55M3500FCE00 Rev C_final_version

i3500 Crane information center

Rated Capacity Indicator System for
Lattice Total Moment Cranes
(including Luffing Jib)

Calibration Instructions

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The purpose of this manual is to provide the customer with the operating procedures essential for the promotion of proper machine operation for its intended use. The importance of proper usage cannot be overstressed. All information in this manual should be read and understood before any attempt is made to operate the machine.

Since the manufacturer has no direct control over machine application and operation, conformance with good safety practice in this area is the responsibility of the user and his operating personnel.
All procedures herein are based on the use of the system under proper operating conditions, with no deviations from the original design. Alteration and/or modification of the equipment are strictly forbidden without written approval from **RaycoWylie** Systems.

The **i3500 RaycoWylie** Systems **C**rane **I**nformation **C**enter must be regarded only as an aid to the operator. When the parameters are set correctly, the indicator will warn the crane operator of an approaching overload condition that could cause damage to equipment, property, and/or injury to the operator or site workers in the vicinity of the crane and its load.
This system must **never** be used, under any circumstances, as a substitute for the good judgment of a crane operator when carrying out approved crane-operating procedures. Responsibility for the safe operation of the crane lies with the crane operator. The indicator equipment will not necessarily prevent crane damage due to overloading and related causes if not set properly.

Before operating a crane equipped with a **RaycoWylie** system RCI, the operator must carefully read the information in both this manual and the crane manufacturer operator's manual. He must also be aware of all the federal, state and local safety standard and regulations applicable to his job.
Correct functioning of the system depends upon routine daily inspection.
Any suspected faults or apparent damage should be immediately reported to the responsible authority before using the crane.

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General Description of the System

1.1 Introduction

This manual contains installation, calibration, diagnostic and troubleshooting information for the i3500 system. Information in this manual will enable qualified personnel to install, calibrate and troubleshoot the i3500 system efficiently.

1.2 Personnel qualification and scope of this manual

This manual is intended to be used by qualified installation technicians and repair technicians who are fully qualified and trained to perform the procedures described in this guide.

1.3 Description of the i3500 System

The i3500 is a computerized safety monitoring system dedicated to hosting systems. It comprises electronic interfaces fitted to the hoisting system and an intelligent display located in the cabin of the crane.

Different electronic interfaces measure either the boom cylinder pressure or the boom angle and length, and it indicates the real time hoisting conditions.

Notes:

- Additional interfaces can be fitted to the hoisting system. For example: an additional rotational sensor or additional sensors to rotate the hoist drum can provide some extra information to the operator.
- All electronic interfaces are linked in network to the main i3500 unit (display), so all sensors are linked by only one cable to the main unit. This special network is called CANBUS (Controlled Area Network). During operation, the load lifted by the hosting system is automatically compared with the manufacturer's curve "Load-Radius".

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The Lattice Total Moment Crane

There are software tools available to installation technicians to provide them with additional help during the calibration stage. A (.Zip) file directory located in our network contains all of these tools. Here is the access path:

Ser Support\externe\tech support\Software Family 3000\All tools for LTM-I3500.

AN3K for I3500 version Lattice TM (an3kltm5.exe):

This software allows to import and transfer (if needed), all files containing the complete calibration data for a given crane. Once the calibration files are imported, The software coverts this information into a different format for data analysis.

FP0 Edit (FP0 edit.exe) :

This software allows for the modification of a calibration file. More precisely, to modify one or several values of FP0 (unloaded boom calibration). It also allows to visualize the curve of FP0.

CC3K version 6.34 (cc3kml6034.exe) :

This software is a chart compiler. All configurations and crane capacity charts are transferred by means of this software into a flash memory. The i3500 system will use this information to perform calculations of crane load and radius as well as braking. The installation technician can use this software to modify a dimension of the crane or to adjust a parameter of configuration.

There are 2 software tools available to allow supervision of the operation phase.

Logger 2.1 (log3k5v201.exe) :

This software allows to acquire all pertinent data related to every lift perfomed by the crane since the last data download.

BlackBox 1.0 (blackboxv100.exe) :

This is similar to the Logger software. But, it provides more information related to the Bridging and Setup modes, in accordance with the EN13000 directive.

2.1 Calibration

This section contains all the calibration information for the i3500 Rated Capacity for Lattice total moment crane.

Step 1 **Perform a system initialization** ***Note:** The sensors' calibration is not changed by an "**init all**".*	1) The calibration switch must be **ON**. 2) Verify the Extension board: (See step #3, item 1 and 8). - Add the memory board for LT crane, - Add the Logger board if one of these options is enabled: either EN13000 directive or the data logger And put the **J1** switch in "**RAM EXT**" position. 3) Before starting the calibration on a i3500 system, make sure that the overall system initialization has been completed. Otherwise, the system may behave erratically. To execute a global system initialization "**init all**", it is necessary, before starting the system, to keep the **Up** (**2**) and **Esc** (**5**) buttons pressed until a question appears on display, prompting for a complete system initialization. It is also possible to initialize the system by selecting the **"init all"** option in the submenu "**22-memory**" in the calibration menu.

2.1 Calibration (cont'd)

Step 2 **Sensors configuration**	1) In the calibration menu, scroll with **Up (2)** or **Down (3) buttons** until you reach the menu **"30-enable/disable I/O"**. Activate all electronic interfaces used for the lifting system. For LTM calibration: **Angle 1, Angle 2 (if luffing), Load 1, Load2, Load 3 (if luffing), Load 4 (if luffing), Relay 1, Slew (if needed)** will be activated. 2) Reset the system by pressing simultaneuosly **Mode (1**) and **Select (4)** buttons or restart the system.

2.1.1 System options : (item "32- system options")

Step 3 Adjust system options **(item "32- system options")**	**1) Data logger :** This option allows you to activate the registration of certain events like the A2B, at the beginning and at the end of a lift, and so on. An electronic "Logger card" is necessary (Part # 22BCB0167). It is composed of a flash memory to backup data and also a RTC module (Real Time Clock) to log the event (i.e. registered hour and date of an event). This card is installed on the display module of the i3500. It's mounted on a male header connector. *Note:* *It should be noted that this card must be installed in the correct direction. A visual indicator has been printed on the circuit board to avoid any error.* *The* J1 *switch* ***RAM IN/EXT*** *position must be switched from* ***RAM IN*** *to the* ***RAM EXT****. This allows the i3500 to use the real time clock module for the time and date.*

2.1.1 System options (cont'd)

Step 3 **(Cont'd)** Adjust system options **(item "32- system options")**	**2) Password Protection :** If this option is activated in calibration then during startup of the i3500 system, a message is displayed on the screen prompting to enter a user identification number. The lockout remains activated until a valid password is recognized by the i3500 system, after which it will enter the Normal Operation Mode. The Lockout function will reactivate itself after a system reinitialization or power shutdown. Note: If the option "Data logger" is activated, the option "Password protection" is automatically activated. Pressing **Select (4)** button when highlighted can deactivate it. --- **3) Message limit saved :** This allows the operator to turn the system On and Off without losing limits. If the option "Message saved limit" has been activated and if there is at least one limit programmed when starting the i3500 system, a message will appear on the screen informing the operator. He will then be able to judge whether this limit should be kept or erased. If erasure is chosen, all of the programmed limits will be removed. **Note:** The i3500 automatically save the limits programmed, even with basics options such as "Rotation" or "Height" and "Radius". This will allow the operator to turn the system on without losing any data related to the programmed limits.

2.1.1 System options (cont'd)

Step 3 **(Cont'd)** **Adjust system options** **(item "32- system options")**	**4) Crane model:** It can be adjustable for Customer requirements. Ex.: Specific Relay outputs for each crane model. Only one frame can manage different crane models. --- **5) Bit rate (kbps) : 125 or 250** We can adjust the CANbus speed. With a 125 bit rate, we can get more cable distance. All of the electronic interfaces must have the same CANbus speed. --- **6) Method : STD or COG** **With COG method:** The chart will be adapted for it. The additional headtype values like COG and weight will be required. And additional deduct values will be required (COG, weight, and spatial position referred by Select field). The deduct field has to be bounded to the duty. But no hoist has to be bounded. The block capacity and the hoist will be chosen by the operator during the duty selection. **With STD method:** No COG and weight will be required. Hoist and deduct could be bounded to the duty.

2.1.1 System options (cont'd)

Step 3 **(Cont'd)** **Adjust system options** **(item "32- system options")**	**7) Start-up image :** We can choose between the **RaycoWylie** icon or an custom icon. This icon will appear on the i3500 system start-up. --- **8) EN13000 : 2010 directive machine :** If enabled, the EN13000:2010 data recorder will be activated. We need to add the logger board. See note of item #1 (Data logger).

2.1.2 Digital inputs: with directive machine EN13000 (Otherwise see section 4.1)

Step 4 **Digital inputs with directive machine EN13000**	**7) Check the connection plan and/or Specification Sheet concerning the Digital Inputs / Output.** Verify if there are 2 digital inputs for the Main boom force compensation. Two additional digital inputs will be required if a luffing jib attachment is present. We need to know the main boom (or luffing jib) direction in order to realize the Force compensation calibration (Step # 15). To verify if the direction sensors work well, do this: - Select an appropriate duty (for the main boom or for the luffing jib), - Enter the **Diagnostic Mode** and choose page #5 (consult the i3500 instruction manual for more details). Now, you"ll be able to evaluate whether the direction value is correct or not.

2.1.3 Selecting the calibration units: (item «29-calib. unit: imperial»)

Step 5 Selection Calibration Units of measurement (item "29-calib. unit: imperial")	**7) Start-up image :** We can choose between the **RaycoWylie** icon or a custom icon. This icon will appear on the i3500 system start-up. --- Units of measure must be selected before starting the system's calibration. There are 2 possible choices: Imperial or metric. **Imperial:** (x 1000 pounds) and in feet. **Metric:** in te (metric ton = x1000 kg) and in meters. In the calibration menu using **Up (2)** or **Down (3)** buttons, select the **"29-calib. unit"** option. Press **Select (4)** to confirm your selection. **Warning:** Once all the required dimensions are entered (see next section), the system will not allow any modification of the calibration units of measurement. This is not the same operation where units can be changed in the operation mode using the "**Mode**" button.

2.1.4 Entering fixed data values (dimensions): (item "26-dimensions")

This menu contains the crane dimensions that are necessary for the hook load calculation, based on the tension in the pendants. Please refer to the diagrams depicted in the following pages for graphic representation of the dimensions. These diagrams cover the dimensions for a crane with mast, a crane without mast, the luffing jib and the fly jib.
Enter the measures using the calibration units selected in step **"2.1.3"**.

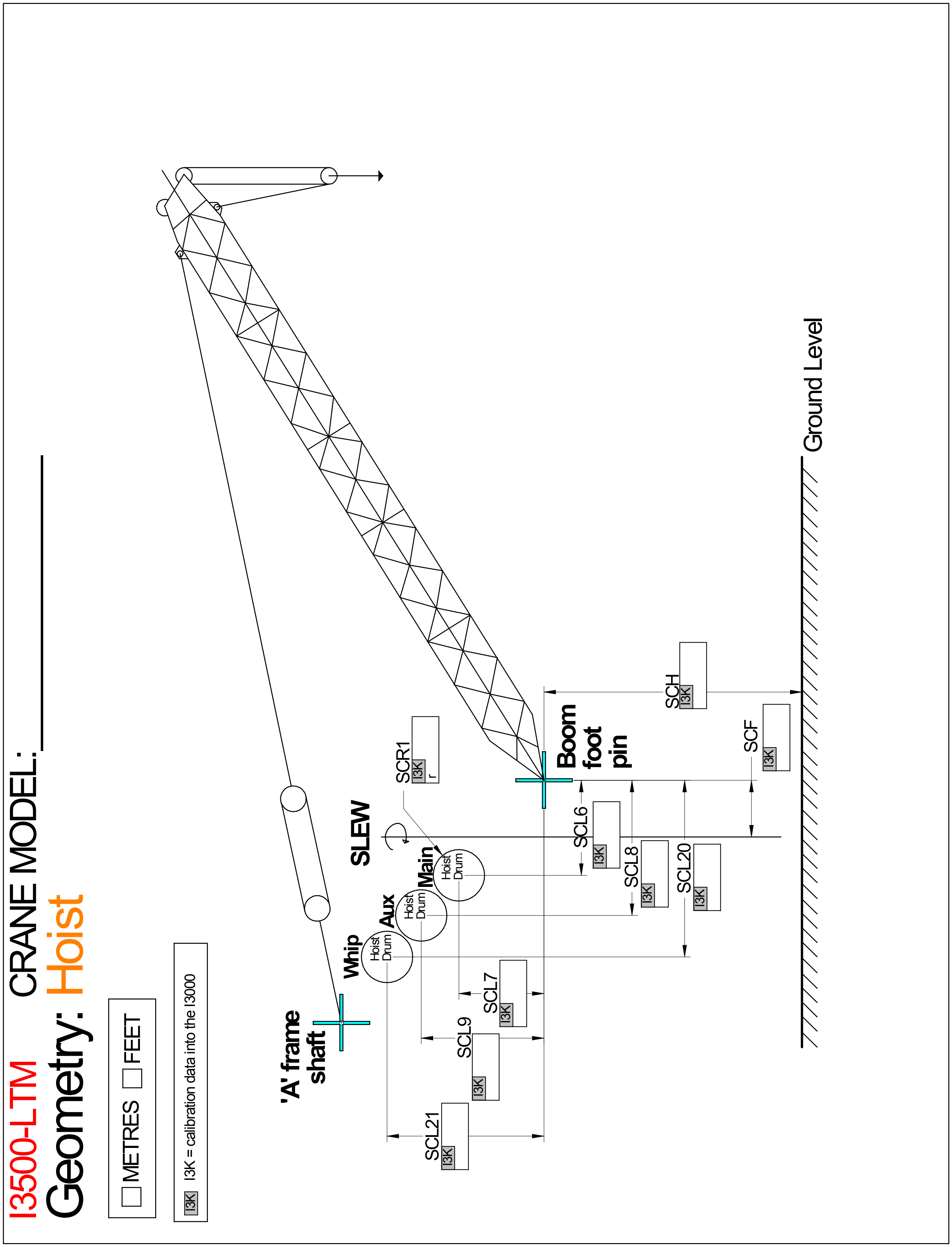
2.1.4 Entering fixed data values (dimensions): (Cont'd)

The dimensions that can change with the configuration selected, like the boom head, the jibs, etc., are saved within the load chart chip and cannot be changed in calibration. These dimensions are identified on the drawing with a label, **HT** (head type), **BL** (boom length), **SEL** (select), which identifies the location of the dimensions in the load chart.

Here is the list of dimensions labeled **I3K** (i3500 system) on the drawing:

Step 6 **Entering fixed data values (dimensions)** **(item "26-dimensions")**	**Scl6, Scl7, Scl8,Scl9, Scl20, Scl21, Scr1:** Hoist locations (H1, H2, H3) **Scl10,Scl11:** A-frame location **Scl12,Scl13:** Mast location **Scf (Slew offset):** This is the horizontal distance between the machine's rotation axis and the main boom's pivot. This value is positive if the main boom's pivot is in front of the rotation axis, it is negative otherwise. **Sch (height offset):** This is the vertical distance between the ground level and the main boom's pivot. **Cyl3, Cyl4, Cyl7, Cyl8, Bore Diam:** Cylinder position and Size. **Nrd (Number of falls in the boom lifting system):** This dimension is used when dead end load cells are located in the derricking system. This is not used when the load cells are located on the pendants.

