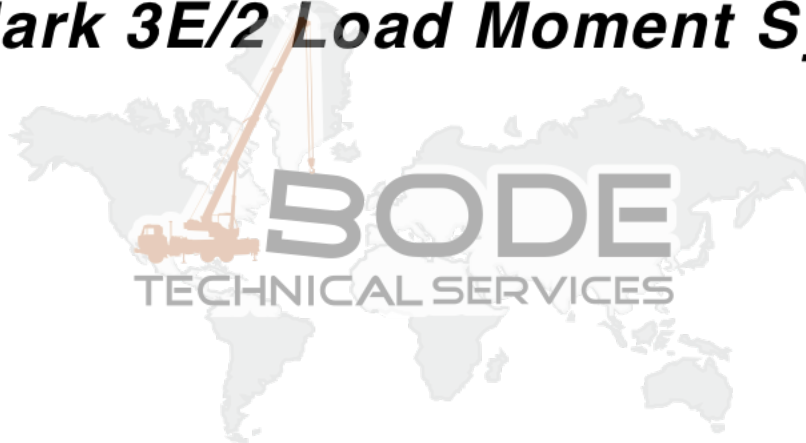


KRÜGER
Mark 3E/2 Load Moment System



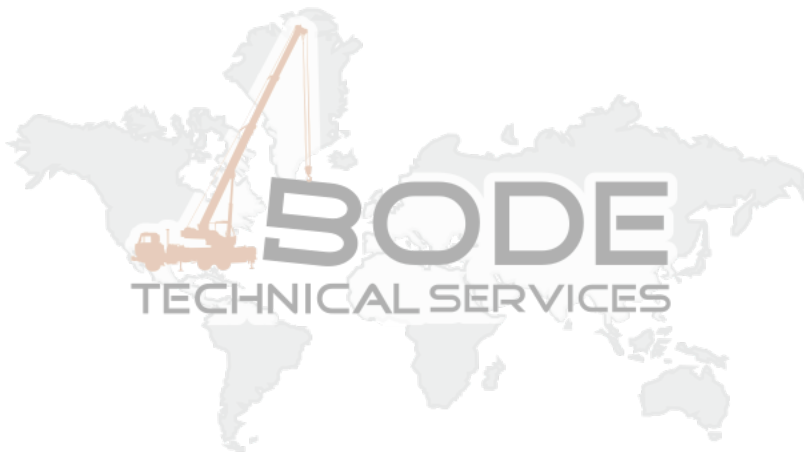
PAT

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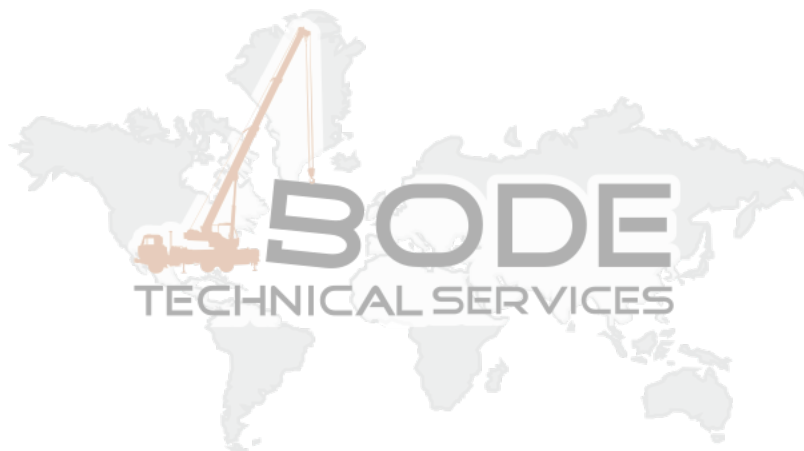


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FOREWORD

The purpose of this manual is to provide the operator with information on start-up, operation and preventative maintenance of the Krüger Mark 3E/2 Load Moment Indicator System.

This system was designed to aid the operator in recognizing conditions where structural failure or loss of stability of the crane might result.

The Krüger Mark 3E/2 Load Moment System will sense and alert the operator to imminent overload and/or two-block conditions. The Mark 3E/2 System can actuate an optional crane function shut off system.

WARNING

DO NOT CONSIDER THIS SYSTEM A SUBSTITUTE FOR GOOD JUDGEMENT, EXPERIENCE AND ACCEPTED SAFE CRANE OPERATIONAL PRACTICES.

THE CONTENTS OF THE KRÜGER MARK 3E/2 OPERATORS HANDBOOK AND THE CRANE MANUFACTURERS HANDBOOKS SHOULD BE READ AND THOROUGHLY UNDERSTOOD BEFORE ATTEMPTING TO OPERATE THE CRANE.

CERTAIN PROGRAMMING STEPS MAY BE NECESSARY BEFORE EACH LIFT. IF INCORRECTLY PROGRAMED, THE SYSTEM WILL NOT SENSE AND ALERT THE OPERATOR TO AN IMMINENT OVERLOAD CONDITION.

NOTE

This system utilizes a series of electrical, mechanical and hydraulic components and cannot be 100% fail safe.

This system should only be serviced by qualified individuals, either PAT-KRUEGER Corporation, Inc. Service Technicians or those who have received special training from Krüger GmbH or their authorized representatives.

To avoid damage and loss of warranty consideration, we recommend repair only be attempted by individuals with a strong electrical/electronic background.

This manual has been reprinted by PAT-KRUEGER Corporation, Inc. with the approval of Krüger GmbH & Co. KG

This manual is effective with Operating System Version 9.24 & later.



INTRODUCTION

The Krüger Mark 3E/2 Load Moment Indicator System is an electronic/mechanical sensing system designed to indicate the approach to maximum rated lifting capacity of the crane and/or an imminent two-block condition.

When properly installed in conjunction with a crane function shut off system, the Mark 3E/2 Load Moment Indicator System prevents crane overload conditions from occurring and/or the hook block of the crane from coming into contact with the sheaves in the boom head.

The system consists of the following components:

- * Display Panel mounted in the crane cab
- * Junction Box with shut off relay
- * Spring-Operated Cable Reel with Angle and Length Sensors
- * One or more Load Sensors - Hydraulic Pressure, Load Cell or Tensiometer
- * Area Definition Sensors
- * Anti-Two-Block Switch with Counterweight

By programming the unit, with the information requested during the start up sequence, the system monitors and displays:

- * Crane Configuration Information
- * Load Moment
- * Boom Angle
- * Boom Length
- * Boom Radius
- * Boom Tip Height
- * Actual Load on the Hook
- * Maximum Load Allowed for crane configuration
- * Service Information - in easily understood text

The system continually monitors output from the force and configuration sensors. It integrates the programmed inputs from the display panel switches, force sensors and configuration sensors and compares the summary of this information to the manufacturers capacity charts, which are stored in the central processor.

The resulting data is displayed for the operator. If an overload and/or imminent two-block condition is determined, the operator is warned with an audible and visual alarm. If the machine incorporates a crane function shut off system, the crane functions are disabled until the overload or imminent two-block condition is corrected.



WARRANTY

THERE ARE NO WARRANTIES EXPRESS OR IMPLIED, MADE BY EITHER THE DISTRIBUTOR OR THE MANUFACTURER ON NEW KRÜGER EQUIPMENT, EXCEPT THE MANUFACTURER'S WARRANTY AGAINST DEFECTS IN MATERIAL AND WORKMANSHIP SET OUT BELOW.

NEW EQUIPMENT WARRANTY

The manufacturer warrants each new product made by the manufacturer to be free from defects in material and workmanship. At its option, all obligation and liability under this warranty is limited to free of charge replacement, repair or reconditioning, at its factory, of any part proven defective under normal use and service within twelve (12) months from the date of delivery. The system or component must be on record with the manufacturer as being delivered by the distributor. If the system or component is not on record as being delivered by the distributor, the warranty period will commence on the date of shipment from the factory. This warranty shall not include any transportation, customs or other charges or the cost of installation or any liability for the cost of installation or any other liability for direct, indirect or consequential damage or delay resulting from the defect. The manufacturer is not responsible for, and makes no warranties in connection with, the installation or servicing, use or operation of the product. Any repair, alteration or adjustment of the product or any substitution of parts without the express written consent of the manufacturer shall void this warranty. This warranty covers only the products of KRÜGER including products replaced, repaired or reconditioned by KRÜGER. The products of other manufacturers are covered only by such warranties as are made by their manufacturers.

THIS WARRANTY IS EXPRESSLY IN LIEU OF ANY OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, AND OF THE OBLIGATIONS OR LIABILITY ON THE PART OF THE MANUFACTURER, AND KRÜGER NEITHER ASSUMES NOR AUTHORIZES ANY OTHER PERSON TO ASSUME FOR IT ANY OTHER LIABILITY IN CONNECTION WITH SUCH EQUIPMENT!



SYSTEM COMPONENTS

This section will identify and describe each component used in the Krüger Mark 3E/2 Load Moment Indicator System. Where necessary, operational instructions are provided to acquaint the operator with the function of push-buttons, warning lights and key switches.

CAUTION

READ THIS SECTION CAREFULLY TO ENSURE THAT PROPER PROGRAMMING WILL BE ACCOMPLISHED DURING THE START UP PROCEDURE.

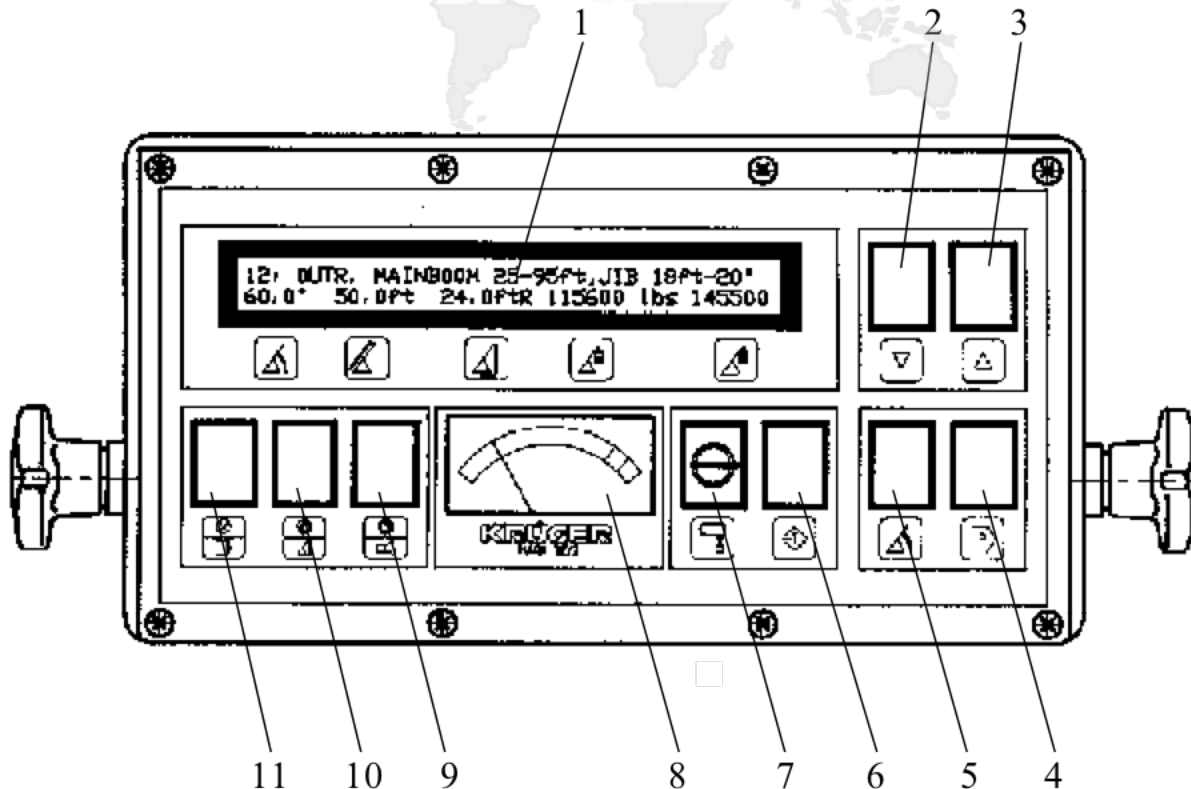
CONTROL PANEL

This unit is located in the operators cab. It has two functions:

1. To transmit information selected by the operator, by means of the selector switches, to the central processor.
2. To display information, received from the central processor, to the operator.

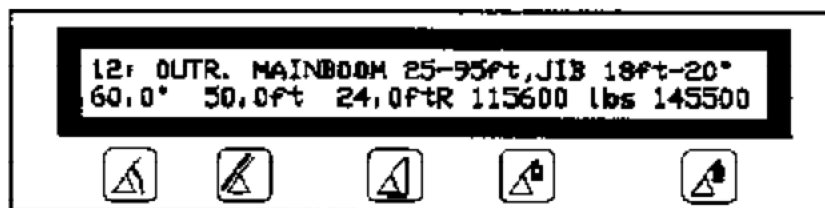
The panel display is illuminated for operation in low light conditions.

The following describes the functions of the various buttons and switches on the panel.



1. DOT-MATRIX DISPLAY OF CRANE INFORMATION

The display shows set-up information and operator instructions, which the operator responds to during the START UP procedure. During OPERATION; the first line displays the machine configuration information, which was programed into memory during START UP, and the second line displays continuously updated information concerning actual crane conditions.

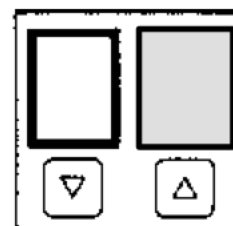


ANGLE	The actual angle of the boom base section, to the horizontal.
LENGTH	The actual main boom length from the boom pivot pin to the head sheaves.
RADIUS/HEIGHT	The actual radius as measured from the crane center of rotation to the center of the load OR the boom tip height as measured from the ground.
ACTUAL LOAD	The actual load on the hook, including other boom attachments, hook block(s), slings and the load.
MAXIMUM LOAD	The capacity chart load for the current conditions as programed for this specific machine.

If a failure of the system should occur or operating conditions exceed the programed values, the display will provide basic information to assist in troubleshooting and/or correction of an operational problem. All operational error messages are displayed in easily understood text. Most troubleshooting messages that can be corrected in the field are displayed in easily understood text. Numeric error messages are used where field repair is generally not practical or possible.

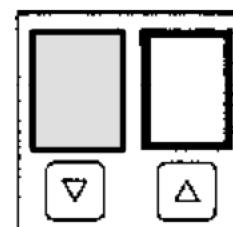
2. SELECT "UP" (BLUE BUTTON)

Used to move crane configuration information forward through the available data, to increase parts of line reeved on the boom or jib and to select the programed main winch line pull. This button is used to switch between an operational error message and the normal operating display information to assist in correcting the problem that caused the message to be displayed.



3. SELECT "DOWN" (BLUE BUTTON)

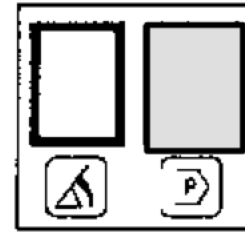
Used to move crane configuration information in reverse through the available data, to decrease parts of line reeved on the boom or jib and to select the programed aux. winch line pull. This button is used to switch between an operational error message and the normal operating display information to assist in correcting the problem that caused the message to be displayed.





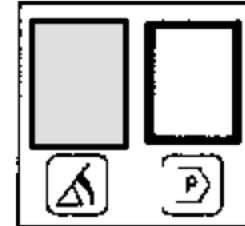
4. PROGRAM (WHITE BUTTON)

When pushed, the system configuration can be changed. Use the blue buttons to move through the crane configurations, part of line and main or aux. winch selection.



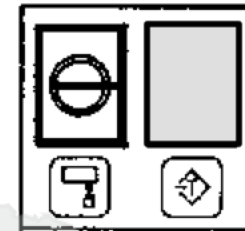
5. ANGLE PRESET (WHITE BUTTON)

When pushed, the system will allow the operator to change the LOW and HIGH boom angles stored in memory. Use the blue buttons to change the currently stored information. When the stored values are exceeded, the appropriate Blue Light is lit and the horn sounds, until the problem is corrected



6. TARE (WHITE BUTTON)

To determine the net load on the hook, press this button. The light is lit. The actual load display will read "000". Lift the load using the winch function only. The weight of the load less the weight tared out will be displayed as the ACTUAL LOAD.

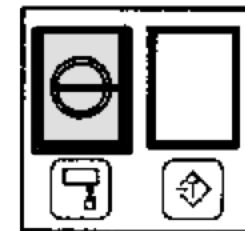


To return to normal operation, push the button and the light goes out.

If the boom angle is changed by 5 degrees or the boom length is changed by 1 foot, the system will automatically return to normal operation.

7. A-2-B KEY SWITCH

This key allows the operator to override the A-2-B shut off for boom rigging or when placing the boom in the boom rest for travel.



WARNING

THE A-2-B BY-PASS KEY SWITCH SHOULD NOT BE USED TO LIFT LOADS HIGHER THAN PERMITTED BY THE COUNTERWEIGHT ATTACHED TO THE A-2-B SWITCH. THE BY-PASS KEY SWITCH MUST BE USED WITH DISCRETION AS UNWARRANTED USE OF IT TO OVERRIDE THE CRANE FUNCTION SHUT OFF SYSTEM COULD RESULT IN LOSS OF LIFE, DESTRUCTION OF PROPERTY AND IRREPARABLE DAMAGE TO THE CRANE. SOUND JUDGEMENT MUST BE USED, WHEN USING THE A-2-B BY-PASS KEY SWITCH.

8. LOAD MOMENT METER

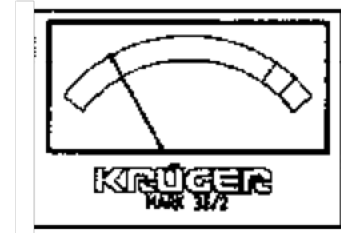
The cranes actual loading as a percentage of permissible load for the current crane configuration capacity chart is displayed on an analog scale

GREEN = SAFE WORKING AREA

The actual load moment; consisting of the actual hook load, attachments, main boom weight and dynamic forces, is less than 90% of the capacity chart load.

YELLOW = CAUTION

The actual load is greater than 90% but less than 100% of the capacity chart load. The Yellow light on the panel is lit.

**RED = MAXIMUM LOAD MOMENT CONDITION**

The actual load is equal too or greater than the capacity chart load or more than 100%. Simultaneously the horn is activated and the Red light on the panel is lit.

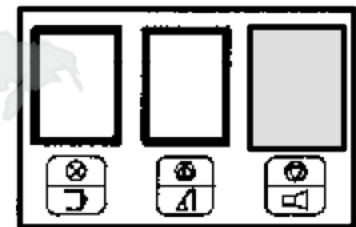
NOTE

If equipped with a Crane Function Shut Off System the shut off system is activated and further operation cannot be continued until the overload condition is corrected.

9. WARNING LIGHT AND AUDIBLE WARNING BY-PASS (RED BUTTON)

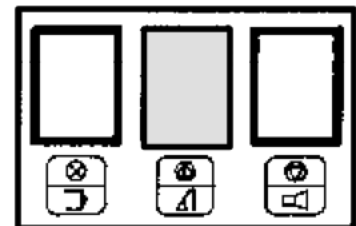
A blinking Red light indicates two-block condition is imminent. A solid Red light indicates that a Maximum Load Moment condition exists or another operational parameter has been exceeded. The display panel will produce an error message to assist the operator in correcting the problem.

Pressing this button will disable the horn, which sounds when the light is lit. When the problem is corrected, the light goes out and the horn is automatically reset.

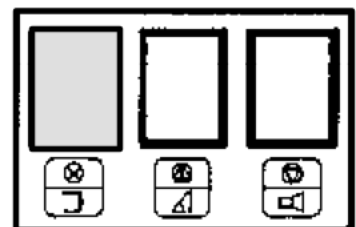
**10. PRE-WARNING LIGHT AND BOOM TIP HEIGHT (YELLOW BUTTON)**

This light appears when Load Moment indication reaches 90% of the capacity chart value.

When pushed and held, the button causes the display to show the Boom Tip Height instead of the load radius. When released, the load radius is again displayed.

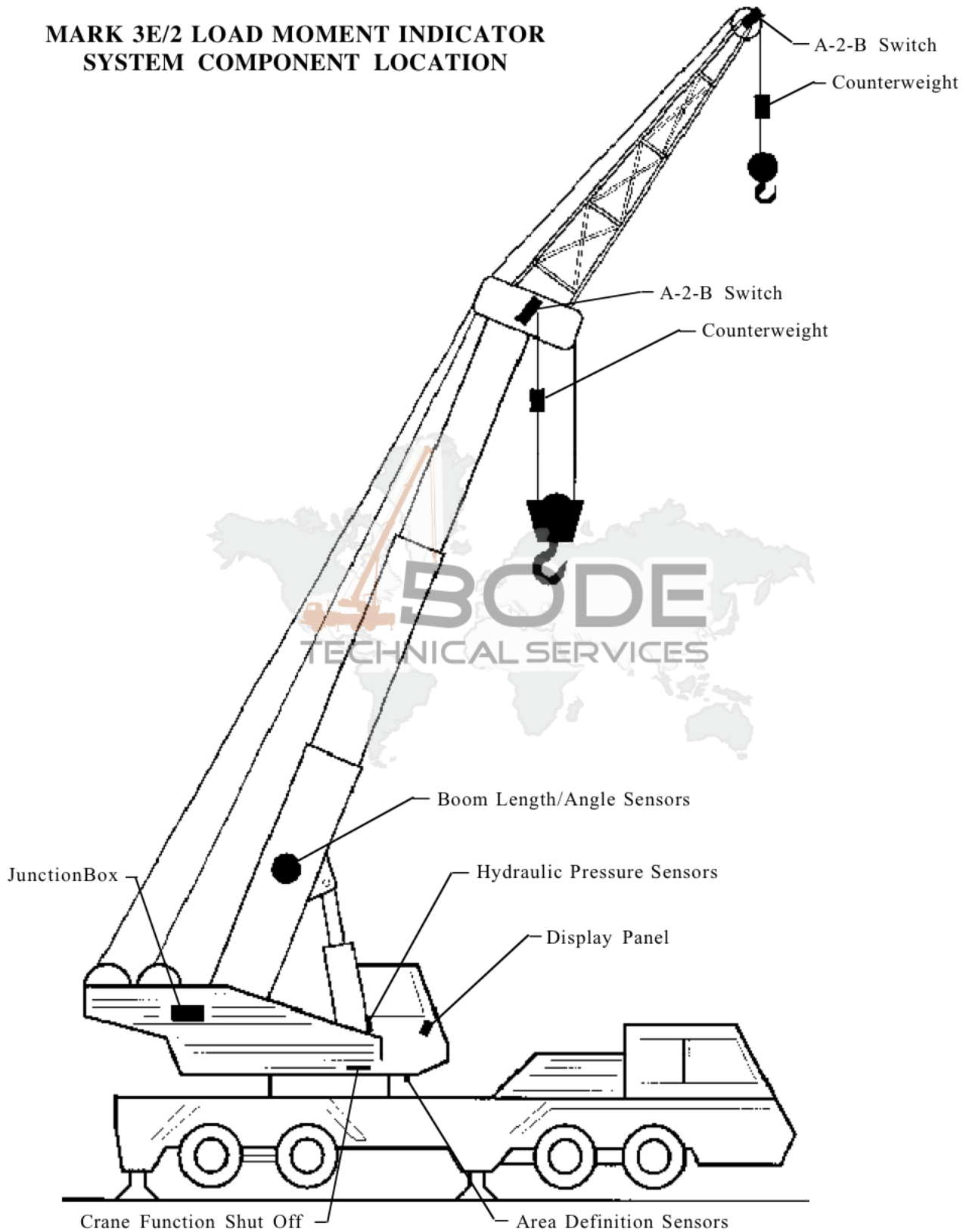
**11. PILOT LIGHT AND CONFIRMATION BUTTON (GREEN BUTTON)**

When lit, this light indicates power has been applied to the system. This button is used to confirm selections made by the crane operator to changes in machine configuration, part of line, winch selection and angle pre-set values.





MARK 3E/2 LOAD MOMENT INDICATOR SYSTEM COMPONENT LOCATION





CABLE REEL

The cable reel, which is mounted on the boom base section of the crane, performs three (3) functions. Built into the cable reel is a Length sensor. The cable attached to the boom tip drives a variable potentiometer as the boom is extended or retracted. The potentiometer sends an electrical signal to the central processor.

Also built into the cable reel is an Angle sensor. A pendulum attached to a potentiometer sends an electrical signal to the central processor as the boom is raised and lowered.

The cable used for length indication also carries the electrical signal for the A-2-B switch, mounted at the boom tip. In special applications this cable may also carry signals from other sensors mounted on the boom tip or other boom attachments.

HYDRAULIC PRESSURE SENSORS

Two hydraulic pressure strain gauge sensors measure hydraulic pressure on the Rod And Piston side of the boom hoist cylinder(s). These sensors are generally mounted directly to the holding valve of the boom hoist cylinder. An electrical signal is carried to the central processor.

Junction Box

This unit is located on the crane structure, generally outside of the crane cab. This box contains terminals for connection of the various system components; the relays used for shut off; a voltage converter, if the crane system voltage is not 12 VDC and a load moment by-pass key switch.

