



MicroGuard 540 Rated Capacity Limiter



Calibration Manual

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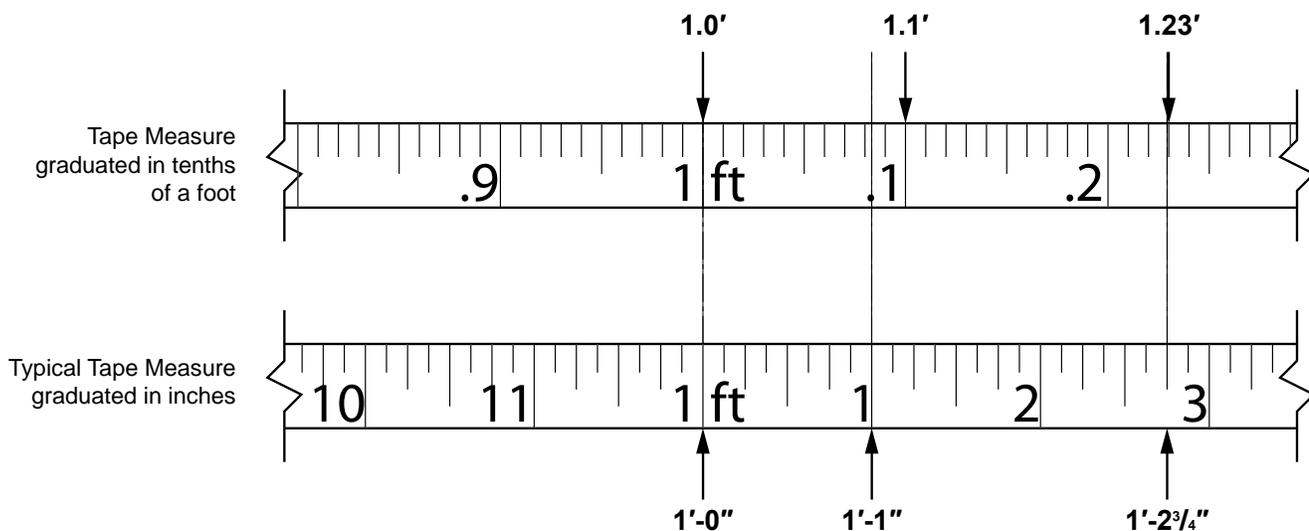
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Introduction

This manual describes the calibration process for the Link-Belt MG-540 Rated Capacity Indicator System (hereinafter referred to as “the system”) in an on-site environment and assumes that there is no prior knowledge of the geometry of the crane other than data provided by the manufacturer. This document also assists personnel in obtaining necessary measurements for calibration and in maintaining a record of the measurements and test results for review and/or comparison when changes are made. Recording measurements and test results during the calibration process will ensure an organized and easy to follow calibration.

Required Tools

- 1/4” nut driver or T15 Torx driver
- Digital or bubble level calibrated and accurate to 0.1° at level
- Minimum 100 foot measuring tape (200 foot may be required) - fiber type graduated in tenths of feet



Note: The computer calculates measurements in feet and tenths of a foot, so having the correct measure will facilitate entering measurements.

- Digital volt/Ohm Meter capable of measurements to three decimal places

Number Conversion

If you are using a standard tape measure, the measurement must be converted into feet and tenths of a foot. For example: a distance of 35'-6" would be entered into the system as 35.5 feet. Whole inches can be easily converted by dividing by 12 ($6/12=.5$). Fractions of an inch are converted by dividing the numerator by the denominator. For example: $1/4"$ would be entered as .25 inches ($1/4=.25$). Conversion of whole inches and fractions of an inch, for example 6-1/4" are converted by first converting the fraction to a decimal and then dividing by 12. In this case 6-1/4" is converted to 6.25 inches and then divided by 12 which equals 0.520 feet.

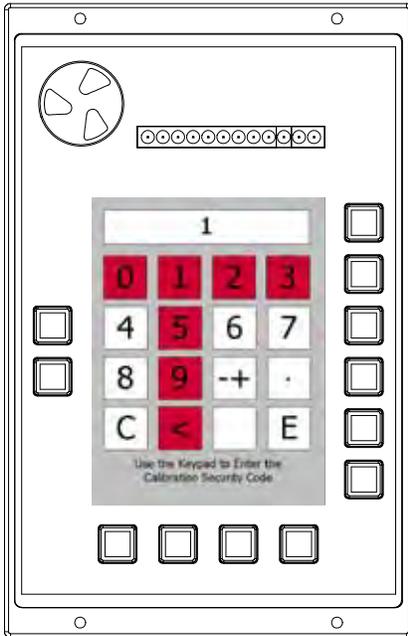
When entering weights, the number must be converted by moving the decimal three places to the left. For example: a weight of 1,400 pounds would be entered as 1.4, and a weight of 300 pounds would be entered as .300.

Number Entry

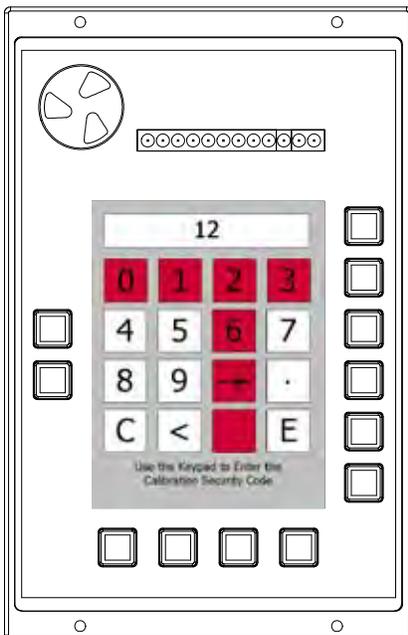
The system display does not use a numeric keypad. Instead, a range of numbers and characters is assigned to a particular key.

To select a particular number, press the key adjacent to the corresponding horizontal row containing the desired number.

Once the desired row is highlighted, press the key below the corresponding vertical column to enter the number.

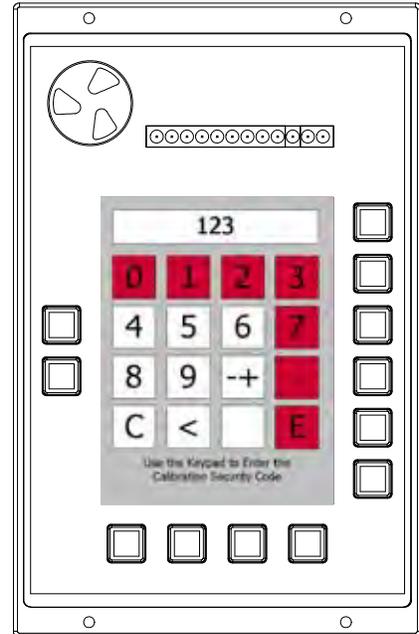


For example: To enter the numbers 1, 2, 3; first select the horizontal row containing the number “1” and then select the intersecting vertical column.

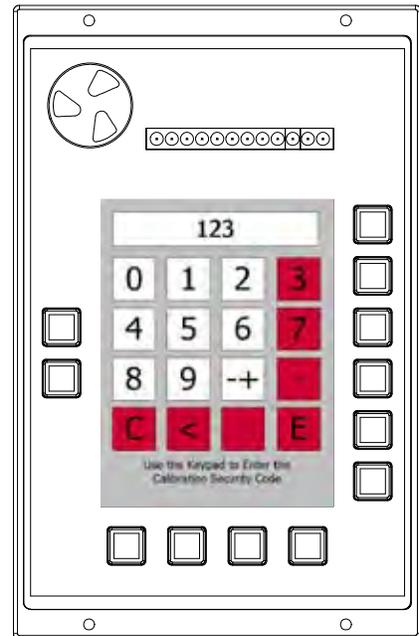


Then, select the horizontal row containing the number “2” and then select the intersecting vertical column.

Then select the horizontal row containing the number “3” and then select the intersecting vertical row.



When all numbers have been selected, highlight the “E” key in the same manner.

