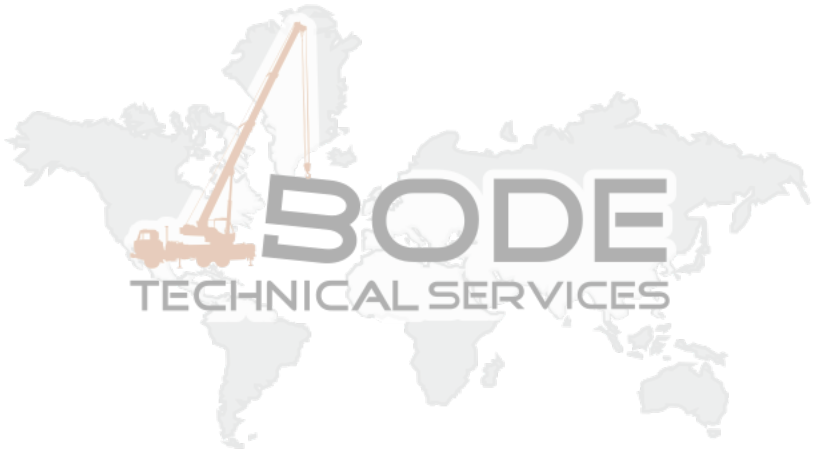
KRÜGER
Mark 3E/1 Load Moment System

PAT

PAT America, Inc.

1665 Orchard Drive Chambersburg, PA 17201
Phone: 717/263-7655 Fax: 717/877-2117


BODE
TECHNICAL SERVICES

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/1 Load Moment System.

The MARK 3E/1 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/1 System will sense and alert the operator to imminent overload and/or two-block conditions. The MARK 3E/1 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/1 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 Ameria, Inc. service technicians or those who have received special training from Krüger Systemtechnik 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/1 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 programed, in conjunction with a crane function shut off system, the MARK 3E/1 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 programing the unit, with the information requested during the start up sequence, the system monitors and displays:

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

The system continually monitors output from the force and configuration sensors. It integrates the programed 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!

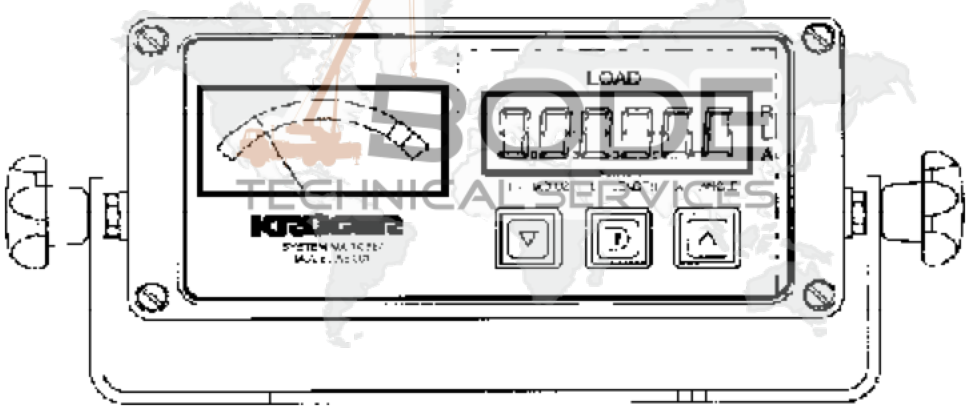
TROUBLESHOOTING

This publication is designed to assist the technician in the troubleshooting and basic repair of the Krüger Mark 3E/1 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/1 system which can create either internal or external problems affecting system performance.

The Mark 3E/1 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/1 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 LCD panel display.



System errors are normally caused by defective hardware or malfunctioning programed 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 America, Inc. for repair.

ERROR LIST FOR MARK 3E/1 - VERSION 1.01

A-2-B Anti-Two-Block
LOAD Overload
BYPASS LMI is by-passed
01 Watchdog has been activated
02 Checksum Program Eprom Wrong
03 Checksum Data Eprom Wrong
04 Checksum EEprom Wrong
05 Ram fault Port 1
06 Ram fault Port 2
07 Ram fault 6116
08 Fault NV Ram
10 Open Circuit Channel 0 (Pressure - Piston)
11 Short Circuit Channel 0 (Pressure - Piston)
20 Open Circuit Channel 1 (Length)
21 Short Circuit Channel 1 (Length)
22 Boom Length too short
23 Boom Length too long
24 Angle smaller than Load Chart
25 Angle greater than Load Chart
26 Radius less than Load Chart
27 Radius greater than Load Chart
28 Boom Length shorter than Load Chart
29 Boom Length Longer than Load Chart
30 Open Circuit Channel 2 (Angle)
31 Short Circuit Channel 2 (Angle)
32 Roller Switch 1 or 2 (no working area)
33 Roller Switch 3 or 4 (Shut-off)
34 programable
35 programable
36 programable
37 programable
38 programable
39 Roller Switch 3 or 4 (Warning)
40 Open Circuit Channel 3 (Not Available)
41 Short Circuit Channel 3 (Not Available)
50 Open Circuit channel 4 (Luffing Jib Angle)
51 Short Circuit Channel 4 (Luffing Jib Angle)
60 Open Circuit Channel 5 (Pressure - Rod)
61 Short Circuit Channel 5 (Pressure - Rod)
62 Pressure Profile not found
63 Wrong Configuration chosen (with Mech. Tele.)
64 Wrong Configuration chosen (without Mech. Tele.)
66 Wrong Parts of Line chosen
70 Program Eprom was Changed
71 Data Eprom was Changed
72 EEprom was Changed
74 Wrong Eprom in EEprom location
75 Wrong Eprom in Data Eprom location
80 Timer not working
81 Converter not working
82 Error in Shut-off Circuit
83 Voltage Error - 12V
84 Voltage Error - 5V analog
90 No Length Programed

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 America, Inc. Technician.

E:01

Watchdog Error

This 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 electronic box should be returned to PAT America, Inc. for evaluation and repair.

E:02

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 electronic box. The reason can be that the original data has been 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 electronic box should be returned to PAT America, Inc. for evaluation and repair.

E:03

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 Eprom 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 Eprom 27C256 (U3) is defective. Another possibility is an electrical failure of the PC board.

In either case, the electronic box should be returned to PAT America for evaluation and repair.

E:04

Checksum EEprom #2 not correct

This EEprom contains the pressure profiles (pressure versus boom angle) and the correction values (modification of pressure profiles, boom deflection, friction, etc,) for a specific crane identified by the cranes serial number.

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 electronic box should be returned to PAT America for evaluation and repair.

E:05

Ram Error Port 2

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 electronic box should be returned to PAT America, Inc. for evaluation and repair.

E:06

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 electronic box should be returned to PAT America, Inc. for evaluation and repair

E:07

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 defective static Ram 6116 (U27).

To correct this situation, the electronic box should be returned to PAT America, Inc. for evaluation and repair.

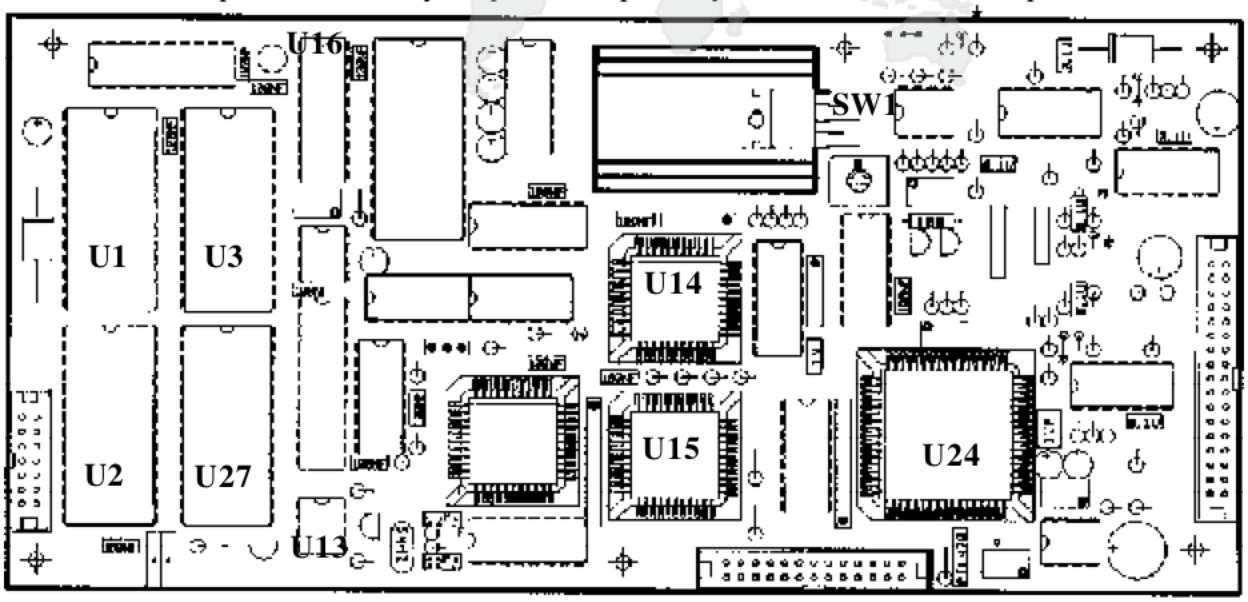
E:08

Ram Error Serial EEprom

The Serial EEprom contains the calibration values of theanalog inputs of all sensors and the checksums from the Operating System (U1), Data Eprom 1 (U3) and Data EEprom 2 (U2). At startup 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 electronic box should be returned to PAT America, Inc for evaluation and repair. This may require complete system calibration to repair.



MARK 3E/1 CPU BOARD

ANALOG SIGNAL ERRORS

The following error codes are displayed as numeric values only. Check the Error Code listing in the Operators Manual for a complete listing. Causes for these error codes could be open or shorted wiring to the external analog components and/or defective external components. All threshold voltages are based on the analog to digital converter input levels.

Repair of the problem can possibly be corrected without PAT America, Inc. on-site assistance. In all cases the first attempt at elimination of the ERROR CODE is to push the P> 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 Kruger Load Moment system.

The pressure settings of the Boom Hoist cylinder holding valves 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 America, Inc. before operating the crane!!

E:10

Open Circuit Channel 00 (Piston Pressure)

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

To correct this situation the following steps are taken:

1. Check all wiring from the piston pressure sensor to the Junction Box for physical damage and/or loose connections at receptacles and other points. The pressure sensor is located on the holding valve of the boom cylinder. Replace if necessary.

2. Check the pressure sensor for physical damage and replace if necessary.

WARNING!! Before piston pressure sensor replacement or troubleshooting bring the boom all the way down to remove all pressure from the sensor. If this is not done before removal of the sensor the boom may come down because it is sensing constant pressure from the piston side of the cylinder. Please note that changing the pressure sensor may effect the accuracy of the load indication on the MARK 3E/1 system and should be load tested after replacing the pressure sensor.

3. With no load on the boom, check the following terminals for the proper output voltage in the electronic box:

Terminal #5,#6,#7 or #8 is system and sensor ground 0VDC. Put the ground lead for a digital multimeter at one of these terminals.

Terminal #3 or #4 is +12 VDC supply voltage for the pressure sensor.

Terminal #16 is the output voltage of the pressure sensor. The output voltage should be between +2.500 VDC at minimum pressure and +7.500 VDC at maximum pressure. Using the positive lead of the multimeter check the voltage output of the sensor. If the voltage at terminal #16 is between +2.500 VDC and +7.500 VDC the defect is in the electronic box. In this case to correct the problem return the electronic box to PAT-Krueger for evaluation and repair.

If the voltage output is greater than +8.200 VDC the defect is either in the pressure sensor or the cable that connects the sensor to the electronic box. To troubleshoot which of these is causing the problem they have to be replaced one at a time until the problem is repaired.

WARNING!! Before piston pressure sensor replacement or troubleshooting bring the boom all the way down to remove all pressure from the sensor. If this is not done before removal of the sensor the boom may come down because it is sensing constant pressure from the piston side of the cylinder. Please note that changing the pressure sensor may effect the accuracy of the load indication on the MARK 3E/1 system and should be load tested after replacing the pressure sensor.