NOTE

The LM by-pass key in the Junction box will only by-pass the Load Moment Shut Off portion of the system. The A-2-B Shut Off Function is still operational when the system has power.

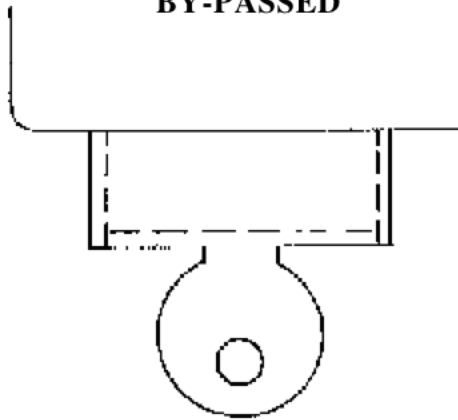
WARNING

THE LOAD MOMENT BY-PASS KEY SWITCH SHOULD BE USED WITH DISCRETION AS UNWARRANTED USE OF IT TO OVERRIDE THE CRANE FUNCTION SHUT OFF SYSTEM COULD RESULT IN LOSS OF LIFE, DESTRUCTION OF PROPERTY AND IRREPARABLE DAMAGE TO THE CRANE. THE KEY SWITCH CAN BE USED IN OVERRIDING THE SYSTEM IN CASE OF EXTREME EMERGENCY. SOUND JUDGEMENT MUST BE USED WHEN USING THE BY-PASS KEY.

WHEN THE KEY HAS BEEN REMOVED FROM THE KEY SWITCH, THE CRANE FUNCTION SHUT-OFF SYSTEM IS ACTIVATED TO PROVIDE PROTECTION. TO REMOVE THE KEY, PUSH IN ON THE SWITCH AND ROTATE THE KEY CLOCKWISE. IF THE KEY CANNOT BE REMOVED, THE CRANE FUNCTION SHUT-OFF SYSTEM IS BY-PASSED AND SYSTEM PROTECTION IS LOST.

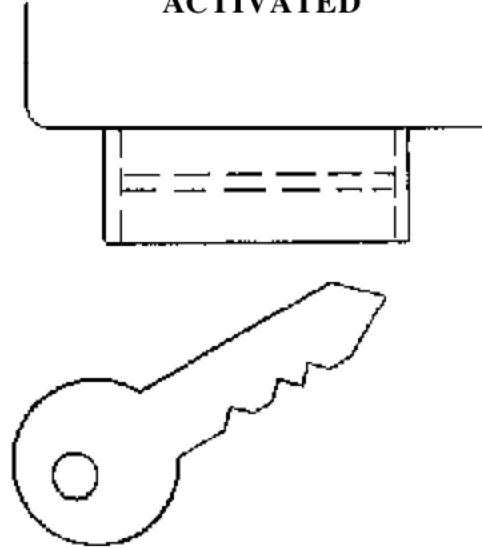


CRANE FUNCTION SHUT OFF BY-PASSED



Push tile of the key switch is flush with the top of the mounting ring. Key CANNOT be removed in this position.

CRANE FUNCTION SHUT OFF ACTIVATED



Push tile of the key switch is recessed below the top of the mounting ring. Key SHALL be removed in this position.

NOTE

The custody of this key is to be controlled by the distributor/customer and/or his agents and such policies are not dictated or controlled by Krüger GmbH & Co. KG or its agents.

AREA DEFINITION SENSORS

One or more roller switches are installed on the crane structure. In combination with cams these sensors provide data on the relative position of the crane upper structure to the carrier/lower frame as described on the crane capacity chart.

During crane operation these sensors provide data to the Central Processor for different working areas and select the proper capacity chart for safe operation.

NOTE

If a roller switch fails, the unit automatically switches to the lowest rating of the capacity chart in use by the Central Processor.

CAUTION

THE SHUT OFF SYSTEM WILL NOT BE ACTIVATED IF THE MACHINE IS OPERATING OUTSIDE OF THE DESIGNATED WORKING AREA.



ANTI-2-BLOCK SWITCH AND COUNTERWEIGHT

This switch is mounted on the main boom tip and on all other boom attachments, where a load line is used. The switch is activated by a counterweight, suspended by chains.

When the counterweight is lifted by the hook block, the audible/visual warning on the control panel is activated. If the crane is equipped with a crane function shut off system, the shut off system is activated.

CAUTION

THE LENGTH OF THE CHAIN IS IN ACCORDANCE WITH HOOK SPEED AND SENSITIVITY OF THE SHUT OFF SYSTEM AND SHOULD NOT BE SHORTENED OR A POSSIBLE TWO-BLOCK CONDITION COULD RESULT PRIOR TO ACTUAL FUNCTION SHUT OFF.

NOTE

With even parts of hoist line, the counterweight should be attached to the dead end line.

With odd parts of hoist line, the counterweight should be attached to the slowest speed line.

CRANE FUNCTION SHUT OFF SYSTEM

This is an optional system. It can be of crane manufacturer design or operate through the use of Krüger Magnet Valves. The basic function of a Shut Off System is to disable the following crane functions:

- MAIN HOIST UP
- AUXILIARY HOIST UP (if machine is so equipped)
- BOOM DOWN
- TELESCOPE OUT



START UP PROCEDURE

The MARK 3E/2 Load Moment Indicator System is manufactured and programmed for installation on a specific crane, as the capacity chart data is crane specific. All capacity chart instructions imposed by the crane manufacturer have been incorporated into the MARK 3E/2 system.

WARNING

CERTAIN PROGRAMMING STEPS MAY BE REQUIRED BEFORE EACH LIFT. IF INCORRECTLY PROGRAMED, THE SYSTEM WILL NOT SENSE AND ALERT THE OPERATOR TO AN IMMINENT OVERLOAD CONDITION.

THE CONTENTS OF THE MARK 3E/2 OPERATORS MANUAL AND THE CRANE MANUFACTURERS HANDBOOKS SHOULD BE READ AND THOROUGHLY UNDERSTOOD BEFORE ATTEMPTING TO OPERATE THE CRANE.

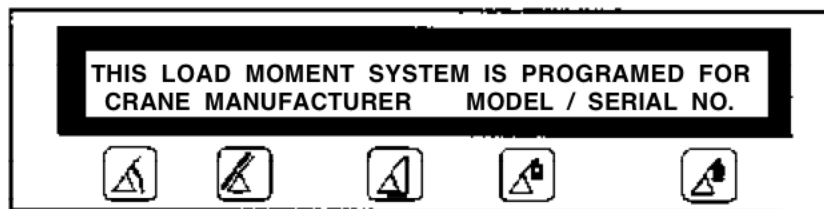
Prior to Start Up of the Mark 3E/2 Load Moment Indicator System inspect the crane for proper installation of:

- A. Counterweight(s) are attached to the Anti-2-Block switches for all load lines being used in the lift.
- B. Install the Jumper Cable at the boom nose receptacle, if auxiliary boom attachments are used.
- C. Install the Dummy Plug in the boom nose receptacle, if the machine is equipped with two (2) winches and NO auxiliary attachments are being used.

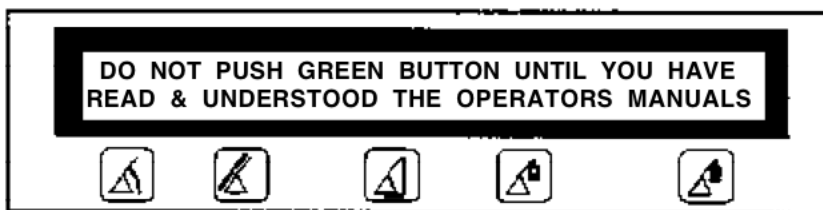
The following steps are required to set-up the MARK 3E/2 Load Moment Indicator System for proper operation.

1. POWER TO THE SYSTEM

The MARK 3E/2 is normally wired to the crane ignition switch. Start up the crane following the crane manufacturers instructions. After power is applied to the system, all warning lights and the audible alarm will be on for about 3 seconds and the display shows...



After 5 seconds the display changes to...

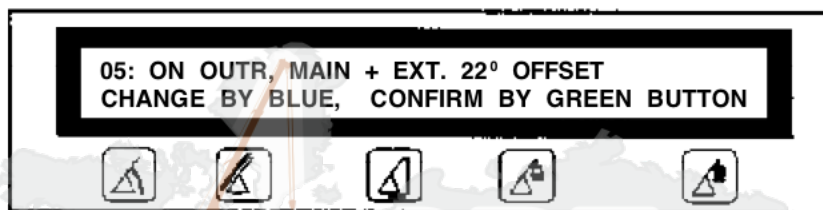


asking the operator to press the green button only after he has carefully read and understood the operator's manuals.

The green light and the red light should be on. The LM Meter needle is in the Red.

2. SELECTING THE CRANE CONFIGURATION

After pressing the green light button, the display shows the previously selected crane configuration and the corresponding program number. The Green and Red Buttons remain lit. In addition the White Program Button is also lit.



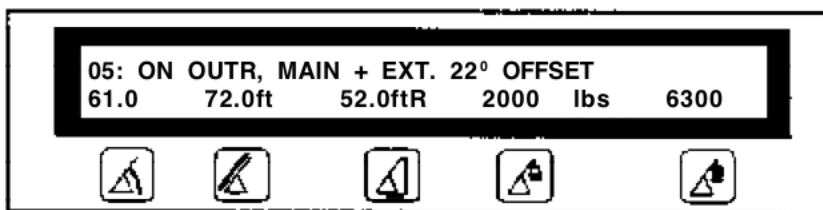
The LM meter needle is in the Red.

At this point in the start up process the operator has two (2) options.

- A. If the operator is sure the machine configuration, including Part of Line and winch selection, has not changed since originally programmed, he can press the Green Button.

The Load Moment Indicator System is ready to assist the operator during lifting operations.

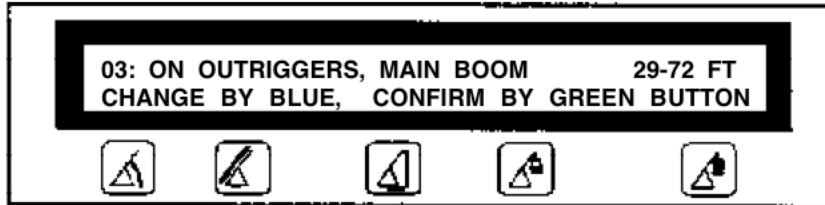
The display will change to...



- B. If the operator is unsure of all the programmed information or if the machine configuration has changed the operator should press the White Program Button. Then press one of the Blue buttons to search the memory for the appropriate crane configuration. If one of these buttons is held down for more than a second, it will "automatically repeat" very quickly.



As the operator searches for the proper crane configuration, only the top line of the display changes.



WARNING

CORRECT PROGRAMMING OF THE ACTUAL CRANE CONFIGURATION MUST BE PERFORMED BY THE OPERATOR OR A POSSIBLE INCORRECT RATING CONDITION WILL RESULT.

Press the Green button to confirm the selected configuration.

3. SELECTING THE WINCH

The display now shows the previously selected winch.



Pressing the Left blue button will change the winch selection to AUX. WINCH. Pressing the Right Blue button will change the selection to MAIN WINCH.

NOTE

This feature will only apply when the machine is equipped with an Auxiliary Winch and a different line pull than the Main Winch.



Press the Green Button to confirm the selection.

4. SELECTING PARTS OF LINE

The display now shows the previously selected parts of hoisting line.



Press the Left Blue Select Button to reduce the parts of line selected or the Right Blue Select Button to increase the parts of line selected.

Press one of these buttons to set the appropriate parts of line.

PARTS OF LINE: 06
CHANGE BY BLUE, CONFIRM BY GREEN BUTTON

NOTE

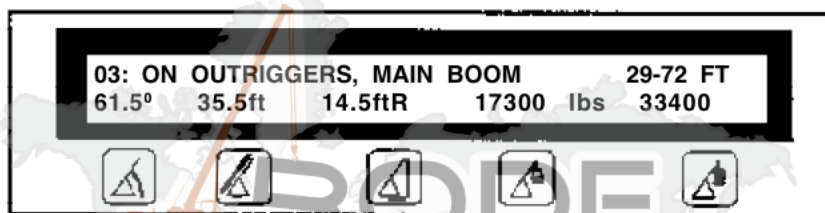
The system takes into consideration the maximum single line pull of the selected winch. If the part of line value set is lower than the actual parts of line installed on the boom, the system may de-rate the maximum capacity.

If “00” is set, the system will ignore the parts of line.

Press the green button to confirm the selected parts of line.

The display now will change to the operating mode. The selected configuration is displayed in the upper line and the actual values of the crane in the lower line.

The LM needle returns to the green area.



BOBDE
TECHNICAL SERVICES

6. SELECTING LOWER BOOM ANGLE LIMIT

To check or change the pre-set boom angle limits, press the Angle Preset Button.

After pressing this button the display will change from standard mode to the boom angle preset mode...

SET LOWER BOOM ANGLE BY BLUE BUTTONS
10 ° CONFIRM BY GREEN BUTTON

Press the Left Blue Button to decrease the angle or the Right Blue Button to increase the angle values.

Press one of these buttons to set the desired or required lower boom angle.

If one of these two buttons is held for more than one second, it will "automatically repeat", very quickly.

Press green button to confirm the selection.



7. SELECTING UPPER BOOM ANGLE LIMIT

The display then will change to the upper boom angle...

**SET UPPER BOOM ANGLE BY BLUE BUTTONS
72 ° CONFIRM BY GREEN BUTTON**

Press the Left Blue Button to decrease the angle or the Right Blue Button to increase the angle values.

Press one of these buttons to set the desired or required upper boom angle.

Press the green button to confirm the selection.

The display then will change back to the operating mode. You are ready to make your lift using the Mark 3E/2 Load Moment Indicator System. Proceed with appropriate care.



DURING OPERATION

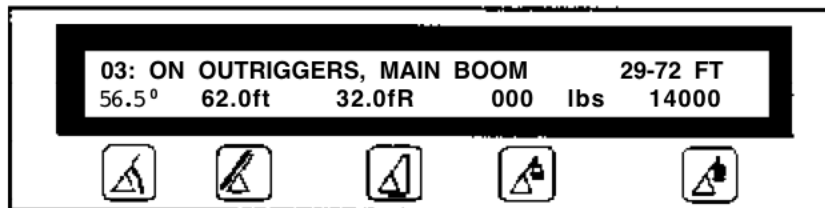
While the crane is in normal operation, the MARK 3E/2 display panel will display continuously updated information concerning machine configuration. Boom angle, length, radius and actual and rated load values will change as you operate.

There are five (5) features of the MARK 3E/2 Load Moment Indicator System that will be explained in this section, as they will be used during crane operation.

1. TARE LOAD

Use the TARE feature to display the actual load on hook weight during a lifting operation.

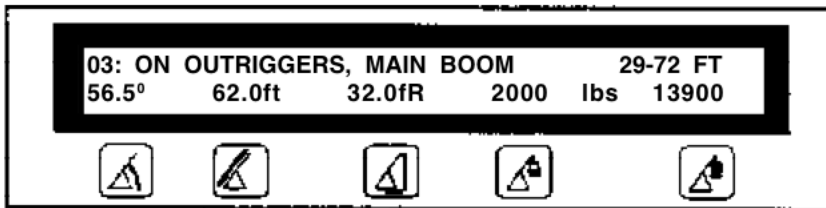
With the load still on the ground, press the White Tare button. The light stays lit and the display changes to...



Note: The actual load indication is “000”.



As the load is raised off the ground using the winch function only the actual load value will display a weight of ONLY the Load. The weight of the hook, slings and other attachments are not included.



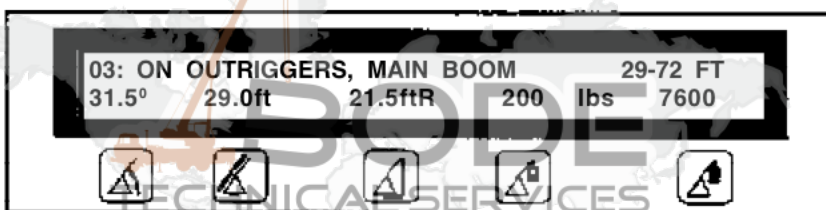
The display will return to the total load on the boom; including hook, slings and attachments if:

- A. The boom angle changes by more than 5 degrees or
- B. The boom length is changed by 1 ft. or
- C. The TARE button is pushed again and the White Tare light goes off.

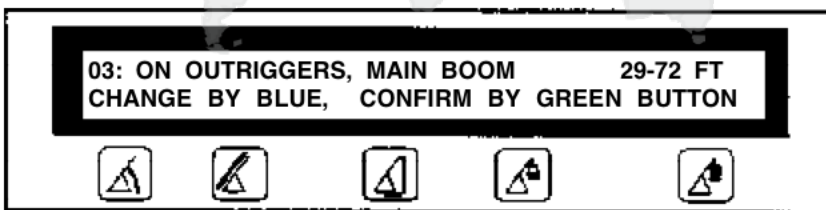
2. PROGRAM CHANGE DURING OPERATION

Due to changing job conditions, it may be necessary to change the operational parameters for the cranes configuration. This is accomplished using the White Program button to begin the change sequence. From this display...

Press the White Program button. The White Program light is lit and the display changes to...

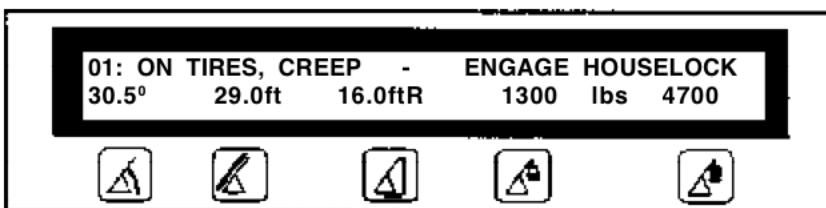


Use the Blue Select buttons to change the configuration. Follow the control panel instructions to



confirm your new configuration; as well as winch selection, if applicable, and Parts of Line.

The White Program light goes off and the display changes to...





Begin crane operation with these new parameters. **PROCEED WITH APPROPRIATE CARE.**

3. QUICK RESTART

During a normal work day it will be necessary to shut off the machine for a variety of reasons. In most cases, it will not be necessary to change the crane configuration data. Restart under these conditions requires the following steps.

- A. Start up the crane following the crane manufacturers instructions.
- B. PUSH the GREEN button to confirm the Introduction message.
- C. PUSH the GREEN button to confirm crane configuration.
- D. The system has run the self-test function and is properly programed and operational.
PROCEED WITH APPROPRIATE CARE.

NOTE

If changes to crane configuration are necessary, follow the instructions for **START UP** or **PROGRAM CHANGE DURING OPERATION**.

4. CRANE CONDITION INFORMATION MESSAGE

Two (2) types of information can be displayed to the operator during operation of the crane. Information relative to operation beyond the crane capacity chart limits or imminent two-block and information relative to a system malfunction.

Each message is self-explanatory. The first line displays the error portion of the message. The second line displays an appropriate method of correction.

OPERATING ERRORS

Operating errors are displayed on the control panel in plain language. These errors are normally caused by operation outside of the programed machine capacity chart values or when actual machine configuration differs from the programed configuration.

To monitor the actual conditions that have caused the error message to be displayed, push and release one of the blue push buttons. This will change the display from the error message to the actual crane configuration information including boom angle, boom length, radius, load on the hook and rated load. This can be compared to the crane manufacturer's capacity chart to assist the operator in selecting the safest method to correct the problem.

When the condition which caused the error message to be displayed is corrected, the system will automatically reset to the normal operating mode.

Unless otherwise noted, all these error messages are accompanied with the Red light being lit and the audible warning sounds. If the machine is equipped with a Crane Function Shut Off, the system will be activated and the crane functions are inoperable until the error is corrected.

Additional information on these error messages can be obtained from the Mark 3E/2 Troubleshooting manual.



**APPROACHING TWO - BLOCK CONDITION
CORRECT ABOVE CONDITION**

The red push button will flash and the horn will sound on the display panel.

This error message is displayed at an approaching two-block condition.

This condition can generally be corrected by either lowering the hook or retracting the boom.

If the machine is equipped with an auxiliary winch, check the following:

If no other attachment is in use, have you installed the dummy plug?

If another attachment is installed, have you plugged in the second Anti-Two-Block switch?

**MAXIMUM CAPACITY
REDUCE LOAD MOMENT**

This error message is displayed when the actual load exceeds the rated load, or because the selected parts of line are restricting the lifting capacity of the machine.

This condition should be corrected by reducing the load or operating at a shorter radius.

Change Parts of Line to agree with actual machine reeving.

**NON WORKING AREA
SWING INTO LOAD CHART AREA**

This error message is displayed when the operator is attempting to work in an area that is not approved by the crane manufacturer. For most On Tire conditions this message will create a Shut Off condition. For restricted Over Front Warning On Outriggers, this is a message only.

This condition is corrected by swinging the upper structure over the rear for a truck crane and over the front on a rough terrain crane.

**NO LOAD CALCULATION POSSIBLE
CHECK LENGTH AND/OR PROGRAM**

This error message is displayed when the actual boom length exceeds the programmed length of the pressure profile.

This can be corrected by retracting the boom.

This error message normally appears when the machine is operating on tires and the capacity chart restricts the maximum boom length to a length less than fully extended.



**COUNTERWEIGHT CONTROL
CHECK**

This error message is displayed when the programmed counterweight position does not agree with the actual installed configuration.

This condition can be corrected by properly positioning the machine counterweight.

**AXLE BLOCKING
CHECK POSITION**

The reason for this message is because the axle lock is not engaged.

To correct this, engage the axle lock.

**BOOM LENGTH SHORTER THAN LOAD CHART
CORRECT ABOVE CONDITION**

This error message is displayed when the actual boom length is shorter than allowed by the programmed machine configuration.

An example would be a fully retracted boom length is measured when the programmed configuration is expecting a main boom length with the powered boom sections retracted and the manual section extended.

Compare the actual displayed boom length to the crane manufacturer's capacity chart.

This condition should be corrected by setting the LMI configuration to match the actual machine configuration or increasing the boom length.

**BOOM LENGTH LONGER THAN LOAD CHART
CORRECT ABOVE CONDITION**

This error message is displayed when the actual boom length is longer than allowed by the programmed machine configuration.

An example would be a measured boom length with main boom with manual section fully extended and the program expecting a maximum boom length equal to a fully extended main boom with manual section retracted.

Compare the actual displayed boom length to the crane manufacturer's capacity chart.

This condition should be corrected by setting the LMI configuration to match the actual machine configuration or reducing the actual boom length.



**BOOM ANGLE BELOW LOAD CHART
CORRECT ABOVE CONDITION**

This error message is displayed when the operator has lowered the boom to a position less than allowed by the crane manufacturers angle/load capacity chart. This message can be expected when operating with the manual section extended and/or a Lattice Extension installed.

Compare the actual displayed boom angle to the crane manufacturer's capacity chart.

This condition should be corrected by raising or increasing the boom angle.

**BOOM ANGLE ABOVE LOAD CHART
CORRECT ABOVE CONDITION**

This error message is displayed when the operator has raised the boom to a position higher than allowed by the crane manufacturers angle/load capacity chart. This message can be expected when operating with the manual section extended and/or a Lattice Extension installed. Compare the actual displayed boom angle to the crane manufacturer's capacity chart.

This condition should be corrected by lowering or reducing the boom angle.

**RADIUS SHORTER THAN LOAD CHART
CORRECT ABOVE CONDITION**

This error message will be displayed when the operator reduces the actual operating radius to a value less the approved by the crane manufacturers capacity chart. This message can be expected when operating with the main powered boom only.

Compare the actual displayed boom radius to the crane manufacturer's capacity chart.

This condition can corrected by lowering the boom angle or increasing the boom length.

**RADIUS LONGER THAN LOAD CHART
CORRECT ABOVE CONDITION**

This error message will be displayed when the operator increases the actual operating radius to a value greater than approved by the crane manufacturers capacity chart. This message can be expected when operating with the main powered boom only.

Compare the actual displayed boom radius to the crane manufacturer's capacity chart.

This condition can corrected by raising the boom angle or decreasing the boom length.



**LOAD MOMENT SHUT OFF "BY-PASSED"
REACTIVATE SHUT OFF WHEN OPERATING CRANE**

This error message will be displayed when the Load Moment Shut Off is by-passed at the junction box. While all of the other Operating Error messages are displayed at the appropriate times, the Crane Function Shut Off will have no effect on operation.

The Red warning light remains lit until this condition is corrected.

This condition will be corrected by following the instructions on the proper use of the LM By-pass Key switch. Refer to instructions on pages 9 & 10 of this manual.

This message can be cleared from the display by pressing one of the Blue buttons.

SYSTEM ERRORS

Analog signal errors are displayed in plain language, as well as with an Error Code Number. Cause for these error codes could be open or shorted wiring to external analog components and/or defective external components.

Repair of the cause of the problem can possibly be corrected without PAT-KRUEGER Corporation, Inc. on-site assistance. In all cases the first attempt at elimination of the ERROR MESSAGE is to Push the Green Button. If this does not correct the problem, use the Troubleshooting Manual in an attempt to identify and correct the problem.

The Troubleshooting Manual covers only the components of the Krueger Load Moment system.

The pressure settings of the Boom Hoist cylinder holding values affect load indication. If either holding valve is replaced, it may be necessary to re-calibrate the system. It is very important that you contact PAT-KRUEGER Corporation, Inc. before operating the crane!!

