

# MOHAWK



## INSTALLATION & OPERATION MANUAL

### MP-18-24VDC-SERIES

### ELECTRIC/HYDRAULIC

### PORTABLE LIFT

### 2, 4, 6 & 8 POST ARRANGEMENTS

#### MOHAWK RESOURCES LTD.

65 VROOMAN AVENUE

P. O. BOX 110

AMSTERDAM, NY 12010

TOLL FREE: 1-800-833-2006

FAX: 1-518-842-1289

LOCAL: 1-518-842-1431

Mohawk File: MP-18-24VDC Series.doc

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**READ MANUAL THOROUGHLY BEFORE  
INSTALLING,  
OPERATING OR SERVICING THIS LIFT!!  
Deliver these instructions to lift  
owner/user/employer along with other  
instructional materials furnished with this lift.**

# IMPORTANT SAFETY INSTRUCTIONS

When using this garage equipment, basic safety precautions should always be followed, including the following:

- 1. Read all instructions.**
2. Inspect lift daily. Do not operate if it malfunctions or problems have been encountered.
3. Never attempt to overload the lift. The manufacturer's rated capacity is shown on the identification label on the power side column. Do not override the operating controls or the warranty will be void.
4. Only trained and authorized personnel should operate the lift. Do not allow customers or bystanders to operate the lift or be in the lift area.
5. Position the lift support forks to contact the vehicle tires. Raise the lift until the forks contact the tires. Check forks for secure contact with the vehicle tires, then raise the lift to the desired working height.
6. NOTE: Always use all 4 posts to raise and support vehicle.
7. Note that the removal or installation of some vehicle parts may cause a critical load shift in the center of gravity and may cause the vehicle to become unstable. Refer to the vehicle manufacturer's service manual for recommended procedures.
8. Always keep the lift area free of obstructions and debris. Grease and oil spills should always be cleaned up immediately.
9. Never raise vehicle with passengers inside.
10. Before lowering check area for any obstructions.
11. Before driving vehicle between the posts, position the lift forks to allow vehicle to freely enter lifting area. To not hit or run over forks as this could damage the lift and/or the vehicle.
12. Before removing the vehicle from the lift area, position the lift forks to allow vehicle to freely leave lifting area. To not hit or run over forks as this could damage the lift and/or the vehicle.
13. Care must be taken as burns can occur from touching hot parts.
14. Do not operate equipment with a damaged cord or if the equipment has been dropped or damaged – until a qualified serviceman has examined it.
15. Do not let cords hang over tables, benches or counters or come in contact with hot manifolds or moving fan blades.
16. If an extension cord is necessary, a cord with a current rating equal to or more than that of the equipment should be used. Cords rated for less current than the equipment may overheat. Care should be taken to arrange the cord so that it will not be tripped over or pulled.
17. Always unplug the equipment from electrical outlet when not in use. Never use the cord to pull the plug from the outlet. Grasp plug and pull to disconnect.
18. Let equipment cool completely before pulling away. Loop cord loosely around equipment when storing.
19. To reduce the risk of fire, do not operate equipment in the vicinity of open containers of flammable liquids (gasoline).
20. Adequate ventilation should be provided when working on operating internal combustion engines.
21. Keep hair, loose clothing, fingers, and all parts of body way from moving parts.
22. To reduce the risk of electrical shock, do not use on wet surfaces or expose to rain.
23. Use only as described in this manual. Use only manufacturer's recommended attachments.
- 24. ALWAYS WEAR SAFETY GLASSES.** Everyday eyeglasses have only impact resistant lenses, and they are NOT safety glasses.

**SAVE THESE INSTRUCTIONS**

## MP-18 24VDC- Series Model Name Matrix:

<i>Mohawk Model Name</i>	<i>Number of Posts:</i>	<i>Total Lift Capacity (lbs):</i>	<i>----- Fork Lengths -----</i>			
			<i>Post 1&amp;2</i>	<i>Post 3&amp;4</i>	<i>Post 5&amp;6</i>	<i>Post 7&amp;8</i>
<b>MP-18-505</b>	<b>2</b>	<b>36,000</b>	<b>15"</b>	N/A	N/A	N/A
<b>MP-18-509</b>	<b>2</b>	<b>32,000</b>	<b>22"</b>	N/A	N/A	N/A
<b>MP-18-513</b>	<b>2</b>	<b>32,000</b>	<b>22" W</b>	N/A	N/A	N/A
<b>MP-18-506</b>	<b>4</b>	<b>72,000</b>	<b>15"</b>	<b>15"</b>	N/A	N/A
<b>MP-18-518</b>	<b>4</b>	<b>68,000</b>	<b>15"</b>	<b>22"</b>	N/A	N/A
<b>MP-18-530</b>	<b>4</b>	<b>68,000</b>	<b>15"</b>	<b>22" W</b>	N/A	N/A
<b>MP-18-510</b>	<b>4</b>	<b>64,000</b>	<b>22"</b>	<b>22"</b>	N/A	N/A
<b>MP-18-514</b>	<b>4</b>	<b>64,000</b>	<b>22" W</b>	<b>22" W</b>	N/A	N/A
<b>MP-18-507</b>	<b>6</b>	<b>108,000</b>	<b>15"</b>	<b>15"</b>	<b>15"</b>	N/A
<b>MP-18-524</b>	<b>6</b>	<b>104,000</b>	<b>15"</b>	<b>15"</b>	<b>22"</b>	N/A
<b>MP-18-558</b>	<b>6</b>	<b>104,000</b>	<b>15"</b>	<b>15"</b>	<b>22" W</b>	N/A
<b>MP-18-525</b>	<b>6</b>	<b>100,000</b>	<b>15"</b>	<b>22"</b>	<b>22"</b>	N/A
<b>MP-18-559</b>	<b>6</b>	<b>100,000</b>	<b>15"</b>	<b>22" W</b>	<b>22" W</b>	N/A
<b>MP-18-511</b>	<b>6</b>	<b>96,000</b>	<b>22"</b>	<b>22"</b>	<b>22"</b>	N/A
<b>MP-18-515</b>	<b>6</b>	<b>96,000</b>	<b>22" W</b>	<b>22" W</b>	<b>22" W</b>	N/A
<b>MP-18-508</b>	<b>8</b>	<b>144,000</b>	<b>15"</b>	<b>15"</b>	<b>15"</b>	<b>15"</b>
<b>MP-18-526</b>	<b>8</b>	<b>140,000</b>	<b>15"</b>	<b>15"</b>	<b>15"</b>	<b>22"</b>
<b>MP-18-560</b>	<b>8</b>	<b>140,000</b>	<b>15"</b>	<b>15"</b>	<b>15"</b>	<b>22" W</b>
<b>MP-18-527</b>	<b>8</b>	<b>136,000</b>	<b>15"</b>	<b>15"</b>	<b>22"</b>	<b>22"</b>
<b>MP-18-561</b>	<b>8</b>	<b>136,000</b>	<b>15"</b>	<b>15"</b>	<b>22" W</b>	<b>22" W</b>
<b>MP-18-528</b>	<b>8</b>	<b>132,000</b>	<b>15"</b>	<b>22"</b>	<b>22"</b>	<b>22"</b>
<b>MP-18-562</b>	<b>8</b>	<b>132,000</b>	<b>15"</b>	<b>22" W</b>	<b>22" W</b>	<b>22" W</b>
<b>MP-18-512</b>	<b>8</b>	<b>128,000</b>	<b>22"</b>	<b>22"</b>	<b>22"</b>	<b>22"</b>
<b>MP-18-516</b>	<b>8</b>	<b>128,000</b>	<b>22" W</b>	<b>22" W</b>	<b>22" W</b>	<b>22" W</b>
<b>Notes:</b> <b>All Posts with 15" Forks are Rated 18,000 lbs each.</b> <b>All Posts with 22" Forks are Rated 16,000 lbs each.</b> <b>W- Denotes Wider Fork Lifts</b>						



The Automotive Lift Institute (ALI) is a trade association comprised of US and Canadian manufacturers and certain national distributors of automotive lifts. For almost 50 years, the ALI in cooperation with the American National Standards Institute (ANSI) has continued to sponsor the national standard ANSI/ALI ALCTV:2006 "Safety Requirements for Construction, Testing, and Validation for Automotive Lifts."

The new "ALI/ETL Automotive Lift Certification Program" is based on ALI developed methods and criteria for third party testing of automotive lifts to validate conformance with ANSI/ALI ALCTV:2006.

For automotive lifts to be certified, manufacturers must execute an agreement with the ALI and ETL / Intertek Testing Services and must meet certain requirements:

- ◆ Must be structurally tested in accordance with the test requirements as outlined in ANSI/ALI ALCTV:2006.
- ◆ All motor operated units must be listed by a nationally recognized testing laboratory (NRTL) in accordance with ANSI/UL-201.
- ◆ The manufacturer's production facility must meet quality control requirements as set forth in the ANSI Z34.1-1987 and the ALI/ETL Automotive Lift Certification Program Procedural Guide.
- ◆ All manufacturer-provided instructions, manuals, and operator safety documents, must meet the requirements of the ANSI/ALI ALCTV:2006 and ANSI/UL-201.

Lifts meeting these rigid requirements may be listed in the directory of certified lifts and be labeled with the "ALI/ETL certification mark" (Above on right), and, if applicable, the ETL listing mark to ANSI/UL-201.

Mohawk has been a long-standing member of ALI and most of Mohawk's popular models are currently listed and certified. Other Mohawk models are in various stages of testing. To obtain a complete and current certification listing, contact Mohawk Resources Ltd. or visit [www.mohawklifts.com](http://www.mohawklifts.com) or [www.ali-directory.org](http://www.ali-directory.org) To obtain a copy of the current automotive lift standard, contact ALI or ANSI or visit [www.autolift.org](http://www.autolift.org)

Some people purchase quality products and others do not. You are assured of quality when you purchase a Mohawk product in compliance with the certification program.

HAVE A QUESTION?

**Call your local  
Mohawk distributor  
For parts, service and technical support.**

Distributor Place Card Here

Please have this unit's model and serial number when calling for service.

Model Number \_\_\_\_\_

Serial Number \_\_\_\_\_

**OR CONTACT:**

**MOHAWK RESOURCES LTD.**

65 Vrooman Ave.

P.O. Box 110

Amsterdam, NY 12010

Toll Free: 1-800-833-2006

Local: 1-518-842-1431

Fax: 1-518-842-1289

Internet: [www.MOHAWKLIFTS.com](http://www.MOHAWKLIFTS.com)

E-Mail: [Service@MOHAWKLIFTS.com](mailto:Service@MOHAWKLIFTS.com)

# MOHAWK WARRANTIES

EFFECTIVE DATE: 5/7/2007 \*

## **GENERAL WARRANTY INFORMATION:**

MOHAWK'S OBLIGATION UNDER THIS WARRANTY IS LIMITED TO REPAIRING OR REPLACING ANY PART OR PARTS RETURNED TO THIS FACTORY, TRANSPORTATION CHARGES PREPAID, WHICH PROVE UPON INSPECTION TO BE DEFECTIVE AND WHICH HAVE NOT BEEN MISUSED. DAMAGE OR FAILURE TO ANY PART DUE TO FREIGHT DAMAGE OR FAULTY MAINTENANCE IS NOT COVERED UNDER THIS WARRANTY. ALL WARRANTY CLAIMS MUST BE PERFORMED IN ACCORDANCE TO MOHAWK'S WARRANTY PARTS RETURN POLICY (CONTACT MOHAWK'S SERVICE DEPARTMENT FOR MORE INFORMATION). THIS WARRANTY DOES NOT COVER MIS-DIAGNOSING OF UNIT OR PARTS RETURNED THAT ARE NON-DEFECTIVE. THIS WARRANTY DOES NOT COVER ANY CONSEQUENTIAL OR INCIDENTAL DAMAGES INCLUDING, BUT NOT LIMITED TO, LOST REVENUES OR BUSINESS HARM. THIS EQUIPMENT HAS BEEN DESIGNED FOR USE IN NORMAL COMMERCIAL VEHICLE MAINTENANCE APPLICATIONS. A SPECIFIC INDIVIDUAL WARRANTY MUST BE ISSUED FOR UNITS THAT DEVIATE FROM INTENDED USAGE, SUCH AS HIGH CYCLE USAGE IN INDUSTRIAL APPLICATIONS, OR USAGE IN EXTREMELY ABUSIVE ENVIRONMENTS, ETC.. MOHAWK RESERVES THE RIGHT TO DECLINE RESPONSIBILITY WHEN REPAIRS HAVE BEEN MADE OR ATTEMPTED BY OTHERS. THIS WARRANTY DOES NOT COVER DOWNTIME EXPENSES INCURRED WHEN UNIT IS IN REPAIR. THE MODEL NAME AND SERIAL NUMBER OF THE EQUIPMENT MUST BE FURNISHED WITH ALL WARRANTY CLAIMS. THIS WARRANTY STATEMENT CONTAINS THE ENTIRE AGREEMENT BETWEEN MOHAWK RESOURCES LTD. AND THE PURCHASER UNLESS OTHERWISE SPECIFICALLY EXPRESSED IN WRITING. THIS NON-TRANSFERABLE WARRANTY APPLIES TO THE ORIGINAL PURCHASER ONLY. THIS WARRANTY IS APPLICABLE TO UNITS LOCATED ONLY IN THE UNITED STATES OF AMERICA AND CANADA. CONTACT MOHAWK RESOURCES LTD. FOR SPECIFIC WARRANTY PROVISIONS FOR UNITS LOCATED OUTSIDE OF THESE COUNTRIES.

## **STRUCTURAL COMPONENTS (ALL LIFTS):**

ALL STRUCTURAL AND MECHANICAL COMPONENTS OF THIS UNIT ARE GUARANTEED FOR THE BELOW STATED TIME FRAME, SPECIFIC TO MODEL LISTED, FROM THE DATE OF INVOICE, AGAINST DEFECTS IN WORKMANSHIP AND/OR MATERIALS WHEN LIFT IS INSTALLED AND USED ACCORDING TO SPECIFICATIONS.

**5-YEAR:** MODELS A-7, SYSTEM IA, SYSTEM IA-10, TOMAHAWK-9000, LMF-12, TP-15, TP-16, TP-18, TP-20, TP-26, TP-30, & TL-7.

**3-YEAR:** MODELS TR-19, TR-25, FL-25, TR-33, TR-35, TR-50, TR-75, TR-110, TR-120, MP-SERIES, RP-SERIES LIFTS.

**2-YEAR:** MODELS PARALLELOGRAM SERIES LIFTS.

**1-YEAR:** MODELS HR-6, TD-1000, CT-1000, USL-6000.

## **POWER UNIT (ALL LIFTS):**

ALL POWER UNIT COMPONENTS (MOTOR, PUMP AND RESERVOIR) ARE GUARANTEED FOR TWO YEARS FOR PARTS (ONE YEAR LABOR), FROM THE DATE OF INVOICE, AGAINST DEFECTS IN WORKMANSHIP AND/OR MATERIALS WHEN THE LIFT IS INSTALLED AND USED ACCORDING TO SPECIFICATIONS.

## **HYDRAULIC CYLINDERS (MODEL SPECIFIC LIFTS):**

SEE MOHAWK'S "EXTENDED LIFETIME CYLINDER WARRANTY" FOR SPECIFIC WARRANTY PROVISIONS FOR HYDRAULIC CYLINDERS. THE "EXTENDED LIFETIME CYLINDER WARRANTY" IS APPLICABLE TO THE FOLLOWING MOHAWK LIFTS ONLY: A-7, SYSTEM IA, SYSTEM IA-10, LMF-12, TP-15, TP-18, TP-20, TP-26, TP-30. ALL OTHER MODELS ARE GUARANTEED FOR TWO YEARS PARTS AND ONE YEAR LABOR (EXCEPT HR-6, WHICH IS ONE YEAR PARTS ONLY), FROM THE DATE OF INVOICE, AGAINST DEFECTS IN WORKMANSHIP AND/OR MATERIALS WHEN THE LIFT IS INSTALLED AND USED ACCORDING TO SPECIFICATIONS.

## **ELECTRICAL COMPONENTS (ALL LIFTS):**

ALL ELECTRICAL COMPONENTS (EXCLUDING MOTOR) ARE GUARANTEED FOR ONE YEAR FOR PARTS AND LABOR, FROM THE DATE OF INVOICE, AGAINST DEFECTS IN WORKMANSHIP AND/OR MATERIALS WHEN THE LIFT IS INSTALLED AND USED ACCORDING TO SPECIFICATIONS.

## **PNEUMATIC-AIR COMPONENTS (ALL LIFTS):**

ALL PNEUMATIC (AIR) COMPONENTS (I.E. AIR CYLINDERS AND POPPET AIR VALVES) ARE GUARANTEED FOR ONE YEAR FOR PARTS AND LABOR, FROM THE DATE OF INVOICE, AGAINST DEFECTS IN WORKMANSHIP AND/OR MATERIALS WHEN THE LIFT IS INSTALLED AND USED ACCORDING TO SPECIFICATIONS.

## **STANDARD OPTIONS (ALL LIFTS):**

ALL STANDARD OPTIONS OF THIS UNIT ARE GUARANTEED FOR ONE YEAR FOR PARTS AND LABOR, FROM THE DATE OF INVOICE, AGAINST DEFECTS IN WORKMANSHIP AND/OR MATERIALS WHEN LIFT IS INSTALLED AND USED ACCORDING TO SPECIFICATIONS.

**SPECIAL AND/OR CUSTOMIZED LIFTS AND OPTIONS:**

ALL "SPECIAL" LIFTS AND/OR "CUSTOMIZED" OPTIONS ON THIS UNIT ARE GUARANTEED FOR ONE YEAR FOR PARTS ONLY (EXCLUDING LABOR), FROM THE DATE OF INVOICE, AGAINST DEFECTS IN WORKMANSHIP AND/OR MATERIALS WHEN THE LIFT IS INSTALLED AND USED ACCORDING TO SPECIFICATIONS.

**WARRANTY EXCEPTIONS (ALL LIFTS):**

**ADJUSTMENTS:** THIS WARRANTY DOES NOT COVER CASUAL AND ROUTINE ADJUSTMENTS SUCH AS, BUT NOT LIMITED TO: FITTINGS, J-BAR ADJUSTMENTS, ANCHOR BOLT RE-TIGHTENING, OR ANY SHIMMING OR ADJUSTMENTS REQUIRED DURING A PROPER AND PROFESSIONAL INSTALLATION BY A QUALIFIED INSTALLER.

**MAINTENANCE AND INSPECTIONS:** IF THIS UNIT IS NOT MAINTAINED AND INSPECTED IN ACCORDANCE TO THE RELEVANT SECTIONS IN THE USERS MANUAL FOR THIS SPECIFIC MODEL, WARRANTY IS SUSPENDED UNTIL THE LIFT CONDITION IS PROVEN TO BE TO MOHAWK'S SATISFACTION (ANY CURRENT CLAIMS WILL NOT BE PAID UNTIL THIS REQUIREMENT IS MET). OSHA, ANSI AND MOHAWK REQUIRE THAT RECORDS MUST BE MAINTAINED TO PROVE THAT INSPECTIONS AND MAINTENANCE OF THIS UNIT HAVE BEEN ROUTINELY PERFORMED BY QUALIFIED INDIVIDUALS.

**ABUSE:** IF THIS UNIT IS FOUND TO BE OVERLOADED (PURPOSELY OR UNKNOWINGLY), USED IN A SITUATION BEYOND ITS INTENDED FUNCTION, NOT MAINTAINED OR INSPECTED REGULARLY, OR USED IN AN ABUSIVE ENVIRONMENT, ETC., THIS WARRANTY IS VOID IN ITS ENTIRETY.

**NON-EXISTENT PROBLEMS:** FOR SERVICE VISITS, PART REPLACEMENTS, LABOR, ETC. FOR PARTS FOUND TO BE NON-DEFECTIVE, OR FOR A UNIT DIS-FUNCTION THAT DOES NOT EXIST, IT IS THE LIFT OWNER THAT REQUESTED THE SERVICE VISIT WHO BEARS THE RESPONSIBILITY OF ALL RELATED EXPENSES.

**BATTERIES:** ALL BATTERIES CARRY THE BATTERY MANUFACTURER'S WARRANTY. MAINTENANCE REQUIREMENTS AND ABUSE PROVISIONS ARE AS STATED BY THE BATTERY MANUFACTURER. REFER TO BATTERY MANUFACTURER'S WARRANTY.

**\* THIS WARRANTY SUPERSEDES ALL OTHER WARRANTY POLICIES PREVIOUSLY STATED AND IN ALL OTHER MOHAWK PRODUCT SPECIFIC LITERATURE (MANUALS, BROCHURES, ETC.).**

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## PARTS

	<b>DWG NO.</b>
POST ASSEMBLY (15" FORKS) .....	MP-5400-A-001
POST ASSEMBLY (22" FORKS) .....	MP-5400-A-004
JACK ASSEMBLY .....	MP-0400-A-003
POWER UNIT ASSEMBLY .....	MP-5400-A-003
FLOOR ROLLER ASSEMBLY .....	MP-0500-A-001
LOCK ASSEMBLY .....	MP-5200-A-001
CARRIAGE ASSEMBLY .....	MP-0700-A-001
CYLINDER ASSEMBLY .....	MP-0900-A-001
CONTROL BOX ASSEMBLY .....	MP-5100-A-001
CONTROL BOX SUB-ASSEMBLY .....	MP-5100-A-003
CONTROL PANEL ASSEMBLY .....	MP-5100-A-004
TERMINAL STRIP #1 ASSEMBLY .....	MP-5100-A-020
TERMINAL STRIP #2 ASSEMBLY .....	MP-5100-A-021
CHARGER ASSEMBLY .....	MP-5100-A-005
STRING POT ASSEMBLY .....	MP-5100-A-014
BATTERY BOX ASSEMBLY .....	MP-5300-A-001
PENDANT ASSEMBLY (OPTIONAL) .....	MP-1300-A-020

## ILLUSTRATIONS

CHARGER STATUS LIGHTS  
BATTERY METER LIGHTS  
JACK OPERATION  
JACK RELIEF SETTING  
ENCLOSURE DIAGRAMS  
COMMUNICATION CABLE & DUMMY PLUG DIAGRAMS  
WARNINGS PICTOGRAM  
CAUTIONS PICTOGRAM  
SAFETY INSTRUCTIONS PICTOGRAM

## SCHEMATICS

	<b>DWG NO.</b>
HYDRAULIC SCHEMATIC .....	MP-5000-A-002
ELECTRICAL SCHEMATIC & WIRING DIAGRAMS (3 PAGES) .....	MP-5000-A-001

## CHARGER

CHARGER INFORMATION

## BATTERY CARE

BATTERY INFORMATION

## OPTIONS

ALL INFORMATION, ILLUSTRATIONS, AND SPECIFICATIONS IN THIS MANUAL ARE BASED ON THE LATEST PRODUCT INFORMATION AVAILABLE AT THE TIME OF PRINTING. WE RESERVE THE RIGHT TO MAKE CHANGES AT ANY TIME WITHOUT NOTICE.

# GENERAL NOTES & WARNINGS

RECOMMENDATIONS BY THE INDIVIDUAL USER OR USING ORGANIZATION FOR IMPROVING THIS PUBLICATION OR ANY ASPECT OF THE PRODUCT ARE ENCOURAGED AND SHOULD BE FORWARDED IN WRITING TO:

**MOHAWK RESOURCES LTD, SERVICE DEPT, 65 VROOMAN AVENUE, AMSTERDAM, NY 12010**

THIS IS NOT A VEHICLE LIFTING PROCEDURE MANUAL AND NO ATTEMPT IS MADE OR IMPLIED HEREIN TO INSTRUCT THE USER IN LIFTING METHODS PARTICULARLY TO THE INDIVIDUAL APPLICATION OF THE EQUIPMENT DESCRIBED IN THIS MANUAL. RATHER, THE CONTENTS OF THIS MANUAL ARE INTENDED AS A BASE LINE FOR OPERATION, MAINTENANCE, TROUBLE SHOOTING, AND PARTS LISTING OF THE UNIT AS IT STANDS ALONE AND AS IT IS INTENDED AND ANTICIPATED TO BE USED IN CONJUNCTION WITH OTHER EQUIPMENT.

PROPER APPLICATION OF THE EQUIPMENT DESCRIBED HEREIN IS LIMITED TO THE PARAMETERS DETAILED IN THE SPECIFICATIONS AND THE USES SET FORTH IN THE DESCRIPTIVE PASSAGES. ANY OTHER PROPOSED APPLICATION OF THIS EQUIPMENT SHOULD BE DOCUMENTED AND SUBMITTED IN WRITING TO MOHAWK RESOURCES LTD. FOR EXAMINATION. THE USER ASSUMES FULL RESPONSIBILITY FOR ANY EQUIPMENT DAMAGE, PERSONAL INJURY, OR ALTERATION OF THE EQUIPMENT DESCRIBED IN THIS MANUAL OR ANY SUBSEQUENT DAMAGES.

DO NOT WELD, APPLY HEAT, OR MODIFY THIS EQUIPMENT IN ANY MANNER WITHOUT WRITTEN AUTHORIZATION FROM MOHAWK RESOURCES LTD. CERTAIN ALLOY OR HEAT-TREATED COMPONENTS MAY BE DISTORTED OR WEAKENED, RESULTING IN AN UNSAFE CONDITION. MOHAWK RESOURCES LTD. IS NOT RESPONSIBLE FOR DISTORTIONS, WHICH RESULT FROM WELDING ON THIS EQUIPMENT AFTER MANUFACTURING IS COMPLETED. UNAUTHORIZED WELDING, APPLICATION OF HEAT, OR MODIFICATION OF THIS EQUIPMENT VOIDS ANY AND / OR ALL APPLICABLE WARRANTIES COVERING THIS EQUIPMENT.

ALL WARRANTIES APPLICABLE TO THIS EQUIPMENT ARE CONTINGENT ON STRICT ADHERENCE TO THE MAINTENANCE SCHEDULES AND PROCEDURES IN THIS MANUAL.

KEEP ALL SHIELDS AND GUARDS IN PLACE. ENSURE ALL SAFETY MECHANISMS ARE OPERABLE. KEEP HANDS, FEET, AND CLOTHING AWAY FROM POWER-DRIVEN AND MOVING PARTS.

## **WARNING**

DO NOT INSTALL THIS UNIT IN A PIT OR DEPRESSION DUE TO FIRE OR EXPLOSION RISK

## **IMPORTANT NOTE**

A **LEVEL FLOOR** IS SUGGESTED FOR A PROPER INSTALLATION SITE AND WILL ENSURE LEVEL LIFTING. ANY MAJOR SLOPE CHANGES WILL AFFECT THE UNIT'S LEVEL LIFTING PERFORMANCE. IF A FLOOR IS OF QUESTIONABLE SLOPE, CONSIDER A SURVEY OF THE SIGHT AND / OR THE POSSIBILITY OF POURING A NEW LEVEL CONCRETE SLAB SECTION. SIMPLY STATED, FOR OPTIMUM LEVEL LIFTING, THE EQUIPMENT, AT BEST, CAN LIFT ONLY AS LEVEL AS THE FLOOR ON WHICH IT IS LOCATED... AND SHOULD NOT BE EXPECTED TO COMPENSATE FOR DRASTIC FLOOR SLOPE DIFFERENCES.

THIS EQUIPMENT MUST BE USED ON A LEVEL **CONCRETE FLOOR WITH A MINIMUM THICKNESS OF 4-1/2" ON GRADE**. THE CONCRETE MUST BE AGED AT LEAST (28) **TWENTY EIGHT** DAYS PRIOR TO INSTALLATION AND HAVE A MINIMUM COMPRESSIVE STRENGTH OF **3000 PSI**. DO NOT USE THIS UNIT ON ANY ASPHALT SURFACE.

DO NOT USE THIS UNIT ON A SECOND FLOOR OR ANY GROUND FLOOR WITH A BASEMENT BENEATH WITHOUT WRITTEN AUTHORIZATION FROM THE BUILDING ARCHITECT.

## **CAUTION**

THE EQUIPMENT DESCRIBED IN THIS MANUAL COULD BE POTENTIALLY DANGEROUS IF IMPROPERLY OR CARELESSLY OPERATED. FOR THE PROTECTION OF ALL PERSONS AND EQUIPMENT, ONLY COMPETENTLY TRAINED OPERATORS WHO ARE CRITICALLY AWARE OF THE PROPER OPERATING PROCEDURES, POTENTIAL DANGERS, AND SPECIFIC APPLICATION OF THIS EQUIPMENT SHOULD BE ALLOWED TO TOUCH THE CONTROLS AT ANY TIME.

SAFE OPERATION OF THIS EQUIPMENT IS DEPENDENT ON USE, IN COMPLIANCE WITH THE OPERATION PROCEDURES OUTLINED IN THIS MANUAL ALONG WITH THE MAINTENANCE AND INSPECTION PROCEDURES WITH CONSIDERATION OF PREVAILING CONDITIONS.

THIS LIFT IS DESIGNED AND INTENDED **FOR USAGE AND STORAGE INDOORS ONLY**. MOHAWK DENIES ALL LIABILITY AND VOIDS WARRANTY IN SITUATIONS WHERE THIS LIFT IS USED OR STORED WHERE IT IS SUBJECTED TO THE OUTDOOR ELEMENTS AND TEMPERATURES.

THE EQUIPMENT DESCRIBED IN THIS MANUAL IS NEITHER DESIGNED NOR INTENDED FOR ANY APPLICATION ALONE OR IN CONJUNCTION WITH ANY OTHER EQUIPMENT THAT INVOLVES THE LIFTING OR MOVING OF **PERSONS**.

ALWAYS CONSULT THE VEHICLE LIFTING GUIDE FOR THE PROPER LIFTING POINTS ON ANY VEHICLE. THESE GUIDES ARE AVAILABLE FROM THE VEHICLE MANUFACTURERS. ALSO, REFER TO THE ANSI STANDARD "VEHICLE LIFT POINTS FOR SERVICE GARAGE LIFTING," ANSI/SAE J2184-OCT92, SAFETY MANUAL "LIFTING IF RIGHT," ALI/SM01, AND "VEHICLE LIFTING POINTS GUIDE" ALI/LP-GUIDE FOR PROPER POSITIONING OF VEHICLES ON LIFT.

AFTER LIFTING THE VEHICLE TO THE DESIRED HEIGHT, ALWAYS LOWER THE UNIT ONTO THE MECHANICAL SAFETIES. THE FORMING OF GOOD OPERATIONAL WORK HABITS WILL ELIMINATE OVERSIGHTS IN THE USE OF PROVIDED SAFETY DEVICES.

# POWER SUPPLY REQUIREMENTS

This lift comes with (2) 12 VDC batteries in series to provide a 24 VDC system. A separate 120 VAC power supply is only required when charging the post. Each post comes equipped with a 120 VAC, 60 HZ receptacle which accepts a 120 VAC extension cord. The minimum amp draw is 3 amps per post. Use sizes of plug, cord and power supply as follows:

## Plug Requirements:

NEMA Type 5-15 (Female), 125 VAC, 2 Pole, 3 Wire Grounding, 15 Amp Rated.

## Cord Requirements:

3 Wire, 125 VAC, 15 Amp Rated, Oil Resistant, Type G, SO, STO, or W. (Maximum Length is 50 feet)

## Power Requirements:

115-120 VAC, 2 Pole, 3 Wire Grounding, 60 Hz, 3 Amps minimum per post. Size circuit breaker to NEC and local codes.

**WARNING:** Keep in mind that branching extension cords between posts will multiply the amp draw. (i.e. 6 posts will collectively draw 18 amps).

**NOTE THAT THESE POSTS WILL NOT OPERATE AND CHARGE AT THE SAME TIME. REMOVE THE POWER LEADS TO THE CHARGER RECEPTACLE PRIOR TO LIFT USAGE.**

## OPTIONAL EQUIPMENT

Note: Refer to Option Equipment Section in the back of this manual for specific user instructions for option available for this lift.

The standard mobile lift is suitable to lift wheeled vehicles by the tires. It normally comes in pairs of columns totaling 2, 4, 6 or 8 column systems. Ordering additional **dummy plugs** may enable one lift to be used in a variety of combinations simultaneously.

A **hand control pendant** is available and can be connected to any column.

If it is desired to raise the vehicle by the frame, this can be done by using optional **chassis lifting beams** or optional **frame contact adapters**. The chassis lift beam fits into the cradle where the tire would normally fit and spans between a pair of columns. Frame contact adapters convert a pair of mobile lift columns into a 2-column frame engaging lift. Refer to the ANSI standard “Vehicle Lift Points for Service Garage Lifting,” ANSI/SAE J2184-Oct92, safety manual “Lifting it Right,” ALI/SM01, and “Vehicle Lifting Points Guide” ALI/LP-Guide for proper positioning of vehicles on lift.

If it is desired to raise fork trucks, a **fork truck adapter kit** is available, which converts a pair of mobile lift columns into a 2-column pad engaging lift.

For lifting applications involving side wing plows or RV’s with side extensions, where the forks of the mobile lifts can not reach to the tires, **wing plow adapters** are available. These adapters span between a pair of columns to achieve engagement of the tires in the same manner of the column forks.

For lifting of vehicles with dual tires, floatation tires, or “super singles”, **longer forks** are available. Note that the longer fork lifts have reduced capacity.

**Jack Stands** are also available that support the vehicle in the raised position for maintenance or to permit using the lift for other vehicles.

### **NOTE:**

The use of any adapters on this lift may reduce the capacity of this lift. Refer to the capacities of the adapters used.

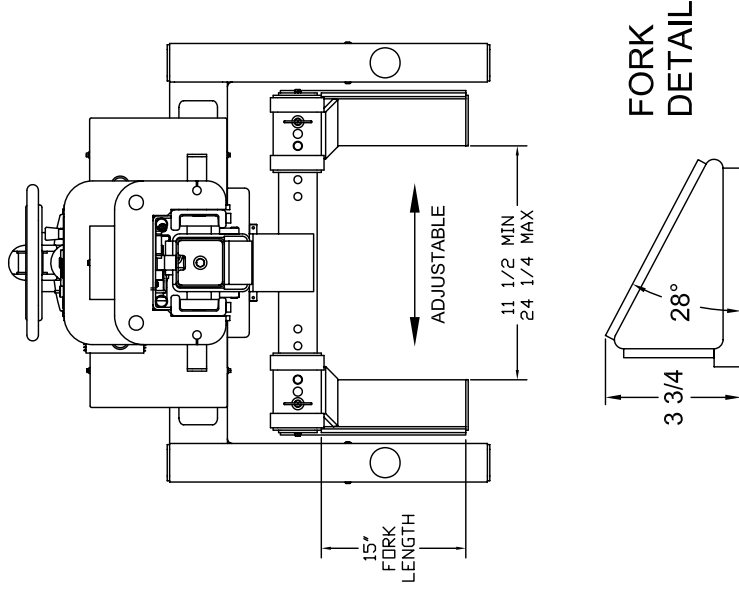
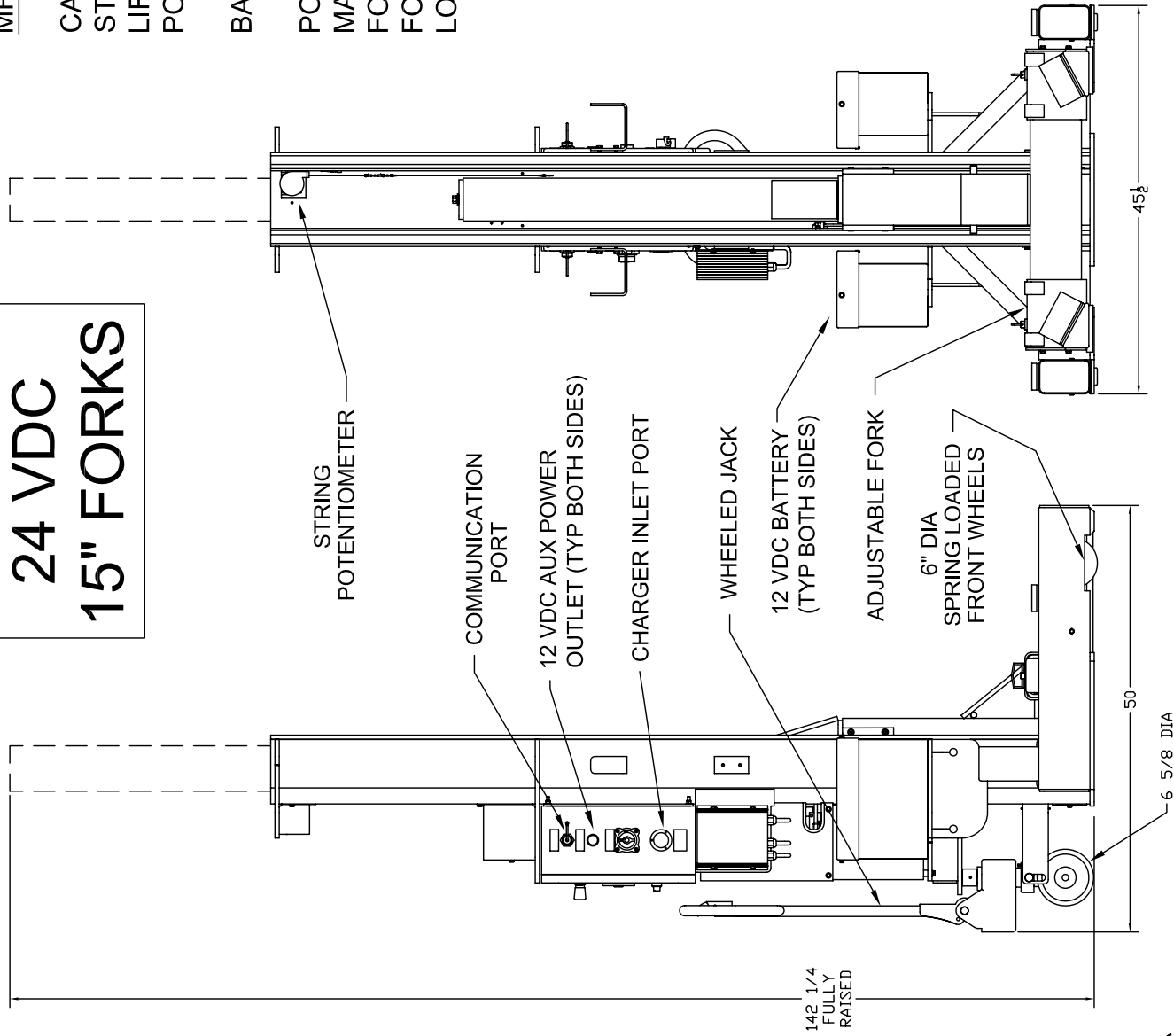
### **WARNING!**

Use only options manufactured by MOHAWK RESOURCES LTD with this lift. Options manufactured by others and used on this lift may result in bodily harm, damage to lift and other equipment, and will void lift warranty, Mohawk Resources Ltd liability, and the ALI certification of the lift.

24 VDC  
15" FORKS

MP-18 (24 VDC) SERIES POST SPECIFICATIONS:

- CAPACITY: 18,000 LB EACH
- STROKE: 67 INCHES
- LIFTING SPEED: 90 SECONDS (VARIES W/ LOAD)
- POWER REQUIRED: 120 VAC, 4 AMPS PER POST (FOR CHARGER)
- BATTERY SPEC: (2) 12 VDC DEEP CYCLE  
SEALED - MAINTENANCE FREE
- POST QUANTITY: 2, 4, 6 OR 8
- MAX TIRE SIZE: 48 INCH DIA
- FORK LENGTH: 15 INCH
- FORK WIDTH: 11 1/2 INCH MIN, 24 1/4 MAX
- LOCK POSITIONS: 3" INTERVALS STARTING @ 12"



C-SIZE

NOTICE OF CONFIDENTIAL INFORMATION

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- NOTES:
1. REMOVE ALL SHARP CORNERS & EDGES.
  2. UNLESS OTHERWISE SPECIFIED, SURFACE FINISH TO BE 125 RMS.
  3. WELDING MEDIUM SHALL CONFORM TO AWS SPECIFICATIONS TO E-70XX ELECTRODES OR E-70T1 CODE 5.3 FLUX CORE WIRE ONLY.

TOLERANCES:  
ANGULAR ± 1°  
DIMENSIONAL ± .030  
DECIMAL 0.XXX ± .005  
FILE NAME  
MP-5400-A-002.dwg

SCALE  
1'0"=1'0"

CHECKED

DATE  
4/07

WEIGHT  
n/a

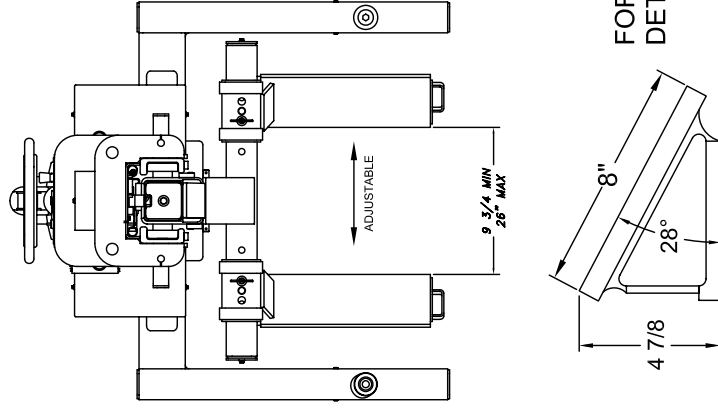
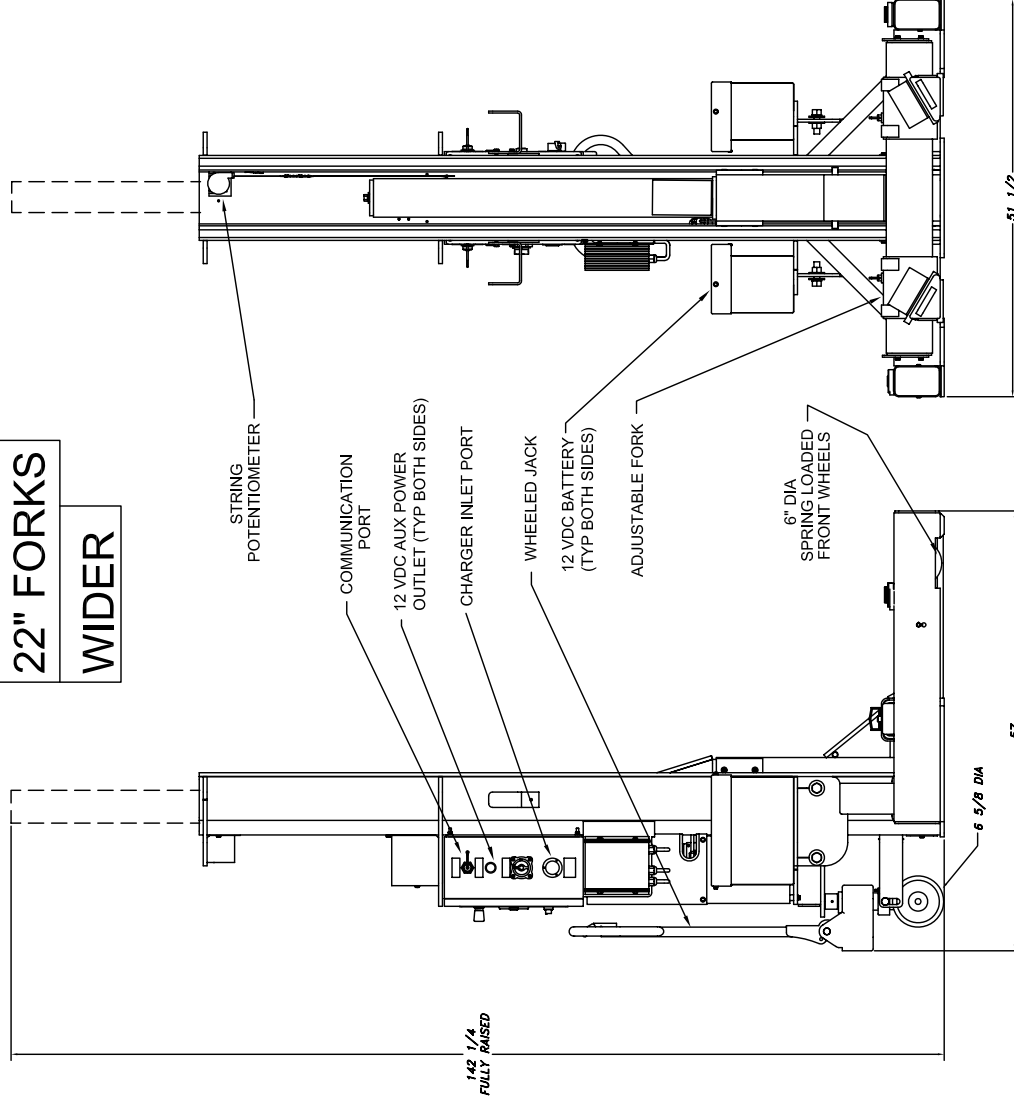
FROM  
n/a

DRAWING NUMBER  
MP-5400-A-002

SCALE	DRAWN	MOHAWK RESOURCES LTD.
CHECKED	APPROVED	TITLE
DATE	WEIGHT	MP-18 (24VDC) w/15" Forks
FROM	DRAWING NUMBER	Specification Drawing
MP-5400-A-002		

**MP-18 (24 VDC) SERIES POST SPECIFICATIONS:**

CAPACITY: 18,000 LB EACH  
STROKE: 67 INCHES  
LIFTING SPEED: 90 SECONDS (VARIES W/LOAD)  
POWER REQUIRED: 120 VAC, 4 AMPS PER POST (FOR CHARGER)  
BATTERY SPEC: (2) 12 VDC DEEP CYCLE  
SEALED - MAINTENANCE FREE  
POST QUANTITY: 2, 4, 6 OR 8  
MAX TIRE SIZE: 48 INCH DIA  
FORK LENGTH: 22 INCH  
FORK WIDTH: 9 3/4 INCH MIN, 26" MAX  
LOCK POSITIONS: 3" INTERVALS STARTING @ 12"

[illegible]

## DESIGN AND CONSTRUCTION

The standard mobile lift is suitable to lift wheeled vehicles by the tires. It normally comes in pairs of columns totaling 2, 4, 6 or 8 column systems. Each column consists of a rigid frame of three-wheel design for maneuverability, lifting carriages with tire forks, control panel, electric-hydraulic power unit, and hydraulic cylinder.

