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In-Line ID OD Wall Configuration

User's Guide

3/9/2018

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Introduction

This document is a supplement to the Total Vu User's Guide & Total Vu Manual. It contains information regarding a specific configuration for an in line ID OD wall setup using a three axis gauge. The basic concepts and screens will be similar in function for both single and dual axis gauges. Total Vu is a highly customizable software. Any changes made to the system after the initial setup will not be reflected in this document.

The Total Vu backup feature can be used to save any changes made to the initial configuration. Press "Ctrl + B" and name the backup. This backup can be restored at any time by pressing "Ctrl + R" and browsing for the correct file. In most cases, only the "Total Vu Configuration" should be restored. If unwanted changes have been made to the recipes, they can also be restored.

The in line ID OD wall configuration has six primary data tabs, two troubleshooting tabs, a settings tab, and a custom tab that can be used for custom applications or displays. The main tab displays a broad overview and basic SPC data for the outer diameter, inner diameter, and wall measurements. The OD tab displays measurement and SPC data for the outer diameter as well as ovality. The wall tab displays measurement and SPC data on the total wall, two-layer wall, and alignment data. The trend tab illustrates length or time based trends of measurements. The SPC tab will give the user statistical information of all measurement parameters at an in-depth level. The spooling tab tracks statistics of each measurement on each spool separately. The process tracker tab shows the basic actions taken by an operator, as well as other details that the user wishes to see. The status tab displays all relevant measurement values and is useful for troubleshooting. Finally, the settings tab is used to change various parameters and states of the system. This screen is often password protected to prevent unwanted changes.

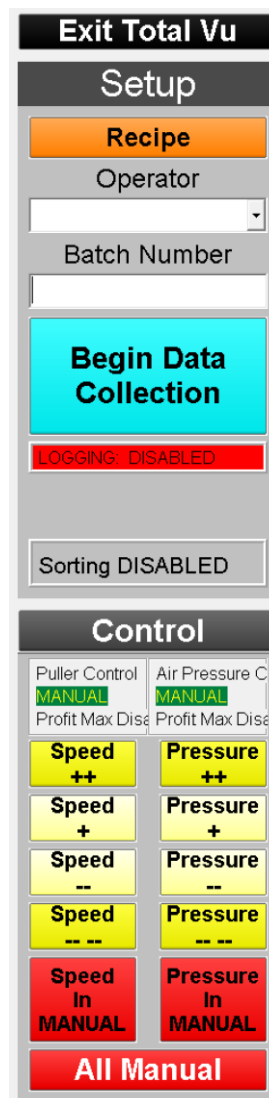
Screen Layout

Primary Display

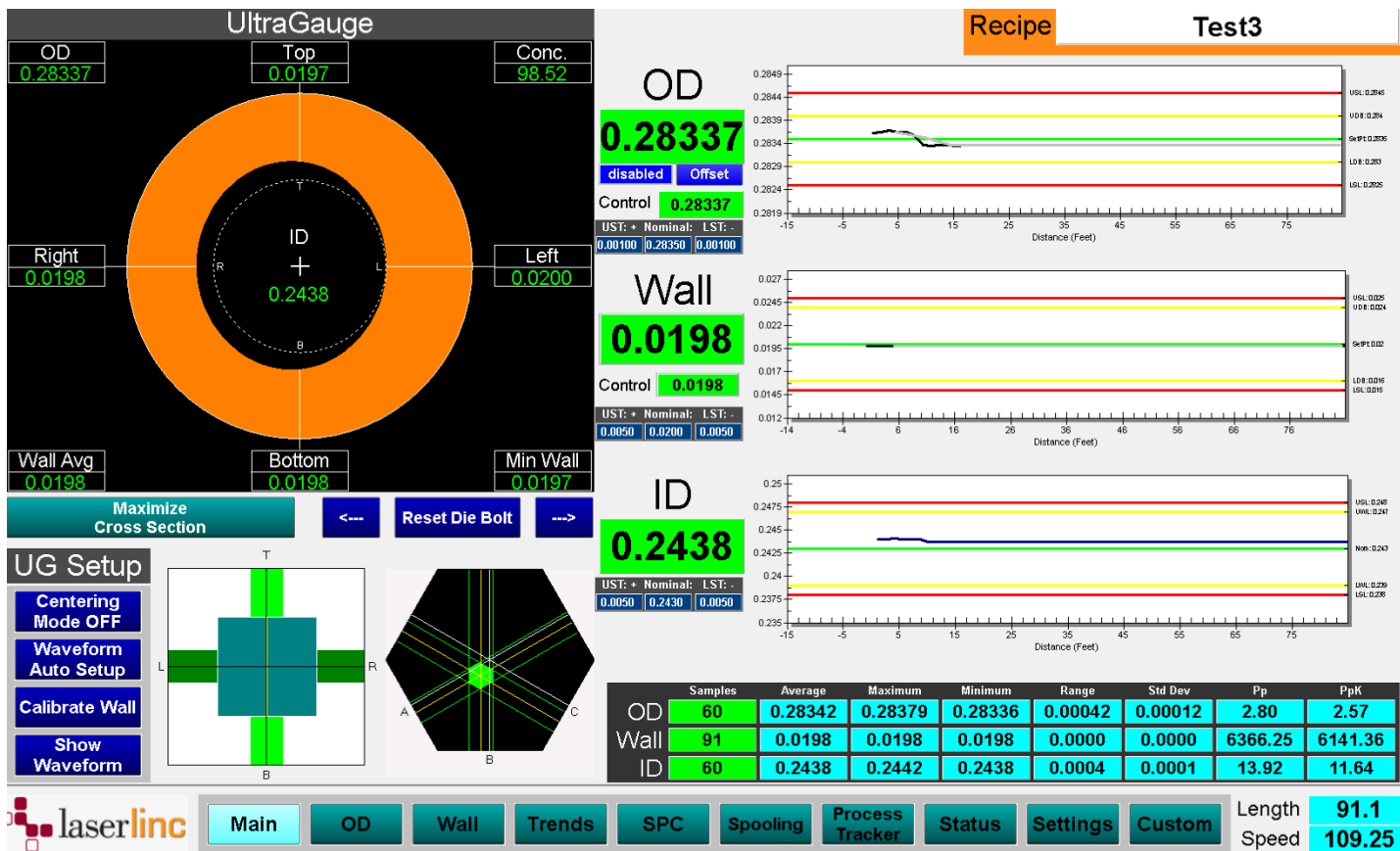


The primary display, located at the bottom and right side of the window, is always visible. The recipe status will be displayed in the orange box at the top of the display. The buttons at the bottom are used to navigate between tabs. A button will be highlighted when on a given tab. The length and speed of the product are displayed to the right of these buttons.

To the right of the loaded recipe, "Exit Total Vu" allows you to exit the software. Below this button are the setup and control panels. The setup panel allows the user to load a recipe, select an operator and name the file for data logging. Clicking "Begin Data Collection" will start data collection. By default, a recipe must be loaded and the Operator and File Name (batch number) fields must be populated to begin data collection. After starting data collection, buttons to pause/resume or end data collection will be available. Below this is the log status window that counts the number of records in each log and turns green when logging is enabled. If a sorting recipe is loaded, an auto sort button will appear to toggle sorting on and off. If a spooling recipe is loaded, the operator will have the option to end the current spool or start the next spool. See sections on Sorting and Spooling for more details. The control panel shows the current state of the control loops. The control status windows tell the user if their control loop is in automatic or manual mode, and also what the control loop is currently doing. It will read increase or decrease to indicate that a control move is being made. Below these measurements are buttons that can be pressed to manually increase or decrease parameters being controlled by Total Vu. These manual buttons are not available when in automatic mode. Buttons labeled +/- result in small increment changes while ++/-- result in large increment changes. Additionally, the buttons at the bottom of the control panel toggle the control loops between auto and manual mode.



