CAUTION

Failure to operate this equipment properly may result in damaged equipment, downtime or injury. For any questions or training, contact Rigsmart Systems before use.

Rigsmart Systems Best Practices

- **Washing** - Please do not pressure-wash Rigsmart components. Direct application of high-pressure water can break seals and lead to moisture damage.

- **Replacing Components** - Remove batteries from spares, or components that have been replaced. Spares and replacement components will share the operating frequency of the unit they are replacing and can interfere with normal system operation if allowed to transmit.

- **Swapping components between rigs** - Rigsmart components are not directly transferable between Rigsmart systems. An identical component from one rig cannot readily be used to replace one from another rig. All components are initialized for a system receiver. This allows adjacent installations while eliminating cross-talk between components.

- **Welding** - Disconnect or power off the Rigsmart system before any welding takes place near the systems placed on the rig. Our components have built-in current protection, but welding can interfere with normal operation.

- **Adding wireless devices** – Wireless routers, bridges and or controls for non-Rigsmart systems, can potentially cause interference with Rigsmart system communications. Please consult a technician before adding wireless devices to a rig.

- **Recalibration** - Loss of power, ground thaws, slipping line and changing components can necessitate a recalibration. Consult this manual for system recalibration. If assistance is required, please contact Rigsmart Systems, at 1-780-438-9475.

- **System Malfunction** - In the event of a system malfunction, record the status of the Rigsmart system, including all alarms and current readings, prior to powering off the system. This information will assist the Rigsmart technicians determine the nature of the problem and find a prompt solution.

- **Pneumatic Device Care** - DO NOT blow Glycol or other methyl hydrates – such as brake line antifreeze or tanner gas, through air lines that lead to Rigsmart pneumatic devices. Permanent damage may occur and safety critical devices may not operate correctly.
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For sales, service or assistance:

1-780-438-9475

You have invested in the industry’s leading technology in rig safety equipment.
Thank you for your business.

RIG SAFETY. MADE SIMPLE.

This manual covers the operation of the Rigsmart system.
Each system is custom designed to the rig and customer.
Not all information contained in this manual may pertain to your specific system.
For any questions about system design, contact Rigsmart Systems.

Warranty

Rigsmart Systems warrants to the purchaser of each new Rigsmart System that any part thereof which proves to be defective in material or workmanship within one (1) year from date of delivery will be repaired or replaced at no charge if the system is returned to us in Edmonton, Alberta with all freight charges prepaid. If a performance problem should occur, contact our office in Edmonton, Alberta at 1-780-438-9475.

This warranty does not cover defects resulting from accident, alteration, improper use, or failure of the purchaser to follow normal operating procedures as outlined in this instruction manual.

PLEASE NOTE:
OPENING THE DISPLAY/RECIEVER PANEL VOIDS WARRANTY.
THIS WARRANTY IS IN LIEU OF ANY WARRANTY OR MERCHANTABILITY AND OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, ALL OF WHICH ARE HEREBY EXCLUDED.

Rigsmart Systems shall in no event be liable for any special, indirect, or consequential damages whatsoever and neither assumes nor authorizes any person to assume for it any other obligation or liability.
1 Description

Anti-Collision System

The Rigsmart Anti-Collision system uses a set of wireless sensors to determine the position and height of the rig’s traveling blocks, top drive and bails. When the traveling blocks or top drive is in a position that could contact or damage the rig, the panel will sound an alarm and apply the brakes. The system may also integrate a wireless crown saver which is installed near the rig crown. This switch is triggered and brakes activated when the blocks lift an attached counterweight. The rig’s main brakes may be activated either pneumatically or electrically based on the design of the system.

Drill Line Weight Indicator

The Drill Line Weight Indicator detects how much weight is suspended by the blocks, and remains accurate over time and through extreme temperatures. Through its design, it does not need to be removed during a slip-and-cut and does not need recalibration as long as the size of the drill line used remains the same. The weight indicator may include an analog dial gauge or a connection to a third party weight system.

Throttle Limiter Speed Control

The Rigsmart Throttle Limiter will automatically limit the speed of the traveling blocks in the upwards direction before a hard stopping limit is reached. It can be integrated pneumatically or electrically based on the design of the system.

Auxiliary Brake Speed Control

The Rigsmart Auxiliary Brake Controller will automatically engage the auxiliary brake, slowing the speed of the traveling blocks in the downwards direction before a hard stopping limit is reached. It can be integrated pneumatically or electrically based on the design of the system.

Other Devices

The Rigsmart system may include a number of other devices such as pressure sensors, emergency stops, flow meters, BOP ram transducers or other transducers.
2 Normal Operation

2.1 Start Up

When the Rigsmart system is powered on, a screen will appear asking for the user to accept control over the system. For safety purposes all outputs from the system are activated at this point, engaging the rig's brakes. When the user accepts control of the system, the rig's brakes are released and normal use can begin. This intermediary control between the system and the operator safeguards the rig in the event of an unexpected power loss/restore situation. To assume control over the system, press the SELECT button on the display panel.

![Waiting for Operator Confirmation]

Press SELECT to Continue.

2.2 Main Operation Screen

In normal operation the panel will display the currently measured load and block height information as shown below. The panel will display different screens based on what sensors are installed and activated.

![Load and Block Height Information]

Pressing the SELECT button will open the Secondary Operation Screen. On this screen, the elevator orientation, as well as the angles of the top drive and bails will be displayed.
After displaying the Secondary Operation Screen for 8 seconds, the panel will automatically return to the Main Operation Screen.

### 2.3 TARE

If the Rigsmart system is equipped with a Drill Line Weight Indicator, it will include a tare function. This enables the operator to ‘zero out’ the weight of the hook load. Once the tare function has been enabled, only the weight below the hook will be displayed as the actual weight on the Main Operation Screen.

To Enable Tare Out:

- From the Main Operation Screen press the SELECT button to display the Secondary Operation Screen
- Use the up or down arrow button to select TARE. This automatically opens the Main Operation Screen and a ‘T’ will be displayed at the end of the bar graph.

To Disable Tare Out:

- From the Main Operation Screen press the SELECT button to display the Secondary Operation Screen.
- Use the up or down arrow button to select TARE. This automatically opens the Main Operation Screen, and the ‘T’ indicator will no longer be displayed.
2.4 SIG

The Signals Screen displays all of the signal strengths and data packets (RF) from the wireless transducers. In optimum conditions, all signal strengths should remain above 95% with a steady increase in RF packets. It is not unusual to see occasional, momentary drops in signal strength or slight delays in RF packets, but the readings should return to normal. If they do not, see the troubleshooting section of this manual.

2.5 INFO

The Info Screen displays system information. This information may be required when calling technical support.

2.6 SETUP

The Setup Menu contains all of the configurable options available on the system.
3 Operating Alarms

When the system encounters a problem (or a pre-set limit) an alarm message will flash on the display panel. For more important alarms, the panel will also beep continuously and if necessary, the rig brakes will also be applied. The message will flash and the beeping will continue until the detected problem is resolved. If however, the panel’s Setup Menu is active when the system detects a problem, the alarm will instead be displayed in the status bar near the bottom of the screen and the panel will not beep.

If any of the components fail, or if a signal is lost for an extended period of time, a system alarm will sound to indicate that there is a problem. The system alarm will display in the same way as a regular operating alarm, but will be accompanied by a faster beeping sound. System alarms for top drive sensors will trigger the brake output as if the sensor had indicated that the top drive was in an unsafe position.

For more information on alarms see the Troubleshooting section at the end of this manual.
3.1 Using Bypass

The panel's BYPASS button can be used if a component is malfunctioning or needs to be temporarily overridden. Pressing BYPASS will disable the alarms and outputs for 30 seconds and allow the blocks to be moved to a safe position. The display panel will count down the 30 second interval, and then resume normal operation.

*It’s very important to use the BYPASS button with caution. If rig activity is resumed before the bypass state is fully counted down, any potential collisions during the countdown will not be prevented by the system.*

3.2 Low Air Pressure

The Rigsmart system may be equipped to pneumatically activate the rig’s main brakes. This equipment requires a steady supply of rig air of no less than 100 PSI to operate correctly. If the system detects the rig air pressure drop below 70 PSI, an alarm will register on the panel; if there is not enough air in the system to activate the rig’s brake, a collision may occur.
3.3 Emergency Shutdown

The Rigsmart system may be equipped with Emergency Shutdown (ESD) switches. These switches send a wireless signal to the display panel, which then shuts down a corresponding output—usually an engine kill or braking system.

In normal operation the panel will display “SHUTDWN1 OKAY” and “SHUTDWN2 OKAY”, as shown below, to indicate that no problems are detected.

The ESD alarm is triggered when any of the ESD switches are pressed. The alarm will flash on the display panel with an audible beeping while the switch is set. The display will also alternate between an alarm message indicating which switch was triggered, and the main status screen showing a status of ‘ALRM’ for the ESD switch that was pressed.

To resolve the alarm, simply pull out the ESD button on the switch.

The BYPASS button (on the front of the display panel) is used to temporarily restore normal system functionality during an alarm condition. However, due to the emergency nature of the ESD switch, the bypass cannot be used to override an alarm caused by an ESD switch being set.

If an ESD switch fails due to damage, dead battery or loss of signal, the corresponding output of the alarm hub will be triggered (as if the switch were set). In this case, the BYPASS button can be used to temporarily restore normal operation.
3.4 Using the Raise Derrick Menu

The Raise Derrick Mode is used to disable alarms associated with the crown saver counterweight. Normally, the rig brakes are applied when weight is taken off the counterweight, in order to avoid a collision between the top drive and the crown. In Raise Derrick Mode however, the counterweight alarm will not be triggered and the rig brakes will not be applied, in order to facilitate a rig-up or rig-down situation. The Raise Derrick option is only available when using the supervisor permission code.

- Using the instructions in the Troubleshooting section, enter the supervisor permission code.
- From the Top Menu, use the arrow buttons to highlight OPERATIONS and press the SELECT button.
- While in Raise Derrick Mode (as indicated by the displayed message) the panel outputs will be disabled.

![Raise Derrick Mode]

When the Rigsmart system is put into Raise Derrick Mode, all outputs are bypassed and the system will not prevent any potential collisions.
To re-enable the brake output and return to normal operation, use the arrow buttons to highlight EXIT and press SELECT. Press the ACCEPT button to confirm switching modes.

*While in Raise Derrick Mode, all statuses for system sensors are unavailable.*

### 3.5 Using Run Casing Mode

The Run Casing Mode allows temporary operation of the top drive without bails attached. This option ignores the current state of the bail angle sensors and does not provide any bail collision prevention. While in Run Casing Mode, the bail angle will be shown as ‘CASING’ instead of the currently measured angle. The floor saver height will be adjusted to the ‘TD BTM FLOOR HT’ (the height of the bottom of the top drive) as set and displayed in the Anti-Collision Limits Menu (if applicable, see the Anti-Collision Limits section below for more information).

The system will not indicate a lack of communication with the bail sensor, allowing movement of the bails to a location away from the panel antenna. If the panel is restarted, the system will automatically turn off Run Casing mode, and will once again display the proper bail angle and indicate any bail-specific alarms.
Follow the instructions below to turn the Run Casing Mode on and off.

*Run Casing will only appear if ‘TOP DRIVE = on’ is shown on the panel. Run casing will not appear when ‘TOP DRIVE=off’ is shown.*

- Using the instructions in the Troubleshooting section, enter the supervisor permission code.
- From the Top Menu, use the arrow buttons to highlight OPERATIONS.
- Highlight RUN CASING and press the SELECT button to turn Run Casing Mode on or off.
• After turning Run Casing Mode on or off, use the arrow buttons to highlight EXIT and press SELECT and then ACCEPT to return to the Main Operation Screen.

