Calibrating a Hopper Dredge using the Entek Bubbler System

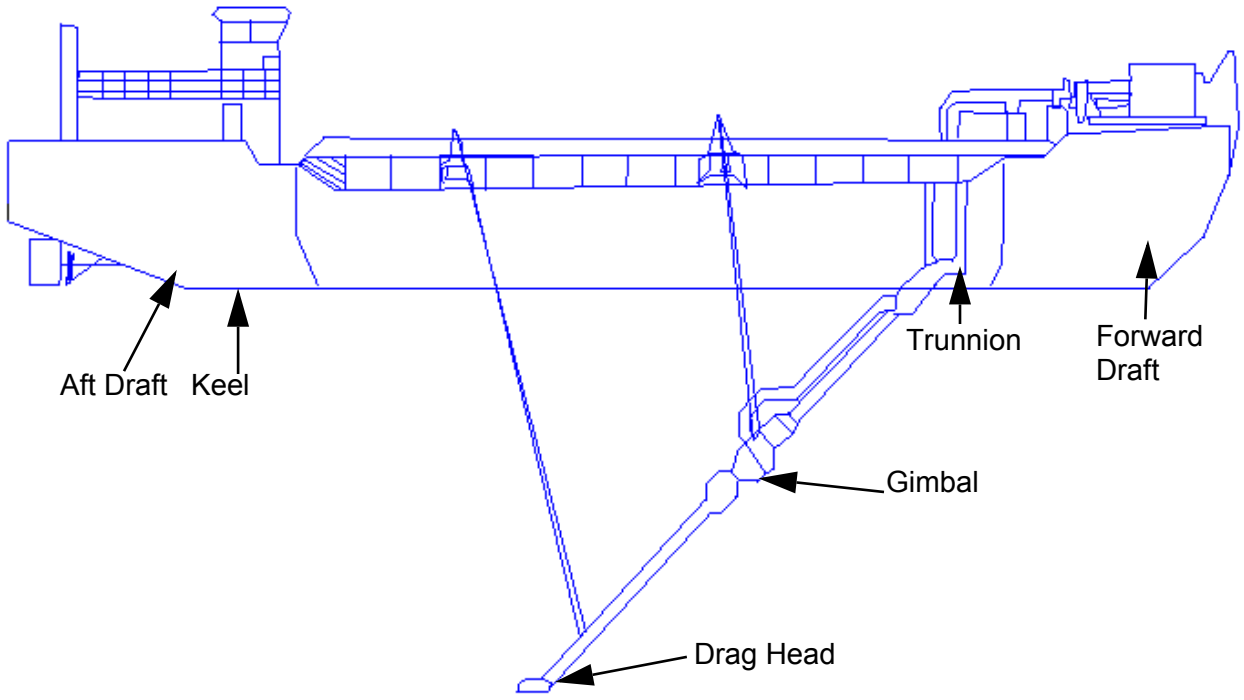
By Jerry Knisley

The ENTEK bubbler system has 6 channels that are typically used for the forward draft, aft draft, port gimbal, port head depth, starboard gimbal and starboard head depth. The calibration for each bubbler channel must be completed independently of the others. Calibration is going to take a few hours, but take care not to rush because all of the dredging parameters rely on a good calibration. There are a series of HYPACK newsletters from Mircea Neacsu regarding hopper dredge instrumentation that should be used as a reference with the guide.

HOPPER DREDGE COMPONENTS

Figure 1 is a drawing of the side profile of a hopper dredge.

FIGURE 1. *Side Profile of a Hopper Dredge*



The order that you calibrate the sensors is not important as each sensor acts independently.

CONFIGURING THE ENTEK BUBBLER SYSTEM

To properly configure the ENTEK Bubbler, use the HYPACK® HARDWARE program to install three mobiles. Each mobile is a vehicle with a position. This may sound confusing because we are dealing with a single hopper dredge. The drag arms are treated as separate

vehicles in DREDGEPACK® because they have a position separate from the main vessel. Figure 2 shows a typical setup.

