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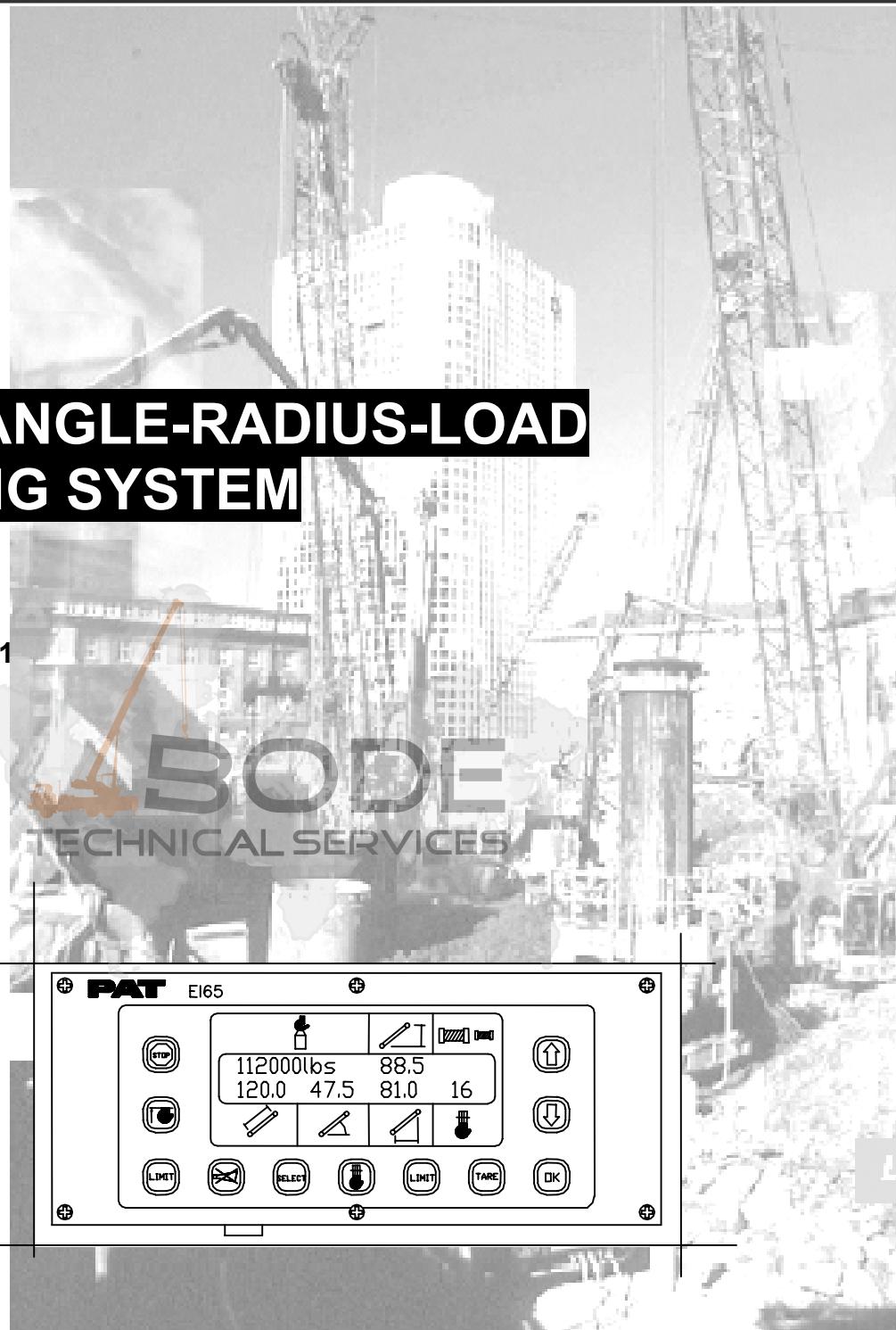
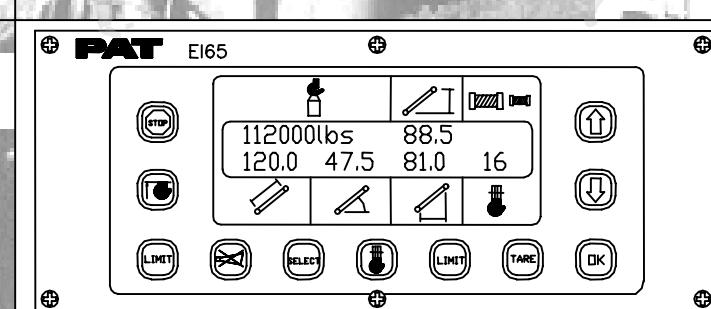
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PAT **LENGTH-ANGLE-RADIUS-LOAD INDICATING SYSTEM**

