 28	1
5	G-1182-05-01	Screw, Drive	2

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**Parts List Illustration**



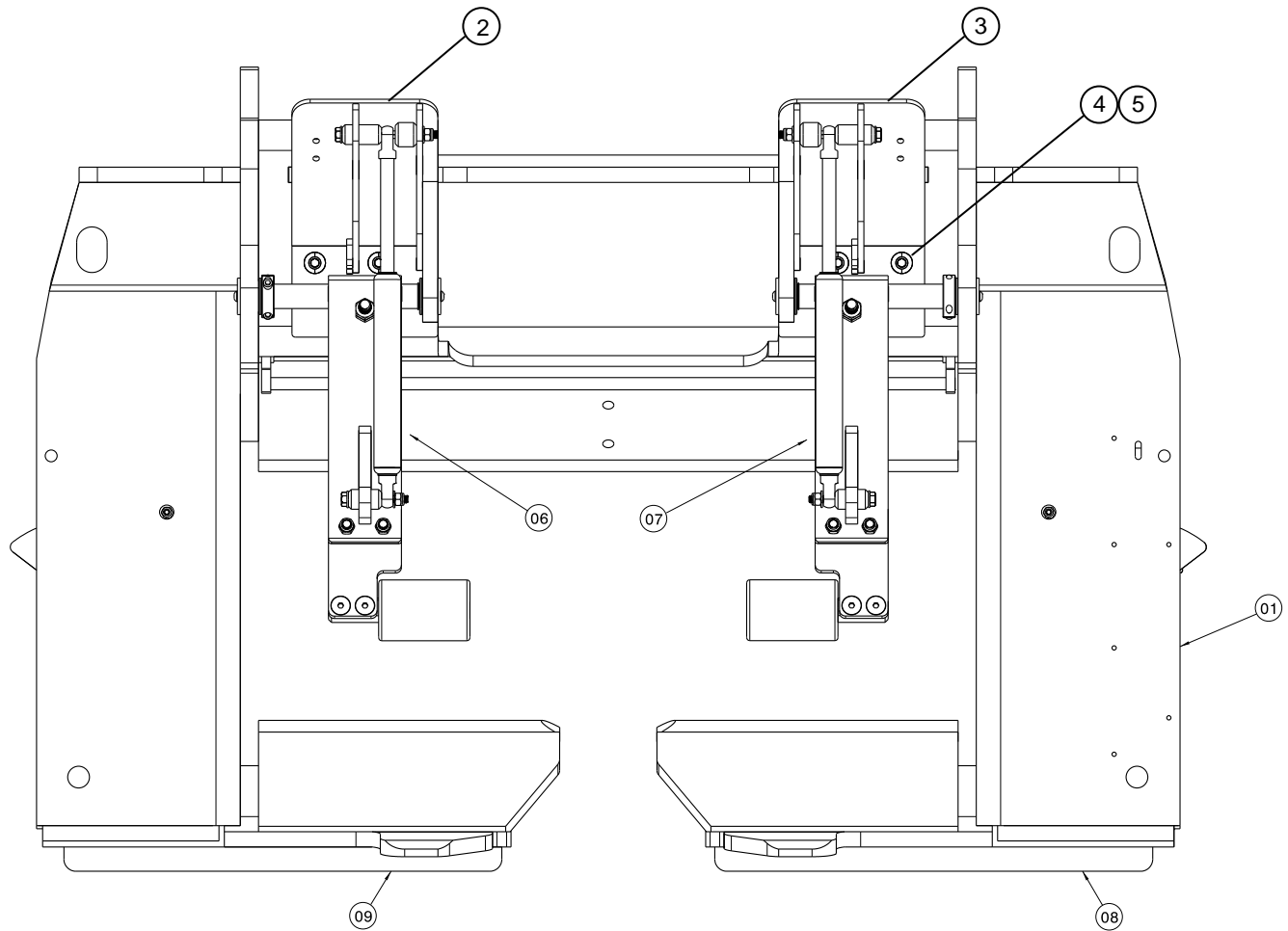
### Parts List

When ordering replacement parts/kits, please specify model, serial number and color of your unit.

Item	Part Number	Description	Qty
1	S-2617-01	Sensor, Box	1
2	G-1476-105012	Bolt, HH GR5, ¼ - 20 x 1 ¼ LG	6
3	G-1502-1050R	Lockwasher, Helical Spring	6
4	G-1503-1050N	Flatwasher, ¼ Narrow	6
5	G-1476-103106	Screw, #10 – 32 BUT HD CAP	4
6	G-1503-1030N	Flatwasher, #10 Narrow	4
7	G-1202-1035	ESN, #10 – 32	5
8	J-4792	Base, Pod	2
9	H-3544	Spacer, Nylon ½ - ¼ x 69 LG	6
10	H-3543	Spacer, Nylon ½ - .192 x 1 ½ LG	1
11	H-3546	Spring, Extension	1
12	G-1202-1020	ESN, #8 – 32	4
13	G-1159-102004	Screw, #8 – 32 RD HD CRS REC	4
14	G-1250-1020N	Flatwasher, #8 Narrow	2
15	G-1207-1050	Nut, Jam ¼ - 20	2
16	G-1203-1050	EJN, ¼ - 20	2
17	EC-2250	Switch, Proximity	2
19	J-5239-01	Sensor, Bar	1
20	G-1163-04	Screw, #6-32 HEX CUP PT SET	2
21	G-1476-103120	Screw, #10 – 32 SOC BUT HD CAP	1
22	G-1476-105006	Screw, ¼ - 20 SOC BUT HD CAP	1
23	J-5480-01	Sensor, Bar	1
24	R-2784	Roller, 1 ½ DIA	1
25	H-3682	Spring, SS 2 ½ Long	1
26	H-3667	Spacer, Nylon ½ x .250 x 1 Long	1
27	G-1202-1050	ESN, ¼ - 20	1
28	G-1250-1050N	Flatwasher, ¼ Narrow	1
29	G-1476-105022	Screw, ¼ - 20 SOC BUT HD CAP	1

## Parts List

When ordering replacement parts/kits, please specify model, serial number and color of your unit.

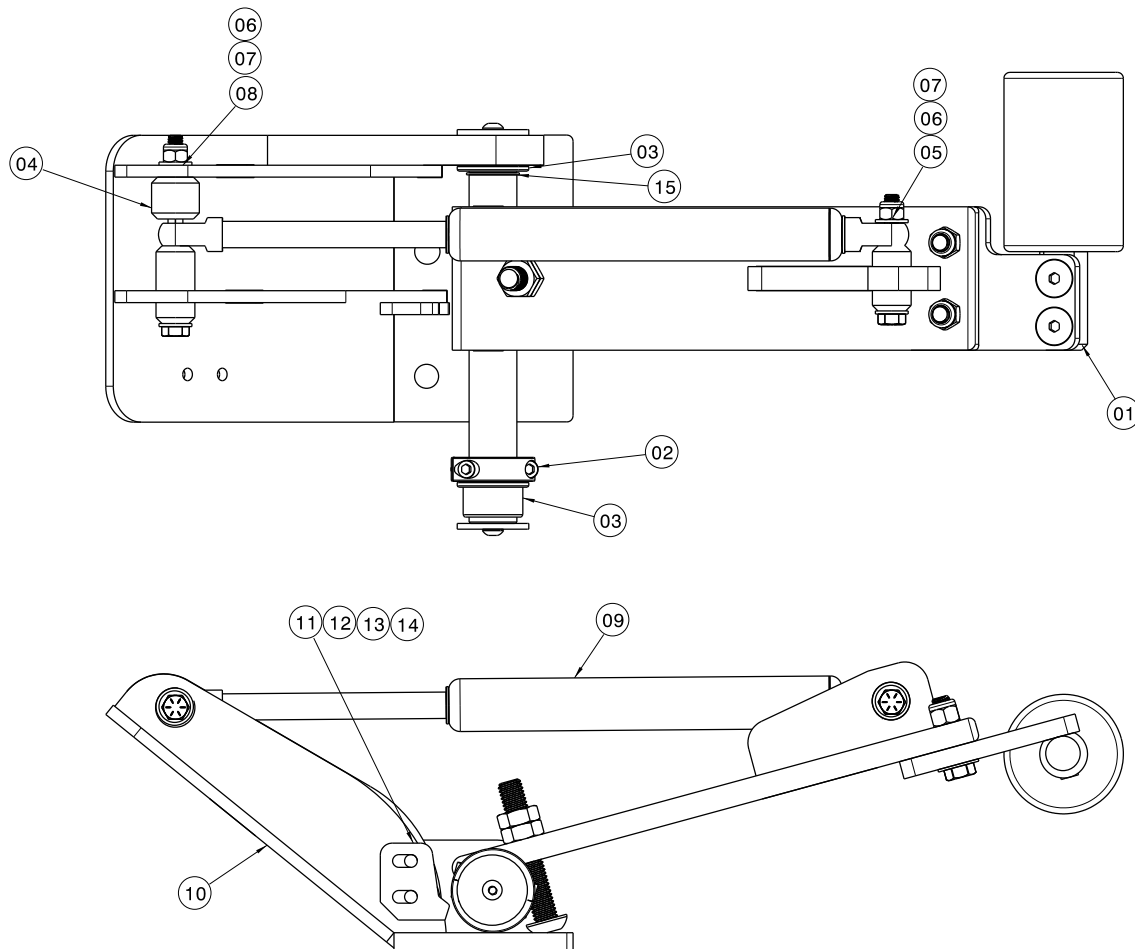


Item	Part Number	Description	Qty
1	Z-8150-01	Weldment, Cradle	1
2	Z-8970-01	Weldment, Arm Right	1
3	Z-8966-01	Weldment, Arm Left	1
4	G-1154-109214	Screw, ½ - 13 SOC BUT HD CAP	4
5	G-1251-1090R	Lockwasher, ½ Regular	10
6	Z-9099	Assembly, Capture Arm Right	1
7	Z-9098	Assembly, Capture Arm Left	1
8	Z-8148	Assembly, Arm Left	1
9	Z-8149	Assembly, Arm Right	1



## Parts List

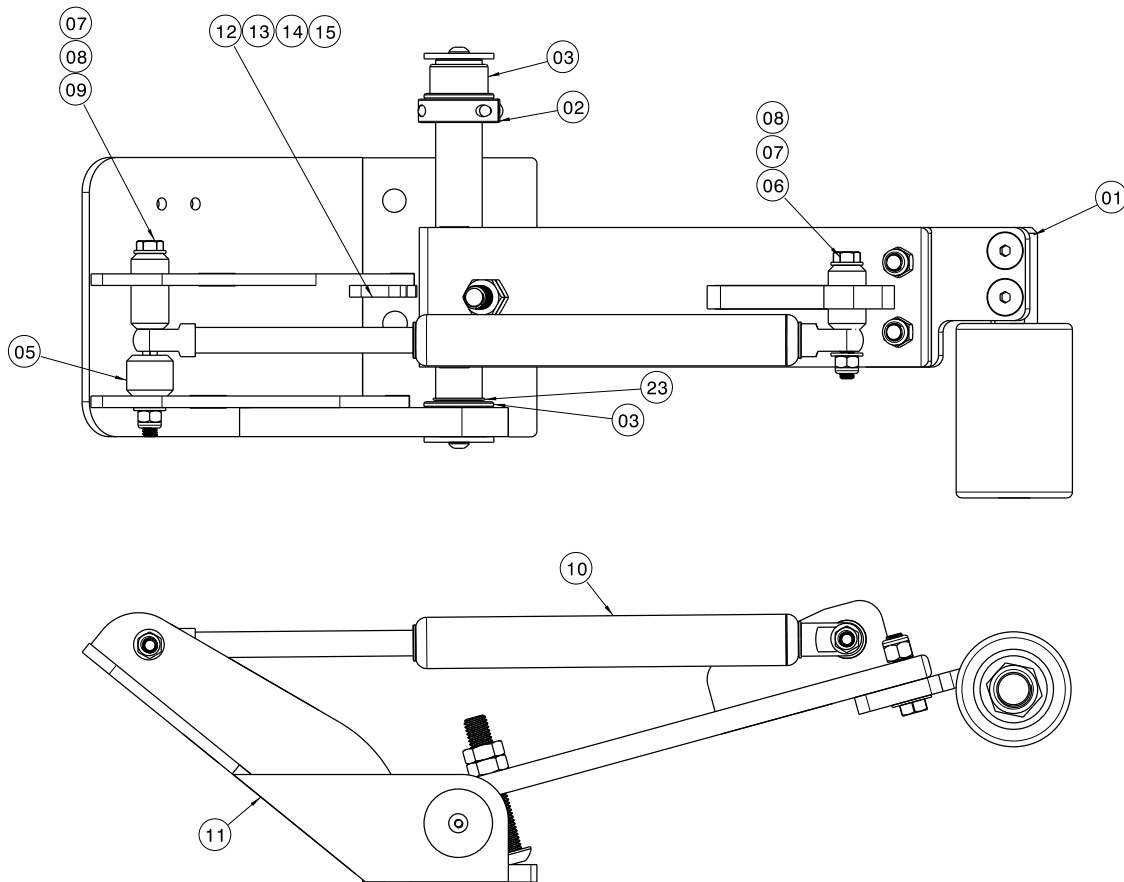
When ordering replacement parts/kits, please specify model, serial number and color of your unit.



Item	Part Number	Description	Qty
1	Z-9097	Assembly, Arm Right	1
2	G-1630	Shaft, Collar	1
3	H-3829	Flange, Bearing	2
4	R-3024-01	Spacer, Rod 7/8 Long	1
5	G-1420-10624	Bolt, 5/16 – 18 Hex Head Grade 8	1
6	G-1503-1060N	Flatwasher, 5/16	4
7	G-1501-1060	Stopnut, Elastic	2
8	G-1420-106040	Bolt, 5/16 – 18 Hex Head Grade 8	1
9	H-3919	Strut, Gas -30°	1
10	Z-8970-01	Weldment, Arm Right Base	1
11	J-6129-01	Plate, Stop	1
12	G-1202-1050	Stopnut, ¼ - 20 Elastic	2
13	G-1250-1050N	Flatwasher, ¼	2
14	G-1100-105010	Bolt, ¼ - 20 Hex Head Grade 5	2
15	G-1392-100-S	Ring, External Retaining	1

## Parts List

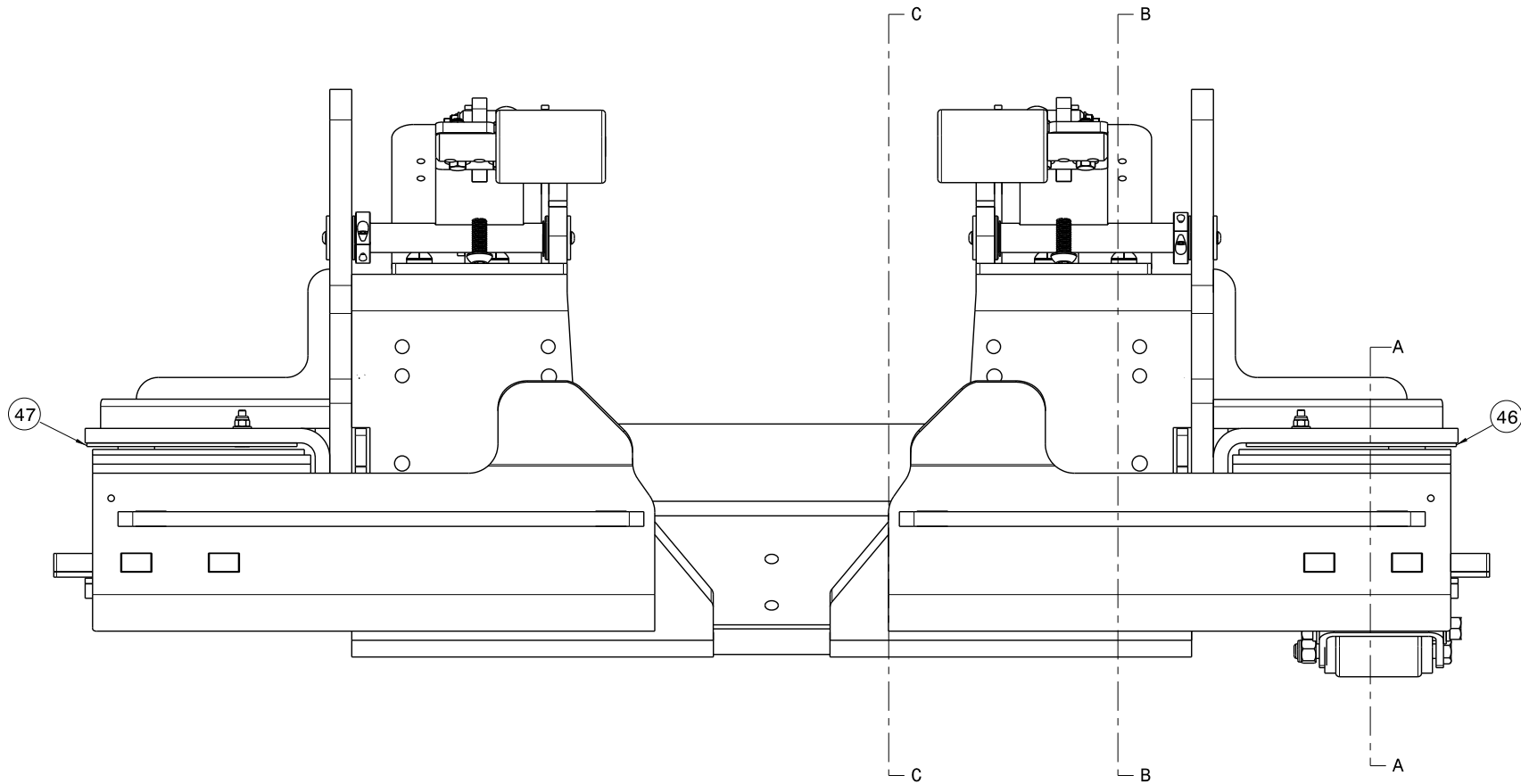
When ordering replacement parts/kits, please specify model, serial number and color of your unit.



Item	Part Number	Description	Qty
1	Z-9096	Assembly, Arm Left	1
2	G-1630	Shaft, Collar	1
3	H-3829	Flange, Bearing	2
4	J-6845	Plate, Sensor Arm	1
5	R-3024-01	Spacer, Rod 7/8 Long	1
6	G-1420-10624	Bolt, 5/16 – 18 Hex Head Grade 8	1
7	G-1503-1060N	Flatwasher, 5/16	4
8	G-1501-1060	Stopnut, Elastic	2
9	G-1420-106040	Bolt, 5/16 – 18 Hex Head Grade 8	1
10	H-3919	Strut, Gas -30°	1
11	Z-8966-01	Weldment, Arm Left Base	1
12	J-6129-01	Plate, Stop	1
13	G-1202-1050	Stopnut, ¼ - 20 Elastic	2
14	G-1100-105010	Bolt, ¼ - 20 Hex Head Grade 5	2
15	G-1392-100-S	Ring, External Retaining	1

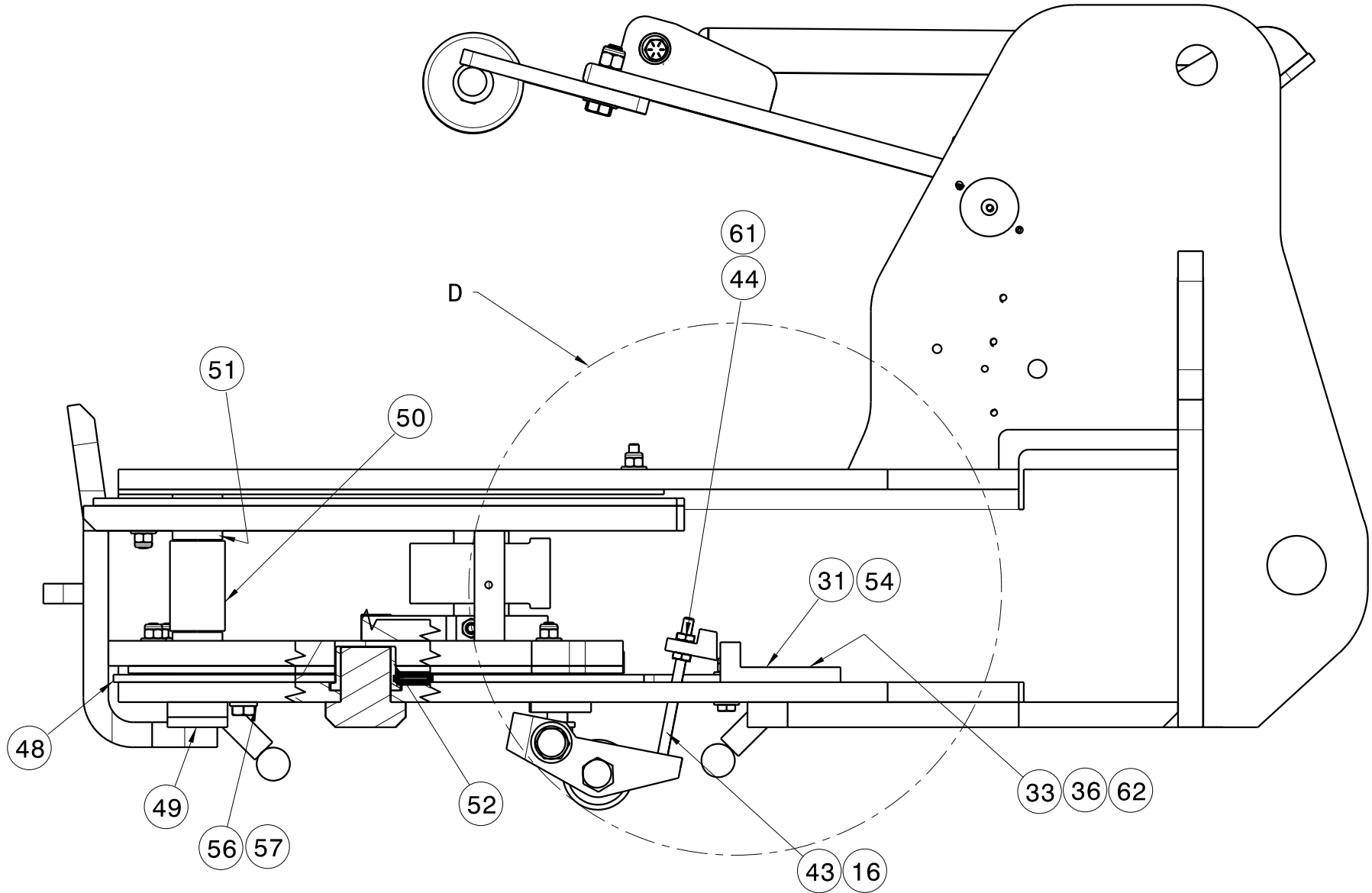
**Parts List**

When ordering replacement parts/kits, please specify model, serial number and color of your unit.



Item	Part Number	Description	Qty
10	J-5481-01	Gear, Lock	1
15	J-5481-02	Gear, Lock	1
17	H-3356	Shim, Round	2
24	G-1630	Shaft, Collar	2
45	R-2681	Spacer, Spring	2
46	J-5471-01	Pad, Outer Bearing	1
47	J-5471-02	Pad, Outer Bearing	1

**Parts List Illustration**

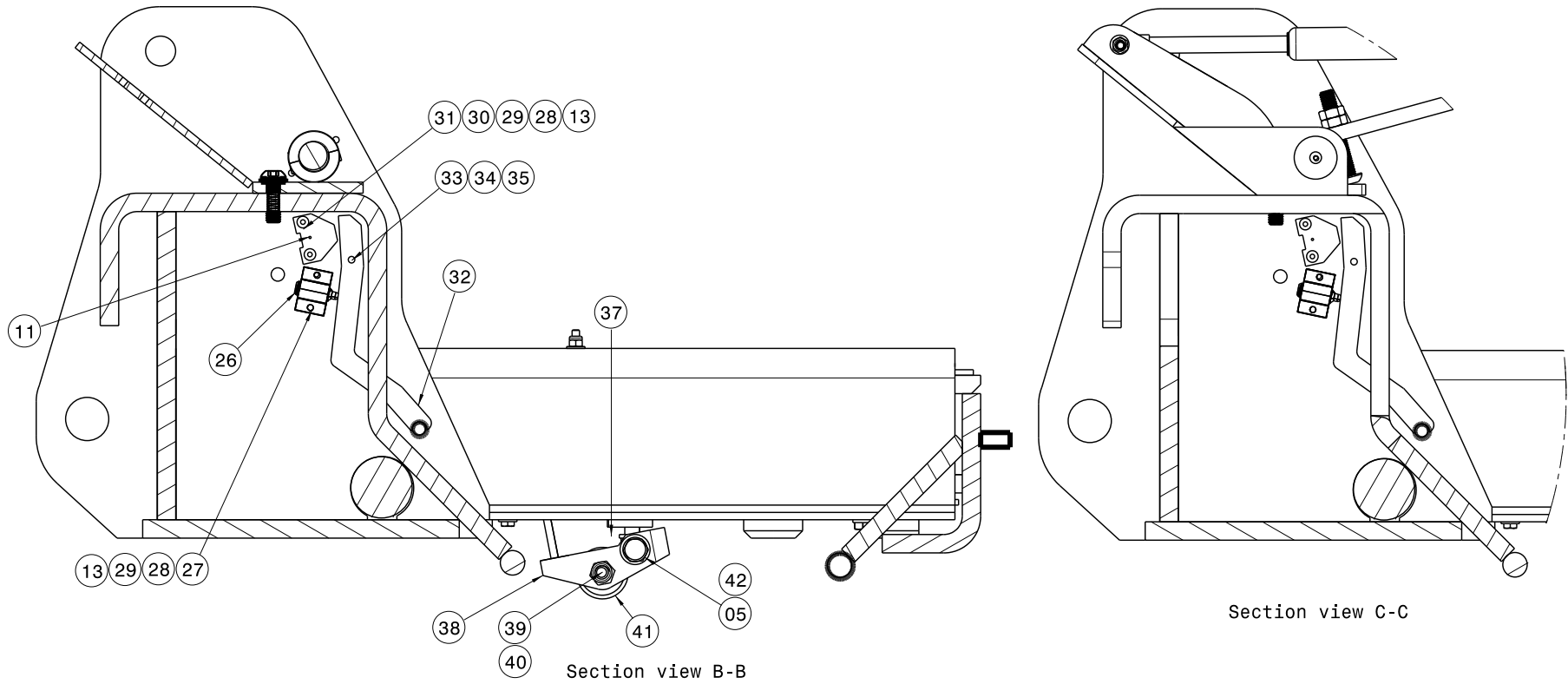


**Parts List**

When ordering replacement parts/kits, please specify model, serial number and color of your unit.

Item	Part Number	Description	Qty
16	H-3552	Spring, Compression	1
31	EC-2250	Switch, Proximity	1
33	G-1250-1050N	Flatwasher, ¼ Narrow	12
36	G-1100-105012	Bolt, HH GR5 ¼ - 20 x 1 ¼ LG	6
43	H-3614	Stud, Thread, ¼ - 20 x 4 LG	2
44	G-1207-1050	Nut, Jam	4
48	J-5190	Pad, Outer Bearing	1
49	Z-7455	Weldment, Rod Pivot	2
50	TR021-10-002.25	TBG, STL DOM, 1 ⅜ - 1.31	2
51	R-2783	Sleeve, Bearing	4
52	R-2683	Machine, Bearing	2
54	J-4862	Block, Sensor	1
56	G-1251-1070R	Lockwasher, ⅜ Regular	2
57	G-1100-107004	Bolt, ⅜ - 16, HEX HD GR5	2
61	J-4793	Block, Switch	1
62	G-1251-1050R	Lockwasher, ¼ Regular	2

**Parts List Illustration**



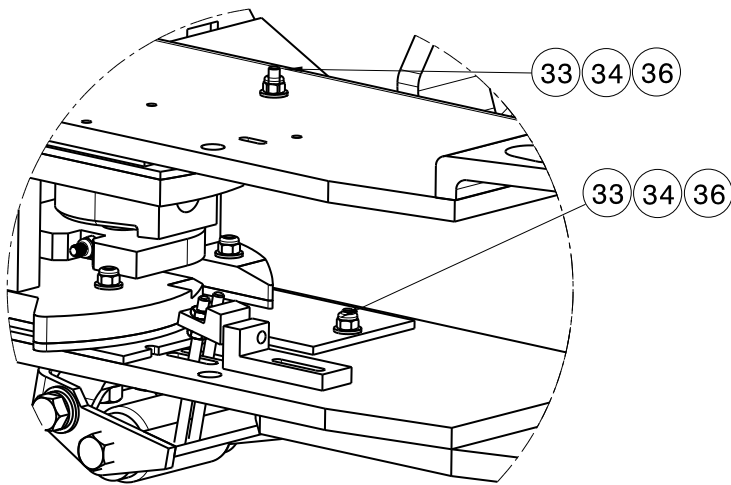
### Parts List

When ordering replacement parts/kits, please specify model, serial number and color of your unit.

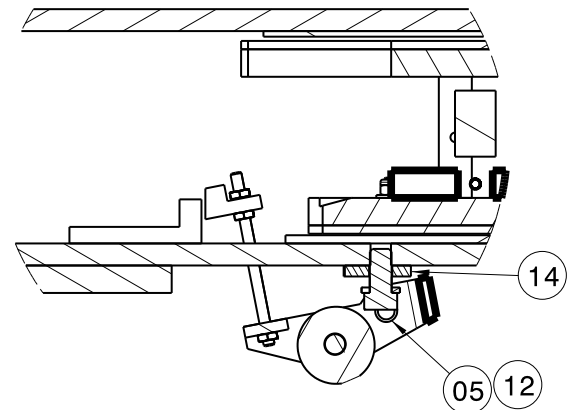
Item	Part Number	Description	Qty
5	G-1251-1090R	Lockwasher, ½ Regular	2
10	J-5481-01	Geer, Rack	1
11	G-1163-04	Screw, #6-32 HEX CUP PT SET	1
13	G-1202-1035	ESN, 10 - 32	6
26	H-3317	Plunger, Spring	2
27	H-3316	Base, Mounting Plunger	2
28	G-1503-1030N	Lockwasher, #10 Narrow	10
29	G-1476-103116	Screw, #10-32 SOC BUT HD CAP	6
30	J-4792	Mount, Sensor	1
31	EC-2250	Switch, Proximity	1
32	Z-7449-01	Weldment, Wheel Switch	1
33	G-1250-1050N	Flatwasher, ¼ Narrow	4
34	G-1202-1050	ESN, ¼ - 20	2
35	G-1100-105016	Bolt, HH GR5, ¼ - 20 x 1 ¾ LG	2
36	G-1100-105012	Bolt, HH GR5, ¼ - 20 x 1 ¼ LG	4
37	J-4678	Bracket, Caster	1
38	Z-7450-01	Weldment, Caster Bracket	1
39	G-1100-109550	Bolt, HH GR5, ½ - 20 x 5 LG	1
40	G-1202-1095	ESN, ½ - 20	1
41	R-2527	Roller	1
42	G-1100-109510	Bolt, HH GR5, ½ - 20 x 1 LG	2

## Parts List

When ordering replacement parts/kits, please specify model, serial number and color of your unit.



