LOAD MOMENT INDICATOR

DS 350 / 1328 GRAPHIC
for GROVE AT422T

OPERATOR'S HANDBOOK
NOTICE

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1 GENERAL INFORMATION

The PAT Load Moment Indicator\(^1\) (LMI) DS 350 has been designed to provide the crane operator with the essential information required to operate the machine within its design parameters.

This low temperature system uses heaters for stable system operation in a subzero climate. The main electronics are automatically warmed before the system boards and components are energized. Therefore, all system components must be installed and sealed from the environment when operating and/or troubleshooting in low temperature conditions.

Using different sensing devices, the Load Moment Indicator monitors various crane functions and provides the operator with a continuous reading of the crane’s capacity. The readings continuously change as the crane moves through the motions needed to make the lift.

The LMI provides the operator with information regarding the length and angle of the boom, working radius, rated load and the total calculated weight being lifted by the crane.

If non permitted conditions are approached, the DS 350 Load Moment Indicator will warn the operator by sounding an audible alarm, lighting a warning light and locking out those functions that may aggravate the crane’s condition.

\(^1\) LOAD MOMENT: generally the product of a force and its moment arm; specifically, the product of the load and the load-radius. Used in the determination of the lifting capacity of a crane
2 WARNINGS

The LMI is an operational aid that warns a crane operator of approaching overload conditions and of overhoist conditions that could cause damage to equipment and personnel. The device is not, and shall not, be a substitute for good operator judgment, experience and use of accepted safe crane operating procedures. The responsibility for the safe crane operation shall remain with the crane operator who shall ensure that all warnings and instructions supplied are fully understood and observed.

Prior to operating the crane, the operator must carefully and thoroughly read and understand the information in this manual to ensure that he knows the operation and limitations of indicator and crane.

⚠️ WARNING ⚠️

The PRIMARY (i.e. cab-side) Anti-two Block Switch must be used in ALL Operations. Simultaneous two-hoist working is prohibited in all circumstances other than Pile-Driving.

Proper functioning depends upon proper daily inspection and observance of the operating instructions set forth in this manual. Refer to Section 6. Pre-Operation Inspection and Calibration Verification of this handbook.

⚠️ WARNING ⚠️

The LMI can only work correctly, if all adjustments have been properly set. For correct adjustment, the operator has to answer thoroughly and correctly all questions asked during the setup procedure in accordance with the real rigging state of the crane. To prevent material damage and serious or even fatal accidents, the correct adjustment of the LMI has to be ensured before starting the crane operation.
3 SYSTEM DESCRIPTION

The PAT Load Moment Indicator DS 350 consists of a central micro processor unit, operating console, length/angle sensor, pressure transducers, and anti-two block switches. This low temperature system uses heaters for stable system operation in a subzero climate. The main electronics are automatically warmed before the system boards and components are energized. Therefore, a warming period will be required in low temperature conditions.

The system operates on the principle of reference/real comparison. The real value, resulting from the pressure measurement is compared with the reference data, stored in the central processor memory and evaluated in the micro processor. When limits are reached, an overload warning signal is generated at the operator's console. At the same time, the aggravating crane movements, such as hoist up, telescope out and boom down, will be stopped. The fixed data regarding the crane, such as capacity charts, boom weights, centers of gravity and dimensions are stored in memory chips in the central processor unit. This data is the reference information used to calculate the operating conditions.

Boom length and boom angle are registered by the length/angle sensor, mounted inside the cable reel which is mounted on the boom. The boom length is measured by the cable reel cable which also serves as an electrical conductor for the anti two-block switches. The crane load is measured by pressure transducers attached to the piston and rod side of the hoist cylinders.

The interactive user guidance considerably simplifies the input of operating modes as well as the setting of geometry limit values.
Fig. 1: Components of the LMI system PAT DS 350

1. Anti Two-Block switches
2. Pressure Transducers
3. Length/angle sensor
4. Operating console
5. Central-Micro-Processor unit
3.1 System Function

Upon switching on, the system starts with an automatic test of the LMI system, of lamps and audible alarm. During the test, the LC display shows the initial logo.

If the system was turned off for more than two hours, the setup configuration has to be entered after the system test. (☞ chapter 4)

First, the operating mode is determined by an interactive step-by-step interrogation of the rigging states.

Next is the interactive input of the reeving.

Now the LC display shows in symbols all inputs and awaits acknowledgment or canceling.

Upon acknowledgment of the inputs the system is ready for operation.

3.2 Operating Console

The console has 3 functions:
- inputs by the crane operator (operating mode, reeving)
- input of geometry limit values and signalization of exceeded limit values
- display of important data and information

The operator's console is mounted in the crane's cab in the operator's field of vision. For a better identification of displays and operating elements, they are continuously backlit during operation.
3.3 Control Identification

This unit contains a display and different controls which are described as follows:

Legend to Fig 2:

1. LC Display Area
2. Load Moment Limit Light
3. Load Moment Prewarning Light
4. Alarm Light “Anti-Two-Block”
5. Override Key Warning Light
6. Button “Alarm Stop”
7. Button and Control Light “TARE”
8. Button and Control Light “LIMITS”
9. Button and Control Light “SELECT OPERATION MODE”
10. Button and Control Light "INFO"
11. Button and Control Light "CONTROL"
12. Audible Alarm
13. By-Pass Key Switch
14. Button and Control Light "By-Pass Anti-Two-Block"
15. Button and Control Light "By-Pass LMI shut-off function"
F1. Button "Function 1"
F2. Button "Function 2"
F3. Button "Function 3"
F4. Button "Function 4"

Fig. 2: Operating Console
1. LC-Display

The LC display visualizes graphical symbols, texts and numerical values. Depending on the selected operating mode (setup, limit mode or LMI representation), the corresponding information is indicated on the display. Please refer to the description of the different operating modes for the signification of the individual elements.

2. Load Moment Limit Light

The red LOAD MOMENT LIMIT LIGHT (2) warns the operator that a rated load condition has been reached. It lights up when the load on the crane reaches the crane load capacity. The audible alarm also sounds when this condition has been reached. The following crane movements will be stopped concurrently:
- hoist up
- telescope out
- boom down

3. Load Moment Prewarning Light

The yellow LOAD MOMENT PRE-WARNING LIGHT (3) will light up when the load on the crane reaches the defined prewarning area, thus indicating that an overload condition is approaching. This means for the operator to continue his crane operation with extreme caution.

4. Alarm Light “Anti-2-Block”

The red “Anti Two-Block Alarm Light” (4) lights up when the anti-two-block limit switch contacts open, indicating that a two-blocking condition is approaching. At the same time the audible alarm will sound. The following crane movements will be stopped subsequently:
- hoist up
- telescope out
- boom down
5 Override Key Warning Light

The red OVERRIDE KEY WARNING LIGHT (5) flashes to indicate that the cut-off function of the A2B / LMI system is deactivated.

6 Button and Control Light “Alarm Stop”

This ALARM STOP BUTTON (6) allows the audible alarm to be silenced for approximately 15 seconds by pressing this button. Reference ⇒ “Audible Alarm” (12).

7 Button and Control Light “Tare”

The button “TARE” (7) is used to indicate the “Net load” on the LC Display (1). Net load is the present load, less lifting tackle and hook block. The Tare Button (7) has to be activated before lifting.

After pushing the “Tare Button” (7) the load display is set to zero (taring) and the control light lights up. After lifting a load the display shows the net load (pay load). The net load display will change to the actual load display when the boom radius is changed (either by angle or length).

8 Button “LIMITS”

Button to start the function ”program limit values”.
For the proceeding please refer to chapter 5.1.
Button "SELECT"

Button to start the function "set operating mode".
For the proceeding please refer to chapter 4.1.

**WARNING**

The correct setting is of utmost importance for the proper function of the system and the crane. Therefore only operators who are thoroughly familiar with use and operation of the system shall set this button.

Button "INFO"

Button to start the function "information crane configuration".
Please refer to chapter 5.2.

Button "CONTROL"

Button to start additional functions.
Please refer to chapter 5.3.

Audible Alarm

The AUDIBLE ALARM (12), sounds during the following conditions:

- overload condition
- approaching two-block condition
- preset limits reached
- malfunction of the LMI system
- operating error

The alarm can be temporarily silenced by pushing the button “Alarm Stop” (6).
13 Key Switch

The anti-two-block switch cut-off function is deactivated when the KEY SWITCH (13) is turned to position "B" and the “By-pass A2B” button (14) is pushed.

OR

The LMI cut-off function is deactivated when the KEY SWITCH (13) is turned to position "B" and the “By-pass LMI” button (15) is pushed.

---

**WARNING**

Since button (14) and (15) deactivate the cut-off function of the LMI system / the anti two-block system, the following instructions must be obeyed:

- The by-pass function shall be used with discretion, as unwarranted use of it to override the control lever lockout system can result in harm to the crane and danger to property and persons.

- Never use the by-pass function to either overload or operate the crane in a non permissible range.

14 Button "By-pass A2B"

This button can be operated only if key switch (13) is turned to position B.

After pushing this button, the cut-off function of the anti-two-block switch is deactivated.

The Override Key Warning Light (5) flashes to indicate that the cut-off function is deactivated.

15 Button "By-pass LMI"

This button can be operated only if key switch (13) is turned to position B.

After pushing this button, the control lever lockout function of the LMI is deactivated.

The Override Key Warning Light (5) flashes to indicate that the cut-off function is deactivated.
4 CONFIGURATION SETUP

The LMI setup procedure allows the operator to input the crane configuration using interactive displays. The operator must complete the setup procedure for the Load Moment Indicator system if the system has been turned off for more than two hours or the crane operation configuration has been changed.

4.1 LMI Setup Procedure

...starts:

- *automatically*, if the system was turned off for more than two hours.
- *manually* at each modification of the crane configuration by pressing key (9) "SEL"

...is operated:

- by answering the different questions using functional keys F1...F4 in accordance with the actual configuration of the crane.

...is cancelled:

- any time by pressing again key (9) "SEL". The system, however, is only ready for operation, if the procedure has been completed and the inputs have been confirmed.

If the system is turned off, for example during short breaks (less than 2 hours), all adjustments remain stored. When turning on again the system these adjustments can be acknowledged by merely pressing one key (provided that the crane configuration has not been modified!).

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During the programming procedure the Load Moment Prewarning Light (3) and the Load Moment Limit Light (2) will light up and the aggravating crane movements will be interrupted.

**Note:**
If a configuration is selected which is not available, the display will indicate error code E04. In this case, the procedure has to be repeated with valid values!

---

**CAUTION**

The correct setting is of utmost importance for the proper functioning of the system and the crane. Therefore, only operators who are thoroughly familiar with the crane and the operation of the system should execute the setting of the system according the operating configuration of the crane.

---

The LMI programming procedure consists of the following steps:

**Note:**
The main boom and counter weight configuration are automatically setup. This system is not set up for use with an extension or additional counter weight.

- setting the hoist configuration
- setting the outrigger configuration
- setting the reeving
- confirmation of the programming procedure

For easy operation, the computer guides the operator through the procedure step by step. (interactive operation)

**Definition of the Displayed Symbols:**

The following illustrations define the symbols appearing on the display during the setup procedure. Not all symbols will be shown, depending on the crane type and the answers to the questions.

- **Setting the hoist configuration**

![Diagram of hoist configuration](image)
• Setting the outrigger configuration

1 on rubber
2 outrigger position 100%

If 1 on rubber is selected you have the following selection.
1 static
2 pick and carry

• Setting the reeving (parts of line)

+ increase reeving
- decrease reeving
OK confirm reeving
• Confirmation of the programming procedure

At the end of the procedure all inputs are represented once again in symbolic forms. If inputs have been made, the corresponding symbols are filled black.

