



V4 Pipelayer System

User Manual

Updated: June 25, 2019

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Warranty and Certification

Cranesmart Systems warrants to the purchaser of each new Cranesmart System that any part thereof which proves to be defective in material or workmanship within two (2) years from date of delivery will be repaired or replaced at no charge if the system is returned to us in Edmonton, Alberta with all freight charges prepaid. If a performance problem should occur, contact our office/manufacturing facility in Edmonton, Alberta at (888) 562-3222 or (780) 437-2986 (Address: 4908 97 St NW, Edmonton, AB T6E 5S1).

This warranty does not cover defects resulting from accident, alteration, improper use, or failure of the purchaser to follow normal operating procedures as outlined in this instruction manual.

PLEASE NOTE:

- Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.
- This device complies with part 15 of FCC rules, and Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.
- The display panel is a category 2 item as per IC and FCC radio certification
- This warranty is in lieu of any warranty or merchantability and of all other warranties, expressed or implied, all of which are hereby excluded.
- The display panel operates at an input range of 12-24 VDC at 1 A.
- The wireless transducers operate at 3.6 VDC at 30mA (battery).
- All Cranesmart devices are FCC compliant and are labeled clearly as such.
- All Cranesmart devices have an IP rating: 68, and an operable temperature range of: -40°C to +60°C (-40°F to 140°F).



- **WARNING:** OPENING THE DISPLAY PANEL VOIDS THE WARRANTY.



- **WARNING:** NO COMPONENTS OF THE SYSTEM ARE TO BE SUBMERGED IN WATER.



- **WARNING:** DO NOT PRESSURE-WASH CRANESMART COMPONENTS. DIRECT APPLICATION OF HIGH-PRESSURE WATER CAN BREAK SEALS AND LEAD TO MOISTURE DAMAGE.



- **WARNING:** POTENTIAL ELECTROSTATIC CHARGING HAZARD: USE A DAMP CLOTH ONLY TO WIPE CLEAN THE EXTERIORS OF COMPONENTS.

Cranesmart Systems shall in no event be liable for any special, indirect, or consequential damages whatsoever and neither assumes nor authorises any person to assume for it any other obligation or liability.



EC Declaration of Conformity

Declaring Organization: ***Cranesmart Systems, Inc.***

4908 97 St NW
Edmonton, Alberta
T6E 5S1

Product Name: LMI 4 Display and UTX-900 Transducer
Product Model Name: LMI 4 and UTX-900
Product Description: Pipelayer LMI 4 System

We, Cranesmart Systems, Inc., declare under our sole responsibility that the above named product conforms to the essential requirements of the European Union Directive 2014/53/EU on Radio Equipment and Restriction of Use of Certain Hazardous Substances in Electrical and Electronic Equipment Directive 2011/65/EU. The following harmonized standards are those to which the product's conformance has been verified.

Safety requirements for electrical equipment for measurement, control, and laboratory use	IEC 61010-1:2010 (Third Edition)
Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 3: Specific conditions for Short-Range Devices (SRD) operating on frequencies between 9 kHz and 246 GHz	ETSI EN 301 489-3 V2.1.1 (2017-03)
Short Range Devices (SRD) operating in the frequency range 25 MHz to 1 000 MHz; Part 2: Harmonized Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU for non-specific radio equipment	ETSI EN 300 220-2 V3.1.1 (2017-02)
Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances	EN 50581:2012

Place

Edmonton, Alberta

Signature

Tom Bilodeau, President

Date

Nov 17, 2017

NOTE: The Cranesmart System is designed for and intended to be used as an operator safety aid for cranes, pipelayers and similar load lifting machinery. Operational parameters such as: load weight, boom angle, anti-2-block status, level indication, (and others) are monitored by the system and displayed clearly for the operator in order to make working conditions safer, and operations more accurate and efficient. This manual has been written in the effort to explain the most pertinent details of this system and its use.

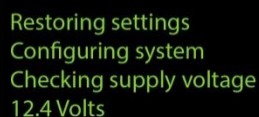
1. The User Interface

The new Cranesmart Pipelayer LMI 4 System utilizes a large full color touchscreen display panel, which is described generally, in this section. All information, parameters, menus and alarms are displayed and accessible directly via the touchscreen, with no need to use the hardware buttons located beneath the display. These buttons will be integrated in later versions of the system for extended functionality.

NOTE: The touchscreen does not respond to increasing pressure on its surface - to make a selection, use only light contact directly overtop the desired button to avoid potentially damaging the screen.

1.1. The Startup Screens

Illustrated below are the Startup Screens, which are displayed immediately upon powering the system. The display shows a quick system diagnostics checklist (left), then the Cranesmart Systems logo. Once the system is fully initialized, the main user interface will appear.



Restoring settings
Configuring system
Checking supply voltage
12.4 Volts



1.2. The Home Screen

Illustrated below is the Home Screen, which is the main display for normal operation. The system updates in real time, all the most important parameters of the system and displays them here for the operator. The elements of the display are labeled and explained on the following page.



1

Menu Tabs

Across the top of the display are the Menu Tabs for accessing the main functions of the system. From left to right, the tabs represent these menus: Home / Configurations / Settings / Information / Permission Level / Brightness and Audio / Language. These tabs are visible and accessible at all times.

2

Load Display

The primary section of the Home Screen shows the load information. Here, the current load on the hook is displayed in the chosen units of measurement, as well as the (programmed) maximum load allowed for the system. The current load as compared to the maximum is also displayed visually as a bar graph and percentage.

3

Bypass Button

Pressing this button will shut off any audible alarm and dismiss any warning message for a period of 30 seconds. The display will show this time interval counting down, until the timer runs out completely and the alarm is reactivated. A more detailed description of the alarms and their displays can be found in the *Troubleshooting* section of this manual.

4

Clock

The upper right area of the screen shows the system clock. The time of day as well as the month and year are displayed clearly for the operator. This information can be changed by pressing the screen directly over the clock display, which will open the Time and Date Screen. See *The Time and Date Menu* section of this manual for more information.

5

Secondary Parameter Tiles

Surrounding the load display are other important parameters being monitored by the system. Information related to the machine's boom (angle, overhang, and tip height) is located below the load display. Information related to the machine's level (pitch and roll) and A2B status is located to the right of the load display. Pressing the area of the screen overtop each parameter shown will open an associated menu for that parameter, where certain values can be changed or displayed.

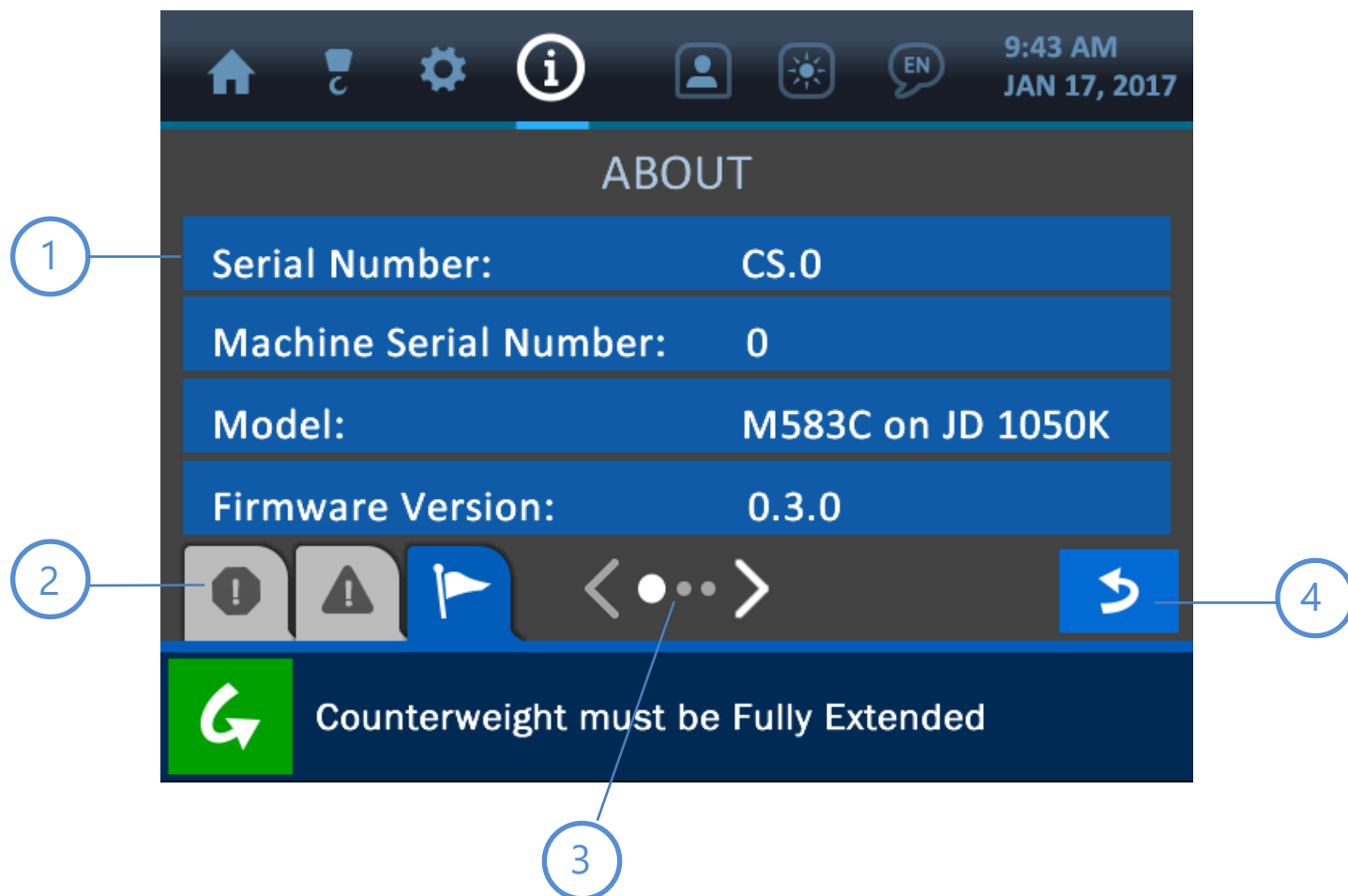
6

Alarm and Notification Bar

The lower section of the screen shows the Alarm and Notification Bar. As shown in the screenshot, the system pictured is experiencing no alarms and shows the default notification, 'Counterweight must be fully extended'. In case of an alarm, an associated message would be displayed in this area, with color changes to indicate the problem visually. Further description of the alarms and their displays are found in the *Troubleshooting* section.

1.3. The Menu Screens

Shown below is an example of a typical Menu Screen. Its various components are described on the following page.



1

Banner Buttons

Every listed item on a menu screen is shown overtop a blue Banner Button. If the item is changeable or linked to a further submenu, pressing anywhere on the banner button will advance the display to show more associated options.

2**Message Tabs**

Across the bottom of the menu screens are the various message tabs that display different kinds of information to the operator. The tabs in order from left to right are: Alarms / Warnings / Notifications.

3**Page Indicator**

This symbol indicates that more menu items are available but cannot all be displayed simultaneously. Pressing directly overtop the page arrows will increment or decrement the menu accordingly.

4**Back Button**

Pressing this button will reopen the previously viewed screen, making menu navigation faster and easier.

1.4. The Value Entry Screen

Shown below is an example of a typical Value Entry Screen. This is the format used for any instance where a numerical parameter must be set or changed. The various components of this screen are labeled and described below.



1

Value Window

The value in question will be displayed in this area, showing updates as they are made by pressing the keypad buttons.

2

Clear Button

Pressing this button will clear the Value Window, setting the value to 0.

3

Delete Button

Pressing the Delete Button will delete the first digit (from the right) displayed in the Value Window.

4

Keypad

Press the keypad buttons to set the new value to be used, as displayed in the Value Window.

5

Cancel and Accept Buttons

Pressing the (red) Cancel Button will nullify any changes made on this screen and open the previous page displayed. The (green) Accept Button will confirm and save any changes made and open the previously displayed page.

2. Normal Operation

The Cranesmart LMI 4 Pipelayer interface was designed to present the user with all the most important, real-time information regarding the machine in use, for the safest and easiest possible operation. This section of the manual explains each parameter on the Home Screen and other screens used during normal operation, how to view and change important settings, and the ways the system indicates potential danger.

NOTE: See 'The User Interface' section for explanations of the screen formats and common functions used throughout the system.

2.1. Load Indication

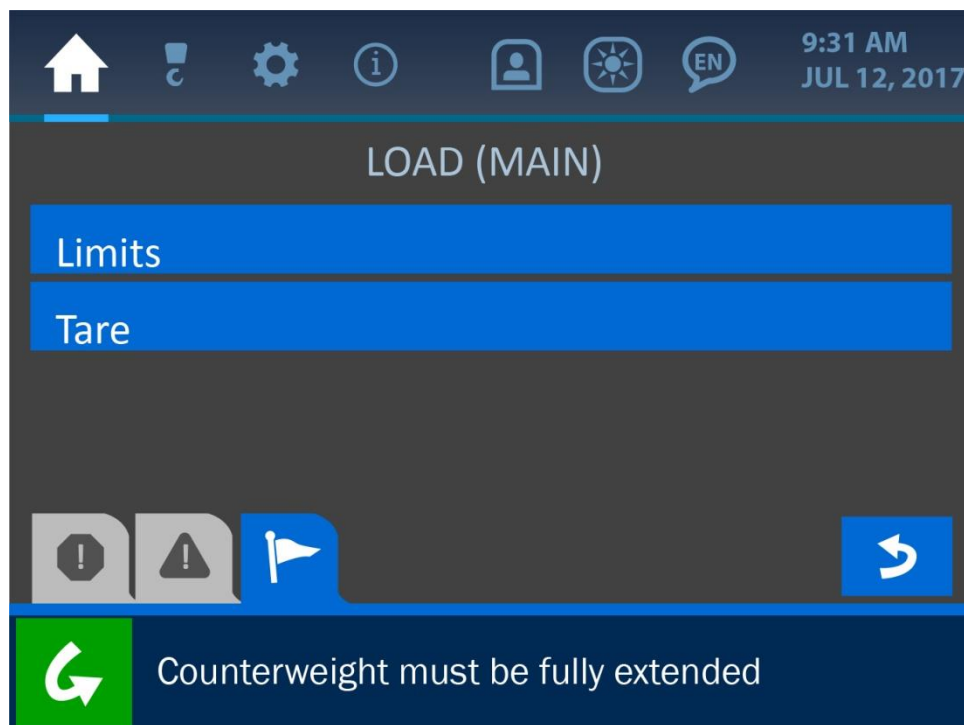
Shown below is the Home Screen, with the Load Indication Tile emphasized.



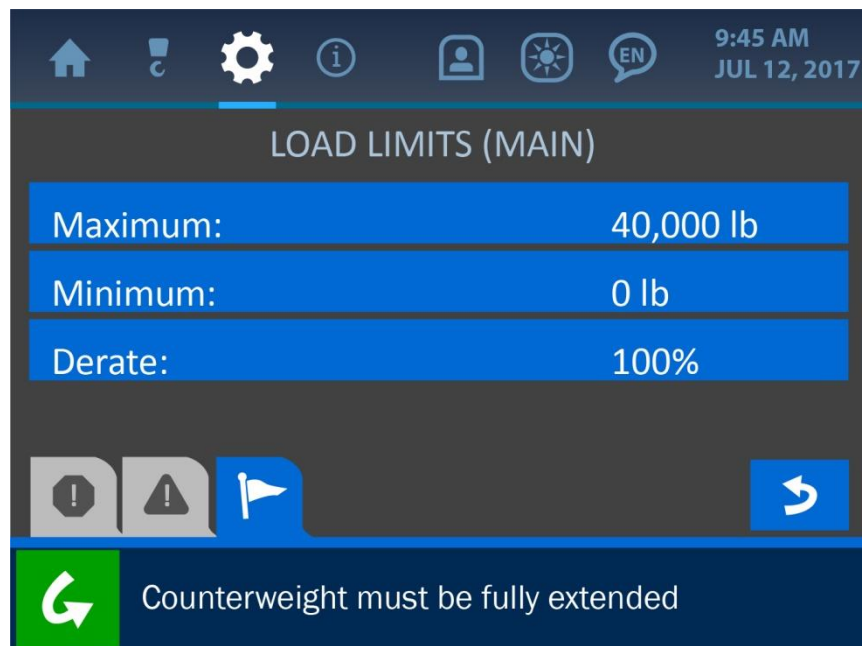
As shown in the previous screenshot, and the detail image below, the load is indicated by several factors at any given time. The current load on the hook is shown, as well as a bar graph and percentage indicating how close the current load is to the maximum capacity of the machine. The maximum capacity is taken either from the machine load chart, or the user set limit – whichever is lowest.



Pressing anywhere directly overtop the Load Indication Tile will open the Load Menu, as shown below. This menu offers the following options for the load: Limits, and Tare. These options are described on the following pages.



Load Limits



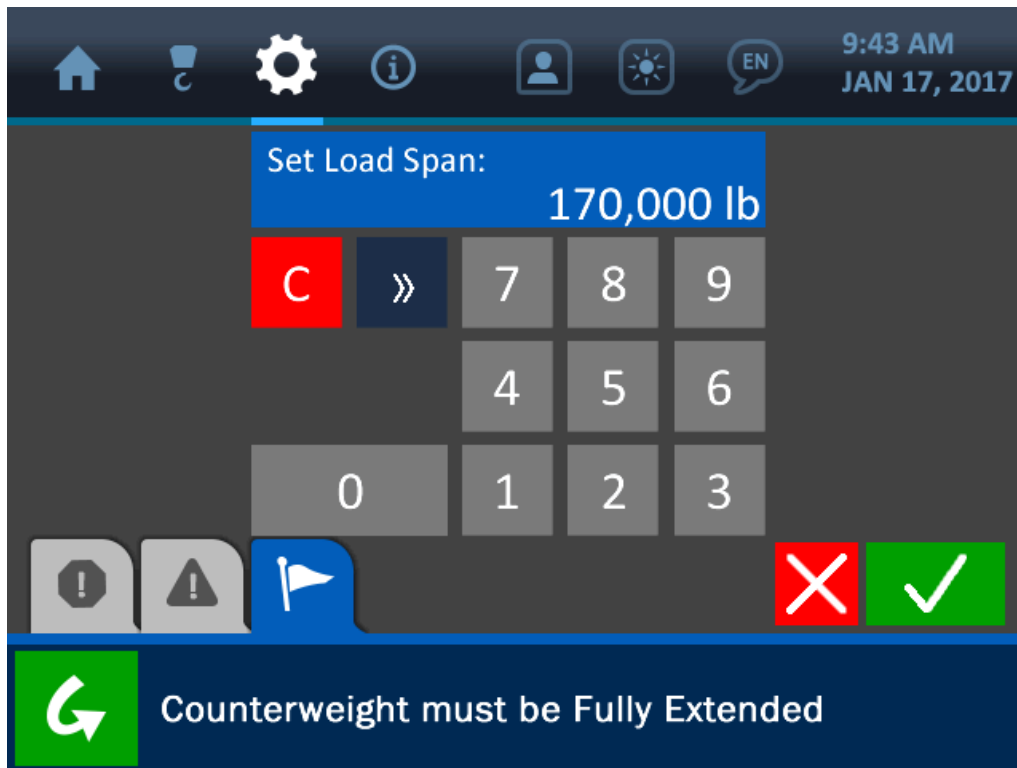
The Load Limits Menu displays the current settings for the following parameters:

Maximum: the current maximum load allowed before the system displays a load alarm condition

Minimum: when the load drops below this value, the system will display a load alarm condition.

Derate: this value indicates the capacity of the load chart that the system is set to recognize. If for example, the Derate value is set to 100%, the entire load chart is used at full capacity. If the Derate value were to be set at 50%, the machine would be enabled to function at only half of its actual capacity before the system shows an alarm state.

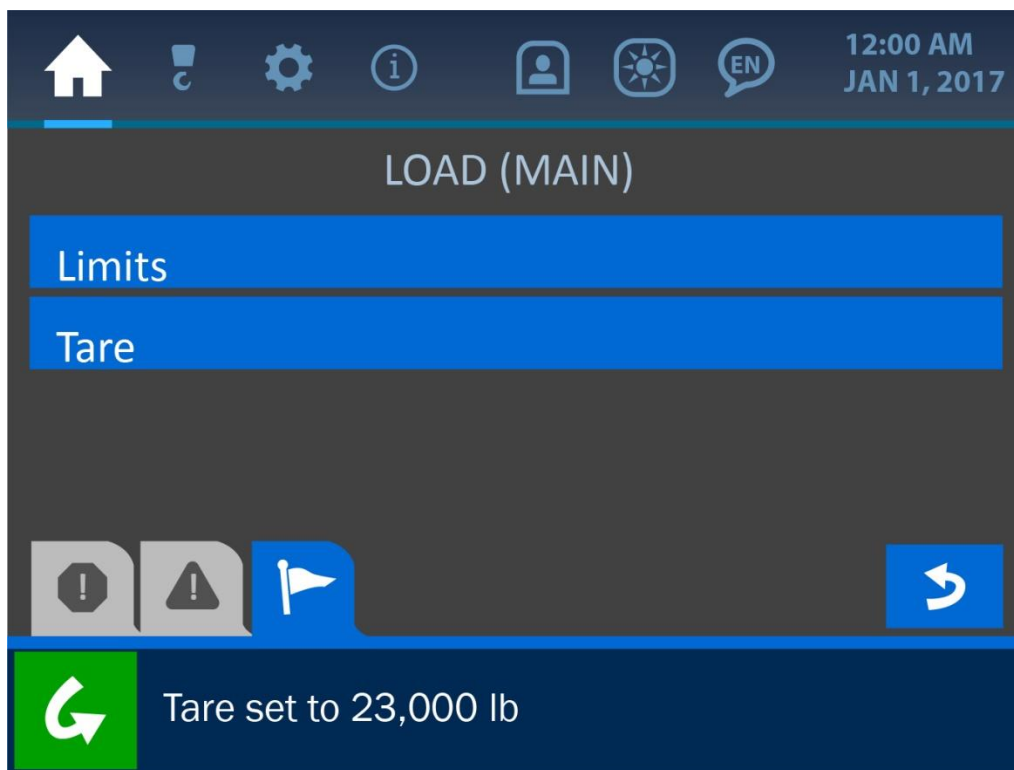
To edit any of the load parameter values, simply press the screen directly overtop the option to be changed to open the Value Entry Screen for that respective option.



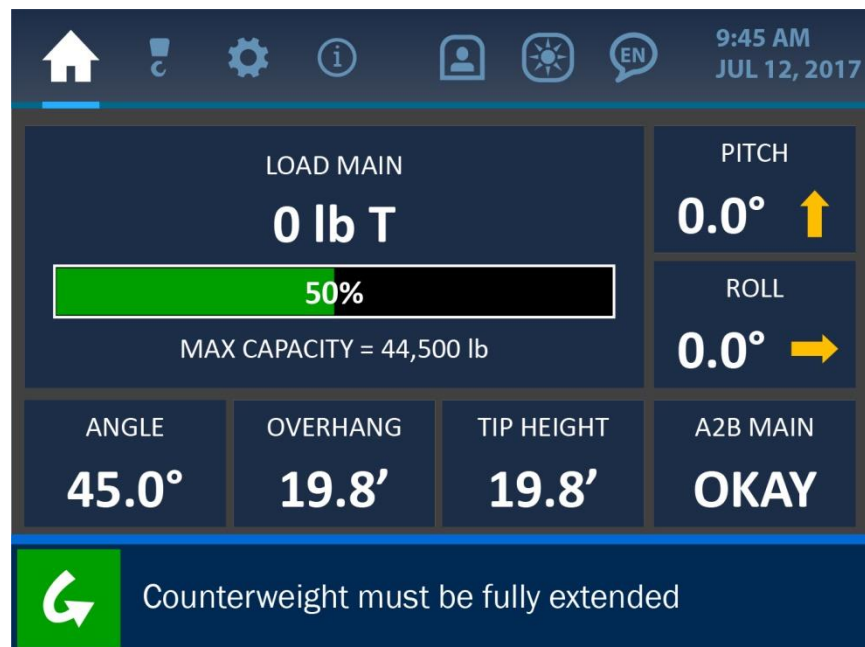
Once the Value Entry Screen is opened, use the keypad to enter the desired value for the parameter, and press the (green) Accept Button to save the change.

NOTE: See 'The User Interface' section of this manual for more information on the Value Entry Screen.

