

Introduction to Import and Measure

This guide shows how to do the following:

1. IMPORTING a STEP file of demo tube 5
2. SENDING tube 5 data to a BENDER
3. MEASURING demo tube 5
4. QUALIFYING demo tube 5
5. CORRECTING a bender
6. Using a FARO Quantum ScanArm

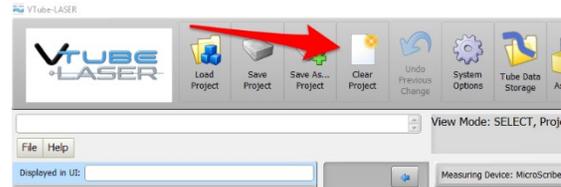


The steps in this guide are demonstrated in a video available online at this link:

https://www.advancedtubular.com/vtube-laser/vtl_v3_Intro_To_Import_And_Measure_VTube-LASER_with_FARO_and_demo_tube_5.mpg

Before working through these steps, it is very important that you read through the **setup guide** document that helps you set up VTube-LASER before the first measure. You can find that document here:

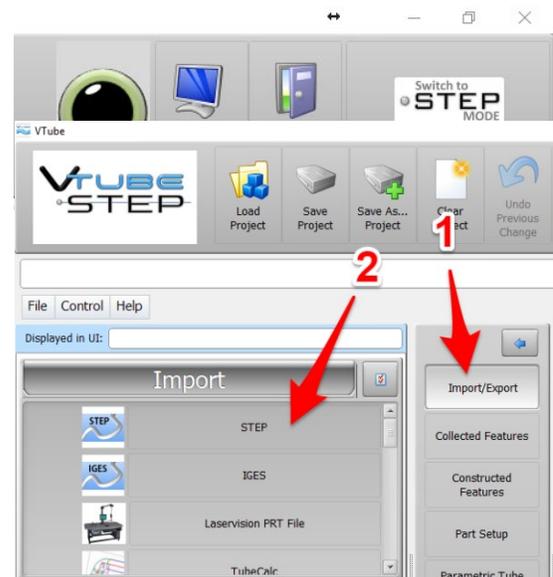
<https://www.advancedtubularsupport.com/vtube-laser-faro-docs.html>



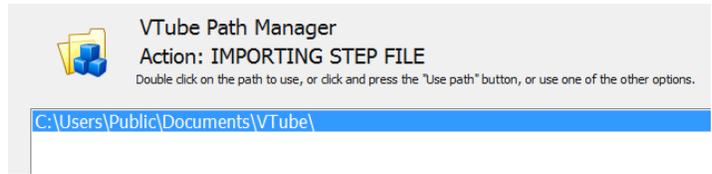
1. If VTube has a tube showing in the viewport, then press the **Clear Project** button in the tool bar on the top of the VTube-LASER window.

2. On the far-right side of the toolbar, press SWITCH TO STEP MODE button. This will allow switch you to the window that allows you to import solid models into VTube.

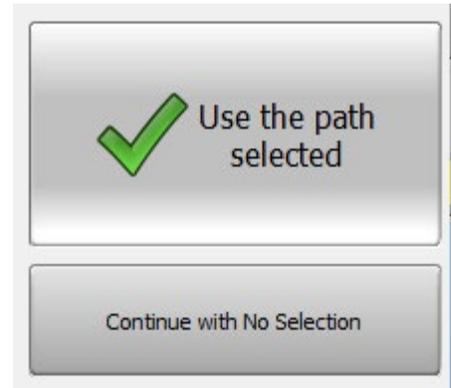
3. You are now in the VTube-STEP Window. Press the **Import/Export** button in the Navigation Pane, then press the **Import STEP** button in the Import menu.



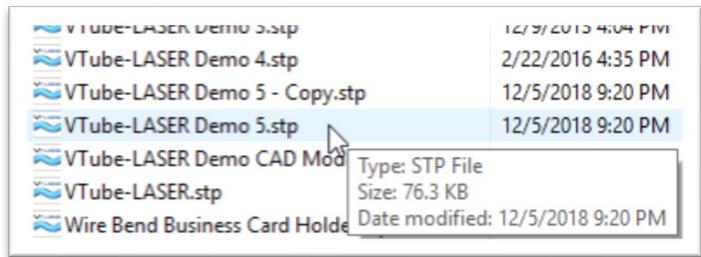
- The page manager contains a persistent list of paths to allow for better management of VTube project files by customer, project, or application.



Double click on the default VTube path in the Path Manager. Or you can click on the path, then click on the button on the right side that says “Use Path Selected.”

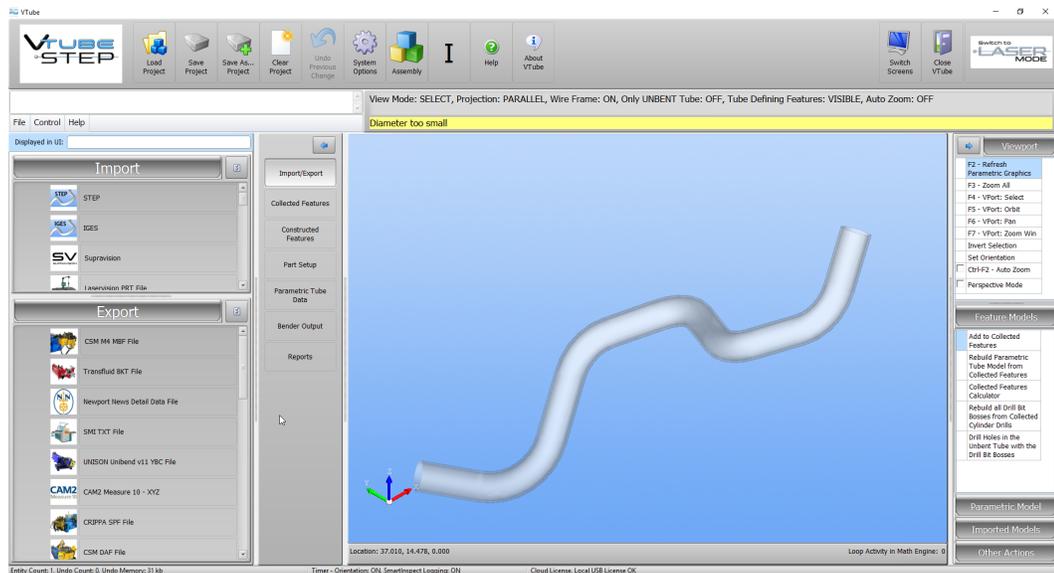


In the Windows explorer, find **VTube-LASER Demo 5.stp** file and load it into VTube-STEP.



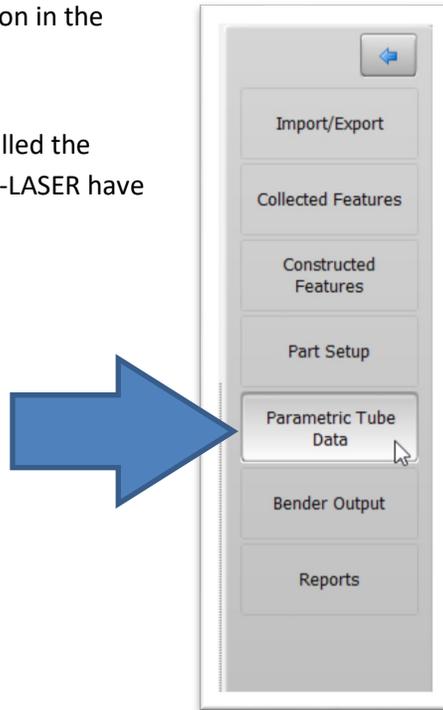
Tip: click on “V” to quickly move to the part of the list that have filenames that start with “V”.

- After the model is imported, the screen will appear like this:



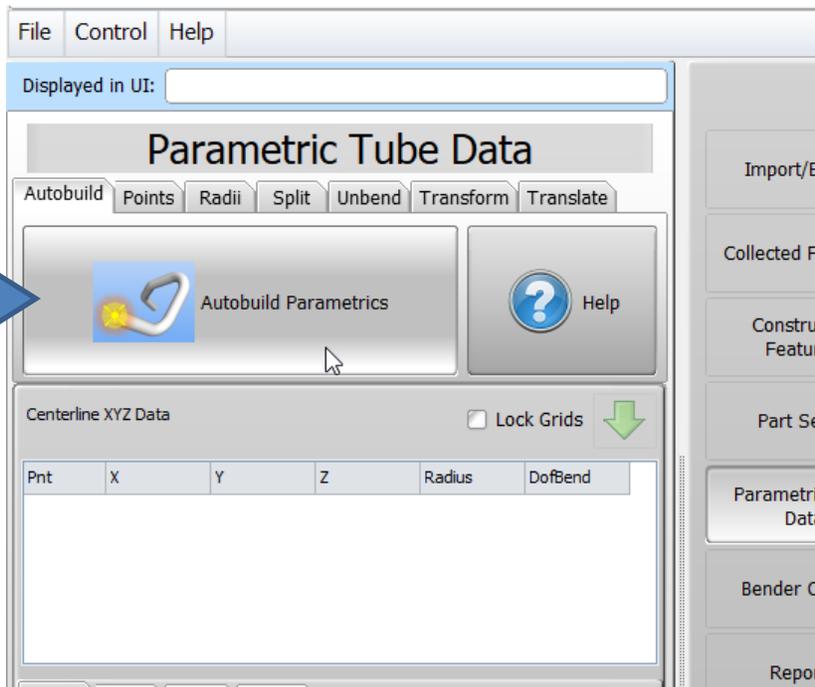
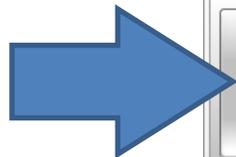
6. Press the **Parametric Tube Data** button in the navigation pane.

Tip: The vertical panel of buttons in VTube is called the **Navigation Pane**. Both VTube-STEP and VTube-LASER have a Navigation Pane.



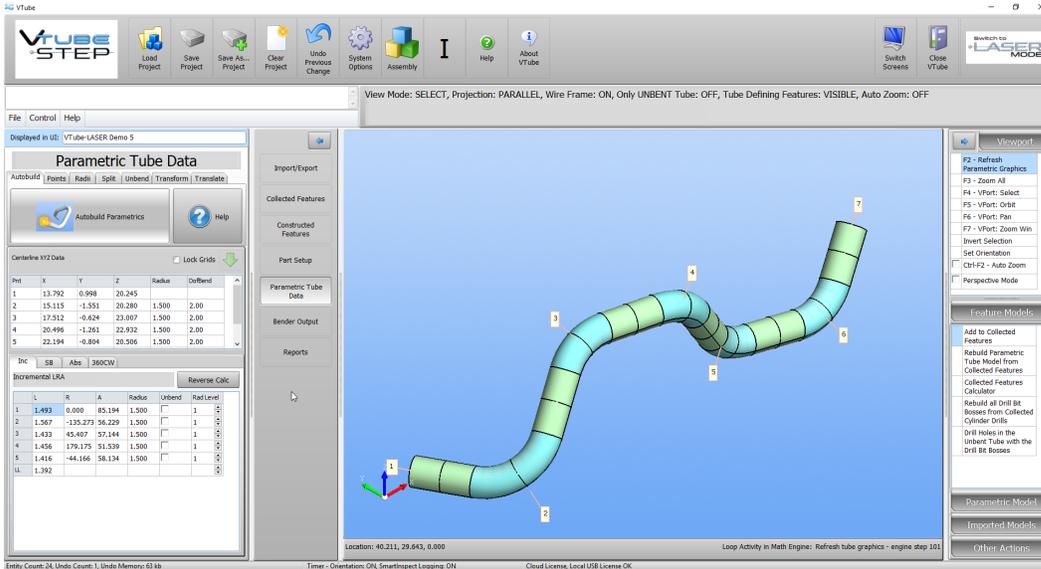
7. Enter the Autobuild tab menu and press the **Autobuild Parametrics** button.

Tip: Autobuild only works for clean tube models like the model shown here. “Clean” means that the model has no extra components, holes, or coping.

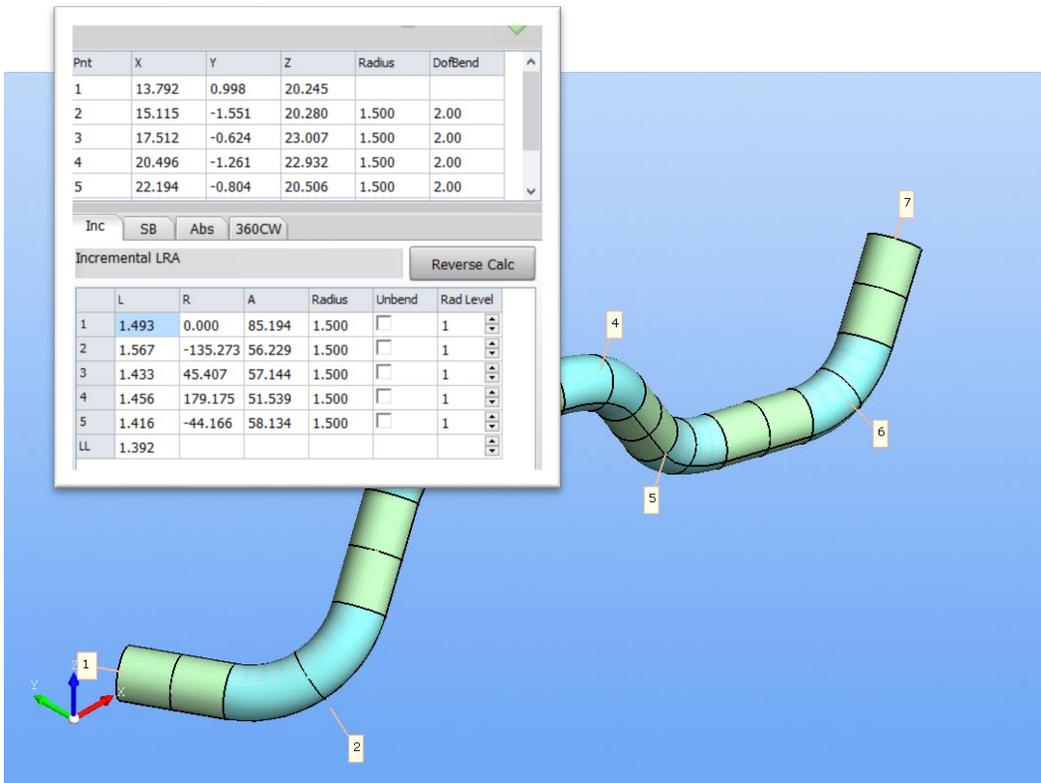


For other tubes, you can use the surface COLLECT method to select each straight manually. The collect method is not covered in this document.

