P-Wave Quick Start Guide

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The P-wave velocity station.

Introduction

The P-wave velocity gantry measures the speed at which ultrasonic sound waves pass through materials that are placed between its transducers. The three orthogonal sets of piezoelectric transducers allow the velocity to be determined in the X-, Y-, and Z-directions (*Figure 1*) on working-half split-core sections. The P-wave bayonets (PWBs) measure the velocity along the core (Z-direction) and across the split-core face (Y-direction), and a P-wave caliper (PWC) measures the velocity perpendicular to the split-core face (X-direction). A laser measures the position of the top of the split-core section, and using this, along with the known distance to the transducers, calculates the position at which the velocity was measured (this is recorded as Offset in the LIMS Database). For discrete sample cubes, the velocity is measured along each of the three axes separately using the PWC. Mini-cores are measured along the axis of the cylinder (X-direction) using the PWC. For discrete samples cubes and mini-cores, all sample information, including offset, is entered by the user.

Velocity data generated from these sensors are part of the physical properties suite of shipboard sample measurements.
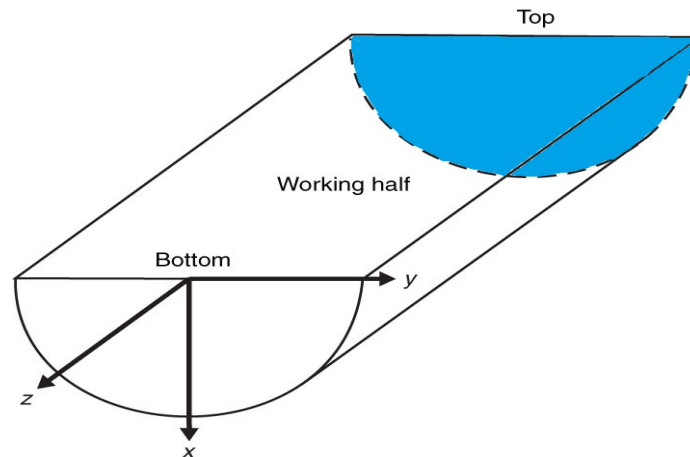

Figure 1. Core section-half liner showing top of section and relative orientations.

Running a sample

1) Open Velocity Gantry Program
The program icon is shown in *Figure 2.* Double click to open and follow the prompts to display the program home screen. **DO NOT** place the sample below the instruments before opening the program, the program will close all transducers upon startup, and can cause severe injury.
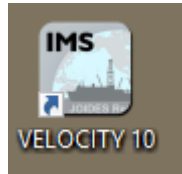
Figure 2. Opening program desktop icon.

CAUTION: When first opening the program, all 3 sensors will go through a communication initiation process where they will move down and up; the program will display a warning message first. However, make sure there are no samples or body parts underneath any of the sensors.

Figure 3, seen below, shows the home screen, which is the main program interface window. There are a number of graphical displays and adjustable settings. These are shown in detail on later figures.

Figure 3. Program home screen.

2) Load Your Sample
Make sure the sensors are clean, then, load your sample as shown in Figure 4 below. To load a section-half, point the top of the core forward (blue end cap toward the laser/ship's bow). Position the section-half under the desired sensor. The laser and program will calculate the sample position later. You may choose to place a small piece of Glad Wrap at the measurement location to keep the sensors clean and the core free of contamination, including added water. Place one or two drops of deionized (DI) water at any relevant sample sensor interfaces. For discrete samples, place them in the caliper with the axis to be measured oriented vertically between the two calipers.

Figure 4. Section-Half loaded under caliper.