- Quick setting the reeving
  (⇒ chapter 4.3)
- Quick hoist line selection
  (⇒ chapter 4.2)
- Cancel procedure
- Confirm inputs
4.2 Quick Setting of the Reevering

If, during the crane operation, the number of reevering is modified, the LMI system has to be adjusted to this modification. The input of the reevering can be carried out directly without having to go through the whole LMI programming procedure again:

Call LMI Programming Procedure.

Directly call function "Quick Setting of the Reeverings".

**Note:**
The direct call is impossible, if the system has been turned off for more than 2 hours.

Input of reevering:
- Increase reevering
- Decrease reevering
- Confirm reevering

Confirm modification.

(select again the function upon faulty input)

**Note:**
If a configuration is selected which is not available on the present crane, the system will not accept the selection and the display will indicate the error code E04.
4.3 Quick Hoist Line Selection

If, during the crane operation, the crane is switched over from front to rear hoist, the LMI system has to be adjusted to this modification. This modification can be entered without having to go through the whole LMI setup procedure again:

Call LMI setup procedure.

Directly call function "Hoist Line Selection".

Note: The direct call is not possible, if the system has been turned off for more than 2 hours.

Select hoist:

1 Front Hoist
2 Rear Hoist

Confirm modification.

(call up the function again if you have selected the wrong winch by mistake)

Note:
If a configuration is selected which is not available on the crane, the system will not accept the selection and the display will indicate the error code E04.
4.4 Anti-two Block (A2B) Switch(es)

AT422T cranes are fielded with two different configurations of A2B switches, i.e. some having only one switch, and some having two switches. Correct use of the A2B switches must be followed to prevent material damage and serious or even fatal accidents. The applications under which these switches are used are described below:

a. Primary A2B Switch (Mandatory For All Operations)

The Primary (i.e. cab-side) Anti-two Block Switch is used in ALL applications. For single-hoist working (i.e. normal lifting operations), always use this switch, with the weight and chain installed correctly around the main hoist cable (if the crane also has a Secondary (i.e. right-side) A2B Switch installed, the Secondary Switch is used only in pile-driving operations).

For single-hoist working with cranes on which a Secondary Switch is also installed, the weight and chain is to be removed from the Secondary Switch and the by-pass flag installed. However, if the crane is being used for pile-driving operations, see Paragraph b. below.

b. Secondary A2B Switch (Pile Driving Applications Only)

The Pile-Driving application requires the use of a Secondary (i.e. right-side) Anti-two Block Switch, as well as the Primary Switch described in Paragraph a. above. The Secondary Switch must be used with the by-pass flag removed and the weight and chain attached around the auxiliary hoist cable.

ONLY during Pile-Driving operations is the Secondary Switch used, because Pile-Driving is the only application in which it is permissible to deploy and operate both hoists simultaneously.

The PRIMARY (i.e. cab-side) Anti-two Block Switch must be used in ALL Operations. Simultaneous two-hoist working is prohibited in all circumstances other than Pile-Driving.
5 OPERATION

After having set the LMI to the actual crane configuration, the system is ready for operation. The display shows the LMI screen (example for value representation).
Upon request, further symbols can be shown on the display:

**Symbol Anti Two-Block Alarm**
- visible when the anti-two-block limit switch contacts open, indicating that a two-blocking condition is approaching.

**Symbol height limitation:**
- continuously visible: *height limitation active*
- blinking: *height limit exceeded*  
  (☞ see chapter 5.1.2)

**Symbol boom angle limitation:**
- continuously visible: *boom angle limitation active*
- blinking: *angle limits exceeded*  
  (☞ see chapter 5.1.3)

**Symbol radius limitation**
- continuously visible: *radius limitation active*
- blinking: *range limits exceeded*  
  (☞ see chapter 5.1.4)

**E####**  
Error code No. ####  
(☞ see chapter 8 "Troubleshooting")
5.1 LIMIT Setting

The LMI system has been equipped with programmable limits for the crane’s operation range.

- Easy programming due to interactive, step-by-step user guidance
- Functions can be used individually or in combinations.
- Exceeding a programmed limit triggers an audible and visual alarm.
- Depending on the crane type not all functions listed below are available.

Overview limits:

- **Tip Height Limitation**
  
  *(chapter 5.1.1)*

- **Boom Angle Limitation**
  
  *(chapter 5.1.2)*

- **Radius Limitation**
  
  *(chapter 5.1.3)*
5.1.1 Tip Height Limitation

Programmable function for the limitation of the tip height

- **Set tip height / delete height limitation:**

  Call LIMIT Setting.

  Press the corresponding figure to select function "tip height limitation".

  Press key

  Move the tip to the required upper limit.

  **set:**
  
  **delete:**

  Display shows symbol and value of the programmed height limit

  Display shows symbol without values

  quit function
5.1.2 Boom Angle Limitation

Programmable function for the limitation of the upper and/or lower boom angle.

- **Call function:**

  ![Call LIMIT Setting](image)

  Enter the corresponding figure to call function "boom angle limitation".

- **set / delete upper limit value:**

  ![Select limit](image)

  Set:
  - Luff up the boom the requested limit value.
  - Set present boom angle as upper limit

  Delete:
  - Delete upper angle limit
  - Display shows symbol without value of the upper angle limit

  ![OK quit function](image)
• set / delete lower limit angle

Select limit:

- selection lower boom angle limit

<table>
<thead>
<tr>
<th>set:</th>
<th>delete:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Luff down boom to the required limit value.</td>
<td>DEL delete lower angle limit</td>
</tr>
<tr>
<td>set present boom angle as lower limit</td>
<td></td>
</tr>
<tr>
<td>Display shows symbol with lower angle limit</td>
<td>Display shows symbol without value of lower limit angle</td>
</tr>
<tr>
<td>quit function</td>
<td></td>
</tr>
</tbody>
</table>
5.1.3 Radius Limitation

Programmable function for the limitation of the minimum and/or maximum working radius.

- **Call function:**
  
  Call LIMIT Setting

  Select the corresponding figure to call the function "radius limitation".

- **set / delete minimum radius:**

  Select limits:

  - select minimum radius limit

  **set:**

  position boom at the required minimum radius value.

  **SET** set present boom radius as minimum radius

  display shows symbol with radius value of minimum limit

  **delete:**

  delete minimum radius limit

  display shows symbol without value of minimum radius

  quit function
• set / delete maximum radius

Select limit:

- selection maximum radius limit

**set:**

- position boom to the required maximum radius value.
- set present boom radius as maximum radius
- display shows symbol with radius value of max. limit

**delete:**

- delete maximum radius limit
- display shows symbol without value of max. radius
- quit function
5.2 INFO crane configuration

With the system being ready for operation, this function serves to display the system configuration

- Call function

  Press key "INFO".

  ![INFO Button]

  The display shows the crane symbol representing the adjusted configuration (marked black), the extended operating code number and the reeving number (parts of line).

- End function

  Press again key "INFO".

  ![INFO Button]
5.3 Display Contrast Control

This function serves for the contrast adjustment of the LC display. The last adjustment is stored and does not have to be repeated at every system start.

- Contrast adjustment

Press "CTRL".

A pattern is shown by means of which the display can be adjusted to the optimum contrast. Use the functional keys to modify the contrast upon request:

- darken display
- brighten display

Press key "OK" to store the momentarily adjusted contrast value and to quit the function.

During normal LMI operation the display contrast can be adjusted too by pressing button:

F2 (brighten display) or
F3 (darken display).
6 Pre-Operation Inspection and Calibration Verification

Before operating the crane, the following electrical connections must be checked to ensure that the system is properly connected for the crane configuration.

Check the weight of the anti two-block switch is properly installed on the main hoist load line. The hoist line runs through the A2B weight. With even parts of hoisting line, the weight shall be attached to the dead-end line. With odd parts of hoisting line, the weight shall be attached to the line of lowest speed.

Pre-Operation Inspection and Calibration Verification

After the electrical connections have been checked to insure that the system is properly connected for the crane configuration, the following checks shall be made:

1. Check the electrical wiring connecting the various parts of the system for physical damage.
2. Check the anti two-block switch and weight for free movement.
3. Check the spring-loaded cable reel to be sure it is free to rotate, has tension and the cable is reeled properly.

---

**WARNING**

The following tests shall be performed with care to prevent damage to the machine or injury to personnel. Proper functioning of the system requires successful completion of these tests before operating the machine.

If the operator cannot see the load handling device approaching the boom nose, he shall have an assistant (signal person) watch the load handling device. The operator shall be prepared to stop the machine immediately should the LMI system not function properly as indicated by lighting the red warning light (4), sounding the audible alarm (12) and locking the crane movements, hoist up, telescope out and boom down.
1. Check the anti two-block alarm light (4) and the audible alarm (12) by performing one of the following tests:

A) By manually lifting the weight attached to the anti two-block switches. When the weight is lifted, the audible alarm (12) should sound, the anti two-block alarm light (4) should light.

B) Slowly raise the main boom load handling device to create a potential two-block condition. When the load handling device lifts the weight, the audible alarm (12) should sound, the anti two-block alarm light (4) should light and the motion of the load handling device should be stopped. Lower the load handling device slightly to eliminate this condition.

C) Slowly lower the boom to create a potential two-block condition. When the load handling device lifts the weight, the audible alarm (17) should sound, the anti two-block alarm light (24) should light and the boom lowering function should be stopped. Lower the load handling device slightly to eliminate this condition.

D) Slowly extend (telescope) the boom to create a potential two-block condition. When the load handling device lifts the weight, the audible alarm (17) should sound, the anti two-block alarm light (24) should light and the boom telescope out function should be stopped. Lower the load handling device slightly to eliminate this condition.

WARNING

If the light and audible alarm do not function as described and the crane movements are not stopped, the system is not working properly. The malfunction shall be corrected before operating the crane.

5. Check that the display of the main boom length agrees with the actual boom length.
6. Check that the display of the main boom angle agrees with the actual boom angles.
7. Check that the display of the operating radius of the crane agrees with the actual radius.
8. Check the load display by lifting a load of known weight.
Operation
Upon correct inspection the LMI is operational. The operator shall be thoroughly familiar with all controls of the LMI before operating the crane. The proper function of the system shall be checked by lifting a load of known weight and comparing the load to the information displayed on the LMI.
Rated loads include the weight of the hook block, slings, and auxiliary load handling devices. Their combined weights shall be subtracted from the listed load capacities as stated on the load capacity chart to obtain the net load to be lifted.

⚠️ WARNING ⚠️
If any of the displays reflects a deviation between displayed and actual values, an authorized PAT service representative shall be called for repair of the system or verification of the crane’s LMI calibration.

⚠️ WARNING ⚠️
Any structural modifications or changes to the crane shall require verification of the crane’s LMI calibration.
7 SERVICE AND MAINTENANCE

Daily maintenance of the load moment indicator consists of inspecting:

1. The electrical wiring connecting the various parts of the system.
   If electrical wiring is damaged, it shall be replaced immediately.