In either case contact PAT America, Inc. for further instructions.

E:11

Short Circuit Channel 00 (Piston Pressure)

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

To correct this situation the following steps are taken:

1. Check all wiring from the piston pressure sensor to the Junction Box for physical damage and/or loose connections at receptacles and other points. The pressure sensor is located on the holding valve of the boom cylinder. Replace if necessary.

2. Check the pressure sensor for physical damage and replace if necessary.

WARNING!! Before piston pressure sensor replacement or troubleshooting bring the boom all the way down to remove all pressure from the sensor. If this is not done before removal of the sensor the boom may come down because it is sensing constant pressure from the piston side of the cylinder. Please note that changing the pressure sensor may effect the accuracy of the load indication on the MARK 3E/1 system and should be load tested after replacing the pressure sensor.

3. With no load on the boom, check the following terminals for the proper output voltage in the electronic box.

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Terminal #3 or #4 is +12 VDC supply voltage for the pressure sensor.

Terminal #16 is the output voltage of the pressure sensor. The output voltage should be between +2.500 VDC at minimum pressure and +7.500 VDC at maximum pressure. Using the positive lead of the multimeter check the voltage output of the sensor. If the voltage at terminal #16 is between +2.500 VDC and +7.500 VDC the defect is in the electronic box. In this case to correct the problem return the electronic box to PAT America, Inc. for evaluation and repair.

If the voltage output is less than +1.850 VDC the defect is either in the pressure sensor or the cable that connects the sensor to the electronic box. To troubleshoot which of these is causing the problem they have to be replaced one at a time until problem is repaired.

In either case contact PAT America, Inc. for further instructions.

WARNING!! Before piston pressure sensor replacement or troubleshooting bring the boom all the way down to remove all pressure from the sensor. If this is not done before removal of the sensor the boom may come down because it is sensing constant pressure from the piston side of the cylinder. Please note that changing the pressure sensor may effect the accuracy of the load indication on the MARK 3E/1 system and should be load tested after replacing the pressure sensor.

E:20

Open Circuit Channel 01 (Length)

The cause for this error message is due to a defect in the cable between the junction box and length sensor or a defective length sensor.

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

1. Check all wiring between the junction box, cable reel and cable from reel to main boom tip for physical damage and/or loose connections at receptacles and other connection points. Also with boom fully retracted check for proper tension of the cable reel. Repair if necessary.

2. With the boom fully retracted and no load on the crane, check the following terminals in the junction box for proper voltage output.

Terminal #22 (Analog Ground 0 VDC). Put the ground lead of a digital multimeter here.

Terminal #21 (Analog +5 VDC) This is the source voltage for your length and angle signal. Put the positive lead of a multimeter here to verify that you are getting approximately +5.00 VDC. If you are not the electronic box will have to be sent to PAT America, Inc for evaluation and repair.

Terminal #17 (Length Sensor Output) This is the output of the length sensor located in the cable reel on the base section of the boom. Put the positive lead of the multimeter here and with the boom fully retracted the sensor output should be approximately +1.00 VDC. With the error code the voltage has to be greater than +4.80 VDC and if the voltage is greater than +4.80 VDC continue to step 3. If the voltage is approximately. +1.00 VDC and you are still getting the error code after system reset the electronic box will have to be sent to PAT America, Inc. for evaluation and repair.

3. With boom fully retracted at low angle remove the cover of the cable reel and locate the terminal strip for the length and angle sensor outputs. Check for shorted or open wiring on the terminal strip. Use a multimeter with the ground lead on terminal #1. Using the positive lead check for +5.00 VDC on terminal #3. If this voltage is not +5.00 VDC go to step 4. After confirming you have source voltage put the positive lead of the multimeter on terminal #2 and check for approximately +1.00 VDC if this is greater than +4.80 VDC locate the metal lever arm located behind the two White Nylon Gears and turn it clockwise and the voltage should decrease. Adjust to +1.00 VDC and reset system. If the voltage does not change the length potentiometer is defective and needs to be replaced. Refer to the Replacement and Adjustment Guide in this manual. If voltage is correct go to step 4.

4. Check the receptacle and plug (located at the rear of the base section of the boom) for shorts or opens caused from water intrusion or corrosion in the receptacle and/or plug. Repair if necessary.

For further instructions contact PAT America,Inc.

E:21

Short Circuit Channel 01 (length)

The cause for this error message is due to a defect in the cable between the junction box and length sensor or a defective length sensor.

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

1. Check all wiring between the junction box, cable reel and cable from reel to main boom tip for physical damage and/or loose connections at receptacles and other connection points. Also with boom fully retracted check for proper tension of the cable reel. Repair if necessary.

2. With the boom fully retracted and no load on the crane, check the following terminals in the junction box for proper voltage output.

Terminal #21 is +5 VDC. This is the angle sensor supply voltage.

Terminal #18 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 #22 and the plus probe on terminal #18 to measure the voltage. To cause this error message the voltage must be GREATER THAN +4.10 VDC.

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.

   For further instructions contact PAT America, Inc.

E:24

Boom Angle Below Load Chart

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, PPF, dead section and/or an extension, swingaway or jib.

Compare the displayed boom angle to the minimum angle for the configuration of the manufacturer's load chart.

o verify displayed angle to actual angle. Lower the boom to a low boom angle. Use an angle protractor to compare the boom angle to the displayed boom angle. Then boom to a high boom angle and using the angle protractor verify actual angle to
displayed angle. If the displayed angle is not the same as the actual angle refer to the Replacement and Adjustment Guide in this manual.

E:25

Boom Angle Above Load Chart

This error message is displayed when the operator has boomed to an angle greater than allowed by the crane manufacturer's angle/load capacity chart. This message can be expected when operating with the manual, PPF, dead section and/or an extension, swingaway or jib.

Compare the displayed boom angle to the maximum angle for the configuration of the manufacturer's load chart.

To verify displayed angle to actual angle, lower the boom to a low boom angle. Use an angle protractor to compare the boom angle to the displayed boom angle. Then boom to a high boom angle and using the angle protractor verify actual angle to displayed angle. If the displayed angle is not the same as the actual angle refer to the Replacement and Adjustment Guide in this manual.

E:26

Radius Shorter Than Load Chart

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 a radius/load capacity chart.

This condition can be corrected by lowering boom angle or increasing the boom length into a load chart radius.

Compare the displayed radius to the crane manufacturer's capacity chart for the configuration selected.

If you feel this message is incorrect measure actual radius and compare this to the displayed radius. If radius is out of tolerance (radius is calculated from input information of Boom length and angle) you may have to verify the length and angle indications using the Replacement and Adjustment Guide in this manual.b
For further instructions contact PAT America,Inc.

E:27

Radius Longer Than Load Chart

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 a radius/load capacity chart.

This condition can be corrected by raising the boom angle or decreasing the boom length into a load chart radius.

Compare the displayed radius to the crane manufacturer's capacity chart for the configuration selected.
If you feel this message is incorrect measure actual radius and compare this to the displayed radius. If radius is out of tolerance (radius is calculated from input information of Boom length and angle) you may have to verify the length and angle indications using the Replacement and Adjustment Guide in this manual.

For further instructions contact PAT America,Inc.

E:28

Boom Length Shorter Than Load Chart

This error message will be displayed when the operator decreases the actual operating length to a value less than approved by the crane manufacturer's capacity chart. This message can be expected when operating in a configuration with a restricted boom length in the capacity chart. Check and verify that you have selected the proper program for the configuration you are working in.

This condition can be corrected by extending the boom to increase the boom length into a capacity chart length.

Verify length indications by fully retracting the boom and compare the displayed length to the crane manufacturer's capacity chart minimum boom length for the configuration selected. Then fully extend the boom and compare the displayed length to the crane manufacturer's capacity chart maximum boom length for the configuration selected. If you find the length is incorrect refer to the Replacement and Adjustment Guide in this manual.

For further instructions contact PAT America,Inc.

E:29

Boom Length Longer Than Load Chart

This error message will be displayed when the operator increases the actual operating boom length to a value greater than approved by the crane manufacturer's capacity chart. This message can be expected when operating in a configuration with a restricted boom length in the capacity chart. Check and verify that you have selected the proper program for the configuration you are working in.

This condition can be corrected by retracting the boom to decrease the boom length into a capacity chart length.

Verify length indications by fully retracting the boom and compare the displayed length to the crane manufacturer's capacity chart minimum boom length for the configuration selected. Then fully extend the boom and compare the displayed length to the crane manufacturer's capacity chart maximum boom length for the configuration selected. If you find the length is incorrect refer to the Replacement and Adjustment Guide in this manual.

For further instructions contact PAT America,Inc.

E:30

Open Circuit Channel 2 (Angle)

The cause for this error message is due to a defect in the cable between the junction box and angle sensor or a defective angle sensor.

To correct this situation the following steps are taken:

1. Check all wiring between the junction box, cable reel and cable from reel to main boom tip for physical damage and/or loose connections at receptacles and other connection points. Also with boom fully retracted check for proper tension of the cable reel. Repair if necessary.

2. With the boom at 0 degrees and no load on the crane, check the following terminals in the junction box for proper voltage output.

Terminal #22 (Analog Ground 0 VDC). Put the ground lead of a digital multimeter here.

Terminal #21 (Analog +5 VDC) This is the source voltage for your length and angle signal. Put the positive lead of a multimeter here to verify that you are getting approximately +5.00 VDC. If you are not the electronic box will have to be sent to PAT America, Inc. for evaluation and repair.

Terminal #18 (Angle Sensor Output) This is the output of the angle sensor located in the cable reel on the base section of the boom. Put the positive lead of the multimeter here and with the boom at 0 degrees the sensor output should be approximately +1.00 VDC. With the error code the voltage has to be greater than +4.10 VDC and if the voltage is greater than +4.10 VDC continue to step 3. If the voltage is approximately. +1.00 VDC and you are still getting the error code after system reset the electronic box will have to be sent to PAT America, Inc. for evaluation and repair.

3. With boom angle at 0 degrees, remove the cover of the cable reel and locate the terminal strip for the length and angle sensor outputs. Check for shorted or open wiring on the terminal strip. Use a multimeter with the ground lead on
terminal #4. Using the positive lead check for +5.00 VDC on terminal #6. If this voltage is not +5.00 VDC go to step 4. After confirming you have source voltage put the positive lead of the multimeter on terminal #5 and check for approximately +1.00 VDC, if this is greater than +4.10 VDC Adjust to +1.00 VDC according to the angle transducer adjustment procedure in the Replacement and Adjustment Guide and reset system. If the voltage does not change the angle potentiometer is defective and needs to be replaced. Refer to the Replacement and Adjustment Guide in this manual. If voltage value is correct go to step 4.

4. Check the receptacle and plug (located at the rear of the base section of the boom) for shorts or opens caused from water intrusion or corrosion in the receptacle and/or plug. Repair if necessary.

For further instructions contact PAT America, Inc.

E:31

Short Circuit Channel 2 (Angle)

The cause for this error message is due to a defect in the cable between the junction box and angle sensor or a defective angle sensor.

To correct this situation the following steps are taken:

1. Check all wiring between the junction box, cable reel and cable from reel to main boom tip for physical damage and/or loose connections at receptacles and other connection points. Also with boom fully retracted check for proper tension of the cable reel. Repair if necessary.

2. With the boom at 0 degrees and no load on the crane, check the following terminals in the junction box for proper voltage output.

Terminal #22 (Analog Ground 0 VDC). Put the ground lead of a digital multimeter here.

Terminal #21 (Analog +5 VDC) This is the source voltage for your length and angle signal. Put the positive lead of a multimeter here to verify that you are getting approximately +5.00 VDC. If you are not the electronic box will have to be sent to PAT America, Inc.or evaluation and repair.

