



RATED CAPACITY LIMITER SYSTEM
DS 350

OPERATOR'S HANDBOOK

DS350/1225/1229 Console

Link-Belt

Construction Equipment

LATTICE BOOM CRANES

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MANUAL REVISIONS

REV	DATE	NAME	DESCRIPTION
-	01/31/97	CSH	General operating handbook created for use with specific operating codes handbook.
A	06/20/97	CSH	Pg 11 - lockout overrides both A2B and load circuits
B	10/20/97	CSH	Pg 09 - N) Add to text display "RIG MODE" Pg 11 - Add keyswitch illustration Pg 12 - Remove 6.4 A2B condition instructions Pg 15 - Chg. Service and Maintenance

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1. GENERAL INFORMATION

The PAT DS 350 Rated Capacity Limiter (RCL) has been designed to provide the crane operator with essential information required to operate the machine within its designed parameters.

The PAT DS 350 Rated Capacity Limiter (RCL) monitors various crane functions and provides the operator with a continuous reading of the crane's rated capacity. The readings continuously change as the crane moves through the motions needed to make the lift. If a non-permitted condition is approached, the RCL is designed to warn the operator by sounding an audible alarm and illuminating a warning light.

During crane operation, The RCL provides the operator with information such as: the selected operating mode, main boom length, main boom angle, jib length, jib angle, and the total load being lifted by the crane. The total load is defined as all weight at the end of the hoist line, which includes hook block, load, rigging, etc..

This manual describes the function, operation, and maintenance of the PAT DS 350 Rated Capacity Limiter (RCL) System for Link-Belt Lattice-Boom Cranes.

This system assists the crane operator in promoting safe and efficient operation by monitoring crane loads and by warning the operator of approaching overload conditions. Always refer to operational instructions and load charts provided by the crane manufacturer for specific crane operation and load limits.

2. WARNINGS

- The PAT DS 350 Rated Capacity Limiter (RCL) is an operational aid which warns a crane operator of an approaching overload and over hoist condition which could cause damage to equipment, property, and/or injury to the operator or bystanders.
- This device is not, and shall not be a substitute for good judgment, experience, and the practice of accepted safe crane operation.
- The operator is solely responsible for the safe operation of the crane and must observe and obey all warnings and instructions supplied by PAT and the crane manufacturer.
- Prior to operating a crane, the operator must carefully and thoroughly read and understand the information in this manual and the crane manufacturer's manual to ensure that the operator understands the function and limitations of the RCL system and the crane.
- Proper operation of the RCL System is dependent upon proper inspection, maintenance, and observance of the operating instructions set forth in this manual.

3. SYSTEM DESCRIPTION

The PAT DS 350 Rated Capacity Limiter (RCL) System consists of a central microprocessor unit, operator's console, and component sensors for angle, load, and anti-two block (A2B) condition. The system uses angle sensors to measure boom and jib angle, if applicable. The hoist line tensiometers (linersiders) measure the load. And the A2B switch senses an approaching a two block condition.

The system operates on the principle of comparing real to reference data. The real data is supplied to the central unit by sensors and the operator's input settings, such as: operating code, hoist selection switch, and reeving switch. The reference data (i.e. crane capacity charts, geometry) is supplied by the crane manufacture and stored in memory chips in the central processor unit. The microprocessor evaluates the real data (sensors and operator input) to determine an operating mode. The operating mode determines the reference data required to calculate permitted operating limits. When limits are exceeded, warning signals are generated and viewed at the operator's console. Note the difference between operator's code and mode; the code is entered by the operator from Appendix, and the system defines the mode.