2. If the insulation is worn on the length sensor cable or cable guides are damaged, these parts shall be replaced.

3. Check the anti two-block limit switch for freedom of movement.

4. The cable reel shall be under tension to operate properly.

5. Check the pressure transducers at the hoist cylinder(s) and the connecting hoses for oil leakage.

Other than correcting the problems identified in the Malfunctions Table and replacing faulty mechanical parts and cables, no other repairs shall be performed by non-expert personnel.
## 8 ERROR CODES


<table>
<thead>
<tr>
<th>ERROR Code</th>
<th>ERROR</th>
<th>CAUSE</th>
<th>ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>E01</td>
<td>Minimum radius or maximum angle range exceeded</td>
<td>Fallen below the minimum radius or above the angle given in the load chart due to raising the boom too far.</td>
<td>Lower boom back to a radius or angle given in the load chart.</td>
</tr>
<tr>
<td>E02</td>
<td>Maximum radius or minimum angle range exceeded</td>
<td>The maximum radius or minimum angle given in the load chart was exceeded due to lowering the boom too far.</td>
<td>Raise boom back to a radius or angle given in the load chart.</td>
</tr>
<tr>
<td>E04</td>
<td>Operating mode not available</td>
<td>Operating mode switch in the console set incorrectly. Operating mode is not permissible with actual crane configuration.</td>
<td>Set operating mode switch correctly to the code assigned to the operating mode of the crane.</td>
</tr>
<tr>
<td>E05</td>
<td>Length range not permitted</td>
<td>Boom has been extended too far or not far enough. Length sensor adjustment changed; i.e. length sensor cable slid off the cable drum.</td>
<td>Retract or extend boom to correct length given in the load chart. See Section 6.</td>
</tr>
<tr>
<td>E07</td>
<td>No acknowledgment signal from overload relay (K1).</td>
<td>Overload relay is stuck, defective or not being selected.</td>
<td>Replace relay.</td>
</tr>
<tr>
<td>E08</td>
<td>No acknowledgment signal from Anti-Two-Block switch relay (K2).</td>
<td>Anti-Two-Block switch relay is defective or not being selected.</td>
<td>Replace relay.</td>
</tr>
<tr>
<td>E11</td>
<td>Fallen below limit for the measuring channel “length”.</td>
<td>a.) Cable between length sensor and central unit defective, not connected or water in the connectors. b.)Length sensor Potentiometer defective. c.)Electronic board in the measuring channel defective.</td>
<td>a.)Check cable and connector as well and replace, if necessary. Section 6. b.)Replace and reset length sensor Potentiometer. See Section 6 &amp; Procedure 5. c.)Replace main board and reset pressure channels. See Drawing 3 &amp; Procedure 4.</td>
</tr>
</tbody>
</table>
### 8. ERROR CODES - continued

<table>
<thead>
<tr>
<th>ERROR CODE</th>
<th>ERROR</th>
<th>CAUSE</th>
<th>ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>E12</td>
<td>Fallen below lower limit value for the measuring channel “pressure transducer piston side”.</td>
<td>a.) Cable leading from the central unit to the pressure transducer defective, loose or water in the connector. b.) Pressure transducer on piston side defective. c.) Electronic component in the measuring channel defective.</td>
<td>a.) Check cable and connector as well and replace, if necessary. Section 7. b.) Replace pressure transducer and reset pressure channel. See Section 7 &amp; Procedure 4. c.) Replace main board and reset pressure channels. See Drawing 3 &amp; Procedure 4.</td>
</tr>
<tr>
<td>E13</td>
<td>Fallen below lower limit value for the measuring channel “pressure transducer rod side”.</td>
<td>a.) Cable leading from the central unit to the pressure transducer defective, loose or water in the connector. b.) Pressure transducer on rod side defective. c.) Electronic component in the measuring channel defective.</td>
<td>a.) Check cable and connectors as well and replace, if necessary. Section No. 7. b.) Replace pressure transducer and reset pressure channel. See Section 7 &amp; Procedure 4. c.) Replace main board and reset pressure channels. See Drawing 3 &amp; Procedure 4.</td>
</tr>
<tr>
<td>E15</td>
<td>Fallen below lower limit value for the measuring channel “angle main boom”.</td>
<td>a.) Cable from central unit to the length/angle sensor defective or loose. b.) Angle sensor defective. c.) Electronic component in the measuring channel defective.</td>
<td>a.) Check cable. Replace if necessary. See Section 6 b.) Replace angle sensor and reset adjustment. Procedure 5 c.) Replace main board and reset pressure channels. See Drawing 3 &amp; Procedure 4.</td>
</tr>
<tr>
<td>E20</td>
<td>No analog voltages</td>
<td>a.) The crane supply voltage is too low. b.) The voltage converter is defective or short circuit in the wiring.</td>
<td>a.) Check crane voltage. b.) Check supply voltages.</td>
</tr>
</tbody>
</table>
### 8. ERROR CODES - continued

<table>
<thead>
<tr>
<th>ERROR CODE</th>
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<th>CAUSE</th>
<th>ACTION</th>
</tr>
</thead>
</table>
| E21        | Upper limiting value for the measuring channel "length" exceeded. | a.) Cable from central unit to the length/angle sensor defective or loose.  
b.) Length potentiometer defective.  
c.) Electronic component in the measuring channel defective on main board. | a.) Check cable. Replace if necessary. See section 6.  
b.) Replace and reset length potentiometer. See Procedure 5.  
c.) Replace main board and reset pressure channels. See Drawing 3 & Procedure 4. |
| E22        | Upper limiting value for the measuring channel "pressure piston side" exceeded. | a.) Cable from central unit to the pressure transducer defective, loose or water in the plug.  
b.) Pressure transducer on piston side defective.  
c.) Electronic component in the measuring channel defective on main board. | a.) Check cable as well as plug. Replace if necessary. See Section 7.  
b.) Replace pressure transducer and reset pressure channels. See Section 7.  
c.) Replace main board and reset pressure channels. See Drawing 3 & Procedure 4. |
| E23        | Upper limit value for the measuring channel "pressure transducer rod side" exceeded. | a.) Cable lead in from the central unit to press trans defective, not connected or water in the connectors.  
b.) Pressure transducer on road side defective.  
c.) Electronic component in the measuring channel defective. | a.) Check cable and connectors as well and replace, if necessary. See Section 7.  
b.) Replace pressure transducer  
c.) Replace main board and reset pressure channels. See Drawing 3 & Procedure 4. |
| E25        | Upper limit value for the measuring channel "angle main boom" exceeded. | a.) Cable leading from the central unit to the length/angle sensor defective, loose or water in the connectors.  
b.) Angle sensor defective.  
c.) Electronic component in the measuring channel defective. | a.) Check cable as well as connectors and replace, if necessary. Section 6.  
b.) Replace angle sensor and reset adjustment. See Section No. 6 & Procedure 5.  
c.) Replace main board and reset pressure channels. See Drawing 3 & Procedure 4. |
| E27        | Upper limit value for the measuring channel 7 exceeded. | a.) Cable leading from the central unit to the sensor of channel 7 defective, loose or water in the connectors.  
b.) Sensor of channel 7 defective.  
c.) Electronic component in the measuring channel 7 defective. | a.) Check cable as well as connectors and replace, if necessary.  
b.) Replace sensor of channel 7 and reset adjustment.  
c.) Replace main board and reset pressure channels. See Drawing 3 & Procedure 4. |
### 8. ERROR CODES - continued

<table>
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<th>ERROR DESCRIPTION</th>
<th>CAUSE</th>
<th>ACTION</th>
</tr>
</thead>
</table>
| E29        | Reference voltage defective.                                                        | a.) The total of the supply and the reference voltages on MP10 is more than 3.3V  
b.) A/D converter defective. | a.) Check supply voltages.  
b.) Replace main board and reset pressure channels. See Drawing 3 & Procedure 4. |
| E31        | Error in the system program.                                                        | a.) EPROM with system program defective.  
b.) Electronic component on the main board defective. | a.) Replace system program EPROM  
b.) Replace main board and reset pressure channels. See Drawing 3 & Procedure 4. |
| E37        | Error in the program run                                                            | a.) EPROM with system program defective.  
b.) Electronic component on the main board defective. | a.) Replace system program EPROM  
b.) Replace main board and reset pressure channels. See Drawing 3 & Procedure 4. |
| E38        | Wrong system program in the LMI.                                                    | The system program in the LMI does not correspond to the programming in the data EPROM | Replace system program EPROM |
| E41        | Error in the external RAM.                                                          |                                                                      | Replace main board and reset pressure channels. See Drawing 3 & Procedure 4. |
| E42        | Error in the external write/read memory (RAM).                                      | Internal defect in digital part of CPU.                              | Exchange write/read memory (CMOS-RAM). Replace main board and reset pressure channels. See Drawing 3 & Procedure 4. |
| E48        | Malfunction in the monitored write/read memory.                                    | Internal defect in digital part of CPU                              | Replace main board and reset pressure channels. See Drawing 3 & Procedure 4. |
| E51        | Error in data memory.                                                              | Data EPROM on the main board defective.                             | Replace Data EPROM. Make sure BR3 on the main board is installed. See Theory 1. |
| E71        | Incorrect acknowledgment of the 1. Relay on the terminal board A101.                | a.) Anti Two-block relay is stuck or defective.  
b.) Anti Two-Block relay is not being selected due to a break on the terminal board A101, main board or ribbon cables. | a.) Replace 1. relay.  
b.) Check terminal board A101, main board and ribbon cables as well as replace defective part, if necessary. |
<p>| E72 - E77  | Analogous to E71 for the relays 2...7.                                              | Analogous to E71 for the relays 2...7.                              | Analogous to E71 for the relays 2..7.                                  |</p>
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<tbody>
<tr>
<td>E89</td>
<td>Change of the operating code during lifting a load.</td>
<td>The operating mode switch in the console was used during lifting a load.</td>
<td>Lower the load and set the operating mode switch correctly to the code assigned to the actual operating mode of the crane.</td>
</tr>
<tr>
<td>E91</td>
<td>No data transmission from console to central unit. (See Section 8)</td>
<td>a.) 24V supply of console interrupted. b.) Interruption or accidental ground in the line from console electronics to central unit. c.) Transmitter/receiver module defective.</td>
<td>a.) Check 24V at terminal X1 of console electronics. b.) Check the connection between console electronics and central unit. c.) If you find an accidental ground, the transmitter module in the console electronics can be damaged. You should, therefore, replace the console electronics. Replace console electronics or main board respectively. See Procedure 3</td>
</tr>
<tr>
<td>E92</td>
<td>Error in the data transmission from console to central unit. (See also Section 8)</td>
<td>a.) Temporary interruption of the data line from console electronics to central unit. b.) Transmitter/receiver module defective.</td>
<td>a.) Check the connection between console electronics and central unit.</td>
</tr>
<tr>
<td>E93</td>
<td>Error in the data transmission from central unit to console. (See also Section 8)</td>
<td>a.) Temporary interruption of the data line from console electronics to central unit. b.) Transmitter/receiver module defective.</td>
<td>a.) Check the connection between console electronics and central unit. b.) Replace console electronics or main board respectively. See Procedure 3</td>
</tr>
</tbody>
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## 8. ERROR CODES - continued

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</thead>
<tbody>
<tr>
<td>E94</td>
<td>No data transmission from central unit to console. (See also Section 8)</td>
<td>a.) Interruption or accidental ground in the line from console electronics to central unit. b.) Transmitter/receiver module defective. c.) Data-EPROM defective. d.) CPU defective. e.) Electromagnetic interference (when switching contractors or valves)</td>
<td>a.) Check the connection between console electronics and central unit. If you find an accidental ground, the transmitter module in the console electronics can be damaged. Replace the console electronics. b.) Replace console electronics or main board respectively. c.) Check data EPROM. d.) Replace main board. e.) Eliminate interference source by inverse diodes or resistors.</td>
</tr>
<tr>
<td>E95</td>
<td>Error in the crane data EPROM</td>
<td>a.) Data EPROM defective b.) Position of jumper for the selection of the type of EPROM is wrong c.) Electronics component on the main board defective.</td>
<td>a.) Replace data EPROM b.) Check the jumper position c.) Replace main board and reset pressure channels. See Drawing 3 &amp; Procedure 4.</td>
</tr>
<tr>
<td>E96</td>
<td>Error in the internal RAM of the CPU of the console</td>
<td>CPU or main board of the console defective</td>
<td>Replace console main board.</td>
</tr>
<tr>
<td>E97</td>
<td>Error in the external RAM of the CPU of the console</td>
<td>a.) External RAM of the console defective b.) Electronic component on the main board defective.</td>
<td>a.) Replace console main board b.) Replace console main board</td>
</tr>
<tr>
<td>E98</td>
<td>Wrong jumper position in the console</td>
<td>a.) The jumper position BR 9/BR 10 in the console does not correspond to the actual type of central unit. b.) Electronic component on the main board defective.</td>
<td>a.) Check the jumper position b.) Replace console main board</td>
</tr>
</tbody>
</table>
DS350 LMI

for GROVE AT422T

TROUBLESHOOTING SECTION
NOTICE

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- Procedure 5 - Mechanical Adjustment of Cable Reel

**Section 12 - Theory of LMI Operation**

- Theory 1A Main Board (0094) Measuring Points and Layout
- Theory 1B Main Board (0222) Measuring Points and Layout
- Theory 2 - Theory of Operation for Length Sensor
- Theory 3 - Theory of Operation for Angle Sensor
- Theory 4 - Theory of Operation for Piston Side Load Sensor
- Theory 5 - Theory of Operation for Rod Side Load Sensor
GENERAL INFORMATION

MANUAL INFORMATION

This troubleshooting handbook is designed to assist a service or maintenance person in identifying the system problem areas or malfunctions. A digital voltmeter and regular maintenance and service tools, see tool list below, will be required to troubleshoot the system.