Terminal #18 (Angle Sensor Output) This is the output of the angle sensor located in the cable reel on the base section of the boom. Put the positive lead of the multimeter here and with the boom at 0 degrees the sensor output should be approximately +1.00 VDC. With the error code the voltage has to be Less Than +0.60 VDC and if the voltage is less than +0.60 VDC continue to step 3. If the voltage is approximately. +1.00 VDC and you are still getting the error code after system reset the electronic box will have to be sent to PAT America, Inc.3. With boom angle at 0 degrees remove the cover of the cable reel and locate the terminal strip for the length and angle sensor outputs. Check for shorted or open wiring on the terminal strip. Using a multimeter with the ground lead on terminal #4. Using the positive lead check for +5.00 VDC on terminal #6. If this voltage is not +5.00 VDC go to step 4. After confirming you have source voltage put the positive lead of the multimeter on terminal #5 and check for approximately +1.00 VDC. If this is less than +0.60 VDC adjust to +1.00 VDC according to the angle transducer adjustment procedure in the Replacement and Adjustment Guide and reset system. If the voltage does not change the angle potentiometer is defective and needs to be replaced. Refer to the Replacement and Adjustment Guide in this manual. If voltage value is correct go to step 5.

5. Check the receptacle and plug (located at the rear of the base section of the boom) for shorts or opens caused from water intrusion or corrosion in the receptacle and/or plug. Repair if necessary. If the problem is not resolved contact PAT America, Inc. for further instructions.

E:32

Non Working Area (Tires Program Only)

This error code is displayed when the operator is attempting to work in an area that is restricted by the crane manufacturer's capacity chart or there is a defective roller switch.

To correct this problem swing the crane upper over the front on a rough terrain or carry deck. If it's a truck crane over the rear.

If problem is not corrected check for defective wiring and/or roller switch. To troubleshoot the roller switch use a multimeter with ground lead on terminal #5, #6, #7, or #8. Using the positive lead on terminal #23 with switch closed you get approximately 12 VDC. If there is no voltage with the switch closed it is either defective wiring and/or roller switch.

E:33

Programmable for Future Use

This error code is not used at this time but can be programed for use.

For further reference contact PAT America, Inc.
for evaluation and repair.

E:34

Programmable for Future Use

This error code is not used at this time but can be programed for use.
For further reference contact PAT America, Inc.

E:35

Programmable for Future Use

This error code is not used at this time but can be programed for use.
For further reference contact PAT America, Inc.

E:36

Programmable for Future Use

This error code is not used at this time but can be programed for use.
For further reference contact PAT America, Inc.

E:37

Programmable for Future Use

This error code is not used at this time but can be programed for use.
For further reference contact PAT America, Inc.

E:38

Programmable for Future Use

This error code is not used at this time but can be programed for use.
For further reference contact PAT America, Inc.

E:39

Over Front Warning (Applies to Truck Cranes Only)

This error code is displayed when the operator is attempting to work in an area that is restricted by the crane manufacturer's capacity chart or there is a defective roller switch.

To correct this problem swing the crane upper over the rear or into the proper working area.

If problem is not corrected check for defective wiring and/or roller switch. To troubleshoot the roller switch use a multimeter with ground lead on terminal #5, #6, #7, or #8. Using the positive lead on terminal #25 with switch closed you get approximately 12 VDC. If there is no voltage with the switch closed it is either defective wiring and/or roller switch.

E:40

Open Circuit Channel 3

This channel is not used and this error should not occur.
For further reference contact PAT America, Inc.

E:41

Short Circuit Channel 3

This channel is not used and this error should not occur.
For further reference contact PAT America, Inc.

E:50

Open Circuit Channel 4

This channel is not used and this error should not occur.
For further reference contact PAT America, Inc.

E:51

Short Circuit Channel 4

This channel is not used and this error should not occur.
For further reference contact PAT America, Inc.

E:60

Open Circuit Channel 5 (Rod Pressure)

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

To correct this situation the following steps are taken:

1. Check all wiring from the rod pressure sensor to the electronic Box for physical damage and/ or loose connections at receptacles and other points. The pressure sensor is located on the holding valve of the boom cylinder. Replace if necessary.

2. Check the pressure sensor for physical damage and replace if necessary.

WARNING!! Before rod pressure sensor replacement or trouble shooting bring the boom all the way down to remove all pressure from the sensor. Please note that changing the pressure sensor may effect the accuracy of the load indication while sitting stationary or booming down. The MARK 3E/1 system should be load tested after replacing the pressure sensor.

3. With no load on the boom, check the following terminals for the proper output voltage in the electronic box:

Terminals #5,#6,#7 or #8 are system and sensor ground 0VDC. Put the ground lead of the digital multimeter at one of these terminals.

Terminal #3 or #4 is +12 VDC supply voltage for the pressure sensor.

Terminal #19 is the output voltage for the pressure sensor. The output voltage should be between +2.500 VDC at minimum pressure and +7.500 VDC at maximum pressure. Using the positive lead of the multimeter check the voltage output of the sensor. If the voltage at terminal #16 is between +2.500 VDC and +7.500 VDC the defect is in the electronic box. In this case to correct the problem return the electronic box to PAT America, Inc. for evaluation and repair.

If the voltage output is greater than +8.200 VDC the defect is either in the pressure sensor or the cable that connects the sensor to the electronic box. To troubleshoot which of these is causing the problem they have to be replaced one at a time until problem is repaired.

WARNING!! Before rod pressure sensor replacement or troubleshooting bring the boom all the way down to remove all pressure from the sensor. Please note that changing the pressure sensor may effect the accuracy of the load indication while sitting stationary or booming down. The MARK 3E/1 system should be load tested after replacing the pressure sensor.

In either case contact PAT America, Inc. for further instructions.

E:61

Short Circuit Channel 5 (Rod Pressure)

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

To correct this situation the following steps are taken:

1. Check all wiring from the rod pressure sensor to the Junction Box for physical damage and/ or loose connections at receptacles and other points. The pressure sensor is located on the holding valve of the boom cylinder. Replace if necessary.

2. Check the pressure sensor for physical damage and replace if necessary.

WARNING!! Before rod pressure sensor replacement or troubleshooting bring the boom all the way down to remove all pressure from the sensor. Please note that changing the pressure sensor may effect the accuracy of the load indication sitting stationary or while booming down. The MARK 3E/1 system should be load tested after replacing the pressure sensor.

3. With no load on the boom, check the following terminals for the proper output voltage in the electronic box:

Terminals #5,#6,#7 or #8 are system and sensor ground 0VDC. Put the ground lead for a digital multimeter at one of these terminals.

Terminal #3 or #4 is +12 VDC supply voltage for the pressure sensor.

Terminal #19 is the output voltage of the pressure sensor. The output voltage should be between +2.500 VDC at minimum pressure and +7.500 VDC at maximum pressure. Using the positive lead of the multimeter check the voltage output of the sensor. If the voltage at terminal #16 is between +2.500 VDC and +7.500 VDC the defect is in the electronic box. In this case to correct the problem return the electronic box to PAT-Krueger for evaluation and repair.

If the voltage output is less than +1.850 VDC the defect is either in the pressure sensor or the cable that connects the sensor to the electronic box. To troubleshoot which of these is causing the problem they have to be replaced one at a time until problem is repaired.

In either case contact PAT-Krueger Corporation, Inc. for further instructions.

WARNING!! Before rod pressure sensor replacement or troubleshooting bring the boom all the way down to remove all pressure from the sensor. Please note that changing the pressure sensor may effect the accuracy of the load indication while sitting stationary or booming down. The MARK 3E/1 system should be load tested after replacing the pressure sensor.

E:62

Pressure Profile Not Found

Not used.

For further reference contact PAT America, Inc.

E:63

Wrong Configuration chosen (mech. Tele.)

Not used.

For further reference contact PAT America, Inc.

E:64

Wrong Configuration chosen (without Mech. Tele.)

Not used.

For further reference contact PAT America, Inc.

E:66

Wrong Parts of Line Chosen

Not used.

For further reference contact PAT America, Inc.

E:70

Program Eprom was Changed

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.

For further instructions contact PAT America,Inc.

E:71

Data Eprom was Changed

This error message is displayed when the actual checksum of the Data Eprom #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.

For further instructions contact PAT America,Inc.

E:72

EEprom was Changed

This error message is displayed when the actual checksum of the Data EEprom #2 28C64 (U2) 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.

For further instructions contact PAT America, Inc.

E:74

Wrong Eprom in EEprom location

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

When this message occurs it generally indicates you have a defective IC or the wrong IC in (U2) location.
For further reference contact PAT America, Inc.

E:75

Wrong Eprom in Data Eprom location

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

When this message occurs it generally indicates you may have a defective IC or have the wrong IC in (U2) location.

For further reference contact PAT America, Inc.

E:80

Timer Not Working

This error message is displayed when the IC NSC 810 (U15) is defective or a surge has corrupted the timer.

To correct the problem push the P> button to reset system. If the error message reappears, the electronic box should be sent to PAT America, Inc. for evaluation and repair.

For further instruction contact PAT America, Inc.

E:81

Converter Not Working

This error message is displayed when the AD Converter (U24) is defective or a surge has corrupted the converter.

To correct the problem push the P> button to reset system. If the error message reappears, the electronic box should be sent to PAT America, Inc. for evaluation and repair.

For further instruction contact PAT America, Inc.

E:82

Error in Shut-off Circuit

This error message occurs in the A-2-B or LMI shut-off circuit.

To correct the problem push the P> button to reset system.

If the error message reappears, the electronic box should be sent to PAT America,Inc. for evaluation and repair.

E:83

Voltage Error - 12V

This error message is displayed when the power source voltage to the system drops below 9.60 VDC.

To determine the source of the problem proceed as follows:

1. Check the voltage on terminal #1 in the electronic box for + 12 VDC or +24 VDC [+/-20%]. Terminal #1 is the unfused power source input.

2. If the voltage at terminal #1 is less than 9.6 VDC (for a 12 VDC charging circuit) or less than 10.3 VDC (for a 24 VDC 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 +12 VDC or +24 VDC. Check the voltage on terminals #3 and #4 in the electronic box. This is the fused 12 VDC power source regardless of the power supply voltage at terminal #1.

If the machine has 24 VDC Charging Circuit and the voltage at terminal #3 and #4 is less than 9.6 VDC and voltage at terminal #1 is OK the 24/12 VDC Converter is defective.

For further instructions contact PAT America, Inc.

E:84

Voltage Error - 5V Analog

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 electronic box to determine the actual voltage.

1. To check +5.00 VDC analog place the ground lead of a multimeter on terminal #22 and the positive lead to terminal #21. If you get +5.00 VDC send the electronic box to PAT-Krueger Corporation, Inc. for evaluation and repair. If there is no voltage continue to step 2.

2. Remove all wires from terminal #21 and reset the system by pushing the P> button. If the system resets there is a short in the wiring, plug and receptacle or in the cable reel. Trace short by unplugging the plug from the receptacle mounted on the rear of the base section on of the boom. If the short is removed the problem is in the wiring to the cable reel or in the cable reel. After repairing problem reset the system to see if error code clears.

For further instructions contact PAT America, Inc.

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 America, Inc. before removing the component. Include crane model and serial number when ordering to allow PAT America, Inc. 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 America, Inc. 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

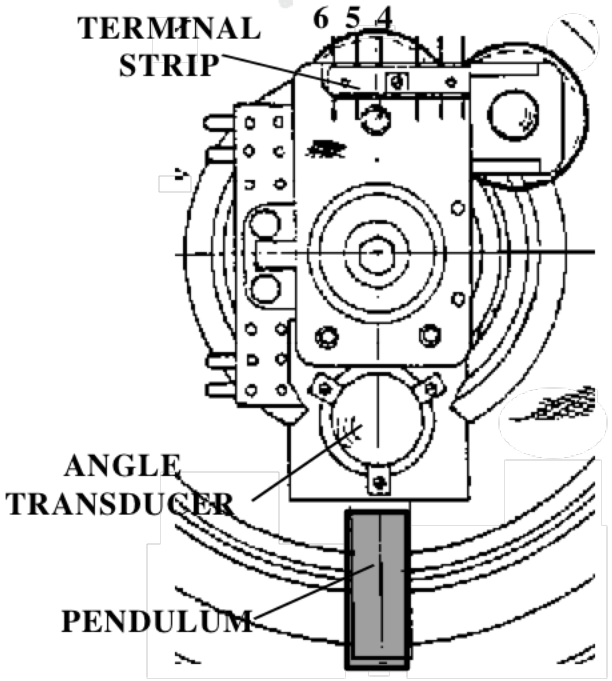
1. Fully retract the boom and lower to an angle that will provide you with access to the cable reel mounted on the boom base section.