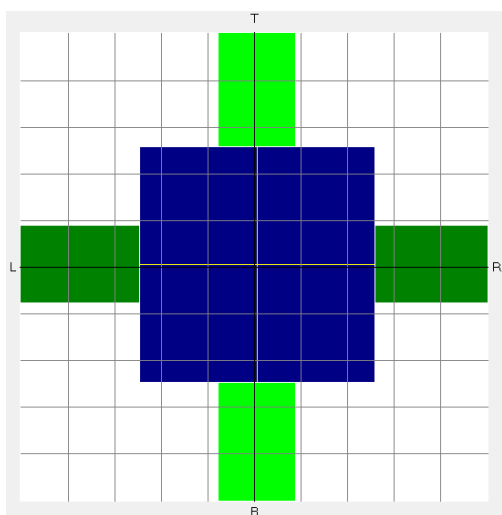
Main Tab



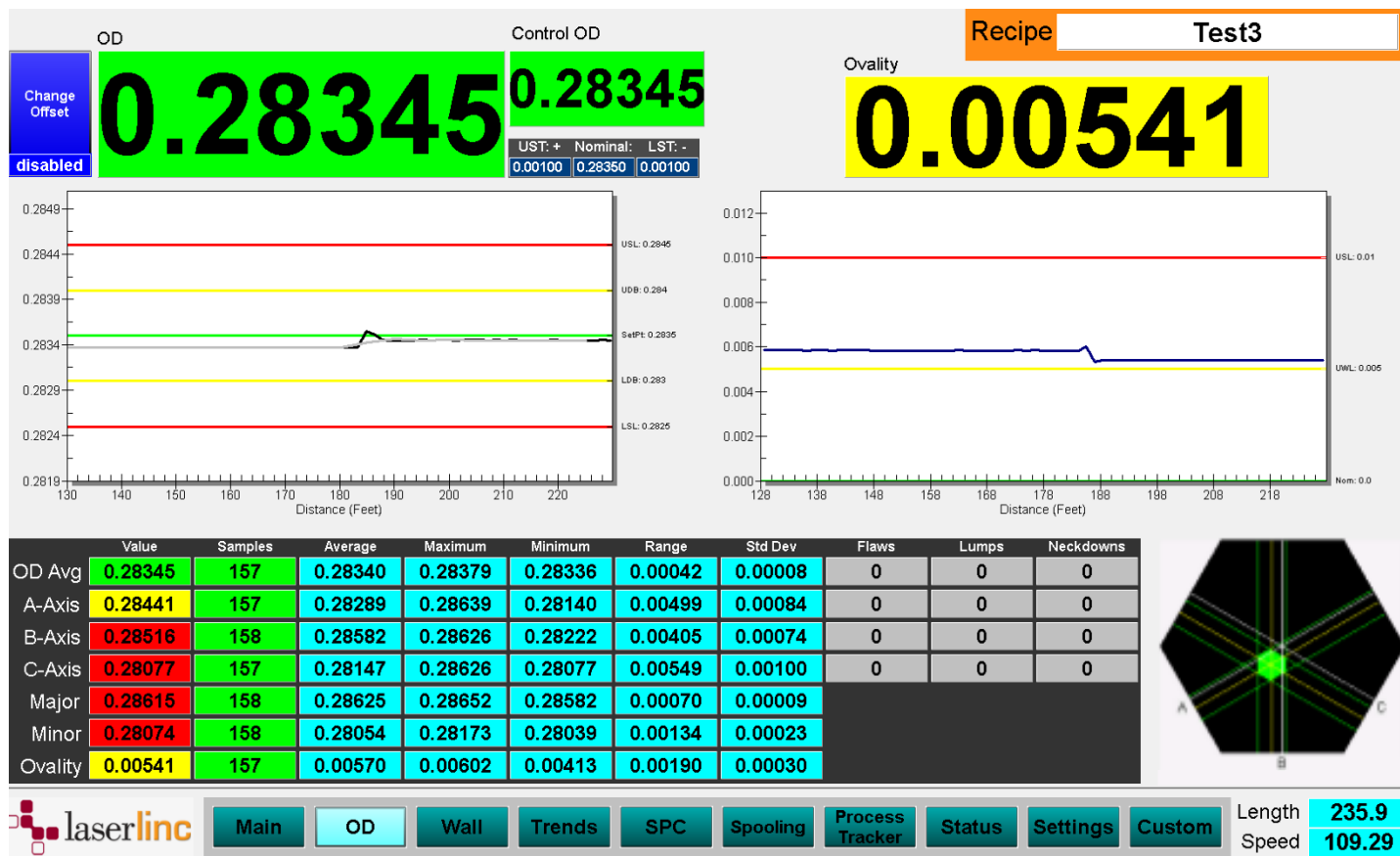
The main tab is used to obtain a general overview of what the system is doing. Located at the top left of the window is a Cross Section Display for the UltraGauge. This graphic will show a variety of live measurements, all of which are configurable by right clicking the cross section display. The wall measurements on the graphic can be rotated clockwise or counterclockwise using the left and right arrow buttons. This function is used to line the wall measurements up with the corresponding die bolts on the extruder to account for product twist. Click "Reset Die Bolt" to reset the position of the wall measurements back to the default position. The "Maximize Cross Section" will open a larger window with the above graphic, allowing for the user to navigate between cross sections of the total and 2-layer walls. UG Setup buttons can be found below the cross section display (See next section titled "UG Setup"). Next to these buttons are position windows that display the position of the product in the UltraGauge and the OD scanner, respectively. Below the Recipe Status window are the measurement and trend data of the outer diameter, wall, and inner diameter. Below these charts is an SPC data table for these measurements.

UG Setup

In order to setup the UltraGauge to get measurements, a recipe must be loaded. A recipe can be made in the Settings tab or the System Configuration Window. Recipes can then be loaded from the Primary Display via the "Setup" window. After the recipe is loaded, centering mode can be toggled on/off. When centering mode is on, a larger position window will be opened (left image below). The closer the product is to center, the stronger the produced waveforms will be. The "Waveform Auto Setup" button will automatically optimize various parameters in the waveform window based on the loaded recipe. "Calibrate Wall" will open a separate window where new calibrations can be done by measuring the product and entering actual wall readings. The "Show Waveform" button opens a new window displaying the waveform of each sensor (right image below). A walk-through for setting up a run can be found in the "Functionality" section at the end of the document.

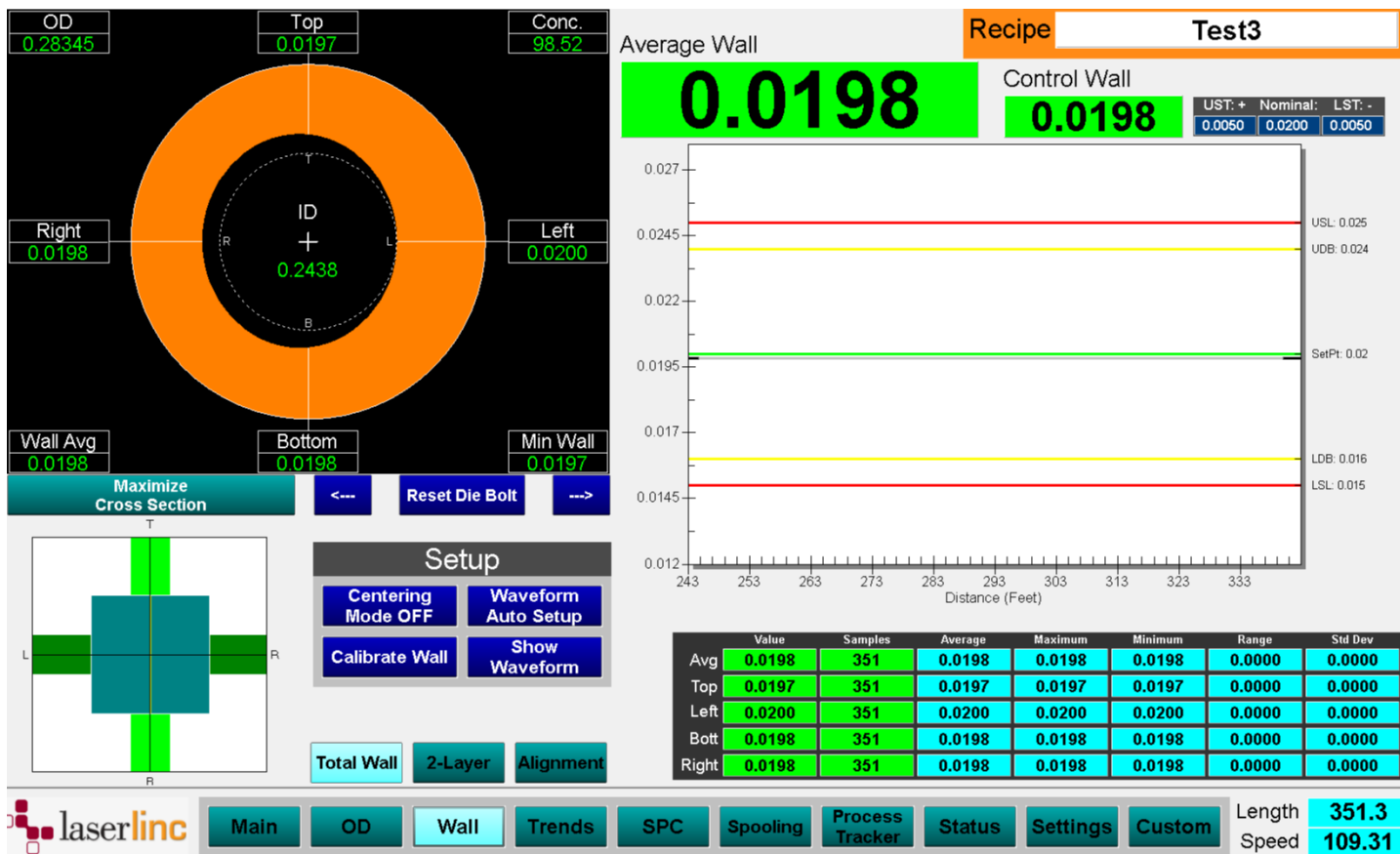


OD Tab



The OD tab displays the outer diameter and control outer diameter, as well as the ovality of the product. The OD offset can be adjusted via the blue button to the left of OD. Below these measurements, trend charts will begin displaying data once measurements are detected and the encoder is counting. In addition, the OD tab displays statistics for the outer diameter of the product. This includes the average outer diameter as well as the individual axes and ovality of the product. Additionally, the software has the ability to detect flaws on each axis and categorize the flaws as lumps or neckdowns. Flaw detection can be toggled on/off in the Settings tab under Flaw Settings. Flaw Detection Setup can be found at the end of the document in the "Functionality" section. A scanner position graphic lies to the right of the statistics table to assist with positioning of the product.

