(((ECHOMETER)))

Total Asset Monitor Acquisition and Analysis

Operating Manual

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TAM Acquisition and Analysis Manual

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General Features in TAM

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I. TAM Overview & Layout

The visual layout of TAM is intentional and meant to aid the user's workflow. At the top left of the screen the user begins by selecting his well and setting up his sensors. He then moves right to select a desired survey. To the right of that, he can then select the specific sensors to use for acquisition, and finally begin acquisition by clicking the ***Start New Test*** button on the far right.

TAM's core components can be seen through the application's layout (Figure 1). In the top left corner is the section dedicated to hardware and sensors. The user can quickly see if any sensors are connected, and can set up and make changes to the hardware configuration by clicking ***Setup Hardware***. This button brings up a dialog box that allows adding or removing sensors and editing sensor properties (e.g. coefficients, acquisition rate, and zero offset). The user can assign nicknames to sensors.

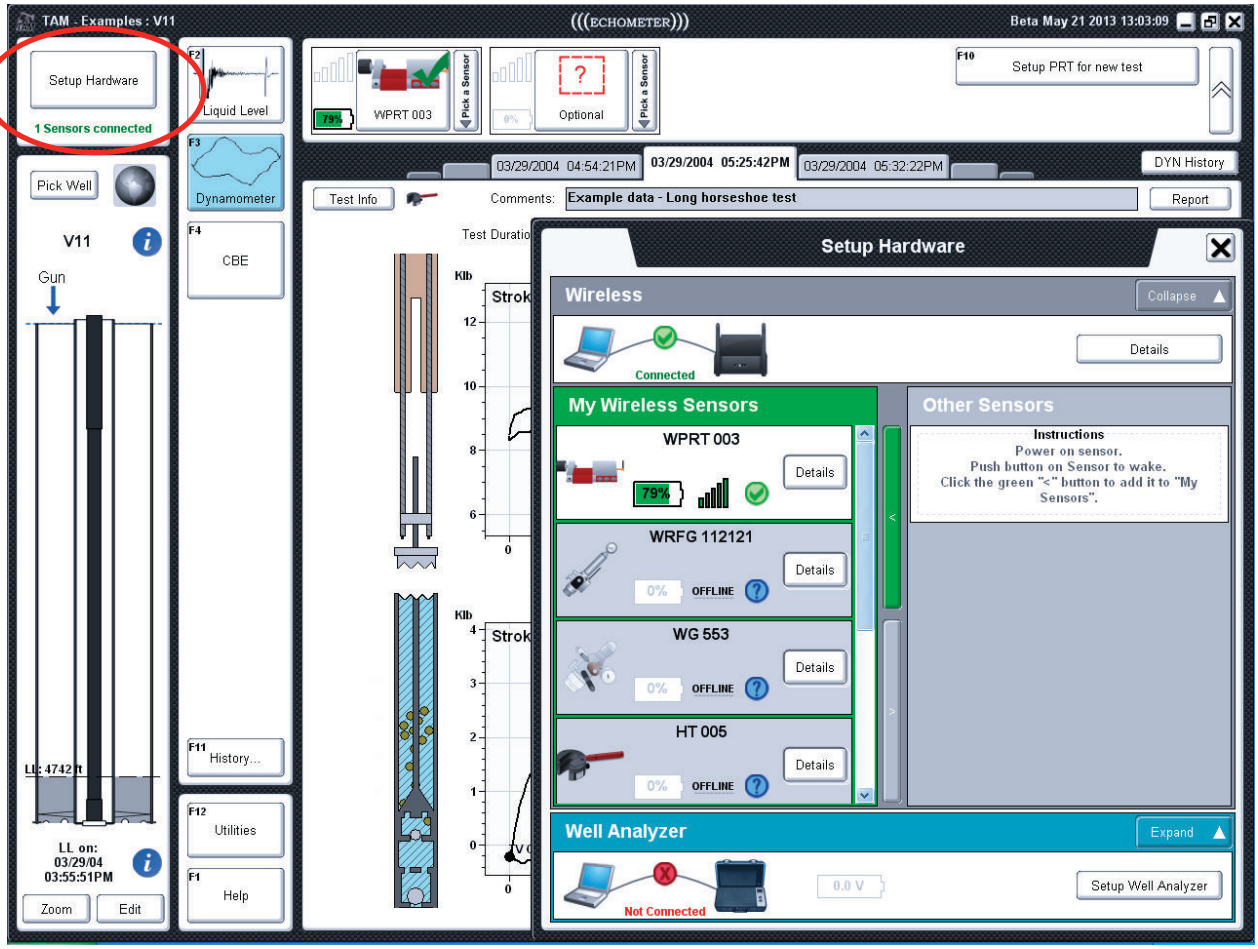


Figure 1: Layout of TAM, Hardware setup

Below the setup section is the area dedicated to the well schematic (Figure 2). At the top of this panel is the ***Pick Well*** button which allows the user to search for a well to load, create a new well, or delete an existing well.

Below the image of the currently selected well is the ***Edit Well*** button. This button brings up a dialog to quickly edit the current well's configuration. For most users, the ***Quick View*** screen allows entering the basic well information. More advanced options can be accessed in the ***Detailed View*** (e.g. deviated wellbore, complex well description, advanced lift system options, etc.). The ***Zoom*** button brings up a dialog that allows the user to select a section of the wellbore to show as a expanded image of the currently selected well.

Through the edit well dialog, the user also has the option to create new well ***Versions***. For example, if the user changes pumps or adds a new piece of jewelry, they can create a ***New*** well version so that all future tests will use the new well configuration, while previously acquired tests will continue to use the previous well configuration. The buttons for adding, removing, and branching well versions can be found at the top right of the ***Quick View*** edit well dialog.

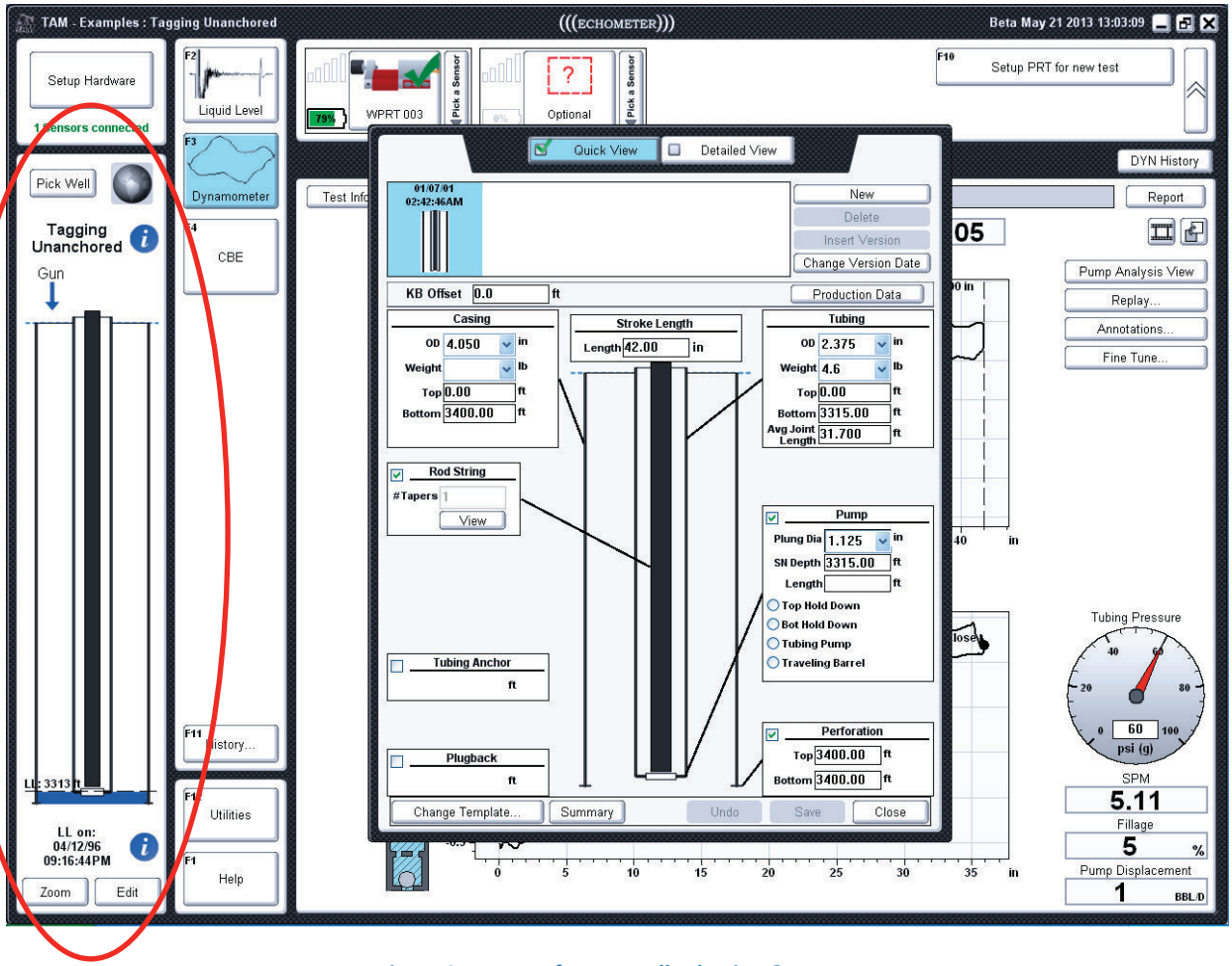


Figure 2: Layout of TAM, Well selection & setup

In the next section of the screen, just to the right of the hardware and well sections, is the module section (Figure 3). Here the user can select the survey module they wish to view or data acquisition to perform. Currently, users have access to acoustic, dynamometer, and CBE modules. At the bottom of this panel is a ***History*** button that allows the user to view a timeline of the well data and records across all modules. This control will be discussed in Section III.

Just below the module panel are the ***Utilities*** and ***Help*** buttons. The ***Utilities*** button brings up a dialog that can be used to change general options in TAM (e.g. units) and also allows access to import, export, and backup utilities (described briefly in the next section). The ***Help*** button gives the user access to quick reference guides and Echometer's support contact information.

Figure 3: Layout of TAM, Module selection & utilities

The remaining part of the application is dedicated to the specific survey module currently active. The program normally opens at the last record that the user analyzed. At the top is the "sensor bar" that allows the user to select the specific sensors to use to perform acquisition for that module. Clicking the button on the far right of the sensor bar reduces the width of the bar and provides more space to display the data.

Below the sensor bar is the main analysis screen for the specific module. Each screen has its own layout and options. One commonality amongst all modules, however, is the presence of history options, test information, and module-specific report. These will all be discussed later.

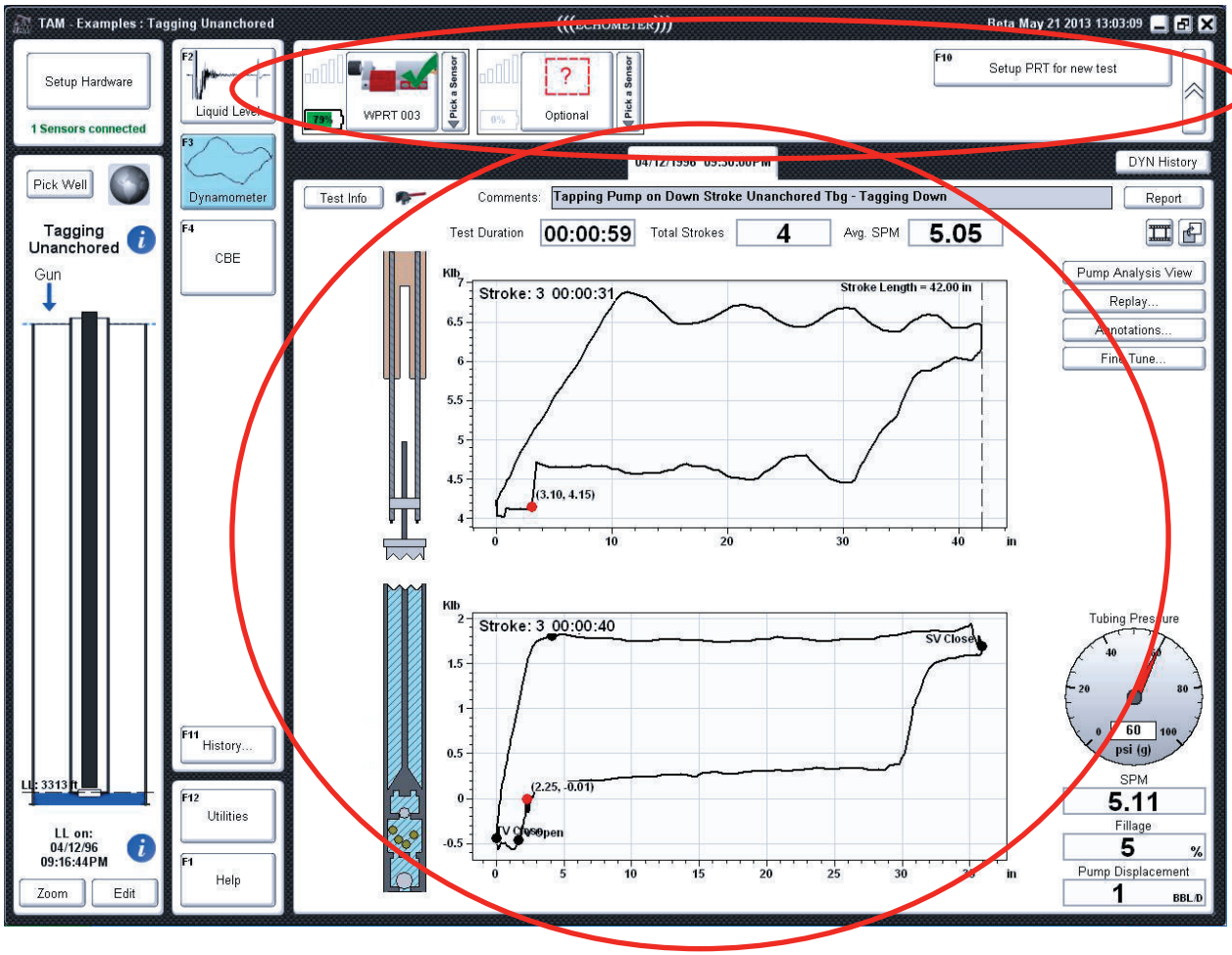


Figure 4: Layout of TAM, Sensor bar & module-specific area

II. Importing Well Information and Data Records

TWM Import

Acoustic, dynamometer, and CBE data can either be acquired in the form of new tests (discussed in the corresponding test quick references), or can be imported from TWM files. To import files from the TWM directory, click the ***Utilities*** button on the main screen, followed by clicking the ***Migrate TWM Data to TAM*** button of the utilities popup dialog. The program will scan through the TWM folder (or the current TWM work space) and create a catalog of importable files and then will bring up the TWM Import dialog (Figure 5).

From here, one can choose whether or not to import just well data or both wells and tests. One can also select records for a particular date range, or can pick and choose the particular wells and tests to import by clicking the ***Pick Data*** button.

Figure 5: TWM Import dialog

TAM Data Import/Export

These tools allow transferring TAM data between computers. If there are tests you wish to export from TAM, you can click the ***Export TAM Data*** option in the Utilities dialog. This will bring up a dialog that looks similar to the TWM import dialog (Figure 6). From this dialog, you can specify what data to export and a file will be created containing the specific data. The exported file name will be the well name and have a .TAM_EXP extension when generated. To import data back into TAM from a .TAM_EXP file, simply choose the ***Import TAM Data*** option from the Utilities dialog. Alternatively, you can also import the data by simply double-clicking the .TAM_EXP file.

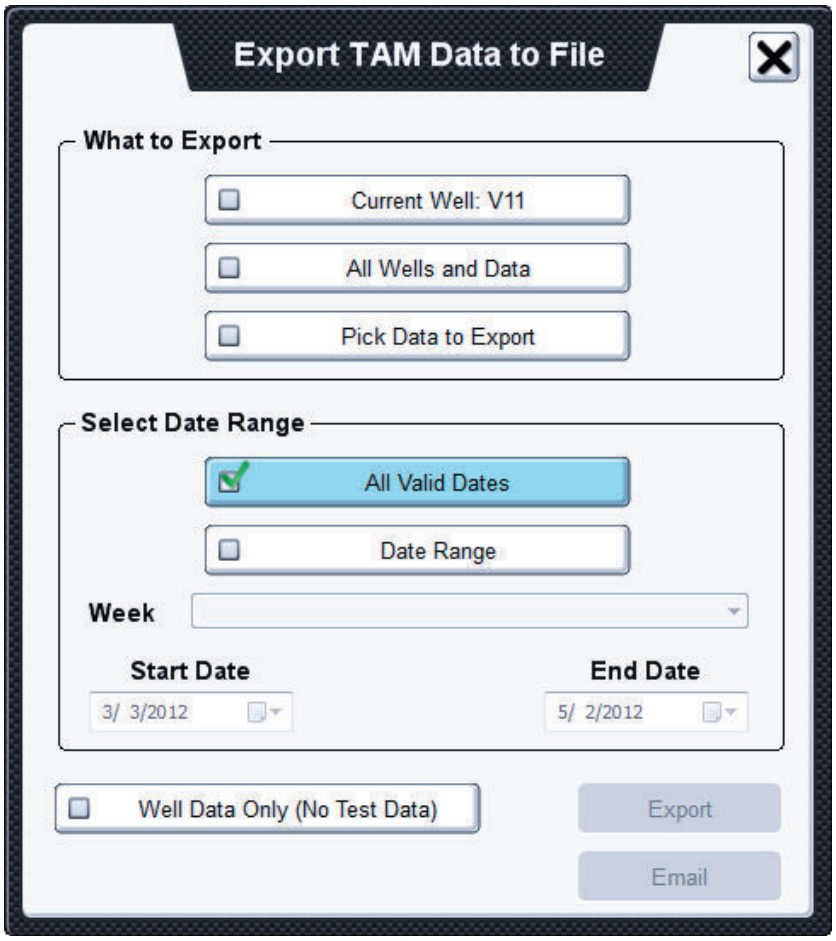


Figure 6: TAM Export dialog

III. Selecting a Test

TAM provides many different options for selecting and displaying a previously recorded test. These options span across all modules and are not specific to one particular type of test. There are three different ways to choose which test you wish to view.

Tab Control

After selecting the specific well and module an option for reviewing all the recorded tests is through the use of the tab control at the top of all analysis windows. You can easily navigate the previous and next tests by simply clicking the on the tabs. You can also view the same abbreviated summaries shown on the module history timeline by simply hovering over the tab. Furthermore, you can navigate between previous and next tests by using the keyboard shortcut keys: *Alt+Left Arrow* and *Alt+Right Arrow*.

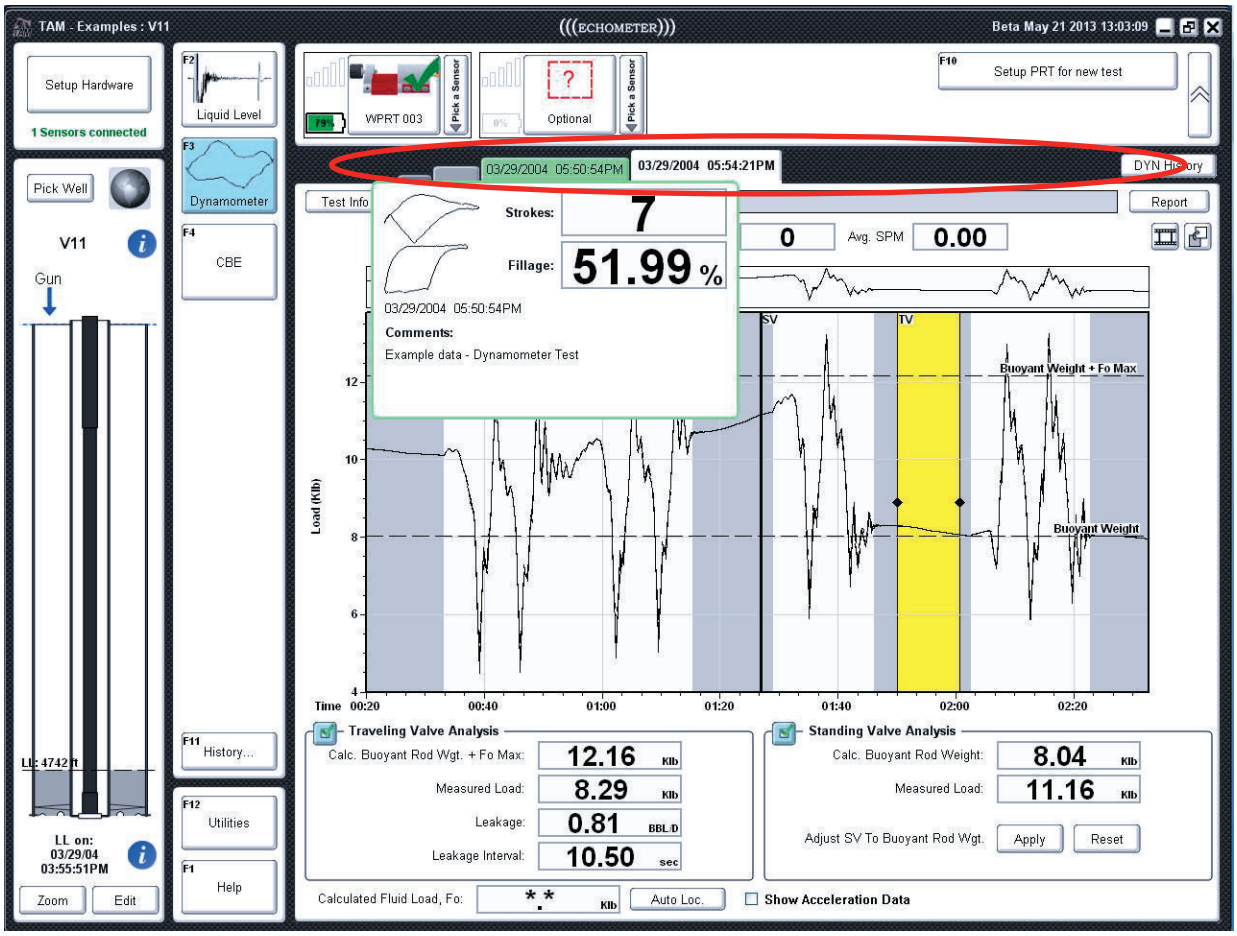


Figure 7: Tab Control

Module History Timeline

The module history timeline can be accessed by clicking the ***History*** button found directly above the ***Utilities*** control (Figure 8). This control displays a visual history of the well throughout its life and the tests that have been acquired to date. The control shows a time line with colored dots that represent all records acquired for the given well throughout all modules. The vertical bars show when the well configuration (Well Version) was changed. A specific test is selected and loaded by simply clicking its colored dot icon. Locating the mouse pointer over a test icon dot will display a thumb nail image and a brief summary of the test so the user can quickly scan through the tests when looking for a specific feature.

Figure 8: Module History Timeline

Detailed Search

For more advanced searching including a summary table of results, the user can click the history button located to the right of the tab controls either ***DYN History*** or ***LL History***, as seen in Figure 9. This will bring up an advanced search dialog that lets the user display, sort and select tests by relevant information such as fillage, sensor name, number of strokes, liquid level, acoustic velocity, etc. The specific record is then opened and displayed by ***double clicking*** on the specific highlighted row of the table. Through this dialog, the user can also view thumbnails of the recorded raw data for each individual test. The ***Select Columns*** button is used to customize which columns are displayed in the table.

Figure 9: Detailed search dialog

IV. Test Information & Reports

All modules contain a test information bar atop each analysis window (highlighted in Figure 10). Clicking this bar displays or the ***Test Info*** button opens the window showing the sensors used to acquire a test, the sensor's properties as well as test comments entered by the user. The additional sensor information, such as coefficients and acquisition rate, is displayed by clicking the ***Details*** button next to each sensor. Extensive comments or notes can be entered or edited as necessary.

Also on this test information strip is a "Report" button. One of the goals of TAM is to keep the analysis screens of each module clean, showing only the most relevant information. For users that would like to see results of more detailed calculations and measurements, we created the report. The report that is generated is dependent upon the analysis screen being shown. For example, if viewing the main DYN screen, TAM will generate a DYN report, and if viewing the valve test screen, a valve test report.

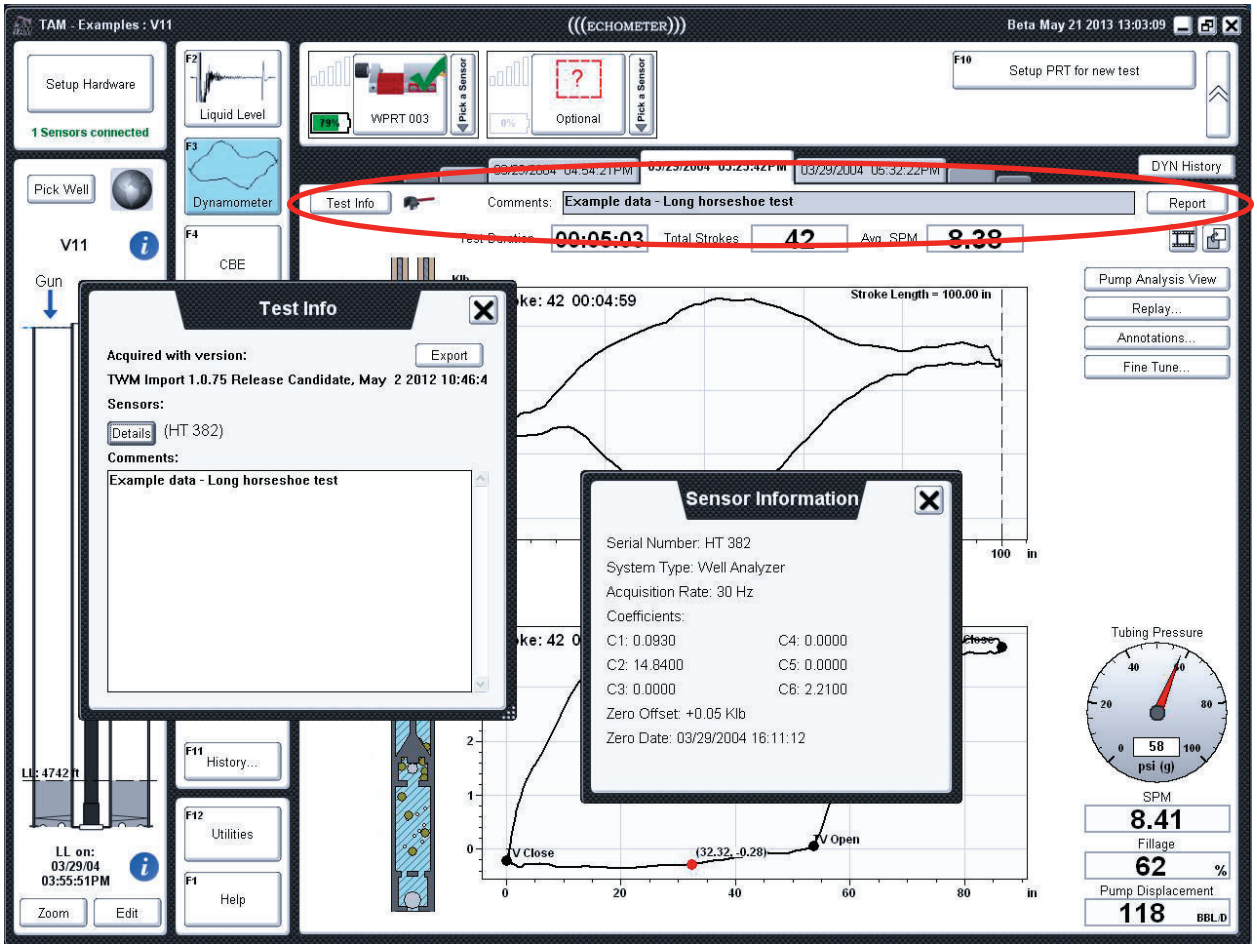


Figure 10: Test information bar and report button

Reports

After clicking the ***Report*** button on the test information strip, a print preview-like window will popup displaying the report (Figure 11). At the top left of the report are buttons to ***Print*** the report, generate a ***PDF*** of the report, or ***Email*** the report as well as zooming in/out with the ***+/-*** buttons. The zoom level can also be adjusted by holding the *Ctrl* key on the keyboard while scrolling with the mouse wheel.

The blue links can be clicked for additional options. For example, in the top right corner of the report, a user can insert a company logo to create custom-looking reports. For DYN reports the ***Modify*** link allows to edit the values used to generate the Goodman table shown in the report. For the Acoustic report the ***Modify*** link is used to update the well production data.

The **<-** and **->** arrows can be used to traverse through the strokes. This is a useful feature because it allows the user to switch strokes without needing to leave the report.

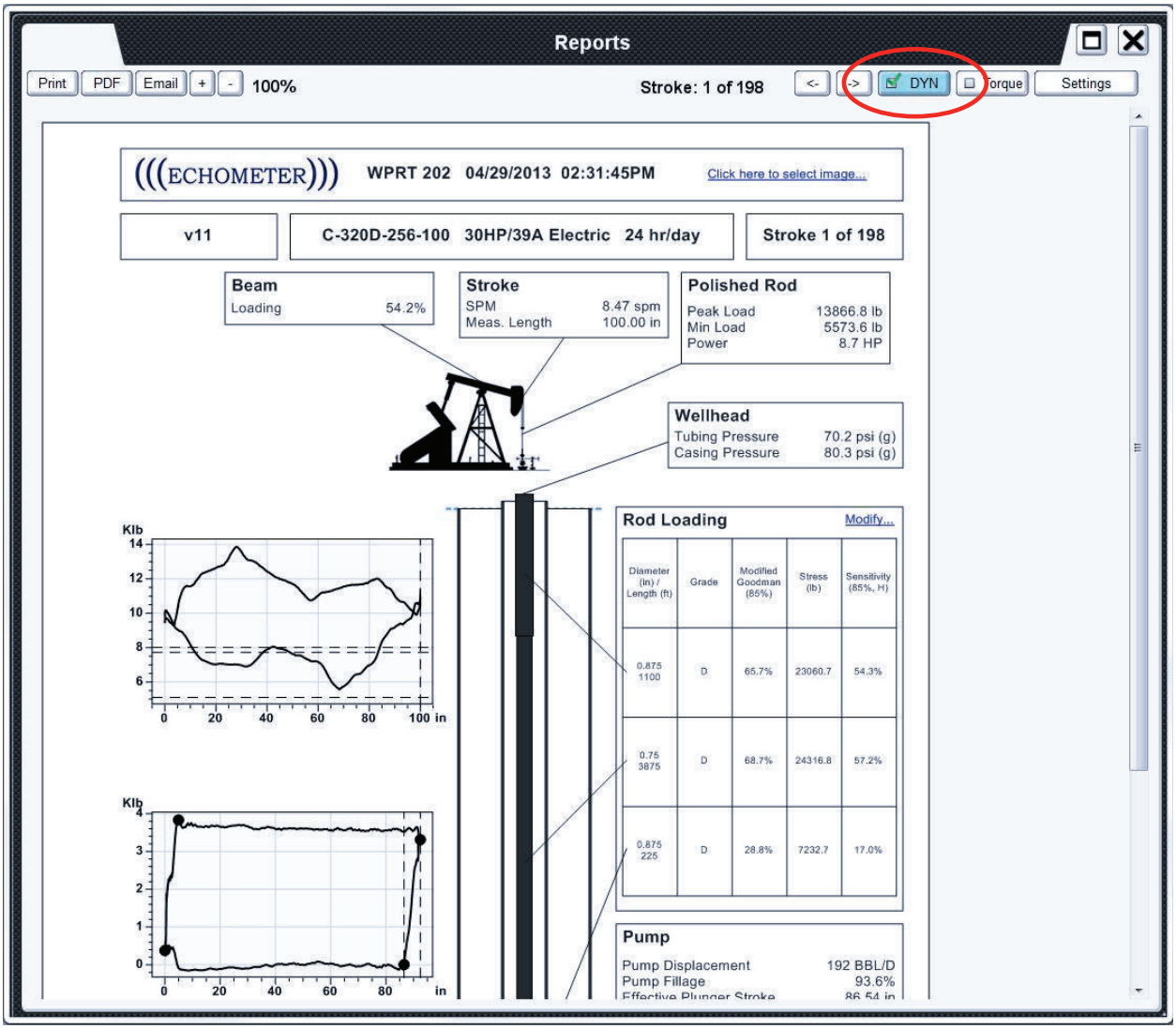


Figure 11: Example DYN Report

Report Settings

Clicking on the ***Click here to select image*** link button in the top-right corner will allow the user to edit the company logo that appears on top of the report, the footer text that appears on the bottom of the report, and to disable or enable showing plot notes on the report. When plot notes are present, a second page will be generated containing the note text. Plot notes will show up in their minimized form on the plots found in the report.

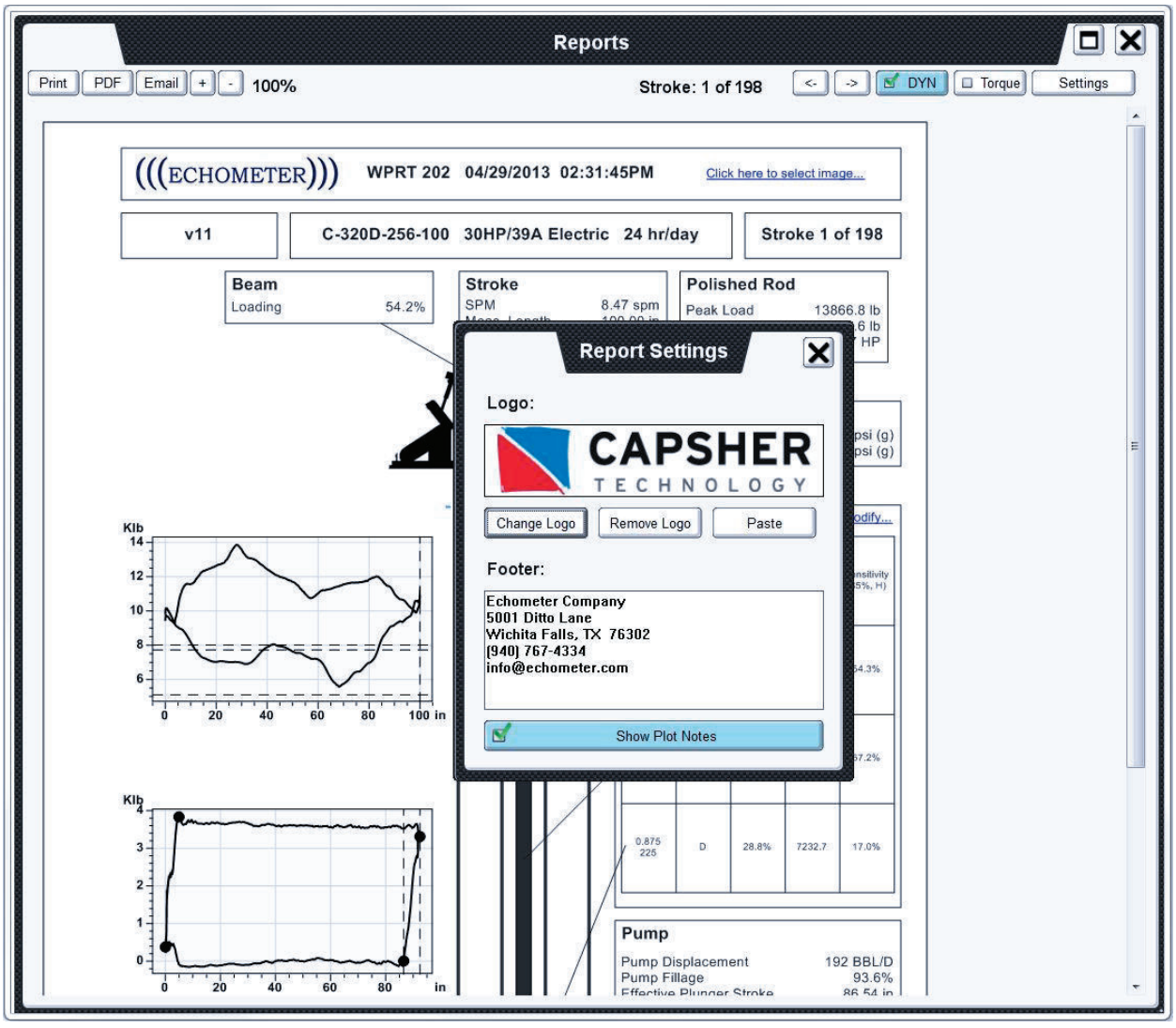


Figure 12: Report settings.

Report Selection

When viewing a Dynomometer report, there are two different reports that can be viewed; the actual Dynomometer report as seen in Figure 11 or the Torque report which can be seen in Figure 13. If there

is not enough information to calculate the torque values then the report will display what is missing in place of the torque report.

Figure 13: Torque Report.

Well State

On the Liquid Level report there is a dropdown which can be used to change the state of the well between producing and static. Each state has its own report which will be generated on switching of the state.

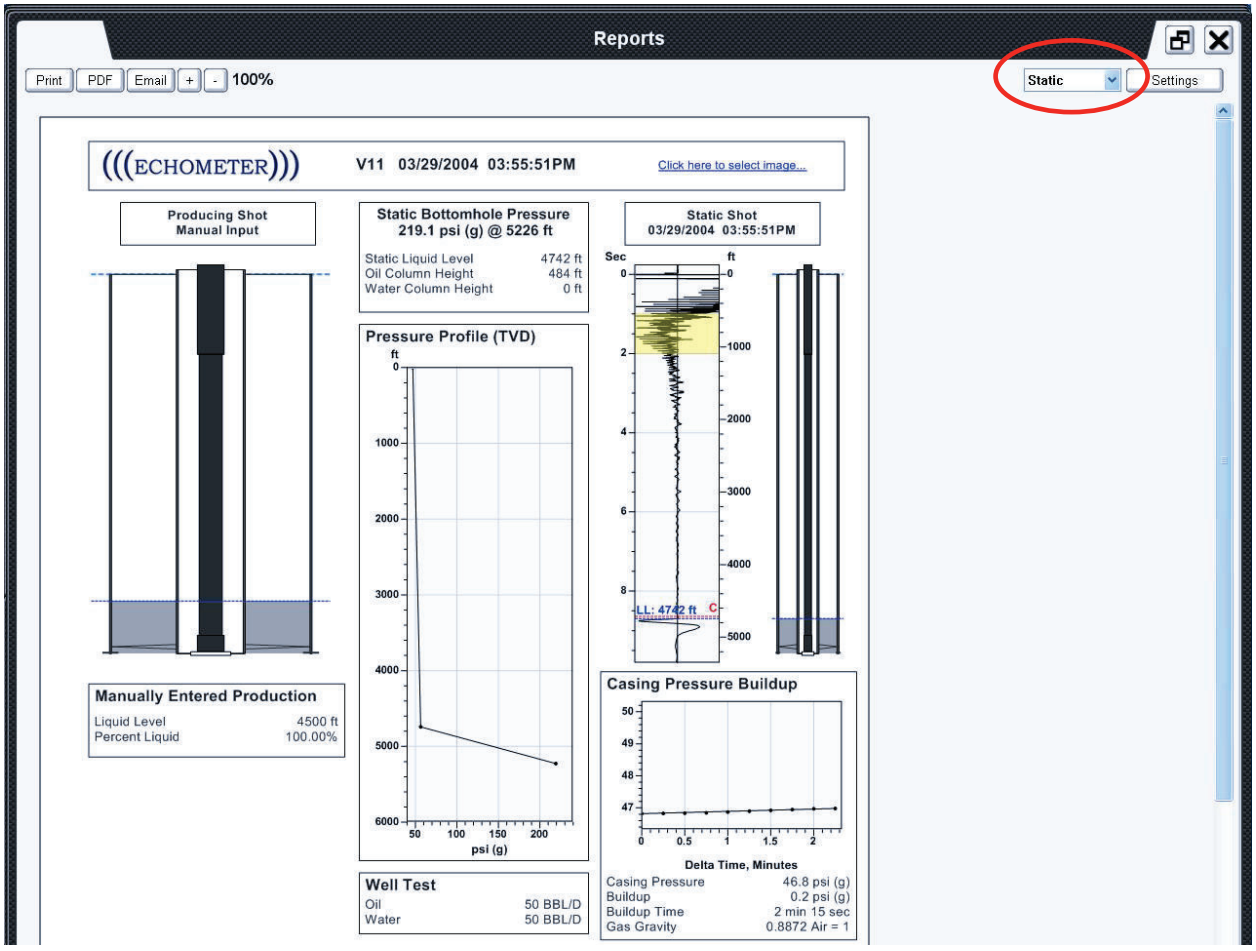


Figure 14: Static Well Liquid Level Report.

