PENSKE RACING SHOCKS®

Link

PENSKE RACING SHOCKS PHD-_ _ _ _ _2HP USER MANUAL

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CHAPTER

1

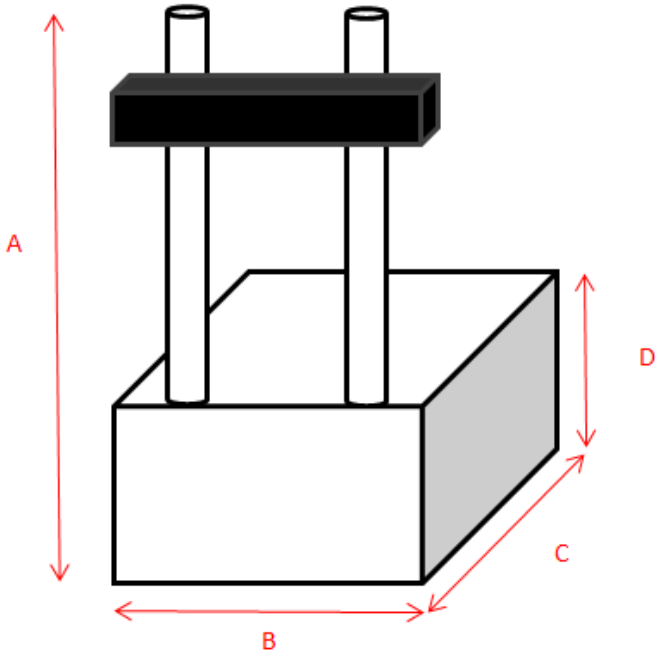
1. Receiving And Set-Up Of Your New Dyno

1.1. Dyno Weight And Measurements

2hp-Shock Dyno Weight – 240lbs (108kg)

Measurement

A. 52.500” / 1333mm
B. 18.125” / 460mm
C. 24.250” / 616mm
D. 10.750” / 273mm



1.2. Mounting Your Dyno

There are three tapped (3/8-24) in the base plate that are used to mount to your bench top. You can locate the mounting points by removing the top cover (black delrin cover), then removing the internal aluminum tray.

1.3. Electrical Requirements

Your S-Link Dyno Is Powered By 220v Single Phase Electric. Your Dyno Comes Pre-Wired With Industrial 220v Four Prong Connection.

1.4. Cable Connections

There are four connection points on the back of the dyno

- **Two serial port**
  - **Temp / force**
- **Two usb**
  - **Daq (data) / motor**

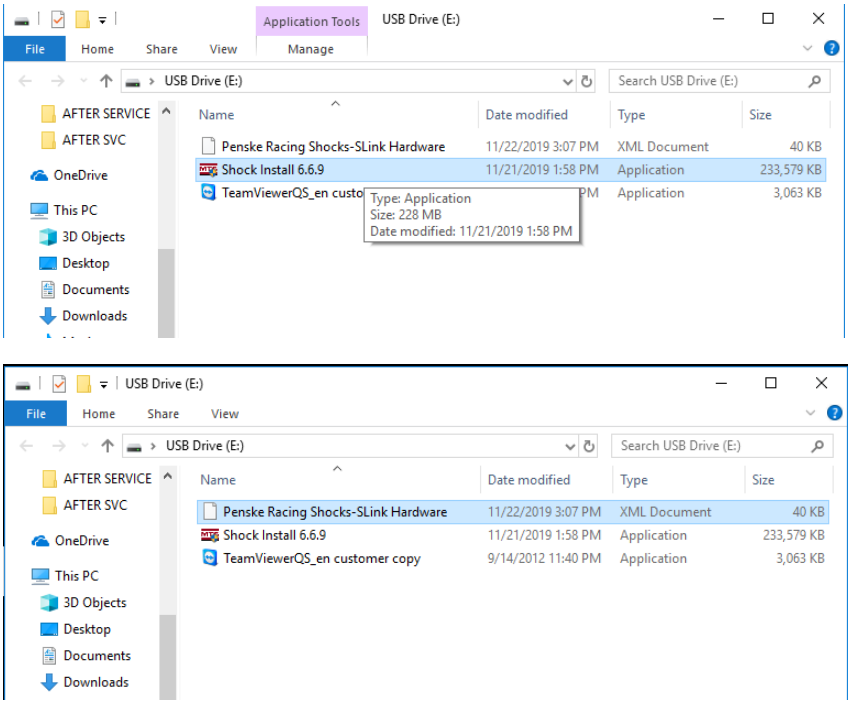
Once you unpack your dyno, you will need to connect the daq and temp connections, and then connect your pc to you dyno via daq and motor usb cables.

1.5. Software Installation

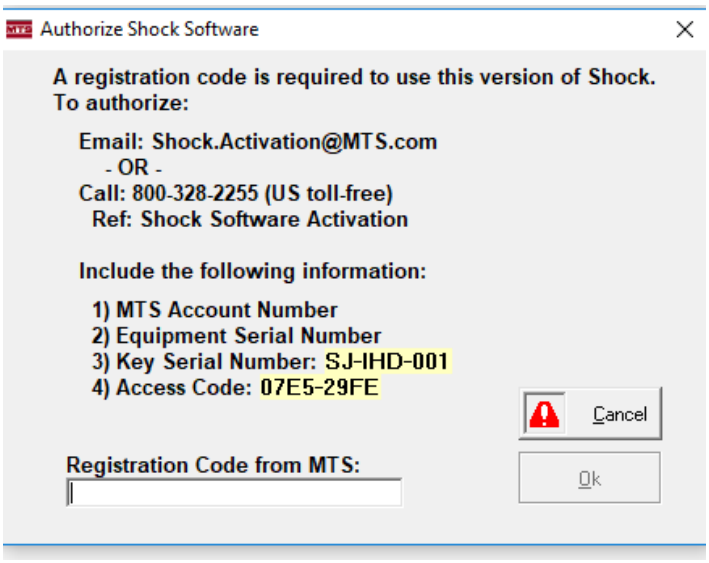
Once you have your dyno plugged in, turned on, and cables connected to your pc, it is time to install your software. The software and other important files and documents are located on the black usb storage device supplied with your dyno.

- **Start by plugging the usb stick into your pc.**
- **You should see three files on your usb stick.**
- **Copy and paste shock install file to your desk top.**
- **Next copy and paste your hardware file (.xml) to your desk top.**

- The hardware file is proprietary to your specific machine. This is where calibration settings are saved from the factory. *****do not lose or save over the original hardware file*****



- Next, remove the usb device and connect the two usb cables to your pc.
- You're now ready to install software. Double click on the shock 6 icon on the desk top. It should begin the auto-install process. (this may take a few minutes to install current drivers).
- Follow on screen instruction for installation.
- Once you reboot your pc, you can launch the shock 6 software
- At initial start-up of software, you will be asked for your registration code. This is supplied on your usb data stick as well. (don't lose this registration code, this is specific for your software and dyno serial #. It will allow you to install software on other pc's and be able to run your machine on multiple pc's. **(see fig. On next pg)**
- Once you type in your registration code, click ok, you will be taken to the software home screen where you're ready to start testing and analyzing your shocks.



1.6. Dyno Features

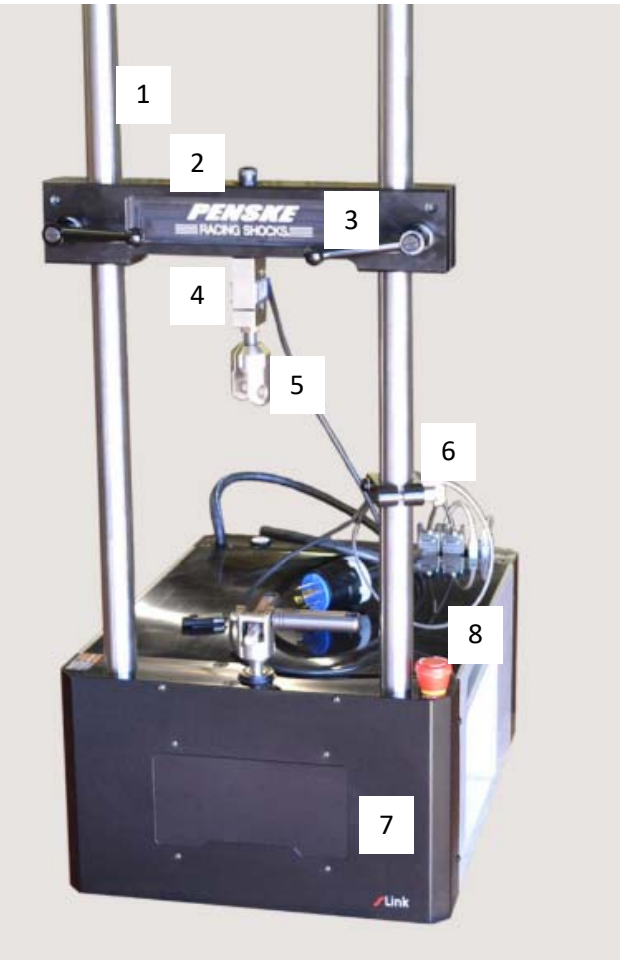
The Dyno Is A Fully Computer Controlled, Variable Motor Speed. It Is Capable Of Testing At Fixed Stroke. One Inch (25mm) Or Two Inch (50mm) Are Available. The Shock™ Test Control And Damper Analysis Software Enables You To Perform Static And Dynamic Gas Tests, Temperature Or Time Based Warm Up Of A Damper, As Well As Stop At Bottom Dead Center Of The Damper Stroke. The Software Also Allows The User To Run CVP, PVP, Or Multi CVP Tests.

Features

- 2 Hp Motor, 220v
- Zero Lash Helical Cut Gear Box
- Precision Scotch Yoke / Wear Plate System
- Two Standard English Strokes: 1.00” Or 2.00”
- Standard 50” Steel Columns (28” / 700mm Eye To Eye Test Area)
- +/- 2000 Lbs. S-Beam Load Cell
- 16 Bit Resolution USB Data Acquisition Standard
- Full Computer Control With Shock™ Software
- Chrome Plated Steel Columns
- IR Temperature Sensor

2. EXTERNAL PARTS IDENTIFICATION

1	Main Pole	6	IR Temp Sensor
2	Cross Bar	7	Main Cover (Front)
3	Dyno Handle	8	Emergency Stop
4	S-Beam Load Cell	9	On/Off Button
5	Clevis	10	Data Card Connection



CHAPTER

3

3. DYNO FUNCTIONALITY

Overview Of Dyno Functions

Your dyno is capable of carrying out standard PVP (peak velocityplot) or CVP (continuous velocity plot) tests on almost any type of linear damper. The dyno is also capable of running a warm-up cycle on the damper, and can measure both gas force and friction force. The technical paper below describes in more detail the fundamentals of damper dyno and their function.

Dynamometer Basics

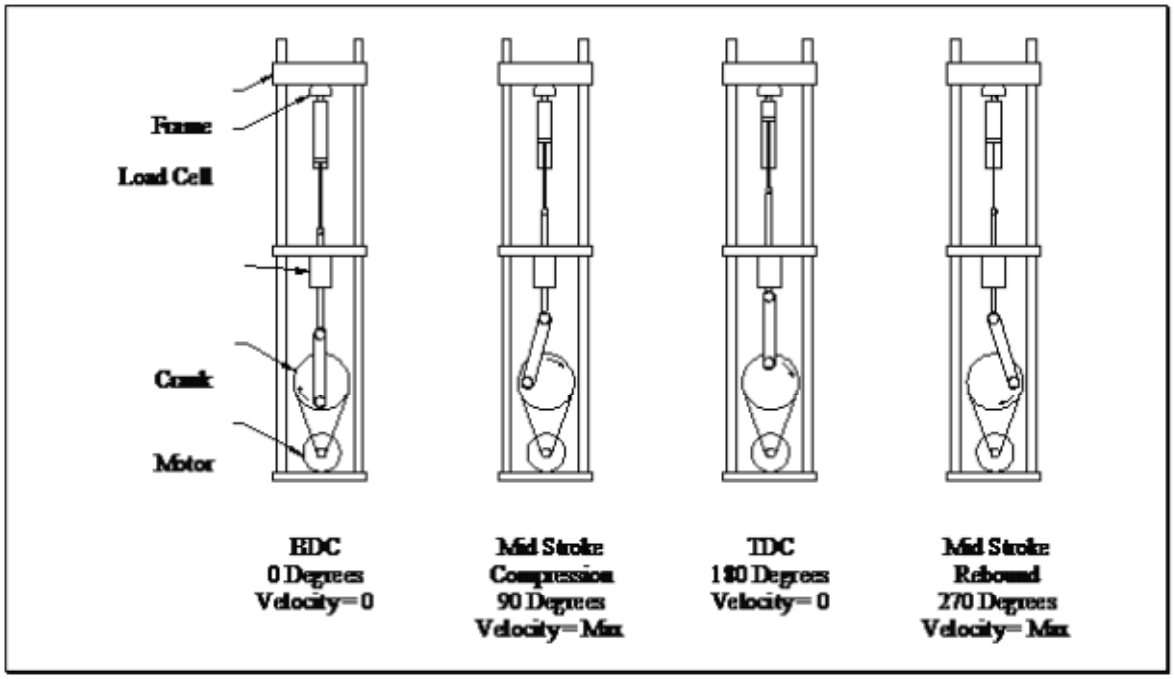
Dampers produce a force proportional to the speed of shaft movement. If you compress a damper slowly, it generates less resistant force than if you move it faster. As mentioned before, a damper on a race car does several very important things including providing a tunable “feel” for the driver during cornering, controlling wheel travel over road irregularities, and most important for a ground-effects car, stabilizing the under wing of the car at optimum ride height and rake.