DETAIL D



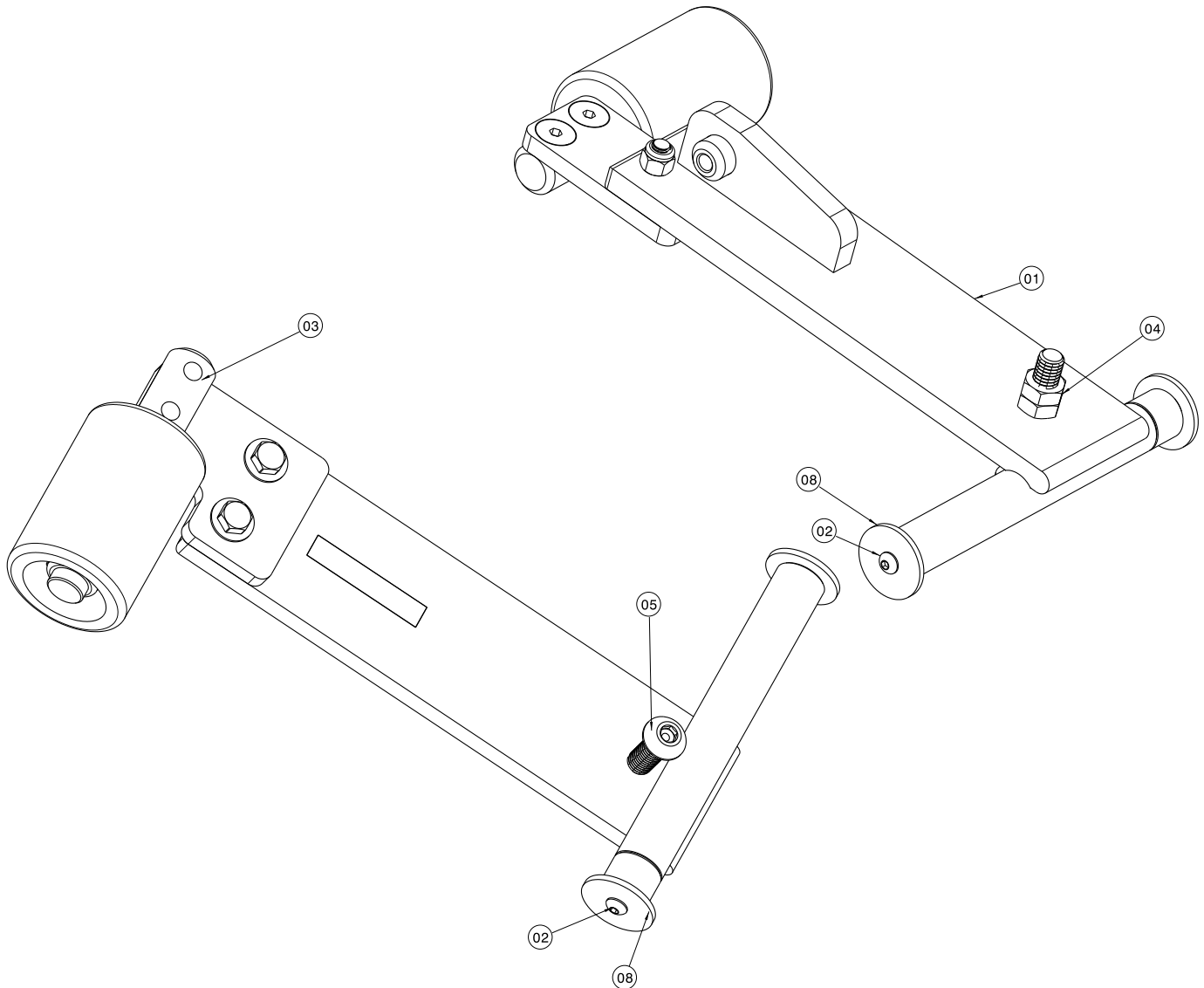
SECTION VIEW A-A

Item	Part Number	Description	Qty
5	G-1251-1090R	Lockwasher, ½ Regular	2
12	G-1100-109010	Bolt, ½ - 13, HEX HD GR5	2
14	J-5214-01	Plate, Spacer	1



## Parts List

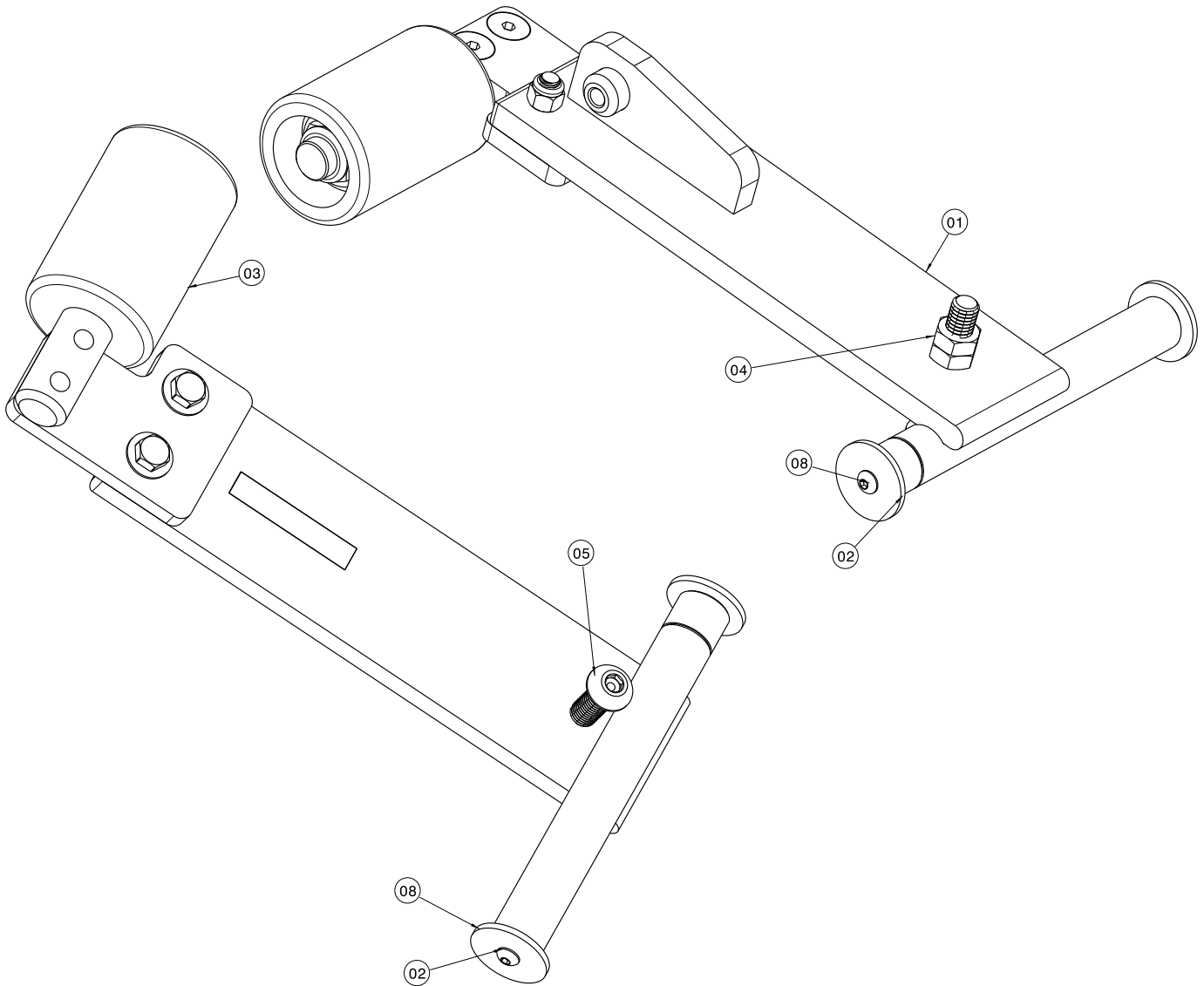
When ordering replacement parts/kits, please specify model, serial number and color of your unit.



Item	Part Number	Description	Qty
1	Z-9094-01/-SP	Weldment, Arm Left	1
2	G-1476-105010	Screw, SOC BUT HD CAP ¼ - 20 X 1.0 LG	2
3	Z-9842	Assembly, Roller Left	1
4	G-1207-1090	Jam Nut, ½ - 13 Hex	2
5	G-1476-109030	Screw, ½ - 13 SOC BUT HD CAP	1
8	S-2627-01-SP	Support, Bearing	2

## Parts List

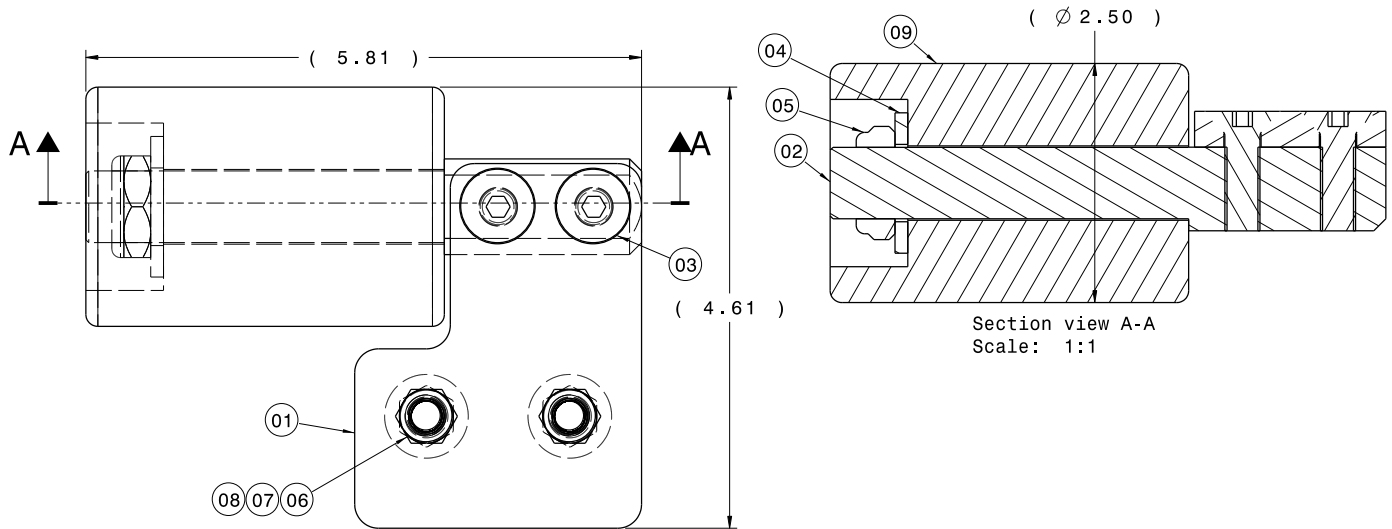
When ordering replacement parts/kits, please specify model, serial number and color of your unit.



Item	Part Number	Description	Qty
1	Z-9095-01/-SP	Weldment, Arm Right	1
2	G-1476-105010	Screw, SOC BUT HD CAP ¼ - 20 X 1.0 LG	2
3	Z-9841	Assembly, Roller Right	1
4	G-1207-1090	Jam Nut, ½ - 13 Hex	2
5	G-1476-109030	Screw, ½ - 13 SOC BUT HD CAP	1
8	S-2627-01	Support, Bearing	2

## Parts List

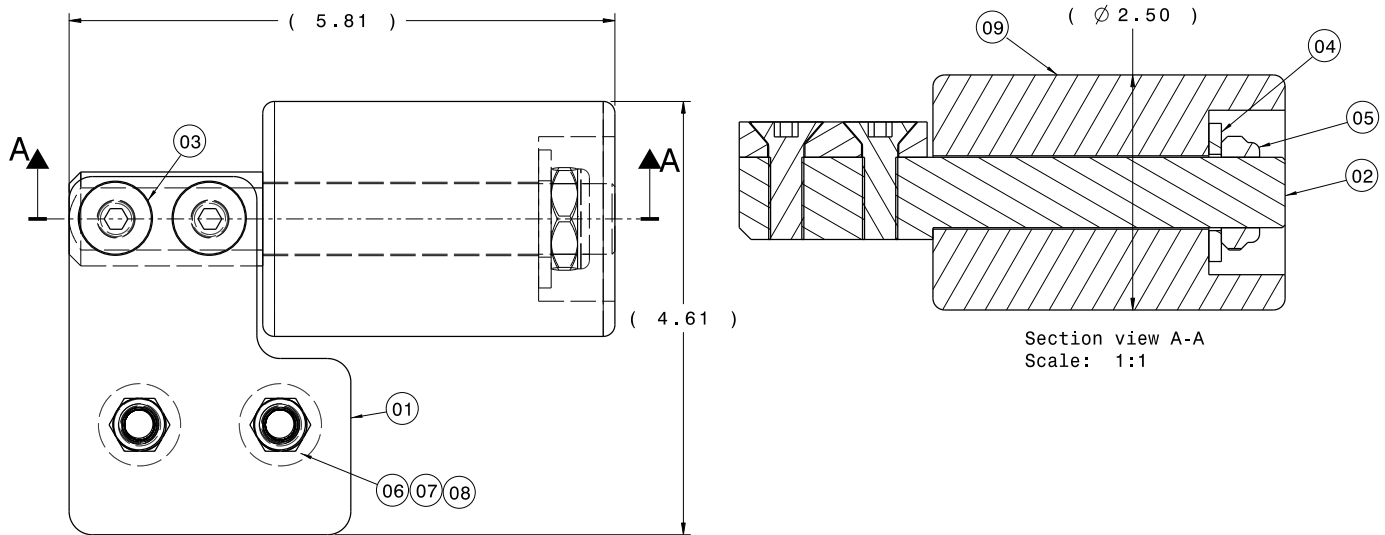
When ordering replacement parts/kits, please specify model, serial number and color of your unit.



Item	Part Number	Description	Qty
1	J-6700-01-00	Plate, Extension Roller	1
2	R-3078-01	Rod, Axle	1
3	G-1152-107212	Screw, Socket Flat Head 82 Cap	2
4	G-1250-1110N	Flatwasher, 3/4 Narrow	1
5	G-1203-1115	Jamnut, 3/4 - 16 Elastic	1
6	G-1420-107014	Bolt, 3/8 - 16 Hex Grade 8	2
7	G-1202-1070	Stopnut, 3/8 - 16 Elastic	2
8	G-1503-1070N	Flatwasher, 3/8 Narrow	2
9	R-3077	Roller	Ref

**Parts List**

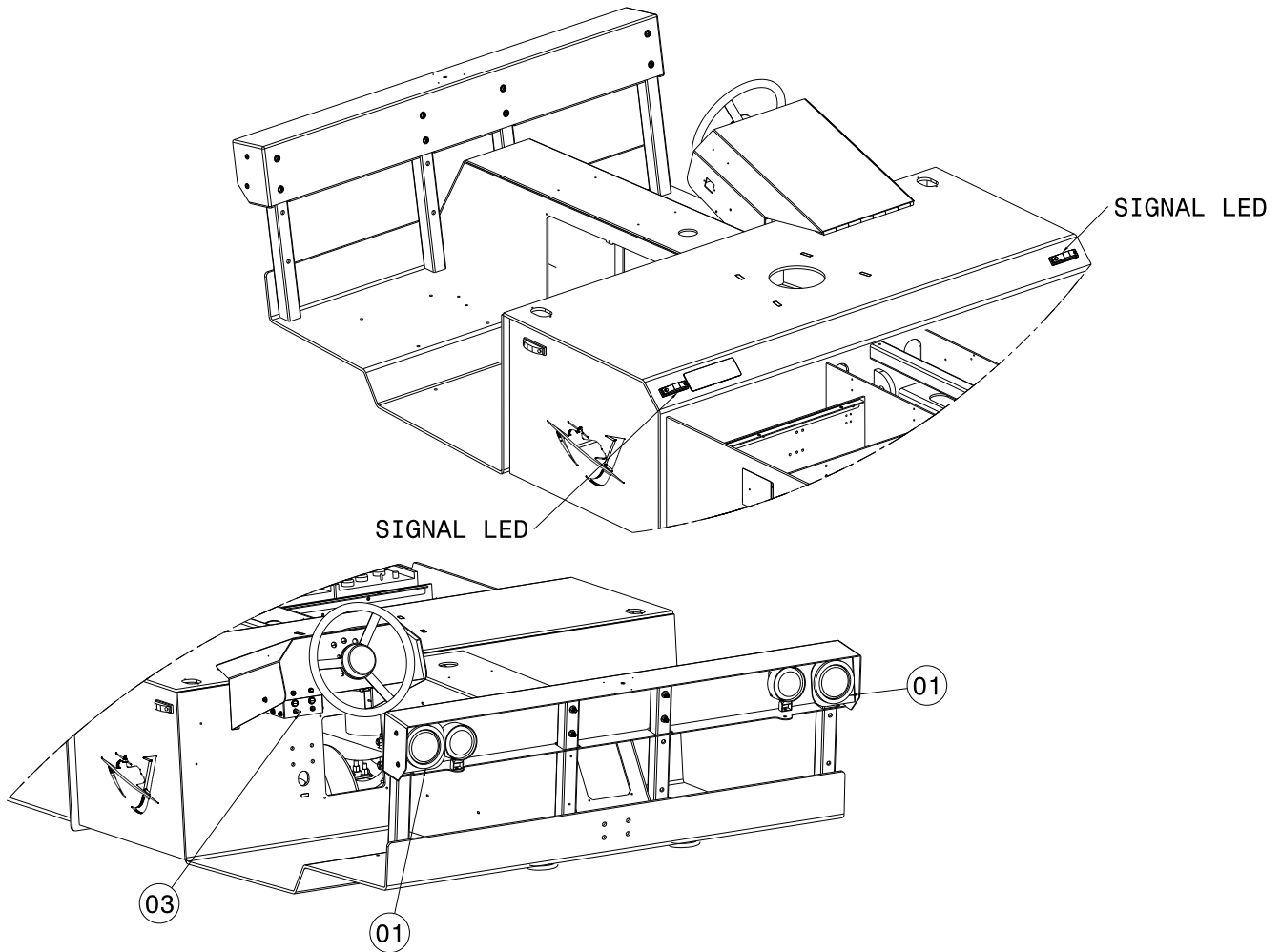
When ordering replacement parts/kits, please specify model, serial number and color of your unit.



Item	Part Number	Description	Qty
1	J-6700-02-00	Plate, Extension Roller	1
2	R-3078-01	Rod, Axle	1
3	G-1152-107212	Screw, Socket Flat Head 82 Cap	2
4	G-1250-1110N	Flatwasher, 3/4 Narrow	1
5	G-1203-1115	Jamnut, 3/4 - 16 Elastic	1
6	G-1420-107014	Bolt, 3/8 - 16 Hex Grade 8	2
7	G-1202-1070	Stopnut, 3/8 - 16 Elastic	2
8	G-1503-1070N	Flatwasher, 3/8 Narrow	2
9	R-3077	Roller	Ref

**Parts List – Turn Signal Light Assembly Kit**

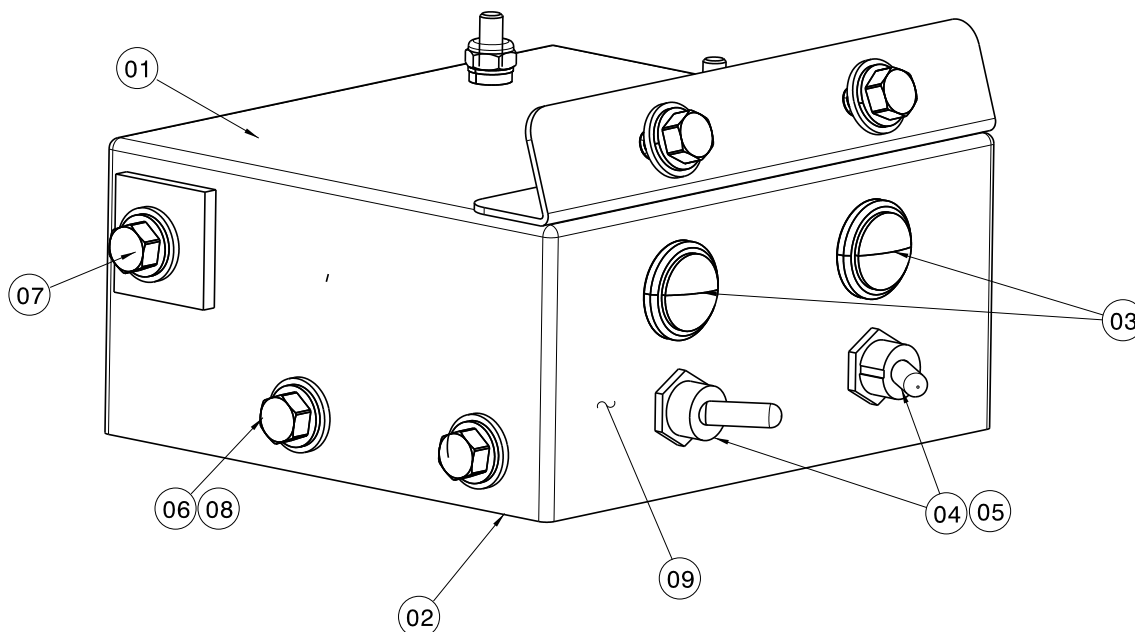
When ordering replacement parts/kits, please specify model, serial number and color of your unit.



Item	Part Number	Description	Qty
1	Z-8554	Assembly, Signal Bracket	2
3	Z-8558	Assembly, Signal Box	1
Not Shown	EC-1326-01	Disconnect, Female Red ¼ F/I	6
Not Shown	EC-1327-01	Disconnect, Male Red ¼	6
Not Shown	EC-1170-06	Cable, Electrical 3 Conductor	208 in

**Parts List – Signal Box**

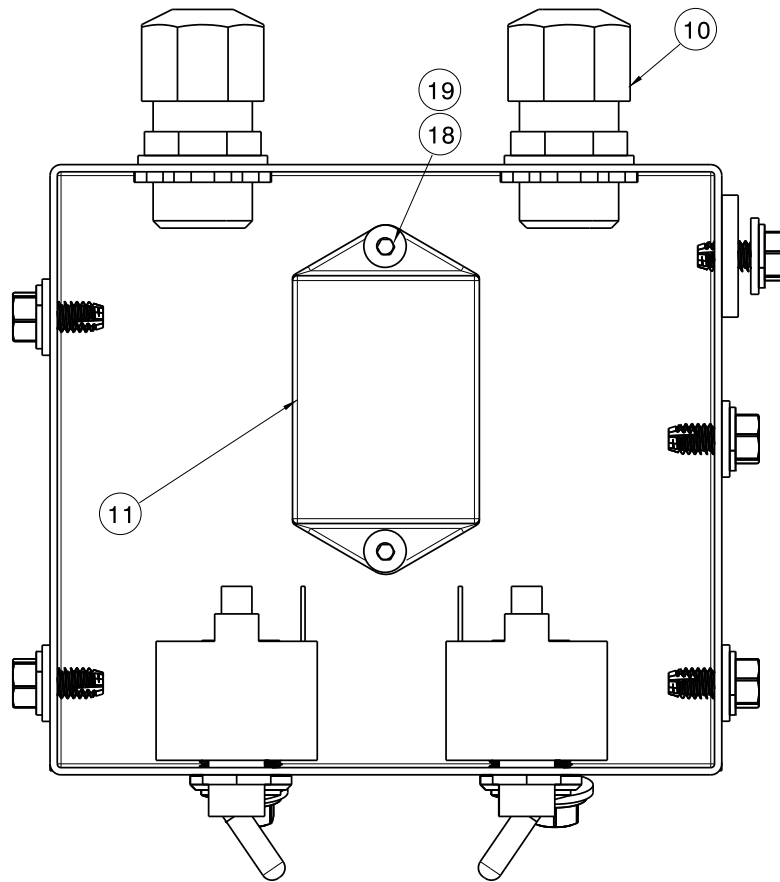
When ordering replacement parts/kits, please specify model, serial number and color of your unit.



Item	Part Number	Description	Qty
1	S-8625-01	Box, Signal	1
2	S-2746-01	Panel, Signal Box	1
3	EC-2826	Lamp, LED Green	2
4	EC-2747	Switch, Toggle 2 Position (SPST)	2
5	EC-2744	Seal, Toggle Boot	2
6	G-1180-105002	Screw, ¼ Hex Head TPG Type F ½ Long	6
7	G-1180-105004	Screw, ¼ Hex Head TPG Type F ¾ Long	1
8	G-1503-1050N	Flatwasher, ¼ Narrow SS	7
9	V-2584	Label, Signal Control	1

**Parts List - Signal Box Bottom View**

When ordering replacement parts/kits, please specify model, serial number and color of your unit.

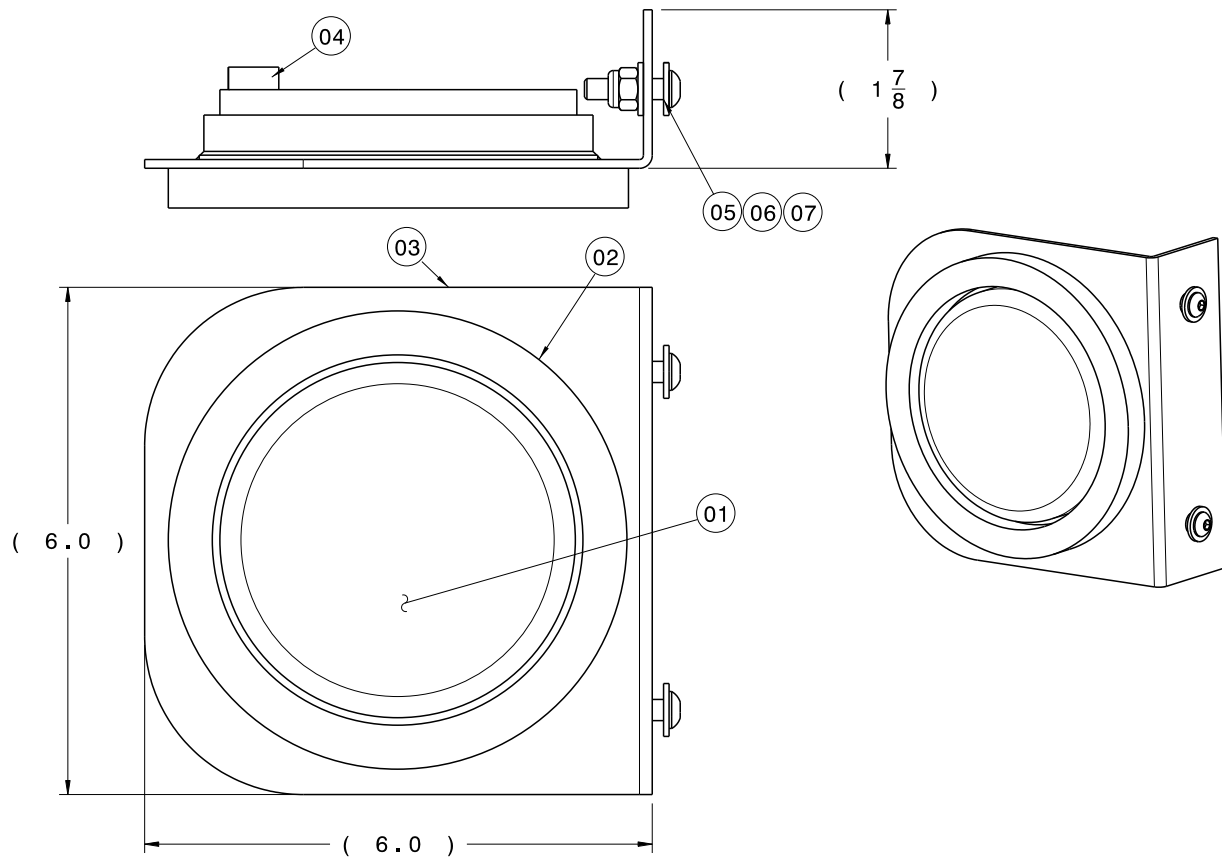


BOTTOM VIEW

Item	Part Number	Description	Qty
10	JP-108	Grip, Cord	2
11	EC-2824	Flasher, Solid State 9 – 32V	1
12	G-1476-103106	Screw, #10-32 Socket Button Head Cap	2
13	G-1658-04	Washer, W/Neoprene #10	2
14	G-1202-1035	Stopnut, #10 – 32 Elastic	2
Not Shown	EC-2051	Connector, Compact 5 Conductor	4
Not Shown	EC-2050	Terminal, Block 3 Position Connector	2
Not Shown	EC-1326-01	Disconnect, Female Red ¼ F/I	8

**Parts List – Signal Bracket**

When ordering replacement parts/kits, please specify model, serial number and color of your unit.