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 termnial 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.

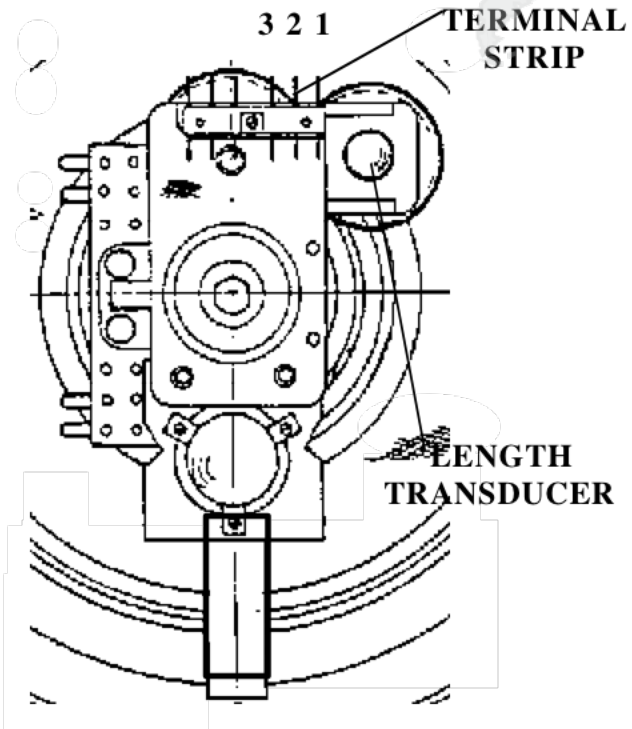
The Angle Transducer has been adjusted. The machine can be put back into service.

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

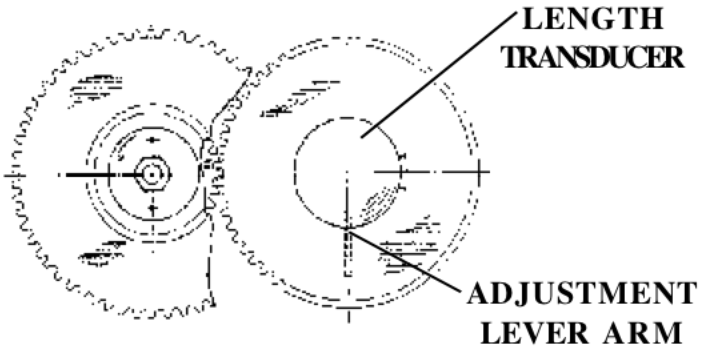


1. Locate machine in an area that will allow you to safely extend the boom to it's full extension (Powered sections plus manual section).

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.

LENGTH TRANSDUCER ADJUSTMENT

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.

Krüger products are sold and serviced in North America by:

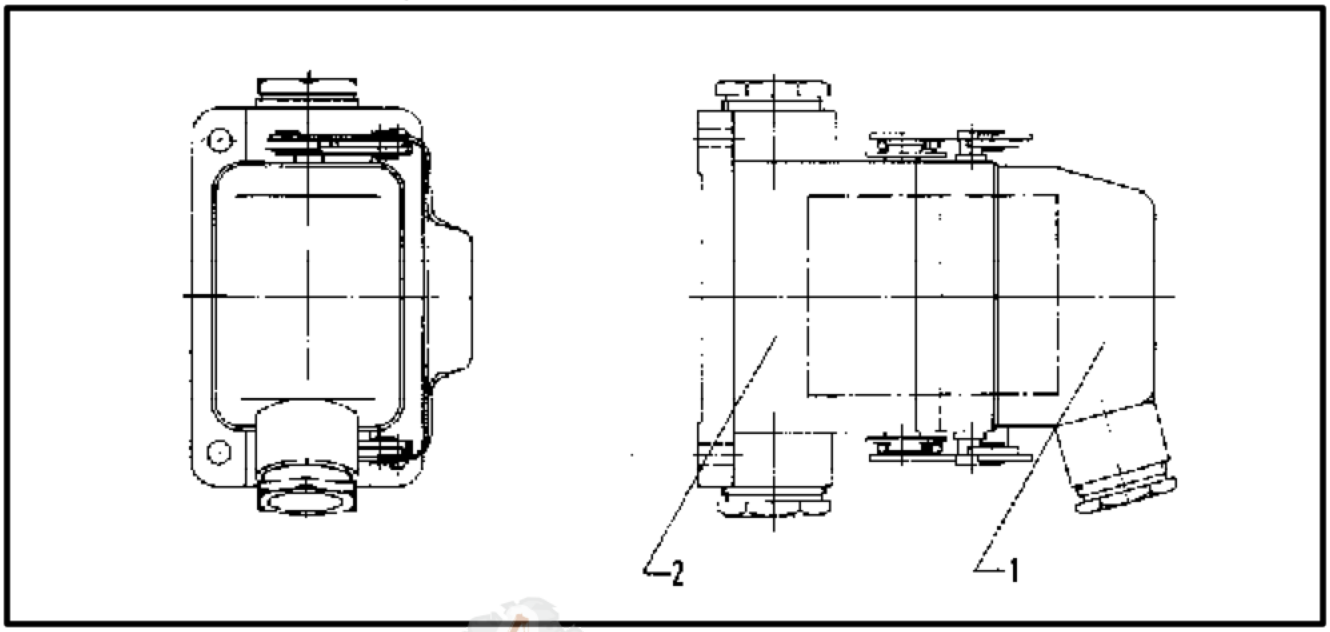
PAT America, Inc.
980 Industrial Court
Loves Park, IL 61111-7512

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

COMPONENT LISTING

PAT America, Inc.
980 Industrial Ct. Loves Park, IL 61111-7512

Component: **10 Pin - Plug/Receptacle** Article No.:

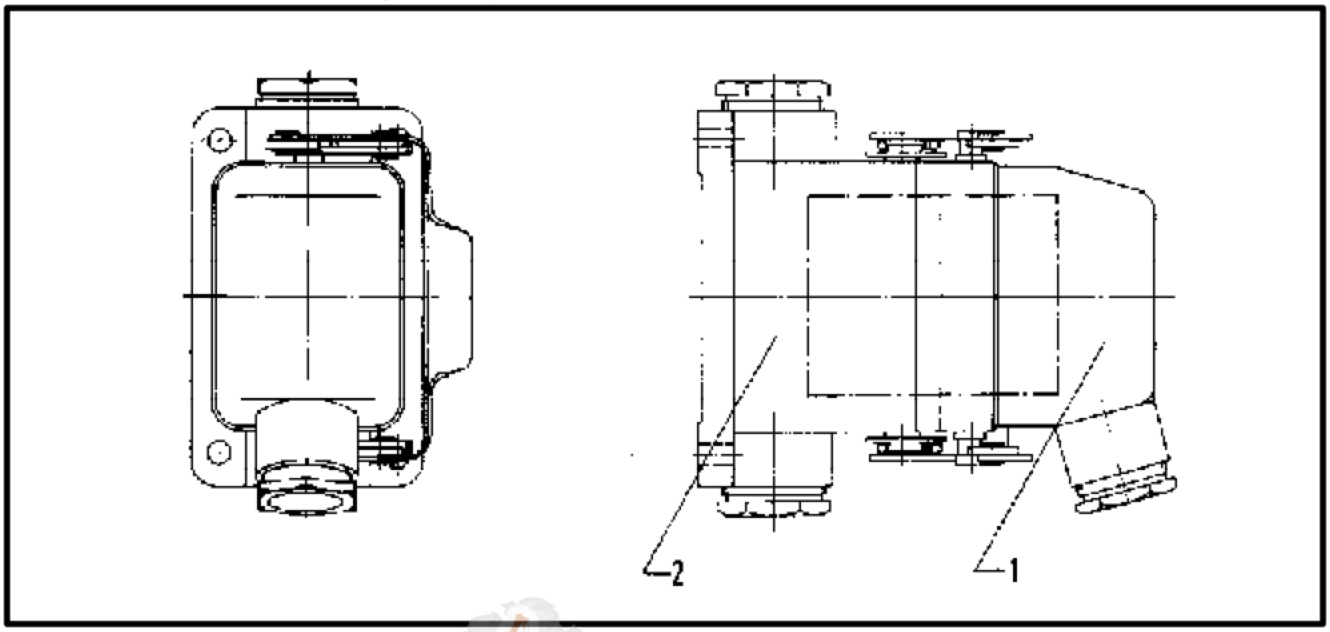


ITEM NO.	DESCRIPTION	QUAN.	ARTICLE NO.
1	10 Pin Plug		**1-0011059.00**
	- Housing	1	2-0001007.00
	- Male Insert	1	1-0016378.00
Not Shown			
	- Cable Connector - PG 16	1	1-0011867.00
2	10 Pin Receptacle		**1-0011058.00**
	- Housing	1	2-0001008.00
	- Female Insert	1	1-0016375.00
Not Shown			
	- Cable Connector - 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

PAT America Inc.
980 Industrial Ct. Loves Park, IL 61111-7512

Component: **6 Pin - Plug/Receptacle** Article No.:

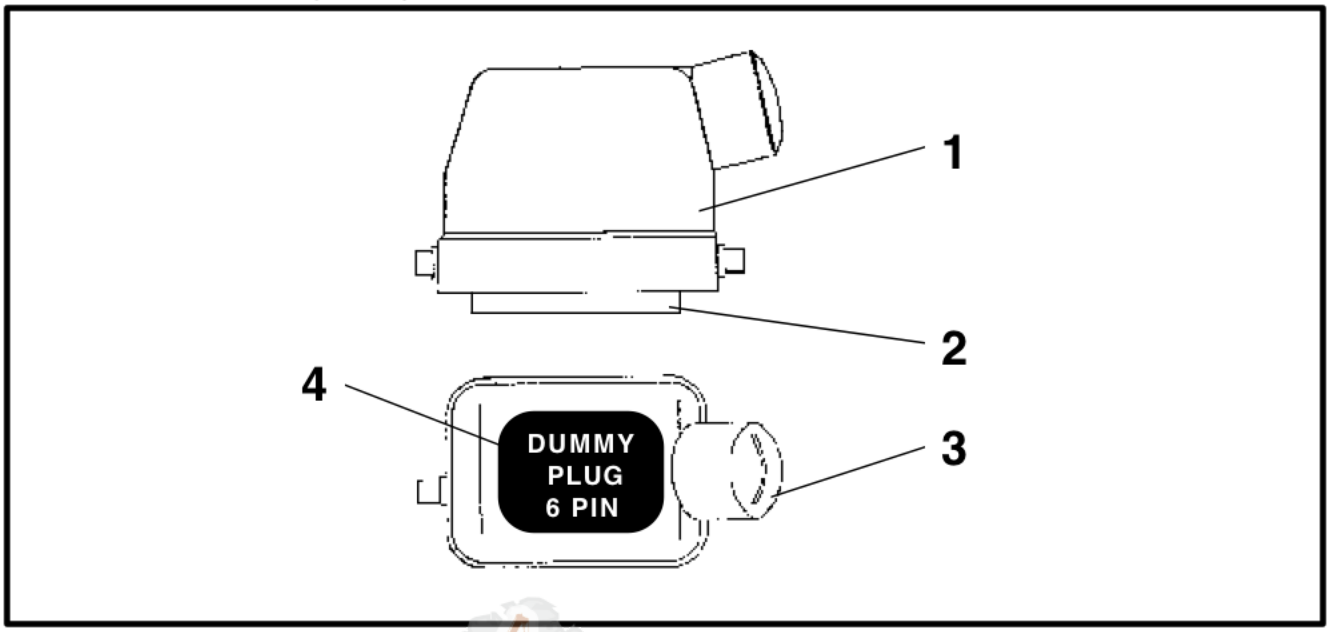


ITEM NO.	DESCRIPTION	QUAN.	ARTICLE NO.
1	6 Pin Plug		**1-0011642.00**
	- Housing	1	2-0001005.00
	- Male Insert	1	1-0016377.00
Not Shown			
	- Cable Connector - PG 16	1	1-0011867.00
2	6 Pin Receptacle		**1-0011641.00**
	- Housing	1	2-0001006.00
	- Female Insert	1	1-0016037.00
Not Shown			
	- Cable Connector - 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 LISTING

