VERTICAL HEAVY-DUTY TOWING (HDT) OPERATOR’S MANUAL

nightscan®

The Will-Burt Company
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www.willburt.com
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Safety Summary

SIGNAL WORD DEFINITION

Per the ANSI Z535.4 standard, the following signal words and definitions are used to indicate hazardous situations:

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

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

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

NOTES address practices not related to personal injury.

GENERAL SAFETY PRECAUTIONS

The following are general safety precautions that are not related to any specific procedures and therefore do not appear elsewhere in this publication. These are recommended precautions that personnel must understand and apply during many phases of operation and maintenance.

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 mast near electrical lines, cables or other unwanted sources of electricity. Do not operate mast in lightning. Be certain electrical cables are undamaged and properly terminated. Always disconnect power at the breaker box of the unit before performing service, repair, or test operations.

Safety Instruction – Read Manual! Failure to follow operating instructions could result in death or serious injury. Read and understand the operator’s manual before using the mast.

Tip Over Hazard! Mast tip over could result in death or serious injury. Do not operate in high winds. Operate on level ground only. Stand clear of mast and mast payload during operation. Be certain mast is level and secure before and during installation, operation, and maintenance.
WARNING

Safety Instruction – Trained Personnel Only! Death or serious injury could result if proper inspection, installation, operation, and maintenance procedures are not observed. Installation, operation, and maintenance to be performed by trained and authorized personnel only. Proper eye protection should be worn when servicing the mast.

WARNING

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

WARNING

Safety Instruction – Do not look at lights! Do not look directly into lights when they are illuminated. Temporary impairment or permanent vision damage could occur.

SPECIFIC SAFETY PRECAUTIONS

The following are safety precautions that relate to specific procedures that may appear elsewhere in this publication for emphasis. These are recommended precautions that personnel must understand and apply during specific phases of installation, operation, and maintenance.

WARNING

Safety Instruction – Operation! For outdoor use only. Do not use in areas that have been classified as hazardous as defined in Article 500 of the National Electric Code.

WARNING

Crush Hazard! Death or serious injury could result if mast fails suddenly. Do not stand directly beneath the mast or its payload. Be certain payload is properly installed and secured.

WARNING

Burst Hazard! Over-pressurizing mast will trip safety valve and could result in death or serious injury. Do not exceed maximum operating pressure of 20 psi (138 kPa) for Standard Duty masts. Keep personnel clear of safety valve exhaust direction.

WARNING

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

WARNING

Relocation Hazard! Relocating the mast during operation or after being raised could result in death or serious injury. Do not relocate the mast during operation or while raised. This applies especially to masts mounted to vehicles. Operate the mast only if the vehicle is stationary and the vehicle engine is off.
Mast Extension Hazard! Extending mast into obstructions could result in death or serious injury and could render the mast inoperable and partially extended. Before applying power and operating the mast, be certain there is sufficient clearance above and to all sides of the expected location of the fully extended mast and payload. Keep all persons clear of mast and mast extension. Do not lean directly over the mast.

Mounting Structure Hazard! Mounting mast into a structure unable to resist the forces generated from customer-specific loading scenario could result in death or serious injury and could damage the mast. Before operation, be certain mounting structure is capable of resisting forces generated from all loading and environmental conditions, including, but not limited to, mast size and weight, payload size and weight, sail size, wind speed, guy line arrangement, support bracket or roof line location, and base plate assembly.

Electrocution Hazard! Do not touch live wires. Death or serious injury could result.

Safety Instruction – Operation! Make sure all power has been disconnected prior performing maintenance.

Safety Instruction – Trained Personnel Only! Only trained and qualified personnel should perform installation, adjustments, and servicing. Only a properly trained and qualified certified electrician should perform electric installations and service.

Safety Instruction – Operation! At all times prior to mast operation, ensure that:

- The mast area is free of personnel and mechanical obstruction;
- All electrical cables are undamaged and properly terminated;
- The operator must have full view of the mast during use;
- Any transit tie-downs on the payload have been removed;
- The vehicle is not moving;
- The area above the mast is free of mechanical obstructions.

When re-lamping an installed fixture, make sure all power to fixture is off and that the fixture is cool.

Make certain that the area is free of overhead power lines and other unwanted sources of electricity. Follow OSHA safety regulations when working near energized power lines. Be sure to allow sufficient clearance on all sides of mast to allow for side-sway.


**WARNING**

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. Contact with combustible materials can cause ignition resulting in fire or explosion.

**WARNING**

Keep personnel clear of mast while during operation.

**WARNING**

Do not move vehicle until mast has been securely stowed.

**WARNING**

Using the emergency stow button causes the actuator to lower the mast without regard to any faults, switches, or system interlocks. It is totally up to the operator to ensure safe operation during an emergency stow attempt.

**WARNING**

When using the emergency stow button, normal operation switches are disabled. The mast can be overdriven into saddle and cause damage to the unit.

**WARNING**

If manually lowering the mast, make sure all power has been disconnected from the system prior to manually lowering the mast.

**WARNING**

Keep hands clear of the descending collars while the mast is being lowered to avoid pinching.

**WARNING**

A pneumatic telescoping mast is a pressurized vessel. Caution must be exercised to stay clear when the mast is being extended. Do not lean directly over the mast. Proper eye protection should be worn when working on the mast.

**WARNING**

Do not lubricate the exterior of the mast. This will cause the lubricant to attract dust and contaminants from the air.

**WARNING**

Make sure the lights are completely cool before attempting to clean the light lenses.

**WARNING**

Make sure all power has been disconnected from the system prior to manually lowering mast. This can be accomplished by turning all breakers to the OFF position.
Safety Instruction – Hard Hat! Due to the risk of head injuries from falling objects, operators should wear a properly secured hard hat while the mast is in the process of being deployed, deployed, or in the processes of being stowed.

Safety Instruction – Operation! Lamps are extremely hot and should not come into contact with people or combustible and/or explosive materials. Do not operate if breakage occurs or unit is knocked over.

Entanglement Hazard! Tangled cables can cause equipment damage. Ensure control cables are not tangled and are free to pay out as mast is raised.

Safety Instruction – Operation! Do not operate the mast during an electrical storm.

Lifting Hazard! Manually lifting over 55 lb. (25kg) is prohibited. In the UK, all lifting equipment must be thoroughly examined annually by a competent person according to the Lifting Operations and Lift Equipment Regulations 1998. Equivalent regulations exist in other EU states.

Safety Instruction – Operation! All operators must read the Operation section of this manual and be properly trained.
Section 1 Introduction

Review this manual in its entirety. Contact the Will-Burt Company with any questions before performing any procedure outlined in this manual.

The Night Scan Vertical Heavy Duty Towing (HDT) is designed to fit between the cab and toolbox of a heavy wrecker. The vertical tower allows installation in areas where a large flat surface is not available. Typically, no interior cab space is required for installation. The dual banks of lights can provide 360° scene lighting by pointing in opposite directions.

The HDT comes pre-wired and includes a:

- 50 ft. bulkhead cable
- 30 ft. lights cable
- 30 ft. solenoid control cable
- 30 ft. power cable

1.1 Safety Precautions

Refer to the Safety Summary for precautions to be observed while operating or servicing this equipment.

1.2 How this Manual is Organized

This manual describes the installation, operation, and maintenance of the Night Scan Vertical HDT. Typical hardware includes the base, mast, lights, remote controlled positioner, and a controller to operate the system.

This manual is organized into the following sections:

Section 1 Introduction

Section 2 Installation

Section 3 Operation

Section 4 Maintenance and Adjustments

Section 5 Reference Information

Section 6 Troubleshooting

Section 7 Drawings
1.3 Additional Documentation

In addition to this manual, your system ships with top-level drawings. These drawings can be referenced during the installation process.

1.4 The Definition of the Mast Position

The mast is pneumatically moved by air pressure to the extended position. The following positions (Figure 1-1) are used throughout this manual:

- “Stowed” is the position in which the remote controlled positioner is firmly seated in the saddle. This position is sometimes referred to as the “nested” position.
- “Extended” is the partial or full raised position that the mast pneumatically raises to from the stowed position. In the extended position, some or all of the mast sections have risen.

![Stowed and Extended Mast Positions](image-url)
1.5 Major Components

The major components of the Vertical HDT are:

- Mast
- Remote Controlled Positioner
- Lights
- Saddle
- Base Assembly
- Control Box
- Controller

Refer to Figure 1-2 for identification of major components.

*Figure 1-2  Vertical HDT Parts (Vertical HDT, Model 72030005 shown)*
1.5.1 Mast
The bottom of the mast connects to the base assembly. The top of the mast connects to the remote controlled positioner (RCP).

The mast contains:

- Tube Sections
- Internal Coil Cord

1.5.1.1 Tube Sections
The mast consists of concentric sections that extend as air is applied. Each tube and collar is protected by low friction synthetic bearings for smooth operation and long life. Bumpers reduce shock on extension and retraction. The exterior surfaces of the tubes are anodized and sealed for long life. The fasteners are corrosion-resistant stainless steel.

