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**LIFEBOAT LAUNCH SYSTEM - DAVIT BOOM CONTROLLER NOTES ON SAFE OPERATION, CALIBRATION AND SETUP**

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**SUMMARY**

This lab memo contains notes on the safe operation and setup of the Davit Boom Controller.

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# LIFEBOAT LAUNCH SYSTEM - DAVIT BOOM CONTROLLER
# NOTES ON SAFE OPERATION, CALIBRATION AND SETUP

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## 1.0    DAVIT CONTROLLER SAFETY NOTES

### 1.1    General Operation

The Davit Controller should be run from the Operator account. Registry values that affect the operation of the Davit Controller have been loaded into the registry for the Operator profile.

The Davit Controller uses two motors, both of which are attached to gearheads having a 1:10 gear ratio. Each motor with the attached gearhead can lift approximately 50 kg. As the motors are quite powerful one should be careful when operating the Davit Controller. For instance, users should avoid standing under weights suspended from the davit cables and they should maintain a safe distance from the davit cable reels.

The davit cables used to lift and lower weights break periodically due to weakening at crimping locations and/or chafing on the davit arms. As a davit cable breakage can occur at any time, users should be very careful when weights are suspended from the davit cables.

### 1.2    Exiting the Davit Controller

When the user exits the Davit Controller, all weights suspended from the davit arms should be lowered to the floor. This is a safety measure designed to prevent a weight from falling and injuring a person and/or damaging equipment.

### 1.3    Cable Breakage

If a davit cable breaks, the user should exit the Davit Controller prior to repairing the cable. Once the cable has been repaired the user can restart the Davit Controller and perform a homing operation on the davits. A homing operation is always required after repairing a damaged cable because the amount of cable payed out has changed and the Davit Controller is unaware of this change. Failure to exit the Davit Controller prior to repairing the davit cable can result in injury and/or equipment damage.

## 2.0    DAVIT CONTROLLER – CALIBRATION INSTRUCTIONS

### 2.1    Wave Probe – Calibration Instructions

The following procedure should be used to calibrate the wave probe

1. Start the Davit Controller application and switch to the calibration tab.
2. Select the wave probe channel. To get a voltage reading from the wave probe press Display Voltage and wait 5 seconds.
3. Adjust the gain and offset on the wave probe so that –4.5 volts is measured at the lowest wave height and 4.5 volts is measured at the highest wave height. This gives the optimal dynamic range for wave height measurements.
4. Measure and record the wave probe voltage and wave height at 5 different wave heights ranging from the lowest wave height to the highest wave height.
5. Use Excel to create a file containing the measured wave probe voltage and wave height at each calibration point.
6. Create a chart plotting Wave Height versus Wave Probe Voltage
7. Add a linear trend line to the chart and specify that its equation should be displayed. The equation of the linear trend line is the calibration equation for the wave probe.
8. Save the current Calibration file as WaveProbe.xls
9. Enter the slope and offset of the linear trend line as the wave probe slope and offset in the Davit Controller calibration tab.

### 2.2    Wave Probe – Re-Zeroing Instructions

The following procedure should be used to re-zero the wave probe

1. Ensure that the water is calm.
2. Start the Davit Controller application and switch to the calibration tab.
3. Select the wave probe channel.
4. Press Display Voltage and wait 5 seconds to get a voltage reading from the wave probe.
5. Enter this voltage as the wave probe offset in the Davit Controller calibration tab.

## 2.3    Load Cell – Calibration Instructions

The following procedure should be used to calibrate the load cell

1.  Start the Davit Controller application and switch to the calibration tab.
2.  Select the load cell channel. To get a voltage reading from the load cell press Display Voltage and wait 5 seconds.
3.  Adjust the gain and offset on the load cell so that –4.5 volts is measured at the lowest load and 4.5 volts is measured at the highest load. This gives the optimal dynamic range for load measurements.
4.  Measure and record the load cell voltage and load at 5 different loads ranging from the lowest load to the highest load.
5.  Use Excel to create a file containing the measured load cell voltage and load at each calibration point.
6.  Create a chart plotting Load versus Load Cell Voltage
7.  Add a linear trend line to the chart and specify that its equation should be displayed. The equation of the linear trend line is the calibration equation for the load cell.
8.  Save the current Calibration file as LoadCell.xls
9.  Enter the slope and offset of the linear trend line as the boom load slope and offset in the Davit Controller calibration tab.

### 2.4 Boom Angle Potentiometer – Calibration Instructions

The following procedure should be used to calibrate the boom angle potentiometer

1. Adjust the gain and offset on the boom angle potentiometer so that – 4.5 volts is measured at the lowest boom elevation and 4.5 volts is measured at the highest boom elevation. This gives the optimal dynamic range for boom angle measurements.
2. Place an inclinometer on the davit controller platform and press the alt button to zero it. This ensures that all angles will be measured relative to the davit controller platform.
3. After zeroing the inclinometer tape it to the base of the boom.
4. Run the Calibrate application.
5. Press the Home Boom button to find the home position for the boom.
6. Use the Raise Boom button to incrementally raise the boom until its highest elevation is found.
7. Set the Raise Limit to the value displayed in the Number of Steps textbox
8. The absolute value of Raise Limit is number of steps required to move the boom from the Home Switch to its highest elevation.
9. Each step can be considered to be a calibration point.
10. Note that there is a constant number of boom controller revolutions between each calibration point
11. Press the Calib Boom button.
12. The boom will now move from its lowest elevation to its highest elevation stopping for 5 seconds at each calibration point.
13. At each calibration point the user should wait for the boom to settle and then record the angle indicated by the inclinometer.
    The calibration procedure creates a file Calibrate.dat that contains a three column record for each calibration point. The first column contains the Boom Controller Revolutions, the second column contains the Computed Boom Angle, and the third column contains the Boom Potentiometer Voltage. The Inclinometer Angle should be entered in the fourth column.
14. Open this file using Excel and enter the Inclinometer Angle recorded at each calibration point.
15. Create a chart plotting Inclinometer Angle versus Boom Potentiometer Voltage
16. Add a linear trend line to the chart and specify that its equation should be displayed. The equation of the linear trend line is the calibration equation for the Boom Angle potentiometer.
17. Save the current Calibration file as BoomAngle.xls
18. Enter the slope and offset of the linear trend line as the Boom Angle slope and offset in the Davit Controller calibration tab.