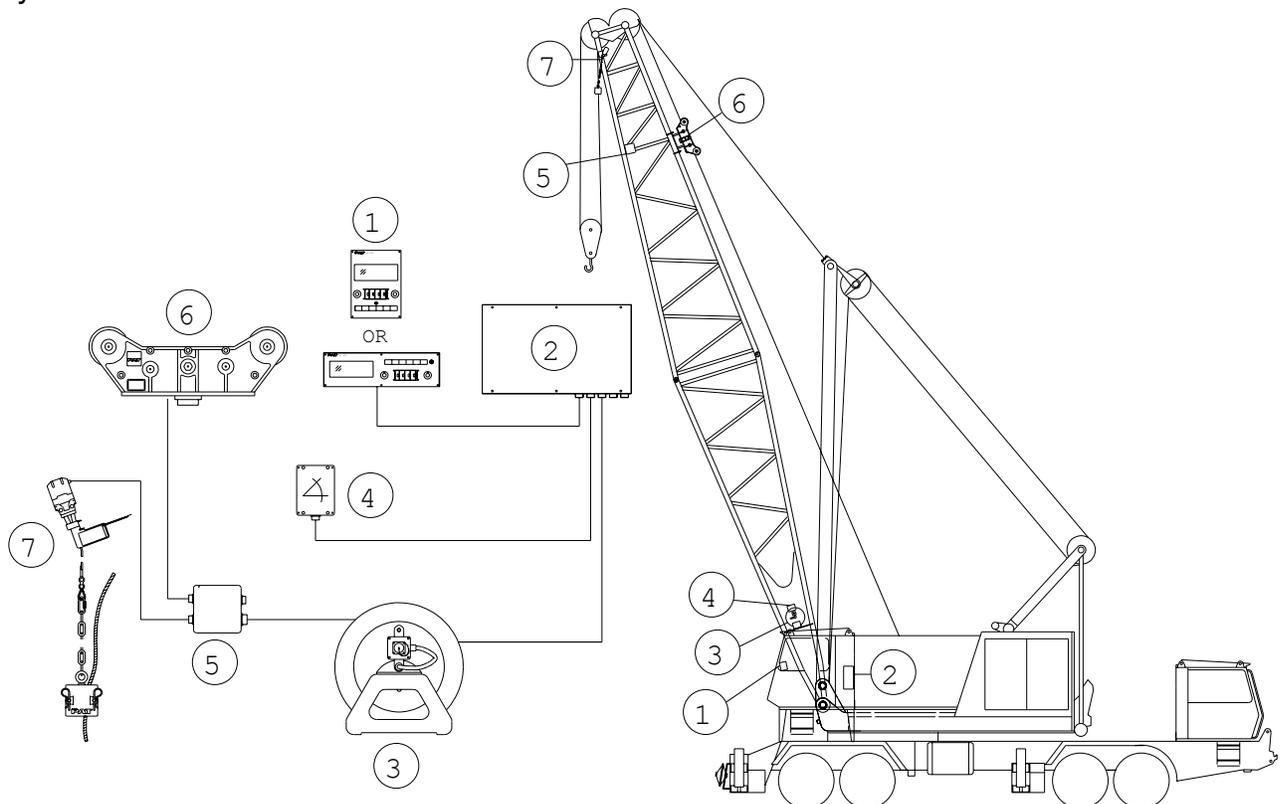


Figure 1. PAT DS 350 Rated Capacity Limiter (RCL) System Components

- | | |
|-----------------------|----------------------------|
| 1. Operator's Console | 5. Junction Box |
| 2. Central Unit | 6. Linerider (Tensiometer) |
| 3. Cable Reel | 7. A2B Switch |
| 4. Boom Angle Sensor | |

4. CONSOLE CONTROLS AND DISPLAYS

The operator's console allows the operator to controlled and identify the cranes configuration using the operating code, hoist selection, reeving, and geometry selection switches. The crane may be equipped with a horizontal (Figure 2) or a vertical (Figure 3) version, these consoles only differ in the shape of the housing. The console is located in the crane operator's cab.

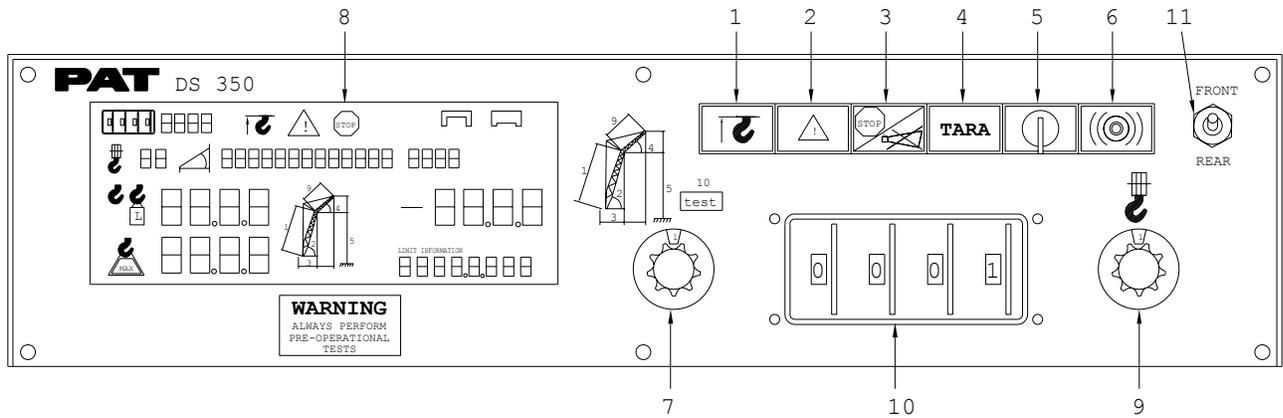


FIGURE 2. Horizontal Operator's Console.