Two of the wheels are spring loaded and in fixed positions on the column base. The third wheel is steerable and hydraulically operated, permitting movement of the unloaded columns, but allowing the column to sit firmly on the floor before a load is applied.

Since this lift is battery powered, each post is identical except for post identification (Post ID), and each has communication outlets to attach to the other posts, forming configurations from 2 posts all the way up to 8 posts (see lift setup).

When the lift is raised or lowered in the “synchronized” mode the actual movement of each carriage is measured and compared by each post’s PLC (programmed logic controller). If the movement of any carriage exceeds that of any other carriage in the system, the carriage is slowed down or stopped until the others catch up.

Each post houses the same controls, enabling the user to control the whole lift, a single post or a post-pair combo at any post desired.

A hydraulic cylinder, powered by an electric-hydraulic pump unit, controls the carriage movement. There is an internal relief valve on the pump unit, which prevents overloading of the carriage.

A separate automatically engaging back-up mechanical safety lock latch prevents lowering of the carriage in the event of failure of the hydraulic system.

All movement controls are of the “vigilance control” type which are operable only as long as the operator is depressing the button. As soon as the button is released the motion will stop.

All columns have controls for synchronized or individual column movement, plus an “Emergency Stop”.

Depressing the Emergency Stop button will stop all columns immediately and will not permit any column movement until the depressed button is reset.

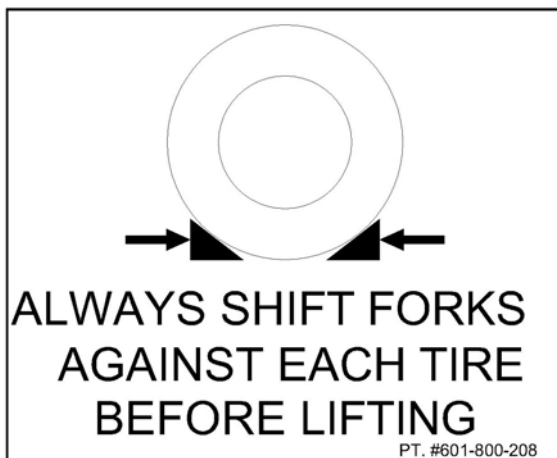
# MOBILE LIFT SET-UP

THOROUGHLY READ THIS SECTION BEFORE OPERATING THE LIFT. IF YOU HAVE ANY QUESTIONS, GET THEM ANSWERED BEFORE PROCEEDING. REFER TO ANSI/ALI ALIS “SAFETY REQUIREMENTS FOR INSTALLATION AND SERVICE OF AUTOMOTIVE LIFTS.”

1. Be sure that the floor is strong enough to support the lift before operating. Do not use the lift on asphalt surfaces, as the lift will sink (cause depressions in the asphalt) if the vehicle is on the lift for any extended period of time. Minimum recommended flooring is 4 ½” thick concrete with 3000 psi compressive strength on grade.

If it is necessary to use the lift on an asphalt surface, it is recommended to use a steel plate, a minimum thickness of 3/8” (8mm) which extends a minimum of 6” on all sides beyond the support points of the base of the lift. This will minimize sinking effect if the vehicle is raised for an extended period of time.

2. Be sure that the surface of the floor is relatively flat. If there is a slope of more than 3 degrees (1 inch decline over 20”) do not operate the lift. Relocate to a flatter surface.
3. Verify adequate ceiling clearance to raise the vehicle without the top of the vehicle coming in contact with any obstruction. If necessary, measure the lowest point to determine how high you can raise the vehicle. Minimum height required is the tallest vehicle height plus 67”. NOTE: the maximum lifting height of these columns is an adjustable setting in the PLC. Contact the factory if you wish to lower the lifting height for a low ceiling or other overhead obstructions.
4. Drive the vehicle to the working spot. Do not drive the vehicle over the cables of the lift. The cables should be arranged in a “U” shape around the entry of the vehicle or the cables should be disconnected and stored before moving the vehicle.
5. Unplug all power leads to chargers on all posts.
6. Ensure posts pairs are opposite each other at each axle (Post Pairs are 1&2, 3&4, 5&6, 7&8). Push the cradle forks of each post around each tire. Be sure to push them in as far as possible. The wheel rim should be larger than the opening in between the forks. See figure below. Ensure that fork pins are placed in holes at fork tubes.

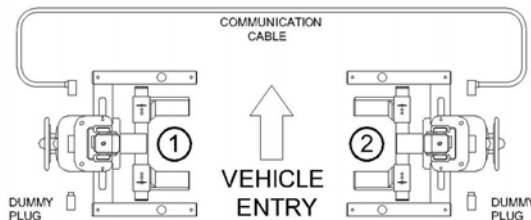


7. Press the release lever to lower all jacking wheels on back of all posts after positioning.
8. Connect the communication cables from post to post in a daisy-chain fashion. For example: Posts 1 to 3 to 4 to 2 for a 4-post setup. Place dummy plugs (male and female ends) at the posts at the end of the chain. (See figure below) Note: This lift indicates what posts are communicating within the system at start up. (Refer to Explanation of Computer System – System Activation Section)

## MP-24VDC-SERIES POST CONFIGURATIONS

MOST COMMONLY USED COMBINATIONS SHOWN  
OTHER COMBINATIONS AVAILABLE (REFER TO USER MANUAL)

### 2-POST CONFIGURATION



#### WARNING!

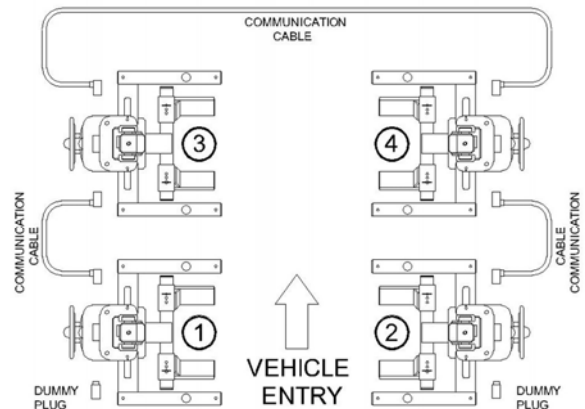
FAILURE TO SETUP AND CONNECT POSTS AS SHOWN ABOVE MAY RESULT IN BODILY INJURY AND/OR DAMAGE TO EQUIPMENT.

#### NOTES:

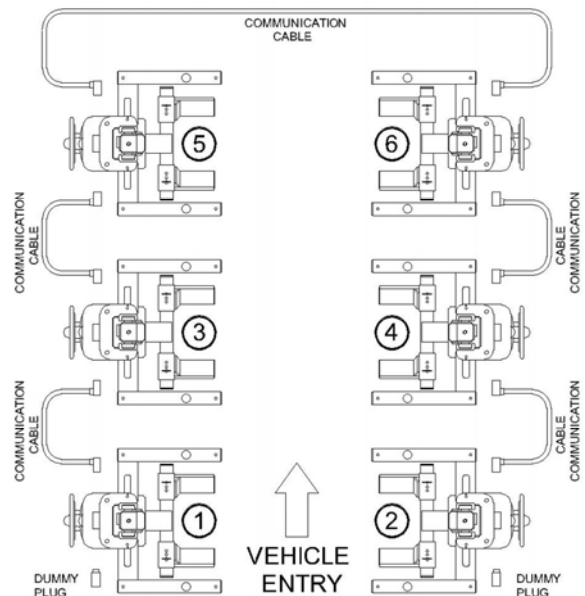
1. CONNECT ALL COMMUNICATION CABLES, AND DUMMY PLUGS AS SHOWN ABOVE FOR THE CONFIGURATION USED.
2. ENSURE THAT ALL CONNECTIONS ARE SECURE.
3. PAIRED COLUMNS WILL ALWAYS ACT AS PAIRS, REGARDLESS OF WHERE THEY ARE LOCATED WITHIN THE SYSTEM. PAIR COMBINATIONS ARE AS FOLLOWS:  
 POST #1 & #2  
 POST #3 & #4  
 POST #5 & #6  
 POST #7 & #8
4. CONSULT MANUAL FOR SETUP AND CONNECTIONS.

P/N #601-800-287

### 4-POST CONFIGURATION



### 6-POST CONFIGURATION



# MOBILE LIFT OPERATION

1. Perform Lift Setup as stated in previous section.
2. Disengage all E-STOP buttons at each post by turning them clockwise to release them. Turn on the main switch for each post to "OPERATE LIFT". The display will light up to indicate the post power is on. Repeat for each post in the system. Notice that the displays will indicate which posts are communicating in the system. Verify this configuration to continue operation. The system is now ready to operate.

## 3. **SINGLE WHEEL OPERATION**

Go to each wheel and engage each tire with the forks. To raise only a single wheel, turn the selector switch to SINGLE at the post that control is desired, while pressing the RAISE button. The SINGLE operation is to be used only to initially engage the tires and for slight equalization adjustments.

During lift operation, if single wheel lifting, lowering or parking is desired, turn the selector switch to SINGLE at the post that control is desired, while pressing the RAISE button.

**BE VERY CAREFUL WHEN DOING THIS OPERATION THAT THE VEHICLE REMAINS STABLE AND THAT THE SIDE OF THE VEHICLE DOES NOT COME IN CONTACT WITH THE COLUMN.**

NOTE: If the SINGLE switch is released while the UP or DOWN button is still pressed the hoist will operate in default ALL synchronized mode (All posts will be controlled).

## 4. **RAISING ALL WHEELS**

The lift controls default to controlling ALL the columns in the system (selector switch is spring returned to ALL). Press the RAISE button to raise the lift. Keep the pressure on the button until the vehicle is raised to the desired position. If necessary, use a second person to observe the area not seen by the operator.

## 5. **PARKING ALL WHEELS (ON MECHANICAL LOCKS)**

The lift controls default to controlling ALL the columns in the system. Press the PARK button to lower the lift onto the mechanical locks. Keep the pressure on the button until the vehicle is completely lowered onto the locks. If necessary, use a second person to observe the area not seen by the operator.

## 6. **LOWERING ALL WHEELS**

The lift controls default to controlling ALL the columns in the system. Press the LOWER button to lower the lift. Keep the pressure on the button until the vehicle is lowered to the desired position. If necessary, use a second person to observe the area not seen by the operator.

NOTE: If lift is in park position (on mechanical locks), you will have to raise lift off of locks first, then lower. Lift will not automatically rise off of locks when pressing lower.

## 7. PAIR OPERATION

To raise, lower or park only a pair of wheels, turn the selector switch to PAIR at the post pair that control is desired, while pressing the RAISE, LOWER or PARK button.

NOTE: Be sure that the set of wheels on the ground is free to move as the effective distance between the front and rear wheels becomes less as one pair of wheels is higher or lower than the other pair. Keep the height difference between pairs as low as practical.

NOTE: If the PAIR switch is released while the UP or DOWN button is still pressed the hoist will operate in default ALL synchronized mode (All posts will be controlled).

### LIFTING EXAMPLE:

Now that all the setup and operations instructions have been presented, an example of a typical lifting application is shown:

A mechanic is to perform maintenance on a school bus. He drives the vehicle into the bay. He then unplugs any power cables to the charger inlets on all of the posts to be used. He jacks each post with the pallet jack and moves them to each of the tires in the post configuration shown in the setup diagram. Pushing the posts firmly against the tires, he checks to ensure that the forks are slid inward as far as possible to engage the tires. He presses the pallet jack release on each column. He then connects the communication cables and dummy plugs to all the posts as shown in the setup diagram.

He is now ready to use the lift. He turns the main switch to “Operate Lift” and releases the E-Stop Button on each post of the system. Once this is done, all the displays should illuminate. He reads the post communication screen to verify that all the columns are present and accounted for on the display. He presses the appropriate button on the screen to verify the post set-up. The lift system is now ready to operate.

The mechanic then goes to each post and presses UP and SINGLE for a short moment to engage each tire with the forks until the spring loaded wheels of the post retract and the post feet are flattened on the floor. (The SINGLE function is to be used for slight adjustments and to initially engage the tires ONLY). The mechanic then presses UP and raises the vehicle to the desired height. Then the PARK button is pressed and held until the vehicle stops on the mechanical locks.

The mechanic is now able to work on the vehicle. Once done, he presses UP to lift the vehicle off of the mechanical locks. The DOWN button is pressed to lower the lift to the ground. If any adjustments were made (like SINGLE or PAIR) which made the lift level vary from the floor level, the lift may experience a fault when lowered to the floor. Pressing RESET will clear this fault and allow further lowering. Also, reversing the adjustments by pressing SINGLE or PAIR will allow the user to lower the lift fully to the floor. Once vehicle is fully lowered, cables are stored and posts are jacked up and pulled away.

# AUTOMOTIVE LIFT SAFETY TIPS

Post these safety tips where they will be constant reminder to your lift operator.

For information specification to the lift, always refer to the lift manufacturer's manual

1. Inspects your lift daily. Never operates if it malfunctions or if it has broken or damaged parts. Repairs should be made with original equipment parts.
2. Operating controls are designed to disengage when released. Do not block closed or override them.
3. Never overload your lift. Manufacturers rated capacity is shown on nameplate affixed to the lift.
4. Positioning of the vehicle and operation of the lift should be done only by trained and authorized personnel.
5. Never raise vehicle with anyone inside it. Customers or bystanders should not be in the lift. During operation.
6. Always keep lift area free of obstructions, grease, tools, trash and other debris.
7. While working under the vehicle, lift should always be set on mechanical locking devices.
8. Note that with some vehicles, the removal (or installation) of components may cause a critical shift in the centre of gravity and results in raised vehicle instability. Refer to the vehicle manufacturer's service manual for recommended procedures when vehicle components are removed.
9. Before lowering lift, be sure tool trays, stands, etc. are removed from under the vehicle. Release locking devices before attempting to lower lift.
10. Before removing vehicle from lift area, remove posts to provide and unobstructed exit .

These "Safety Tips" along with "Lifting it Right" a general lift safety manual, are presented as an industry service by the Automotive Lift Institute. For more information on this topic, writes to ALI, PO Box 85, Cortland, NY 13045

# MAINTENANCE INSTRUCTIONS

1. The channel sections where the carriage bearings ride against should be cleaned and lubricated twice a year (once every 6 months) using a light lubricant (WD-40). The channel sections where the slide blocks ride against should be cleaned and lubricated twice a year (once every 6 months) using a light lubricant (WD-40).
2. The main carriage bearings are factory lubricated and do not require any additional periodic lubrication. However, if additional lubrication is desired on these under the customer's own inspection and maintenance program, it is recommended to use CAM2 – Multipurpose #2 Grease (Part No. 86035) or equivalent. Use approximately 2 oz. per bearing.
3. Weekly, or whenever the hoist is used after any extended down time, the communication cables should be checked to make sure that there are no nicks or cuts which may reduce or compromise the insulation. Use a de-greasing cleaner to clean all cables so they maintain their visibility (Ensure cables are disconnected when cleaning them and do not spray cleaner on end connections). Also, check visually the hydraulic line connections for leaks and tighten or repair as necessary.
4. The hydraulic fluid should be changed once every two years using new Dexron III ATF. Drain the reservoir tank only when the carriage is in the lowered position. Fill with 3.25 US gallons per reservoir.
5. Every three months check snap rings on wheels and carriage lock. Apply a light coating of lubricant to pins as needed (WD-40).
6. In case of electrical break down have qualified service personnel service the lift using only factory direct replacement parts.
7. Call your Distributor or Factory direct if you have any questions with regards to operating the lift or need of replacement parts.

## **NOTE:**

**ONLY TRAINED LIFT SERVICE PERSONNEL ARE PERMITTED TO REPLACE WORN OR BROKEN PARTS.**

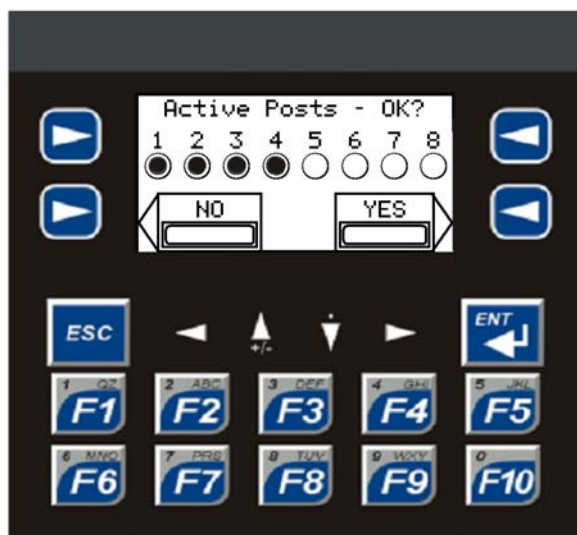
**REPLACE FAULTY PARTS WITH GENUINE MOHAWK RESOURCES LTD. FACTORY DIRECT PARTS ONLY.**

# EXPLANATION OF COMPUTER SYSTEM

## SYSTEM ACTIVATION

All posts on this system are identical (there is no master or slave columns). After the posts are connected as described in the lift setup, the lift is ready to be activated. As each post is turned on, they “search” for each other, establishing a shared network for synchronizing and controlling the lift as a system.

The first thing the user must do to operate the lift is to verify that the network is detecting the desired number of columns to use. Pressing the selection key arrow to the right of “YES” will allow the user to begin raising and lowering the lift.



Example Screen shows lift with 4 posts present in system, Post #1, #2, #3, and #4. Pressing the right selection key arrow will activate lift.

Post presence will be affected by how many posts are connected in the system, if they are connected properly (see lift setup), if the dummy plugs are connected properly (see lift setup), and if they are turned on (to “Operate Lift”).

## OPERATION OF SYNCHRONIZED LIFTING OR LOWERING

Each PLC (programmable logic controller) is “addressed” which establishes its identity on the network. For example, post #1 has a PLC with address #1, etc. Once communication of the network of PLCs is established, each PLC senses control and position inputs from each other. Be aware that pairs are designated as post #1&2, post #3&4, post #5&6, and post #7&8, regardless of where they are physically placed in the system.

The height of each carriage above floor level is measured by string potentiometers (see next section) and compared to the other carriages by the PLC network. During raising, if any one carriage position is more than 1” higher than the lowest carriage, the higher (fastest) one slows down or stops to allow the lowest (slowest) one to catch up. During lowering, if any one carriage position is more than 1” lower than the highest carriage, the lower one slows down or stops to allow the highest one to catch up. This is all done by shifting motor contactors and lowering solenoid valve.

When lifting in Pair or Single mode, counting is not done, resulting in the PLC’s seeing a “synchronized” state after this adjustment is made. There are limits on how far the lift will allow a Single post to raise/lower, and how far a Pair of posts can raise/lower relative to the rest of the system.

If you turn off the unit or press the Emergency Stop button, the computer position for each column is still retained and the columns will still maintain synchronized relative positions.

## FUNCTION OF STRING POTENTIOMETER (String-Pot)

There is a string potentiometer (string-pot) mounted on the top of each column, and connected to each carriage, which senses the movement of the carriage. The string-pot sends an absolute analog (4-20mA) signal to the PLC as the string is pulled in and out of the sensor. This signal is absolute, which means that the lift will always know the height of the lift, even when powered off and on again. This signal is directly translated into height position and can be witnessed by viewing the Post Height Screen, F2. If raising or lowering is not possible, manually pulling the string-pot cable, while the unit is powered and pressing F2, will enable you to see the height changes.

## FUNCTION MENUS

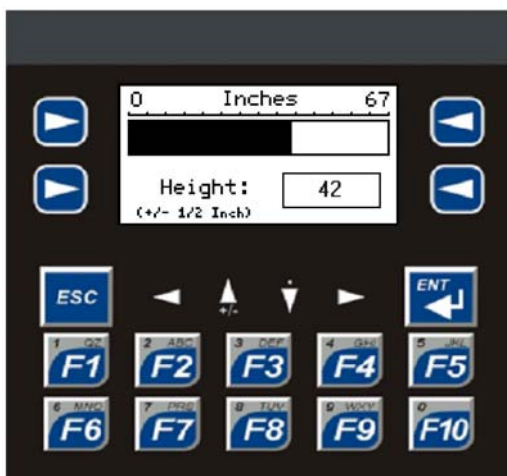
The control screen has 10 function keys that will display various menus. They are as follows:



### F1: Post ID and Active Posts Display

This screen will display the Post ID and all the active posts of the system it is connected to.

i.e. The display to the left shows post #2 connected in a 4-post system manner with posts #1, 2, 3, & 4.



### F2: Post Height Display

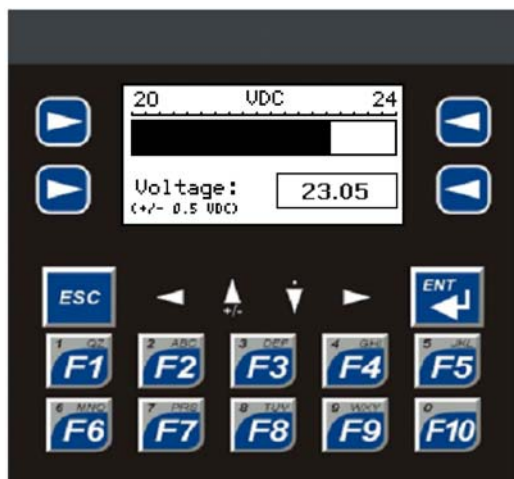
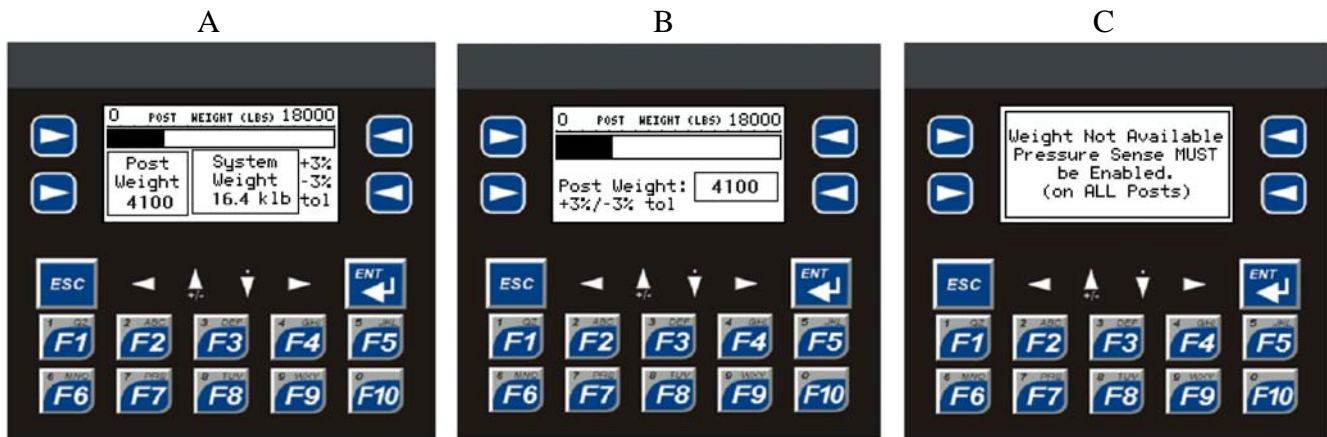
This screen will display the current post height in inches.

i.e. The display to the left shows the post at a height of 42 inches. (Note the tolerance of +/- 1/2 inch)

### F3: Weight Display

This screen will display 1 of 3 screens, depending if the lift has the hydraulic pressure sensing option present. If all the posts in the system have the pressure sense option, the screen (A) will display showing the weight on the post and the total weight of the system. If only the present column has the pressure sense option, then screen (B) will display, showing only the post weight. If you are at a column that does not have a pressure sense option, then screen (C) will display. (Note the tolerance of +/- 3% in weights shown)

Refer to F9 for factory settings enabling and disabling the pressure sense option in each post.



### F4: Voltage Display

This screen will display the current voltage (VDC) of the battery system.

i.e. The display to the left shows the post at 23.05 VDC.  
(Note the tolerance of +/- 0.5 VDC)

### F5: User Settings Display

This screen displays general user settings of the lift. Pressing enter and the up or down arrow keys will scroll through this menu. Press Escape and the Exit Key to Exit Menu. Item shown in this menu are as follows:



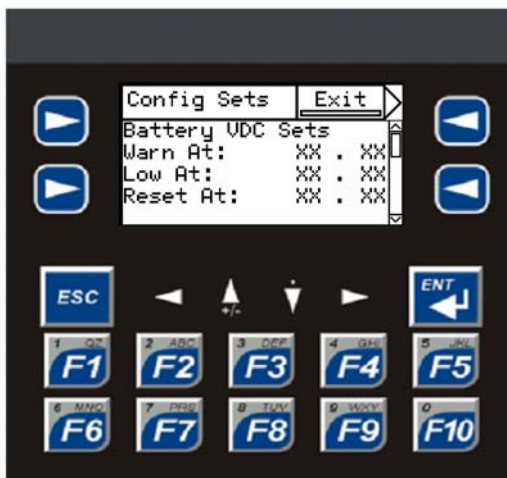
Post ID  
Post Capacity  
Serial Number  
Maximum Height Limit  
Warranty Expiration Date  
Lifting Cycles Used



### F7: Maintenance/Service Display

#### (Distributor or Factory Password Protected)

This screen displays general service and inspection information and service contact information. Distributor or Maintenance personell password required. (See F10).



### F8: Configuration Settings (Factory Password Protected)

This screen displays configuration settings for the battery voltage monitoring, string-pot height sensor, and the pressure sensor. This is only accessible with the factory password (See F10).



### **F9: Factory Settings (Factory Password Protected)**

This screen displays factory settings. This is only accessible with the factory password (See F10).



### **F10: Password**

This screen allows entry of the password which will give access to the PLC configuration settings and screens F9 and F10. Enter either the Distributor Password to give limited access to F7 screen, or the Factory Password to give access to all password protected screens.

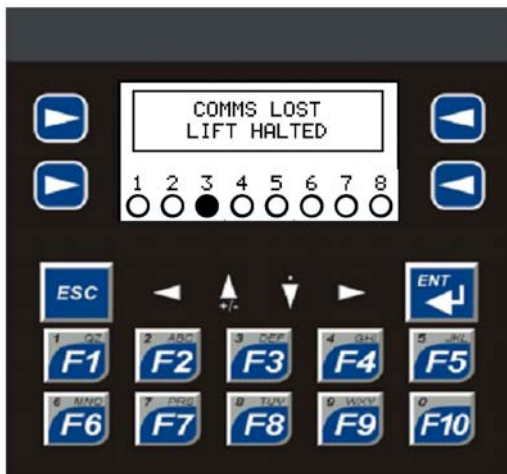
### **ERROR MESSAGES:**

The following are a list of error messages that may display if certain situations arise.



### **Post Count Error:**

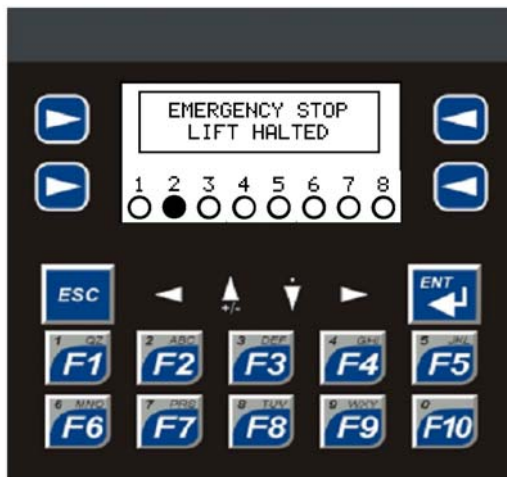
This screen appears if the user says “NO” to the initial Active Posts response screen.  
(See System Activation above)



### Comms Lost Error:

This screen appears if any column in the system is lost after it was previously present. This could be due to a column being turned off or if the communications to the post are not connected. The post in which communications is lost will be identified on the screen. All controls will be locked-out until this is remedied.

i.e. The display to the left shows loss of communications to post 3.



### E-Stop Error:

If any post in the system has an Emergency Stop button pushed, this screen will appear showing which post was stopped. All controls will be locked-out until this is remedied.

i.e. The display to the left shows the emergency stop button pushed on post 2.



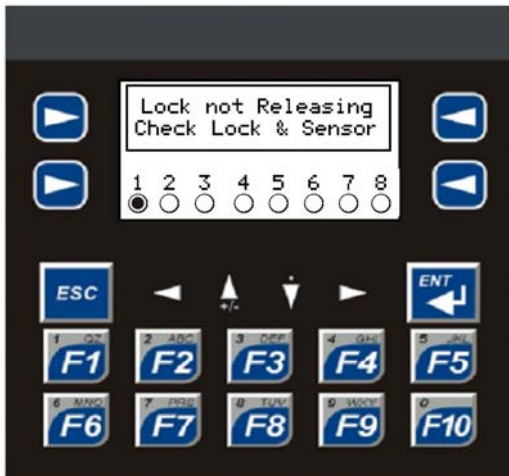
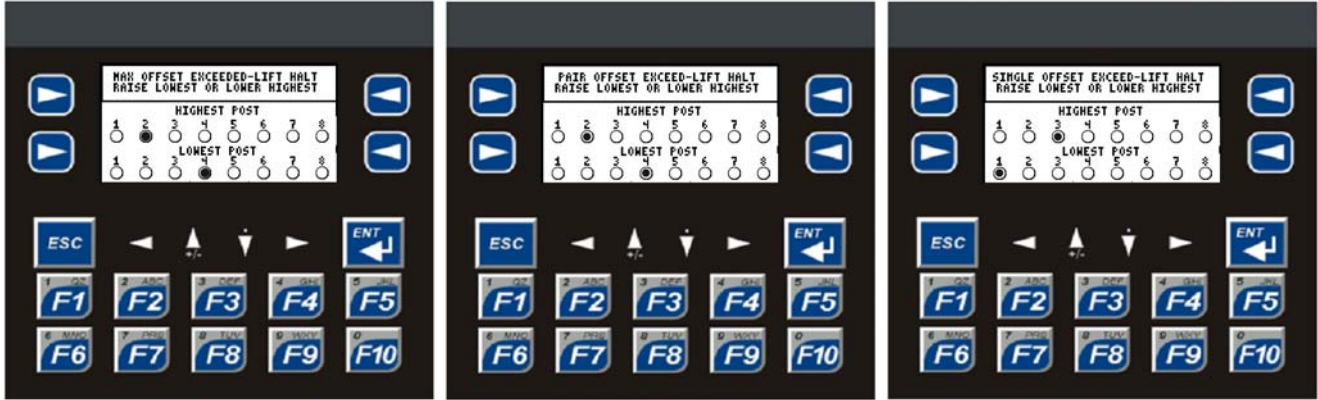
### Lift at Max Height Error:

Indicates that a post has raised to the maximum height setting (set in the factory setting menu). The post that has reached this height will be identified. Raising and parking are **not** allowed in this situation, only lowering. (Note that the max height setting is adjustable for buildings with low clearance, etc..)

i.e. The display to the left shows that post 4 has reached max height.

### Maximum Offset Error:

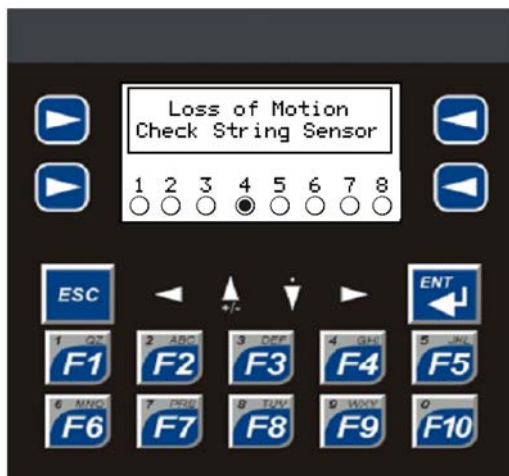
There are limits on how far any post can be out of level from any other post, even when using Single and Pair overrides. If any post reaches its limits, one of the following screens will be displayed (depending on if the unit is being used in All, Pair, or Single). The highest and lowest posts will be identified. Raising is only allowed on the lowest post, Lowering only allowed on the Highest post. These offsets are normally outside the bounds of normal usage and prevent extreme out of level conditions.



### Lock Not Releasing Error:

This screen will only occur during Lowering of the lift. This screen indicates that one of the locks is not released, and it will prevent the lift from lowering. This may be due to a lock on the identified post from being mechanically parked, the solenoid not pulling the lock back, or the sensor not “seeing” the lock pulled back (sensor may need to be adjusted). The post that causes this error will be identified.

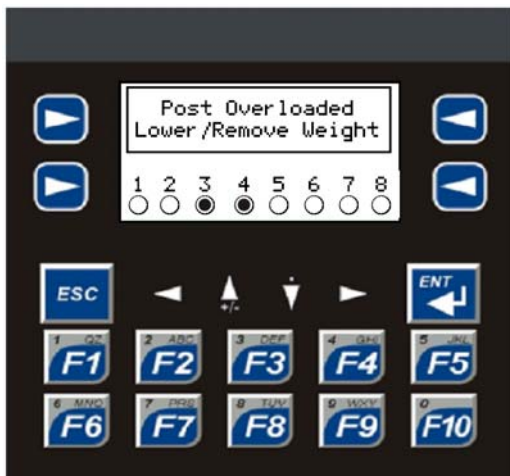
i.e. The display to the left shows that post 1 lock is not released.



### Loss of Motion Error:

This screen will occur if any post is not sensing motion when a raise or lowering command is present. This may occur if a post string-pot is disconnected, malfunctioning, or cable is broken. This also may occur if the lift is lowering onto an obstruction to prevent its motion. Press Exit key at post this occurs at to remove message. (Note: If message remains, then the string-pot is disconnected and needs to be repaired)

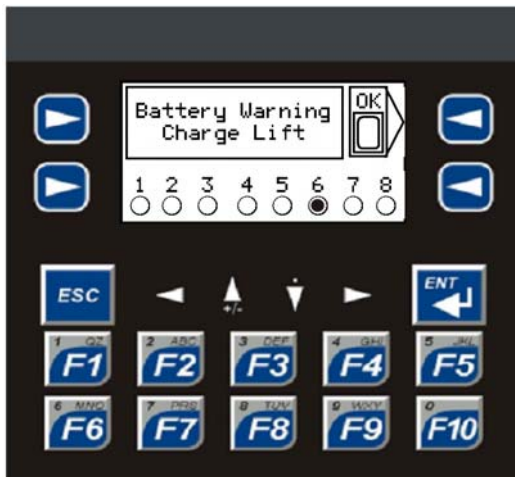
i.e. The display to the left shows that post 4 experienced a loss of motion while raising or lowering.



### Post Overload Error: (Optional)

This screen will appear if any post has a weight on it that exceeds the capacity of the post. Post capacities are set in the factory setting menu. Raising and parking are not allowed in this situation, only lowering. (This error will only be present if the lift has the pressure sensing option.)

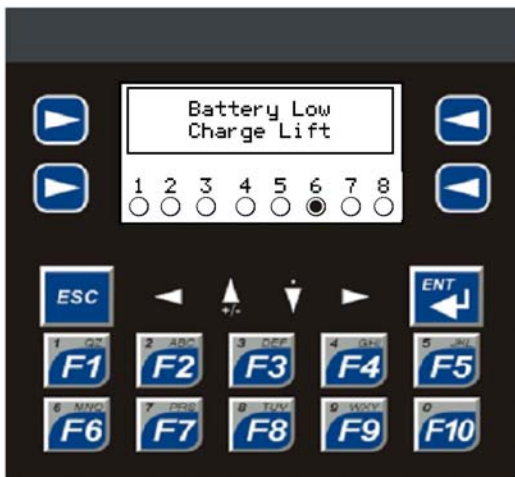
i.e. The display to the left shows that post 3 & 4 are overloaded.



### Battery Warning:

This indicates that one of the post's batteries are low on charge and need to be recharged. (Also, refer to battery meter above control screen.) Pressing the "OK" button will allow lift function, but only for a few cycles until the "Battery Low" error occurs (see below).

i.e. The display to the left warns that post 6 battery is low.



### Battery Low Error:

This indicates that one of the post's batteries is too low on charge and needs to be recharged. The lift will **not** function until this post is fully recharged.

i.e. The display to the left shows that post 6 battery is low and lift will **not** function until post 6 is fully recharged.

# TROUBLE SHOOTING

**NOTICE:** Read manual prior to trouble shooting. A good understanding of how this lift and its controls function will greatly help in understanding any problems that may occur.

## **START-UP:**

**Problem:** Upon power up, screen does not illuminate (on any single column).

**Solution1:** Verify that power cables are unplugged from charger inlets on all posts. Post will not power up unless power is removed from charger.

**Solution2:** Check to see that battery cables are connected to batteries properly. Also verify 24 VDC at the control panel.

**Solution3:** PLC may have faulty screen. Consult Mohawk Service department.

**Problem:** All posts are not shown on activation screen.

**Solution1:** Verify that all posts in system are turned on to “Operate Lift”.

**Solution2:** Check for proper communication cable and dummy plug connection of all posts. (See lift setup)

**Solution3:** Possible faulty communication cable or dummy plug. Consult Mohawk Service department.

**Problem:** Error Code present.

**Solution:** See Error Code Section in this manual.

## **DURING OPERATION:**

**Problem:** Error Code present.

**Solution:** See Error Code Section in this manual.

**Problem:** There is more than 1-1/2” height difference between carriages.

**Solution:** This may be due to the fact that one column was operated on SINGLE before operating the unit in the ALL mode. This may also be due to operating in the PAIR mode before operating in ALL mode.

**Problem:** Lift jack not raising lift or lift jack not collapsing when loaded.

**Solution1:** Lift jack relief valve needs to be adjusted. Turn relief set screw clockwise to increase lifting ability of jack. Turn relief set screw counter-clockwise to reduce lifting ability of jack. See illustration in back of manual.

Solution2: Jack is low on oil. Add oil. (Dexron III AFT or equivalent)

**Problem:** Carriage is lowering on its own.

Solution1: Check that there are no oil leaks by checking around the column. If so, repair the leak condition.

Solution2: If Solution 1 does not produce results, check for leakage of cylinder piston seals. Remove black plastic vent tube from power unit reservoir tank port and see if any fluid is flowing out. If so, cylinder piston seals are leaking. Contact Mohawk's Service department.

Solution3: If Solution 2 does not produce results, the lowering valve(s), located on the power unit may have collected some dirt, preventing them from sealing properly. Make sure that the carriage is lowered to floor level in order that there is no pressure in the system. Disconnect the power so that no one can start the unit. You can now remove the lowering valve(s). Disconnect the electrical leads from the solenoid using a screwdriver to remove the screw holding the two mating connectors. Remove the lowering valve(s) from the power unit and check to see that there is no foreign material in the valve ends, which prevent the balls from sealing. Remove the foreign material. If you cannot find any problem, replacement of valve may be required. Contact Mohawk's Service department.

Solution4: If Solution 3 does not produce results, the power unit's main load holding check valve may have collected some dirt, preventing it from sealing properly. Make sure that the carriage is lowered to floor level in order that there is no pressure in the system. Disconnect the power so that no one can start the unit. You can now remove the check valve components and check to see if there is any foreign material in the valve cavity to prevent the ball from sealing. Remove the foreign material. If you cannot find any problem, re-seating of the valve, or replacement of valve may be required. Contact Mohawk's Service department.

MODEL:
SERIAL NUMBER:
DATE OF INSTALLATION:

### SERVICE CHART

DATE	PART REPLACED / SERVICED	SERVICE COMPANY	SERVICED BY

### MAINTENANCE CHART

DATE	MAINTENANCE PERFORMED	SERVICE COMPANY	SERVICED BY

# MOHAWK



## PARTS

MP-18-24VDC-SERIES  
ELECTRIC/HYDRAULIC  
PORTABLE LIFT

#	DESCRIPTION	DATE	APPROVED
A	ITEM 10 WAS MP-5400-A-003	07/15/2008	DM

ATTACH PACKING TUBES  
(TYP 4 PLACES)

ATTACH PU ON POST SHELF  
(TYP 4 PLACES)

FOR MOUNTING ELECTRICAL CONTROL BOX  
(TYP 4 PLACES)

ATTACH PACKING TUBES  
(TYP 4 PLACES)

ATTACH PU ON POST SHELF  
(TYP 4 PLACES)

FOR MOUNTING ELECTRICAL CONTROL BOX  
(TYP 4 PLACES)

ATTACH PACKING TUBES  
(TYP 4 PLACES)

ATTACH PU ON POST SHELF  
(TYP 4 PLACES)

FOR MOUNTING ELECTRICAL CONTROL BOX  
(TYP 4 PLACES)

ATTACH PACKING TUBES  
(TYP 4 PLACES)

ATTACH PU ON POST SHELF  
(TYP 4 PLACES)

FOR MOUNTING ELECTRICAL CONTROL BOX  
(TYP 4 PLACES)

ATTACH PACKING TUBES  
(TYP 4 PLACES)

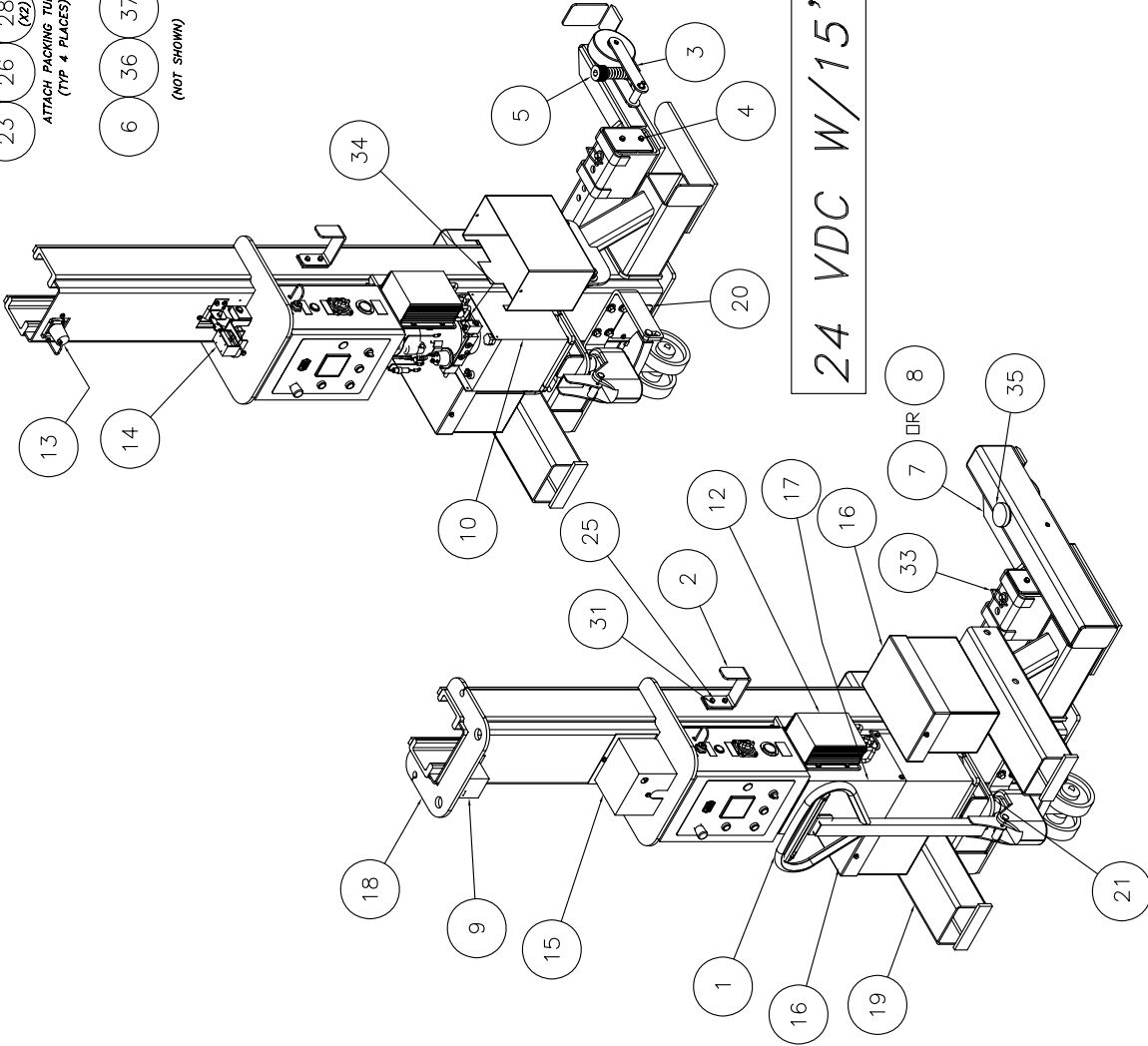
ATTACH PU ON POST SHELF  
(TYP 4 PLACES)

FOR MOUNTING ELECTRICAL CONTROL BOX  
(TYP 4 PLACES)

ATTACH PACKING TUBES  
(TYP 4 PLACES)

ATTACH PU ON POST SHELF  
(TYP 4 PLACES)

FOR MOUNTING ELECTRICAL CONTROL BOX  
(TYP 4 PLACES)



24 VDC W/15" FORKS

38	MP-5400-A-011	Tag & Decal Location, MP-24VDC	1
37	MP-5100-A-011	Cable Assy, 40" Lg, Black	1
36	MP-5100-A-010	Cable Assy, 36" Lg, Red	1
35	601-460-005	Cap, Plastic, Red, 3" Dia x 1/2 Thk	2
34	601-420-017	Elbow, 90 Deg, #6 ORB to #6 JIC	1
33	600-900-006	Hitch Pin, 3/4 Dia	2
32	600-720-008	Washer, Lock, 3/4	4
31	600-720-002	Washer, Lock, 5/16	8
30	600-710-004	Washer, Flat, 1/4	6
29	600-710-003	Washer, Flat, 5/16	12
28	600-710-001	Washer, Flat, 3/4	8
27	600-690-001	Nut, Nylon Lock, 5/16-18 NC	4
26	600-680-005	Nut, Plain, 3/4-16 NF	4
25	600-640-053	Bolt, Hex Head, 5/16-18 NC x 1/2 Lg (Gr 5)	4
24	600-640-039	Bolt, Hex Head, 1/4-20 NC x 3/8 Lg (Gr 5)	6
23	600-640-003	Bolt, Hex Head, 3/4-16 NF x 2 1/2" (GR5)	4
22	600-640-001	Bolt, Hex Head, 5/16-18 NC x 1 1/4" Lg (Gr 5)	8
21	600-630-003	Set Screw, 1/4-20 NC x 1/2 Lg	1
20	P-150-P-004	Access Hole Cover	1
19	MP-5400-W-001	Packing Tube Weldment (24V)	2
18	MP-5300-W-003	Leg Secondary Weldment, 24 VDC	1
17	MP-5300-A-002	PU Cover Assy (24 VDC)	1
16	MP-5300-A-001	Battery Box Assy	2
15	MP-5200-P-001	Lock Cover	1
14	MP-5200-A-001	Lock Release Assy, 24 VDC	1
13	MP-5100-A-014	String Pot Assembly, ANALOG	1
12	MP-5100-A-005	Charger Assembly	1
11	MP-5100-A-001	Master Box Assy	1
10	MP-5400-A-014	Power Unit Assy, 24 VDC (8-2008)	1
9	MP-1100-P-003	Sensor Cover	1
8	MP-1000-W-006	Fork Weldment, Right	1
7	MP-1000-W-005	Fork Weldment, Left	1
6	MP-0900-A-001	Cylinder Assembly	1
5	MP-0800-P-024	Threaded Spring Retainer	2
4	MP-0700-A-001	Carriage Assembly	1
3	MP-0500-A-001	Floor Roller Assembly	2
2	MP-0400-P-002	Cable Hook	2
1	MP-0400-A-003	Jack Assembly	1
ITEM	NAME	DESCRIPTION	QTY

TOLERANCES		SCALE		DRAWN		MOHAWK RESOURCES LTD.	
FRACTIONAL		1/8"=1'-0"		FW7089		TITLE	
DECIMAL				APPROVED		MP-24VDC-SERIES	
DIMS				CHECKED		Master Post Assembly	
FILE NAME		MP-5400-A-001.dwg		DATE		WEIGHT	
DESCRIPTION		NEXT ASSEMBLY		9/07		1700	
DRAWING NUMBER		MP-5400-A-001		FROM		1700	

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NOTES

1. FINISH ALL SHARP CORNERS & EDGES.
2. UNLESS OTHERWISE SPECIFIED, SURFACE FINISH TO BE 125 RMS.
3. WELDING MEDIUM SHALL CONFORM TO AWS E-7011 CODE S3 FLUX CURE WIRE ONLY.

