
PAT

OPERATOR'S HANDBOOK

PAT LOAD MOMENT INDICATOR

DS 350 G

Operators Handbook DS 350 GOPHB11E.TXT 2/1/87

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PART 1

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HINWEIS:

Inhaltliche Änderungen in diesem Handbuch sind vorbehalten.

PAT ÜBERNIMMT KEINERLEI GEWÄHR FÜR DAS MATERIAL, EINSCHLIESSLICH DER DAMIT VERBUNDENEN GEWÄHR HINSICHTLICH MARKTGÄNGIGKEIT UND EIGNUNG FÜR BESTIMMTE VERWENDUNGSZWECKE.

PAT HAFTET WEDER FÜR INHALTLICHE FEHLER DES HANDBUCHES NOCH FÜR DIREKTE ODER INDIREKTE SCHÄDEN IM ZUSAMMENHANG MIT DER BEREIT STELLUNG UND DEM GEBRAUCH DES HANDBUCHES.

1 GENERAL INFORMATION

The PAT Load Moment Indicator[1)] (LMI) DS 350 G 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, rated load and the total calculated weight being lifted by the crane.

If non permitted conditions are approached, the DS 350 G 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.

WARNING

This system is equipped with an override key on the central microprocessor unit. This key switch bypasses control lever lockout function of load moment indicator device. The switch may only be used by authorized personnel during emergency situations. Failure to follow this instruction may result in property damage and/or personal injury.

3 SYSTEM DESCRIPTION

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

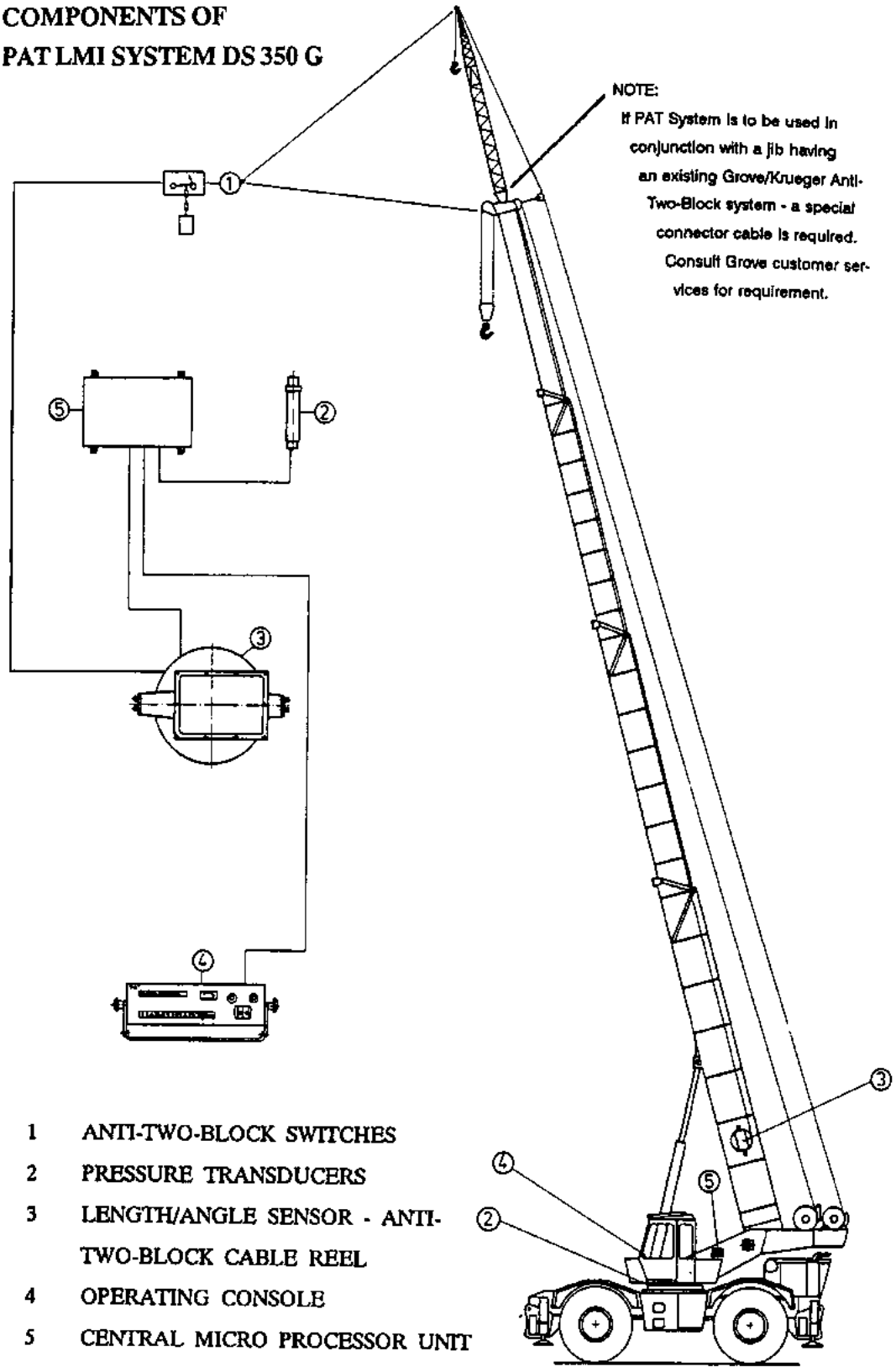
The system operates on the principle of reference/real comparison. The real value, resulting from the force or pressure measurement is compared with the reference data, stored in the central processor memory and evaluated in the micro processor. When limits are reached, an overload warning signal is 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.