**SENSOR OUTPUT (ANGLE) E:30
PRESS GREEN BUTTON OR CALL SERVICE**

System errors are normally caused by defective hardware or malfunctioning programmed data stores. When a system error occurs, the green light on the control panel goes out. System errors are displayed as an Error Code Number only. They will be related to problems that are internal to the system and require evaluation and repair by an experienced PAT-KRUEGER technician.

For assistance in identifying the source of a problem where only a ERROR CODE NO. appears on the panel display, refer to the Error Code Descriptions for additional information. Those Error Codes which have been shaded indicate to the operator that the repair can only be performed by a PAT-KRUEGER technician. As the Display Panel is equipped with a quick disconnect, the panel can be removed and returned directly to PAT-KRUEGER for repair.

**CODE NO. 04
PRESS GREEN BUTTON OR CALL SERVICE**



Mark 3E/2 System Error Codes

Hydraulic Machines

<u>Number</u>	<u>Description</u>
01	Watchdog Error
02	Checksum PG-EPROM not correct
03	Checksum D-EPROM not correct
04	Checksum EEPROM not correct
05	RAM-Fault Port1
06	RAM-Fault Port2
07	RAM-Fault 6116
08	NON-VOLITALE RAM-Fault
10	High Output Voltage Channel 0 (Piston or Complete Hydraulic)
11	Low Output Voltage Channel 0 (Piston or Complete Hydraulic)
20	High Output Voltage Channel 1 (Length)
21	Low Output Voltage Channel 1 (Length)
30	High Output Voltage Channel 2 (Main Boom Angle)
31	Low Output Voltage Channel 2 (Main Boom Angle)
40	High Output Voltage Channel 3 (Luffing Jib Angle)
41	Low Output Voltage Channel 3 (Luffing Jib Angle)
50	High Output Voltage Channel 4 (Load Cell)
51	Low Output Voltage Channel 4 (Load Cell)
60	High Output Voltage Channel 5 (Pressure Rod)
61	Low Output Voltage Channel 5 (Pressure Rod)
70	PG-EPROM was Exchanged (Operating System)
71	D-EPROM was Exchanged (Crane specific data)
72	EEPROM was Exchanged (Pressure Profile)
74	Wrong EPROM in EEPROM Location
75	Wrong EPROM in DATA EPROM Location
80	Time Clock does NOT Run
81	Converter does NOT Work
82	Error in Shut Off Circuit
83	Incorrect 12V. Power Supply
84	Incorrect 5V. Analog Voltage



Mark 3E/2 System Error Codes

Lattice Machines

<u>Number</u>	<u>Description</u>
01	Watchdog Error
02	Checksum PG-EPROM not correct
03	Checksum D-EPROM not correct
04	Checksum EEPROM not correct
05	RAM-Fault Port 1
06	RAM-Fault Port 2
07	RAM-Fault 6116
08	NON-VOLITALE RAM-Fault
10	High Output Voltage Channel 0 (Main Boom - DMS #1)
11	Low Output Voltage Channel 0 (Main Boom - DMS #1)
20	High Output Voltage Channel 1 (Main Boom - DMS #2)
21	Low Output Voltage Channel 1 (Main Boom - DMS #2)
30	High Output Voltage Channel 2 (Main Boom Angle)
31	Low Output Voltage Channel 2 (Main Boom Angle)
40	High Output Voltage Channel 3 (Jib - DMS #1)
41	Low Output Voltage Channel 3 (Jib - DMS #1)
50	High Output Voltage Channel 4 (Jib - DMS #2)
51	Low Output Voltage Channel 4 (Jib - DMS #2)
60	High Output Voltage Channel 5 (Luffing Jib - Angle)
61	Low Output Voltage Channel 5 (Luffing Jib - Angle)
70	PG-EPROM was exchanged (Operating System)
71	D-EPROM was exchanged (Crane Specific data)
72	EEPROM was exchange (Pressure Profile)
74	Wrong EPROM in EEPROM Location
75	Wrong EPROM in DATA EPROM Location
80	Time Clock does NOT Run
81	Converter does NOT Work
82	Error in Shut Off Circuit
83	Incorrect 12V. Power Supply
84	Incorrect 5V. Analog Voltage
90	No Length Programed



PREVENTIVE MAINTENANCE

The MARK 3E/2 Load Moment Indicator System uses electronic, electrical, mechanical and hydraulic components. The system should only be serviced by PAT-KRUEGER Corporation, Inc. Service Technicians or those who have received special training from Krüger GmbH or their authorized representatives.

The operator retains the responsibility for inspection of the system components. To insure that no external damage will affect proper system operation, inspections should include:

DAILY INSPECTION

1. Inspect all Anti-2-Block switches for free movement of the lever arm that supports the counterweight.
2. Counterweights should be free of obstructions in the operating position and installed on all switches where a load line is being used for a lift.
3. Insure that the anti-2-block portion of the system is properly wired at the boom nose.
 - A. Install JUMPER CABLE from auxiliary attachment to the boom nose receptacle, if used.
 - B. Install DUMMY PLUG in the boom nose receptacle, if the machine is equipped with two (2) winches and NO auxiliary attachment is being used.
4. Check anti-2-block operation. Individually lift each counterweight. The RED Push Button on the Control Panel should be blinking and the audible alarm should sound. If equipped with an optional Crane Function Shut Off System, this system should be activated.
5. EXTEND the boom and check the cable from the cable reel to the boom nose for cuts, abrasions or other physical damage.
6. While RETRACTING the boom check the cable reel for proper spooling of the cable and spring tension.
7. Check the hydraulic connections at the boom hoist cylinders and the Hydraulic Box for leaks.
8. Check the Area Definition Roller Switches. The arm should move freely when the upper is rotated and the arm moves off the cam. The machine can be equipped with as many as four (4) Roller Switches. When operating properly the panel will display an error message or shift a capacity chart.
9. Report all damage to your supervisor for appropriate action



SEMI-ANNUAL INSPECTION

In addition to the requirements of the DAILY INSPECTION, the LOAD MOMENT portion of the system should be tested.

Load Moment system testing should be performed by a Service Technician of PAT-KRUEGER Corporation, Inc. or someone who has received special training by Krüger GmbH or their authorized representatives.

1. All functions of the System will be inspected for continued compliance with manufacturer operational specifications.
2. Load tests of a minimum two (2) separate capacity chart ratings shall be performed.
3. Calibrate to meet Current SAE Specifications, if necessary
 - J159 Apr85 Load Moment System
 - J375 Apr85 Radius-of-Load or boom angle indicating system
 - J376 Apr85 Load indicating devices in lifting crane service
 - J1180 Oct80 Telescopic boom length indicating system
 - J1305 Jun87 Two-block warning and limit system

ANNUAL INSPECTION

Certification by an authorized Testing Company shall include calibration verification, as required by applicable laws.



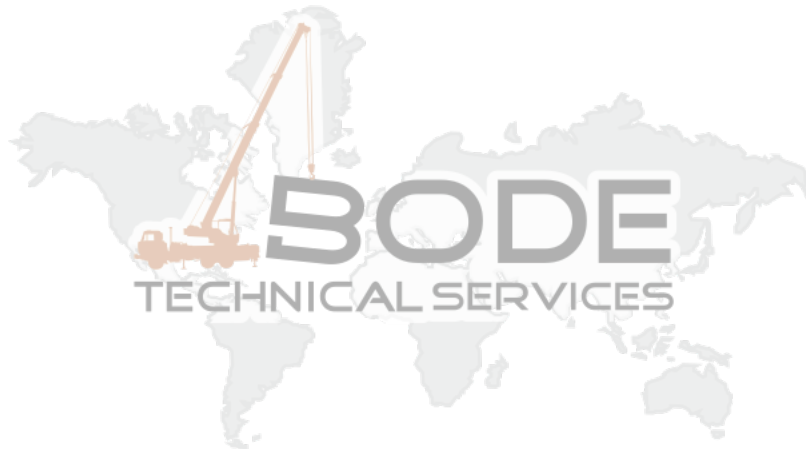


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FOREWORD

The purpose of this handbook is to provide the technician with instructions in the proper methods and techniques of troubleshooting problems that may occur during operation of the MARK 3E/2 Load Moment System.

The MARK 3E/2 Load Moment System is designed to aid the operator in recognizing conditions where structural failure or loss of stability of the crane may occur.

The MARK 3E/2 System will sense and alert the operator to imminent overload and/or two-block conditions. The MARK 3E/2 System can actuate an optional Crane Function Shut Off System.

WARNING

DO NOT CONSIDER THIS SYSTEM A SUBSTITUTE FOR GOOD JUDGEMENT, EXPERIENCE AND ACCEPTED SAFE CRANE OPERATIONAL PRACTICES.

THE CONTENTS OF THE MARK 3E/2 OPERATORS HANDBOOK AND THE CRANE MANUFACTURERS HANDBOOKS SHOULD BE READ AND THOROUGHLY UNDERSTOOD BEFORE ATTEMPTING TO OPERATE THE CRANE.

CERTAIN PROGRAMING STEPS MAY BE NECESSARY BEFORE EACH LIFT. IF INCORRECTLY PROGRAMED, THE SYSTEM WILL NOT SENSE AND ALERT THE OPERATOR TO AN IMMINENT OVERLOAD CONDITION.

NOTE

This system utilizes a series of electrical and mechanical components and cannot be 100% fail safe.

This system should only be serviced by qualified individuals, either PAT-KRUEGER Corporation, Inc. service technicians or those who have received special training from Krüger GmbH or their authorized representatives.

To avoid damage and loss of warranty consideration, we recommend repair only be attempted by individuals with a strong electrical/electronic background.



INTRODUCTION

The Krüger MARK 3E/2 Load Moment System is an electronic/mechanical sensing system designed to indicate the approach to maximum rated lifting capacity of the crane and/or an imminent two-block condition.

When properly installed and programmed, in conjunction with a crane function shut off system, the MARK 3E/2 prevents crane overload conditions from occurring and/or the hook block of the crane from coming into contact with the sheaves in the boom head.

The system consists of the following components:

- * Display Panel mounted in the crane cab
- * Junction Box with shut off relay
- * Spring-Operated Cable Reel with Angle and Length Sensors
- * One or more Load Sensors - Hydraulic, Load Cell or Tensiometer
- * Area Definition Sensors
- * Anti-Two-Block Switch with Counterweight

By programming the unit, with the information requested during the start up sequence, the system monitors and displays:

- * Program Information
- * Load Moment
- * Boom Angle
- * Boom Length
- * Boom Radius
- * Actual Load on the Hook
- * Maximum Load Allowed for crane configuration
- * Service Information



The system continually monitors output from the force and configuration sensors. It integrates the programmed inputs from the Display Panel switches, force sensors and configuration sensors and compares the summary of this information to the manufacturers capacity charts, which are stored in the central processor.

The resulting data is displayed for the operator. If an overload and/or imminent two-block condition is determined, the operator is warned with an audible and visual alarm. If the machine incorporates a crane function shut off system, the crane functions are disabled until the overload or imminent two-block condition is corrected.

This publication will concentrate on an explanation of and possible repairs to system components that may have caused the system to become inoperative.



WARRANTY

THERE ARE NO WARRANTIES EXPRESS OR IMPLIED, MADE BY EITHER THE DISTRIBUTOR OR THE MANUFACTURER ON NEW KRÜGER EQUIPMENT, EXCEPT THE MANUFACTURER'S WARRANTY AGAINST DEFECTS IN MATERIAL AND WORKMANSHIP SET OUT BELOW.

NEW EQUIPMENT WARRANTY

The manufacturer warrants each new product made by the manufacturer to be free from defects in material and workmanship. At its option, all obligation and liability under this warranty is limited to free of charge replacement, repair or reconditioning, at its factory, of any part proven defective under normal use and service within twelve (12) months from the date of delivery. The system or component must be on record with the manufacturer as being delivered by the distributor. If the system or component is not on record as being delivered by the distributor, the warranty period will commence on the date of shipment from the factory. This warranty shall not include any transportation, customs or other charges or the cost of installation or any liability for the cost of installation or any other liability for direct, indirect or consequential damage or delay resulting from the defect. The manufacturer is not responsible for, and makes no warranties in connection with, the installation or servicing, use or operation of the product. Any repair, alteration or adjustment of the product or any substitution of parts without the express written consent of the manufacturer shall void this warranty. This warranty covers only the products of KRÜGER including products replaced, repaired or reconditioned by KRÜGER. The products of other manufacturers are covered only by such warranties as are made by their manufacturers.

THIS WARRANTY IS EXPRESSLY IN LIEU OF ANY OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, AND OF THE OBLIGATIONS OR LIABILITY ON THE PART OF THE MANUFACTURER, AND KRÜGER NEITHER ASSUMES NOR AUTHORIZES ANY OTHER PERSON TO ASSUME FOR IT ANY OTHER LIABILITY IN CONNECTION WITH SUCH EQUIPMENT!



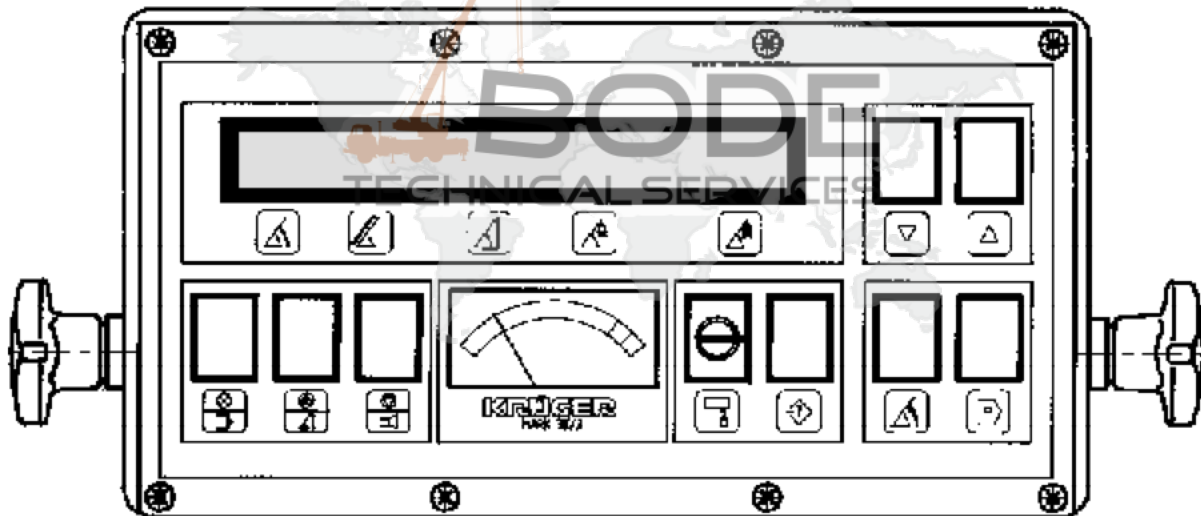
TROUBLESHOOTING

This publication has been developed as a compliment to the video presentation of Testing/Troubleshooting of the Mark 3E/2 Load Moment System. It is designed to assist the technician in the troubleshooting and basic repair of the Krüger Mark 3E/2 Load Moment System.

As described in the introduction a complete Load Moment System is made up of various components. We will cover all those components of the Mark 3E/2 system which can create either internal or external problems affecting system performance.

The Mark 3E/2 system operates on various voltages. The specific voltage is determined by the circuit. Excessive variation of the voltage inputs to the circuitry can cause the system to provide erratic output information. To assist the technician, the Mark 3E/2 system continuously monitors each circuit and will produce an error message when normal circuit parameters are exceeded.

Two types of error messages are generated by the system. System Errors and Operating Errors. If system errors or operating errors are detected, they will be shown on the alpha-numeric DOT-MATRIX panel display.



System errors are normally caused by defective hardware or malfunctioning programmed data stores. When a system error occurs, the green light on the control panel goes out. System errors are displayed with a two digit code number.

Operating Errors can occur by selecting improper boom configurations or exceeding the allowable parameters of the crane functions. Operating errors are displayed in plain language.

For assistance in identifying the source of a problem where only a ERROR CODE NO. appears on the panel display, refer to the Error Code Descriptions for additional information. Those Error Codes which have been shaded indicate to the technician that the repair can only be performed by a PAT-KRUEGER technician. As the Display Panel is equipped with a quick disconnect, the panel can be removed and returned directly to PAT-KRUEGER for repair.



MARK 3E/2 SYSTEM ERROR CODES

HYDRAULIC MACHINES

<u>Number</u>	<u>Description</u>
01	Watchdog Error
02	Checksum PG-EEPROM not correct
03	Checksum D-EEPROM not correct
04	Checksum EEPROM not correct
05	RAM-Fault Port 1
06	RAM-Fault Port 2
07	RAM-Fault 6116
08	NON-VOLITALE RAM-Fault
10	High Output Voltage Channel 0 (Piston or Complete Hydraulic)
11	Low Output Voltage Channel 0 (Piston or Complete Hydraulic)
20	High Output Voltage Channel 1 (Length)
21	Low Output Voltage Channel 1 (Length)
30	High Output Voltage Channel 2 (Main Boom Angle)
31	Low Output Voltage Channel 2 (Main Boom Angle)
40	High Output Voltage Channel 3 (Luffing Jib Angle)
41	Low Output Voltage Channel 3 (Luffing Jib Angle)
50	High Output Voltage Channel 4 (Load Cell)
51	Low Output Voltage Channel 4 (Load Cell)
60	High Output Voltage Channel 5 (Pressure Rod)
61	Low Output Voltage Channel 5 (Pressure Rod)
70	PG-EEPROM was Exchanged (Operating System)
71	D-EEPROM was Exchanged (Crane specific data)
72	EEPROM was Exchanged (Pressure Profile)
74	Wrong EPROM in EEPROM Location
75	Wrong EPROM in DATA EPROM Location
80	Time Clock does NOT Run
81	Converter does NOT Work
82	Error in Shut Off Circuit
83	Incorrect 12V. Power Supply
84	Incorrect 5V. Analog Voltage
92	Incorrect 1V. Slew Angle Supply Voltage
93	Incorrect 3.8V. Slew Angle Supply Voltage



MARK 3E/2 SYSTEM ERROR CODES

LATTICE MACHINES

<u>Number</u>	<u>Description</u>
01	Watchdog Error
02	Checksum PG-EPROM not correct
03	Checksum D-EPROM not correct
04	Checksum EEPROM not correct
05	RAM-Fault Port 1
06	RAM-Fault Port 2
07	RAM-Fault 6116
08	NON-VOLITALE RAM-Fault
10	High Output Voltage Channel 0 (Main Boom - DMS #1)
11	Low Output Voltage Channel 0 (Main Boom - DMS #1)
20	High Output Voltage Channel 1 (Main Boom - DMS #2)
21	Low Output Voltage Channel 1 (Main Boom - DMS #2)
30	High Output Voltage Channel 2 (Main Boom Angle)
31	Low Output Voltage Channel 2 (Main Boom Angle)
40	High Output Voltage Channel 3 (Luffing Jib - DMS #1)
41	Low Output Voltage Channel 3 (Luffing Jib - DMS #1)
50	High Output Voltage Channel 4 (Luffing Jib - DMS #2)
51	Low Output Voltage Channel 4 (Luffing Jib - DMS #2)
60	High Output Voltage Channel 5 (Luffing Jib - Angle)
61	Low Output Voltage Channel 5 (Luffing Jib - Angle)
70	PG-EPROM was Exchanged (Operating System)
71	D-EPROM was Exchanged (Crane specific data)
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75	Wrong EPROM in DATA EPROM Location
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81	Converter does NOT Work
82	Error in Shut Off Circuit
83	Incorrect 12V. Power Supply



84	Incorrect 5V. Analog Voltage
90	No Length Programed

To troubleshoot the system, four basic tools will be needed: A digital multi-meter, a standard screwdriver, the system wiring diagram and the Error Code sheet.

SYSTEM ERRORS

The following error codes are displayed as an Error Code Number only. They will be related to problems that are internal to the system and require evaluation and repair by an experienced PAT-KRUEGER Corporation, Inc. technician.

CODE NO. 01 PRESS GREEN BUTTON OR CALL SERVICE

Watchdog Error

This error occurs when the program is not functioning properly. The problem can be caused by outside influences or an improper program loop.

To correct this problem, push and release the green button on the control panel to reset the system. If this code continues to be displayed, the panel should be returned to PAT-KRUEGER Corporation, Inc. for evaluation and repair.

CODE NO. 02 PRESS GREEN BUTTON OR CALL SERVICE

Checksum for Operating System Eprom is incorrect

The Operating System Eprom contains the instruction set for operation of the CPU and produces all the system calculations required to produce the values for system display and operation.

The problem is created when the checksum calculated by the system is different than the checksum stored in the Operating System Eprom. This test is performed by the system at every start up or reset. This Eprom is identified as item (U1) on the CPU board in the display panel. The reason can be that the original data has changed for some reason, which means that the Eprom 27C256 (U1) is defective. Another possibility is an electrical failure of the PC board.

In either case, the panel should be returned to PAT-KRUEGER for evaluation and repair.

CODE NO. 03 PRESS GREEN BUTTON OR CALL SERVICE

Checksum Data Eprom #1 is incorrect

The data Eprom #1 contains crane specific data such as crane geometrical data, crane specific capacity charts, display text and crane specific operating parameters.



The problem is created when the checksum calculated by the system is different than the checksum stored in data Eeprom 27C256 (U3). This test is performed by the system at every start up or reset. The reason can be that the original data has changed for some reason, which means that the Eeprom 27C256 (U1) is defective.

Another possibility is an electrical failure of the PC board.

In either case, the panel should be returned to PAT-KRUEGER for evaluation and repair.

**CODE NO. 04
PRESS GREEN BUTTON OR CALL SERVICE**

Checksum Eeprom #2 not correct

This Eeprom contains the pressure profiles (pressure verses boom angle) and the correction values (modification of pressure profiles, boom deflection, friction, etc.) for a specific crane identified by it's serial number. For lattice cranes, it also contains the load cell sizes.

The problem is created when the checksum calculated by the system is different than the checksum stored in the data Eeprom #2 28C64 (U2). This test is performed by the system at every start up or reset. The reason can be that the original data has changed for some reason, which means that the Eeprom 28C64 (U2) is defective. Another possibility is an electrical failure of the PC board.

In either case, the panel should be returned to PAT-KRUEGER for evaluation and repair.

**CODE NO. 05
PRESS GREEN BUTTON OR CALL SERVICE**

Ram Error Port 1

This IC is 128 byte memory and a controller for all warning lights of the control panel. At start up and/or reset it checks the digital input channels and the internal code switch SW1 for possible errors.

The reason for this error code is that the NSC 810 (U14) is defective.

To correct, the panel should be returned to PAT-KRUEGER for evaluation and repair.

**CODE NO. 06
PRESS GREEN BUTTON OR CALL SERVICE**

Ram Error Port 2

This IC is 128 byte memory and controller for the serial Eeprom (U13) and all push buttons on the control panel. At start up or reset it checks the serial Eeprom and push buttons for faults.

The cause for this error code is that the NSC 810 (U15) is defective.

To correct, the panel should be returned to PAT-KRUEGER for evaluation and repair.

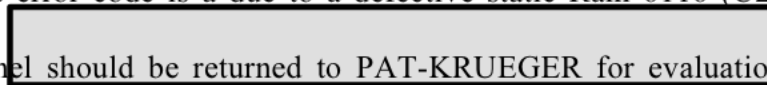


**CODE NO. 07
PRESS GREEN BUTTON OR CALL SERVICE**

Ram Error Static Ram 6116

This IC stores calculation data which the micro processor uses during system operation.

The reason for this error code is a due to a defective static Ram 6116 (U27).



To correct, the panel should be returned to PAT-KRUEGER for evaluation and repair.

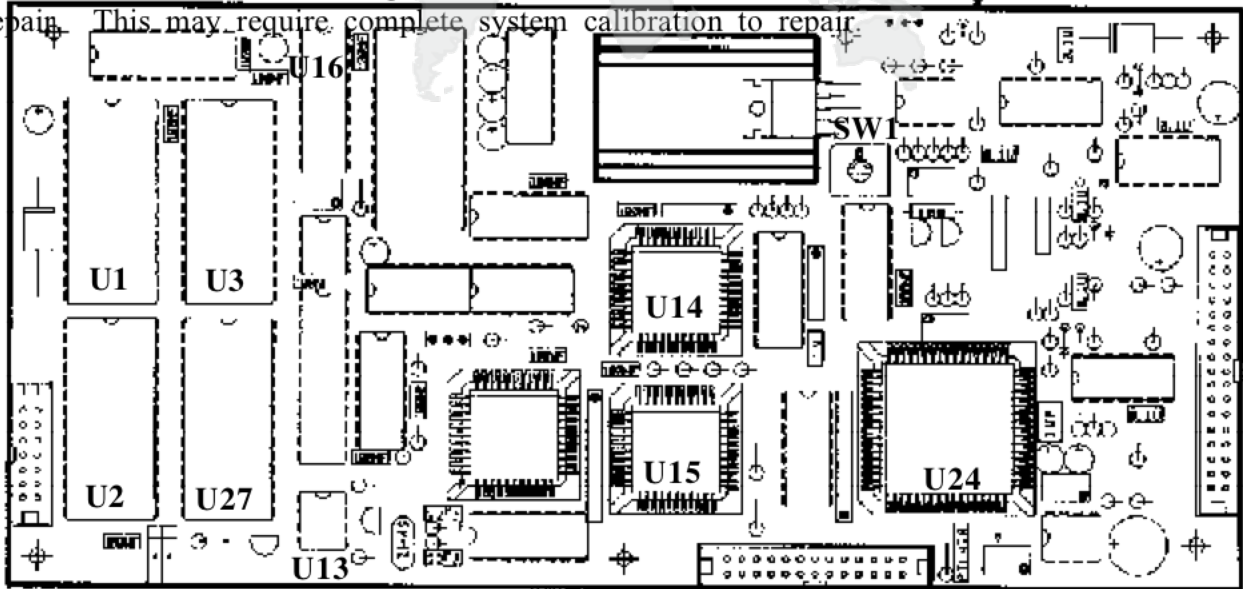
**CODE NO. 08
PRESS GREEN BUTTON OR CALL SERVICE**

Ram Error Serial EEprom

The Serial EEprom contains the calibration values of the analog inputs of all sensors and the checksums from the Operating System (U1), Data Eprom 1 (U3) and Data EEprom 2 (U2). At start up or reset this IC is tested for proper operation.