24 VDC W/22" FORKS

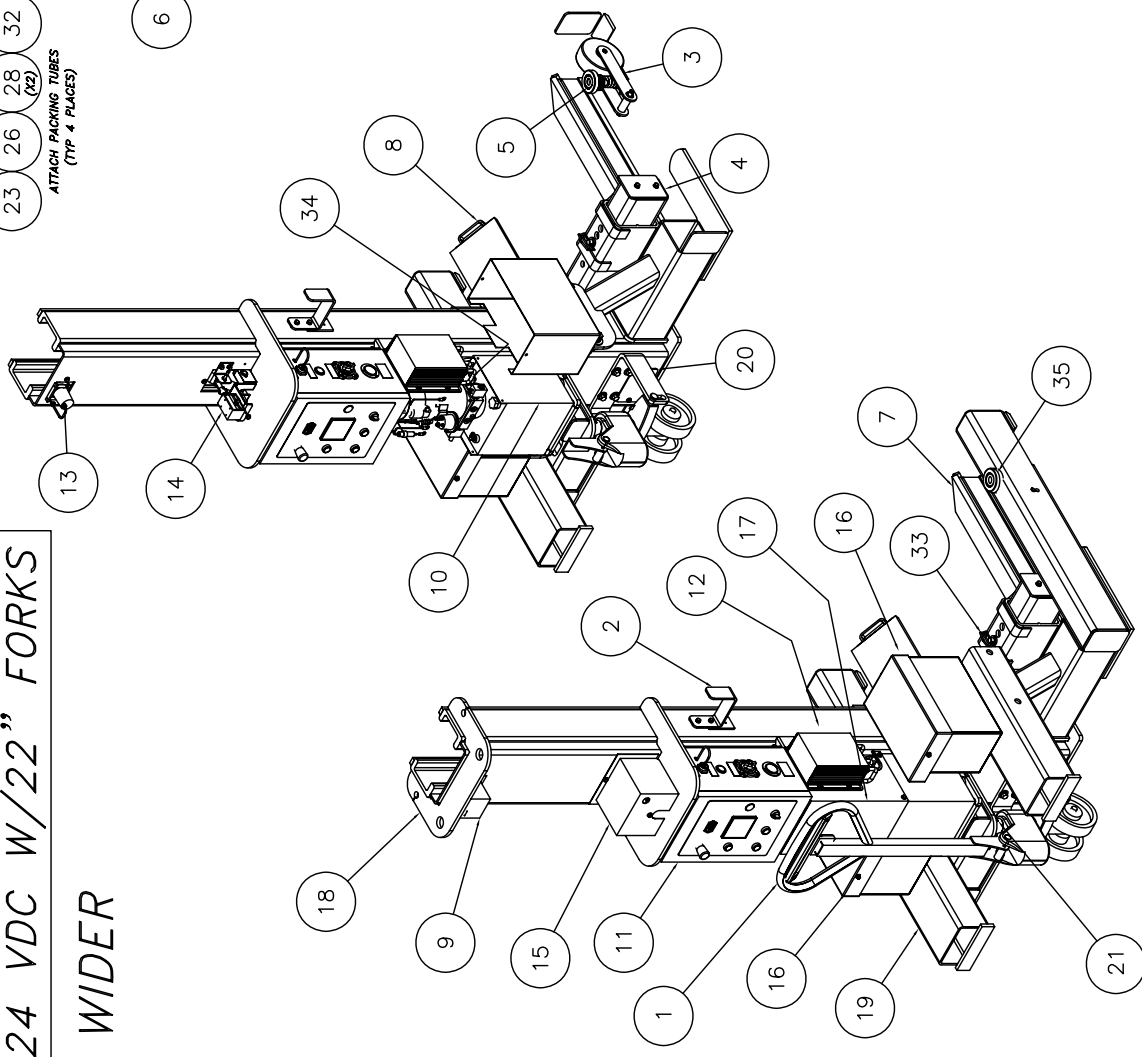
WIDER

- 23 26 28 32
- ATTACH PACKING TUBES  
(TYP & PLACES)
- 22 29 31
- ATTACH PU ON POST SHELF  
(TYP & PLACES)
- 22 27 29
- FOR MOUNTING ELECTRICAL CONTROL BOX  
(TYP & PLACES)

- 6 36 37
- (NOT SHOWN)

- 24 30
- AT ALL COVERS  
(TYP & PLACES)

- 25 31
- AT CABLE BRACKETS  
(TYP & PLACES)



37	MP-5100-A-011	Cable Assy, 40" Lg, Black	1
36	MP-5100-A-010	Cable Assy, 36" Lg, Red	1
35	601-460-005	Cap, Plastic, Red, 3" Dia x 1/2 Thk	2
34	601-420-017	Elbow, 90 Deg, #6 ORB to #6 JIC	1
33	600-900-006	Hitch Pin, 3/4 Dia	2
32	600-720-008	Washer, Lock, 3/4	4
31	600-720-002	Washer, Lock, 5/16	8
30	600-710-004	Washer, Flat, 1/4	6
29	600-710-003	Washer, Flat, 5/16	12
28	600-710-001	Washer, Flat, 3/4	8
27	600-690-001	Nut, Nylon Lock, 5/16-18 NC	4
26	600-680-005	Nut, Plain, 3/4-16 NF	4
25	600-640-053	Bolt, Hex Head, 5/16-18 NC x 1/2 Lg (Gr 5)	4
24	600-640-039	Bolt, Hex Head, 1/4-20 NC x 3/8 Lg (Gr 5)	6
23	600-640-003	Bolt, Hex Head, 3/4-16 NF x 2 1/2" (GR5)	4
22	600-640-001	Bolt, Hex Head, 5/16-18 NC x 1 1/4" Lg (Gr 5)	8
21	600-630-003	Set Screw, 1/4-20 NC x 1/2 Lg	1
20	P-150-P-004	Access Hole Cover	1
19	MP-5400-W-001	Packing Tube Weldment (24V)	2
18	MP-5300-W-006	Leg Secondary Weldment, 24 VDC (22" Forks)WIDER	1
17	MP-5300-A-002	PU Cover Assy (24 VDC)	1
16	MP-5300-A-001	Battery Box Assy	2
15	MP-5200-P-001	Lock Cover	1
14	MP-5200-A-001	Lock Release Assy, 24 VDC	1
13	MP-5100-A-014	String Pot Assembly, ANALOG	1
12	MP-5100-A-005	Charger Assembly	1
11	MP-5100-A-003	Master Enclosure Assembly	1
10	MP-5400-A-014	Power Unit Assy, 24 VDC (8-2008)	1
9	MP-1100-P-003	Sensor Cover	1
8	MP-1500-W-004	Fork Weldment, Right, LONGER (22")	1
7	MP-1500-W-003	Fork Weldment, Left, LONGER(22")	1
6	MP-0900-A-001	Cylinder Assembly	1
5	MP-0800-P-024	Threaded Spring Retainer	2
4	MP-1900-A-001	Carriage Assembly (WIDER)	1
3	MP-0500-A-001	Floor Roller Assembly	2
2	MP-0400-P-002	Cable Hook	2
1	MP-0400-A-003	Jack Assembly	1
ITEM	NAME	DESCRIPTION	QTY

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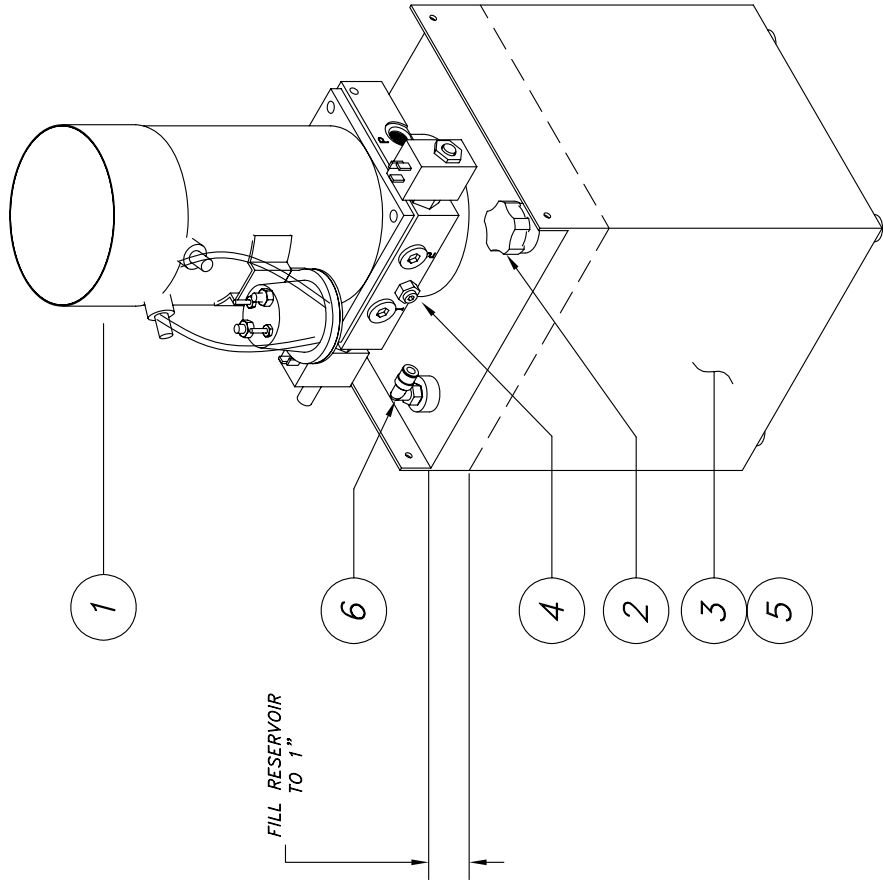
NOTES:  
1. FINISHES: ALL SURF GRINDERS & SIZES.  
2. UNLESS OTHERWISE SPECIFIED, SURFACE FINISH TO BE 125 RMS.  
3. WELDING MEDIUM SHALL CONFORM TO AWS E-7011 CODE S3 FLUX CURE WIRE ONLY.  
E-7011 CODE S3 FLUX CURE WIRE ONLY.

MOHAWK RESOURCES LTD.  
TITLE: Master Post Assy (22" Forks)  
MP-5400-  
FILE NAME: MP-5400-A-015.dwg  
NEXT ASSEMBLY:  
DRAWING NUMBER: MP-5400-A-015

Parts List  
SCALE: 1/8  
CHECKED: 06/06/29  
APPROVED: 10/06  
WEIGHT: 1637 LB  
FROM: 10/06  
QTY: 1



#	DESCRIPTION	DATE	APPROVED
A	ITEM 1 WAS 601-300-094	08/15/2008	dak0879



6	601-520-003	90 Deg Swivel, 1/4 NPT to 1/4 Tube	1
5	601-610-007	Hydraulic Fluid Additive	1
4	601-610-006	Tamper-Proof Sealant	1
3	601-610-001	Hydraulic Fluid,	1
2	601-310-005	Breather Cap	1
1	601-300-095	Power Unit, 24 VDC Mobile Post	1
ITEM	NAME	DESCRIPTION	QTY

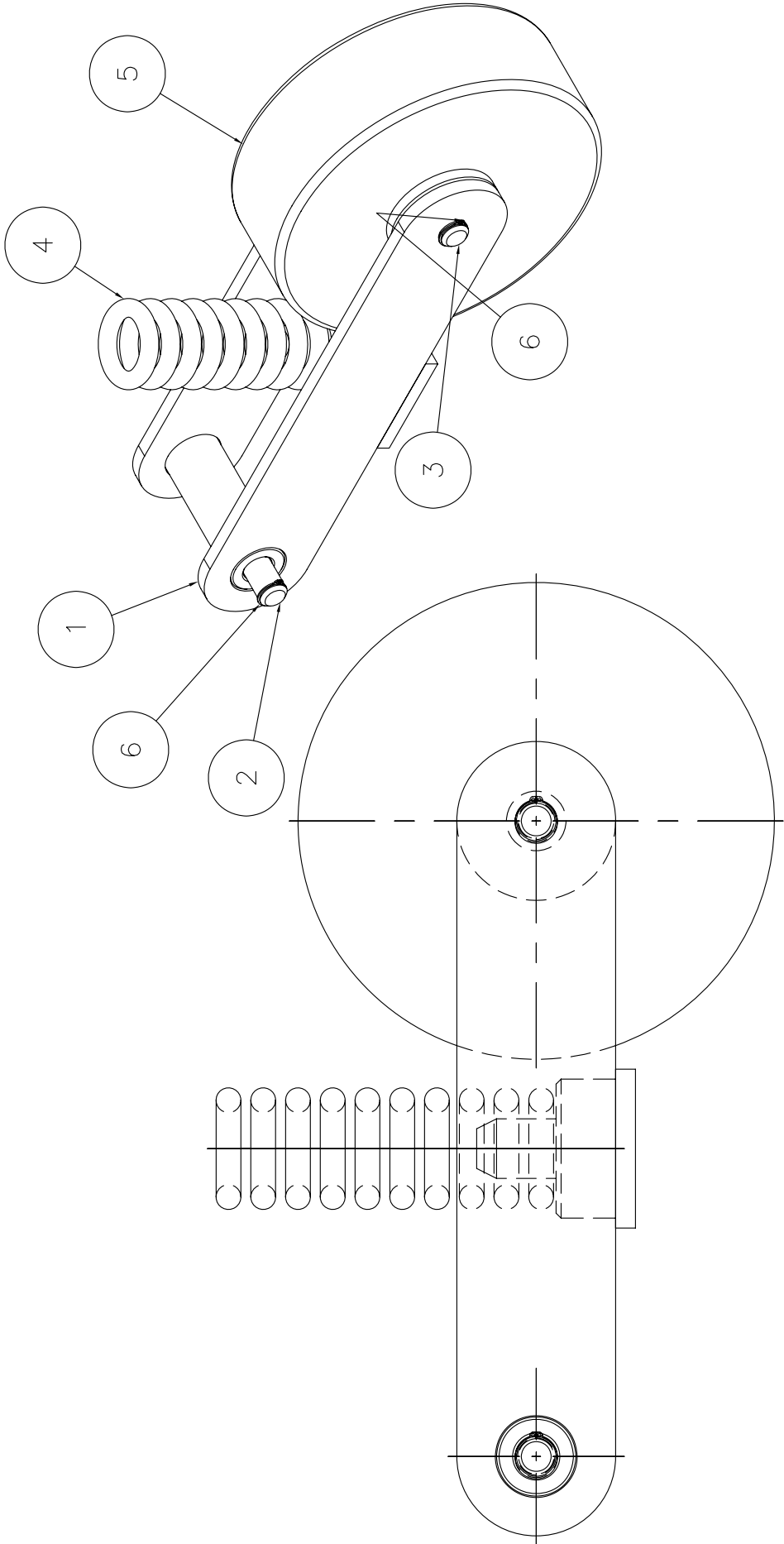


C-SIZE

Parts List

NOTICE OF CONFIDENTIAL INFORMATION				MOHAWK RESOURCES LTD.			
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				TOLERANCES: ANGULAR ± 1° DIMENSIONAL ± .030 DECIMAL 0.XX ± .005 0.XXX ± .005	CHECKED	APPROVED	TITLE
				FILE NAME MP-5400-A-014	DATE 7/08	WEIGHT 75	FROM MP-5400-A-014
NOTES: 1. REMOVE ALL SHARP CORNERS & EDGES. 2. UNLESS OTHERWISE SPECIFIED, SURFACE FINISH TO BE 125 RMS. 3. WELDING MEDIUM SHALL CONFORM TO AWS SPECIFICATIONS TO E-70XX ELECTRODES OR E-70T1 CODE 5.3 FLUX CORE WIRE ONLY.				NEXT ASSEMBLY			

#	DESCRIPTION	DATE	APPROVED
A	1) VIEWS UPDATED	08/30/2005	dak0879
	2) WT WAS 7.92		



6	600-870-003	Snap Ring, Externdl, 1/2	4
5	600-920-018	Wheel, 6" Dia x 1/2 ID x 2 3/16 Hub	1
4	600-840-025	Spring, 4.25 Lg x 1.531 OD x .907 ID	1
3	MP-0500-P-006	Roller Axle Pin	1
2	MP-0500-P-005	Pivot Pin	1
1	MP-0500-W-001	Roller Pivot Weldment	1

ITEM	NAME	DESCRIPTION	QTY
Parts List			

NOTES:  
1. REMOVE ALL SHARP CORNERS & EDGES.  
2. UNLESS OTHERWISE SPECIFIED, SURFACE FINISH TO BE 125 RMS.  
3. WELDING MEDIUM SHALL CONFORM TO AWS SPECIFICATIONS TO E-70XX ELECTRODES OR E-70TT CODE 5.3 FLUX CORE WIRE ONLY.

MOHAWK RESOURCES LTD.

SCALE  
1'0"=1'0"

CHECKED

DATE  
07/26/2004

DRAWN  
rw7089

WEIGHT  
7.84

FROM  
N/A

MP-

DATE  
07/26/2004

WEIGHT  
7.84

FROM  
N/A

MOBILE POST LIFT

MOBILE POST LIFT

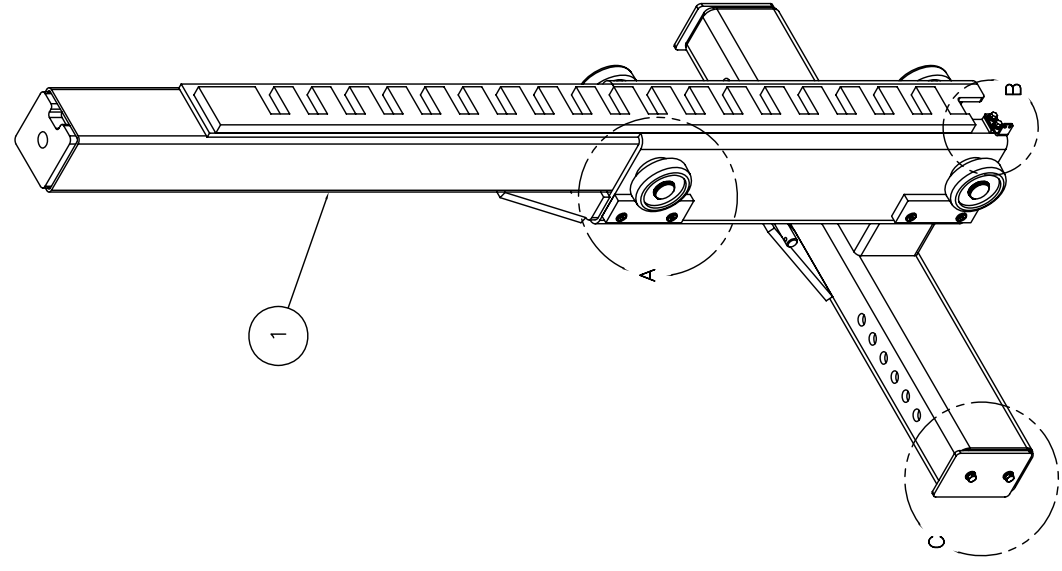
MP-0500-A-001

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# WIDER

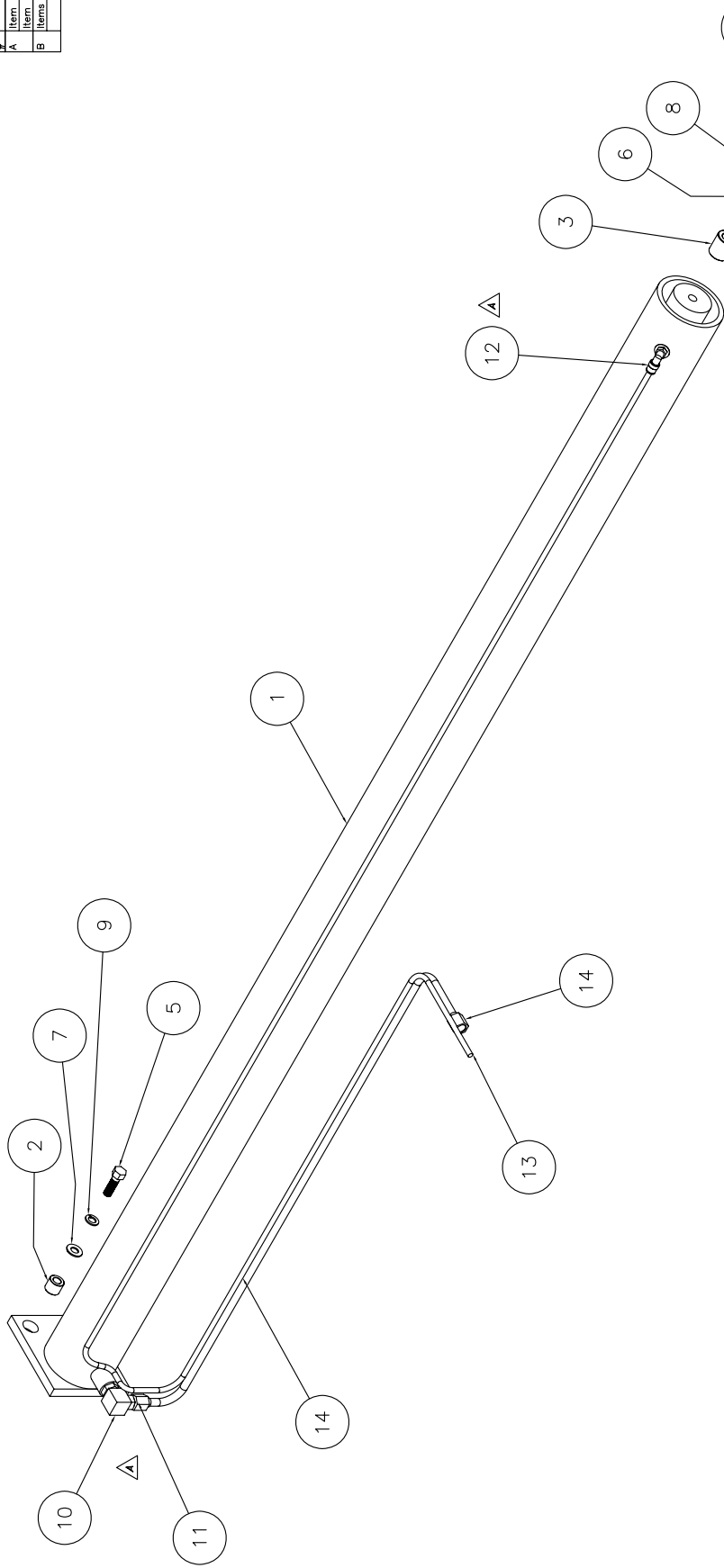
MOHAWK RESOURCES LTD.	Parts List	
MOBILE LIFT CARRIAGE ASSEMBLY	SCALE 1/4"	DRAWN JAW
	CHECKED	APPROVED
MP-1900-		
MP-1900-		
DATE 7/7/05	WEIGHT 300	DRAWING NUMBER MP-1900-A-001
NEXT ASSEMBLY		

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*D-SIZE*

#	DESCRIPTION	DATE	APPROVED
A	Item 12 was 601-520-003	03/01/2005	rw7/089
B	Item 10 was at 45 Degrees		
	Items 13, 14, 15 & 16 Added	07/08/2005	rw7/089



15  
USE TO SECURE BLACK  
TUBING TO CYLINDER BARREL  
(NOT SHOWN)

16  
USE TO SECURE BLACK  
TUBING TO HYDRAULIC LINE  
(NOT SHOWN)

ITEM	NAME	DESCRIPTION	QTY
16	601-600-029	Pull Tie, Black, 8 1/2" Long	6
15	601-600-021	Pull Tie, Black, 15" Long	4
14	MP-1200-A-002	Tube Assembly	1
13	MP-0900-P-401	Tubing, Black Plastic, 1/4" x 115" Long	1
12	601-520-002	90° Elbow Swiv, 1/8 NPT To 1/4 Tube	1
11	601-420-019	Straight, #6 ORB to #6 JIC	1
10	601-410-073	Velocity Fuse, 5 GPM	1
9	600-720-011	Washer, Lock, 3/8	2
8	600-720-005	Washer, Lock, 1/2	1
7	600-710-009	Washer, Flat, 3/8	2
6	600-710-008	Washer, Flat, 1/2	2
5	600-640-095	Bolt, Hex Head, 3/8-16 NC x 1 1/4 (GR8)	2
4	600-640-030	Bolt, Hex Head, 1/2-13 NC x 2" (GR8)	1
3	MP-0900-P-003	Cylinder Rod Bushing	1
2	MP-0900-P-002	Cylinder Base Bushing	2
1	MP-0900-P-001	Cylinder Assembly, Purchased	1

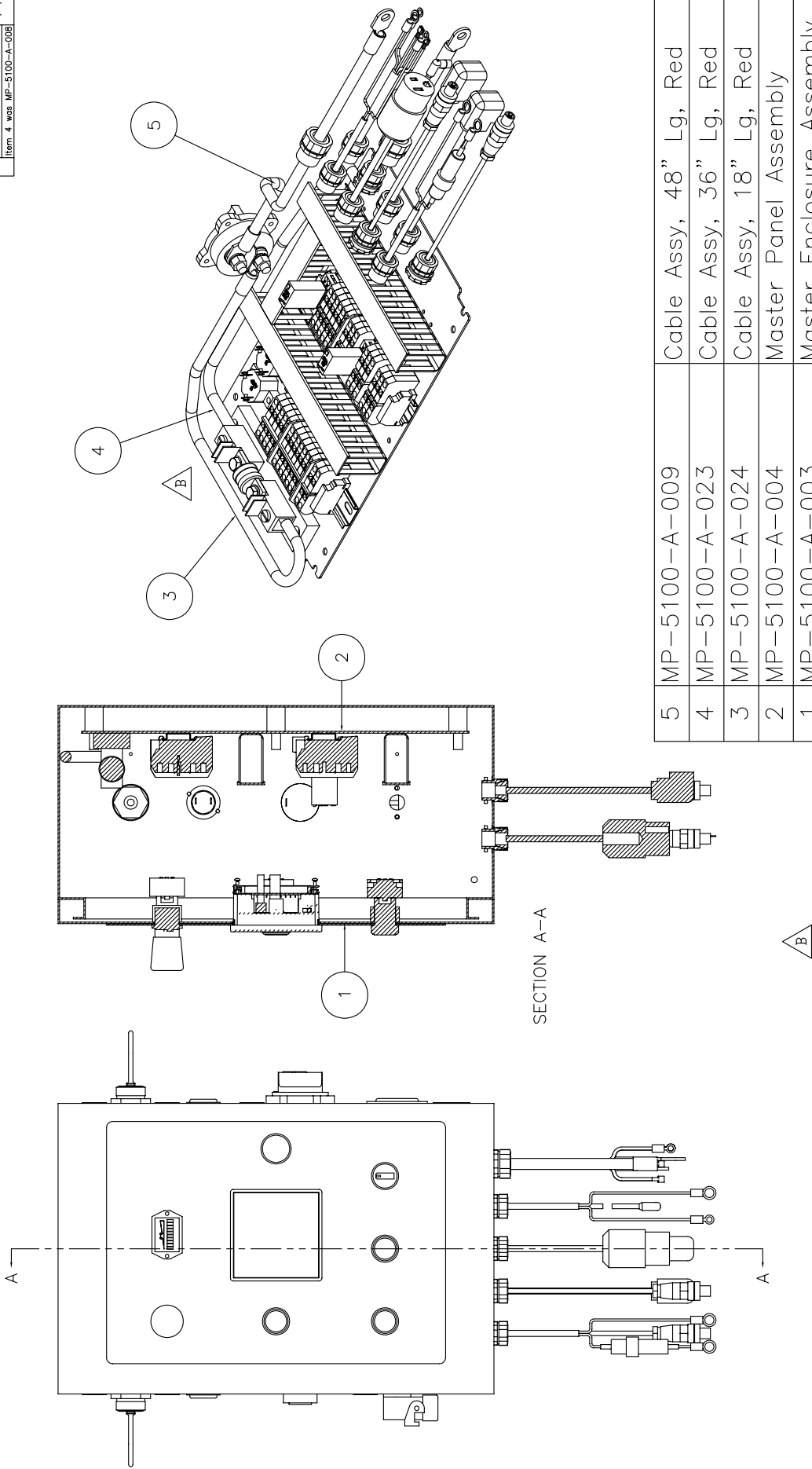
SCALE	DRAWN	MOHAWK RESOURCES LTD.
1/2" = 1'0"	rw7/089	
CHECKED	APPROVED	TITLE
		Mobile Post Lift
		Cylinder Assembly
DATE	WEIGHT	FINISH
07/08/2004	120 LB	1/2"
FILE NAME	NEXT ASSEMBLY	DRAWING NUMBER
MP-0500-A-001.dwg		MP-0500-A-001

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NOTES:  
1. FINISHES: ALL SHARP CORNERS & EDGES TO BE ROUNDED.  
2. FINISH TO BE 125 RMS.  
3. WELDING MEDIUM SHALL CONFORM TO AWS D1.1.  
4. WELDING SHALL BE DONE IN ACCORDANCE WITH AWS D1.1.  
5. E-7011 CODE S3 FLUX CURE WIRE ONLY.

TOLERANCES:  
FRACTIONAL ± 1/32  
DECIMAL ± .030  
DIA ± .005

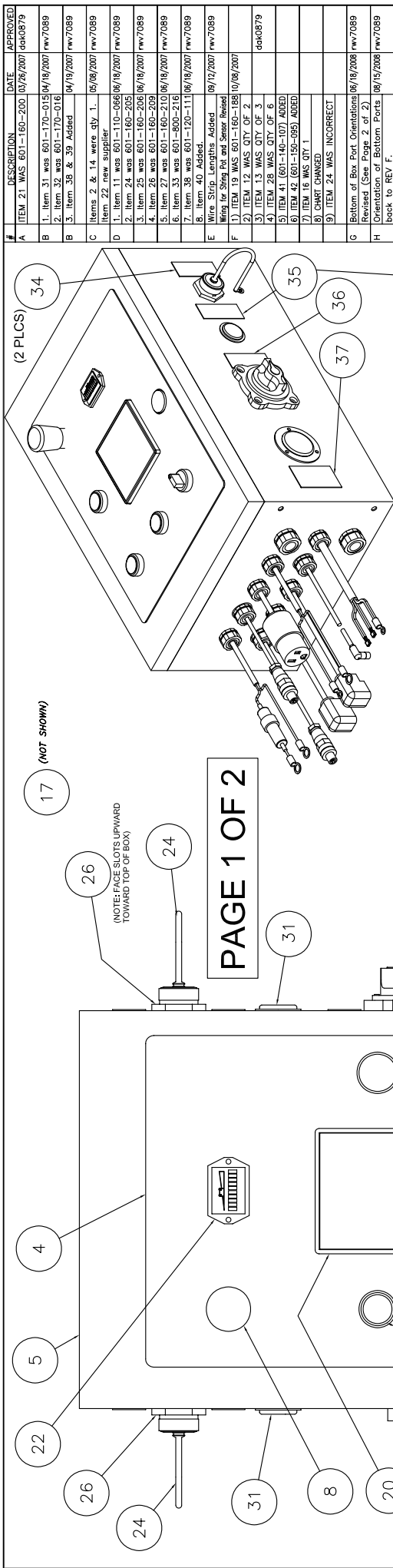
#	DESCRIPTION	DATE	APPROVED
A	View of Bottom Page 18 Revised	06/18/2008	rw7089
B	Item 3 was MP-5100-A-002	06/15/2008	rw7089
	Item 4 was MP-5100-A-008		



ITEM	NAME	DESCRIPTION	QTY
5	MP-5100-A-009	Cable Assy, 48" Lg, Red	1
4	MP-5100-A-023	Cable Assy, 36" Lg, Red	1
3	MP-5100-A-024	Cable Assy, 18" Lg, Red	1
2	MP-5100-A-004	Master Panel Assembly	1
1	MP-5100-A-003	Master Enclosure Assembly	1

### Parts List

NOTICE OF CONFIDENTIAL INFORMATION			
INFORMATION CONTAINED HEREIN IS CONFIDENTIAL AND PROPERTY OF MOHAWK RESOURCES LTD. IT SHALL BE USED ONLY FOR THE PURPOSES OF THE PROJECT AND NOT BE DISCLOSED TO ANY OTHER EMPLOYEE OR CONTRACTOR.			
NOTES: 1. FINISH ALL SHARP CORNERS & EDGES. 2. UNLESS OTHERWISE SPECIFIED, SURFACE FINISH SHALL CONFORM TO AISC 3. WELDING SHALL CONFORM TO AISC E-7011 CODE S3 FLUX CURE WIRE ONLY.		TOLERANCES: FINISH DIMS. ± .030 HOLE DIMS. ± .030 HOLE DIA. ± .005 FILE NAME: MP-5100-A-001	
SCALE	1/2	DRAWN	rw7089
CHECKED		APPROVED	
DATE	11/30/08	WEIGHT	30 LB
NEXT ASSEMBLY		FROM	MP-5100-A-001
MOHAWK RESOURCES LTD.		TITLE	
		MP-51	
		Master Box Assy	



PAGE 1 OF 2

#	DESCRIPTION	DATE	APPROVED
A	ITEM 21 WAS 601-160-200	03/26/2007	dkk0879
B	1. Item 31 was 601-170-015	04/18/2007	rw7089
C	2. Item 32 was 601-170-016		
D	3. Item 35 & 39 Added	04/19/2007	rw7089
E	Item 22 changed to 601-160-200		
F	Item 22 & 14 were qty 1.	05/08/2007	rw7089
G	Item 11 was 601-110-066	06/18/2007	rw7089
H	Item 24 was 601-160-205		
I	Item 25 was 601-160-206	06/18/2007	rw7089
J	Item 26 was 601-160-208		
K	Item 27 was 601-160-210	06/18/2007	rw7089
L	Item 33 was 601-800-216		
M	Item 38 was 601-120-111	06/18/2007	rw7089
N	Item 40 Added.		
O	Wire Strip Lengths Added	09/12/2007	rw7089
P	Wiring for String Pot and Sensor Revised		
Q	1. ITEM 19 WAS 601-160-188	10/08/2007	
R	2. ITEM 12 WAS QTY OF 2		
S	3. ITEM 13 WAS QTY OF 3		
T	4. ITEM 28 WAS QTY OF 6		
U	5. ITEM 41 (601-140-107) ADDED		
V	6. ITEM 42 (601-150-095) ADDED		
W	7. ITEM 16 WAS QTY 1		
X	8. CHART CHANGED		
Y	9. ITEM 24 WAS INCORRECT		
Z	Bottom of Box Port Orientations	06/18/2008	rw7089
AA	Revised (See Page 2 of 2)		
AB	Orientation of Bottom Ports	06/15/2008	rw7089
AC	Back to REV F.		