COMPONENTS OF PAT LMI SYSTEM DS 350 G

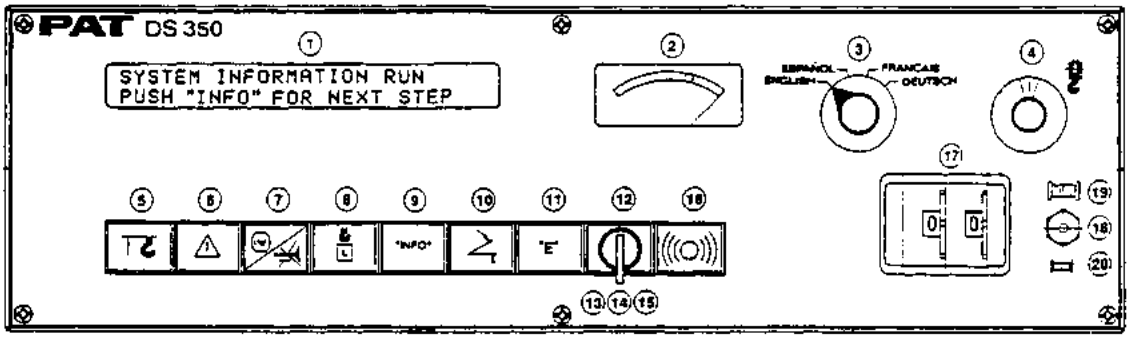


1 ANTI-TWO-BLOCK SWITCHES
2 PRESSURE TRANSDUCERS
3 LENGTH/ANGLE SENSOR - ANTI-TWO-BLOCK CABLE REEL
4 OPERATING CONSOLE
5 CENTRAL MICRO PROCESSOR UNIT

3.1 OPERATING CONSOLE

The console has 2 functions:

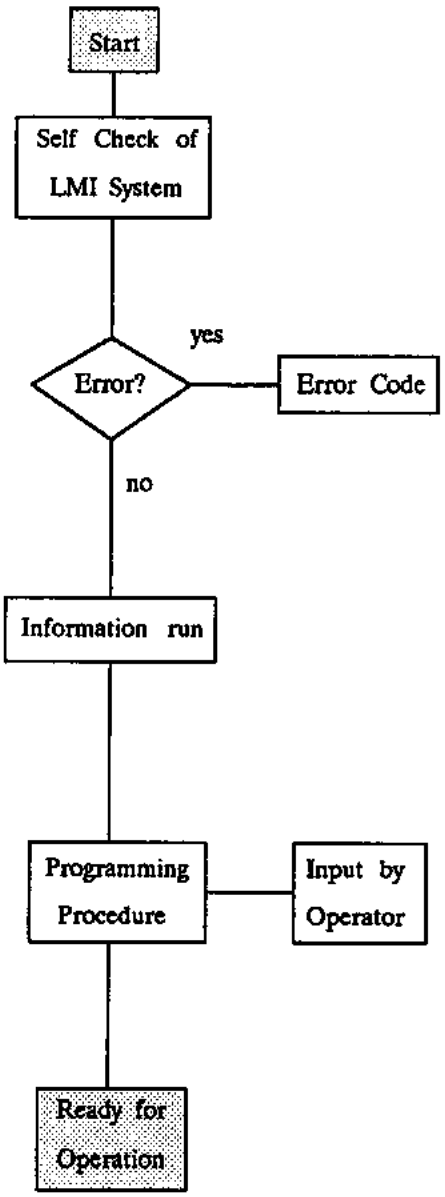
- terminal for input of instructions to the system by the crane operator
- display of important data, information and instructions



1 DISPLAY
2 LOAD MOMENT INDICATOR
3 SWITCH "LANGUAGE"
4 SWITCH "REEVINGS"
5 ANTI-2-BLOCK ALARM LIGHT
6 LOAD MOMENT PREWARNING LIGHT
7 LOAD MOMENT ALARM LIGHT and BUTTON "HORN OFF"
8 BUTTON "LOAD INDICATION"
9 BUTTON "INFO"
10 BUTTON "ANGLE LIMIT"
11 BUTTON "E"
12 KEY SWITCH
13 BY-PASS ANTI-2-BLOCK LOCKOUT
14 NORMAL OPERATION
15 BY-PASS LMI LOCKOUT
16 AUDIBLE ALARM
17 SWITCH "OPERATING CODE"
18 SWITCH "MAIN/AUX. HOIST"
19 MAIN HOIST
20 AUXILIARY HOIST

3.2 SYSTEM FUNCTION

The PAT Load Moment Indicator (LMI) works with a user guide system that simplifies the operation of the crane and the LMI system. The system run during the start up phase is shown in the following block diagram.



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

In case of system malfunction an error code number will be displayed on the console.

The system will display information and directions which the operator will follow by using the respective function of the key.

The system is in the programming procedure. The operator has to set the LMI to the configuration of the crane.

The system is ready for operation

4 SYSTEM'S OPERATION

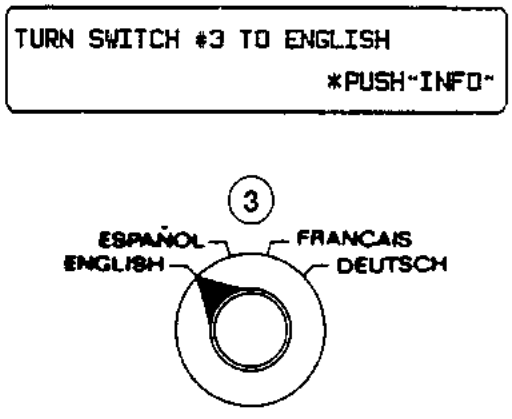
During the start up phase the crane operator will receive information about the function and meaning of the various elements of the console. This process will also remind the crane operator to follow the respective operating instructions.