Since dampers are a critical component of a race car, they should be tested periodically to make sure they are working correctly. Also, when a race engineer finds a damper set-up that makes the car faster under certain conditions at a certain racetrack, that engineer will want to have dampers set up the same way the next time the car runs on that or a similar track. As with any critical component, the race engineer would like to know more about how it works.

The shock dyno is a tool used to test dampers and learn about their behavior.

The force vs. Shaft speed graphs you see in this article come from data generated by testing a damper in what is generally known as a damper dynamometer or shock dyno. This is a machine that compresses and extends a damper at known speeds and measure the forces produced by the damper.

We’ll start out by describing the simplest form of a shock dyno. Figure 1 shows a frame holding an electric motor with a drive belt and pulleys that spins a crank attached to the damper shaft through a linear bearing. As the motor spins the crank, the damper piston moves up and down just like the piston in a engine. A variable speed motor give different crank rotation speeds. The load cell measures the damper force.



We all know that the speed of a piston connected to a crank varies continuously as the crank rotates. You might remember from high school math or physics that this type of motion is called sinusoidal because it varies with the sine of the crank angle. The piston comes to a stop at bottom dead center (BDC), accelerates to a maximum speed halfway up the cylinder, and slows down to a stop again at the top (TDC). If you have a damper attached to a crank, its piston does the same, and the force generated also varies continuously. We know, however, that the maximum speed of the piston happens only once per stroke, when the piston is halfway between top and bottom, and that's also when the damper generates maximum force. With our simple shock dyno we could change the crank stroke to vary the maximum shaft speed and/or we could use drive pulleys of different sizes. However both of these methods are cumbersome and time consuming during testing. Variable speed AC motors allow easy manipulation of the crank RPM.

How It Works

You put a damper in the dyno, choose a stroke and RPM, and turn on the motor. The crank turns and the damper shaft moves up and down until you turn off the motor. If you know the crank RPM, and the stroke, you can calculate the maximum damper shaft speed. For example, let's say the crank turns 100 RPM, and the stroke is 1 inch. 100 rpm is 1.67 revolutions per second and the length of 1 revolution is the circumference of the circle traveled by the crank bolt or Pi times the stroke. 1.67 x 3.14 x 1 inches is about 5 inches per second. This is the maximum speed of the damper piston, and it happens twice each revolution of the crank, once with the piston going up in compression and once again with the piston going down in rebound.

If we keep this example really simple and connect the damper directly to a weighing scale with a circular dial, we can stand there and read the scale pointer directly. What we'll see is the pointer cycling from 0 to some maximum bump force as the shock compresses, returns to 0, and then peaks out again at the max rebound force as the piston comes back down. The needle on our scale goes from plus some number to

minus some number as the damper cycles from compression to rebound and back. We can just write down the numbers at which the needle peaks as it goes back and forth. A commercially available shock dyno uses a computer to read the load cell and store the data.

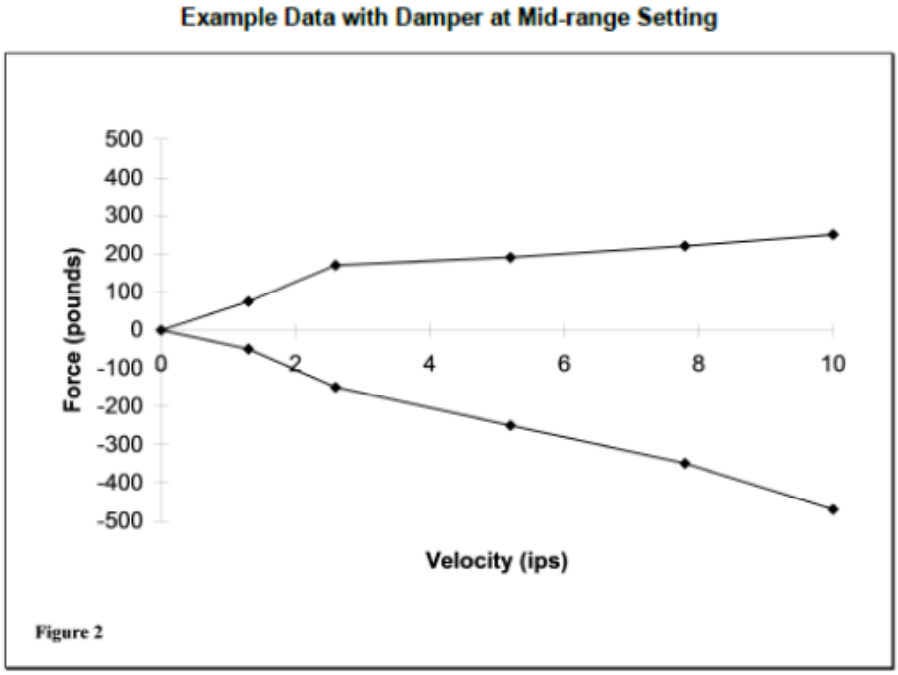
Some dampers are set up to give more force in rebound than compression so, as our simple machine cranks away; we might see the scale peak at 190 pounds in compression and 250 pounds in rebound. So we know that, at a shaft speed of 5 inches per second, the damper produces 190 pounds in compression (or bump) and 250 pounds in rebound. We'd like several data points so we can draw a curve. If we reduce the crank speed to 50 RPM, and 25 RPM, and also speed it up to 150, and 200 RPM, this gives us five data points. After we make these runs and read the scale we can make a table like this:

Example Data

CRANK MAX SPEED IN/SEC	BUMP FORCE LBS	REBOUND FORCE LBS
25	1.3	75	50
50	2.6	170	150
100	5.2	190	250
150	7.8	220	350
200	10.4	250	470

Presented as a force vs. shaft speed graph, it looks like Figure 2. We generated this data by running the crank at a 1.0" stroke and changing the crank RPM to give us 5 maximum piston speeds, and we read the bump and rebound forces at those maximum speeds. Then we made a graph by connecting the dots. If we want data at higher shaft speeds we need to speed up the crank or lengthen the stroke. Figure 2 shows us that the shock we tested has a pretty steep rebound curve while the compression curve starts low, rises quickly, and then levels off.

The real benefit of a machine like this comes when you test all four dampers off your race car and find out that they all give different readings even though they are supposed to have the same valving, and you've, hopefully, set them all to the same external adjustments before you started the test. Some small difference in readings is OK, but the closer together the better. If you've got the tools and experience, you can overhaul your shocks and test them again. Maybe you'll find contaminated oil, bad seals, or worn parts. Shocks wear out like any other mechanism and need to be rebuilt periodically.



A shock dyno also allows you to see the effects of external adjustments. If the data above represents settings in the middle of the range of adjustments, varying them in increments from full-hard to full-soft will give you curves that show the effect of those changes. That will happen if your dampers produce changes big enough to be seen by your machine. If you really are just reading a scale by eye you might miss some fine points. That's why people buy dynos instead of building them Figure 2 above came from data generated by looking at maximum or peak velocities. This is called Peak Velocity Pickoff, and that's the way a simple dyno works. We varied crank speed and the damper stroke to give us peak velocities in our range of interest.

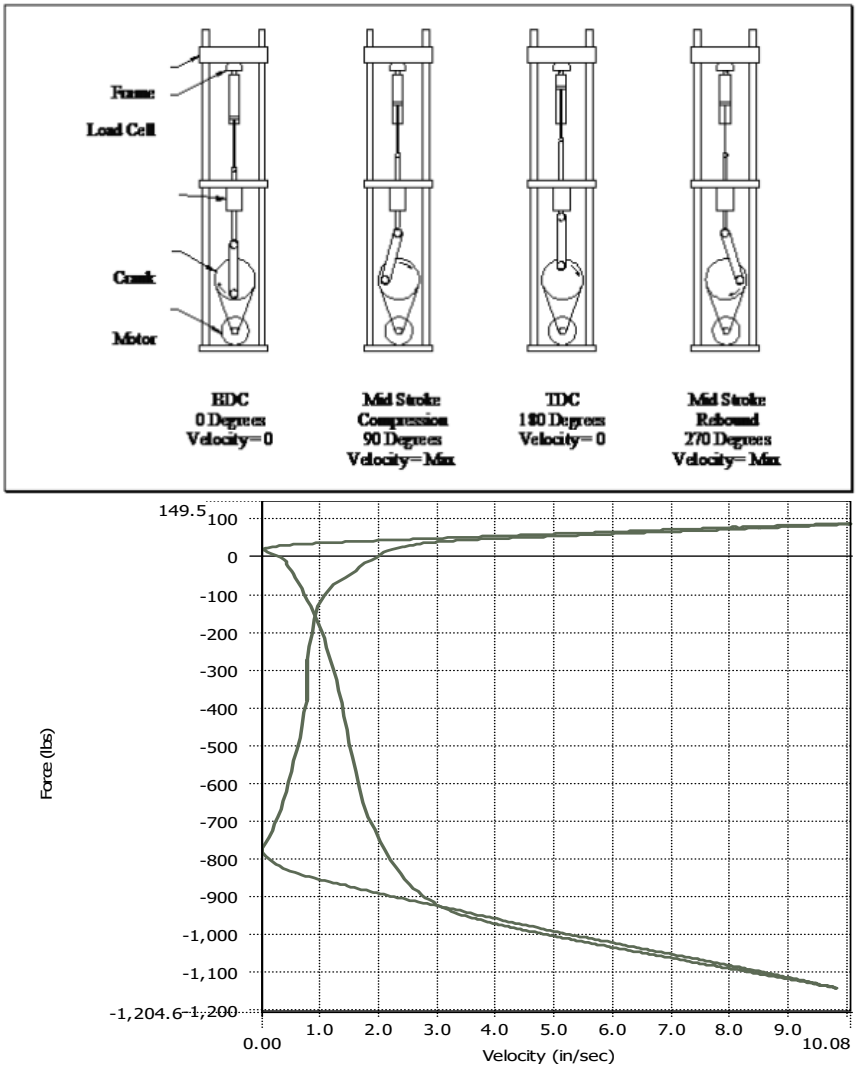
Collecting Data from an Entire Cycle

You can get more data from a damper by taking data over a complete cycle of compression and rebound and graphing that. This is called a Continuous Velocity Plot, and there are commercially available damper dynamometers that do this. Figure 1 has notations around the crank for Bottom Dead Center (BDC, 0 deg.), Top Dead Center (TDC, 180 deg.), and 90/270 degrees. When the crank pin is at BDC the damper is fully extended. As the crank rotates clockwise it's compressing the shock in the bump direction so that the damper piston accelerates from a stop to maximum speed at 90 degrees and then slows to a stop again at TDC. Rotation continues and the piston accelerates in rebound direction to maximum speed at 270 degrees and slows to a stop again at BDC.

Figure 3 shows force data taken continuously during one revolution of the crank. Shaft speed in the down direction is positive and compression force is positive. The bottom part of the curve shows shaft speed and negative force increasing as the crank goes from TDC (180 deg.) to 270 degrees and then decreasing as the curve goes back toward zero speed and force at BDC (0 deg.). As rotation continues, speed goes negative (compression) and force increases to a maximum at 90 degrees and back to 0 at TDC (180 deg.). The speed and force data taken to produce a graph like this comes from a velocity sensor and a strain-gauge load cell. A data acquisition system in a

personal computer reads these sensors 1,000 times a cycle or more. Software processes the data and displays it in this form.

This can be confusing and you might have to look at this sketch and the graph a while before it becomes clear. The important point is the force increases with piston speed. On the lower section of the curve the piston is accelerating where the curve is headed down and slowing down as the curve swings back up. It's the same on the top part. The piston speed and damping force increase to a maximum and then slow again. This is a lot more data than we had when we just changed crank RPM and looked at the damper force at maximum piston speed. So why doesn't the damper develop the same force when it's slowing down as it did when it speeded up? I'm not certain, myself, but remember you've got a bunch of oil moving through the washer stacks and bypass paths, and it has some mass and momentum. Those washer valves do not necessarily close the same way they open. Also, the fact that the damper piston is always accelerating, slowing down or speeding up, may have something to do with the shape of this curve.



