Please read the Owner’s Manual carefully and make sure you understand the instructions before using the machine.
NOTE

All assembly and operation instructions located on the MULE units and accessories take precedence over information contained in this manual. Should there be any discrepancies discovered throughout any published documentation issued by Construction Robotics or its authorized affiliates, the following order of precedence shall prevail:

1. Written documents issued by the Construction Robotics Engineering Department
2. Recall instructions
3. Assembly or operation instructions displayed in the MULE or MULE accessory manual
4. Owner’s Manual

Any use of a MULE unit, in a configuration or manner as not explicitly described in this manual is not recommended without the prior written permission of Construction Robotics, LLC.

CAUTION! Please read the operator’s manual carefully and make sure you understand the instructions before using the machine.

WARNING! You must use approved personal protective equipment whenever you use the machine. Personal protective equipment cannot eliminate the risk of injury but it will reduce the degree of injury if an accident does happen. Ask your dealer for help in choosing the right equipment.

<table>
<thead>
<tr>
<th>Release No.</th>
<th>Date</th>
<th>Revision Description</th>
</tr>
</thead>
</table>
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A INTRODUCTION

1 Thank You
Thank you for choosing a MULE 135. This Owner's Manual is a valuable document. Make sure it is always on hand at the job site.

2 System Overview
MULE is a work area tool used to assist in the lifting and placement of units and material up to 135lb over an 11’ vertical distance.

Grippers and hook devices are developed for many specific applications. Specialized gripper or attachment devices can be developed upon requests. Please contact Construction Robotics (CR) for more information.

3 Product Registration and Warranty
Please visit http://www.construction-robotics.com/mulecentral/ for:
- Product registration
- Downloading the latest documentation
- Available accessories

3.1 Warranty Period
Refer to your purchase agreement for the warranty period of your MULE.

3.2 Warranty Policy
All warranty claims will be determined after inspection at a designated facility. A Returned Goods Authorization (RGA) is required for all warranty claims. Contact Construction Robotics Customer Service Department at 585-742-2004 for a RGA. The customer must prepay the freight and absorb any labor expense required to return or replace a product submitted for warranty consideration.

3.3 Equipment
Equipment manufactured by Construction Robotics is warranted to be free from manufacturing defects in normal service for a period of twelve (12) months from date of purchase by the original consumer purchaser. See the warranty details that you received with your purchase documentation or call 844-476-2684 for more information.

4 User Responsibility
It is the owner’s/employer’s responsibility that the operator has sufficient knowledge about how to use the machine safely. Supervisors and operators must have read and understood the Owner’s Manual. They must be aware of:
- The machine’s safety instructions
- The machine’s application and limitations
- How to use and maintain the machine

Federal, state and local legislation could regulate the use of this machine. Find out what legislation is applicable in the place where you work before you start using the machine.
5 Safety Overview

![Warning]

There is no one single factor that is more important for minimizing the possibility of personal injury to the operator and those working in the area, or damage to property, equipment, or material than being familiar with the equipment and using Safe Operating Practices.

MULE is designed for lifting and transporting of material only. Under no circumstances, either during initial installation or in any other use, should the hoist be used for lifting or transporting personnel.

No operator should be permitted to use the equipment that is not familiar with its operation, is not physically or mentally fit, or has not been schooled in safe operating practices. The misuse of MULE can lead to certain hazards which cannot be protected against by mechanical means; hazards which can only be avoided by the exercise of intelligence, care, and common sense.

Safe Operating Practices also involve a program of periodic inspection and preventative maintenance (covered in a separate section). Part of the operator’s training should be an awareness of potential malfunctions/hazards requiring adjustments or repairs, and bringing these to the attention of supervision for corrective action.

Supervision and management also have an important role to play in any safety program by ensuring that a maintenance schedule is adhered to, and that the equipment provided for the operators is suitable for the job intended without violation of one or more of the rules covering safe operating practices and good common sense.

Do’s and Don’ts (Safe Operation of MULE)

The following are Do’s and Don’ts for safe operation of MULE. A few minutes spent reading these rules can make an operator aware of dangerous practices to avoid and precautions to take for their own safety and the safety of others. Frequent examinations and periodic inspections of the equipment as well as a conscientious observance of safety rules may save lives as well as time and money.

DON’TS:

- Never lift or transport a load until all personnel are clear and do not transport the load over personnel.
- Do not allow any unqualified personnel to operate hoist.
- Never pick up a load beyond the capacity rating appearing on the MULE. Overloading can be caused by jerking as well as by static overload.
- Never carry personnel on the gripper, the hook or the load.
- Do not operate MULE if you are not physically fit.
- Do not operate MULE to extreme limits of travel of cable without first checking for proper limit switch action.
- Do not tamper with or adjust any parts of the MULE unless specifically authorized to do so.
- Never use the wire rope as a sling.
- Do not divert attention from load while operating hoist.
- Never leave a suspended load unattended.
- Never operate a MULE that has an inherent or suspected mechanical or electrical defect.
- Do not jog controls unnecessarily.
- Do not operate MULE if cable is twisted, kinked, or damaged.
- Do not remove or obscure label.

DO’S:

- Read and follow manufacturer’s instruction, installation, and maintenance manuals. When repairing or maintaining a MULE, use only manufacturer’s recommended parts and materials.
- Read and follow all instruction and warning information on or attached to the MULE.
- Remove the MULE from service and thoroughly inspect and repair, as necessary, if unusual performance or visual defects (such as peculiar noise, jerky operations, travel in improper direction, or obviously damaged parts) are noticed.
- Establish a regular schedule of inspection and maintain records for all MULEs with special attention given to hooks, grippers, wire rope, brakes, and limit switches.
- Check operation of brakes for excessive drift.
- Never lift loads over people, etc.
• Check for damaged hooks, grippers and wire rope.
• Keep wire rope clean and well maintained.
• Check the wire rope for improper seating, twisting, kinking, wear, or other defects before operating the MULE.
• Make sure a load clears neighboring stockpiles, machinery, or other obstructions when raising, lowering, or traveling the load.
• Avoid swinging of load or load gripper when traveling the MULE.
• Be sure the load attachment is properly seated in the saddle of the gripper or hook. Balance load properly before handling. Avoid gripper tip loading.

6 Owner’s Manual Use

This manual is for use with the following Construction Robotics model numbers, for any other models contact CR for documentation:

• CR003340 – MULE 135 (which includes sub-assemblies CR003341, CR003342 and CR003344)
• CR003068 – Ground Base
• CR003419 – MCWP Mast Adapter - Hydro Mobile (M2 & P)
• CR003086 & CR003484 – Wheel Set
• CR003611, CR003612, CR003613, CR003616 & CR003617 – CR Mast Assemblies

This manual provides instructions for operating within the typical uses of MULE. This manual covers systems used in the following manner.

• Mast height not to exceed 41 ft

If the desired setup exceeds any of the requirements above or other limits described throughout this manual, contact Construction Robotics with specific details for non-standard engineering approval. Additional engineering charges may apply.

If any uncertainties with the contents of this manual arise or clarifications are required, contact Construction Robotics immediately.

7 Acronyms and Abbreviations

<table>
<thead>
<tr>
<th>CMU:</th>
<th>Concrete Masonry Unit</th>
<th>MULE:</th>
<th>Material Unit Lift Enhancer</th>
</tr>
</thead>
<tbody>
<tr>
<td>CR:</td>
<td>Construction Robotics</td>
<td>MCWP:</td>
<td>Mast Climbing Work Platform</td>
</tr>
<tr>
<td>GFCI:</td>
<td>Ground-Fault Circuit Interrupters</td>
<td>RGA:</td>
<td>Returned Goods Authorization</td>
</tr>
<tr>
<td>HM:</td>
<td>Hydro Mobile</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
B SYSTEM SUMMARY

1 Meet MULE

MULE is a smart material handling tool designed for construction that does the heavy lifting for you.

Features and benefits:

- MULE makes any material weightless up to 135 pounds
- Eliminates the fatigue and physical wear and tear associated with repetitive heavy lifting
- Designed for efficiency and comfort in the construction working environment
- Simple control and operation
- Increased productivity
- Flexible deployment, multiple base configurations, works from the ground, traditional scaffold or mast climbing work platforms
- Can free stand up to 20+ feet
- Runs off 120V AC power

2 Standard System Components

2.1 Component Names

**Powerpack** – Houses power management and distribution devices, air compressor and Lifting Cable actuator.

**Primary Arm** – 1st Boom element closest to the mast. The Powerpack is attached to the Primary Arm and rotates around the rotation mast.

**Ground Base** – The Ground Base is the platform MULE is built on. It can be picked in all 4 directions for easy transport. Its slim size allows for it to fit through 36” openings while the incorporated outriggers and jacks provide for a level and stable footprint.

**Controller** – The main operational interface for MULE where most of the functions are located. The Controller attaches to the working end of the Wire Rope.

**Fork Tubes** – The Fork Tubes is attached to the bottom of the rotation mast and is used to pick, transport, and lift MULE. Cross pockets allow the Fork Tubes to be picked from all four sides. System can rest on level ground on the Fork Tubes. The Fork Tubes can be disconnected to decrease weight or remove obstacle.

**Grippers** – The gripper or hook type device attaches to the Handle through a U-Joint connection. Different grippers allow for grabbing of different materials and the incorporated U-Joint allow for the tilt of the load to be precisely controlled during placement.

**Secondary Arm** – 2nd Boom element. Rotates around the end of the Primary Arm. Data coil cord, coil airline and Wire Rope come down from the end of the Secondary Arm.
Mast – The mast sections allow for MULE to be built to different heights depending on the situation. During transport the mast sections can be removed to create a compact package, which can then be assembled to a variety of heights on the jobsite.

Power Cord – MULE comes standard with a 50’ power cord that can be plugged into most wall or generator outlets.

Handles – The Handle provides a convenient grip to operate MULE from. These handles attach to the bottom of the Controller. There are several handle options available to support different preferences and button configurations. Grippers attach to the bottom of the Handle and can be configured in multiple orientations and installed using a quick-change pin.

2.2 Weights

2.2(a) MULE 135
Figure B-1 - As shown: 1160 lb

2.2(b) BASES

Ground Base
Figure B-2 - As shown: 950 lb

Fork Tubes
Figure B-3 - As shown: 290 lb

2.2(c) MASTS - Figure B-4

<table>
<thead>
<tr>
<th>Length</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>2’</td>
<td>135 lb</td>
</tr>
<tr>
<td>2 ½’</td>
<td>145 lb</td>
</tr>
<tr>
<td>4’</td>
<td>180 lb</td>
</tr>
<tr>
<td>5’</td>
<td>200 lb</td>
</tr>
<tr>
<td>6’</td>
<td>225 lb</td>
</tr>
</tbody>
</table>

3 Optional MULE Accessories

Below is the list of currently available MULE accessories. Construction Robotics is constantly in development of new products, our most current list is available on our website.

Custom accessories can be developed upon request, contact Construction Robotics for more information.