V. Plot Notes and Graph Export Options

Plot Notes

The user can annotate specific features on liquid level and DYN plots. If chosen, the notes will also appear in the reports that are generated by TAM. A note is added by right-clicking anywhere on the plot and choosing ***Add Note*** from the drop down menu (Figure 15). Double click the note to edit the text of the note. If you wish to re-position the note around its point of interest, simply click the callout box and drag it on the plot. To move the entire note, click and drag the yellow dot indicating the point of interest. Notes can be minimized to their numbered form by clicking the minimize icon in the top left corner and can be deleted by clicking the trash can icon in the top right corner.

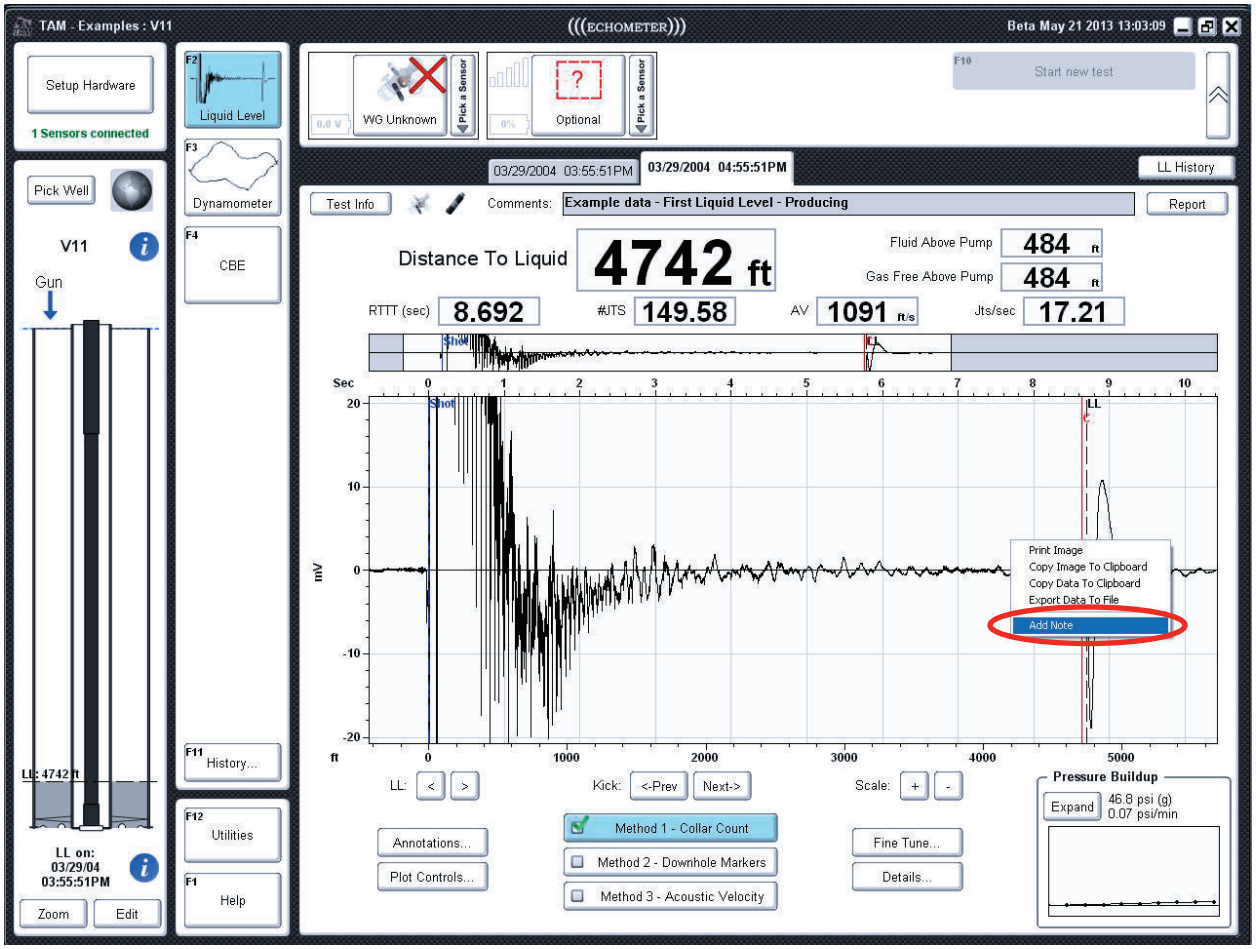


Figure 15: Adding a note to a plot

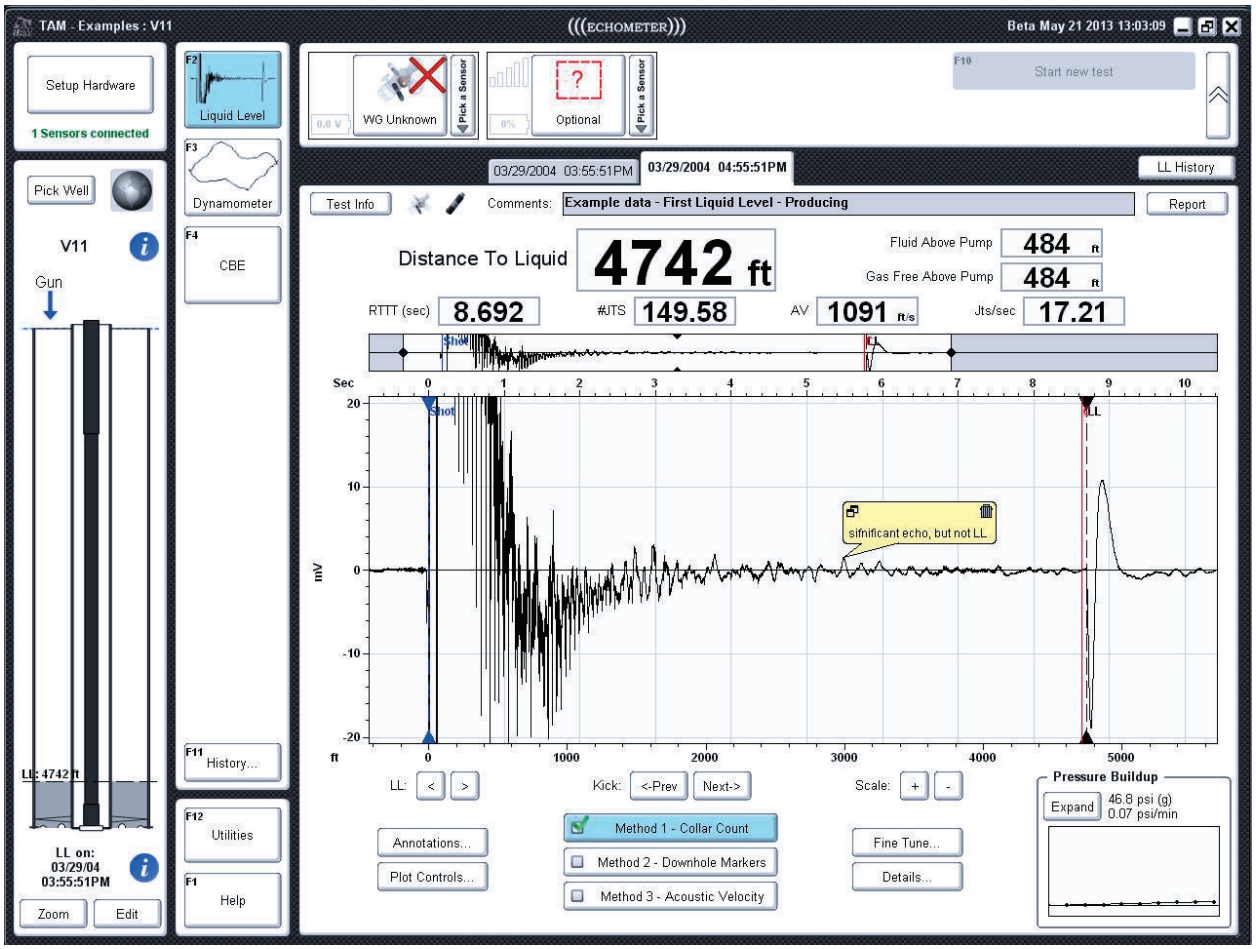


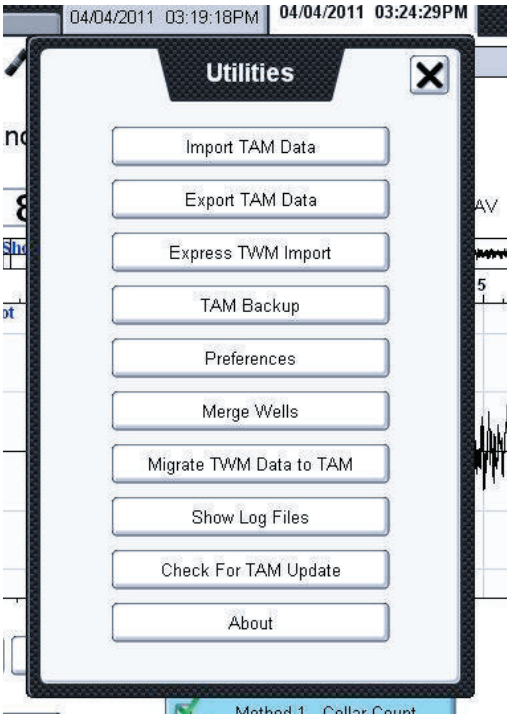
Figure 16: Example of a note added to a plot

Graph Export Options

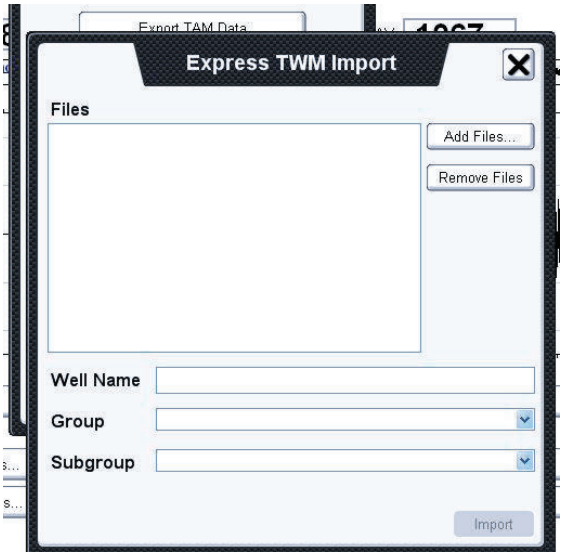
Right clicking on the graph displays, as seen in Figure 15, the menu of commands that can be used to send the graph to a printer, copy to the clipboard the graph or the graph data or export the information to a text file.

VII. Other Utilities

TAM includes additional utilities besides those already discussed as shown in the following tab:

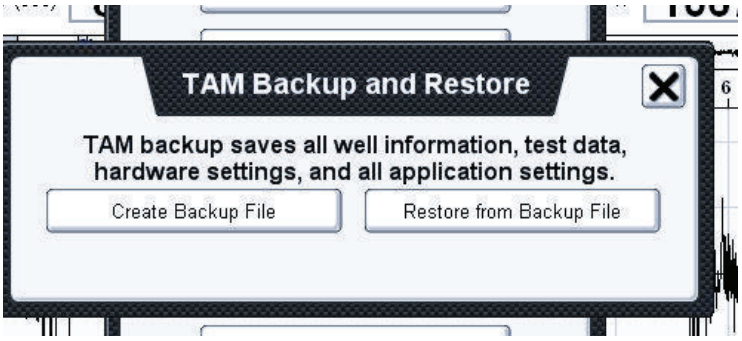


Express TWM Import



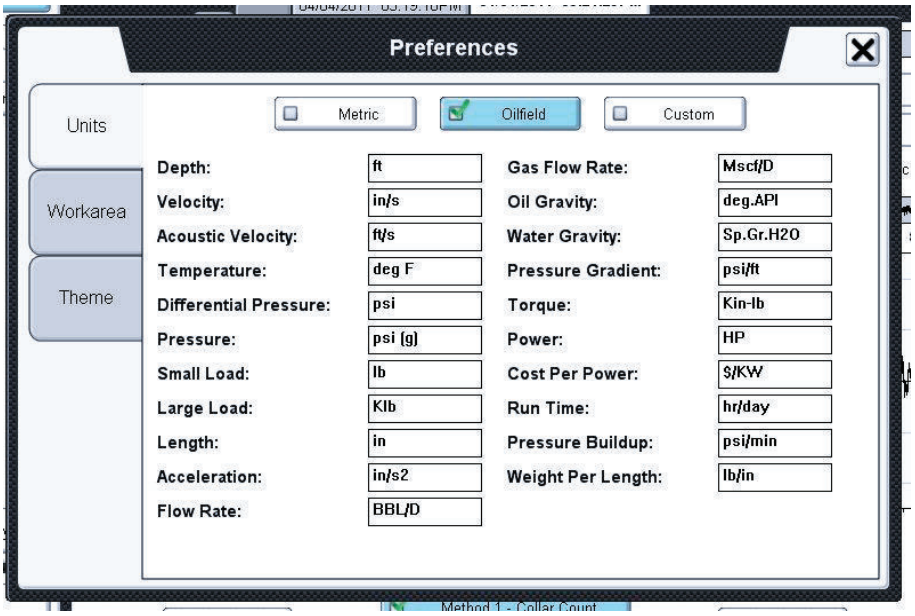
Designed to quickly import single TWM data and well file from a USB memory or from a downloaded e-mail attachment. The ***Add Files*** button opens a dialog to select the specific file.

TAM Backup and Restore



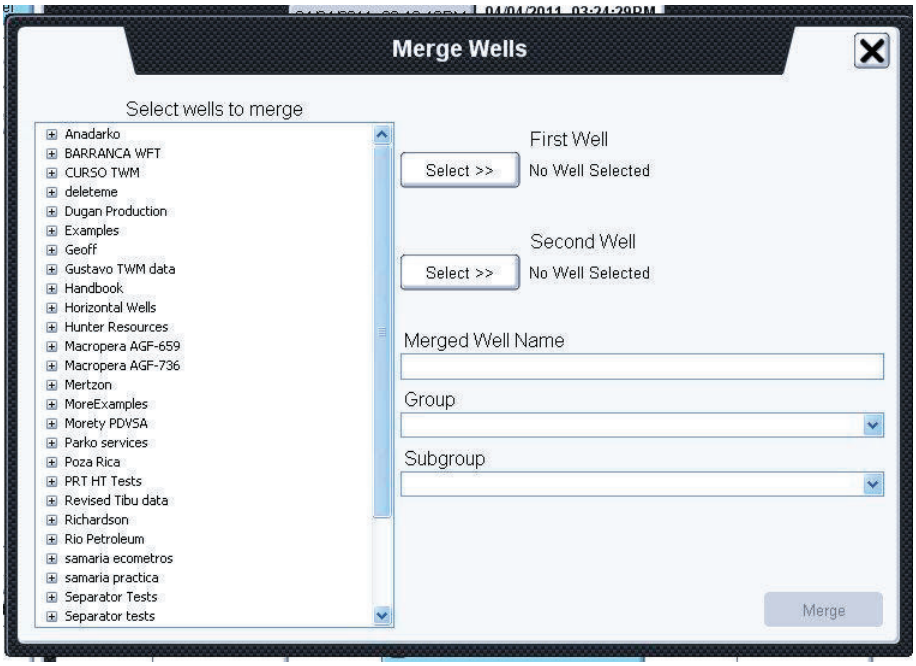
This utility creates a backup of all the TAM records and well files existing on the specific computer. It is not an incremental backup but will export **all the existing** records. The backup file is to be used to restore the information in case of a hard drive failure.

Preferences



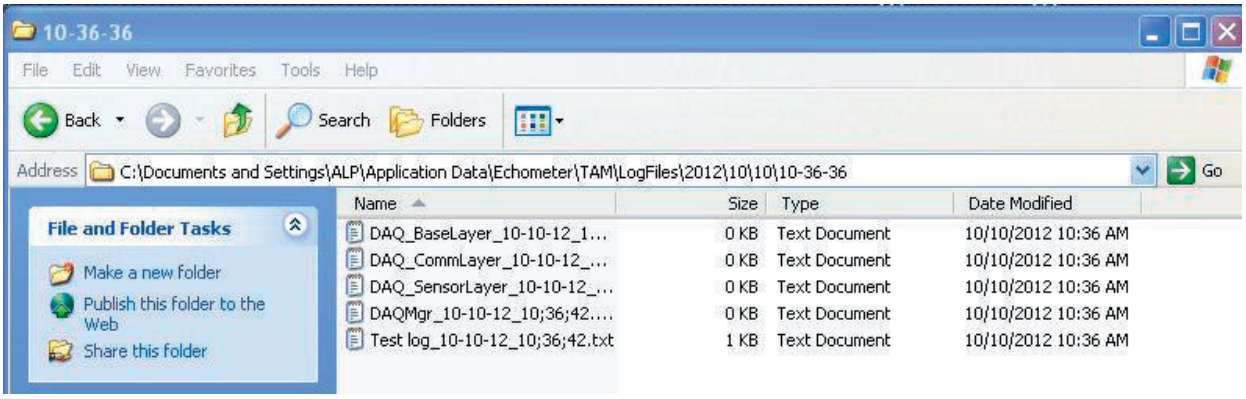
This utility is used to select the Units displayed with the variables, change the location of the TAM data files (Workarea) and adjust the brightness of the screens depending on the lighting conditions (Theme)

Merge Wells



This utility provides the tool to merge well information and data records that have been acquired on different computers so as to create a single archive under a common well name.

Show Log Files



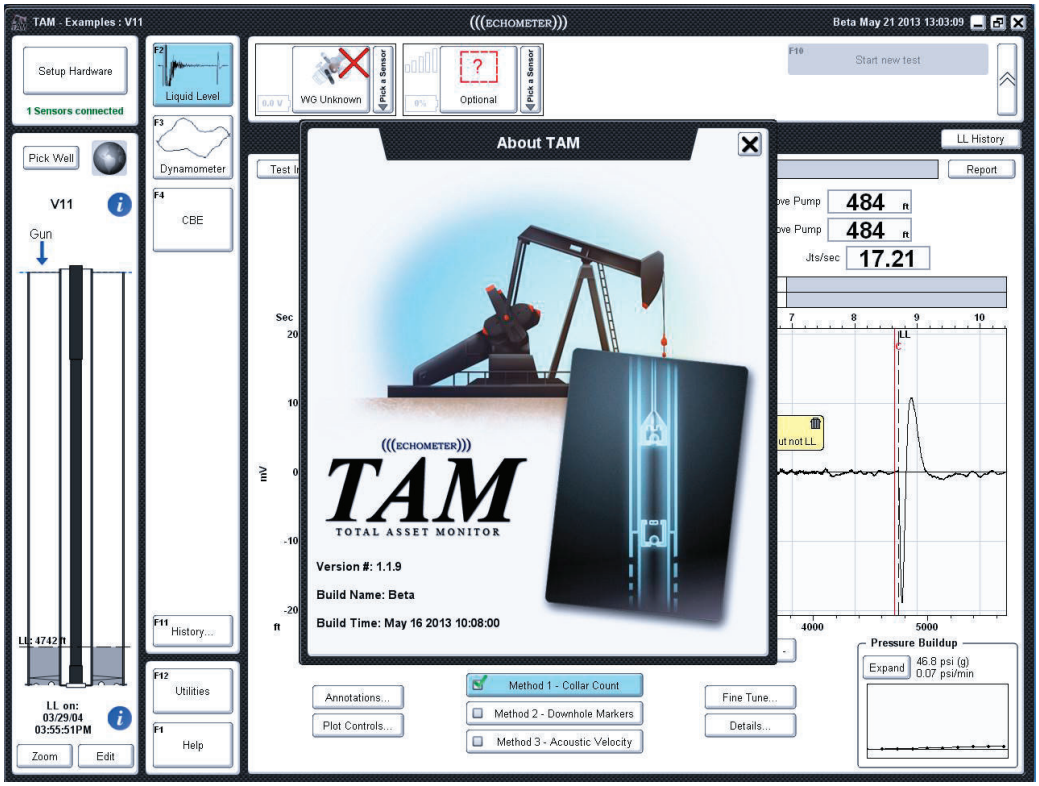
This utility is used for program debugging purposes when program misbehaves or crashes. The location of the log files that contain the sequence of the user's keystrokes and button clicks is displayed. Echometer's IT personnel may request that these files be e-mailed to them by the user.

NOTE: The program also will display a warning message: ***" Send Crash Report to Echometer"*** in the event of a malfunction. If the user clicks "Yes" then the report will be saved and sent to Echometer the next time the computer is connected to the Internet.

Check for Update

If the computer is connected to the Internet when Tam is first loaded, then the program will automatically check whether an updated version of TAM is available for download. Alternately the user can manually perform the check by selecting this utility.

About TAM



Clicking on this button displays the version and date of creation of the Tam program being executed.

LL Features in TAM

Table of Contents:

I. Main LL Analysis Window

The primary ***Liquid Level (LL)*** analysis screen (Figure 1) shows the acoustic trace and results, such as distance to liquid, acoustic velocity, and fluid above pump at the top of the screen and a detailed wellbore schematic with the corresponding fluid distribution. At the bottom of the screen are buttons used for plot modification and analysis updates.

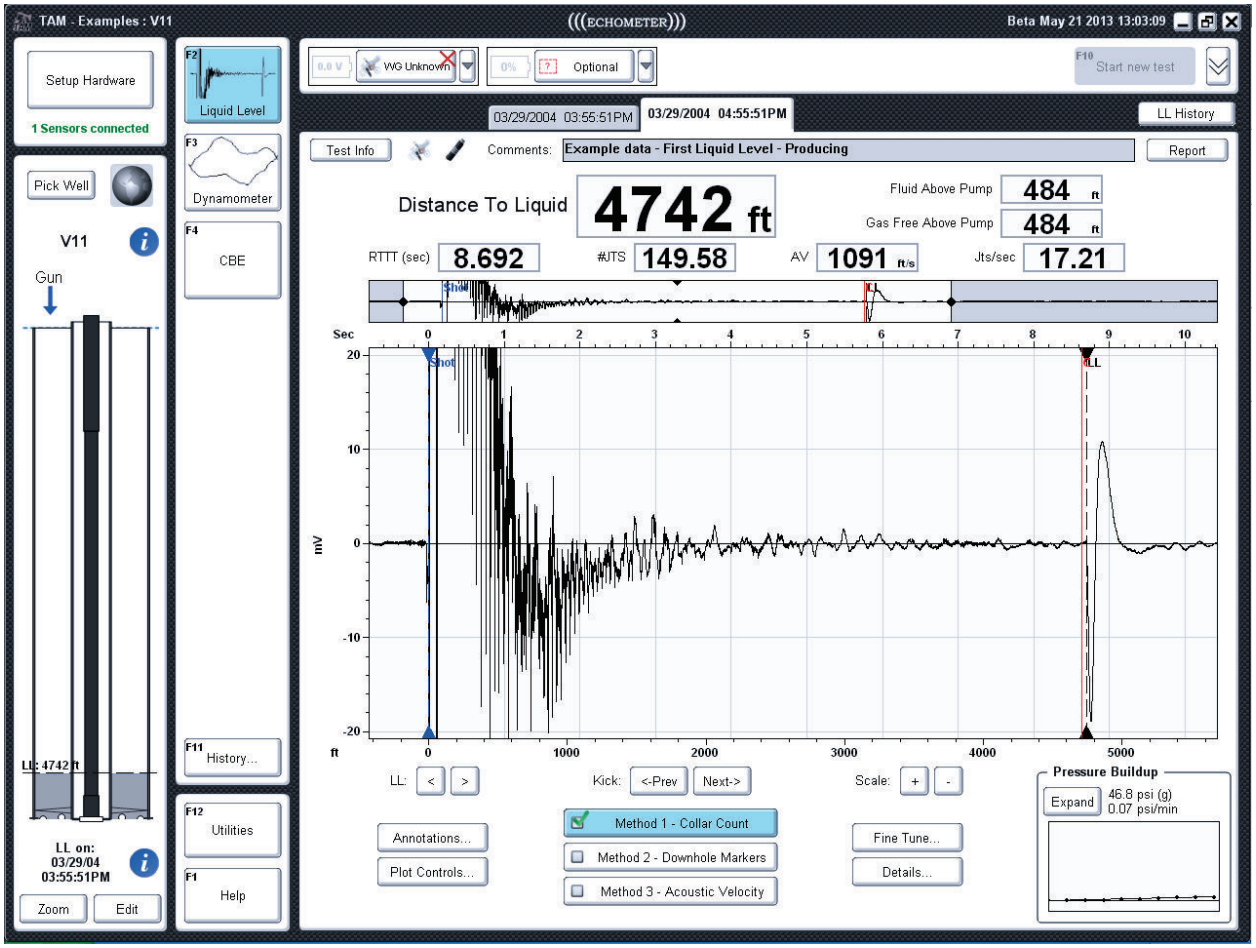


Figure 1: Main LL Analysis Screen

Navigation Sub-plot

Directly above the main shot trace plot, is a smaller sub-plot that can be used to adjust the horizontal and vertical region of interest displayed in the primary plot. Clicking and dragging in the middle of the white region of the sub-plot allows the user to pan the region of interest left and right. Dragging near the ends of this region box allows it to be resized. Figure 2 shows an example of how the sub-plot can be manipulated to get an expanded view of the liquid level echo for this particular example.

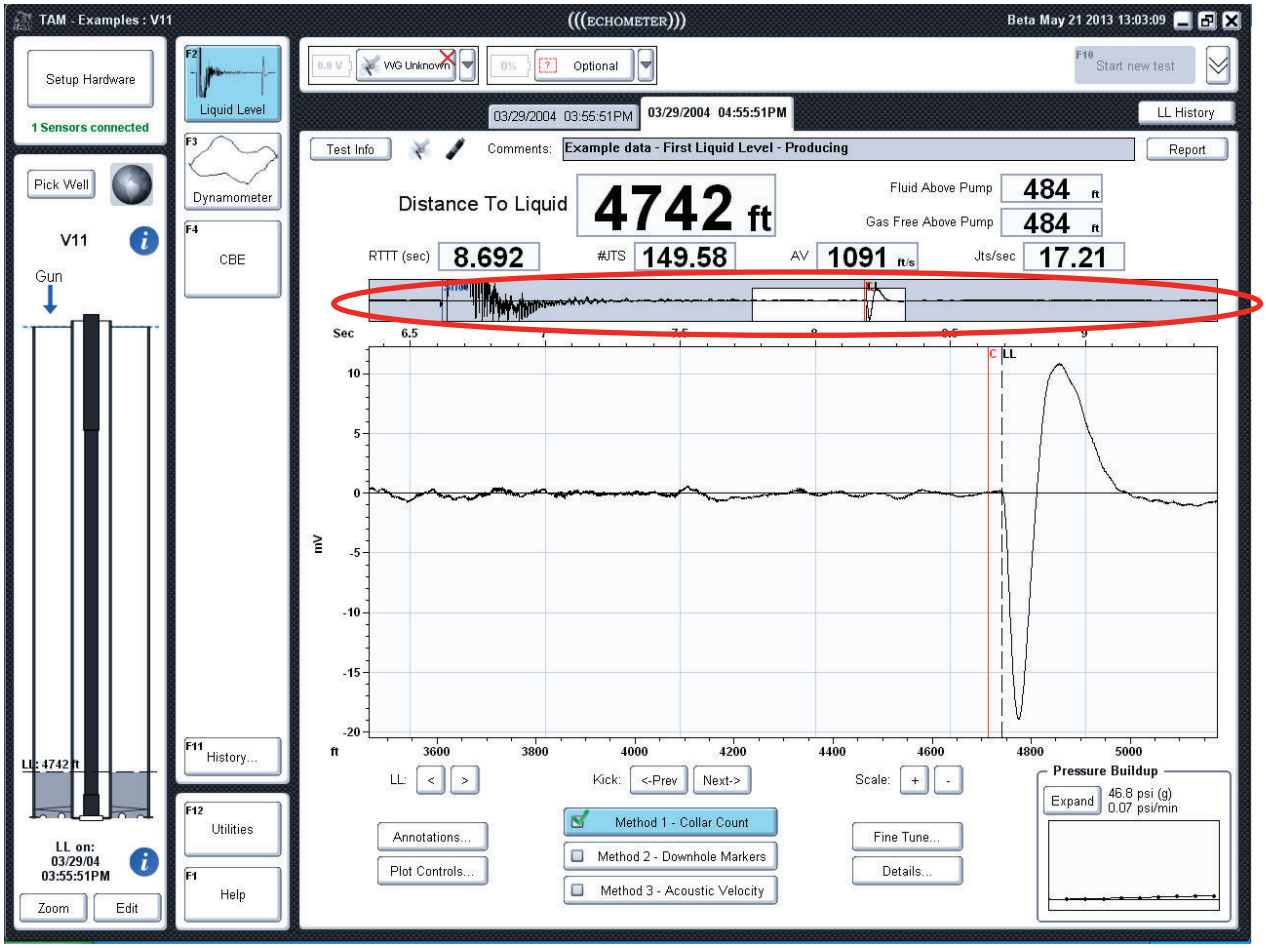


Figure 2: Adjusting the region of interest by manipulating the selection box of the sub-plot.

Adjusting Plot Scale

The scale of the vertical axis, in millivolts, of the shot trace plot can be increased or decreased using the ***+/-*** scale buttons directly below the plot. The scale of the plot can also be adjusted by manipulating the mouse wheel. Figure 3 shows the example shot trace after scaling down the graph to an 800 mV range.

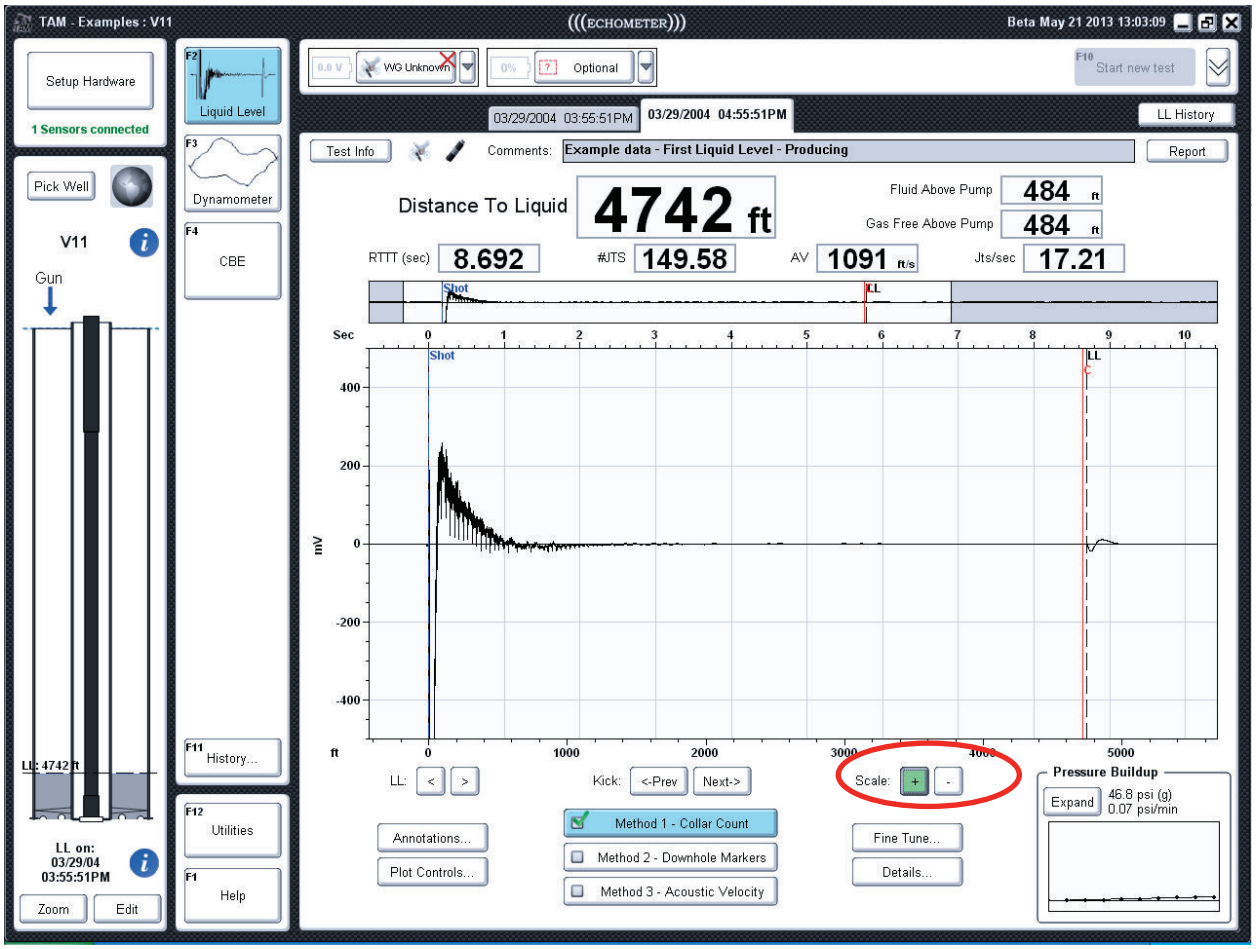


Figure 3: Shot trace after being scaled down

Adjusting Shot Beginning & Liquid Level

When hovering over the plot, users will notice that drag indicators appear at the ends of both the ***Shot*** beginning marker (blue) and liquid level ***LL*** marker (black) in Figure 4. Both of these markers can be clicked and dragged to adjust their positions along the shot trace. After adjusting these markers, the liquid level distance calculation analysis is automatically re-run and new results will appear.

NOTE: after manually adjusting the markers they can be reset to their original position using the ***Fine Tune*** button and selecting the ***Reset*** option for the corresponding marker.

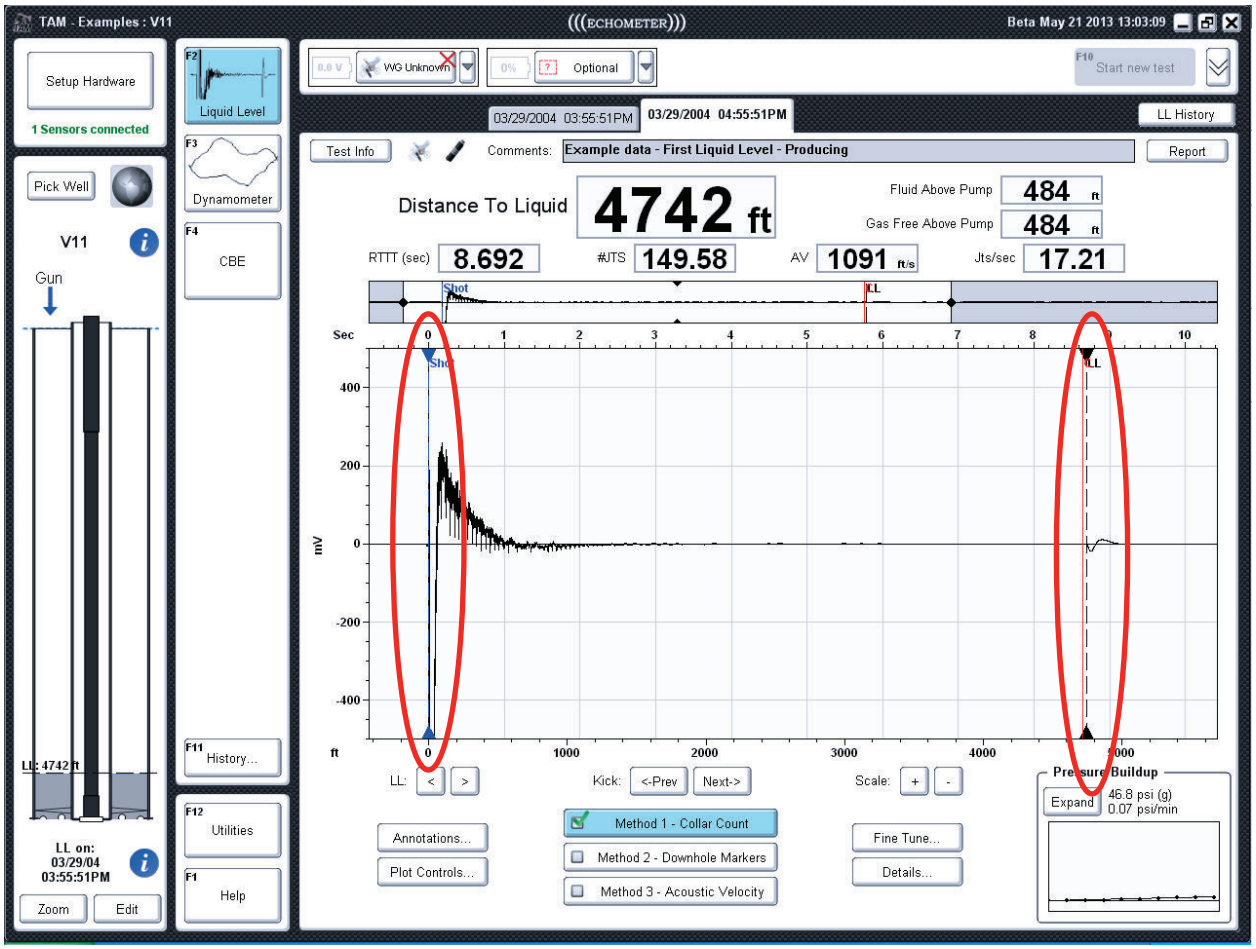


Figure 4: Drag indicators for shot beginning and liquid level cursors.

When multiple echoes, that satisfy the characteristics of a liquid level echo, are present, the user can investigate which echoes the software thinks that could also correspond to the liquid level by using the ***<- Prev*** and ***Next->*** kick buttons directly below the plot. Clicking these buttons will cause the ***LL*** marker to jump to the other possible echoes. When such additional echoes are not present in the trace, the ***LL*** marker will not move. The user can refine the ***LL***

marker position by using the **"<"** and **">"** buttons found just to the left of the kick candidate buttons.