CHAPTER 4

4. OPERATING THE DYNO SOFTWARE

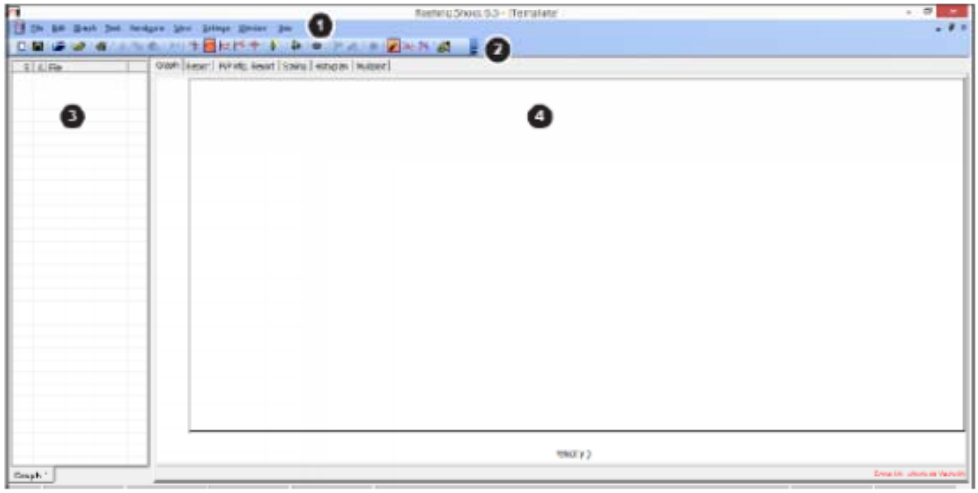
Shock6 Software Reference

- Introduction
- File Menu
- Edit Menu
- Graph Menu
- Test Menu
- Hardware Menu
- View Menu
- Settings Menu
- Window Menu
- Help Menu
- Motor Properties

Introduction

The following section is a reference for the screens and controls found in the Shock6 software. All functionality can be reached through the drop-down menus at the top of the screen. Some of the more commonly used functions and tasks can also be found on the toolbar, or can be accessed through hot keys. The toolbar can be modified using standard windows procedures. The following figure shows the main program screen.
Note: Data files saved in Shock96 or Shock5 can be opened and viewed with Shock6.

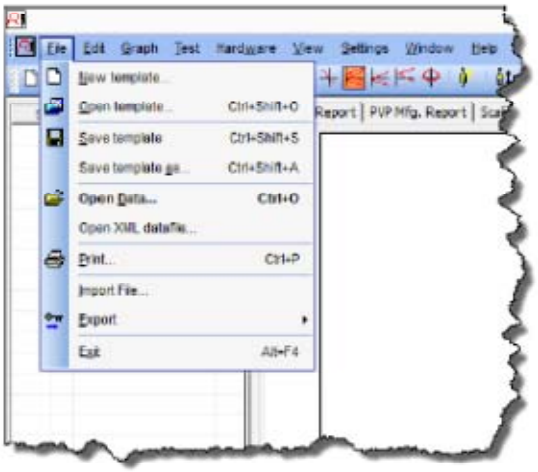
Shock6 Main Screen



Item	Description
1	Drop-down menus
2	Toolbar
3	Legend
4	Tabbed Analysis Window

File Menu

File Menu



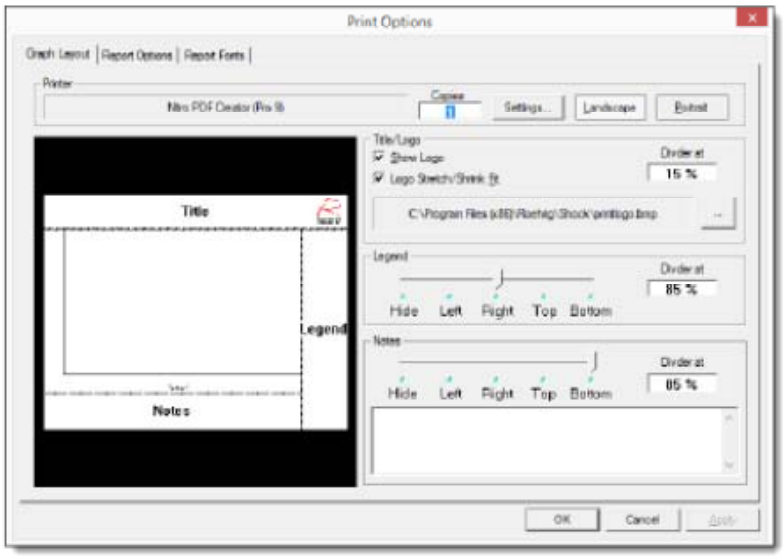
Item	Description
New Template	Creates a new template. Templates allow the user to open, analyze, and save single or multiple data files in one place. The Legend and Tabbed Analysis Window make up a template. Multiple templates can be opened at the same time.
Open Template	Opens a previously saved template.
Save Template	Saves the current template.
Save Template As	Saves the current template as a new template with a unique file name.
Open Data	Opens a previously saved data file and places it in the current template. A data file is created and saved after running a test. A data file contains all the data for only a single test.
Open XML Datafile	Opens a previously saved .xml data file.
Print	Allows the user to print graphs and reports from the current template.
Import File	Creates a data file from imported user data.
Export	Exports the highlighted data file displayed in the current template. Data files can be exported as an XML or CSV (comma separated value) file. Export selected traces will export only the channels displayed on the current graph. Both options will also export all field data. Raw data may also be exported by using copy and paste from the signal vs. time graph.
Exit	Used to exit the Shock6 program.

Print Options Window

Graph Layout Tab

Use the **Graph Layout** tab to size the graph, legend, and notes for the printout.

Graph Layout Options

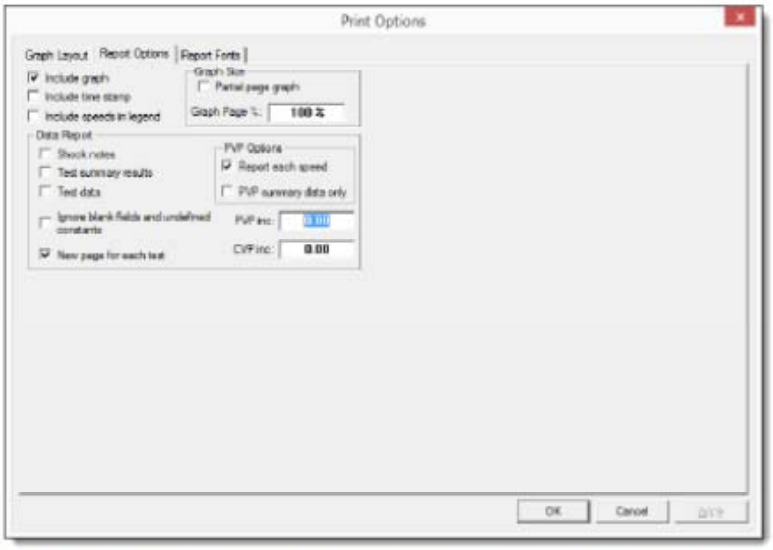


Item	Description
Show Logo	Adds a user-defined logo to the Title block.
Logo Stretch/Shrink Fit	Adjusts the size of the logo to fit within the Title block.
Legend and Notes	Blocks can be moved to different positions using the corresponding sliders.
Divider at	Adjusts the sizes of the Title/Logo, Legend, and Notes boxes. The number entered in this box is the percent of the page from the top or left from which each block will start.

Report Options Tab

Use the **Report Options** tab to define all parameters for the numeric report page which is printed after the graph page.

Report Options

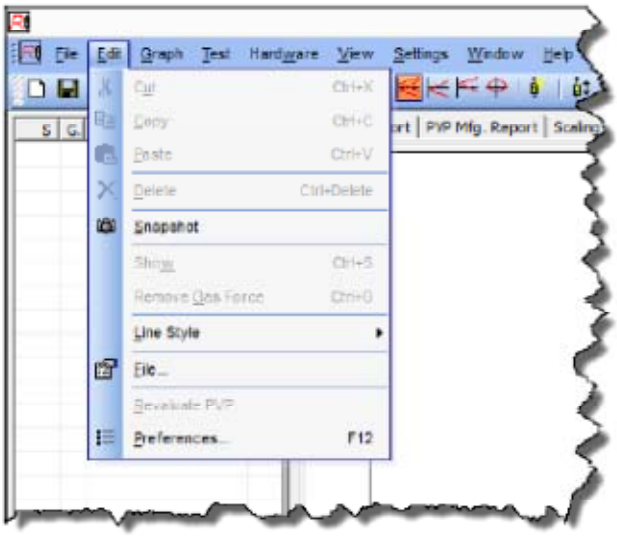


Most controls on this tab are self-explanatory. Those requiring explanation are described in the following table.

Item	Description
Shock notes	Prints the fields, data, constants, and any notes that were entered for each file displayed in the legend.
Test summary results	Prints the test results for each file displayed in the legend.
PVP inc and CVP inc	Prints data points at the specified increments. If no data point exists, one is interpolated.
Partial page graph	Allows the graph and report to be printed on the same page. Adjust the graph page size as necessary.

Edit Menu

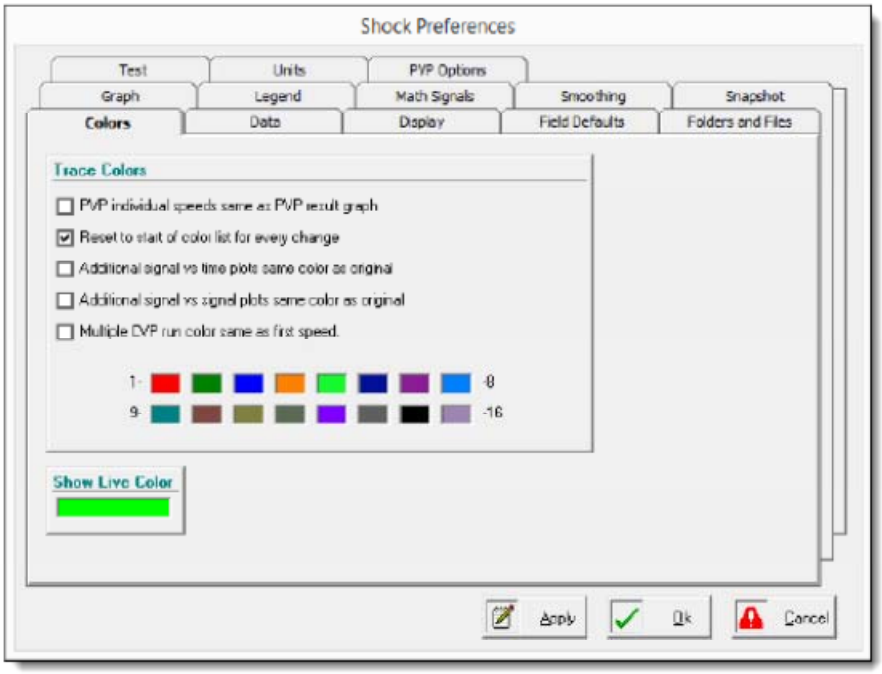
Edit Menu Options



Item	Description
Cut	Used to cut the selected item and place it on the clipboard.
Copy	Used to copy the selected item and place it on the clipboard.
Paste	Used to paste the item on the clipboard to the selected location.
Delete	Used to delete the selected item.
Snapshot	Takes a "snapshot" (similar to print screen) of the current graph and legend and places it on the clipboard. The snapshot can then be pasted into any windows program such as Paint or Word. The size of the snapshot can be changed in Preferences (F12).
Show	Click to display/conceal the highlighted data file. This command is also available as a check box on the legend.
Remove Gas Force	Click to include/exclude the gas force from the highlighted data file. This command is also available as a check box on the legend.
Line Style	Changes the line style for the highlighted data file.
File	Allows the user to open and edit the data file properties/description page, also known as "Fields".
Re-evaluate PVP	Regenerates the PVP summary graph for the selected PVP file.
Preferences	Opens the Shock Preferences window, where the majority of the default settings for the program are found. Keep in mind, many of these settings can be changed in other areas of the program without affecting the default settings.