The cause for this error code is a defect in the Serial EEprom 24C04 or 24C16 (U13).

To correct this situation, the panel should be returned to PAT-KRUEGER for evaluation and repair. This may require complete system calibration to repair.



MARK 3E/2 CPU BOARD



ANALOG SIGNAL ERRORS

The following error codes are displayed in plain language, as well as with an Error Code Number. Cause for these error codes could be open or shorted wiring to external analog components and/or defective external components. All threshold voltages are based on the analog to digital converter input levels.

Repair of the cause of the problem can possibly be corrected without PAT-KRUEGER Corporation, Inc. on-site assistance. In all cases the first attempt at elimination of the ERROR MESSAGE is to push the Green Button. If this does not correct the problem use the following to attempt to identify and correct the problem.

This Troubleshooting section covers only the components of the Krüger Load Moment system.

The pressure settings of the Boom Hoist cylinder holding values affect load indication. If either holding valve is replaced, it may be necessary to re-calibrate the system. It is very important that you contact PAT-KRUEGER Corporation, Inc. before operating the crane!!

**SENSOR OUTPUT (PRESS/PISTON) E:10
PRESS GREEN BUTTON OR CALL SERVICE**

The cause for this error code is due to a defect in the cable between the junction box and the pressure sensor (high output voltage) or a defective pressure sensor.

To correct this situation the following steps are to be taken.

1. Check all wiring from the individual pressure sensors or complete Hydraulic Box to the junction box for physical damage and/or loose connections at receptacles and other connection points. The pressure sensors are located on the holding valve of the lift cylinder. The complete Hydraulic Box, if used, is located near the junction box. Repair as necessary and push the Green Button to reset the system.
2. Check the pressure sensors for physical damage and replace if needed. Press the Green button to reset the system. Please note that changing the pressure sensors may affect the accuracy of the Mark 3E/2 System.
3. With no load on the boom, check the following terminals for voltage outputs in the junction box:

Terminals #2, #3 or #4 are 0 VDC. This is system ground.

Terminals #5, #6 or #7 are +12 VDC. This is supply voltage.

Terminal #30 is the output of the pressure sensor. Output voltage should be between +2.50 VDC and 7.50 VDC. Place the minus probe of the volt meter on terminal #2, #3 or #4 and the plus probe on terminal #30 to measure the output voltage. To cause this error message the voltage must be GREATER THAN +8.20 VDC.



If the voltage is GREATER THAN +8.20 VDC the problem is either a damaged cable between the junction box and pressure sensor or a defective pressure sensor.

If the voltage at the junction box is BETWEEN +2.50 and 7.50 VDC., the problem is either in the 32 Conductor Cable between the junction box and display panel or in the panel itself.

In either case contact PAT-KRUEGER for further instructions.

**SENSOR OUTPUT (PRESS/PISTON) E:11
PRESS GREEN BUTTON OR CALL SERVICE**

The cause for this error message is due to a defect in the cable between the junction box and pressure sensor (low output voltage) or a defective sensor.

To correct this situation the following steps are to be taken:

1. Check all wiring from the individual pressure sensors or complete Hydraulic Box to the junction box for physical damage and/or loose connections at receptacles and other connection points. The pressure sensors are located on the holding valve of the lift cylinder. The complete Hydraulic Box, if used, is located near the junction box. Repair as necessary and push the Green Button to reset the system.
2. Check the pressure sensors for physical damage and replace if needed. Press the Green button to reset the system. Please note that changing the pressure sensors may affect the accuracy of the Mark 3E/2 System.
3. With no load on the boom, check the following terminals for voltage outputs in the junction box:

Terminals #2, #3 or #4 are 0 VDC. This is system ground.

Terminals #5, #6 or #7 are +12 VDC. This is supply voltage.

Terminal #30 is the output of the pressure sensor. Output voltage should be between +2.50 VDC and 7.50 VDC. Place the minus probe of the volt meter on terminal #2, #3 or #4 and the plus probe on terminal #30 to measure the output voltage. To cause this error message the voltage must be LESS THAN +1.85 VDC.

If the voltage is LESS THAN +1.85 VDC the problem is either in the cable between the junction box and pressure sensor or a defective pressure sensor.

If the voltage at the junction box is BETWEEN +2.50 and 7.50 VDC., the problem is either in the 32 Conductor Cable between the junction box and display panel or in the panel itself.

In either case contact PAT-KRUEGER for further instructions.



**SENSOR OUTPUT (LENGTH) E:20
PRESS GREEN BUTTON OR CALL SERVICE**

The cause for this error message is due to a defect in the cable between the junction box and Length Sensor (high output voltage) or a defective length sensor.

To correct this situation the following steps are to be taken:

1. Check all the wiring between the junction box and the cable reel for physical damage and/or loose connections at receptacles and other connection points. Repair as necessary and push the Green Button to reset the system.
2. With the boom fully retracted and no load on the crane, check the following terminals in the junction box for voltage output.

Terminals #37 or #38 are 0 VDC. This is the length sensor ground.

Terminals #39 or #40 are 5 VDC. This is the length sensor supply voltage.

Terminal #31 is the output of the length sensor. With the boom fully retracted output should be approximately +1.00 VDC. Place the minus probe of the volt meter on terminal #37 or #38 and the plus probe on terminal #31 to measure the voltage. To cause this error message the voltage must be GREATER THAN +4.80 VDC.

If the voltage is LESS THAN +4.80 VDC the problem is either in the 32 Conductor Cable between the junction box and display panel or in the panel itself. In either case contact PAT-KRUEGER for further instructions.

If the voltage is GREATER THAN +4.80 VDC continue to step 3.

3. Check the length sensor for physical damage. The sensor is located in the cable reel mounted on the boom base section.

Remove the cover and locate the length sensor and two white plastic gears. Behind the gear set is a metal lever arm used to adjust the length display.

Identify posts #1, #2 and #3 on the terminal strip. Place the minus probe of the volt meter on post #1 and the plus probe on post #3. This should be 5 VDC. If this value is NOT 5 VDC then the problem is in the wiring to the junction box.

Leave the minus probe on post #1 and place the plus probe on post #2 (length sensor output). If this value is GREATER THAN +4.80 VDC the length sensor is defective and must be replaced.

Refer to the Section on Replacement and Adjustment for further instructions or contact PAT-KRUEGER.



**SENSOR OUTPUT (LENGTH) E:21
PRESS GREEN BUTTON OR CALL SERVICE**

The cause for this error message is due to a defect in the cable between the junction box and Length Sensor (low output voltage) or a defective length sensor.

To correct this situation the following steps are to be taken:

1. Check all the wiring between the junction box and the cable reel for physical damage and/or loose connections at receptacles and other connection points. Repair as necessary and push the Green Button to reset the system.
2. With the boom fully retracted and no load on the crane, check the following terminals in the junction box for voltage output.

Terminals #37 or #38 are 0 VDC. This is the length sensor ground.

Terminals #39 or #40 are 5 VDC. This is the length sensor supply voltage.

Terminal #31 is the output of the length sensor. With the boom fully retracted output should be approximately +1.00 VDC. Place the minus probe of the volt meter on terminal #37 or #38 and the plus probe on terminal #31 to measure the voltage. To cause this error message the voltage must be LESS THAN +0.70 VDC.

If the voltage is GREATER THAN +0.70 VDC the problem is either in the 32 Conductor Cable between the junction box and display panel or in the panel itself. In either case contact PAT-KRUEGER for further instructions.

If the voltage is LESS THAN +0.70 VDC continue to step 3.

3. Check the length sensor for physical damage. The sensor is located in the cable reel mounted on the boom base section.

Remove the cover and locate the length sensor and two white plastic gears. Behind the gear set is a metal lever arm used to adjust the length display.

Identify posts #1, #2 and #3 on the terminal strip. Place the minus probe of the volt meter on post #1 and the plus probe on post #3. This should be 5 VDC. If this value is NOT 5 VDC then the problem is in the junction box.

Leave the minus probe on post #1 and place the plus probe on post #2 (length sensor output). If this value is LESS THAN +0.70 VDC the length sensor is defective and must be replaced.

Refer to the Section on Replacement and Adjustment for further instructions or contact PAT-KRUEGER.



**SENSOR OUTPUT (ANGLE) E:30
PRESS GREEN BUTTON OR CALL SERVICE**

The cause for this error message is due to a defect in the cable between the junction box and Angle Sensor (high output voltage) or a defective angle sensor.

To correct this situation the following steps are to be taken:

1. Check all the wiring between the junction box and the cable reel for physical damage and/or loose connections at receptacles and other connection points. Repair as necessary and push the Green Button to reset the system.
2. With the boom fully retracted and at a 0 degree angle, check the following terminals in the junction box for voltage outputs.

Terminals #37 or #38 are 0 VDC. This is the angle sensor ground.

Terminals #39 or #40 are +5 VDC. This is the angle sensor supply voltage.

Terminal #32 is the output of the angle sensor. With the boom at 0 degrees output should be approximately +1.00 VDC. Place the minus probe of the volt meter on terminal #37 or #38 and the plus probe on terminal #32 to measure the voltage. To cause this error message the voltage must be GREATER THAN +4.10 VDC.

If the voltage is LESS THAN +4.10 VDC the problem is either in the 32 Conductor Cable between the junction box and display panel or in the panel itself. In either case contact PAT-KRUEGER for further instructions.

If the voltage is GREATER THAN +4.10 VDC continue to step 3.

3. Check the angle sensor for physical damage. The sensor is located in the cable reel mounted on the boom base section.

Remove the cover and locate the angle sensor and pendulum weight.

Identify posts #4, #5 and #6 on the terminal strip. Place the minus probe of the volt meter on post #4 and the plus probe on post #6. This should be 5 VDC. If this value is NOT 5 VDC then the problem is in the wiring to the junction box.

Leave the minus probe on post #4 and place the plus probe on post #5 (angle sensor output). If this value is GREATER THAN +4.10 VDC the angle sensor is defective and must be replaced.

Refer to the Section on Replacement and Adjustment for further instructions or contact PAT-KRUEGER.



**SENSOR OUTPUT (ANGLE) E:31
PRESS GREEN BUTTON OR CALL SERVICE**

The cause for this error message is due to a defect in the cable between the junction box and Angle Sensor (low output voltage) or a defective angle sensor.

To correct this situation the following steps are to be taken:

1. Check all the wiring between the junction box and the cable reel for physical damage and/or loose connections at receptacles and other connection points. Repair as necessary and push the Green Button to reset the system.
2. With the boom fully retracted and at a 0 degree angle, check the following terminals in the junction box for voltage outputs.

Terminals #37 or #38 are 0 VDC. This is the angle sensor ground.

Terminals #39 or #40 are +5 VDC. This is the angle sensor supply voltage.

Terminal #32 is the output of the angle sensor. With the boom at 0 degrees output should be approximately +1.00 VDC. Place the minus probe of the volt meter on terminal #37 or #38 and the plus probe on terminal #32 to measure the voltage. To cause this error message the voltage must be LESS THAN +0.60 VDC.

If the voltage is GREATER THAN +0.60 VDC the problem is either in the 32 Conductor Cable between the junction box and display panel or in the panel itself. In either case contact PAT-KRUEGER. for further instructions.

If the voltage is LESS THAN +0.60 VDC continue to step 3.

3. Check the angle sensor for physical damage. The sensor is located in the cable reel mounted on the boom base section.

Remove the cover and locate the angle sensor and pendulum weight.

Identify posts #4, #5 and #6 on the terminal strip. Place the minus probe of the volt meter on post #4 and the plus probe on post #6. This should be 5 VDC. If this value is NOT 5 VDC then the problem is in the wiring to the junction box.

Leave the minus probe on post #4 and place the plus probe on post #5 (angle sensor output). If this value is LESS THAN +0.60 VDC the angle sensor is defective and must be replaced.

Refer to the Section on Replacement and Adjustment for further instructions or contact PAT-KRUEGER.



**CODE NO. 40
PRESS GREEN BUTTON OR CALL SERVICE**

The cause for this error message is due to a defect in the cable between the junction box and Luffing Jib Angle Sensor (high output voltage) or a defective angle sensor.

To correct this situation the following steps are to be taken:

1. Check all the wiring between the junction box and the Angle Sensor, located on the Jib base section, for physical damage and/or loose connections at receptacles and other connection points. Repair as necessary and push the Green Button to reset the system.
2. With the Luffing Jib at a 0 degree angle, check the following terminals in the junction box for voltage outputs.

Terminals #37 or #38 are 0 VDC. This is the angle sensor ground.

Terminals #39 or #40 are +5 VDC. This is the angle sensor supply voltage.

Terminal #33 is the output of the angle sensor. With the Luffing Jib at 0 degrees output should be approximately +1.00 VDC. Place the minus probe of the volt meter on terminal #37 or #38 and the plus probe on terminal #33 to measure the voltage. To cause this error message the voltage must be **GREATER THAN +4.10 VDC**.

If the voltage is **LESS THAN +4.10 VDC** the problem is either in the 32 Conductor Cable between the junction box and display panel or in the panel itself. In either case contact PAT-KRUEGER for further instructions.

If the voltage is **GREATER THAN +4.10 VDC** continue to step 3.

3. Check the angle sensor for physical damage. The angle sensor is located on the luffing Jib base section.

Remove the cover and locate the angle sensor and pendulum weight.

Identify posts #1a1, #12 and #13 on the angle sensor. Place the minus probe of the volt meter on post #1a1 and the plus probe on post #13. This should be 5 VDC. If this value is **NOT 5 VDC** then the problem is in the wiring to the junction box.

Leave the minus probe on post #1a1 and place the plus probe on post #12 (angle sensor output). If this value is **GREATER THAN +4.10 VDC** the angle sensor is defective and must be replaced.

Refer to the Section on Replacement and Adjustment for further instructions or contact PAT-KRUEGER.



CODE NO. 41
PRESS GREEN BUTTON OR CALL SERVICE

The cause for this error message is due to a defect in the cable between the junction box and Luffing Jib Angle Sensor (low output voltage) or a defective angle sensor.

To correct this situation the following steps are to be taken:

1. Check all the wiring between the junction box and the Angle Sensor, located on the Luffing Jib base section, for physical damage and/or loose connections at receptacles and other connection points. Repair as necessary and push the Green Button to reset the system.
2. With the luffing Jib at a 0 degree angle, check the following terminals in the junction box for voltage outputs.

Terminals #37 or #38 are 0 VDC. This is the angle sensor ground.

Terminals #39 or #40 are +5 VDC. This is the angle sensor supply voltage.

Terminal #33 is the output of the angle sensor. With the Luffing Jib at 0 degrees output should be approximately +1.00 VDC. Place the minus probe of the volt meter on terminal #37 or #38 and the plus probe on terminal #33 to measure the voltage. To cause this error message the voltage must be LESS THAN +0.60 VDC.

If the voltage is GREATER THAN +0.60 VDC the problem is either in the 32 Conductor Cable between the junction box and display panel or in the panel itself. In either case contact PAT-KRUEGER for further instructions.

If the voltage is LESS THAN +0.60 VDC continue to step 3.

3. Check the angle sensor for physical damage. The sensor is located on the Luffing Jib base section.

Remove the cover and locate the angle sensor and pendulum weight.

Identify posts #1a1, #12 and #13 on the angle sensor. Place the minus probe of the volt meter on post #1a1 and the plus probe on post #13. This should be 5 VDC. If this value is NOT 5 VDC then the problem is in the wiring to the junction box.

Leave the minus probe on post #1a1 and place the plus probe on post #12 (angle sensor output). If this value is LESS THAN +0.60 VDC the angle sensor is defective and must be replaced.

Refer to the Section on Replacement and Adjustment for further instructions or contact PAT-KRUEGER.



**CODE NO. 50
PRESS GREEN BUTTON OR CALL SERVICE**

The cause for this error code is due to a defect in the cable between the junction box and the load cell (high output voltage) or a defective load cell.

To correct this situation the following steps are to be taken:

1. Check all wiring from the Load Cell to the junction box for physical damage and/or loose connections at receptacles and other connection points. The load cell will be mounted on the Luffing Jib in a dead end load cell or tensiometer. Repair as necessary and push the Green Button to reset the system.
2. Check the load cell for physical damage and replace if needed. Press the Green Button to reset the system. Please note that changing the load cell may affect the accuracy of the Mark 3E/2 System.
3. With no load on the jib load line, check the following terminals for voltage outputs in the junction box:

Terminals #2, #3 or #4 are 0 VDC. This is system ground.

Terminals #5, #6 or #7 are +12 VDC. This is supply voltage.

Terminal #34 is the output of the load cell. Output voltage should be between +2.50 VDC and 7.50 VDC. Place the minus probe of the volt meter on terminal #2, #3 or #4 and the plus probe on terminal #34 to measure the output voltage. To cause this error message the voltage must be GREATER THAN +8.20 VDC.

If the voltage is GREATER THAN +8.20 VDC the problem is either in the cable between the junction box and load cell or a defective load cell.

If the voltage at the junction box is between +2.50 and 7.50 VDC., the problem is either in the 32 Conductor Cable between the junction box and display panel or in the panel itself.

In either case contact PAT-KRUEGER for further instructions.

**CODE NO. 51
PRESS GREEN BUTTON OR CALL SERVICE**

The cause for this error message is due to a defect in the cable between the junction box and load cell (low output voltage) or a defective sensor.

To correct this situation the following steps are to be taken:

1. Check all wiring from the load cell to the junction box for physical damage and/or loose



connections at receptacles and other connection points. The load cell is located on the jib in a dead end load cell or tensiometer. Repair as necessary and push the Green Button to reset the system.

2. Check the load cell for physical damage and replace if needed. Press the Green button to reset the system. Please note that changing the load cell may affect the accuracy of the Mark 3E/2 System.
3. With no load on the jib load line, check the following terminals for voltage outputs in the junction box:

Terminals #2, #3 or #4 are 0 VDC. This is system ground.

Terminals #5, #6 or #7 are +12 VDC. This is supply voltage.

Terminal #34 is the output of the load cell. Output voltage should be between +2.50 VDC and 7.50 VDC. Place the minus probe of the volt meter on terminal #2, #3 or #4 and the plus probe on terminal #34 to measure the output voltage. To cause this error message the voltage must be LESS THAN +1.85 VDC.

If the voltage is LESS THAN +1.85 VDC the problem is either in the cable between the junction box and load cell sensor or a defective load cell.

If the voltage at the junction box is BETWEEN +2.50 and 7.50 VDC., the problem is either in the 32 Conductor Cable between the junction box and display panel or in the panel itself.

In either case contact PAT-KRUEGER for further instructions.

**SENSOR OUTPUT (ROD) E:60
PRESS GREEN BUTTON OR CALL SERVICE**

The cause for this error code is due to a defect in the cable between the junction box and the pressure sensor (high output voltage) or a defective pressure sensor.

To correct this situation the following steps are to be taken:

1. Check all wiring from the individual pressure sensors or complete Hydraulic Box to the junction box for physical damage and/or loose connections at receptacles and other connection points. The pressure sensors are located on the holding valve of the lift cylinder. The complete Hydraulic Box, if used, is located near the junction box. Repair as necessary and push the Green Button to reset the system.
2. Check the pressure sensors for physical damage and replace if needed. Press the Green button to reset the system. Please note that changing the pressure sensors may affect the accuracy of the Mark 3E/2 System.



3. With no load on the boom, check the following terminals for voltage outputs in the junction box:

Terminals #2, #3 or #4 are 0 VDC. This is system ground.

Terminals #5, #6 or #7 are +12 VDC. This is supply voltage.

Terminal #35 is the output of the pressure sensor. Output voltage should be between +2.50 VDC and 7.50 VDC. Place the minus probe of the volt meter on terminal #2, #3 or #4 and the plus probe on terminal #35 to measure the output voltage. To cause this error message the voltage must be GREATER THAN +8.20 VDC.

If the voltage is GREATER THAN +8.20 VDC the problem is either in the cable between the junction box and pressure sensor or a defective pressure sensor.

If the voltage at the junction box is BETWEEN +2.50 and 7.50 VDC., the problem is either in the 32 Conductor Cable between the junction box and display panel or in the panel itself.

In either case contact PAT-KRUEGER for further instructions.

**SENSOR OUTPUT (ROD) E:61
PRESS GREEN BUTTON OR CALL SERVICE**

The cause for this error message is due to a defect in the cable between the junction box and pressure sensor (low output voltage) or a defective sensor.

To correct this situation the following steps are to be taken:

1. Check all wiring from the individual pressure sensors or complete Hydraulic Box to the junction box for physical damage and/or loose connections at receptacles and other connection points. The pressure sensors are located on the holding valve of the lift cylinder. The complete Hydraulic Box, if used, is located near the junction box. Repair as necessary and push the Green Button to reset the system.
2. Check the pressure sensors for physical damage and replace if needed. Press the Green button to reset the system. Please note that changing the pressure sensors may affect the accuracy of the Mark 3E/2 System.
3. With no load on the boom, check the following terminals for voltage outputs in the junction box:

Terminals #2, #3 or #4 are 0 VDC. This is system ground.

Terminals #5, #6 or #7 are +12 VDC. This is supply voltage.

Terminal #35 is the output of the pressure sensor. Output voltage should be between +2.50



VDC and 7.50 VDC. Place the minus probe of the volt meter on terminal #2, #3 or #4 and the plus probe on terminal #35 to measure the output voltage. To cause this error message the voltage must be LESS THAN +1.85 VDC.

If the voltage is LESS THAN +1.85 VDC the problem is either in the cable between the junction box and pressure sensor or a defective pressure sensor.

If the voltage at the junction box is BETWEEN +2.50 and 7.50 VDC., the problem is either in the 32 Conductor Cable between the junction box and display panel or in the panel itself.

In either case contact PAT-KRUEGER for further instructions.

**CODE NO. 70
PRESS GREEN BUTTON OR CALL SERVICE**

Eprom was Exchanged

This error message is displayed when the actual checksum of the Operating System Eprom 27C256 (U1) is different than the checksum stored in Serial EEprom 24C04 or 24C16 (U13).

When this message occurs, it generally indicates that data has been corrupted.

Contact PAT-KRUEGER for further instructions.

**CODE NO. 71
PRESS GREEN BUTTON OR CALL SERVICE**

Eprom was Exchanged

This error message is displayed when the actual checksum of the Data E-Prom #1 27C256 (U3) is different than the checksum stored in Serial EEprom 24C04 or 24C16 (U13).

When this message occurs, it generally indicates that data has been corrupted.

Contact PAT-KRUEGER for further instructions.

**CODE NO. 72
PRESS GREEN BUTTON OR CALL SERVICE**

EEprom was Exchanged

This error message is displayed when the actual checksum of Data EE- Prom #2 28C64 (U2) is different than the checksum stored in Serial EEprom 24C04 or 24C16 (U13).

When this message occurs, it generally indicates data has been corrupted.

Contact PAT-KRUEGER for further instructions.



**CODE NO. 74
PRESS GREEN BUTTON OR CALL SERVICE**

Wrong EPROM in EEPROM location

This error message is displayed when an incorrect EEPROM is installed at location (U2) of the CPU board.

If this occurs in the field, it would indicate that someone has tampered with the LMI.

Contact PAT-KRUEGER for further instructions.

**CODE NO. 75
PRESS GREEN BUTTON OR CALL SERVICE**

Wrong EPROM in DATA EPROM location

This error message is displayed when an incorrect EPROM is installed at location (U3) of the CPU board.

If this occurs in the field, it would indicate that someone has tampered with the LMI.

Contact PAT-KRUEGER for further instructions.

**CODE NO. 80
PRESS GREEN BUTTON OR CALL SERVICE**

Time Clock does NOT Run

This error message is displayed when the IC NSC 810 (U15) is defective.

To correct, the panel should be returned to PAT-KRUEGER for evaluation and repair.

**CODE NO. 81
PRESS GREEN BUTTON OR CALL SERVICE**

Converter does NOT work

This error message is displayed when the AD-converter (U24) is defective.

To correct this situation, the panel should be returned to PAT-KRUEGER for evaluation and repair.



**CODE NO. 82
PRESS GREEN BUTTON OR CALL SERVICE**

Error in Shut Off Circuit

This error message is displayed when a failure occurs in the A-2-B shut off circuit or the LM shut off circuit. This problem can be created by damaged wiring, failure of either relay K2 or K4 in the junction box, or a defect in the display panel.