4.1 INFORMATION RUN

The information run is a simple step by step procedure. The information will be displayed until a button is pressed to call for the next info step. The info run is followed by the programming phase.

In the following the system start will be explained step by step.

MESSAGE 1



After the ignition of the crane has been activated and the system has passed through the system test without errors, the console will display this phrase alternately in all 4 languages. With the switch (3), the crane operator can select the desired language. The language does not have any influence on the function of the system.

INSTRUCTION:
POSITION SWITCH (3) TO THE DESIRED LANGUAGE.

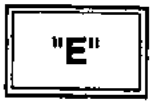
PUSH BUTTON 

MESSAGE 2

```
INFO RUN IS NOW IN ENGLISH
TO CONFIRM                *PUSH"E"
```

The display now shows the selected language. Button "E" has to be pressed to accept this language. After the info run has been completed, the language can be changed anytime.

INSTRUCTION:
PUSH BUTTON "E"



MESSAGE 3

```
FIND OPERATOR MANUALS
READ AND UNDERSTAND  *PUSH"INFO"
```

Prior to operating, the crane operator must carefully and thoroughly read and understand the crane load charts and the information contained in the manuals for the crane and the LMI, to ensure that the operator knows the operation and limitations of the crane and the LMI.

INSTRUCTION:
PUSH BUTTON "INFO"

MESSAGE 4

```
YOU WILL NOW GET A DESCRIPTION
OF THE CONSOLE          *PUSH"INFO"
```

A description of all elements of the frontplate such as display, switches and buttons follows now.

INSTRUCTION:
PUSH BUTTON "INFO"

MESSAGE 5

```
DESCRIPTION IS MADE ACCORDING TO
#1 TO #17 ON CONSOLE *PUSH"INFO"
```

The description of the info run follows the reference numbers. The numbers are printed on the frontplate of the console next to the various operation and information elements, such as display, lights, switches, buttons.

(Shown for unit without hoist selector switch)

```
DESCRIPTION IS MADE ACCORDING TO
#1 TO #20 ON CONSOLE *PUSH"INFO"
```

(Shown for unit with hoist selector switch)

INSTRUCTION:
PUSH BUTTON "INFO"

INFORMATION:

Experienced operators who are thoroughly familiar with the LMI system do exclusively now have the opportunity to by-pass the info-run. If you are confident, you may push button "E" now and the system will show message "END OF INFO RUN" (Refer to page #22).

MESSAGE 6

```
REF #1: READOUT FOR INFO/LOAD/
BOOM/ERROR CODE DATA *PUSH"INFO"
```

The readout will display technical information as well as operating information and instructions for the operator.

```
RADIUS  LENGTH   ANGLE   HEIGHT
 56.3ft  80.5ft  64.8°   57.1ft
```

During crane operation the readout will display radius, boom length, boom angle and height of boom tip.

(Display will be in units corresponding to load charts)

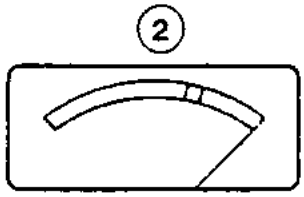
```
E01: ABOVE ANGLE RANGE
     ANGLE = 80°
```

In case of system malfunctions the various faults will be indicated via an error code.

INSTRUCTION:
PUSH BUTTON "INFO"

MESSAGE 7

```
REF #2: DISPLAY OF LOAD MOMENT
                    *PUSH"INFO"
```



The load moment will be displayed in the indicator (2). This meter displays how much of the crane rated capacitiy is being used. As the rated capacity of the crane changes as it is moved through its various motions, the meter will constantly change to coincide with the crane ratings.

The meter is divided into 3 areas:

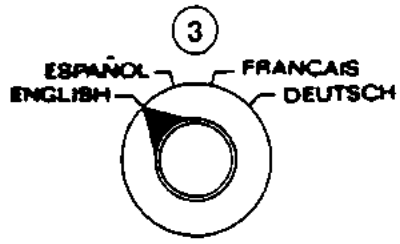
- a green area (0 to 90% of rated capacity)
- a yellow caution area (90 to 100% of rated capacity)
- a red overload area (beyond 100% of rated capacity)

Operating within the red area is not permitted.

INSTRUCTION:
PUSH BUTTON "INFO"

MESSAGE 8

```
REF #3: LANGUAGE SWITCH TO
SELECT YOUR LANGUAGE *PUSH"INFO"
```

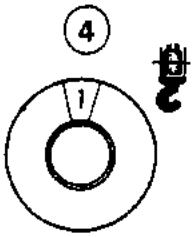


The Language Switch (3) allows you to select any of the four languages ENGLISH, SPANISH, FRENCH and GERMAN after system has passed through the system test satisfactorily or anytime after info run has been completed.

INSTRUCTION:
PUSH BUTTON "INFO" **INFO**

MESSAGE 9

```
REF #4: REEVING SWITCH    REFER
TO OPERATOR'S MANUAL *PUSH"INFO"
```



The Reeving Switch (4) provides the load moment indicator with information regarding the number of parts of line used to reeve the hook block. The switch has 16 positions which are shown under the window of the control knob when it is turned.