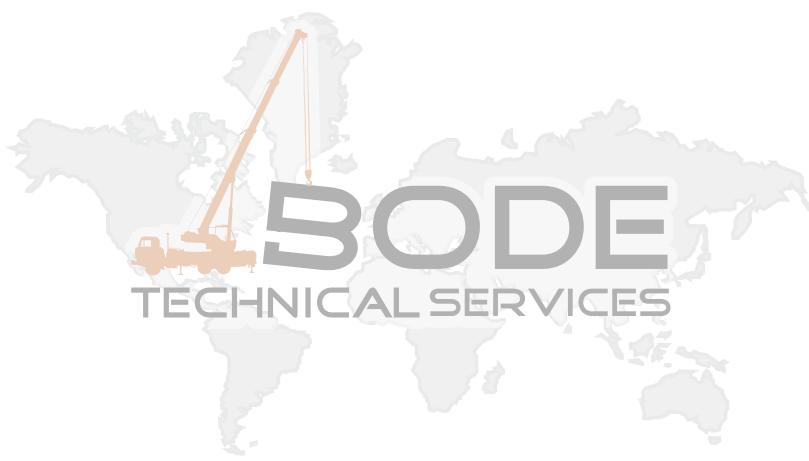
EI65/0005

Software Version 1.61



CALIBRATION MANUAL

P/N 031-300-190-009 REVISION C 11/26/00



NOTICE

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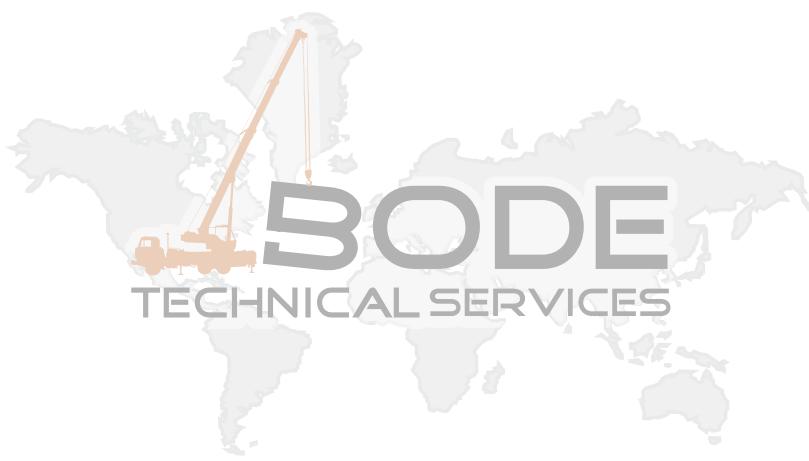
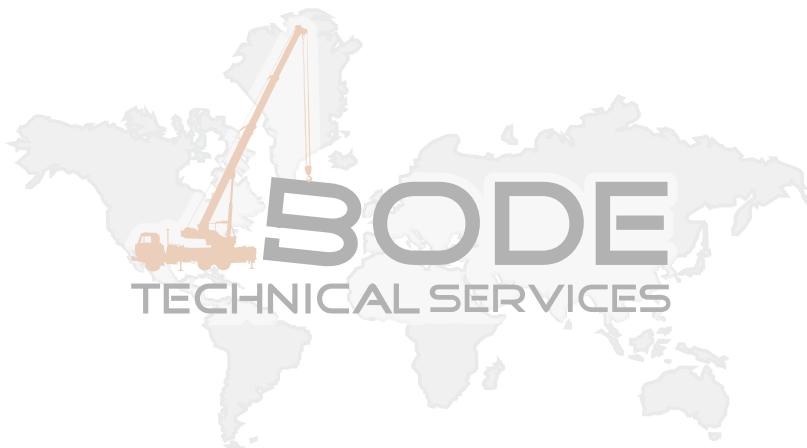
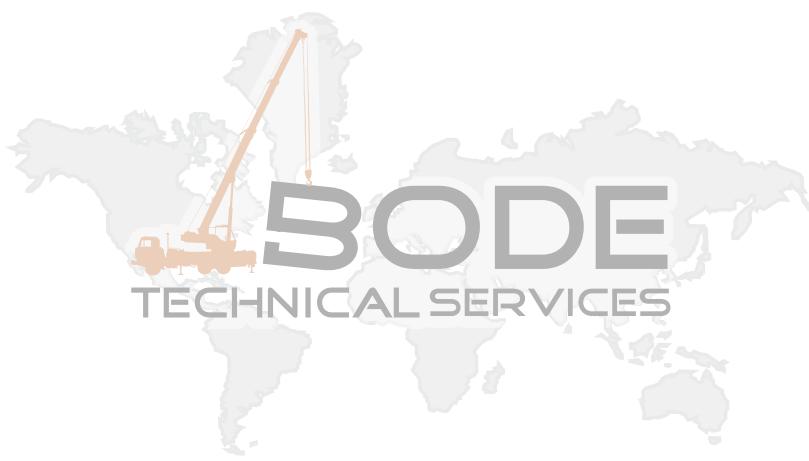


Table of Contents

1	GENERAL INFORMATION.....	1
2	WARNINGS.....	1
3	ESSENTIAL INFORMATION FOR CALIBRATION:.....	2
4	CALIBRATION	5
5	OPERATIONAL CHECKS.....	12
	APPENDIX A - MECHANICAL ADJUSTMENT OF SENSORS	13





1 GENERAL INFORMATION

The Length-Angle-Radius-Load Indicating System EI 65 must be calibrated after completing installation, crane modification, or anytime there is an indication of inaccuracy. The calibration will match the sensor installed on the industrial crane. Refer to the Installation Manual for the system and sensor installation.

Prior to starting the calibration, it is advised to first read over this procedure in its entirety. This will also allow you a chance to obtain any necessary information. The purpose of this manual is to provide calibration information required before operating the system. Refer to the Operator Manual for system description and console controls.