NOTE: Knowledge of how to use a digital voltmeter is assumed.

This handbook covers machines with 024-350-062-766 and 024-350-062-767 central units. The troubleshooting the system use ‘A’ drawings for the 2766 central unit and ‘B’ drawings for the 2767 central unit. The central unit 024-350-062-767 hardware changes is effective on crane serial number 86638 and beyond.

The drawings in Section 10 and the procedures in Section 11 are provided as reference material that will be used in the troubleshooting flow charts. Use the drawings and procedures in conjunction with the flow charts to help understand the operation of the LMI. To further understand the theory for LMI operations, refer to Section 12.

TOOL LIST

| 1 - DIGITAL MULTIMETER COMPLETE WITH 2 SETS OF LEADS | 1 - STANDARD HEX KEYS SIZES 5/64, 3/32, 7/64, 1/8, 9/64, 5/32, 3/16, 7/32, 1/4, 5/16, 3/8 INCH |
| 1 - SOLDERING IRON | 1 - VICE GRIP PLIERS |
| 1 - INCLINOMETER | 3 - ROLLS INSULATION TAPE |
| 1 - #0, #1, & #2 PHILLIPS HEAD SCREWDRIVERS | 1 - 3/8" DRIVE ½", 7/10", 9/16", DEEP WELL SOCKETS - |
| 1 - #0 & #1 - PHILLIPS HEAD PRECESSION SCREWDRIVERS | 1 - 3/8" DRIVE RATCHET AND 3" EXTENSION BAR |
| 1 - 3/16, 1/4, & 9/32 INCH SLOTTED HEAD SCREWDRIVERS | 1 - 1/4" ADAPTER FOR 3/8" DRIVE RATCHET |
| 1 - 0.040, 0.070, & 0.100 INCH SLOTTED HEAD PRECESSION SCREWDRIVERS | 1 - 1/4" - DRIVE 1/4, 9/32, 5/16, 11/32, 3/8, 7/16, & 1/2 INCH SOCKET SET |
| 1 - 5.5mm, 10mm NUT DRIVERS | 1 - 1/4" - DRIVE 4, 5, 5.5, 6, 7, 8, 9, 10, 11, 12, 13, & 14 mm SOCKET SET |
| 1 - 8" ADJUSTABLE WRENCH | 1 - RETAINING RING PLIERS |
| 1 - 10" ADJUSTABLE WRENCH | 1 - NEEDLE NOSE PLIERS |
| 1 - 200’ TAPE MEASURE FT/METERS | 1 - CHANNEL LOCK PLIERS |
| 1 - WIRE CUTTERS | 1 - FLASHLIGHT |
| 1 - WIRE CRIMPING PLIERS | 1 - EPROM PULLER |
| 1 - UTILITY KNIFE | 1 - METRIC HEX KEYS SIZES 1.5, 2, 2.5, 3, 4, 5, 6, 8, & 10. |
BASIC SYSTEM INFORMATION

This low temperature system uses heaters for stable system operation in a subzero climate. The main electronics are automatically warmed before the system boards and components are energized. Therefore, all system components must be installed and sealed from the environment when operating and/or troubleshooting in low temperature conditions.

For system operation refer to the Operator’s Section of this manual.

The PAT Load Moment Indicator (LMI) DS 350 has been designed to provide the crane operator with the essential information required to operate the machine within its design parameters.

Using different sensing devices, the Load Moment Indicator monitors various crane functions and provides the operator with a continuous reading of the crane’s capacity. The readings continuously change as the crane moves through the motions needed to make the lift.

The LMI provides the operator with information regarding the length and angle of the boom, working radius, rated load and the total calculated weight being lifted by the crane.

If non permitted conditions are approached, the DS 350 Load moment Indicator will warn the operator by sounding an audible alarm, lighting a warning light and locking out those functions that may aggravate the crane’s condition.
1. GENERAL FLOWCHART AND DRAWINGS

This section explains how to handle a problem that may arise with the PAT Load Moment Indicator System-PAT DS350. The procedures are given in flowchart form for the following sections. Start with the general flowchart below which will guide you to one of the detailed flowcharts shown in Sections 2 through 9. The drawings in this section will be referenced in the troubleshooting flow charts, Sections 2 through 9.

START

What’s Wrong?

- Lever Lockout Activated → Go to Section 2
- Broken Length Cable → Go to Section 3
- No display → Go to Section 4
- Anti-Two Block Problem → Go to Section 5
- Length Displayed Incorrect → Go to Section 6
- Load Displayed Incorrect → Go to Section 7
- Bad Data Transfer/Interference Between Central Unit and Console → Go to Section 8
- Error Code Displayed → Go to Section 9
2. LEVER LOCKOUT ACTIVATED

PROBLEM: The lever lockout system of the crane is activated. Crane movements "hoist up", "telescope out", and "boom down" are stopped. Crane is not in overload or two-block condition.

Start

Use the key switch and the LMI by-pass button on the console to instructions (pages 12 and 13).

Corrected

YES

NO

Does console indicate Anti-Two-block warning?

NO

Fault in crane electric or hydraulic system.

Check lever lockout system in crane service manual.

YES

If console display are blank. The fault is located in power supply, wiring or fuses.

Go to Section 4

If the display Load Moment Limit Light is lit. The fault is located in LMI, cables, wiring, fuses, or console.

Go to Section 5

Fault in Anti-Two Block system.

Go to Section 9

Read error code displayed on console and go to Section 9.
3. BROKEN LENGTH CABLE

PROBLEM: Damaged or broken length cable.

Replace length cable using the following procedure:
Refer to: Drawing 2 - Electrical Wiring Central Unit to Console/Cable Reel
Drawing 4 - Cable Reel - Parts List
Drawing 10 - Boom Tip Junction Box w/voltmeter on 1 & 2
Drawing 11 - Slip Ring Assembly w/voltmeter on Red & Brown
Procedure 5 - Mechanical Adjustment of Cable Reel

1. Cut old cable at cable drum
2. Disconnect damaged length cable from junction box at the boom nose. Refer to Drawing 2, 10.
3. Open cable reel cover and disconnect wiring from terminal block. Pull 7 conductor cable out of strain relief.
4. Remove cable reel from mounting brackets.
5. Remove damaged length cable, which is mounted to the slip rings in the cable reel, from slip ring terminal. Refer to Drawings 2, 4, 11.
6. On the back side of the cable reel, open the strain relief attached to the axle in the center of the drum. Pull existing length cable out of the cable reel.
7. Pull new length cable through the hole, pipe and strain relief and push it through the axle of the reeling drum. Tighten strain relief to ensure sealing.
8. Reconnect the length cable to the slip ring. Refer to Drawing 2, 4, 11.
9. Remount cable reel to the boom.
10. Turn reeling drum clockwise to spool the new cable neatly onto the drum.
11. Set pre-load on cable reel by turning the drum counter-clockwise 5 to 8 turns.
12. Wrap the new length cable around the boom tip anchor pin (8 - 10 wraps) and secure with tie wraps. Leave enough length cable to connect into the boom tip junction box.
13. Connect the length cable into the boom tip junction box. Refer to Drawing 2, 10.
14. Reset length potentiometer in length angle transducer (screw is located in center of white gear); with boom fully retracted, turn potentiometer carefully counter-clockwise until it stops. Recheck length and angle display. Refer to Procedure 5.
4. NO DISPLAY

All crane moments have been stopped.

Start

Check fuses on CPU box.

Correct? NO → Replace fuses.

Correct? YES

Measure crane voltage on central unit heater board between X1:11 (+24V) and X1:2 (ground). Note: X1:1,8,9,10,11 are all +24V.

Refer to Drawing 1, 3, 6 in Section 10.

NOTE: If crane voltage is measured below 20V system will switch off.

Check crane power supply for faulty crane electric or if supply is too low.

Measure crane voltage on connection board between X1:1 (+24V) and X1:3 (ground).

Refer to Drawing 1, 3, 7 in Section 10.

NOTE: Heater board will only supply power to connection board above +10 C

Correct? NO → Check relay on heater control board.

Correct? YES

Replace connection board. Diode D4, inductance L1 or capacitor C1 is faulty.
4. NO DISPLAY - continued

Measure crane voltage on main board between X1:1 (+24V) and X1:3 (ground).
Refer to Drawing 1, 3, 8 in Section 10.

Correct? NO

and main board. Check wiring connections.

YES

Disconnect ribbon cables from X2 and X3 of main board. Measure voltage out of power supply between:
MP15 = ground (analog) and MP1 = +5V
MP15 = ground (analog) and MP2 = -5V
MP13 = ground (digital) and MP12 = +5V
MP 15 = ground (analog) and MP 18 = +5V
MP15 = ground (analog) and MP19 = -5V
MP are test points on main board.
Refer to Drawing 3, 8 in Section 10.

Correct? NO

board and reset pressure channels

YES

Measure voltage on console heater board between X1:1 (+24V) and X1:3 (ground).
Refer to Drawing 2, 9 in Section 10.

Correct? NO

Fault between connection board and console heater

YES

Measure voltage on console connection board between X1:1 (+24V) and X1:2 (ground).
Refer to Drawing 2, 9 in Section 10.

Replace console.
Refer to Drawing 2, 5 in Section 10.

YES

Replace console heater control board
Refer to Drawing 2, 5 in Section 10.

NO

END
5a. ANTI TWO BLOCK PROBLEM (SINGLE SWITCH)

PROBLEM: Function of Anti-Two-Block System is faulty.

START

Correct? NO Lower hook down into safe position

YES

Turn power off or disconnect wire from connection board X1:35 in central unit.
Refer to Drawing 3, 14 in Section 10.

Next

Remove length cable core wire from terminal 1 in Boom Nose Junction Box.
Measure the resistance at the boom nose junction box between terminals 1 and 2 with
Switch closed = 4700 ± 500 Ohms (weight installed)
Switch open => 1 Megaohm (weight removed)
Refer to Drawing 2, 10 in Section 10.
Replace length cable core wire from terminal 1 in Boom Nose Junction Box.

Correct? No Replace Anti-Two-Block switch.

Yes

Next Page
5a. ANTI TWO BLOCK PROBLEM (SINGLE SWITCH) - cont'

Remove length cable core wire from terminal X:1 on cable reel slip ring. Measure the A2B signal in the cable reel between X1:Brown and X2:Red wires on the slip ring with an ohmmeter.
- Switch closed = 4700 ± 500 Ohms
- Switch open => 1 Megaohm
Reconnect length cable core wire.
Refer to Drawing 2, 4, 11 Section 10.

Correct? No

Check for damaged length cable and wiring.
Refer to Drawing 2 Section 10.
If broken length cable, Refer to Section 3.

Measure the A2B signal in the cable reel between terminal 7 and 8 with an ohmmeter.
- Switch closed = 4700 ± 500 Ohms
- Switch open => 1 Megaohm
Reconnect blue wire.
Refer to Drawing 2, 4, 11 Section 10.

