



EXCAVATOR INTERFACE

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The following article is meant to explain a few of the settings regarding the installation of the EXCAVATOR device system.

There are two drivers that make up the interface. The use of the two drivers was initially meant to make configuration easier. In the future, we will combine them into a single driver.

EXCAVPARSER DRIVER

The first driver is the EXCAVATOR INTERFACE, also known as the EXCAVPARSER.DLL. This is the driver that talks to the sensors. Over the years, we have interfaced with several systems. Figure 1 is the Setup Dialog for this driver.

EXCAVPARSER SETUP - GENERAL TAB

FIGURE 1. Excavparser Driver Setup--General Settings

SETUP

Excavator Type: Simulator

Sensor Override: ☐ Boom Sensor ☐ Stick Sensor ☐ Bucket Sensor

Filtering: ☐ Boom Angle ☐ Stick Angle ☐ Bucket Angle

Filter factor: 0

Adjustments: Boom Angle: 0 Multiplier: 0 Stick Angle: 0 Multiplier: 0 Bucket Angle: 0 Multiplier: 0

The method for calculating the offsets is:
Angle = (raw angle * multiplier) + offset
Enter a -1.0 in the Multiplier to reverse the angle.

NOTES:
1. Enter the Trunion to Water distance in the ExcavatorSM driver as a Vertical Offset.

Cancel OK

The various systems that we support are listed on the **Excavator Type** drop-down list:

- The **eTrac** system is our most installed system.
- The **HYPACK®** system is a new system using the same sensors as the eTrac system, but with a more intelligent control box that allows for Pitch and Roll built into the cabinet and an Ethernet interface to the controller.
- The **Ocala Instruments** System is included as a legacy system. This is the first sensor package that we used on excavators and is still available.
- The **Custom** System is a new addition to the driver that will allow you to specify the Boom, Stick and Bucket angles in a string. This allows you to parse the string in a fashion similar to the GenDevParse driver. I will explain this more later in the article.

In the section for **Sensor Override**, you specify an angle to be used if a sensor fails. The most probable use of the Sensor Override is to create a bucket down situation when the bucket sensor fails. The angle is considered 0 horizontal and rotates in a counter-clockwise direction so that bucket straight down is 270 degrees. Yes this is a bit confusing, but it makes perfect sense somewhere so we are going with it.

