i4000

Excavator Rated Capacity Limiter and Range Limiting System

Instruction Manual

Rev: MLF April 2019

Wylie Systems
(Rayco Technology Group)

201 Prospect Avenue
Suite 106 - box 159
Hagerstown, MD 21742
USA

Tel: +1 888-252-1957
Fax: +1 (418) 266-6610

Rayco Electronic Systems
(Rayco Technology Group)

2440 Dalton Avenue
Ste-Foy, Qc
CANADA
G1P 3X1

Tel: (418) 266-6600
Fax: (418) 266-6610

Wylie Systems
(Rayco Technology Group)

Drury Lane
St-Leonards on Sea, East Sussex
ENGLAND
TN38 9BA

Tel: (+44) 1-424-421235
Fax: (+44) 1-424-433760

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 **i4000 RaycoWylie** Systems **Excavator 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 excavator 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 excavator and its load.
This system must **never** be used, under any circumstances, as a substitute for the good judgment of a excavator operator when carrying out approved excavator-operating procedures. Responsibility for the safe operation of the excavator lies with the excavator operator. The indicator equipment will not necessarily prevent excavator damage due to overloading and related causes if not set properly.

Before operating a excavator equipped with a **RaycoWylie** system RCI, the operator must carefully read the information in both this manual and the excavator 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 excavator.

Since the personnel's safety and the appropriate use of the machinery are a priority, different symbols are used in this manual to highlight important points.

The following definitions indicate the level of risk each symbol represents. Each time you see one of these symbols in this manual, the operator's safety or the machinery's integrity are concerned.

Please take your time to read and understand these definitions!

DANGER: INDICATES A POTENTIALLY DANGEROUS SITUATION WHICH, IF NOT AVOIDED, COULD RESULT IN A PERSON'S DEATH OR IN SIGNIFICANT DAMAGE TO THE MACHINERY.

ATTENTION: INDICATES A POTENTIALLY DANGEROUS SITUATION WHICH, IF NOT AVOIDED, COULD RESULT IN MINOR OR MODERATE DAMAGES. IT CAN BE USED TO WARN ABOUT UNSAFE PRACTICES.

IMPORTANT: INDICATES A SITUATION WHICH COULD DAMAGE THE MACHINERY.

NOTE: PROVIDES INFORMATION WHICH CAN BE OF SPECIAL INTEREST.

CONTENTS

CONTENTS

-1-

General description of the system

1.1 Introduction

This manual contains information regarding the operation, troubleshooting, and maintenance procedures of the i4000 system. Please make sure you respect the safety rules currently in force in the country where you are using the i4000 system, in order to reduce the risk of injuries or of damages to the machinery. Please consider each safety directive mentioned in this manual when using the i4000 system. This manual will help qualified personnel use the system and perform its maintenance.

1.2 Operator skill

The i4000 system shall be operated only by personnel without limitations in the physical abilities of the upper limbs and no visual or hearing impairment, who have completed all operator trainee qualification requirements and have read and fully understood the instructions in this manual. Operator requirements shall include: demonstrating the ability to read, write, comprehend, use arithmetic, read and understand the load / capacity charts in the language of the excavator manufacturer's operating instruction materials. Maintenance of the system is intended only for fully qualified and trained personnel for this task.

1.3 Usefulness of the i4000 system

The i4000 system shall prevent the excavator from supporting a load outside the limits of the permitted radius and outside the loads shown and described on the rated capacity chart or the permissible working load of the ropes when set and operated correctly.

1.4 Description of the i4000 system

The i4000 is a computerized excavator monitoring system, designed as an operator aid. It comprises sensors fitted to the excavator and a display located in the cabin of the excavator. This version measures the boom cylinder pressure, the boom angle and the stick angle to indicate safe or critical conditions, while performing an authorized lift of loads. An optional sensor may also be fitted to monitor the slew angle to provide some extra information to the operator. All the sensors are linked through a single CAN bus (Controlled Area Network).

The pressure sensors provides electrical signals that are proportional to the actual pressure in the hydraulic boom cylinder system of the excavator. Inclinometers provides a signal that is proportional to the boom and stick angles. The radius and the load are calculated from these signals with the dimensional excavator data pre programmed in the i4000 system.

During operation the load lifted by the excavator is calculated from the measured boom cylinder pressure and is automatically compared with corresponding data related to the maximum permissible excavator loading. (Load charts)

The actual load is expressed as a percentage of the permitted load (% SWL). If this percentage exceeds a preset value, alarms and safety functions are activated. The values of the hook load, the permissible load (SWL), the lifting point height and the radius are displayed in a digital form on a graphic liquid crystal display (LCD).

If the additional slew sensor is fitted, then some information about the current slew angle will also be available. The required duty charts are stored in a non-volatile memory and **can only be modified with the approval of the excavator manufacturer**.

The calculated machine parameters and calibration data are stored in an additional non-volatile memory. The calibration of the system is performed only with the use of known loads, boom angles, and other pre-determined data.

1.4 Description of the i4000 system (continued)

1.4.1 Audible alarm

An intermittent audible alarm within the display unit warns the excavator operator that an intervention is necessary before the load reaches its nominal value. The default threshold for the approaching alarm is 90% of the nominal capacity. The overload alarm is activated continuously when 100% of the nominal capacity is reached or exceeded. The excavator operator will also be warned by the internal audible alarm when approaching or reaching a limit that has already been defined.

The approach and overload alarm settings can be modified according to the user's preferences.

If you are wearing hearing protectors or headphones during lifting operations, make sure they do not impair your ability to hear the sound alarms of the i4000 system.

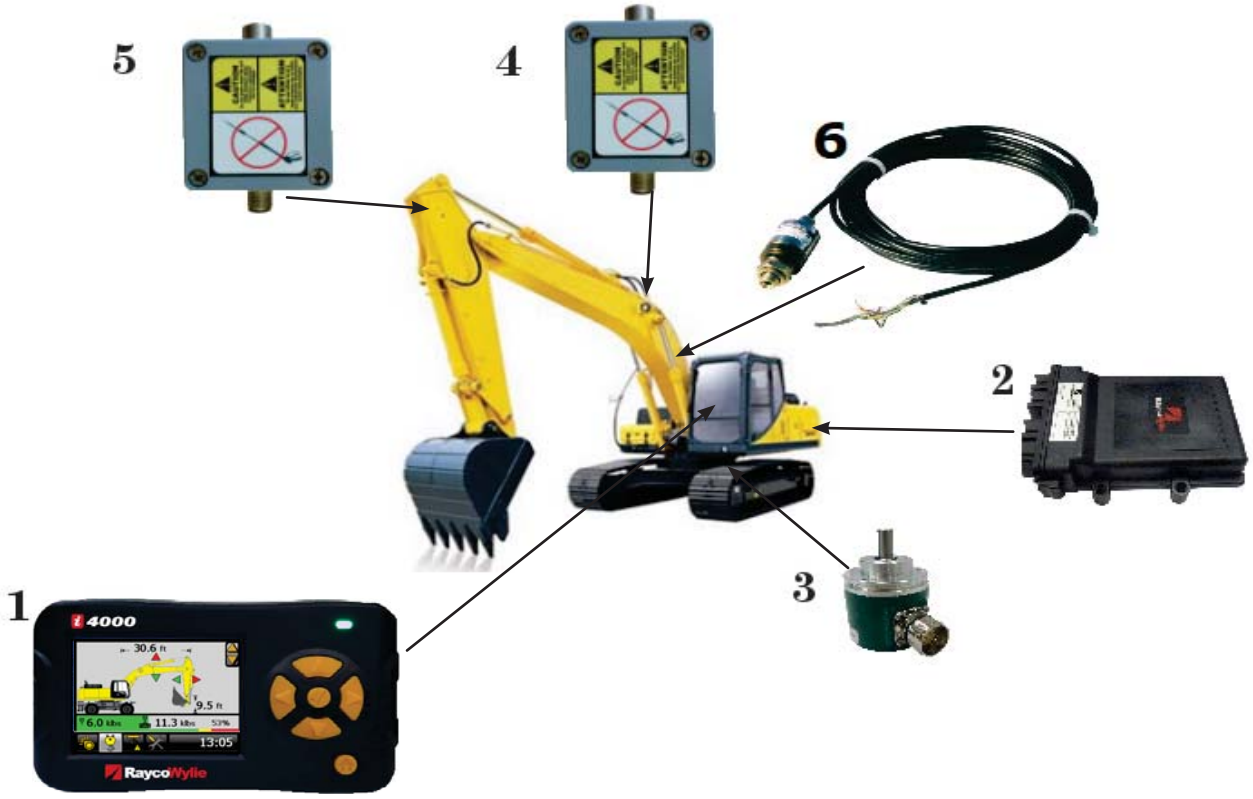
1.4.2 Visual alarm

The i4000 system display has been equipped with a 3-colour warning light to alert the operator and to indicate a specific action.

The flashing yellow light turns on intermittently with the intermittent audible alarm when the load reaches the approach alarm's threshold, that is, 90% of the nominal capacity. This is the default value and it can be changed in the calibration menu.

The light turns red when 100% of the nominal capacity is reached or exceeded and the audible alarm is continuous.

1.5 Location and description of typical components



1. **i4000 display system**: It is also the central processing unit (CPU) of the system. Its principal feature is a CAN Bus communication interface and graphical LCD screen.

2. **Central I/O interface:** This relay interface module is connected to individual external I/O devices to be controlled or monitored by the i4000 system.

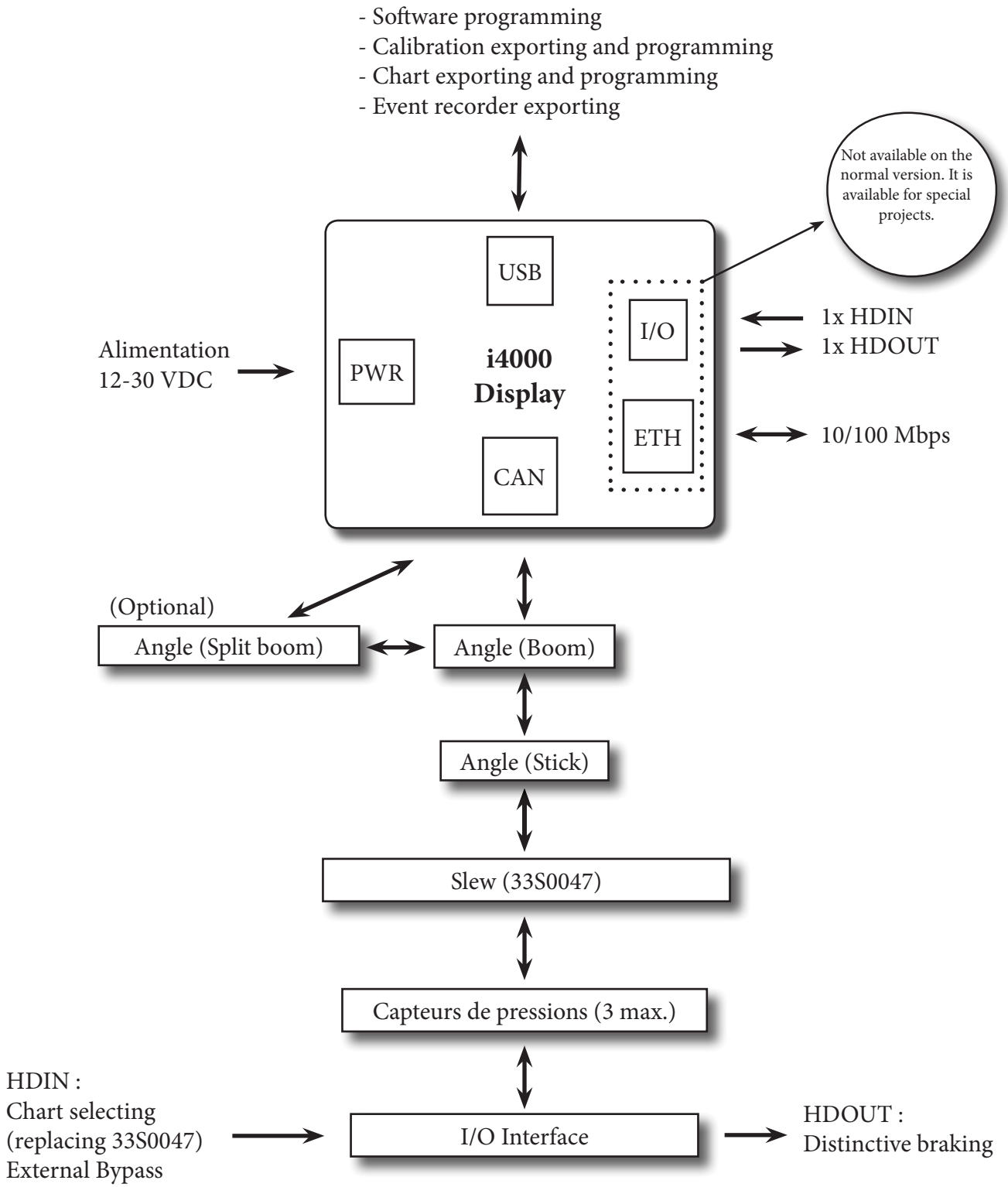
3. **Slew sensor (optional)**: A slew sensor is used to determine the position of the boom for the range limiting and/or to determine the load chart selection.

4. **Angle sensor**: An angle sensor is used to measure the Boom angle.

5. **Angle sensor:** Another angle sensor is used to measure the Stick angle.

6. **Pressure sensor**: 3 Pressure sensors are used to determine the weight of the load being lifted by measuring the pressure in the lifting cylinder.

