POWER DYNE PC

Mustang Dynamometer

Operator Manual

MUSTANG DYNAMOMETER

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Chapter

1

Introduction

This document provides the operating instructions for Mustang Dynamometer's Power Dyne PC control software. You're reading,

Before operating your dynamometer, please read and understand the following section titled "Safety Information", along with any and all other safety information provided with your dynamometer.

Based on our own experience with various software packages, we recommend that the reader of this manual follow the following procedure for learning about our software:

1. Before trying to operate your dynamometer, you should quickly review this document in its entirety, in order to gain an overall idea of the capabilities of the software

2. The following sections require that you actually use the software, so you should have this manual handy for reference.

3. Since your system should arrive with the software preinstalled, we suggest that you start working with the software by navigating through the various menus, again to gain an overall impression of how the software works, and how to get to the various functions provided.

4. Next, we suggest that you add your company information, the screen for which can be found under the "Database" menu.

5. Now you can add a customer and vehicle definition, so that you can save the results of any tests that you will run.

6. On the "Calibration" menu, make sure that all the physical parameters (roll diameter, etc) of your dynamometer are set to the correct values, and calibrate the load cell inputs of your system.

7. You are now ready to start performing vehicle tests, which will generate test data that you can use to learn about the various test reports, graphing and data exporting facilities.

Operators of this software have frequently reported that the Power Dyne PC software takes longer to master than some other dynamometer control packages, but that the initial effort yields significant long-term benefits. The better you understand your dynamometer, the better your dynamometer will serve you.

Instructions for all database, calibration and testing routines are provided, along with screen images to help the reader identify the correct screen for performing the described actions.

Unlike some other dynamometer control systems, our Power Dyne PC series software has been designed to work with many different types of dynamometers. Thus, there are many, many configurable parameters in the software. For most applications, only a handful of parameters will require changes. However, in some cases other parameters will require changes, and this document does not describe every parameter used in the software. In the event of unusual system requirements, every parameter that the software uses is available in the standard Windows "Ini" file that the application uses for parameter storage. Before attempting any manual modifications to values in the application's "Ini" file, please contact Mustang Dynamometer for technical assistance.

While this document has been carefully written and verified, errors may still exist. In the event that you find any information in this document that appears to be incorrect, please contact Mustang Dynamometer using the contact information provided below:

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Chapter

2

Safety Information

Dynamometers are dangerous! *The following list of safety precautions is not exhaustive, but represents a minimum level of safety precautions to be used.*

KEEP PEOPLE AWAY FROM THE DYNAMOMETER TESTING AREA WHILE TESTS ARE IN PROGRESS. ONLY THE VEHICLE OPERATOR SHOULD BE IN THE VICINITY OF THE DYNAMOMETER/VEHICLE-UNDER-TEST WHEN A TEST IS BEING PERFORMED.

ALWAYS SECURELY RESTRAIN A VEHICLE BEFORE TESTING ON A DYNAMOMETER. FRONT-DRIVE VEHICLES IN PARTICULAR MUST BE RESTRAINED NOT ONLY AGAINST FORWARDS/BACKWARDS MOVEMENT, BUT ALSO AGAINST SIDE-TO-SIDE MOVEMENT.

DO NOT WEAR LOOSE FITTING CLOTHING AROUND A DYNAMOMETER. TIES, SLEEVES, SCARVES, CHAINS, ETC. CAN BECOME WRAPPED THE ROLLS, SHAFTS, ETC. AND CAUSE SERIOUS OR FATAL INJURIES.

DO NOT LEAVE TOOLS, ROPES, CHAINS, PARTS OR ANY OTHER OBJECTS LOOSE AROUND THE DYNAMOMETER. THESE OBJECTS MAY BE THROWN, CRUSHED, TWISTED, ETC. IF THEY VIBRATE INTO CONTACT WITH THE DYNAMOMETER OR THE VEHICLE UNDER TEST.

DO NOT APPLY SUDDEN THROTTLE OR BRAKE CHANGES WHILE ON THE DYNAMOMETER, AS THIS MAY CAUSE THE VEHICLE UNDER TEST TO SUDDENLY CHANGE POSITION ON THE DYNAMOMETER CAUSING A LOSS OF CONTROL OF THE VEHICLE.

DYNAMOMETERS CONTAIN VERY HEAVY COMPONENTS OPERATING AT HIGH SPEEDS WITH HIGH FORCES. DO NOT TOUCH OR COME INTO CONTACT WITH ANY PART OF THE DYNAMOMETER WHEN IT IS IN OPERATION, PARTICULARLY THE ROLLS, SHAFTS AND BELTS.

DYNAMOMETERS CAN THROW FOREIGN OBJECTS AT VERY HIGH VELOCITY. ALWAYS WEAR APPROVED EYE PROTECTION WHEN WORKING AROUND A DYNAMOMETER.

THE CONTROL BOX CONTAINS DANGEROUS VOLTAGES. ONLY QUALIFIED PERSONELL SHOULD EVER WORK ON A CONTROL BOX, PAU (POWER ABSORBING UNIT), MOTOR, OR ANY OTHER ELECTRICAL COMPONENT OF A DYNAMOMETER. FURTHERMORE, SOME CONTROL BOXES CONTAIN MULTIPLE POWER SOURCES; ANYONE WORKING ON A CONTROL BOX MUST BE CERTAIN THAT ALL POWER SOURCES HAVE BEEN DISCONNECTED PRIOR TO WORKING ON THE EQUIPMENT.

DYNAMOMETERS CONTAIN POWER ABSORBING UNITS (PAU'S OR MOTORS) THAT BECOME VERY HOT. DO NOT TOUCH ANY PART OF A PAU OR MOTOR TO AVOID POTENTIALLY SEVERE BURNS.

HIGH PRESSURE AIR IS USED IN VARIOUS ELEMENTS OF A DYNAMOMETER. OBSERVE ALL PRECAUTIONS REQUIRED FOR SAFELY WORKING AROUND COMPRESSED AIR WHEN WORKING ON A DYNAMOMETER.

THE LIFT/ROLL-LOCK OF A DYNAMOMETER CAN LIFT A CAR! DO NOT ALLOW ANY PART OF YOUR BODY TO FALL INTO THE LIFT/ROLL-LOCK AREA OF THE DYNAMOMETER TO AVOID POTENTIALLY FATAL CRUSHING WOUNDS.

VEHICLE EXHAUST GASSES, AS WELL AS EXHAUST GAS SENSOR CALIBRATION GASSES, ARE POISONOUS AND CAN BE FATAL. MAKE SURE THAT ADEQUATE VENTILATION IS PROVIDED BEFORE OPERATING A VEHICLE OR EXHAUST GAS ANALYZER IN AN ENCLOSED SPACE.

Chapter

3

Dynamometer Information

A dynamometer or "dyno" for short is a device used to measure power and torque produced by an engine. There are two types of dynos; One that gets bolted directly to an engine, known as an engine dyno, or a dyno that can measure power and torque without removing the engine from the frame of the vehicle, this is known as a chassis dyno.

The Power Dyne PC uses a Chassis dynamometer that performs the two following functions:

1. Measures the power output of a vehicle
2. Applies a specific load to a vehicle

Chassis dynamometers are capable of very accurately measuring the speed, torque and power that is delivered to them. With the appropriate hardware and software, they are also capable of applying a well-controlled loading to the vehicle under test. The typical loading modes used with a chassis dynamometer are constant force, constant speed, or a vehicle-simulation value.

Values Reported by a Chassis Dynamometer

A chassis dynamometer can directly measure the following values:

1. Roll shaft RPM/speed.
2. Torque/force applied to the dynamometer's roll shaft(s).

All other values are based on these original 2 values. For example, acceleration is computed from 2 successive speed measurements, power are calculated based on the measured speed and torque of the dynamometer's rolls shaft(s), etc.

When a chassis dynamometer reports a "torque" value, the value reported is the torque measured on the dynamometer's rolls shaft(s), not on the vehicle's drive axle or engine crankshaft.

A chassis dynamometer and the vehicle that is being tested on it effectively form a geared power transfer system. While force is obviously not an engine-crankshaft relative term, and power values

do not scale (ignoring transmission losses) from shaft to shaft in a geared system, torque values do scale from shaft to shaft in a geared system. So, in order for a chassis dynamometer to report engine crankshaft relative torque values, the control software must know:

1. Dynamometer roll shaft torque.

2. Dynamometer roll shaft RPM.

3. Engine crankshaft RPM.

Using these 3 values, the control software can calculate the engine crankshaft torque that the engine must be producing, using the formula below:

```
EngineTorque = ((DynoShaftTorque * DynoShaftRPM) / EngineRPM)
```

When engine RPM is not available, there is no way to report an engine crankshaft relative torque value.

In Mustang Dynamometer chassis dynamometer software, when an engine-crankshaft relative torque value is reported, it is simply a calculated value as described above. No "correction" factor has been applied to account for drive-train losses. The overall gearing between the vehicle's engine and the

Dynamometer's rolls has been calculated and used to scale the measured torque from a dynamometer roll shaft value to an engine crankshaft value. So, just as power values will be lower on a chassis dynamometer than on a test-stand dynamometer, any reported engine torque values will be similarly lower.

Differences Between Chassis and Test-Stand Dynamometers

It is important to remember that a chassis dynamometer reports the power, force, and speed experienced by the dynamometer's roll shaft(s). A power figure obtained for an engine using a test stand dynamometer will (and should) inevitably be higher than the power figure obtained using a chassis dynamometer, for (among others) the following reasons:

1. On a test stand, there are no torque-converter/clutch, transmission, driveshaft, differential or axle bearing losses.

2. On a test stand, there are no losses between the tires of the vehicle and the rolls of the dynamometer.

3. On a test stand, some or all of the engine accessories may be disconnected.

4. On a test stand, the engine intake air, water and oil supplies may be externally controlled.

5. On a test stand, the exhaust may be different than the exhaust system used on the vehicle.

Differences in Reported Power Between Dynamometers

All of the following factors can influence the power measured by a chassis dynamometer:

1. Tire compound, pressure and temperature.
2. Engine, transmission and differential temperatures.
3. Lubricant types.
4. Method of vehicle restraint (downward pressure will waste power).
5. Type of testing performed: fast decelerating sweeps will generate the highest values, steady state tests will generate intermediate values, and fast accelerating sweeps will generate the lowest values, due to the internal power requirements of the engine and drive-train in the vehicle under test.
6. Atmospheric condition corrections to different "standard" conditions.
7. Operator driving differences (can be very significant!).
8. Data acquisition options, particularly smoothing/averaging and clipping functions.

While all chassis dynamometers should report the same power output for the same vehicle, this is seldom the case. Most commonly, the difference in reported power values for the same vehicle on different dynamometers can be traced to one or more of the factors listed above.

Chapter

4

Installation

The installation software for Mustang Dynamometer's Power Dyne PC software is provided on CD. This section describes the installation procedure to use with our standard CD distribution.

In order to install the software, follow these steps:

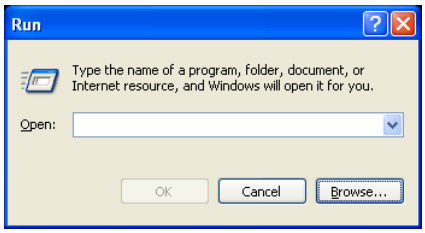
1. Insert the CD into the CD drive.
2. Click on the start button located at the lower left hand corner of the screen.

FIGURE 4.1 the above illustration shows the menu items that appear when the operator clicks on the Start button.

3. Select the Run menu item

FIGURE 4.2 the above illustration shows what the Run menu item will look like when it is selected and highlighted in blue.

4. When the Run menu item is selected then the following dialog box will display prompting the operator for the name of the installation to run.



5. The operator will then type in D:\PowerDynePC v100 No Docs.EXE at the dialog prompt. (Note: The exact install program name will vary depending on the software version number and whether or not various documentation files will be installed.)

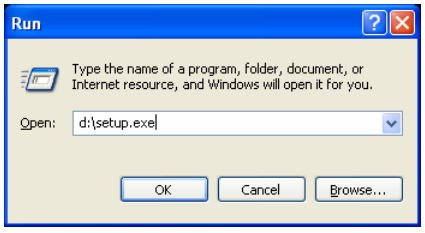


FIGURE 4.3 the actual drive letter for the CD drive will vary.

6. The installation will then walk the operator through the installation process.

Chapter

5

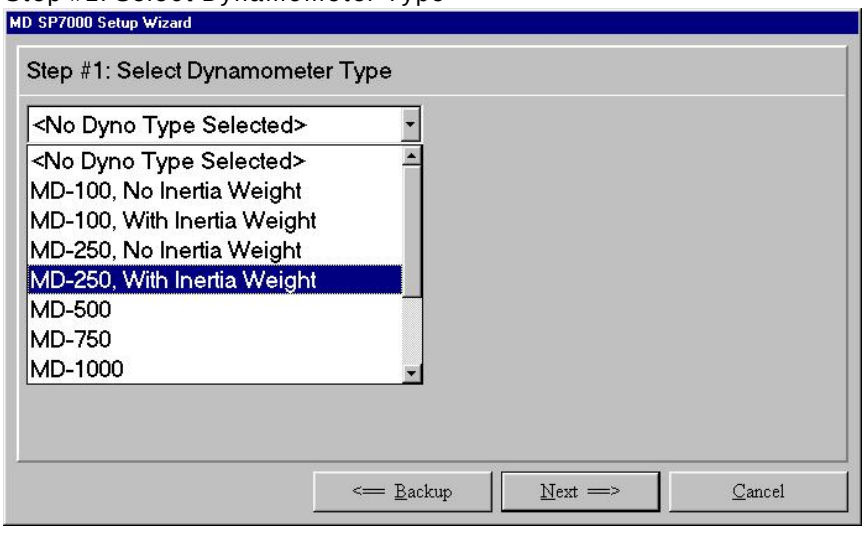
Setup Wizard

The first time the software is run on a new installation, the Setup Wizard will execute before the software is run. This wizard is intended to help the operator properly configure the software for the particular model of dynamometer that they have.

Note

There are numerous systems in the field that have non-standard configurations; the default values provided by this wizard, based on the selected dynamometer type, will not work with every dynamometer. If you are unsure as to the status of your dynamometer (standard or non-standard configuration), try the standard configuration first; if the standard configuration doesn't appear to operate correctly, contact Mustang Dynamometer for further assistance.

Step #1: Select Dynamometer Type

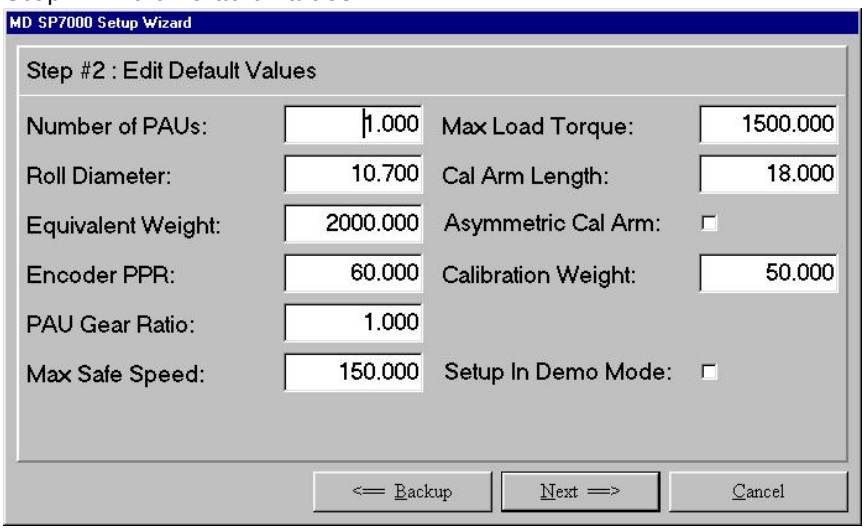


This page allows the operator to select the type of dynamometer that they have. This value is used to set the default values for several operating parameters, and must be set correctly.

The operator will press the button labeled "Next ➔" to proceed to the next step of the Setup Wizard. The operator can also press the button labeled "➔Backup" to return to the previous step of the Setup Wizard.

FIGURE 5.1 The above illustration shows how easy it is for the operator to select from the list of dynamometers simply by pointing with the mouse and clicking with the left mouse button on the dynamometer that they have.

Step #2: Edit Default Values

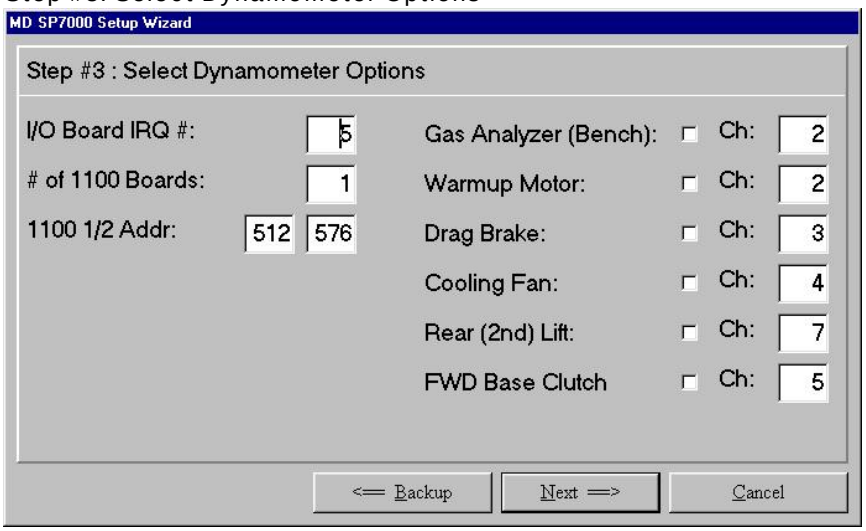


This page allows the operator to review and/or modify the following default configuration values for their dynamometer.

Number of PAUs:	The number of eddy-current Power Absorber Units in the dynamometer.
Roll Diameter:	The diameter of the tire rollers, in inches.
Equivalent Weight:	The equivalent vehicle weight of the dynamometer, in pounds.
Encoder PPR:	The number of pulses generated by the speed encoder per revolution of the tire rollers.
PAU Gear Ratio:	The gear ratio between the tire rollers and the PAU(s) of the dynamometer. If the PAU(s) will turn faster than the tire rollers, this number will be greater than 1. If the PAU(s) will turn slower than the tire rollers, this number will be less than 1.
Max Safe Speed:	The maximum safe operating speed of the dynamometer, in MPH.

Max Load Torque:	The maximum tire roller-shaft torque that the dynamometer's PAU(s) can generate.
Cal Arm Length:	The length of the PAU load cell calibration arm, in inches. More specifically, the distance between the center of the calibration weight and the PAU shaft center when the calibration arm is installed on the PAU.
Asymmetric Cal Arm:	This option MUST be left UN-CHECKED if you have a dynamometer with a built-in calibration arm, eg older MD-100's, MD-250's, etc. If you have a separate calibration arm, the setting of this value is determined this way: If the calibration arm for your dynamometer is symmetrical (sticks out the same length on each side of the PAU), leave this option un-checked. If the calibration arm for your dynamometer is asymmetrical (sticks out further on one side of the PAU than on the other side), check this option.
Calibration Weight:	The PAU load cell calibration weight, in pounds. This value is stamped into the calibration weight itself.
Setup In Demo Mode:	WARNING: If this option is selected, no dynamometer control will be possible. This option is provided for operators who wish to run the software on PCs that are not connected to a dynamometer. This may be done for evaluation or training purposes. This may also be done by operators who wish to view/print test results (generated on the dynamometer control PC) on another PC.

Step #3: Select Dynamometer Options

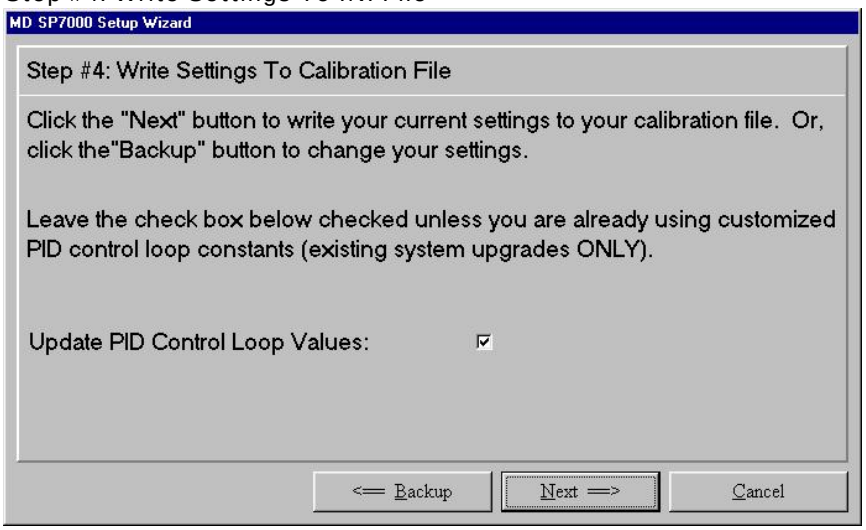


This page allows the operator to review and/or modify the following dynamometer option values.

I/O Board IRQ #:	The PC hardware interrupt number in use by the dynamometer controller board in the PC. This number is most commonly 5, but may be 7 (on Compaq PCs) or 2 (on older systems). Note that systems older than 1996 may have the controller board configured to use (2) interrupts; if you have a system of that vintage, you will need to have Mustang Dynamometer modify your controller board for use with this software.
B97 Engine RPM:	If you have the B97 engine RPM board installed in your PC, check this option.
Use SAE Corrections:	If you wish to have all data corrected per SAE J1349 (Jun90) (or your own custom standards), check this option.
Use Binary Data Files:	Checking this (recommended) option causes all trace (strip-chart) data for tests to be stored in binary files, rather than in the system database. Binary file storage is ~1000 times faster than database storage, and minimizes the load on the database facility, leading to a more stable database. If this option is not checked, all test data will be stored in the database (not recommended). If you are updating an existing system, you will probably want to use the "Export To Binary Files" utility located under the "Database" menu.
Gas Analyzer (Bench):	If you have an Andros 5-gas bench, check this box, and specify the serial communications port it is connected to.

Warmup Motor:	If you have a warmup motor on your dynamometer, check this box, and specify the digital output channel it is connected to.
Drag Brake:	If you have a drag brake on your dynamometer, check this box, and specify the digital output channel it is connected to.
Cooling Fan:	If you have a vehicle cooling fan on your dynamometer, check this box, and specify the digital output channel it is connected to.
Rear (2nd) Lift:	If you have a rear (2nd) lift on your dynamometer, check this box, and specify the digital output channel it is connected to.

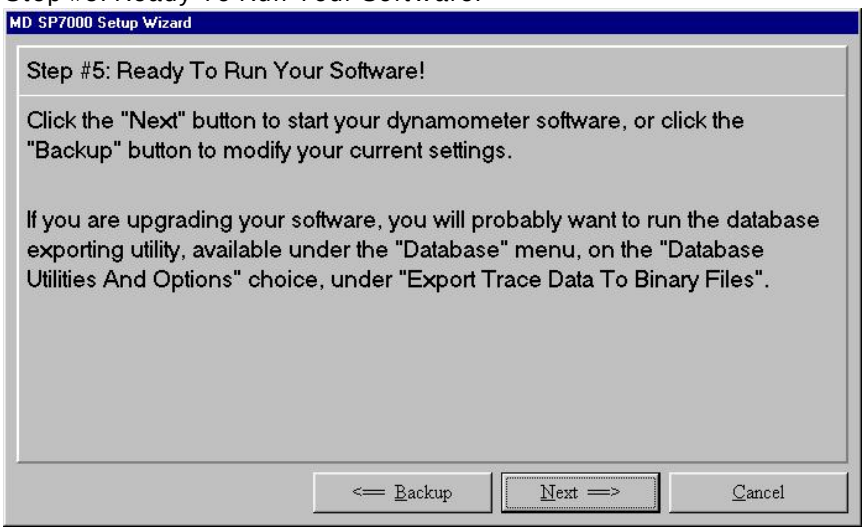
Step #4: Write Settings To INI File



This page allows the operator to save their dynamometer configuration to a application's INI file and specify whether PID control loop values should be updated.

Update PID Control Loop Values:	If this option is checked (recommended), the PID control loop values will be updated. This option should always be checked, **UNLESS** you have developed a set of custom PID values that you wish to keep.

Step #5: Ready To Run Your Software!



This page allows the operator to confirm that the current settings are correct, and launch the dynamometer control software.

Chapter

6

Start Up

The application will display the following welcome screen to the operator when it is first starts up:

As this screen is being displayed, the application will start loading pertinent system and database parameters vital for the proper functioning of the application.

If the application was able to start up successfully then the following message will be displayed to the operator, if the dynamometer has been setup to accommodate various hardware configurations – otherwise this reminder will not be displayed.

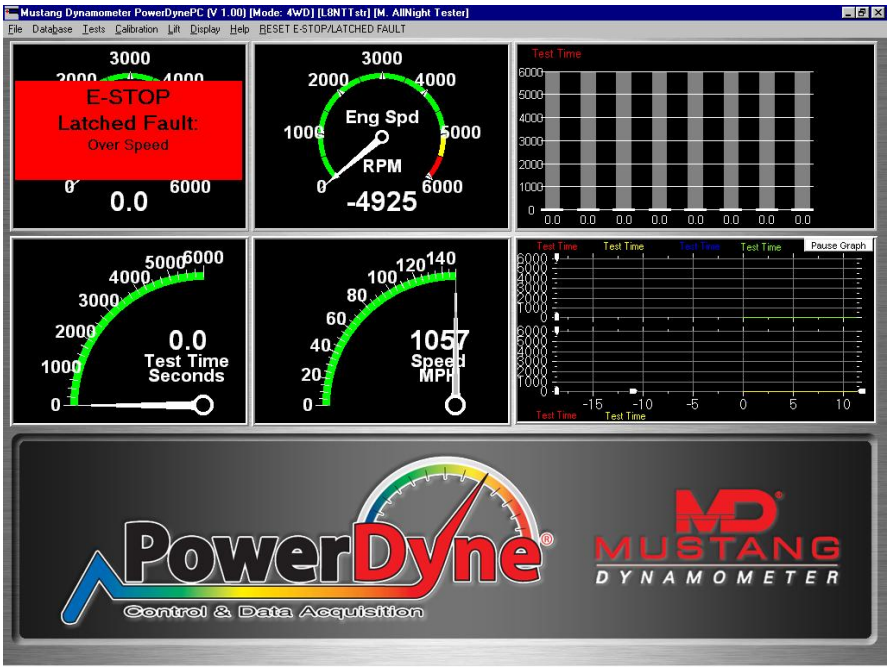
Chapter

7

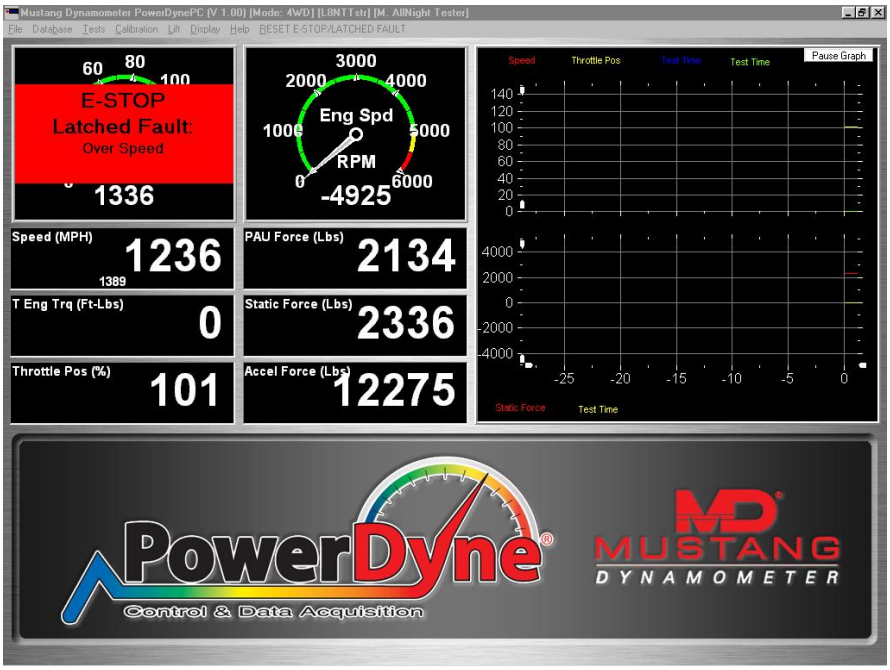
The Main Screen

This is the main screen of the dynamometer control software. The screen is broken up into two sections. The upper section displays various circular and angular gauges as well as graphs for displaying real time data from the dynamometer and is always visible during testing.

The lower section initially displays a Power Dyne PC logo, but when a test is being run the interface for that test will be displayed in the lower section.



Two alternative views that are currently available are:



The gauges and graphs may be configured as to the value displayed, format used, and safe/warning/danger limit values and colors.

Value Display Configuration

The operator can configure each gauge or graph to display a specific value by simply double-clicking on it. The following prompt will appear allowing the operator to specify a value to be displayed:

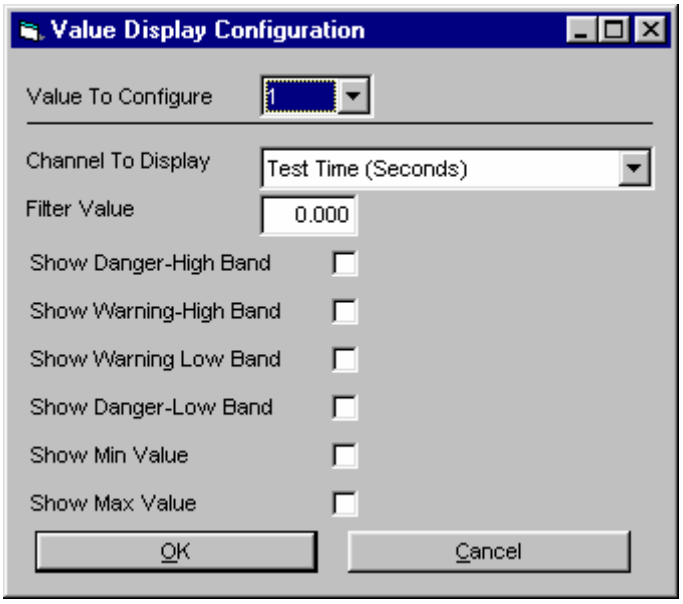


FIGURE 7.1 this is the screen that gets displayed when the operator double clicks on any gauge or graph in the upper section of the screen.

The operator can also specify the minimum and maximum values that get displayed as well as bands that represent input channel values that are OK (green), somewhat low (yellow), very low (red), somewhat high (yellow) and very high (red).

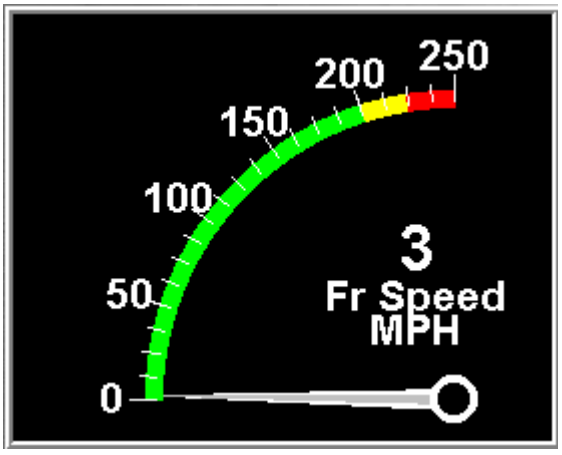


FIGURE 7.2 please note the green, yellow and red bands displayed on this gauge

The fields of the Value Display Configuration screen	Description

<table>
<tr><td>Value To Configure</td><td>Specifies which displayed value to configure. While numeric indicators can only show one value, clusters of bar graphs can show several different channels values simultaneously.</td></tr>
<tr><td>Channel To Display</td><td>Specifies which system channel should be displayed on the gauge or graph. The operator can select a channel to use from a drop-down list box.

The complete list of input channels that the operator can select from are as follows:

<table>
<tr><td>Test Time</td><td>Elapsed time into the current test, in seconds.</td></tr>
<tr><td>Distance</td><td>Distance traveled in the current test.</td></tr>
<tr><td>Speed</td><td>Current speed – may be an average of front and rear speeds.</td></tr>
<tr><td>Fr Speed</td><td>Current speed from front roll encoder.</td></tr>
<tr><td>Rr Speed</td><td>Current speed from rear roll encoder.</td></tr>
<tr><td>Accel</td><td>Current acceleration– may be an average of front and rear acceleration.</td></tr>
<tr><td>Front Accel</td><td>Current acceleration from front roll encoder.</td></tr>
<tr><td>Rear Accel</td><td>Current acceleration from rear roll encoder.</td></tr>
<tr><td>Dyno Cmd</td><td>Commanded loading value for the dyno – units will vary depending on loading mode.</td></tr>
<tr><td>Dyno Target</td><td>Ramped target for load controller – approaches Dyno Cmd at specified ramp rate – units will vary depending on loading mode.</td></tr>
<tr><td>Dyno Feedback</td><td>Current feedback for load</td></tr>
</table>
</td></tr>
</table>

		controller – should equal Dyno Target – units will vary depending on loading mode.
	Dyno Output	The control signal output by the load controller, in volts.
	Throttle Cmd	Commanded loading value for the throttle controller – units will vary depending on loading mode.
	Throttle Target	Ramped target for throttle controller – approaches Throttle Cmd at specified ramp rate – units will vary depending on loading mode.
	Throttle Feedback	Current feedback for throttle controller – should equal Throttle Target – units will vary depending on loading mode.
	Throttle Output	The control signal output by the throttle controller, in volts.
	Throttle Pos	The current feedback position of the throttle controller, in percent.
	Brake Cmd	Commanded loading value for the brake controller – units will vary depending on loading mode.
	Brake Target	Ramped target for brake controller – approaches Brake Cmd at specified ramp rate – units will vary depending on loading mode.
	Brake Feedback	Current feedback for brake controller – should equal Brake Target – units will vary depending on loading mode.
	Brake Output	The control signal output by

		the brake controller, in volts.
	Brake Pos	The current feedback position of the brake controller, in percent.
	FWD WlBs	The current wheelbase for 4-wheel-drive units.
	PAU Trq	Roll shaft torque delivered to and measured by the PAU torque sensing load cell.
	Para Trq	Roll shaft torque delivered to the parasitic losses of the dynamometer.
	Accel Trq	Roll shaft torque delivered to the inertia of the dynamometer during accelerations.
	Static Trq	Sum of PAU Trq and Para Trq – only really valid at steady state speed, but more stable than Total Trq.
	Total Trq	Sum of Static Trq and Accel Trq – always valid, but more noisy than Static Trq.
	PAU Force	Linear force delivered to and measured by the PAU torque sensing load cell.
	Para Force	Linear force delivered to the parasitic losses of the dynamometer.
	Accel Force	Linear force delivered to the inertia of the dynamometer during accelerations.
	Static Force	Sum of PAU Force and Para Force – only really valid at steady state speed, but more stable than Total Force.

	Total Force	Sum of Static Force and Accel Force – always valid, but more noisy than Static Force.
	PAU Pwr	Power delivered to and measured by the PAU torque sensing load cell.
	Para Pwr	Power delivered to the parasitic losses of the dynamometer.
	Accel Pwr	Power delivered to the inertia of the dynamometer during accelerations.
	Static Pwr	Sum of PAU Power and Para Power – only really valid at steady state speed, but more stable than Total Power.
	Total Pwr	Sum of Static Power and Accel Power – always valid, but more noisy than Static Power.
	Eng Spd	Engine speed, in RPM.
	Opacity	Exhaust gas opacity for diesel vehicles, in percent opacity.
	Temp	Ambient weather temperature.
	Press	Ambient weather pressure, in mmHg.
	RH	Ambient weather relative humidity, in percent relative humidity.
	WCF	Weather Correction Factor – a multiplier used to correct measured torque, force and power values based on the ambient weather conditions.
	CO	Exhaust gas concentration of CO (carbon monoxide).

	CO2	Exhaust gas concentration of CO2 (carbon dioxide).
	HC	Exhaust gas concentration of HC (various hydrocarbons).
	NO	Exhaust gas concentration of NO (nitric oxide, or various NOx varieties).
	O2	Exhaust gas concentration of O2 (atmospheric oxygen).
	Eng/Rl RPM Rt	Engine / Roll RPM ratio – measured ratio of engine RPM to roll shaft RPM – can be used to detect tire slip in manual transmission vehicles, or automatics when in torque converter lockup.
	S Eng Trq	Static engine torque – does not include values from acceleration measurement – more stable for steady state testing.
	S Eng Trq WCF	Same as above, but with the current weather correction factor applied.
	T Eng Trq	Total engine torque – always valid.
	T Eng Trq WCF	Same as above, but with the current weather correction factor applied.
	S Eng Pwr	Static engine power – does not include values from acceleration measurement – more stable for steady state testing.
	S Eng Pwr WCF	Same as above, but with the current weather correction factor applied.
	T Eng Pwr	Total engine power – always

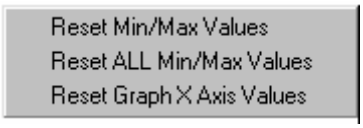
		valid.
	T Eng Pwr WCF	Same as above, but with the current weather correction factor applied.
	Auxiliary analog inputs 1 through 16	The labels for these channels will vary depending on the configuration of your analog inputs, as will the units of measurement.
Filter Value	An IIR filter constant used to filter the associated input values. This value must be in the range 0 to .999. 0 represents no filtering, while 0.999 represents a very heavy filter. These values should normally be left at 0, although values up to approximately 0.95 can be used to smooth measured values.	
Show Danger-High Band	Used to display a RED band on a gauge to represent input channel values that are above the danger display limit.	
Show Warning-High Band	Used to display a YELLOW band on a gauge to represent input channel values that are between the warning and danger display limits.	
Show Danger-Low Band	Used to display a RED band on a gauge to represent input channel values that are below the danger display limit.	
Show Warning -Low Band	Used to display a YELLOW band on a gauge to represent input channel values that are between the warning and danger display limits.	
Show Min Value	Enables the display of the minimum value encountered for the selected channel since the last reset of the min/max values.	
Show Max Value	Enables the display of the maximum value encountered for the selected channel since the last reset of the min/max values.	