REFERENCE INFORMATION:

PAT Angle-Length-Radius-Load Indicator System EI 65 Operator's Manual. 56 065 08 0005.

PAT Angle-Length-Radius-Load Indicator System EI 65 Installation Manual. 031-300-190-008.

2 WARNINGS

Always refer to operational instructions and load charts provided by the crane manufacturer for specific crane operation and load limits.

The Length-Angle-Radius-Load Indicating System EI 65 is not and shall not be, a substitute for good operator judgment, experience, or use of acceptable safe operating procedures.

The operator is responsible for operating the crane within the manufacturer's specified parameters.

The crane operator shall ensure that all warnings and instructions provided by the manufacturer are fully understood, observed, and remain with the crane.

Prior to operating the crane, the operator must carefully read and understand the information in the Operator's Manual so that he knows the operation and limitations of the Length-Angle-Radius-Load Indicating System EI 65.

3 ESSENTIAL INFORMATION FOR CALIBRATION:

- 3.1 Prior to powering up the system, verify all wiring. All unused channels must be occupied with dummy signals meeting the following requirements:

The second angle channel must have a voltage divider installed. Install two 4.7k resistors, one between X1 #21-22 and the other between X1 #22-23.

The second and third A2B channels must have a 4.7k resistor. Install a 4.7k resistor between X1 #11-12 and X1 #13-14.

The second force channel must have a jumper installed between X1 #30-31.

A no load system must have a jumper installed between X1- #26-27, for the first force channel.

- 3.2 Mechanically set the length and angle sensors as follows: (See Appendix A. Mechanical Adjustment for Sensors).

Length Sensor - With the boom sections fully retracted set the length potentiometer by turning the center screw counter clockwise slowly to a soft stop.

Angle Sensors: Align the angle sensors with the boom at zero degrees.

- 3.3 Write down the following geometric measurements, which will be used during calibration. (See Figure 1. Crane Measurements). The measurements taken should be in units that correspond to the load chart. (i.e. lbs/feet, Kg/meters, US-Tons/feet, Metric-ton/meters).

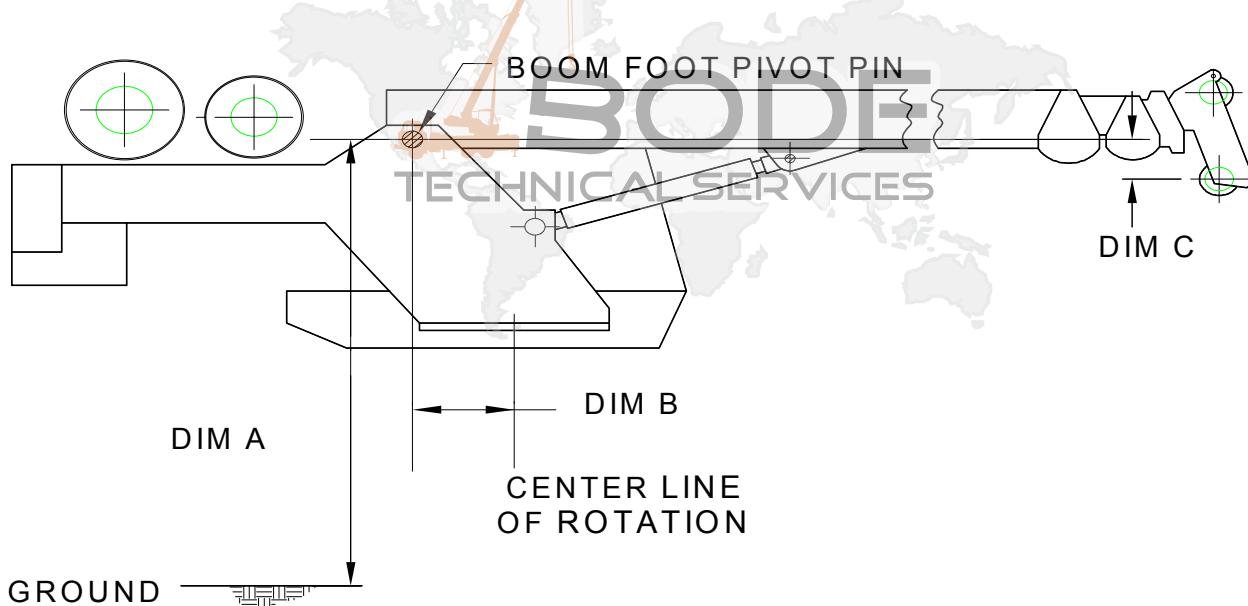


FIGURE 1. CRANE MEASUREMENTS

Dimension A: The vertical distance from the boom foot pivot pin to the ground. (Elevation Offset)

- Dimension B: The horizontal distance from the boom foot pivot pin to the centerline of rotation. (Radius Offset)
- Dimension C: The head offset, which is the vertical measurement between the boom foot pivot pin to the lower head sheave center pin. (Head Offset)
- Jib extension lengths minimum and maximum

Write the dimensions in the Table provided.

