



COMPACT ELEVATION SYSTEM

Operating Instructions



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Original Instructions



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1 Safety Summary

This section describes safety instructions for the Compact Elevation System that personnel must understand and apply throughout all product activities such as transportation, handling, installation, operation, maintenance, storage, disposal and troubleshooting. Read and understand this entire document, and contact The Will-Burt Company with any questions, before performing any procedure outlined in this document. Keep this document during the entire duration of use of the device. Pass this document along to trained and qualified end users.

1.1 Signal Word Definitions

The following signal words and definitions are used to indicate hazardous situations:

DANGER

DANGER indicates an imminently hazardous situation that, if not avoided, will result in death or serious injury.

WARNING

WARNING indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury.

CAUTION

CAUTION indicates a potentially hazardous situation that, if not avoided, may result in minor or moderate injury or equipment damage. It is also used to alert against unsafe practices.

1.2 Safety Instructions

DANGER

Electrocution Hazard! Contact with high voltage will result in death or serious injury. Observe general safety precautions for handling equipment using high voltage. Do not locate or operate tilt system near electrical lines, cables or other unwanted sources of electricity. Allow sufficient clearance on all sides of mast to allow for side sway. Do not operate tilt system during an electrical storm. Be certain electrical cables are undamaged and properly terminated. Do not touch live wires. Follow OSHA or other national safety regulations when working near energized power lines. Personnel working with or near high voltages should be familiar with methods of resuscitation.

DANGER

Disconnect Power for Service! Always disconnect all power sources following proper lock-out tag-out procedures before performing service, repair or test operations. Remove the tethered hand held control where applicable for added protection during maintenance.

DANGER

Tip Over Hazard! Mast and tilt system tip over could result in death or serious injury. Before operation, be certain mounting structure is capable of resisting forces generated from all loading

and environmental conditions, including, but not limited to, tilt system size and weight, mast size and weight, payload and cable size and weight, payload sail area, wind speed, guy line arrangement, support bracket or roof line location, and base plate assembly. Do not operate in wind speed conditions exceeding the maximum rated wind speed. Do not operate on slopes exceeding the maximum deployment angle. Do not install a payload that exceeds the maximum payload lifting capacity of mast. Do not install a payload with the center of gravity offset from mast centerline exceeding the maximum allowed offset. Stand clear of tilt system, mast and mast payload during operation. Be certain tilt system and mast are level and secure before and during installation, operation, and maintenance.

⚠ DANGER

Falling Objects from Mast Hazard! Wear a protective hard hat when working on tilt system or situated near tilt system operating area while tilt system is raising or lowering. Improperly secured payload or mast components, ice formations, etc. could be dislodged from mast and fall. Be sure the payload is properly installed and secured.

⚠ DANGER

Relocation/Driving Hazard! Do not relocate the system during operation, while tilt system is tilted to any height above the stowed position or powered up. Do not move vehicle until tilt system has been securely stowed and isolated from power. Power-up and operate tilt system only if the vehicle is stationary and securely parked with the parking brake properly applied. Do not put tilt system in service or operate without the vehicle interlock warning circuit or magnetic warning kit installed to provide confirmation mast is nested prior to moving the vehicle. Contact The Will-Burt Company Engineering for special on-the-move situations for military only use on specialized products.

⚠ DANGER

Burst Hazard! For pneumatically operated masts, do not operate without the over-pressure safety valve installed. Keep personnel clear of safety valve exhaust direction. Do not exceed the maximum rated pressure of mast. If the mast air pressure is not fully discharged prior to removing air hoses, a rapid release of air pressure will occur requiring hearing and eye protection.

⚠ DANGER

Driving Visibility Hazard! Install the operator tilt controls in a location that does not impede the vehicle operator from driving the vehicle.

⚠ WARNING

Payload Lifting Hazard - Intended Use! The tilt system is intended to mount a mast with the purpose to lift a specific payload for lighting, surveillance or communication use only. Any other use without written consent is prohibited and could cause death or serious injury. Do not use tilt system to lift personnel. Do not exceed specified payload capacity. Large payload wind sail areas can reduce payload capacity. Consult The Will-Burt Company engineering.

⚠ WARNING

Read Operating Instructions! Read and observe the operating instructions. Non-observance of the instructions, operation which is not in accordance with use as prescribed in the instructions, wrong installation or incorrect handling can seriously affect the safety of operators and machinery. Adhere to the safety instructions when carrying out any activity relating to the Compact Elevation System.

⚠ WARNING

Trained Personnel Only! This product is intended for use by trained professionals only. It is not intended for general use by the public or untrained personnel. Handling, installation, operation and maintenance to be performed by trained and authorized personnel only. Only a properly trained and qualified certified electrician should perform electric installations and service.

⚠ WARNING

Erratic Tilt Operation Impact Hazard! The tilt system should operate smoothly during extension and retraction. If erratic tilt motion is observed during raising or stowing that results in impact loading between the components, cease use of the tilt system and contact The Will-Burt Company service department. Repeated operation with impact loading can damage components.

⚠ WARNING

Over-current Protection! Over-current protection or power switching by the installer on mast incoming power supply as specified in this document should be a type suitable to allow lock-out tag-out procedures for power disconnect.

⚠ WARNING

Safety Instruction - Explosion! For outdoor use only. Do not use in explosive areas or areas that have been classified as hazardous as defined in Article 500 of the National Electric Code or equivalent national standards. Do not use in the presence of flammable gases or liquids such as paint, gasoline or solvents. Do not use in areas of limited ventilation or where high ambient temperatures are present.

⚠ WARNING

Safety Equipment (PPE)! Proper personal protective equipment (PPE) like hard hats, gloves, and safety shoes shall be properly worn while working on tilt system or near the deployment area of tilt system. In addition, eye protection shall be worn during maintenance procedures. Follow national PPE guidelines in your area of operation.

⚠ WARNING

Pinch Point Hazard! Keep clear of all moving parts like tilt system stowing. Be sure to stay clear of system during operation. Moving parts can crush and cut resulting in serious injury. The tilt system shall be mounted out of reach of the operator during operation. Do not operate without all covers installed.

⚠ WARNING

Crush Hazard - Tilt Failure! Do not stand directly beneath tilt system. Keep all personnel out of the area of the mast and tilt path at all times. Be certain the mast and payload are properly installed and secured.

⚠ WARNING

Entanglement Hazard! Tangled cables can cause equipment damage. Ensure payload cables, Nycoil®, trip lines, guy lines or other cables are not tangled and are free to pay out as tilt system is deployed. Cables that get tangled or snagged on tilt system or other objects can cause the tilt system to not raise and fall back down. This can cause damage to tilt system and lead to internal damage if repeatedly allowed to continue.

⚠ WARNING

Health and Safety Hazard while Cleaning! Solvent used to clean parts is potentially dangerous. Avoid inhalation of fumes and prolonged contact to skin.

⚠ WARNING

Fire Hazard Solvent! Cleaning solvent, used for maintenance, is flammable and can be explosive. Do not smoke near solvent. Use cleaning solvent in a well-ventilated area. Keep cleaning solvent away from ignition sources. Always store cleaning solvent in the proper marked container and in a proper location.

⚠ WARNING

Tilt System Extension Hazard - Obstruction! Raising tilt system into obstructions could result in death or serious injury and could render tilt system inoperable and partially raised. Before applying power and operating tilt system, be certain there is sufficient clearance in the tilting path, above and to all sides of the expected location of the fully raised tilt system. Keep all persons clear of tilt system and tilt system raising. Do not lean directly over tilt system. Locate the operator station such that the operator has a clear view of the operating space of tilt system prior to deployment to avoid contact with overhead objects. Locate operator station such that the operator cannot reach the tilt system.

⚠ WARNING

Manual Retraction/Operation! Make sure all power sources have been disconnected from the tilt system and the mast assembly prior to manually stowing tilt system to avoid unexpected start-up motion and/or damage to tilt system. Always ensure that all electrical circuits to the tilt system and mast assembly are de-energized and properly tagged during manual operation. Use care when manually raising or lowering the tilt system because the normal stops and protections are being bypassed. Do not stand in path of tilt during manual operation. Remove all tilt locks before manual operation.

⚠ WARNING

Mast Lifting/Handling! Use extreme caution while lifting tilt system and when tilt system is suspended to avoid injury and equipment damage. Be certain tilt system is properly secured using at least two sling points or forklift rails. All operators should be aware of and follow the applicable local, regional, and national standards and codes of practice for slinging and transporting equipment. Never lift tilt system over people. Ensure lifting equipment including, but not limited to, lifting straps and hoist, are capable of handling the forces generated from lifting the system. Observe manufacturer instructions on lifting equipment.

⚠ WARNING

Remove Payload! For tilt systems shipped with no payload (customer installed payloads), remove mast and payload before performing maintenance on tilt system. The Will-Burt Company installed devices can remain installed.

⚠ WARNING

Equipment Damage - Submerged! Do not submerge tilt system in liquid or operate the vehicle in a fording situation that would result in a submerged tilt system. The mounting surface of the tilt must have adequate drainage to prevent water pooling at tilt base.

⚠ WARNING

Safety Instruction – Keep Clear! Keep personnel clear of the system and mast tilt path direction during operation. Do not be in truck bed during operation. Being in these locations during operation could lead to serious injury.

⚠ WARNING

Fastener Vibration Hazard! Tilt system must include proper means to resist vibration loosening such as thread-locking compound, locking hardware, or equivalent. Use specified assembly torques appropriate for the fastener size.

⚠ WARNING

Safety Instruction - Operation! At all times prior to system operation, ensure that:

- The tilting system pivot path is free of personnel and mechanical obstruction.
- All electrical cables are undamaged and properly terminated.
- The control is receiving proper voltage and current.
- The mast assembly and payload are properly installed.
- Any transit tie-downs on the tilt system, mast assembly and payload have been removed.
- The vehicle is not moving and the parking brake is applied.
- Ensure the tilt system is on level terrain and does not exceed a 10° slope.
- The area above the tilt system is free of mechanical obstructions. Striking an overhead obstruction can damage the payload and/or the tilt system.
- Ensure the area above the tilt system is free of electrical wires. Operator death may occur by tilting the system and/or extending the mast into power lines.

⚠ WARNING

Tilt Locks Hazard! The tilt locks engage at the horizontal nested position and fully deployed vertical position. Do not stop and hold the tilt at any intermediate tilt angle position.

⚠ WARNING

Equipment Damage! Do not disconnect any cables in the tilt system while the tilt system is powered on. Damage to the tilt system may occur.

⚠ CAUTION

Equipment Damage - Forces! Before unloading the system, be certain the unloading region is capable of resisting forces generated from unloading the system including but not limited to system weight. Ensure the unloading region is level and has sufficient room and strength to hold the system. If the unloading region is incapable of meeting the requirements of the system, damage to the system and/or unloading region could occur.

⚠ CAUTION

Equipment Damage - Support Bracket! When installing mast into tilt system, do not over-tighten mast support bracket. Over-tightening may damage the base tube causing mast tubes to stick.

⚠ CAUTION

Tilt System Access! The operator must provide safe means to access tilt system during installation, removal and maintenance.

⚠ CAUTION

Tripping Hazard! Cables, trip lines, guy lines and guy anchors can be hard to see during and after installation. Any equipment posing trip hazards should be clearly marked.

⚠ CAUTION

Equipment Damage – Cable Routing! Cabling or Nycoil should be routed such that it cannot become trapped or pinched during equipment operation.

⚠ CAUTION

Equipment Damage! Verify that a power source capable of delivering the specified system voltage and current has been properly connected to the control box.

⚠ CAUTION

Polarity! Ensure the electrical mains polarity is correct before initializing the system.

⚠ CAUTION

Equipment Damage – Deviation! Deviation from standard operating conditions could cause tilt system and/or mast assembly failure.

⚠ CAUTION

Equipment Damage – Overriding Sensor and Faults! Only use OVERRIDE Switch for emergency operation of mast. When the OVERRIDE Switch is engaged, all sensors and faults generated by the controls of the mast are ignored. Power to the Motor will continue as long as the OVERRIDE Switch is held, even at the extreme high and low ends of travel. The limit switches typically used to prevent the mast from over-traveling at the extreme ends of travel will not function normally. Use extreme caution when using the OVERRIDE Switch at the fully extended and fully nested areas of mast deployment. Holding the UP/DOWN Switch beyond the limits of travel may result in equipment damage.

⚠ CAUTION

Equipment Damage – Overheating Motor! When operating the tilt system, let the tilt system rest for 3 minutes after raising before lowering back to the horizontal position. After lowering, let the tilt system rest for 3 minutes before raising again. Raising and lowering the tilt system without rest breaks can lead to the motor overheating.

⚠ CAUTION

Operation at Incline! The tilt system relies on gravity to tilt down. If operating on an inclined surface, orient the tilt system so that tilt system will tilt down in the downward direction on the slope. Do not operate the tilt system on a slope exceeding the maximum operating angle of $\pm 10^\circ$.

1.3 Symbols Used on Product Labels

The following symbols are displayed on the product. The symbol meanings are as follows:



This symbol indicates an electrocution hazard or hazardous voltage hazard. There is voltage present inside mast and control box. Do not operate mast near electrical lines or during electrical storms. Contact with high voltage will result in death or serious injury.



This symbol indicates a pinch point hazard. Keep fingers and hands clear of moving parts.



This symbol indicates a tip-over hazard. The mast must be properly supported during transport, handling, installation, maintenance, operation and decommissioning. System tip-over could result in death or serious injury.



This symbol indicates a general warning. In this unit, this symbol indicates a frozen water hazard. Water must be permitted to exit mast to avoid ice damage to mast.



This symbol is used to remind users to read and understand the operator's manual before operating the mast system. Failure to follow operating instructions could result in death or serious injury. Read and understand operating instructions before handling, installing, operating, or maintaining the mast system.



This symbol indicates a hard hat is required when working under the mast operating area. Failure to wear a hard hat could result in death or serious injury.



This symbol indicates an electrical ground connection point.



This symbol is used to indicate the center of gravity (COG) of a fully nested mast in a horizontal transport position.

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2 Specification Compliance

2.1 CE Declaration of Conformity

Refer to the Product page at www.willburt.com for the latest Declaration of Conformity.

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3 Introduction

Thank you for selecting The Will-Burt Company for your critical payload elevation needs. These operating instructions describe transporting, handling, installing, operating, maintaining, storing, and troubleshooting procedures for the Compact Elevation System (CES). These procedures assume the use of a standard tilt system. Procedures and characteristics for tilt systems customized to meet customer-specific needs may vary.

These operating instructions are intended for professionals who are qualified by their appropriate training and experience to perform the procedures. Review this document in its entirety. Contact The Will-Burt Company with any questions before performing any procedure outlined in this manual.

The views depicted in this manual are provided for clarification and are subject to change without notice. Views are not to scale.

The Compact Elevation System consists of a mechanical mast tilting assembly and a control system that tilts itself and the installed mast from 0° to 90°. The tilt system can be installed in the bed of a truck, on a trailer, or on a platform. The tilt system can be controlled through a control box or through a display controller. The following tilt system models are covered in these operating instructions:

- Compact Elevation System

The Compact Elevation System can be used with many The Will-Burt Company's mast models including Pneumatic Masts, Stiletto Masts, Stiletto AL Masts, Stiletto HD Masts and SPM Spindle Masts.



Figure 3-1 Compact Elevation System Extended (Trailer Mount)

3.1 Intended Use

The Compact Elevation System is intended for use by professionals in the surveillance/border patrol/security industries to provide elevated and directional emergency scene lighting and surveillance or communication capabilities. It is not intended for use by non-professionals. Do not use the tilt system to lift personnel. The tilt system is intended to be installed on the bed of a truck, trailer, or platform of surveillance/border patrol/security industry vehicles/mounting structures with the vehicle interconnect safety circuit installed and operational.

The Compact Elevation System is intended to be used only when the vehicle is stationary and the vehicle parking brake is properly applied. Do not supply input supply voltage or operate the tilt system when the vehicle is in motion. The tilt system shall remain in the powered-down, stowed position during vehicle motion.

3.2 Additional Documentation

In addition to this manual (TP-5986201), see your mast operator's manual for information pertaining to the mast. If necessary, contact The Will-Burt Company to obtain this document. Review and understand the mast operator's manual before performing installation, operation, transportation, maintenance, storage, and troubleshooting procedures for the mast.

3.3 Definitions of Terms

Throughout this manual, the following terms are used:

- **CES:** to refer to the Compact Elevation System.
- **Tilt System:** to refer to the entire CES tilt system.
- **Mast:** to refer to the telescoping mast that is installed inside the tilt system.

3.4 Tilt Position Definition

An actuator electrically pivots the tilt system from the stowed (horizontal, 0°) position to the raised (vertical, 90°) position. The following positions (see Figure 3-2) are used throughout this manual:

- **Stowed (0°):** is the horizontal position in which the mast is firmly seated in the jack stand. This position is sometimes referred to as the “horizontal” position.
- **Raised (90°):** is the position that the tilt system goes to from the stowed position. This position is sometimes referred to as the “vertical” position.



Figure 3-2 Tilt Positions (Left: Stowed, Right: Raised)

3.5 Mast Position Definition

The following positions (see Figure 3-3) are used throughout this manual:

- **Stowed:** the mast is fully nested and in the horizontal (0°) position. The mast is firmly seated on the jack stand.
- **Nested:** all tubes are lowered but mast is still in the vertical (90°) position.
- **Extended:** the partial or full raised position that the mast raises to from the nested position. In the extended position, some or all of the mast sections have risen.



Figure 3-3 Mast Positions (Left: Nested; Right: Extended)

3.6 Tilt System Component Descriptions

Tilt Assembly: The automated tilt assembly is used to secure and support the mast. It pivots the mast between horizontal (0°) and vertical (90°). It is secured to the mounting surface. The automated tilt assembly is controlled through the control box and/or display controller

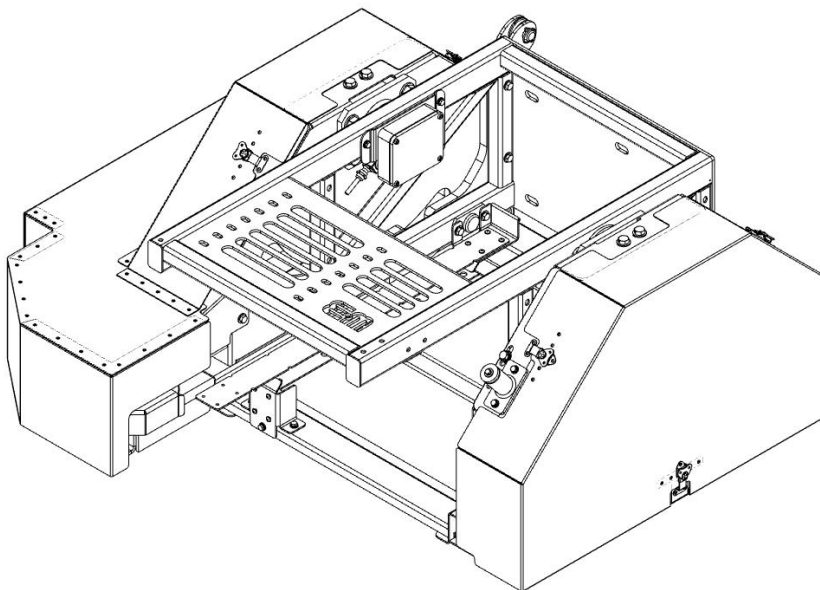


Figure 3-4 Tilt Assembly

Tilt System Base Structure: The tilt system base structure is a rigid base that supports the pivot cradle and secures the pivot cradle to the mounting surface. It has formed channels designed to accept the forks of a lift truck for transportation during installation. The tilt system base structure contains the tilt motor and the locking points for both the horizontal (0°) and vertical (90°) positions.

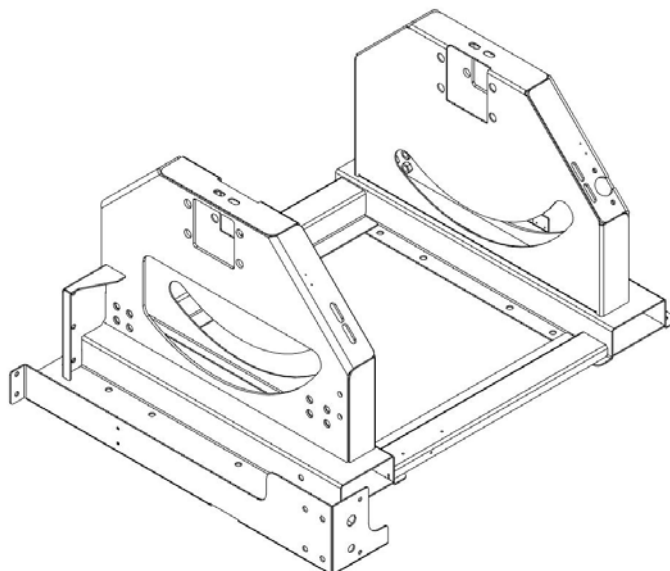


Figure 3-5 Tilt System Base Structure

Tilt Motor: The tilt motor is used rotate the pivot cradle and mast between the horizontal position (0°) and the vertical position (90°). The tilt motor is mounted on the side of the tilt system base structure. The tilt motor is mounted on the left side of the base. It uses a rotary encoder to control position stops. The contactor box assembly includes power and control cables which are connected to the motor.

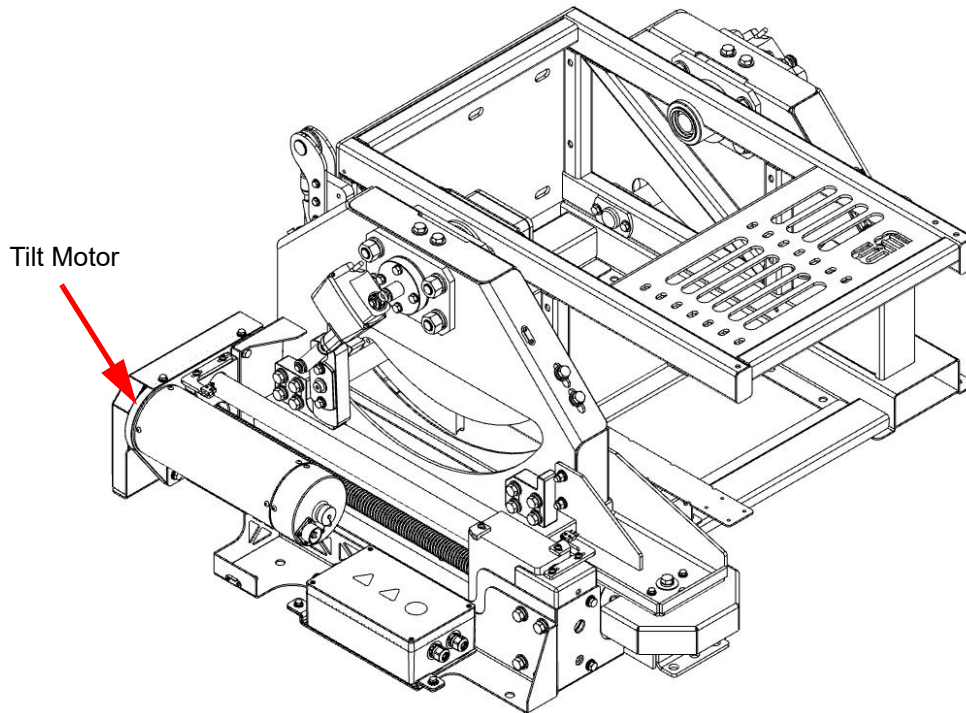


Figure 3-6 Tilt Motor (Cover Removed for Clarity)

Pivot Cradle: The pivot cradle supports the mast. It is mounted on pivot pins in the tilt system support structure. The pivot cradle is pivoted between horizontal (0°) and vertical (90°) by the tilt motor.

