Understanding the Rod Force, Multi-Point and Seal Drag

Part 2 – Multi-Point Rod Force

CTW Probe has various ways of measuring the resultant force generated by the damper shaft displacing fluid as it moves in and out of the damper body.

The MultiPoint Rod Force command is a powerful tool to use when the damper shows signs of a large increase in Rod Force from BDC to TDC. This could be from a spring, or something internal that operates like a spring force, a small gas chamber that reacts quickly to the volume changes or maybe a large shaft diameter that displaces a large amount of fluid. Some dampers have internal spring components or simply the stroke you are using is so long that the rod force builds over the stroke. This command is a way to compensate for that.

Have you ever tested a damper or fork and when you view the Force vs Displacement, you can see the graph rise when going from the left side (BDC) to the right side (TDC)? This is a result of an internal spring effect and the Multi-point can help to remove this. Figure 1 shows an extreme case, actually a damper with a spring. You can see how the graph rises from left to right because of the spring affect. If you use the Multi-point Rod Force command, you can remove the static spring force and the graph will better line up from left to right.

Note: like the Rod Force, this only removes the “static component”. There will still be dynamic components to handle.

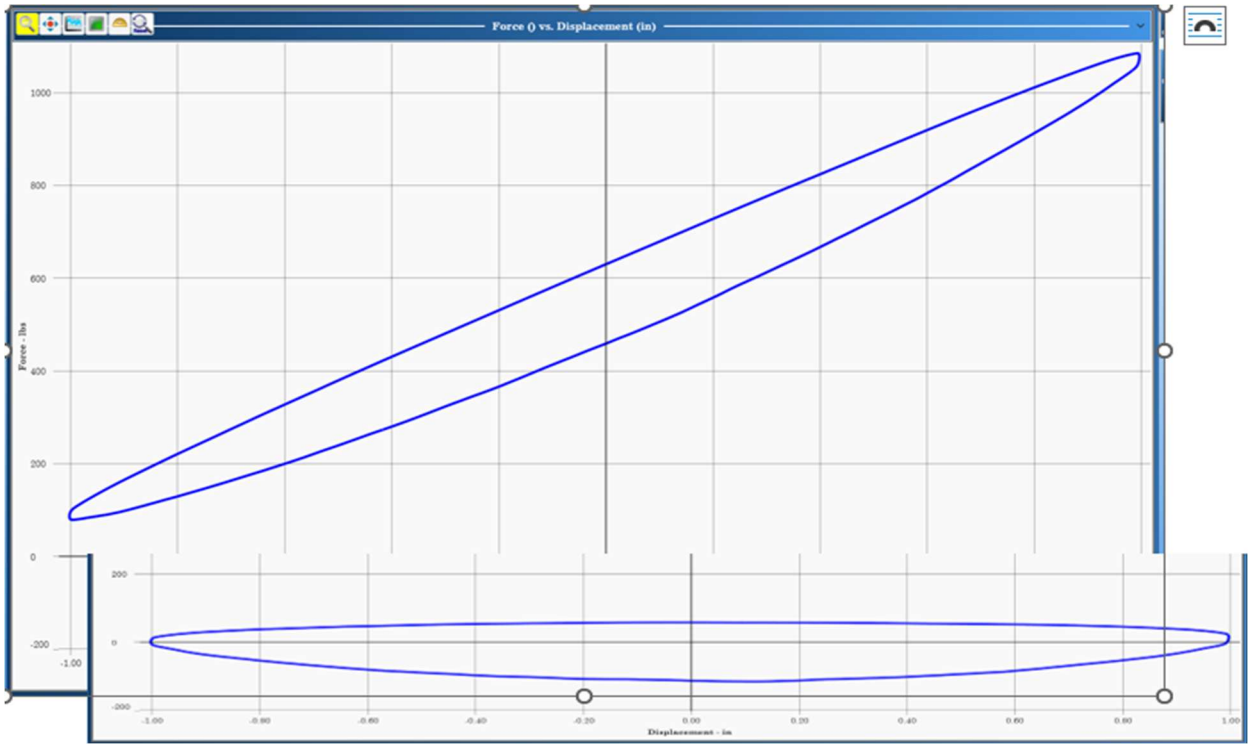

Figure 1: Overlay of a Coil-Over Damper with and without the Multi-Point Rod Force removed

If we look at this command in Probe© Diagnostic, we can get a better understanding of what it does when compared to the normal Rod Force. You can see the Rod Force takes (2) points at mid-stroke. The Multi-point Rod Force takes many points as defined by the User.