3.1 Wheel Set
Installs onto the bottom of the Ground Base, allows for MULE to be rolled between setup locations on jobsite. Capacity of 3200 lb
Weight: 530 lb

3.2 Hydro Mobile Mast Adapters
Allow for using HM mast as the mast for MULE, also can be used to attach MULE to the top of a HM mast supported by something other than a CR base.
Weight of adapter pair: 205 lb
3.3 Fork Tubes Adapter Plate
Allows Mast Sections to be directly mounted to the Fork Tubes. Without special engineering approval, this is only for use with Strap-over style MCWP mounts.

Weight of adapter plate: 75 lb

3.4 One-Button Handle
This handle has a GRIP button built in for easy access when the Gripper is unloaded.

3.5 Two-Button Handle
This handle has the GRIP and SET buttons built in for easy access when the Gripper is unloaded. This allows for a typical place cycle to be done without releasing the handle.

3.6 Cord Reel
As an upgrade to the standard power cord, a retracting cord reel can be installed to easily dispense the right length of cord at the jobsite.

3.7 CMU Gripper 1" - 2 1/4" W/Button Mount
The CMU Gripper 1" - 2 1/4" W/Button Mount is the first of many grippers available for MULE. This gripper is capable of picking CMU with center webs between 1" and 2-1/4" thick. The profile is minimized to avoid rebar interference. An articulating arm holds the GRIP and SET buttons to allow for easy access to the buttons while holding the block. The user adjusts the position of the button box for personal comfort based on the material being handled.

This gripper does not change the load capacity of MULE.

3.8 Wire Rope Extensions
Wire Rope Extensions allow for vertically moving the 11' working zone further from MULE. They attach to the Wire Rope and coil cords the same way that the Controller does. The Controller is then attached to the extensions. Multiple extensions can be hooked together for long reaches.

The extensions will decrease the allowable load by the weight of the extension.
4 System Dimensions

Inches (Centimeters)

111 (282) 144 (365) 175 (445)

9.75 (24.7) INSIDE OF POCKET

32 (82) 38 (97) 50 (127) 62 (158)

14.5 (37) 17 (43)

48 (122)
Inches (Centimeters)

SECTION B – SYSTEM SUMMARY

Maximum Reach 11’ (132”/335cm)
Extension required if working area is greater than 11’.
5 Safety Features

Rotation Lock
When power is removed from MULE, a pin is engaged to lock the rotation of the Primary Arm. This is primarily used in 2 situations; when building/dismantling MULE and moving MULE. When MULE is being transported between sites, there is a pin that can be inserted to prevent the lock from coming disengaged.

Preventing the Load from Dropping
When MULE is placing a load utilizing the GRIP button, it will not release the block until it senses that the load weight is being carried by something else. This prevents a load from dropping unexpectedly when the GRIP button is accidentally triggered.

Loss of Air
If air pressure is lost for any reason MULE is still in a safe condition. When air pressure is lost, the Primary Arm Rotation Lock will engage keeping the arm and any possible load from drifting away. Also the design of the Grippers prevents loads from being dropped by requiring air pressure to release. If air is not available, the unit will no longer operate but will be in a safe condition.
Overload Protection
The software running MULE is constantly monitoring the load on the Wire Rope. If the capacity of 135lb is exceeded the software will only allow for the controller to be lowered at a slow speed. This feature prevents heavy loads from being lifted and possibly damaging the unit or risking a tip-over. Repeated overload will cause premature failure of components.

6 Basic Requirements
Power: 20A@120V AC, 60Hz 
Load to be placed: 10-135 lb

7 Your Machine
As each MULE is made up of several main components, there are multiple serial numbers on each machine to allow for product tracking. For your records it is smart to record these numbers upon receipt.

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Part Number</th>
<th>Serial #</th>
<th>Picture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Controller</td>
<td>CR003340A</td>
<td>00000001</td>
<td><img src="image" alt="Controller" /></td>
</tr>
<tr>
<td>Arm</td>
<td></td>
<td></td>
<td><img src="image" alt="Arm" /></td>
</tr>
<tr>
<td>Powerpack</td>
<td></td>
<td></td>
<td><img src="image" alt="Powerpack" /></td>
</tr>
<tr>
<td>Ground Base</td>
<td></td>
<td></td>
<td><img src="image" alt="Ground Base" /></td>
</tr>
</tbody>
</table>

Note: This sticker is in a protected location and therefore difficult to access.
C SYSTEM SETUP

1 Owner's Manual Limitations

This manual is for use with the following Construction Robotics part numbers, for any other parts contact CR for documentation:

- CR003340 – MULE 135 (which includes sub-assemblies CR003341, CR003342 and CR003344)
- CR003068 – Ground Base
- CR003419 – MCWP Mast Adapter - Hydro Mobile (M2 & P)
- CR003086 & CR003484 – Wheel Set

This Owner’s Manual applies for the typical uses of MULE. If any of the following cases exist, the contents of this manual are invalid.

- Mast height not to exceed 41 ft

If the desired setup exceeds any of the requirements above or other limits described throughout this manual, contact Construction Robotics with specific details for non-standard engineering approval. Additional engineering charges may apply.

If any uncertainties with the contents of this manual arise or clarifications are required, contact your Dealer immediately.

2 Powering MULE

MULE requires clean, steady power to run. When running off a standard wall outlet with no extension cord, no issues should be encountered during standard operation.

If a generator or extension cord is being used, be sure to follow the guidelines in the sections below to ensure smooth operation of MULE.

2.1 Power Requirements

Voltage: 120V (+/- 6V) (if voltage is out of range, see section G6.1 on page 39 to adjust MULE)
Amperage: 20A (at full speed and full capacity)
Frequency: 60 Hz

OSHA requires that MULE be powered through a GFCI receptacle when using temporary site power or generators over 5000W (1926.404).

Be sure to follow all OSHA procedures for all power connections.

2.2 Generator Power

When site conditions require the use of a generator, it is important to have capable equipment available.

Many standard jobsite generators with less than 4000 Starting Watts do not have the power to handle the peak loads of MULE without creating power conditions that will cause faults. The newer inverter style generators provide cleaner power than standard generators.

When using a generator CR recommends using Honda EB2800i with Eco mode turned off.

2.3 Using Additional Extension Cords

Ensure MULE is fully assembled and the Controller plugged in prior to plugging MULE in

MULE comes standard with 50’ of power cord. Whenever possible, it is best to bring the power source into the range of MULE’s power cord.

If it is necessary to add an extension cord, refer to the chart below for the proper gauge based on the length that is needed. Use of a smaller gauge cord than specified may lead to errors that prevent machine function.

<table>
<thead>
<tr>
<th>Extension Cord Length</th>
<th>Minimum Extension Cord Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 50’</td>
<td>12AWG</td>
</tr>
<tr>
<td>50’-75’</td>
<td>10AWG</td>
</tr>
<tr>
<td>75’-100’</td>
<td>8AWG</td>
</tr>
</tbody>
</table>
3 Setup Process

3.1 Base Distance from Wall
The distance MULE sits from the wall face determines how many lineal feet of wall can be worked in a single setup.

In some cases, MULE must be set further back than desired due to site obstacles. No problems will be encountered if the area in Figure C-1 is clear.

![Figure C-1 – Required MULE Clearance](image)

Be sure to follow all Local, State and Federal regulations on clearance distances to Electrical Lines. As a reference, North American regulations typically require a minimum of 10’ of clearance on lines less than 50,000V.

Consult OSHA standards 1926.1407, 1926.1408 and 1926.1409 for more information.

For a straight wall follow the table below:

<table>
<thead>
<tr>
<th>Distance From Face</th>
<th>1’</th>
<th>1’-6”</th>
<th>2’</th>
<th>2’-6”</th>
<th>3’</th>
<th>3’-6”</th>
<th>4’</th>
<th>4’-6”</th>
<th>5’</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lineal Reach</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21’-8”</td>
<td>21’-4”</td>
<td>20’-11”</td>
<td>20’-5”</td>
<td>19’-11”</td>
<td>19’-3”</td>
<td>18’-7”</td>
<td>17’-10”</td>
<td>16’-11”</td>
<td></td>
</tr>
<tr>
<td>21’-6”</td>
<td>21’-1”</td>
<td>20’-8”</td>
<td>20’-2”</td>
<td>19’-7”</td>
<td>18’-11”</td>
<td>18’-2”</td>
<td>17’-4”</td>
<td>16’-5”</td>
<td></td>
</tr>
</tbody>
</table>
3.2 Outrigger Position
Before assembling MULE the outriggers within the Ground Base have to be extended and locked into position. These allow MULE to be stable while making the Ground Base able to fit through a 36" opening.

To extend the outriggers, pull the center pin out completely, this will allow both outriggers on one end of the Ground Base to slide freely.

Once the outrigger is free to move, slide it out until the line on the outrigger is lined up with the edge of the Ground Base. Be sure that the correct side of the outrigger is facing up.

Once the outrigger is extended to the correct position slide the center pin back in to lock them in place.

This procedure needs to be done on both ends of the Ground Base for all 4 outriggers.

Install the jacks in the outriggers, with the handle pointing up.

3.3 Base Leveling
The maximum capacity of the Ground Base is 3700 lb. Do not exceed this capacity; use the weights above in the document to determine how much non-MULE weight can be supported at any time.

Ensure the ground or bearing surface under the jacks has the necessary capacity to support the total load. Follow the table below based on system weight for bearing surface requirements:

<table>
<thead>
<tr>
<th>System Weight</th>
<th>Required Bearing Surface (psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000-2399</td>
<td>33.0</td>
</tr>
<tr>
<td>2400-2799</td>
<td>38.2</td>
</tr>
<tr>
<td>2800-3199</td>
<td>43.4</td>
</tr>
<tr>
<td>3200-3599</td>
<td>48.6</td>
</tr>
<tr>
<td>3600-3999</td>
<td>53.8</td>
</tr>
</tbody>
</table>

When using cribbing, ensure that the height never exceeds the width.

Using a 2’ or 4’ level, level the base in both directions using the jacks.

Ensure that the jacks are not extended more than 22” below the bottom of the outrigger. See Figure C-2.

To fully extend the jacks, a pin adjustment is required. Remove the pin shown in Figure C-3, extend the jack by 1 position and insert the pin. It is not permitted to extend the jack past the 2nd position.

When leveling is complete, check that all 4 jacks are contacting the ground and carrying weight.

3.4 Using Wire Rope Extensions
When work is required below the standard cable reach extensions to the Wire Rope are required. They connect to the Wire Rope and coil cords as the controller does. The controller then connects to the extension. Multiple extensions may be hooked together for tall setups.

3.5 Controller Installation

Attach the Controller to the Wire Rope loop using the clevis pin at the top. Secure the clevis pin with the lock pin.
Strain Relief – Push the rubber tabs attached to the black coil cord on to the studs. The tab closest to the connector should be installed on the back set of studs.

Communications Cable – The black cable connector is keyed and will point toward the front panel when properly installed. Thread on the connector taking care not to cross thread it. Be sure to fully tighten connection.

Connect the blue air supply hose to the top of the Controller using the quick connect fittings. See Figure C-4 for diagram of connections.

3.6 Handle Installation
Select the preferred Handle for the application, attach to the bottom of the controller using the (4) provided M5 screws. Figure C-5

Run the switch cable according to the directions provided with your particular Handle and screw connection into the bottom of the controller.