8. VTube-STEP will automatically build the parametric tube after having sorted the straights from the bends like this:



The centerline XYZ data and LRA bender will show in the grids on the left. These numbers will build a tube model on top of the imported tube.



- Click on the **Part Setup** menu in the navigation pane to see how VTube automatically calculated what it could be extracted from the model.

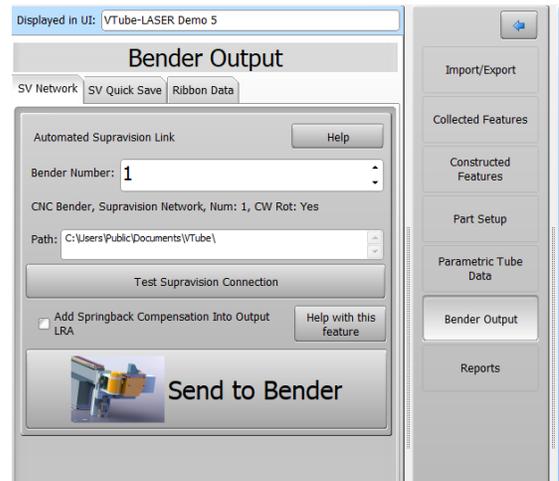
During the calculation, VTube calculated at least these values...

- The **Diameter** (row 16)
- If an inner wall is in the model, then the **Wall** (row 19)
- The **Cut Length** (row 25)
- And **Radius 1** (row 26).

15	Diameter Profile Setup	Cylinder	
16	Diameter	0.750	inches
17	A-End Diameter	0.750	inches
18	B-End Diameter	0.750	inches
19	Wall	0.050	inches
20	Rec Width 1	1.000	inches
21	Rec Width 2	0.500	inches
22	Rec Wall	0.059	inches
23	Rec Fillet Radius	0.125	inches
24	Rec Angle	0.000	deg
25	Cut Length	16.826	inches
26	Radius 1	1.500	inches
27	Radius 2	0.000	inches
28	Radius 3	0.000	inches

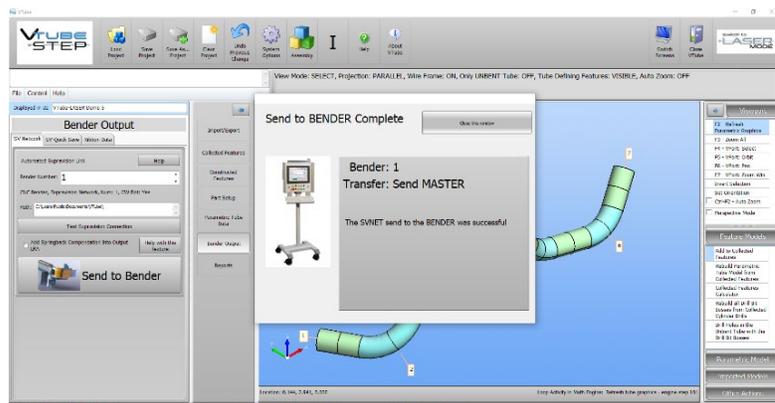
- Click on the **Bender Output** menu in the navigation pane, VTube-STEP can send new bender data out to any one of a group of 100 benders if they are on the network.

VTube supports many different bender protocols. The most common protocol is one that VTube-STEP users here.



- Press the **Send to Bender** button to see what happens when data is sent to a bender using this protocol.

The operator would then go to the bender and find the new bender data in the control. He/she would then build up a program to bend the part. Note that bender data was *never manually entered* using this method. Not only is the method of programming tube bender data *faster*, but it's *safer* too – because mistakes with manually entering numbers become a thing of the past.



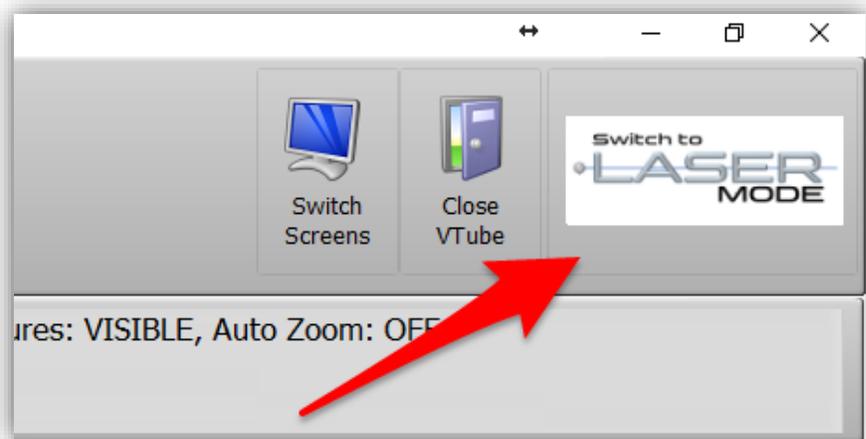
12. The import and calculation of the master data is complete.

In our training example, we are simulating the process where the bending machine has received the data from the imported model. The operator has bent the tube. Now we have the bent tube in-hand. (It is the actual demo tube 5 that we send with the demo kit.)

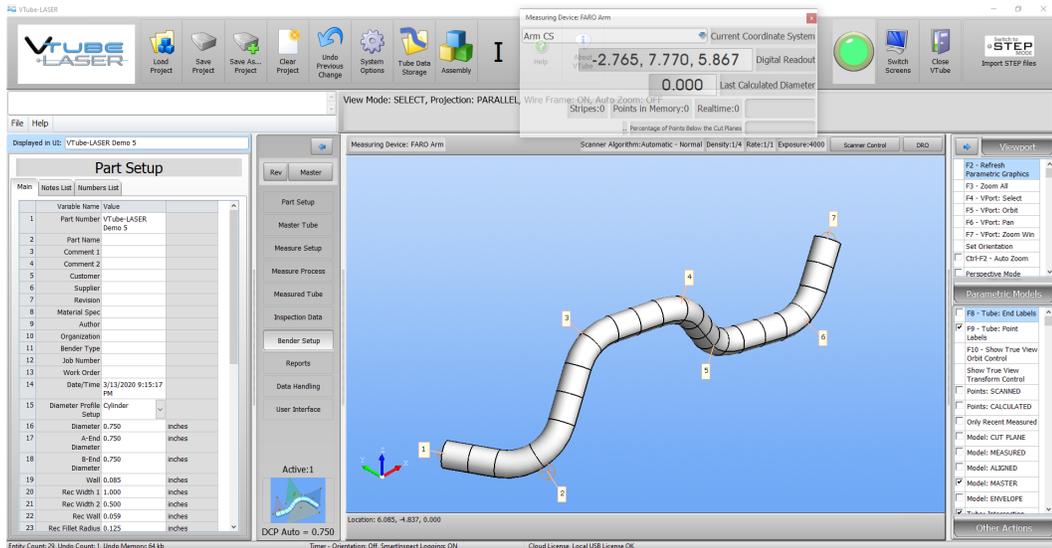


13. Press the LASER button in the upper right corner to change to LASER mode. The LASER window is the only one that connects to the FARO arm.

When you press this button, VTube-STEP will automatically close any control and guide windows.



14. If the master tube is not automatically displayed on the screen, then click on the screen like you see in this screen image, then...

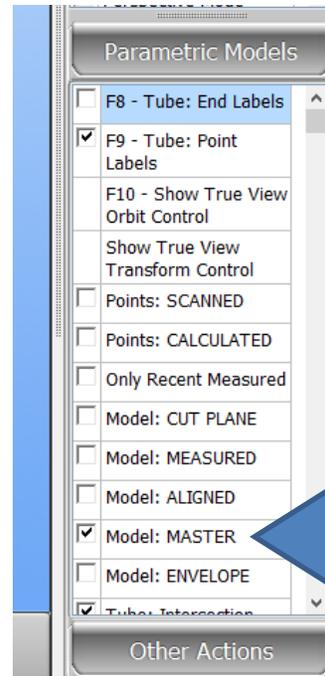


...enable the Model: MASTER tube model on the right side of the screen under Parametric Models, then press F2 then F3 to redraw and “zoom all” the graphics. (See the blue arrow.)

The tube data in the VTube-STEP window is always the same data as the **MASTER DATA in the VTube-LASER window**. Both sets of data are from the same database in VTube. If you change a number in one XYZ grid, then it will also be changed in the other grid automatically.

The Master data is used to help us know if we have a good part after measurement by comparing the measured data.

You are now ready to measure the part.



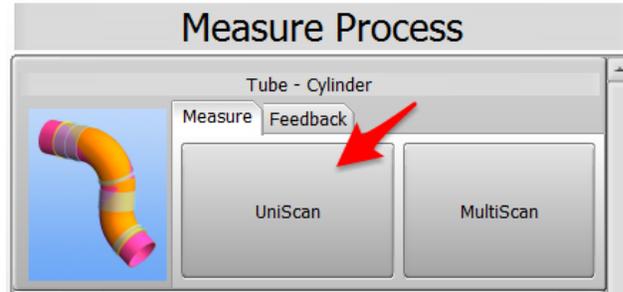
Measuring and Qualifying the Tube Shape

Follow these steps to setup to measure the tube.

1. Go to the Navigation Pane and press

MEASURE PROCESS

menu and find the Tube - Cylinder panel at the top of the choices on the left side of the screen. Press the **UniScan**.



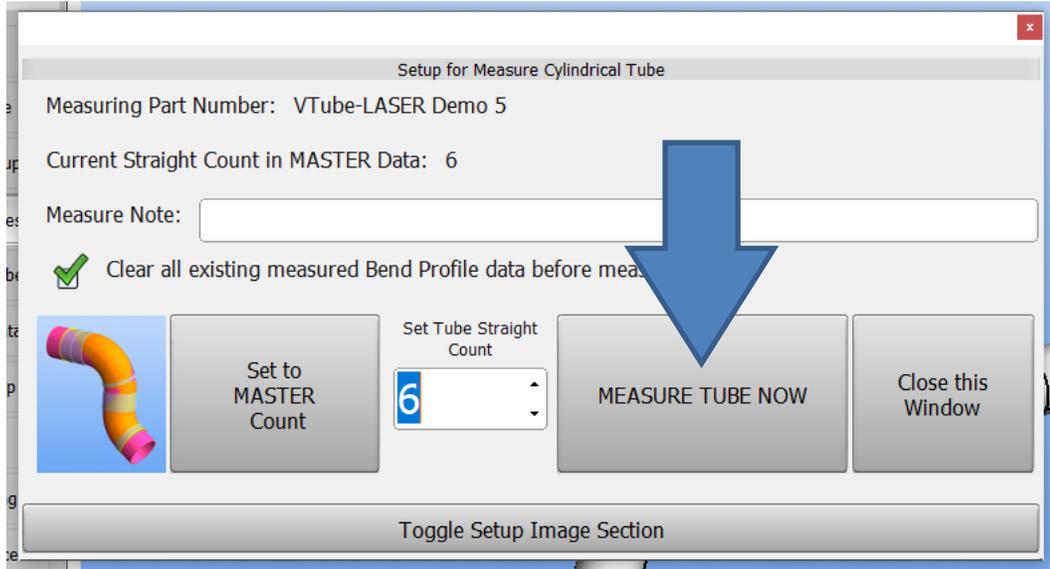
UNISCAN versus MULTISCAN Note

We are going to learn using the **UNISCAN** method to measure tubes because it offers the best measurement results and protects the operator better than MultiScan.

The UNISCAN motion feels like spray-painting the tube with laser stripes. When you press the green button, then VTube takes in the laser stripes. During scanning, when you release the green button, the cylinder centerline will calculate. As a reminder: **It is important to hold the green button down during the entire motion of scanning.**

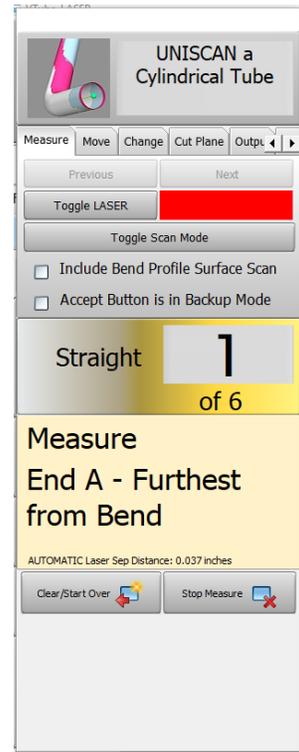
The other method of scanning, **MULTISCAN**, is ideal for situations where the straights are bowed or curved. In MULTISCAN, you aim near the first tangent, then hold the arm still, then press and hold the green button until you hear the scan complete sound. Then you do the same at the other end of the straight.

2. Press **MEASURE TUBE NOW**.



3. Measure the part following the instructions in the guide box like the one shown here.

The yellow box tells you the current step.



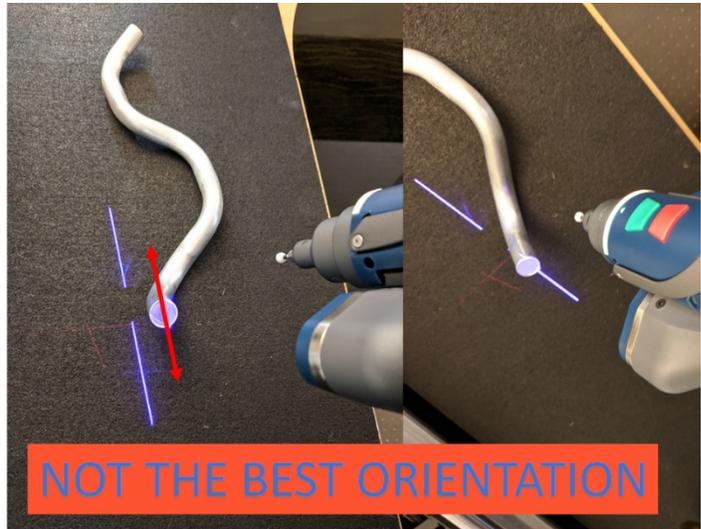
4. Measure the end A using the technique shown here.