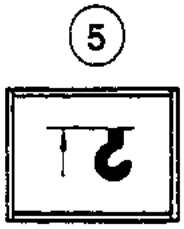
The operator has to set the reeving switch to the actual number of parts of line being used.

THE CORRECT SETTING IS OF UTMOST IMPORTANCE FOR THE PROPER FUNCTION OF THE SYSTEM AND THE CRANE.

INSTRUCTION:
PUSH BUTTON "INFO" **INFO**

MESSAGE 10

```
REF #5: ANTI-TWO-BLOCK WARNING
        LIGHT          *PUSH"INFO"
```



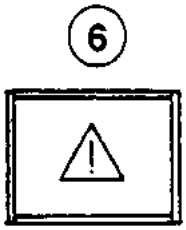
This red warning light (5) will light up when the anti-two-block limit switch contacts open, indicating that a two-blocking condition is approaching. At the same time the audible alarm will sound.

The following crane movements will be stopped subsequently: hoist up, telescope out, boom down. On units with luffing jib, in addition to above lockouts, the luffing hoist down will be stopped.

INSTRUCTION:
PUSH BUTTON "INFO"

MESSAGE 11

```
REF #6: LOAD MOMENT PREWARNING
        LIGHT          *PUSH"INFO"
```



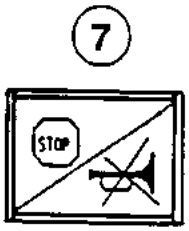
This yellow light (6) will light up when the load on the crane is between 90 and 100% of the crane rating, indicating that an overload condition is approaching.

This means for the operator to continue his crane operation with extreme caution.

INSTRUCTION:
PUSH BUTTON "INFO"

MESSAGE 12

```
REF #7: LOAD MOMENT LIMIT LIGHT/
ALARM STOP BUTTON     *PUSH"INFO"
```

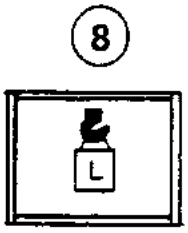


This control (7) serves a dual purpose. First, it is a red warning light, which warns the operator that a rated load condition has been reached. It lights up, when the load on the crane is at 100% of the crane rating. Second, it allows the audible alarm to be silenced for 15 seconds by pressing this button.

INSTRUCTION:
PUSH BUTTON "INFO"

MESSAGE 13

```
REF #8: LOAD DATA BUTTON   PRESS
FOR DISPLAY ON REF#1 *PUSH"INFO"
```



After button (8) has been pushed, the display (1) shows the following data for approx. 10 seconds. MAX. LOAD is the maximum permissible load according to the load capacity chart or maximum load permitted by number parts line selected by reeving switch (4). Intermediate values of the load capacity chart are linearly interpolated by the computer. ACTUAL LOAD is the actual load (gross load). Slings and hook block are included. If boom extension or jib is erected it will be reflected in the actual load displayed, however operator must use weight reduction values, shown in the load chart.

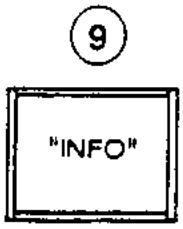
```
MAX. LOAD      ACTUAL LOAD
15.700 lbs      6.800 lbs
```

(Display will be in units corresponding to load charts)

INSTRUCTION:
PUSH BUTTON "INFO"

MESSAGE 14

```
REF #9: INFO BUTTON FOR SYSTEM
INFORMATION RUN        *PUSH"INFO"
```

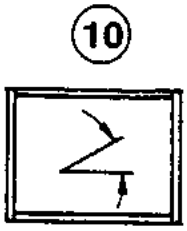


The button (9) is used to request information which will be shown on the display (1). The direction to use this button will be given through the information PUSH "INFO" at the display.

INSTRUCTION:
PUSH BUTTON "INFO" **INFO**

MESSAGE 15

```
REF#10: SET BUTTON FOR
ANGLE LIMIT VALUES    *PUSH"INFO"
```



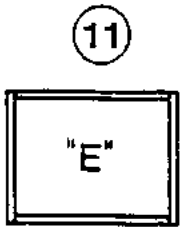
Button (10) activates the features to recognize and work with boom angle limits. After this function has been activated, the lamp in the button will light up and the display will show the max. and min. angle presets in addition to the data for radius, length and actual angle. Once these angles are reached, the horn will sound until the boom is moved back into permissible angle range.

The procedure to set the angle limit values is discribed in detail in chapter 4.2.2

INSTRUCTION:
PUSH BUTTON "INFO" **INFO**

MESSAGE 16

```
REF#11: ENTER BUTTON     ACTIVATE
ONLY ON REQUEST        *PUSH-INFO*
```

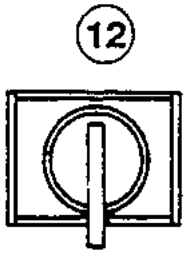


The button "E" (11) is used to confirm values and data which are used as input for the system. The direction to use this button will always be given on the display (1).

INSTRUCTION:
PUSH BUTTON "INFO"

MESSAGE 17

```
REF#12: BY-PASS KEY SWITCH
SEE REF #13 #14 #15  *PUSH-INFO*
```



The element (12) is a switch which can only be activated with a key. This by-pass key 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. The spring-loaded by-pass switch has 3 positions which are further described as follows.