*Restarting the panel will also cause the system to exit Run Casing Mode.*

3.6 Using Ram Saver Mode

If the Rigsmart system is equipped with BOP Ram Sensors, the system may allow the Ram Saver Mode. In normal operation, if the Ram Sensors detect that a BOP ram has been closed, an alarm will sound, but there will be no output or brake control. With the Rams Saver Mode turned on, the system will enable the brakes immediately upon detecting a BOP ram being closed.

Use the following instructions to turn the Ram Saver Mode on and off:

• Using the instructions in the Troubleshooting section, enter the supervisor permission code.

• From the Top Menu, use the arrow buttons to highlight OPERATIONS and press the SELECT button.

• Use the arrow buttons to highlight RAM SAVER and press SELECT. Use the arrow buttons to select ON or OFF. Press the ACCEPT button twice to save the change.
4 System Calibration

4.1 Block Height Calibration

In order for the panel to use and display the correct block height, the drill line payout transducer must be calibrated first. The system will be pre-calibrated during installation, but the displayed value may need to be adjusted occasionally. See the section below for instructions on how to do so.

If the block height has been previously calibrated but the displayed block height on the panel is no longer correct, the calibration can be restored using the Height Re-Cal Menu (see the ‘Simple Block Height Re-Calibration’ section for instructions).

*If the bails or elevators are changed and the new equipment is of a different size, the anti-collision limits and system calibration will need to be changed to accommodate the new equipment.*

4.2 Full Block Height Calibration – Encoder on Drawworks

If this is the first time a full block height calibration has been done, follow the steps below to calibrate the system.

1. Set POL (parts of line)
2. Set drawworks direction
3. Set the lowest point
4. Set the layer change points, all the way up the derrick
5. Set the crown calibration point

4.2.1 Enter Supervisor Mode

In order to access the calibration settings, you must first enter the supervisor permission code. Refer to the Troubleshooting section for instructions on how to do so.

4.2.2 Choose the Block Parts of Line

By default, the system is set to one part of line. If a different number of parts of line are being run through the block, this setting must be changed before calibrating the block height. If only 1 part of line is being used, skip ahead to the next section.
• After entering the supervisor permission code and being returned to the Top Menu, new options will be available. Use the arrow buttons to highlight the COMPONENTS option and press the SELECT button.

![Components Menu](image1)

• This will open the Components Menu. Use the arrow buttons to highlight the CALIBRATE option and press SELECT.

![Calibration Menu](image2)

• This will open the Calibration Menu. Use the arrow buttons to highlight the PAY-OUT option and press SELECT.

![Pay-Out Menu](image3)

• This will open the Pay-Out (calibration) Menu. Use the arrow buttons to highlight SETTINGS and press SELECT.
- Use the arrow buttons to highlight MAIN POL and press SELECT.

```

TOP MENU>COMPONENTS>CALIBRATE>PAY-OUT

PAY-OUT DIRECTION
DECIMAL POINTS 1
MAIN POL 1
SYS TYPE drum shaft

BLOCK HEIGHT 4.5m
EXIT BACK TOP MENU
```

- Use the arrow buttons to change the value to match the number of parts of line being used.

```

TOP MENU>COMPONENTS>CALIBRATE>PAY-OUT
Press ACCEPT to save changes.
Press SELECT to discard changes.
MAIN POL 4
SYS TYPE drum shaft

BLOCK HEIGHT 4.5m
EXIT BACK TOP MENU
```

- When the desired number of parts of line is shown, press the ACCEPT button, then press ACCEPT again to confirm and save the setting.

```

TOP MENU>COMPONENTS>CALIBRATE>PAY-OUT

SAVE - ARE YOU SURE?

MAIN POL 4
SYS TYPE drum shaft

BLOCK HEIGHT 4.5m
EXIT BACK TOP MENU
```

```

TOP MENU>COMPONENTS>CALIBRATE>PAY-OUT

SAVING...

MAIN POL 4
SYS TYPE drum shaft

BLOCK HEIGHT 4.5m
EXIT BACK TOP MENU
```
4.2.3 Calibrate the Drawworks Direction

Because the Pay-Out Transducer can spin clockwise and counter clockwise, and can be installed on either side of the drawworks, the panel needs to set which spin direction is ‘up’.

- While in the Pay-Out Calibration Settings Menu from the previous step, use the arrow buttons to highlight PAY-OUT DIRECTION and press the SELECT button.

- Highlight the START option and press SELECT.

- As indicated on the status bar, increase the block height by a short distance until the panel displays ‘DIRECTION FOUND-PRESS STOP TO SAVE’ on the status bar.
• With STOP highlighted, press SELECT to store the detected direction.

```
TOP MENU>COMPONENTS>CAL>PAY-OUT>DIREC

Detect the Pay-out direction.
START STOP →CANCEL

PAY-OUT DIRECTION SAVED
EXIT BACK TOP MENU
```

• After detecting the spin direction, pay-out calibration can continue. Highlight BACK and press SELECT.

```
TOP MENU>COMPONENTS>CAL>PAY-OUT>DIREC

Detect the Pay-out direction.
START STOP CANCEL

PAY-OUT DIRECTION SAVED
EXIT BACK TOP MENU
```

• Again, highlight BACK and press SELECT.

```
TOP MENU>COMPONENTS>CALIBRATE>PAY-OUT

PAY-OUT DIRECTION
DECIMAL POINTS 1
MAIN POL 4
SYS TYPE drum shaft

BLOCK HEIGHT 4.5m
EXIT BACK TOP MENU
```

• This will open the Pay-Out Calibration Menu.

```
TOP MENU>COMPONENTS>CALIBRATE>PAY-OUT

→BLOCK POSITION POINT 0 BLOCK POL 4
BLOCK HEIGHT .0m CAL POL 1
SETTINGS
OTHER RE COUNT 1

READY — for PAY-OUT Calibration
EXIT BACK TOP MENU
```
4.2.4 Calibrate the Lowest Point

- Move the block down, as close to the rig floor as possible.
- Measure the distance from the rig floor to the bottom of the elevator.
- Ensure that the BLOCK POSITION setting shows POINT 0.

- Use the arrow buttons to highlight BLOCK HEIGHT and press the SELECT button.

- Use the arrow buttons to adjust the number to the measured height.
• Press the ACCEPT button once the desired height is displayed. Press ACCEPT again to confirm and store the value.

![Save - Are You Sure?](image1)

![Saving...](image2)

• If the position was stored correctly ‘SUCCESS – POINT 0 Cal STORED’ will be displayed on the status bar and BLOCK POSITION will change from POINT 0 to POINT 1.

![Top Menu>Components>Calibrate>Pay-Out](image3)

### 4.2.5 Enter the Layer Change and Crown Calibration Points

Further calibration points are taken at the start of each drawworks cable layer change, and at the maximum height (near the height of the crown saver). If there are no cable layer changes on the drawworks, only the crown position point needs to be set.

If the drawworks has cable layer changes, move the block to the start of the next cable layer change. If there are no layer changes, move the block to the crown position.

• Measure the block height from the rig floor to the bottom of the elevator.
• With BLOCK HEIGHT highlighted press the SELECT button.

• Use the arrow buttons to change the number to match the measurement.

• Press ACCEPT once the desired height is displayed. Press ACCEPT again to confirm and store the value.
If the position was stored correctly ‘SUCCESS – FULL Cal STORED point’ will be displayed on the status bar and BLOCK POSITION will change to the next point.

- (Repeat the above steps for each layer change while raising the block to the crown.)

- Continue to take measurements and enter points at each layer change until the position of the crown saver is reached.

- Once the layer changes are complete, measure the height of the block near the crown saver and enter the value in the manner that the layer change points were entered.

### 4.2.6 Return to the Main Operation Screen

Once the calibration is complete, return to the Main Operation Screen to verify that everything was entered correctly.

- Use the arrow buttons to highlight EXIT and press the SELECT button.
- Press the ACCEPT button to confirm the move to the Main Operation Screen.

### 4.3 Full Block Height Calibration (4mA – 20mA)

**SPECIAL NOTICE:**
This procedure is only used if the Rigsmart system receives block height data from a PLC via a special 4-20mA input. The rig’s PLC must first be calibrated before the Rigsmart system can be used. The Rigsmart system’s height should be set to match the PLC’s height to eliminate confusion between the two systems. When calibrating the Rigsmart block height, there is no need to physically measure the height—it may be referenced from the PLC’s display. This calibration is very different from the normal Rigsmart block height calibration found on other systems.
If this is the first time the calibration has been done, follow the steps detailed in the next section. If the system has already been calibrated but is no longer displaying the correct block height, see the ‘Simple Block Height Recalibration’ section for instructions.

A full block height calibration is done by completing the following steps, in order:

1. Set the lowest point
2. Set the highest point

### 4.3.1 Enter Supervisor Mode

In order to access the calibration settings, the Supervisor Permission Code must be entered. Refer to ‘Using the Supervisor Permission Code’ in the Troubleshooting section for instructions.

### 4.3.2 Calibrate the Lowest Point

- Move the block as close to the rig floor as possible.
- Reference the height given by the PLC HMI.
- Ensure that the BLOCK POSITION setting shows POINT 0.
- Use the arrow buttons to highlight BLOCK HEIGHT and press the SELECT button.
• Use the arrow buttons to adjust the block height value to match the height displayed by the PLC.

Press ACCEPT once the desired height is displayed. Press ACCEPT again to confirm and store the value.

• If the position was stored correctly ‘SUCCESS – POINT 0 STORED’ will be displayed on the status bar and BLOCK POSITION will change from POINT 0 to POINT 1.
4.3.3 Enter the Second Calibration Point

A second calibration point must be made at the top of the derrick.

- Move the top drive to the highest point in the derrick
- Reference the block height from the PLC.
- With BLOCK HEIGHT highlighted press SELECT.

- Use the arrow buttons to change the block height value to match the height displayed by the PLC.
• Press ACCEPT once the correct height is displayed. Press ACCEPT again to confirm and store the value.

If the position was stored correctly ‘SUCCESS – FULL Cal STORED point’ will be displayed on the status bar and BLOCK POSITION will change to the next point.

4.3.4 Return to the Main Operation Screen

Once the calibration is complete, return to the Main Operation Screen to verify that the calibration was entered successfully.

• Use the arrow buttons to highlight EXIT and press the SELECT button.

• Press ACCEPT to confirm and return to the Main Operation Screen.
4.4 SLIP AND CUT (First Layer Change Block Height Recalibration)

If a slip and cut operation has been done, or if the cable lay on the drum has changed in relation to the height of the block for any reason, a first layer change recalibration must be done.

- Using the instructions in the Troubleshooting section, enter the supervisor permission code.
- After entering the supervisor permission code and being returned to the Top Menu, use the arrow buttons to highlight the HEIGHT RE-CAL option and press the SELECT button.
- This will open the Height Re-Cal Menu.

  - Move the block to position the cable on the drawworks at the start of the first layer change.
  - Measure the current height of the block from the rig floor to the bottom of the elevator.
  - With RESET TO 1ST LAYER CHG highlighted, press the SELECT button.
- Use the arrow buttons to enter the height measured above.

- Press ACCEPT when the correct value is displayed, then press ACCEPT again to confirm.

- Use the arrow buttons to highlight EXIT and press SELECT.

- Press ACCEPT to confirm and return to the Main Operation Screen.
4.5 Simple Block Height Recalibration

If no slip-and-cut operation has been done, and the cable lay on the drum has not changed in relation to the height of the block since the last time the block height has been recalibrated, the Simple Height Recalibration can be used instead of the First Layer Change Recalibration. This recalibration is used if the system was temporarily turned off, and the blocks were moved.