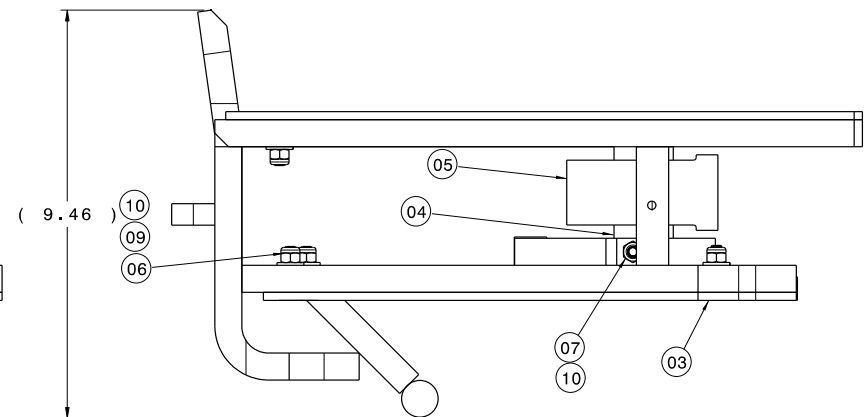
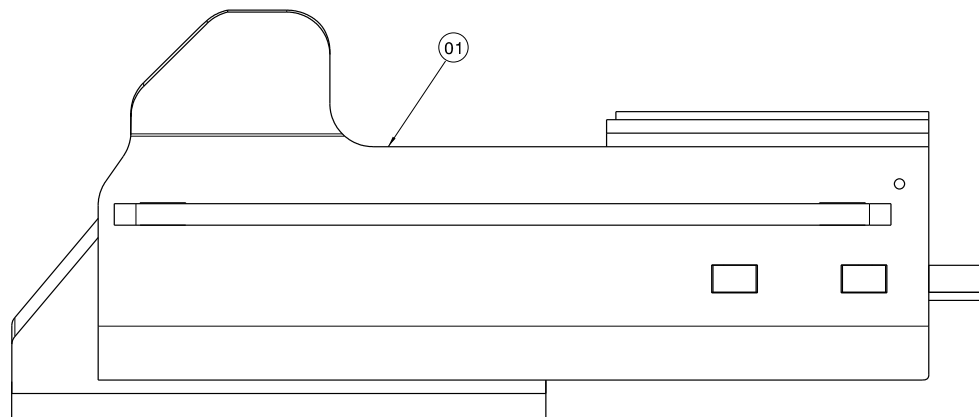
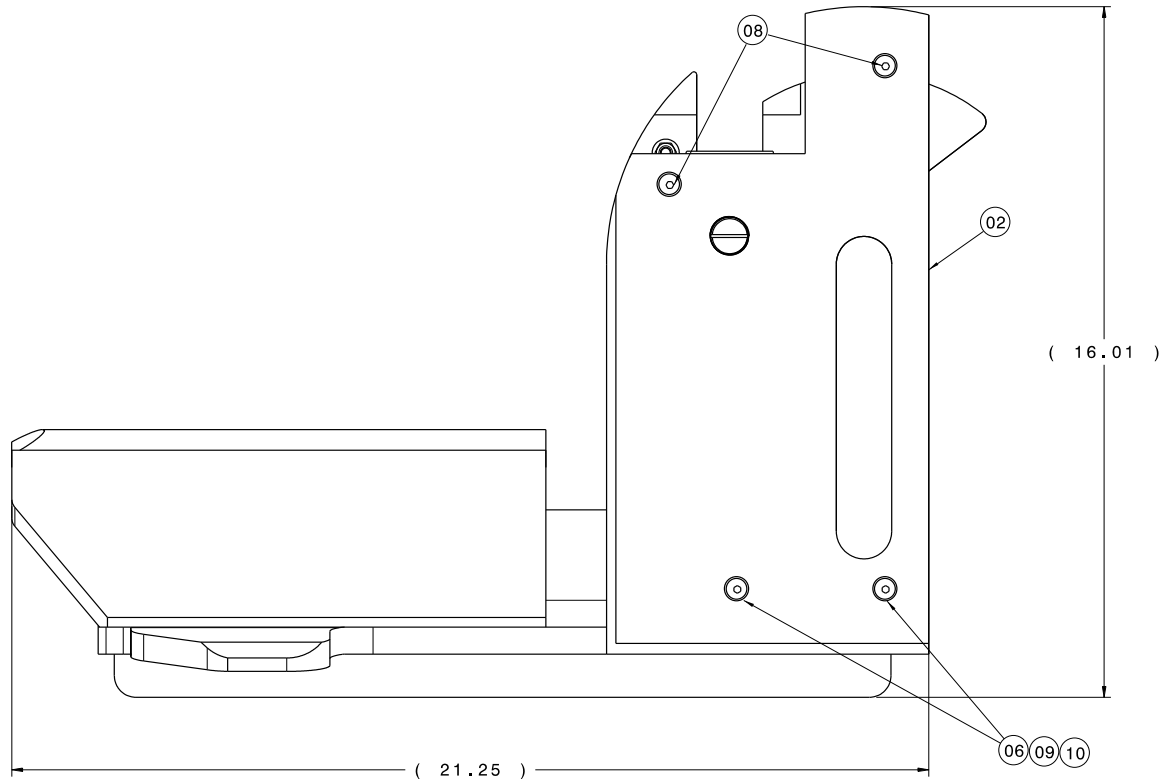


Item	Part Number	Description	Qty
1	EC-2819	Light, LED Red	1
2	H-3804	Bracket, Gasket	1
3	H-3805	Bracket, LED Holder	1
4	EC-2820	Harness, LED Light	1
5	G-1476-105010	Screw, ¼ - 20 Socket Button Head cap	2
6	G-1503-1050N	Flatwasher, ¼ ID Narrow	4
7	G-1202-1050	Stopnut, ¼ - 20 Elastic	2



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**Parts List Illustration**

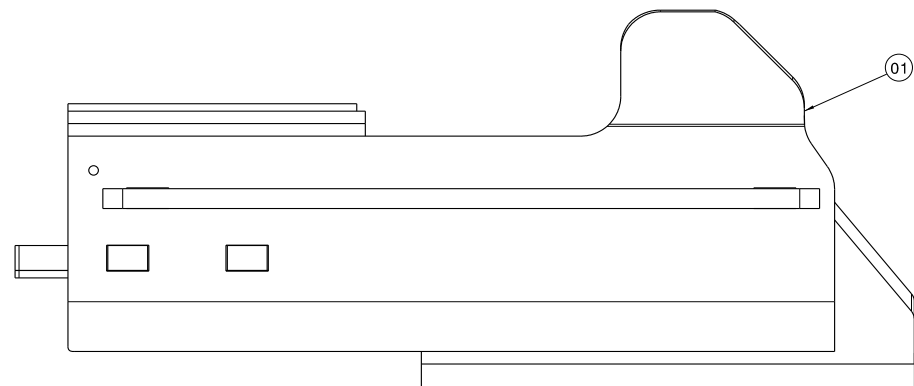
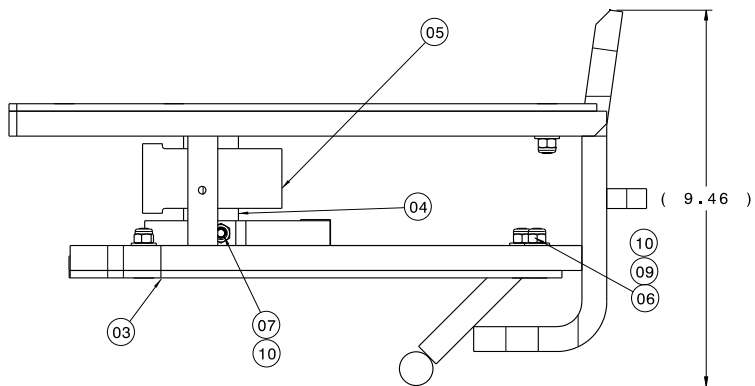
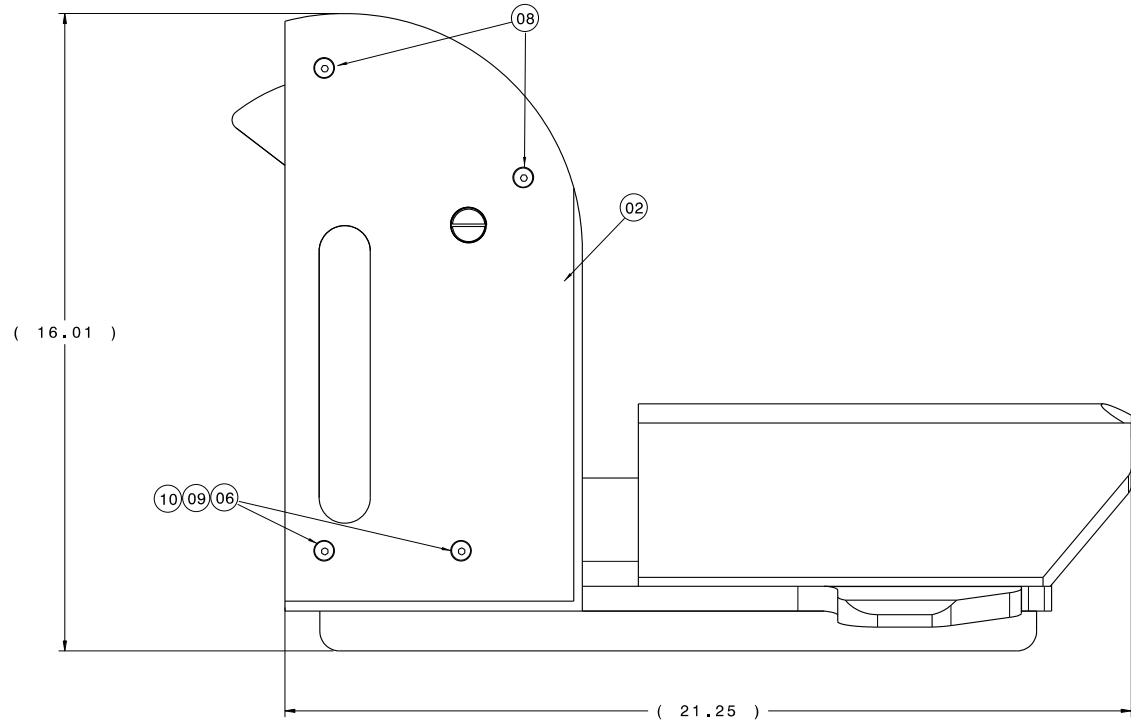


**Parts List**

When ordering replacement parts/kits, please specify model, serial number and color of your unit.

Item	Part Number	Description	Qty
1	Z-8146	Weldment, Left Swing Gate	1
2	J-5465-02	Pad, Outer Bearing Top	1
3	J-5464-02	Pad, Outer Bearing Bottom	1
4	R-2557	Pin, Clevis	1
5	Z-7332	Assembly, Shackle	1
6	G-1152-105212	Screw, SOC FLT HD 82° CAP, ¼ - 20 x 1 ¼ LG	6
7	G-1151-105240	Screw, HEX SOC HD CAP, ¼ - 20	1
8	G-1152-105206	Screw, SOC FLT HD 82° CAP, ¾ LG	2
9	G-1250-1050N	Flatwasher, ¼ Narrow	6
10	G-1202-1050	ESN, ¼ - 20	7

**Parts List Illustration**



**Parts List**

When ordering replacement parts/kits, please specify model, serial number and color of your unit.

Item	Part Number	Description	Qty
1	Z-8147	Weldment, Right Swing Gate	1
2	J-5465-01	Pad, Outer Bearing Top	1
3	J-5464-01	Pad, Outer Bearing Bottom	1
4	R-2557	Pin, Clevis	1
5	Z-7332	Assembly, Shackle	1
6	G-1152-105212	Screw, SOC FLT HD 82° CAP, ¼ - 20 x 1 ¼ LG	6
7	G-1151-105240	Screw, HEX SOC HD CAP, ¼ - 20	1
8	G-1152-105206	Screw, SOC FLT HD 82° CAP, ¾ LG	2
9	G-1250-1050N	Flatwasher, ¼ Narrow	6
10	G-1202-1050	ESN, ¼ - 20	7

**Parts List**  
**REPLACEMENT KITS**

Part Number	Description	Qty
K-4225	Kit, Replacement Filter Element (Includes O-rings)	1

**Parts List**  
**REPLACEMENT LABELS**

Part Number	Description	Qty
V-2231	Filter Element Replacement	1
V-2512	Operator Control Panel	1
V-1001	Made IN USA	1
V-2247	Driving Operation	2
V-2118	Serial Number CE	1
V-2187	Battery Instructions	1
V-2249	Fasten Seat Belt	1
V-2268-02	Tronair	1
V-2194	Sit Down	2
V-2295	Use AW32 Oil	1
V-2343	When Backing Away	1
V-2421	Loading and Unloading	1
V-2191	Caution Hands/Feet	1
V-1814	Warning Keep 5 Ft Clear	2
V-2295	Use AW32 Oil	1
V-2515	Rocker Switch	1
V-2423	Electrical Failure (Hand Pump Operation)	1

**Parts List**  
**REPLACEMENT PARTS FOR HC-2373 HYDRAULIC MANIFOLD**

Part Number	Description	Qty
HC-2373-10	Cartridge for CV1, CV3	2
HC-2373-11	Cartridge for CV2	1
HC-2373-12	Pilot Piston for CV2	1
HC-2373-13	Cartridge for SV4, SV5, SV6	2
HC-2373-14	Cartridge for SV3	1
HC-2373-15	Cartridge for RV1	1
HC-2373-16	Seal Kit for all cartridges	1
HC-2373-17	Cartridge for SV1	1
HC-2373-18	Cartridge for SV2	1
HC-2373-19	Coil for all solenoid valves	9
HC-2373-20	Coil Spacer for SV1, SV2	2
HC-2373-21	Seal Kit for SV1, SV2	2
HC-2373-22	Not Used	1
HC-2373-23	Not Used	1
HC-2373-24	Cartridge for FC1	1
HC-2373-25	Seal Kit for FC1	2
HC-2373-26	Cartridge for CBV1	1

**Parts List**  
**ELECTRICAL PARTS QUICK REFERENCE**

Identifier	Part Number	Qty
K1, K8	Relay P/N 13064	2
K1, K8	Base P/N 13074	2
K1, K8	Diode P/N EC-2075	2
K2, K6, K10, K11, K12, K13, K14, K18	Relay P/N EC-2258	8
K2, K6, K10, K11, K12, K13, K14, K18	Base P/N EC-2259	8
K2, K6, K10, K11, K12, K13, K14, K18	Diode P/N EC-2060	8
K2, K6, K10, K11, K12, K13, K14, K18	Clip P/N EC-2260	8
K5	Relay P/N EC-2252	1
K5	Base P/N EC-2253	1
K5	Diode P/N-EC-2060	1
K7 relay	EC-2012	1
K9, K17, K19	Relay P/N 13063	3
K9, K17, K19	Base P/N 13073	3
K9, K17, K19	Diode P/N EC-2260	3
K15	Relay P/N EC-2106	1
K16	Relay P/N EC-2470	1
K16	Base P/N EC-2333	1
K16	Diode P/N EC-2075	1
FU1	Holder P/N EC-1618	1
FU1	Fuse P/N EC-1619-04	1
FU2, FU3	Holder P/N EC-1618	2
FU2, FU3	Fuse P/N EC- 1619-18	2
FU4, FU5, FU9, FU10	Holder P/N EC-2555	4
FU4, FU5, FU9, FU10	Fuse P/N EC-2113-10.0	4
FU6, FU7, FU8	Holder P/N EC-2555	3
FU6, FU7, FU8	Fuse P/N EC-2113-5.00	3
Proximity Sensors (All)	EC-2250	1
SEN7 (Pressure Switch)	EC-2204	1
Cont1 (Line Contactor)	EC-2452	1
Cont2 (Pump Motor Contactor)	EC-2671	1
E-Sop Operator	14132	2
KS Operator	EC-2197	1
SW6 Operator	EC-2672	1
N.O. Contacts (Green)	14143	4
N.C. Contacts (Red)	14144	7
POT1	EC-2208	1
VR1	EC-2275	1





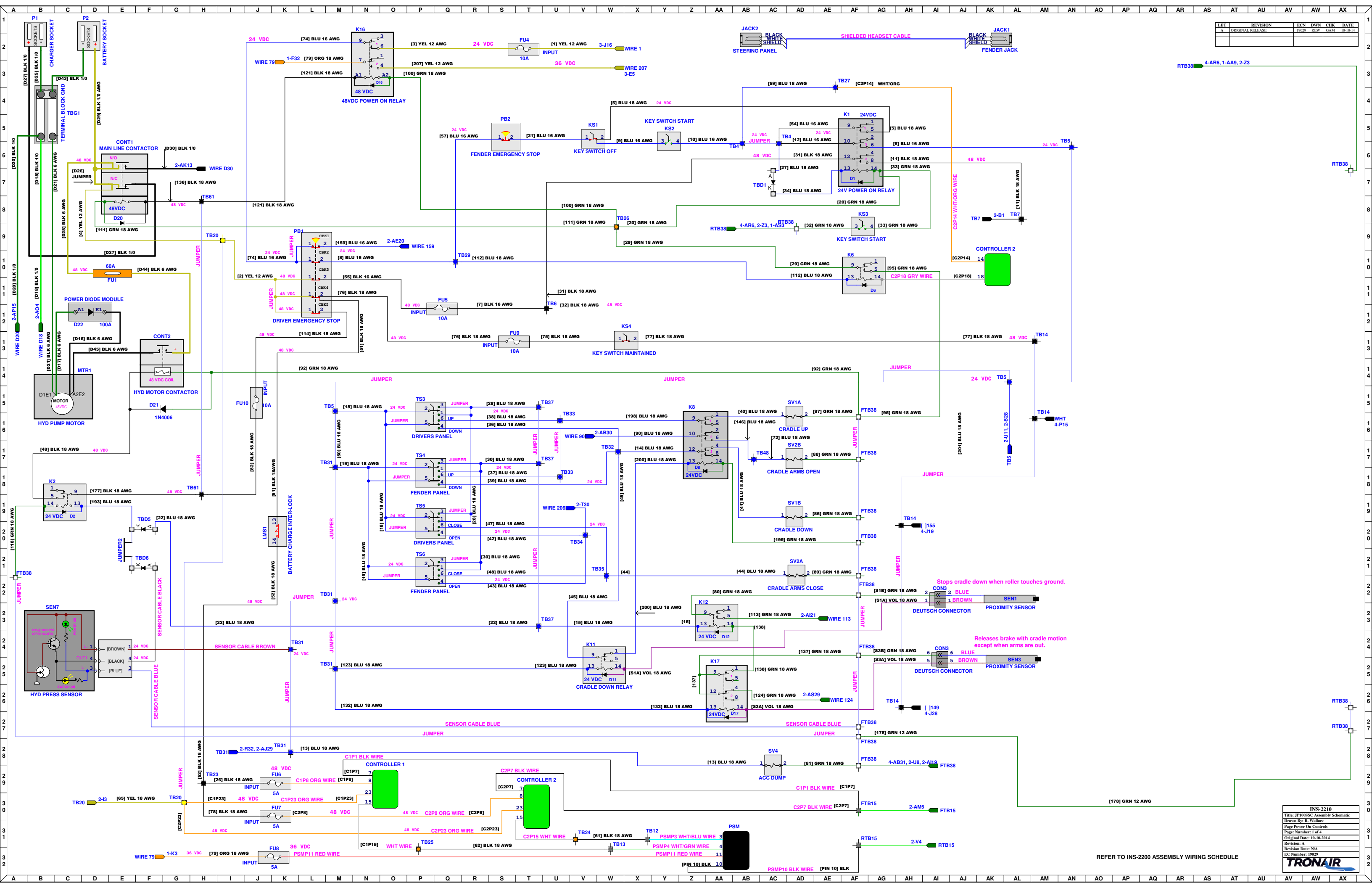


## **APPENDIX I**

### **Wiring Diagram INS-2210**



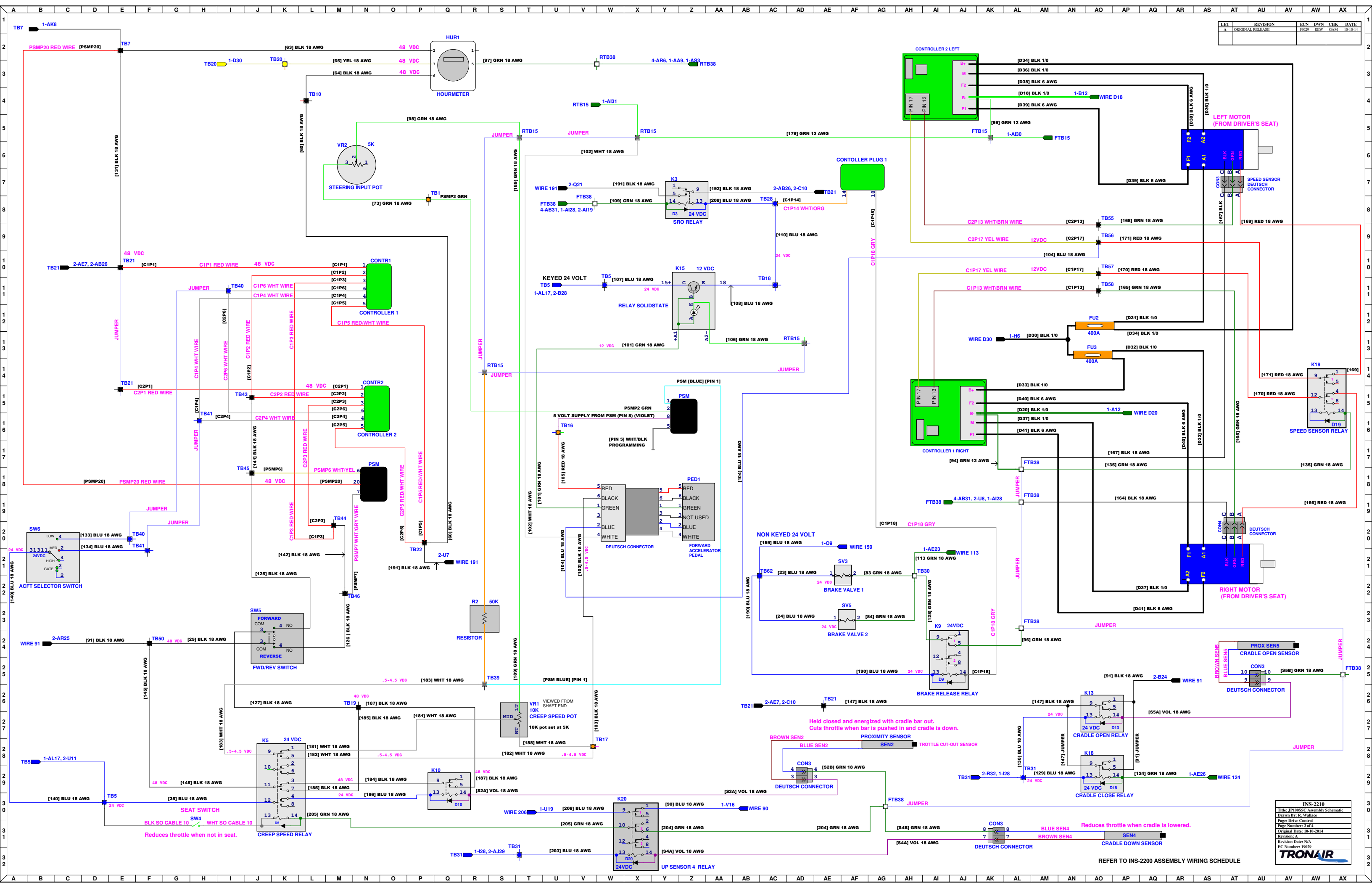
LET	REVISION	ECN	DWN	CHK	DATE
A	ORIGINAL RELEASE				19029 REV GAM 10-10-14



INS-2210					
Title: JPI08NSC Assembly Schematic					
Drawn By: R. Wallace					
Page Power On Controls					
Page Number: 1 of 4					
Original Date: 06-10-2014					
Revision: A					
Revision Date: N/A					
EC Number: 19029					
<b>TRONAIR</b>					

REFER TO INS-2200 ASSEMBLY WIRING SCHEDULE

REV	REVISION	ECN	DWN	CHK	DATE
A	ORIGINAL RELEASE		19029	RW	GAM 10-10-14

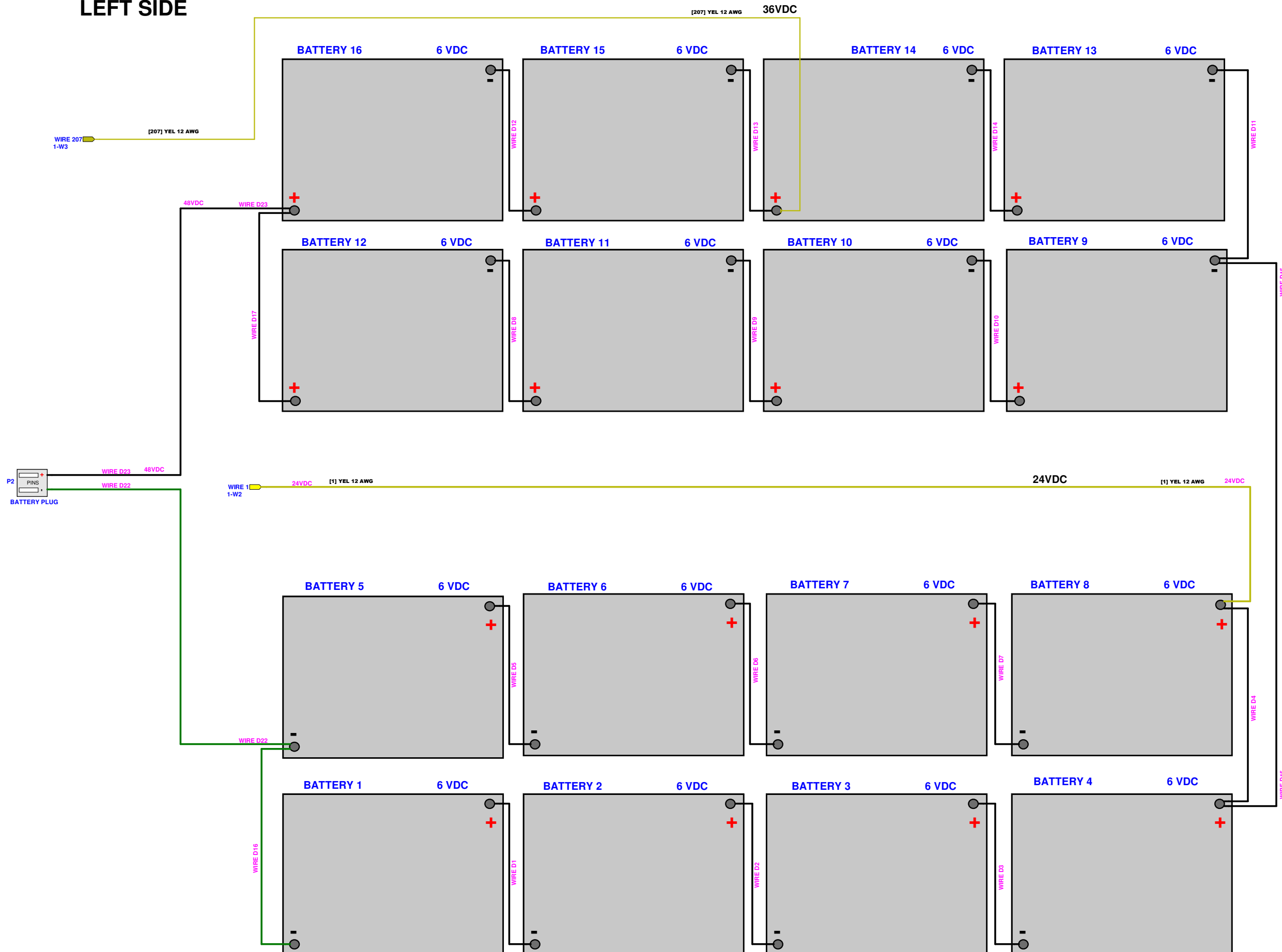


INS-2210
Title: JPI085SC Assembly Schematic
Drawn By: R. Wallace
Page: Drive Control
Page Number: 2 of 4
Original Date: 10-10-2014
Revision: A
Revision Date: N/A
ECN Number: 19029
<b>TRONAIR</b>

REFER TO INS-2200 ASSEMBLY WIRING SCHEDULE

# LEFT SIDE

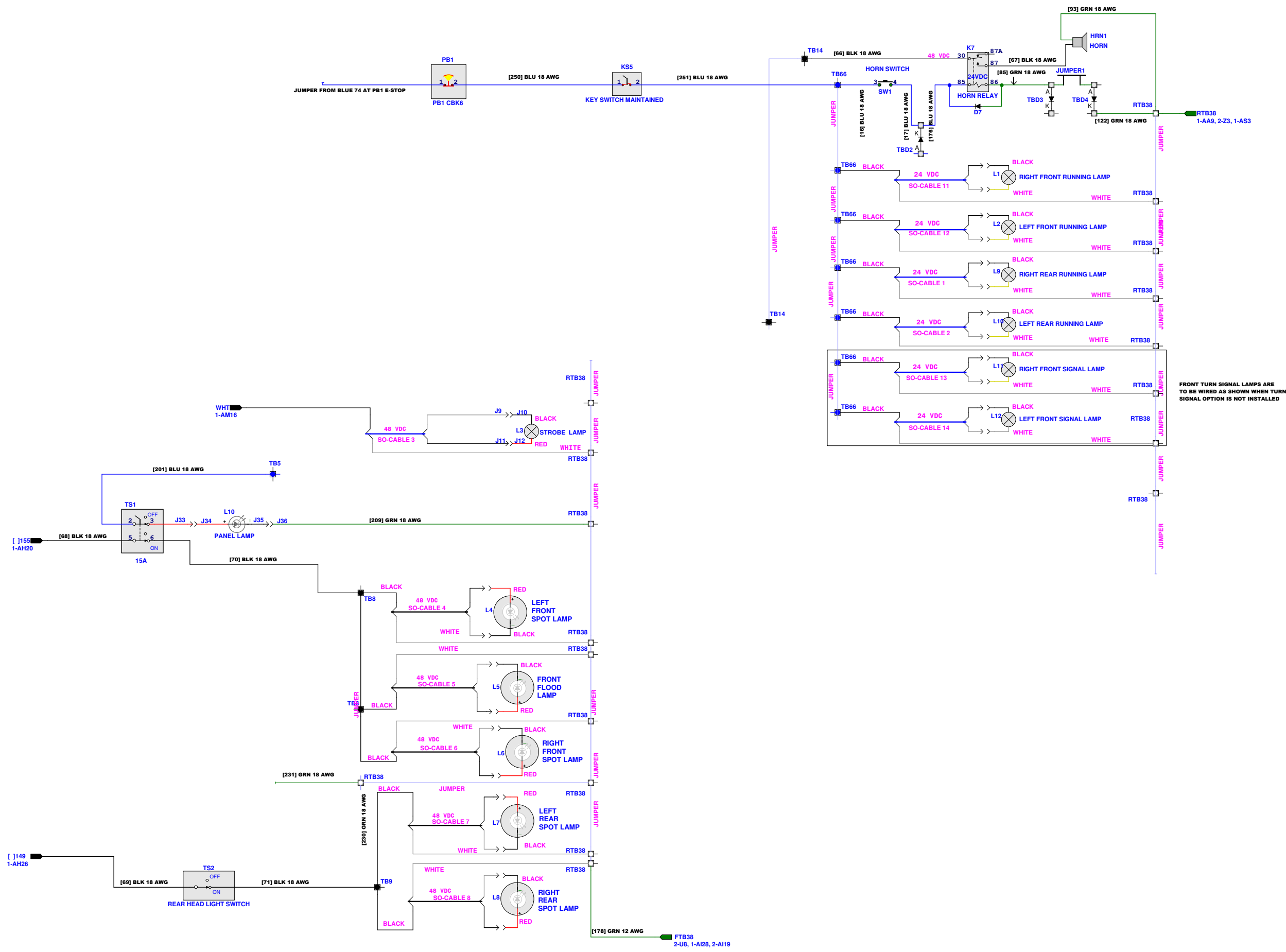
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A	ORIGINAL RELEASE	19029	REW	GAM	10-10-14



# RIGHT SIDE

INS-2210					
Title: JP180SSC Assembly Schematic					
Drawn By: R. Wallace					
Page: Battery Connections					
Page Number: 3 of 4					
Original Date: 10-10-2014					
Revision Number: A					
Revision Date: N/A					
ECN Number: 19029					

LET	REVISION	ECN	DWN	CHK	DATE
A	ORIGINAL RELEASE	19029	REW	GAM	10-10-14



FRONT TURN SIGNAL LAMPS ARE TO BE WIRED AS SHOWN WHEN TURN SIGNAL OPTION IS NOT INSTALLED



## APPENDIX II

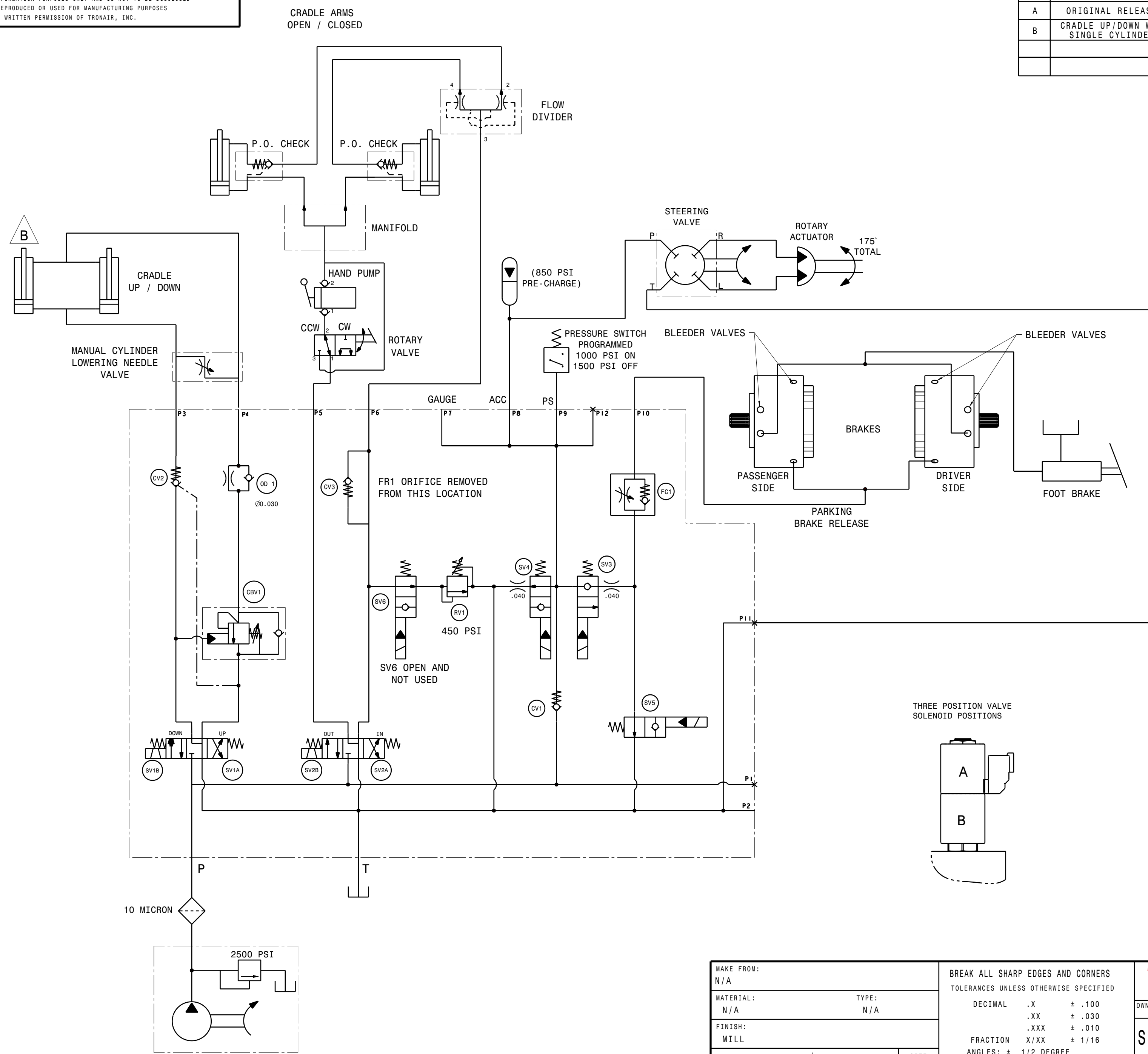
### Hydraulic Schematic INS-2162





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LET	REVISION	ECN	DWN	CHK	DATE
A	ORIGINAL RELEASE	18627	-	-	08-16-12
B	CRADLE UP/DOWN WAS SINGLE CYLINDER	19014	GAM	KJY	07-17-13