INSTRUCTION:
PUSH BUTTON "INFO"

Note:

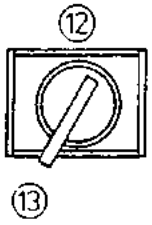
SINCE THIS SWITCH DEACTIVATES THE CUT-OFF FUNCTION OF THE LMI SYSTEM AND THE ANTI-TWO-BLOCK SYSTEM, THE FOLLOWING INSTRUCTIONS HAVE TO BE ADHERED TO:

THE BY-PASS KEY SHOULD 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 KEY TO EITHER OVERLOAD OR OPERATE THE CRANE IN A RANGE NOT PERMISSIBLE.

MESSAGE 18

```
REF#13: KEY POSITION FOR ANTI-
TWO-BLOCK OVERRIDE   *PUSH"INFO"
```

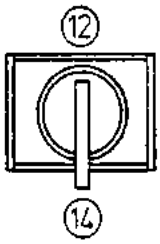


The position (13) by-passes the anti-two-block control lever lock-out which does not influence the LMI system. The red warning light (5) and the audible alarm (16) for approaching two-block condition will also come on at all times. The by-pass key switch is spring-loaded in order to return the switch to the neutral position (14). To activate the switch, it therefore has to be held manually during it's operation.

INSTRUCTION:
PUSH BUTTON "INFO" **INFO**

MESSAGE 19

```
REF #14: KEY POSITION FOR
NORMAL OPERATION     *PUSH"INFO"
```



This is the neutral position (14) to which the switch returns because of it's spring-loaded mechanism. In this position, the by-pass switch is without influence to the LMI and anti-two-block control lever lock-out.

INSTRUCTION:
PUSH BUTTON "INFO" **INFO**

MESSAGE 20

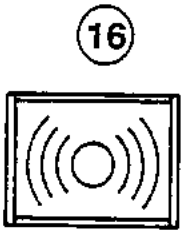
```
REF#15: KEY POSITION FOR
LMI LOCKOUT OVERRIDE *PUSH"INFO"
```

In this position (15), the by-pass key switch (12) deactivates the control lever lockout function of the LMI. All other display, indicating and alarm functions, as well as the control lever lockout function of the anti-two-block system will continue to work. The by-pass switch is springloaded in order to return the switch to the neutral position (14). Therefore to activate the switch, it has to be held manually during its operation.

INSTRUCTION:
PUSH BUTTON "INFO"

MESSAGE 21

```
REF#16: AUDIBLE ALARM
                    *PUSH"INFO"
```



Element (16) is the audible alarm, which sounds during the following conditions:

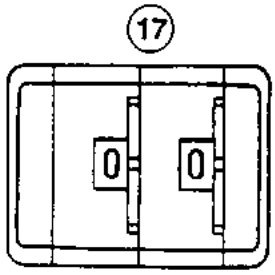
- max. load situation
- approaching two-block condition
- angle limits are reached
- in case of a failure of the LMI system
- in case of an operating error

The audible alarm can be turned off temporarily by pushing the button (7)

INSTRUCTION:
PUSH BUTTON "INFO"

MESSAGE 22

```
REF#17: OPERATING CODE SWITCH
REFER TO LOAD CHART  *PUSH"INFO"
```



The thumb wheel switches (17) are used to set the load moment indicator to the operating configuration of the crane.

CAUTION

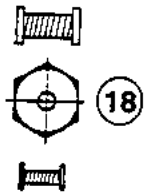
THE CORRECT SETTING IS OF UTMOST IMPORTANCE FOR THE PROPER FUNCTION OF THE SYSTEM AND THE CRANE. THEREFORE ONLY OPERATORS WHO ARE THOROUGHLY FAMILIAR WITH CRANE LOAD CHARTS AND THE USE AND OPERATION OF THE SYSTEM SHOULD SET THE THUMBWHEEL SWITCHES.

The programming procedure is described in detail in chapter 4.2.1

INSTRUCTION:
PUSH BUTTON "INFO"

MESSAGE 23

```
REF#18: HOIST SELECTOR SWITCH
SEE REF #19 #20        *PUSH"INFO"
```



This toggle switch (18) provides the load moment indicator with information regarding the hoist line. The switch has two positions which are further described as follows.

NOTE:

This switch is not provided in all systems.

INSTRUCTION:
PUSH BUTTON "INFO"

MESSAGE 24

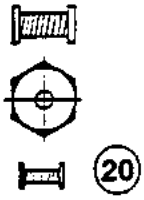
```
REF*19: SWITCH POSITION FOR
MAIN HOIST              *PUSH"INFO"
```

This position (19) has to be set when the main hoist is used to lift the load.

INSTRUCTION:
PUSH BUTTON "INFO"

MESSAGE 25

```
REF*20: SWITCH POSITION FOR
AUX. HOIST              *PUSH"INFO"
```



This position (20) has to be set when the auxiliary hoist is used to lift the load.

INSTRUCTION:
PUSH BUTTON "INFO"

MESSAGE 26

```
THE LMI SYSTEM IS AN OPERATIONAL
AID WHICH CAN FAIL      *PUSH"INFO"
```

The load moment indicator (LMI) is a system which supports an operator in his action to operate the crane.

BUT THE SYSTEM CANNOT BE 100% FAIL-SAFE AND NOT ALL CAUSES FOR DANGER CAN BE RECOGNIZED AT THE SAME TIME.

INSTRUCTION:
PUSH BUTTON "INFO"

MESSAGE 27

```
CONSULT AND OPERATE ACCORDING TO
INCAB LOAD CHARTS    *PUSH"INFO"
```

For the loading capacity of the crane solely the load charts are relevant. The operator shall also observe the operating instructions in the load charts.