Table 1. Measurements

Dimension A (Elevation Offset)	
Dimension B (Radius Offset)	
Dimension C (Head Offset)	
Jib 1 min/max	
Jib 2 min/max	
Jib 2 angle min/max	

- 3.4 Calibration of a linerider will require the hoist rope line pull information, which should be provided by the manufacturer. Use single part line when calibrating the linerider. Lineriders require specific wire rope size. See Table 2 to ensure your rope size matches your linerider that is provided.

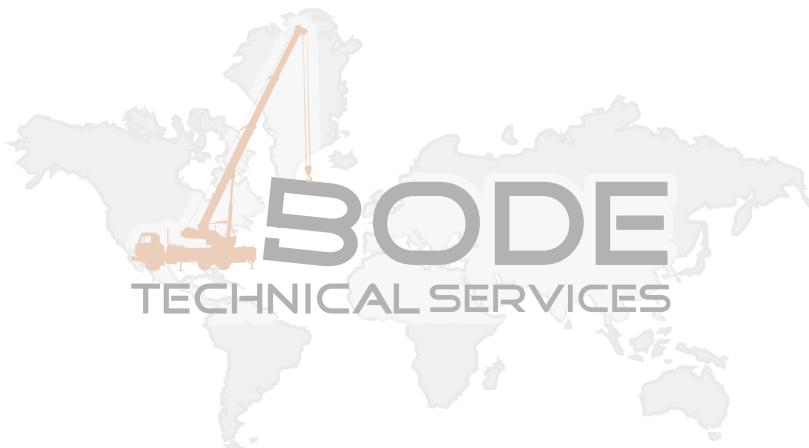
NOTE: A new wire rope is normally oversized, and the oversized amount will depend on the diameter of the rope. With normal wear, the inner core breaks down and the diameter decreases. See manufacturer's guidelines for wire rope replacement conditions.

Table 2. Lineriders should match the wire diameter of your hoist rope.

ITEM NUMBER	DESCRIPTION with WIRE ROPE SIZE	WIRE ROPE DIAMETER ADVISED RANGE
048-311-060-001	SENSOR, LINERIDER SKM311 1/4"	±1/32
048-311-060-002	SENSOR, LINERIDER SKM311 1/2"	±1/32
048-311-060-003	SENSOR, LINERIDER SKM311 9/16"	±1/32
048-312-060-002	SENSOR, LINERIDER SKM312 3/4"	±1/32
048-312-060-001	SENSOR, LINERIDER SKM312 5/8"	±1/32
048-312-060-003	SENSOR, LINERIDER SKM312 7/8"	±3/64
048-312-060-004	SENSOR, LINERIDER SKM312 1"	±3/64
048-312-060-005	SENSOR, LINERIDER SKM312 1 1/8"	±3/64
031-300-060-009	SENSOR, LINERIDER SKM312 1-1/4"	±1/16

- 3.5 Calibration of dead end force transducers requires two parts of line.
- 3.6 Always follow the manufacturer's guidelines when operating the crane.
- 3.7 Always work within the capacity of the rated load charts provided by the manufacturer.
- 3.8 The total load includes the load, rigging, cables, and hook block.
- 3.9 Test load should be 75% of maximum rated load for the crane's configuration or condition.

NOTE: To comply with SAE J376 standards, the test load must be to a known accuracy of $\pm 1\%$.



4 CALIBRATION

- 4.1. Power up the system, the screen will display EI 65/10 software version 1.61 and date 30.10.00.
- 4.2. Within 5 seconds, simultaneously press the "OK" and "SELECT" buttons in order to start calibration. Hold these buttons (approximately 15 seconds) until the screen changes to "CALIB. PASSWORD". If these buttons are not pressed and held the screen then changes to the existing operating configuration. See [Operators Manual 56 065 08 0005](#) for operating instructions.
- 4.3. Enter the calibration password "0815". Use the "UP" and "DOWN" buttons to select the number and the "OK" button to confirm each entry.

Enter 0 - OK

8 - OK

1 - OK

5 - OK

NOTE: From this point forward, the sections can be made by pressing "OK" or skipped by pressing arrow "DOWN".

- 4.4. Select CONFIG DEFAULT by pressing the "OK" button.
- 4.5. CONFIG LANGUAGE - Press "OK" to select and use the arrow "UP and DOWN" buttons to select a language; English, Spanish, or French. When complete press the "OK" button.
- 4.6. CONFIG UNITS - Press "OK" to select and use the arrow "UP and DOWN" buttons to select the load units; LBS (lbs), TONS (t), KILOGRAMS (kg), US-TONS (tons). When complete, press the "OK" button.

NOTE: Select the units used in the load charts provided by the manufacturer.

- 4.7. SET CRANE DIMENSIONS - Calibrates the angle sensor and defines the required geometric measurement of the crane. Press "OK" to select.
 - 4.7.1. SET BOOM ANGLE - Measure the boom angle, using an inclinometer or similar device. Press the arrows "UP or "DOWN" to adjust the displayed angle to match the measured angle. Press "OK" to enter angle.

NOTE: Measurements should be in units that correspond to the load chart. (i.e. lbs/feet, Kg/meters, US-Tons/feet, Metric-ton/meters).

- 4.7.2. ELEV. OFFSET – Elevation Offset is the vertical measurement from the boom foot pivot pin to the ground, as taken in step 3.3.A. Press the arrows "UP and DOWN" to adjust the display. Press "OK" to enter measurement.