3.7 Gripper Installation
Select and attach the appropriate Gripper for the application. Remove the quick change pin from the U-Joint located at the bottom of the Handle. Align the U-Joint connections on the Handle and Gripper and reinsert the pin.

If applicable, run the external switch cable according to the directions provided with your particular handle. Connect the cable to the Handle.

If applicable, run the plastic air tubing according to the directions for your particular Handle.

3.8 Wheel Set Assembly – Optional Accessory
For MULE to be assembled to the Wheel Set, the mast must be no taller than:
- CR Mast: 6 ft (11ft with specific approval from CR Engineering)
- HM Mast: 1 Section (6 ft with adapters) (11ft with specific approval from CR Engineering)
- The Wheel Set is attached to the Ground Base using (4) plow bolts provided with the Wheel Set.

To lift the Ground Base, move the pin in the jacks to the 2nd position and crank the jacks evenly to lift the pallet high enough to allow the Wheel Set to roll under, never exceed 3° of tilt (on both inclinometers) during this process.

Once the Wheel Set is under the Ground Base, align the 4 holes in the Wheel Set with the holes in the bottom of the Ground Base. Insert provided plow bolts and install washer, lock washer and nut on the bottom of the Wheel Set. Tighten with provided wrench to 80 ft-lbs. Once the bolts have been tightened the jacks can be let down so that the assembly can roll.

The Wheel Set has a maximum capacity of 3200 lb. Do not exceed this capacity; use the weights above in the document to determine how much non-MULE weight can be carried at any time. The Wheel Set has enough capacity to support MULE in the standard configuration. If using the Flat and Smooth case (Section C4.2(b) on Page 16), capacity may be an issue and weight must be calculated.

When using MULE, no wheels may be touching the ground, they should be able to spin freely; ensure that all 4 jacks are contacting the ground and have similar amounts of weight on them. When in operation on the jacks, Section C3.3 must be followed.
3.9 Fork Tube Disassembly
On some setups, it can be beneficial to remove the Fork Tubes for either capacity or head height reasons. When the Fork Tubes are removed MULE will not sit unsupported.

To remove the Fork Tubes from MULE, remove the 4 bolts highlighted in Figure C-9.

4 Maximum Freestanding Height
This manual provides the standard cases for using MULE. Contact CR for approval on special scenarios not outlined in this manual.

<table>
<thead>
<tr>
<th>Base Type</th>
<th>CR Mast</th>
<th>HM Mast</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground Base – Freestanding (Section C4.1)</td>
<td>22’ of Mast</td>
<td>4 Sections (21’ including adapters)</td>
</tr>
<tr>
<td>Ground Base – Wall Ties (Section C5)</td>
<td>41’ of Mast</td>
<td>8 Sections (41’ including adapters)</td>
</tr>
<tr>
<td>Standard Wheel Set (Section C4.2(a))</td>
<td>6’ of Mast</td>
<td>1 Section – 6’ including adapters</td>
</tr>
<tr>
<td></td>
<td>(11’ with specific approval)</td>
<td>(2 Sections – 11’ including adapters with specific approval)</td>
</tr>
<tr>
<td>Wheel Set with Flat and Smooth Exception (Section C4.2(b))</td>
<td>22’ of Mast Specific approval required</td>
<td>3 Sections (16’ including adapters Specific approval required)</td>
</tr>
<tr>
<td>Fork Tubes (Section C4.3)</td>
<td>Not Permitted for Operation</td>
<td></td>
</tr>
</tbody>
</table>

⚠️ If a combination of CR and HM mast is required consult with CR for approval on details of your specific setup.

4.1 Ground Base
When operating on the Ground Base, the wind requirements are:
- Operation: Maximum 30 mph
- Not in Operation: Maximum 45 mph
- Remove MULE from top of Mast: above 45 mph

In all cases the Ground Base must be supported by all 4 jacks with the outriggers extended and locked into position. When not in operation, there should be no load on the gripper.

⚠️ Before any mast assembly is started ensure that the Ground Base is setup per Sections C3.1 – C3.3 (Pages 12 – 13)

⚠️ MULE must be mounted in the center of the Ground Base. Contact CR for exceptions on specific setups as required.
4.1(a) **CR Mast**

**Free-Standing**
When utilizing MULE in a single location with CR Mast it can Free-Stand up to 22 ft of mast.

**Wall Ties**
When site conditions require MULE to be built taller than Free Standing will allow, the Mast can be tied into existing structure. See Section C5 for details.

4.1(b) **HM Mast**

**Free-Standing**
When utilizing MULE in a single location with HM Mast it can Free-Stand up to 4 sections (21 ft including adapters)

**Wall Ties**
When site conditions require MULE to be built taller than Free Standing will allow, the Mast can be tied into existing structure. See Section C5 for details.

4.2 **Mounted to Wheel Set**

When operating on the Wheel Set, the wind requirements are:

- Operation: Maximum 30 mph
- Not in Operation on Wheels: Maximum 30 mph
- Not in Operation on Jacks: Maximum 45 mph
- Remove MULE from top of Mast: above 45 mph

When not in operation, there should be no load on the gripper.

Wall ties may not be used on setups with the Wheel Set.

4.2(a) **Typical Use**
The Wheel Set is ideal for sites that have solid, flat and consistent surfaces so that MULE can be moved without the need of a Forklift or Crane.

The Wheel Set is rated to operate on surfaces with less than 10% of grade (6°) with sufficient bearing capacity (see table to the right). The running surface must be smooth; free from ditches, divots or similar.

When using MULE, no wheels may be touching the ground, they should be able to spin freely; ensure that all 4 jacks are contacting the ground and have similar amounts of weight on them. When in operation on the jacks, Section C3.3 must be followed.

Moving speed must be kept below 4 ft/sec (average walking speed) when on the Wheel Set.

**CR Mast**
When moving MULE on the Wheel Set with CR Mast it can Free-Stand up to 6 ft (11ft with specific approval from CR Engineering).

When on the Wheel Set, order of the mast sections does matters. The shortest mast section must be on the bottom, getting progressively longer at the top of the stack.

**HM Mast**
When moving MULE on the Wheel Set with HM mast it can Free-Stand up to 1 section (6 ft including adapters) (11ft with specific approval from CR Engineering)

4.2(b) **Flat and Smooth Surfaces**

<table>
<thead>
<tr>
<th>System Weight</th>
<th>Required Bearing Surface (psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000-2399</td>
<td>79.2</td>
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<td>116.7</td>
</tr>
<tr>
<td>3600-3700</td>
<td>119.8</td>
</tr>
</tbody>
</table>

**CR must provide Special Engineering Approval prior to using the Flat and Smooth Surface Exception!**

When conditions are right, MULE is capable of free-standing higher on the Wheel Set than typically allowable provided certain safety steps are taken during the move.

For this height revision to be acceptable, ALL of the following conditions must apply:

- The base material is completely flat and smooth (compacted stone is not acceptable)
- The base material is capable of supporting 200 lb/in² with no deformation
During the move of the Wheel Set, the following requirements must be followed:

- The surface must be swept to clear any obstacles
- The path must be inspected for overhead obstacles
- The jacks must be no more than ½" off the floor
- The Wheel Set must be moved solely by manual means (no towing, pushing etc.)
- Moving speed must be kept below 4 ft/sec (average walking speed) when on the Wheel Set

Provided that all of these conditions are followed, the alternate Free-Stand specifications can be used.

**Alternate Wheel Set Free-Stand – CR Mast**

MULE on the Wheel Set, on a smooth and flat surface with CR Mast can Free-Stand up to 22 ft

Depending on the mast configuration, the Wheel Set capacity may be exceeded. Use the weights listed in Sections B2.2 & B3 (Page 5) to stay within the 3200 lb capacity of the Wheel Set.

During this process the stack can have no more than the following of each mast:

When on the Wheel Set, order of the mast sections **does** matters. The shortest mast section must be on the bottom, getting progressively longer at the top of the stack.

<table>
<thead>
<tr>
<th>Mast Length</th>
<th>Maximum Sections Allowed</th>
</tr>
</thead>
<tbody>
<tr>
<td>2'</td>
<td>3</td>
</tr>
<tr>
<td>2 1/2'</td>
<td>4</td>
</tr>
<tr>
<td>4'</td>
<td>5</td>
</tr>
<tr>
<td>5'</td>
<td>4</td>
</tr>
<tr>
<td>6'</td>
<td>3</td>
</tr>
</tbody>
</table>

**Alternate Wheel Set Free-Stand – HM Mast**

MULE on the Wheel Set, on a smooth and flat surface with HM Mast can Free-Stand up to 3 sections (16 ft including adapters)

The Fork Tubes may **only** be used to support a MULE **when not in operation**.

CR has created a special exception for use on a MCWP when properly restrained; see Section D3 for more information.

**5 Working with Mast Ties**

When site conditions require MULE to be built taller than Free Standing will allow, the Mast can be tied into existing structure. Wall ties are required every 15 ft beginning 3-10ft from the base. There must be no more than 15 ft of mast above the last tie. A minimum of 3 ties are required in each location per the diagram below.

Each anchor point must be capable of 3000 lb of tension/compression and 1500 lb of shear.

Once the ties are installed, verify mast plumb in both directions prior to operation.
5.1(a) **CR Mast**

When working with the CR Mast in a tied configuration, additional components are required. Wall ties can only attach at the interface of 2 mast sections. At that interface the standard 3” bolts are switched with fully threaded 4” bolts keeping the standard washer, lock washer and nut. This connection is tightened in the same fashion as all other connections, using the same order and torques.

Then install the CR Mast Tie Plate with another lock washer and nut. These are then tightened following the typical specifications. See Section C6.1(a) on Page 18

These plates provide attachment points for ties to the wall. CR suggests using HM mast ties but others are acceptable if they fit and can support the same loads.

5.1(b) **HM Mast**

When using HM Mast, the tie schedule is unchanged (See Page 17). Please refer to your HM manual for installation instructions of each tie.

6 **Assembling the Mast and Installing MULE**

Once you have determined how high you are building MULE and if you are required to use wall ties, it is time to assemble.

As a rule of thumb, MULE can build as high as the top of the upper mast section.

---

**CR suggests that MULE be powered on to ensure the Primary Arm Rotation Lock disengages prior to raising MULE. If the lock does not disengage, see Section G7 (Page 41) for quick things to check.**

---

Once the rotation lock is functional, unplug MULE.

---

**Ensure that MULE is unplugged and the Primary Arm rotation lock is engaged to prevent movement; restrain the Secondary Arm from swinging using a rope or bungee cord. It is highly recommended to remove the Controller for this process.**

---

**MULE must be mounted in the center of the Ground Base. Contact CR Engineering for exceptions on specific setups as required.**

---

**When installation/dismantling or rigging requires the certified installer to exceed safe working heights allowable per OSHA or site specific regulations the use of approved fall protection is required.**

---

6.1(a) **CR Mast**

Bolt a single mast section to the center of the Ground Base using (4) Grade 5 or higher ¾”-10 x 3” bolts up through the bottom and a ¾” washer, a ¾” lock washer, and a ¾”-10 nut on top of each. Nuts require a 1-1/8” wrench or socket (Taper and ratchet wrenches are provided). Tighten bolts to a torque of 80 ft-lb in the cross pattern shown in Figure C-13.