1.6 Overall scheme



1.7 Technical information

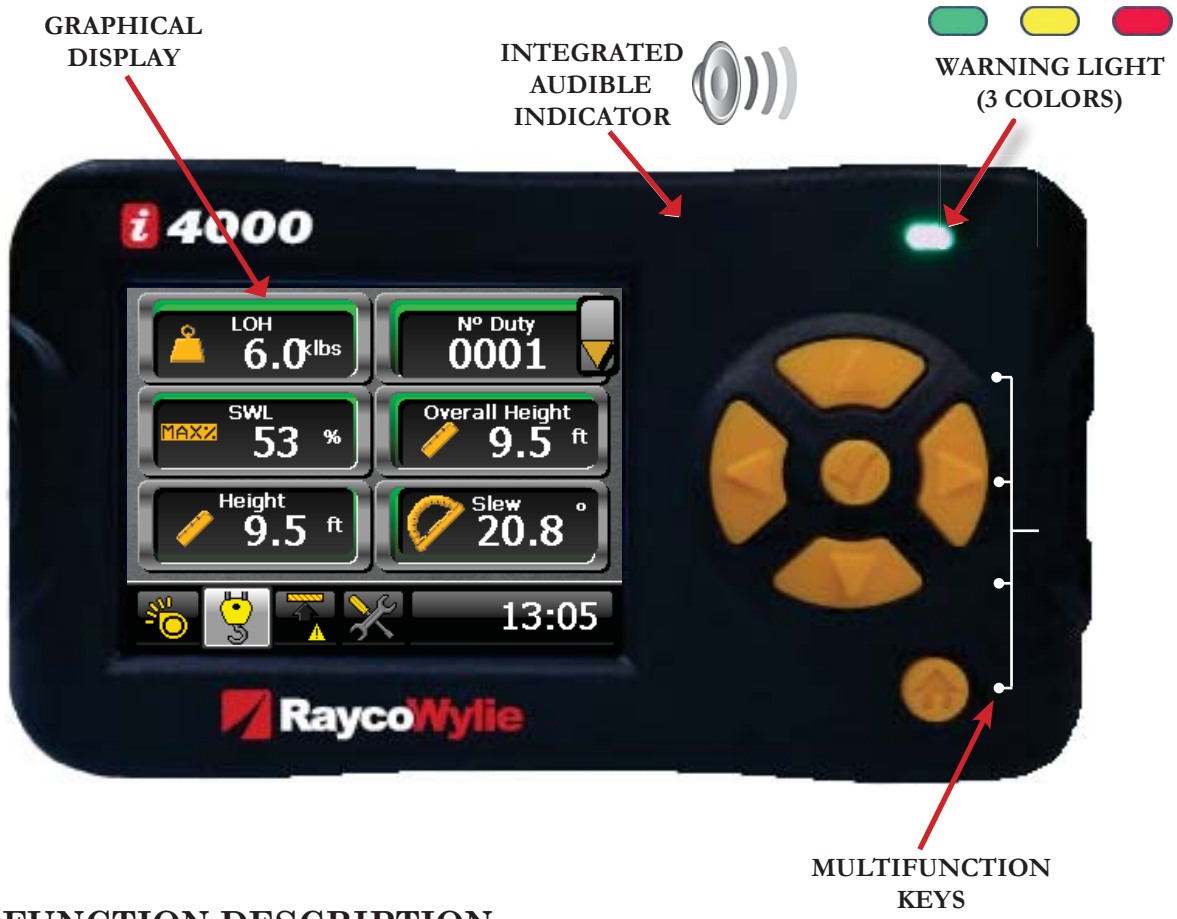
Accuracy:	In accordance with SAE J159
Operating temperature:	-20°C to +70°C
Extended temperature:	-40°C to +70°C
Power supply:	10-30 VDC (maximum power supply)
Display unit dimensions:	3.5” Crystal liquid screen (320 x 240)
Display unit protection:	IP67

Bus CAN interface/ sensors:	**Default quantity**	**Maximum quantity**
-Load or pressure sensors	3	3
-Angle or length sensors	2	3
- Relay output	1	1
- Rotation sensor	1	1
- Possibility of additional sensors	NO	

-2-

Detailed description of the display unit

2.1 Overview of the display unit



FUNCTION DESCRIPTION

MULTIFUNCTION KEYS

Each key has a different function depending on the current mode. In other words, the activated function when pressing a multifunction key will vary according to the menu or window you are in.

GRAPHICAL DISPLAY

The Liquid Crystal Display allows access to multiple tabs and options to control the i4000 system.

WARNING LIGHT

When working in normal conditions, the light is green. It turns to yellow when approaching a limit and turns red to alert the operator that a limit has been reached.

2.2 Description of operation keys

LEFT KEY
Press this key to scroll left through the tabs of the main menu or, in Edit mode, to return to the previous digit of a configurable value.

RIGHT KEY
Press this key to scroll right through the tabs of the main menu or, in editing mode, to move on to the next digit of a configurable value.

UP KEY
Press this key to scroll up through the options of the main menu or, in Edit mode, to increase a configurable value.

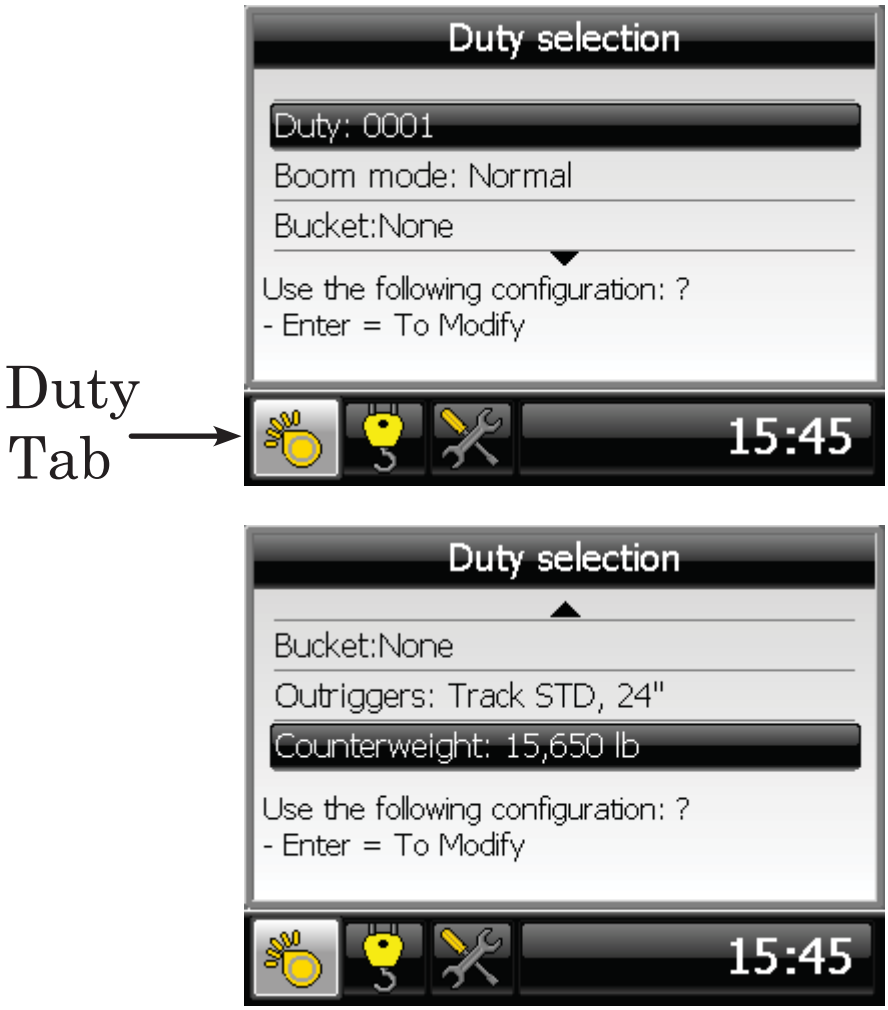
DOWN KEY
Press this key to scroll down through the tabs of the main menu or, in Edit mode, to decrease a configurable value.

CONFIRM KEY
Press this key to confirm your choice in any menu and to accept new values in the system.

BACK KEY
Press this key to leave a menu or settings window, and to return to the previous screen without saving the changes. Press several times to return to the main menu.

2.3 Duty selection tab

This tab will show every information relative to the current duty selected. The duty will automatically switch to the correct duty corresponding to the current sensor values. Some options can be modified depending on the available attachments in the chart file. If the chart file contains two different buckets, you must select the appropriate one in this window.



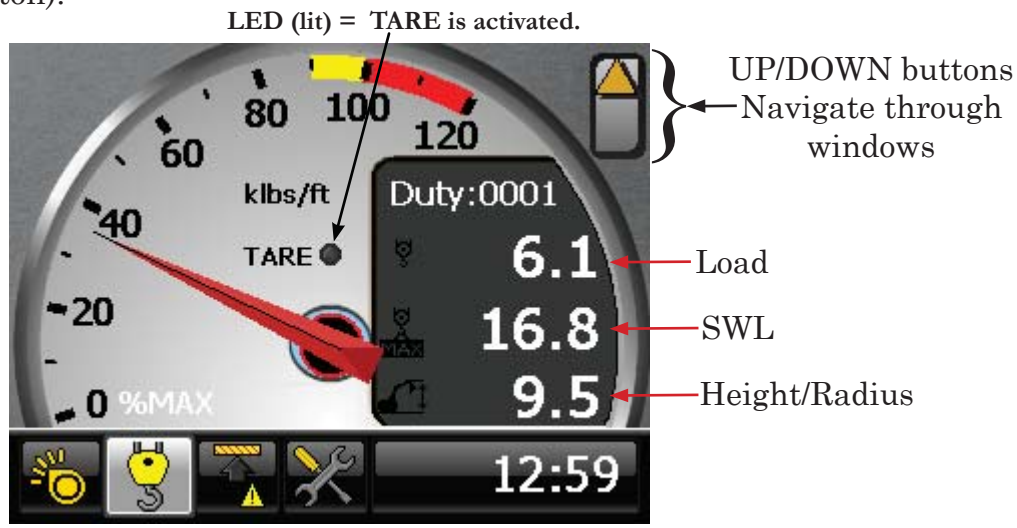
Parameters selection in the duty menu changes according to excavator type and options programmed in the load chart.

2.4 Lifting Tab

This tab contains 3 different windows accessible by pressing the UP/DOWN keys.

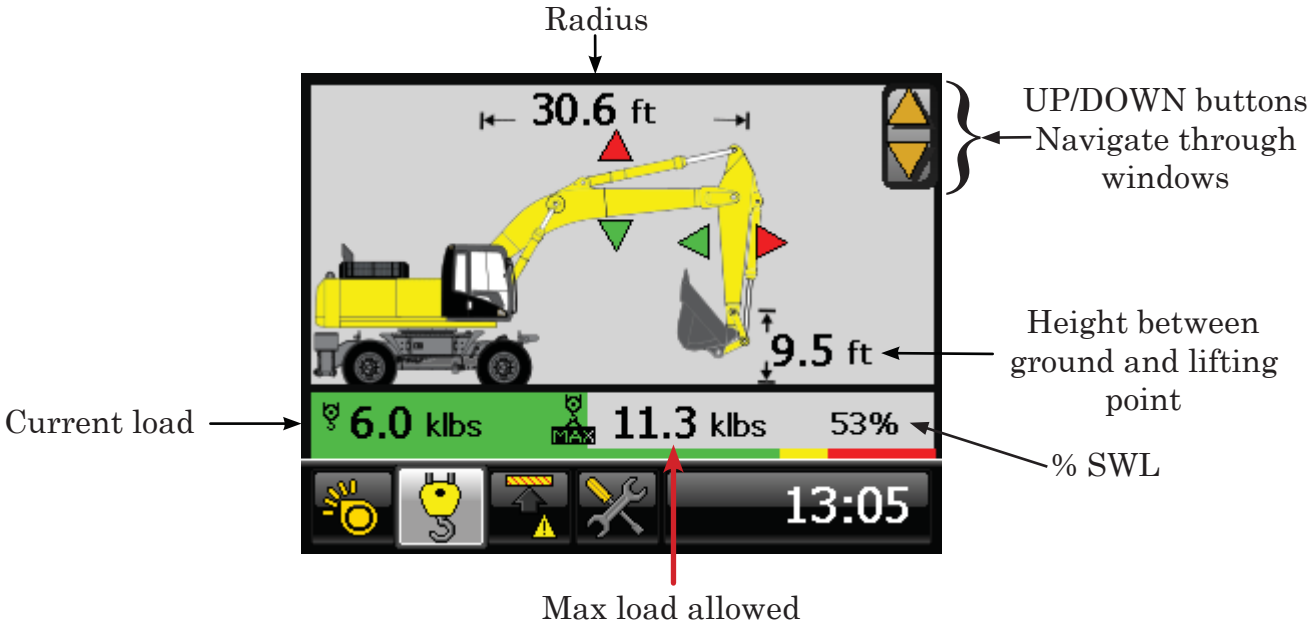
2.4.1 Safe working load gauge (1 of 3):

A simple gauge shows the current safe working load (%SWL). It is also showing on the bottom right the weight of the load, the maximum load allowed and the height or the radius (select height or radius by pressing the ENTER button).