- Using the instructions in the Troubleshooting section, enter the supervisor permission code.
- After entering the supervisor permission code and being returned to the Top Menu, use the arrow buttons to highlight HEIGHT RE-CAL and press the SELECT button.
- This will open the Height Re-Cal Menu.

- Move the block to a known or easy to measure height (such as 0.0m with the elevator touching the floor).
- Measure the current height of the block from the rig floor to the bottom of the elevator.
- Use the arrow buttons to highlight RESET TO HEIGHT and press SELECT.
- Use the arrow buttons to enter the measured height.

- Press ACCEPT once the correct value is displayed, then again to confirm.

- Highlight EXIT and press SELECT, then press ACCEPT to confirm and return to the Main Operation Screen.
4.6 Top Drive Angle Calibration

With the top drive and bails in ‘home’ position, the displayed angles should be at or near zero. If this is not the case, the angles must be adjusted to display properly.

- Bring the bails and/or top drive to the ‘home’ position.
- Using the instructions in the Troubleshooting section, enter the supervisor permission code.
- After being returned to the Top Menu, use the arrow buttons to highlight the COMPONENTS option and press the SELECT button.

- This will open the Components Menu. Use the arrow buttons to highlight the CALIBRATE option and press SELECT.

- From the Calibration Menu, highlight the TD ANGLE option and press SELECT.
• This will open the Top Drive Menu.

If both the block and bail are in the home position, or if there’s only one angle, the Zero All option can be used.

• Use the arrow buttons to highlight ZERO ALL and press SELECT. The current angles will be set to zero.

If a component cannot be moved to the home position, or if only one angle needs to be calibrated, they can be reset individually.
• Use the arrow buttons to highlight ZERO BAIL ANGLE or ZERO BLOCK ANGLE and press SELECT. The selected angle will be set to zero.

When finished, highlight EXIT and press SELECT, and then press ACCEPT. The angle should now display ‘0.0°’ in the home position.

4.7 Load Calibration

The Rigsmart Weight Indicator is pre-calibrated. As long as the same size and type of drill line is used, it does not need to be recalibrated (even if the line rider is taken off during a rig move). However, if the weight indicator readings are inaccurate, minor adjustments can be made to the calibration. The original factory calibration is hard coded into the panel and can be restored at any time.

4.7.1 Set Span

To calibrate the system to a particular, known weight, use the following steps:

• Using the instructions in the Troubleshooting section, enter the supervisor permission code.
- In the Top Menu, use the arrow buttons to highlight COMPONENTS and press the SELECT button.

- Use the arrow buttons to highlight CALIBRATE and press SELECT.

- Highlight LOAD and press SELECT.

- Highlight SET SPAN and press SELECT. Use the arrow buttons to change the value to the known weight on the hook.

- When the correct weight is displayed, press ACCEPT twice to save.
4.7.2 Set Zero

To calibrate the system to a weight of zero use the following steps:

- Using the instructions in the Troubleshooting section, enter the supervisor permission code.
- When returned to the Top Menu, use the arrow buttons to highlight COMPONENTS and press the SELECT button.
- Use the arrow buttons to highlight CALIBRATE and press SELECT. Use the arrow buttons to select LOAD and press SELECT.
- Use the arrow buttons to highlight SET ZERO and press SELECT.
- Press ACCEPT twice to save.
4.7.3 Restore Factory Calibration

To calibrate the system to the original factory calibrations use the following steps:

- Using the instructions in the Troubleshooting section, enter the supervisor permission code.
- In the Top Menu, use the arrow buttons to highlight COMPONENTS and press SELECT.
- Use the arrow buttons to highlight CALIBRATE and press SELECT.
- Highlight LOAD and press SELECT.
- Use the arrow buttons to highlight FACTORY CAL and press SELECT.
- Press ACCEPT twice to save.

4.7.4 POL (Parts of Line)

POL is used in weight calculation. The parts of line for the particular rig must be set in the panel before the correct weight will be displayed. Use the following steps to set the POL:

- Using the instructions in the Troubleshooting section, enter the supervisor permission code.
- In the Top Menu, use the arrow buttons to highlight COMPONENTS and press the SELECT button.

- Highlight SETTINGS and press SELECT.

- Highlight LOAD and press SELECT.

- Highlight MAIN POL and press SELECT.

- Use the arrow keys to change POL to the correct value.
• Press ACCEPT twice to save.

4.7.5 4-20mA Weight Output

Some systems are equipped with an analog 4-20mA output signal to indicate weight. This signal may be used for a Rigsmart Dial Gauge or input to a PLC. Regardless of the device in use, before the signal will read correctly it must first be calibrated. To calibrate the 4-20mA output, complete the following steps:

• Using the instructions in the Troubleshooting section, enter the supervisor permission code.
• In the Top Menu, use the arrow keys to highlight COMPONENTS and press the SELECT button.
• Use the arrow keys to highlight CALIBRATE and press SELECT, then highlight CNV4-20mA and press SELECT.
• First, set the load and current low end (displayed beneath SET ZERO). Highlight LOAD and press SELECT. Change the value to 0dN and press ACCEPT twice to save. Similarly, change the CURRENT low end to 4.0mA.

• Now, set the load and current spans (displayed beneath SET SPAN). Highlight LOAD and press SELECT. Change the value displayed to the rated value for the load device used, and press ACCEPT twice to save. Similarly, change the maximum CURRENT to 20.0mA.

• Because every analog device may output a slightly different signal, the ADJUST OUTPUT function is used to fine tune the output. To change the ADJUST OUTPUT use the arrow keys to highlight and select it, then change the multiplying factor. The multiplying factor will increase or decrease the final analog output.
4.8 ERS Tag Reader Calibration

In order for the panel to use and display the correct elevator position, the ERS transducer must be calibrated first to either DRILL or TRIP position. See the section below for instructions on how to do so.

*If the ERS has been previously calibrated but is not displaying the correct position of the top drive, the top drive block position must be recalibrated using the following procedure. This must be done while the power is off, and the top drive rotated while the panel is offline.*

Full Block Height Calibration – Encoder on Drawworks

Follow the steps below to calibrate the elevator position.

4.8.1 Enter Supervisor Mode

In order to access the calibration settings, the supervisor permission code must be entered. Refer to the Troubleshooting section for instructions on how to do so.

4.8.2 Calibrate to Trip or Drill

After entering the supervisor permission code and being returned to the Top Menu, new options will be available. Use the arrow buttons to highlight the COMPONENTS option and press the SELECT button.

This will open the Components Menu. Use the arrow buttons to highlight the CALIBRATE option and press SELECT.
Highlight The ELEV POS option and press SELECT.

*Before proceeding to the final step, ensure that the elevators are set correctly with the top drive, in either DRILL or TRIP position. Once the position is confirmed, the calibration can be finalized.*

Highlight SET ELEV TO TRIP OR SET ELEV TO DRILL option and press SELECT on the correct option, depending on how the top drive is positioned.
5 Limits

The Rigsmart system uses digitally stored limits to determine when the traveling blocks or top drive is in an unsafe position. Situations where the Rigsmart system would intervene include:

Crown Saver

- The Crown Saver prevents collisions between the travelling block and the rig crown.
- The Crown Saver is activated when the block travels above the Crown Saver Height Limit.

Floor Saver

- The Floor Saver prevents collisions between the elevator (or top drive) and the rig floor.
- The Floor Saver is activated when the block travels below the Floor Saver Height Limit.
- If the Auto-Adjusting Floor Saver Height feature is enabled, the floor saver height will automatically adjust when the bails are tilted. This allows the top drive to move closer to the floor than would otherwise be safe with the bails floated.

Monkey Board Saver

- The Monkey Board Saver prevents collisions between the top drive and bails and the monkey board.
- The rig brakes will be activated if the bails and/or block are past their V-door Limits, while the block is above the monkey board, and the block moves below the Elevator Monkey Board Height Limit.
- The rig brakes will be activated if the bails are past their V-door Limits, while the block is below the monkey board, and moves above the Bail Monkey Board Height Limit.
- The rig brakes will be activated if the block is extended past its V-door Limit while below the monkey board, and moves above the Block Monkey Board Height Limit.

Torque Track Saver

- The Torque Track Saver prevents collision between the elevators (and bails) and the torque track.
- The brakes will be activated if the bails are tilted past their Drawworks Limit and the block is above the Torque Track Height.

Load Limits

- The Maximum Load Limit prevents over-pulling the drawworks. An alarm will sound at 90% and 100% of the set limit.

Pressure Limits
• The Maximum Pressure Limit prevents over-pressuring of pipes and lines. An alarm will sound when this limit is reached.

Wind Limits

• The Maximum Wind Speed Limit sounds an alarm when environmental wind speeds rise above the limit.

IF THE BAILS OR ELEVATORS ARE CHANGED AND THE NEW EQUIPMENT IS OF A DIFFERENT SIZE, THE ANTI-COLLISION LIMITS AND SYSTEM CALIBRATION WILL NEED TO BE ADJUSTED TO ACCOMODATE THE NEW EQUIPMENT.

5.1 Bail and Block Angle Limits

5.1.1 Definitions

Setting the angle limits allows customization of safe operating zones of the bails and top drive. Use the instructions in the next section to set the Top Drive Angle Limits.

The Block Angle transducer should be mounted so that it is on the side of the top drive facing the driller's console.

The Bail Angle transducer should be mounted so that it is on the side of the bails facing the driller's console while the top drive is in Trip orientation. The Bail Angle ON D limits will then refer to Trip position and the OFF D limits will refer to Drill position.

Block Angle ON D, VD1 – The maximum angle of top drive extension that will allow the top drive to safely pass by the monkey board with the angle sensor mounted on the driller side.

Block Angle ON D, VD2 – Used in conjunction with the Bail VD2 to determine partial extend. This angle is slightly more than the fully retracted position.

The Block Angle OFF D - Not used

Bail Angle ON D, VD1 – The maximum angle of bail tilt that will allow the bails and elevator to safely pass by the monkey board when the top drive is in Trip position.

Bail Angle ON D, VD2 – Used in conjunction with the Block VD2 to determine partial extend. This angle is slightly more than the floated position.
Bail Angle ON D, DWKS – The maximum negative angle of bail tilt that will allow the bails and elevator to safely pass by the torque track when the top drive is in Trip position.

Bail Angle OFF D, VD1 – The maximum negative angle of bail tilt that will allow the bails and elevator to safely pass by the monkey board when the top drive is in Drill position.

Bail Angle OFF D, VD2 – Used in conjunction with the Block VD2 to determine partial extend. This angle is slightly more than the floated position.

Bail Angle OFF D, DWKS – The maximum angle of bail tilt that will allow the bails and elevator to safely pass by the torque track when the top drive is in Drill position.
See the following pages for instructions on how to set limits illustrated above.
5.1.2 Procedure Overview

Set the VD1 Limits first, then the VD2 Limits.

5.1.3 VD1 Limits

For the Bail:

1. Set the ‘On D’ Limits:
   a. Turn the top drive to the TRIP position.
   b. Run the top drive up to the monkey board, so the elevators are level with the diving board.
   c. Slowly link tilt out until the horns on the elevators are just about to contact the diving board (on a small rig this may be as little as 4 or 5 degrees, on a larger rig this may be 15 or 16 degrees).
   d. SET VD1 (positive value)- maximum bail angle before hitting the monkey board.
   e. Float the bails and then link tilt them in the opposite direction as VD1, towards the torque track, until just before making contact.
   f. SET DWKS (negative value)- maximum rear angle.