---

**Building from the Top-Down**

If wall ties are being used, this section will not apply. Follow the guidelines in Building from the Bottom-Up below.

---

**Figure C-12 - Installed Mast Tie Plate**
Assuming more than 1 section of mast is being used lift MULE up with the Fork Tubes. Bolt a single mast section to the bottom of MULE using the same hardware and procedure as used for the base. All of the bolts run from the bottom up and the head is captured to only require 1 tool.

Lift MULE and attach another mast section to the bottom of the previous mast. Repeat this procedure for as many mast sections as required up to the max free stand height, being sure to follow the tightening order and torque for each. Once the mast stack has been assembled on MULE, bolt the stack to the mast pre-installed on the Ground Base. The provided taper wrench is very helpful in getting these sections to align.

If the Ground Base is or will be installed onto the Wheel Set, the mast stack MUST be assembled in order of ascending height with the shortest mast at the bottom and the tallest mast at the top.

Use the jacks on the Ground Base to level MULE to within 1/2° of plumb using the indicators mounted above the Fork Tubes. If the indicators are not visible, check mast plumb with a 4’ level.

When complete ensure that all 4 jacks are contacting the ground and have similar amounts of weight on them. When in operation on the jacks, Section C3.3 (Page 13) must be followed.

Building from the Bottom-Up

When building from the Bottom-Up, the entire mast stack is assembled to the Ground Base prior to adding MULE. The mast stack can be assembled on the ground and lifted into place on top of the pre-installed mast section on the Ground Base. All of the typical hardware applies to this assembly with the same tightening sequence and torque specifications.

To lift the mast stack CR suggests attaching ¾” eye bolts (rated for lifting) to the mast (through the standard mast bolt holes) as shown in Figure C-15. Each eye should use an individual strap/chain to prevent slippage. Be sure to follow all manufacturer instructions and ratings for all rigging equipment.

Once the mast stack is assembled and installed, MULE can be installed on top of it using either the Fork Tubes or rigging points. Follow the same tightening sequence and torque specifications using the typical hardware.

If using rigging to attach MULE, use the rigging points as shown in Figure C-16. As the rigging points on MULE have a maximum capacity of 500 lb the entire mast stack cannot be assembled in the same fashion as when assembling from the Top-Down.

Use the jacks on the Ground Base to level MULE to within 1/2° of plumb using the indicators mounted above the Fork Tubes. If the indicators are not visible, check mast plumb with a 4’ level.

When complete ensure that all 4 jacks are contacting the ground and have similar amounts of weight on them. When in operation on the jacks, Section C3.3 (Page 13) must be followed.

6.1(b) Hydro Mobile Mast

When utilizing the HM mast on the CR Ground Base, no climbing of the HM mast is allowed!

If you are utilizing Hydro Mobile Mast for MULE the adapters need to be installed on the Ground Base and at the bottom of MULE.
The base adapter is a 2 piece assembly that gets bolted onto the Ground Base using the rectangular hole pattern in the center of the pallet. Be sure the bolts that interface with the HM mast are installed prior to attaching the assembly to the Ground Base.

Bolt the mast adapter to the center of the base using (4) Grade 5 or higher ¾"-10 x 3" bolts up through the bottom and a ¾" washer, a ¾" lock washer, and a ¾"-10 nut on top of each. Nuts require a 1-1/8" wrench or socket (Taper and ratchet wrenches are provided). Tighten bolts to a torque of 80 ft-lb in a cross pattern (shown in Figure C-13).

Install the upper adapter to the base plate of MULE (same plate that the Fork Tubes attaches to). Using the standard ¾"-10 x 3" bolts, washer, lock washer and nut, bolt the connection together following the same tightening procedure and torque specifications as used for all of the mast connections.

**Building from the Top-Down**

If wall ties are being used, this section will not apply. Follow the guidelines in Building from the Bottom-Up below.

Lift MULE up with the Fork Tubes; attach a single HM mast section to the bottom of MULE using the hardware built into the HM Mast. Tighten these bolts according to your HM manual.

Lift MULE and attach another mast section to the bottom of the previous mast. Repeat this procedure for as many mast sections as required being sure to follow the tightening order and torque for each.

Once the mast stack has been assembled on MULE, bolt the stack to the pre-installed mount on the Ground Base.

**Building from the Bottom-Up**

When building from the Bottom-Up, the entire mast stack is assembled to the Ground Base prior to adding MULE. The mast stack can be assembled on the ground and lifted into place on top of the pre-installed mast section on the Ground Base. All of the hardware needed is part of the HM mast or the Ground Base adapter.

Once the mast stack is assembled and installed, MULE can be installed on top of it. Use the rigging points as shown in the diagram below. Follow the tightening sequence and torque specifications found in your HM manual.

Once the mast stack is assembled and installed, MULE can be installed on top of it using either the Fork Tubes or rigging points. Follow the tightening sequence and torque specifications found in your HM manual.

If using rigging to attach MULE, use the rigging points as shown in Figure C-19. As the rigging points on MULE have a maximum capacity of 500 lb the entire mast stack cannot be assembled in the same fashion as when assembling from the Top-Down.
7 Raising MULE Height (Adding Mast Sections)

Once MULE is assembled and needs to be raised to change the work zone, Mast sections need to be added.

**Before unplugging MULE, raise the Controller as high as possible**

**Ensure that MULE is unplugged and the Primary Arm rotation lock is engaged to prevent movement; restrain the Secondary Arm from swinging using a rope or bungee cord. It is highly recommended to remove the Controller for this process.**

**When adding Mast Sections be sure to follow the Free Stand Height or Wall Tie Requirements found in Section C4 (Page 15)!**

**When using the Wheel Set, the mast stack MUST always be assembled in ascending order (shortest on bottom, longest on top)**

7.1(a) Using Fork Pockets

Carefully maneuver your Forklift into the Fork Tubes mounted on MULE from any of the 4 directions. Take load on the forklift but do not lift the unit. Remove the bolts holding the bottom mast section to the Ground Base (in the case of HM mast, disconnect the mast from the adapter on the Ground Base). Lift the Fork Tubes up to allow for a new section of Mast to be added. Attach the new mast to the Ground Base following the torque and tightening procedures found in Section C6 (Page 18). Then attach MULE to this newly inserted Mast following the same torque and tightening procedures.

7.1(b) Using Rigging Points

In order to use this procedure, the mast and Fork Tubes attached to MULE while lifted must weigh less than 500 lb. Consult the included weights chart (see Sections B2 & B3 on pages 4 – 5) to ensure that the lift is within capacity.

Attach your rigging to the points on MULE shown in Figure C-20.

Lift the rigging so that there is tension on it but you are not lifting more than 500 lb. Remove the bolts at the junction you intend to add mast to and lift the unit. Attach the new mast on the bottom side (either to the existing mast stack or the Ground Base) and follow the torque and tightening procedures found in Section C6 (Page 18). Lower the unit and attach it to the new mast section following the same torque and tightening procedure.

Before unplugging MULE, raise the Controller as high as possible

Ensure that MULE is unplugged and the Primary Arm rotation lock is engaged to prevent movement; restrain the Secondary Arm from swinging using a rope or bungee cord. It is highly recommended to remove the Controller for this process.

When adding Mast Sections be sure to follow the Free Stand Height or Wall Tie Requirements found in Section C4 (Page 15)!

When using the Wheel Set, the mast stack MUST always be assembled in ascending order (shortest on bottom, longest on top)

7.1(a) Using Fork Pockets

Carefully maneuver your Forklift into the Fork Tubes mounted on MULE from any of the 4 directions. Take load on the forklift but do not lift the unit. Remove the bolts holding the bottom mast section to the Ground Base (in the case of HM mast, disconnect the mast from the adapter on the Ground Base). Lift the Fork Tubes up to allow for a new section of Mast to be added. Attach the new mast to the Ground Base following the torque and tightening procedures found in Section C6 (Page 18). Then attach MULE to this newly inserted Mast following the same torque and tightening procedures.

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In order to use this procedure, the mast and Fork Tubes attached to MULE while lifted must weigh less than 500 lb. Consult the included weights chart (see Sections B2 & B3 on pages 4 – 5) to ensure that the lift is within capacity.

Attach your rigging to the points on MULE shown in Figure C-20.

Lift the rigging so that there is tension on it but you are not lifting more than 500 lb. Remove the bolts at the junction you intend to add mast to and lift the unit. Attach the new mast on the bottom side (either to the existing mast stack or the Ground Base) and follow the torque and tightening procedures found in Section C6 (Page 18). Lower the unit and attach it to the new mast section following the same torque and tightening procedure.
8 Moving MULE on a Jobsite
As work is completed MULE will need to be relocated to keep producing.

Before moving MULE, make sure that the wind conditions are within the operational requirement of 30 mph.

Ensure that MULE is unplugged and the Primary Arm rotation lock is engaged to prevent movement; restrain the Secondary Arm from swinging using a rope or bungee cord. It is highly recommended to remove the Controller for this process.

8.1 General Location Requirements for MULE
Before moving the Ground Base, ensure that the ground or bearing surface under the jacks at the new location has the necessary capacity to support the total load. Follow the table to the right based on system weight for bearing surface requirements:

<table>
<thead>
<tr>
<th>System Weight</th>
<th>Required Bearing Surface (psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000-2399</td>
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<tr>
<td>2400-2799</td>
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</tr>
<tr>
<td>3600-3999</td>
<td>53.8</td>
</tr>
</tbody>
</table>

Cribbing may be needed under each jack foot to increase the bearing surface capacity.

When using cribbing, ensure that the height never exceeds the width.

8.2 Free Standing Ground Base

It is not permitted to move an assembled MULE with anything other than the MULE Wheel Set or a Fork Lift (No Pallet Jacks)

When MULE is built on the Ground Base the entire assembled system can be moved provided that certain criteria are met. If the values below are exceeded, MULE must be partially disassembled to be moved.

- Travel Grade is less than 8% (5°)
- Mast must remain plumb within 5° in all directions during transit
- The amount of mast does not exceed 22’
- The final position of MULE is on flat and level ground.
- Move must be made with a capable lifting device (a pallet jack is not permitted)
- System Weight does not exceed 3500lb

If the move meets all of the requirements, MULE can be moved using the Fork Tubes at the top of the mast.

When moving an assembled MULE, MULE must be chained to the basket of the Fork Truck!

Once the move is complete, do not move the Fork Truck until releveling. Re-level MULE to within 1/2° using the built in indicators above the Fork Tubes.

If any of the requirements are not met then MULE needs to be separated from the Mast/Ground Base and reconnected once the setup procedure in Sections C3.1- C3.3 (Pages 12 – 13) has been completed.

If it is necessary to move an assembled MULE with a Fork Truck using the Ground Base, the amount of mast may not exceed 8’.
8.3 Wheel Set

If your setup is built to the Flat and Smooth Surfaces exception within Section C4.2 (Page 16) be sure that the area of travel complies with ALL requirements and the specific procedures are followed.

The Wheel Set is ideal for sites that have solid, flat and consistent surfaces so that MULE can be moved without the need of a Forklift or Crane.