FIGURE 2. *Entek Bubbler Setup in HYPACK® HARDWARE*

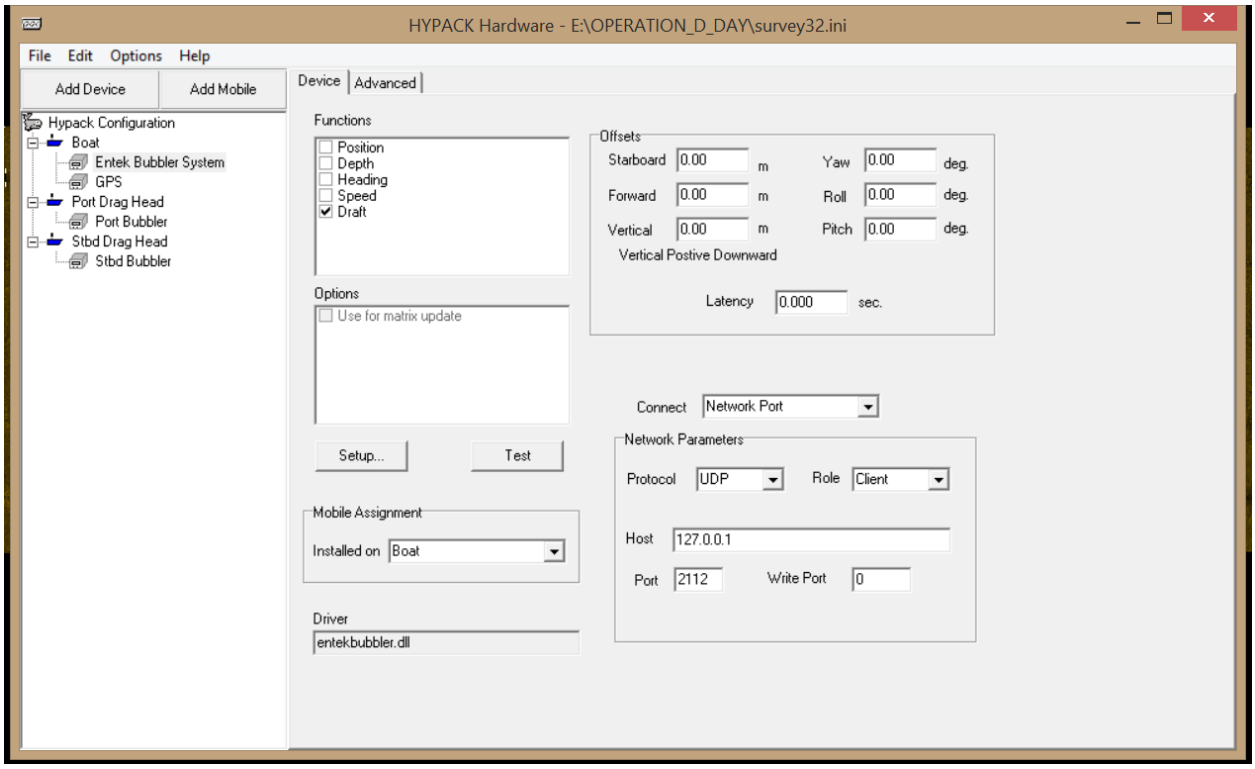
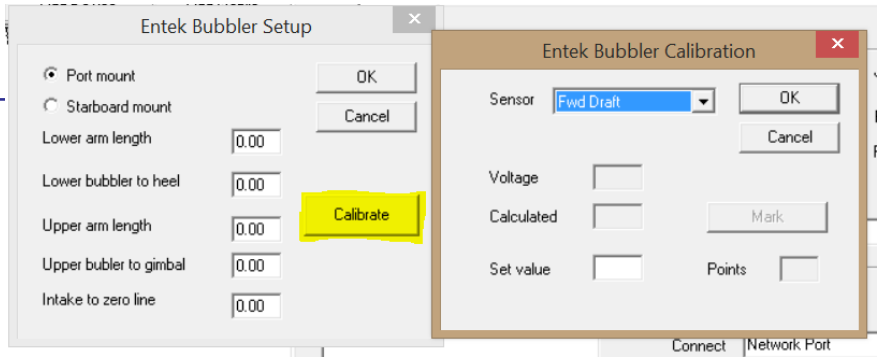