ITEM	NAME	DESCRIPTION	QTY
42	601-150-095	Insulated Ring Terminal	3
41	601-140-017	Straight Adapter, Yellow	2
40	601-160-221	Decal, Handwritten Resistor...	2
39	601-120-112	Plug, 1/2" VAC, 15A/120V/1Ph	1
38	601-120-116	Fuse Holder, In-Line, Crimp Style	1
37	601-800-285	Decal, "120 VAC CHARGER INLET"	1
36	601-800-284	Decal, "CHARGE LEFT - OPERATE LEFT"	1
35	601-800-283	Decal, "12 VDC POWER PORT"	1
34	601-800-221	Decal, "COMMUNICATION"	2
33			0
32			0
31	601-170-017	Outlet, 12 VDC, Marine	2
30	601-170-014	Plugged Inlet with Dust Cover, 3 Pole, 120 VAC, 15 Amp	1
29	601-170-006	Connector, 3 Prong, 15A/120V/1Ph	1
28	601-165-053	Straight Adapter, Red	3
27			0
26	601-160-219	Receptacle, DeviceNET, Female	2
25			2
24	601-160-221	Secure Cap w/ Chain, Mini Male	2
23	601-160-204	Pass-Through, 24 VDC, Red	1
22	601-160-203	Battery Gauge, 24 VDC	1
21	601-160-214	Quick-Disconnect Cable	1
20	601-160-198	PLC w/ Display & Buttons (NLE OGS)	1
19	601-160-142	Cover for Female Insert	1
18	601-160-154	DIN Cable Assembly w/ 4' Cable	2
17	601-150-088	Wire Nut, 5 Pole	4
16	601-150-081	Insulated Ring Terminal	2
15	601-150-080	Quick Connect Terminal, 0.187 x 0.020, Fully Insulated	2
14	601-140-071	Circular Connector, 5 Pin, Male	2
13	601-140-064	Straight Adapter, Blue	2
12	601-140-045	Straight Adapter, White	4
11	601-110-067	Switch, ON/OFF, 300 Amp Continuous	1
10	601-110-056	Rotary Switch, 3 Position, Return to Center, 22mm	1
9	601-110-055	Push Button, Green, 22mm	3
8	601-110-054	Push Button, Red, 22mm	1
7	MP-5100-P-408	Cable Tie Strap, 1/8" x 12" Long	1
6	MP-5100-P-407	Cable, Open Jacketed w/ Red/Blk Wire, 14/2 x 36" Long	2
5	MP-5100-P-002	Master Enclosure Drilling	1
4	MP-5100-P-001	Control Decal, MP-24VDC-Series	1
3	MP-1300-P-403	Cable, 16/3 SOW-A/50 x 5 Feet	1
2	MP-1300-P-402	Cable, Shielded, 6/24 x 7 Feet	2
1	MP-1300-A-009	Pendant Receptacle Assembly	1

NOTES:		TOLERANCES:		PORTS LIST		MOHAWK RESOURCES LTD.	
1. UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN INCHES.		FRACTIONAL		SCALE	DRAWN	TITLE	
2. UNLESS OTHERWISE SPECIFIED, SURFACE FINISH TO BE 125 RMS.		DECIMAL		CHECKED	APPROVED	MP-24VDC-SERIES	
3. WELDING MEDIUM SHALL CONFORM TO AWS E-7018 CODE (3.3 FLUX CORE WIRE ONLY).		3.3XXX				Master Enclosure Box Assy	
4. WELDING MEDIUM SHALL CONFORM TO AWS E-7018 CODE (3.3 FLUX CORE WIRE ONLY).		FILE NAME		DATE	WEIGHT	DRAWING NUMBER	
		MP-5100-A-001		1/1/2008	26.5	MP-5100-A-003	
		MP-5100-A-003.dwg					
		NEXT ASSEMBLY					

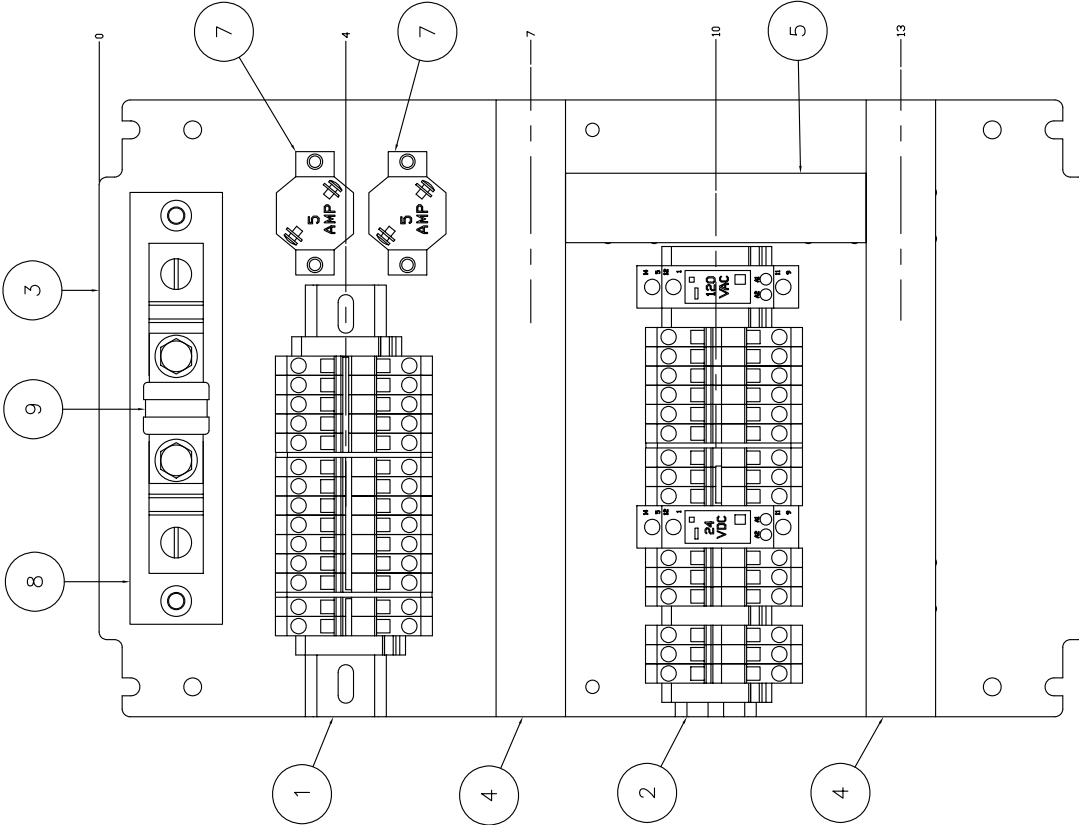
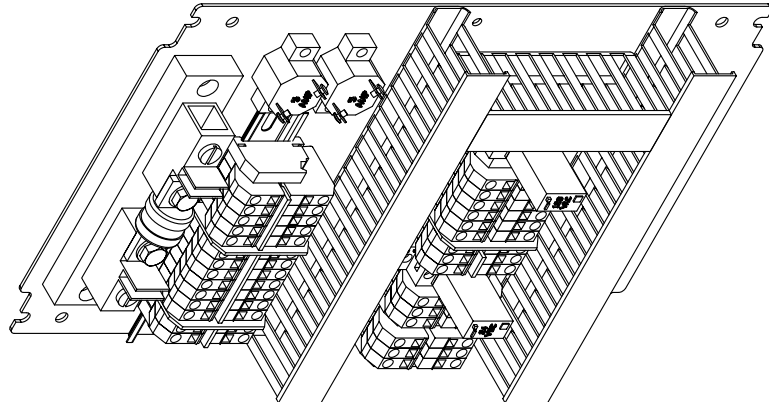
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NOTE ORIENTATION OF DIN CONNECTIONS

D-SIZE



#	DESCRIPTION	DATE	APPROVED
A	1. Item 5 was 601-120-113 2. Item 6 was 601-120-109 (6/2)	06/18/2007	rwv7089
B	3. Item 7 was 601-120-107 4. Item 8 was MP-5100-P-015 (was 120 Amp Circuit Breaker)	06/18/2007	rwv7089
	1. Item 6 was 601-120-113 (was 120 Amp Circuit Breaker)	06/15/2008	rwv7089
	2. Item 8 & 9 Added	06/15/2008	rwv7089



9	601-120-117	Fuse, 200 Amp, Fast Acting, Class T	1
8	601-120-118	Fuse Holder, 200 Amp, Class T	1
7	601-120-115	Circuit Breaker, 5 Amp, Auto Reset	2
6			0
5	MP-5100-P-015	Wire Ducting, 1" x 2" High x 4 7/8 Long	1
4	MP-5100-P-014	Wire Ducting, 1" x 2" High x 10" Long	2
3	MP-5100-P-004	Panel Drilling	1
2	MP-5100-A-021	Terminal Strip Assy #2, TR-Series	1
1	MP-5100-A-020	Terminal Strip Assy #1	1
ITEM	NAME	DESCRIPTION	QTY

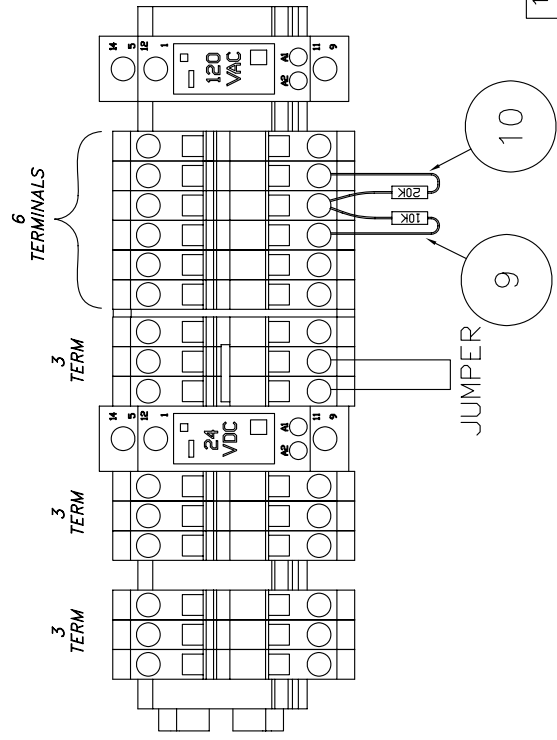
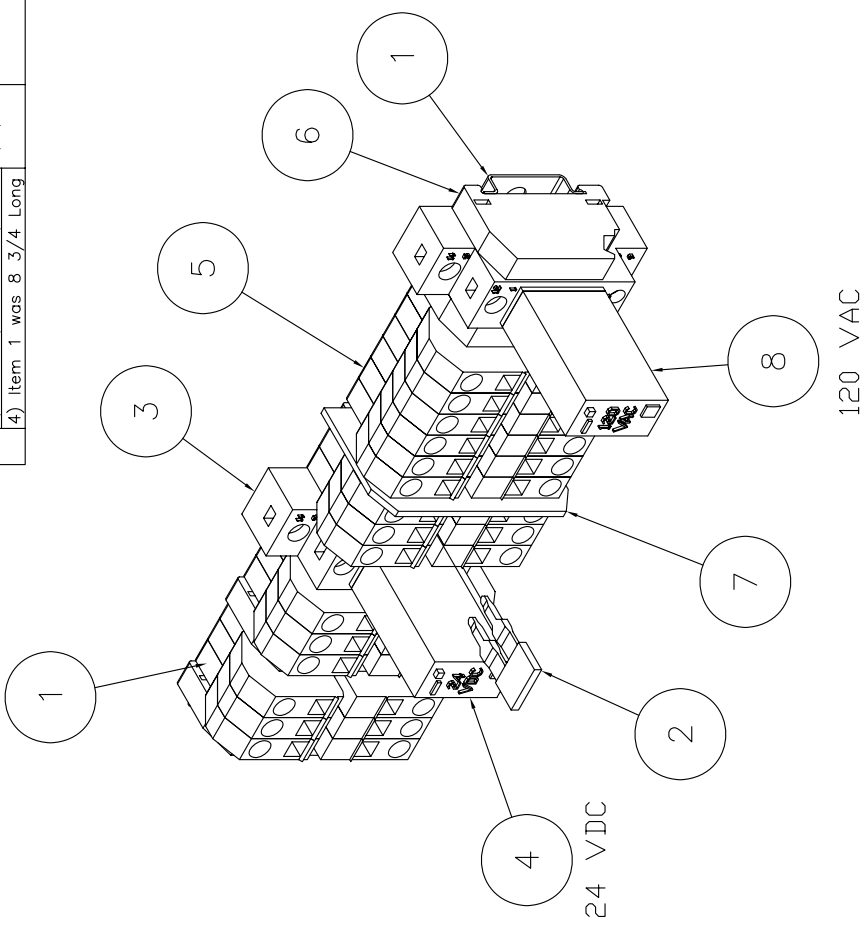
Parts List		SCALE	DRAWN	MOHAWK RESOURCES LTD.
1/2	rwv7089	CHECKED	APPROVED	TITLE
MP-5100-A-	MP-5100-A-004	DATE	WEIGHT	MP-24VDC-SERIES
FILE NAME	MP-5100-A-004	11/30/08	13	Master Panel Assy
FILE NAME	MP-5100-A-004	11/30/08	13	Master Panel Assy
FILE NAME	MP-5100-A-004	11/30/08	13	Master Panel Assy

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#	DESCRIPTION	DATE	APPROVED
A	1) ONE ITEM 5 (601-165-059) ADDED 03/27/2007		
	2) ITEM 9 (601-160-215) ADDED		
	3) ITEM 10 (601-160-216) ADDED 03/27/2007		
	4) Item 1 was 8 3/4 Long		dkk0879



ITEM	NAME	DESCRIPTION	QTY
10	601-160-216	Resistor, 20k Ohm	1
9	601-160-215	Resistor, 10k Ohm	1
8	601-160-144	Relay, Miniature, SPDT, 15 A, 120 VAC Coil, LED w/Bypass	1
7	601-165-063	End Cover, Screwless Terminal Strip	1
6	601-165-061	End Stop	4
5	601-165-059	Terminal Block, Screwless, Grey	15
4	601-160-196	Relay, Miniature, SPDT, 15 A, 24 VDC Coil, LED w/Bypass	1
3	601-160-146	Relay Socket, Screw Terminal	2
2	MP-5100-P-013	Top Jumper Bar, 2 Pole, Screwless	1
1	MP-5100-P-010	Din Rail, 7 5/8 Lg	1
			QTY

C-SIZE

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- NOTES:
1. REMOVE ALL SHARP CORNERS & EDGES.
  2. UNLESS OTHERWISE SPECIFIED, SURFACE FINISH TO BE 125 RMS.
  3. WELDING MEDIUM SHALL CONFORM TO AWS SPECIFICATIONS TO E-70XX ELECTRODES OR E-70T1 CODE 5/3 FLUX CORE WIRE ONLY.

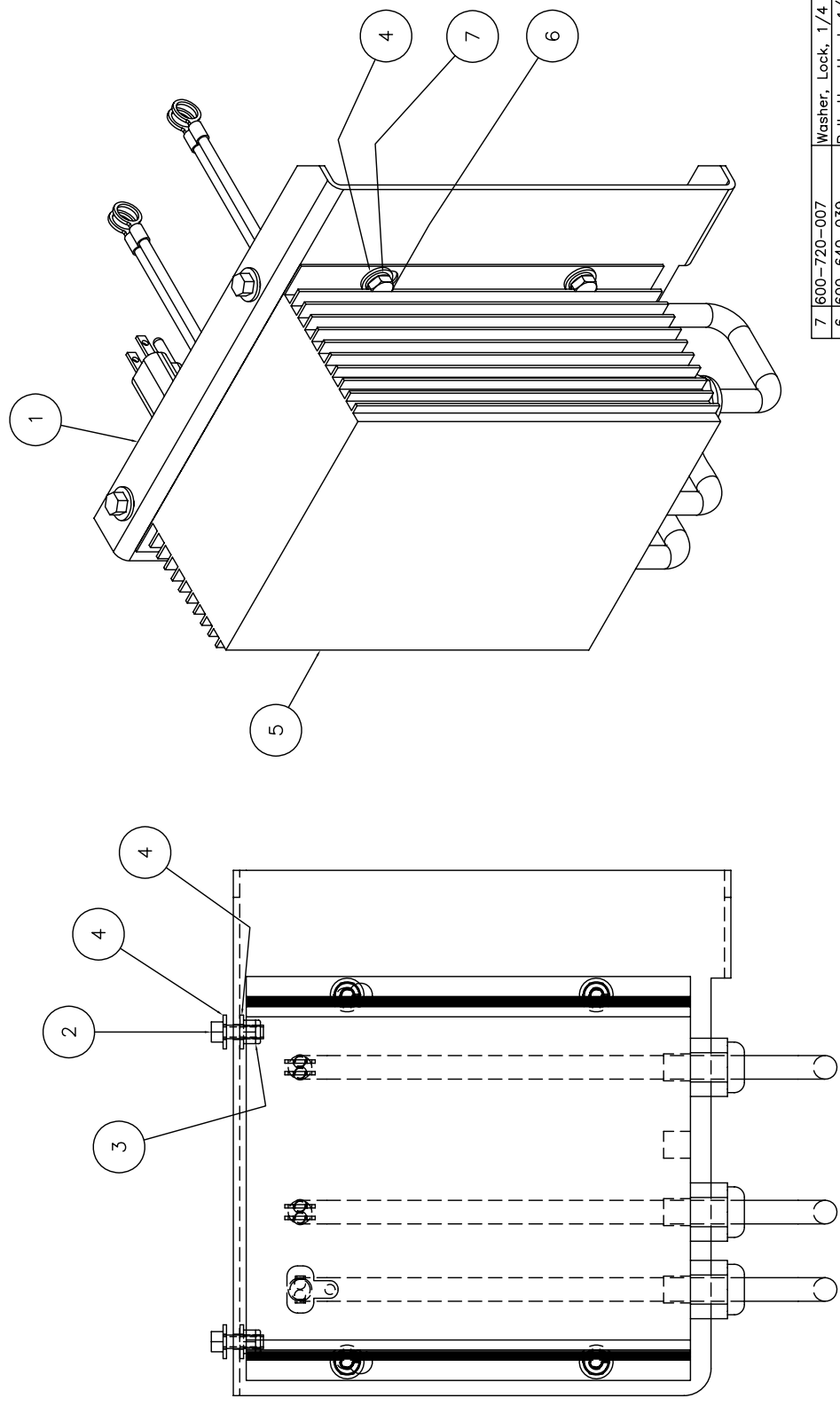
TOLERANCES:	± 1.0°
ANGULAR	± .030
FRACTIONAL	± .030
DECIMAL	± .005
0.0001	
FILE NAME	MP-5100-A-021

MP-5100-A-	MP-5100-A-
MP-5100-A-	MP-5100-A-

SCALE	3/4
CHECKED	APPROVED

DATE	11/27/06
WEIGHT	1.4
FROM	n/a

DRAWN	rw7089
MOHAWK RESOURCES LTD.	
TITLE	MP-24VDC-SERIES Terminal Strip Assy #2
DRAWING NUMBER	MP-5100-A-021



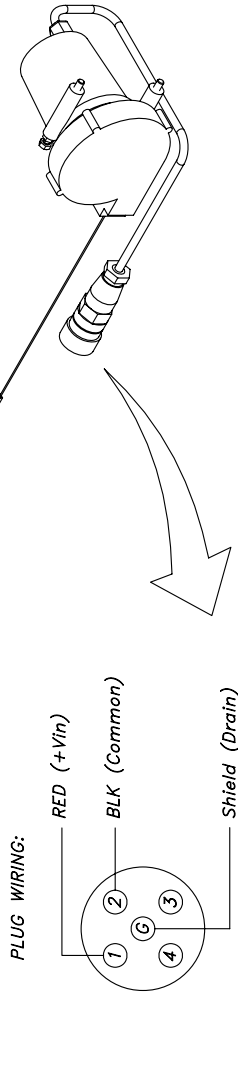
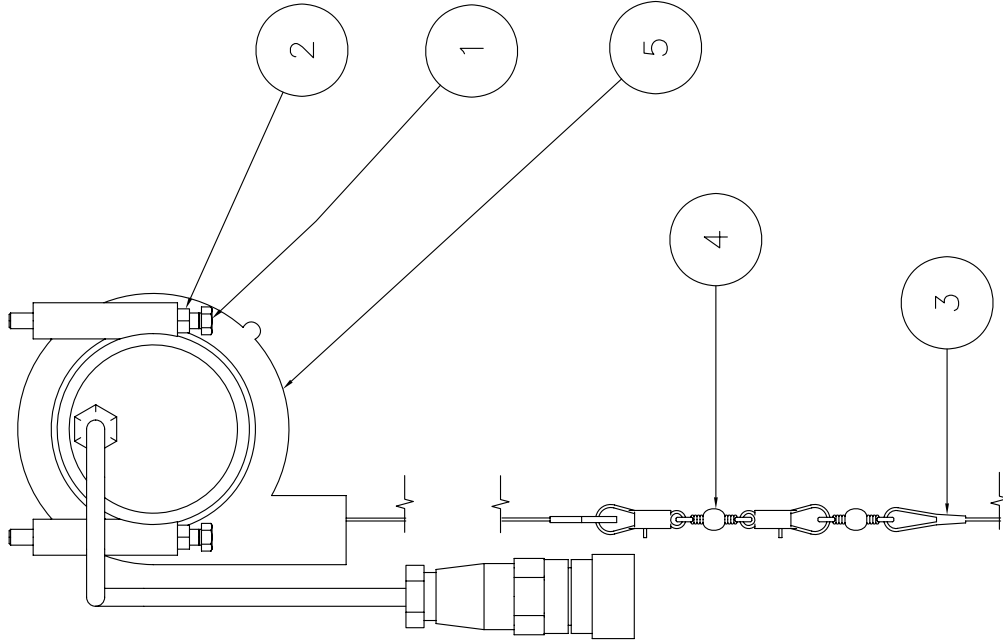
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**NOTES**  
1. REMOVE ALL SHARP CORNERS & EDGES.  
2. ALL DIMENSIONS UNLESS SPECIFIED, SURFACE FINISH TO BE 125 RMS.  
3. WELDING MEDIUM SHALL CONFORM TO AWS SPECIFICATIONS TO E-70XX ELECTRODES OR E-70XX GORE 301 FLUX CORE WELD UNITS.

TOLERANCES
ANGULAR ± 1.00
LINEAR ± .030
RECTANGULAR ± .030
ROUND ± .030
FILE NAME MP-5100-A-005

DATE	3/2/07	WEIGHT	13	LB	FROM	MP-18	DRAWING NUMBER	MP-5100-A-005
NEXT ASSEMBLY		CHECKED		APPROVED		TITLE MP-18 24VDC Charger Assembly		
SCALE 1=1		DRAWN PM-7089		MOHAWK RESOURCES LTD.				

ITEM	NAME	DESCRIPTION	QTY
7	600-720-007	Washer, Lock, 1/4	4
6	600-640-039	Bolt, Hex Head, 1/4-20 NC x 3/8 Lg (Gr 5)	4
5	601-160-222	Battery Charger, 20 Amp, Dual 12 VDC Output	1
4	600-710-004	Washer, Flat, 1/4	8
3	600-690-005	Nut, Nylon Lock, 1/4-20 NC	2
2	600-640-013	Bolt, Hex Head, 1/4-20 NC x 3/4 (Gr5)	2
1	MP-5100-P-008	Charger Mounting Bracket	1

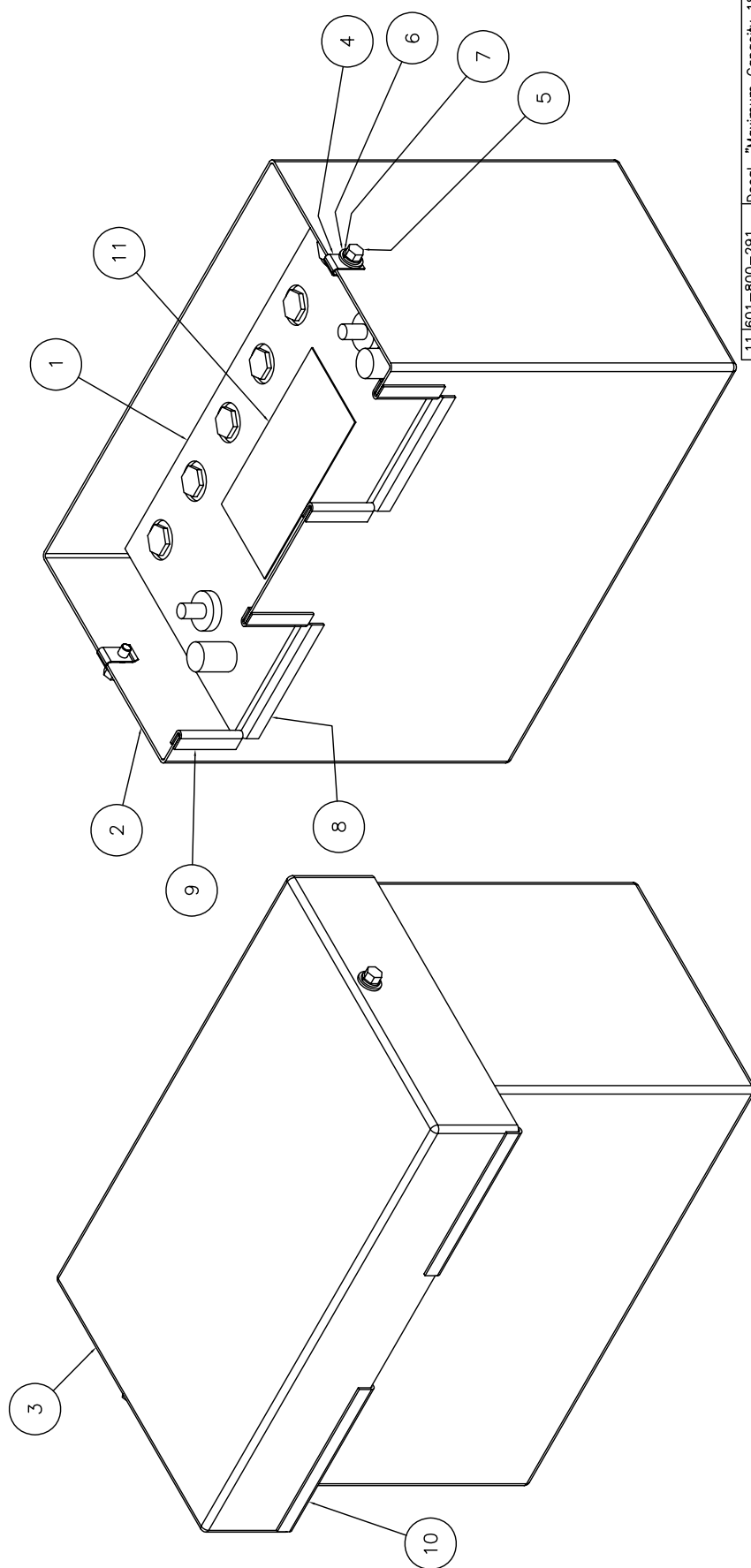


5	601-160-201	Linear Position Sensor, NEMA 4X, ANALOG	1
4	600-850-019	Double Swivel	1
3	600-850-018	Leader Line, 18" Long	1
2	600-680-028	Nut, Plain, #8-32 NC	2
1	600-600-021	Hex Machine Screw, #8-32NC x 2" Lg	2
ITEM	NAME	DESCRIPTION	QTY

C-SIZE

Parts List

NOTICE OF CONFIDENTIAL INFORMATION <small>INFORMATION CONTAINED HEREIN IS CONFIDENTIAL AND PROPERTY OF MOHAWK RESOURCES LTD. IT IS TO BE USED SOLELY FOR THE PURPOSES OF INSPECTION, TESTING, OR MAINTENANCE. THE INFORMATION SHALL NOT BE USED OR DISCLOSED BY THE RECIPIENT FOR ANY OTHER PURPOSES WHATSOEVER.</small>		NOTES: 1. REMOVE ALL SHARP CORNERS & EDGES. 2. UNLESS OTHERWISE SPECIFIED, SURFACE FINISH TO BE 125 RMS. 3. WELDING MEDIUM SHALL CONFORM TO AWS SPECIFICATIONS TO E-70XX ELECTRODES OR E-70TT CODE 5.3 FLUX CORE WIRE ONLY.		TOLERANCES: ANGULAR ± 1.0 DIMENSIONAL ± .030 DECIMAL ± .030 XXX ± .005		SCALE 1" = 1'-0"		DRAWN rw7089		MOHAWK RESOURCES LTD.	
						MP-5400-A-002		CHECKED		TITLE Mobile Post Lift String Pot Assembly, ANALOG	
FILE NAME MP-5100-A-014.dwg		NEXT ASSEMBLY		DATE 11/2/2004		WEIGHT 0.70		FROM N/A		DRAWING NUMBER MP-5100-A-014	



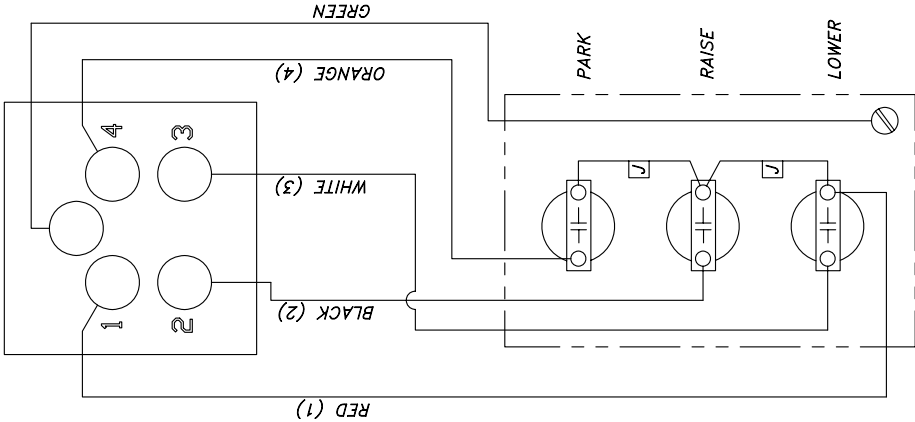
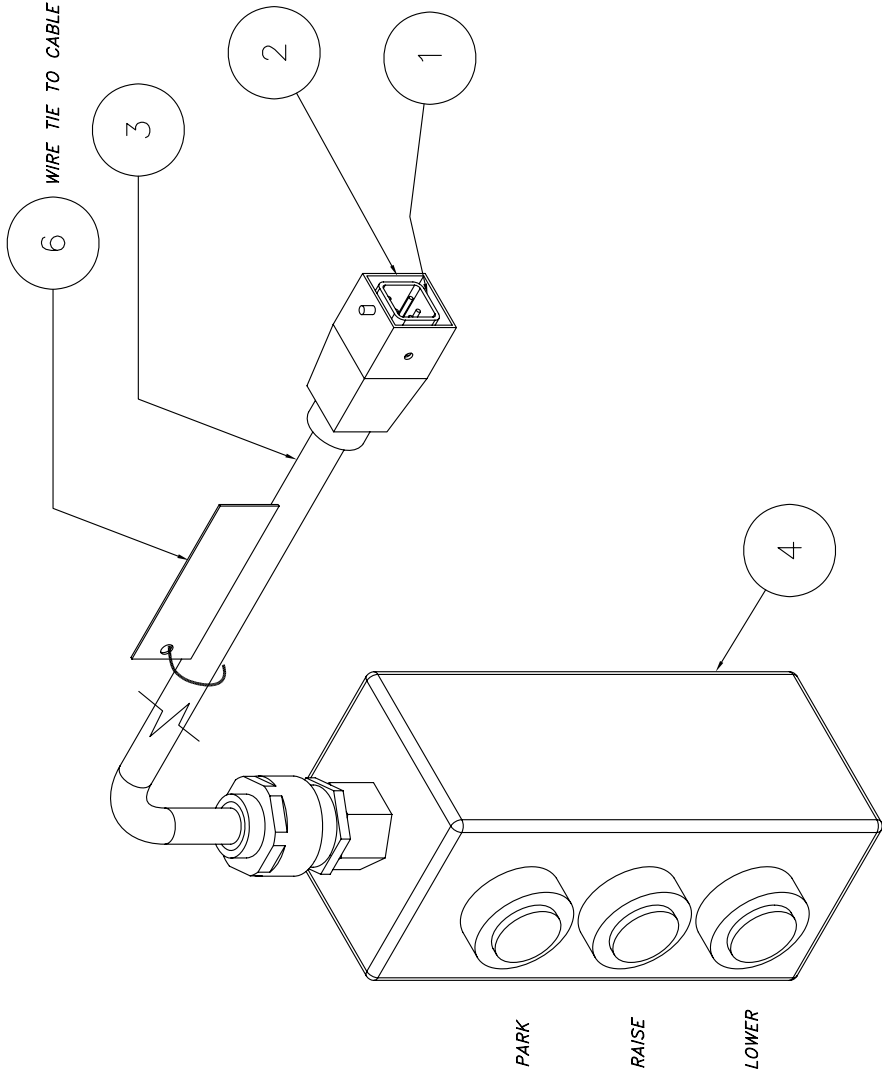
ITEM	NAME	DESCRIPTION	QTY
11	601-800-291	Decal, "Maximum Capacity 18000 LBS"	1
10	MP-5300-P-405	Trim Molding, 5" Long, 1/16 Sheet Metal	2
9	MP-5300-P-404	Trim Molding, 1 7/8" Long, 1/16 Sheet Metal	4
8	MP-5300-P-403	Trim Molding, 4" Long, 1/16 Sheet Metal	2
7	600-720-007	Washer, Lock, 1/4	2
6	600-710-004	Washer, Flat, 1/4	2
5	600-640-042	Bolt, Hex Head, 1/4-20 NC x 1/2 (GR5)	2
4	601-200-010	U-Nut, Automotive, 1/4-20	2
3	MP-5300-P-004	Battery Box Top	1
2	MP-5300-P-003	Battery Box Bottom	1
1	601-190-011	Battery, 12VDC	1

Parts List			
SCALE	DRAWN	TITLE	DATE
3/4	PM-7089	MOHAWK RESOURCES LTD.	4/07
CHECKED	APPROVED	Battery Box Assembly	8/07
MP-	MP-	FROM	MP-5300-A-001
FILE NAME	FILE NAME	WEIGHT	WEIGHT
MP-5300-A-001	MP-5300-A-001	85.6	85.6

NOTES	TOLEANCES
1. REMOVE ALL SHARP CORNERS & EDGES. 2. ALL DIMENSIONS UNLESS SPECIFIED, SURFACE FINISH TO BE 125 RMS. 3. WELDING MEDIUM SHALL CONFORM TO AWS SPECIFICATIONS TO E-70XX ELECTRODES OR E-70T1 CODE FOR FLUX CORD WELDING.	ANGULAR ± .030 DIMENSIONAL ± .005 HOLE DIA ± .005 HOLE DIA ± .005

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CERTIFIABLE OPTION WITH X-PROOF PENDANT.



ITEM	NAME	DESCRIPTION	QTY
6	601-800-223	Plastic Tag, "Hand Pendant Option..."	1
5	601-140-046	Connector, 1/2 NPT, 1/2"-5/8" Cable (Brown)	1
4	601-160-168	Pendant, 3 Button, Class I, Div 2	1
3	601-150-082	Cable, 18/5 SOW x 25 Feet	1
2	601-160-139	Hood, Straight, Metallic w/ cable gland, PENDANT	1
1	601-160-193	4-Pin Insert, Male, PENDANT	1
		DESCRIPTION	QTY

C-SIZE

Parts List

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		2. UNLESS OTHERWISE SPECIFIED, SURFACE FINISH TO BE 125 RMS.		CHECKED		APPROVED					
		3. WELDING MEDIUM SHALL CONFORM TO AWS SPECIFICATIONS TO E-70XX ELECTRODES OR E-70T1 CODE 5.3 FLUX CORE WIRE ONLY.		DATE		WEIGHT					
FILE NAME MP-1300-A-020.dwg		NEXT ASSEMBLY		10/10/2005		3		FROM N/A		DRAWING NUMBER MP-1300-A-020	
										A	

# MOHAWK



## ILLUSTRATIONS

MP-18-24VDC-SERIES

ELECTRIC/HYDRAULIC

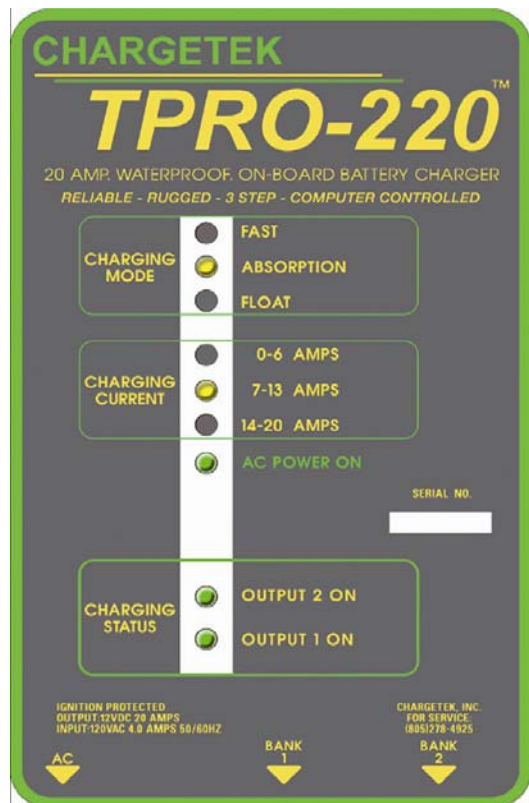
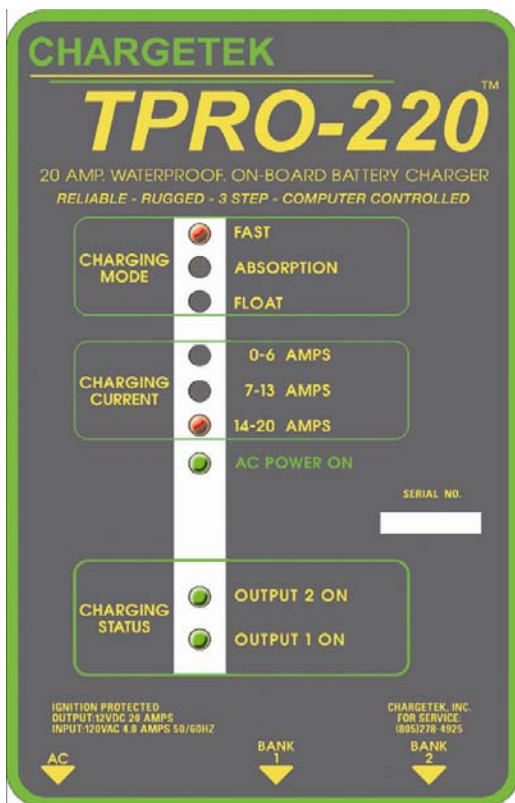
PORTABLE LIFT

# Charger Status Lights:

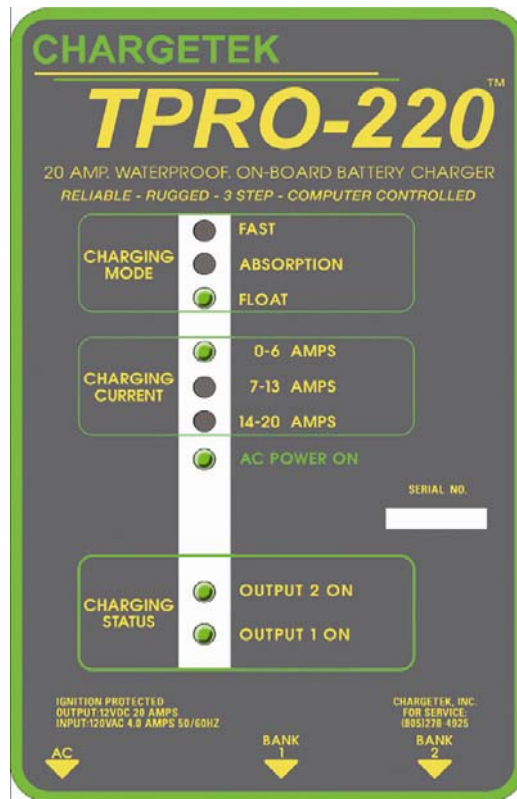
Each post comes equipped with a dual battery charger which provides charging for two 12 VDC batteries (in series makes 24 VDC). Each charger is rated for 120 VAC, 60 Hz, 4 Amp draw. Keep this in mind if using extension cords and multiple adapters into a single outlet. (4 chargers will draw 4 x 4 amps = 16 amps total). There are three charging levels that the charger progresses through to full charge. Refer to CHARGETEK TPRO-220 manual enclosed at end of this manual.

**Charging:** (Red lights on)  
This shows each battery  
in a charging state.

**Finishing:** (Yellow lights on)  
This shows the battery at a  
finishing state.



**Ready:** (Green lights only)  
This shows the batteries are fully charged.



**NOTE:** Avoid halting charging cycle until batteries are fully charged (this may decrease the life and charge holding capacity of the batteries). Do not recharge fully charged batteries. Status of left battery may differ from status of right battery. Wait until both batteries are fully charged prior to using lift.

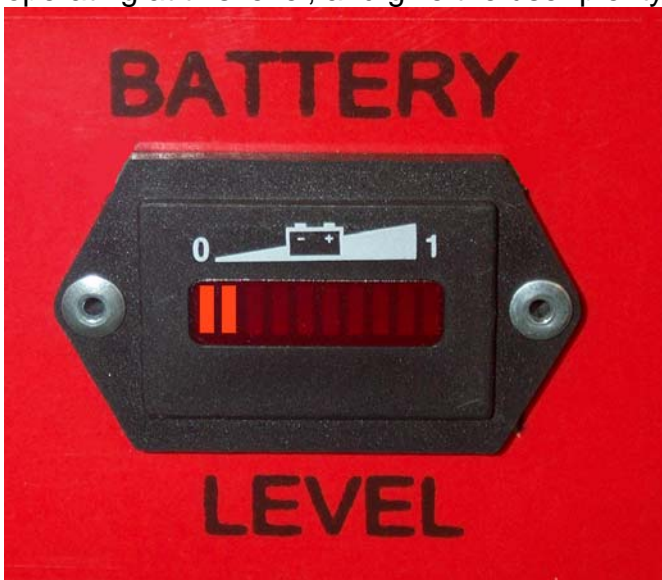
## Battery Status Indicator:

The front panel of each post has a battery level indicator which shows the current charge of the batteries. (Battery level is also available by pressing the F3 button.) Be aware that the lower the battery level is, the higher the amp draw, and thus the deeper the level of charge drawn by the batteries. Paying attention to these meters and using a regular recharge routine will provide the user with years of trouble free usage.

**Battery Full:** This shows the battery at fully energized state. When depleted, the battery level meter will only “reset” to full after the battery has been fully charged.

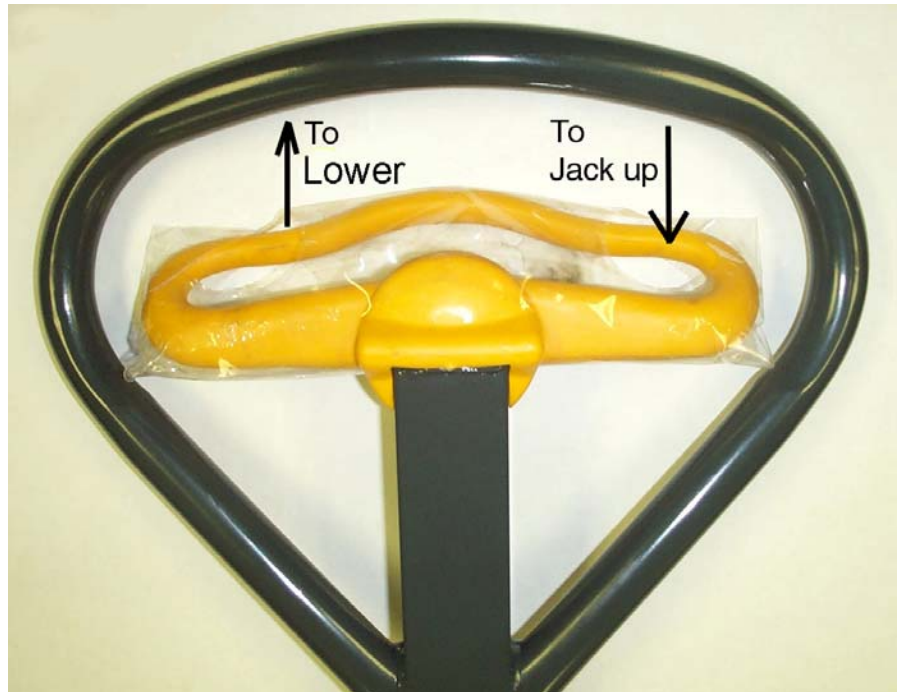


**Battery Low:** (Both lights alternate flash). This shows the battery at 80% discharge. Use of the lift below this level may damage the batteries. The controls on this unit will prevent the lift from operating at this level, and give the user plenty of warning before approaching this discharged state.



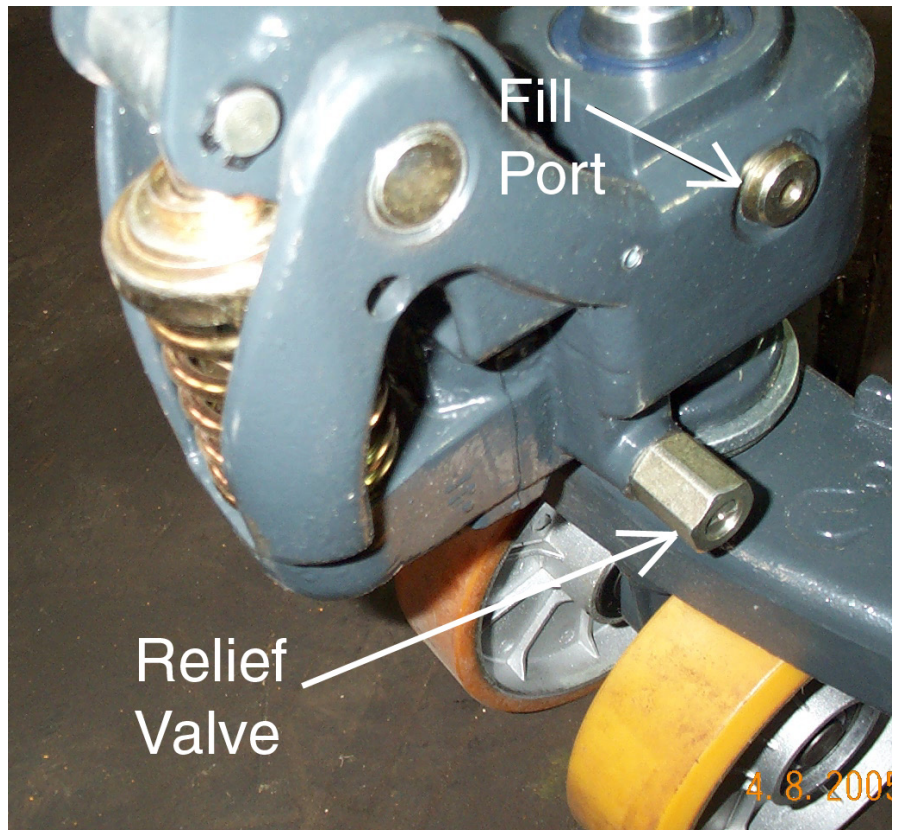
## Jack Operation:

Prior to moving posts, the rear jack wheels must be engaged. To do this, push yellow lever down, then jack handle to desired height. When post is in position, collapse jack wheel fully.



## Jack Relief Adjustment:

If jack does not collapse under load or if jack does not raise back of post onto wheel, then the relief valve may need to be adjusted. To set proper jack capacity, lift empty post with jack, then turn relief screw counter-clockwise SLOWLY until jack collapses. Then screw in clockwise 1/2 turn.





## **24 VDC MASTER ENCLOSURE:**

**MAIN CONTROL PANEL** – Showing controls for Raise, Lower, Park, Single/All/Pair, and Emergency Stop. Battery Level Gauge and Lift Display also present.