Figure 2: comparing the Rod Force and the Multi-point Rod Force commands

The Multi-Point command as viewed in Probe©

You add the command to the test sequence. You set the settle time and move to speeds just like the Rod Force, but now you have the software build a table by selecting how many points to use. For a 2 inch / 50mm you might want (3), for 100mm you might want (5) and for 160mm you can do more. Things to keep in mind:

* Always use an odd number so that you always get a point at mid-stroke.

* Do not use more than necessary because it does add time to the test.

* You can change the values after the table has been created to best fit your needs.

* The idea is to use enough points to generate an approximate curve for the gas pressure from BDC to TDC. We will talk more about this later in the paper.

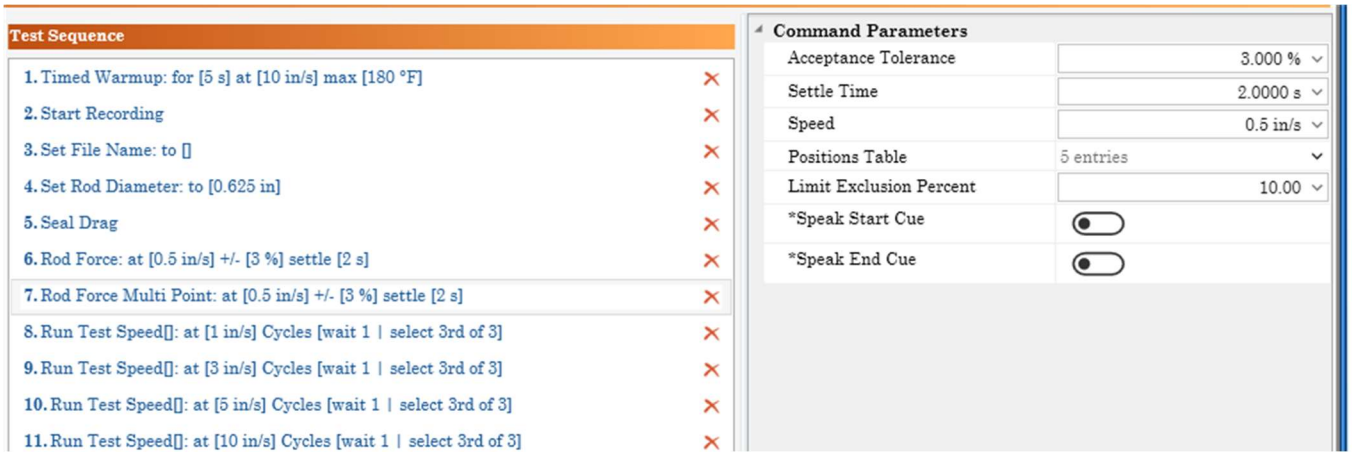

Figure 3 – Multi-Point command