MAKE FROM: N/A	TYPE: N/A
MATERIAL: N/A	SIZE: C
FINISH: MILL	SCALE: N.T.S.
THIRD ANGLE PROJECTION	DO NOT SCALE DRAWING

BREAK ALL SHARP EDGES AND CORNERS TOLERANCES UNLESS OTHERWISE SPECIFIED	
DECIMAL	.X ± .100
	.XX ± .030
	.XXX ± .010
FRACTION	X/XX ± 1/16
ANGLES: ± 1/2 DEGREE	
< > INDICATES CRITICAL DIMENSIONS	
( ) INDICATES REFERENCE DIMENSIONS	

**TRONAIR** AIRCRAFT GROUND SUPPORT EQUIPMENT

DWN BY	GAM	GKD BY	KJY	DATE	08-16-12
SCHEMATIC, HYDRAULIC					
JP	INS-2162			REV	B





## **APPENDIX III**

### **Remote Actuator Installation and Service Instructions**



Models: 02-460-093 03-460-028  
 03-460-026 03-460-030

## INSTALLATION

(Refer to Figures 1, 2 & 3)

1. Mount actuator assembly (4) in a convenient location using four 5/16" diameter bolts, lock washers and lock nuts. The mounting bracket can be used as a template to locate mounting holes.
2. Install knob (1) on the coarse threaded end of handle (2).
3. Thread nut (3) on handle (2). Install handle (2) in clevis on actuator assembly (4) and tighten nut.
4. Install hydraulic fittings (5, 6 & 7) as necessary to make hydraulic connections. Install bleeder screw (8) and torque 16.3-19.0 N-m (12-14 lb-ft). **NOTE: Bleeder screw must be kept in an upright position.**
5. Bleed the system until all air is removed from the system. Apply hydraulic pressure and check for leaks. Make several applications to be sure actuator is working properly. **NOTE: All fittings must be inspected for leaks and tightened if leaks occur.**

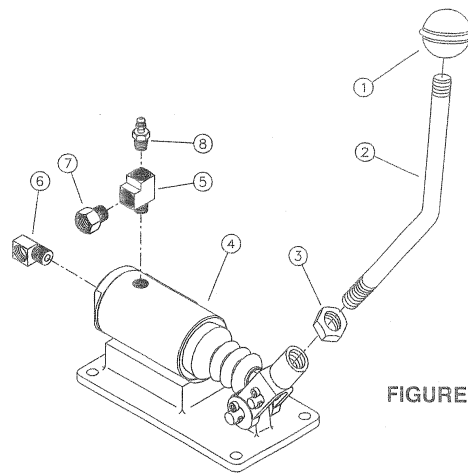


FIGURE 3

## DISASSEMBLY

(Refer to Figure 4)

1. Remove actuator by disconnecting necessary fluid lines and removing four mounting bolts. Drain fluid from assembly.
2. Disconnect push rod (14) by removing cotter pin (16) and pin (19).
3. Remove screws (18) and lock washers (17) and separate actuator assembly from base assembly (15).
4. Separate push rod (14) from piston (10) by folding back boot (13) and removing spring pin (11).
5. Remove boot (13) from push rod (14).
6. Place the actuator assembly in a vise and remove end plug assembly (1), spring (6) and piston assembly (7). **NOTE: Not all models use spring (6).**

● Items included in Repair Kit  
 \* Not used in all models

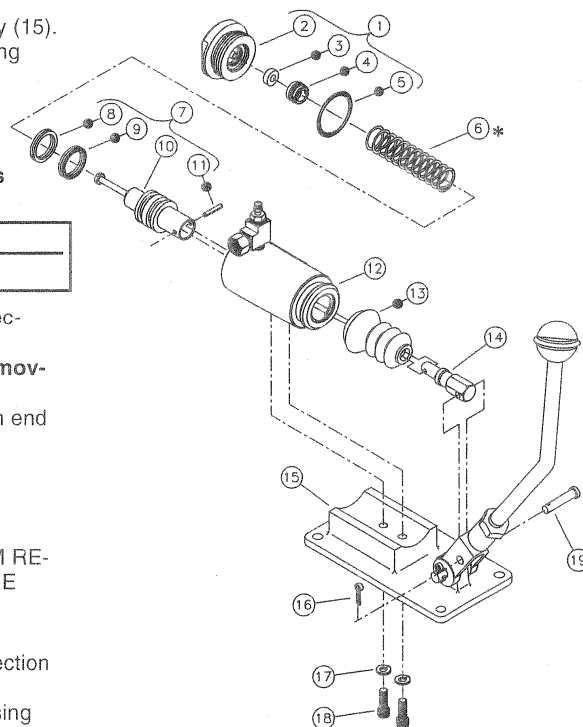


FIGURE 4

### CAUTION

End plug (2) is under tension of spring (6).

7. Remove cups (8 & 9) from piston (10). Note direction of cups (8 & 9) for reassembly. **NOTE: Be careful not to scratch or mar piston when removing cups.**
8. Remove o-ring (5), retainer (4) and seat (3) from end plug (2).

## ASSEMBLY

(Refer to Figure 4)

LUBRICATE ALL RUBBER COMPONENTS FROM REPAIR KIT WITH CLEAN TYPE FLUID USED IN THE SYSTEM.

1. Clean all parts thoroughly before assembling.
2. Install new cups (8 & 9) on piston (10). Note direction of cups (8 & 9).
3. Lubricate piston assembly (7) and install in housing (12) bore. Twist slightly to avoid damaging cups.
4. Install new seat (3), new retainer (4) and new o-ring (5) on end plug (2).

5. Install spring (6) and end plug assembly (1) in housing (12) bore. Torque end plug 67.8-108.5 N-m (50-80 lb-ft). **NOTE: Not all models use spring (6).**
  6. Remove the actuator assembly from vise. Apply loctite to the threads of screws (18). Attach actuator assembly and base assembly (15) using screws (18) and lock washers (17). Torque screws (18) 16.3-19.0 N-m (12-14 lb-ft).
  7. Install new boot (13) on push rod (14). Fold back boot (13) and connect push rod (14) and piston (10) using new spring pin (11). Connect new boot (13) to housing (12).
  8. Align the hole in push rod (14) with the hole in the clevis on base assembly (15). Install pin (19) and cotter pin (16).
  9. Install actuator on vehicle. Connect fluid lines. Bleed system of air. Tighten fittings if leaks occur. Make several applications to be sure actuator is working properly. **NOTE: All fittings must be inspected for leaks and tightened if leaks occur.**
-

# General Guidelines for installing Hydraulic Brake Components

MICO Hydraulic Brake Components are precision built devices and must be treated as such. The following guidelines must be followed at the time of installation to ensure optimum performance.

## Where to Mount

To properly locate the brake component or brake line, you must...

1. Make it convenient for operator.
2. Use the shortest and most protected route. Protect components from road salts and general debris.
3. Avoid exposing components and lines in wheel compartments.
4. Avoid mounting near engine, exhaust lines, muffler or anywhere that heat may be generated. **NOTE: Excessive heat transferred to brake fluid may result in damage to lines or seals.**
5. Mount units that have to be bled lower than master cylinder and with bleeder screws on top to facilitate bleeding.

## Internal Heat - Cause, Effect, Solution

It is possible for heat to come from within the system itself as in the case of heat generated by the friction of lining to drum when braking. This heat can cause the fluid to expand. If the fluid is then held captive, subsequent cooling and contracting can cause a pressure drop.

MICO Hydraulic Locking Devices that include a pressure accumulator are designed to dampen these fluctuations of pressure and to absorb the increase in pressure within its operating range.

## Cleanliness

It is impossible to overemphasize the importance of cleanliness during installation. All lines, fittings and adjacent areas must be cleaned of dirt or road residue before any lines or fittings are disconnected. Special care must be taken so dirt and road residue are not allowed to enter the hydraulic brake system. This can contaminate the system and interfere with the proper operation of the brakes and other hydraulic components. Always...

1. Use good, clean, quality fluid. Improper or contaminated brake fluid may cause gummy deposits and softening and swelling of other rubber seals in the entire brake system. Such a condition must be corrected immediately.
  - a. Use brake fluid which conforms to SAE Spec. No. J1703 or DOT 3 or 4 if the product is used with a system utilizing automotive brake fluid.
  - b. Refer to vehicle manufacturer for fluid specification if product is used with:
    1. Mineral based hydraulic oil.
    2. Phosphate ester base fluid.
    3. Water/glycol fluid.
    4. Water-in-oil emulsion fluid.
    5. DOT 5 or silicone fluid.
2. Be sure fittings and seats are clean before making connections. Do not use sealants, tapes, teflon or cement compounds on any connections or fittings. These sealants or compounds can contaminate the hydraulic brake system and interfere with the operation of brake system components.
3. Clean top of master cylinder before removing filler cap.

## How to Mount

To properly mount components and brake lines to withstand the most severe vibration conditions, always...

1. Follow the procedures outlined in Vehicle Manufacturer's Service Manual or SAE Standards when making new connections or adding to existing brake system. Use only steel brake tubing conforming to SAE specifications.
2. Use the proper size bolt for the hole and secure with a steel lock washer whenever possible.
3. Secure tubing to frame with proper size tube clamps to avoid possible fractures or fittings loosening and leaking.
4. Use good, factory flared lengths of steel tubing. Hand made flares, when used, must be double flared. Any flash or loose particles must be moved.
5. Use flexible brake line between frame and body.
6. Use grommets or some other means to protect brake lines that pass through the frame or firewall.
7. Make sure fittings and connections are in good condition and tightened to proper torque values as specified in the installation and service instructions.

## Importance of Bleeding

The hydraulic brake system must be bled whenever any line has been disconnected. Air trapped in the system can cause spongy and inadequate brakes. There are two methods of bleeding hydraulic systems, pressure bleeding and manual bleeding. Both methods are acceptable and adequate but pressure bleeding is recommended if the equipment is available. Follow bleeding instructions as specified by vehicle manufacturer.

To properly bleed the system...

1. Be certain all fittings are tight to avoid leaking.
2. Depress pedal and open up bleeder screws to allow air to escape. Air will always seek the highest level.
3. Retighten bleeder screws and allow pedal to return.
4. Repeat cycle until pedal is firm.
5. Make several static brake applications and then repeat cycle once more.

## Leak in the System

Even the smallest leak in a brake system will adversely affect the system. A leak may eventually deplete the reserve spongy and reduce braking pressure. To help prevent leaking...

1. Check connections during bleeding and static brake processes to be sure they are tight.
2. Always reinstall new hoses, lines and fittings if they look the least bit questionable.
3. Brake hoses, brake lines, MICO locking device, brake components, cylinders, and all fittings must be routinely inspected for leaks, damage or wear. Adequate fluid levels must be maintained. In the event of any loss of fluid, the brake system must be carefully inspected for leaks.

MICO has made every attempt to present accurate information in catalogs, brochures and other printed material. MICO can accept no responsibility for errors from unintentional oversights that may exist. Due to a continuous program of product improvement, both materials and specifications are subject to change without notice or obligation.

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Form No. 81-600-001 Revised 5/97



Printed in U.S.A.







**APPENDIX IV**

**Mobil DTE 10 Excel 32  
SDS**



Product Name: MOBIL DTE 10 EXCEL 32

Revision Date: 26 Jul 2017

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# SAFETY DATA SHEET

<b>SECTION 1</b>	<b>PRODUCT AND COMPANY IDENTIFICATION</b>
------------------	---

## PRODUCT

**Product Name:** MOBIL DTE 10 EXCEL 32  
**Product Description:** Base Oil and Additives  
**Product Code:** 201560103630, 622621  
**Intended Use:** Hydraulic fluid

## COMPANY IDENTIFICATION

**Supplier:** East Coast Lubes Pty Ltd (Queensland and Northern Territory)  
A.B.N. 37 117 203 611  
Cnr North and Mort Streets  
Toowoomba, Queensland 4350 Australia

**24 Hour Emergency Telephone** 1300 131 001  
**Supplier General Contact** 1800 069 019

**Supplier:** Southern Cross Lubes (Victoria and Tasmania)  
58-66 Ajax Road  
Altona, Victoria 3018, Australia

**24 Hour Emergency Telephone** 1300 131 001  
**Product Technical Information**  
**Supplier General Contact** 1300 466 245  
1300 552 861

**Supplier:** Perkal Pty Ltd Trading as Statewide Oil (Western Australia)  
A.B.N. 43 009 283 363  
14 Beete Street  
Welshpool, Western Australia 6106 Australia

**24 Hour Emergency Telephone** (8:00am to 4:30pm Mon to Fri) 1300 919 904  
**Product Technical Information**  
**Supplier General Contact** (08) 9350 6777  
(08) 9350 6777

**Supplier:** Perkal Pty Ltd Trading as Statewide Oil (South Australia)  
A.B.N. 43 009 283 363  
6-10 Streiff Rd  
Wingfield, South Australia 5013 Australia

**24 Hour Emergency Telephone** (8:00am to 4:30pm Mon to Fri) 1300 919 904  
**Product Technical Information**  
**Supplier General Contact** (08) 8359 8995  
(08) 8359 8995

Product Name: MOBIL DTE 10 EXCEL 32

Revision Date: 26 Jul 2017

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<b>SECTION 2</b>	<b>HAZARDS IDENTIFICATION</b>
------------------	-------------------------------

This material is not hazardous according to regulatory guidelines (see (M)SDS Section 15).

**Other hazard information:**

**Physical / Chemical Hazards:**

No significant hazards.

**Health Hazards:**

High-pressure injection under skin may cause serious damage. Excessive exposure may result in eye, skin, or respiratory irritation.

**Environmental Hazards:**

No significant hazards.

**NOTE:** This material should not be used for any other purpose than the intended use in Section 1 without expert advice. Health studies have shown that chemical exposure may cause potential human health risks which may vary from person to person.

<b>SECTION 3</b>	<b>COMPOSITION / INFORMATION ON INGREDIENTS</b>
------------------	---

This material is defined as a mixture.

**Reportable Hazardous Substance(s) or Complex Substance(s)**

Name	CAS#	Concentration*	GHS Hazard Codes
2,6-DI-TERT-BUTYLPHENOL	128-39-2	0.1 - < 1%	H315, H400(M factor 1), H410(M factor 1)
ALKYL DITHIOPHOSPHATE	255881-94-8	0.1 - < 1%	H319(2A), H400(M factor 1), H410(M factor 1)
DISTILLATES, HEAVY, C18-50 - BRANCHED, CYCLIC AND LINEAR	848301-69-9	40 - < 50%	H304
SEVERELY HYDROTREATED HEAVY PARAFFINIC DISTILLATE	64742-54-7	1 - < 5%	H304
SOLVENT DEWAXED HEAVY PARAFFINIC DISTILLATE	64742-65-0	1 - < 5%	H304

\* All concentrations are percent by weight unless ingredient is a gas. Gas concentrations are in percent by volume. Other ingredients determined not to be hazardous up to 100%.

Product Name: MOBIL DTE 10 EXCEL 32

Revision Date: 26 Jul 2017

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<b>SECTION 4</b>	<b>FIRST AID MEASURES</b>
------------------	---------------------------

#### **INHALATION**

Remove from further exposure. For those providing assistance, avoid exposure to yourself or others. Use adequate respiratory protection. If respiratory irritation, dizziness, nausea, or unconsciousness occurs, seek immediate medical assistance. If breathing has stopped, assist ventilation with a mechanical device or use mouth-to-mouth resuscitation.

#### **SKIN CONTACT**

Wash contact areas with soap and water. If product is injected into or under the skin, or into any part of the body, regardless of the appearance of the wound or its size, the individual should be evaluated immediately by a physician as a surgical emergency. Even though initial symptoms from high pressure injection may be minimal or absent, early surgical treatment within the first few hours may significantly reduce the ultimate extent of injury.

#### **EYE CONTACT**

Flush thoroughly with water. If irritation occurs, get medical assistance.

#### **INGESTION**

First aid is normally not required. Seek medical attention if discomfort occurs.

#### **NOTE TO PHYSICIAN**

None

<b>SECTION 5</b>	<b>FIRE FIGHTING MEASURES</b>
------------------	-------------------------------

#### **EXTINGUISHING MEDIA**

**Appropriate Extinguishing Media:** Use water fog, foam, dry chemical or carbon dioxide (CO<sub>2</sub>) to extinguish flames.

**Inappropriate Extinguishing Media:** Straight streams of water

#### **FIRE FIGHTING**

**Fire Fighting Instructions:** Evacuate area. Prevent run-off from fire control or dilution from entering streams, sewers or drinking water supply. Fire-fighters should use standard protective equipment and in enclosed spaces, self-contained breathing apparatus (SCBA). Use water spray to cool fire exposed surfaces and to protect personnel.

**Unusual Fire Hazards:** Pressurised mists may form a flammable mixture.

**Hazardous Combustion Products:** Aldehydes, Incomplete combustion products, Oxides of carbon, Smoke, Fume, Sulphur oxides

#### **FLAMMABILITY PROPERTIES**

**Flash Point [Method]:** >200°C (392°F) [ASTM D-92]

**Flammable Limits (Approximate volume % in air):** LEL: 0.9 UEL: 7.0

**Autoignition Temperature:** N/D

<b>SECTION 6</b>	<b>ACCIDENTAL RELEASE MEASURES</b>
------------------	------------------------------------

**NOTIFICATION PROCEDURES**

In the event of a spill or accidental release, notify relevant authorities in accordance with all applicable regulations.

**PROTECTIVE MEASURES**

Avoid contact with spilled material. See Section 5 for fire fighting information. See the Hazard Identification Section for Significant Hazards. See Section 4 for First Aid Advice. See Section 8 for advice on the minimum requirements for personal protective equipment. Additional protective measures may be necessary, depending on the specific circumstances and/or the expert judgment of the emergency responders.

**SPILL MANAGEMENT**

**Land Spill:** Stop leak if you can do so without risk. Recover by pumping or with suitable absorbent.

**Water Spill:** Stop leak if you can do so without risk. Confine the spill immediately with booms. Warn other shipping. Remove from the surface by skimming or with suitable absorbents. Seek the advice of a specialist before using dispersants.

Water spill and land spill recommendations are based on the most likely spill scenario for this material; however, geographic conditions, wind, temperature, (and in the case of a water spill) wave and current direction and speed may greatly influence the appropriate action to be taken. For this reason, local experts should be consulted. Note: Local regulations may prescribe or limit action to be taken.

**ENVIRONMENTAL PRECAUTIONS**

Large Spills: Dyke far ahead of liquid spill for later recovery and disposal. Prevent entry into waterways, sewers, basements or confined areas.

<b>SECTION 7</b>	<b>HANDLING AND STORAGE</b>
------------------	-----------------------------

**HANDLING**

Prevent small spills and leakage to avoid slip hazard. Material can accumulate static charges which may cause an electrical spark (ignition source). When the material is handled in bulk, an electrical spark could ignite any flammable vapors from liquids or residues that may be present (e.g., during switch-loading operations). Use proper bonding and/or earthing procedures. However, bonding and earthing may not eliminate the hazard from static accumulation. Consult local applicable standards for guidance. Additional references include American Petroleum Institute 2003 (Protection Against Ignitions Arising out of Static, Lightning and Stray Currents) or National Fire Protection Agency 77 (Recommended Practice on Static Electricity) or CENELEC CLC/TR 50404 (Electrostatics - Code of practice for the avoidance of hazards due to static electricity).

**Static Accumulator:** This material is a static accumulator.

**STORAGE**

The type of container used to store the material may affect static accumulation and dissipation. Do not store in open or unlabelled containers. Keep away from incompatible materials.

Material is defined under the National Standard [NOHSC:1015] Storage and Handling of Workplace Dangerous Goods.

Product Name: MOBIL DTE 10 EXCEL 32

Revision Date: 26 Jul 2017

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<b>SECTION 8</b>	<b>EXPOSURE CONTROLS / PERSONAL PROTECTION</b>
------------------	--

### EXPOSURE LIMIT VALUES

**Exposure limits/standards (Note: Exposure limits are not additive)**

Substance Name	Form	Limit/Standard	Note	Source
SEVERELY HYDROTREATED HEAVY PARAFFINIC DISTILLATE	Mist.	TWA 5 mg/m3		ACGIH
SOLVENT DEWAXED HEAVY PARAFFINIC DISTILLATE	Mist.	TWA 5 mg/m3		Australia OELs
SOLVENT DEWAXED HEAVY PARAFFINIC DISTILLATE	Mist.	TWA 5 mg/m3		ACGIH

**Exposure limits/standards for materials that can be formed when handling this product:**

NOTE: Limits/standards shown for guidance only. Follow applicable regulations.

### Biological limits

No biological limits allocated.

### ENGINEERING CONTROLS

The level of protection and types of controls necessary will vary depending upon potential exposure conditions. Control measures to consider:

No special requirements under ordinary conditions of use and with adequate ventilation.

### PERSONAL PROTECTION

Personal protective equipment selections vary based on potential exposure conditions such as applications, handling practices, concentration and ventilation. Information on the selection of protective equipment for use with this material, as provided below, is based upon intended, normal usage.

**Respiratory Protection:** If engineering controls do not maintain airborne contaminant concentrations at a level which is adequate to protect worker health, an approved respirator may be appropriate.

Respirator selection, use, and maintenance must be in accordance with regulatory requirements, if applicable. Types of respirators to be considered for this material include:

Particulate

No special requirements under ordinary conditions of use and with adequate ventilation.

For high airborne concentrations, use an approved supplied-air respirator, operated in positive pressure mode. Supplied air respirators with an escape bottle may be appropriate when oxygen levels are inadequate, gas/vapour warning properties are poor, or if air purifying filter capacity/rating may be exceeded.

**Hand Protection:** Any specific glove information provided is based on published literature and glove manufacturer data. Glove suitability and breakthrough time will differ depending on the specific use conditions. Contact the glove manufacturer for specific advice on glove selection and breakthrough times for your use conditions. Inspect and replace worn or damaged gloves. The types of gloves to be considered for this material include:

Nitrile, Viton

No protection is ordinarily required under normal conditions of use.

**Eye Protection:** If contact is likely, safety glasses with side shields are recommended.

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**Skin and Body Protection:** Any specific clothing information provided is based on published literature or manufacturer data. The types of clothing to be considered for this material include:

No skin protection is ordinarily required under normal conditions of use. In accordance with good industrial hygiene practices, precautions should be taken to avoid skin contact.

**Specific Hygiene Measures:** Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants. Discard contaminated clothing and footwear that cannot be cleaned. Practise good housekeeping.

## ENVIRONMENTAL CONTROLS

Comply with applicable environmental regulations limiting discharge to air, water and soil. Protect the environment by applying appropriate control measures to prevent or limit emissions.

## SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

**Note:** Physical and chemical properties are provided for safety, health and environmental considerations only and may not fully represent product specifications. Contact the Supplier for additional information.

### GENERAL INFORMATION

**Physical State:** Liquid

**Colour:** Amber

**Odour:** Characteristic

**Odour Threshold:** N/D

### IMPORTANT HEALTH, SAFETY, AND ENVIRONMENTAL INFORMATION

**Relative Density (at 15 °C):** 0.847

**Flammability (Solid, Gas):** N/A

**Flash Point [Method]:** >200°C (392°F) [ASTM D-92]

**Flammable Limits (Approximate volume % in air):** LEL: 0.9 UEL: 7.0

**Autoignition Temperature:** N/D

**Boiling Point / Range:** > 316°C (600°F)

**Decomposition Temperature:** N/D

**Vapour Density (Air = 1):** > 2 at 101 kPa

**Vapour Pressure:** < 0.013 kPa (0.1 mm Hg) at 20 °C

**Evaporation Rate (n-butyl acetate = 1):** N/D

**pH:** N/A

**Log Pow (n-Octanol/Water Partition Coefficient):** > 3.5

**Solubility in Water:** Negligible

**Viscosity:** 32.7 cSt (32.7 mm<sup>2</sup>/sec) at 40 °C | 6.6 cSt (6.6 mm<sup>2</sup>/sec) at 100°C

**Oxidizing Properties:** See Hazards Identification Section.

### OTHER INFORMATION

**Freezing Point:** N/D

**Melting Point:** N/A

**Pour Point:** -45°C (-49°F)

**DMSO Extract (mineral oil only), IP-346:** < 3 %wt



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<b>SECTION 10</b>	<b>STABILITY AND REACTIVITY</b>
-------------------	---------------------------------

**STABILITY:** Material is stable under normal conditions.

**CONDITIONS TO AVOID:** Excessive heat. High energy sources of ignition.

**INCOMPATIBLE MATERIALS:** Strong oxidisers

**HAZARDOUS DECOMPOSITION PRODUCTS:** Material does not decompose at ambient temperatures.

**POSSIBILITY OF HAZARDOUS REACTIONS:** Hazardous polymerization will not occur.

<b>SECTION 11</b>	<b>TOXICOLOGICAL INFORMATION</b>
-------------------	----------------------------------

**INFORMATION ON TOXICOLOGICAL EFFECTS**

<u>Hazard Class</u>	<u>Conclusion / Remarks</u>
<b>Inhalation</b>	
Acute Toxicity: No end point data for material.	Minimally Toxic. Based on assessment of the components.
Irritation: No end point data for material.	Negligible hazard at ambient/normal handling temperatures.
<b>Ingestion</b>	
Acute Toxicity: No end point data for material.	Minimally Toxic. Based on assessment of the components.
<b>Skin</b>	
Acute Toxicity: No end point data for material.	Minimally Toxic. Based on assessment of the components.
Skin Corrosion/Irritation: No end point data for material.	Negligible irritation to skin at ambient temperatures. Based on assessment of the components.
<b>Eye</b>	
Serious Eye Damage/Irritation: No end point data for material.	May cause mild, short-lasting discomfort to eyes. Based on assessment of the components.
<b>Sensitisation</b>	
Respiratory Sensitization: No end point data for material.	Not expected to be a respiratory sensitizer.
Skin Sensitization: No end point data for material.	Not expected to be a skin sensitizer. Based on assessment of the components.
<b>Aspiration:</b> Data available.	Not expected to be an aspiration hazard. Based on physico-chemical properties of the material.
<b>Germ Cell Mutagenicity:</b> No end point data for material.	Not expected to be a germ cell mutagen. Based on assessment of the components.
<b>Carcinogenicity:</b> No end point data for material.	Not expected to cause cancer. Based on assessment of the components.
<b>Reproductive Toxicity:</b> No end point data for material.	Not expected to be a reproductive toxicant. Based on assessment of the components.
<b>Lactation:</b> No end point data for material.	Not expected to cause harm to breast-fed children.
<b>Specific Target Organ Toxicity (STOT)</b>	
Single Exposure: No end point data for material.	Not expected to cause organ damage from a single exposure.
Repeated Exposure: No end point data for material.	Not expected to cause organ damage from prolonged or repeated exposure. Based on assessment of the components.

**OTHER INFORMATION**

**Contains:**

Base oil severely refined: Not carcinogenic in animal studies. Representative material passes IP-346, Modified

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Ames test, and/or other screening tests. Dermal and inhalation studies showed minimal effects; lung non-specific infiltration of immune cells, oil deposition and minimal granuloma formation. Not sensitising in test animals.

**IARC Classification:**

The following ingredients are cited on the lists below: None.

--REGULATORY LISTS SEARCHED--

1 = IARC 1

2 = IARC 2A

3 = IARC 2B

<b>SECTION 12</b>	<b>ECOLOGICAL INFORMATION</b>
-------------------	-------------------------------

The information given is based on data available for the material, the components of the material, and similar materials.

**ECOTOXICITY**

Material -- Not expected to be harmful to aquatic organisms.

**MOBILITY**

Base oil component -- Low solubility and floats and is expected to migrate from water to the land. Expected to partition to sediment and wastewater solids.

**PERSISTENCE AND DEGRADABILITY**

**Biodegradation:**

Base oil component -- Expected to be inherently biodegradable

**BIOACCUMULATION POTENTIAL**

Base oil component -- Has the potential to bioaccumulate, however metabolism or physical properties may reduce the bioconcentration or limit bioavailability.

**ECOLOGICAL DATA**

**Ecotoxicity**

Test	Duration	Organism Type	Test Results
Aquatic - Chronic Toxicity	21 day(s)	Daphnia magna	NOELR 1.05 mg/l: data for similar materials

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<b>SECTION 13</b>	<b>DISPOSAL CONSIDERATIONS</b>
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Disposal recommendations based on material as supplied. Disposal must be in accordance with current applicable laws and regulations, and material characteristics at time of disposal.

**DISPOSAL RECOMMENDATIONS**

Product is suitable for burning in an enclosed controlled burner for fuel value or disposal by supervised incineration at very high temperatures to prevent formation of undesirable combustion products. Protect the environment. Dispose of used oil at designated sites. Minimize skin contact. Do not mix used oils with solvents, brake fluids or coolants.

**Empty Container Warning** Empty Container Warning (where applicable): Empty containers may contain residue and can be dangerous. Do not attempt to refill or clean containers without proper instructions. Empty drums should be completely drained and safely stored until appropriately reconditioned or disposed. Empty containers should be taken for recycling, recovery, or disposal through suitably qualified or licensed contractor and in accordance with governmental regulations. **DO NOT PRESSURISE, CUT, WELD, BRAZE, SOLDER, DRILL, GRIND, OR EXPOSE SUCH CONTAINERS TO HEAT, FLAME, SPARKS, STATIC ELECTRICITY, OR OTHER SOURCES OF IGNITION. THEY MAY EXPLODE AND CAUSE INJURY OR DEATH.**

<b>SECTION 14</b>	<b>TRANSPORT INFORMATION</b>
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**LAND (ADG)** : Not Regulated for Land Transport

**SEA (IMDG)**: Not Regulated for Sea Transport according to IMDG-Code

**Marine Pollutant**: No

**AIR (IATA)**: Not Regulated for Air Transport

<b>SECTION 15</b>	<b>REGULATORY INFORMATION</b>
-------------------	-------------------------------

This material is not considered hazardous according to Australia Model Work Health and Safety Regulations.

Product is not regulated according to Australian Dangerous Goods Code.

No Poison Schedule number allocated by the Standard for the Uniform Scheduling of Medicines and Poisons (SUSMP) established under the Therapeutic Goods Act.

AS1940 COMBUSTIBLE CLASS: C2

**REGULATORY STATUS AND APPLICABLE LAWS AND REGULATIONS**

**Listed or exempt from listing/notification on the following chemical inventories:** AICS, DSL, ENCS, KECI, PICCS, TCSI, TSCA

**Special Cases:**

Inventory	Status
IECSC	Restrictions Apply

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<b>SECTION 16</b>	<b>OTHER INFORMATION</b>
-------------------	--------------------------

**KEY TO ABBREVIATIONS AND ACRONYMS:**

N/D = Not determined, N/A = Not applicable, STEL = Short-Term Exposure Limit, TWA = Time-Weighted Average

**KEY TO THE H-CODES CONTAINED IN SECTION 3 OF THIS DOCUMENT (for information only):**

H304: May be fatal if swallowed and enters airways; Aspiration, Cat 1

H315: Causes skin irritation; Skin Corr/Irritation, Cat 2

H319(2A): Causes serious eye irritation; Serious Eye Damage/Irr, Cat 2A

H400: Very toxic to aquatic life; Acute Env Tox, Cat 1

H410: Very toxic to aquatic life with long lasting effects; Chronic Env Tox, Cat 1

**THIS SAFETY DATA SHEET CONTAINS THE FOLLOWING REVISIONS:**

Perkal Pty Ltd Trading as Roto Oil (South Australia): Section 01: Supplier Mailing Address information was deleted.