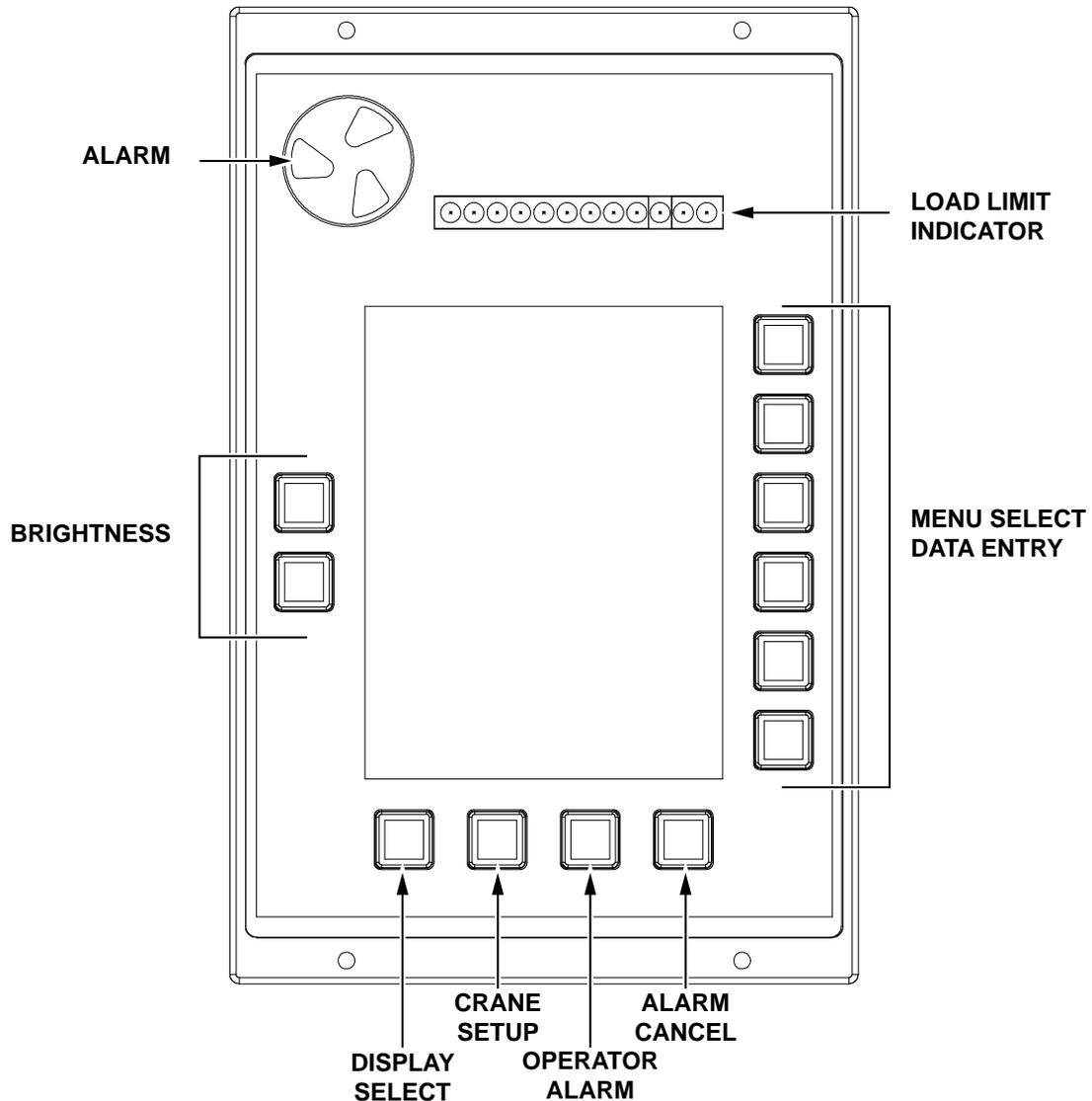


When entering negative numbers, select the negative symbol [-] first.

Decimal points are entered the same as numbers.

If an error is made in data entry, selecting the “<” symbol and pressing the key in the corresponding vertical column will delete one character. Selecting the “C” symbol and pressing the key in the corresponding vertical column will erase the entire entry.

The Display



The **Alarm** sounds when approaching overload, overload, violation of operator settable alarms, and other alarm violations. Turn the speaker cover to dampen the alarm volume.

The **Brightness** keys increase and decrease the brightness of the display.

The **Load Limit Indicator** notifies the operator of load limit, approaching overload (amber lights), and overload (red lights).

The **Menu Select/Data Entry** keys are used to select configuration and select menus and data values during calibration.

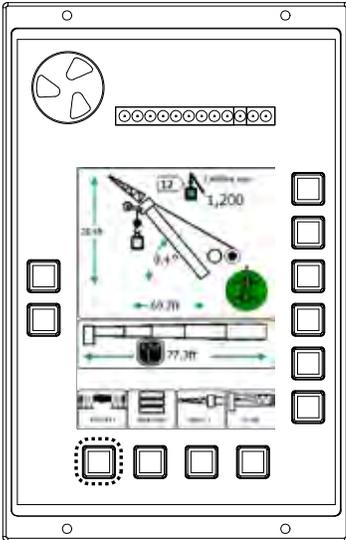
The **Display Select** key is used to view error codes and enter calibration mode.

The **Crane Setup** key is used to set or select crane configuration.

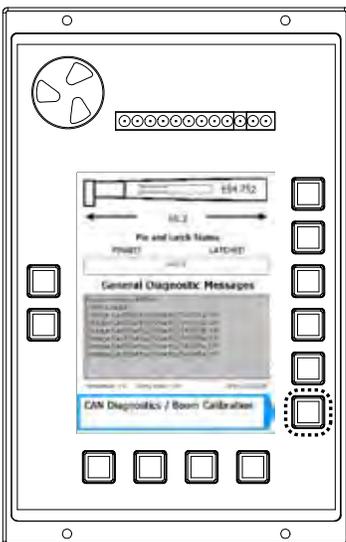
The **Operator Alarm** key is used to configure operator settable alarms.

The **Alarm Cancel** key is used to mute the Alarm Speaker. Press and hold for seven to ten seconds to cancel the function kick-out in the event of a two-block or overload condition.

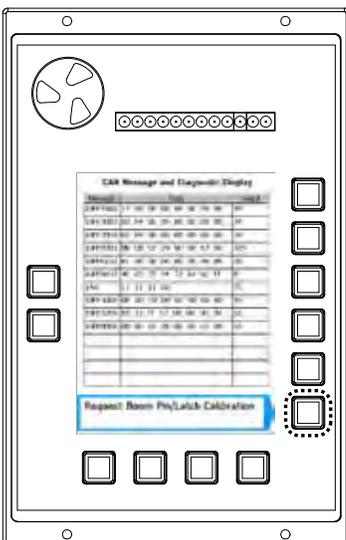
Error Codes



From the normal working screen, press the “Display/Select” key.



Any communication errors will be displayed here (i.e. “No Communication with MG5 Unit”; “No Communication with Boom Latching Controller”; etc.).

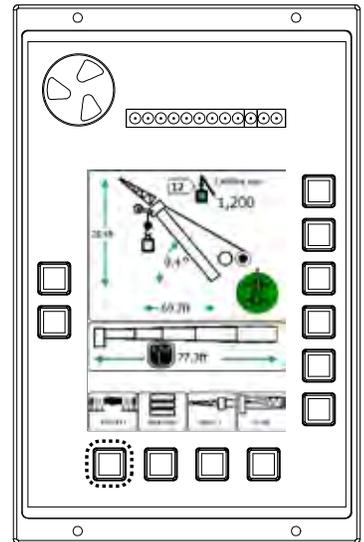


To view specific error codes, press the key adjacent to “CAN Diagnostics”. If the fault cannot be determined by the general diagnostics screen, the CAN diagnostics screen will show if an component has stopped transmitting it’s signal or is transmitting an incorrect signal.

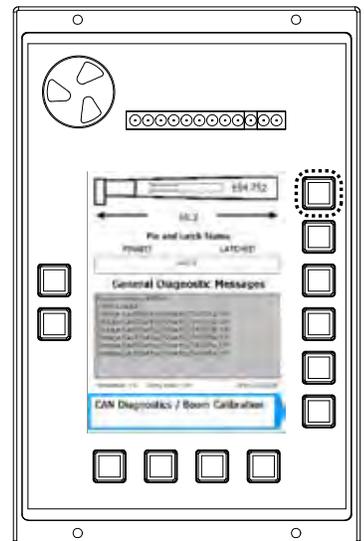
Calibration Mode

Use of the functions described in this manual requires that the system be in the calibration mode of operation.