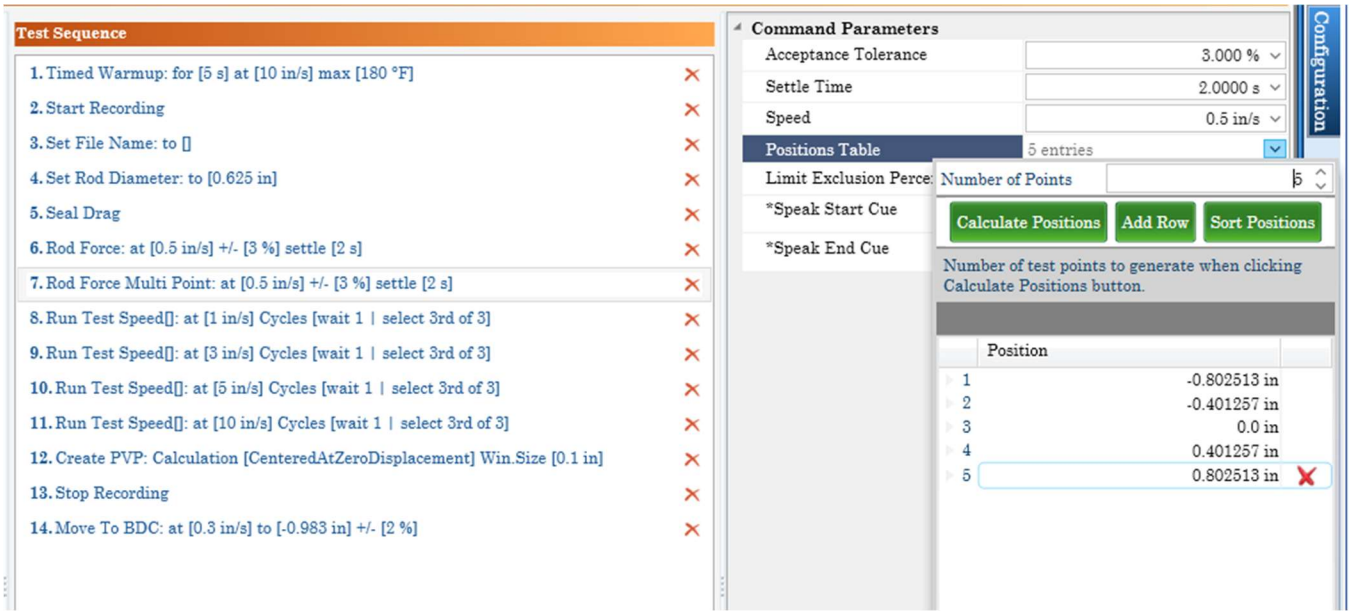

Figure 4 – the Table of points

During the test, Probe© will run this command and you can see the dyno stop at the points going in the compression direction and then again in the extension. The compression and extension values at each point are added and then divided by 2 for an average. These points then create a curve that will be used to subtract a force value from the test data based on displacement. In the Test Data legend, you can add fields so that you can get the information easily accessible. Instead of a “Rod Force” number, you get a **Rod Force** that opens into a table of data. You can use this data to get even more information. Click on it and the table opens and you can see the curve that has been created. If it is linear, then you can reduce the number of points. If it has a curve to it, you might need more. If it is flat, you might not need the Multi-point.