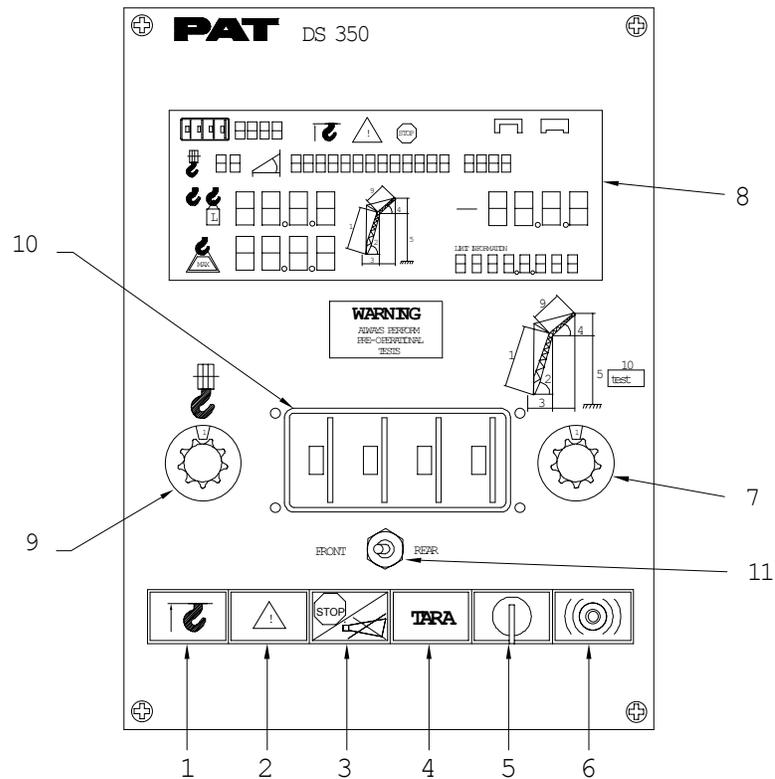
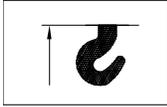


FIGURE 3. Vertical Operator's Console.

4. CONSOLE CONTROLS AND DISPLAYS (continued)

1. ANTI-TWO-BLOCK INDICATOR

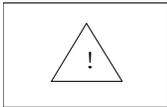


This symbol will light when the hoist A2B switch opens, indicating that a two-blocking condition is imminent. At the same time, the load hoist up functions will be disabled.

NOTE: Some **Link-Belt** machines are equipped with **Link-Belt** A2B Systems which incorporate their own horn and/or light.

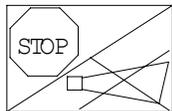
The term “two-block” is a crane term which refers to a condition when the hook block comes into contact with the boom head. This condition, if not prevented, will cause the wire rope to break, allowing the load to fall. Two-blocking can be caused by raising the load into the boom head, and by lowering the boom without paying out hoist line.

2. PREWARNING LIGHT



This yellow light will illuminate when the load on the hook is between 90% and 100% of the crane rating, indicating that an overload condition is approaching.

3. OVERLOAD LIGHT/AUDIBLE ALARM SILENCE BUTTON



A red warning light signals the operator that an overload condition has occurred. The red warning light will illuminate when the total load exceeds the crane rating or a system error occurs. This button allows the audible alarm to be silenced.



The audible alarm must not be silenced during crane operation, as the operator may not be alerted by the red warning light alone.

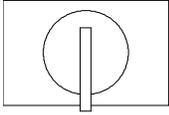
4. TARA BUTTON



This button will tare the net load. (See Section 8.G.) The tare condition will automatically be canceled, when changing the boom position.

4. CONSOLE CONTROLS AND DISPLAYS (continued)

5. KEY OVERRIDE



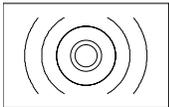
A key activated, 3-position spring loaded switch allows the operator to override the overload and A2B cut-off functions, which allows control lever operation during lockout.



WARNING

NEVER use the key override to either overload or operate the crane out of the manufactures allowable or safe operating range (refer to the crane load charts).

6. BUZZER

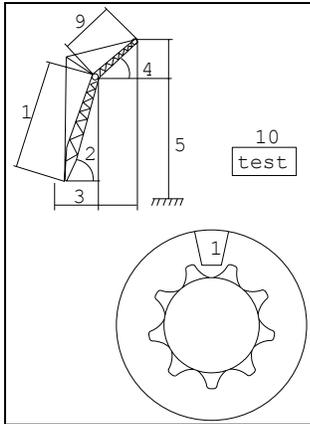


This is an audible alarm which will sound when one of the following conditions occur:

- a. Two-block condition has occurred
- b. The load on the hook has reached rated capacity
- c. System detects an error or malfunction

4. CONSOLE CONTROLS AND DISPLAYS (continued)

7. GEOMETRY SELECTOR SWITCH



The geometric selector switch determines the information to be shown on the geometry display (4.8.D). Each switch position is identified by a number (1 to 10) under the window of the control knob. The numbers 1,2,3,4,5,9 and 10 refer to the crane symbol (4.8.E) and, if selected, the corresponding arrow will flash to emphasize the displayed geometric value.