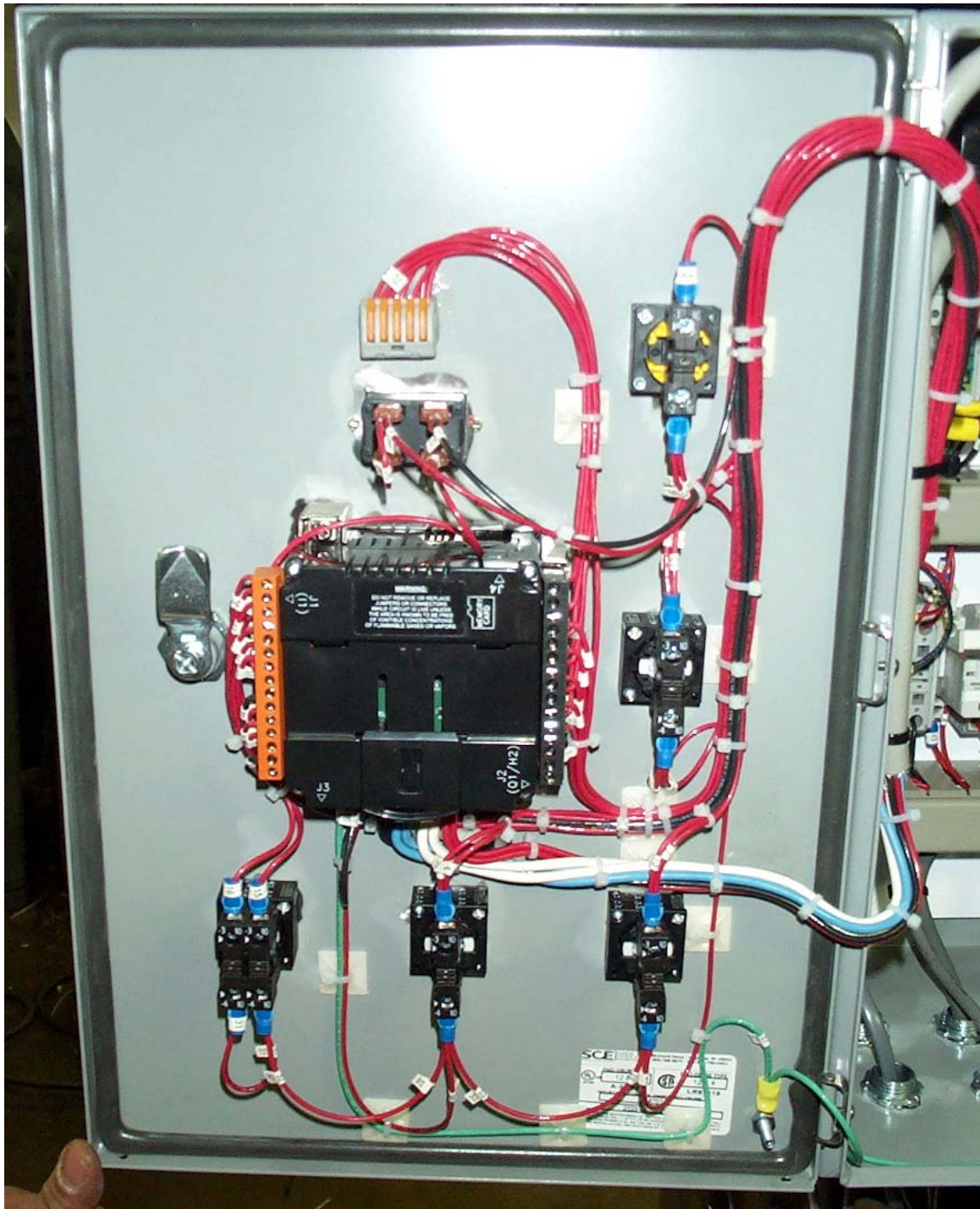
Left Side of Control Box



Right Side of Control Box

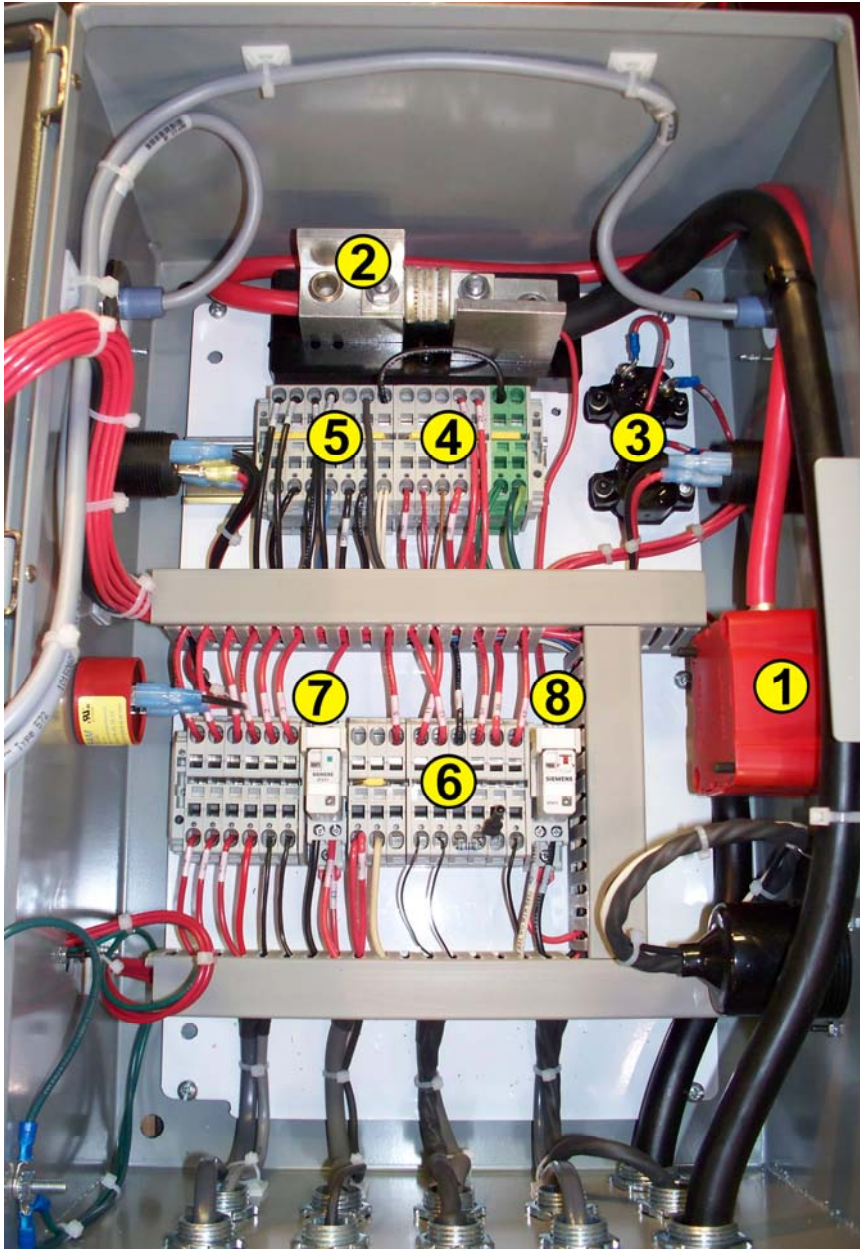
## **MASTER ENCLOSURE PORTS:**

1. **COMMUNICATION RECEPTACLE** – Place where communication cable or dummy plug connects.
2. **12 VDC AUXILIARY POWER RECEPTACLE** – Provided to plug in standard electrical items that run on 12 VDC, (i.e. Lights)
3. **HORN** – Sounds when mechanical locks are released. Volume is adjustable.
4. **PENDANT RECEPTACLE** – Place where hand pendent connects.
5. **COMMUNICATION RECEPTACLE CAP** – Can also be used to hold spare dummy plugs.
6. **OPERATE LIFT/CHARGE LIFT SWITCH** – Turns on Power to post. When post power is turned off, charging is enabled.
7. **120 VAC CHARGER POWER INLET** – Connecting a 120 VAC Power Cord to this inlet provides power to the dual battery charger.



### **MASTER ENCLOSURE COMPONENTS (DOOR):**

**PLC (Programmable Logic Controller)** – “Computer” that provides logic to the entire system, controlling all inputs and outputs, and networking with all other posts in the system. The orange strip is all the Inputs and the black strip is all the outputs. Communications are branched off the bottom of the PLC to both sides of the box to allow connectivity to other PLC’s in the system.



### **MASTER ENCLOSURE COMPONENTS (PANEL):**

1. **MAIN POWER SWITCH** – Turns on Power to the post.
2. **MAIN POWER FUSE** – 200 Amp rated to protect the whole electrical system, and sized to accommodate the motor amperage.
3. **CONTROL CIRCUIT BREAKERS** – One protects the PLC and the raising/lowering solenoids. A separate breaker protects the Lock Solenoid.
4. **24 VDC (+) TERMINAL BLOCKS** – Provide distribution for the +24 VDC.
5. **24 VDC (-) TERMINAL BLOCKS** – Provide distribution for the -24 VDC.
6. **INPUT/OUTPUT TERMINAL BLOCKS** – Provide distribution to several inputs and outputs.
7. **LOCK RELEASE RELAY (24 VDC)** – When energized, will divert power to lock release solenoid.
8. **CHARGER RELAY (120 VAC)** – Energizes when charger is supplied power (120 VAC) and prevents lift from running when lift is charging.



### **COMMUNICATION CABLE:**

This is a DEVICENET network cable that is 10 meters long (32'-10" Long) with male ends. This cable is readily available from a variety of electrical suppliers that deal in network components.



### **DUMMY PLUGS:**

Place male dummy plugs into opposite ends of post system at unused communication ports.

**⚠ WARNING**



Clear area if vehicle  
is in danger of falling.

©

**⚠ WARNING**



Remain clear of lift  
when raising or  
lowering vehicle.

©

**⚠ WARNING**



Locate lift  
on firm, level surface,  
preferably concrete.

©

**⚠ WARNING**



Be sure intended lifts  
are moving together  
evenly.

©

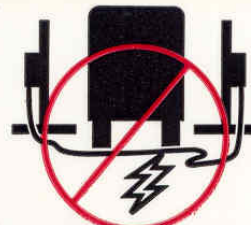
**⚠ WARNING**



All lifting forks must  
properly engage  
vehicle tires  
or supports.

©

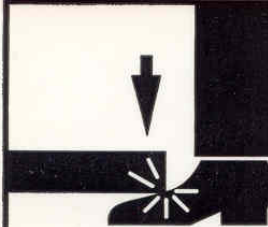
**⚠ WARNING**



Do not drive over or  
pinch electrical cables.

©

**⚠ WARNING**



Keep feet  
clear of lift  
while lowering.

©

The messages and pictographs  
shown are generic in nature and  
are meant to generally represent  
hazards common to all automotive  
lifts regardless of specific style.

Funding for the development and  
validation of these labels was  
provided by the Automotive Lift  
Institute, PO Box 33116 Indian  
Lake, FL 32903.

They are protected by copyright.  
Set of labels may be obtained from  
ALI or its member companies.

<p><b>⚠ CAUTION</b></p>  <p>Lift to be used by trained operator only.</p> <p>©</p>	<p><b>⚠ CAUTION</b></p>  <p>Authorized personnel only in lift area.</p> <p>©</p>
<p><b>⚠ CAUTION</b></p>  <p>When moving lift, be careful to avoid tipping.</p> <p>©</p>	<p><b>⚠ CAUTION</b></p>  <p>Check for overhead obstructions before raising vehicle.</p> <p>©</p>

The messages and pictographs shown are generic in nature and are meant to generally represent hazards common to all automotive lifts regardless of specific style.

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<p><b>SAFETY INSTRUCTIONS</b></p>  <p>Read operating and safety manuals before using lift.</p> <p>©</p>	<p><b>SAFETY INSTRUCTIONS</b></p>  <p>Proper maintenance and inspection is necessary for safe operation.</p> <p>©</p>
<p><b>SAFETY INSTRUCTIONS</b></p>  <p>Do not operate a damaged lift.</p> <p>©</p>	<p>The messages and pictographs shown are generic in nature and are meant to generally represent hazards common to all automotive lifts regardless of specific style.</p> <p>Funding for the development and validation of these labels was provided by the Automotive Lift Institute, PO Box 33116 Indialantic, FL. 32903.</p> <p>They are protected by copyright. Set of labels may be obtained from ALI or its member companies.</p> <p>© 1992 by ALI, Inc. ALI/WL400a</p>

# MOHAWK

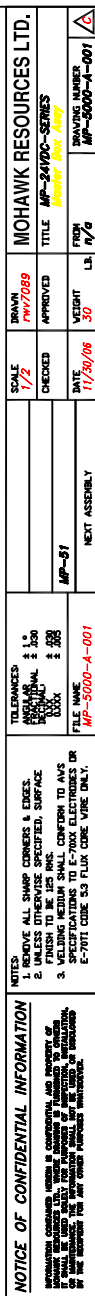
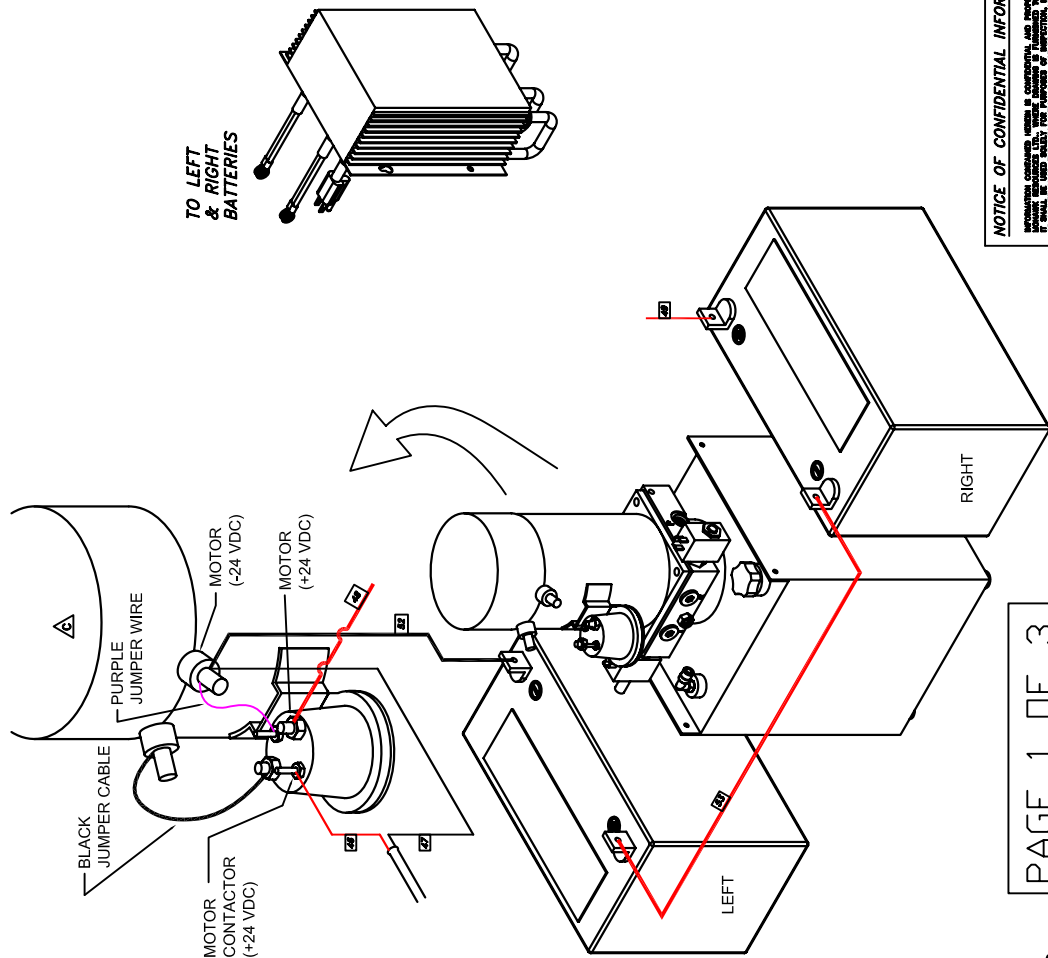


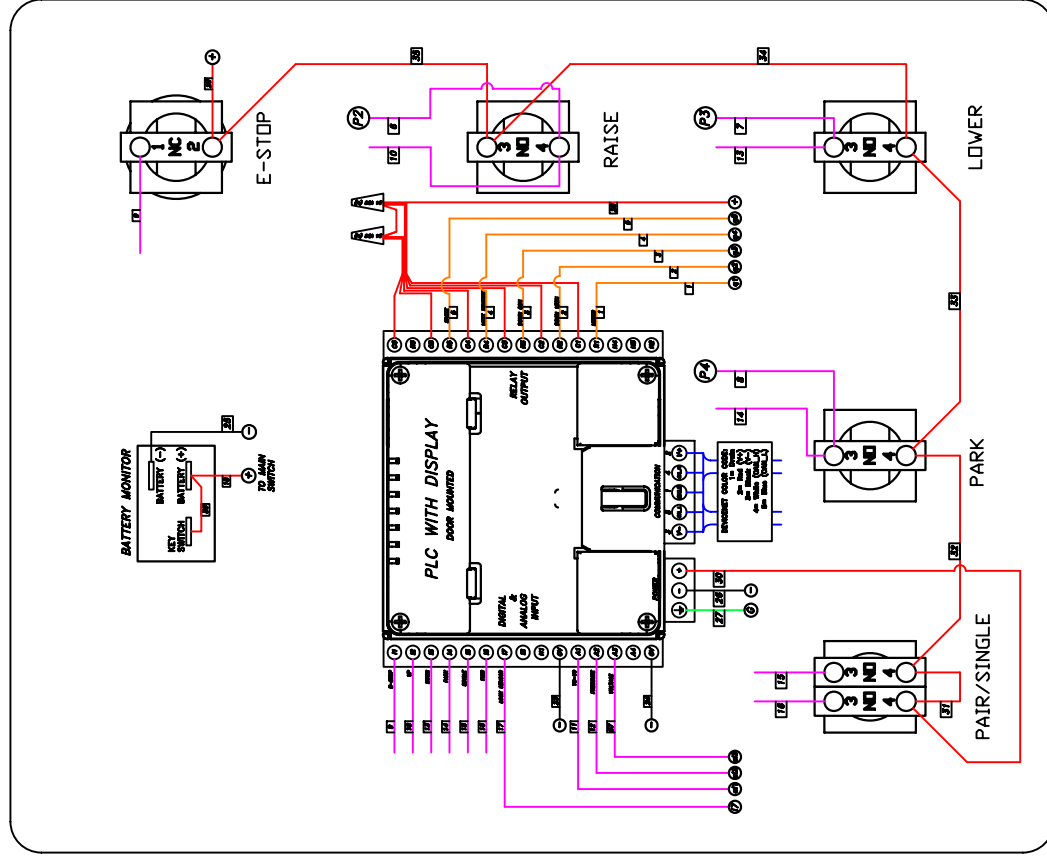
## SCHEMATICS

MP-18-24VDC-SERIES

ELECTRIC/HYDRAULIC

PORTABLE LIFT





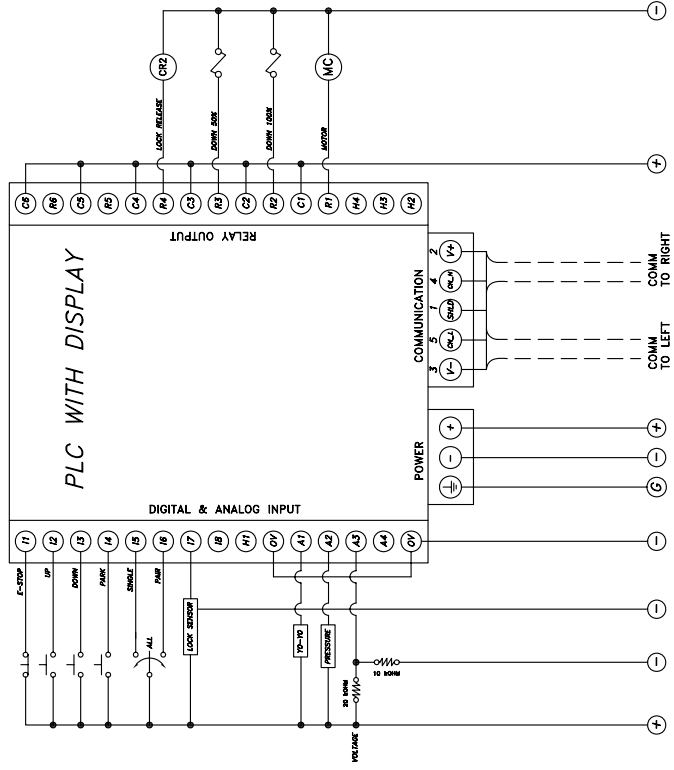
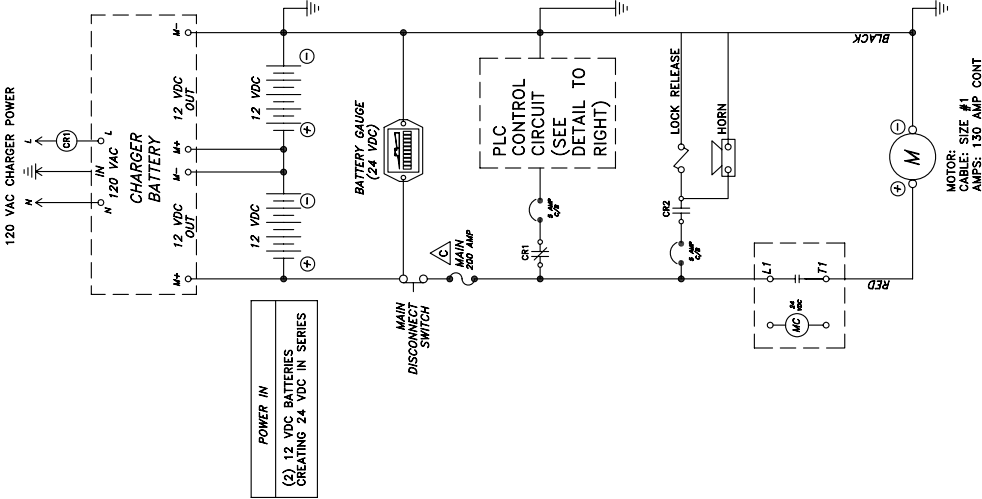
## PANEL WIRING

**PNP-SOURCING-POSITIVE LOGIC WIRING**

PAGE 2 OF 3

**D-SIZE**

NOTICE OF CONFIDENTIAL INFORMATION	
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# MP-SERIES (24 VDC)

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- 1. FINISH ALL SHARP CORNERS & EDGES.
- 2. UNLESS OTHERWISE SPECIFIED, SURFACE FINISH SHALL CONFORM TO A.S.T.M. A-12.3.
- 3. WELDING SHALL CONFORM TO A.S.T.M. A-12.3.
- 4. E-7011 CODE S-3 FLUX CURE WIRE ONLY.

TOLERANCES	UNLESS OTHERWISE SPECIFIED
FINISH	± 0.00
DRILL	± 0.00
BORE	± 0.00
FILE NAME	MP-5100-A-001

NOTES	FILE NAME	DATE	WEIGHT	APPROVED	SCALE	DRAWN	MOHAWK RESOURCES LTD.
1. FINISH ALL SHARP CORNERS & EDGES.	MP-51	11/30/08	30	11/30/08	1/2	11/30/08	MP-24VDC-SERIES
2. UNLESS OTHERWISE SPECIFIED, SURFACE FINISH SHALL CONFORM TO A.S.T.M. A-12.3.	MP-51	11/30/08	30	11/30/08	1/2	11/30/08	MP-24VDC-SERIES
3. WELDING SHALL CONFORM TO A.S.T.M. A-12.3.	MP-51	11/30/08	30	11/30/08	1/2	11/30/08	MP-24VDC-SERIES
4. E-7011 CODE S-3 FLUX CURE WIRE ONLY.	MP-51	11/30/08	30	11/30/08	1/2	11/30/08	MP-24VDC-SERIES



# MOHAWK



## CHARGER INFORMATION

MP-18-24VDC-SERIES

ELECTRIC/HYDRAULIC

PORTABLE LIFT

# Chargetek TPRO-220

## Lead-Acid Battery Charger Specification

### 1 INTRODUCTION

This document establishes the performance of the Chargetek TPRO-220 two output Lead-Acid Battery Charger.

### 2 DESCRIPTION

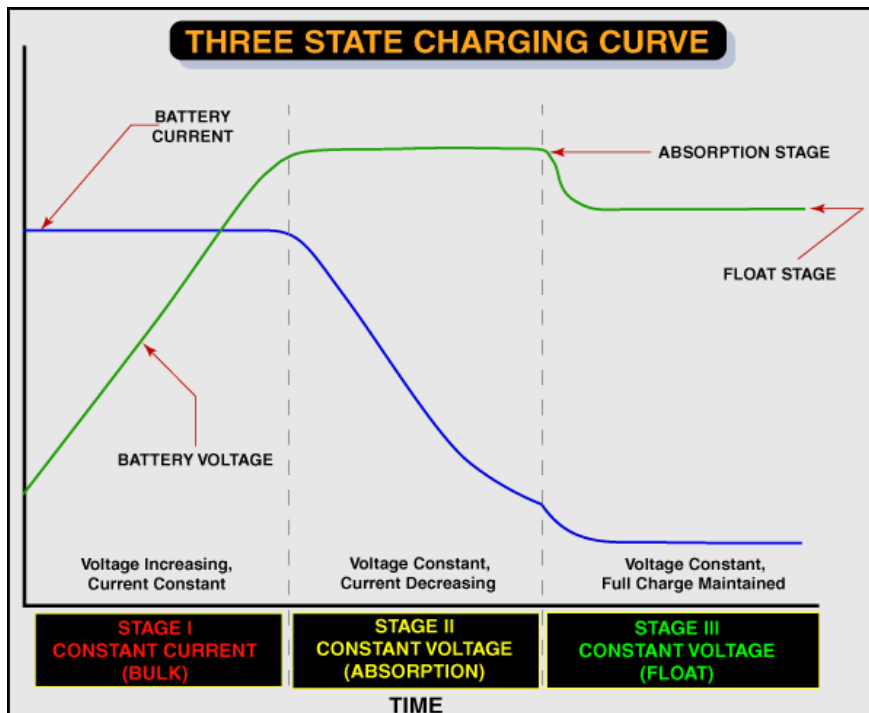
The TPRO-220 is an intelligent two bank lead acid battery charger with two fully isolated outputs. The charger is intended for use with 12/24/36V battery systems and operates from 120VAC 50-60Hz service. LED indicators are provided for state of charge, charging current and other information.

The charger is hermetically sealed, completely waterproof and extremely vibration resistant. The TPRO-220 is convection cooled and has thermal regulation to phase back the charging current in high ambient temperature environments. Charging is implemented with a three state algorithm insuring 100% returned capacity.

### 3 CHARGE ALGORITHM AND INDICATORS

**Fast charge:** Supplies  $I_{FAST}$  in a constant current mode until the battery voltage reaches  $V_{FASTTERM}$ . Charging mode changes to absorption mode.

**Absorption mode:** Regulates battery voltage at  $V_{FASTTERM}$  until charger current drops to  $I_{ABSORBTERM}$  at which time the charging mode changes to float charge.



**Float charge:** Regulate battery voltage at  $V_{\text{FLOAT}}$ . If the output current increase to  $I_{\text{FLOATTERM}}$  the charger will begin charging in the fast charge mode.

**The following LED indicators are provided:**

**Charging Mode:** Individual LEDs for Fast (Red), Absorption (Yellow) and Float (Green) modes.

**Charging Current:** Three LEDs are provided to indicate output current; 0-6A(green), 7-13A(Yellow), 14-20A(red)

**Output On:** Green LEDs, one for each output, illumination indicates the outputs are connected correctly.

**AC On light:** Indicates AC power is applied

## 4 PROTECTION AND SAFETY FEATURES

The following protection features are incorporated into the TPRO-220:

**Reverse Polarity:** Battery leads may be reversed without damage to the charger or battery.

**Short Circuit:** The output may be short-circuited without damage to the charger.

**Over Voltage:** In the event of a component failure resulting in loss of regulation, the charger will automatically shutdown to prevent damage to the battery.

**Over Temperature:** Over temperature protection is provided to lower the output current until the unit's temperature drops to an acceptable level.

**Vibration Resistant:** The TPRO-220 is encapsulated in UL approved, flame retardant material providing rigid support for all internal components.

**Waterproof:** The encapsulation provides complete waterproofing.

**Wire Insulation:** AC power cord is SJTOWA: weather and oil resistant insulation.

**Charge Balancing:** Each battery in the stack is charged independently providing equal charging for each battery and eliminating stack imbalances.

## 5 ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit	Conditions
$V_{\text{AC}}$	AC Supply Voltage	100-132	VAC	47Hz – 63Hz
$I_{\text{ACFAST}}$	AC Current	7.0	Amps AC	100VAC
$T_{\text{OPR}}$	Operating Temperature	-10 to 50	°C	Ambient

T <sub>STG</sub>	Storage Temperature	-30 to 80	°C	
	Operating Humidity	99	% RH	

## 6 DC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Minimum	Typical	Maximum	Unit	Conditions
V <sub>FASTTERM</sub>	Fast charge termination voltage	14.6	14.7	14.8	V	25 °C
V <sub>FLOAT</sub>	Float voltage	13.4	13.5	13.6	V	I <sub>OUT</sub> < 1.0 A, 25°C
I <sub>FAST</sub>	Fast charge current	20	21	22.5	A	V <sub>BATTERY</sub> = 12V
I <sub>ABSORBTERM</sub>	Absorption mode charge termination current	1.5	1.8	2.2	A	
I <sub>FLOATTERM</sub>	Float charge termination current	3.3	3.5	3.7	A	
I <sub>STANDBY</sub>	Standby Current		10		ma	AC Off

## 7 PHYSICAL CHARACTERISTICS

Size: 8" x 7" x 3.5" – see Figure 1  
 Weight: 13 lbs.  
 AC Cord length: 6'  
 DC Cord length: 6'  
 DC Cord termination: Ring terminals (can be changed upon request)

# CHARGER OPERATION

The TP20220 is fully automatic once installed properly. The indicator lights (LEDs) informs the user of the progress of the charging cycle and confirms proper connections. The charger monitors each battery individually and charges each to full capacity. The charging current is distributed to the three banks as determined by the state of charge of the batteries.

## ELECTRICAL CHARACTERISTICS

- AC Input Voltage Range: 100-132VAC
- AC Input Current: 6A rms Maximum
- Max. Charging Current: 22A (Fast Mode)
- Max. Charging Voltage (Absorption Mode): 14.5-14.85VDC
- Max. Float Voltage (Float Mode): 13.2-13.5VDC

## LED INDICATORS

Charging Mode LEDs indicate the state of charge of the batteries. The green Float light is the final charge state indicating the batteries are fully charged. Only one Charging Mode LED should be on at any one time.

Charging Current LEDs indicate the amount of charging current being delivered by the charger to all three outputs.

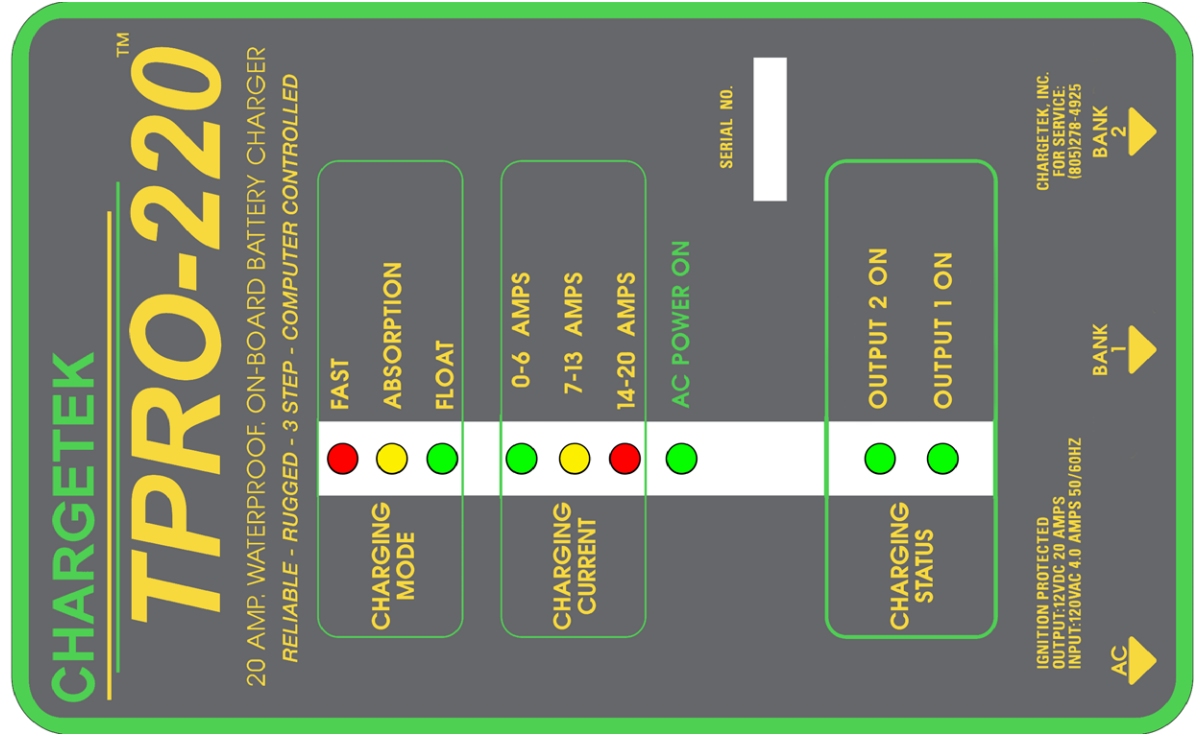
AC Power On LED indicates AC power is applied to the charger

Charging Status LED indicates outputs are connected properly to their respective batteries and are being charged. When properly installed all Charging Status LEDs should be on.

## PROTECTION MODES:

Over Temperature: The TP20220 will reduce its charging current as its case temperature increases to insure proper operation. In the event of a charger over temperature the unit will turn off until it cools off and then restart automatically. This over temperature condition is indicated by the AC Power on and Float LEDs flashing. If the unit is operated in a very high ambient temperature, it is possible for the temperature to increase further, as indicated by the AC Power on and 14-20 Amp Charging Current LEDs flashing. In the rare event this condition occurs the AC power and three Battery Banks should be disconnected and reconnected once the charger has cooled off.

Over Voltage: The charger is equipped with an overvoltage protection circuit in the event of a regulation malfunction. The charger will turn off if the overvoltage persists. The AC power and three Battery Banks should be disconnected for 2 minutes and reconnected to the batteries. An over voltage condition is



indicated by the AC Power On and Fast LEDs flashing. If the over voltage persists then the factory should be consulted.

Good battery maintenance procedures dictate that battery fluid levels be checked on a regular basis, especially in high ambient temperatures.

LIMITED WARRANTY

For two years from date of purchase, Chargetek Inc. will at its discretion repair or replace for the original consumer, free of charge any part or parts found to be defective by Chargetek in workmanship or material. All shipping charges under this warranty must be paid by the consumer. Proof of purchase is required.

There is no other expressed warranty. Implied warranties, including those of merchantability and fitness for a particular purpose are limited to two years from the date of purchase. This is the exclusive remedy and consequential damages are excluded where permitted by law.

# CHARGETEK

## TP20220

### OWNER'S MANUAL



The TP20220 is a sophisticated 20A two-bank battery charger. It can be configured in a multitude of battery system configurations and used as either an on-board or portable unit

to insure a complete recharge every time. The charger may be left connected indefinitely to the batteries, maintaining full charge at all times.

Charging is controlled by an embedded microcontroller that contains software developed and proprietary to Chargetek. This electronic "brain" insures that all batteries will be fully and properly recharged regardless of the condition of any one battery. The TP20220 precisely controls charging voltage and current

The TP20220 utilizes state of the art high frequency power processing that converts the AC line power to 12 VDC efficiently and safely. The charger is completely waterproof and sealed with UL approved 94VO flame retardant epoxy. This sealing also provides extreme vibration and shock resistance since the encapsulated unit is effectively a "brick".

## CHARGETEK

2240 CELSIUS, UNIT E ~ OXNARD, CA 93030 ~ PHONE: (805) 278-4925 FAX: (805) 278-7966

WWW.CHARGETEK.COM

# INSTALLATION

## LOCATION

- ❑ Do not mount directly over or under a battery or onto a carpeted, upholstered or varnished surface.
- ❑ Install in an area where all charger electrical cords will avoid hot surfaces such as exhaust pipes and moving parts such as fan wheels.
- ❑ Operating ambient temperature is 15 to 130 degrees Fahrenheit. Storage temperature is -20 to 160 degrees Fahrenheit.

- ❑ Pick an area that will provide as much surrounding cooling clearance as possible for maximum efficiency and shortest recharge times. Maintain a 12 inch clearance around charger and never mount in the vicinity of explosives, pressurized cans or other flammable material.

## MOUNTING

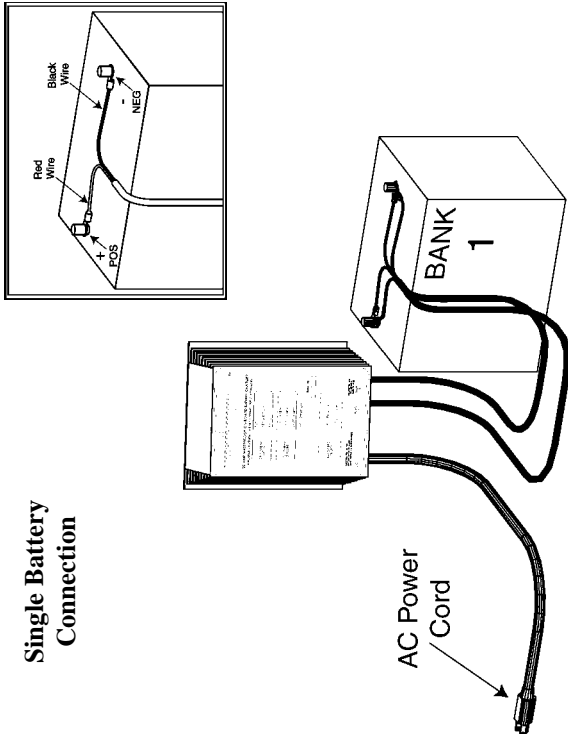
- ❑ Wear safety goggles, gloves and a long sleeve shirt when drilling mounting holes near a battery.
- ❑ In most cases, #10 stainless steel mounting bolts with aircraft nuts or nylocks or #10 screws provide for solid mounting.

## ELECTRICAL

### DC WIRE CONNECTIONS

- ❑ Each output should be connected only to a standard 12V lead-acid battery.
- ❑ DC wire connections must be made before plugging in the AC cord. The charger will not operate until DC connections are made. Do not remove DC connections while the AC cord is plugged in.

- ❑ When installing in the bilge and or battery compartment of boats, open hatches and operate bilge blowers if any for ten minutes to



remove any fumes and hydrogen gas. Be certain the area is ventilated for personal health and safety

- ❑ Keep wire routing from the charger to the battery neat and secure by anchoring with cable tie to a solid surface every few inches, not to exceed 18” intervals.
- ❑ As is true with any device connected to a battery, an in-line fuse added to the positive lead to the battery is recommended to provide protection if the DC cord is somehow damaged.
- ❑ Connect #1 lead set to battery #1, red to positive and black to negative. Connect lead set #2 to battery #2, red to positive and black to negative. Do not leave any lead set disconnected when charging less than two batteries. If charging only one battery connect both red leads to positive, and both black leads to negative. If charging two batteries, connect one of the lead sets to one battery and the other lead set to the other battery. All connections should be clean and tight. See installation diagrams.

### AC Wire Connections

#### Note:

**The Chargetek TP20220 is equipped with a factory installed 6’ grounded AC cord. Though hook up is only a matter of plugging this cord into a suitable extension cord, please follow the following precautionary tips.**

- ❑ Insure that the AC cord cannot reach moving parts, lids, hoods, etc. Secure with a cable tie to solid anchor point if necessary.
- ❑ The charger will operate properly with either 120 volts 50 Hz or 120 volts 60 Hz AC input. Never use 230 volt service with this unit.

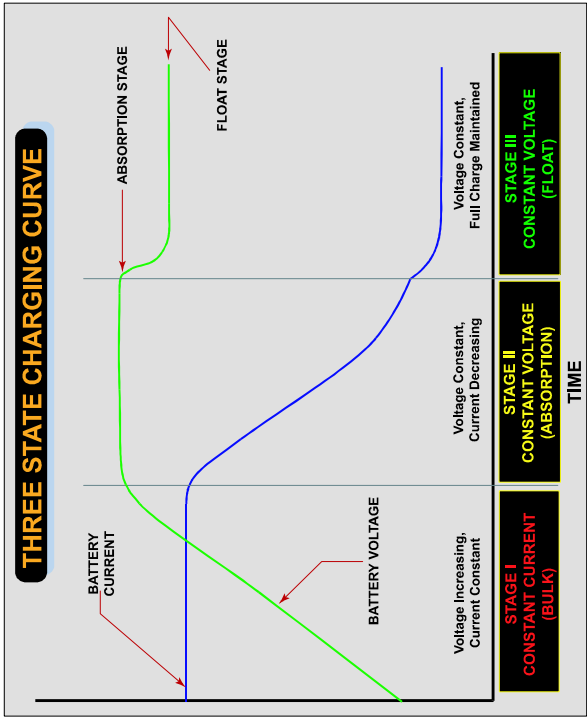
#### CAUTION:

**Never connect the AC plug into an electrical outlet when you are wet or barefoot.**

# SAFETY INSTRUCTIONS

**CAUTION: The following are important safety instructions. Save these instructions.**

- ❑ Charge only lead acid. (maintenance free or refillable), or “gel-cell” rechargeable batteries. Other types of batteries may burst causing personal injury and damage
- ❑ Never smoke or allow sparks or flame in the vicinity of a battery.
- ❑ Someone should be within range of your voice and close enough to come to your aid when you are working near a battery.
- ❑ Wear eye protection and clothing protection. Avoid touching eyes while working near a battery.
- ❑ Have plenty of fresh water and soap nearby in case battery acid contact’s skin, clothing or eyes.
- ❑ If battery acid contact’s skin or clothing, wash immediately with soap and water. If acid enters eyes, immediately flood eyes with running cold water for at least ten minutes and get immediate medical attention.
- ❑ Never operate a charger with a damaged cord or plug. Wearing of AC and DC cords, accidentally nicking or cutting the cords could result in sparking and cause injury.
- ❑ Never operate a charger that has been damaged in any way or try to disassemble. Return to factory when service or replacement is required. Incorrect reassembly may result in a risk of electrical shock or fire.
- ❑ Become familiar with all instructions, specifications and cautionary markings on chargers, batteries and equipment used. Only adults should install and operate the charger. Children should be kept out of reach of the charger and batteries it is charging.
- ❑ When using an extension cord the Chargetek TP20220 requires a quality grounded extension cord of at least 16 awg wire size for cords up to 50’ and a minimum of 14 awg for cords up to 150’.
- ❑ Never unplug a cord by pulling on the cord itself. Always grasp the plug when disconnecting the charger.
- ❑ Even though the Chargetek TP20220 is waterproof and designed for harsh environments, do not operate submerged.
- ❑ Never charge a frozen battery. If the battery has an odor or is visibly damaged disconnect charger and consult factory.
- ❑ Study battery manufacturer’s precautions such as removing or not removing cell caps while charging.
- ❑ Keep batteries full. Add distilled water in each cell until it reaches levels specified by battery
- ❑ Keep battery terminals clean. Always unplug charger before cleaning and be careful to keep corrosion from coming in contact with eyes.
- ❑ Remove personal metal items such as rings, bracelets, necklaces, and watches when working with a lead-acid battery. A lead-acid battery can produce a short circuit high enough to weld a ring, etc. to metal, causing a severe burn.



# MOHAWK



## BATTERY INFORMATION

MP-18-24VDC-SERIES

ELECTRIC/HYDRAULIC  
PORTABLE LIFT



Effective June 1, 2005  
Supersedes all previous information. Subject to change without notice.

# MARINE MASTER™

## BATTERY LINE SPECIFICATIONS

GROUP NUMBER	PART NO. (WET)	PERFORMANCE LEVEL				SUGG. WARR.	QUARTS OF ACID	APPROXIMATE WEIGHT		MAXIMUM OVERALL DIMENSIONS (in inches and mm)					COLOR CODE COVER/ CASE	FOOT NOTES		
		CCA @ 0°F	RESERVE CAPACITY	MCA @ 32°F				WET	DRY	L	W	H						
12-VOLT MARINE/RV STARTING CALCIUM MAINTENANCE-FREE																		
24	24M7	875	125	1000		24	—	45	—	10%	273	6%	171	9%	238	WW	+HMU	
	24M6	650	120	820	24	—	40	—	BB							+HMU		
	24M5	550	90	650	24	—	35½	—	BB							+HMU		
	24M4	440	70	550	24	—	32	—	BB							+HMU		
27	27M6	750	182	925		24	—	56	—	12½	318	6%	171	9%	238	BB	+HU	
GROUP NUMBER	PART NO. (WET)	PERFORMANCE LEVEL				SUGG. WARR.	QUARTS OF ACID	APPROXIMATE WEIGHT		MAXIMUM OVERALL DIMENSIONS (in inches and mm)					COLOR CODE COVER/ CASE	FOOT NOTES		
		CCA @ 0°F	MINS. @ 23 A ≈	MINS. @ 25 A ≈	20 AH RATE ≈			MCA @ 32°F ≈	WET	DRY	L	W	H					
12-VOLT DUAL PURPOSE STARTING/DEEP CYCLE SERVICE																		
24	DP24	525	140	120	65	650	24	—	42	—	10%	273	6%	171	9%	238	BB	★HU
27	DP27	625	175	150	80	770	24	—	49	—	12½	318	6%	171	9%	238	BB	★HU
31	DP31DT	650	205	182	100	810	24	—	57	—	13	330	6%	171	9%	241	BB	HLMSX \$
12-VOLT MARINE/RV HEAVY-DUTY DEEP CYCLE SERVICE (INCLUDING STARTING)																		
24	DC24	500	150	130	75	625	24	—	45	—	10%	273	6%	171	9%	238	BB	• HU \$
27	DC27	575	200	175	90	715	24	—	53	—	12½	318	6%	171	9%	238	BB	• HU \$
31	DC31DT	650	225	185	105	810	24	—	59	—	13	330	6%	171	9%	241	BB	• HLMSX \$
Note: The three “DC” deep cycle part numbers above include double insulated glass mat separators.																		
GROUP NUMBER	PART NO. (WET)	PERFORMANCE LEVEL				SUGG. WARR.	QUARTS OF ACID	APPROXIMATE WEIGHT		MAXIMUM OVERALL DIMENSIONS (in inches and mm)					COLOR CODE COVER/ CASE	FOOT NOTES		
		CCA @ 0°F	RESERVE CAPACITY	MCA @ 32°F				WET	DRY	L	W	H						
12-VOLT HEAVY-DUTY COMMERCIAL SERVICE																		
4D	804DMM	900	260	1100		30	—	97	—	20%	527	8%	216	10%	258	BB	★H	
	904DMM	1010	290	1235	30	16	99½	58	BB							⊗★H		
8D	708DMM	1100	325	1340		30	—	117½	—	20%	527	11	279	10	254	BB	★H	
	908DMM	1375	430	1630	30	18½	130	80	BB							⊗★H		
	908DMFMM	1450	450	1790	30	—	134	—	BB							HL		
GROUP NUMBER	PART NO. (WET)	PERFORMANCE LEVEL				SUGG. WARR.	QUARTS OF ACID	APPROXIMATE WEIGHT		MAXIMUM OVERALL DIMENSIONS (in inches and mm)					COLOR CODE COVER/ CASE	FOOT NOTES		
		CCA @ 0°F	8 AH RATE ≈	6 AH RATE ≈	MCA @ 32°F ≈			WET	DRY	L	W	H						
8-VOLT MARINE AND INDUSTRIAL																		
	8V195	980	170	166	1170	24	11½	90	60	20¾	527	7¼	184	10%	270	BB	⓪•HR	
	819	510	167	158	610	24	13	119	90	24½	622	7½	191	10½	267	BB	⓪•HKT \$	
	821	530	187	177	635	24	14½	135	98	27½	699	7½	191	10½	267	BB	⓪•HKT \$	
	825	730	224	212	870	24	16½	160	120	26%	683	8½	216	11¼	298	BB	⓪•FHK \$	
GROUP NUMBER	PART NO. (WET)	PERFORMANCE LEVEL				SUGG. WARR.	QUARTS OF ACID	APPROXIMATE WEIGHT		MAXIMUM OVERALL DIMENSIONS (in inches and mm)					COLOR CODE COVER/ CASE	FOOT NOTES		
		20 AH RATE ≈	6 AH RATE ≈	MINS. DISCH @ 75 AMPS				WET	DRY	L	W	H						
6-VOLT MARINE, RV, GOLF CAR, EV, MOTIVE POWER & DEEP CYCLE SERVICE																		
GC2	GC10GMM	190	156	100		10	—	59	—	10%	260	7%	181	10%	276	BB	•G^	
	GC15GMM	215	178	115		12	6%	63	44							CC	⓪•G^	
GROUP NUMBER	PART NO. (WET)	PERFORMANCE LEVEL				SUGG. WARR.	QUARTS OF ACID	APPROXIMATE WEIGHT		MAXIMUM OVERALL DIMENSIONS (in inches and mm)					COLOR CODE COVER/ CASE	FOOT NOTES		
		CCA @ 0°F	RESERVE CAPACITY	MCA @ 32°F				WET	DRY	L	W	H						
6-VOLT MARINE, RV AND COMMERCIAL SERVICE																		
4	904MFMM	1000	270	1220		30	—	47	—	12½	318	6%	175	9%	241	BB	L	

See other side for detailed explanations of footnotes and symbols.