The first bend is the bend that is close to 90-degrees.

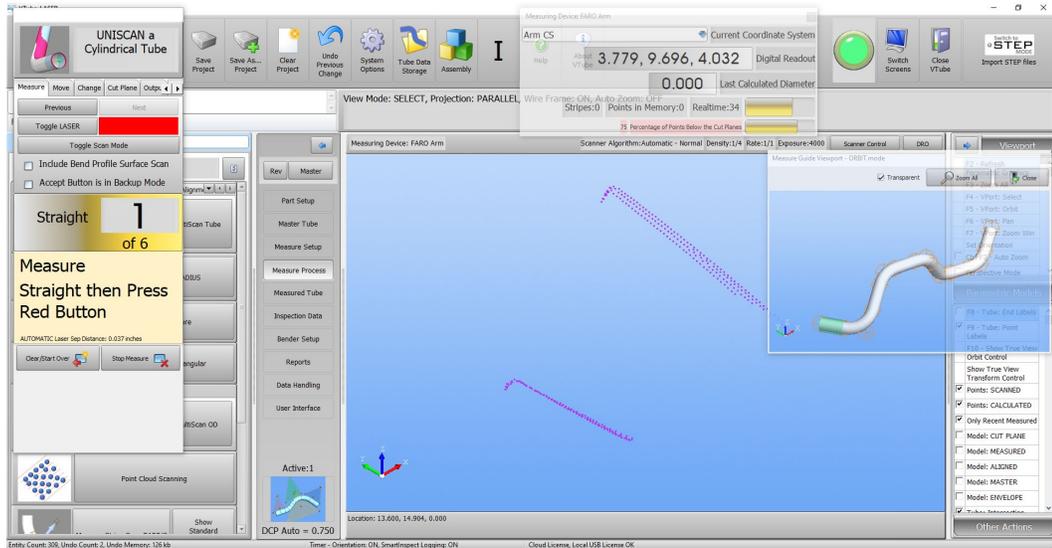
After performing GR&R tests, we are confident that we've discovered the best-practice for laser alignment on the ends. This is how it works.

It is important to align the laser so that the closest object to scanner's field of view is the tube and not the table. Position the laser line to the left and right of the tube end like we show in the top image.

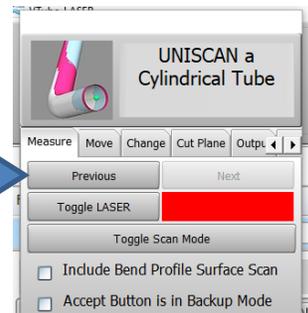
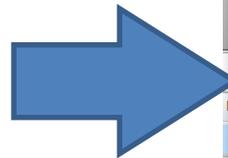
The bottom image demonstrates what orientation to avoid. This orientation that increases the chance of flyer points where the end of the laser is closer to the camera. (In this image this is the part of the laser line that is on the bottom of the image.)



5. VTube-LASER is designed to be very visual. As of version 3, we have designed the end-scan point cloud display to be very clear on the screen with a dense point cloud. It should look something like this:

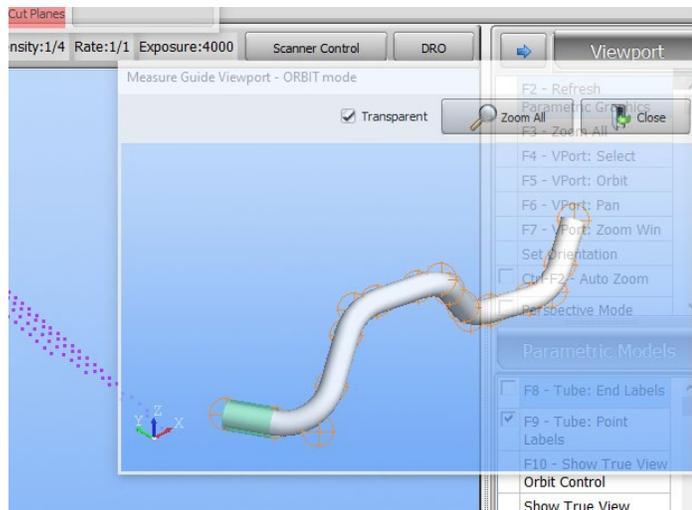


Ideally, you should see tails on the end of the end-scans that will allow you to confirm a good end-point placement after scanning the first straight. If you are not sure about the quality of the end scan, then press the Previous button in the UNISCAN window and measure the end again.



6. The Measure Guide Viewport should display on the right side of the screen like shown here. If it does not, then it can be enabled in Measure Setup, Other Tab, Row 8 – Automatic Display of MASTER.

In the viewport, the green band shows what VTube expects you to scan next. You can use this image to be sure that you are scanning the correct straight in the tube.

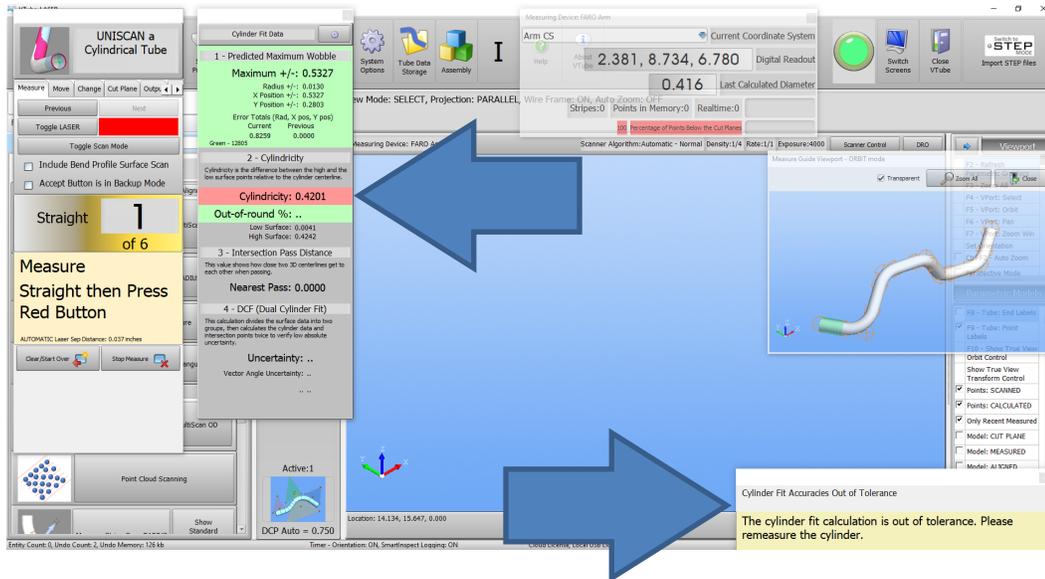


7. Measure the first straight. Start at the end nearest the end of the tube and scan toward the first bend. Do not start OFF the end of the tube – but ON the cylinder and near the end.



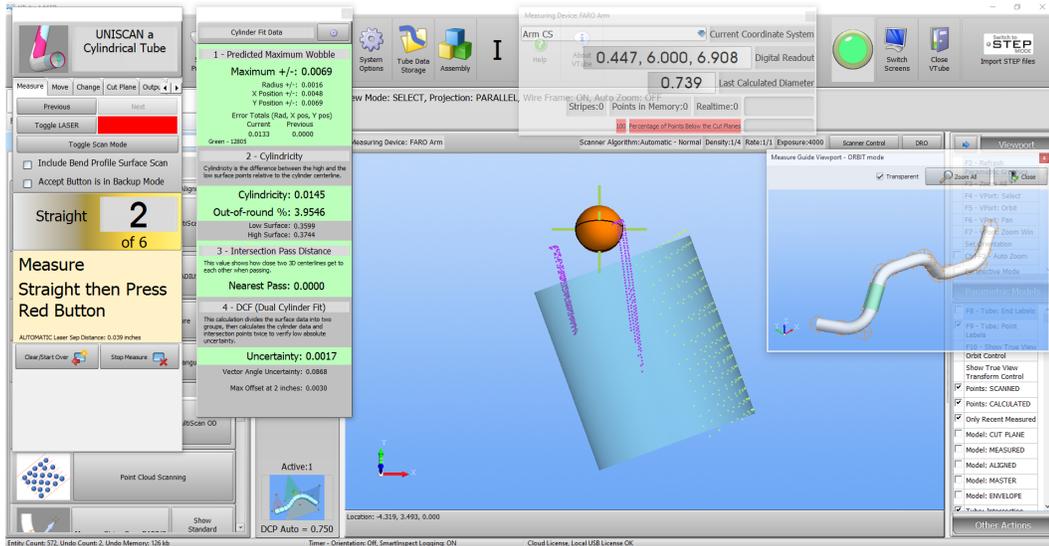
The moment you let go of the green button, VTube-LASER will attempt to calculate the centerline of the cylinder – so be sure to move down the straight with the green button pressed.

8. If the cylinder calculation fails, you will see red somewhere in the Cylinder Fit window with a yellow guide box on the bottom right like this:



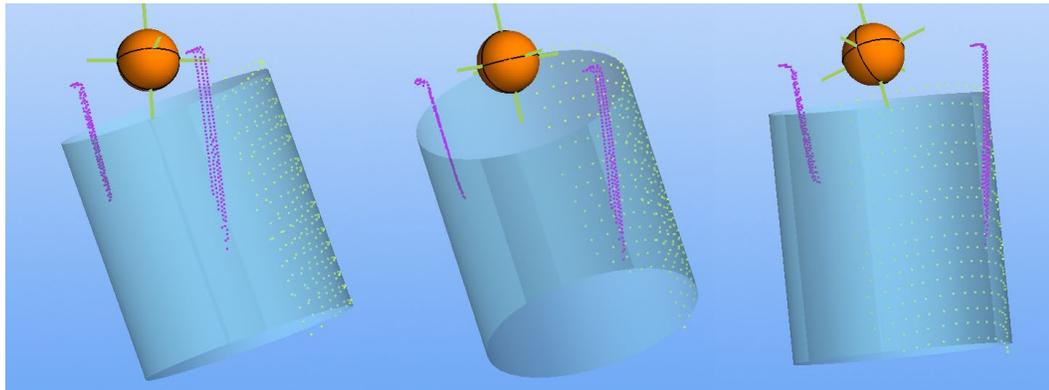
This feedback is helpful because it protects the operator from making mistakes – like scanning into a bend. If this happens, then you will hear an error sound that is designed to sound like an error. You don't need to reach for a mouse or change straights. Just rescan the end until you get all green in the Cylinder Fit window with an accompanying high-pitched mallet sound.

- When the cylinder calculation succeeds, you will see all green in the Cylinder Fit window like this.



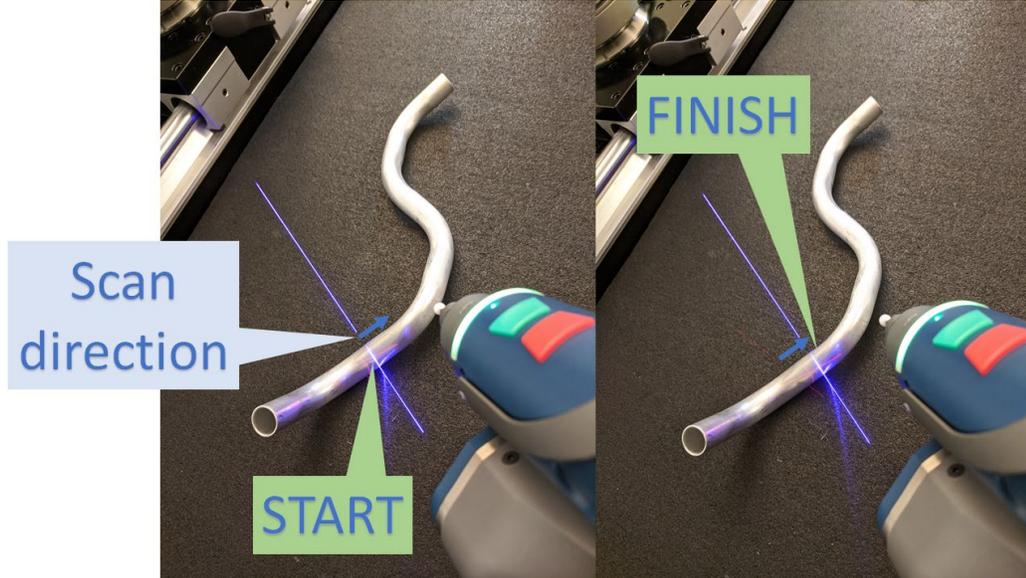
VTube-LASER makes the last cylinder calculated true (flat) to the screen so that the operator can confirm that the projected end point is exactly where it should be. The large orange ball is exactly where it should be – this is a good end scan.

You can switch to ORBIT mode by press the mouse wheel, pressing F5, or press the “F5 – VPort: Orbit” option on the right in the Viewport menu, then dragging the mouse.



It is clear from this image that the end point is where it should be, so we can move on to scan the next straight.

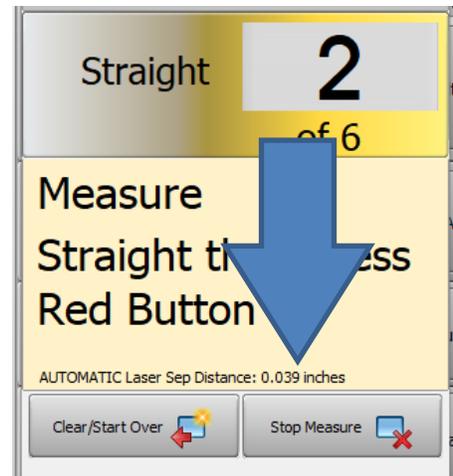
10. Scan straight 2 like this. Be careful to keep the laser out of the bend sections.



