CTW Automation Spring Raters and Probe Software

Rev D

Contents

Introduction

This manual is for the CTW Probe Analysis Software to be used with the Spring rater series of machines designed, built, and manufactured by CTW Automation. It is intended for the purposes of our customers and their Spring testing machines. It is not intended for mass distribution or publication by anyone other than CTW Automation. It is setup to first go through all the Tabs and screens before proceeding to building and executing a Test.

As with all of our products and services, CTW Automation wants you to be able to use the equipment and obtain results you can use to develop and characterize your shocks, springs and specimens. To that end, we want to help you get the most out of the equipment and for you to be happy to use it.

Technical Help

Your machine was delivered with a full one-year Support contract. This allows the owner e-mail, phone, and remote access help via CTW TeamViewer license. Any time after training, if you have questions or concerns, contact CTW for help.

To get the best help, it is important you try to use the following avenues:

E-mail to: Service@ctwautomation.com

Send your name, location and a number to reach you

Please include your serial number, for example RD3-043

Or

Phone: 336-542-5252

We are located on the East Coast in the Eastern Standard Time zone.

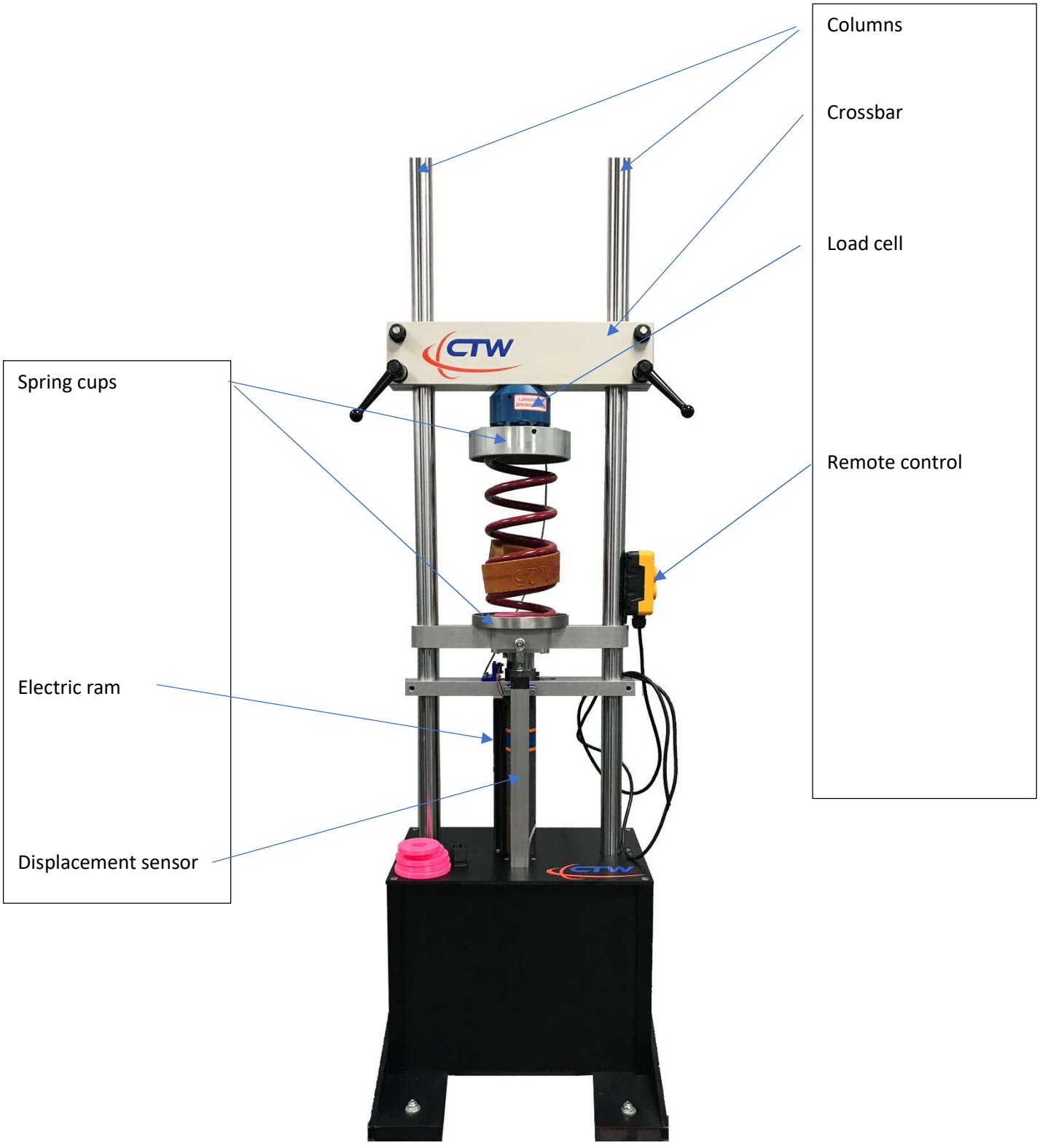
- If you have questions about data or a graph, PLEASE attach the data file to the e-mail. We can open it on our computer and understand more than just sending a picture.
- If you have questions about a particular Test you created, it could be helpful to attach that to the e-mail so we can see what you are using for commands.
- TeamViewer should be loaded on your computer during calibration or install. If you need a copy it can be found on our website: www.ctwautomation.com go to the Exchange tab.

Overview of the CTW Series of Spring Raters

All CTW Spring raters measure force and displacement to a user defined limit, then graph that collected data as a force vs displacement or rate vs displacement or force. Remember rate is not a collected signal it is a calculation of the force change over a given displacement.

CTW stand-alone manual spring rater.

Spring Rater Overview



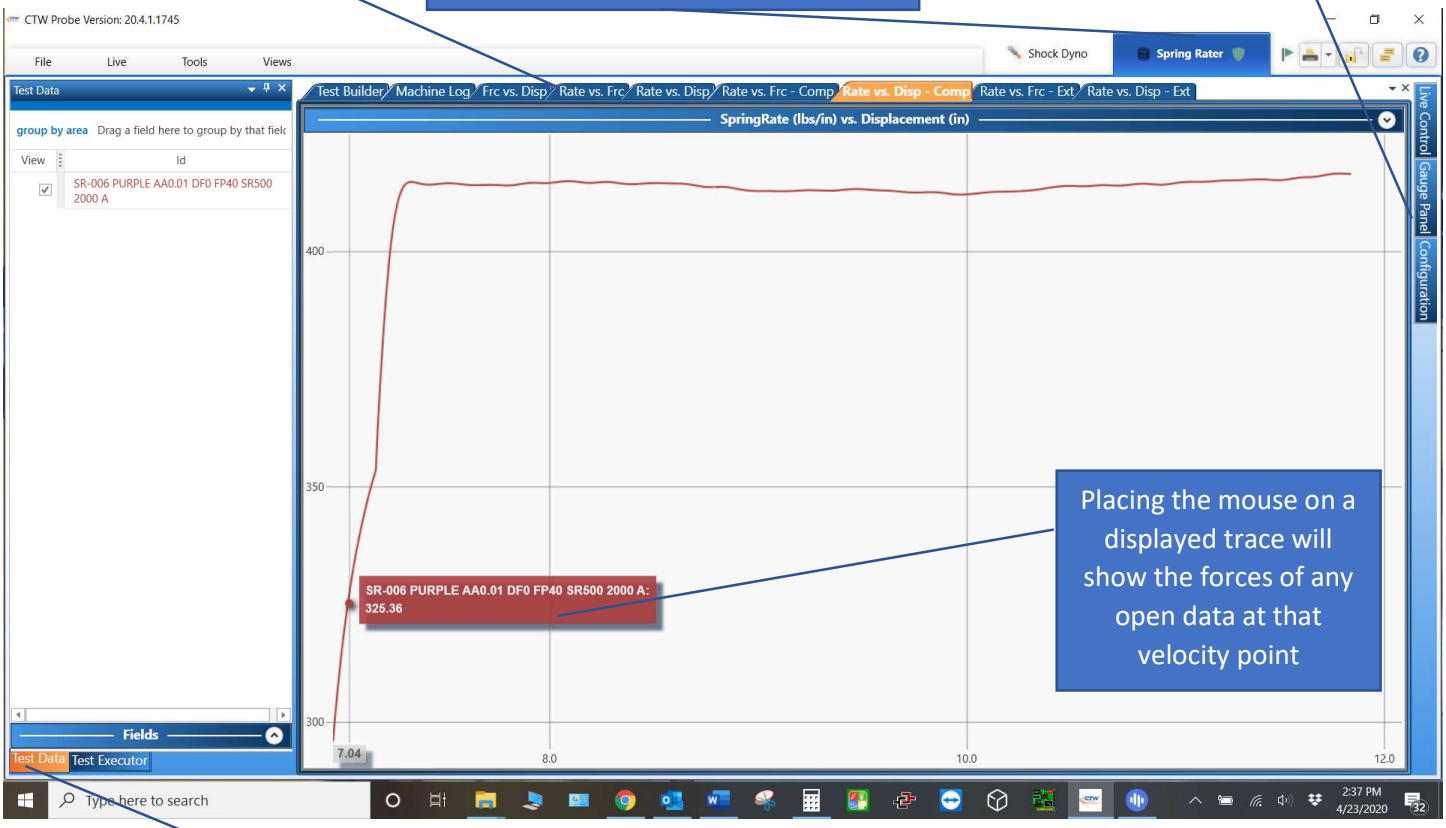
Layout of the software.