All others dimensions will be entered into the chart compiler.
HT = Head Type, **BL** = Boom Length, **SEL** = Select.


I3500-LTM
CRANE MODEL: ____________
Geometry: Hoist
METRES
FEET
I3K
I3K = calibration data into the I3000
'A' frame shaft
Whip
Hoist Drum
Aux
Hoist Drum
Main
Hoist Drum
SLEW
SCR1
I3K
r
Boom foot pin
SCL6
I3K
SCL8
I3K
SCL20
I3K
SCL7
I3K
SCL9
I3K
SCL21
I3K
SCH
I3K
SCF
I3K
Ground Level

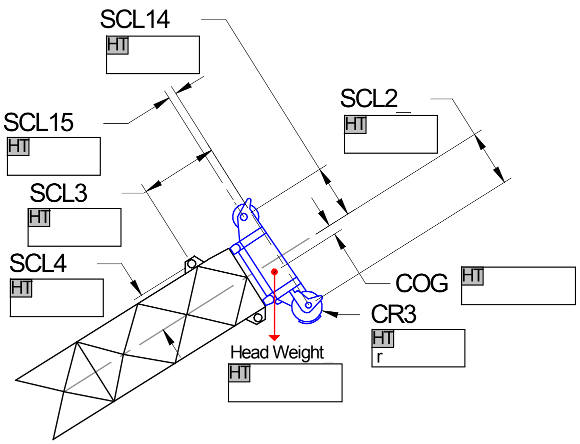
I3500-LTM CRANE MODEL: ____________

Geometry: Headtype

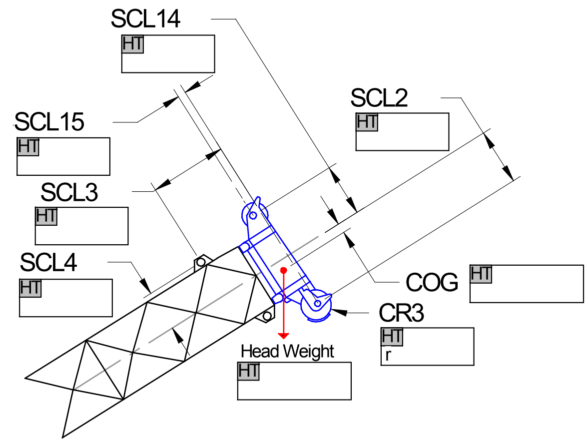
☐ METRES ☐ FEET

HT = head type field in the chart compiler

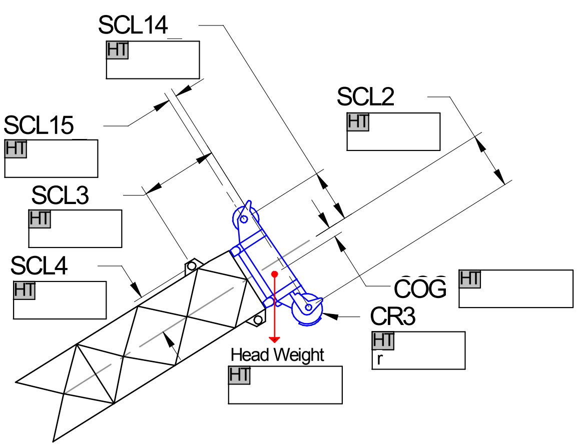
Headtype #1: __________



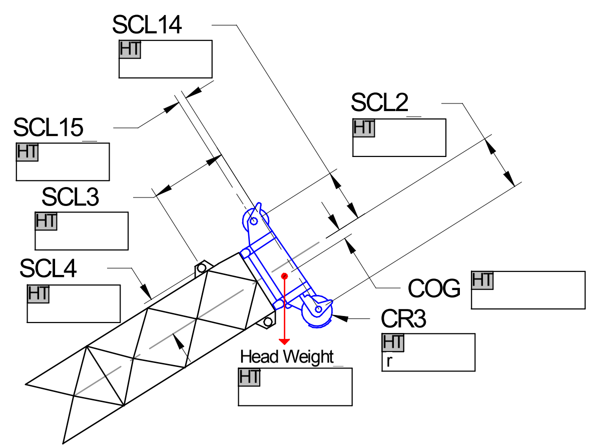
Headtype #2: __________

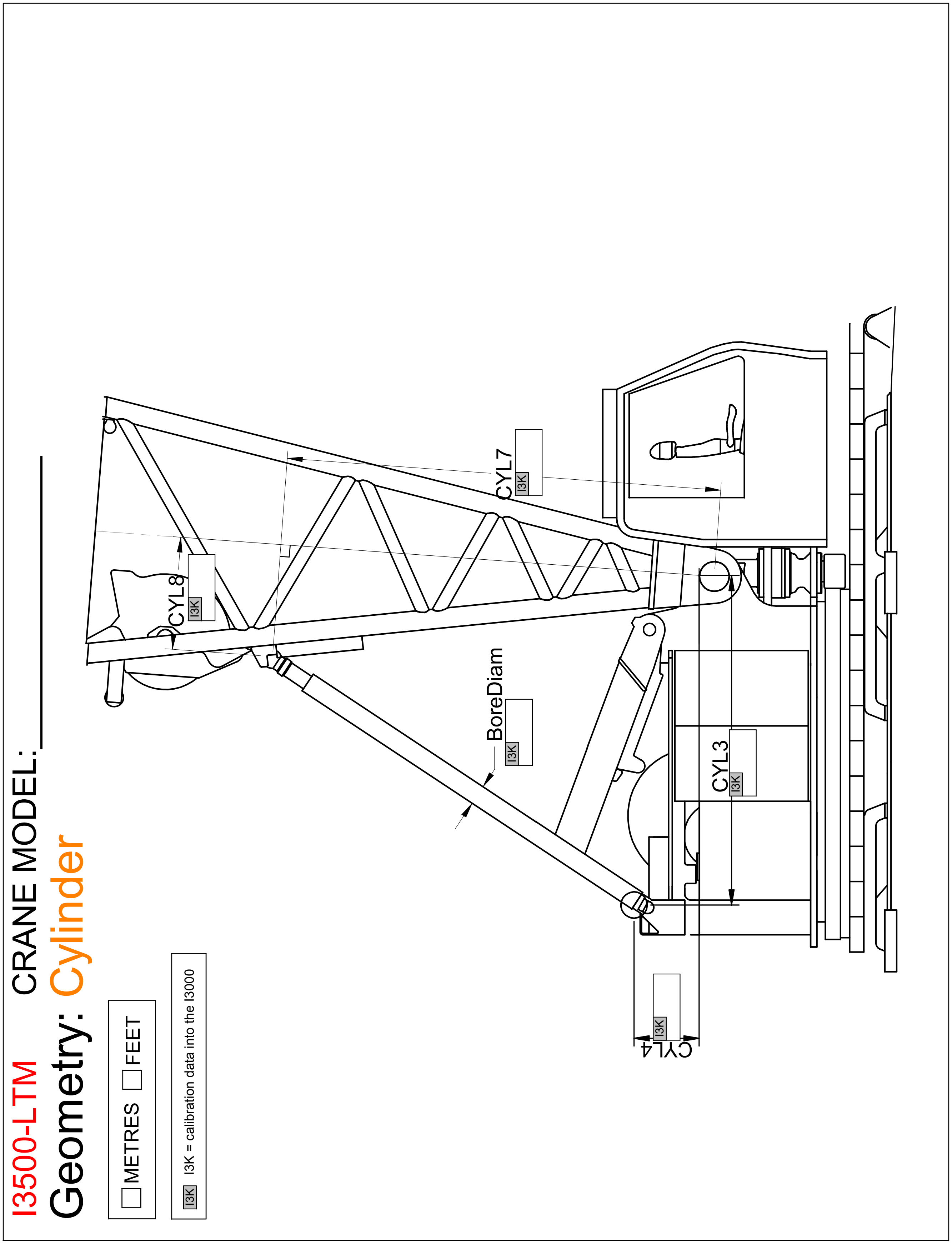


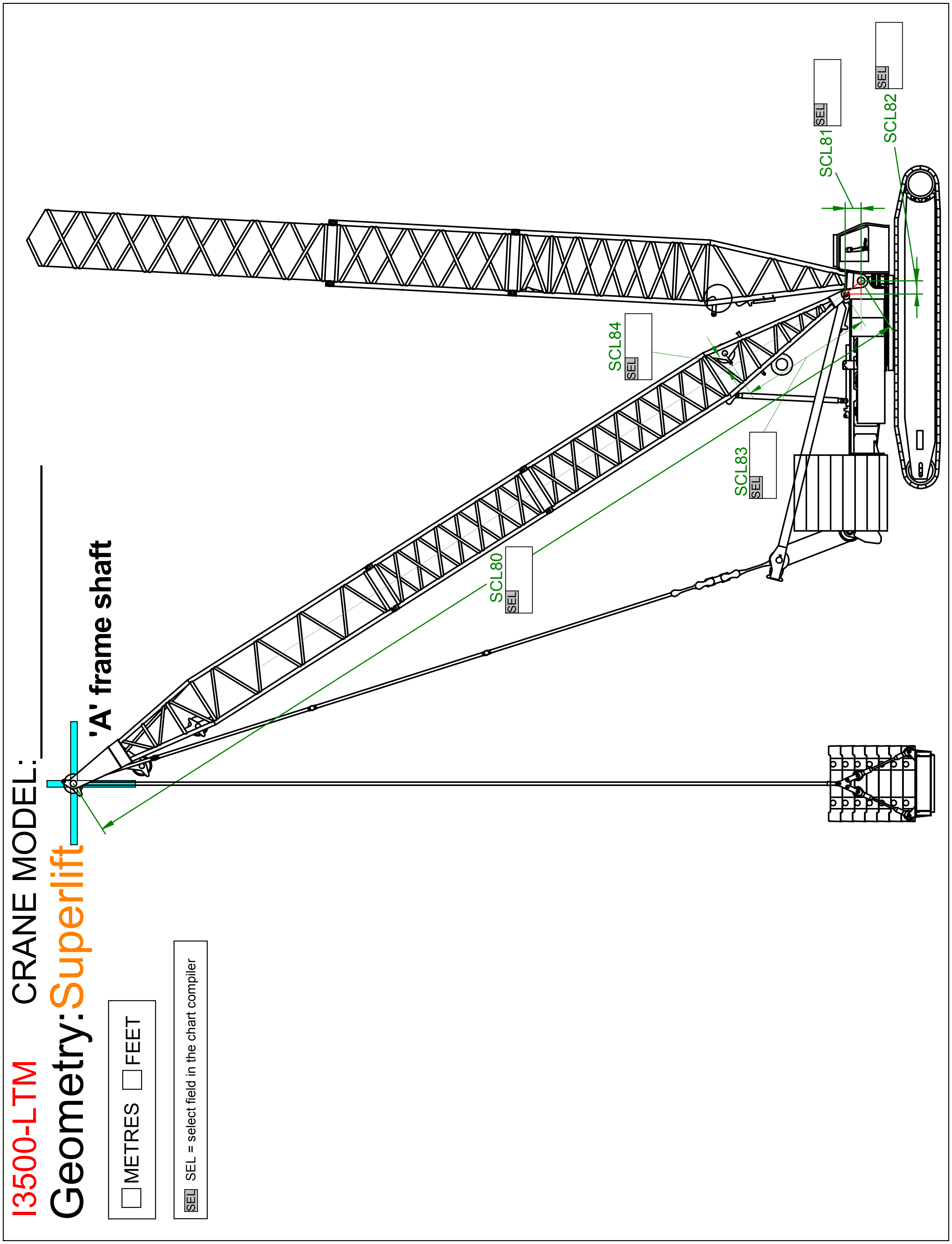
Headtype #3: __________

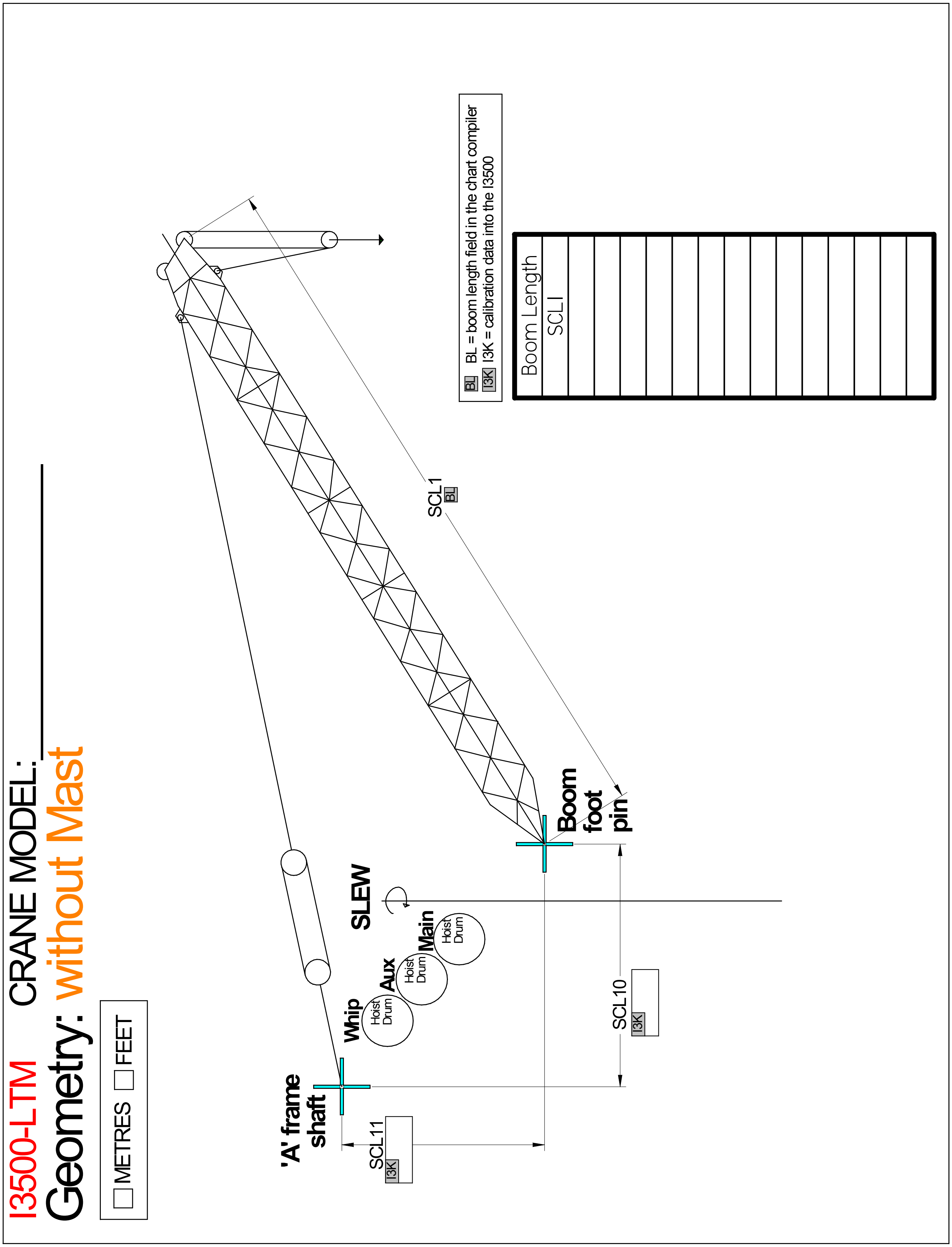


Headtype #4: __________




I3500-LTM
CRANE MODEL:
Geometry: Cylinder
METRES
FEET
I3K = calibration data into the I3000
CYL7
CYL8
BoreDiam
CYL3
CYL4
I3K