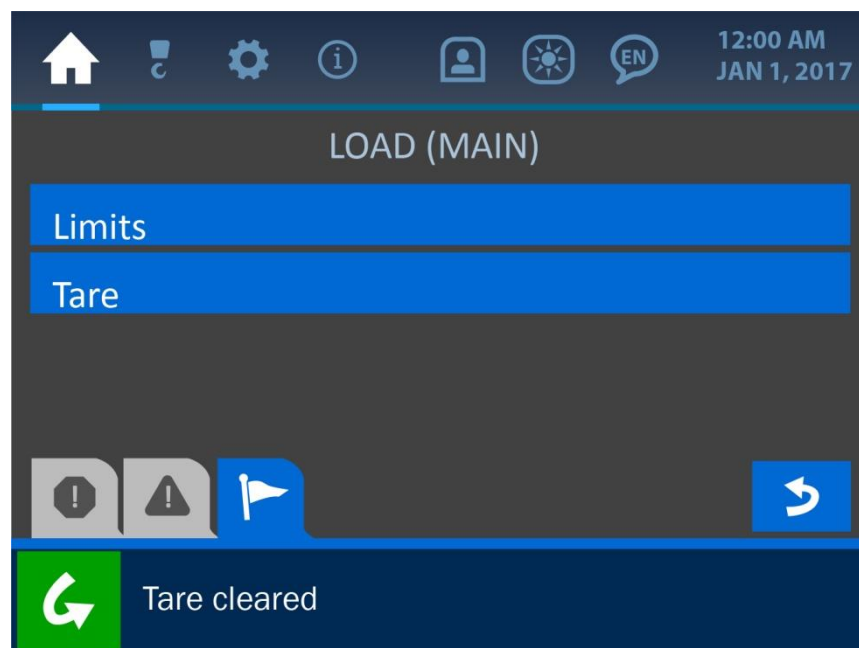
Load Tare



The Load Tare option enables an operator to set the current weight on the hook to zero. To do this, simply press the Tare Banner Button in the Load Menu. For the example of this screenshot, the system shown is displaying in the Notification Bar (along the bottom of the screen) that the current load of 23,000 lb has been set to zero. This is further indicated by the following screenshot of the modified Home Screen – the current load shows 0 lb and the 'T' symbol indicates that this zero-load is the result of the tare operation.



To clear the tare set point, simply re-enter the Load Menu, and press the Tare Banner Button again. The Notification Bar will indicate that the tare has been cleared, as shown in the screenshot below.

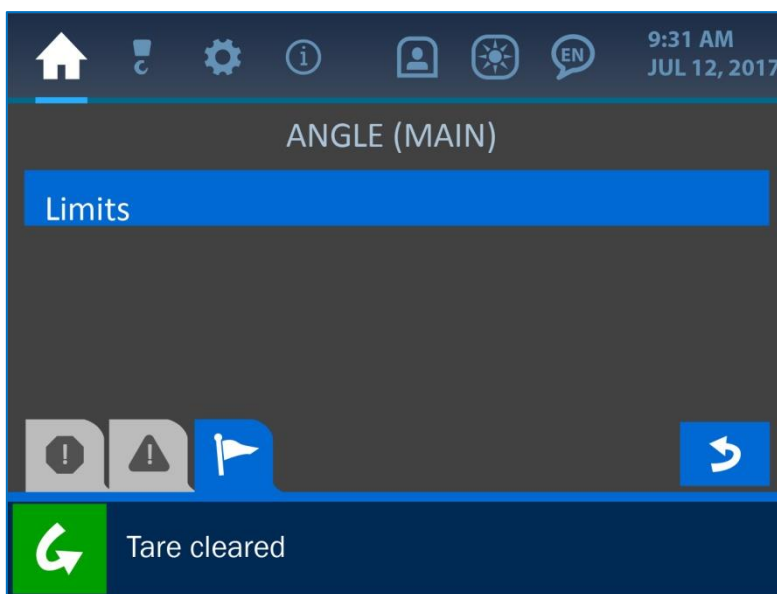


2.2. Angle Indication

Shown below is the Home Screen, with the Angle Indication Tile emphasized.



As illustrated above, the current boom angle is shown in degrees, to the resolution of 0.5°. Pressing anywhere directly overtop the Angle Indication Tile will open the Angle Menu, where the angle limits can be adjusted.



Angle Limits

The Angle Limits Menu should initially show the default values for a Maximum of 180° and a Minimum of -180°. This simply ensures that the angle transducer is given its full potential range of operation, though these values can be changed at any time to accommodate special circumstances of operation.



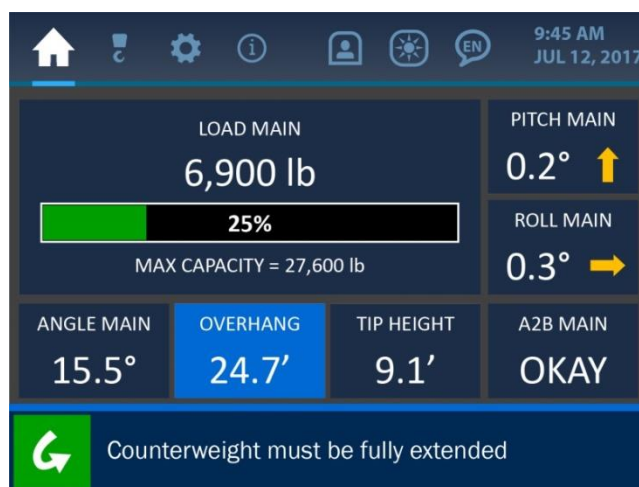
To change either of these values, simply press the screen directly overtop the desired limit value to open the Value Entry Screen, as shown below.



Once the Value Entry Screen is opened, use the keypad to enter the desired value for the parameter, and press the (green) Accept Button to save the change. **NOTE: See 'The User Interface' section of this manual for more information on the Value Entry Screen.**

2.3. Overhang Indication

Shown below is the Home Screen, with the Overhang Indication Tile emphasized.



As illustrated above, the current overhang is shown in feet, to the resolution of 0.1 feet. Pressing anywhere directly overtop the Overhang Indication Tile of the screen will open the Overhang Limits Menu, as shown below.



The overhang limits are defined as a maximum and minimum value, according to the particular machine the system is installed on. These limits define how far the tip of the boom can extend from the machine base, and are factory-set but can be changed in the field as necessary by pressing the screen overtop either limit. This will open the Value Entry Screen, as shown below.



Once the Value Entry Screen is opened, use the keypad to enter the desired value for the parameter, and press the (green) Accept Button to save the change.

NOTE: See 'The User Interface' section of this manual for more information on the Value Entry Screen.

2.4. Tip Height Indication

Shown below is the Home Screen, with the Tip Height Indication Tile emphasized.



As illustrated above, the current tip height is shown in feet, to the resolution of 0.1 feet. Pressing anywhere directly overtop the Tip Height Indication Tile will open the Tip Height Limits Screen, as shown below.



The tip height limits are defined as a maximum and minimum value, according to the particular machine the system is installed on, and define the range of height for the boom tip, from the ground. These values are factory-set but can be changed in the field as necessary, by pressing the screen overtop either limit. This will open the Value Entry Screen, as shown below.

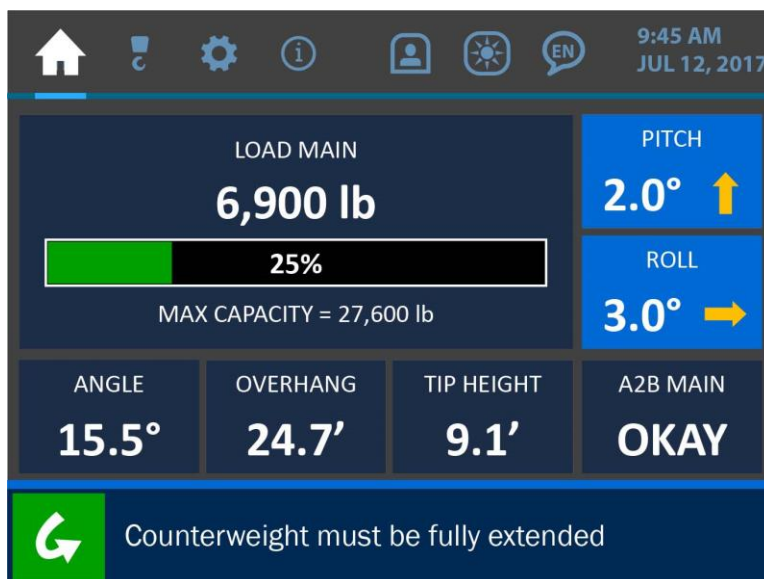


Once the Value Entry Screen is opened, use the keypad to enter the desired value for the parameter, and press the (green) Accept Button to save the change.

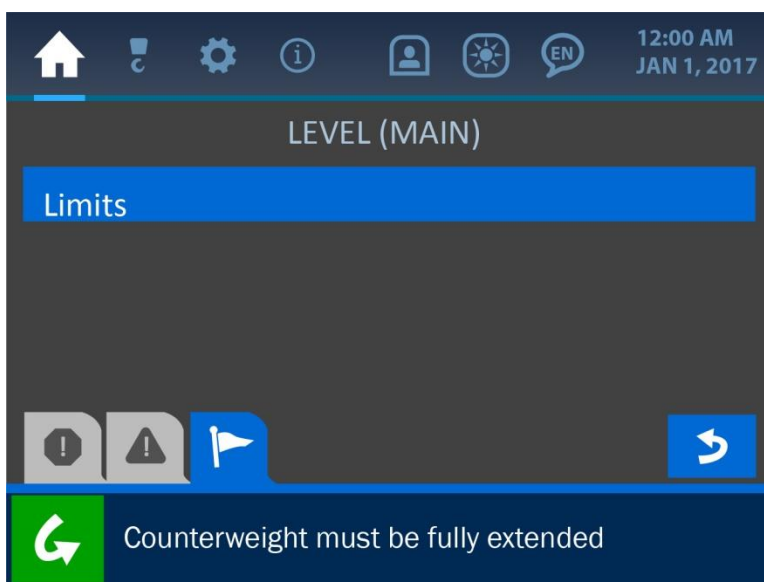
NOTE: See 'The User Interface' section of this manual for more information on the Value Entry Screen.

2.5. Level Indication

Shown below is the Home Screen, with the Level Indication Tile (Pitch and Roll) emphasized.



As illustrated above, the current machine pitch and roll values are shown in degrees, to the resolution of 1.0°. Pressing anywhere directly overtop either parameter will open the Level Menu, as shown below.



Level Limits



The level limits are defined as a maximum and minimum values for machine pitch and roll, according to the particular machine the system is installed on. These values are factory-set but can be changed in the field as necessary, by pressing the screen overtop any limit. This will open the Value Entry Screen, as shown below.

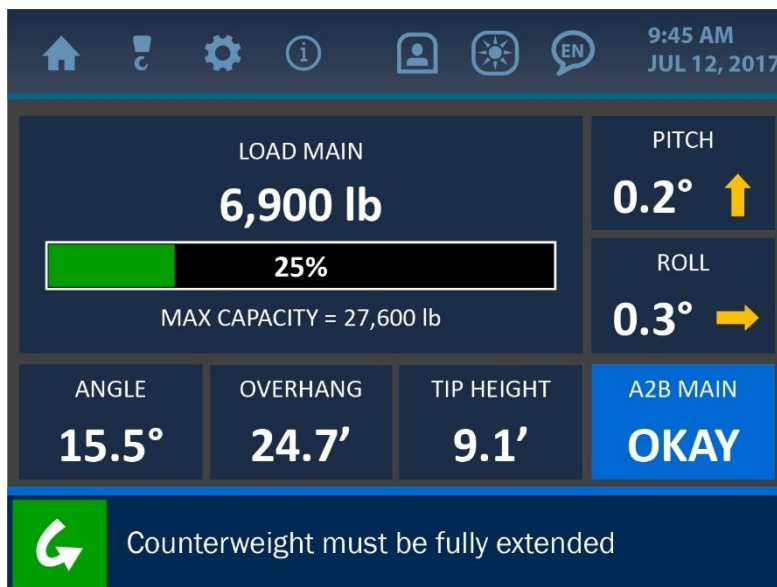


Once the Value Entry Screen is opened, use the keypad to enter the desired value for the parameter, and press the (green) Accept Button to save the change.

NOTE: See 'The User Interface' section of this manual for more information on the Value Entry Screen.

2.6. Anti-2-Block Indication

Shown below is the Home Screen, with the Anti-2-Block Indication Tile emphasized.



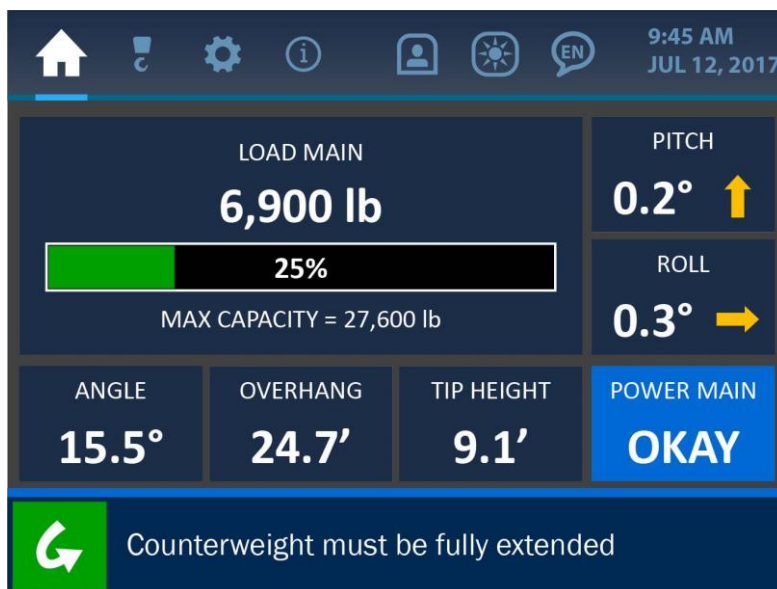
As illustrated above, the A2B status reads simply 'OKAY', indicating the transducer is sensing the load of the counterweight and is operating normally. In case of a 2-block situation, the A2B status will display this state as shown below. An associated alarm message will also display in the Alarm and Notification Bar along the bottom of the screen.

A2B MAIN
2BLK

NOTE: See 'Troubleshooting' section of this manual for more information on various alarm states and displays.

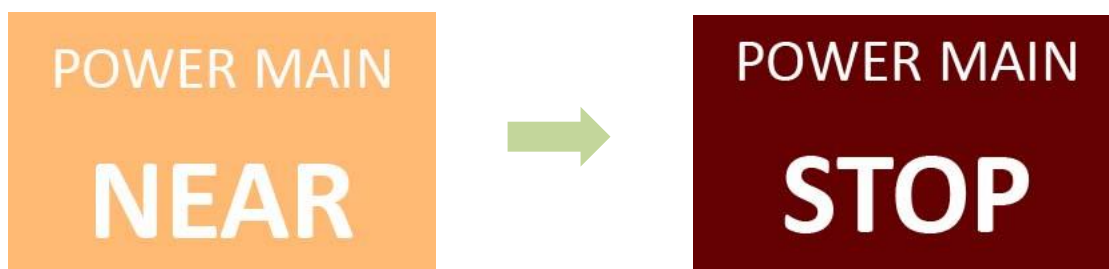
2.7. Powerline Indication

Shown below is the Home Screen, with the Powerline Indication Tile emphasized.



As illustrated above, the Powerline status reads simply 'OKAY', indicating the machine is at a safe distance away from the nearest powerline. Once the machine approaches to within 80% of its set limit distance, the powerline tile will change appearance as shown below. An associated alarm message will also display in the Alarm and Notification Bar along the bottom of the screen.

NOTE: See the appendix at the end of this manual for information related to ASME and OSHA safety standards concerning power lines.

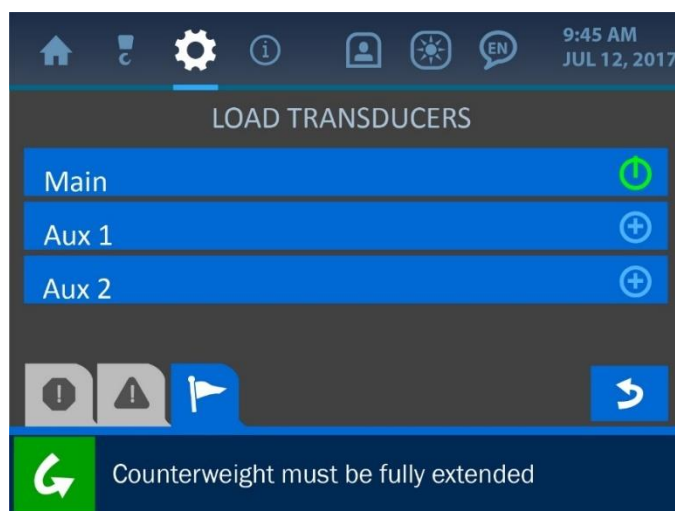


2.8. Adding a Spare Transducer

The LMI 4 panel allows for spare components to be added to the system quickly and easily. First, enter the user permission code to gain access to the required menus for this operation (see the section: *Entering the Permission Level Code* of this manual).



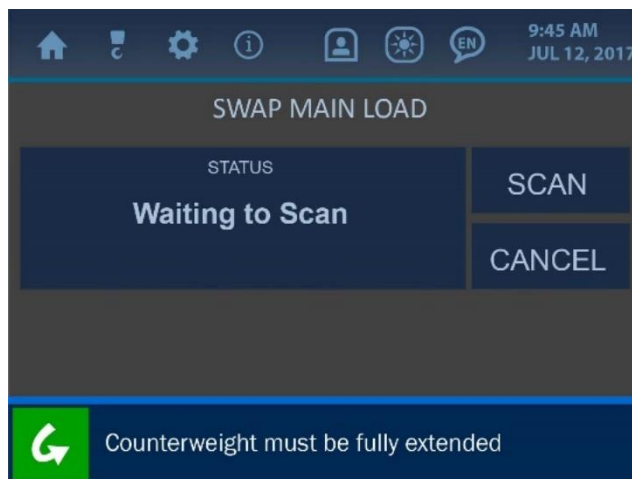
Select the transducer type to open further options for the component. From the transducer menu, an inactive component can be added to the system, or an already active component can be disabled, swapped or removed.

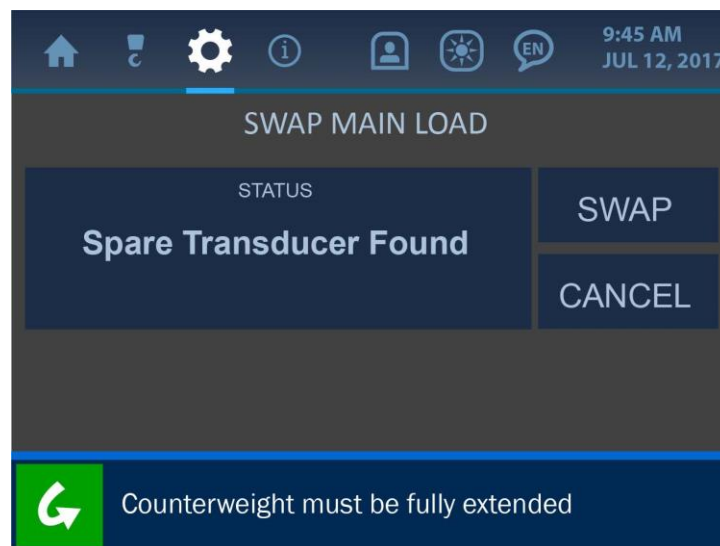




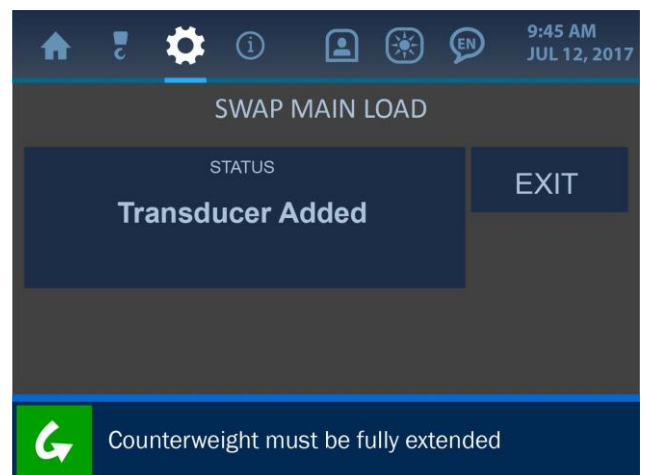
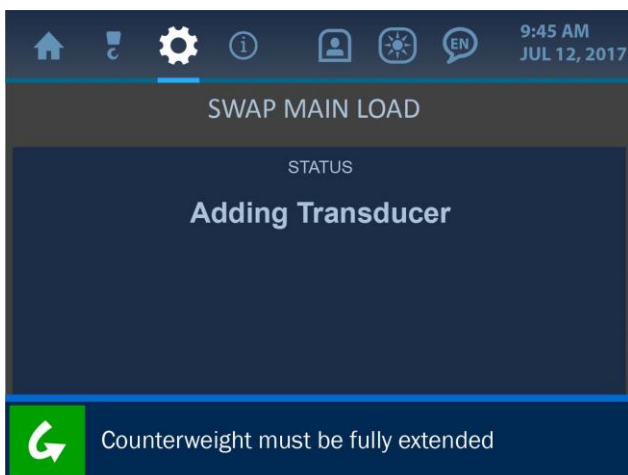
The **disable** function will keep a component's ID number registered in the system and assigned to that particular transducer but will not accept communications from it. A disabled transducer will not trigger system alarms as it is unable to send signals to the display panel. The **swap** function will disable one component and enable another in its place. The **remove** function will completely ignore communication from a component and reassign its ID number to another component when necessary.

Once a new component is selected to be added or swapped for another, the system will prompt the user to initiate a scan for a new transducer. Press the 'Scan' button to start the scan.





Once found, the message: 'Spare Transducer Found' will be displayed. Press the 'Swap' button to complete the operation. The system will then perform the replacement, while displaying accompanying messages on the screen. All calibration and identification assignment will also be handled automatically within the system.



After the new transducer has been added to the system, press the 'Exit' button to return to normal operation.

2.9. Using the USB Functions (Data Logging and Upgrading the System Firmware)

The LMI 4 system introduces new functions available via a built-in USB port, located on the back of the display panel as shown in the illustration below. The USB port can be used to download internal log data as well as upgrade the system firmware. Both of these functions are described in the following sections.

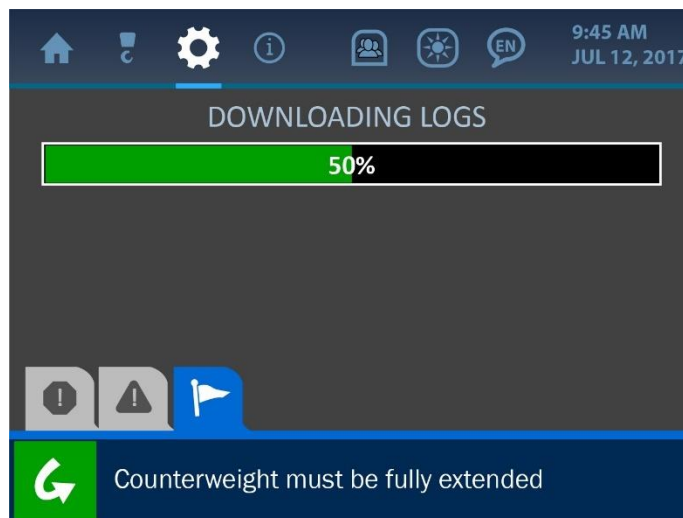
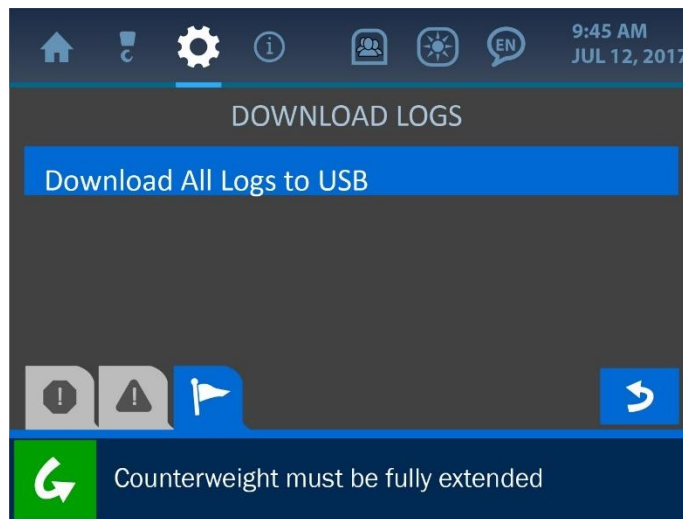


Data Logging

To begin downloading logged data from the LMI 4 system display panel, first insert a FAT formatted USB drive into the panel's USB port. Next, enter the Supervisor Permission Code to access the data logging option in the Settings Menu (see the section: *Entering the Permission Level Code* of this manual).

Next, navigate to the Logs Menu (screenshot shown below) by entering: Settings / Panel / Logger. Select the option 'Download to USB' to begin downloading logs to the USB drive. This may take several minutes, depending on how many logs are being downloaded.

NOTE: While logs are being downloaded to the USB drive, the display panel's functionality is limited and will not operate as an LMI or Non-LMI system component.



Once finished, the system will indicate that the download is complete and the USB drive can be safely removed from the display panel.