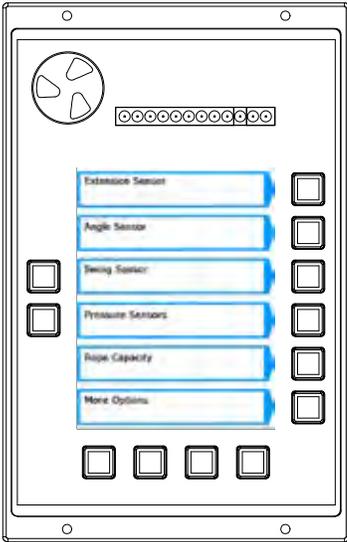
From the normal working screen, press the “Display/Select” key.



Press the uppermost-right key.



Enter the calibration code sequence. Use the number entry procedure on page 3. The calibration code is 1-2-3. If the sequence is entered incorrectly, the calibration will be aborted and the normal working screen will appear.

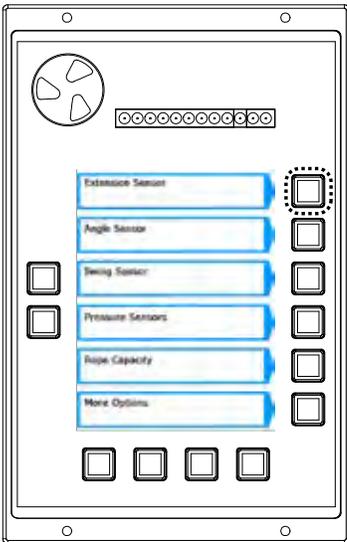


The calibration menu will appear upon entering the calibration code.

⚠WARNING

WHEN IN THE CALIBRATION MODE, THE TWO-BLOCK ALARM AND FUNCTION KICKOUT ARE DISABLED.

Extension Sensor



From the main calibration menu, press the key adjacent to “Extension Sensor”.

The extension sensor menu enables you to zero the sensor to reflect the boom in a fully retracted position, set the span of the extension, zero the telescoping cylinder, and set the pin/latch position.

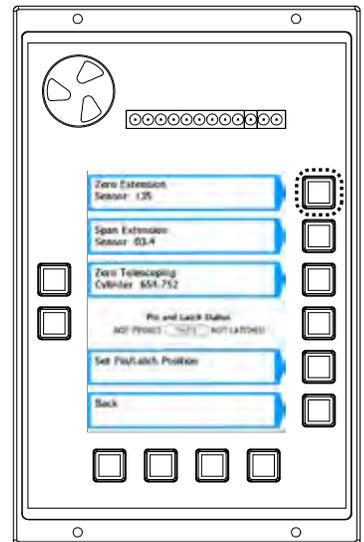
Extension Sensor Zero

Fully retract the boom.

Press the key adjacent to “Zero Extension Sensor XX” (where XX = current value).

The sensor is now zeroed.

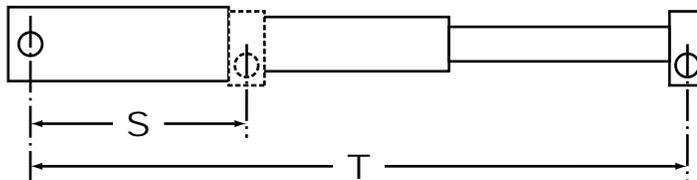
NOTE: Do not press the “Span Extension” key at this time. Otherwise the boom will not extend in automatic mode and the “Manual Box” will have to be used.



Span Extension Sensor

⚠WARNING

DO NOT FULLY EXTEND THE BOOM IF THIS ACTION COULD CAUSE A TIPPING CONDITION. CARRY OUT CALIBRATION PROCEDURES ONLY WITHIN THE STABILITY LIMITS OF THE CRANE.

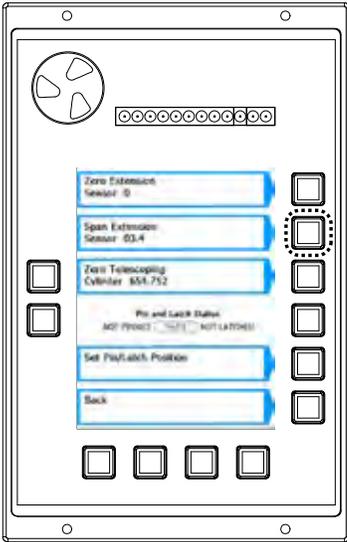


With the boom still fully retracted, lower it to a horizontal position. Measure the distance from the boom pivot to the hook centerline (S).

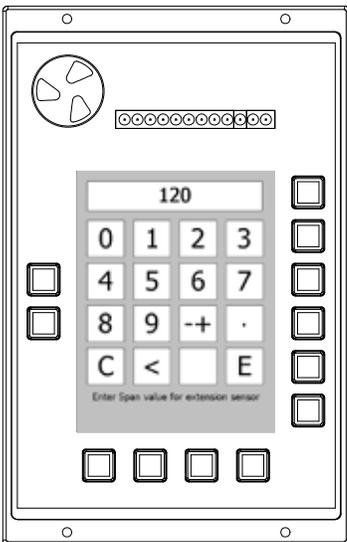
Next, fully extend the boom and measure the distance from the boom pivot to the hook centerline (T).

Calculate the span by subtracting the fully retracted length from the fully extended length ($T - S = \text{span}$).¹

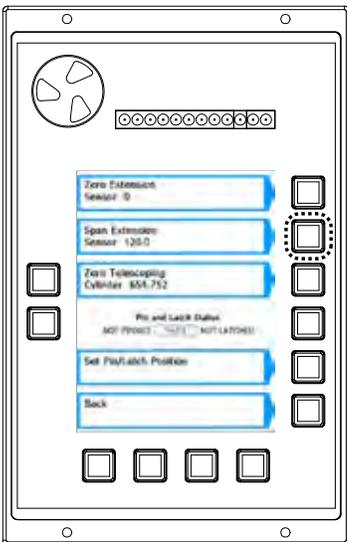
¹ An optional method for calculating the span is to refer to the crane load chart which will show the fully retracted boom length and the full extended boom length.



Press the key adjacent to "Span Extension Sensor XX.X" (where XX.X = current value).



Use the number entry procedure on page 3 to enter the calculated span.

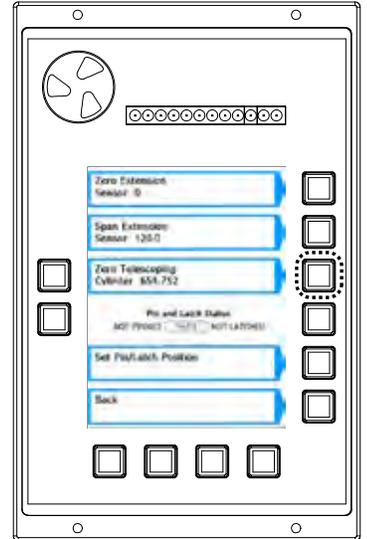


The extension sensor now reflects the proper span.

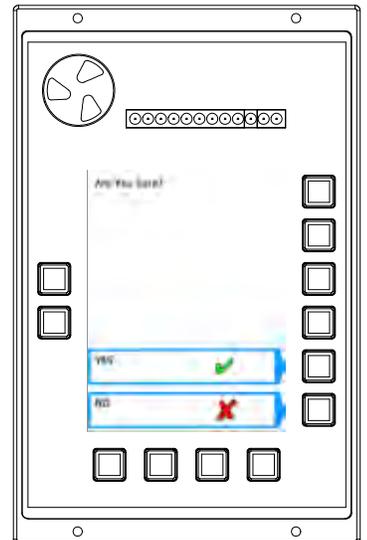
Zero Telescoping Cylinder

NOTE: Refer to Link-Belt procedures for ensuring the telescope cylinder is in its proper position before zeroing, or contact Link-Belt Product Support for more information.

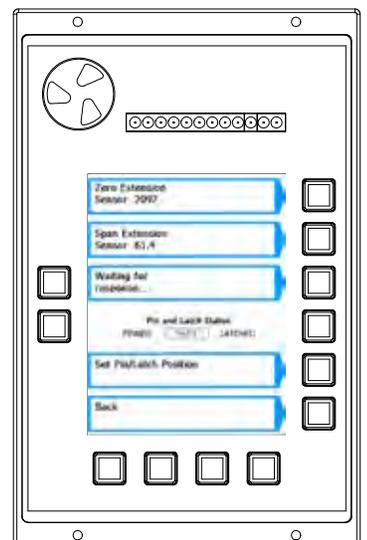
Press the key adjacent to “Zero Telescoping Cylinder X.XXX” (where X.XXX = current value).