CTW software has different windows or pages depending on what function you are executing. Almost everything the user needs to run a test and display data is on this one window.

Tabs for different graph types, live data windows, and test builder.

Indicator lights for data card, if not green there is a problem that must be corrected before testing

Tabs for live data window, manual control and configuration page.



Placing the mouse on a displayed trace will show the forces of any open data at that velocity point

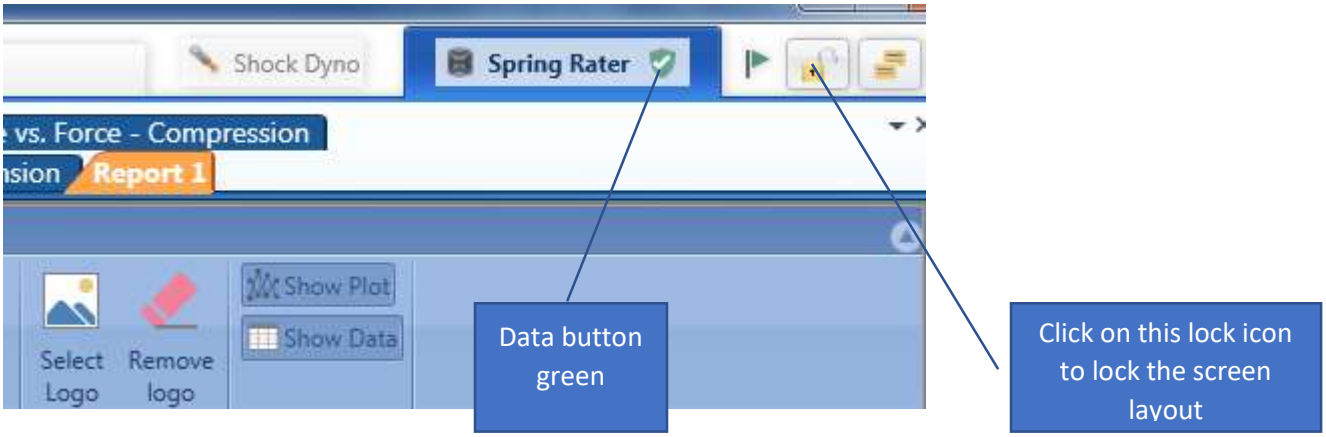
Tab buttons to select the test execution window or the run data page that displays the file name of open data files

Default screen layout

Running a test

The “Test Executor” window is the panel you perform a standard test from. You must properly load the spring into the tester and select the test you want to perform, then execute the test.

Before running a test make sure the Data light in the upper right-hand corner is green. If this light is not green the software will not run the test. Locate the problem with the data system before proceeding.



Loading a Spring in the rater

Before installing a spring in the rater make sure the actuator is at BDC (bottom dead center). If you are uncertain if the rater is all the way down, please verify. Always make sure the rater is at BDC before loading a spring!

1. Place the spring on the lower spring cup. Always load the spring in the same orientation, mark the spring for what end is down and always rotate the spring to the same position.

2. Lower the cross bar to sit on the spring. Tighten all four cross bar nuts.

3. You may also place the crossbar a distance above the spring so that you can change the spring without having to move the crossbar each time.

Executing a test

Once you have the spring properly loaded into the rater you are ready to run a test and collect data.

1. From the “Test execution” window on the left side of the page, click the “load” button to select a test. If you have no test created see the “create test” section of the manual; you can create as many tests as you like. Keep in mind a test is just a series of commands, the collected data from those commands is what we will be looking at. Tests are stored your computers documents folder at ‘Documents/CTW Automation/Tests’. Tests can be copied and pasted into other computers.

2. To start a test click the “Execute” button in the lower left corner. The execute test window will appear and instruct you to compress the spring to the test defined force or displacement. When the actuator reaches your test limit the window will instruct you to lower the actuator back to BDC.

3. At the end of the test the “save” window will open. Name the test when the “save test” window appears after the test is complete. As a default your data will be saved in a data folder in ‘Documents/CTW Automation/Data’. You can save data anywhere you wish. Data is saved just like any document in Windows so you can save data to any location.