FIGURE 3. *Driver Setup in HYPACK® HARDWARE*



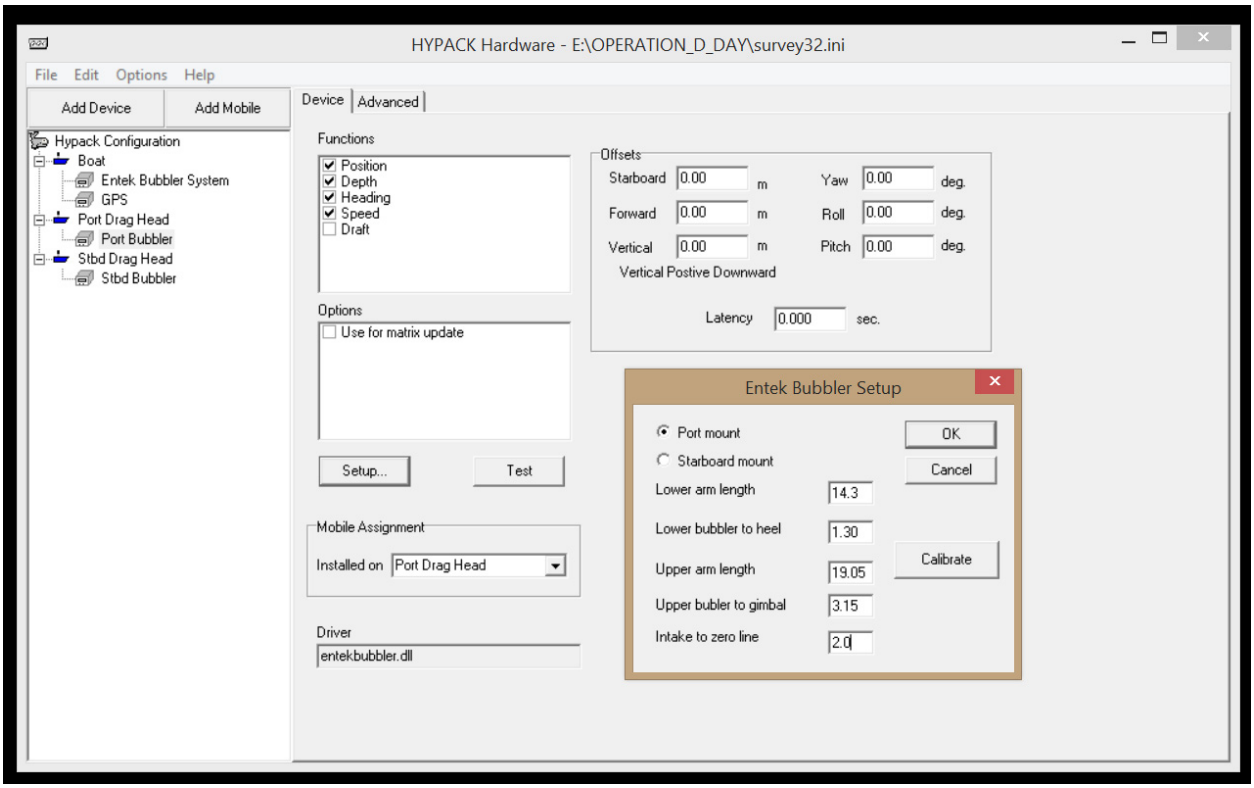
The Boat mobile is the main hull of the dredge. On this mobile is the GPS and the first instance of the Entek bubbler. In the first instance, the only function chosen is the draft. Draft is required of the hull to help determine the displacement of the vessel.

The Setup dialog for this instance is simple. The port and starboard selection has no effect on the operation of the driver. To calibrate the sensors click [Calibrate] and select the Fwd Draft / Aft Draft sensor. This will be discussed in more detail later.

The second and third instances of the driver support the drag arms. Each of them are configured in the same manner so only one will be discussed here. Figure 4, shows the configuration for a hopper dredge that was recently installed. The measurements are from

the ships manual for the previous system and have not been remeasured. Notice that the device functions for the drag arm except draft are all enabled.