2. Set the ‘OFF D’ Limits:
   a. Turn the top drive to the DRILL position.
   b. Repeat steps 1(b) – 1(f) for DRILL position.
   c. For DRILL position, VD1 and VD2 should be negative, and DWKS should be positive.

For the Block:

1. Set On D Limits, (OFF D is not used):
   a. Position the top drive to be just under the monkey board.
   b. Extend the top drive so that its top nearly makes contact with the monkey board.
   c. SET VD1- Maximum angle the top drive can be extended before hitting the monkey board (this is a positive value).
   d. Retract the top drive back in fully then extend it slightly, just out of ‘home’ position.
5.1.4 VD2 Limits

1. Set VD1 on the bail and block as usual.

2. Return everything to the floated, ‘home’ position.

3. Raise the top drive to just below the monkey board, so the results of the angles can easily be seen in comparison to the monkey board.

4. Link tilt out the bails to a couple degrees less than Bail VD1 (at VD1, there’s already an alarm set point).

5. Extend out the block until just before the bails contact the monkey board (still link tilted). (This should be a much shorter extension than the Block VD1 Limit).

6. Set this limit as Block Extend VD2.

7. Return everything to the floated home position.

8. Extend the block to several degrees less than Block VD1 (at VD1 there’s already an alarm set point).

9. Link tilt out the bails (still block extended) until just before they contact the monkey board (this angle should be much less than the Bail VD1 Limit).

10. Set this angle as Bail VD2.

5.1.5 Step by Step Instructions

Using the instructions in the Troubleshooting section, enter the supervisor permission code.

- From the Top Menu, highlight the COMPONENTS option and press SELECT.
- This will open the Components Menu. Use the arrow buttons to highlight the LIMITS option and press SELECT.

- Highlight the TD ANGLE option and press SELECT.

- Highlight the angle limit to be changed and press SELECT. (Both the block and bail are set in the same manner).

- This will open the specific angle sensor’s Limits Menu.
The displayed limits can be changed in two ways. To change the limits manually:

- Highlight the limit to be changed and press SELECT.

- Use the arrow buttons to change the displayed value to the desired limit.

- When the proper limit value is displayed, press the ACCEPT button. Press ACCEPT again to confirm and save the new limit.
To set the limit automatically:

- Tilt the bails or extend the block to the position to be used as the new limit. When the bails and/or block are physically at the new limit position, use the arrow buttons to highlight SET beside the corresponding limit to be set.

- Press the SELECT button to set the limit to the current angle.

5.2 Crown and Floor Saver Limits

The Pay-Out Crown & Floor Limits Menu allows specification of the crown saver and floor saver related settings.

CROWN SVR HT—The distance from the floor to the bottom of the elevator when the top of the travelling blocks are near the crown, with enough space to avoid collision if the brakes are applied. This software crown saver is not the same as a hardware wireless crown saver (which may or may not be installed).
FLOOR SVR HT—The distance from the floor to the bottom of the elevators when the elevators are near the floor, but with enough space to avoid collision if the brakes were applied.

CROWN SAVER / FLOOR SAVER—This allows the enabling (ON) and disabling (OFF) of the block height crown saver and/or floor saver alarms.

WARNING: Disabling the crown or floor saver will remove any protection that the Rigsmart system provides against crown and/or floor collision. Disabling the crown or floor saver will also disable any speed control for the respective direction.

TD BTM FLOOR HT—The indicated block height with the bails fully tilted or removed and the bottom of the top drive (pipe handler) approaching the floor, with enough space to avoid collision if the brakes were applied. This height will generally be negative and lower than the floor saver height.

BAIL LENGTH—The length of the bails being used. This length is used when using the Auto-Adjust Floor Height feature. The distance may need to be adjusted to accommodate the bail pivot point and the height of the elevator and will usually be longer than the actual measured length of the bails.

ADJ FLOOR—Set this option to ON to enable the Auto-Adjust Floor Height feature. With this feature enabled, the floor height is automatically adjusted as the bails are tilted. This allows the top drive to move closer to the floor than would otherwise be safe with the bails floated.
See below for instructions on how to set limits that define the above situations.
5.2.1 Procedure Overview

For the software crown saver, floor saver, TD BTM FLOOR HT:

1. Set the crown saver (this should be just below the *hardware*, wireless crown saver):
   a. Move the blocks up until they are touching the hardware crown saver, then move them back down slightly (the exact distance below is up to the rig manager’s discretion).
   b. Use the **SET HERE** function to define this limit.

2. Set the floor saver (this should be where the bottom of the elevators just meet the floor, with the bails floated):
   a. Bring the blocks down to the floor.
   b. Use the **SET HERE** function to define this limit.
   c. If the rig is not equipped with a top drive and bails, bring the Kelly bar down to the floor, where a collision would occur.

3. Turn the crown and floor savers on.

4. Set the TD BTM FLOOR HT:
   a. At the floor, link-tilt the bails all the way out.
   b. Lower the pipe handler as far as possible.
   c. Bring the top drive down to the floor, so the bottom of the pipe handler touches the floor.
   d. Use the **SET HERE** function to define this limit.

   **NOTE:** The TD BTM FLOOR HT value will be a negative number.

5. Turn the ADJ FLOOR option on (this will only work if the bail angle limits are already set).

6. Set the bail length:
   a. By default, use the actual length of the bails.
   b. Test the ADJ FLOOR feature (the bail length value may have to be set longer than the actual bails for this feature to work properly).
5.2.2 Step by Step Instructions

Follow the instructions below to set the Block Height Limits.

- Using the instructions in the Troubleshooting section, enter the supervisor permission code.

- From the Top Menu, use the arrow buttons to highlight the COMPONENTS option and press SELECT.

- From the Components Menu, highlight the LIMITS option and press SELECT.

- Highlight the PAY-OUT option and press SELECT.

- Highlight the CROWN & FLOOR option and press SELECT.
From the Crown and Floor Saver Limits Menu, the displayed limits can be changed in two ways. To change the limits manually:

- Highlight the limit to be changed and press SELECT.
  - Use the arrow keys to change the displayed value to the desired limit.
When the correct limit is displayed, press the ACCEPT button. Press ACCEPT again to confirm and save the new limit.

To set the limit automatically:

- Raise or lower the block to the position that will be used as the new limit.

- When the block is in position, use the arrow buttons to highlight SET HERE beside the corresponding limit on the display panel.

- Press the SELECT button to set the limit to the current block height.
5.3 Anti-Collision Limits

Setting the anti-collision limits allows specification of the monkey board height, derrick collision point and torque track collision point.

ELEVATOR MBRD HT (downward collision prevention) — This limit references the distance between the rig floor and the bottom of the elevator while the top drive is above the monkey board. It is set at a point where a collision between the elevator and the top of the monkey board would be prevented if the rig brakes were applied.

BAIL MBRD HT (upward collision prevention) — This limit references the distance between the rig floor and the bottom of the elevator, while the bails are below the monkey board. It is set at a point where a collision between the bails and the monkey board would be prevented if the rig brakes were applied.

BLOCK MBRD HT (upward collision prevention) — This limit references the distance between the rig floor and the bottom of the elevator while the top drive is below the monkey board, and the top drive is extended from the torque track. It is set at a point where a collision between the top of the traveling blocks and the bottom of the monkey board would be prevented if the rig brakes were applied.

TORQUE TRACK HT (upward collision prevention) — This limit references the distance between the rig floor and the bottom of the elevator, while the bails are approaching and link tilted towards the torque track. It is set at a point where a collision between the bails and the torque track would be prevented if the rig brakes were applied. *This limit is only used when an elevator position top drive rotation sensor is installed.*

DERRICK SVR HT (upward collision prevention) — This limit references the distance between the rig floor and the bottom of the elevator, at a point where a collision would occur between the derrick structure and the top drive (if turned sideways, in either trip or drill position). *Tilting the bails while above this height limit will cause the rig brakes to be applied.*
5.3.1 Procedure Overview

1. Set the **ELEVATOR MBRD HT** (this point is above the monkey boards, where the bottom of the elevators would contact the top of the monkey boards).

   a. (The ELEVATOR MBRD HT Limit references the BAIL VD1 Limit).

   b. Move the top drive to a position above the monkey boards and link tilt the bails out to the BAIL VD1 limit.

   c. Move the top drive down to a point slightly above where the bottom of the elevators would contact the top of the monkey board.

   d. Use the **SET HERE** function to define this limit.

2. Set the **BLOCK MBRD HT** (this point is below the monkey board, where the top drive would contact the bottom of the monkey board, if it were extended).

   a. (The BLOCK MBRD HT Limit references the BLOCK VD1 Limit).

   b. Move the top drive to a position below the monkey board and extend it from the torque track to the BLOCK VD1 Limit.

   c. Move the top drive to a point slightly below where its top would contact the bottom of the monkey board.

   d. Use the **SET HERE** function to define this limit.

3. Set the **BAIL MBRD HT** (this point is below the monkey board, where the bails would contact the monkey board if they were link tilted while the top drive was being raised).

   a. (This point references the BAIL VD1 Limit).

   b. Move the top drive to a point below the monkey board and link tilt them out as far as possible—past the BAIL VD1 Limit.

   c. Move the top drive to a point slightly below where the top of the tilted bail arms would contact the bottom of the monkey board.

   d. Use the **SET HERE** function to define this limit.

4. Set the **TORQUE TRACK HT** (this point is near the floor, where the bails would contact the bottom of the torque track, if they were reverse link tilted).

   a. (This point references the BAIL DWKS Limit).
b. Move the top drive down to the drill floor and link tilt the bails backwards to the BAIL DWKS limit.

c. Move the top drive to a point slightly below where the top of the elevators would contact the bottom of the torque track.

d. Use the SET HERE function to define this limit.

5. Set the **DERRICK SVR HT** (this is the height at which the bails would contact the derrick if they were link tilted, and the top drive turned sideways).

   a. (This limit references the BAIL DWKS Limit).

   b. Move the top drive to a position above the normal working area of the drill floor.

   c. Use the SET HERE function to define this limit.

### 5.3.2 Step by Step Instructions

Follow the instructions below to set anti-collision height limits.

- Using the instructions in the Troubleshooting section, enter the supervisor permission code.
- From the Top Menu, use the arrow buttons to highlight the COMPONENTS option and press SELECT.

```
TOP MENU
COMPONENTS  SYSTEM
HEIGHT RE-CAL  DIAGNOSTIC
OPERATIONS  CALCULATIONS
```

- From the Components Menu, use the arrow buttons to highlight the LIMITS option and press SELECT.

```
TOP MENU>COMPONENTS
LIMITS  ENABLE/DISABLE
CALIBRATE  SETTINGS
```

- From the Top Menu, use the arrow buttons to highlight the COMPONENTS option and press SELECT.
- Use the arrow keys to highlight the PAY-OUT option and press SELECT.

- Use the arrow keys to highlight the ANTI-COLLISION option and press SELECT.

- This will open the Anti-Collision Limits Menu.
The displayed limits can be changed in two ways. To change the limits *manually*:

- Highlight the limit to be changed and press SELECT.

- Use the arrow keys to change the displayed value to the desired limit.

- When the correct value is displayed, press the ACCEPT button to set the new limit, then again to confirm and save it.
To set the limits *automatically*:

- Raise or lower the block to the position of the new limit.
- With the block in place, use the arrow keys to highlight SET HERE beside the corresponding limit to be set.

![Screen Shot of Limit Settings](image)

- Press the SELECT button to set the limit to the current height.

![Setting Elevator Mboard Height](image)

![Elevator Mboard Height Set](image)

- When you are done changing limits, use the arrow keys to highlight EXIT and press SELECT and then ACCEPT.