MEMBERS OF:



GROUP NO.	PART NO.	FOOT NOTES	VOLTS	CCA @ 0°F	MCA @ 32°F	RES. CAP. @ 80°F	APPROX. WT. LBS. (KGS)	DIMENSIONS IN. (MM)								
								L	W	H						
U1	8GU1HM	HZ	12	175	250	44	23.4 (10.6)	8 <sup>5</sup> / <sub>16</sub> (211)	5 <sup>1</sup> / <sub>4</sub> (133)	7 <sup>1</sup> / <sub>8</sub> (181)						
24	8G24M	HQ	12	410	575	132	52.5 (23.8)	10 <sup>7</sup> / <sub>16</sub> (276)	6 <sup>3</sup> / <sub>4</sub> (171)	9 <sup>1</sup> / <sub>8</sub> (251)						
27	8G27M	HQ	12	505	700	160	63.2 (28.7)	12 <sup>3</sup> / <sub>4</sub> (324)	6 <sup>3</sup> / <sub>4</sub> (171)	9 <sup>1</sup> / <sub>8</sub> (251)						
31	8G31DTM	HSX	12	550	780	180	70.0 (31.7)	12 <sup>15</sup> / <sub>16</sub> (329)	6 <sup>3</sup> / <sub>4</sub> (171)	9 <sup>1</sup> / <sub>8</sub> (238)						
4D	8G4DM	HS	12	970	1245	375	127.0 (57.5)	20 <sup>3</sup> / <sub>4</sub> (527)	8 <sup>1</sup> / <sub>2</sub> (216)	10 (254)						
8D	8G8DM	HS	12	1150	1470	475	157.0 (71.1)	20 <sup>3</sup> / <sub>4</sub> (527)	11 (279)	10 (254)						
GC2	8GGC2M	G	6	585	850	92	68.4 (31.0)	10 <sup>1</sup> / <sub>4</sub> (260)	7 <sup>1</sup> / <sub>8</sub> (181)	10 <sup>1</sup> / <sub>8</sub> (276)						
GROUP NO.	PART NO.	MINUTES DISCHARGED AT ~						AMPERE HOUR CAPACITY ~				PALLET INFO.		WARRANTY INFO. (MTHS)		
		75 AMPS	50 AMPS	25 AMPS	15 AMPS	8 AMPS	5 AMPS	20 HR. RATE	6 HR. RATE	3 HR. RATE	1 HR. RATE	QTY.	WT. LBS.	FREE REPL.	PRO RATA	TOTAL
U1	8GU1HM	5	12	47	90	190	325	31.6	28.0	25.5	21.0	120	2900	3	3	6
24	8G24M	33	57	140	245	500	845	73.6	64.5	59.3	48.5	44	2450	12	48	60
27	8G27M	40	70	170	300	605	1000	86.4	76.0	69.9	57.0	36	2350	12	48	60
31	8G31DTM	51	84	190	335	690	1160	97.6	85.2	78.6	64.5	36	2570	12	48	60
4D	8G4DM	105	175	395	685	1385	2300	183.0	160.2	147.6	122.0	16	2250	12	48	60
8D	8G8DM	135	220	500	890	1750	3000	225.0	198.0	181.8	150.0	12	2050	12	48	60
GC2	8GGC2M	92	155	375	680	1360	2200	180.0	155.0	136.0	99.0	40	2980	3	9	12

All Dominator Gel batteries have a grey case and grey cover.

**IMPORTANT CHARGING INSTRUCTIONS:** WARRANTY VOID IF OPENED OR IMPROPERLY CHARGED. Do not install in a sealed container. Constant under or overcharging will damage any battery and shorten its life! Use a good constant potential, voltage-regulated charger. **For 12-volt batteries, charge to at least 13.8 volts but no more than 14.1 volts at 68°F (20°C).** **For 6-volt batteries, charge to at least 6.9 volts but no more than 7.05 volts at 68°F (20°C).** The open circuit voltage of a fully charged 12-volt battery is 12.8V and a fully charged 6-volt battery is 6.4V at 68°F (20°C). However, as the battery charges, the building internal pressure (voltage) causes resistance to the charge. Therefore, the **on-charge voltage** must be higher (at least 13.8V for 12-volt and 6.9V for 6-volt) to overcome this internal pressure (voltage) during charging.

\* NON-SPILLABLE by DOT (Department of Transportation), ICAO (International Commercial Airline Organization) and IATA (International Airline Transport Association) definitions.

GROUP NO.	PART NO.	FOOT NOTES	VOLTS	SUGG. WARR.	PERFORMANCE LEVEL				APPROX. WEIGHT lbs. (kg)	MAXIMUM OVERALL DIMENSIONS inches (mm)						
					CCA @ 0°F	RC @ 25 AMP	20 A.H. CAP. ≈	REF. MCA @ 32°F		L		W		H		
MARINE ABSORBED GLASS MAT																
U1	8AU1HM	HZ12	12	6	240	48	32	335	24	10.9	8 <sup>5</sup> / <sub>16</sub>	211	5 <sup>1</sup> / <sub>4</sub>	133	7 <sup>1</sup> / <sub>8</sub>	181
22NF	8A22NFM	G12	12	6	280	90	55	390	38.5	17.5	9 <sup>1</sup> / <sub>16</sub>	238	5 <sup>1</sup> / <sub>2</sub>	140	9 <sup>1</sup> / <sub>8</sub>	235
24	8A24M	HQ12	12	36	470	140	79	660	53	24.0	10 <sup>7</sup> / <sub>16</sub>	276	6 <sup>3</sup> / <sub>4</sub>	171	9 <sup>1</sup> / <sub>8</sub>	251
27	8A27M	HQ12	12	36	580	175	92	810	63	28.6	12 <sup>3</sup> / <sub>4</sub>	324	6 <sup>3</sup> / <sub>4</sub>	171	9 <sup>1</sup> / <sub>8</sub>	251
31	8A31DTM	HSX1	12	36	800	190	105	1000	69	31.3	12 <sup>15</sup> / <sub>16</sub>	329	6 <sup>3</sup> / <sub>4</sub>	171	9 <sup>1</sup> / <sub>8</sub>	238
4D	8A4DM	HS	12	36	1110	380	198	1420	129	58.5	20 <sup>3</sup> / <sub>4</sub>	527	8 <sup>1</sup> / <sub>2</sub>	216	10	254
8D	8A8DM	HS	12	36	1350	480	245	1725	158	71.7	20 <sup>3</sup> / <sub>4</sub>	527	11	279	10	254
GC2	8AGC2M	G	6	12	690	380	187	915	69.5	32.0	10 <sup>1</sup> / <sub>4</sub>	260	7 <sup>1</sup> / <sub>8</sub>	181	10 <sup>1</sup> / <sub>8</sub>	276
	ETX16LM	123	12	12	275	10 A.H. Rating = 19			17.0	7.7	6 <sup>1</sup> / <sub>16</sub>	175	4	102	6 <sup>1</sup> / <sub>8</sub>	155 <sup>†</sup>
	ETX20LM	12	12	12	270	10 A.H. Rating = 17.5			15.5	7.0	6 <sup>1</sup> / <sub>16</sub>	175	3 <sup>3</sup> / <sub>8</sub>	88	6 <sup>1</sup> / <sub>8</sub>	155

All Seamate AGM batteries have a grey case and black cover.

**IMPORTANT CHARGING INSTRUCTIONS:** WARRANTY VOID IF OPENED OR IMPROPERLY CHARGED. Do not install in a sealed container. Constant under or overcharging will damage any battery and shorten its life! Use a good constant potential, voltage-regulated charger. **For 12-volt batteries, charge to at least 14.4 volts but no more than 14.6 volts at 68°F (20°C).** The open circuit voltage of a fully charged 12-volt AGM battery is 12.8V. However, as the battery charges, the building internal pressure (voltage) causes resistance to the charge. Therefore, the **on-charge voltage** must be higher (at least 14.2V for 12-volt) to overcome this internal pressure (voltage) during charging.

### SYMBOL DEFINITIONS:

- + - Maintenance-free calcium alloy grids
- - Low maintenance - Low antimony grids
- \$ - Deduct 15% from CA and CCA rating shown to allow for double insulation (glass mat)
- ≈ - Nominal rating
- ★ - Hybrid construction
- ^ - Ratings after 15 cycles
- † - Height without adapter

### COLOR CODES:

- First letter indicates cover, second letter indicates case.
- W - White
- B - Black
- C - Charcoal

### FOOTNOTES:

- F - Standing upright terminal w/ 3/8" diameter hole
- G - Offset post w/ horizontal hole, stainless steel 5/16" bolt and hex nut
- H - Includes handles
- K - Hard rubber, multi-cell cover construction
- L - Anchor lock elements
- M - Flush manifold vented cover
- Q - Dual top terminals with SAE post and 3/8" POS., 5/16" NEG. stainless steel studs & wing nuts
- R - Hard rubber, one-piece cover construction
- S - SAE "automotive type" post
- T - Heavy Duty L terminal w/ 3/8" diameter hole
- U - Offset SAE post w/ vertical 5/16" NEG., 3/8" POS. stainless steel studs and wing nuts

- V - Dual terminal universal design
- X - 3/8" x 16 stainless steel stud posts
- Z - Terminals have round holes
- ① - Available dry - add "D" suffix to part number
- ② - Available dry - add "Y" suffix to part number
- 1 - "Non-Spillable" defined by DOT (Department of Transportation) definition
- 2 - "Non-Spillable" defined by ICAO (International Commercial Airline Organization) and IATA (International Airline Transport Association) definitions
- 3 - Shipped with 20mm adapter

All ratings conform to B.C.I. specifications. Dry MF = up to 10% reduced capacity.

All batteries manufactured in polypropylene cases except where noted.

Maintenance-free batteries have microporous, polyethylene envelope separators



**"POWERED FOR PERFORMANCE"®**

**EAST PENN manufacturing co., inc.**

LYON STATION, PA 19536 • Phone: 610-682-6361 • Fax: 610-682-4781

Order Department Hotline: 610-682-4231 • www.dekabatteries.com

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# Valve-Regulated Lead-Acid (VRLA): Gelled Electrolyte (gel) and Absorbed Glass Mat (AGM) Batteries

*EAST PENN Expertise and American Workmanship*

*Quality System Certified to ISO 9001*

## Introduction

Valve-regulated lead-acid (VRLA) technology encompasses both gelled electrolyte and absorbed glass mat (AGM) batteries. Both types are valve-regulated and have significant advantages over flooded lead-acid products.

More than a decade ago, East Penn began building valve-regulated batteries using tried and true technology backed by more than 50 years experience. East Penn's unique computer-aided manufacturing expertise and vertical integration have created a product that is recognized as the **highest quality, longest lived VRLA battery available from any source.**

East Penn's gel and AGM batteries are manufactured to tough quality standards. East Penn manufactures high power gel and AGM batteries with excellent performance and life.

## Applications

VRLA batteries can be substituted in virtually any flooded lead-acid battery application (in conjunction with well-regulated charging), as well as applications where traditional flooded batteries cannot be used. Because of their unique features and benefits, VRLA batteries are particularly well suited for:

### Deep Cycle, Deep Discharge Applications

- Marine Trolling
- Electronics
- Sailboats
- Electric Vehicles
- Wheelchairs
- Golf Cars
- Portable Power
- Floor Scrubbers
- Personnel Carriers
- Marine & RV House Power
- Commercial Deep Cycle Applications

### Standby and Emergency Backup Applications

- UPS (Uninterrupted Power Systems)
- Cable TV
- Emergency Lighting
- Computer Backup
- Solar Power
- Telephone Switching
- Village Power

### Unusual and Demanding Applications

- Race Cars
- Air-transported Equipment
- Off-road Vehicles
- Wet Environments
- Marine & RV Starting
- Diesel & I.C.E. Starting

## What is a gel battery?

A gel battery is a lead-acid electric storage battery that:

- is sealed using special pressure valves and should never be opened.
- is completely maintenance-free.\*
- uses thixotropic gelled electrolyte.
- uses a recombination reaction to prevent the escape of hydrogen and oxygen gases normally lost in a flooded lead-acid battery (particularly in deep cycle applications).

- is non-spillable, and therefore can be operated in virtually any position. However, upside-down installation is not recommended.
- \* Connections must be retorqued and the batteries should be cleaned periodically.*

## What is an AGM battery?

An AGM battery is a lead-acid electric storage battery that:

- is sealed using special pressure valves and should never be opened.
- is completely maintenance-free.\*
- has all of its electrolyte absorbed in separators consisting of a sponge-like mass of matted glass fibers.
- uses a recombination reaction to prevent the escape of hydrogen and oxygen gases normally lost in a flooded lead-acid battery (particularly in deep cycle applications).
- is non-spillable, and therefore can be operated in virtually any position. However, upside-down installation is not recommended.

*\* Connections must be retorqued and the batteries should be cleaned periodically.*

## How does a VRLA battery work?

A VRLA battery is a "recombinant" battery. This means that the oxygen normally produced on the positive plates of all lead-acid batteries is absorbed by the negative plate. This suppresses the production of hydrogen at the negative plate. Water (H<sub>2</sub>O) is produced instead, retaining the moisture within the battery.

**It never needs watering, and should never be opened** as this would "poison" the battery with additional oxygen from the air. Opening the battery will void the warranty.

## What are the differences between gel batteries and absorbed glass mat (AGM) batteries?

Both are recombinant batteries. Both are sealed valve-regulated (SVR) – also called valve-regulated lead-acid (VRLA). AGM batteries and gel batteries are both considered "acid-starved". In a gel battery, the electrolyte does not flow like a normal liquid. The electrolyte has the consistency and appearance of petroleum jelly. Like gelled electrolyte batteries, absorbed electrolyte batteries are also considered non-spillable – all of the liquid electrolyte is trapped in the sponge-like matted glass fiber separator material.

The "acid-starved" condition of gel and AGM batteries protects the plates during heavy deep-discharges. The gel battery is more starved, giving more protection to the plate; therefore, it is better suited for super-deep discharge applications.

Due to the physical properties of the gelled electrolyte, gel battery power declines faster than an AGM battery's as the temperature drops below 32°F. AGM batteries excel for high current, high power applications and in extremely cold environments.

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## ***What is the difference between VRLA batteries and traditional wet batteries?***

Wet batteries do not have special pressurized sealing vents, as they do not work on the recombination principle. They contain liquid electrolyte that can spill and cause corrosion if tipped or punctured. Therefore, they are not air transportable without special containers. They cannot be shipped via UPS or Parcel Post or used near sensitive electronic equipment. They can only be installed "upright."

Wet batteries lose capacity and become permanently damaged if:

- left in a discharged condition for any length of time (due to sulfation). This is especially true of antimony and hybrid types.
- continually over-discharged, due to active material shedding. This is especially true of automotive starting types.

Our gel cells have triple the deep cycle life of wet cell antimony alloy deep cycle batteries, due to our unique design. The shelf life of a VRLA battery is seven times higher than the shelf life of a deep cycle antimony battery.

## ***How do VRLA batteries recharge? Are there any special precautions?***

While our VRLA batteries accept a charge extremely well due to their low internal resistance, **any** battery will be damaged by continual under- or overcharging. Capacity is reduced and life is shortened.

Overcharging is especially harmful to any VRLA battery because of the sealed design. Overcharging dries out the electrolyte by driving the oxygen and hydrogen out of the battery through the pressure relief valves. Performance and life are reduced.

If a battery is continually undercharged, a power-robbing layer of sulfate will build up on the positive plate, which acts as a barrier to recharging. Premature plate shedding can also occur. Performance is reduced and life is shortened.

Therefore, **it is critical that a charger be used that limits voltage.** The charger must be temperature-compensated to prevent under- or overcharging due to ambient temperature changes. (See **Charging Voltage vs. Ambient Temperature** chart on page 11.)

### ***Important Charging Instructions***

**The warranty is void if improperly charged.** Use a good constant potential, temperature-compensated, voltage-regulated charger. **Constant current chargers should never be used on VRLA batteries.**

## ***Can VRLA batteries be installed in sealed battery boxes?***

**NO!** Never install any type of battery in a completely sealed container. Although most of the normal gasses (oxygen and hydrogen) produced in a VRLA battery will be recombined as described above, and not escape, **oxygen and hydrogen will escape from the battery in an overcharge condition** (as is typical of any type battery).

For safety's sake, these potentially explosive gasses **must** be allowed to vent to the atmosphere and **must never be trapped in a sealed battery box or tightly enclosed space!**

## ***Can our VRLA batteries be used as starting batteries as well?***

Our VRLA batteries will work in SLI (Starting, Lighting and Ignition) applications as long as the charging voltage is regulated to the appropriate values from the tables on page 11. Many vehicle regulators are set too high for gel batteries; therefore, the charging system may require adjustment to properly recharge a gel battery for best performance and life.

AGM batteries excel in low temperature, high current applications such as cold weather starting.

## ***What do the ratings and specifications signify for this line?***

All ratings are **after 15 cycles** and conform to BCI specifications.

### ***CCA = Cold Cranking Amperes at 0°F (-17.8°C)***

Cold cranking amperes equal the number of amperes a new, fully charged battery will deliver at 0°F (-17.8°C) for thirty seconds of discharge and maintain at least 1.2 volts per cell (7.2 volts for a 12-volt battery).

### ***CA = Cranking Amperes at 32°F (0°C)***

Same as above, tested at 32°F (0°C).

### ***RC = Reserve Capacity at 80°F (27°C)***

The reserve capacity is the time in minutes that a new, fully charged battery can be continuously discharged at 25 amperes and maintain at least 1.75 volts per cell (10.5 volts for a 12-volt battery).

### ***Minutes discharged at 50, 25, 15, 8 and 5 Amperes***

Minutes discharged is the time in minutes that a new, fully charged battery will deliver at various currents and maintain at least 1.75 volts per cell. These are nominal or average ratings.

### ***Ampere Hour Capacity at 20, 6, 3 and 1 Hour Rates***

Ampere hour capacity is a unit of measure that is calculated by multiplying the current in amperes by the time in hours of discharge to 1.75 volts per cell. These are nominal or average ratings.

#### ***EXAMPLE***

10 amperes for 20 hours (10 x 20) = 200 Ah @ the 20-hour rate  
8 amperes for 3 hours (8 x 3) = 24 Ah @ the 3-hour rate  
30 amperes for 1 hour (30 x 1) = 30 Ah @ the 1-hour rate

Therefore, if you have an application that requires a draw of 17 amperes for 3 hours, you would need a 51 Ah battery (@ the 3 hour rate)...(17 x 3 = 51). However, this is 100% of the capacity of this 51 Ah battery.

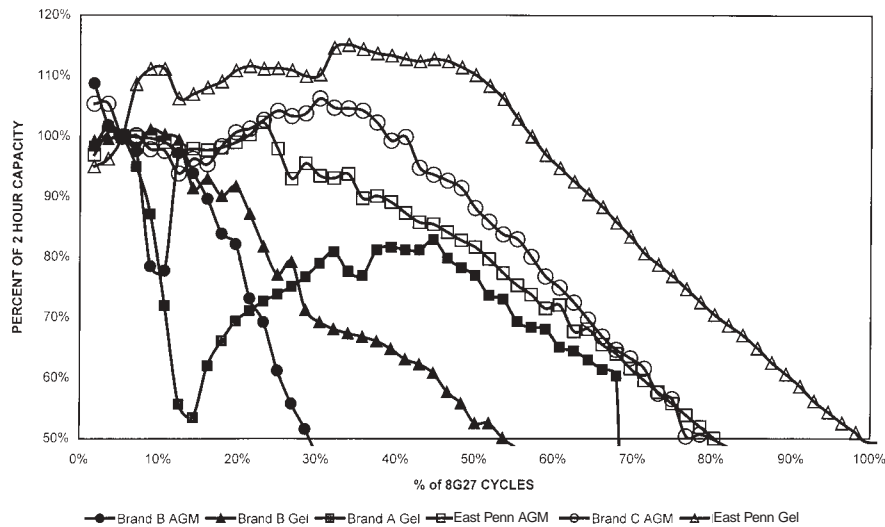
**Most system designs will specify a battery that will deliver a minimum of twice the capacity required.** This means the battery will discharge to 50% of its capacity. Using a 50% depth of discharge (versus 80% or 100%) will dramatically extend the life of any battery. Therefore, when helping to specify a battery for a system, choose a battery with at least **twice** the capacity required for best performance. If 50 Ah is required, specify at least a 100 Ah battery.

## CHART A

### Independent Laboratory Testing BCI 2-Hour Life

#### Group Size "27" Batteries East Penn Gel and AGM vs. Competitor

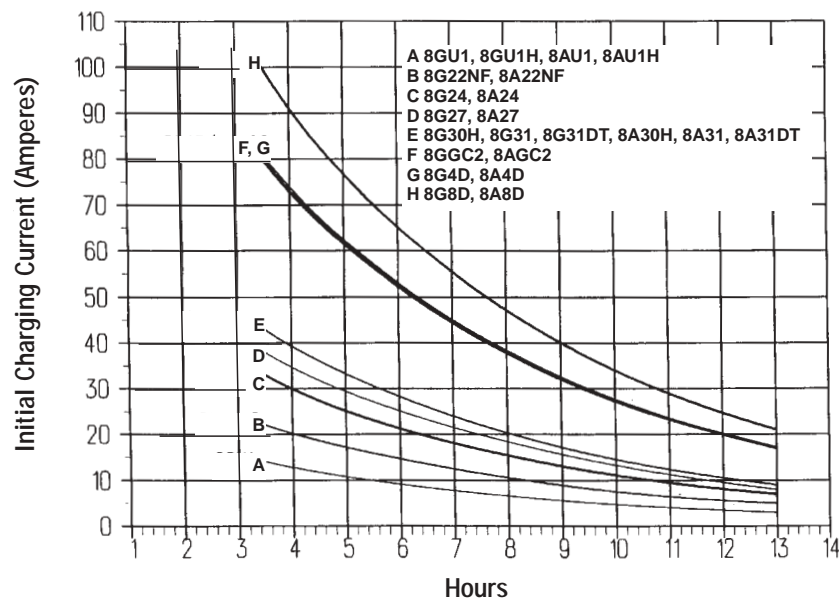
This chart compares the cycles run until the battery capacity dropped to 50% of the 15th cycle's capacity (on discharges at the 2-hour rate to a 10.5-volt cutoff).



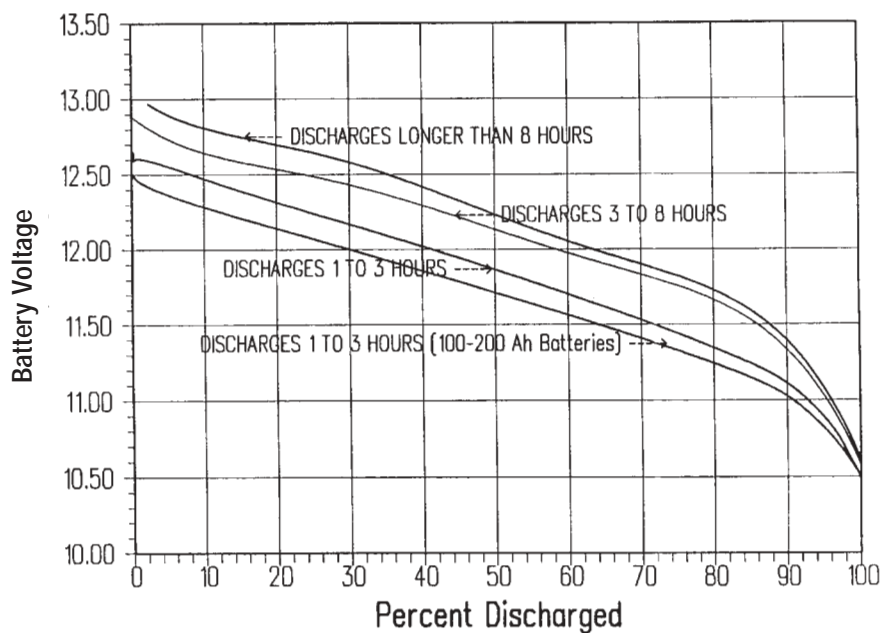
## CHART B

### Charging Current vs. Charging Time

Shown is the current needed to charge a battery from 0% to 90% state of charge in a given time. Or time required to charge a battery from 0% to 90% state of charge at a given current. For example, to charge an 8G8D (curve H) to 90% in 3.5 hours, 100 amperes are required; at 35 amperes, it would take 10 hours

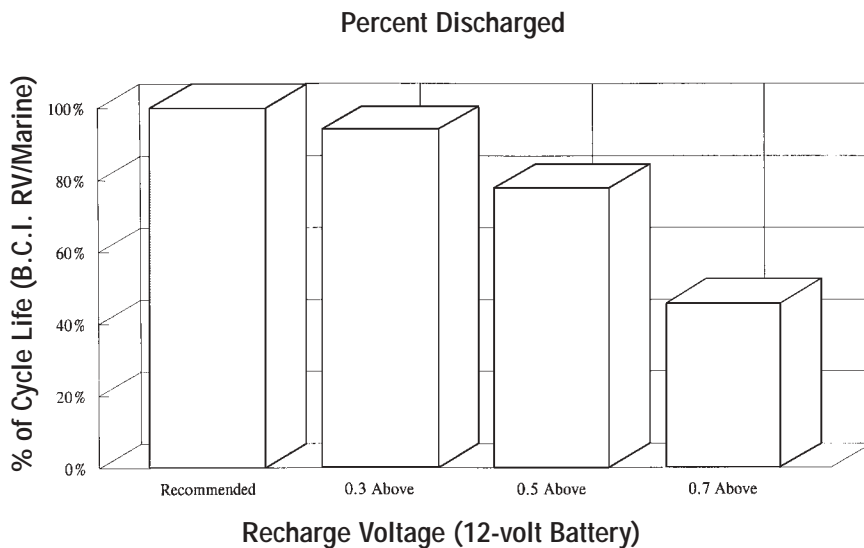


**CHART C**  
**VRLA Battery Voltage During Constant Current Discharge**  
*Voltage vs. Percent Discharged*



**CHART D**  
**Gel Percent Cycle Life vs. Recharge Voltage**

This chart shows the effect on life of overcharging a gel battery.  
 (e.g.: Consistently charging at 0.7 volts above the recommended level reduces life by almost 60%!)



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## ***What are the features and benefits that make East Penn's VRLA batteries unique?***

### ***East Penn Expertise***

East Penn builds VRLA batteries to the highest standards. Our manufacturing process features improved controls using state-of-the-art computers and the latest manufacturing technology and equipment. Therefore, the VRLA batteries produced by East Penn consistently meet the highest quality performance and life standards.

### ***Ultrapremium Sealing Valve***

A critical feature of any VRLA battery, gelled or absorbed, is the quality of the sealing valve. Not only must the valve keep the cell pressurized and safely release excessive pressure and gas due to overcharging, but it must also keep the cell from being contaminated by the atmosphere. Oxygen contamination will discharge a VRLA battery and eventually ruin the battery.

Our valves are UL recognized and 100% tested after manufacturing. The benefit is **reliable performance and long life**.

### ***Spillproof and Leakproof***

A major advantage of VRLA batteries is their spillproof and leakproof feature. However, all VRLA batteries are not created equal in their degree of non-spillability. Some manufacturer's AGM batteries are unevenly filled. Over-saturation of the separators leaves liquid electrolyte that could spill. Under-saturation could lead to premature failure. Some gels do not set properly; they remain liquid and can leak or spill.

Our exclusive gel electrolyte is formulated, mixed and controlled to assure proper "set" in every battery. East Penn's computer-controlled gel mixing and filling equipment ensures homogenization of the mix. This assures a gel battery that will not spill or leak. This feature allows our gel cell to be operated in virtually any position. However, we do not recommend an upside-down orientation.

The AGM filling process assures that each cell is saturated with the maximum amount of electrolyte that can be held by the separators, without leaving excess electrolyte that could spill or leak.

### ***Exclusive Gel Formula***

The gelled electrolyte is another critical element in this type of battery. Our gelled electrolyte contains sulfuric acid, fumed silica, pure demineralized, deionized water, and a phosphoric acid additive. The phosphoric acid is a key reason that our batteries deliver **dramatically longer cycle life** than leading gel competitors and 3 times longer cycle life than traditional wet cells.

### ***Exclusive AGM Electrolyte***

Our AGM electrolyte contains high purity sulfuric acid and absolutely pure totally demineralized, deionized water to increase battery performance. Since the designs are "acid-starved" to protect the plates from deep discharge, the acid concentration can drop to nearly zero during an extremely deep discharge. Substances that will not dissolve in acid may become soluble when the concentration drops this low. Upon recharge, these dissolved substances crystallize out of the electrolyte, potentially destroying the battery. Our electrolyte prevents these events.

### ***Exclusive Computerized Gel Mixing***

Proper gel mixing is critical to life and performance. Consistency in mixing means consistent reliability. We have designed and built the newest, state-of-the-art gel battery manufacturing facility in the world. An example is our proprietary computerized gel mixing operation.

Our exclusive formula is mixed using computer control in every stage of the process. **Computer control delivers superior consistency for gel battery performance that is unequalled.**

Our temperature-controlled process and specially designed equipment assure a homogenous gel. It is important to note that our equipment was designed by our engineers specifically for gel mixing... even down to the contour of the tank bottoms and feed pipe locations. **No other battery manufacturer has comparable equipment.**

### ***Multi-Staged Filling/Vacuuming Operation***

Most other manufacturers fill their gel cells in a one step process, vibrating the battery with hopes of releasing most of the air pockets. This system is less than perfect and leaves voids or air pockets at the critical gel-to-plate interface. These voids are non-reactive and reduce overall battery performance.

Our process fills and vacuums each cell several times. This multi-step process assures complete evacuation of air and **complete gel-to-plate interface**. Our computerized process also weighs every battery before and after filling as a check for proper gel levels. The benefit is **more power-per-pound of battery**.

Our AGM topping process assures that the maximum retainable electrolyte quantity is held within the battery separators, without leaving any unabsorbed liquid to spill or leak.

### ***Tank Formed Plates***

East Penn is the **only** battery manufacturer that uses tank formation to activate the battery plates. This process **guarantees a fully formed and voltage matched plate**. The extra handling of the plates provides an additional inspection step in the process to verify plate quality.

### ***Ultrapremium, Gel Glass Mat, Double Insulating Separators***

Another critical component is the separator, which isolates the positive from the negative plate. The separator must allow maximum charge flow between the plates for maximum performance. Separator failure is a leading cause of warranty claims and customer dissatisfaction.

East Penn uses an **ultrapremium grade separator** in our gel batteries. We believe that this expense (which is 5 to 6 times higher than other types) is worth the benefits of extended life and performance:

- The fiberglass mats embed themselves into the surface of the plates, acting like reinforcing rods in concrete. This extra reinforcement locks the active material onto the plate for longer life and extended performance.
- The ultra-clean separators have no oil contamination or other impurities. Therefore, **resistance is low and battery performance is high**.
- Excellent porosity allows maximum charge flow, which means **more power-per-pound**.
- Superior resistance to oxidation dramatically reduces separator failure, which **extends life**.
- Our separators are **especially suited for gel batteries**, while others use separators designed for flooded automotive batteries.

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### ***Ultrapremium AGM glass mat separators***

Glass mat separator properties can vary considerably. East Penn uses glass mat engineered to have an ideal balance of properties—i.e. absorbency, compressibility, puncture resistance and electrical resistance. This attention to detail results in high performance and long life.

### ***Exclusive Thru-Partition Weld Seals***

One of the causes of self-discharge in batteries is the minute electrical currents that flow between each cell through the partition at the weld area. These currents accelerate the discharge of batteries not in use.

We block these currents by using an **exclusive weld seal** or gasket. This feature **dramatically reduces self-discharge** to less than 3% per month: the lowest self-discharge rate of any battery manufacturer and seven times lower than many conventional batteries!

### ***Exclusive Patented Calcium/Copper Lead Alloy Grids***

This exclusive alloy provides **longer shelf life, more power-per-pound and superior corrosion resistance**. By using special grain refiners, we can **dramatically improve performance and life**.

### ***Heavy-Duty Motive Power Style Grid Design***

While other manufacturers cut costs by using automotive style grids, we use a high-performance deep cycle grid. This heavy-duty grid design is similar to the grid in a motive power battery.

The hefty “power rods” designed into our grids not only lock the active material onto the grid, but also act as “bus bars” to collect and direct the energy to the terminals. The benefit is **more power-per-pound** of battery for your equipment and **longer battery life**.

### ***Multiple Plate Lug Milling***

Shiny, well milled plate lugs are critical to our superior cast-on-strap quality. Each of our plate lugs is automatically milled **to assure the highest quality** strap with no loose or dropped plates. Our lugs are then fluxed and tinned automatically for an **additional assurance of quality**.

### ***Heavier Plate Straps***

We use an **exclusive lead/tin alloy** in a unique multi-stage cast-on-strap operation. The result is heavier straps with **outstanding lug-to-strap knit**. This eliminates dropped and loose plates, thereby **improving performance and life**.

### ***Polyester Element Wrap***

Another cause of deep-cycle battery failure is “mossing.” This phenomenon occurs late in a battery’s life, as the positive active material actually grows around the edge of the separator and eventually “shorts” against the negative plate. This ends the battery’s service life.

Our AGM separators wrap around the bottom of the plate and are wider than the plates. This makes mossing failures unlikely. To prevent life-shortening mossing in our gel batteries, we use a **special polyester fiber sheet** that is wrapped around the edge of each element, similar to the wrap in an industrial battery. The result is **longer service life**.

### ***Exclusive Forged Posts and Bushings***

“Black” posts and oxygen-contaminated batteries are often due to porous lead terminal posts. A battery can lose its critical pressure through tiny pores and fissures in the battery terminals. Pressure

loss is harmful to the battery and is evident by black posts, which are caused by sulfuric acid fumes escaping from the battery through and around the lead posts and bushings. These fumes can cause corrosion and can damage sensitive electronic equipment.

These pores and fissures are caused by the industry’s method of casting posts and bushings. This method produces tiny air pockets and paths which allow corrosive gas to escape, causing life shortening depressurization, cell dry-out and corrosion damage.

To eliminate this problem, **we use forged terminal posts and bushings**, which are completely solid with absolutely **no porosity**. The benefit is **longer life**, better performance and **no leakage of corrosive gas**...especially important when installed in or near sensitive electronic equipment.

### ***Acid Stratification Prevention***

Acid stratification can occur in conventional wet cells. During charge, acid is released at the plate surfaces. During discharge, acid is consumed at the plate surfaces. Since the concentration is not uniform, diffusion (spontaneous mixing by random molecular motions) begins. If this mixing occurred rapidly, stratification would not occur, but it is relatively slow, allowing lighter parts of electrolyte to “float” toward the surface and heavier parts to “sink” toward the bottom.

The top portion of the plates do not perform as well in contact with lower concentration electrolyte. The bottom portion of the plates do not perform as well with the higher concentration, and will corrode prematurely. High voltage “equalization” charging is sometimes used in wet batteries to make gas bubbles that re-mix the electrolyte.

Because the immobilized gel will not “float” or “sink” within itself when a non-uniform concentration exists, it cannot stratify. Therefore, **no high-voltage equalizing charge is necessary**. Simply recharge at the standard 13.8 to 14.1 voltage setting. This means **longer life and consistent performance** in stationary and standby applications.

Electrolyte in an AGM battery is strongly held by the capillary forces between the glass mat fibers, but not completely immobilized. Stratification is possible in extremely tall cells, but cannot occur in batteries of the size covered in this document.

### ***Convenient Carrying Handles***

Carrying handles are included on the (gel) 8GU1H, 8G24, 8G27, 8G30H, 8G31DT, 8G31, 8G4D and 8G8D models. Handles are also available on (AGM) 8AU1H, 8A24, 8A27, 8A31DT, 8A4D and 8A8D. **This feature makes carrying, installation and removal easier, more convenient and less time consuming.**

### ***Dozens of Terminal Options Available***

Our batteries are delivered with the most popular type of terminal; however, on a special order basis **many terminal options are available**. This gives you total flexibility to specify the **proper terminal for your application**... without making compromises.

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### ***Proprietary Case, Cover, and Pressure Vent***

We design and mold our own rugged polypropylene cases, vents and covers in our on-site, state-of-the-art plastics molding facility. This provides **ultimate control** of our high performance designs, quality and delivery to our manufacturing plant, **assuring you the highest quality** battery and most reliable service.

### ***Environment and Worker Protection***

It's nice to know that every possible safeguard was designed into our process to **protect our co-workers and the environment**... special safeguards that are exclusive to East Penn. One benefit is assurance of a consistent source for batteries without fear of governmental interference or delays.

### ***Over 250 Quality Assurance Checks***

Hundreds of quality checks are performed to assure total confidence in the performance and life of our batteries.

For example:

- **100% Cycling.** After initial charging, **every battery is discharged and then recharged** at the factory. This allows us to check the performance of the battery and give it a second charge that **equalizes the cells for improved performance and longer life.**  
  
It's interesting to note that, as a cost-saving measure, we use the current generated during the initial discharge to recharge other batteries in this computer-controlled process.
- **Extended Shelf Stand Test.** Before shipment, every battery is required to stand for a designated period of time. Beginning and ending voltages are compared. This **extra quality assurance step** verifies that the critical pressure control valves are functioning properly.
- **Filling Weight Control.** During this computerized process, batteries are weighed before and after filling. This **assures that the exact amount of electrolyte** is in each battery.
- **Multi-Staged Filling and Vacuuming Process.** Every battery is filled and vacuumed several times during this computerized process. Multi-staged vacuuming **assures complete electrolyte-to-plate interface**, with no power-robbing air pockets.
- **Computerized Polarity Check.** Every battery is checked by computer for proper polarity.
- **High Rate Discharge Test.** Every battery is discharged at approximately twice the rated capacity. A sensitive computer monitors the voltage drop during this discharge to assure that every battery performs as designed.
- **Formed Element Inspection.** Elements are assembled and **charged outside the battery container** in a computerized forming and drying process. This allows visual inspection of every grid, plate, separator, and formed element before being sealed inside the battery, assuring perfect cell elements with longest life and highest performance.
- **Tank Formed Plates.** Voltage matched plates are critical in standby applications. Forming each plate outside the battery assures the **highest quality**, best matched plates in the industry, and also allows a visual check before and during assembly.

### ***State-of-the-Art Technology***

Within our newly constructed multi-million dollar VRLA production facility, we have incorporated **state-of-the-art manufacturing processes** that are unmatched by any other battery manufacturer. This major addition allows us to build the **most modern and reliable VRLA batteries in the industry.**

*The designs of East Penn's VRLA batteries are always improving. The preceding sections accurately describe East Penn's VRLA products as of the date of publication. East Penn reserves the right to change their processes to improve quality, value or utilize advances in manufacturing technology. Ratings and capacities may change without notice.*

***How do East Penn's VRLA battery features compare with other types of batteries?***

<b>FEATURE</b>		<b>EPM GEL</b>	<b>OTHER GEL</b>	<b>EPM AGM</b>	<b>OTHER AGM</b>	<b>ALL WET CELLS</b>
1.	EPM Expertise	YES	NO	YES	NO	EPM ONLY
2.	Spillproof and Leakproof	YES	YES	YES	YES	NO
3.	Sealed Valve-Regulated	YES	YES	YES	YES	NO
4.	Ultra-Premium Sealing Valve	YES	NO	YES	NO	NO
5.	Exclusive Gel Formula	YES	NO	NO	NO	NO
6.	Deep Discharge Protection	YES	YES	YES	YES	NO
7.	Exclusive Computerized Gel Mixing	YES	NO	NO	NO	NO
8.	Tank Formed Plates	YES	NO	YES	NO	NO
9.	Multi-Staged Gel Filling/Vacuuming	YES	NO	NO	NO	NO
10.	Ultra-Premium Glass-Mat Dual Insulating Separators	YES	NO	NO	NO	NO
11.	Exclusive Thru-Partition Weld Seals	YES	NO	YES	NO	NO
12.	Exclusive Patented Calcium/Copper Lead Alloy Grids	YES	NO	YES	NO	NO
13.	Heavy-Duty Motive Power Style Grids	YES	NO	YES	NO	NO
14.	Grid Lug Milling, Brushing and Fluxing	YES	?	YES	NO	EPM ONLY
15.	Heavy-Duty Special Alloy Plate Straps	YES	NO	YES	NO	NO
16.	Special Polyester "Moss Guard" Element Wrap	YES	NO	NO	NO	NO
17.	Forged Posts and Bushings	YES	NO	YES	NO	EPM ONLY
18.	Acid Stratification Prevention	YES	YES	YES	YES	NO
19.	Carrying Handles	YES	?	YES	LIMITED	LIMITED
20.	Dozens of Terminal Options	YES	?	YES	?	EPM ONLY
21.	Highest Cycle Life	YES	NO	YES	NO	NO
22.	Highest Performance	YES	NO	YES	NO	N.A.
23.	Shelf Stand Test	YES	?	YES	NO	NO
24.	250+ Quality Assurance Checks w/ ISO 9001 Certification	YES	?	YES	NO	EPM ONLY
25.	State-of-the-Art Technology & Facility	YES	NO	YES	NO	EPM ONLY

# Answers to the Most Frequently Asked Questions

*NOTE: Before reviewing this section, be sure you understand the difference between gel, AGM, and flooded batteries.*

## ***How do we justify the premium price of VRLA batteries to those unfamiliar with this type of battery?***

Simply review the advantages, features and benefits, performance, and **impressive life cycle results**. Based upon this and the **lowest cost-per-month or duty cycle** you and/or your customer should have no trouble choosing VRLA batteries.

However, please remember that these batteries are not for everyone or every application. Always be aware of the charging considerations. (See pages 11 & 12.)

## ***What are the advantages and disadvantages of the different types of battery designs?***

### ***Gelled Electrolyte Advantages:***

- Totally maintenance-free
- Air transportable
- Spillproof/leakproof
- No corrosion
- Superior deep cycle life
- Installs upright or on side (side installation may lose about 10% capacity)
- Very low to no gassing (unless overcharged)
- Compatible with sensitive electronic equipment
- Superior shelf life
- Superior rechargeability (from 0% to 90% in 3½ hours)
- No recharge current limitation @ 13.8 volts
- Rugged and vibration-resistant
- Very safe at sea with no chlorine gas in bilge (due to sulfuric acid and salt water mixing)
- Versatile: Starting, Deep Cycle, Stationary
- Operates in wet environments...even under 30 feet of water
- Will not freeze to -20°F/-30°C (if fully charged)
- Lowest cost-per-month (cost ÷ months of life)
- Lowest cost-per-cycle (cost ÷ life cycles)

### ***Gelled Electrolyte Disadvantages:***

- Higher initial cost
- Heavier weight
- Water cannot be replaced if continually overcharged
- Automatic temperature-sensing, voltage-regulated chargers **must** be used
- Charge voltage **must** be limited to extend life (13.8 to 14.1 volts maximum at 68°F)

### ***Absorbed Electrolyte Advantages:***

- Totally maintenance-free
- Air transportable
- Spillproof/leakproof
- No corrosion
- Installs upright or on side
- Lower cost than gel cell batteries
- Compatible with sensitive electronic equipment
- Very low to no gassing (unless overcharged)
- Excellent for starting and stationary applications
- Superior for shorter duration/higher rate discharges
- Superior under extreme cold conditions when fully charged
- Superior shelf life
- Superior rechargeability (from 0% to 90% in 3½ hours)
- Rugged and vibration-resistant
- Very safe at sea with no chlorine gas in bilge (due to sulfuric acid and salt water mixing)
- Operates in wet environments...even under 30 feet of water

### ***Absorbed Electrolyte Disadvantages:***

- Shorter cycle life than gel in very deep cycle applications
- Automatic temperature-sensing, voltage-regulated chargers **must** be used
- Water cannot be replaced if continually overcharged
- Charge voltage **must** be limited (14.4 to 14.6 volts maximum at 68°F)

### ***Flooded Electrolyte Advantages:***

- Lowest initial cost
- Higher cranking amps
- Water can be added (if accessible)
- Excellent for starting applications
- Tolerant of improper recharge voltage
- Certain designs are good for deep cycle applications
- Replacements readily available
- Good under extreme cold conditions when fully charged

### ***Flooded Electrolyte Disadvantages:***

- Spillable
- Operates upright only
- Shorter shelf life
- Fewer shipping options
- Cannot be installed near sensitive electronic equipment
- Watering may be required (if accessible)

## Why can't VRLA batteries be opened?

VRLA (Valve-Regulated Lead-Acid) batteries, sometimes called SLA (Sealed Lead-Acid) batteries or SVR (Sealed Valve-Regulated) batteries work on a recombination principle. Oxygen gas is produced at the positive plates during charge. The charged negative plates react first with this oxygen and subsequently with the electrolyte. Water is produced and the negative plates are very slightly discharged. Additional charging recharges the negative plates instead of producing hydrogen gas. Since very little hydrogen and oxygen is lost and the water (H<sub>2</sub>O) is retained, we say that the gasses have recombined. To work properly, the oxygen produced must be retained in the battery until the reaction is completed. Positive pressure allows the gas to be retained.