Chapter

8

Reset Popup Menu

The reset popup menu gets displayed whenever the operator right clicks the mouse button on any gauge or graph located in the upper section of the screen.



Menu item	Description
Reset Min/Max Values	Resets the minimum and maximum values encountered during a test run for a particular gauge or graph.
Reset ALL Min/Max Values	Resets the minimum and maximum values encountered during a test run for ALL gauges or graphs.
Reset Graph X Axis Values	Resets the X-axis for a particular graph (to make time start at 0).

Chapter

9

The File Menu

This menu item allows the operator to load and save dynamometer configurations for testing 2WD or 4WD vehicles as well as motorcycles.

<table>
<tr><th>Menu Items</th><th>Description</th></tr>
<tr><td>Load Configuration</td><td>Load the following dynamometer configurations:
<table>
<tr><th>Menu Items</th><th>Description</th></tr>
<tr><td>2WD Mode</td><td>Load configuration settings specific for testing a 2 wheel drive vehicle.</td></tr>
<tr><td>4WD Mode</td><td>Load configuration settings specific for testing a 4 wheel drive vehicle.</td></tr>
<tr><td>Bike Mode</td><td>Load configuration setting specific for testing a motorcycle.</td></tr>
</table></td></tr>
<tr><td>Save Configuration</td><td>Save the following dynamometer configurations:
<table>
<tr><th>Menu Items</th><th>Description</th></tr>
<tr><td>2WD Mode</td><td>Save configuration settings specific for testing a 2 wheel drive vehicle.</td></tr>
<tr><td>4WD Mode</td><td>Save configuration settings specific for testing a 4 wheel drive vehicle.</td></tr>
<tr><td>Bike Mode</td><td>Save configuration setting specific for testing a</td></tr>
</table></td></tr>
</table>

		motorcycle.

These menu items allow the operator to load/store the following dynamometer configurations:

- The inertia value for the Dynamometer.
- Which load cell inputs should be read.
- Which PAU enables should be driven.
- Which PAU control signals should be driven.
- Which parasitic losses file should be loaded.
- Whether the second speed input should be used to derive an averaged speed.

The software must be configured for the desired mechanical configuration, and then the settings must be saved. Later, the "Load" commands can be used to quickly restore the software to the saved configurations whenever the mechanical configuration is changed.

Chapter

10

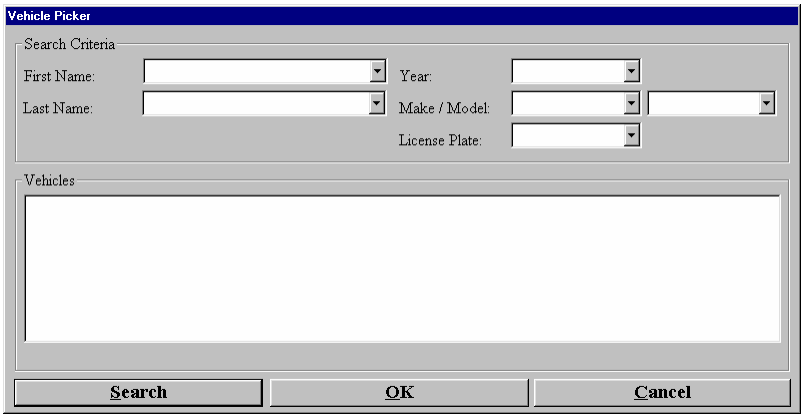
The Database Menu

All company, customer, vehicle and test data can be accessed via the database menu. The database is a hierarchical relational database, wherein the primary relationships are: customers have vehicles, and vehicles have test results. There are also utilities for backing up, restoring, repairing and exporting values from the database, along with several data entry and viewing screens.

Pick Vehicle For Testing

This screen allows the operator to select a vehicle that future test result will be saved under.

> **Note**
>
> The selected vehicle will be in effect until the operator selects a new vehicle.



Search Criteria

The operator has the ability to search for vehicle based on the following search criteria:

- First Name
- Last Name
- Year
- Make
- Model
- License Plate

The operator can either select a value for the criteria by using the drop-down list box, or they can manually type a value in.

Once the operator fills in the criteria, then they can press the search button and the vehicles matching the criteria will get filled in and the operator can then point and click on a vehicle to select it.

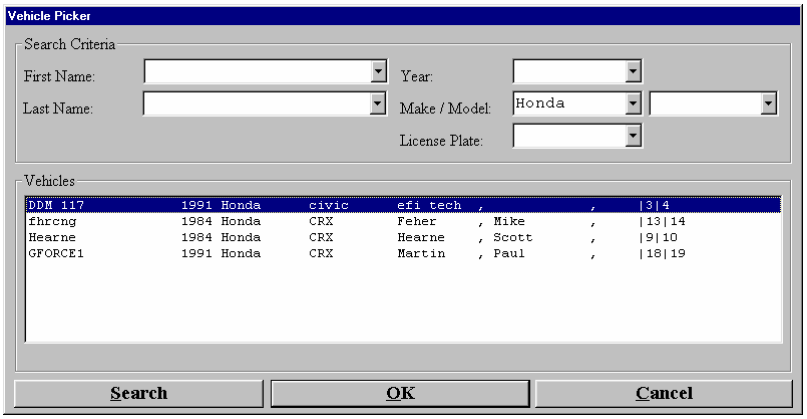
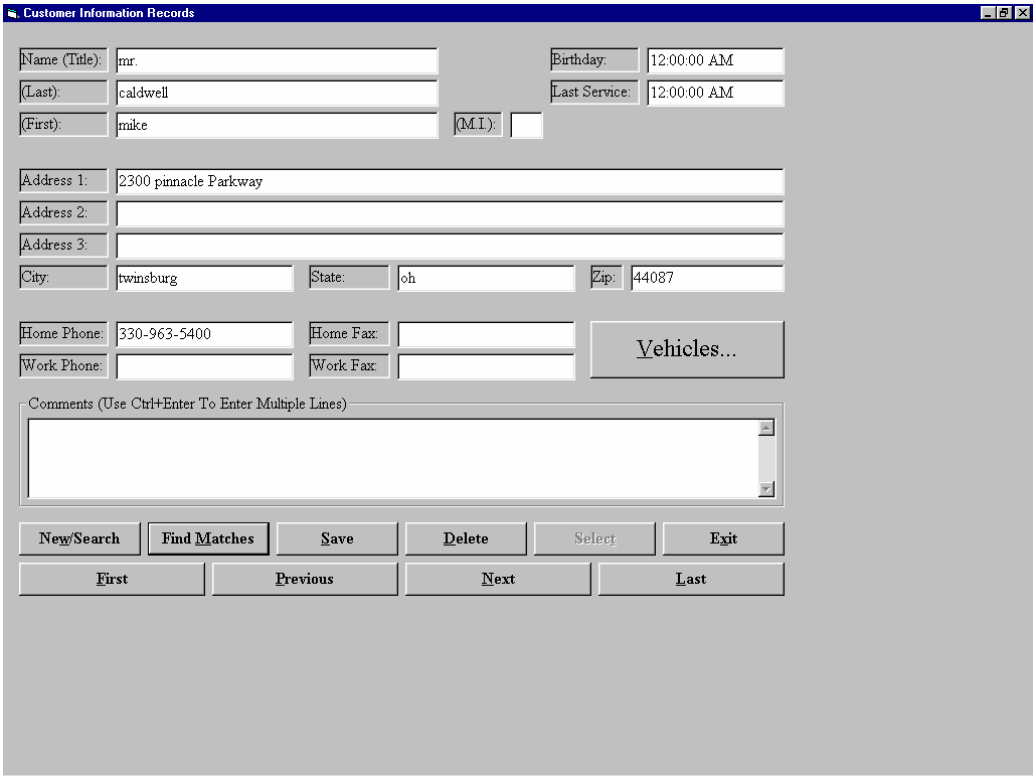


FIGURE 9.1 the operator can specify full or partial values for each field, to narrow the search results.

Customer/Vehicles

This screen allows the operator to edit their customer information as well as assign vehicles to their customers.



To add a new customer

- Left click "New/Search" button.
- Enter the information for the new customer.
- Left click "Save" button and the new customer will be saved.

To find an existing customer

- Left click "New/Search" button.
- If desired, enter any full or partial field values to reduce the number customers that will be found.
- Left click "Find Matches".
- The list of all existing customers can now be navigated using the "Next", "Previous", "First" and "Last" buttons.

To edit an existing customer

- Find the customer using the method given above.
- Make any desired changes to the current customer information.

- Left click the "Save" button.
- The new customer information will be saved.

To delete an existing customer

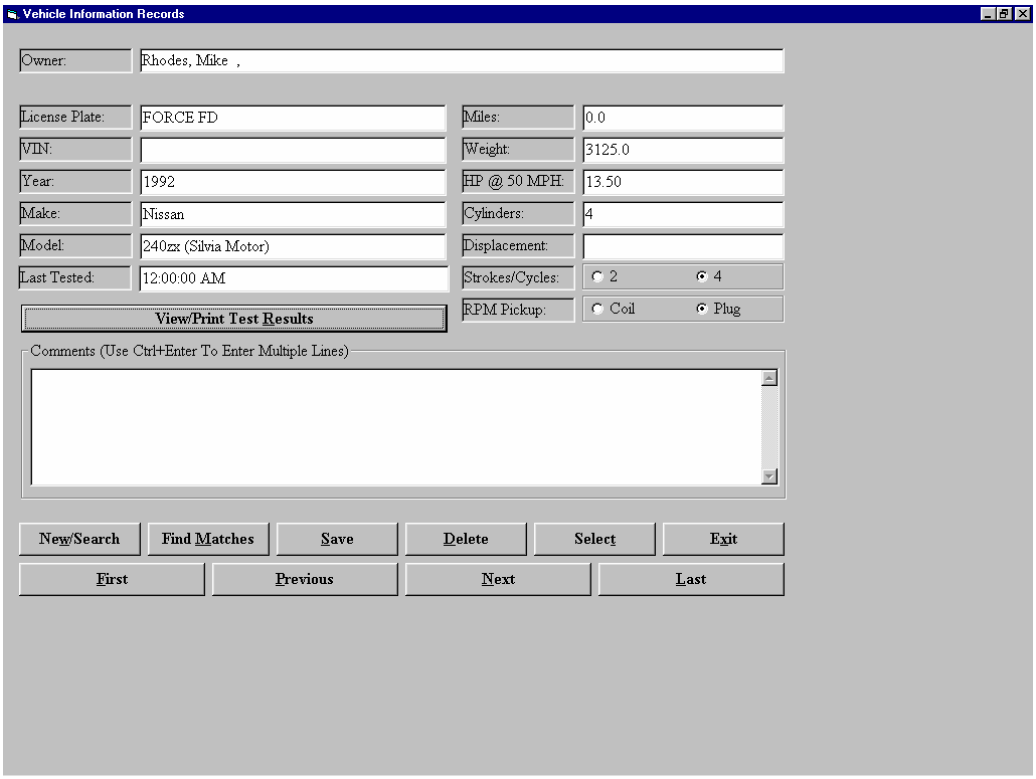
- Find the customer using the method given above.
- Left click the "Delete" button.
- The customer, ALONG WITH ALL OF THE CUSTOMER'S VEHICLES, AND THE TEST RESULTS FOR THOSE VEHICLES, WILL BE ERASED.

To add/change/delete/view the current customer's vehicles and their test results

- Find the customer using the method given above.
- Left click the "Vehicles..." button.
- You will be taken to a similar data entry screen where the current customer's vehicles, and the vehicle's test results, can be edited and/or viewed.

Customers/Vehicles (Vehicles)

This screen allows the operator to edit vehicles for a customer.



To add a new vehicle

- Left click the "New/Search" button.

- Enter the information for the new vehicle.
- Left click the "Save" button.
- The new vehicle information will be saved.

To find existing vehicles

- Left click the "New/Search" button.
- If desired, enter any full or partial field value to reduce the number of records that will be found.
- Left click the "Find Matches" button.
- The list of all existing vehicles (for the current customer) can now be navigated using the "Next", "Previous", "First" and "Last" buttons.

To edit an existing vehicle

- Find the vehicle using the method given above.
- Make any desired changes to the current vehicle information.
- Left click the "Save" button.
- The new vehicle information will be saved.

To delete an existing vehicle

- Find the vehicle using the method given above.
- Left click the "Delete" button.
- The vehicle, ALONG WITH ALL OF THE TEST RESULTS FOR THE VEHICLE, WILL BE ERASED.

To select the current vehicle (so test results will be saved under this vehicle)

- Find the customer using the method given above.
- Left click the "Select" button.
- All future test results will be saved under the current vehicle (until another vehicle is selected).

To view/print the current vehicles test results

- Find the customer using the method given above.
- Left click the "View/Print Test Results" button.
- You will be taken to a similar data entry screen where the current vehicle's test results can be viewed and/or printed.

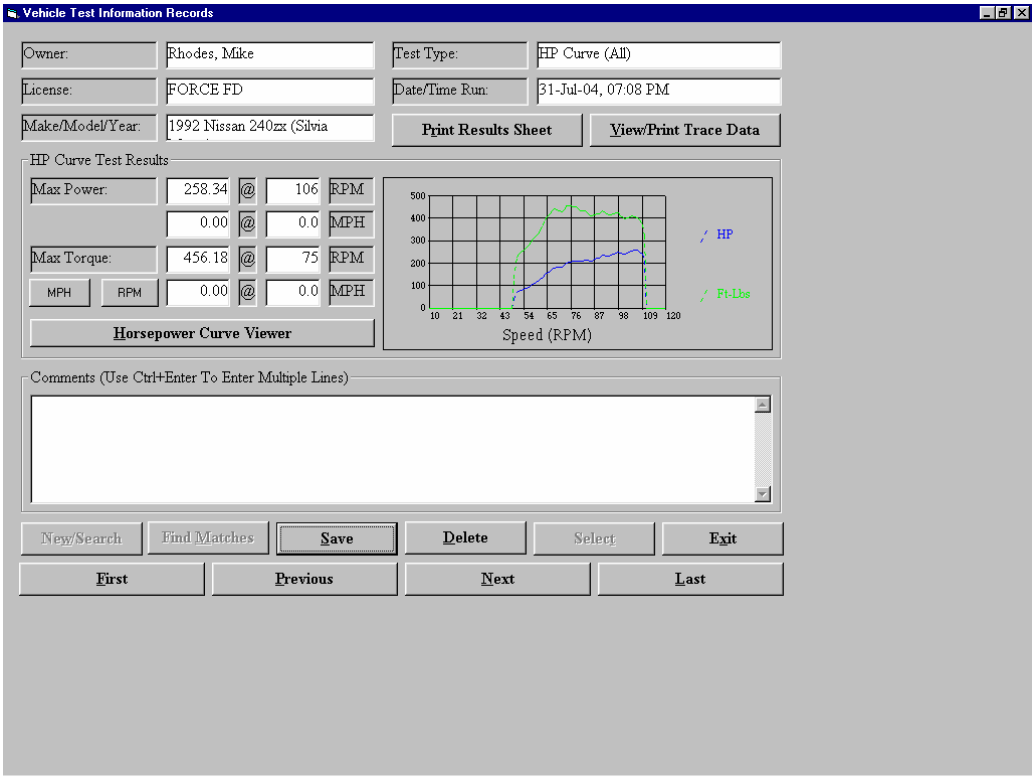


FIGURE 9.2 this is the screen that the operator will see when they press the View/Print Test Results.

To edit an existing test

- The operator can edit a test by typing in comments in the box labeled Comments located just above the buttons. The operator can enter in multiple lines by pressing the Ctrl + Enter keys at the same time which will create a new line of comments. The operator can then press the "Save" button to save the comments for the test.

To delete an existing test

- The operator can delete a test by pressing the "Delete" button, the operator will then be prompted if should want to delete the test record, if they press the "Yes" button then the test will be deleted, however if they press the "No" button then the test will not be deleted.

FIGURE 9.4 this is the screen that the operator will see when they press the Delete button.

To find a test

- The list of all existing test (for the vehicle) can now be navigated using the "Next", "Previous", "First" and "Last" buttons.

To print results sheet

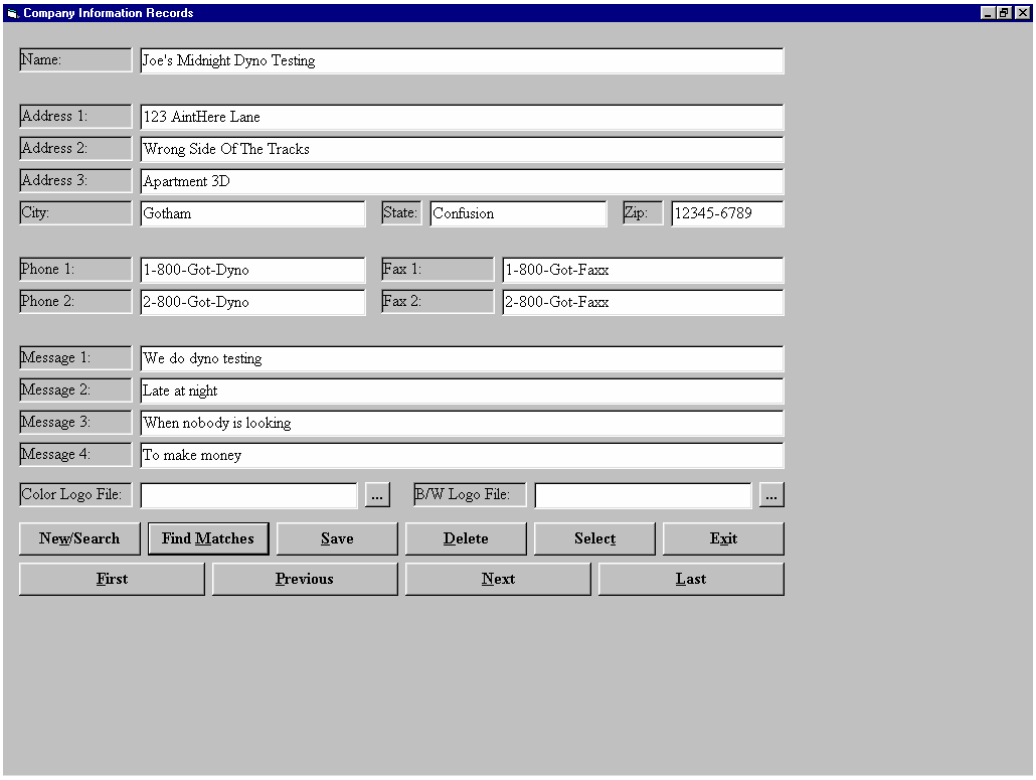
- The operator will press this button when they want to print out a test result sheet for the selected test.

To view/print trace data

- The operator will press this button when they want to print trace data for the test.

Companies

This screen allows the operator to edit company information.



Company records allow the operator to specify their company specific information. This information is used when test results are printed. Multiple company definitions may be entered, to allow for facilities where dynamometer use is shared among multiple companies.

> **Note**
>
> It is important to remember that company information is only used once it has been selected; after you add your company information and save it, make sure to select that company, so that the appropriate company information will be printed on future test report sheets.

To add a new company

- Left click the "New/Search" button.
- Enter the information for the new company.
- Left click the "Save" button to save the new company information.

To find existing companies

- Left click the "New/Search" button.
- If desired, enter any full or partial field value to reduce the number of records that will be found.
- Left click the "Find Matches" button.
- The list of all existing company can now be navigated using the "Next", "Previous", "First" and "Last" buttons.

To edit an existing company

- Find the company using the method given above.
- Make any desired changes to the current company information.
- Left click the "Save" button.
- The new company information will be saved.

To delete an existing company

- Find the company using the method given above.
- Left click the "Delete" button.
- The operator will be prompted to confirm delete.

Note

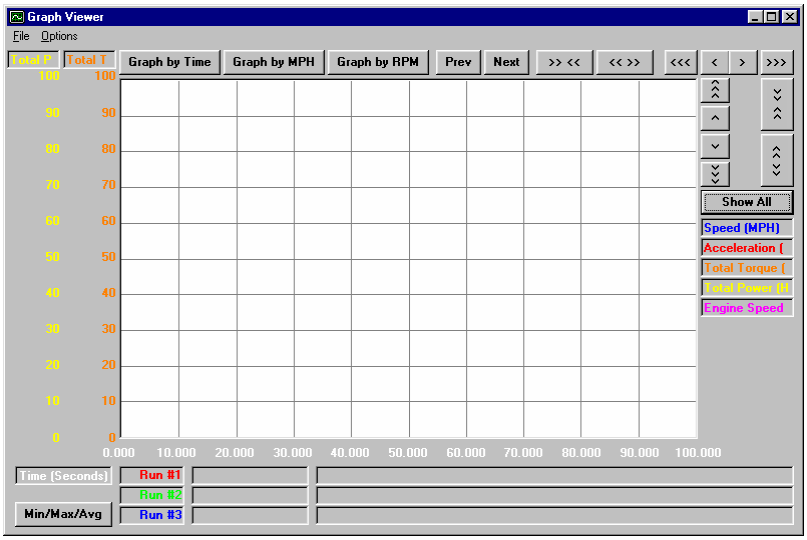
If the left clicks the "Yes" button then the company information will be deleted. If on the other hand the operator left clicks the "No" button then the company information will not be deleted.

To select the current company (so test reports will print this company's information)

- Find the company using the method given above.
- Left click the "Select" button.
- All future test reports will include the current company's information (until another company is selected).

Trace Graph Viewer

The trace graph viewer allows the operator to perform multiple functions on test results. The operator has the ability of loading up to three test runs. Modifying the colors of each test run as well as what channel is displayed on the Y-axis. The operator also has the ability to change the color used to display a channel, enter specific X-axis or Y-axis scale limits, zoom in and out of the graph area, show specific values for each data point in the graph, perform smoothing, display the minimum/maximum/average values for all loaded tests. The operator can also specify Time, MPH or RPM as the X-axis channel to display. Once the operator has configured the Trace Graph Viewer to their specific needs, then they can save the settings away as defaults.



To open a test run

Left double-click on the "Run #1", "Run #2" or "Run #3" panels located at the bottom of the screen. The operator can also load test runs from the File menu.

To load the test runs from the File Menu, the operator will do the following:

To load "Run #1", select "Baseline Test" from the File Menu, then select the "Load" menu item

To load "Run #2", select "Second Test" from the File Menu, then select the "Load" menu item

To load "Run #3", select "Third Test" from the File Menu, then select the "Load" menu item

To "hide" or "un-hide" a loaded test run

Right double-click on the "Run #1", "Run #2" or "Run #3" panels.

> **Note**
>
> Loaded but hidden test runs will have a red background.

To unload a test run

Left double-click on the "Run #1", "Run #2" or "Run #3" panels while holding down the shift keyboard button. The operator can also unload test runs from the file menu.

To Unload test runs from the File Menu, the operator will do the following:

To Unload "Run #2", select "Second Test" from the File Menu, then select the "UnLoad" menu item

To Unload "Run #3", select "Third Test" from the File Menu, then select the "UnLoad" menu item

> **Note**
>
> The baseline test cannot be unloaded

To set the color for any test run (when in per-test coloring mode)

Left double click on the vehicle description box just to the right of the "Run #1", "Run #2", "Run #3" boxes, a dialog box will display allowing the operator to point and click on the colors that they would like to assign to a test run:

FIGURE 9.3 this is the dialog box that appears when the operator left double clicks on the vehicle description box..

To edit the comments for a test run

Left double click on the test comments box for the test run you wish to edit.

Changing Y-axis channels

To change channels used in the Y-axis scales, click on the Y-axis scale headers ("Acceleration" and "Acceleration); a menu of channels will be displayed which you can use to select the channels used for each of the two (2) Y-axis scales. Alternatively, simply click on the channel in the legend area to set one of the Y-axis scale channels, or <Ctrl>+Click to set the other Y-axis scale channel.

Changing a Channel color

To change the color used to display a channel, left double click on the channels legend (on the right side of the graph, and a color-selecting window will be displayed as shown in Figure 9.3 above, which you can use to change the color of the channel you clicked on.

Entering specific X-axis or T-axis scale limits

To enter specific X- or Y-axis scale limits, left click on the minimum or maximum value that you would like to change (Y-axis minimum and maximum values are located on the left side of the screen at the bottom and top of the Y-axis scales, X-axis minimum and maximum values are located at the bottom of the graphing area at the left and right of the X-axis scale.) The following dialog box will display, allowing the operator to enter in the scale limits.

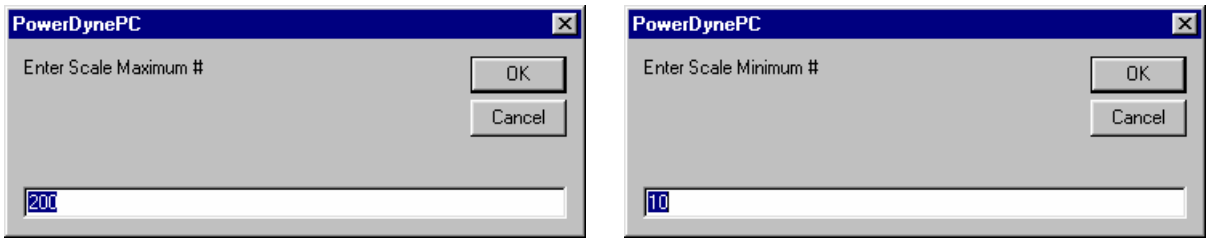


FIGURE 9.5 these are screen snap shots of what the dialogs look like when the operator left click the min and max scale limits.

Zooming in on the graph

To zoom in on the displayed graph area, use your mouse to draw a box around the area you would like to zoom in to; click down with the left mouse button, and hold that button down while dragging the mouse to draw a box. When you let go of the mouse button, the display will zoom in to the area inside the box you have drawn. The box you draw must be at least 20% of the width/height of the graphing area, or nothing will happen. If you draw a very "thin" box (20+% vertically or horizontally, but very small in the other direction), the display will zoom in on the axis that your box is larger in only.

Display data point values

To show specific values for each data point in the graph, click down on the graph area using the right mouse button. What happens next will depend on the setting of "Free-Ranging Cursor" / "Point-Locked Cursor" under the "Options" menu.

If "Free-Ranging Cursor" is checked: An X/Y crosshair will be shown on the graphing area, and the corresponding X-scale and Y-scale values will be displayed in sliding value boxes aligned with the crosshair lines.

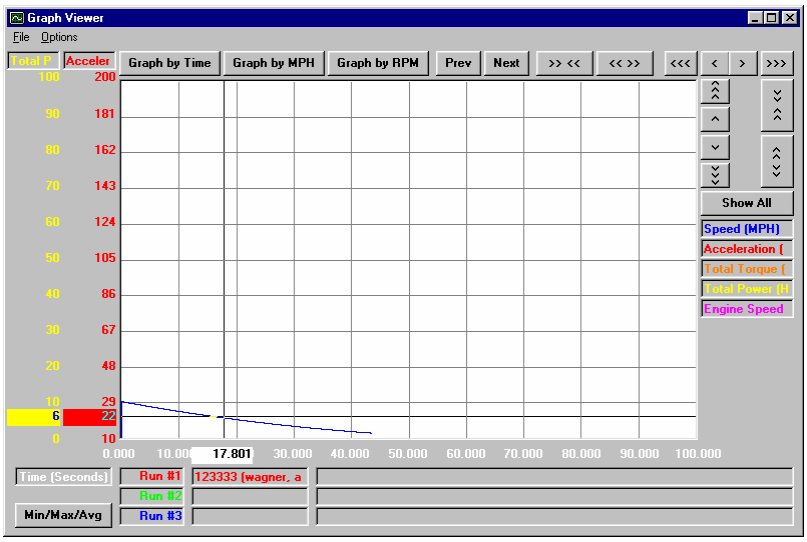


FIGURE 9.6 note the X/Y crosshair displayed in the graph.

If "Point-Locked Cursor" is checked: An X/Y crosshair will be shown on the graphing area, but with two (2) horizontal lines. The vertical line will "snap" to the nearest actual data point, and the horizontal lines will snap to the nearest actual data point for each of the two (2) Y-axis scales. The sliding value boxes will be aligned with the crosshair lines, and will show the actual point values. Additionally, the graph legend on the right side of the graphing area will show the actual point values for all channels.

Smoothing

The Graph Smoothing function is used to eliminate any spikes in the data that may occur during or testing.

By setting the smoothing values under the "Options" menu, you can make the displayed values more or less smoothed looking. The "FIR" (Finite Impulse Response) mode is generally superior to the "IIR" (Infinite Impulse Response) mode.

> **Note**
>
> Heavy smoothing values (>50 in "FIR" mode, > 90 in "IIR" mode) can hide transient values that may be important indicators of your vehicle's performance.

Getting Min/Max/Avg Values

The operator has the ability to show the minimum, maximum and average values for all loaded test runs, for all selected channels, as currently smoothed and displayed.

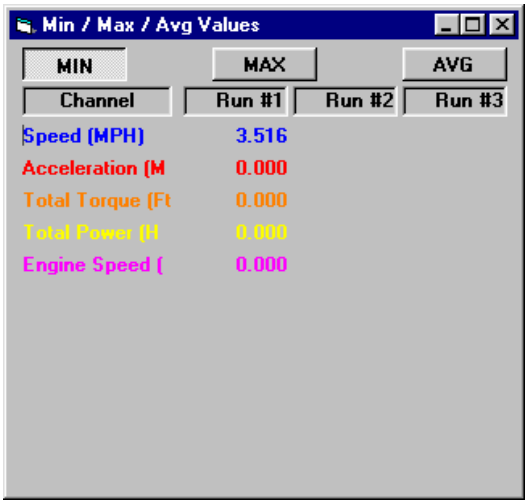


FIGURE 9.7 this is the screen that will appear when the operator presses the button labeled "Min/Max/Avg".

Per-channel - vs. - per-test coloring

The operator can select either per-channel or per-test coloring of the traces displayed. When examining many channels from a single test run, per-channel coloring will be easier to see. When examining the same channels from several test runs, per-test coloring will be easier to see. When examining multiple channels from multiple test runs, it is easiest to see with per-channel coloring, with patterned lines enabled. The first run lines will be solid, the second run lines will be dashed, the third run lines will be dashed, but more off than on.

Graph by Time / MPH / RPM

The operator can select any of these three common X-axis channels using the buttons on the screen.

> **Note**
>
> This screen maintains X-axis limit values for all three of these channels.

The operator has the ability to graph data by some other channel (possibly intake manifold pressure, if you do constant speed/RPM tests while varying boost levels); by left double clicking on the X-axis caption ("Time (Seconds)" above) to pick any channel from a list as defined in FIGURE 9.4.

> **Note**
>
> The X-axis limit values are not stored for other channels.

Saving Default Display Settings

The operator can save their configuration setting to disk as defaults for future sessions.

Saving/Restoring Custom Display Settings

The operator can save their custom display settings to whatever file they want, and then load up the saved file to restore those custom display the settings.

> **Note**
>
> This can save significant time when using 2 or more significantly different viewing setups.

Exporting Data

The operator can export the values currently displayed to a text file or as text to a printer. If the operator exports test data from one specific test, the values exported will be the exact values from the dataset – however many are displayed. If the operator exports test data from all of the loaded tests (which can be just one test if desired), they are prompted to enter the number of X-axis units per data point exported (since you want one value for each test run per line, but the raw test data will not have exact X-axis matches for multiple test runs).

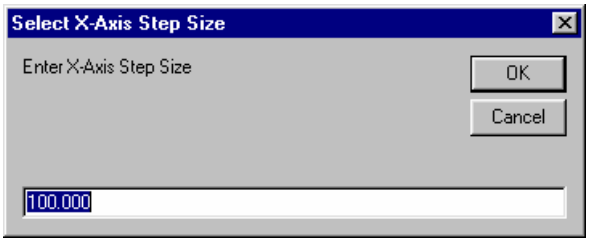
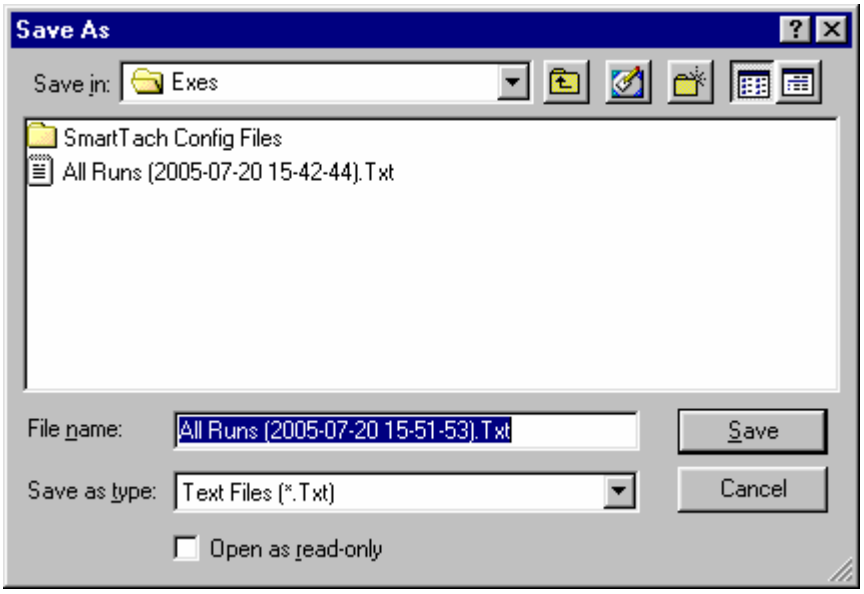


FIGURE 9.8 this is the prompt that the operator will see if they export test data from all of the loaded tests.

For example, if the display is showing 2000 through 7000 RPM, and you specify 100 X-axis units per exported data point, you would get lines in the exported data for 2000, 2100, 2200, … 6900, 7000 RPM.

> **Note**
>
> The exported data EXACTLY matches the displayed data, including the current smoothing settings. Only channels that are currently displayed will be exported.

The following screen will display to the operator prompting them for the name and location of the export file.



Note

The name of the export file will be in the following format:

All Runs (YYYY-MM-DD HH:MM:SS).txt

Where YYYY-MM-DD HH:MM:SS is the current date and time.

Graph Viewer Menu System

File Menu

The following table is a description of each menu and corresponding menu-item along with a description of its function:

Menu Item	Description
Baseline Test	This option gives the operator the ability to load, export, print and enter comments for a baseline test, which is a test from which all other tests are measured.

Menu Item	Description
Load	This option displays the Test Result Picker so that the operator can load a baseline test.

<table>
<tr><td></td><td>
<table>
<tr><td>Export To Text File</td><td>This option prompts the operator to save the baseline test data to a file.</td></tr>
<tr><td>Print As Text</td><td>This option prints the baseline test data to the printer.</td></tr>
<tr><td>Edit Comments</td><td>This option prompts the operator for comments.</td></tr>
</table>
</td></tr>
<tr><td>Second Test</td><td>This option gives the operator the ability to load, export, print and enter comments for a second test.
<table>
<tr><th>Menu Item</th><th>Description</th></tr>
<tr><td>Load</td><td>This option displays the Test Result Picker so that the operator can load a second test.</td></tr>
<tr><td>Export To Text File</td><td>This option prompts the operator to save the second test data to a file.</td></tr>
<tr><td>Print As Text</td><td>This option prints the second test data to the printer.</td></tr>
<tr><td>Edit Comments</td><td>This option prompts the operator for comments.</td></tr>
</table>
</td></tr>
<tr><td>Third Test</td><td>This option gives the operator the ability to load, export, print and enter comments for a third test.
<table>
<tr><th>Menu Item</th><th>Description</th></tr>
<tr><td>Load</td><td>This option displays the Test Result Picker so that the operator can load a third test.</td></tr>
<tr><td>Export To Text File</td><td>This option prompts the operator to save the third test data to a file.</td></tr>
<tr><td>Print As Text</td><td>This option prints the third test data to the printer.</td></tr>
</table>
</td></tr>
</table>

	Edit Comments	This option prompts the operator for comments.
Print Graph	Print The graph	
Export all by X-axis step	This option prompts the operator for the name and location of a text file that will hold the currently displayed test values. If the operator exports test data from all of the loaded tests, they are prompted to enter the number of X-axis units per data point exported (since you want one value for each test run per line, but the raw test data will not have exact X-axis matches for multiple test runs).	
Print all as text by X-axis step	Allows the operator to print the test values currently displayed. If the operator exports test data from all of the loaded tests, they are prompted to enter the number of X-axis units per data point exported (since you want one value for each test run per line, but the raw test data will not have exact X-axis matches for multiple test runs).	
Save configurations as defaults	This option will save the current configuration settings as defaults for future sessions.	
Save configuration as file	This option prompts the operator for the name and location of a file that will hold custom display settings. The operator can save as many files that they want. **Note** This can save significant time when using 2 or more significantly different viewing setups.	
Read Configuration from file	This option prompts the operator for the name and location of a file that holds the custom display settings to display. **Note** This can save significant time when using 2 or more significantly different viewing setups.	

Exit	Exit the Graph Viewer

Test Results Picker

The operator can load a test result by selecting this option from the baseline test, second test, or third test menus. The following prompt will display where the operator can specify what test to load based on a search criteria.