### 5.4 Load Limits

The Rigsmart Weight Indicator uses a pre-set limit to determine when to alarm. The Maximum Load Limit is usually set to the smallest maximum load limit of all the load bearing components (derrick structure, sub structure, drawworks, etc).
Use the following instructions to change this load limit:

- Using the instructions in the Troubleshooting section, enter the supervisor permission code.
- In the Top Menu, use the arrow buttons to highlight COMPONENTS and press SELECT.

- From the Components Menu, highlight LIMITS and press SELECT.

- Highlight LOAD and press SELECT.
• Use the arrows and SELECT button to select a MAX LOAD MAIN value. This is the value at which the MAX LOAD alarm will be triggered.

• After selecting the desired value, press the ACCEPT button to set the new limit, and again to confirm the changes.

5.5 Pressure Limits

The Rigsmart Pressure Sensors use pre-set limits to determine when to alarm. When a pressure limit is reached, the panel will alarm but no output will be triggered (unless specifically requested by the customer).

Use the following steps to set the pressure limits:

• Using the instructions in the Troubleshooting section, enter the supervisor permission code.

• From the Top Menu, use the arrow buttons to highlight the COMPONENTS option and press SELECT.
• Highlight the LIMITS option and press SELECT.

• Highlight the PRESSURE option and press SELECT.

• Highlight and select the specific pressure sensor to be set. When selected, change the limit to the required maximum value. Press the ACCEPT button twice to save the change.
5.6 Wind Speed Limits

The Rigsmart Wind Speed Sensor will display the current environmental wind speed. When a pre-set wind speed limit is reached, an alarm will sound but no output will be triggered (unless specifically requested by the customer).

Use the following steps to set the wind speed limits:

- Using the instructions in the Troubleshooting section, enter the supervisor permission code.

- From the Top Menu, use the arrow buttons to highlight the COMPONENTS option and press SELECT.

- From the Components Menu, highlight the LIMITS option and press SELECT.

- Highlight the WIND option and press SELECT.
Use the arrow buttons to highlight and select MAX WIND. When selected, change the limit to the required maximum value. Press ACCEPT twice to save the change.

![Menu Screen]

- TOP MENU
- COMPONENTS
- LIMITS
- PRESSURE

- MAX WIND: 95 kmh

MAIN LOAD: 1,500 dN BLOCK 4.5 m

EXIT BACK TOP MENU
6 Speed Control Limits- Throttle Limiter and Aux Brake Controller

The Throttle Limiter and Aux Brake Controller automatically reduce the speed of the blocks before a hard limit is reached. There is a ‘Height Offset’ value that controls the distance the throttle limiter and brake controller engage before a hard limit is reached. Setup, maintenance and troubleshooting of the Throttle Limiter and Aux Brake Controller is complex and should be done with the aid of Rigsmart Systems service. If maintenance is required, please call the 24 hour support line at: 1-780-438-9475.

6.1 Block Speed and Height Offsets

- Using the instructions in the Troubleshooting section, enter the supervisor permission code.
- From the Top Menu, use the arrow buttons to highlight COMPONENTS and press SELECT.

![TOP MENU]

- Highlight the LIMITS option and press SELECT.

![TOP MENU>COMPONENTS>LIMITS]

- Highlight the PAY-OUT option and press SELECT.

![TOP MENU>COMPONENTS>LIMITS>LOAD]
• Highlight BLOCK SPEED and press SELECT.

See the following page for a detailed description of the BLOCK SPEED Menu.
*Each OFFSET value can be set independently.
A value of ‘0’ disables the specific zone.*

In the BLOCK SPEED Menu the following options are available:

- **CROWN OFFSET**—Indicates the distance below the software crown saver that the throttle limiter will begin limiting the throttle in the upwards direction. This should be a positive number.

- **MBRD TOP OFFSET**—Indicates the distance above the monkey board that the aux brake controller will begin engaging the aux brake in the downwards direction. This should be a positive number.

- **MBRD BOTTOM OFFSET**—Indicates the distance below the monkey board that the throttle limiter will begin limiting the throttle in the upwards direction. This should be a positive number.

- **FLOOR OFFSET**—Indicates the distance above the drill floor that the aux brake controller will begin engaging the aux brake in the downwards direction. This should be a positive number.

- **MAX SPEED UP**—Indicates the maximum payout speed in the upward direction before the throttle limiter is engaged. It is defined on a 0-999 scale.

- **MAX SPEED DOWN**—Indicates the maximum payout speed in the downwards direction before the aux brake controller is engaged. It is defined on a 0-999 scale.

- **BLOCK SPD ALM (Block Speed Alarm)**—Enables and disables the speed control. *This must be set to ON for any speed control to work.*
6.2 Pneumatic Control Boxes

Pneumatic control is separated into two individual boxes: the Pneumatic Throttle Limiter and the Pneumatic Aux Brake Controller. The Pneumatic Throttle Limiter is integrated between a full pressure rig airline and the airline to the rig engine’s throttle. While no limits (set within the Rigsmart system) are being exceeded, the throttle limiter will pass the original air signal to the engine. If these limits are breached, the throttle limiter will regulate the air signal pressure before passing it to the engine.

The Pneumatic Aux Brake Controller is integrated between a full pressure rig airline and the rig’s brakes. This control box will pass the original air signal to the brakes, as long as no set Rigsmart system limits are breached. If limits are breached, the controller will regulate the air pressure being supplied to the brake accordingly.

6.3 Electric Control Boxes

Electric control is separated into two individual boxes: the Electric Throttle Limiter and the Electric Brake Controller. The Electric Throttle Limiter intakes an electric signal from the rig’s normal throttle control. While no limits (set within the Rigsmart system) are being exceeded, the throttle limiter will pass the original electric control signal to the rig’s existing PLC or throttle control. If limits are breached, the limiter will modify the throttle signal accordingly before passing it on.

The Electric Brake Controller outputs a signal based on the current alarm condition of the system. The signal is sent to the rig’s existing PLC or electric auxiliary brake controller.

6.4 Setup and Operation

6.4.1 Activate and Enable

To engage the Pneumatic Throttle Kickout and/or Brake Controller, enter the Limits Menu and set SPD ALM to ‘ON’:

1. Enter the Supervisor permission code
2. Go To: COMPONENTS>LIMITS>PAYOUT>BLOCKSPEED
3. Change SPD ALM to ‘ON’
4. Set the offset and speed values
6.4.2 Limits

MAKE SURE HARD-STOPPING LIMITS ARE SET AND TESTED FIRST!

As with any other limit, these settings will be specific to each individual rig.

Before setting the limits for each device, the maximum possible speeds of upwards and downwards travel must be found.

To view travel speeds, follow these steps:

1. Enter the supervisor permission code.

2. **Go To:** TOP MENU>DIAGNOSTICS>DEVICE DIAG>PAYOUT

![Image of menu options]

- **TOP MENU**
  - COMPONENTS
  - SYSTEM
  - HEIGHT RE-CAL
  - DIAGNOSTIC
  - OPERATIONS
  - CALCULATIONS

  MAIN LOAD= 1,500dN BLOCK 4.5m

- **TOP MENU>DIAGNOSTIC**
  - SIGNALS
  - VIEWER
  - RF METER
  - OUTPUTS
  - VOLTAGE
  - DEVICE DIAG
  - FIRMWARE

  MAIN LOAD= 1,500dN BLOCK 4.5m

- **TOP MENU>DIAGNOSTIC>DEVICE DIAG**
  - Em SHUTDOWN
  - CNV4-20mA
  - TEMPERATURE
  - THROT OVR
  - TOP DRIVE
  - THROT LIM
  - SPEED CTRL

  MAIN LOAD= 1,500dN BLOCK 4.5m
3. Monitor the value ‘SPEED’ for steps 4 and 5.

4. Raise the blocks as fast as possible and record the top speed reached.

5. Drop the blocks (complete free fall) and record the top speed reached.

Set the speed limits and offsets:

1. Enter the supervisor permission code.

2. **Go To:** COMPONENTS>LIMITS>PAYOUT>BLOCK SPEED

3. Set each offset to the desired distance. For testing and setup purposes, use only the crown and floor saver; give each at least 10m offsets.

4. Set both the upwards and downwards speed limits to values lower than the max speeds found above.

### 6.4.3 Pneumatic Regulators

Each Rigsmart pneumatic box has a regulator on the output signal. Along with the limits in the software, these pneumatic regulators also need to be adjusted. The following steps describe how to do this.

**Throttle Kickout:**

1. Adjust the throttle kickout regulator to approximately half of the input air pressure. The regulator will only show pressure on it when there is pressure coming in from the driller’s throttle.
2. The best way to adjust this is to have the driller raise the blocks at full speed. Watch what the input pressure reads (coming from the throttle) and quickly adjust the output regulator to approximately half this value, while the blocks are still being raised at full speed. To ensure these pressures are set correctly, the driller may have to raise the blocks several times, so there’s enough time to both view the original pressure and change the output pressure.

Aux Brake Controller:

1. Have the driller manually control the aux brake. Note how much pressure is required to grab and slow the blocks. The aux brake should not be set to stop the blocks – only slow it down.

2. Adjust the regulator in the pneumatics box to match the driller’s manual control.

6.4.4 Testing

To test the limits:

1. Set all the limits listed above.

2. Set the HEIGHT OFFSET to at least 10m. This ensures a large window for viewing the speed limiting in action before a hard limit is reached.

3. Set the crown and floor saver limits with some extra padding distance, in case the driller has to stop the blocks manually.

4. Bring the top drive and blocks to the middle of the derrick height and float the top drive bail.

5. Test the Throttle Kickout:

   a. Move the top drive towards the crown at a high speed. Note the block height to see when the limiting is supposed to engage.

   b. The system should begin limiting speed at the crown saver height (CROWN OFFSET). For example, with a crown height of 30m and an offset of 10m, limiting starts at 20m.

   c. Based on how the throttle kickout engaged, the MAX SPEED UP and pneumatic regulator may need to be adjusted.

   d. First, change the MAX SPEED UP value, and repeat the tests until the kickout works at the correct speed.

   e. Second, change the pneumatic regulator and repeat the tests until the kickout slows the speed appropriately.

   f. The correct amount of speed control will vary by rig and user preference. A speed reduction of approximately 50% (or idle) is normal.
6. Test the Brake Controller:
   a. Move the top drive towards the floor at a high speed, and note the block height to see when the braking is supposed to engage.
   b. Speed limiting should begin at the floor saver height + height offset. For example, if the floor height is 5m with an offset of 10m, braking starts at 15m.
   c. Based on how the braking engaged, the MAX SPEED DOWN and pneumatic regulator may need to be adjusted.
   d. First, change the MAX SPEED DOWN value and repeat the tests until the braking engages at the correct speed.
   e. Second, change the pneumatic regulator value and repeat the tests until the braking slows the speed appropriately.
   f. The correct amount of speed control will vary by rig and user preference. A speed reduction of approximately 50% is normal.

7. After the correct speed and pneumatic regulator values are found for both devices:
   a. Reset the HEIGHT OFFSET values back to their correct values.
   b. Reset the crown and floor saver limits back to their correct values.
   c. Test the Throttle Kickout for all limits in the upwards direction.
   d. Test the Brake Controller for all limits in the downwards direction.
   e. The Pneumatic Throttle Kickout and Brake Controller will operate the same for monkey board limits as it does for the crown and floor saver limits.
7 Snubsmart Systems

Rigsmart Systems offers a number of different systems based on the type of rig being outfitted. One system specifically designed for snubbing units is called the Snubsmart System.