Correct? No

Replace slip ring
Refer to Drawing 2, 4, 11 in Section 10.

Unplug cable assembly from Central Unit to Boom Base Junction Box. Measure the A2B signal in boom base junction box between terminal 5 and 6 with an ohmmeter.
- Switch closed = 4700 ± 500 Ohms
- Switch open => 1 Megaohm
Reconnect cable assembly
Refer to Drawing 2, 4, 11 Section 10.

Correct? No

Fault in 7 conductor cable between cable reel and boom base junction box.
Refer to Drawing 2, 4, 13 in Section 10.

NEXT PAGE
5a. ANTI TWO BLOCK PROBLEM (SINGLE SWITCH) - cont’

Connect blue wire back to the terminal X1:35 on the connection board.

Turn system power off. Check Anti-Two-Block signal in central unit with ohmmeter measure between X1:35 and X1:34.
Anti-Two-Block switch closed = 4700 Ohms ±50 0Ohms
Anti-Two-Block switch open => 1 Megaohm.
Refer to Drawing 2, 3, 14 in Section 10.

Correct? NO Faulty wiring between boom base junction box and central unit. Check cable.
YES

Disconnect X1:34 and X1:35. Check main board function by installing a temporary resistor, 4700 Ohms between X1-35 and X1-34 in central unit. With resistor connected alarm should be inactive.
Refer to Drawing 2, 3, 15 in Section 10.

Correct? NO Defect on main board. Replace main board and reset pressure channel.
YES Refer to Drawing 1 in Section 10 and Procedure 4 in Section 11.

Reconnect Gray to X1:34 and Blue to X1:35
Refer to Drawing 2 in Section 10.

End
5b. ANTI TWO BLOCK PROBLEM (DOUBLE SWITCH)

PROBLEM: Function of Anti-Two-Block System is faulty.

START

Correct? NO → Lower hook down into safe position

Correct? YES →

Turn power off or disconnect wire from connection board X1:35 in central unit. Refer to Drawing 3, 14 in Section 10.

Remove length cable core wire from terminal 1 in Boom Nose Junction Box. Measure the resistance at the boom nose junction box between terminals 2 and 3 with ohmmeter. This checks the function of the Secondary Anti-Two Block switch.
- Switch closed = 4700 ±500 Ohms (weight installed)
- Switch open => 1 Megaohm (weight removed)
Refer to Drawing 10, and 22 in Section 10. Replace Length cable core wire.

Correct? NO → Replace Anti-Two-Block switch.

Correct? YES →

Measure the resistance of the Primary Anti-Two Block switch between 1 and 2 with ohmmeter. This checks the function of the Primary Anti-Two Block switch.
- Switch closed = <100 Ohms (weight installed)
- Switch open = > 1 Megaohm (weight removed)
Replace length cable core wire to terminal 1 in Boom Nose Junction Box.

Correct? NO → Replace Anti-Two-Block switch.

Correct? YES →

Next Page
5b. ANTI-TWO BLOCK PROBLEM (DOUBLE SWITCH) - cont’

Remove length cable core wire from terminal X:1 in cable reel slip ring. Measure the A2B signal in the cable reel between X1:Brown and X2:Red wires on the slip ring with an ohmmeter.
- Switch closed = 4700 ±500 Ohms
- Switch open => 1 Megaohm
Reconnect length cable core wire. Refer to Drawing 2, 4, 11 Section 10.

Correct? No

Check for damaged length cable and wiring. Refer to Drawing 2 Section 10. If broken length cable, Refer to Section 3.

Measure the A2B signal in the cable reel between terminal 7 and 8 with an ohmmeter.
- Switch closed = 4700 ±500 Ohms
- Switch open => 1 Megaohm
Reconnect blue wire. Refer to Drawing 2, 4, 11 Section 10.

Correct? No

Replace slip ring Refer to Drawing 2, 4, 11 in Section 10.

Unplug cable assembly from Central Unit to Boom Base Junction Box. Measure the A2B signal in boom base junction box between terminal 5 and 6 with an ohmmeter.
- Switch closed = 4700 ±500 Ohms
- Switch open => 1 Megaohm
Reconnect cable assembly. Refer to Drawing 2, 4, 11 Section 10.

Correct? No

Fault in 7 conductor cable between cable reel and boom base junction box. Refer to Drawing 2, 4, 13 in Section 10.

NEXT PAGE
5b. ANTI TWO BLOCK PROBLEM (DOUBLE SWITCH) - cont’

Connect blue wire back to the terminal X1:35 on the connection board.

Turn system power off. Check Anti-Two-Block signal in central unit with ohmmeter measure between X1:35 and X1:34.
Anti-Two-Block switch closed = 4700 Ohms ±50 0Ohms
Anti-Two-Block switch open => 1 Megaohm.
Refer to Drawing 2, 3, 14 in Section 10.

Correct?

NO  Faulty wiring between boom base junction box and central unit. Check cable.

YES

Disconnect X1:34 and X1:35. Check main board function by installing a temporary resistor, 4700 Ohms between X1:35 and X1:34 in central unit. With resistor connected alarm should be inactive.
Refer to Drawing 2, 3, 15 in Section 10.

Correct?

NO  Defect on main board. Replace main board and reset pressure channel.
Refer to Drawing 1 in Section 10 and Procedure 4 in Section 11.

YES  Reconnect Gray to X1:34 and Blue to X1:35
Refer to Drawing 2 in Section 10.

End
6. LENGTH READING PROBLEM

**PROBLEM:** Length displayed incorrect. Crane is not in "out of load chart" condition.

START

Check mechanical adjustment of length potentiometer in cable reel. When main boom is fully retracted, adjust length potentiometer counter-clockwise until it stops.

Refer to Drawing 16 in Section 10.

Correct? NO →

potentiometer axle. Unscrew mounting plate and remove wires from terminal block. Connect new assembly to terminal block. Reinstall mounting plate, gear wheel and slip rings. With boom fully retracted, reset potentiometer by turning counter-clockwise until it stops. Refer to Procedure 5 in Section 11. Refer to Drawing 4, 11 in Section 10.

Correct? YES →

Check out clutch in big gear wheel of length transducer. Extend and retract boom to ensure that clutch is not sipping on potentiometer axle. Refer to Drawing 4 in Section 10.

Correct? NO →

Replace the gear wheel, clean potentiometer axle. Reset length potentiometer. Refer to Drawing 4 in Section 10. Procedure 5 in Section 11.

Correct? YES →

terminal X1:8 (ground) and X1:11 (-5V)

Refer to Drawing 2, 3, 16 in Section 10.

Correct? NO →

Main board defective. Replace main board and reset pressure channel. Refer to Drawing 3 in Section 10. Procedure 4 in Section 11.

Correct? YES →

NEXT PAGE
6. LENGTH READING PROBLEM - continued

Measure supply to length transducer in cable reel between terminal 1 (ground) and 3 (-5v)
Refer to Drawing 4, 17 in Section 10.

Correct? NO Faulty wiring between central unit and length transducer. Check wiring

Measure signal from length transducer in cable reel between terminal 2 (signal) and 1 (ground).
Boom fully retracted - 0 Potentiometer turn = -0.5v Refer to Drawing 4, 17 in Section 10.

Correct? NO Replace length potentiometer assembly. Remove slip ring body from shaft
and remove gear wheel from potentiometer axle. Unscrew mounting plate and
remove potentiometer assembly from mounting plate. Remove assembly wires form terminal block. Connect new assembly to terminal block. Reinstall mounting plate, gear wheel and slip rings. With boom fully retracted, reset

Correct? YES Measure signal from length transducer in central unit connection board between X1-8 (ground) and X1-10 (signal: -0.5 and -4.5v)
Refer to Drawing 2, 3, 18 in Section 10.

Correct? NO Faulty wiring between central unit and cable reel. Check wiring.

YES NEXT PAGE
6. LENGTH READING PROBLEM - continued

Measure length signal of amplified output on main board between test point MP15 and test point MP6.
NOTE: Negative signal at terminal X1 Pin 15 will be converted into positive signal at MP6 (i.e.: input at terminal X1 Pin 15 = -0.5V; output test between MP15 and MP6 = +0.5v).
Refer to Drawing 8 in Section 10.

Correct?  

Main board defective. Replace Main board.  
Reset pressure channel.  
Refer to Drawing 3 in Section 10.  
Procedure 4 in Section 11.
7. LOAD READING PROBLEM

PROBLEM: Load reading incorrect.

START

Select operating mode switch to correct position (see operating mode in Refer to Drawing 8 in Section 10.

Correct? NO

Check boom length reading on display.

Correct? NO

Reset length potentiometer. With fully retracted boom, turn potentiometer Refer to Procedure 5 in Section 11.

Correct? YES

Measure radius and check with the displayed radius.

Correct? NO

Angle transducer box should be in line with boom and adjusted to actual boom angle. Refer to Procedure 5 in Section 11.

Correct? YES

Check power supply to pressure transducer (rod side). Unplug transducer cable from transducer. Measure at the cable connection between B (ground) and C (-5V). And measure between B (ground) and A (+5V). Refer to Drawing 1, 3, 20 in Section 10.

Correct? NO

Check power supply at connection board between X1:14 (gnd) to X1:13 (-5.0V) and X1:14 (gnd) to X1-15 (+5.0) for rod side and measure between X1-19 (gnd). Refer to Drawing 1, 3, 20 in Section 10.

Correct? YES

Fault in pressure transducer cable. Refer to Drawing 1 Section 10.
7. LOAD READING PROBLEM - continued

Measure the power supply on the main board between test point Mp 15 (ground) & Mp1 (+5.0v) and Mp 15 (ground) & Mp2 (-5.0v)
Refer to Drawing 8 in Section 10.

Correct? NO
Replace main board and reset zero point on pressure transducers. Refer to Procedure 3, 4 in Section 11.

Adjust zero point on pressure transducers.
Refer to Procedure 4 in Section 11.

Correct? NO
If transducer(s) are not adjustable.
Replace pressure transducer(s) and adjust zero point.
Refer to Procedure 4 in Section 11.

YES END
8 BAD DATA TRANSFER BETWEEN CONSOLE & CENTRAL UNIT, INTERFERENCE PROBLEM

PROBLEM: Error Code “E93/E94” No data transfer to and from console, interference from crane electric, or console display frozen.

START

Make sure that Data EPROM is plugged into main board socket D5 and System EPROM is plugged into main board socket D4. Check that EPROM's are inserted with notch on EPROM to matching notch on socket. Refer to Procedure 2 in Section 11.

Correct? NO

Place EPROM in correct socket.

Correct? YES

Check supply crane voltage to the console from the central unit at connection board between X1: 33 (ground) and X1:30 (+24V). Refer to Drawing 2, 3, 21 in Section 10.

Correct? NO

Make sure external and internal power supply is correct. Refer to Section 4.

YES

NEXT PAGE
8 BAD DATA TRANSFER BETWEEN CONSOLE & CENTRAL UNIT, INTERFERENCE PROBLEM - continued

Check if additional ground link between main board terminal X9 and central unit box mounting bracket is in place. Refer to Drawing 3, 8 in Section 10.

Correct? NO → Install ground line - single cable minimum of AWG14 (2.0mm) between terminal X9/2 and central unit box mounting bracket. Refer to Drawing 3, 8 in Section 10.

YES → Ensure that cable shields are connected correctly. Refer to connection and wiring diagrams, Drawings 1, 2, 3 in Section 10. Refer to Procedure 1 in Section 11.

Correct? NO → Make correct shield connection. Refer to connection and wiring diagrams, Drawings 1, 2, 3 in Section 10. Refer to Procedure 1 in Section 11.

YES → Find out which component of the crane electric is spiking out (e.g. dump valve, outrigger relay). Install a diode or resistor across terminals of spiking component. Diode type such as 1N4001 can be used (watch + and - connection for diode). Refer to Crane Electrical Diagrams.