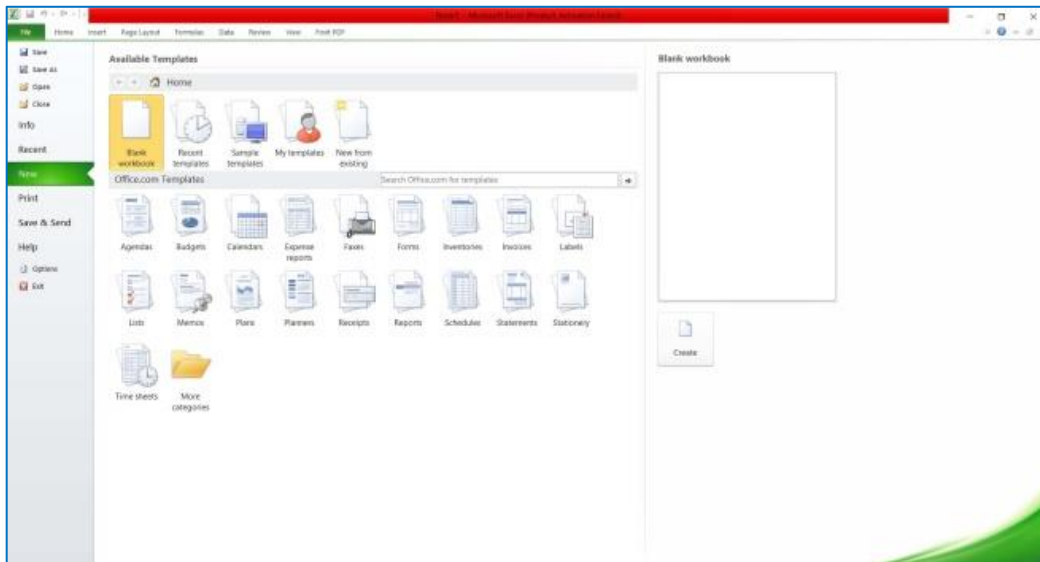
Viewing the Data Logs

The downloaded logs will be saved to the USB drive with a title indicating the date and time saved. The naming format is described below:

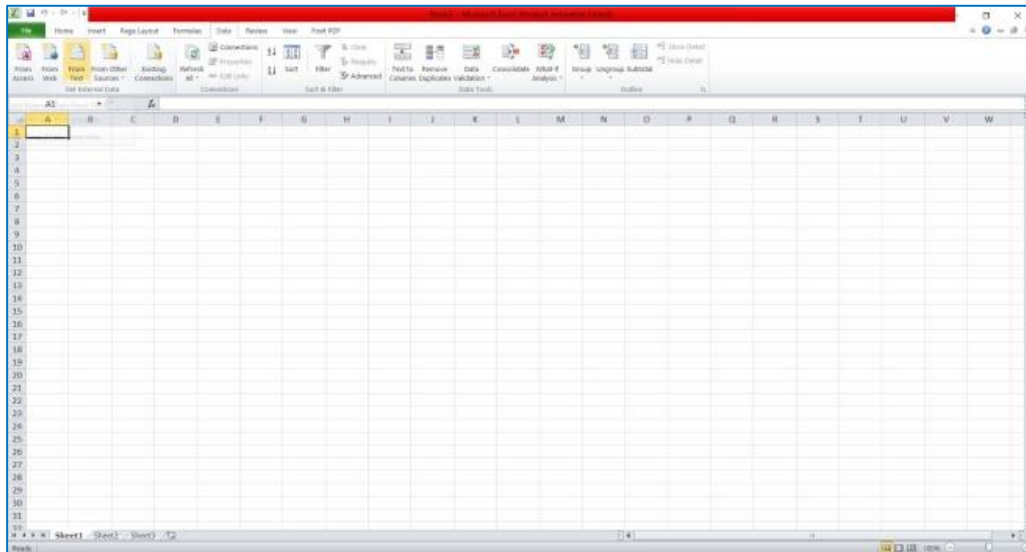
CS.20000-2017-10-24_10h10m37s.csv

System Serial Number Year Month Day Hour Minute Second File Type

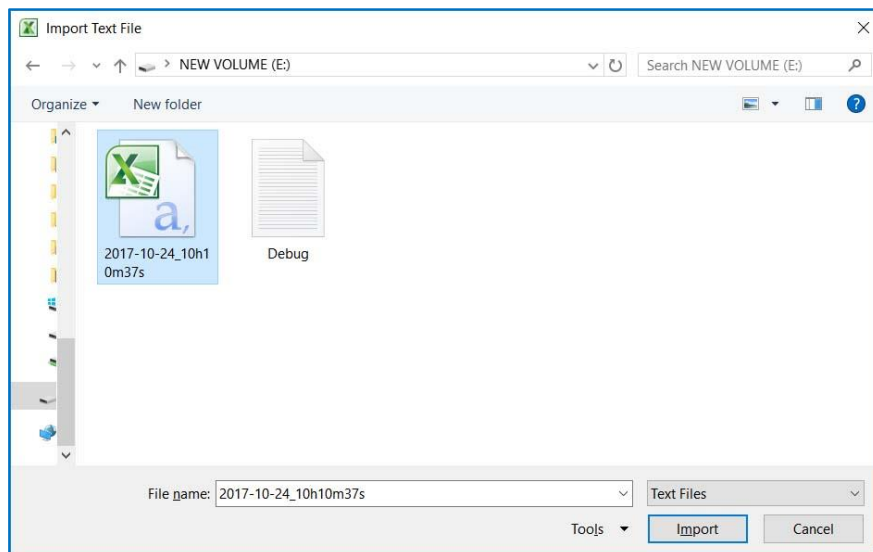
Once the USB drive is inserted into a computer, open Microsoft Excel and create a new workbook, as shown in the screenshot below.



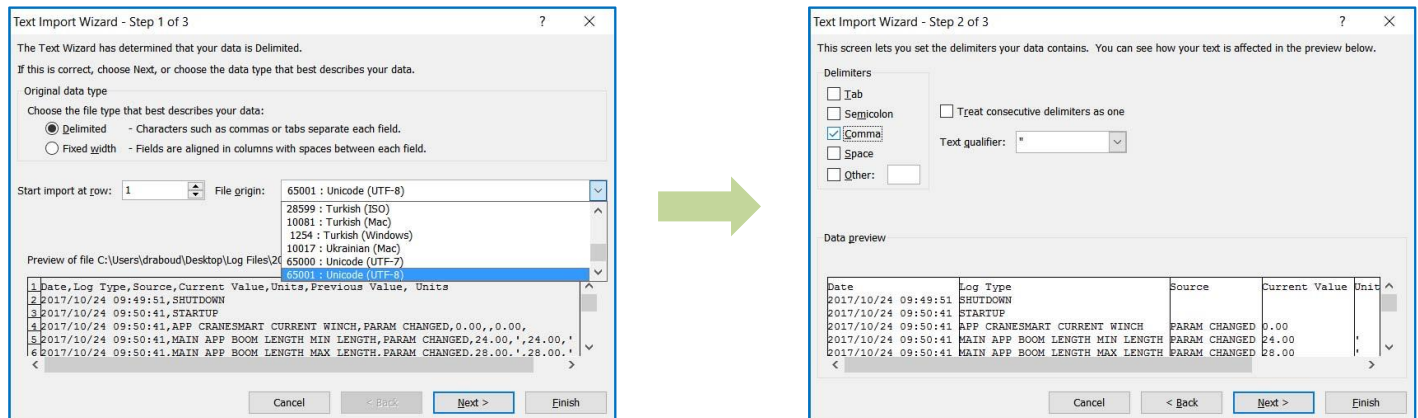
From the new workbook interface, click to open the 'Data' tab located along the top of the menu bar. Then, from the 'Get External Data' section of the 'Data' tab, click the option *From Text*.



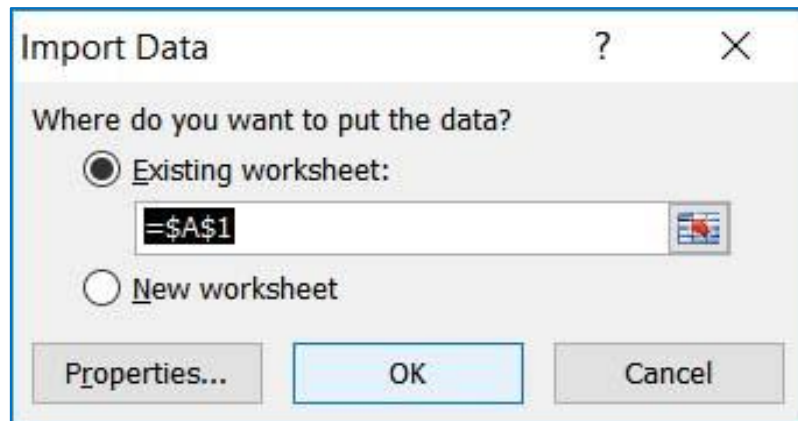
Upon selection, an 'Import Text File' window will open, allowing the user to navigate to the log files on the USB drive. Select the appropriate csv file and click 'Import'.



At this point, a 'Text Import Wizard' will be displayed, allowing for various options and customization of the data. From the 'File origin' dropdown box, select the option '65001: Unicode (UTF-8)' and click the 'Next' button. Then, deselect the 'Tab' option in the 'Delimiters' section and select the 'Comma' option. Click 'Finish' to close the wizard.



The program will open one final dialogue box, asking where the data should be placed. The default setting of 'Existing worksheet: =\$A\$1' is appropriate – simply click 'OK' to close the dialogue box and view a spreadsheet of the saved logs.

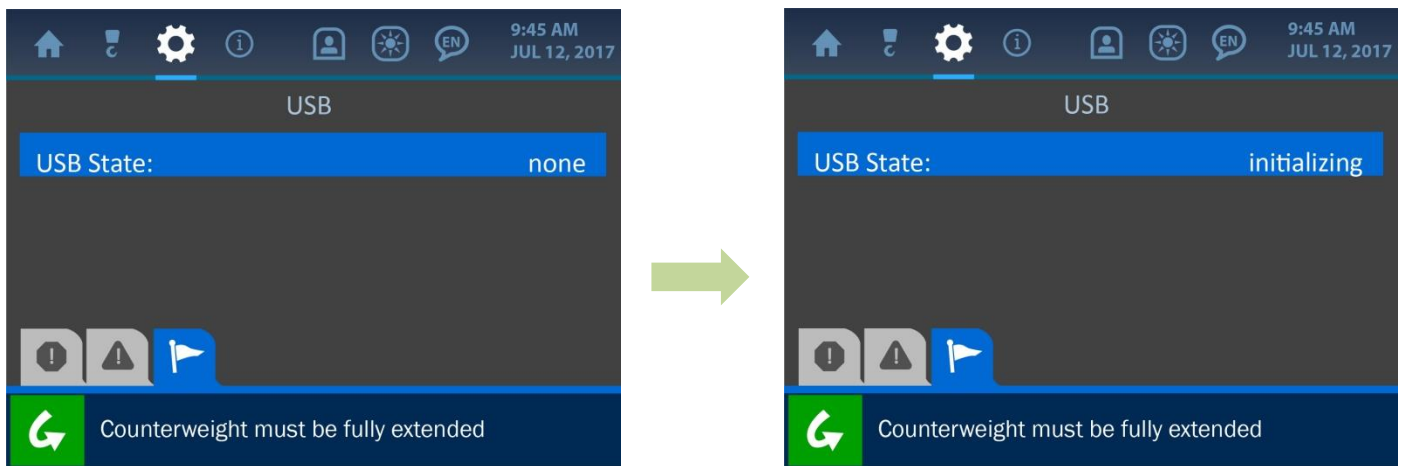


The logs will now be displayed as a detailed and columned list, marked by a timestamp (left column) and describing qualities such as: parameter changes, transducer output values, alarms and limits breached, bypass button presses and start-up / shutdown points.

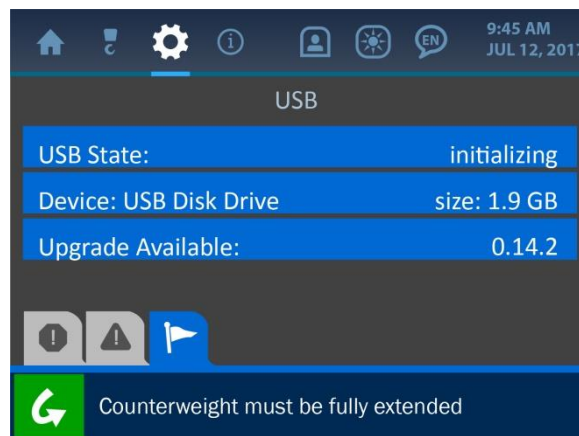
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
	Date	Log Type	Source	Current Value	Units	Previous Value	Units										
2	10/24/2017 9:49	SHUTDOWN															
3	10/24/2017 9:50	STARTUP															
4	10/24/2017 9:50	APP CRANESMART CURRENT WINCH	PARAM CHANGED	0		0											
5	10/24/2017 9:50	MAIN APP BOOM LENGTH MIN LENGTH	PARAM CHANGED	24	'	24	'										
6	10/24/2017 9:50	MAIN APP BOOM LENGTH MAX LENGTH	PARAM CHANGED	28	'	28	'										
7	10/24/2017 9:50	APP LOGGER SHUTDOWN PERIOD	PARAM CHANGED	60		60											
8	10/24/2017 9:50	APP CRANESMART CURRENT WINCH	PARAM CHANGED	0		0											
9	10/24/2017 9:50	PARAM LIST	MAIN A2B STATE	2													
10	10/24/2017 9:50	PARAM LIST	MAIN ANGLE STATE	2													
11	10/24/2017 9:50	PARAM LIST	MAIN ANGLE USER MAX ANGLE	180	°												
12	10/24/2017 9:50	PARAM LIST	MAIN ANGLE USER MIN ANGLE	-180	°												
13	10/24/2017 9:50	PARAM LIST	MAIN ANGLE ZERO VALUE	89.5	°												
14	10/24/2017 9:50	PARAM LIST	MAIN LEVEL STATE	2													
15	10/24/2017 9:50	PARAM LIST	MAIN LEVEL USER PITCH MAX	49	°												
16	10/24/2017 9:50	PARAM LIST	MAIN LEVEL USER PITCH MIN	-49	°												
17	10/24/2017 9:50	PARAM LIST	MAIN LEVEL USER PITCH ZERO	0	°												
18	10/24/2017 9:50	PARAM LIST	MAIN LEVEL USER ROLL MAX	49	°												
19	10/24/2017 9:50	PARAM LIST	MAIN LEVEL USER ROLL MIN	-49	°												
20	10/24/2017 9:50	PARAM LIST	MAIN LEVEL USER ROLL ZERO	0	°												
21	10/24/2017 9:50	PARAM LIST	MAIN LOAD STATE	2													
22	10/24/2017 9:50	PARAM LIST	MAIN LOAD USER MAX	1000000	lb												
23	10/24/2017 9:50	PARAM LIST	MAIN LOAD USER MIN	0	lb												
24	10/24/2017 9:50	PARAM LIST	MAIN LOAD USER ZERO	0	lb												
25	10/24/2017 9:50	SNAPSHOT	MAIN LOAD VALUE	0	lb												
26	10/24/2017 9:50	SNAPSHOT	LOAD CHART MAX LOAD	216000	lb												
27	10/24/2017 9:50	SNAPSHOT	MAIN ANGLE CURRENT VALUE	-89.5	°												
28	10/24/2017 9:50	SNAPSHOT	LOAD CHART OVERHANG	1.71	'												
29	10/24/2017 9:50	SNAPSHOT	LOAD CHART TIP HEIGHT	-22	'												
30	10/24/2017 9:50	SNAPSHOT	MAIN LEVEL PITCH VALUE	0	°												
31	10/24/2017 9:50	SNAPSHOT	MAIN LEVEL ROLL VALUE	0	°												
32	10/24/2017 9:50	SNAPSHOT	MAIN A2B STATE	0													

Upgrading the System Firmware

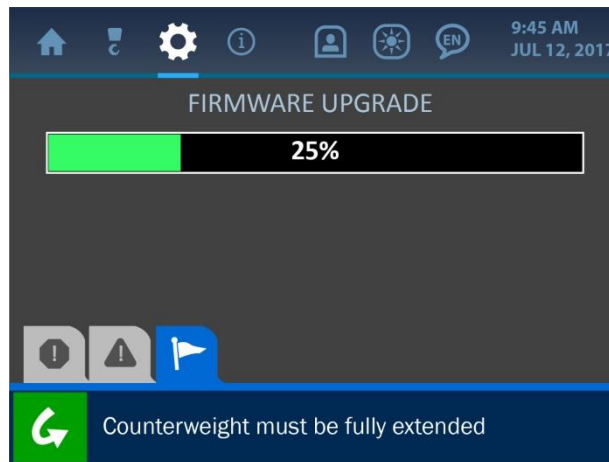
To upgrade the system firmware, first ensure that the USB drive to be used is FAT formatted, and that the appropriate *Upgrade.bin* file is located in its root directory. Then, enter the Supervisor Permission Code to gain access to the USB Menu in the system (see the section: *Entering the Permission Level Code* of this manual).



Next, enter the USB Menu, by entering: Settings / Panel / USB. Before a USB drive is inserted into the display panel, the USB Screen will indicate that there is no device detected. Once a USB drive is inserted, the status will change to 'initializing', and will display various parameters once the contents of the drive have been read by the system. As shown in the following screenshot, these include: the device name, disk size, and the version of the available upgrade.



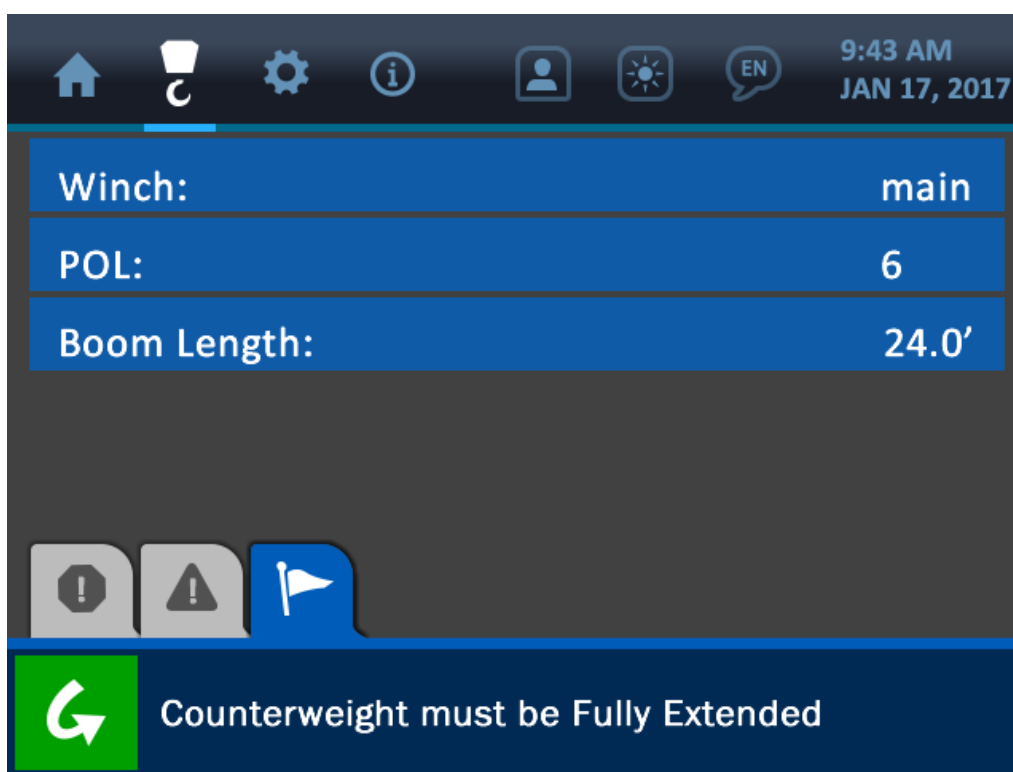
To upgrade the system firmware, simply press the screen directly overtop the upgrade version number. The system will prompt the user to confirm the upgrade, then will display the following progress screen:



Depending on what kind of upgrade is being installed, the update may take up to 15 minutes. Once the upgrade is complete, the system will restart, run a diagnostic routine and return to normal functioning. At this point, the system will be upgraded and the USB drive can be safely removed from the display panel.

3. The Configuration Menu

The Configuration Menu is symbolized by the boom hook icon at the top of the display and can be accessed by pressing the screen directly overtop this icon. This menu shows the major parameters that vary with each pipelayer and are crucial to ensuring that the system's logic, displays and calculations will be accurate. This section describes these major parameters: Winch, POL (parts of line), and Boom Length.



NOTE: Typically, the winch and POL values are factory-set and cannot be changed without the assistance of a Cranesmart Service Technician. The Boom Length can be changed as needed, though this operation requires a Supervisor Permission Code (see the 'Supervisor Access Screens' section of this manual for an explanation of how to gain access to restricted areas of the system).

3.1. Winch

The winch parameter indicates that the system is using the 'main' winch line. This parameter is factory-set and cannot be changed.

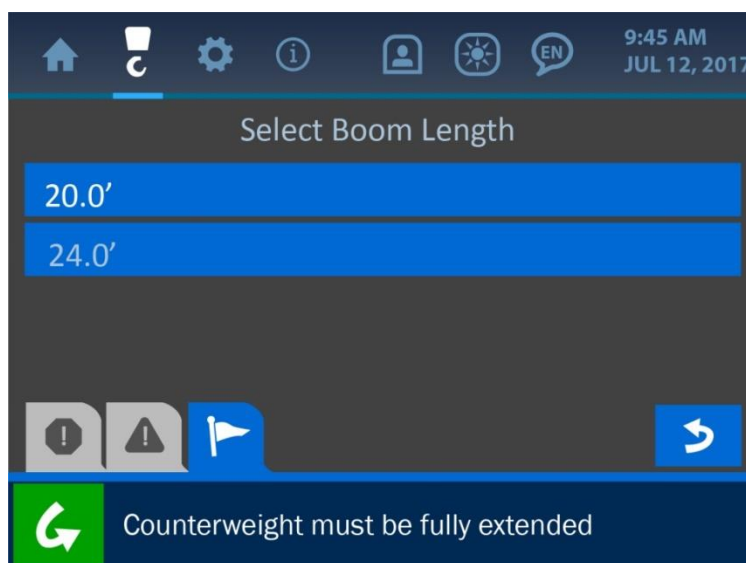
3.2. POL (Parts of Line)

The POL (Parts of Line) parameter is also factory-set and cannot be changed by the user. This parameter may vary with the pipelayer machine type.

3.3. Boom Length

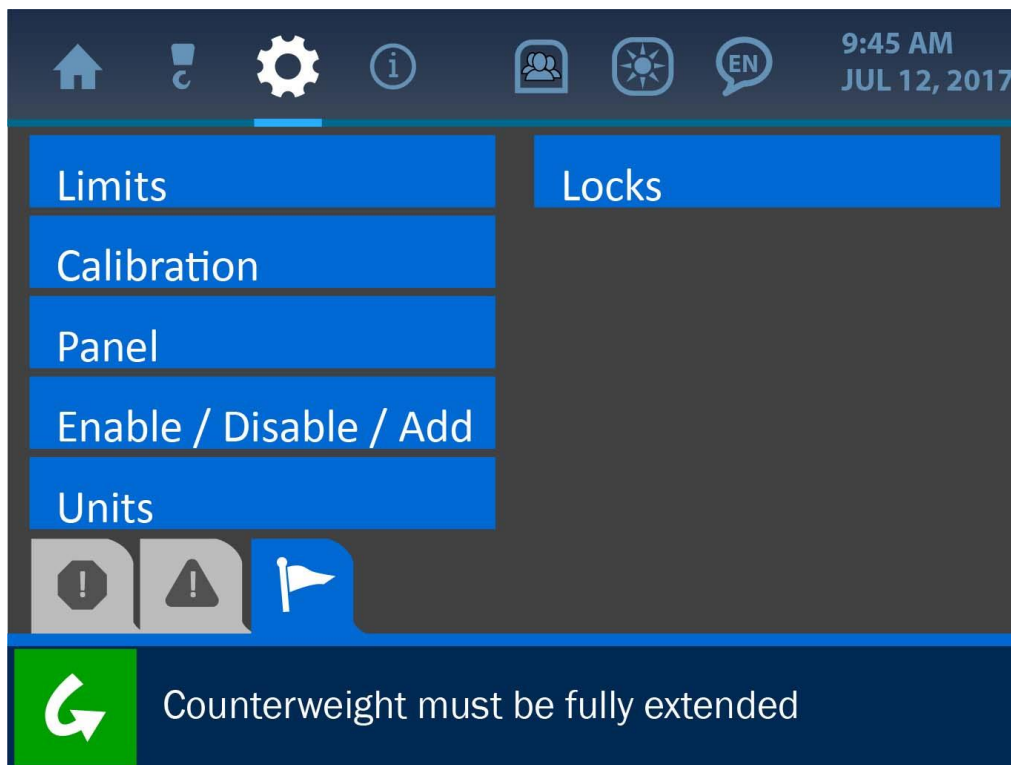
The boom length can only be changed after entering the Supervisor Permission Code (see the section: *Entering the Permission Level Code* of this manual).