FIGURE 4. *Drag Arm Configuration in HYPACK® HARDWARE*



On the setup form there are a few items that should be explained.

- The **Lower Arm Length** is measured from the Gimbal point to the drag head visor pin.
- The **Lower Bubbler to Heel** is the distance from the end of the bubbler hose to the visor pin.
- **Upper Arm Length** is measured from the center of the trunnion to the Gimbal point.
- The **Upper Bubbler to the Gimbal** is the end of the upper bubbler hose to the Gimbal point.
- The **Intake to the Zero Line** is the trunnion to the keel.

Each of these measurements should be as accurate as possible. That being said, it is very difficult to measure the distances on the arm because the arm is typically very long. In many cases, a good ship's drawing is checked and a measurement is taken. If the measurements are close, the drawing should be considered more accurate.

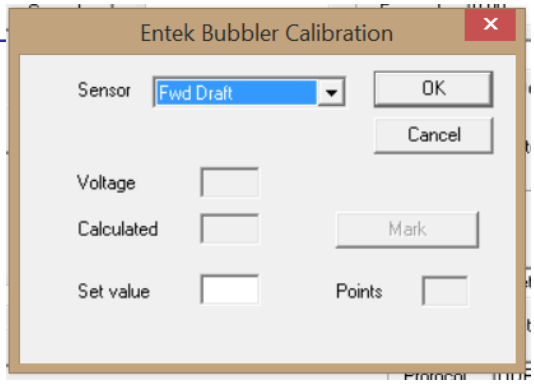
When the devices are calibrated, each driver is used to calibrate only the functions used by that instance. For example, to calibrate the starboard drag head, the instance of the driver that is installed on the starboard arm is used to calibrate the starboard drag. Only that instance of the driver will know the configuration parameters for the sensors used on that arm and the calibration parameters for that arm.

TO CALIBRATE THE DRAFT SENSORS

The process to calibrate is the same for all of the sensors. The sensor needs to be moved in the water column and measurements need to be taken at different points to build a depth to pressure table.

1. **Start with the ship light, start HYPACK® HARDWARE**.
2. **Select the Entek bubbler that is installed on the main vessel as the draft device**.
3. **Select [Setup]** to access the dialog.

FIGURE 5. Calibrating the Forward Draft Sensor



4. **Click [Calibrate]** to access the calibration dialog.
5. **Set the Sensor option to Fwd Draft**.
6. **Enter the measured depth under Set Value.**
7. **Click [MARK]**.
   - **Voltage** is the actual reading for that sensor from the Entek bubbler system.
   - **Calculated** is the scaled draft value based upon the current calibration.
   - **Points**: The number of calibration points you have used. For draft you will need two readings.
8. **Load water into the hopper to increase the draft of the vessel**. The Voltage reading will increase.
9. **When the dredge is settled, enter the measured draft under Set Value and press [MARK].**
10. **Click [OK]** on the calibration dialog.
11. **Click [Calibrate]** to access the Calibration dialog.
12. **Set the Sensor option to Aft Draft**.
13. **Enter the measured depth under Set Value.**
14. **Click [MARK].** The ship should still be loaded so the value should be the maximum draft possible.
15. **Release the water from the hopper** so that the draft decreases to the minimum.
16. **Enter the measured draft for the Aft Draft.**
17. **Verify that the number listed for points is at least 2**.
18. **Click [OK]** on the calibration dialog.
19. **Click [OK]** on the SETUP dialog.
20. **Save the hardware setup and exit HYPACK® HARDWARE.**

After a calibration it is always a good practice to check the draft against the measured draft read from the hull markings on the ship.