Right Click Menu

Additional plot options can be accessed by right-clicking inside the plot area. This will bring up the popup menu seen in Figure 5 with the following options:

- ***Print Image***: sends an image of the plot to the printer
- ***Copy Image to Clipboard***: copies the plot image to the system clipboard
- ***Copy Data to Clipboard***: copies the shot trace data (time, mV) to the system clipboard
- ***Export Data to File*****:** saves the time/mV values of the trace to a text file (which can be loaded into spreadsheet programs like Excel)
- ***Add Note***: add a note/annotation to the plot (see details in **"Plot Notes"** in **"TAM Features"** document)

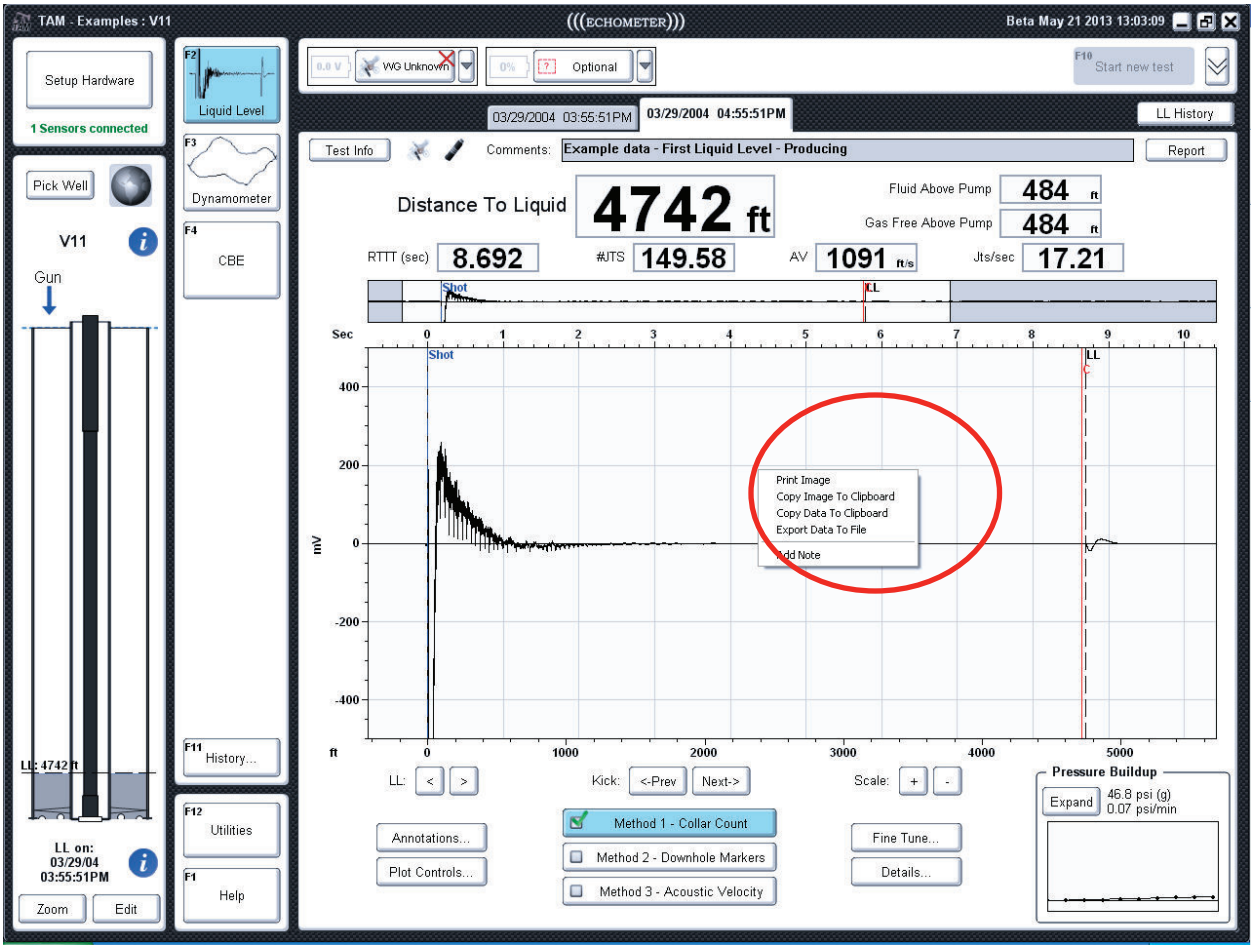


Figure 5: LL plot right click menu

II. Pressure Buildup Window

When wellhead pressure (casing or tubing) is acquired alongside a shot, the pressure buildup window will appear in the bottom right-hand side of the analysis window (Figure 6). Clicking on the ***"Expand"*** button will allow the user to see the full results of the pressure buildup record.

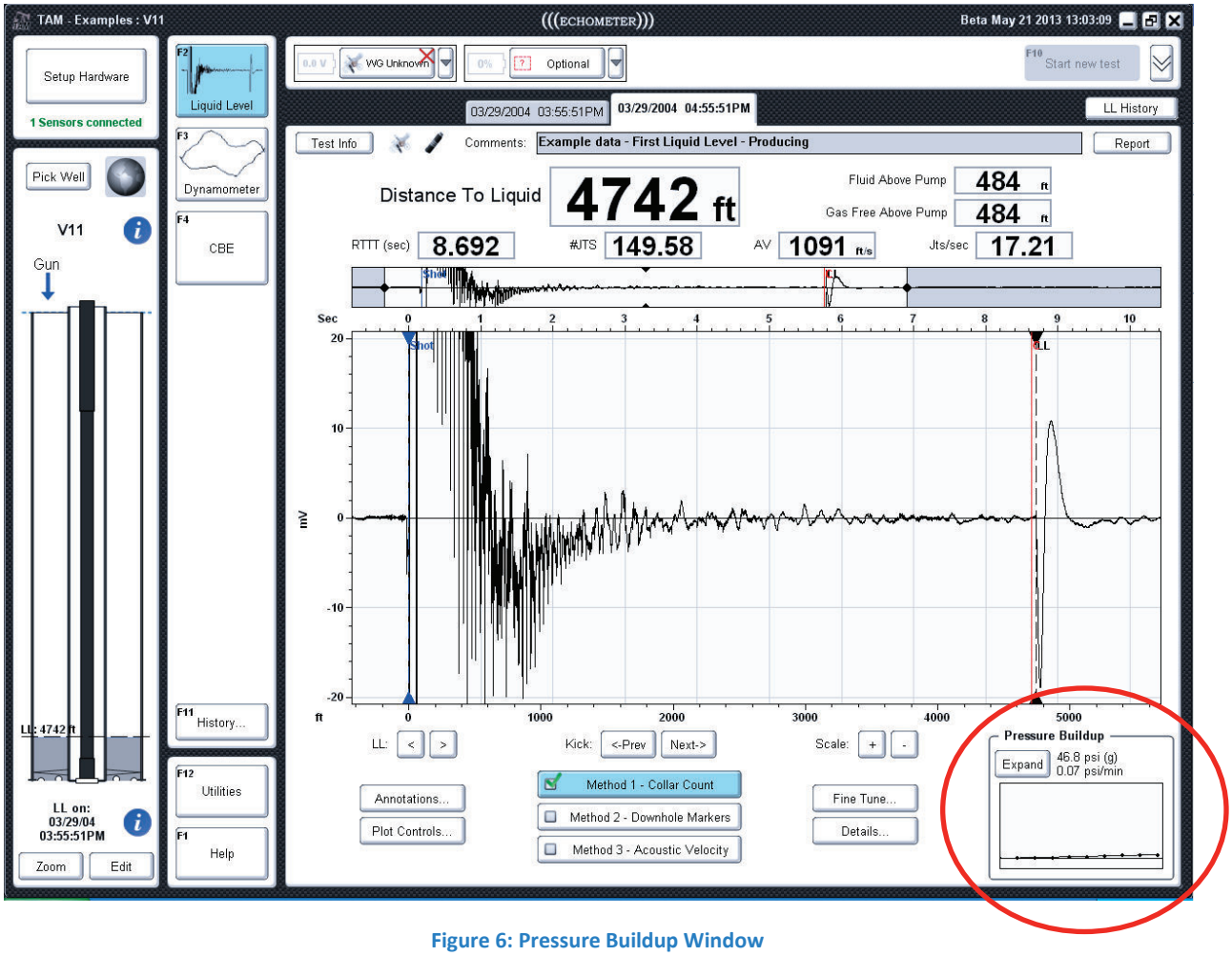


Figure 6: Pressure Buildup Window

Figure 7 shows a screenshot of the expanded pressure buildup window. This window shows the results of pressure buildup, including casing pressure, change in pressure/time, and gas flow. These calculations will automatically update if the user selects a different end point for pressure buildup (using the ***"<-- Left"*** and ***"Right -->"*** buttons). If the user wishes to bypass the calculations altogether and enter directly information for casing pressure, change in pressure, and change in time, it can be done by clicking the ***Modify Casing Pressure*** button. This will bring up a dialog where the user can manually enter the pressure and time values.

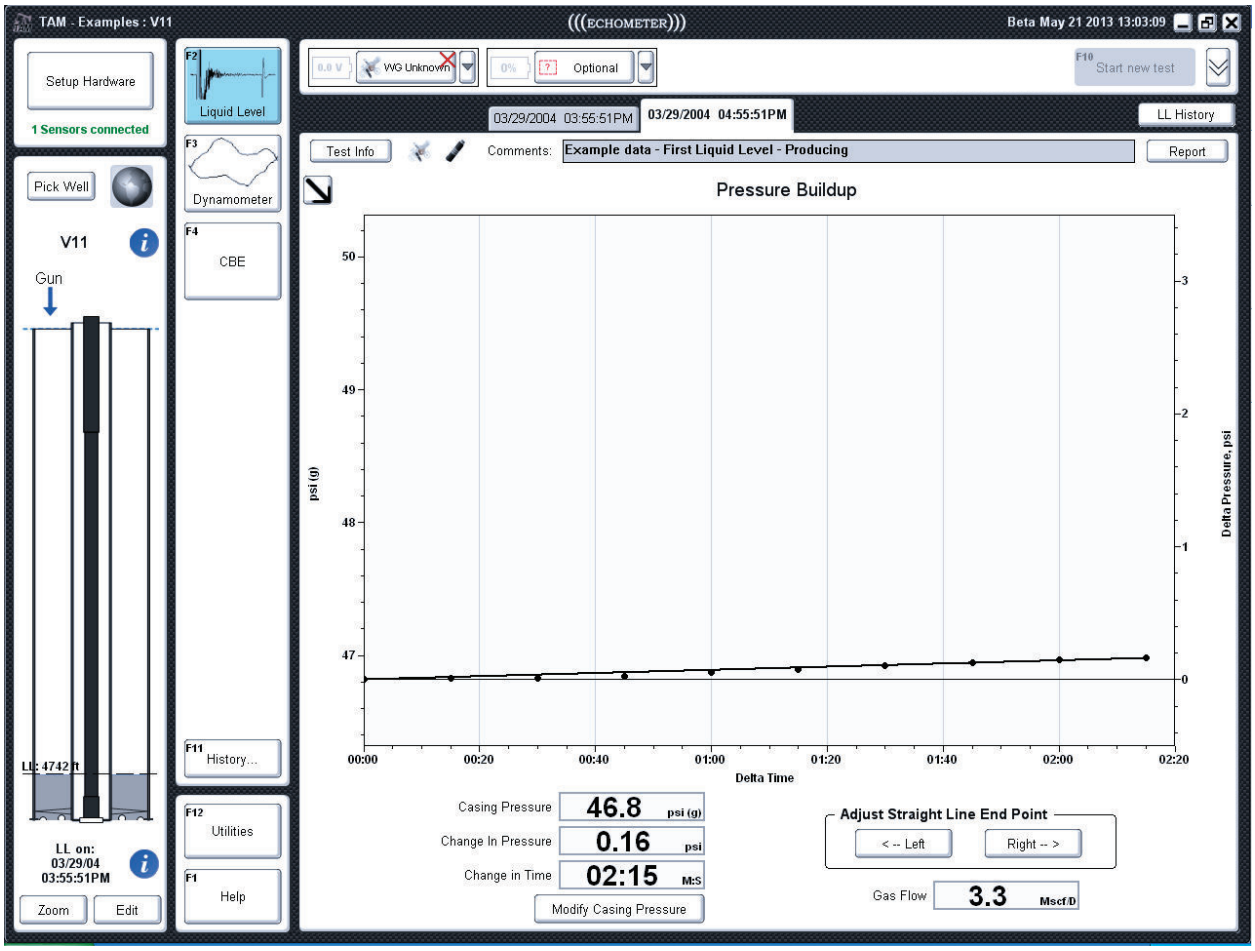


Figure 7: Pressure Buildup Window

III. LL Annotations

Annotations can be added to the main ***LL*** plot by clicking the ***Annotations*** button in the bottom left-hand corner (Figure 8). Users can add multiple overlays including previous shot traces, a depth reference line, a trace folded about the LL marker and wellbore overlay. The "Opacity" slider can be used to modify the opacity of the wellbore overlay, when it is enabled.

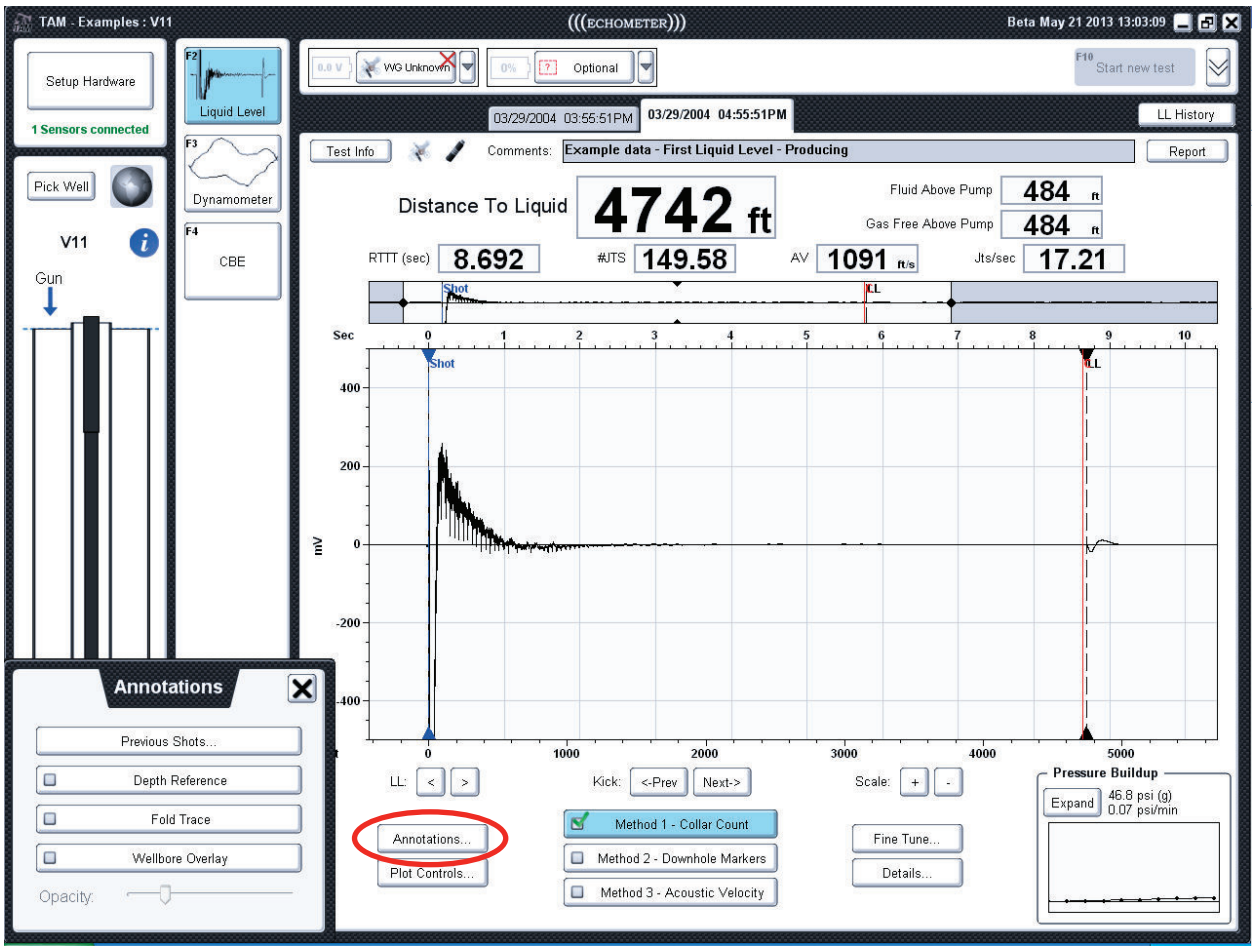


Figure 8: Annotations dialog.

Trace Overlays

Clicking on ***Previous Shot*** opens an additional dialog that allows selecting up to five overlays from existing acoustic tests, for the specific well, and plotting them simultaneously with the trace being analyzed as shown in Figure 9 where the **black** trace is the signal being analyzed and the **blue** trace corresponds to the overlay. Traces for overlay are enabled or disabled by clicking the corresponding ***On/Off*** buttons in the ***Overlay Selection*** table. Clicking on one of the two ***Spread*** buttons will increase or decrease the vertical spread between the center lines of each trace. The ***Clear All*** button will deselect all traces currently turned on. The ***Swap Order*** button inverts the position of overlays relative to the current trace and "Show LL On Cursors" displays the liquid level depth for the overlays on their ***LL*** cursors. The user also has the option of lining up overlays based on ***Depth*** (default) or based on ***Time***.

NOTE: before applying overlays it is convenient to process each trace using the same vertical ***mV*** scale.

Figure 9: Overlay selection dialog.

Depth Reference Line

Clicking the ***Depth Reference Line*** button, places on the graph a moveable cursor that displays the time and depth of its current location. It is used to display the position (in time and depth) of certain physical features of the acoustic trace. This marker can be dragged and moved with the mouse to any place along the trace. A corresponding dashed cursor will also appear on the wellbore diagram on the far left of the screen.

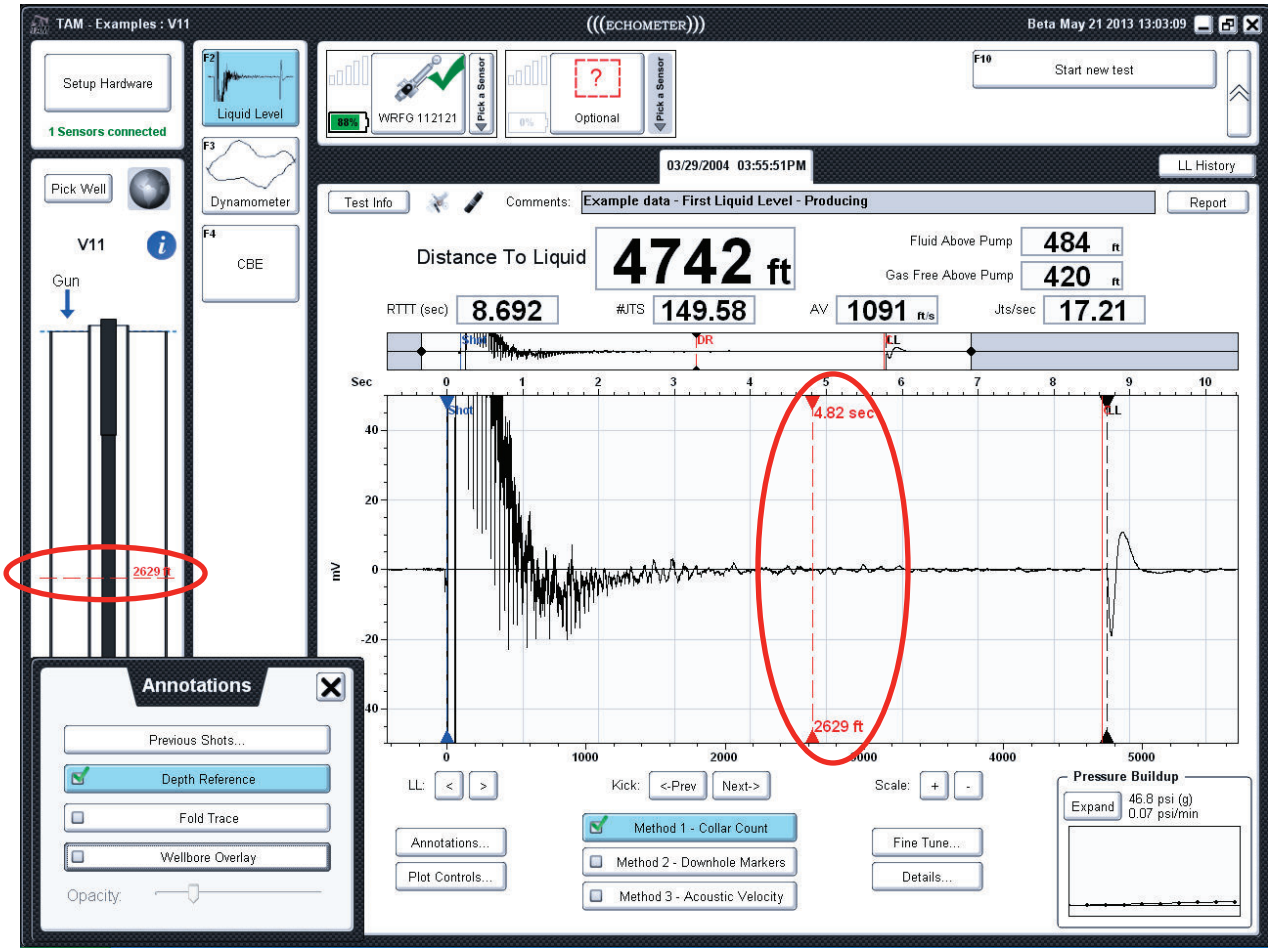


Figure 10: Depth Reference Line

Trace Folding

The ***Fold Trace*** option under ***Annotations*** allows the user to see a reflection of the data around the selected liquid level echo. This view may be helpful when aligning multiple reflected echoes found along the shot trace. When enabled, the folded shot trace appears in red. A "shadow" of the reflected part of the shot remains in a lighter gray color (see Figure 11).

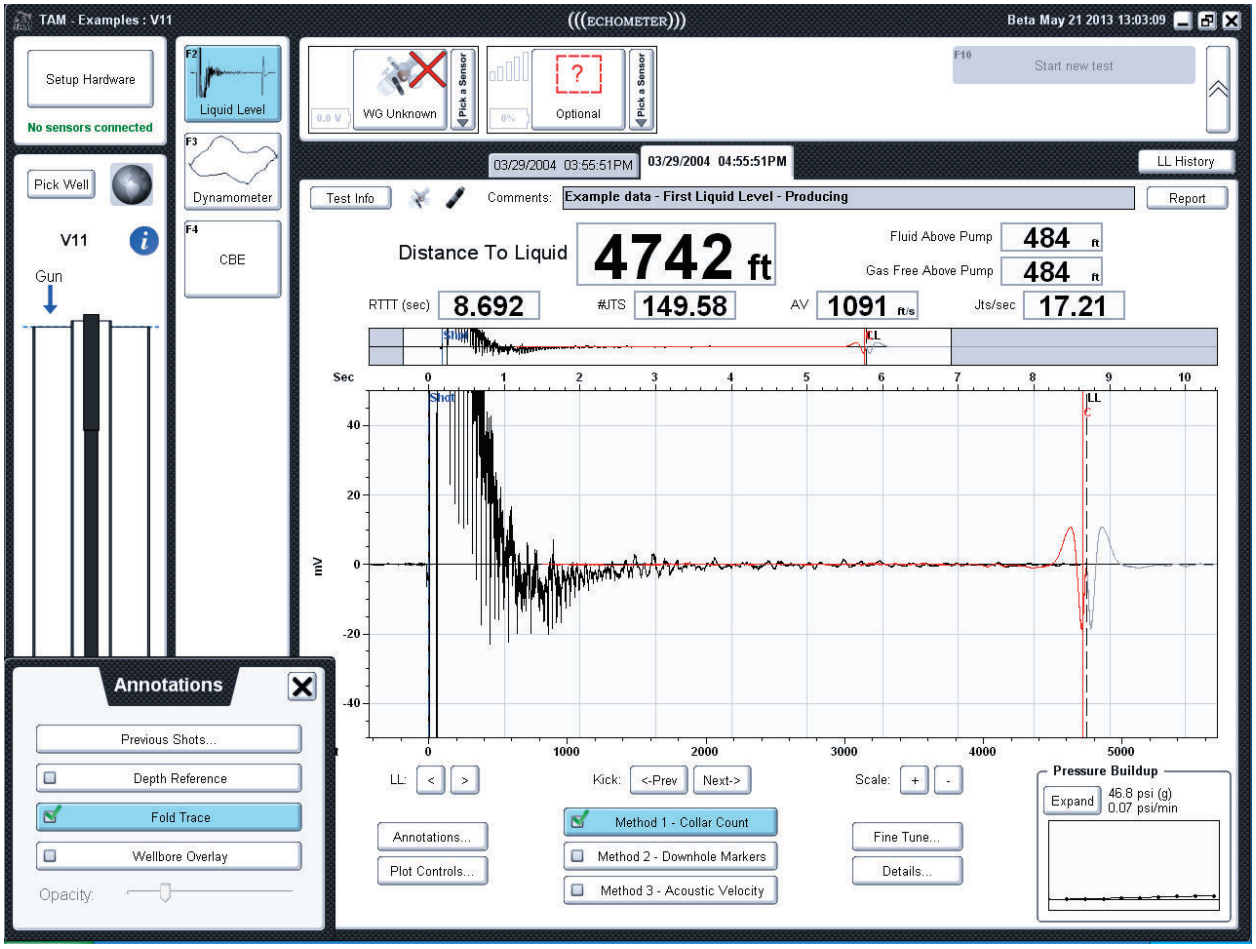


Figure 11: Example shot trace that has been folded.

Wellbore Overlay

The wellbore details shown on the wellbore schematic at the left of the screen can be displayed on the acoustic trace using the ***Wellbore Overlay*** button. The user will see a semi-transparent image of the well diagram on top of their trace. The opacity of this overlay can be adjusted using the ***Opacity*** slider at the bottom of the ***Annotations*** menu. This feature is very useful when it is difficult to identify the LL echo when the trace exhibits multiple echoes and to show the position of the liquid in relation to the perforations.

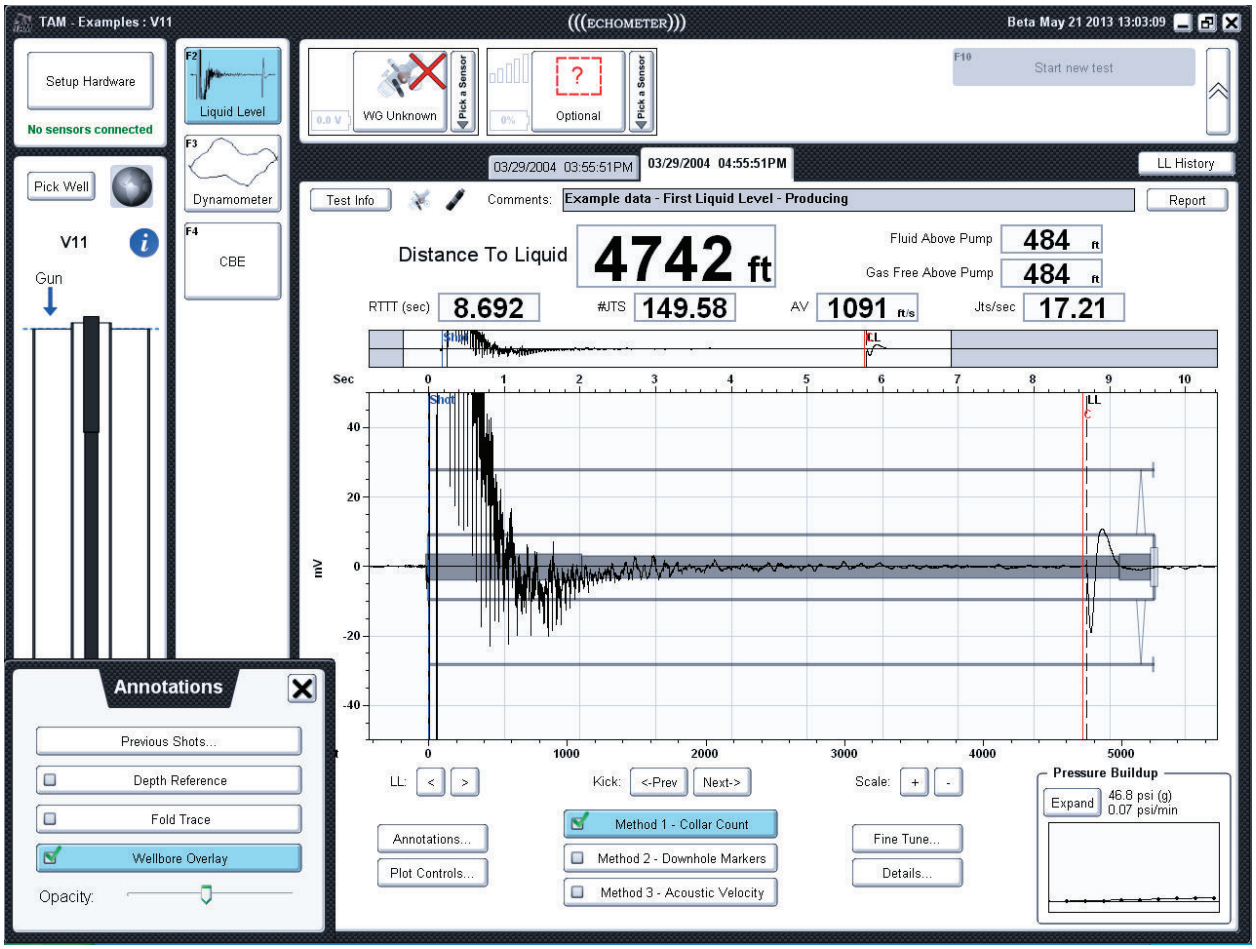


Figure 12: Wellbore overlay

IV. LL Plot Controls

Clicking on the ***Plot Controls*** button on the main ***LL*** screen brings up a dialog with options for interacting with the shot trace plot (Figure 13). The options currently available include: ***Echo Zoom, Zoom All, Select, Pan,*** and ***Undo***.

- The ***Echo Zoom*** button is a smart-zooming feature that automatically adjusts the viewing region of the recorded trace to an optimum range. It determines this region based on the location of the shot beginning and liquid level cursors, as well as, the kick height at the selected liquid level.

- The ***Zoom All*** button allows the user to quickly adjust the viewing region such that the entire shot trace is visible.

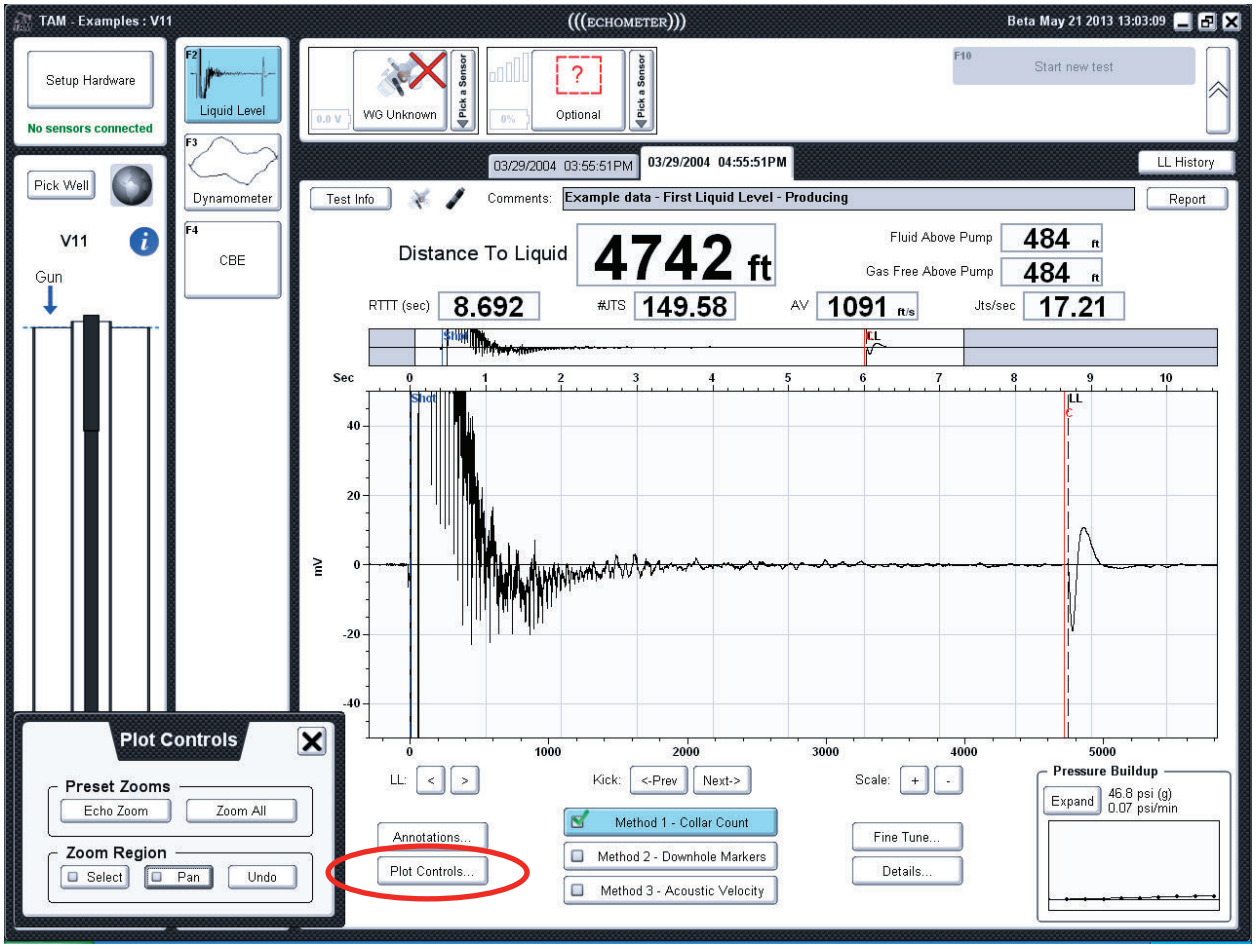


Figure 13: Plot controls dialog

- Using the ***Select*** tool allows the user to draw a box around a region of interest directly on the main trace plot. After clicking the "Select" button, the user's mouse cursor will turn into a plus (+) sign when hovering over the main plot. Clicking and dragging on the plot will allow the user to draw a red box (see Figure 14 left) over the trace section of interest to display the record with an expanded timescale as shown at right in Fig 14.

- The ***Pan*** tool coverts the mouse cursor into a four-way arrow. When in ***"Pan"*** mode the user can click and drag inside the main plot to adjust the viewing area horizontally.

- The ***Undo*** button allows the user to undo previous ***Select*** and ***Pan*** operations and return to the original viewing area and scale.

Note: Performing these operations will automatically adjust the region of interest shown on the navigation sub-plot.

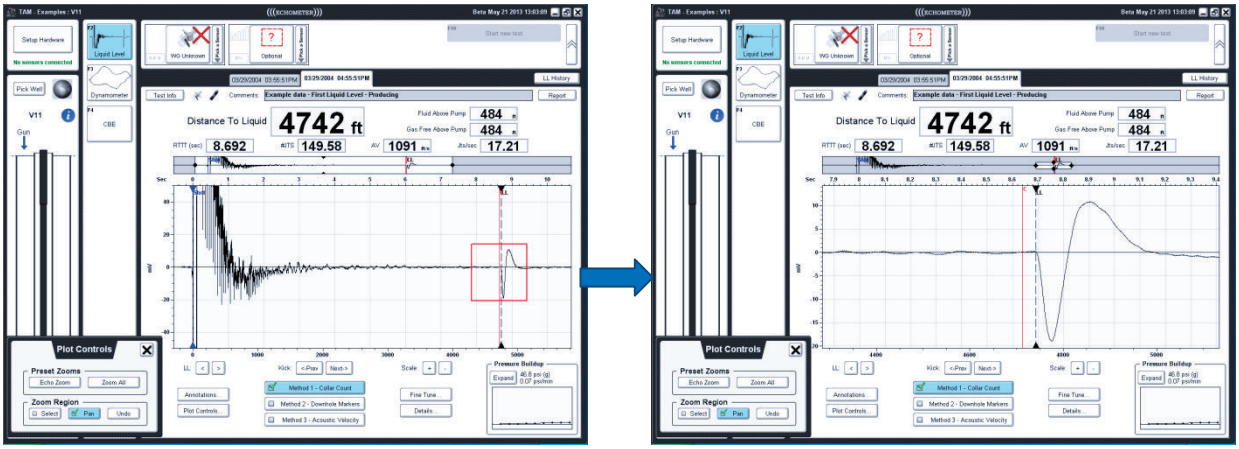


Figure 14: Selecting a new region of interest

V. Liquid Level Fine Tune

As seen in Figure 15, the ***Fine Tune*** button on the main LL screen gives the user access to dialogs that are helpful when refining the location of the cursors. This button brings up a dialog with the options to fine tune the position in time of either the ***Shot Beginning*** or the ***Liquid Level*** cursor. There is also a checkbox that can be used to apply a low-pass filter to the shot trace data. The results of this filter will be present not only on the fine tune dialogs, but also the plot on the main ***LL*** screen.

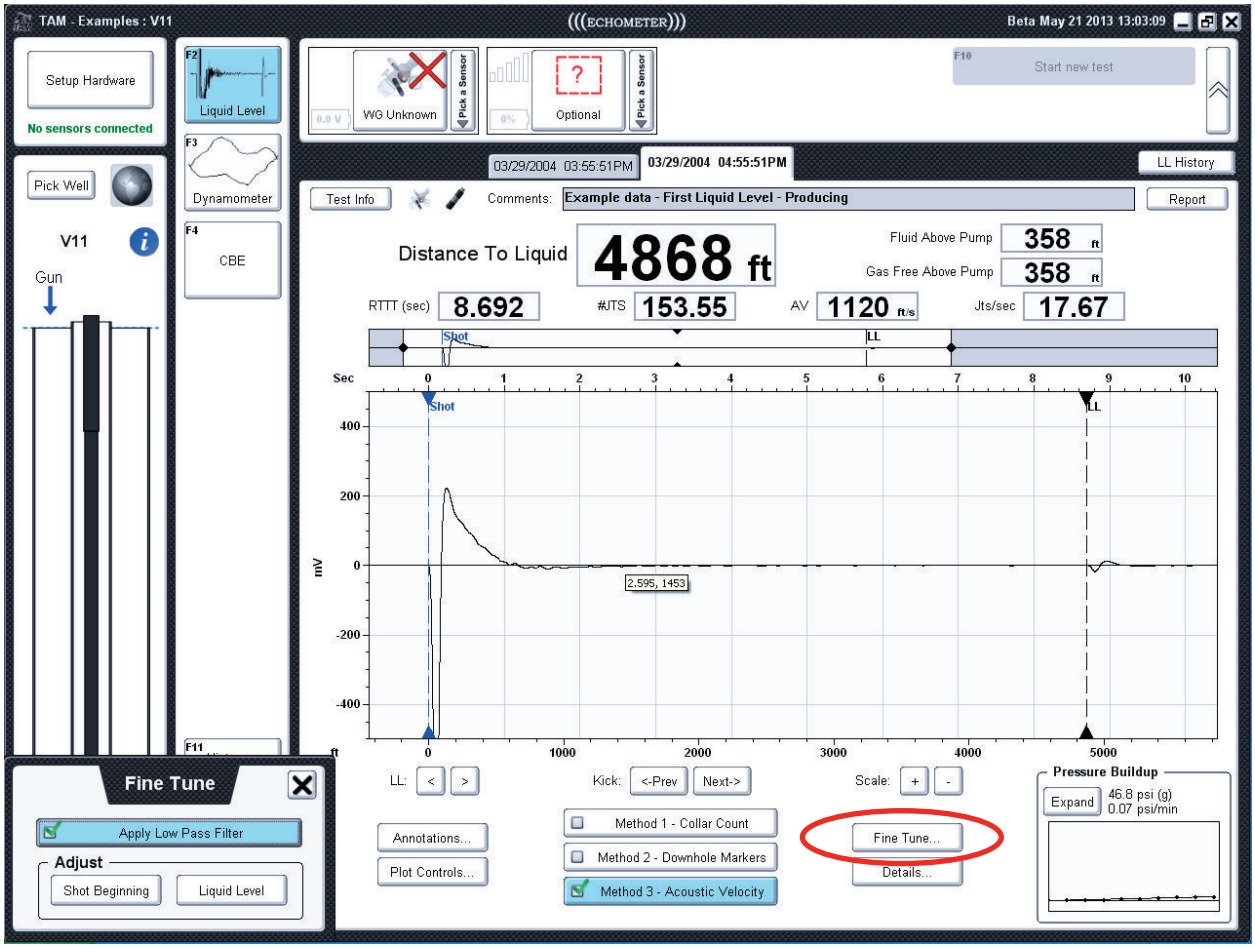


Figure 15: LL fine tune dialog (after applying low pass filter)

Shot Beginning

The shot beginning dialog displays a plot similar to the one on the main ***LL*** screen (see Figure 16). Like the main trace plot, the shot beginning dialog plot has a sub-plot that can be used to adjust the viewing region of interest. It also contains scale buttons that can adjust the millivolt range. The ***Shot*** cursor can be moved directly on the plot or by using the ***Move*** arrow keys, labeled ***"<<", "<", ">", ">>"***. The ***Reset*** button at the top of the plot is used to return to the shot beginning time automatically detected by TAM.