4.7.3. RADIUS OFFSET - This is the horizontal measurement between the boom foot pivot pin and the centerline of rotation, as taken in Step 3.3.B. If the boom foot pivot pin is located behind the centerline of rotation, the value needs to be entered as a positive. If the Pivot pin is forward of the centerline of Rotation the value needs to be entered as a negative. Press the arrows "UP or "DOWN" to adjust the display. Press "OK" to enter measurement.

4.7.4. HEAD OFFSET - The vertical measurement between the boom foot pivot pin and the lower head sheave center pin, as taken in Step 3.3.C. If the center pin is below the boom foot pivot pin, enter the value as a negative by using the arrows "UP or DOWN" to adjust the display. Press "OK" to enter measurement.

4.8. SET BOOM TYPE - This section configures the type of main boom, FIXED or TELE. Press the "OK" button and proceed by answering the questions on the screen.

4.8.1. MAIN BOOM FIXED? - Press "OK" to accept or the arrow "DOWN" for next selection.

4.8.1.1. Enter the minimum length using the arrows "UP or DOWN" to adjust the display. Press "OK" to enter length.

4.8.1.2. Enter the maximum length using the arrows "UP or DOWN" to adjust the display. Press "OK" to enter length.

4.8.2. MAIN BOOM TELE? - Press "OK" to accept or the arrow "DOWN" for next selection.

WARNING: The operator is responsible for operating the crane within the manufacturer's specified parameters.

4.8.2.1. MAIN BOOM MIN? - DRIVE MAIN BOOM ON MIN POSITION! - Fully retract the main boom. Ensure that the length potentiometer has been reset by turning the center screw counter clockwise until you have reached a soft stop. Refer to Section 3.2.

4.8.2.2. Press "OK" to display minimum length preset value.

4.8.2.3. Press the arrows "UP or "DOWN" to adjust the displayed length to minimum or fully retracted length.

4.8.2.4. Press "OK" to enter length minimum preset value.

4.8.2.5. MAIN BOOM MAX? - DRIVE MAIN BOOM ON MAX POSITION! Fully extend the main boom; include the power pin fly extension when applicable.

4.8.2.6. Press "OK" to display maximum preset value.

4.8.2.7. Press the arrows "UP or "DOWN" to adjust the displayed length to maximum or fully extended length.

4.8.2.8. Press "OK" to enter length.

4.9. CONFIG EXTENSION - This section configures two extensions with minimum and maximum length, a minimum and maximum angle (OFFSET MIN/MAX) for the second extension (LENGTH 2), and whip extension or variable angled extension with angle sensor. Use Figures 2 through 5 to help identify your configuration. Press "OK" and proceed by entering extension lengths, angle, and calibrating whip extension angle. Configure the extensions that your crane will use and enter zero for unused portions of CONFIG EXTENSION. Recommendation: Set up the extension's minimum length as zero, so if this extension is removed you can change the length in the SELECT section of operation instead of entering calibration mode to remove extension.



Figure 2. Fixed Extension
(Enter extension as Length 1 minimum and maximum)

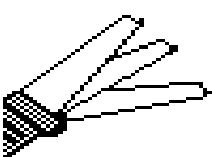


Figure 3. Fixed, Offsettable Extension
(Enter extension as Length 2 minimum and maximum and angle offset minimum and maximum)

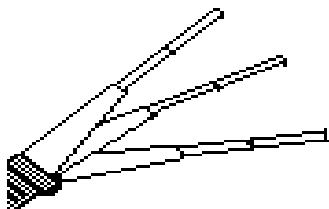


Figure 4. Tele-Offsettable Extension
(Enter extension as Length 2 minimum and maximum and angle offset minimum and maximum)

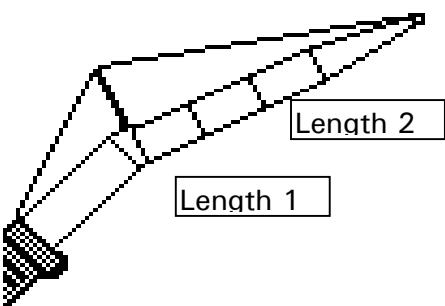


Figure 5. Fixed Extension with Offsettable Jib
(Enter base extension as Length 1 minimum and maximum. Enter luffing extension as Length 2 minimum and maximum and set whip extension angle sensor.)

- 4.9.1. LENGTH_1 MIN - Press the arrows "UP or "DOWN" to display minimum length.
Press "OK" to enter length.
- 4.9.2. LENGTH_1 MAX - Press the arrows "UP or "DOWN" to display maximum length.
Press "OK" to enter length.
- 4.9.3. LENGTH_2 MIN - Press the arrows "UP or "DOWN" to display minimum length.
Press "OK" to enter length.
- 4.9.4. LENGTH_2 MAX - Press the arrows "UP or "DOWN" to display maximum length.
Press "OK" to enter length.
- 4.9.5. OFFSET MIN - Press the arrows "UP or "DOWN" to display minimum offset angle.
Press "OK" to enter angle.
- 4.9.6. OFFSET MAX - Press the arrows "UP or "DOWN" to display maximum offset angle.
Press "OK" to enter length.
- 4.9.7. WHIP EXTENSION - This is a variable angled extension (luffing) with angle sensor.
Press the arrows "UP or "DOWN" to select yes or no and Press "OK" to confirm entry. If no go to Step 9.