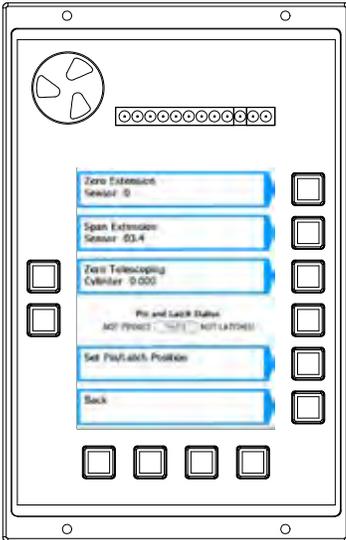


A confirmation screen will appear. Press the key adjacent to “Yes” to perform the calibration. Otherwise, press the key adjacent to “No” to abort.



While the system is performing the calibration, the message “Waiting for response” will appear.

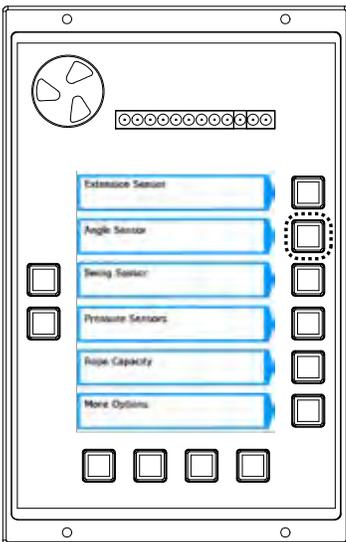




When it has finished, the telescoping cylinder will be zeroed.

Press the key adjacent to “Back” to return to the main calibration menu.

Angle Sensor



From the main calibration menu, press the key adjacent to “Angle Sensor”.

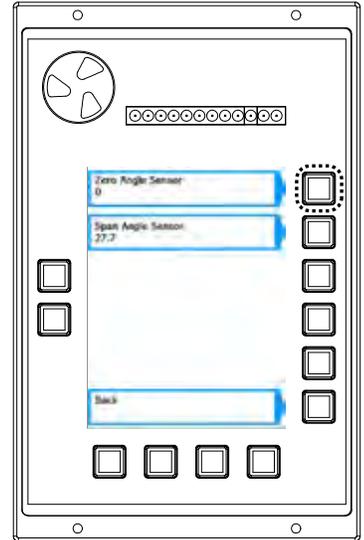
The angle sensor menu enables you to zero the angle sensor to reflect the boom in a horizontal position (0°), and adjust the sensor to reflect the current angle of the boom.

Zero Angle Sensor

Place the boom in the rest (stowed position). Use an inclinometer or a digital level to verify the boom is at zero degrees (0°).

Press the key adjacent to “Zero Angle Sensor”.

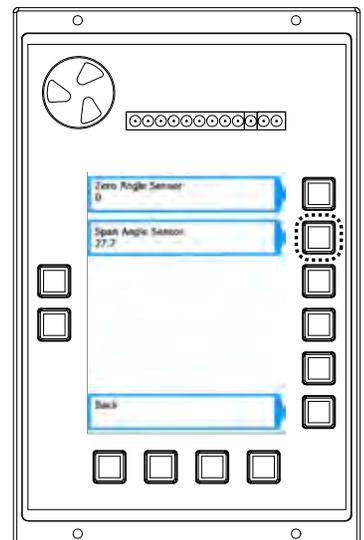
The angle sensor is now zeroed.

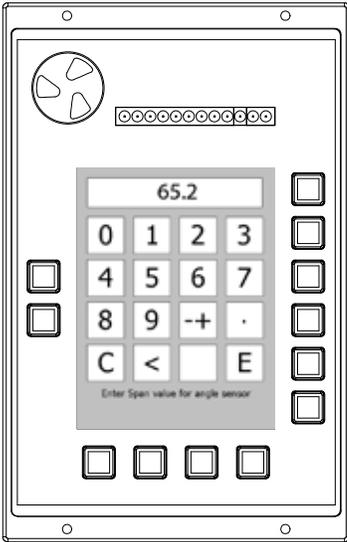


Span Angle Sensor

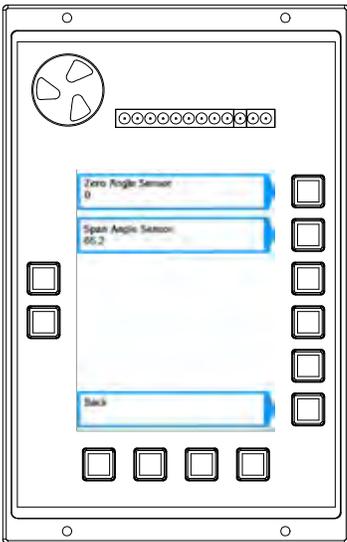
Place an inclinometer or a digital level (accurate to 0.1°) on the boom and raise the boom to about 65° .

Press the key adjacent to “Span Angle Sensor”.





Use the number entry procedure on page 3 to enter the angle.



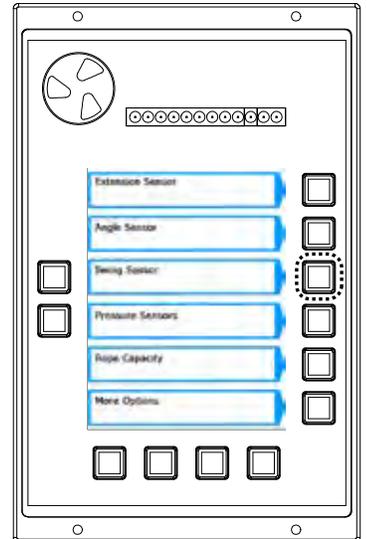
The angle sensor now reflects the proper span.

Press the key adjacent to "Back" to return to the main calibration menu.

Swing Sensor

Press the key adjacent to “Swing Sensor”.

The swing sensor menu enables you to zero the swing to reflect the boom in a zero degree (stowed position), and to mirror the displayed direction of the swing.

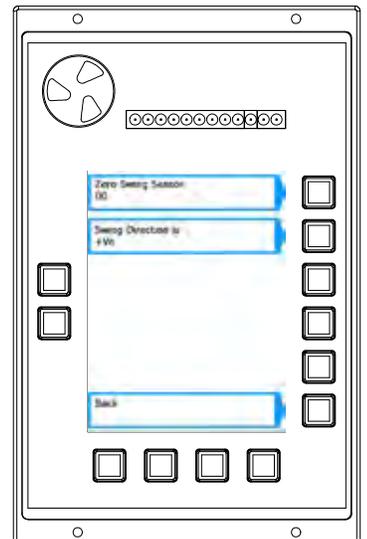


Zero Swing Sensor

Swing the upper to the front of the machine and set the house lock, this is the zero point for the swing of the machine.

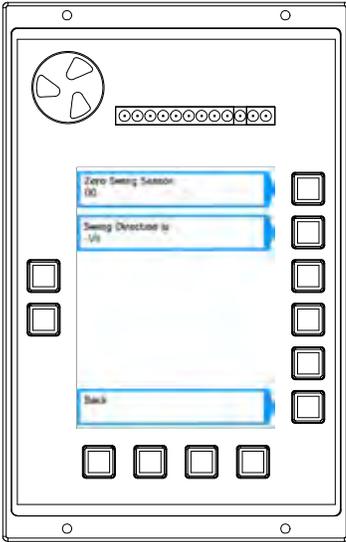
Press the key adjacent to “Zero Swing Sensor”.

The swing is now zeroed.



Swing Direction

Rotate the boom to the right (clockwise). The swing readout should progress from zero (0) and increase in one degree increments (through 359 if rotated full circle). If it counts down (359, 358, etc.) then change the swing direction to count up.



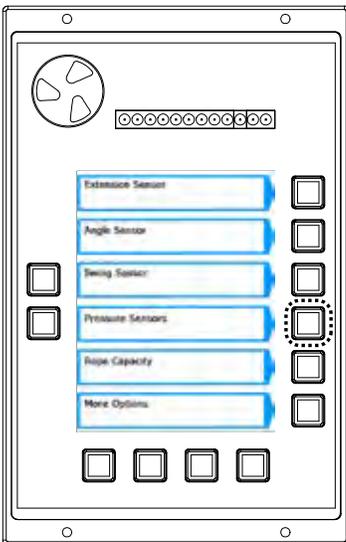
Press the key adjacent to "Swing Direction is +/-Ve" (where +/- = current swing direction).

The readout should now reflect the correct swing direction.

Press the key adjacent to "Back" to return to the main calibration menu.