Perkal Pty Ltd Trading as Statewide Oil (South Australia): Section 01: Supplier Mailing Address information was added.

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DGN: 7093387DAU (1022091)

-----  
Prepared by: Exxon Mobil Corporation  
EMBSI, Clinton NJ USA

Contact Point: See Section 1 for Local Contact number

**End of (M)SDS**



## APPENDIX V

# Battery Mate 80 and Battery Charger Controller



### WARNING

Consult local, state or national electric codes for battery charger installation in an aircraft hangar.



# **OWNER'S MANUAL 193111-080**

Issued March 7, 2008

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**IMPORTANT:** Read these instructions before installing, operating, or servicing this system.

---

## **BATTERY-MATE 80**

**Silicon Diode  
Ferroresonant Transformer type  
Battery Charger**

**DO NOT DESTROY**

**Note:** This manual also applies to Battery-Mate units that were shipped prior to January 1, 2005.

**AMETEK/PRESTOLITE POWER , TROY, OHIO 45373-1099, U.S.A.**

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# INTRODUCTION

## How To Use This Manual

**IMPORTANT: It is especially important that all charger internal components be kept clean and dry, and all electrical connections as tightened as instructed in the Maintenance chapter of this manual. Replace any precautionary or instruction label that cannot be easily read.**

To ensure safe operation, read the entire manual, including the chapter on Safety Instructions and Warnings.

Throughout this manual, the words **WARNING**, **CAUTION**, and **NOTE** may appear. Pay particular attention to the information provided under these headings. These special annotations are easily recognized as follows:

**WARNING gives information regarding possible personal injury. Warnings will be enclosed in a box such as this.**

**CAUTION refers to possible equipment damage. Cautions will be shown in bold type.**

*NOTE offers helpful information concerning certain operating procedures. Notes will be shown in italics.*

## Equipment Identification

The unit's identification number (specification, model, serial number) usually appears on a nameplate attached to the front panel.

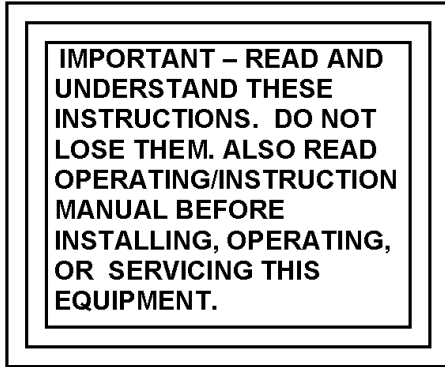
## Receipt Of Equipment

When you receive the equipment, check it against the invoice to make sure it is complete and inspect the equipment for possible damage due to shipping. If there is any damage, notify the carrier immediately to file a claim. Furnish complete information concerning damage claims or shipping errors to the company shown on the cover of this manual. Include all equipment identification numbers and group part numbers (if any) as described above along with a full description of the parts in error.

Additional copies of this manual may be purchased by contacting the company shown on the cover of this manual. Include the Owner's Manual number and equipment identification numbers.

# SAFETY INSTRUCTIONS AND WARNINGS

## FOR OPERATION OF BATTERY CHARGING EQUIPMENT



### A. General

Battery charging products can cause serious injury or death, or damage to other equipment or property, if the operator does not strictly observe all safety rules and take precautionary actions.

Safe practices have developed from past experience in the use of charging equipment. These practices must be learned through study and training before using this equipment. Anyone not having extensive training in battery charging practices should be taught by experienced operators.

Only qualified personnel should install, use, or service this equipment.

### B. Shock Prevention

Bare conductors, or terminals in the output circuit, or ungrounded, electrically-live equipment can fatally shock a person. To protect against shock, have competent electrician verify that the equipment is adequately grounded and learn what terminals and parts are electrically HOT.

The body's electrical resistance is decreased when wet, permitting dangerous current to flow through the body. Do not work in damp area without being extremely careful. Stand on dry rubber mat or dry wood and use insulating gloves when dampness or sweat cannot be avoided. Keep clothing dry.

1. Installation and Grounding of Electrically Powered Equipment – Electrical equipment must be installed and maintained in accordance with the National Electrical Code, NFPA 70, and local codes. A power disconnect switch must be located at the equipment. Check nameplate for voltage and phase requirements.

If a grounding lead (conductor) is part of the power supply cable, be sure to connect it to a properly grounded switch box or building ground. If not part of the supply cable, use a separate grounding lead (conductor). Do not remove a ground prong from any plug. Use correct mating receptacles. Check ground for electrical continuity before using equipment.

The grounding conductor must be of a size equal to or larger than the size recommended by Code or in this manual.

2. Charging Leads – Inspect leads often for damage to the insulation. Replace or repair cracked or worn leads immediately. Use leads having sufficient capacity to carry the operating current without overheating.
3. Battery Terminals – Do not touch battery terminals while equipment is operating.
4. Service and Maintenance – Shut OFF all power at the disconnect switch or line breaker *before* inspecting, adjusting, or servicing the equipment. Lock switch OPEN (or remove line fuses) so that the power cannot be turned ON accidentally. Disconnect power to equipment if it is to be left unattended or out of service.

Disconnect battery from charger. Measure voltage on capacitors and discharge through an insulated screwdriver if there is any voltage reading.

Keep inside parts clean and dry. Dirt and/or moisture can cause insulation failure. This failure can result in high voltage at the charger output.

### C. Burn and Bodily Injury Prevention

The battery produces very high currents when short circuited, and will burn the skin severely if in contact with any metal conductor that is carrying this current. Do not permit rings on fingers to come in contact with battery terminals or the cell connectors on top of the battery.

Battery acid is very corrosive. Always wear correct eye and body protection when near batteries.

### D. Fire and Explosion Prevention

Batteries give off explosive flammable gases which easily ignite when coming in contact with an open flame or spark. Do not smoke, cause sparking, or use open flame near batteries. Charge batteries only in locations which are clean, dry, and well ventilated. Do not lay tools or anything that is metallic on top of any battery. All repairs to a battery must be made only by experienced and qualified personnel.

### E. Arcing and Burning of Connector

To prevent arcing and burning of the connector contacts, be sure the charger is OFF before connecting or disconnecting the battery. (If the charger is equipped with an ammeter, the ammeter should not indicate current flow.) Always connect battery before turning charger ON.

### F. Medical and First Aid Treatment

First aid facilities and a qualified first aid person should be available for each shift for immediate treatment of electrical shock victims.

**EMERGENCY FIRST AID: Call physician and ambulance immediately. Use First Aid techniques recommended by the American Red Cross.**

**DANGER: ELECTRICAL SHOCK CAN BE FATAL. If person is unconscious and electric shock is suspected, do not touch person if he or she is in contact with charging leads, charging equipment, or other live electrical parts. Disconnect (open) power at wall switch and then use First Aid. Dry wood, wooden broom, and other insulating material can be used to move cables, if necessary, away from person. IF BREATHING IS DIFFICULT, give oxygen. IF NOT BREATHING, BEGIN ARTIFICIAL BREATHING, such as mouth-to-mouth. IF PULSE IS ABSENT, BEGIN ARTIFICIAL CIRCULATION, such as external heart massage.**

IN CASE OF ACID IN THE EYES, flush very well with clean water and obtain professional medical attention immediately.

### G. Equipment Warning Labels

Inspect all precautionary labels on the equipment. Order and replace all labels that cannot be easily read.

# DESCRIPTION OF EQUIPMENT

## Charger

The basic charging circuit is the silicon diode, rectifier-type with ferroresonant transformer (s). This ferroresonant transformer design regulates charging current by allowing the battery to determine its own charge cycle rate in accordance with its state of discharge. It provides a constantly-tapering charge that eliminates the possibility of overcharging, even with line voltage variations of  $\pm 10\%$ . Three-phase input chargers have two transformers. The charger is internally protected from overload and short circuits.

When charging lead acid batteries, with the same number of cells and ampere-hour capacity as shown on charger nameplate, the charging time will be approximately 8 hours. Batteries of smaller or larger ampere-hour capacities can also be charged, but will require shorter or longer charging, respectively.

## Charge Control

The AC500 Control is provided as the standard charger control. It utilizes either a voltage/time (VT) charge termination or a patented  $pT/dV/dT$  charge termination technique which eliminates excessive gassing by returning approximately 107% of the amp-hours removed from the battery.

Features of the AC500 Control include manual equalize, manual stop, back-up timer protection, two charge termination methods, 80% voltage point selection, high and low battery voltage discrimination, and AC power fail recovery.

The AC500 Control is "matched" to the output voltage of the charger by means of a printed circuit board mounted DIP switch. It will operate on 6, 12, 18, 24, 36, and "optional" cell batteries. "Optional" is provided to accommodate batteries between 6 and 36 cells that are not listed above.

The status of a normal charge cycle is indicated by the four LEDs on the front panel. The "80% Charged" LED will light when the battery voltage reaches the 80% charged voltage. This voltage may be 2.37 volts/cell or 2.45 volts/cell nominal, depending on the status of DIP switch S1-7. The "Charge Complete" LED will light only if the battery has completed the charge cycle and is ready for use. The "Abnormal Shutdown" LED will light if the charger terminates a charge prematurely. See the Troubleshooting chapter of this manual to determine the cause of the fault. The "Equalize" LED will light solid when a equalize charge is requested by pressing the EQUALIZE push button. The "Equalize" LED will flash when the charger is equalizing the battery.

**WARNING: Do not connect a battery to this charger if any LED is lit. Do not disconnect a battery from this charger while a charge is in progress. Otherwise, arcing and burning of connector parts or a battery explosion may result. Batteries produce explosive gases. Keep sparks, flame, and cigarettes away. Ventilate when charging in an enclosed area. Always shield eyes when working near batteries.**

# INSTALLATION

## Location

For best operating characteristics and longest unit life, take care in selecting an installation site. Avoid locations exposed to high humidity, dust, high ambient temperature, or corrosive fumes. Moisture can condense on electrical components, causing corrosion or shorting of circuits (especially when dirt is also present).

Adequate air circulation is needed at all times in order to assure proper operation. Provide a minimum of 6 inches of free air space at rear and sides of the unit. Make sure that ventilation openings are not obstructed.

Always remove the charger shipping skid from the unit before installation. The charger must be installed over a noncombustible surface such as concrete or metal. Keep the charging area clear of all combustible material such as wood, paper, and cloth.

**WARNING: SPARKS OR MOLTEN METAL falling through open bottom can cause fire or explosion.**


- Install over noncombustible material such as concrete or metal.
- Keep charging area clear of combustible material.

## Grounding

The frame of the power source must be grounded for personnel safety. Where grounding is mandatory under state or local codes, it is the responsibility of the user to comply with all applicable rules and regulations. Where no state or local codes exist, it is recommended that the National Electrical Code be followed.

In addition to the usual function of protecting personnel against the hazard of electrical shock due to fault in the equipment, grounding serves to discharge the static electrical charges which tend to build up on the surfaces of equipment. These static charges can cause painful shock to personnel, and can lead to the erroneous conclusion that an electrical fault exists in the equipment.

If a charger is to be connected to the AC power supply with a flexible jacketed cable, one having a separate grounding conductor should be used. When included in cable assembly, grounding conductor will be green, green with a yellow stripe, or bare. When connecting input power to charger (as instructed in Line

Connection to Battery Charger section of this manual), connect grounding conductor to equipment grounding terminal (stud with a green nut and a cup washer and identified by symbol ) , taking care to make a good electrical connection. Connect other end of grounding conductor to the system ground.

If, for any reason, an input cable which does not include a grounding conductor is used, the equipment must be grounded with separate conductor. Minimum size and color coding requirements must be in accordance with any applicable state or local code, or the National Electrical Code.

If metallic armored cable or conduit is used, the metal sheathing or conduit must be effectively grounded as required by state or local code, or the National Electrical Code.

If a system ground is not available, the charger frame must be connected to a driven ground rod (at least 8 ft [2438 mm] long), or to a water pipe that enters the ground not more than 10 ft (3048 mm) from the charger. A grounding conductor must be connected to the rod or pipe in a manner that will assure a permanent and effective ground. The conductor must be sized in accordance with any applicable state or local code, or by the National Electrical Code. If in doubt, use the same size conductor as is used for the conductors supplying power to the charger.

**WARNING: ELECTRIC SHOCK HAZARD – Under no circumstance should you use a grounding conductor with a current carrying capacity less than the ampere rating shown in Table 4-1.**

## Line Voltage Changeover Instructions

1. Determine if the charger is connected for available line voltage. A label located near AC input terminals is marked with the AC voltage for which the charger is factory connected.
2. If charger is not connected correctly, check serial nameplate to determine that charger is equipped to be connected for available line voltage. If charger is suitably equipped, make voltage changeover connections by following instructions on AC INPUT label inside charger.

LINE AMPS	DISCONNECT SWITCH *	BRANCH FUSE SIZE (AMPERES)	COPPER CABLE SIZE AWG **	
			POWER	GROUND
0-2.5	30A	5	No. 14	No. 14
2.6-4.5	30A	7	No. 14	No. 14
4.6-7.5	30A	10	No. 14	No. 14
7.6-12	30A	15	No. 14	No. 14
12.1-16	30A	20	No. 12	No. 12
16.1-18	30A	25	No. 10	No. 10
18.1-22	30A	30	No. 10	No. 10
22.1-24.5	60A	35	No. 8	No. 10
24.6-32.5	60A	40	No. 8	No. 10
32.6-40	60A	50	No. 8	No. 10
40.1-45	60A	60	No. 6	No. 10
45.1-57.5	100A	80	No. 4	No. 8
57.6-78	100A	100	No. 2	No. 8
78.1-102.5	200A	125	No. 2	No. 6
102.6-135	200A	150	No. 1/0	No. 6

**Table 4-1 Recommended AC Input and Branch Fusing**

The above table (Table 4-1) is based on 75°C (167°F) rated conductors and 40°C (104°F) ambient temperatures. Refer to National Electrical Code (2008) Tables 310-16 corrected to 40°C (104°F).

\* For 115, 208, and 230-volt lines, use 250-volt disconnect switch.  
 For 440-480, 575-volt lines, use 600-volt disconnect switch.

\*\* Two conductors and ground conductor required for single phase.  
 Three conductors and ground conductor required for three phase.

Recommended minimum size of grounding conductors (based on National Electrical Code 2008 – Table 250-95).

- If charger is reconnected, check input fuse(s) ratings with ratings specified on label and replace if necessary.

**CAUTION: INCORRECT CONNECTIONS AND INCORRECT FUSE SIZE can damage this equipment. Follow voltage changeover instructions carefully.**

### Line Connections to Battery Charger

Follow local code requirements if different than instructions in this manual.

- Turn charger OFF.
- Be sure charger is connected correctly for available line voltage as instructed above.

- On charger nameplate, note the AC input amperes corresponding to the line voltage to which charger is to be connected. Use that ampere value to select the proper disconnect switch, fuse, and power cable sizes from Table 4-1. A "WARNING" label inside charger also lists fuse sizes for each line voltage (circled fuse rating is required for internal line voltage connections made at factory).

- Route AC power input cable in through knockout provided in side panel of charger cabinet. Securely fasten cable wires to a power input terminal inside charger. Refer to Grounding section of this manual for proper connection of grounding conductor. (Charger cabinet top or side panel, or both, may have to be removed to provide access to terminal block).

- With disconnect switch (on AC input power line) in "OPEN" or "OFF" position, connect power cable coming from charger, to the switch. Install fuses in switch.

## Charging Cable Connectors

If connectors are already attached to charging cables, make sure that they're attached so that positive charger polarity will connect to positive battery terminal.

If connectors must be attached to charging cables, follow instructions supplied with connectors.

**CAUTION:** Make sure connectors are securely attached to cables (good solder joint or well tightened set screws, whichever is applicable). Be certain that positive charger cable will connect to positive battery terminal. If necessary, trace cables into charger and use supplied connection diagram to determine polarity. The use of a DC voltmeter may show polarity. Improper connections will "blow" output fuse and may cause other damage.

*Note: If this charger is equipped with certain optional features, the connector attaching procedure may be modified.*

## Pre-operation Checks

1. Inspect charger thoroughly for damage; loose screws, nuts, or electrical connections.

**WARNING: ELECTRICAL SHOCK HAZARD – Before inspecting or cleaning inside cabinet, turn OFF and remove fuses of disconnect switch (supplying AC power to charger), disconnect battery, and check for voltage on capacitors. Discharge through insulated screwdriver if there is any reading.**

2. Remove all special tags that are tied to charger. Keep tags with this manual for future reference. Leave all precautionary and instruction labels in place on charger. Carefully read and follow instructions on all tags and labels. Make sure all labels remain visible to anyone operating charger.
3. Make sure all charger cabinet panels are fastened in place, to assure proper flow of ventilating air through cabinet.

# OPERATION

## Preliminary

1. Make sure that charger is installed and grounded as instructed in this manual.
2. Make sure the charge control is set to the proper cell size via the charge control DIP switch cell selector.
3. Turn on main fused disconnect switch that supplies AC power to charger.
4. Maintain electrolyte level in batteries to be charged, as instructed by battery manufacturer. The volume of electrolyte will expand during the charge. Therefore, to avoid overfilling, do not add water until the battery has received at least an 80% charge. This will usually be reached at the time gassing starts.

## Normal or Daily Charge

**WARNING: DO NOT connect a battery to this charger if any LED is lit. Do not disconnect a battery from this charger while a charge is in progress; otherwise, arcing and burning of connector parts or a battery explosion may result. Batteries produce explosive gases. Keep sparks, flame and cigarettes away. Ventilate when charging in an enclosed area. Always shield eyes when working near batteries.**

1. Insure that battery size matches the charger. (Number of cells and ampere-hour capacity are within charger nameplate rating.)
2. Securely engage the battery and charger connectors.
3. After a 5 second delay (all LED's will be lit), the charger will turn on. The "Charge in Progress" LED will indicate charging current.
4. The "80% Charged" LED will light when the battery on charge reaches the 80% charged voltage.
5. The charger will automatically turn off and the "Charge Complete" LED will light when the charge has finished. The light will remain on until the battery is disconnected from the charger.

*NOTE: To disconnect battery from charger before charge is complete, first press the STOP key, then disconnect the battery from the charger.*

## Equalize or Weekend Charge

The AC500 features Auto Equalize every fifth charge cycle. Closing S1-9 disables the auto equalize feature; and an equalize charge request can be performed by pressing the "Equalize" pushbutton on the control front panel. When Auto Equalize is enabled (S1-9 is open), then the "Equalize" pushbutton cannot be used to request an equalize charge. The AC500 is shipped with auto equalize enabled. With auto equalize disabled, an equalize charge can be selected or de-selected for any charge cycle using the sequence below.

1. Insure that battery size matches the charger. (Number of cells and ampere-hour capacity are within charger nameplate rating.)
2. Securely engage the battery and charger connectors.
3. After a 5 second delay (all LED's will be lit), the charger will turn on. The "Charge in Progress" LED will indicate charging current.
4. Press the "Equalize" key. The "Equalize" LED will light solid. Press the key again to cancel the equalize charge.

*NOTE: The equalize charge cannot be cancelled once the battery reaches the equalize charging period. Press the STOP key to terminate the charge.*

5. The "80% Charged" LED will light when the battery on charge reaches the 80% charged voltage.
6. The battery reaches the normal termination point (pT/dV/dT or VT). However, the battery is charged another 3 hours. The "Equalize" LED will flash during this equalize period.
7. The charger will automatically turn off, and the "Charge Complete" and the "Equalize" LED will light when the equalized charge has finished. The LED's will remain on until the battery is disconnected from the charger.



**WARNING: DO NOT connect a battery to this charger if any LED is lit. Do not disconnect a battery from this charger while a charge is in progress; otherwise, arcing and burning of connector parts or a battery explosion may result. Batteries produce explosive gases. Keep sparks, flame and cigarettes away. Ventilate when charging in an enclosed area. Always shield eyes when working near batteries.**

## Manual Stop

1. To turn the charger off during any part of a charge cycle, press the STOP key. All four LEDs will flash.
2. To restart the charger, disconnect and reconnect the battery. A new charge cycle will begin.

## Battery Discrimination

The AC500 Control has the ability to reject batteries with cell sizes that do not match the cell size that the control is set up for (via DIP switch S1-1 through S1-6). If the battery connected to the charger has an average terminal voltage of greater than 2.30 volts/cell, the charger will not start and all 4 LEDs will flash, then the "Charge in Progress" LED will flash (high battery fault indication). If the battery voltage eventually falls below 2.30 volts/cell, the control will begin a normal charge sequence.

If the battery connected to the charger has an average terminal voltage of less than 1.75 volts/cell, the charger will not start and all 4 LEDs will flash, then the "80% Charged" LED will flash (low battery fault indication). If the battery voltage eventually rises above 1.75 volts/cell, the control will start a normal charge sequence. If the battery connected to the charger has a terminal voltage of less than 1.75 volts/cell and the operator wishes to start the charge regardless of this low battery voltage, the charge cycle will start if both the EQUALIZE and the STOP keys are held pushed in until all LEDs go out (approximately 5 seconds). Release the key at this time.

## Refresh Charge

In order to guarantee that a fully charged battery is always ready for use, a "Refresh" feature has been incorporated into the AC500 Control. If a battery is left connected to the charger for 72 hours after a "Charge Complete" has been reached, the AC500 will start a charge sequence. The running time of this "Refresh" charge will depend on the depth of self-discharge of the battery.

## Backup Timer Shutdown

A backup timer will shut down the charger and all 4 LEDs will flash then the "Charge Complete" LED will flash if the battery on charge does not reach the 80% voltage during the first 10 hours of charging.

Likewise, if the AC500 Control is set to terminate via the pT/dV/dT methodology (DIP switch S1-8 off) and the charger does not reach the termination point within 5 hours after reaching the 80% charged voltage, all 4 LEDs will flash then the "Charge Complete" LED will flash.

**WARNING: DO NOT connect a battery to this charger if any LED is lit. Do not disconnect a battery from this charger while a charge is in progress. Otherwise, arcing and burning of connector parts or a battery explosion may result. Batteries produce explosive gases. Keep sparks, flame, and cigarettes away. Ventilate when charging in an enclosed area. Always shield eyes when working near batteries.**

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### **Battery Disconnect Shutdown**

If the battery is disconnected from the charger during a charge cycle, the charger will be shutdown. All LEDs will be off.

### **Low Current Shutdown**

If the charger output current falls below a predetermined level, a low current shutdown will occur. All 4 LEDs will flash, then the "Equalize" LED will flash.

### **AC Power Fail**

During an AC power failure, the AC500 Control stores key information about the charge cycle. The information is retained by powering some of the control's key components with a battery derived power supply. This causes the control to resume the charge where it left off when the AC power is returned, unaffected timers and equalize requests.

# MAINTENANCE

**WARNING: ELECTRICAL SHOCK HAZARD** — Before inspecting or cleaning inside cabinet, turn **OFF** and remove fuses of disconnect switch (supplying AC power to charger), disconnect battery, and check for voltage on capacitors. Discharge through insulated screwdriver if there is any reading.

## Inspection And Cleaning

For uninterrupted, satisfactory service from this charger, it's necessary to keep unit clean, dry, and well ventilated. At least every three months, or more often as necessary, wipe and blow out all dirt from unit's interior components, with clean, dry air of not over 25 psi (172 kPa) pressure. Use a hand bellows if compressed air isn't available.

Check and tighten all electrical connections as necessary to eliminate unnecessary losses and to avoid subsequent trouble from overheating or open circuits. Check for broken wiring or damaged insulation on wiring.

**WARNING: ELECTRICAL SHOCK HAZARD** — Failure to keep internal parts clean and dry may allow transformer (s) to short out, causing secondary circuits to carry dangerously high voltage.

Be sure to replace all charger cabinet panels after any servicing, to assure proper flow of cooling air through unit and to protect internal components.

**WARNING: ELECTRICAL SHOCK HAZARD** — All cabinet panels must be replaced to protect personnel from contact with hazardous voltages.

## Lubrication

None required.

## Charging Rate Adjustment

Although it is normally not required, the charging rate can be adjusted to accommodate unusually high or low AC power line voltages, unusually high or low ambient temperatures, or aged battery.

A rate adjustment is necessary if battery consumes more water than normal or if its specific gravity after a normal (daily) charge is not within 10 points of its gravity after a weekend (equalizing) charge.

**CAUTION: Before adjusting charging rate, make sure that bad connections or damage to charger isn't affecting charging process. Also make sure proper charging procedure has been followed (thoroughly read Operation chapter of this manual).**

**WARNING: ELECTRICAL SHOCK HAZARD** — Before adjusting charging rate, turn **OFF** and remove fuses of disconnect switch (supplying AC power to charger), disconnect battery, and check for voltage on capacitors. Discharge through insulated screwdriver if there is any reading.

	Yellow Jumper	Orange Lead	Charger Output
	8 to 9	to 12	Maximum Output ↑ Higher Output ↓ Lower Output Minimum Output
	8 to 10	to 12	
	8 to 9	to 11	
	8 to 10	to 11	
	8 to 9	to 10	
	8 to 9	to 8	
	8 to 10	to 9	
	8 to 11	to 10	
	8 to 11	to 9	
	8 to 12	to 10	
8 to 12	to 9		

Table 6-1 Charging Rate Adjustment Table

1. Locate charging rate adjustment label inside charger cabinet (same as Table 6-1). The factory set charging rate is indicated on this label by circles around terminal numbers to which YELLOW jumper and ORANGE lead were connected.
2. Locate YELLOW jumper and ORANGE lead on each transformer terminal block present in your unit (one transformer for single-phase, two for three-phase).
3. Mark present location of YELLOW jumper and ORANGE lead on charger rate adjustment label and on Table 6-1 if different from that marked by factory.
4. Reconnect YELLOW jumper and ORANGE lead to the terminals giving the desired change of charging rate, as shown in Table 6-1.

**CAUTION: Do not change connections more than one step before observing effect on charging rate. On fully charged battery (approx. 1.270 to 1.290 specific gravity), rate should not exceed 26% of "MAX AMPS" on charger nameplate. On fully discharged battery (approx. 1.140 specific gravity), rate should not exceed 110% of "MAX AMPS".**

**On three-phase chargers, both transformer terminal blocks must be identically connected.**

### Fuse Replacement

The silicon diodes in this charger are protected by a "fast-clearing" type fuse.

**CAUTION: The use of any other type fuse besides the "fast-clearing" type may cause damage to silicon diodes.**

### Silicon Diode Testing

**WARNING: ELECTRICAL SHOCK HAZARD — Before checking electrical components, turn OFF and remove fuses of disconnect switch (supplying AC power to charger), disconnect battery, and check for voltage on capacitors. Discharge through insulated screwdriver if there is any reading.**

1. Disconnect one diode lead to isolate diode from electrical circuitry.
2. Use a good quality ohmmeter (preferably one having a mid-scale value of approximately 50 ohms) to measure resistance values.
3. Zero ohmmeter on R x 1 scale.
4. Record indicated resistance while placing either ohmmeter lead on threaded end of diode and other ohmmeter lead on diode lead.

5. Reverse ohmmeter leads on diode and record indicated resistance.
6. Consider diode good if one resistance reading is infinitely (or very) high and the other is extremely low.

*NOTE: An acceptable low resistance value or range of values can't be given because of different readings from different ohmmeters, and differences in diodes of the same rating.*

### **Capacitor Testing**

1. Heed WARNING in Silicon Diode Testing section.
2. Disconnect capacitor and connect leads of ohmmeter (set to highest scale) to capacitor terminals.

3. If capacitor is good, pointer will deflect, indicating capacitor is being charged, followed by a deflection in the opposite direction indicating partial discharge.

If there is no deflection, capacitor is "open" and must be replaced. Also, if meter needle moves and stops at one value, replace capacitor.

Replacement capacitors must be ordered from factory. When ordering, supply serial number of charger and microfarad (MFD) or ( $\mu$ F) value printed on capacitor.

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## Troubleshooting

**DANGER: ELECTRICAL SHOCK HAZARD** — Before checking electrical components, turn OFF and remove fuses of disconnect switch (supplying AC power to charger), disconnect battery, and check for voltage on capacitors. Discharge through insulated screwdriver if there is any reading.

**CAUTION: HIGH VOLTAGE FROM TEST EQUIPMENT** can damage silicon diodes and other parts. Short silicon diodes with extremely short leads, or disconnect, before applying voltage from a "megger" or other high voltage test equipment.

The following chart contains information which can be used to diagnose and correct unsatisfactory operation or failure of various components of the unit. Each malfunction is followed by a suggested checking or inspection procedure. Refer to Connection/Schematic Diagram in the Diagrams chapter included in this manual.

### Troubleshooting Guide

#### **No charging current (Ammeter reads zero)**

Check line voltage.

*Close fused disconnect switch or repair open circuit.*

Check for proper line voltage.

*Refer to Line Voltage Changeover instructions in Installation chapter.*

Check for blown fuses.

*Replace blown fuses. See Table 4-1 for proper fuse sizes.*

Check for internal short circuit (diode, winding, wiring).

*Repair short circuit, or replace faulty component.*

Check for "open" battery circuit.

*Clean and tighten connections, especially battery cable connections.*

Check Charge Control.

*Connect a jumper from the red-white lead of Control Transformer T1 to the red lead of Contactor K1 coil. If charger starts and ammeter shows charging current when a battery is connected, check further for faulty printed circuit card on control and replace as necessary.*

Check output circuit fuses. If fuse has blown, check for problem causing fuse to blow.

a. *Reverse battery connections, if polarity is wrong.*

b. *Determine whether a diode is shorted. Refer to Silicon Diode Testing.*

**Low charging current at beginning of cycle (battery fully discharged)**

Check for failed capacitor (s) (one or more).

*Replace capacitor if can is ruptured or fails test. Refer to Capacitor Testing.*

Check charging rate for "too low" adjustment.

*Refer to Charging Rate Adjustment in Maintenance chapter.*

Check line voltage for connection to proper input voltage.

*Refer to Line Voltage Changeover instructions in Installation chapter.*

Check battery for one or more defective cells.

**Less than rated output on fully discharged battery (approximately 1/2 rated output)**

Check input fuses (one probably blown). Check for either a shorted transformer, or wiring short circuit.

*Replace as necessary.*

**High charging current at beginning of cycle (battery overcharged)**

Check charging current for "too high" adjustment.

*Refer to Charging Rate Adjustment.*

**Charger does not shut OFF automatically or start automatically**

Check Charge Control.

1. If charger does not start automatically, check for 24 volts AC between the red-white lead and the red-black lead of control transformer T1. If 24V AC is present, connect a jumper from the red-white lead of control transformer T1 to the red lead of contactor K1 coil. If charger starts, check further for faulty printed circuit card on control and replace as necessary.
2. If charger does not stop automatically, check to be sure charging voltage rises above 2.37 volts/cell during the cycle. If not, see low charging current or less than rated output above. If battery on-charge voltage rises above 2.37 volts/cell during the cycle, check for defective control printed circuit card.

	HIGH BATT	LOW BATT	LOW CURR	9 HOUR BACKUP TIMER	5 HOUR BACKUP TIMER	MANUAL STOP
<b>80% LED</b>					solid	
<b>CHARGER COMPLETE LED</b>	flash		solid			
<b>ABNORMAL SHUTDOWN LED</b>	flash	flash	flash	flash	flash	solid
<b>EQUALIZE LED</b>	flash	flash				

**Table 7-1 AC500 Control LEDs**

**Flashing Green “Charge Complete” LED**  
**Flashing Red “Abnormal Shutdown” LED**  
**Flashing Yellow “Equalize” LED**

**High Battery Voltage Indication**

Cause #1: Battery number of cells is greater than rated charger number of cells.