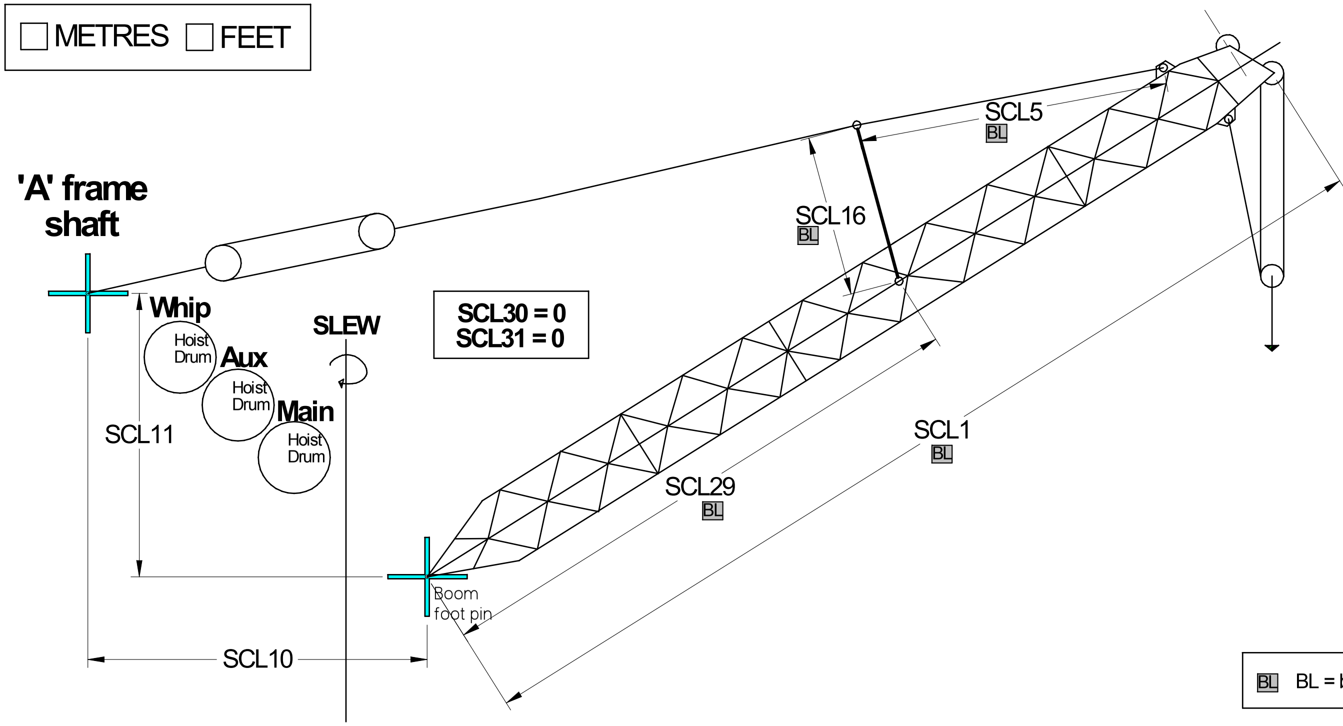

I3500-LTM
CRANE MODEL:
Geometry: Superlift
'A' frame shaft
METRES
FEET
SEL SEL = select field in the chart compiler
SCL80
SEL
SCL81
SEL
SCL82
SEL
SCL83
SEL
SCL84
SEL


I3500-LTM
CRANE MODEL:
Geometry: without Mast
METRES
FEET
BL BL = boom length field in the chart compiler
I3K I3K = calibration data into the I3500
Boom Length
SCLI
SCL1
BL
Boom foot pin
SLEW
Main
Hoist Drum
Aux
Hoist Drum
Whip
Hoist Drum
SCL10
I3K
'A' frame shaft
SCL11
I3K

I3500-LTM CRANE MODEL:____________________

Geometry: without Mast with Waist Line

☐ METRES ☐ FEET



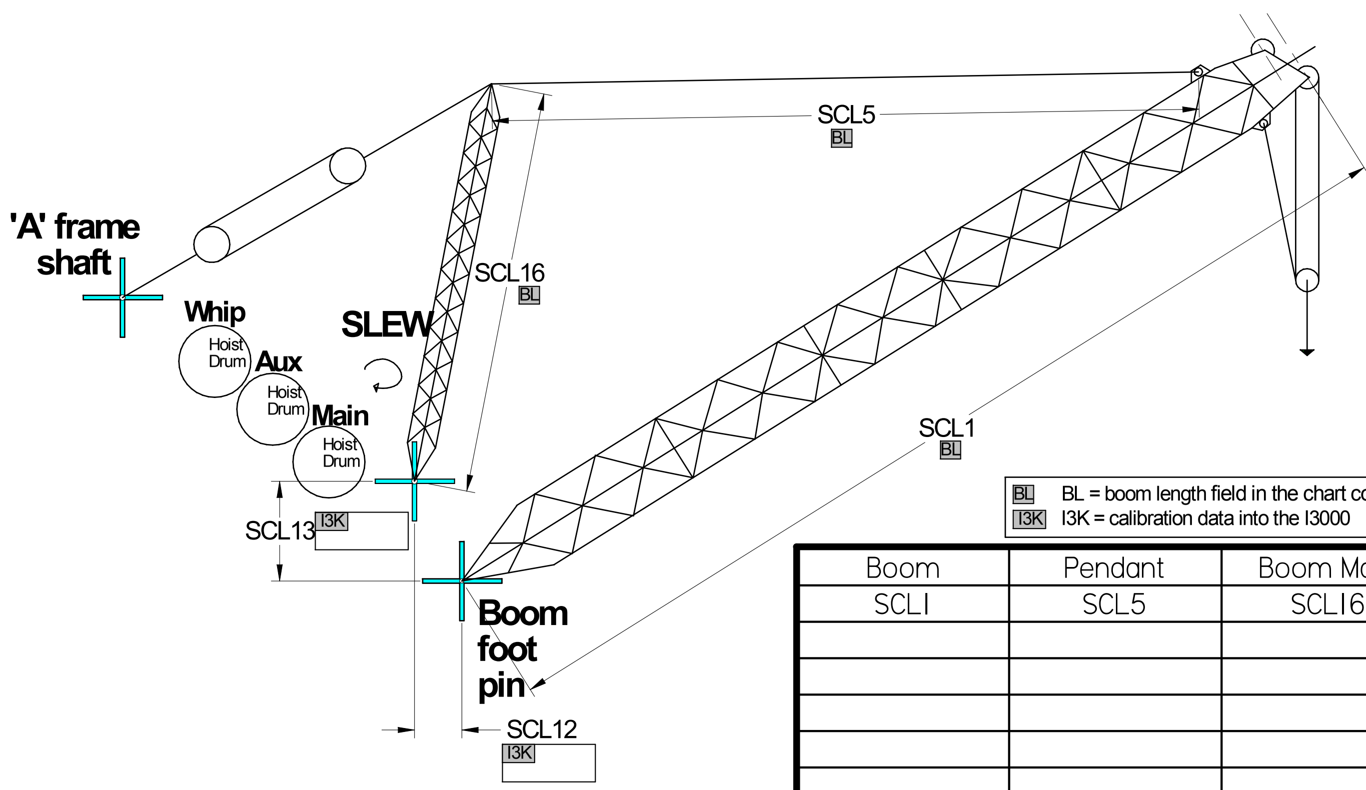
BL BL = boom length field in the chart compiler

Boom	Pendant B	Waist Mast	Waist Length
SCL1	SCL5	SCL16	SCL29

I3500-LTM CRANE MODEL: ____________

Geometry: with Mast

☐ METRES ☐ FEET



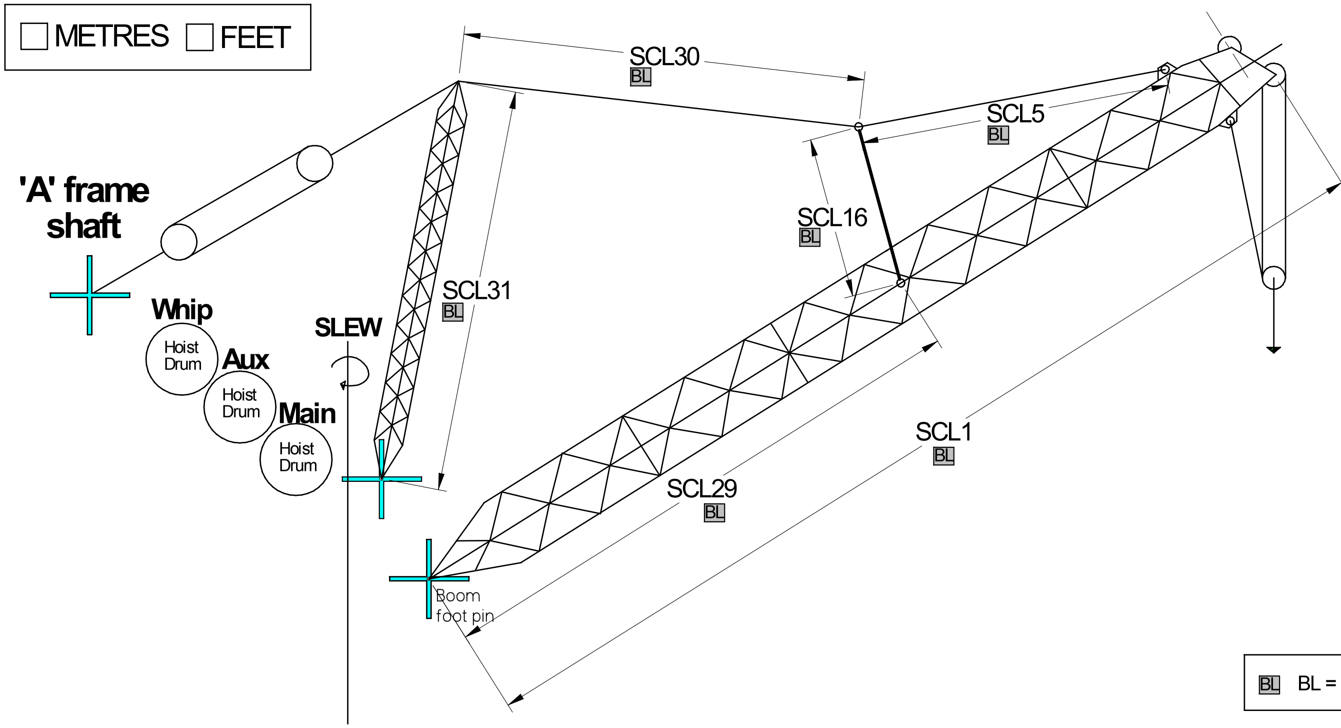
BL = boom length field in the chart compiler
I3K = calibration data into the I3000

Boom	Pendant	Boom Mast
SCL1	SCL5	SCL16

I3500-LTM CRANE MODEL: ____________

Geometry: with Mast with waist line

☐ METRES ☐ FEET



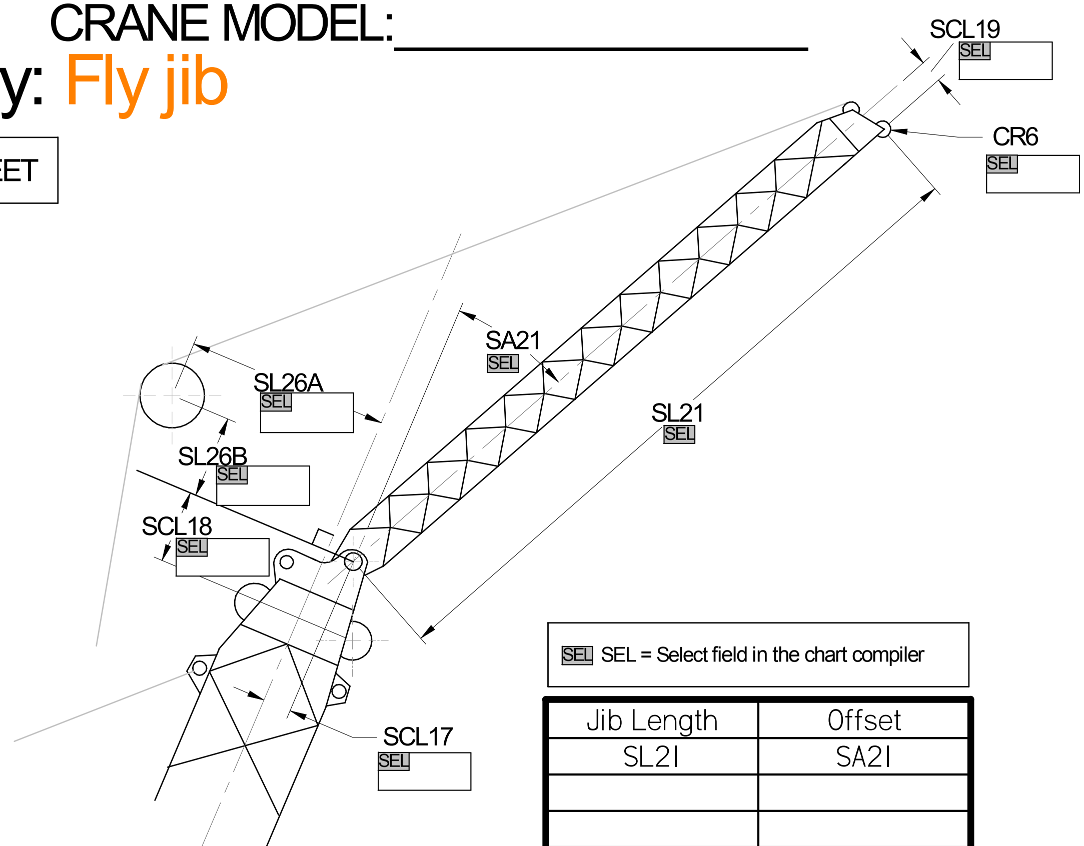
BL BL = boom length field in the chart compiler

Boom	Pendant A	Pendant B	Waist Mast	Boom Mast	Waist Length
SCL1	SCL30	SCL5	SCL16	SCL31	SCL29