7.1 Description

The Snubsmart System consists of a pair of Ram Position Sensors for each BOP Ram on the unit, an LED Ram Indicator Module for each set of rams, and a Rigsmart Display Panel to control and monitor the entire system. Ram Position Sensors are attached to each side of the rams, allowing accurate position sensing, in case one side remains closed or partially closed, while the other side is open. Each LED Ram Indicator Module will correspond to a pair of ram sensors. A green light indicates that both sides of the ram are open, while a red light indicates that one or both sides of the ram are closed. The Rigsmart Panel acts as a ram indicator and can turn off the LED ram indicators when they are not being used, in order to conserve battery life. If equipped, the Strobe Hub allows for long range viewing of ram position sensor status. If one ram position sensor is detecting its BOP ram is closed, the strobe light will switch to red.

7.2 Snubsmart Normal Operation

In normal operation, the panel will display the current BOP ram status with the graphic shown below.

```
<table>
<thead>
<tr>
<th>RAM1</th>
<th>RAM2</th>
<th>RAM3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLOSED</td>
<td>OPEN</td>
<td>OPEN</td>
</tr>
<tr>
<td>LED OFF</td>
<td>LED ON</td>
<td>LED ON</td>
</tr>
</tbody>
</table>
```

Pressing the SELECT button will open the Secondary Operation Screen. On this screen, BOP ram pair status, LED status and average ram pair temperature is displayed, as shown below.

```
<table>
<thead>
<tr>
<th>RAM1</th>
<th>RAM2</th>
<th>RAM3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLOSED</td>
<td>OPEN</td>
<td>OPEN</td>
</tr>
<tr>
<td>LED 18.0°C</td>
<td>LED 18.0°C</td>
<td>LED 18.0°C</td>
</tr>
<tr>
<td>LED OFF</td>
<td>LED ON</td>
<td>LED ON</td>
</tr>
</tbody>
</table>
```

After displaying the Secondary Operation Screen for 8 seconds, the panel will automatically return to the Main Operation Screen.
7.3 Snubsmart Standard Alerts

When the BOP rams close, the panel screen flashes and pneumatic control is activated. There is no audible alarm for this. The screens are shown below:

![Ram 1 Closed Screen](image1)

7.4 Snubsmart Operating Alarms

When the system encounters a problem, an alarm message will flash on the panel screen and the panel will beep. The message will flash and the beeping will continue until the detected problem is resolved.

![Ram 2 Side B System Alarm Screen](image2)
7.5 Snubsmart Top Menu

During normal system use the operator will occasionally need to access more advanced system menus to turn on and off different parts of the system. The system’s design is modular, so sets of rams and LEDs can be added or eliminated without major software changes. Also, LEDs can be individually turned on or off, rather than all at once. All of these options can be accessed from the Top Menu.

| TOP MENU | LED INDICATORS ➔ SYSTEM OPERATIONS
|-----------|-----------------------------------|
| RAM2 SIDE B SENSOR NOT FUNCTIONING =403
| EXIT      |                                   |

7.5.1 LED Indicators Menu

When the snubbing unit is not being used, the LED Indicator Modules can be turned off, in order to extend their battery life.

To turn on or off LEDs individually, follow these steps:

- From the Top Menu, use the arrow buttons to select LED INDICATORS and press the SELECT button.

- Use the arrow buttons to select either all LEDs or the particular LED to be changed and press SELECT. Use the arrow buttons to change the state of the LED(s) to either ‘ON’ or ‘OFF’. Once the correct state is displayed, press the ACCEPT button twice to save the change.
7.5.2 Enable/Disable

If a particular RAM pair or LED is not required, it can be disabled from the system. While this device is disabled, no communication will occur between its transducer and the panel. The transducer will not operate and will not register alarms on the panel. All other devices (that have not been disabled) will continue to work as normal.

To disable (or re-enable) a device, follow these steps:

- Enter the supervisor permission code, as outlined in the Troubleshooting section.
- In the Top Menu, use the arrow buttons to highlight COMPONENTS and press the SELECT button.
- Using the arrow buttons, highlight ENABLE / DISABLE and press SELECT.
- Highlight MANUAL and press SELECT.
- Highlight RAM&LEDs and press SELECT.
• Highlight the specific RAM or LED to be enabled or disabled and press SELECT.

• Once selected, use the arrow buttons to change the value to ENABLE or DISABLE and press the ACCEPT button twice to save the change.
### 7.6 Snubsmart Troubleshooting

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Panel Alarm Message</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Panel displays the message “RAM## SYSTEM ALARM” (where ## represents a number-letter combination referring to a ram) | • The panel is not receiving a signal from the indicated Ram Position Sensor | • Reposition the antenna so that it is in direct line-of-sight with the Ram Position Sensors  
• Check antenna connection  
• Check for signs of physical damage |
| Panel displays the message “RAM## LOW BATTERY” (where ## represents a number letter combination referring to a ram) | • The battery in the indicated Ram Position Sensor is low | • Contact the Rigsmart service department for a replacement battery. |
| **Panel Display** | | |
| Panel incorrectly shows a ram as being open when it is closed, or vice versa | • One side of the rams is locked or stuck in an unexpected position | • Verify by physically checking the rams  
• Reposition the antenna so that it is in direct line-of-sight with the Ram Position Sensors  
• If a replacement component has been received recently, ensure that the red and black wires have been cut on the old component |
| | • The panel antenna is not positioned where it can receive the best signal from the Ram Position Sensors: too far away, behind an obstruction, etc | |
| | • The panel is receiving a conflicting signal from another sensor with the same ID | |
| **LED Indicators** | | |
| The LED Indicator lights flash alternating red and green | • The LED Indicator is not receiving a signal from the Ram Position Sensors | • Check the Rigsmart panel for displayed errors, then check the signal strength screen  
• Reposition the LED Indicator so that it is in direct line-of-sight with the Ram Position Sensors  
• Check for signs of physical damage  
• The battery in one of the Ram Position Sensors may be dead. Contact the Rigsmart service department. |
| The LED Indicator gives a double flash, or no longer flashes brightly | • The LED Indicator battery is low | • Contact the Rigsmart service department for a replacement battery |
| The LED Indicator does not turn on or off when turned on or off by the panel | • The LED Indicator cannot receive a signal from the panel | • Try turning the LED Indicators on and then off again, or vice versa  
• Reposition the LED Indicator so that it is in direct line-of-sight with the panel antenna  
• Check for signs of physical damage  
• Contact the Rigsmart Service department for assistance with adjusting the transmission settings  
• The LED Indicator has been disabled |
8 The External Event Logger

The Event Logger stores information related to all system alarms, power ups and power downs, and time stamps them. This data can then be transferred to an external USB storage device and referred to for any rig service or maintenance related issues.

8.1 Checking the Log Counter

- Enter the supervisor permission code, as outlined in the Troubleshooting section of this manual.
- From the Top Menu, use the arrow buttons and the SELECT button to enter the Components Menu.
- From the Components Menu, enter the Settings Screen, then Ext Logger.
- Below is a sample screenshot of the Ext Logger display:

```
TOP MENU>COMPONENTS>SETTINGS>EXT LOG
EXTERNAL INTERNAL
NEW 0 115
TOTAL 115 115
→CLEAR EXT LOGS CLEAR INT LOGS
CLEAR EXT & RESEND
EXIT BACK TOP MENU
```

- The left column on screen (EXTERNAL) represents the logger box, and the right column (INTERNAL) represents the data stored within the panel itself.
- Ensure that the totals for both the external and the internal storage are the same. If they are not, select the CLEAR EXT & RESEND option.

8.2 Downloading the Logs

**NOTE:** It's good practice to keep the panel nearby as the logs are being downloaded, in order to check the transfer progress. Once the total under the EXTERNAL heading for the NEW logs reaches zero, the data transfer is complete.

- Use the LMI3 USB Programmer cable with a new wiring adaptor.
- While the system is powered on, connect the adapted cable to the logger.
• Start the program External Alarm Download on a PC, and ensure the correct COM Port is being used.

• Click Start.

• Click Get New / All.

• Allow logs to download (this may take several minutes).

• Click Stop once all the logs have been downloaded.

• Exit the program. The logs will now be stored in the same directory where the program itself is located.
9 Troubleshooting

It is important to note that after the Rigsmart system sets an alarm or detects a significant disruption, the panel may display a corresponding message even after the conditions have been returned to normal. This commonly occurs during rig-up operations, or after the rig air supply has been shut off. Pressing the BYPASS button on the panel will advance these screen messages and return the system to normal operation.

9.1 Testing the Hardware Wireless Crown Saver, with a Software Crown Saver Installed

Usually the hardware wireless crown saver is set higher in the derrick then the software crown saver. To test the hardware crown saver the software crown saver must temporarily be disabled. If the software crown saver is not temporarily disabled, then the brakes will be applied before hitting the hardware crown saver. To temporarily disable the software crown saver complete the following steps:

- After entering the supervisor permission code, use the arrow keys to highlight the COMPONENTS option in the Top Menu and press SELECT.

```
TOP MENU
  COMPONENTS    SYSTEM
  HEIGHT RE-CAL DIAGNOSTIC
  OPERATIONS    CALCULATIONS
  MAIN LOAD= 1,500dN BLOCK 4.5m
  EXIT
```

- This will open the Components Menu. Use the arrow buttons to highlight the LIMITS option and press SELECT.

```
TOP MENU
  COMPONENTS
  LIMITS
  ENABLE/DISABLE
  CALIBRATE
  SETTINGS
  MAIN LOAD= 1,500dN BLOCK 4.5m
  EXIT BACK TOP MENU
```
• Highlight the PAY-OUT option and press SELECT.

![PAY-OUT Menu](image)

• Highlight the CROWN & FLOOR option and press SELECT.

![CROWN & FLOOR Menu](image)

• This will open the Crown & Floor Saver Limits Menu.

![Crown & Floor Saver Limits Menu](image)

• Select the option for CROWN SAVER and change the value to OFF.

• Test the crown saver.

• Repeat the steps listed above and turn the software crown saver back ON.

9.2 Using the Supervisor Permission Code

The supervisor permission code is used to make changes to the system. The code is given to the rig manager or supervisor when the system is installed. If this code has been lost, Rigsmart Systems can provide the code to the rig manager over the phone.
- From the Main Operation Screen press the SELECT button.

- Use the up and down arrows on the panel to highlight the SETUP option and press SELECT.

If no buttons are pressed for 8 seconds while viewing the Secondary Operation Screen, redirection to the Main Operation Screen will automatically occur. Press SELECT again to return to the Secondary Operation Screen.

- From the Top Menu, use the up and down arrows to highlight SYSTEM and press SELECT.
• Use the up and down arrow buttons to highlight PERMISSION and press SELECT.

![Menu Screen 1]

![Menu Screen 2]

• On the PERMISSION screen, with the word PERMISSION highlighted, press the SELECT button.

![Menu Screen 3]

![Menu Screen 4]
- Use the up and down arrows to change the value to the predetermined supervisor permission code. This number is set with the rig manager during installation.

```
TOP MENU>SYSTEM>PERMISSION

Press ACCEPT to save changes.
Press SELECT to discard changes.

PERMISSION 126

MAIN LOAD= 1,500dN BLOCK 4.5m
EXIT BACK TOP MENU
```

- When the desired value is reached, press the ACCEPT button once to accept the change, then again to confirm and save the selection.

```
TOP MENU>SYSTEM>PERMISSION

SAVE - ARE YOU SURE?

PERMISSION 126

MAIN LOAD= 1,500dN BLOCK 4.5m
EXIT BACK TOP MENU

SAVING...

PERMISSION 126

MAIN LOAD= 1,500dN BLOCK 4.5m
EXIT BACK TOP MENU
```
• After entering the correct permission code, the Top Menu will open. New options will be available in many menus.