To correct this situation, the following steps are to be taken:

1. With **no** Two Block condition (12 volts at terminal 16) read the voltage at terminal 17.
If the voltage is **NOT** 0 volts, then relay K2 is defective.
2. **Create** a Two Block condition (0 volts at terminal 16) read the voltage at terminal 17.
If the voltage is **NOT** 5 volts, then either relay K2 is defective or the external wiring in this circuit should be checked for possible damage.
3. Remove the pink/green wire from terminal 17 and read the voltage on the wire.
If the voltage is **NOT** 5 volts, then the external wiring for this circuit should be checked for possible damage. Replace the pink/green wire on terminal 17.
4. With **no** Two Block condition (12 volts at terminal 16) read the voltage at terminal 18.
If the voltage is **NOT** 12 volts, then either relay K2 is defective or the external wiring in the circuit should be checked for possible damage.

If the voltage **IS** 12 volts, then go to the next step.
5. **Create** a Two Block condition (0 volts at terminal 16) and read the voltage at terminal 18.
If the voltage is **NOT** 0 volts, then either relay K2 or K4 is defective or the external wiring in this circuit should be checked for possible damage.
6. With **no** Two Block condition (12 volts at terminal 16) read the voltage at terminal 23.
If the voltage is **NOT** 5 volts, then either relay K4 is defective or the external wiring in this circuit should be checked for possible damage.
7. Remove the brown/black wire from terminal 23 and read the voltage on the wire
If the voltage is **NOT** 5 volts, then the external wiring in this circuit should be checked for possible damage.
8. **Create** a Two Block condition (0 volts at terminal 16) and read the voltage at terminal 23.
If the voltage is **NOT** 5 volts, then relay K4 is defective.

Contact PAT-KRUEGER for further instructions. Field repair may be possible.



**CODE NO. 83
PRESS GREEN BUTTON OR CALL SERVICE**

Incorrect 12V. Power Supply

This error message is displayed when the power supply voltage to the system drops below 9.6 VDC.

To determine the source of the problem proceed as follows:

1. Check the voltage on terminal #1 in the junction box for +12 VDC or +24 VDC [+/- 20%]. Terminal #1 is the unfused power source input. Voltage at terminal #1 will be determined by the Crane electrical system.
2. If the voltage at terminal #1 is < 9.6 VDC. (for a 12V. charging circuit) or < 10.3 VDC. (for a 24V. charging circuit), check the electrical charging system of the crane to determine the cause for the low voltage.
3. If the voltage at terminal #1 is > 9.6 VDC. Check the voltage on terminals #5, #6, and #7 in the junction box. This is the fused 12 VDC power source regardless of the power supply voltage at terminal #1.

If the machine has a 24V. Charging Circuit and the voltage at terminals #5, #6 or #7 < 9.6 VDC. the 24/12V converter module is defective.

Contact PAT-KRUEGER for further instructions. Field repair may be possible.

**CODE NO. 84
PRESS GREEN BUTTON OR CALL SERVICE**

Incorrect 5V. Analog Voltage

This error message is displayed when the regulated +5.00 VDC source is above or below the allowable range of +4.875 VDC to +5.125 VDC or the D-A converter (U16) is defective.

Check the following terminals in the junction box to determine the actual voltage.

1. Place the minus probe of the volt meter on terminal #37 or #38 and the plus probe on terminal #39 or #40.
2. If the voltage is below 4.875 VDC remove all wire connections to terminal #39 and #40 except for the Blue and Red wires coming from the 32 Conductor panel cable.

Again check the voltage as described in step #1.

3. If the voltage is in the acceptable range the display panel or wiring from the junction box to



the panel is defective.

Contact PAT-KRUEGER for further instructions.

**CODE NO. 90
PRESS GREEN BUTTON OR CALL SERVICE**

No Length Programed

This code pertains to lattice cranes only. This message should not be displayed during operation as it is only used as a programmer's tool.

OPERATING ERRORS

Operating errors are displayed on the control panel in plain language. These errors are normally caused by operation outside of the programed machine capacity chart values or when actual machine configuration differs from the programed configuration.

To monitor the actual conditions that have caused the error message to be displayed push and release one of the blue push buttons. This will change the display from the error message to the actual crane configuration information including boom angle, boom length, radius, load on the hook and maximum load. This can be compared to the crane manufacturer's capacity chart to assist the operator in selecting the safest method to correct the problem.

When the condition which caused the error message to be displayed is corrected, the system will automatically reset to the normal operating mode.

**APPROACHING TWO-BLOCK CONDITION
CORRECT ABOVE CONDITION**

The red push button will flash and the horn will sound on the display panel.

This error message is displayed at an approaching two-block condition, if there is open wiring in the two-block circuit or if the K2 relay in the junction box is defective.

This condition can generally be corrected by either lowering the hook or retracting the boom.

1. If the machine is equipped with an auxiliary winch check the following:

If no other attachment is in use, have you installed the dummy plug?

If another attachment is installed, have you plugged in the second Anti-Two-Block switch?

2. If the condition CANNOT be cleared with the momentary key switch on the panel the shut



off circuit relay K2 is defective.

3. If the problem persists check terminal #16 for +12 VDC in the junction box. This is the anti-two-block return line. In a two-block condition, terminal #16 should be 0 VDC.

If terminal #16 is 0 VDC and the Two-Block condition has been corrected, lower the boom and inspect the cable reel cable for damage and check for loose connections at the Anti-Two-Block switch or receptacles.

If terminal #16 is 12 VDC and the Two-Block condition has been corrected, the problem is in the wiring between the junction box and display panel or a defective panel.

Contact PAT-KRUEGER for further instructions.

**MAXIMUM CAPACITY
REDUCE LOAD MOMENT**

The red push button will light and the horn will sound.

This error message is displayed when the actual load exceeds the rated load, or because the selected parts of line are restricting the lifting capacity of the machine.

This condition should be corrected by reducing the load or operating at a shorter radius.

Change Parts of Line to agree with actual machine reeving.

**NON WORKING AREA
SWING INTO LOAD CHART AREA**

This error message is displayed when the operator is attempting to work in an area that is not approved by the crane manufacturer or because there is a defective roller switch.

To correct this condition swing the crane upper over the front of a Rough Terrain Crane or over the rear of a Truck Crane.

If this does not correct the problem check the roller switches and wiring for damage. Repair as necessary.

1. Check terminals #13, #26, #27, or #29 in the junction box for +12 VDC. Refer to the wiring diagram for roller switch usage. The error message is displayed when terminal #13 is 12 VDC and terminals #26, #27, and #29 are 0 VDC.
2. The roller switch connected to terminal #29 is used for Over Front Shut off in an on Tires condition for a Truck Crane only.



Contact PAT-KRUEGER for further instructions.

**NO LOAD CALCULATION POSSIBLE
CHECK LENGTH AND/OR PROGRAM**

This error message is displayed when the actual boom length exceeds the programmed length of the pressure profile.

This can be corrected by retracting the boom.

This error message normally appears when the machine is operating on tires and the capacity chart restricts the maximum boom length to a length less than fully extended.

**COUNTERWEIGHT CONTROL
CHECK**

This error message is displayed when the programmed counterweight position does not agree with the actual installed configuration or the sensor is defective.

This condition can be corrected by properly positioning the machine counterweight.

If this does not correct the problem check the sensor and wiring for possible damage.

1. Check terminal #28 in the junction box for +12 VDC. Check the wiring diagram for roller switch usage. The error message is displayed when #28 is 0 VDC.

Contact PAT-KRUEGER for further instructions.

**AXLE BLOCKING
CHECK POSITION**

The reason for this message is either because the axle lock is not engaged or because the wiring to the axle lock is defective.

To correct this engage the axle lock.

If this does not correct the problem check the sensor and wiring for possible damage.

1. Check terminal #29 in the junction box for +12 VDC. Check the wiring diagram for roller switch usage. The error message is displayed when #29 is 0 VDC.

Contact PAT-KRUEGER for further instructions.



**BOOM LENGTH SHORTER THAN LOAD CHART
CORRECT ABOVE CONDITION**

This error message is displayed when the actual boom length is shorter than allowed by the programed machine configuration.

An example would be a fully retracted boom length is measured when the programed configuration is expecting a main boom length with the powered boom sections retracted and the manual section extended.

Compare the actual displayed boom length to the crane manufacturer's capacity chart.

This condition should be corrected by setting the LMI configuration to match the actual machine configuration or increasing the boom length.

To verify boom lengths:

1. Select a program configuration that measures only main boom length. Fully retract the main boom.
2. The display panel should indicate a main boom length comparable to the shortest main boom length on the capacity chart.
3. Fully extend the main boom. The display panel should indicate a boom length comparable to the longest main boom length on the capacity chart.

A variation of approximately ± 3 Feet would indicate one wrap of cable was removed or added to the cable reel.

Refer to the Section on Replacement and Adjustment for further instructions or contact PAT-KRUEGER.

**BOOM LENGTH LONGER THAN LOAD CHART
CORRECT ABOVE CONDITION**

This error message is displayed when the actual boom length is longer than allowed by the programed machine configuration.

An example would be a measured boom length with main boom with manual section fully extended and the program expecting a maximum boom length equal to a fully extended main boom with manual section retracted.

Compare the actual displayed boom length to the crane manufacturer's capacity chart.

This condition should be corrected by setting the LMI configuration to match the actual machine configuration or reducing the actual boom length.



To verify boom lengths:

1. Select a program configuration that measures only main boom length. Fully retract the main boom.
2. The display panel should indicate a main boom length comparable to the shortest main boom length on the capacity chart.
3. Fully extend the main boom. The display panel should indicate a boom length comparable to the longest main boom length on the capacity chart.

A variation of approximately ± 3 Feet would indicate one wrap of cable was removed or added to the cable reel.

Refer to the Section on Replacement and Adjustment for further instructions or contact PAT-KRUEGER.

**BOOM ANGLE BELOW LOAD CHART
CORRECT ABOVE CONDITION**

This error message is displayed when the operator has lowered the boom to a position less than allowed by the crane manufacturer's angle/load capacity chart. This message can be expected when operating with the manual section extended and/or a Lattice Extension installed.

Compare the actual displayed boom angle to the crane manufacturer's capacity chart.

This condition should be corrected by raising or increasing the boom angle.

To verify Boom Angle:

Lower the boom to 0 degree angle. Use an angle protractor to verify angle of boom.

Compare the actual angle to the angle displayed on the panel.

Raise the boom to a high angle. Use an angle protractor to verify the actual angle.

Compare the actual measured angle to the angle displayed on the panel.

Refer to the Section on Replacement and Adjustment for further instructions or contact PAT-KRUEGER.

**BOOM ANGLE ABOVE LOAD CHART
CORRECT ABOVE CONDITION**

This error message is displayed when the operator has raised the boom to a position higher than allowed by the crane manufacturer's angle/load capacity chart. This message can be expected



when operating with the manual section extended and/or a Lattice Extension installed.

Compare the actual displayed boom angle to the crane manufacturer's capacity chart.

This condition should be corrected by lowering or reducing the boom angle.

To verify Boom Angle:

Lower the boom to 0 degree angle. Use an angle protractor to verify angle of boom.

Compare the actual angle to the angle displayed on the panel.

Raise the boom to a high angle. Use an angle protractor to verify the actual angle.

Compare the actual measured angle to the angle displayed on the panel.

Refer to the Section on Replacement and Adjustment for further instructions or contact PAT-KRUEGER.

**RADIUS SHORTER THAN LOAD CHART
CORRECT ABOVE CONDITION**

This error message will be displayed when the operator reduces the actual operating radius to a value less than approved by the crane manufacturer's capacity chart. This message can be expected when operating with the main powered boom only.

Compare the actual displayed boom radius to the crane manufacturer's capacity chart.

This condition can be corrected by lowering the boom angle or increasing the boom length.

The radius is calculated from input information of Boom length and boom angle.

If you feel that this message is incorrect for your conditions verify that both boom length and boom angle are accurate. Refer to previous Boom Angle and Boom Length error messages for additional information.

**RADIUS LONGER THAN LOAD CHART
CORRECT ABOVE CONDITION**

This error message will be displayed when the operator increases the actual operating radius to a value greater than approved by the crane manufacturer's capacity chart. This message can be expected when operating with the main powered boom only.

Compare the actual displayed boom radius to the crane manufacturer's capacity chart.

This condition can be corrected by raising the boom angle or decreasing the boom length.



The radius is calculated from input information of Boom length and boom angle.

If you feel that this message is incorrect for your conditions verify that both boom length and boom angle are accurate. Refer to previous Boom Angle and Boom Length error messages for additional information.

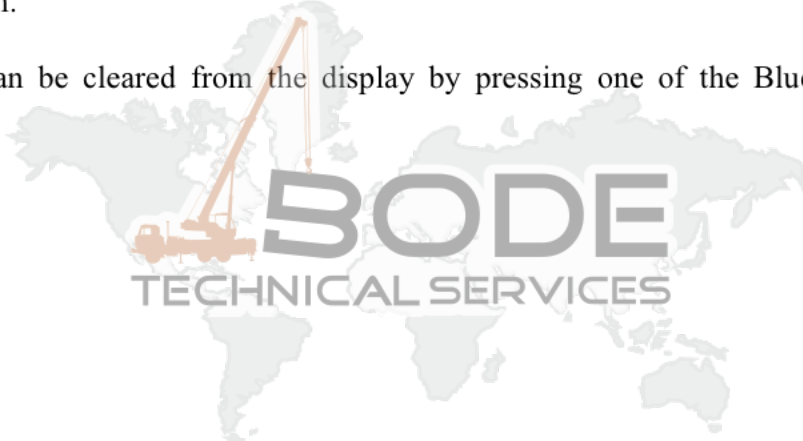
**LOAD MOMENT SHUT OFF "BY-PASSED"
REACTIVATE SHUT OFF WHEN OPERATING CRANE**

This error message will be displayed when the Load Moment Shut Off is by-passed at the junction box. While all other Operating Error messages are displayed at the appropriate times, the Crane Function Shut Off will have no effect on operation.

The Red warning light remains lit until this condition is corrected.

This condition will be corrected by following the instructions on the proper use of the LM Bypass Key switch.

This message can be cleared from the display by pressing one of the Blue buttons.





REPLACEMENT AND ADJUSTMENT

This section will provide the user with step-by-step procedures to replace the Angle and Length Transducers and to perform the necessary adjustments on these components

Please read through the replacement and/or adjustment procedures before you attempt to replace a component or make an adjustment. If a component replacement is necessary order the component from PAT-KRUEGER Corporation, Inc. before removing the component. Include crane model and serial number when ordering to allow PAT-KRUEGER technician's to test the potentiometer to ensure operation over the voltage range of the original system installation.

Not following these instructions completely could result in the need for a PAT-KRUEGER technician to completely re-calibrate the system.

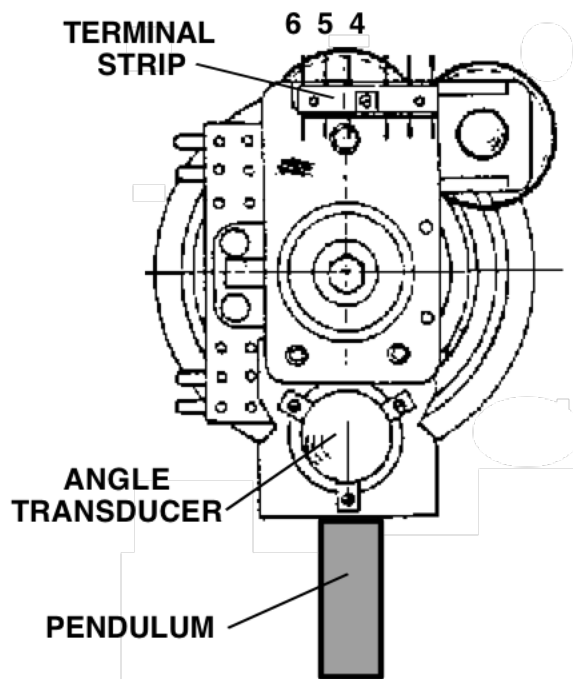
ANGLE TRANSDUCER REPLACEMENT

TOOLS REQUIRED:

- 5mm Allen wrench
- 8mm Box wrench
- Needle nose pliers
- Magnetic base angle protractor
- Small flat blade screwdriver
- Medium flat blade screwdriver

PROCEDURE

1. Fully retract the boom and lower to an angle that will provide you with access to the cable reel mounted on the boom base section.
2. Turn Off power to the Load Moment System.
3. Remove cable reel cover. Store the 4 screws, washers and clamps in a safe place.
4. Use the needle nose pliers to remove the three (3) wires from the Angle transducer at the terminal strip. These should be number #4, #5 and #6 on the terminal strip.
5. With the Allen wrench and the Box wrench remove the screws and nuts holding the angle transducer bracket to the cable reel.





6. Install the new Angle transducer in reverse sequence.
 7. Using the needle nose pliers connect the wires from the Angle transducer to the terminal strip.
 - BLUE to #4
 - BLACK to #5
 - GREEN to #6
 8. Supply power to the Load Moment System.
 9. Follow system start up procedure to put the display panel in the normal operating mode.
 10. Boom up to 5 or 6 degrees. Be sure to verify using Magnetic base angle protractor.
 11. If angle displayed on panel AGREES with actual angle shown on angle protractor proceed to step 13.
 12. If the angle displayed on the panel does NOT AGREE with the actual angle shown on the angle protractor proceed as follows:
 - Loosen, but DO NOT remove the three (3) screws holding the angle potentiometer clamps.
 - SLOWLY rotate the Potentiometer until the angle indication on the panel is the same as the actual angle on the angle protractor.
 - Tighten the 3 screws that hold the angle potentiometer clamps.
 13. Boom up to the maximum angle possible. Be sure to verify the actual boom angle using the Magnetic base angle protractor.
 14. If the angle displayed on the panel AGREES with the actual angle shown on the angle protractor go to step 16.
 15. If the Angle displayed on the panel DOES NOT agree with the actual angle shown on the angle protractor proceed as follows:
 - Loosen, but DO NOT remove the three (3) screws holding the angle potentiometer clamps.
 - SLOWLY rotate the Potentiometer until the angle indication on the panel is the same as the actual angle on the angle protractor.
 - Tighten the 3 screws that hold the angle potentiometer clamps.
- Steps 10 through 15 may need to be repeated more than once.



16. Lower boom and reinstall the cable reel cover.

The Angle Transducer has been replaced and adjusted. The machine can be put back into service.

ANGLE TRANSDUCER ADJUSTMENT

TOOLS REQUIRED:

- Small flat blade screwdriver
- Medium flat blade screwdriver
- Magnetic base angle protractor

PROCEDURE

1. Fully retract the boom and lower to an angle that will provide you with access to the cable reel mounted on the boom base section.
2. Remove cable reel cover. Store the 4 screws, washers and clamps in a safe place.
3. Supply power to the Load Moment System.
4. Follow system start up procedure to put the display panel in the normal operating mode.
5. Boom up to 5 or 6 degrees. Be sure to verify using Magnetic base angle protractor.
6. If angle displayed on panel AGREES with actual angle shown on angle protractor proceed to step 8.
7. If the angle displayed on the panel does NOT AGREE with the actual angle shown on the angle protractor proceed as follows:

Loosen, but DO NOT remove the three (3) screws holding the angle potentiometer clamps.

SLOWLY rotate the Potentiometer until the angle indication on the panel is the same as the actual angle on the angle protractor.

Tighten the 3 screws that hold the angle potentiometer clamps.
8. Boom up to the maximum angle possible. Be sure to verify the actual boom angle using the Magnetic base angle protractor.
9. If the angle displayed on the panel AGREES with the actual angle shown on the angle protractor go to step 11.

10. If the Angle displayed on the panel DOES NOT agree with the actual angle shown on the angle protractor proceed as follows:

Loosen, but DO NOT remove the three (3) screws holding the angle potentiometer clamps.

SLOWLY rotate the Potentiometer until the angle indication on the panel is the same as the actual angle on the angle protractor.

Tighten the 3 screws that hold the angle potentiometer clamps.

Steps 5 through 10 may need to be repeated more than once.

11. Lower boom and reinstall the cable reel cover.

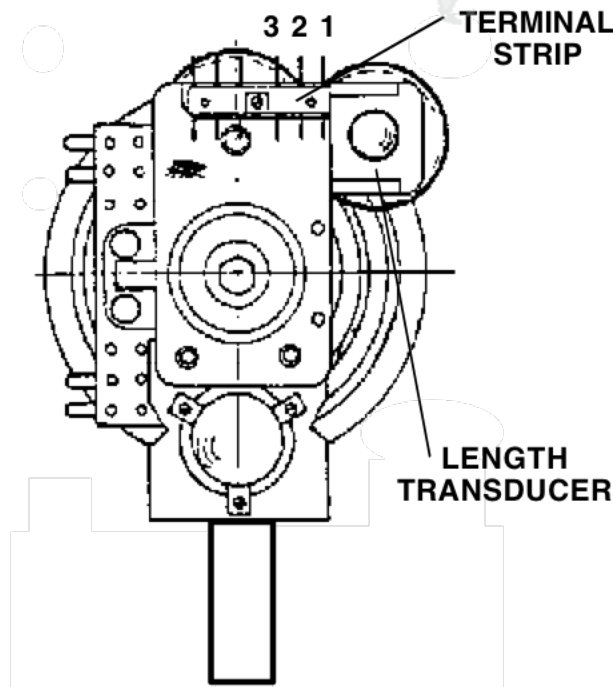
The Angle Transducer has been adjusted. The machine can be put back into service.

LENGTH TRANSDUCER REPLACEMENT

TOOLS REQUIRED:

- 1.5mm Allen wrench
- 13mm Open end wrench
- Medium flat blade screwdriver
- Needle nose pliers
- Digital Volt-Ohm meter

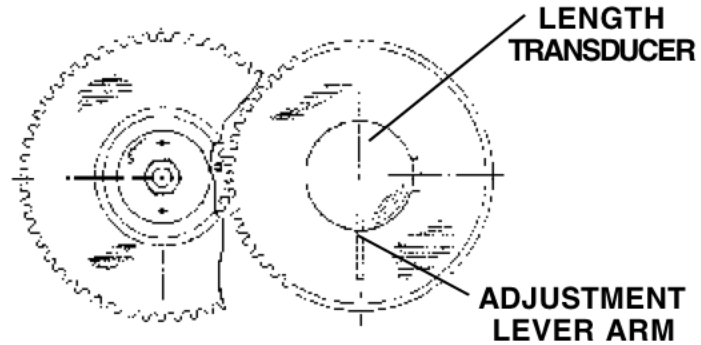
PROCEDURE



1. Locate machine in an area that will allow you to safely extend the boom to it's full extension (Powered sections plus manual section).
2. Fully retract the boom and lower to an angle that will provide you with access to the cable reel mounted on the boom base section.
3. Turn Off power to the Load Moment System.
4. Remove cable reel cover. Store the 4 screws, washers and clamps in a safe place.



5. Rotate the arm attached to the length potentiometer until the setscrew is accessible. Loosen, but DO NOT remove the setscrew.
6. Rotate the arm until the second setscrew is accessible. Loosen, but DO NOT remove the setscrew.



7. Remove the arm from the Length potentiometer and store in a safe location.
8. Remove the nylon gear from the length potentiometer shaft.
9. Use the 13mm wrench to remove the length potentiometer from the mounting bracket.
10. Use the needle nose pliers to remove the three (3) wires from the length transducer at the terminal strip. These will be #1, #2 and #3 on the terminal strip.
11. Install the new length potentiometer in the mounting bracket. Tighten ONLY finger tight at this time.
12. Insert the blade of the screwdriver between the potentiometer and mounting bracket. This will locate the potentiometer to ensure proper mesh of the gear set. Tighten the nut on the potentiometer tightly to secure it in the bracket.
13. Install the large nylon gear on the potentiometer shaft. Be sure that the brass spacer is facing toward the boom.
14. Install the lever arm on the potentiometer shaft and tighten both setscrews.
15. Using the needle nose pliers connect the wires from the length potentiometer to the terminal strip.
BLUE to #1
BLACK to #2
GREEN to #3
16. Set VOLT-OHM meter to read OHMS. Place one probe on terminal #1 of the terminal strip and the other probe on terminal #2.

Turn the lever arm until the meter indicates approximately 95 OHMS.

Remove the meter from the circuit.

17. Supply power to the Load Moment System.



18. Follow system start up procedure to put the display panel in the normal operating mode.
19. With all boom sections FULLY RETRACTED rotate lever arm on the length potentiometer until the length displayed on the panel indicates the shortest boom length shown on the crane capacity chart.
20. FULLY EXTEND all boom sections, including the manual section. Panel should display the maximum extended boom length.
21. FULLY RETRACT all boom sections, including the manual section. The panel should display the fully retracted length originally set in step 19.

If the length displayed on the panel AGREES with the length set in step 19 go to step 22.

If the length displayed DOES NOT AGREE with the length set in step 19, the lever arm has slipped. Re-tighten the setscrews with the 1.5mm Allen wrench and repeat steps 19 through 21.

22. Reinstall the cable reel cover.

The Length transducer has been replaced and adjusted. The machine can be put back in service.