THE LOAD VALUES IN THE LOAD CHART MAY UNDER NO CIRCUMSTANCES BE EXCEEDED. IT IS ESSENTIAL TO SELECT THE CORRECT OPERATING CODE NUMBER WHICH IS ALSO PRINTED IN THE LOAD CHART.

INSTRUCTION:
PUSH BUTTON "INFO"

MESSAGE 28

```
YOU ARE ALWAYS RESPONSIBLE FOR
YOUR LIFT OPERATIONS *PUSH"INFO"
```

THE OPERATOR IS SOLELY RESPONSIBLE FOR SAFE CRANE OPERATION.

He has to make sure that the crane is in good condition and that he works on firm supporting surface. The operator shall fully acquaint himself with the latest safety standards for cranes.

INSTRUCTION:
PUSH BUTTON "INFO"

MESSAGE 29

```
IF IN DOUBT CONSULT THE
OPERATOR MANUALS      *PUSH"INFO"
```

If there is anything unclear or if there are doubts about operating the crane or LMI, the operator should consult the operator manuals.

INSTRUCTION:
PUSH BUTTON "INFO"

MESSAGE 30

```
END OF INFO RUN
                      *PUSH"INFO"
```

At this point the information procedure is finished.

INSTRUCTION:
PUSH BUTTON "INFO"

During the next procedure the system will now be programmed to the intended operating configuration of the crane.

4.2 PROGRAMMING PROCEDURE

The information procedure will automatically be followed by the programming procedure which will be effected by the crane operator.

This procedure consists of two parts:

1. Setting of the LMI to the operating configuration of the crane

2. Activating and setting of the angle limits (if desired)

For simple operation, the computer guides the operator through the procedure step by step. He gets information and instructions on the display and he has to answer some questions by pushing the appropriate buttons.

4.2.1 Setting of Operating Mode

The thumb wheel switches (17) are used to set the load moment indicator to the operating configuration of the crane. 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 the crane load charts and the use and operation of the system should set the thumb wheel switches.

MESSAGE 1

```
OPERATING CODE WAS CHANGED
                    *PUSH"INFO"
```

NOTE:

This message will only appear when the setting of the thumb wheel switches was changed. After the information procedure the system will skip over message 1.

To set the operating mode, the operator has to adjust the thumb wheel switches (17) according to a code number which is printed in the load chart. After changing the position of the thumb wheel switches (17) this message will be shown at the display.

INSTRUCTION:
PUSH BUTTON "INFO" **INFO**

MESSAGE 2

```
DETERMINE OPERATING CODE FROM
INCAB LOAD CHARTS    *PUSH"INFO"
```

The operator has to determine the code number of the intended operating configuration. This number is printed in the load chart for the different crane configurations e.g. "on outriggers", "on rubber", "with jib".

INSTRUCTION:
PUSH BUTTON "INFO" **INFO**

20 FT. A-FRAME JIB

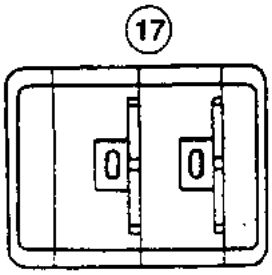
	# 11		# 12		# 13	
MAIN BOOM ANGLE	0° OFFSET		15° OFFSET		30° OFFSET	
	Ref. Radius	Cap. lbs	Ref. Radius	Cap. lbs	Ref. Radius	Cap. lbs
75°	21.5	9,500	25.8	8,100	28.9	4,200
70	27.8	8,400	31.9	5,450	34.8	3,870
65	33.9	7,140	37.8	4,850	40.5	3,660
60	39.7	5,440	43.4	4,400	45.9	3,500

#=LMI Operating Code

This is an example of the operating code numbers of a jib with 3 different offset angles.

MESSAGE 3

```
SET REF#17 TO SELECTED
OPERATING CODE        *PUSH"INFO"
```



The operator has to set the operating code switches (17) to the determined operating code number.

After change of the switch position, the system will cut-off the crane movements for the present. Additionally the alarm lamps (5), (6) and (7) will light and the audible alarm (16) will sound. The audible alarm can be silenced by pressing the button (7).

INSTRUCTION:
PUSH BUTTON "INFO"

MESSAGE 4

```
CODE 01 MAIN BOOM ON OUTRIGGERS
 - W/O PPF - OVER REAR *PUSH "E"
```

The display now shows the operating code which was set by the operating code switch (17). Additionally, the crane configuration is displayed. If the displayed operating code and crane configuration is in accordance with that desired, the operator has to confirm this by pressing the button "E".

INSTRUCTION:
PUSH BUTTON "E"

MESSAGE 5

Outrigger beams shall be fully extended and jack cylinders set with tires raised free of crane weight. When equipped with a front jack cylinder, the cylinder shall be set in accor dance with the written procedure.

```
ARE OUTRIGGERS PROPERLY POSI-
TIONED?          IF YES  PUSH "E"
```

(Only displayed when 'on outrigger' codes are selected)

Axle lockouts must be functioning before lifting on rubber.

When this is accomplished the operator has to confirm by pressing button "E".

```
AXLE LOCKOUTS FUNCTIONING?
                 IF YES  PUSH "E"
```

(Only displayed when 'on rubber' codes are selected)

INSTRUCTION:
PUSH BUTTON "E"

MESSAGE 6

The machine shall be leveled on a firm supporting surface.

```
IS CRANE LEVEL?
                 IF YES  PUSH "E"
```

All rubber lifting depends on proper tire inflation.

When this condition is met the operator has to confirm by pressing button "E".