2.4.2 Excavator window (2 of 3):

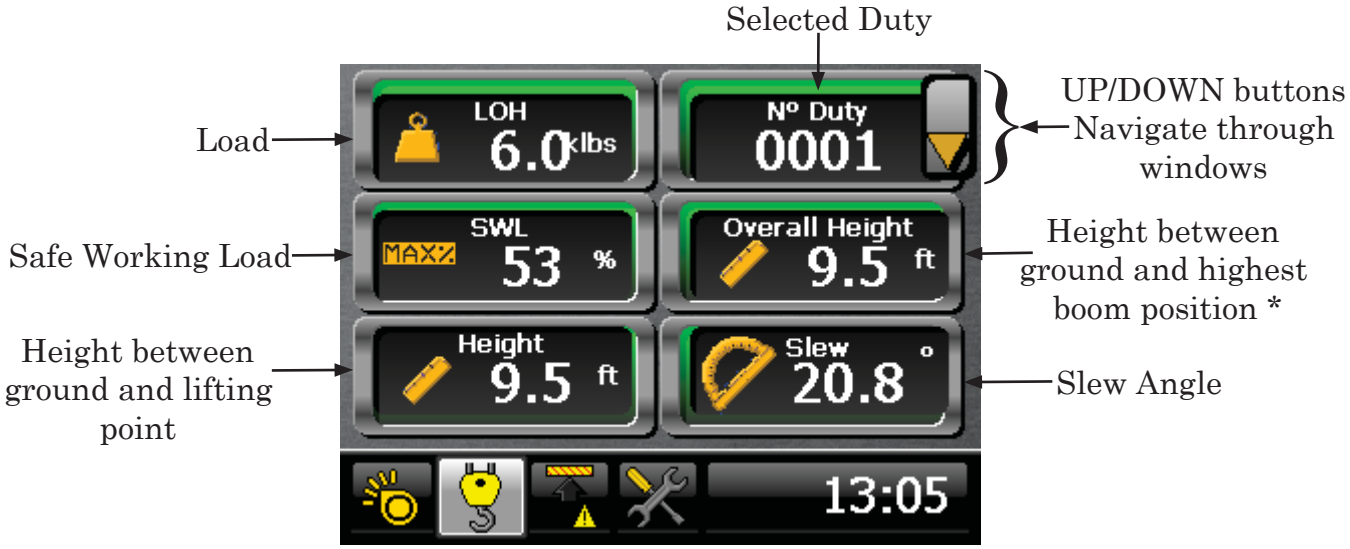
An illustration of an excavator showing the current load, the allowed load and the safe working load (%SWL). It also shows the Radius from the base of the boom to the lifting point and the Height from the ground to the lifting point. The red and green arrows shows permitted and prohibited movements.



2.4 Lifting Tab (continued)

2.4.3 Indicator window (3 of 3):

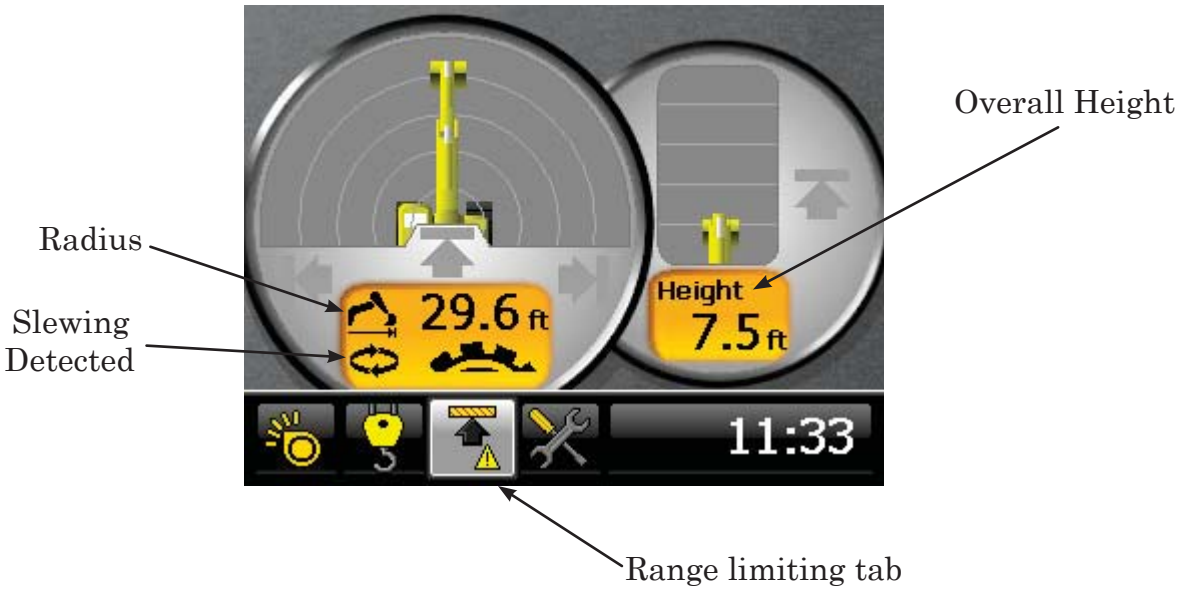
It allows the display of multiple sensors, providing a good overview of the excavator during operation.



* The parameter indicating the boom tip height should only be used as a guide and NOT as an indicator of whether the excavator clears a narrow pass.

2.5 Range limiting tab (optional)

This tab contains all the necessary options to program the safe working zone(s)

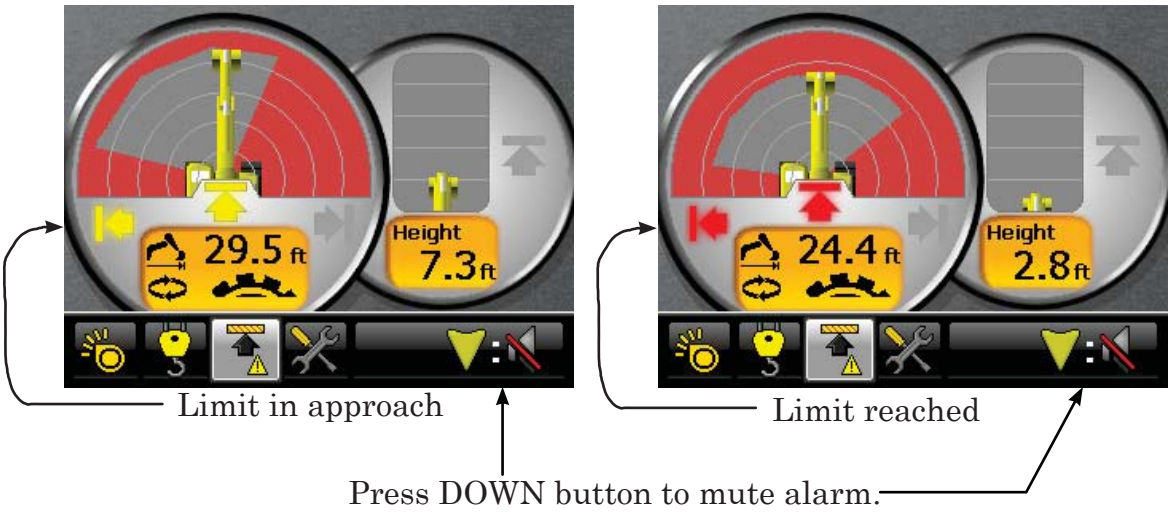


The range limiting tab is only available once activated in the calibration.

2.5 Range limiting tab (continued)

2.5.1 Meaning of each lights and messages of the range limiter

If one or more range limits have been programmed, such as Height limit, Slew limit, Slew and variable height limit, Height with free zone or Slew and variable radius, here are the significations of each lights and alarms. (Refer to section 6 - RANGE LIMITING for more details).



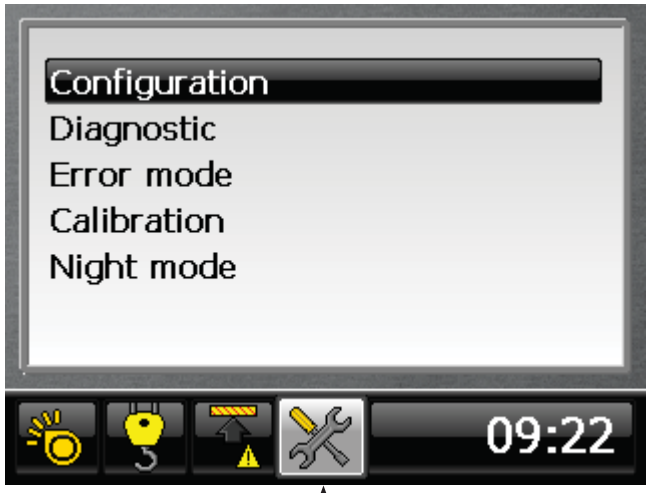
When approaching a programmed range limit, the corresponding arrow(s) blinks yellow, the warning light blinks YELLOW and the audible alarm can be heard intermittently.

After reaching a programmed range limit, the corresponding arrow(s) blinks red, the warning light turns RED and the audible alarm can be heard continuously.

* A warning message will also be displayed on the other tabs to inform the operator that a range limit has been reached.

2.6 Tools Tab

This tab contains all the necessary options to make the system function properly. This is also the menu where you can find the calibration menu.



Tools tab

-3-

Installation and Calibration

The installation and calibration must be performed by a qualified person having a good understanding of all Raycowylie installation and calibration instructions. He must perform a complete and precise verification of the system installation before starting the calibration. The installation must have been done in compliance with Raycowylie instructions using only Raycowylie components supplied with the system.

A bad calibration of the system can cause an overload which could damage the machine (breaking the structure or tilting), causing serious injuries and even death.

Failure to install all parts, or replacing parts with parts not supplied by RaycoWylie may lead to system failure causing serious injuries and even death.

Installation and calibration manuals are available upon request from RaycoWylie. Please note that the calibration and installation instructions have been intentionally left out of this manual.

-4-

Operating Instructions

4.1 Safety recommendations:

Please make sure you respect the safety rules currently in force in the country where you are using the i4000 system, in order to reduce the risk of injuries or of damages to the machinery. Please read the following safety instructions before trying to operate the system.

1. The machine operator must configure the excavator and the work environment correctly. A bad configuration could threaten the reliability of the system and cause dangerous situations such as an overload.

2. The i4000 system is purely an operator aid. It is the operator's responsibility to handle the excavator with caution, since the i4000 system will not necessarily prevent damages to the machine due to an overload or other causes.

3. The proper functioning of the equipment depends on a daily inspection and on compliance with this manual's operating instructions.

4. The excavator should always be operated smoothly and at a safe speed.

5. In order to have an adequate work radius, the system must be correctly configured. A wrong configuration may generate a wrong calculation of the radius, which the operator will use to assess the maximum load allowed for a given lifting operation. This may result in damages to or toppling of the machine.

4.2 Residual risks

Even if all safety rules are applied and safety devices are installed, certain residual risks are present. For example:

The system will not warn about a malfunction of relay outputs, which could prevent the locking of commands in case of an overload. This may increase the risk of the machine breaking or tilting, thus causing injuries and even death.

The system does not indicate the presence of electric wires in the excavator's work zone. The machine may therefore work close to and come in contact with undetected electric wires, which may cause serious injuries or even death.

The system does not indicate if the outriggers or undercarriage have been completely extended. This may increase the risk of the machine breaking or tilting, thus causing injuries and even death.

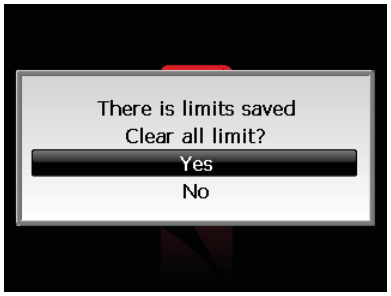
The system does not indicate the excavator's level. This may increase the risk of the machine breaking or tilting, thus causing injuries and even death.

The system does not indicate if the soil is stable. This may increase the risk of the machine breaking or tilting, thus causing injuries and even death.

4.3 Power-up

When the i4000 system is turned on, it runs a self-diagnostic during which it verifies the communication with the CAN bus installed sensors. It then loads in its usage memory (RAM) the information saved in its non-volatile (ROM) memory. During this stage, the RaycoWylie logo appears on the screen. When the test is completed and the live memory is ready, the warning light turns green and the i4000 system is ready to be used.

If a limit has been set up, the "Save limit" option is turned ON in the calibration mode and it has not been erased during the last session, the i4000 will then display the following screen:



This tells the operator that a limit has been saved already and asks if it is still valid.

This screen will not appear if the "Save limit" option is disabled in the calibration or if no limit is programmed into the system.

DANGER

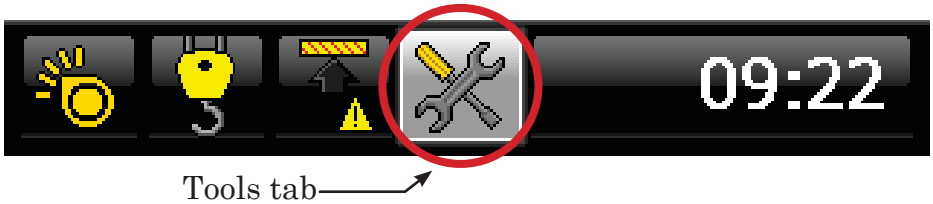
if the excavator has been moved (traction) since the previously saved limit(s), they should be erased and reprogrammed.

4.4 Configuration

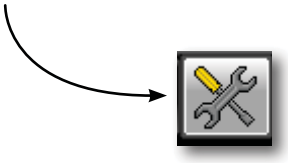
This allows the operator to personalize his system. Namely the load displayed unit, the display language, the light intensity of the graphical display and the date and time.

4.4.1 Access the Configuration menu

The configuration menu is located in the tools tab.



1. Navigate to the Tools tab with the LEFT or RIGHT keys.



2. Press the **'ENTER'** key to access the configuration options.

Now you can choose the option you wish to configure.