Test Execution Window

Open button will load the test you select

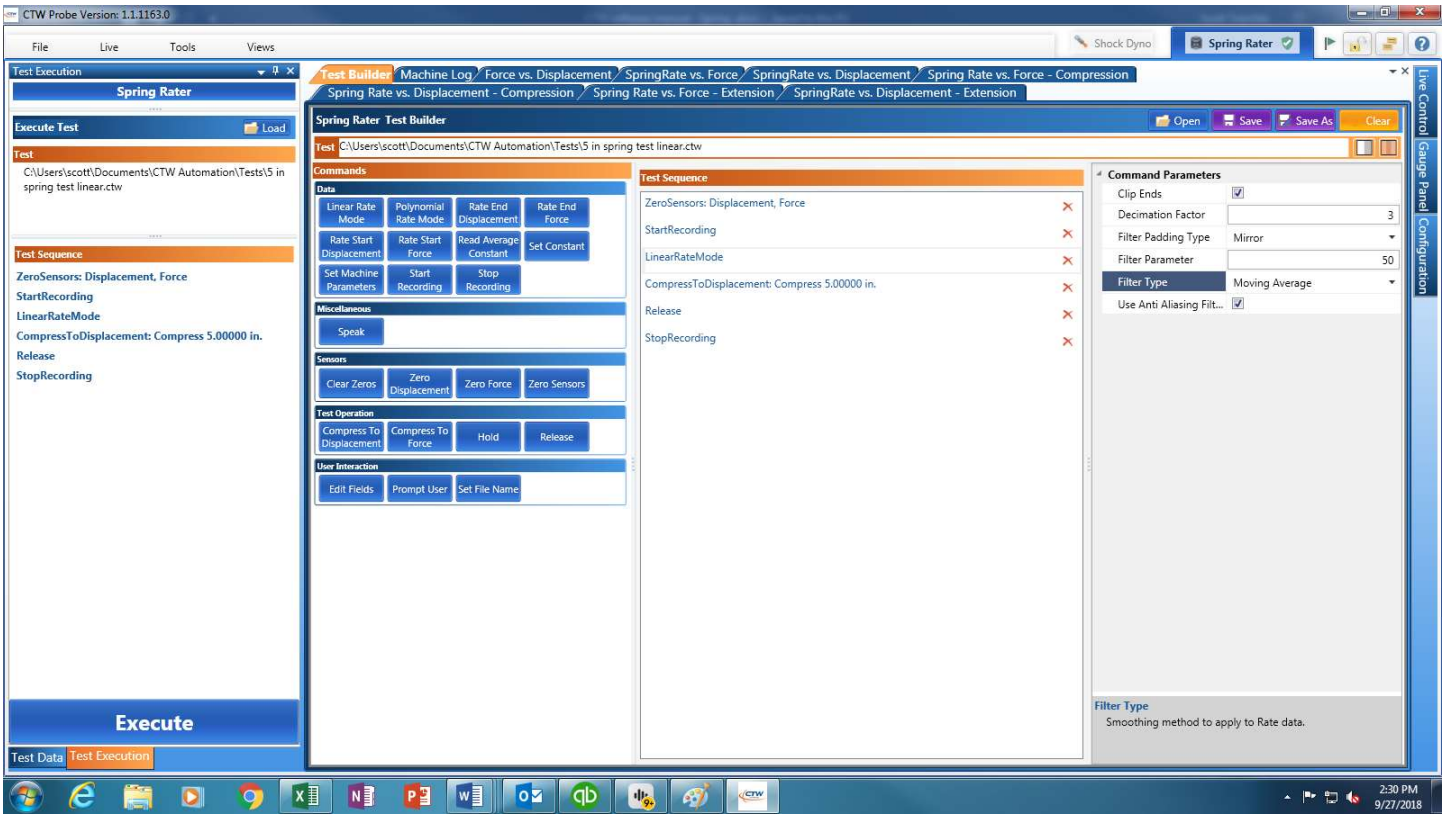
Name of the test you have selected

Test sequencer lists each step of the test. If some of these steps are red, this indicates the rater cannot perform that step

Execute button will start the test

Click these tabs to open the test executor or data run column

Creating a test.



Clicking on the Test builder tab at the top of the page will open the window to create or modify a test. You can click on buttons to add steps to your test. When you click on a command in the “commands” column, it adds that command to the “test sequence” column.

If you want to modify an existing test click the “load” button and select the test from your test folder.

If you create or modify a test it will automatically load in the test execution window when you save the test.

Information in the Command Parameters column defines that particular step in the test.

A Test should contain the following:

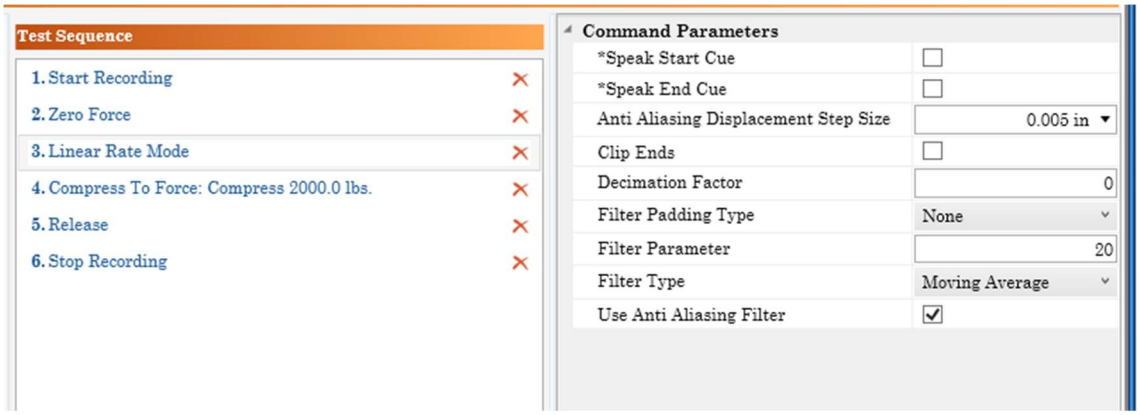
1. Start Recording
2. Zero Force
3. Linear Rate Mode
4. Compress To Force or Compress To Displacement
5. Release
6. Stop Recording

Create test options

Data commands

Linear or Polynomial rate mode

Place one of these buttons at the start of the test to define the smoothing used for the calculated rate graph. Because rate is calculated between each data point the rate graph must have smoothing applied to remove any noise. Linear rate is recommended for most testing. Below is the recommended default settings for the **linear** rate mode.



Anti Aliasing Displacement Step Size (AAD) - this is the increment the software will use for reporting data for the Test. If this is set to “0.01”) then the graph will have a data point every 0.01”. By changing this number the User can get more / less data for viewing. Long stroke linear springs can use higher numbers, 0.10”, while smaller springs or springs that go through transitions can use smaller increments.

- For low travel springs, this number should be smaller, ex. 0.01”
- For higher travel testing, this number should be larger, ex. 0.10”

Decimation Factor (**DF**) - this is a filter that can be applied and it will remove samples based on the number entered. Using “0” means no samples will be removed, no smoothing applied.

Filter Padding Type - None.

Filter Parameter (FP)- this is a smoothing number to be used with the Filter Type below. The idea would be to use a smaller number but enough to have the data be presentable. This works in conjunction with the AA.

- Using zero (0) will result in a very "spiky" or "harsh" graph.
- Using a high number, 40 and more will result in a loss of data
- Use a number that gives you a graph that can be understood and used
- This number also involves just how long the test was and how much data is available for smoothing

Filter Type - None and Moving Average

Start and stop recording - tells the software when to start recording data and when to stop. If you forget to include the start/stop commands in your test, the dyno will run the test but not save any data. If you run a test and no data appears on your screen make sure you started and stopped the collection.

Rate start displacement, force/rate end displacement force.

The program will display an average spring rate number in the test data column. The rate start/end will define the test range that this rate will be calculated from.

Sensor commands

It is a good idea to zero the sensors before the test is executed. Use zero sensors at the start of the test to accomplish this task.

Test commands

Test commands are steps that will record data.

Compress to force or displacement – defines how far the spring will be compressed

Hold - allows the user to place a timed hold in the test.

Release – commands the user to run the actuator back to BDC.

Edit Fields allows the operator to modify the field he will be saving with the data run.

Prompt will allow you to pause the test.

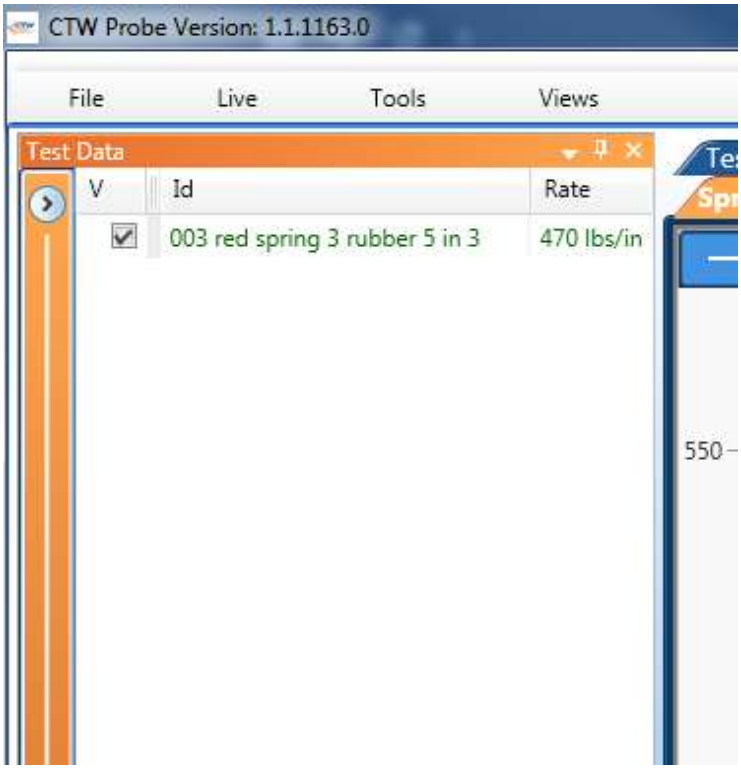
Set File Name defines the file name before the test is saved.

Displaying and viewing data after a collection.

After running and saving a test the data will display automatically. You can also open saved data buy using the FILE/OPEN pull down menu.

Data can be displayed as the displacement or force, compression or extension or both. Data also can be viewed as the force vs displacement.

Average rate number can be displayed in the Test data column by selecting that option from the fields column.