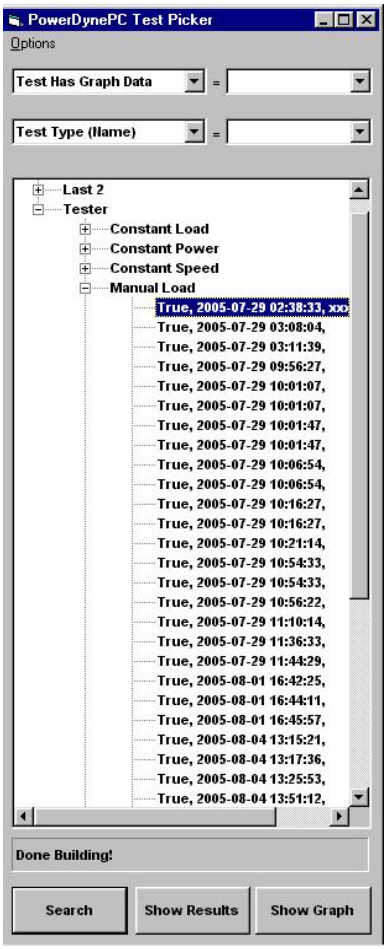


FIGURE 9.9 this is the prompt that the operator will see when they choose to load a baseline, second or third test and allows them to load a test based on a search criteria.

The list of tests displayed is defined by the following:

- Test results fields used for levels in the tree (0-4 levels may be used)
- Test results fields displayed for test records (0-4 fields may be displayed)
- Search criteria used to limit the set of test results displayed (0-2 fields may be restricted)

When a test record is clicked on, this display may:

- Do nothing

- Automatically show a test results summary form
- Automatically display the test results in a graphing window

Configuration of this form is done through the "Options" menu, which has the following options:

Auto-Show Graph

If this option is checked a test results summary form will automatically be displayed when a test record is clicked on.

Auto-Show Results

If this option is checked the test's graph data will automatically be displayed when a test record is clicked on.

Tree Levels

This option will open a form used to specify which test results fields should be used to create the levels in the results tree.

Displayed Values

This option will open a form used to specify which test results fields should be displayed for each matching test record.

Searching For Specific Test Records

The two drop-down list boxes at the top of the form are used to restrict the number of test records displayed. If these boxes are blank, no restriction is applied. If a test results field is selected, then only test records with values in the specified field that match the value entered in the text box to the right of the drop-down list box will be displayed. If both restriction drop-down list boxes are non-blank (ie a field name is selected in each box), then the list of test records displayed will be restricted based on both fields in an "AND" meaning (test record fields for Field-1 AND Field-2 must match the restriction (search) values entered in the text boxes).

The list of field names available in the drop-down lists is below:

Test Type (Code)

The numeric value associated with each test type – normally not used by end-users of this software.

Test Type (Name)

The name of each test type – the available values are available in the text boxes to the right of the list boxes in the drop-down list of the text box.

Test Date/Time

The year/month/day that the tests were run – the search value is in the format mm/dd/yyyy, and all tests performed on that day will be displayed.

Test Has Graph Data

Either "True" or "False" (available in the list for the matching-value text boxes). If this field is restricted to "True", the list will not show any tests that do not have graph data, which is handy when picking tests to graph.

Test Data File

The name of the data file that the test's results are stored in. Can be used to determine exactly what test results are in a given disk file.

Test Comments

Any comments entered for the test. You can then search for tests with comments like "Good pull…", or any strings you may enter for comments.

Owner First Name

The vehicle owner's first name.

Owner Last Name

The vehicle owner's last name.

Vehicle VIN

The vehicle's VIN number.

Vehicle License

The vehicle's license plate number (WAY2QIK).

Vehicle Make

The make of the vehicle tested (Eagle).

Vehicle Model

The model of the vehicle tested (Talon TSi).

Vehicle Year

The model year of the vehicle tested.

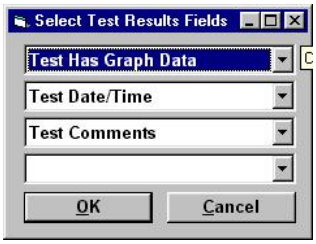
Specifying Fields for Tree Levels

The form shown below is used to specify which test results fields should be used to create each level in the test results tree.

The first field specified will be used to create the left-most level (column) in the list of test results displayed. With 2 fields specified as shown above (Test Type (Name), Owner Last Name), you will see a list of all the test types you have performed, and under each test type, a list of all the customers (Last Name) that each test type has been performed for.

Specifying Fields to be Displayed for Each Test Record

The form shown below is used to specify which test results fields should be displayed for each test record in the list displayed.



Each field that is selected will be displayed for each test record in the list.

Fields that are used to create the columns in the tree should generally not be displayed for each test record, since that information is already available by looking at the column values of the tree.

With 3 fields specified as shown above (Test Has Graph Data, Test Date/Time, Test Comments), you will see entries like that shown below for each test record displayed:

"True, 7/23/2005, Wastegate feedback tube blew off, huge power, blown engine"

Generally, fields with shorter values (like the True/False displayed for Test Has Graph Data) should be selected for display before longer fields, so the displayed values can be read more easily.

Export To Text File

This option prompts the operator for a name and location of a file to save either baseline, second or third test data to.

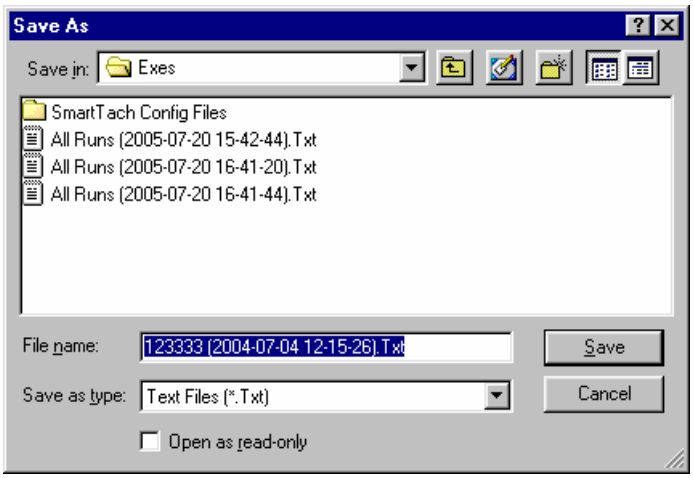


FIGURE 9.11 this is the dialog that the operator will see when they select "Export To Text File".

> **Note**
>
> The name of the export file will be in the following format:
>
> All Runs (YYYY-MM-DD HH:MM:SS).txt
>
> Where YYYY-MM-DD HH:MM:SS is the current date and time.

Edit Comments Prompt

This option prompts the operator for comments for either baseline, second, or third tests.

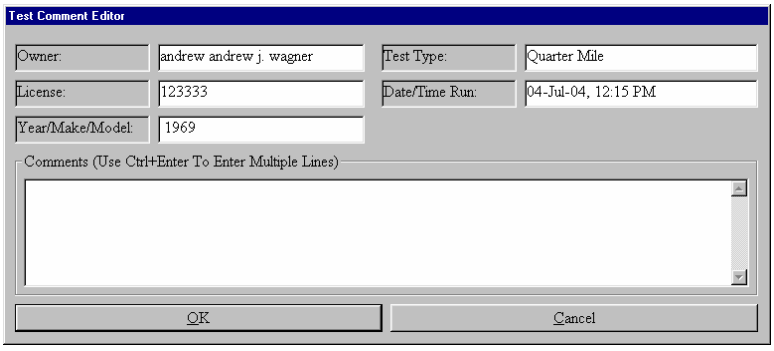


FIGURE 9.12 this is the dialog that the operator will see when they select "Edit Comments".

The operator can enter multiple lines by press the Ctrl and Enter keys at the same time, and then press the OK button to save them away.

Export all by X-axis step prompt

This option prompts the operator for the name and location of a text file that will hold the currently displayed test values.

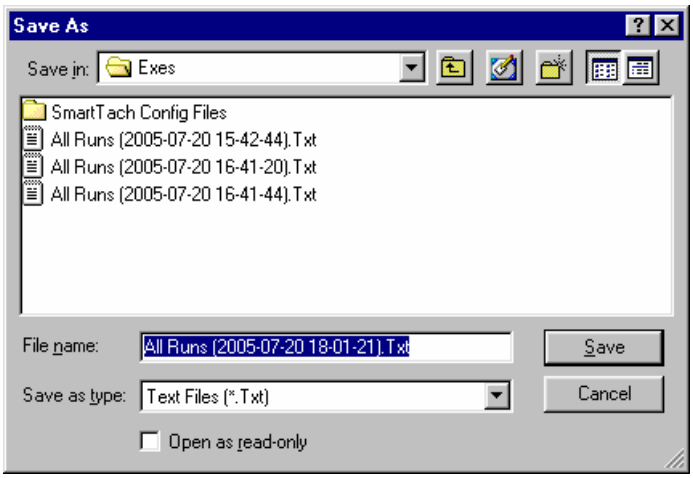


FIGURE 9.13 this is the dialog that the operator will see when they select "Export all by X-axis".

> **Note**
>
> The name of the export file will be in the following format:
>
> All Runs (YYYY-MM-DD HH:MM:SS).txt
>
> Where YYYY-MM-DD HH:MM:SS is the current date and time.

If the operator exports test data from all of the loaded tests, they are prompted to enter the number of X-axis units per data point exported (since you want one value for each test run per line, but the raw test data will not have exact X-axis matches for multiple test runs).

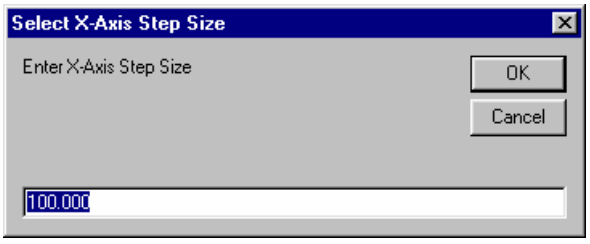


FIGURE 9.14 this is the dialog that the operator will see when prompted to enter the number of X-axis units per data point exported..

Save configuration as file prompt

This option prompts the operator for the name and location of a file that will hold custom display settings. The operator can save as many files that they want.

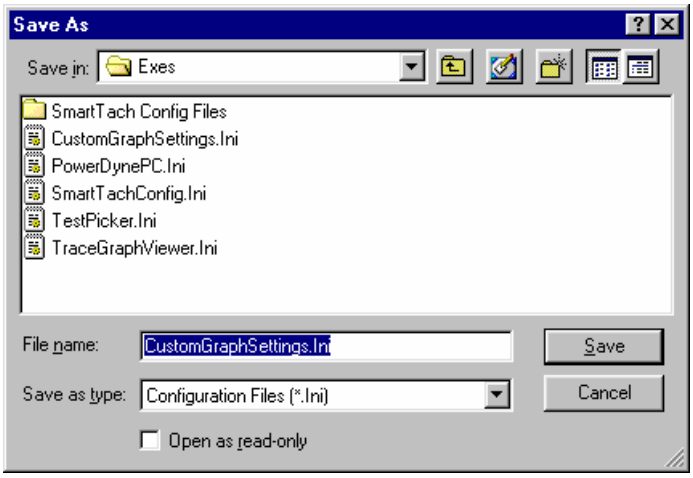


FIGURE 9.15 this is the dialog that the operator will see when they select the menu item "Save Configuration As File"..

> **Note**
>
> This can save significant time when using 2 or more significantly different viewing setups.

Read Configuration from file prompt

This option prompts the operator for the name and location of a file that holds the custom display settings to display.

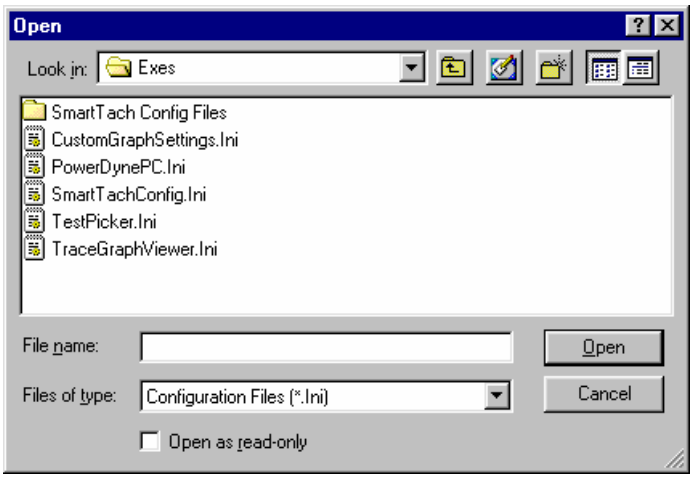


FIGURE 9.16 this is the dialog that the operator will see when they select the menu item "Read Configuration From File".

> **Note**

This can save significant time when using 2 or more significantly different viewing setups.

Options Menu

Menu Item	Description
Channels To Show	Displays a list of channels that the operator can select from, for a list of channels, please refer to Figure 9.4.
Smoothing (##)	The Graph Smoothing function is used to eliminate any spikes in the data that may occur during calibration or testing. The operator will be prompted for a number between 0 and 99. The higher the number the more smoothing there is.
Use IIR Filter	Infinite Impulse Response (IIR) filters have an impulse response function, which is non-zero over an infinite length of time.
Use FIR Filter	Finite Impulse Response filters (FIR) which have fixed-duration impulse responses.
Don't Smooth Unseen Data	speeds up re-draws by not smoothing (filtering) any channels that are not getting displayed
Line Graph	A diagram of lines, connecting points on a graph, representing the successive changes in the value of a variable quantity or quantities.
Scatter Graph	A scatter graph is a graph used in statistics to visually display and compare two sets of related quantitative, or numerical, data by displaying only finitely many points, each having a coordinate on a horizontal and a vertical axis.
Use Thick Lines	Makes the graphed lines for each test run thicker.
Use Patterned Lines	Draws the graphed lines for each test run in a different pattern.
Free-Ranging Cursor	An X/Y crosshair will be shown on the graphing area, and the corresponding X-scale and Y-scale values will be displayed in sliding value boxes aligned with the crosshair lines.
Point-Locked Cursor	An X/Y crosshair will be shown on the graphing area, but with two (2) horizontal lines. The vertical line will "snap" to the nearest actual data point, and the horizontal lines will snap to the nearest actual data point for each of the two (2) Y-axis scales. The sliding value boxes will be aligned with the crosshair

	lines, and will show the actual point values. Additionally, the graph legend on the right side of the graphing area will show the actual point values for all channels.
Force Identical Scales	Makes the Y-axis scale the same for all channels - lets them enter min and max values.
Use Per-Channel Colors	When examining many channels from a single test run, per-channel coloring will be easier to see. **Note** When examining multiple channels from multiple test runs, it is easiest to see with per-channel coloring, with patterned lines enabled. The first run lines will be solid, the second run lines will be dashed, the third run lines will be dashed, but more off than on.
Use Per-Run Colors	When examining the same channels from several test runs, per-test coloring will be easier to see.

Smoothing (##) prompt

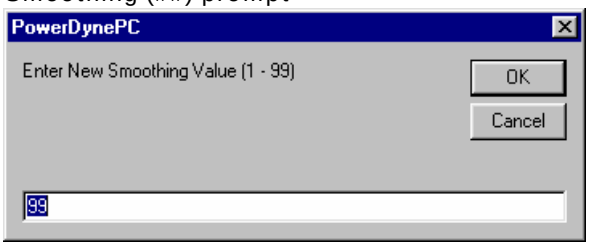
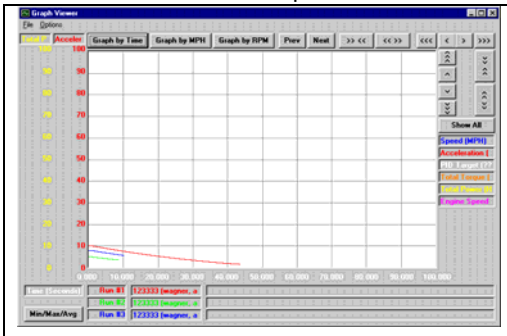
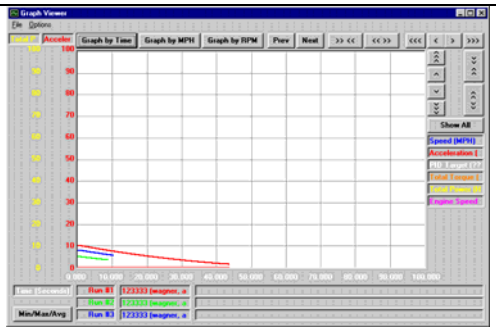


FIGURE 9.17 this is the dialog that the operator will see when they select the menu item "Smoothing (##)".

Use Thick Lines Prompt

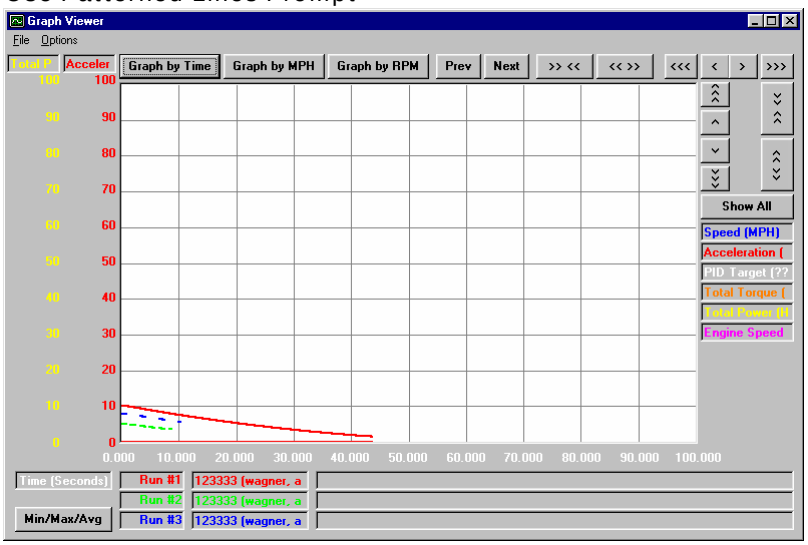


This is how the test runs will appear when the "Use Thick Line" menu item is not selected.



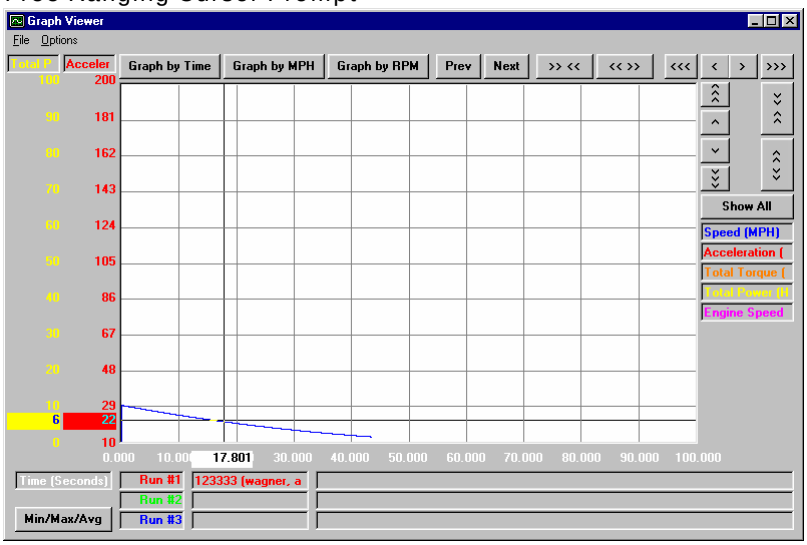
This is how the test runs will appear when the "Use Thick Line" menu item is selected. Note how much thicker the lines of the test run are.

Use Patterned Lines Prompt



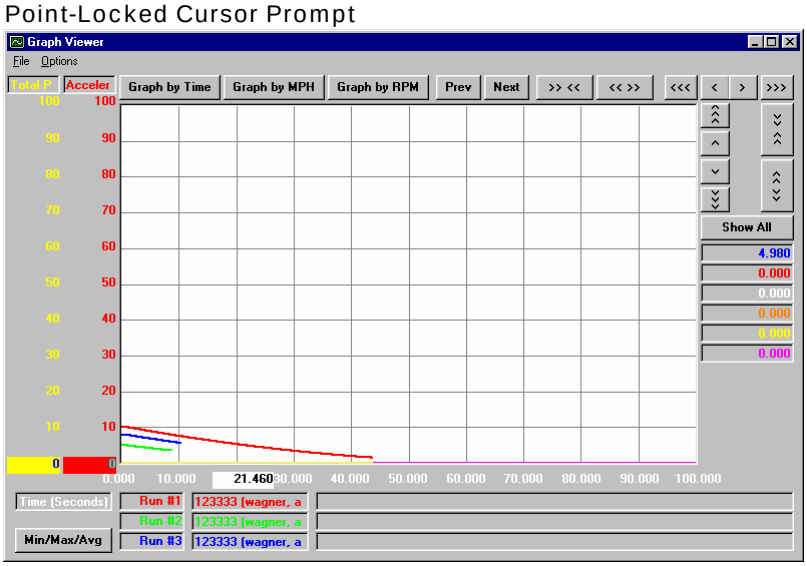
The "Use Patterned Line" menu item displays the lines of the test runs in different patterns. Please note from the above example that test run #1 is a solid line, run #2 is a dotted line, and test run #3 is a dashed line.

Free-Ranging Cursor Prompt



The "Free-Ranging Cursor" displays an X-axis and Y-axis cross hairs that are updated in real time as the cross hairs are moved by holding down the right mouse button. Please note that the X-scale and Y-scale values are displayed in real time in sliding boxes that are aligned with the cross hairs. This mode lets the operator see the value for each Y-axis scale at any point in the graphing area, but does not show the values actually recorded during testing.

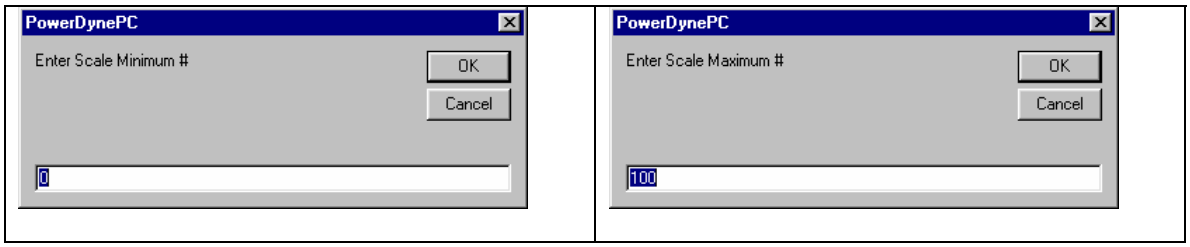
Point-Locked Cursor Prompt



The "Point-Locked Cursor" displays in real time the X-scale value as the operator holds down the right mouse button. Please note that the X-scale value is displayed in real time in a sliding box. This mode shows only values that were recorded during testing – the cursor is locked onto actual sample point values.

Force Identical Scales Prompt

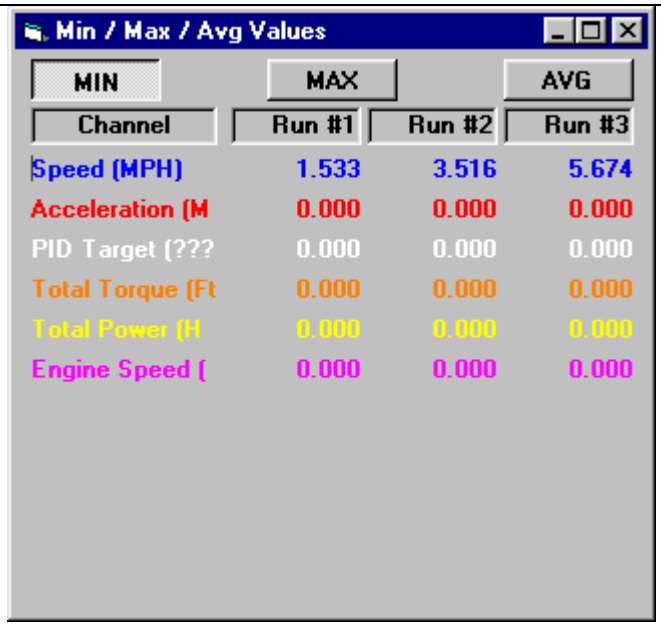
The "Force Identical Scales" prompts the operator for the minimum and maximum scale values in order to make the Y-axis scale the same for all channels.



Buttons and their function

Buttons	Description
Graph by Time	Displays the Time channel on the X-axis.
Graph by MPH	Displays Speed (MPH) channel on the X-axis.
Graph by RPM	Displays Engine Speed (RPM) on the X-axis.
Prev	Puts all display settings back to how they were previous to the last change - undoes whatever you just did, like a zoom or color change or whatever.
Next	Moves through the list of saved display options sets.
>> <<	Zoom in on the X-axis.
<< >>	Zoom out on the X-axis.
<<<	Scroll the graph left three divisions.
<	Scroll the graph left one division.
>	Scroll the graph right one division.

	Scroll the graph right three divisions.
	Scroll the graph up three divisions.
	Scroll the graph up one division.
	Scroll the graph down one division.
	Scroll the graph down three divisions.
	Zoom in on the X-axis.
	Zoom out on the X-axis.
	Makes the X- and Y-axis scales just big enough to show all the data points in the current data set.
	Displays the minimum, maximum, and average values for all selected channels.

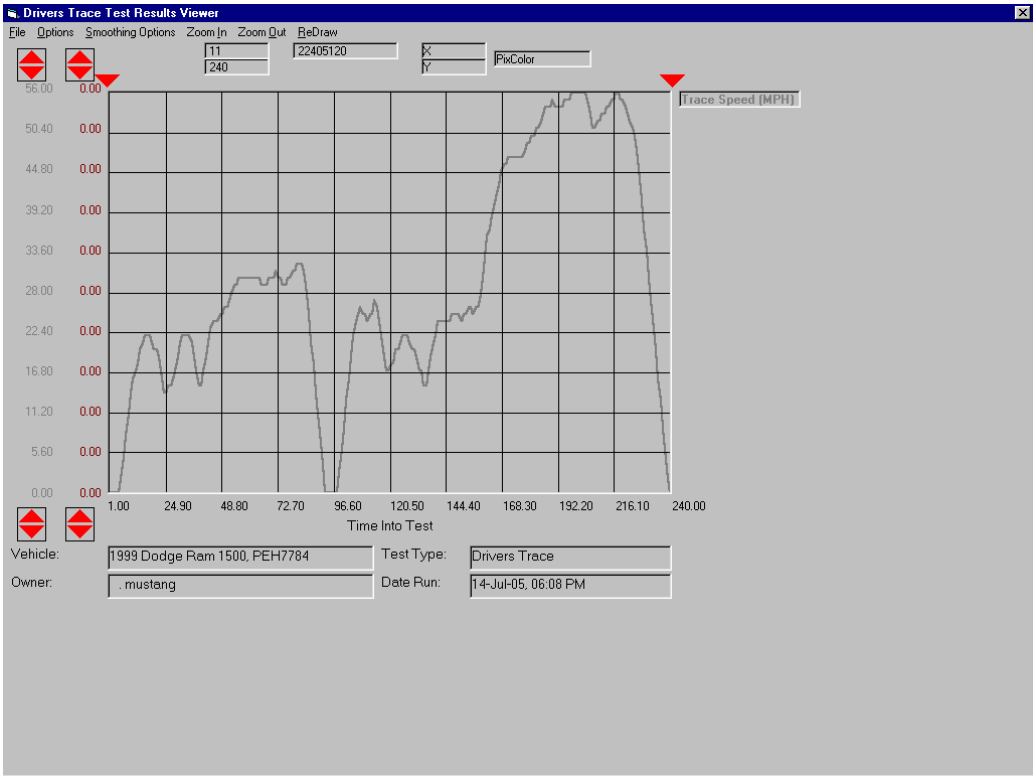


This allows the operator to display:

- The minimum values for all channels by pressing the "MIN" button.
- The maximum values for all channels by pressing the "MAX" button.
- The average values for all channels by pressing the "AVG" button.

Driver's Trace Test Results Viewer

This screen allows the operator to view the results of an IM-240 type emissions test.



The Main Screen Interface

The main interface of the Driver Trace Result Viewer allows the operator to view the graph in different ways by adjusting the minimum and maximum scale values for both of the Y-axis. Adjusting the minimum and maximum value allows the operator to see more of the data from other channels. The operator also has the ability of zooming in on the data by adjusting the minimum and maximum X-pointer limits.

Buttons	Description
	This is a spinner that the operator can use for adjusting the minimum and maximum Y-axis scale values for a particular channel, to achieve a "panning" effect.
	This is a pointer that the operator can use to zoom in and out of the graph for a single channel in the Y-axis.

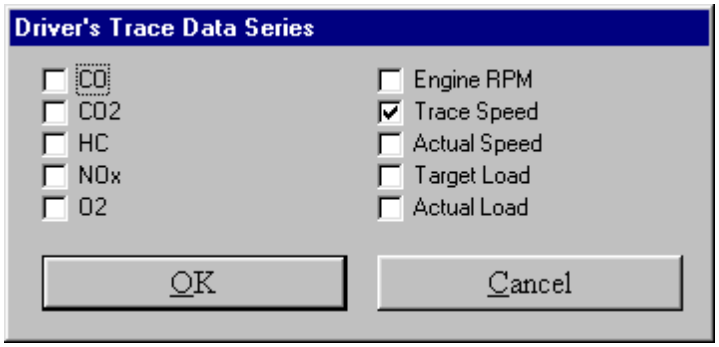
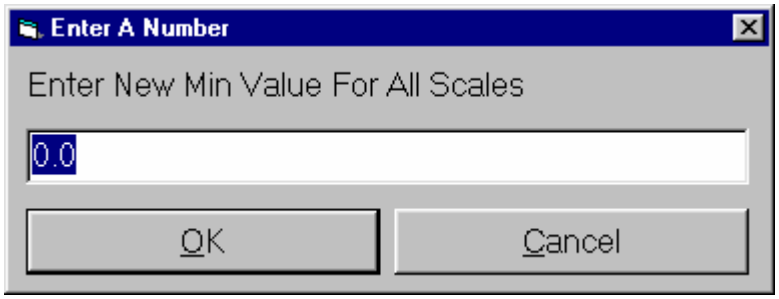
The File Menu

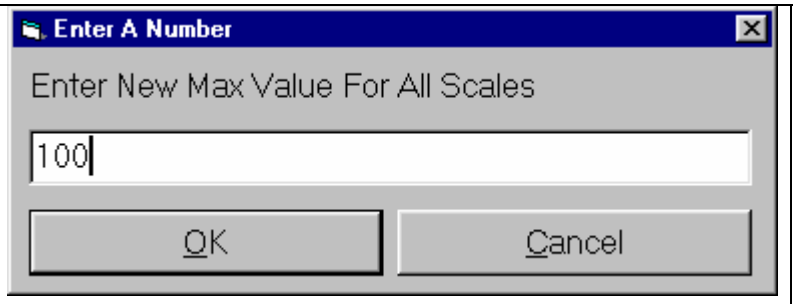
The following is a list of menu items for the File Menu and their corresponding description.

Menu Item	Description
Open	Opens the Test Result Picker, so that the operator can select a test to graph, please refer to FIGURE 9.9 for an example.
View Detail	This screen allows the operator to view specific test run parameters, please refer to FIGURE 9.18 for an example.
Edit Comments	This screen allows the operator displays the edit comments dialog box so that the operator can enter in comments, please refer to FIGURE 9.18 for an example.
Print Test Report	This allows the operator to print out a test report.
Print Graph	This allows the operator to print out the graph.
Print Text	This allows the operator to print out the test results in a text format.
Export To Text File	This allows the operator to export the test result to a file, please refer to FIGURE 9.11 for an example.
Close	Exit the screen.

The Options Menu

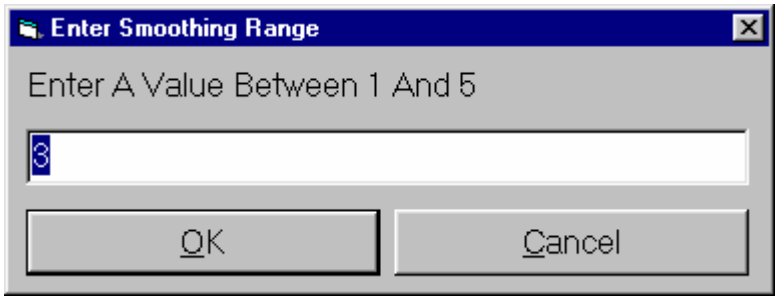
The following is a list of menu items for the Option Menu and their corresponding description.

Menu Item	Description
Input Channels	Displays the following input channels that the operator can select from:  From this screen the operator will check which input channels they want to display. A legend will be displayed for each channel the operator selects and will be displayed to the right of the graph.
Show Grid	This will toggle the grid lines on/off.
Thick Lines	Makes the graphed lines for each input channel thicker.
Force Identical Scales	Makes the Y-axis scale the same for all channels - lets them enter min and max values. 

	
Force Full Scales	Makes the X- and Y-axis scales just big enough to show all the data points in the current data set.
Force Custom Scales	Makes the display use the stored custom scaling values instead of whatever values it is using now
Default To Custom Scale	Makes the display default to the custom scaling values when the window is opened

Smoothing Options Menu

The following is a list of menu items for the Smoothing Options Menu and their corresponding description.

Menu Item	Description
Smooth Data	This allows the operator to eliminate any spikes in the data that may occur during calibration or testing. The operator will be prompted to enter a filter value that will be used to smooth the data.  The higher the value, the more smoothing there is.
Revert Data	This allows the operator to revert the data back to no smoothing.

Zoom In Menu
This menu item allows the operator to closely examine the graph.

Zoom Out Menu
This menu item allows the operator to get more of an overall view of the graph.

Redraw Menu
This menu item causes the graph to be redrawn. This is useful when the display is over-written or for any reason is not reflecting the current display settings.

Drivers Trace Test Results Details Viewer
This screen allows the operator to view test parameters for a selected test.

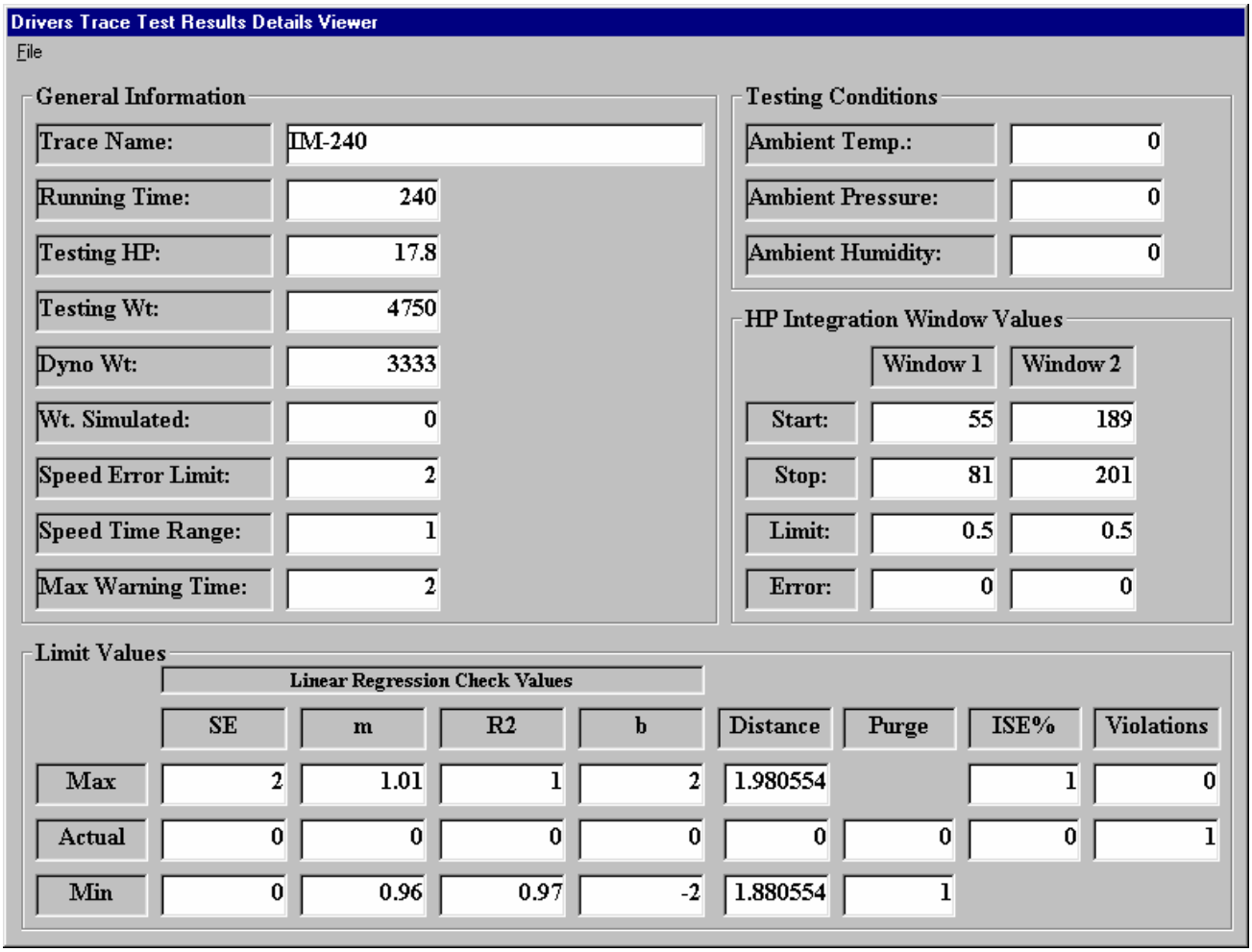


FIGURE 9.18 this is the prompt that the operator will see when they select the view detail menu item.

The screen is broken down into the following four sections:

- General Information
- Testing Conditions
- HP Integration Window Value
- Limit Values

General Information

The following is a list of fields in the general information section along with a corresponding description:

Field	Description
Trace Name	The name of the trace.
Running Time	The total time of the trace.
Testing HP	The amount of horsepower applied during the test.
Testing Weight	The weight of the vehicle.
Dyne Weight	The equivalent weight of the dynamometer.
Wt. Simulated	Tells the vehicle weight simulated during the test.
Speed Error Limit	MPH error allowed on top of time based error limits.
Speed Time Range	Seconds on each time of current time to use in error limits calculations.
Max Warning Time	Number of seconds before a warning becomes a violation.