Don't be concerned about whether enough data is entering VTube-LASER on such short straights with one pass of stripes.

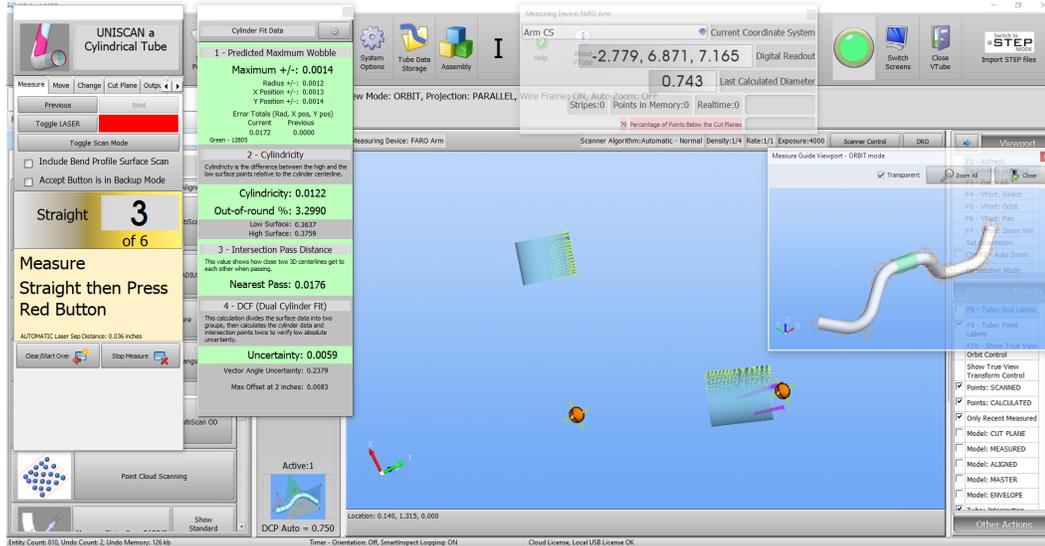
VTube-LASER automatically sets the laser line separation distance based on the length of the straights. You can always know that VTube-LASER is taking enough data in – even if the straight is short.

In fact, you can always know the laser separation distance because VTube-LASER reports it in the UNISCAN window (See the arrow in the image on the right.)



As in the first straight, if the cylinder calculation fails, then just rescan until it succeeds.

11. This is how the screen will appear after straight 2 has been scanned successfully.



You will see two cylinders with an intersection point between them.

12. The Cylinder Fit Data window is very important because it gives helpful feedback about the quality of the most recent cylinder calculation. Each cylinder is required to pass several tests before VTube-LASER will allow the operator to measure the next straight. This keeps operators from measuring the entire tube without knowing that one of the scans is a bad scan.

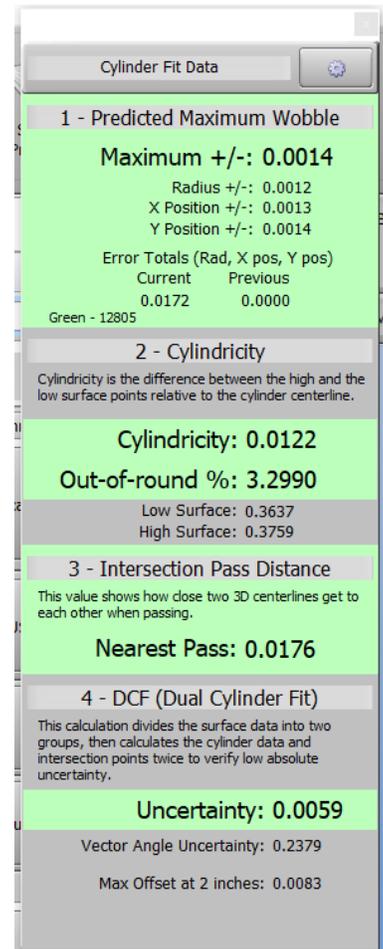
Maximum Wobble predicts how accurately the math engine believes the projection to the centerline is. The greater the wobble, the more the potential error.

Cylindricity is the total variance of the surface points from low to high from the centerline of the cylinder.

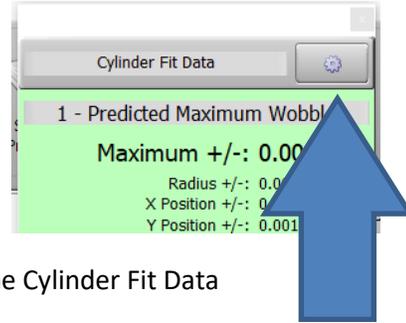
Out-of-round% is similar to ovality – but without reference to a nominal diameter.

Nearest Pass (for straights 2 and up) is the distance by which the two intersection centerlines miss each other at the intersection point in 3D space.

The **Dual Cylinder Fit** breaks the cylinder stripes into two groups then calculates two centerlines then compares them. The resulting value is called Uncertainty. If uncertainty is below 0.020” (or 0.5 mm), then the cylinder calculation is considered highly certain and it is allowed to pass.



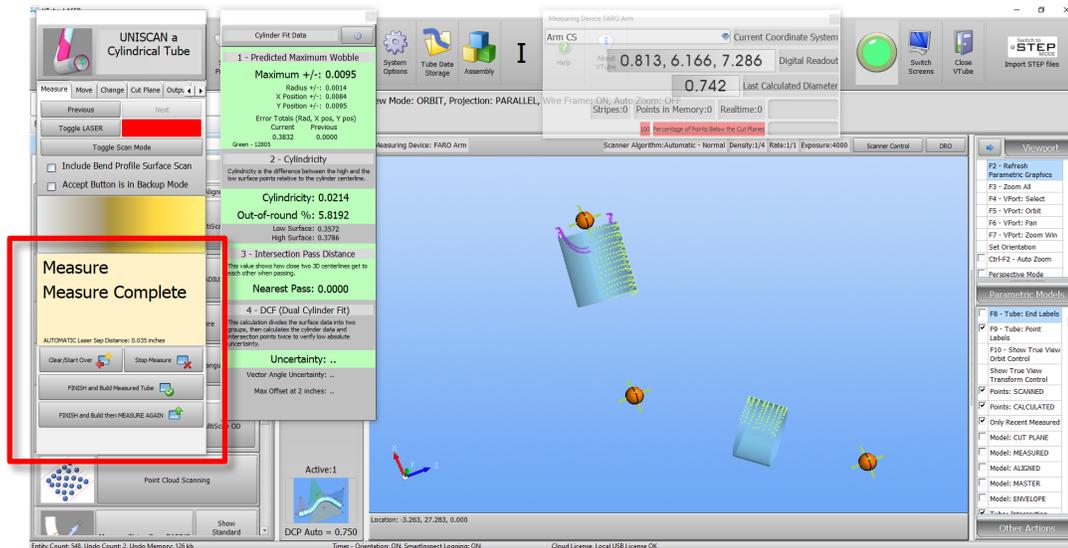
- The Cylinder Fit **tolerances** that control if scans are considered good or bad can be changed for each project if necessary. For example, for tubes that are very deformed and need more tolerant values to pass a cylinder measure, you will want to open these tolerances.



To change the cylinder fit tolerances, click on the button with the gear in the upper right corner of the Cylinder Fit Data window.

Opening tolerances is rare for most cases. However, if you suspect that it is necessary, then please allow us to show you which variables should be adjusted.

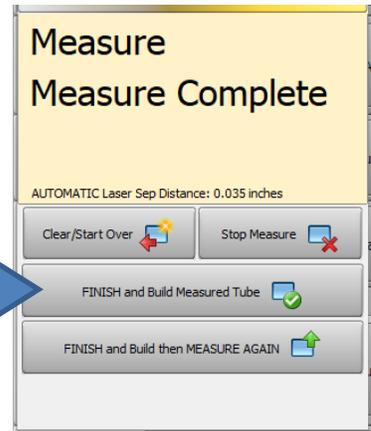
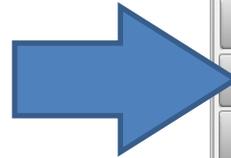
- Measure the rest of the straights and then scan End B. This is how the screen will appear at this point:



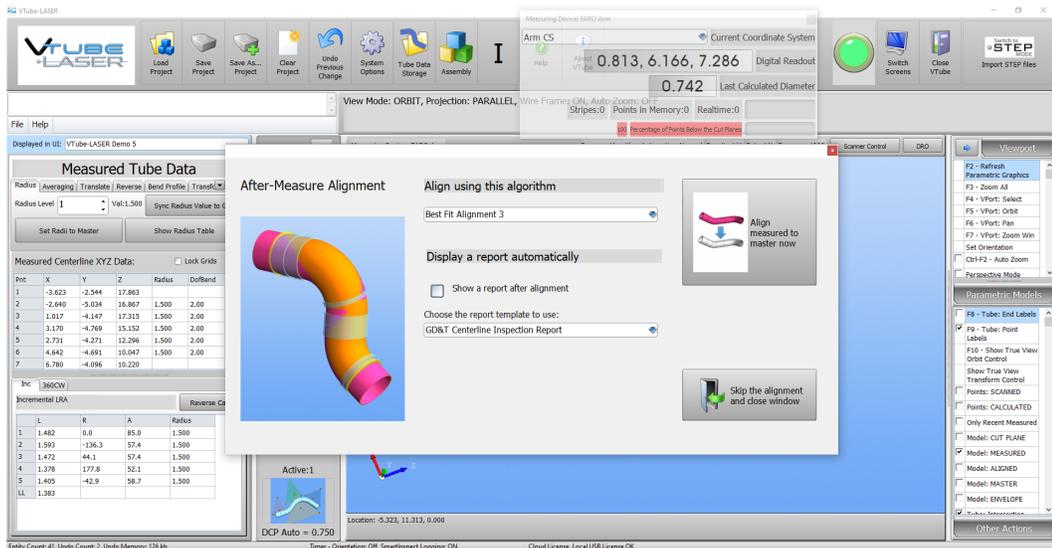
The yellow box inside the UNISCAN window will say “Measure Complete” and show some new buttons on the bottom of the of this window that allow you to move to the next step.

15. Press the **FINISH and Build Measured Tube** button.

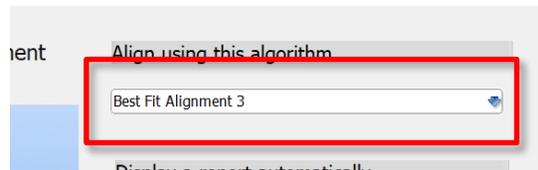
Tip: The other possible choice is to press the button below it which reads “FINISH and Build the MEASURE AGAIN.”



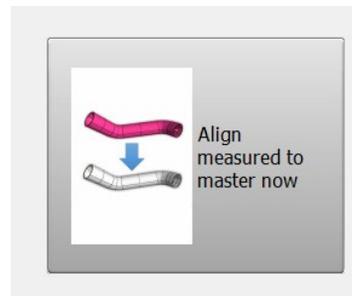
16. The After-Measure Alignment window will display.



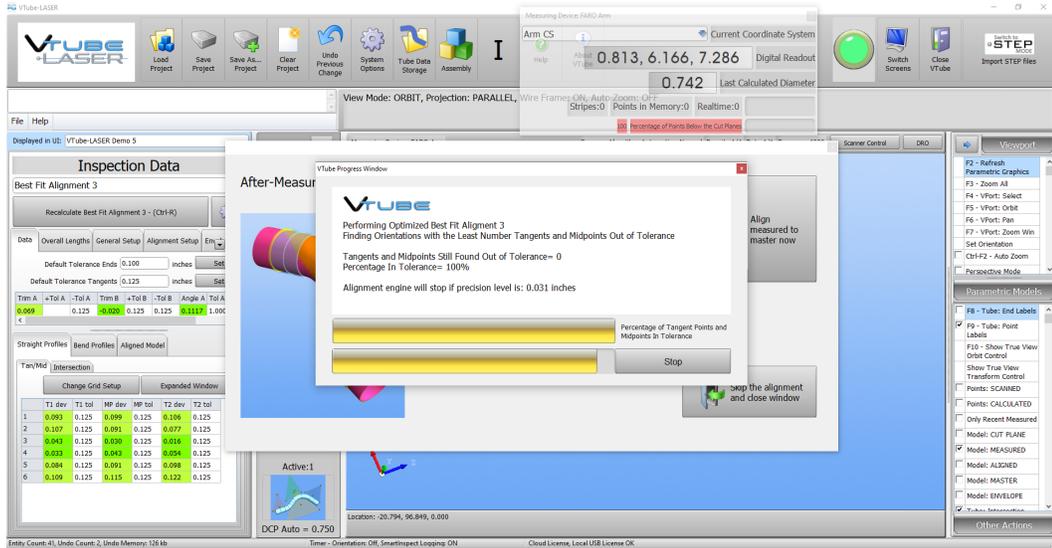
17. Be sure the “Align using this algorithm” value is set to “Best Fit Alignment 3”. This is the best “Best Fit” in VTube-LASER in this version because it is the most comprehensive.