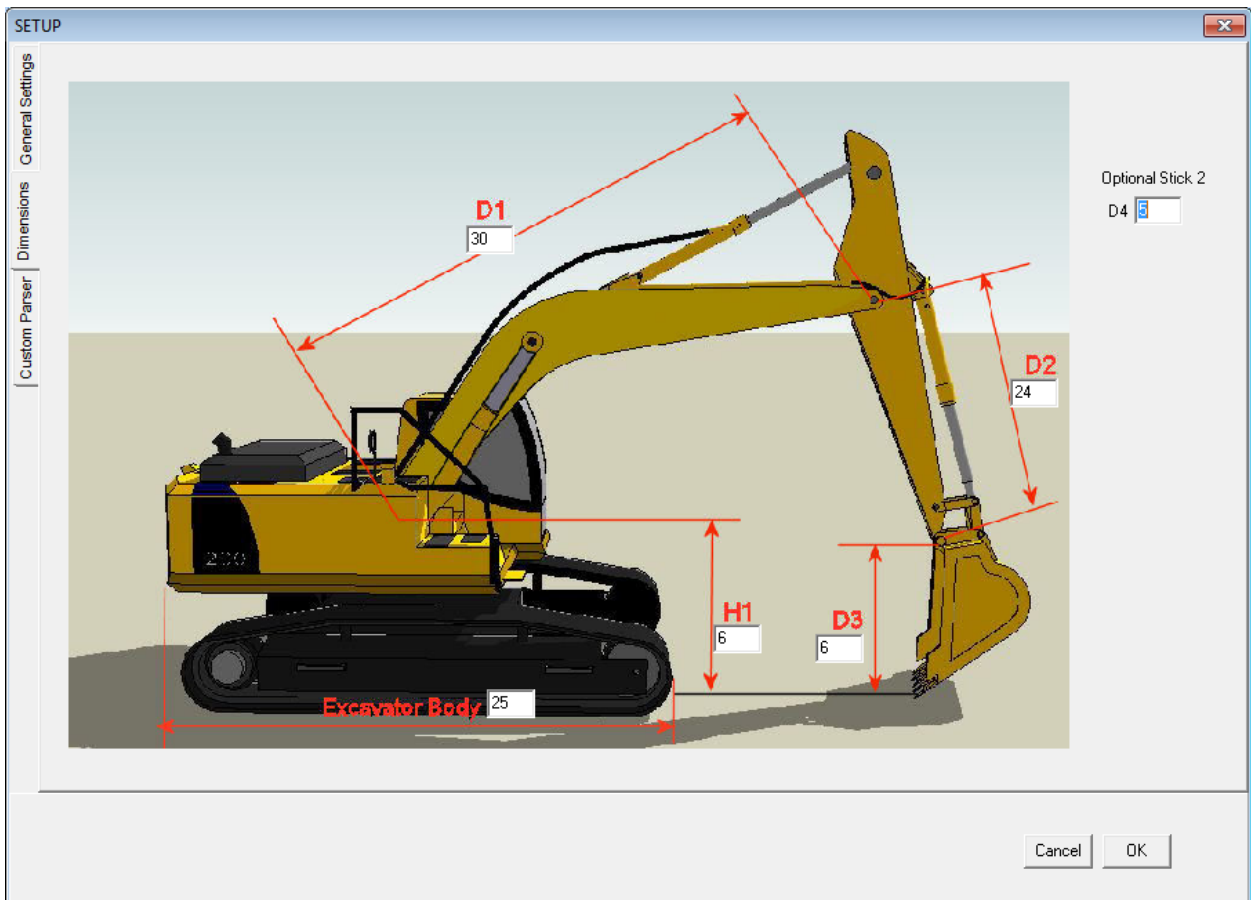
Filtering: This section is added to allow you to dampen changes in the angles. In the past, the system has been used on machines that are breaking rock and digging in rough terrain so the angles jump a lot. The filters allow the jumpiness to be dampened, which allows you to better see where the tool is. The values in the Filter section are from 0 (minimum filtering) to 1. The filter is a low pass filter written by Lazar that is pretty simple, but it is also very effective.

The **Adjustments** part of the GENERAL SETTINGS page allows you to apply an offset to a value that is read in and a multiplier. In some systems, this can save a lot of time in the event an angle sensor breaks.

On one project, our user had several excavators. The angle sensors were calibrated to absolute horizontal level, then during calibration, the angle of the boom, stick and bucket were mathematically calculated using a Total Station. Those angles were merged with the angles the system was reading to develop a differential angle which was entered in the adjustment section to make the system read the true calibrated angle (as measured by the Total Station). Seems kinda complicated huh? In reality, the down time of a broken sensor could be minimized. They had several spare sensors on hand that were calibrated to absolute horizontal level. When a sensor broke (which only happened three times over 6 months on a project that had 85 sensors working 24 hours a day 6 days a week) a new, pre-calibrated sensor was bolted on and the system was returned to work with no loss of accuracy and no need to recalibrate. So this method requires a lot more in depth calibration but in the case of lost work time, it was worth it.

EXCAVARSER DRIVER SETUP - DIMENSIONS TAB

FIGURE 2. ExcavParser Driver Setup - Dimensions Tab



In the past, we had to enter the dimensions in several places. Now the dimensions are only required in the EXCAVARSER driver or the web interface of the HYPACK® SYSTEM. The driver passes the dimensions on to the EXCAVATORSM driver that we will discuss in the next section.

Note: Each measurement is from pin to pin.

The **Bucket** is measured from the Bucket Pin to the teeth of the bucket when the teeth are directly below the bucket pin.

The **H1** value is from the trunnion point, which is also the center of the pin that connects the boom to the excavator body, down to the deck. If the machine is sitting on a pad and the teeth are placed on the deck then the H1 value is from the boom pin to the deck and not the pad. If the teeth are placed on the pad for calibration then the H1 value is from the boom pin to the pad. It is assumed in the calibration that the machine is level.

The Optional **Stick length** is for the future development of a four arm excavator. Currently we can handle this with a different driver but in the future, choosing the eTrac system will allow you to choose the fourth arm as well.