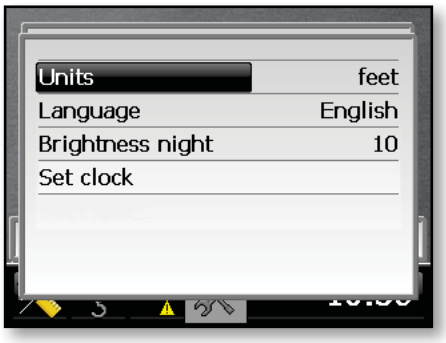
4.4 Configuration (continued)

4.4.2 Selecting the measuring unit

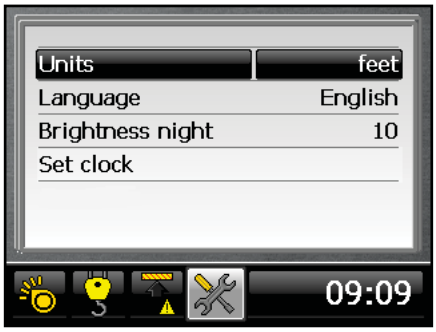
Select this option in order to switch between the Metric (meter) and Imperial (Feet) measurement system.

1. Access the Configuration menu (see section 4.4.1).

2. Scroll vertically to the “Units” menu with the “UP/DOWN” keys.



3. Press “ENTER” to change the unit.



4. Choose the desired unit using the “UP/DOWN” keys.

5. Press “ENTER” again to save the unit. Or press the “BACK” key to quit without saving the changes.

4.4 Configuration (continued)

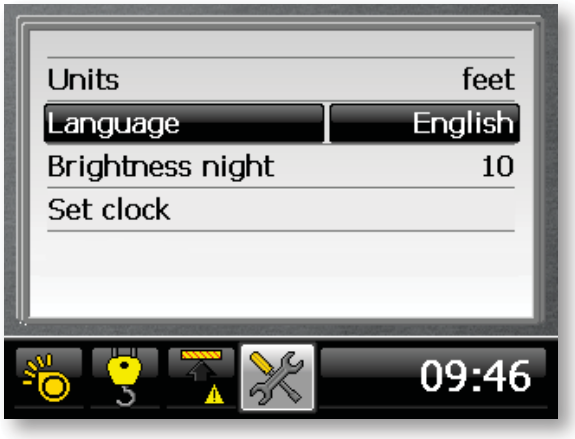
4.4.3 Selecting the language

This option allows the operator to choose the language in which all the texts in the system will be displayed. The default language is English.

1. Access the Configuration menu (see section 4.4.1).

2. Scroll vertically to the “Language” menu with the “UP/DOWN” keys.

3. Press ‘ENTER’ to change the language.



4. Choose the desired language using the “UP/DOWN” keys.

5. Press “ENTER” again to save the language. Or press the “BACK” key to quit without saving the changes.

4.4 Configuration (continued)

4.4.4 Selecting the night light intensity

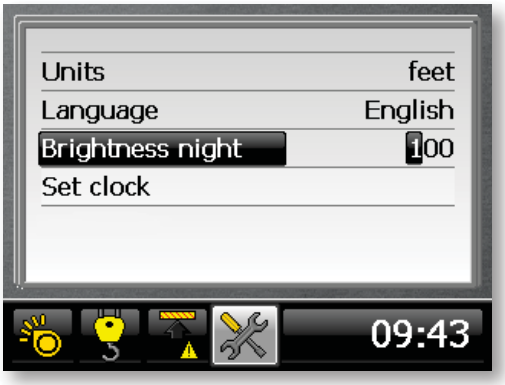
This option allows the operator to adjust the light intensity of the graphical display in NIGHT MODE. The values range from 5 to 100. 5 is the lowest intensity and 100 is the maximum intensity.

1. Access the Configuration menu (see section 4.4.1).

2. Scroll vertically to the “Brightness night” menu with the “UP/DOWN” keys.

3. Press ‘ENTER’ to modify the value.

4. Modify the selected digit using the ‘UP/DOWN’ keys to the desired value.



5. Then, press ‘ENTER’ to confirm the selected digit.
   Repeat steps 4 and 5 for the next digits. At the last digit, the value will automatically be saved when pressing ‘ENTER’.
   It is possible not to save by pressing the ‘BACK’ key at any moment.

At any time, press the 'BACK' key to go back without saving changes.

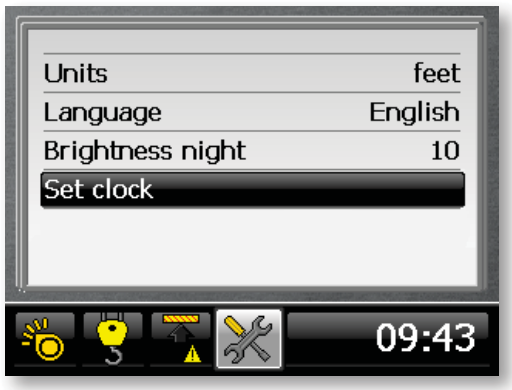
4.4 Configuration (continued)

4.4.5 Adjust system date and time

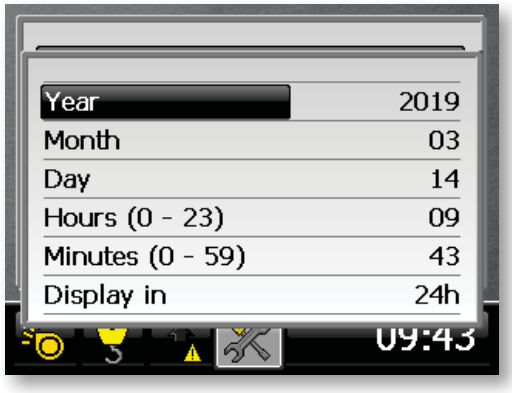
This option allows the operator to modify the date and time of the system. It is important to enter the right date and time since the event logger will use them.

1. Access the Configuration menu (see section 4.4.1).

2. Scroll vertically to the "Set clock" menu with the "UP/DOWN" keys.



3. Press "ENTER" to access the menu. The following menu will appear:



4. Scroll vertically to the option you wish to change, using the "UP/DOWN" keys.

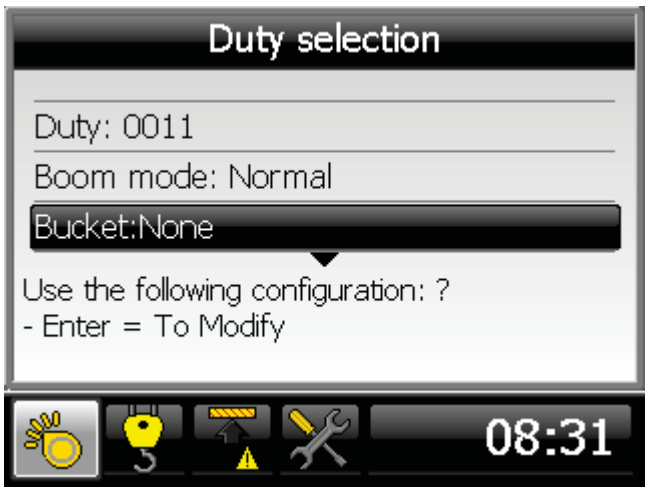
5. Press "ENTER" to make the change. In the example, "Year" has been selected.

6. Change the first digit by entering your desired value, using the "UP/DOWN" keys. Next, press "ENTER" to move to the next digit. Repeat this for the following digits. After entering the last digit, press "ENTER" to save the value.

4.5 Duty selection

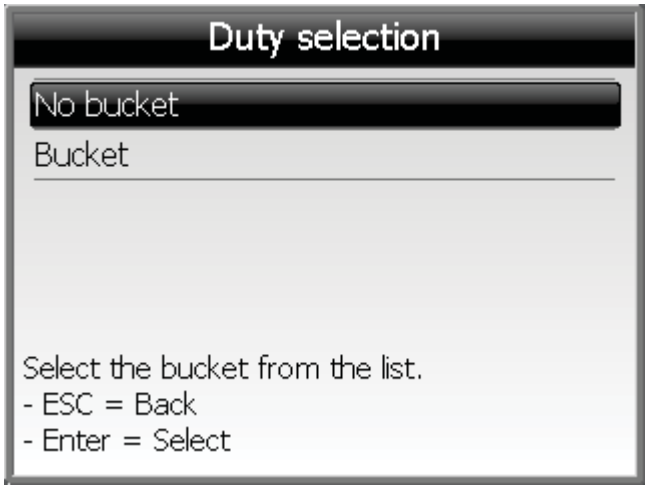
When changing a piece of equipment from the excavator, you must change the parameter in the duty selection window. For example, let's say that the bucket has been changed.

1. Access the Duty selection tab by using the "LEFT" button.



2. Scroll vertically to the "Bucket" attachment with the "UP/DOWN" keys.

3. Press "ENTER" to access the menu. The following menu will appear:



4. To tell the system that a bucket has been installed on the excavator, scroll vertically to "Bucket" using the "UP/DOWN" keys.

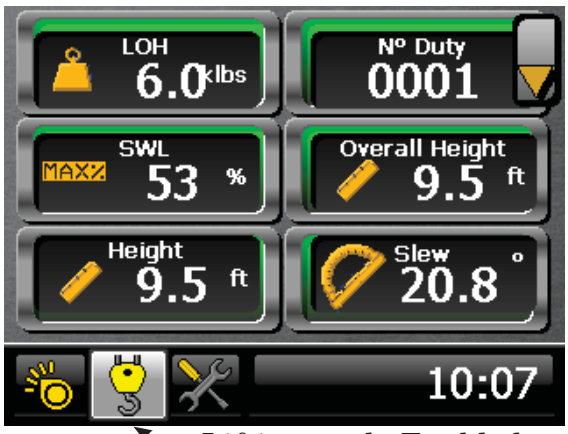
4.5 Duty selection (continued)

5. Press “ENTER” to confirm your choice.

-5-

Rated Capacity Indicator

The Rated Capacity Limiter (RCL) for excavators indicates the load and Safe Working Load (%SWL) during the handling of heavy objects in order to prevent the tipping over of the machine or the failure of an hydraulic component. An audible and visible warning device alerts the operator when the SWL is reached or in approach during object handling. The lifting mode (RCL) can be disabled by the operator at any time when the excavator performs operations others than handling heavy objects. Once deactivated, this mode will stay disabled until reactivated, even on a system restart.

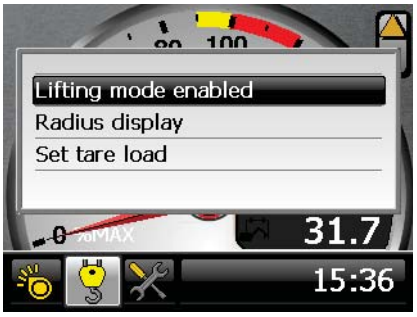


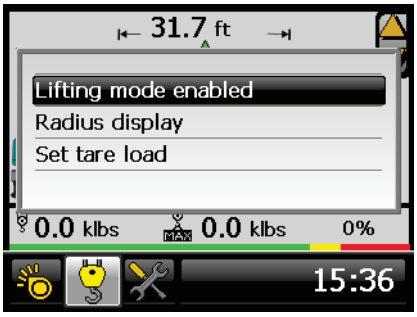
Lifting mode Enabled

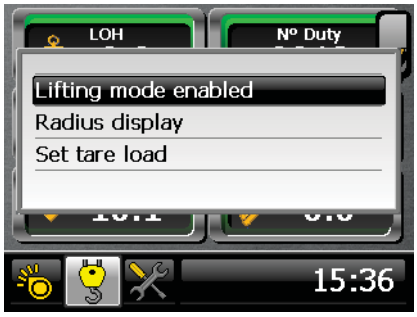
Lifting mode Disabled

5.1 Enabling/Disabling the lifting mode

1. Navigate to the lifting tab and press the “ENTER” key.



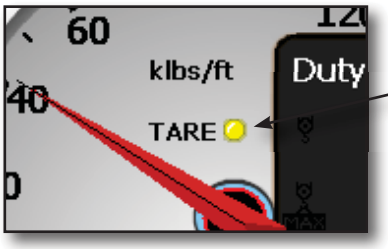




2. Select “Lifting mode enabled/disabled” and press the “ENTER” key.

5.2 Defining or removing the zero setting mode (Tare)

Enable the tare mode option to display the actual load on hook during a lifting operation. This mode is used to remove the weight of the block, hook and hoisting rope. This way it only shows on the screen the weight of the lifted load.



A YELLOW LIGHT INDICATES THAT THE TARE IS ACTIVATED (LOAD ON HOOK ONLY)

1. Navigate to the Lifting mode tab using the LEFT or RIGHT keys.

2. Select the load gauge window using the “DOWN” key.

3. Press the “ENTER” key.

4. Select the third line “Set tare load” and Press ‘ENTER’ to activate the tare load. The line will then change to ‘Clear tare load’.

5. Repeat these steps to cancel the Zero setting (remove tare).

To apply the ‘Tare Load’, the load must be higher than 0. Otherwise, nothing happens.

-6-

Range Limiting System

Carefully read and understand these instructions before setting the Operational Range Limits. Setting the wrong Operational Range Limits can result in accidentally running into obstacles which could lead to serious injury or death.

Excavator travel is prohibited when Range Limiting is activated.

The Operational Range Limits settings must be reprogrammed every time the excavator is moved.