![Top Menu Table]

• If an incorrect permission code is entered, simply use the up and down arrows to highlight PERMISSION and repeat the previous steps to retry.

If the permission code is unavailable, please contact Rigsmart Service at 1-780-438-9475.
9.3 Diagnostics

If there is a problem with the Rigsmart system, it might be necessary to access important system information for troubleshooting purposes. A ‘Diagnostic Menu’ is available via the supervisor permission code. All of the information under this menu is read only; no damage can be done to the system by viewing it.

To enter the Diagnostics Menu:

- Enter the supervisor permission code as outlined in the Troubleshooting section of this manual.
- From the Top Menu, use the arrow buttons to highlight DIAGNOSTICS and press the SELECT button.

9.3.1 Signals

The Signals Screen shows the signal strength of all enabled wireless devices.

9.3.2 Outputs

The Outputs Screen shows the current output status of either the Alarm Hub or Panel wire.

9.3.3 Device Diag

The Device Diag Screen shows very detailed information about specific devices. Each device shows different information specific to its function.
9.3.4 Viewer

The Viewer Screen displays load calibration info and device IDs.

9.3.5 Voltage

The Voltage Menu displays the current voltage entering the panel.

9.3.6 Firmware

The Firmware Menu displays information about the panel's loaded firmware.

9.3.7 RF Meter

The RF Meter Screen shows the quality of the wireless signals being received. This is different than the Signals Screen, which shows the signal strengths.
9.4 Battery Replacement

The Rigsmart Display Panel will indicate a low battery for approximately three weeks before the battery fails. Before replacing the batteries, call the Rigsmart Systems service department at (780) 438-9475, with the serial number of the system readily available. The serial number can be found on the display panel or the transmitter itself. Once the technical problem has been verified as being due to a dead battery, follow the steps below to replace it.

Tools and Equipment for Battery Replacement:

The battery replacement kit contains:

- (1) 3.6 Volt Lithium Ion D-cell battery
- (1) 1/8 Inch Allen key

**NOTE:** The transmitter should be removed from the rig before battery replacement occurs. However, replacement can still be done with the transmitter on the rig. If it is raining or snowing, remove the transmitter and perform the battery replacement indoors or under cover.

To Replace the Battery:

1. Remove the screws from the battery compartment lid and remove the lid.
2. Remove the battery from the holder.
3. Insert the new battery according to the battery orientation diagram on the base of the battery clip.
4. Ensure that the o-ring is greased and has not been damaged, as this will affect the seal.
5. Secure the lid with the screws.
9.5 Antenna and Signal Issues

All of the wireless sensors on the Rigsmart system are received by the panel through a common antenna. If there is a problem with the antenna, the wireless sensors may not work correctly. Also, if there is outside wireless interference in the local environment, there may be a reduction in signal strength and quality.

For the best possible communication, the Rigsmart antenna should have a clear line-of-sight to each wireless transducer, which should be no more than 100m away. In practice this may be challenging to obtain; the best compromise for line-of-sight to every wireless transducer should be made.

The Rigsmart antenna can be fitted with an extension cable so that it can be placed further away from the panel. Every effort should be made to reduce the number of extension cables and connector fittings used; each extension and connector fitting will reduce the signal strength.

<table>
<thead>
<tr>
<th>SIGNAL STRENGTH</th>
<th>RF</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOAD MAIN</td>
<td>60%</td>
</tr>
<tr>
<td>CROWN SVR1</td>
<td>10%</td>
</tr>
<tr>
<td>BAIL ANG</td>
<td>FAIL</td>
</tr>
<tr>
<td>PAY-OUT</td>
<td>FAIL</td>
</tr>
<tr>
<td>EXIT</td>
<td>BACK</td>
</tr>
</tbody>
</table>

If any particular sensor is experiencing a loss of signal, there are a few quick troubleshooting steps that can easily be completed before contacting technical support:

1. The most common issue is a dead battery. If the battery in a sensor is dead, it cannot transmit and will have no signal. Replace the battery and recheck the signal.

2. Move the sensor closer to the antenna. Check to see if the signal has returned.

3. Check to ensure there are no breaks, pinches or cuts in the antenna cable. Very tight bends or crimps in the antenna cable may permanently damage the wire inside.

4. If all transducers are experiencing a signal failure, there may be an issue with the antenna – it is the common point for all the devices.
   a. Move the antenna around and check to see if the signal has returned.
   b. Often, moving the antenna inside the derrick structure will improve signals from a top drive.
   c. Change the orientation of the antenna; if it is placed vertically, change it so it is mounted horizontally.
   d. Replace the antenna completely.
9.6 Measuring Block and Top Drive Heights

When calibrating block height or setting anti-collision limits, it is very important to measure heights correctly. It should be noted that the ‘Block Height’ is not actually the height of the traveling blocks, rather the height of the lowest point of the top drive or the top of the Kelly bar. This is common to most height calculation systems. The drill floor is always used as the reference point of measurements. When using a top drive, measure from the floor to the bottom of the elevators. If there is no top drive, measure from the floor to the top of the Kelly bar. The important factor is that measurement reference points remain constant through the calibration and limit-setting process.
## 9.7 Common Error Messages Codes and Solutions

During the course of operation, alarms may be displayed on the panel screen. The following list contains all alarms, with their reference numbers and brief descriptions. Refer to this list for troubleshooting purposes.

<table>
<thead>
<tr>
<th>Alarm Text</th>
<th>Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>** ** BY-PASS ** ** XX SEC REMAIN</td>
<td>0</td>
<td>This message indicates that the BYPASS button has been pressed, which will disable all alarms for 30 seconds. During this 30 seconds, this message will flash to indicate how much time is left.</td>
</tr>
<tr>
<td>MAIN LOAD ABOVE PRESET</td>
<td>3</td>
<td>This alarm indicates that the measured load is above the entered load limit. If this alarm is being triggered at too low or too high a load value, the limit may need to be adjusted.</td>
</tr>
<tr>
<td>CROWN SAVER 1 ALARM</td>
<td>4</td>
<td>This alarm indicates that the Crown Saver Counterweight is lifted and the block is approaching the crown of the rig.</td>
</tr>
<tr>
<td>BLOCK HEIGHT ABOVE MAXIMUM</td>
<td>8</td>
<td>This alarm indicates that the measured block height is above the entered preset crown saver height. If this alarm is being triggered when the block is not near the crown the block height may need recalibration, or the crown saver height value may need to be changed.</td>
</tr>
<tr>
<td>BLOCK HEIGHT BELOW MINIMUM</td>
<td>9</td>
<td>This alarm indicates that the measured block height is below the entered preset minimum (floor) height. If this alarm is being triggered when the block is not near the floor, the minimum height value or block height may need recalibration.</td>
</tr>
<tr>
<td>Em SHUTDOWN 1 *** STOP ***</td>
<td>12</td>
<td>This alarm indicates that the Emergency Shutdown button has been pressed.</td>
</tr>
<tr>
<td>CROWN SAVER 1 ABOVE THRESHOLD</td>
<td>14</td>
<td>This alarm indicates that the weight on the Crown Saver Switch is too high or that it has been damaged. Check for extra weight on the crown saver counterweight or obvious physical damage.</td>
</tr>
<tr>
<td>TOP DRIVE BLOCK EXTENDED</td>
<td>19</td>
<td>This alarm indicates that the top drive is extended away from the derrick while there is a danger of it contacting the monkey board. If this alarm is being triggered while the top drive is not extended, it may be necessary to zero the block angle or adjust the set limits. See the Calibration or Limits section for more information.</td>
</tr>
<tr>
<td>TOP DRIVE BAILS TILTED</td>
<td>20</td>
<td>This alarm indicates that the bails are tilted while there is a danger of them contacting the monkey board. If this alarm is being triggered while the bails are not tilted, it may be necessary to zero the bail angle or adjust the set limits. See the Calibration or Limits section for more information.</td>
</tr>
<tr>
<td>ELEVATOR POS ALARM</td>
<td>21</td>
<td>This alarm indicates that the bails are tilted while the elevator is not in trip nor drill position. If this alarm is being triggered while the elevator is in trip or drill position, it may be necessary to adjust the positioning of the sensor in relation to the RFID targets.</td>
</tr>
<tr>
<td>TOP DRIVE BLK &amp; BAILS EXT</td>
<td>25</td>
<td>This alarm indicates that both the bails and block are at least partially extended while there is a danger of the bails contacting the monkey board. If this alarm is being triggered while the bails are not tilted, it may be necessary to zero the bail angle or adjust the set limits. See the Calibration or Limits section for more information.</td>
</tr>
<tr>
<td>TOP DRIVE BAILS TILTED</td>
<td>26</td>
<td>This alarm indicates that the bails are tilted while there is a danger of them contacting the torque track. If this alarm is being triggered while the bails are not tilted, it may be necessary to zero the bail angle or adjust the set limits. See the Calibration or Limits section for more information.</td>
</tr>
<tr>
<td>LOAD 90% OF MAXIMUM LOAD</td>
<td>29</td>
<td>This alarm indicates that the measured load is approaching the entered load limit. If this alarm is being triggered at too low or too high a load value, the limit may need to be adjusted.</td>
</tr>
<tr>
<td>Alarm Type</td>
<td>Alarm Code</td>
<td>Description</td>
</tr>
<tr>
<td>------------------------------------</td>
<td>------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Alarm Hub Malfunction</td>
<td>43</td>
<td>This alarm indicates that the panel cannot communicate with the attached Alarm Hub. This can happen if the cable between the panel and the Alarm Hub is disconnected or damaged.</td>
</tr>
<tr>
<td>Main Load System Alarm</td>
<td>45</td>
<td>This alarm indicates that the panel is not receiving a signal from the Load Sensor. Either the sensor has stopped functioning due to a dead battery, damage, or failure, or the signal strength from the switch is too low. Try repositioning the antenna for a more direct line-of-sight with the sensor.</td>
</tr>
<tr>
<td>Crown Saver 1 System Alarm</td>
<td>47</td>
<td>This alarm indicates that the panel is not receiving a signal from the Crown Saver Switch. Either the switch has stopped functioning due to a dead battery, damage, or failure, or the signal strength from the switch is too low. Try repositioning the antenna for a more direct line-of-sight with the switch.</td>
</tr>
<tr>
<td>RFID Tag Reader System Alarm</td>
<td>51</td>
<td>This alarm indicates that the Elevator Position Transmitter cannot communicate with the RFID Tag Reader. This can happen if the cable between the Tag Reader and Transmitter is disconnected or damaged.</td>
</tr>
<tr>
<td>Line Pay-Out System Alarm</td>
<td>54</td>
<td>This alarm indicates that the panel is not receiving a signal from the Pay-Out Sensor. Either the sensor has stopped functioning due to lost power, damage, or failure, or the signal strength from the sensor is too low. Try repositioning the antenna for a more direct line-of-sight with the sensor.</td>
</tr>
<tr>
<td>Em Shutdown 1 System Alarm</td>
<td>59</td>
<td>This alarm indicates that the panel is not receiving a signal from the Emergency Shutdown sensor. Either the sensor has stopped functioning due to a dead battery, damage, or failure, or the signal strength from the sensor is too low. Try repositioning the antenna for a more direct line-of-sight with the sensor.</td>
</tr>
<tr>
<td>Block Angle System Alarm</td>
<td>63</td>
<td>This alarm indicates that the panel is not receiving a signal from the Block Angle Sensor. Either the sensor has stopped functioning due to a dead battery, damage, or failure, or the signal strength from the sensor is too low. Try repositioning the antenna for a more direct line-of-sight with the sensor.</td>
</tr>
<tr>
<td>Bail Angle System Alarm</td>
<td>64</td>
<td>This alarm indicates that the panel is not receiving a signal from the Bail Angle Sensor. Either the sensor has stopped functioning due to a dead battery, damage, or failure, or the signal strength from the sensor is too low. Try repositioning the antenna for a more direct line-of-sight with the sensor.</td>
</tr>
<tr>
<td>Elevator Pos System Alarm</td>
<td>65</td>
<td>This alarm indicates that the panel is not receiving a signal from the Elevator Position Sensor. Either the sensor has stopped functioning due to a loss of power, damage, or failure, or the signal strength from the sensor is too low. Try repositioning the antenna for a more direct line-of-sight with the sensor.</td>
</tr>
<tr>
<td>Low Brake Pressure Detected</td>
<td>69</td>
<td>This alarm indicates that the rig air pressure into the Main Air Kill has dropped below 70psi. This may have been done intentionally to bypass the Rigsmart system, or it may be due to an air pressure leak or malfunction. To resolve this, increase the rig air pressure going into the Main Air Kill.</td>
</tr>
<tr>
<td>Main Load Low Battery</td>
<td>72</td>
<td>This alarm indicates that the battery in the Load Sensor is low. Please contact our service department for a replacement.</td>
</tr>
<tr>
<td>Crown Saver 1 Low Battery</td>
<td>74</td>
<td>This alarm indicates that the battery in the Crown Saver Switch is low. Please contact our service department for a replacement.</td>
</tr>
<tr>
<td>Em Shutdown Low Battery</td>
<td>84</td>
<td>This alarm indicates that the battery in the Emergency Shutdown Sensor is low. Please contact our service department for a replacement.</td>
</tr>
<tr>
<td>Block Angle Low Battery</td>
<td>87</td>
<td>This alarm indicates that the battery in the Top Drive Extend Angle Sensor is low. Please contact our service department for a replacement.</td>
</tr>
<tr>
<td>Bail Angle Low Battery</td>
<td>237</td>
<td>This alarm indicates that the battery in the Bail Tilt Angle Sensor is low. Please contact our service department for a replacement.</td>
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## 9.8 Alarm Code Master List