The display (4.8.D) will show one of the following selected switch positions:

Position 1: main boom length

Position 2: main boom angle

Position 3: main boom radius(including jib/extension, if any)

Position 4: jib angle

Position 5: boom tip height above ground level (including jib/extension, if any)

Position 9: jib length

Position 10: Test position. All lamps and characters of the liquid crystal display (LCD) will illuminate, when this position is selected. Only use this position to check the display.



Selecting position 10 for extended periods of time could cause damage to the display. Only use this position to check the display.

NOTE: Position 4 and 9 will only display correct data if a jib operating mode is selected. During this test, some characters may appear which are insignificant for operating this crane.

4. CONSOLE CONTROLS AND DISPLAYS (continued)

E) CRANE SYMBOL

The crane symbol will flash indicating the selection for the geometry display (4.8.D).

F) LOAD DISPLAY

This digital display indicates the total load on the crane. The total load is shown in KIPS (1000's pounds). A reading of 7.6 means the lifted load is 7,600 pounds. NOTE: A load over 200,000lbs will not display a decimal point. The total load is defined as all weight at the end of the hoist line, which includes hook block, load, rigging, etc..

G) TARE SYMBOL

This symbol will light after pressing the button "TARA" (4.4) to have the net load displayed at (4.8.F). When changing the boom position, the tare condition will automatically be canceled.

H) RATED CAPACITY DISPLAY

This display shows the maximum capacity for the crane. The maximum capacity is dependent on the radius and operating mode. The total load is shown in KIPS (1000's pounds). A reading of 7.6 means the rated capacity is 7,600 pounds. NOTE: A load over 200,000lbs will not display a decimal point.

J) PERCENT OF RATED CAPACITY DISPLAY

This bar graph display indicates how much of the crane's rated capacity is being used. The rated capacity of the crane changes as the boom moves through its operating range.

The bar graph display has three sections:

1. A green "safe" section (0% to 90% of the rated capacity);
2. A yellow "prewarning" section (90% to 100% of the rated capacity);
3. A red "overload" section (beyond 100% of rated capacity).

K) OPERATING MODE DISPLAY

This display shows crane operating mode, determined by the crane configuration, capability, and the operating code selected by the crane operator. The operating mode is specified by manufacturer's reference data stored in the software. The operating mode and code may or may not be the same depending on the crane configuration and capability.

L) REEVING DISPLAY

This display shows the number of parts of line used to reeve the hook block (see 4.9 for reeving switch information).

4. CONSOLE CONTROLS AND DISPLAYS (continued)

M) ERROR CODE DISPLAY

In case of an error, this display will show a code number which describes the error (see Section 10. Troubleshooting).

N) TEXT DISPLAY

This display will show one of the system conditions:

- 1) "SYSTST" during test mode, selector switch (7) in position 10;
- 2) "SYSERR" together with "E93" in error code display (8 M);
- 3) "CU-ERR" together with "E94" in error code display (8 M).
- 4) "360 DEG" or "OVR REAR", working range definition
- 5) "RIG MODE" System is by-passed and in rigging mode

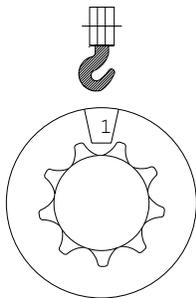
P) RADIUS/ANGLE SYMBOL

The corresponding segment of this symbol will light with regard to whether the load chart is angle-based or radius-based.

Q) LIFTING CONFIGURATION SYMBOL

The applicable symbol will illuminate, to indicate the lifting configuration of the crane, i.e., lifting "on outriggers" (outrigger symbol) or lifting "on rubber" (tire symbol). The symbol should correspond to the operating mode selected.

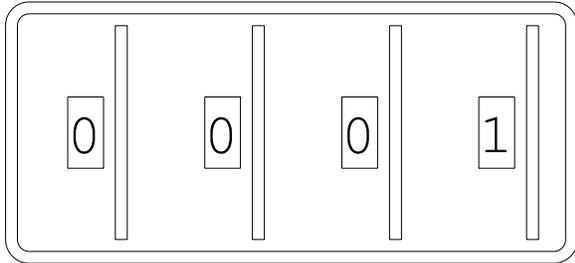
9. REEVING SWITCH



The reeving switch provides the Rated Capacity Limiter with information regarding the number of parts of line used to reeve the hook block. The operator selects the number of lines using the 16 position switch (1 to 15 and N), which are shown under the control knob window, when it is turned. The 'N' position automatically selects the maximum parts of line defined in the software for a operating mode.

4. CONSOLE CONTROLS AND DISPLAYS (continued)

10. OPERATING CODE SELECTOR SWITCH



These thumb wheel switches are used to select the operating code of the crane. Each possible configuration is shown in the Operating Codes Section. The operating or configuration codes are specific to crane model.



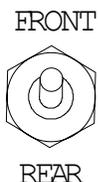
WARNING

The crane operator must select the correct operating mode to match the crane configuration or the RCL System will not provide the operator with the correct information

Select the operating mode in the Operating Codes Section as follows:

- a) Locate the crane configuration in The Operating Codes Section.
- b) Identify the operating code that corresponds with the existing main boom and/or jib length.
- c) Turn each thumb wheel switch individually until the selected crane operating code is shown on the operating code selector switch.