I3500-LTM CRANE MODEL:____________________

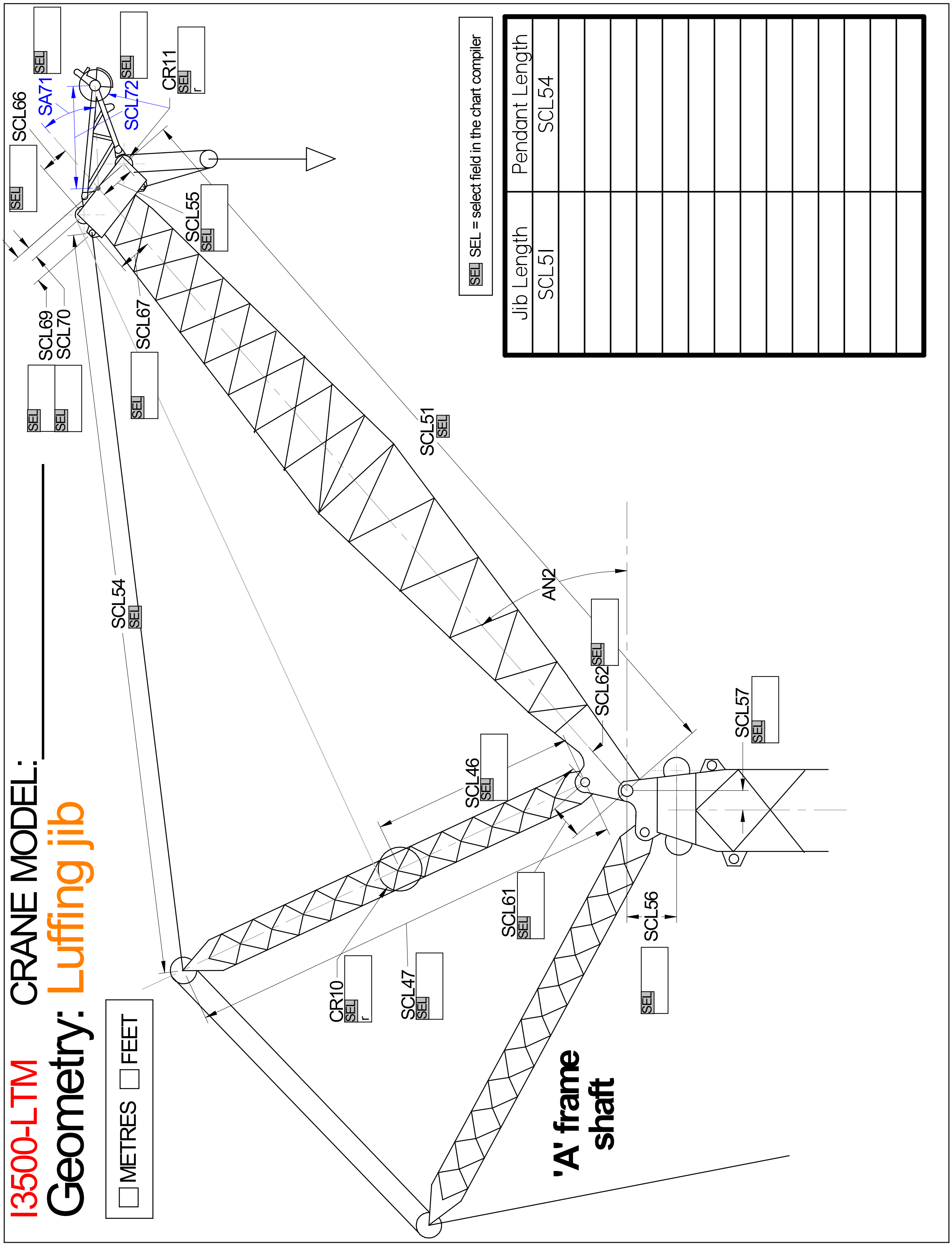
Geometry: Fly jib

☐ METRES ☐ FEET

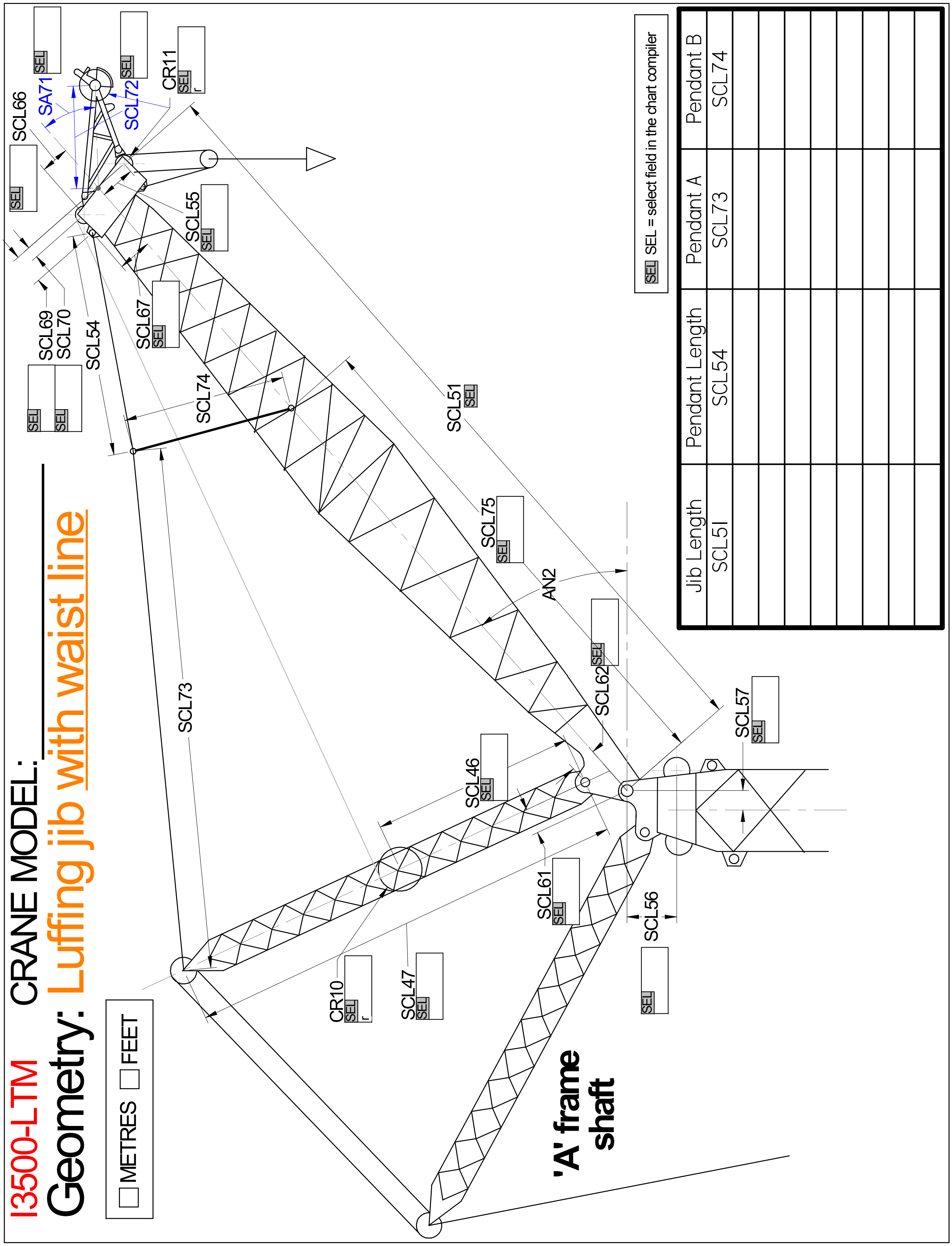


SEL SEL = Select field in the chart compiler

Jib Length	Offset
SL2I	SA2I



Jib Length	Pendant Length
SCL51	SCL54



Jib Length	Pendant Length	Pendant A	Pendant B
SCL51	SCL54	SCL73	SCL74

2.1.5 Calibration Data : (item «25-calibration. data»)

Step 7 Entering Calibration data **(item "25-calibration data")**	**1) Rope limit (Main/Aux): NOT USED** **(Replaced by Step # 8)** --- **2) Maximum of parts of line:** This is the maximum number of parts of line that can be rigged on the crane. --- **3) Rigging Angle : (not used if EN13000 is enabled)** The **Rig Angle** is a set angle below which the operator can permanently bypass the lockout by pressing the **Rig** button. The Rigging mode is automatically disabled as soon as the value of the angle sensor is greater than the rig angle. --- **4) Alarms Zone :** **Alarm 1:** a percentage that indicates an approach limit. If the % SWL is greater than Alarm 1, an audible alarm (intermittent) will be activated and the yellow light will blink. **Note: % SWL = Load / Capacity x 100.** **Alarm 2:** a percentage that indicates an overload limit. Once Alarm 2 is reached, the red and yellow lights will be switched on and the audible alarm will sound continuously. **Alarm 3:** a percentage that indicates a lockout limit "Cut-off". When Alarm 3 is reached, two red lights and one yellow light will be switched on, an audible alarm will sound continuously. The lockout system will be enabled.

2.1.5 Calibration Data : (cont'd)

Step 7 (Cont'd) **Entering Calibration data** **(item "25-calibration data")**	**5) Chart Adjustment :** **Outside Duty Radius:** This variable represents a transition distance between the last radius rating and zero capacity greater than the radius rated in the load chart. Note : This option is valid only if the chart interpolation (in the calibration menu) is set to "ON". **Outside Duty Angle:** This variable works in the same way as "outside duty radius" but is used for charts where the SWL is determined by boom angle not the radius. **Outside duty (height) :** This variable represents an upper tolerance on the external selection of the relevant load capacity chart. The column on the load chart represents the height of the knuckle boom. Example: At 0.5 feet the height will be increased by 0.5 feet in order to prevent an out of duty warning. **Inside Duty (Height) :** This variable represents a lower tolerance on the internal selection of the relevant load capacity chart. The column on the load chart represents the height of the knuckle boom. Example : By selecting 0.5 feet this will increase the first column of the loadchart by 0.5 feet which will permit the system to read the first column instead of jumping to the second if the height of the boom slightly exceeds the value of the first column. -- **6- Changing the duty >20% SWL :** If activated, we can change the duty setting while the load is suspended. If not activated, no changes will be permitted unless the load is lower than 20% of the SWL.

2.1.5 Calibration Data : (cont'd)

Step 7 (Cont'd) **Entering Calibration data** **(item "25-calibration data")**	**7) 1 Step Hoist Change External :** When enabled, it is possible to change hoist by using an external switch instead of using the **i3500** keypad. A "**One touch**" option load chart is required. When the external switch is toggled, the system will change duty even if the load is greater than **20 % SWL**, whatever the setup value of the "**Duty change > 20 % SWL**" option. Although this option is not presently supported, it will be added in a future software version. --- **8) Number of Hoists :** This tells the **i3500** system the number of winches on the crane. This is used to display the proper available winches when the Hoist option is selected in the **Main/Aux Block Menu**. A special adaptation can be made. Ex. Sany 400t. --- **9) Gap for interpol:** This represents the maximum distance, in feet or in meters according to the calibration units, between two calibrated boom lengths where the total moment interpolation can be used. This is used for both the main boom and the luffing jibs. A value of **60 feet** (**18m**) **is recommended** for most of the applications. --- **10) Angle sensor p. boom:** This represents the number of angle sensors installed on a main boom or a luffing jib. There can be one or two. The second sensor, if used, is installed on the boom tip. The same number of sensors must be installed on the main boom and on the luffing jib.

2.1.5 Calibration Data : (cont'd)

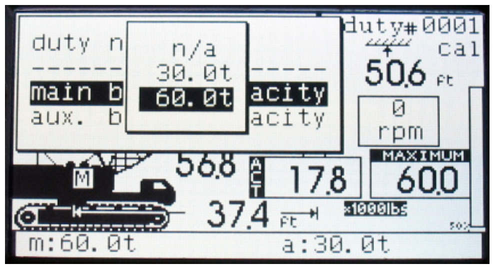
Step 7 (Cont'd) **Entering Calibration data** **(item "25-calibration data")**	**11) Load Adjust: (Global)** This is a factor that is multiplied by the final load value to allow an additional adjustment. ***This factor should only be used when we retrieve a calibration file already done on the same crane model.*** --- **12) Max/Min Angle main boom with luffing : (Optional.)** These are the maximum and the minimum angles allowed for the main boom when the luffing jib is installed. The relay output can be customised. --- **13) Max/Min Angle Luffing : (Optional)** This is the maximum and the minimum angles allowed for the luffing jib. The relay output can be customised. --- **14) Filter: (see section 5.1 for more details)** **Sensitivity Coefficient (5-50%):** Adjust the % of the load variation in order to bypass the filter. **Low Frequency Coefficient (10-75) :** Adjust the number of samples. **The filter will be functional in operating mode only.**

2.1.6 Calibration Block Data : (item "33- special calibration. data")

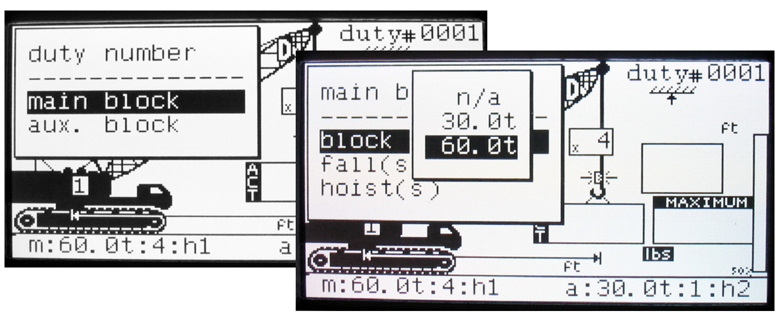
Step 8 **Entering Special-Calibration Data** **(item "33-special calibration data")**	**1) Rope Limit:** This is the maximum tension that the cable is rated per fall. This value will be used as a load limit if it is inferior to the capacity shown on the load charts. There are 18 rope limit values which correspond to the same number of falls. We have a maximum of 18 parts of line for each hoist. If H1+H2 is selected then a maximum of 2 x 18 parts of line is possible. --- **2) Block Weight :** There are up to 8 blocks' weight values which can be adjustable. Each value greater than 0 will be added into the block capacity list. By pressing the "**Duty**" button, you can choose either the "**Main Block** or **"Aux. Block"**. By choosing either one, the block capacity item will allow you to select from its list, the block weight desired. It will be used for the load lifting calibration and calculation. --- **3) Block Capacity :** There are up to 8 block capacities. They are are linked with the Blocks' weight. Example: By choosing the block weight #3, the block capacity #3 is automatically selected. This value will be used as a load limit. And it will be compared with Rope limit and Load chart capacity. **The lowest value will be retained.** *Note 1: The Capacity evaluation:* ***Among the following 3 capacities, the lowest value will be taken as reference.*** - *Load Chart Capacity,* - *Rope Limit Capacity,* - *Weight Capacity.*

2.1.6 Calibration Block Data : (cont'd)

Note 2: In Normal mode, by pressing the "**Duty**" button: with Standard Method (method 1)



Selecting the block capacity using
Method 1 (the Hoist could be bound)

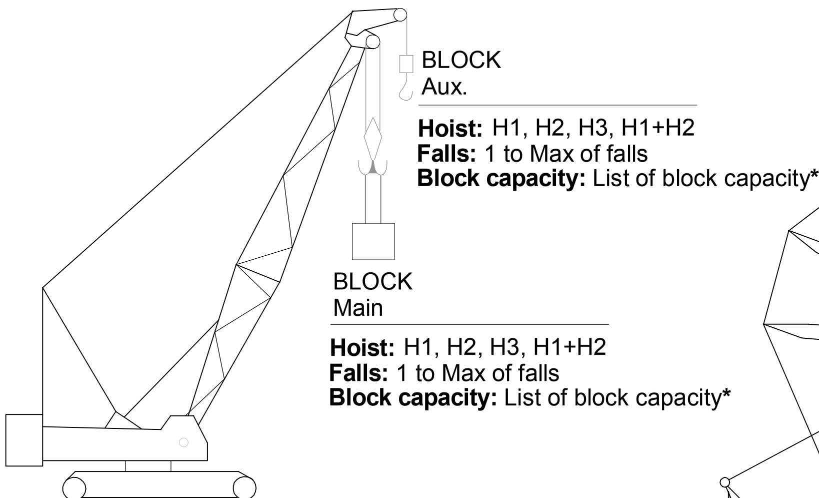


Selecting the block capacity using
Method 2 (COG)