The Wheel Set is rated to operate on surfaces with less than 10% of grade (6°) with sufficient bearing capacity (see table below). The running surface must be smooth; free from ditches, divots or similar.

To move the Wheel Set, lower the jacks evenly until there is no weight on them. While doing this, be sure to keep MULE level; do not exceed 3° on the indicators above the Fork Tubes during this process.

Roll the Wheel Set to the new working position. Ensure that the travel surface has less than 10% of grade (6°) with sufficient bearing capacity. The running surface must be smooth; free from ditches, divots or similar.

Raise evenly on the jacks. While doing this, be sure to keep MULE level; do not exceed 3° on the indicators above the Fork Tubes during this process.

Use the jacks on the Ground Base to level MULE to within 1/2° of plumb using the indicators mounted above the Fork Tubes.

When using MULE, no wheels may be touching the ground, they should be able to spin freely; ensure that all 4 jacks are contacting the ground and have similar amounts of weight on them. When in operation on the jacks, Section C3.3 (Page 13) must be followed.

If your setup is built to the Flat and Smooth Surfaces exception within Section C4.2 (Page 16) be sure that the area of travel complies with ALL requirements and the specific procedures are followed.

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</tr>
<tr>
<td>3600-3700</td>
<td>119.8</td>
</tr>
</tbody>
</table>

8.4 System with Wall Ties

If the maximum free stand height is exceeded and wall ties are required, MULE cannot be moved without some level of disassembly.

If the mast length is less than or equal to 15 ft (if moving with an overhead crane in a fixed position, any mast length up to 20 ft is acceptable), then the Ground Base and mast stack can be moved as 1 piece. Remove MULE from the top of the mast with either the Fork Tubes or Rigging points. At this point the wall ties can be removed. The Ground Base and mast stack can be moved through the Ground Base fork pockets or by rigging from the top mast section in the same way as lifting an assembled mast stack. Be sure to follow all manufacturer instructions and ratings for all rigging equipment. If moving by the Ground Base, pick the Ground Base by the built-in fork pockets and move it to the new position.

Once the Ground Base has been relocated, follow the setup procedure in Sections C3.1- C3.3 (Pages 12 – 13) and tie the mast into the wall being sure that the anchorage point and tie schedule meets the requirements in Section C5 (Page 17). Once the base is prepared and the mast is plumbed, MULE can be reinstalled.

If the mast length exceeds 15 ft more disassembly is required. Remove MULE from the top of the mast with either the Fork Tubes or Rigging points. In this case the mast stack needs to be split into sections of no longer than 20 ft; as the stack is split apart, the wall ties can be removed. Once the remaining mast is less than 15 ft the remaining mast can be left assembled on the Ground Base and moved via the built in fork pockets. Once the Ground Base has been relocated, follow the setup procedure in Sections C3.1- C3.3 (Pages 12 – 13) and tie the mast into the wall being sure that the anchorage point and tie schedule meets the requirements in Section C5 (Page 17). Once the base is prepared and the mast is plumbed, MULE can be reinstalled.
9 MULE Dismantling and Packing for Transport

When installation/dismantling or rigging requires the certified installer to exceed safe working heights allowable per OSHA or site specific regulations the use of approved fall protection is required.

When MULE is finished working on a site it can be packed into a convenient package for transport. This packaging is solely for convenience; see Section F on Page 31 for shipping requirements.

Remove Controller and place in Transport box.

Remove MULE from the top of the mast and place on ground. Move rotation lock pin into the locked position.

Remove mast sections from the Ground Base. To pack MULE for transport a 2.5’ and 5’ mast is recommended.

Attach the 2.5’ mast to one end of the Ground Base; install MULE on top of it.

Add the 5’ mast to the opposite side of the Ground Base, offset from the center (see diagram)

Install shipping support bracket that came with your unit to the 5’ mast. Tie arms down to support.

Rotate the jacks to the “stowed position”

The assembled package weighs approximately 2500 lb.

Transport any additional mast in desired fashion.
D SYSTEM SETUP ON MAST CLIMBING PLATFORM

1 Introduction
As Mast Climbing Work Platforms’ (MCWP) are so critical in construction, CR has made special mounting solutions to optimize the valuable deck space and decrease overall system weight.

At this time, CR has 2 different styles of dedicated MCWP mount. Refer to the documentation that came with your specific mount for details.

All MCWP mount styles support up to 21 lineal feet of reach (when utilizing a 2-board setup) and are capable of setting the unit back from the wall when working against a backer.

All of these mounts can be used with CR or HM mast sections.

For all mounts, MULE must be removed from the scaffold if the winds may exceed 45mph

![Warning: When utilizing the HM mast on the CR Ground Base, no climbing of the HM mast is allowed!]

2 Fixed Position Deck Mount

2.1 Overview
The Fixed Position Deck Mount allows MULE to be bolted to the deck in 1 specific location. Holes are drilled through the deck plate and the mount clamps to the platform structure.

Check with CR for the appropriate hardware set for your scaffold.

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple, space saving design</td>
<td>Limited adjustment of distance to the wall without drilling additional holes</td>
</tr>
<tr>
<td>Built-in Leveling</td>
<td>To have the optimal location on varying lengths of scaffold, many holes will have to be drilled.</td>
</tr>
<tr>
<td>Built-in Leveling</td>
<td>Installation requires access to the bottom of the scaffold</td>
</tr>
<tr>
<td>Built-in Leveling</td>
<td>Only fits in specific locations on the scaffold</td>
</tr>
</tbody>
</table>

2.2 Installation
A four hole pattern is drilled into the deck. The mount is then installed by clamping against the underside of the deck.

See the additional documentation that came with your mount on the exact installation and drilling procedure.

2.3 Leveling the Base
This mount has a leveling system built in. To adjust, loosen or tighten one of the nuts until the mast is plumb, then tighten the locking nut.

If MULE is not kept plumb some drifting of the arms and increased effort of moving material may be experienced.

2.4 Adding Masts and MULE
On this base, mast sections are added in the same way as a Ground Base. Total mast height is limited to 6’. Once the mast is installed MULE can be installed.

To maximize capacity on the scaffold, it is suggested to disassemble the Fork Tubes and leave it on the ground.

2.5 Moving MULE and Mount
The Fixed Position Deck Mount can be moved while attached to MULE. If using the rigging points; ensure that the mount, mast, mast adapters (if installed) and Fork Tubes (if installed) are under the 500lb limit.
3 Strap-over Deck Mount

3.1 Overview
The Strap-over deck mount allows for MULE to be mounted in nearly any position on the scaffold with no permanent modifications required.

Utilizing this mounting kit MULE can be installed quickly to the scaffold.

Check with CR for the appropriate hardware set for your scaffold.

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extremely flexible positioning, both along the wall and distance from it</td>
<td>Guarding must be adjusted during installation</td>
</tr>
<tr>
<td>No access to the bottom of the scaffold is required</td>
<td>Mount spans the entire deck width</td>
</tr>
<tr>
<td></td>
<td>Bracket hangs over front edge of deck</td>
</tr>
<tr>
<td></td>
<td>No Built-in Leveling</td>
</tr>
<tr>
<td></td>
<td>Medium Footprint</td>
</tr>
</tbody>
</table>

3.2 Installation
To install this mount the guarding must be adjusted. When doing this you must use the appropriate PPE and comply with all Local, State and Federal rules and regulations.

Guarding is loosened in the selected location and slightly lifted. The mount is then placed over the deck, slid under the guarding and clamped to the front and back of the scaffold. Guarding is then lowered to rest on the mount and tightened in place.

3.3 Leveling the Base
This base does not allow for MULE to be leveled. If the deck is not level some drifting of the arms and increased effort of moving material may be experienced.

3.4 Adding Masts and MULE
The Fork Tubes must be well supported on a level surface.

Remove MULE from the Fork Tubes using the rigging points. Add the mast adapter plate to the Fork Tubes and install the standard mast sections to it. Total mast height is limited to 6’. Add MULE on the top.

In winds exceeding 30 mph this assembly will not sit on its own and must be dismantled or strapped down using the Fork Tubes.

3.5 Moving MULE and Mount
The Strap-over Deck Mount can be moved while attached to MULE using the Fork Tubes or the rigging points. If using the rigging points; ensure that the mount, mast and mast adapters (if installed) are under the 500lb limit.

During the move, MULE may not sit or operate without being supported by a Fork Truck or appropriate lifting device.
4 On Existing Hydro Mobile Mast Tower

In some cases it may be desired to mount MULE directly to a HM mast that is also supporting the scaffold deck. Hydro Mobile has approved this special use of their product when being used with MULE.

When using either the M or P-Series units MULE can be attached directly to the top of the mast that is supporting the scaffold. The only additional requirement for use is that MULE may not be any further above the top tie than the approved maximum overhang.

MULE must always be removed from the mast prior to the scaffold being moved to a different location (horizontal moves) and when scaffold operational wind limits are reached.

For efficient use of MULE, a wall tie should not be installed between the scaffold deck and MULE.
SECTION E – SYSTEM OPERATION

1 Controller Buttons

1.1 RUN STOP
The RUN STOP button disables all functionality on the Controller and Actuator. When pressed the screen will show “E-STOP ENGAGED”

1.2 Manual/Calibrate Up/Down
Typically used as the calibration for the load weight in RUN MODE FLOAT.
This is also the method to directly drive the Wire Rope Up or Down at a variable speed (the further the button is depressed the faster it moves).

1.3 Speed
The SPEED button changes MULE between fast and slow speed in speed dependent modes. For typical operation this button only changes the speed at which the load is placed (after the GRIP button is pressed but before the Gripper releases). This button also changes the speed at which the MANUAL/Calibrate UP/DOWN buttons function. Fast and slow speeds are configurable within the Controller menu (See Section G4 on page 34 for details).

1.4 Float
The FLOAT button turns on Float Mode, which makes the load feel weightless. In typical operation the FLOAT button will always be pressed in. The main reason to release this button is to get into the Controller menu.
The blue light below the screen is typically illuminated when FLOAT is enabled.

1.5 Auto Retract
The AUTO RETRACT button turns on Auto Retract, which raises the Controller/Gripper after the load is placed. In typical operation the AUTO RETRACT button will always be pressed in, unless you want the Controller/Gripper to stay in position once the load is released.
The Auto Retract function will only work when a load is placed (through the GRIP button) while in Float Mode. The Controller/Gripper will never retract to a point lower than the release height.
If the Controller is grabbed or snagged while retracting, it will stop.

1.6 Retract Height
The RETRACT HEIGHT button sets the current height of the Controller to the height that the Auto Retract function will move the Controller to. The Auto Retract function will not lower the Controller if the retract height is set below where the load was placed.
To set the height, move the Controller to the desired height and press the RETRACT HEIGHT button once.

2 External Buttons - Gripper and Handle
Depending on the configuration of your unit, you may have 1 or 2 buttons on your handle and possibly 2 buttons on the gripper. Buttons on the gripper and handles are labeled with their function.