Shock Preferences Window

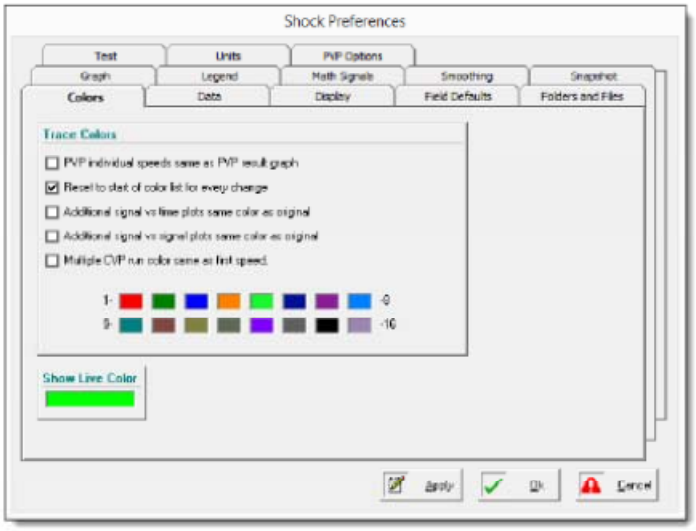
The Shock Preferences window consists of 13 tabs which are described in the following topics.



Colors Tab

This tab controls the default colors and order used when displaying data traces. Left-click a color to bring up the Color Selection window.

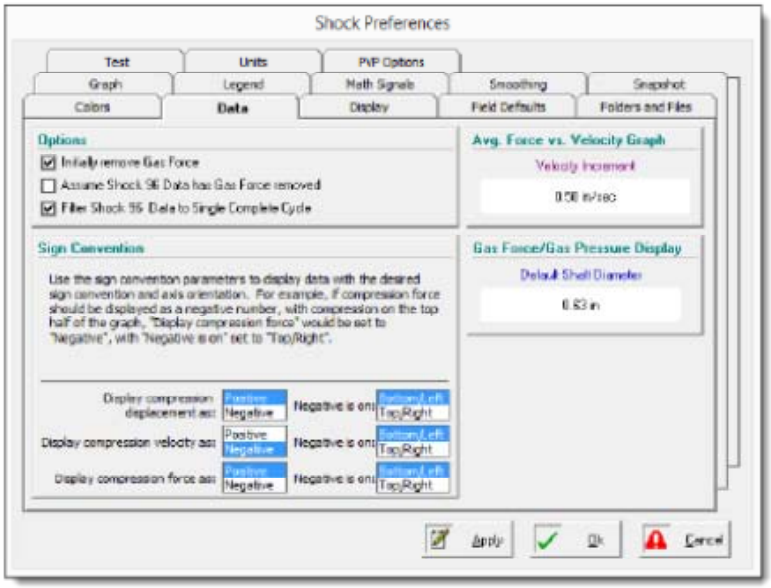
Colors Tab Options



Data Tab

This tab contains the default data display options.

Data Tab Options

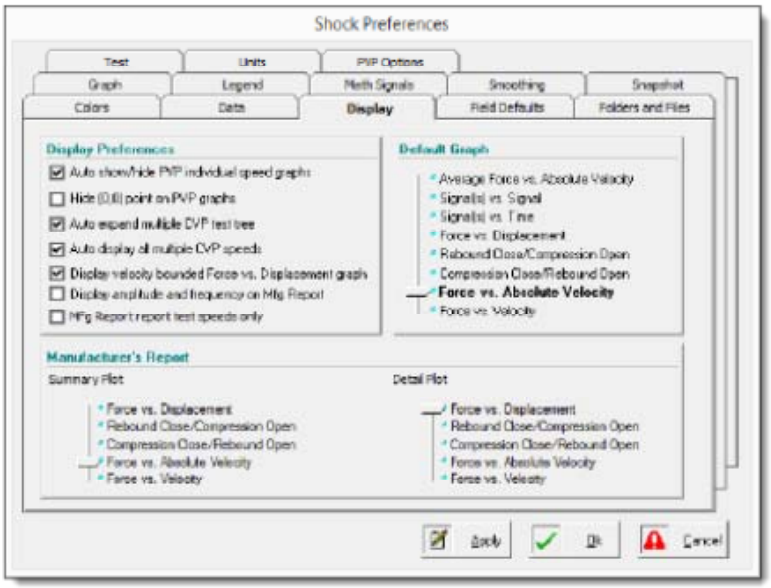


Item	Description
Initially remove Gas Force	Check this box to initially remove gas force from data when displayed.
Assume Shock 96 Data has Gas Force removed	Check this box if importing Shock 96 data which already has the gas force removed.
Filter Shock 96 Data to Single Complete Cycle	Check to display only one complete cycle when importing Shock 96 data.
Sign Convention	Allows you to change the default sign convention and axis used when displaying data.
Avg. Force vs. Velocity Graph	Controls the cursor step size on the average force graph only.
Gas Force/Gas Pressure Display	Default shock shaft diameter used for calculating the gas pressure.

Display Tab

Use this tab to select default graphing display options.

Display Tab Options

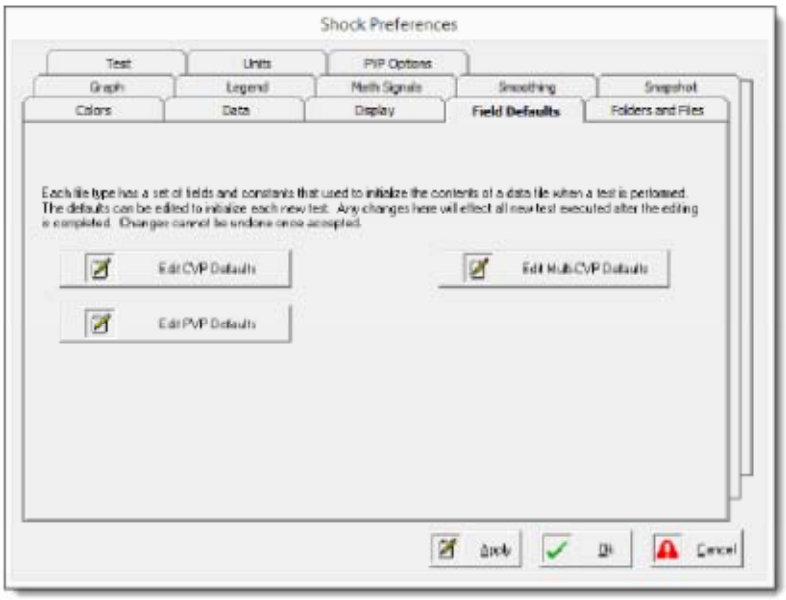


Item	Description
Display Preferences	Check box options for PVP and CVP data display defaults.
Default Graph	Allows you to determine the default graph which is initially displayed in the analysis window.
Manufacturer's Report	Allows you to determine which two graphs are displayed in the manufacturer's report. The manufacturer's report is only available for PVP test data.

Field Defaults Tab

Use this tab to edit the fields which are stored with each test and displayed in the report tab.

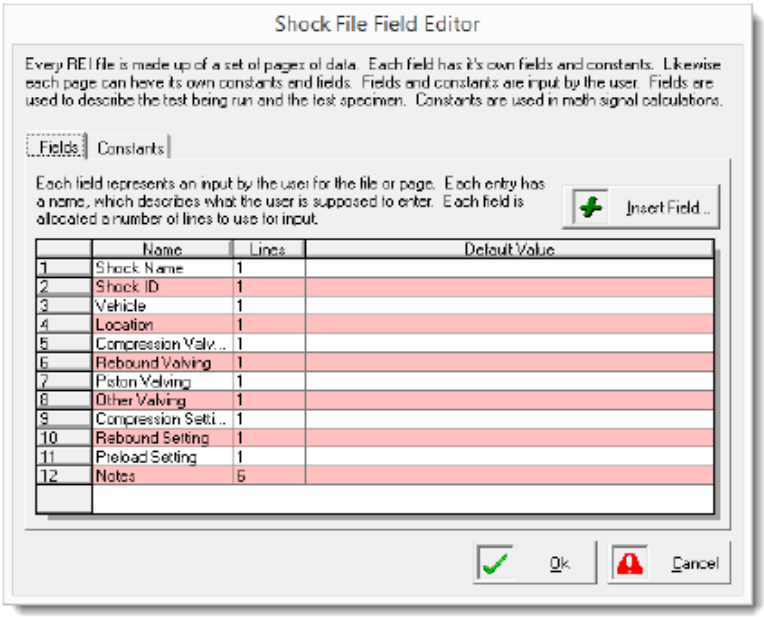
Field Defaults Tab Options



Edit CVP Defaults, Edit PVP Defaults, and Edit Multi-CVP Defaults

These fields can be edited separately for each type of test. When editing the fields for a specific test, use the **Insert Field** button to add a row. Use the delete key to delete a row. The names for each row can be edited by clicking that particular cell. The number of lines displayed for each row can also be edited by clicking the "lines" cell. Constants are numbers which can be used with math channels.

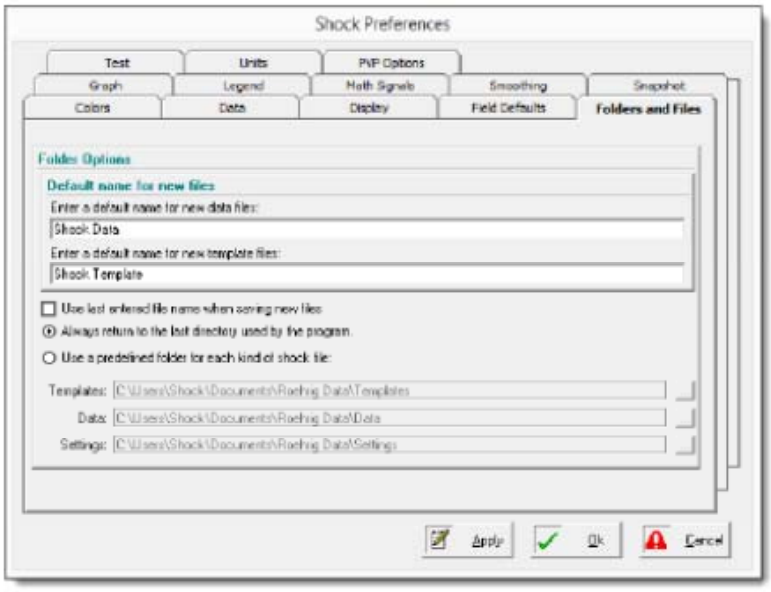
Edit Defaults



Folder and Files Tab

Use this tab to set the default file names and default directories where the files are saved.

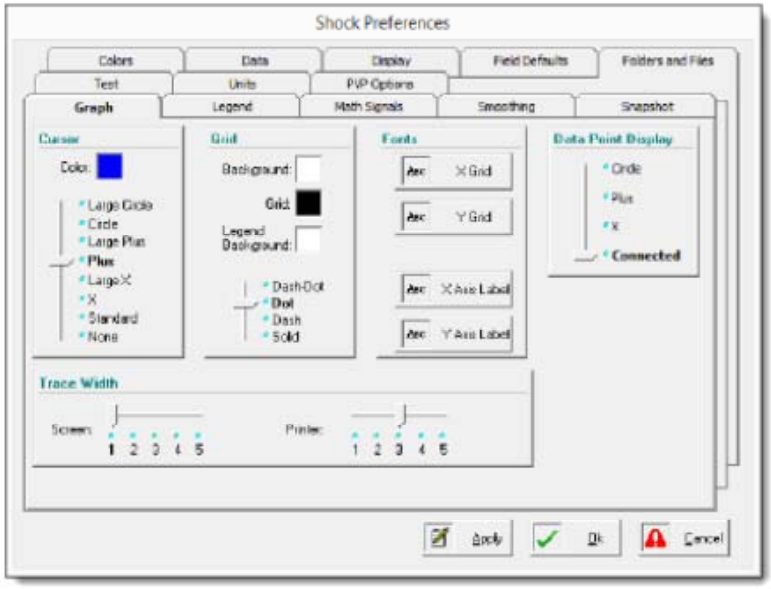
Folder and Files Tab Options



Graph Tab

Use this tab to change the default cursor, grid options, fonts, data trace style, and data trace width.

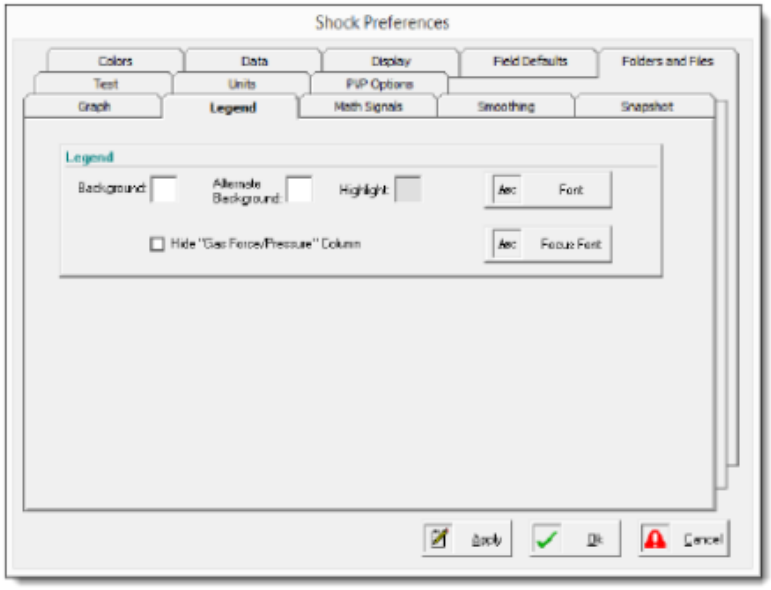
Graph Tab Options



Legend Tab

Use this tab to control the default colors and fonts for the legend. Click a color to bring up the Color Selection window. Click the font box to bring up the Font window.