Testing Conditions

The following is a list of fields in the Testing Conditions section along with a corresponding description:

Field	Description
Ambient Temperature	Current weather station temperature.
Ambient Pressure	Current weather station pressure.
Ambient Humidity	Current weather station humidity

HP Window Integration Values

The following is a list of fields in the HP Window Integration Values section along with a corresponding description:

Field	Description
Window 1 Start	Starting time, in seconds, for the first HP integration window.
Window 1 Stop	Ending time, in seconds, for the first HP integration window.
Window 1 Limit	Max HP deviation in this window without generating an error.
Window 1 Error	Max HP deviation must be less than or equal to this to pass.
Window 2 Start	Starting time, in seconds, for the second HP integration window.
Window 2 Stop	Ending time, in seconds, for the second HP integration window.
Window 2 Limit	Max HP deviation in this window without generating an error.
Window 2 Error	Max HP deviation must be less than or equal to this to pass.

Limit Values

The following is a list of fields in the Limit Values section along with a corresponding description:

Field	Description
SE Max	Max SE value from linear regression before generating an error.
SE Actual	The actual standard error.
SE Min	Min SE value from linear regression before generating an error.
M Max	Max value of "m" from linear regressions before generating an error.
M Actual	The slope of the line.
M Min	Min value of "m" from linear regressions before generating an error.
R^2 Max	Max value of "r^2" from linear regressions before generating an

	error.
R^2 Actual	Coefficient determination.
R^2 Min	Min value of "r^2" from linear regressions before generating an error.
B Max	Max value of "b" from linear regression before generating an error.
B Actual	The Y-intercept of the sloped line.
B Min	Min value of "b" from linear regression before generating an error.
Distance Max	Maximum distance a valid trace can cover.
Distance Actual	The actual distance a trace covered.
Distance Min	Minimum distance a valid trace can cover.
Purge Actual	The actual purge volume (in liters) measured during testing.
Purge Min	The minimum purge volume (in liters) a valid trace can produce.
ISE% Max	Max ISE% (Inertia Simulation Error) before generating an error.
ISE% Actual	The actual ISE% (Inertia Simulation Error) measured during a test.
Violations Max	The maximum number of driving violations allowed during a valid test.
Violations Actual	The actual number of driving violations generated during a test.

Driver Trace Test Results Detail Viewer Menu System

File Menu

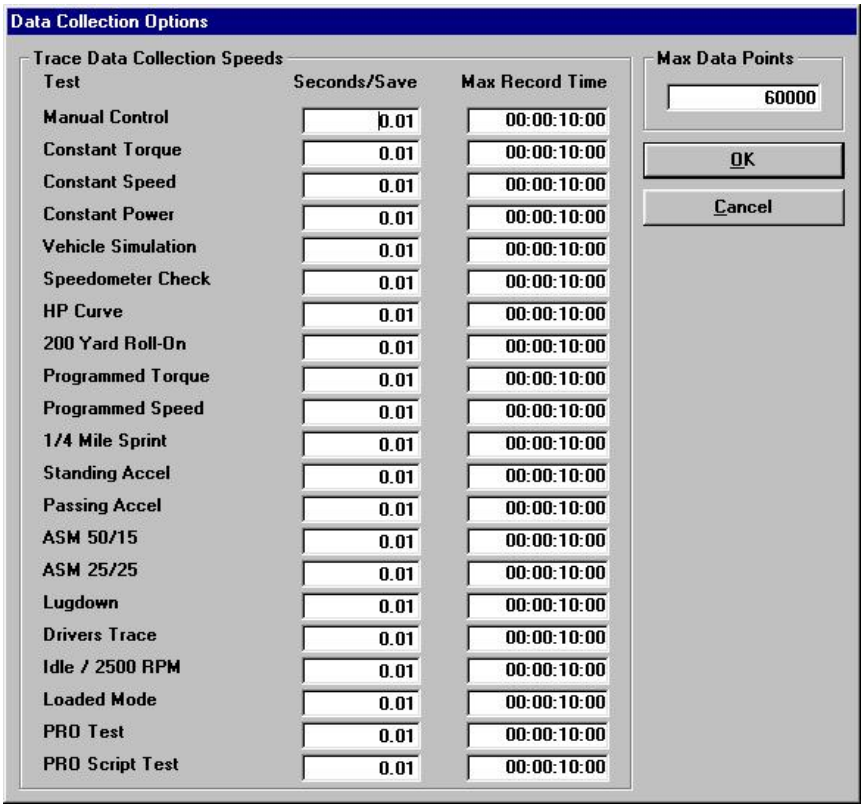
The operator can access the following menu item:

Menu Item	Description
Select Text	This menu item displays the "Test Result Picker" (please see FIGURE 9.9) so that the operator can select a test to view details for.

Edit Comments	This menu item displays the "Test Comment Editor" (please see FIGURE 9.12) so that the operator can view or edit the comments for the test.
Exit	Close out of the Drivers Trace Test Result Viewer.

Trace Data Collection Speed

This screen allows the operator to specify how frequently data points will be recorded during testing, if trace data collection is enabled.



For each test routine that the software supports, the operator may specify a recording rate for trace data collection, in terms of seconds per save. Based on the specified recording rate, the maximum trace data recording time is shown just to the right of the recording rate values. The maximum recording time also depends upon the maximum number of data points specified. This allows the operator to collect data at high speed during highly transient testing, while recording at much slower rates in durability type testing.

NOTE: The value for each test can be specified from the test form itself by pressing "<Ctrl>S".

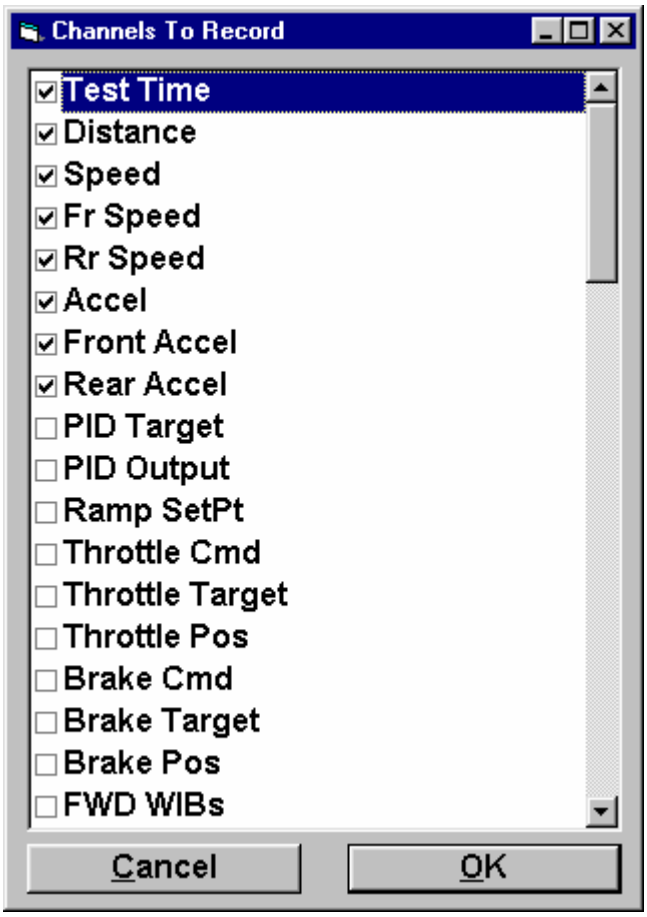
Fields	Description
Test	All the tests that the software supports.
Seconds/Save	The time between trace data points. This value can range from 0.01 (100 samples/second) up to 3600 (1 sample / hour).
Max Record Time	The maximum trace data recording time available, based on the specified recording rate and the specified maximum number of data points.

Max Data Points	The maximum number of data points that can/will be recorded. The operator may modify this value, although 6000 data points is normally more than enough. If a value that cannot be supported by the available memory (RAM) is entered, an error message will be displayed.

Channels To Record

This screen allows the operator to specify which trace data channels will be RECORDED in the trace data for each test performed in the future.

NOTE: This is different from the MD-7000 software package – the MD-7000 software always recorded every channel. PowerDynePC records ONLY the channels selected for recording using this form.

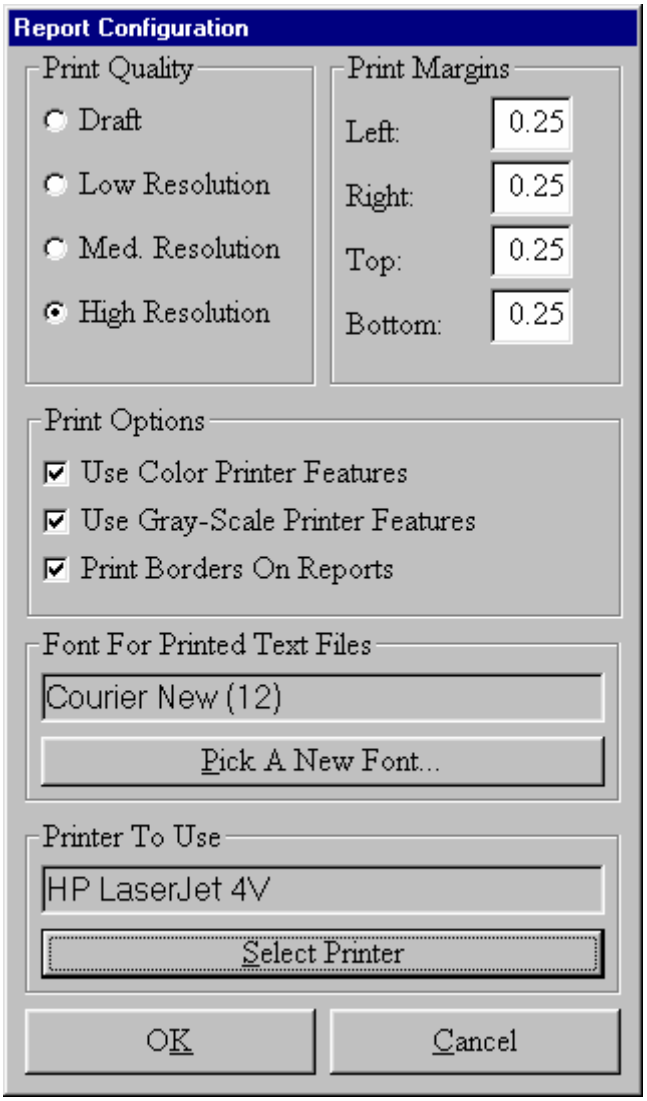


Note

This screen is accessible from the trace graph viewer screen; access to this screen from the Database menu is incidental and not recommended, also the channels displayed on this screen represent the left-mouse-button and right-mouse-button menus that can be used to select value for display on the main screen.

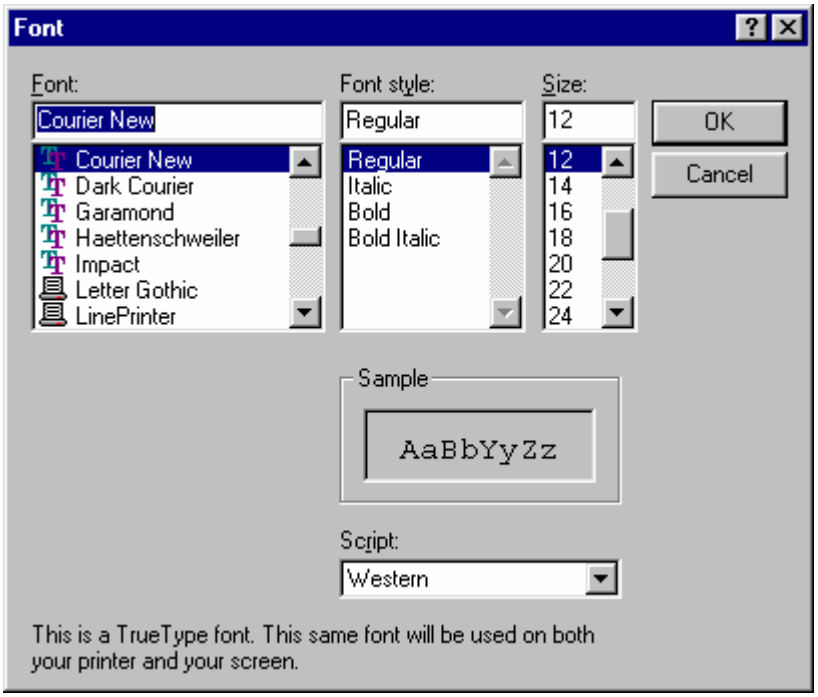
Report Page Layout

This screen allows the operator to specify certain formatting parameters for printed reports.

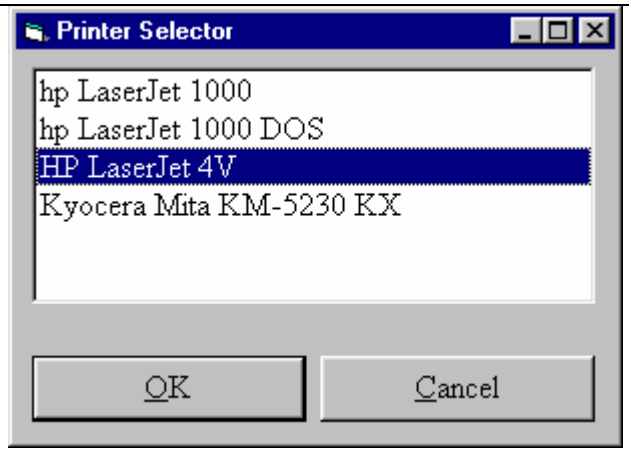


The following is a list of functions that the operator can perform from this screen:

Function	Description
Print Quality	The operator can select from several print quality settings. Higher print quality usually results in slower printing, whereas reduced print quality usually results in faster printing.
Print Margins	The Left, Right, Top and Bottom print margins can be set to correctly center printed reports on the paper.
Print Options	These options allow the operator to customize the printing of all test reports.

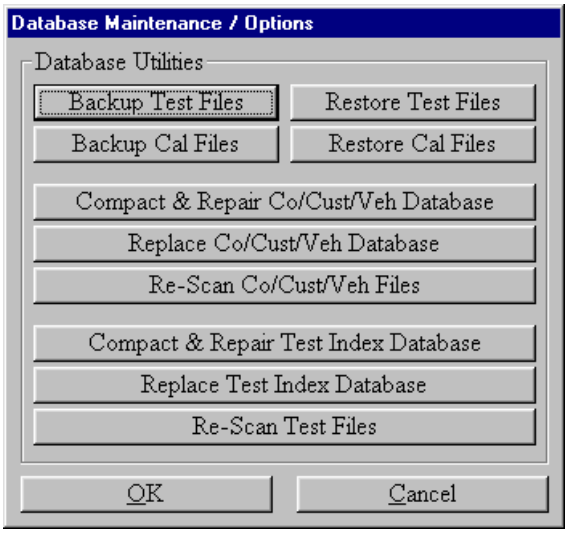
<table>
<tr><td></td><td>
<table>
<tr><th>Print Options</th><th>Description</th></tr>
<tr><td>Color Printer Features</td><td>If enabled, reports will print with various elements in color.</td></tr>
<tr><td>Use Gray-Scale Printer Features</td><td>If enabled, reports will print with various elements gray-scaled.</td></tr>
<tr><td>Print Borders On Reports</td><td>If enabled, a border box will be printed around all test reports.</td></tr>
</table>
</td></tr>
<tr><td>Font For Printed Text Files</td><td>The operator can specify the font used when printing simple text files. The following dialog box will display when the operator presses the button “Pick A New Font”:
 

The operator can use this dialog box to select from all the possible fonts that are on the computer.</td></tr>
<tr><td>Printer To Use</td><td>This button displays the following dialog box that allows the operator to select which printer to use when printing reports, test reports or text files.</td></tr>
</table>


Printer Selector
hp LaserJet 1000
hp LaserJet 1000 DOS
HP LaserJet 4V
Kyocera Mita KM-5230 KX
OK
Cancel

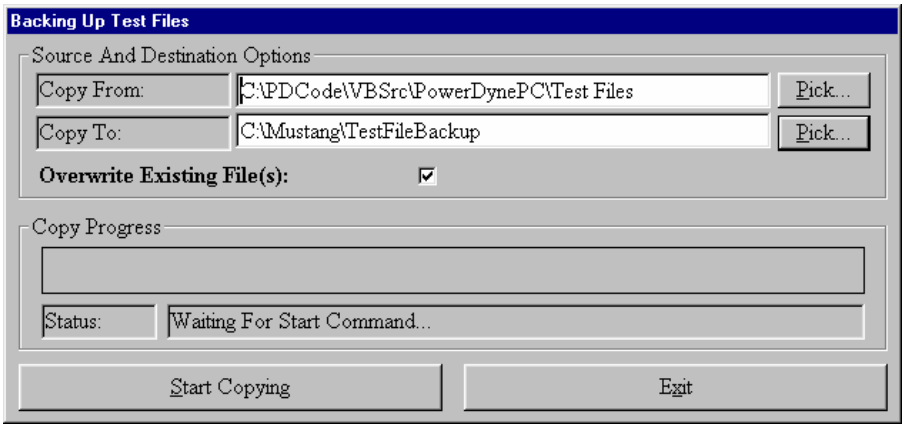
Database Utilities and Options

This screen allows the operator access to the various database related utilities and options.



Backup Test Files

The operator can select this option when they want to backup test files, when they do this the following screen will display:

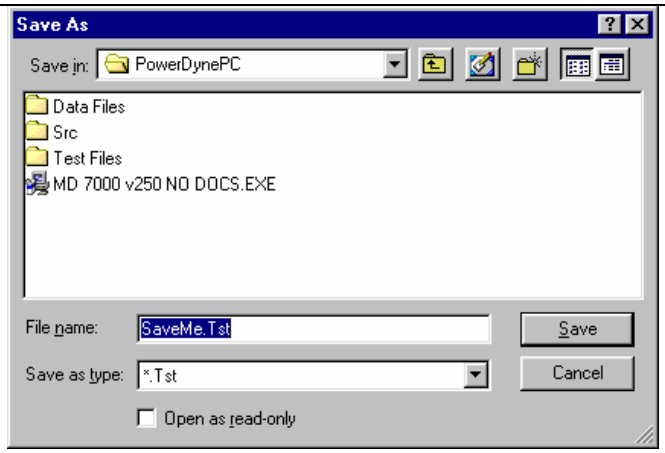


> **Note**
>
> Regular use of this utility will protect your vehicle test data from hardware failure, power outages, virus attacks, etc.

The operator will press the "Start Copying" button after they have setup their source and destination options to start the backup. Once the operator has finished, and then they will press the "Exit" button to close out of this screen.

Source And Destination Options

Option	Description
Copy From	The location where you test results files are stored. This will normally be "C:\Mustang\Chassis\PowerDynePC\Test Files", but can be something else if the software was not installed to the default location.
Copy To	The directory to which your test files will be backed-up. This can be any directory that is NOT located under the "Copy From" directory – a file server, a FLASH USB key, etc.
Overwrite Existing Files	If set, any existing files in the backup-to directory will be overwritten with newer versions. If not set, the operator will be prompted before any files are overwritten.
Pick Button	The operator will press this button to display the following dialog box:



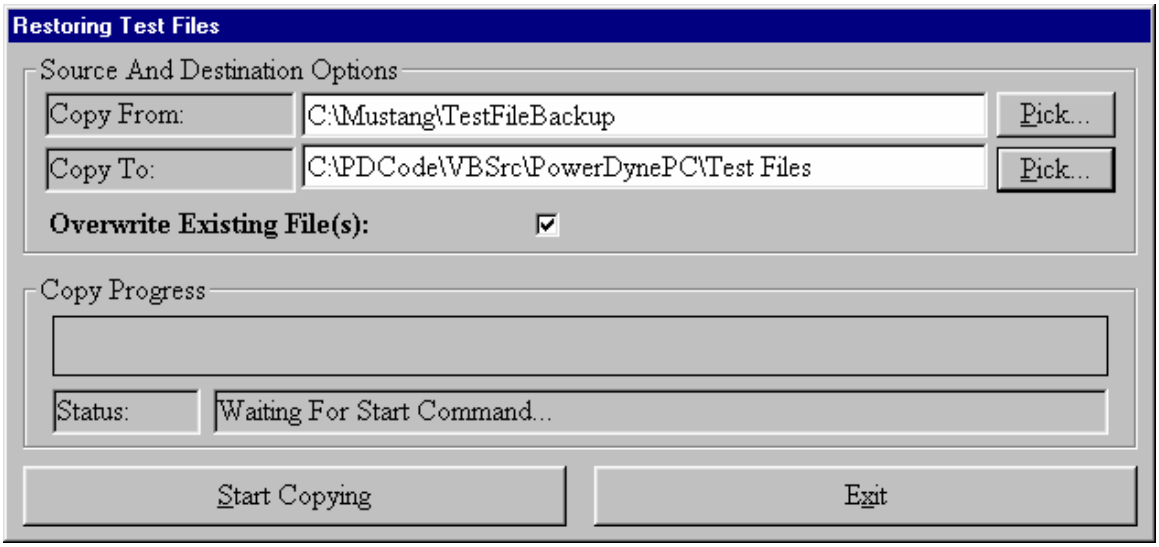
The operator can use this dialog box to "point and click" on a folder to backup test files to.

Copy Progress

Option	Description
Status Bar	The status bar indicates to the operator the status of the copy process.
Status	Indicates the status of the copy process, by default the status will say "Waiting For Start Command" that indicates that the prompt is waiting on the operator to press the "Start Copying" button. As the copying is taking place then the status will change to indicate the file that is being copied: "Copying File '...'". When the copying is complete, then the status will change to "Done...".

Restore Test Files

The operator can select this option when they want to restore test files, when they do this the following screen will display:



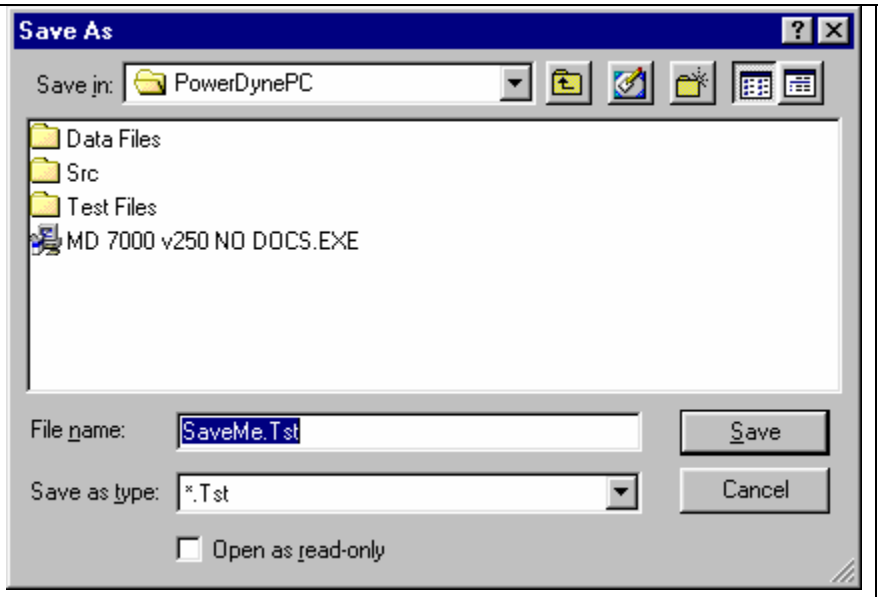
Note

This can be used to restore lost or corrupted test data files from existing Backup source directories.

The operator will press the "Start Copying" button after they have setup their source and destination options to start the restore. Once the operator has finished, and then they will press the "Exit" button to close out of this screen.

Source And Destination Options

Option	Description
Copy From	The directory from which your test files will be restored. You can select any existing backup directory to restore from using the "Pick..." button.
Copy To	The location where you test results files are stored. This will normally be "C:\Mustang\Chassis\PowerDynePC\Test Files", but can be something else if the software was not installed to the default location.
Overwrite Existing Files	If set, any existing files in the restore-to directory will be overwritten with backup versions. If not set, the operator will be prompted before any files are overwritten.
Pick Button	The operator will press this button to display the following dialog box:

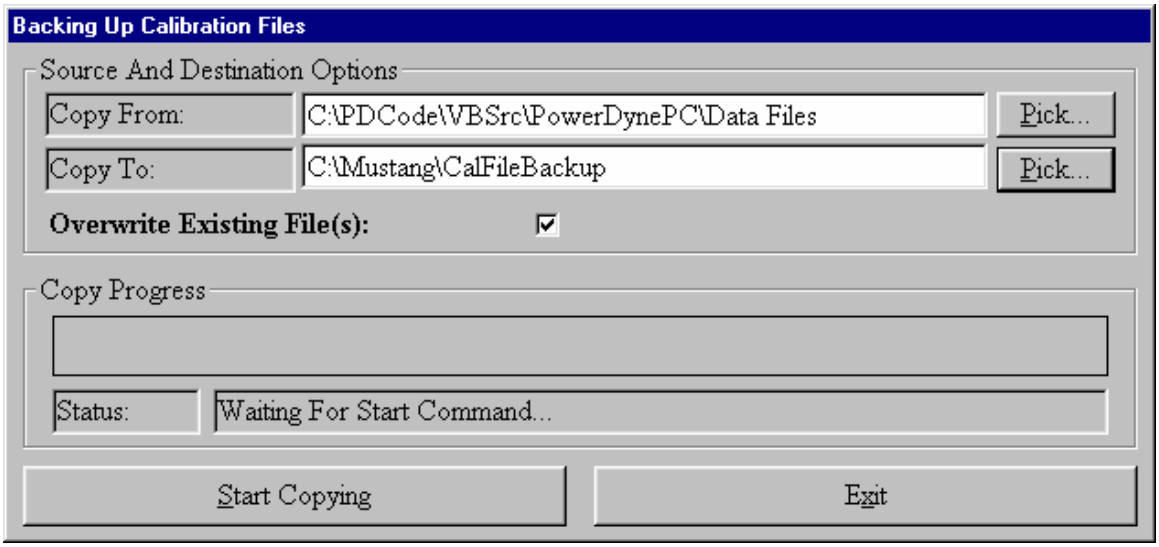
	 The operator can use this dialog box to "point and click" on a folder to backup test files to.

Copy Progress

Option	Description
Status Bar	The status bar indicates to the operator the status of the copy process.
Status	Indicates the status of the copy process, by default the status will say "Waiting For Start Command" that indicates that the prompt is waiting on the operator to press the "Start Copying" button. As the copying is taking place then the status will change to indicate the file that is being copied: "Copying File '...'". When the copying is complete, then the status will change to "Done..."

Backup Cal Files

The operator can select this option when they want to backup calibration files, when they do this the following screen will display:



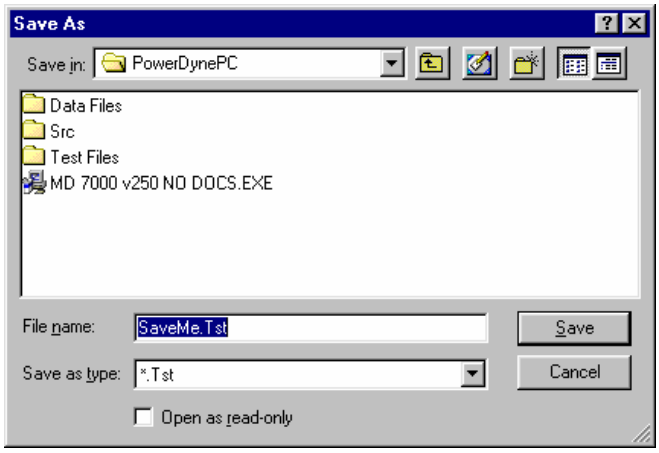
Note

Regular use of this utility will protect your calibration data from hardware failure, power outages, virus attacks, etc.

The operator will press the "Start Copying" button after they have setup their source and destination options to start the backup. Once the operator has finished, and then they will press the "Exit" button to close out of this screen.

Source And Destination Options

Option	Description
Copy From	The location where you calibration files are stored. This will normally be "C:\Mustang\Chassis\PowerDynePC\Data Files", but can be something else if the software was not installed to the default location.
Copy To	The directory to which your calibration files will be backed-up. This can be any directory that is NOT located under the "Copy From" directory – a file server, a FLASH USB key, etc.
Overwrite Existing Files	If set, any existing files in the backup-to directory will be overwritten with newer versions. If not set, the operator will be prompted before any files are overwritten.

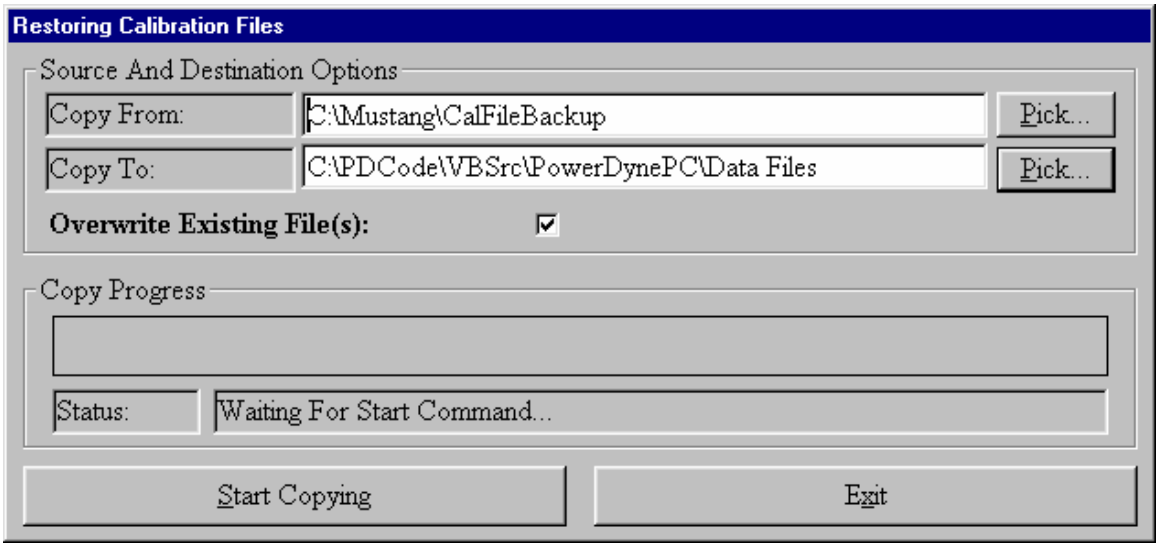
Pick Button	The operator will press this button to display the following dialog box:  The operator can use this dialog box to "point and click" on a folder to backup test files to.

Copy Progress

Option	Description
Status Bar	The status bar indicates to the operator the status of the copy process.
Status	Indicates the status of the copy process, by default the status will say "Waiting For Start Command" that indicates that the prompt is waiting on the operator to press the "Start Copying" button. As the copying is taking place then the status will change to indicate the file that is being copied: "Copying File '...'". When the copying is complete, then the status will change to "Done...".

Restore Call Files

The operator can select this option when they want to restore calibration files, when they do this the following screen will display:



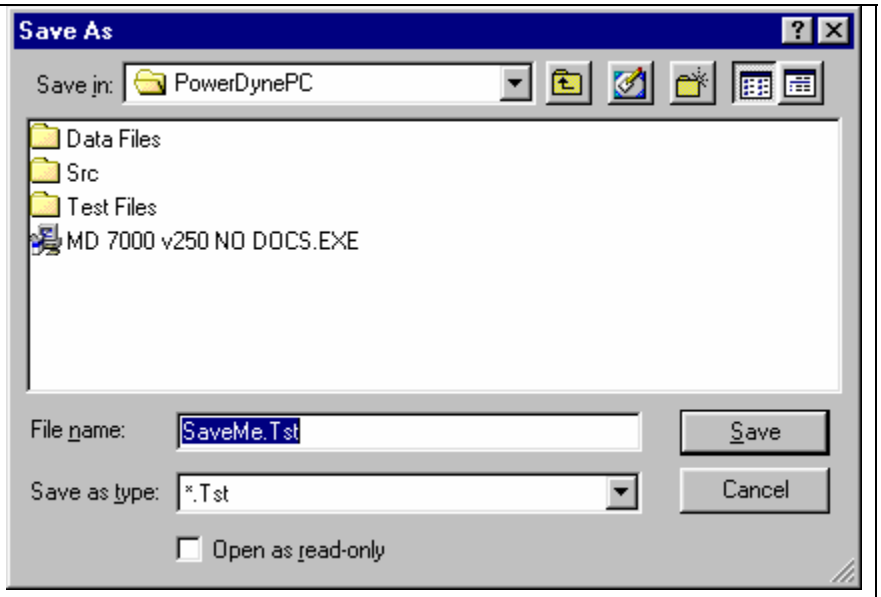
Note

This can be used to restore lost or corrupted calibration data files from existing Backup source directories.

The operator will press the "Start Copying" button after they have setup their source and destination options to start the restore. Once the operator has finished, and then they will press the "Exit" button to close out of this screen.

Source And Destination Options

Option	Description
Copy From	The directory from which your calibration files will be restored. You can select any existing backup directory to restore from using the "Pick..." button.
Copy To	The location where you calibration files are stored. This will normally be "C:\Mustang\Chassis\PowerDynePC\Data Files", but can be something else if the software was not installed to the default location.
Overwrite Existing Files	If set, any existing files in the restore-to directory will be overwritten with backup versions. If not set, the operator will be prompted before any files are overwritten.
Pick Button	The operator will press this button to display the following dialog box:

	 The operator can use this dialog box to "point and click" on a folder to backup test files to.

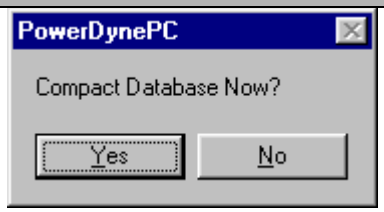
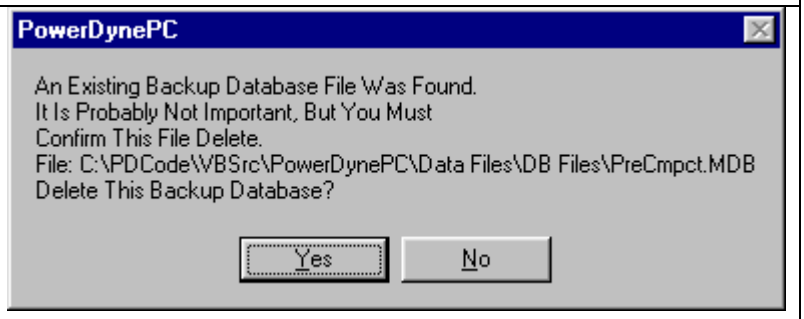
Copy Progress

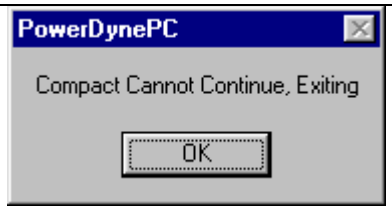
Option	Description
Status Bar	The status bar indicates to the operator the status of the copy process.
Status	Indicates the status of the copy process, by default the status will say "Waiting For Start Command" that indicates that the prompt is waiting on the operator to press the "Start Copying" button. As the copying is taking place then the status will change to indicate the file that is being copied: "Copying File '...'". When the copying is complete, then the status will change to "Done..."

Compact & Repair Co/Cust/Veh Database

This button allows the operator to access the Compact & Repair database utilities for the Company/Customer/Vehicle Database. These utilities can be used to repair a corrupted database, or compact your database following the deletion of unwanted records.

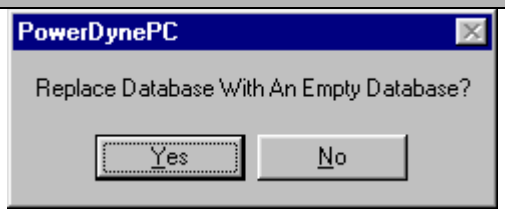
> **Note**
>
> It is important to compact your database following the deletion of any large number of records, since the database does not actually release unused disk space until the compact utility is run.

Description	Prompt
The operator will first be prompted if they should want to compact the database, If they press the "No" button then the prompt will disappear, otherwise if they press the "Yes" button then the next prompt will display.	
The operator will be prompted to confirm the deletion of a file, if they chose to delete this file by press the "Yes" button then the file will be deleted, and a prompt will display notifying the operator that the compaction was successful. **Note** It is important to delete this backup database file in order for the compaction to be successful!	
If the operator chose to delete the file (C:\Mustang\Chassis\PowerDynePC\Data Files\DB Files\PreCmpt.MDB") by pressing the "Yes" button, then the file will be deleted, and the following prompt will display notifying the operator that the	

compaction was successful.	
If the operator chose not to delete the file by pressing the "No" button, then the following two prompt will be displayed notifying the operator that compaction was not successful.	 

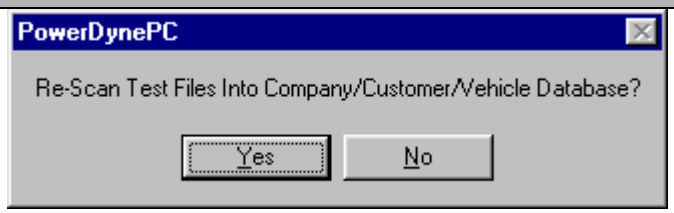
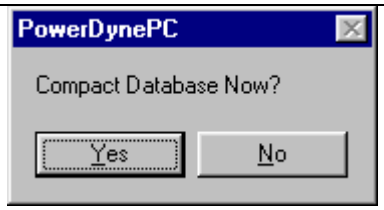
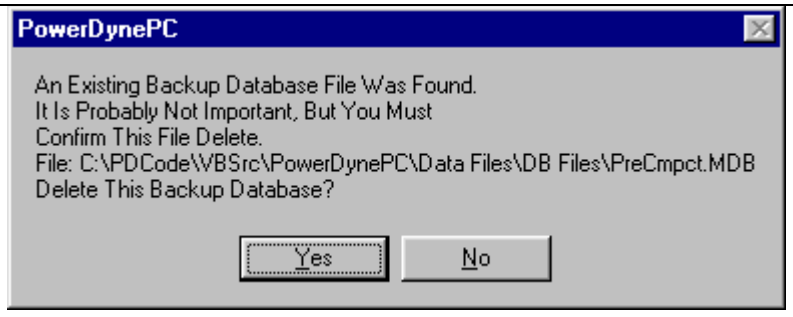
Replace Co/Cust/Veh Database

This button allows the operator to replace the Company/Customer/Vehicle database with a blank one. This is a recovery option used in the even that the database becomes so corrupt that it cannot be repaired.