2.1 Grip
The GRIP button engages and disengages the clamping mechanism on the Gripper. When the GRIP button is pressed for the 1st time the clamping mechanism will close on the load. The function of the GRIP button past that depends on what “mode” MULE is running in.
If the controller screen shows “RUN MODE FLOAT” (typical operation) then pressing GRIP while loaded will begin the Place Sequence, where the load is slowly lowered at a constant speed until MULE is no longer carrying the weight. At this point the clamping mechanism will disengage. If GRIP is pressed again before unclamping, the place sequence is canceled and the load will go back to feeling weightless.
If the controller screen shows “LIFT READY” (manual operation) then GRIP will disengage the clamping mechanism if MULE is not carrying the weight of a load. When in this mode, the Wire Rope will not move to release the weight from MULE.
2.2 Set

The **SET** button changes the load from feeling weightless to having some weight when the Controller screen shows “RUN MODE FLOAT”. Pressing **SET** again changes the load back to feeling weightless.

When placing a load on a soft material (ie setting a block in a mortar bed) this feature is very advantageous.

The Set weight (Negative Tare within menu) is configurable within the Controller Menu (See Section G4.3 on page 34 for details).

3 Typical Use Cycle

- Ensure the screen shows “RUN MODE FLOAT”, if not press in the **FLOAT** button on the Controller and wait for the Blue light below the screen to appear.
- Gripper is placed over the load and the **GRIP** button is pressed to engage the clamps.
- If the load does not act weightless, use the **MANUAL/CALIBRATE UP** button to lift the load several inches. Remove hands.
- Once the blue light appears under the Controller screen, the load will act weightless. Move by manipulating the load or Controller Handle.
- When the load is nearly in position, press the **SET** button. The load will now have some weight and will go down if not supported.
- Set the load in the final position and press the **GRIP** button once, the load will slowly lower and release when the load is being supported.
- If the **AUTO RETRACT** button is pressed in, the Controller will retract to the preset Retract Height.
- Repeat steps. The **MANUAL/CALIBRATE** buttons should not be needed unless the weight of the load changes (higher or lower).

3.1 Common User Errors

**The gripper will not release the load**

Typically this is caused by pressing the **GRIP** button multiple times.

When in RUN MODE FLOAT, once the **GRIP** button is pressed MULE will slowly lower the load until it senses that it is no longer holding it, this causes a delay between the button press and load release. If the grip button is pressed again before the release, the release operation is canceled.

To solve this, be sure to only hit the **GRIP** button once.

**The gripper will not retract although the **AUTO RETRACT** button is pressed**

This is typically caused by one of two conditions:

The gripper binding on the load or being held after placing.

The retract height is set below the place height

When in RUN MODE FLOAT with **AUTO RETRACT** pressed, once the load is placed the gripper will try to move up to the programmed Retract Height.

If the gripper is held by the load, operator or other obstruction, MULE will stop the retract sequence.

If the gripper is attempting to retract to a position that is lower than place height, retract is disabled.

To solve this be sure that the gripper is free from obstructions (including hands) and that the retract height is set above the place height.

**The loaded gripper “stutters” when the **SET** button is pressed**

Typically this is caused by pressing the **SET** button multiple times.

When in RUN MODE FLOAT, once the **SET** button is pressed MULE will give the load some weight (adjustable in the menu, see Section G4 on page 34) and the load will begin to go down if not supported.

If the **SET** button is pressed multiple times the gripper will slightly lower then stop moving.

To solve this be sure to only press the **SET** button 1 time.
4 Primary Arm Rotation Lock

The Primary Arm is equipped with a locking mechanism to prevent the arm from swinging when MULE is not powered. The lock is driven by the pneumatic system and can be manually operated if desired. Sometimes it is necessary to rotate the arm while not powered. Lift up on the attached handle and the lock will be disengaged, if it will not move check that the locking pin is not installed. Once the handle is released the lock will extend and lock in at the next available slot.

When MULE is transported between sites, this lock should be pinned so that it cannot release accidentally. After the power has been removed, move the cross pin into the lower hole. After doing this the rotation lock cannot be released until the pin is moved.

![Locked for Transport](image)

![Unlocked for Operation](image)
F TRANSPORT AND STORAGE

1 Shipping Position
MULE can be shipped attached only to the Fork Tubes or assembled with masts and the Ground Base as it was initially received. In either case, it is important to support both of the arms in both the up and down directions.

Ensure that the Primary Arm rotation lock is engaged and that the lock pin is preventing the lock from releasing (See Section E4 on page 30). Pull up on the release handle to verify.

1.1 Tie Down Locations
MULE should only be tied down using the specified locations. Any other locations may cause permanent damage to MULE.

1.2 Orientation on Open Trailer
When possible, the Powerpack should always be at the front of MULE when moved on an open trailer.

When that is not possible, additional steps should be taken to prevent contamination of the actuator by road debris. In this case, wrap the Primary-Secondary Arm joint with a tarp or similar.

2 Controller Transport
After the controller has been removed from MULE, it should be stored and transported within the provided case. CR recommends storing the Controller above 40° for optimal operation.

This case also provides storage for additional mast hardware, wrenches, Wire Rope lubricant and this manual.
G SETTINGS AND TROUBLESHOOTING

1 Key Access Areas

2 Friction Brake Adjustment

The friction brakes control how fast the arms move and how quickly they start and stop. Looser friction brakes allow the arm to move easier but also allow for more unintended movement. Tight friction brakes take more effort to move but will not drift away as easy.

2.1 Primary Arm

Tools:
- 4mm Allen key
- ½” drive socket extension at least 6” long
- ½” drive ratchet or breaker bar

The Primary Arm friction brake is located at the top of the Rotation Mast. To access it, the Arm Access Panel must be removed using the 4mm Allen key.
With the panel removed, a hole near the rigging eye is exposed. Insert the extension into the silver piece below and attach the breaker bar or ratchet.

Little adjustment is needed to change the feel of the arm, adjust the nut no more than 1/8 of a turn at a time.

Do not loosen or tighten more than 1 turn from factory delivered setting.

Once the adjustment has been completed reinstall the Arm Access Panel.

2.2 Secondary Arm

Tools:
- 3mm Allen key
- 10mm open end wrench

The Secondary Arm friction brake is located at the bottom of the Primary-Secondary Arm joint.

To adjust hold one of the screws with the Allen key and loosen the locking nut. Tighten or loosen the screw as needed, the adjustment is very sensitive and will only require a small turn (less than 1/8th of a turn at a time). Both screws should be adjusted evenly.

When the brake is adjusted as desired, hold the screw stationary and tighten the locknut with the 10mm wrench.
3 Virtual Limits
If work is being performed repeatedly in the same height range, limits can be set to prevent the Controller from travelling up or down further than intended.

To set and adjust Virtual Limits see the Controller Menu section (G4 on page 34).

4 Controller Menu
The current software version is V1.00, for any other versions refer to information specific for that version.

The two button menu provides the ability to change user, application and system specific settings. Through this menu some troubleshooting information is also available.

4.1 Virtual Limits (V-limits)
Software limits that prevent the controller from leaving a certain range, this can be useful if work is always at the same height.

To set, drive the Controller to the position of the desired limit, then navigate in the menu to the limit and select. The screen will flash and return to “LIFT READY” when the sequence is complete.

4.2 Switch Speed Menu
Allows for changing the speeds that control Auto-Retract, RUN MODE PENDANT and placing a load. By default slow is set to 30% and fast to 50%. Auto-Retract will always run at the fast speed.

4.3 Negative Tare Menu (SET Weight)
Allows for the adjustment of the “SET” weight. The SET weight can be adjusted in 2 lb increments from 2-30lb.

4.4 Anti-Drop Tool Weight
Teaches the weight of the unloaded tool. To set, navigate the menu (within SETTINGS MENU 2) and remove hands from the Controller. The screen will flash “RECORD DATA” and then return to “LIFT READY” when the sequence is complete.

4.5 Diagnostics
STANDARD DIAGNOSE and I/O BLK 1 DIAGNOSE within the SERVICE MENU allow for checking what signals MULE is receiving if there are issues.

STANDARD DIAGNOSE shows the state of I/O inside the actuator and the MANUAL CALIBRATE buttons. If there are issues related to travel limits, slack or some Controller buttons, this is the best way to understand what is going on.

I/O BLK 1 DIAGNOSE shows the state of the main Controller functions. This includes the 4 silver button on the front, 2 buttons on the handle and the grip/ungrip signal. The diagram in Section G6.2 (Page 40) shows which I/O point each function is.
4.6 Software Flowchart

PROGRAM MODE

UNLOAD WEIGHT

Press & Hold Left Button Right Button
Click

Sets weight allowed to release load

V-LIMITS MENU

UPPER V-LIMIT

Sets a upper limit to stop travel

LOWER V-LIMIT

Sets a lower limit to stop travel

LOWER SLOW DN

Does not apply

UPPER SLOW DN

Does not apply

UPPER RESUME

Does not apply

V-LIMIT RESET

Deletes all V-limits

SET AUTO HOME POS

Same function as RETRACT HEIGHT button on face plate

SWITCH SPD MENU

SET FAST SPEED

Left button to select 10%-100%

SET SLOW SPEED

Left button to select 10%-100%

RESPONSE MENU

Does not apply

TO NEXT PAGE NEGATIVE TARE
FROM LAST PAGE RESPONSE MENU

NEGATIVE TARE

Hit left button to cycle, dwell to set 2lb-30lb

SETTINGS MENU

Does not apply

SETTINGS MENU 2

Antidrop Tool Wt (dwell to set and remove hands)

LED MENU

Does not apply

SERVICE MENU

SRV MENU UP CYCLE

Does not apply

SRV MENU LOW CYCLE

Does not apply

DISPLAYS SYS INFO

Does not apply

CLEAR COUNT

Does not apply

CLEAR RUN TIME

Does not apply

SRV WARN OFF

Does not apply

TO NEXT PAGE SERVICE MENU

TO NEXT PAGE SRV WARN 500
Definitions:
Unload Weight – Maximum load weight on wire rope allowed to release load
V-limits – Software limits to prevent travel outside desired range
Anti-Drop Tool Wt – Weight in the software of the unloaded Gripper/Controller, if the gripper must remain perfectly stationary in a certain area this should be set in this area
5 Pneumatic System

5.1 Air Compressor
MULE contains an integrated Air Compressor to power the gripper and rotation lock. This compressor’s integrated regulator is set to 80 psi.

5.2 Pneumatic Connection Diagram
6 Electrical Information

6.1 Transformer Adjustments

MULE requires a specific voltage range in order to function. In the event that your voltage supply does not match the listed requirements, there is an adjustable transformer on board to compensate for this.

If the Powerpack Service Panel is removed, you will notice a digital readout on the electrical enclosure. For MULE to operate properly this number needs to read between 220 and 242 at all times. Based on your specific power supply scenario the voltage may decrease when additional load is quickly added by MULE (such as when the Air Compressor starts) or external sources.

If voltage errors are being encountered (See Section G9.2 on page 43), adjust the switch on the right of the display.