INSTRUCTION:
PUSH BUTTON "E"

MESSAGE 7

The system is now ready to operate. The cut-off of the crane movements will be canceled and the warning lamps and audible alarm will go out.

RADIUS	LENGTH	ANGLE	HEIGHT
56.3ft	80.5ft	64.8°	57.1ft

The display shows the actual values of radius, length, angle and tip height.

(Display will be in units corresponding to load charts)

RADIUS	LENGTH	JIB ANGLE	HEIGHT
110.3ft	160.9ft	54.3°	107.2ft

If the crane is equipped with a luffing fly jib the display will show the actual values of radius, boom length, angle and tip height of luffing fly jib.

(Display will be in units corresponding to load charts)

4.2.2 Activating and Setting of Angle Limits

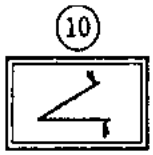
The system is equipped with presets for boom angle range selection. There are limits for maximum and minimum boom angle which can be set by the operator as allowed by crane geometry.

After a system start, the angle limits default to maximum and minimum boom as allowed by crane geometry.

The operator has the possibility to activate only one or both limits. For setting the limit values, the boom has to be moved to the intended limit positions.

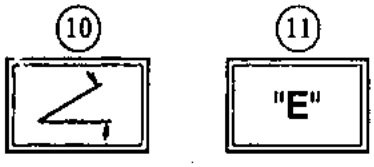
For simple operation, the computer guides the operator through the procedure step by step. He gets information and instructions on the display and he has to answer some questions by pushing two buttons.

The procedure for **activating** and **setting** the angle limits will be started by pressing the button (10)



INSTRUCTION: PUSH BUTTON #10

To **deactivate** or **reset,** the button "angle limits" (10) and the button "E" (11) have to be pressed simultaneously. When this is done, the angle limits return to the min. and max. angles allowed by the crane.



INSTRUCTION:
PUSH BUTTON #10 AND BUTTON #11 SIMULTANEOUSLY

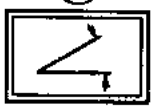
MESSAGE 1

```
SET ANGLE LIMITS?
YES: PUSH REF#10      NO: PUSH"E"
```

For working with angle limits, the operator has to confirm by pressing button #10

With angle limits: (10)

PUSH BUTTON # 10



Without angle limits: (11)

PUSH BUTTON "E" (11)

After pushing the button "E" (11), the system returns to the operating mode and the display shows the actual values of radius, length, angle and tip height.

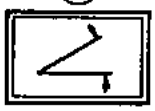
MESSAGE 2

```
MAX. ANGLE LIMIT?
YES: PUSH REF#10      NO: PUSH"E"
```

If a limit is desired in maximum (high) boom position, the operator has to push button #10. If no maximum press button "E" (11).

With max. angle limit: (10)

PUSH BUTTON # 10



Without max. angle limit: (11)

PUSH BUTTON "E" (11)

After pushing button "E" (11), the system will skip over messages 3 and 4

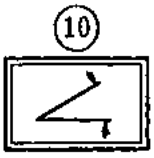
MESSAGE 3

```
MAX.ANGLE  90.0  ACT.ANGLE  25.4
CHANGE? YES:PUSH #10  NO:PUSH"E"
```

The display shows the actual boom angle and the formerly set maximum angle limit. To change this former value, the operator has to push button #10. To keep the former limit, the button "E" (11) has to be pushed.

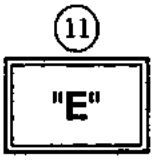
Change max. angle limit:

PUSH BUTTON #10



No change max. angle limit:

PUSH BUTTON "E" (11)



After pushing button "E" (11), the system will skip over message 4.

MESSAGE 4

```
MAX.ANGLE  90.0  ACT.ANGLE  25.4
MOVE BOOM TO MAX. PUSH"E" TO SET
```

The display shows again the actual boom angle and the formerly set maximum angle limit. To set the new value for the maximum angle limit, the boom has to be moved to the intended position. For setting the value, the operator has to push button "E" (11).

Set max. angle limit:

PUSH BUTTON "E" (11)

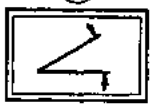
MESSAGE 5

```
MIN. ANGLE LIMIT?
YES: PUSH REF #10    NO: PUSH"E"
```

If a limit is desired in minimum (low) boom position, the operator has to push button #10. If no minimum limit is desired, the operator has to press button "E" (11).

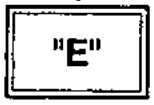
With min. angle limit: (10)

PUSH BUTTON # 10



Without min. angle limit: (11)

PUSH BUTTON "E" (11)



After pushing button "E" (11), the system will skip over messages 6 and 7.

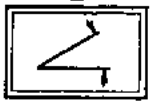
MESSAGE 6

```
MIN.ANGLE 10.0    ACT.ANGLE 25.4
CHANGE? YES:PUSH #10  NO:PUSH"E"
```

The display shows the actual boom angle and the formerly set minimum angle limit. To change this former value, the operator has to push button #10. To keep the former limit, the button "E" (11) has to be pushed.

Change min. angle limit: (10)

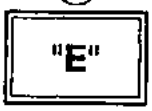
PUSH BUTTON #10



No change min. angle limit:

(11)

PUSH BUTTON "E" (11)



After pushing button "E" (11), the system will skip over message 7.

MESSAGE 7

MIN.ANGLE 10.0	ACT.ANGLE 25.4
MOVE BOOM TO MIN	PUSH"E" TO SET

The display shows again the actual boom angle and the formerly set minimum angle limit. To set the new value for the minimum angle limit, the boom has to be moved to the intended position. For setting the value, the operator has to push button "E" (11).