Legend Tab Options

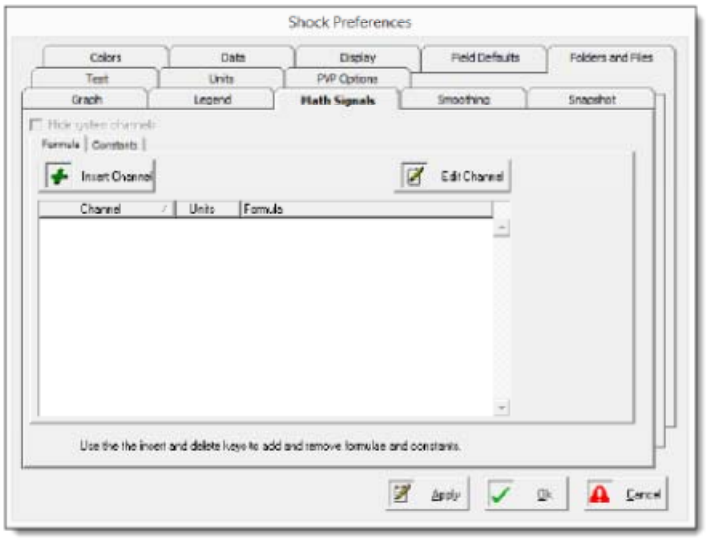


Item	Description
Hide "Gas Force/Pressure" Column	Check to conceal the "Remove Gas Force" check box in the legend.

Math Signals Tab

Use this tab to create additional data channels which are created using constants, math functions, and collected data channels. Math channels are treated the same as collected channels and may be graphed or used in other math channels. The math syntax used in creating these channels can be found in the Appendix.

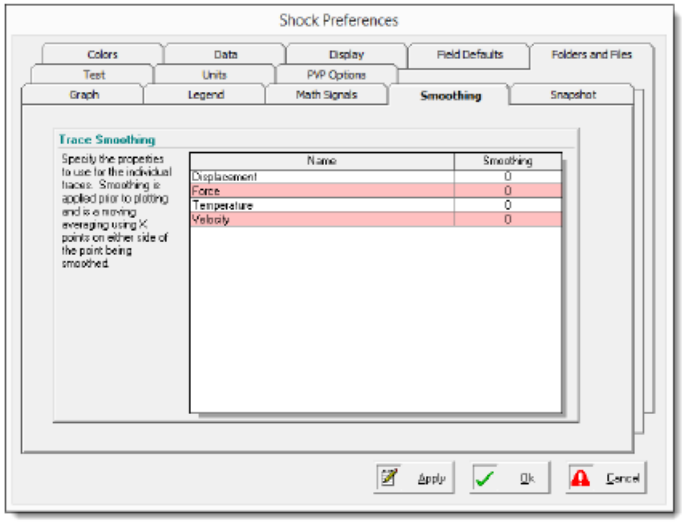
Math Signals Tab Options



Smoothing Tab

Use this tab to place a moving average filter on a selected channel(s). All collected channels and all math channels are listed here. Use caution when using smoothing values above 5. Smoothing can cause phase shifts and attenuation in the data. If using smoothing, it is best to use the same amount of smoothing on all channels.

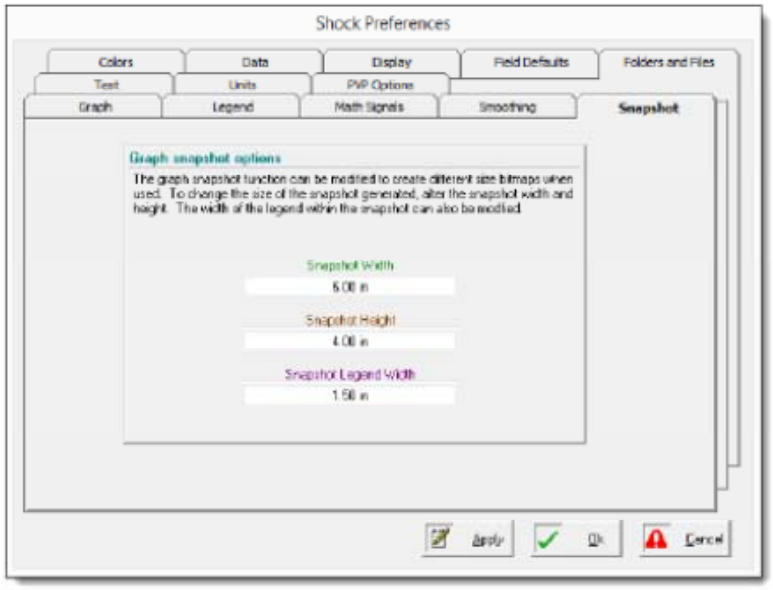
Smoothing Tab Options



Snapshot Tab

Use this tab to alter the size of the snapshot taken of the graph and legend when using the "snapshot" function.

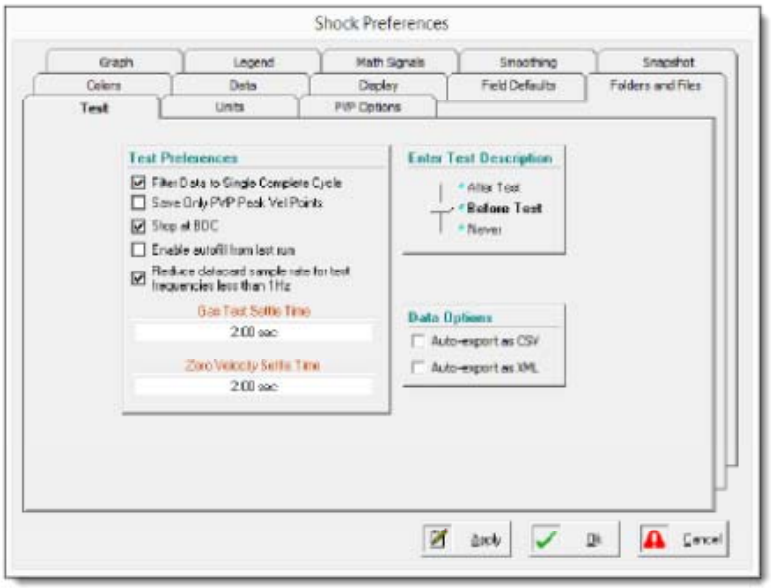
Snapshot Tab Options



Test Tab

Use this tab to edit default test settings.

Test Tab Options

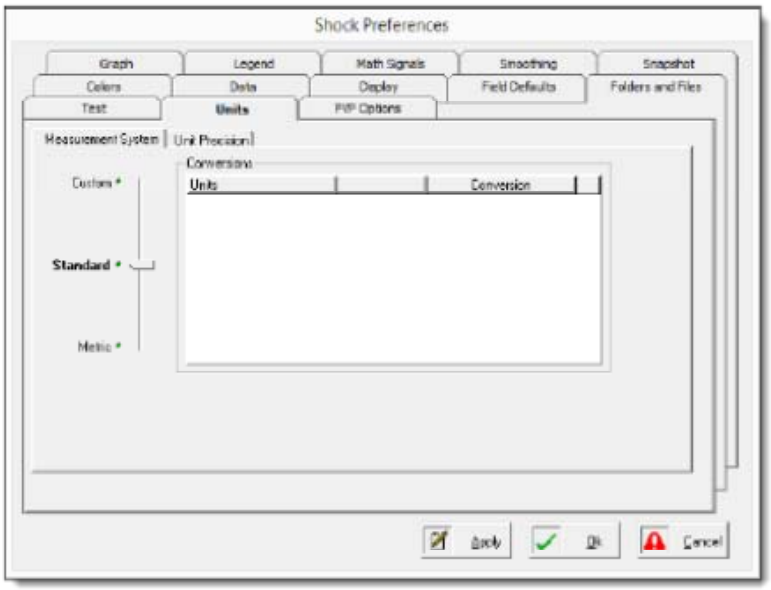


Item	Description
Filter Data to Single Complete Cycle	Check this box to display only one cycle from the data collected. The dyno by default runs three cycles at each given speed.
Save Only PVP Peak Vel Points	Check this box to save only the peak velocity data points. Do not check this box to save the entire CVP data for each PVP test speed.
Stop at BDC	Check this box to have the dyno automatically stop at "bottom dead center" after each test.
Enable autofill from last run	Check this option to automatically fill the Fields with the data from the last test.
Reduce datacard sample rate for test frequencies less than 1 Hz	If the test speed is below 1 Hz, this control slows the data collection speed to reduce file size.
Gas Test Settle Time	This sets the length of time the dyno pauses when measuring the gas force.
Zero Velocity Settle Time	This sets the length of time the dyno pauses when taking the zero velocity recording for a PVP test.
Enter Test Description	Allows you to choose when the Fields are displayed for test description entry.
Data Options	Check these boxes to automatically save a .csv or .xml file when you run and save a test.

Units Tab

Measurement System Tab

Units Tab — Measurement System Options

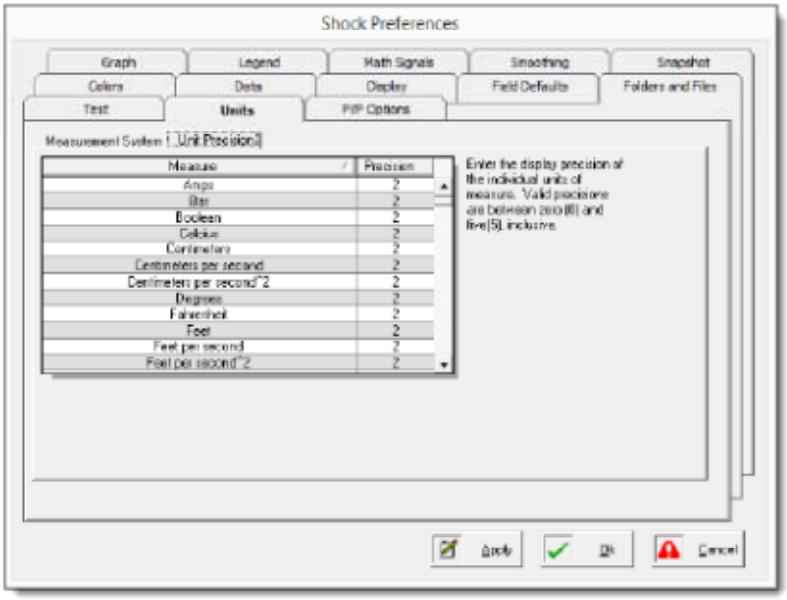


Item	Description
Custom	The English units collected by Shock6 can be converted to any units you specify.
Standard	English units (which is the native unit set used by Shock6)
Metric	Metric units from which you can choose to convert English units. For example, lbs could be converted to kgf or N.

Unit Precision Tab

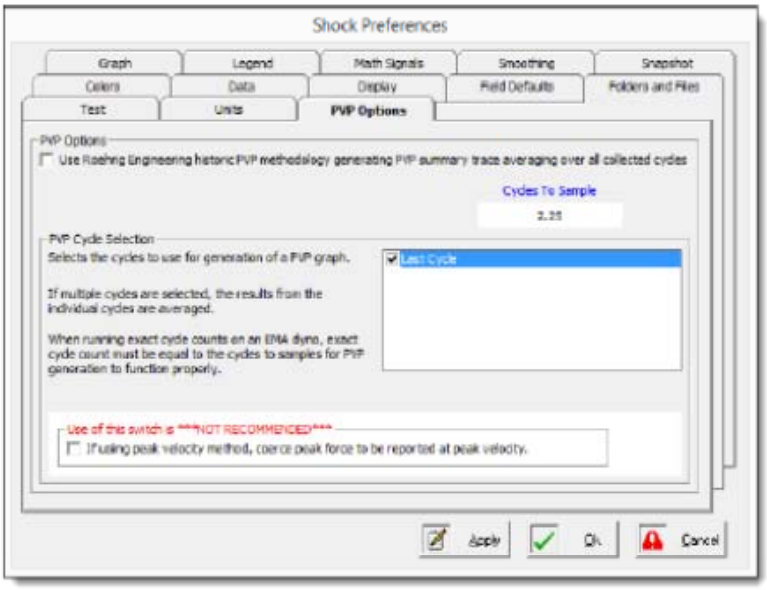
Enter the display precision of the individual units of measure. Valid precisions are between zero (0) and five (5), inclusive.