1.5.1.2 Internal Coil Cord
The center of the tubes route an internal coil cord from the bottom of the mast to the RCP. The highly flexible internal coil cord contains power to the RCP.

1.5.2 Remote Controlled Positioner (RCP)
The dual-tilt RCP (Figure 1-3) mounts on top of the mast and between the lights. The RCP contains gears and gear motors to position the lights. The RCP also contains the RCP Board which receives data through the Base Board from the controllers. This allows the RCP to control the lights to pan and tilt. The dual-tilt RCP allows for individual tilt control of each side of lights. For example, one side of the lights could be directed forward, while the other side of the lights could be directed backward.

![Figure 1-3 Dual-Tilt Remote Controlled Positioner (RCP) (Shown with lights attached)](image-url)
1.5.3 Lights

Night Scan Vertical HDT systems ship with Will-Burt XL-160 LED lights (Figure 1-4). For additional information on the lights, see www.willburt.com.

![Night Scan Vertical HDT Lights](image)

1.5.4 Saddle

The saddle is connected to the mast and extends to provide a curved surface for the RCP to rest on when the mast is stowed.

1.5.5 Base Assembly

The base assembly is connected to the mast and is used to secure the vertical HDT to the mounting structure (Figure 1-5). The optional adjustable mounting plate can assist in securing the mast.

![Vertical HDT Mounting](image)
1.5.6 Power Converter

The system uses a 12 to 48 volt DC to DC power converter (Figure 1-6). The power converter has a 58 volt, 30 amp fuse (P/N: 221033) on the output side. Operating the power converter above 150°F (65°C) may cause damage to the unit.

1.5.7 Control Box

The control box (Figure 1-7) contains the Base Board for the system.
1.5.8 Controllers

The wired hand-held remote controller (HHRC) can be used to operate all functions of the system. The controller (Figure 1-8) has the following features:

- Two-way communication with the system and LED display that includes alphanumeric feedback
- Connects with a 25 foot (7.62 meter) bayonet-disconnect coiled cord
- Integrated emergency stop button

![Figure 1-8 Wired HHRC. Standard (non-NFPA) models appear the same, except that they do not have the green NFPA Start button.](image)

1.5.8.1 Controller Interface

The wired HHRC connects through a bulkhead (Figure 1-9).

![Figure 1-9 Bulkhead](image)
### 1.6 Unit Specifications

Table 1-1 lists the specifications for your system.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
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<tr>
<td>Extended Height</td>
<td>15 ft. (4.5 m)</td>
</tr>
<tr>
<td>Stowed Height</td>
<td>5 ft. 9 in. (1.8 m)</td>
</tr>
<tr>
<td>Approximate Weight</td>
<td>170 lb. (77 kg)</td>
</tr>
<tr>
<td>Number of Tubes</td>
<td>5</td>
</tr>
<tr>
<td>Tube Diameter Range</td>
<td>5.0 to 3.0 in. (127 to 76 mm)</td>
</tr>
<tr>
<td>Footprint</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Base of System: 12 x 12 in. (304.8 x 304.8 mm)</td>
</tr>
<tr>
<td></td>
<td>• Overall System: 69 11/16 x 44 ⅜ x 12 in. (1770.1 x 1127.1 x 304.8 mm)</td>
</tr>
<tr>
<td>Number of Lights Available</td>
<td>6</td>
</tr>
<tr>
<td>Light Type Available</td>
<td>LED Spot/Flood</td>
</tr>
<tr>
<td>Maximum Lumens</td>
<td>90,000</td>
</tr>
<tr>
<td>Time to Light</td>
<td>15 Seconds</td>
</tr>
<tr>
<td>Maximum Operating Air Pressure</td>
<td>20 psig (1.4 bar)</td>
</tr>
</tbody>
</table>

Note: The electronics in the system will run from 10-33 VDC, but are nominal 12 VDC devices. The boards driving them monitor and chop the battery voltage at 300 Hz adjusting the duty cycle to deliver 12 VDC. During mast incline at 13.8 VDC the system may draw up to 13 amps. During mast incline at 28.8 VDC the system may draw up to 9 amps.
Section 2 Installation

This section describes the installation of your 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 before beginning installation.

2.1 Ensuring That it Fits

Ensure that the mounting surface is flat and has sufficient room and strength to hold the system. The roofline must lie between the weep hole and the base tube collar. Mounting hardware should be at least 1 inch (25 mm) above the weep hole and 3” inches (76 mm) below the collar. The area beneath the floor must be free of obstructions to allow for accessibility to base plate fasteners and, if used, the bottom air inlet port.

2.1.1 Dimensions

Refer to the drawings which ship with the mast for detailed information on the size of the system. Additional room may be required for optional components such as a camera, strobe light, or D-Tec II Power Line Detection System.

2.2 Get Your Tools

Table 2-1 lists recommended tools and materials for installation.

<table>
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<tr>
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<tr>
<td>Safety Glasses</td>
<td>Safety Gloves</td>
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<tr>
<td>Hard Hat or Helmet</td>
<td>Hearing Protection</td>
</tr>
<tr>
<td>Wrenches</td>
<td>Screwdrivers</td>
</tr>
<tr>
<td>Torque Wrench</td>
<td>Drill</td>
</tr>
<tr>
<td>Wire cutter/stripper</td>
<td>RTV Silicone</td>
</tr>
<tr>
<td>Clean shop rags</td>
<td>Hoist (minimum 500 lb. capacity)</td>
</tr>
</tbody>
</table>

Note: Depending on the national and local standards and codes of practice, and the environment, additional personal protective equipment may be necessary.
2.3 Components

When unpacking, check to ensure all ordered components have arrived. Your system should ship with the following components:

- Mast
  - Base Plate
  - Saddle Kit
  - RCP Assembly
  - Lights
  - Board Power Cable
  - Light Cable
  - Label Kit
- Mounting Kit (Internal or External)
- Wired HHRC with Bulkhead
- Operator’s Manual (this manual) on CD

Additionally, you should receive drawings of your system to assist in the installation process.

The labels from the label kit can be applied where the operator deems appropriate.

2.4 Unpacking

Unpack the items as follows:

1. Carefully remove all the cartons.
2. Remove all the items from the cartons.
3. Ensure that all components are included and that the required tools are readily available.
4. Inspect for any shipping damage. If damage has occurred, notify your carrier.
5. Lift the base out with a hoist. Lift the unit from the shipping container by the two struts and the lower portion of the base tube (Figure 2-1). Do not lift by the lights or Remote Controlled Positioner. Lifting from locations other than those indicated could result in equipment damage.

![Figure 2-1 Lifting Points on the Vertical HDT](image)

2.5 Attaching to the Vehicle

Your system is designed to withstand adverse weather conditions; however, it cannot be submerged in water. Hardware for attaching the base is not included with the shipped items.

Physically attach the system as follows:

1. If the system is to be mounted in a well, provide adequate drainage. A minimum of four 1” diameter drain holes (one per corner) are recommended.

2. Drill eight 9/16” mounting holes into the mounting structure (Figure 2-2).

3. Attach the mast using 9/16” studs or bolts (not provided). Torque all hardware as appropriate for its material and size.

4. The saddle must be attached so that it is centered with the RCP and mast base tube.

**NOTE:** The mast, RCP, and control box assemblies must be installed and wired prior to power up. Failure to do so will result in errors and could damage the unit.
Figure 2-2  Saddle Mounting Holes
2.6 Attaching the Control Box

The control box may be surface mounted using four \( \frac{1}{4} \)" screws, nuts, and lock washers provided by the installer.

To install the control box:

1. Mount the unit through the clearance holes located on the back of the control box (Figure 2-3).

2. Attach the lock washers and nuts to secure the unit.

3. Be sure to secure the green ground wire provided on the bulkhead to vehicle ground.

2.7 Attaching the Air Connections

Air may be supplied externally by a compressor or other source of clean, dry air with a maximum pressure of 100 psi. The inlet fittings are for use with 3/8" inside diameter air hose rated for the pressure supplied in combination with environmental factors, which may derate the hose (e.g. high temperatures). The Night Scan has an internal regulator factory set to 20 psi. The unit is supplied with 20 ft. of air hose labeled SUPPLY to designate the pressurized air to be routed to the INLET of the unit. The exhaust fitting is to be used with a 1/2" inside diameter air hose. The unit is supplied with 20 ft. of air hose labeled EXHAUST to designate its use to route exhausted air to a location where it will not expel air or water onto personnel or equipment.
sensitive to moisture. The different size hose with the labeled intention of the hose is designed to prevent pressurized air to be routed into the EXHAUST of the unit. If pressurized air is routed into the EXHAUST port of the mast, the unit is equipped with a blow-off valve that will prevent this pressurized air from entering the mast. An audible air leak will be evident to alert you that air has been improperly connected to the unit.

Refer to Figure 2-4 for identification of the air fittings in the system. The exhaust hose must be routed to a location where it will not expel air or water onto personnel or equipment sensitive to moisture.
2.8 Attaching the Controller

This section will describe how to install the Wired HHRC with a bulkhead.

