

**PAT
LOAD MOMENT
INDICATOR
DS 350 M**

OPERATOR'S HANDBOOK

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1 GENERAL INFORMATION

The PAT Load Moment Indicator¹⁾ (LMI) DS 350 M has been designed to provide the crane operator with the essential information required to enable the machine to be used within its design parameters.

Using various 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, tip height, working radius and the total calculated weight being lifted by the crane.

If non permitted conditions are approached, the DS 350 M Load Moment Indicator will warn the operator by sounding an audible alarm, lighting a warning light and cutting-off the unwanted crane movements.

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 which warns a crane operator of approaching overload conditions and also warns of overhoist conditions which could cause damage to equipment and personnel.

The device is not, and shall not, be a substitute for good operator judgement, experience and use of accepted safe crane operating procedures.

The responsibility for the safe operation of the crane 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 the indicator and crane.

Proper functioning is dependent upon proper daily inspection and observations of the operating instructions set forth in this manual.

3 SYSTEM DESCRIPTION

The PAT Load Moment Indicator DS 350 M consists of a central micro processor unit, operating console, length/angle sensor, pressure transducers and anti-two block switches.

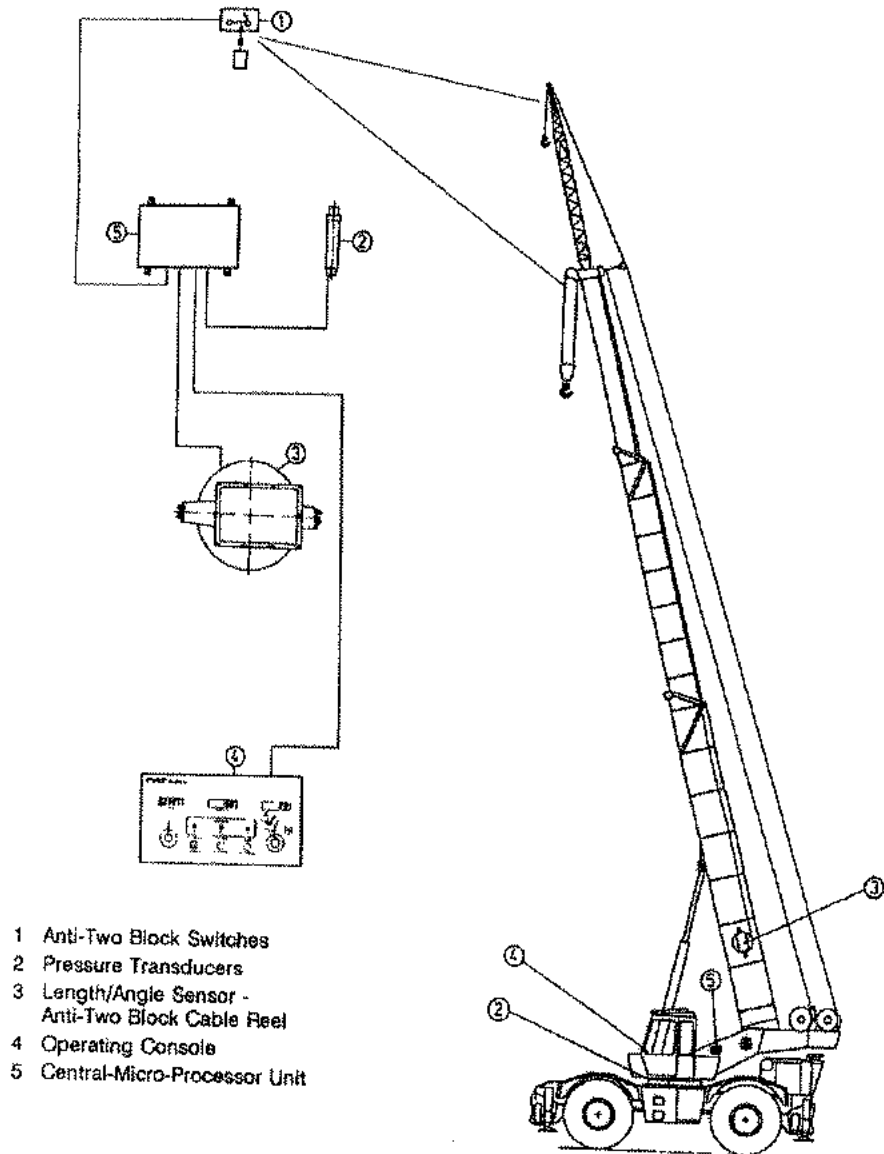
The system operates on the principle of reference/real comparison. The real value, resulting from the pressure measurement, is compared with the reference data, stored in the central processor memory and evaluated in the micro processor. When limits are reached, an overload warning signal is generated at the operator's console. At the same time, the dangerous 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 lift cylinders.