Units Tab — Unit Precision Options



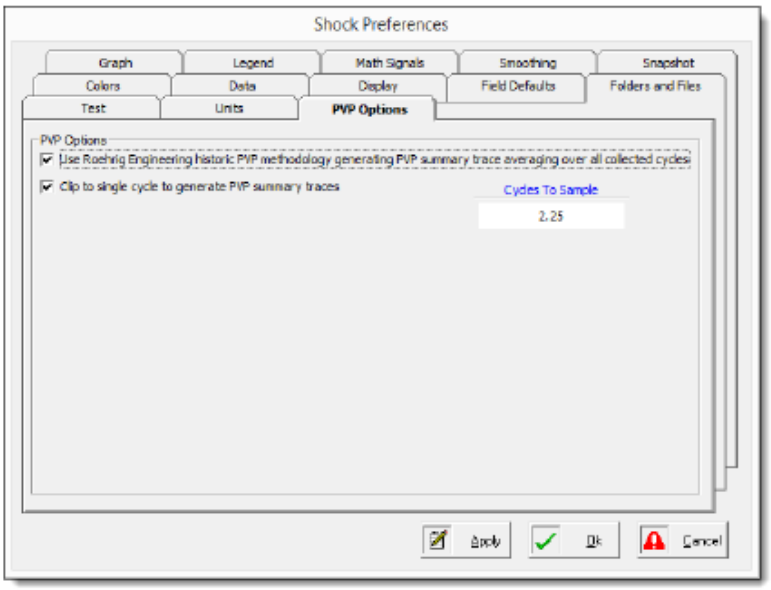
PVP Options Tab

PVP Options Tab



Item	Description
Use Engineering historic PVP methodology generating PVP summary trace averaging over all collected cycles	If this option is selected, the program will average all collected cycles and use that average as the peak points for the PVP trace. When you check this box you will also be given the option to clip to a single cycle; in this mode the program will use the second to last cycle. This is how previous versions of Shock 6 displayed PVP traces. See the additional panel that follows this table.
Cycles to sample	Defines the number of cycles that the dyno will run and the user will have to select. Increase this number to see more cycles under cycle selection.
PVP Cycle Selection	This option allows you to select what cycle or group of cycles you would like to use for PVP generation. Any number of cycles can be selected.
If using peak velocity method, coerce peak force to be reported at peak velocity	This method should not be used without contacting MTS technical support beforehand to make sure the operator has a complete understanding of the effects on the data.

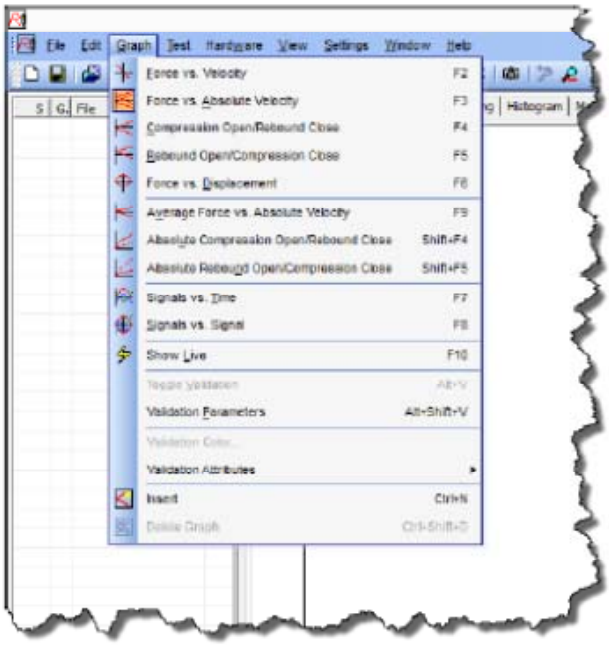
If the Engineering historic PVP methodology ... box is checked, the following panel appears.



Item	Description
Use Engineering historic PVP methodology generating PVP summary trace averaging over all collected cycles	Uses all cycles of each test run to generate the PVP points for each individual test run.
Clip to single cycle to generate PVP summary traces	Clips to the last full cycle of each test run to generate the PVP test points.

Graph Menu

Graph Menu Options



Force vs. Velocity	Changes the current graph to the force vs. velocity graph. Depicts a full 360 degree stroke, showing positive and negative velocity values.
Force vs. Absolute Velocity	Changes the current graph to the force vs. absolute velocity graph. Depicts a full 360 degree stroke; however, all velocities are shown as positive in value.
Compression Open/Rebound Close	Changes the current graph to the compression open/rebound close graph. Depicts half of the cycle.
Rebound Open/Compression Close	Changes the current graph to the rebound open/compression close graph. Depicts the other half of the cycle.
Force vs. Displacement	Changes the current graph to the force vs. displacement graph. Commonly known as a "football" or "potato" plot.
Average Force vs. Absolute Velocity	Changes the current graph to the average force vs. absolute velocity graph. Depicts the average of the compression forces and the average of the rebound forces vs. the absolute velocity. MTS Engineering does not recommend the use of this graph, as it is a poor representation of the shock data.
Absolute Compression Open/Rebound Close	Changes the current graph to the absolute compression open/rebound close graph. Same as compression open/rebound close graph, except all force values are shown as positive values.
Absolute Rebound Open/Compression Close	Changes the current graph to the absolute rebound open/compression close graph. Same as rebound open/compression close graph, except all force values are shown as positive values.

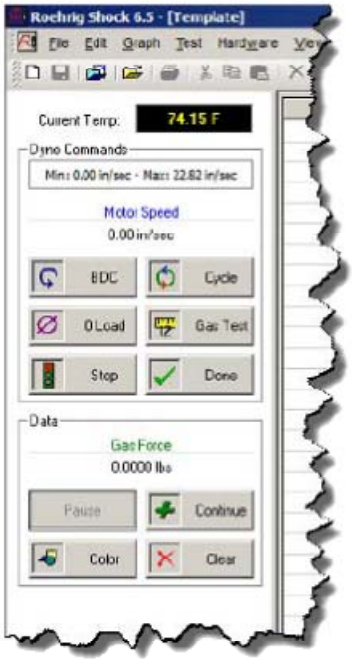
Signals vs. Time	Allows you to plot any signal or math channel vs. time. A menu will appear with a list of all available signals/channels. Select the channel to be graphed. Press the "Ctrl" key to select multiple channels.
Signals vs. Signal	Allows you to plot any signal or math channel vs. any other signal or math channel. You must first select the units for the x axis. Once units are selected, click "insert plot". Pull down menus will appear under the X-axis trace and Y-axis trace columns with available signals/channels.
Show Live	Allows you to operate the motor and view the data live rather then running a particular test.
Toggle Validation	Turns current validation parameters on and off.
Validation Parameters	Allows you to enter a validation table based on a master shock or manually inputted data. See the following topic for details.
Validation Color	Allows you to change the color of the displayed validation parameters.
Validation Attributes	1, 3, and 5 correspond to line thickness. Allows you to change the line style of the displayed validation parameters.
Insert	Creates another graph inside the current template. You can toggle between graphs using the tabs displayed on the bottom of the legend.
Delete Graph	Deletes the selected graph from the current template.

Show Live Panel

The Show Live allows you to manipulate dyno controls and observe the results in real time.

Dyno Commands

Show Live Dyno Commands



Item	Description
Min/Max	Shows the range of speeds that can be entered in the motor speed box.
Motor Speed	Enter the desired motor speed.
BDC	Moves the motor to bottom dead center.
0 Load	Zeroes the load cell (sensor).
Stop	Stops the motor wherever it is at.
Cycle	Completes the current cycle and brings the motor to bottom dead center (used on crank dyno systems).
Gas Test	Performs the standard gas test and shows the gas force in the data group box.
Done	Closes Show Live.
Pause	Stops updating the data.
Color	Shows the color of the trace.
Continue	Resumes updating the data.
Clear	Clears the data so that you can start over.

Build Validation Table

Build Validation Table allows you to validate the gas force and seal drag of the shock absorber.

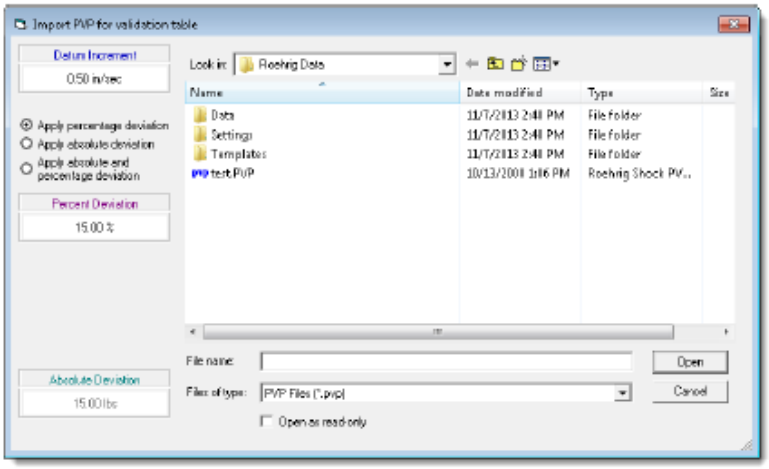
Build Validation Table Options

Item	Description
Validate Gas Force	Turns validation for gas force on and allows you to specify a minimum and maximum force.
Gas Force Minimum and Maximum	Gas force validation fails if the gas force is not between the minimum and maximum.
Validate Seal Drag	Turns validation for gas force on and allows you to specify a minimum and maximum force.
Seal Drag Minimum and Maximum	Seal drag validation fails if the gas force is not between the minimum and maximum.
Zero Speed Minimum and Maximum	Validation will fail if the zero point is not between the minimum and maximum.
Velocity	To validate, you select a velocity you want to validate at.
C. Min. and Max.	Compression minimum and maximum.
R. Min. and Max.	Rebound minimum and maximum.
Import PVP	See the following section and illustration.
Load Validation	Allows you to load a set of validation parameters (a known good test and a range of acceptable values).
Save Validation	Allows you to save the current table and ranges for acceptable values as a validation table.
Clear Table	Allows you to clear the current table and ranges for acceptable values so that you can start over.

Import PVP

Import PVP for Validation Table allows you to import a PVP test so that you can compare shocks to a known good test.

Import PVP for Validation Table

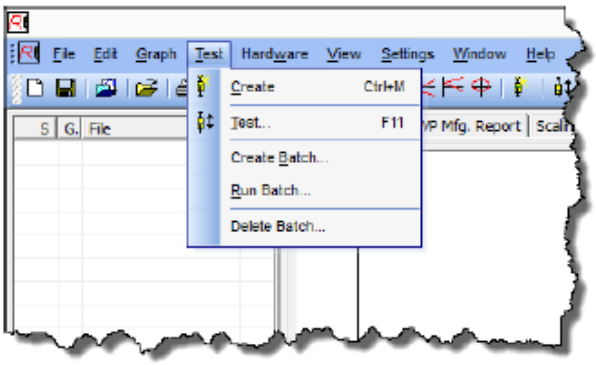


Item	Description
Datum Increment	Provides trace points at the specified increment. If a data point does not exist at the specified increment, one is interpolated.
Apply percentage deviation	Allows you to specify a range of acceptable values around the known good trace based on percentage.*
Apply absolute deviation	Allows you to specify a range of acceptable values around the known good trace based on a numeric value.*
Apply percentage and absolute deviation	Allows you to specify a range of acceptable values around the known good trace based on a percentage and a numeric value.*

* If a data point for the shock being tested falls outside the range of acceptable values, the validation fails.