Pressure Sensors

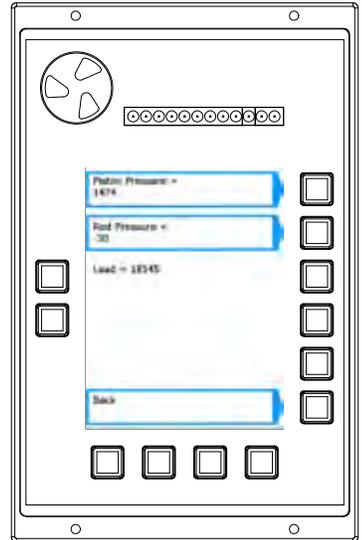
The pressure sensors menu is a monitoring screen. No manual entry of information is available.



Press the key adjacent to "Pressure Sensors".

The display will show the current psi values of the piston pressure and the rod pressure.

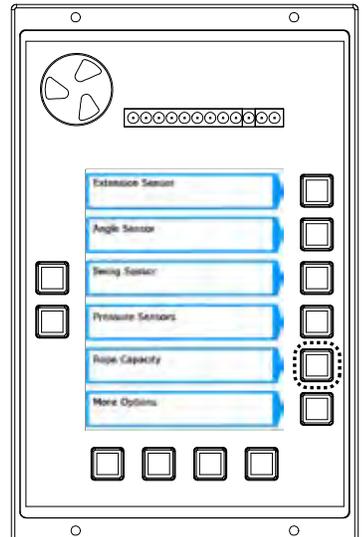
Press the key adjacent to “Back” to return to the main calibration menu.



Rope Capacity

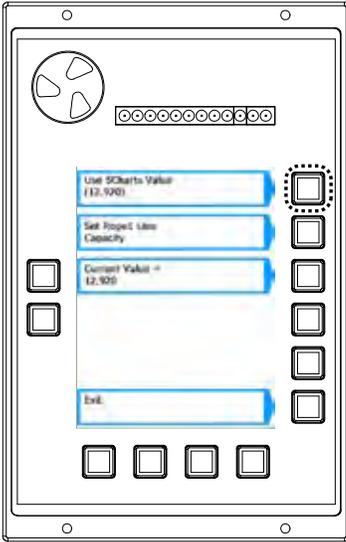
Press the key adjacent to “Rope Capacity”.

The rope capacity menu enables to set the capacity of the rope or cable currently in use. You can do this by setting the value to the data stored in the crane chart, or the value can be entered manually. This calibration reflects the rope capacity of the winch currently in use.



Resetting the Rope Capacity (Use 5Charts Value)

At any point if the rope capacity has been entered manually and is incorrect, the value can be reset to match the value from the crane chart.

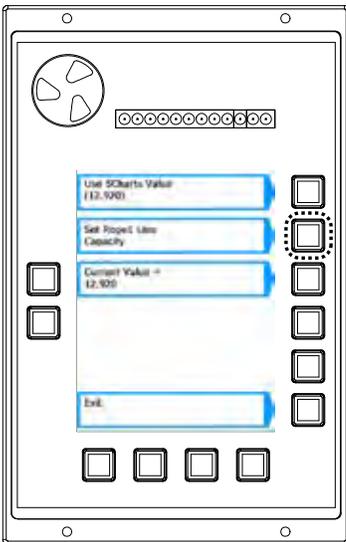


Press the key adjacent to “Use 5Charts Value”.

The value shown will change to match the chart value.

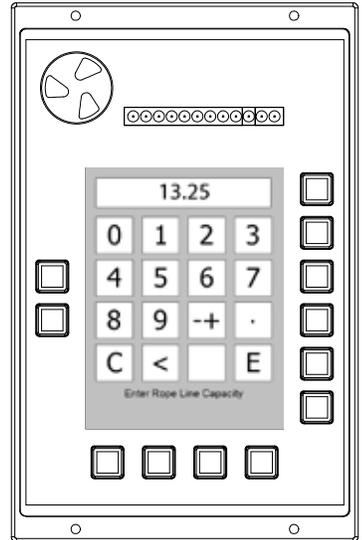
Manually Setting the Rope Capacity

If the cable is changed and is of a higher or lower capacity than what is reflected in the crane chart, the capacity value must be entered manually.

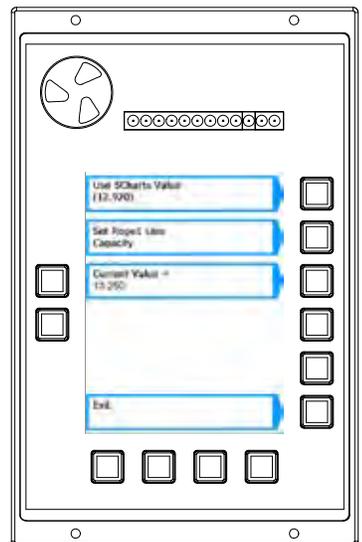


Press the key adjacent to “Set RopeX Line Capacity” (where X = the selected winch).

Use the number entry procedure on page 3 to enter the rope limit value. Numbers must be entered in hundredths of a pound. For example, for a value of 1,200 pounds you would enter 1.2, for a value of 12,900 you would enter 12.9, and so on.



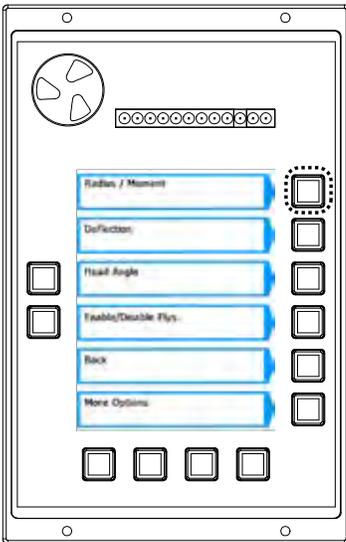
The “Current Value” displayed will change to reflect the proper rope limit. Press the key adjacent to “Back” to return to the main calibration menu.



⚠WARNING

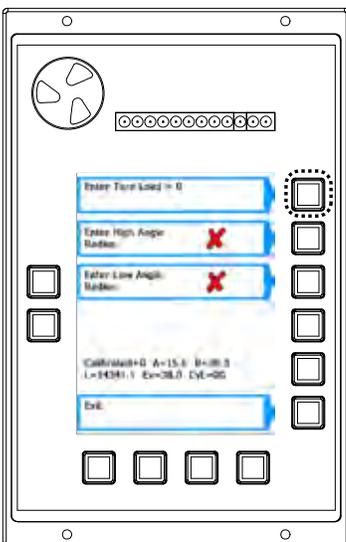
MAKE SURE THE CRANE IS SET UP IN ACCORDANCE WITH THE MANUFACTURER'S OPERATION MANUAL FOR MAXIMUM STABILITY. ENSURE THAT ALL BOOM EXTENSIONS AND LOADS LIFTED ARE WITHIN THE APPROPRIATE LOAD CHARTS AND LIMITS. FAILURE TO COMPLY WITH MANUFACTURER'S LIMITS MAY RESULT IN SERIOUS INJURY OR DEATH. CONSULT THE FACTORY BEFORE PROCEEDING WITH ANY CALIBRATION TO THE MAIN BOOM.

NOTE: The main boom can be calibrated with stowed attachments if the crane setup reflects what is stowed. The main boom cannot be calibrated from erected attachments, pick point must be from the main boom.



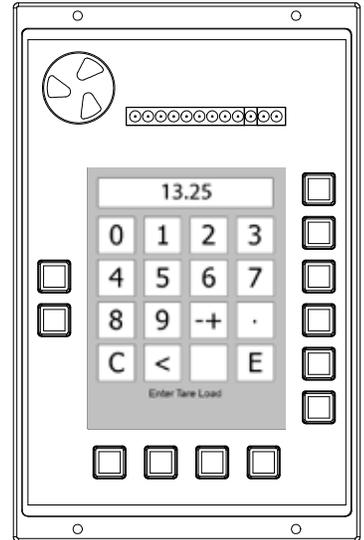
Press the key adjacent to "Radius/Moment".

The radius/moment menu enables to calibrate the natural moment and radius of the boom, taking into account its deflection under its own weight at a high and low angle.



Press the key adjacent to "Enter Tare Load = 0".