PAT America, Inc.
980 Industrial Ct. Loves Park, IL 61111-7512

Component: **Dummy Plug - 6 Pin** Article No.: **1-0011642.20**

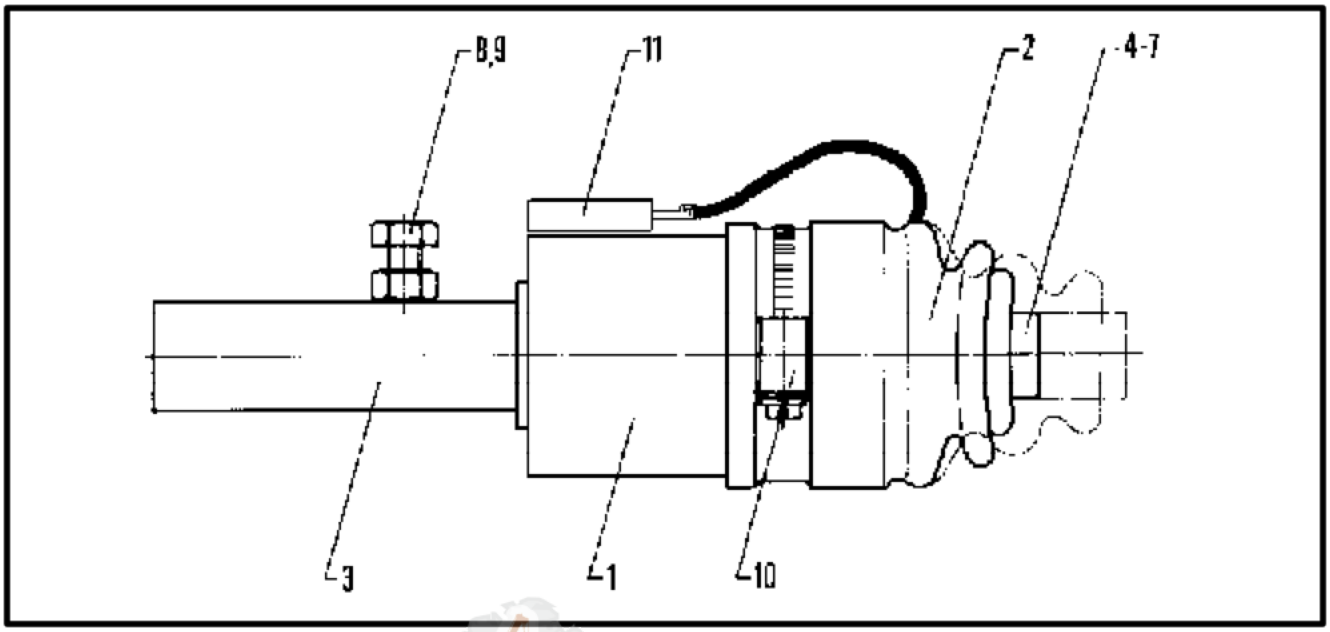


ITEM NO.	DESCRIPTION	QUAN.	ARTICLE NO.
1	Housing	1	2-0001005.00
2	Male Insert	1	1-0016377.00
3	Blind Plug - PG 16 (Metallic)	1	2-0000813.00
4	Decal	1	2-0000992.00

COMPONENT LISTING

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

Component: **MAGNET VALVE - 12V. "D"** Article No.: **1-0010387.00**

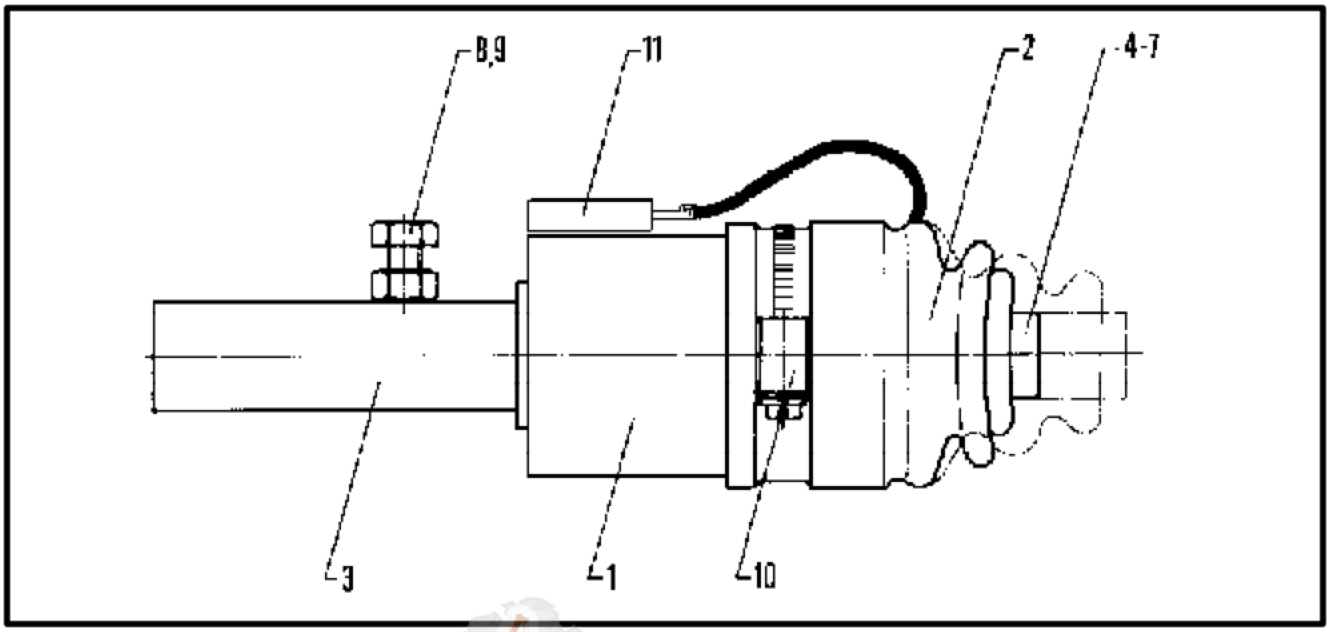


ITEM NO.	DESCRIPTION	QUAN.	ARTICLE NO.
1	Magnet Valve Body - 12 V.	1	1-0023248.00
2	Rubber Valve Cover	1	1-0010428.00
3	Weld Rod Case	1	1-0101028.00
4	Shaft - 20mm	1	1-0010434.00
5	Shaft Retainer	1	1-0010424.00
6	Short Weld Adapter	1	1-0010423.00
7	Hex Nut - M12	1	1-0010422.00
8	Hex Head Capscrew - M8 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

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

COMPONENT LISTING

Component: **MAGNET VALVE - 12V. "Z"** Article No.: **1-0010386.00**

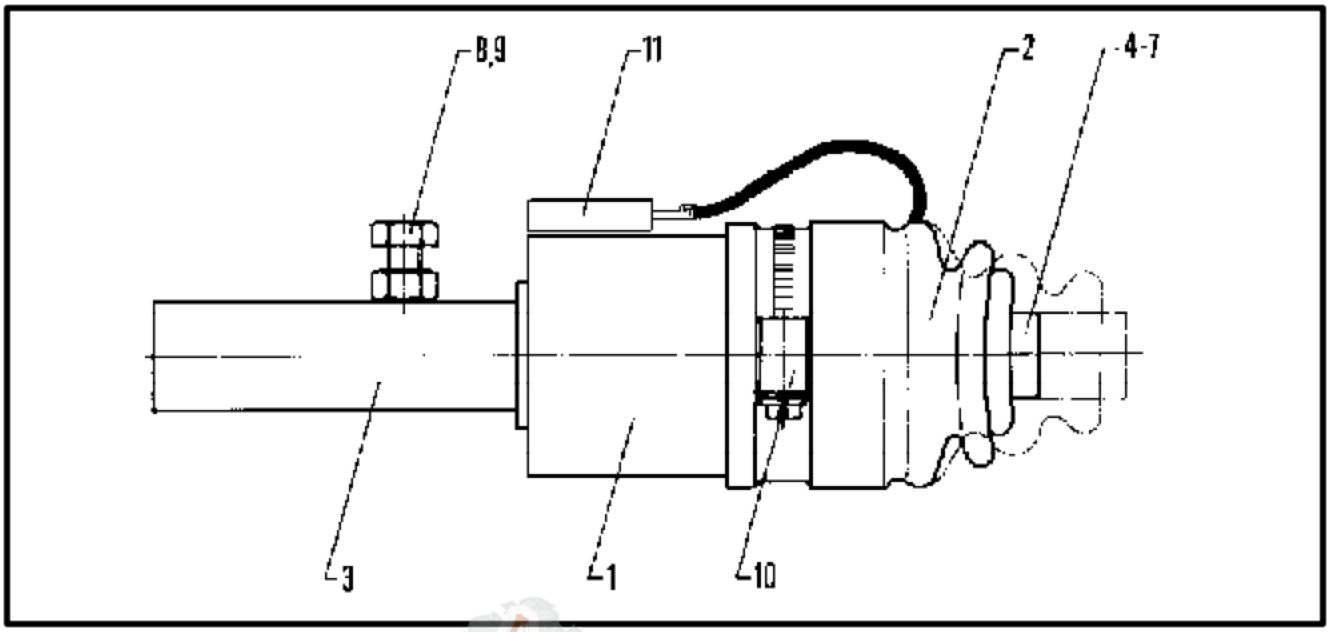


ITEM NO.	DESCRIPTION	QUAN.	ARTICLE NO.
1	Magnet Valve Body - 12 V.	1	1-0023248.00
2	Rubber Valve Cover	1	1-0010428.00
3	Weld Rod Case	1	1-0101028.00
4	Shaft - 20mm	1	1-0010435.00
5	Shaft Retainer	1	1-0010424.00
6	Short Weld Adapter	1	1-0010423.00
7	Hex Nut - M12	1	1-0010422.00
8	Hex Head Capscrew - M8 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 LISTING

PAT America Inc.
980 Industrial Ct. Loves Park, IL 61111-7512

Component: **MAGNET VALVE - 24V. "D"** Article No.: **1-0010392.00**

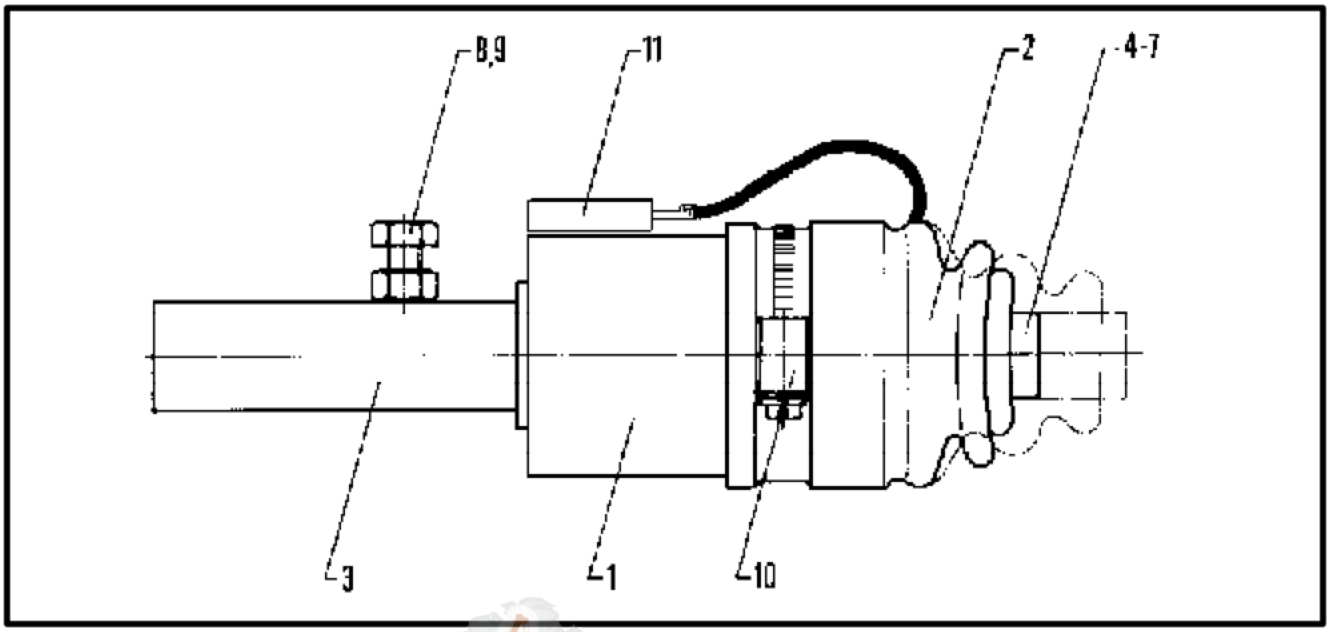


ITEM NO.	DESCRIPTION	QUAN.	ARTICLE NO.
1	Magnet Valve Body - 12 V.	1	1-0023260.00
2	Rubber Valve Cover	1	1-0010428.00
3	Weld Rod Case	1	1-0101028.00
4	Shaft - 20mm	1	1-0010434.00
5	Shaft Retainer	1	1-0010424.00
6	Short Weld Adapter	1	1-0010423.00
7	Hex Nut - M12	1	1-0010422.00
8	Hex Head Capscrew - M8 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 LISTING