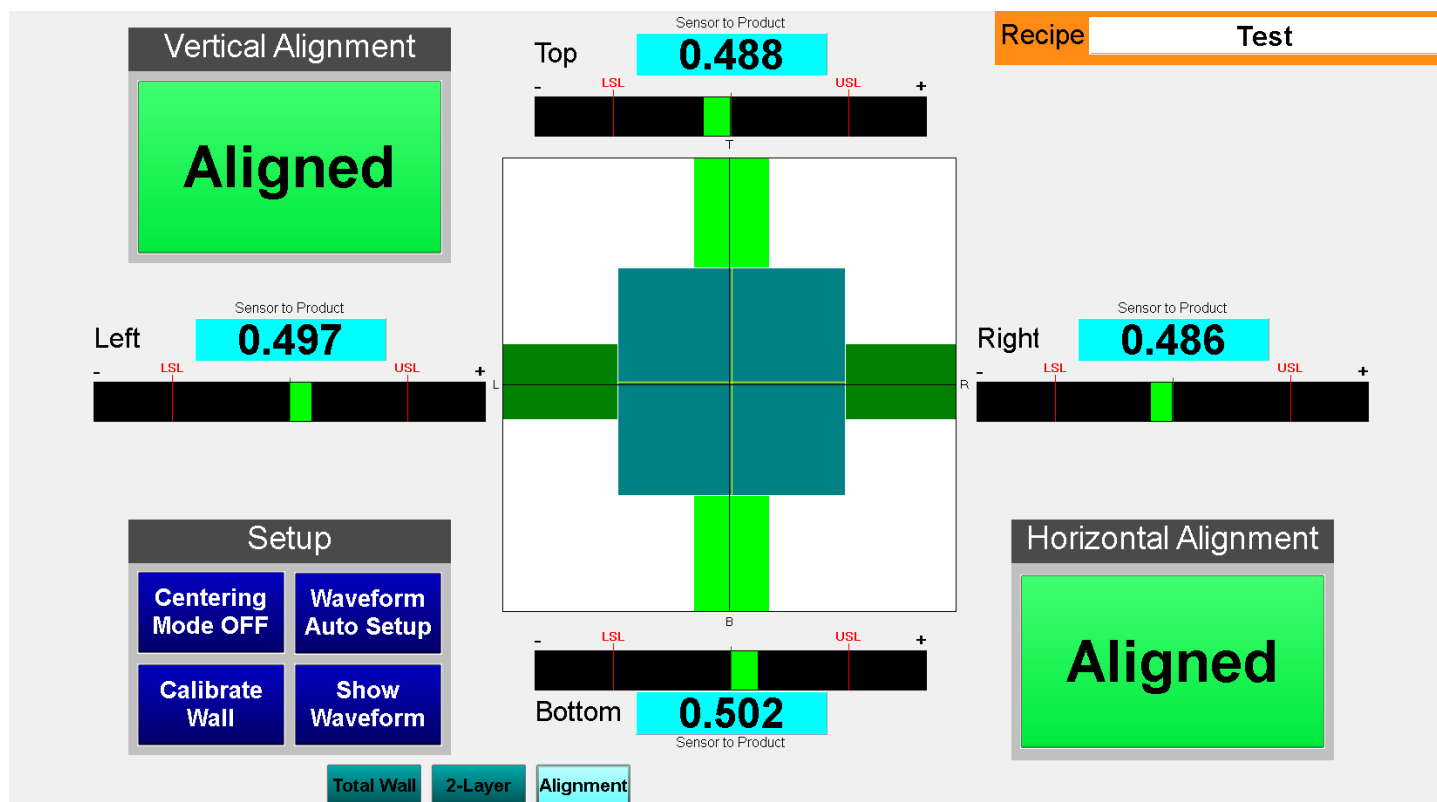
Wall Tabs



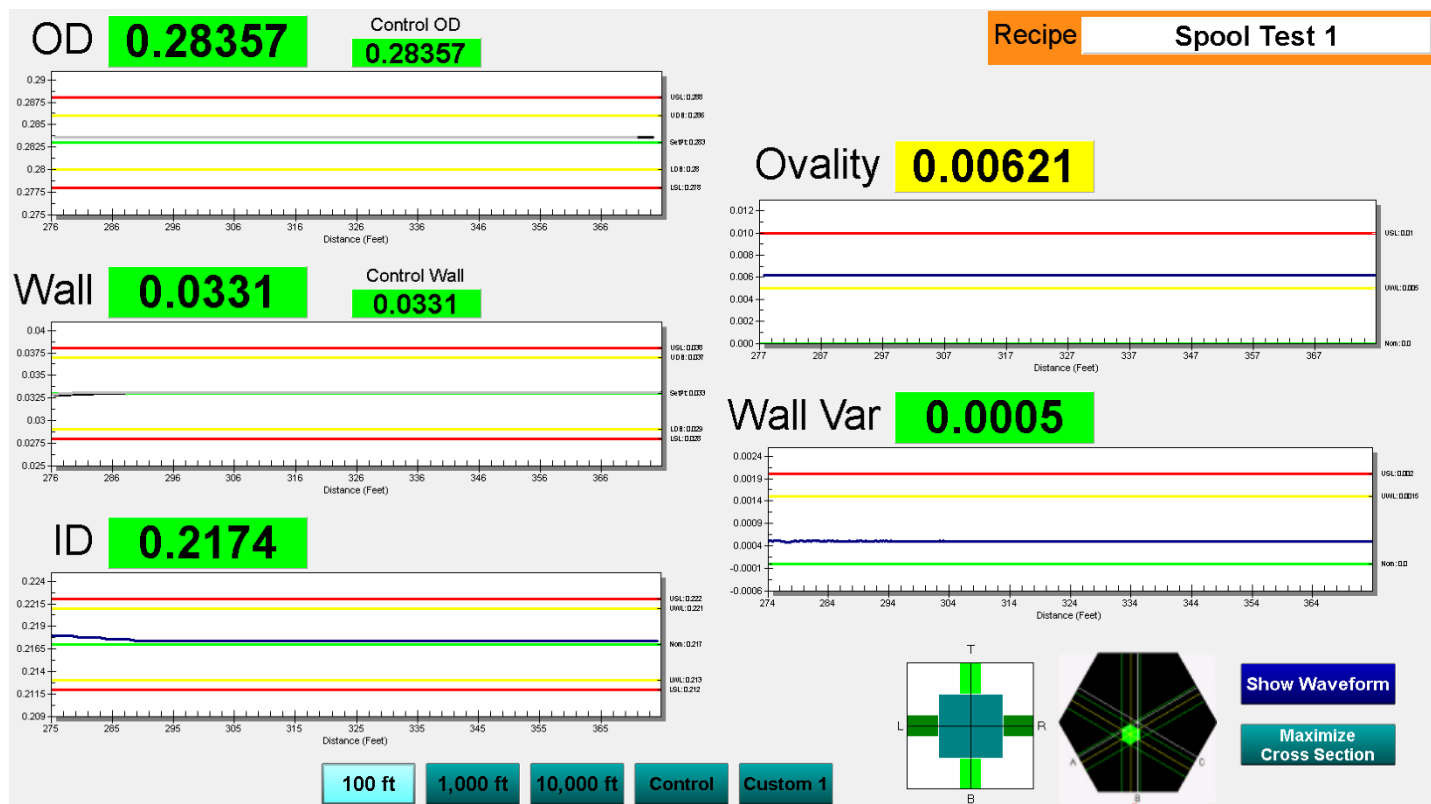
The Wall tab will display live measurements on the cross section display. However, the trend charts are displaying data that has been delayed to update at the same spot as the live OD measurements. There are buttons to navigate between total wall and 2-layer tabs. Additionally, the alignment tab is useful for aligning the UltraGauge.

The wall tab has two main tabs: Total Wall and 2-Layer. There is a position window as well as UG Setup buttons on both tabs. Both of these items function the same as items on the main tab. On the right side of the "Total Wall" tab, measurements are displayed for the average wall and control wall as well as a trend chart and an SPC table. The 2-Layer tab is similar to the Total Wall tab but takes in readings for both walls. Data for each wall is displayed in both the cross section display and SPC data table.

The alignment tab contains the UltraGauge position windows and column gauges to show how far each sensor is from the product. The objective is to have all 4 column gauges show green and lie in the center of the USL and LSL lines. When all 4 sensors are within their position specs, the Vertical and Horizontal alignment panels will read "Aligned". If the block is not properly aligned, yellow buttons will appear to indicate which direction adjustment is needed. If there are not valid wall readings coming from the UltraGauge, the alignment panel will read "Echo Error".



Trend Tabs



The Trend tabs are used to obtain graphical representations of outer diameter, wall thickness, inner diameter, ovality, and wall variation with respect to length of product. The data for their respective graphs can be viewed in 100, 1,000 and 10,000 feet representations. Note that the wall and wall variation trends display measurements that have been delayed to the same spot as the OD measurements.



The Control trend tab displays trend data on the OD Control measurement and Wall Control measurement. A vertical red line on a control trend chart indicates that an automatic control change was made for the respective loop.

SPC Tabs



The SPC tabs are used to obtain statistical data about the outer diameter, wall thickness or inner diameter. Each tab shows advanced statistics, as well as a histogram and x-bar and range chart.

	OD Avg	Wall Avg	ID	OD A-Axis	OD B-Axis	OD C-Axis	Ovality	Wall Top	Wall Left	Wall Bott	Wall Right
Samples	75	113	75	75	75	75	75	113	113	113	113
Subgroups	7	11	7	7	7	7	7	11	11	11	11
Value	0.28338	0.0198	0.2438	0.28664	0.28230	0.28120	0.00656	0.0197	0.0200	0.0198	0.0198
UST: +	0.00100	0.0050	0.0050	0.00100	0.00100	0.00100	0.01000	0.0050	0.0050	0.0050	0.0050
UWT: +	0.00050	0.0040	0.0040	0.00050	0.00050	0.00050	0.00500	0.0040	0.0040	0.0040	0.0040
Nominal:	0.28350	0.0200	0.2430	0.28350	0.28350	0.28350	0.00000	0.0200	0.0200	0.0200	0.0200
LWT: -	0.00050	0.0040	0.0040	0.00050	0.00050	0.00050	0.00000	0.0040	0.0040	0.0040	0.0040
LST: -	0.00100	0.0050	0.0050	0.00100	0.00100	0.00100	0.00000	0.0050	0.0050	0.0050	0.0050
% Out-of-Spec	0.00 %	0.00 %	0.00 %	53.33 %	89.33 %	81.33 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %
% OOS High	0.00 %	0.00 %	0.00 %	30.67 %	45.33 %	30.67 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %
% OOS Low	0.00 %	0.00 %	0.00 %	22.67 %	44.00 %	50.67 %	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %
Average	0.28353	0.0198	0.2439	0.28400	0.28363	0.28296	0.00556	0.0197	0.0200	0.0198	0.0198
Maximum	0.28406	0.0198	0.2445	0.28675	0.28708	0.28650	0.00769	0.0197	0.0200	0.0198	0.0198
Minimum	0.28335	0.0198	0.2438	0.28113	0.28116	0.28077	0.00462	0.0197	0.0200	0.0198	0.0198
Range	0.00071	0.0000	0.0007	0.00562	0.00592	0.00573	0.00307	0.0000	0.0000	0.0000	0.0000
Std Dev	0.00010	0.0000	0.0001	0.00170	0.00200	0.00200	0.00060	0.0000	0.0000	0.0000	0.0000
Pp	3.21	2032.90	15.91	0.20	0.17	0.17	2.78	514.37	6817.71	1408.43	908.55
PpK	3.10	1961.39	12.94	0.10	0.14	0.08	2.47	486.45	6776.05	1343.73	866.22
Cp	4.94	3088.79	24.77	0.58	0.87	0.66	4.54	1613.32	7007.77	1569.31	1322.58
CpK	4.75	2980.12	20.11	0.40	0.65	0.35	4.09	1525.72	6964.94	1497.22	1260.95