In very noisy wells, where the automatic shot detection fails to correctly locate the start of the pulse, rather than moving the shot beginning cursor manually, the user can adjust the threshold voltage used by TAM's automatic shot detection algorithm by editing the value in the ***Threshold Voltage*** box and pressing **Enter.** If necessary it is possible to apply an offset to account for gun noise by clicking the ***Account for gun noise*** checkbox. The ***Defaults*** button will return the threshold voltage value and gun noise checkbox value back to their normal values.

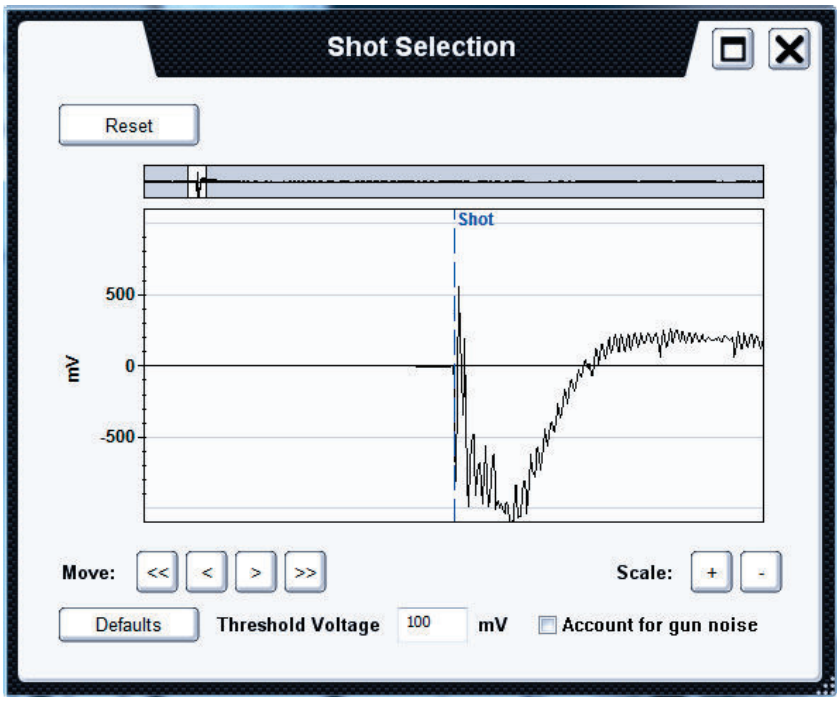


Figure 16: Shot beginning dialog

Liquid Level

Although the liquid level cursor can be moved on the main ***LL*** analysis screen, a user may wish to refine the value even further. Clicking on the ***Liquid Level*** button in the ***"Fine Tune…"*** menu brings up the ***Kick Selection*** panel showing a zoomed-in region around the current liquid level indicator (Figure 17). Here the user can refine the cursor position by dragging it directly on the plot or by using the ***Move*** buttons in the bottom left-hand corner. The ***Reset*** button at the top will return the ***LL*** indicator to the original time picked automatically by TAM.

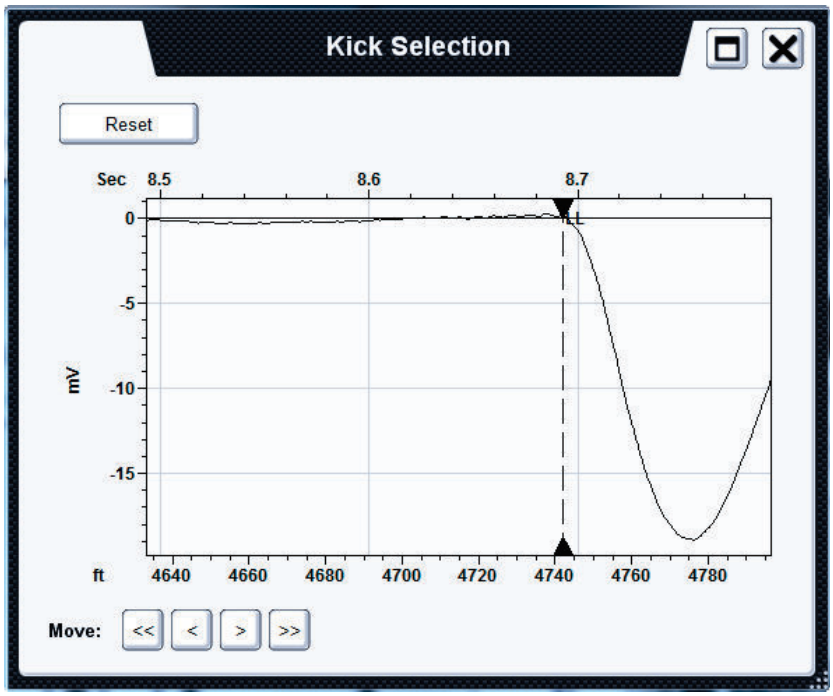


Figure 17: Refining the liquid level position

VI. LL Details

The ***Details*** button on the main LL screen will bring up a dialog that allows the user to indicate the pulse type used for the shot (explosion or implosion), the position where the gun is installed – either on the casing or the tubing, as well as the state of the well. Adjusting these options will automatically trigger a re-analysis on the ***LL*** test. Changing the pulse type from explosion to implosion inverts the polarity of the acoustic trace so it is very important to indicate to the program the actual pulse type used.
NOTE: Implosion shots can only be done when using manually operated gas guns such as the Echometer Compact Gas Gun or the 5000 psi and 15000 psi gas guns.

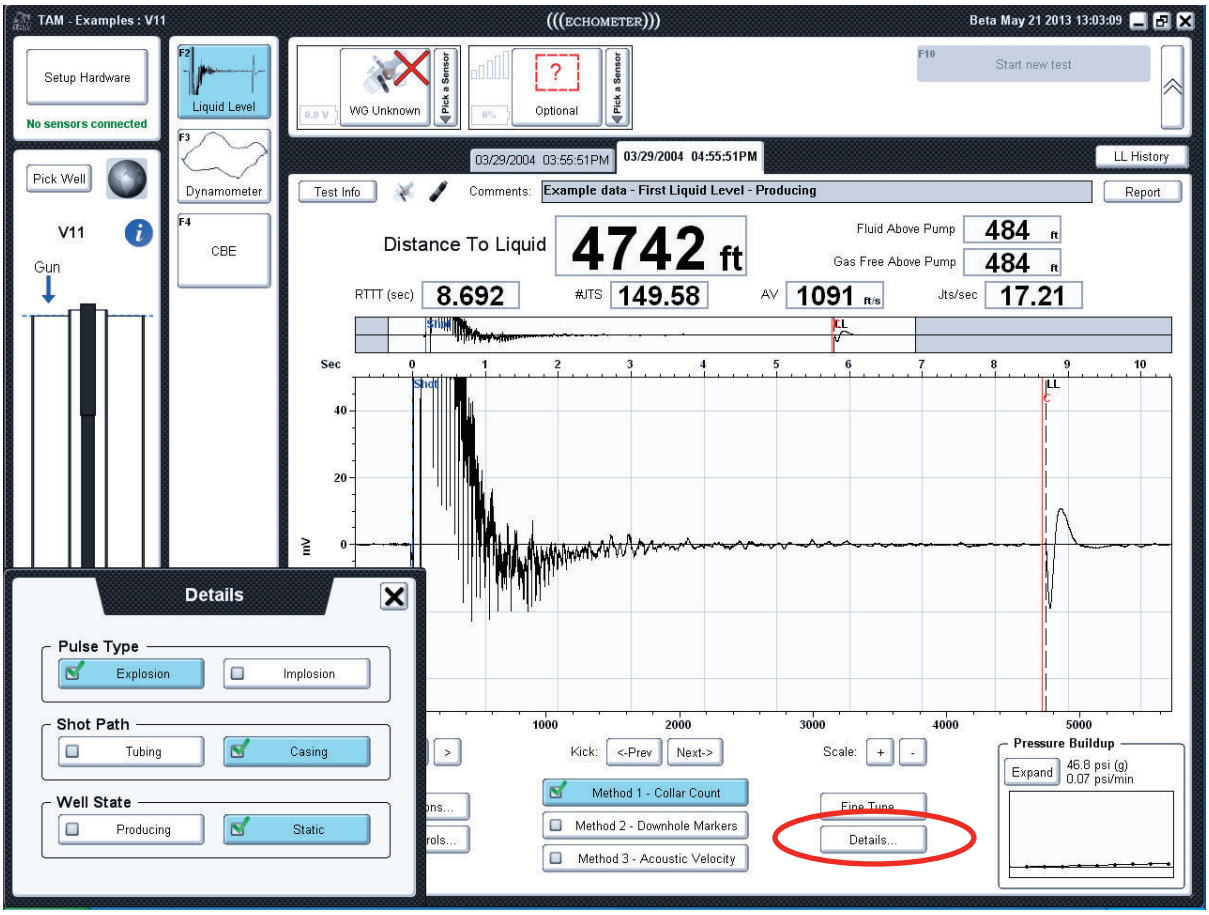


Figure 18: LL details dialog, results after changing pulse type

VII. LL Analysis Methods

TAM currently provides three different methods for determining acoustic velocity, and consequently, the distance to the liquid level. TAM, by default, applies the ***Collar Count Method*** but the user can toggle between the analysis methods by clicking on one of the three buttons at the bottom of the main LL analysis screen, as seen in Figure 19. Clicking on a given method button will bring up the corresponding dialog allowing the user to manually adjust the parameters used for depth determination. The three methods include:

- *Method 1 - Collar Count Method*
- *Method 2 - Downhole Marker Method*
- *Method 3 - Acoustic Velocity Method*

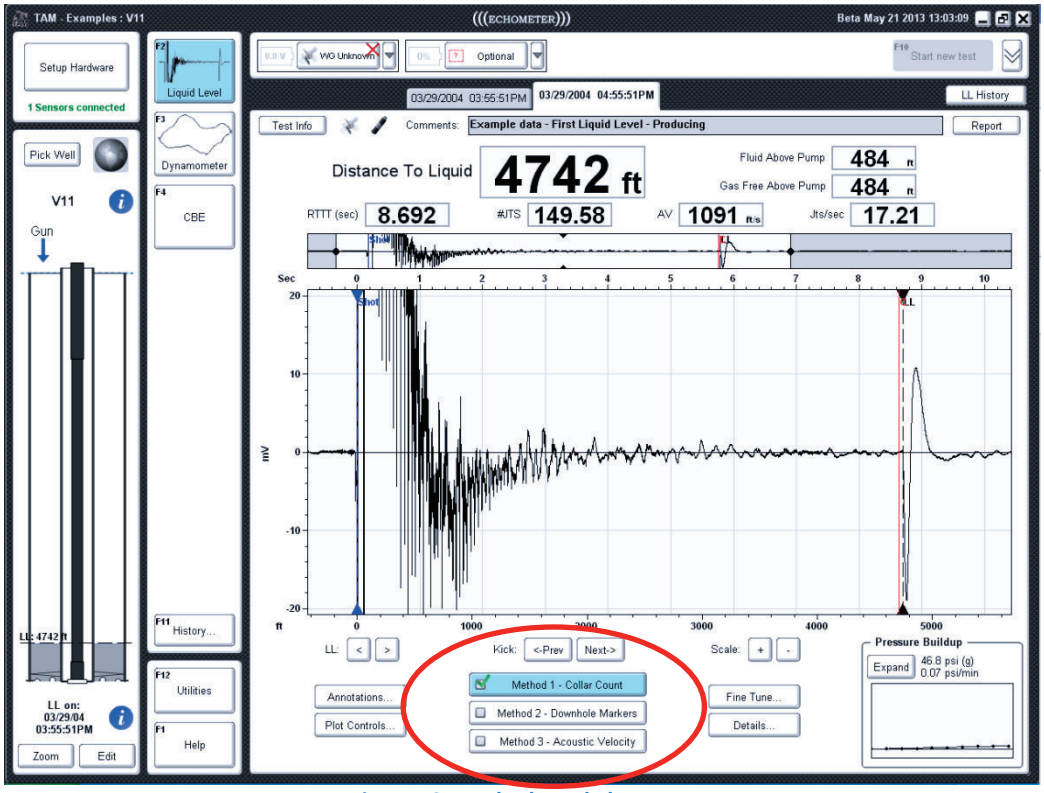


Figure 19: Method toggle buttons

Collar Count Method

No action by the user is normally required since the TAM program follows a very efficient method to identify and count collar echoes automatically to the deepest part of the record. In those cases where the collar count marker line **"C"** is located significantly above the liquid level echo it may be appropriate for the user to intervene manually to attempt to obtain a deeper collar count.

Clicking on the ***Method 1 – Collar Count*** button displays the collar analysis dialog (Figure 20) which is in the ***Auto Collar Selection*** mode by default. The user can override the automatic mode by interacting with this dialog by a two-step process. To ***Manually Adjust Collars*** the user selects a one second region from the top plot indicating the section of the record where the collar echoes will be identified. This one second region is indicated by a yellow selection box that can be clicked and dragged to any position along the top plot.

Once the area of interest has been selected, the bottom plot automatically updates to show a zoomed-in view of the region. Here, dashed red lines appear bounded by solid red marker lines  which can be dragged to align collar markers to the corresponding echo positions along the trace. The move buttons ***"<<", "<", ">", ">>"*** can be used to move all markers left or right. The spread buttons "***--", "-", "+", "++"*** can be used to spread or shrink the spacing between cursors. The markers can also be adjusted by dragging the first and last collar lines.

To return to the collar analysis used by TAM initially, click the ***"Auto Collar Selection"*** button in the top-left corner. This dialog also contains filter buttons that can be used to filter the trace displayed in the bottom plot. ***Raw*** displays the trace data without applying any filter, ***HP*** applies a high-pass filter, ***BP*** applies a band-pass filter, and ***HBP*** applies a high band-pass filter before plotting the trace. After performing collar analysis, the user will notice a red cursor labeled ***C*** on the main LL analysis screen. This indicates the position of the last collar counted.

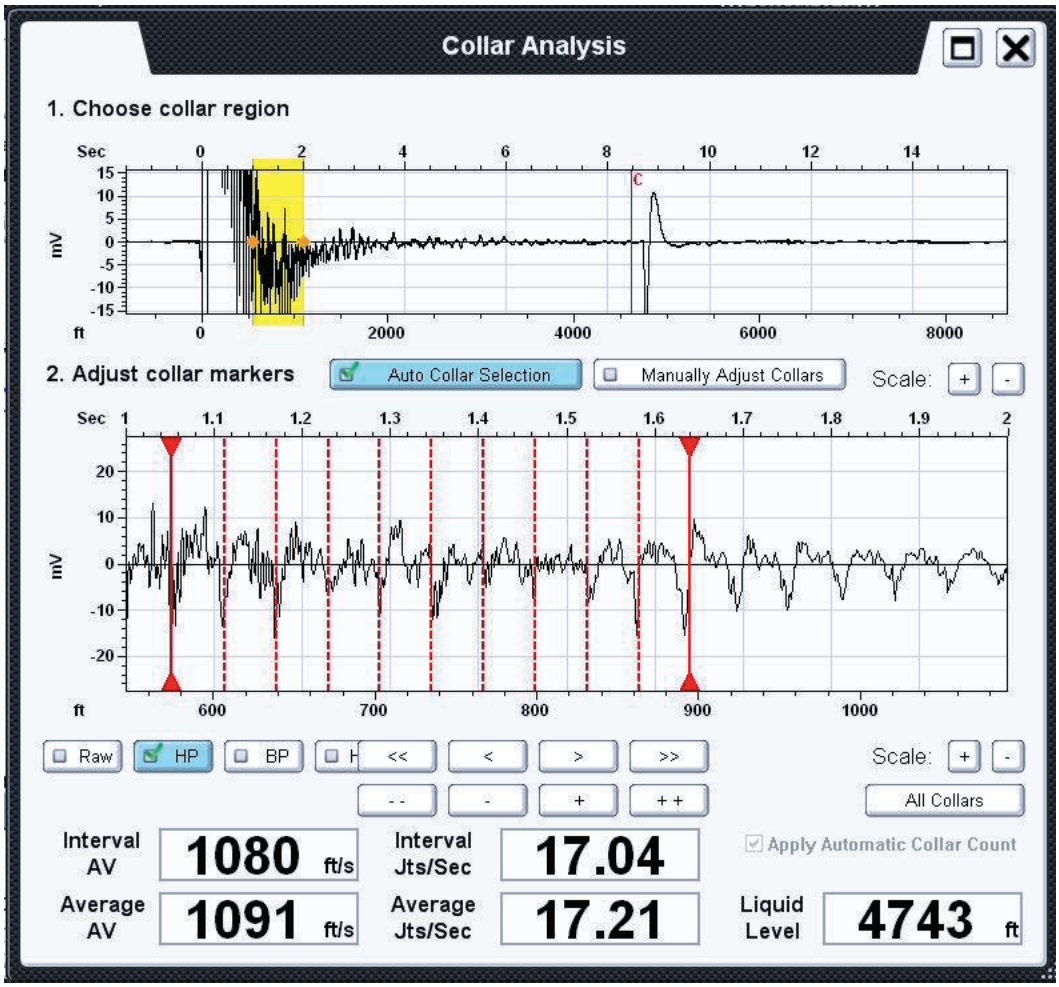


Figure 20 – Collar analysis dialog

By default the ***Apply Automatic Collar Count*** box is checked so that the program processes the collar echoes using a digital filter to identify the echoes as deeply as possible. The result of the automatic count is displayed by clicking the ***All Collars*** button to display the screen shown in Figure 21 where the acoustic trace has been subdivided in 2 seconds intervals and the collar echoes have been identified by the tick marks. Un-checking this box forces the program to use the number of collars per second for the section highlighted in yellow to estimate the number of joints to the liquid level echo.

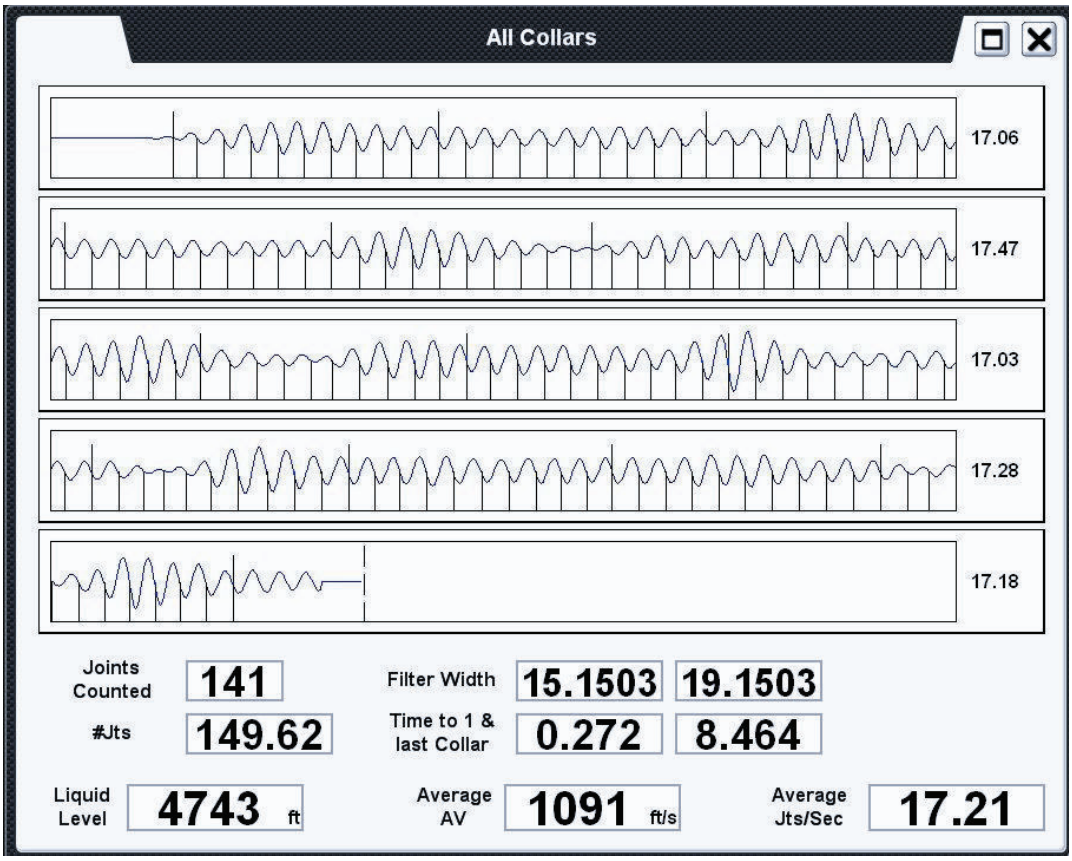


Figure 21 – Total Collar Count

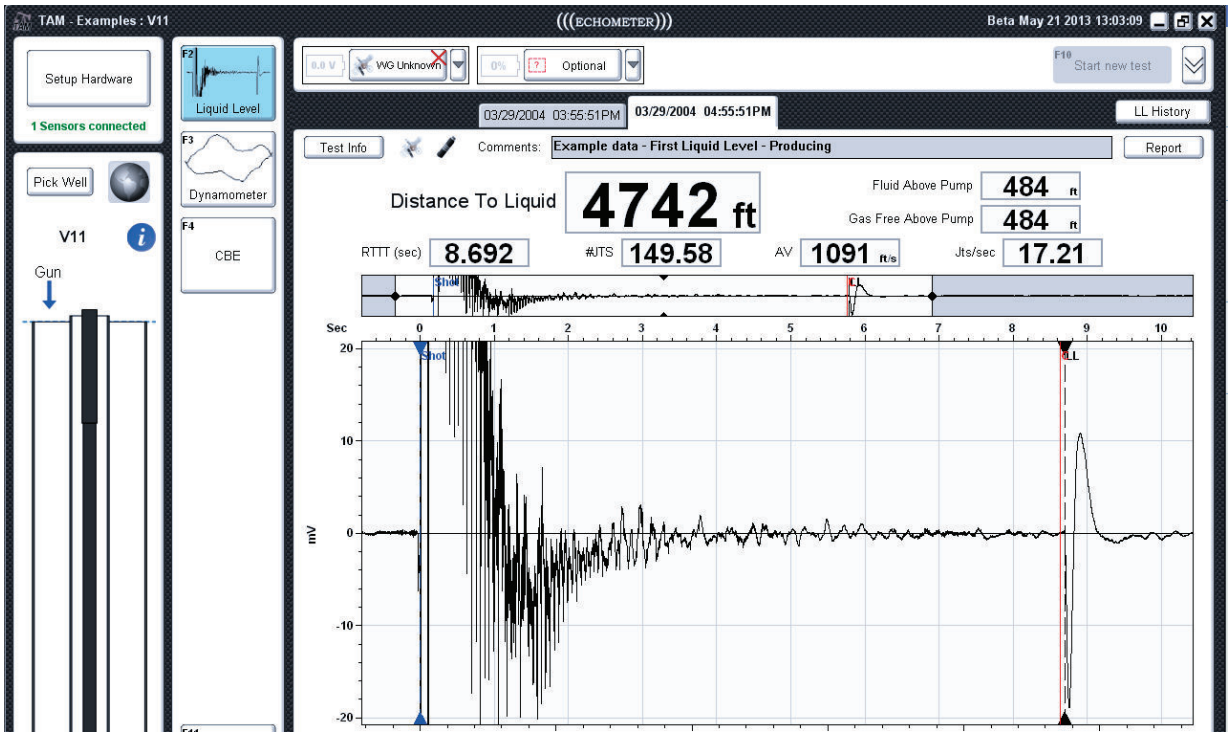


Figure 22 – Automatic Collar Count

Downhole Marker Method

Wellbores that include downhole features that cause acoustic reflections, such as a tubing anchor shown in Figure 22, that can be used to determine the average acoustic velocity of the gas and calculate the distance to the liquid level.

Clicking the ***Method 2 – Downhole Markers*** will give the dialog shown in Figure 23. At the top of this screen is a list of possible markers, based on the information entered in the ***Detailed*** well description, with their corresponding depths. Faint red lines show their corresponding positions on the acoustic trace and the small zoomed-in window displaying the section of record near the liquid level. Clicking the button of the marker to be used (tubing anchor in this example) thickens and highlights its corresponding indicator that can then be moved directly on the main plot to its correct position or using the smaller plot showing the zoomed in area around the selected marker. Here the marker can be further refined as needed. This screen also provides buttons for adjusting the millivolt scale, adjusting the window size of the sub-plot (the width of the yellow region on the main plot), adjusting the wellbore overlay's opacity, and buttons to provide quick zooming.

The result of the marker analysis is shown in Figure 24 with the annotation Tubing Anchor displayed on the record to indicate which marker was used for the calculations.

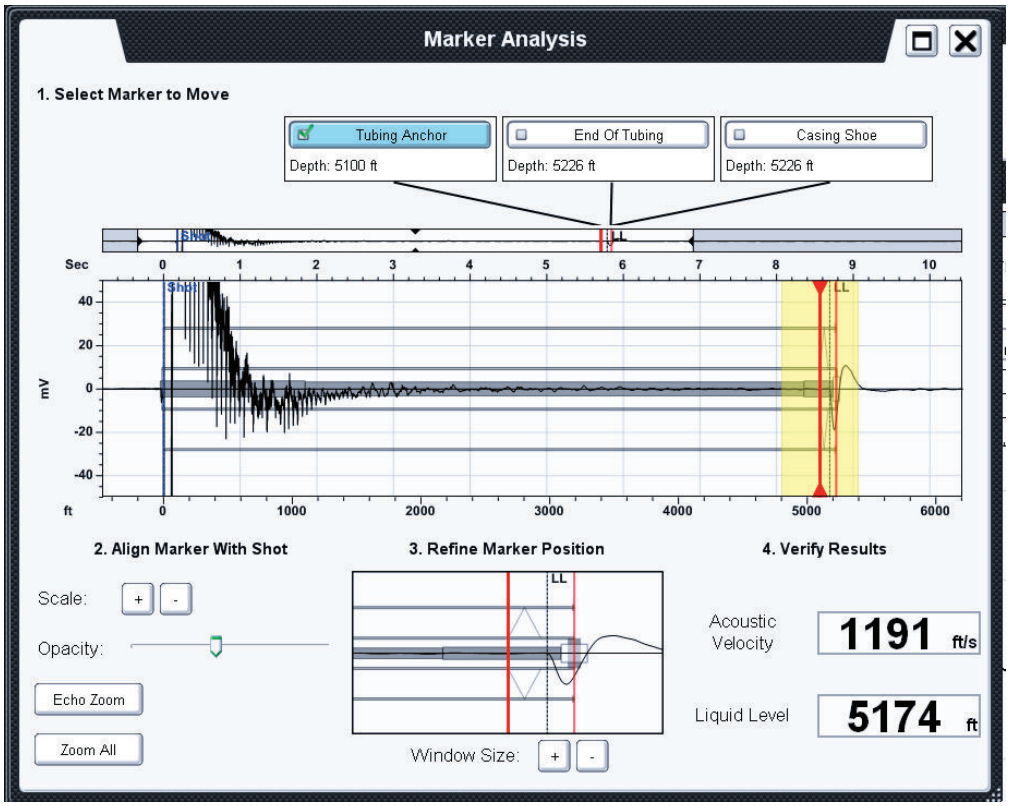


Figure 23 – Marker analysis dialog

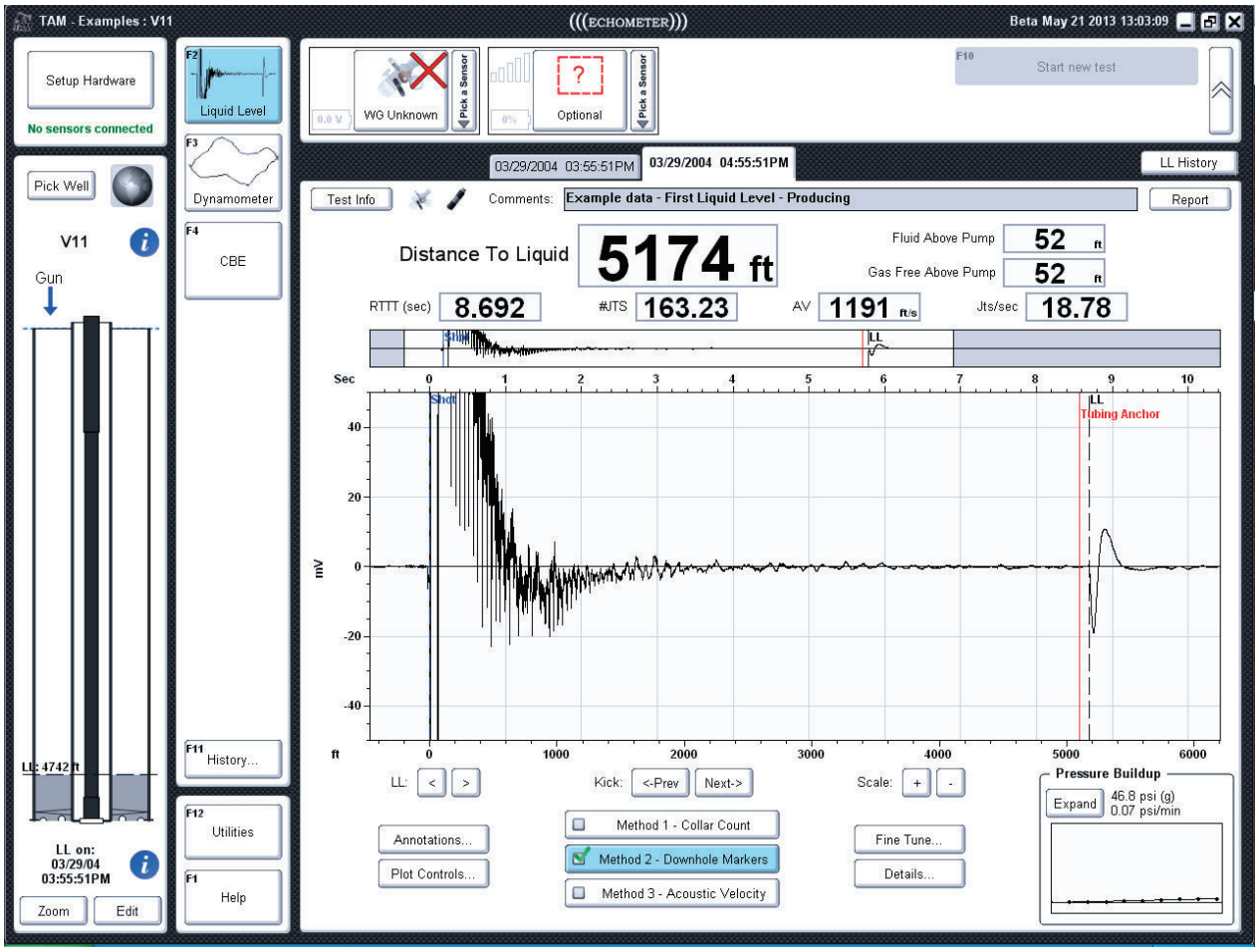


Figure 24 – Marker analysis results

Acoustic Velocity Method

This method is used whenever the record does not show echoes from tubing collars or downhole markers such as for acoustic measurements inside internally flush tubing or cased holes without tubing. Clicking on ***Method 3 – Acoustic Velocity*** allows the user to manually enter a known acoustic velocity (Figure 25) or have the program calculate a velocity by manually entering a value for gas gravity or a detailed gas composition. To enter gas properties select the ***Compute from Gas Gravity*** button to derive an acoustic velocity based on entered gas gravity (Figure 26) or computed from gas composition(Figure 27) . The fluid level analysis based on acoustic velocity is shown in Figure 28.

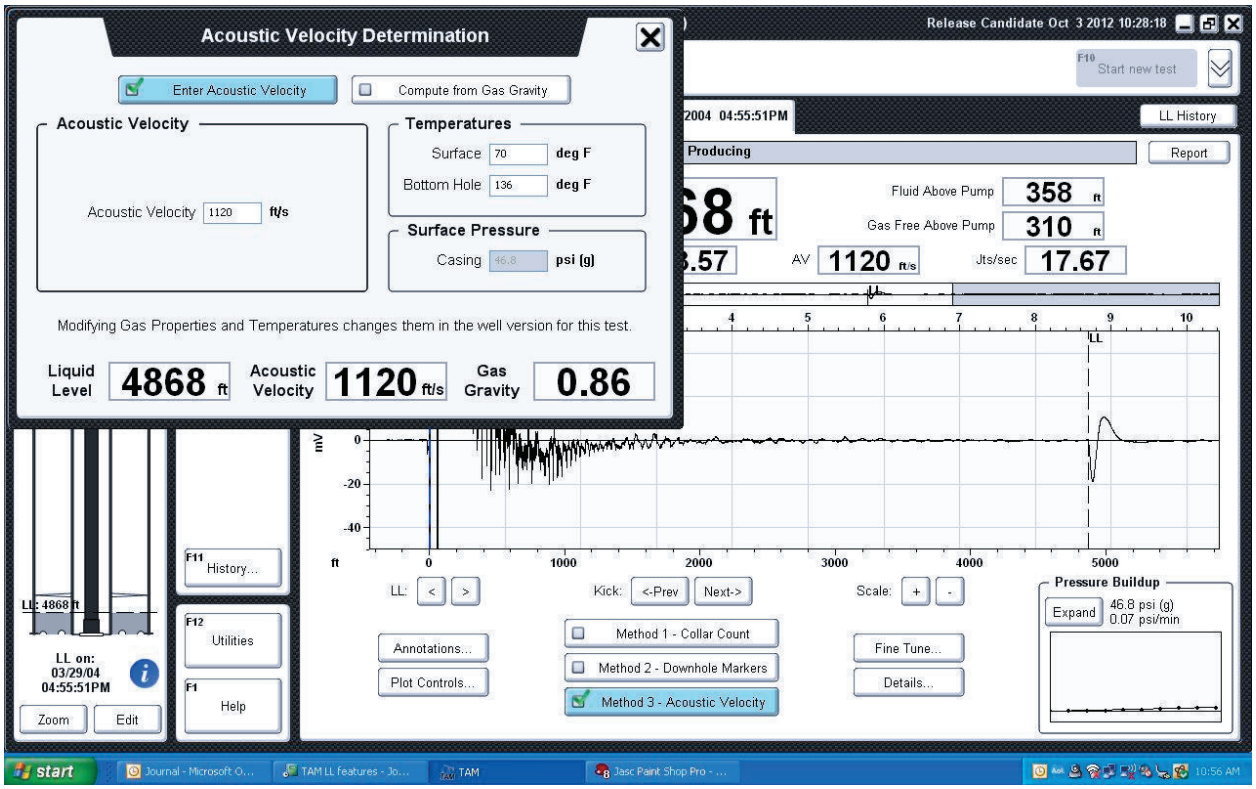


Figure 25 – Acoustic velocity dialog

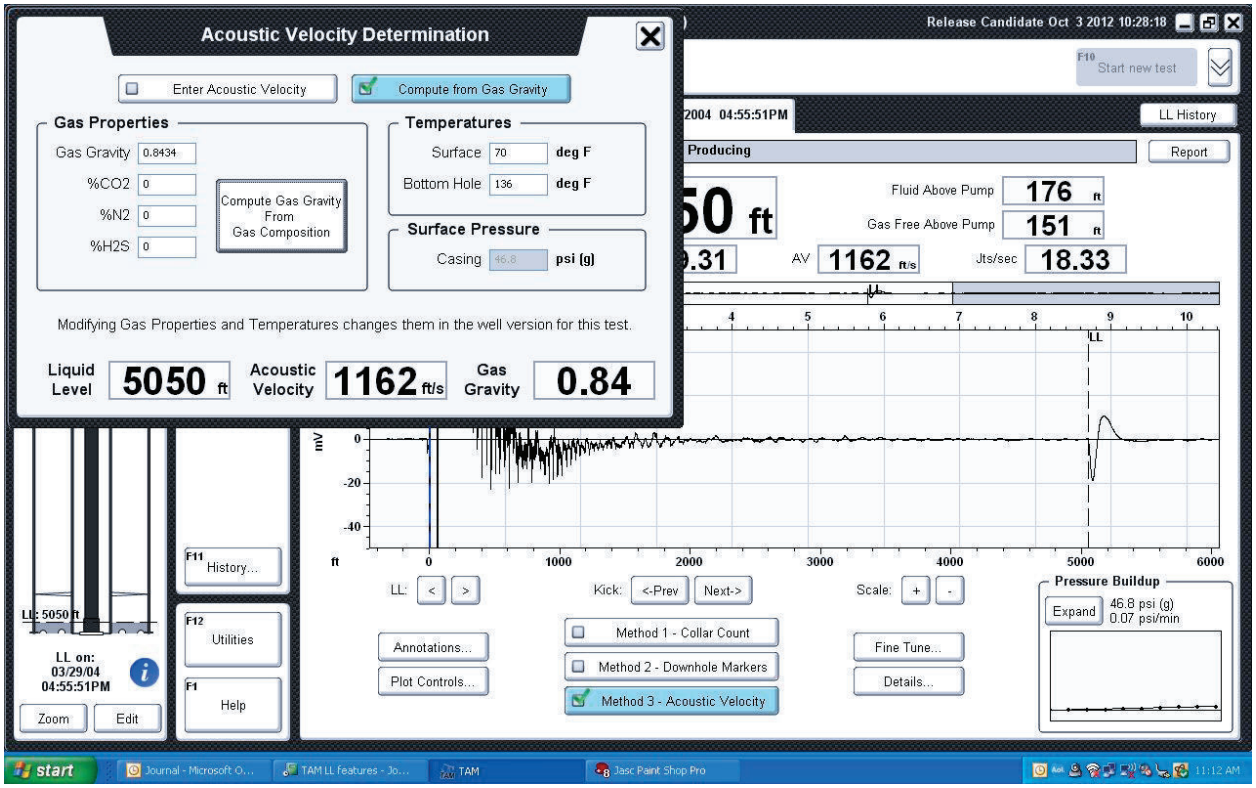


Figure 26 – Velocity from Gas Gravity Dialog

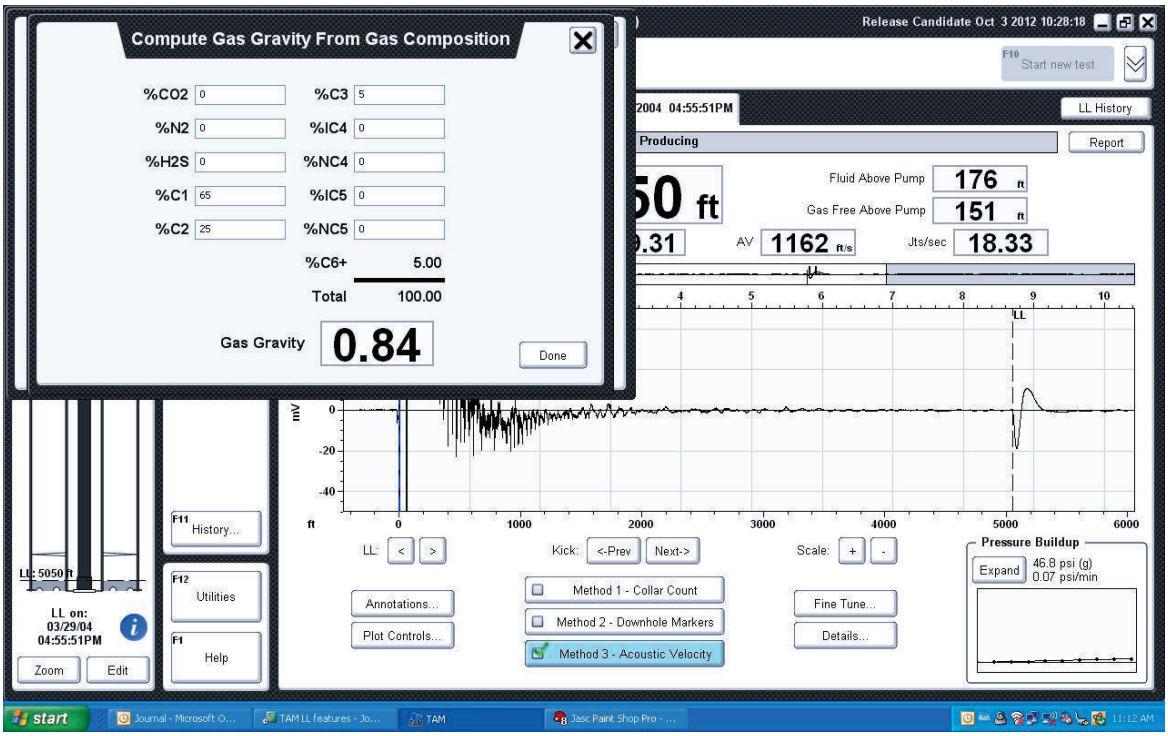


Figure 27 – Velocity from Gas Composition Dialog

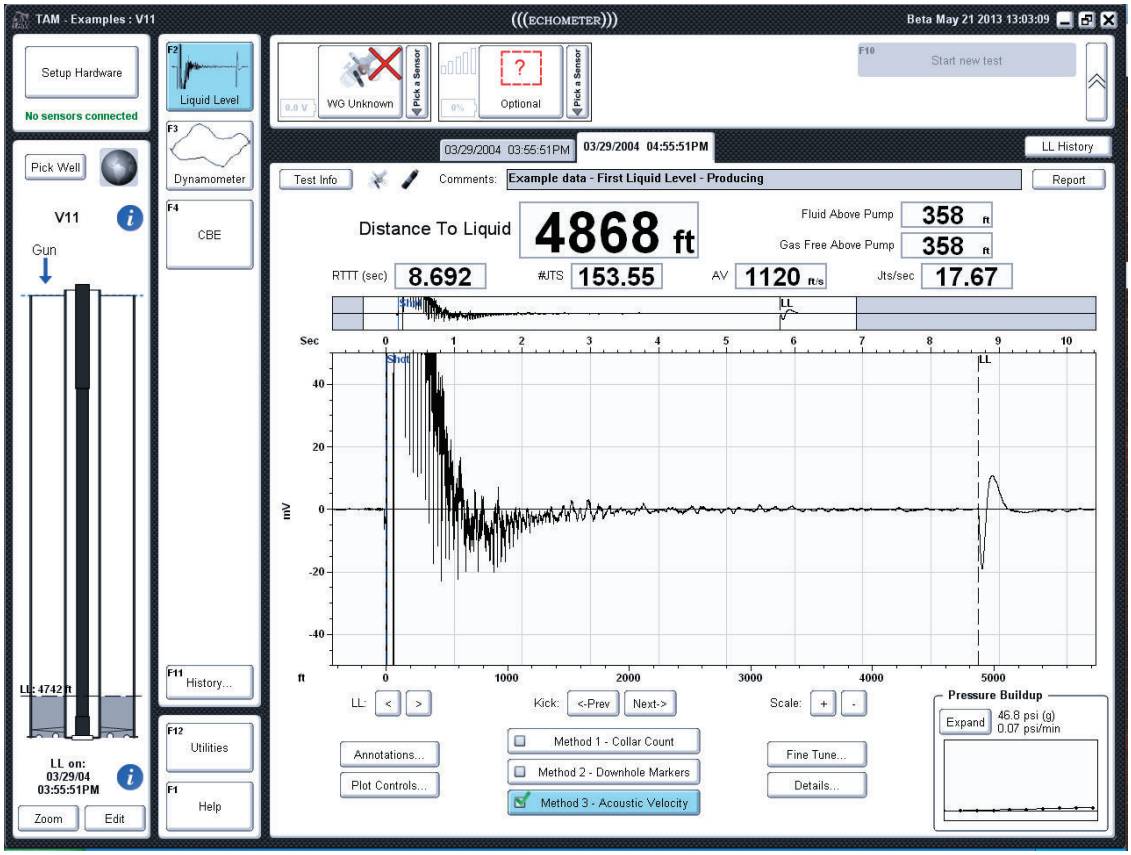


Figure 28 – Acoustic velocity result

Dynamometer Analysis Features in TAM

Table of Contents:

I. Dynamometer Analysis Windows

For analysis and review of dynamometer records, TAM provides four different analysis windows: the traditional surface and pump card view, raw data view, pump analysis view and valve test view when a valve test was performed.