Advanced - How to develop your Test for different springs

** Linear Rate Springs **

The CTW Probe software for the Spring Rater is very powerful and has many features that can be used to get the desired level of data and curve the User requires. A test should be developed for each type of spring you want to Test based on the characteristics. A linear small travel spring will require different settings than a large travel air-spring. The following will take you through making a test for a linear rate spring.

1) Working first to find the Force / Displacement to use

* The greater the movement, the more data to use and different settings are applied. Your ultimate settings, ***Filter Parameter (FP)***, will be different based on the travel involved because of the number of data points available.

* This example uses a peak force of 1750 lbs which is roughly 5.00 inches of travel

2) Then choose your ***Anti Aliasing Displacement (AAD)*** spacing for your desired interval of points. This is critical as to how the data can be used and displayed. A very fine / course spacing results in varied curves.

* This example showed best at 0.050" / 0.100"

3) Now, your ***Filter Parameter (FP)*** in conjunction with the ***Filter Type (FT)*** will work to give your curves the desired level of precision. The FT should be ***"Moving Average".*** Too high a number and data is lost, the curve goes flat and poor results occur.

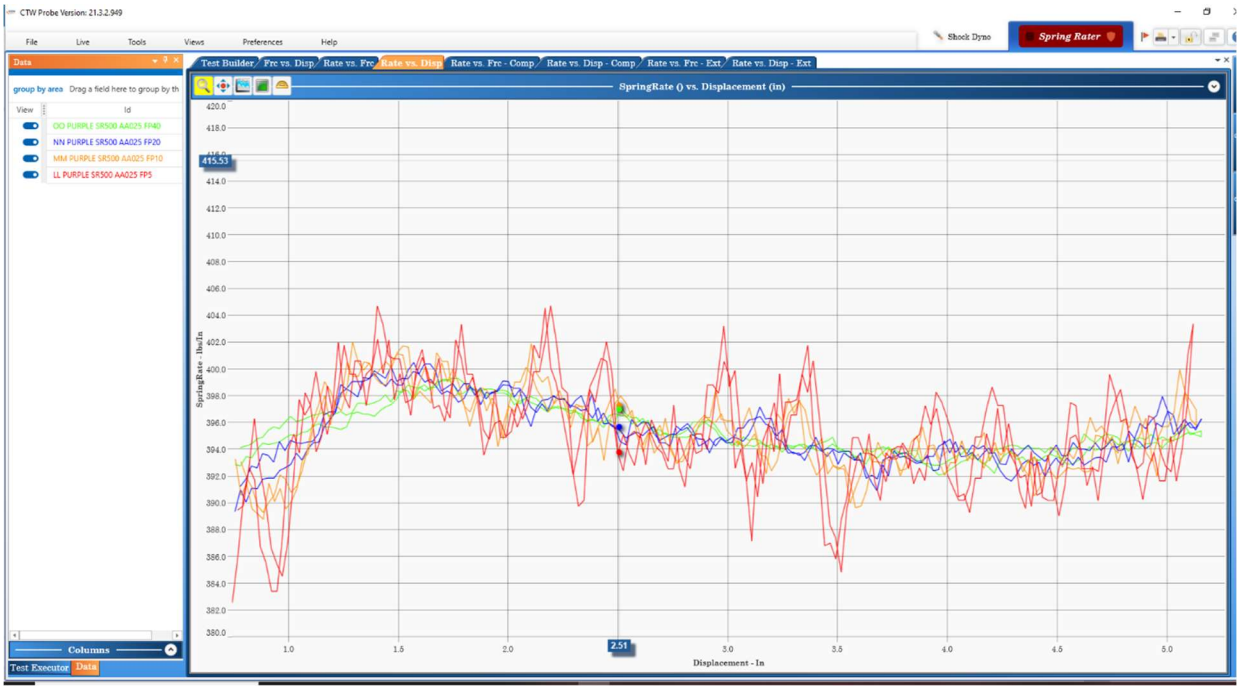
* The User should start with a small FP, "5" for example and then work in multiples from there. "5" will show close to no smoothing which likely makes the data very erratic looking, spiky or "noisy". Going to "10" and then "20" shows the curves as they begin to become more visually manageable. If you go too far, they lose data and flatten out any events or slope changes in the rate.

- The smaller the AAD, the higher the FP needs to be - more data means more smoothing.
- You are only trying to be refined enough to capture the slope changes.

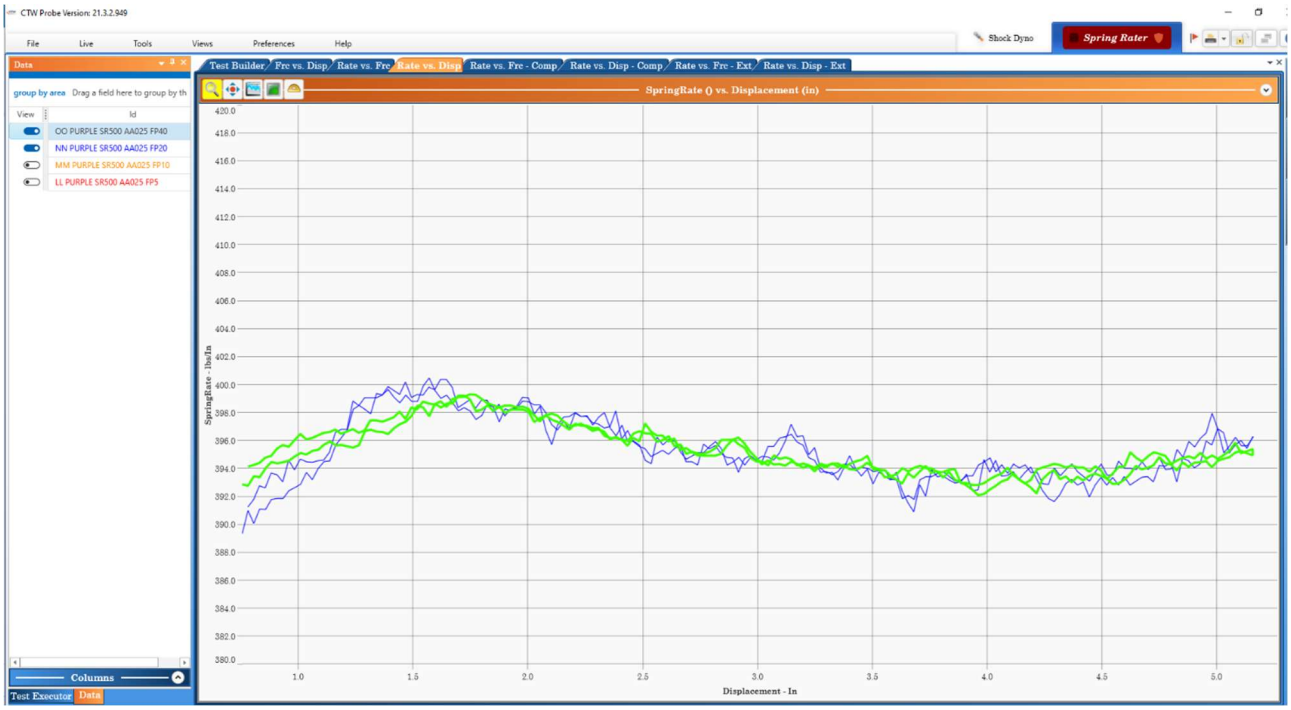
** Example of using the same AAD and then changing the FP to find your best value, noting that the reported rate was within a 0.1 lb/in range.

For a Linear rate spring, using a AAD of 0.025” increments and then changing the FP from 5 to 10 to 20 and 40

FP of 5 is far to “noisy” to be useable. FP10 is better but still likely not easily read.



Just viewing the data from the FP 20 and FP40. You can see the curve, the slope changes and best decide what will work for you.



** This example shows how the AAD and the FP work together. The same spring and the same Test were used while the AAD was changed and then the FP to match. The User can see the same curves were created with different spacings.