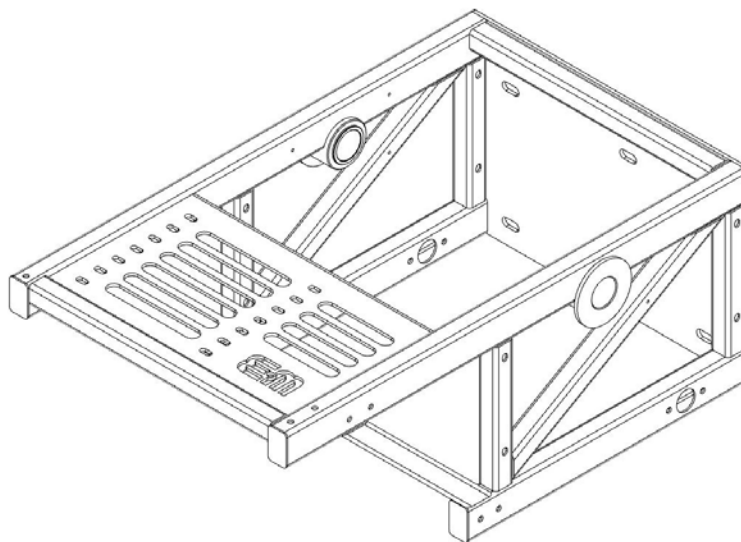


Figure 3-7 Pivot Cradle

Lock Actuator: Is a linear actuator used to lock and unlock the pivot cradle. The lock actuator includes the actuator power and control cables which are hardwired to the actuator.

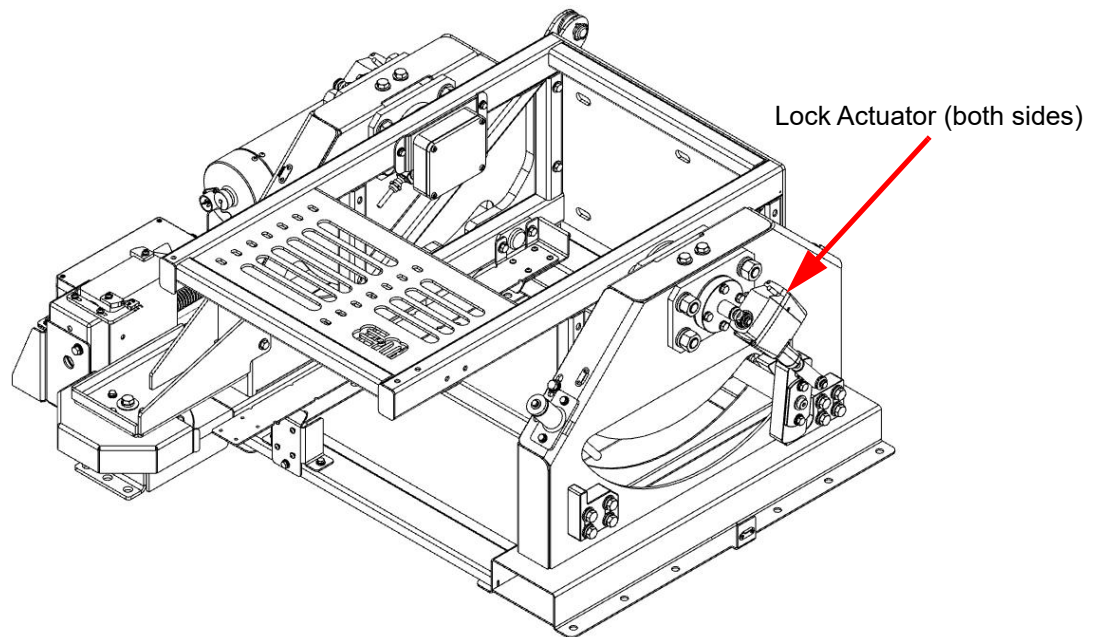


Figure 3-8 Lock Actuator

Support Bracket: The support bracket is used to secure and support the mast when in the transport position. When transporting the mast, the support bracket must be used.

Mast: The mast is installed into the tilt system. It consists of concentric tube sections that extend. These tubes are protected by low friction synthetic bearings. The exterior surfaces of the tubes are anodized and sealed for long life.

Jack Stand: The jack stand supports the mast and payload when nested for stable vehicle transit. The jack stand position varies by model.

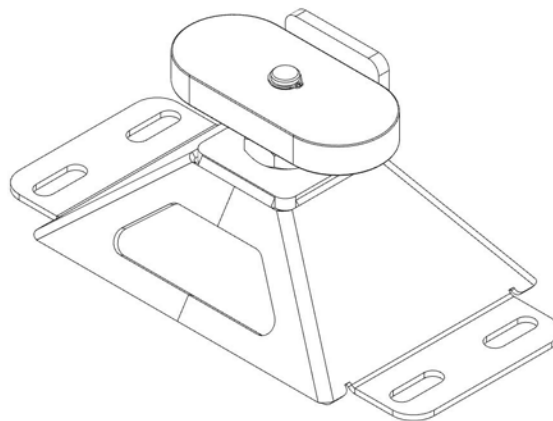


Figure 3-9 Jack Stand

Labels: Extra warning labels are provided to attach near the operator control station.

Contactor Box: The contactor box connects power from the customer-supplied power source to the tilt system.

Long Crank Handle Assembly: The long crank handle assembly can be used to manually crank the mast motor to extend and retract the tilt system and Mechanical Masts. When manually cranking the motor, it is necessary to remove all power from the system.



Figure 3-10 Long Crank Handle Assembly (P/N: 5339101)

3.7 System Controllers

Display Controller: The tilt system comes with a display controller. The display controller controls mast functions and provides full system control. The display controller comes with an emergency stop (E-Stop) button. There are two different kinds of display controllers: one that mounts to a panel and one that mounts inside the cab of a vehicle.

Cab Mount: Mounts inside the cab of a vehicle. There is a ball on the back to allow the display controller to be moved to different angles for better vision.

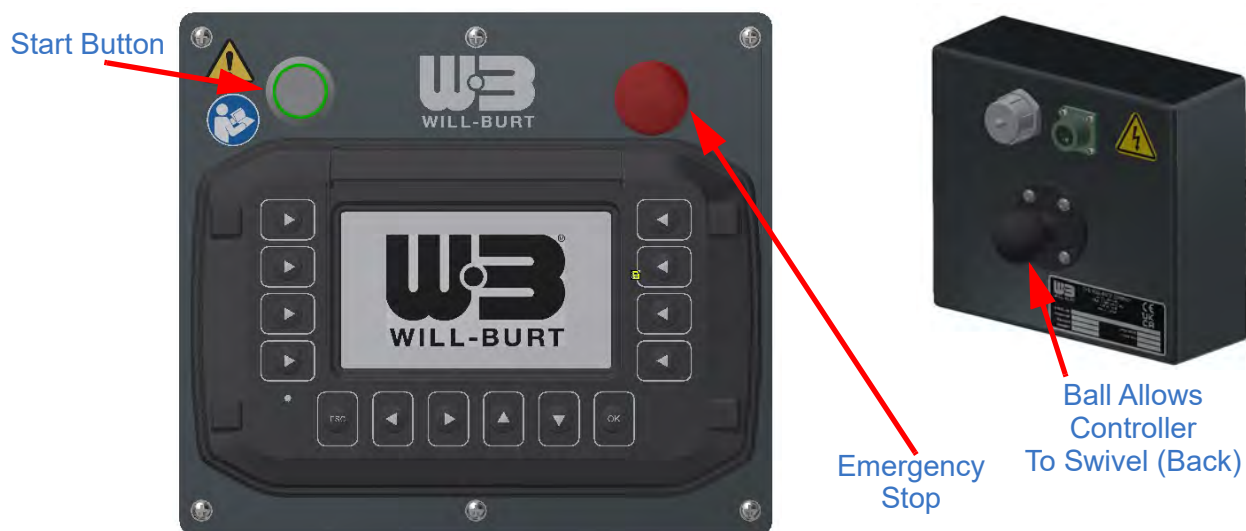


Figure 3-11 Cab Mount

Panel Mount: Mounts to a panel. Can be used outside, on trailers, etc.



Figure 3-12 Panel Mount

Error Codes: In the event of any unexpected switch feedback, communication errors, or amp draws on the mast, the display controller will show the associated error message. See Troubleshooting (Section 9).

The Control Box: The control box includes a(n):

- UP/DOWN Switch with waterproof boot that allows the operator to pivot the tilt system between horizontal (0°) and vertical (90°) and extend and retract the mast.
- Emergency Stop Button that stops all mast and tilt system motion when pressed.
- Mechanical Masts only: OVERRIDE Switch with waterproof boot that is used with the UP/DOWN Switch to ignore any errors returned by the Control Box in order to allow for emergency extension and retraction of the mast.

Mechanical Masts: Bulkhead Connectors to allow for connection of the:

- Power and Vehicle Interlock Connector
- Mast Sensor Connector
- Mast Motor and Brake Connector
- Connector for Tilt Motor Contactor
- CAN / Power Connectors to Control Panel and Actuators
- Connector for optional SCRAM / RS485 Serial Communication
- Connector for CANOPEN Absolute Rotary Encoder

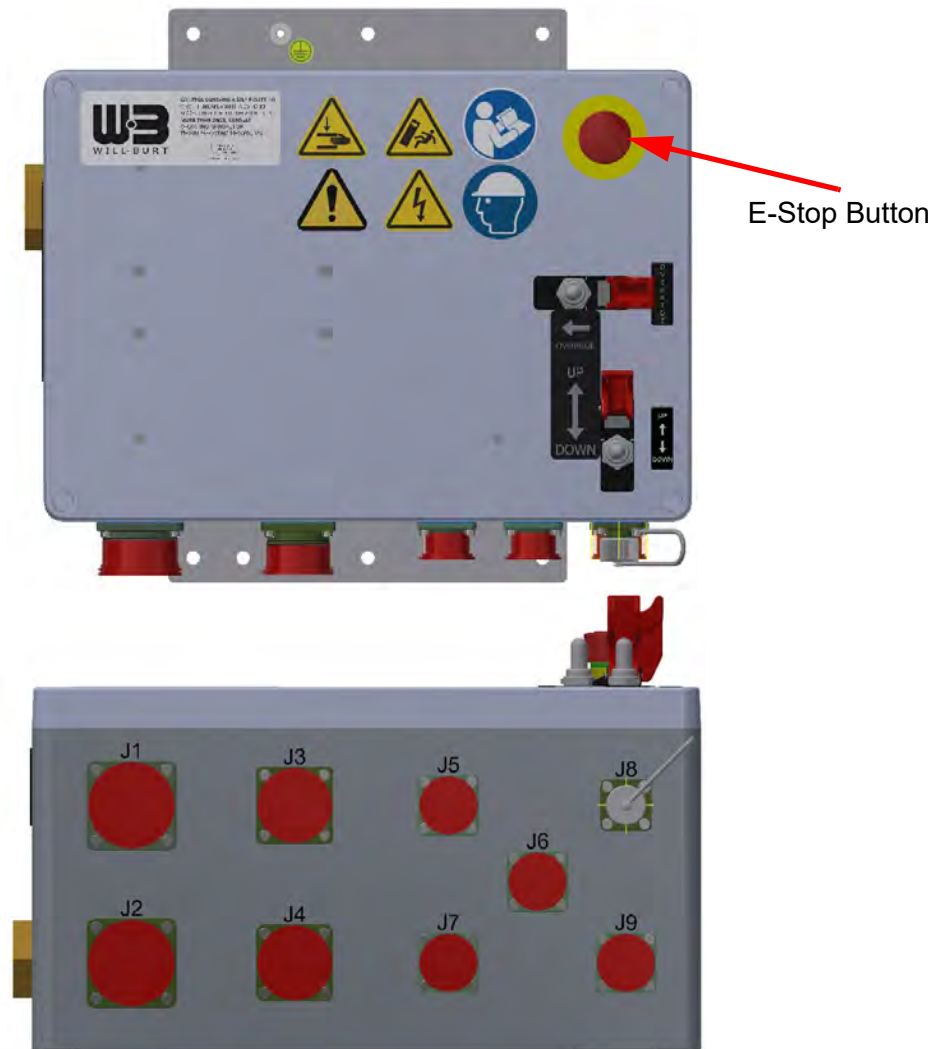


Figure 3-13 Mechanical Mast Control Box

Pneumatic Masts: Bulkhead Connectors to allow for connection of the:

- Power and Vehicle Interlock Connector
- Pneumatic Control Box and Control Valves
- Compressor Control Connector
- Connector for Tilt Motor Contactor
- CAN / Power Connectors to Remote Panel and Actuators
- Connector for Optional SCRAM / RS485 Serial Communication
- Connector for CANOPEN Absolute Rotary Encoder

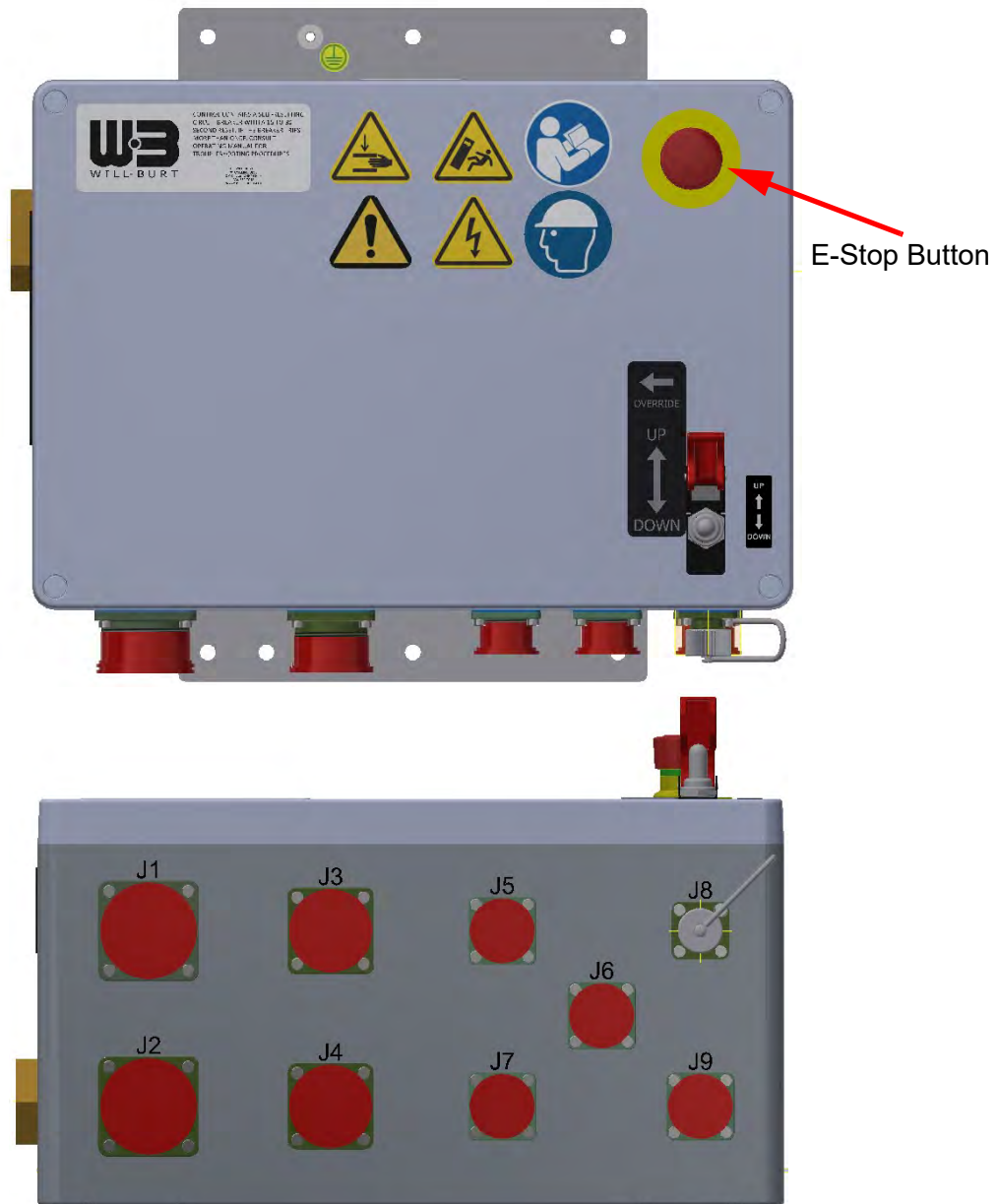


Figure 3-14 Pneumatic Mast Control Box

4 Technical Data

This section describes specifications for the tilt system. The specifications listed in this section are for the catalog tilt systems only. For specifications on custom configurations or mast specifications, contact The Will-Burt Company.

Table 4-1 Tilt System Specifications

Functional Characteristic	Specification*
Approximate Weight (Including electrical system and cables)	750 lb. / 340 kg
Maximum Tilt Payload Torque (includes mast and payload)	5050 Nm / 3725 ft-lb
Height with Pivot Cradle Vertical (90°)	44.5" / 1130.3 mm
Height with Pivot Cradle Horizontal (0°)	21.8" / 553.7 mm
Overall Width (Latch to Latch)	54.1" / 1374.1 mm
Overall Width (Cover Faces)	53.0" / 1346.2 mm
Overall Length with Pivot Cradle Horizontal	45.0" / 1143 mm
Survival Wind Speed ***	81 mph / 130 km/h
Maximum Deployment Wind Speed (Stiletto Family Masts)	40 mph / 64 km/h
Maximum Deployment Wind Speed (Pneumatic Masts)	25 mph / 40 km/h
Estimated Tilting Time from Horizontal to Vertical (At actuator full load condition)	60 sec.
Estimated Tilting Time from Vertical to Horizontal (At actuator full load condition)	60 sec.
Operating Voltage Range	20 to 28 VDC
Maximum Running Current (full load)	60 Amps
Maximum Start-Up Current (full load)	100 Amps
Maximum Tilt Deployment Angle **	±10°
Operating Temperature	-40°F to 140 °F / -40°C to 60 °C
Storage Temperature	-40°F to 160 °F / -40°C to 71 °C
Tilt System Duty Cycle Interval	1 Up cycle (approx. 1 minute) → 3 minutes rest → 1 Down cycle (approx. 1 minute) → 3 minute rest → repeat
<p>* Specifications for tilt system only. Mast not included.</p> <p>** If on an inclined surface, do not operate if tilt system cannot fold down in the downward direction on the slope.</p> <p>*** Based on 6m mast with 12 sq ft sail area and C_d=1.5 and 0.3m above mast.</p>	

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5 Installation

This section describes the physical and electrical installation of the Compact Elevation System and provides the general procedures that must be followed to ensure a successful installation. Be sure to read and understand the entire installation procedure and the Safety Summary (Section 1) before beginning installation.

The exact installation procedures may vary based on the configuration of the tilt system and the installation environment. Use the best and safest method for your circumstances.

These instructions assume the mounting hole locations are not pre-drilled and that the components will be used as templates to drill these holes during installation. Alternatively, the mounting hole locations could be found and pre-drilled using the installation dimensions (Figure 5-4 and Figure 5-5). When pre-drilling the mounting holes, use care to ensure the mounting holes properly align.

5.1 Mounting Location Requirements

The following factors must be included when selecting an appropriate mounting location:

1. Your system is designed to withstand adverse weather conditions, however it cannot be submerged in water. If the system is mounted in a well, provide adequate drainage. A minimum of four 1 inch (25 mm) diameter drain holes (one per corner) are recommended.
2. Ensure that the tilt system base and jack stand are on a flat surface and in the same plane. The horizontal position is set at the factory based on a level surface. If the system is not level, the stowed position may need adjusted as described in Section 8.8.
3. Cables will need routed between components of the system as follows:
 - Customer power to control box
 - Customer power to contactor box
 - CAN bus control (several connections)
 - Control box to remote panel display
 - Control box to CES lock actuators
 - Control box to contactor box
 - Tilt position encoder to control box
 - For mechanical masts: Mast to control box
 - For pneumatic masts: Pneumatic box to control box

4. The mounting structure must have sufficient room to mount the system. The mounting structure must be capable of holding the forces required by the bolts. Check the strength and rigidity of the mounting structure where the system is to be attached. Reinforce as necessary. It is important that both the base and the jack stand be securely mounted to a mounting surface which will not overturn during operational loading of the mast. The surface must be reinforced to withstand the loads at the different points on the tilt system that can be expected during operation as shown in Figure 5-1. These are maximum load estimates placed downward and upward on the mounting surface by the tilt system and mast.

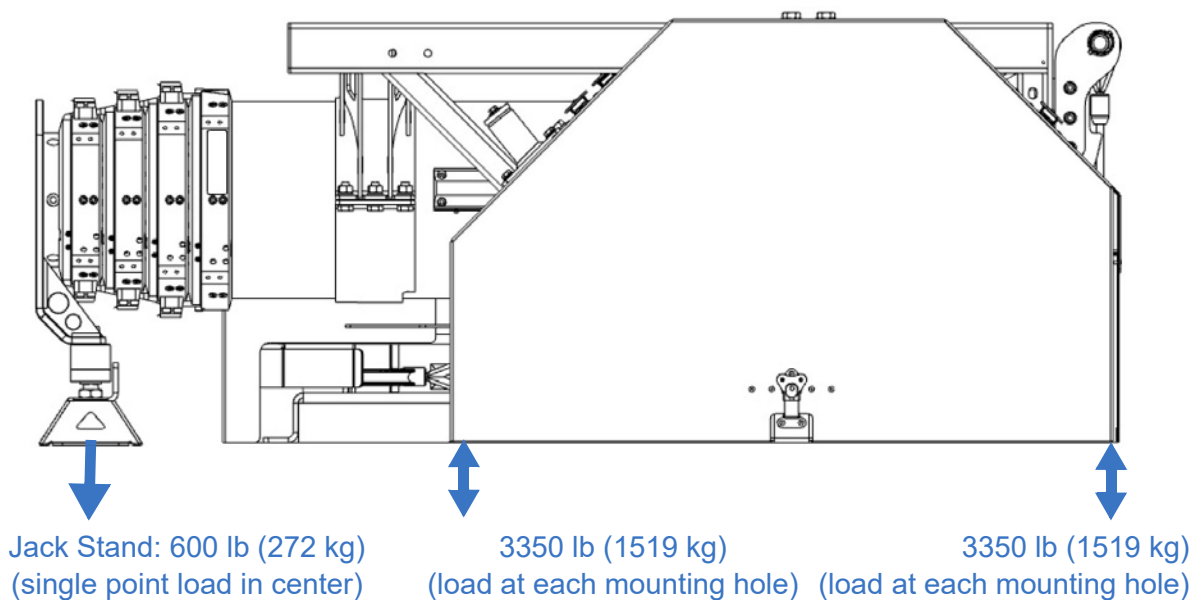


Figure 5-1 Maximum Reaction Loads on Mounting Structure (Stiletto AL Shown in Tilt System)

5.2 Recommended Installation Tools

Table 5-1 lists recommended tools and materials for installation.