Prompt	Description
If the operator presses the "No" button then the prompt will disappear and no file replacement will take place, If on the other hand the operator presses the "Yes" button then the Company/Customer/Vehicle database file will be replaced with an empty one	
A message will be displayed notifying the operator that the replacement was successful.	
If the replacement could not take place then the following error message will display notifying the operator that the replacement did not take place.	

Re-Scan Co/Cust/Veh Files

This function will scan all existing test records to re-build the Companies/Customers/Vehicles database, normally only used after replacing the database with a blank copy due to a database problem. All Companies/Cutomers/Vehicles referenced in the test results files will be restored to the database.

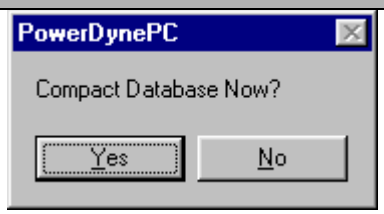
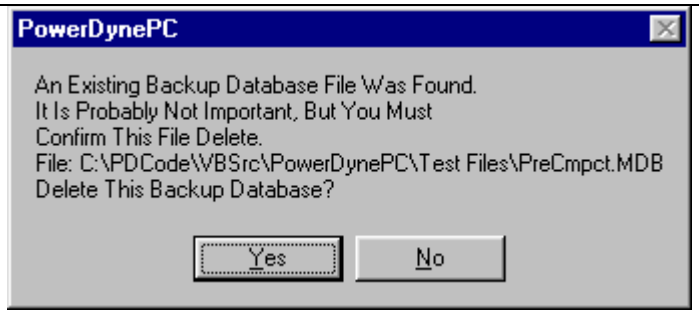
Description	Prompt
The operator will be prompted to Re-Scan the test files or not. If the operator presses the "No" button then the screen will disappear and no Re-Scan will take place.	
If on the other hand the "Yes" button is pressed, then the operator will be prompted to compact the database before Re-Scanning can take place. If the operator presses the "No" button then no database compaction will take place and thus no Re-Scan will take place.	
If the operator presses the "Yes" button then they will be prompted to delete a database backup file.	

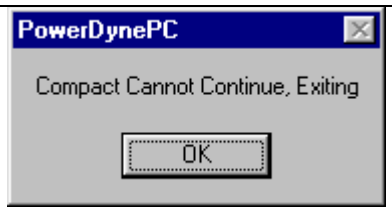
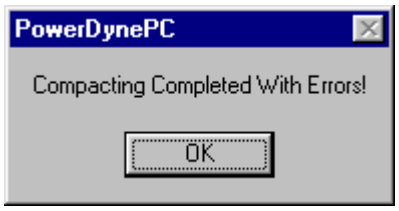
If the compaction was successful then the following prompt will be displayed to the operator.	
After the database compaction has taken place then the test data files will be Re-Scan and the Index database built, after that is done then the following prompt will display notifying the operator that the Re-Scan was successful.	

Compact & Repair Test Index Database

This button allows the operator to access the Compact & Repair database utilities for the Test Database. These utilities can be used to repair a corrupted database, or compact your database following the deletion of unwanted records.

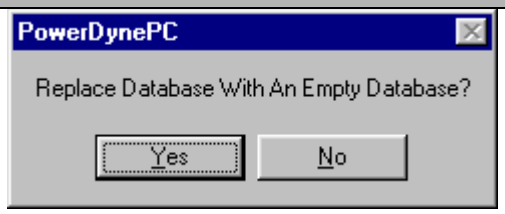
> **Note**
>
> It is important to compact your database following the deletion of any large number of records, since the database does not actually release unused disk space until the compact utility is run.

Description	Prompt
The operator will first be prompted if they should want to compact the database, If they press the "No" button then the prompt will disappear, otherwise if they press the "Yes" button then the next prompt will display.	
The operator will be prompted to confirm the deletion of a file, if they chose to delete this file by press the "Yes" button then the file will be deleted, and a prompt will display notifying the operator that the compaction was successful. **Note** It is important to delete this backup database file in order for the compaction to be successful!	
If the operator chose to delete the file (C:\Mustang\Chassis\PowerDynePC\Data Files\PreCmpt.MDB") by pressing the "Yes" button, then the file will be deleted, and the following prompt will display notifying the operator that the compaction was successful.	

If the operator chose not to delete the file by pressing the "No" button, then the following two prompt will be displayed notifying the operator that compaction was not successful.	 

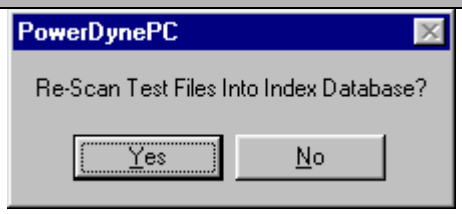
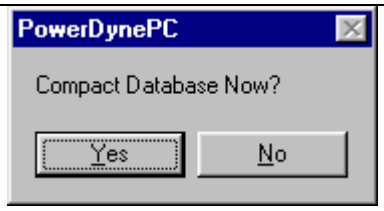
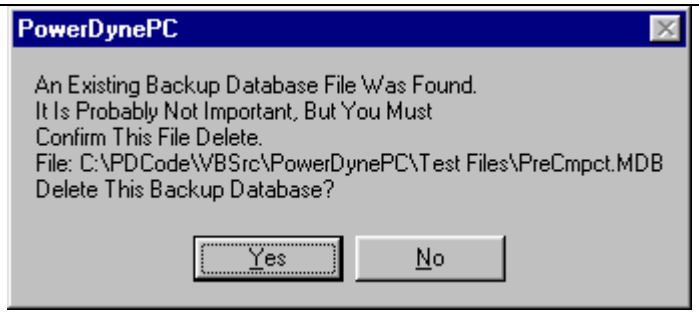
Replace Test Index Database

This button allows the operator to replace the test results index database with a blank one. This is a recovery option used in the even that the database becomes so corrupt that it cannot be repaired.

Prompt	Description
If the operator presses the "No" button then the prompt will disappear and no file replacement will take place, If on the other hand the operator presses the "Yes" button then the Test database file will be replaced with an empty one	
A message will be displayed notifying the operator that the replacement was successful.	
If the replacement could not take place then the following error message will display notifying the operator that the replacement did not take place.	

Re-Scan Test Files

This function will scan all existing test records to re-build the test index database, normally only used after replacing the database with a blank copy due to a database problem. All test results files will be restored to the database.

Description	Prompt
The operator will be prompted to Re-Scan the test files or not. If the operator presses the "No" button then the screen will disappear and no Re-Scan will take place.	
If on the other hand the "Yes" button is pressed, then the operator will be prompted to compact the database before Re-Scanning can take place. If the operator presses the "No" button then no database compaction will take place and thus no Re-Scan will take place.	
If the operator presses the "Yes" button then they will be prompted to delete a database backup file.	
If the compaction was successful then the following prompt will be displayed to the operator.	

After the database compaction has taken place then the test data files will be Re-Scan and the Index database built, after that is done then the following prompt will display notifying the operator that the Re-Scan was successful.		

Chapter

11

Test Menu

The Test menu allows access to the various vehicle-testing routines. The vehicle testing routines are broken down into four (4) main groups. Each group of test types is available from the associated sub-menu; please refer to the following table:

<table>
<tr><th>Menu</th><th>Description</th></tr>
<tr><td>Diagnostics</td><td>This menu allows access to the diagnostic vehicle testing routines.
<table>
<tr><th>Menu</th><th>Description</th></tr>
<tr><td>Manual Loading Test</td><td>This test allows the operator to apply a manually controlled load to the vehicle.</td></tr>
<tr><td>Constant Force Test</td><td>This test allows the operator to apply a controlled constant force loading to the vehicle.</td></tr>
<tr><td>Constant Speed Test</td><td>This test allows the operator to hold the vehicle's speed at a constant value.</td></tr>
<tr><td>Constant Horsepower Test</td><td>This test allows the operator to apply a constant power loading to the vehicle.</td></tr>
<tr><td>Vehicle Simulation Test</td><td>This test allows the operator to apply a vehicle simulation loading to the vehicle.</td></tr>
<tr><td>PRO Test</td><td>This test allows the operator to apply any of the loading modes described above, changing modes as desired.</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><td></td><td>
<table>
<tr><td>Speedometer Check Test</td><td>This test allows the operator to check the accuracy of the vehicle's speedometer.</td></tr>
</table>
</td></tr>
<tr><td>Performance</td><td>This menu allows access to the performance vehicle testing routines.
<table>
<tr><th>Menu</th><th>Description</th></tr>
<tr><td>Power Curve</td><td>This test allows the operator to perform a controlled sweep rate type power curve test on the vehicle.</td></tr>
<tr><td>Programmed Force</td><td>This test allows the operator to apply a time-based force loading profile to the vehicle.</td></tr>
<tr><td>Programmed Force Editor</td><td>This screen allows the operator to edit/create time-based force loading profiles.</td></tr>
<tr><td>Programmed Speed</td><td>This test allows the operator to apply a time-based speed control to the vehicle.</td></tr>
<tr><td>Programmed Speed Editor</td><td>This screen allows the operator to edit/create time-based speed control profiles.</td></tr>
<tr><td>PRO Test Script</td><td>This test allows the operator to execute any stored PRO Test Script routine.</td></tr>
<tr><td>PRO Test Script Editor</td><td>This screen allows the operator toe edit/create scripts for the PRO Test Script routine.</td></tr>
</table>
</td></tr>
<tr><td>Timing</td><td>This menu allows access to the timing-type vehicle testing</td></tr>
</table>

<table>
<tr><td></td><td>routines.
<table><tr><th>Menu</th><th>Description</th></tr><tr><td>Quarter Mile Sprint</td><td>This test allows the operator to simulate a 1/4-mile sprint race with the vehicle.</td></tr><tr><td>Standing Start Acceleration</td><td>This test allows the operator to simulate a 0-60 type standing start acceleration run with the vehicle.</td></tr><tr><td>Passing Acceleration</td><td>This test allows the operator to simulate a 50-70 type passing acceleration run with the vehicle.</td></tr><tr><td>200 Yard Roll-On</td><td>This test allows the operator to simulate a 200-yard roll-on acceleration run with the vehicle.</td></tr></table></td></tr>
<tr><td>Emissions</td><td>This menu allows access to the emissions vehicle testing routines.
<table><tr><th>Menu</th><th>Description</th></tr><tr><td>Drivers Trace (IM240/FTP/etc)</td><td>This test allows the operator to perform a (non-certified) IM-240/FTP/etc. type transient emissions test.</td></tr><tr><td>ASM 50/15</td><td>This test allows the operator to perform a (non-certified) ASM 50/15 type emissions test.</td></tr><tr><td>ASM 25/25</td><td>This test allows the operator to perform a (non-certified) ASM 25/25 type emissions test.</td></tr></table></td></tr>
</table>

<table>
<tr><td></td><td>
<table>
<tr><td>Loaded Mode</td><td>This test allows the operator to perform a (non-certified) loaded mode type emissions test.</td></tr>
<tr><td>Idle / 2500 RPM</td><td>This test allows the operator to perform a (non-certified) idle/2500 RPM type emissions test.</td></tr>
<tr><td>Lug down</td><td>This test allows the operator to perform a (non-certified) diesel lug-down exhaust opacity test.</td></tr>
</table>
</td></tr>
<tr><td>PID Values -> Dyno PID Values</td><td>This screen allows the operator to specify PID, ramping and step-size values for the various control modes of the dyno.

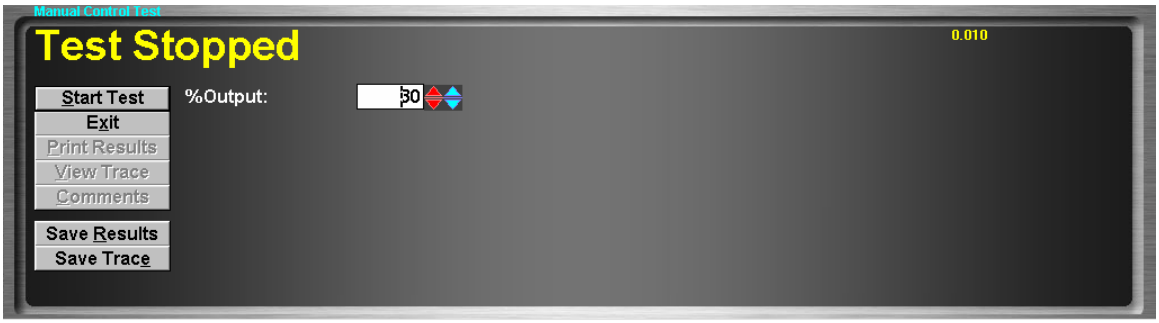
NOTE: Unlike the MD-7000 software, the PowerDynePC software does not maintain different PID values for every test mode – there are now only two sets of PID values, one for each <u>basic</u> control mode (torque (load) control, and speed control). Ramping control is available for each <u>actual</u> control mode (manual, force, power, speed, acceleration, engine RPM – vehicle simulation does not use ramping).</td></tr>
<tr><td>PID Values -> Throttle Controller PID Values</td><td>This screen allows the operator to specify PID, ramping and step-size values for the various control modes of the (optional) throttle controller.</td></tr>
<tr><td>PID Values -> Brake Controller PID Values</td><td>This screen allows the operator to specify PID, ramping and step-size values for the various control modes of the (optional) brake controller.</td></tr>
</table>

In each of the testing modes, several functions are available via "hot keys", as described below:

Hot Key	Function
<Ctrl>S	Lets the operator see/edit the graph data recording rate, using a small pop-up window that shows the current recording time period, and lets the operator specify a new (or the same) recording time period.
<Ctrl>P	Pops up the PID, ramp rate and step-size values editor for the dynamometer.
<Ctrl>C	Pops up the channels-to-record selection list, to specify which channels should be recorded in the graph data for future tests.
<Ctrl>E	In the PRO Script Test only, brings up the PRO Script editing screen.

Manual Loading Test

This test allows the operator to apply a manually controlled load to the vehicle.



Purpose

The Manual Control Test allows the operator to apply a manually controlled load to the vehicle under test. This routine is useful for very simple testing, and as a diagnostic tool for verifying correct functioning of the dynamometer control system.

Intended Test Procedure

This test has no fixed ending time or structure. The vehicle is simply driven under the desired loading. The general testing procedure is outlined below.

- The "% Output" field should be set to a relatively low value to avoid suddenly applying a jarring load to the vehicle when the test is started.
- The "Save Results" and "Save Trace" check boxes should be set appropriately.
- The "Start Test" button is clicked.
- The vehicle is driven under load.
- The "Stop Test" button is clicked, and the test terminates.
- Any saved test results may be viewed and/or a test report printed.

Results Obtained

If the "Save Results" check box is checked, a record that this type of test was performed on the currently selected vehicle, along with the date and time the test was performed and any comments about the test session, is saved to the application's database.

For this test type, the following additional information is saved as part of the final test results record:

- (None)

If the "Save Trace" check box is checked, this test generates strip-chart style trace data for all input channels, at the sampling speed specified in the "Trace Data Collection Speed" screen found under the database menu.

Note

Trace data cannot be saved unless the "Save Results" check box is checked along with the "Save Trace" check box.

Special Considerations for This Test

You should make sure that the output setting is not too high when starting a test, as the vehicle under test may be violently loaded or bogged down.

Constant Force Test

This test allows the operator to apply a controlled constant force loading to the vehicle.

Purpose

The Constant Force Test allows the operator to drive the vehicle under a constant, calibrated force. This routine is useful for very simple testing, and for PID loop tuning.

Intended Test Procedure

This test has no fixed ending time or structure. The vehicle is simply driven under the desired loading.

The general testing procedure is outlined below.

- The "Target Force" field should be set to a relatively low value to avoid suddenly applying a jarring load to the vehicle when the test is started.
- The "Save Results" and "Save Trace" check boxes should be set appropriately.
- The "Start Test" button is clicked.
- The vehicle is driven under load.
- The "Stop Test" button is clicked, and the test terminates.
- Any saved test results may be viewed and/or a test report printed.

Results Obtained

If the "Save Results" check box is checked, a record that this type of test was performed on the currently selected vehicle, along with the date and time the test was performed and any comments about the test session, is saved to the application's database.

For this test type, the following additional information is saved as part of the final test results record:

- (None)

If the "Save Trace" check box is checked, this test generates strip-chart style trace data for all input channels, at the sampling speed specified in the "Trace Data Collection Speed" screen found under the database menu.

Note

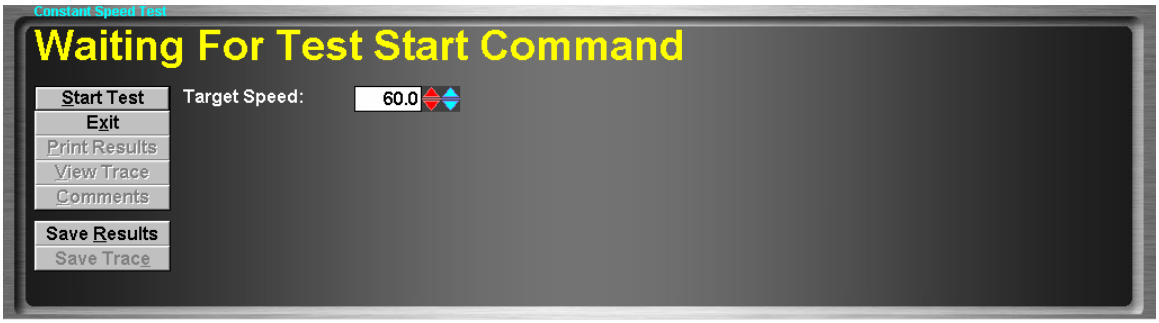
Trace data cannot be saved unless the "Save Results" check box is checked along with the "Save Trace" check box..

Special Considerations for This Test

The "Target Force" value should not be too high when the test is started, to avoid suddenly applying a jarring load to the vehicle when the test is started.

Constant Speed Test

This test allows the operator to hold the vehicle's speed at a constant value.



Purpose

The Constant Speed Test allows the operator to hold the vehicle at a specific speed. This test is useful for full-throttle tuning at specific speeds, durability testing, and PID loop tuning.

Intended Test Procedure

This test has no fixed ending time or structure. The vehicle is simply driven at the specified speed, regardless of throttle position. The general testing procedure is outlined below.

- The "Target Speed" field should be set to a value higher speed than the vehicle is operating at to avoid suddenly applying a jarring load to the vehicle when the test is started.
- The "Save Results" and "Save Trace" check boxes should be set appropriately.
- The "Start Test" button is clicked.
- The vehicle is driven under load.
- The "Stop Test" button is clicked, and the test terminates.
- Any saved test results may be viewed and/or a test report printed.

Results Obtained

If the "Save Results" check box is checked, a record that this type of test was performed on the currently selected vehicle, along with the date and time the test was performed and any comments about the test session, is saved to the application's database.

For this test type, the following additional information is saved as part of the final test results record:

- (None)

If the "Save Trace" check box is checked, this test generates strip-chart style trace data for all input channels, at the sampling speed specified in the "Trace Data Collection Speed" screen found under the database menu.

Note

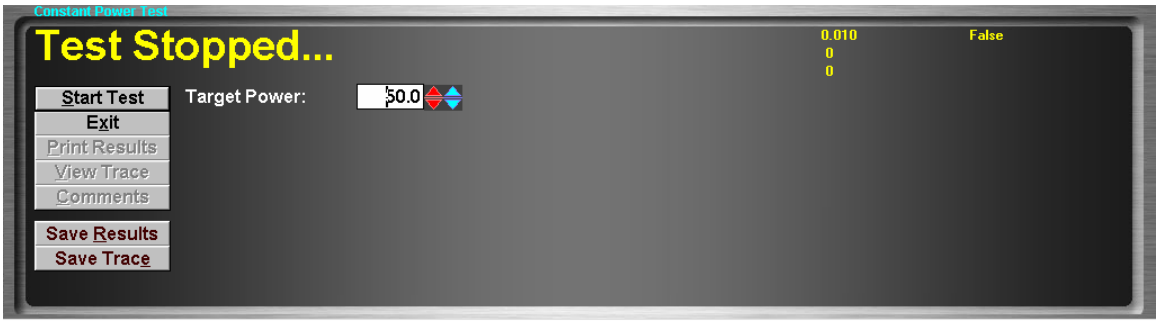
Trace data cannot be saved unless the "Save Results" check box is checked along with the "Save Trace" check box.

Special Considerations for This Test

You should not start this test with a "Target Speed" value that is less than the current speed of the vehicle to avoid sudden jarring loading of the vehicle when the test is started.

Constant Horsepower Test

This test allows the operator to apply a constant power loading to the vehicle.



Purpose

The Constant Power Test allows the operator to test the vehicle with a constant power loading applied. This test has limited usefulness for most customers, but may be of use to some very specialized tuners.

Intended Test Procedure

This test has no fixed ending time or structure. The vehicle is simply driven under the desired loading. The general testing procedure is outlined below.

- The "Target Power" field should be set to a relatively low value to avoid suddenly applying a jarring load to the vehicle when the test is started.
- The "Save Results" and "Save Trace" check boxes should be set appropriately.
- The "Start Test" button is clicked.
- The vehicle is driven under load.
- The "Stop Test" button is clicked, and the test terminates.
- Any saved test results may be viewed and/or a test report printed.

Results Obtained

If the "Save Results" check box is checked, a record that this type of test was performed on the currently selected vehicle, along with the date and time the test was performed and any comments about the test session, is saved to the application's database.

For this test type, the following additional information is saved as part of the final test results record:

- (None)

If the "Save Trace" check box is checked, this test generates strip-chart style trace data for all input channels, at the sampling speed specified in the "Trace Data Collection Speed" screen found under the database menu.

Note

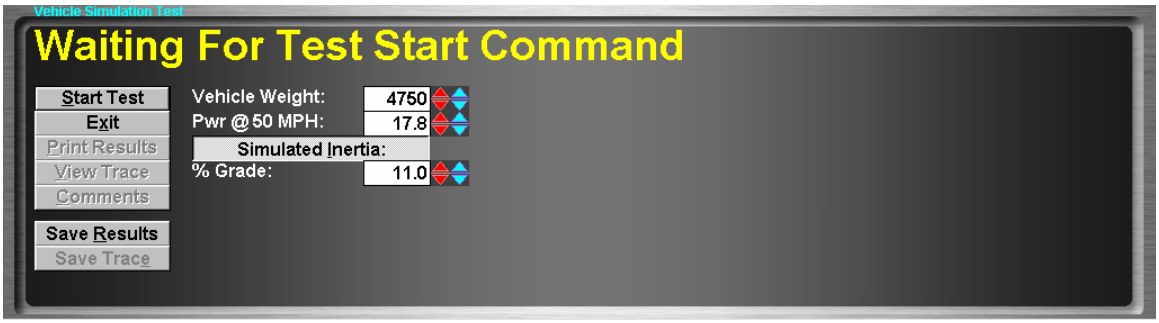
Trace data cannot be saved unless the "Save Results" check box is checked along with the "Save Trace" check box.

Special Considerations for This Test

The "Target Power" field should not be set to too high a value when the test is started to avoid applying a sudden jarring load to the vehicle when the test is started.

Vehicle Simulation Test

This test allows the operator to apply a vehicle simulation loading to the vehicle.



Purpose

The Vehicle Simulation Test allows the operator to drive the vehicle on the dynamometer with the same loading that the vehicle would experience on the road. This test is useful for performing road tests on the dynamometer and for diagnosing cruise-speed problems.

Intended Test Procedure

This test has no fixed ending time or structure. The vehicle is simply driven under the desired loading. The general testing procedure is outlined below.

- The "Vehicle Weight" field will default to the weight entered for the vehicle currently selected for testing. The operator may change this weight if desired.
- The "Pwr @ 50 MPH" field will default to the value entered for the vehicle currently selected for testing. The operator may change this value if desired.
- The "Simulated Inertia" check box determines whether inertia simulation will be used or not. Mustang Dynamometer recommends that this option always be used.
- The "% Grade" field will default to the most recently used value. The operator may adjust this value while the test is running to simulate different road grade values.
- The "Save Results" and "Save Trace" check boxes should be set appropriately.
- The "Start Test" button is clicked.
- The vehicle is driven under load.
- The "Stop Test" button is clicked, and the test terminates.
- Any saved test results may be viewed and/or a test report printed.

Results Obtained

If the "Save Results" check box is checked, a record that this type of test was performed on the currently selected vehicle, along with the date and time the test was performed and any comments about the test session, is saved to the application's database.

For this test type, the following additional information is saved as part of the final test results record:

- (None)

If the "Save Trace" check box is checked, this test generates strip-chart style trace data for all input channels, at the sampling speed specified in the "Trace Data Collection Speed" screen found under the database menu.

Note

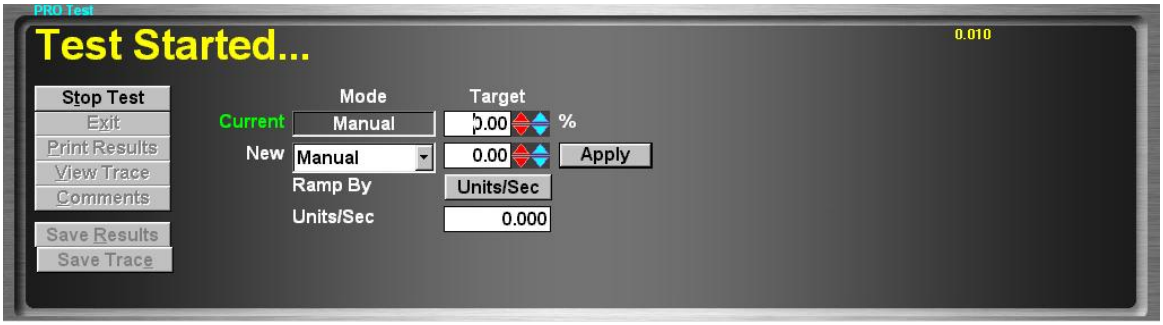
Trace data cannot be saved unless the "Save Results" check box is checked along with the "Save Trace" check box.

Special Considerations for This Test

The test should not be started with high "% Grade" values, or at very high speeds, in order to avoid applying sudden jarring loads to the vehicle when the test is started.

PRO Test

This test allows the operator to apply any of the loading modes described above to the vehicle – the loading mode can be changed at any time.



Purpose

The PRO Test allows the operator to drive the vehicle on the dynamometer with any of the loading modes described in the previous test routines. Although this routine provides access to all of the various loading modes, it is best used in situations where the operator needs to switch between loading modes without stopping the vehicle test between modes.

Intended Test Procedure

This test has no fixed ending time or structure. The vehicle is simply driven under the desired loading. The general testing procedure is outlined below.

1) The operator must start the test routine, with the dyno load controller turned off.

2) The operator must select a loading mode, specify a target value and ramping values, and press "Apply" (or hit "Enter").

3) The dyno load controller will switch to the specified mode, with the specified target and ramping values, and the cursor will move to the "Current" "Target" field, which can then be adjusted using the Up/Down and <Ctrl>Up/<Ctrl>Down buttons in step sizes selected for the current mode in the dyno PID/Ramping/Step Size form.

4) When in vehicle simulation mode, the "Current" "Target" field represents road grade in percent.

For all loading modes except vehicle simulation, the following fields will be displayed:

- The "Target" field, used to specify the target loading value for the selected mode.
- The "Ramp By" field, used to select either "Units/Sec" or "Fixed Time" mode ramping control. For either mode, a "Units/Sec" field value of "0" means to not use ramping, ie to move to the next loading value as quickly as possible.
- The "Units/Sec" field, used to specify either a) the number of units to ramp the loading value at per second (eg MPH/Second, Pounds/Second, etc) or b) The number of seconds over which the loading target should be ramped from the current value to the new value, regardless of the step size involved.

For vehicle simulation mode, the following fields will be displayed:

- The "Vehicle Weight" field will default to the weight entered for the vehicle currently selected for testing. The operator may change this weight if desired.
- The "Pwr @ 50 MPH" field will default to the value entered for the vehicle currently selected for testing. The operator may change this value if desired.
- The "Simulated Inertia" check box determines whether inertia simulation will be used or not. Mustang Dynamometer recommends that this option always be used.
- The "% Grade" field will default to the most recently used value. The operator may adjust this value while the test is running to simulate different road grade values.

- The "Save Results" and "Save Trace" check boxes should be set appropriately.
- The "Start Test" button is clicked.
- The vehicle is driven under load.
- The "Stop Test" button is clicked, and the test terminates.
- Any saved test results may be viewed and/or a test report printed.

Results Obtained

If the "Save Results" check box is checked, a record that this type of test was performed on the currently selected vehicle, along with the date and time the test was performed and any comments about the test session, is saved to the application's database.

For this test type, the following additional information is saved as part of the final test results record:

- (None)

If the "Save Trace" check box is checked, this test generates strip-chart style trace data for all input channels, at the sampling speed specified in the "Trace Data Collection Speed" screen found under the database menu.

Note

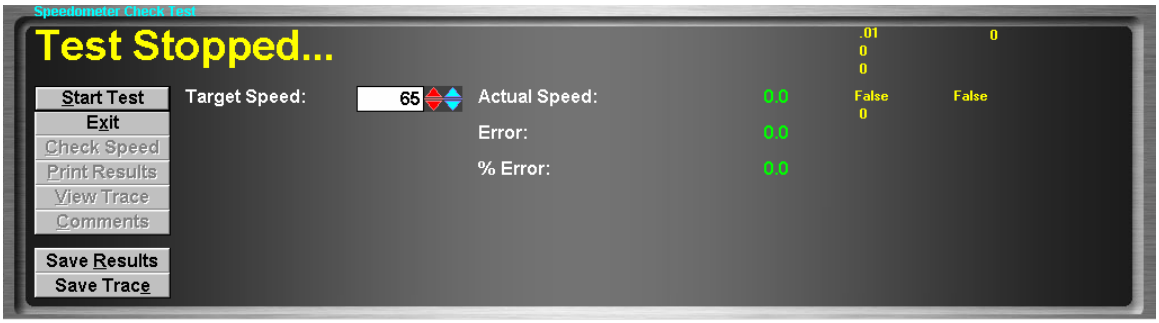
Trace data cannot be saved unless the "Save Results" check box is checked along with the "Save Trace" check box.

Special Considerations for This Test

This test routine always starts with the dyno load controller in "OFF" mode, in order to avoid applying sudden jarring loads to the vehicle when the test is started. However, as with the other test routines, the operator must be careful to avoid enabling the dyno load controller with a large loading value, to avoid jarring the vehicle during testing.

Speedometer Check Test

This test allows the operator to check the accuracy of the vehicle's speedometer.



Purpose

The Speedometer Check Test allows the operator to check the accuracy of the vehicle's speedometer. No load is applied to the vehicle during this test.

Intended Test Procedure

This test has no specific ending point, as the speedometer may be checked several times before ending the test. The general testing procedure is outlined below.

- The "Target Speed" field should be set to the speed at which the speedometer is to be checked.
- The "Save Results" and "Save Trace" check boxes should be set appropriately.
- The "Start Test" button is clicked.
- The vehicle is driven, with no load. When the driver sees the speedometer indicating the target speed, the "Check Speed" button should be clicked. At this point, the actual speed (according to the dynamometer's very accurate digital speed input) is displayed, along with the absolute error of the vehicle's speedometer at the testing speed, and the percentage error that the absolute error represents.
- The "Stop Test" button is clicked, and the test terminates.
- Any saved test results may be viewed and/or a test report printed.

Results Obtained

If the "Save Results" check box is checked, a record that this type of test was performed on the currently selected vehicle, along with the date and time the test was performed and any comments about the test session, is saved to the application's database.

For this test type, the following additional information is saved as part of the final test results record:

- Target Speed
- Actual (Dynamometer) Speed

- Speedometer Error, MPH/KPH
- Speedometer Error, %

If the "Save Trace" check box is checked, this test generates strip-chart style trace data for all input channels, at the sampling speed specified in the "Trace Data Collection Speed" screen found under the database menu.

Note

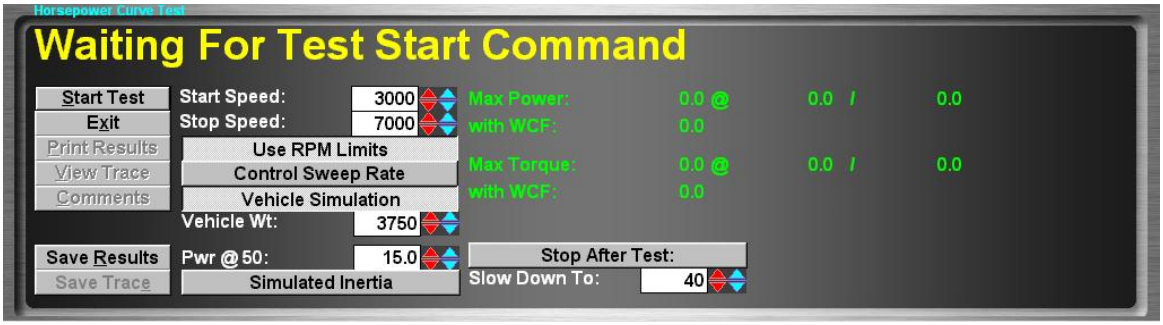
Trace data cannot be saved unless the "Save Results" check box is checked along with the "Save Trace" check box.

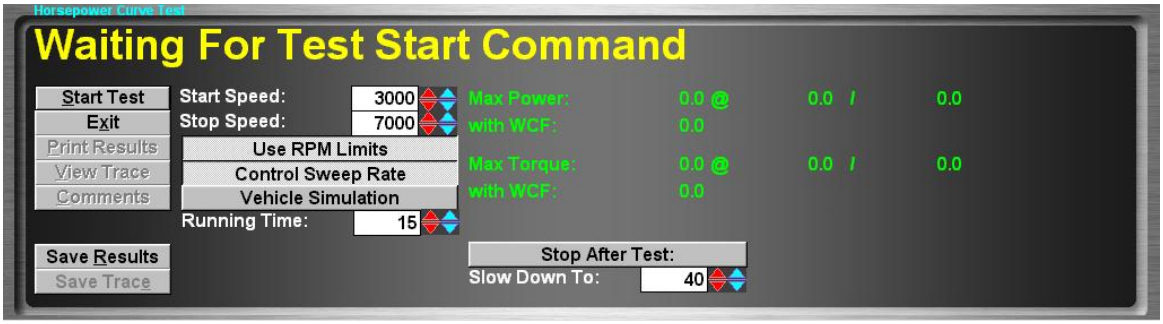
Special Considerations for This Test

None.

Power Curve (Controlled Sweep Rate/ Vehicle Simulation Mode)

This test allows the operator to perform a controlled sweep rate type power curve test on the vehicle.





Purpose

The Horsepower Curve Test allows the operator to perform a sweep-type power measurement test on the vehicle. This test routine supports both a fixed-sweep-time mode and a vehicle-simulation-loading mode. The vehicle-simulation-loading mode will most accurately reflect the actual power that the vehicle will deliver in use, while a fixed-sweep-time mode test can be used for comparing against test-stand dynamometer values.

Intended Test Procedure

This test has a specific ending point, which is reached when the vehicle's speed increases past the value entered in the "Stop Speed" field. The general testing procedure is outlined below.

NOTE: This power curve test does NOT generate by-MPH and by-RPM data independent of the test's graph data, as the MD-7000 series software did. In PowerDynePC, the trace/graph data is required to view/print power curve graphs.

- The "Start Speed" field should be set to the lowest speed at which the vehicle is to be tested. This should be the lowest speed at which the vehicle will run cleanly in the gear selected for testing if single-gear testing is to be performed. If "Use RPM Limits" is selected, this value will be in engine RPM, otherwise in vehicle speed units (MPH/KPH).

- The "Stop Speed" field should be set to the highest speed at which the vehicle is to be tested. This should be the highest speed at which the vehicle can be operated in the highest gear that will be used during testing. If "Use RPM Limits" is selected, this value will be in engine RPM, otherwise in vehicle speed units (MPH/KPH).

- The "Stop After Test" check box should be set appropriately. If this check box is checked, the dynamometer's PAU will be used to stop the dynamometer after the power sweep is complete, to save wear on the vehicle's brakes.

- You must select either the "Control Sweep Rate" or the "Vehicle Simulation" mode of testing. The "Vehicle Simulation" mode is preferred, since it will most accurately measure the power that the vehicle will deliver during actual driving, while the controlled sweep rate mode may be more useful for comparing to test-stand dynamometers.

- If "Control Sweep Rate" mode is selected, you must specify a value (in seconds) for the sweep "Running Time". Mustang Dynamometer recommends that you use the longest running time that the vehicle can comfortably tolerate, to enable additional data collection during the sweep.

- If "Vehicle Simulation" mode is selected, the "Vehicle Wt", "Pwr @ 50" and "Simulated Inertia" fields must be set appropriately. The numeric values will default to the values entered for the vehicle currently selected for testing, and Mustang Dynamometer recommends that the "Simulated Inertia" option always be left on.

- The "Save Results" and "Save Trace" check boxes should be set appropriately.

- The "Start Test" button is clicked.

- The vehicle is driven at just below the specified starting speed, and then accelerated at full power until the specified stopping speed is matched or exceeded. The screen will indicate to the driver when the test is complete.

- The "Stop Test" button does not need to be clicked, as the test automatically terminates once the dynamometer is stopped. The "Stop Test" button may be used to cancel a test, which you do not wish to complete.

- Any saved test results may be viewed and/or a test report printed.