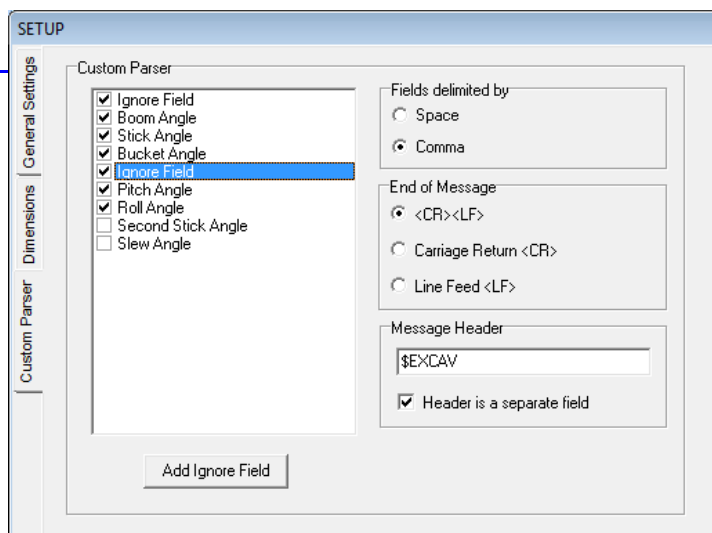
FIGURE 3. Sample Custom Excavator Setup

Figure 3 is an example of a CUSTOM Excavator setup. In the example, the string is similar to the one below.

```
$EXCAV,44.2,20.0,0.0,01:23
AM,-0.2,1.4<cr><lf>
```

This is a made up string so don't pay too much attention to the angles; it is meant as an example.

The **Ignore Fields** option allows you to parse any string, ignoring select sections during the process. This section is still under development but will be released soon.



CALIBRATING THE SYSTEM IN THE EXCAVPARSER DEVICE WINDOW

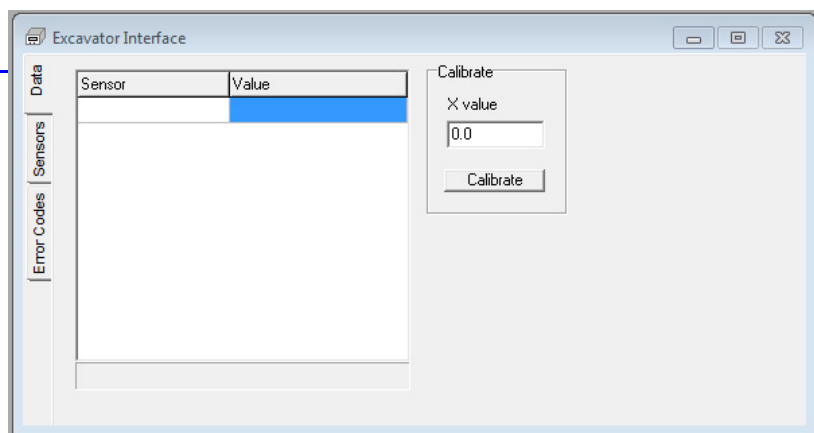
The Excavparser device window depicts an eTrac installation.

FIGURE 4. Excavparser Device Window

The Data tab would show the sensors as they are read from the SEI BUS.

To calibrate the system:

1. **Measure the distance from the Boom pin to the Bucket pin.**
2. **Enter the measurement as the X value in the Calibrate section.**
3. **Press [Calibrate]** to compute the angles for each sensor.