3) Select Your Sample/Measurement Type

There are seven different measurement configurations. Each pictured in the vertical buttons to the left of the signal graph, as shown in *Figure 5* on the next page. The most common measurements are made in the liner, in section-halves, on the X-Y-Z-Axis, with the caliper and bayonet.
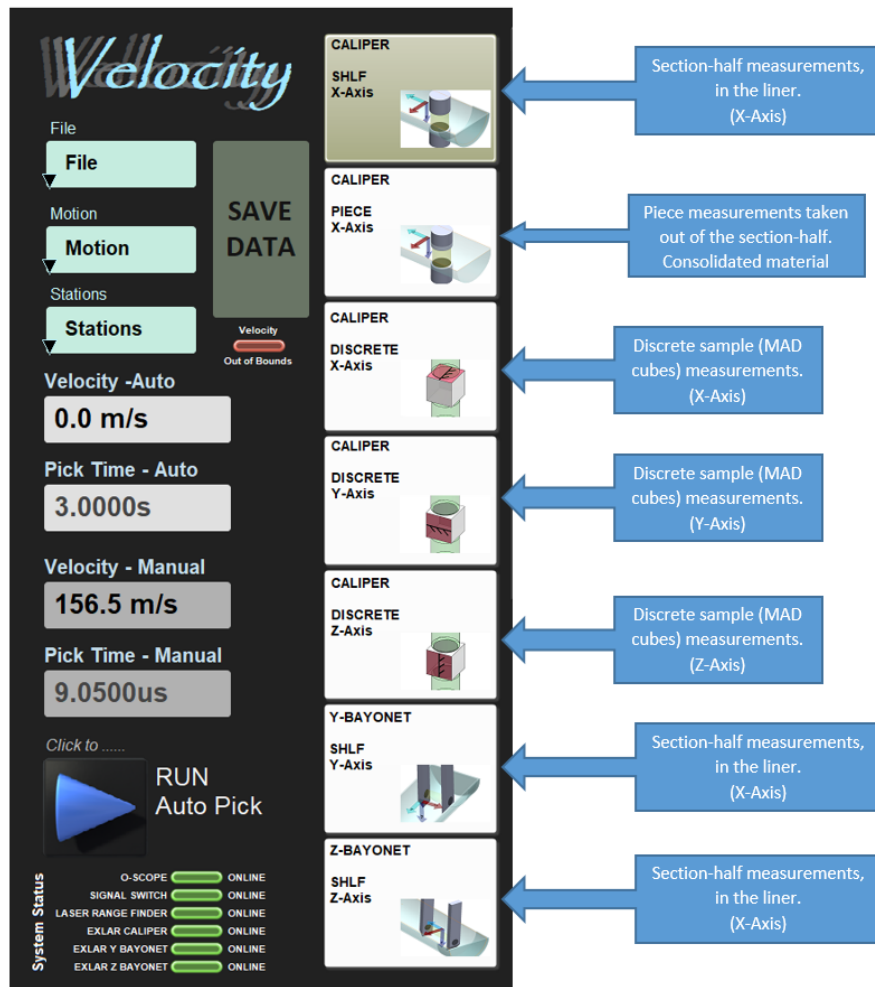

Figure 5. Measurement Configuration Options

4) Close or Insert the Caliper or Bayonets into Your Sample

Use the instrument motion buttons (*Figure 6*) to **slowly** lower the transducers to the sample. For the bayonets, you need to insert them so the circular part of the black sensor dot is fully submerged in the sample, but try not to go so deep you make contact with the liner. Use the slow motion buttons until you are comfortable with the speed. There is a slight delay between releasing the mouse click and the motion, so be careful not to crush your sample. For either the caliper or bayonet, keep an eye on the signal graph (*Figure 7*) while moving the instrument to see when you begin to get a good signal. Make sure the run button is selected so the signal graph is updating. You can use a few drops of deionized (DI) water at the sample-sensor interface to improve signal transmission. A piece of Glad Wrap is also a good way to keep the sensors clean and the core free of added water and contamination.
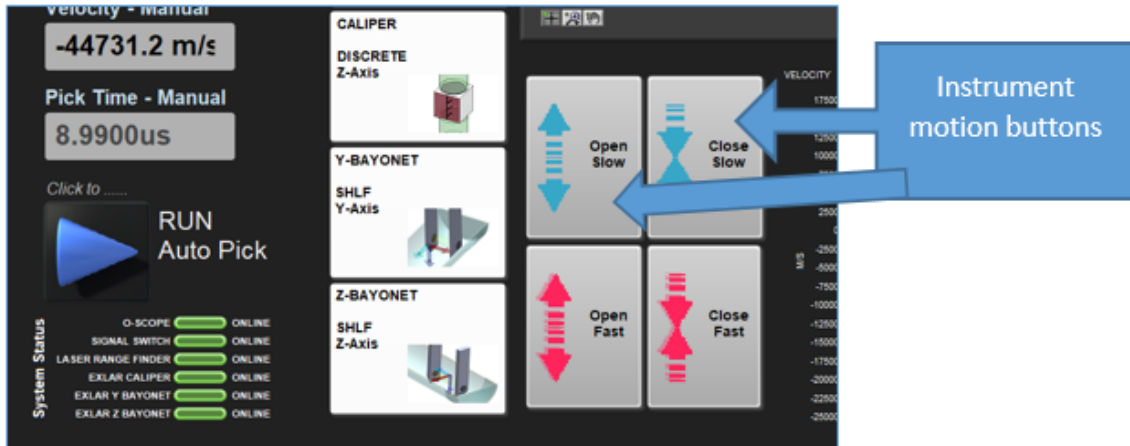

Figure 6. Instrument motion buttons.