Table 5-1 Recommended Installation Tools & Materials

Tools and Materials		
Safety Glasses	Safety Gloves	Safety Shoes
Hard Hat or Helmet	Hearing Protection	Nitrile or Vinyl Gloves
Wrenches	Measuring Tape	Level
Torque Wrench	Drill	Washers or Spacers (For Shimming)
Rubber Mallet	Anti-Seize	Mounting Hardware
Hoist	Sling	Thread-Locking Compound
Shop Rags (Clean and Dry)	Wire Cutter/Stripper	Touch-Up Paint in tilt system color
Sweet Metal Cutters/Device	Loctite 243 (Pneumatic Mast)	
<p>Note:</p> <ul style="list-style-type: none"> Depending on the local, regional, and national standards and codes of practice, and the environment, additional personal protective equipment may be necessary. Depending on the system configuration, additional equipment, including but not limited to electrical components (e.g. wire, switches, fuses, circuit breakers, etc.), may be required. When disposing of any disposables or components, do so according to any applicable local, regional, and national standards and codes of practice. 		

5.3 Unpacking & Handling

During installation, it will be necessary to lift the system. The tilt system has formed channels designed to accept the forks of a lift truck for transportation during installation. To lift the tilt system, use a sling / hoist or a lift truck to transport during installation. These instructions assume this method of lifting the system. Depending on the environment and equipment available, other methods may work better. Use the best and safest method for your circumstances.

Unpack and handle the items as follows:

1. Carefully open the shipping crate.
2. Remove all loose components.
3. Ensure all components are included and that the required tools are readily available.
4. Inspect for any shipping damage. If damage has occurred, notify the carrier.
5. Dismantle the shipping crate so that the lifting device can access the tilt system. Remove any banding fixing the tilt system to the shipping crate or carton. Remove any banding fixing the tilt system.
6. **If using a lifting truck:** Using the lifting truck, carefully lift the system by inserting the truck forks into the tilt system channels (Figure 5-2).

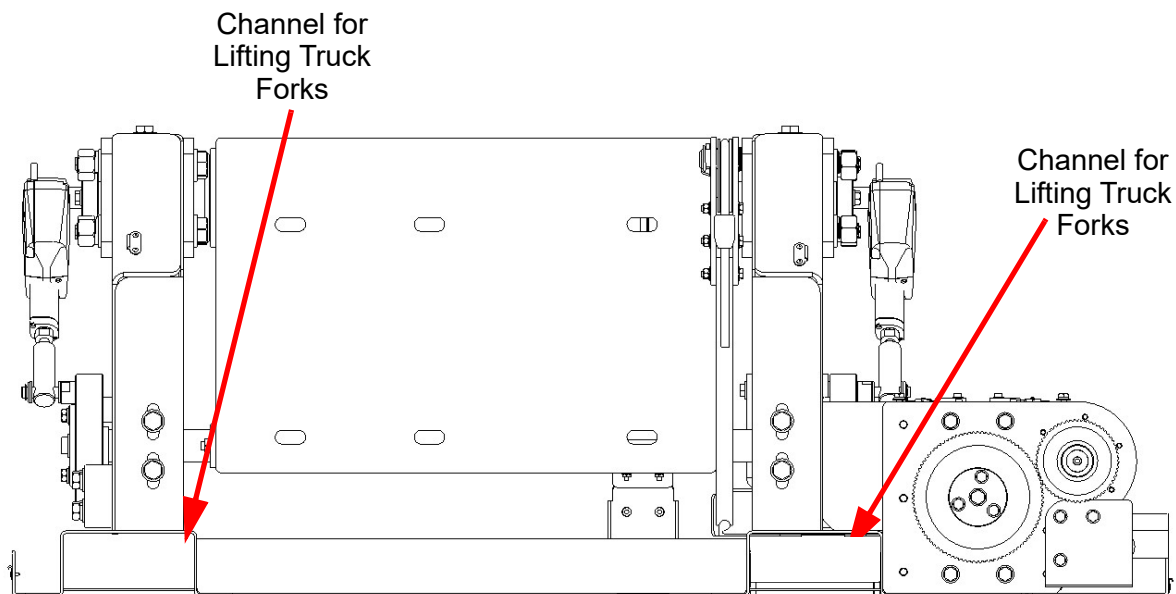


Figure 5-2 Lifting Points

If using a hoist / sling: Using a hoist / sling or lift truck, lift the tilt system from the shipping container by the cradle at the lifting points shown below (Figure 5-3). Lifting from locations other than those indicated could result in equipment damage. Use two point contact for slings to keep the load stable while moving.

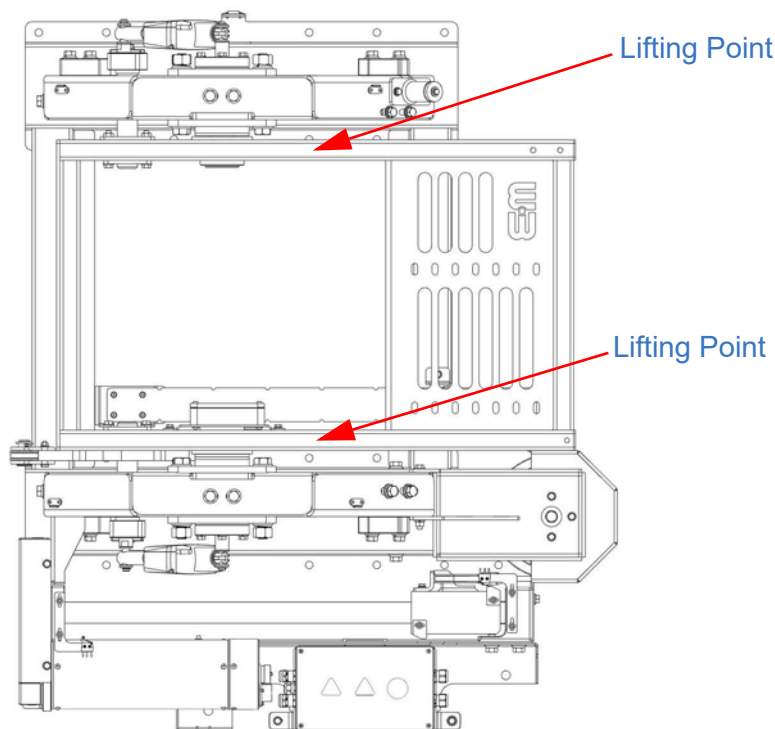


Figure 5-3 Lifting Points

7. Carefully maneuver the system to the desired mounting location. The operator should be able to view the system at all times to ensure the tilt system does not collide with any obstructions.
8. Slowly lower the tilt system until the system is on the mounting surface and the weight of the system has settled.
9. Ensure the system is temporarily secured to prevent it from tipping over during the installation process.

5.4 Unpack and Handle the Mast System

For instructions on how to unpack and handle the mast system, refer to the manual that shipped with the mast.

5.5 Attaching to Mounting Location

Physically attach the tilt system as follows:

1. Carefully position the tilt system in the desired position in the mounting location.
2. Ensure the system is level in all directions. If necessary, shims may be added to correct the alignment. It is necessary to check the system in two places 90° apart when leveling.
3. Mounting holes have been provided along the channels on each side of the tilt system. Use the mounting holes as a template to drill holes in the mounting surface. Indicated below are the minimum locations that need to be secured to the mounting surface.

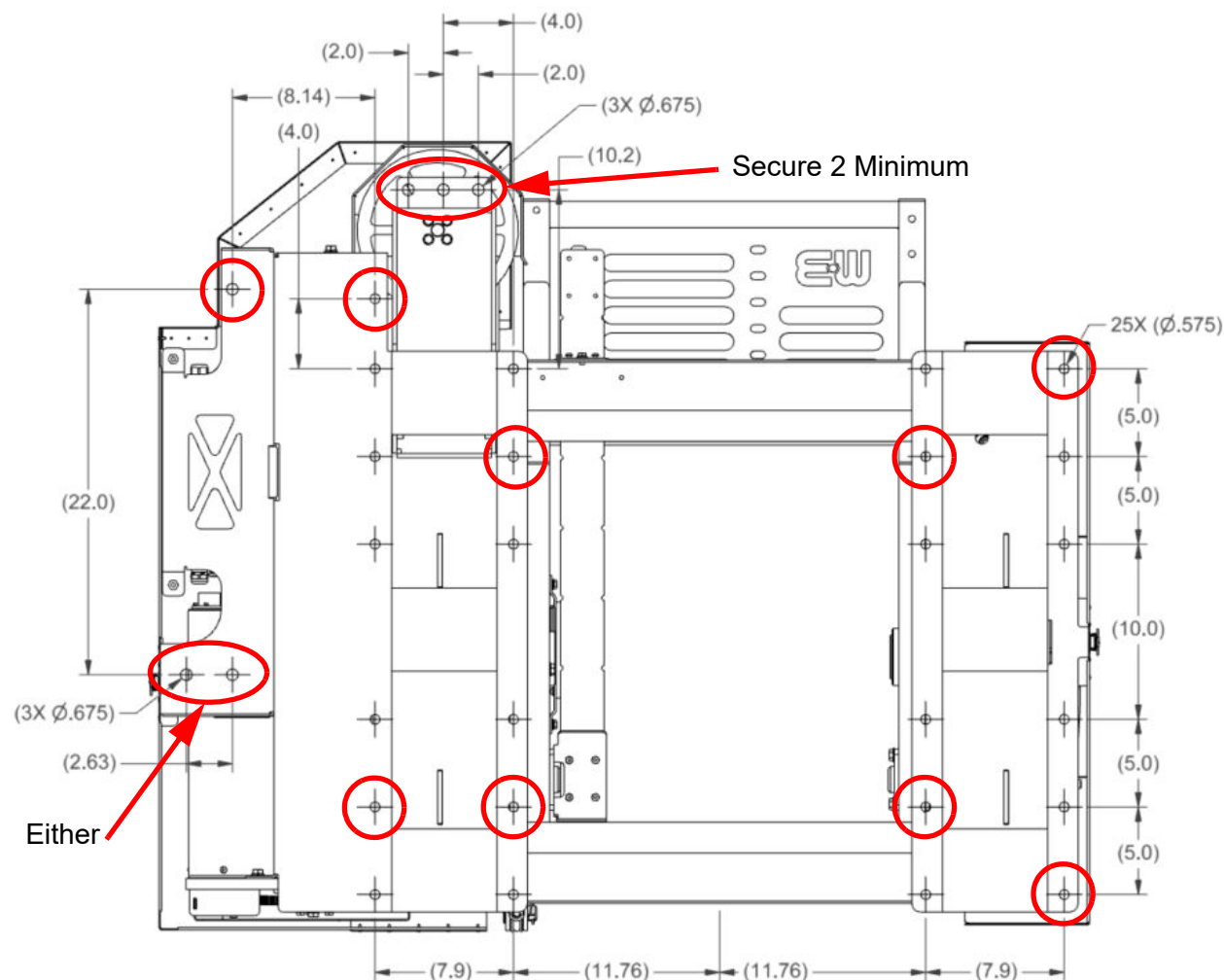


Figure 5-4 Mounting Holes (Bottom View)

- Secure the system in position. Torque all hardware as appropriate for its size and grade. The customer-provided mounting hardware must include proper means to resist vibration loosening such as thread-locking compound or locking hardware. Ensure the system remains level as it is torqued.

Note: Dimensions are provided for reference only and are not intended for vehicle design purposes. Characteristics of components customized to meet customer-specific needs may vary. If necessary, contact The Will-Burt Company for additional details.

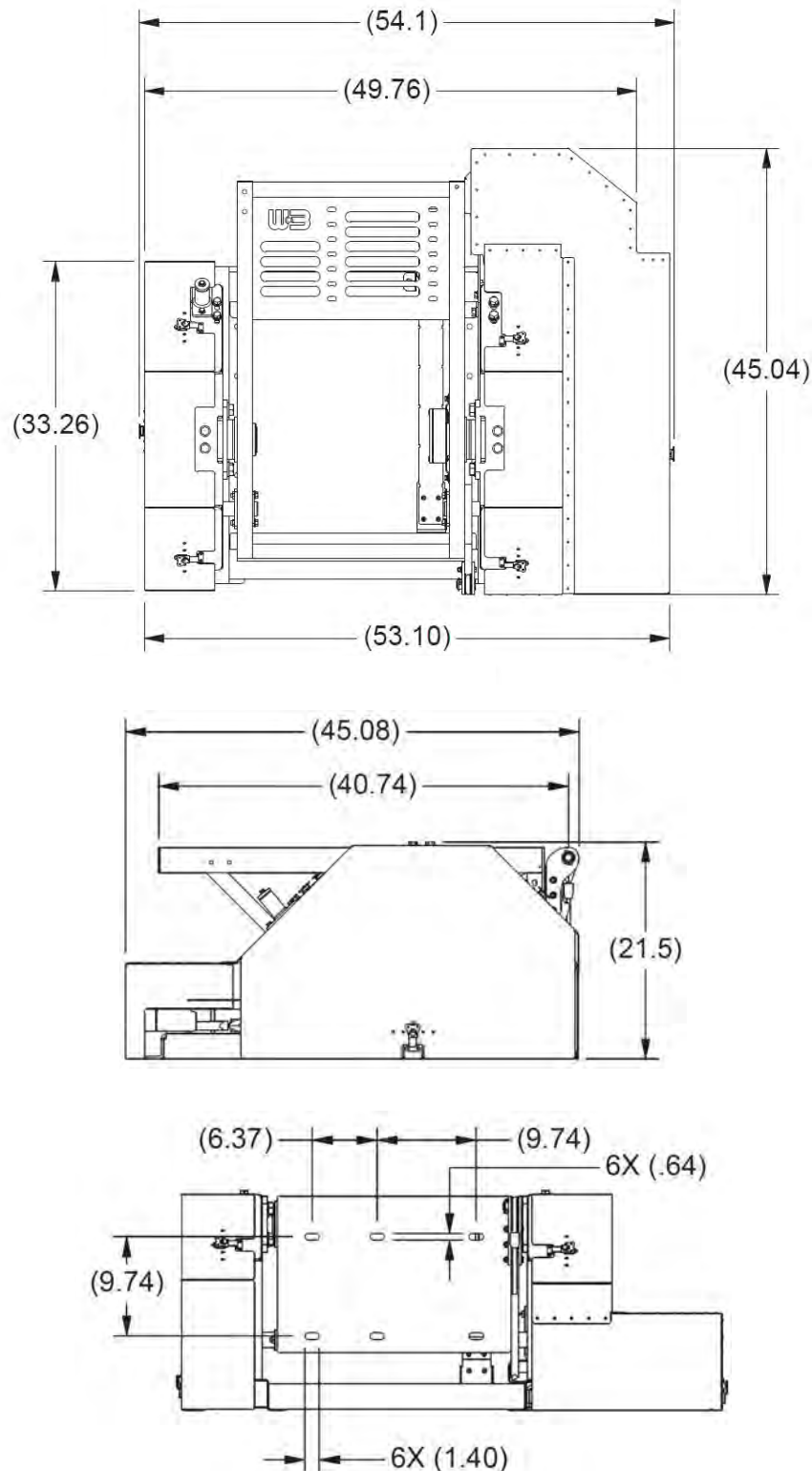


Figure 5-5 Tilt System Dimensions

5.6 Install the Mast System

Note: The tilt system must be at the vertical (90°) position in order to install the mast.

To install the mast:

1. Unpack and unload the mast system. Refer to the unpacking and handling section in the manual that shipped with the mast.
2. If not already done, move tilt system cradle to the vertical (90°) position:

If installing a pneumatic mast: Proceed to Step 3.

If installing mechanical mast: To move the tilt system, disconnect the cable to J2 on the control box. Place the jumper on J2 between pins E and F. This allows you to move the tilt system.

3. Loosely install the back half of the support bracket to the cradle using the appropriate hardware.
4. **If installing a pneumatic mast:** Mount the base plate to the mast base using Loctite 243 and appropriate hardware.

If installing a mechanical mast: Proceed to Step 5.

5. Place mast into the tilt system and against the support bracket. Use appropriate hardware to loosely mount the base of the mast to the cradle base.
6. Loosely clamp the front half of the support bracket around the mast to the back half of the support bracket using the provided hardware. Once properly aligned, torque all support bracket hardware as appropriate for its size and grade. The mounting hardware must include proper means to resist vibration loosening such as thread-locking compound or locking hardware. Ensure the support bracket remains level as it is torqued.
7. Tighten and torque all hardware attaching the support bracket to the cradle as appropriate for its size and grade. The mounting hardware must include proper means to resist vibration loosening such as thread-locking compound or locking hardware. See mast operating instructions.
8. Secure mast base / base plate to cradle base with appropriate hardware. Torque all hardware as appropriate for its size and grade. The mounting hardware must include proper means to resist vibration loosening such as thread-locking compound or locking hardware. See mast operating instructions.

9. **If tilt system does not come installed on a vehicle or trailer:** Cable management will need to be implemented. To implement cable management:

- a. Remove the 2 bolts from the left side of the cradle frame (Figure 5-6).
- b. Align one bracket of the Cable Management Strip against where the bolt holes are. Reinstall the bolts through the bracket back into the cradle frame. Apply Loctite 243 to hardware and torque to 15.8-20 ft-lb (Figure 5-6).

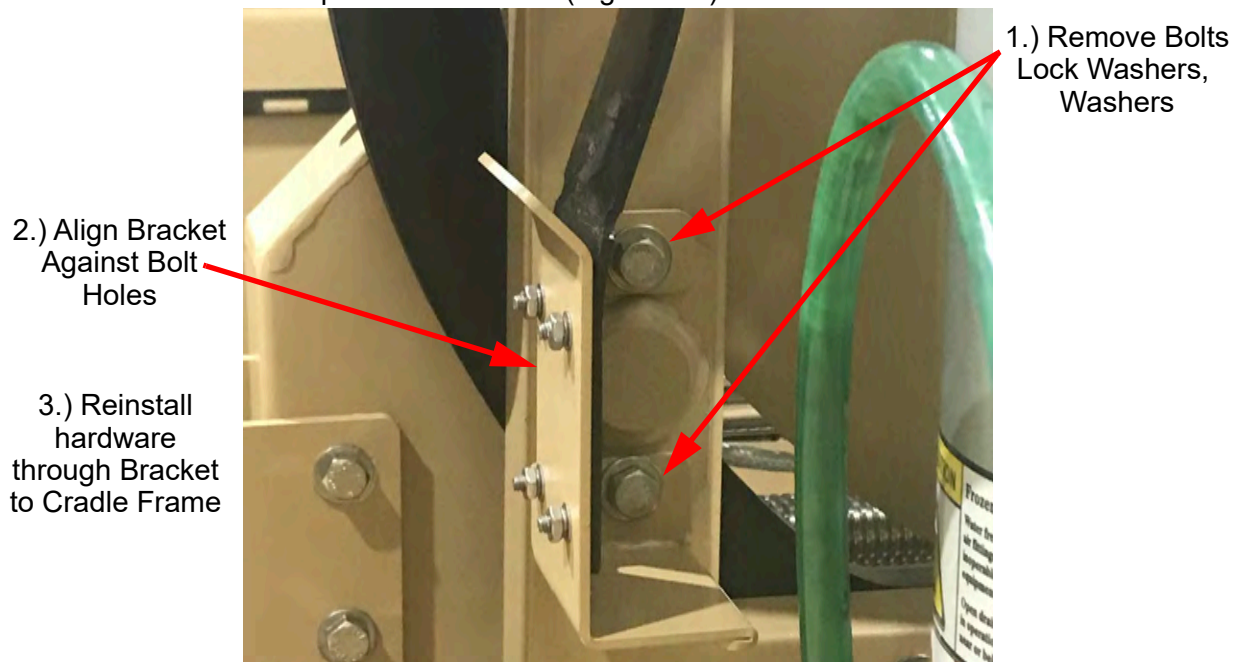


Figure 5-6 Install 1 Bracket of Cable Management Strip to Cradle Frame

- c. Install the other bracket to the bottom of the cradle frame by installing the provided 3 bolts to the cradle frame. Apply Loctite 243 to hardware and torque to 62-70 in-lb (Figure 5-7).

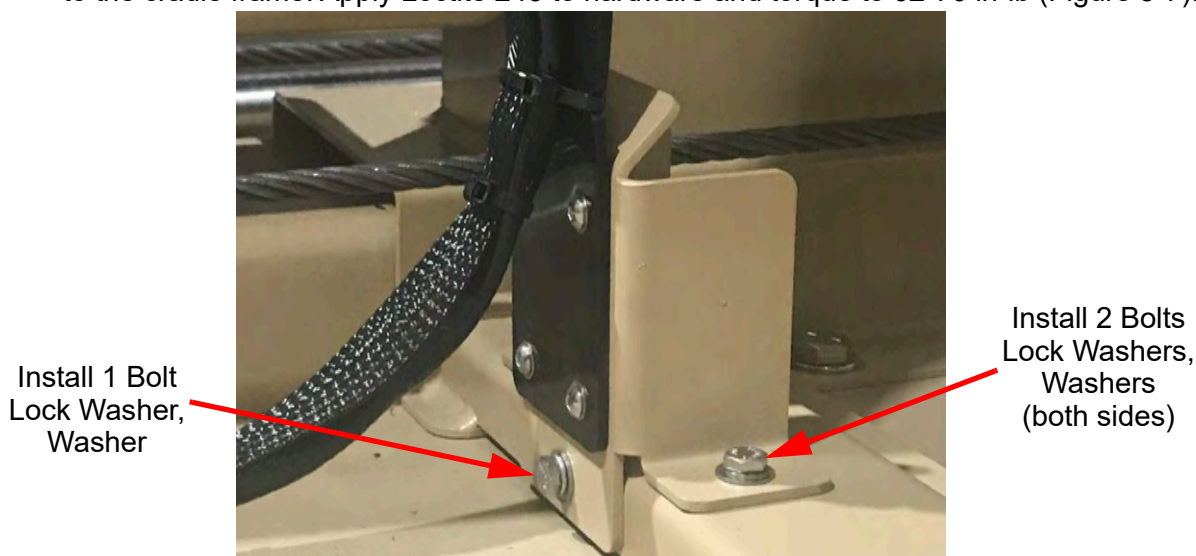


Figure 5-7 Install Bracket to Cradle Frame

- d. Once the Cable Management Strip is installed, the cables can be placed onto the black strip and zip tied (customer-supplied) in place. It is recommended to use UV stabilized zip ties. Note that there are notches along the black strip that allow for zip tie placement. It is recommended to zip tie all the way up to the bracket (Figure 5-8).