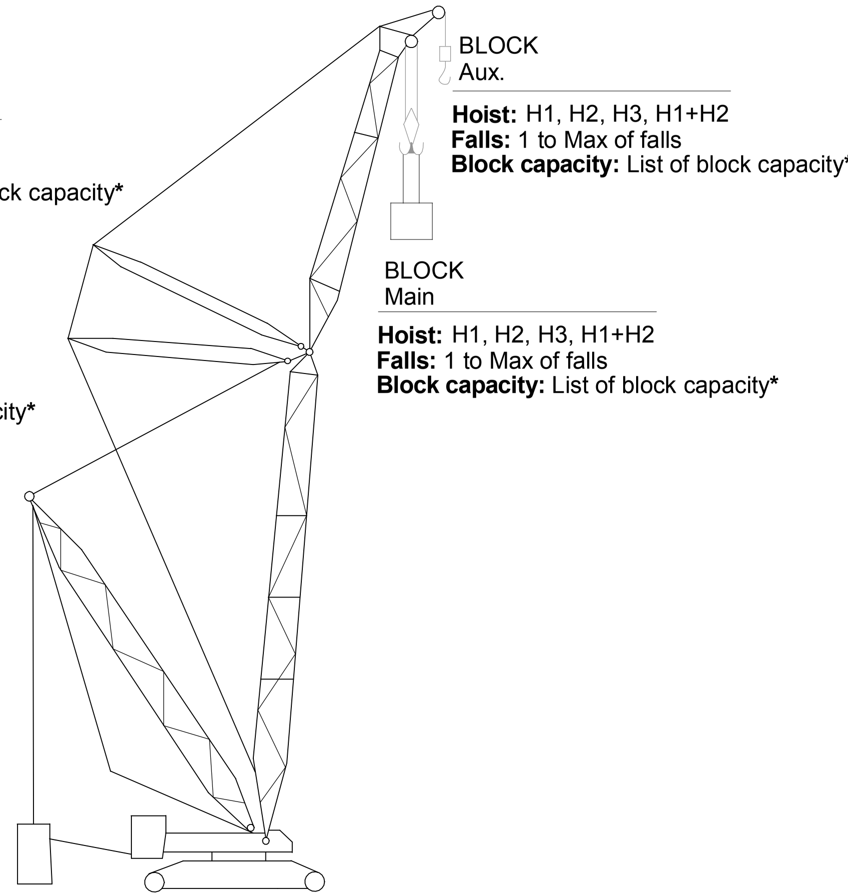
The following figure shows the difference between the Main Boom and Luffing Jib configuration.
Concerning the block selection.

Block selection (Duty item)

Configuration: Main boom



Configuration: Luffing jib



* When we choose a Block capacity, his block weight will be used for COG method. Into the calibration mode, select the item menu 'special cal data' and you can add up to 8 blocks (capacity+weight).

* The blocks let to 0 will not appear inside the list of block capacity.

2.1.7 Zero/Side Interface Angle: (items 1, 2 and 3)

Step 9

Zero/side Angle, (item " 1-select sensor") (item " 3-span sensor") (item " 2-zero sensor")

1) Address selection:

Every angle sensor installed has its own dedicated address. Please refer to the section 3) Canbus Interfaces boards to see how to adjust the address. The next table shows the predetermined address for each angle sensor.

Angle Sensor	Angle 1	Angle 2	Angle 3	Angle 4
Addresses	0x80	0x81	0x82	0x83
1 sensor per boom	Main boom	Luffing jib	N/A	N/A
2 sensors per boom	Main boom base	Main boom tip	Luffing jib base	Luffing jib tip

2) Zero Angle Calibration :

The screen is displayed as follows:

2- Zero sensor

Zero (angle1) 0.1
Sensor's Value 149.3

-push √
-esc to exit

3) Side Angle Calibration :

The screen is displayed as follows:

3- Sensor span

angle 1 sensor
Installed on: left

-push √
-esc to exit

Note : The angle sensors are already pre-calibrated only the side position and the zero adjustment are required.

2.1.7 Zero/Side Interface Angle: (cont'd)

4) ATB :

The ATB is part of the angle sensor. It must be enabled on the closest angle sensor from the tip of the boom when two sensors per boom are installed. Please refer to section 3.1.3 ATB for more details.

2.1.8 Zero/Span Load cell Interface: (items 4,5 and 6)

Step 10

Zero/Span Load cell (item "4-select loadcell") (item "5-zero loadcell")(item "6-span loadcell")

1) Address selection:

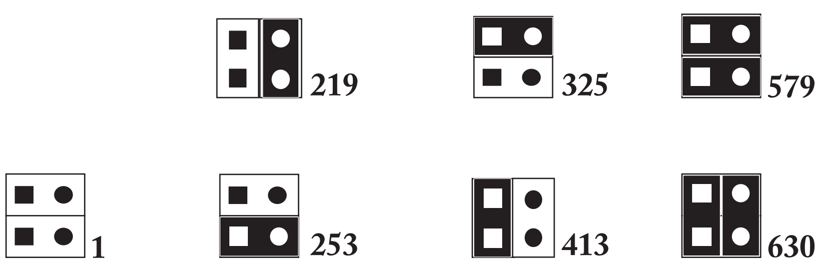
Every load sensor installed has its own dedicated address. Please refer to section 3. Canbus Interfaces Boards to see how to adjust the address. The next table shows the predetermined address for each load sensors.

Loadcell sensors	Load #1	Load #2	Load #3	Load #4	Load #5
Addresses	0xB0	0xB1	0xB2	0xB3	0xB4
Sensor position	Main boom pendant	Main boom pendant	Luffing jib pendant	Luffing jib pendant	Pressure Cylinder

2) Gain Adjustment :

The following table shows the available gain values and the positioning of the jumpers to set them. For example: when the selected gain is 1, the Gain switch must be positioned at " **= 1**", otherwise, it must be placed at the **" > 1 "** position. This switch allows the management of the fault conditions according to the signal level at the input of the amplifier.

Jumper Amplifier Gain



Step 10 (Cont'd)

To calculate the gain we must know the **F**ull **S**cale **O**utput (**FSO**) or **F**ull **R**ated **O**utput (**FRO**) of the load cell. This value usually varies between 1.0mV/V and 1.5mV/V.
The output signal of the amplifier should be between 2680 and 3500 bits, or 3.275V and 4.277V.
The excitation voltage of the load cell is 5.0V, thus for a FRO equal to 1.3mV/V we get a gain of :
4.277V / (0.0013 * 5V) = 658.
The selected gain must be the highest available gain that is lower than the calculated gain, so we select 630.

3) Zero loadcell calibration:

The screen is displayed as follows:

```
2- Zero loadcell

zero (load 1)     0.0  (Klbs/te) *
sensor value      350 (bits)

-push √
-esc to exit
```

4) Span loadcell calibration:

The screen is displayed as follows:

```
3- Span loadcell

span (load 1)  55.0  (Klbs/te) *
sensor value    2800 (bits)

-push √
-esc to exit
```

5) Pressure cylinder: (Load # 5)

The zero and span values are considered as BAR unit (regardless of the chosen calibration unit).

*****Klbs*** *or* ***Te*** *according to the calibration unit (see step #5).*

2.1.9 Preliminary before the-load calibration:

This procedure must be carried out for each different condition that requires a modification of the center of gravity (COG.) (ex. different head type, available offsets of the jibs, luffing jibs, etc.).

Step 11 **Entering special Preliminary before the Load Calibration** **(item 13- fp0 angles values)** **(item 14- fp0 luff. angles values)**	**1) Before starting the load calibration:** • Ensure that the crane chassis is level for all no load, boom deflection and load correction calibration. • It is essential that all geomeric data was checked and entered correctly. -- **2) Preset angles for the no load calibration:** (item 13- fp0 angles values) (item 14- fp0 luff. angles values). The system uses a number of reference angles for the no load calibrations. The maximum angles reached are different for the main boom and for the luffing jib. We use two different groups of angles that can be set in the sub-menus “13-fp0 angle values” and “14-fp0 luff. angle values”. The standard group of angles for the main boom is from 83° to 0° while it is from 70° to 0° for the luffing jibs. These values can be changed if the crane cannot reach these maximum angles. Establish the highest angle where the boom can be raised, taking account of the full range of boom lengths that could be fitted. Choose a set of reference angles starting 1° degree below the maximum possible angle and ranging down to zero using the standard values as a guide. These angles cannot be closer than 2° degrees apart and should not be further than 5° degrees apart. **Warning:** These angles cannot be changed once a no load calibration has been completed. (For all duties to be calibrated)

2.1.9 Preliminary before the-load calibration: (cont'd)

Step 11 **Entering special Preliminary before the-load calibration** **(item 13- fp0 angles values)** **(item 14- fp0 luff. angles values)**	**3) Crane configuration setting:** The crane configuration is defined as boom and jib configuration, head type, boom length, hoist, parts of line and block weight. In the operating mode: (it cannot be changed within the calibration mode) A- Ensure the duty to be calibrated is set correctly, B- Set the blocks weight (main and aux): they will be used for the no-load calibration, (we could see at the bottom line the block weight used for each hoist.) C- Set the part of line and the hoist if not bounded to the duty. In calibration mode, items "7-boom configuration", "8-headtype", "9-boom length" and "10-hoist" to verify that the current configuration is set correctly. When either of these items is highlighted, the current selection is shown at the bottom line of the display.

2.1.10 Loaded boom deflection: (item " 12-boom deflection")

Step 12 **Loaded boom deflection** **(item "12-boom deflection")**	1- Follow the on screen instructions to position the boom to the required angle, the screen will change when the boom is at the correct position and will show live information of current calculated radius, indicated load, current %swl, and an angle compensation factor. 2- Lift a test load between 50% and 90% of the crane capacity for this configuration at this radius. 3- Measure the actual radius according to the calibration units selected. It should be either equal to or slightly greater than the displayed radius. Note this value (the actual radius).

2.1.11 No-load boom calibration: (item «15-fp0 calibration»)

The displayed values in this mode reflect the state of the main boom or the luffing jib depending on the selected duty. In this section, the word boom is used either for the main boom or the luffing jib depending on the configuration.

Step 13 **No load boom calibration** **(item "15-fp0 calibration")**	1- Follow the on screen instructions to raise the boom to the maximum angle, the boom must be higher than 1° above the maximum calibration reference angle set above. When the boom has been raised high enough the display will change to allow the calibration to begin. 2- Press **Select (4)** button to begin the calibration. Slowly and carefully lower the boom at a steady rate until the hook is at a radius beyond the maximum rated radius. Continue to lower the boom to the lowest safe angle possible taking account of the suspended hook weight. Press **Esc (5)** button when the boom has reached the lowest point. --- **3- Calibrating multiple boom lengths:** If your system is programmed with charts for a range of boom lengths and configurations it is not necessary to calibrate every configuration using the procedure described above. The available configurations are divided into calibration groups in which only the boom length is different between each configuration in the group. The i3500 system is normally supplied with a laminated duty selection table that identifies all the configurations programmed; each column of this table represents a calibration group. In order to fully calibrate a group it is only necessary to physically calibrate the shortest and longest booms plus intermediate lengths that are no more than 15m (50ft) apart (adjustable in calibration section 2.2.5.10). All remaining boom lengths will be calibrated automatically. If you have any questions, please contact **RaycoWylie Systems** for guidance.

2.1.12 Angles selection (forces compensation and Load adjustment) : ("item 16-fc angles selection")

Step 14 **Angles selection (forces compensation and Load adjustment)** **("item 16-fc angles selection)**	1- In normal operating mode, verify the general behavior of the load taking readings for different angles and adjust the angles used for the forces compensation in calibration. There are up to 8 angles points that can be modified. These angles are fixed at 10°, 20°, …, 80° degrees during the "**init all**" process. There is, usually, less precision at higher angles because the tension in the pendant is lower. It might be preferable to have more preset angles at higher boom angles to get a better precision. Note that these preset angles are saved for the current configuration and that they may be different for a different configuration.

2.1.13 Forces compensation for each direction:

The force compensation is unique for each of the crane configuration and allows the correction of the load, taking into account the state of the boom: booming up, boom up and stop, booming down, boom down and stop. The procedure is the same for the main boom and for the luffing jib. This procedure is optional and can be omitted in whole or in part if the displayed load is acceptable.

Notes: *This procedure should not be used before making sure that the possible load reading error does not come from an error in the dimensions.*

The force compensation factors are implicated into the FP0 calculation (No load calibration). Whereas the adjust load factors (step #16) are directly implicated on the Load calculation

Step 15 **Force compensation for each direction** **(10-25% SWL)**	**1) Actual load: (item 17- fc actual load)** This is the total load, including the block weight, used for the force compensation. It is used by the system, with the measured load, to calculate the compensation factors. --- **2) Forces compensation (calibration with a load) : (item18- fc fp0 with load)** The forces compensation is a dynamic process used to correct the error reading while the boom is moving and after it stops. The force compensation is done while booming up, after a boom up and stop as well as after a boom down and stop. It is important to wait that the load stabilizes before confirming the point in the boom and stop conditions. While booming up, it is preferable that the load does not swing, or very slightly, to have a better precision.
--------------- **(Optional)** **Force compensation for each direction** **(Load < 1.5 x block weight)**	--- **3) Forces compensation (calibration without a load): (item20 - fc fp0 without load)** ***The previous section # 2 (Forces compensation - calibration with a load) must be completed before starting this section.*** If the block weight seems stable, you don't need to carry-out this step. Go directly to **Step 16** "No load adjustment". Only one value (best fit) is calibrated for each moving action (for booming up (adjust while moving up), for boom up and stop, for boom down and stop). If the system has a load smaller than 1.5 x block weight, the best fit value will be added to the calculated correction (evaluated by the force compensation with load).

If this section #4 is not done, then, only the calculated corrections of section # 2 will be applied.

2.1.14 Load and No-Load adjustment :

This is a new feature that allows a fine-tuning on the load. It is based on the angles selection (see step #14). The Load and No-Load adjustment is unique for each crane configuration. The state of the boom is ignored. The procedure is the same for the main boom and for the luffing jib. This procedure is optional and can be omitted in whole or in part if the displayed load is acceptable.

2.1.15 Add an offset to the load:

Step 16 **Load offset (item 11-load offset)**	**1) Load offset: (item 11-load offset)** It is possible to add an offset to the load if you want to get a load a little heavier. The load offset is unique for each of the crane configuration. This procedure is optional and can be omitted in whole or in part if the displayed load is acceptable.

Step 17 **Load adjustment** **(> 70% SWL)** --------------- **No-Load adjustment** **(the block weight only)**	**1) Load adjustment: (item 22-load adjust)** 8 possible adjustments to the 8 points angles already identified in section #14. The i3500 system will show the actual load reading and it can be adjusted to the target load. This adjustment will be considered in the load calculus if the load, without taking into account this adjustment is **> 1.5 x block weight**. -- **2) No-Load adjustment: (item 21- no load adjust)** 8 possible adjustments to the 8 points angles already identified in section #14. The i3500 system will show the actual load reading and it can be adjusted to the target load. This adjustment will be considered on the load calculus if the load without taking into account this adjustment is **< 1.5 x block weight.**

2.1.16 Down friction adjustment :

Step 18 **Down friction (item 19- fc down friction)**	**3) Down friction: (item 19- fc down friction)** Only one value is saved for all the angles so the best value must be chosen to adjust the load **while booming down.** If the load > (1.5 x block weight), then this value will be divided by 100 and will be added to the compensation factor.