Figure 7. Clean waveform indicating a strong/good signal.

The program continually updates the velocity calculation and displays the value in the "Velocity – Auto" box (see *Figure 5*). The value is an average of the sets of stacks. It also displays a red vertical auto-pick location line (*Figure 7*), where the program's algorithm has placed the first arrival wave. If the velocity and auto-pick location look good, save and upload your data. If, however, the velocity is out of the expected range, or the pick location is not near or at the first arrival wave, see the *Supplemental Information* section at the end of this guide titled *Evaluating Your Measurement*.
NOTE, The typical slide bar settings are between 50 and 100 for the stack bar and just above 10mV for the threshold bar.

5) Save Your Data

The program has an expected velocity range setting, which doesn't allow the user to save data that is slower than 1000 m/sec, or faster than 7000 m/sec. If the measured velocity is within this range the "Save Data" button is activated and you can save your data to the sample and upload. Click the "Save Data" button. A new window appears (*Figure 8*) that prompts you to enter the sample information. This is accomplished with the bar code scanner (gun). With the cursor flashing in the "SCAN" field (required), scan the barcode on the section-half D-Tube cap or the discrete sample label.
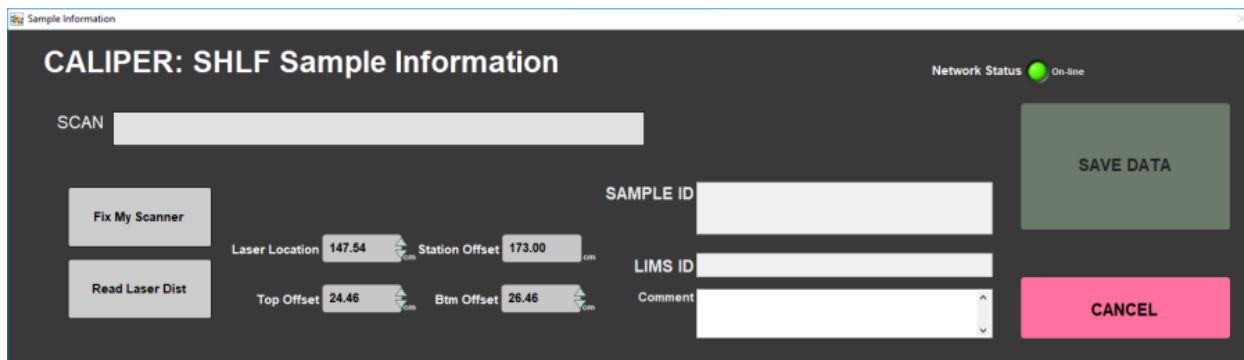
Figure 8. Unpopulated Sample Information window.

The "SAMPLE ID" and "LIMS ID" fields will then be populated with the relevant sample information (*Figure 9*). Check that the core, section, and test offset data are correct, then click "SAVE DATA". The "Top Offset" should be the top edge of the test location or your section-half. If you are measuring a discrete sample, the offset is already in the database because it was entered when the sample was first taken.
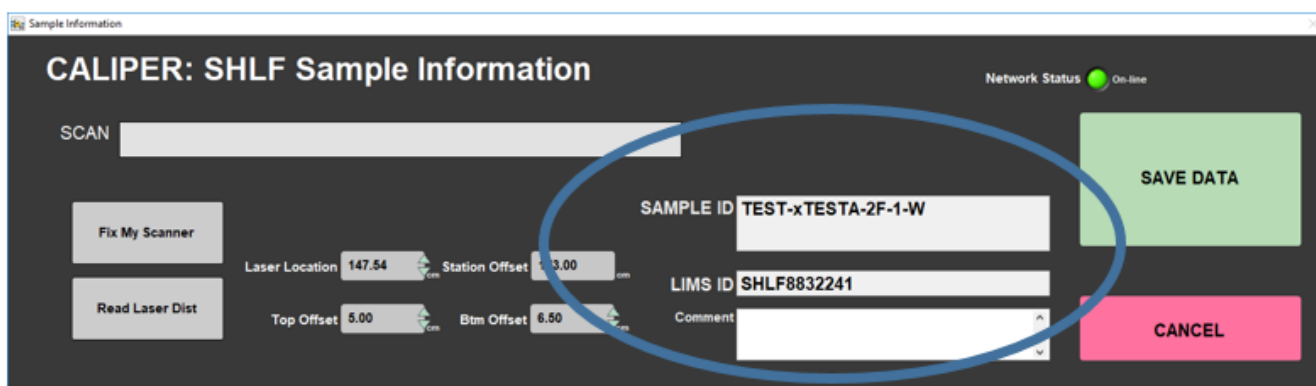