- 4.9.7.1. WG_OFFSET EXT. - Align the offsettable jib with the extension and/or main boom so that the angles are equal. Measure the extension angle using an inclinometer or similar device. Press the arrows "UP or "DOWN" to adjust the displayed angle to match the measured angle. Press "OK" to enter angle.

NOTE WHEN SETTING THE FORCE – There are 2 possible sets of minimum and maximum load data when calibrating the force sensors.

The first set of load data is used to calibrate the force sensor at single or minimum parts of line and must be completed.

The second set of data is used to calibrate the force sensor with many or maximum parts of line. The second set of data is not required. If data is not entered, the system will use a friction factor that is defined in the software.

- 4.10. SET FORCE 1 FIRST SET - This is the first set of data for the main boom force sensor.

- 4.10.1. Press "OK" to calibrate the KMD1 - Main linerider/load cell or press the arrow "DOWN" to continue.

- 4.10.2. PARTS OF LINE - Use the arrows "UP or DOWN" to select parts of line.

NOTE: For the 1st set of data the parts of line should be a small figure.
Recommended is '1'. Two parts of line are needed for a load cell and one part of line for a Linerider.

- 4.10.3. FORCE 1 ZERO – With no load on the hook block, use the arrows “UP or DOWN” to enter the value for the minimum force on the main boom. NOTE: The total load includes the rigging, cables, and hook block.
- 4.10.4. Press “OK” to confirm Load.
- 4.10.5. FORCE 1 LOAD - Lift a test load of at least 75% of permissible line pull for the crane configuration. See crane manufacturer’s data for approximate load. NOTE: To comply with SAE J376 standards, the test load must be to a known accuracy of $\pm 1\%$.
- 4.10.6. Use the arrows “UP or DOWN” to adjust the display load to indicate your total test load. NOTE: The total load includes the load, rigging, cables, and hook block.
- 4.10.7. Press “OK” to confirm total load.
- 4.11. SET FORCE 1 2nd SET - This is the second set of data for the main boom force sensor. NOTE: The first set of data must be used before entering the second set of data. NOTE: For the second set of data, the parts of line should be increased. The maximum number of possible parts of line is recommended.
- 4.11.1. Press “OK” to calibrate the KMD1 - Main linerider/load cell or press the arrow “DOWN” button to continue.
- 4.12. PARTS OF LINE - Use the arrows “UP or DOWN” to select parts of line. NOTE: For the second set of data the parts of line should be a large figure. The maximum number of possible parts of line is recommended.
- 4.12.1. FORCE 1 ZERO – With no load on the hook block, use the arrows “UP or DOWN” to enter the value for the minimum force on the main boom. NOTE: The total load includes the rigging, cables, and hook block.
- 4.12.2. Press “OK” to confirm Load.
- 4.12.3. FORCE 1 LOAD - Lift a test load that is different than the first set of data. See crane manufactures data for approximate load. NOTE: To comply with SAE J376 standards, the test load must be to a known accuracy of $\pm 1\%$.
- 4.12.4. Use the arrows “UP or DOWN” to adjust the display load to indicate your total test load. NOTE: The total load includes the load, rigging, cables, and hook block.
- 4.12.5. Press “OK” to confirm total load.
- 4.13. SET FORCE 2 FIRST SET - This is the first set of data for the auxiliary force sensor KMD2.
- 4.13.1. Press “OK” to calibrate the KMD2 – auxiliary linerider/load cell or press the arrow “DOWN” button to continue.

4.13.2. PARTS OF LINE - Use the arrows "UP or DOWN" to select parts of line.

NOTE: For the 1st set of data the parts of line should be a small figure.

Recommended is '1'. Two parts of line are needed for a load cell and one part of line for a linerider.

4.13.3. FORCE 2 ZERO – With no load on the hook block, use the arrows "UP or

DOWN" to enter the value for the minimum force on the main boom. NOTE:

The total load includes the rigging, cables, and hook block.

4.13.4. Press "OK" to confirm Load.

4.13.5. FORCE 2 LOAD - Lift a test load of at least 75% of permissible line pull for the crane's configuration. See crane manufacturer's data for approximate load. NOTE: To comply with SAE J376 standards, the test load must be to a known accuracy of $\pm 1\%$.

4.13.6. Use the arrows "UP or DOWN" to adjust the display load to indicate your total test load. NOTE: The total load includes the load, rigging, cables, and hook block.

4.13.7. Press "OK" to confirm total load.

4.14. SET FORCE 2 SECOND SET - This is the second set of data for the auxiliary force sensor. NOTE: The first set of data must be used before entering the second set of data. NOTE: For the second set of data the parts of line should be increased. The maximum number of possible parts of line is recommended.

4.15. Press "OK" to calibrate the KMD2 - Auxiliary linerider/load cell or press the arrow "DOWN" button to continue.

4.15.1. PARTS OF LINE - Use the arrows "UP or DOWN" to select parts of line.

NOTE: For the second set of data the parts of line should be a large figure.

Recommended is the maximum number of possible parts of line.

4.15.2. FORCE 2 ZERO – With no load on the hook block, use the arrows "UP or DOWN" to enter the value for the minimum force on the main boom. NOTE: The total load includes the rigging, cables, and hook block.