RODE
LENGTH TRANSDUCER ADJUSTMENT
TECHNICAL SERVICES

TOOLS REQUIRED:

- Medium flat blade screwdriver
- 1.5mm Allen wrench

PROCEDURE

1. Locate machine in an area that will allow you to safely extend the boom to it's full extension (Powered sections plus manual section).
2. Fully retract the boom and lower to an angle that will provide you with access to the cable reel mounted on the boom base section.
3. Remove cable reel cover. Store the 4 screws, washers and clamps in a safe place.
4. Follow system start up procedure to put the display panel in the normal operating mode.
5. With all boom sections FULLY RETRACTED rotate lever arm on the length potentiometer until the length displayed on the panel indicates the shortest boom length shown on the crane capacity chart.



6. FULLY EXTEND all boom sections, including the manual section. Panel should display the maximum extended boom length.
7. FULLY RETRACT all boom sections, including the manual section. The panel should display the fully retracted length originally set in step 5.

If the length displayed on the panel AGREES with the length set in step 5 proceed to step 8.

If the length displayed DOES NOT AGREE with the length set in step 5, the lever arm has slipped. Re-tighten the setscrews with the 1.5mm Allen wrench and repeat steps 5 through 7.

8. Reinstall the cable reel cover.

The Length Transducer has been adjusted. The machine can be put back in service.

Additional assistance may be obtained by watching the Troubleshooting Video. This video has been provided to compliment this Troubleshooting Manual.

Krüger products are sold and serviced in North America by:

PAT-KRUEGER Corporation, Inc.
980 Industrial Court
Rockford, IL 61111-7512

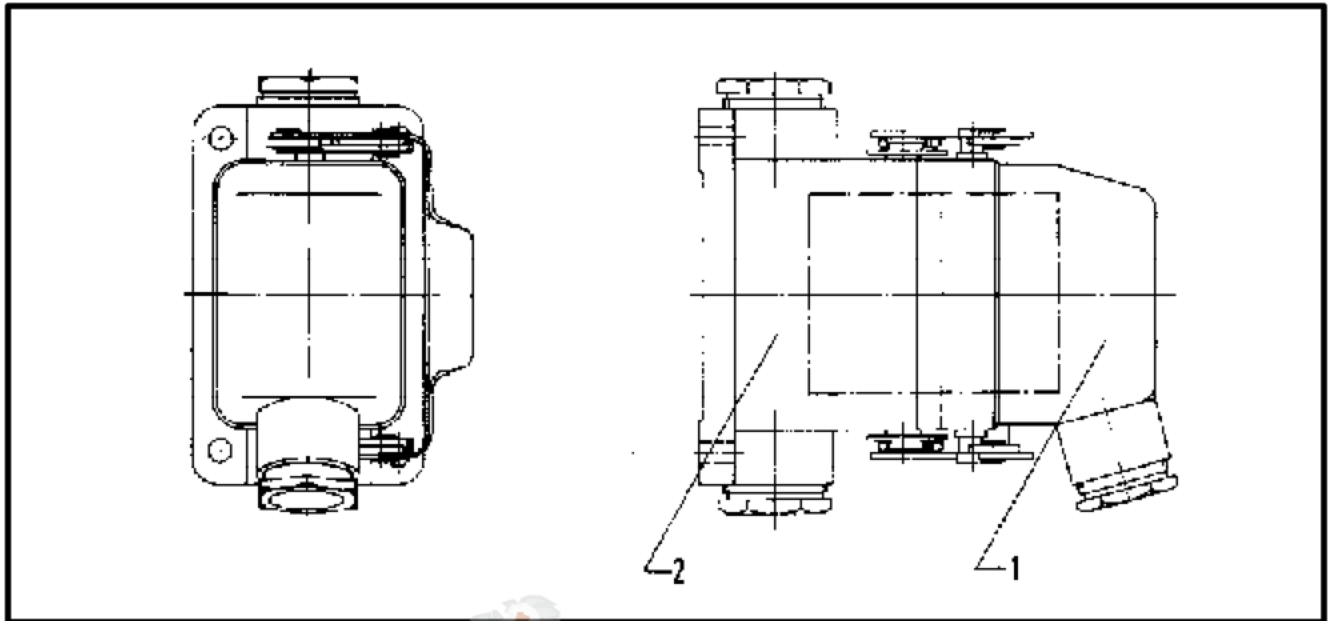
Telephone: (815) 877-2100
Fax: (815) 877-2117



COMPONENT LISTING

Component: **10 Pin - Plug/Receptacle**

Article No.:



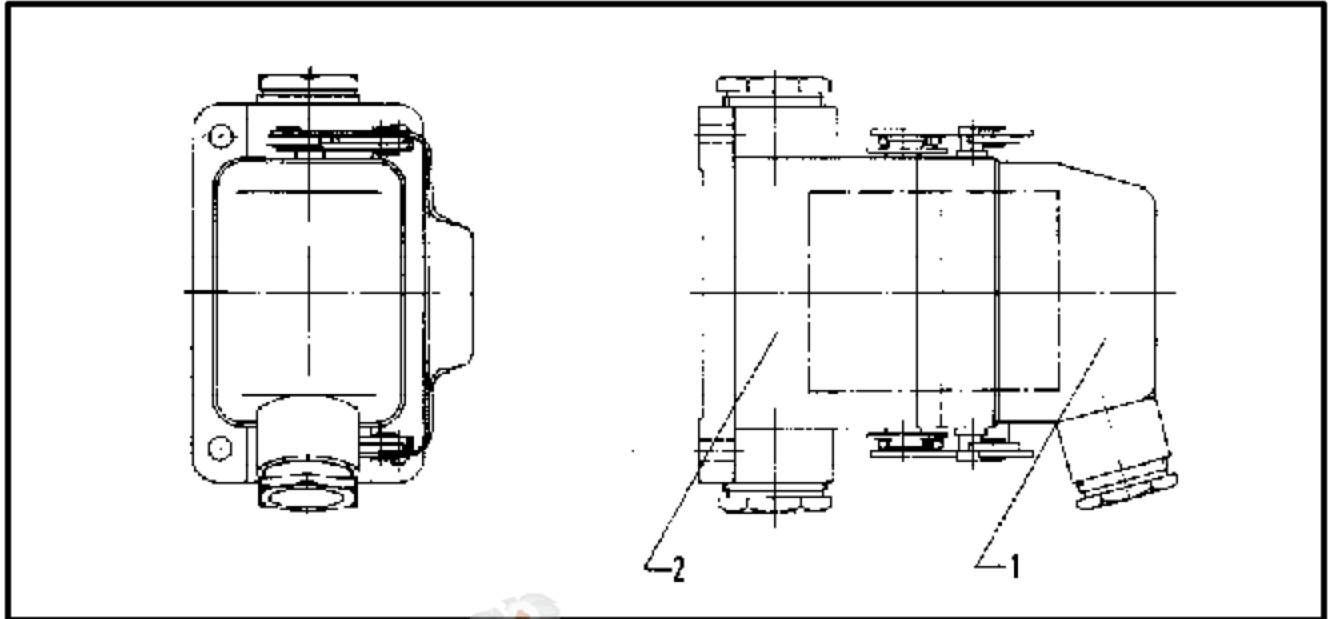
<u>ITEM NO.</u>	<u>DESCRIPTION</u>	<u>QUAN.</u>	<u>ARTICLE NO.</u>
1	10 Pin Plug		1-0011059.00
	- Housing	1	2-0001007.00
	- Male Insert	1	1-0016378.00
Not Shown	- Cable Connector - PG 16	1	1-0011867.00
2	10 Pin Receptacle		1-0011058.00
	- Housing	1	2-0001008.00
	- Female Insert	1	1-0016375.00
Not Shown	- Cable Connector - PG 16	2	1-0011867.00
	- Blind Plug - PG 16 (Metallic)	1	2-0000813.00
	Required for mounting - Order separately		
	Weld Plate	1	2-0000255.00



COMPONENT LISTING

Component: **6 Pin - Plug/Receptacle**

Article No.:

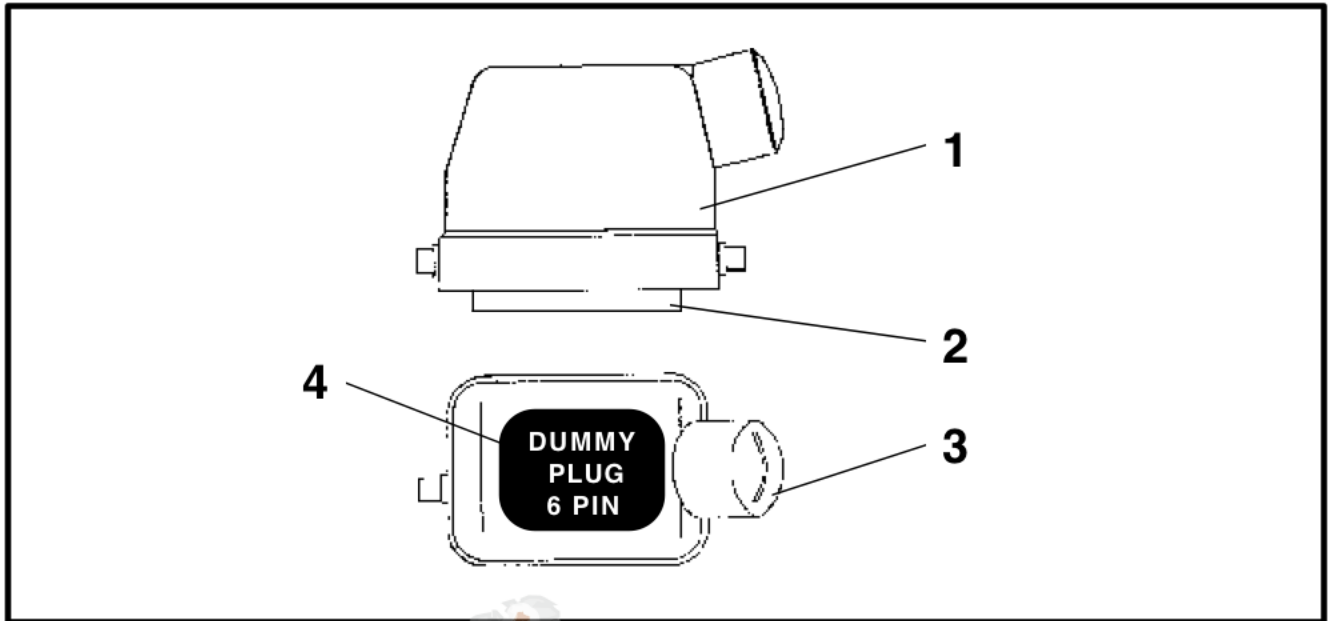


<u>ITEM NO.</u>	<u>DESCRIPTION</u>	<u>QUAN.</u>	<u>ARTICLE NO.</u>
1	6 Pin Plug		1-0011642.00
	- Housing	1	2-0001005.00
	- Male Insert	1	1-0016377.00
Not Shown	- Cable Connector - PG 16	1	1-0011867.00
2	6 Pin Receptacle		1-0011641.00
	- Housing	1	2-0001006.00
	- Female Insert	1	1-0016037.00
Not Shown	- Cable Connector - PG 16	2	1-0011867.00
	- Blind Plug - PG 16 (Metallic)	1	2-0000813.00
	Required for mounting - Order separately		
	Weld Plate	1	2-0000255.00



Component: **Dummy Plug - 6 Pin**

Article No.: **1-0011642.20**



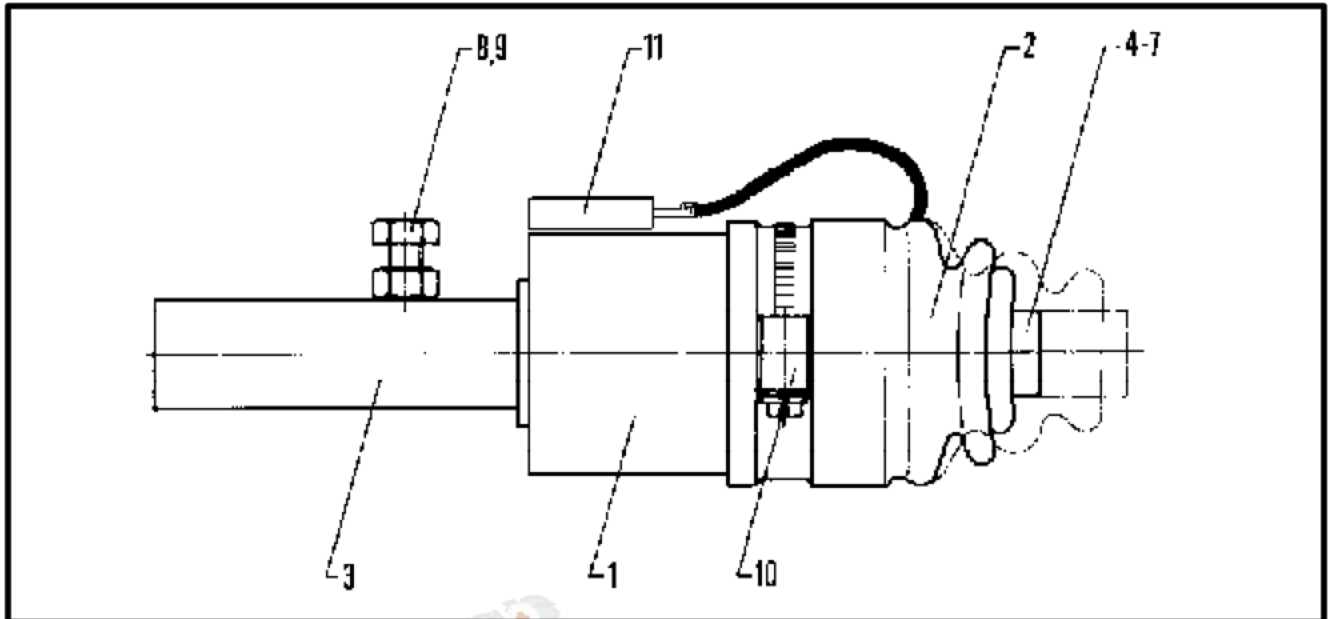
<u>ITEM NO.</u>	<u>DESCRIPTION</u>	<u>QUAN.</u>	<u>ARTICLE NO.</u>
1	Housing	1	2-0001005.00
2	Male Insert	1	1-0016377.00
3	Blind Plug - PG 16 (Metallic)	1	2-0000813.00
4	Decal	1	2-0000992.00





Component: **MAGNET VALVE - 12V. "D"**

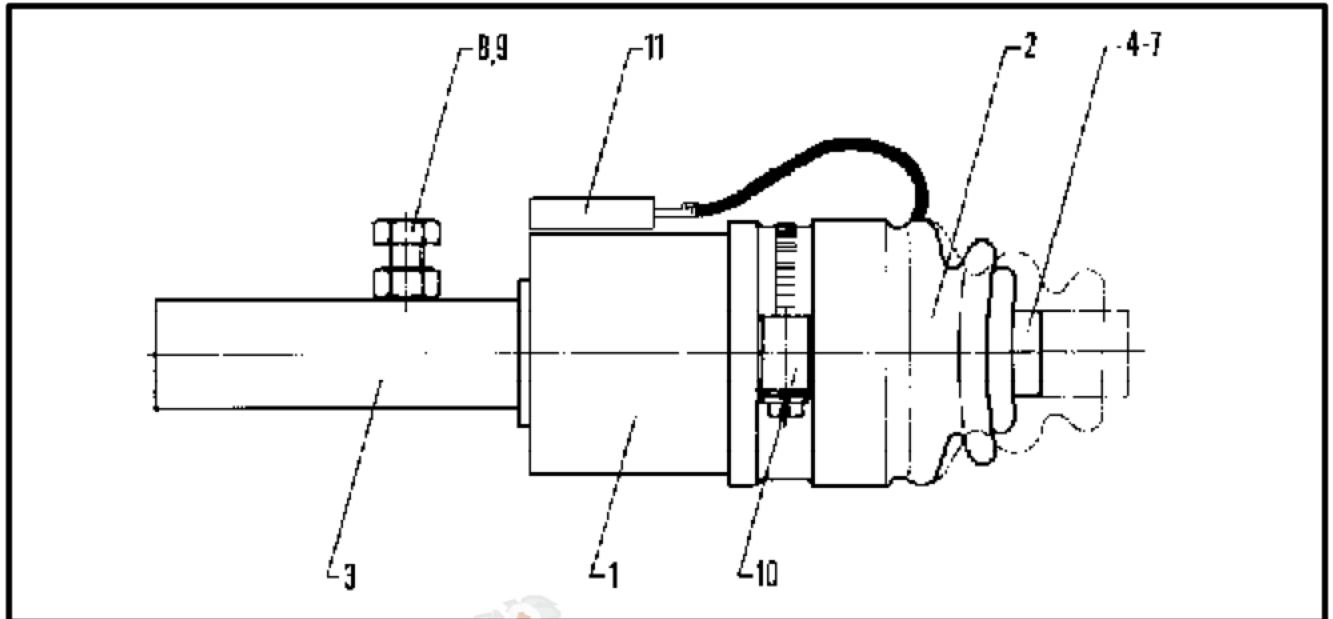
Article No.: **1-0010387.00**



<u>ITEM NO.</u>	<u>DESCRIPTION</u>	<u>QUAN.</u>	<u>ARTICLE NO.</u>
1	Magnet Valve Body - 12 V.	1	1-0023248.00
2	Rubber Valve Cover	1	1-0010428.00
3	Weld Rod Case	1	1-0101028.00
4	Shaft - 20mm	1	1-0010434.00
5	Shaft Retainer	1	1-0010424.00
6	Short Weld Adapter	1	1-0010423.00
7	Hex Nut - M12	1	1-0010422.00
8	Hex Head Capscrew - M8 x 16	1	1-0010089.00
9	Hex Nut - M8	1	1-0010427.00
10	Clamp	1	1-0010429.00
11	Terminal	1	1-0019368.00

Component: **MAGNET VALVE - 12V. "Z"**

Article No.: **1-0010386.00**

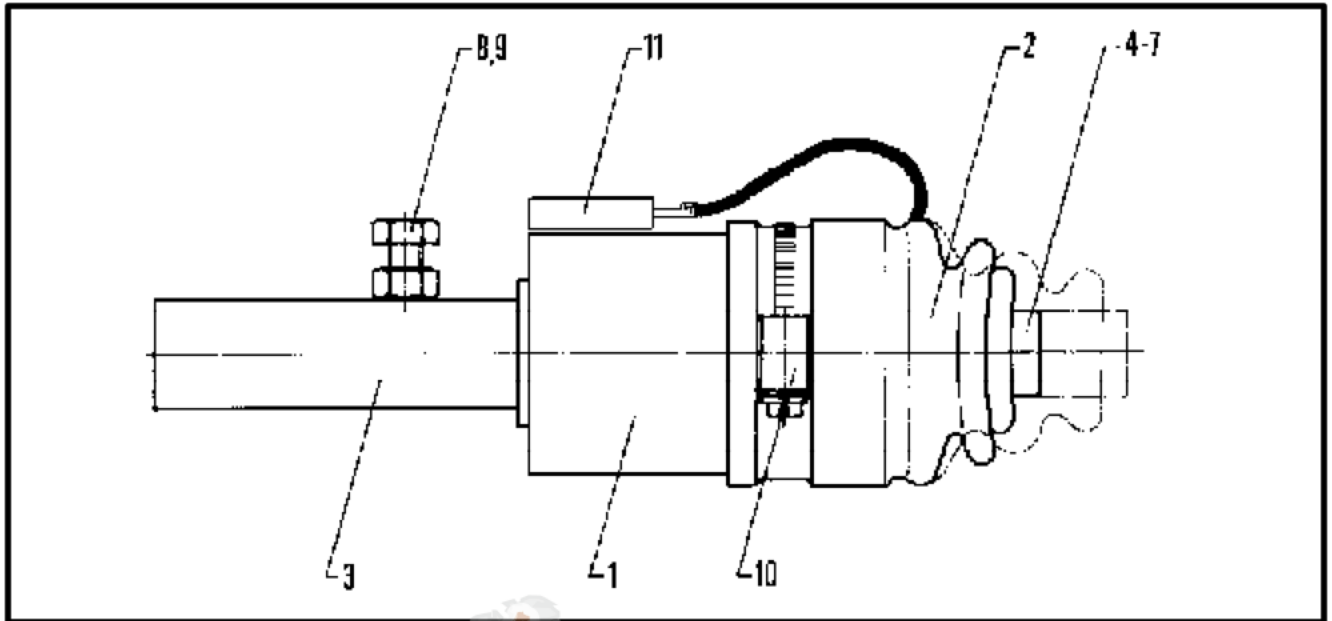


<u>ITEM NO.</u>	<u>DESCRIPTION</u>	<u>QUAN.</u>	<u>ARTICLE NO.</u>
1	Magnet Valve Body - 12 V.	1	1-0023248.00
2	Rubber Valve Cover	1	1-0010428.00
3	Weld Rod Case	1	1-0101028.00
4	Shaft - 20mm	1	1-0010435.00
5	Shaft Retainer	1	1-0010424.00
6	Short Weld Adapter	1	1-0010423.00
7	Hex Nut - M12	1	1-0010422.00
8	Hex Head Capscrew - M8 x 16	1	1-0010089.00
9	Hex Nut - M8	1	1-0010427.00
10	Clamp	1	1-0010429.00
11	Terminal	1	1-0019368.00



Component: **MAGNET VALVE - 24V. "D"**

Article No.: **1-0010392.00**

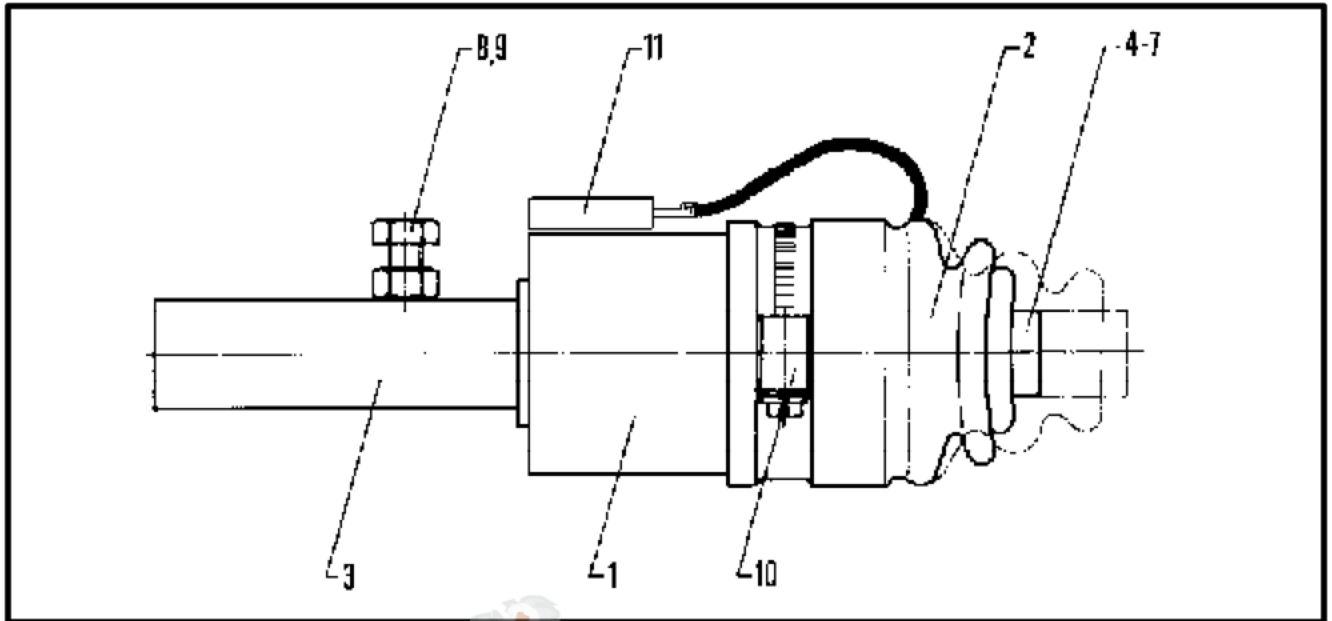


<u>ITEM NO.</u>	<u>DESCRIPTION</u>	<u>QUAN.</u>	<u>ARTICLE NO.</u>
1	Magnet Valve Body - 12 V.	1	1-0023260.00
2	Rubber Valve Cover	1	1-0010428.00
3	Weld Rod Case	1	1-0101028.00
4	Shaft - 20mm	1	1-0010434.00
5	Shaft Retainer	1	1-0010424.00
6	Short Weld Adapter	1	1-0010423.00
7	Hex Nut - M12	1	1-0010422.00
8	Hex Head Capscrew - M8 x 16	1	1-0010089.00
9	Hex Nut - M8	1	1-0010427.00
10	Clamp	1	1-0010429.00
11	Terminal	1	1-0019368.00