RaycoWylie recognizes that operating excavators in proximity to power lines or equipment is an extremely hazardous practice that requires extra precautions. It is therefore essential to operate the excavator outside the minimum clearances allowed in such a way that there is no possibility of the excavator, load line or load becoming a conductive path, to avoid the risk of being electrocuted. The excavator shall not be used to handle material stored under electrical power lines unless any combination of boom, load, load line, or machine cannot enter the prohibited zone. The range limiting option provided by the **i4000** system shall not be used to delimit the prohibited zone. Refer to federal, state, local safety standards and regulations applicable in your country regarding operating excavators in proximity to power lines.

6 Range limiting (continued)

If the range limiting option has been activated on your system, a new tab will appear next to the lifting tab. The range limiting option can be disabled by the operator at any time. Once deactivated this mode will stay disabled until reactivated, even on a system restart. Inside the range limiting option tab, multiple options are available to configure.

- Height limit
- Slew limit
- Slew and variable limit
- Height with free zone
- Slew and variable radius

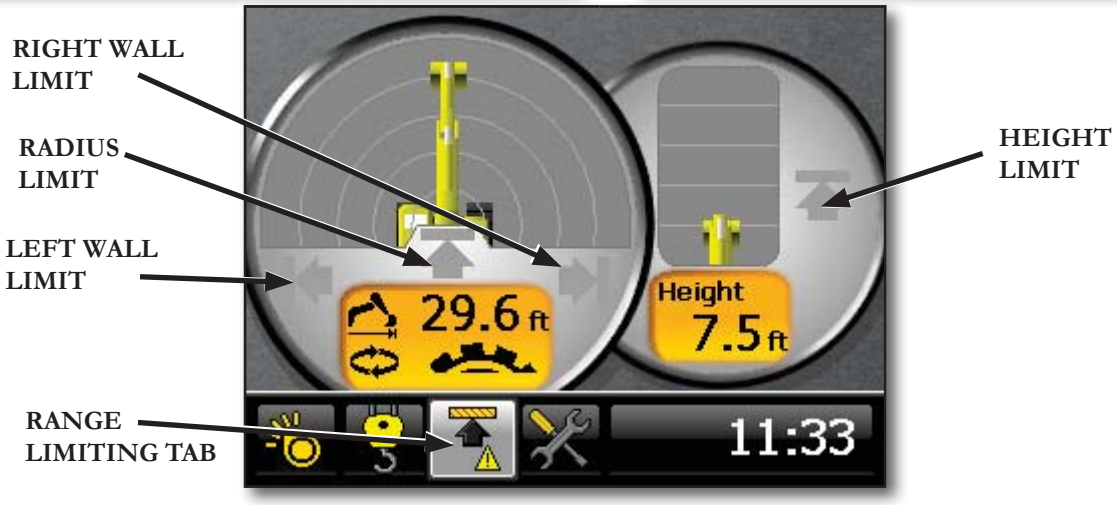
The yellow bar shows the moving boom position.

A yellow arrow indicates an approaching limit.

A red arrow indicates a reached limit.

The dial on the left shows a view from above:
-the radius limit as well as the left and right walls will be shown in red.

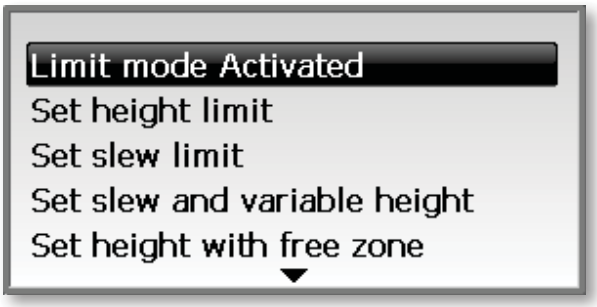
The dial on the right shows a view from the side:
- the height limit will be shown in red.



6.1 Enabling/Disabling the range limiting mode

1. Navigate to the Range limiting tab using the LEFT or RIGHT keys and then press “ENTER”

2. Select “Limit mode Activated/Deactivated” and press “Enter” to Activate/Deactivate it.



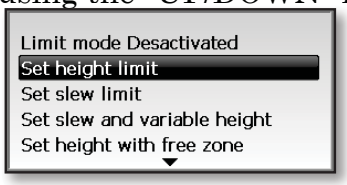
6 Range limiting (continued)

6.2 Height Limit

The height limit is the maximum boom or stick height desired. We can also consider that is a ceiling of fixed height on 360 °.

1. When in the range limiting tab, press the 'ENTER' key to access the range limiting adjustment menu.

2. Select "Set height limit" using the "UP/DOWN" keys.



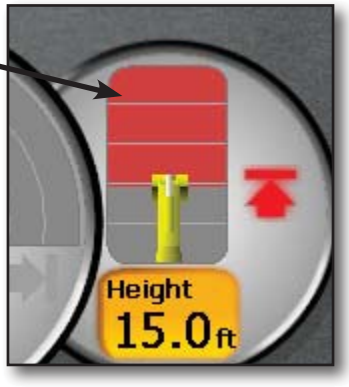
3. Press the "Enter" key to confirm your choice.

4. Boom up to the desired height limit using the stick tip.

5. Press the "Enter" button to confirm the maximum limit.

6. As you release the "Enter button, a 10 seconds countdown will allow you to boom down before your programmed height limit becomes active.

Height limit programmed (RED ZONE)



Height limit reached

Height limit approached

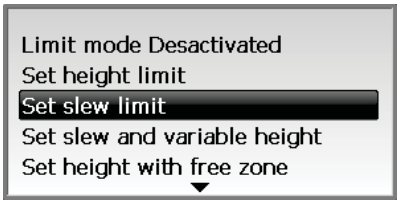
6 Range limiting (continued)

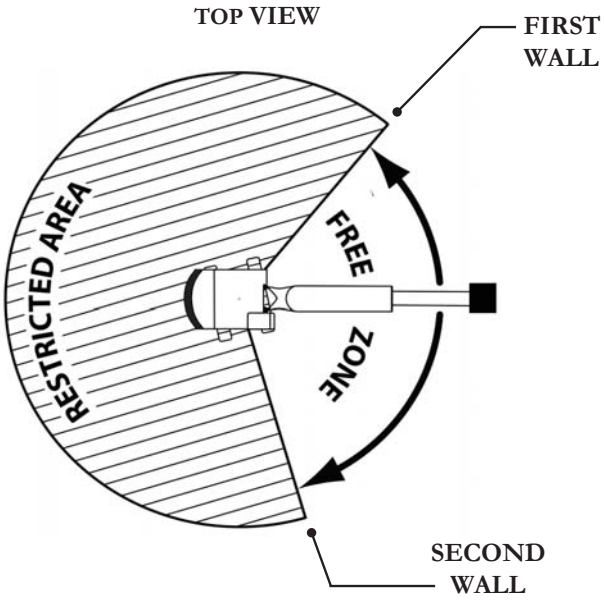
6.3 Slew limit

The slew limit is a zone without height limits. The slew limit is limited by 2 walls on each side.

1. When in the range limiting tab, press the "ENTER" key to access the range limiting adjustment menu.

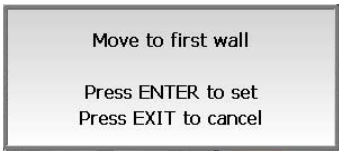
2. Scroll up or down to highlight the 'Set slew limit' line.





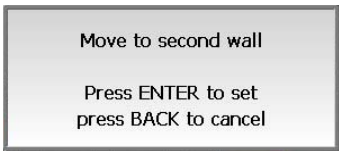
3. Press the "ENTER" key to confirm your choice.

4. Slew to establish the position of the first limit (first wall).



5. Press "ENTER" to confirm the position of the first wall.

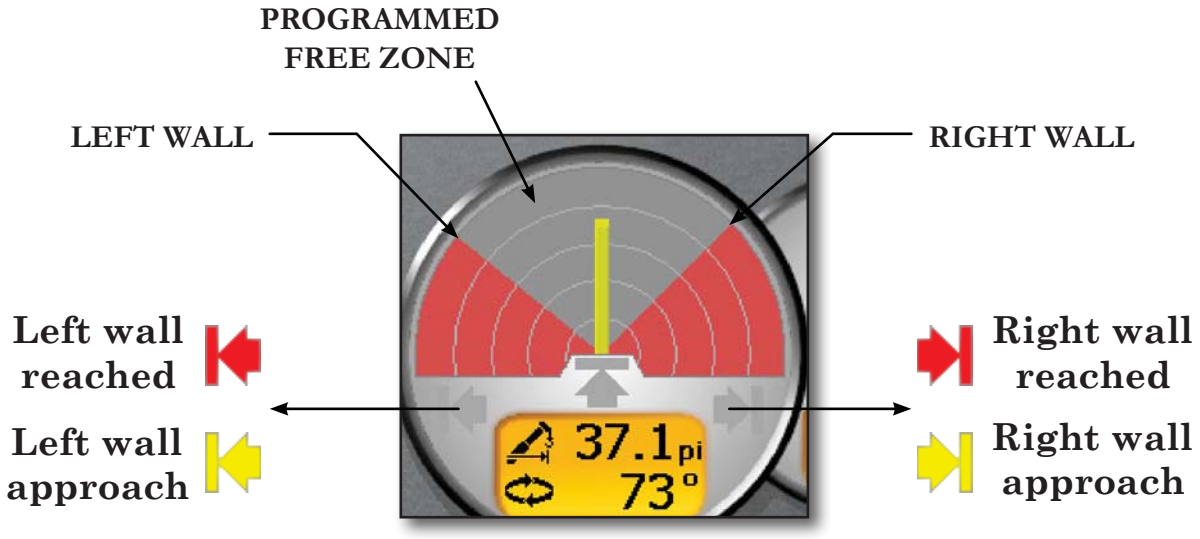
6. Slew in the other direction and establish the position of the second limit (second wall).



7. Press "ENTER" to confirm the position of the second wall. After you release the key, you will have a 10 second countdown to bring the boom between both walls before your programmed limit is activated.

6 Range limiting (continued)

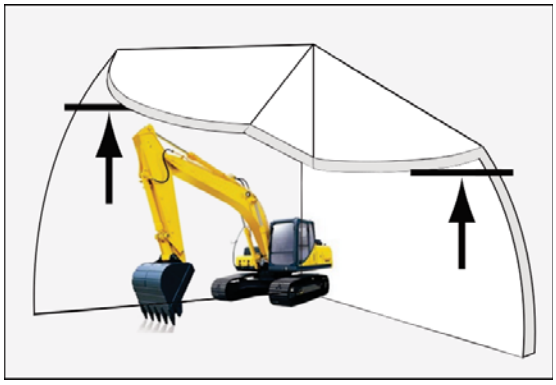
6.3 Slew limit (continued)



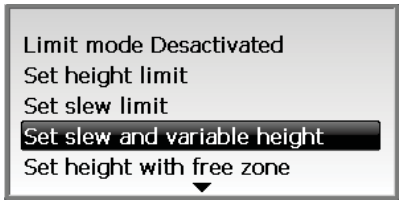
6.4 Slew and variable height

A variable height limit is a height limit which can be different at different slew angles (variable ceiling).

1. When in the range limiting tab, press the 'ENTER' key to access the range limiting adjustment menu.



2. Scroll up or down to highlight the 'Set slew and variable limit height' line.

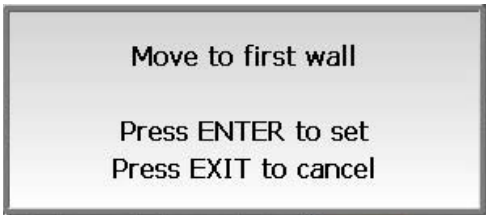


3. Press **'Enter'** to confirm your choice.

6 Range limiting (continued)

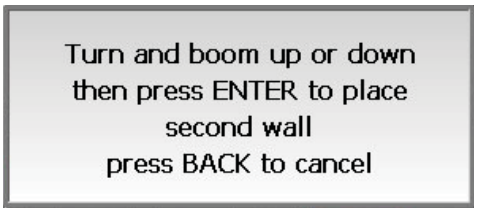
6.4 Slew and variable height (continued)

4. Rotate the boom until you reach the position of your first limit (first wall).



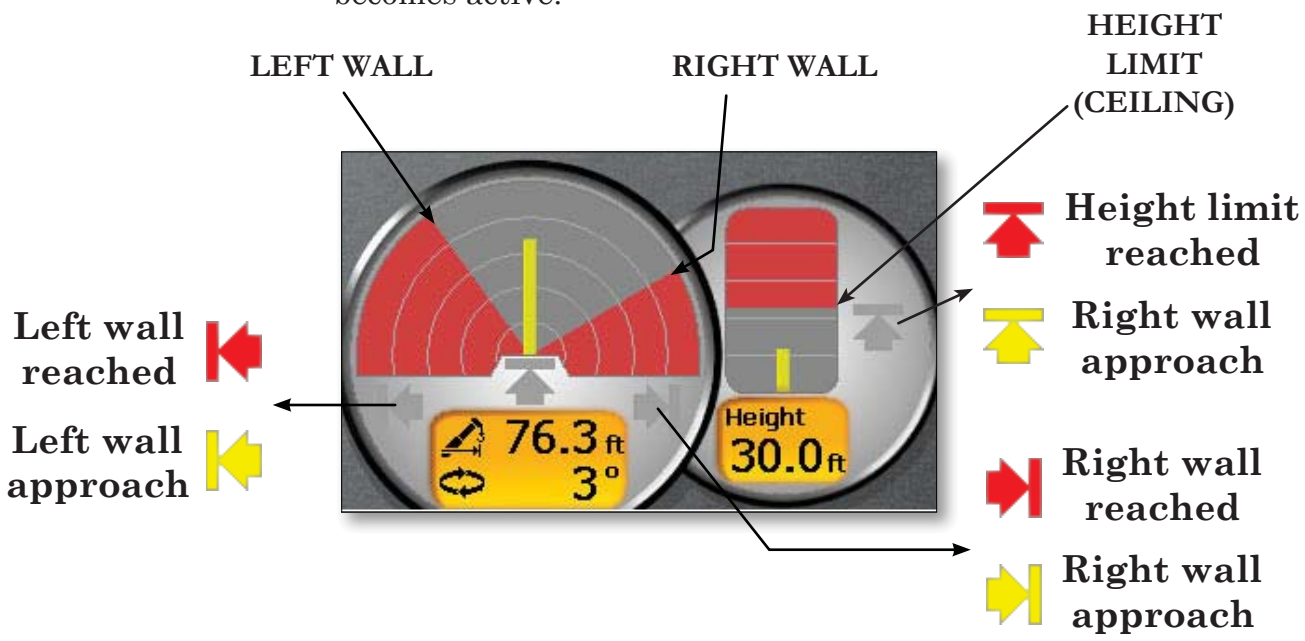
5. Press the 'Enter' button to confirm the position of your first limit.