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

Component: **MAGNET VALVE - 24V. "Z"** Article No.: **1-0010391.00**

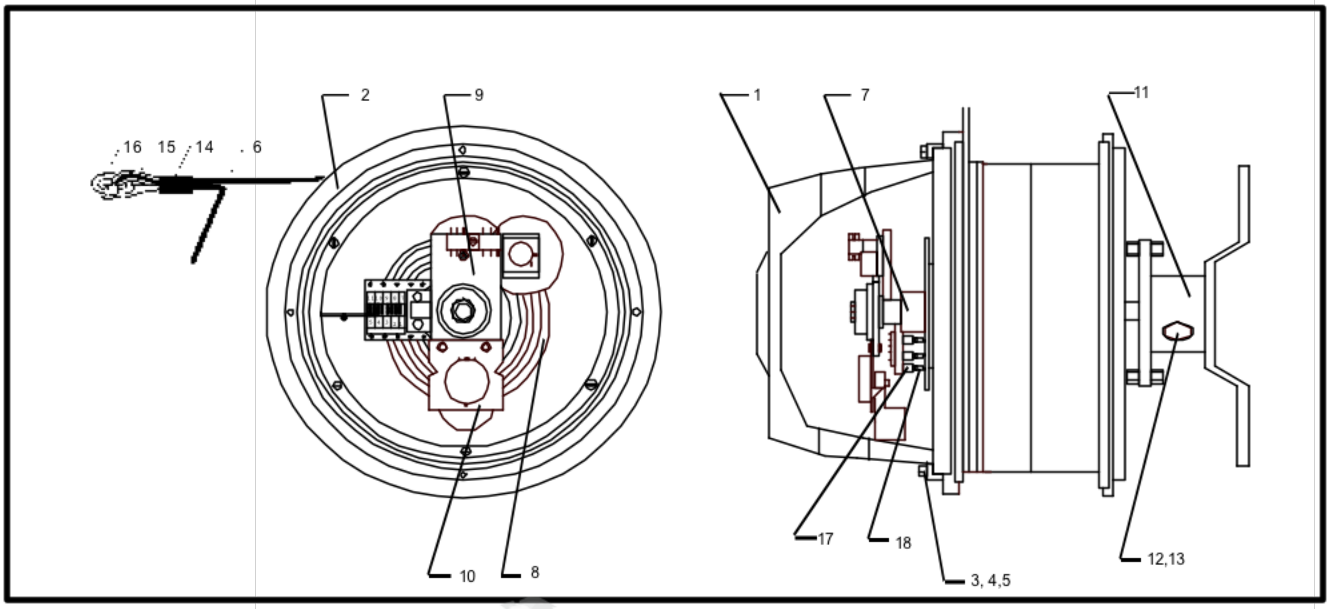


ITEM NO.	DESCRIPTION	QUAN.	ARTICLE NO.
1	Magnet Valve Body - 12 V.	1	1-0023260.00
2	Rubber Valve Cover	1	1-0010428.00
3	Weld Rod Case	1	1-0101028.00
4	Shaft - 20mm	1	1-0010435.00
5	Shaft Retainer	1	1-0010424.00
6	Short Weld Adapter	1	1-0010423.00
7	Hex Nut - M12	1	1-0010422.00
8	Hex Head Capscrew - M8 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

COMPONENT LISTING

PAT America, Inc.
980 Industrial Ct. Loves Park, IL 61111-7512

Component: **LMI Cable Reel - 24/30M** Article No.: **1-0115463.20**

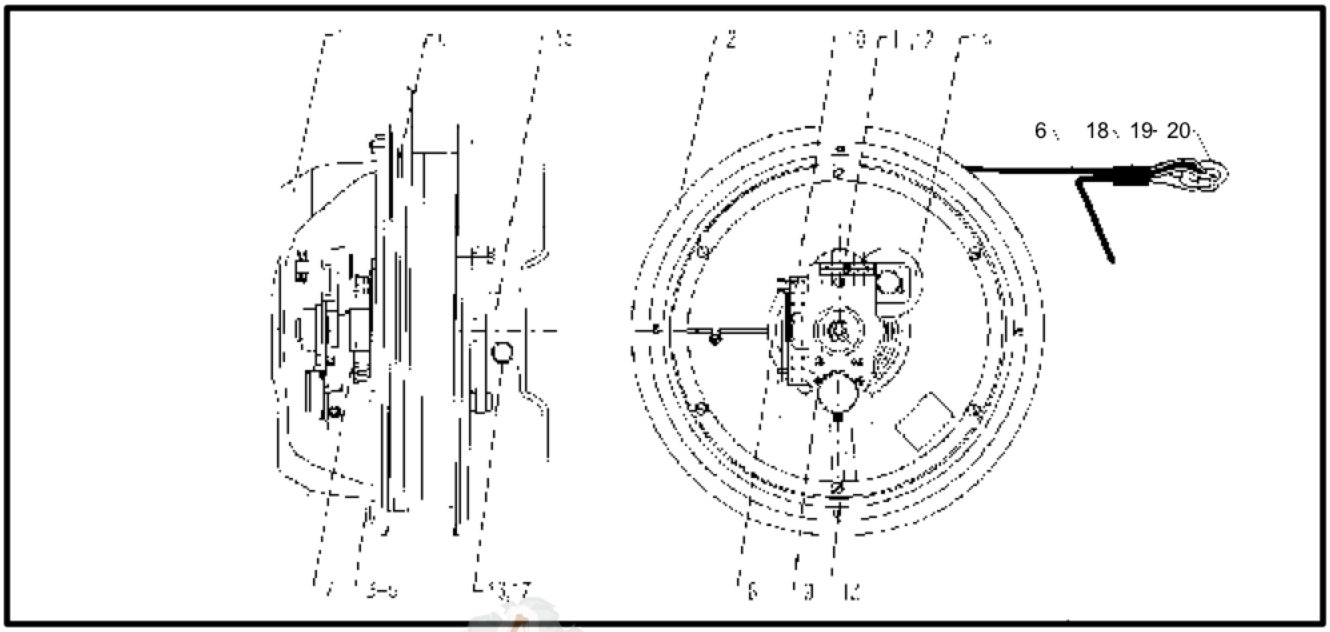


ITEM NO.	DESCRIPTION	QUAN.	ARTICLE NO.
1	Cover Complete	1	1-0107886.00
2	Cable Reel Body	1	1-0107885.00
3	Angle Clamp	4	1-0010613.00
4	Slotted Flat Head Screw - M5 x 14	4	1-0012350.00
5	Nylon Washer - M5	4	1-0010581.00
6	Shielded Cable 1 x 1	30M	1-0010328.00
7	Receiver Complete	1	1-0010615.00
8	Slip 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 LISTING

PAT America, Inc.
980 Industrial Ct. Loves Park, IL 61111-7512

Component: **LMI Cable Reel - 32/45M** Article No.: **1-0106926.20**

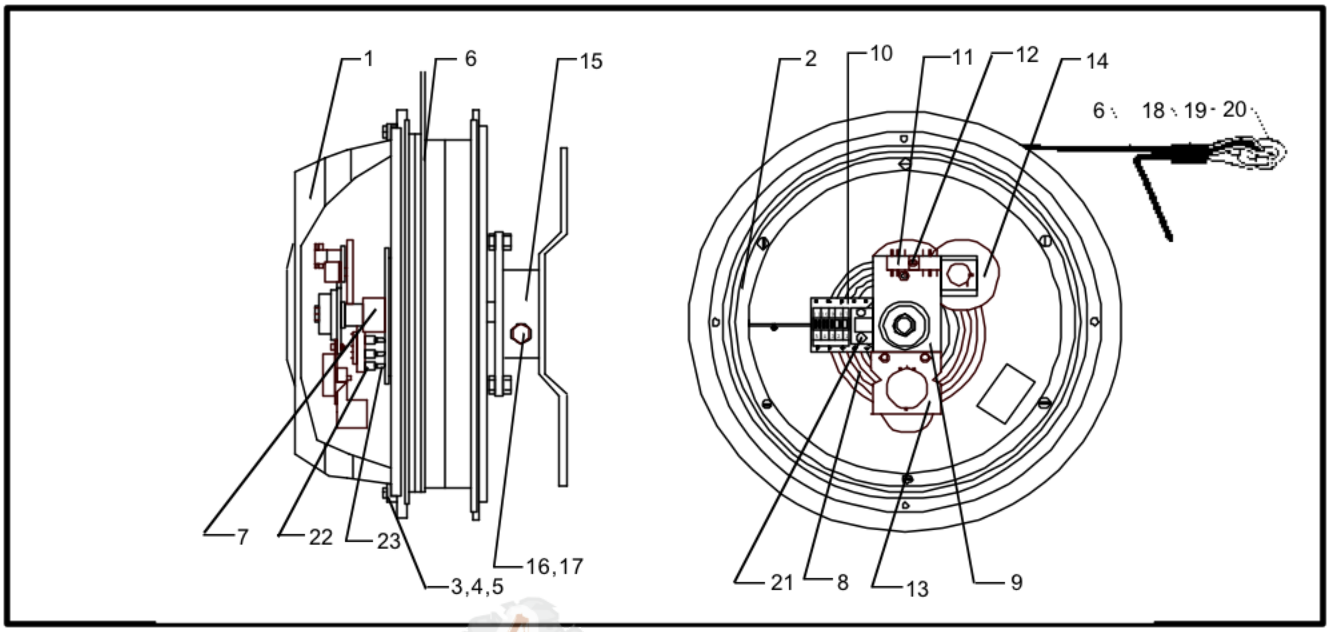


ITEM NO.	DESCRIPTION	QUAN.	ARTICLE NO.
1	Cover Complete	1	1-0016897.00
	- Cover	1	1-0010159.00
	- Rubber Seal	1	1-0010631.00
2	Cable Reel Body	1	1-0010653.00
3	Angle Clamp	4	1-0010613.00
4	Slotted Flat Head Screw - M5 x 14	4	1-0012350.00
5	Nylon Washer - M5	4	1-0010581.00
6	Shielded Cable 1x1	45M	1-0102079.00
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