If any VRLA (gelled or absorbed electrolyte) battery is overcharged, gas will be vented from the valves. Hydrogen as well as oxygen will be released. If continued, the electrolyte will eventually dry out and the battery will fail prematurely. This is why charging limits are so critical.

In a sealed battery a balance is maintained between the hydrogen, oxygen and charge. If a VRLA battery is opened, or leaks, the negative plates are exposed to extra oxygen from the atmosphere. This excess oxygen upsets the balance. The negative plates become discharged. The positive plates may be subsequently severely overcharged. The battery *will* fail prematurely, and the **warranty will be voided**.

## Some say calcium grids don't do well in flooded deep cycle applications. Why does East Penn use calcium grids in VRLA batteries for deep cycle applications?

Flooded calcium alloy makes a very efficient, low resistance battery. Therefore, when deeply discharged, the plates release all their available power, eventually causing plate shedding and active material fall-out. In contrast, with flooded antimony batteries, the antimony helps lock the active material onto the grid. Therefore, the plate does not shed as easily, which extends the deep cycle life of the battery when compared to flooded calcium.

Our VRLA calcium alloy battery (**East Penn's exclusive patented alloy**) is also very efficient with low resistance. However, when deeply discharged, the electrolyte is used up before the plates are totally discharged because the battery is "acid-starved." This feature:

- limits the discharge the plates can deliver.
- protects the plates from shedding due to deep discharge.
- extends the life of the battery.

## Why do EPM VRLA batteries have longer cycle life than others?

Some of the major features that contribute to our long cycle life are:

- Our patented calcium/copper grid alloy **delivers superior performance** due to the purity of the lead. Copper is added as a "grain refiner." This means that the microscopic grains in our lead grids are odd-shaped, so they retard corrosion and **extend the life** of our grid.
- Our **thicker grids** have more corrosion resistance than thinner grids.

- Our VRLA batteries are protected against deep discharge because they are "**acid-starved**." This means that the battery uses the power in the acid before it uses the power in the plates. Therefore, the **plates are never subjected to destructive ultra-deep discharges**.
- With proper temperature-sensing, voltage-regulated charging (refer to table on page 11) the VRLA battery **never runs out of water**.
- Our gel batteries contain ultra-premium, **glass-mat**, dual-insulating separators which will not break down in service. The glass mat embeds itself into the plate, which **retards life-shortening shedding**.
- Our gel batteries contain polyester element wrap which **retards "mossing"** or active material growth that causes short circuits.
- Our AGM batteries contain separators at the ideal compression and ideal saturation to achieve the best balance between capacity utilization and recombination efficiency.
- Over **250 quality control checks** assure superior performance and long battery life.

## Why do EPM VRLA batteries have longer shelf life?

Our calcium/copper lead alloy premium separators and demineralized electrolyte are **ultra-pure**. Impurities in the lead alloy, separators and electrolyte cause tiny currents inside a cell which eventually discharge the battery and shorten its shelf life. **The purer the components, the longer the shelf life**. No one can match East Penn's purity!

Our exclusive "**weld seal gasket**" blocks the minute cell-to-cell currents that cause self-discharge. The better the weld seal, the longer the shelf life. Weld seals are **exclusive** to East Penn VRLA batteries.

## Does depth of discharge affect cycle life?

Yes! The harder any battery has to work, the sooner it will fail.

Typical* VRLA Battery Cycling Ability vs. Depth of Discharge		
	Typical Life Cycles	
Capacity Withdrawn	Gel	AGM
100%	450	150
80%	600	200
50%	1000	370
25%	2100	925
10%	5700	3100

\* You may experience longer or shorter life based upon application, charging regimen, temperature, rest periods, type of equipment, age of battery, etc.

As you can see, **the shallower the average discharge, the longer the life**. This is why it's important to size a battery system to deliver at least twice the average power required, to assure shallow discharges.

Follow these tips for the longest life:

- Avoid ultra-deep discharges.
- Don't leave a battery at a low stage of charge for an extended length of time. Charge a discharged battery as soon as possible.
- Don't cycle a battery at a low state of charge without regularly recharging fully.
- Use the highest initial charging current available (up to 30% of the 20-hour capacity per hour) while staying within the proper temperature-compensated voltage range.

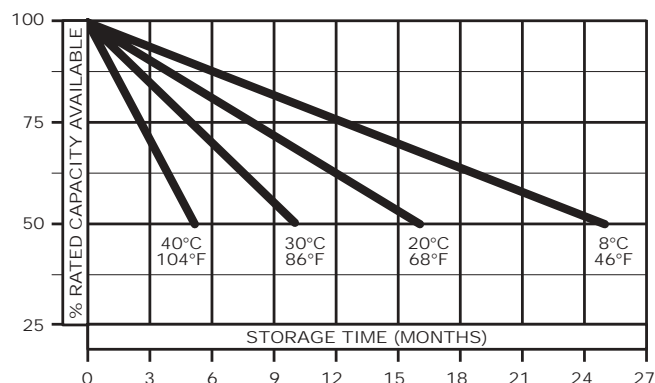
## Why can't EPM VRLA batteries be discharged too low?

Our VRLA batteries are designed to be “acid-starved.” This means that the power (sulfate) in the acid is used before the power in the plates. This design protects the plates from ultra-deep discharges. Ultra-deep discharging is what causes life-shortening plate shedding and accelerated positive grid corrosion which can destroy a battery.

## Why does temperature have such a dramatic effect on batteries?

Temperature is a major factor in battery performance, shelf life, charging and voltage control. At higher temperatures there is dramatically more chemical activity inside a battery than at lower temperatures. The following charts graphically illustrate this fact.

### Typical Self-Discharge of VRLA Batteries at Different Temperatures



### AGM Charge and Float Voltages at Various Temperature Ranges

Temp. °F	Charge		Float		Temp. °C
	Optimum	Maximum	Optimum	Maximum	
≥ 120	13.60	13.90	12.80	13.00	≥ 49
110 – 120	13.80	14.10	12.90	13.20	43 – 49
100 – 110	13.90	14.20	13.00	13.30	38 – 43
90 – 100	14.00	14.30	13.10	13.40	32 – 38
80 – 90	14.10	14.40	13.20	13.50	27 – 32
70 – 80	14.30	14.60	13.40	13.70	21 – 27
60 – 70	14.45	14.75	13.55	13.85	16 – 21
50 – 60	14.60	14.90	13.70	14.00	10 – 16
40 – 50	14.80	15.10	13.90	14.20	4 – 10
≤ 40	15.10	15.40	14.20	14.50	≤ 4

### Gel Charge and Float Voltages at Various Temperature Ranges

Temp. °F	Charge		Float		Temp. °C
	Optimum	Maximum	Optimum	Maximum	
≥ 120	13.00	13.30	12.80	13.00	≥ 49
110 – 120	13.20	13.50	12.90	13.20	44 – 48
100 – 109	13.30	13.60	13.00	13.30	38 – 43
90 – 99	13.40	13.70	13.10	13.40	32 – 37
80 – 89	13.50	13.80	13.20	13.50	27 – 31
70 – 79	13.70	14.00	13.40	13.70	21 – 26
60 – 69	13.85	14.15	13.55	13.85	16 – 20
50 – 59	14.00	14.30	13.70	14.00	10 – 15
40 – 49	14.20	14.50	13.90	14.20	5 – 9
≤ 39	14.50	14.80	14.20	14.50	≤ 4

## What is acid stratification? How do VRLA batteries prevent it?

See page 6 for a detailed explanation of this phenomenon.

## How does a battery recharge?

The process is the same for all types of lead-acid batteries: flooded, gel and AGM. The actions that take place during discharge are the reverse of those that occur during charge.

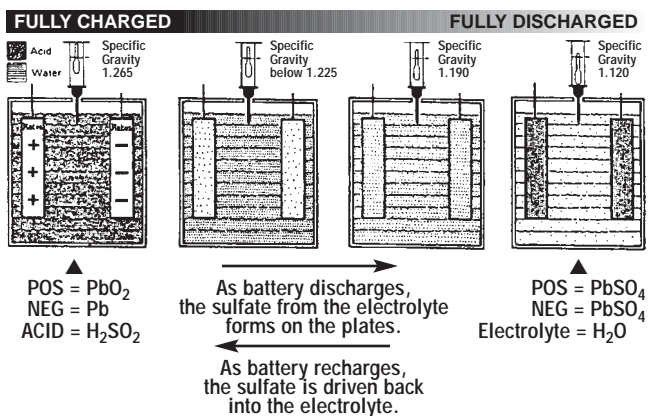
The discharged material on both plates is lead sulfate ( $\text{PbSO}_4$ ). When a charging voltage is applied, charge flow occurs. Electrons move in the metal parts; ions and water molecules move in the electrolyte. Chemical reactions occur at both the positive and negative plates converting the discharged material into charged material. The material on the positive plates is converted to lead dioxide ( $\text{PbO}_2$ ); the material on the negative plates is converted to lead ( $\text{Pb}$ ). Sulfuric acid is produced at both plates and water is consumed at the positive plate.

If the voltage is too high, other reactions will also occur. Oxygen is ripped from water molecules at the positive plates and released as a gas. Hydrogen gas is released at the negative plates—unless, oxygen gas can reach the negative plates first and “recombine” into  $\text{H}_2\text{O}$ .

A battery will “gas” near the end of charge because the charge rate is too high for the battery to accept. A temperature-compensating, voltage-regulating charger, which automatically reduces the charge rate as the battery approaches the fully charged state, eliminates most of this gassing. **It is extremely important not to charge batteries for long periods of time at rates which cause them to gas** because they use water, which in sealed valve-regulated batteries cannot be replaced. Of course, no battery should be overcharged for a long period of time...even at low rates using so-called “trickle charges.”

In a fully charged battery, most of the sulfate is in the sulfuric acid. As the battery discharges, some of the sulfate begins to form on the plates as lead sulfate ( $\text{PbSO}_4$ ). As this happens, the acid becomes more dilute, and its specific gravity drops as water replaces more of the sulfuric acid. A fully discharged battery has more sulfate in the plates than in the electrolyte.

The following illustration shows the relationship between specific gravity readings and the combination of the sulfate from the acid with the positive and negative plates at various states of charge.



## How critical is recharge voltage? Why are all VRLA batteries so charge sensitive?

All lead-acid batteries give off hydrogen from the negative plate and oxygen from the positive plate during charging.

VRLA batteries have pressure-sensitive valves. Without the ability to retain pressure within the cells, hydrogen and oxygen would be lost to the atmosphere, eventually drying out the electrolyte and separators.

Voltage is electrical pressure. Charge (ampere-hours) is a quantity of electricity. Current (amperes) is electrical flow (charging speed). A battery can only store a certain quantity of electricity. The closer it gets to being fully charged, the slower it must be charged. Temperature also affects charging.

If the right pressure (voltage) is used for the temperature, a battery will accept charge at its ideal rate. If too much pressure is used, charge will be forced through the battery faster than it can be stored. Reactions other than the charging reaction occur to transport this current through the battery—mainly gassing. Hydrogen and oxygen are given off faster than the recombination reaction. This raises the pressure until the pressure relief valve opens. The gas lost cannot be replaced. Any VRLA battery will dry out and fail prematurely if it experiences excessive overcharge. **Note:** It is the pressure (voltage) that initiates this problem—a battery can be “over-charged” (damaged by too much voltage) even though it is not fully “charged.”

This is why charging voltage must be carefully regulated and temperature compensated to the values on page 11.

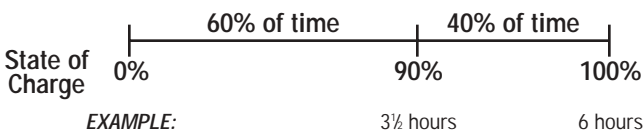
## How long does it take to recharge a fully discharged VRLA battery?

A specific time is difficult to determine because recharging depends on so many variables:

- Depth of discharge
- Temperature
- Size and efficiency of the charger
- Age and condition of the battery

See the following Charging Guides for an estimated time based upon the initial charge current the battery accepts.

## Typical Charging Time vs. 90% and 100% State of Charge



It will take about 60% of the charge time to bring a VRLA battery from 0% charged to 90% charged. It will take the remaining 40% of the total charging time to put the last 10% of the charge back into the battery.

Charge is a quantity of electricity equal to rate of flow (Amperes) times time (hours), and usually expressed in Ampere-hours (Ah).

0% state of charge is defined as the depth of discharge giving a terminal voltage of 10.50 Volts – measured under a steady load at the 20-hour rate at 80°F. (The 20-hour rate is the 20-hour capacity divided by 20 hours.)

Typically, the charge that must be returned to a VRLA battery to achieve a 100% state of charge is from 105% to 115% of the charge removed.

## Charging Guides

### Typical Charge Time vs. Initial Charge Current to 90% Full Charge

(Using an automatic temperature-sensing, voltage-regulating charger set at 13.8V. Totally discharged battery at 11.80–12.0 volts.)

Part No.	Initial Amperes		
	13 hrs*	6 hrs*	3 1/2 hrs*
8GU1, 8GU1H, 8AU1, 8AU1H	3	8	15
8G22NF, 8A22NF	5	12	23
8G24, 8A24	7	17	33
8G27, 8A27	8	21	41
8G30H, 8G31, 8G31DT, 8A30H, 8A31, 8A31DT	9	24	45
8G4D, 8GGC2, 8A4D, 8AGC2	17	42	83
8G8D, 8A8D	20	50	100

\*approximate

HOW TO USE THIS CHART: When charger is first turned on, read amps after about one minute. Initial ampere reading will indicate approximate charging time.

### EXAMPLE

If an 8G24 reads about 17 ampere charge current when first turned on, the battery will be at 90% in about 6 hours.

**IMPORTANT:** Always use an automatic temperature-sensing, voltage-regulated charger! Set charger at 13.8 to 14.1 volts at 68°F for gel, or 14.4 to 14.6 volts at 68°F for AGM. Do not exceed 14.1 volts for gel or 14.6 volts for AGM.

## How can continual undercharging harm a battery?

In many respects, **undercharging is as harmful as overcharging**. Keeping a battery in an undercharged condition allows the positive grids to corrode and the plates to shed, dramatically shortening life. Also, an undercharged battery must work harder than a fully charged battery, which contributes to short life as well.

An undercharged battery has a greatly reduced capacity. It may easily be inadvertently over-discharged and eventually damaged.

## How can you tell if an VRLA battery is fully charged?

By using a voltmeter.

<b>Open Circuit Voltage vs. State of Charge Comparison*</b>			
% Charge	Flooded	Open Circuit Voltage Gel	AGM
100	12.60 or higher	12.85 or higher	12.80 or higher
75	12.40	12.65	12.60
50	12.20	12.35	12.30
25	12.00	12.00	12.00
0	11.80	11.80	11.80

NOTE: Divide values in half for 6-volt batteries.  
\* The "true" O.C.V. of a battery can only be determined after the battery has been removed from the load (charge or discharge) for 24 hours.

## How can you tell if a VRLA battery has been damaged by under- or overcharging?

The only way is **with a load test**. Use the same procedure you would use with a wet cell battery:

- Recharge if the open circuit voltage is below 75%.
- If adjustable, set the load at  $\frac{1}{2}$  the CCA rating or three times the 20 hour rate.
- Apply the load for 15 seconds. The voltage should stabilize above 9.6 volts while on load.
- If below 9.6 volts, recharge and repeat test.
- If below 9.6 volts a second time, replace the battery.

## What is a float charger? What float voltage is recommended?

This type of charger continually delivers a pre-set voltage to the battery, regardless of charge conditions.

These chargers are used in stationary, emergency back-up power, emergency lighting, and other applications.

The frequency of discharge and temperature will dictate a more exact setting. For example, the more frequent the discharge, the higher the suggested recharge voltage, to a **maximum of 2.35 volts per cell (at 20°C/68°F)**.

Our recommended float voltage is 2.25 to 2.3 volts per cell for gel and absorbed models.

## What is a thermal runaway?

The appropriate charge voltage depends on the battery temperature (see page 11). A warmer battery requires a reduced voltage. If the voltage is not reduced, current accepted by the battery increases. When the current increases, the heating increases. This can continue in a loop feeding on itself with the battery temperature and charging current rising to destructive levels.

Gel batteries are much less susceptible to thermal runaway than AGM batteries. Batteries may become more susceptible with increasing age. Without a recombination reaction, flooded batteries convert most excess charging energy to gas, not heat. This makes them almost immune from the thermal runaway.

Thermal runaway can be prevented with:

- Temperature compensation monitoring at the battery—not at the charger.
- Limiting charging currents to appropriate levels (see page 11).
- Allowing for adequate air circulation around the batteries.
- Using timers, or Ampere-hour counters.
- Using smart chargers that recognize the signature of a thermal runaway event which will shut the charger down.

## How do I know if a charger is "gel friendly" or "AGM friendly"?

Unfortunately, many chargers on the market claim to be gel "friendly" or "OK for sealed batteries", but are not. Some overcharge the batteries, while others may not fully charge the batteries. Some chargers claim to be "smart". Some "smart" chargers do a good job, others do not. The best choice of charger often depends on the application.

Use only "voltage-regulated" or "voltage-limited" chargers. **Standard constant current or taper current chargers must not be used. The voltage must fall in the range of the chart on page 11.** Almost all applications require temperature sensing and voltage compensation. Beware, many chargers measure the ambient temperature which could be significantly different from the battery's internal temperature.

Low frequency current ripple (to about 333 Hz) can be detrimental to sealed batteries depending on the application. On applications where the charger is connected continuously to a float voltage, especially where simultaneous charge and discharge may occur, the level of current ripple must be a consideration.

If you are not sure if a charger is performing properly, follow this procedure:

- Using a fully discharged VRLA battery (OCV about 11.8V) and a digital voltmeter, record the initial open circuit voltage at the battery terminals.
- Using an automatic charger as described above, set voltage if adjustable (14.1V for gel, 14.4V for AGM models).
- Connect and start charging. Record initial on-charge voltage and current.
- Each hour or so, check and record the on-charge voltage across the battery terminals. Except for occasional, brief "blips" or pulses, the voltage should not exceed the voltage limits noted in "b" above.

- e. At the end of charge (when the current is very low or goes to zero) check and record the voltage. Note that the charger may have turned off by then.
- f. The disconnected battery should be at 100% or above after a 24 hour rest.

During the charging time, the charger should not have exceeded the limit (except for occasional, brief pulses). This indicates that the charger is working properly.

Keep in mind that the voltage limit is at 68°F/20°C. Charging at higher or lower temperatures will change this limit.

**A temperature-sensing charger should always be used, as manual adjustments are never accurate and will damage any VRLA battery.**

### ***Do VRLA batteries have a "memory" like ni-cad batteries?***

One of the major disadvantages of nickel-cadmium (ni-cad) batteries is that after shallow discharge cycles, the unused portions of the electrodes "remember" the previous cycles and are unable to sustain the required discharge voltage beyond the depth of the previous cycles. The capacity is lost and can only be restored by slowly discharging completely (generally outside the application), and properly recharging. **VRLA batteries do not exhibit this "use it" or "lose it" capacity robbing effect known as memory.**

### ***What is a safe charge rate or voltage setting for outdoor applications with wide temperature fluctuations if a temperature-sensing charger is not available?***

**NONE!** As the chart on page 11 (Effect of Temperature on Recharge Voltage) shows, charging voltage varies widely with temperature. **There is no fixed voltage setting or current that will work.** A temperature-sensing, voltage-regulated charger must be used. Anything else will damage any battery and **cause premature failure!**

### ***Can a VRLA battery be load tested?***

Yes. See page 13 (How can you tell if a VRLA battery has been damaged by under- or overcharging?).

### ***Why do some VRLA batteries bulge? Why do some VRLA batteries appear "sucked in"? Are there visual signs of a faulty or plugged pressure relief valve?***

To prevent the permanent loss of gases so that recombination has time to take place, each cell can hold up to about 1.5 psi without venting.

Batteries with very large cells, such as the 8G4D, 8G8D, 8A4D, 8A8D and 8GGC2, will bulge somewhat as this normal pressure builds. This is especially true in higher temperatures, because the polypropylene case is pliable. Therefore, **a certain amount of bulge is normal.**

The valves only let gas out, never in. A partial vacuum can form within a sealed battery under various circumstances. Battery temperature and ambient pressure play a role, but predominantly the recombination and discharge reactions are responsible. After charging ends, the recombination reaction continues until most of the oxygen in the battery headspace is consumed. The total volume of the battery components decreases slightly during a discharge. Deeply discharged batteries often have a "sucked-in" appearance. Batteries with large cells may display this appearance even when fully charged.

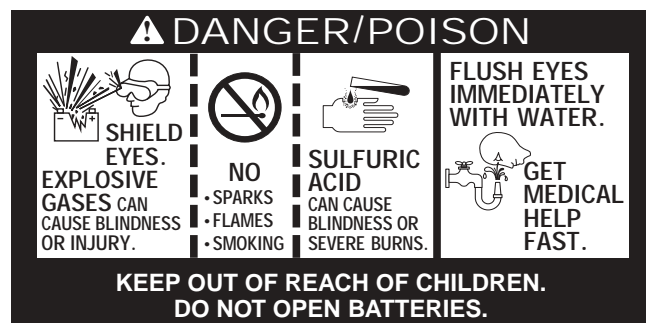
If a battery bulges severely on charge, this is not normal. It is an indication of a blocked valve or an overcharge situation. Such a battery should be removed from service.

A sucked-in appearance can also be normal. A sucked-in battery should be charged, but if it remains sucked-in after charging, the appearance can safely be ignored; however, if only a single cell displays or lacks this appearance a load test would be prudent.

### ***How safe are VRLA batteries? Can they explode?***

VRLA batteries are very safe, unless abused. However, as with any type battery, certain safety precautions must be taken.

**ALWAYS WEAR SAFETY GLASSES  
WHEN WORKING AROUND BATTERIES!**



**CALIFORNIA PROPOSITION 65 WARNING:** Batteries, battery posts, terminals and related accessories contain lead and lead compounds and other chemicals known to the state of California to cause cancer and birth defects or other reproductive harm. **Wash hands after handling.**

Because VRLA batteries normally emit very little to no hydrogen gas, they are safe near sensitive electronic equipment. They do not cause corrosion of surrounding metals. No hydrogen gas means no dangerous explosions... **UNLESS SEVERELY OVERCHARGED!**

**Do not install any lead-acid battery in a sealed container or enclosure. Hydrogen gas from overcharging must be allowed to escape.**

**DO NOT CHARGE IN EXCESS OF 14.1V @ 68°F - Gel Cells  
14.6V @ 68°F - Absorbed**

**Always use a reliable, temperature-sensing, voltage-regulated, automatic charger.**

Because SVR batteries have immobilized electrolyte, they cannot spill or leak, even if punctured. That is why they are approved for air transport by the International Commercial Airline Organization (ICAO), International Airline Transport Association (IATA), and Department of Transportation (DOT) as noted on the label if properly insulated from short circuits.

Also, when protected against short circuits and securely braced/ blocked, our VRLA batteries “are not subject to any other requirements of 49 CFR Parts 171-180...” for shipping.

### ***Which way does current flow? On which side should a circuit breaker be installed?***

During discharge, electrons progress through the external circuit from the negative post toward the positive post. Inside the battery, positive ions move toward the positive plate by diffusion where they react, leaving neutral molecules in solution. The resulting neutral molecules move back toward the negative plate by diffusion. There are also negative ions in the electrolyte offsetting the positive ion charges. Some travel by diffusion toward both the negative and the positive plates, where they are consumed. During charge, all of the directions reverse.

Although not physically accurate, when designing circuits or making calculations, it is just as valid to consider positive charges moving through the whole circuit. Indeed, this is the convention used to define the direction of current in electronics (known as conventional current).

#### **Proper location of disconnects depends on the application.**

Vehicles can vary, but in most cases, the negative terminal is treated as ground. The entire chassis is connected to the negative terminal of the battery. The positive side of the circuit is considered “hot.”

**Switches/circuit breakers should usually be installed on the hot side of a device.** When disconnecting the entire battery from the system with a fusible link or circuit breaker, breaking the connection from the negative terminal to the chassis often works best.

In multiple battery installation, there could be other considerations such as total voltage, multiple voltages, and the effects on other devices.

### ***What do I need to know about installation, especially in salt water marine applications?***

#### ***Wiring and Waterproofing***

**ALWAYS WEAR SAFETY GLASSES  
WHEN WORKING AROUND BATTERIES!**

- Cabling of the approved gauge should be tinned copper. If using untinned copper, allow plenty of spray silicone to “wick” along the strands.
- Install heat-shrink tubing with a silicone interior; the silicone forms an excellent moisture barrier. Cut the tubing long enough to cover the terminal lug and plenty of the insulated portion of the cable. Slip tubing onto the cable.
- Crimp on the appropriate terminal.
- Position the heat-shrink tubing. Heat and inspect.
- Clean battery terminals and connect. Be sure perfect metal-to-metal contact is made, with no dirt, corrosion, grease or foreign material to interfere with current flow.
- Always attach the cable connected to the solenoid or starter first. Attach the ground cable last! Tighten snugly, BUT DO NOT OVERTIGHTEN, which will damage the terminals or crack the battery cover. This will destroy the battery and VOID THE WARRANTY.

g. Spray exposed terminals and connectors with several coats of battery terminal corrosion protection spray. (Mask surrounding areas to protect against overspray.)

h. For batteries which may be exposed to very wet environments (e.g. bilge mounted batteries) total encasement of the exposed terminals and connectors is necessary. However, do not block or cover the vents. **Allow ventilation.**

A battery terminal boot should be used. Install the boot on the cable before crimping the terminal. Fill the boot with petroleum jelly and fit over the sprayed connectors (as in “g” above).

i. Battery charging in a boat requires a charger specifically designed for marine applications. In addition to battery gases, bilges often contain potentially dangerous fuel fumes. Follow all wiring and grounding recommendations of the charger manufacturer for on-board and on-shore connections.

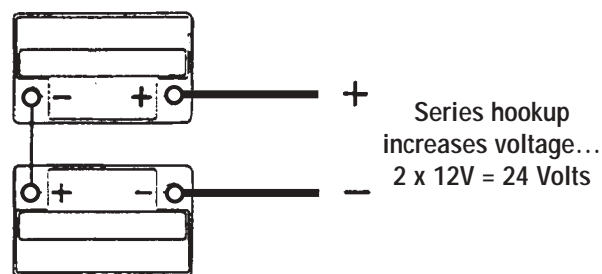
**Using a charger not specifically designed for marine applications or failure to follow the marine charger manufacturer's grounding and wiring recommendations could result in major corrosion damage to the hull or prop, and create a serious risk of electrical shock or fire, personal injury or death.**

#### ***Battery Installation***

**Note:** In a multi-battery installation, it is often best to replace the entire set of batteries when one battery is weak or has failed.

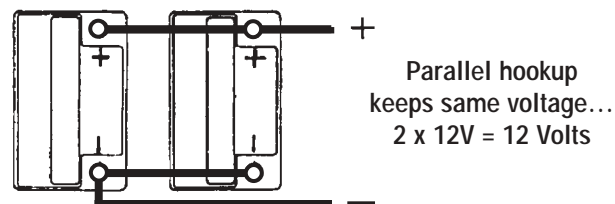
#### ***Series***

A “series” system increases the voltage, but keeps the battery capacity (cranking amps, amp hours, reserve minutes, and minutes running time) the same. Therefore, two 12-volt batteries connected in series (POS to NEG, NEG to POS) will deliver 24 volts at the same rating as one battery: During recharge, each battery receives the same amount of current; e.g. if the charger is putting out 10 amps, both batteries are getting 10 amps.



#### ***Parallel***

A “parallel” system increases the capacity available, but keeps the voltage the same. Therefore, two 12-volt batteries with 400 CCA, 110 R.C. and 65 Ah will deliver 12 volts, 800 CCA, 220 R.C. and 130 Ah. (Actually, since each battery's load is lighter, the reserve capacity will more than double.)



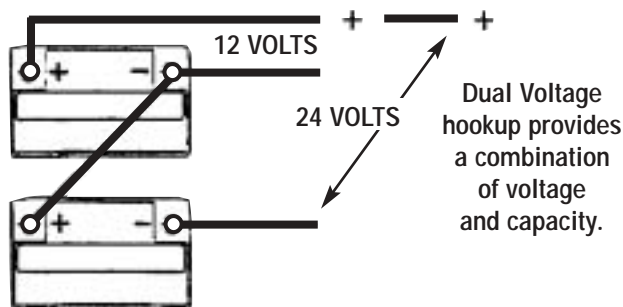
During recharge, the current (amps) is split between the batteries. The battery that is discharged the most will receive more current than the other until both are brought up to full charge.

### Series/Parallel

A "series/parallel" system provides a combination of voltage and capacity for special applications. Note: Never mix different types and sizes of batteries in the same bank.

### Dual Voltage

The illustration shows an arrangement that would supply 24 volts to a starter and 12 volts to the electronics (or vice versa).



To properly recharge, a sophisticated "battery isolator" should be installed. Otherwise, one battery will be continually overcharged and the other undercharged in a dual-voltage set-up.

**IMPORTANT: Do not install any type of battery in a completely sealed box or enclosure. In the event of overcharging, the potentially explosive gasses must be allowed to escape.**

MEMBER OF:



QUALITY SYSTEM  
CERTIFIED TO  
**ISO 9001**  
**ISO/TS 16949**



**ABYC**  
AMERICAN BOAT  
& YACHT CLUB



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**EAST PENN manufacturing co., inc.**

Lyon Station, PA 19536-0147 • Phone: 610-682-6361 • Fax: 610-682-4781

**Order Department Hotline: 610-682-4231**

www.eastpenn-deka.com

E-mail: eastpenn@eastpenn-deka.com

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## RECYCLING IS CRITICAL

Did you know lead-acid batteries are virtually 100% recyclable? They have a higher recycling rate than other waste products such as aluminum, paper, glass and plastic. Be sure to return your lead-acid batteries to a dealer. In most states it is illegal to discard a battery in the trash.



## BE CAREFUL!

**WARNING:** Batteries produce explosive gases. Keep sparks, flames, and cigarettes away from batteries at all times. Protect your eyes at all times. Never lean over battery when jumping or performing other maintenance. Remember... always wear safety glasses when working around batteries!

**EXPLOSIVE GASES CAN CAUSE BLINDNESS OR INJURY.**

**NO SPARKS • FLAMES • SMOKING**

**SULFURIC ACID CAN CAUSE BLINDNESS OR SEVERE BURNS.**

**FLUSH EYES IMMEDIATELY WITH WATER. GET MEDICAL HELP FAST.**

**⚠ DANGER/POISON**

**KEEP OUT OF THE REACH OF CHILDREN. DO NOT TIP. KEEP VENT CAPS TIGHT AND LEVEL. DO NOT OPEN FLUSH COVER BATTERIES.**

## TYPES OF MARINE/RV BATTERIES

The various types of batteries used in Marine and RV service are:

- Maintenance-Free Non-Accessible Engine Starting with no filler caps
- Low-Maintenance Accessible Starting with filler caps
- Dual Purpose (Starting/ Cycling) with filler caps
- Deep Cycle with filler caps

You may have one or more of the same type or different types on board your boat or RV. Determine which type of battery or batteries you have and follow the correct set of instructions.

## SERVICE TIPS

Always wear safety glasses when working around batteries. Batteries can explode! Protect your eyes.

1. Perform a visual inspection. Inspect for defective or cracked case and cover, and loose or damaged terminal posts or cables. Replace battery and/ or cables immediately if any damage is found.

## SERVICE TIPS (continued)

Look for loose connections or hold-downs. Tighten snugly if appropriate. **DO NOT OVER-TIGHTEN TO AVOID BATTERY DAMAGE!**

2. Keep the batteries and battery compartment clean and corrosion free. Dirty, corroded batteries can self-discharge, which will affect performance and life.

Clean corrosion with a paste made from baking soda and water. Apply liberally. Any corrosion is neutralized when the solution stops bubbling. Wash off with large quantities of water to avoid environmental damage.

3. Shine lead posts and terminal ends with a wire brush or steel wool to clean corrosion and assure a low resistance connection. Reassemble and coat lead parts with petroleum jelly or a terminal protection spray.  
Repaint hold-down, tray and surrounding parts if necessary.

## CHECK THE STATE OF CHARGE

Always wear safety glasses when working around batteries. Batteries can explode! Protect your eyes.

- **MAINTENANCE-FREE NON-ACCESSIBLE TYPES, WITH NO FILLER CAPS:**

1. Check the state-of-charge of the battery with a voltmeter. If the reading is above 12.4 volts, the battery is at least 75% charged and should be OK. If below 12.4 volts, see the Charging Tips section.

- **ACCESSIBLE TYPES, WITH FILLER CAPS:**

1. Using a voltmeter: Check the state-of-charge of the battery. If the reading is above 12.4 volts, the battery is at least 75% charged and should be OK. If below 12.4 volts, see the Charging Tips Section. Or,
2. Using a hydrometer: Check the state-of-charge of the battery by taking a reading from one cell. Use a different cell each time. If the reading is above 1.225 specific gravity, the battery is at least 75% charged and should be OK. If below 75%, see the Charging Tips section.

**Be careful of the sulfuric acid in the battery.** It can burn eyes, clothing and damage paint and electronic equipment. **FLUSH EYES IMMEDIATELY WITH LARGE QUANTITIES OF COOL WATER. GET MEDICAL HELP FAST.**

Specific gravity readings need to be corrected to 80°F (27°C) to allow for temperature of the electrolyte and to insure accurate readings. For each 10 degrees above 80°F (27°C), add four points to the hydrometer reading.

## CHECK THE STATE OF CHARGE (continued)

For each 10 degrees below 80°F (27°C), subtract four points to the hydrometer reading. For example, at 90°F (32°C) a hydrometer reading of 1.250 would be corrected to 1.254. Likewise, at 70°F (21°C) a hydrometer reading of 1.250 would be corrected to 1.246.

If the electrolyte level is too low to read with a hydrometer, add distilled water as noted below and run the engine or equipment at least two hours to mix the electrolyte and avoid a false reading.

3. Check electrolyte levels in all cells. If necessary, add distilled water (or clear, odorless drinking water). Do not use water with high iron content to avoid battery damage. **Never add acid, only water to a battery.** If it will be necessary to charge the battery, bring the levels in all cells to just above the separators inside the cells to allow for expansion during charging. Top off after charging as noted below.

If it is not necessary to charge the battery, (or after charging) top off by filling each cell with distilled water to just below the filler tube in each cell.

## LOAD TESTING

Always wear safety glasses when working around batteries. Batteries can explode! Protect your eyes.

Using a voltmeter or hydrometer will tell you if your battery is charged. But these tests will not indicate if a battery can "hold a load." A battery can be fully charged, but be so weak or worn out that it can no longer perform its function of starting an engine or running accessory loads. Therefore, you must also perform a load test to determine the state of health of your battery.

1. Follow the instructions on the variable load tester or ask your favorite service dealer to load test your battery.
2. If the battery maintains a minimum "on load" voltage of 9.6 volts for 30 seconds, it is in good condition. If not, recharge and load test again.
3. If it fails a second time, **replace the battery immediately.**

### CHARGING TIPS

**Always leave filler caps in place**, tight and secure to reduce the risk of battery explosion and serious injury!  
**Always wear safety glasses when working around batteries. Batteries can explode! Protect your eyes.**

Do not charge batteries without proper instruction.

1. Batteries should be charged if hydrometer reading is below 1.225 specific gravity, or open circuit voltage is below 12.4 volts, or if the first load test is below 9.6 volts as noted previously.
2. Carefully read and follow the instructions that came with the charger to avoid serious injury, property damage and/or battery damage.
3. Unplug the charger before connecting or disconnecting a battery to avoid dangerous sparks which can cause a battery to explode.
4. Do not leave a battery on charge for more than 48 hours to avoid damaging the battery by over-charging. If gassing or spewing of electrolyte occurs, or the battery case feels hot, reduce or temporarily halt charging to avoid damaging the battery.
5. Stop the charge when two hydrometer or voltage readings recorded two hours apart indicate no increase. Further charging would be useless and may damage the battery and shorten its life. If the battery won't come up to full charge, replace it.
6. **NEVER attempt to charge a frozen battery.** To avoid explosion and serious injury, allow it to warm to 60°F (16°C) before charging.
7. **NEVER** leave a battery on a trickle charger longer than 48 hours. Serious damage to the battery WILL occur.

### 12 VOLT BATTERY CHARGING TIME TO FULL CHARGE @ 80°F

BATTERY VOLTAGE	SPECIFIC GRAVITY	STATE OF CHARGE	MAXIMUM RATE @				
			50 AMPS	30 AMPS	20 AMPS	10 AMPS	
12.6	1.265	100%	--- FULL CHARGE ---				
12.4	1.225	75%	20 min.	35 min.	48 min.	90 min.	
12.2	1.190	50%	45 min.	75 min.	95 min.	180 min.	
12.0	1.155	25%	65 min.	115 min.	145 min.	280 min.	
11.8	1.120	0%	85 min.	150 min.	195 min.	370 min.	

### NOTE:

Times are approximate and depend upon battery condition, age and design, the efficiency of the charger, line voltage and other factors.

### OFF-SEASON STORAGE

Batteries that are not in use during the off-season must be cared for as follows to extend battery life and reliability:

1. Disconnect the batteries to avoid self-discharge due to parasitic loads such as clocks, ground faults, etc.
2. Put into storage fully charged and keep them above 75% state-of-charge. Check state-of-charge every 90 days and recharge if necessary.
3. Ideally, store batteries in a cool, dry place with temperatures not below 32°F (0°C) or above 80°F (27°C). Typically, batteries will self-discharge at faster rates at higher temperatures. For example:

#### TEMPERATURE SELF-DISCHARGE RATE

100°F (38°C)	.....3 Pts. Specific Gravity per day
80°F (27°C)	.....2 Pts. Specific Gravity per day
50°F (10°C)	.....1/2 Pt. Specific Gravity per day
30°F (-1°C)	.....1/10 Pt. Specific Gravity per day

### NOTE:

This is only an example. Self-discharge may be higher or lower depending upon battery chemistry, lead alloys, age and other factors.

### California Proposition 65 Warning

Batteries, battery posts, terminals and related accessories contain lead and lead compounds, and other chemicals known to the state of California to cause cancer and birth defects or other reproductive harm. **Wash hands after handling.**

# Marine / RV Battery Care & Maintenance

- STARTING
- DEEP-CYCLE
- DUAL PURPOSE

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**– Material Safety Data Sheet –****Lead Acid Battery Wet, non-spillable (UN2800)****SECTION I**

**Manufacturer's Name:** East Penn Manufacturing Co., Inc.  
Deka Road, Lyon Station, PA 19536  
**Telephone Number for Information:** (610) 682-6361  
**Emergency Telephone Number:** CHEMTREC: 1-800-424-9300, In Washington D.C. or outside continental U.S., call 1-202-483-7616

**Date:** January 29, 2007  
**Trade Name:** Gell; Absorbed Electrolyte, Sealed Valve Regulated Non Spillable Battery  
**Classification:** Battery wet, non-spillable, electric storage UN2800

**SECTION II****HAZARDOUS INGREDIENTS/IDENTITY INFORMATION**

Hazardous Components Specific Chemical Identity (Common Name (s))	OSHA PEL	ACGIH TLV	Range Percent By Weight	Average
Lead, CAS #7439921	0.05 mg/m <sup>3</sup>	0.05 mg/m <sup>3</sup>	60-75%	67%
Sulfuric Acid, CAS #7664939	1.00 mg/m <sup>3</sup>	1.00 mg/m <sup>3</sup>	5-15%	10%
Antimony, CAS #7440360	0.50 mg/m <sup>3</sup>	0.50 mg/m <sup>3</sup>	0-0.1%	<0.1%
Arsenic, CAS #7440382	0.01 mg/m <sup>3</sup>	0.01 mg/m <sup>3</sup>	0.01 %	<0.1%
Polypropylene, CAS#9003070	N/A	N/A	2-10%	4%
Calcium, CAS#7440702	1.0 mg/m <sup>3</sup>	1.0 mg/m <sup>3</sup>	0-0.1%	<0.1%
Tin CAS #7440315	2.0 mg/m <sup>3</sup>	2.0 mg/m <sup>3</sup>	0-0.1%	<0.1%

**SECTION III****PHYSICAL/CHEMICAL CHARACTERISTICS**

**Electrolyte (Sulfuric Acid):**  
**Appearance and Odor:** Clear, Odorless, colorless liquid  
**Boiling Point:** 235 – 240° F  
**Evaporation Rate (Butyl Acetate=1):** less than 1.0  
**Melting Point:** N/A

**Solubility in Water:** 100%  
**Specific Gravity (H<sub>2</sub>O=1):** 1.270 – 1.330  
**Vapor Density (AIR=1):** Greater than 1  
**Vapor Pressure (mm Hg):** 10

**SECTION IV****FIRE AND EXPLOSION HAZARD DATA**

**Flash Point (Method Used):** Non-Flammable  
**Extinguishing Media:** Class ABC extinguisher,  
**NOTE:** CO<sub>2</sub> may be used, but not directly on the cell. The thermal shock may cause cracking of the battery case and/or cases.  
\* Hydrogen gas may be generated during battery changing.

**Flammable Limits:** \*Hydrogen Gas  
**LEL:** 4% **UEL:** 74%

**SECTION V****REACTIVITY DATA**

**Stability:** Stable **Condition to Avoid:** Prolonged overcharging, sources of ignition

**Incompatibility (Materials to Avoid):** Sulfuric Acid: Contact with combustibles and organic materials may cause fire and explosion. Also reacts violently with strong reducing agents, metals, strong oxidizers and water. Contact with metals may produce toxic sulfur dioxide fumes and may release flammable hydrogen gas.

**Hazardous Decomposition of By-Products:** Sulfuric Acid: Excessive overcharging or fire may create Sulfur trioxide, carbon monoxide, sulfuric acid mist, sulfur dioxide, and hydrogen.

**Lead Compounds:** Contact with strong acid or base or presence of nascent hydrogen may generate highly toxic arsine gas.

## SECTION VI HEALTH HAZARD DATA

**Route(s) of Entry:** Not Applicable under normal use.

**Carcinogenicity:**

Sulfuric Acid: The International Agency for Research on Cancer (IARC) has classified "strong inorganic acid mist containing sulfuric acid" as a Category 1 carcinogen, a substance that is carcinogenic to humans. This classification does not apply to liquid forms of sulfuric acid contained within a battery. Inorganic acid mist (sulfuric acid mist) is not generated under normal use of this product. Misuse of the product such as overcharging, may result in the generation of sulfuric acid mist.

Lead Compounds: Lead is listed as a 2B carcinogen, likely in animals at extreme doses. Proof of carcinogenicity in humans is lacking at present.

Arsenic: Listed by National Toxicology Program (NTP), IARC, OSHA and NIOSH as a carcinogen only after prolonged exposure at high levels.

**Signs and Symptoms of Exposure:** Avoid contact, with absorbed electrolyte (sulfuric acid) may cause irritation of eyes, nose and throat. Contact with eyes and skin causes irritation and skin burns. Absorbed electrolyte is corrosive.

**Medical Conditions Generally Aggravated by Exposure:** Pregnant women and children must be protected from lead exposure.

**Health Hazards (Acute and Chronic):** Do not open battery, avoid contact with internal components. Internal components include lead and absorbed electrolyte. Electrolyte is corrosive and contact may cause skin irritation and chemical burns.

**Emergency and First Aid Procedures: (contact with electrolyte)**

- 1) Flush contacted area with large amounts of water for at least 15 minutes. Remove contaminated clothing and obtain medical attention if necessary. Eye wash and/or emergency shower should be readily available.
- 2) If swallowed, give large volumes of water. **DO NOT** induce vomiting, obtain medical treatment.

## SECTION VII PRECAUTIONS FOR SAFE HANDLING AND USE

**Steps to be Taken in Case Material is Released or Spilled:** Electrolyte material is corrosive. Contains sulfuric acid. Neutralize any spilled material. Reference 1996 North American Emergency Response Guidebook, #154.

**Waste Disposal Method:** Lead-acid batteries are completely recyclable. For information on returning batteries to East Penn for recycling, contact your East Penn Representative. Dispose of any collected material in accordance with local, state or applicable federal regulations.

**Precautions to be Taken in Handling and Storing:** Store away from reactive material as defined in Section V, Reactivity Data. Place cardboard between layers of stacked batteries to avoid damage and short circuit. Do not allow metallic materials to simultaneously contact both terminals.

**Other Precautions:** If battery case is broken, avoid direct contact with internal components. Keep away from ignition sources during charging.

## SECTION VIII CONTROL MEASURES

**Respiratory Protection (Specific Type):** N/A

**Ventilation:** Must be provided when charging in an enclosed area.

**Protective Gloves:** Recommended

**Eye Protection:** Recommended

**Other Protective Clothing or Equipment:** N/A

**Work Hygienic Practices:** Good Personal hygiene and work practices are recommended.

## SECTION IX

### OTHER REGULATORY INFORMATION

<u>NFPA Hazard Rating</u>	<u>Sulfuric Acid</u>	<u>Lead</u>
Health (Blue)	3	3
Flammability (Red)	0	0
Reactivity (Yellow)	2	0

Note: Sulfuric acid is water-reactive if concentrated.