2.1.17 Final step:

Step 19 **Final step**	**1- Load adjust global: (located into item 25-calibration data)** It is possible to make a global adjustment. It will be applied for all duties calibrated. This option can be very useful if you want to use the calibration file already done from the same crane model. --- **2- Filter option: (located into item 25-calibration data)** Adjust if necessary the digital filter about the load reading. -- **3- The calibration switch must be OFF.** When the calibration is completed, move the calibration switch to the **OFF** position to avoid all unwanted modifications or possible corruption of the calibration data. A warning message is shown in the operating mode if the calibration switch is **ON**.

2.2 Copy a calibration :

Step 20 **Copy a calibration**	The no load calibrations are identical for fixed jib duties where it is possible to lift with either the main boom's block or the fixed jib's block. The sub menu "**21-copy fp0 calibration**" makes possible to copy a calibration from a calibrated duty to the current duty. Select the duty to calibrate in the normal mode and find the duty number of the comparable configuration (duty) that we want to copy. **Warning:** The calibration switch must be **ON.** Turn it **OFF** when you are done !

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Appendix

3.1 Numeric filter

This allows the stabilisation of the load value in order for the information to be displayed without a lot of variations on the LMI screen. It was developed to cover all lifting machines. This filter has 2 functions, the first one is to control the load variation and the second filter is to reduce huge and abrupt load variations.

Two adjustment factors can be modified for the optimisation of the filter module to the lifting machine behaviour. These are the sensitive coefficient and the low frequency coefficient.

3.1.1 Sensitive Coefficient: gap adjustment (5% to 50%)

This allows to determine the filter area. This value is expressed as a percentage (%). The default is 25%. This means that while filter is processing, if the system detects a variation of over ±25% on load reading samples, the LMI system will detect a start of a lift or the end of a lift. The filter will be momentary bypassed in order to allow a better timing response for this variation.

Summary: it allows to determine the start of a lift event or the end of a lift event.

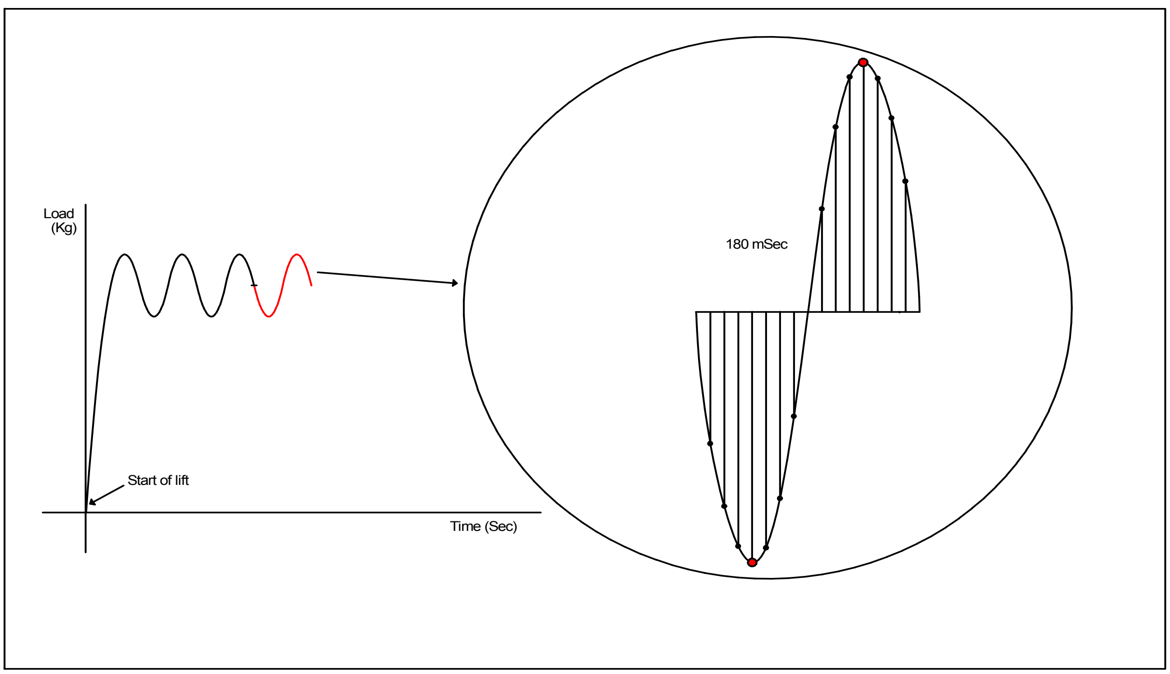
3.1.2 Low frequency Coefficient: gap adjustment (10 to 75)«

This allows modifying the filter sample rate in order to reach the lowest lift machine oscillation. The default rate is 20.

For the i3500 system, at 180msec, it receives the pressure/weight value for each load electronic interface. For a coefficient of 20, the system will have a pool seizing 20 samples (each of them received at 0.18sec.). It will take 20 x 0.18sec. = 3.6sec. to fill in the pool. Hence a frequency of 1/3.6sec = 0.28oscillations/sec = 16.7 oscillations/Min.

For the gap adjustment mentioned above, the frequency area will be 33 oscillations/Min to 4 oscillations/Min. The Greater will be the coefficient, greater will be the stabilization load time. Trying to make a good low frequency filter, the stabilization load time will increase. Abrupt load variation (ex. load landed to the ground), can take a lot of seconds before seeing the hook load on the display.

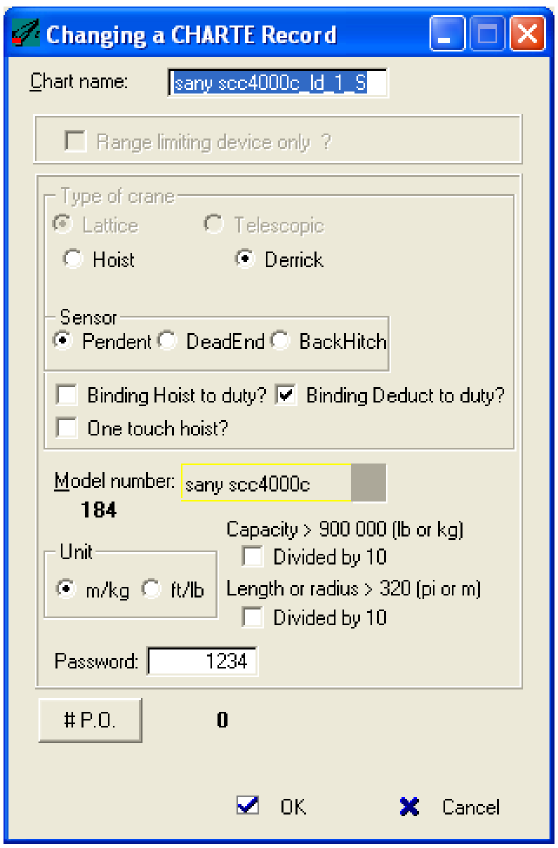
Summary: it allows to optimize the low frequency filter.

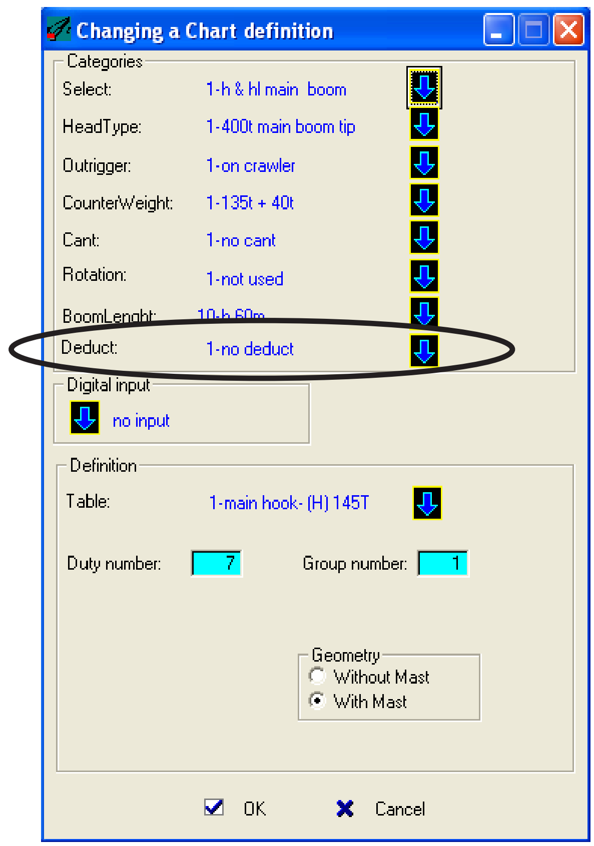


3.2 Chart Compiler

The i3500 system with LTM with luffing cranes should use the chart compiler **cc3kML6033** or higher. This section will present the new added features.

3.2.0 Create a new charte



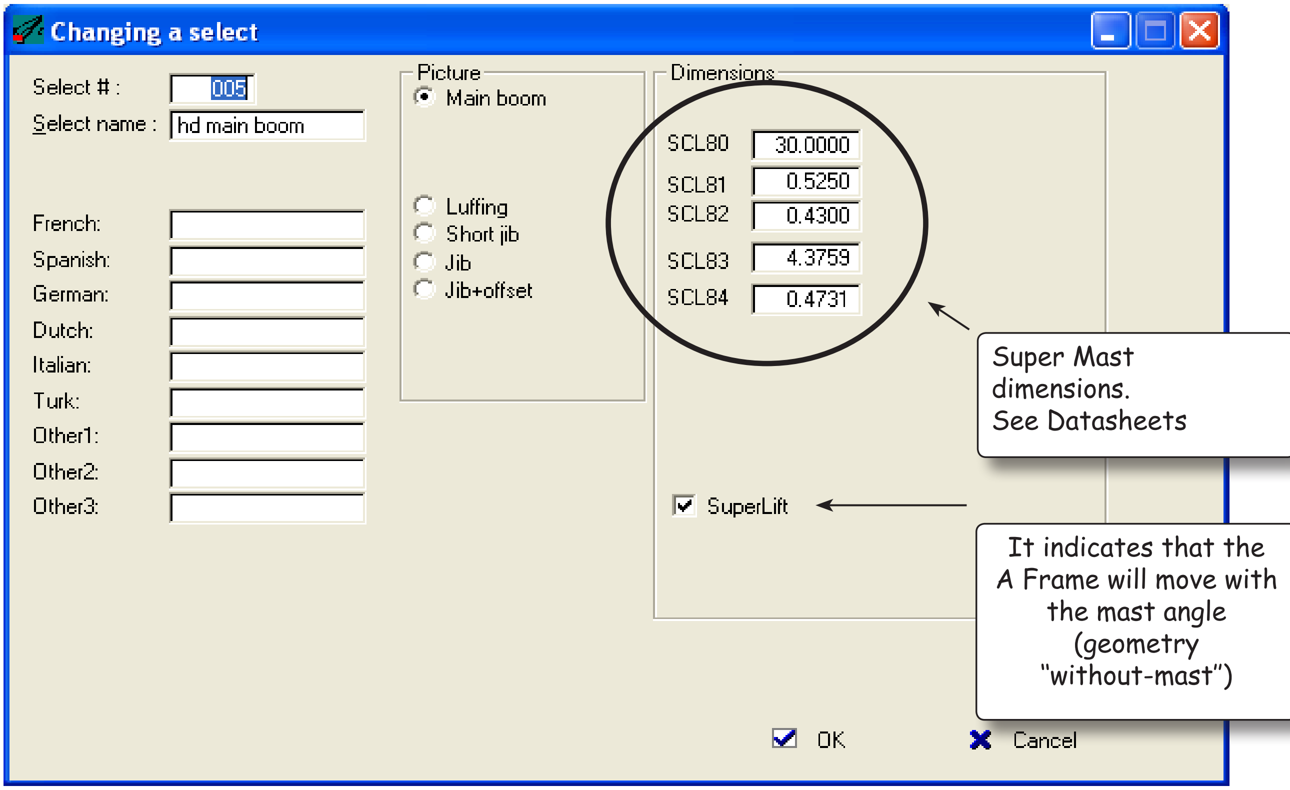


Don't bind the hoist to duty if you choose the LTM frame with COG method. If you want to use the COG method, you have to select the "**Binding deduct to duty**" option. The "One touch hoist" should **never** be used with the COG method.

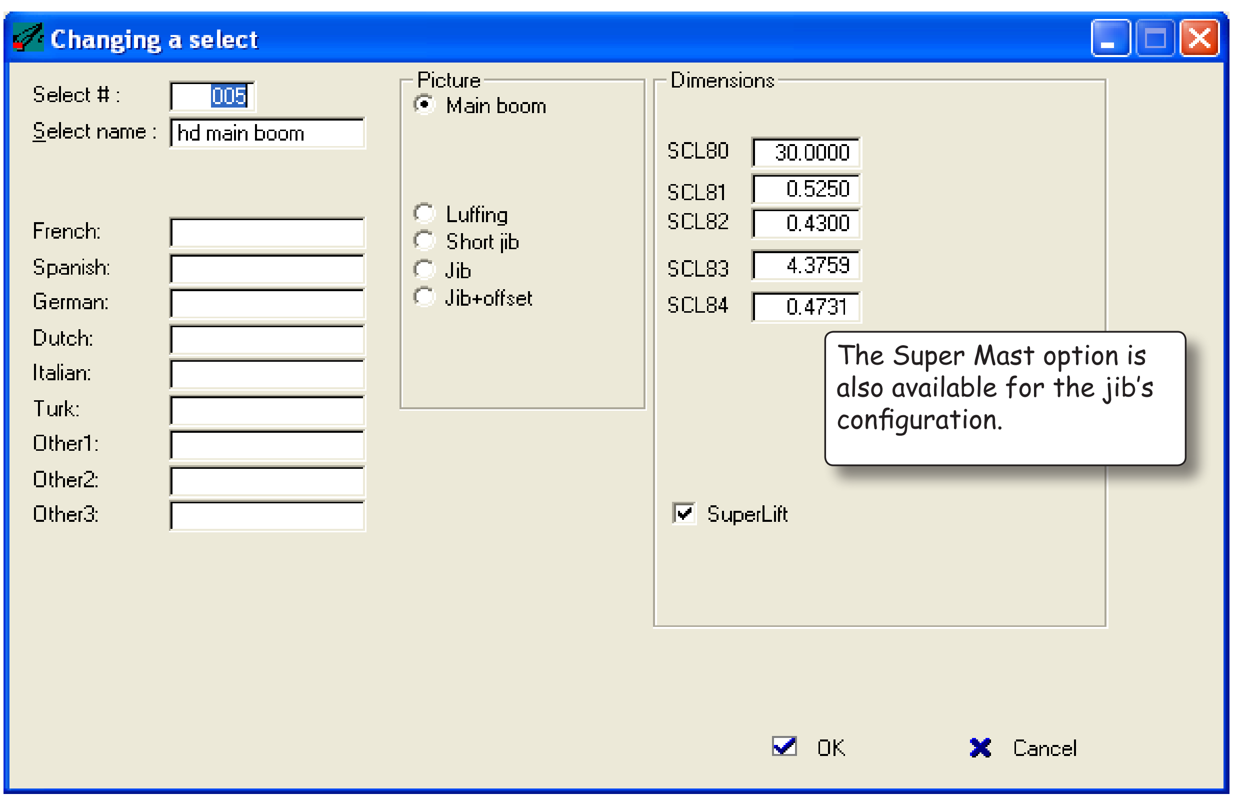
The deduct field becomes a part of the duty definition.