Figure 5-8 Fully Installed Cable Management Strip with Cables and Zip Ties Installed

- e. If desired, the cables in other locations can be zip tied to allow for cleaner cable management. Below is an example of how one could organize their cables (Figure 5-9).



Figure 5-9 Example of Cable Management

5.7 E-Spool Assembly Set Up (Optional)

This section provides information to install and set up the E-Spool Assembly. Several options are available. Follow the instructions appropriate for your system.

Note: The maximum cable diameter size that will fit inside the 7m E-Spool Assembly is 17 mm or 0.7 inches. The maximum cable diameter size that will fit inside the 4m E-Spool Assembly is 12.7 mm or 0.5 inches.

5.7.1 4m E-Spool Assembly

To set up the 4m E-Spool Assembly, proceed as follows:

1. Ensure the tilt system is in the vertical position.
2. Unscrew the 5 bolts attaching the E-Spool Assembly to the brackets. Set hardware aside. Lift up and remove the whole E-Spool Assembly from the tilt system. Place onto a nearby, stable surface.



Figure 5-10 Remove Hardware Connecting Assembly to Unit and Remove Assembly from Unit

3. Unreel the entire E-Chain and coil band from the E-Spool. The E-Spool is spring-loaded, so to prevent the E-Chain and coil band from retracting, place a rod through the holes on the reel. This should keep the E-Chain and coil band in place.
4. Unlatch every link in the coil band by placing a screw driver into the designated gap. Twist the screwdriver to unlatch the link (Figure 5-11).



Figure 5-11 Insert Screwdriver into Gap and Twist to Unlatch Coil Band Link

5. Feed the cable through the E-Chain.

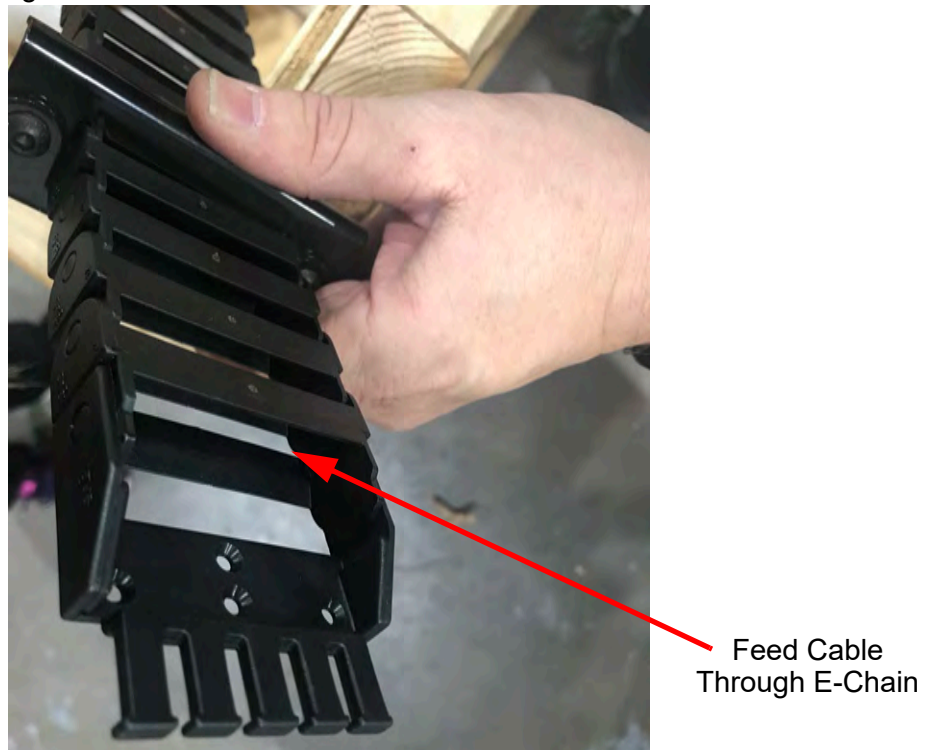


Figure 5-12 Feed Cable Through E-Chain

6. Place the cabling into the coil band. Ensure there is an appropriate amount of cable on each end.
7. Close all of the links by snapping links back together on the coil band with the cable now inside.
8. Carefully remove the rod and let the coil band and E-Chain slowly retract back around the E-Spool.
9. Reinstall the E-Spool Assembly to the tilt system by placing the E-Spool Assembly back onto the brackets on the tilt system.
10. Screw in the 5 bolts through the brackets back into the E-Spool Assembly. Apply Loctite 243 or equivalent to hardware and torque as appropriate.

5.7.2 7m E-Spool Assembly

To set up the 7m E-Spool Assembly, proceed as follows:

1. Ensure the tilt system is in the vertical position.
2. Unscrew the 6 bolts attaching the E-Spool Assembly to the brackets (Figure 5-13). Set hardware aside.
3. Lift up and remove the whole E-Spool Assembly from the tilt system (Figure 5-13). Note that the E-Spool assembly is heavy and the weight is awkwardly distributed. It may be best to have 2 people lift the E-Spool Assembly. Place onto a nearby, stable surface.

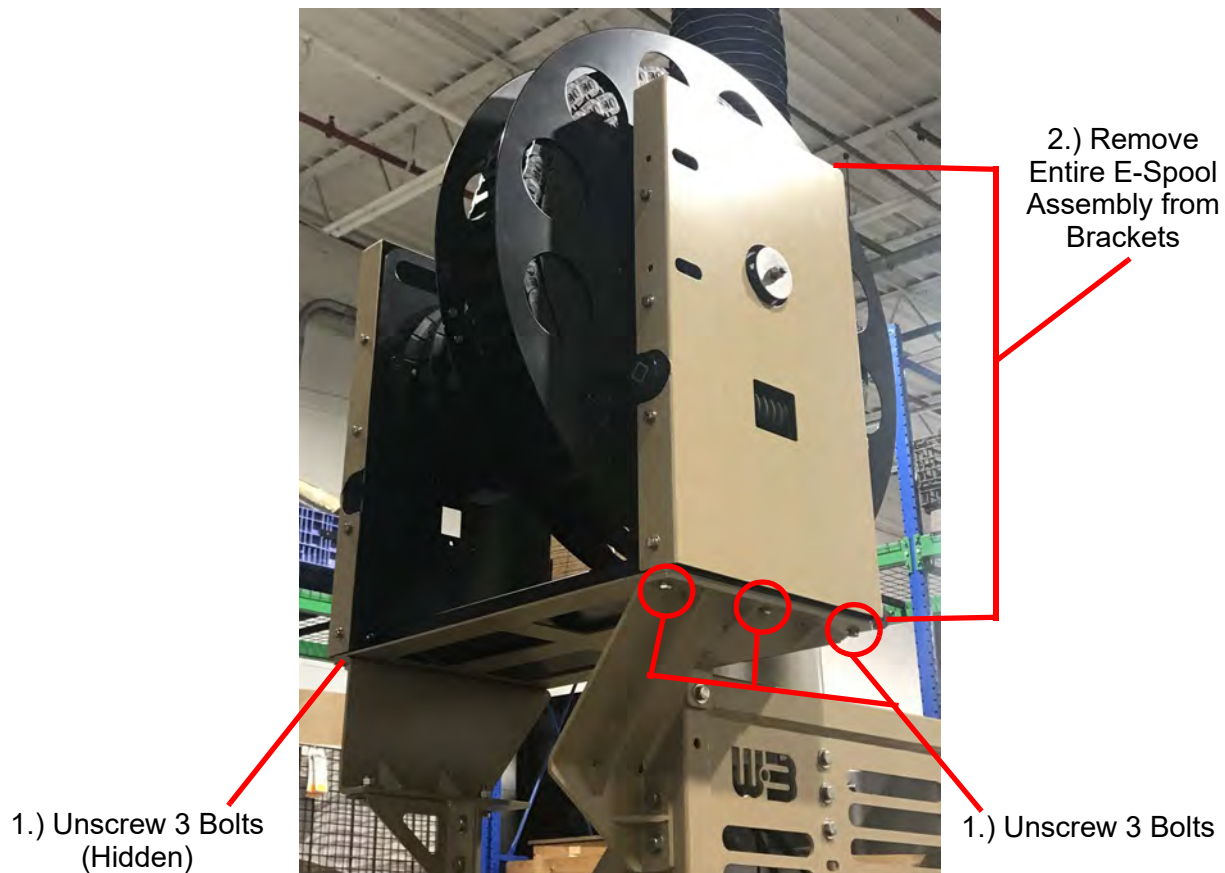


Figure 5-13 Remove Hardware Connecting Assembly to Unit and Remove Assembly from Unit

4. Unreel the entire E-Chain and coil band from the E-Spool. The E-Spool is spring-loaded, so to prevent the E-Chain and coil band from retracting, place a rod through the holes on the reel. This should keep the E-Chain and coil band in place.
5. Unlatch every link in the E-Chain by placing a screw driver into the designated gap. Twist the screwdriver and pull up on the link to unlatch the link (Figure 5-14).



Twist Screwdriver to Unlatch



Unlatched Link

Figure 5-14 Insert Screwdriver into Gap and Twist to Unlatch E-Chain Link

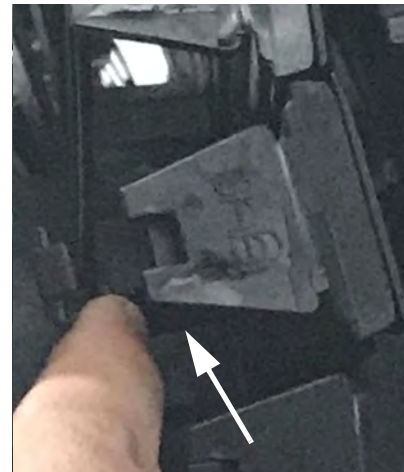
6. Unlatch every link in the coil band by placing a screw driver into the designated gap. Twist the screwdriver to unlatch the link (Figure 5-15).



Place Screwdriver
into Gap



Twist Screwdriver
to Unlatch



Unlatched Link

Figure 5-15 Insert Screwdriver into Gap and Twist to Unlatch Coil Band Link

7. Place the cabling into the coil band and E-Chain. Ensure there is an appropriate amount of cable on each end.
8. Close all of the links by snapping the links back together on both the E-Chain and the coil band with the cable now inside.
9. Carefully remove the rod and let the coil band and E-Chain slowly retract back around the E-Spool.
10. Reinstall the E-Spool Assembly to the tilt system by placing the E-Spool Assembly back onto the brackets on the tilt system.
11. Screw in the 6 bolts through the brackets back into the E-Spool Assembly. Apply Loctite 243 or equivalent to hardware and torque as appropriate.

5.8 Installing the Display Controller

This section provides information to install the display controller. Several options are available. Follow the instructions appropriate for your system.

5.8.1 Panel Mount

Go to Section 5.8.2 if you are installing the cab mount display controller.

The panel mount should be located where the operator has line-of-sight to the mast operating space. To attach the panel mount display controller:

1. Cut the panel according to the dimensions shown in Figure 5-16.
2. Place the display controller through the panel cutout and secure with the provided M6 nuts. It is recommended to install with a torque of 20-24 in.-lb. (2.2-2.7 Nm).

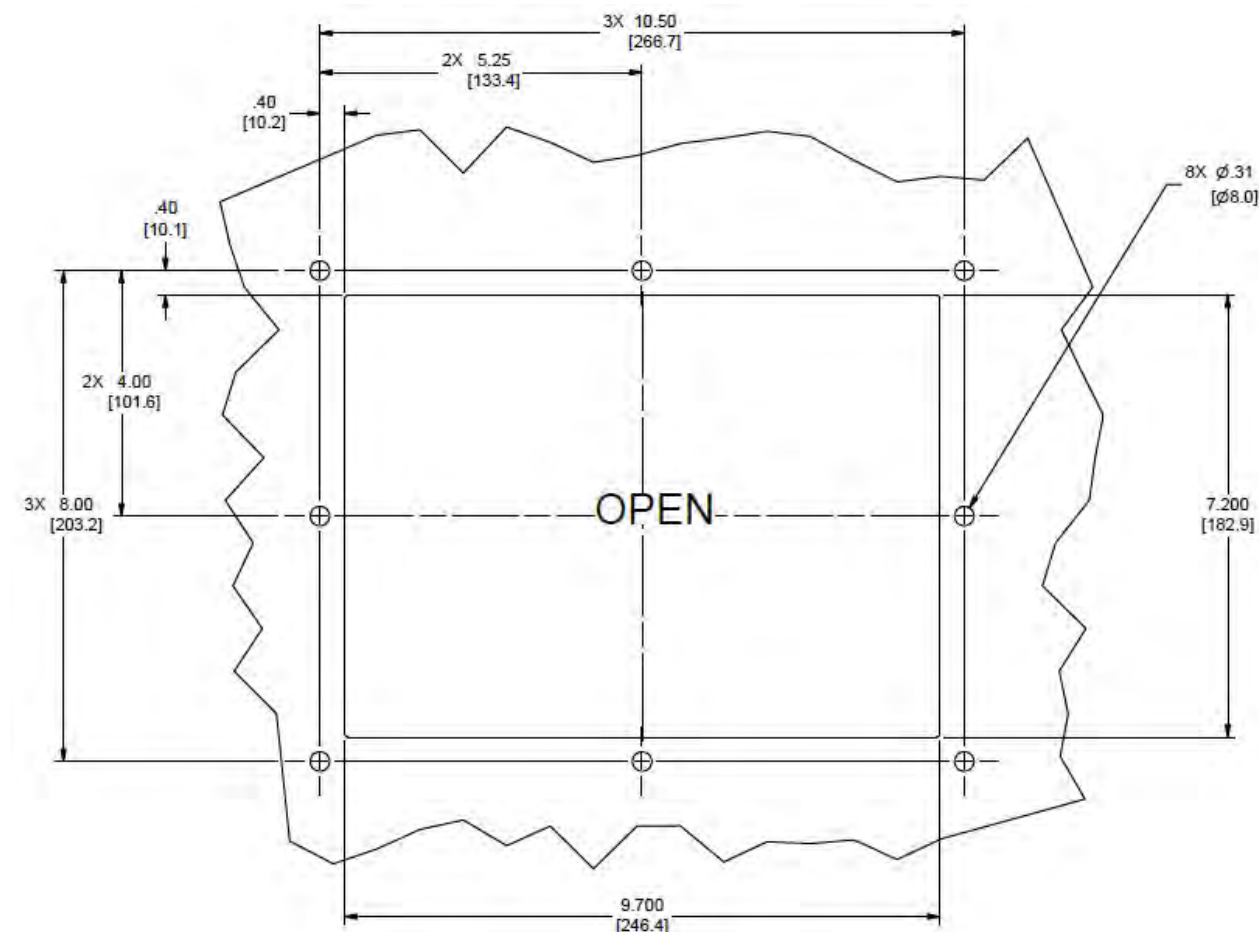


Figure 5-16 Panel Mount Cutout Dimensions

3. To wire the display controller, plug the display controller connector into the matching control box connector.

5.8.2 Cab Mount

Go to Section 5.8.1 if you are installing the panel mount display controller.

The cab mount should be located inside the cab of a vehicle in a protected, dry location. It should not be installed outdoors. To attach the cab mount display controller:

1. The cab mount assembly uses a Ram Mount Type C ball (Ø1.50 in) on the back. Use Ram Mount Type C adapters and supports or equivalent to mount the controller inside vehicle.
2. Ensure controller and mounting hardware are securely attached to vehicle when installing.
3. Connect the HMI connector to J5, J6 or J7 connector on control box.

5.9 Install Control Box

The control box may be installed outside or inside an enclosure such as the cab of a vehicle. To install the control box:

1. Using the control box as a template, drill six M6 (¼ inch) holes into the mounting structure.

Note: The control box has seven mounting holes. It is only necessary to use six of the mounting holes to secure the control box.

2. Secure the control box using six M6 (¼ inch) stainless steel fasteners. Torque all hardware as appropriate for its material and size. The mounting hardware must include proper means to resist vibration loosening such as thread-locking compound or locking hardware.
3. Use 10-32 UNF-2B hardware and a ground strap to ground the control box from the designated ground location to the chassis of the vehicle or a known earth ground. The ground location on the control box is designated with the electrical ground label.

5.10 Install the Jack Stand

Note: The jack stand must be installed before the payload is installed.

To install the jack stand:

1. Lower the tilt system so that the mast is fully at the horizontal (0°) position.
2. Slide the jack stand under the mast so that the payload plate will lay on top of the jack stand.
3. Secure jack stand to mounting surface with customer-supplied mounting hardware.
4. Rotate the elevator screw on the jack stand so that the jack stand plate is flush against the payload plate and an upward force is applied to the mast to remove mechanical play from the mast tubes. This keeps the payload from bouncing during transit.
5. Tighten jam nut on the jack stand to 106-115 ft-lb (144-156 Nm).

5.11 Electrical Installation

The tilt system requires DC power. Source DC power is provided by the installer from the vehicle battery. The power supply must be capable of supplying the minimum Amps to the tilt system and mast as instructed below.

The installer is responsible for providing the means to remove/isolate power from the mast and permit the operator to follow proper lock-out tag-out procedures for maintenance or troubleshooting. Power cables for the mast controls are provided by the installer. See the wiring diagrams in the Appendix (Section 11) for additional information on over-current protection and calculating cable size.

For 24V systems, the contactor box cables must:

- Be type SGX or SGT #2 AWG or AWG #4.
- #2 AWG: Have a maximum length for acceptable voltage drop of 30 feet (9.1 meters).
- #4 AWG: Have a maximum length for acceptable voltage drop of 20 feet (6.1 meters).
- The power supply must be capable of supplying 150A.
- The installer must provide over-current protection set to 150A (see WD-5967401 or WD-5842201 in the Appendix, Section 11).

The control box must have a 24V power source with #8 AWG wire.

To electrically install the tilt system:

Refer to WD-5842201 and WD-5967401 in the Appendix (Section 11) for system wiring.

1. Run the mast motor and mast sensor cables from the mast to the control box. Plug the mast motor cable into J3 and the mast sensor cable into J2 on the control box. Screw both connectors in place so that the cables are secure.

2. Run the lock control cables from the lock actuators to the control box. Plug the lock cables into J5 and J6 on the control box. Screw both connectors in place so that the cables are secure.
3. Run the tilt control cable from the contactor box to J4 on the control box.
4. Connect the remote control panel cable to the remote panel and J7 on the control box.
5. Connect the encoder cable to the encoder and J9 on the control box.
6. Secure all loose wires with wire ties.
7. Once all wiring connections are complete, replace the base cover.

5.12 Connect Power to the System

Power and vehicle interlock lines enter the control box through bulkhead connector J1. The Will-Burt Company supplies a 9-pin power cable connector to connect to J1. The customer is responsible for integrating 10-gauge power lines (with optional ground) and any interlock lines into the power cable connector. With cable runs longer than three meters (10 feet), a lower gauge wire will be needed.

The system does not have a master power switch. If a master power switch is desired, the customer must provide it with the source power.

To connect customer power to the system:

1. Wire the power cable connector according WD-5842201 in the Appendix (Section 11).
2. Plug customer power into J1 on the control box. Screw the connector in place so that the cable is secure.

5.12.1 Wiring Vehicle Interlock on Sensor

The tilt system is designed to allow for integration into vehicle safety circuitry to eliminate the possibility of driving with the mast extended. Usage shall be used to comply with various safety standards such as NFPA-1901. Possible Vehicle Interlock systems include a customer-supplied flashing warning lamp in the cab, or wiring into the parking brake or transmission circuit. The customer is responsible for determining which system works best for the specific application. The installer shall ensure that voltage is only supplied to the mast system when the vehicle is stationary.

5.13 Test the Installation

Review the Operation Section (Section 6) and Safety Summary (Section 1) and observe all safety dangers, warnings, and cautions before proceeding to test the installation. If any part of the testing fails, check the display controller display and control box.

Note: When testing the tilt system, let the tilt system rest for 3 minutes after raising before lowering back to the horizontal position. After lowering, let the tilt system rest for 3 minutes before raising again. This is to prevent the motor from overheating.

To test the installation, proceed as follows:

1. Review the Pre-Operation Check.
2. Turn the E-Stop button to reset and enable the system (if it was activated).
3. Push and hold the start button until the system begins power-up.
4. Raise the tilt system and extend the mast:
 - a. **Display Controller:** Press the Up Arrow until the tilt system raises fully to vertical (90°). Once fully raised, the Mast Control button will appear in the upper right corner. Press the Mast Control button and then press “OK” to go to the Mast Control Screen. Once in Mast Control, the mast can be raised or lowered using the Up or Down Arrow, respectively. Press the Up Arrow until the mast starts to raise. Once the mast starts to raise, release the “Mast Up” button.

Auto Up Feature: Press the “AUTO” button. Press “OK” after confirming there are no obstructions. Once fully vertical (90°), the Mast Control button will appear in the upper right corner. Press the Mast Control button and then press “OK” to go to the Mast Control Screen. Once in Mast Control, the mast can be raised or lowered using the Up or Down Arrow, respectively. To abort the Auto Features, press any controller button.
 - b. **Control Box:** Hold the UP/DOWN switch up until the tilt system raises fully to vertical (90°). Once the tilt system is fully raised, use the display controller to switch to the Mast Control screen. Hold the UP/DOWN switch up until the mast starts to raise. Once the mast starts to raise, release the UP/DOWN switch.

5. Lower the mast and stow the tilt system:

- a. **Display Controller:** Press the Down Arrow until the mast fully lowers. Once the mast is fully lowered, the Tilt Control button will appear in the upper right corner. Press the Tilt Control button and then “OK” to go to the Tilt Control Screen. Press the Down Arrow until the tilt system fully stows (0°).

Auto Features: Press the “NEST” button. Press “OK” after confirming there are no obstructions. Once the mast is fully retracted, the Tilt Control Screen will display. Press “AUTO” and press “OK” after confirming there are no obstructions. To abort the Auto Features, press any controller button. It is recommended to use the Auto Features to nest the mast and stow the tilt system.

- b. **Control Box:** Hold the UP/DOWN switch down until the mast fully lowers. Once the mast is fully nested, use the display controller to switch to the Tilt Control screen. Hold the UP/DOWN switch down until the tilt system fully stows (0°).

6. See Section 6 for additional details on these procedures.

Note: If a button is hit by mistake, a confirmation window for the unwanted function will pop up for 5 seconds. Hit “ESC” or ignore the window for 5 seconds and the window will clear.

6 Operation

This section describes the operation of the system. Be sure to read and understand the entire operation procedure and the Safety Summary (Section 1) before beginning operation. The exact operating procedures may vary based on the configuration of your tilt system. Follow the appropriate operation procedures for your tilt system.

Note: When operating the tilt system, let the tilt system rest for 3 minutes after raising before lowering back to the horizontal position. After lowering, let the tilt system rest for 3 minutes before raising again. This is to prevent the motor from overheating.