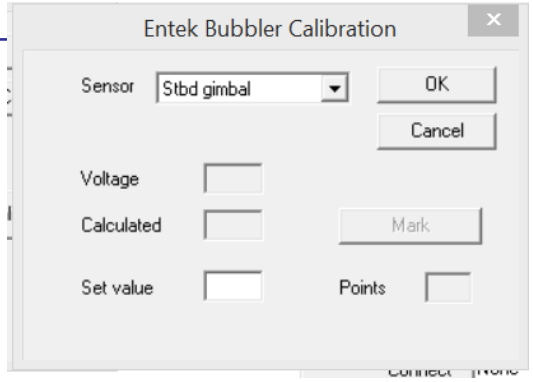
TO CALIBRATE THE GIMBAL SENSOR (PORT OR STARBOARD)

The process to calibrate is the same for all of the sensors. You must move the sensor in the water column and take measurements at different points to build a depth to pressure table.

For this test there must be a measuring device attached to the drag arm at the gimbal as close to the end of the bubbler hose.

1. **Start with the gimbal in the water at a depth that causes the bubbler hose to be completely submerged by at least 5ft / 2 meters, start HYPACK® HARDWARE.**
2. **Select the Entek bubbler that is installed on the drag arm** as a depth device.
3. **Click [Setup]** to access the dialog.
4. **Click [Calibrate]** to access the Calibration dialog.

FIGURE 6. *Calibration Dialog*



5. **Set the Sensor option to Port or Stbd Gimbal.**
6. **Enter the measured depth under Set Value.**
7. **Click [MARK].**
   - A value will be present in the VOLTAGE box that is the actual reading for that sensor from the ENTEK BUBBLER system
   - A value will be in the CALCULATED box that equates to the scaled draft value based upon the current calibration.
   - A number of points will be listed in the box next to the label POINTS. For draft you will need two readings.
8. **Lower the gimbal in the water to a maximum depth**. The Voltage reading will increase.
9. **When the gimbal is settled, enter the measured draft under Set Value and press [MARK].**
10. **Click [OK]** on the calibration dialog.
11. **Click [OK]** on the Setup dialog.
12. **Save the hardware setup and exit** HYPACK® HARDWARE

After a calibration it is always good practice to check the depth in DREDGEPACK® against the measured read.

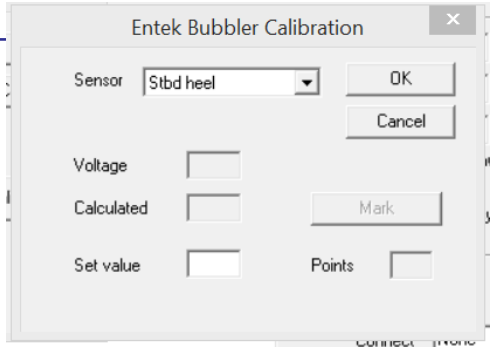
TO CALIBRATE THE DRAG HEAD SENSOR (PORT OR STARBOARD)

The process to calibrate is the same for all of the sensors. The sensor needs to be moved in the water column and measurements need to be taken at different points to build a depth to pressure table.

For this test there must be a measuring device attached to the drag arm at the gimbal as close to the end of the bubbler hose as possible.

1. **Start with the Drag head in the water at a depth that causes the bubbler hose to be completely submerged by at least 5ft / 2 meters and start HYPACK® HARDWARE**.
   The minimum operating depth is a good place to start. Maintain safety of the arm angle at all times.
2. **Select the Entek bubbler that is installed on the drag arm** as a depth device.
3. **Click [Setup]** to access the Driver Setup dialog.
4. **Click [Calibrate]** to access the Calibration dialog.
5. **Set the Sensor option to Port or Stbd Heel.**
6. **Enter the measured depth under Set Value.**
7. **Click [MARK].**

FIGURE 7. Calibrating the Drag Head Sensor



- **Voltage** is the actual reading for that sensor from the Entek bubbler system.
- **Calculated** is the scaled draft value based upon the current calibration.
- **Points**: The number of calibration points you have used. For draft you will need two readings.

8. **Lower the heel in the water to a maximum depth**. The Voltage reading will increase.
9. **When the heel is settled, enter the measured depth under Set Value and press [MARK].**
10. **Click [OK]** on the calibration dialog.
11. **Click [OK]** on the Setup dialog.
12. **Save the hardware setup and exit HYPACK® HARDWARE.**

After a calibration, it is always a good practice to check the depth in DREDGEPACK® against the measured read.