Once accessible, this menu shows a list of available boom lengths to choose from. Press the button of the desired boom length, then press the (green) Accept Button to save the change and return to the Configuration Menu.



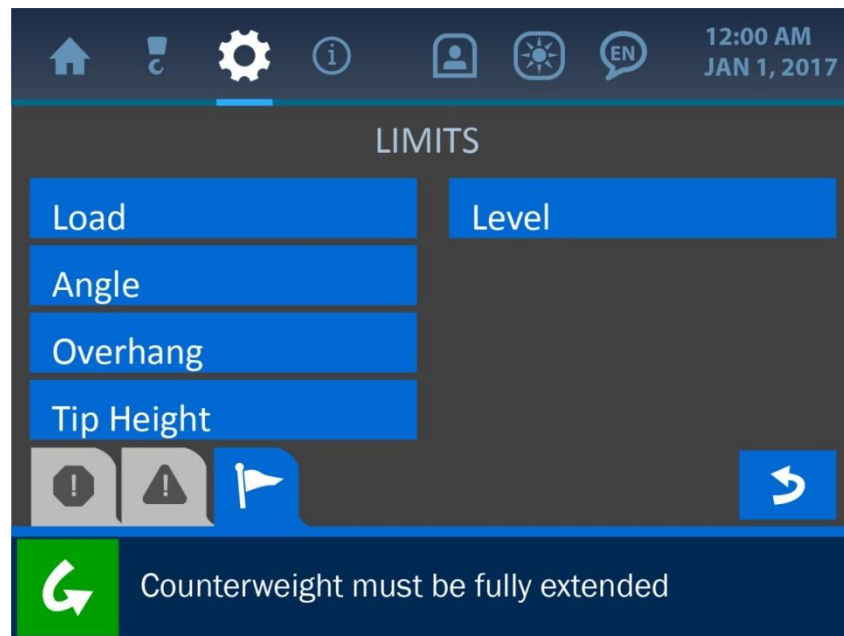
4. The Settings Menu

The Settings Menu is symbolized by the gear icon at the top of the display and can be accessed by pressing the screen directly overtop this icon. This menu offers many important options to the operator for how the system functions and displays information. The Settings Menu is shown below, and explanations of its various components follow. **NOTE: For the sake of this manual, the supervisor access level of this menu is shown. Normal user access will have less options available than those shown for this description.**



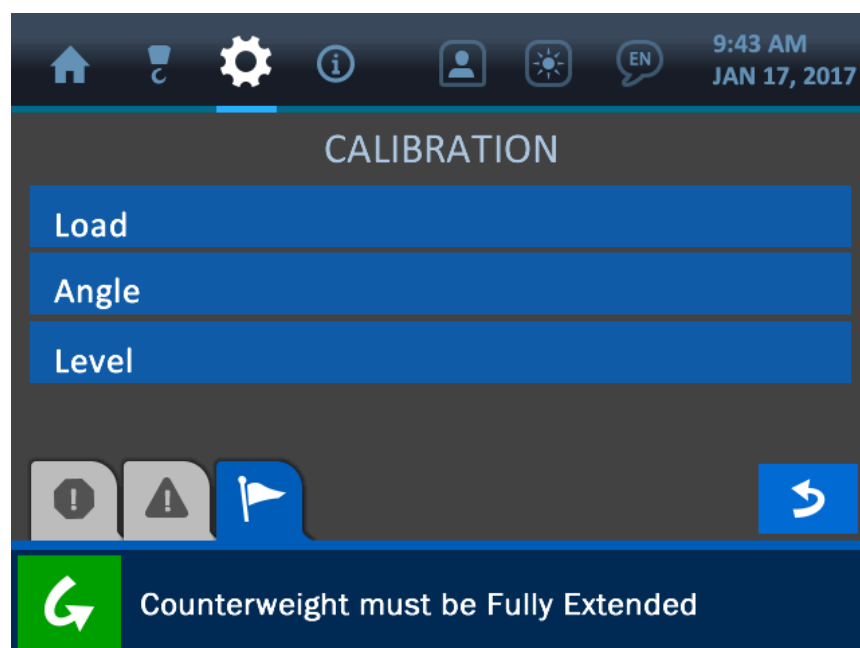
4.1. Limits

The Limits Menu presents all the various parameters that can be adjusted to define what the machine's safe zones of operation are. As listed and shown on the following screenshot, these limit categories are: Load, Angle, Overhang, Tip Height and Level. For more information on each of the listed limits see *The Normal Operation* section of this manual.

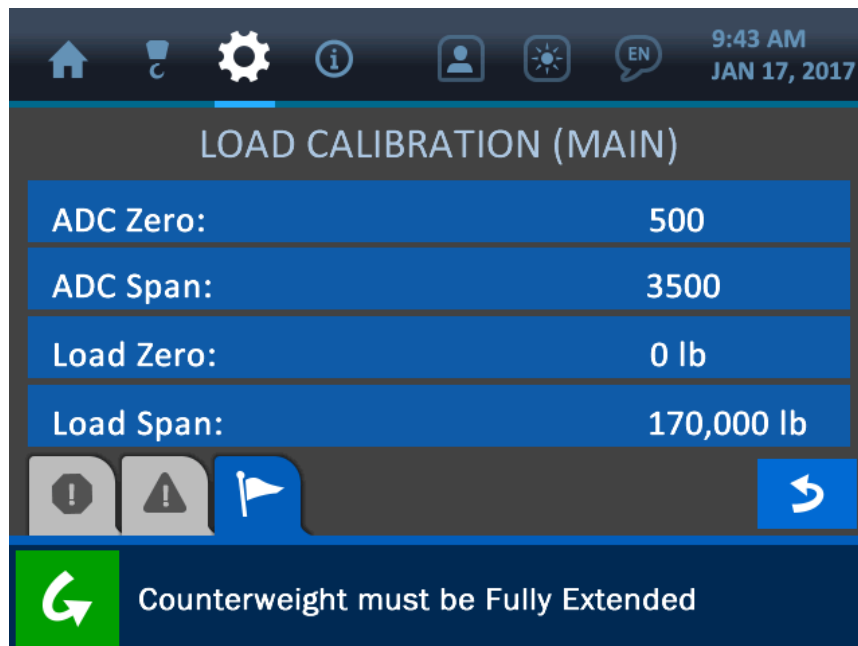


4.2. Calibration

The Calibration Menu lists the system indicators that require proper adjustment for accurate operation. As listed and shown on the following screenshot, these indicators are: Load, Angle and Level. Each of these calibrations is described in its respective section of this manual.



Load Calibration



The Load Calibration Menu is accessible only after the Supervisor Permission Code has been entered (see the section: *Entering the Permission Level Code* of this manual). Once made accessible, this menu displays the current settings for the following parameters:

ADC Zero: indicates the system's analog to digital conversion value when there is no load on the hook

ADC Span: indicates the system's analog to digital conversion value when the maximum possible load is on the hook (before the system shows a load alarm)

Load Zero: indicates the displayed load value when there is no load on the hook

Load Span: indicates the displayed load value when there is a maximum load on the hook (before the system shows a load alarm)

Angle Calibration

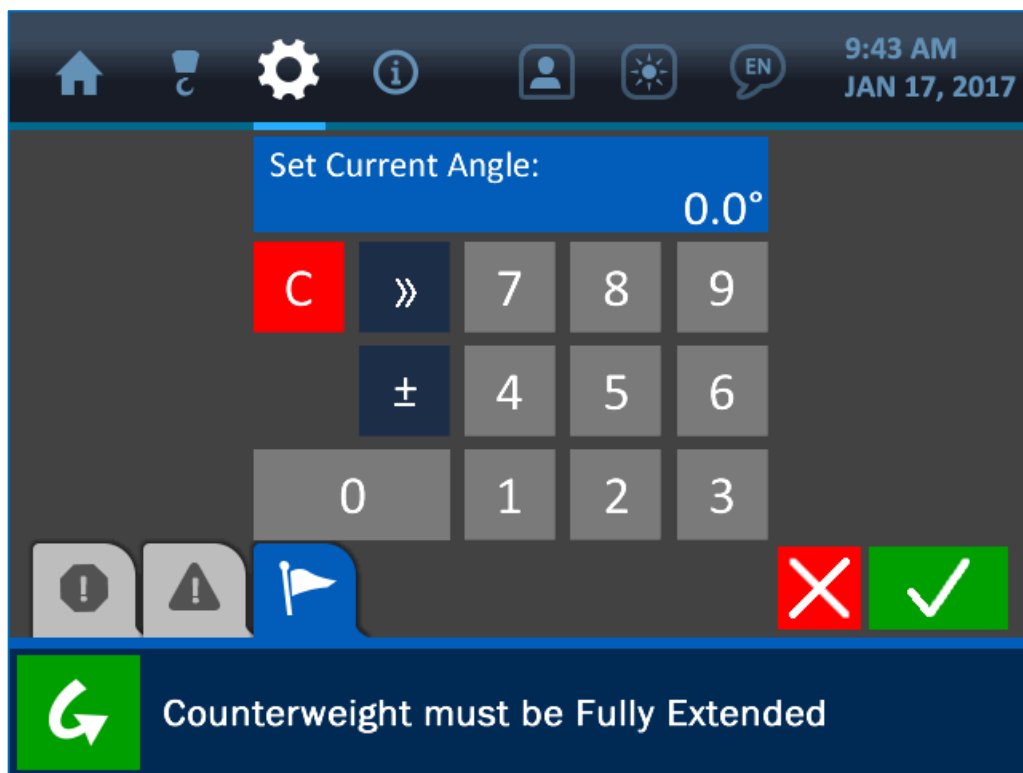
The Angle Calibration Menu allows the operator to set a target angle and orientation for the angle transducer.

Concerning the Target Angle, set this value to what the system should be reading at a known boom angle. If the machine boom is currently at 0° but the system is displaying a different value, using the Target Angle Option will compensate for this discrepancy, by introducing an offset value in order to make the display more accurate.

NOTE: The boom can be set to any angle, as long as that angle is known to be accurate by some other means (for example a level, applied to the boom horizontally or vertically). The resolution of the angle indicator is 0.5°.



To change the target angle value, simply press the screen directly overtop the target angle option to enter the Value Entry screen for this parameter.

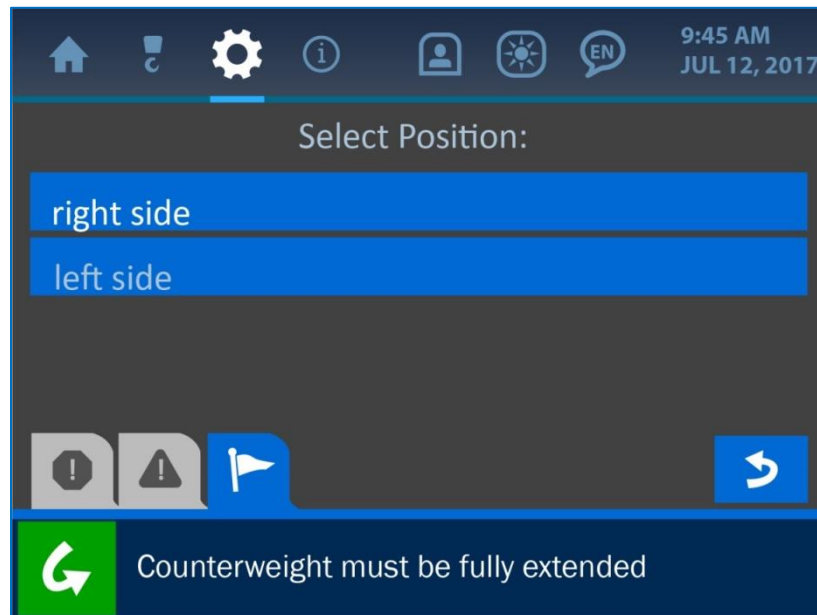


Once the Value Entry Screen is opened, use the keypad to enter the desired value for the parameter, and press the (green) Accept Button to save the change.

NOTE: See 'The User Interface' section of this manual for more information on the Value Entry Screen.

The Position option simply ensures that the system displays the boom angle correctly by indicating which side of the boom the transducer is mounted on (in relation to the operator's viewpoint). As shown in the following screenshot, selecting this option will open a submenu, allowing the choice of either the left or right side of the boom.

Selecting either option for the orientation will automatically enter that selection into the system and return the user to the Angle Calibration Screen.



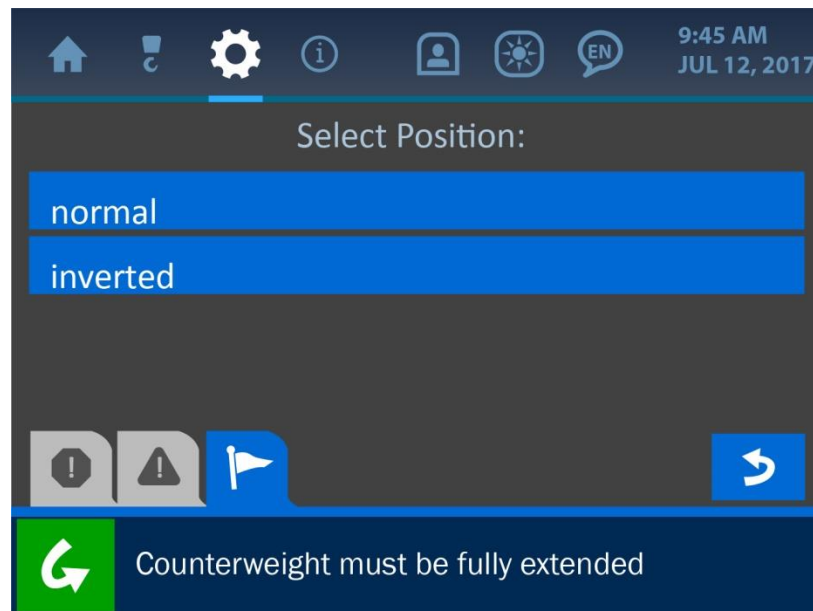
Level Calibration



The first option listed the Level Calibration Menu is 'Auto Calibration'. To use the automatic calibration method, position the machine so it is level (within 0.5°) and press the Auto Calibration Button. If calibration is successful, the message: 'Roll Offset set Successfully' will be displayed in the Notification Bar at the bottom of the screen, and the values for Pitch and Roll should display as 0.0° on the Home Screen. If calibration has failed, or if the level transducer has been disabled, the message: 'Level Transducer is Disabled' will be shown instead to indicate the problem.

NOTE: If at any point, the machine is positioned more than 5.0° out of level (either pitch or roll) the system will enter an alarm state, and the load indication will only show the weight on the line alone, without accounting for angle limits.

The 'Position' button on the Level Calibration Menu offers the option to either normalize or invert the roll orientation.



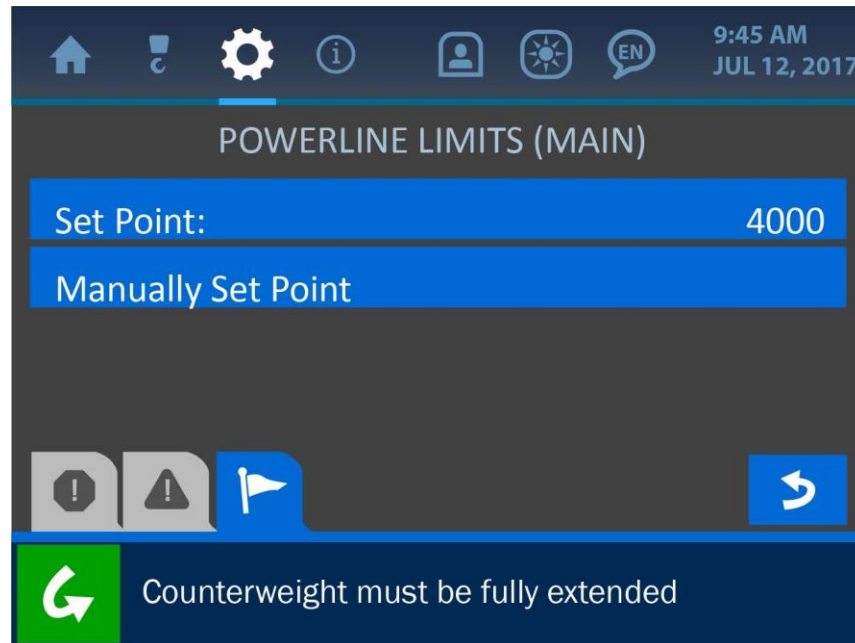
The 'normal' orientation applies to level sensors that are installed with the label facing up. Some machines require the sensor to be installed to the cab ceiling, in which case the label is facing down, and the 'inverted' setting should be used.

Boom Length Calibration



To calibrate the boom length of the machine, first ensure that the boom is fully retracted. Once retracted, press the 'Set Fully Retracted' button. Then, fully extend the boom and press the 'Set Fully Retracted' button. The system is now calibrated for the specific boom length of the machine.

Powerline Calibration

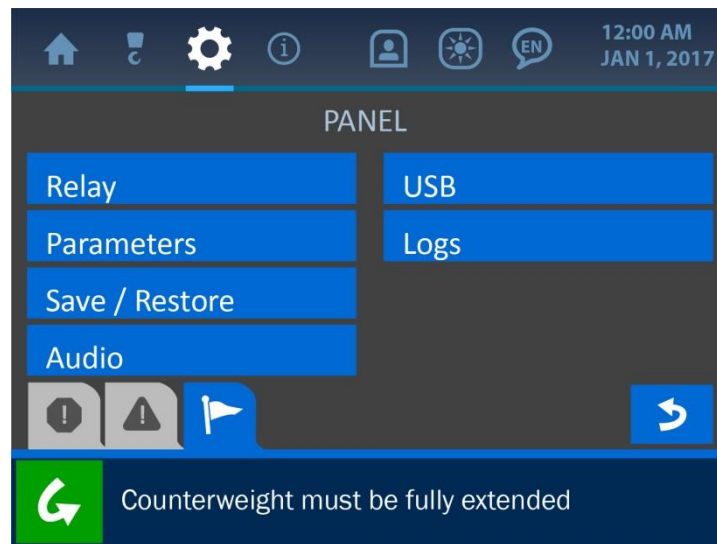


To set the powerline limit automatically, move the machine boom to the position that is to be marked as the safety limit in terms of distance to a powerline. Once in position, press the 'Set Point' button at the top of the menu. The A/D value will be automatically set and displayed based on the sensed proximity to the powerline. To set this limit manually, press the 'Manually Set Point' button and enter a value for the system.

NOTE: The system will warn the operator once the proximity to a power line exceeds 80% of the limit value. The machine will only engage the shutoff function after the powerline limit is exceeded.

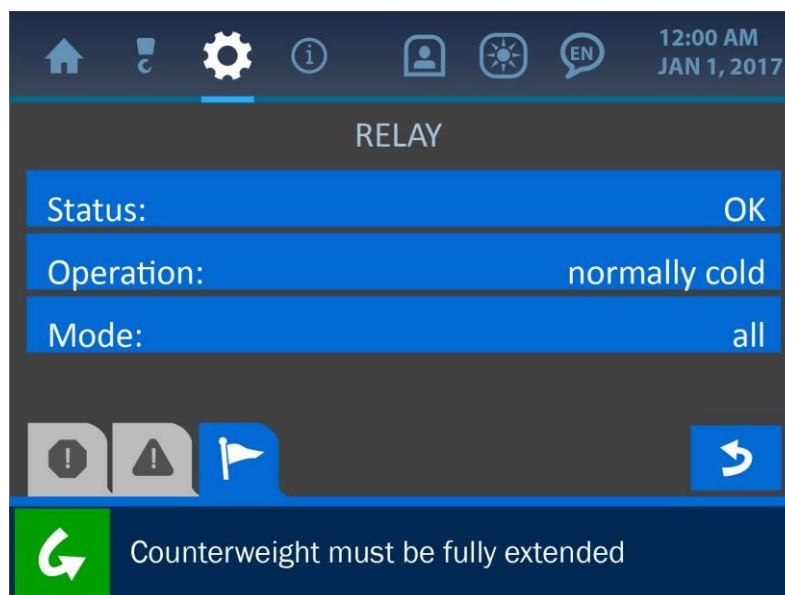
4.3. Panel

The Panel Menu offers the options to: adjust the relay settings, machine type parameters, save or restore the panel and system settings, adjust the audio levels, and enter the USB and logging options.



Relay

The Relay Menu allows a supervisor to check on the relay status, adjust the operation mode (normally cold or normally hot) and select which components are controlled by the relay function.



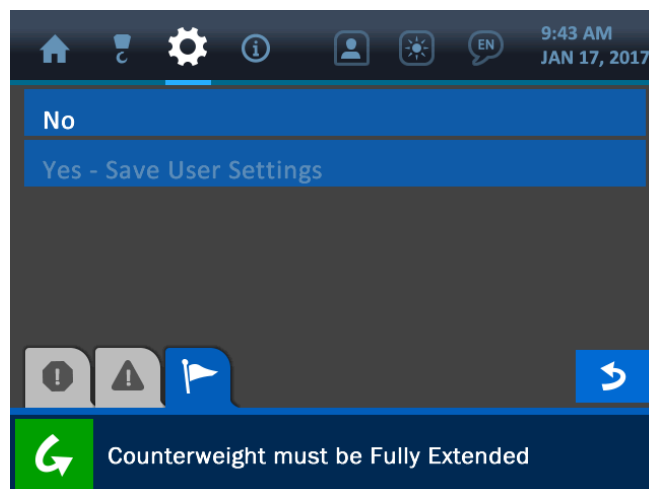
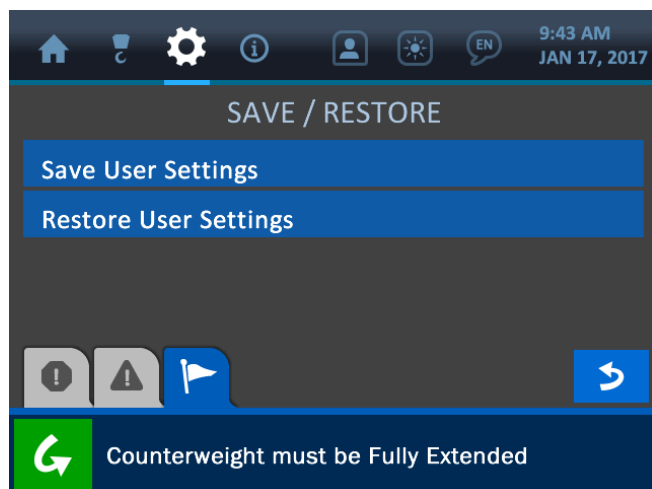
Parameters

The Parameters Menu allows a supervisor to adjust various characteristics of the machine being monitored. Some of these options include: machine type, serial number, tipping point locations and various winch measurements.



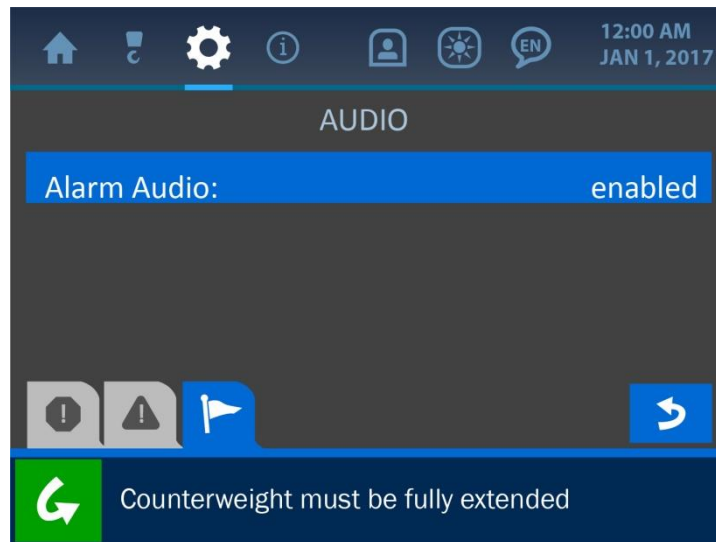
Save / Restore

From the Save/Restore Menu, the operator can choose to save the current system settings or restore previous ones. Pressing either button will prompt a confirmation screen to ensure the right selection has been made.



Audio

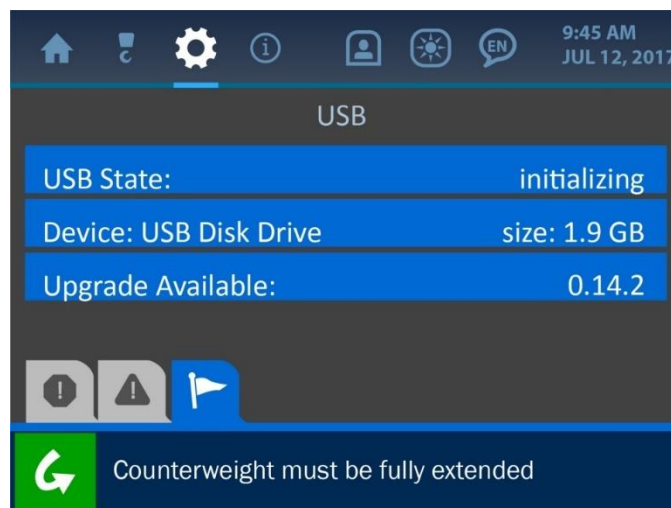
The Audio Menu allows the supervisor to enable or disable the alarm audio.