Card View

The default view for the ***Dynamometer*** Analysis module is the traditional two card view (Figure 1). In addition to it showing both the surface and pump cards, this screen also displays a pump animation computed from the recorded data, tubing pressure gauge (when pressure was acquired), and digitals showing values like fillage and pump displacement. On this screen, the user can also manually adjust the effective plunger stroke by clicking and dragging the ***EPT*** dashed cursor displayed on the pump card.

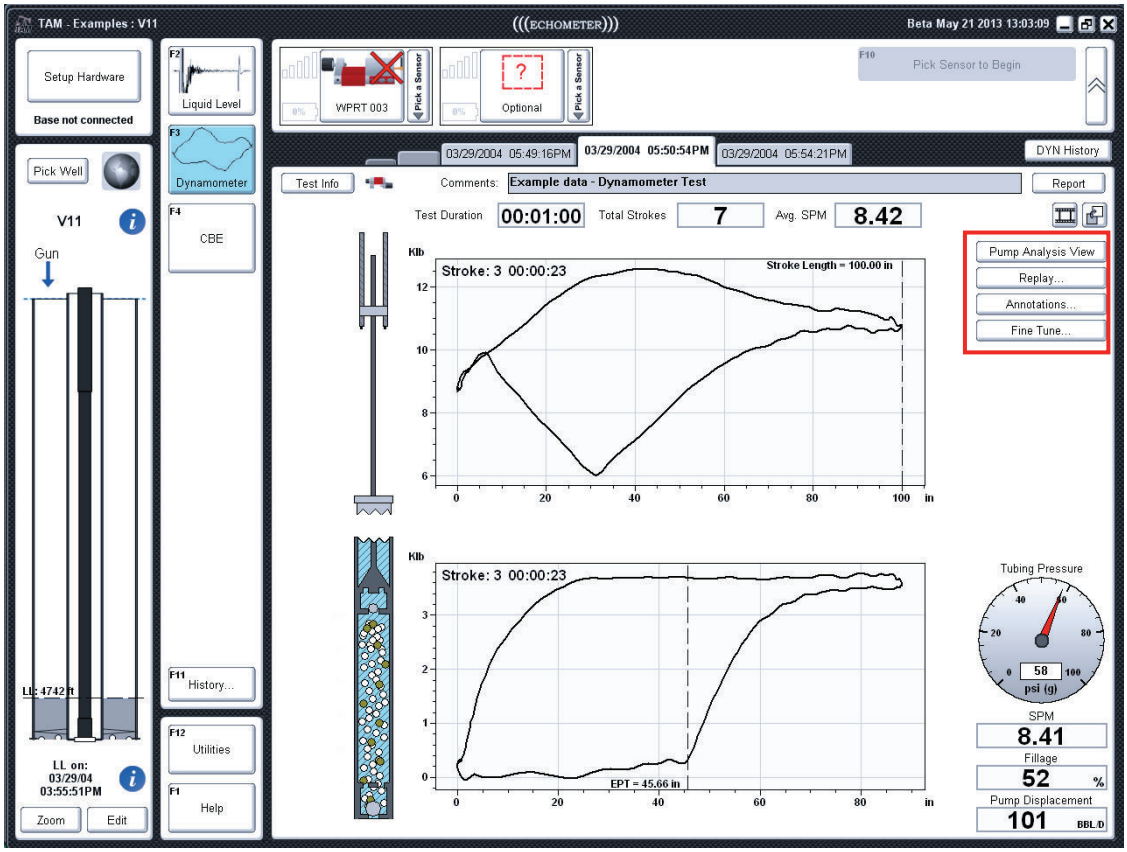


Figure 1: DYN Card View

Several action buttons are displayed to the right of the surface dynamometer card. Their function is discussed in the following sections.

Raw Data View

Both during acquisition and when reviewing the data the user can see the ***raw data*** as a function of time as it was acquired from the sensors. One can switch between the ***card view*** and ***raw data*** view by clicking the button  in the top right corner, directly under the report button (see Figure 2). On the raw data screen, load and acceleration are displayed by default. The display can be customized with options to view pressure (when acquired), position, and velocity. Filters can also be used to apply smoothing to the displayed curves. Engineering units versus raw units (mV/V) can be toggled using the ***Eng Units*** button in the top-left corner of the analysis screen.

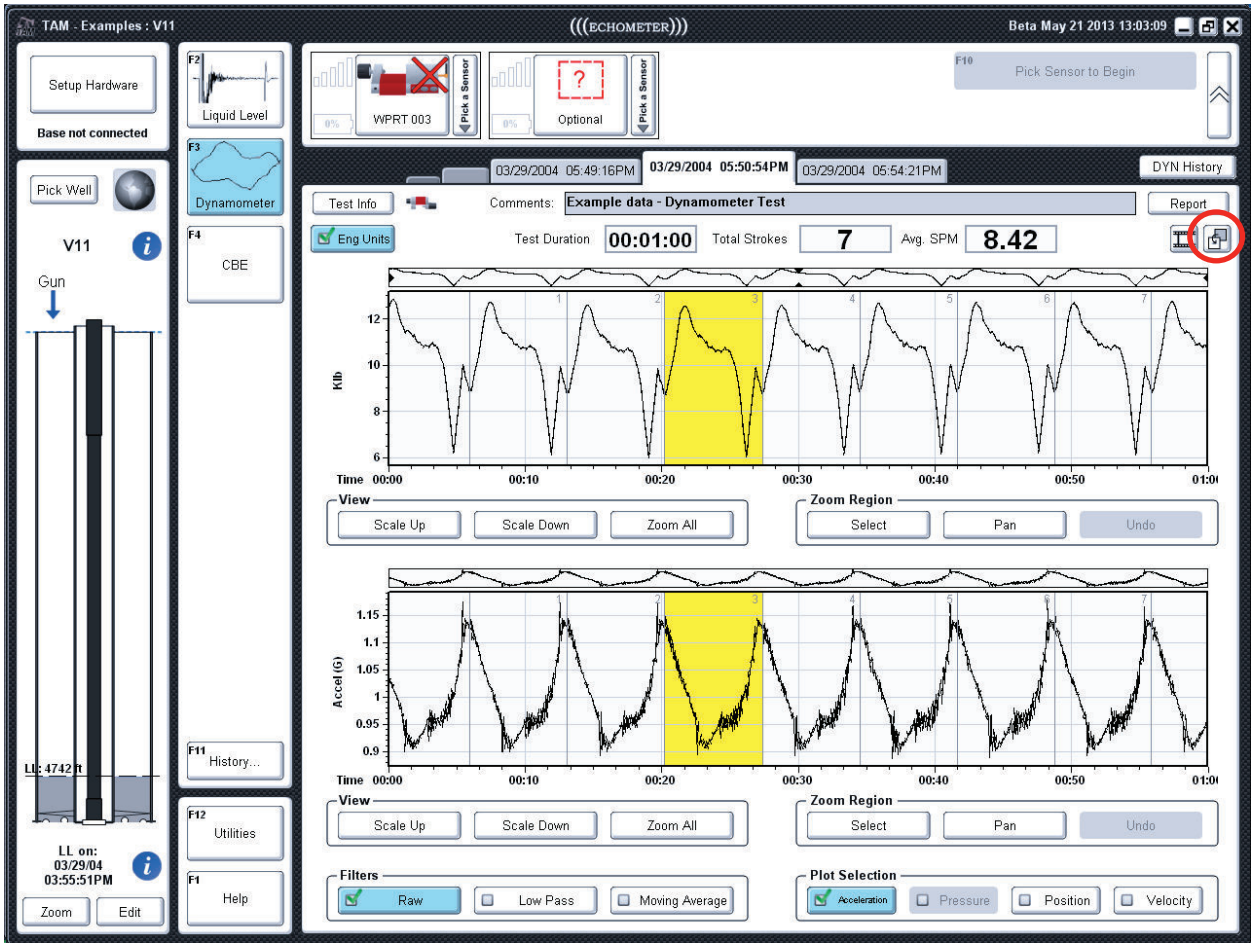


Figure 2: Dynamometer Raw Data View

To return to the dynamometer ***card view*** the same button should be clicked.

Pump Analysis View

The ***Pump Analysis View*** is accessed by clicking the corresponding action button at the top right of the dynamometer analysis. This figure shows the load of the pump card, the plunger position and the variation of chamber pressure during the stroke. Users can switch back to the card view by clicking the ***Card View*** button underneath the raw data view's switch button, as seen in Figure 3. The pump animation is also expanded to show plunger and tubing movement relative to the position of the standing valve at the bottom of the stroke

Additional annotations like discharge pressure of pump intake pressure are also present on this screen and can be turned on and off using the Annotations dialog (Section IV).

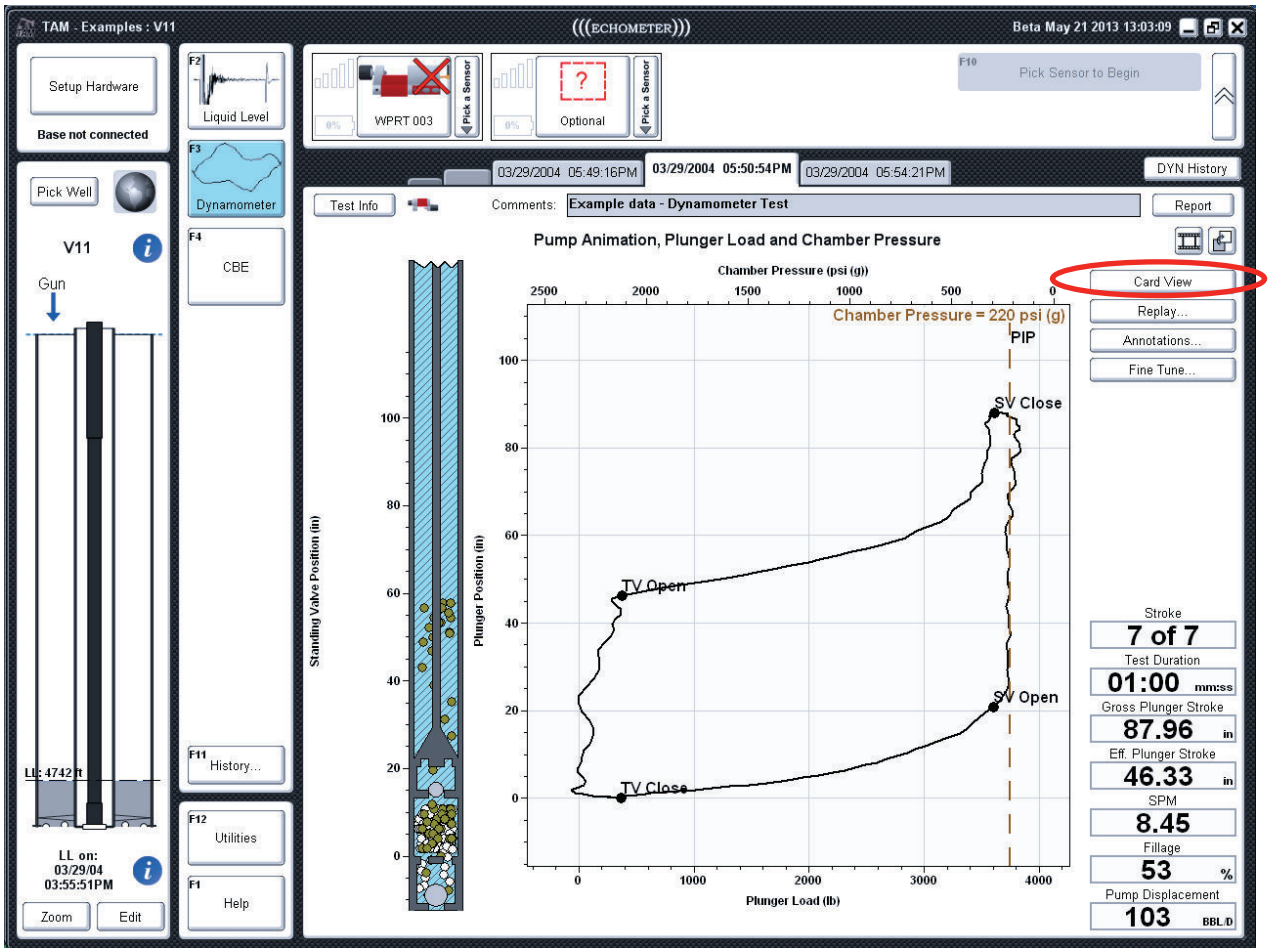


Figure 3: Dynamometer Pump Analysis View

Valve Test View

One of the novel features of TAM is the ability for to automatically detect that the operator is performing a valve tests during the normal acquisition of a Dynamometer test; generally it is not necessary to interact with the software when a valve test is going to be performed. TAM monitors the acceleration signal and determines when the polished rod is stopped and exits the dynamometer card screens to display the load vs. time record until the normal pumping operation of the unit is continued for at least two strokes. If the user performed a valve test while acquiring dynamometer data, then he may review the valve test screen by clicking on the corresponding tab. The valve test screen shows a plot containing the load values acquired over time (Figure 4). Candidate intervals for valve test analysis are highlighted by gray bands. When the ***Enable TV/SV Analysis*** buttons are clicked, the program automatically selects the most appropriate interval to be analyzed and displays the corresponding vertical markers (Figure 5). If not satisfied with the software's analysis, the user can change the size and position of the ***yellow TV region***, by clicking and dragging it to a new leakage interval. The traveling valve leakage calculations are controlled by the width of the yellow marker bars which is defaulted to 5 seconds but can be adjusted using the corresponding handles. Also the ***SV cursor*** can be moved to the position where its corresponding load should be measured.

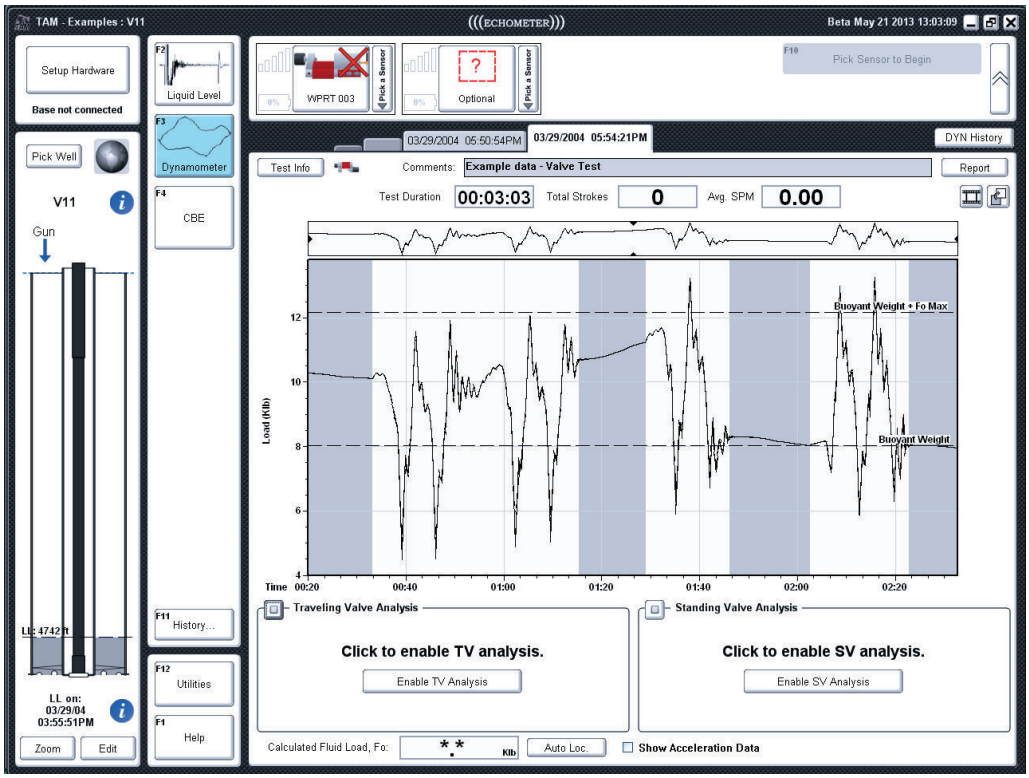


Figure 4: Dynamometer Valve Test View

Results are shown in the digitals below the plot. Clicking the Auto Locate button positions all markers to the automatic analysis. When the valve test is performed using a PRT, that was not properly stabilized and the data exhibits significant drift, it may be necessary to adjust the SV load to match the computed ***Buoyant Rod Weight*** by clicking the corresponding button.

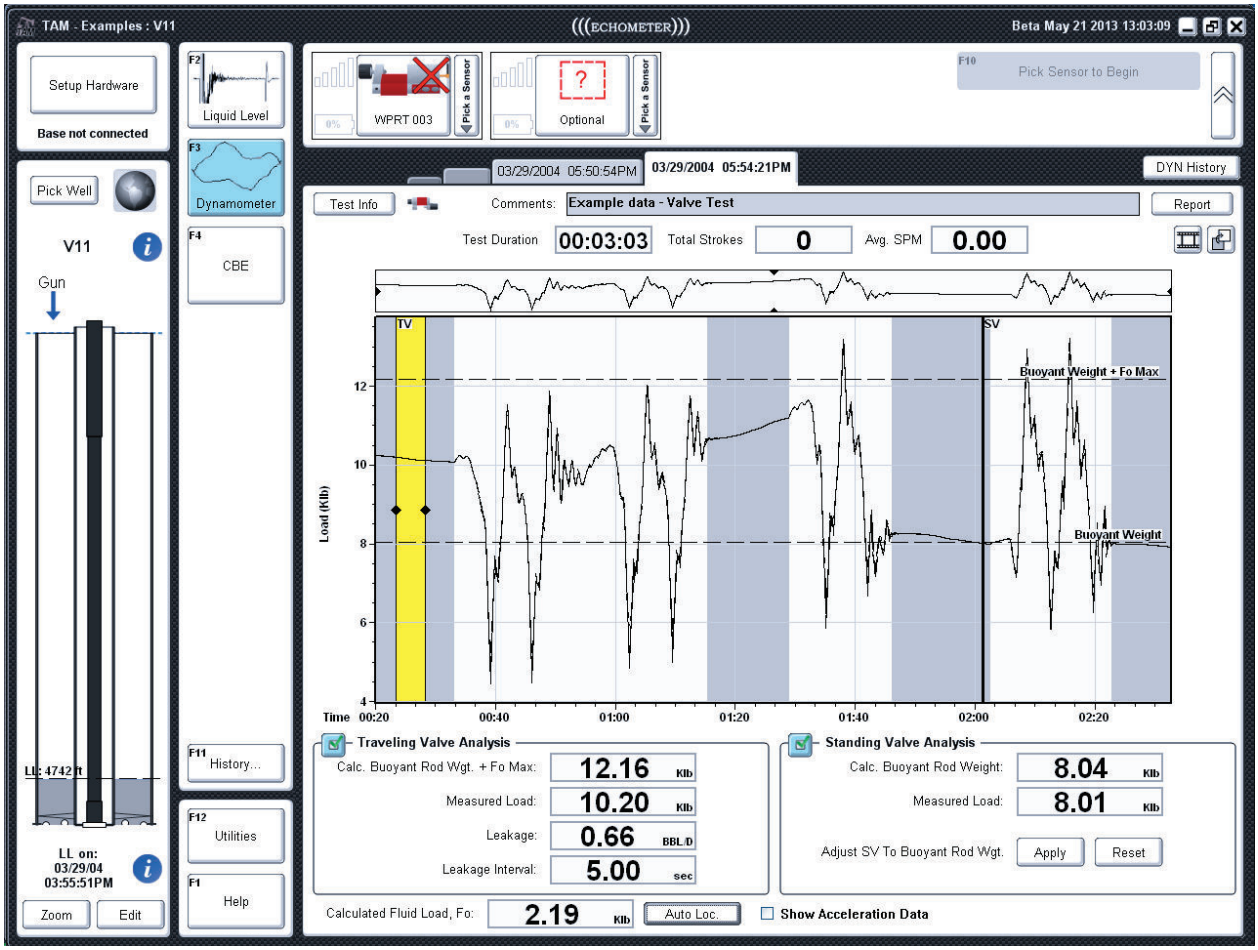


Figure 5: Dynamometer Valve Test Analysis View

II. Selecting Dynamometer Strokes

Specific strokes are selected from the dynamometer record via the stroke viewer control, accessed through the button  at the top right of the analysis screen, directly to the left of the raw data button (Figure 6). This control displays thumbnails of all the strokes in the current test. By default it highlights and displays the last stroke. To switch to a different stroke, click the corresponding numbered thumbnail.

You can also overlay multiple strokes on top of one another by holding ***Ctrl*** while you are clicking strokes (Figure 7). If you click while holding ***Shift,*** you will be able to select a range of strokes. Right clicking on a stroke will give you the option to **"Lock"** or **"Unlock**" a stroke. When a stroke is locked, it will always be selected as an overlay as you click through other strokes. Finally, you can select all strokes by hitting ***Ctrl+A*** on the keyboard, or by right-clicking a stroke and selecting ***"Select All".***

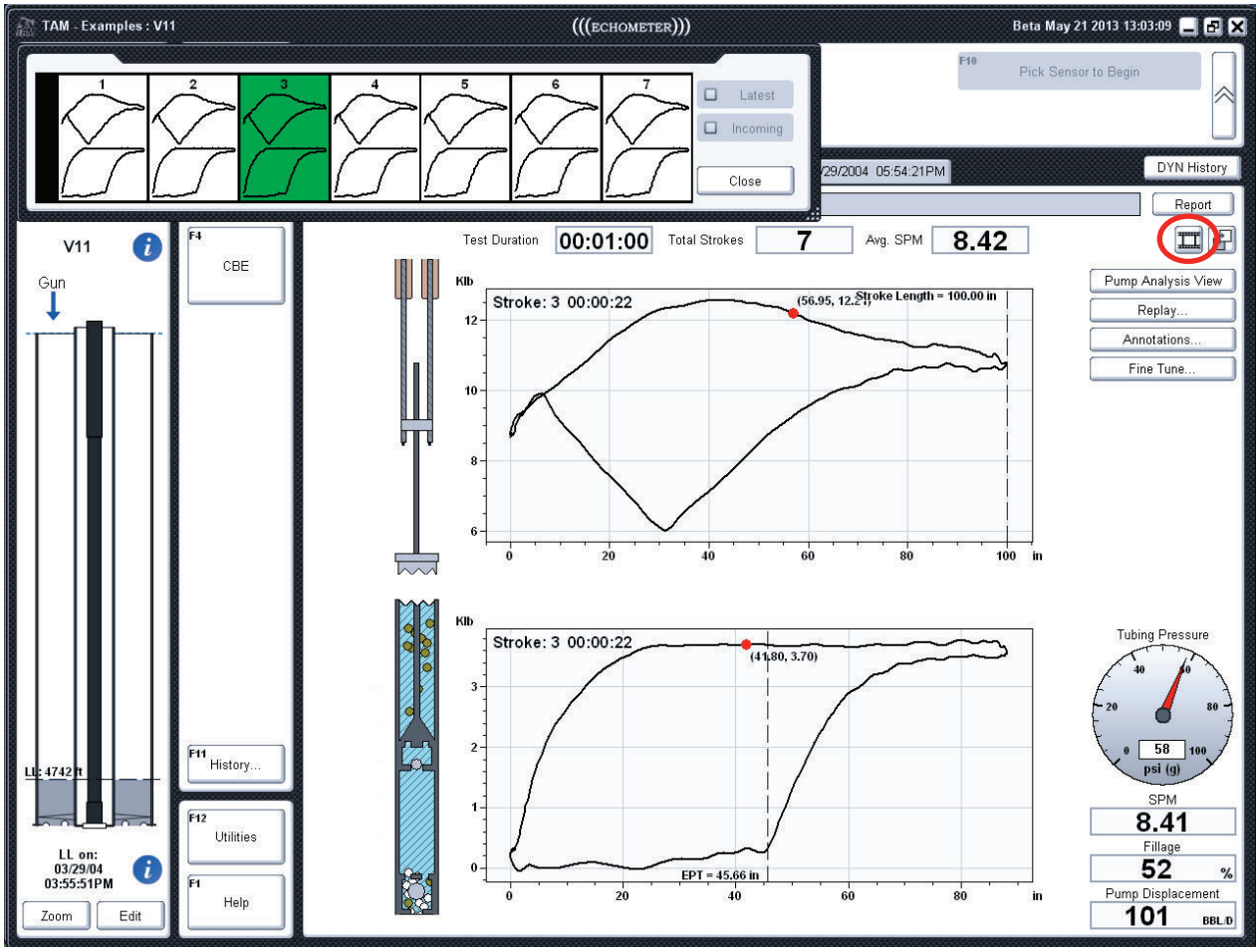


Figure 6: Stroke Viewer Control

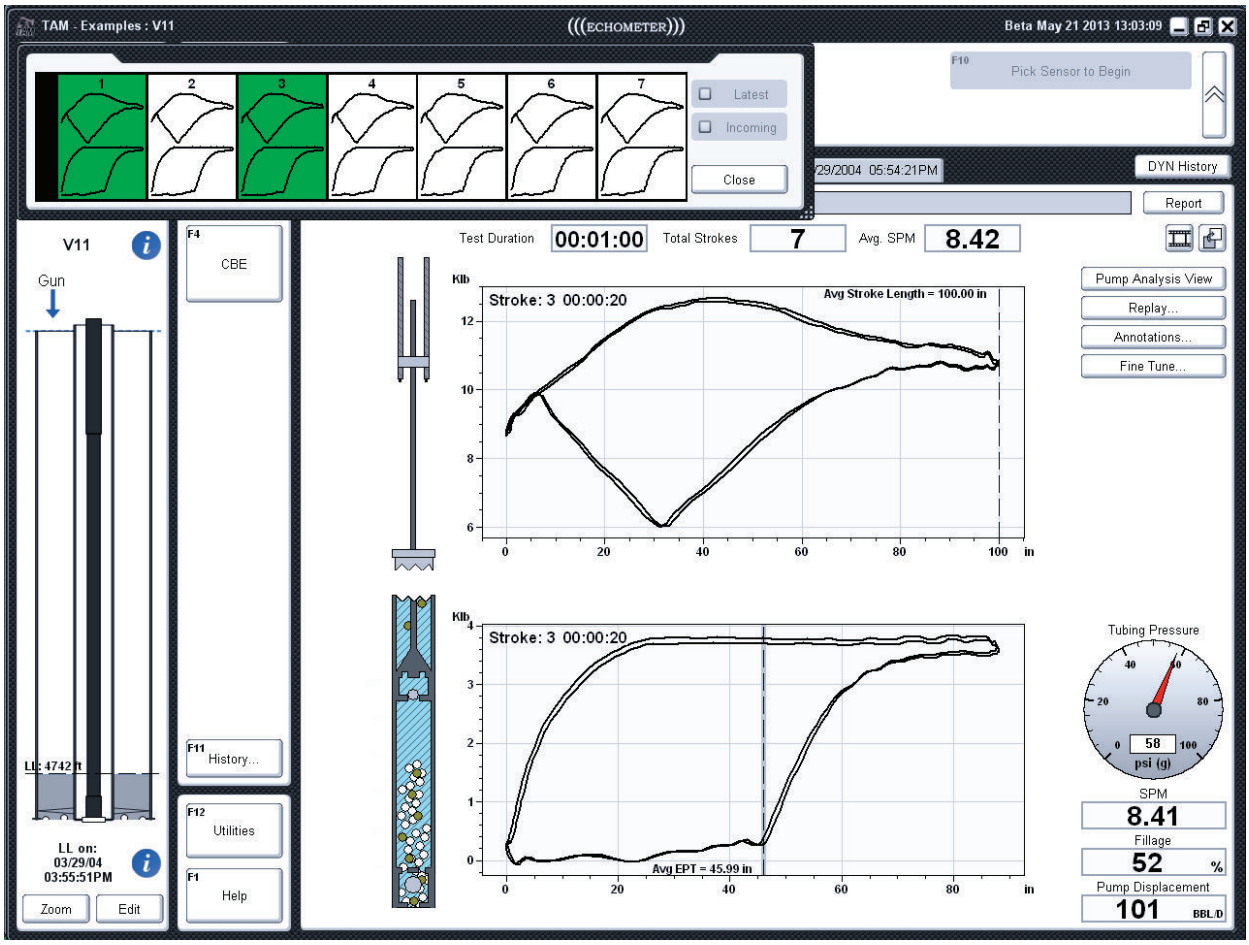


Figure 7: Stroke Overlay Example

III. Dynamometer Replay

Clicking on the ***"Replay"*** button on the Dynamometer Analysis window will display the replay controls for viewing the recorded pump strokes as they were acquired originally in real time.

Controls

Figure 8 shows at the top left the replay controls dialog. Some of the basic controls include play, stop, pause, and rewind. There is also a loop button (circular arrow) that allows the replay to continue indefinitely until the user decides to stop replay. Below these buttons are plus and minus buttons that can be used to control the playback speed. Playback speed include: 0.25x speed, 0.5x speed, 1x speed (**real time**), 2x speed, 4x speed, and 8x speed. The user can also specify a stroke range to use for replay by entering the stroke number into the provided textboxes and clicking ***"Update***". The moving red line on the stroke viewer indicates the current replay position.

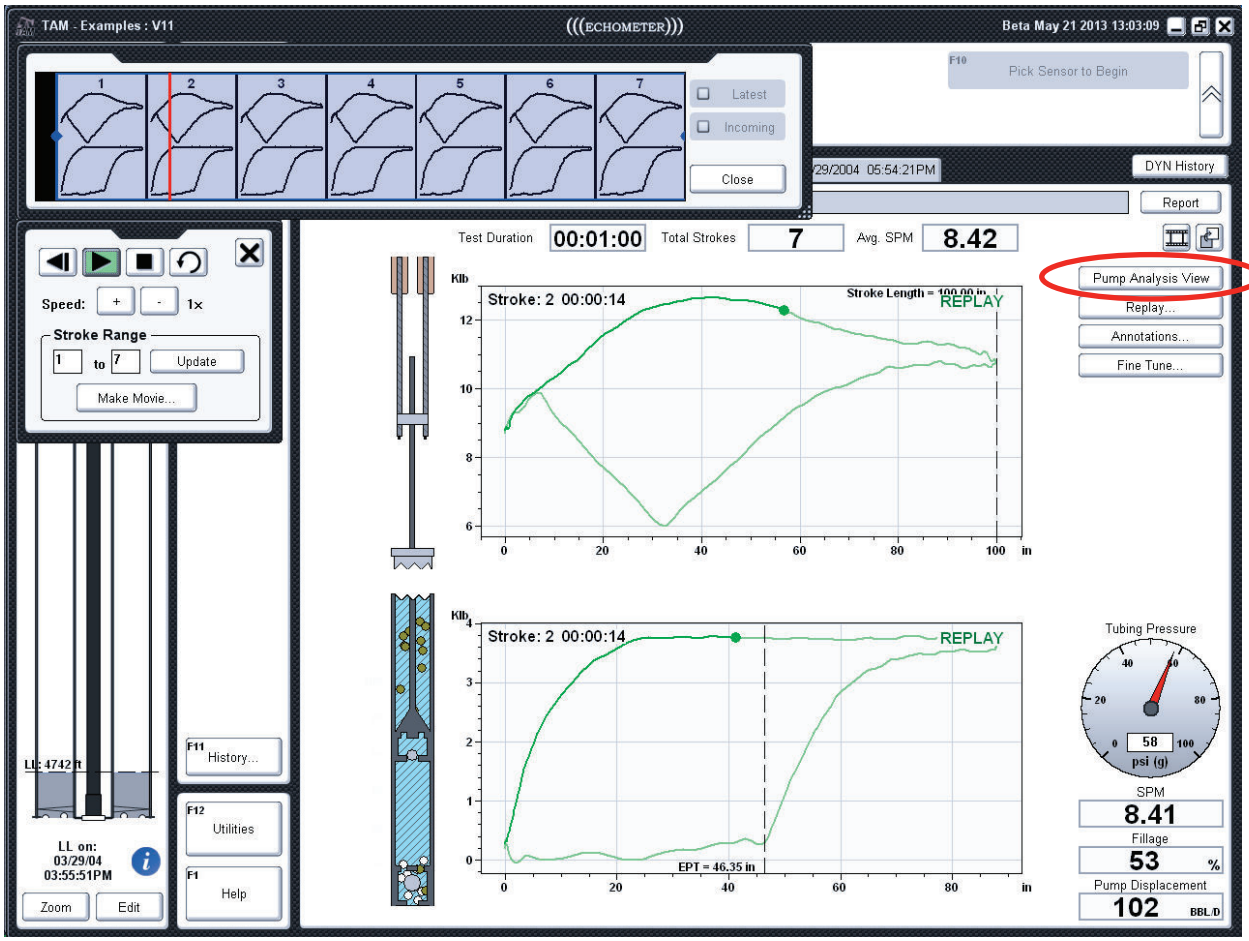


Figure 8: Dynamometer Replay Controls

Selecting a Stroke Range

In addition to manually entering a range in the textboxes of the replay dialog, the user can also specify a range in the stroke viewer above the replay dialog, as seen in Figure 9. On the stroke viewer, a transparent blue area will appear indicating the selected stroke range. The ends of this box can be clicked and dragged to specify a new range.

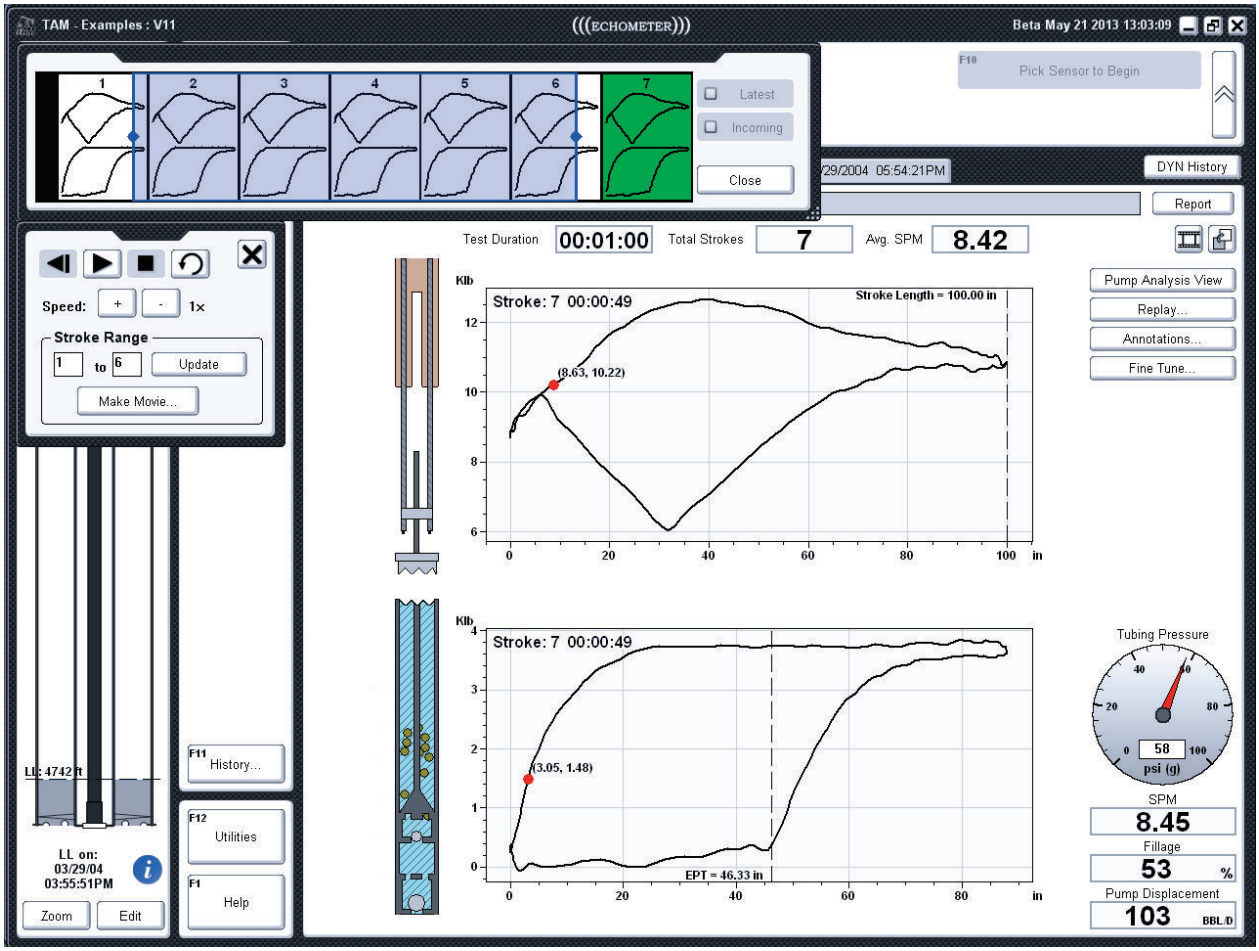


Figure 9: Selecting Range in the stroke viewer alongside replay.