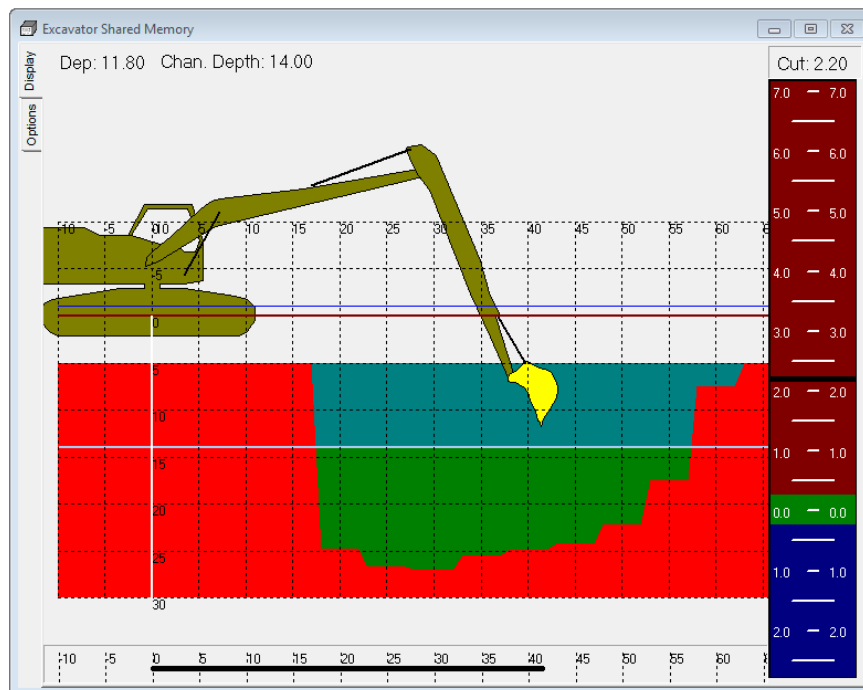


EXCAVATOR DISPLAY DRIVER

The Excavator Display driver is the EXCAVATORSM.DLL. This driver is used to compute position and depth of the bucket. Without this driver, the Excavator Interface doesn't do anything. The driver has been modified over the years to the current version.

EXCAVATORSM DEVICE WINDOW - DISPLAY TAB

FIGURE 5. Sample ExcavatorSM Device Window--Display Tab



- **Cut/Fill bar (far right):** This bar is used to show the depth of the teeth in relation to the channel design. The area in Green on the Cut/Fill bar represents the acceptable depths for dredging. You can configure this area or remove the Cut/Fill bar from the display in the Options tab. In the display shown in Figure 5, the excavator operator has 2.2 feet of cut left at the current location before the teeth are at grade.
- **Reach bar (bottom bar):** This is how far the boom and stick are extended away from the trunnion point of the excavator. This is not important to a lot of the installations we have performed, but it is critical to a few. This Reach Bar and the Cut/Fill bar can be removed from the display on the Options tab.
- **Undredged area (Red)**
- **Channel Line (Horizontal blue line across the digging profile)**
- **Area above the channel (Teal)**
- **Area below the channel that had been dredged (Green)**
- **Tide (horizontal blue line above the digging surface)**

- **Strike line (horizontal red line):** Used to highlight a depth. In this case, the strikeline is set to '0' so it looks like it is the height of the trunnion.
- **Current tide corrected depth** (top of the display)
- **Channel depth where the digging tool is currently located** (top of the display)

EXCAVATORSM DEVICE WINDOW - OPTIONS TAB

The Options tab has many settings that exist in the driver setup dialog; they have been added here in case you wanted to change them without exiting DREDGEPACK®. For example, it might be necessary to change the colors based upon the lighting conditions at different times of day.

FIGURE 6. ExcavatorSM Device Window - Options Tab

Excavator Shared Memory

Display Options

Screen Displays

- ☒ Enable CUT/FILL BAR
- ☒ Enable REACH BAR

Options

- ☐ Track Bucket

Cut Fill Bar

Ind

Cut Color

Grade Color

Fill Color

Cut Tolerance 0.5

Fill Tolerance 0.5

Apply

Colors

Mark1		Dredge Above Channel	
Mark2		Dredge in Overdepth	
Pontoon		Dredge Below Ovd.	
Channel		Survey	
Bucket		Excavator	

Grid

Minimal Depth	-10	Profile Width	100	Apply
Maximal Depth	30	Boat Position	10	

The **Screen Displays** area lets you turn off the Cut/Fill Bar or the Reach Bar.

The **Options** sections currently only has the **Track Bucket** option. In the future, other options may be added as they are developed. The Track Bucket option ensures that, as the bucket is moved around the screen it stays in the center of the display. This is useful when the operator is working to grade and wants to see the bucket up close as they dredge near the template.