6.1 Pre-Operation Check

Before operating the system:

1. Ensure that there are no overhead obstructions, and that there are no power lines within 20 feet (6 meters) of the mast. Note that whenever operating the tilt system, there is the possibility of the mast extending.
2. The tilt system, mast, and payload are properly installed.
3. All electrical cables are undamaged and properly terminated.
4. Any transit tie-downs on the payload have been removed.
5. When using a vehicle, ensure that the vehicle is not moving and the parking brake is applied.
6. Ensure the tilt system is on level terrain and does not exceed a 10° slope.
7. Ensure if on a slope to orient the tilt system so that the tilt system will tilt down in the downward direction on the slope.
8. Visually inspect the system for damage. If damage is apparent, do not use the tilt system or mast and have it serviced prior to use.
9. Check for and remove any objects which might obstruct motion of the tilt system or mast, cause binding or hinder tilt system or mast function.

6.2 Operation Equipment

Table 6-1 lists recommended tools and materials for operation.

Table 6-1 Recommended Installation Tools & Materials

Tools and Materials		
Safety Glasses	Safety Gloves	Safety Shoes
Hard Hat or Helmet	Hearing Protection	Nitrile or Vinyl Gloves
Long Crank Handle Assembly		6 mm Hex Wrench (Manual Operation)
Note: Depending on the national and local standards and codes of practice, and the environment, additional personal protective equipment may be necessary.		

6.3 Control Functions

Using the display controller (Figure 6-1), the operator can perform an emergency stop, raise and lower the tilt system and extend and retract the mast.



Figure 6-1 Display Controller Control Functions (Cab Mount Shown)

6.4 Powered Operation

This section describes powered operation of the tilt system with either the display controller or control box. If an emergency stop is required at any time, press the Emergency Stop Button on the control box or display controller. This will cause all mast and tilt system motion to stop.

Note: Do not be in truck bed during operation. Do not be in area of tilt system path during operation. Being in these locations during operation could lead to a serious injury.

6.4.1 Quick Operation Summary

The following is a quick summary of the operation of the system. Detailed steps follow the quick summary.

If an emergency stop (E-Stop) is required at any time, press the “E-Stop” button. This will halt motion and disable all operation. When the E-Stop is used, a red block will appear informing the operator that the mast has been stopped (Figure 6-2).

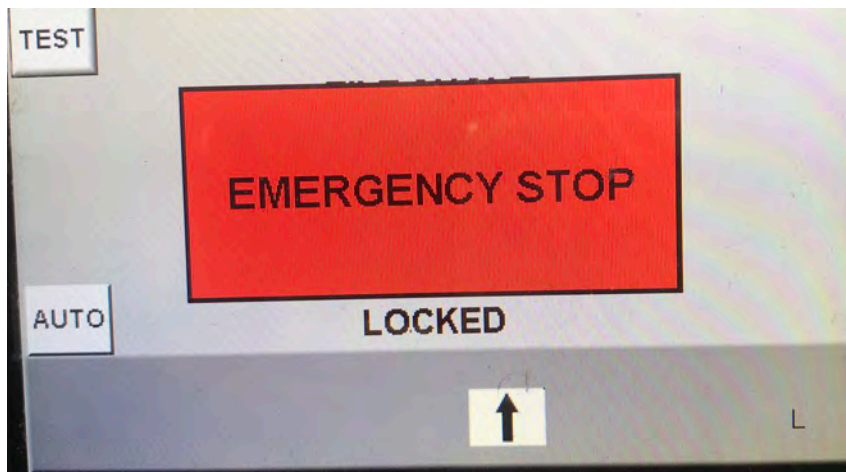


Figure 6-2 Emergency Stop Screen

The quick operation summary is as follows:

1. If using a vehicle, ensure the vehicle is stationary, on level ground and the parking brake is engaged.
2. Ensure there are no obstructions in the tilt system operating space.
3. If the “E-Stop” was activated, it must be reset by turning to enable system operation. Do not reset the “E-Stop” until the cause of the event is corrected. Turn the red “E-Stop” button if needed.

4. To raise the tilt system to 90° and extend the mast, perform the following steps:
 - a. **Display Controller:** Press the Up Arrow until the tilt system raises fully to vertical (90°). Once fully vertical (90°), the Mast Control button will appear in the upper right corner. Press the Mast Control button and then press “OK” to go to the Mast Control Screen. Once in Mast Control, the mast can be raised or lowered using the Up or Down Arrow, respectively. Press the Up Arrow until the mast starts to raise. Once the mast starts to raise, release the “Mast Up” button.

Auto Up Feature: Press the “AUTO” button. Press “OK” after confirming there are no obstructions. Once fully vertical (90°), the Mast Control button will appear in the upper right corner. Press the Mast Control button and then press “OK” to go to the Mast Control Screen. Once in Mast Control, the mast can be raised or lowered using the Up or Down Arrow, respectively. To abort the Auto Features, press any controller button.
 - b. **Control Box:** Hold the UP/DOWN switch up until the tilt system raises fully to vertical (90°). Once the tilt system is fully raised, use the display controller to switch to the Mast Control screen. Hold the UP/DOWN switch up until the mast starts to raise. Once the mast starts to raise, release the UP/DOWN switch.
5. If desired, lower the mast and lower the tilt system to 0° by:
 - a. **Display Controller:** Press the Down Arrow until the mast fully lowers. Once the mast is fully lowered, the Tilt Control button will appear in the upper right corner. Press the Tilt Control button and then “OK” to go to the Tilt Control Screen. Press the Down Arrow until the tilt system fully stows (0°).

Auto Features: Press the “NEST” button. Press “OK” after confirming there are no obstructions. Once the mast is fully retracted, the Tilt Control screen will display. Press “AUTO” and press “OK” after confirming there are no obstructions. To abort the Auto Features, press any controller button. It is recommended to use the Auto Features to nest the mast and stow the tilt system.
 - b. **Control Box:** Hold the UP/DOWN switch down until the mast fully lowers. Once the mast is fully nested, use the display controller to switch to the Tilt Control screen. Hold the UP/DOWN switch down until the tilt system fully stows (0°).

Note: If a button was hit by mistake, a confirmation window for the unwanted function will pop up for 5 seconds. Hit “ESC” or ignore the window for 5 seconds and the window will clear.

6.4.2 Display Controller Controls

This section describes how to operate the tilt system and the mast system with the Display Controller. If an emergency stop is required at any time, press the Emergency Stop Button on the display controller. This will cause all mast and tilt system motion to stop.

6.4.2.1 Initiating (Power-Up)

Perform the following to power up the system:

1. If the E-Stop was activated during prior use, it must be reset by turning to enable the system to power-up. Do not reset the E-Stop until the cause of the event is corrected. Turn the red E-Stop button if needed.
2. Turn on the power source and press the start button on the display controller to power-up the display controller.

On initiation, the tilt system will calculate where the tilt system is in its tilting path and determine the screen that is most suitable for the operator. For example, if the tilt system is at 90°, the Mast Control screen will display. If the tilt system is at 0°, the Tilt Control screen will display.

For trailer units, the locking clamp will open and unlock the mast from the trailer during power-up.

6.4.2.2 Raise Tilt System to the Vertical (90°) Position

The tilt system is fully tilted when it reaches the 90° position. Once the tilt system reaches this position, the mast can be extended.

When the tilt system is at the horizontal position (0°), the display screen shows the Tilt Control screen (Figure 6-3):

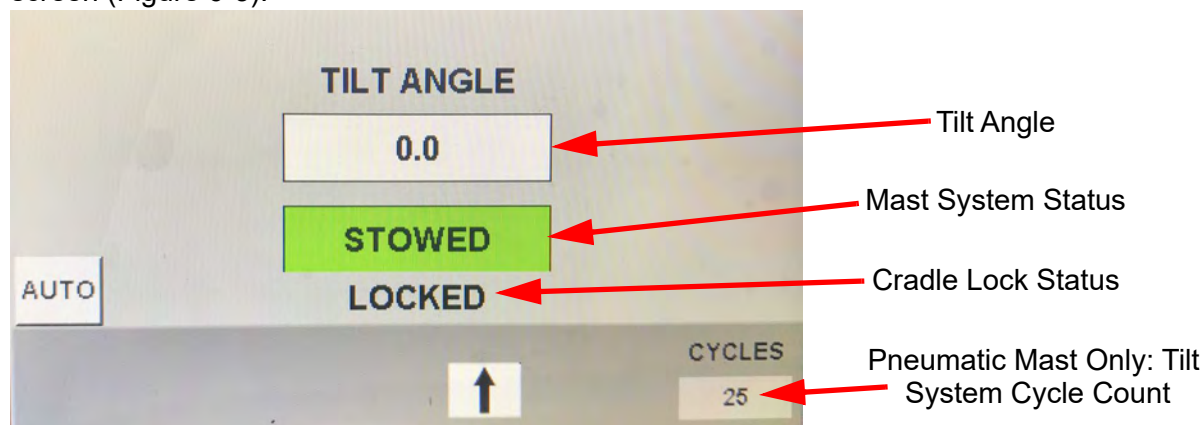


Figure 6-3 Tilt Control Screen

The box below “Cycles” will increment when the tilt system is raised from stowed and returned to stowed again. This number is stored in memory and can be used to determine when maintenance on the tilt system is due.

The tilt system can be tilted by using:

- **Auto Up® Feature**
 - Quickest and most reliable method to raise the tilt system to 90°.
 - Automatically tilts the tilt system to 90°.
 - The Auto Up sequence can be aborted by pushing any of the buttons on the controller at any point during the Auto Up sequence. If the Auto Up sequence is aborted, the tilt system will stop and wait for input from the display controller.
- **Up Arrow:**
 - The tilt system uses a DC powered motor to drive the tilt system from stowed to 90°. The position sensor communicates its position to the display controller. The display controller memorizes the value of the position sensor for the stowed and the 90° position. When the display controller determines the mast is at 90°, the switch the mast control button becomes available.

To raise the tilt system to 90°:

Auto Up® Feature: Press the “AUTO” button. Once you press the “AUTO” button, a notification will pop up asking you to check for obstructions. After ensuring the operation area is clear, press “OK”. The tilt system will raise to 90°.

Up Arrow: Check that there are no obstructions. Once done, press and hold down the Up button to raise the tilt system to 90°. Note: The tilt system will not move until the cradle lock status is unlocked.

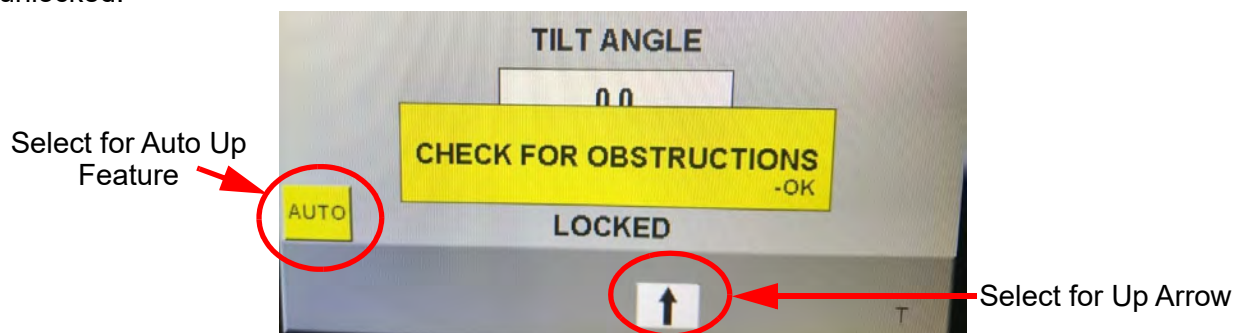


Figure 6-4 Raise Tilt System to 90°

As the tilt system is raising 90°, the display screen will show the tilt angle increasing.

Tilt angle increases
as tilt system raises
to 90°

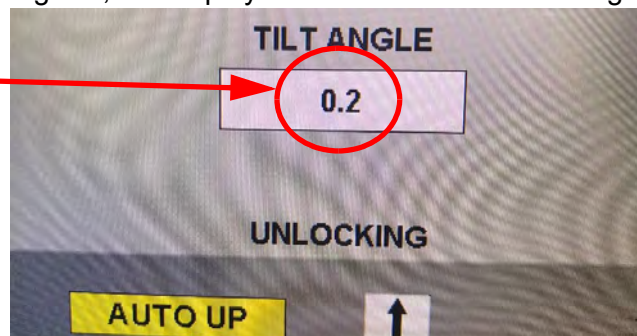


Figure 6-5 Tilt Angle Increases During Tilt to 90°

Once the tilt system is at 90°, the display will show “READY” and the “MAST” button will be visible. The mast is now locked into place and can be operated.



Figure 6-6 Tilt System has Reached 90°

Note: If you stop in between 0° and 90°, the Auto feature is no longer available. Use the Up or Down keys or the UP or DOWN switch on the control box. Stopping at angles between 0° and 90° should be avoided as there are no locks at intermediate angles.

6.4.2.3 Go To Mast Control Screen

To operate the mast, go to the Mast Control Screen:

Select the “MAST” button. A pop up will ask for confirmation to go to mast control. Select “OK”.

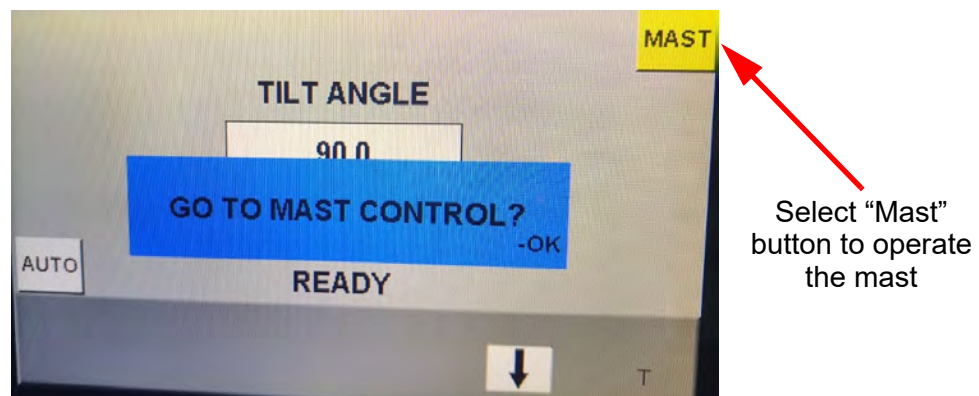


Figure 6-7 Press “OK” to Go to Mast Control Screen

Below is the Mast Control Screen according to your installed mast.

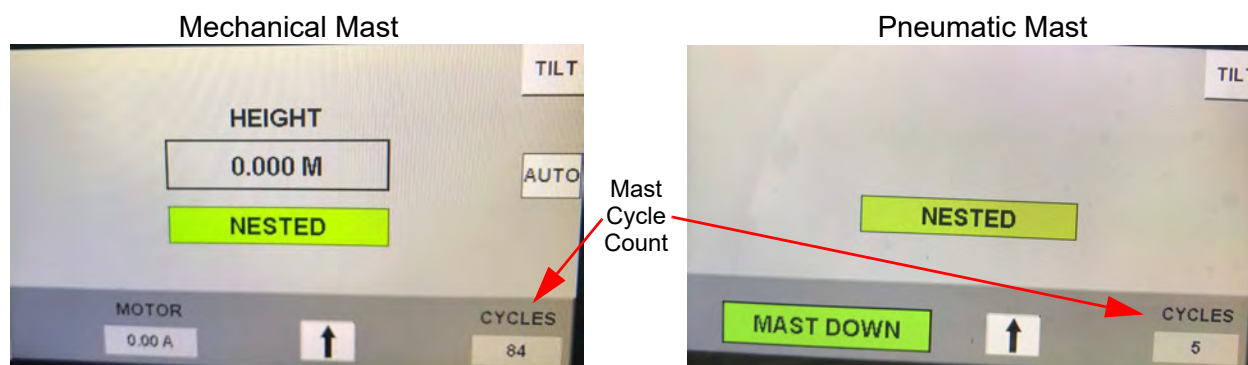


Figure 6-8 Mast Control Screen (Left: Mechanical Mast; Right: Pneumatic Mast)

The box below “Cycles” will increment when the mast is extended from nested and returned to nested again. This number is stored in memory and can be used to determine when maintenance on the mast is due.

6.4.2.4 Mechanical Mast: Input the Mast Auto Up Parameters

To set up the Auto Up parameters for the mast:

1. Select the “AUTO” button. Click “OK”. This is what the Auto Up Input Screen looks like:

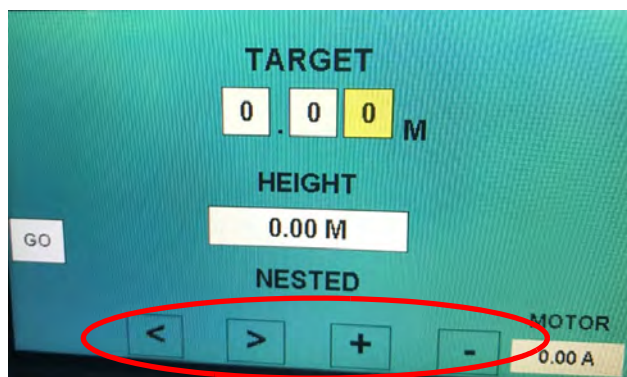


Figure 6-9 Auto Up Input Screen

2. Select the desired height you want the mast to automatically extend to. Use the Up/Down arrows to change the height. Use the Left/Right arrows to choose the value you want to change.
3. Press “GO” once the height has been input.

6.4.2.5 Mechanical Mast: Extend the Mast

After the tilt system reaches 90°, the mast can be extended to full or partial height. The mast can be extended with the Auto Up feature or the Up Arrow.

To extend the mechanical mast:

Auto Up Feature: To make the mast extend to the input height, select the “GO” button. Once the “GO” button is selected, an alert will pop up asking you to check for obstructions. After ensuring the operation area is clear, press “OK”.

The operating current of the mast motor is displayed in the box below “MOTOR”.

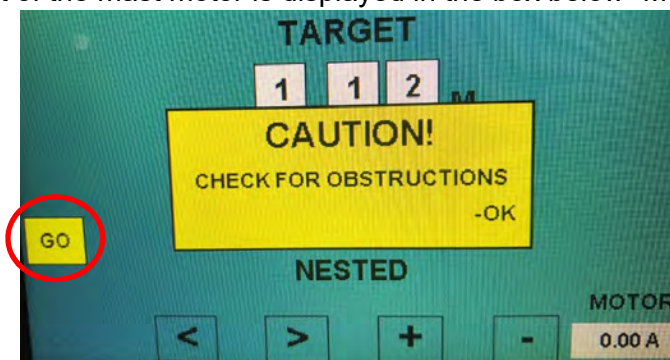


Figure 6-10 After Ensuring There are No Obstructions, Press “OK”

Once the mast reaches the input height, the height tab on the display will show that the height has been reached.

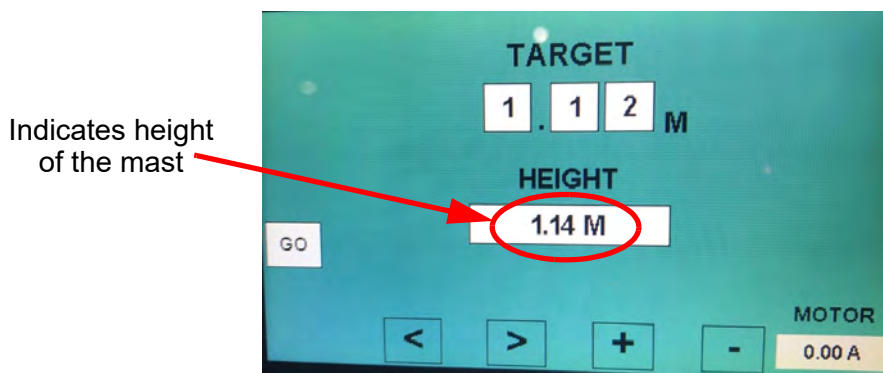


Figure 6-11 Input Height Has Been Reached

Note: Pressing any key during Auto Up will cancel Auto Up and movement will stop.

Up Arrow: Press and hold the Up Arrow until the mast reaches the desired height. As the mast extends, the display screen will show the mast height increasing.

Height increases
as mast extends

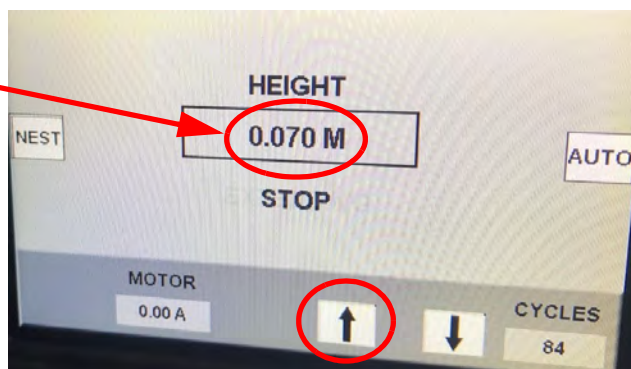


Figure 6-12 Display Shows Mast Height Increasing

Pushing the "Mast Up" button will cause the mast to rise until the "Mast Up" button is released.

When the mast is fully extended, "DEPLOYED" will appear. The UP Arrow will disappear and the extend function is disengaged.

The operating current of the mast motor is displayed in the box below "MOTOR".

6.4.2.6 Pneumatic Mast: Extend the Mast

After the tilt system reaches 90°, the mast can be extended to full or partial height. The mast can be extended with the Up Arrow.

To extend the pneumatic mast:

Press and hold the Up Arrow until the mast reaches the desired height. As the mast extends, the display screen will say "EXTENDING".

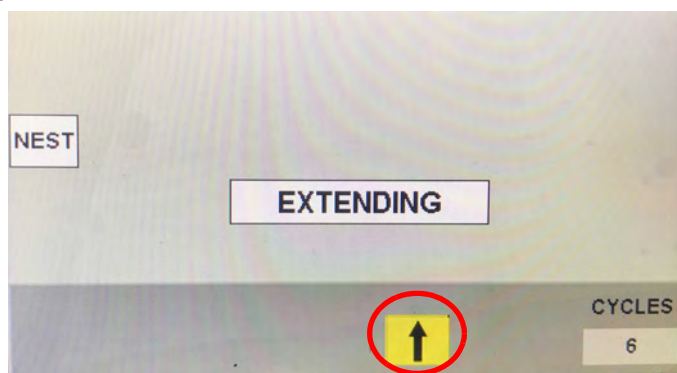


Figure 6-13 Display Screen says "EXTENDING"

Pushing the "Mast Up" button will cause the mast to rise until the "Mast Up" button is released.

6.4.2.7 Lowering the Mast

Pressing the Down Arrow on the Mast Control screen will lower the mast. Continue to press the Down Arrow until the mast reaches the desired height and then release the button.

Mechanical Mast: You can also use the auto feature lower the mast to a desired height from an extended height. To do this, input the desired height (Section 6.4.2.4) and press “GO”. The mast will lower to the programmed height.