To attach the bulkhead:

1. Find a convenient, dry location to mount the bulkhead.
2. Drill the mounting holes as indicated (Figure 2-5).
3. Using the screws, washers, and nuts provided, attach the bulkhead to the vehicle.
4. Attach the ground wire to the vehicle.

*Figure 2-5 Bulkhead Dimensions*
2.9 Attaching the Holder

The HHRC has a holder to hang the controller on. To install the holder:

1. Using the (2) screws and the holder provided, attach the holder where the HHRC will hang. The inside of the holder is angled to better hold the HHRC (Figure 2-6). Ensure that the wider end of the bevel is up.

![Figure 2-6 Holder for the Controller]

2. Place the HHRC onto the holder.

2.10 Attaching the Power Converter

Mount the power converter vertically (fins up and down) for better heat dissipation (Figure 2-7). The best practice is to mount the power converter in a fan-cooled enclosure. Do not mount the power converter in the engine compartment or an enclosed space without ventilation.

![Figure 2-7 Power Converter Mounting]

**Safety Instruction – Operation!** Do not operate the power converter at temperatures above 150°F (65°C). Operating the power converter above 150°F may cause damage to the unit.
2.11 Wiring the Base Board

The HDT comes pre-wired internally from the factory. During installation, electrically connect the other ends of the following:

- Solenoid Power
- DC Board Power
- DC Light Power Input
- Bulkhead Control Cable

See drawing WD-47621 in Section 8 of this manual.

If the customer needs to adjust electrical connections, for example to shorten the HHRC cable, proceed as follows:

Ensure the power is off before wiring the Base Board. See Figure 2-8 for information on where the cables run into the control box.

2.11.1 Wiring the Bulkhead Control Cable to the Base Board

The Bulkhead Control Cable connects the bulkhead, controller, and Base Board. Depending on the components used in your system, the Bulkhead Control Cable in your system may be connected through either a control box with plugs, or a control box without plugs.
To electrically connect a control box without plugs, run the Bulkhead Control Cable into the control box through one of the strain reliefs, then follow these steps:

1. The Bulkhead Control Cable connects to the green J4 connector ensuring the wires match the color strip on the J4 connector (Figure 2-9).

![Figure 2-9 Wiring J4](image)

If using the “Mast Active” contacts, note that they are factory set to be OPEN when the mast is active; S2-1 is OFF (open). To set them to be CLOSED when the mast is active, set S2-1 ON (closed).

Important! Be aware of the different "look" of the ON position of rocker and slide switches. Both are shown (Figure 2-10) with position 1 ON (closed).

![Figure 2-10 Switches](image)

2.11.2 Wiring the DC Power to the Base Board

Incoming DC power is provided by the customer from the vehicle battery.

2. DC battery power is connected to the +VIN (white) and COM (black) connections on terminal block TB4 on the Base Board (Figure 2-9). The source must be capable of delivering 5 amps minimum.
2.12 Connecting the Warning Light/Interlock Output Contact

The mast provides an isolated relay contact output to enhance integration into vehicle safety circuitry (Figure 2-11). This relay output is from a bi-stable (latching) relay whose contacts either open or close (switch selectable) when the mast is active (not stowed). Its state is not affected by whether or not there is power to the mast. This contact is capable of carrying up to two amperes and is available on pins J4-8 and 9. Its usage is highly recommended by Will-Burt and should be used to comply with various safety standards. It can be used in conjunction with a customer-supplied relay to drive a flashing warning light.

![Figure 2-11 Relay](image)

2.13 Connecting the Interlock Input Contact

Some safety standards require preventing operation of the mast unless other conditions are first met. An example might be having the parking brake set. This can be accomplished by inserting an isolated contact in series with the stop circuit of the “Start/Stop” button. Inserting these contacts in line with the wire connected to pin J4-7 on the base circuit board breaks continuity and will inhibit operation of the mast and prevent operation until the parking brake is set. After use, and properly stowing the mast, when the parking brake is released, the mast is again prohibited from energizing until the parking brake is set.

Note: Using this parking brake feature is the same as pushing the E-stop button—power to the control is opened, the mast immediately exhausts air, and the mast comes down without regard to the proper RCP alignment (stowing to the home position). The parking brake should not be released until the mast is safely (and automatically) stowed by the controls.
2.14 Testing the Installation

Review the operation section of this manual and observe all safety dangers, warnings, and cautions in this manual before proceeding to test the installation. If any part of the testing fails, check the LEDs on the controller and Base Board.

To test the installation, proceed as follows:

1. Reconnect power.
2. Turn the red “Start/Stop” button to enable the system, then push the green “Start” button.
3. Check for proper clearance above the mast.
4. Press the “Mast Up” button to raise the first tube section to activate the RCP.
5. Press each “Light” button several times to turn the lights on and off.
6. Tilt (and ) and pan ( and ) both sets of lights. Check the lights on each side again.
7. Press and hold the “Mast Up” button. When the mast is fully extended and the blow-off valve opens, release the “Mast Up” button.
8. Press each “Light” button several times to turn the lights on and off.
9. Tilt and pan both sets of lights. Check the lights on each side again.
10. If the strobe/beacon light is installed, press the “Auxiliary Light” button several times to turn the light on and off.
11. To ensure that the mast is properly sealed, while the mast is fully extended, watch for any type of mast settling.
12. Press the “Mast Down” button twice rapidly. This invokes the Auto Stow® feature that places the mast into the saddle and turns power off.
Section 3 Operation

This section describes the operation of the system. Be sure to read and understand the entire operation procedure before beginning operation.

3.1 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 of the mast.
2. Visually inspect the system for damage. If damage is apparent, do not use the mast and have it serviced prior to use.
3. Check for and remove any objects which might obstruct motion of the mast; cause binding; or hinder mast function.
4. Ensure that the following warnings are understood and followed:

   **WARNING**

   Make certain that the area is free of overhead power lines and other unwanted sources of electricity. Follow OSHA safety regulations when working near energized power lines. Be sure to allow sufficient clearance on all sides of mast to allow for side-sway.

   **WARNING**

   Safety Instruction – Operation! For outdoor use only. Do not use in areas that have been classified as hazardous as defined in Article 500 of the National Electric Code.

   **WARNING**

   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. Contact with combustible materials can cause ignition resulting in fire or explosion.

   **WARNING**

   Keep personnel clear of mast while during operation.

   **WARNING**

   Do not move vehicle until mast has been securely stowed.

   **CAUTION**

   Safety Instruction – Operation! All operators must read the Operation section of this manual and be properly trained.
3.2 Controller

Using the dual-tilt wired hand-held remote controller (HHRC), the operator can move the mast up and down, tilt the lights up and down, pan the lights right and left, turn the lights on and off, and turn the optional strobe light on and off.

The following are the controller buttons:

- **Start/Stop**
- **Auxiliary Light**
- **Lights**
- **Mast Up**
- **Tilt Up**
- **Start**
- **Pan Left**
- **Pan Right**
- **Mast Down**
- **Tilt Down**

The “Start” button is only found on NFPA controllers.

There are three duplicate buttons on the controller:

- Tilt Down
- Tilt Up
- Lights

These buttons operate the separate sides of the RCP. For example, if you Press the “Tilt Down” button on the right side of the controller, the lights on the right side will go down. If you press the “Tilt Down” button on the left side of the controller, the lights on the left side will go down.

3.3 Quick Summary

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

If an emergency stop is required at any time, press the “Start/Stop” button. This will disconnect the unit from power and cause all air to be exhausted from the mast.

1. Ensure that the vehicle parking brake is engaged.
2. Ensure that there are no obstructions overhead.
3. Turn the red “Start/Stop” button. For NFPA systems, then press the green “NFPA Start” button.
4. Raise the mast by press and hold the “Mast Up” button to raise the mast. Then press the “Lights” to turn the lights on.
5. If desired, raise the mast further by pressing “Mast Up”.
6. Position the lights vertically by pressing “Tilt Down” and “Tilt Up”.
7. Position the lights horizontally by pressing “Pan Right” and “Pan Left”.

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8. Use the “Lights” button to turn on the strobe/beacon light (if equipped).

9. If desired, lower the mast by pressing “Mast Down”.

10. Stow the mast by performing one of the following steps:
   - Quickly press the “Mast Down” button twice (Auto Stow® feature). It is recommended to use the Auto Stow® feature to stow the mast. To abort Auto Stow®, press the any controller button.
   - Press and hold “Mast Down” until all LEDs on the controller turn off. Ensure that “Mast Down” is released only after the controller LEDs turn off which means the mast is stowed.

3.4 Initiating

Before operating a stowed mast, the “Start/Stop” button must be turned. This will enable the system to power up and initiate. NFPA systems must also then press the green “NFPA Start” button. On initiation, the Base Board establishes communication with the other boards in the system. If communication cannot be established, an error code is shown on the display and the communication system is shut down.

To initiate the system:

1. Ensure the wired HHRC is plugged in before initiation. This allows the board to establish communication between all boards. If the wired HHRC is connected after the unit is powered up, then an error will occur.