Figure 9. Sample Information window with relevant sample ID fields populated.

5) Upload Your Data
To upload your data, open the MegaUploadertron (MUT, the puppy icon) application from the task bar. Login with your LIMS password (*Figure 10*) and a directory window will open (*Figure 11*). Hint, your username default is *jrs_lastname* and your password default is $Firstname2017, with the first letter of your first name capitalized, followed by the current year.

In the MUT directory window below, you can either upload the files individually with the "Upload" button in the bottom right of the window, or in the box next to it, check "Automatic Upload". Once the files have uploaded successfully, they will be cleared from the directory window, and a copy is saved to the computer's local drive in a folder titled "Archive." You should leave this program running in the background. Simply minimize the directory window.

NOTE, do not close the window with the "X", always use File Exit or minimize. If you do accidentally close with the "X" you have to find the puppy icon on the expanded taskbar and double click it to re-open.
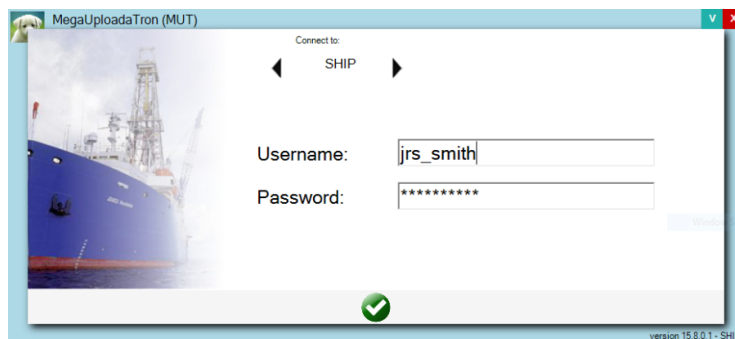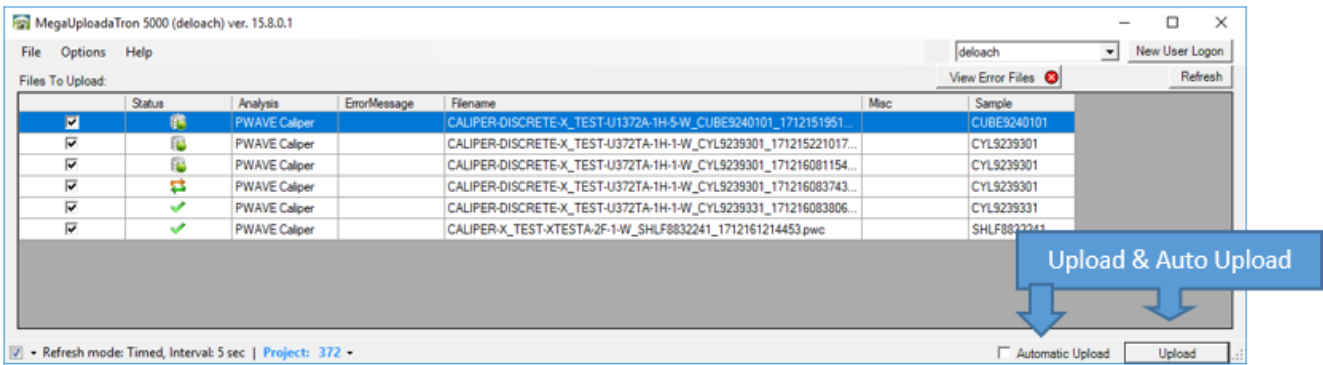

Figure 10. MUT login window.

Figure 11. Sample Information window with relevant sample ID fields populated.

The "Status" column symbol in the figure above, should be a green check prior to uploading. When uploading the figure will change a cylinder with a green dot. If there is an issue with the filename, or database connection, the symbol will appear as a purple question mark. Please ask a technician for assistance if this happens. If everything is uploaded, you are done and can prepare the station for the next sample. Once you are finished uploading data, it is always a good idea to check the data in the IODP database. Please see the supplementary information section on the next page for more information.