Example:

At AAD – 0.010” the FP should be 80

At AAD – 0.025” the FP should be 40

At AAD – 0.050” the FP should be 20 noting that FP40 is too much and flattens the curve

At AAD – 0.100” the FP should be 10 noting that FP20 and FP40 are too much, they flatten the data

Graph A – Zoomed in 390 to 400 #/inch

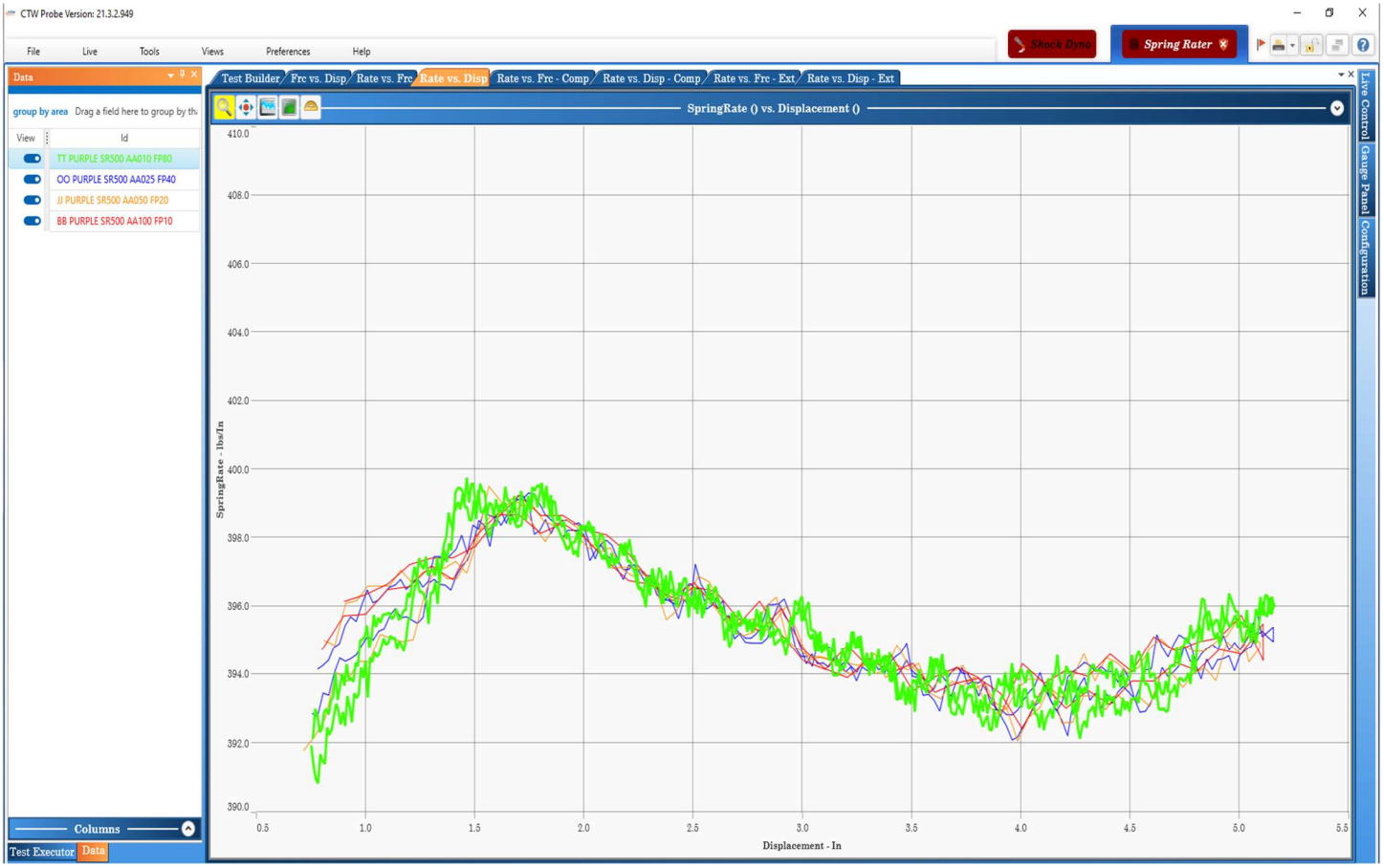
Showing the same Test, same spring run at (4) AAD and the “best” FP as determined by CMK.

AAD 0.010 / FP80

AAD 0.025 / FP40

AAD 0.050 / FP20 (orange)

AAD 0.100 / FP10

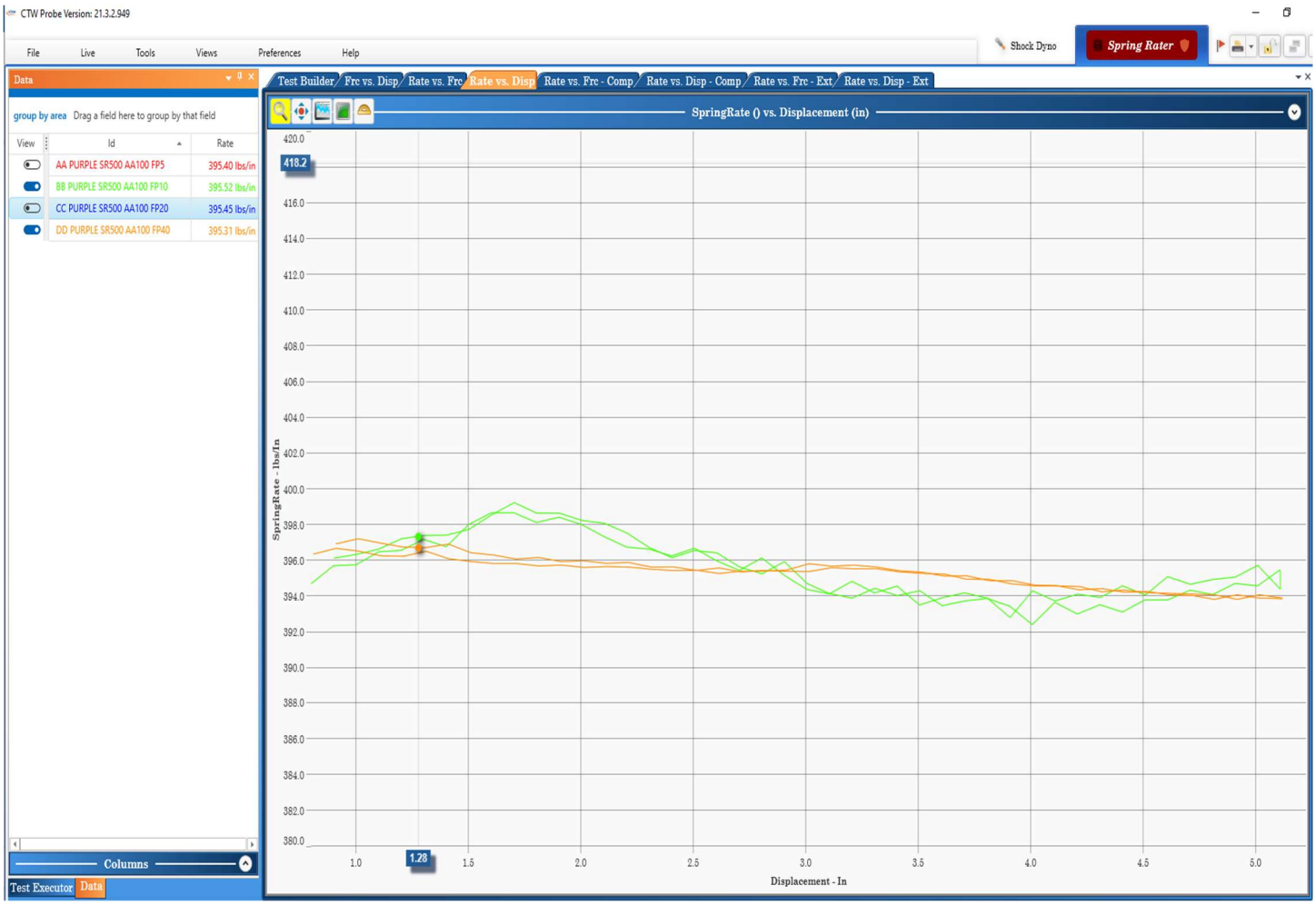


** This example shows what happens when too much smoothing, the FP, is used. The User should be very aware of this effect which can occur in any data stream that is smoothed with a moving average.

If the FP is too high, then the data will be over-smoothed and the curve will not be useable to define slope changes in the given spring.