Use RPM Limits	If selected, the "Start Speed" and "Stop Speed" values will be interpreted as engine RPM values rather than vehicle MPH values.
Slow Down To	If "Stop After Test" is not enabled, then the system will be slowed to this speed at the end of a test, once the measured speed has fallen to the highest speed encountered during actual testing minus 5 MPH. This value might be set to the start speed minus 5 MPH for operators performing back-to-back sets of 3 runs.

Results Obtained

If the "Save Results" check box is checked, a record that this type of test was performed on the currently selected vehicle, along with the date and time the test was performed and any comments about the test session, is saved to the application's database.

For this test type, the following additional information is saved as part of the final test results record:

- Maximum torque and power values, and the speed (MPH/KPH) and engine RPM at which they were measured, in both raw and SAE/ambient conditions corrected (WCF, With Correction Factor) values.

If the "Save Trace" check box is checked, this test generates strip-chart style trace data for all input channels, at the sampling speed specified in the "Trace Data Collection Speed" screen found under the database menu.

Note

Trace data cannot be saved unless the "Save Results" check box is checked along with the "Save Trace" check box.

Special Considerations for This Test

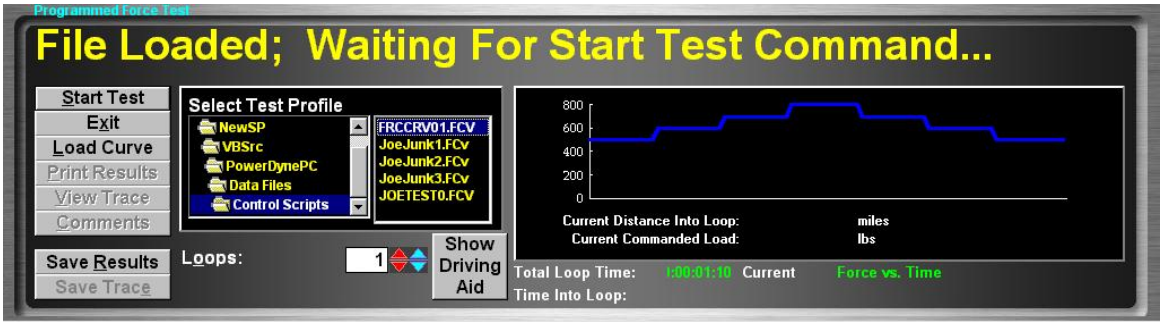
- Torque values can only be recorded in terms of engine crankshaft torque when a good engine RPM signal is present, otherwise torque values will be recorded in terms of dynamometer roll shaft torque.

- A longer sweep time should generate higher power and torque readings, since a lower acceleration rate means that less power is absorbed by the vehicle's drive train.

- If you experience wavy torque or power curves, you should try to isolate the cause of the waves. You should use the Trace Graph Viewer to isolate torque waves to either "PAU Torque" or "Accel Torque", and you may wish to filter the wavy input, which can be done in the "Dyno Parameters" screen. An unstable engine RPM input can also cause distorted torque and power curves.

Programmed Force

This test allows the operator to apply a time-based force loading profile to the vehicle.



Purpose

The Programmed Force Test can be used for durability or performance testing, or to simulate real-world loading profiles.

Intended Test Procedure

This test has a fixed termination time, when the last data point has been processed for the last loop through the selected test profile. The general testing procedure is outlined below.

- Select a test profile using the "Select Test Profile" directory- and file-picking boxes.
- Enter the number of loops through the selected profile that you wish to execute.
- If a driving aid script file is available for the selected loading script, you may wish to click the "Show Driving Aid" button, to bring up the driving aid display (not commonly used).
- The "Save Results" and "Save Trace" check boxes should be set appropriately.
- A driver should start driving the vehicle at the desired testing speed.
- The "Start Test" button is clicked.
- The vehicle is driven until the test completes, while the load on the vehicle is controlled by the selected test profile.
- When the last data point has been processed for the last time through the selected profile, the test terminates.
- Any saved test results may be viewed and/or a test report printed.

Results Obtained

If the "Save Results" check box is checked, a record that this type of test was performed on the currently selected vehicle, along with the date and time the test was performed and any comments about the test session, is saved to the application's database. For this test type, the following additional information is saved as part of the final test results record:

- (None)

If the "Save Trace" check box is checked, this test generates strip-chart style trace data for all input channels, at the sampling speed specified in the "Trace Data Collection Speed" screen found under the database menu.

Note

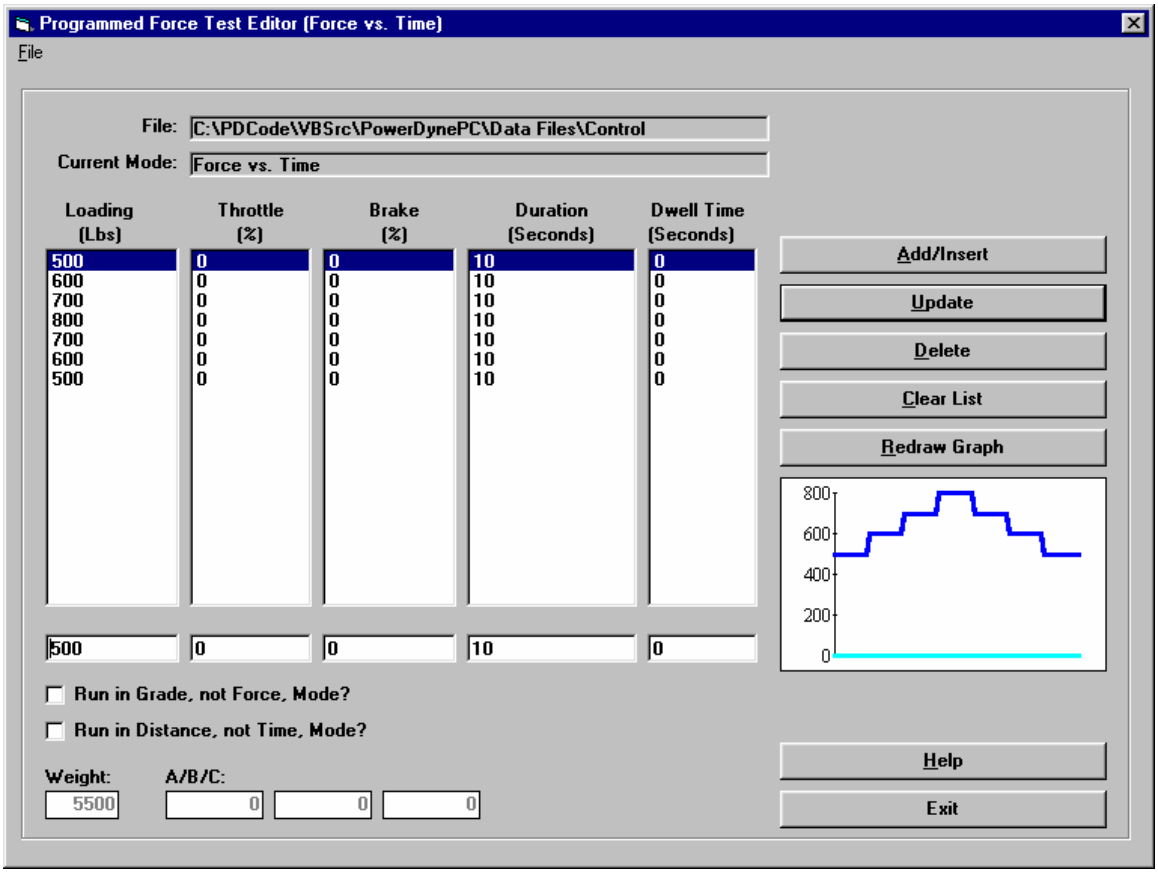
Trace data cannot be saved unless the "Save Results" check box is checked along with the "Save Trace" check box..

Special Considerations for This Test

None.

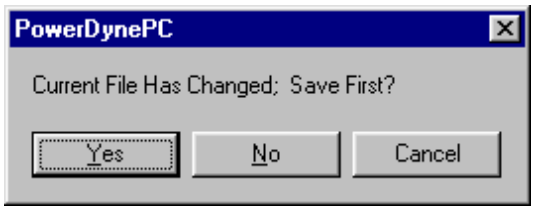
Programmed Force Editor

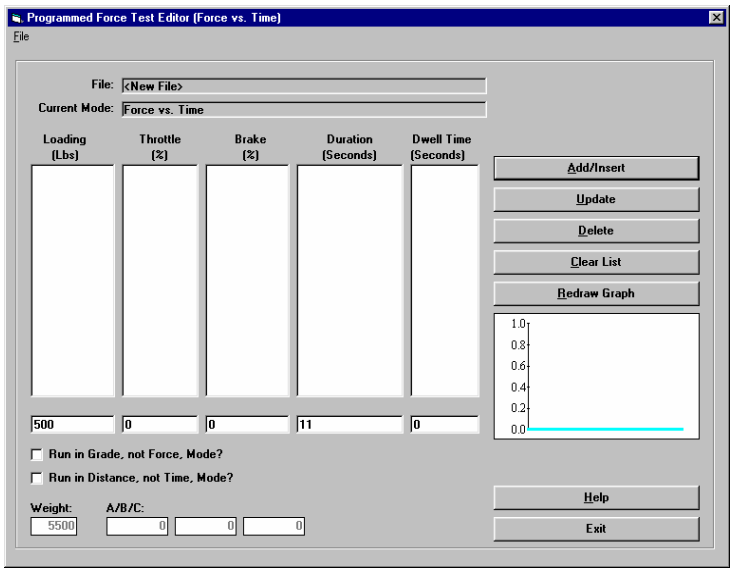
This screen allows the operator to edit/create time-based force loading profiles.

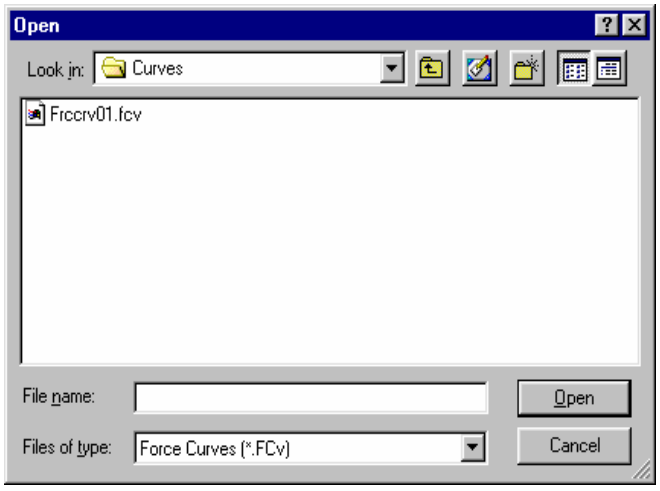
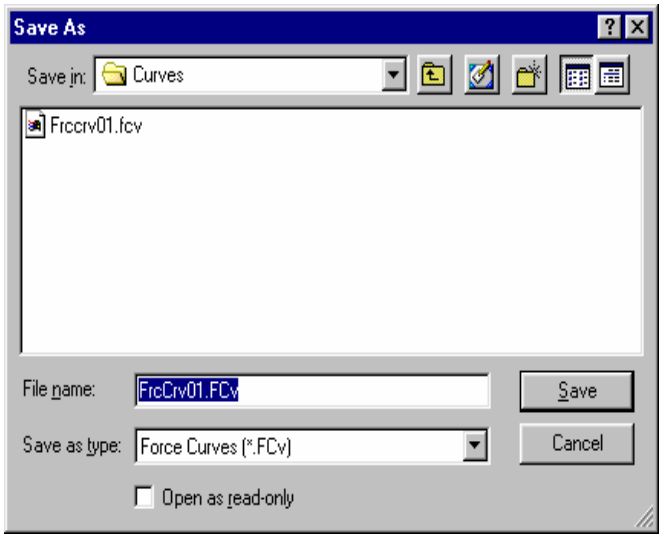


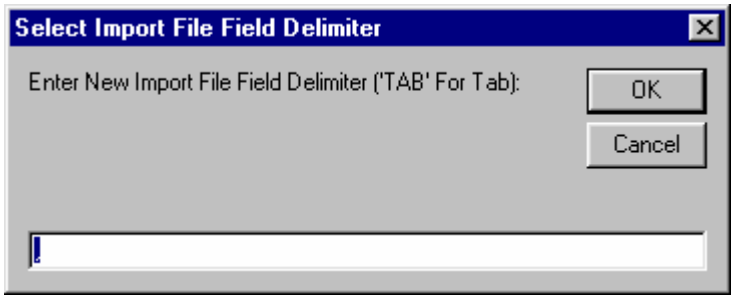
Programmed Force Test Editor Menu

Profiles may be read, written and imported when using this menu. The following is a list of menu-items that the operator has access to along with a description on what they are used for:

Menu	Description
New	Clears out any profiles, so that the operator can enter in a new one. If there is a profile loaded and changes have been made then when the operator tries to load a new one, the following prompt will be displayed.  If the operator presses "Yes" then any changes made to a

	profile will get save away before a new profile is created. If the operator presses the "No", then any changes made will not get saved away. If the operator presses "Cancel" then the prompt will disappear. After the operator presses the "New" button and any previously loaded profiles have been saved away or not then a blank profile will be loaded and the screen will look as follows: 
Import	Imports profiles from a .TXT file. When the operator selects this menu item then the following screen will display, prompting the operator the name of the import file: 

Load	Loads a profile. When the operator selects this menu item then the following screen will display prompting the operator for the name of a previously saved away profile: 
Save	Saves a profile.
Save As	Saves a profile to whatever file that the operator wants to save it to. When the operator selects this menu item, then the following screen will display prompting the operator for the name they want to save the profile under: 

Change Import Delimiter	Change the delimiter that appears between values of the import file. 
Exit	Close out of this screen.

Programmed Force Editor Screen explanation:

The following attempts to explain the screen layout and what purpose the fields serve on the screen.

Field/Button	Description
File	Whenever the operator loads a profile, the full path and filename will appear in this field.
Current Mode	This displays to the operator the mode that the Programmed Force Test will operate in, the possible modes of operator are: ▪ Force Versus Time ▪ Grade Versus Time ▪ Force Versus Distance ▪ Grade Versus Distance
Loading (LBS)/ Grade (%)	This is the first column of the data point of the profile and represents the amount of loading that gets applied and can be expressed as either a force or as a grade. When the operator checks the checkbox labeled "Run In Grade, Not In Force Mode", then the load that gets applied is in terms of Grade. If it is unchecked then the force applied is expressed in terms of force.
Throttle (%)	This is the second column of the data point of the profile and represents the amount of throttle to apply if there is an integrated throttle controller. When an existing profile is loaded, the value will be set to "0", and will not affect the functioning

	of the script. If a value in entered and an optional throttle controller is connected, then the vehicle's throttle will be set to the specified position as a percentage.
Brake (%)	This is the third column of the data point of the profile and represents the amount of throttle to apply if there is an integrated brake controller. When an existing profile is loaded, the value will be set to "0", and will not affect the functioning of the script. If a value in entered and an optional brake controller is connected, then the vehicle's brake will be set to the specified position as a percentage.
Duration (Seconds)/ Distance (Feet)	This is the fourth column of the data point of the profile and represents when the loading is applied, The loading can either be a function of distance or a function of time. By default, the loading will be a function of time. To Change to distance mode, select the checkbox on this screen labeled "Run In Distance, Not Time Mode". When this checkbox is selected, the 4th column will change to read "Distance" and each entry in that column will represent a mileage.
Dwell Time (Seconds)	In by-distance mode, the time spent at a point **at zero speed** can be limited by specifying a dwell time for that point, in seconds.
Run in Grade, not force mode	This is a checkbox that the operator can use to specify if the loading to apply will be in terms of Force or Grade. If the checkbox is unchecked then the loading will be in terms of force, however if it is checked then the loading will be in terms of grade – this can be used to simulate driving on a specific piece of road. Note When running in terms of grade, then the operator will be prompted for the weight of the vehicle being tested along with the ABC power coefficient.
Run In Distance, Not Time Mode	This is a checkbox that the operator can use to specify if the load being applied will be a function of distance or time. If the checkbox is unchecked then the loading will be a function of time, however if it is checked then the loading applied will be a function of time.
Weight	The weight of the vehicle.

	Note This needs to be known when the load being applied is in terms Grade and not Force, in other words the checkbox "Run In Grade, Not Force Mode" is checked.
A/B/C	These are the ABC power coefficients that represent the wind resistance exerted on a moving vehicle. **Note** This needs to be known when the load being applied is in terms Grade and not Force, in other words the checkbox "Run In Grade, Not Force Mode" is checked.
Add/Insert	This adds a new row of the Profile.
Update	This updates a row of the Profile.
Delete	This deletes a row of the Profile.
Clear List	This clears the entire Profile.
Redraw Graph	This redraws the graph after rows have been updated
Help	Displays help that explains the use of "Run in Grade, not force mode" and "Run In Distance, Not Time Mode".
Exit	Closes out of the screen

The points in these profiles specifies a target loading value, and the number of seconds for which the specified loading should be maintained. Files may be read, written and imported using the related "File" menu items. Creating a new file or editing an existing file is a simple process outlined below. The "Throttle (%)" column has been added to support scripted loading scenarios using the integrated throttle controller. When any existing script file is loaded, the "Throttle (%)" values will show up as "0", and will not affect the functioning of the script. If a value is entered, and the optional throttle controller is connected, the vehicle's throttle will be controlled to the specified position (in %).)

To Create A New Profile

- Select "New" from the "File" menu.
- Click in the box under the "Loading (Lbs)" or "Grade (%)" column, and enter the loading force you wish to apply.
- Click in the box under the "Duration (Seconds)" or "Distance (Feet)" column, and enter the number of seconds for which you wish the load to be applied.
- Click the "Add/Insert" button.
- Repeat as necessary.

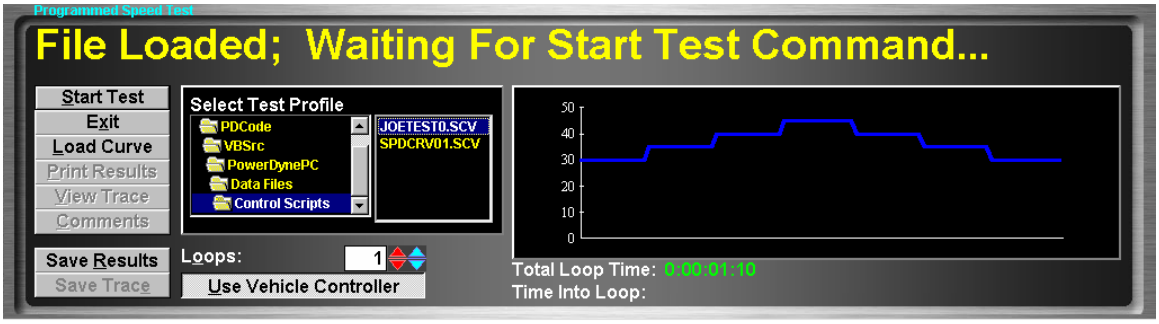
To Edit An Existing Profile

- Select "Load" from the "File" menu, and select a file to load.
- Edit the existing profile data as described above.

Programmed Speed

This test allows the operator to apply a time-based speed control to the vehicle.

> **Note**
>
> This test is very similar to the "Programmed Force Test", except that the systems speed is controlled, rather than the applied loading force.



Purpose

The Programmed Speed Test can be used for durability or performance testing, or to simulate real-world loading profiles.

Intended Test Procedure

This test has a fixed termination time, when the last data point has been processed for the last loop through the selected test profile. The general testing procedure is outlined below.

- Select a test profile using the "Select Test Profile" directory- and file-picking boxes.
- Enter the number of loops through the selected profile that you wish to execute.
- The "Save Results" and "Save Trace" check boxes should be set appropriately.
- A driver should start driving the vehicle at the desired testing speed.
- The "Start Test" button is clicked.
- The vehicle is driven until the test completes, while the load on the vehicle is controlled by the selected test profile.
- When the last data point has been processed for the last time through the selected profile, the test terminates.
- Any saved test results may be viewed and/or a test report printed.

Results Obtained

If the "Save Results" check box is checked, a record that this type of test was performed on the currently selected vehicle, along with the date and time the test was performed and any comments

about the test session, is saved to the application's database. For this test type, the following additional information is saved as part of the final test results record:

- (None)

If the "Save Trace" check box is checked, this test generates strip-chart style trace data for all input channels, at the sampling speed specified in the "Trace Data Collection Speed" screen found under the database menu.

Note

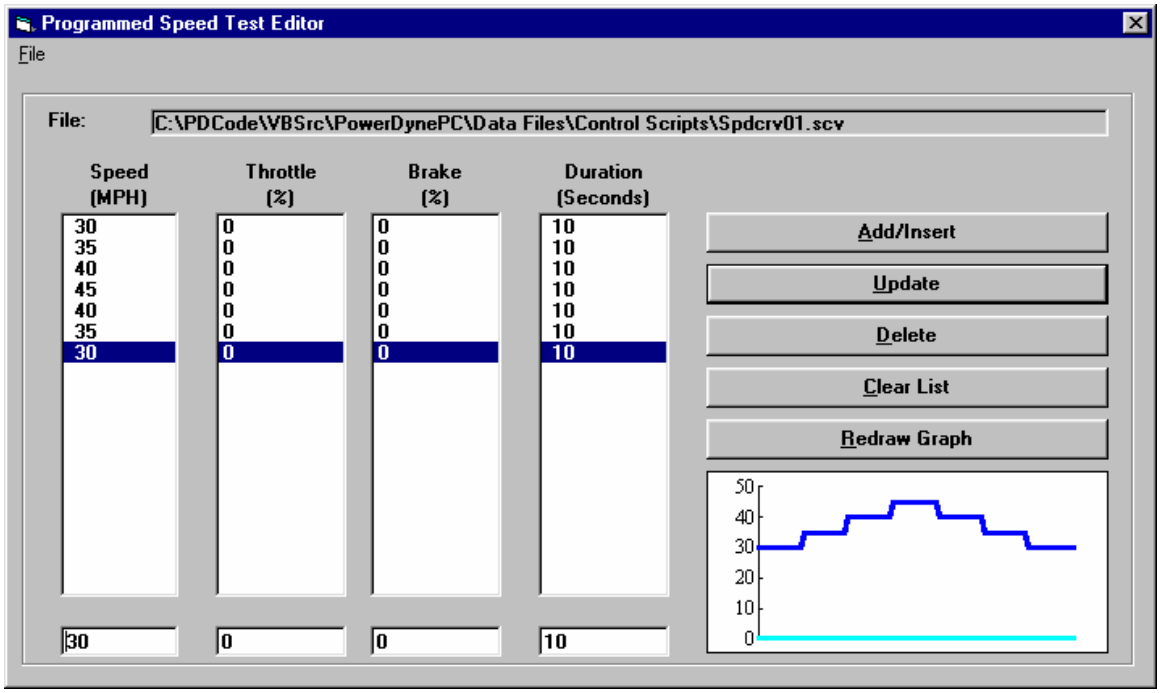
Trace data cannot be saved unless the "Save Results" check box is checked along with the "Save Trace" check box..

Special Considerations for This Test

None.

Programmed Speed Editor

This screen allows the operator to edit/create time-based speed control profiles and is very similar in operation to the Programmed Force Editor.



PRO Script Test

This test allows the operator to play back a pre-defined loading script, with more advanced control options than the programmed force or speed routines.

Purpose

The PRO Script Test can be used for durability or performance testing, or to simulate real-world loading profiles.

Intended Test Procedure

This test has a fixed termination time, when the last script point has been processed; however, the duration and/or distance covered during testing may not be defined, since various logical control options are available. The general testing procedure is outlined below.

- Select a test profile using the "Select Script" file-picking box.
- The "Save Results" and "Save Trace" check boxes should be set appropriately.
- A driver should start driving the vehicle at the desired testing speed.
- Be aware that PRO Scripts can include steps that wait for the operator click a "Continue" button, which will only appear on this screen when required.
- The "Start Test" button is clicked.
- The vehicle is driven until the test completes, while the load on the vehicle is controlled by the selected test profile.
- When the last data point has been processed for the last time through the selected profile, the test terminates.
- Any saved test results may be viewed and/or a test report printed.

Results Obtained

If the "Save Results" check box is checked, a record that this type of test was performed on the currently selected vehicle, along with the date and time the test was performed and any comments about the test session, is saved to the application's database. For this test type, the following additional information is saved as part of the final test results record:

- (None)

If the "Save Trace" check box is checked, this test generates strip-chart style trace data for all input channels, at the sampling speed specified in the "Trace Data Collection Speed" screen found under the database menu.

Note

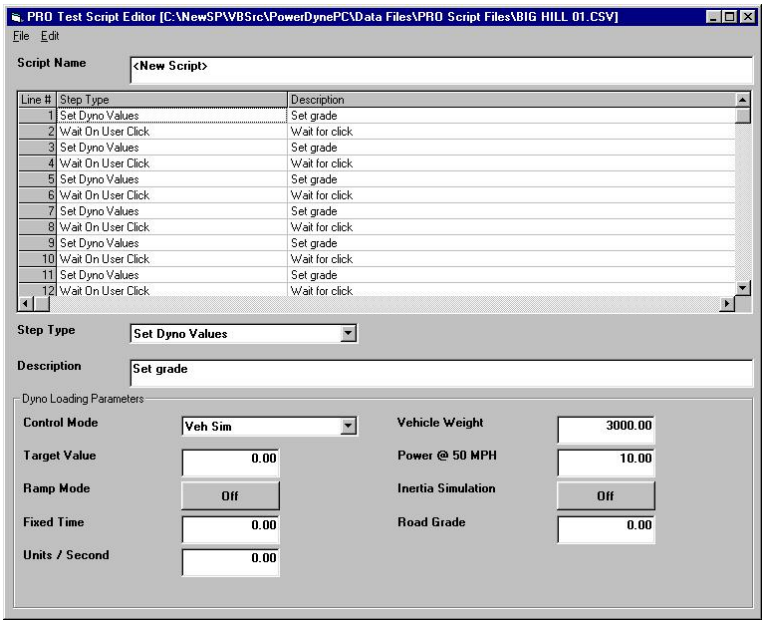
Trace data cannot be saved unless the "Save Results" check box is checked along with the "Save Trace" check box..

Special Considerations for This Test

None.

PRO Script Editor

This screen allows the operator to create/edit scripts for use in the PRO Script Test.



Basic notes:

1) The scripting logic provided allows the use of up to 50 general purpose variables.

2) When scripts are executed, one line of the script is processed every 0.01 seconds (100 lines / second). This prevents execution of a script from interfering with the control functions of the dynamometer control software.

3) While you can assign a description to each line in a script, the description may not be visible to the operator for most commands, since execution passes through each script line very quickly. Concentrate on assigning good descriptions to lines in your script that are of the various "Skip On xxx" types, since scripts will usually be waiting (looping) on such a command during execution.

4) The scripting logic provided does not include explicit LOOP commands. Rather, looping is implemented using the various "Skip On xxx" commands and the "Go To Line" command. For example, to implement a counted loop with 5 iterations:

    a) (Line 1) Set Variable (1, =0)

    b) <Control commands in your loop…>

    c) Increment Variable (1, +1)

    d) Skip On Variable (1, >= 5)

    e) Go To Line (1)

f) End Of Script

5) The normal Windows Cut/Copy/Paste commands all work as usual, but on a line-by-line basis – these commands operate on all selected lines – you can select multiple lines by holding down the "Shift" key while scrolling through the list, or by holding down the "Shift" key and clicking on a second point in the list (to define a range).

6) You can Insert/Delete lines using the "Insert" and "Delete" options on the "Edit" menu.

7) When you insert or delete a line or a range of lines, the line number in all "Go To Line" commands in the script will be adjusted as well as possible, but it is still possible for the line numbers to be disturbed.

8) If you paste a block of lines, the line numbers in "Go To Line" commands in the pasted-in block will be adjusted as well as possible, but it is still possible for the line numbers to be disturbed.

The PRO Script test scripts currently support the following command types.

Set Dyno Load Controller Values (load, ramping, etc)

Set Throttle Controller Values (load, ramping, etc)

Set Brake Controller Values (load, ramping, etc)

Set Variable (to constant)

Increment Variable (by constant)

Skip Next Command On

Step Time (> constant)

Test Time (> constant)

Step Distance (> constant)

Test Distance (> constant)

Variable Value (<= constant, >= constant, either)

System Channel Value (<= constant, >= constant, either)

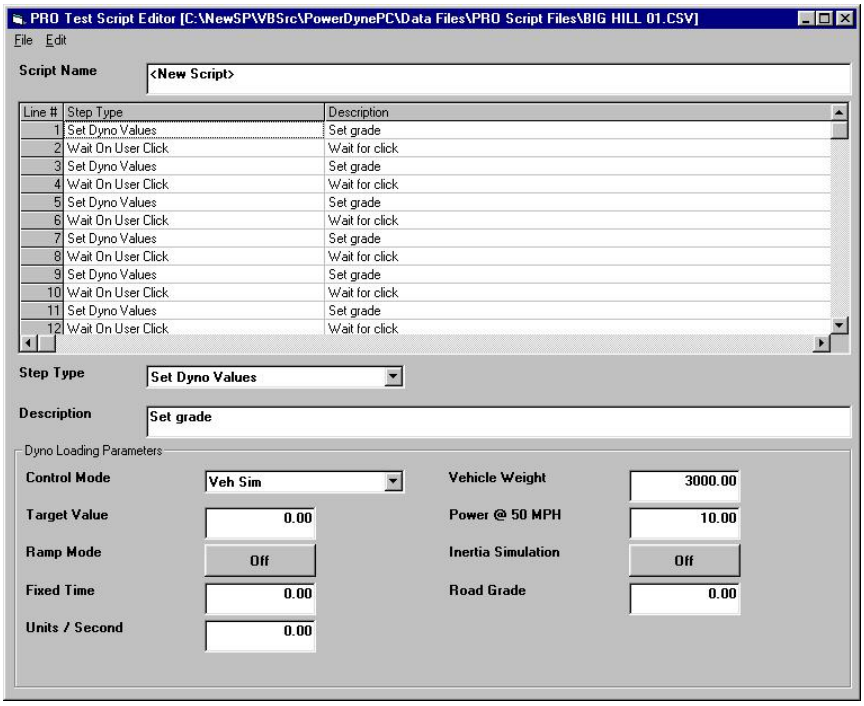
Wait For User Click

Go To Line (#)

End Script

Detailed information on each command type is given below.

Set Dyno Load Controller Values (load, ramping, etc)



Control Mode

Specify the control mode for the dynamometer (off, manual, force, power, speed, acceleration, engine RPM, vehicle simulation).

Target Value

For all modes except vehicle simulation, the target loading value for the selected mode.

Ramp Mode

For all modes except vehicle simulation, the ramping mode to use for the selected mode. Fixed time means all loading changes should be accomplished in the number of seconds specified, while Units/Second means to ramp from the current value to the specified value at a rate of xxx units per second.

Fixed Time

The number of seconds to use in fixed-time ramping mode (if selected).

Units/Second

The number of units to ramp by per second (if selected).

Vehicle Weight

For vehicle simulation mode only, the vehicle weight to use for inertial and road grade loading.

Power @ 50 MPH

For vehicle simulation mode only, establishes the vehicle drag loading curve by specifying one point on that curve.

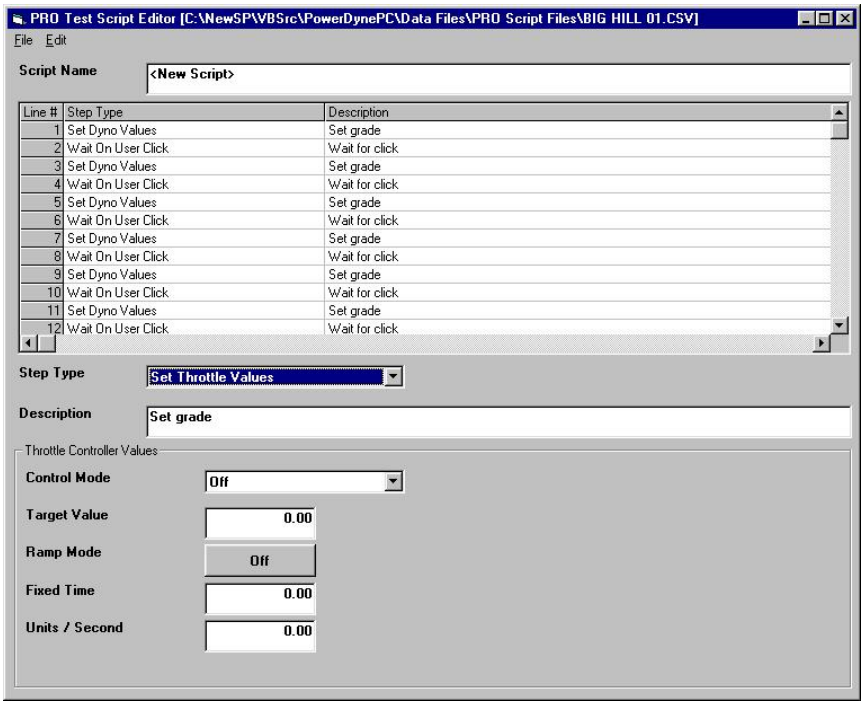
Inertia Simulation

For vehicle simulation mode only, enables or disables simulation of the vehicle's weight. If disabled, the vehicle loading will be based on the dynamometer's weight.

Road Grade

For vehicle simulation mode only, specifies the road grade to be used in loading the vehicle, in percent.

Set Throttle Controller Values (load, ramping, etc)



Control Mode

Specify the control mode for the throttle controller (off, position, force, power, speed, acceleration, engine RPM, engine torque).

Target Value

The target loading value for the selected mode.

Ramp Mode

The ramping mode to use for the selected mode. Fixed time means all loading changes should be accomplished in the number of seconds specified, while Units/Second means to ramp from the current value to the specified value at a rate of xxx units per second.

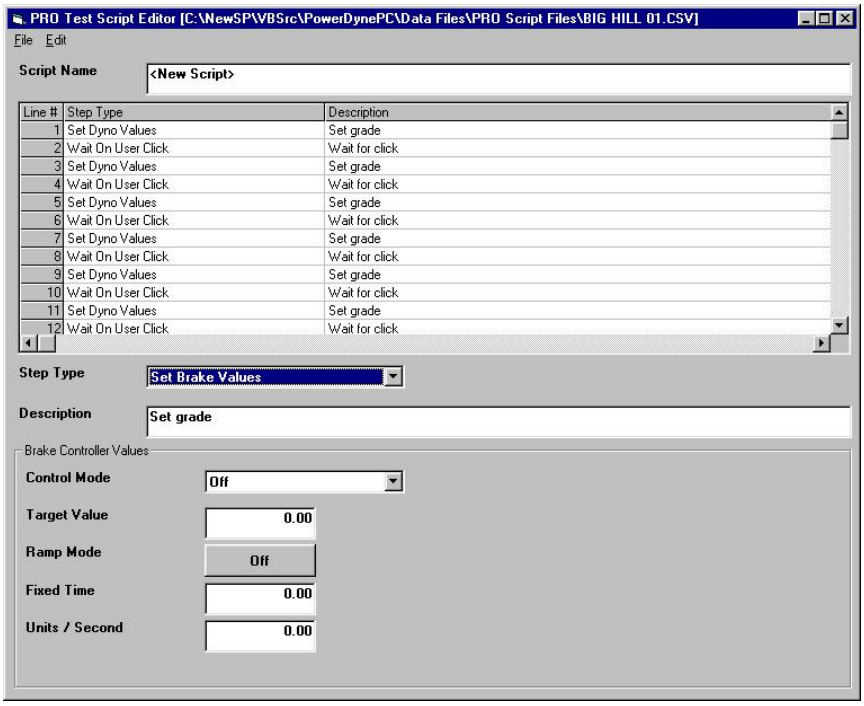
Fixed Time

The number of seconds to use in fixed-time ramping mode (if selected).

Units/Second

The number of units to ramp by per second (if selected).

Set Brake Controller Values (load, ramping, etc)



Control Mode

Specify the control mode for the brake controller (off, position, force, power, speed, acceleration).

Target Value

The target loading value for the selected mode.

Ramp Mode

The ramping mode to use for the selected mode. Fixed time means all loading changes should be accomplished in the number of seconds specified, while Units/Second means to ramp from the current value to the specified value at a rate of xxx units per second.

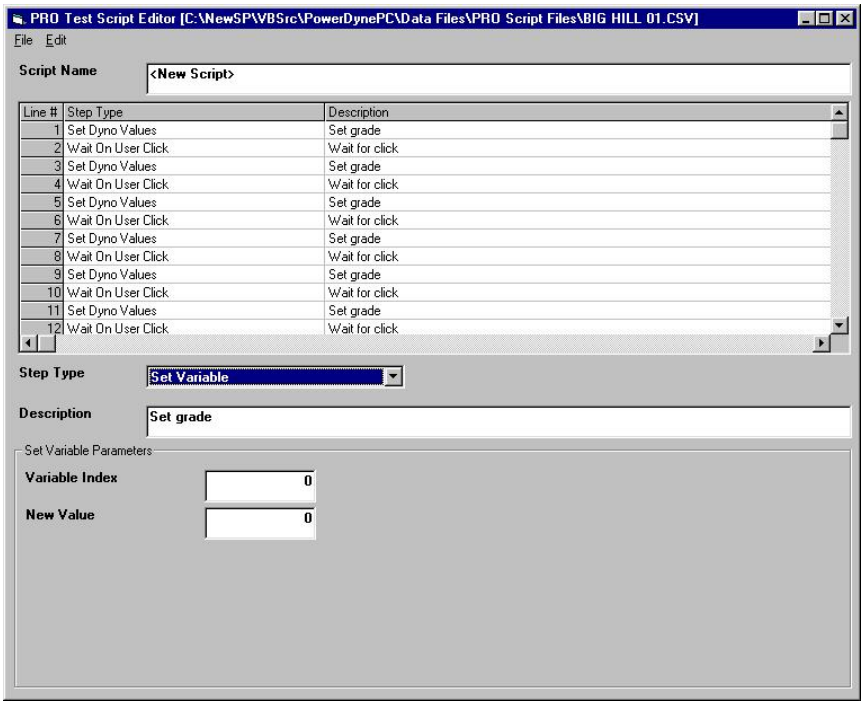
Fixed Time

The number of seconds to use in fixed-time ramping mode (if selected).