END
## 9. ERROR CODE DISPLAY

**PROBLEM:** Error code displayed. Lever lockout activated. Warning lights on.

<table>
<thead>
<tr>
<th>ERROR CODE</th>
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<tbody>
<tr>
<td>E01</td>
<td>Minimum radius or maximum angle range exceeded</td>
<td>Fallen below the minimum radius or above the angle given in the load chart due to raising the boom too far.</td>
<td>Lower boom back to a radius or angle given in the load chart.</td>
</tr>
<tr>
<td>E02</td>
<td>Maximum radius or minimum angle range exceeded</td>
<td>The maximum radius or minimum angle given in the load chart was exceeded due to lowering the boom too far.</td>
<td>Raise boom back to a radius or angle given in the load chart.</td>
</tr>
<tr>
<td>E04</td>
<td>Operating mode not available</td>
<td>Operating mode switch in the console set incorrectly. Operating mode is not permissible with actual crane configuration.</td>
<td>Set operating mode switch correctly to the code assigned to the operating mode of the crane.</td>
</tr>
<tr>
<td>E05</td>
<td>Length range not permitted</td>
<td>Boom has been extended too far or not far enough. Length sensor adjustment changed; i.e. length sensor cable slid off the cable drum.</td>
<td>Retract or extend boom to correct length given in the load chart. See Section 6.</td>
</tr>
<tr>
<td>E07</td>
<td>No acknowledgment signal from overload relay (K1).</td>
<td>Overload relay is stuck, defective or not being selected.</td>
<td>Replace relay.</td>
</tr>
<tr>
<td>E08</td>
<td>No acknowledgment signal from Anti-Two-Block switch relay (K2).</td>
<td>Anti-Two-Block switch relay is defective or not being selected.</td>
<td>Replace relay.</td>
</tr>
</tbody>
</table>
| E11        | Fallen below limit for the measuring channel “length”. | a.) Cable between length sensor and central unit defective, not connected or water in the connectors. 
b.) Length sensor Potentiometer defective. 
c.) Electronic board in the measuring channel defective. | a.) Check cable and connector as well and replace, if necessary. Section 6.  
b.) Replace and reset length sensor Potentiometer. See Section 6 & Procedure 5. 
c.) Replace main board and reset pressure channels. See Drawing 3 & Procedure 4. |
## 9. ERROR CODES - continued

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| E12        | Fallen below lower limit value for the measuring channel “pressure transducer piston side”. | a.) Cable leading from the central unit to the pressure transducer defective, loose or water in the connector.  
   b.) Pressure transducer on piston side defective.  
   c.) Electronic component in the measuring channel defective. | a.) Check cable and connector as well and replace, if necessary. Section 7.  
   b.) Replace pressure transducer and reset pressure channel. See Section 7 & Procedure 4.  
   c.) Replace main board and reset pressure channels. See Drawing 3 & Procedure 4. |
| E13        | Fallen below lower limit value for the measuring channel “pressure transducer rod side”. | a.) Cable leading from the central unit to the pressure transducer defective, loose or water in the connector.  
   b.) Pressure transducer on rod side defective.  
   c.) Electronic component in the measuring channel defective. | a.) Check cable and connectors as well and replace, if necessary. Section No. 7.  
   b.) Replace pressure transducer and reset pressure channel. See Section 7 & Procedure 4.  
   c.) Replace main board and reset pressure channels. See Drawing 3 & Procedure 4. |
| E15        | Fallen below lower limit value for the measuring channel “angle main boom”. | a.) Cable from central unit to the length/angle sensor defective or loose.  
   b.) Angle sensor defective.  
   c.) Electronic component in the measuring channel defective. | a.) Check cable. Replace if necessary. See Section 6  
   b.) Replace angle sensor and reset adjustment. Procedure 5  
   c.) Replace main board and reset pressure channels. See Drawing 3 & Procedure 4. |
| E20        | No analog voltages | a.) The crane supply voltage is too low.  
   b.) The voltage converter is defective or short circuit in the wiring. | a.) Check crane voltage.  
   b.) Check supply voltages. |
### 9. ERROR CODES - continued

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| E21        | Upper limiting value for the measuring channel “length” exceeded. | a.) Cable from central unit to the length/angle sensor defective or loose. 
b.) Length potentiometer defective. 
c.) Electronic component in the measuring channel defective on main board. | a.) Check cable. Replace if necessary. See section 6. 
b.) Replace and reset length potentiometer. See Procedure 5. 
c.) Replace main board and reset pressure channels. See Drawing 3 & Procedure 4. |
| E22        | Upper limiting value for the measuring channel “pressure piston side” exceeded. | a.) Cable from central unit to the pressure transducer defective, loose or water in the plug. 
b.) Pressure transducer on piston side defective. 
c.) Electronic component in the measuring channel defective on main board. | a.) Check cable as well as plug. Replace if necessary. See Section 7. 
b.) Replace pressure transducer and reset pressure channels. See Section 7. 
c.) Replace main board and reset pressure channels. See Drawing 3 & Procedure 4. |
| E23        | Upper limit value for the measuring channel “pressure transducer rod side” exceeded. | a.) Cable lead in from the central unit to press trans defective, not connected or water in the connectors. 
b.) Pressure transducer on road side defective. 
c.) Electronic component in the measuring channel defective. | a.) Check cable and connectors as well and replace, if necessary. See Section 7. 
b.) Replace pressure transducer. 
c.) Replace main board and reset pressure channels. See Drawing 3 & Procedure 4. |
| E25        | Upper limit value for the measuring channel “angle main boom” exceeded. | a.) Cable leading from the central unit to the length/angle sensor defective, loose or water in the connectors. 
b.) Angle sensor defective. 
c.) Electronic component in the measuring channel defective. | a.) Check cable as well as connectors and replace, if necessary. Section 6. 
b.) Replace angle sensor and reset adjustment. See Section No. 6 & Procedure 5. 
c.) Replace main board and reset pressure channels. See Drawing 3 & Procedure 4. |
| E27        | Upper limit value for the measuring channel 7 exceeded. | a.) Cable leading from the central unit to the sensor of channel 7 defective, loose or water in the connectors. 
b.) Sensor of channel 7 defective. 
c.) Electronic component in the measuring channel 7 defective. | a.) Check cable as well as connectors and replace, if necessary. 
b.) Replace sensor of channel 7 and reset adjustment. 
c.) Replace main board and reset pressure channels. See Drawing 3 & Procedure 4. |
9. ERROR CODES - continued

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| E29        | Reference voltage defective.               | a.) The total of the supply and the reference voltages on MP10 is more than 3.3V  
b.) A/D converter defective. | a.) Check supply voltages.  
b.) Replace main board and reset pressure channels. See Drawing 3 & Procedure 4. |
| E31        | Error in the system program.               | a.) EPROM with system program defective.                              | a.) Replace system program EPROM                                     |
|            |                                             | b.) Electronic component on the main board defective.                  | b.) Replace main board and reset pressure channels. See Drawing 3 & Procedure 4. |
| E37        | Error in the program run                   | a.) EPROM with system program defective.                              | a.) Replace system program EPROM                                     |
|            |                                             | b.) Electronic component on the main board defective.                  | b.) Replace main board and reset pressure channels. See Drawing 3 & Procedure 4. |
| E38        | Wrong system program in the LMI.           | The system program in the LMI does not correspond to the programming in the data EPROM | Replace system program EPROM                                        |
| E41        | Error in the external RAM.                 |                                                                        | Replace main board and reset pressure channels. See Drawing 3 & Procedure 4. |
| E42        | Error in the external write/read memory (RAM). | Internal defect in digital part of CPU.                              | Exchange write/read memory (CMOS-RAM). Replace main board and reset pressure channels. See Drawing 3 & Procedure 4. |
| E48        | Malfunction in the monitored write/read memory | Internal defect in digital part of CPU.                              | Replace main board and reset pressure channels. See Drawing 3 & Procedure 4. |
| E51        | Error in data memory.                      | Data EPROM on the main board defective.                               | Replace Data EPROM. Make sure BR3 on the main board is installed. See Theory 1. |
| E71        | Incorrect acknowledgment of the 1. Relay on the terminal board A101. | a.) Anti Two-block relay is stuck or defective.  
b.) Anti Two-Block relay is not being selected due to a break on the terminal board A101, main board or ribbon cables. | a.) Replace 1. relay.  
b.) Check terminal board A101, main board and ribbon cables as well as replace defective part, if necessary. |
| E72 - E77  | Analogous to E71 for the relays 2...7.      | Analogous to E71 for the relays 2...7.                                | Analogous to E71 for the relays 2..7.                                |
### 9. ERROR CODES - continued

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<td>E89</td>
<td>Change of the operating code during lifting a load.</td>
<td>The operating mode switch in the console was used during lifting a load.</td>
<td>Lower the load and set the operating mode switch correctly to the code assigned to the actual operating mode of the crane.</td>
</tr>
<tr>
<td>E91</td>
<td>No data transmission from console to central unit. (See Section 8)</td>
<td>a.)24V supply of console interrupted. b.) Interruption or accidental ground in the line from console electronics to central unit. c.) Transmitter/receiver module defective.</td>
<td>a.) Check 24V at terminal X1 of console electronics. b.) Check the connection between console electronics and central unit. c.) If you find an accidental ground, the transmitter module in the console electronics can be damaged. You should, therefore, replace the console electronics. Replace console electronics or main board respectively. See Procedure 3</td>
</tr>
<tr>
<td>E92</td>
<td>Error in the data transmission from console to central unit. (See also Section 8)</td>
<td>a.) Temporary interruption of the data line from console electronics to central unit. b.) Transmitter/receiver module defective.</td>
<td>a.) Check the connection between console electronics and central unit.</td>
</tr>
<tr>
<td>E93</td>
<td>Error in the data transmission from central unit to console. (See also Section 8)</td>
<td>a.) Temporary interruption of the data line from console electronics to central unit. b.) Transmitter/receiver module defective.</td>
<td>a.) Check the connection between console electronics and central unit. b.) Replace console electronics or main board respectively. See Procedure 3</td>
</tr>
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| E94        | No data transmission from central unit to console. (See also Section 8) | a.) Interruption or accidental ground in the line from console electronics to central unit.  
b.) Transmitter/receiver module defective.  
c.) Data-EPROM defective.  
d.) CPU defective.  
e.) Electromagnetic interference (when switching contractors or valves) | a.) Check the connection between console electronics and central unit.  
If you find an accidental ground, the transmitter module in the console electronics can be damaged. Replace the console electronics.  
b.) Replace console electronics or main board respectively.  
c.) Check data EPROM.  
d.) Replace main board.  
e.) Eliminate interference source by inverse diodes or resistors. |
| E95        | Error in the crane data EPROM | a.) Data EPROM defective  
b.) Position of jumper for the selection of the type of EPROM is wrong  
c.) Electronics component on the main board defective. | a.) Replace data EPROM  
b.) Check the jumper position  
c.) Replace main board and reset pressure channels. See Drawing 3 & Procedure 4. |
| E96        | Error in the internal RAM of the CPU of the console | CPU or main board of the console defective | Replace console main board. |
| E97        | Error in the external RAM of the CPU of the console | a.) External RAM of the console defective  
b.) Electronic component on the main board defective. | a.) Replace console main board  
b.) Replace console main board |
| E98        | Wrong jumper position in the console | a.) The jumper position BR 9/BR 10 in the console does not correspond to the actual type of central unit.  
b.) Electronic component on the main board defective. | a.) Check the jumper position  
b.) Replace console main board |
10. DRAWING 1. ELECTRICAL WIRING FOR CRANE/PRESSURE TRANSDUCER

NOTES:

1. OUTER SHEILD CONNECTED TO STRAIN RELIEF INSERT
2. INNER SHEILD INSULATED AND CONNECTED AS SHOWN
3. INNER SHEILD CUT AND INSULATED
4. INNER SHEILD INSULATED AND CONNECTED AS SHOWN

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10. DRAWING 2. ELECTRICAL WIRING FOR CONSOLE/CABLE REEL

NOTES:

1. TAPE AND STRIP ALL WIRES NOT CONNECTED
2. OUTER SHEILD CONNECTED TO STRAIN RELIEF BUSHING
3. INNER SHEILD INSULATED AND CONNECTED AS SHOWN
4. INNER SHEILD CUT AND INSULATED
5. SWITCH WIRELED & PETTED
6. AFTER ALL ELECTRICAL CONNECTIONS ARE COMPLETED, SPRAY ALL ELECTRICAL TERMINALS WITH WC 775 CONTACT CLEANER.