18. Press the large “Align measured to master now” button.

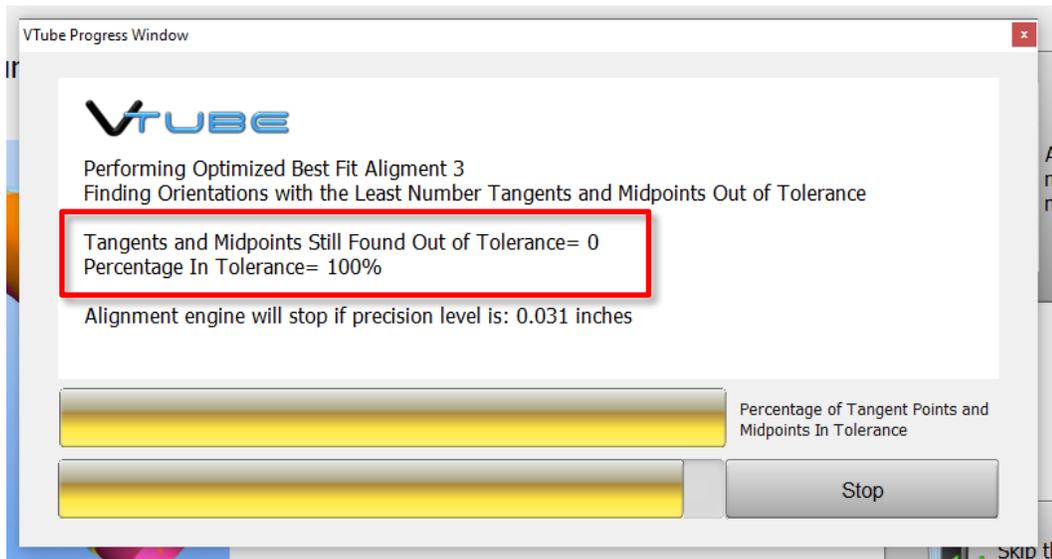


19. VTube-LASER will begin its alignment process. You will see changing colors on the left side. They will be either green or red.

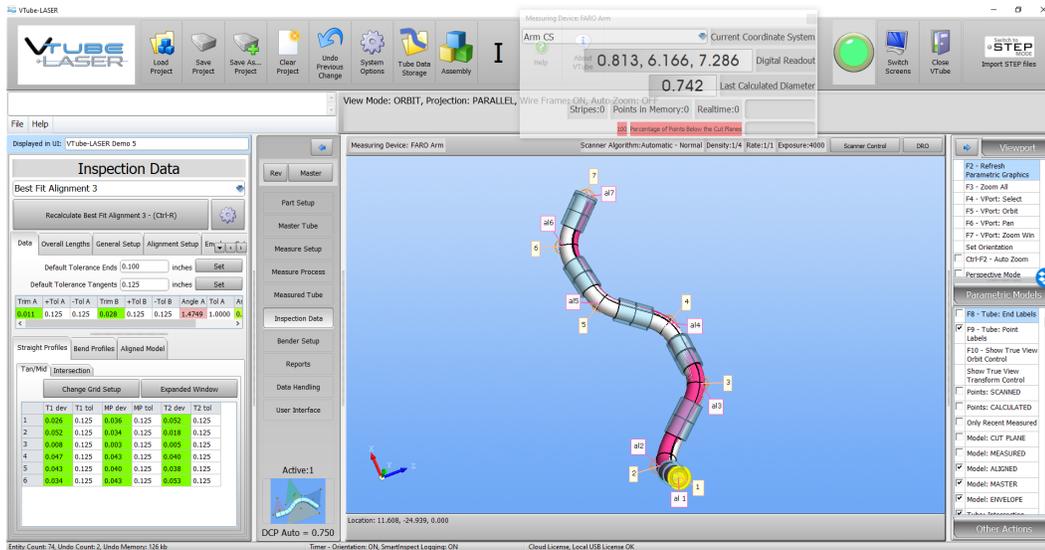


20. The first item to look at is the middle progress window.

Even though the alignment is not complete, we can see that “Tangents and Midpoints Still Found Out of Tolerance= 0”. This means that we can know that this part’s shape is in tolerance even before the alignment is complete.



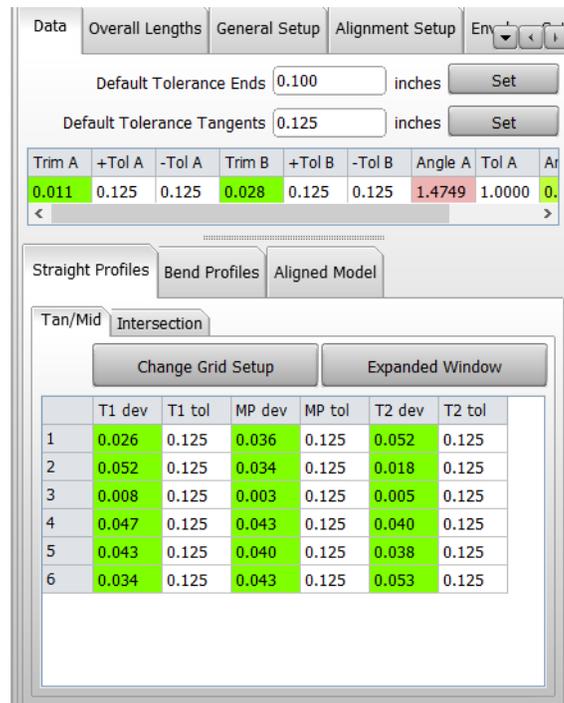
21. When the alignment is complete, the progress window will close and you will see the **Inspection Data** menu on the left and an alignment of tube tubes inside tolerance envelopes.



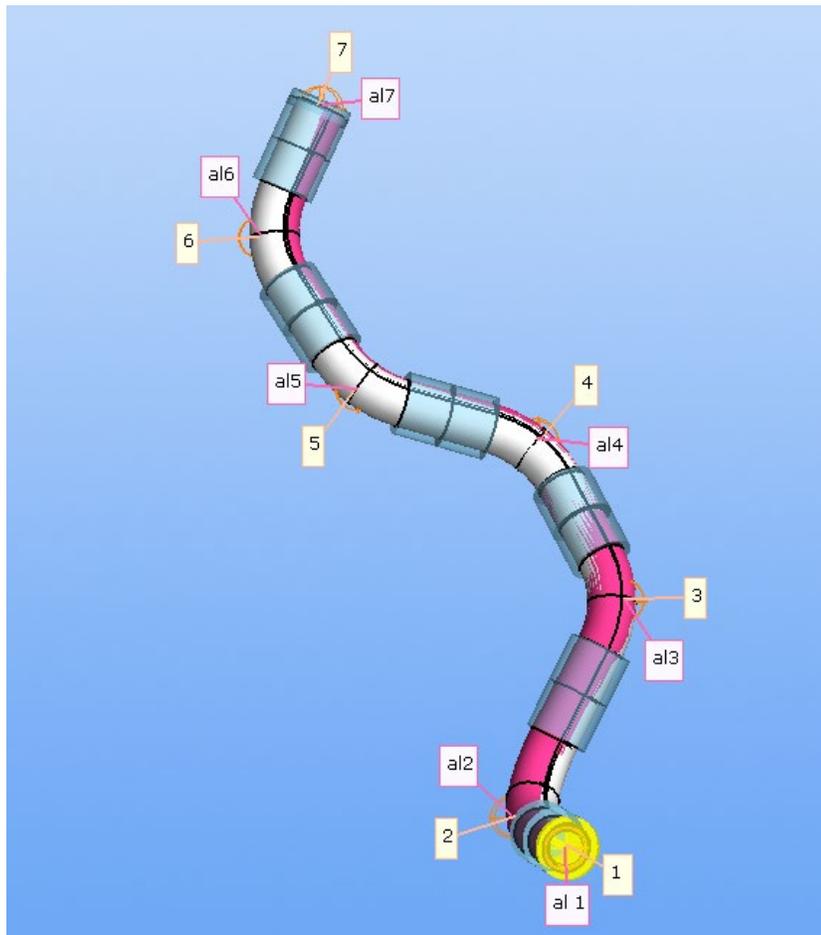
22. Examine the **Inspection Data** menu up close, and you will see two grids.

The **Tan/Mid** deviation grid qualifies the shape by using an expanded envelope of each straight as a virtual gauge. For the non-end straights, tangent points are where the straights meet the bends on the centerline. For example, the **row 2-T1 dev** cell shows the deviation where the second straight starts after the first bend. (In this grid, the **1-T1** and **6-T2** cells in this grid are trimmed end points - not actual tangent points).

The **end lengths** are qualified in the single line grid at the top.



23. In the viewport, the pink tube is the MEASURED ALIGNED tube. The white tube is the MASTER TUBE. The blue cylinders are the TOLERANCE ENVELOPES.



You can see that the pink tube, while not perfectly aligned with the white tube, is well inside the tolerance envelope of 0.125". Operators love the visual feedback in VTube-LASER. It is very descriptive for operators that like to know what is happening inside the tube shape.

The GD&T profile tolerance is double the tolerance envelope inside VTube-LASER. If you have a GD&T profile of 3 mm, then the VTube-LASER tolerance in the Tan/Mid grid should be set to 1.5mm in every tolerance cell.

- Change the tolerance to show some out of tolerance deviations like this. Give focus to the Default Tolerance Tangents edit box, enter a new lower value, and press the Enter key. (In this case, we chose 0.050" because it is lower than some of the deviations in the grid.)

Default Tolerance Tangents inches

Trim A	+Tol A	-Tol A	Trim B	+Tol B	-Tol B	Angle A	Tol A	Ar
0.011	0.125	0.125	0.028	0.125	0.125	1.4749	1.0000	0.

< >

Straight Profiles | Bend Profiles | Aligned Model

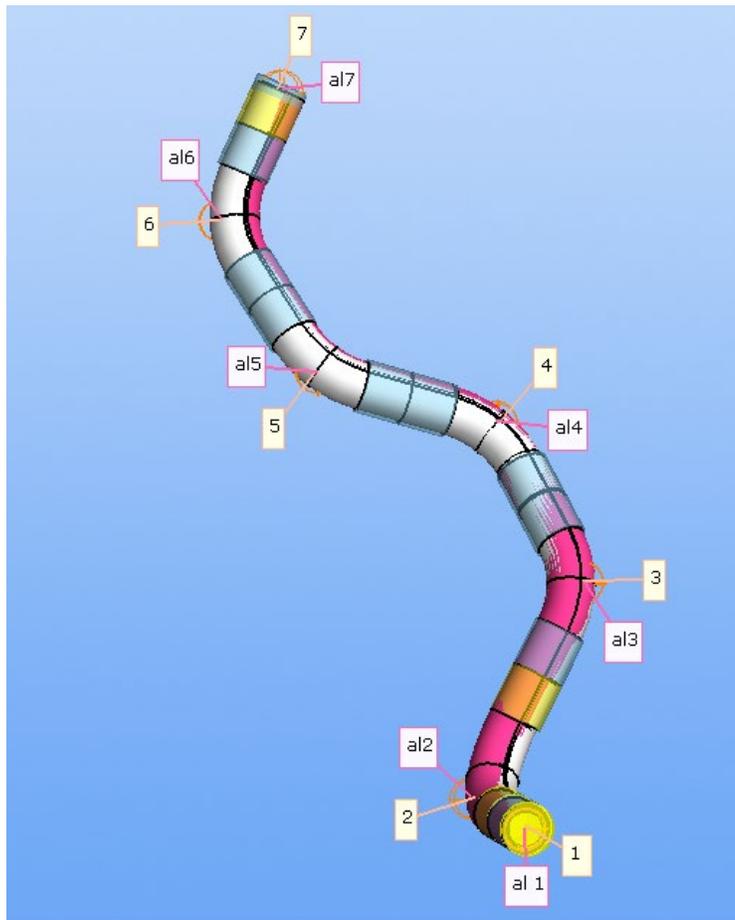
Tan/Mid | Intersection

	T1 dev	T1 tol	MP dev	MP tol	T2 dev	T2 tol
1	0.026	0.050	0.036	0.050	0.052	0.050
2	0.052	0.050	0.034	0.050	0.018	0.050
3	0.008	0.050	0.003	0.050	0.005	0.050
4	0.047	0.050	0.043	0.050	0.040	0.050
5	0.043	0.050	0.040	0.050	0.038	0.050
6	0.034	0.050	0.043	0.050	0.053	0.050

This tolerance change made three of the tangents go out of tolerance.

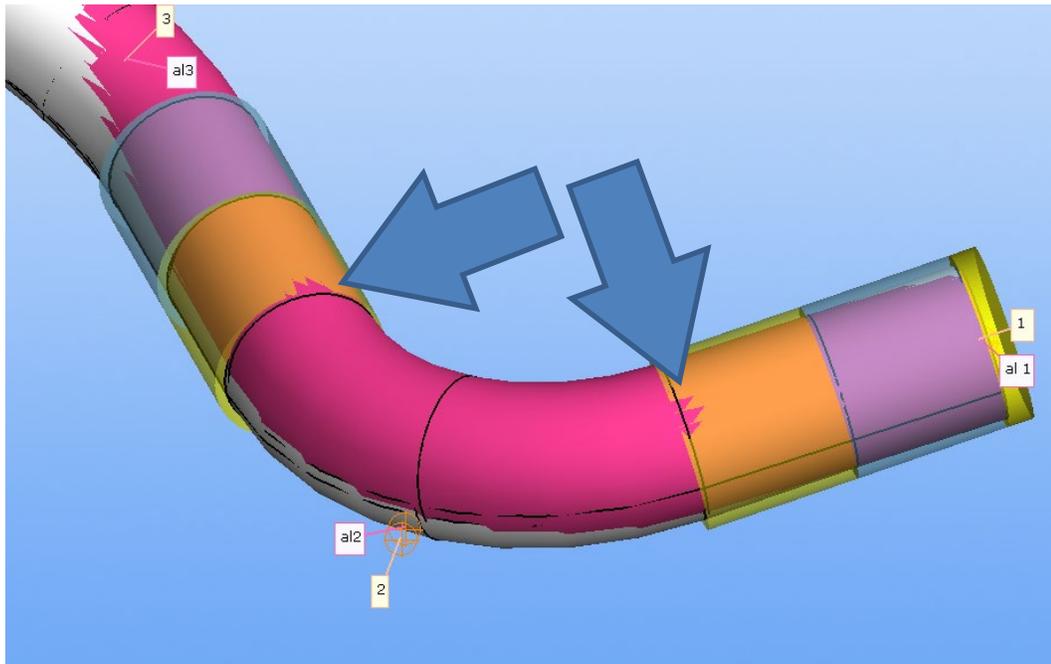
(If you decrease the tolerance and all the cells stay green, then choose a lower tolerance until some of the cells turn red like is shown above.)