4.15.3. Press "OK" to confirm Load.

4.15.4. FORCE 2 LOAD - Lift a test load different from the first set of data. See crane manufactures data for approximate load. NOTE: To comply with SAE J376 standards, the test load must be to a known accuracy of $\pm 1\%$.

4.15.5. Use the arrows "UP or DOWN" to adjust the display load to indicate your total test load. NOTE: The total load includes the load, rigging, cables, and hook block.

4.15.6. Press "OK" to confirm total load.

4.16. CONFIG DISPLAY - This section configures the data that will be displayed on the screen.

4.16.1. SHOW LOAD? - YES arrow "UP", NO arrow "DOWN". Press "OK" to confirm.

4.16.2. SHOW TIP HEIGHT? - YES arrow "UP", NO arrow "DOWN". Press "OK" to confirm.

4.16.3. SHOW HOIST? - YES arrow "UP", NO arrow "DOWN". Press "OK" to confirm.

4.16.4. SHOW LENGTH? - YES ARROW "UP", NO arrow" DOWN". Press "OK" to confirm.

4.16.5. SHOW ANGLE? - YES arrow "UP", NO arrow "DOWN". Press "OK" to confirm.

4.16.6. SHOW RADIUS? - YES arrow "UP", NO arrow "DOWN". Press "OK" to confirm.

4.16.7. SHOW JIB ANGLE? - YES arrow "UP", NO arrow "DOWN". Press "OK" to confirm.

4.16.8. SHOW REEVING? - YES arrow "UP", NO arrow "DOWN". Press "OK" to confirm.

4.17. ANALOG VALUES – This selection displays the sensor output voltages in millivolts. Can be used to help troubleshoot sensors.

4.18. CONFIGURATION READY??? - At this point, you may return to any part of the calibration sections by using the arrows "UP" or "DOWN" to change calibration data. Press "OK" to confirm.

4.19. SAVE TO E-EPROM??? - Save calibration data to E-EPROM by pressing "OK". Pressing the arrow "DOWN" for NO will disregard data entries made during this calibration session. If the calibration data is disregarded and the system has not been calibrated as stated in this document, the crane must not be operated. The screen then changes to the current operating configuration. Press "OK" button to proceed to the working screen. Refer to the Operator's Manual, Section 4.2. to set operating conditions

4.20. TURN POWER OFF – Turn power off and back to reset the system with the previously defined calibration.

5 OPERATIONAL CHECKS

After completing calibration, do the following operational checks to verify displayed values. These operational checks should be performed any time there is an indication of inaccuracy.

NOTE: We recommend completing all operational checks before correcting calibration data.

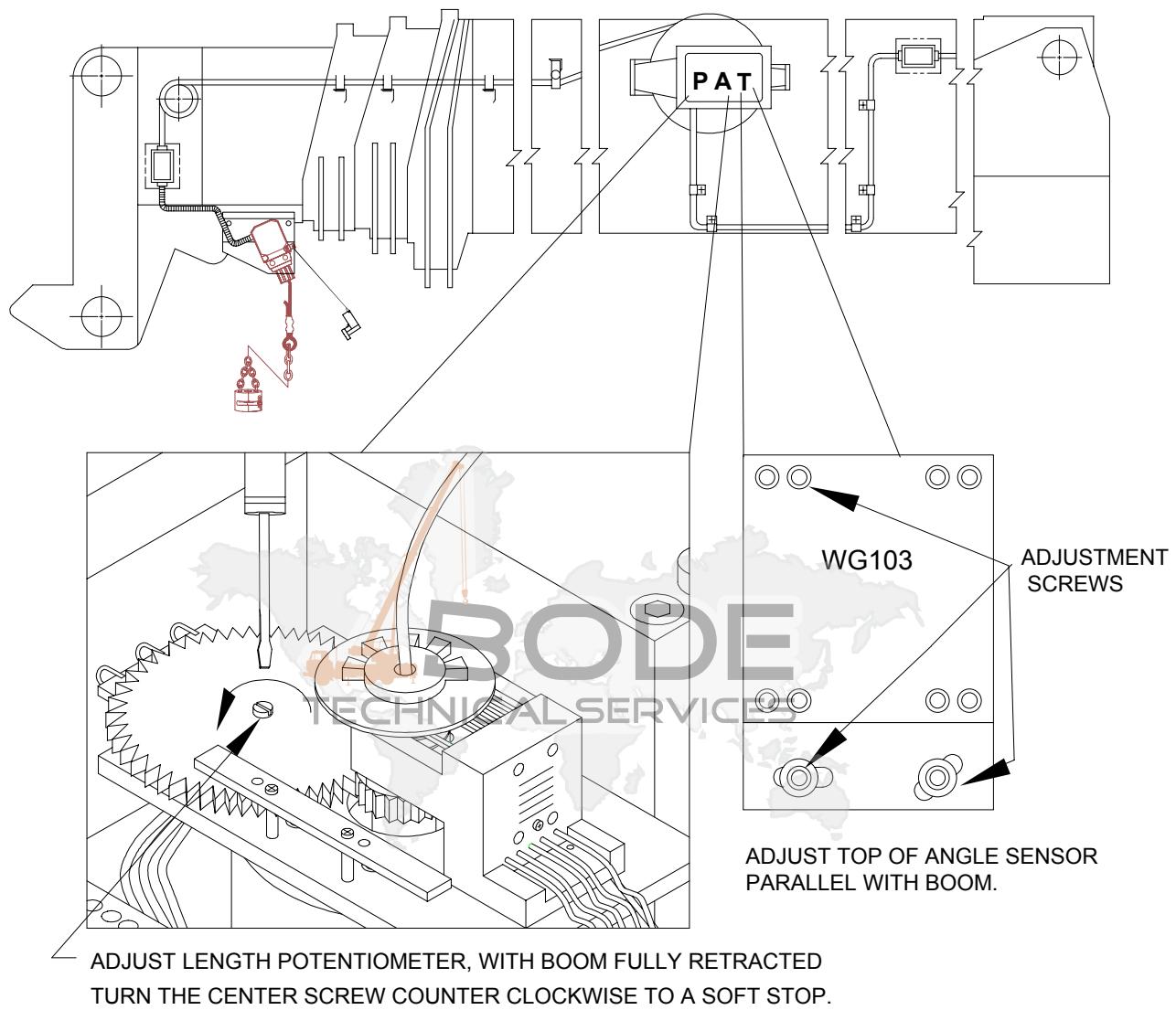
5.1 Check the angle of the main boom and compare it with the measure value. It should be $\pm 1^\circ$. If the angle is incorrect, complete Sections 4.1, 4.2, 4.3 and 4.6.