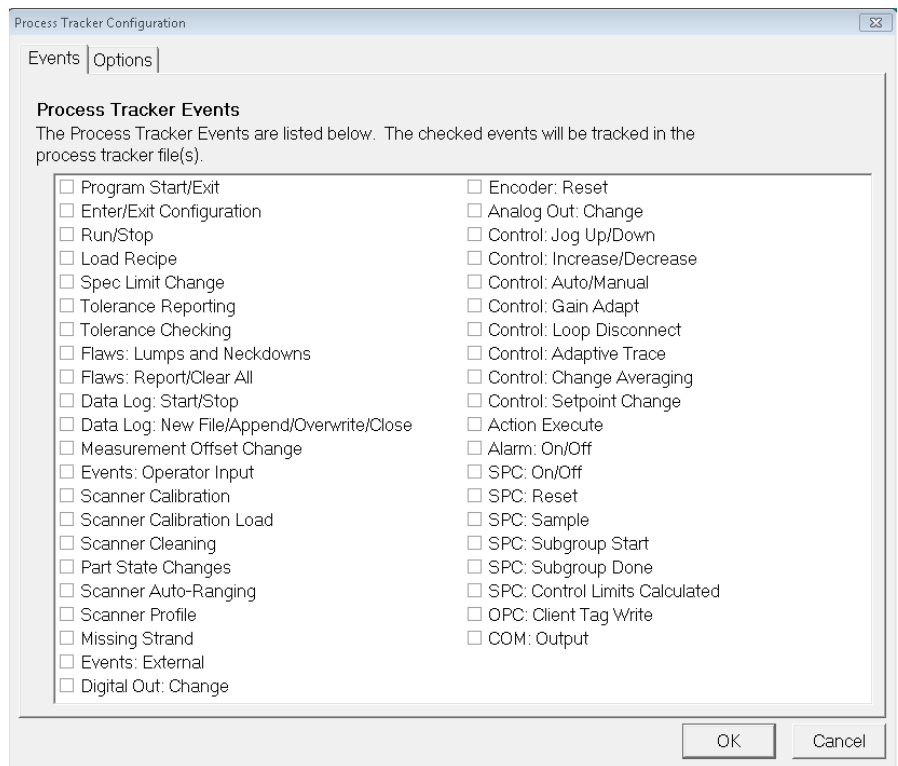
A summary of most statistical information can be found on the "Summary" tab. There are two blank custom screens that can be configured for custom applications or displays.

Spooling Tab

The spooling tab is used to display statistics on individual spools. Spools can be started and stopped with the spooling buttons on the primary display when a spooling recipe is loaded and data has started. The tab will display data on the current and previous spools, as well as data on the total run of the current product. A walk-through for setting up Spooling can be found at the end of the document in the "Functionality" section.

Process Tracker Tab

The Process Tracker tab informs the user of various events being triggered. These updates can be paused or resumed, although this does not pause any data being processed in the process tracker file. This tab is primarily used in troubleshooting but can also be used in tracking the processes on the line. The following messages will be displayed in the Process Tracker window with the date, time, batch number, and operator (these attributes can also be changed if needed): Auto sort start and stop, Control OD to auto and manual, Control Wall to auto and manual, data end, data pause, data reset, data resume, data start, entering full configuration and pausing or resuming the process tracker.



Status Tab

Measurement Status

OD		Wall			
OD A-Axis	1.50903	Wall Total Avg	0.0216	Wall L1 Avg	0.0216
OD B-Axis	1.52115	Wall Total Top	0.0216	Wall L1 Top	0.0216
OD C-Axis	1.50090	Wall Total Left	0.0216	Wall L1 Left	0.0216
OD Avg	1.51036	Wall Total Bottom	0.0216	Wall L1 Bottom	0.0216
OD Major-Axis	1.52213	Wall Total Right	0.0215	Wall L1 Right	0.0215
OD Minor-Axis	1.49855	Wall Total Conc	99.71	Wall L1 Conc	99.71
Ovality	0.02358	Wall Total Var	0.0001	Wall L1 Var	0.0001
OD Control	1.51036	Delayed to OD: Wall	0.0216	Wall L2 Avg	ECHO ERR
0.010430	Offset	Delayed to OD: Wall Top	0.0216	Wall L2 Top	ECHO ERR
		Delayed to OD: Wall Left	0.0216	Wall L2 Left	ECHO ERR
		Delayed to OD: Wall Bottom	0.0216	Wall L2 Bottom	ECHO ERR
		Delayed to OD: Wall Right	0.0215	Wall L2 Right	ECHO ERR
		Delayed to OD: Wall Conc	99.74	Wall L2 Conc	ECHO ERR
		Delayed to OD: Wall Var	0.0001	Wall L2 Var	ECHO ERR

Logging Status

Data: OD Avg	1.51039
Data: OD A-Axis	1.50900
Data: OD B-Axis	1.52126
Data: OD C-Axis	1.50091
Data: OD Major-Axis	1.52222
Data: OD Minor-Axis	1.49851
Data: Ovality	0.02371
Data: Wall Avg	0.0216
Data: Wall Top	0.0216
Data: Wall Left	0.0216
Data: Wall Bottom	0.0216
Data: Wall Right	0.0215
Data: Wall Conc	99.75
Data: Wall Var	0.0001
Data: ID	1.4672

LOGGING: DISABLED

Recipe
Test

Sort Status

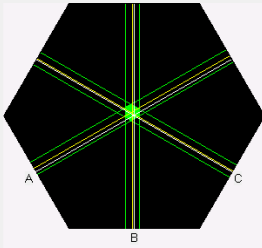
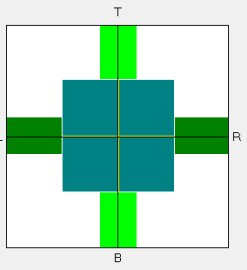
DISABLED

Name	Value	Flaws	Lump	Nckdown
Sort OD Avg	1.51036	0	0	0
Sort OD A	1.50903	0	0	0
Sort OD B	1.52115	0	0	0
Sort OD C	1.50090	0	0	0
Sort Ovality	0.02358			
Sort Wall	0.0216			
Sort Wall Top	0.0216			
Sort Wall Left	0.0216			
Sort Wall Bottom	0.0216			
Sort Wall Right	0.0215			
Sort Wall Conc	99.7443			
Sort Wall Var	0.0001			
Sort ID	1.4672			

Spooling Status

DISABLED

OD	1.51039
Wall	0.0216
ID	1.4672

OD Gauge Status

Show OD Gauge Status

The Status tab displays the current status of live measurements, logging, sorting, spooling, and the status of the OD Gauge. This tab is primarily used in troubleshooting and will display errors where data is not being updated.

The "Show OD Gauge Status" will open a separate window displaying the status of the laser gauge. This is primarily used in troubleshooting. When a part is in the field, the edges should all read 4. If there are two edges in one or more axis, that means that there is no part in the field, or that the part is not centered well enough in the window. If the status window shows more than 4 edges, that means that there is more than one part in the field, or that the windows of the gauge are dirty. In addition, measuring a clear product with glass logic turned off will show more than 4 edges. When measuring clear products, be sure to turn glass logic on from the settings tab.

Device: OD

SCAN RATE: 606
EDGES: 4, 4, 4 ALARMS DISABLED

LOGGING: DISABLED

NetLinc Status

Scanner State: ACTIVE	Packets Rcvd: 11528
Scanner IP: 10.10.10.2	Packets Lost: 0 (0.00%)
Host IP: 10.10.10.1	Overflow: 0
Device S/N: x00189	Queue Full: 0
	Enc Events: 24037
	Scan Events: 4148872

Write Event Counts to File

Settings Tab

The screenshot displays the Settings Tab interface with several panels:

- System Settings:** System Configuration, Reset Length
- Configuration Settings:** Restore Master Configuration
- Utilities:** Data Folder, User's Guide, Quick Support
- Control Settings:** OD (Set Gain, Set Delay, Set Averaging), Wall (Set Gain, Set Delay, Set Averaging)
- UltraGauge+ Settings:** Disable/Enable All, Top, Left, Bottom, Right with numerical values (0.0216, 0.0215)
- Measurement Settings:** Inches, mm, Microns, Set OD Resolution, Set Wall Resolution, Set ID Resolution, Set OD Scan Averaging, Set Wall Ping Averaging, Change OD Offset (0.010430)
- Recipe Settings:** Edit Recipes
- OD Gauge Settings:** Glass Logic is OFF, Calibrate Laser Micrometer
- Flaw Settings:** Average OD Flaw Detection DISABLED, Individual Axis Flaw Detection DISABLED
- Recipe/Tab Header:** Recipe, Test
- Line Layout:** Line Layout
- Sort Measurement Settings:**

Disable	Sort OD Avg	1.51037	Enable
Disable	Sort OD A	1.50902	Enable
Disable	Sort OD B	1.52120	Enable
Disable	Sort OD C	1.50089	Enable
Disable	Sort Ouality	0.02365	Enable
Disable	Sort Wall	0.0216	Enable
Disable	Sort Wall Top	0.0216	Enable
Disable	Sort Wall Left	0.0216	Enable
Disable	Sort Wall Bottom	0.0216	Enable
Disable	Sort Wall Right	0.0215	Enable
Disable	Sort Wall Conc	99.7426	Enable
Disable	Sort Wall Var	0.0001	Enable
Disable	Sort ID	1.4672	Enable

The Settings tab is used to access settings of the entire system within one window.

System Settings

To edit system settings, select “System Configuration”. This page is used to edit the lower-level settings that control how the system functions. These include settings for scanners, measurements, recipes, actions, attributes, data logging, alarms, and more. This page is often password protected to avoid unwanted changes to the system configuration. Users have the option to password protect individual tabs as well as any buttons within the tab. For more information on how to change the system configuration settings of a configuration, reference the Total Vu manual in the documents folder in the installation folder, or reference the tutorial videos at the following link.

http://public.laserlinc.com/docs/Tutorial_Videos/

The length of the product measured can also be reset from this window.

Configuration Settings

To restore the configuration to its original setup state, click “Restore Master Configuration”. This button is looking for a specific backup file that was created when the system was originally set up. In order to update the location of the file, go to 'System Configuration'>'Actions'>'Screen Buttons'>'Settings'>'B: Settings Restore Master'>'Restore'. The file location can be updated under 'File Name'. This button will not change any of the current recipes, but only the Total Vu configuration by default.