Test Menu

Test Menu Options



Create **Allows you to create and save a test.**

Test **Opens the test control panel. For more information, see "Test Control Panel"**

Note: **When editing a test, you have the option of saving it as a new test with a new name by clicking the** Save As **button.**

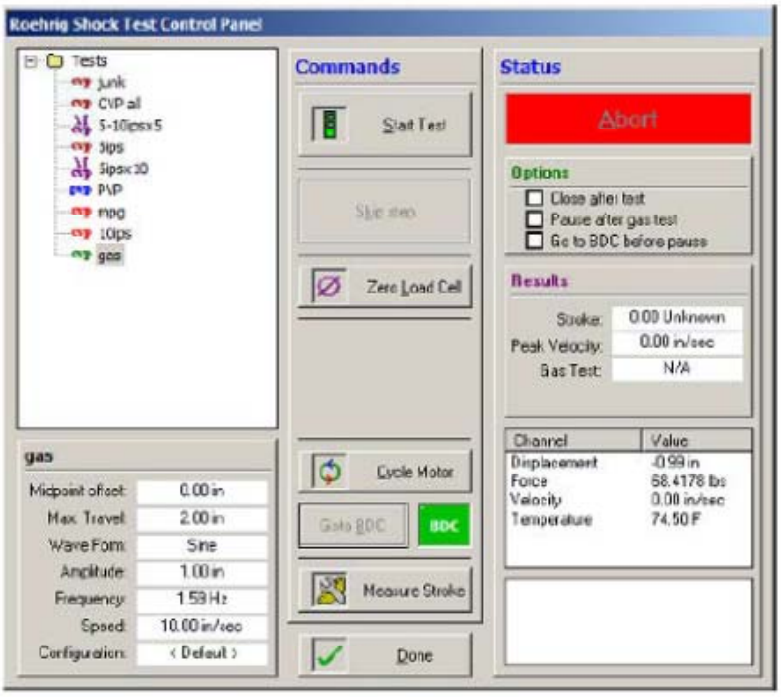
Create Batch **Allows you to create a batch test (multiple tests run together). For more information, see "Create Batch" pg 41.**

Run Batch **Allows you to run a previously created batch test. For more information, see "Run Batch" pg 42.**

Delete Batch **Allows you to delete a previously created batch test or tests.**

Test Control Panel

Test Control Panel Options



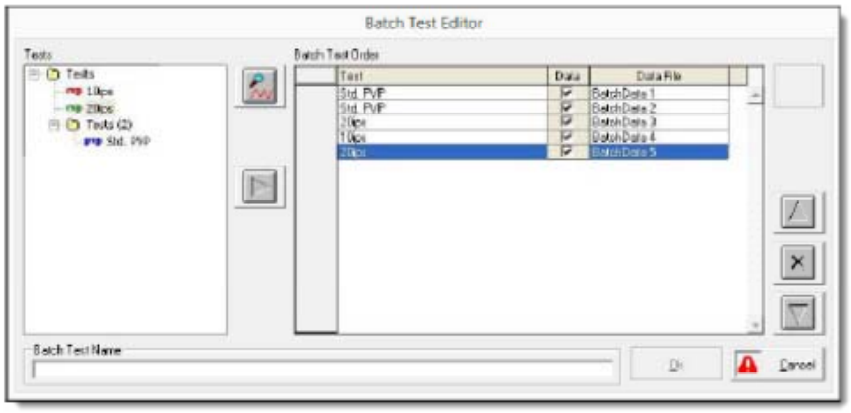
Item	Description
Explorer Window	Single-click a test to select it. Double-click to edit a test. In a folder, right-click to add new, delete, rename, or sort. In a test, right-click to edit, execute, delete, or rename. You can also use drag and drop to organize tests and folders.
Test Data Area	Displays data for the currently selected test.
Commands Column	Command buttons are found in this column.
Start Test	Starts the currently selected test.

Item	Description
	Warning: The actuator must be in the full down position the first time you run a test or run show live each time you start the software (the first time the motor runs after the software is started). This is especially important if a specimen is loaded because it can prevent the actuator from falling to the BDC position. If the actuator is in a position other than the full down position, the EMA may incorrectly interpret absolute zero (BDC) which may result in specimen or equipment damage. To ensure the actuator is at the full down position the first time you run a test, disconnect the specimen and allow the actuator to fall until it rests on the bump stop.
Skip Step	Skips the current step in the test.
Zero Load Cell	Zeros the load cell reading. The program will retain this zero value until the program is exited or the **Zero Load Cell** button is clicked again.
Cycle Motor	Completes the current cycle and brings the motor to bottom dead center
Go to BDC	Moves the dyno to "bottom dead center". The box to the right of this button indicates if the dyno is at bottom dead center. If the box is green, the dyno is at BDC. If the box is black, the dyno is not at BDC.
BDC	Turns bright green when the dyno is at BDC
Measure Stroke	Runs the dyno slowly to determine the stroke. Use this the first time you set up the machine or anytime you change the stroke. Failure to run Measure Stroke at those times can result in the dyno running improperly.
Done	Exits the Test Control Panel.
Status column	The lower half of this column displays live sensor readings and the current test step which is being executed.
Abort	This button stops the current test. **Important:** This is NOT an emergency stop button!
Close after test	When this box is checked, the **Test Control Panel** will close after the test is complete.
Pause after gas test	When this box is checked, the dyno will pause after the gas test, allowing you to make adjustments to the shock. The dyno will only resume after you click the **Continue** button.
Go to BDC before pause	Self explanatory.
Results	Displays data from the last test run.

Create Batch

Use Create Batch to create a batch test (multiple tests run together). The user can string together any available tests in any order, and have the software automatically run each test and save the data. The available test hierarchy is displayed on the left side of the window. To add a test to the batch, click the test, and then click the right arrow button. The test will be added to the batch. Tests can be deleted from the batch using the black X button. The order of the tests can also be changed using the up arrow and down arrow buttons. Each test is assigned a default data file name. You can change this name if desired. If you do not want to collect and save data for a given test in the batch, simply uncheck the data box. The batch test is given a default name in the lower left corner of the window which can be changed, if desired. Click the **OK** button when finished.

Batch Test Editor Options

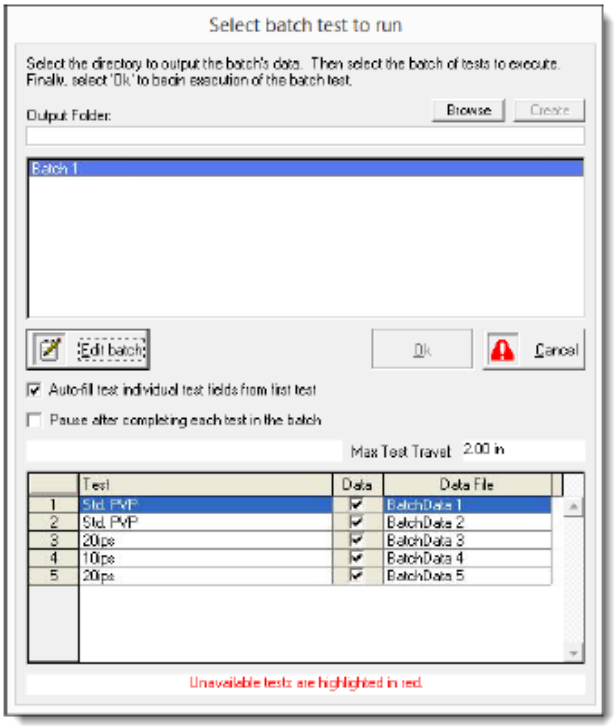


Item	Description
	Use the Browse button to add tests to the batch.
Data	The data column allows you to run a test without saving data in the event you want to run a test to exercise the specimen.

Run Batch

Use Run Batch to run a previously created batch test. Select a batch test from the list. The individual tests for that batch are listed at the bottom of the window. The batch test can be edited if required. Before running the batch test, select the output folder to which the data files will be saved. Once this is done, click the **OK** button to begin the test.

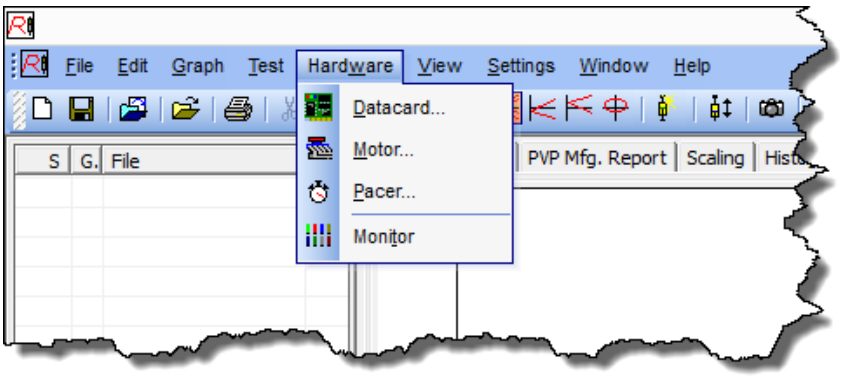
Select Batch Test to Run Options



Item	Description
Browse	Browse for an output folder.
Output Folder	Indicates the location where the batch data will be stored.
Edit batch	Allows you to edit the currently selected batch.
Auto-fill test individual test fields from first test	Fills in each subsequent test with the information for all the test fields you entered in the first test.
Pause after completing each test in the batch	Self explanatory.
Data	The data column allows you to run a test without saving data in the event you want to run a test to exercise the specimen.
Max. Test Travel	Displays the maximum test travel found in all of the tests in the batch. ! **Important:** Ensure your specimen as intalled has enough travel to accommodate each test in the batch. Be sure to account for preload.

Hardware Menu

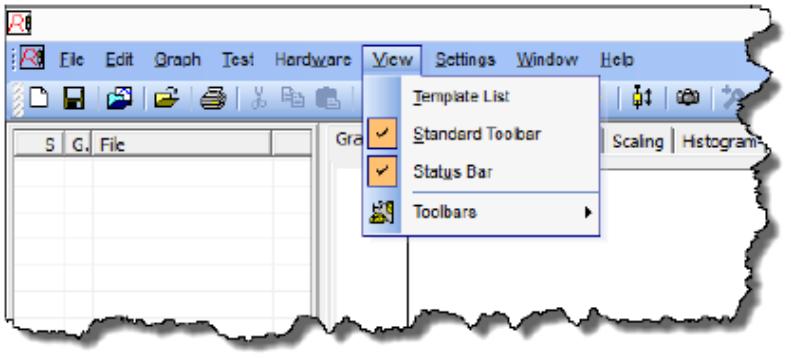
Hardware Menu Options



Item	Description
Datacard	**Contains information regarding the datacard including sampling rate and calibration data for each sensor.** ! Important: **Altering these numbers will change the calibration of the dyno. Please contact a Penske representative before making changes to the datacard values.**
Motor	**Contains information regarding the motor, including motor type and motor parameters. For more information see Motor Properties.**
Pacer	**Outputs a digital output signal at a user specified frequency. This is useful for magnetorheological dampers.**
Monitor	**Displays the live senor readings for the dyno.**

View Menu

View Menu Options



Item	Description
Template List	Displays a list of the currently open templates in a toolbar.
Standard Toolbar	Displays the standard toolbar, which contains the most commonly used functions. For more information, see "Standard Toolbar" on page 92
Status Bar	Displays the lower status bar.
Toolbars	Lists and displays all other available toolbars.

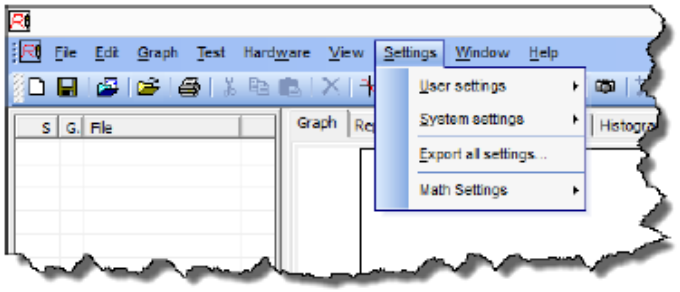
Standard Toolbar

Toolbars may be moved by clicking on the crosshatching located on the left side of the toolbar and dragging it to the top, bottom, left, or right side of the program window, or to the center to display it in a new window. The More Options button located on the right side of the toolbar can be used to modify the contents of the toolbar.

Item	Description	Function
1	Crosshatching	Essentially a handle with which to move the toolbar around. **Note:** The menu bar can also be moved around in the same manner.
2	More Options	Allows you to add and remove toolbar buttons so that you can customize the toolbar.

Settings Menu

Settings Menu Options

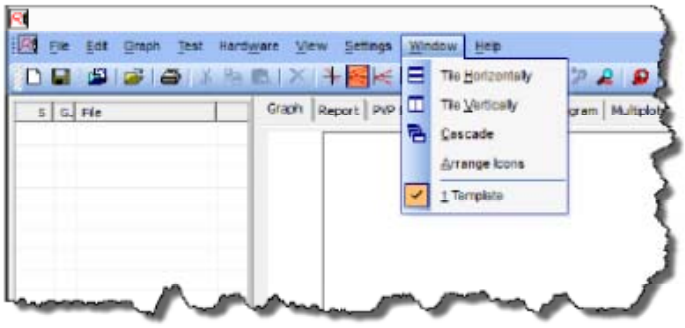


Item	Description
User Settings	Exports or imports user settings. User settings include all settings contained in the **Preferences**, including all user tests and math channels. It is recommended that the user export and back up all settings listed under the **Settings** menu on a regular basis in case of a computer crash.
System Settings	Exports datacard settings, motor settings, or both. These settings can be used to restore the motor properties and datacard properties (sensor calibration) in case of a computer crash. To import these settings, simply double-click the desired system settings file in any Windows Explorer window.
Export all Settings	Exports all user and system settings and saves them as one file.
Math Settings	Exports or imports only the math channels created in "preferences." Can be used to transfer math channels to other computers running Shock6. When importing math channels, the user can choose to replace existing channels with the new channels or merge the existing channels with the new channels.

Window Menu

Allows you to arrange templates within the program using standard Microsoft Windows functionality. Also lists currently open templates and the currently selected (active) template. Click a template to select it.