Fig. 1: Components of PAT LMI System DS 350 M



- 1 Anti-Two Block Switches
- 2 Pressure Transducers
- 3 Length/Angle Sensor -
Anti-Two Block Cable Reel
- 4 Operating Console
- 5 Central-Micro-Processor Unit

3.1 System Function

After ignition of the engine, the system starts with an automatic test of all lamps, the audible alarm and the complete system.

After the system has passed through the system test without errors, the system is ready for operation. The console will display the actual load on display (1), the relative moment on display (2) and crane data on display (3).

In case of system malfunction an error code number will be displayed on the crane data display (2) at the console.

3.2 Operating Console

The console has 2 functions:

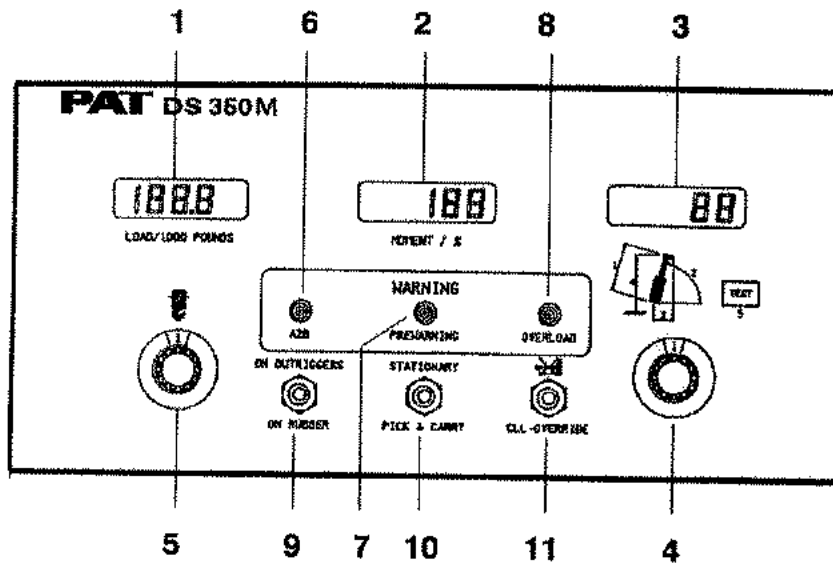
- terminal for input of instructions to the system by the crane operator
- display of important data and information

The operating console is located in the operator's cabin in front of the operator. This unit contains different displays and controls which are described in chapter 3.3.

3.3 Control Identification

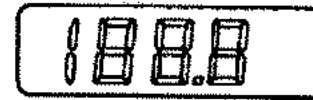
Figure 2 illustrates the controls and displays of the DS 350 M Load Moment Indicator. The numbers of the illustration correspond to the numbers in the following list, which describes the function of each control.

Fig. 2: Operating Console



- 1 Load Display [(x1000) LBS]
- 2 Moment Display / Error Code Display
- 3 Data Display
- 4 Switch "Data"
- 5 Switch "Reevings"
- 6 Anti-Two Block Alarm Light
- 7 Load Moment Prewarning Light
- 8 Load Moment Overload Light
- 9 Switch "On Outriggers/On Rubber"
- 10 Switch "Stationary/Pick & Carry"
- 11 Switch "Horn Off/CLL-Override"

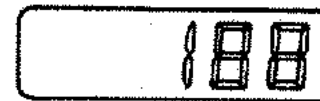
1 Load Display



LOAD / 1000 POUNDS

This digital display indicates the *actual load* (gross load / 1000 LBS) of the crane. Slings and hook block are included.

2 Moment / Error Code Display



MOMENT / %

This digital display indicates the percentage of the *load moment*. It displays how much of the crane rated capacity is being used. As the rated capacity of the crane changes as it is moved through its various motions, the display will constantly change to coincide with the crane ratings.

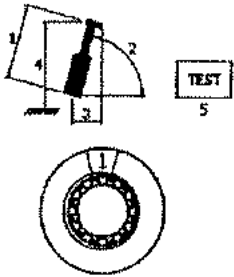
In the case of a malfunction of the system or an operating error, the display will indicate an *error code* used to identify system problems.

3 Data Display



This digital display is used in conjunction with the *Data Selector Switch* (4) to provide the operator with information regarding the operating geometry of the crane.

4 Data Selector Switch



The *Data Selector Switch* determines the information which will be displayed on the Data Display (3). Each mode is identified by a number (1 to 4) under the window of the control knob. The function of each position is as follows:

Position 1: With the data selector switch in this position, the data display will indicate the *length* of the boom in feet.