11. HOIST SELECTOR SWITCH



A toggle switch, on the console, permits the operator to select either the FRONT HOIST or REAR HOIST, depending on the crane configuration and lifting requirements. The system will then automatically select the appropriate maximum line pull, based upon stored data for wire rope type being used.

5. LOCKOUT CONTROLS

5.1 CONTROL LOCKOUT OVERRIDE KEYSWITCH

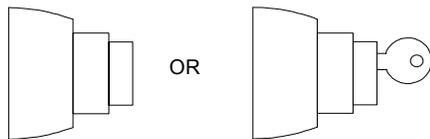
A key-actuated switch, installed on the central processor unit, enables the operator to override the control lockout feature for the load/A2B circuits. Since this switch deactivates the lockout function of the RCL system, the following instructions **MUST** be adhered to:

The bypass switch must be used with discretion. **OVERRIDING THE CONTROL LOCKOUT SYSTEM CAN RESULT IN INJURY TO PERSONNEL, DAMAGE TO THE CRANE AND/OR PROPERTY.** When overriding the system an operator must be fully aware of the crane capabilities defined by the load charts for the crane.

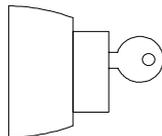


NEVER use the by-pass switch to either overload or operate the crane out of the manufactures allowable or safe operating range.

To override the lockout features: insert the key, turn the switch to the right, press in, and turn key back to the left. The key cannot be removed, and system lockouts are bypassed. To return to normal operation simply turn the key to the right and allow the key switch to spring out and to the left. The key should be remove and kept in a safe place. The following illustration shows the keyswitch positions.



KEYSWITCH IN NORMAL OPERATION, PLUNGER OUT →



KEYSWITCH IN OVERRIDE POSITION, PLUNGER IN ←

6. PRE-OPERATION INSPECTION

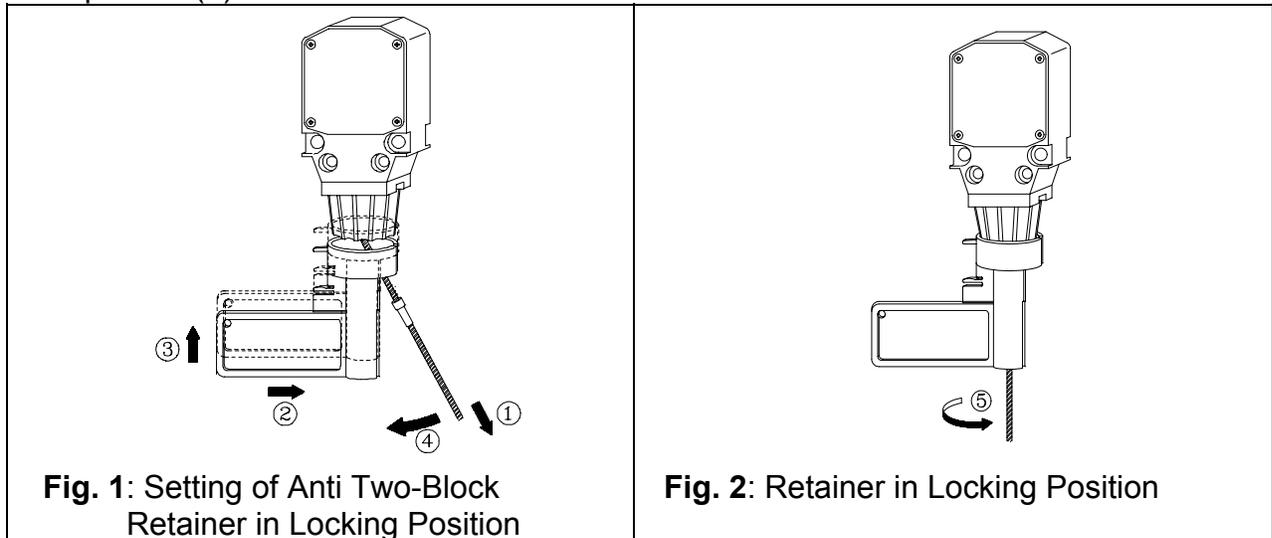
Prior to operating the crane, visually inspect the RCL System to ensure that the system is properly electrically connected and mounted on the crane. Inspect the console, central unit, cable reel, A2B switch(es) and weight(s), linerider(s), junction box(es), and wire cable for damages or defects.

1. Check the linerider(s) for binding.
2. Check the A2B switch(es) and weight(s) for free movement by cycling.
3. Check the anti two-block switch weight for proper installation 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.