3.2.1 In the select category

A) Main boom with Super Mast Option

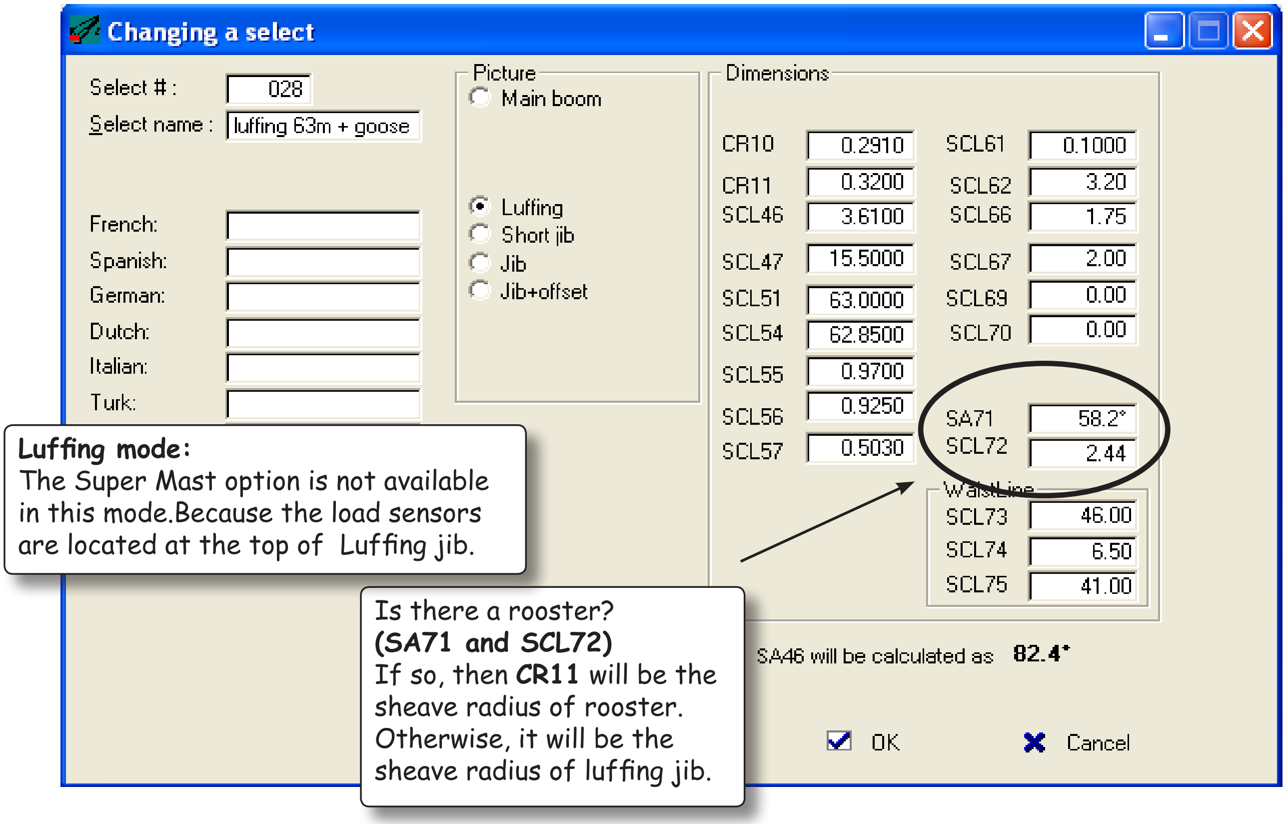


B) Jib, Short Jib, Jib With Offset

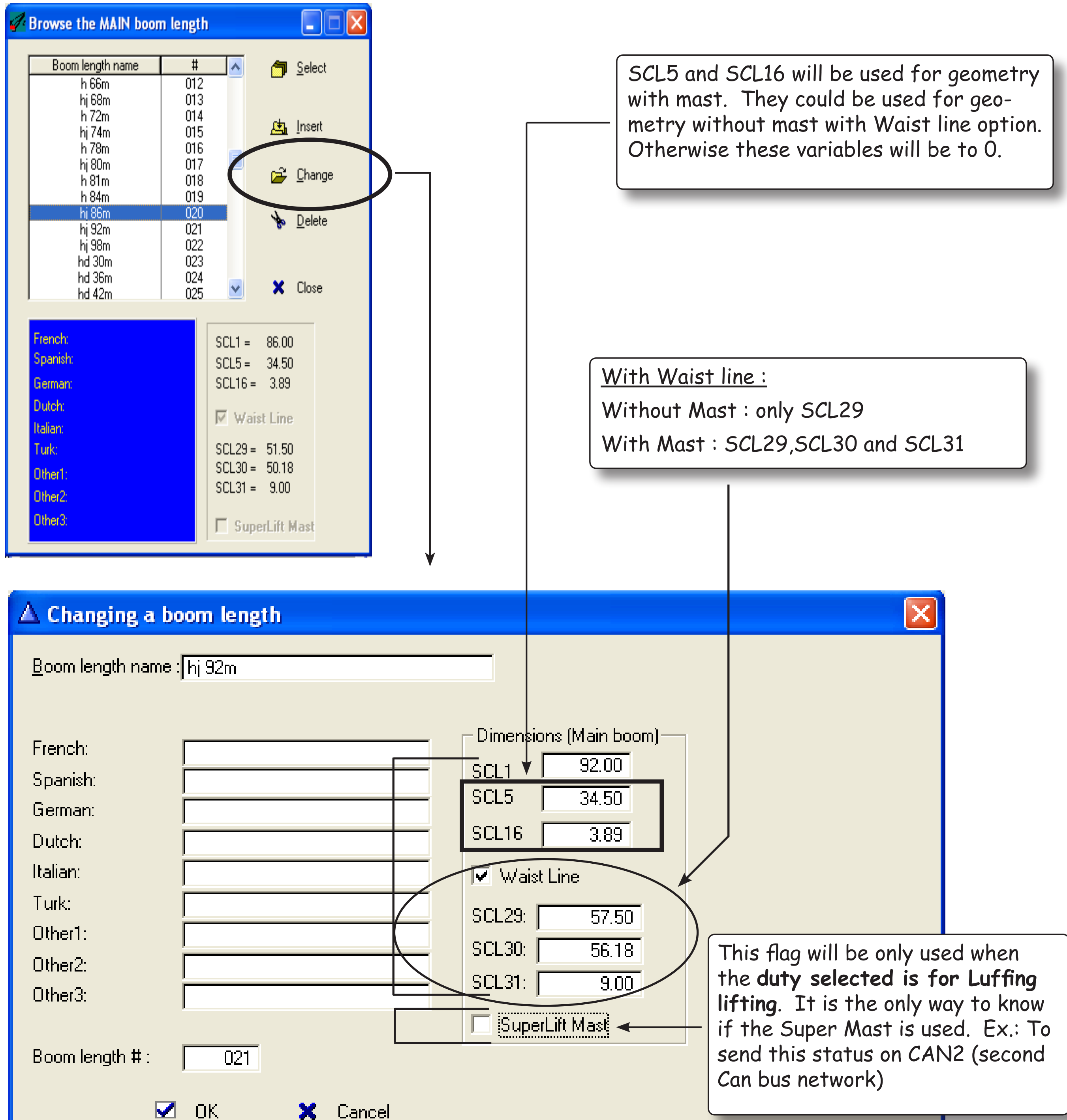


3.2.1 In the select category (cont'd)

C) Luffing Jib



3.2.2 In the “Boom Length” category :



The “Boom Length” category is composed of all main boom lengths only.

1) The lengths of different density and insertions :(H,HDB,HJ,HJDB)

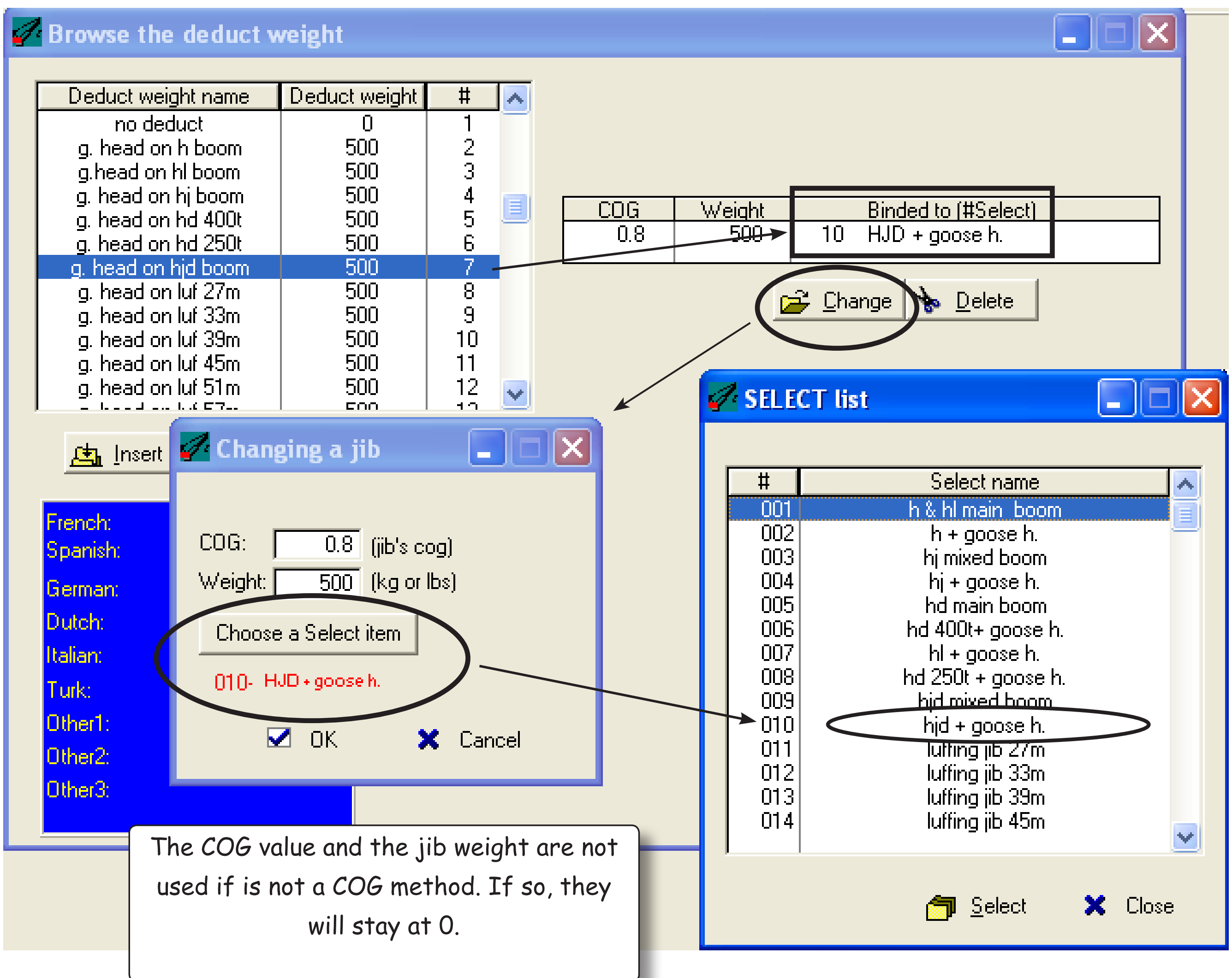
2- The lengths of different density and insertions (H,HDB,HJ,HJDB) with **Waist line**

Where H = Std Boom, HJ = Mixed Boom, DB = Super Mast+Counterweight

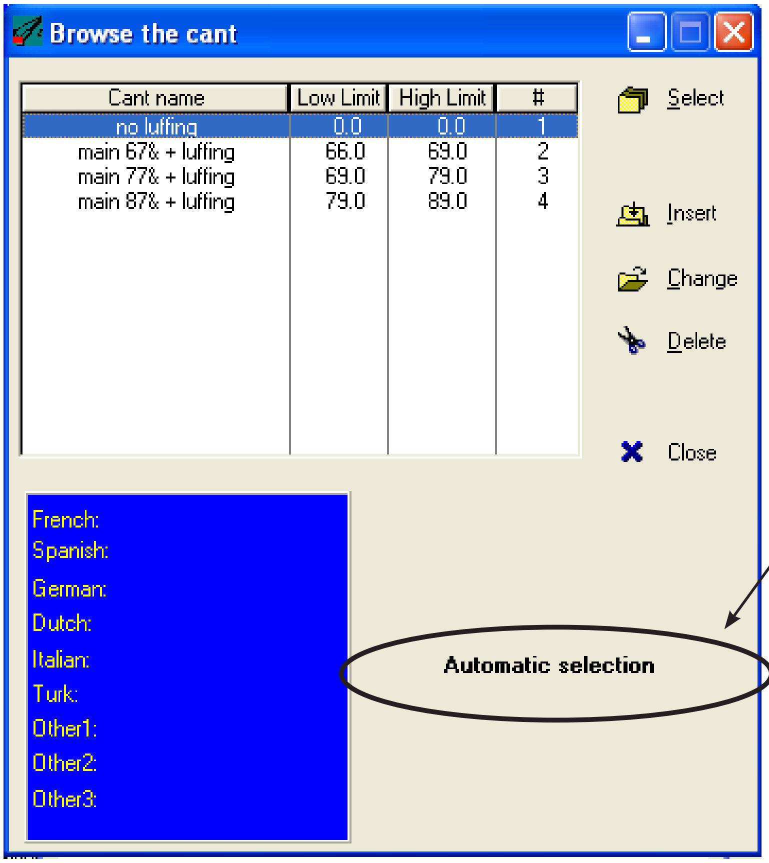
Note: We can check “SuperLift Mast” if all main boom lengths for HDB and HJDB are used for Luffing jib lifting.

3.2.3 In the "Deduct" category:

The **STD** and the **COG** (center of gravity) methods use the deduct category in order to know the geometry of the jib. For the STD method, we use it to consider the jib block weight effect. And in the case of the COG method, we use it to consider the jib block weight effect and the jib effect.