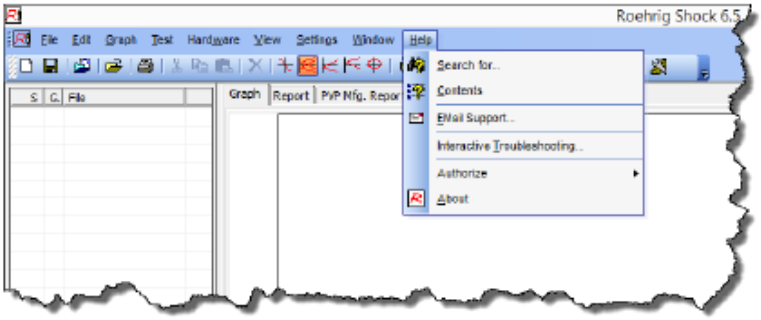
Window Menu Options



Help Menu

The Help menu provides access to this manual, email support, and troubleshooting. You can also authorize Output Control and find information regarding the Shock6 software version.

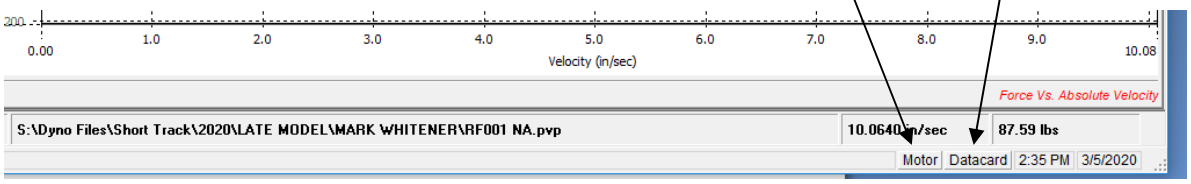
Help Menu Options



Item	Description
Search for	Searches the .chm help file which is different from this manual.
Contents	Provides the contents for the .chm help file.
Email Support	Emails MTS using your default mail program.
Interactive Troubleshooting	Starts an interactive web-based troubleshooting application.
Authorize	Enter an authorization code to activate additional software features.
About	Provides version information for the Shock6 software.

Initial Operation

Once assembly is complete and the software is installed, the dyno can be operated. Ensure that the software key is installed. Start the Roehrig Shock program by double clicking on the icon. Once the software is up and running, the user must verify that both the motor and data card are recognized by the software. There are two boxes in the lower right hand corner of the software with the words “motor” and “datacard”. If the word is shown in a black font, then it is recognized by the software. If the word is shown in a grey font, then it is no t recognized by the software.



Running a Test and Viewing the Results

Creating and Running a Test
Viewing and Analyzing the Data

Creating and Running a Test

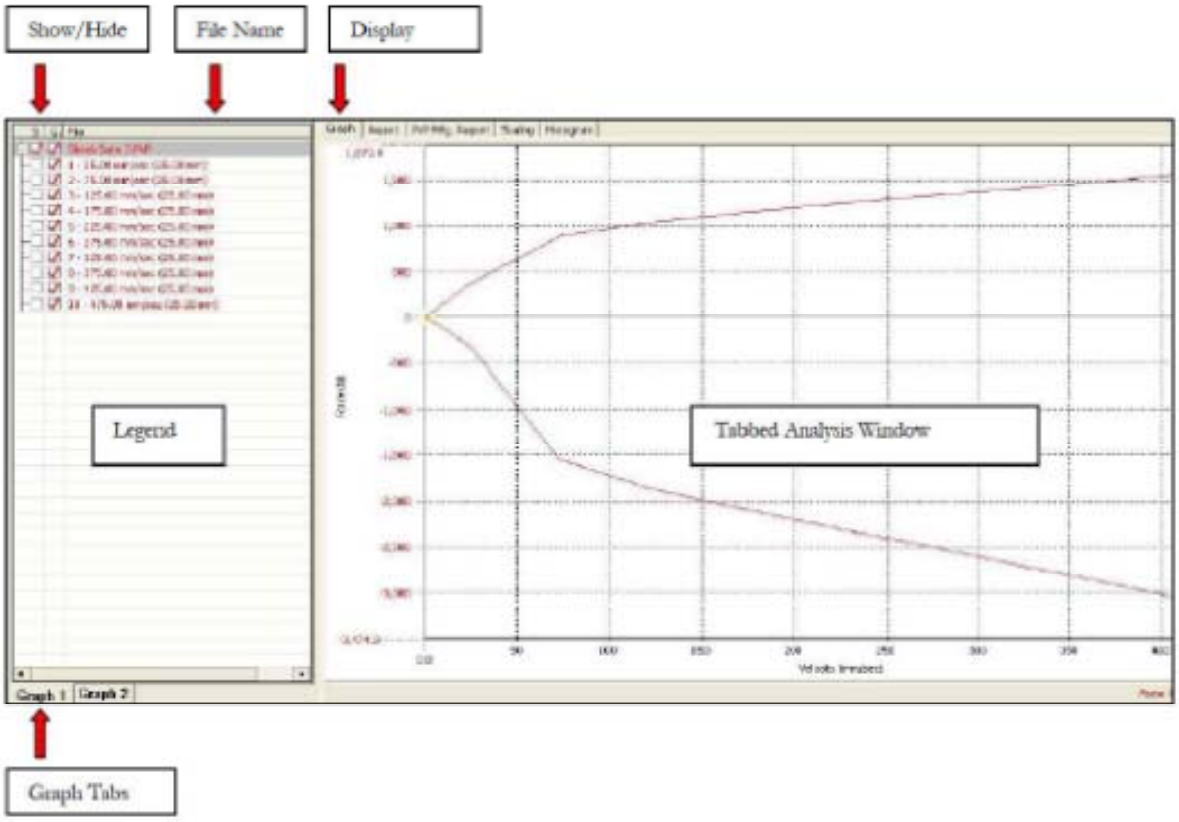
Once the dyno has been commissioned as described in Commissioning the Dyno, it is ready for use.

1. First, power up both the dyno and the computer system. Make sure all connections to the computer are made.
2. Once the computer has booted, start the Roehrig Shock program.
3. Load the shock to be tested following the procedure.
4. If you wish to create a new test, click on the Create icon either from the Test menu or from the toolbar. The create test wizard will appear.
5. Pick the desired test type, and click **Next**. The wizard will guide you through the rest of the test creation procedure.
6. Once finished, you will be asked to name the test. Enter a unique name and click **OK**.
7. Once the test has been created, or if you wish to run a previously created test, click on the Test icon either from the Test menu or from the toolbar. The test screen will appear.
8. Click on the desired test in the test profile column (left side of the test screen). The desired test will now be highlighted.
9. Click on the Start Test button. Depending on the settings in preferences, you will be prompted to enter information regarding the test run at this point, after the test is run, or not at all. The next screen displayed will be the Dyno Starting window.
10. When you are ready to start the test, click **OK**. Once the test is completed, you will be prompted to save the data. The data is saved as an individual file using standard Microsoft Windows functions. Once the data is saved, it will automatically open in the currently active template.

Viewing and Analyzing the Data

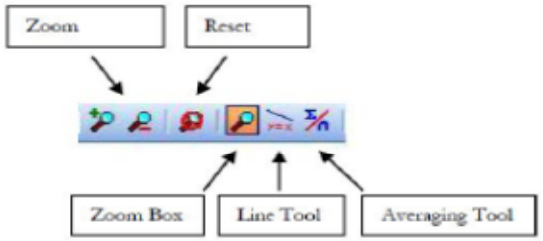
Once a test run is completed, the data is automatically opened in the currently active template. The data file name is listed in the legend. Multiple data files can be opened and displayed in the same template. To open a data file, click on the “Open Data” icon either from the “File” menu or from the toolbar. The data will open in the currently active template. To remove a data file from the template, click on the data file in the legend, and click on the “Delete” icon in the toolbar. PVP data can be expanded to show the data from each individual speed. Click on the “+” to the left of the file name to expand the data tree. Multiple templates can be open at the same time. The user can save a template which also saves all associated data files with it. Once the data of interest is opened in the template, you can analyze that data. The tabbed analysis window allows you to view the data in several different ways.

Template with open PVP Data File, "Graph" Display Tab Selected



When the "Graph" display tab is selected, the user-defined graph will be displayed in the analysis window. You can choose the desired graph either from the "Graph" menu or from the toolbar. The show/hide check boxes allow you to turn on and off selected traces. When the check box under the "S" column is checked, the selected trace will show up on the graph, and vice versa. When the check box under the "G" column is checked, the gas force (if measured) will be subtracted from the trace, and vice versa. A template can have multiple graphs. Right click on one of the graph tabs (lower left) to create, delete, or rename a graph. Once the desired graph is chosen, you can use the zoom, line, and averaging tools on the selected trace in the graph. The selected trace is the trace which is highlighted in the legend. A cursor (crosshair) will also be displayed on the selected trace on the graph. This cursor can be moved using the arrow keys on the keyboard, or by clicking on the desired point with the left mouse button. The data values for this point (where the cursor is located) are displayed in the status bar. The displayed graph can also be printed by clicking on the "Print" icon either under the "File" menu or from the toolbar.

Graph Analyzing Tools, Located in the Main Toolbar

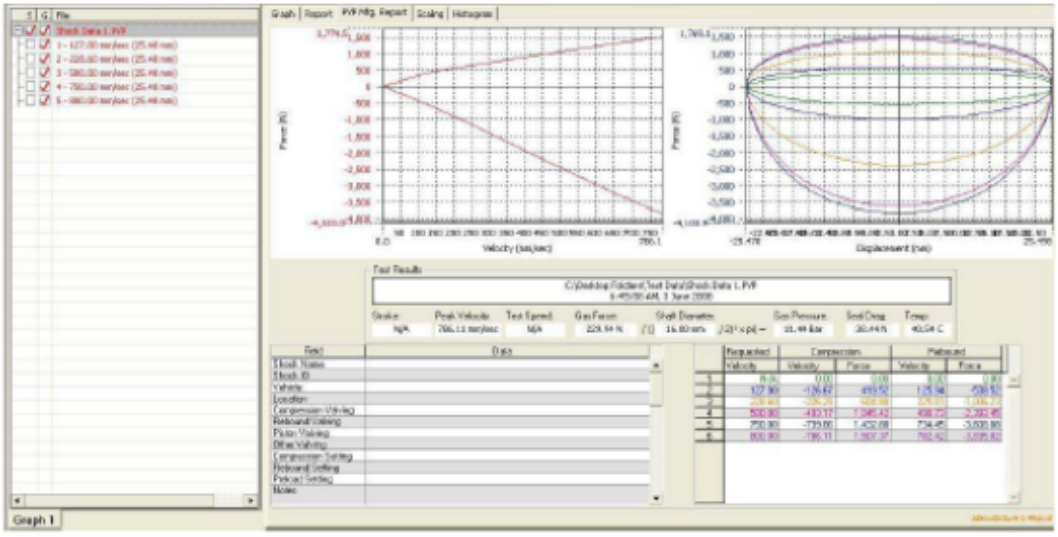


The graph scaling can be changed by clicking on the "Scaling" display tab. When the "scaling" display tab is selected, the scaling preferences are shown for both the x and y axis. The user has the option of auto scaling by checking the box under "auto", or manual scaling. If auto scaling is not checked, the values under "min" and "max" will be used to manually scale the graph. The "Report" display tab allows the user to view the data from the selected trace in a tabbed format. The report tabs allow the user to display different information associated with the selected trace. The measured force vs. velocity data is also shown in the bottom table. The velocity increment for this table can be changed by clicking on the "velocity increment" pull down box. The report data can also be printed by clicking on the "Print" icon either under the "File" menu or from the toolbar.

Template with open PVP Data File, "Report" Display Tab Selected

The "PVP Mfg. Report" tab displays two user definable graphs along with the field data and the tabbed force vs. velocity data for the selected PVP data file. The report data can also be printed by clicking on the "Print" icon either under the "File" menu or from the toolbar.

Template with open PVP Data File, "PVP Mfg. Report" Display Tab Selected



The "Histogram" display tab allows the user to create a histogram using data from the selected trace. The user must define which data channel to display, the bin size, and the start and end points.

Template with open PVP Data File, "Histogram" Display Tab Selected

5. Warranty And Service

5.1. Warranty

Your S-Link Dyno comes with a 1-year manufacture warranty that covers all hardware items from manufacture defect. This warranty does not cover damaged items that may have resulted from improper use, mounting, or physical damage.

5.2. Technical Support

The supplied Shock 6.9.9 software is supported by MTS Corp. For on-line technical support there may be a fee from MTS Corp. S-Link customers have the option to purchase a 1-year Technical Support Plan from MTS for $299/yr. This gives you full on-line support and free upgrades for the length of the contract. This can be purchased at any time thru MTS on their web-site. MTSECHO.COM.

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