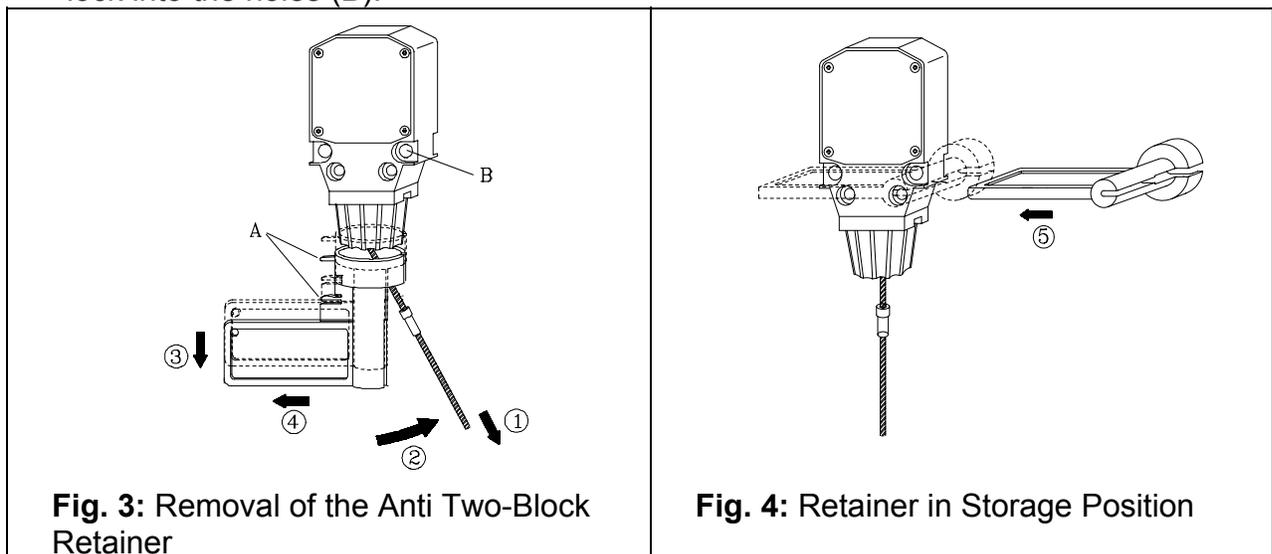
PRE-OPERATION INSPECTION (continued)

4. Check the installation of the A2B retainer (when applicable - see the above section.)

Locking Procedure (see Fig. 1 and 2): Pull the cable out of the switch and bend back parallel to the boom and hold (1). Slide the retainer from left side with its slot over the cable between the crimped stop and the switch (2). Push it firmly straight onto the cable guide of the Anti Two-Block switch (3). Straighten the cable completely into the slot and release the cable (4). Turn the flag of the retainer for best visibility for the operator (5).



Removal and Storage Procedure (see Fig. 3 and 4): Pull the cable out of the switch (1) and bend back parallel to the boom and hold (2). Move the retainer down (3) and then left (4) to remove it from the Anti Two-Block switch. Release the cable. For storage slide the retainer from right side (5) over the Anti Two-Block switch until the clips (A) lock into the holes (B).



7. SYSTEM OPERATION

After performing the operational inspection and properly setting the operating code and parts of line for the crane configuration, the Rated Capacity Limiter (RCL) is fully automatic. Therefore, it is imperative that the system setup be completed according to the following procedure. The setup must agree with the real rigging state of the crane.

1. Select the operating code in The Operating Codes Section as follows:
 - a) Locate the crane configuration in The Operating Codes Section.
 - b) Identify the operating code that corresponds with the existing main boom and or jib length.
 - c) Turn each thumb wheel switch (4.10) individually until the selected crane operating code is shown on the operating code selection switch.



The crane operator must select the correct operating code to match the crane configuration or the RCL System will not provide the operator with the correct information

2. Select the parts of lines used during the lift (4.9)
3. Select the hoist with the hoist select switch (4.11)
4. Review section 6 to ensure A2B switch(es) and weight(s) are properly installed.

NOTE: Possible system code letter messages:

O = OVERLOAD

P = PREWARNING

H = ANTI-TWO-BLOCK WARNING

8. 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. Check the anti two-block limit switches for freedom of movement.
 3. Verify that the displayed main boom angle agrees with the actual angle.
 4. Inspect linerider sheave. Lubricate as necessary.
- Other than correcting the problems identified in the Malfunctions Table and replacing faulty mechanical parts and cables, all other repairs shall be performed by PAT Authorized Service Representatives.

9. OPERATIONAL TEST

The operation test will test the Rated Capacity Limiter System and verifies the system sensors are functioning properly. This test should be completed periodically or anytime there is an indication of inaccuracy.



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

If the operator cannot clearly see the hook block approaching the boom head, an assistant must watch the hook block.

The operator should be prepared to stop the machine immediately, should the Rated Capacity Limiter (RCL) System not function properly by lighting the red warning light and /or sounding the audible alarm.

Any structural modifications or changes to the crane shall require verification of the crane's RCL System calibration.