Utilities

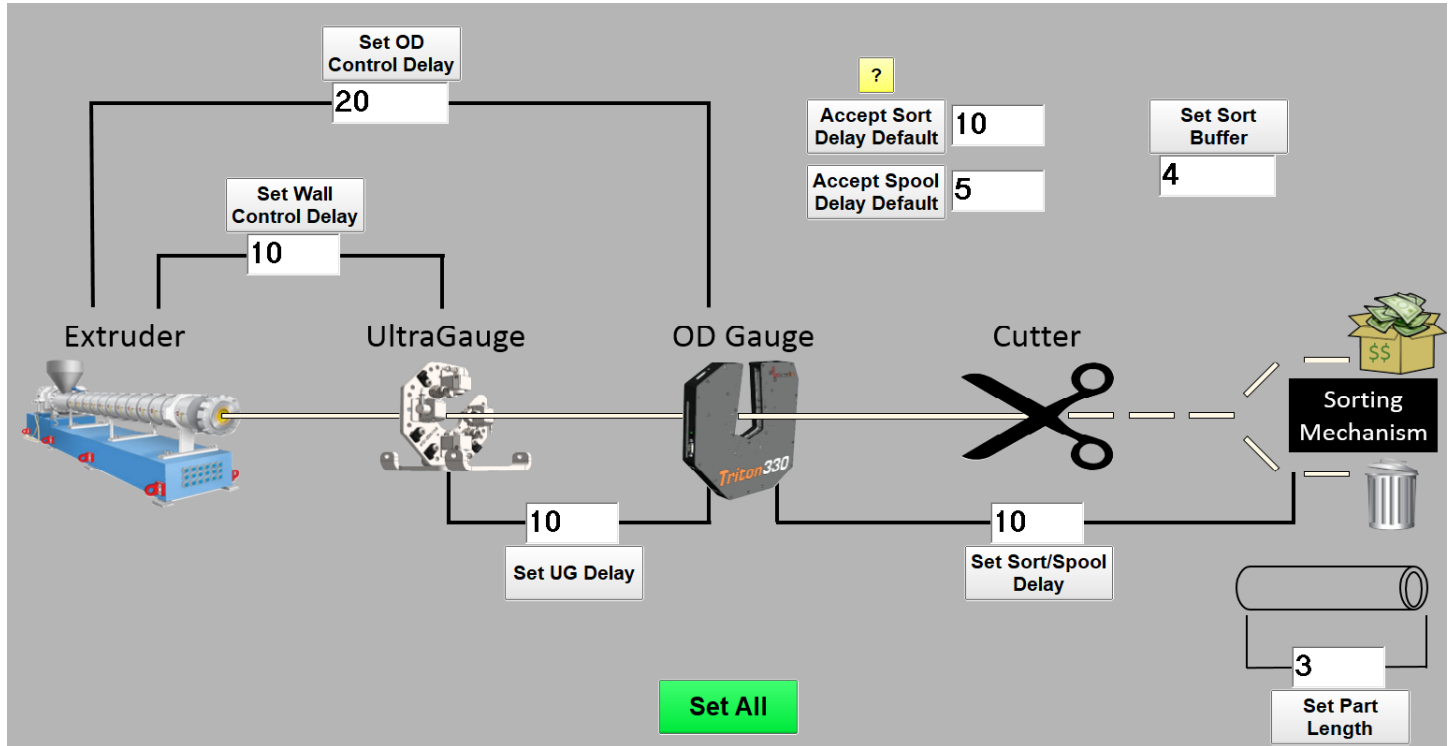
The data folder used in data logging, this user's guide, and quick support with Laser Linc can be accessed under Utilities.

Control Settings

The control settings can be adjusted from this window. In particular, the gain adjusts the magnitude of change that is made with each out of spec condition. The particular formula used in this change is $\text{Gain} \times \text{Measurement Deviation from Deadband Limits} = \text{Magnitude of Change}$. Clicking the "Set Delay" button will bring up the "Line Layout" tab. The averaging can be adjusted to determine the number of scans or length of product used in averaging the control OD and/or Wall. The control averaging is typically high compared to averaging of other measurements so that short deviations in measurements do not significantly alter the control measurements. A walk-through for control setup can be found at the end of this document under "Functionality".

Line Layout

The line layout screen is used to set the correct delays and distances for a specific line. See definitions of each item below.



Sort/Spool Delay- corresponds to the distance between the OD gauge and the sorting mechanism when a sorting recipe is loaded. When a bad reading is recorded at the OD gauge, the system will wait until the sort delay passes to begin scrapping parts.

When a spooling recipe is loaded, this value corresponds to the distance between the OD gauge and the spooler.

Sort Delay Default- when a sorting recipe is loaded, the Sort/Spool delay is set to be equal to the sort delay default value.

Spool Delay Default- when a spooling recipe is loaded, the Sort/Spool delay is set to be equal to the spool delay default value.

Sort Buffer- corresponds to the extra length that is scrapped after one or more bad parts.

Part Length- corresponds to the length of product for which the "bad part" output will remain asserted after all readings are in spec at the OD gauge. This ensures that an entire part is scrapped even if only a short portion of that part is out of spec.

UG Delay- corresponds to the distance between the UltraGauge and the OD Gauge. This allows for part measurements from the UltraGauge to update when the same spot is being measured by the OD Gauge. This allows the system to calculate same-spot ID

Wall Control Delay- corresponds to the distance the software will wait before making additional control changes to alter the wall thickness.

OD Control Delay- corresponds to the distance the software will wait before making additional control changes to alter the OD.

The line layout will display the production line and allows for changes in Wall Control Delay, OD Control Delay, UG Delay, Sort Delay, Sort Buffer and Part Length. For more information on these settings see sections under "Functionality" for Control and Sorting. It is important to note that ALL distances in this layout are measured in the same units as the encoder. By default, this is measured in FEET.

OD Gauge Settings

Glass Logic can be toggled on if the object is transparent. Otherwise, this can remain in the OFF configuration. Additionally, the gauge can be calibrated from this window.

Recipe Settings

Recipes can be added or edited from 'Edit Recipes'. Current recipes can be used as templates for new recipes. In order to create a new recipe from the Clone Recipe window, the user must first select an existing recipe or a template. The spec limits for the new recipe can be adjusted accordingly. After making changes, selecting "Save as New Recipe" will create a new recipe. If the changes are being made to the current recipe and not for construction a new recipe, the user can opt to "Save Over Selected Recipe".

Measurements Settings

This panel allows the user to select the units for all measurements in the configuration. The light green button shows the current units. To change the units, click on the button with the desired units. This button will also change the resolution of all measurements depending on the units selected.

Averaging can be adjusted to suit the needs of the user. By adjusting the scan averaging, the user sets the number of scans that will be taken to calculate a measurement before producing a result. For example, if the scan averaging is set to 100 scans, the scanner will take 100 scans and average them together to yield a measurement. The scanner then takes another independent set of 100 scans to produce the next measurement. It is important to note that this is different than running average. Using 100 as a sample number once again, the scanner will collect the first 100 scans and produce a measurement. When a new scan

is introduced, the first scan in the interval is dropped from the calculations to keep the scan averaging number constant. When using a running average, the measurement update rate is the same as the scan rate of the scanner. To change resolution or averaging, click "Set Resolution" or "Set Averaging". Select the desired resolution or enter the desired averaging and click "OK". This will change the resolution or averaging for the respective measurement type within the configuration.

UltraGauge+ Settings

The UltraGauge+ Settings panel allows the user to enable or disable all the sensors or individual sensors.

Sort Measurement Settings

The Sort Measurement Settings panel allows the user to enable and disable measurements from both the laser micrometer and the UltraGauge via the green and black buttons. This allows the user to stop sorting on particular measurements without affecting other measurements in the system. A walk-through for sorting setup can be found at the end of the document under "Functionality".

Flaw Settings

Flaw detection settings for both average OD and individual axes can be toggled on or off via the green or red button, respectively. A walk-through for flaw detection can be found at the end of the document under "Functionality".

Custom

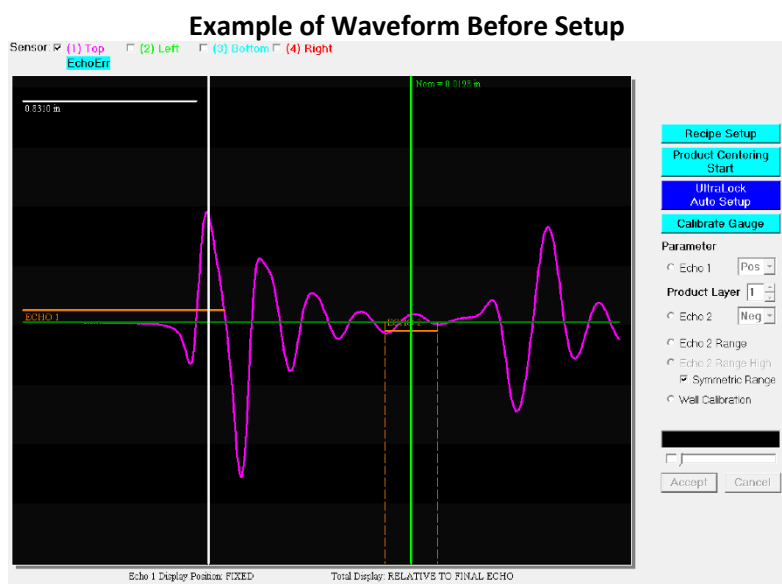
Any additional tabs can be added if needed due to the highly customizable nature of Total Vu.

Functions

The following sections can be used as a reference when settings up various aspects within Total Vu.

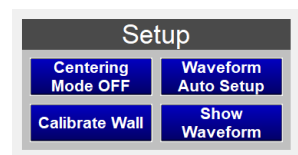
UG: Setting Up a Run

Getting a valid waveform is critical to obtaining accurate measurements. The ensuing steps will guide how to correctly set up a waveform, center the product, and optimize the measurements. The waveform to the right is an example of one that has not been set up correctly. Notice that the echo range 2 is not locked on to the correct echo.

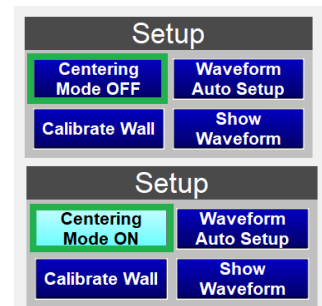


1. **Loading a Recipe**- The first step to setting up a run is to load a recipe. This can be done by clicking the "Recipe" button on the primary display and selecting the appropriate recipe.

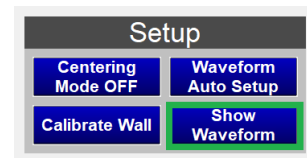
2. **UG Setup Panel**- Navigate to the Wall or Main Tab and observe the 4 Setup buttons (pictured to the right).