6.4.2.8 Mechanical Mast: Nesting the Mast

The nested position is when the mast is fully retracted.

Note: The mast system will stop when the nested position is reached.

To nest the mechanical mast:

Auto Nest Feature: Select the “NEST” button. Once the “NEST” button is selected, an alert will pop up asking you to check for obstructions. After ensuring the operation area is clear, press “OK”.

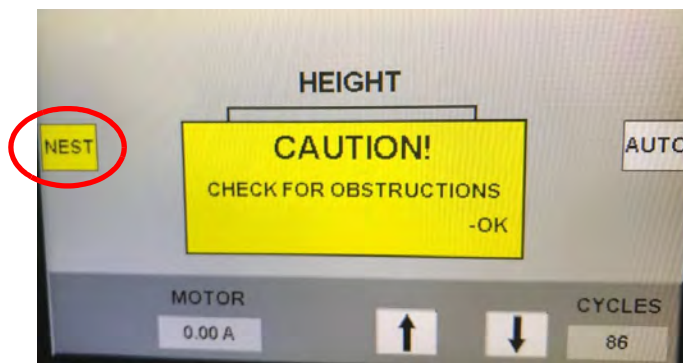


Figure 6-14 Press “OK” to Nest the Mast

As the mast is lowering, the display screen will show the height decreasing.

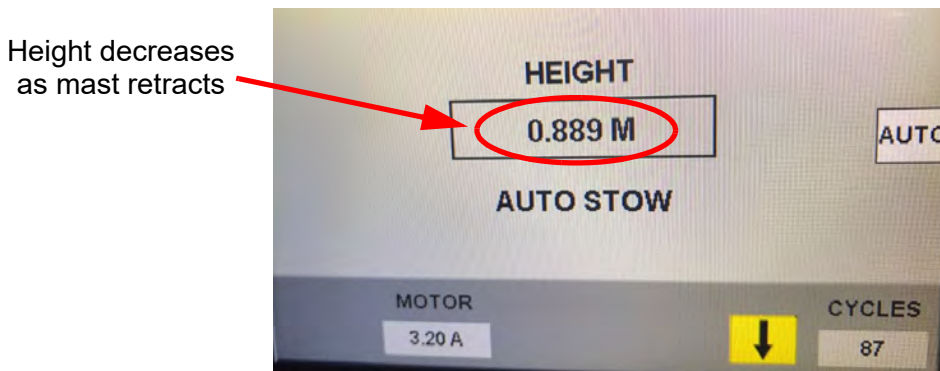


Figure 6-15 Height Decreases as Mast Lowers

Note: Pressing any key will cancel Auto Nest.

Down Arrow: Manually push and hold the Down Arrow to lower the mast. As the mast is lowered, the display screen will show the height decreasing.

Height decreases
as mast retracts

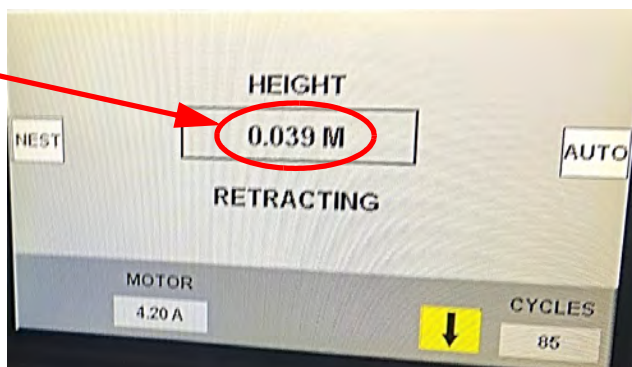


Figure 6-16 Height Decreases as Mast Lowers

6.4.2.9 Pneumatic Mast: Nesting the Mast

The nested position is when the mast is fully retracted.

Note: The mast system will stop when the nested position is reached.

To nest the mast:

Auto Nest Feature: Select the “NEST” button. Once the “NEST” button is selected, an alert will pop up asking you to check for obstructions. After ensuring the operation area is clear, press “OK”.

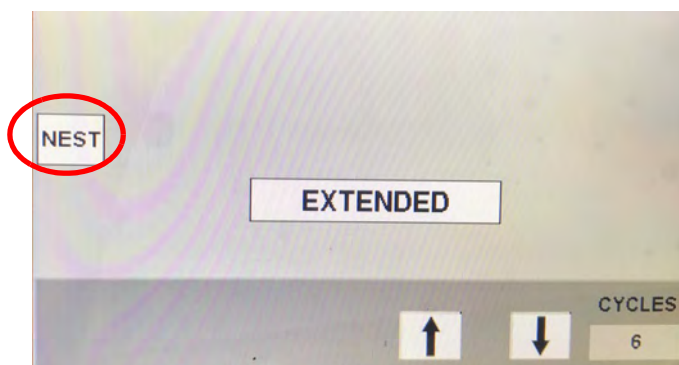


Figure 6-17 Press “OK” to Nest the Mast

Note: Pressing any key will cancel Auto Nest.

Down Arrow: Manually push and hold the Down Arrow to lower the mast. As the mast is lowering, the display screen will say “RETRACTING”.

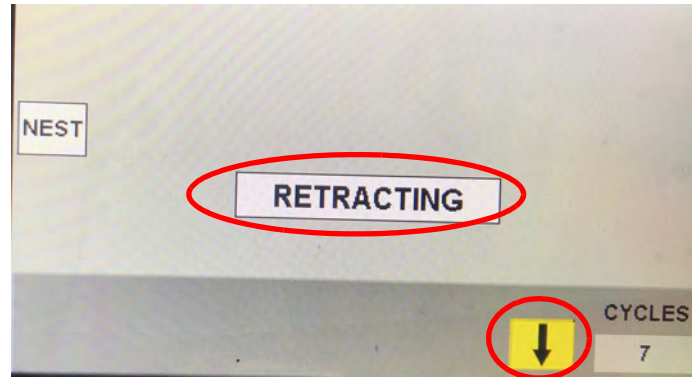


Figure 6-18 Display Screen says “RETRACTING”

6.4.2.10 Lower the Tilt System to the Horizontal (0°) Position

The horizontal (0°) position is also called the "stowed" position. Stowed will appear on the display when the mast is at the horizontal (0°) position and the cradle locks are in the lock position.

The tilt system can be lowered by using:

- **Auto Stow® Feature**
 - Quickest and most reliable method to lower the tilt system to 0°.
 - Automatically tilts the tilt system to 0°.
 - The Auto Stow sequence can be aborted by pushing any of the buttons on the controller at any point during the Auto Stow sequence. If the Auto Stow sequence is aborted, the tilt system will stop and wait for input from the display controller.
- **Down Arrow**
 - Care must be taken to ensure that the operator does not release the button before the tilt system is completely stowed and powered down. If the tilt system is not completely nested, equipment may be damaged during transportation.
- **Emergency Stow Without Power**
 - Used in emergencies when there is no power.
 - Manually tilt the tilt system to 0°.

To lower the tilt system to the horizontal position:

1. Once the mast is fully nested, the Tilt Control screen option will pop up. Select the "TILT" button. Once the "TILT" button is selected, an alert will pop up asking you to confirm that you want to go to the Tilt Control Screen. Press "OK" to confirm.



Figure 6-19 Press "OK" to Go the Tilt Control Screen (Mechanical Mast Control Screen Shown)

2. Once the Tilt Control Screen is active:
 - **Auto Stow:** Select the "AUTO" button. Once the "AUTO" button is selected, an alert will pop up asking you to check for obstructions. After ensuring the operation area is clear, press "OK".
 - **Down Arrow:** Check that there are no obstructions. Once done, press and hold down the DOWN button to lower the tilt system to 0°.

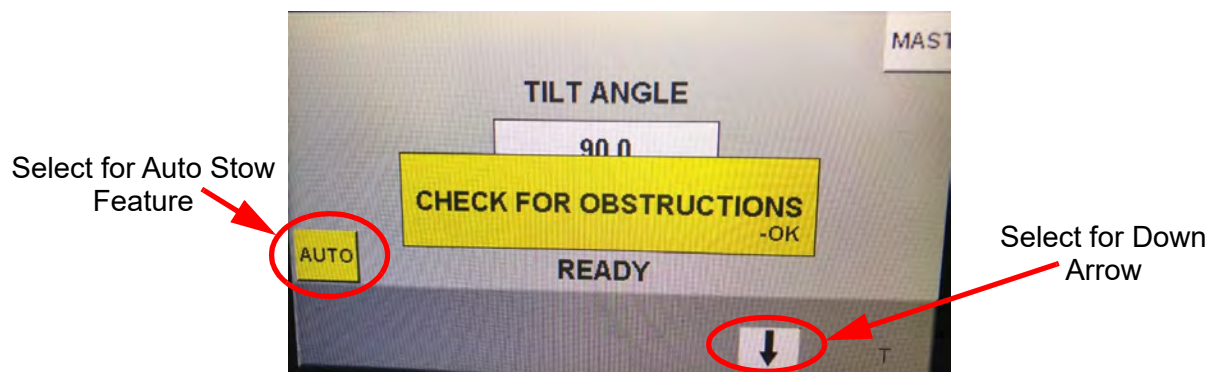


Figure 6-20 Lower Tilt System to 0°

As the tilt system is lowering to 0°, the display screen will show the tilt angle decreasing.



Figure 6-21 Tilt Angle Decreases During Tilt to 0°

Note: If you stop in between 90° and 0°, Auto is no longer available. Use Up or Down keys or UP or DOWN switch on the control box.

6.4.2.11 Power Off the Tilt System

To power off the tilt system, hold both the “OK” and “ESC” buttons at the same time. Continue holding until the screen below (Figure 6-22) is shown.

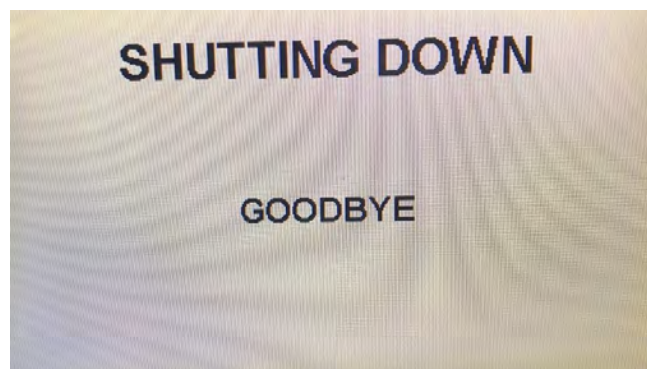


Figure 6-22 Powering Down

For trailer units, the locking clamp will extend and lock the mast to the trailer before powering off.

6.4.3 Control Box Controls

This section describes how to operate the tilt system and how to extend and lower the mast system with the control box. If an emergency stop is required at any time, press the Emergency Stop Button on the control box. This will cause all mast and tilt system motion to stop.

Note: You must use the display controller screen to switch between the tilt system control and the mast control.

Mechanical Mast: The OVERRIDE switch is used with the UP/DOWN switch to ignore any errors returned by the control box in order to operate/retract the mast. Only use the OVERRIDE switch for emergency operation of the mast. Note: The OVERRIDE switch is for mast operation. It does not affect tilt system faults or warnings. Tilt system errors and warnings will need to be resolved before operating the tilt system. See mast operating instructions.

6.4.3.1 Raise the Tilt System and Extend the Mast

To raise the tilt system to the vertical (90°) position and extend the mast:

1. Push back the switch guard covering the UP/DOWN switch (Figure 6-23).



Figure 6-23 UP/DOWN Switch (Left: Mechanical Mast; Right: Pneumatic Mast)

2. Hold the UP/DOWN switch on the control box in the UP position. With the switch held in the UP position, the tilt system will move through the following sequence:
 - a. The cradle locks will rotate, unlocking the tilt system.
 - b. The tilt system will pivot the mast from the horizontal (0°) position to the vertical (90°) position. As long as the UP/DOWN switch is held in the up position, the tilt system will raise and the display will show the appropriate intermediate tilt angle. Be sure to stay clear of the tilt system and tilting path during operation.
 - c. When the tilt system reaches the vertical (90°) position, the tilt system will automatically stop tilting and the cradle locks will rotate, locking the tilt system in place.

3. Select the Mast Control Button on the display controller to operate the mast. Once in the Mast Control screen, hold the UP/DOWN switch on the control box in the UP position. With the switch held in the UP position, the mast will extend from the nested position to the extended position.

As long as the UP/DOWN switch is held in the up position, the mast will extend and the display will show the appropriate intermediate extension height. Be sure to stay clear of the collars during operation as they create a pinch point hazard. The mast will automatically stop extending when it reaches the fully extended height limit.

4. Release the UP/DOWN switch when the desired height is reached.

If the UP/DOWN Switch is released before the maximum extension is reached, the mast will quickly stop and the display controller will show the current extension.

If the UP/DOWN Switch is held long enough, the mast will automatically stop when the Full Extension Limit Switch is reached and the display controller will show the deployed height.

5. Push the switch guard back into position to protect the UP/DOWN Switch.

6.4.3.2 Retract the Mast and Lower the Tilt System

To retract the mast and lower the tilt system to the horizontal (0°) position:

1. Push back the switch guard covering the UP/DOWN switch (Figure 6-24).



Figure 6-24 UP/DOWN Switch (Left: Mechanical Mast; Right: Pneumatic Mast)

2. Hold the UP/DOWN switch on the control box in the DOWN position. With the switch in the DOWN position, the mast will retract. As long as the UP/DOWN switch is held in the DOWN position, the mast will retract and the display controller will show the appropriate intermediate extension height. Be sure to stay clear of the collars during operation as they create a pinch point hazard.

3. Release the UP/DOWN switch when the desired height is reached.

If the UP/DOWN switch is released before the nested position is reached, the mast will quickly stop and the display will show the current extension.

If the UP/DOWN switch is held long enough, the mast will automatically stop when the Full Nested Limit Switch is reached and the display controller will show the nested height.

4. When the mast is fully retracted, select the Tilt Control button on the display controller to operate the tilt system. Once in the Tilt Control screen, hold the UP/DOWN switch on the control box in the DOWN position. With the switch held in the DOWN position, the tilt system will move through the following sequence:
 - a. The cradle locks will rotate, unlocking the tilt system.
 - b. The tilt system will pivot the mast from the vertical (90°) position to the horizontal (0°) position. As long as the UP/DOWN switch is held in the DOWN position, the tilt system will lower and the display controller will show the appropriate intermediate tilt angle. Be sure to stay clear of the tilt system and tilting path during operation.
 - c. When the tilt system reaches the horizontal (0°) position, the tilt system will automatically stop tilting and the cradle locks will rotate, locking the tilt system in place.
5. Release the UP/DOWN switch when the tilt system is fully stowed.
6. Push the switch guard back into position to protect the UP/DOWN switch.

6.5 Emergency Operation Without Power (Manual Operation)

This section describes manual operation of the tilt system. Manual operation is typically only used for emergency operation when power to the system has been lost.

Note: Do not be in area of tilt system path during operation.

To manually raise or lower the tilt system without power:

1. Ensure all power has been disconnected from the system following lock-out tag-out procedures.
2. Ensure mast is fully nested. To manually nest the mast, refer to the manual that shipped with the mast system.
3. Take off both side covers by unlatching the latches. Set aside.
4. If necessary, peel back the sticker covering the back of the lock actuator.
5. Insert a 6 mm hex wrench into the hex drive on the back of the actuator.
6. Turn the 6 mm hex wrench clockwise until the locks rotate and are unlocked.
7. Repeat Steps 4-6 on the other actuator on the other side of tilt system.
8. Once the tilt system is unlocked, remove the cap on the motor.



Figure 6-25 Remove Cap on Motor

9. Insert the Long Crank Handle Assembly in the manual crank point (Figure 6-26).

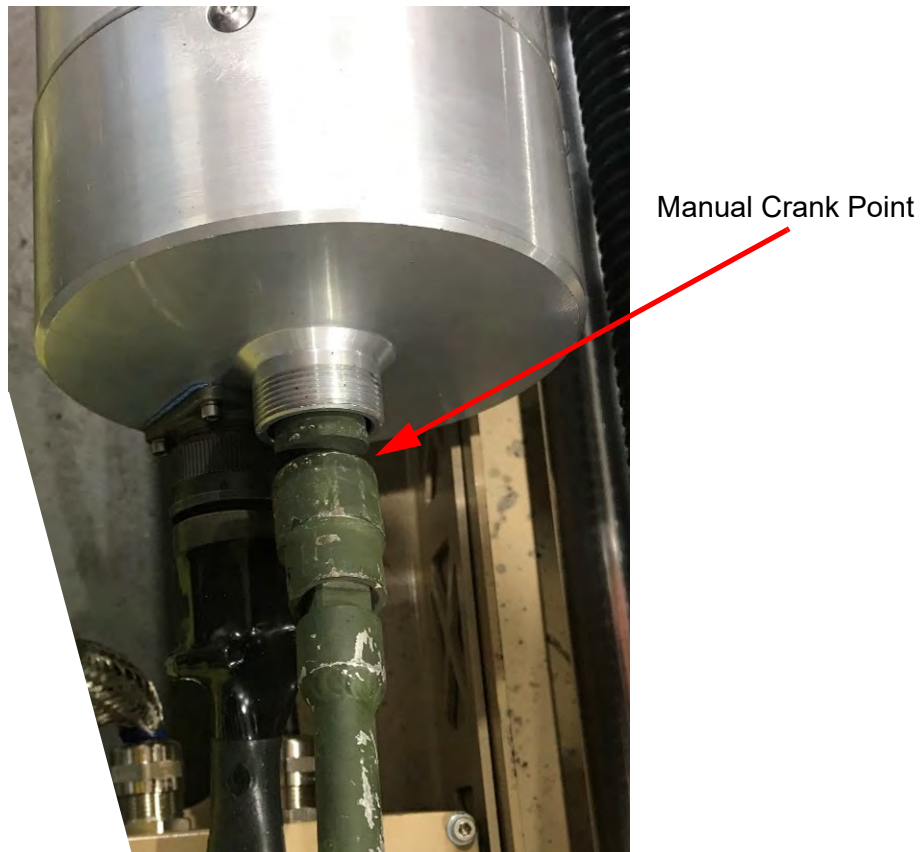


Figure 6-26 Manual Crank Point

10. Use the Long Crank Handle Assembly to:
- Raise the tilt system by turning the Long Crank Handle Assembly clockwise.
 - Lower the tilt system by turning the Long Crank Handle Assembly counterclockwise.

Note: If tilting through the entire range of tilt motion, it may be necessary to adjust the lock positions periodically to prevent contact with the frame or lock seats.

11. Once the tilt system is in the desired position, replace the cap on the motor.
12. Insert the 6 mm hex wrench into the hex drive on the back of the actuator.
13. Turn the 6 mm hex wrench until the locks rotate and are locked.
14. Repeat Steps 12-13 on the other actuator on the other side of tilt system
15. Once the tilt system is locked, replace the side covers.

7 Transportation

Before transporting the system, the system needs to be secured. The exact procedures for transportation will vary based on the system configuration. The process described in this manual represents a possible method of transporting the system. Depending on the environment and equipment available, other methods may work better. Use the best and safest method for your circumstances.

7.1 General Transportation

To prepare the system for transportation:

1. Ensure the mast is fully nested and the tilt system is fully in the horizontal (0°) position. Always visually confirm the mast is fully retracted before tilting the mast. Lift up on the mast payload adapter. There should be no mechanical play that allows the payload to bounce during transport.
2. Remove power from the system to eliminate the possibility of inadvertent operation of the system.
3. Ensure the payload is removed, supported, or otherwise isolated from the top tube to prevent damage to the mast and payload.

Note: The operator should always visually confirm the mast is entirely retracted.

7.2 Shipping

When shipping the tilt system and the mast system, The Will-Burt Company recommends shipping the tilt system and the mast system in their original shipping crates. If the original shipping crates are not available, contact The Will-Burt Company to order replacements.

When shipping:

1. Remove the payload.
2. Uninstall the mast system from the tilt system.
3. Prepare the mast system for transportation (refer to the manual that shipped with the mast system).
4. Properly secure the mast system in the correct shipping crate.
5. Uninstall the tilt system from the mounting structure.
6. Prepare the tilt system for transportation.
7. Properly secure the tilt system in the correct shipping crate.

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8 Maintenance, Adjustments and Disposal

This section describes the routine maintenance and adjustment procedures required to keep your system operational. Be sure to read and understand the entire operation procedure and the Safety Summary Section 1 before beginning any maintenance or adjustment procedure.

8.1 Maintenance Equipment

Table 8-1 lists recommended equipment for maintenance.

Table 8-1 Recommended Installation Tools & Materials

Tools and Materials		
Safety Glasses	Safety Gloves	Safety Shoes
Hard Hat or Helmet	Hearing Protection	Nitrile or Vinyl Gloves
Wrenches	Screwdrivers	Paint Brushes
Torque Wrench	Wire Brush	Rags (Soft, Clean and Dry)
Touch-Up Paint	Sling	Non-Abrasive Cleaners (Soap and Water)
Hoist	Throw-Away Brush	Lubricant (P/N: 5978001) (for Drive Screw)
<p>*Note:</p> <ul style="list-style-type: none"> Depending on the local, regional, and national standards and codes of practice, and the environment, additional personal protective equipment may be necessary. When disposing of any disposables or components, do so according to any applicable local, regional, and national standards and codes of practice. 		

8.2 Pre-Maintenance Check

Before performing maintenance procedures, ensure:

- The system is level and secure
- If necessary, the payload is removed prior to performing maintenance on the system.

8.3 Power Isolating Procedure

Remove all power sources from the mast system including mast controls, lighting power, auxiliary device power before performing any maintenance operation on the mast system other than optional cleaning and lubricating. Use proper lock-out tag-out procedures.

To isolate power to the mast and tilt system:

1. Operate the tilt system and mast to the desired position for the maintenance procedure.
2. Press and hold down the “ESC” and “OK” buttons simultaneously until the mast and tilt system powers down.
3. Disconnect all power sources using lock-out tag-out procedures. It is recommended that the vehicle ignition keys be held by the maintenance engineer as an additional precaution to prohibit unexpected power up.

Refer to Section 6.4.2 for power-up procedure once maintenance is complete.

8.4 Cleaning the System

Signs that cleaning is needed can be a noticeable gritty film on the exterior surfaces of the tilt system. To clean the system:

1. While at 90°, wipe down the base using a soft cloth or sponge and a mild solution of soapy water.
2. While at 0°, wipe down the cradle using a soft cloth or sponge and a mild solution of soapy water.

8.5 Cleaning and Lubricating the Drive Screw

The drive screw comes from the factory pre-lubricated but will need to be re-lubricated in certain circumstances. Use the lubricant that was supplied with the tilt system (P/N: 5978001).

Apply the lubricant to the screw drive when:

- 500 cycles have been completed (routine maintenance); In salty or sandy environments, lubricate the drive screw monthly
- There is noisy operation of the tilt system

To lubricate the drive screw:

1. Remove the cover on the left side to expose the drive screw.
2. Inspect the drive screw for dust, dirt, sand, debris, etc.
3. Wipe down the drive screw with a dry rag to remove any dust, dirt, sand, debris, etc.
4. Using a throw-away brush, apply a light layer of grease all across the drive screw. There does not need to be a lot applied, just enough to coat the drive screw.
5. Wait several minutes to allow the lubricant to settle.
6. Replace the cover on the drive screw side.