*Action: Disconnect the battery from the charger and connect to a charger with the same number of cells as the battery.*

Cause #2: Battery was just removed from a charger and has an open circuit terminal voltage greater than the high voltage discrimination setting (2.40 volts/cell).

*Action: Confirm that the battery matches the rating of the charger and that none of the battery cells are defective. The charge cycle will begin automatically when the battery voltage falls below 2.40 volts/cell.*

Cause #3: DIP switch S1 settings on the AC500 Control are incorrect.

*Action: Set the DIP switch S1 according to the Setup chapter in this manual.*

**Solid Red “Abnormal Shutdown” LED**

**Manual Stop Shutdown Indication**

Cause #1: Charge cycle deliberately terminated by pressing STOP button.

**CAUTION: BATTERY IS NOT FULLY RECHARGED.**

*Action: Disconnect battery from charger. Reconnect battery to charger to begin new charge cycle.*

Cause #2: Reason for abnormal shutdown is unknown.

*Action: Check specific gravities to determine need for additional charge. Disconnect and reconnect battery to charger to begin new charge cycle.*

**Solid Yellow “80% Charged” LED**  
**Flashing Red “Abnormal Shutdown” LED**

**5 Hour Backup Timer Shutdown Indication**

Cause: Battery did not reach the dV/dT charge termination within 5 hours after the 80% trip point was reached. Check for one of the following:

1. Abnormally high battery counter EMF
  - a. Sulfation on plates
  - b. Loose/corrected inter-cell connectors
  - c. Battery # of cells not matched to charger
2. Incorrect cell switch setting on the control

**Flashing Red “Abnormal Shutdown” LED**  
**Flashing Yellow “Equalize” LED**

**Low Battery Voltage Indication**

Cause #1: Battery number of cells is less than rated charger number of cells.

*Action: Disconnect the battery from the charger and connect to a charger with the same number of cells as the battery.*



Cause #2: Battery is over-discharged and has an open circuit terminal voltage less than the low voltage discrimination setting (1.85 volts/cell).

*Action: Confirm that the battery matches the rating of the charger and that none of the battery cells are defective. If it is desired to start the charge cycle on this low voltage battery, then press both buttons for about 5 seconds. The control will ignore the low battery indication and start the charge cycle.*

Cause #3: DIP switch S1 settings on the AC500 Control are incorrect.

*Action: Set the DIP switch S1 according to the Setup chapter in this manual.*

**Solid Green “Charge Complete” LED**  
**Flashing Red “Abnormal Shutdown” LED**

**Low Current Shutdown Indication**

Cause: Low charger output current possibly caused by one of the following:

1. Battery # cells greater than charger cell rating
2. Battery amp-hour rating much less than charger amp-hour rating
3. High resistance in charge circuit
  - a. Cable
  - b. Connector
  - c. Intercell connectors
  - d. Internal cell open
4. Sulfated battery
5. Low acid level
6. Rate incorrectly set
7. Blown input fuses
8. Incorrect line voltage/connections
9. Open rectifier diode
10. Defective power transformer
11. Blown output fuse
12. Wiring between control and the charger

**Solid Yellow “80% Charged” LED**  
**Solid Green “Charge Complete” LED**  
**Solid Red “Abnormal Shutdown” LED**  
**Solid Yellow “Equalize” LED**

*NOTE: All four LEDs will be lit solid for about 5 seconds anytime a battery is connected to the control. However, if the LEDs remain lit (probably dimmer than normal), and the charger does not turn on after the 5 second delay, there is a problem.*

**Improper AC Voltage Input To Control Indication**

Cause #1: AC input to charger is incorrect.

*Action: Refer to charger owner's manual.*

Cause #2: Connections to and/or from the control transformer are incorrect.

*Action: Refer to charger owner's manual.*

**Flashing Red "Abnormal Shutdown" LED**

**9 Hour Backup Timer Shutdown Indication**

Cause: Battery did not reach the 80% voltage point within 9 hours. Check for one of the following:

1. One or more low voltage cells
2. Low charger output
  - a. Incorrect line voltage/connection
  - b. Blown input fuse
  - c. Charge rate set too low
  - d. Defective power transformer
  - e. Battery has incorrect number of cells for charger/control
  - f. High impedance in cable or connector
  - g. Open rectifier diode

# PARTS LIST

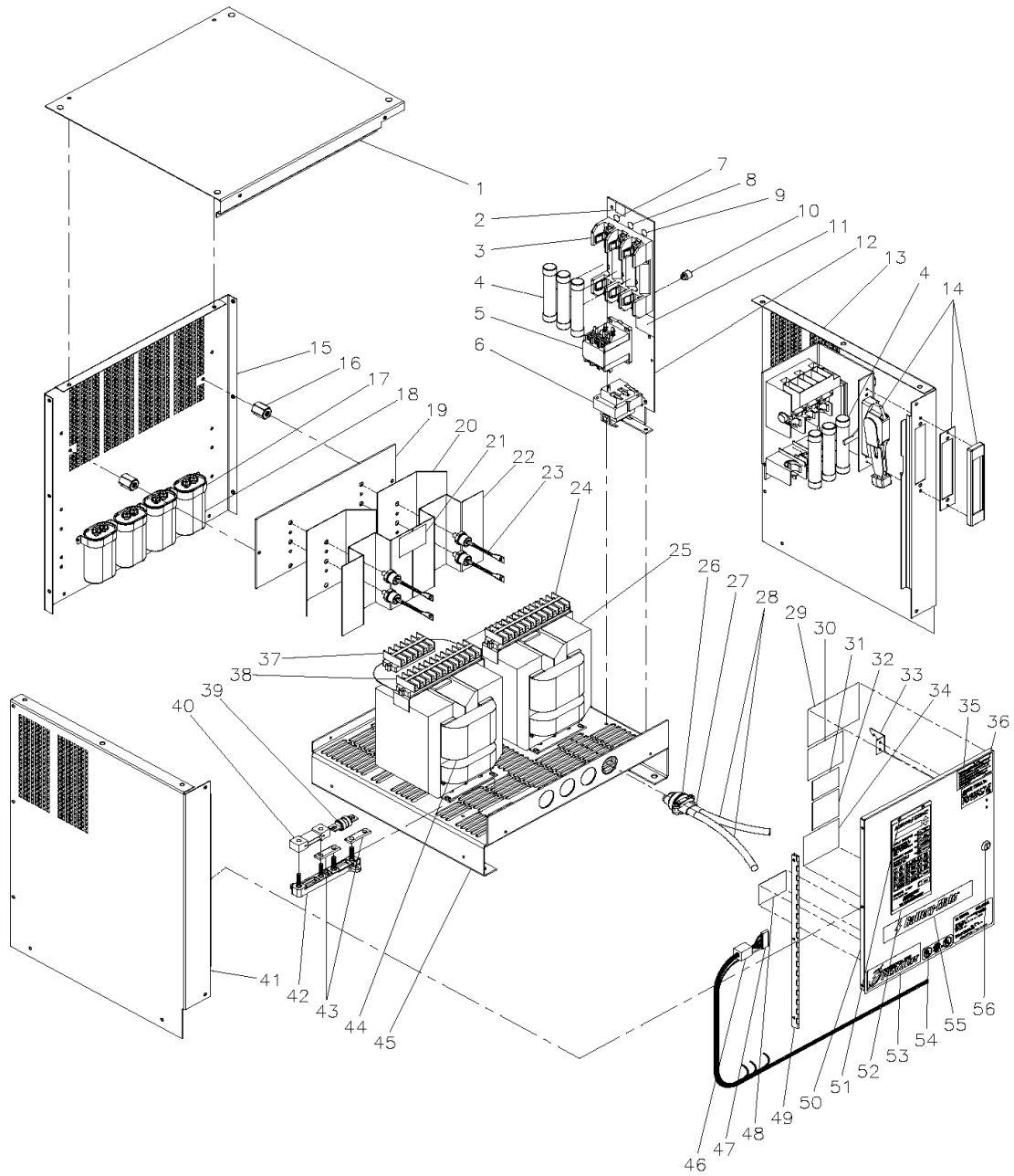


Figure 8-1

ITEM #	PART #	DESCRIPTION
1	194457	Panel, Top
2	405548	Label, Frame Ground
3	See Table	Block, Fuse, Input
4	See Table	Fuse, Input (3 Req'd.)
5	406243-1	Contact, Line
6	See Table	Transformer, Control
7	400092	Label, L1
8	400096	Label, L2
9	400097	Label, L3
10	194827-1	Grommet, Mounting
11	406593	Label, Supply Connections
12	194447	Panel, Interior
13	194565	Panel, Side, Right (w/o Disc. Sw.)
	194456	Panel, Side, Right (w/Disc. Sw.)
14	Call Factory	Switch, Disconnect
15	194454	Panel, Rear
16	404033	Insulator, Heat Sink
17	TRY174-3	Bracket, Mtg., Capacitor
18	See Table	Capacitor, Transformer
19	191191	Heat Sink, Flat
20	191192	Heat Sink, Fin, 45
21	406518	Label, Warning, Heat Sink
22	191193	Heat Sink, Fin, 90
23	See Table	Diode, Silicon (4 Req'd.)
24	Call Factory	Block, Terminal, Transformer, T3
25	See Table	Transformer, T3
26	W10080-5	Connector, Strain Relief
27	378234-13	Cover, Neoprene
28	See Table	Cable, Output Charging
29	See Table	Label, AC Input
30	194335	Label, Danger, Input Volt. & Fuse
31	191892	Label, Warning, Rain Exposure
32	406434	Label, Warning, Sparks
33	194379	Latch, Door, Disconnect (When Used)
34	402717	Label, Charging Rate
35	404099	Label, Danger
36	407250	Label, Disconnect Switch (When Used)
37	191455	Block, Terminal, Transformer, T2
38	191456	Block, Terminal, Transformer, T2
39	See Table	Fuse, Output
40	See Table	Shunt, Current
41	194455	Panel, Side, Left
42	193114	Insulator, Shunt / Fuse
43	392458	Bus Bar (2 Req'd.)
44	See Table	Transformer, T2
45	194453	Base, Charger
46	192266-1	Suppressor, Harness
47	196096	Harness, Interior Panel
48	405026	Label, Fuse, DC Output
49	194377	Hinge, Door
50	194458	Door, Hinged
51	193101-1	Rivet, Snap (2 Req'd.)
52	Call Factory	Control, Charger
53	196036	Label, Prestolite Power
54	404079	Label, UL and CUL
55	196664	Label, Charger, Battery-Mate 80
56	194530	Latch, Door

193111-080  
PARTS LIST - 3 PHASE

**3 PHASE**  
**208/240/480 VOLT UNITS**

MODEL NUMBER	SPEC	INPUT FUSE			OUTPUT FUSE	CURRENT SHUNT	INPUT FUSE BLOCK	T2 TRANS	T3 TRANS	DIODE (4 Red)	CAPS /TRANS	AC INPUT LABEL	CONTROL TRANS	OUTPUT CABLE
		208	240	480										
600H3-6C	500367C-200	W10386-5	W10386-5	W10386-5	Y1890-4	193125-2	404605-4	193688	193689	193143-1	TRY154-4	406461	406247-2	396143-60
510H3-12C	500170C-200	W10386-5	W10386-5	W10386-5	Y1890-4	193125-2	404605-4	192523	192524	193143-1	TRY154-4	406461	406247-2	396143-60
600H3-12C	500207C-200	W10386-5	W10386-5	W10386-5	Y1890-4	193125-2	404605-4	192556	192557	193143-1	TRY154-4	406461	406247-2	396143-60
750H3-12C	500171C-200	W10386-6	W10386-6	W10386-6	Y1890-4	193125-2	404605-4	192532	192533	193143-1	TRY154-4	406461	406247-2	396143-60
860H3-12C	500175C-200	W10386-6	W10386-6	W10386-6	Y1890-5	193125-2	404605-4	193958	193959	402832-3	TRY154-4	406461	406247-2	396143-61
965H3-12C	500368C-200	W10386-7	W10386-6	W10386-5	Y1890-6	193125-2	404605-4	193783	193784	402832-3	TRY154-4	406461	406247-2	396143-61
1050H3-12C	500172C-200	W10386-7	W10386-6	W10386-5	Y1890-6	193125-3	404605-4	192542	192543	402832-3	TRY154-4	406461	406247-2	396143-61
1260H3-12C	500487C-200	W10386-8	W10386-7	W10386-5	Y1890-7	193125-3	404605-4	194818	194819	402832-3	TRY154-4	406461	406247-2	396143-62
510H3-18C	500178C-200	W10386-8	W10386-5	W10386-5	Y1890-4	193125-2	404605-4	192564	192565	193143-1	TRY154-4	406461	406247-2	396143-60
600H3-18C	500208C-200	W10386-6	W10386-6	W10386-6	Y1890-4	193125-2	404605-4	192927	192928	193143-1	TRY154-4	406461	406247-2	396143-60
750H3-18C	500186C-200	W10386-7	W10386-6	W10386-5	Y1890-4	193125-2	404605-4	192747	192748	193143-1	TRY154-4	406461	406247-2	396143-60
860H3-18C	500187C-200	W10386-8	W10386-7	W10386-5	Y1890-5	193125-2	404605-4	192761	192762	402832-3	TRY154-6	406461	406247-2	396143-61
965H3-18C	500366C-200	W10386-8	W10386-8	W10386-8	Y1890-6	193125-2	404605-4	193895	193896	402832-3	TRY154-6	406461	406247-2	396143-61
1050H3-18C	500189C-200	W10386-9	W10386-8	W10386-5	Y1890-6	193125-3	404605-5	192828	192829	402832-3	TRY154-6	406461	406247-2	396143-61
1260H3-18C	500189C-200	W10386-10	W10386-9	W10386-6	Y1890-7	193125-3	404605-5	192774	192775	402832-3	TRY154-3	406461	406247-2	396143-62
1400H3-18C	500764C-200	W10386-9	W10386-9	W10386-9	Y1890-8	193125-3	404605-5	196925	196926	402832-3	TRY154-3	406461	406247-2	396143-62
360H3-24C	500654C-200	W10386-6	W10386-6	W10386-5	Y1890-3	193125-1	404605-4	196068	196069	193143-1	TRY154-2	406461	406247-2	396143-72
500H3-24C	500370C-200	W10386-7	W10386-7	W10386-5	Y1890-4	193125-2	404605-4	193927	193928	193143-1	TRY154-1	406461	406247-2	396143-60
750H3-24C	500190C-200	W10386-8	W10386-8	W10386-8	Y1890-4	193125-2	404605-4	192788	192789	193143-1	TRY154-6	406461	406247-2	396143-60
860H3-24C	500191C-200	W10386-9	W10386-9	W10386-5	Y1890-5	193125-2	404605-4	192757	192758	402832-3	TRY154-6	406461	406247-2	396143-61
965H3-24C	500369C-200	W10386-10	W10386-9	W10386-6	Y1890-6	193125-2	404605-5	193793	193794	402832-3	TRY154-6	406461	406247-2	396143-61
1050H3-24C	500192C-200	W10386-11	W10386-10	W10386-6	Y1890-6	193125-3	404605-5	192794	192795	402832-3	TRY154-6	406461	406247-2	396143-61
1260H3-24C	500765C-200	W10386-13	W10386-12	W10386-9	Y1890-7	193125-3	404605-5	196892	196893	402832-3	TRY154-6	406461	406247-2	396143-62

**3 PHASE**  
**480/575 VOLT UNITS**

MODEL NUMBER	SPEC	INPUT FUSE		OUTPUT FUSE	CURRENT SHUNT	INPUT FUSE BLOCK	T2 TRANS	T3 TRANS	DIODE (4 Req'd)	CAPS /TRANS	AC INPUT LABEL	CONTROL TRANS	OUTPUT CABLE
		480	575										
500H3-6C	500367C	W10386-5	W10386-5	Y1890-4	193125-2	404605-4	193741	193742	193143-1	TRY-154-4	406461	406247-2	396143-60
510H3-12C	500170C	W10386-5	W10386-5	Y1890-4	193125-2	404605-4	192527	192528	193143-1	TRY-154-4	406461	406247-2	396143-60
600H3-12C	500207C	W10386-5	W10386-5	Y1890-4	193125-2	404605-4	192962	192964	193143-1	TRY-154-4	406461	406247-2	396143-60
750H3-12C	500171C	W10386-5	W10386-5	Y1890-4	193125-2	404605-4	192536	192537	193143-1	TRY-154-4	406461	406247-2	396143-60
880H3-12C	500175C	W10386-5	W10386-5	Y1890-5	193125-2	404605-4	193960	193961	402832-3	TRY-154-4	406461	406247-2	396143-61
										TRY-154-1			
965H3-12C	500368C	W10386-5	W10386-5	Y1890-6	193125-2	404605-4	193840	193841	402832-3	TRY-154-4	406461	406247-2	396143-61
										TRY-154-1			
1050H3-12C	500172C	W10386-5	W10386-5	Y1890-6	193125-3	404605-4	192546	192547	402832-3	TRY-154-4	406461	406247-2	396143-61
										TRY-154-1			
1260H3-12C	500487C	W10386-5	W10386-5	Y1890-7	193125-3	404605-4	194822	194823	402832-3	TRY-154-4	406461	406247-2	396143-62
										TRY-154-1			
510H3-18C	500178C	W10386-5	W10386-5	Y1890-4	193125-2	404605-4	192588	192589	193143-1	TRY-154-4	406461	406247-2	396143-60
500H3-18C	500208C	W10386-5	W10386-5	Y1890-4	193125-2	404605-4	192966	192968	193143-1	TRY-154-4	406461	406247-2	396143-60
										TRY-154-2			
750H3-18C	500186C	W10386-5	W10386-5	Y1890-4	193125-2	404605-4	192752	192753	193143-1	TRY-154-4	406461	406247-2	396143-60
										TRY-154-2			
880H3-18C	500187C	W10386-5	W10386-5	Y1890-5	193125-2	404605-4	192816	192817	402832-3	TRY-154-6	406461	406247-2	396143-61
965H3-18C	500366C	W10386-5	W10386-5	Y1890-6	193125-2	404605-4	193745	193746	402832-3	TRY-154-6	406461	406247-2	396143-61
1050H3-18C	500188C	W10386-5	W10386-5	Y1890-6	193125-3	404605-4	192832	192833	402832-3	TRY-154-6	406461	406247-2	396143-61
										TRY-154-1			
1260H3-18C	500189C	W10386-6	W10386-5	Y1890-7	193125-3	404605-4	192838	192840	402832-3	TRY-154-4	406461	406247-2	396143-62
										TRY-154-3			
380H3-24C	500654C	W10386-5	W10386-5	Y1890-3	193125-1	404605-4	196072	196073	193143-1	TRY-154-2	406461	406247-2	396143-72
										TRY-154-1			
600H3-24C	500370C	W10386-5	W10386-5	Y1890-4	193125-2	404605-4	193860	193861	193143-1	TRY-154-6	406461	406247-2	396143-60
750H3-24C	500190C	W10386-5	W10386-5	Y1890-4	193125-2	404605-4	192842	192844	193143-1	TRY-154-6	406461	406247-2	396143-60
880H3-24C	500191C	W10386-5	W10386-5	Y1890-5	193125-2	404605-4	192846	192848	402832-3	TRY-154-6	406461	406247-2	396143-61
										TRY-154-1			
965H3-24C	500369C	W10386-6	W10386-5	Y1890-6	193125-2	404605-4	193879	193880	402832-3	TRY-154-6	406461	406247-2	396143-61
1050H3-24C	500192C	W10386-6	W10386-6	Y1890-6	193125-3	404605-4	192850	192852	402832-3	TRY-154-6	406461	406247-2	396143-61
										TRY-154-1			

# DIAGRAMS

**3 PHASE**  
**208/240/480 VOLT UNITS**

<u>MODEL NO.</u>	<u>SPEC NO.</u>	<u>DIAGRAM</u>	<u>OUTLINE</u>
600H3-6C	500367C-200	192120	194449
510H3-12C	500170C-200	192120	194449
600H3-12C	500207C-200	192120	194449
750H3-12C	500171C-200	192120	194449
880H3-12C	500175C-200	192120	194449
965H3-12C	500368C-200	192120	194449
1050H3-12C	500172C-200	192120	194449
1260H3-12C	500487C-200	192120	194449
510H3-18C	500178C-200	192120	194449
600H3-18C	500208C-200	192120	194449
750H3-18C	500186C-200	192120	194449
880H3-18C	500187C-200	192120	194449
965H3-18C	500366C-200	192120	194449
1050H3-18C	500188C-200	192120	194449
1260H3-18C	500189C-200	192120	194449
1400H3-18C	500764C-200	192120	194449
380H3-24C	500654C-200	192120	194449
600H3-24C	500370C-200	192120	194449
750H3-24C	500190C-200	192120	194449
880H3-24C	500191C-200	192120	194449
965H3-24C	500369C-200	192120	194449
1050H3-24C	500192C-200	192120	194449
1260H3-24C	500765C-200	192120	194449

**3 PHASE**

**480/575 VOLT UNITS**

<b>MODEL NO.</b>	<b>SPEC NO.</b>	<b>DIAGRAM</b>	<b>OUTLINE</b>
600H3-6C	500367C-201	192954	194449
510H3-12C	500170C-201	192954	194449
600H3-12C	500207C-201	192954	194449
750H3-12C	500171C-201	192954	194449
880H3-12C	500175C-201	192954	194449
965H3-12C	500368C-201	192954	194449
1050H3-12C	500172C-201	192954	194449
1260H3-12C	500487C-201	192954	194449
510H3-18C	500178C-201	192954	194449
600H3-18C	500208C-201	192954	194449
750H3-18C	500186C-201	192954	194449
880H3-18C	500187C-201	192954	194449
965H3-18C	500366C-201	192954	194449
1050H3-18C	500188C-201	192954	194449
1260H3-18C	500189C-201	192954	194449
380H3-24C	500654C-201	192954	194449
600H3-24C	500370C-201	192954	194449
750H3-24C	500190C-201	192954	194449
880H3-24C	500191C-201	192954	194449
965H3-24C	500369C-201	192954	194449
1050H3-24C	500192C-201	192954	194449









193111-080  
PARTS LIST - 1 PHASE

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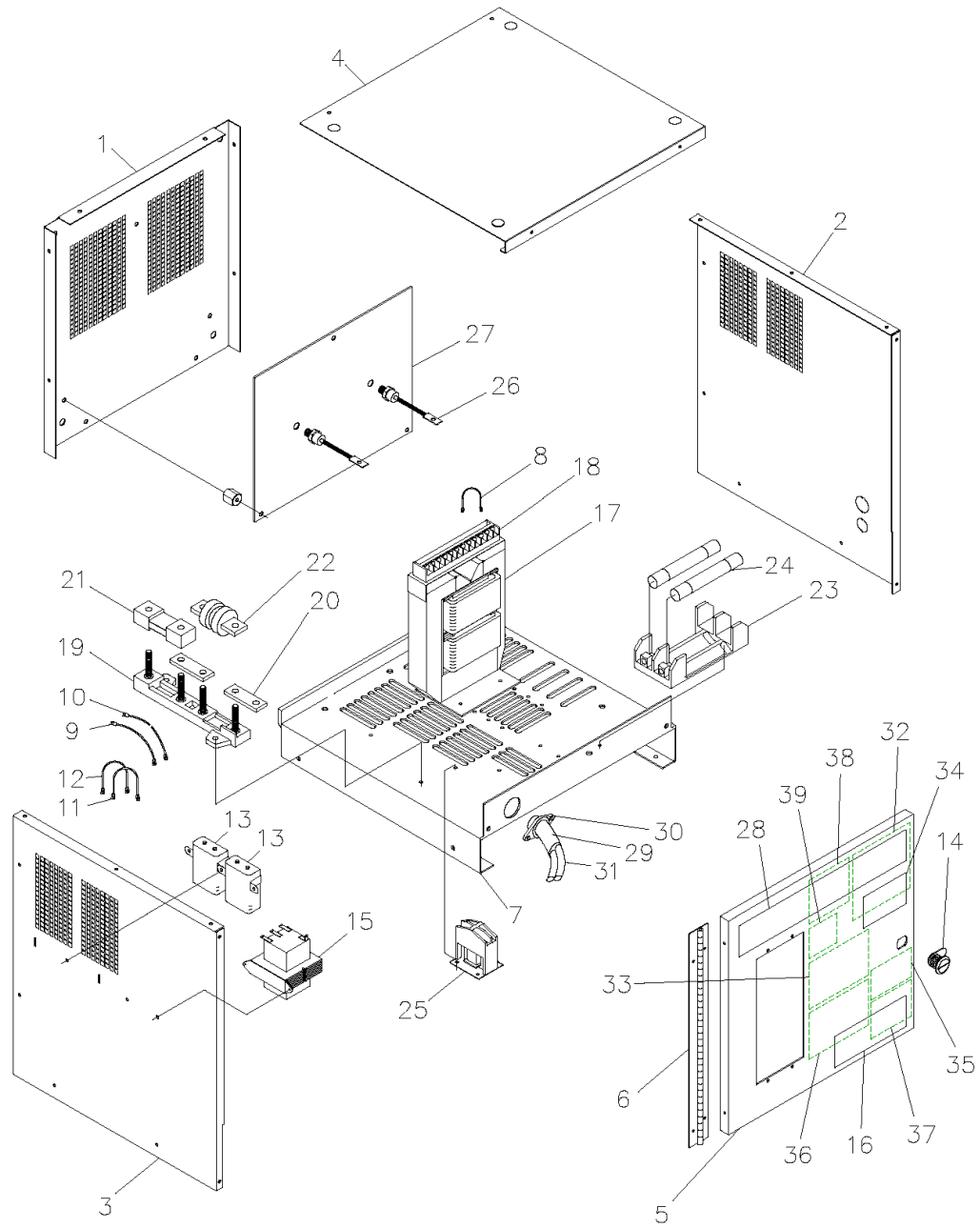


Figure 8-2 1 Phase

**193111-080**  
**PARTS LIST - 1 PHASE**

<u>ITEM NO.</u>	<u>PART NO.</u>	<u>DESCRIPTION</u>
1	197157	Panel, Rear
2	197159	Panel, Side, Right
3	197158	Panel, Side, Left
4	197163	Top
5	197164	Door
6	197165	Hinge
7	197324	Base
8	357205-357	Lead, Yellow (1 Req'd)
9	357205-127	Lead, Orange (1 Req'd)
10	357205-128	Lead, White (1 Req'd)
11	357205-060	Jumper, Orange (2 Req'd)
12	357205-061	Jumper, White (2 Req'd)
13	See Table	Capacitor, Transformer
14	194530	Latch, Door
15	See Table	Transformer, Control
16	196036	Label, Prestolite
17	See Table	Transformer, Power
18	Contact Factory	Terminal Block
19	193114	Insulator, Fuse & Shunt
20	392458	Bus Bar
21	See Table	Shunt, Meter
22	See Table	Fuse, Output
23	See Table	Block, Input Fuse
24	See Table	Fuse, Input
25	See Table	Contact, AC Input
26	402832-003	Diode, Silicon (2 Req'd)
27	197024	Heat Sink
28	196664	Label, Identification
29	378234-013	Cover, Outer Neoprene
30	W10085-005	Connector, Strain Relief
31	See Table	Cable, DC Output
32	See Table	Label, AC Input
33	194335	Label, Danger, AC Volts & Fuse
34	404099	Label, Danger
35	191892	Label, Rain Exposure
36	402717	Label, Charging Rate
37	406434	Label, Input Warning
38	195531	Label, DC Output Fuse
39	406593	Label, AC Input Fuse
40	197290	Harness, Wire (For Modular Control)

193111-080  
PARTS LIST - 1 PHASE

1 PHASE  
208/240/480 VOLT UNITS

MODEL NUMBER	SPEC	INPUT FUSE			OUTPUT FUSE	METER SHUNT	INPUT FUSE BLOCK	T2 TRANS	CONTACTOR	CAPS /TRANS	RECTIFIER ASSEMBLY	AC INPUT LABEL	CONTROL TRANS	OUTPUT CABLE
		208	240	480										
380MM1-6C	500374C-200	W-10386-5	W-10386-5	W-10386-5	Y-1890-3	193125-1	406207-1	193697	406240-1	TRY-154-4	194701	406461	406247-2	396143-72
450MM1-6C	500378C-200	W-10386-5	W-10386-5	W-10386-5	Y-1890-3	193125-1	406207-1	193779	406240-1	TRY-154-4	194702	406461	406247-2	396143-72
510MM1-6C	500193C-200	W-10386-5	W-10386-5	W-10386-5	Y-1890-4	193125-2	406207-1	192884	406240-1	TRY-154-4	194702	406461	406247-2	396143-60
600MM1-6C	500194C-200	W-10386-5	W-10386-5	W-10386-5	Y-1890-4	193125-2	406207-1	192895	406240-1	TRY-154-4	194707	406461	406247-2	396143-60
250MM1-12C	500371C-200	W-10386-5	W-10386-5	W-10386-5	Y-1890-1	193125-1	406207-1	193693	406240-1	TRY-154-4	194700	406461	406247-2	396143-72
380MM1-12C	500372C-200	W-10386-5	W-10386-5	W-10386-5	Y-1890-3	193125-1	406207-1	193690	406240-1	TRY-154-4	194701	406461	406247-2	396143-72
450MM1-12C	500375C-200	W-10386-5	W-10386-5	W-10386-5	Y-1890-3	193125-1	406207-1	193698	406240-1	TRY-154-4	194702	406461	406247-2	396143-72
510MM1-12C	500195C-200	W-10386-5	W-10386-5	W-10386-5	Y-1890-4	193125-2	406207-1	192888	406240-1	TRY-154-6	194702	406461	406247-2	396143-60
600MM1-12C	500196C-200	W-10386-7	W-10386-7	W-10386-5	Y-1890-4	193125-2	406207-1	192888	406240-1	TRY-154-6	194707	406461	406247-2	396143-60
750MM1-12C	500197C-200	W-10386-9	W-10386-9	W-10386-9	Y-1890-4	193125-2	406207-2	192953	406240-1	TRY-154-6	194703	406461	406247-2	396143-60
880MM1-12C	500198C-200	W-10386-10	W-10386-9	W-10386-9	Y-1890-5	193125-2	406207-2	192932	406241-1	TRY-154-6	194704	406461	406247-2	396143-61
965MM1-12C	500380C-200	W-10386-10	W-10386-9	W-10386-9	Y-1890-6	193125-2	406207-2	193831	406241-1	TRY-154-6 TRY-154-4	194704	406461	406247-2	396143-61
510MM1-18C	500379C-200	W-10386-3	W-10386-7	W-10386-5	Y-1890-4	193125-2	406207-1	193787	406240-1	TRY-154-6	194702	406461	406247-2	396143-60
600MM1-18C	500199C-200	W-10386-9	W-10386-9	W-10386-9	Y-1890-4	193125-2	406207-2	192923	406240-1	TRY-154-4	194707	406461	406247-2	396143-60
750MM1-18C	500200C-200	W-10386-11	W-10386-10	W-10386-9	Y-1890-4	193125-2	406207-2	192950	406241-1	TRY-154-6 TRY-154-4	194703	406461	406247-2	396143-60
450MM1-24C	500373C-200	W-10386-9	W-10386-9	W-10386-9	Y-1890-3	193125-1	406207-2	193694	406240-1	TRY-154-6	194702	406461	406247-2	396143-72
510MM1-24C	500376C-200	W-10386-10	W-10386-9	W-10386-9	Y-1890-4	193125-2	406207-2	193701	406241-1	TRY-154-6	194702	406461	406247-2	396143-60
600MM1-24C	500377C-200	W-10386-11	W-10386-10	W-10386-9	Y-1890-4	193125-2	406207-2	193704	406241-1	TRY-154-6	194707	406461	406247-2	396143-60