NOTE: Use the select button to specify crane configuration before performing the following checks. See Operators Manual 056 065 08 0005.

5.2. Check the radius displayed and compare it with the measured radius. The radius is a horizontal measurement from the centerline of rotation to the center of the hook block. The displayed radius should be equal to or greater than the measured radius by 10%. For example, if the measured radius equals 15ft then the displayed radius should be 15ft to 16.5ft. If displayed value is incorrect, verify the Rad Offset measurement taken in Section 3.3.B and complete Sections 4.1, 4.2, 4.3, and 4.6.

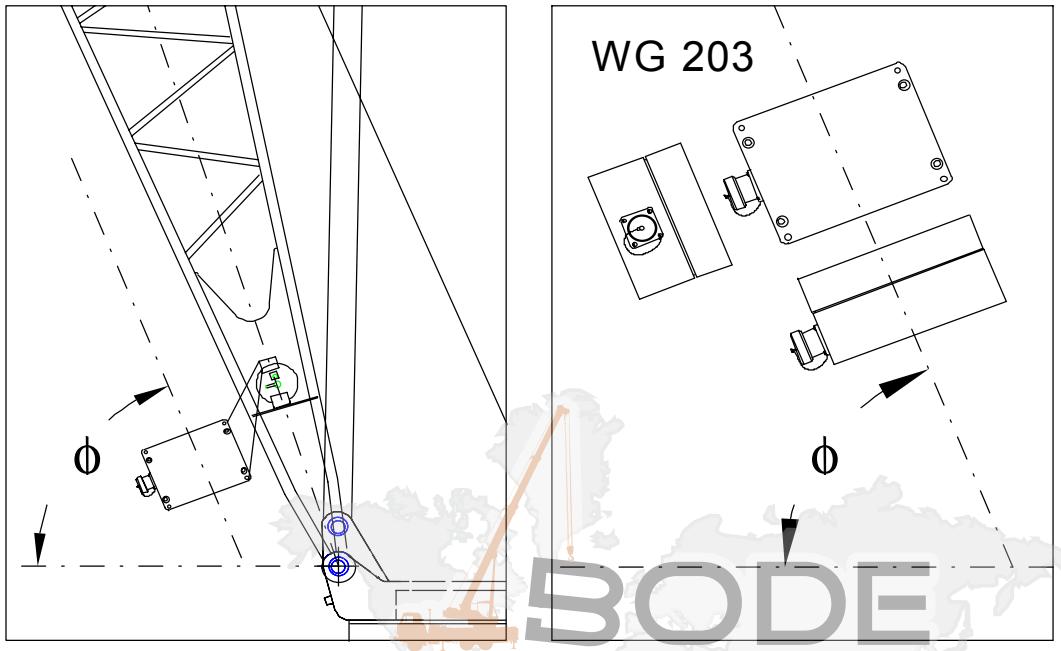
5.3. Check the total load displayed by picking the known test load. This will require picking a load for each force sensor, KMD1 and KMD2, if applicable. The displayed load should be equal to or greater than the known load by 10%. For example, if the known load equals 12,000lbs then the displayed load should be 12,000lbs to 13,200lbs. If displayed value is incorrect, complete Sections 4.1, 4.2, 4.3, and 4.9 for KMD1 and/or 4.10 for KMD2.

NOTE: To comply with SAE J376 standards, the test load must be to a known accuracy of $\pm 1\%$.

APPENDIX A - MECHANICAL ADJUSTMENT OF SENSORS

LATTICE CRANE ANGLE SENSOR ADJUSTMENT

The angle ϕ shown in Figure 1 needs to be within $+0, -0.4$ of the actual angle of the boom. Check boom angle at base/heel section only. After adjustment, compare the actual boom angle with the displayed angle at about 0, 30 and 60. To comply with the SAE J375 standards the displayed angle must be $+0.0$ to -2.0 of the actual angle.



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