**2.5 Equations for Converting Between Boom Controller Revolutions and Boom Angle for a No Load Condition (Developer Setup)**

The following procedure is used to get an equation for converting from Boom Controller Revolutions to Boom Angle

1. Use Excel to open BoomAngle.xls
2. Create a chart plotting Inclinometer Angle versus Boom Controller Revolutions
3. Add a cubic polynomial trend line to the chart and specify that its equation should be displayed. This equation can be used to convert Boom Controller Revolutions to Boom Angle when the boom is not under load.
4. This equation is used to code the subroutine BoomRevsToAngle in frmDavitController.

The following procedure is used to get an equation for converting from Boom Angle to Boom Controller Revolutions

1. Use Excel to open BoomAngle.xls
2. Create a chart plotting Boom Controller Revolutions versus Inclinometer Angle
3. Add a cubic polynomial trend line to the chart and specify that its equation should be displayed. This equation can be used to convert Boom Angle to Boom Controller Revolutions when the boom is not under load.
4. This equation is used to code the subroutine BoomAngleToRevs in frmDavitController.

## 3.0    DAVIT CONTROLLER CALIBRATION LESSONS

When one performs a linear calibration on a data acquisition sensor, SMALLER slopes are generally MORE DESIRABLE. BIG slopes are UNDESIRABLE since SMALL changes in VOLTAGE will give rise to BIG changes in the PHYSCIAL UNITS being measured.

Note that changes to equipment, cabling, and gains affect the slope of the calibration curve and therefore require a recalibration of the affected channels. Changes that affect only the offset of calibration curve normally require only a re-zeroing of the affected channel. Note that it is recommended that the wave probe be re-zeroed twice per day.

Once a calibration has been performed, check that the sensor voltage range maps favorably into the FULL physical unit range of interest. For example, if it is possible to accurately measure sensor voltages between –5 Volts and 5 Volts and the physical unit range of interest is –100 Newtons to 100 Newtons then the slope of the linear calibration should be about (100 - -100)/(5 - -5) = 200/10 = 20.  If the slope is smaller, then it will not be possible to accurately measure over the full physical unit range of interest and if the slope is larger then the Signal To Noise Ratio will be reduced. Note that the slope of the linear calibration is primarily affected by cabling and gain applied to the sensor voltage. Once cabling and appropriate sensor voltage gains have been established then the linear calibration slope normally does not vary.

If the physical unit range of interest increases, then a recalibration of the sensors will normally be required. However, if the full voltage range of the sensors is NOT being used, it is sometimes possible to accurately measure the full physical unit range simply by changing the voltage offset at the sensor. For example if one is interested in a physical unit range of 0 Newtons to 100 Newtons and is using a range of 0 Volts to 5 Volts on a sensor capable of reading –5 Volts to 5 Volts then the linear calibration could be Physical Units = 0 + 20 * Sensor Voltage. If one were subsequently interested in measuring a physical unit range of –100 Newtons to 100 Newtons, then this can be achieved simply by changing the voltage offset at the sensor from 0 Volts to –5 Volts. The linear calibration would then be
Physical Units = -100 + 20 * (Sensor Voltage - -5). Notice in this example that the slope of the linear calibration remains unchanged – therefore a recalibration of the sensor is not required.

## 4.0    DAVIT CONTROLLER I/O CHANNELS

The Davit Controller uses three analog input channels, two analog output channels, and two digital output channels. These channels are described in the table below.

| Analog Input Channels | | | | |
|---|---|---|---|---|
| Channel | Description | Physical Units | Voltage Range | Notes |
| 0 | Wave Elevation | Centimetres (cm) | -5 to 5 | |
| 1 | Boom Load | Newtons        (N) | -5 to 5 | |
| 2 | Boom Angle | Degrees        (Deg) | -5 to 5 | |

| Analog Output Channels | | | | |
|---|---|---|---|---|
| Channel | Description | Physical Units | Voltage Range | Notes |
| 0 | Davit Payout | Centimetres (cm) | 0 to 5 | |
| 1 | Boom Angle | Degrees        (Deg) | 0 to 5 | |

| Digital Output Channels | | | | |
|---|---|---|---|---|
| Channel | Description | Physical Units | Voltage Range | Notes |
| 0 | Auto Launch Signal | Volts (V) | 0 or 5 | |
| 1 | Lifeboat Release Signal | Volts (V) | 0 or 5 | |

**5.0    DAVIT CONTROLLER REGISTRY SETTINGS**

Note that most Davit Controller parameters are saved in the registry under
My Computer\HKEY_CURRENT_USER\Software\VB And VBA Program
Settings\Davit Controller\Startup.

The Davit Controller application does not enable the user to modify the Davit
Controller parameters Drum Diameter, Stowed Position, and Max Velocity nor
the Boom Controller parameters Drum Diameter and Max Velocity because
improper settings for these values can result in unsafe operation and/or
equipment damage. One can modify these parameters only by editing their
corresponding registry keys. Note that only qualified staff should modify registry
settings.