USB

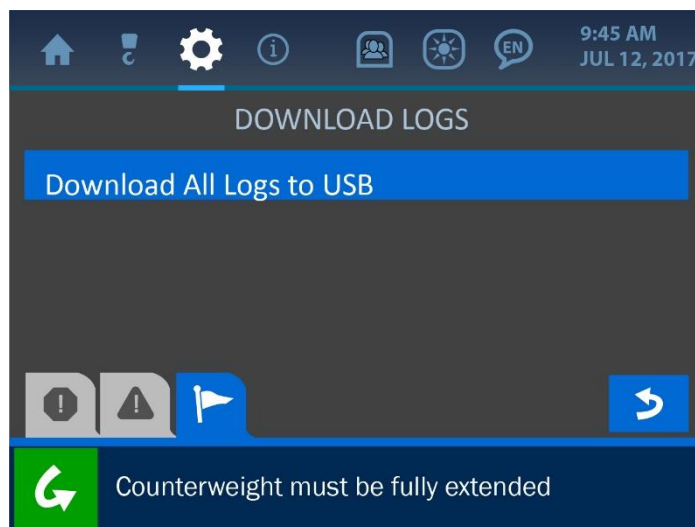
The USB Menu allows the supervisor to update the system firmware, via a USB drive.

NOTE: See the section: 'Upgrading the System Firmware' of this manual for more information on using this function.



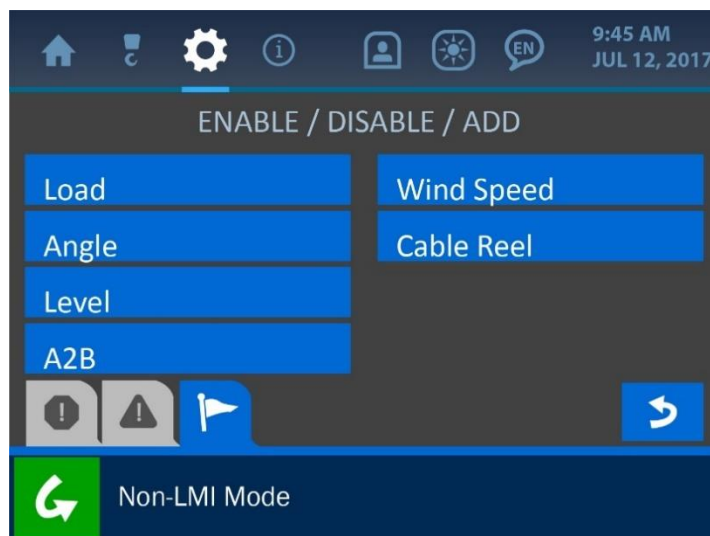
Logs

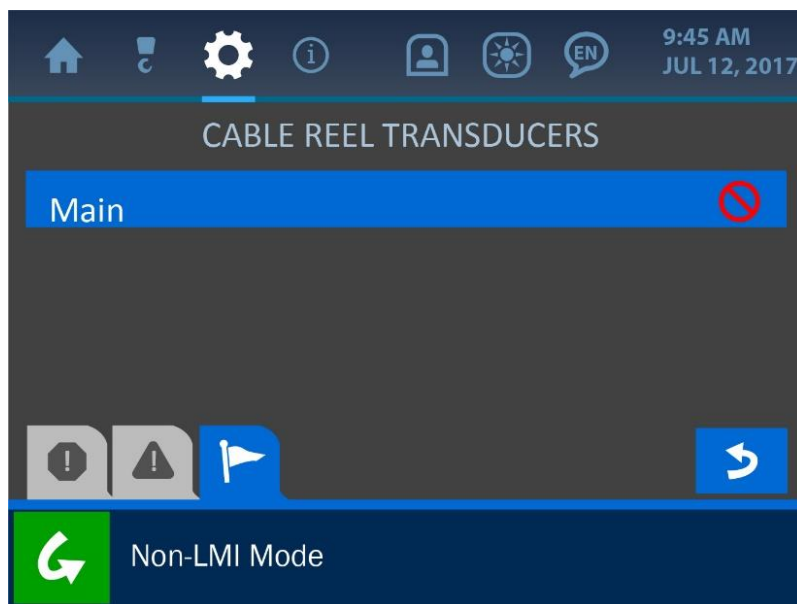
The Parameters Menu allows a supervisor to adjust various characteristics of the machine being monitored. Some of these options include: machine type, serial number, tipping point locations and various winch measurements.



4.4. Enable / Disable / Add

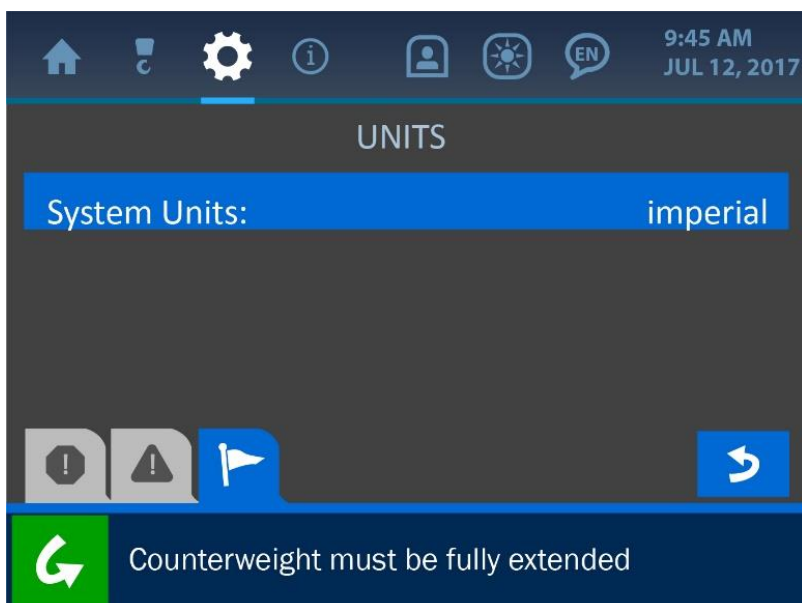
This menu is used to add or remove components from the system and active display. Simply select which transducer to affect, and either activate or deactivate it.





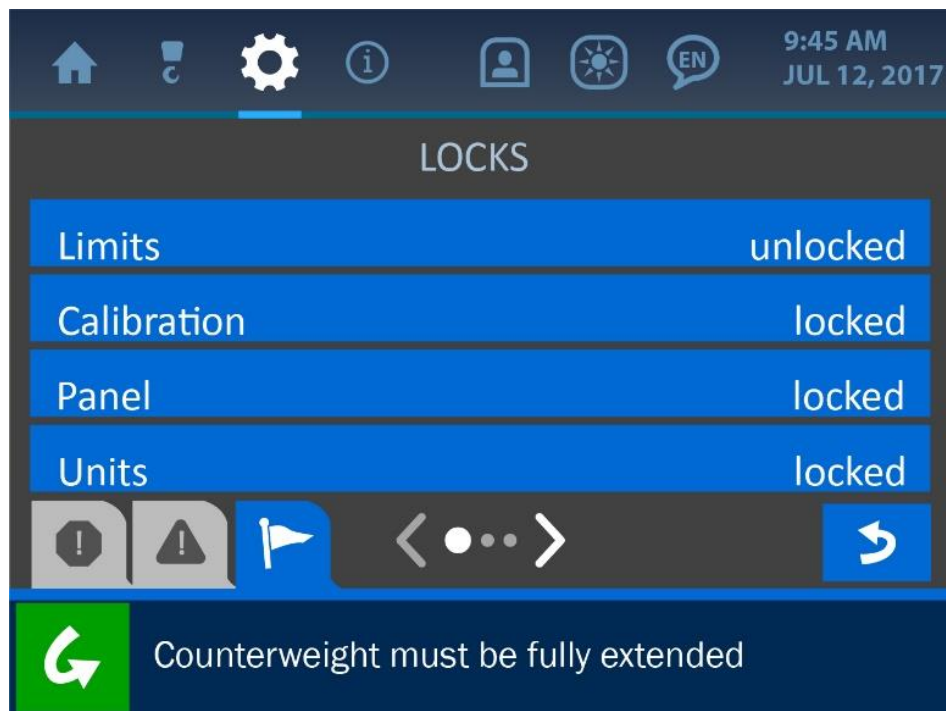
4.5. Units

This menu is used to toggle between these options for the parameter display: imperial, metric, imperial-tons, or metric-tonnes.



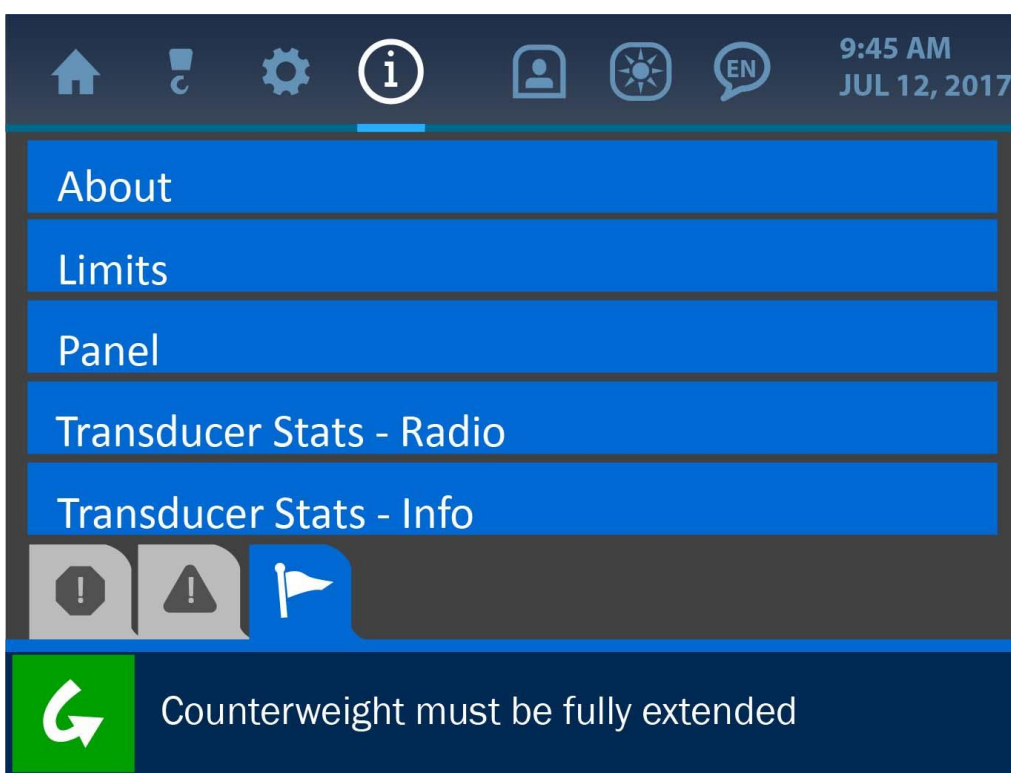
4.6. Locks

This menu can be used by a supervisor to restrict access to various parts of the system. See the section *Supervisor Access Screen* of this manual for further information.



5. The Information Menu

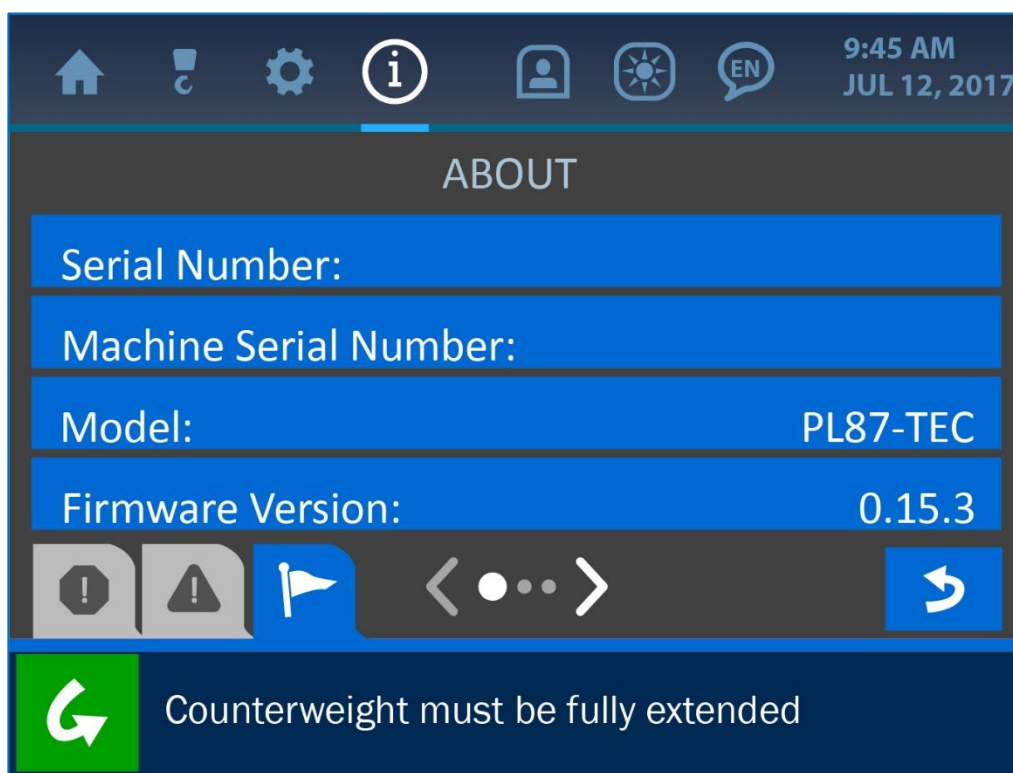
The Information Menu is symbolized by the encircled 'i' icon at the top of the display and can be accessed by pressing the screen directly overtop this icon. This menu offers options for displaying important information about the system such as: serial number, machine number, firmware version, system limits, transducer communication status and more. The Information Menu is shown below, and explanations of its various components follow.



NOTE: The displays in the Information menu are for display purposes only. Other menus must be accessed to edit the settings and information found here.

5.1. About

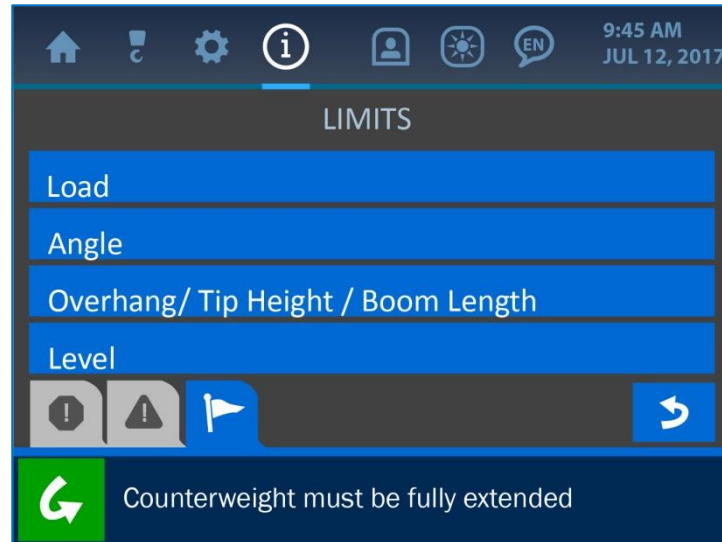
The About option shows information related to the initial setup of the system. The system serial number, machine serial number, machine model, firmware version, and compiler timestamp can all be found in this menu.



NOTE: Press the Page Indicator Button (depicted by white arrows) at the bottom, center of the display to reveal a second page of options.

5.2. Limits

The Limits option offers displays of the set limits for all the major components, which are: load, angle, level and overhang/tip height.

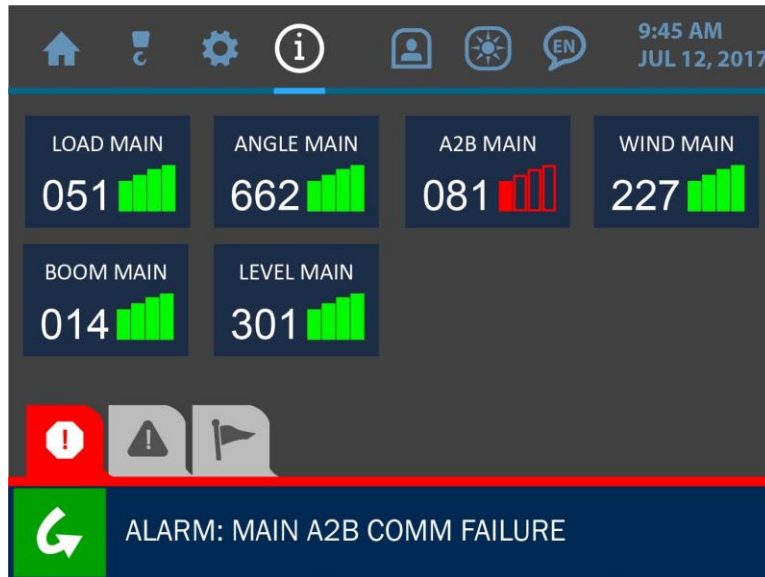


Press the screen overtop any of the options to reveal the set limits of that parameter.



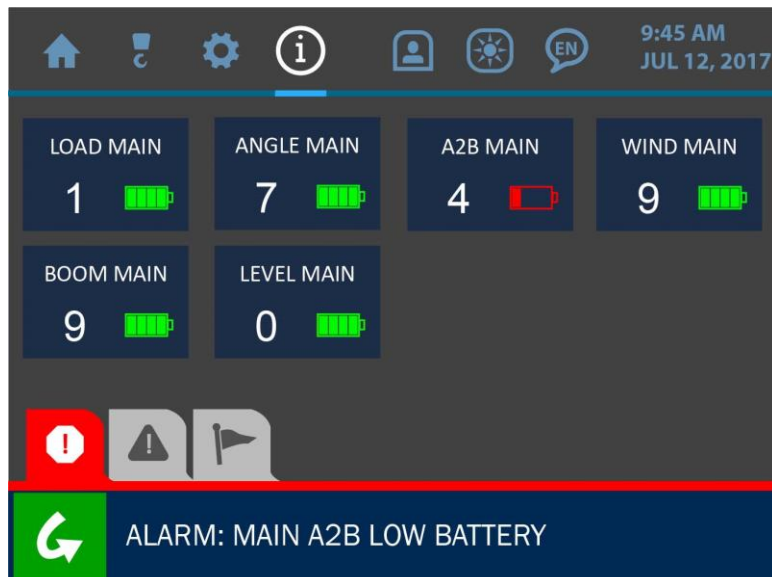
5.3. Transducer Stats – Radio

The Transducer Stats – Radio option shows each transducer's packet count (an increasing count indicates open communication with the display panel) and signal strength.



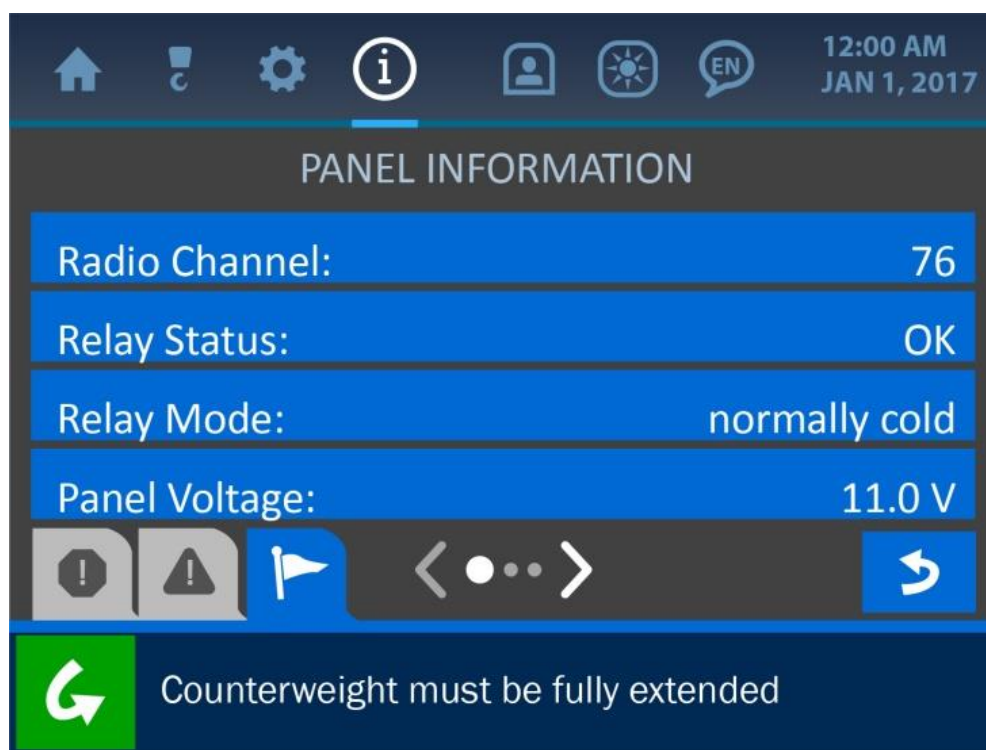
5.4. Transducers Stats – Info

The Transducer Stats – Info option shows each transducer's ID and battery strength.



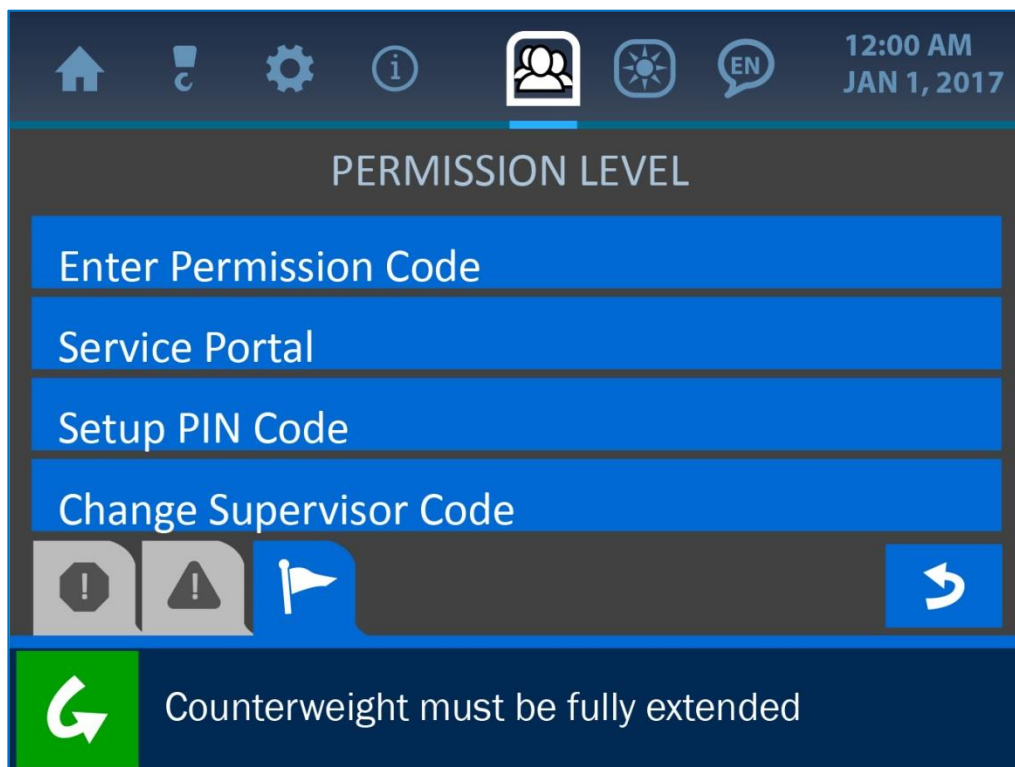
5.5. Panel

The Panel option shows information related to the display panel's relay function, relay mode and power settings, as shown in the screenshot below. The relay function is used (optionally) to limit or disable the machine in the case of an alarm. See the *Supervisor Access Screens* section of this manual for more information on configuring the panel's relay function.