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10. DRAWING 3A. CENTRAL UNIT DS350/2766

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10. DRAWING 3B. CENTRAL UNIT DS350/2767

ACCUCAL UPGRADE (SERIAL NUMBER 86638 AND BEYOND)

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10. DRAWING 4. CABLE REEL

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10. DRAWING 5. 050-350-061-328 CONSOLE
10. DRAWING 6. HEATER CONTROL BOARD W/VOLTMETER ON X1:1 & X1:4

VOLTMETER SHOULD MEASURE +24 VOLTS BETWEEN CONNECTIONS X1:1,8,9,10, or 11 (+24V, POSITIVE) AND X1:2 (GROUND)
REFER TO DRAWING 1 AND 2 FOR WIRING
REFER TO DRAWING 3 FOR BOARD LOCATION

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10. DRAWING 7. CONNECTION BOARD
W/VOLTMETER ON X1:1 & X1:3
W/VOLTMETER ON X4:1 & X4:3

VOLTMETER SHOULD MEASURE +24 VOLTS BETWEEN CONNECTIONS:
INPUT - X1:1 (POSITIVE) & X1:3 (GROUND)
OUTPUT - X4:1 (POSITIVE) & X4:3 (GROUND)
REFER TO DRAWING 3 FOR BOARD LOCATION

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10. DRAWING 8A. MAIN BOARD W/VOLTMETER ON X1:1 & X1:3

Main Board 024-350-060-094

VOLTMETER SHOULD MEASURE +24 VOLTS BETWEEN CONNECTION X1:1 (POSITIVE) AND X1:3 (GROUND)

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10. DRAWING 8B. MAIN BOARD W/VOLTMETER ON X1:1 & X1:3

Main Board 024-350-060-222

VOLTMETER SHOULD MEASURE +24 VOLTS BETWEEN CONNECTION X1:1 (POSITIVE) AND X1:3 (GROUND)

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10. DRAWING 9. CONSOLE HEATER CONTROL BOARD
W/VOLTMETER ON X1:1 & X1:3

VOLTMETER SHOULD MEASURE +24 VOLTS BETWEEN CONNECTIONS
X1:1 (+24V) AND X1:3 (GROUND)
10. DRAWING 10. BOOM TIP JUNCTION BOX
W/VOLTOMETER ON 1 & 2

TURN POWER OFF OR DISCONNECT X1:35 ON CONNECTION BOARD IN CENTRAL UNIT. MEASURE THE RESISTANCE BETWEEN TERMINALS 1 & 2.

- A2B SWITCH CLOSED = 4700 ±500 OHMS
- A2B SWITCH OPEN = 1MEGOHM

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10. DRAWING 11. SLIP RING W/VOLTMETER ON RED & BROWN

TURN POWER OFF OR DISCONNECT X1:35 ON CONNECTION BOARD IN CENTRAL UNIT. MEASURE THE RESISTANCE BETWEEN X2:RED & X1:BROWN.

- A2B SWITCH CLOSED = 4700 ±500 OHMS
- A2B SWITCH OPEN = 1MEGAOHM

NOTE: REFER TO DRAWING 2 FOR WIRING DIAGRAM.
10. DRAWING 12. CABLE REEL W/VOLTMETER ON 7 & 8

TURN POWER OFF OR DISCONNECT X1:35 ON CONNECTION BOARD IN CENTRAL UNIT. MEASURE THE RESISTANCE BETWEEN TERMINALS 7 & 8.

- A2B SWITCH CLOSED = 4700 ±500 OHMS
- A2B SWITCH OPEN = 1MEGOHM

NOTE: REFER TO DRAWING 2 FOR WIRING DIAGRAM.
10. DRAWING 13. BOOM BASE JUNCTION BOX
W/VOLTMETER ON 5 & 6

TURN POWER OFF OR DISCONNECT X1:35 ON CONNECTION BOARD IN CENTRAL UNIT. MEASURE THE RESISTANCE BETWEEN TERMINALS 5 & 6.
- A2B SWITCH CLOSED = 4700 ±500 OHMS
- A2B SWITCH OPEN = 1MEGAOHM

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10. DRAWING 14. CONNECTION BOARD
W/VOLTMETER ON X1:34 & X1:35

TURN POWER OFF TO CENTRAL UNIT. MEASURE THE RESISTANCE BETWEEN X1:34 & X1:35.
- A2B SWITCH CLOSED = 4700 ±500 OHMS
- A2B SWITCH OPEN = 1MEGOHM

REFER TO DRAWING 3 FOR BOARD LOCATION

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10. DRAWING 15. CONNECTION BOARD W/TEMPORARY 4.7K RESISTOR INSTALLED ON X1:34 & X1:35

TURN POWER OFF TO CENTRAL UNIT. INSTALL THE RESISTANCE BETWEEN X1:34 & X1:35. TURN POWER ON TO CENTRAL UNIT AND THE A2B ALARM SHOULD BE INACTIVE.
10. DRAWING 16. CONNECTION BOARD
W/VOLTMETER ON X1:8 & X1:11

VOLTMETER SHOULD MEASURE -5.0 VOLTS BETWEEN CONNECTIONS X1:8 (GROUND) & X1:11 (-5.0V)
10. DRAWING 17. CABLE REEL W/VOLTMETER ON 1 & 2  
W/VOLTMETER ON 1 & 3

WITH THE BOOM FULLY RETRACTED:

- THE VOLTMETER SHOULD MEASURE -0.50 VOLTS BETWEEN CONNECTIONS 1 (GROUND) AND 2 (SIGNAL VOLTAGE)
- THE VOLTMETER SHOULD MEASURE -5.0 VOLTS BETWEEN CONNECTIONS 1 (GROUND) AND 3 (SUPPLY VOLTAGE) - VOLTMETER NOT SHOWN

NOTE: REFER TO DRAWING 2 FOR WIRING DIAGRAM.
10. DRAWING 18. CONNECTIN BOARD
W/VOLTMETER ON X1:8 & X1:10

WITH THE BOOM FULLY RETRACTED, THE VOLTMETER SHOULD MEASURE
-0.5 VOLTS BETWEEN CONNECTIONS:X1:8 (GROUND) & X1:10 (LENGTH SIGNAL)
REFER TO DRAWING 3 FOR BOARD LOCATION
10. DRAWING 19. PRESSURE TRANSDUCER CABLE
W/VOLTMETER ON A & B AND B & C

- VOLTMETER SHOULD MEASURE +5.0 VOLTS BETWEEN CONNECTION A (+5.0V) & B (GROUND)
- VOLTMETER SHOULD MEASURE -5.0 VOLTS BETWEEN CONNECTION C (-5.0V) & B (GROUND)
REFER TO DRAWING 1 FOR WIRING DIAGRAM

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10. DRAWING 20. CONNECTION BOARD

W/VOLTMETER ON X1:13 & X1:14
W/VOLTMETER ON X1:15 & X1:14
W/VOLTMETER ON X1:18 & X1:19
W/VOLTMETER ON X1:20 & X1:19

- VOLTMETER SHOULD MEASURE +5.0 VOLTS BETWEEN CONNECTIONS: X1:13 (+5.0V) & X1:14 (GROUND) X1:18 (+5.0V) & X1:19 (GROUND) - ACTUAL MEASUREMENT NOT SHOWN
- VOLTMETER SHOULD MEASURE -5.0 VOLTS BETWEEN CONNECTIONS: X1:15 (-5.0V) & X1:14 (GROUND) X1:20 (-5.0V) & X1:19 (GROUND) - ACTUAL MEASUREMENT NOT SHOWN

REFER TO DRAWING 1 FOR WIRING DIAGRAM
10. DRAWING 21. CONNECTION BOARD
W/VOLTMETER ON X1:30 & X1:33

VOLTMETER SHOULD MEASURE +24 VOLTS BETWEEN CONNECTIONS:
X1:30 (POSITIVE) & X1:33 (GROUND)
REFER TO DRAWING 3 FOR BOARD LOCATION

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10. DRAWING 22. SECONDARY ANTI-TWO BLOCK SWITCH
FOR USE WITH PILE-DRIVER OPERATION

TO CHECK FUNCTION OF SECONDARY ANTI-TWO BLOCK SWITCH, MEASURE RESISTANCE AT BOOM NOSE JUNCTION BOX BETWEEN TERMINALS 2 AND 3 WITH OHMMETER.

SWITCH CLOSED = 4700 +/- 500 Ohms (WEIGHT INSTALLED)
SWITCH OPEN = > 1 MegaOhm (WEIGHT REMOVED)
11. PROCEDURE 1. STRAIN RELIEF INSTALLATION

DOUBLE SHIELDED CABLE PREPARATION FOR EMC APPLICATIONS
Outer shield is grounded at strain relief with ferrite filter.

Inner shield is grounded on connection board.

Cut inner shield back to approximately 1.2 inch. Then fold inner shield back to inner jacket, so the inner shield is 0.6 inches in length.

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11. PROCEDURE 2A. EPROM LOCATION AND INSTALLATION

- Ensure the notch is in the correct direction.
  * Notch on eprom must match the notch on the socket and markings on the board.
- Place eproms in the correct eprom socket as shown.
11. PROCEDURE 2B. EPROM LOCATION AND INSTALLATION

- Ensure the notch is in the correct direction. Notch on eprom must match the notch on the socket and markings on the board.
- The DATA and TLK eproms fill the bottom of the socket as shown by the arrows.
- Place eproms in the correct eprom socket as shown.
11. PROCEDURE 3A. MAIN BOARD 024-350-300-094 REPLACEMENT

Refer to Drawing 3A, central unit parts list for board location.

Note: Mark all connections before removing, to identify location for reconnecting.

1. Turn system power off.
2. Remove the central unit lid.
3. See Procedure 2A for main board layout of data and system eproms. Use a eprom puller to remove eprom, be careful not to bend or break the legs on the eprom. Remove data and system eproms from old board and place in new board.
4. Remove timer board and 90° adapter #20 and #21 from old board and place in new board, see Drawing 3A for timer board location.
5. Disconnect ribbon cable #7 and #8, see Drawing 3A.
6. Disconnect connection X1:1 and X1:3, see Drawing 3A.

NOTE: Take care not to damage boards, when removing and inserting screws.

7. Remove the 9 main board mounting screws.
8. Take notice of the orientation of the main board in the central unit. Remove main board and place in the packing material that the replacement main board came in.
9. Carefully insert the new main board in place. see Drawing 3B.
10. Insert the main board mounting screws and washers.
11. Connect X1:1, X1:3 and ribbon cables #7 and #8, see Drawing 3A.
12. Inspect the gasket for nicks, cuts, or damages. Refer to 031-300-340-003 DS 350 Central Unit Gasket Recommendations and 031-300-340-002 Central Unit Cover Installation and Tightening Procedure.
11. PROCEDURE 3B. MAIN BOARD 024-350-300-222 REPLACEMENT

Refer to Drawing 3B, central unit parts list for board location.

Note: Mark all connections before removing, to identify location for reconnecting.

1. Turn system power off.
2. Remove the central unit lid.

NOTE: Take care not to damage the boards with the screwdriver, when removing and inserting screws.