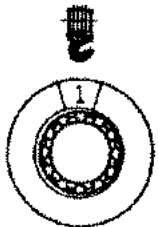
Position 2: The data display will indicate the *angle* of the boom in degrees

Position 3: The data display will indicate the operating *radius* of the boom in feet.

Position 4: The data display will indicate the *height* of the boom tip above the ground in feet.

Position 5: System test. All warning lamps will light, the horn will sound, the moment display (2) and the data display (3) will show the test figure "-188.8", the load display will show the test figure "8888", and the dangerous crane movements will be stopped.

5 Reeving Switch



This switch provides the load moment indicator with information regarding the number of parts of line used to reeve the hook block. The switch has 10 positions which are shown under the window of the control knob when it is turned.

The operator has to set the Reeving Switch to the actual number of parts of line being used.

The correct setting of the Reeving Switch is of utmost importance for the proper function of the system and the crane.

6 Anti-Two Block Warning Light



A2B

This red warning light will light 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 simultaneously: hoist up, telescope out, boom down.

7 Load Moment Prewarning Light



PREWARNING

This yellow light will light up when the load on the crane reaches 90% of the crane rating. The operator may continue crane operation but with caution.

8 Load Moment Limit Light



OVERLOAD

This red warning light will light up when the load on the crane reaches 100% of the crane rating. The operator may continue crane operation but with extreme caution. At the same time the audible alarm will sound.

NOTE: When the load on the crane reaches 100% of crane rating, hoist up, boom down, and telescope out functions will lock out.

9 Switch "ON OUTRIGGERS/ON RUBBER"

ON OUTRIGGERS



DN RUBBER

This toggle switch (9) provides the load moment indicator with the information regarding the outrigger configuration of the crane.

For working ON OUTRIGGERS, the operator has to set this switch to the UP position.

For working ON RUBBER, the operator has to set this switch to the DOWN position.

10 Switch "STATIONARY/PICK & CARRY"

STATIONARY



PICK & CARRY

This toggle switch (10) provides the load moment indicator with the information regarding the on rubber lifting of the crane.

For STATIONARY operation, the operator has to set this switch to the UP position.

For PICK & CARRY operation, the operator has to set this switch to the DOWN position.

CAUTION

The correct setting of switches 9 and 10 is of utmost importance for the proper function of the system and the crane. Therefore, the operator shall check the correct setting of these switches every time before starting crane operation.

11 Switch "HORN OFF/CLL-OVERRIDE"



CLL-OVERRIDE

If this switch is placed in the UP position, the audible alarm will be silenced for 15 seconds.

In the DOWN position, this by-pass switch can deactivate the cut-off of the LMI or anti-two block momentarily to allow the crane operator to override the control lever lockout (CLL).

The switch is spring-loaded to return from the up or down position to the neutral center position after the switch has been released. To activate the switch, it therefore has to be held manually during its operation.

NOTE:

Since this switch deactivates the cut-off function of the LMI system and the Anti-Two Block System, the following instructions have to be adhered to:

- the by-pass switch 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 switch to either overload or operate the crane in a range not permissible.

4 SETTING OF OPERATING MODE

ON OUTRIGGERS



ON RUBBER

STATIONARY



PICK & CARRY

The operator has the responsibility for setting the LMI to the operating configuration of the crane. The toggle switches (9) and (10) are used for that purpose.

The correct setting of these switches is of utmost importance for the proper function of the system and the crane. Therefore only operators who are thoroughly familiar with the crane load charts and the use and operation of the system should set the operating mode switches.

ON OUTRIGGER LIFTING

ON OUTRIGGERS



For working ON OUTRIGGERS, the operator shall set the toggle switch (9) to the UP position.

NOTE: *Outrigger beams shall be fully extended and jack cylinders set with tires raised free of crane weight. The machine shall be leveled on a firm supporting surface.*

ON RUBBER LIFTING



ON RUBBER

For working ON RUBBER, the operator shall set the toggle switch (9) to the DOWN position.

NOTE: *Axle lockouts must be functioning before lifting on rubber. All rubber lifting depends on proper tire inflation.*

When selecting "ON RUBBER", selection between "STATIONARY" and "PICK & CARRY" is also required.

STATIONARY OPERATION

STATIONARY



For working ON RUBBER STATIONARY, the operator shall set the toggle switch (10) to the UP position.

NOTE: *The setting of the LMI to the different load charts "OVER FRONT" and "360 DEGREE" is fully automated:*

For the definition of the working areas, see the applicable notes on the load capacity chart.

PICK & CARRY OPERATION

PICK & CARRY

For working ON RUBBER PICK & CARRY, the operator shall set the toggle switch (10) to the DOWN position.