6. The Permission Menu

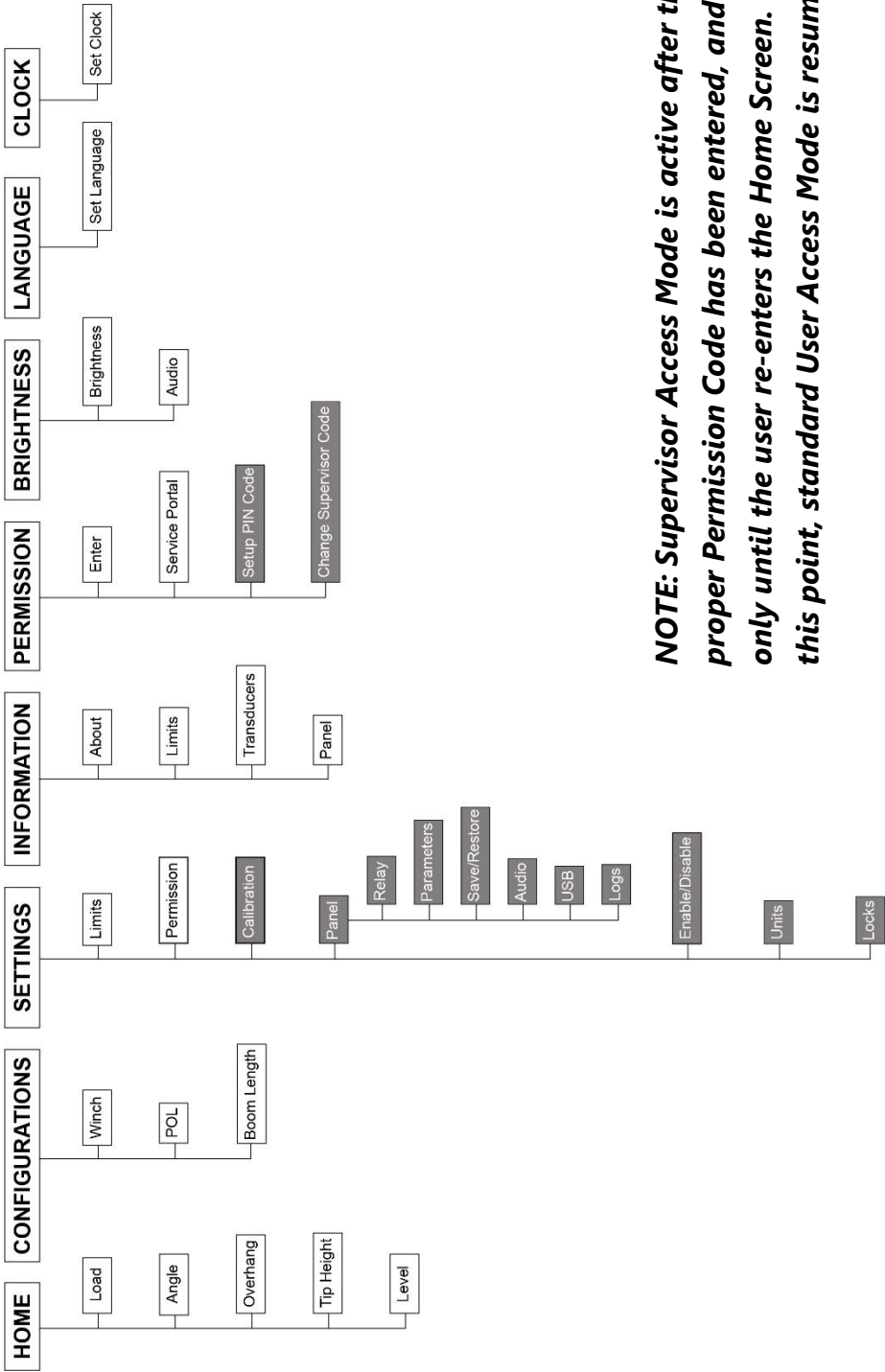
The Permission Menu is symbolized by the figure icon at the top of the display and can be accessed by pressing the screen directly overtop this icon. This menu is used to enter restricted areas of the system. A Supervisor Permission Code entered on the Permission Code Screen opens restricted areas to supervisors for safety control. A Service Code via the Service Portal Screen is used for technical maintenance and adjustment. The default Supervisor Permission Code from the factory is: 111, but can be customized to each system and changed at any time. **NOTE: For the sake of this manual, the supervisor access level of this menu is shown. Normal user access will have less options available than those shown for this description.**



Once a permission code is entered into the system, a Supervisor Mode is enabled and new options become available in many of the system's menus. Refer to the following page for a visual layout of which screens are available in each mode. The Supervisor Access Mode will be active until the user navigates back to the Home Screen, at which time normal access resumes. (Refer to the *Supervisor Access Screens* section of this manual for a description of the supervisor options).

6.1 System Screen Flowchart

This illustration shows the basic layout of the system’s main menus and screens. The screens shaded in grey are the areas that are only available in Supervisor Access Mode, once the code has been entered.

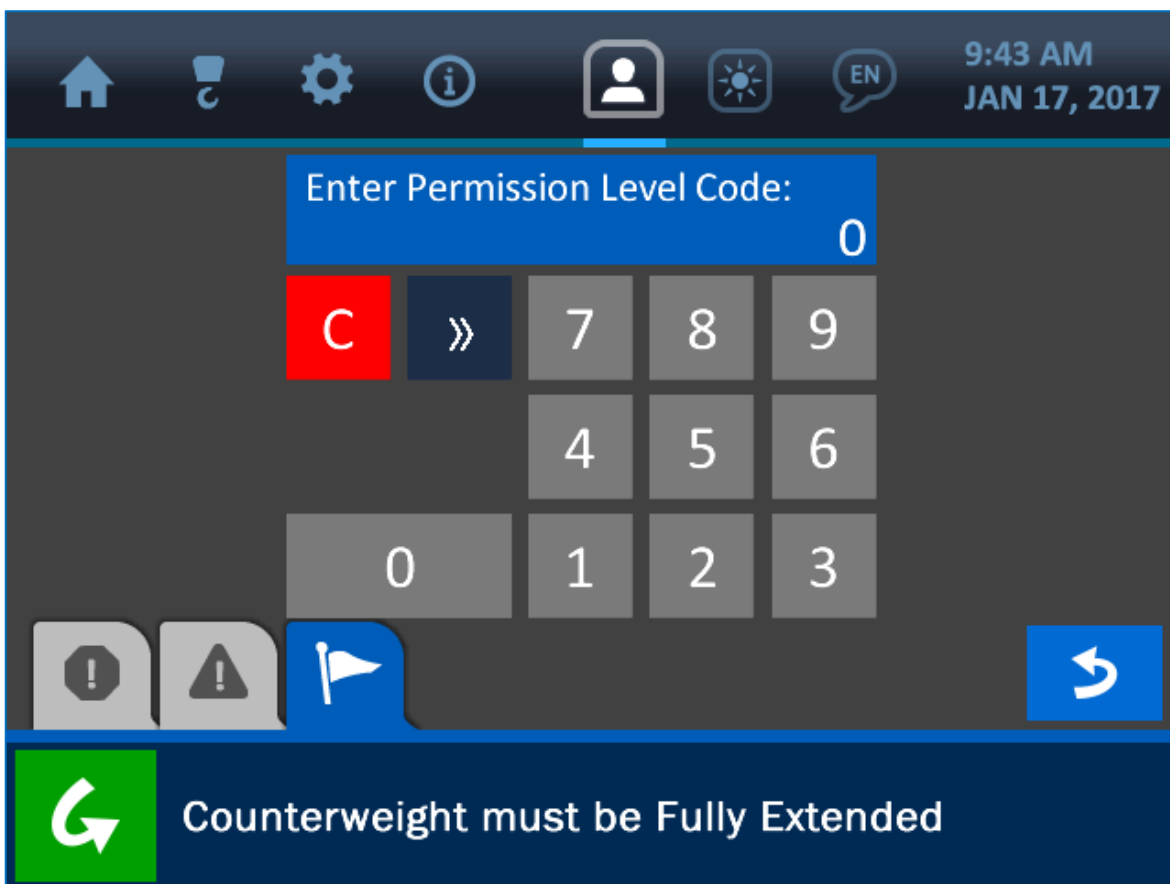


NOTE: Supervisor Access Mode is active after the proper Permission Code has been entered, and only until the user re-enters the Home Screen. At this point, standard User Access Mode is resumed.

6.2. Entering the Permission Level Code

To gain supervisor access to the system, press the 'Enter Permission Code' Button from the Permission Menu (symbolized by the figure icon at the top of the display). Then, enter the code via the keypad and press the (green) Accept Button to save the change to the system. To cancel this operation, simply press the (red) Cancel Button to return to the previous screen.

NOTE: The default Supervisor Permission Code from the factory is: 111, however this code can be customized to each system and changed at any time.



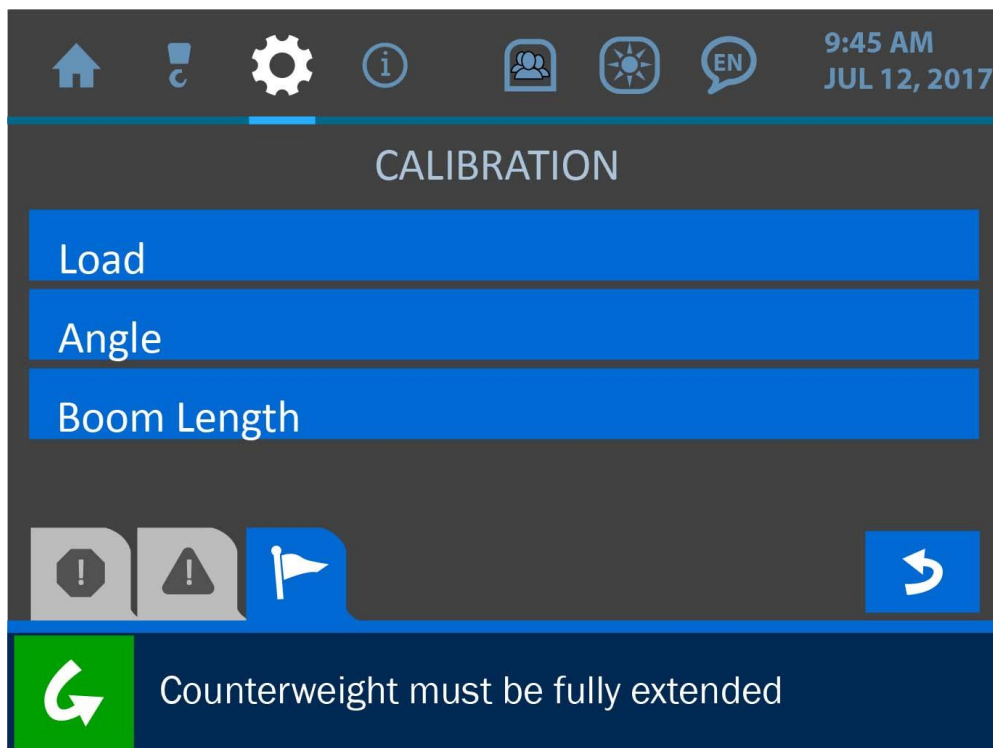
NOTE: See 'The User Interface' section of this manual for more information on The Value Entry Screen.

6.3. Supervisor Access Screens

Once the supervisor access level is gained (by entering the correct Permission Code) the Permission Menu symbol will be changed to reflect the new setting, and the following listed screens will now be made available. **NOTE: As noted earlier, these screens will no longer be available once the user cancels the Supervisor Access Mode by re-entering the Home Screen.**

Settings / Calibration Menu:

- **Load / Angle / Boom Length:** Calibration of the load, angle and boom length sensors are done from this menu. See the section titled 'Calibration' for more information on the specific calibration procedures for each parameter.

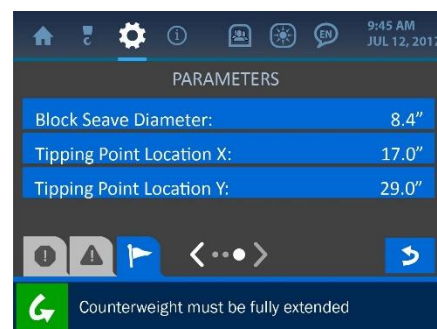
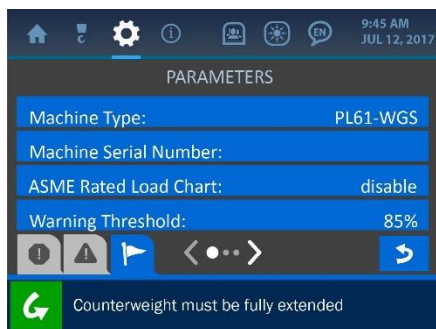


Settings / Panel Menu:

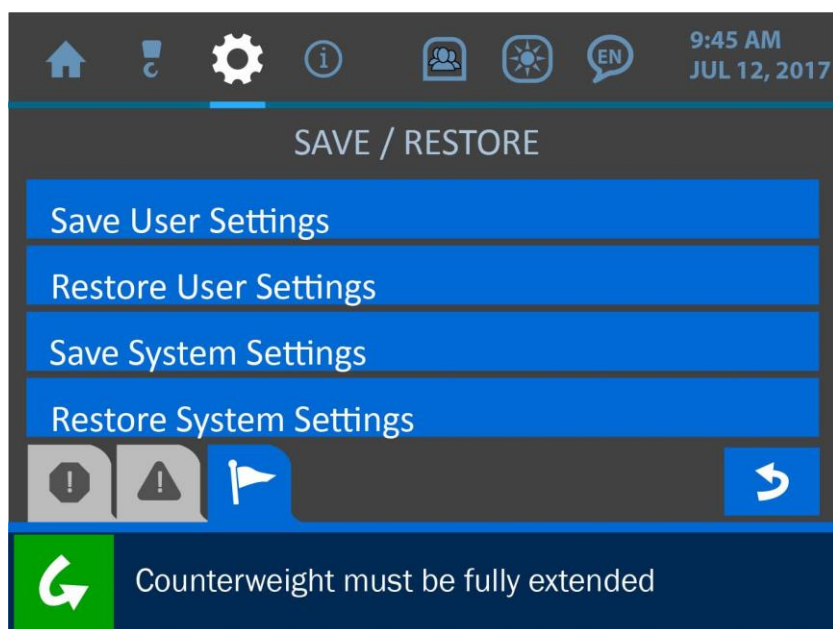
- **Relay:** The Relay Screen offers options for adjusting how the relay function (shutoff option) operates, including whether the shut off is normally hot or cold, and which components it will affect. For example, the panel can be configured to interrupt the winch up function to prevent the operator from damaging the pipelayer. Overload, A2B, Angle and Level can also be used to shut down the pipelayer in unsafe conditions.



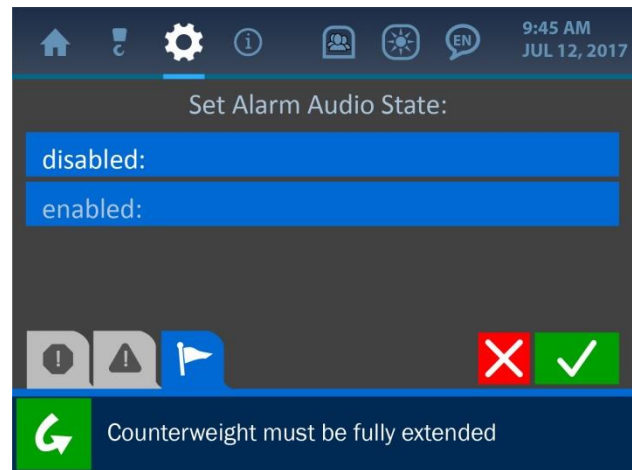
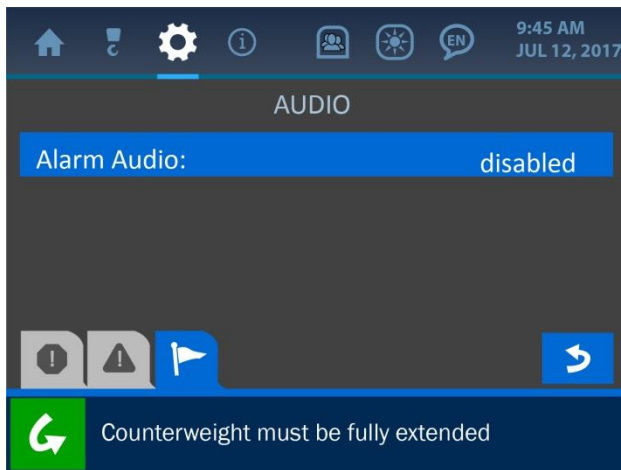
- **Parameters:** The Parameters Menu is used to set the machine type and various dimensions so that the logic calculations are correct and able to display accurately. These values are pre-set in the factory but can be changed as necessary.



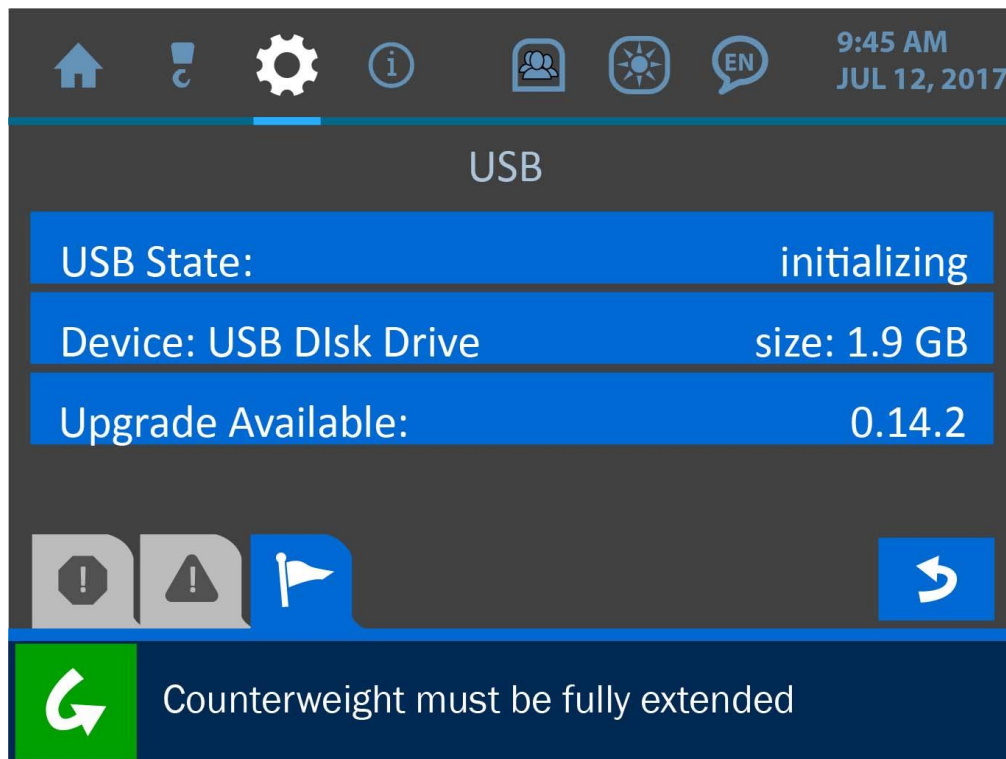
- **Save/Restore:** This menu is used to adjust and recall user and system settings. This eliminates the necessity to readjust values before using the system each time.



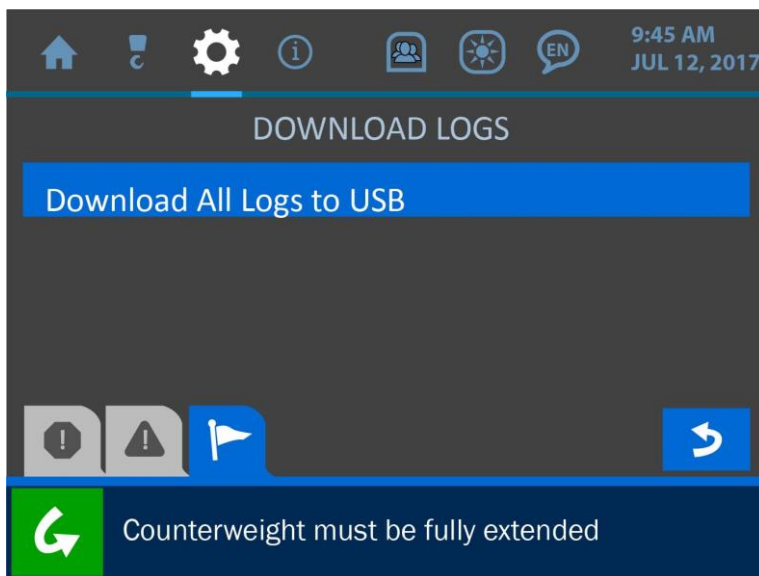
- **Audio:** The Audio Screen is used to either enable or disable the alarm sound. Pressing the Banner Button will open the Audio State Submenu, where either state can be selected and saved into the system.



- **USB:** This menu displays information pertaining to USB state, disk size and firmware version.



- **Logs:** This menu is used when downloading logs to a USB drive. The system will automatically detect whether a USB is inserted in the panel or not.



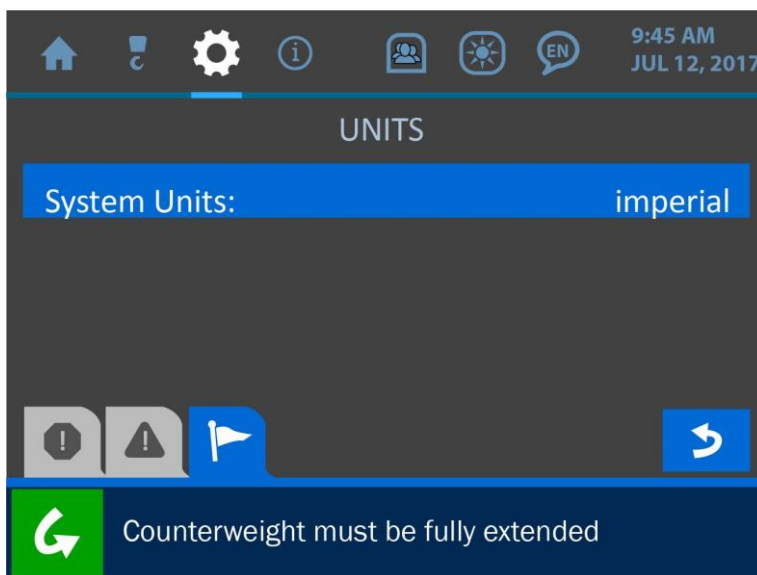
Settings / (Enable/Disable/Add) Menu:

This screen allows the supervisor to configure all the transducers in the system. Once a sensor is enabled, it can be added to the system's main display.



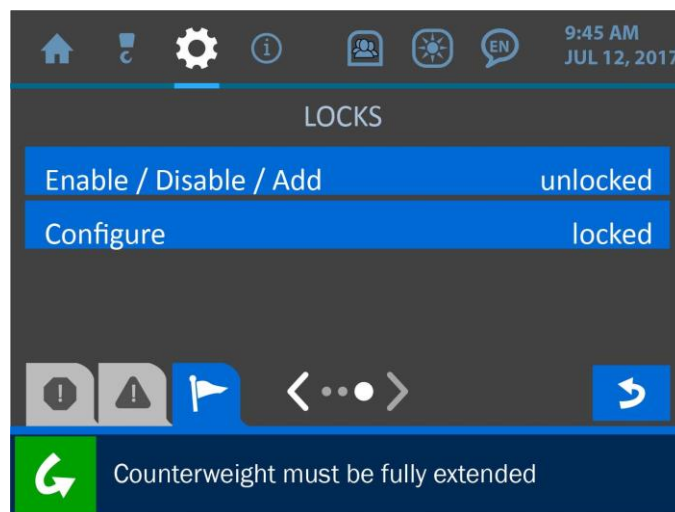
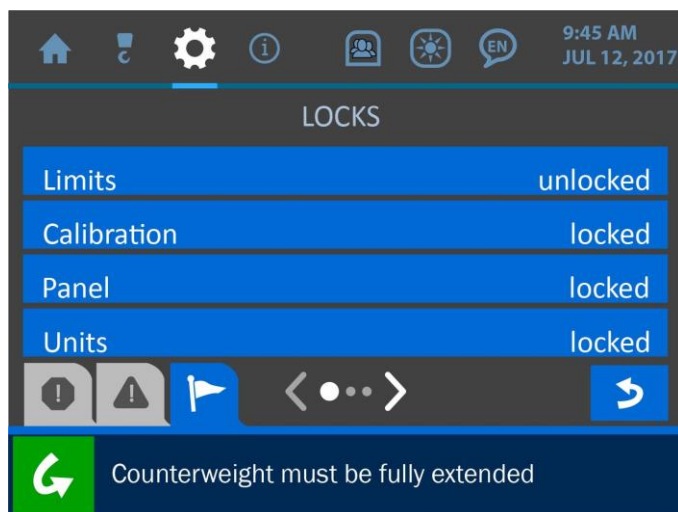
Settings / Units Menu:

This menu is used to toggle between these options for the parameter display: imperial, metric, imperial-tons, or metric-tonnes.