NOTE: Use care when lifting the CPU module board and analog input module from the main board, due to the fact that these boards have pins on the bottom side which insert into the main board.

1. Remove CPU module board and eprom module Items #20 and #21, see Drawing 3B, by taking out the 4 small Philips screws holding them in place.
2. Disconnect ribbon cable #7 and #8, see Drawing 3B.
3. Disconnect connection X1:1 and X1:3, see Drawing 3B.
4. Remove the 9 main board mounting screws.
5. Take notice of the orientation of the main board in the central unit. Remove main board and place in the packing material that the replacement main board came in.
6. Carefully insert the new main board in place. See Drawing 3B.
7. Insert the main board mounting screws and washers.
8. Insert CPU module board by lining up the pins into the sockets on the main board and the 4 screws holes.
9. Insert the 4 small Philips screws and washers.
10. Connect X1:1, X1:3 and ribbon cables #7 and #8, see Drawing 3B.
11. Inspect the gasket for nicks, cuts, or damages. Refer to 031-300-340-003 DS 350 Central Unit Gasket Recommendations and 031-300-340-002 Central Unit Cover Installation and Tightening Procedure.
11. PROCEDURE 4A. PRESSURE TRANSDUCER ZERO ADJUSTMENT

1. Lower boom all the way down (no rest pressure) then disconnect hydraulic hose from the piston side pressure transducer.

2. Connect a digital voltmeter to main P.C. board
   A) black (-) lead to MP15
   B) red (+) lead to MP4

3. Adjust P4 to obtain a reading of 0.500 volts (500mv) on meter.

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11. PROCEDURE 4A. PRESSURE TRANSDUCER ZERO ADJUSTMENT - continued

4. Disconnect hydraulic hose from the rod side pressure transducer.
5. Connect a digital voltmeter to main P.C. board
   A) black (-) lead to MP15
   B) red (+) lead to MP5
6. Adjust P5 to obtain a reading of 0.500 volts (500mv) on meter.
7. Reconnect hydraulic hoses to pressure transducers, then bleed the air from hydraulic lines.

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11. PROCEDURE 4B. PRESSURE TRANSDUCER ZERO ADJUSTMENT

1. Lower boom all the way down (no rest pressure) then disconnect hydraulic hose from the piston side pressure transducer.

2. Connect a digital voltmeter to main P.C. board
   A) black (-) lead to MP15
   B) red (+) lead to MP4

3. Adjust P4 to obtain a reading of 0.500 volts (500mv) on meter.

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11. PROCEDURE 4B. PRESSURE TRANSDUCER ZERO ADJUSTMENT - continued

4. Disconnect hydraulic hose from the rod side pressure transducer.

5. Connect a digital voltmeter to main P.C. board
   A) black (-) lead to MP15
   B) red (+) lead to MP5

6. Adjust P5 to obtain a reading of 0.500 volts (500mv) on meter.

7. Reconnect hydraulic hoses to pressure transducers, then bleed the air from hydraulic lines.

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11. PROCEDURE 5. LENGTH AND ANGLE SENSOR ADJUSTMENT

TURN THE CENTER SCREW COUNTER CLOCKWISE TO A SOFT STOP.

ADJUST LENGTH POTENIOMETER, WITH BOOM FULLY RETRACTED.

TURN THE CENTER SCREW COUNTER CLOCKWISE TO A SOFT STOP.

ADJUST TOP OF ANGLE PARALLEL WITH BOOM.

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12. THEORY 1A. MAIN BOARD MEASURING POINTS

* Notch on eprom must match the notch on the socket and markings on the board.

**MP TEST POINTS**

MP- 0 / X9 = KGND
MP- 1 = +5V
MP- 2 = -5V
MP- 3 = SIGNAL FORCE TRANSDUCER (LOAD CELL)
MP- 4 = SIGNAL PRESSURE PISTON SIDE
MP- 5 = SIGNAL PRESSURE ROD SIDE
MP- 6 = 1ST LENGTH INPUT FOR MAIN BOOM
MP- 7 = 2ND LENGTH INPUT
MP- 8 = ANGLE MAIN BOOM
MP- 9 = ANGLE LUFFING FLY JIB
MP-10 = +3V REFERENCE VOLTAGE
MP-11 = GROUND MP-12 = +5V
MP-13 = DIGITAL GROUND
MP-14 = +9V
MP-15 = ANALOG GROUND
MP-16 = -9V

MP-17 = +5V
MP-18 = +5V
MP-19 = -5V
MP-20 = OPERATING VOLTAGE
MP-21 = INPUT VOLTAGE
MP-22 = +10V
CH.1 BOOM LENGTH, MP-6/P6 (DO NOT ADJUST)
CH.2 FORCE CHANNEL, MP-4/P4 (NOT USED)
CH.3 FORCE CHANNEL, MP-5/P5 (AUX. HOIST)
CH.4 FORCE CHANNEL, - MP-3/P3 (MAIN HOIST)
CH.5 ANGLE CHANNEL, - MP-8/P8 (MAIN BOOM) (DO NOT ADJUST)
CH.6 ANGLE CHANNEL, - MP-9/P9 (LUFFING) (DO NOT ADJUST)
12. THEORY 1B. MAIN BOARD MEASURING POINTS

MP TEST POINTS
MP- 0 / X9 = KGND
MP- 1 = +5V
MP- 2 = -5V
MP- 3 = SIGNAL FORCE TRANSDUCER (LOAD CELL)
MP- 4 = SIGNAL PRESSURE PISTON SIDE
MP- 5 = SIGNAL PRESSURE ROD SIDE
MP- 6 = 1ST LENGTH INPUT FOR MAIN BOOM
MP- 7 = 2ND LENGTH INPUT
MP- 8 = ANGLE MAIN BOOM
MP- 9 = ANGLE LUFFING FLY JIB
MP-10 = +3V REFERENCE VOLTAGE
MP-11 = GROUND MP-12 = +5V
MP-13 = DIGITAL GROUND
MP-14 = +9V
MP-15 = ANALOG GROUND
MP-16 = -9V

MP-17 = +5V
MP-18 = +5V
MP-19 = -5V
MP-20 = OPERATING VOLTAGE
MP-21 = INPUT VOLTAGE
MP-22 = +10V

CH.1 BOOM LENGTH, MP-6/P6 (DO NOT ADJUST)
CH.2 FORCE CHANNEL, MP-4/P4 (NOT USED)
CH.3 FORCE CHANNEL, MP-5/P5 (AUX. HOIST)
CH.4 FORCE CHANNEL, MP-3/P3 (MAIN HOIST)
CH.5 ANGLE CHANNEL, MP-3/P3 (MAIN BOOM) (DO NOT ADJUST)
CH.6 ANGLE CHANNEL, MP-9/P9 (LUFFING) (DO NOT ADJUST)
12. THEORY 2. OPERATION OF LENGTH SENSOR

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## PAT DS350 MAIN BOOM LENGTH SIGNAL VOLTAGES

<table>
<thead>
<tr>
<th>NO. OF TURNS ON CABLE REEL</th>
<th>NO. OF TURNS ON LENGTH POT.</th>
<th>&quot;INPUT&quot; SIGNAL IN VOLTS AT TERM. X1:10 IN CU (VOLTS)</th>
<th>&quot;OUTPUT&quot; SIGNAL IN VOLTS AT MP6 TEST POINT ON MAIN BOARD IN CU (VOLTS)</th>
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<tbody>
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<td>0.50</td>
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<td>5</td>
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<td>2.50</td>
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<td>27</td>
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<td>4.10</td>
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<tr>
<td>30</td>
<td>10</td>
<td>-4.50</td>
<td>4.50</td>
</tr>
</tbody>
</table>

(3 TURNS OF THE CABLE REEL = 1 TURN OF THE LENGTH POT = 0.4V)

Chart shows typical voltages. These voltages are to be used as reference only, the actual signal may vary slightly. For specific boom length voltages, check voltages at MP6 or X1:10 and compare with test data in central unit.
12. THEORY 3. OPERATION OF ANGLE SENSOR

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PAT DS350 MAIN BOOM ANGLE SIGNAL VOLTAGES

<table>
<thead>
<tr>
<th>ACTUAL BOOM ANGLE</th>
<th>INPUT SIGNAL AT TERM #4 IN CABLE REEL AND TERM X1:9 IN CU (VOLTS)</th>
<th>OUTPUT SIGNAL AT MP8 TEST POINT ON MAIN BOARD IN CU (VOLTS)</th>
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</thead>
<tbody>
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<td>-1.875</td>
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<td>75</td>
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<td>-3.125</td>
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</table>

Chart shows typical voltages. These voltages are to be used as reference only, the actual signal may vary slightly.
12. THEORY 4. OPERATION OF PISTON SIDE LOAD SENSOR

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### PAT DS350 TRANSDUCER SIGNAL VOLTAGES

<table>
<thead>
<tr>
<th>PRESSURE (PSI)</th>
<th>INPUT SIGNAL AT TERM X1:21 IN CU (MILLIVOLTS)</th>
<th>OUTPUT SIGNAL AT MP4 TEST POINT ON MAIN BOARD IN CU (VOLTS)</th>
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<td>435</td>
<td>-99.9</td>
<td>0.89</td>
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<tr>
<td>580</td>
<td>-133.3</td>
<td>1.03</td>
</tr>
<tr>
<td>725</td>
<td>-166.6</td>
<td>1.17</td>
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<tr>
<td>870</td>
<td>-199.9</td>
<td>1.29</td>
</tr>
<tr>
<td>1015</td>
<td>-233.2</td>
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<td>1.57</td>
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<td>1305</td>
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<tr>
<td>4350</td>
<td>-999.9</td>
<td>4.50</td>
</tr>
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</table>

Chart shows typical voltages. These voltages are to be used as reference only, the actual signal may vary slightly.
12. THEORY 5. OPERATION OF ROD SIDE LOAD SENSOR

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PAT DS350 TRANSUDCER SIGNAL VOLTAGES

<table>
<thead>
<tr>
<th>PRESSURE (PSI)</th>
<th>INPUT SIGNAL AT TERM X1:21 IN CU (MILLIVOLTS)</th>
<th>OUTPUT SIGNAL AT MP4 TEST POINT ON MAIN BOARD IN CU (VOLTS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.0</td>
<td>0.50</td>
</tr>
<tr>
<td>145</td>
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<tr>
<td>290</td>
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<tr>
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Chart shows typical voltages. These voltages are to be used as reference only, the actual signal may vary slightly.
# HANDBOOK REVISIONS

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<td>Add Appendix F Tool List - Pages changed #1, and Table of Contents</td>
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<td>Chg console wiring in system diagram drawings 1 and 2 Correct drawing 3 and page 6; CU Parts List Correct drawing 4; Cable Reel Parts List Correct drawing 6; Console Parts List</td>
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<td>Chg CU to DS350/2767 with hardware for Accucal. AT422T Crane Serial Number 86638 and Beyond Restructure Troubleshooting Section • Drawings to Section 10 • Procedures to Section 11 • Theory to Section 12</td>
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<td>Chg Key Switch Operation description in Operator’s Hbk. Update Error Codes to match Trouble Shooting Section. Update Trouble Shooting Section • Corrections to flow chart (dwg.no.’s and procedures) • Corrections to wiring diagrams • Update Central Unit Parts List • Update Console Parts List • Correction to Drawing 6 (Section 10) • Delete Section 13</td>
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<td>Combine Trouble Shooting and Parts Manual. Handbook separate manual. • Corrections to wiring diagrams (console &amp; J.B.) • Delete all Parts Lists from Trouble Shooting Section • Update Boom Nose Junction Box • Correction of Section 5 (Primary Anti-Two block Problem) • Addition of Section 5a (Secondary Anti-Two block Problem) • Addition of drawing 22 (Secondary Anti-Two block)</td>
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<td>• Correct error codes operator’s and troubleshooting Manual. • Correct section 4. No Display • Correct section 10, drawing 6</td>
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