**1 PHASE**  
**480/575 VOLT UNITS**

MODEL NUMBER	SPEC	INPUT FUSE		OUTPUT FUSE	METER SHUNT	INPUT FUSE BLOCK	T2 TRANS	CONTACTOR	CAPS /TRANS	RECTIFIER ASSEMBLY	AC INPUT LABEL	CONTROL TRANS	OUTPUT CABLE
		480	575										
380MMI-6C	500374C-201	W-10386-5	W-10386-5	Y-1890-3	193125-1	406207-1	193800	406240-1	TRY-154-4	194701	191655	406247-4	396143-72
450MMI-6C	500378C-201	W-10386-5	W-10386-5	Y-1890-3	193125-1	406207-1	193810	406240-1	TRY-154-4	194702	191655	406247-4	396143-72
510MMI-6C	500193C-201	W-10386-5	W-10386-5	Y-1890-4	193125-2	406207-1	192910	406240-1	TRY-154-4	194702	191655	406247-4	396143-80
600MMI-6C	500194C-201	W-10386-5	W-10386-5	Y-1890-4	193125-2	406207-1	192912	406240-1	TRY-154-4	194707	191655	406247-4	396143-80
250MMI-12C	500371C-201	W-10386-5	W-10386-5	Y-1890-1	193125-1	406207-1	193771	406240-1	TRY-154-4	194700	191655	406247-4	396143-72
380MMI-12C	500372C-201	W-10386-5	W-10386-5	Y-1890-3	193125-1	406207-1	193806	406240-1	TRY-154-4	194701	191655	406247-4	396143-72
450MMI-12C	500375C-201	W-10386-5	W-10386-5	Y-1890-3	193125-1	406207-1	193844	406240-1	TRY-154-4	194702	191655	406247-4	396143-72
510MMI-12C	500195C-201	W-10386-5	W-10386-5	Y-1890-4	193125-2	406207-1	192908	406240-1	TRY-154-6	194702	191655	406247-4	396143-80
600MMI-12C	500196C-201	W-10386-5	W-10386-5	Y-1890-4	193125-2	406207-1	192914	406240-1	TRY-154-6	194707	191655	406247-4	396143-80
750MMI-12C	500197C-201	W-10386-5	W-10386-5	Y-1890-4	193125-2	406207-1	192970	406240-1	TRY-154-6	194703	191655	406247-4	396143-80
880MMI-12C	500198C-201	W-10386-6	W-10386-6	Y-1890-5	193125-2	406207-1	192972	406240-1	TRY-154-6	194704	191655	406247-4	396143-81
965MMI-12C	500380C-201	W-10386-6	W-10386-6	Y-1890-6	193125-2	406207-1	193911	406240-1	TRY-154-6 TRY-154-4	194704	191655	406247-4	396143-81
510MMI-18C	500379C-201	W-10386-5	W-10386-5	Y-1890-4	193125-2	406207-1	193874	406240-1	TRY-154-6	194702	191655	406247-4	396143-80
600MMI-18C	500199C-201	W-10386-5	W-10386-5	Y-1890-4	193125-2	406207-1	192960	406240-1	TRY-154-4	194707	191655	406247-4	396143-80
750MMI-18C	500200C-201	W-10386-6	W-10386-6	Y-1890-4	193125-2	406207-1	192974	406240-1	TRY-154-6 TRY-154-3	194703	191655	406247-4	396143-80
450MMI-24C	500373C-201	W-10386-5	W-10386-5	Y-1890-3	193125-1	406207-1	193737	406240-1	TRY-154-6	194702	191655	406247-4	396143-72
510MMI-24C	500376C-201	W-10386-6	W-10386-6	Y-1890-4	193125-2	406207-1	193822	406240-1	TRY-154-6	194702	191655	406247-4	396143-80
600MMI-24C	500377C-201	W-10386-6	W-10386-6	Y-1890-4	193125-2	406207-1	193837	406240-1	TRY-154-6	194707	191655	406247-4	396143-80

193111-080  
PARTS LIST - 1 PHASE

**1 PHASE**  
**120/208/240 VOLT UNITS**

MODEL NUMBER	SPEC	INPUT FUSE			OUTPUT FUSE	METER SHUNT	INPUT FUSE BLOCK	T2 TRANS	CONTACTOR	CAPS /TRANS	RECTIFIER ASSEMBLY	AC INPUT LABEL	CONTROL TRANS	OUTPUT CABLE
		120	208	240										
380M1-6C	500374C-204	W10386-5	W10386-5	W10386-5	Y1890-3	193125-1	405357-1	193804	406240-1	TRY154-4	193853-4	406465	406247-1	396143-72
450M1-6C	500378C-204	W10386-6	W10386-5	W10386-5	Y1890-3	193125-1	405357-1	193812	406240-1	TRY154-4	193853-4	406465	406247-1	396143-72
510M1-6C	500193C-204	W10386-6	W10386-5	W10386-5	Y1890-4	193125-2	405357-1	194495	406240-1	TRY154-4	193853-1	406465	406247-1	396143-60
250M1-12C	500371C-204	W10386-6	W10386-5	W10386-5	Y1890-1	193125-1	405357-1	193802	406240-1	TRY154-4	193853-5	406465	406247-1	396143-72
380M1-12C	500372C-204	W10386-8	W10386-6	W10386-5	Y1890-3	193125-1	405357-1	193808	406240-1	TRY154-4	193853-4	406465	406247-1	396143-72



# DIAGRAMS - 1 PHASE

## 1 PHASE 208/240/480 VOLT UNITS

MODEL NUMBER	SPEC NUMBER	DIAGRAM	OUTLINE
380M1-6C	500374C-200	197325	197203
450M1-6C	500378C-200	197325	197203
510M1-6C	500193C-200	197325	197203
600M1-6C	500194C-200	197325	197203
250M1-12C	500371C-200	197325	197203
380M1-12C	500372C-200	197325	197203
450M1-12C	500375C-200	197325	197203
510M1-12C	500195C-200	197325	197203
600M1-12C	500196C-200	197325	197203
750M1-12C	500197C-200	197325	197203
880M1-12C	500198C-200	197325	197203
965M1-12C	500380C-200	197325	197203
510M1-18C	500379C-200	197325	197203
600M1-18C	500199C-200	197325	197203
750M1-18C	500200C-200	197325	197203
450M1-24C	500373C-200	197325	197203
510M1-24C	500376C-200	197325	197203
600M1-24C	500377C-200	197325	197203

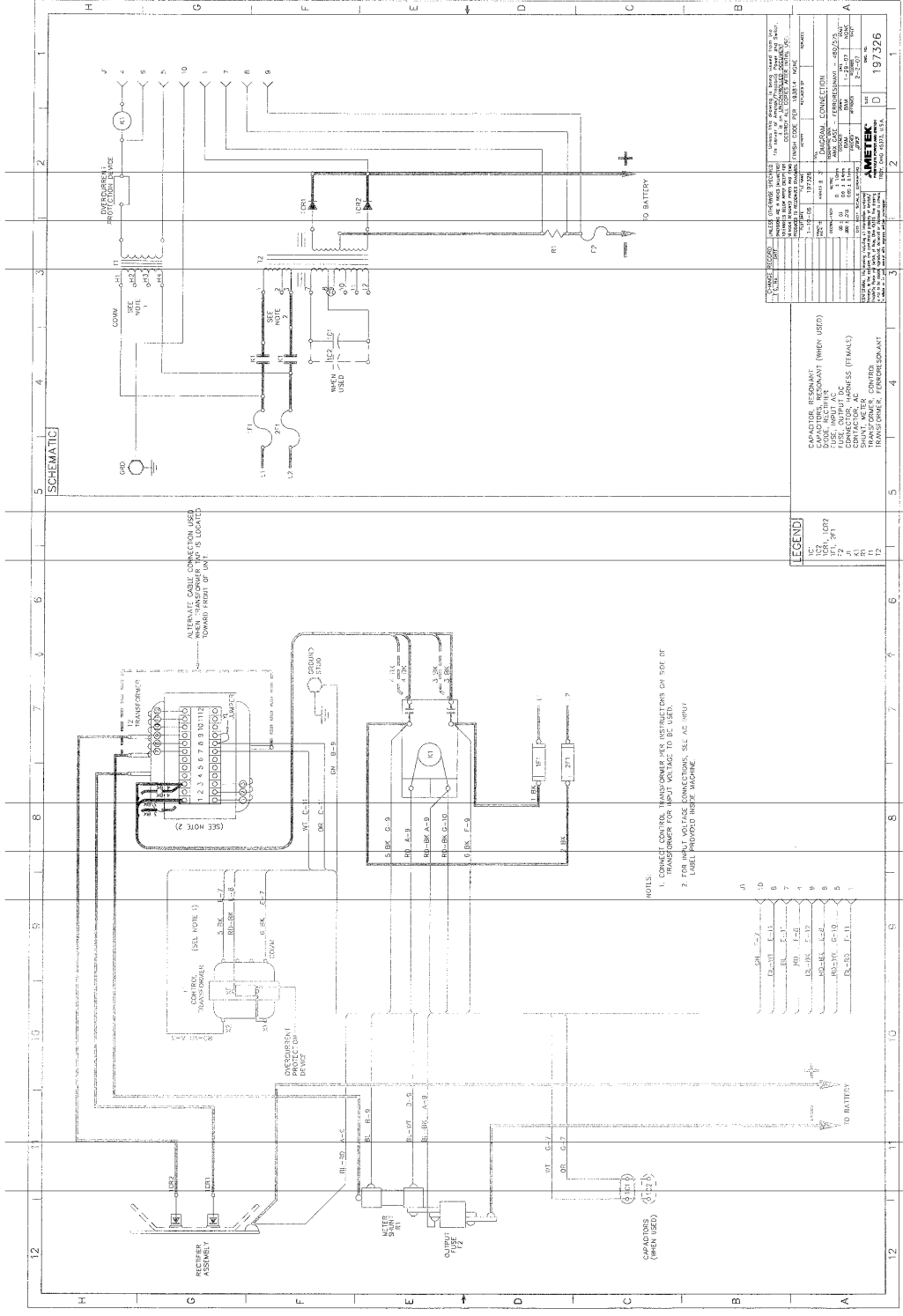
**1 PHASE**  
**480/575 VOLT UNITS**

MODEL NUMBER	SPEC NUMBER	DIAGRAM	OUTLINE
380M1-6C	500374C-201	197326	197203
450M1-6C	500378C-201	197326	197203
510M1-6C	500193C-201	197326	197203
600M1-6C	500194C-201	197326	197203
250M1-12C	500371C-201	197326	197203
380M1-12C	500372C-201	197326	197203
450M1-12C	500375C-201	197326	197203
510M1-12C	500195C-201	197326	197203
600M1-12C	500196C-201	197326	197203
750M1-12C	500197C-201	197326	197203
880M1-12C	500198C-201	197326	197203
965M1-12C	500380C-201	197326	197203
510M1-18C	500379C-201	197326	197203
600M1-18C	500199C-201	197326	197203
750M1-18C	500200C-201	197326	197203
450M1-24C	500373C-201	197326	197203
510M1-24C	500376C-201	197326	197203
600M1-24C	500377C-201	197326	197203

**1 PHASE**  
**120/208/240 VOLT UNIT**

MODEL NUMBER	SPEC NUMBER	DIAGRAM	OUTLINE
380M1-6C	500374C-204	197325	197203
450M1-6C	500378C-204	197325	197203
510M1-6C	500193C-204	197325	197203
250M1-12C	500371C-204	197325	197203
380M1-12C	500372C-204	197325	197203





SCHEMATIC

ALTERNATE CABLE CONNECTION USE  
TOWARD FRONT OF UNIT

- NOTES
1. CAPACITOR RESONANT TRANSFORMER USE SUBSTITUTION OF 500 BT TRANSFORMER FOR 500V VOLTAGE TO BE USED.
  2. FOR INPUT VOLTAGE CONNECTIONS, SEE AC INPUT LABEL PROVIDED INSIDE MACHINE.

10	11	12
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88	89	90
91	92	93
94	95	96
97	98	99
100	101	102

LEGEND

- 100 CAPACITOR RESONANT
- 101 CAPACITOR RESONANT
- 102 CAPACITOR RESONANT
- 103 CAPACITOR RESONANT
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- 110 CAPACITOR RESONANT
- 111 CAPACITOR RESONANT
- 112 CAPACITOR RESONANT

CHANGE RECORD		UNLESS OTHERWISE SPECIFIED	THIS DRAWING IS TO BE USED FOR THE
REV.	DATE	BY	DESCRIPTION
1	1-14-55	197326	ISSUED FOR PRODUCTION
2	1-14-55	197326	ISSUED FOR PRODUCTION
3	1-14-55	197326	ISSUED FOR PRODUCTION
4	1-14-55	197326	ISSUED FOR PRODUCTION
5	1-14-55	197326	ISSUED FOR PRODUCTION
6	1-14-55	197326	ISSUED FOR PRODUCTION
7	1-14-55	197326	ISSUED FOR PRODUCTION
8	1-14-55	197326	ISSUED FOR PRODUCTION
9	1-14-55	197326	ISSUED FOR PRODUCTION
10	1-14-55	197326	ISSUED FOR PRODUCTION
11	1-14-55	197326	ISSUED FOR PRODUCTION
12	1-14-55	197326	ISSUED FOR PRODUCTION

AMETEK  
197326  
D





# WARRANTY

## AMETEK/PRESTOLITE POWER "FERRORESONANT" INDUSTRIAL BATTERY CHARGERS

Ametek/Prestolite Power (hereinafter called "Prestolite") warrants that each new and unused Industrial Battery Charger manufactured and supplied by it is of good workmanship and is free from any inherent mechanical defects, provided that (1) the product is installed and operated in accordance with generally accepted industrial standards and in accordance with the printed instructions of Prestolite, (2) the product is used under normal conditions for which designed, (3) the product is not subjected to misuse, negligence or accident, and (4) the product receives proper care, protection and maintenance under supervision of competent personnel. This warranty is subject to the following provisions:

1. **PRODUCT AND PARTS WARRANTED.** Subject to the exceptions listed below each Industrial Battery Charger is warranted for a specific period of time commencing from the date of it's shipment by Prestolite, provided the charger is used in accordance with Prestolite's published performance rating for the unit involved. The exceptions to this warranty are as follows:

- a) Terms and conditions for warranty coverage:

<u>FERRORESONANT PRODUCTS</u>	ACCU CHARGER	BATTERY MATE 100	BATTERY MATE 80	BATTERY MATE 60
FULL COVERAGE - LABOR, TRAVEL, MILEAGE & PART REPLACEMENT	10-year "full"	10-year "full"	1-year	1-year
PRINTED CIRCUIT BOARD (REPLACEMENT ONLY)				
TRANSFORMER, INDUCTOR, SCR & DIODE (REPLACEMENT ONLY)			9-years additional	9-years additional
TOTAL WARRANTY TERM (YEARS)	10-years	10-years	10-years	10-years

- b) Warranty Expense Limitation: The maximum warranty expense Prestolite will incur for any Battery Charger will be limited to the original purchase price of the Battery Charger.

- c) Primary switch contacts, fuses, bulbs and filters are not warranted unless found to be defective prior to use.

2. **COMMENCEMENT OF WARRANTY TIME PERIODS.** The warranty periods indicated in the Warranty Schedule shall commence on the date of shipment by Prestolite. The ACCU CHARGER and BATTERY MATE 100, 10-year full warranty only applies to chargers manufactured after the 4<sup>th</sup> quarter of 2004. Units manufactured previous to the 4<sup>th</sup> quarter will have 1-year full, plus 9-years parts limited coverage.
3. **PERSONS COVERED BY WARRANTY.** Prestolite extends this warranty only to the purchaser of new equipment from Prestolite or one of its authorized distributors. The products purchased under this agreement shall be used exclusively by the buyer and its employees and by no other persons; and therefore there shall be no third party beneficiary to this warranty.
4. **LIMITATION OF REMEDY.** The existence of claimed defects in any product covered by this warranty is subject to Prestolite's factory inspection and judgement. Prestolite's liability is limited to repair of any defects found by Prestolite to exist or, at Prestolite's option, the replacement of the defective product F.O.B. factory after the defective product has been returned by the purchaser at its expense to Prestolite's shipping place. Replacement and exchange parts will be warranted for the remainder of the original Industrial Battery Charger Warranty or for a period of ninety (90) days, whichever is greater.
5. **USE OF DEFECTIVE PRODUCT.** Continued use of an Industrial Battery Charger after discovery of a defect VOIDS ALL WARRANTIES.
6. **ALTERED EQUIPMENT.** Except as authorized in writing, the warranty specified does not cover any equipment that has been altered by any party other than Prestolite.

**THIS WARRANTY IS GIVEN AND ACCEPTED IN LIEU OF ALL OTHER WARRANTIES, WHETHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, OTHER THAN AS EXPRESSLY SET FORTH HEREIN. IN NO EVENT SHALL PRESTOLITE BE LIABLE FOR ANY ANTICIPATED OR LOST PROFITS, SPECIAL, DIRECT, INDIRECT OR INCIDENTAL DAMAGES, CONSEQUENTIAL DAMAGES, TIME CHARGES OR OTHER COMMERCIAL EXPENSES OR LOSSES, AND BUYER ASSUMES ALL RISK AND LIABILITY RESULTING FROM USE OF THE GOODS. PRESTOLITE DOES NOT AUTHORIZE ANY REPRESENTATIVE OR OTHER PERSON TO ASSUME ON BEHALF OF PRESTOLITE ANY OTHER LIABILITY IN CONNECTION WITH THE SALE OR USE OF THE GOODS SOLD, AND THERE ARE NO ORAL AGREEMENTS OR WARRANTIES COLLATERAL TO OR AFFECTING THIS WRITTEN WARRANTY.**

### WARNING

At all times, safety must be considered an important factor in the installation, servicing and operation of the product and skilled, qualified technical assistance should be utilized.

**AMETEK/PRESTOLITE POWER - TROY, OHIO USA**

Data Sheet: 1153  
 Index: 030105  
 Replaces: Original

# **BATTERY-MATE80<sup>®</sup>** *Single & Three Phase Ferroresonant Industrial Battery Chargers*



## ***The Battery-Mate 80 is Quality Designed to Provide Efficient, Problem Free Charging Everytime***

*The Battery-Mate 80 is engineered for one and two shift operations. Manufactured to meet the most stringent requirements of industrial and distribution applications.*

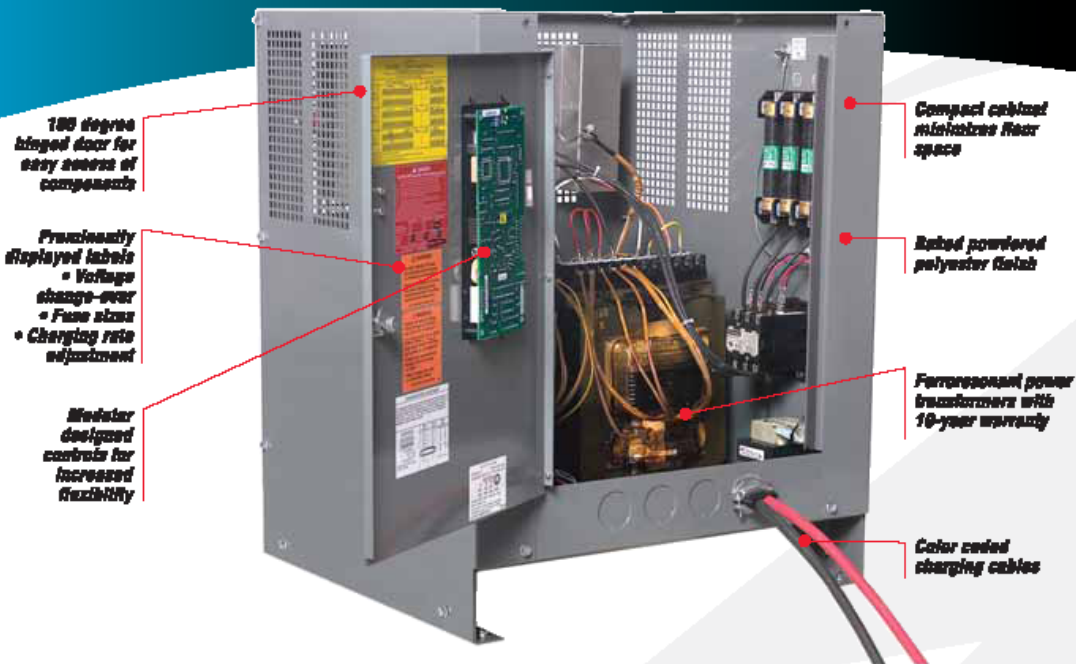
*It is rated to recharge normally discharged batteries in 8 hours or less.*

- *Charges 80% discharged batteries in 8 hours or less*
- *Interchangeable control design*
- *Economically priced*
- *Fall-safe design*
- *Quality-built for years of trouble-free service*
- *Ten-year transformer & diode warranty*
- *UL and cUL listed and meets BCI standards*





# BATTERY-MATE 80<sup>®</sup> For Dependable



### **Designed for Quality & Value**

The Battery-Mate 80 is an Industrial-rated charger, value-designed and extensively engineered to furnish an efficient, problem-free charge each time a battery is connected. Sized and rated to charge 80% discharged batteries in 8 hours or less, the Battery-Mate 80 uses ferroresonant power conversion circuitry, which is virtually maintenance-free, to provide years of dependable service. The power conversion circuitry maximizes battery life by using a constantly tapering charge which is automatically regulated by the "On Charge" battery voltage. The output current of the charger is determined by the state of discharge of the battery. The battery is precisely charged, based on its depth of discharge.

### **Low Operating Cost**

The Battery-Mate 80 is inherently efficient due to its ferroresonant circuitry, the most utilized method of charging lead acid batteries.

### **Interchangeable Control Design**

The Battery-Mate 80 is designed to allow the quick and easy installation or removal of the controls. Unmatched in the industry, this design allows controls to be interchanged in minutes for greater control, flexibility and automation of any battery charging operation.

### **Control Options**

Depending on your charging requirements, the Battery-Mate 80 can be controlled by any one of the following controls: AC1000 and AC2000.

### **Automatic Operation**

After the battery is connected, the Battery-Mate 80 will automatically start the charging operation. When the battery is fully charged, the charger will automatically terminate the operation.

### **Single & Three Phase Service**

The Battery-Mate 80 is available in a variety of single or three phase models. Each model provides multiple AC input voltages for increased flexibility of the charging operation.

### **Easy to Change AC Input Voltage**

AC input voltage change-overs take just minutes because of conveniently located taps and quick-connect jumpers.

### **Adjustable DC Output**

In rare instances where changes to the DC output might be required, necessary adjustments are made simple with conveniently located quick-connect jumpers.

### **Rating**

The Battery-Mate 80 is rated to recharge a 80% discharged battery in its ampere-hour rating within eight hours.

# Efficient Charging Every Time!

## Regulation

The Battery-Mate 80 will hold the finish rate of the charge within  $\pm 1\%$ , even with line voltage variations as high as  $\pm 10\%$ . This protects, and properly charges the battery, even when severe input voltage variations exist.

## Convection Cooled & Quiet

The Battery-Mate 80 uses no fans to draw in dirty air and has low sound levels for quiet operation.

## Battery Charger Safeguards

The Battery-Mate 80 is internally protected against overload, short circuit, reverse polarity connection, voltage transients and other unsafe failure modes. These safeguards protect the charger and battery, assuring longer life for both.

## Warranty

Minimize repair costs with ten year original purchaser warranty on power transformers and silicon diodes, plus one year warranty on other components.

## Accessible Cabinet Design

The Battery-Mate 80 has been designed to conveniently facilitate charger adjustment and any necessary service or maintenance requirements. The front door opens to 180 degrees to provide easy access to all major components.

## Minimize Floor Space

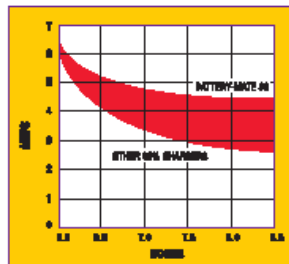
Because of its compact cabinet, the Battery-Mate 80 requires a minimum amount of floor space. All case styles can be wall, bench or floor mounted and all cases are stackable up to 3 high to save more floor space.

## UL, cUL and BCI

Most Battery-Mate 80 models are UL and cUL listed and meet BCI standards, adding further support to the "safety first" design.

## 100% Finish Rate

The Battery-Mate 80 is designed to provide a higher finish rate than other similarly rated 80% chargers. Because of the Battery-Mate 80's higher finish rate, batteries receive the precise recharge characteristics they require to maximize battery life.



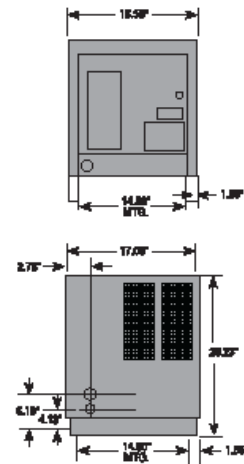
The above graph shows the last two hours of the charge cycle and illustrates the higher finish rate of the Battery-Mate 80. The output current of the Battery-Mate 80 at finish is 4.5 amps per 100A-H of the battery, compared to 2.6 amps for most other 80% chargers.

## Quality-Built for Years of Trouble-Free Service

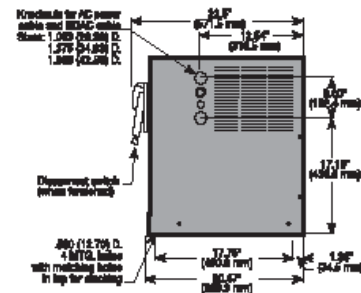
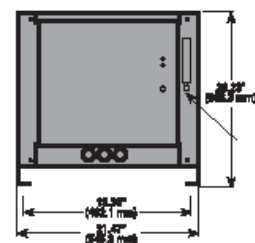
The Battery-Mate 80, as with all our products, is engineered to meet the everyday challenges associated with charging batteries. Unmatched in construction, reliability and value, the Battery-Mate 80 is subject to intensive quality control and test procedures to ensure many years of trouble-free service.

## Dimensions

### 7 1/2" Case



### 7" Case



# BATTERY-MATE80®

Single & Three Phase Ferroresonant  
Industrial Battery Chargers

## Battery-Mate 80 Models

Single Phase Models				Max AC Amps RMS					Cabinet Size	Weight Lbs.
Model #	Amp Hour	DC Volts	DC Amps	@120 VAC	@208 VAC	@240 VAC	@480 VAC	@575 VAC		
380M1-6C	380	12	65	10.8	6.2	5.4	2.7	2.2	M	95
450M1-6C	450	12	77	12.9	7.4	6.4	3.2	2.7	M	105
510M1-6C	510	12	87	13.6	7.9	6.8	3.4	4.9	M	110
600M1-6C	600	12	102		10.2	8.9	4.4	3.7	M	115
250M1-12C	250	24	43	13.1	7.5	6.6	3.3	2.7	M	105
380M1-12C	380	24	65	21	12.1	10.5	5.3	4.4	M	110
450M1-12C	450	24	77		13.8	12	6	5	M	120
510M1-12C	510	24	87		15.6	13.6	6.8	5.6	M	120
600M1-12C	600	24	102		18.5	16.1	8.1	6.7	M	145
750M1-12C	750	24	128		25.2	21.9	11	9.1	M	150
880M1-12C	880	24	150		29.2	25.4	12.7	10.6	M	175
965M1-12C	965	24	164		30.8	26.9	13.4	11.2	M	195
965H1-12C	965	24	164		30.8	26.9	13.4	11.2	H	215
510M1-18C	510	36	87		22.1	19.3	9.6	8	M	175
600M1-18C	600	36	102		28	24.4	12.2	10.1	M	180
750M1-18C	750	36	128		35.6	31	15.5	12.9	M	190
880H1-18C	880	36	150		42.2	36.6	18.3	15.3	H	290
965H1-18C	965	36	164		44.3	38.4	19.2	16	H	335
1050H1-18C	1050	36	179		45	37	19.5	16.3	H	350
1275H1-18C	1275	36	216		N/A	50.6	25.3	21.1	H	385
450M1-24C	450	48	77		25.7	22.4	11.2	9.3	M	170
510M1-24C	510	48	87		29.9	26.1	13	10.8	M	175
600M1-24C	600	48	102		36	31.4	15.7	13	M	190
750H1-24C	750	48	128		47	40.8	20.4	17	H	310
Three Phase Models				Max AC Amps RMS					Cabinet Size	Weight Lbs.
Model #	Amp Hour	DC Volts	DC Amps	@120 VAC	@208 VAC	@240 VAC	@480 VAC	@575 VAC		
600H3-6C	600	12	102		5.3	4.6	2.3	1.9	H	185
510H3-12C	510	24	87		8.9	7.8	3.9	3.2	H	190
600H3-12C	600	24	102		10.9	9.5	4.8	3.9	H	195
750H3-12C	750	24	128		12.7	11	5.5	4.6	H	200
880H3-12C	880	24	150		15.2	13.3	6.6	5.5	H	240
965H3-12C	965	24	164		16.6	14.5	7.2	6	H	245
1050H3-12C	1050	24	179		17.5	15.2	7.6	6.3	H	250
1260H3-12C	1260	24	214		21.3	18.6	9.3	7.7	H	280
510H3-18C	510	36	87		13	11.3	5.7	4.7	H	220
600H3-18C	600	36	102		14.7	12.8	6.4	5.3	H	240
750H3-18C	750	36	128		18.2	15.8	7.9	6.6	H	275
880H3-18C	880	36	150		21.9	19.1	9.5	7.9	H	285
965H3-18C	965	36	164		23.5	20.5	10.2	8.5	H	295
1050H3-18C	1050	36	179		25.8	22.5	11.2	9.3	H	300
1260H3-18C	1200	36	214		31.8	27.7	13.9	11.5	H	325
1400H3-18C	1400	36	238		32.3	28	14	11.7	H	390
380H3-24C	380	48	65		13.3	11.5	5.8	4.8	H	195
450H3-24C	600	48	102		18.8	16.4	8.2	6.8	H	280
750H3-24C	750	48	128		24	20.9	10.5	8.7	H	285
880H3-24C	880	48	150		27	23.5	11.8	9.8	H	330
965H3-24C	965	48	164		31.1	27.1	13.6	11.3	H	360
1050H3-24C	1050	48	179		35	30.5	15.3	12.7	H	365
1260H3-24C	1260	48	214		43.5	37.7	18.9	15.7	H	425
510H3-40C	510	80	87		27.9	24.2	12.1	10.1	H	360
600H3-40C	600	80	102		34.6	30	15	12.5	H	365
750H3-40C	750	80	128		46.6	40.4	20.2	16.9	H	425

AC Input Configurations Available: 120/208/240, 208/240/480, 480/575

### Control Features

	AC1000	AC2000
Automatic start/stop	•	•
Timed delay start	•	•
PT/DV/DT termination	•	•
VT termination	•	•
Universal control for 6,12,18, 24,36 cell	•	•
Back-up timers	•	•
AC fail recovery	•	•
Battery/charger mismatch protection	•	•
Refresh charge	•	•
Automatic equalize	•	•
Full battery reject	•	•
Modular design	•	•
Optional start modes	•	•
Forming cycles	•	•
Extended run time	•	•
Optional equalize modes	•	•
Data-Mate compatible	•	•
99 cycle archive	•	•
Cool down	•	•
Thermal runaway protection	•	•
80% volts/cell	•	•
AC power/reset charge cycle option	•	•

### Full Line of Automatic Start/Stop Controls



Series AC1000

Series AC2000

For more charger control information, see the following:  
AC1000 – data sheet 1322  
AC2000 – data sheet 1320



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2220 Corporate Drive • Troy, Ohio 45373  
Phone: 800.367.2002 • Fax: 800.654.4024  
www.prestolitepower.com

Because we continually improve our products, specifications are subject to change without notice.  
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Data Sheet: 1309 9/09 5M Printed in U.S.A.  
Replaces: 11/08

# AC500

## Automatic Start/Stop Charger Control



*Value-priced control provides maximum protection*

- ⚡ Modular design for maximum flexibility*
- ⚡ Universal control for 6, 12, 18, 24 and 36 cell batteries*
- ⚡ User selectable charge termination*
- ⚡ Battery/charger mismatch protection*
- ⚡ Automatic Equalize*
- ⚡ Back-up timers for additional battery protection*
- ⚡ User selectable 80% voltage points*
- ⚡ AC fail recovery*
- ⚡ Quality-built for years of trouble-free service*
- ⚡ Specify with or without analog ammeter*

**AMETEK**<sup>®</sup>  
PRESTOLITE POWER



# Excellent control at an economical price

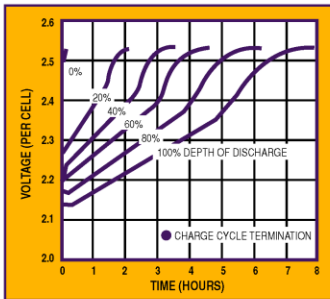
## ⚡ Designed to take charge

The AC500 control is fully automatic, featuring four bright LEDs for easy identification of the charging status, and two manual push-buttons, "Equalize" and "Stop," to allow further management of the charging operation.