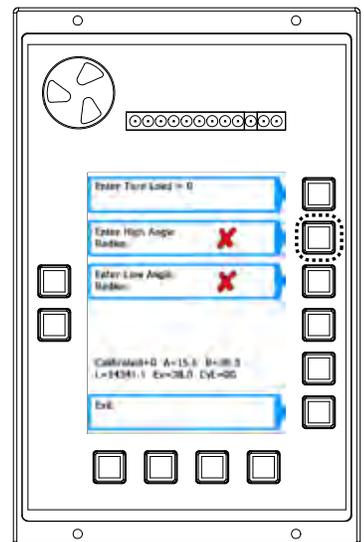
Use the number entry procedure on page 3 to enter the tare load. The only weight should be that of the hook block or ball. Also, the unit must be configured with a single part line. However, multiple parts-of-line can be used as long as it is reflected in the crane setup and preferably using an even number parts-of-line. When entering the tare load in the calibration routine, adding 100 pounds (0.1) to the actual weight will help guarantee a slightly positive load reading in all operating configurations.



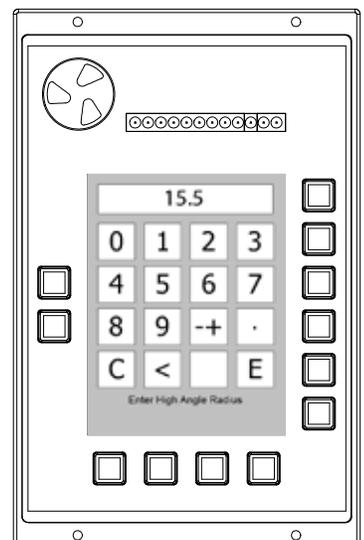
Raise the boom to between 60° and 70°.

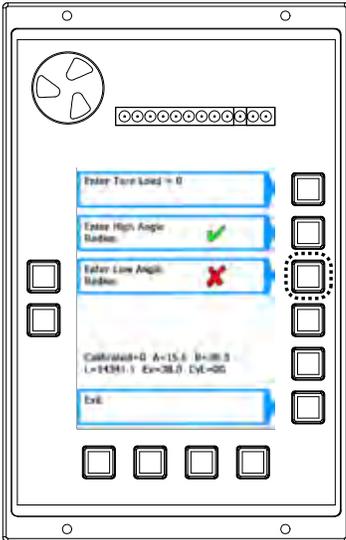
Measure the distance from the center point of the hook block or ball to the center of rotation of the crane. Once the measurement has been taken, raise the hook block or ball to relieve the weight of the rope.

Press the key adjacent to “Enter High Angle Radius”.



Use the number entry procedure on page 3 to enter the measurement in tenths of a foot.

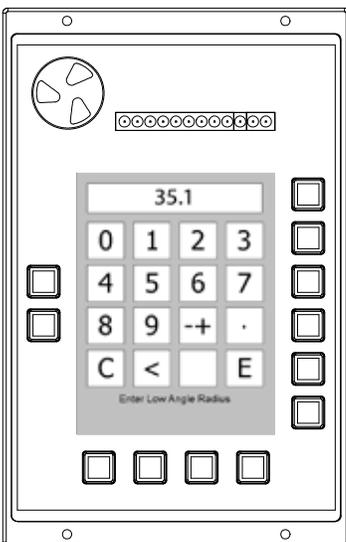




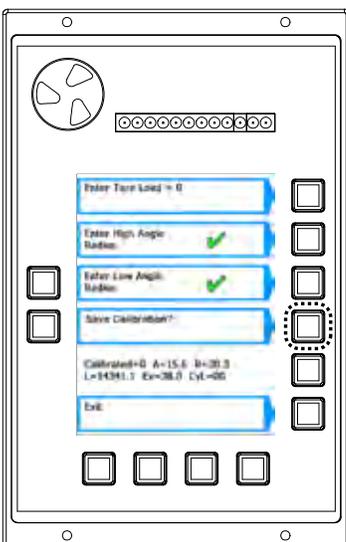
Lower the boom to as close to zero degrees as possible.

Measure the distance from the center point of the hook block or ball to the center of rotation of the crane.

Press the key adjacent to “Enter Low Angle Radius”.



Use the number entry procedure on page 3 to enter the measurement in tenths of a foot.

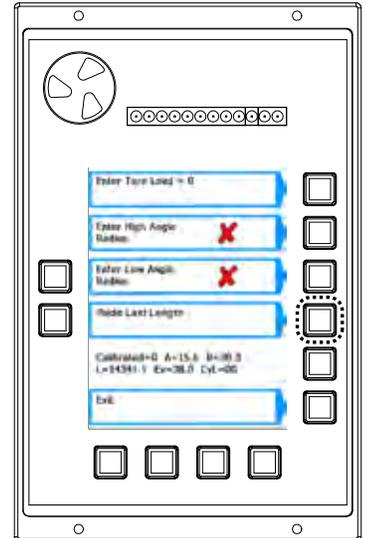


Press the key adjacent to “Save Calibration?” to store the data.

After the save has been completed and accepted, extend one section of the boom and let the telescoping cylinder retract. Repeat the process for high and low angle radius input. This process should be repeated until the boom is full extended. As well, this process should be repeated for each boom mode.

If the numbers were entered incorrectly, the message “Redo Last Length” will appear and you will need to either re-enter the measurements or redo the calibration.

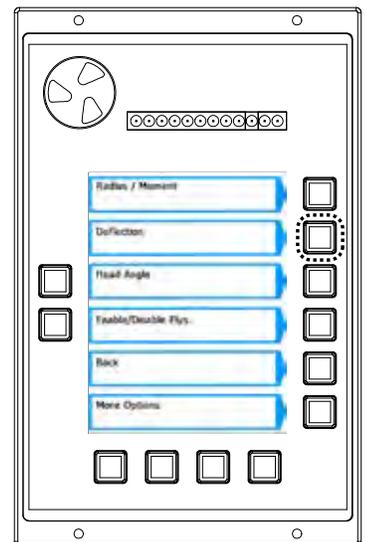
Press the key adjacent to “Exit” to return to the main calibration menu.



Deflection

Press the key adjacent to “Deflection”.

This deflection menu enables you to quantify the amount that a boom or attachment bends, or deflects under load. The boom has its own bending factor called “F.” Each jib combination can have its own independent “F” value. Before entering the routine, the display will show the angle of the boom head under no load and under the current load.



⚠️WARNING

MAKE SURE THE CRANE IS SET UP IN ACCORDANCE WITH THE MANUFACTURER’S OPERATION MANUAL FOR MAXIMUM STABILITY. ENSURE THAT ALL BOOM EXTENSIONS AND LOADS LIFTED ARE WITHIN THE APPROPRIATE LOAD CHARTS AND LIMITS. FAILURE TO COMPLY WITH MANUFACTURER’S LIMITS MAY RESULT IN SERIOUS INJURY OR DEATH.

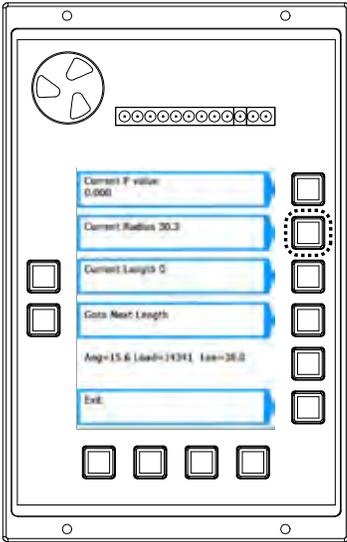
IMPORTANT!

MAKE SURE THAT THE CRANE IS CONFIGURED TO PICK OFF THE MAIN BOOM AND THAT THERE ARE NO ERECTED AND UNUSED ATTACHMENTS.

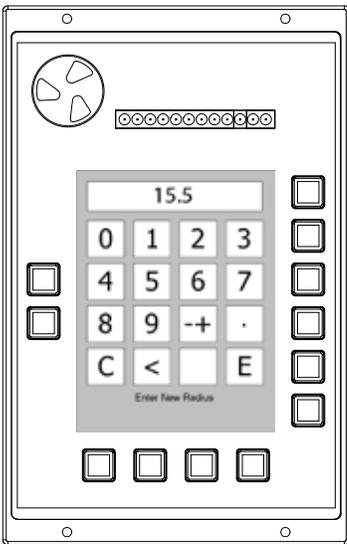
Use a suitable calibration load. The load should induce significant deflection in the boom.

With the boom fully retracted, lift the calibration load.

Measure the loaded main boom radius.