Unplug MULE prior to adjusting the switch

From the factory, this switch is set in the 2 position. By turning the switch counter-clockwise the number on the readout will lower, when turning clockwise the number will rise. Each step of the switch will change the display up or down by approximately 12V. When adjusting the switch it is best to get the readout as close to 240V as possible, as this will provide the most constant power.
6.2 Electrical Connection Diagram

**Power**

![Electrical Connection Diagram for Power]

**Control**

![Electrical Connection Diagram for Control]

**MULE I/O PINOUT**

<table>
<thead>
<tr>
<th>BUTTON</th>
<th>I/O POINT</th>
</tr>
</thead>
<tbody>
<tr>
<td>RETRACT ENABLE</td>
<td>INPUT-1</td>
</tr>
<tr>
<td>GRIP</td>
<td>INPUT-2</td>
</tr>
<tr>
<td>RETRACT SET</td>
<td>INPUT-3</td>
</tr>
<tr>
<td>FLOAT</td>
<td>INPUT-4</td>
</tr>
<tr>
<td>SET</td>
<td>INPUT-5</td>
</tr>
<tr>
<td>SPEED</td>
<td>INPUT-6</td>
</tr>
<tr>
<td>CLOSE GRIPPER</td>
<td>OUTPUT-7</td>
</tr>
<tr>
<td>OPEN GRIPPER</td>
<td>OUTPUT-8</td>
</tr>
</tbody>
</table>
7 Primary Arm Rotation Lock
The Primary Arm Rotation Lock should be disengaged when MULE is powered on. If it fails to release, several typical settings should be checked.

Check that the handle can release the lock. If it does not release, the lock pin is likely still engaged from transport.

On the bottom of the Powerpack near the fan, there is a Red light that is illuminated when the lock should be released. If this light is not on, flip the toggle switch to the opposite position.

If the lock is still engaged there is no air power to release the lock. Check the Pneumatic system.

8 Additional Features

8.1 Air Hose Quick Connect
The bottom of the Powerpack has an air quick-disconnect fitting to allow for external equipment to utilize the built in air compressor. This connection is especially useful for an air blower when servicing the Powerpack; it will not provide sufficient air to run air tools (impact etc.)

8.2 Cord Reel (If Equipped)
If your MULE has the optional cord reel, it operates the same way as a standard cord reel. When pulling out the cord, the unit will click in a sequence of 4 clicks. After the 1st 3 clicks the reel will lock in place if released. If the cord is released between the groups of clicks, the cord will retract. To retract the cord after use, pull on the cord when it is between the group of clicks and release.
9 Troubleshooting

## 9.1 Common Issues

<table>
<thead>
<tr>
<th>Failure</th>
<th>Possible Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Controller screen shows “EXCESSIVE PAUSE”</td>
<td>• Briefly press one of the MANUAL CALIBRATE buttons until the Controller moves</td>
</tr>
<tr>
<td>Primary arm rotation lock will not disengage</td>
<td>• Ensure MULE is plugged in</td>
</tr>
<tr>
<td></td>
<td>• Ensure the red light on the bottom of the Powerpack is lit, otherwise flip the toggle switch near the light</td>
</tr>
<tr>
<td></td>
<td>• Unplug MULE and attempt to manually disengage with handle (Check for lock pin)</td>
</tr>
<tr>
<td></td>
<td>• Check for a major air leak</td>
</tr>
<tr>
<td></td>
<td>• Contact Dealer</td>
</tr>
<tr>
<td>Controller Screen is Dark</td>
<td>• Ensure that MULE is plugged in</td>
</tr>
<tr>
<td></td>
<td>• Check that the black data cord is plugged into the top of the Controller</td>
</tr>
<tr>
<td></td>
<td>• See if the Primary Arm rotation lock is disengaged</td>
</tr>
<tr>
<td></td>
<td>• Check all data connectors in Powerpack and Arm (see Section G6.2 on page 40)</td>
</tr>
<tr>
<td>Controller Screen shows ###########</td>
<td>• Cycle power</td>
</tr>
<tr>
<td></td>
<td>• Check that the black data connector is fully connected to the Controller</td>
</tr>
<tr>
<td></td>
<td>• Check all data connectors in Powerpack and Arm (see Section G6.2 on page 40)</td>
</tr>
<tr>
<td>Controller/Gripper drifts up or down when loaded</td>
<td>• Briefly press one of the MANUAL CALIBRATE buttons until the Controller moves, wait until the Blue light below the screen returns to touch the Controller or Load</td>
</tr>
<tr>
<td>Controller/Gripper drifts up or down when unloaded</td>
<td>• Controller &amp; Gripper weight in software does not match physical weight, Teach new Anti-Drop tool weight (Section G4.4 on page 34)</td>
</tr>
<tr>
<td>Controller not entering Float Mode</td>
<td>• Check that the FLOAT button is pressed in</td>
</tr>
<tr>
<td></td>
<td>• Power Cycle MULE</td>
</tr>
<tr>
<td></td>
<td>• Teach a new Anti-Drop Tool Weight (Section G4.4 on page 34)</td>
</tr>
<tr>
<td></td>
<td>• Check the I/O block is seeing input (Section G4 on page 34)</td>
</tr>
<tr>
<td></td>
<td>• Contact Dealer</td>
</tr>
<tr>
<td>Controller doesn’t retract after place</td>
<td>• Check that the AUTO-RETRACT button is pressed in</td>
</tr>
<tr>
<td></td>
<td>• Teach a new Retract Height by pressing the RETRACT HEIGHT button at the desired height</td>
</tr>
<tr>
<td></td>
<td>• Power Cycle MULE</td>
</tr>
<tr>
<td></td>
<td>• Check the I/O block is seeing input (Section G4 on page 34)</td>
</tr>
<tr>
<td></td>
<td>• Teach a new Anti-Drop Tool Weight (Section G4.4 on page 34)</td>
</tr>
<tr>
<td></td>
<td>• Contact Dealer</td>
</tr>
<tr>
<td>Controller moves unusually fast/slow in manual mode</td>
<td>• Check if the SPEED button is pressed in (out is fast)</td>
</tr>
<tr>
<td></td>
<td>• Adjust speeds in the Controller menu (Section G4.2 on page 34)</td>
</tr>
<tr>
<td>The SPEED button does not change anything</td>
<td>• Check that the software speeds are set to different values</td>
</tr>
<tr>
<td></td>
<td>• Check the I/O block is seeing input (Section G4 on page 34)</td>
</tr>
<tr>
<td>Fuse repeatedly blows in Actuator</td>
<td>• Check all wiring for damage and tight connections</td>
</tr>
<tr>
<td></td>
<td>• Contact Dealer</td>
</tr>
<tr>
<td>Grip button doesn’t work</td>
<td>• Power Cycle MULE</td>
</tr>
<tr>
<td></td>
<td>• Check that air is connected to the Controller</td>
</tr>
<tr>
<td></td>
<td>• Check that the rotation lock is released</td>
</tr>
<tr>
<td></td>
<td>• Make sure external buttons are plugged into the bottom of the Controller</td>
</tr>
<tr>
<td></td>
<td>• Check the I/O block is seeing input (Section G4 on page 34)</td>
</tr>
<tr>
<td></td>
<td>• Teach a new Anti-Drop Tool Weight (Section G4.4 on page 34)</td>
</tr>
<tr>
<td></td>
<td>• Contact Dealer</td>
</tr>
<tr>
<td>Set button doesn’t work</td>
<td>• Ensure the screen says “RUN MODE FLOAT”</td>
</tr>
<tr>
<td></td>
<td>• Make sure external buttons are plugged into the bottom of the Controller</td>
</tr>
<tr>
<td></td>
<td>• Check that “Negative Tare” value in menu is set high enough to be noticed</td>
</tr>
<tr>
<td></td>
<td>• Check the I/O block is seeing input (Section G4 on page 34)</td>
</tr>
<tr>
<td>Only 1 cam moves</td>
<td>• Unplug air from Controller, check for mechanical binding</td>
</tr>
<tr>
<td></td>
<td>• Listen for air leaks</td>
</tr>
<tr>
<td>Air is leaking from the Controller/the buttons are whistling</td>
<td>• Unplug air from Controller</td>
</tr>
<tr>
<td></td>
<td>• Send Controller to CR for servicing</td>
</tr>
<tr>
<td>Error appears on screen</td>
<td>• See section G9.2 (Page 43)</td>
</tr>
</tbody>
</table>
### 9.2 Error Codes

In case of certain actuator and other electrical errors, a message will be displayed on the Controller Screen.

There are 3 different types of messages that will display based on the error; Drive Fault, Command Fault and Command Warning

**Drive Fault:** Faults detected in the motor controller that result in an Actuator Shutdown. The Controller Screen will display “DRIVE FAULT” with the appropriate error code.

**Command Fault:** Faults detected by the electronics while executing a command that results in a system shutdown. The Controller Screen will display “COMMAND FAULT” with the appropriate error code.

**Command Warning:** A condition sensed by the electronics that will allow the system to continue to operate. These warnings are cleared through the Controller Menu Structure. The Controller Screen will display “COMMAND WARNING” with the appropriate error code.

#### 9.2(a) Common Error Codes

- **Drive Fault**
  - 4005 – Drive in Error State
    - Look to other messages for more information
  - 7211-7219 – Supply voltage not in range
    - Ensure that any extension cord used is within requirements (See Section C2.3 on Page 11)
    - Adjust Transformer Switch (See Section G6.1 on page 39)
- **Command Fault**
  - 501 – 2 travel or slack switches engaged during power-up
    - Check that there is tension on the Wire Rope, cycle power
  - 11000 – 2 travel or slack switches engaged after power-up
    - Check that there is tension on the Wire Rope, cycle RUN STOP
- **Command Warning**
  - 10500 – PLC Battery Error
    - The battery in the PLC needs to be replaced, contact your Dealer. If this warning is ignored for too long, MULE will lose all functionality

### 10 Shut Down

To shut down MULE, no special procedure is required. Rotate the Primary Arm to the desired position and tie off the controller as desired. Unplug MULE.

If a generator is being used to power MULE, CR suggests that MULE be unplugged prior to turning off the generator to avoid potential issues.
H PREVENTATIVE MAINTENANCE AND BASIC SERVICE

1 Maintenance Summary

1.1 Daily
- Pre-shift inspection on Wire Rope
- Pre-shift inspection on MULE Power Cord
- Drain Air Compressor Tanks
- Inspect for structural damage and loose parts

1.2 Weekly
- Clean the fan filter on the bottom of the Powerpack, replace as needed
- Inspect Coil Cords for wear or damage
- Inspect MULE structure for damage

1.3 Monthly
- Documented Wire Rope inspection
- Documented Power Cord inspection
- Wire Rope lubrication
- Test Wire Rope slack detection system
- Inspect rollers on the base of the hoist arm and the joint between the Primary and Secondary Arms
- Check Inclinometer calibration
- Clean Air Compressor Air Filter

2 Wire Rope

2.1 Inspection
Much like Forklifts, OSHA requires that machines using Wire Rope must be frequently inspected.

2.1(a) Each Shift
At the beginning of each shift, a trained employee must visually inspect the Wire Rope prior to the machine being used. This visual inspection is designed to identify gross damage such as:

- Kinking
- Crushing
- Unstranding
- Birdcaging
- Large contaminates or broken wires
- Significant Corrosion
- Electrical Arc Damage
- Heat Damage

2.1(b) Monthly
Each month a documented inspection must be performed that covers the same items as the Pre-Shift inspection but is much more thorough. The conclusion of this inspection is an ideal time to re-lubricate the Wire Rope as explained in Section H2.2 (Page 45).