6. Slew toward the second limit position (second wall) with the stick tip always at the maximum height permitted by the surrounding environment .



7. Press 'Enter' to confirm the position of the second wall.

8. As you release the '**Enter'** key, a 10 second countdown will allow you to return between the two walls and boom down before your programmed Slew and variable height Limit becomes active.



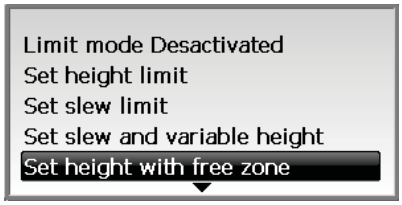
6 Range limiting (continued)

6.5 Height with free zone

A Height limit with free zone is the same as combining an height limit with a slew limit. It gives the ability to add a fixed height limit with two walls.

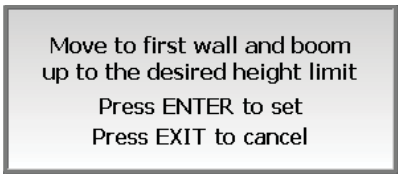
1. When in the range limiting tab, press the 'ENTER' key to access the range limiting adjustment menu.

2. Scroll up or down to highlight the 'Set height with free zone' line.



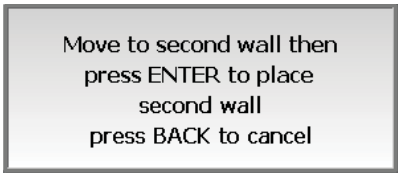
3. Press **'Enter'** to confirm your choice.

4. Rotate the boom until you reach the position of the first wall then boom up to the desired height limit using the stick tip.



5. Press the 'Enter' button to confirm the position of your first limit.

6. Rotate the boom until you reach the position of the second wall.

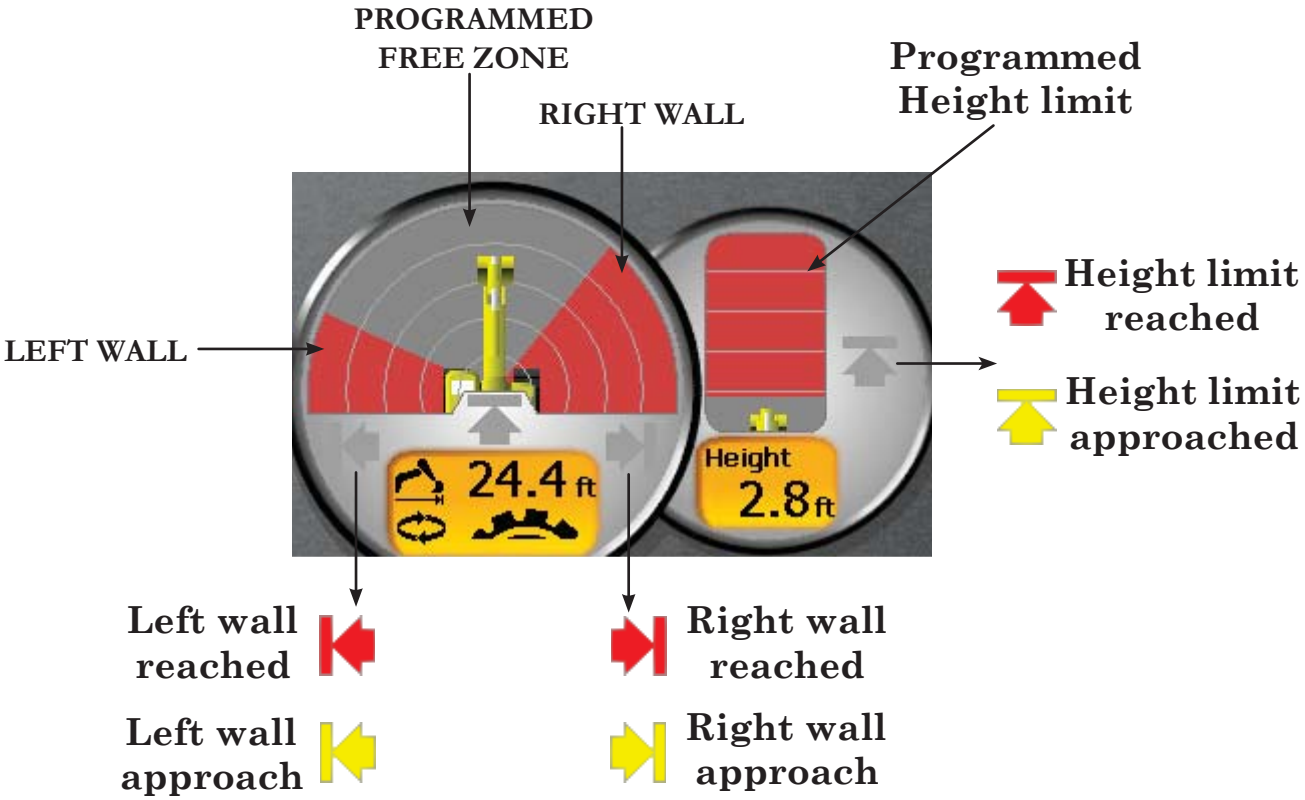


7. Press 'Enter' to confirm the position of the second wall.

6 Range limiting (continued)

6.5 Height with free zone (continued)

8. As you release the '**Enter'** key, a 10 second countdown will allow you to return between the two walls and boom down before your programmed Slew and height Limit becomes active.

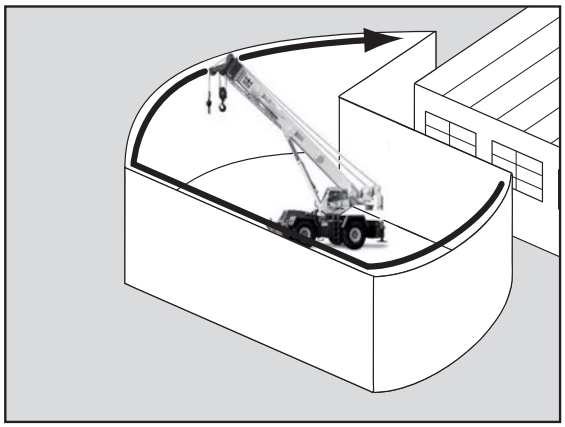


6 Range limiting (continued)

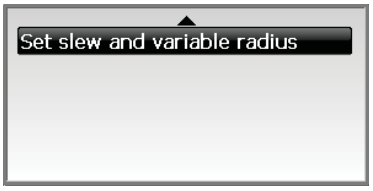
6.6 Slew and variable radius limit

A variable radius limit is a radius limit which can vary depending on the rotation angle of the boom.

1. When in the range limiting tab, press the 'ENTER' key to access the range limiting adjustment menu.

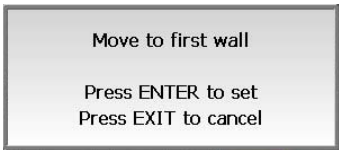


2. Scroll up or down to highlight the 'Set slew and variable limit radius' line.



3. Press 'Enter' to confirm your choice.

4. Slew until you reach the position of your first limit (first wall).

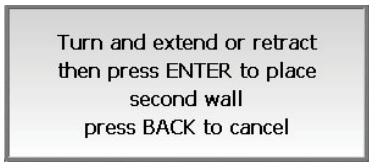


5. Press 'Enter' to confirm the position of your first limit.

6 Range limiting (continued)

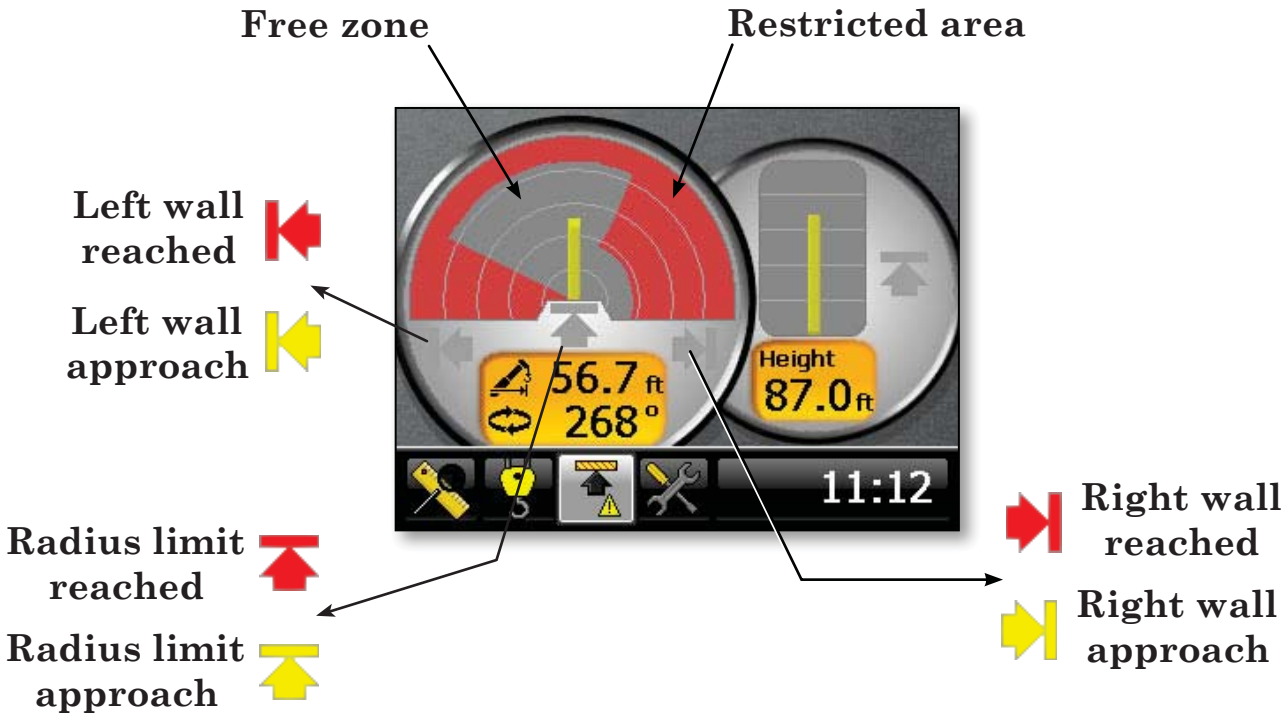
6.6 Slew and variable radius limit (continued)

6. Slew toward the second limit position (second wall) with the boom tip at the maximum radius permitted by the surrounding environment .



7. Press ‘Enter’ to confirm the position of the second wall.

8. As you release the ‘Enter’ button, a 10 second countdown will allow you to return between the two walls and boom up within the allowed radius limit before your programmed Variable Radius Limit becomes active.



-7-

Diagnostic and maintenance

Warning! Maintenance must be performed by a qualified technician, or by an operator aided by a RaycoWylie technician.

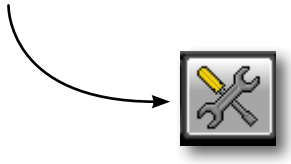
In this section you will find the necessary technical assistance for performing maintenance. This section provides answers to the questions frequently asked to the personnel during installation, repair, or maintenance of the i4000 system.

7.1 Diagnostic menu

A diagnostic menu provides information on the system state and also the state of every connected sensors.

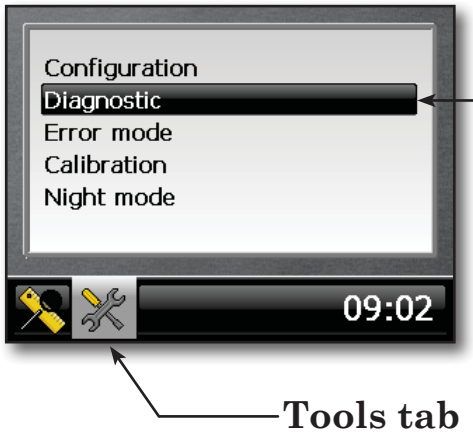
To access the diagnostic menu:

1. Navigate to the Tools tab with the LEFT or RIGHT keys.



2. Use the '**UP/DOWN**' keys to highlight the diagnostic line.

3. Press the **'ENTER'** key to access the diagnostic menu.



7.1 Diagnostic menu (continued)

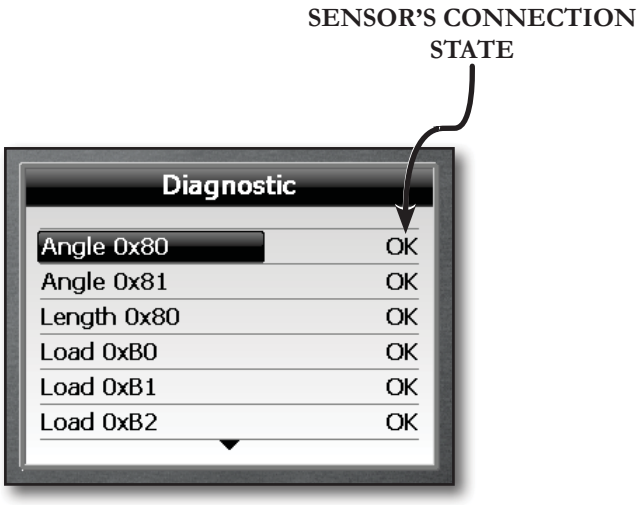
Each line in the diagnostic menu will open up another page when you select it. Each page deals with a specific type of sensor or a particular type of information.