Supplementary Information

Evaluating Your Measurement

The program will automatically calculate the velocity from its auto-picked first arrival wave. It will display the value in the "Velocity – Auto" box (see *Figure 3*) and display the auto-pick location line (*Figure 12*). If either of these do not look good, the following steps A, B, and C are suggested, in that order.

A) First Arrival Picking

The program's method of automatically picking the first arrival from the signal is a multi step process. For more information on how an auto-pick is made, see the user manual or ask the Physical Properties Technician.

To evaluate the auto-pick velocity, you need to look at two graphs.
Auto-pick location line

The signal graph has several different displays, all accessible by clicking on different tabs at the top. Tip, you can zoom by pausing the program and clicking on the magnifying glass in the Graph Tools box, *Figure 12*. The first graph you need to examine is the stacked raw value ("RAW STACKED" tab), (*Figure 11*). Here you see the stacked measurements display with a vertical red line showing the location of the programs auto-pick of the first arrival wave. If the red line appears very near the first significant deviation from 0 on the Y-Axis, then the value is very likely reliable.
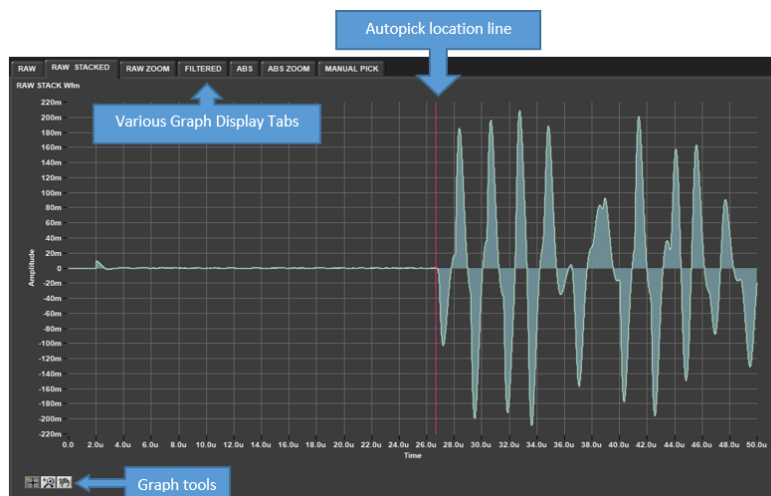

Figure 12. Raw Stacked signal display with red line indicating auto-pick location.

However, if the auto-pick location is off, or the velocities don't seem right, you may need to adjust the threshold voltage, which corresponds to amplitude on the Y-Axis. This will move the auto-pick location. Go to the "ABS ZOOM" display (*Figure 13*). Here you see a zoomed window of the absolute (ABS) signal value. Verify the auto-pick location is at the zero crossing after the first significant wave above noise levels. This wave may be very difficult to determine. If the pick line is not at the zero crossing after the first non noise peak, use the threshold slide bar on the right to adjust its location; NOTE the program must be running for changes to apply. As you move the threshold you should see a red horizontal line, indicating the threshold value, move up and down. When you change the threshold value enough to go over or under a neighboring peak, the auto-pick location will change in steps and your velocity will be recalculated. It is important to remember that in this display (ABS ZOOM), you are not trying to pick the first arrival peak, but the zero crossing after it. Because of the weakness of the first arrival peak, it is often difficult to resolve, which we can't do much about. However, we can reduce the error by picking a consistent location. Once picked, the program will then apply a standard half-waveform correction to get the first arrival location.
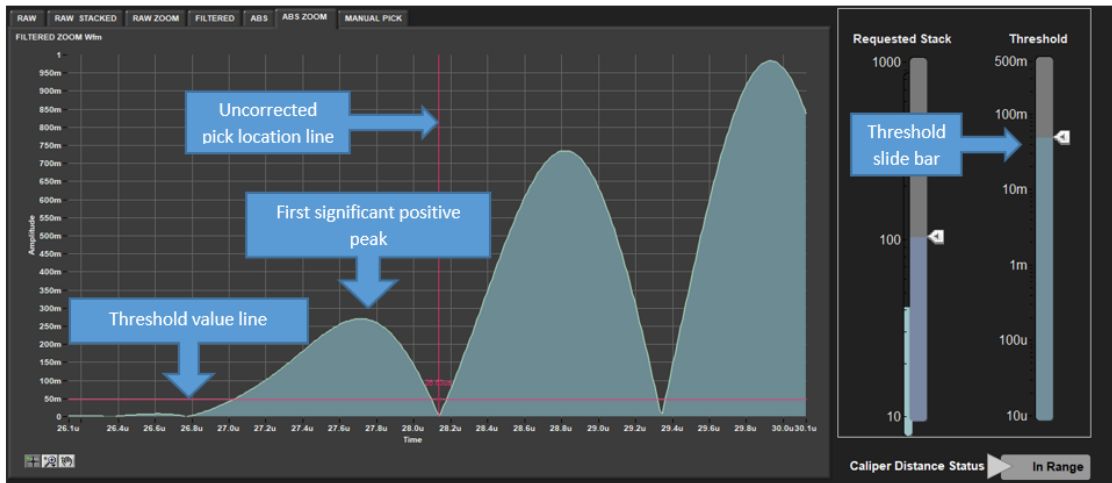