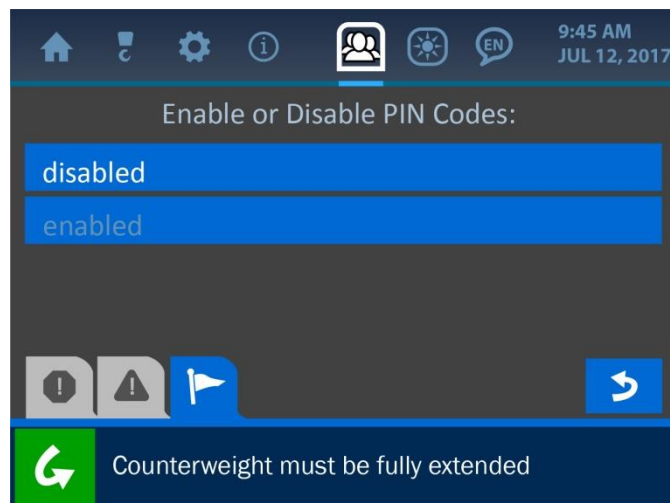
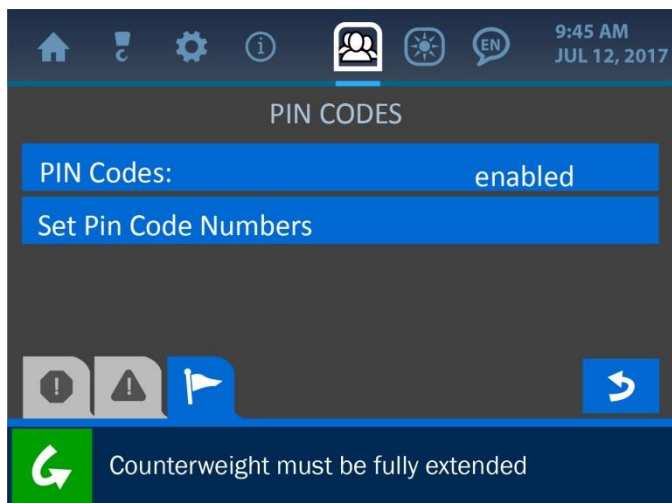
Settings / Locks Menu:

The Locks Menu offers options for restricting operators from accessing various parts of the system.

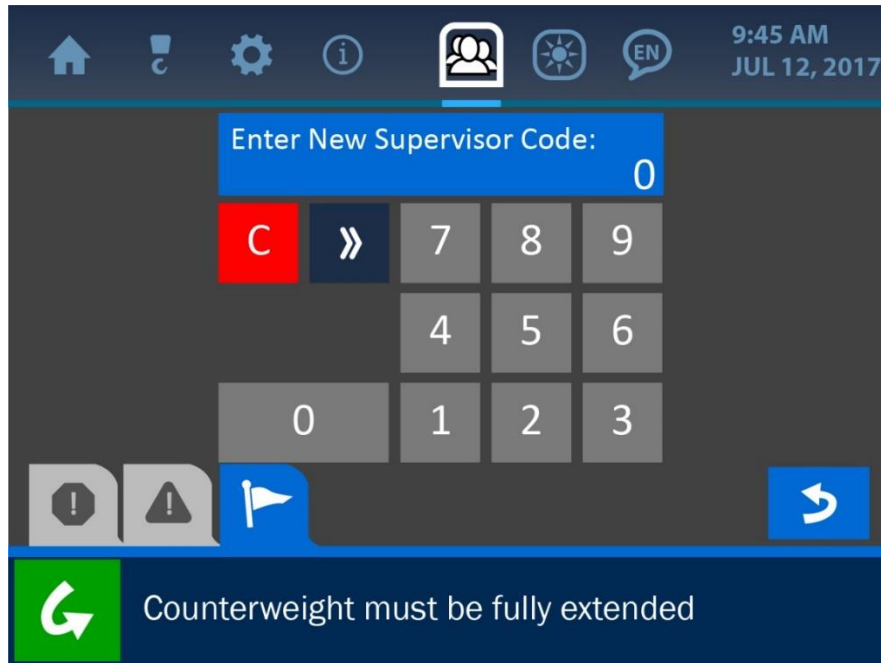


Permission Menu:

- **Setup PIN Code:** This screen is used to set optional user access codes, in order to customize and track each operator's access to the system. First, enable the feature by pressing the Enable Banner Button, then press the 'Set PIN Code Numbers' button to enter the codes themselves.



- **Change Supervisor Code:** Customize or change the Supervisor Code from this screen.



NOTE: See 'The User Interface' section of this manual for more information on The Value Entry Screen.

8. The LCD Brightness and Audio Menu

The LCD Brightness and Audio Screen is symbolized by the 'sun' icon at the top of the display and can be accessed by pressing the screen directly overtop this icon. Use this menu to adjust the screen's brightness and the system sound for optimal display and performance. Press directly overtop the percentage bars in the center of the screen or press the increment / decrement buttons on either side of the bars to fine tune the adjustment of either parameter.



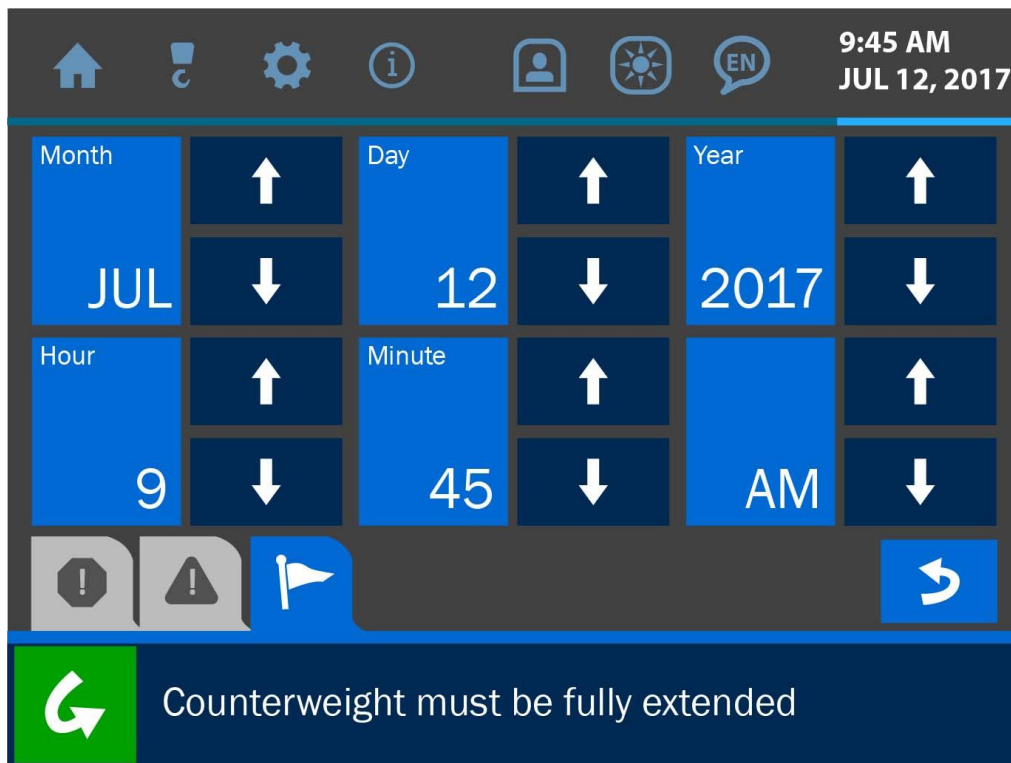
8. The Language Menu

The Language Menu is symbolized by the figure icon at the top of the display. Although this icon appears on the display in line with the other active menu options in the system, the language menu has yet to be integrated for functionality. The mention of it in this manual is strictly for clarification purposes.



9. The Time and Date Menu

Setting the correct time and date for the system is important for the accuracy of data logs, in case certain job information must be recalled or a machine needs to be serviced. The clock is backed up by a separate battery contained within the panel, eliminating the need to set this parameter each time the panel is powered off. The Time and Date Screen is shown and described below.



To change the date and time currently displayed, use the arrow buttons next to the month/day/year/hour/minute portions of the display to change their values. Once the display is correct, press the (green) 'Accept' button to save the change and return to the previous screen.

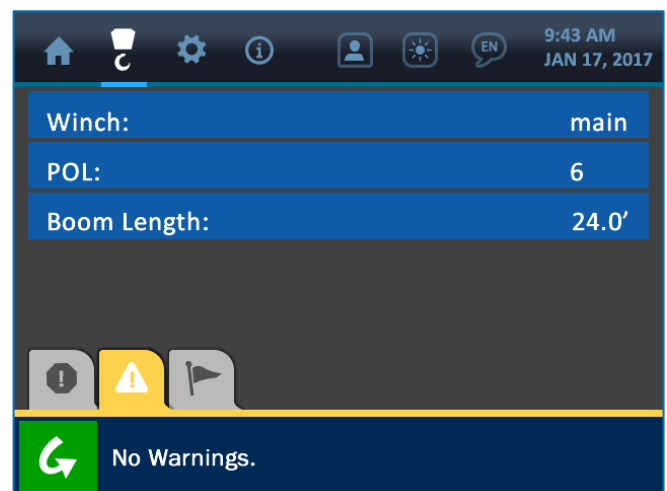
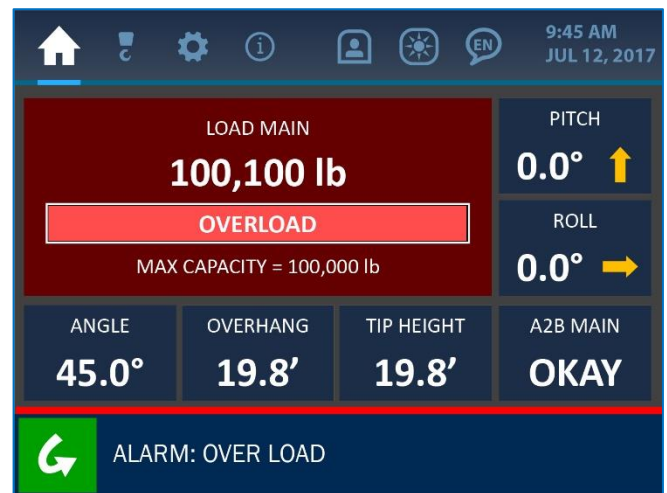
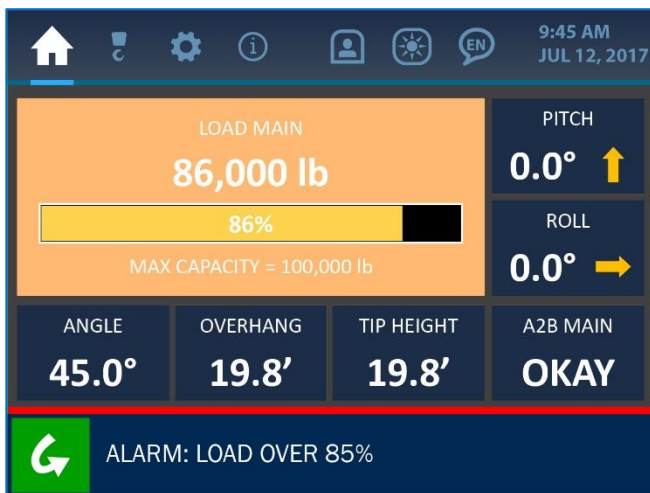
NOTE: See 'The User Interface' section of this manual for more information on the Value Entry Screen.

10. Troubleshooting

The Cranesmart Pipelayer System performs self-checks for system errors, exceeded limits and any equipment malfunctions. This section illustrates and briefly describes some examples of this.

10.1. Alarm and Warning Screens

The system will notify the operator of any unsafe condition via the built in audible and visual alarms. A loud beep will sound from the display panel speaker, and an associate screen will show what error or unsafe condition has arisen. The alarms may be bypassed using the Bypass Button, located in the lower left corner of the display, which will silence the speaker for 30 seconds. However, the alarm state will persist until the error causing the alarm is corrected.



NOTE: Alarms will normally sound while the system components are being installed, and until there is a clear line of sight between the transducers and display panel. If alarms still sound after the components are properly installed, check the Transducer Stats Screen via the Information Menu to ensure a clear signal is being received from all components. If an alarm still persists, please contact the Cranesmart service department at: (780) 437-2986.

10.2. Replacing a Transducer Battery

Before replacing the batteries, call the Cranesmart Systems service department at (780) 437-2986, with the system serial number ready. The serial number can be found on the display panel or any transducer. Once it has been verified that a faulty battery is causing the error, follow the steps below.

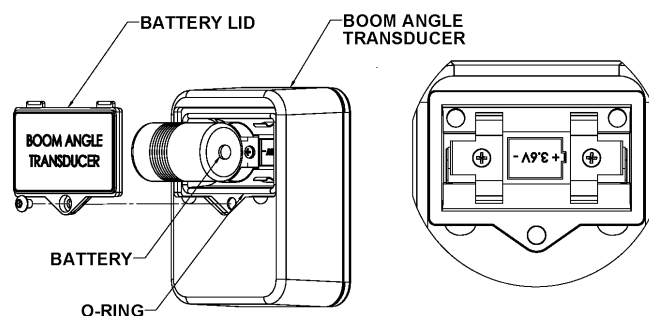
Tools and Equipment needed for battery replacement:

- (1) battery replacement kit (obtain a free battery replacement kit from Cranesmart Systems).
The kit contains:
 - (1) 3.6 volt Lithium Ion D-cell battery
 - (1) 1/8" Allen key(Alternatively, a 3.6V lithium battery may be purchased from a battery supplier.)

NOTE: If it is humid, raining or snowing – DO NOT OPEN THE TRANSMITTER. Remove the transmitter and perform the battery replacement indoor or undercover.

To Replace the Battery:

1. Remove the cap screw from the battery compartment lid and remove the lid.
2. Remove the battery from the holder.
3. Insert the new battery according to the battery picture on the base of the battery clip.
4. Secure the lid.



11. Appendix

11.1. Load Pin Installation

Free rotation

Ensure that when the load pin is installed, it is able to rotate freely through a full 360°, without binding at all. This is an important factor in the accuracy of the load sensing; unexpected forces on the pin can register as loads on the line.

Protection and care for the load pin

The transducer box is attached directly to the load pin, so care must be taken to ensure that there will be ***no direct impacts*** made on this end of the pin (during installation ***do not hit the pin*** to force it into alignment). If the blue transmitter case located on the load pin is in danger of receiving damage during normal operations, please call the Cranesmart service department at (780) 437-2986 for assistance.

Load pin radio

The Cranesmart System works by receiving radio signals from the load pin transducer box and displaying the readings on the display panel. It is important to keep a clear line-of-sight between the panel and the load pin transducer box.

To Install the Load Pin:

1. **Remove the existing pin**
2. **Install the Cranesmart System load pin**

The transducer box contains sensitive electronics. Do not use a hammer or any other object to strike the load pin directly.

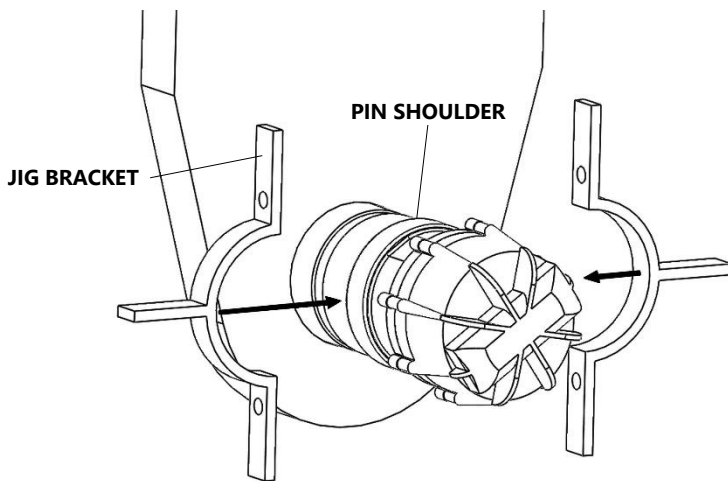


Figure 11-1a: Place Jig Brackets Around Pin

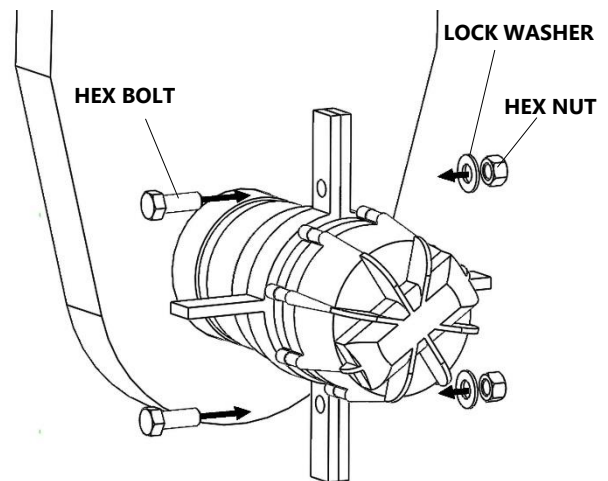
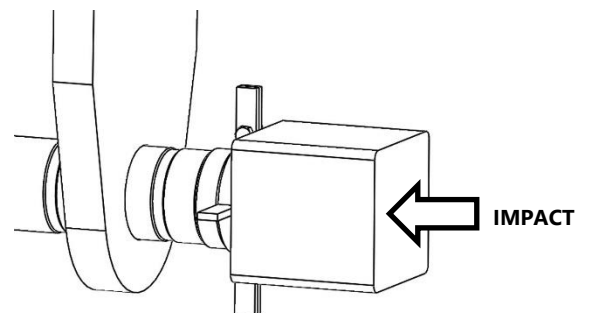
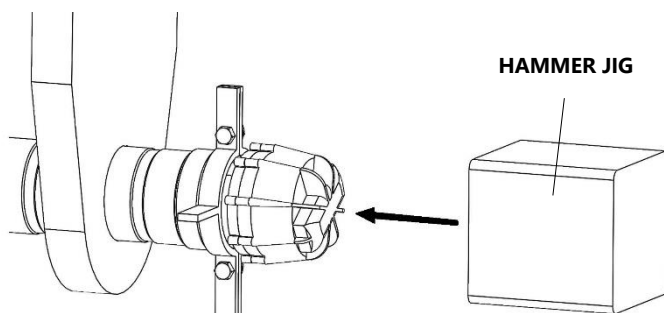


Figure 11-1b: Secure Brackets with Bolts

3. **Assemble the hammer jig brackets around the load pin (for pins larger than PL72)**
Place the jig brackets around the pin – between the transducer and the pin shoulder, then secure the brackets with the provided hex bolts, nuts and washers (see figure 11-1a and 11-1b above).

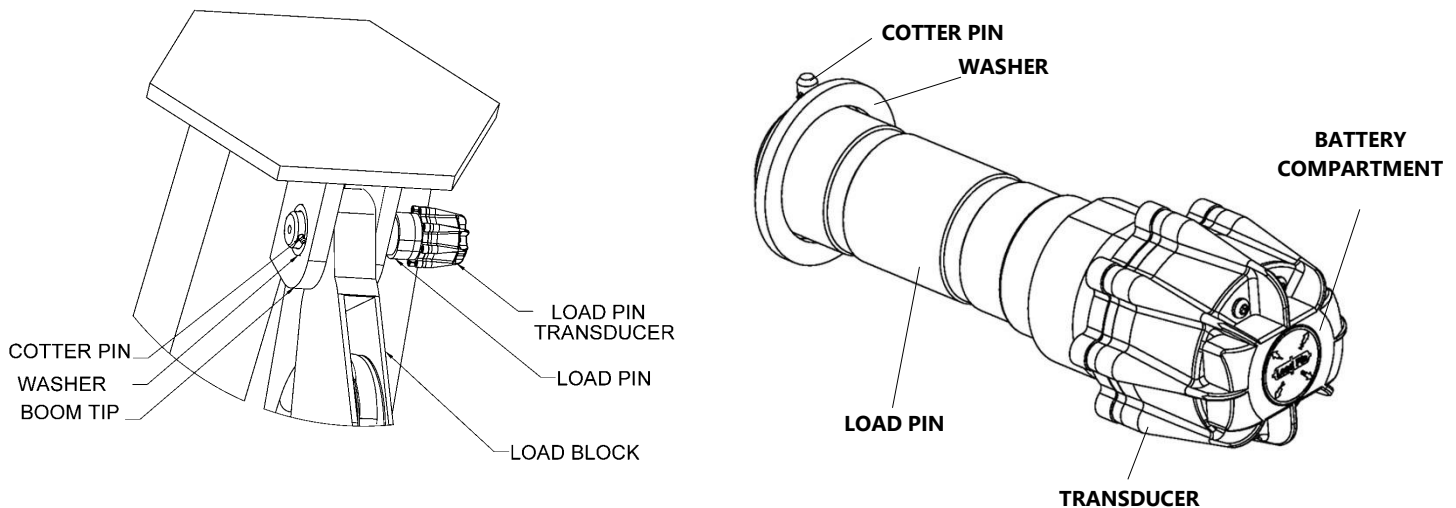


4. **Place the hammer jig**

Place the hammer jig overtop the transducer box, against the jig brackets, and hammer the front face of the hammer jig to push the pin firmly into place.

5. Secure the load pin

Secure the load pin by installing the cotter pin through the hole in the end of the pin. Use washers to secure the pin and keep it from moving from side to side as this would affect calibration.



6. Check for free rotation of the load pin

Once the pin is installed properly, check that it can move freely by rotating it 360°.

7. Check for good signal strength on the display panel

See the Information Menu section of this manual for instructions on checking the component signal strengths.

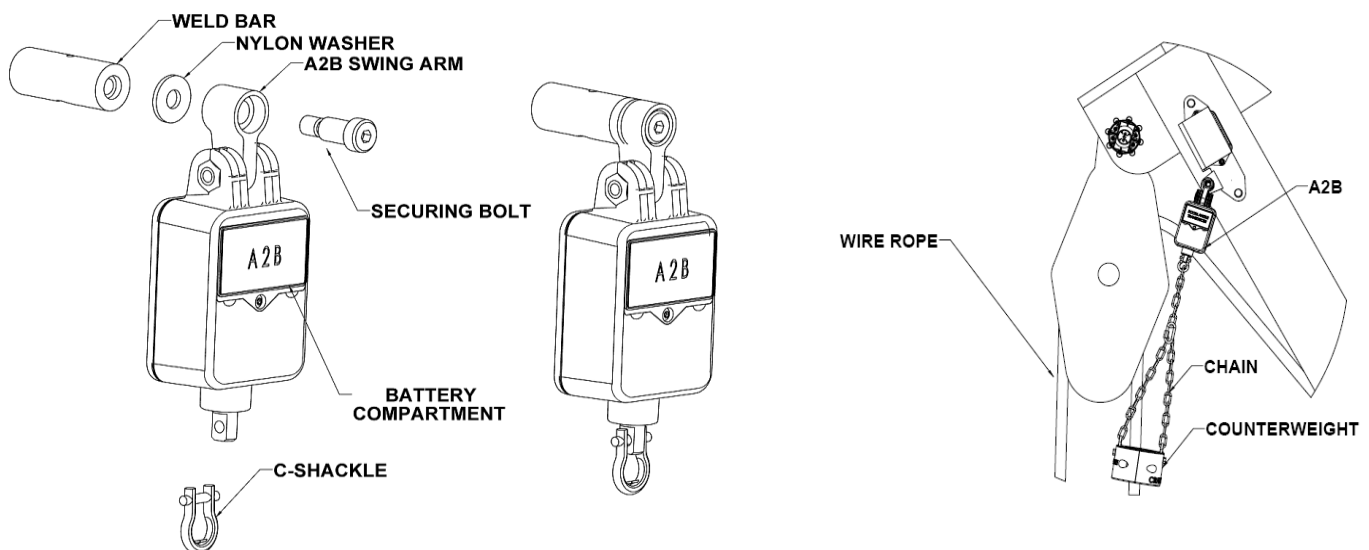
8. Verify the load pin calibration

Load pins are factory calibrated, but due to small differences in pipelayer boom ends, the calibration of each machine may require slight adjustment. Verify the calibration of the load pin by lifting a certified weight. If it is necessary to refine the load pin's calibration, refer to the Load Indication section of this manual.

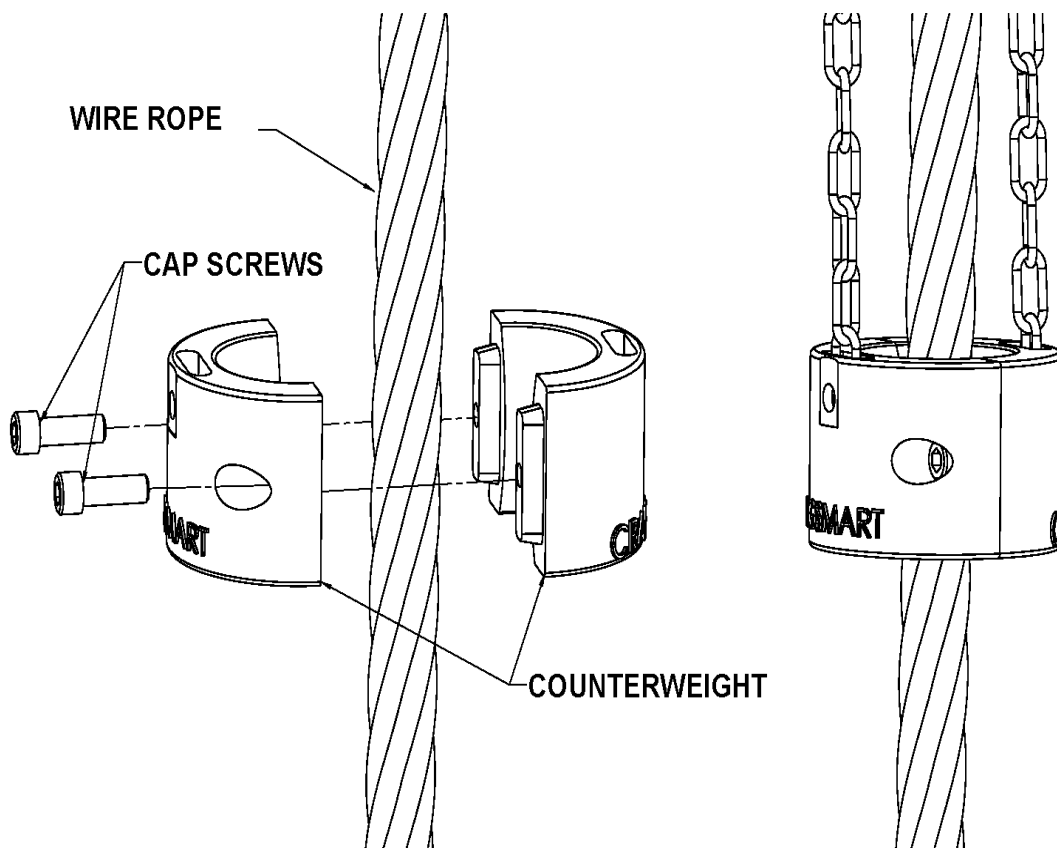
11.2. Anti-2-Block Installation (Optional)

The A2B transducer is designed to swivel and pivot so that it is always in an upright vertical position, in line with the wire rope – regardless of boom angle.