2. Turn the “Start/Stop” button while viewing the display.

3. For NFPA operation, wait until the system initializes before releasing the “Start/Stop” button. When the first letter “N” of NightScan is shown on the controller display, release the “Start/Stop” button.

4. The letter “N” of NightScan is normally displayed a couple of seconds after turning the “Start/Stop” button. You may also be able to hear the initiate relay click into place. Do not release the “Start/Stop” button before seeing the first letter on the display. Releasing too early may cause a communication error between the Base Board and the controller. After the letter “N” of NightScan is displayed, the “Mast Up” LED is lit showing that the “Mast Up” button is enabled.

5. For NFPA controllers, press the green “NFPA Start” button.
3.5 Extending the Mast

The mast can be extended to full or partial height. To extend the mast, press the “Mast Up” button until the mast reaches the desired height.

Pushing the “Mast Up” button will cause the mast to rise until the “Mast Up” button is released, or the mast reaches its maximum extended height. If the “Mast Up” button is not released, the mast will reach its fully extended height, the air pressure will rise to 20 lb., and then the exhaust valve will open and exhaust any more air that enters the mast, leaving the mast at its maximum extended height.

3.6 Controlling the Lights

The lights can be turned on and off from the controller after the first tube section has been extended and the RCP become active. The RCP can only initially position the lights down and to the right. Once the RCP reaches a 350° position, the RCP can only rotate back in the other direction.

To pan and tilt the lights:

- Holding the “Tilt Down” button turns the lights down and all the way around to 350°.
- Holding the “Tilt Up” button, turns the lights back in the other direction.
- Holding the “Pan Right” button turns the lights to the right.
- Holding the “Pan Left” button turns the lights to the left.
- Pressing the “Lights” button turns the lights on and off.

3.7 Lowering the Mast

Once the mast has been extended, pressing the “Mast Down” button will lower the mast. Continue to press the “Mast Down” button until the mast reaches the desired height and then release the button.
3.8 Stowing the Mast

The “stowed” position is also called the “nested” position. The stowed position is the position of the mast when it is firmly seated in the saddle. When the mast lowers and comes to the upper magnetic switch, the RCP begins to Auto Stow®. When the lower magnetic switch is reached, the system is stowed and shuts down.

It is the responsibility of the customer to properly secure the payload for vehicle travel.

The mast can be stowed by using:

- Auto Stow®
- Mast Down

The best method is to stow the mast with the Auto Stow® feature. It does not require the operator to stop the mast exactly in the saddle. The mast can be auto stowed from any position including partially extended or fully extended.

On NFPA systems, all power is removed after the mast is stowed. To operate the mast again on NFPA systems, the red “Start/Stop” button must be turned. The green “NFPA Start” button must then be pushed. This is a safety feature that prevents the mast from being inadvertently raised.

On Standard systems, power is still applied to the system after the mast is stowed and it is not required to turn the “Start/Stop” button to operate the mast again. Since power is still applied, care must be taken to ensure the controller buttons are not accidently hit.

If the mast loses power, the mast will lose power and lower.

3.8.1 Using the Auto Stow® Feature

To use the Auto Stow® feature:

1. Press the “Mast Down” button twice quickly in successive depressions (two depressions within ½ second). The mast will pan and tilt the RCP to the home position, turn off any lights, and stow the mast. This automatic sequence can be aborted by pushing any of the buttons on the controller at any point during the Auto Stow®. If a button is pressed, the mast will not stow by itself, and will await further operator input.

2. On an NFPA system, wait until all controller LEDs turn off. Any lit LEDs indicate that the mast is not stowed.

3. Visually inspect that the mast is properly stowed. Ensure that the payload will not bounce as the vehicle drives down the road.

4. Store any controllers so they will not be damaged during transportation.
3.8.2 Using the Mast Down Button

Another method used to stow the mast is to press the “Mast Down” button on the controller. This method is not as reliable as using the Auto Stow® feature. Care must be taken to ensure that the operator does not release the button before the mast is completely stowed. If the mast is not completely stowed, equipment may be damaged during transportation.

To stow the mast using the “Mast Down” button:

1. Press the “Mast Down” button until the mast stops and the “Mast Down” LED is turned off. The mast will go to the home position and then stow the mast. Once stowed, the Mast Stowed Safety Interlock Contact signals it is safe to move the vehicle.

2. On an NFPA system, wait until all controller LEDs turn off. Any lit LEDs indicate that the mast is not stowed.

3. Visually inspect that the mast is properly stowed. Ensure that the payload will not bounce as the vehicle drives down the road.

4. Store any controllers so they will not be damaged during transportation.
Section 4 Maintenance and Adjustments

This section describes the routine maintenance and adjustment procedures required to keep your system operational.

4.1 Cleaning the System

Will-Burt pneumatic telescoping masts come from the factory pre-lubricated and require no scheduled maintenance under normal operating conditions. In extremely harsh environmental conditions, maintenance of the mast might be required.

Signs that cleaning and lubrication are needed can be:

- A noticeable gritty film on the exterior surfaces of the mast sections
- Erratic extension or retraction of the mast
- Noisy operation of the mast
- Sticking of one or more mast sections when mast is extending or retracting

 WARNING

Make sure the lights are completely cool before attempting to clean the light lenses.

To clean the system:

1. Wipe down the RCP using a soft cloth or sponge and a mild solution of soapy water.
2. Clean the light lenses using a soft cloth and standard glass cleaner.

 WARNING

A pneumatic telescoping mast is a pressurized vessel. Caution must be exercised to stay clear when the mast is being extended. Do not lean directly over the mast. Proper eye protection should be worn when working on the mast.

After cleaning the mast, if the mast is in extremely harsh environmental conditions, lubricate the mast with TMD Mast Lubricant (P/N: 900600). TMD Mast Lubricant is specifically formulated for cold weather use, but is also suitable for year around use. Regular winter maintenance and frequent use of TMD Mast Lubricant should significantly reduce the potential for mast freeze-ups.

To clean and lubricate the mast:

1. Reduce the regulator setting such that it pressurizes the mast to between 5 and 10 PSIG. Pull up on the regulator cap and rotate counterclockwise. Push cap down to lock into place.
2. While at the 90° position, have one person press the “Mast Up” button to slowly pressurize the mast just enough to extend the desired mast section. A second person may have to hold down the larger mast section collars to ensure the desired tube extends. Release “Mast Up” button as soon as the desired mast section is fully exposed.

**WARNING**

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

3. Wipe down the desired mast section using a non-abrasive cleanser or solvent such as lacquer thinner. Do not allow the cleaning fluid or solvent to run down inside the collar.

4. Repeat steps two and three for the next larger mast section.

**WARNING**

Do not lubricate the exterior of the mast. This will cause the lubricant to attract dust and contaminants from the air.

5. Inject approximately ½ oz. of TMD Mast Lubricant or lightweight machine oil into the weep hole (drain) of each exposed mast section. The weep holes are located approximately 10” below the collar on each tube except the top tube.

**WARNING**

Keep hands clear of the descending collars while the mast is being lowered to avoid pinching.

6. Using the “Mast Down” button, lower the mast to 90°.

7. Wait several minutes to allow the lubricant to settle and spread around the wear ring and seal at the bottom of each mast section.

8. Using the “Mast Up” button, extend the mast one section at a time. For each section wipe off any excess lubricant which flows out the weep holes.

### 4.2 Functional Test

To test the functionality of the system, perform the following tests.

#### 4.2.1 Emergency Circuit Test

To test the emergency circuit, power up the system and operate the system, and then press the “Start/Stop” button at the following stages and check if the system is stopped and de-energized:

1. Mast Extending (Up valve active – actual telescoping mast raising in height)
2. Light Pan ( and )
3. Light Tilt (and )
4. Mast Down (Down valve active – telescopic mast lowering in height)

**4.2.2 Brake Function Test**

To test the brake function, check the following:

1. If the vehicle brake signal is off, the system should not operate.
2. If the vehicle brake is on, the system should be able to operate.
3. During operation, if the vehicle brake signal goes off, the system should shut down and exhaust the air (same as using the emergency stop).

**4.2.3 Function Circuit Test**

To test the limit switches:

1. Pan Left: Hold the “Pan Left” button on HHRC to let the light pan to left side. The light will turn almost one circle (less than 360°) and the motor will stop. After fully panned to the left, only the “Pan Right” button on HHRC is active; the indicator for the “Pan Left” button on HHRC should be off.
2. Pan Right: Hold the “Pan Right” button on HHRC to let the light pan to right side. The light will turn back to the original home position and the motor will stop. At the home position, only the “Pan Left” button on HHRC is active; the indicator for the “Pan Right” button on HHRC should be off.
3. Tilt down: Hold the “Tilt Down” button on HHRC to let the light tilt down. The light will tilt almost one circle (less than 360°) and the motor will stop. After fully tilted down, only the “Tilt Up” button on HHRC is active; the indicator for the “Tilt Down” button on HHRC should be off. (This applied to both side of the lights.)
4. Tilt up: Hold the “Tilt Up” button on HHRC to let the light tilt up. The light will tilt back to the original home position and the motor will stop. At home position, only the “Tilt Down” button on HHRC is active; the indicator for the “Tilt Up” button on HHRC should be off. (This applied to both side of the lights.)
5. Mast Down and Mast Not Down: Power on the system. Using an external magnet to attach the top magnet switch and observe the LED D3 and D4 on the base board. If the sensor is active, D3 should be on and D4 off, otherwise D4 should be on and D3 off.
4.3 Adjusting the Magnetic Switches

The Magnetic Switches are located on the mast base tube (Figure 4-1). The Upper Magnetic Switch senses that the top tube is extended. The Lower Magnetic Switch senses when the mast is completely stowed. It is important that the mast has properly nested by verifying that the collars are stacked with no gaps between them. If a switch is found to require adjustment, it will most commonly need to be moved upward (toward the RCP) on the mast. The magnet is located at the lower end and side of the top tube. It is not visible outside the mast.