Figure 13. ABS Zoom display with threshold slide bar and uncorrected auto-pick location.

Once you have adjusted the threshold and got the auto-pick to the correct location, go back to the "RAW STACKED" or other raw displays and verify the red line is at the first arrival wave. If satisfied, you can now save your data. If the velocities and picks still don't look right, you have the option of manually picking the first arrival.

B) Manual pick

In order to do a manual pick, first pause the program. Now the "MANUAL PICK" display tab will be visible above the signal graph (*Figure 14*). Select that display; find the graph toolbox in the lower left corner of the display. If you need to zoom in, use the magnifying glass tool. Next, click on the crosshair tool on the far left side of the toolbox bar (*Figure 14*). Hover over the dotted yellow-green vertical pick line. When the icon changes, click and drag the pick line to the desired location and release. You will now see that the "Velocity –Manual" box has updated with the manually picked velocity. Both the auto-pick and manual pick velocities are saved simultaneously to the database when you upload.

Figure 14. Manual Pick display with yellow-green manual pick location.

C) Running a Standard as a QAQC Check

If you are not confident that the gantry system is running normally, you can run one of our standards to verify the instrument is giving the expected velocities for the material.
We have three materials available as a standard. Aluminum and acrylic are for the caliper, and a core liner with D.I. water for the bayonets. The expected velocities for each are below:

Aluminum 6295 meters/sec (+/- 63 m/s)

Acrylic 2730 meters/sec (+/- 27 m/s)

Water 1480 meters/sec (+/- 7 m/s)

The typical allowable deviation is 1% for the caliper and 0.5% for the bayonets. There will also be differences based on temperature, especially for water and aluminum. If the standard values are out of this range, ask a technician to help calibrate the instrument.

Viewing Your Data

To view your data, or most data around the lab, you can use the LIMS Online Report Portal (LORE) or the LIMS data viewer (LIVE) through a Firefox web browser. It is good practice to check once per core or after each upload to check that your data has made it into the database.

With Firefox open, click on the toolbar link "LIMS Online Reports" or go to the "Download LIMS core data" link on the ship's homepage (*Figure 15*). Once in LORE, click through the search options and sample filters to find your data (*Figure 16*). You can leave the window open in the background and simply refresh next time you want to check your data.
LORE gives you a fast way to download core data from most lab systems aboard the JR. You can export directly to an Excel or .csv file.

Figure 15. Ship's Home page with links to LORE and core data.

Figure 16. LORE, with P-Wave caliper data downloaded by hierarchy search.

Calibrating the PWV CALIPER

To begin calibration for the PWV select the "Caliper Piece X-Axis"
Click on the "Stations" tab to access the drop down menu, then click on "Calibrate Calipers".
Enter the Aluminum width- 30 mm, place Aluminum Standard (30mm) on the transducer.
Close transducers slowly
Click "Laser Offset" tab (blue)
Aluminum Standard field should be 6295.00
Click "Determine System Delay" tab (purple)
Adjust "threshold" till the redline on the graph is at first arrival point
The Velocity should be very close to 6295.00. If so, then "Accept Changes".

Credits

This document originated from Word document Gantry Velocity: Quick Start Guide *Version 1.0; Version 372 written by A. de Loach (2017-12-16).* Credits for subsequent changes to this document are given in the page history.

Archived Versions

- P-Wave Quick Start Guide (*.pdf)
- PWV_QSG_372.docx: A Word document of the Gantry Velocity: Quick Start Guide