1. Start the crane in accordance with crane operator's manual.
2. Test display using the geometry selector switch.
3. Check that anti-two-block indicator and audible alarm function properly by manually lifting the weight attached to the A2B switches on the crane. When the weight is lifted, the audible alarm should sound, the anti two-block alarm light should light. (See SAE J1305 for two block warning and limit system operation)
4. Slowly raise the main boom hook block to bring it into contact with the A2B switch weight.

NOTE: 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 RCL System not function properly by lighting the red warning light, sounding the audible alarm and locking the hoist up function.

9. OPERATIONAL TEST (continued)

When the hook block contacts the weight, the red anti-two-block indicator should light and the audible alarm should sound. NOTE: The hoist up function of the crane will be disabled. Lower the hook block to eliminate the two-block condition.



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. If the crane is equipped with a boom extension, repeat the test procedure for the boom extension anti two-block switch.
6. Check that displayed length of main boom agrees with actual length. (Verify operating code selection before checking length)
7. Check that displayed angle of main boom agrees with actual angle. (See SAE J375 for recommended tolerances)
8. Check that displayed operating radius of crane agrees with actual radius. (See SAE J375 for recommended tolerances)
9. Check the load display by lifting a load of known weight. (See SAE J376 for recommended tolerances)

NOTE: Total load 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.



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.

10. TROUBLESHOOTING GUIDE

The console display will indicate an error code at the geometry display (4.8.D), if an error occurs in the system.

A list of error codes are shown below. The troubleshooting guide in this section may help you correct the problem. If the problem can not be corrected, contact your dealer for further instructions.

If the error concerns electronic processing (component boards), the repair must be made by factory-trained (PAT) service personnel.

All repairs must be performed by PAT Authorized Service Representatives.

WARNING: THE ERROR MUST BE CORRECTED BEFORE OPERATING THE CRANE.

Error Codes with Description:

01: Fallen below the radius angle or range angle	27: Error in the no-load moment correction
02: Radius range exceeded	29: Error in the reference voltage
03: Prohibited slewing range	31: Error in the system program PROM 1
04: Operating mode not existing	32: Error in the system program PROM 2
06: Prohibited angle range	33: Error in the system program PROM 3
07: Error overload relay	34: Error in the system program PROM 4
08: Error hoist end switch relay	38: Error in the system program in LMI
09: Error relay 2	41: Error in the RAM memory 1
11: Error in the length registration	42: Error in the RAM memory 2
13: Error in the auxiliary force channel registration	51: Error in the data memory PROM 1
14: Error in the main force channel registration	52: Error in the data memory PROM 2
15: Error in the angle registration main boom	53: Error in the data memory PROM 3
16: Error in the angle registration jib	54: Error in the data memory PROM 4
17: Error in the no-load moment correction	55: Error in the data memory PROM 5
18: Error in the reference voltage	56: Error in the data memory PROM 6
19: Error in the reference voltage	57: Error in the data memory PROM 7
20: Error in analog voltages	58: Error in the data memory PROM 8
23: Error in the auxiliary force channel registration	59: Error in the data memory PROM 9
24: Error in the main force channel registration	91: No data transmission from the console
25: Error in the angle registration main boom	92: Error in the data transmission from the console
26: Error in the angle registration jib	93: Error in the data transmission to the console
	94: No data transmission to the console

11. ERROR CODE CHART

ERROR DISPLAY	ERROR	CAUSE	ACTION
E 01	Fallen below radius or angle range	Fallen below the minimum radius or angle given in the load chart due to rising the boom too far.	Put boom back to a radius or angle given in the load chart.
E 02	Radius or angle range exceeded.	The maximum radius or angle given in the load chart was exceed due to lowering the boom too far.	Raise boom back to a radius or angle given in the load chart.
E 03	Prohibited slewing range (no load area).	Slewing range prohibited with load.	Slew back into permissible range.
E 04	Operating mode not available.	Operating mode switch on the console set incorrectly.	Set operating mode switch correctly to the code assigned to the operating mode of the machine. (see Section 9 operator's handbook)
E 06	Angle luffing jib exceeded.	The maximum angle given in the corresponding load chart was exceeded due to lowering the luffing jib too much.	Raise luffing jib to an angle given in the load chart.
E 07	No acknowledge signal from overload relay.	Hoist limit switch relay is stuck, defective, or not being selected.	Replace relay
E 08	No acknowledge signal from hoist limit switch relay	Hoist limit switch relay is stuck, defective, or not being selected.	Replace relay
E 09	No acknowledge signal from relay 2.	Relay 2 is stuck, defective, or not being selected.	Replace relay
E 13	Fallen below lower limiting value for the measuring channel "auxiliary force".	Cable from central unit to the force transducer defective or water in the plugs. Electronic component in the measuring channel defective.	Check cable and plugs; replace items as necessary. See Section 3, force transducer adjustments.
E 14	Fallen below lower limiting value for the measuring channel "force-main hoist".	Cable from central unit to the force transducer defective or water in the plugs. Electronic component in the measuring channel defective.	Check cable and plugs; replace items as necessary. See Section 3, force transducer adjustments.
E 15	Fallen below lower limiting value for the measuring channel "angle main boom".	Cable from central unit to the angle sensor defective or loose, or water in the plugs. Electronic component the measuring channel defective.	Check cable and plugs; replace items as necessary. See Section 2, angle sensor adjustments.