![Upper and Lower Magnetic Switches](image)

The following procedure must be followed to adjust the Magnetic Switch.

1. Loosen the band clamp securing the switch to the base tube. Move the switch upwards approximately ¼ inch and tighten band clamp.

2. Initiate the mast, if necessary, and press the down button on the hand held remote. If the mast does not nest, repeat the adjustment until it does. A small piece of steel or iron filings may be used to help locate the magnet.

3. If repeated attempts do not succeed, hold a magnet up to the switch and press the down button. If the mast begins to nest, continue repeating the adjustment until the switch has sensed the magnet.

4. If the mast will not nest when a magnet is held to the switch, check the wiring to at the circuit board for loose or disconnected wires. If the wiring is intact, replace the Magnetic Switch.
4.4 Adjusting the RCP Home Position

The RCP home position is the position of the RCP and lights where the light bars are parallel to the axis of the mast and the lights are facing down when stowed. If the RCP home position is set properly, when being stowed the RCP shafts should contact the saddle simultaneously. The home position is established by setting small flags in the RCP that engage photo interrupters on the RCP board. Adjusting the RCP home position should be done indoors. Adjusting the home position outside can cause improper RCP operation due to sunlight reaching the photosensors. Before delivery of a new system, the RCP home position is tested and normally no adjustment is necessary.

WARNING

Make sure all power has been disconnected from the system prior to manually lowering mast. This can be accomplished by turning all breakers to the OFF position.

If an adjustment is required, adjust the RCP home position as follows:

1. Disconnect all light power to the system.
2. Initiate the mast raise the mast to the 90° position. The controller should show both left and right tilt up functions, and the pan left function as available.
3. Remove the RCP cover to access the flags. The flags are attached to the timing rings on the horizontal and vertical shaft gears (Figure 4-2). Each timing ring has two set screws that must be loosened. It may be necessary to loosen one in each, then pan and tilt the unit to access the others. Note: The flags have sharp edges which may cause cuts.
4. Once the set screws are loose, pan ( and ) and tilt ( and ) the unit to the correct home position. Be careful that the flags do not come into contact when panning and tilting, or they may be bent.
5. It is important that the flags engage the correct photo interrupter when setting the home position (Figure 4-3). Turn the timing ring on the right horizontal shaft such that it rotates down toward the upper photo interrupter. As you approach the interrupter, watch the controller. As soon as the right tilt down LED goes out, stop rotating the ring and tighten the set screw. Repeat on the left horizontal shaft.

6. To set the pan home position, turn the timing ring counterclockwise (looking from above the RCP) until the pan right LED goes out. Tighten the set screw to secure the ring.

7. Pan and tilt the unit until the second set screw in each ring is accessible. Tighten each set screw.

8. Stow the mast, watching for the RCP and lights to become oriented as described in the beginning of this section.

9. Turn the red “Start/Stop” button and raise the mast to 90°. Replace the RCP cover.
Section 5 Reference Information

This section describes reference information for your system.

5.1 DIP Switch Definitions

DIP Switches on the Base Board and the RCP board are set at the factory and normally do not have to be changed. The DIP Switches on the Base Board define the warning light signal, NFPA verses Standard mode, if an RCP is present, and if the mast is a Vertical or a fold-down. The RCP DIP Switches define if the system should stow automatically while on a fault, if the RCP is a Profiler unit, and if the system stows before or while lowering. For additional information on the DIP Switches and their settings, see the drawings in Section 8. By default, the RCP becomes active when the upper magnetic switch is sensed. If this is too early and the RCP may be accidently turned and hit the vehicle, an addition of 5, 10, or 15 seconds of “Mast Up” time can be set as shown in Table 5-1. If set, the RCP will continue to be inactive for 5, 10, or 15 seconds after sensing the upper magnetic switch.

<table>
<thead>
<tr>
<th>DIP Switch Position</th>
<th>Delay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Position 8 On</td>
<td>5 Seconds</td>
</tr>
<tr>
<td>Position 9 On</td>
<td>10 Seconds</td>
</tr>
<tr>
<td>Positions 8 and 9 On</td>
<td>15 Seconds</td>
</tr>
</tbody>
</table>

Note: The controls check the status of the DIP switches only during initialization. After flipping a DIP switch, the system will need restarted for the change to take effect.

5.2 D-TEC II Sensor

The D-TEC II Sensor is an optional accessory that is mounted on the backside of the RCP. Refer to the Will-Burt D-TEC II Safety System Manual before installing the D-TEC II.

5.2.1 D-TEC II Functionality

An optional D-TEC II Sensor provides additional limited protection against raising the mast into power lines or physical obstructions. As soon as the mast begins raising, the control begins initiating the D-TEC II Sensor and self-tests it until it either passes, or the mast reaches the point where the RCP becomes active (first tube section extended). Assuming that it passes, the operator is then permitted to extend the mast. If the mast senses an obstruction or a power line, the mast will stop extending even though the operator continues to push the “Mast Up” button. In each of these two cases, there will be a message displayed on the alphanumeric display of the Remote Control(s). If the operator believes the sensed condition to be false, they may clear it in either of two ways: momentarily initiating an Auto Stow® function, or lowering the mast to the bottom of the 90° position. This will clear the alarm and allow the operator another chance to raise the mast to its full extension. The following messages may be displayed on the Remote Control(s).
Table 5-2  D-TEC II Error Codes

<table>
<thead>
<tr>
<th>Message</th>
<th>Meaning</th>
<th>Root Issue</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-TEC Testing</td>
<td>The D-TEC II Sensor is performing a self-test.</td>
<td>The D-TEC II has repeatedly been trying to pass the self-test while moving to the RCP active position. Normally, it will pass one of these attempts and no message will be displayed. If not, once there it tries one more time to pass and this message will displayed during the self-test.</td>
</tr>
<tr>
<td>Power Line E-Field</td>
<td>The D-TEC II has sensed voltage from a power line.</td>
<td>A power line may be in close proximity. If so, move the vehicle to a location away from the power line, and then redeploy the system.</td>
</tr>
<tr>
<td>Power Line H-Field</td>
<td>The D-TEC II has sensed current from a power line.</td>
<td>A power line may be in close proximity. If so, move the vehicle to a location away from the power line, and then redeploy the system.</td>
</tr>
<tr>
<td>D-TEC Obstruction</td>
<td>The D-TEC II has sensed some type of physical obstruction.</td>
<td>A physical obstruction may be in close proximity. If so, move the vehicle to a location away from the obstruction, and then redeploy the system. Certain high frequency sounds (e.g. air from pneumatic tools) or fluorescent lights may also interfere.</td>
</tr>
<tr>
<td>D-TEC OSHA Limit</td>
<td>The D-TEC II has sensed voltage from a very high power line.</td>
<td>A power line may be in close proximity. If so, move the vehicle to a location away from the power line, and then redeploy the system.</td>
</tr>
</tbody>
</table>

5.2.2 D-TEC II Sensor Faults

The D-TEC II Sensor is not serviceable, so most issues will end with returning the sensor to Will-Burt for repair. See Troubleshooting for a list of related error codes.
5.3 Will-Burt Mast Oil MSDS Sheet

MATERIAL SAFETY DATA SHEET (MSDS)
The Will-Burt Company  Orrville, Ohio  330-682-7015

SECTION 1: PRODUCT AND COMPANY IDENTIFICATION
Etna Products Inc.
16824 Park Circle Drive
Chagrin Falls, Ohio 44022

Company Phone Number: (440)-543-9845
Emergency Phone Number: (800)-229-3862
CHEMTREC Phone Number: (800)-424-9300

Product Name: Masterdraw B985 B
Product Number: 000826
Issue Date: 02/03/2014
Supersedes Date: 09/22/2009

Will-Burt Product Name: Mast Lubrication
Will-Burt Part Number: 900600

SECTION 2: HAZARDS IDENTIFICATION
EMERGENCY OVERVIEW
Appearance / Odor: Transparent blue liquid with a petroleum oil odor
WARNING: May cause slight to mild irritation of the skin, eyes and mucus membranes with repeated exposure.
Fire: Will burn in a fire.
Likely Routes of Exposure: Skin contact, Eye contact, Inhalation
Skin: Prolonged or repeated exposure may cause irritation or oil acne
Eyes: Contact with the eyes may cause temporary irritation
Inhalation: Vapors generated at high temperatures or oil mist may cause mild irritation of the mucus membranes.
Ingestion: Considered no more than slightly toxic if swallowed.
Medical Conditions Aggravated by Exposure: Pre-existing skin and respiratory disorders.
This product does not contain any SARA 313 reportable compounds
This product does not contain any carcinogens as defined by OSHA, NTP and IARC at greater than 0.1%
Hazardous Materials Identification System Rating (HMIS®) 110 c

SECTION 3: COMPOSITION / INFORMATION ON INGREDIENTS
The table below will only list hazardous ingredients. If the table below is blank none are present.