8.6 Spare Parts

To order spare or replacement parts, always refer to the mast model number and serial number. The model number, serial number, and additional information is located on the mast Identification Plate on the mast base. To order spare parts, contact The Will-Burt Company.

8.7 Periodic Inspections

This section describes the systematic care and inspection of equipment to keep it in safe operating condition and to prevent breakdowns. If the system does not perform as required, see Section 9 for troubleshooting. If anything looks wrong and cannot be diagnosed and/or fixed, contact The Will-Burt Company. Table 8-2 provides a schedule of periodic inspections and procedures required to keep the tilt system in safe operating condition.

Table 8-2 Periodic Inspections

Frequency	Inspection	Action
As Needed; In salt water or sandy environments, clean the tilt system every 3 months.	Keep Clean - Inspect to ensure the tilt system is kept clean and free from foreign material. Dirt, grease, oil, sand and debris may cover up a serious problem.	Clean as you work and as needed. Use denatured alcohol on all metal surfaces. Use water when cleaning rubber or plastic material. Use soap and water when cleaning the exterior surfaces. Use a soft, non-abrasive cloth to wipe clean the bezel on the control box display. Clean the tilt system per the procedure in Section 8.4.
Every 500 Cycles; In salt water or sandy environments, lubricate the drive screw monthly	Lubricate Screw in the Motor Box - Will need re-lubricated every 500 cycles. Will also need re-lubricated if there is noisy operation of the tilt system.	Lubricate the drive screw every 500 cycles or if there is noisy operation of the tilt system. See Section 8.5.
During Operation	Damage - Inspect for damage before use. During operation, inspect the outer surfaces for damage.	If damage is apparent, do not use the system, and have it serviced prior to use.
During Operation	Binding - During operation, observe system operation for evidence of binding.	Remove any foreign material or obstructions as necessary.
Weekly	Damage - Inspect all visible surfaces for damage.	If damage is apparent, do not use the system and have it serviced before use.
Monthly	Test the Vehicle Interconnect safety warning circuit to ensure the vehicle driver is warned or prevented from driving with the mast deployed.	Repair the interconnect circuit if not functioning properly.
Weekly	Finish - Inspect for bare metal, rust, and corrosion.	Remove any rust or corrosion with a wire brush. Apply touch-up paint to any bare metal.

Table 8-2 Periodic Inspections (Continued)

Frequency	Inspection	Action
Monthly	Fasteners - Inspect all hardware to ensure fasteners are not damaged, loosening, bent, backing out or missing. Take special note of hardware used to mount the tilt system to the support structure. Look for chipped paint, bare metal, or rust around the bolt heads.	Tighten or replace any loose, damaged or missing fasteners. If any hardware is found loose, retighten. If loose fasteners joining major components cannot be tightened, do not use the system and have it serviced before use.
Weekly	Cables - Inspect system cables. Look for cracked, frayed, or broken insulation; bare wires; loose or broken connectors. Ensure the cables and bulkhead connectors are clean, the pins undamaged, and the threads in good condition.	Replace cables as required. Tighten loose connections. If the bulkhead connectors are unable to mate with the corresponding cable, do not use the system and have it serviced before use.
Yearly	Test the function of the emergency stop button to ensure it is working properly.	Replace defective parts.

8.8 Adjusting and Calibrating Positions

The following sections define and explain procedures regarding the positions available for adjustment, which are:

- 0 DEG (Section 8.8.2.1)
- 90 DEG (Section 8.8.2.2)
- Middle Zone (Section 8.8.2.3)

For more information, see www.willburt.com or contact The Will-Burt Company.

Note: Before calibrating and adjusting the tilt system, remove the covers on the tilt system.

8.8.1 Enter Adjustment Mode and Screen

When the customer receives the system, it should already be calibrated. Under normal operating conditions, calibration should not be necessary.

Note: Use caution in calibration. Locks do not automatically adjust and it is possible to move tilt beyond 0° and 90°. Damage to the system could occur.

To adjust the actuator and locks parameters in the tilting path, the system will need to be in the Tilt Control screen (Figure 8-1).



Figure 8-1 Tilt Control Screen

To enter the Tilt Calibration Screen, press the Up and Down Arrows at the same time. A window will pop up confirming that the operator wants to calibrate the tilt system. Press “OK” to confirm. If you wait more than 5 seconds or press “ESC”, the window will disappear and normal operation will resume.

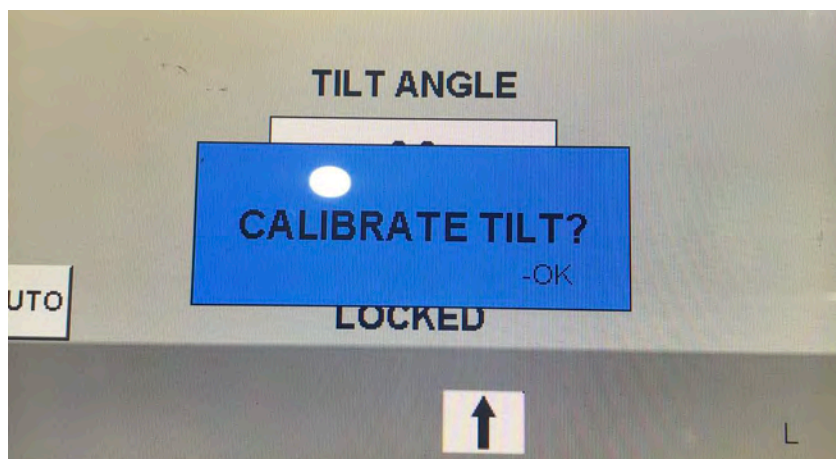


Figure 8-2 Press “OK” to Calibrate Tilt System Parameters

8.8.2 Actuator Calibration and Adjustment to Set Locks and Positioning in Tilting Path (Mechanical Mast)

To input the actuator parameters, there are 3 different zones that need to be programmed. The zones that need to be programmed are:

1. 0 DEG
2. 90 DEG
3. Middle Zone

It is recommended to have two people perform this process. One person must observe the tilt locks to ensure they do not cause any damage to the tilt base. The other person must control the display controller and input the parameters. It is possible for one person to input the parameters, but it may take longer because they must be more cautious and tilt the system carefully and slowly.

8.8.2.1 0 DEG

The 0 DEG parameter is the horizontal (0°) position of the tilt system. The 0 DEG tab is preset to start at the 5000 value.

To program the 0 DEG parameter:

1. Make sure that the Tilt Control screen (Figure 8-1) is active.
2. Press “UP” and “DOWN” buttons at the same time. Press “OK” to confirm. The Tilt Calibration screen should now be visible (Figure 8-3).

Once in the Tilt Calibration screen, the selected input slot will be lit yellow. To change which input parameter is selected, use the “NEXT” button to select different input slots.

After the correct information has been entered, press the “SAVE” button to save the newly programmed information.



Figure 8-3 Tilt Calibration Screen

3. **Adjust the LOCKS parameters:** In the 0 DEG quadrant, the LOCKS parameter controls the angle the locks are in when in the horizontal position (0°) and extending the mast to the vertical (90°) position. The positioning of the locks allow the tilt system to move or remain locked in place. Move the left and right keys to adjust the input on the locks (both lock inputs adjust at the same time). In the tilting path arc, move the locks so they do not clash into anything.
4. **Adjust the POSITION parameter:** The POSITION parameter is the current positioning of the tilt system in the tilting path. Press either the Up or Down Arrows to move the tilt system. You can also use the UP/DOWN switch on the control box to move the tilt system's position.
5. **Enter a new 0 DEG position:** At 0 DEG, save the position for 0 DEG. Move the locks so that they are vertical and roughly perpendicular to the base. This is the lock position and can be saved. After this position is saved, move the locks so they will be free from the base when the system is tilted up. This is the unlock position and can be saved.

Once the lock and unlock positions are saved, the tilt system will automatically move the locks to those positions in tilt control when the tilt system is raising to the 90° position.

Note: Locks do not automatically adjust in calibration mode. When raising the tilt system, it will be necessary to adjust locks to avoid crashing.

6. Once the tilt system programming is complete for the 0° position, the operator will need to program the positioning for the 90° position.

8.8.2.2 90 DEG

The 90 DEG parameter is the vertical (90°) position of the tilt system and where the mast is ready to deploy.

To program the 90 DEG parameters:

1. Make sure that the Tilt Calibration screen is active. If the display is in Tilt Control, press the “UP” and “DOWN” buttons at the same time. Press “OK” to confirm. The Tilt Calibration screen should now be visible (Figure 8-4).

Once in the Tilt Calibration screen, the selected input slot will be lit yellow. To change which input parameter is selected, use the “NEXT” button to select different input slots.

After the correct information has been entered, press the “SAVE” button to save the newly programmed information.



Figure 8-4 Tilt Calibration Screen

2. **Adjust the LOCKS parameters:** In the 90 DEG quadrant, the LOCKS parameter controls the angle the locks are in when in the vertical (90°) position and lowering the mast to the horizontal (0°) position. The positioning of locks allow the tilt system to move or remain locked in place. Move the left and right keys to adjust the input on locks (both lock inputs adjust at the same time). In the tilting path arc, move the locks so they do not clash into anything.
3. **Adjust the POSITION parameter:** The POSITION parameter is the current positioning of the tilt system is in the tilting path. Press either the Up or Down Arrows to move the tilt system. You can also use the UP/DOWN switch on the control box to move the tilt system's position.

4. **Enter a new 90 DEG position:** At 90 DEG, save the position for 90 DEG. Move the locks so that they are vertical and roughly perpendicular to the base. This is the lock position and can be saved. After this position is saved, move the locks so they will be free from the base when the system is tilted down. This is the unlock position and can be saved.

Once the lock and unlock positions are saved, the tilt system will automatically move the locks to those positions when the display is in tilt control.

Note: Locks do not automatically adjust in calibration mode. When lowering the tilt system, it will be necessary to adjust locks to avoid crashing.

5. Once the tilt system programming is complete for the 90° position, the operator will need to program the positioning for the Middle Zone.

8.8.2.3 Middle Zone

One final calibration to adjust is a middle zone. The middle zone parameter is between the 0° and 90° positions. The middle zone tells the tilt system how to move its locks in the tilting path arc so that no damage is done to the tilt system's structure during movement.

To program the middle zone parameters:

1. Make sure that the Tilt Control screen is active.
2. Press "UP" and "DOWN" buttons at the same time. Press "OK" to confirm. The Tilt Calibration screen should now be visible (Figure 8-5).

Once in the Tilt Calibration screen, the selected input slot will be lit yellow. To change which input parameter is selected, use the "NEXT" button or the "SELECT" button to select different input slots.

After the correct information has been entered, press the "SAVE" button to save the newly programmed information.

3. Press “Add ZN” which stands for Add Zone (Figure 8-5). Press “OK” to confirm.



Figure 8-5 Press Add Zone Button

Here is the Add Zone screen (Figure 8-6).

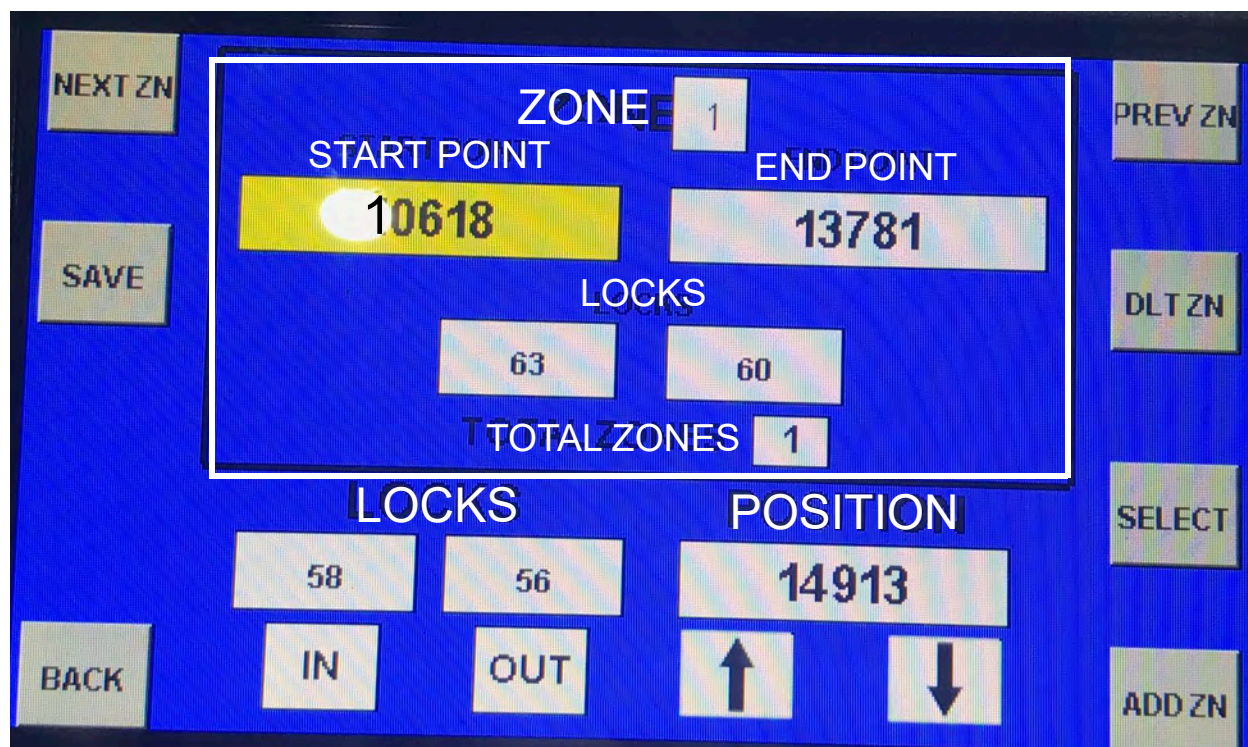


Figure 8-6 Add Zone Screen

To go back to the regular Tilt Calibration screen, press the “BACK” button.

4. Consult Figure 8-7 while programming the Middle Zone parameters.

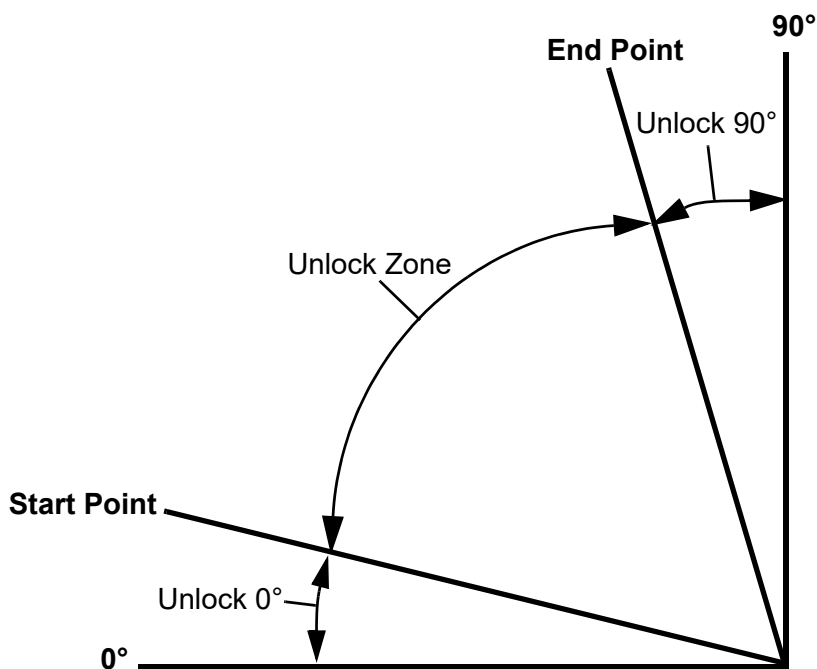


Figure 8-7 Middle Zone Parameters in Tilting Path Arc

5. **Adjust the START POINT parameter:** The START POINT parameter is the lower limit of the zone. The lower limit is closest to the 0° angle (Figure 8-7).

To adjust the locks, move the left and right keys (both lock inputs adjust at the same time). In the tilting path arc, move the locks so they do not clash into anything.

To adjust the position, press either the Up or Down Arrows to move the tilt system. You can also use the UP/DOWN switch on the control box to move the tilt system's position.

6. **Adjust the END POINT parameter:** The END POINT parameter is the upper limit of the zone. The upper limit is closest to the 90° angle (Figure 8-7).

To adjust the position, press either the Up or Down Arrows to move the tilt system. You can also use the UP/DOWN switch on the control box to move the tilt system's position.

Once the start point and end point positions are saved, the tilt system will automatically move the locks to those positions when the tilt system is lowering from the 90° position.

There is the option to add more zones, however, if done correctly, only 1 zone will need to be added.

Once the tilt system programming is complete for the 0° position, 90° position and the Middle Zone, the tilt system is ready for operation.

8.8.3 Return to Tilt Control Screen

To exit the calibration screen and return to the Tilt Control screen, press the Up and Down arrows at the same time. Press "OK" to confirm. The confirmation window will disappear after 5 seconds if "OK" is not pressed.

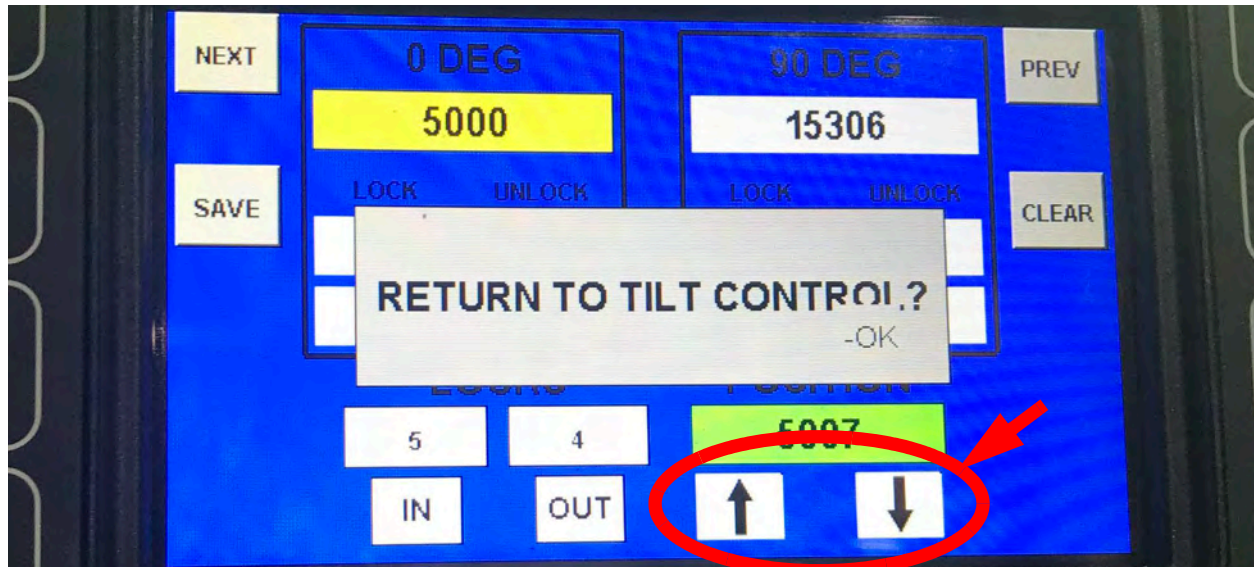


Figure 8-8 Press Up and Down Arrows at the Same Time to Return to Tilt Control Screen

8.9 System Disposal

Dispose of the mast in accordance with the national environmental regulations.

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9 Troubleshooting

This section describes system troubleshooting information. Please contact The Will-Burt Company if these guides do not solve the issue. Be sure to read and understand the entire operation procedure and the Safety Summary Section 1 before beginning any maintenance or troubleshooting procedure.

9.1 Error Screens

When something is not working correctly, the display controller will show an error screen. These screens are either a red error screen, red fault screen or a yellow warning screen. At the top of the notice box, it will either say “ERR”, “FAULT” or “WARNING” with the reason for the error written underneath.

When an error screen or a fault screen occurs, the system is completely disabled and will not move until the issue is fixed. When a warning screen occurs, the system can still be used and moved, but the operator should fix the issue.

Below is an example of an error screen.

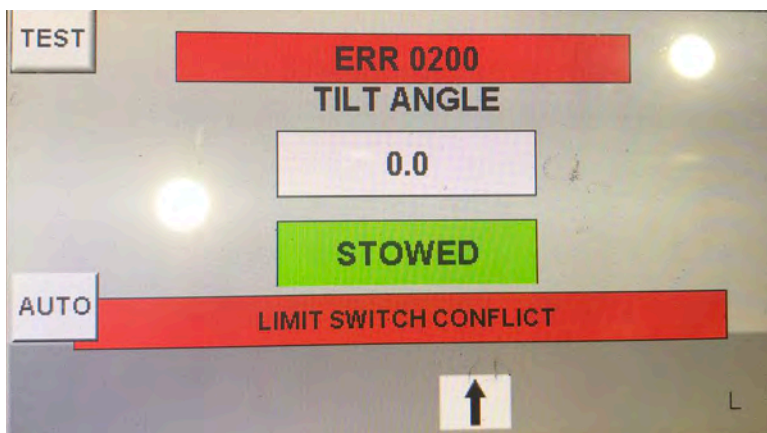


Figure 9-1 Example of a Error Screen

9.2 Troubleshooting Electrical

This section includes a list of warning and fault notices and their potential causes. Warning notices do not stop motion or use, but let you know of potential issues. Fault codes point out problems and usually inhibit operation to prevent potential damage. These notices are shown on the display controller.

Table 9-1 Tilt System Errors, Warnings and Faults

Description	Type	Probable Cause	Remedy
Mechanical and Pneumatic			
Lock actuator start-up failure. This is annunciated in the WB logo screen. System will not start if this happens	Fault	<ul style="list-style-type: none"> • Actuator not connected. • Actuator lost power. • Actuator failed. 	<ul style="list-style-type: none"> • Check actuator connections and cables. • Check fuses on junction board in control box. • Replace actuator.
Actuators out of sync	Fault	There is an obstruction preventing actuator from operating.	<ul style="list-style-type: none"> • Check for obstruction. • Recalibrate actuators.
Tilt limit	Fault	<ul style="list-style-type: none"> • Tilt has traveled past 0° or 90° and activated one of the tilt limit switches. • May be another underlying fault. 	<ul style="list-style-type: none"> • Manually reposition tilt system between 0° and 90°. • Check for other fault annunciations.
Tilt motor brake failure	Fault	<ul style="list-style-type: none"> • Connection to tilt motor is faulty. • Brake on tilt motor has failed. 	<ul style="list-style-type: none"> • Check connector on tilt motor is seated properly. • Check cable from contactor box tilt motor. • Replace tilt motor.
Encoder failed to start	Fault	Tilt sensor did not complete start-up sequence.	Check connections and cable between the encoder and the control box.
Encoder offline	Fault	Connection with the tilt sensor was lost.	Check connections and cable between the encoder and the control box.
Encoder Fault/ Encoder Emergency	Fault	Tilt sensor has encountered a serious problem.	<ul style="list-style-type: none"> • Check connections and cable between the encoder and the control box. • Encoder may need to be replaced.