Making a Movie

Another tool provided by the replay control is the ability to save a movie file of stroke playback. Simply click ***"Make Movie"*** and a save dialog will appear, allowing the user to specify a save location of the movie file (Figure 11). The movie will be generated using the stroke range and speed settings specified in the replay dialog. Movie generation occurs in the background of the application, so the user can still work in TAM while a movie file is being created.

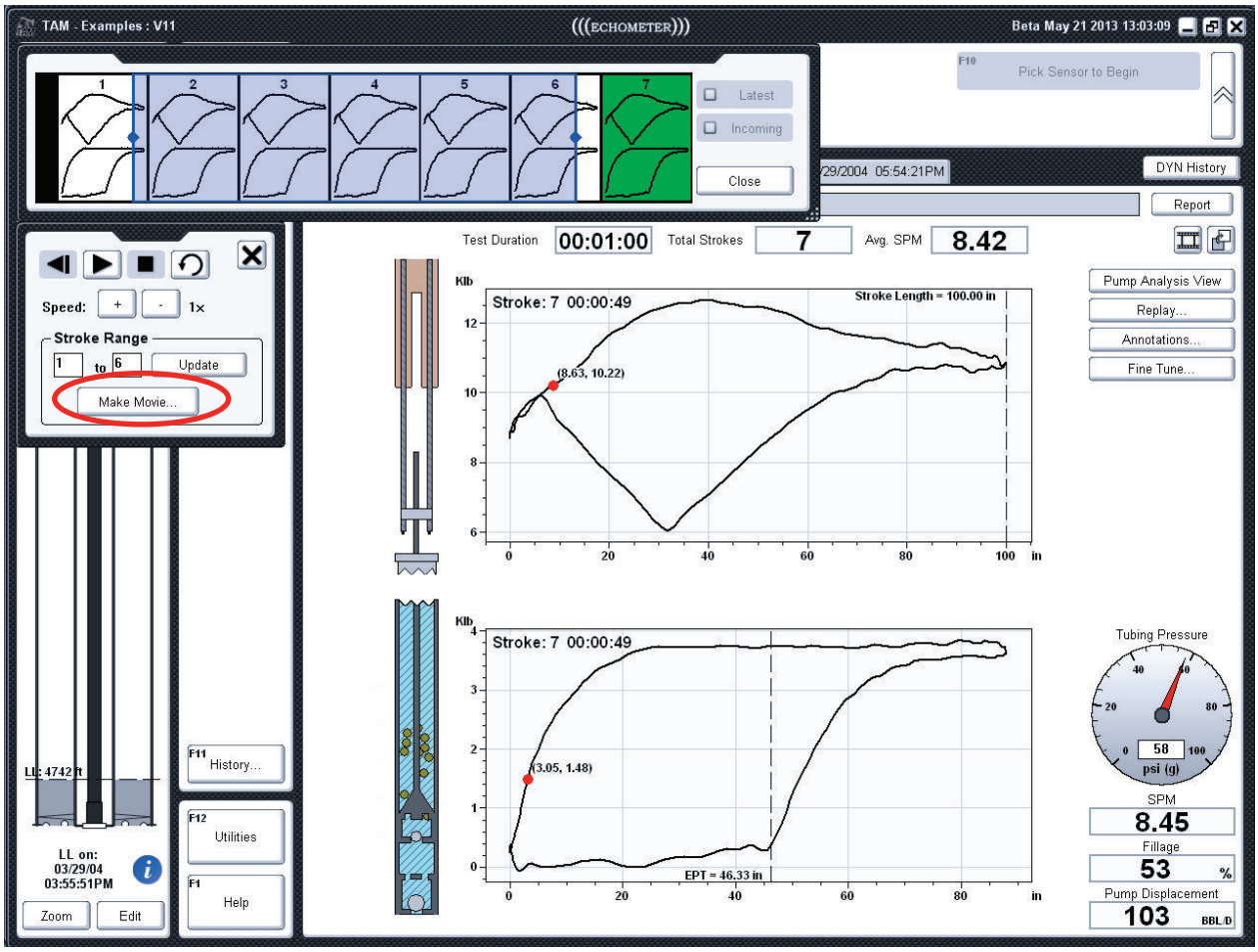


Figure 10: Make Movie Tool

After the user selects the destination of the movie file (Figure 11) the progress of movie generation is displayed on the screen as a sequence of information screens as shown in Figure 12 through Figure 14. Once the movie has been generated the file can be located ***(Show Movie in Folder***) or attached to an E-mail message (***E-Mail***) or the movie can be replayed (***Play Movie***).

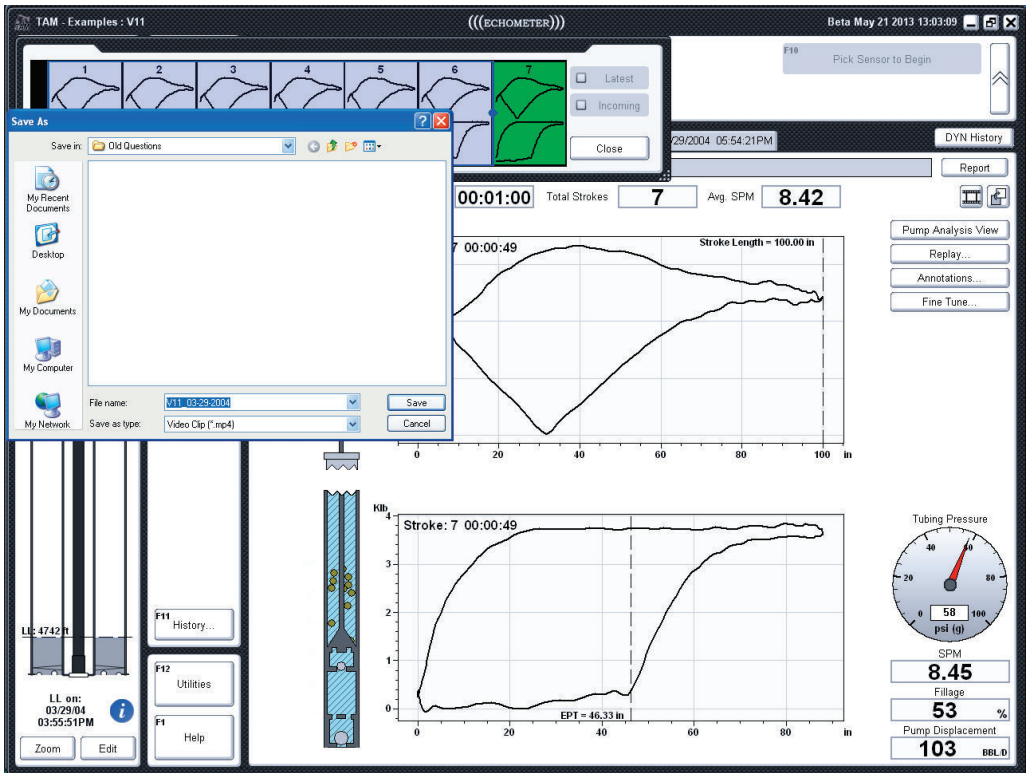


Figure 11: Save Movie Dialog

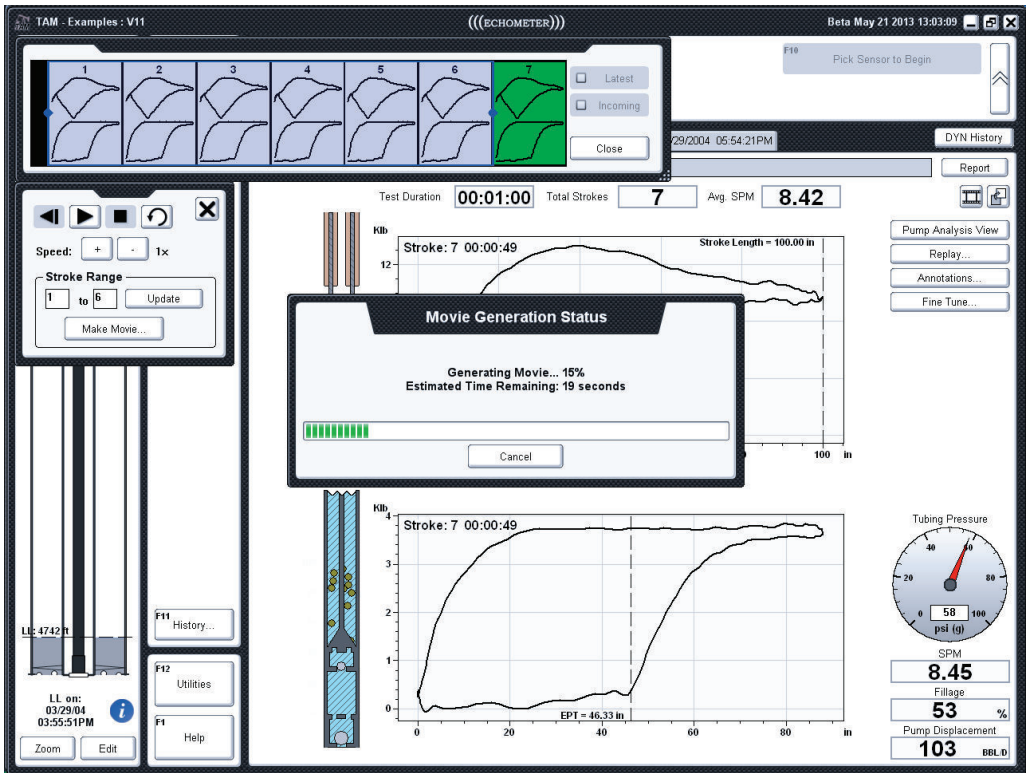


Figure 12: Movie Generation Progress

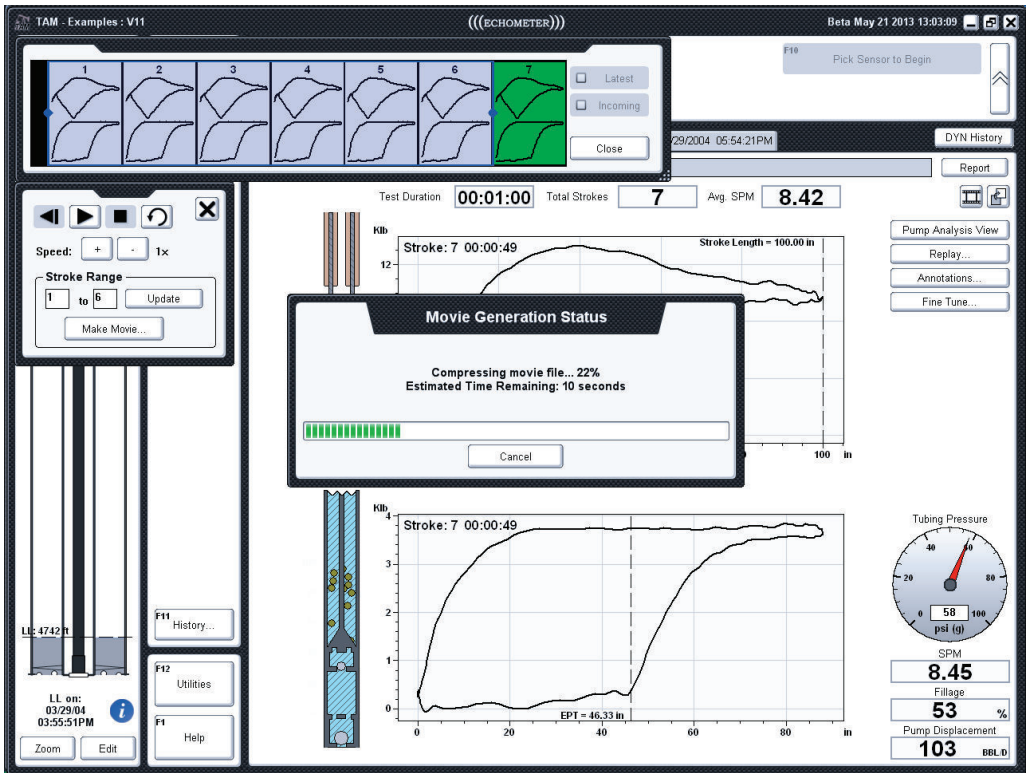


Figure 13: Movie File Compression

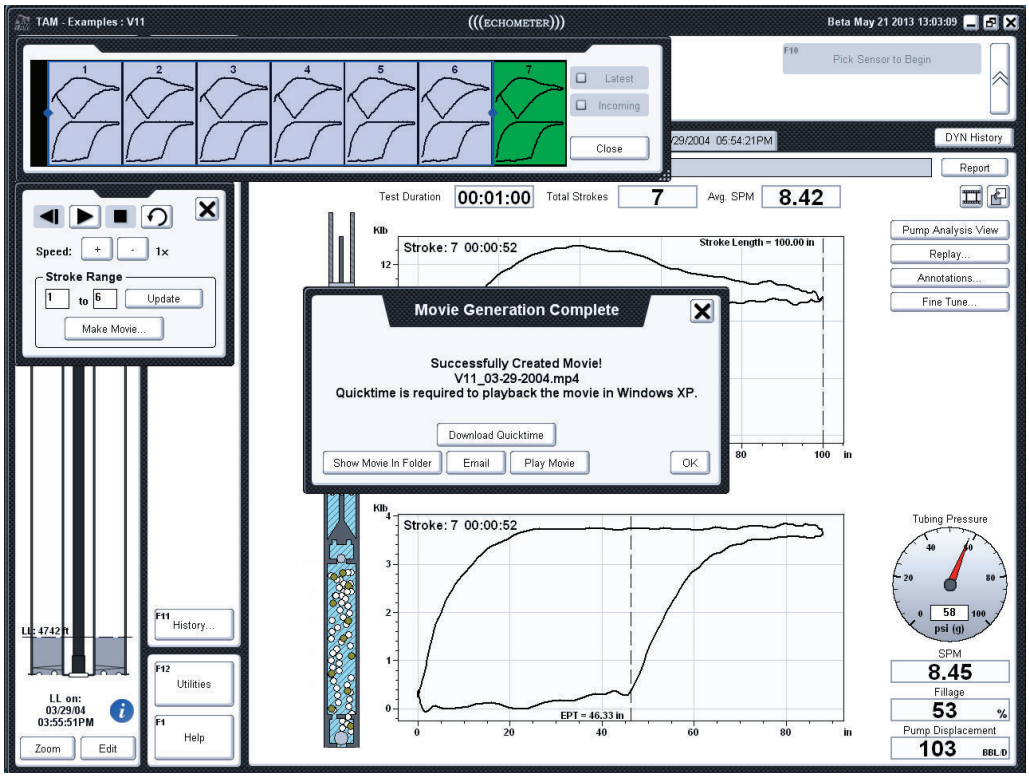


Figure 14: Completion Dialog and Options

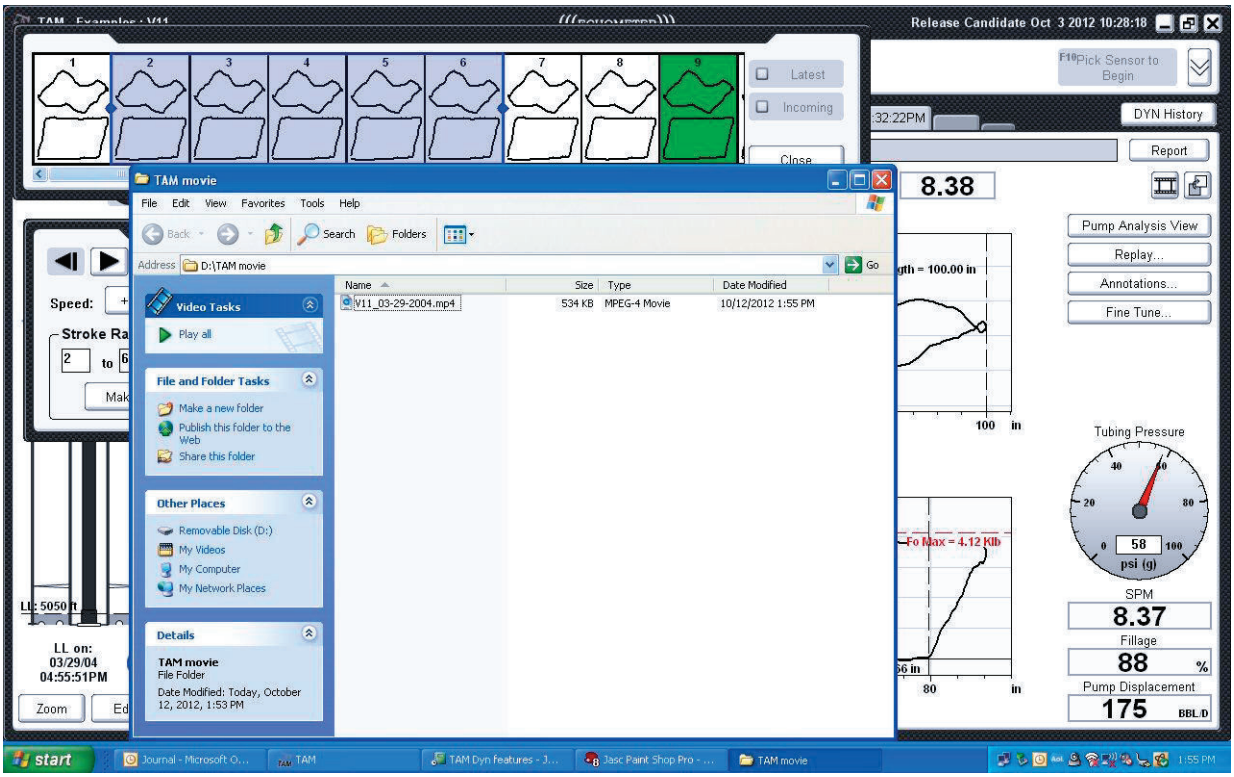


Figure 15: Movie File Properties and Location

IV. Dynamometer Annotations

The Dynamometer Analysis screen provides a set of annotations that can be turned on and off depending on the level of detail the user is interested in seeing. Most of these annotations appear as cursors or reference lines on the plots of particular views. To turn annotations on or off, simply click the ***"Annotations"*** button on the card or pump analysis view (Figure 16). Table I shows a brief overview of what each option in the annotations dialog does, as well as the Dynamometer views that are affected by it.

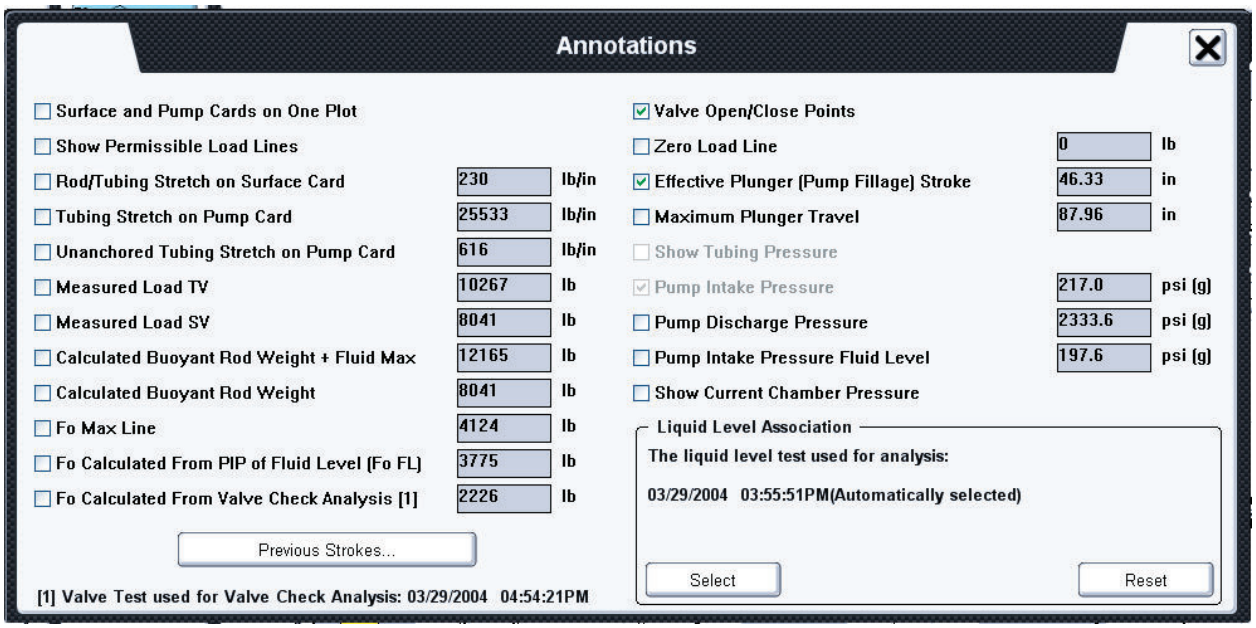


Figure 16: Annotations Dialog

Label	View(s) Affected	Description
Surface and Pump Cards on One Plot	Card	Displays card on a single, continuous plot instead of two
Show Permissible Load Lines	Card	Displays the Permissible Load Lines if they were able to be calculated.
Rod/Tubing Stretch on Surface Card	Card	Displays the Kr line on the surface card plot
Tubing Stretch on Pump Card	Card, Pump	Displays the Kt line on the pump card plot
Measured Load TV	Card	Displays the measured TV load on the surface card plot (if valve test performed)

Measured Load SV	Card	Displays the measured SV load on the surface card plot (if valve test performed)
Calculated Buoyant Rod Weight + Fluid Max	Card	Displays the Wrf + FoMax load value on the surface card plot
Calculated Buoyant Rod Weight	Card	Displays the Wrf load value on the surface card plot
Fo Max Line	Card	Displays the FoMax load value on the pump card
Fo Calculated From PIP of Fluid Level Analysis	Card	Fo computed from pump intake pressure found during a recent fluid level test
Fo Calculated From Valve Check Analysis	Card	Fo computed from the difference in measured TV and SV loads (if valve test performed)
Valve Open/Close Points	Card, Pump Analysis	Displays the TV and SV opening and closing points used for the pump animation
Zero Axis	Card	Displays a solid line at zero load of the pump card
Effective Plunger (Pump Fillage) Stroke	Card	Displays the EPT cursor at fillage position on the pump card
Maximum Plunger Travel	Card	Displays the MPT cursor at the max position of the pump card
Show Pressure	Card	Displays acquired pressure vs. position overlay on the surface card
Pump Intake Pressure	Pump Analysis	Displays the PIP cursor on the pump card plot and PIP value shown at the bottom of the pump animation
Pump Discharge Pressure	Pump Analysis	Displays the discharge pressure cursor on the pump card and DP value shown at the top of the pump animation
Pump Intake Pressure Fluid Level	Pump Analysis	Displays the PIP FL cursor on the pump card plot and PIP FL value shown at the bottom of the pump animation
Show Current Chamber Pressure	Card, Pump Analysis	Displays the chamber pressure value next to the pump animation at a given point on the pump card

Table 1: List of annotations

Overlaying Strokes from Previous Tests

The user can click on the ***"Previous Strokes"*** button (Figure 17) to overlay on the dynamometer stroke that is currently being analyzed, one or more strokes from different dynamometer tests. This is similar to overlaying multiple strokes on top of another using the stroke viewer. Clicking the ***"Previous Strokes"*** button will bring up a dialog that is similar to the advanced search dialog. A user can choose to overlay the strokes from up to five different tests by clicking the checkbox next to each test they wish to overlay (see Figure 17).

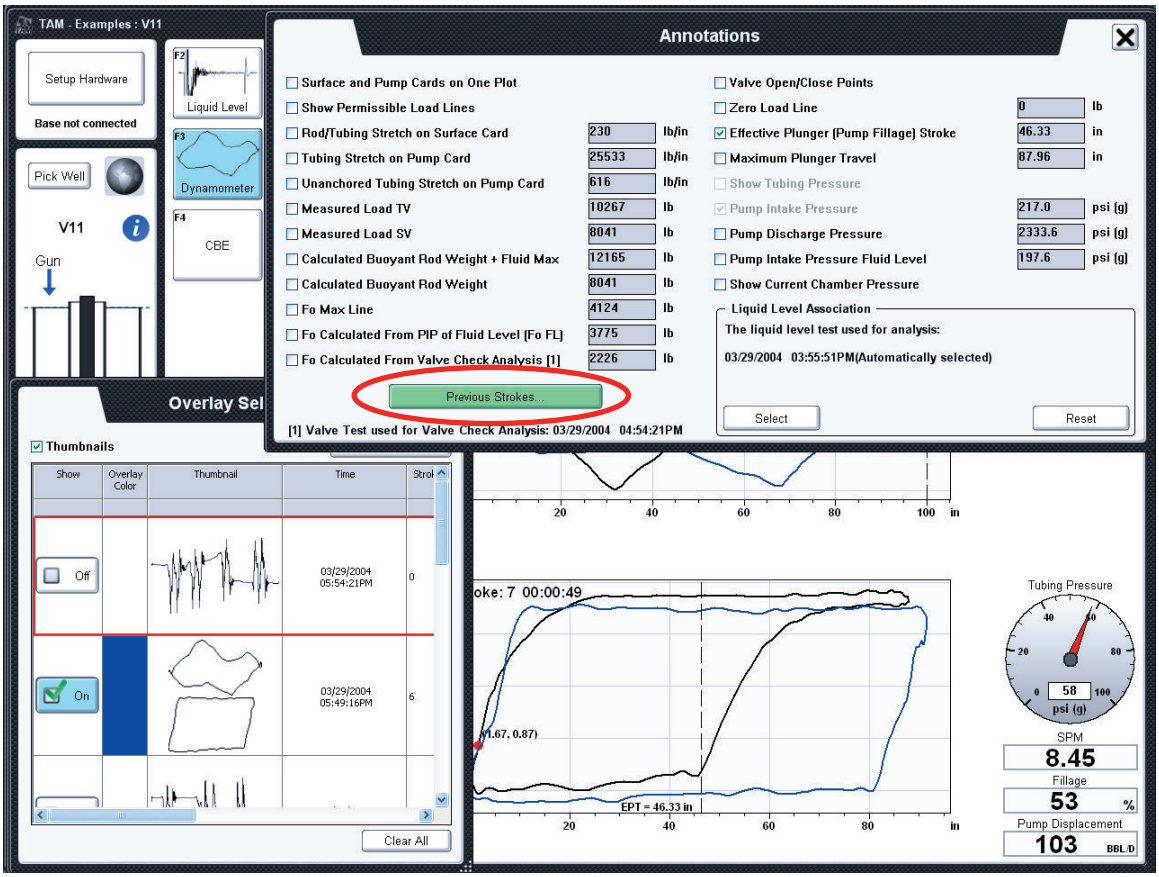


Figure 17: Control Button for Overlay of Strokes from Different Records

Note that the black dynamometer card corresponds to the stroke being analyzed and the blue card is the overlay card. The overlay card corresponds to the particular stroke in that record that was last analyzed by the user as shown in Figure 18. After selecting the strokes the selection window can be closed as shown in Figure 19.

Figure 18: Selection of Stroke for Overlay

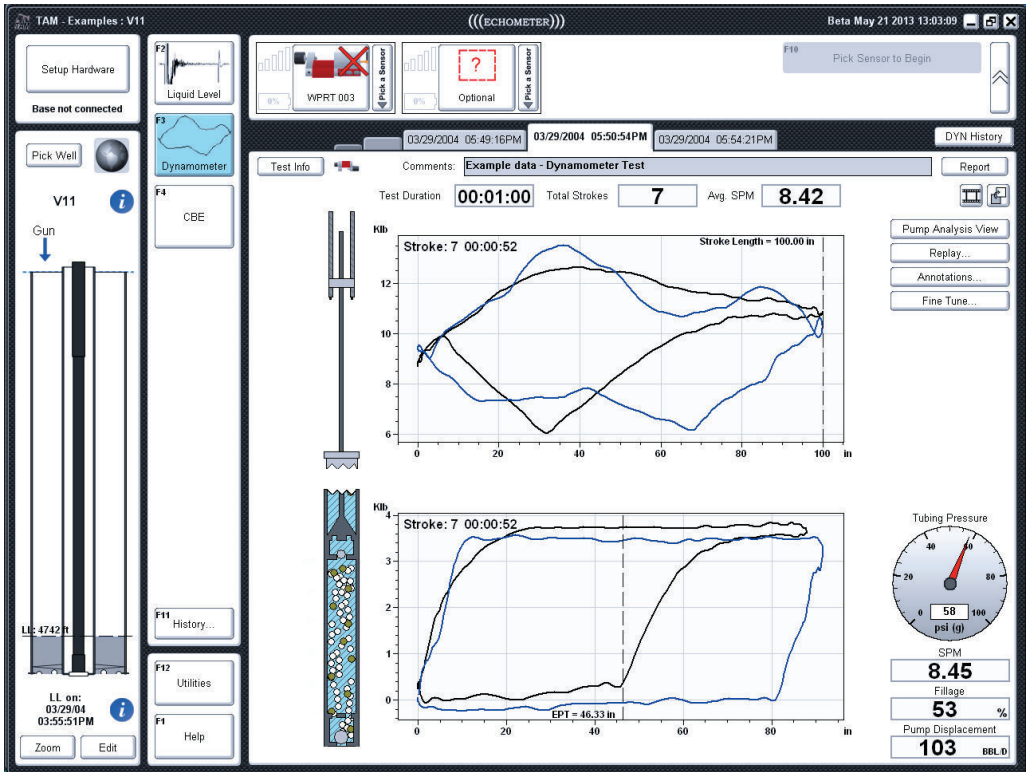


Figure 19: Overlaying strokes from other tests

V. Dynamometer Fine Tune

The Fine Tune dialog can be accessed through the ***Fine Tune*** button on the card or pump analysis view (Figure 20). Currently, this dialog only allows the user to modify the damping factor used for card calculation. The user can modify the damping factor used for card calculation, choose to de-ramp the cards, reset valve open/close points, or reprocess the entire test.

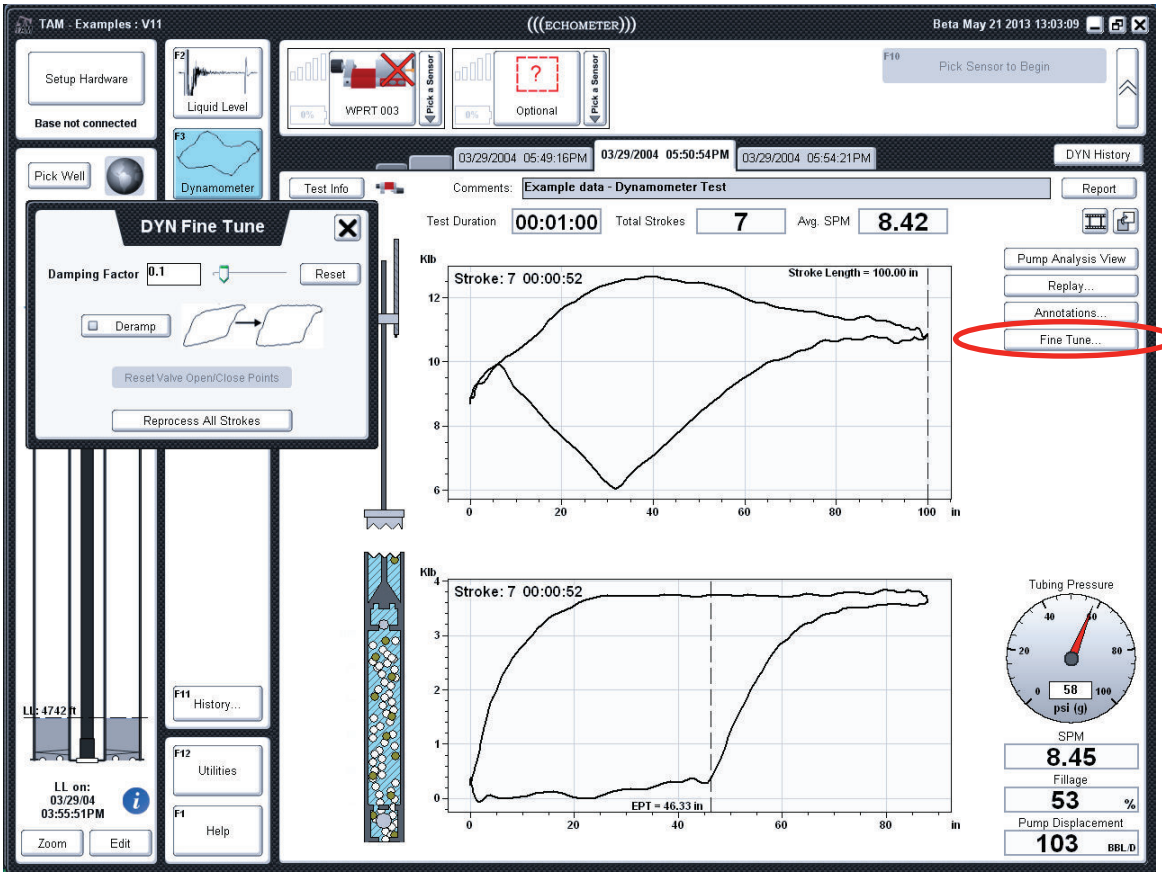


Figure 20: Dynamometer Fine Tune dialog

Damping Factor

The user can change the damping factor of the rod string. Doing so updates the calculation of the pump card. A new value can be entered or the slider control can be used to quickly view the change in the pump card characteristics as the damping factor is adjusted.

De-ramping

This tool is used to adjust the tilt of a dynamometer card acquired with a PRT on a well where the polished rod is bending due to misalignment of the pumping unit and the wellhead. The user can choose to de-ramp the pump card by clicking on the **Deramp** button. The software eliminates the tilt and redraws the card so that the load on the upstroke is mostly horizontal as shown in Figure 22.

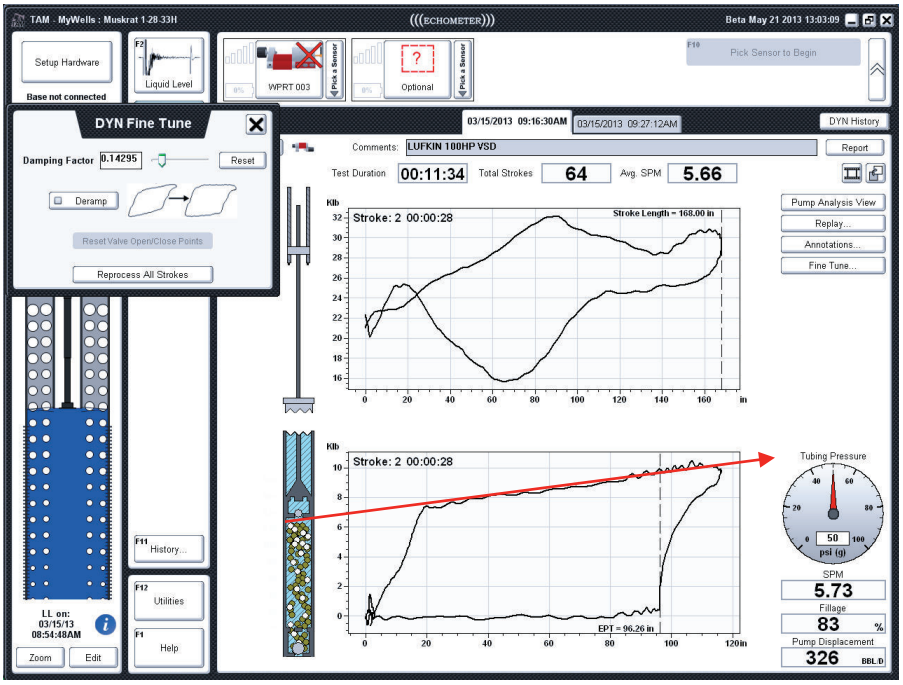


Figure 21: Pump card before deramping

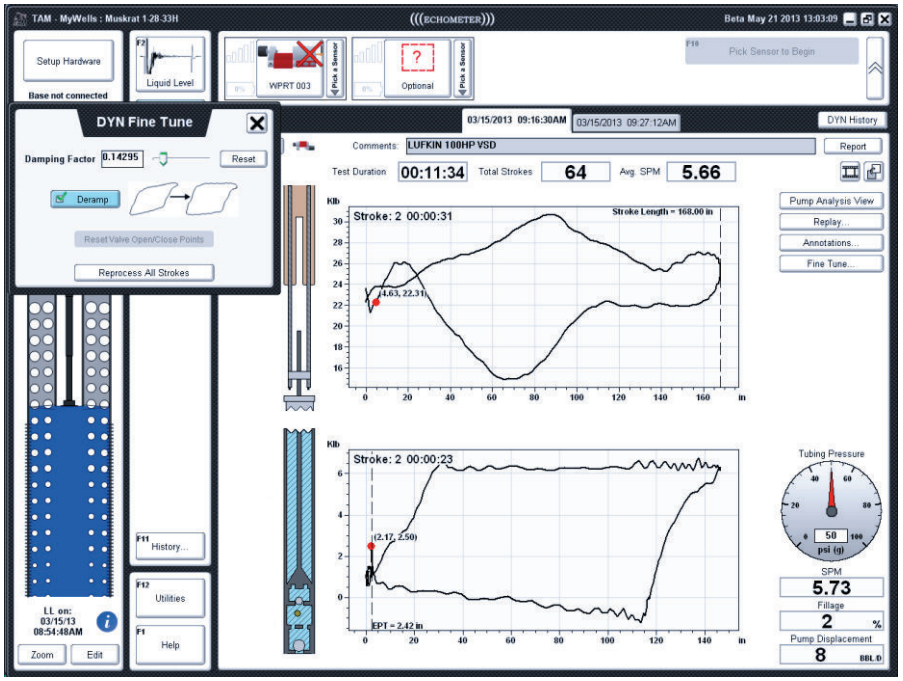


Figure 22: Pump card after deramping

Valve Open/Close Points

When the option to display the valve status annotation is active, the user can choose either to accept the program's choices or to manually move the points indicated on the pump card. The valve status points are moved by clicking and dragging them to the desired location. The fine tune screen provides a button to reset the positions to the automatically computed values.

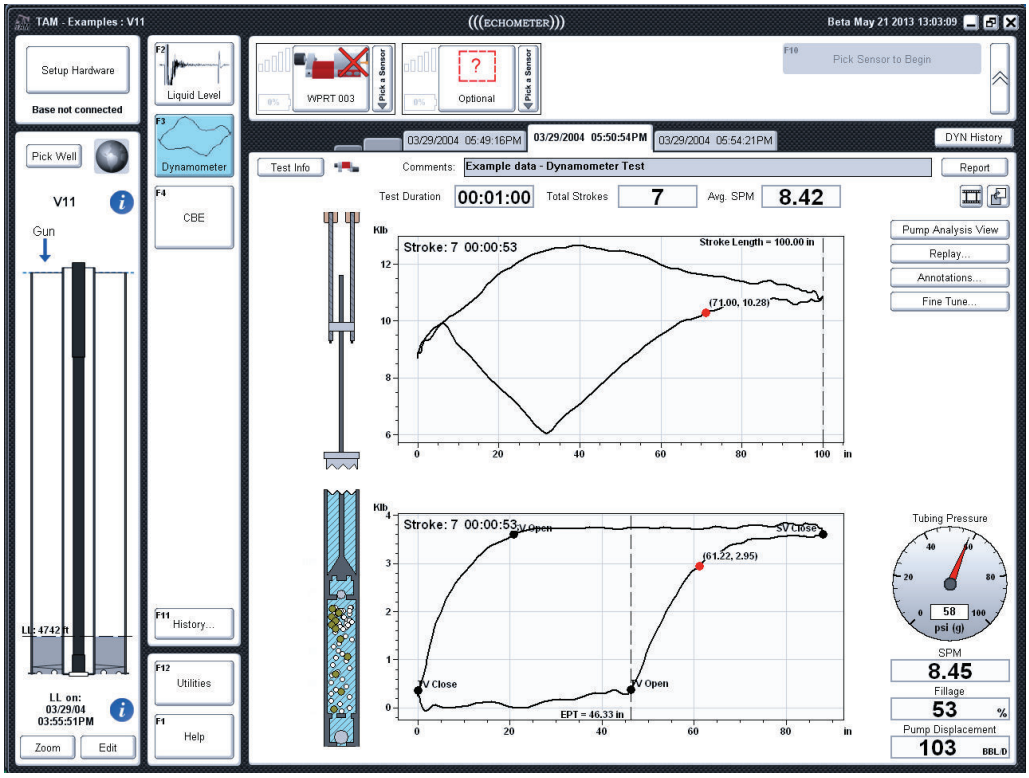


Figure 23: Moving TV Open valve point

Reprocessing

The user can completely reprocess a test after making adjustments or corrections. This recalculates where strokes and valve tests start and stop, and may result in detecting more strokes and valve tests. The drawback to this is that settings for the previous analysis, such as valve open/close points, selected strokes, and valve test results, are lost.