<table>
<thead>
<tr>
<th>Component</th>
<th>Chemical Abstracts Number (CAS)</th>
<th>% by Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

SECTION 4: FIRST AID MEASURES
Skin Contact: Remove contaminated clothing and wash with soap and water. If irritation occurs get medical attention.
Eye Contact: Flush with water for 15 minutes. If irritation occurs get medical attention.
Inhalation: Remove victim to fresh air and provide oxygen if breathing is difficult. Get medical attention.
Ingestion: Do not induce vomiting. Get medical attention.

SECTION 5: FIRE FIGHTING MEASURES
Use water, fog, foam, dry chemical or CO2. Do not use a direct stream of water. Product may float and can be reignited on the surface of the water.

SECTION 6: ACCIDENTAL RELEASES

SECTION 7: HANDLING AND STORAGE
Handling: Keep containers away from heat, open flame or strong oxidants. Use personal protection recommended in Section 8 and by the HIMS Rating.
Storage: Store inside away from heat, open flame and strong oxidants. Keep containers closed when not in use.

SECTION 8: EXPOSURE CONTROL / PERSONAL PROTECTION
Occupational Exposure Guidelines
OSHA PEL / TWA: 5 mg / M3
OSHA PEL / Ceiling: N/E
ACGIH TLV / TWA: 5 mg / M3
ACGIH TLV / STEL: 10 mg / M3
Based on: oil mist
Engineering Controls: Provide local exhaust ventilation to prevent exceeding recommended exposure limits. Controls are required only to capture vapor, mist or fumes.
Eye and Face Protection: Use safety glasses or goggles to prevent eye contact.
Skin Protection: Use chemically resistant gloves to avoid prolonged skin contact. Use chemically resistant apron as necessary.
Respiratory Protection: As needed to prevent over exposure to mist or fumes. Use NIOSH approved chemical mist and organic vapor respirator.
General Hygiene Considerations: Wash thoroughly after handling. Wash with soap and water prior to using toilet facilities, eating, drinking or smoking.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES
Boiling Point: > 500 °F
Specific Gravity @ 15.6 °C: .87
Vapor Pressure: Unknown
% Volatile / % VOC: Unknown
Vapor Density (Air = 1): Unknown
Evaporation Rate (N-BA=1): > 1
Solubility in Water: Nil
pH: Not available
Reactivity in Water: Nil
Appearance: Transparent Blue liquid
Odor: Petroleum odor
Flashpoint: > 300 °F
Flammable Limits (In air % by Volume): Upper: Unknown Lower: Unknown
Auto Ignition: Unknown

SECTION 10: STABILITY AND REACTIVITY
Stability: Stable
Conditions to Avoid: Strong oxidizers, heat, sparks and open flames
Hazardous Polymerization: Will not occur
Incompatibility: Strong oxidants
Decomposition Products: Mixture of air borne solids, liquid and gases evolve upon decomposition by heat or combustion.

SECTION 11: TOXICOLOGY INFORMATION
ACUTE EFFECTS
Oral LD₅₀ Not established
Dermal LD₅₀ Not established
Inhalation LD₅₀ Not established
CHRONIC EFFECTS None

SECTION 12: ECOLOGICAL INFORMATION
Not available

SECTION 13: DISPOSAL INFORMATION
The material is non hazardous, dispose of material in compliance with all federal, state and local regulations.

SECTION 14: TRANSPORTATION INFORMATION
Proper shipping Description: None
Consider the product to be non-hazardous. No special labeling is required by the Department of Transportation.

SECTION 15: REGULATORY INFORMATION
Global Inventories
TSCE. United States The ingredients of this product are included
DSL. Canada The ingredients of this product are included
EINECS. European Union The ingredients of this product are included
SARA 313 Information:
Component CAS # % by weight
None

WHMIS: Canadian Workplace Hazardous Material Information System:

SECTION 16: OTHER INFORMATION
Prepared by: The Will-Burt Company Technical Department
The information contained herein is based on the data available to us and is believed to be correct. The Will-Burt Company does not warrant or guarantee their accuracy or reliability and The Will-Burt Company shall not be liable for any loss or damage arising out of the use thereof. The information and recommendations are offered for the user's consideration and examination and it is the user's responsibility to satisfy oneself as to the suitability and completeness of this information for their own particular use.

February 2016
Section 6 Troubleshooting

This section describes the troubleshooting of your system. The CD that contains this manual will also contain a software Night Scan Product Troubleshooting Guide.

6.1 Troubleshooting Electrical

This section includes a list of warning and error codes and their potential causes. Warning codes do not halt the situation, but let you know of potential issues. Error codes point out problems and usually inhibit operation to prevent potential damage. These codes are shown on the status light on the Base Board. For example, an error of 3,07 would be shown on the status light as three flashes, pause, seven flashes. Additionally, if the controller for your system has a display, errors and warnings will typically be shown there. For more extensive information, see the Night Scan Product Troubleshooting Guide.

Table 6-1 Base Codes

<table>
<thead>
<tr>
<th>Message</th>
<th>Meaning</th>
<th>Root Issue</th>
<th>Potential Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>WRN 1.04</td>
<td>Look-Up light is burned out.</td>
<td>The control circuit is not sensing the look-up light current.</td>
<td>Look-up light is burned out or disconnected somehow.</td>
</tr>
<tr>
<td></td>
<td>Well cover switches indicate closed when they should be open.</td>
<td>Well cover switches indicate closed when they should be open.</td>
<td>Wiring error, or defective switch.</td>
</tr>
<tr>
<td>WRN 1.06</td>
<td>RCP Stow (Vertical, upper mag switch) – Sensor State Error</td>
<td>Switch outputs are valid (opposite), but switch shows wrong polarity for nested state.</td>
<td>Defective mag switch, defective base board.</td>
</tr>
<tr>
<td></td>
<td>At power up, the lower mag switch is indicating “up” (yellow) when it should be “down” (green). If you ignore the warning and continue, the mast will go up, but will shut down after a few seconds with an ERR 1.14.</td>
<td>The lower mag switch needs to be adjusted. D13 should be green when it “sees” the magnet</td>
<td>Wiring error, defective mag switch.</td>
</tr>
<tr>
<td>1.01</td>
<td>Mast Down (mag switch) – Sensor State Error</td>
<td>This is only checked at power up, if stowed. Sensor outputs are O.K., but it is indicating that the mast is extended (not down).</td>
<td>1. The magnetic sensor is not being energized or is defective.</td>
</tr>
<tr>
<td></td>
<td>Mast Stowed (near 0°) – Sensor Output Error</td>
<td>Sensor outputs are bad.</td>
<td>2. Mag switch out of position.</td>
</tr>
<tr>
<td>1.03</td>
<td>Mast Stowed (near 0°) – Sensor State Error</td>
<td>Sensor outputs are O.K., but sensor shows wrong polarity for nested state. The board remembers where it was (0° or 90°) when it was shut off, and this time it powered up, it's sensing the opposite condition.</td>
<td>Base board was changed or software was updated with the mast at 90°.</td>
</tr>
<tr>
<td>Message</td>
<td>Meaning</td>
<td>Root Issue</td>
<td>Potential Cause</td>
</tr>
<tr>
<td>---------</td>
<td>---------</td>
<td>------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>1,04</td>
<td>Excessive amp draw during actuator decline</td>
<td>Current sensor indicating it has exceeded: (12v systems) 10A for 100ms (24v systems) 6.0 amps AND less than 10 amps for (100 msec)</td>
<td>If mast stops at ~70° and issues error, replace Base Board. Current sense circuit has failed. If error occurs during nesting, check LED D7 “MAST STOWED (near 0°)”. Once the sensor “sees” the magnet, it allows 0.5 sec to see the (nesting) current rise. If the circuit does not see the sensor, it does not look for nesting current to shut down. It will keep driving into the saddle and then issue a 1,04. Re-adjust Near 0° sensor. Bad actuator – AC component in current wave shape due to internal mechanical problem. Replace actuator.</td>
</tr>
<tr>
<td>1.05</td>
<td>Well Open (Vertical with well cover) - Switch Output Error</td>
<td>Sensor outputs are bad.</td>
<td>Defective switch or wiring error. Refer to System Wiring Diagram.</td>
</tr>
<tr>
<td>1.06</td>
<td>Well Open (vertical with well cover) - Switch State Error.</td>
<td>Switch outputs are O.K., but show wrong polarity for closed state.</td>
<td>Well cover open or wiring error. System is expecting the well cover to be closed at power-up.</td>
</tr>
<tr>
<td>1.07</td>
<td>Microprocessor Error</td>
<td>No successful poll / response communication for 250ms.</td>
<td></td>
</tr>
<tr>
<td>1.08</td>
<td>Internal firmware detected error.</td>
<td>Internal state machine logic has detected an invalid state transition. Firmware logic error.</td>
<td></td>
</tr>
<tr>
<td>1.09</td>
<td>Initiate Pushbutton input error.</td>
<td>Init input has remained active for 5 seconds. Input is stuck, or has been hot-wired.</td>
<td>1. Unit is in NFPA mode and connected to a Non-NFPA J-box. (Note: if the unit is in Non-NFPA mode and connected to an NFPA junction box, the unit will look normal (UP led on HHRC on), but will not respond to the HHRC. The software is expecting to see the init signal always on. No error message is generated). 2. Wiring short in the control cable or defective switch/wiring in the junction box.</td>
</tr>
<tr>
<td>1,11</td>
<td>Actuator current has unexpectedly stopped</td>
<td>During decline, the Base board senses actuator current. After the “Near 0°” sensor is detected, it is expecting to see the current level rise before it stops. This error indicates the sensed current has stopped before nesting.</td>
<td>If it occurs near the nested position: Actuator has reached its internal stop before nesting completed, most likely saddle too low or saddle not secured causing sideways movement when nesting.</td>
</tr>
<tr>
<td>Memory Error</td>
<td>Memory Error</td>
<td>Memory Error</td>
<td></td>
</tr>
</tbody>
</table>