## ⚡ Automatic start/stop

When the battery is connected to the charger, the AC500 will provide a five-second delay to check for proper connection before it automatically begins the charging operation. When charging is complete, the AC500 will automatically terminate the operation and the "Charge Complete" LED will illuminate.

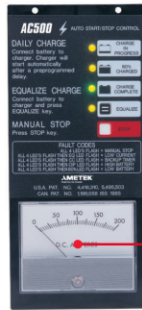
## ⚡ PT/DV/DT charge termination



The AC500 utilizes our patented charge termination technique, DV/DT, or rate of change of battery voltage with respect to time, with proportional time (PT) to determine when to terminate a charge cycle. The length of time it takes the battery to reach the 80% charged point determines the sampling rate. This termination method ensures a precise charge every time, never under or over charging, even on lightly discharged batteries. This technique used in conjunction with the tapered curve of the ferroresonant chargers, ensures that the rate of change for both battery voltage and current always provides an efficient and accurate termination of charge.

Should the user prefer a voltage/time charge termination, the AC500 can be set for this popular termination method by closing the proper dip switch on the PC board.

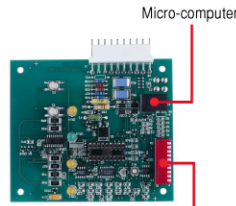
Because we continually improve our products, specifications are subject to change without notice.  
©2000, AMETEK, Inc. Prestolite Power, Troy, Ohio  
Data Sheet: 1323 11/00 5M Printed in U.S.A.  
Replaces: 7/99



AC500 (with meter)

Charge status LEDs

Full scale ammeter to match your charger output (0-100A, 0-200A, or 0-400A)



Micro-computer

Battery cell selector switches



AC500 (without meter)

Charge status LEDs

## ⚡ Universal control

The AC500 can be used to control any of the following 6, 12, 18, 24, or 36 cell chargers: Accu-Charger, 'R' Series, Multiple-Circuit Accu-Charger or Battery-Mate. Set cell size easily through cell selector switches located on the PC board.

## ⚡ User selectable 80% voltage point

The AC500 control may be set for an average 80% voltage point of 2.37 volts/cell or 2.45 volts/cell. In cold storage applications, ensure a complete charge by using the dip switch on the PC board to select the 2.45 volts/cell 80% point.

## ⚡ Automatic Equalize

The AC500 automatically provides an equalize charge of three hours beyond a normal charge complete on every 5th cycle. When an equalize charge is desired out of sequence, one can be selected by pressing the "Equalize" key on the front panel. Pressing the "Equalize" key at any time during an equalize charge cycle will deselect the equalize function for that cycle.

## ⚡ Battery/charger mismatch protection

The AC500 has the ability to discriminate and reject batteries that do not match the charger and control—thus providing additional protection for the battery. If the battery voltage is over or under sized, the charger will not start.

## ⚡ 72-hour refresh charge

If the battery and charger are left connected for 72 hours after the initial charge has been completed, the AC500 provides a refresh charge to ensure a fully charged battery when needed.

## ⚡ Unaffected by AC power failures

If AC power is interrupted during a charge cycle, the AC500 is designed so that when AC power is restored the charge cycle is resumed at the point where it was stopped.

## ⚡ Modular design

The AC500 is easy to install and remove. Its modular design allows it to be interchanged with other controls in just minutes.

## ⚡ Back-up timer protection

The AC500 is equipped with two back-up timers for additional battery protection. These back-up timers terminate the charge if (1) the battery is not 80% charged in 10 hours or (2) the charge is not completed within 5 hours after reaching 80% charged. These timers protect the battery from excessive overcharging – and possible permanent damage.

## ⚡ Quality-built for years of trouble-free service

The AC500, as with all our products, is engineered to meet the everyday challenges associated with charging batteries. Unmatched in construction, reliability and value, the AC500 is subject to intensive quality control and test procedures to ensure many years of trouble-free service.

## ⚡ Analog Ammeter

When ordering, please specify with or without the analog ammeter.



**AMETEK®**  
PRESTOLITE POWER

2220 Corporate Drive • Troy, Ohio • 45373-1099 • 800 367 2002






**APPENDIX VI**

**NAPA Prem Perf Gear Oil 80W-90  
SDS**





		Page: 1
<b>SAFETY DATA SHEET</b>		Revision Date: 09/28/2016
		Print Date: 10/3/2016
		SDS Number: R0091437
NAPA® PREM PERF GEAR OIL SAE 80W-90 GEAR OIL NP75213		Version: 1.4

29 CFR 1910.1200 (OSHA HazCom 2012)

**SECTION 1. PRODUCT AND COMPANY IDENTIFICATION**

**Product identifier**

Trade name : NAPA® PREM PERF GEAR OIL SAE 80W-90 GEAR OIL

**Relevant identified uses of the substance or mixture and uses advised against**


<b>Details of the supplier of the safety data sheet</b> Valvoline LLC 3499 Blazer Parkway Lexington, KY 40509 United States of America (USA) 1-800-TEAMVAL	<b>Emergency telephone number</b> 1-800-VALVOLINE  <b>Regulatory Information Number</b> 1-800-TEAMVAL  <b>Product Information</b> 1-800-TEAMVAL
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**SECTION 2. HAZARDS IDENTIFICATION**

**GHS Classification**

Skin sensitization : Category 1

**GHS label elements**


Hazard pictograms : 

Signal Word : Warning

Hazard Statements : May cause an allergic skin reaction.

Precautionary Statements : **Prevention:**  
 Avoid breathing dust/ fume/ gas/ mist/ vapors/ spray.  
 Contaminated work clothing must not be allowed out of the workplace.  
 Wear protective gloves.  
**Response:**  
 IF ON SKIN: Wash with plenty of soap and water.  
 If skin irritation or rash occurs: Get medical advice/ attention.  
 Wash contaminated clothing before reuse.  
**Disposal:**  
 Dispose of contents/ container to an approved waste disposal plant.

**Other hazards**

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None known.

### SECTION 3. COMPOSITION/INFORMATION ON INGREDIENTS

Substance / Mixture : Mixture

Chemical nature : Defatter

#### Hazardous components


Chemical name	CAS-No.	Classification	Concentration (%)
RESIDUAL OILS (PETROLEUM), SOLVENT-DEWAXED	64742-62-7	This material is not considered hazardous under the OSHA Hazard Communication Standard (HazCom 2012).	21.105
DISTILLATES (PETROLEUM), HYDROTREATED LIGHT	64742-47-8	Asp. Tox. 1; H304	1.393
AMINES, C12-14-TERT-ALKYL	68955-53-3	Flam. Liq. 4; H227 Acute Tox. 4; H302 Acute Tox. 2; H330 Acute Tox. 3; H311 Skin Corr. 1B; H314 Eye Dam. 1; H318 Skin Sens. 1A; H317	0.343

### SECTION 4. FIRST AID MEASURES

General advice : Move out of dangerous area.  
Show this safety data sheet to the doctor in attendance.  
Do not leave the victim unattended.

If inhaled : If breathed in, move person into fresh air.  
If unconscious, place in recovery position and seek medical advice.  
If symptoms persist, call a physician.

In case of skin contact : Remove contaminated clothing. If irritation develops, get medical attention.

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If on skin, rinse well with water.  
 First aid is not normally required. However, it is recommended that exposed areas be cleaned by washing with soap and water.  
 Wash contaminated clothing before re-use.

In case of eye contact : Flush eyes with water as a precaution.  
 Remove contact lenses.  
 Protect unharmed eye.  
 If eye irritation persists, consult a specialist.

If swallowed : Do not give milk or alcoholic beverages.  
 Never give anything by mouth to an unconscious person.  
 If symptoms persist, call a physician.

Most important symptoms and effects, both acute and delayed : Acute aspiration of large amounts of oil-laden material may produce a serious aspiration pneumonia. Patients who aspirate these oils should be followed for the development of long-term sequelae. Repeated aspiration of small quantities of mineral oil can produce chronic inflammation of the lungs (i.e. lipoid pneumonia) that may progress to pulmonary fibrosis. Symptoms are often subtle and radiological changes appear worse than clinical abnormalities. Occasionally, persistent cough, irritation of the upper respiratory tract, shortness of breath with exertion, fever, and bloody sputum occur. Inhalation exposure to oil mists below current workplace exposure limits is unlikely to cause pulmonary abnormalities.  
 Signs and symptoms of exposure to this material through breathing, swallowing, and/or passage of the material through the skin may include:  
 stomach or intestinal upset (nausea, vomiting, diarrhea)  
 irritation (nose, throat, airways)  
 Headache  
 Dizziness  
 May cause an allergic skin reaction.


Notes to physician : No hazards which require special first aid measures.

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## SECTION 5. FIREFIGHTING MEASURES

Suitable extinguishing media : Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.  
 Water spray  
 Foam  
 Carbon dioxide (CO<sub>2</sub>)  
 Dry chemical

Unsuitable extinguishing media : High volume water jet

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- Specific hazards during firefighting : Do not allow run-off from fire fighting to enter drains or water courses.
- Hazardous combustion products : carbon dioxide and carbon monoxide  
Hydrocarbons
- Specific extinguishing methods :
- Product is compatible with standard fire-fighting agents.
- Further information : Fire residues and contaminated fire extinguishing water must be disposed of in accordance with local regulations.
- Special protective equipment for firefighters : In the event of fire, wear self-contained breathing apparatus.

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#### SECTION 6. ACCIDENTAL RELEASE MEASURES

- Personal precautions, protective equipment and emergency procedures : Use personal protective equipment.  
Persons not wearing protective equipment should be excluded from area of spill until clean-up has been completed.
- Environmental precautions : Prevent product from entering drains.  
Prevent further leakage or spillage if safe to do so.  
If the product contaminates rivers and lakes or drains inform respective authorities.
- Methods and materials for containment and cleaning up : Soak up with inert absorbent material (e.g. sand, silica gel, acid binder, universal binder, sawdust).  
Keep in suitable, closed containers for disposal.
- Other information : Comply with all applicable federal, state, and local regulations.

---

#### SECTION 7. HANDLING AND STORAGE

- Advice on safe handling : Do not breathe vapours/dust.  
Do not smoke.  
Persons susceptible to skin sensitisation problems or asthma, allergies, chronic or recurrent respiratory disease should not be employed in any process in which this mixture is being used.  
Container hazardous when empty.  
Avoid exposure - obtain special instructions before use.  
Avoid contact with skin and eyes.  
Smoking, eating and drinking should be prohibited in the application area.  
For personal protection see section 8.

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Dispose of rinse water in accordance with local and national regulations.

Conditions for safe storage : Keep container tightly closed in a dry and well-ventilated place.  
Containers which are opened must be carefully resealed and kept upright to prevent leakage.

## SECTION 8. EXPOSURE CONTROLS/PERSONAL PROTECTION

### Components with workplace control parameters

Components	CAS-No.	Value type (Form of exposure)	Control parameters / Permissible concentration	Basis
DISTILLATES (PETROLEUM), HYDROTREATED LIGHT	64742-47-8	TWA	5 mg/m3 Mist	OSHA Z-1
		TWA	200 mg/m3 (total hydrocarbon vapor)	ACGIH
		TWA	5 mg/m3 Mist	OSHA P0
		TWA	5 mg/m3 Mist	NIOSH REL
		ST	10 mg/m3 Mist	NIOSH REL
		PEL	5 mg/m3 particulate	CAL PEL

### Hazardous components without workplace control parameters

Components	CAS-No.
AMINES, C12-14-TERT-ALKYL	68955-53-3

**Engineering measures** : Provide sufficient mechanical (general and/or local exhaust) ventilation to maintain exposure below exposure guidelines (if applicable) or below levels that cause known, suspected or apparent adverse effects.

### Personal protective equipment


Respiratory protection : Respiratory protection is not required under normal conditions of use.

### Hand protection

Remarks : The suitability for a specific workplace should be discussed with the producers of the protective gloves.

### Eye protection

: Not required under normal conditions of use. Wear splash-proof safety goggles if material could be misted or splashed into eyes.


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- Skin and body protection : Wear as appropriate:  
Impervious clothing  
Safety shoes  
Choose body protection according to the amount and concentration of the dangerous substance at the work place.  
Discard gloves that show tears, pinholes, or signs of wear.  
Wear resistant gloves (consult your safety equipment supplier).
- Hygiene measures : Wash hands before breaks and at the end of workday.

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#### SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

- Physical state : liquid
- Colour : amber
- Odour : No data available
- Odour Threshold : No data available
- pH : No data available
- Melting point/freezing point : No data available
- Boiling point/boiling range : > 424.9 °F / 218.3 °C  
(1013.333 hPa)
- Flash point : > 222 °C  
Method: Cleveland open cup
- Evaporation rate : > 1  
Ethyl Ether
- Flammability (solid, gas) : No data available
- Upper explosion limit : No data available
- Lower explosion limit : No data available
- Vapour pressure : < 0.1000000 mmHg
- Relative vapour density : > 1AIR=1
- Relative density : 0.89 (60.00 °F)
- Density : 0.8916 g/cm<sup>3</sup> (15.56 °C)
- Solubility(ies)

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Water solubility : No data available

Solubility in other solvents : No data available

Partition coefficient: n-octanol/water : No data available

Thermal decomposition : No data available

Viscosity

Viscosity, dynamic : No data available

Viscosity, kinematic : 146 mm<sup>2</sup>/s (40 °C)

Oxidizing properties : No data available

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#### SECTION 10. STABILITY AND REACTIVITY

Reactivity : No decomposition if stored and applied as directed.

Chemical stability : Stable under recommended storage conditions.

Possibility of hazardous reactions : Product will not undergo hazardous polymerization.

Incompatible materials : Strong oxidizing agents

Hazardous decomposition products : Aldehydes  
carbon dioxide and carbon monoxide  
Carbon monoxide

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#### SECTION 11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure : Inhalation  
Skin contact  
Eye Contact  
Ingestion

**Acute toxicity**


Not classified based on available information.

**Components:**

RESIDUAL OILS (PETROLEUM), SOLVENT-DEWAXED:

Acute oral toxicity : LD50 (Rat): > 5,000 mg/kg

Acute inhalation toxicity : LC50 (Rat): > 5.58 mg/l  
Exposure time: 4 h  
Test atmosphere: dust/mist

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Assessment: Not classified as acutely toxic by inhalation under GHS.

Remarks: No mortality observed at this dose.

Acute dermal toxicity : LD50 (Rabbit): > 5,000 mg/kg  
Remarks: No mortality observed at this dose.

LD50 (Rabbit): > 2,000 mg/kg  
Assessment: Not classified as acutely toxic by dermal absorption under GHS.

DISTILLATES (PETROLEUM), HYDROTREATED LIGHT:  
Acute oral toxicity : LD50 (Rat): > 5,000 mg/kg

Acute dermal toxicity : LD50 (Rabbit): > 3,160 mg/kg  
Assessment: No adverse effect has been observed in acute dermal toxicity tests.

AMINES, C12-14-TERT-ALKYL:  
Acute oral toxicity : LD50 (Rat): 612 mg/kg  
Method: OECD Test Guideline 401

Acute inhalation toxicity : LC50 (Rat, female): 1.19 mg/l  
Exposure time: 4 h  
Test atmosphere: vapour  
Method: OECD Test Guideline 403

Acute dermal toxicity : LD50 (Rat): 251 mg/kg  
Method: OECD Test Guideline 402

**Skin corrosion/irritation**

Not classified based on available information.

**Product:**

Remarks: May cause skin irritation in susceptible persons.

**Components:**

RESIDUAL OILS (PETROLEUM), SOLVENT-DEWAXED:  
Species: Rabbit  
Result: No skin irritation

DISTILLATES (PETROLEUM), HYDROTREATED LIGHT:  
Result: Slight, transient irritation

AMINES, C12-14-TERT-ALKYL:  
Species: Rabbit  
Result: Corrosive after 3 minutes to 1 hour of exposure


**Serious eye damage/eye irritation**

Not classified based on available information.

**Product:**

Remarks: Vapours may cause irritation to the eyes, respiratory system and the skin.



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Remarks: Unlikely to cause eye irritation or injury.

**Components:**

RESIDUAL OILS (PETROLEUM), SOLVENT-DEWAXED:

Species: Rabbit

Result: No eye irritation

DISTILLATES (PETROLEUM), HYDROTREATED LIGHT:

Result: Slight, transient irritation

AMINES, C12-14-TERT-ALKYL:

Species: Rabbit

Result: Corrosive

**Respiratory or skin sensitisation**

Skin sensitisation: May cause an allergic skin reaction.

Respiratory sensitisation: Not classified based on available information.

**Components:**

RESIDUAL OILS (PETROLEUM), SOLVENT-DEWAXED:

Test Type: Buehler Test

Species: Guinea pig

Assessment: Does not cause skin sensitisation.

AMINES, C12-14-TERT-ALKYL:

Test Type: Buehler Test

Species: Guinea pig

Assessment: The product is a skin sensitiser, sub-category 1A.

Germ cell mutagenicity

Not classified based on available information.

**Components:**

AMINES, C12-14-TERT-ALKYL:

Genotoxicity in vitro

: Test Type: Ames test

Test species: Salmonella typhimurium

Metabolic activation: with and without metabolic activation

Method: OECD Test Guideline 471

Result: negative

Genotoxicity in vivo

: Test Type: Micronucleus test

Test species: Mouse

Cell type: Bone marrow

Method: OECD Test Guideline 474

Result: negative

**Carcinogenicity**

Not classified based on available information.


**Reproductive toxicity**

Not classified based on available information.

**STOT - single exposure**

Not classified based on available information.

**STOT - repeated exposure**

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Not classified based on available information.

**Aspiration toxicity**

Not classified based on available information.

**Product:**

No aspiration toxicity classification

**Components:**

RESIDUAL OILS (PETROLEUM), SOLVENT-DEWAXED:

No aspiration toxicity classification

DISTILLATES (PETROLEUM), HYDROTREATED LIGHT:

May be fatal if swallowed and enters airways.

**Further information**

**Product:**

Remarks: No data available

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**SECTION 12. ECOLOGICAL INFORMATION**

**Ecotoxicity**

**Product:**

Ecotoxicology Assessment

Acute aquatic toxicity : Acute aquatic toxicity Category 3; Harmful to aquatic life.

Chronic aquatic toxicity : Chronic aquatic toxicity Category 3; Harmful to aquatic life with long lasting effects.

**Components:**


RESIDUAL OILS (PETROLEUM), SOLVENT-DEWAXED:

Toxicity to fish : LL50 (Pimephales promelas (fathead minnow)): > 100 mg/l  
 Exposure time: 96 h  
 Test Type: static test  
 Test substance: WAF  
 Method: OECD Test Guideline 203  
 Remarks: No toxicity at the limit of solubility

Toxicity to daphnia and other aquatic invertebrates : EL50 (Daphnia magna (Water flea)): > 10,000 mg/l  
 Exposure time: 48 h  
 Test Type: static test  
 Test substance: WAF  
 Method: OECD Test Guideline 202

Toxicity to algae : NOEL (Pseudokirchneriella subcapitata (green algae)): >= 100 mg/l  
 End point: Growth inhibition  
 Exposure time: 72 h  
 Test Type: static test  
 Test substance: WAF  
 Method: OECD Test Guideline 201

Toxicity to fish (Chronic toxicity) : NOELR (Oncorhynchus mykiss (rainbow trout)): Calculated >= 1,000 mg/l

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Exposure time: 14 d

Toxicity to daphnia and other aquatic invertebrates (Chronic toxicity) : NOEL (Daphnia (water flea)): 10 mg/l  
 Exposure time: 21 d  
 Test substance: WAF  
 Method: OECD Test Guideline 211

DISTILLATES (PETROLEUM), HYDROTREATED LIGHT:  
 Toxicity to fish : LC50 (Oncorhynchus mykiss (rainbow trout)): 2 - 5 mg/l  
 Exposure time: 96 h  
 Test Type: semi-static test  
 Test substance: WAF  
 Method: OECD Test Guideline 203  
 Remarks: Information given is based on data obtained from similar substances.

Toxicity to daphnia and other aquatic invertebrates : EL50 (Water flea (Daphnia magna)): 1.4 mg/l  
 Exposure time: 48 h  
 Test Type: static test  
 Test substance: WAF  
 Method: OECD Test Guideline 202  
 Remarks: Information given is based on data obtained from similar substances.


Toxicity to algae : EL50 (Pseudokirchneriella subcapitata (green algae)): > 1 - 3 mg/l  
 Exposure time: 72 h  
 Test Type: static test  
 Test substance: WAF  
 Method: OECD Test Guideline 201  
 Remarks: Information given is based on data obtained from similar substances.

Toxicity to daphnia and other aquatic invertebrates (Chronic toxicity) : NOEL (Water flea (Daphnia magna)): 0.48 mg/l  
 Exposure time: 21 d  
 Test Type: semi-static test  
 Test substance: WAF  
 Method: OECD Test Guideline 211  
 Remarks: Information given is based on data obtained from similar substances.

AMINES, C12-14-TERT-ALKYL:  
 Toxicity to fish : LC50 (Oncorhynchus mykiss (rainbow trout)): 1.3 mg/l  
 Exposure time: 96 h  
 Test Type: static test  
 Method: OECD Test Guideline 203

Toxicity to daphnia and other aquatic invertebrates : EC50 (Water flea (Daphnia magna)): 2.5 mg/l  
 Exposure time: 48 h  
 Test Type: static test

Toxicity to algae : ErC50 (Pseudokirchneriella subcapitata (microalgae)): 0.44 mg/l

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End point: Growth inhibition  
 Exposure time: 72 h  
 Test Type: static test  
 Method: OECD Test Guideline 201

NOEC (Pseudokirchneriella subcapitata (microalgae)): 0.05 mg/l  
 End point: Growth inhibition  
 Exposure time: 72 h  
 Test Type: static test  
 Method: OECD Test Guideline 201

M-Factor (Acute aquatic toxicity) : 1

Toxicity to fish (Chronic toxicity) : NOEC (Oncorhynchus mykiss (rainbow trout)): 0.078 mg/l  
 Exposure time: 96 d  
 Test Type: flow-through test  
 Method: OECD Test Guideline 210

M-Factor (Chronic aquatic toxicity) : 1

**Persistence and degradability**

**Components:**

RESIDUAL OILS (PETROLEUM), SOLVENT-DEWAXED:  
 Biodegradability : Result: Not readily biodegradable.  
 Biodegradation: 2 - 4 %  
 Exposure time: 28 d  
 Method: OECD Test Guideline 301B

DISTILLATES (PETROLEUM), HYDROTREATED LIGHT:  
 Biodegradability : Result: Inherently biodegradable  
 Biodegradation: 58.6 %  
 Exposure time: 28 d  
 Method: OECD Test Guideline 301F

Remarks: Expected to be biodegradable

AMINES, C12-14-TERT-ALKYL:  
 Biodegradability : Result: Not readily biodegradable.  
 Biodegradation: 22 %  
 Exposure time: 28 d  
 Method: OECD Test Guideline 301D


No data available

**Bioaccumulative potential**

**Components:**

AMINES, C12-14-TERT-ALKYL:  
 Partition coefficient: n-octanol/water : log Pow: 2.9

No data available

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**Mobility in soil**

**Components:**

No data available

**Other adverse effects**

No data available

**Product:**

Additional ecological information : An environmental hazard cannot be excluded in the event of unprofessional handling or disposal., Harmful to aquatic life with long lasting effects.

**Components:**

**SECTION 13. DISPOSAL CONSIDERATIONS**

**Disposal methods**

General advice : The product should not be allowed to enter drains, water courses or the soil.  
Do not contaminate ponds, waterways or ditches with chemical or used container.  
Send to a licensed waste management company.  
  
Dispose of in accordance with all applicable local, state and federal regulations.

Contaminated packaging : Empty remaining contents.  
Dispose of as unused product.  
Empty containers should be taken to an approved waste handling site for recycling or disposal.  
Do not re-use empty containers.

**SECTION 14. TRANSPORT INFORMATION**

**International transport regulations**

**REGULATION**

ID NUMBER	PROPER SHIPPING NAME	*HAZARD CLASS	SUBSIDIARY HAZARDS	PACKING GROUP	MARINE POLLUTANT / LTD. QTY.

**U.S. DOT - ROAD**


Not dangerous goods

**CFR\_RAIL\_C**

Not dangerous goods

**U.S. DOT - INLAND WATERWAYS**

Not dangerous goods

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**TDG\_ROAD\_C**

Not dangerous goods
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**TDG\_RAIL\_C**

Not dangerous goods
---------------------

**TDG\_INWT\_C**

Not dangerous goods
---------------------

**INTERNATIONAL MARITIME DANGEROUS GOODS**

Not dangerous goods
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**INTERNATIONAL AIR TRANSPORT ASSOCIATION - CARGO**

Not dangerous goods
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**INTERNATIONAL AIR TRANSPORT ASSOCIATION - PASSENGER**

Not dangerous goods
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**MX\_DG**

Not dangerous goods
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**\*ORM = ORM-D, CBL = COMBUSTIBLE LIQUID**

Marine pollutant	no
------------------	----

Dangerous goods descriptions (if indicated above) may not reflect quantity, end-use or region-specific exceptions that can be applied. Consult shipping documents for descriptions that are specific to the shipment.


**SECTION 15. REGULATORY INFORMATION**

**SARA 311/312 Hazards** : Acute Health Hazard

**SARA 313** This material does not contain any chemical components with known CAS numbers that exceed the threshold (De Minimis) reporting levels established by SARA Title III, Section 313.

**California Prop 65** This product does not contain any chemicals known to State of California to cause cancer, birth defects, or any other reproductive harm.

**The components of this product are reported in the following inventories:**

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- TSCA : On TSCA Inventory
- DSL : All components of this product are on the Canadian DSL
- AICS : On the inventory, or in compliance with the inventory
- ENCS : On the inventory, or in compliance with the inventory
- KECI : On the inventory, or in compliance with the inventory
- PICCS : On the inventory, or in compliance with the inventory
- IECSC : On the inventory, or in compliance with the inventory

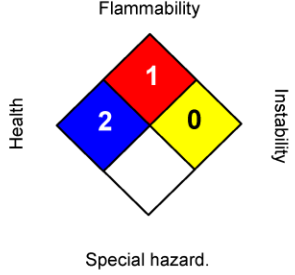
**Inventories**

AICS (Australia), DSL (Canada), IECSC (China), REACH (European Union), ENCS (Japan), ISHL (Japan), KECI (Korea), NZIoC (New Zealand), PICCS (Philippines), TCSI (Taiwan), TSCA (USA)

**SECTION 16. OTHER INFORMATION**

**Further information**


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<p><b>NFPA:</b></p>  <p>Special hazard.</p>	<p><b>HMIS III:</b></p> <table border="1"> <tr> <td style="background-color: blue; color: white;"><b>HEALTH</b></td> <td style="text-align: center;"><b>2</b></td> </tr> <tr> <td style="background-color: red; color: white;"><b>FLAMMABILITY</b></td> <td style="text-align: center;"><b>1</b></td> </tr> <tr> <td style="background-color: yellow; color: black;"><b>PHYSICAL HAZARD</b></td> <td style="text-align: center;"><b>0</b></td> </tr> </table> <p>0 = not significant, 1 = Slight, 2 = Moderate, 3 = High 4 = Extreme, * = Chronic</p>	<b>HEALTH</b>	<b>2</b>	<b>FLAMMABILITY</b>	<b>1</b>	<b>PHYSICAL HAZARD</b>	<b>0</b>
<b>HEALTH</b>	<b>2</b>						
<b>FLAMMABILITY</b>	<b>1</b>						
<b>PHYSICAL HAZARD</b>	<b>0</b>						

**NFPA Flammable and Combustible Liquids Classification**  
Combustible Liquid Class IIIB

**Full text of H-Statements**

- H227 Combustible liquid.
- H302 Harmful if swallowed.
- H304 May be fatal if swallowed and enters airways.
- H311 Toxic in contact with skin.
- H314 Causes severe skin burns and eye damage.
- H317 May cause an allergic skin reaction.

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H318 Causes serious eye damage.  
H330 Fatal if inhaled.

Sources of key data used to compile the Safety Data Sheet  
Valvoline internal data including own and sponsored test reports  
The UNECE administers regional agreements implementing harmonised classification for labelling (GHS) and transport.


The information accumulated herein is believed to be accurate but is not warranted to be whether originating with the company or not. Recipients are advised to confirm in advance of need that the information is current, applicable, and suitable to their circumstances. This SDS has been prepared by Valvoline's Environmental Health and Safety Department (1-800-VALVOLINE).

List of abbreviations and acronyms that could be, but not necessarily are, used in this safety data sheet :

ACGIH : American Conference of Industrial Hygienists  
BEI : Biological Exposure Index  
CAS : Chemical Abstracts Service (Division of the American Chemical Society).  
CMR : Carcinogenic, Mutagenic or Toxic for Reproduction  
FG : Food grade  
GHS : Globally Harmonized System of Classification and Labeling of Chemicals.  
H-statement : Hazard Statement  
IATA : International Air Transport Association.  
IATA-DGR : Dangerous Goods Regulation by the "International Air Transport Association" (IATA).

ICAO : International Civil Aviation Organization  
ICAO-TI (ICAO) : Technical Instructions by the "International Civil Aviation Organization"  
IMDG : International Maritime Code for Dangerous Goods  
ISO : International Organization for Standardization  
logPow : octanol-water partition coefficient  
LCxx : Lethal Concentration, for xx percent of test population  
LDxx : Lethal Dose, for xx percent of test population.  
ICxx : Inhibitory Concentration for xx of a substance  
Ecxx : Effective Concentration of xx  
N.O.S.: Not Otherwise Specified  
OECD : Organization for Economic Co-operation and Development  
OEL : Occupational Exposure Limit  
P-Statement : Precautionary Statement  
PBT : Persistent , Bioaccumulative and Toxic  
PPE : Personal Protective Equipment  
STEL : Short-term exposure limit  
STOT : Specific Target Organ Toxicity  
TLV : Threshold Limit Value  
TWA : Time-weighted average  
vPvB : Very Persistent and Very Bioaccumulative  
WEL : Workplace Exposure Level



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CERCLA : Comprehensive Environmental Response, Compensation, and Liability Act  
 DOT : Department of Transportation  
 FIFRA : Federal Insecticide, Fungicide, and Rodenticide Act  
 HMIRC : Hazardous Materials Information Review Commission  
 HMIS : Hazardous Materials Identification System  
 NFPA : National Fire Protection Association  
 NIOSH : National Institute for Occupational Safety and Health  
 OSHA : Occupational Safety and Health Administration  
 PMRA : Health Canada Pest Management Regulatory Agency  
 RTK : Right to Know  
 WHMIS : Workplace Hazardous Materials Information System





## **APPENDIX VII**

### **Declaration of Conformity**





## DECLARATION of CONFORMITY

The design, development and manufacture is in accordance with European Community guidelines

Towbarless Tug  
JP100SSC

Relevant provisions complied with by the machinery:  
2006/42/EC  
EN 1915-1  
EN 12312-7

Relevant standards complied with by the machinery:  
EN ISO 12100-1

Identification of person empowered to sign on behalf of the Manufacturer:

A handwritten signature in black ink that reads "Patrick Finch". The signature is written in a cursive style and is positioned above a solid horizontal line.

Quality Assurance Representative