NOTE: *For Pick & Carry operation, the boom shall be centered over front of machine and mechanical swing lock engaged. Load shall be restrained from swinging.*

5 PRE-OPERATION INSPECTION

Prior to operating the crane, the following checks must be made:

1. Check the cabling connecting the various parts of the system for physical damage.
2. Check the anti-two block switches and weights 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.

If the operator cannot clearly see the hookblock approaching the boom head, he shall have an assistant watch the hookblock. The operator shall be prepared to stop the machine immediately should the LMI system not function properly by lighting the red warning light, sounding the audible alarm and locking the dangerous crane movements.

1. Check the anti-two block alarm light (6) and the audible alarm by manually lifting the weight attached to the anti-two block switches.
2. Slowly raise the main boom hookblock to bring it into contact with the switch weight. When the hookblock lifts the weight, the audible alarm should sound, the anti-two block alarm light (6) should light and the motion of the hookblock should be stopped. Lower the hookblock slightly to eliminate this condition.
3. Then slowly lower or extend the boom to create a potential two-block condition. When the hookblock lifts the weight, the audible alarm should sound, the anti-two block alarm light (6) should light and the boom lowering and/or boom extension function should be stopped.

NOTE: *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.*

4. Check that the display of the main boom length agrees with the actual boom length.
5. Check that the display of the main boom angle agrees with the actual angles.
6. Check that the display of the operating radius of the crane agrees with the actual radius.

Operation

After being properly set, the operation of the LMI is fully automated. Therefore, the operator shall be thoroughly familiar with all controls of the LMI and he shall properly set each switch before operating the crane. All settings shall be checked by lifting a load of known weight and comparing the load to the information displayed on the load moment indicator.

Rated loads include the weight of slings and auxiliary lifting devices and their weights shall be subtracted from the listed ratings to obtain the net load to be lifted.

6 SERVICE AND MAINTENANCE

Maintenance of the load moment indicator consists of inspecting:

1. The cabling connecting the various parts of the system: If a cable is damaged, it shall be replaced immediately.
2. The insulation of the length sensor cable and the cable guides: If the insulation is worn or the cable guides damaged, these parts shall be replaced.
3. Check the anti-two block limit switches for freedom of movement.
4. The cable reel shall be under tension to operate properly.
5. Check the pressure transducers at the hoist cylinders 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.

7 TROUBLESHOOTING

GENERAL

In case of a malfunction of the system, the display (2) will indicate a code which identifies the system malfunction.

The error codes listed in the Malfunction Table will identify various faults which can occur with the LMI. Following the Malfunction Table are pages which explain each fault and describe the action which shall be taken to correct the fault.

Faults within the electronic microprocessor must be repaired by factory trained service personnel. When these faults occur, the competent service organization shall be contacted.

Malfunctions Table

Error Code	Error
E01	Fallen below the radius or above angle range
E02	Radius range exceeded or fallen below angle range
E04	Incorrect operating mode selected
E05	Prohibited length range
E80	Below accuracy range for load indication NOTE: This error will appear on the load display on console
EEE	Exceeds 200% of rated machine capacity

NOTE:

If there is any Error Code displayed on the console which is not listed in the Malfunctions Table you shall call the Service Department.

OPERATING ERRORS

Malfunctions in the system which are caused by exceeding approved working range or operating errors by the crane operator himself are indicated on the display. These error codes are E01, E02, E04, E05, E80 and EEE. They can normally be eliminated by the crane operator himself.

ERROR 01

Cause:	Elimination:
Fallen below the minimum radius or above the angle given in the load chart due to raising the boom too far.	Lower boom back to a radius or angle given in the load chart.

ERROR 02

Cause:	Elimination:
The maximum radius or minimum angle given in the load chart was exceeded due to lowering the boom too far.	Raise boom back to a radius or angle given in the load chart.

ERROR 04

Cause:	Elimination:
Operating mode switch in the console set incorrectly. Operating mode selected is not permissible with actual crane configuration	Set operating mode switch correctly to the operation mode of the crane

ERROR 05

Cause 1:	Elimination:
Boom was telescoped too far (i.e. load curves for "on rubber", you may only operate up to a certain maximum or minimum boom length or with load curves for jibs where you have to telescope the main boom to a certain length).	Telescope boom to correct length, given in the load chart.
Cause 2:	Elimination:
Length sensor adjustment changed i.e. length sensor cable slid off the length sensor drum.	For elimination refer to service manual.

ERROR 80

Cause:	Elimination:
Load indicating device meets SAE J 376 Sec. 4.2 accuracy requirements for loads on hook from 9,000# to 80,000#. This error code indicates load on hook is below 9,000#.	No corrective action required. Load indication will occur between 9,000# and 80,000#.

ERROR EEE

Cause:	Elimination:
This display will appear if actual load exceeds 200% of rated machine capacity at a give operating condition.	This will not occur when operating within approved machine load chart and operating conditions..