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<tr>
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<th>Menu Alarm Text</th>
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<tr>
<td>237</td>
<td>BAIL ANGLE</td>
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<td>TD BAIL ANGLE LOW BATTERY</td>
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<tr>
<td>238</td>
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<td>253</td>
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<tr>
<td>254</td>
<td>CROWN SAVER 3</td>
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<td>260</td>
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<td>261</td>
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<td>262</td>
<td>Em SHUTDOWN 3</td>
<td>*** STOP ***</td>
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<td>263</td>
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<td>PITCH &amp; ROLL</td>
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<td>AUX2 90% OF PIPE STRENGTH</td>
<td>AUX2 LOAD AT 90% OF PIPE STRENGTH</td>
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<tr>
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<td>H2S 4 SENSOR LOW BATTERY</td>
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<td>LEL 4 SENSOR LOW BATTERY</td>
</tr>
<tr>
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<td>Em SHUTDOWN 4 LOW BATTERY</td>
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<tr>
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<td>ABOVE PRESET</td>
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<tr>
<td>610</td>
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<td>RAM3 SIDE B SENSOR LOW BATTERY</td>
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<td>636</td>
<td>PRESSURE 6</td>
<td>LOW BATTERY</td>
<td>PRESSURE 6 LOW BATTERY</td>
</tr>
</tbody>
</table>
9.9 In the Event of System Power Loss

In the event of a rig black out while the Rigsmart System is in use (either while drilling, rig-up, rig-down, or any other time), complete the following steps to avoid potential accidents. By default, if power is lost to the Rigsmart System, the main brakes will engage. The brakes will not be released until power is restored to the Rigsmart system.

1. Stop operations.

2. Chain brake the main brakes.
   (This ensures that the rig’s blocks will not move while the power issue is being resolved).

3. Turn off the MAIN POWER to the Rigsmart system at the Power Disconnect.
   (Turning off the main power to the Rigsmart system ensures that if the power unexpectedly restores, the Rigsmart system will still be off and the main brakes will still be applied).

4. Troubleshoot and repair the power issues on the rig.

5. After stable power has been restored to the rig, ensure that the main brakes are still chained down. Turn on the main power to the Rigsmart system at the Power Disconnect.
   (Depending on the alarm condition the Rigsmart system was in before the power loss, the system may release the brakes when power is restored. This is why the rig’s main brakes MUST be chained down first).

6. Once the operator has assumed control of the rig again, the Rigsmart system needs to be recalibrated.
   a. Complete a ‘First Layer Change’ height recalibration.
   b. If the block height is supplied by a 4-20mA connection to a PLC, a height calibration must be done.

7. Continue operations.
# 10 Service

## 10.1 Regular System Maintenance

For the Rigsmart system to operate correctly there are a number of regular system maintenance items that should be tended to on a regular basis. Consistent testing of the system should be worked into the rig’s regular schedule to ensure that it is continuously protecting the rig. This maintenance list is a guide only; if the customer’s safety program recommends more frequent safety checks, the greater of the two should be observed. For example, if the customer’s safety policy is to check the crown saver every tour, the Rigsmart crown saver should be checked at the same time.

<table>
<thead>
<tr>
<th>Maintenance Item</th>
<th>Description</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load Calibration</td>
<td>Any device used to indicate weight should be returned to Rigsmart Systems annually to ensure proper calibration and functionality.</td>
<td>X (annually)</td>
</tr>
<tr>
<td>Visual inspection of equipment</td>
<td>Visual inspection of components, transducers and brackets. Checking for obvious damage.</td>
<td>X</td>
</tr>
<tr>
<td>Wash equipment</td>
<td>If equipment becomes heavily soiled with drilling fluids or mud they should be sprayed off. Make sure all covers are securely closed and lids are tight. Use only a light spray with soap and water. Do not pressure wash with high pressure sprays. <strong>No harsh chemicals or diesel fuel should be used.</strong></td>
<td>X</td>
</tr>
<tr>
<td>Function Crown Saver</td>
<td>The hardware and software Crown Savers should be tested every day to ensure functionality.</td>
<td>X</td>
</tr>
<tr>
<td>Limit Testing</td>
<td>Test each of the Anti-Collision Limits. Make sure the brakes activate correctly and the limits are placed in the correct positions.</td>
<td>X</td>
</tr>
<tr>
<td>Emergency Shutdown</td>
<td>If equipped, test the Emergency Shutdown to ensure it functions correctly.</td>
<td>X</td>
</tr>
<tr>
<td>Maintenance Item</td>
<td>Description</td>
<td>Frequency</td>
</tr>
<tr>
<td>------------------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td><strong>General</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elevator Position</td>
<td>If equipped, rotate the top drive pipe handler to ensure the Elevator Position Sensor is working correctly and all micro-dots are being sensed.</td>
<td>X</td>
</tr>
<tr>
<td>Check Safety Cables</td>
<td>Ensure all safety cables on overhead equipment are connected and tight.</td>
<td>X</td>
</tr>
<tr>
<td><strong>Electrical</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antenna Connection</td>
<td>Apply a moderate amount of dielectric grease to create a watertight seal on the antenna connection and any extension cables or bulkheads. Make sure each connection is tight.</td>
<td>X</td>
</tr>
<tr>
<td>Check Electrical Cables</td>
<td>Check cables for damage, kinks or pinch points.</td>
<td>X</td>
</tr>
<tr>
<td>Replace Batteries</td>
<td>If a transducer’s battery has died or the panel displays a ‘low battery’ warning message, replace the battery in the corresponding component. After replacing the battery, ensure that the lid is greased and closed tightly.</td>
<td>X</td>
</tr>
<tr>
<td>Electrical Connections</td>
<td>All electrical cables NOT on the component stand should be opened and a moderate amount of dielectric grease should be applied to create a water tight seal. Make sure to tighten connections when connecting and reconnecting. <strong>NOTE: This should NOT be done while drilling, as the brakes will be applied if a connection is broken.</strong></td>
<td>X</td>
</tr>
<tr>
<td><strong>Pneumatic</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Check Hoses</td>
<td>Check hoses for damage, kinks or pinch points.</td>
<td>X</td>
</tr>
<tr>
<td>Air Pressure</td>
<td>The supply pressure tank should be checked to ensure there is a constant supply of at least 90PSI.</td>
<td>X</td>
</tr>
</tbody>
</table>
## Maintenance

<table>
<thead>
<tr>
<th>Maintenance Item</th>
<th>Description</th>
<th>Frequency</th>
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</thead>
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<tr>
<td></td>
<td></td>
<td>Every Day</td>
</tr>
<tr>
<td>General</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pneumatic Filters</td>
<td>All of Rigsmart’s pneumatic boxes have air filters in them; these filters should be checked and cleaned.</td>
<td>X</td>
</tr>
</tbody>
</table>

### 10.2 The Rigsmart Replacement Exchange System:

1. A customer calls with a valid Rigsmart component serial number. (XXX-XXXX.), and specifies which components need to be replaced. (Example: Panel, Crown Saver, Bail Angle, Elevator Rotation System…etc.).

2. A replacement agreement is then faxed to the customer. The customer is responsible for signing and returning the agreement to Rigsmart Systems. No product will leave Rigsmart Systems until this agreement is signed.

3. The replacement parts are spooled up and tested.

4. Parts are then shipped to the customer. If the system is still within the warranty period, no charges will be applied at this time, unless importing to a country with a value added tax (VAT). If the part’s warranty period is expired, the customer is responsible for the cost of freight. A purchase order number will be required.

5. Upon receiving the new parts, the customer can then reuse the same box to package and ship the faulty or damaged components back to Rigsmart Systems.

### Service Contact Information

- **E-mail:** service@rigsmart.com
- **Telephone:** +1 780 438 9475
- **Facsimile:** +1 780 438 9477
- **Address:** 4908 97 Street NW
  Edmonton, Alberta
  Canada T6E 5S1
Replacement Agreement – please complete

Between Rigsmart Systems and

Company: __________________________
Address: __________________________
City: ______________________________
State/Province: _____________________
Zip/Postal Code: ____________________

Contact Name: ______________________
Phone: _____________________________
Fax: ________________________________

Serial Number: n/a
Component(s): ______________________

Service Order #: ____________________
Replacement Value: $________________

On behalf of (COMPANY)_________________________ I hereby request in writing, replacement system component(s) for Rigsmart System (RS#_________________________). I agree to return the non-functioning component(s) to Rigsmart Systems at the above address within 15 business days of receipt. In the event I fail to return the non-functioning component(s) to Rigsmart Systems within 15 business days – and do not notify Rigsmart Systems, I hereby authorize Rigsmart Systems to charge my account or credit card on file for the cost of the equipment as detailed on this agreement.

I understand this replacement is being provided as a service. Any subsequent costs charged for this replacement due to loss are non-refundable. I also understand that there may be additional fees to repair the component(s) being replaced. If this is a replacement for a known repair please provide a purchase order number in the space below.

COMPLETION AND RETURN OF THIS AGREEMENT, AND ACCEPTANCE OF REPLACEMENT EQUIPMENT CONSTITUTES ACCEPTANCE OF THESE TERMS AND CONDITIONS. AS AN AUTHORIZED EMPLOYEE OF YOUR COMPANY, BY SIGNING THIS DOCUMENT IT BECOMES A BINDING CONTRACT.

*Authorized
Signature: __________________________

*Name: _____________________________
Title: ______________________________

*Date: ______________________________

*Purchase Order Number:____________
Crane/Rig Description

Fax copy of signed agreement to 1-780-438-9477

*These fields are mandatory. If a Purchase Order Number is not available, please print name in field

**Note: No equipment shall be shipped until a completed copy is received by Rigsmart Systems**
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