6-2 TP-5314001-D October 2016
<table>
<thead>
<tr>
<th>Message</th>
<th>Meaning</th>
<th>Root Issue</th>
<th>Potential Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor Output Error</td>
<td>Sensor outputs are bad.</td>
<td>Wiring error, faulty sensor (Vertical only) mag switch positioning. Note: Sensor is only active as mast tube magnet goes by. Software watches for direction of travel and sensor activation to determine if mast is “up” or “down”.</td>
<td></td>
</tr>
<tr>
<td>Roof-mount - Actuator at 90° magnetic sensor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vertical - Upper magnetic sensor switch</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RCP STOWED magnetic sensor – Sensor Output Error</td>
<td>Sensor outputs are bad.</td>
<td>Wiring problem, defective magnetic sensor.</td>
<td></td>
</tr>
<tr>
<td>(Upper magnetic sensor on Vertical)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mast Down (lower magnetic sensor)</td>
<td>1. Sensor outputs bad. They have not been opposite for &gt;250ms.</td>
<td>1. There may be a wiring problem, or a defective magnetic sensor.</td>
<td></td>
</tr>
<tr>
<td>2. Sensor State Error</td>
<td>or</td>
<td>or</td>
<td></td>
</tr>
<tr>
<td>2. Mast was told to go up, and the sensor indicates it did not move after 8 seconds (v7.2), or 15 seconds (v7.3).</td>
<td>2. Defective magnetic sensor, air supply inadequate, or external magnet affecting sensor.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Sensor is not seeing magnet when mast is fully retracted.</td>
<td>3. Sensor not seeing magnet - sensor needs to be re-aligned.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>At 90° (Actuator) - Sensor State Error</td>
<td>Checked at power up after stowing. Sensor outputs are O.K., but sensor shows wrong polarity for nested state.</td>
<td>Board was changed or updated while the mast was at 90°.</td>
<td></td>
</tr>
<tr>
<td>Well Closed (Vertical with well cover) - Switch Output Error.</td>
<td>Sensor outputs are bad.</td>
<td>D7 Green = Closed</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>D8 Yellow = Not Closed</td>
<td></td>
</tr>
<tr>
<td>Well Closed (Vertical with well cover) – Sensor State Error</td>
<td>Switch outputs are O.K., but show wrong polarity for Well Closed.</td>
<td>Switch wiring, defective switch, board.</td>
<td></td>
</tr>
<tr>
<td>Both Near 0° and 90° - Sensor State Error</td>
<td>Both the Nested LS and the 90° LS have been detected active at the same time. This is an invalid condition, and indicates a problem with one or both sensors.</td>
<td>Both sensors indicate proximity, one may be bad.</td>
<td></td>
</tr>
<tr>
<td>Forced Stow has been activated</td>
<td>This fault is set when the Forced Stow switch is activated to assure the system is not in normal operation during the forced stow operation.</td>
<td>Forced Stow button has been activated</td>
<td></td>
</tr>
<tr>
<td>Message</td>
<td>Meaning</td>
<td>Root Issue</td>
<td>Potential Cause</td>
</tr>
<tr>
<td>---------</td>
<td>---------</td>
<td>------------</td>
<td>-----------------</td>
</tr>
<tr>
<td><strong>WRN 2,04</strong></td>
<td>Single-tilt - Tilt Stuck</td>
<td>Checked only when moving out of a limit position. The software indicates the state of the (left) tilt photosensor has not changed even though the motor has been told to move for more than 1/2 second.</td>
<td>Something is preventing movement of left tilt mechanism, the motor is defective, or the RCP board is defective.</td>
</tr>
<tr>
<td></td>
<td>Dual-tilt - Left Tilt Stuck</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>WRN 2,06</strong></td>
<td>Right Tilt Stuck</td>
<td>Checked only when moving out of a limit position. The software indicates the state of the right tilt photosensor has not changed even though the motor has been told to move for more than 1/2 second.</td>
<td>Something is preventing movement of right tilt mechanism, the motor is defective, or the RCP board is defective.</td>
</tr>
<tr>
<td></td>
<td>Pan Stuck</td>
<td>Checked only when moving out of a limit position. The software indicates the state of the pan photosensor has not changed even though the motor has been told to move for more than 1/2 second.</td>
<td>Something is preventing movement of pan mechanism, the motor is defective, or the RCP board is defective.</td>
</tr>
<tr>
<td></td>
<td>Pan Limit Overlap</td>
<td>The software indicates both pan photosensors are blocked simultaneously.</td>
<td>Foreign material in one of the photosensors or faulty photosensor.</td>
</tr>
<tr>
<td><strong>2,03 (Positioner Only)</strong></td>
<td>TILT pot stuck</td>
<td>No movement detected in expected direction for 2.0 seconds</td>
<td>Soft stops are not set, something is preventing the sense voltage (pot) movement, the motor is defective, the sense voltage is going the wrong way (miswire), or the P/T drive board is defective.</td>
</tr>
<tr>
<td></td>
<td>PAN pot stuck</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>2,07</strong></td>
<td>Communication Timeout</td>
<td>The RCP or P-T Drive board has not sent out communications recently.</td>
<td>Bad board or connection in communications link.</td>
</tr>
<tr>
<td><strong>2,09 (RCP Only)</strong></td>
<td>(Left) Tilt Up wrap around</td>
<td>The software indicates the same photosensor was made before the opposite limit photosensor was made to stop rotation. This indicates wrap around.</td>
<td>1. The flag that interrupts the light may need to be adjusted to go deeper into the photocell. 2. The limit photosensor is defective</td>
</tr>
<tr>
<td></td>
<td>(Left) Tilt Down wrap around</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>2,09 (Positioner Only)</strong></td>
<td>Pan Pot Failure</td>
<td>The Positioner software indicates the pot feedback voltage is out of acceptable operating range.</td>
<td>Defective pot, incorrect wiring, bad connection, defective P-T board.</td>
</tr>
<tr>
<td></td>
<td>Tilt Pot Failure</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>2,11</strong></td>
<td>2,11 Right Tilt Up wrap around</td>
<td>The software indicates the same photosensor was made</td>
<td></td>
</tr>
<tr>
<td>Message</td>
<td>Meaning</td>
<td>Root Issue</td>
<td>Potential Cause</td>
</tr>
<tr>
<td>---------</td>
<td>---------</td>
<td>------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>2,12</td>
<td>Right Tilt Down wrap around</td>
<td>before the opposite limit photosensor was made to stop rotation. This indicates wrap around.</td>
<td>1. The flag that interrupts the light may need to be adjusted to go deeper into the photocell. 2. The limit photosensor is defective</td>
</tr>
<tr>
<td>2,13</td>
<td>Pan Right wrap around</td>
<td>The software indicates the same photosensor was made before the opposite limit photosensor was made to stop rotation. This indicates wrap around.</td>
<td>The limit photosensor is defective.</td>
</tr>
<tr>
<td>2,14</td>
<td>Pan Left wrap around</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2,15</td>
<td>Left Tilt Limit Overlap</td>
<td>The software indicates both tilt photosensors appear to be blocked simultaneously.</td>
<td>Foreign material in one of the photosensors or faulty photosensor.</td>
</tr>
<tr>
<td></td>
<td>Right Tilt Limit Overlap</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Message</th>
<th>Meaning</th>
<th>Root Issue</th>
<th>Potential Cause</th>
</tr>
</thead>
</table>
| WRN 3,02 | Dual HHRC simultaneous inputs | Two HHRCs are sending commands simultaneously.  
If commands are not conflicting, they will be allowed (Base Board decides).  
If commands are conflicting, no action/movement will be allowed by the Base Board.  
Warning appears regardless of conflicting or not conflicting to alert operators that someone else is trying to operate the unit simultaneously. | |
| 3,07    | Unrecoverable Communication Error | The display board in the HHRC or PMRC has power, but the Base Board is not communicating with it. It may be caused by the HHRC, Base Board, RCP Board, or any other device that is using the RS-485 communication lines in the system.  
On an error, the Base Board stops the program, sends out the error code to the display devices and ‘flashes’ the code on the Base Board LED. Because one error can cause others to follow, the only code that is displayed/flashed is the first one that occurs. Other errors may happen after that, but they are not displayed. The idea is to show the actual initial problem, rather than any potentially confusing follow-on errors. | Defective HHRC or defective base board. Bad or improper connection in communications link, or HHRC is not properly powered. Check continuity of the data lines from the DC power cable connector to the HHRC connector. Refer to System schematic. Also check that the shield in the junction box has a good electrical connection to the electronics common at one end or the other, but not both. |
<p>| 3,08    | Microprocessor Error | Internal firmware detected error. | Replace HHRC or HHRC Display pcb. |
| 3,09    | RF module Error | Wireless Transmitter/Receiver did not properly initialize. | Return HHRC to factory for repair. |</p>
<table>
<thead>
<tr>
<th>Message</th>
<th>Meaning</th>
<th>Root Issue</th>
<th>Potential Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>5,01</td>
<td>Lamp Fault</td>
<td>The D-Tec has sensed a fault in the LED lamp circuit.</td>
<td>This check is made when the mast thinks it has just arrived at 90°. The D-Tec Sensor measures the current through the look-up LED’s to see if it is within a certain range. If it is not, the fault occurs.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SPI Fault</td>
<td>A communications bus internal to the D-Tec II sensor has failed during self-test.</td>
<td>Defective Sensor</td>
</tr>
<tr>
<td>5,07</td>
<td>Unrecoverable Communication Error</td>
<td>No successful communication for 250ms.</td>
<td>Check connection (data lines, ground) for continuity.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>This error may also be displayed on systems without a D-Tec if the Base Board is missing the 4710801 DIP Switch Shunt Board.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>E-Field Fault</td>
<td>E-Field portion of the D-Tec II failed its self-test.</td>
<td>Defective sensor</td>
</tr>
<tr>
<td>5,10</td>
<td>H-Field 1 Fault</td>
<td>One axis of the Magnetic Field portion of the D-Tec II failed its self-test.</td>
<td>Defective sensor</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>H-Field 2 Fault</td>
<td>One axis of the Magnetic Field portion of the D-Tec II failed its self-test.</td>
<td>Defective sensor</td>
</tr>
<tr>
<td>5,12</td>
<td>H-Field 3 Fault</td>
<td>One axis of the Magnetic Field portion of the D-Tec II failed its self-test.</td>
<td>Defective sensor</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ultrasonic Fault</td>
<td>The ultrasonic portion of the D-Tec II failed its self-test.</td>
<td>Check for ultrasonic physical sensor or deflector damage.</td>
</tr>
<tr>
<td>5,16</td>
<td>Supply Voltage Fault</td>
<td>The power supply section of the D-Tec II sensor is outside proper operational limits.</td>
<td>Check power connections, voltage level and induced noise on power source.</td>
</tr>
</tbody>
</table>
6.2 Troubleshooting Mechanical Symptoms