Units/Second

The number of units to ramp by per second (if selected).

Set Variable (to constant)



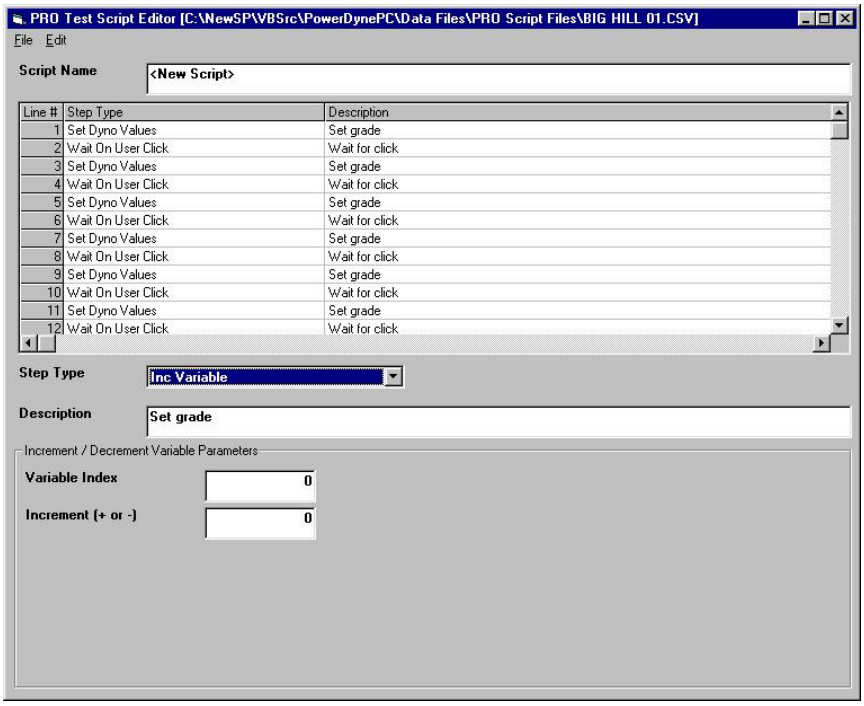
Variable Index

Specifies which of the available general purpose variables to affect.

New Value

Specifies the value that the variable should be set to.

Increment Variable (by constant)



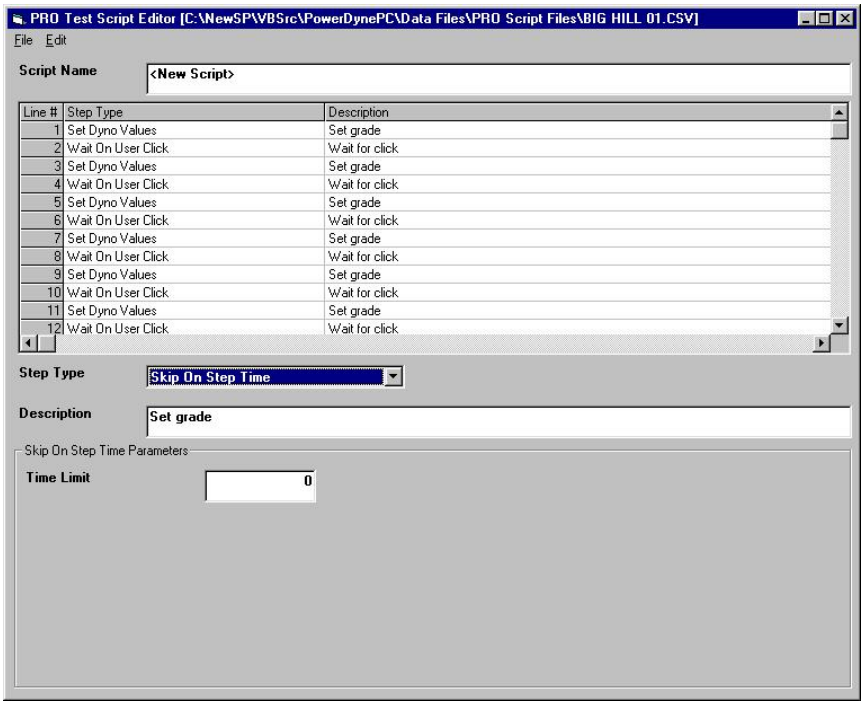
Variable Index

Specifies which of the available general purpose variables to affect.

Increment

Specifies the value that should be added to the variable (can be + or -).

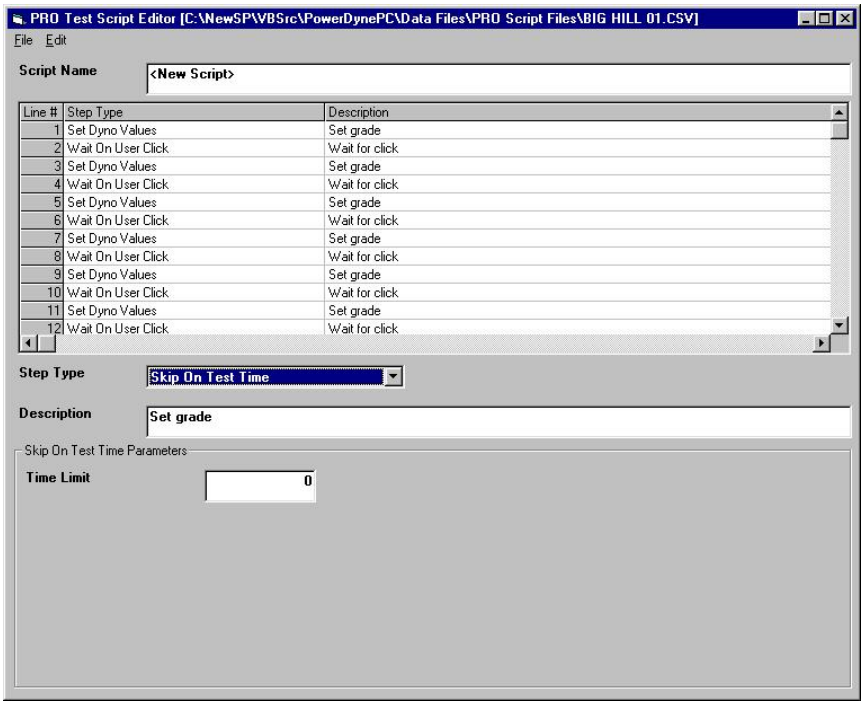
Skip Next Command On Step Time (> constant)



Time Limit

The number of seconds into the current step that should cause execution to skip the next line of the script.

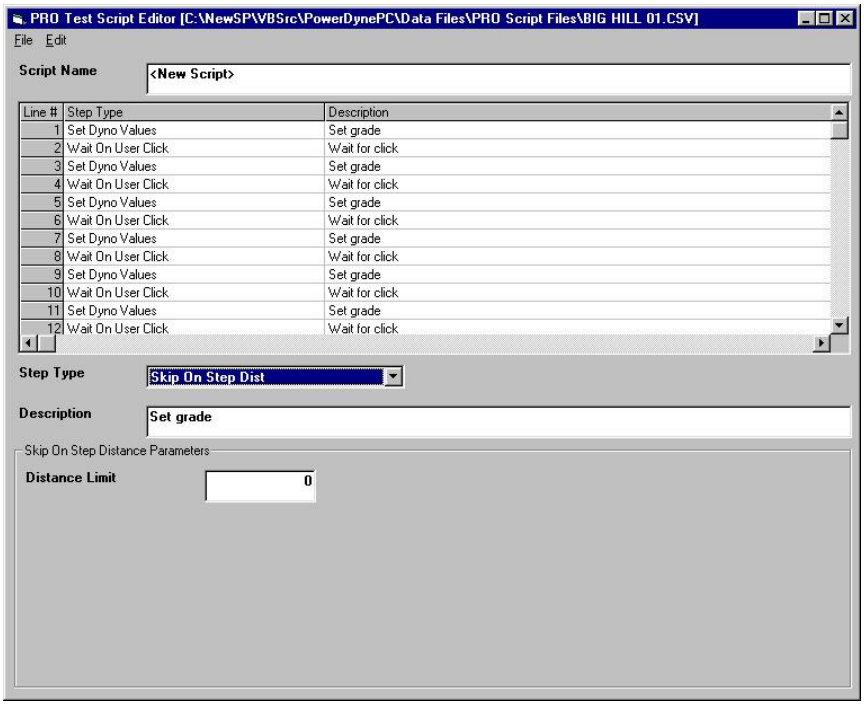
Skip Next Command On Test Time (> constant)



Time Limit

The number of seconds into the current test that should cause execution to skip the next line of the script.

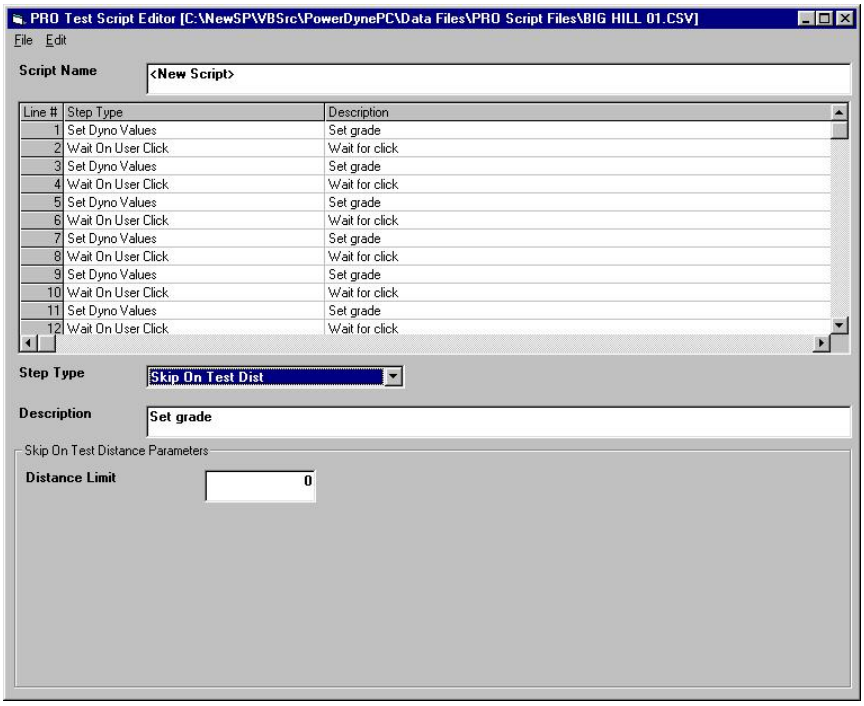
Skip Next Command On Step Distance (> constant)



Distance Limit

The distance into the current step that should cause execution to skip the next line of the script.

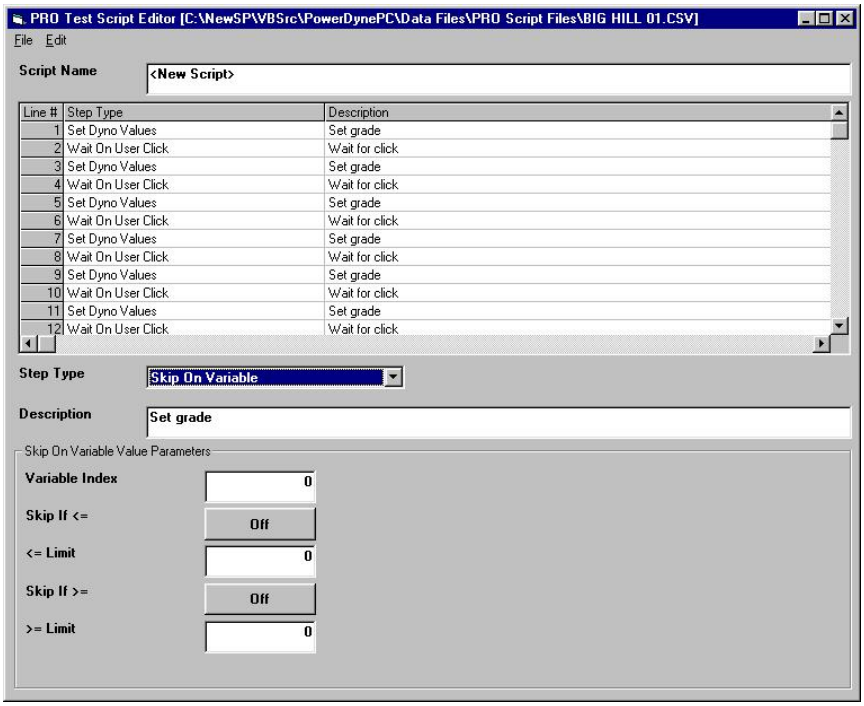
Skip Next Command On Test Distance (> constant)



Distance Limit

The distance into the current test that should cause execution to skip the next line of the script.

Skip Next Command On Variable Value (<= constant, >= constant, either)



Variable Index

Identifies which of the available general purpose variables should be used for this comparison.

Skip If <=

If enabled, the variable will be checked against the "<= Limit" value.

<= Limit

If the variable's value is <= this value, execution will skip the next line in the script.

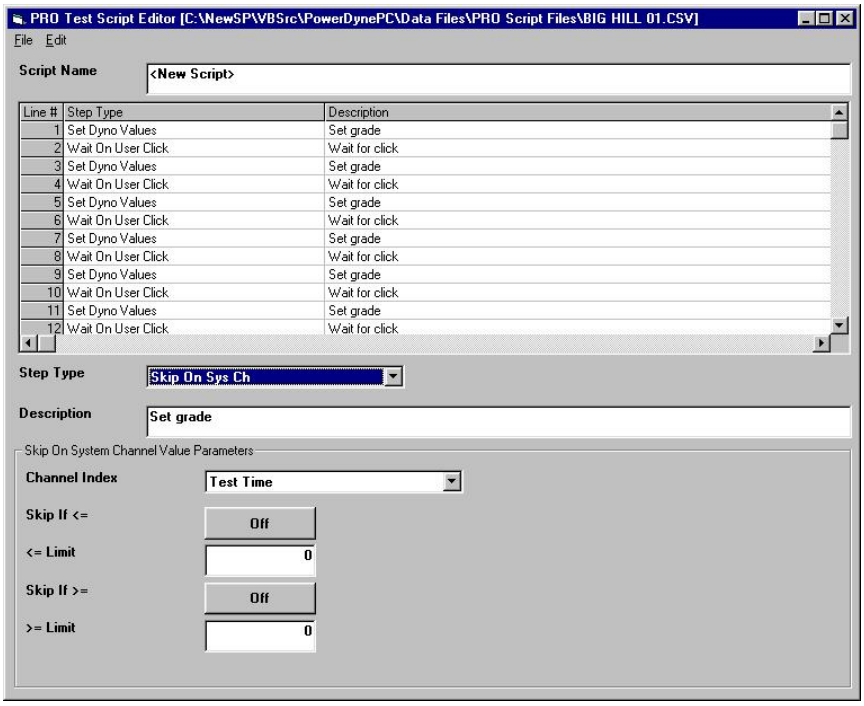
Skip If >=

If enabled, the variable will be checked against the ">= Limit" value.

>= Limit

If the variable's value is >= this value, execution will skip the next line in the script.

Skip Next Command On System Channel Value (<= constant, >= constant, either)



Channel Index

Identifies which of the available system channels should be used for this comparison.

Skip If <=

If enabled, the channel will be checked against the "<= Limit" value.

<= Limit

If the channel's value is <= this value, execution will skip the next line in the script.

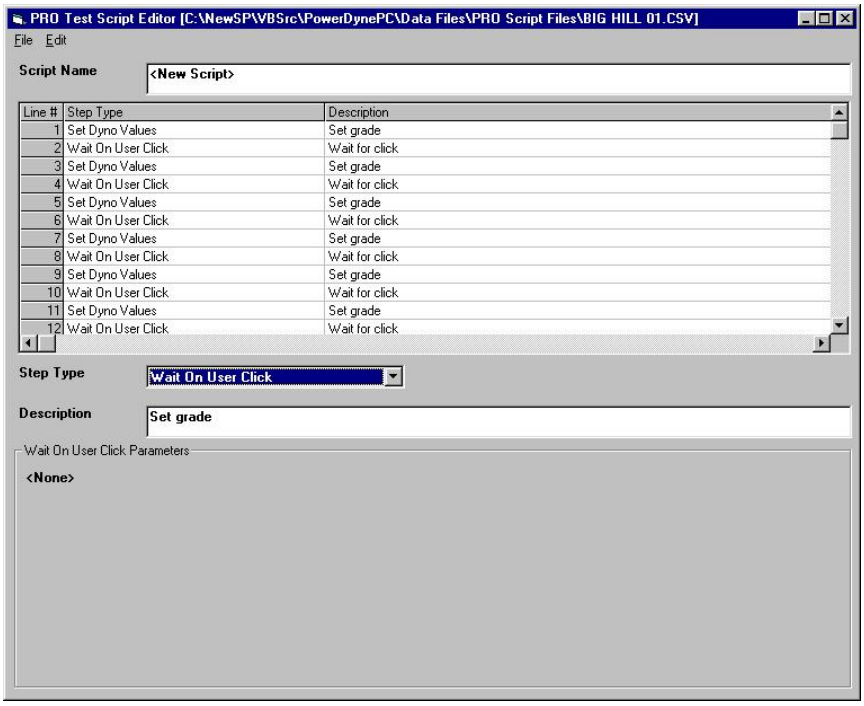
Skip If >=

If enabled, the channel will be checked against the ">= Limit" value.

>= Limit

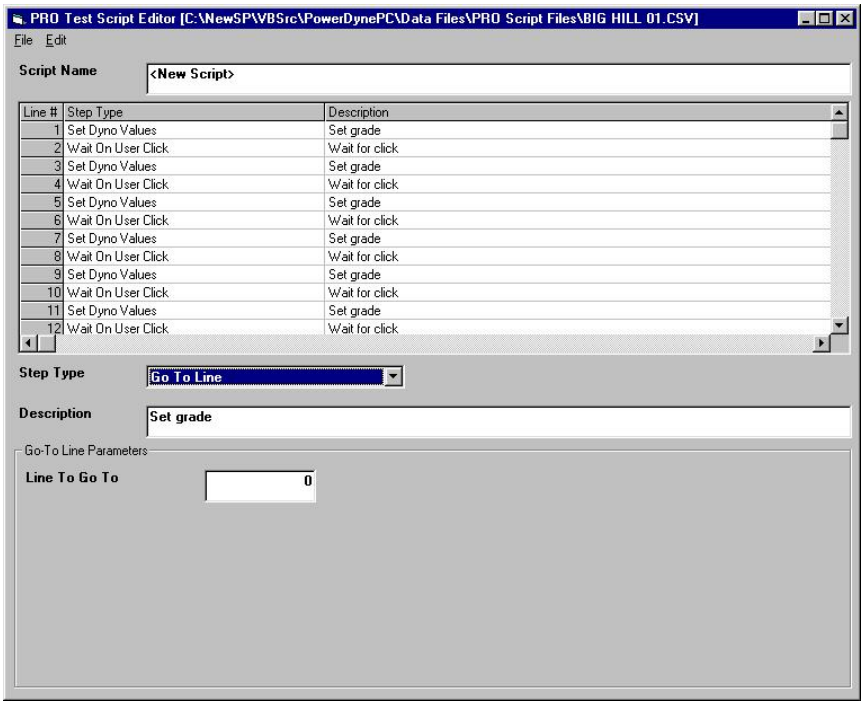
If the channel's value is >= this value, execution will skip the next line in the script.

Wait For User Click



This command displays a button on the scripting test display, and waits for the operator to click on that button. Useful for points in a script where the operator is required to perform some action.

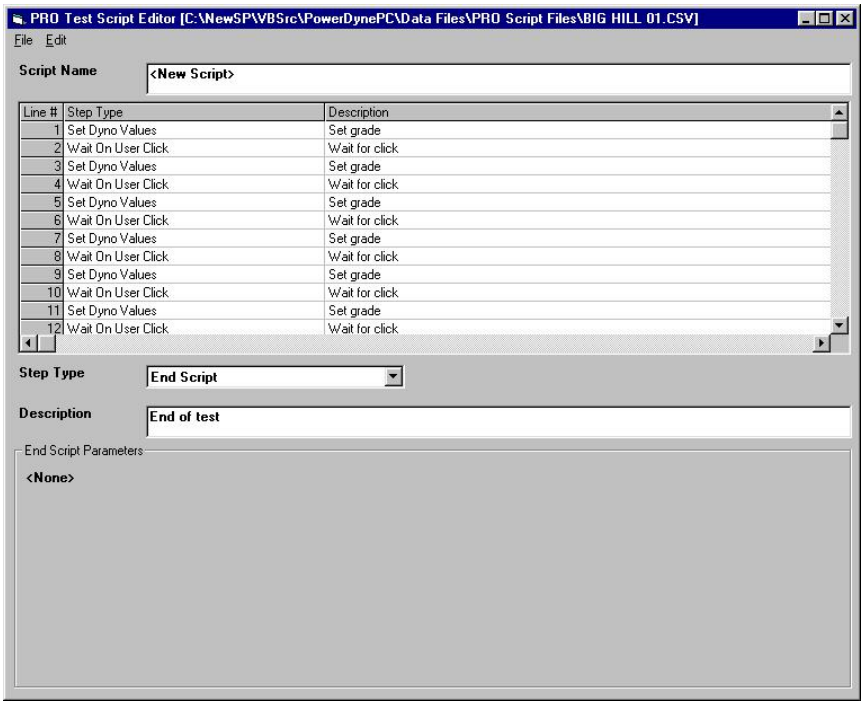
Go To Line (#)



Causes script execution to immediately jump to the specified line number.

Useful for looping, and also conditional script flow control.

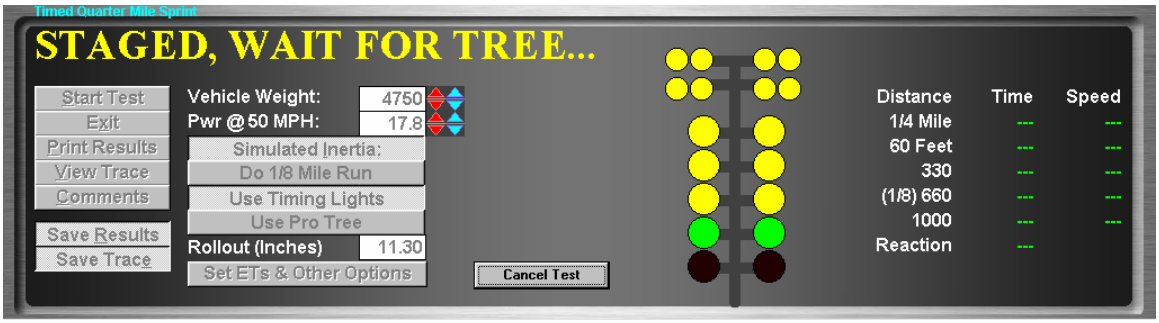
End Script



This command causes script execution to terminate immediately.

Quarter Mile Sprint

This test allows the operator to simulate a 1/4-mile sprint race with the vehicle.



Purpose

The Timed Quarter Mile Sprint test allows the operator to simulate a 1/4-mile sprint race on the dynamometer. The results of these tests are generally within 0.1 to 0.2 seconds of the actual times recorded by a vehicle at a drag strip (if accurate vehicle loading parameters are used).

Intended Test Procedure

This test has a fixed termination time, when the vehicle has traveled 1/4 mile. The general testing procedure is outlined below.

- The "Vehicle Weight" field will default to the weight entered for the vehicle currently selected for testing. The operator may change this weight if desired.
- The "Pwr @ 50 MPH" field will default to the value entered for the vehicle currently selected for testing. The operator may change this value if desired.
- The "Simulated Inertia" check box determines whether inertia simulation will be used or not. Mustang Dynamometer recommends that this option always be used.
- The "Save Results" and "Save Trace" check boxes should be set appropriately.
- Optionally select use of the timing lights (tree), use of pro tree timing, and ¼ or 1/8th mile track lengths.
- Specify your vehicle's roll out distance (used for reaction timing). If you stage very deeply, this value can approach 0.00, but can not be 0.00.
- Use the "Set Ets & Other Options" button to access an additional settings form (described below).
- The "Start Test" button is clicked.
- The vehicle is accelerated as quickly as possible through a distance of 1/4 mile. Test timing begins as soon as the vehicle's speed exceeds 0.1 MPH.
- The test terminates when the vehicle has traveled 1/4 mile. The "Stop Test" button may be used to terminate a test you do not wish to finish.

- Use the "Cancel Test" button to cancel a test when the tree is showing.
- Once the test is complete, the dynamometer's PAU is used to stop the system, to avoid wear to the vehicle's brakes.
- Any saved test results may be viewed and/or a test report printed.

Results Obtained

If the "Save Results" check box is checked, a record that this type of test was performed on the currently selected vehicle, along with the date and time the test was performed and any comments about the test session, is saved to the application's database.

For this test type, the following additional information is saved as part of the final test results record:

- Time to 1/4 mile, 60 feet, 100, 200, 300 and 400 yards.
- Speed at 1/4 mile, 60 feet, 100, 200, 300 and 400 yards.
- Reaction Time

If the "Save Trace" check box is checked, this test generates strip-chart style trace data for all input channels, at the sampling speed specified in the "Trace Data Collection Speed" screen found under the database menu.

Note

Trace data cannot be saved unless the "Save Results" check box is checked along with the "Save Trace" check box.

Special Considerations for This Test

- Do not let the vehicle roll until you are read to start the test.
- As soon as the vehicle starts rolling, the test will start timing.
- Drive like you are at the drag strip (including being very careful!)

Options Under the "Set Ets & Other Options" Button

This form lets you set various options for the ¼ mile test routine.

Your ET

Your estimated ¼ mile ET, used for staggered starts on the timing lights.

Staged->Start Delay, Min

Staged->Start Delay, Max

Used to set the minimum and maximum delays from when you start the test until the tree starts turning on the lights.

Use Opponent

If checked, the opposite side of the tree will be driven appropriately for the opponent you have described.

Opponent's ET

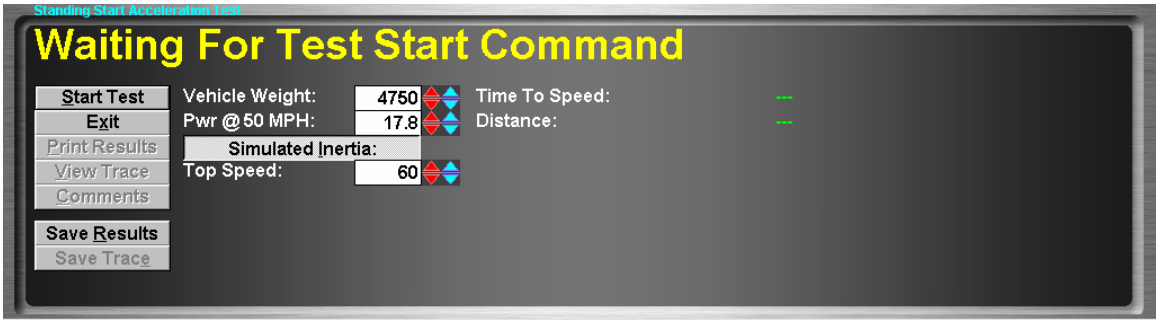
Your opponent's estimated ¼ mile ET, used for staggered starts on the timing lights.

Use Left Side (Else Right)

If checked, you should follow the left side of the tree, otherwise you should follow the right side of the tree.

Standing Start Acceleration

This test allows the operator to simulate a 0-60 type standing start acceleration run with the vehicle.



Purpose

This test allows the operator to simulate a 0-60 type standing start acceleration run with the vehicle.

Intended Test Procedure

This test has a fixed termination time, when the vehicle has reached the specified top speed. The general testing procedure is outlined below.

- The "Vehicle Weight" field will default to the weight entered for the vehicle currently selected for testing. The operator may change this weight if desired.
- The "Pwr @ 50 MPH" field will default to the value entered for the vehicle currently selected for testing. The operator may change this value if desired.
- The "Simulated Inertia" check box determines whether inertia simulation will be used or not. Mustang Dynamometer recommends that this option always be used.
- The "Top Speed" value should be entered, typically 50, 60 or 100 MPH.
- The "Save Results" and "Save Trace" check boxes should be set appropriately.
- The "Start Test" button is clicked.
- The vehicle is accelerated as quickly as possible to the specified top speed. Test timing begins as soon as the vehicle's speed exceeds 0.1 MPH.
- The test terminates when the vehicle reaches the specified top speed. The "Stop Test" button may be used to terminate a test you do not wish to finish.
- Once the test is complete, the dynamometer's PAU is used to stop the system, to avoid wear to the vehicle's brakes.
- Any saved test results may be viewed and/or a test report printed.

Results Obtained

If the "Save Results" check box is checked, a record that this type of test was performed on the currently selected vehicle, along with the date and time the test was performed and any comments about the test session, is saved to the application's database.

For this test type, the following additional information is saved as part of the final test results record:

- Top speed accelerated to.
- Time required to reach specified top speed.

If the "Save Trace" check box is checked, this test generates strip-chart style trace data for all input channels, at the sampling speed specified in the "Trace Data Collection Speed" screen found under the database menu.

Note

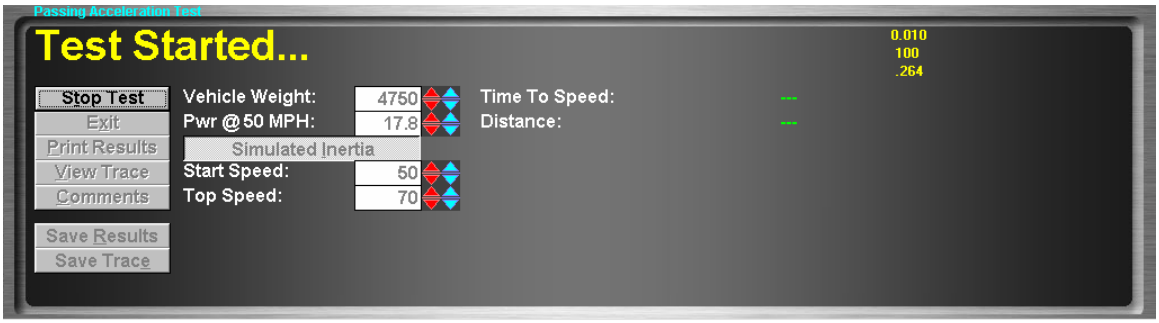
Trace data cannot be saved unless the "Save Results" check box is checked along with the "Save Trace" check box.

Special Considerations for This Test

- Do not let the vehicle roll until you are read to start the test.
- As soon as the vehicle starts rolling, the test will start timing.
- Drive like you are at the drag strip (including being very careful!

Passing Acceleration

This test allows the operator to simulate a 50-70 type passing acceleration run with the vehicle.



Purpose

This test allows the operator to simulate a 50-70 type passing acceleration run with the vehicle.

Intended Test Procedure

This test has a fixed termination time, when the vehicle has reached the specified top speed. The general testing procedure is outlined below.

- The "Vehicle Weight" field will default to the weight entered for the vehicle currently selected for testing. The operator may change this weight if desired.
- The "Pwr @ 50 MPH" field will default to the value entered for the vehicle currently selected for testing. The operator may change this value if desired.
- The "Simulated Inertia" check box determines whether inertia simulation will be used or not. Mustang Dynamometer recommends that this option always be used.
- The "Start Speed" value should be entered, typically 30 or 50 MPH.
- The "Top Speed" value should be entered, typically 50 or 70 MPH.
- The "Save Results" and "Save Trace" check boxes should be set appropriately.
- The "Start Test" button is clicked.
- The vehicle is driven just below the starting speed, and then accelerated as quickly as possible to the specified top speed. Test timing begins as soon as the vehicle's speed exceeds the specified starting speed.
- The test terminates when the vehicle reaches the specified top speed. The "Stop Test" button may be used to terminate a test you do not wish to finish.
- Once the test is complete, the dynamometer's PAU is used to stop the system, to avoid wear to the vehicle's brakes.
- Any saved test results may be viewed and/or a test report printed.

Results Obtained

If the "Save Results" check box is checked, a record that this type of test was performed on the currently selected vehicle, along with the date and time the test was performed and any comments about the test session, is saved to the application's database.

For this test type, the following additional information is saved as part of the final test results record:

- Starting speed.
- Top speed.
- Time required to accelerate from the specified starting speed to the specified top speed.

If the "Save Trace" check box is checked, this test generates strip-chart style trace data for all input channels, at the sampling speed specified in the "Trace Data Collection Speed" screen found under the database menu.

Note

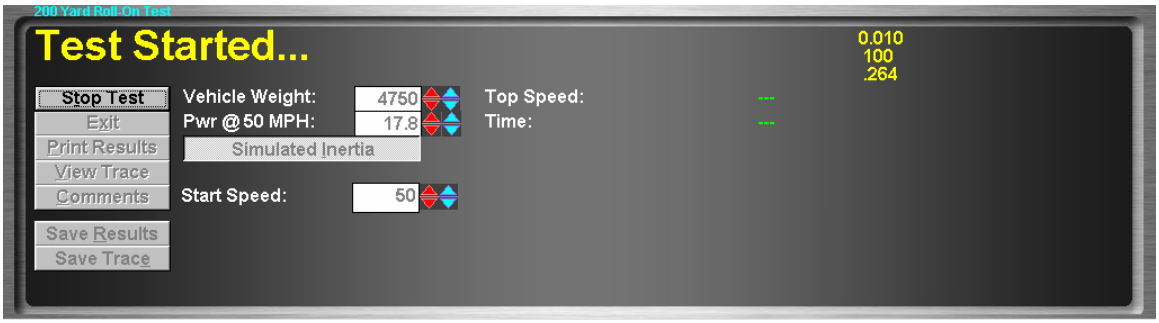
Trace data cannot be saved unless the "Save Results" check box is checked along with the "Save Trace" check box.

Special Considerations for This Test

- Do not let the vehicle roll until you are read to start the test.
- As soon as the vehicle exceeds the specified starting speed, the test will start timing.
- Drive like you are at the drag strip (including being very careful)!

200-Yard Roll-On

This test allows the operator to simulate a 200-yard roll-on acceleration run with the vehicle.



Purpose

This test allows the operator to simulate a 200-yard roll-on acceleration run with the vehicle. (This test is more popular with motorcycle testers than with automotive testers.)

Intended Test Procedure

This test has a fixed termination time, when the vehicle has traveled 200 yards after reaching the specified starting speed. The general testing procedure is outlined below.

- The "Vehicle Weight" field will default to the weight entered for the vehicle currently selected for testing. The operator may change this weight if desired.
- The "Pwr @ 50 MPH" field will default to the value entered for the vehicle currently selected for testing. The operator may change this value if desired.
- The "Simulated Inertia" check box determines whether inertia simulation will be used or not. Mustang Dynamometer recommends that this option always be used.
- The "Start Speed" value should be entered, typically 50 or 60 MPH.
- The "Save Results" and "Save Trace" check boxes should be set appropriately.
- The "Start Test" button is clicked.
- The vehicle is driven just below the starting speed, and then accelerated as quickly as possible to cover 200 yards. Test timing begins as soon as the vehicle's speed exceeds the specified starting speed.
- The test terminates when the vehicle travels 200 yards after reaching the specified starting speed. The "Stop Test" button may be used to terminate a test you do not wish to finish.
- Once the test is complete, the dynamometer's PAU is used to stop the system, to avoid wear to the vehicle's brakes.
- Any saved test results may be viewed and/or a test report printed.

Results Obtained

If the "Save Results" check box is checked, a record that this type of test was performed on the currently selected vehicle, along with the date and time the test was performed and any comments about the test session, is saved to the application's database.

For this test type, the following additional information is saved as part of the final test results record:

- Starting speed.
- Time required to cover 200 yards.
- Speed at 200 yards after starting speed is reached.

If the "Save Trace" check box is checked, this test generates strip-chart style trace data for all input channels, at the sampling speed specified in the "Trace Data Collection Speed" screen found under the database menu.

Note

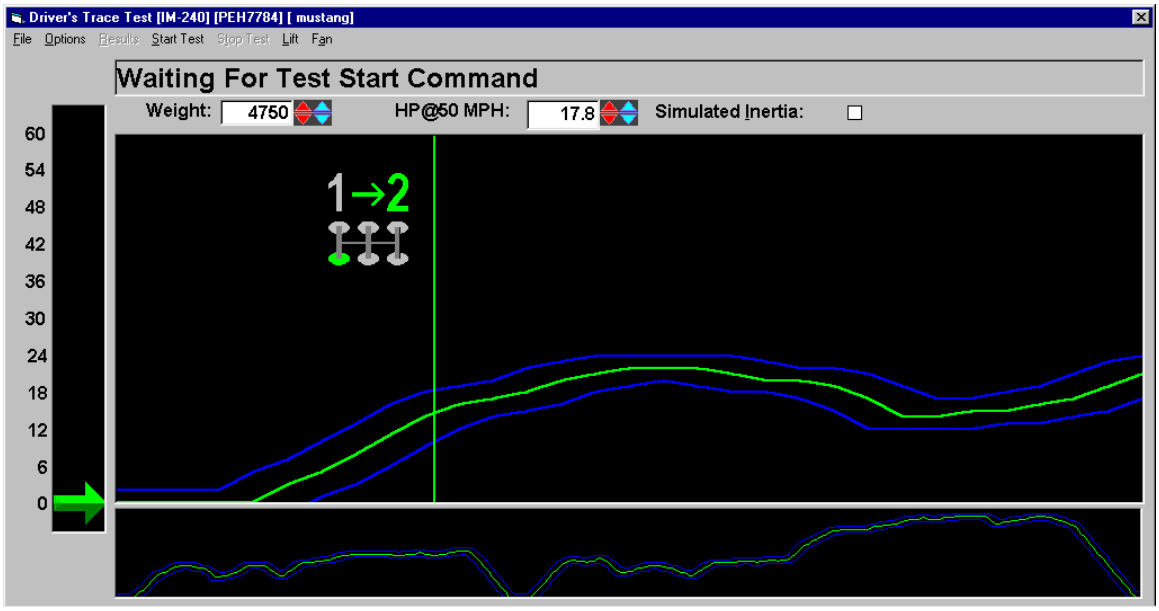
Trace data cannot be saved unless the "Save Results" check box is checked along with the "Save Trace" check box.