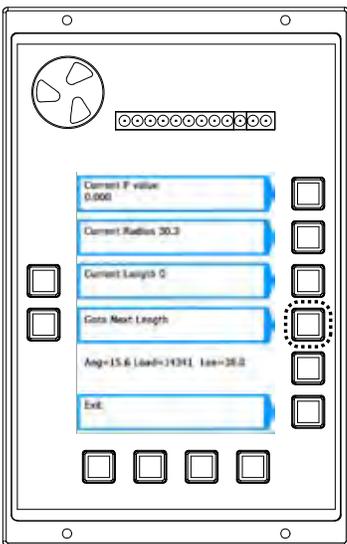


Press the key adjacent to “Current Radius NaN”.



Use the number entry procedure on page 3 to enter the measurement. It is a good idea to add 0.1 ft to the radius when entering the radius in the calibration for boom deflection. This will help ensure a slightly positive radius in most operating conditions.

Check that the new displayed radius matches (or slightly exceeds) the actual measured radius.

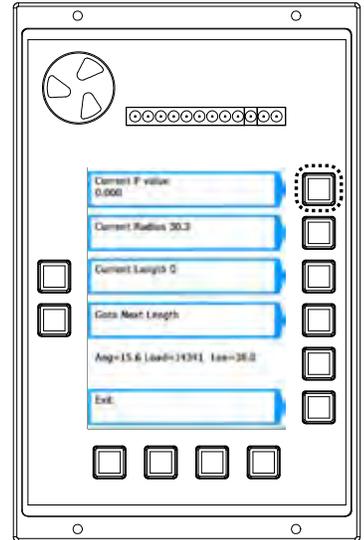


Press the key adjacent to “Goto Next Length”.

Extend one section of the boom and repeat the measurement process until all sections have been extended.

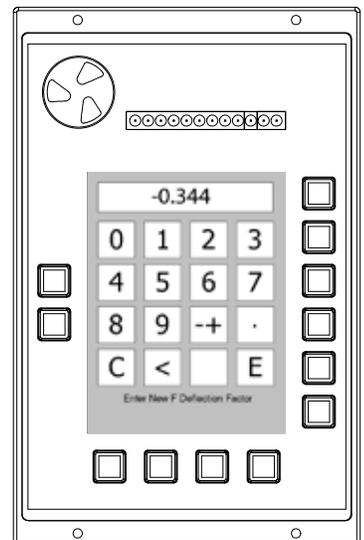
You can also edit the “F” number manually without entering a radius; this is useful to trim the BDC up or down a bit.

Press the key adjacent to “Current F value X.XXX” (where X.XXX is the current value).



Use the number entry procedure on page 3 to enter the value.

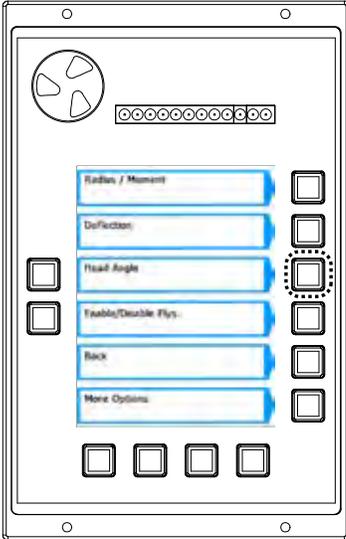
Press the key adjacent to “Exit” to return to the main calibration menu.



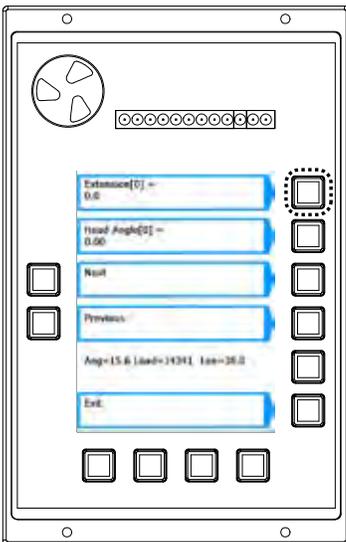
Head Angle

The head angle menu enables you to enter the boom head angles against extension. These angles are used to correct the computed radius for flies and jibs.

If this system is not a prototype, this information has been precalibrated and this menu can be skipped.

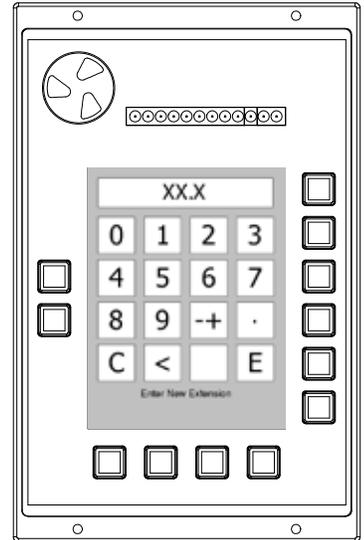


Press the key adjacent to “Head Angle”.

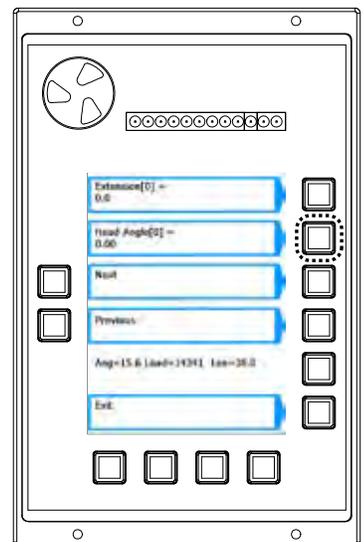


Press the key adjacent to “Extension[0] = X.X” (where [0] = the current extension and X.X = the current value).

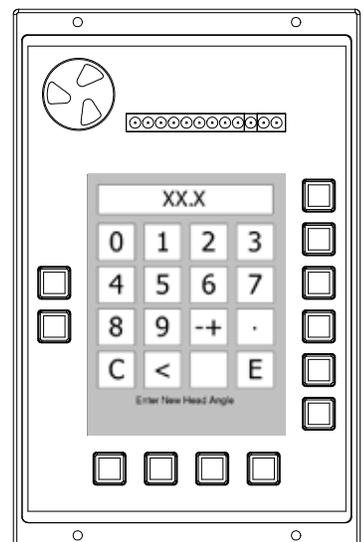
Use the number entry procedure on page 3 to enter the length of the current extension in tenths of a foot.

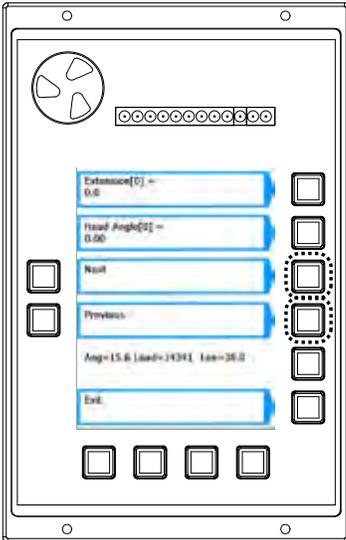


Press the key adjacent to “Head Angle[0] = X.XX” (where [0] = the current extension and X.XX equals the current value).



Use the number entry procedure on page 3 to enter the angle of the current extension.

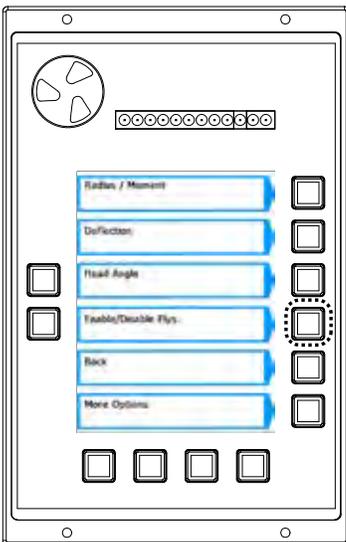




Press the key adjacent to “Next” or “Previous” to enter values for different extensions.

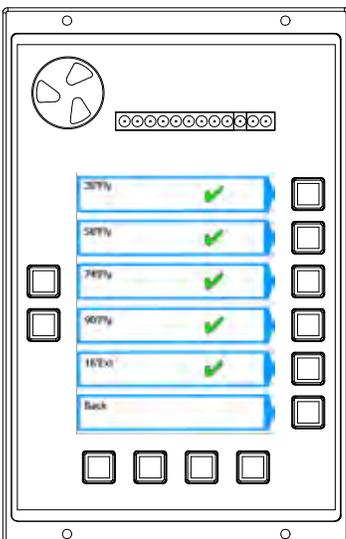
Press the key adjacent to “Exit” to return to the main calibration menu.