This section describes mechanical troubleshooting of your system.

Table 6-5 lists some problems that may be observed, but may not generate an error or warning code on the controller.

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Root Issue</th>
<th>Troubleshooting Sequence</th>
</tr>
</thead>
</table>
| Mast sticking during extension or retraction.| Mast is dirty and/or requires lubrication.      | 1) Clean and lubricate mast.  
                                              |                                                 | 2) If condition continues, mast requires overhaul.                                      |
| Mast leaks down when extended.               | Air leak in mast or valve/compressor assembly.   | Use a soapy water solution to pinpoint the leak. If the mast is leaking, it will require  |
                                              |                                                 | new seals. If the valve or compressor assembly is leaking at a fitting, remove the fitting,  |
                                              |                                                 | clean and reinstall using thread tape or sealant. Replace a faulty valve or compressor.     |
| RCP continually pans or tilts.              | Bent flag in RCP.                               | 1) Remove RCP cover straighten or replace flag.                                          |
                                              |                                                 | 2) Make sure wiring is not wound tight. Reset home position.                            |
| Pan or tilt motor will not respond with no  | Broken or loose motor wire lead or faulty motor. | 1) Reconnect wire lead.  
                                              |                                                 | 2) Replace motor.                                                                    |
Section 7 Drawings

This section contains drawings for your system.
RCP wiring (page 2) of the HDT system is identical to Will-Burt standard systems (WD-46276) and included in this drawing set.
Night Scan Powerlite HDT
with 4311701 Control
Vertical System Wiring

Drawing: WD-47621
HHRC WITH EMERGENCY STOP
NFPA OR STANDARD OPERATION

<table>
<thead>
<tr>
<th>NFPA</th>
<th>STANDARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>KIT</td>
<td>HHRC</td>
</tr>
<tr>
<td>4756919</td>
<td>4520001</td>
</tr>
<tr>
<td>4756920</td>
<td>4520002</td>
</tr>
<tr>
<td>CHIEF SINGLE-TILT</td>
<td></td>
</tr>
<tr>
<td>4735019</td>
<td>4745801</td>
</tr>
<tr>
<td>4735020</td>
<td>4745802</td>
</tr>
<tr>
<td>POWERLITE DUAL-TILT</td>
<td></td>
</tr>
</tbody>
</table>

*NFPA START* SWITCH AND WIRING ON NFPA MODELS ONLY

CONNECT SHIELD GROUNDS TO J4-2
JUMPER FROM 5-7 REQUIRED FOR STANDARD (NON-NFPA) OPERATION

J4 ON BASE BOARD

TO BASE BOARD - SEE SYSTEM WIRING DIAGRAM

INTERCONNECT CABLE
CONTROL CABLE ONLY (DOES NOT INCLUDE 10 GA RED & BLACK, 18 GA RED & BLACK NOT TWISTED PAIR)

NOTES
1. TORQUE 4-8 in-lbs. 0.5Nm
2. "MAST ACTIVE" CONTACTS, J4-1 OR J4-9.10
3. USE SW1-1 ON BASE BOARD TO SELECT OPEN (ON) OR CLOSED (OFF) WHEN NESTED.
4. SW1-0 OPEN = CONTACTS CLOSED WHEN NESTED.
5. SW1-0 CLOSED = CONTACTS OPEN WHEN NESTED.
6. 30 AMP MAX CURRENT, 20 GA, MINIMUM CONDUCTOR, CUSTOMER SUPPLIED WIRING.
7. SW2-0 ON BASE BOARD MUST BE OPEN (OFF) FOR NFPA MODE.
8. SW2-1 ON BASE BOARD MUST BE CLOSED (ON) STANDARD MODE.
9. REMOVE JUMPER(S) IF REPLACED BY PARKING BRAKE INTERLOCK. G-H CLOSED WHEN BRAKE "ON".
10. 4521802 CABLE: ALL WIRES 20 GA, EXCEPT RED AND BLACK (J4-1 AND 2).
11. 4521803 SIGNAL CABLE TO BASE BOARD WITH SEPARATE 10 GA TO BASE BOARD.
12. BATTERY CONNECTION TO SYSTEM: IN-LINE SPICE RECOMMENDED. DO NOT USE TERMINAL E & F.
13. 18 GA. MIN. IF USING 4521803 SIGNAL CABLE TO BASE BOARD WITH SEPARATE 10 GA TO BASE BOARD.
Night Scan Universal Control
Roof-Mount, NFPA or Standard,
HHRC with Emergency Stop

Drawing: WD-72212
HDT CONVERTER WIRING

CONVERTER POWER CONTROL

A SIGNAL FROM THE NIGHTSCAN IS USED TO CONTROL POWER TO THE CONVERTER USED FOR THE LIGHTS, J4-1, 2 ON THE BASE BOARD SUPPLIES BATTERY VOLTAGE WHEN THE SYSTEM IS ON. USING THIS POWER TO ACTIVATE THE SOLENOID, IT WILL TURN THE CONVERTER ON AND OFF WITH THE SYSTEM. SOLENOID RATED FOR CONTINUOUS DUTY AND OPERATES AT SAME VOLTAGE AS THE BATTERY VOLTAGE.

THIS DIAGRAM SHOWS THE CONNECTIONS:

FROM J4-1, 2 TO THE SOLENOID
FROM TB4-1, 2 (BOARD POWER) TO THE DC DISTRIBUTION SYSTEM
FROM THE LIGHT POWER IN (TB1 & 2) TO THE CONVERTER OUT