1. Weld the weld bar to the pipelayer. Ensure that the switch is mounted directly to the slowest moving line. The weld bar can be welded directly to the pipelayer or to an existing weld plate. (Both sides of the weld bar are identical).
2. Ensure that the mounted A2B transducer has a direct line-of-sight to the display panel and install the large securing bolt into the A2B swing arm.
3. Attach the A2B transducer to the weld bar. (Install the nylon washer between the bar and the swing arm).



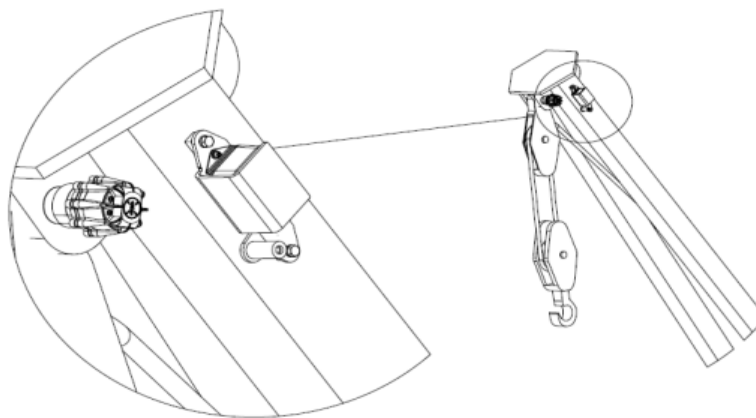
4. Attach the counterweight chain to the bottom of the A2B transmitter using the C-shackle supplied.
5. Assemble the counterweight around the slowest moving line, using the bolts provided.



11.3. Boom Angle Transducer Installation

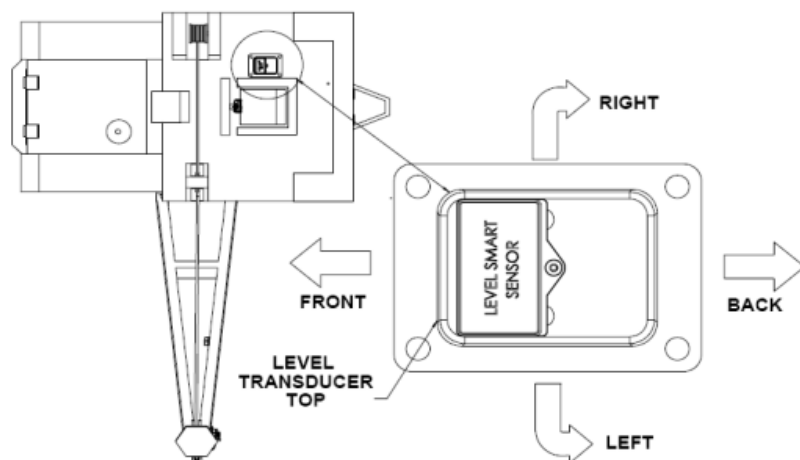
The boom angle transducer must maintain line-of-sight with the display panel in all boom positions. The transducer should be mounted on the side of the boom, preferably on the left as shown in the diagram below. The transducer cannot be installed on the top or bottom of the boom. Do not weld the transducer mounting plate permanently before testing, in case adjustments are required. Weld the weld bar to the pipelayer, and ensure that the switch is mounted directly to the slowest moving line. The weld bar can be welded directly to the pipelayer or to an existing weld plate. (Both sides of the weld bar are identical).

1. Remove the weld plate from the angle transducer
2. Align and mark the installation position. Use the illustration on the transducer label to position the transducer parallel (level) with the boom line.
3. Tack weld the weld plate before testing the system
4. Mount the transducer to the weld plate
5. Calibrate the boom angle transducer (see the Angle Indication section of this manual).



11.4. Level Transducer Installation

1. The level transducer should have a line-of-sight to the display panel.
2. Normally, the level transducer is mounted with the label facing up. (In some cases the transducer must be installed to the cab ceiling, and therefore the label would be facing down). Make sure that the level transducer is not mounted in a position where it may suffer impact damage. Possible mounting locations are on top of the operator's cab or roll bar.
3. The level transducer should be made as level as possible but it is not critical that it be perfectly level. The unit will be calibrated after installation.
4. The correct mounting position of the level transducer is critical. The top of the level transducer must be aligned with the front of the pipelayer as shown in the diagram.
5. The pipelayer **must** be level during the calibration process.
6. **Do not** weld the weld plate with the level transducer attached.
7. Once the transducer is installed, see Level Indication section of this manual to calibrate the component.



11.5. Powerline Proximity Sensor Installation

The powerline proximity sensor must be mounted to the highest point and leading edge of the machine, (boom tip for example). The leading side may not be the same as the angle indicator, depending on where the powerlines are located in relation to the boom. For strongest communication, maintain the best line of site between the transducer and the display panel as possible.

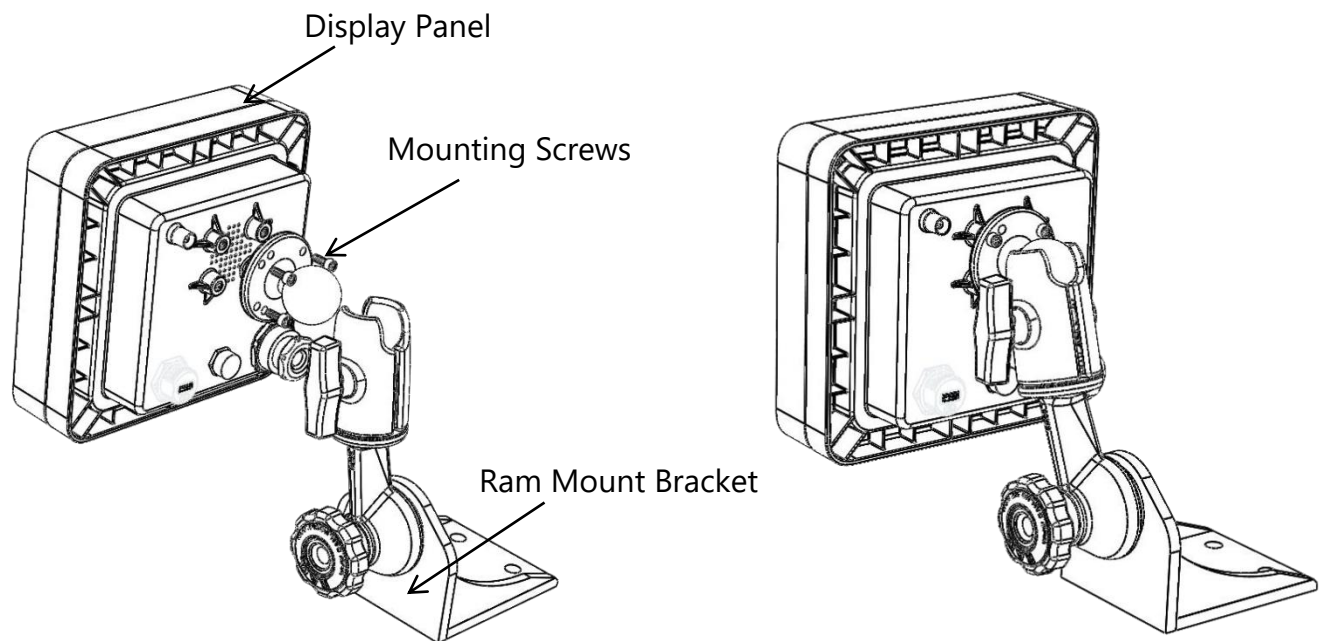
1. Align and mark the installation position of the weld bar.
2. Tack weld the weld plate before testing the system. **NOTE: Ensure that transducer is not attached to the weld bar during welding.**
3. Mount the transducer to the weld plate.
4. Adjust the setpoint of the transducer (see the Powerline Calibration section of this manual).
NOTE: This setpoint is field adjustable and must be configured properly for every powerline affecting work.
5. Remove the transducer from the weld bar.
6. Complete the weld and remount the transducer.



11.6. Display Panel Installation

Mounting the Display Panel

1. Mount the display panel to ensure the operator has an unobstructed view.
2. Align the ram mount bracket; mark and drill mounting holes using the mounting bracket as a guide.
3. Attach the bracket using the hardware provided.
4. Install the display panel to the bracket.
5. Mount the ram mount bracket to an appropriate place within the cab, using the 3/8" bolts provided.



NOTE:

- *The display panel can pivot horizontally or vertically by changing the position of the mounting bracket.*
- *The panel should be mounted in the operator's field of view but not obstruct sight during a lift.*
- **DO NOT PRESSURE WASH THE DISPLAY PANEL OR SUBMERGE IT IN WATER.**

Wiring the Display Panel

Power to the display panel is supplied through the cable included in the kit, which plugs into the back of the panel. Refer to the wiring diagram on the following page.

1. Connect the red wire to a positive 12-24VDC (28VDC Max) terminal.
2. Connect the black wire to a good ground connection on the pipelayer.
3. *(Optional)*: Connect the white wire to an optional 'shut off' solenoid or to sound external horns. (Maximum output is 7.5 amps).

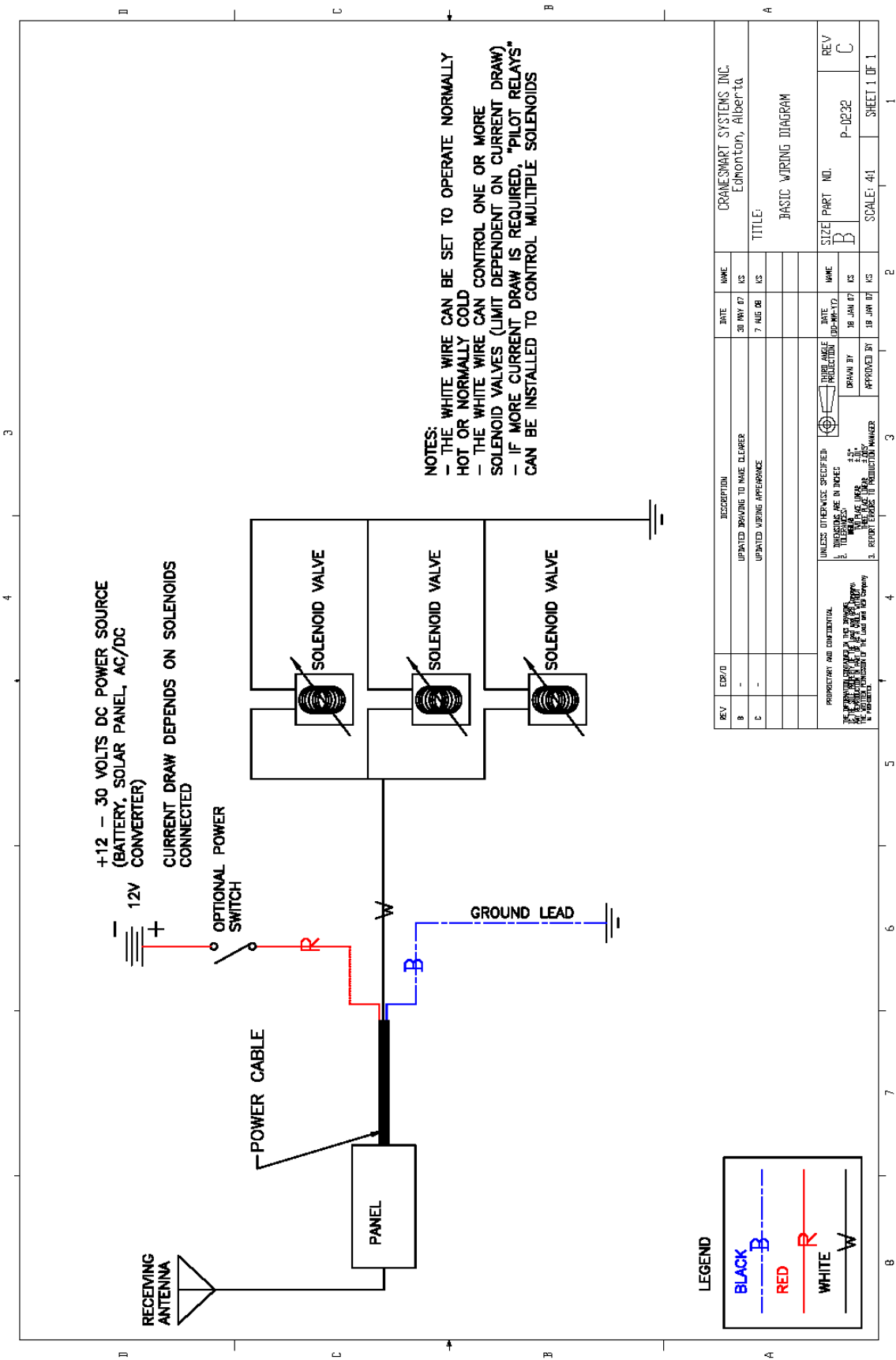
NOTE: Ensure that a continuous 12-24VDC (28VDC max) is available to the panel at all times while the pipelayer is in operation. If the voltage drops below 10.5 VDC the panel will not function.

11.7. Alarm Shutoffs (White Wire)

The Pipelayer System is shipped with a three conductor wiring harness, which includes black, red, and white wires. The white wire may be used in conjunction with external alarm horns, lights, or shut-offs, if they are installed.

NOTE: When supplying power to the Cranesmart system (with 12 or 24 VDC) the white wire is normally hot (energized) with the supply voltage in a non-alarm condition. If the white wire will not be used for any of the above applications, please ensure that the exposed end of the wire remains sealed to prevent grounding and damage to the display panel.

11.7. Display Panel Wiring Diagram

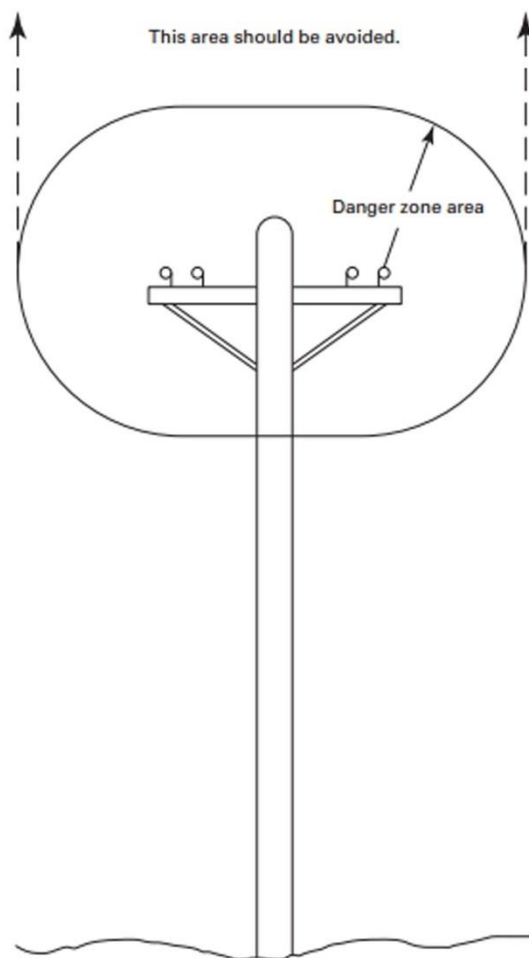


11.8. ASME B30.14 Excerpt (Power Lines)

The following excerpt from ASME B30.14 details the safety guidelines for operating side boom tractors near power lines.

ASME B30.14-2015

(15) **Fig. 14-3.4.1-1 Danger Zone for Side Boom Tractors and Lifted Loads Operating Near Electrical Transmission Lines**



GENERAL NOTE: For minimum radial distance of danger zone, see para. 14-3.4.1.

Table 14-3.4.1-1 Required Clearance for Normal Voltage in Operation Near High-Voltage Power Lines and Operation in Transit With No Load and Boom or Mast Lowered (15)

Normal Voltage, kV (Phase to Phase)	Minimum Required Clearance, ft (m)
When Operating Near High Voltage Power Lines	
Up to 50	10 (3.05)
Over 50 to 200	15 (4.60)
Over 200 to 350	20 (6.10)
Over 350 to 500	25 (7.62)
Over 500 to 750	35 (10.67)
Over 750 to 1,000	45 (12.80)
While in Transit With No Load and Boom or Mast Lowered	
Up to 0.75	4 (1.22)
Over 0.75 to 50	6 (1.83)
Over 50 to 345	10 (3.05)
Over 345 to 750	16 (4.87)
Over 750 to 1,000	20 (6.10)

11.9. Occupational Safety and Health Administration 1926.1408 Excerpt (Power Lines)

The following excerpt from OSHA (1926.1408) details the safety guidelines for operating side boom tractors near power lines.

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§ 1926.1408 Power line safety (up to 350 kV)—equipment operations.

(a) *Hazard assessments and precautions inside the work zone.* Before beginning equipment operations, the employer must:

- (1) *Identify the work zone by either:*
 - (i) Demarcating boundaries (such as with flags, or a device such as a range limit device or range control warning device) and prohibiting the operator from operating the equipment past those boundaries, or
 - (ii) Defining the work zone as the area 360 degrees around the equipment, up to the equipment's maximum working radius.

- (2) Determine if any part of the equipment, load line or load (including rigging and lifting accessories), if operated up to the equipment's maximum working radius in the work zone, could get closer than 20 feet to a power line. If so, the employer must meet the requirements in Option (1), Option (2), or Option (3) of this section, as follows:

- (i) *Option (1)—Deenergize and ground.* Confirm from the utility owner/operator that the power line has been deenergized and visibly grounded at the worksite.

- (ii) *Option (2)—20 foot clearance.* Ensure that no part of the equipment, load line, or load (including rigging and lifting accessories), gets closer than 20 feet to the power line by implementing the measures specified in paragraph (b) of this section.

- (iii) *Option (3)—Table A clearance.*

- (A) Determine the line's voltage and the minimum approach distance permitted under Table A (see § 1926.1408).

- (B) Determine if any part of the equipment, load line or load (including rigging and lifting accessories), while operating up to the equipment's maximum working radius in the work zone, could get closer than the minimum approach distance of the power line permitted under Table A (see § 1926.1408). If so, then the employer must follow the requirements in paragraph (b) of this section to ensure that no part of the equipment, load line, or load (including rigging and lifting accessories), gets closer to the line than the minimum approach distance.

- (b) *Preventing encroachment/electrocution.* Where encroachment precautions are required under Option (2) or Option (3) of this section, all of the following requirements must be met:

- (1) Conduct a planning meeting with the operator and the other workers who will be in the area of the equipment or load to review the location of the power line(s), and the steps that will be implemented to prevent encroachment/electrocution.

- (2) If tag lines are used, they must be non-conductive.

- (3) Erect and maintain an elevated warning line, barricade, or line of signs, in view of the operator, equipped with flags or similar high-visibility markings, at 20 feet from the power line (if using Option (2) of this section) or at the minimum approach distance under Table A (see § 1926.1408) (if using Option (3) of this section). If the operator is unable to see the elevated warning line, a dedicated spotter must be used as described in § 1926.1408(b)(4)(ii) in addition to implementing one of the measures described in §§ 1926.1408(b)(4)(i), (iii), (iv) and (v).

- (4) Implement at least one of the following measures:

- (i) A proximity alarm set to give the operator sufficient warning to prevent encroachment.

- (ii) A dedicated spotter who is in continuous contact with the operator. Where this measure is selected, the dedicated spotter must:

- (A) Be equipped with a visual aid to assist in identifying the minimum clearance distance. Examples of a visual aid include, but are not limited to: A clearly visible line painted on the ground; a clearly visible line of stanchions; a set of clearly visible line-of-sight landmarks (such as a fence post behind the dedicated spotter and a building corner ahead of the dedicated spotter).

- (B) Be positioned to effectively gauge the clearance distance.

- (C) Where necessary, use equipment that enables the dedicated spotter to communicate directly with the operator.

- (D) Give timely information to the operator so that the required clearance distance can be maintained.

- (iii) A device that automatically warns the operator when to stop movement, such as a range control warning device. Such a device must be set to give the operator sufficient warning to prevent encroachment.

- (iv) A device that automatically limits range of movement, set to prevent encroachment.

- (v) An insulating link/device, as defined in § 1926.1401, installed at a point between the end of the load line (or below) and the load.

- (5) The requirements of paragraph (b)(4) of this section do not apply to work covered by subpart V of this part.

- (c) *Voltage information.* Where Option (3) of this section is used, the utility owner/operator of the power lines must provide the requested voltage information within two working days of the employer's request.

- (d) *Operations below power lines.*

- (1) No part of the equipment, load line, or load (including rigging and lifting accessories) is allowed below a power line unless the employer has confirmed that the utility owner/operator has deenergized and (at the worksite) visibly grounded the power line, except where one of the exceptions in paragraph (d)(2) of this section applies.

- (2) *Exceptions.* Paragraph (d)(1) of this section is inapplicable where the employer demonstrates that one of the following applies:

- (i) The work is covered by subpart V of this part.

- (ii) For equipment with non-extensible booms: The uppermost part of the equipment, with the boom at true vertical, would be more than 20 feet below the plane of the power line or more than the Table A of this section minimum clearance distance below the plane of the power line.

- (iii) For equipment with articulating or extensible booms: The uppermost part of the equipment, with the boom in the fully extended position, at true vertical, would be more than 20 feet below the plane of the power line or more than the Table A of this section minimum clearance distance below the plane of the power line.

- (iv) The employer demonstrates that compliance with paragraph (d)(1) of this section is infeasible and meets the requirements of § 1926.1410.

- (e) *Power lines presumed energized.* The employer must assume that all power lines are energized unless the utility owner/operator confirms that the power line has been and continues to be deenergized and visibly grounded at the worksite.

- (f) When working near transmitter/communication towers where the equipment is close enough for an electrical charge to be induced in the equipment or materials being handled, the transmitter must be deenergized or the following precautions must be taken:

- (1) The equipment must be provided with an electrical ground.

- (2) If tag lines are used, they must be non-conductive.

- (g) *Training.*

- (1) The employer must train each operator and crew member assigned to work with the equipment on all of the following:

- (i) The procedures to be followed in the event of electrical contact with a power line. Such training must include:

- (A) Information regarding the danger of electrocution from the operator simultaneously touching the equipment and the ground.

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(B) The importance to the operator's safety of remaining inside the cab except where there is an imminent danger of fire, explosion, or other emergency that necessitates leaving the cab.

(C) The safest means of evacuating from equipment that may be energized.

(D) The danger of the potentially energized zone around the equipment (step potential).

(E) The need for crew in the area to avoid approaching or touching the equipment and the load.

(F) Safe clearance distance from power lines.

(ii) Power lines are presumed to be energized unless the utility owner/operator confirms that the power line has been and continues to be deenergized and visibly grounded at the worksite.

(iii) Power lines are presumed to be uninsulated unless the utility owner/operator or a registered engineer who is a qualified person with respect to electrical power transmission and distribution confirms that a line is insulated.

(iv) The limitations of an insulating link/device, proximity alarm, and range control (and similar) device, if used.

(v) The procedures to be followed to properly ground equipment and the limitations of grounding.

(2) Employees working as dedicated spotters must be trained to enable them to effectively perform their task, including training on the applicable requirements of this section.

(3) Training under this section must be administered in accordance with § 1926.1430(g).

(h) Devices originally designed by the manufacturer for use as: A safety device (see § 1926.1415), operational aid, or a means to prevent power line contact or electrocution, when used to comply with this section, must meet the manufacturer's procedures for use and conditions of use.

TABLE A—MINIMUM CLEARANCE DISTANCES

Voltage (nominal, kV, alternating current)	Minimum clearance distance (feet)
up to 50	10
over 50 to 200	15
over 200 to 350	20
over 350 to 500	25
over 500 to 750	35
over 750 to 1,000	45
over 1,000	(as established by the utility owner/operator or registered professional engineer who is a qualified person with respect to electrical power transmission and distribution).

Note: The value that follows "to" is up to and includes that value. For example, over 50 to 200 means up to and including 200kV.