11 ERROR CODE CHART (continued)

ERROR DISPLAY	ERROR	CAUSE	ACTION
E 16	Fallen below lower limiting value for the measuring channel "angle luffing jib".	Cable from central unit to the angle sensor defective or loose, or water in the plugs. Electronic component the measuring channel defective.	Check cable and plugs; replace items as necessary. See Section 2, angle sensor adjustments.
E 18	Error in the reference voltage.	Electronic component on main board defective.	Replace main board & reset force transducers as shown in Section 3.2.
E 19	Error in the reference voltage.	Electronic component on main board defective.	Replace main board & reset force transducers as shown in Section 3.2.
E 20	No analog voltage.	Crane voltage to low Short in supply voltage from crane to central unit. Voltage converter is defective on main board	Check crane voltage Check wiring Replace main board & reset force transducers as shown in Section 3.2.
E 23	Upper limiting value for the measuring channel "auxiliary-force" exceeded.	Cable from central unit to the force transducer defective or water in the plugs. Electronic component in the measuring channel defective.	Check cable and plugs; replace items as necessary. Replace main board & reset force transducers as shown in Section 3.2.
E 24	Upper limiting value for the measuring channel "force - main hoist" exceeded.	Cable from central unit to the force transducer defective or water in the plugs. Electronic component in the measuring channel defective.	Check cable and plugs; replace items as necessary. Replace main board & reset force transducers as shown in Section 3.2.
E 25	Upper limiting value for the measuring channel "angle main boom" exceeded.	Cable from central unit to the angle sensor defective or loose, or water in the plugs. Electronic component the measuring channel defective.	Check cable and plugs; replace items as necessary. See Section 2, angle sensor adjustments.
E 26	Upper limiting value for the measuring channel "angle luffing jib" exceeded.	Cable from central unit to the angle sensor defective or loose, or water in the plugs. Electronic component the measuring channel defective.	Check cable and plugs; replace items as necessary. See Section 2, angle sensor adjustments.

11. ERROR CODE CHART (continued)

ERROR DISPLAY	ERROR	CAUSE	ACTION
E 28	Error in the reference voltage.	Electronic component on main board defective.	Replace main board & reset force transducers as shown in Section 3.2.
E 31-34	Error in system software.	Eprom's with system software defective.	Replace system eprom Replace main board & reset force transducers as shown in Section 3.2.
E 37	Error in system software.	Eprom's with system software defective.	Replace system eprom Replace main board & reset force transducers as shown in Section 3.2.
E 38	Wrong system or data eprom.	Eprom's with system software does not correspond with data eprom.	Replace system eprom
E 41-42	Error on the ram.	Ram range on the main board defective.	Replace main board & reset force transducers as shown in Section 3.2.
E 45	Error in internal communications	Electronic component on main board defective.	Replace main board & reset force transducers as shown in Section 3.2.
E 45	Error in read/write memory.	Electronic component on main board defective.	Replace main board & reset force transducers as shown in Section 3.2.
E 51-59	Error in data memory.	Data eprom's defective Electronic component on main board defective.	Replace data eprom Replace main board & reset force transducers as shown in Section 3.2.
E71	Incorrect acknowledgment of the 1. Relay on the terminal board a101.	Anti two-block relay is stuck or defective. Anti two-block relay is not being selected due to a break on the terminal board a101, main board or ribbon cables.	Replace 1. Relay. Check terminal board a101, main board and ribbon cables as well as replace defective part, if necessary.
E72 - 77	analogous to E71 for the relays 2...7.	Analogous to e71 for the relays 2...7.	Analogous to E71 for the relays 2..7.
E89	Change of the operating code during lifting a load.	The operating mode switch in the console was used during lifting a load.	Lower the load and set the operating mode switch correctly to the code assigned to the actual operating mode of the crane.

11. ERROR CODE CHART (continued)

ERROR DISPLAY	ERROR	CAUSE	ACTION
E 91-92	No data transmission from console.	Plug on console loose; cable defective.	Check cable and plug; replace console, as necessary.
E 93-94	Error in the data transmission to the console.	Cable to the console not plugged in or interrupted. Eprom not installed or defective Defect in the central electronics (main board).	Check cable; attach plug properly. Replace Eproms Replace main board & reset force transducers as shown in Section 3.2.

E-19/20/29 Error in reference supply voltage. Identify supply voltage that is being shorted, (+/-5 or + -9) disconnect ribbon cable. If power supply returns then problem is external. Reconnect ribbon cables and disconnect all components individually to identify the location of the short.