PAT America, Inc.
980 Industrial Ct. Loves Park, IL 61111-7512

Component: **LMI Cable Reel - 32/45M** Article No.: **1- 0115068.20**

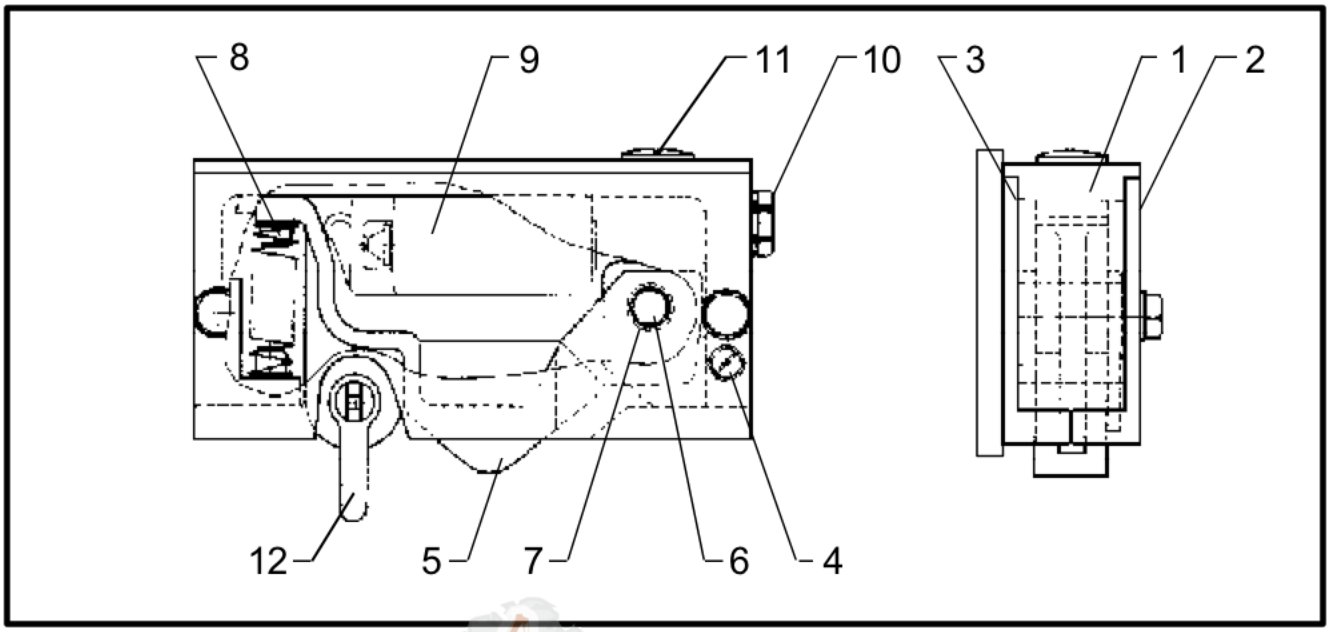


ITEM NO.	DESCRIPTION	QUAN.	ARTICLE NO.
1	Cover Complete	1	1-0016897.00
	- Cover	1	1-0010159.00
	- Rubber Seal	1	1-0010631.00
2	Cable Reel Body	1	1-0010653.00
3	Angle Clamp	4	1-0010613.00
4	Slotted Flat Head Screw - M5 x 14	4	1-0012350.00
5	Nylon Washer - M5	4	1-0010581.00
6	Shielded Cable 1x1	45M	1-0102079.00
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.
980 Industrial Ct. Loves Park, IL 61111-7512

Component: **A-2-B Switch** Article No.: **1-0024849.20**

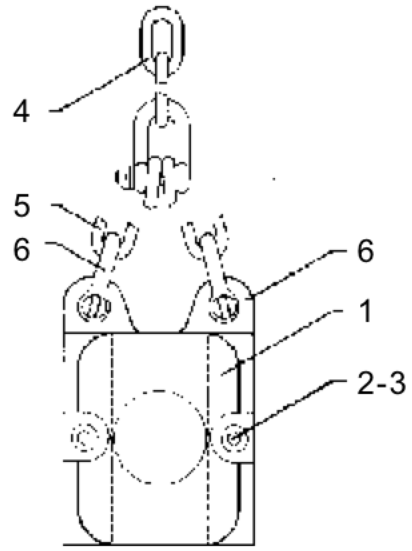


ITEM NO.	DESCRIPTION	QUAN.	ARTICLE NO.
1	Center Housing	1	1-0112531.00
2	Cover - Left	1	1-0010045.00
3	Cover - Right	1	1-0010044.00
4	Slotted Flat Head Screw - M5 x 8	2	1-0013391.00
5	Lever	1	1-0010041.00
6	Straight Pin	1	1-0010042.00
7	Bushing	1	1-0010104.00
8	Spring	1	1-0100326.00
9	Micro Switch	1	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

COMPONENT LISTING

PAT America Inc.
980 Industrial Ct. Loves Park, IL 61111-7512

Component: **Counterweight with Chain** Article No.: **1-0016800.11**

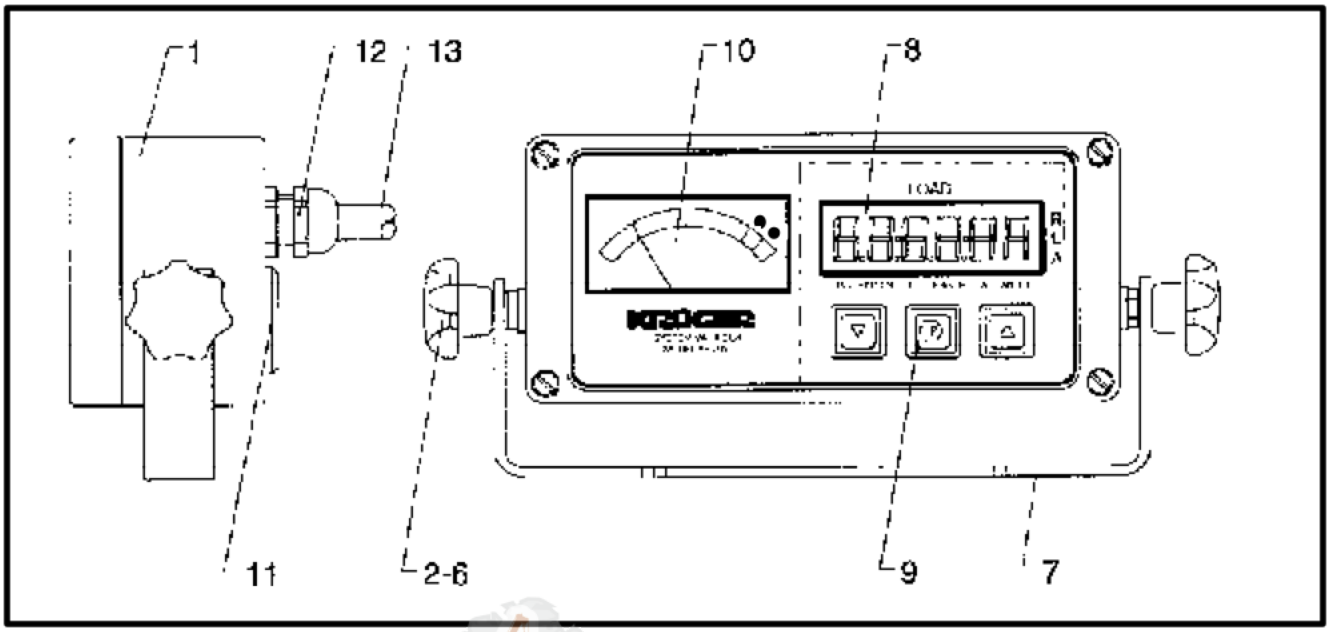


ITEM NO.	DESCRIPTION	QUAN.	ARTICLE NO.
1	Counterweight Half (Drilled)	2	1-0009995.00
2	Clevis Pin	2	2-0001388.00
3	Cotter Pin	2	2-0001389.00
4	Chain #1	1	1-0016908.00
5	Chain #2	2	1-0016909.00
6	Shackle	3	1-0010107.00

COMPONENT LISTING

PAT-KRUEGER Corporation, Inc.
980 Industrial Ct. Rockford, Il 61111-7512

Component: **Panel - Mark 3E/1 Load Moment Ind.** Article No.: **1-0108526.00**

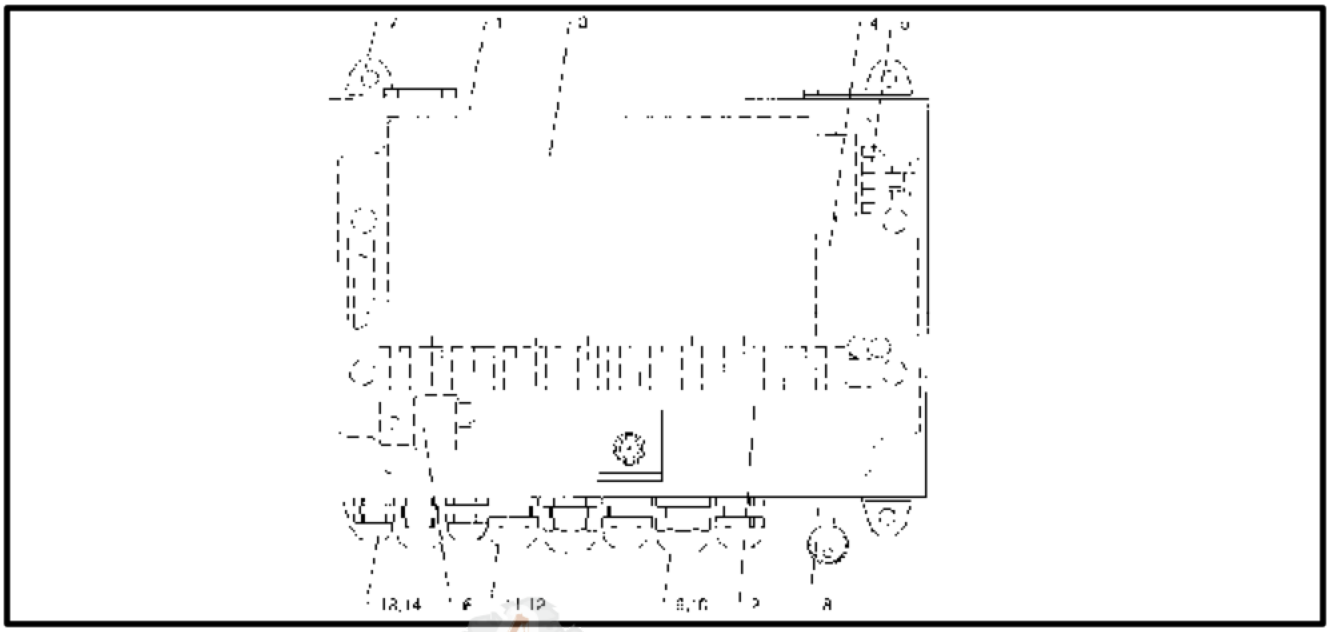


ITEM NO.	DESCRIPTION	QUAN.	ARTICLE NO.
1	Housing	1	1-0107573.00
2	Mounting Knob	2	1-0106678.00
3	Socket Head Capscrew - M6 x 25	2	1-0017292.00
4	Hex Nut - M6	2	1-0016719.00
5	Lock Washer - M6	2	1-0020543.00
6	Sealing Washer - M6	2	1-0107588.00
7	Mounting Bracket	1	1-0107595.00
8	PCB (Display)	1	1-0110985.00
9	PCB (Push Button)	1	1-0110532.00
10	Meter - LM w/ Scale	1	1-0110299.00
11	Electronic Beeper	1	1-0012135.00
12	Cable Connector - PG 13.5	1	1-0103590.00
13	Shielded Cable - 16 x 0.5	7M	1-0014411.00