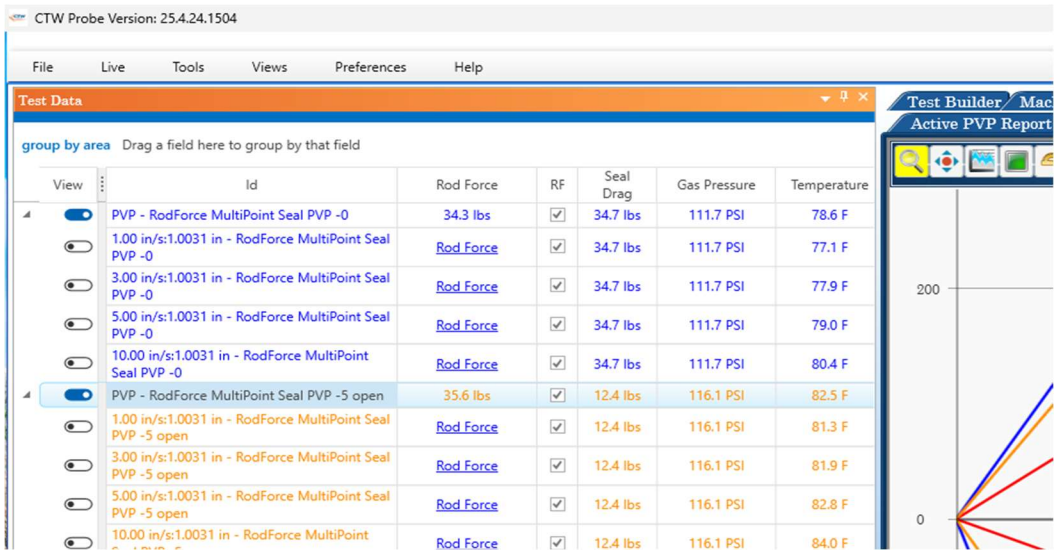

Figure 5 – view of the test data information in the legend

Figure 6 - Multi-point table showing a very linear growth curve. No need for more than (3) points. The next figure, you can see the curve is not linear, it is increasing in rate. You might want to use 5 or 7 points, depending on the stroke.

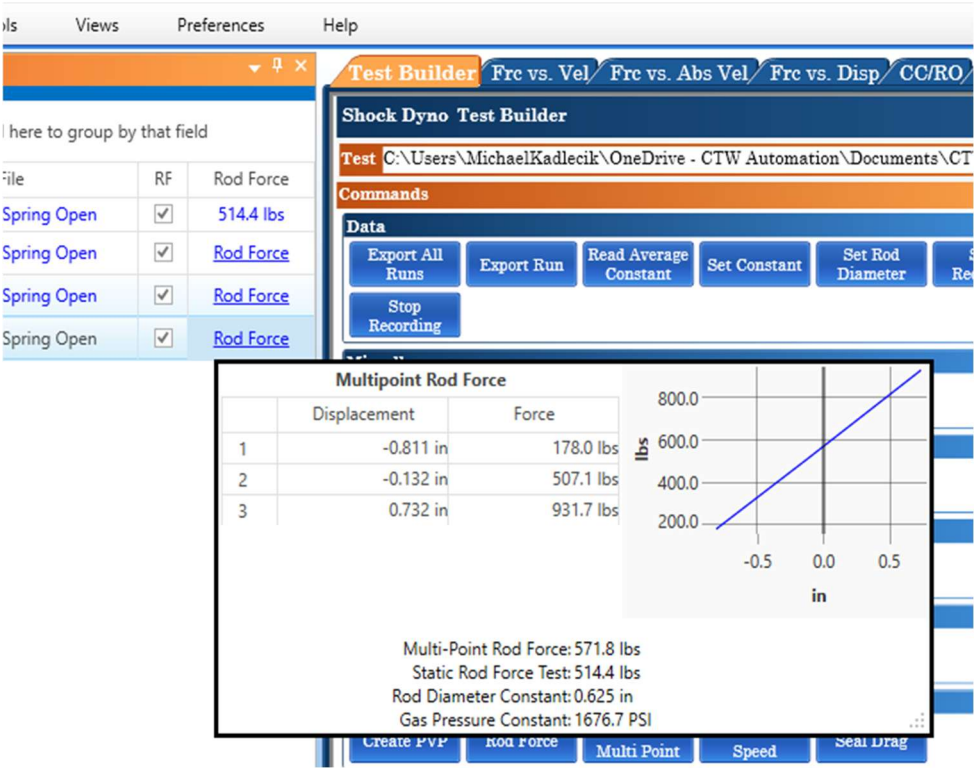

Figure 6 – the Multi-point Rod Force Data Table

Now, when the growth is not linear, this is when more points might need to be added. You can see in the table that the line has a growing rate as the damper is compressed.

Figure 7 – an example of non-linear multi-point rod force

In conclusion, use the Multi-Point rod force command when there is a large growth in rod force from BDC to TDC. A quick clue for the is to view the Force v Displacement graph. If it rises from the left side to the right side, then there is a spring effect internal.

Next up…Seal Drag

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“Don’t Panic”