The example below is the same spring using a AAD of 0.100” and the difference between a FP of 10 vs. 40. It is clear the curve has been flattened. While the “Rate” is reported to be the same, the definition the curve and the slope changes in the spring are not visible at FP40.

The User needs to be careful. You can make “smooth” graphs but lose information.



Advanced - How to develop your Test for different springs

*** Non-linear / air springs / elastomers / large slope changes ****

The CTW Probe software for the Spring Rater is very powerful and has many features that can be used to get the desired level of data and curve the User requires. A test should be developed for each type of spring you want to Test based on the characteristics. A linear small travel spring will require different settings than a large travel air-spring. The following will take you through making a test for a linear rate spring.

1) Working first to find the Force / Displacement to use

* The greater the movement, the more data to use and different settings are applied. Your ultimate settings, ***Filter Parameter (FP)***, will be different based on the travel involved because of the number of data points available.

- This example uses a peak force of 2000 lbs which is roughly 4.00 inches of travel
- Because of the extreme rate change over the travel the settings should capture as much as possible

2) Then choose your ***Anti Aliasing Displacement (AAD)*** spacing for your desired interval of points. This is critical as to how the data can be used and displayed. A very fine / course spacing results in varied curves.

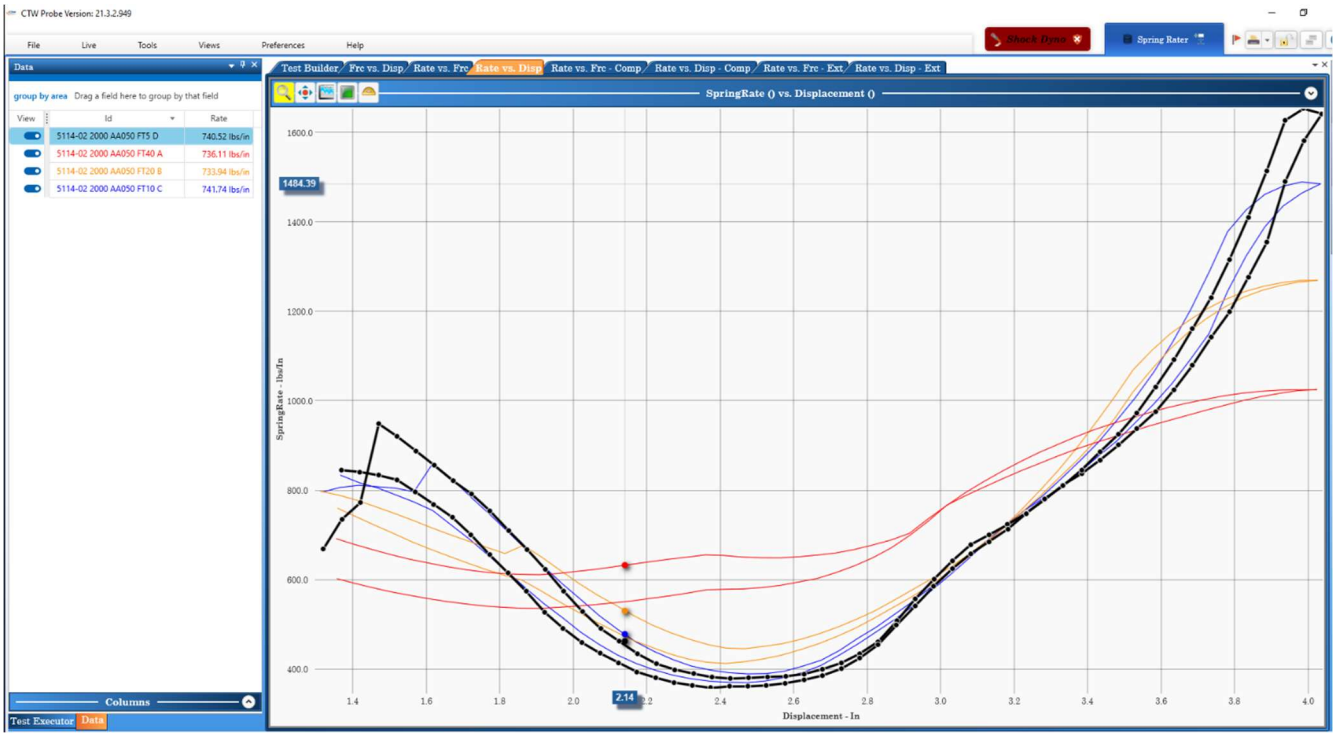
* This example showed best at 0.050" / 0.025"

3) Now, your ***Filter Parameter (FP)*** in conjunction with the ***Filter Type (FT)*** will work to give your curves the desired level of precision. The FT should be ***"Moving Average".*** Too high a number and data is lost, the curve goes flat and poor results occur.

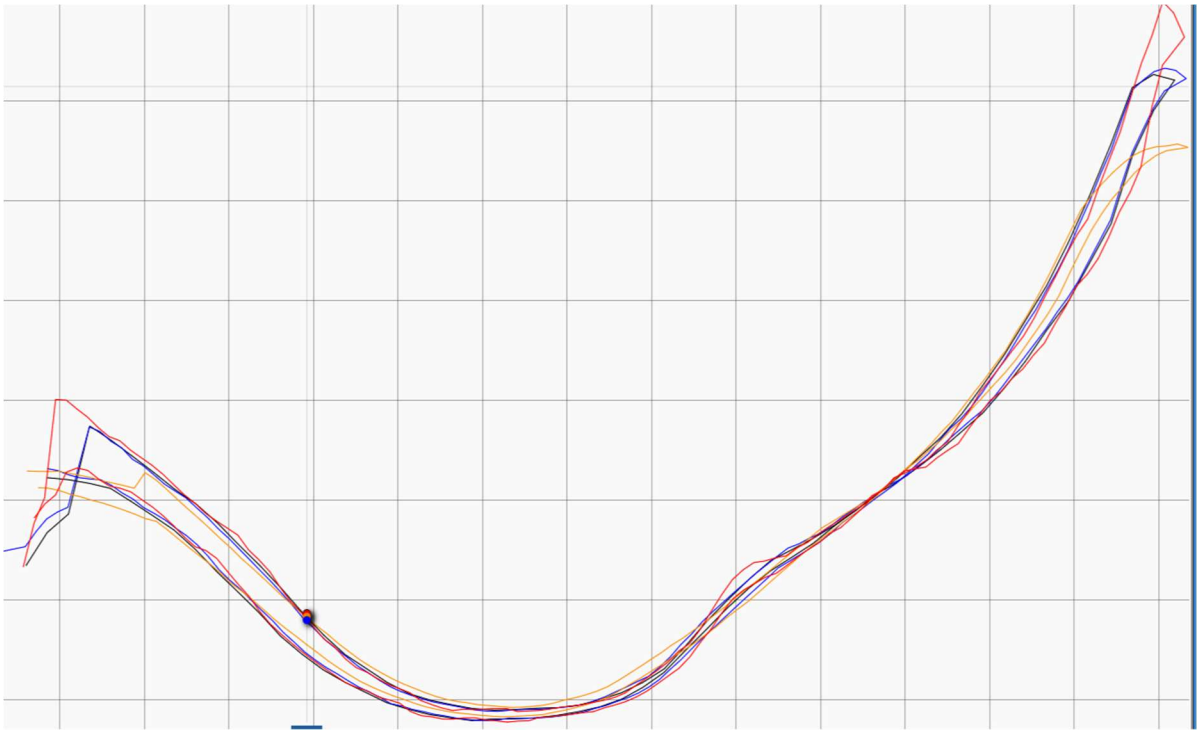
* The User should start with a small FP, "5" for example and then work in multiples from there. "5" will show close to no smoothing which likely makes the data very erratic looking, spiky or "noisy". Going to "10" and then "20" shows the curves as they begin to become more visually manageable. If you go too far, they lose data and flatten out any events or slope changes in the rate.

- The smaller the AAD, the higher the FP needs to be - more data means more smoothing.
- You are only trying to be refined enough to capture the slope changes.