Table 9-1 Tilt System Errors, Warnings and Faults (Continued)

Description	Type	Probable Cause	Remedy
Mechanical Only			
Low Voltage Warning	Wrn 0002	System voltage is below 20V, nut remaining above 18.	<ul style="list-style-type: none"> • Check power supply. • Replace/charge batteries.
Low Voltage Fault	Err 0001	System voltage is below 17V.	<ul style="list-style-type: none"> • Check power supply. • Replace/charge batteries.
Low Temperature Warning	Wrn 0008	Low ambient temperature below -40°C	Operate in warmer ambient temperature.
High Temperature Warning	Wrn 0004	High ambient temperature below 80°C	<ul style="list-style-type: none"> • Control box may be in direct sunlight. Shade the controls. • Operate in lower ambient temperature.
Limit Switch Conflict	Err 200	Up and Down limit switches are active at the same time (not physically possible)	<ul style="list-style-type: none"> • Switch(es) require adjustment or recalibration • Switch(es) failed and require replacement(s) • Cable or connection failure
Mast Motor Over-Current	Err 0002	Control Box detects 80 Amps for more than 5 seconds	Excessive Motor current due to mast resistance, excessive payload, or drive system binding
Up Switch is stuck on	Err 0004	Local Up Switch active for excessive time period	<ul style="list-style-type: none"> • Switch is being held on • Switch is damaged • Water ingress may be activating switch input • Cable or connection failure
Down Switch is stuck on	Err 0010	Local Down Switch active for excessive time period	<ul style="list-style-type: none"> • Switch is being held on • Switch is damaged • Water ingress may be activating switch input • Cable or connection failure
Down Limit switch failure	Err 0040	From Nested position, Up Switch active for more than 2 seconds with no Down limit switch change	<ul style="list-style-type: none"> • Switch requires adjustment or recalibration • Switch failed and requires replacement • Drive system damaged

Table 9-1 Tilt System Errors, Warnings and Faults (Continued)

Description	Type	Probable Cause	Remedy
Up Limit switch failure	Err 0080	From Fully deployed position, Down Switch active for more than 2 seconds with no Up limit switch change	<ul style="list-style-type: none"> • Switch requires adjustment or recalibration • Switch failed and requires replacement • Drive system damaged
Override Switch Stuck	Err 0100	OVERRIDE Switch has been active for an excessive time period	<ul style="list-style-type: none"> • Switch is being held on • Switch is damaged • Water ingress may be activating switch input
Temperature Sensor Failure	Wrn 0010	Invalid (or no) response from Temperature Sensor	<ul style="list-style-type: none"> • Temperature Sensor failed and requires replacement • Temperature Sensor Wiring damaged and requires repairs or replacement
Height Sensor Failure	Wrn 0020	Pulses not detected during mast positioning	<ul style="list-style-type: none"> • Pulse counter requires adjustment or recalibration • Pulse counter failed and requires replacement • Pulse counter wiring damaged and requires repairs or replacement
Conflicting Input Commands	Wrn 0001	Both Up and Down switches detected simultaneously	<ul style="list-style-type: none"> • One or both Switch(es) are being held on • One or more Switch(es) are damaged • Water ingress may be activating switch input(s) • Cable or connection failure

9.3 Troubleshooting Mechanical Symptoms

This section describes mechanical troubleshooting. Table 9-2 lists some problems that may be observed, but may not generate an error or warning code on the controller.

Table 9-2 Mechanical Symptoms and Troubleshooting Sequence

Symptom	Root Issue	Troubleshooting Sequence
Tilt system sticking during extension or retraction	Tilt system is dirty and/or requires lubrication	1) Clean and lubricate tilt system 2) If condition continues, tilt system requires overhaul
Erratic or noisy when raising to 90°	Bent or worn actuator or pivot shaft	Replace damaged component
Tilt system fails to fully stow and disconnects power	The tilt system no longer remembers the proper calibration positioning	Recalibrate actuator. See Calibration Section
Tilt system will not begin to lower from 90° position	The tilt system no longer remembers the proper calibration positioning	1) Follow Emergency Operation Without Power procedure 2) Start tilt system again 3) Recalibrate positions. See Calibration Section 3) If this still does not resolve the problem, contact Will-Burt Service

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10 Document History

Table 10-1 Document History

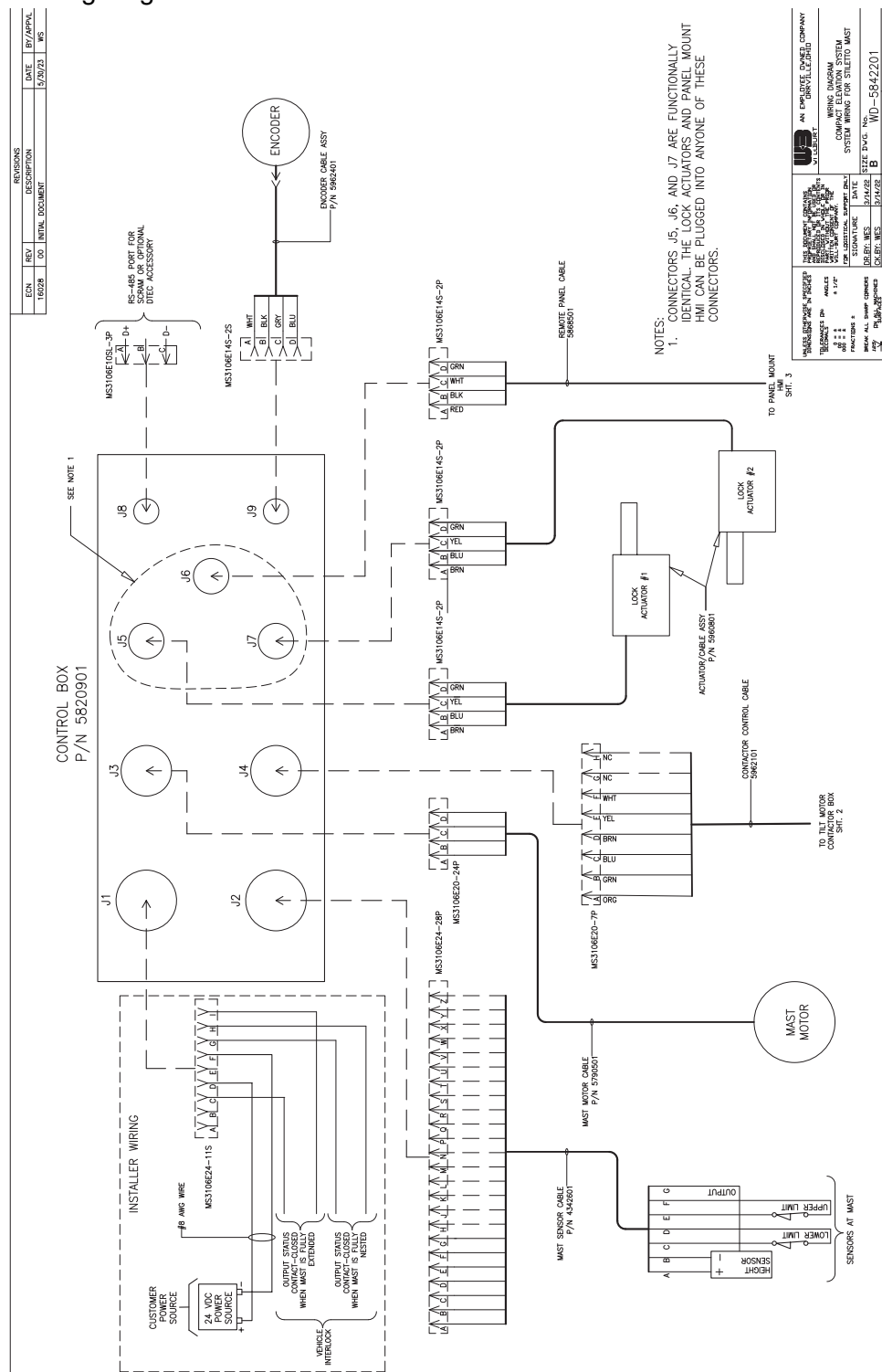
Document Revision	Date	Change Details	Changes Backward Compatible with Previous Manual Version
TP-5986201-00	Nov. 2023	Initial Release	--

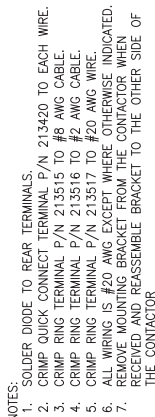
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11 Appendix

11.1 System Wiring Diagrams

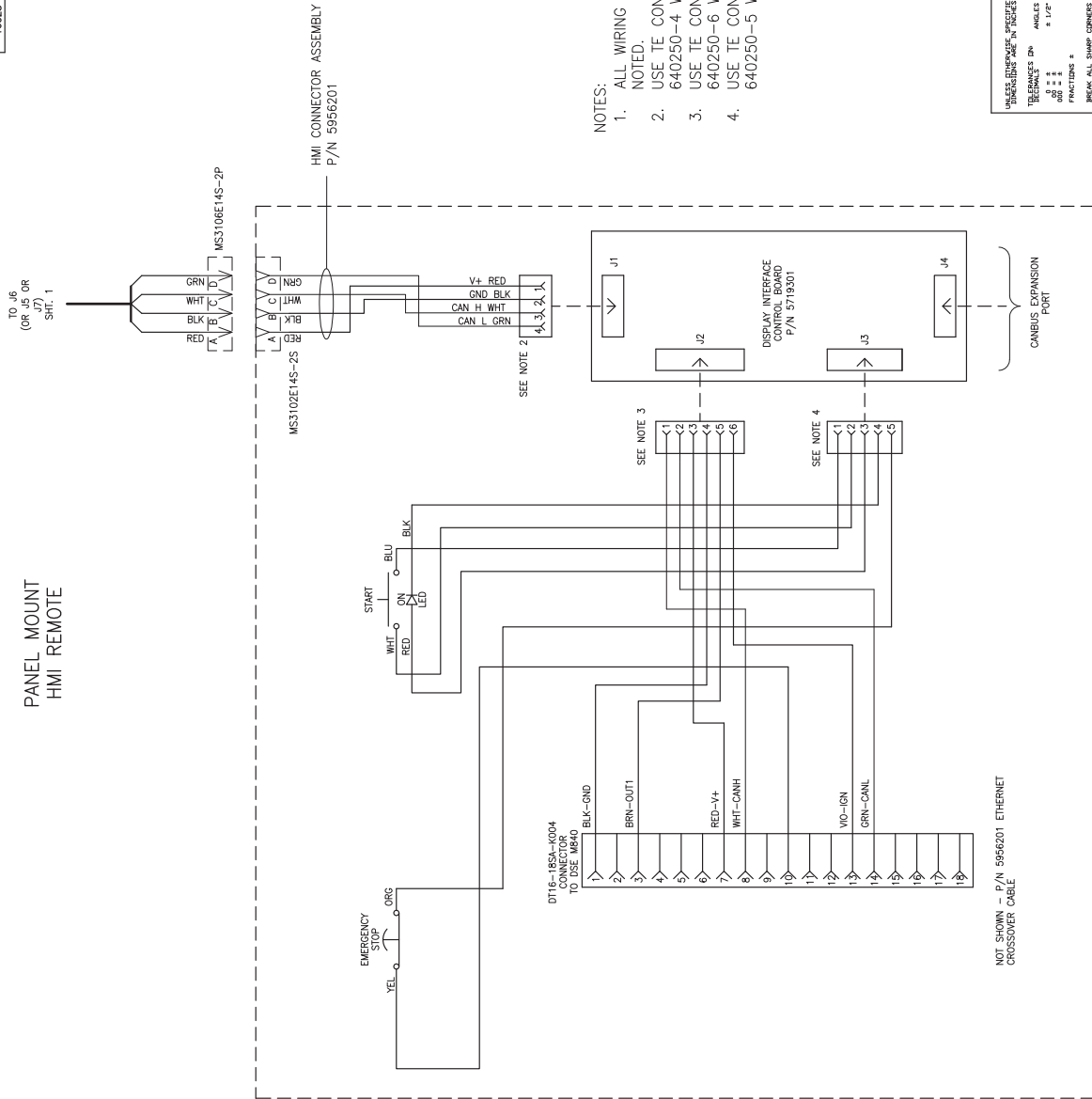
The system wiring diagrams are as follows:



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REVISIONS			
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			BY/APPV: WS

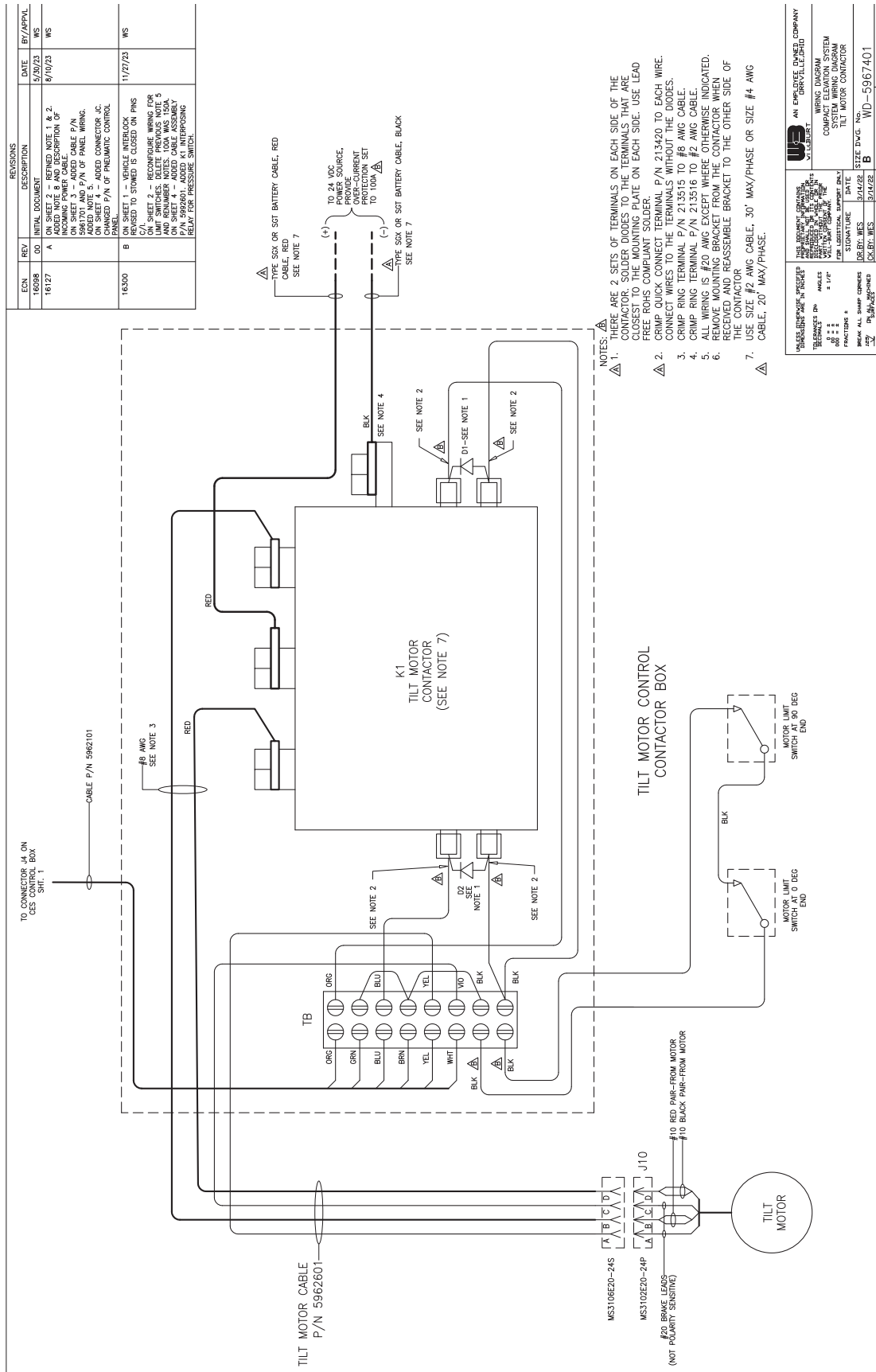
PANEL MOUNT
HMI REMOTE

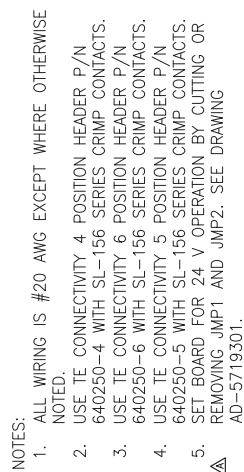


- NOTES:
1. ALL WIRING IS #20 AWG EXCEPT WHERE OTHERWISE NOTED.
 2. USE TE CONNECTIVITY 4 POSITION HEADER P/N 640250-4 WITH SL-156 SERIES CRIMP CONTACTS.
 3. USE TE CONNECTIVITY 6 POSITION HEADER P/N 640250-6 WITH SL-156 SERIES CRIMP CONTACTS.
 4. USE TE CONNECTIVITY 5 POSITION HEADER P/N 640250-5 WITH SL-156 SERIES CRIMP CONTACTS.

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WILL-BURT AN EMPLOYEE OWNED COMPANY DRIVELLEE, OHIO	WIRING DIAGRAM COMPACT ELEVATION SYSTEM SYSTEM WIRING DIAGRAM PANEL MOUNT DISPLAY
DATE 3/14/22	SIGNATURE DR. B. WES
DATE 3/14/22	SIGNATURE DR. B. WES
SIZE DWG. NO. B WD-5842201	SCALE NTS
SHEET 3 OF 3	

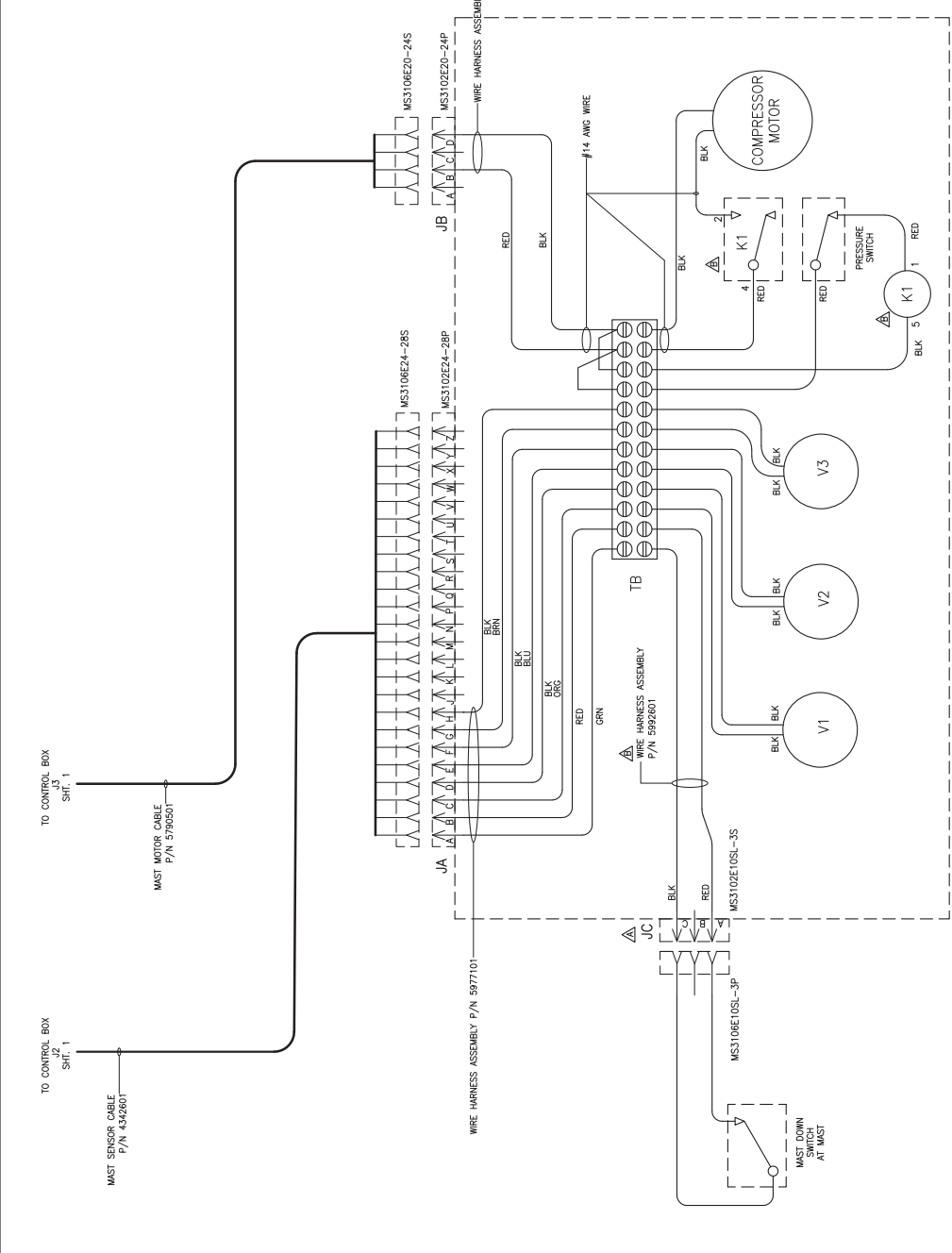




PANEL MOUNT
HMI REMOTE

TP-5986201-00
NOVEMBER 2023

REVISIONS			
ECN	REV	DESCRIPTION	DATE
16098	00	INITIAL DOCUMENT	8/22/23
16127	A	ON SHEET 2 - REFINED NOTE 1 & 2. ADDED P/N AND DESCRIPTION OF INCOMING POWER CABLE. ON SHEET 3 - ADDED CABLE P/N 5981701 AND P/N OF PANEL WIRING. ON SHEET 4 - ADDED CONNECTOR JC. CHANGED P/N OF PNEUMATIC CONTROL BOX.	8/10/23
16300	B	ON SHEET 1 - VEHICLE INTERLOCK P/N. ON SHEET 2 - RECONFIGURE WIRING FOR LIMIT SWITCHES. DELETE PREVIOUS NOTE 5 AND RENUMBER NOTES 1-4. ON SHEET 3 - ADDED CABLE ASSEMBLY P/N 5992601. ADDED K1 INTERPOSING RELAY FOR PRESSURE SWITCH.	11/27/23



NOTES:
1. ALL WIRE IS #20 AWG EXCEPT WHERE
OTHERWISE INDICATED.

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PNEUMATIC MAST
CONTROL BOX
△ P/N 5935901-XXXX

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	<p>APPROVED BY 25-8-10 THIRD ANGLE PROJECTION</p> 	<p>SHEET 6 OF 14</p>
	<p>DATE 25-8-10</p>	

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