Component: **MAGNET VALVE - 24V. "Z"**

Article No.: **1-0010391.00**



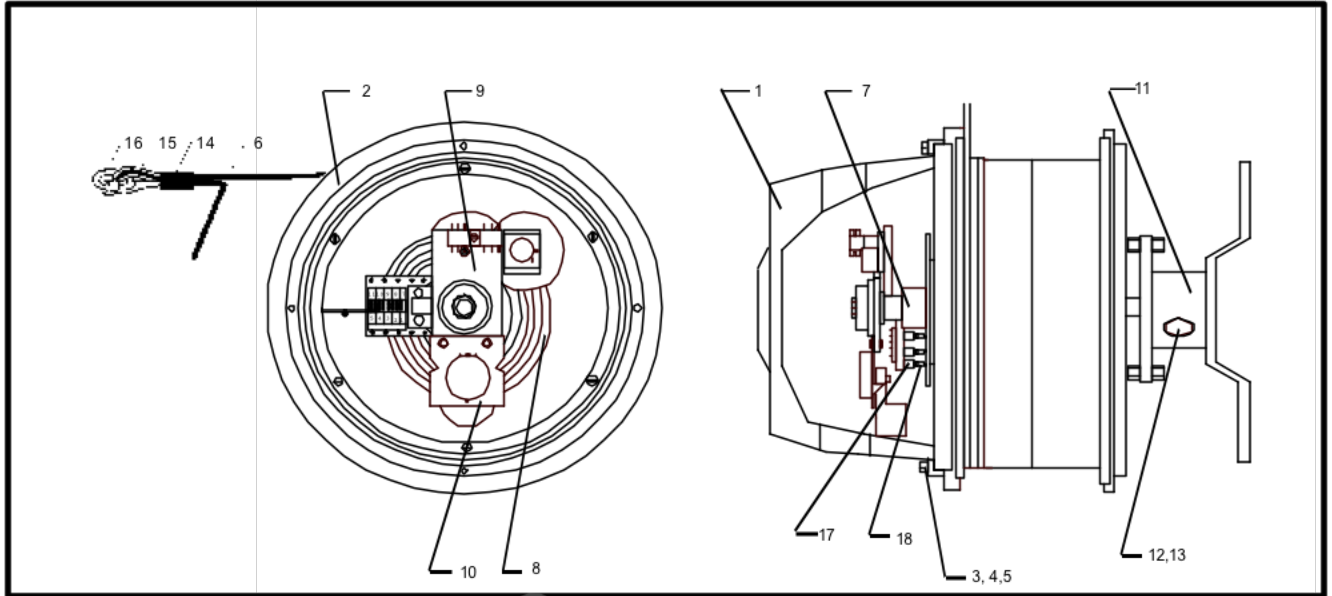
<u>ITEM NO.</u>	<u>DESCRIPTION</u>	<u>QUAN.</u>	<u>ARTICLE NO.</u>
1	Magnet Valve Body - 12 V.	1	1-0023260.00
2	Rubber Valve Cover	1	1-0010428.00
3	Weld Rod Case	1	1-0101028.00
4	Shaft - 20mm	1	1-0010435.00
5	Shaft Retainer	1	1-0010424.00
6	Short Weld Adapter	1	1-0010423.00
7	Hex Nut - M12	1	1-0010422.00
8	Hex Head Capscrew - M8 x 16	1	1-0010089.00
9	Hex Nut - M8	1	1-0010427.00
10	Clamp	1	1-0010429.00
11	Terminal	1	1-0019368.00



PAT

Component: **LMI Cable Reel - 24/30M**

Article No.: **1-0115463.20**

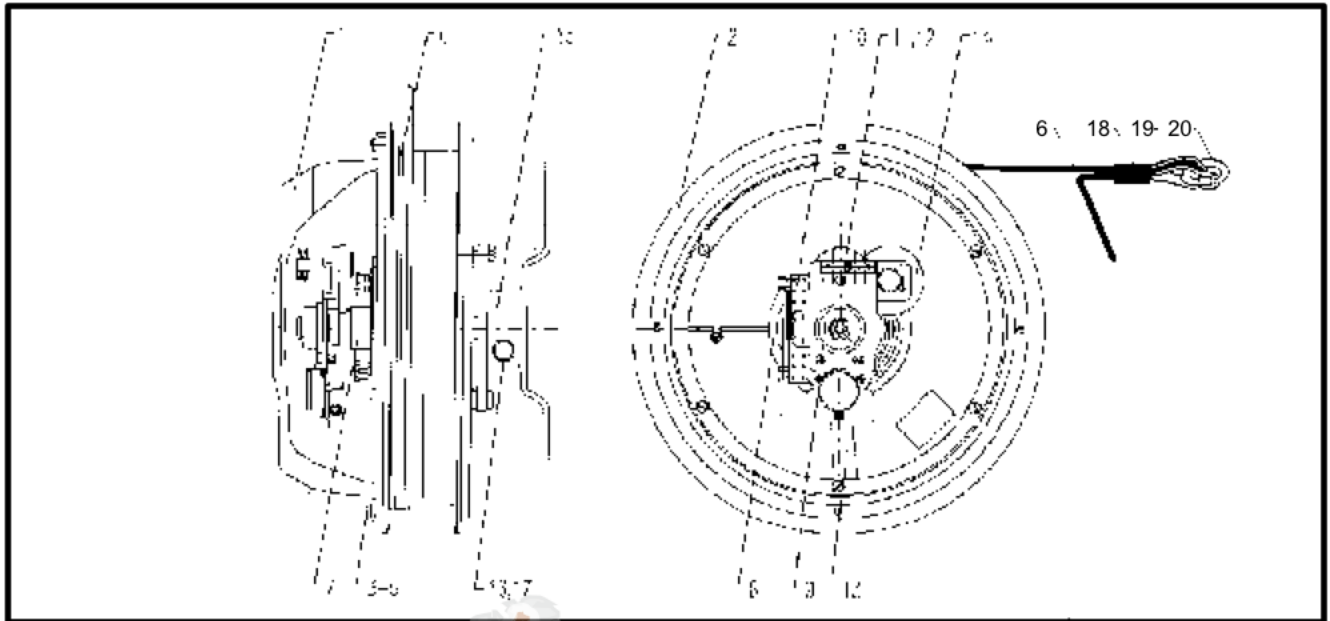


<u>ITEM NO.</u>	<u>DESCRIPTION</u>	<u>QUAN.</u>	<u>ARTICLE NO.</u>
1	Cover Complete	1	1-0107886.00
2	Cable Reel Body	1	1-0107885.00
3	Angle Clamp	4	1-0010613.00
4	Slotted Flat Head Screw - M5 x 14	4	1-0012350.00
5	Nylon Washer - M5	4	1-0010581.00
6	Shielded Cable 1 x 1	30M	1-0010328.00
7	Receiver Complete	1	1-0010615.00
8	Slip Ring Disk	1	1-0021448.00
9	Length Gear Drive	1	1-0107887.00
	- Angle Bracket	1	1-0010175.00
	- Pot	1	1-0013697.00
	- Terminal Strip	1	1-0011684.00
10	Angle Transducer	1	1-0015601.00
	- Mounting Plate	1	1-0010626.00
	- Pot	1	1-0012157.00
	- Pendulum	1	1-0015113.00
11	Mounting Bracket	1	1-0027856.00
12	Hex Head Capscrew - M10 x 45	1	1-0012207.00
13	Lock Washer - M10	1	1-0010096.00
14	Shrink Tubing - Alpha 1/4"	2	3-0000117.00
15	Thimble	1	1-0009988.00
16	Thimble Link	1	1-0009987.00
17	Contact Socket	3	1-0110095.00
18	Contact Pin	3	1-0110094.00
19	Contact Holding Plate	1	1-0116041.00



Component: **LMI Cable Reel - 32/45M**

Article No.: **1-0106926.20**



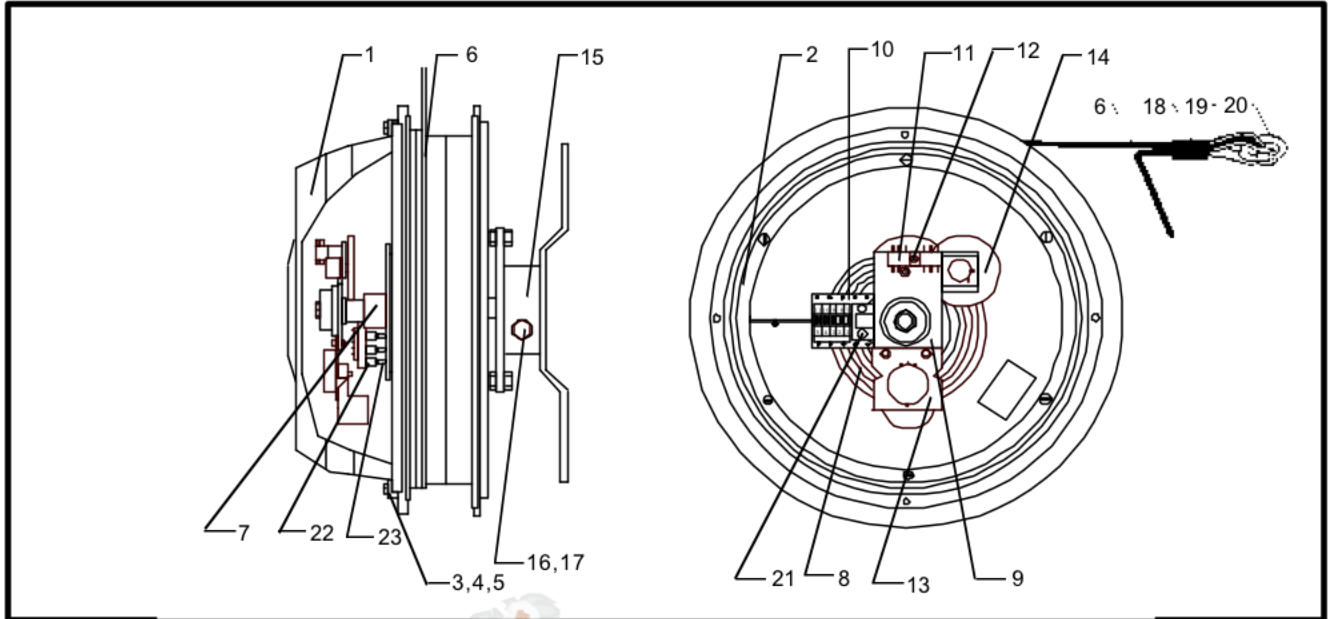
<u>ITEM NO.</u>	<u>DESCRIPTION</u>	<u>QUAN.</u>	<u>ARTICLE NO.</u>
1	Cover Complete	1	1-0016897.00
	- Cover	1	1-0010159.00
	- Rubber Seal	1	1-0010631.00
2	Cable Reel Body	1	1-0010653.00
3	Angle Clamp	4	1-0010613.00
4	Slotted Flat Head Screw - M5 x 14	4	1-0012350.00
5	Nylon Washer - M5	4	1-0010581.00
6	Shielded Cable 1x1	45M	1-0102079.00
7	Receiver	1	1-0010615.00
8	Slip Ring Disk	1	1-0021448.00
9	Angle Bracket	1	1-0010175.00
10	Slipper Complete (2x2)	1	1-0017383.00
	- Slipper - Contact Spring	4	1-0023914.00
	- Strip	1	1-0010627.00
11	Terminal Strip	1	1-0011684.00
12	Slotted Flat Head Screw - M4 x 10	1	1-0010582.00
13	Angle Transducer Complete	1	1-0015601.00
	- Mounting Plate	1	1-0010626.00
	- Pot	1	1-0012157.00
	- Pendulum	1	1-0010628.00
14	Gear Drive Complete	1	1-0107887.00
	- Pot	1	1-0013697.00
15	Mounting Bracket	1	1-0027856.00
16	Hex Head Capscrew - M10 x 45	1	1-0012207.00
17	Lock Washer - M10	1	1-0010096.00
18	Shrink Tubing - Alpha 1/4" x 2"	1	1-0009986.00
19	Thimble	1	1-0009988.00
20	Thimble Link	1	1-0009987.00



COMPONENT LISTING

Component: **LMI Cable Reel - 32/45M**

Article No.: **1- 0115068.20**



<u>ITEM NO.</u>	<u>DESCRIPTION</u>	<u>QUAN.</u>	<u>ARTICLE NO.</u>
1	Cover Complete	1	1-0016897.00
	- Cover	1	1-0010159.00
	- Rubber Seal	1	1-0010631.00
2	Cable Reel Body	1	1-0010653.00
3	Angle Clamp	4	1-0010613.00
4	Slotted Flat Head Screw - M5 x 14	4	1-0012350.00
5	Nylon Washer - M5	4	1-0010581.00
6	Shielded Cable 1x1	45M	1-0102079.00
7	Receiver	1	1-0010615.00
8	Slip Ring Disk	1	1-0021448.00
9	Angle Bracket	1	1-0010175.00
10	Contact Holding Plate	1	1-0116041.00
11	Terminal Strip	1	1-0011684.00
12	Slotted Flat Head Screw - M4 x 10	1	1-0010582.00
13	Angle Transducer Complete	1	1-0015601.00
	- Mounting Plate	1	1-0010626.00
	- Pot	1	1-0012157.00
	- Pendulum	1	1-0010628.00
14	Gear Drive Complete	1	1-0107887.00
	- Pot	1	1-0013697.00
15	Mounting Bracket	1	1-0027856.00
16	Hex Head Capscrew - M10 x 45	1	1-0012207.00
17	Lock Washer - M10	1	1-0010096.00
18	Shrink Tubing - Alpha 1/4" x 2"	1	1-0009986.00
19	Thimble	1	1-0009988.00
20	Thimble Link	1	1-0009987.00
21	Screw 2.3 mm slotted flat head	1	1-0011819.00
22	Contact Socket	3	1-0110095.00
23	Contact Pin	3	1-0110094.00

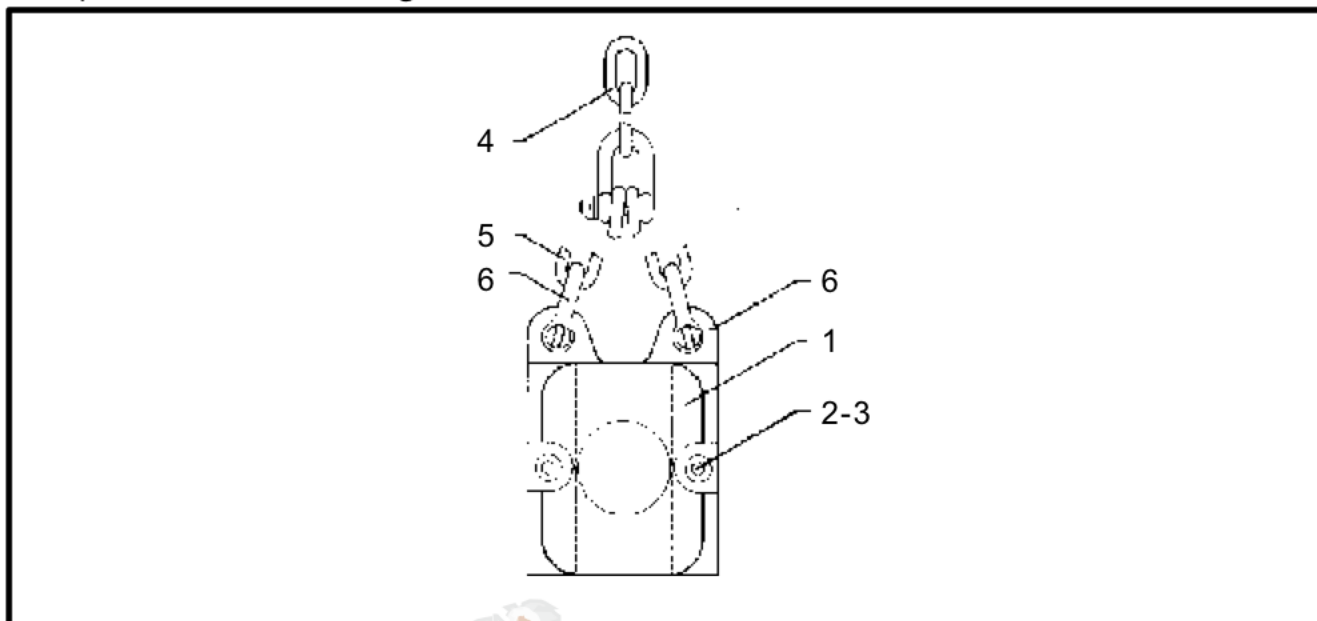
COMPONENT LISTING



PAT America Inc.

Component: **Counterweight with Chain**

Article No.: **1-0016800.11**

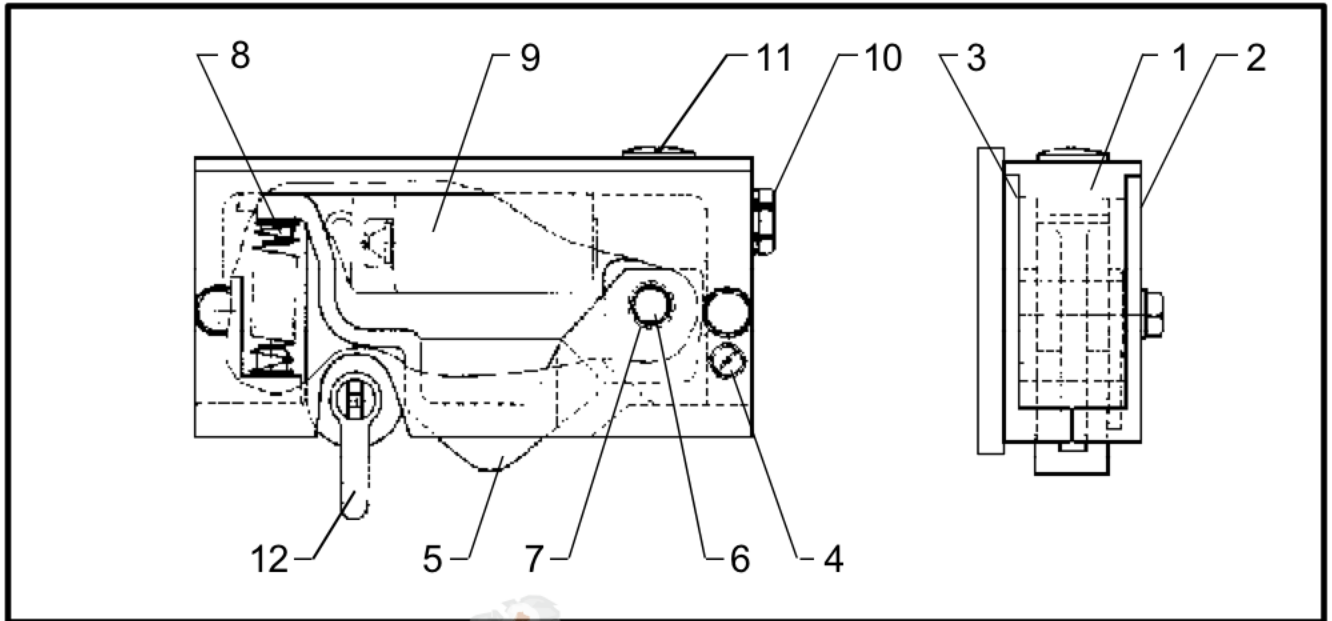


<u>ITEM NO.</u>	<u>DESCRIPTION</u>	<u>QUAN.</u>	<u>ARTICLE NO.</u>
1	Counterweight Half (Drilled)	2	1-0009995.00
2	Clevis Pin	2	2-0001388.00
3	Cotter Pin	2	2-0001389.00
4	Chain #1	1	1-0016908.00
5	Chain #2	2	1-0016909.00
6	Shackle	3	1-0010107.00



Component: **A-2-B Switch**

Article No.: **1-0024849.20**



<u>ITEM NO.</u>	<u>DESCRIPTION</u>	<u>QUAN.</u>	<u>ARTICLE NO.</u>
1	Center Housing	1	1-0112531.00
2	Cover - Left	1	1-0010045.00
3	Cover - Right	1	1-0010044.00
4	Slotted Flat Head Screw - M5 x 8	2	1-0013391.00
5	Lever	1	1-0010041.00
6	Straight Pin	1	1-0010042.00
7	Bushing	1	1-0010104.00
8	Spring	1	1-0100326.00
9	Micro Switch	1	1-0010039.00
10	Cable Connector	1	1-0010037.00
11	Blind Plug	1	1-0010038.00
12	Shackle with Cotter Pin	1	1-0009999.00
Required for Mounting - Order Separately			
	Weld Plate	1	1-0010046.00
	Hex Head Capscrew - M8 x 50	2	1-0010083.00
	Lock Washer - M8	2	1-0010097.00

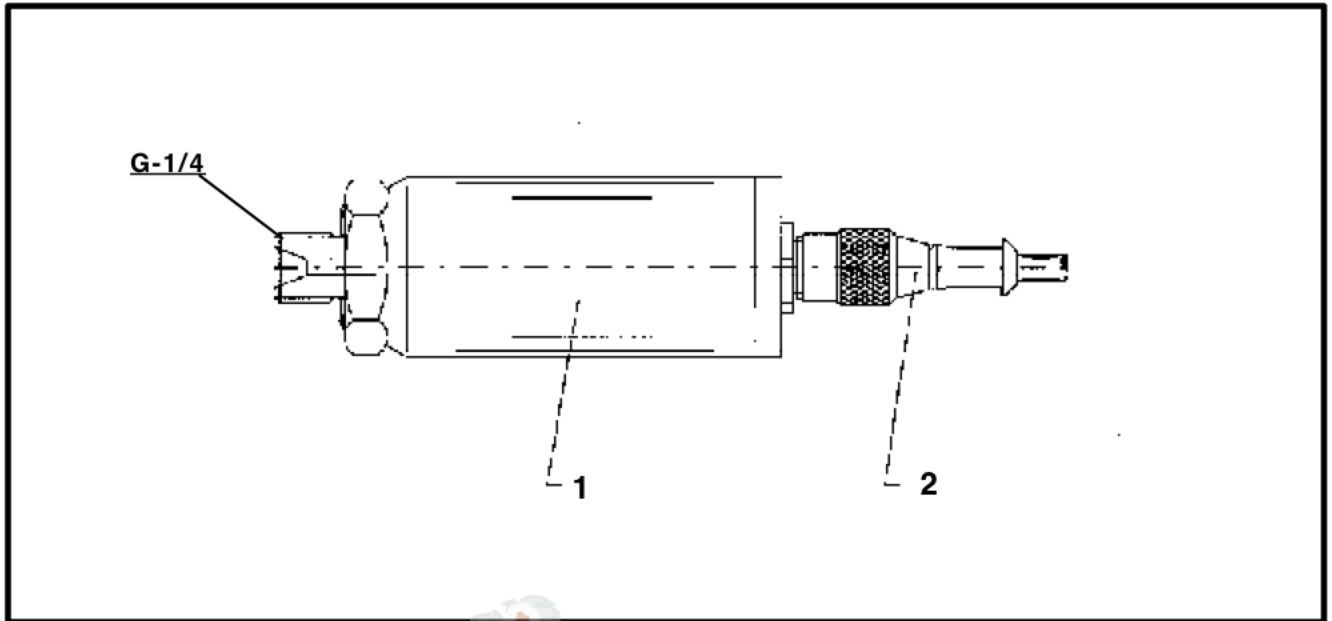


PAT America Inc.