25. Press F2 to redraw the model in the viewport. Now it will show some yellow envelopes like this:



The yellow envelope cylinders are where the tangents are out of tolerance. The grid shows that 1-T2, 2-T1, and 6-T2 are out of tolerance. You can see the envelopes turn yellow at those points.

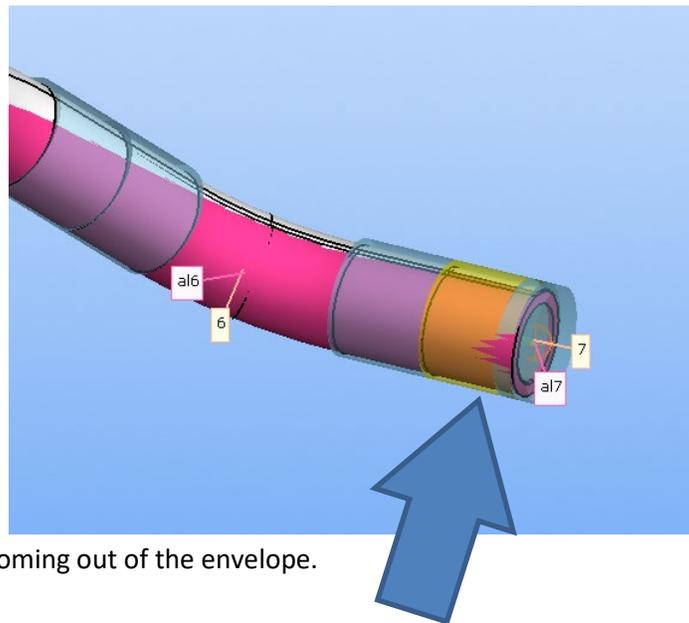
26. Orbit around the part to see where the pink tube exits the tolerance envelopes



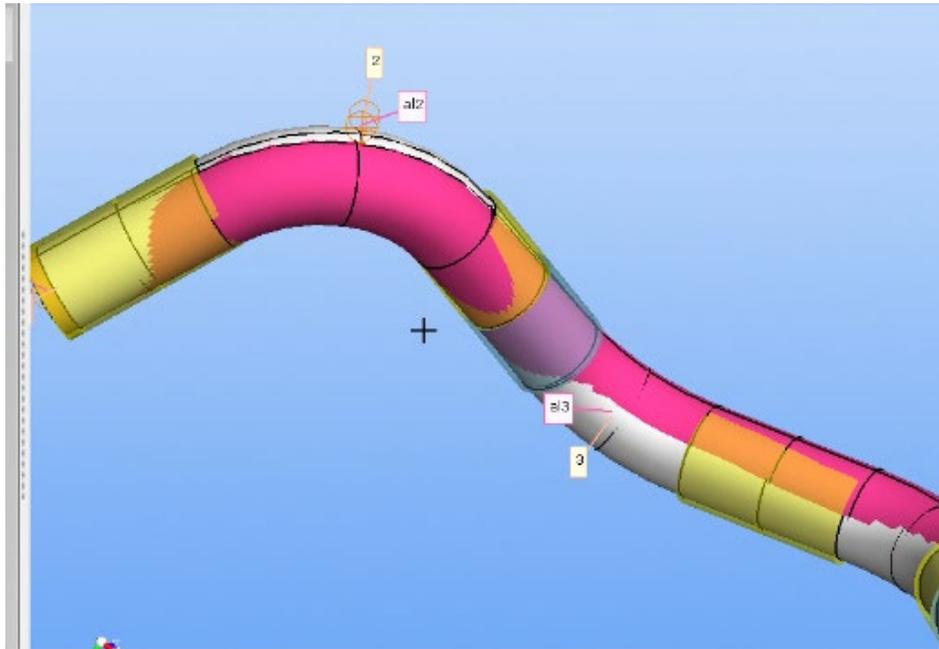
You can see two places in the model that correspond to the red cells in the Tan/Mid grid. If you were to drop this part into a gauge with this exactly tolerance, then the part would rub at these two points.

If you orbit so that you can see the other end, we can see the place where straight 6 exists the envelope.

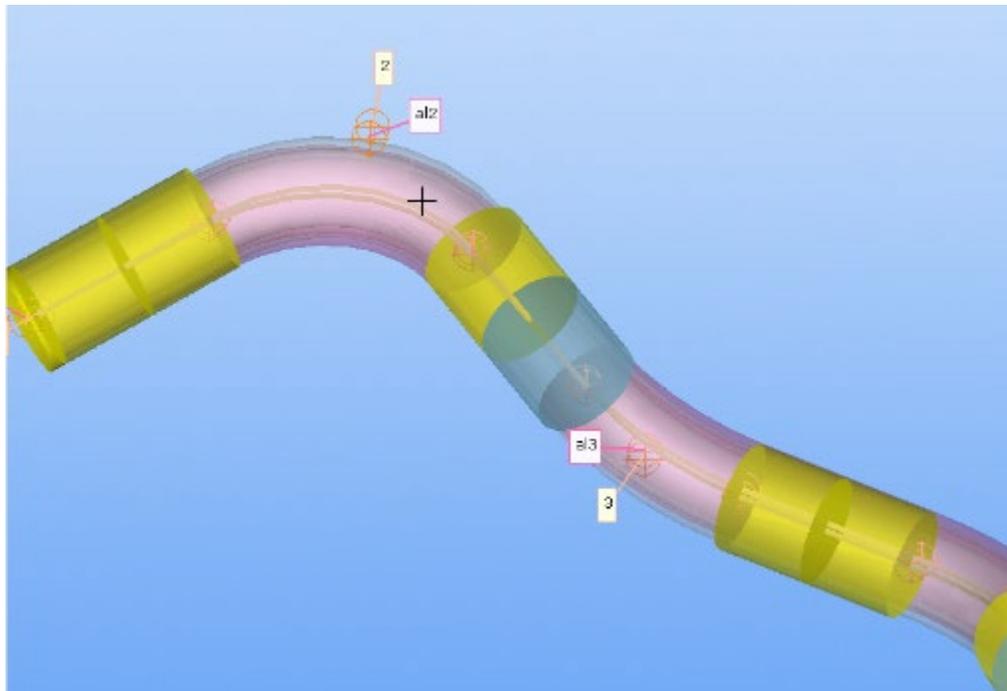
The point of this exercise is to show that VTube-LASER is a virtual gage. If you were to drop this part in a gage with this tolerance, then it will rub in three places – just like the graphic shows three places coming out of the envelope.



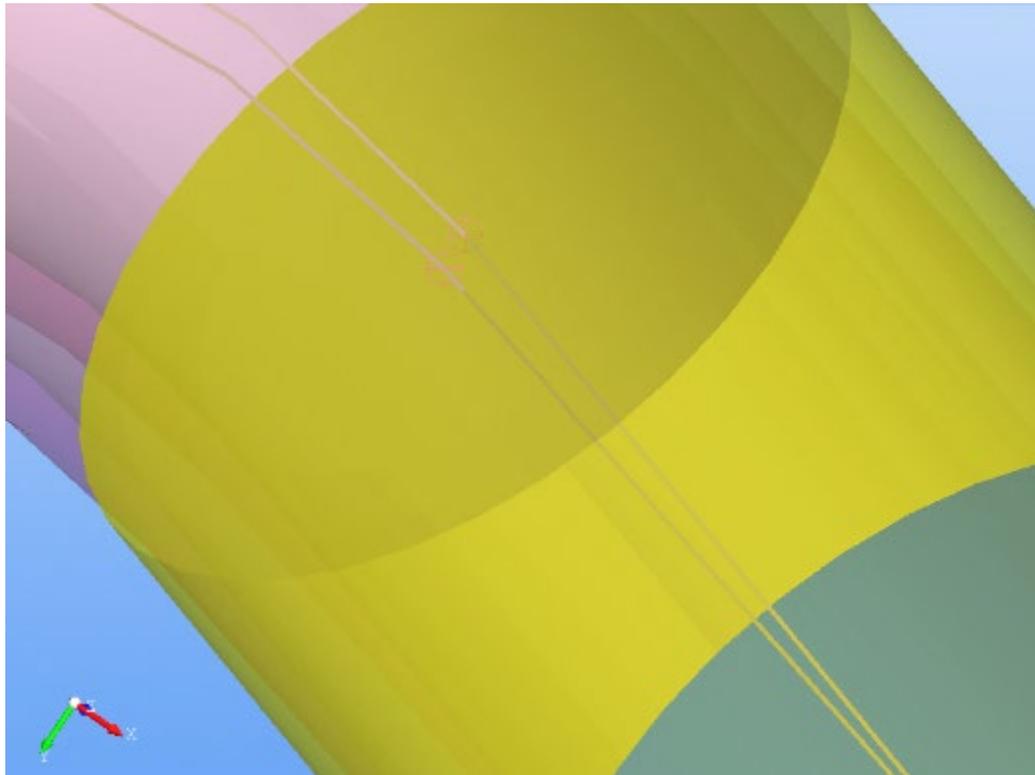
27. Let's demonstrate where the tangent/midpoint deviations are in the graphic image. Orbit and zoom in on a section of tube on one of the straights.



28. Press Ctrl-T to toggle transparency on.



29. Using the mouse wheel, zoom in on one of the tangent points in the straight. In the video, I zoom in on straight 2, tangent point 1.



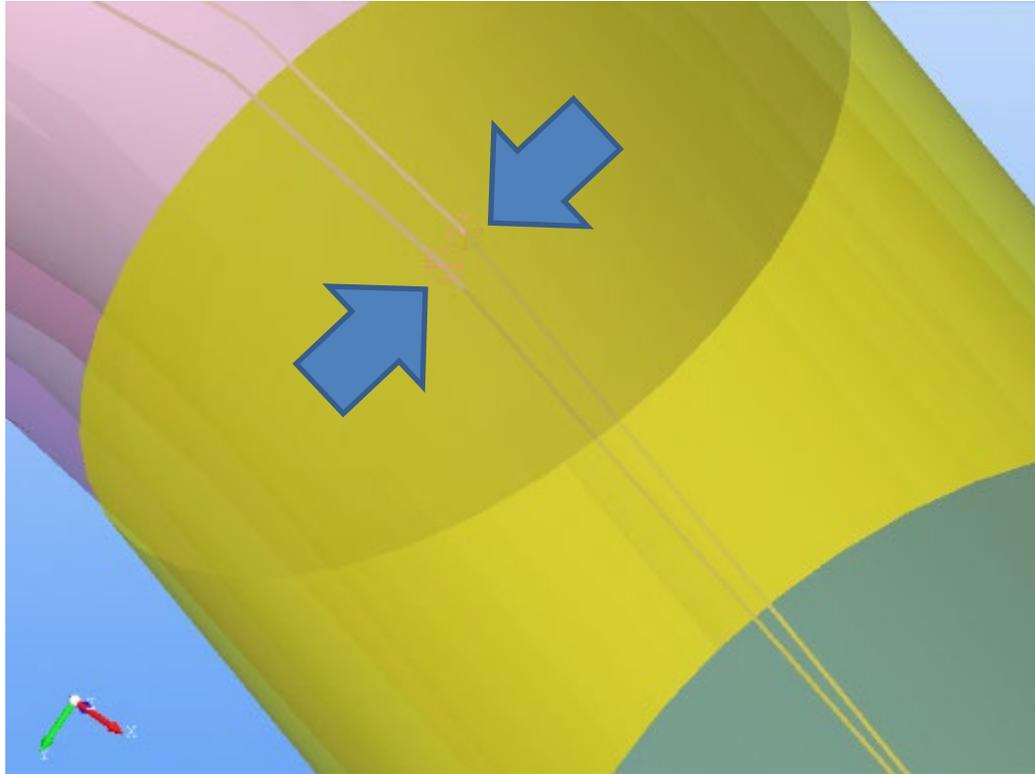
Straight Profiles Bend Profiles Aligned Model

Tan/Mid Intersection

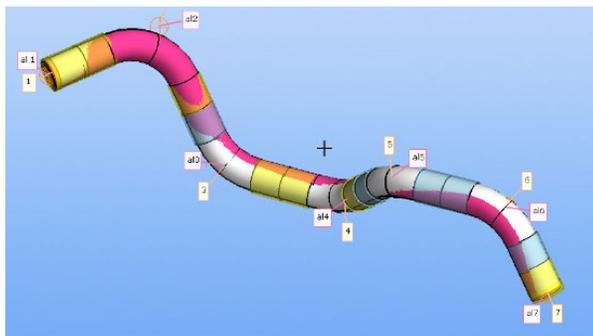
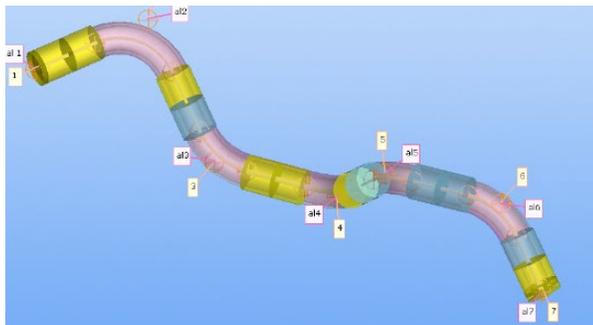
Change Grid Setup Expanded Window

	T1 dev	T1 tol	MP dev	MP tol	T2 dev	T2 tol
1	0.064	0.045	0.015	0.045	0.051	0.045
2	0.079	0.045	0.030	0.045	0.017	0.045
3	0.055	0.045	0.056	0.045	0.058	0.045
4	0.059	0.045	0.037	0.045	0.015	0.045
5	0.016	0.045	0.019	0.045	0.025	0.045
6	0.033	0.045	0.041	0.045	0.052	0.045

In the Tan/Mid grid, the distance between the two tangent points is 0.079" (about 2 mm). This can be seen in the models (see the next image).