The **Cut Fill Bar settings** allow you to set the color for the area to be cut, over depth and at grade. Recently the IND section was added to allow you to change the color of the line indicating the digging tool.

The **Cut Tolerance** is used to allow an under cut value.

- **If you enter a positive value**, the green on the Cut Fill bar will begin that distance short of the template. For example, if you are working in feet and enter 0.5 in this area, the green on the Cut Fill bar will start 0.5 feet short of the template.
- **If you enter '0'**, want to reach grade they can set this to 0 so that green starts at the template.
- **If you enter a negative number**, it forces an over cut. For example, a -0.5 foot in the Cut Tolerance means that the green section starts 0.5 feet below the template.

Important! Be careful if you do this because the Fill Tolerance would be a positive number greater than 0.5. The values are positive away from the template. Positive cut is above the template and positive fill is below the template.

The **Color** section is pretty self explanatory. The changes to colors are immediate and are stored when you exit DREDGEPAK®.

The **Grid** Section controls the depth grid lines on the profile view. It is important to remember is that the minimum depth **MUST** be less than the maximum depth even in Elevation Mode. The example is a -10 to 30 feet in depth mode. The driver is entirely compatible with Elevation Mode.

EXCAVATOR SM – SETUP DIALOG

The setup dialog has a few more options than the online options.

FIGURE 7. Excavator SM Driver Setup

The screenshot shows the 'Excavator Setup' dialog box with the 'Profile' tab selected. The dialog is divided into several sections: 'Grid' with input fields for 'Minimal Depth', 'Maximal Depth', 'Profile Width', and 'Boat Position'; 'Control Lines' with input fields for 'Horiz. Mark 1', 'Horiz. Mark 2', 'Overdredge', and 'Pontoon Protection'; and 'Dredge Filtering' with input fields for 'Bucket Angle Range' (both set to 0) and a note 'Set to 0.0 to disable'. There are also checkboxes for 'Track Bucket' and 'Enable Playback'. At the bottom right are 'OK' and 'Cancel' buttons.

The first tab is the PROFILE tab. This section controls the grid lines on the display. Again, the minimum depth **MUST** be less than the maximum depth even in Elevation Mode.

The **Control Line** section places two horizontal lines on the display at set depths:

- A **channel overdredge line**
- A vertical **Pontoon Protection line**. If the bucket gets closer to the trunnion than the pontoon protection value, the display will change color as a warning that the operator is near the pontoon with the excavator teeth.

The **Dredge Filtering** section is a new feature of the driver. This is used to control when the driver is allowed to update the matrix. If the values are entered, the driver will only update the matrix with the excavator depth between the angles specified. The angle of absolute vertical is 0 degrees with positive towards the dredge and negative away. A setting of 0 to 15 would only allow the 15 degrees from vertical to the dredge to activate matrix updates.

Enable Playback allows the driver to store a special Binary file with all of the information of the dredge movements. This is a special case and if it is to be used please contact us at help@hypack.com before you choose to try it. We will have to assist you with the viewing software.

I am going to skip over the colors tab because it is pretty self explanatory. Choose a color and that is what we will make it look like on the display.

FIGURE 8. Driver Setup - Grapple Tab

The **GRAPPLE Section** is made for cases where the system is installed on a standard excavator with a grapple attachment. Basically the grapple is a fixed finger that the bucket is pressed against to allow the operator to pick up objects. This has only been done a few times so you might need a call to Technical Support to get it up and running.

- The **Direction** is the angle offset from the Stick to the tip of the grapple tooth. This angle is used to determine the depth of the tool since it is almost always going to be the deepest point that the tool reached. The bucket sensor is used to show the bucket on the screen in relation to the grapple. The grapple stick shape is a little different than a standard stick shape. I have an example I can email to anyone if it is needed.

The last tab is the **Shapes tab**. It is used to specify the shapes used to draw to the screen. You cannot change the shapes unless you check the 'Enable Shape Selection' check box. This is to prevent inadvertent changes that make the driver not show the object. There are standard shapes loaded when the HYPACK® software is loaded. A special folder in the Boat Shapes directory holds all of the standard shapes in HYPACK® format that we are used to drawing. In the future we hope to have the AutoCAD DXF shapes available, but that is a future development when we have time.