In this example, the large change in rate can be viewed even in the very “smoothed” trace in red. This is with a ADD of 0.050” and the FP from 5 / 10 / 20 and 40. The FP-40 (red) is too much smoothing. The FP20 gets closer but the area at the end is still not clear. Finally at 10 and 5 the end of the spring can be fully captured, the rate changes seen and the User can decide.



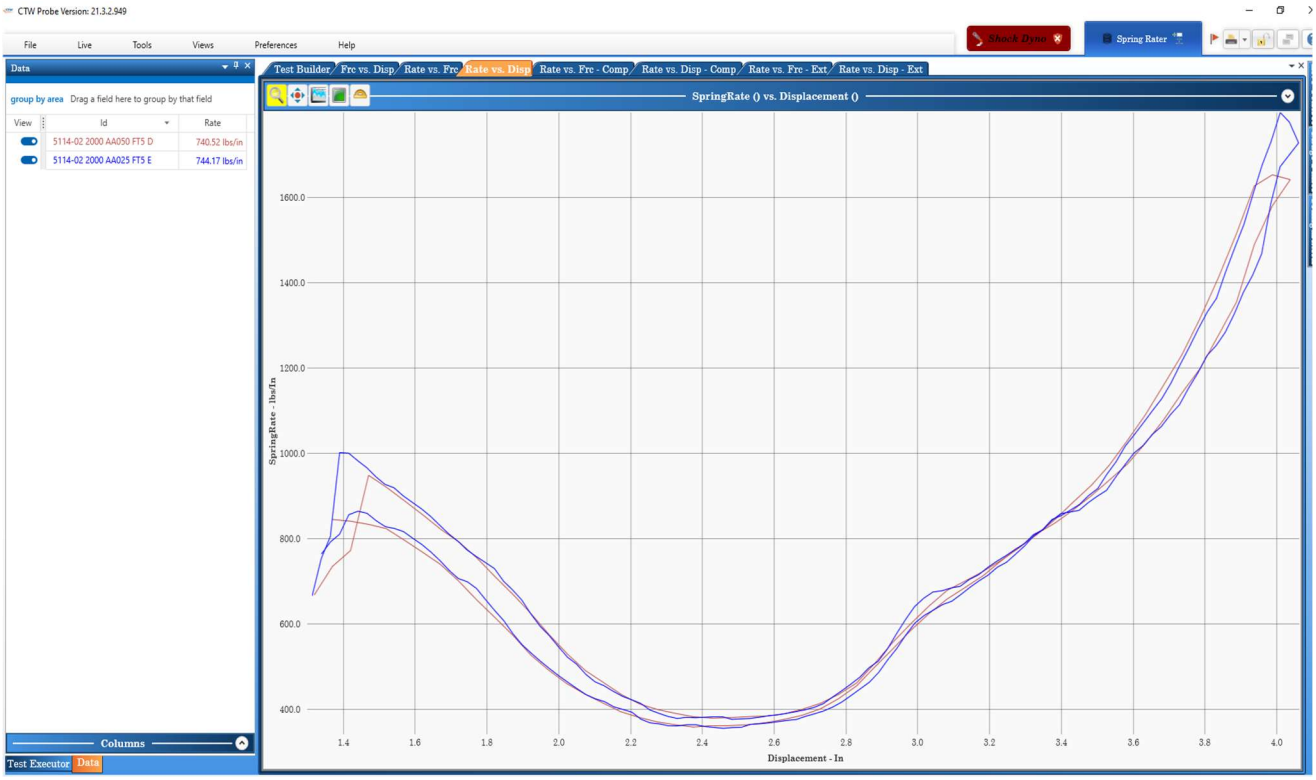
Then, to ensure this was enough, several runs were made using a AAD of 0.025” instead. Again, for these large rate changes and progressive rates the end becomes the important part visually, even thought the reported “rate” number is only different by 5 lbs/in or less than 1%.



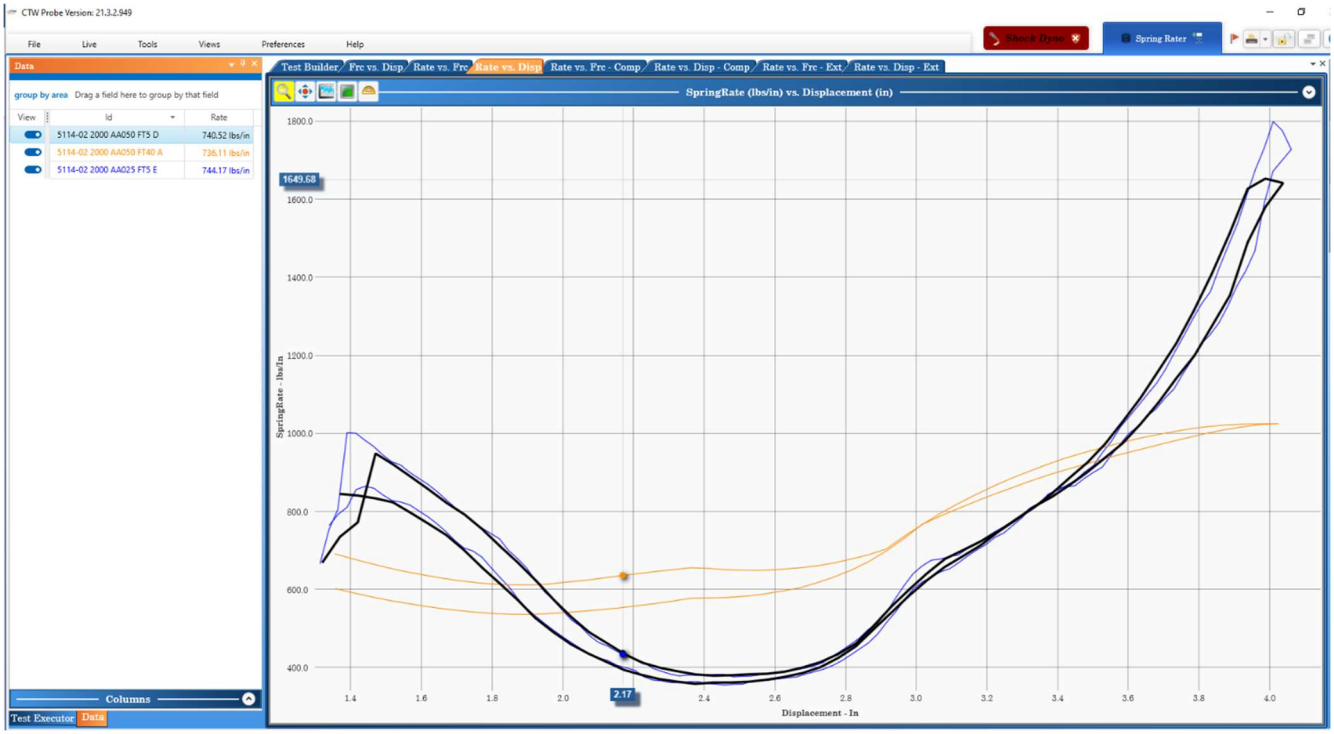
Finally, the User can decide based on which AAD to use. Below is the comparison of the two best from each.

Red is AAD at 0.050” and FP at 5. Blue is AAD at 0.025” and FP at 5.

The Reported rate is within 3.5 lbs./inch even with the two variations of the end / peak rate.