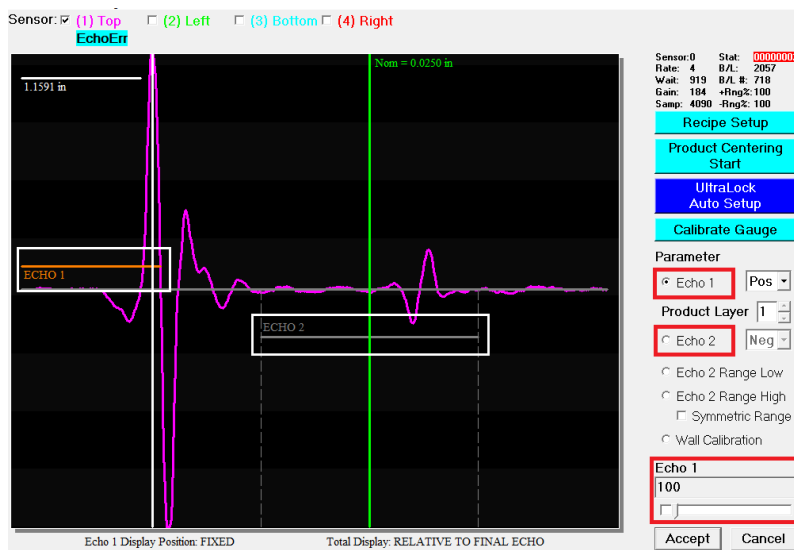
3. **Product Centering**- Center the product by selecting the "Centering Mode OFF" button (green box, right). This will turn it ON and bring up a position window in the top left indicating where the product is located in the field of the sensors. Use the knobs on the UltraGauge to adjust the positioning of the product until it is in the correct location (by aligning the crosshairs with the center of the field). Once it is centered select "Centering Mode ON" to turn it off.



4. Adjusting the Waveform- After centering, adjustments must be made to obtain a valid waveform. To observe what the waveform looks like and to make adjustments, select the "Show Waveform" button (green box, right) to bring up the waveform window. This window will display what your waveform looks like along with other measurement parameters. For a single layer product, the waveform has a first and second echo which need to be selected by adjusting echo settings to get the best results. After the waveform has been optimized, the user must calibrate the UltraGauge.



4a) Echo Thresholds- Since there is often noise occurring in these waveforms, an echo threshold must be incorporated to make sure the appropriate peak is selected for the first and second echo. These thresholds are shown as either orange or gray lines next to the "Echo 1" and "Echo 2" texts (white boxes). Orange lines indicate that an echo has exceeded the threshold whereas a gray line means that no data in the range has exceeded the threshold. The vertical position of the threshold lines can be increased or decreased via a slider bar at the bottom of the waveform screen after selecting the intended echo (Red boxes). All slider bars may also be adjusted using Page Up or Page Down keys on a keyboard.



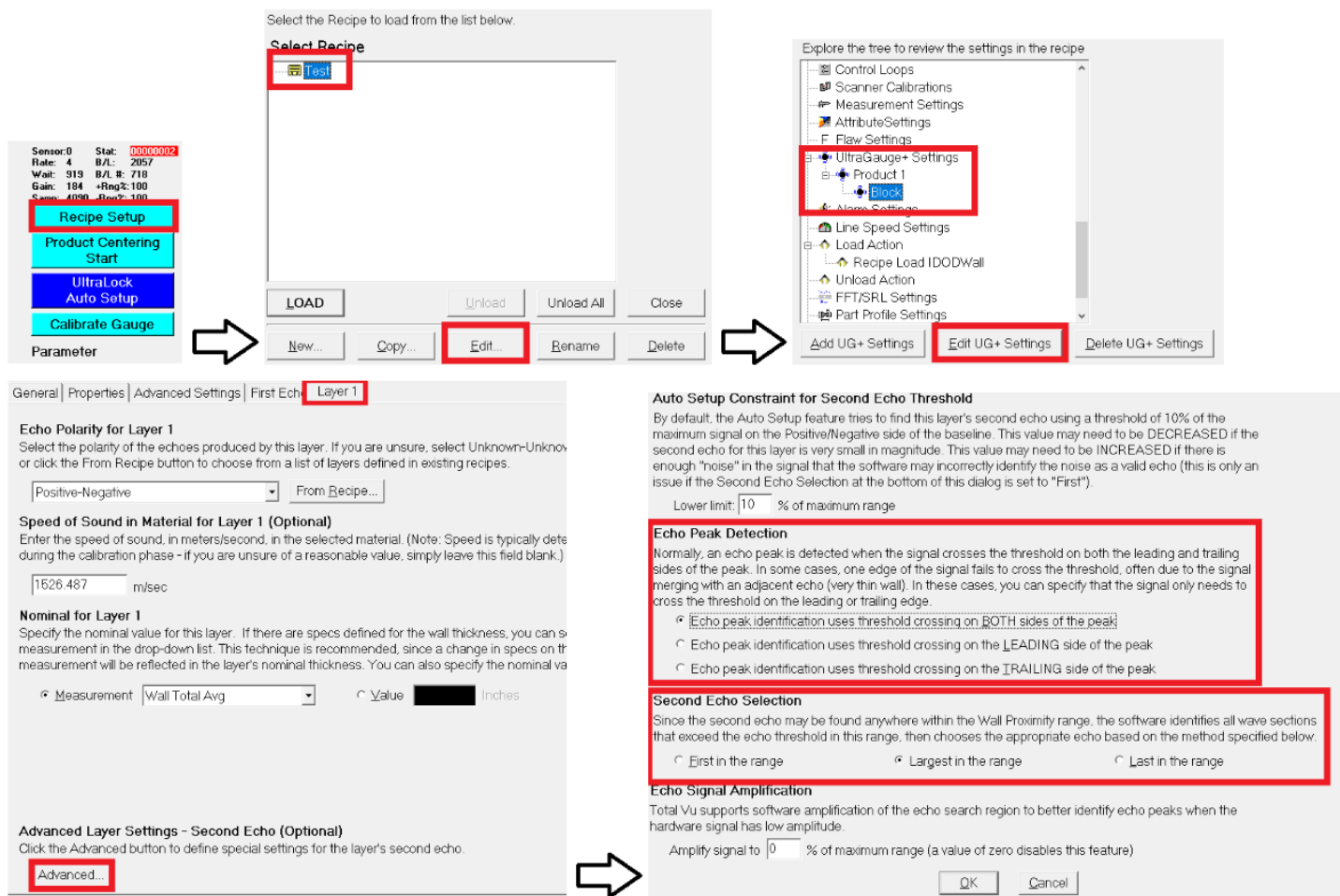
4b) Waveform Polarity- There are also polarities associated with each echo with a positive polarity referring to a peak above the middle line of the waveform and a negative being below the baseline (middle line) of the waveform. They can be changed by selecting the radio button next to the respective echo and selecting either "Pos" or "Neg" from the dropdown. These depend on the speed of sound of the material that the waves are passing through and also the frequency of the transducers. If the wave is travelling from a lower speed of sound to a higher speed of sound (e.g. from water to steel) then the polarity will generally be positive, while high speed to low speed (e.g. steel back to water) generally results in a negative polarity. However, there are a few exceptions to this rule. Finally, if there are 30 or 50 MHz transducers being used then these polarities will be flipped (e.g. high speed of sound to low speed of sound will now have a positive polarity). Higher frequency sensors such as these are typically used for measuring thin walls (less than .005").

4c) Echo 2 Range- The range for Echo 2 may also be changed by selecting the radio button next to "Echo 2 Range" and pressing page up or page down. This will increment the value by 10. Alternatively, the user can use

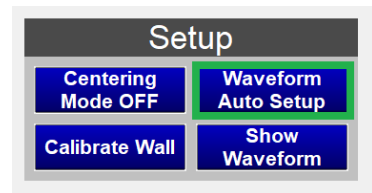
the arrow keys to increment by 1. This will increase or decrease the horizontal dimension (width) of the range in which the software looks for the second echo.

4d) **Echo 2 Position**- Changing the wall calibration setting causes the position of the Echo 2 search range in the waveform to shift either left (increasing speed of sound of the product) or right (decreasing speed of sound of the product). This can be done by selecting the radio button next to "Wall Calibration" and adjusting the slider bar at the bottom of the screen. This should only be done to obtain a valid wall reading. A formal calibration should be done after the waveform has been optimized (Step 6).

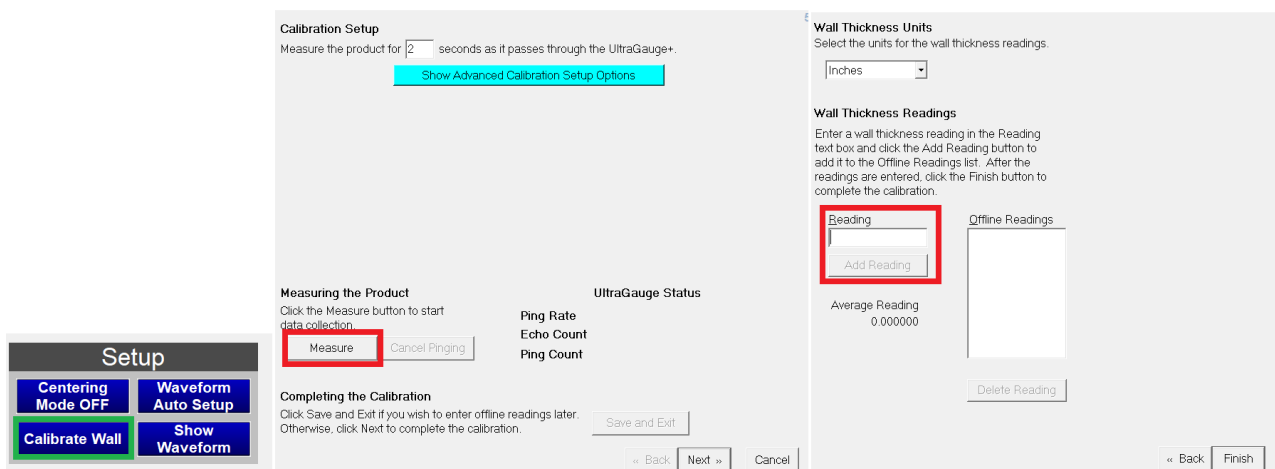
4e) **Peak Settings**- Sometimes there may be multiple large peaks that occur for the second echo. In this case there are special settings under the UG Block recipe. To get there click "Recipe Setup" (below) under the waveform window and select the "Edit" button at the bottom. Then, scroll down until you see the UltraGauge+ Settings, select the block being used and click edit. Navigate to the "Layer 1" tab and select "Advanced..." at the bottom of the tab. Once there you can see "Echo Peak Detection" and "Second Echo Selection". Echo Peak Detection is not often used but is useful for oddly-shaped second echos. Second Echo Selection allows for filtering out noise to get the correct echo when there are multiple large peaks present. "First in the range" means that the first echo exceeding the threshold will be used, "Largest in the range" means the largest echo will be used and "Last in the range" means the last echo will be used.