30. Press Ctrl-T to toggle the transparency off.

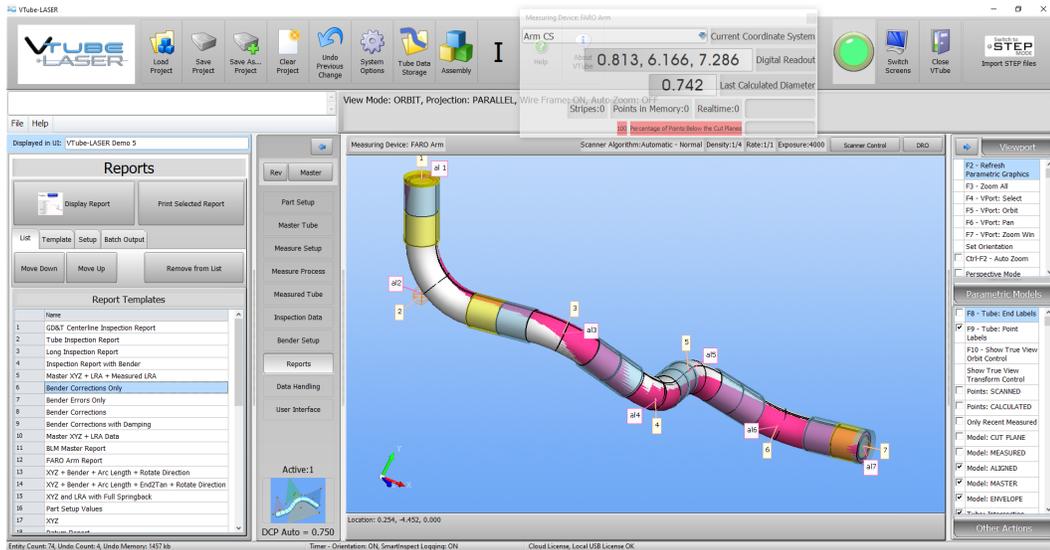


CORRECTING BENDERS with REPORTS

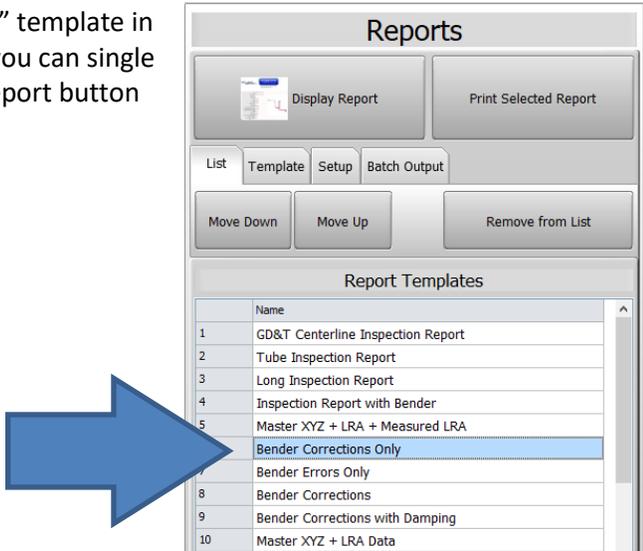
Operators can use VTube-LASER reports to correct benders, or they can directly communicate with benders to send data through a connection.

First, we want to demonstrate what about half of our customers do: Print reports that correct benders.

1. Press F3 to zoom the model so that it fits in the viewport. Click on Reports in the navigation pane. You will see a list of report templates on the left.



2. Find the “Bender Corrections Only” template in the list and double click on it. Or you can single click on it, the press the Display Report button above the list.



3. A report will display like this:



The values in this report are the values that you add to the current bender setup values to correct the bender. If the operator were to add these values to the bender control and bend another part, then you will see the Tangent deviations drop – because VTube-LASER will drive the part toward the perfect MASTER tube.

CORRECTING BENDERS with DIRECT COMMUNICATIONS

The other half of our customers prefer direct connections to benders. This next section works through a simulation of how to communicate with the bender. It simulates the Benderlink feature to teach the principles of communications to benders.

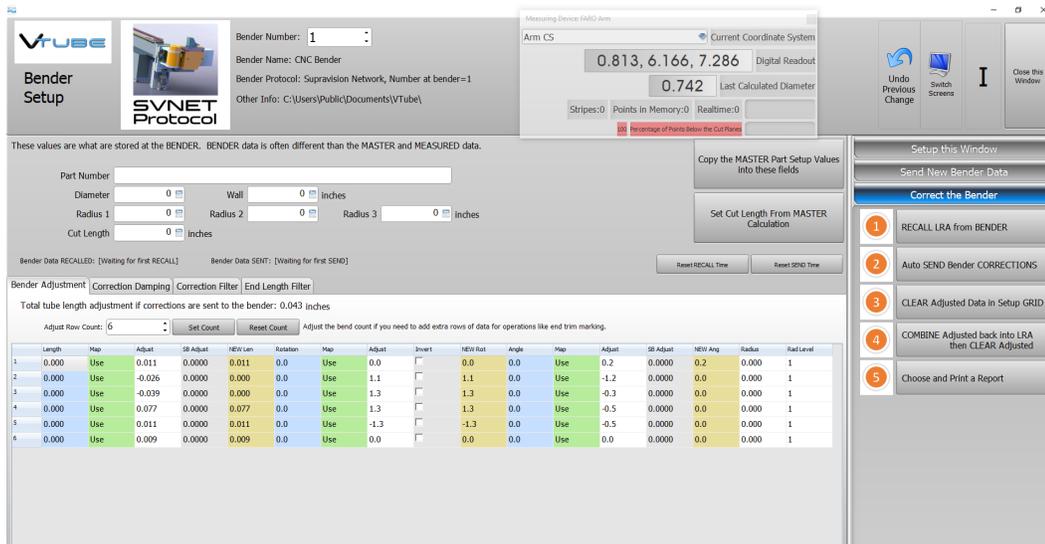
To make communications work (and not just simulate), the Benderlink feature usually must be setup with the help of an experienced technician. The Benderlink setup steps are not covered in this document because it is beyond the scope of an initial training.

Note one: “Benderlink” is a word that we coined in 1993 and have been using it ever since. This is one area that the Advanced Tubular technicians can help greatly. We will gladly help you navigate through which benders can be connected, and which ones connect well.

Note two: The need to link increases exponentially as the number of bends increases. For customers with one bend parts, manually typing in corrections makes sense. But for customers with 8-bend parts, bender linking makes a lot of sense because they must correct 25 separate values on every correction. Manually adjusting 25 values is risky and slow.

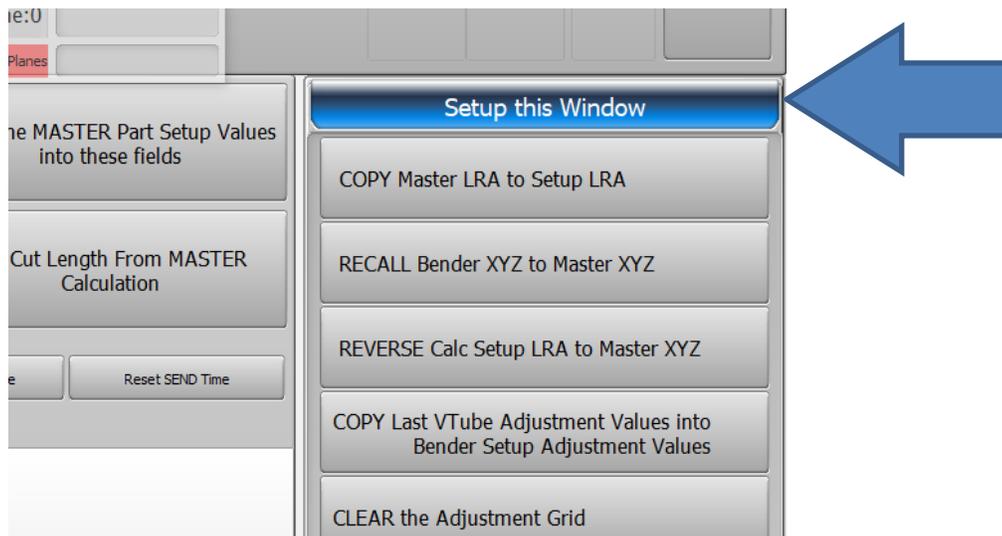
Follow these steps to simulate a bender correction.

1. Close the report window if it is still open and then press the **Bender Setup** button in the Navigation Pane. This is what you will see.

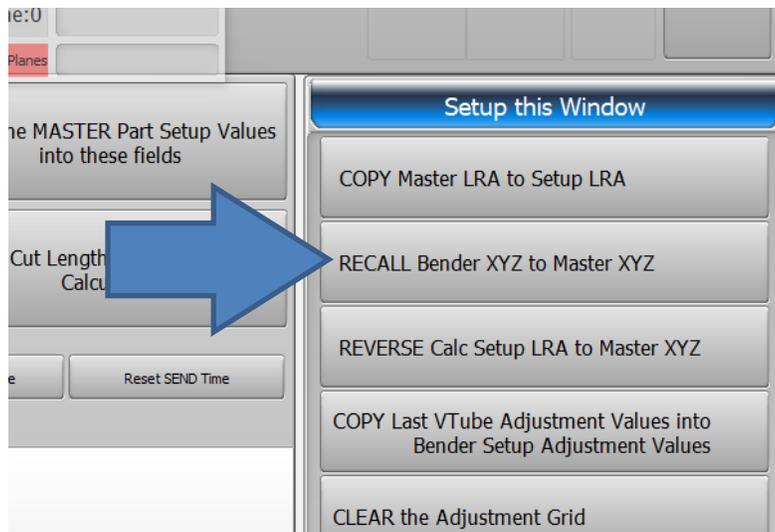


This menu allows customers to communicate with up to 100 benders. The bender number is at the top. Leave the bender number as #1.

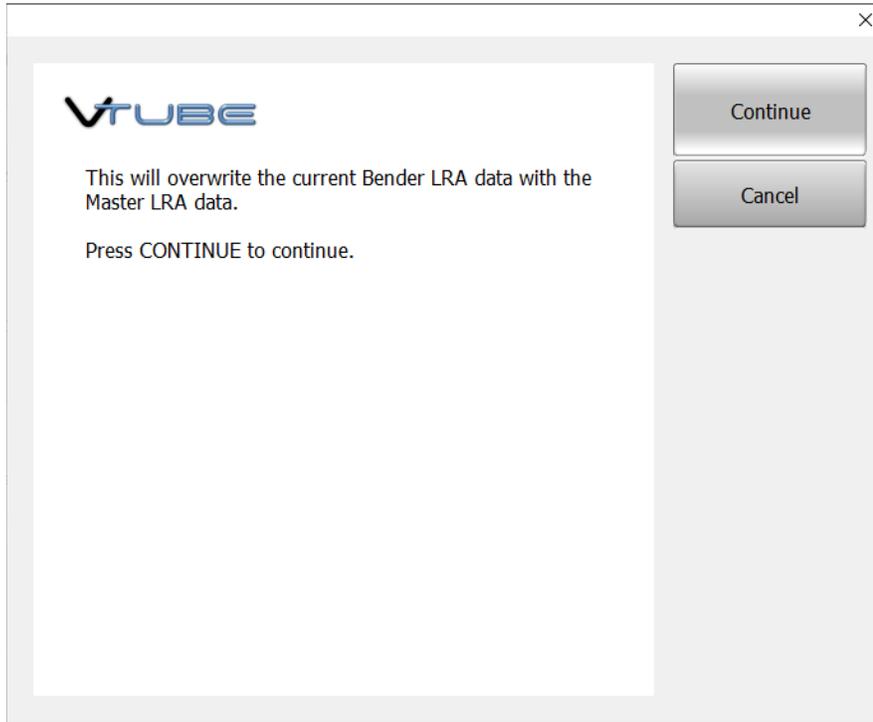
2. Click on **Setup This Window** on the right side.



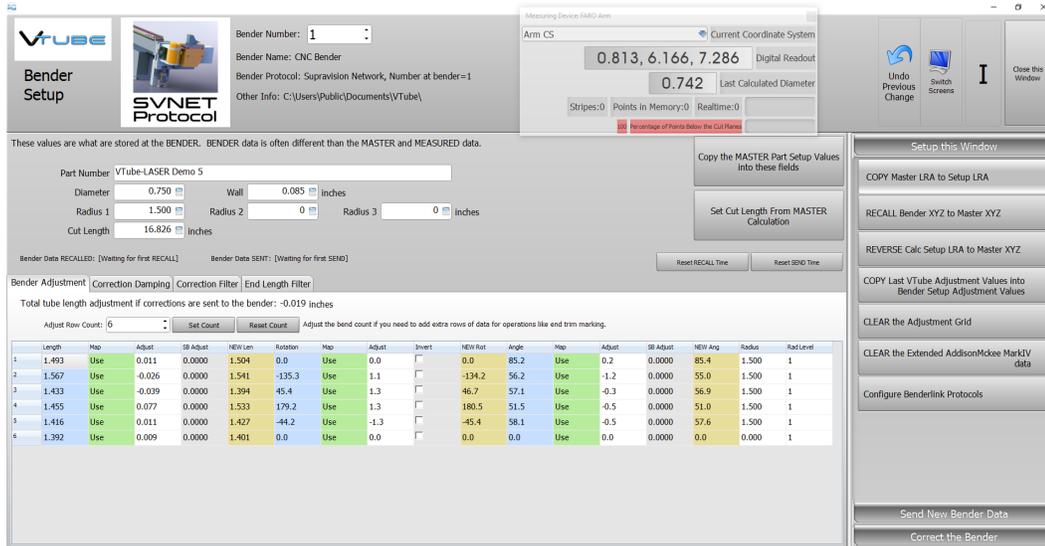
3. Click on **COPY Master LRA to Setup LRA**.