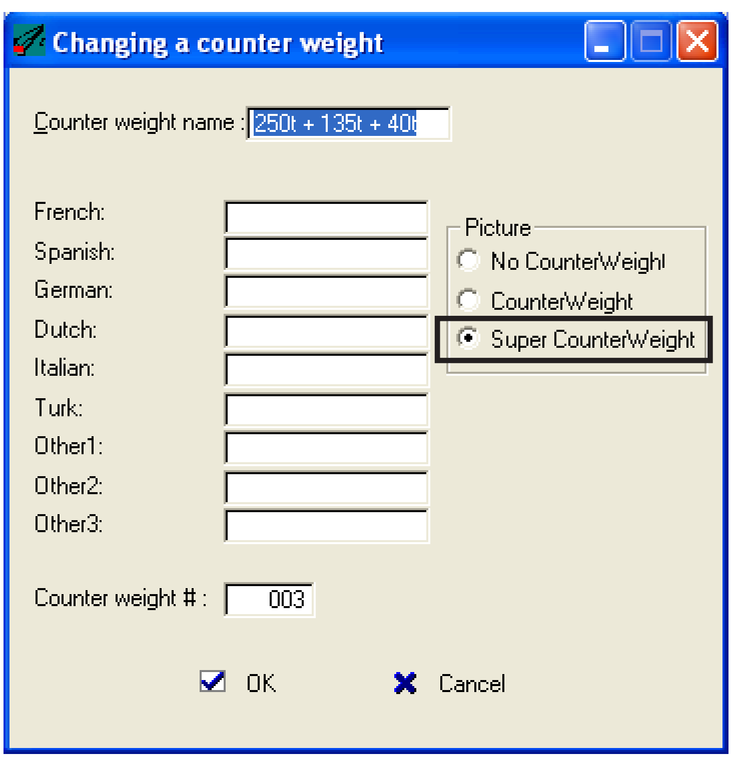


3.2.4 In the "Cant" category:



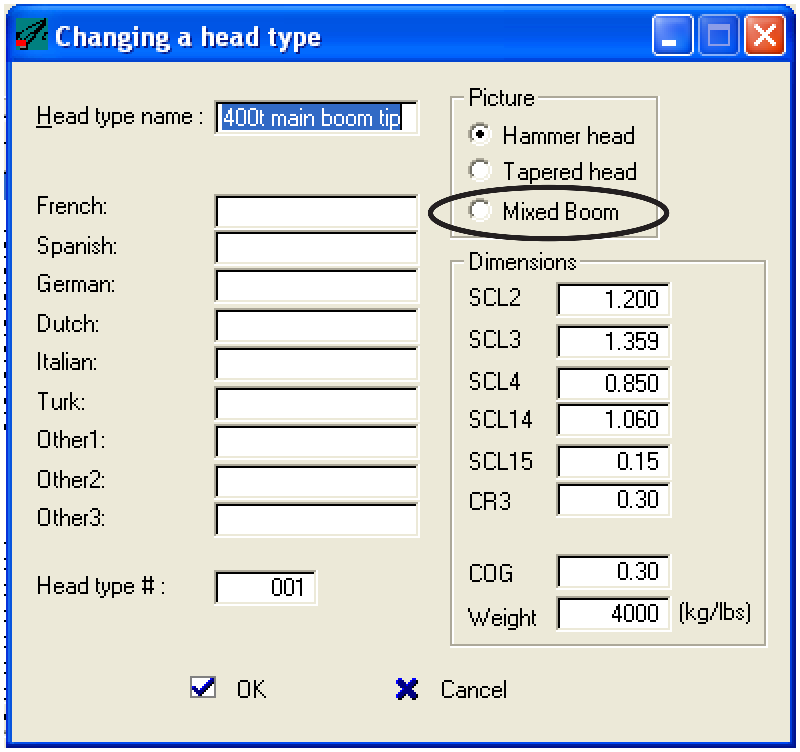
As shown here, the "CANT" field is used for the luffing duties. The system will constantly check where the angle main boom is located and will choose the appropriate selection for the lifting in progress.

3.2.5 In the "Counter Weight" category:



Another Picture option has been added "Super CounterWeight".

3.2.6 In the “Head Type” category :



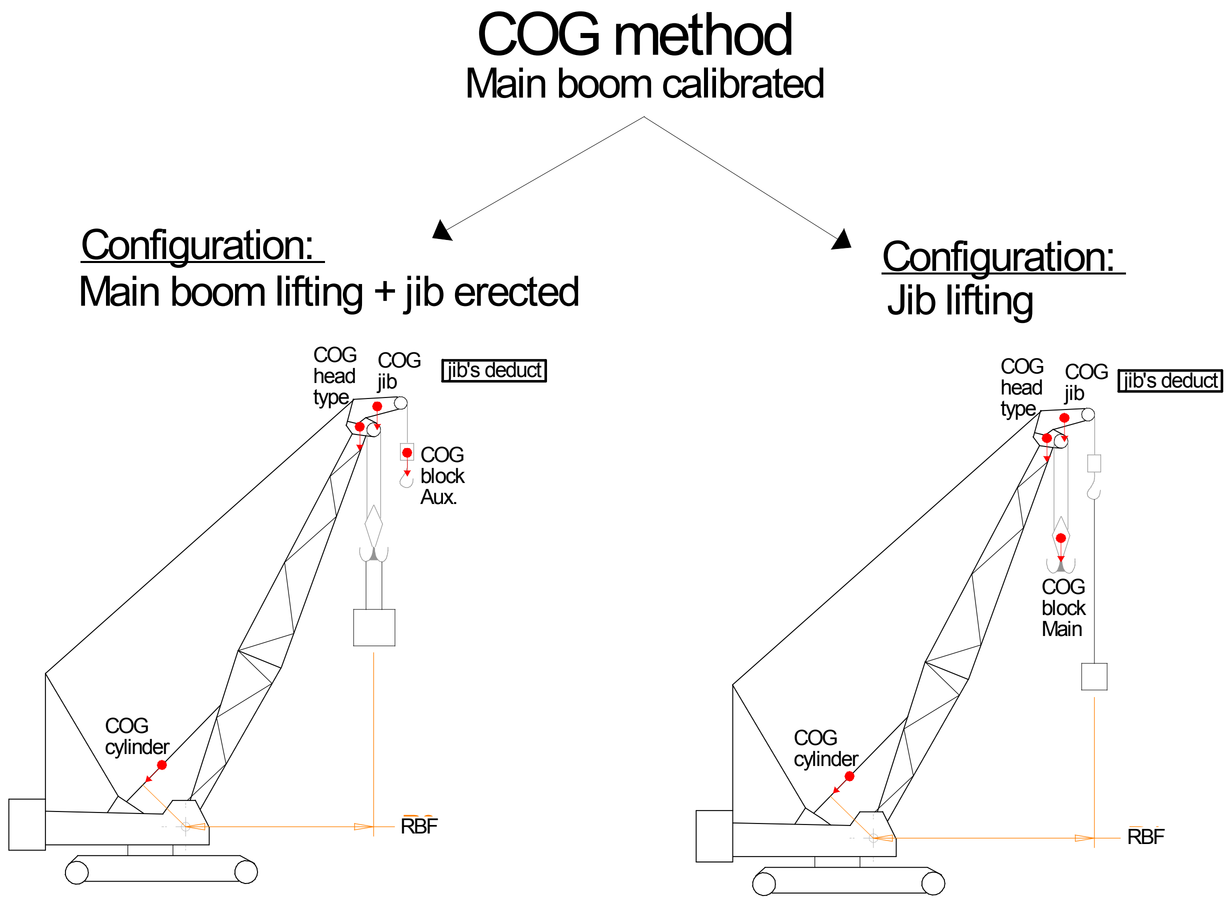
By selecting an head type, we will know which load sensors will be used.

Removing the head type effect during the no-load calibration and during the load calculation.

3.3 COG method:

This method aims to reduce the number of calibrations to be performed on a crane. Thus also decreasing the calibration time. To optimize this method, we need to remove any effects that may affect the load during the calibration (e.g., head type, weight hook and cylinder).

3.3.1 Main Boom:



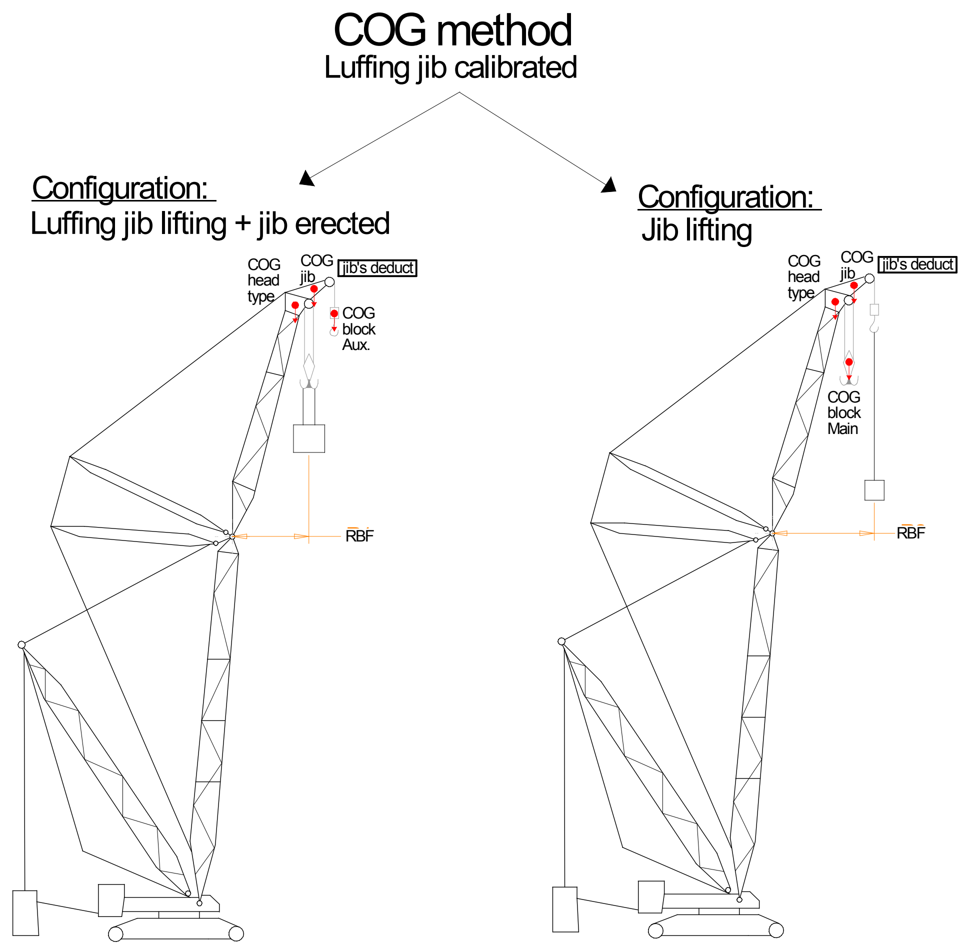
Only the main boom will be calibrated:

1) The main boom has to be calibrated by itself (e.g. no jib erected).
2) During the "no load calibration", the effect provided by the main hook block, the head type and by the cylinder will be removed.

All other duties (jib erected and jib) will take into account the main boom calibration and will add their own deduct effect (e.g. COG's jib) for the load calculation.

1) The duty needs to get the same Group Number as the Main boom calibrated and we have to choose the right "Deduct" field bounded to the "Select" field. Thus, we obtain the right geometry for the COG's jib calculation. (See section 5.2.3)
2) All concerned calibrated main boom parameters will be considered when calculating the load. That means the deflection and adjustment factors (e.g. friction compensation, load and no-load adjustment).

3.3.2 Luffing Jib



Only the Luffing jib will be calibrated:

1) The Luffing jib has to be calibrated alone (e.g. no rooster erected).
2) During the "no load calibration", the effect provided by the main hook block, and by the head type will be removed.

All other duties based on the "luffing picture" with Rooster will take into account the Luffing jib calibration and will add their own deduct effect (e.g. COG's Rooster) for the load calculation.

1) The duty needs to have the same Group number as the Luffing JIB calibrated and we have to choose the right "Deduct" field bounded to the "Select" field. Thus, we obtain the right geometry for COG's rooster calculation. (See section 5.2.3)
2) All concerned calibrated Luffing jib parameters, will be considered when calculating the load, this means the deflection and adjustment factors (e.g. friction compensation, load and no-load adjustment).

3.4 Tables

Table 1
Errors level (Voltage) Electronic Interfaces

	Bits		Volts	
	Min	Max	Min	Max
Angle	819	3277	1.00	4.00
Length	39	985	0.19	4.81
Load	150	3945	0.18	4.82
Generic	150	3945	0.18	4.82
DR+	N/A	N/A	4.5	5.5

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The Lattice Total Moment Crane

4.1 If the Directive Machine EN13000 is Not Enabled: Then, the Step # 4 will be as follows:

Step 4

Configuration Digital Inputs/Outputs + Bypass (item "31- relays configuration") + (item "32- dig. inputs config.") + (item "33- High dig. inputs config.")

1) Digital inputs (reference to bat -) :

This option allows the digital input selection. The Config # 1 will consider **d1, d2, d3** as DIN inputs linked to the LTM chart and "be" as external bypass (the Bypass (9) button of the keypad will be ignored). These inputs can be a magnetic or mechanical proximity switch of NPN type. They are used to detect the working area, i.e.: over end, over side, as determined by the chart compiler.

Step 4 (cont'd)

	DIN4	DIN 3	DIN 2	DIN 1
Config. # 1	be	d3	d2	d1
Config. # 2	Option #1	d3	d2	d1
Config. # 3	be	Option #2	Option #1	d1
Config. # 4	Option #3	Option #2	Option #1	be

All Options are not implemented at this time and should be seen as future expansion. They will require a software modification before being considered by the i3500 system and will be renamed afterwards to reflect their functionality.

2) High Digital Inputs : (reference to bat+)

The **HDIN** inputs are usually a **PNP** proximity switch. If the first configuration is selected, the HDIN1 and HDIN2 inputs will be used by the i3500 system to know the direction of movement of the main boom whereas HDIN3 and HDIN4 will have the same function for the luffing jib. If the third or fourth configuration is selected, then all the inputs will be used for a specific function for a specific customer.

	HDIN4	HDIN 3	HDIN 2	HDIN 1
Option # 1	Force Comp. Luffing Jib	Force Comp. Luffing Jib	Force Comp. Luffing Jib	Force Comp. Luffing Jib
Option # 2	Option #2	Option #1	Force Comp. Main boom	Force Comp. Main boom
Option # 3	Option #4	Option #3	Option #2	Option #1
Option # 4	Option #4	Option #3	Option #2	Option #1

3) Digital Outputs : (Relays)

This option allows the digital output selection. The digital outputs are linked to the action of each relay involved; a digital output can be linked to a particular relay. According to the table, the relay # 5, for example, can play the role of an external buzzer or roof light for the RLD. There are some digital outputs that are dedicated to a single role such as the relay # 3 (left swing).

Step 4 (cont'd)

Relay # 1	ATB+ Cutout	ATB	Deactivated	**Relay #5**	External Overload Buzzer	Amber lamp for Range Limiting Device	Deactivated
Relay # 2		Cutout	Deactivated	**Relay #6**		Boom Up	Deactivated
Relay # 3		Left Swing	Deactivated	**Relay #7**		Left Swing Approach	Deactivated
Relay # 4		Right Swing	Deactivated	**Relay #8**		Right Swing Approach	Deactivated

All the blank spaces are not implemented at this time and should be seen as future expansion. It will require a software modification before being considered by the system.

4) **Bypass** :

This option will allow the operator to select the relays that will remain unlocked during bypass. The bypass can be activated using the keypad or by an external digital input.

Bypass		Cutout + ATB+ SWL+SWR		Deactivated

If the bypass option is disable, the button on the keypad or the external digital input will be ignored.

ANNEXE

Calibration System Checklist

☐	Step 1:	Perform a system initialization	page 9
☐	Step 2:	Sensors configuration	page 10
☐	Step 3:	Adjust system options	page 10
☐	Step 4:	Configuration digital inputs (EN13000 enabled)	page 13
		Or	
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