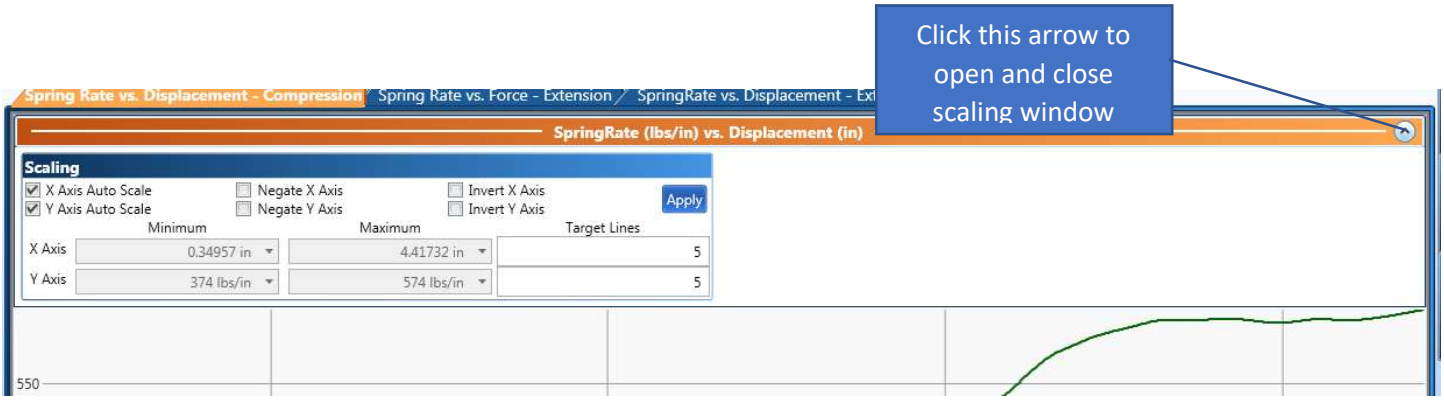


Below is the start curve vs. the finals for comparison.



Other features and tools

Scaling - As a default, the program will "auto scale" the graph to fit the data trace just inside of the paper. So the scaling on the page will increase or decrease depending on the displacement or force your spring produces. If you want to lock the graph scaling you can do that by clicking on the arrow in the upper right-hand side of the graph. This will open the scaling page. Remove the check from auto scale, type in your minimum and maximum for each axis, and hit apply when done. Each graph type scales independently.



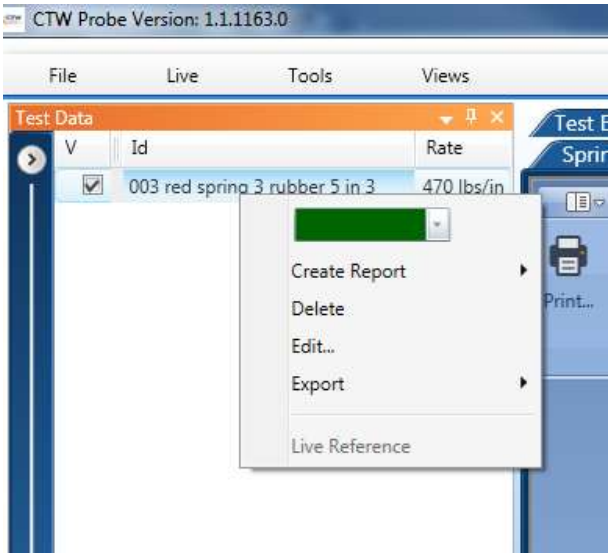
Features under the File pull down menu.

Units - In the file menu click "Unit System" to select US standard or metric units. Use the "unit preferences" to define which metric units your prefer (mm,m,cm) and the unit precision.

Layout - The "layout" selection under the file pull down menu allows the user to reset his software layout to a factory default or save and reload a custom layout.

Check for updates - If your computer is connected to the internet you can click on "check for updates" in the file pull down menu to find and download any software updates that may be available.

Features found by right mouse click on file name in data display column



Report - Collected data can be displayed as a text report by right clicking on any open data file names in the "data display" column. You will be able to select any or all of the open data files to produce a report. Reports show up as a tabbed page at the top of the screen. If you have a lot of reports open the "thumbnail button at the top of the page will list the page as thumbnails on the left side of the report. You can also export or e-mail the reports from tool bar buttons at the top of the report page.

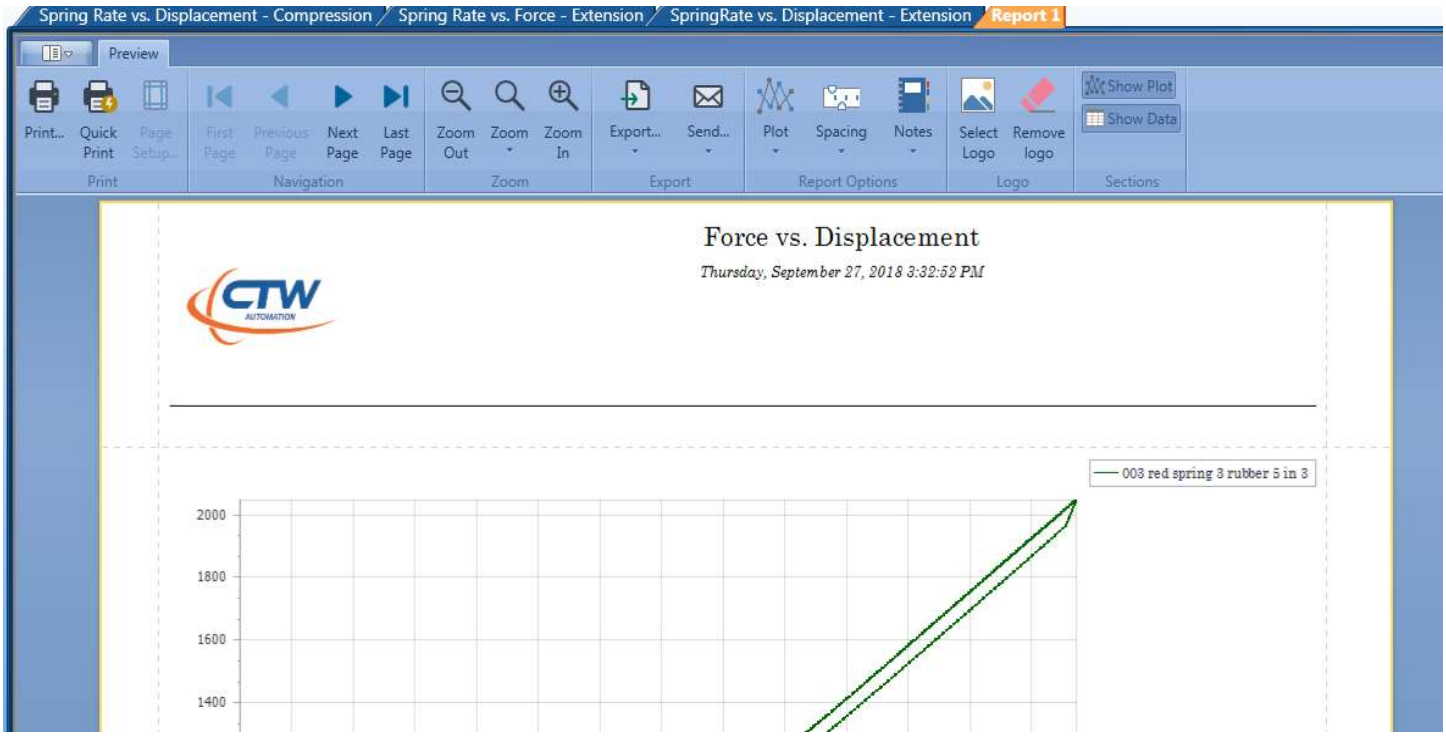
Other features on report page

Print - Printing is done from the report page using two tool bar buttons at the top of the report page. Quick print will print whatever graph or report you have displayed using the default printer settings. Custom print allows the user to select print features and pages.

If you want to add some notes to your printed graph page click on the "notes" tab at the top of the page. Notes will be added above the graph.

Add logo - The add logo tool bar button allows the user to import their company or team logo to print on the reports.

Report and print page tool bar - Data can be displayed and printed as graph or numerically. Data file can be saved as a PDF or e-mailed from this page report page tool bar.


Spring Rate vs. Displacement - Compression
Spring Rate vs. Force - Extension
SpringRate vs. Displacement - Extension
Report 1
Preview
Print...
Quick Print
Page Setup...
First Page
Previous Page
Next Page
Last Page
Zoom Out
Zoom
Zoom In
Export...
Send...
Plot
Spacing
Notes
Select Logo
Remove logo
Show Plot
Show Data
Print
Navigation
Zoom
Export
Report Options
Logo
Sections
Force vs. Displacement
Thursday, September 27, 2018 3:32:52 PM
003 red spring 3 rubber 5 in 3
2000
1800
1600
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