4. Press Continue to allow VTube-LASER to bring the current bender data into this window.

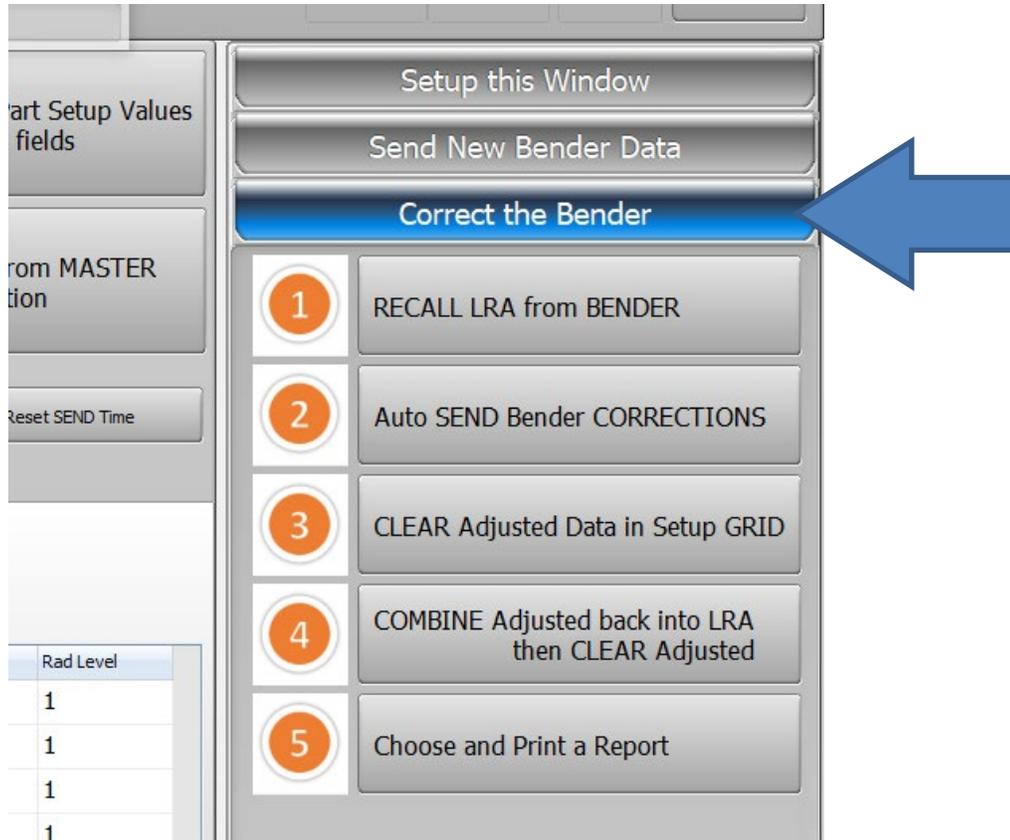


5. You should now see non-zero values in all the columns in the grid like this:

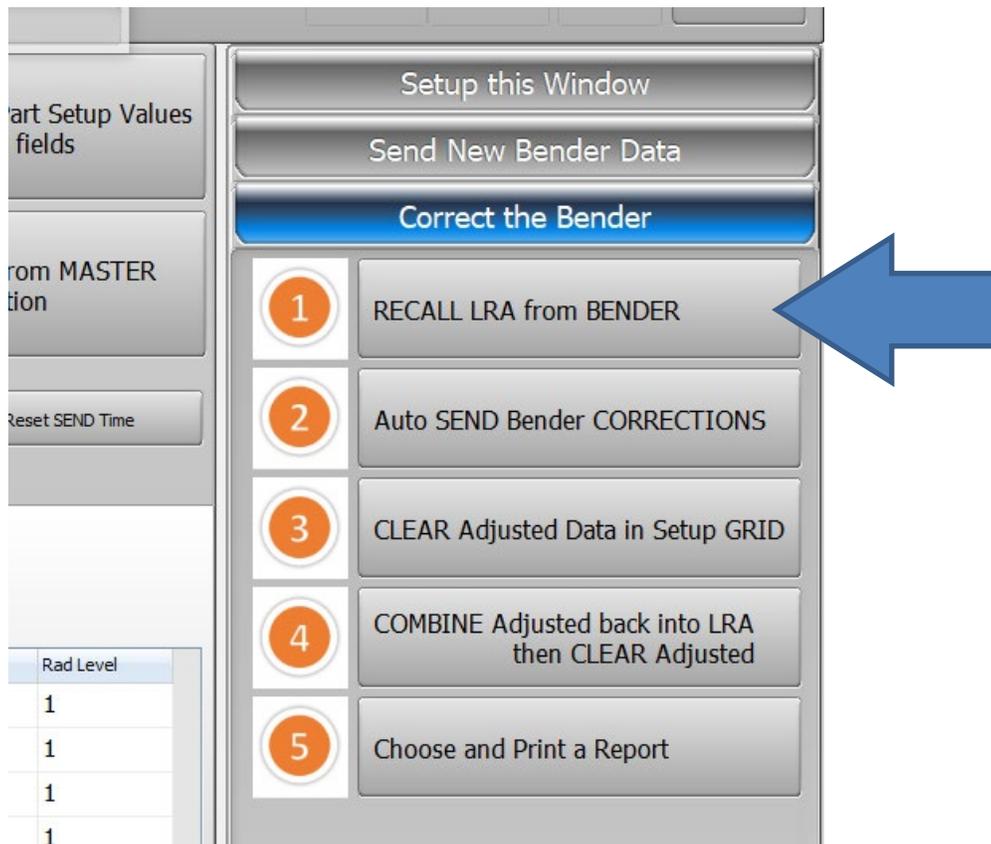


- The BLUE columns represent bender data *before* correction.
- The ORANGE columns represent corrected data to be sent to the bender.
- The WHITE columns in between the BLUE and ORANGE columns are ADJUSTMENT columns. The values in the white columns change each value in the blue columns into the values in the orange columns.
- The GREEN columns are mapping columns that let the operator skip corrections for any value (like the end lengths), or even SKIP ROWS for avoidance moves at the bender.
- This BLUE and the WHITE cells can be manually adjusted for total control by the operator over the corrections being sent to the bender.

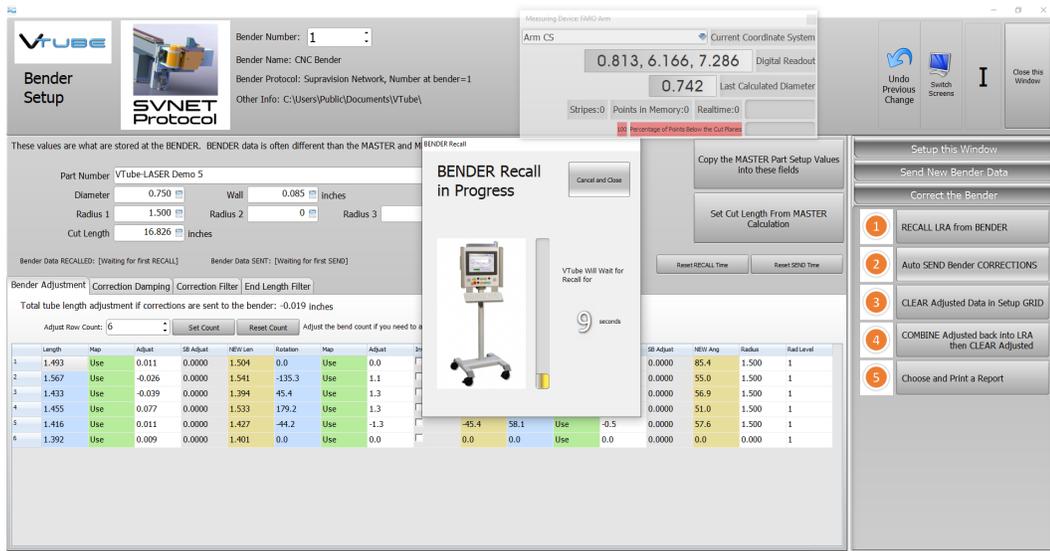
- Next, we will simulate a bender correction. Click on Correct the Bender at the bottom right corner of the screen.



7. Click on the **RECALL LRA from BENDER** button next to the orange #1 on the right.



8. A RECALL dialog will appear like this:

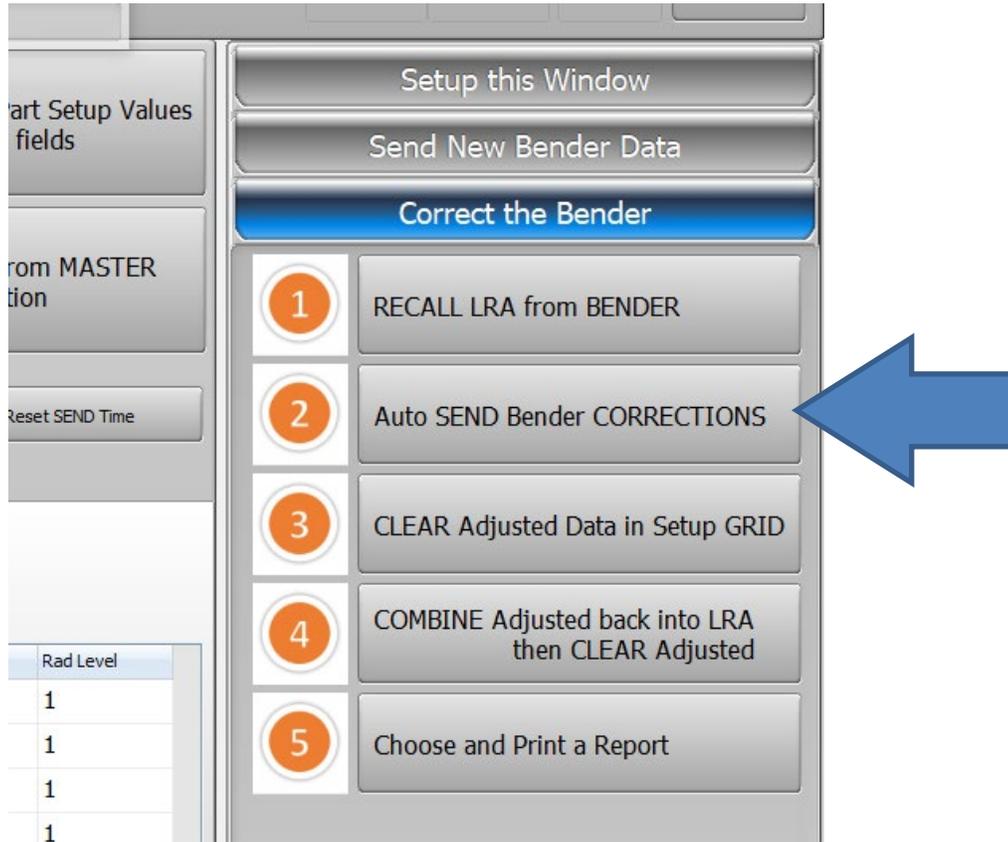


9. After the time has expired without a bender answering, VTube-LASER will show an error message. In this case, you can click **“Cancel and Close”** before the timer expires.

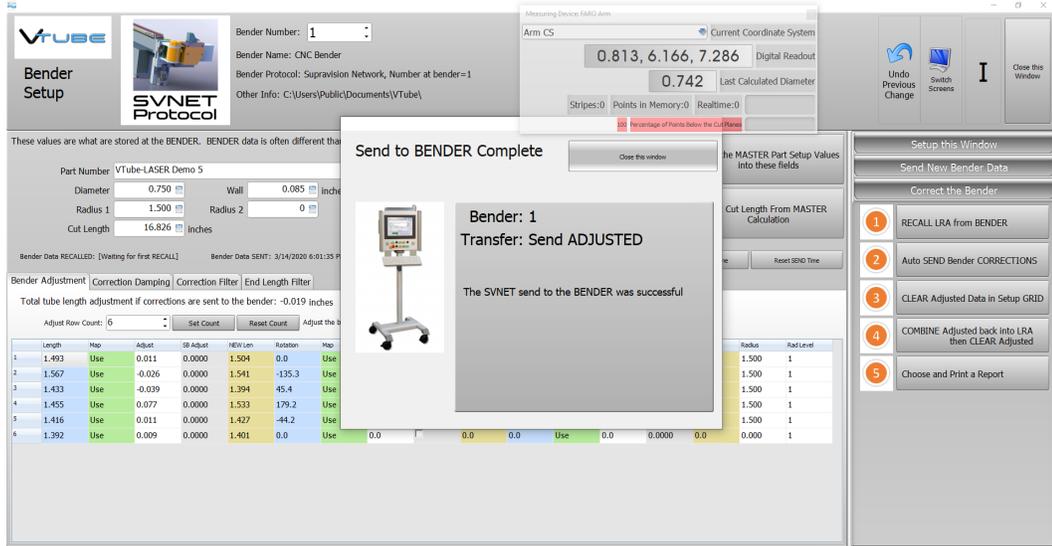
Since you are not connected to the bender, press **“Cancel and Close”** before the timer expires. (This is only a simulation.)

If VTube-LASER was connected to a bender, then this step would have updated all the blue columns with data from the current bender setup in the CNC bender.

10. Press the **Auto SEND Bender CORRECTIONS** button next to the orange #2 on the right.



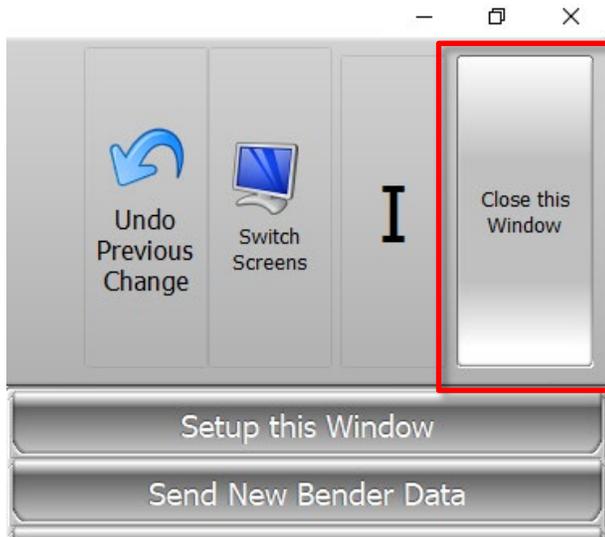
11. A **Send to BENDER Complete** dialog will appear.



This assures us that VTube-LASER sent data to bender #1. If bender #1 is on the network and listening for communication, it will receive this data and use it to correct its bender data.

This dialog will close itself after a few seconds. Or you can press “Close this window.”

12. Press **Close this Window** on the top right corner of this window.



This is the end of the document.