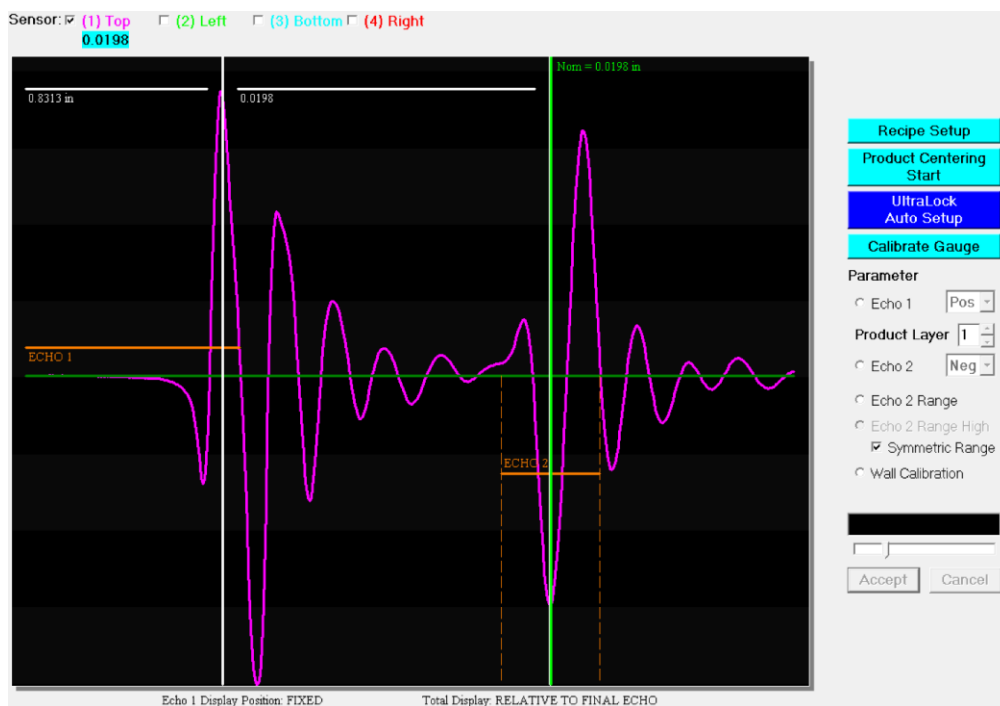
5. **Waveform Auto Setup**- Once a valid waveform is obtained, the "Waveform Auto Setup" (above) feature can be used by selecting the button on the Wall or Main Tab. Due to the complexity of the echo settings, it is recommended to use the automatic waveform setup button on the Wall or Main Tab. This optimizes the echo 1 and echo 2 thresholds along with the echo 2 range.



6. **Wall Calibration**- Select the "Calibrate Wall" button (Green box, below) on the Wall Tab to calibrate the UltraGauge. After pressing "New Calibration", select the "Measure" button (below) to measure the product. Once it is finished, press next. You will then be prompted to enter the average wall thickness taken from an offline measurement, or several individual wall readings for the product (below). Once finished, the speed of sound will be automatically adjusted to the correct value.



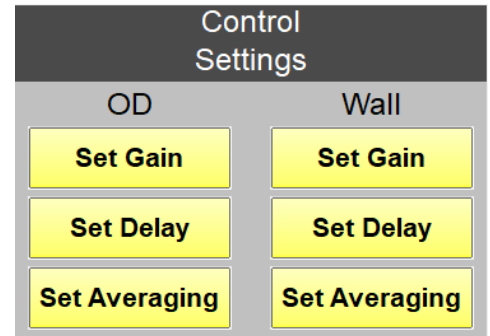
After performing these actions the product and waveform should be ready for optimal measurements. A good waveform set up will result in a waveform similar to the one below.



Control

Note: *The Control feature requires one control loop activated in the software for each device being controlled.*

Overview- Settings for control can be found by navigating to the "Settings" tab. The gain and measurement averaging (pictured to the right) for the OD Gauge and UltraGauge can be changed by selecting their respective buttons under the "Control Settings" panel. To determine the magnitude of a control change, deadband limit deviations and gain are used. Control measurement values are compared to the deadband limits to determine if a control change is required. If the control measurement is outside the deadband limits, the magnitude of the deviation from the deadband limit is multiplied by the gain to determine the magnitude of the control change. Clicking the control delay buttons takes you to the line layout screen. Control delays are used to ensure that the result of a control change is seen by the gauge before deciding to make an additional change.

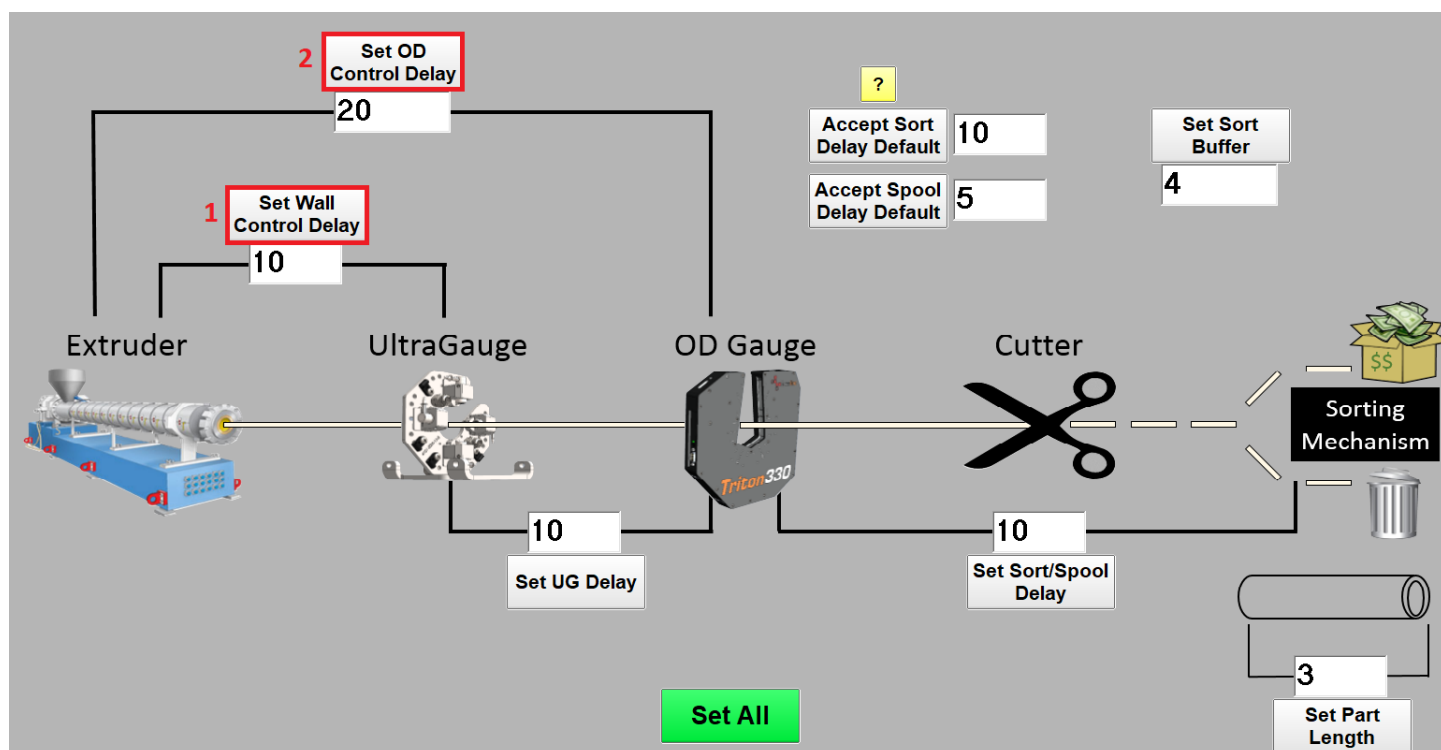


Adjusting the Gain- A larger gain corresponds to a larger control correction and vice versa. A gain that is too large can lead to over-corrections, while a gain that is too small may not make any change at all, or require several control changes to obtain the desired results. It is better to start at a lower gain and increase as needed until the system adjusts steadily and effectively.

Pulse Count vs. Pulse Width- The magnitude of the control output can be translated to either pulse count or pulse width. Pulse Count means that the system will send more pulses for a larger control change. Pulse Width means that the system will send a longer pulse for a larger control change. This setting is specific to the device being controlled, and can be changed by going into "System Configuration", selecting "Control", selecting the appropriate control loop, and navigating to the "Port" tab.