Independently of your system configuration, the following 2 pages are always accessible: “System and Detected Adress”.

Additional pages are optional and they are only visible if one or more sensors are activated (refer to the option ‘Activate / Deactivate I / O’ in the calibration manual).

The ‘UP/DOWN’ keys allow the user to navigate within the diagnostic menu.

In the diagnostic menu, this is the information normally shown:



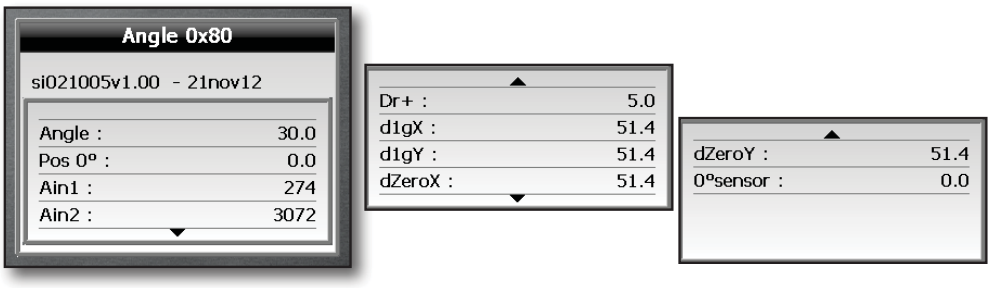
Some application have more than one angle or load sensor.
In such a case, the pages showing these sensors will equally appear in this menu.

The second column shows the connection state of the sensor in the CAN Bus network.

Press ‘BACK’ to access the previous menu or to quit the diagnostic mode.

7.2 Angle and Length sensor

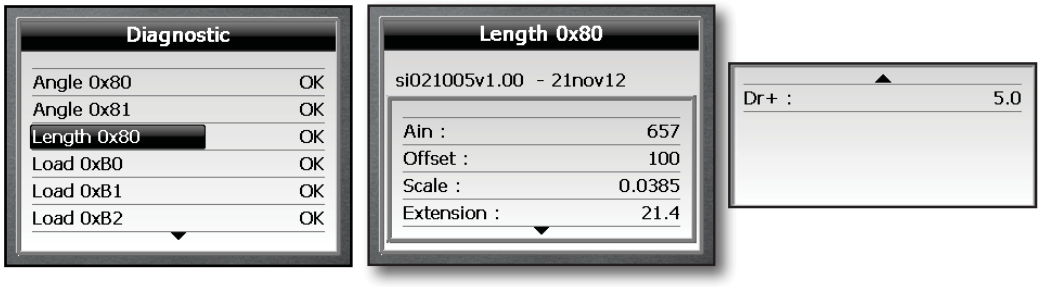
Press 'ENTER' when 'Angle' is highlighted to view the name and version of the angle sensor software as well as its calibration status. The information shown will look like this:



These values will allow the RaycoWylie technician to diagnose a problem with the sensor. In case of an angle sensor multifunction, take note of these values and report them to a RaycoWylie technician.

Press 'BACK' to go back to the main screen of the diagnostic mode.

Press 'ENTER' when 'Length' is highlighted to view the calibration status of the length sensor. The information shown will look like this:

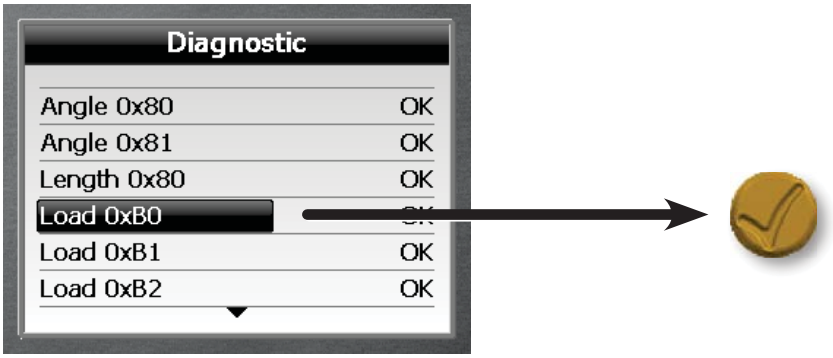


The following are the basic criteria for a proper functioning of the length sensor:

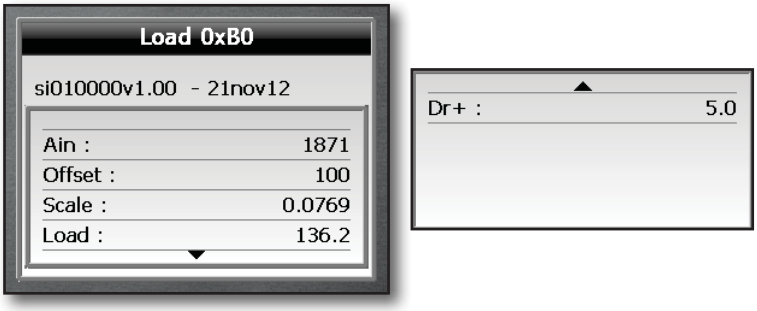
- The value of the Scale factor must be less than 1,0.
- **Dr+** must be close to **5,00** DC volts.

7.3 Load sensor

To find out about the load sensor software version or calibration status, press 'ENTER' when a Load sensor is highlighted.



The information displayed will look like this:



The following are the basic criteria for a proper functioning of the load sensor:

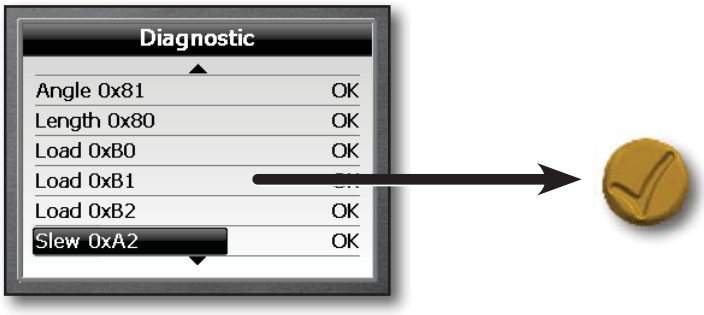
- The value of the Scale factor must be less than 1,0.

- Dr+ must be close to 5,00 DC volts.

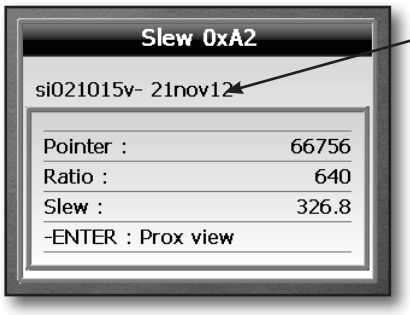
Press 'ESCAPE' to go back to the main screen of the diagnostic mode.

7.4 Slew sensor (Option of the range limiting device)

In the diagnostic menu, press the 'ENTER' key after highlighting the slew.



The slew sensor information should look like this :



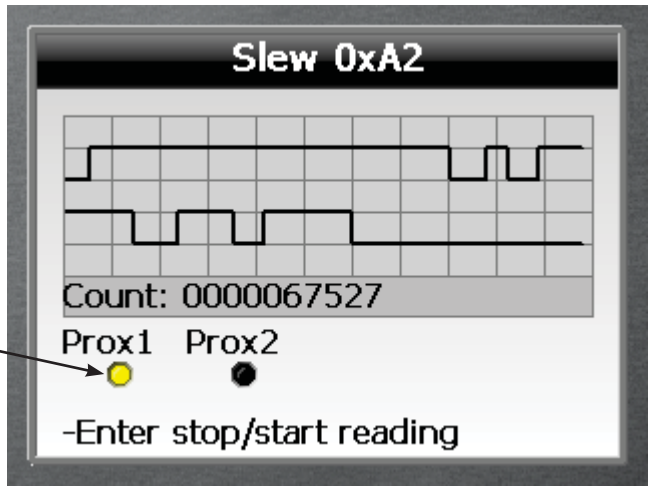
This line shows the name and software version of the slew interface.

The values in the box will allow the technician to diagnose a potential problem coming from the slew sensor.

> The information represented here may differ according to the slew sensor used.

When using proximity switches to replace a slew sensor, it is possible to monitor the value of each switch independently by pressing "ENTER" while viewing the slew sensor diagnostic screen.

Proximity switch ON/OFF indicator

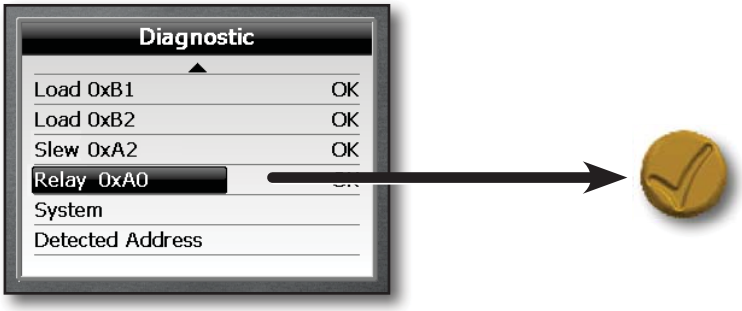


Press "ENTER" to stop/start the real-time reading of the proximity switches.

7.5 Relay board

The information shown for the relay board depends on the relay card used. For example, the 33M0110 is composed of 4 HDIN and 8 HDOUT. For the HDIN, a '1' means that there is a valid signal at this particular input. For the HDOUT, a '1' means that the output is powered and a '0' means that there is no power on the output. See the relay board specifications for more info.

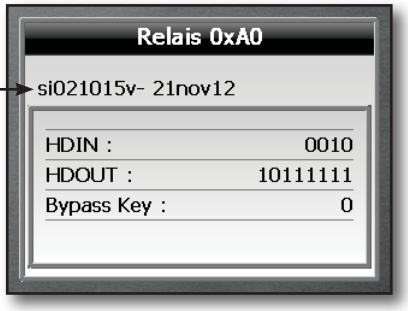
In the diagnostic menu, press the 'ENTER' key after highlighting the 'Relay' option.



The system shows the diagnostic screen of the relay board which should look like this :

*three relay cards are supported by the system, the displayed information will vary depending on the relay card used. (33M0106, 33M0110 & 33M0118)

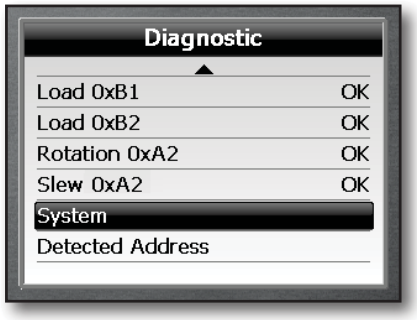
This line indicates the name and software version of the relay board as well as the creation date.



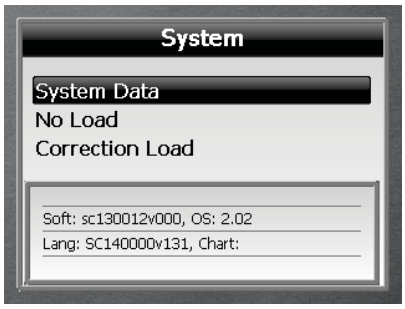
Press the 'BACK' key to return to the main screen of the diagnostic screen.

7.6 Software information

To find the software information, press the 'ENTER' key after highlighting the 'System' option.



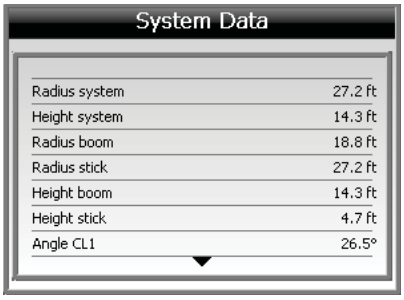
In this menu, there are 3 additional options. System data, No load and correction load.

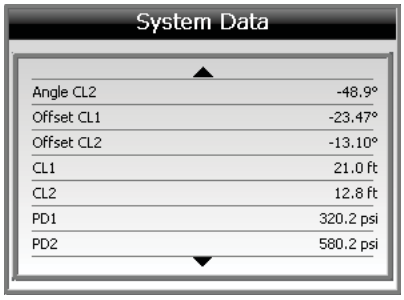


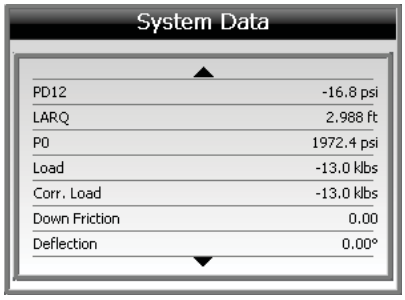
At the bottom is displayed the Software version, the Operating system version and the Language file.

Press the 'BACK' key to access the previous menu or to quit the diagnostic menu.