Set min. angle limit:

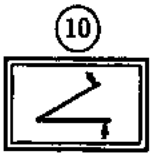
PUSH BUTTON "E" (11)

MESSAGE 8

RADIUS	LENGTH	ANGLE	LIMITS
65.2ft	80.0ft	45.3°	25°/78°

(Display will be in units corresponding to load charts)

The setting procedure is now finished. The system returns to the operating mode and the display shows the actual values of radius, length, angle and the angle limit values.



To indicate that the angle limits are activated, the lamp in the button (10) will light up.

5 PRE-OPERATION INSPECTION

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

Machines with only a Main Hoist

If the crane works only with the boom and *without extension or jib,* no additional connections are necessary. However, be sure the weight of the anti-two-block switch is properly installed on the main hoist load line. With even parts of hoisting line, the weight should be attached to the dead-end line. With odd parts of hoisting line, the weight should be attached to the line of lowest speed.

If the crane works *with extension/jib,* the connecting cable must be installed between the junction box on the extension/jib and the boom junction box. The weight attached to the main hoist anti-two-block switch must then be removed and reattached to the extension/jib anti-two-block switch.

WARNING

Failure to re-position the anti-two-block switch will prevent the overhoist system from functioning properly. No weight must be on the main hoist anti-two-block switch when the extension/jib is being used.

Machines with Main and Auxiliary Hoists

If the extension/jib *is not* in the operating position, the by-pass plug must be installed in the main boom junction box. The weight of the main hoist anti-two-block switch must be installed.

If the extension/jib *is* in the operating position, the connecting cable must be installed between the junction boxes on the extension/jib and the main boom. Weights must also be attached to the anti-two-block switches on both the main boom and extension/jib. If no load line is being used on main boom, to prevent injury or damage to equipment, the weigth should be removed from main boom switch and the locking pin provided installed.

After the electrical connections have been checked to insure that the system is properly connected for the crane configuration, 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 must 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 hook block aproaching the boom head, he should have an assistant watch the hook block. The operator should 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 (5) and the audible alarm (7) by manually lifting the weight attached to the anti-two-block switches.

2. Slowly raise the main boom hook block to bring it into contact with the switch weight. When the hook block lifts the weight, the audible alarm (7) should sound, the anti-two-block alarm light (5) should light and the motion of the hook block should be stopped. Lower the hook block slightly to eliminate this condition.

3. Then slowly lower or extend the boom to create a potential two-block condition. When the hook block lifts the weight, the audible alarm (7) should sound, the anti-two-block alarm light (5) should light and the boom lowering and/or boom extension function should be stopped.

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 must be corrected before operating the crane.**

4. If the crane is equipped with an extension/jib, repeat the test procedure for the extension/jib anti-two-block switch.

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 angles.

7. 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 must be thoroughly familiar with all controls of the LMI and he must properly set each switch before operating the crane. All settings must 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 hook block, 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 should 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 should be replaced.

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

4. The cable reel must 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 are to be performed by non expert personnel.

7 TROUBLESHOOTING

GENERAL

In case of a malfunction of the system, the display (1) 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 describes the action which should 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 must 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
E03	Boom position is out of the permissible working area
E04:	Operating mode not existing
E05:	Prohibit length range
E06:	Radius range exceeded or fallen below luffing jib angle range

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

OPERATING ERRORS

Malfunctions in the system which are caused by range exceedings or operating errors by the crane operator himself are indicated on the display together with an explanation. These error codes are E01, E02, E04, E05 and E06 and they can normally be eliminated by the crane operator himself.

ERROR 01

CAUSE:

Fallen below the minimum radius or above the angle given in the load chart due to raising the boom too far.

ELIMINATION:

Lower boom back to a radius or angle given in the load chart.

(Display will be in units corresponding to load charts)

ERROR 02

CAUSE:

The maximum radius or minimum angle given in the load chart was exceeded due to lowering the boom too far.

ELIMINATION:

Raise boom back to a radius or angle given in the load chart.

(Display will be in units corresponding to load charts)

ERROR 03

```
E03: NO-LOAD AREA
     BOOM OVER FRONT
```

CAUSE:

Boom position is out of the permissible working area (over front).

ELIMINATION:

Move boom back in the permissible working area. See lifting diagramm in the load charts.

ERROR 04

```
E04: OPERATING MODE NOT AVAIL.
     SEE LOAD CHART
```

CAUSE:

Operating mode switch in the console set incorrectly.

Operating mode is not permissible with the actual crane configuration, boom position or area definition.

ELIMINATION:

Set operating mode switch correctly to the code assigned to the operating mode of the crane.

Be sure crane is set up according to proper operating configurations.

ERROR 05

E05: LENGTH RANGE NOT PERMITTED
LENGTH = 75.3ft

(Display will be in units corresponding to load charts)

CAUSE 1:

Boom was telescoped too far or not far enough, 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.

ELIMINATION:

Telescope boom to correct length, given in the load chart.

CAUSE 2:

Length sensor adjustment changed i.e. length sensor cable slid off the length sensor drum.

ELIMINATION:

For elimination refer to service manual.

ERROR 06

```
E06: BELOW JIB ANGLE RANGE
     JIB ANGLE = 20°
```

```
E06: RADIUS RANGE EXCEEDED
     RADIUS = 95.5ft
```

CAUSE:

The minimum angle or the maximum radius of the luffing fly jib given in the load chart was exceeded due to lowering the jib too far.

ELIMINATION:

Raise jib back to an angle given in the load chart.