COMPONENT LISTING

Component: **Pressure Sensor - 250 Bar**

Article No.: **1-0108060.00**

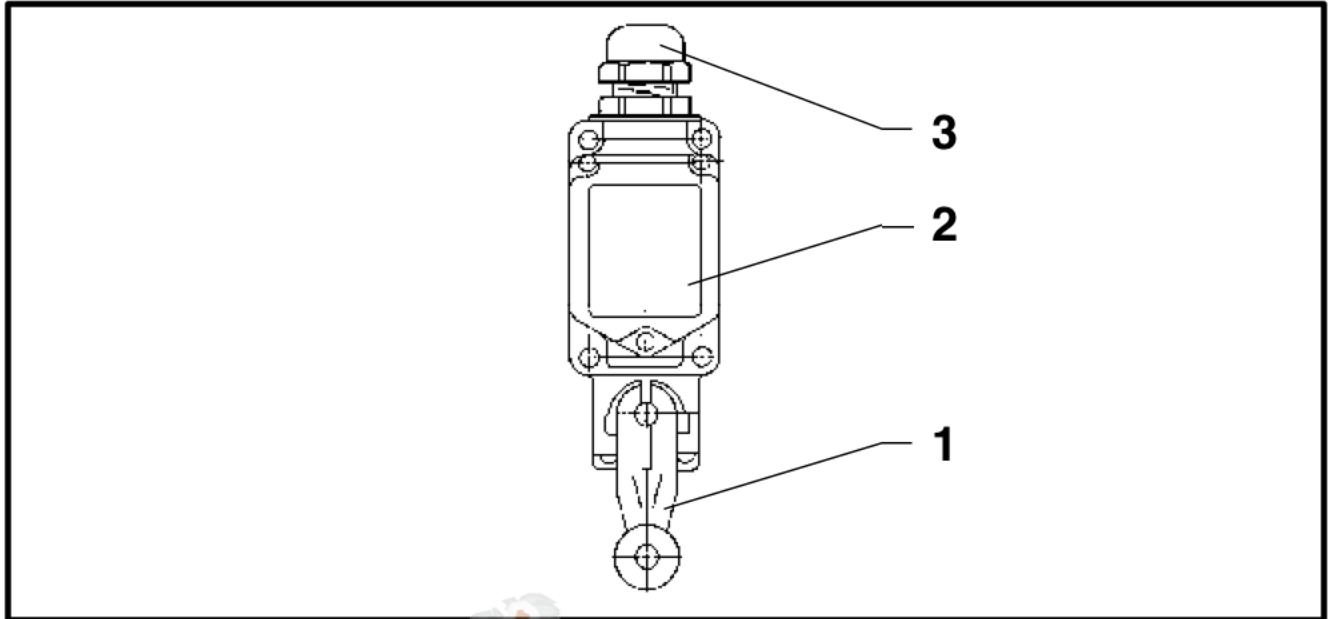


<u>ITEM NO.</u>	<u>DESCRIPTION</u>	<u>QUAN.</u>	<u>ARTICLE NO.</u>
1	Pressure Sensor - 250 Bar	1	1-0108060.00
PURCHASE SEPARATELY:			
2	Connector Cable - Straight x 7M.	1	1-0114293.00
	Connector Cable - 90° Connector	1	1-0101758.00
	Connector Cable - Straight x 10M.	1	1-0114294.00



Component: **Roller Switch - Omron**

Article No.: **2-0000290.00**

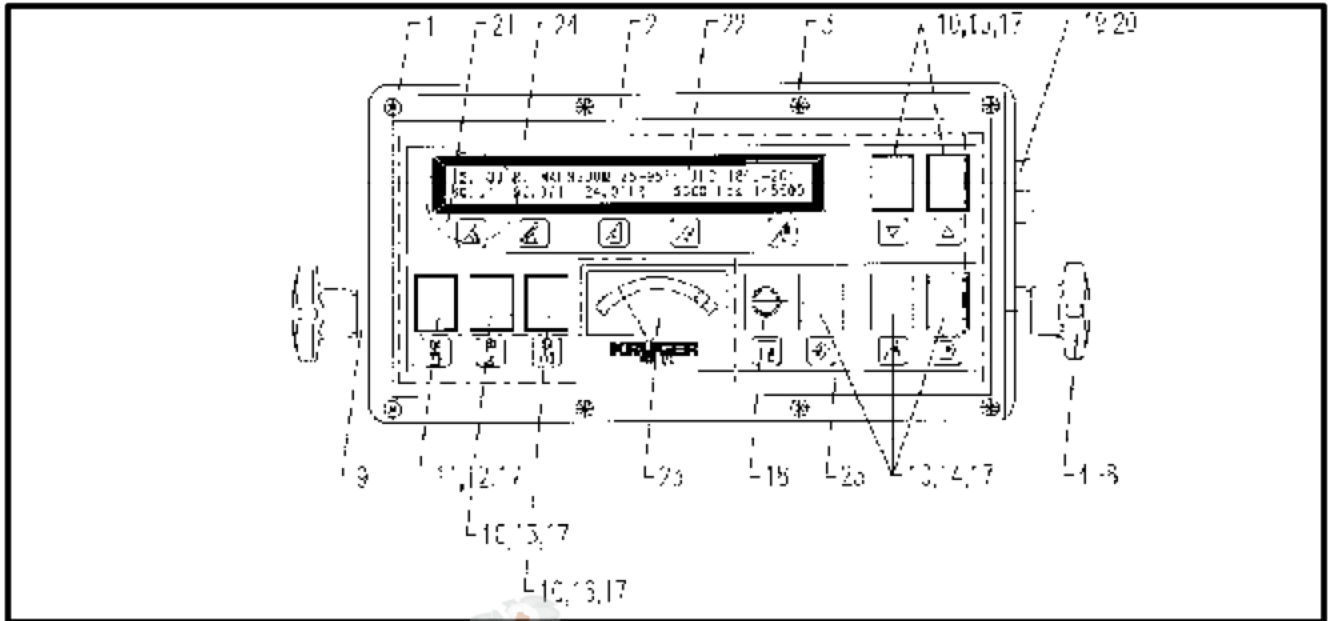


<u>ITEM NO.</u>	<u>DESCRIPTION</u>	<u>QUAN.</u>	<u>ARTICLE NO.</u>
1	Operating Head w/ Roller	1	2-0000607.00
2	Housing w/ Micro Switch	1	2-0000606.00
3	Cable Connector - PG 13.5	1	1-0010536.00
NOT SHOWN	Weld Plate	1	2-0000289.00



Component: **Indicator Panel - Mark 3E/2**

Article No.: **1-0114302.10**

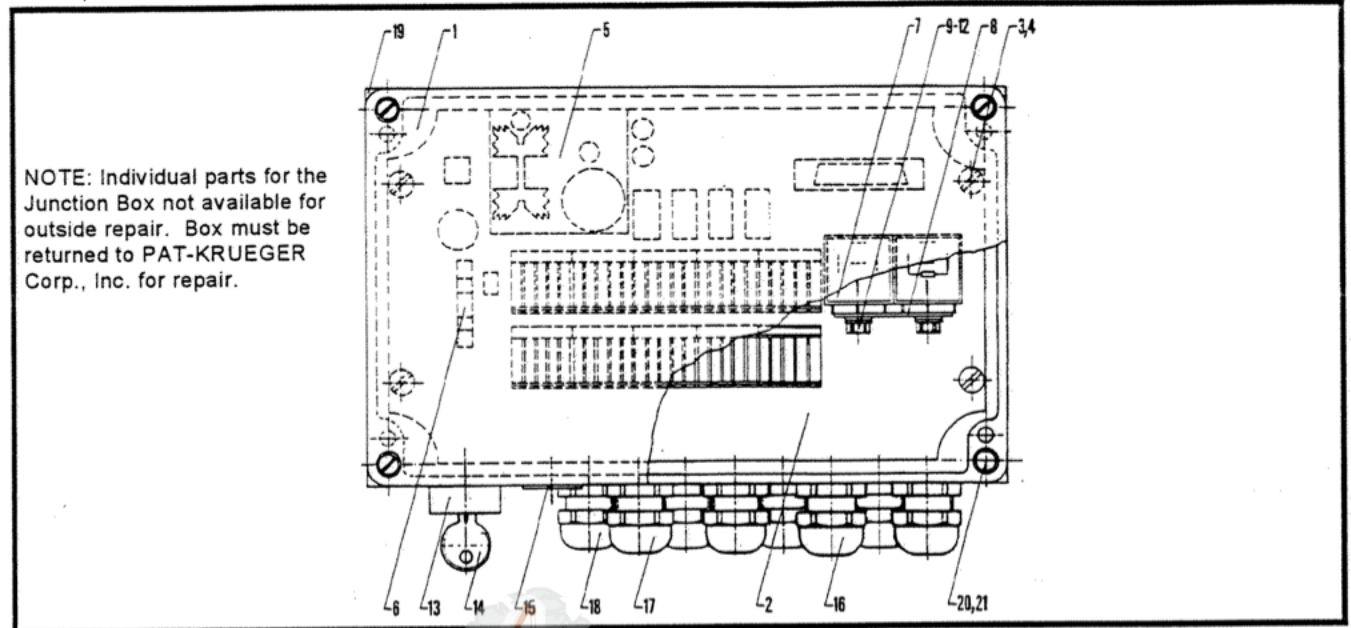


<u>ITEM NO.</u>	<u>DESCRIPTION</u>	<u>QUAN.</u>	<u>ARTICLE NO.</u>
1	Housing - Type 3	1	1-0011808.00
2	Front Panel	1	1-0029591.00
3	Phillips Head Screw - M4 x 12	8	1-0015282.00
4	Mounting Knob	2	1-0010528.00
5	Hex Head Capscrew - M8 x 30	2	1-0010322.00
6	Hex Nut - M8	2	1-0010427.00
7	Star Lock Washer M8	6	1-0103806.00
8	Sealing Washer - M8	2	1-0012073.00
9	Mounting Legs	2	1-0017950.00
	- Angle Bracket	2	1-0010810.00
	- Strip	2	1-0017949.00
	- Socket Head Capscrew - M8 x 20	2	1-0010807.00
	- Hex Nut - M8	2	1-0010427.00
	- Lock Washer - M8	2	1-0010094.00
10	Illuminated Push Button	7	1-0012607.00
11	Illuminated Push Button	1	1-0012608.00
12	Lens Cover - GREEN	1	1-0011532.00
13	Lens Cover - YELLOW	1	1-0011530.00
14	Lens Cover - WHITE	3	1-0011527.00
15	Lens Cover - BLUE	2	1-0011533.00
16	Lens Cover - RED	1	1-0011531.00
17	Light Bulb	8	1-0014919.00
18	Key Switch	1	1-0023162.00
	-Key	2	1-0011571.00
19	Flange Mtd. Receptacle w/Harness	1	1-0024971.00
20	Not Used		
21	Electronic Beeper	1	1-0012135.00
22	LCD-Matrix Display	1	1-0101389.00
23	LM Meter w/ Scale	1	1-0012342.00
24	P.C. Board -CPU	1	1-0114042.00
25	P.C. Board - Push Button Interconnect	1	1-0028916.00



Component: **Junction Box - 12V. - Mark 3E/2**

Article No.: **1-0108390.00**

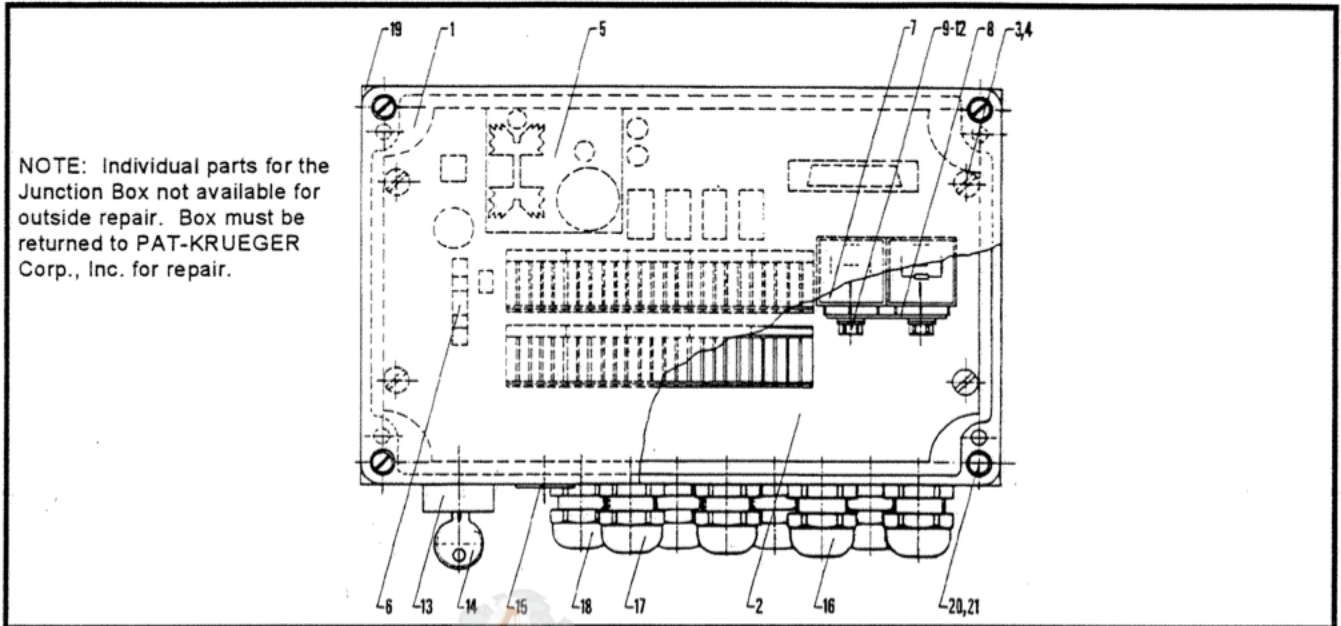


<u>ITEM NO.</u>	<u>DESCRIPTION</u>	<u>QUAN.</u>	<u>ARTICLE NO.</u>
1	Housing Complete	1	1-0106823.00
2	Junction Board	1	1-0107917.00
3	Slotted Flat Head Screw - M6 x 10	4	1-0010483.00
4	Washer - M6	4	1-0010609.00
5	NOT USED		
6	Fuse - 2AT	1	1-0010670.00
7	Relay w/ Diode - 12VDC	2	1-0026247.00
8	Angle Bracket	1	1-0026426.00
9	Slotted Flat Head Screw - M5 x 12	3	1-0010580.00
10	Flat Washer - M5	3	1-0010638.00
11	Lock Washer - M5	3	1-0020539.00
12	Hex Nut - M5	3	1-0011042.00
13	Key Switch	1	1-0013452.00
14	Key	2	1-0016153.00
15	Blind Plug	1	1-0026325.00
16	Cable Connector - PG 16	2	1-0103591.00
17	Cable Connector - PG 13.5	2	1-0103590.00
18	Cable Connector - PG 11	4	1-0103589.00
19	Weld Frame	1	1-0010537.00
20	Slotted Flat Head Screw - M6 x 30	4	1-0010612.00
21	Lock Washer - M6	4	1-0013983.00



Component: **Junction Box - 24V. - Mark 3E/2**

Article No.: **1-0107093.00**

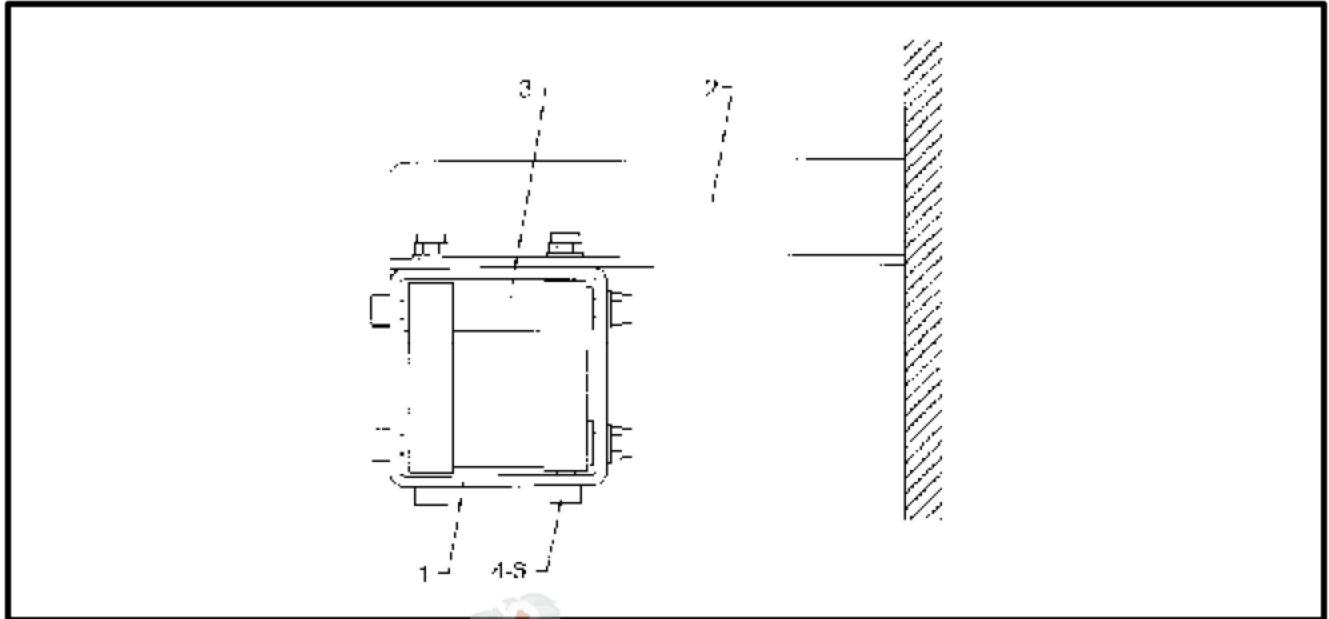


<u>ITEM NO.</u>	<u>DESCRIPTION</u>	<u>QUAN.</u>	<u>ARTICLE NO.</u>
1	Housing Complete	1	1-0106823.00
2	Junction Board	1	1-0107917.00
3	Slotted Flat Head Screw - M6 x 10	4	1-0010483.00
4	Washer - M6	4	1-0010609.00
5	Converter Module - 24V/12V	1	1-0028174.00
6	Fuse - 2AT	1	1-0010670.00
7	Relay w/ Diode - 12VDC	2	1-0026247.00
8	Angle Bracket	1	1-0026426.00
9	Slotted Flat Head Screw - M5 x 12	3	1-0010580.00
10	Flat Washer - M5	3	1-0010638.00
11	Lock Washer - M5	3	1-0020539.00
12	Hex Nut - M5	3	1-0011042.00
13	Key Switch	1	1-0013452.00
14	Key	2	1-0016153.00
15	Blind Plug	1	1-0026325.00
16	Cable Connector - PG 16	2	1-0103591.00
17	Cable Connector - PG 13.5	2	1-0103590.00
18	Cable Connector - PG 11	4	1-0103589.00
19	Weld Frame	1	1-0010537.00
20	Slotted Flat Head Screw - M6 x 30	4	1-0010612.00
21	Lock Washer - M6	4	1-0013983.00



Component: **Roller Guide**

Article No.: **1-0010561.00**

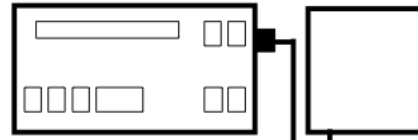


<u>ITEM NO.</u>	<u>DESCRIPTION</u>	<u>QUAN.</u>	<u>ARTICLE NO.</u>
1	Frame	1	1-0012365.00
2	Angle Bracket	1	1-0012367.00
3	Roller	4	1-0010589.00
4	Countersunk Hex Capscrew - #10-32 x 3"	4	1-0009977.00
5	Hex Nut w/ teflon Insert - #10	4	1-0009975.00
6	Flat Washer - #10	2	2-0000882.00

Central Unit

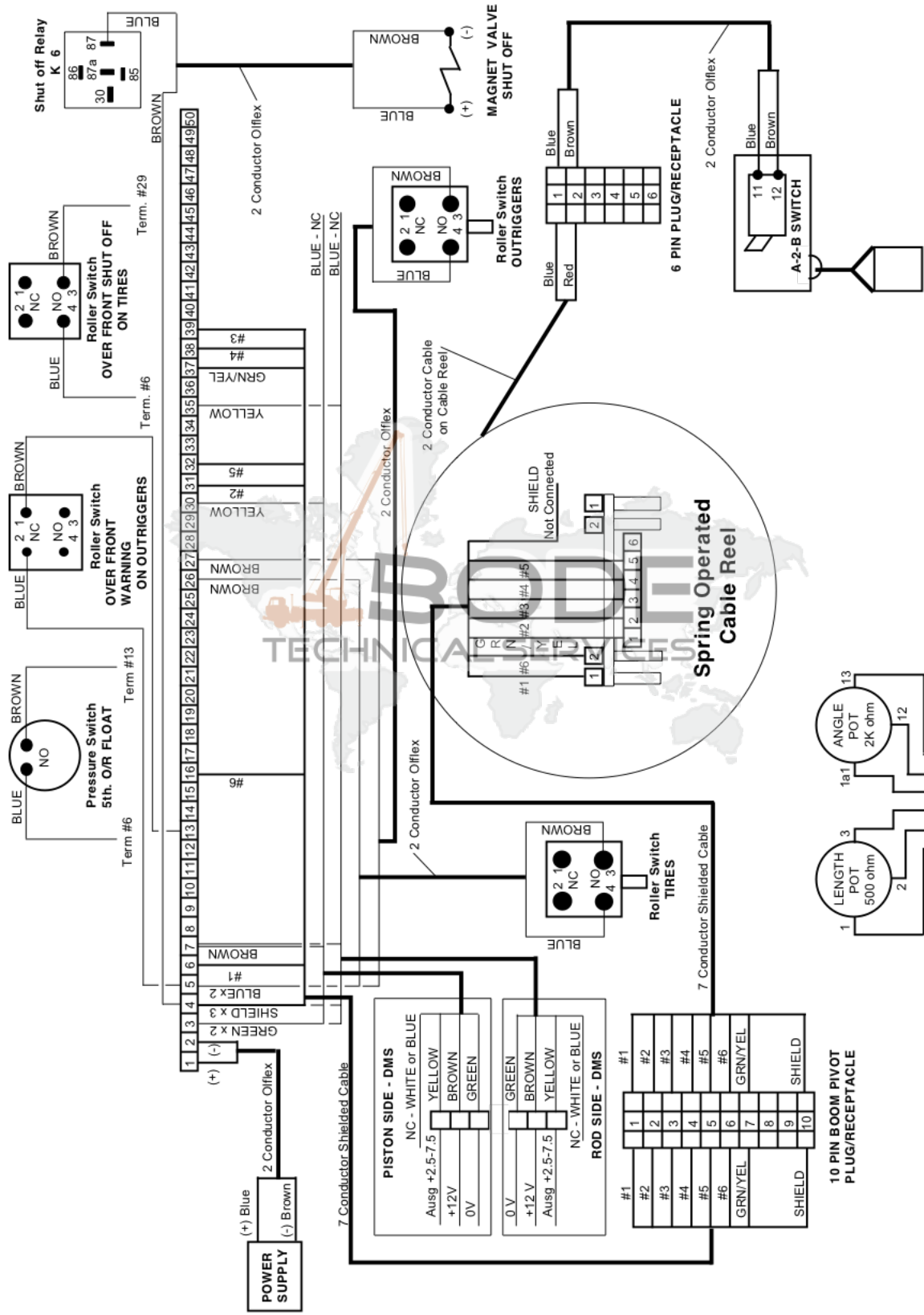
12/24 VDC Input	1	
0 VDC	2	White + Brown + Green
0 VDC	3	Green or Clear (Shield)
0 VDC	4	
+12 V Fused	5	Yellow + Gray + Pink
+12 V Fused	6	
+12 V Fused	7	
XLZ2 (Relay out)	8	Pink/Brown
	9	
	10	
	11	
	12	
S5 (Over Front)	13	
	14	
Optional In/Out	15	Green/Blue
A-2-B B-P/Return	16	Yellow/Brown
A-2-B Feedback	17	Pink/Green
Shut Off	18	White/Black
VA Valve	19	Yellow/Pink
	20	
	21	
Shut Off - f/b	22	Brown/Black
	23	
	24	
S1 (On Tires)	25	Red/Blue
S2 (On Outr.)	26	White/Green
S3 (Roller Sw.)	27	White/Red
S4 (Roller Sw.)	28	Brown/Red
Pressure (Ch. 0)	29	Black
Length (Ch. 1)	30	Violet
Angle (Ch. 2)	31	Gray/Pink
Luff Angle (Ch. 3)	32	White/Pink
Luff Load (Ch. 4)	33	Gray/Green
Rod-Comp (Ch. 5)	34	Yellow/Gray
Automatic Reset	35	Yellow/Blue
0 V (Analog)	36	White/Blue + Brown/Blue
0 V (Analog)	37	
+5 V (Analog)	38	Blue + Red
+5 V (Analog)	39	
	40	
	41	
	42	
CTS	43	White/Gray
RXD	44	White/Yellow
TXD	45	Brown/Green
DTR	46	Gray/Brown
	47	
	48	
	49	
	50	

Console



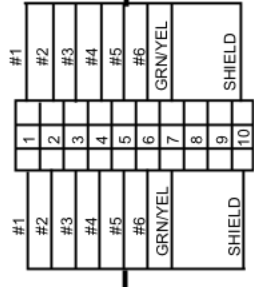
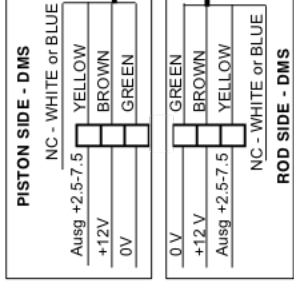
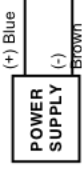
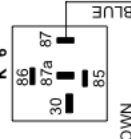
32 Conductor cable
w/quick disconnect



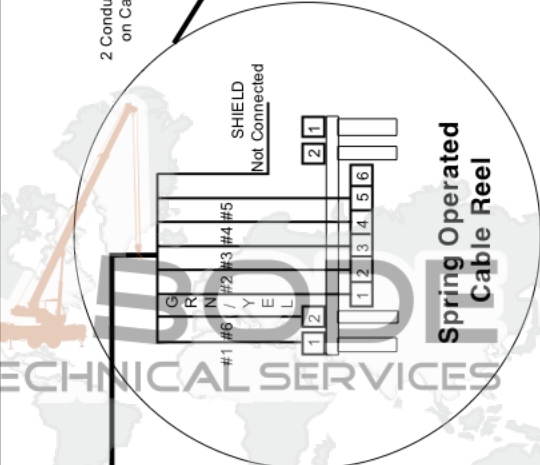
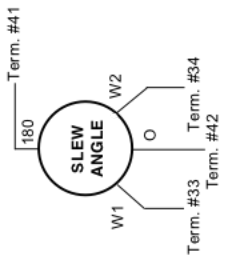


For use with Operating System - Version 2.15 & later

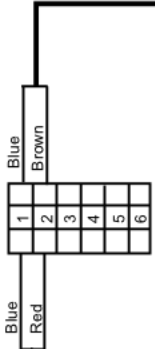
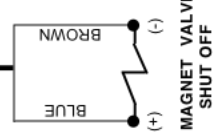
Shut off Relay
K 6



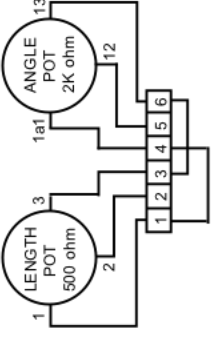
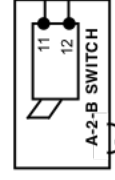
10 PIN BOOM PIVOT
PLUG/RECEPTACLE



Spring Operated
Cable Reel



6 PIN PLUG/RECEPTACLE



Use for Operating System Version 8.03 and later
with Data Pack Version 3.08