Enable/Disable Flies



Press the key adjacent to “Enable/Disable Flies”.

This menu shows the available flies for the crane in use (according to the chart data loaded). You can tell the system which flies are on the crane either to be stowed or erected.



Press the key adjacent to the desired fly to toggle it either enabled (green check mark) or disabled (red cross).

Press the key adjacent to “Back” to return to the main calibration menu.

Press the key adjacent to “More Options” to go to the next page of the main calibration menu.

Reset Calibration

This function enables you to reset all the calibration values to a default value.

Press the key adjacent to “Reset Calibration”.

The computer will load the contents of the compact flash card to the display RAM. This does not effect length, angle, and swing sensor calibration data as this process reloads the factory calibration data.

Delete Personality

Each time a “Reset Calibration” is performed, the computer creates a new personality file and stores it on the compact flash card. Using this function will delete the current personality file.

Read Personality

This feature enables you to reload the current personality file. If custom calibration entries have been made and the system is not functioning properly, you can use this function to reload the personality file. Otherwise, use the “Reset Calibration” feature to reload the factory calibration.

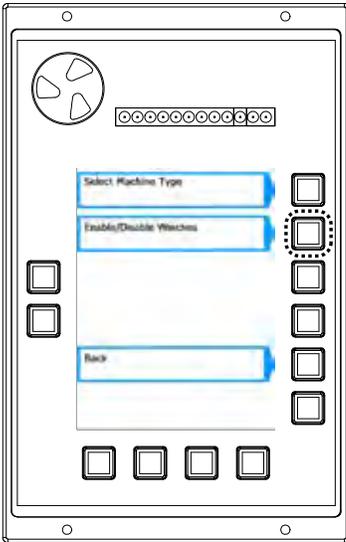
Read Misc File

This number represents the zero point for the telescoping cylinder.

Select Machine Type

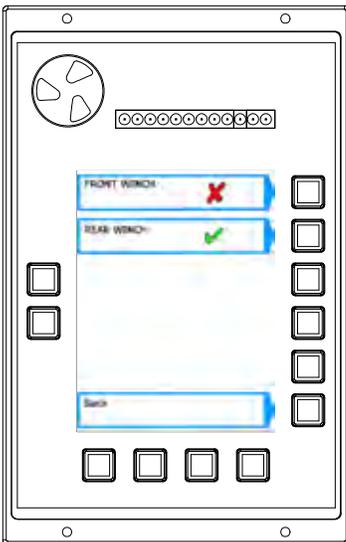
The system is programmed for three different machines and can be programmed for up to six. This function loads the correct pin and latch points into the boom mode controller for the different machines.

Enable/Disable Winches



Press the key adjacent to "Enable/Disable Winches".

This menu shows the available winches for the crane in use (according to the chart data loaded). You can tell the system which winch to make available or unavailable.



Press the key adjacent to the desired winch to toggle it either enabled (green check mark) or disabled (red cross). You cannot disable both winches at the same time.

Appendix A

Glossary of terms

Term	Definition
Abort	Stops data entry into the system before the entry process is finalized.
Alarm	A visual or audible warning signal.
Amplifier	Increases - example: a pressure transducer in the millivolt range is amplified up to ten volts).
Amplifier gain	The factor used to express the level of amplification.
Analog	A mechanism in which data is represented by continuously variable physical quantities.
Angle sensor	A device that measures the angle of the boom relative to the horizon.
Annular	Relating to, or forming a ring (e.g. the pressure around the rod of a boom hoist cylinder).
Annular gain	The factor used to modify the pressure signal from the rod side of the boom hoist cylinder based on the difference in areas of the rod and the bore.
Back-up	A copy of data saved in a separate computer chip.
Boom deflection	The change of radius due to the bending of a boom under load.
Boom moment	The turning moment around the boom pivot caused by the moment of the unladen boom.
Bore	The piston side of a boom hoist cylinder.
Calibration	The adjustment of the graduation of sensors.
Capacity chart	A table, supplied by the crane manufacturer, showing the specifications and ratings for each individual crane.
Center of gravity	The point at which the entire weight of a body may be considered as concentrated, so that if supported at this point, the body would remain in equilibrium in any position.
Commissioning	Preparing to be put into service.
Configuration	The position of the crane supporting appendages and all lifting elements of a crane.
Cursor	A pointer on a display that indicates where data is to be entered.
Data	Factual information used as a basis for calculation.
Deduct	A reduction in rated capacity for an unused, stowed, or erected attachment.
Deflection	The bending of a boom or the stretching of pendant lines within the elastic limits of the boom or pendants.
Digital	Operating with numbers shown as digits.
Digital inputs	Computer - usually controlled by external on/off switches.
Direction	The course on which the upper section (superstructure) of a crane rotates.
Duty	A working configuration of a crane usually found in a single column of a capacity chart.
Eeprom	Electrically erasable and programmable "read only" memory (rom).
Elastic	Capable of recovering size or shape after expansion.
Erected attachment	An attachment on the main boom in working (not stowed) position.
Extension sensor	A device that measures the extension of the telescoping sections of a boom.
Fly/jib	An attachment connected by one edge to a crane boom (e.g. A lattice fly, or jib).
Force	Energy exerted, in this case to support the weight of an object.
Geometry	A branch of mathematics addressed to the measurement and relationships of points, lines, angles, surfaces, and solids.
Graduated	Marked with degrees of measurement.

Term	Definition
Height	The vertical distance from the ground to the tip of the boom or attachment.
Hite	An abbreviation of the word height. The height of the boom pivot above ground level.
Horizontal	Parallel to the horizon.
Hydraulic cranes	Using the pressure of oil for operation.
Increment	The action of increasing a number or value.
Initializes	Erases all data from memory prior to a new calibration.
Integrated circuits	A tiny complex of electronic components and connections on a small slice of material (such as silicon).
Measure height	To determine the vertical distance from below the boom pivot to the ground. Radius measurements are made from these points when calibrating.
Microprocessor	A computer processor contained on an integrated chip.
Millivolt	One thousandth of a volt.
Moment	The product of force and distance in relation to a particular axis or point.
Out of duty	A point that is either longer than the longest permitted radius or lower than the lowest permitted angle on a capacity chart.
Outrigger	A mechanical device that projects from the main structure of the crane to provide additional stability or support.
Personality	A computer chip storing active calibration data.
Pressure	Hydraulic pressure in the boom hoist cylinder.
Radius	The horizontal distance from the centerline of rotation to the center of the hook.
Rated capacity	The lifting capacity of a crane, as determined by the manufacturer's published capacity chart.
Rated capacity	The load that a crane can safely support, based on factors such as strength, stability, and rating.
Rating	A factor determined by legislation that limits the action of a crane in a lifting operation. Usually expressed as a percentage of strength or stability.
Restore	Move data from a back-up chip to the personality "a" active chip.
Rom	"Read only" memory. Data can be read but not changed after programming.
Rope limit	The maximum permitted single line pull determined by the construction and diameter of a wire rope.
Save	Move data from the working personality to a 'write protected' area of memory.
Scale	The use of a factor to set the scaling of analog sensors.
Scale	Something graduated when used in measurement.
Sensitivity	The capacity of a sensor to respond to physical stimulus.
Sensor	A device that responds to a physical stimulus and transmits a resulting impulse.
Sheave	A grooved wheel or pulley.
Slew offset	The horizontal distance from the boom pivot to the center of rotation.
Span	An extent or spread between two limits.
Span	The calibration of an analog sensor between zero and maximum span.
Stowed attachment	An attachment usually stored in an inactive position on the main boom.
Superstructure	The structural part of a crane above the carrier, usually rotating.
Swing	The rotation of a crane upper around its centerline.

Term	Definition
Swl (%swl)	Percentage of 'safe working load.' The proportion of the crane capacity that is being utilized at any one time and expressed as a percentage of rated capacity.
Transducer	A device that is actuated by energy from one system and converts this energy to another form for use by a different system (as a loudspeaker that is actuated by electrical signals and supplies acoustic power).
Tx.0	The piston side pressure transducer.
Tx.1	The rod side pressure transducer.
Unladen	A boom that has no additional stowed or erected attachments and is not supporting a load.
Volt	Unit of electrical potential difference and electromotive force.
Weight	The amount that a body weighs.
Write protected	An area of memory in a computer that cannot be accessed by a microprocessor for data entry or change.
Zero	The zero point on a graduated scale.



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