This inspection should cover the entire length of the Wire Rope which will require the Arm Access Panel to be removed and MULE to be located such that the Wire Rope can travel the full 11’.

If any broken wires in the Wire Rope are found during the inspection, CR suggests that the MULE should be scheduled for Wire Rope replacement.

When the inspection has been completed, the Wire Rope shall be lubricated immediately.
2.2 Lubrication
MULE’s Wire Rope comes pre-lubricated from the Factory. As MULE is used and the Wire Rope flexes, the lubricant will need to be replenished.

CR recommends that the Wire Rope is lubricated with Prelube 6 which is available through CR. OSHA prohibits the use of any Wire Rope lubricants that hinder inspection.

To lubricate the Wire Rope, the following items are needed:

- 2 people
- 1 can of Prelube 6
- A clean rag
- 4mm Allen key
- MULE positioned so that the Wire Rope can travel the full 11’ feet
- Personnel access to the top of the mast and the ability to reach the controller along the full 11’ of range

Clear any Virtual Limits that have been set (see Section G3 on page 34)

Remove the Arm Access Panel

Move the controller up until it stops on its own

While moving the controller down at a smooth and steady speed, spray the Wire Rope with Prelube 6 as it travels through the Arm Access Panel opening. Use a rag to catch any overspray.

Once the controller is all the way down move to the end of Secondary Arm where the Wire Rope turns down to the Controller. Repeat the lubrication as the Controller travels up.

2.3 Required Replacement Criteria
CR recommends that Wire Ropes be scheduled for replacement as soon as any broken strands are found.

Removal criteria for the rope replacement shall be as follows, see Figure H-1 for Wire Rope terminology:

- 6 randomly distributed broken wires in one lay or 3 broken wires in one strand in one lay (1-3/4” of Wire Rope), (OSHA 1926.1413)
- one outer wire broken at the contact point with the core of the rope, which has worked its way out of the rope structure and protrudes or loops out from the rope structure
- wear of one-third the original diameter of outside individual wires
- kinking, crushing, birdcaging, or any other damage resulting in distortion of the rope structure
- evidence of heat damage from any cause
- reductions from nominal diameter greater than 1/64” (.4 mm) for 3/16” (4.76 mm) diameter rope.

2.4 Slack Detection
The slack detection system prevents damage to the Wire Rope and actuator when the load is placed.

2.4(a) Testing
Ensure MULE is powered on

Ensure the FLOAT button on the Controller is released and the screen shows “LIFT READY”

Using the MANUAL/CALIBRATE DN button on the Controller, lower the Controller on to the table so that it is fully supported and detach the Wire Rope so it hangs freely Figure H-2
Feed the Wire Rope through the coil cord so that the Wire Rope has a direct path to the ground. 
Attach a 10 lb load to the Wire Rope directly. Using the MANUAL/CALIBRATE DN button attempt to move the load down, if the load does not move the slack spring is too tight and must be adjusted (see If 10 pound weight was unable to drive down) Figure H-3

Attach a 5 lb load to the Wire Rope directly. Using the MANUAL/CALIBRATE DN button attempt to move the load down, if the load does move the slack spring is too loose and must be adjusted (see If 5 pound weight was able to drive down (most common)) Figure H4

Figure H-2
Place Controller on a table keeping electrical and air connected. Attach weight directly to wire rope

Figure H-3
10 pounds should be able to lower using manual button

Figure H-4
5 pounds should not be able to lower using manual button

2.4(b) Adjustment
Unplug MULE
Remove the air compressor side panel
Remove the actuator cover above the air compressor Figure H-5

If 5 pound weight was able to drive down (most common)
Loosen the eye bolt nut on the top side of the bracket. Holding the eye bolt from turning, tighten the nut on the bottom of the bracket ½ turn.

Power MULE on and redo the slack test
Repeat tightening until the slack test is performed and the 5 pound weight cannot be driven down
When complete, tighten the top eye bolt nut down onto the bracket and reassemble

If 10 pound weight was unable to drive down
Loosen the eye bolt nut on the bottom side of the bracket. Holding the eye bolt from turning, tighten the nut on the top of the bracket ½ turn.

Power MULE on and redo the slack test
Repeat loosening until the 10 pound weight is able to be driven down
When complete, tighten the bottom eye bolt nut down onto the bracket and reassemble
2.5 Replacement

Warning: Wire Rope replacement is to be performed by qualified maintenance personnel only.

Tools:
- Table or similar flat surface
- 3mm Allen key
- 4mm Allen key
- 5mm Allen key
- 6mm Allen key
- 7mm wrench
- 8mm wrench
- 17mm wrench
- Long screwdriver or Allen key

Removing Existing Wire Rope
Ensure MULE is powered on
Ensure the FLOAT button on the Controller is released and the screen shows “LIFT READY”
Using the manual buttons on the Controller, lower the Controller on to the table so that it is fully supported
Reset any virtual limits; see section G4 (Page 34)
Disconnect the Wire Rope from the Controller (Leave the air and data coil cords attached)
Remove the Arm Access Panel

With your right hand keep tension on the Wire Rope through the Arm Access Panel (use a rag to avoid injuring your hand) while pressing the down jog button (beside programing port) with your left hand. Continue until Wire Rope will not go down any more.

Fully press in the spring loaded screw, hold in position. Apply tension to the Wire Rope with your right hand and jog down until rotation stops.

Unplug the limit switch assembly from the circuit board

Using the 4mm Allen key, remove the 4 bolts fastening the circuit board bracket to the actuator, carefully tilt the bracket down once loose.

Remove the Powerpack Service Panel (has knobs not screws)

Remove the blue cover from the Actuator; there are 4 bolts, 2 on top and 2 on bottom. Take extreme care to avoid the circuit board during the remainder of the replacement process.
Using the 5mm Allen key, remove 2 bolts from plastic drum cover, slide cover out.

Using the 3mm Allen key, remove 2 bolts from the rope retainer. Slide retainer off the Wire Rope.

Push rope with Right Hand into the drum to unseat the stop sleeve. The rope should now be free of the actuator.

Remove the Secondary Arm cover (including attached joint cover), removing the 2-19mm bolts will allow this assembly to slide out.

Using the 6mm Allen key, remove the bolts holding the pulleys at the arm joint, these bolts need to be removed evenly. Slide the one of the pulleys over so that the stop sleeve of the Wire Rope will pass through the gap.
Installing New Wire Rope

Take care to keep new rope clean and orderly during installation. Avoid twisting or kinking Wire Rope.

Slide the stop sleeve end of the Wire Rope through the arm to the actuator.

Bend the Wire Rope approximately 3" from the stop sleeve end; try to kink rope to make a bend radius.

Insert the stop sleeve into the slot in the drum; pull on the rope to seat fully.

Using the 3mm Allen key, reinstall the rope retainer, tightening until the lock washers are fully compressed.

Ensure that the rope is seated in the drum slot and bolt the plastic retainer back in place, tightening until the lock washers are fully compressed.

Reattach the circuit board bracket, tightening the bolts until the lock washers are fully compressed.

Reattach the limit switch connector.

Reassemble both pulleys and make sure Wire Rope is going through the center of the coil cords; the Wire Rope should be fully routed at this point.

Using a clean rag, pull on the Wire Rope through the Arm Access Panel and use the jog buttons to move up.

Reattach the controller and check that it moves as expected to upper limit.

Reinstall the actuator cover, Arm Access Panel and Powerpack Service Panel.
3 Pneumatic System
Any service to the air system should be performed with the compressor drained and the valve locked in the open position to prevent accidental pressurization.

3.1 Air Compressor
To drain the air compressor, unplug MULE and open the ball valve at the bottom of the Powerpack.

3.1(a) Filter
The compressor filter should be cleaned monthly to increase longevity and performance.

To access the filter, remove the Air Compressor side panel (same access area as slack spring adjustment).

At the top left of the air compressor there is a black canister that houses the filter, rotate counterclockwise to open.

The filter should be shaken out and blown out with compressed air from the air compressor side. If any holes are found the filter should be replaced.

3.2 Water Separator
The water separator installed within the Powerpack automatically drains. If the drain needs to be manually activated for any reason fully open the fitting at the bottom of the unit. When draining is complete, tighten the fitting fully and loosen 1 full turn. If the drain is left open air will continually bleed from the water separator.

Every 2 years the separator element should be replaced.

4 Structural Inspection
As part of each weekly inspection, the entire structure must be inspected for damage. If any damage is found, the damaged piece must be removed from operation immediately.

Consult with CR Engineering on all damaged components and repairs prior to returning the component to operation.

5 Power Cord

5.1 Daily Inspection
During the daily inspection the power cord must be checked for the following issues (OSHA 1926.404):

- Deformed or missing pins on plug.
- Insulation Damage.
- Indications of possible internal damage.

5.2 Monthly Inspection
During the monthly inspection the power cord must be checked for the following issues (OSHA 1926.404):

- Deformed or missing pins on plug.
- Insulation Damage.
- Indications of possible internal damage.
- Ground conductor is tested for continuity between both ends.

This inspection must be documented.
6 Rollers on Arm

2 sets of rollers should be inspected to ensure that they are still functional. If any structural damage or flat spotting is observed the rollers should be replaced.

6.1 Primary Arm Rollers
The primary arm has 2 rollers near the rotation lock. Ensure that these rollers are both present and not flat. Also ensure that the spring loaded band connecting the 2 rollers on the back side of the rotation mast is intact.

6.2 Secondary Arm Roller
The Secondary Arm has 1 roller (also used as the Friction Brake) at the joint with the Primary Arm. Ensure that this roller is present and not flat.

7 Fan Filter
To access the fan filter, unplug MULE and slide the filter out of the housing (towards the arrow). Keep track of which side of the filter is facing the fan.

Once the filter is free use compressed air (from the fan side of the filter) to blow the contaminates out.

If the filter has become plugged with contaminates or physically damaged the filter should be replaced.

Reinstall the filter in the same orientation as it was removed.

8 Inclinometers
Inclinometers have been installed to provide a visual indicator of how plumb MULE is. Calibration should be checked as part of the monthly inspection.

To check calibration, plumb the rotation mast in both directions using a 2’ level (it is important not to do this on the mast stack itself)

When the rotation mast is plumb, check each inclinometer for accuracy. CR does not suggest making an adjustment unless the measurement is more than ½° off of 0.

To adjust loosen both mounting bolts slightly and slide into position. Once in position tighten both mounting bolts
### Part Weight (lb)

<table>
<thead>
<tr>
<th>Part</th>
<th>Weight (lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MULE 135 (weight w/out fork tubes)</td>
<td>870</td>
</tr>
<tr>
<td>Fork Tubes</td>
<td>290</td>
</tr>
<tr>
<td>5' Mast</td>
<td>200</td>
</tr>
<tr>
<td>2 1/2' Mast</td>
<td>145</td>
</tr>
<tr>
<td>Ground Base</td>
<td>950</td>
</tr>
</tbody>
</table>

**Total Weight as Shown** | **2455**