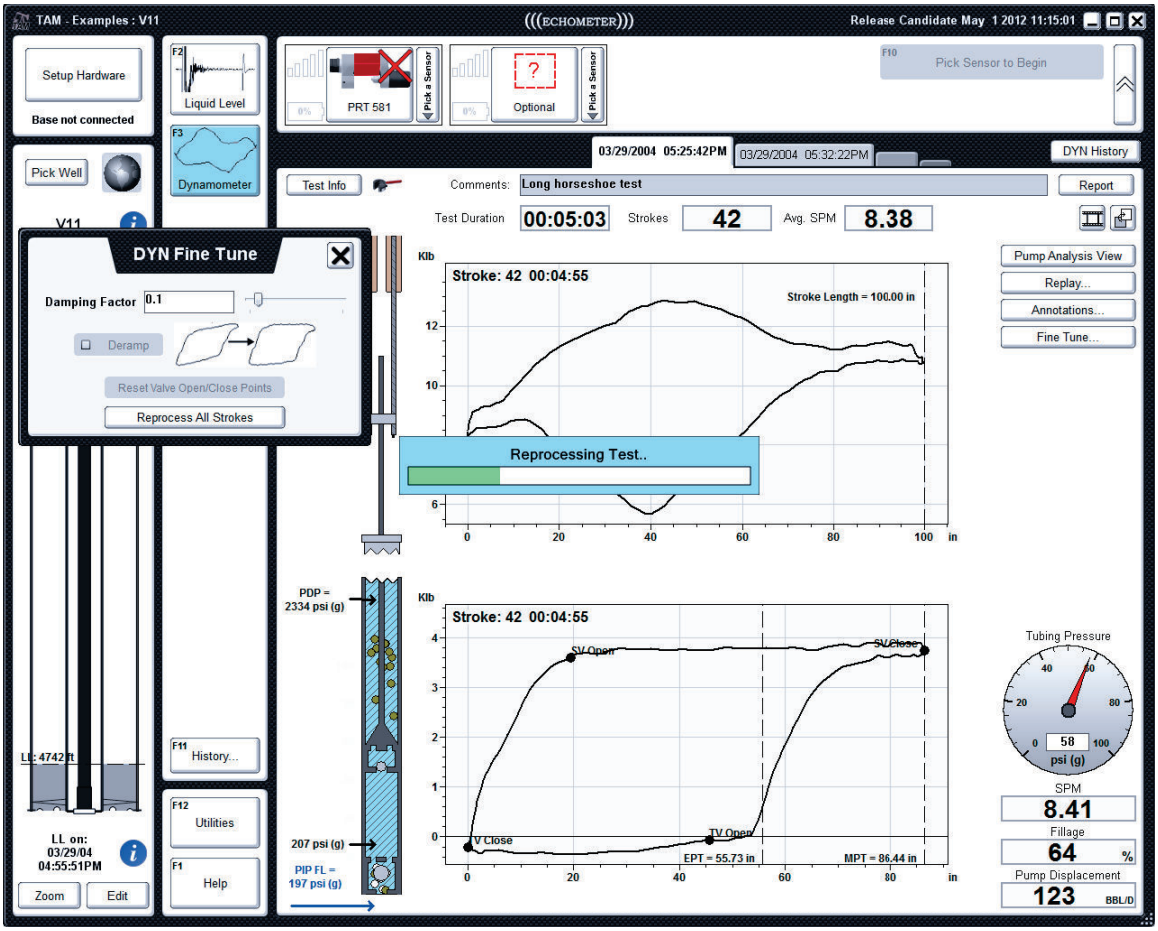


Figure 24: A test in the middle of reprocessing

VI. Dynamometer Plot Interaction

There are several useful tools for interaction with the data on the card view and pump analysis dynamometer screens.

Follow Dot

A red dot will follow the user's mouse cursor around as the curves of the card plots are traced (Figure 25). The cursor will display the current position and load value next to the red dot and will also update the pump animation and tubing pressure gauge (when tubing pressure is measured with the wireless pressure transducer). Right-clicking the dot and selecting the ***"Lock"*** option locks the dot in place and no longer follow the mouse cursor. Repeating the process and choosing ***"Unlock"*** will re-enable the dot's motion. At any point, the left and right arrow keys on the keyboard can be used to control the motion of the dot.

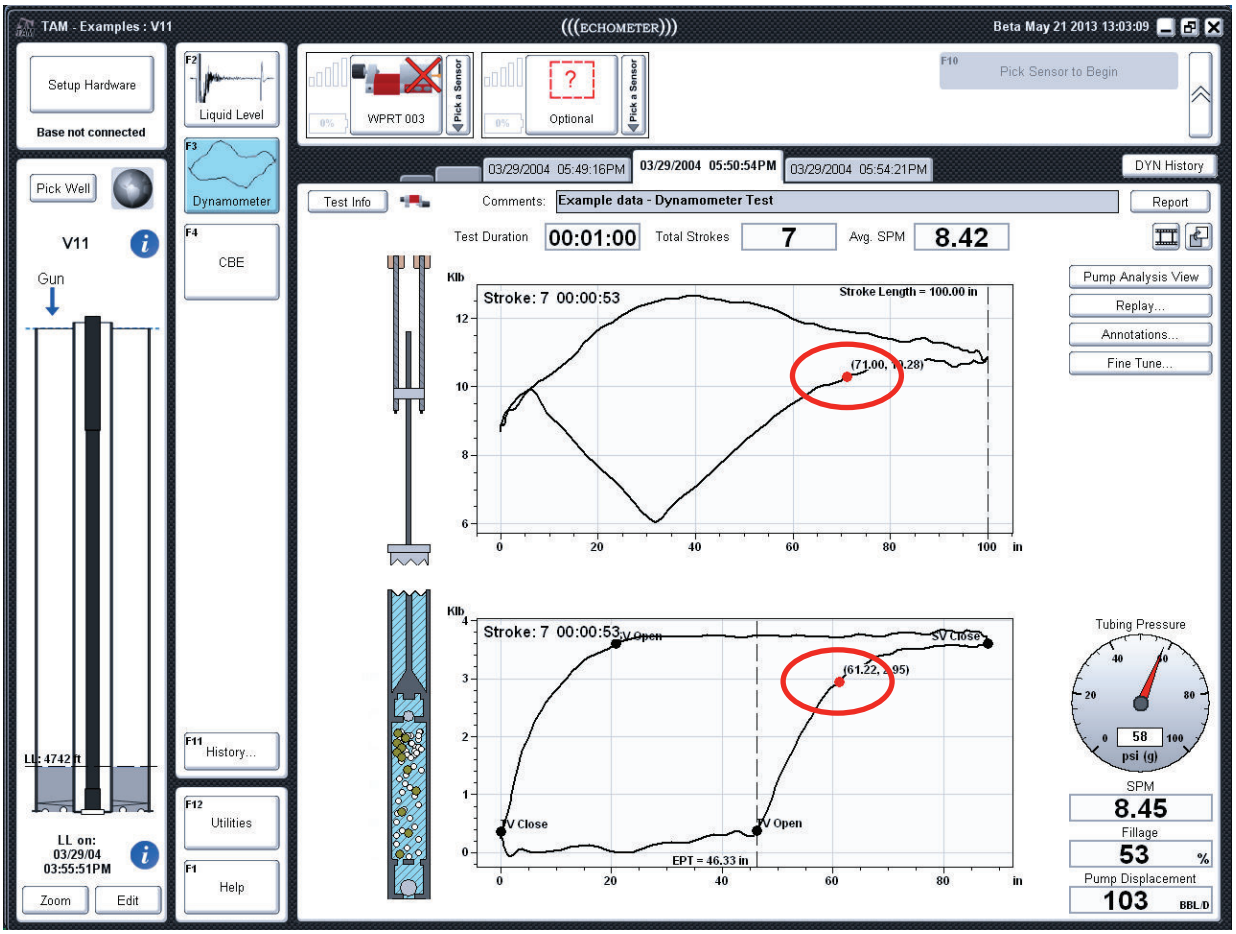


Figure 25: Follow cursor on Dynamometer card plots

Right Click Menu

Additional plot options can be accessed by right-clicking inside the plot area. This brings up the popup menu seen in Figure 26 with the following options:

- *Print Image*: sends an image of the plot to the printer
- *Copy Image to Clipboard*: copies the plot image to the system clipboard
- *Copy Data to Clipboard*: copies the position, load, and pressure (if acquired) values of the selected strokes to the system clipboard
- *Export Data to File*: saves the position, load, and pressure values of the selected strokes to a text file (which can be loaded into spreadsheet programs like Excel)
- *Export Stroke to DYN*: saves the stroke load data, CBE information, valve loads, calculated stroke information, and information about the well and sensors used to record the data to an industry standard .DYN file.
- *Add Note*: add a note/annotation to the plot (see ***"Plot Notes"*** section in ***"TAM Features"*** document)

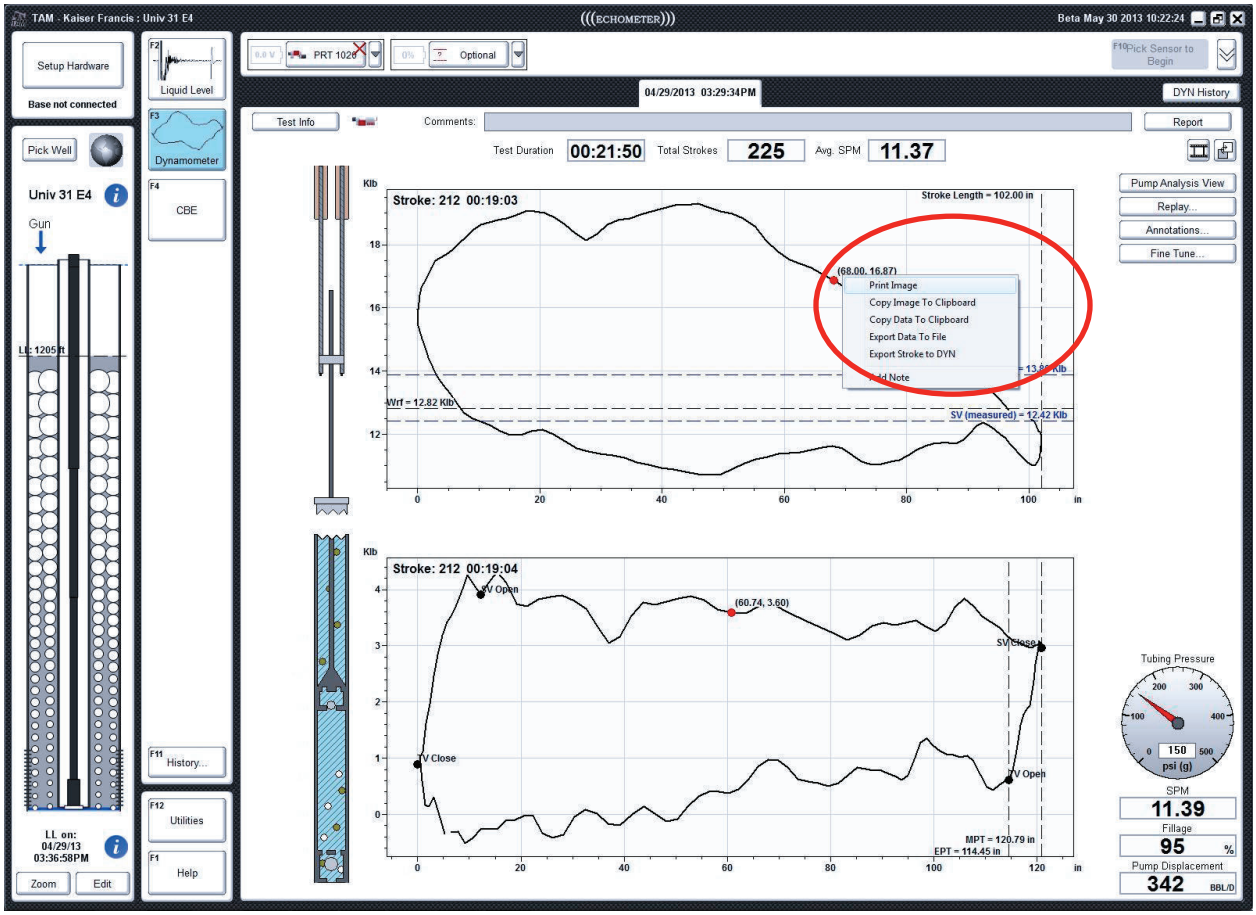


Figure 26: Dynamometer plots right click menu

VII. Manual Valve Test Analysis

This option is useful when Automatic Valve Test Detection interrupts the real time display of surface and pump cards and the display reverts to showing load and acceleration vs. time as if a valve test were in progress although the pumping unit is stroking the polished rod. Typically this may happen when the pumping system is operating at pumping speeds slower than 2 strokes per minute. In order to take advantage of this feature, Automatic Valve Detection must be turned off on the Lift System tab of the Edit Well Dialog (Figure 27).

When this mode is implemented the valve test is performed stopping the polished rod at the usual position but the program does not display the valve test analysis screen. After acquisition of the dynamometer data is completed, the user selects the portion of the record that corresponds to the valve test section and directs the program to perform the Custom Valve analysis as shown in the next section.

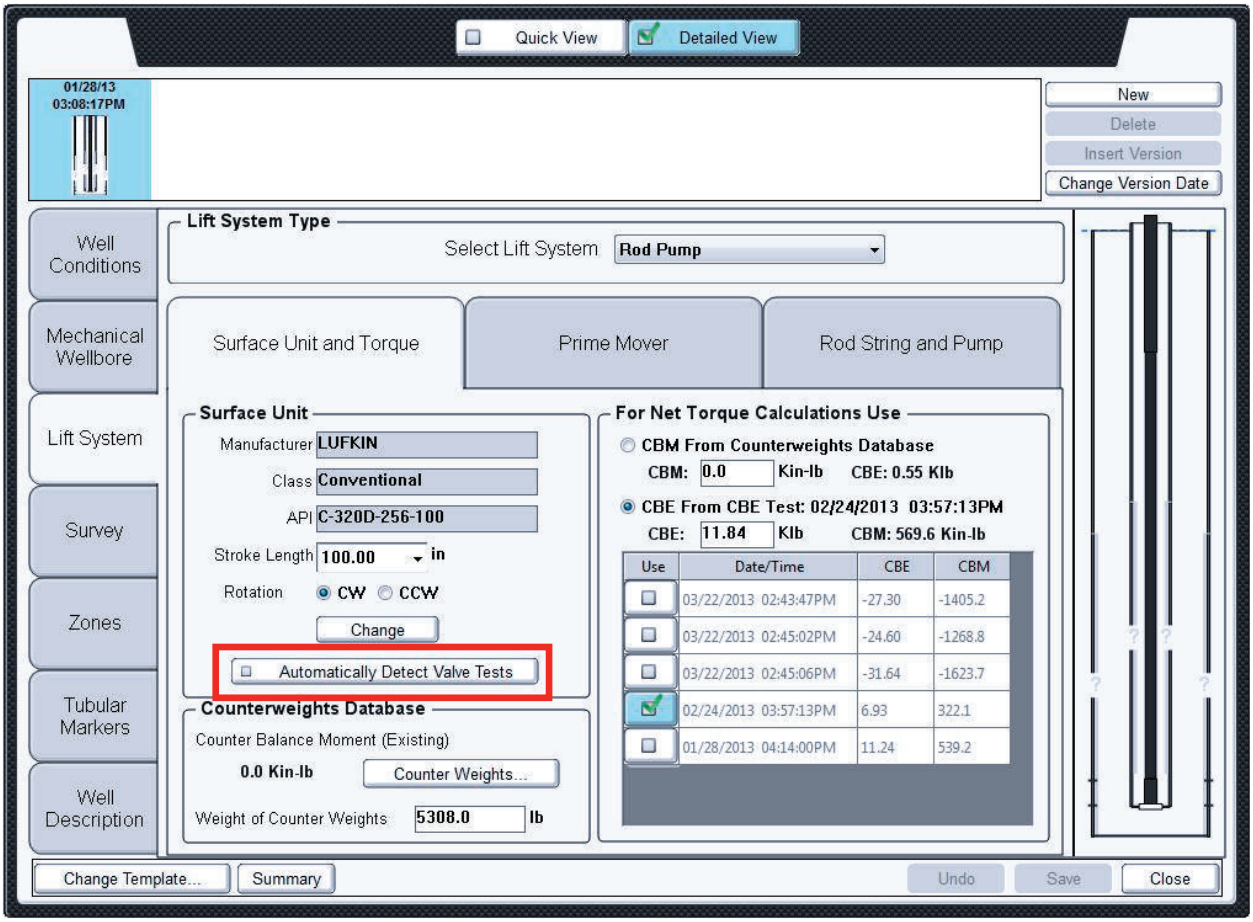


Figure 27: Automatic Valve Test Detection Option

Custom Valve Test Analysis Cursor

The Custom Valve Test Analysis Cursor is used to define and edit a Custom Valve Test Analysis. The cursor can be accessed on the Raw Data view and on the Stroke Selection Strip.

Figure 28: Automatic Valve Test Analysis Cursor on the Raw Data View

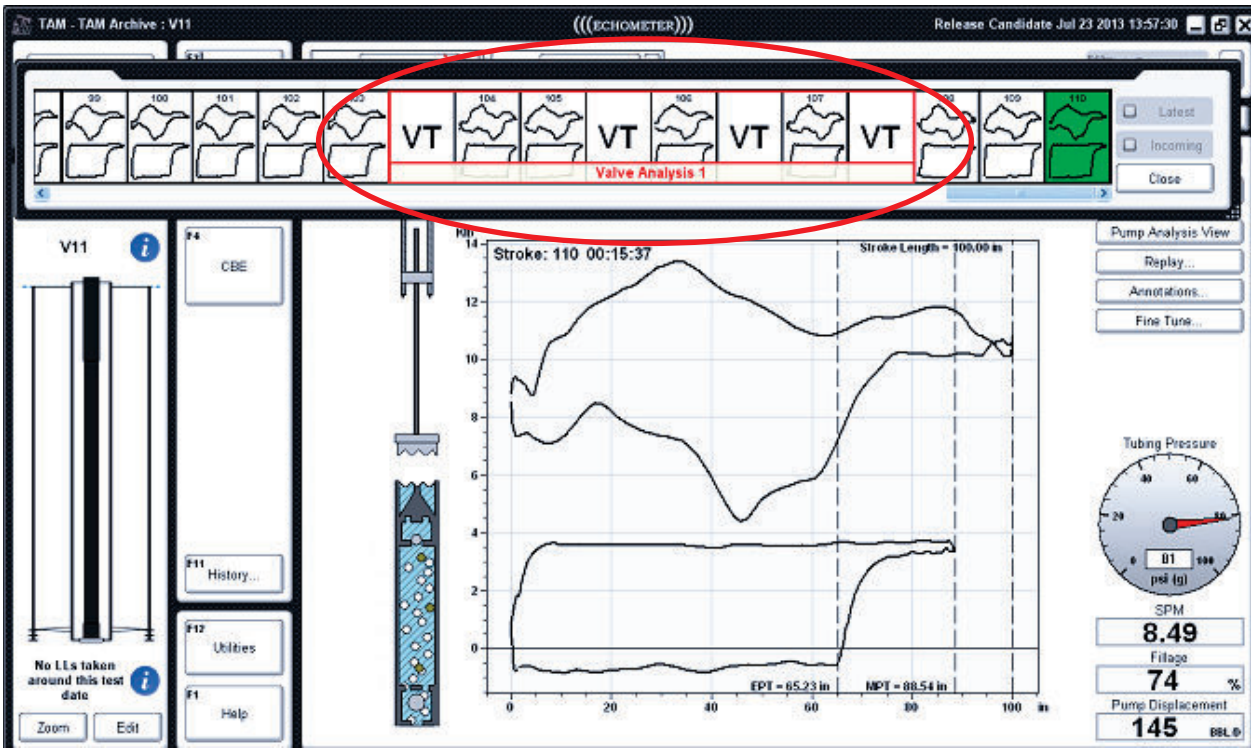


Figure 29: Automatic Valve Test Analysis Cursor on the Event Manager

The Cursors can be created by right-clicking on either the top graph of the Raw Data view or on a stroke or selection of strokes from the Stroke Selection Strip and selecting “Add Valve Analysis.” Both cursors can be adjusted by clicking and dragging on the left and right edges of the cursor. The Raw Data view cursor can be dragged by clicking on the yellow tinted label of the cursor and dragging. Both cursors can be deleted by right clicking on the cursor and selecting the “Delete Valve Analysis” option. The Custom Valve Analysis can be examined in more detail by double clicking on the label of either cursor (Figure 28 and 29).

CBE Analysis Features in TAM

Table of Contents:

I. CBE Analysis Window

For analysis and review of CBE records, TAM provides three different plots that can be viewed: Load, Acceleration, and Position. The Load plot is always visible. On this screen, the user can choose to view time in either seconds or minutes and seconds.

Load Plot

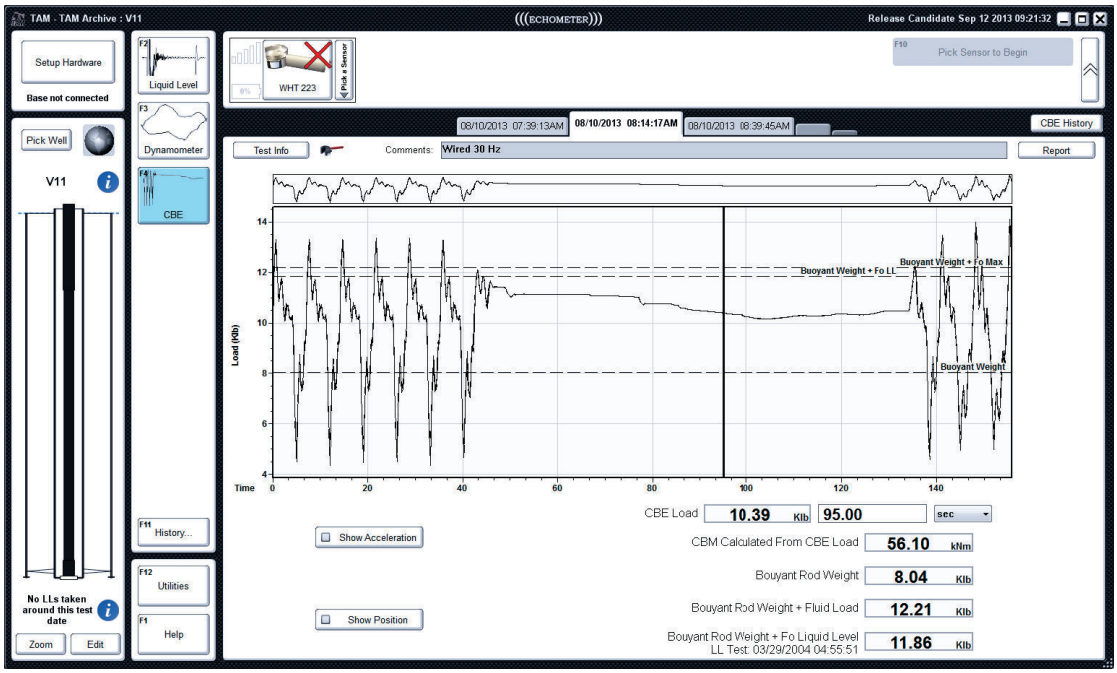


Figure 1: CBE Analysis Window displaying only Load

CBE Load Cursor

The CBE load cursor is the vertical black line on the plot. This cursor selects the desired load to be used for the CBE Test. The cursor can be clicked and dragged with the mouse, or a time can be entered in the box to the left of the time format selection.

II. Plot Selection

The Acceleration and Position plots that can be toggled on and off using the buttons shown in Figure 2.

Load and Acceleration Plots

When the Acceleration plot is turned on, it appears in green and the load plot appears in black.

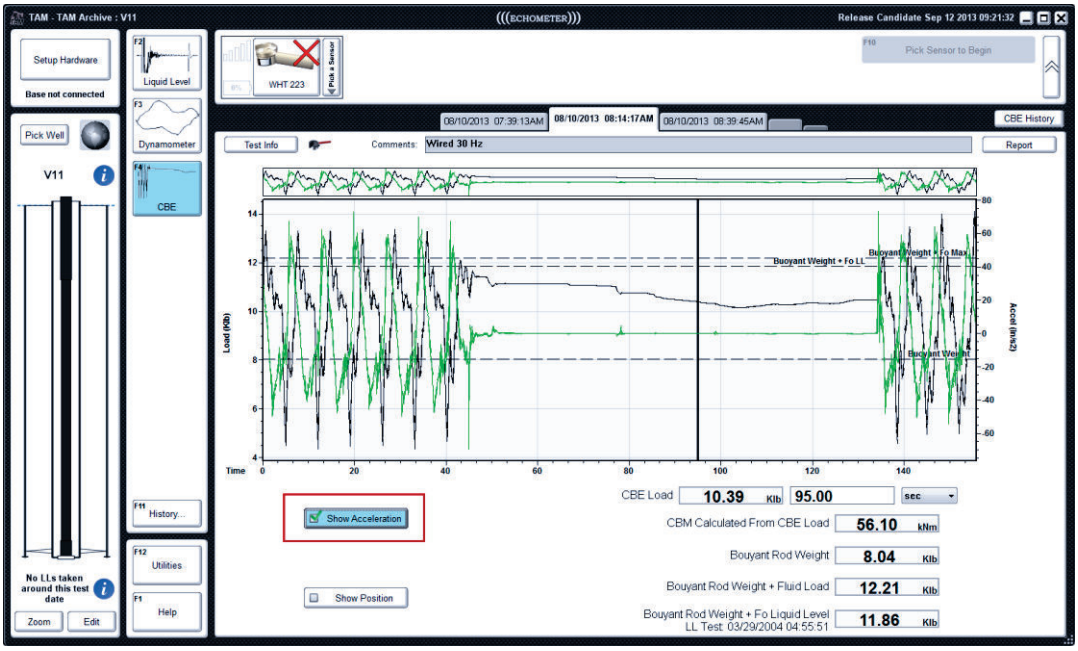


Figure 2: CBE Analysis Window displaying Load and Acceleration

Load and Position Plots

When the Position plot is turned on, it appears in blue and the load plot appears in black.

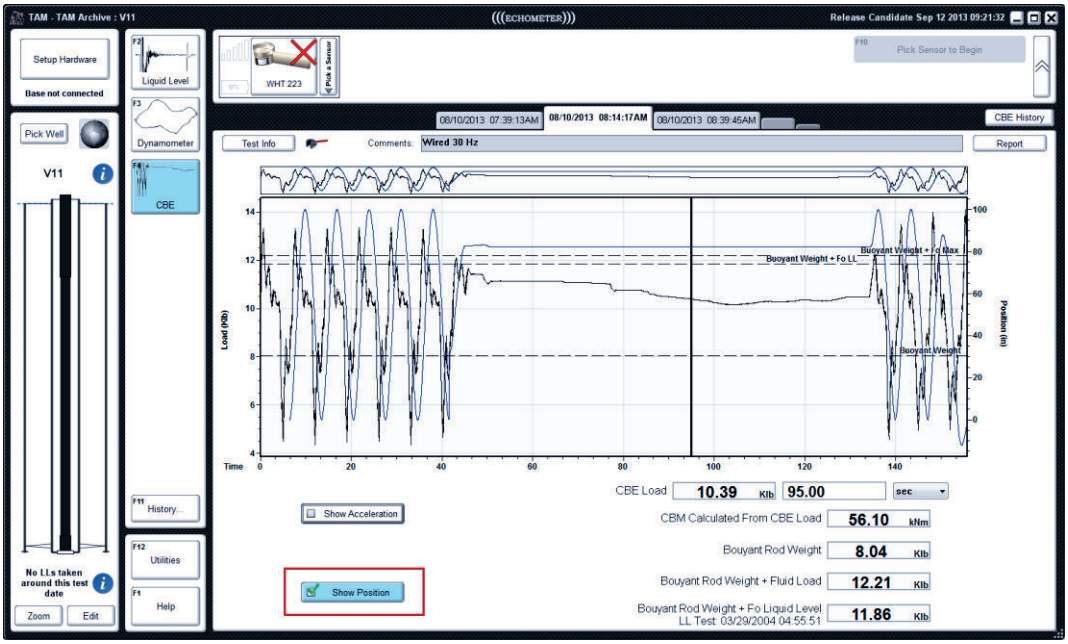


Figure 3: CBE Analysis Window displaying Load and Position

Load, Position and Acceleration Plots

All three plots can be toggled on at one time to produce the plot below; acceleration appears in green, position in blue, and load in black.

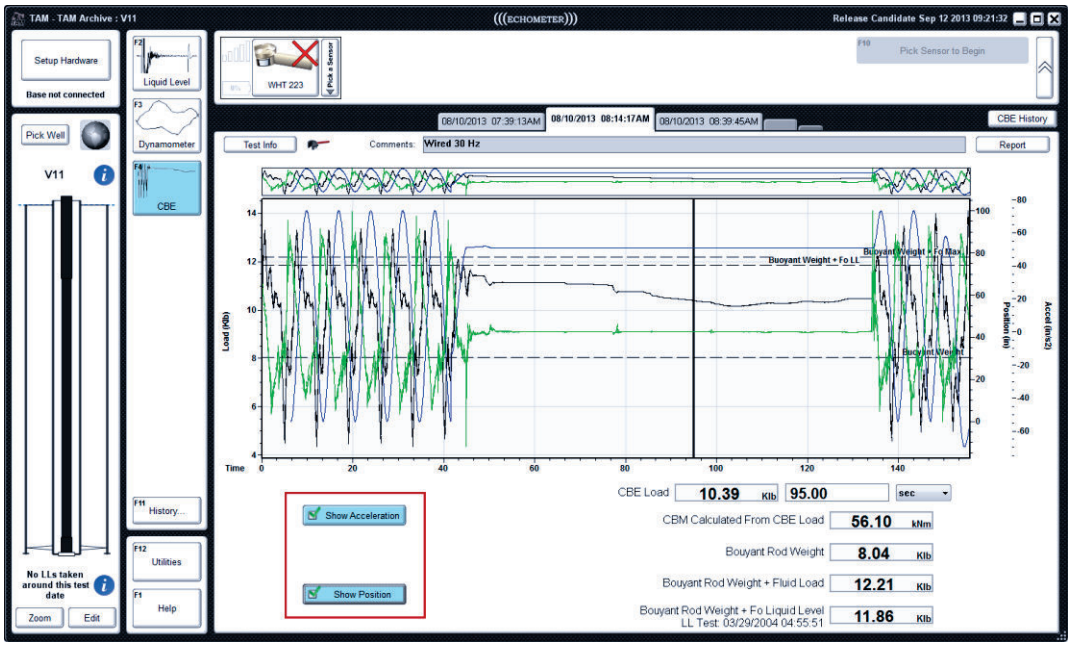


Figure 4: CBE Analysis Window displaying Load, Acceleration and Position

Right Click Menu

Additional plot options can be accessed by right-clicking inside the plot area. This brings up the popup menu seen in Figure 5 with the following options:

- *Print Image*: sends an image of the plot to the printer
- *Copy Image to Clipboard*: copies the plot image to the system clipboard
- *Copy Data to Clipboard*: copies the position, load, and pressure (if acquired) values of the selected strokes to the system clipboard
- *Export Data to File*: saves the position, load, and pressure values of the selected strokes to a text file (which can be loaded into spreadsheet programs like Excel)
- *Add Load Note*: add a note/annotation to the Load plot (see ***"Plot Notes***" section in ***"TAM Features"*** document)
- *Add Acceleration Note*: add a note/annotation to the Acceleration plot (see ***"Plot Notes***" section in ***"TAM Features"*** document)
- *Add Position Note*: add a note/annotation to the Position plot (see ***"Plot Notes***" section in ***"TAM Features"*** document)

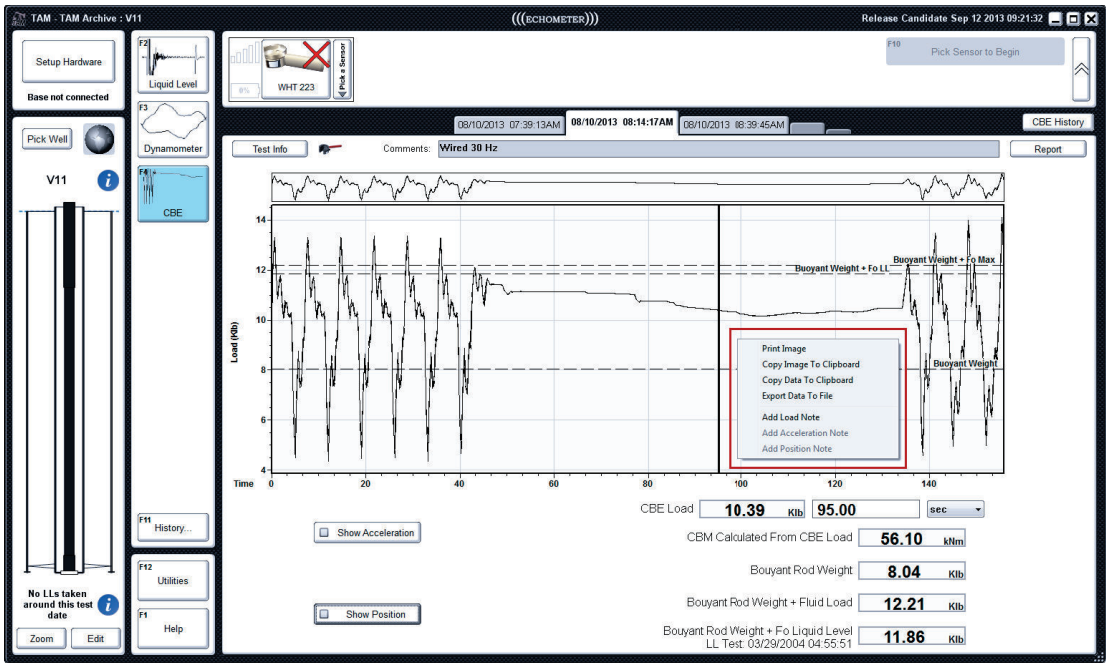


Figure 5: CBE plots right click menu

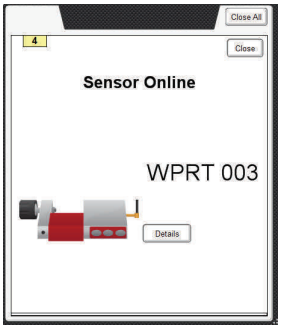
Wireless Sensor Setup

1 Connect Base Station

Connect wireless base to computer with USB cable

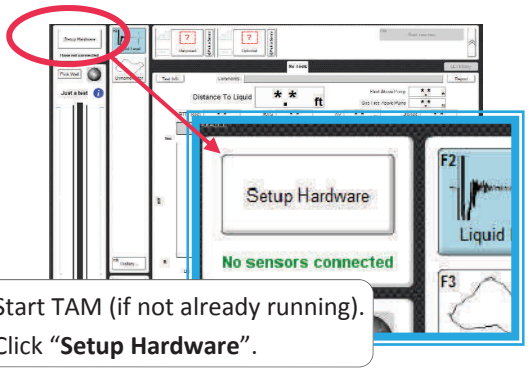
2 Turn on Sensor

Turn on wireless sensor

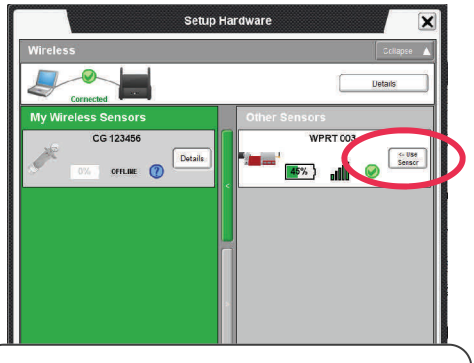


Popup briefly appears

3 Add Sensor to My Sensors

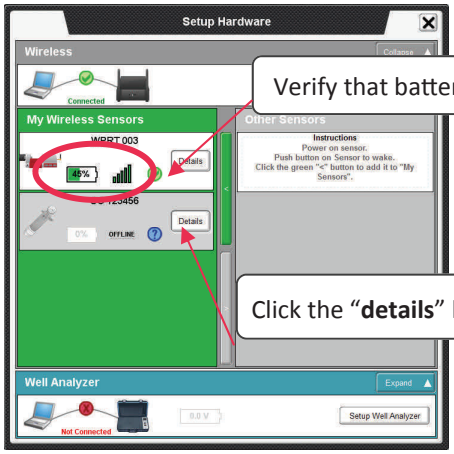


Start TAM (if not already running). Click "**Setup Hardware**".



Add the sensor to My Sensors by clicking **"Use Sensor"** (if not already listed under "My Wireless Sensors")

4 Verify Battery & Signal

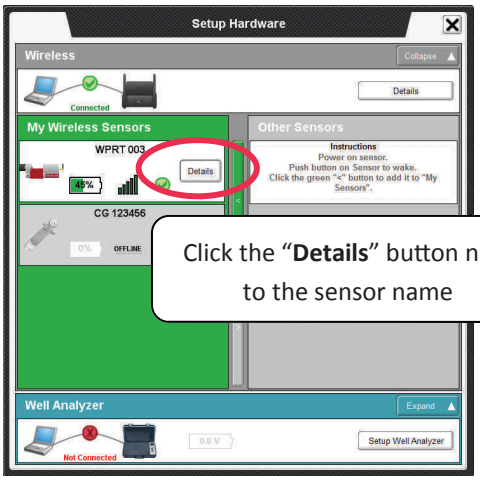


Verify that battery level and signal strength are good

Click the "**details**" button to proceed with sensor setup

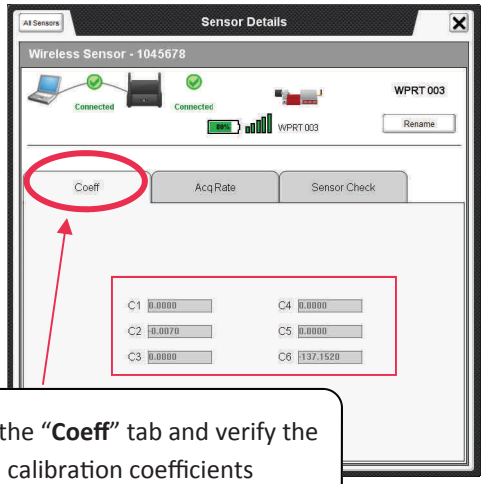
Wireless Sensor Setup

5 Open Detail Screen



Click the "**Details**" button next to the sensor name

6 Verify Coefficients

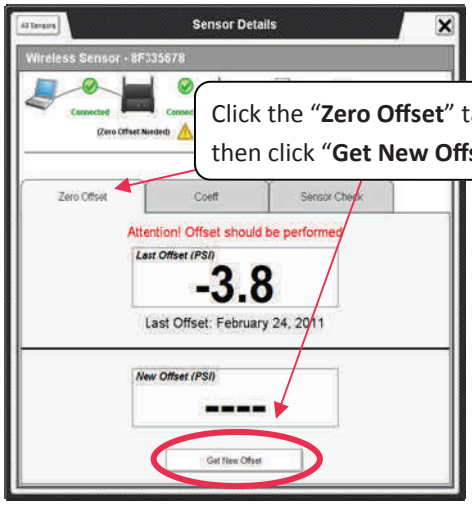


Click the "**Coeff**" tab and verify the calibration coefficients

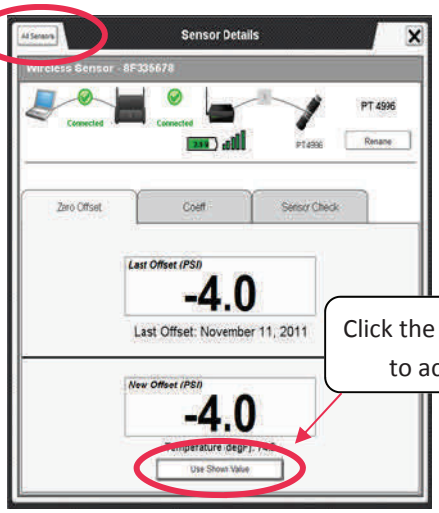
For WPRT's no additional setup is required. You may close the popup window and proceed with testing.