COMPONENT LISTING

PAT America, Inc.
980 Industrial Ct. Loves Park, IL 61111-7512

Component: **Electronic 24V. - Mark 3E/1** Article No.: **1-0108242.10**

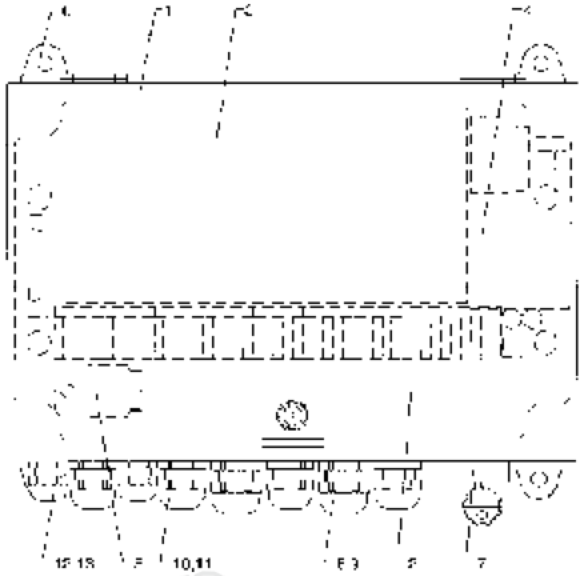


ITEM NO.	DESCRIPTION	QUAN.	ARTICLE NO.
1	Housing	1	1-0107672.00
2	PCB - Basic	1	1-0107919.00
3	PCB - CPU	1	1-0107907.00
4	PCB - 24/12V. Converter	1	1-0028174.00
5	Fuse (1 AT)	2	1-0011343.00
6	Relay - 12VDC	1	1-0011489.00
7	Mounting Foot - Kit	1	1-0107626.00
8	Key Switch	1	1-0026244.00
	- Key	2	1-0016153.00
9	Cable Connector - PG 13.5	2	1-0103590.00
10	Hex Nut - PG 13.5	2	1-0020701.00
11	Cable Connector - PG 11	4	1-0103589.00
12	Hex Nut - PG 11	4	1-0020700.00
13	Cable Connector - PG 9	2	1-0027705.00
14	Hex Nut - PG 9	2	1-0020699.00
ORDER SEPARATELY			
	Weld Frame	1	2-0001914.00

COMPONENT LISTING

PAT America, Inc.
980 Industrial Ct. Loves Park, IL 61111-7512

Component: **Electronic 12 V. - Mark 3E/1** Article No.: **1-0107689.10**

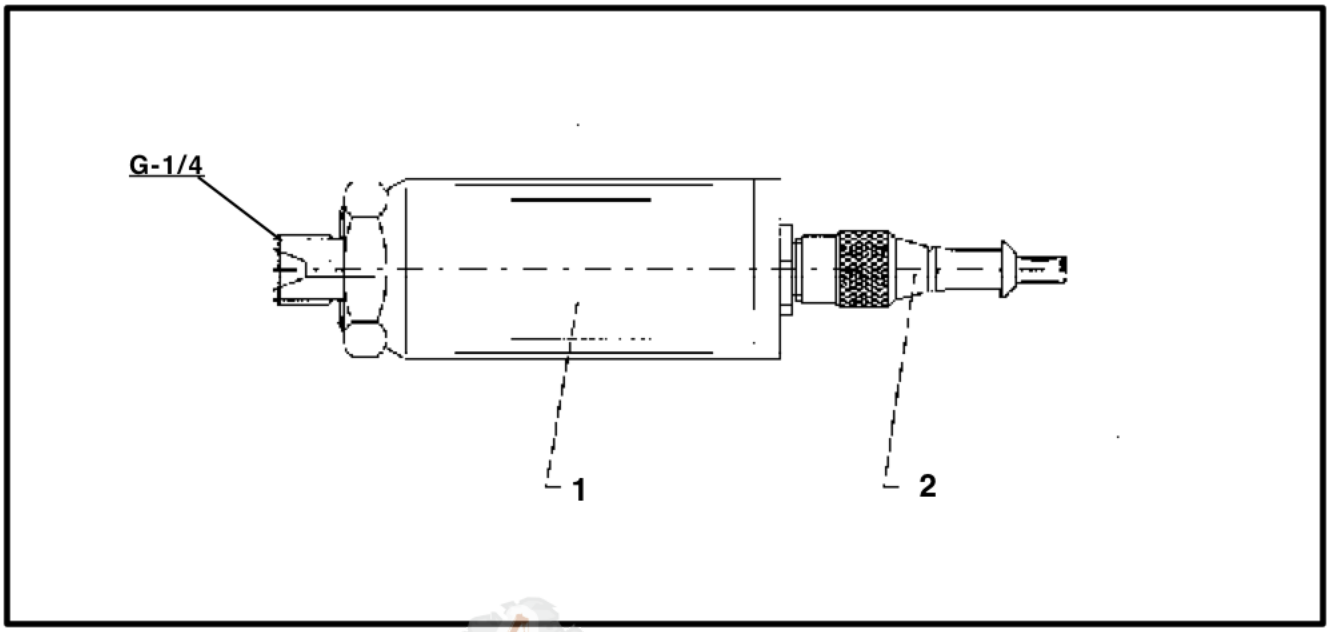


ITEM NO.	DESCRIPTION	QUAN.	ARTICLE NO.
1	Housing	1	1-0107672.00
2	PCB - Basic	1	1-0107919.00
3	PCB - CPU	1	1-0107907.00
4	Not Used		
5	Relay - 12 VDC	1	1-0011489.00
6	Mounting Feet - Kit	1	1-0107626.00
7	Key Switch	1	1-0026244.00
	- Key	2	1-0016153.00
8	Cable Connector - PG 13.5	2	1-0103590.00
9	Hex Nut - PG 13.5	2	1-0020701.00
10	Cable Connector - PG 11	4	1-0103589.00
11	Nex Nut - PG 11	4	1-0020700.00
12	Cable Connector - PG 9	2	1-0027705.00
13	Hex Nut - PG 9	2	1-0020699.00
ORDER SEPARATELY			
	Weld Frame	1	2-0001914.00

COMPONENT LISTING

PAT America Inc.
980 Industrial Ct. Loves Park, IL 61111-7512

Component: **Pressure Sensor - 250 Bar** Article No.: **1-0108060.00**

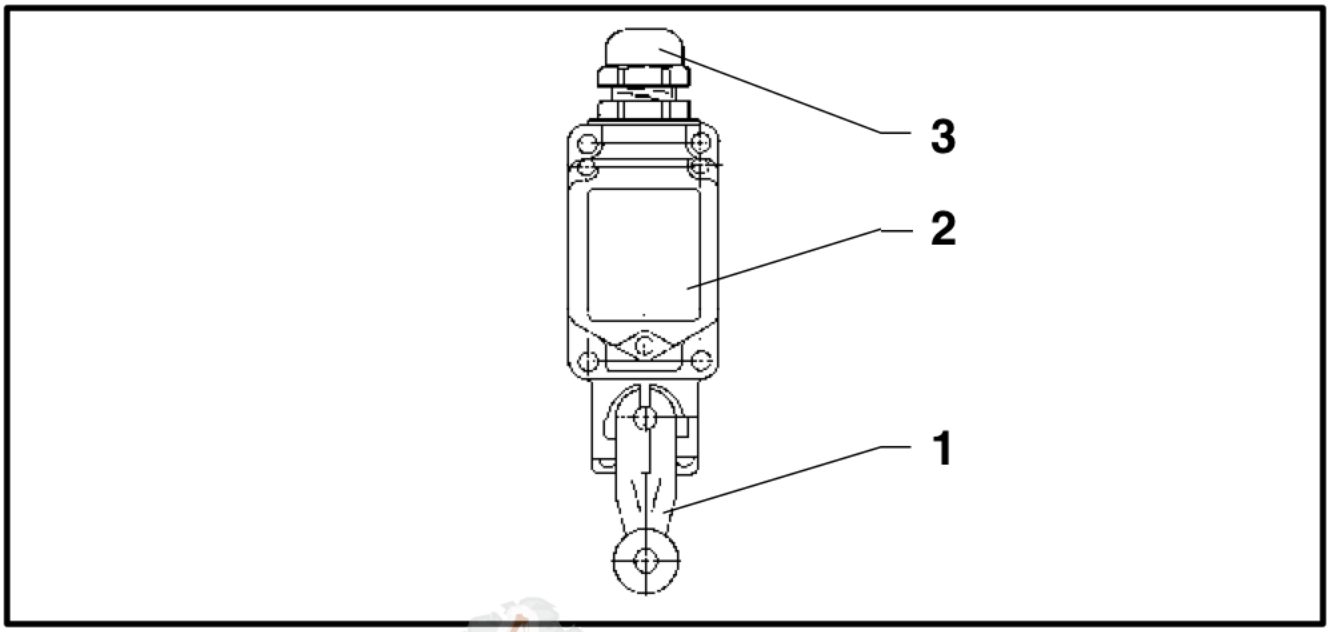


ITEM NO.	DESCRIPTION	QUAN.	ARTICLE NO.
1	Pressure Sensor - 250 Bar	1	1-0108060.00
	PURCHASE SEPARATELY:		
2	Connector Cable - Straight x 7M.	1	1-0114293.00
	Connector Cable - 90° Connector	1	1-0101758.00
	Connector Cable - Straight x 10M.	1	1-0114294.00

COMPONENT LISTING

PAT-KRUEGER Corporation, Inc.
980 Industrial Ct. Loves Park, IL 61111-7512

Component: **Roller Switch - Omron** Article No.: **2-0000290.00**

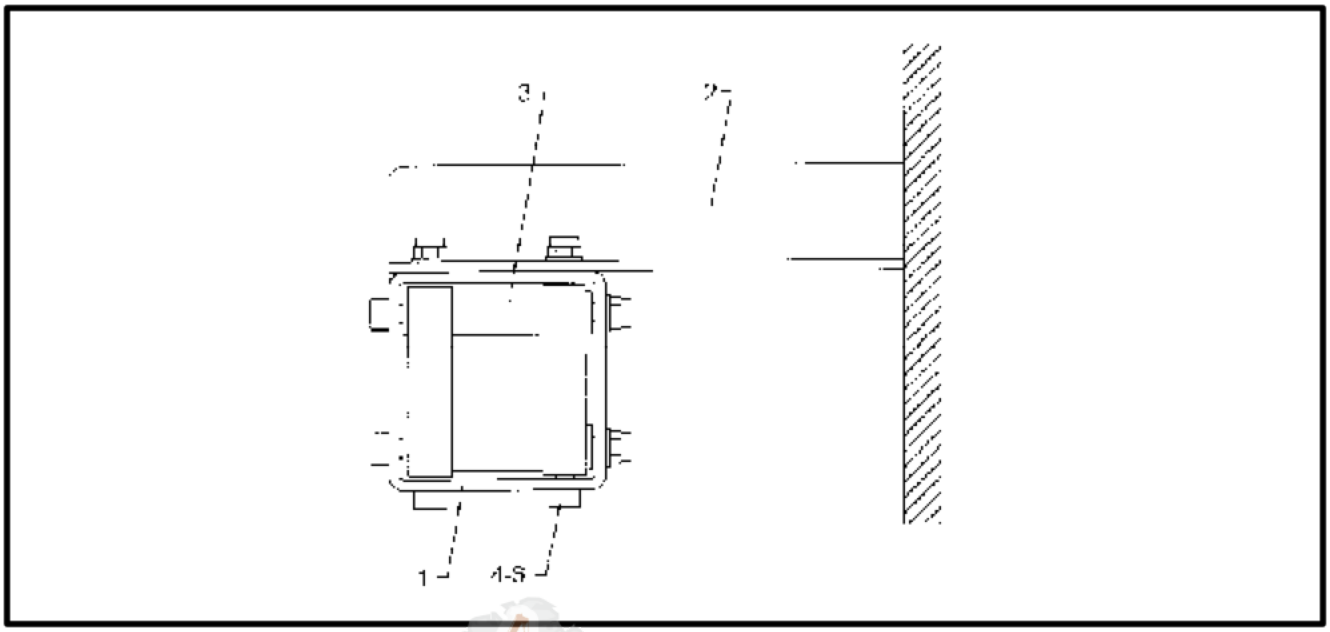


ITEM NO.	DESCRIPTION	QUAN.	ARTICLE NO.
1	Operating Head w/ Roller	1	2-0000607.00
2	Housing w/ Micro Switch	1	2-0000606.00
3	Cable Connector - PG 13.5	1	1-0010536.00
NOT SHOWN			
	Weld Plate	1	2-0000289.00

COMPONENT LISTING

PAT America Inc.
980 Industrial Ct. Loves Park, IL 61111-7512

Component: **Roller Guide** Article No.: **1-0010561.00**



ITEM NO.	DESCRIPTION	QUAN.	ARTICLE NO.
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