7.6.1 System Data





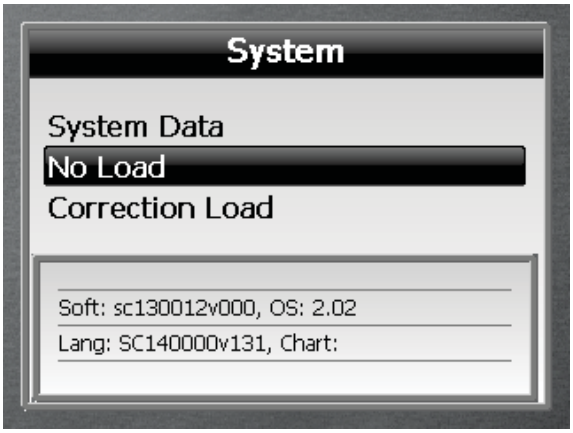


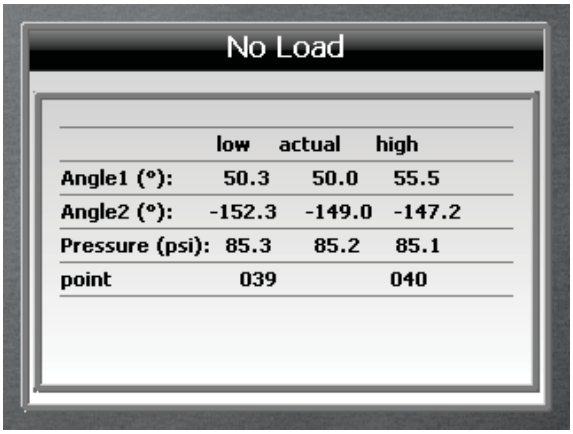
All the important informations of activated sensors can be found in this menu.

Press the 'BACK' key to access the previous menu.

7.6 Software information (continued)

7.6.2 No Load

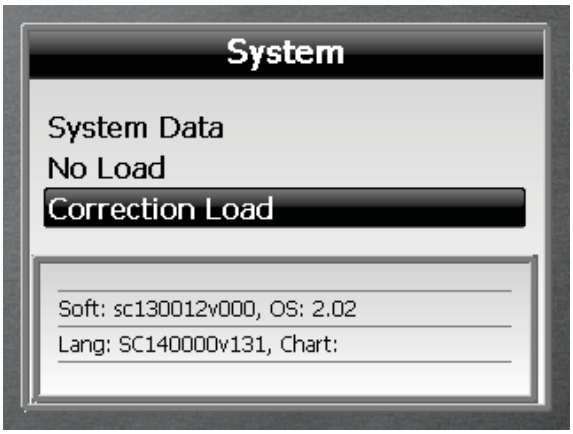


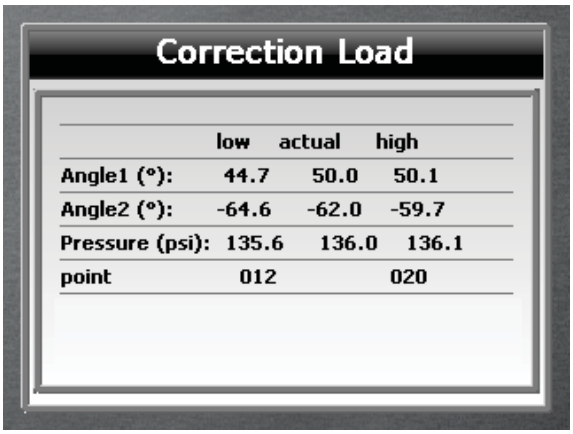


The informations concerning the No Load relative to the current duty can be found in this menu.

Press the 'BACK' key to access the previous menu.

7.6.3 Correction Load



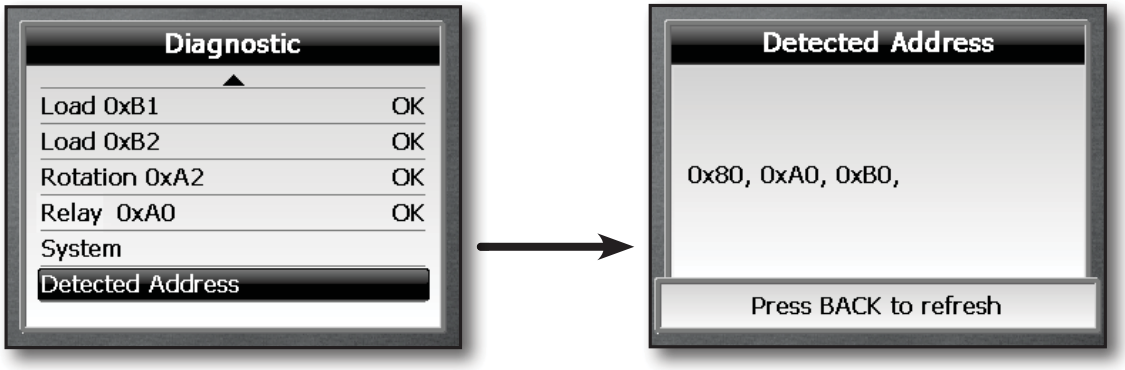


The informations concerning the Correction Load relative to the current duty can be found in this menu.

Press the 'BACK' key to access the previous menu.

7.7 Detected addresses

This page of the diagnostic menu displays the addresses of the different sensors on the bus CAN network detected by the i4000 system. The addresses remain in the memory as long as the system is on, even if a sensor stops sending information.



7.8 Error messages

At power-up and during other processes, the i4000 system analyzes all the interactions between the internal peripherals (memories, controllers, extension boards) and the external peripherals (physical boards connected with the CAN Bus network). The system error indicator will appear on the main screen if an error is detected.

7.8.1 Internal peripherals

*If you have any questions or need assistance, please contact the **RaycoWylie** technical assistance department.*

Error message	Runtime process	Error cause
Read calibration **Read canbus config.** **Read logger** **Read absolute limiter**	During start-up, the system runs an integrity check of all the data in the flash memory (CRC).	There is a problem with the flash memory of the system in the display of the i4000. Contact the RaycoWylie technical assistance department.
Bus Off	Verification of the bus CAN controller.	1) There is a physical problem on the CAN network.. Contact the RaycoWylie technical assistance department.
Calib. parameter	The excavator's dimensions must be correctly entered, otherwise the load value could be nil or wrong.	The value of variables CL1, CL2 and CL2MR should never be zero.

7.8 Error messages (continued)

7.8.2 External peripherals

A) Angle / Length interface errors

The i4000 system can communicate with multiple angle and one length interface. Each sensor is activated through the calibration menu in the **"Enable/Disable sensors"**section.

Error message	Runtime process	Error cause
Angle 1: Sensor fail	The value of the sensor's signal in volts is not valid (1 to 4 volts).	1) The 12 bit converter or accelerometer is faulty.
Length 1: Sensor fail	A code is sent by the angle/ length interface to indicate that the length sensor is disconnected.	1) The length sensor is not installed. 2) A cable between the length sensor and the interface is broken.
Angle 1: In prod. Cal		Indicates that the angle/length interface is in pre calibration mode.
Angle 1: Lost communication **Length 1: Lost communication**	The system has not received a valid message from the Angle/Length interface within the required time frame.	1) The Angle/Length interface is faulty. 2) The cable linking the interface to the bus CAN network is broken.
Length 1: Is not calib.		The Length sensor is not calibrated.
Angle 1: Is not calib.		The Angle sensor is not calibrated.
Angle 1: DR+ fail **Length 1: DR+ fail**	The 5 Volts reference tension is not valid (If < 4.5 volts or > 5.5 volts).	The Angle/Length interface circuit is faulty.

7.8 Error messages (continued)

7.8.2 External peripherals (continued)

B) Load interface error

The i4000 system can communicate with multiple load interfaces. Each sensor is activated through the calibration menu in the **"Enable/Disable sensors"**section.

Error message	Runtime process	Error cause
Load 1 (or 2): Sensor fail	The value of the load sensor signal in bits is not valid)(If < 150 or > 3945).	1) The 12 bit converter or amplifier is faulty. 2) The cable linking the load sensor and the interface is broken.
Load 1 (or 2): Not calib		The load 1 or load 2 sensor is not calibrated.
Load 1 (or 2): Dr+ fail	The 5 Volts reference tension is not valid (If < 4.5 volts or > 5.5 volts).	The load interface circuit is faulty.
Load 1 (or 2): Lost communication	The system has not received a valid message from the Load interface within the required time frame.	1) The Load interface is faulty.. 2) The cable linking the interface to the bus CAN network is broken.

C) Relay interface and digital input error.

The i4000 system can communicate with 1 relay interface and digital input. Each relay interface is activated through the calibration menu in the **"Enable/ Disable sensors"**section.

Error message	Runtime process	Error cause
Relay 1: Lost communication	The system has not received a valid message from the relay interface within the required time frame.	1) The relay interface is faulty.. 2) The cable linking the interface to the bus CAN network is broken.

There is no automatic test to verify the relay output contacts. As a result, if a relay contact is faulty, this error cannot be detected by the system. The operator should periodically test the proper functioning of the lockout system.

7.8 Error messages (continued)

7.8.2 External peripherals (continued)

D) Slew Sensor J1939 error

Absolute slew

The i4000 system can communicate with only one slew sensor (encoder). The slew interface is activated through the calibration menu in the **"Enable/Disable sensors"**section.

Absolute slew (same position kept at all times)

Error message	Runtime process	Error cause
Slew 1: Ratio not set	The system detects a ratio of 0.	No ratio has been entered or calibrated.
Slew 1: Lost communication	The system has not received a valid message from the slew (encoder) within the required time frame.	1) The slew interface is faulty.. 2) The cable linking the interface to the bus CAN network is broken.

-8-

Inspections and maintenance

8.1 Frequent inspections
(Performed each time the excavator is used)

- When you switch on the system, check if all the alarm lights, audible alarms, and lockout are working.
- Make sure the system is correctly configured.
- Check the accuracy of the clock.
- Make sure the system has not detected any errors.
- Check the weight on the hook (it should be the same as the last time you checked).
- Check the radius according to the boom selection. The radius displayed should be between 0 and 10 % larger than the current radius of the excavator.

Careful! Before using the machine, you should identify any defects and assess if they can have serious consequences.

8.2 Periodic inspections (every six months)

Please perform regular inspections of:

- The cables (verify they are not cut or damaged) and the connectors (verify the contacts are not corroded).
- Relay functionality for the lockout.

8.3 Checking the displayed load

- Position and level the machine.
- The person who does the test should be qualified to operate the excavator and the i4000 system.
- The excavator and the system must be correctly configured.
- The capacity chart must be respected.
- A known weight, accurate by ± 1% and equal to the nominal capacity close to the maximum radius should be used to test the alarm and the load indicator's accuracy.
- Another known weight, accurate by ± 1% and equal to the nominal capacity close to the minimum radius should be used to test the alarm and the load indicator's accuracy.
- Rig with enough strands to lift a significant load.
- Measure and enter the radius and the load on the hook.
- Record the radius, load on hook and number of strands on the display unit's screen.
- Lift the load.
- Enter the current weight including the hook and the rigging accessories.
- Record the average, maximum, and minimum values.
- Rig the hoist, stop and record the same values than in the previous step.
- Record the current and displayed radius.
- Lower the load.
- **RaycoWylie** recommends that all tests be signed and dated, and a copy of the last test be available at all times.

8.4 Maintenance

Unless otherwise specified by a RaycoWylie technician, all (original and replacement) parts must be provided by RaycoWylie.

Preventive maintenance

- Your i4000 system has been designed to work during long periods, requiring the least maintenance possible. However, the system does need to be maintained and cleaned to function properly.

Important: Do not clean the i4000 display unit, the junction boxes, the angle sensors, load cells, and connectors with a high-pressure air stream. This could cause mold to appear in the connectors, and a possible failure of the sensors.

- Use a soft soap (or a glass cleaner) and a soft cloth to wash the surface of the display unit.

Important: If you see condensation forming inside the display screen, open the cover and let it dry for a whole day in a dry place.

- Replace all cables that might be damaged. Check that the contacts of the connectors are not corroded.
- Replace the switches if the piston is too corroded.

In order to ensure that the i4000 display is water resistant, make sure the back has an X-shaped **tightening**.
Your i4000 system does not need any additional lubrication.

8.5 Maintenance procedure

Before making any adjustments or repairs on the excavator, make sure you take these precautions.

- Place the excavator where it will not disturb other machines or operations in progress.
- Lock out all commands and make sure all functions are rendered inoperative.
- Make sure you lock out the start-up commands.
- Lower the boom to the ground if possible, or prevent it from falling.
- Lower the pulley block to the ground if possible, or prevent it from falling.
- Increase the hydraulic pressure of all hydraulic circuits before releasing or lifting the hydraulic components.
- A 'Danger' or 'Broken' sign should be placed on the excavator commands, to be removed only by authorized personnel.
- Once the adjustments and repairs are finished, the excavator should still not be used until all the safety devices have been activated and the air released from the hydraulic system. The instructions to release the air from the hydraulic systems should be provided by the excavator manufacturer.

8.6 Adjustments and repairs

- All unsafe conditions noted during an inspection should be fixed before using the excavator again.

Important: Only qualified personnel should perform the adjustments and repairs.

All adjustments should be made in compliance with the tolerated values specified by RaycoWylie in order to keep each system component in proper working condition.

- If you need spare parts to complete the maintenance or repairs, please contact the **RaycoWylie** technical assistance department**.**

If you have any questions or need assistance, please contact our technical assistance department. Have your i4000 system's serial number handy.

Notes