6 Zero Offset (WHT, WRFG, and WPT)

Verify that the **WHT** sensor is **not loaded** and that the pressure **is atmospheric** for **WPT and WRFG**



Click the "**Zero Offset**" tab, then click "**Get New Offset**"



Click the "**Use Shown Value**" to accept new offset

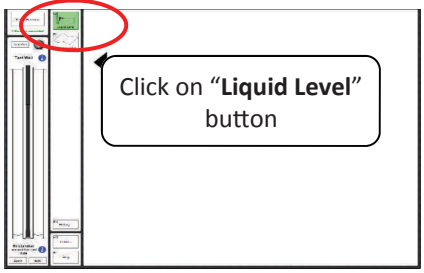
Click the "**All Sensors**" button to return to the main setup screen and configure other devices, or close the popup window to proceed with testing. Changes will save automatically.

Wireless Liquid Level Acquisition

1 Connect Well Analyzer

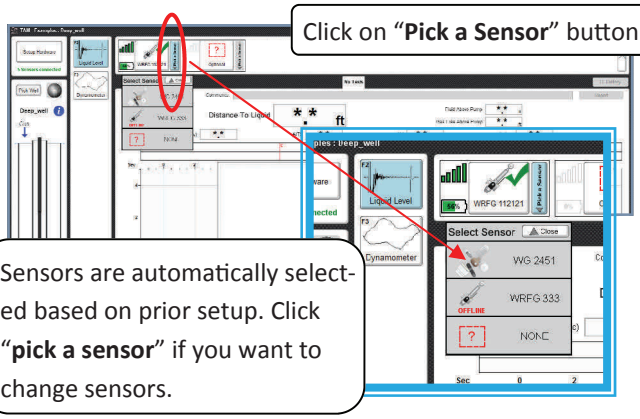
Click on "**Pick Well**" button

2 Select Liquid Level



Click on "**Liquid Level**" button

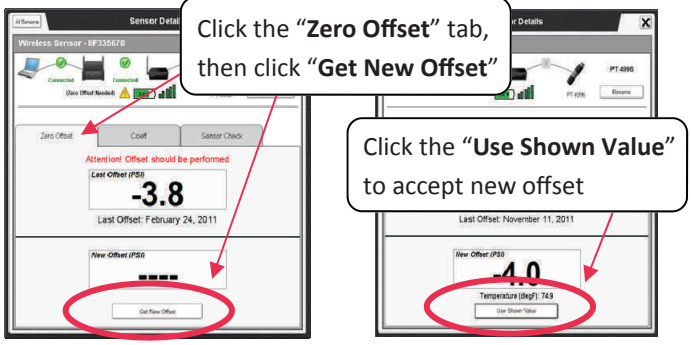
3 Pick Sensors



Click on "**Pick a Sensor**" button

Sensors are automatically selected based on prior setup. Click "**pick a sensor**" if you want to change sensors.

4 Zero the Pressure Sensor



Click the "**Zero Offset**" tab, then click "**Get New Offset**"

Click the "**Use Shown Value**" to accept new offset

When finished, close popup window to proceed with testing. Changes save automatically.

5 Install Sensors on Well

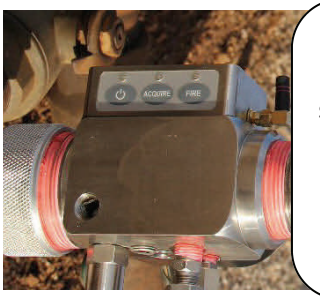
Charge the gas gun 150-300 psi above surface pressure on the well.

Close the gun bleed valve.

Open casing valve between gun and wellhead.

Close casing valve to the flowline.

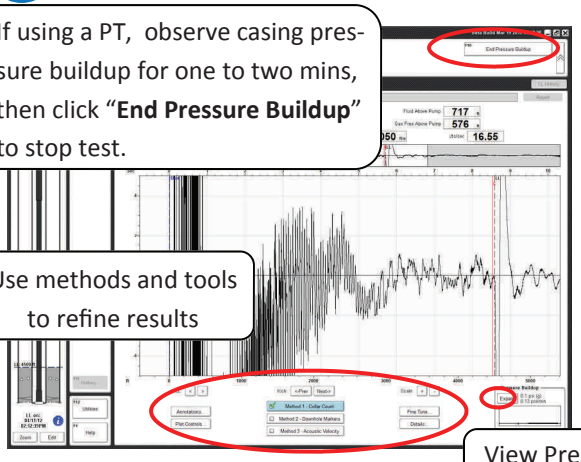
6a Start Acquisition from Sensor



Press "**Acquire**" switch on gun and wait for the "Fire" light to stop blinking, then press "**Fire**" button when ready to shoot. Make sure the chamber pressure is greater than the well pressure.

7 Results, Finish Pressure Buildup

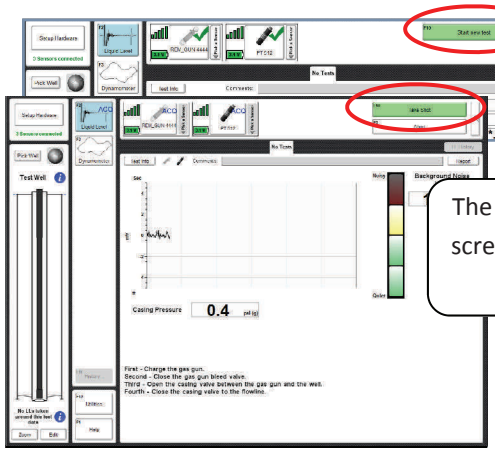
If using a PT, observe casing pressure buildup for one to two mins, then click "**End Pressure Buildup**" to stop test.



Use methods and tools to refine results

View Pressure Buildup

6b Start Acquisition from Laptop

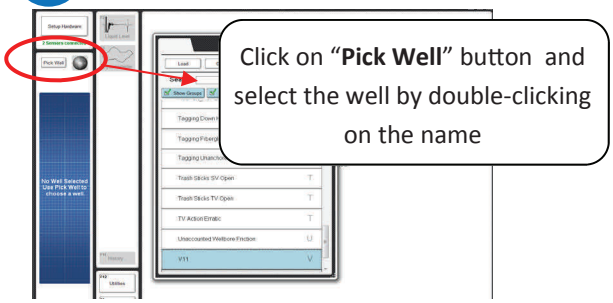


Click on "**Start New Test**" button

The background noise screen will show. Click "**Take Shot**".

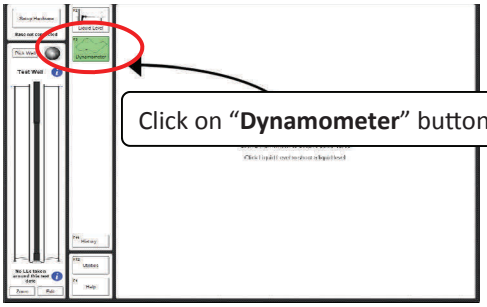
Wireless PRT Acquisition

1 Pick Well



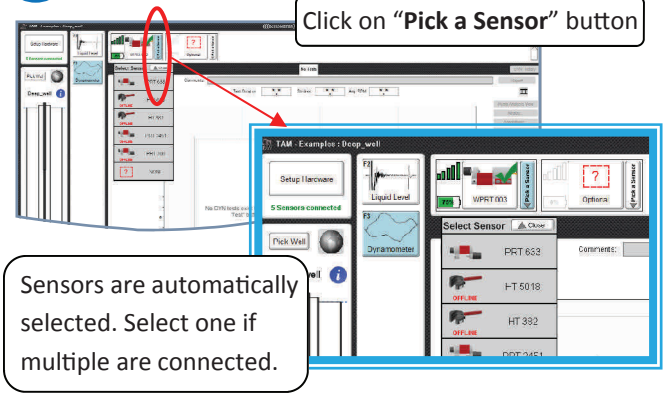
Click on "**Pick Well**" button and select the well by double-clicking on the name

2 Select Dynamometer



Click on "**Dynamometer**" button

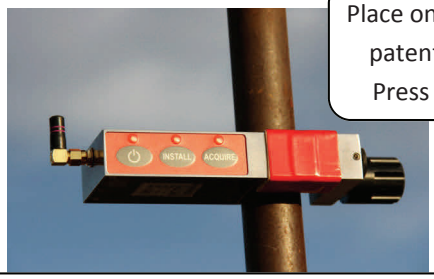
3 Pick Sensor



Click on "**Pick a Sensor**" button

Sensors are automatically selected. Select one if multiple are connected.

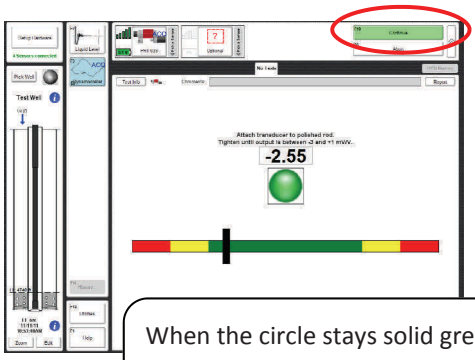
4 Install Sensor On Well



Place on polished rod with patent label facing up. Press "**Install**" switch.

While the light above the install switch blinks green, tighten PRT until the light turns solid green. Loosen PRT if light turns red. Start pumping unit and return to laptop.

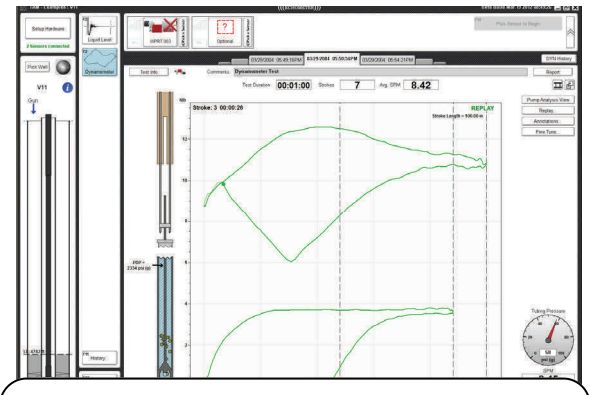
5 Verify Installation & Start Acquisition at Laptop



When unit is running the speedometer should oscillate inside the **green** bar. If not, stop the unit and adjust tightness.

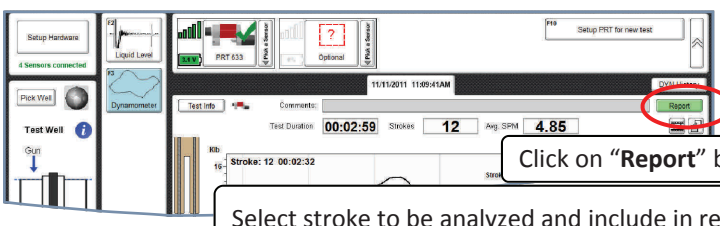
When the circle stays solid green, click the **"Continue"** button to start acquiring dynamometer data..

6 See Results in Real-Time



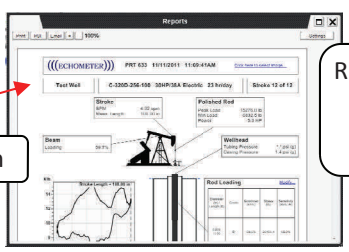
After two complete strokes the surface and pump dynamometer cards are displayed in real time. End Acquisition by pressing the "**Acquisition**" button on the sensor.

7 Get Report



Click on "**Report**" button

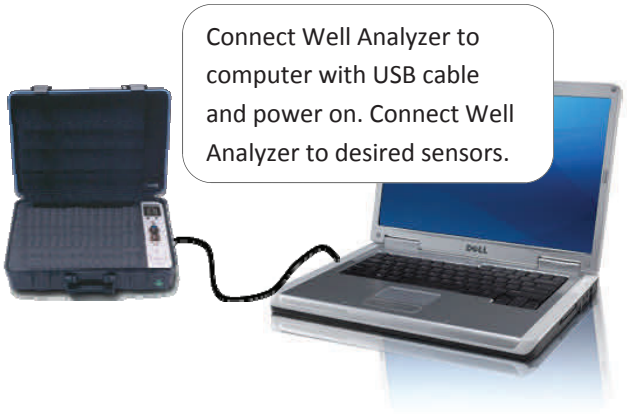
Select stroke to be analyzed and include in report



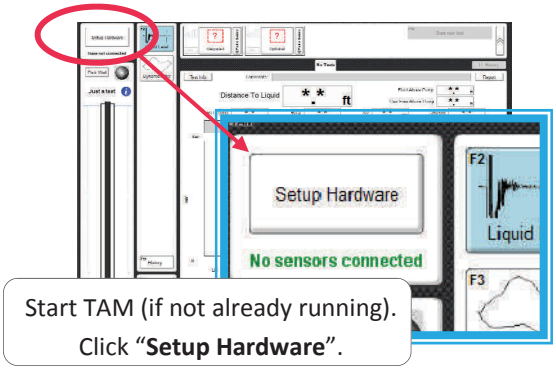
Report can be printed or emailed

Wired Liquid Level Sensor Setup

1 Connect Well Analyzer & Sensors

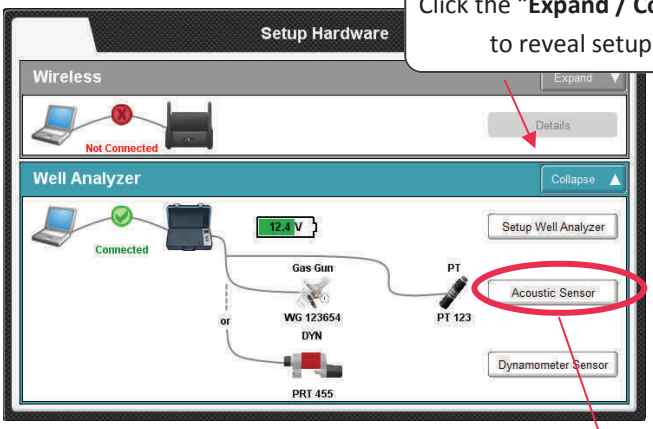


Connect Well Analyzer to computer with USB cable and power on. Connect Well Analyzer to desired sensors.



Start TAM (if not already running). Click "**Setup Hardware**".

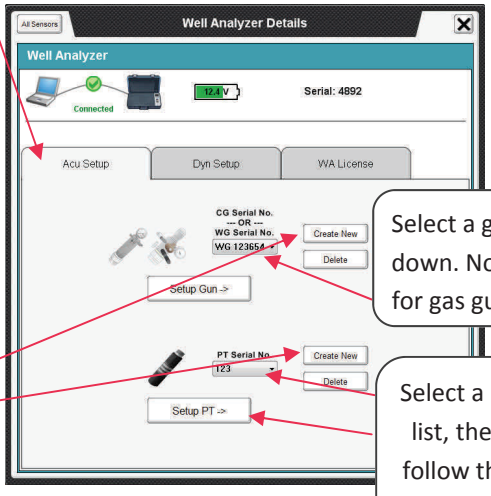
2 Select & Configure Sensors

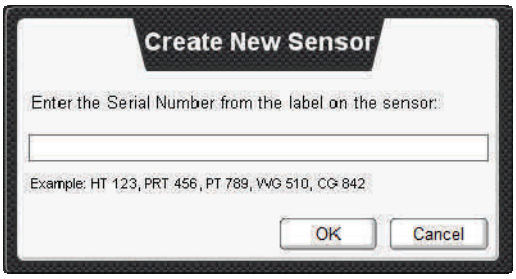


Click the "**Expand / Collapse**" toggle to reveal setup options

Click "**Acoustic Sensor**"

Acoustic





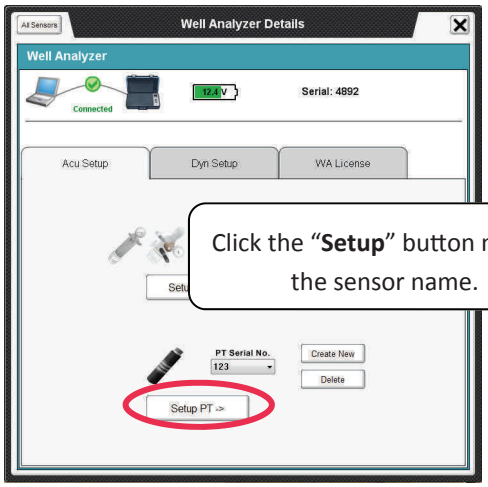
If the desired sensor does not appear in the drop down list, click "**Create New**". Enter the sensor's serial number to add the sensor to the drop down list.

Select a gas gun from the drop down. No further setup is needed for gas guns

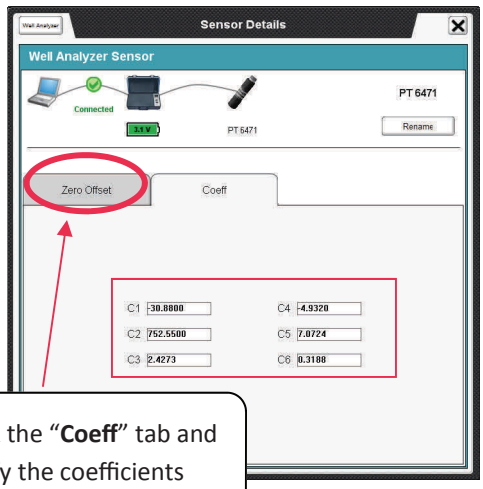
Select a PT from the drop down list, then click "**Setup PT**" and follow the directions for sensor setup on the next page.

Wired Liquid Level Sensor Setup

3 Open Detail Screen

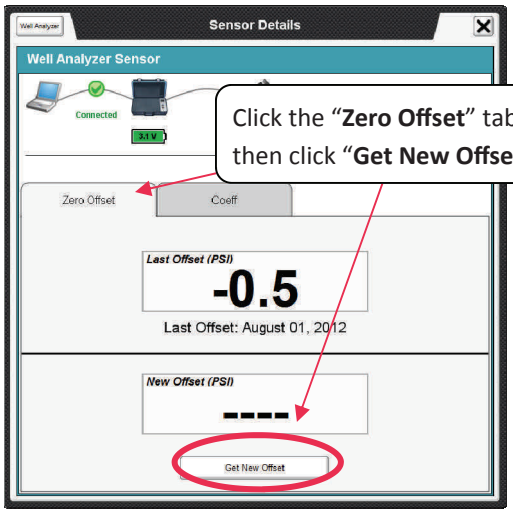


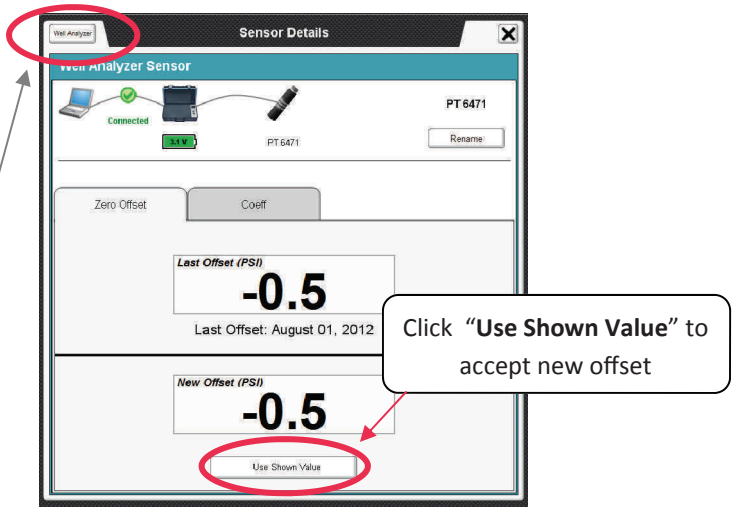
4 Enter Coefficients



5 Zero Offset (For PT's Only)

Verify that the pressure is atmospheric

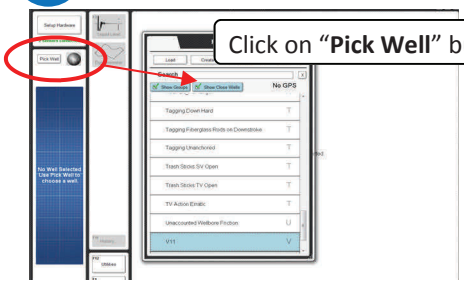




Click the "**Well Analyzer**" button to return to the main setup screen and configure other devices, or close the popup window to proceed with testing. Changes will save automatically.

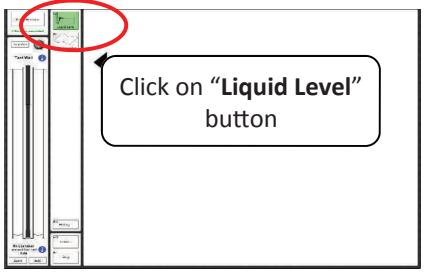
Wired Liquid Level Acquisition

1 Connect Well Analyzer



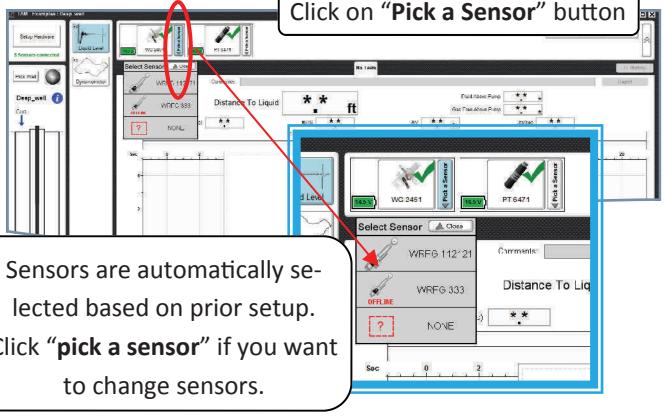
Click on "**Pick Well**" button

2 Select Liquid Level



Click on "**Liquid Level**" button

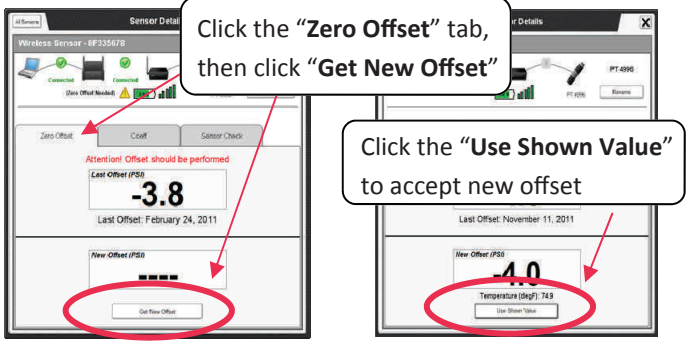
3 Pick Sensors



Click on "**Pick a Sensor**" button

Sensors are automatically selected based on prior setup. Click "**pick a sensor**" if you want to change sensors.

4 Zero the Pressure Sensor



Click the "**Zero Offset**" tab, then click "**Get New Offset**"

Click the "**Use Shown Value**" to accept new offset

When finished, close popup window to proceed with testing. Changes save automatically.

5 Install Sensors on Well

Well Analyzer Gas Gun & PT

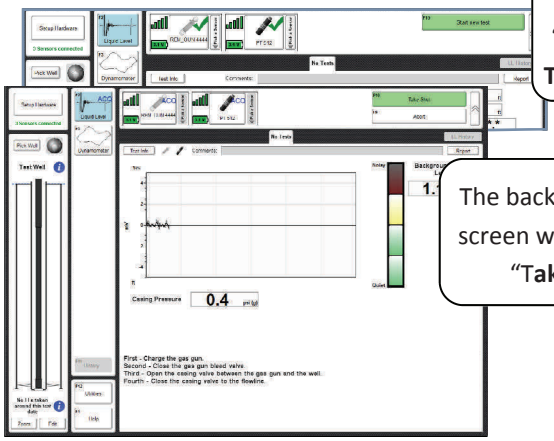
Charge the gas gun 150-300 psi above surface pressure on the well.

Close the gun bleed valve.

Open casing valve between gun and wellhead.

Close casing valve to the flowline.

6 Start Acquisition

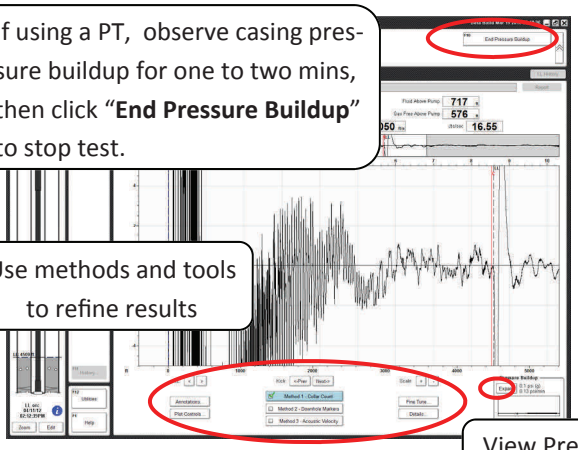


Click on "**Start New Test**" button

The background noise screen will show. Click "**Take Shot**".

7 Results, Finish Pressure Buildup

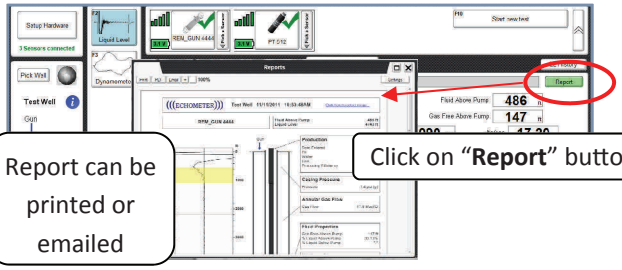
If using a PT, observe casing pressure buildup for one to two mins, then click "**End Pressure Buildup**" to stop test.



Use methods and tools to refine results

View Pressure Buildup

8 Get Report

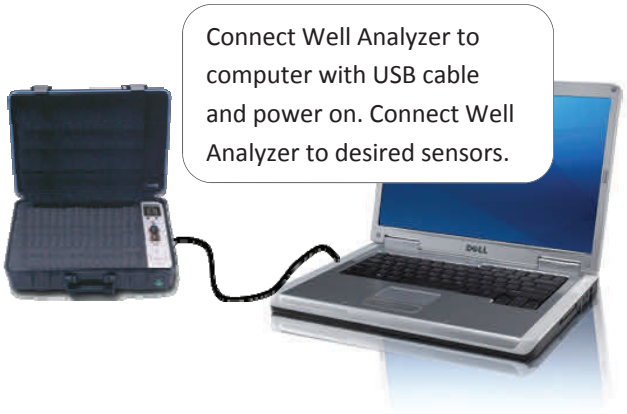


Report can be printed or emailed

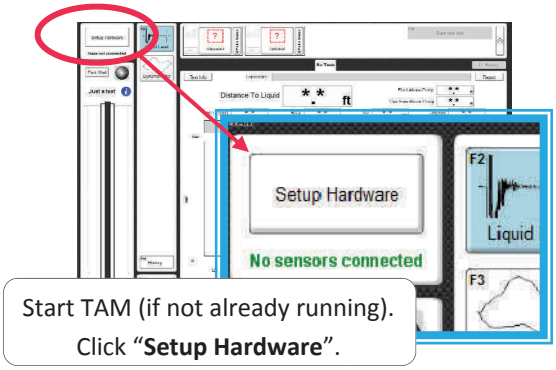
Click on "**Report**" button

Wired Dynamometer Sensor Setup

1 Connect Well Analyzer & Sensors

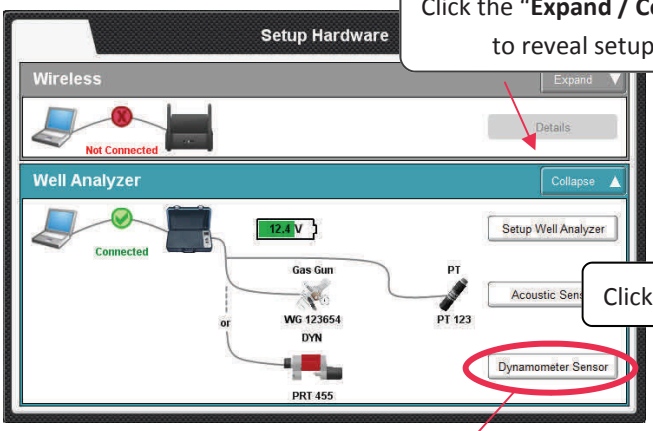


Connect Well Analyzer to computer with USB cable and power on. Connect Well Analyzer to desired sensors.



Start TAM (if not already running). Click "**Setup Hardware**".

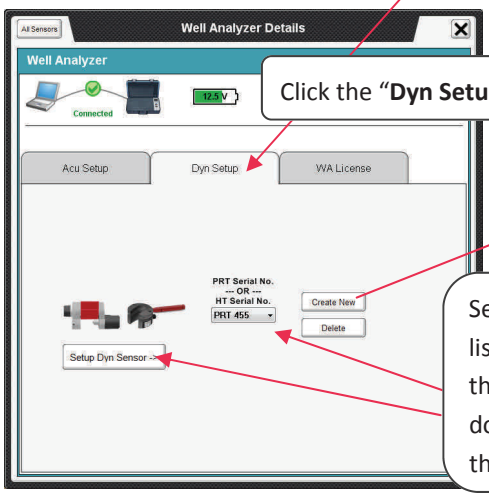
2 Select & Configure Sensors



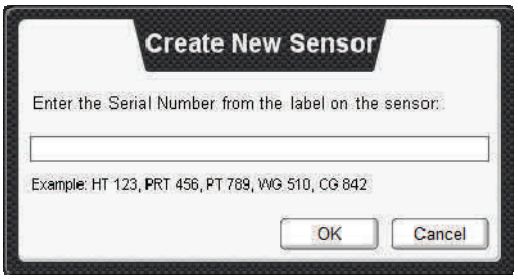
Click the "**Expand / Collapse**" toggle to reveal setup options

Click "**Dynamometer Sensor**"

Dynamometer



Click the "**Dyn Setup**" tab

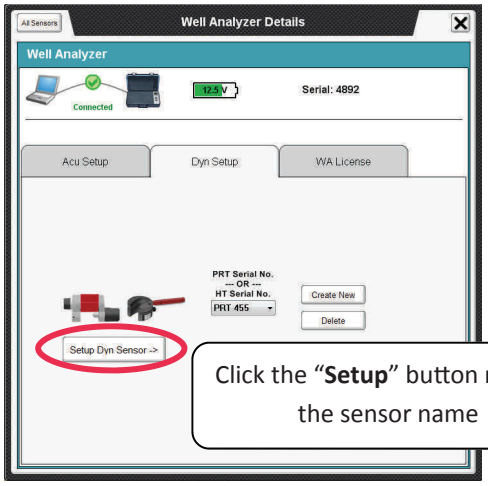


Enter the sensor's serial number to add the sensor to the drop down list.

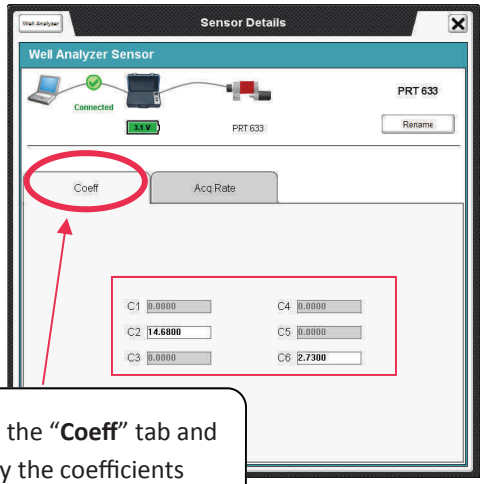
Select a device from the drop down list, then click "**Setup Dyn Sensor**". If the desired device is not in the drop down list, click "**Create New**". Close the popup window to proceed.

Wired Dynamometer Sensor Setup

3 Open Detail Screen



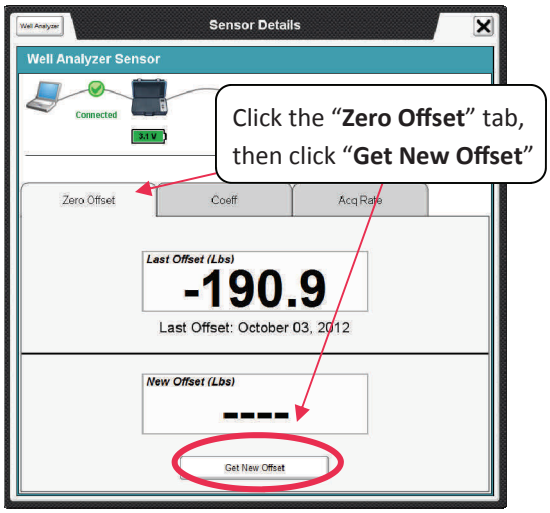
4 Enter Coefficients

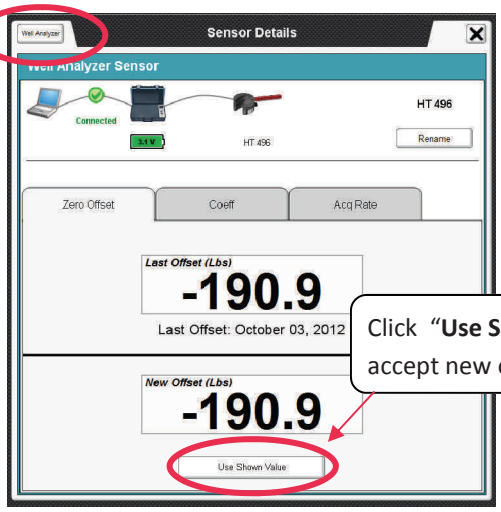


For PRT's no additional setup is required. You may close the popup window and proceed with testing. For HT's continue to Step 3.

5 Zero Offset (For HT's Only)

Verify that the HT sensor is **not loaded**.

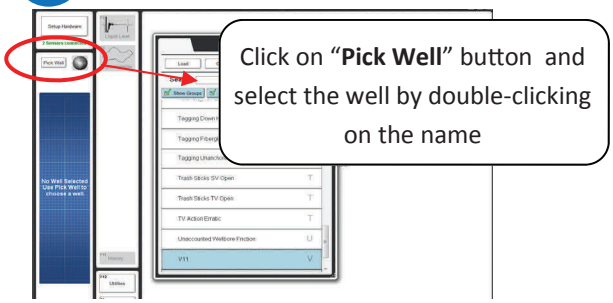




Click the "**Well Analyzer**" button to return to the main setup screen and configure other devices, or close the popup window to proceed with testing. Changes will save automatically.

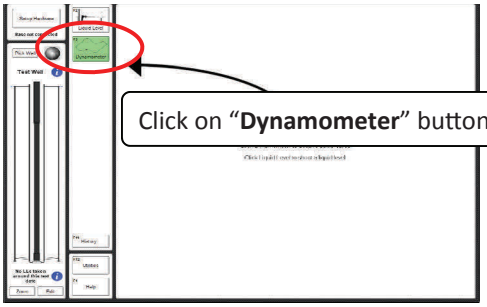
Wired PRT Acquisition

1 Pick Well



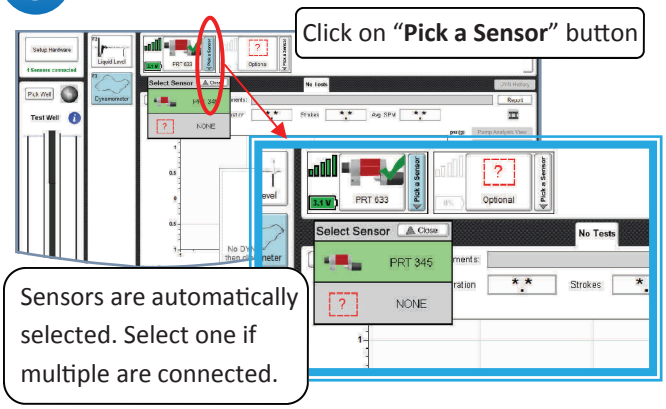
Click on "**Pick Well**" button and select the well by double-clicking on the name

2 Select Dynamometer



Click on "**Dynamometer**" button

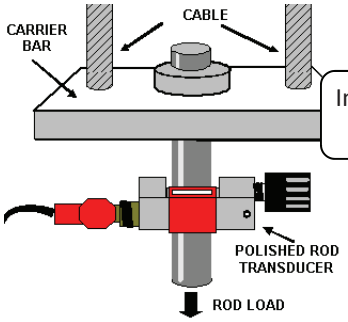
3 Pick Sensor



Click on "**Pick a Sensor**" button

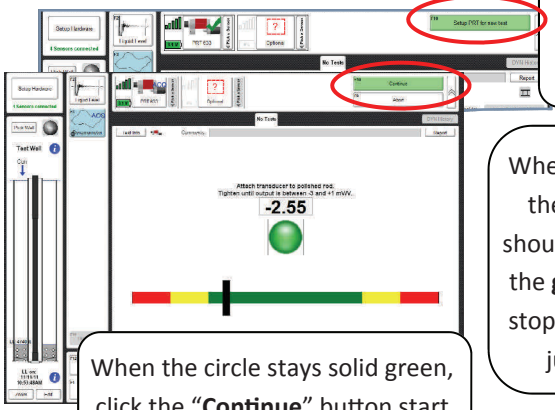
Sensors are automatically selected. Select one if multiple are connected.

4 Install Sensor On Well



Install with patent label facing up

5 Start Acquisition

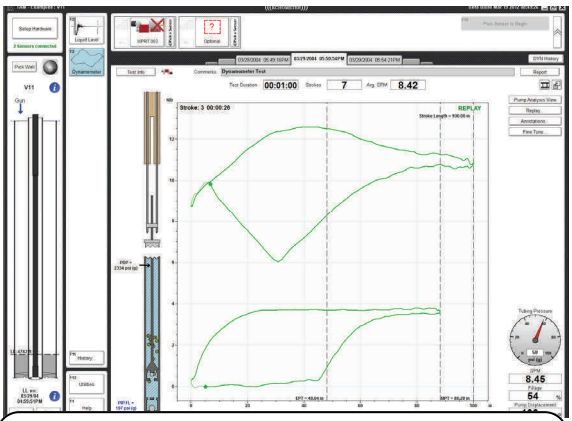


Click on "**Setup PRT for New Test**" button

When unit is running the speedometer should oscillate inside the **green** bar. If not, stop the unit and adjust tightness.

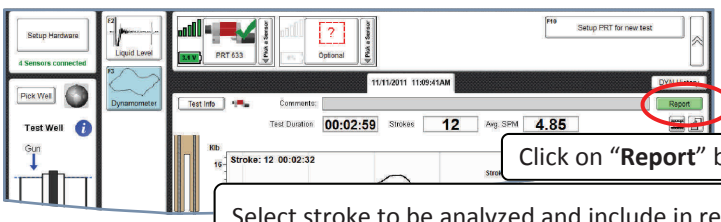
When the circle stays solid green, click the "**Continue**" button start acquiring dynamometer data.

6 See Results in Real-Time



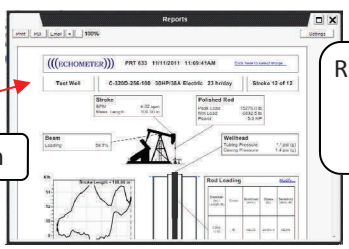
After two complete strokes the surface and pump dynamometer cards are displayed in real time. End Acquisition with the "**Stop**" button.

7 Get Report



Click on "**Report**" button

Select stroke to be analyzed and include in report



Report can be printed or emailed