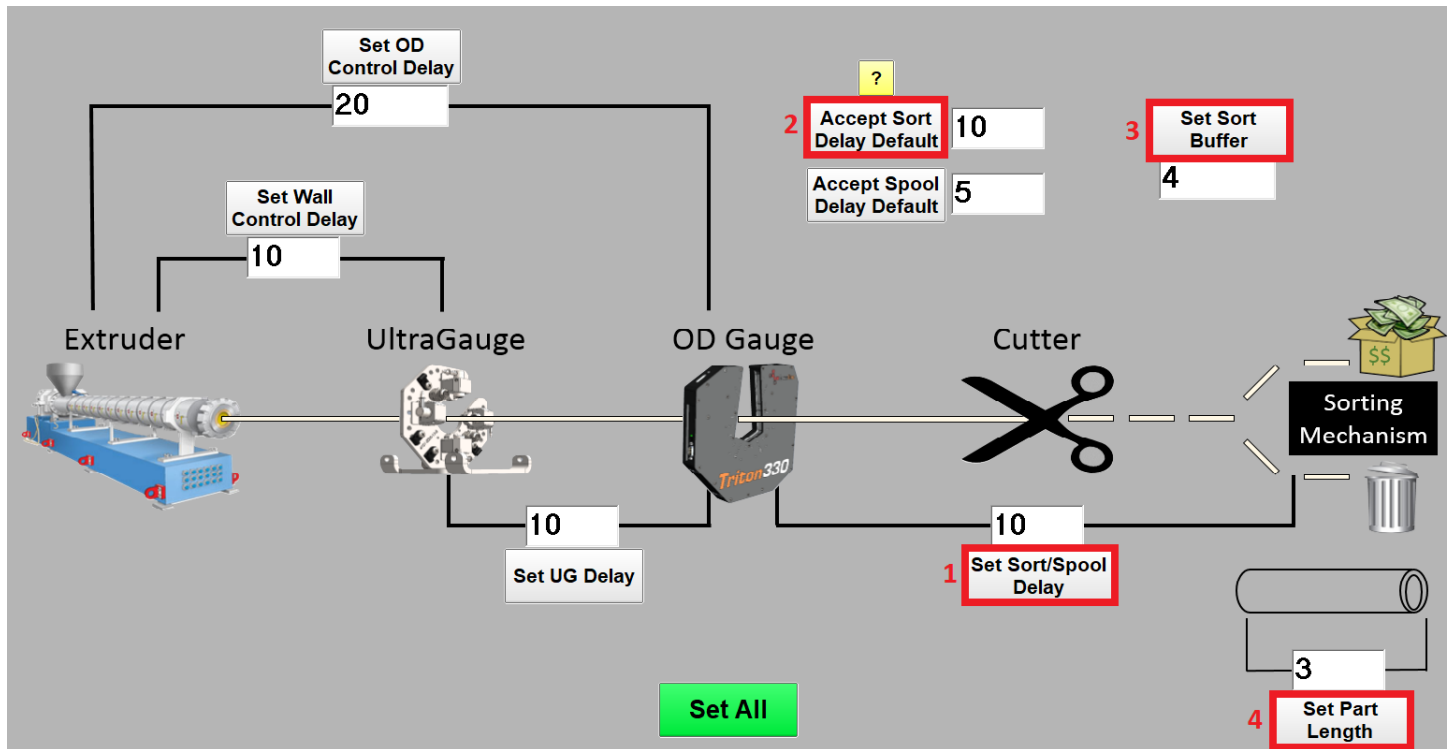
Control Measurement Averaging- Control measurement averaging determines how many feet or how many measurements are averaged before reporting a value for control. It is better to average over a long distance (5 feet or more, 1000 scans or more) to ensure that control changes are not made due to small defects or deviations in the product. The control measurement is meant to monitor the overall performance of the process, and not to detect short-term changes.

Setting Control Delays- The first control delay setting is the "Wall Control Delay" (below, 1) from the UltraGauge. This value corresponds to the distance the software will wait after making a control change before making additional control changes to alter the wall thickness. It is suggested to set this delay to a number slightly higher than the actual physical distance between the extruder and UltraGauge to ensure the effects of the previous change are seen before other changes are made. For example, if the physical distance between the UltraGauge and the extruder is 10 feet, a suitable delay distance might be 12 feet. Note: a suitable distance can be determined by looking at the control trend charts and observing the distance between the point where the control change was made and the point where the effect is observed. Next is the "OD Control Delay" (2) box. Similar to the wall control delay, this control delay corresponds to the distance between the OD Gauge and the extruder plus a small buffer.



Sorting

Note: The Sorting feature requires the Digital I/O and Encoder software options



The sorting feature is used to physically sort good and bad parts while only keeping data on the good parts. A bad part condition output is sent through a dry contact relay from a digital output box. By default, the relay is closed when the part is bad, and open when the part is good. The polarity can be changed by going into "System Configuration", selecting "Alarms", selecting "Sort", navigating to the "Connection" tab, and making the selection "Output Off when Conditions True".

Sort/Spool Delay- corresponds to the distance between the OD gauge and the sorting mechanism when a sorting recipe is loaded. When a bad reading is recorded at the OD gauge, the system will wait until the sort delay passes to scrap the part (box 1).

Sort Delay Default- when a sorting recipe is loaded, the sort/spool delay is set to be equal to the sort delay default value (box 2).

Sort Buffer- corresponds to the extra length that is scrapped after one or more bad parts (box 3).

Part Length- corresponds to the length of product for which the "bad part" output will remain asserted after all readings are in spec at the OD gauge. This ensures that an entire part is scrapped even if only a short portion of that part is out of spec (box 4).

If there is a bad wall reading detected by the UltraGauge, the bad part will be scrapped after the UG Delay and Sort Delay have passed. If a bad OD or ID reading occurs at the OD Gauge, the part will be scrapped after the sort delay has passed. This is to ensure that only the bad parts plus the buffer amounts are being scrapped. Once all readings are in spec at the OD Gauge, the output will turn off (indicating a good part) after the sum of the Sort Delay, Part Length, and Sort Buffer has passed. Temporary changes to the Sort Delay can be made by manually changing the value in the Sort Delay box and then selecting "Set Sort Delay". Temporary changes should not be needed unless there is a physical change in the location of the gauge relative to the sorting mechanism.

Under the "Settings" tab there are "Sort Measurement Settings" (below) to enable or disable measurements that are evaluated for sorting purposes. For example, if the "Sort Wall Conc" measurement is disabled, a part that has an out of spec wall concentricity measurement will not be considered a bad part. To sort based on wall concentricity again, simply enable the "Sort Wall Conc" measurement. Disabling the sort measurements will not affect any other system function or data logging.

Sort Measurement Settings			
Disable	Sort OD Avg	NO SCAN	Enable
Disable	Sort OD A	NO SCAN	Enable
Disable	Sort OD B	NO SCAN	Enable
Disable	Sort OD C	NO SCAN	Enable
Disable	Sort Ovality	NO SCAN	Enable
Disable	Sort Wall	PENDING	Enable
Disable	Sort Wall Top	PENDING	Enable
Disable	Sort Wall Left	PENDING	Enable
Disable	Sort Wall Bottom	PENDING	Enable
Disable	Sort Wall Right	PENDING	Enable
Disable	Sort Wall Conc	PENDING	Enable
Disable	Sort Wall Var	PENDING	Enable
Disable	Sort ID	Enable

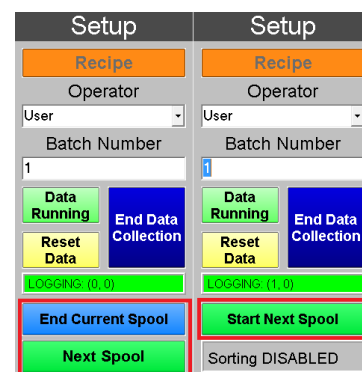
Spooling

OD 0.28355		Wall 0.0330		ID 0.2176		Recipe Spool Test 1	
	Current Spool	Previous Spool	Total Run				
Spool #	8	7					
Length	12.9	56.8	96.1				
Length OOS	0.0	0.0	0.0				
OD Average	0.28355	0.28355	0.28355				
OD Max	0.28355	0.28355	0.28355				
OD Min	0.28355	0.28355	0.28355				
Wall Average	0.0330	0.0330	0.0330				
Wall Max	0.0330	0.0330	0.0330				
Wall Min	0.0330	0.0330	0.0330				
ID Average	0.2176	0.2176	0.2175				
ID Max	0.2176	0.2176	0.2176				
ID Max	0.2176	0.2176	0.2176				

laserlinc	Main	OD	Wall	Trends	SPC	Spooling	Process Tracker	Status	Settings	Custom	Length	116.1
											Speed	110.22

The Spooling function is useful for applications where products are being put on several spools throughout one continuous run. Spooling, as well as sorting, are recipe-based operations. Note that if spooling is active then sorting cannot be. Refer to the Line Layout section for more information regarding spool-specific delays. A spooling recipe can be created via the "Edit Recipe" button in the Settings tab. A Spooling template can be used as a basis for the new Spooling recipe. Refer to the Recipe Settings sub-section in the Settings section for setting up a recipe via "Edit Recipe". When the recipe is loaded, the following buttons will be active.

The spool data will begin logging as soon as data collection is begun. "Ending current spool" will stop the spool data until "Start Next Spool" has been selected. This is useful if there is time between spool changes that should be ignored in data collection, such as a re-spooling application. If there is no such time between spools, "Next Spool" will begin data collection on the next spool without the need to start and stop spools. Users have the option to automate the execution of "Next Spool" via digital input from the spooler.



Flaw Detection

Flaw detection is used to detect short flaws on a product that would not otherwise be detected by measurements with long averaging periods. In Total Vu, flaw detection can be set up absolutely or relatively on any scanner measurement.

In order to set up flaw detection on a measurement, the user must go to “Edit Flaw Settings” in the Settings tab under Flaw Settings. A window titled “Edit Flaw Settings”, as seen above, will open up. All measurements affected by changes in these flaw settings can be seen in the “Flaw Detection Measurements” section. A flaw length must be specified under “Flaw Length”. The length can be read via scans, milliseconds or feet. The minimum number of units needed to detect a flaw as well as the number of units read for one flaw before resetting must be set as well. For example, if settings are set to 5 out of 20, the system begins grouping measurements into groups of 20 and looks to see if 5 of them have satisfied the flaw conditions set in the Absolute Flaw Size or Relative Flaw Size sections. If there is a reset of 1000 scans, that means the scanner needs to see 1000 good flaw measurements before ending the current flaw and looking for the next flaw.

Absolute vs. Relative: It is important to note the difference between absolute and relative flaw detection. When using absolute flaw detection, the user detects flaws via a set value from nominal. This value can be determined as a user input value, a percentage away from nominal, or from the specifications in the recipe. When using relative flaw detection, Total Vu will detect flaws based on a change in dimension or percentage change. For example, if a flaw causes a rapid change in outer diameter, it can be detected via relative flaw detection even if the measurement does not go out of spec or satisfy the absolute flaw condition. Absolute and relative flaw detection can also be used in conjunction with each other. This is useful if some flaws are significant but do not pass the absolute flaw detection threshold or vice versa.

Other Settings: The averaging of scans in detecting the flaws can be adjusted under “Flaw Averaging”. This will determine the number of scans used in calculating a measurement that is put through the flaw detection criteria. A lower scan averaging (1-3) is ideal for detecting short flaws, although this may cause the system to register false positives for products with uneven outer surfaces. An offset can also be set in flaw readings if relevant (feet) to delay the flaw signal. This should be set to 0 if sorting based on flaws, as these distances have already been accounted for in the line layout. Any flaw detection settings can be saved to the configuration (global) or active recipe only. If flaw settings are not saved, they will be overwritten when the system restarts or when the next recipe is loaded.