**U.S. DOT:** Batteries, wet, non-spillable, electric storage

Hazard Class/Division	8
ID Number	UN2800
Packing Group	III
Label Requirements	Corrosive

**RCRA:** Spent lead-acid batteries are not regulated as hazardous waste when recycled. Spilled sulfuric acid is a characteristic hazardous waste, EPA hazardous waste number D002 (corrosivity).

**CERCLA (Superfund) and EPCRA (Emergency Planning and Community Right to Know ACT)**

- a) Reportable Quantity (RQ) for spilled 100% sulfuric acid is 1000 lbs.
- b) Sulfuric acid is a listed "Extremely Hazardous Substance" under EPCRA with a Threshold Planning Quantity (TPQ) of 1000 lbs.
- c) Batteries are subject to EPCRA reporting requirements under sections 302/304, 311/312, and 313.  
Reporting quantities are as follows:
  - Lead: section 311/312 = 10,000 lbs.
  - Title II I section 313 = 100 lbs.
  - Sulfuric Acid: section 311/312 = 500 lbs.
  - Title III section 313 = 500 lbs.

**California Prop 65:** Batteries, battery posts, terminals and related accessories contain lead and lead compounds, and other chemicals known to the State of California to cause cancer and birth defects or other reproductive harm. **WASH HANDS AFTER HANDLING.**

For additional information concerning East Penn Manufacturing Co., Inc. products or questions concerning the content of this MSDS please contact your East Penn representative.

This information is accurate to the best of East Penn Mfg. Co.'s knowledge or obtained from sources believed by East Penn to be accurate. Before using any product, read all warnings and directions on the label.

# MOHAWK



## OPTIONS

MP-18-SERIES  
ELECTRIC/HYDRAULIC  
PORTABLE LIFT

# CHASSIS LIFTING BEAM

See next page for chassis beam diagram and specifications.

If it is desired to raise a vehicle by the frame, this can be done by using optional chassis lifting beams. The chassis lift beam fits into the cradle where the tire would normally fit and spans between a pair of posts. The beam comes with lifting pads and height adapters that slide and stack along the beam to accommodate the frame pick up points.

## **Directions for Use:**

Drive vehicle into bay.

Roll chassis beam under desired end of vehicle where frame pick points are.

Slide pads to desired positions and stack adapters as desired to accommodate frame pick points.

Roll posts to each end of chassis beam, cradling ends of chassis beam with forks.

Lift pair until chassis beam contacts frame.

Verify proper frame engagement.

Check other posts for proper engagement of tires or frame (depending on if another chassis beam is used or the other end is lifted by tires)

Operate lift as desired.

## **NOTICE:**

The chassis beam is rated for 35,000 lbs total.

Always ensure that the beams are cradled in the forks as close as possible to the carriages. (Do not place beams on tips of forks) Also, ensure that vehicle is centered on chassis beam to ensure even loading of beam and posts.

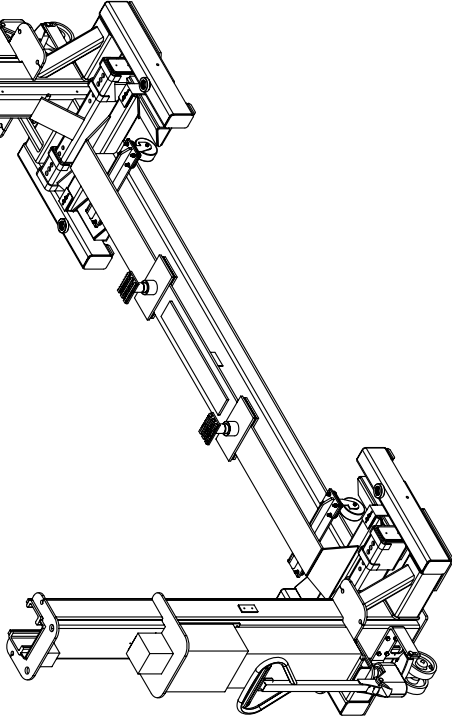
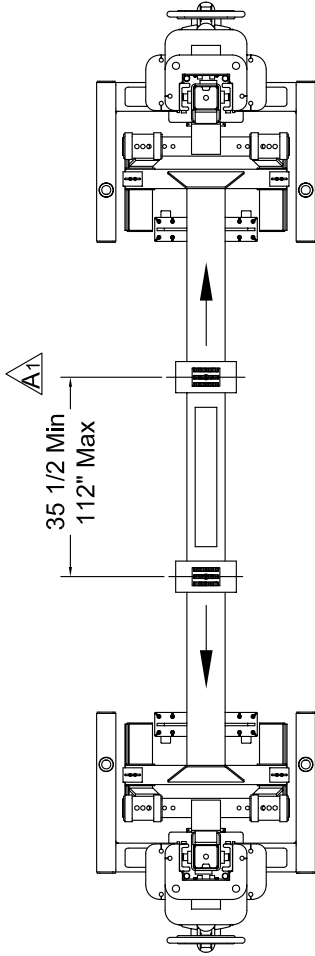
This beam is intended to be used in conjunction with another beam or another set of mobile column posts to lift the entire vehicle. Do not use this beam to pick up just one end of a vehicle only. Load beam only on lifting pads, do not load beam on center.

This beam is intended for use on Mohawk MP-Series 15" Long Fork lifts ONLY.

Refer to the ANSI standard "Vehicle Lift Points for Service Garage Lifting," ANSI/SAE J2184-Oct92, safety manual "Lifting it Right," ALI/SM01, and "Vehicle Lifting Points Guide" ALI/LP-Guide for proper positioning of vehicles on lift.



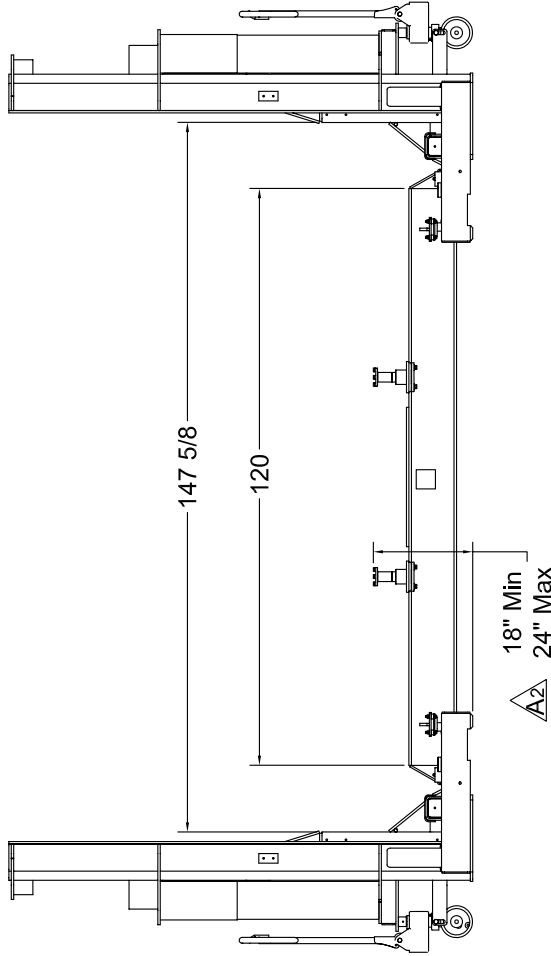
THIS ACCESSORY HAS BEEN TESTED AND CERTIFIED BY A NATIONALLY RECOGNIZED TESTING LABORATORY (NRTL) TO MEET THE REQUIREMENTS OF ANSI/ALI ALCV-1998 FOR AUTOMOTIVE LIFT CONSTRUCTION. FOR USE WITH MOHAWK MP-SERIES LIFTS WITH 15" FORKS.



## Chasis Beam

These beams can be rolled on the floor between to Mohawk MP-Series mobile lifts and lifted by the column forks. Beams include twin lifting pads to engage vehicle chassis.

Capacity: 35,000 lbs per beam  
(35,000 lbs per post pair)



C-SIZE

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- NOTES:
1. REMOVE ALL SHARP CORNERS & EDGES.
  2. UNLESS OTHERWISE SPECIFIED, SURFACE FINISH TO BE 125 RMS.
  3. WELDING MEDIUM SHALL CONFORM TO AWS SPECIFICATIONS TO E-70XX ELECTRODES OR E-70T1 CODE 5.3 FLUX CORE WIRE ONLY.

TOLERANCES:  
ANGULAR ± 1°  
FRACTIONAL DECIMAL ± .030  
DECIMAL ± .005  
0.XX  
0.XXX

FILE NAME  
MP-18 Options.dwg

NEXT ASSEMBLY

#	DESCRIPTION	DATE	APPROVED
A	1) WAS 36 1/2 MIN, 112" MAX 2) WAS 17 1/2 MIN, 23 1/2 MAX	05/30/2006	dak0879

DRAWN	SCALE	CHECKED	DATE	WEIGHT	FROM	DRAWING NUMBER
rw7089	1/16		8/2005	~500	n/a	MP-2300-Spec

MOHAWK RESOURCES LTD.	
TITLE	FROM
Mobile Post Lift Chassis Beam	n/a



# WING PLOW ADAPTERS

See next page for wing plow adapter diagram and specifications.

The wing plow adapters are to be used when it is desired to raise a vehicle with side wing plows or RV's with side extensions where the forks are not able to get close to the tires. The wing plow adapters are used with a pair of posts to enable lifting of the whole front axles of a vehicle by the tires.

## **Directions for Use:**

Drive vehicle into bay.

Roll wing plow adapters around each side of front axle tires (center tires on beam lengths).

Roll posts to each end of adapters, inserting forks fully into adapter sockets.

Lift pair until wing plow adapters engaged tires.

Verify proper engagement.

Check other posts for proper engagement of tires.

Operate lift as desired.

## **NOTICE:**

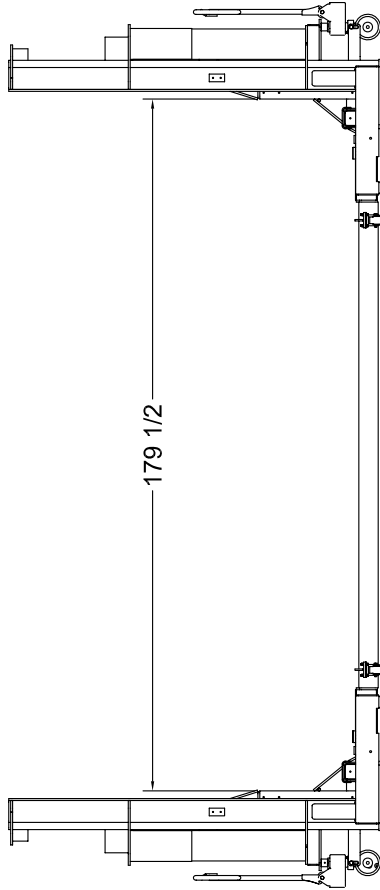
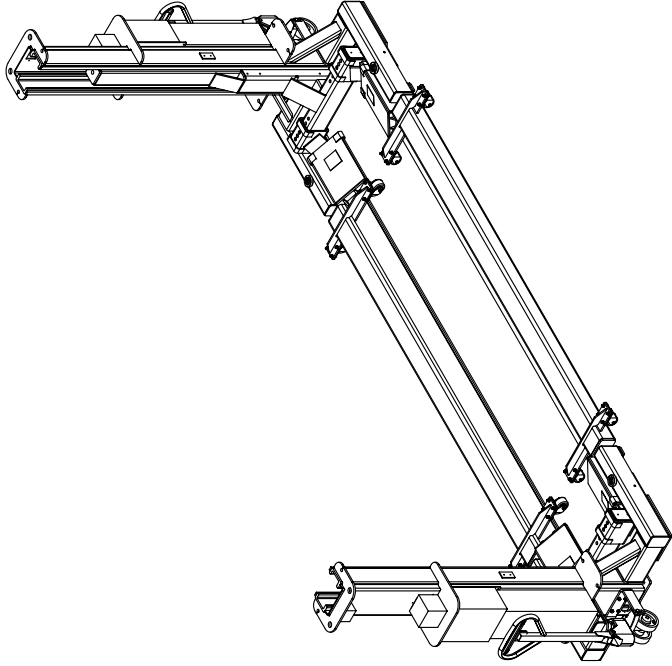
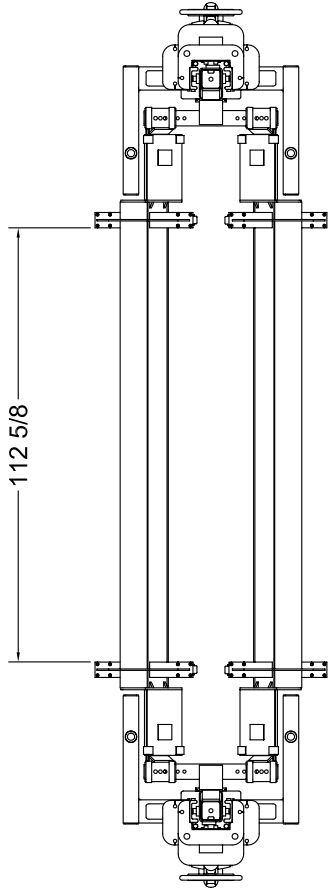
The wing plow adapters are rated for 24,000 lbs total (per pair of beams, see spec on next page) Always ensure that the wing plow adapters are fully inserted over the lifting forks. Also, ensure that vehicle is centered on the wing plow adapters to ensure even loading of beams and posts.

These adapters are intended to be used in conjunction with another set of mobile column posts to lift the entire vehicle. Do not use these to pick up just one end of a vehicle only. These adapters are designed to lift only tires and must not be top loaded. Do not use these to pick up vehicles by frames. Use adapters only in pairs. These adapters must not be single loaded.

The wing plow adapters are intended for use on Mohawk MP-Series 15" Long Fork lifts ONLY.



THIS ACCESSORY HAS BEEN TESTED AND CERTIFIED BY A NATIONALLY  
RECOGNIZED TESTING LABORATORY (NRTL) TO MEET THE REQUIREMENTS OF  
ANSI/ALI ALCV-1998 FOR AUTOMOTIVE LIFT CONSTRUCTION. FOR USE  
WITH MOHAWK MP-SERIES LIFTS WITH 15" FORKS.



## Wing Plow Beam Adapters

A.K.A. RV SLIDE OUT ADAPTERS

These beams can be rolled on the floor between two Mohawk MP-Series mobile lifts and lifted by the column forks. Beams are used in pairs to engage a full set of tires in the same manner that the lifting forks would. Length of beam gives lift the ability to raise plows with side wing plows or RV's with side extensions.

Capacity: 24,000 lbs per Post Pair

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- NOTES:
1. REMOVE ALL SHARP CORNERS & EDGES.
  2. UNLESS OTHERWISE SPECIFIED, SURFACE FINISH TO BE 125 RMS.
  3. WELDING MEDIUM SHALL CONFORM TO AWS SPECIFICATIONS TO E-70XX ELECTRODES OR E-70T1 CODE 5.3 FLUX CORE WIRE ONLY.

TOLERANCES:
ANGULAR
FRONTAL
DECIMAL:
0.XX
0.XXX
FILE NAME
MP-18 Options.dwg

SCALE	DRAWN	CHECKED	DATE	WEIGHT	FROM	DRAWING NUMBER
1/16	rw7089		8/2005	~2000	n/a	MP-2400-Spec
NEXT ASSEMBLY						

APPROVED	LB.

MOHAWK RESOURCES LTD.	TITLE	FROM	DRAWING NUMBER
	Mobile Post Lift Wing Plow Beam Adapters	n/a	MP-2400-Spec

# FORK TRUCK ADAPTERS

See next page for fork truck adapter diagram and specifications.

The fork truck adapters are to be used when it is desired to raise a fork truck by the undercarriage for wheels free servicing. The fork truck adapters are used with a pair of posts.

## **Directions for Use:**

Locate a pair of posts (Master and Slave) in the desired lifting location.

Assembly ramps and pads onto posts as shown in specification diagram.

Drive fork truck onto pads until center of gravity of fork truck is at center of pad.

Locate rubber blocks as desired to contact frame.

Lift pair until fork truck pad engaged fork truck frame.

Verify proper frame engagement with pads.

Lift pair approximately 6 inches verifying that truck center of gravity is centered on pad.

Shake truck slightly to ensure secure and balanced support of frame.

Operate lift as desired.

## **WARNING:**

Any removal of components from vehicle while raised may alter the center of gravity of the vehicle and produce an unsafe or unstable condition of the vehicle or the lifting system that may cause injury to personnel or damage to equipment. Ensure vehicle center of gravity is always located at center of lifting pads. Use jack stands as an added measure of safety to ensure load stabilization.

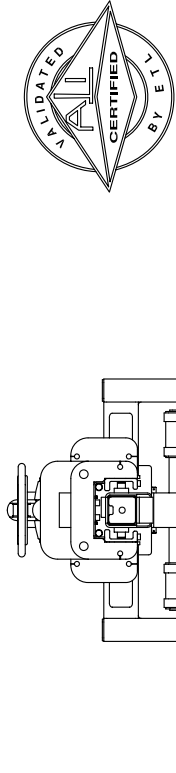
## **NOTICE:**

The fork truck adapters are rated for 10,000 lbs per post (20,000 lbs per post pair).

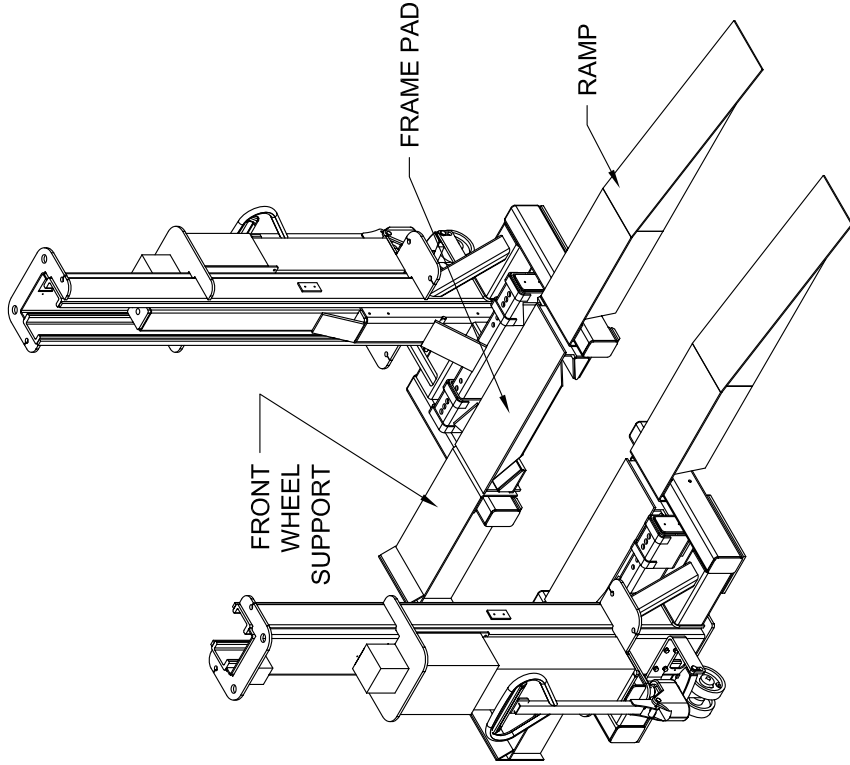
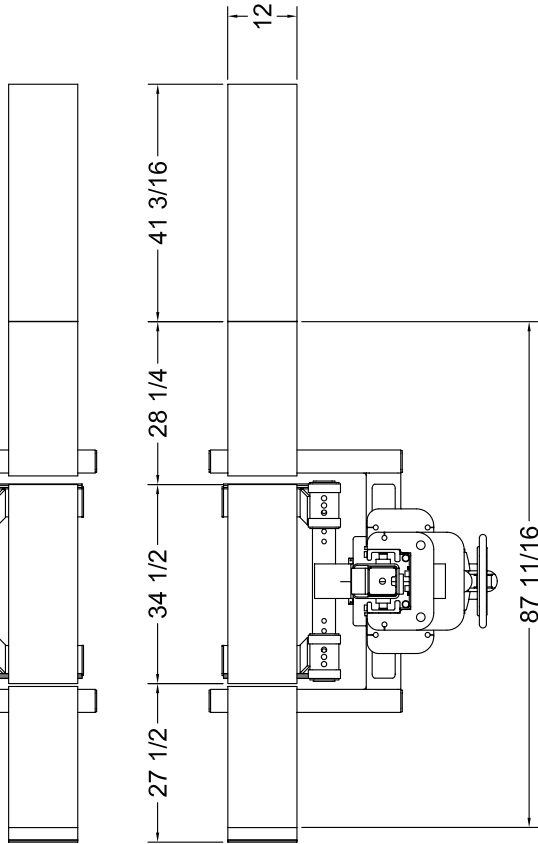
Always ensure that the fork truck adapter pads are fully inserted over the lifting forks inboard against fork tubes. (not on tips of forks). Also, ensure that fork truck center of gravity is centered on the adapter pads to prevent offset loading of posts.

Do not use these to pick up just one end of a vehicle only. Do not use these to pick up vehicles by tires. Use adapters only in pairs. These adapter are designed only to pick up fork trucks.

The fork truck adapters are intended for use on Mohawk MP-Series 15" Long Fork lifts ONLY.



THIS ACCESSORY HAS BEEN TESTED AND CERTIFIED BY A NATIONALLY RECOGNIZED TESTING LABORATORY (NRTL) TO MEET THE REQUIREMENTS OF ANSI/ALI ALCTV-1998 FOR AUTOMOTIVE LIFT CONSTRUCTION. FOR USE WITH MOHAWK MP-SERIES LIFTS WITH 15" FORKS.



## Fork Truck Adapters

These adapters consist of 2 ramps, 2 frame pads and 2 front wheel supports that set on top of the standard Mohawk MP-series mobile lift forks. As the lift raises, the frame pads are lifted by the forks while the ramps and front wheel supports stay on the floor.

Capacity: 10,000 lbs per pad (per post)  
(20,000 Lbs Total per set)

C-SIZE

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- NOTES:
1. REMOVE ALL SHARP CORNERS & EDGES.
  2. UNLESS OTHERWISE SPECIFIED, SURFACE FINISH TO BE 125 RMS.
  3. WELDING MEDIUM SHALL CONFORM TO AWS SPECIFICATIONS TO E-70XX ELECTRODES OR E-70T1 CODE 5.3 FLUX CORE WIRE ONLY.

TOLERANCES:  
ANGULAR: ± 1°  
FRACTIONAL: ± .030  
DECIMAL: ± .030  
0.XXX ± .005

FILE NAME  
MP-18 Options.dwg

NEXT ASSEMBLY

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1/16

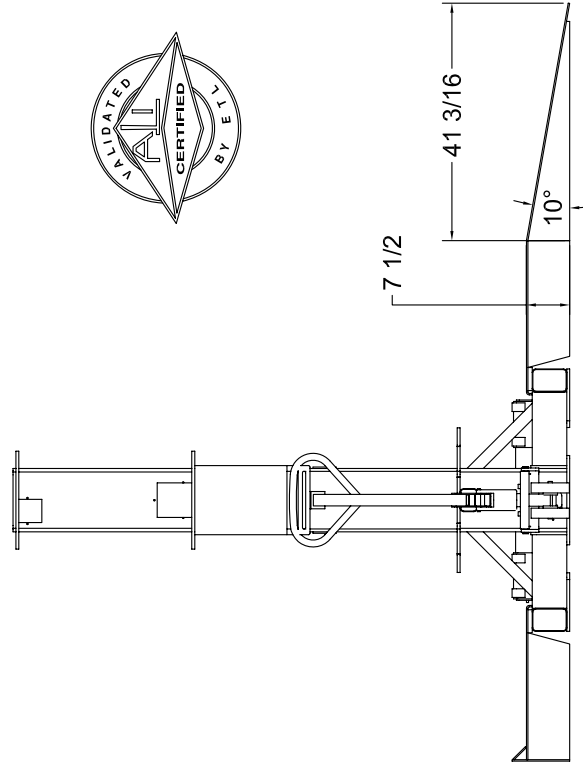
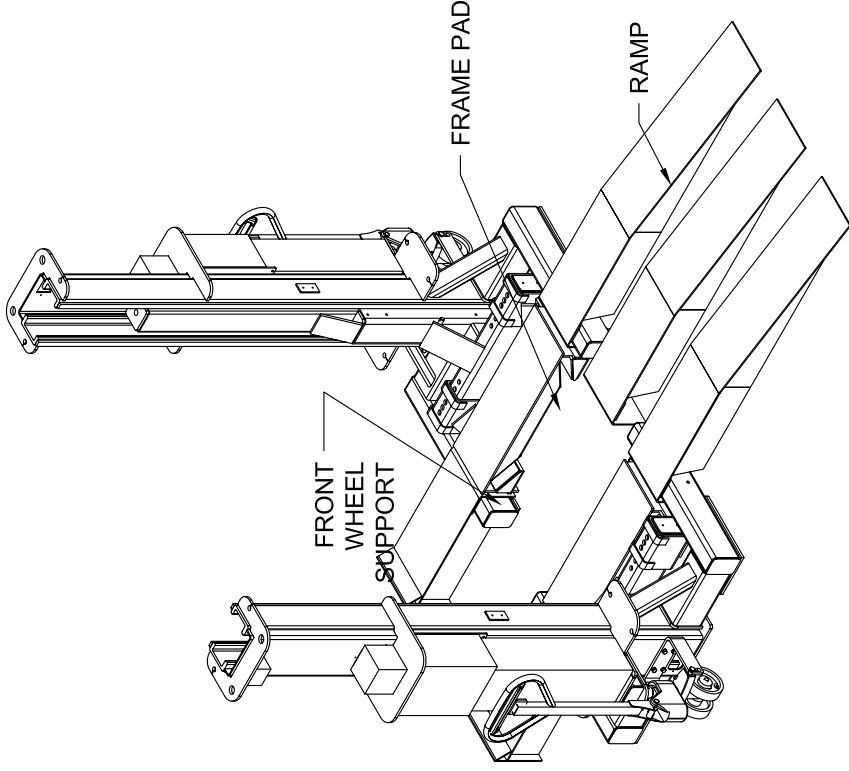
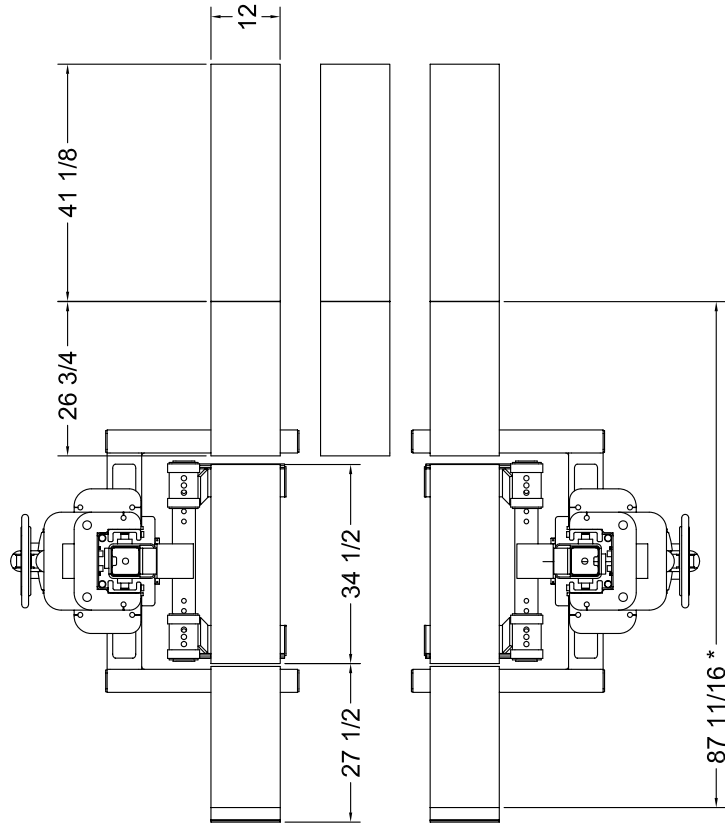
CHECKED  
DATE 8/2005

APPROVED  
WEIGHT ~550 LB.

DRAWN  
rwt/7089  
FROM n/a

TITLE  
Mobile Post Lift  
Fork Truck Adapters  
DRAWING NUMBER  
MP-2200-Spec

MOHAWK RESOURCES LTD.



THIS ACCESSORY HAS BEEN TESTED AND CERTIFIED BY A NATIONALLY RECOGNIZED TESTING LABORATORY (NRTL) TO MEET THE REQUIREMENTS OF ANSI/ALI ALCTV-1998 FOR AUTOMOTIVE LIFT CONSTRUCTION. FOR USE WITH MOHAWK MP-SERIES LIFTS WITH 15" FORKS.

### Fork Truck Adapters (with 3rd Wheel Ramp)

These adapters consist of 3 ramps, 2 frame pads and 2 front wheel supports that set on top of the standard Mohawk MP-series mobile lift forks. As the lift raises, the frame pads are lifted by the forks while the ramps and front wheel supports stay on the floor.

Capacity: 10,000 lbs per pad (per post)  
(20,000 Lbs Total per set)

\* Ensure that this dimensions can accomodate wheel base of fork truck.

C-SIZE

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  3. WELDING MEDIUM SHALL CONFORM TO AWS SPECIFICATIONS TO E-70XX ELECTRODES OR E-70T1 CODE 5.3 FLUX CORE WIRE ONLY.

TOLERANCES:	± .030
ANGULAR:	± .030
DECIMAL:	± .005
FILE NAME	MP-18 Options.dwg

SCALE	1/16
CHECKED	APPROVED
DATE	8/2005
FROM	LB.
WEIGHT	~700
DRAWING NUMBER	MP-2200-Spec2

#### MOHAWK RESOURCES LTD.

TITLE	Mobile Post Lift Fork Truck Adaps w/3rd Wheel Ramp
FROM	n/a
WEIGHT	~700
DRAWING NUMBER	MP-2200-Spec2



# HMMWV ADAPTERS

See next page for HMMWV adapter diagram and specifications.

The HMMWV adapters are specifically to be used when it is desired to raise a HMMWV (Hummer) by the front and rear bumpers for wheels free servicing. These adapters can also be used to pick up mobile military generators, a/c units, etc. These adapters are used with a pair of posts.

## **Directions for Use:**

Drive the vehicle into the lifting area.  
Slip the HMMWV adapters over the forks of a master and slave post.  
Drop the fork retainer pins in the holes at the carriages.  
Locate posts at the front and rear of the vehicle.  
Locate lifting pads at desired locations to contact frame at bumper ends.  
Ensure pads are at widest settings possible.  
Lift pair until pads engaged frame.  
Verify proper frame engagement with pads.  
Lift pair approximately 6 inches.  
Shake truck slightly to ensure secure and balanced support of frame.  
Operate lift as desired.

## **WARNING:**

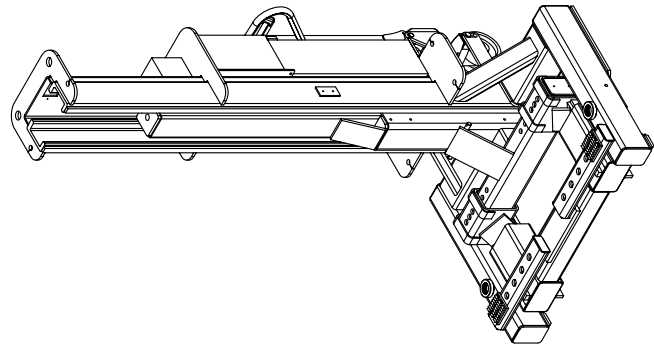
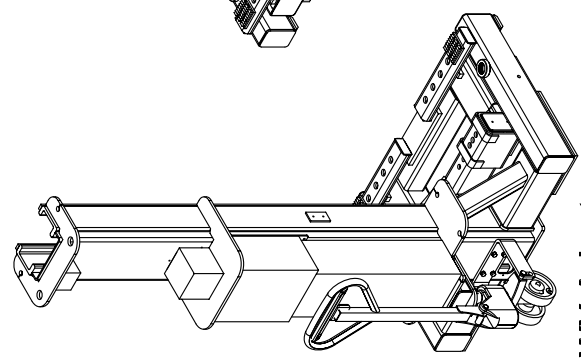
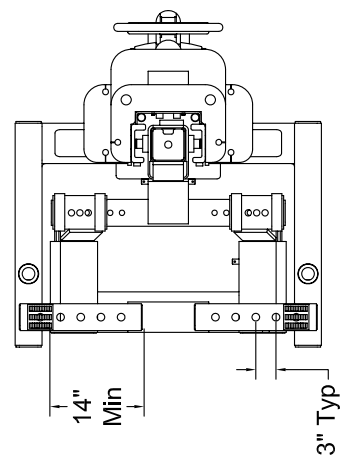
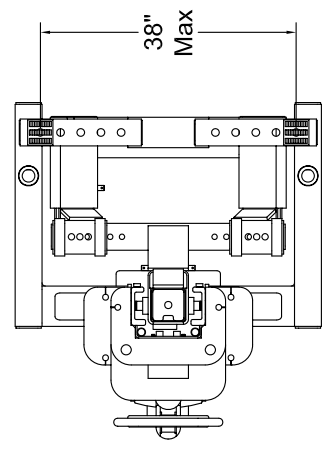
Any removal of components from vehicle while raised may alter the center of gravity of the vehicle and produce an unsafe or unstable condition of the vehicle or the lifting system that may cause injury to personnel or damage to equipment. Ensure vehicle center of gravity is always located at center of lifting pads. Use jack stands as an added measure of safety to ensure load stabilization.

## **NOTICE:**

The HMMWV adapters are rated for 8,000 lbs per post (16,000 lbs per post pair)  
Always ensure that the HMMWV adapters are fully inserted over the lifting forks and retaining pins are inserted into carriage holes. Also, ensure that HMMWV center of gravity is centered on the between the pads to prevent offset loading of posts.  
Do not use these to pick up just one end of a vehicle only. Use adapters only in pairs.  
The HMMWV adapters are intended for use on Mohawk MP-Series 15" Long Fork lifts ONLY.



THIS ACCESSORY HAS BEEN TESTED AND CERTIFIED BY A NATIONALLY RECOGNIZED TESTING LABORATORY (NRTL) TO MEET THE REQUIREMENTS OF ANSI/ALI ALCTV-1998 FOR AUTOMOTIVE LIFT CONSTRUCTION. FOR USE WITH MOHAWK MP-SERIES LIFTS WITH 15" FORKS.



### HMMWV Adapters

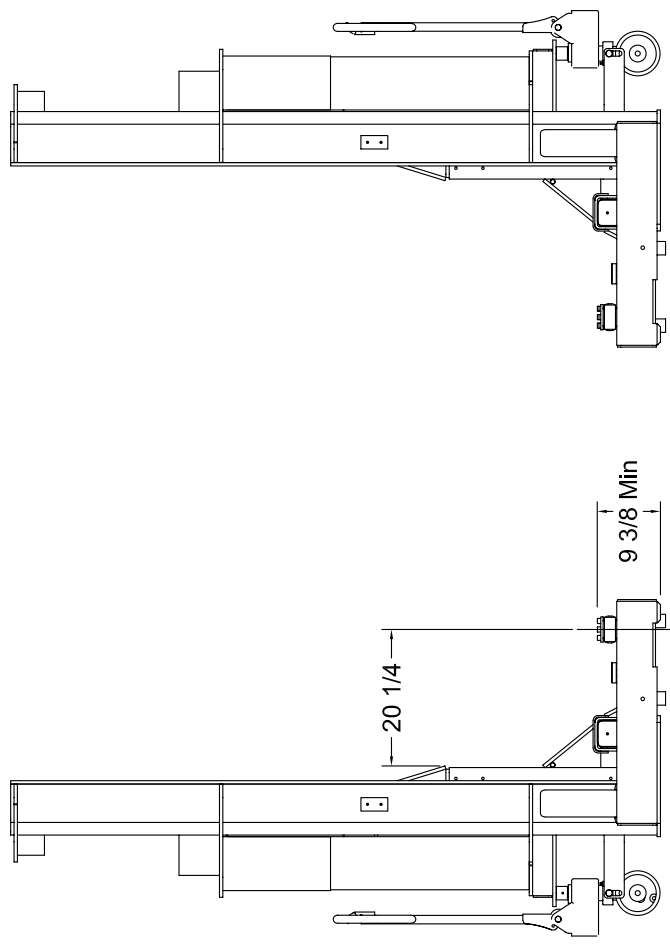
A.K.A. FRONT TO REAR BUMPER ADAPTERS  
A.K.A. U.S.A.F GENERATOR ADAPTER

These adapters slip over the standard forks of the Mohawk MP-18 Series lifts and convert the lift into a "2-Post Frame Engaging Lift". They can also be used to pick by the bumpers. Designed specifically for military HMMWV's.

Capacity: 8,000 lbs per post  
(16,000 Lbs Total)

Accessories include:

- (4) Lifting Pads, Square
- (4) Lifting Pads, Square, 1"
- (4) Lifting Pads, Square, 2"
- (4) 3" Height Adapters
- (4) 6" Height Adapters



C-SIZE

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- NOTES:
1. REMOVE ALL SHARP CORNERS & EDGES.
  2. UNLESS OTHERWISE SPECIFIED, SURFACE FINISH TO BE 125 RMS.
  3. WELDING MEDIUM SHALL CONFORM TO AWS SPECIFICATIONS TO E-70XX ELECTRODES OR E-70TT CODE 5.3 FLUX CORE WIRE ONLY.

TOLERANCES:  
ANGULAR: ± 1°  
FRACTIONAL: ± .030  
DECIMAL: ± .005  
0.XXX  
FILE NAME: MP-18 Options.dwg

SCALE	DRAWN	MOHAWK RESOURCES LTD.
1/16	rw7089	
CHECKED	APPROVED	TITLE
		Mobile Post Lift
DATE	WEIGHT	HMMWV Adapters
8/2005	~550 LB.	
NEXT ASSEMBLY	FROM	DRAWING NUMBER
	n/a	MP-2500-Spec

# FRAME CONTACT ADAPTERS

See next page for Frame Contact Adapters diagram and specifications.

The frame contact adapters are designed to convert a mobile column lift post pair into a frame engaging lift for wheels free servicing. These adapters are used with a pair of posts.

## **Directions for Use:**

Drive the vehicle into the lifting area.  
Slip the frame contact adapters over the forks of a master and slave post.  
Drop the fork retainer pins in the holes at the carriages.  
Locate posts at the both sides of the vehicle.  
Locate lifting pads at desired locations to contact frame pick up points.  
Ensure pads are at widest settings possible for stability.  
Lift pair until pads engaged frame.  
Verify proper frame engagement with pads.  
Lift pair approximately 6 inches.  
Shake truck slightly to ensure secure and balanced support of frame.  
Operate lift as desired.

## **WARNING:**

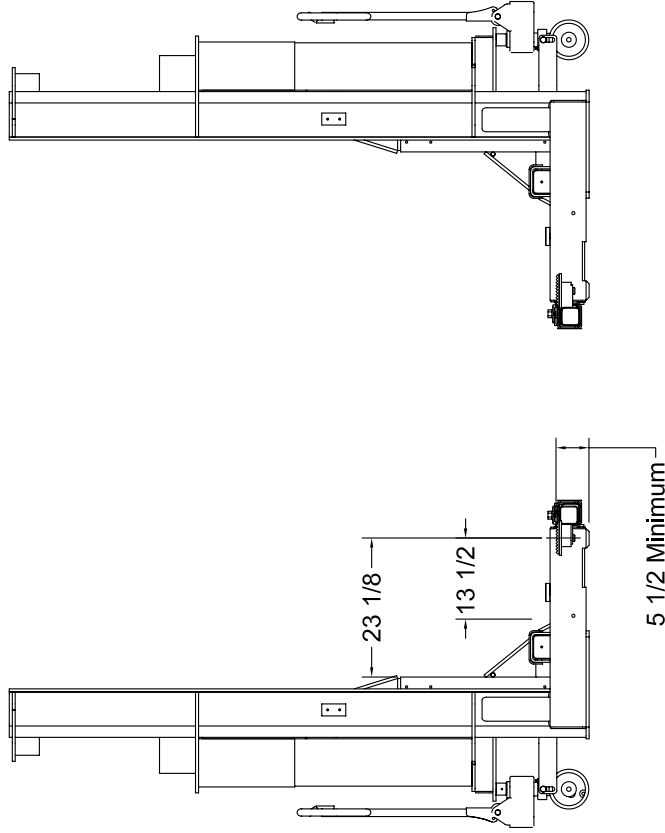
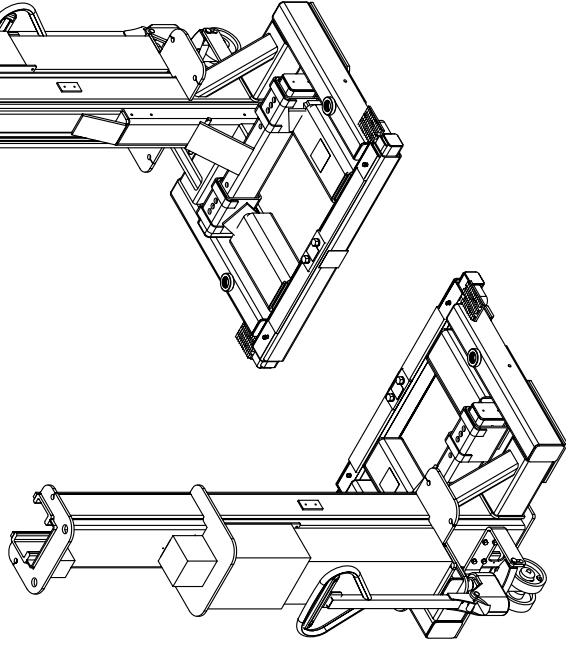
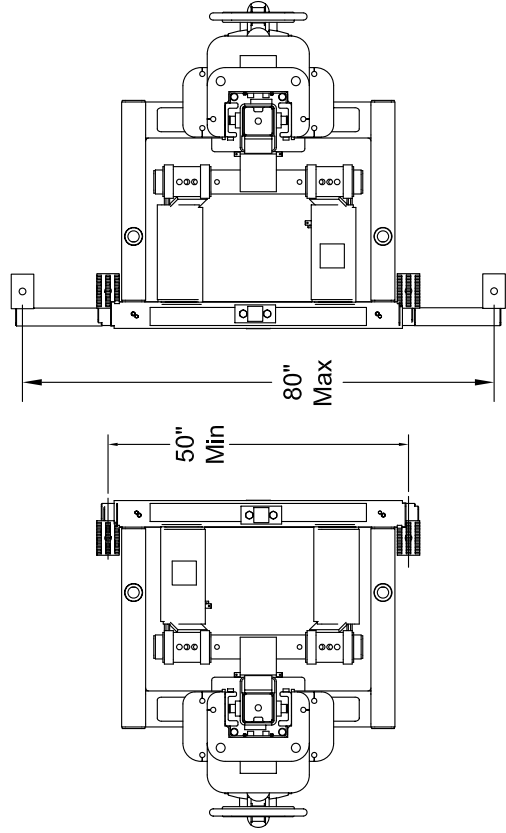
Due to the nature of this design where loading of the adapters is outside the base envelope of the posts, this is a non-certifiable option and voids the certification on the lift it is used on.

## **WARNING:**

Any removal of components from vehicle while raised may alter the center of gravity of the vehicle and produce an unsafe or unstable condition of the vehicle or the lifting system that may cause injury to personnel or damage to equipment. Ensure vehicle center of gravity is always centrally located between the lifting pads. Use jack stands as an added measure of safety to ensure load stabilization.

## **NOTICE:**

The frame contact adapters are rated for 4,000 lbs per post (8,000 lbs per post pair)  
Always ensure that the frame contact adapters are fully inserted over the lifting forks and retaining pins are inserted into carriage holes. Also, ensure that vehicle center of gravity is centered between the pads to prevent offset loading of posts.  
Do not use these to pick up just one end of a vehicle only. Use adapters only in pairs.  
The frame contact adapters are intended for use on Mohawk MP-Series 15" Long Fork lifts ONLY.



## Universal Frame Contact Adapters

These adapters slip over the standard forks of the Mohawk MP-18 Series lifts and convert the lift into a "2-Post Frame Engaging Lift".

Capacity: 4,000 lbs per Post  
(8,000 lbs Total per Post pair)

Accessories include:  
(4) Lifting Pads  
(4) 3" Height Adapters  
(4) 6" Height Adapters

Note: Due to the nature of this design extending beyond the base frame of the posts, this is NOT a certified option and use of this option on a certified lift void the certification of the lift.

C-SIZE

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- NOTES:
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TOLERANCES:	± .030
ANGULAR	± .030
DECIMAL	± .005
FILE NAME	MP-18 Options.dwg

SCALE	DRAWN	MOHAWK RESOURCES LTD.
1/16	rw7089	
CHECKED	APPROVED	
DATE	WEIGHT	TITLE
8/2005	500	Mobile Post Lift
NEXT ASSEMBLY	FROM	Frame Contact Adapters
	LB.	
	n/a	DRAWING NUMBER
		MP-2100-Spec