Special Considerations for This Test

- Do not let the vehicle roll until you are read to start the test.
- As soon as the vehicle exceeds the specified starting speed, the test will start timing.
- Drive like you are at the drag strip (including being very careful)!

Drivers Trace (IM240/FTP/etc)

This test allows the operator to perform a (non-certified) IM-240/FTP/etc. type transient emissions test.



> **Note**
>
> Please note that the screen contains two sections, the first section is the Big Window that only displays a certain number of second of the drivers trace which can be configured by selecting from the "Options" menu, the menu item "Show Time" and then selecting how many second the operator wants to display. The Second window displays the entire trace and can either be turned on or off by selecting from the "Options" menu the menu item "Show Whole Trace".

Purpose

This test allows the operator to perform A (non-certified) IM-240/FTP/etc. type transient emissions test.

Intended Test Procedure

This test has a fixed termination time, when the vehicle has completed the emissions testing profile. The general testing procedure is outlined below.

- The "Vehicle Weight" field will default to the weight entered for the vehicle currently selected for testing. The operator may change this weight if desired.
- The "Pwr @ 50 MPH" field will default to the value entered for the vehicle currently selected for testing. The operator may change this value if desired.
- The "Simulated Inertia" check box determines whether inertia simulation will be used or not. Mustang Dynamometer recommends that this option always be used.

- The desired emissions driving profile should be selected using the "Load Trace" option on the "File" menu.
- The desired display options should be selected using the entries on the "Options" menu.
- The "Save Results" and "Save Trace" check boxes should be set appropriately.
- The "Start Test" button is clicked.
- The vehicle is driven so that the speed-indicating arrow stays between the two (2) blue lines, or very near the green line if the blue lines are not displayed. This test displays a speed profile that the driver is required to follow to perform the emissions test. The driver will find that driving to the displayed trace grows easier with practice.
- The test terminates when the vehicle completes the selected driving trace. The "Stop Test" button may be used to terminate a test you do not wish to finish.
- Any saved test results may be viewed and/or a test report printed.

Results Obtained

If the "Save Results" check box is checked, a record that this type of test was performed on the currently selected vehicle, along with the date and time the test was performed and any comments about the test session, is saved to the application's database.

For this test type, the following additional information is saved as part of the final test results record:

- Emissions test specific data is recorded, including strip-chart data for each exhaust gas component, vehicle speed, and profile specified speed.

If the "Save Trace" check box is checked, this test generates strip-chart style trace data for all input channels, at the sampling speed specified in the "Trace Data Collection Speed" screen found under the database menu.

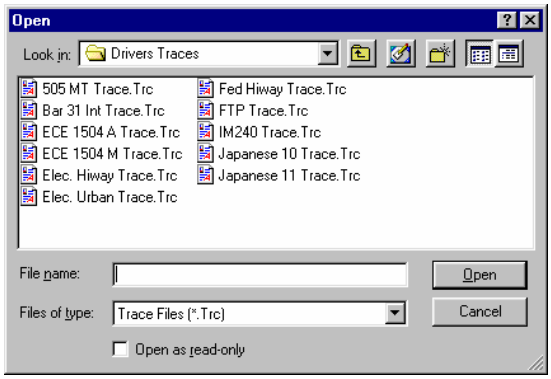
> **Note**
>
> Trace data cannot be saved unless the "Save Results" check box is checked along with the "Save Trace" check box.

Special Considerations for This Test

- A non-integrated emissions analyzer may be used as an alternative to the optional integrated Andros 5-gas bench.

Drivers Trace Menu System

The following is a list of the menu item and a description of their functionality.

<table>
<tr><th>Menu Item</th><th>Description</th></tr>
<tr><td>File</td><td>
<table>
<tr><th>Menu Item</th><th>Description</th></tr>
<tr><td>Load Trace</td><td>This option displays the following dialog that allows the operator to load a previously saved drivers trace.
 
</td></tr>
<tr><td>Exit</td><td>Close out of the drivers trace.</td></tr>
</table>
</td></tr>
<tr><td>Options</td><td>
<table>
<tr><th>Menu Item</th><th>Description</th></tr>
<tr><td>Save Results</td><td>When this menu item is selected then the test results will get saved away so that the operator can view and print them out using the “Drivers Trace Test Results Viewer”. If it is not selected then the test results do not get saved and therefore cannot be printed and viewed. When this menu item is selected the operator also has the ability to edit comments using the “Comment Editor”.</td></tr>
<tr><td>Save Trace Data</td><td>When this menu item is selected then the trace results will get saved away so that the operator can view and print them out using the “Graph Viewer”.</td></tr>
</table>
</td></tr>
</table>

	Show Shift Points	Displays the shift points in the drivers trace when selected.
	Show Error Lines	Displays the minimum and maximum error lines in the drivers trace when selected.
	Show Whole Trace	This will display the entire drivers trace when selected.
	Show Time Bars	Displays the vertical bars that indicate the portion of the total trace that the large graph window is currently showing will be displayed on the entire trace window when selected.
	Use Thick Lines	Draws the lines of the drivers trace thicker when selected.
	Show Time	The numbers of seconds of the driving trace to show in the big window.
	Demo Mode	Run the drivers trace automatically, this could be used for training purposes.

Results

Menu Item	Description
Print Results	Print out the test results.
View/Print Results	Displays the Drivers Trace Test Result Viewer when selected, to see an example of this please refer the chapter 9 under the heading "**Displays the Drivers Trace Test Result Viewer**".

> **Note**
>
> This menu item is enabled only when menu item "Save Results" off of the "Options" menu is

<table>
<tr><td></td><td>
<table>
<tr><td></td><td>selected.</td></tr>
<tr><td>View/Print Trace</td><td>Displays the Graph Viewer when selected, to see an example of this please refer to chapter 9 under the heading “Graph Viewer”.

Note

This menu item is enabled only when menu item “Save Trace Data” off of the “Options” menu is selected.</td></tr>
<tr><td>Edit Comments</td><td>Displays the Comment Editor so that the operator can enter comments for the test run and save them away. For an example of what this looks like please refer to chapter 9 under the heading “Comment Editor”.</td></tr>
</table>

Note

Before a drivers trace is initiated, this menu is disabled, and become enabled only after a drivers trace has been performed.</td></tr>
<tr><td>Start Test</td><td>Starts the test.</td></tr>
<tr><td>Stop Test</td><td>Stop the test.

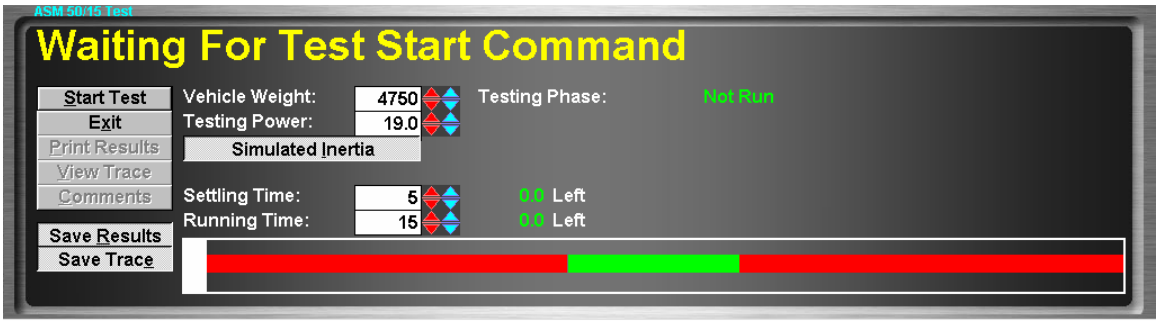
Note

This menu will initially be disabled, and becomes enabled only after the operator has selected the “Start Test” menu.</td></tr>
</table>

Lift	This allows the operator to raise and lower the lifts.
Fan	This allows the operator to turn on and off the fan.

ASM 50/15

This test allows the operator to perform a (non-certified) ASM 50/15 type emissions test.



Purpose

This test allows the operator to perform a (non-certified) ASM 50/15 type emissions test. This test requires the optional Andros 5-gas analyzer bench to be meaningful.

Intended Test Procedure

This test has a fixed termination time, when the vehicle has completed the specified emissions sampling times. The general testing procedure is outlined below.

- The "Vehicle Weight" field will default to the weight entered for the vehicle currently selected for testing. The operator may change this weight if desired.
- The "Testing Power" field's value will automatically be set to the "Vehicle Weight" field divided by 250, or the operator can manually over-ride this default value.
- The "Simulated Inertia" check box determines whether inertia simulation will be used or not. Mustang Dynamometer recommends that this option always be used.
- The desired emissions "Settling Time" and "Running Time" values should be entered.
- The "Save Results" and "Save Trace" check boxes should be set appropriately.
- The "Start Test" button is clicked.
- The vehicle is driven so that the speed-indicating bar stays within the green section of the speed indicator. If the vehicle's speed falls outside of the green range, testing is re-started.
- The test terminates when the vehicle completes the emissions test. The "Stop Test" button may be used to terminate a test you do not wish to finish.
- Any saved test results may be viewed and/or a test report printed.

Results Obtained

If the "Save Results" check box is checked, a record that this type of test was performed on the currently selected vehicle, along with the date and time the test was performed and any comments about the test session, is saved to the application's database.

For this test type, the following additional information is saved as part of the final test results record:

- Average exhaust gas concentrations of each of the gasses of interest.

If the "Save Trace" check box is checked, this test generates strip-chart style trace data for all input channels, at the sampling speed specified in the "Trace Data Collection Speed" screen found under the database menu.

Note

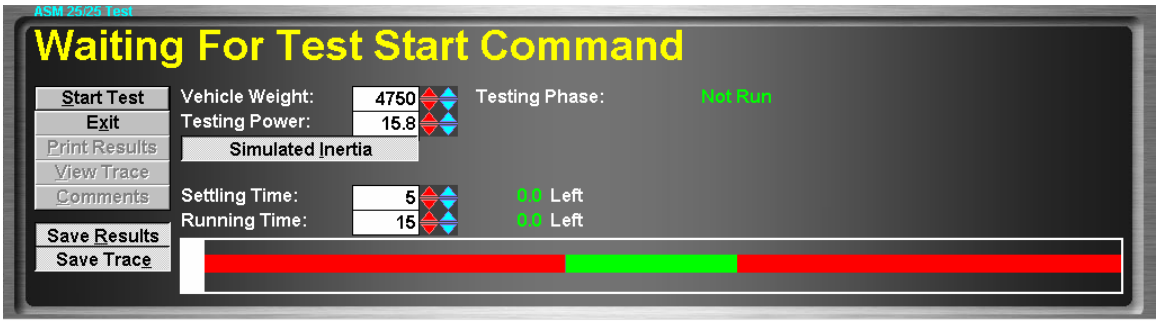
Trace data cannot be saved unless the "Save Results" check box is checked along with the "Save Trace" check box.

Special Considerations for This Test

None.

ASM 25/25

This test allows the operator to perform a (non-certified) ASM 25/25 type emissions test.



Purpose

This test allows the operator to perform a (non-certified) ASM 25/25 type emissions test. This test requires the optional Andros 5-gas analyzer bench to be meaningful.

Intended Test Procedure

This test has a fixed termination time, when the vehicle has completed the specified emissions sampling times. The general testing procedure is outlined below.

- The "Vehicle Weight" field will default to the weight entered for the vehicle currently selected for testing. The operator may change this weight if desired.
- The "Testing Power" field's value will automatically be set to the "Vehicle Weight" field divided by 300, or the operator can manually over-ride this default value.
- The "Simulated Inertia" check box determines whether inertia simulation will be used or not. Mustang Dynamometer recommends that this option always be used.
- The desired emissions "Settling Time" and "Running Time" values should be entered.
- The "Save Results" and "Save Trace" check boxes should be set appropriately.
- The "Start Test" button is clicked.
- The vehicle is driven so that the speed-indicating bar stays within the green section of the speed indicator. If the vehicle's speed falls outside of the green range, testing is re-started.
- The test terminates when the vehicle completes the emissions test. The "Stop Test" button may be used to terminate a test you do not wish to finish.
- Any saved test results may be viewed and/or a test report printed.

Results Obtained

If the "Save Results" check box is checked, a record that this type of test was performed on the currently selected vehicle, along with the date and time the test was performed and any comments about the test session, is saved to the application's database.

For this test type, the following additional information is saved as part of the final test results record:

- Average exhaust gas concentrations of each of the gasses of interest.

If the "Save Trace" check box is checked, this test generates strip-chart style trace data for all input channels, at the sampling speed specified in the "Trace Data Collection Speed" screen found under the database menu.

Note

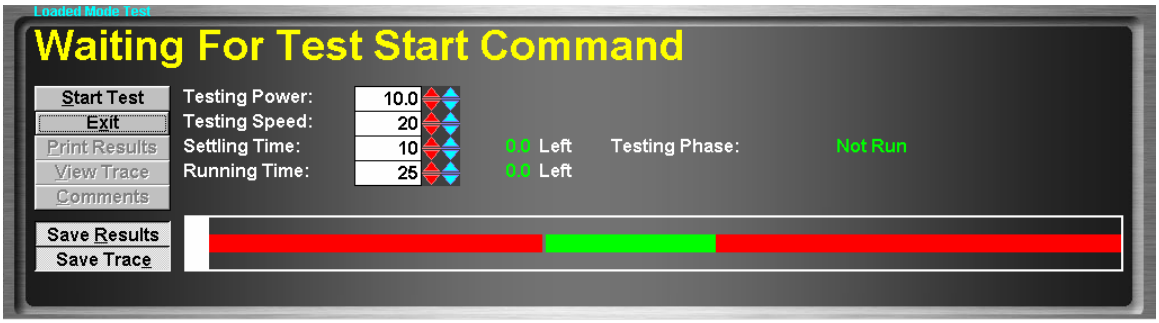
Trace data cannot be saved unless the "Save Results" check box is checked along with the "Save Trace" check box.

Special Considerations for This Test

None.

Loaded Mode

This test allows the operator to perform a (non-certified) loaded mode type emissions test.



Purpose

This test allows the operator to perform a (non-certified) loaded mode emissions test. This test requires the optional Andros 5-gas analyzer bench to be meaningful.

Intended Test Procedure

This test has a fixed termination time, when the vehicle has completed the specified emissions sampling times. The general testing procedure is outlined below.

- The "Testing Power" should be set to the desired power loading.
- The "Testing Speed" should be set to the desired testing speed.
- The desired emissions "Settling Time" and "Running Time" values should be entered.
- The "Save Results" and "Save Trace" check boxes should be set appropriately.
- The "Start Test" button is clicked.
- The vehicle is driven so that the speed-indicating bar stays within the green section of the speed indicator. If the vehicle's speed falls outside of the green range, testing is re-started.
- The test terminates when the vehicle completes the emissions test. The "Stop Test" button may be used to terminate a test you do not wish to finish.
- Any saved test results may be viewed and/or a test report printed.

Results Obtained

If the "Save Results" check box is checked, a record that this type of test was performed on the currently selected vehicle, along with the date and time the test was performed and any comments about the test session, is saved to the application's database.

For this test type, the following additional information is saved as part of the final test results record:

- Average exhaust gas concentrations of each of the gasses of interest.

If the "Save Trace" check box is checked, this test generates strip-chart style trace data for all input channels, at the sampling speed specified in the "Trace Data Collection Speed" screen found under the database menu.

Note

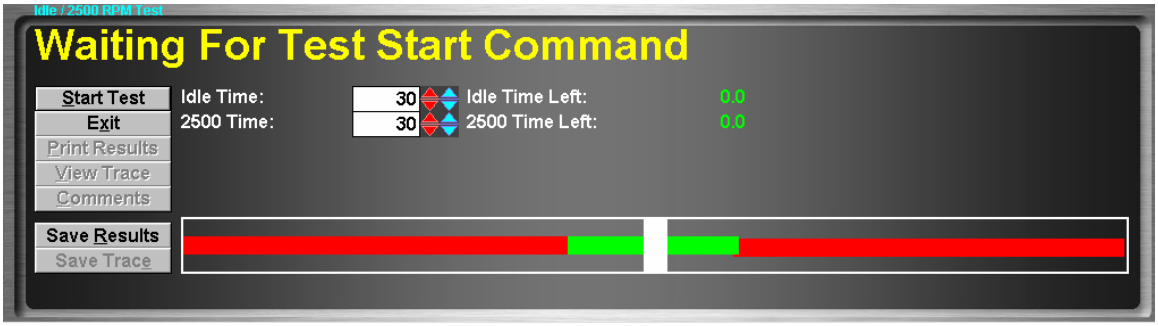
Trace data cannot be saved unless the "Save Results" check box is checked along with the "Save Trace" check box.

Special Considerations for This Test

None.

Idle / 2500 RPM

This test allows the operator to perform a (non-certified) idle/2500 RPM type emissions test.



Purpose

This test allows the operator to perform a (non-certified) idle/2500 RPM type emissions test. This test requires the optional Andros 5-gas analyzer bench to be meaningful.

Intended Test Procedure

This test has a fixed termination time, when the vehicle has completed the specified emissions sampling times. The general testing procedure is outlined below.

- The desired idle and 2500-RPM emissions testing time values should be entered.
- The "Save Results" and "Save Trace" check boxes should be set appropriately.
- The "Start Test" button is clicked.
- The vehicle is driven so that the RPM-indicating bar stays within the green section of the speed indicator. If the vehicle's speed falls outside of the green range, testing is re-started.
- The test terminates when the vehicle completes the emissions test. The "Stop Test" button may be used to terminate a test you do not wish to finish.
- Any saved test results may be viewed and/or a test report printed.

Results Obtained

If the "Save Results" check box is checked, a record that this type of test was performed on the currently selected vehicle, along with the date and time the test was performed and any comments about the test session, is saved to the application's database.

For this test type, the following additional information is saved as part of the final test results record:

- Average exhaust gas concentrations of each of the gasses of interest, for the idle speed testing.
- Average exhaust gas concentrations of each of the gasses of interest, for the 2500 RPM testing.

If the "Save Trace" check box is checked, this test generates strip-chart style trace data for all input channels, at the sampling speed specified in the "Trace Data Collection Speed" screen found under the database menu.

Note

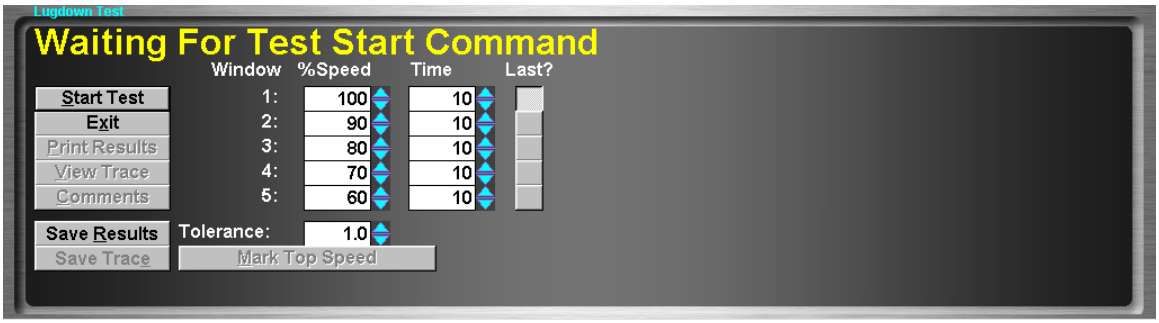
Trace data cannot be saved unless the "Save Results" check box is checked along with the "Save Trace" check box.

Special Considerations for This Test

None.

Lugdown

This test allows the operator to perform a (non-certified) diesel lug-down exhaust opacity test.



Purpose

This test allows the operator to perform a (non-certified) diesel lug-down exhaust opacity test. An opacity meter is generally required to make use of this test routine.

Intended Test Procedure

This test has a fixed termination time, when the vehicle has completed the specified emissions sampling times. The general testing procedure is outlined below.

- % of maximum speed that should be maintained at each testing step in use should be entered, along with the number of seconds that each point is to be held for.
- The radio button in the "Last?" column next to the lowest-speed point to be used should be selected.
- The "Tolerance" field should be set to the maximum number of MPH/KPH by which the system speed can vary from the specified lug-down point speed without triggering a re-start of testing at the point.
- The "Save Results" and "Save Trace" check boxes should be set appropriately.
- The "Start Test" button is clicked.
- The vehicle is driven at its top speed in the gear selected for testing, and the "Mark Top Speed" button is pressed. At this point, the lug-down sequence begins, during which the vehicle's speed will be maintained at each of the in-use testing points for the specified times. (Note that this test logic assumes that the vehicles tested will be equipped with engine RPM governors.)
- The test terminates when the vehicle completes the lowest-speed testing point. The "Stop Test" button may be used to terminate a test you do not wish to finish.
- Any saved test results may be viewed and/or a test report printed.

Results Obtained

If the "Save Results" check box is checked, a record that this type of test was performed on the currently selected vehicle, along with the date and time the test was performed and any comments about the test session, is saved to the application's database.

For this test type, the following additional information is saved as part of the final test results record:

- (None)

If the "Save Trace" check box is checked, this test generates strip-chart style trace data for all input channels, at the sampling speed specified in the "Trace Data Collection Speed" screen found under the database menu.

Note

Trace data cannot be saved unless the "Save Results" check box is checked along with the "Save Trace" check box.

Special Considerations for This Test

You should not attempt to lug an engine down below its lowest acceptable operating speed. Engines operating at full throttle at very low RPM speeds tend to vibrate heavily, in part due to the reduced effectiveness of the crankshaft's harmonic balancer at very low speeds.

PID Closed-Loop Control Basics

Dynamometer's that incorporate a loading device, such as a PAU, motor or water brake, generally employ some type of closed-loop control to achieve and maintain the desired loading and/or speed values. Inertia-only dynamometers obviously have no need for any closed-loop control, since no loading device is present. All Mustang Dynamometer control systems employee the PID form of closed-loop control.

PID closed-loop control constantly compares the desired loading or speed value to the actual measured loading or speed value, and makes fine adjustments to the PAU control signal to make the measured loading or speed match the desired loading or speed. The letters "PID" stand for "Proportional", "Integral" and "Derivative", which represent the different ways by which the output signal is modified based on the desired values and measured values. For each element in the PID control loop, a constant is used to adjust the magnitude of adjustment the PAU control signal will experience due to various types of errors between the measured and desired values.

The "Proportional" term constant is used to scale the system's response to a simple error between the desired and measured loading values. Thus, the "Proportional" term is never 0 unless the measured value exactly matches the desired value. Additionally, The "Proportional" term is used to provide over-all scaling of all three terms of the PID control loop. The "Proportional" term handles low to medium frequency response requirements.

The "Integral" term constant is used to scale the system's response to a following error between the desired and measured loading values. The "Integral" term is used to handle situations where the measured values continuously lag behind the desired values, in the same direction of error. In almost all dynamometer-loading schemes, the desired value changes rapidly, and the measured value chases the desired value both upwards and downwards. Thus, the "Integral" term is very seldom required, and its use is not recommended in our control systems. The "Integral" term handles relatively low frequency response requirements.

The "Derivative" term constant is used to scale the system's response to the rate of change of error between the desired and measured loading values. The "Derivative" term responds to sudden changes in both or either of the desired loading or measured loading values, and to the rate of change of the error between them. The "Derivative" term is never 0 unless the rate of change of error is 0. The "Derivative" term handles medium to high frequency response requirements.

The basic logic for our implementation of the PID closed-loop control logic is given below. The "Desired" and "Measured" values may be torques, forces, speeds, etc. The logic given below happens 100 times per second (by default).

```
Error = (Desired – Measured)

ProportionalTerm = (PConstant * Error)

IntegralTerm = IntegralTerm + (PConstant * ICconstant * Error)

DerivativeTerm = (PConstant * DConstant * ((Error – LastError) / UpdateTime))
```

PAUVoltage = ProportionalTerm + IntegralTerm + DerivativeTerm

OldError = Error

Since the mathematics above remain constant regardless of the value being controlled (e.g. torque or speed), the sign of the "P" constant is critical. This can be observed by considering the "ProportionalTerm" above; if the measured torque is less than the desired torque, the PAU signal must be increased, whereas if the measures speed is less than the desired speed, the PAU signal must be decreased. A sign-error on the "P" constant will result in a loop that works backwards, in effect saying to itself, "The actual load is too low, I must decrease it!"

"Tuning" a PID-type control loop refers to the process of determining the P, I, and D constants required to achieve the desired control characteristics. Generally, the time required to achieve a 90% response to a step change in the desired loading value and the long-term stability of the control loop are the primary considerations in tuning a PID loop.

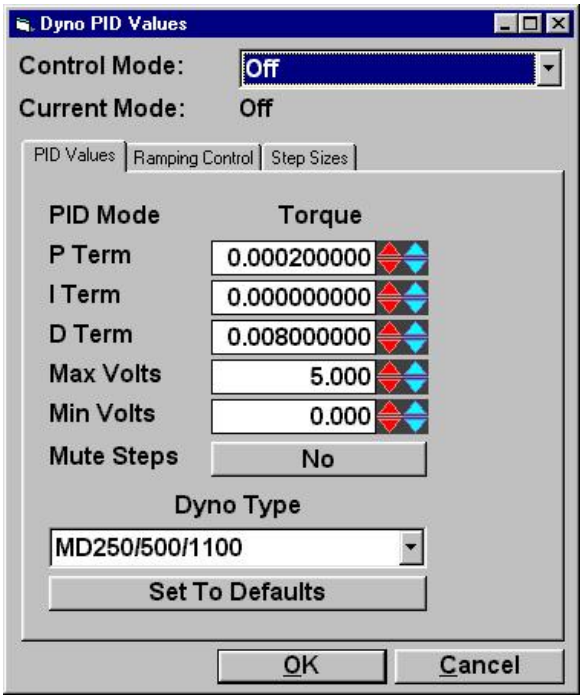
People new to the concept of closed-loop control frequently ask if there is a method of directly calculating the optimal P, I, and D constant values. Control theory tells use that, in theory, this is possible. In reality, tuning a PID loop requires that some initial PID constant values be selected, and iterative tuning be performed. The initial PID constants selected must be of the correct sign, and must be relatively small. By appropriately selecting the initial PID constants, a very slow, but probably stable, control loop may be achieved. Iterative tuning, wherein the PID constants are gradually varied and the control loop's response evaluated, is then used to increase the PID constants until the desired control loop response characteristics are achieved. For the truly motivated reader, the PID control loop math outlined above can be used to select initial PID constants, knowing that the PID loop's output value is fed to the PAU controller, and has a range of 0.0 volts to 5.0 volts, and that the control loop is updated (by default) at 100 times per second.

Mustang Dynamometer strongly recommends that the default PID values for your dynamometer type be used.

Operators familiar with PID closed-loop control may wonder why there are individual PID constant sets for each test routine, since a dynamometer can generally only control the torque on or the speed of its rolls.

The reason that individual PID constant sets are supported for each test routine is to allow the operator to configure tests that use the same type of control (torque or speed) to have different response characteristics.

This screen allows the operator to specify PID values and/or restore the default PID values, set ramping options, and set the step sizes used by the scrolling arrows and arrow keys in the various test routines.



Control Mode

Lets the operator select the specific control mode that they want to adjust the PID values for. Note that all control modes map to 1 of 2 actual PID value sets, one for load based PID control, and one for speed based PID control. The associated PID set will be identified next to the "PID Mode" identifier.

Current Mode

Shows the current control mode of the dyno's load controller.

P Term

The "P" term for the PID control logic.

I Term

The "I" term for the PID control logic – normally 0.

D Term

The "P" term for the PID control logic.

Max Volts

The maximum output voltage the PID loop can generate. This value should normally be left at 5.0, but can be set to a lower value to reduce the maximum load applied by the dynamometer.

Min Volts

The maximum output voltage the PID loop can generate. This value should normally be left at 0.0 (or –5.0 for dyno's with motors rather than PAUs). For dyno's with motors rather than PAUs, can be set to a lower value (eg –3, NOT –6) to reduce the maximum reverse load applied by the dynamometer.

Mute Steps

If this is selected, the PID loop's response to sudden changes to the commanded value will be muted, otherwise full response will be used.

Dyno Type

Lets the operator specify the type of dyno they have, for use in resetting the PID values to the default values appropriate for that dyno type.

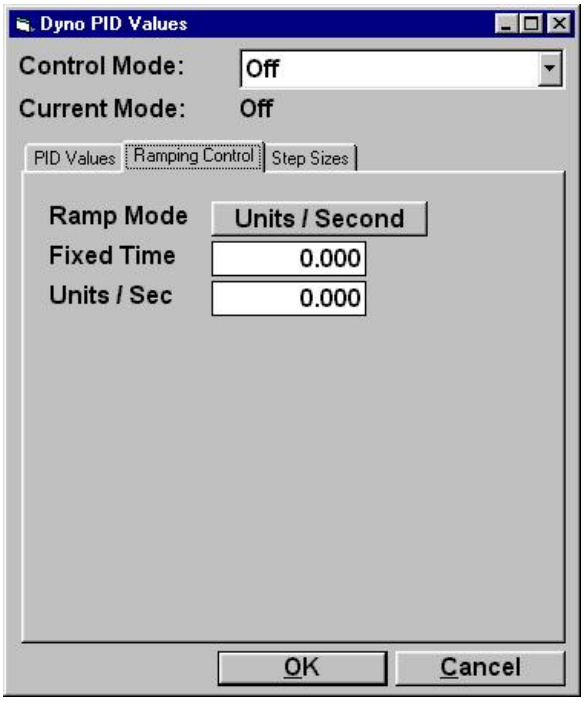
Set To Defaults

Mustang Dynamometer engineers have spent many long hours performing the iterative PID loop tuning described above. The results of their testing sessions are the default PID constants available to operators of this screen by clicking on the "Set To Defaults" button. Mustang Dynamometer recommends that these default PID constant values be used. Note that the ramp rate settings do not require any tuning, and may be varied as desired.

Before resetting any PID values, make sure you first select the type of dynamometer you have.

Dyno PID Values – Ramping Control Values

This screen allows the operator to specify PID values and/or restore the default PID values, set ramping options, and set the step sizes used by the scrolling arrows and arrow keys in the various test routines.



Control Mode

Lets the operator select the specific control mode that they want to adjust the PID values for. Note that all control modes map to 1 of 2 actual PID value sets, one for load based PID control, and one for speed based PID control. The associated PID set will be identified next to the "PID Mode" identifier.

Current Mode

Shows the current control mode of the dyno's load controller.

Ramp Mode

May be set to "Units / Second" or "Fixed Time". "Units / Second" means to ramp the PID loop's target from the current value to any new command value at "xxx" units / second. "Fixed Time" means to ramp the PID loop's target from the current value to any new command value in "xxx" seconds, regardless of the step size.

Fixed Time

Specifies the number of seconds it should take to ramp to a new command value. A value of 0 means to not ramp at all, just immediately apply the new command value.

Units / Second

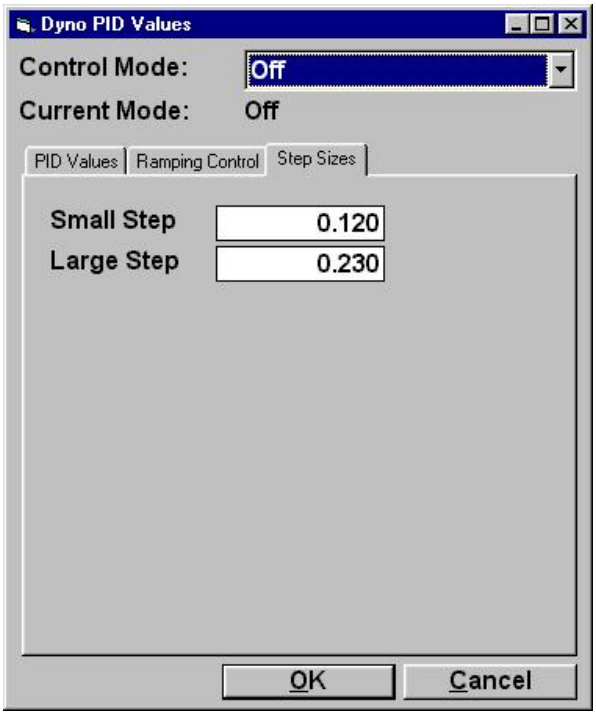
Specifies the number of units / second at which the PID loop's target should be ramped to a new command value. A value of 0 means to not ramp at all, just immediately apply the new command value.

Since a PID closed-loop controller is generally tuned to achieve the fastest response possible with the maximum tolerable long-term instability, the closed-loop control will move from a previously desired value to a newly specified desired value as quickly as possible. In cases where the fastest possible response to a change in the desired loading value is not desired, a ramping function may be used.

Ramping refers to the process of gradually varying the control loop's set-point value from the previously specified value to any newly specified value. For example, the control loop's set-point value will not change from 100 pounds of force to 200 pounds of force instantaneously; rather, the set-point value will be gradually "ramped" from 100 to 200 pounds using the ramping values currently in effect.

Dyno PID Values – Step Size Values

This screen allows the operator to specify PID values and/or restore the default PID values, set ramping options, and set the step sizes used by the scrolling arrows and arrow keys in the various test routines.



Control Mode

Lets the operator select the specific control mode that they want to adjust the PID values for. Note that all control modes map to 1 of 2 actual PID value sets, one for load based PID control, and one for speed based PID control. The associated PID set will be identified next to the "PID Mode" identifier.

Current Mode

Shows the current control mode of the dyno's load controller.

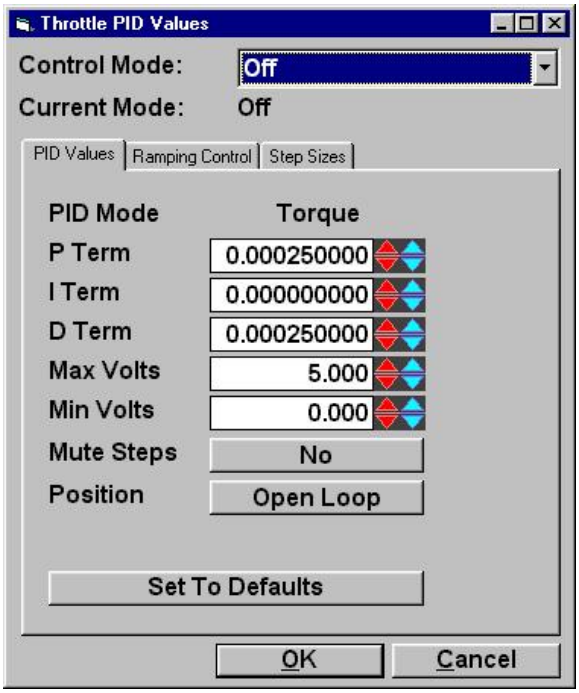
Small Step

The amount that the user-specified command value will change by for each click on the small-step up or down arrows next to a command value, or when the <Ctrl>Up or <Ctrl>Down keystrokes are used during a test.

Large Step

The amount that the user-specified command value will change by for each click on the large-step up or down arrows next to a command value.

This screen allows the operator to specify PID values and/or restore the default PID values, set ramping options, and set the step sizes used by the scrolling arrows and arrow keys in the various test routines.



Control Mode

Lets the operator select the specific control mode that they want to adjust the PID values for. Note that all control modes map to 1 of 2 actual PID value sets, one for load based PID control, and one for speed based PID control. The associated PID set will be identified next to the "PID Mode" identifier.

Current Mode

Shows the current control mode of the throttle controller.

P Term

The "P" term for the PID control logic.

I Term

The "I" term for the PID control logic – normally 0.

D Term

The "P" term for the PID control logic.

Max Volts

The maximum output voltage the PID loop can generate. This value should normally be left at 5.0, but can be set to a lower value to reduce the maximum load applied by the throttle controller.

Min Volts

The maximum output voltage the PID loop can generate. This value should normally be left at 0.0.

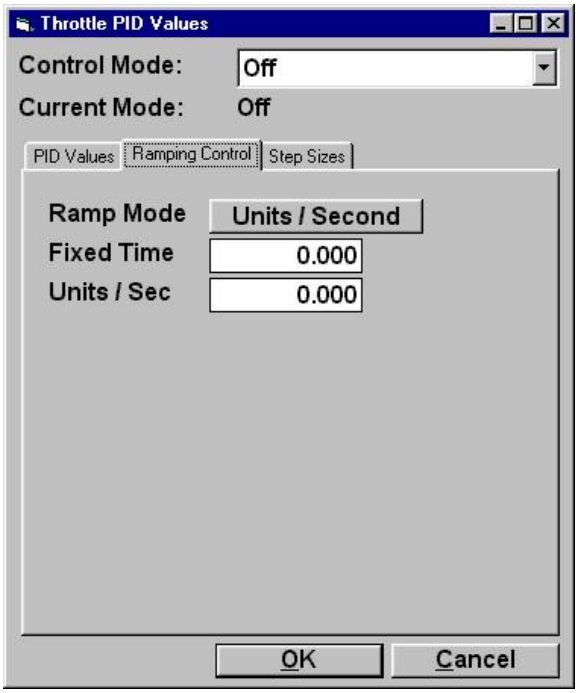
Mute Steps

If this is selected, the PID loop's response to sudden changes to the commanded value will be muted, otherwise full response will be used.

Set To Defaults

Mustang Dynamometer engineers have spent many long hours performing the iterative PID loop tuning described above. The results of their testing sessions are the default PID constants available to operators of this screen by clicking on the "Set To Defaults" button. Mustang Dynamometer recommends that these default PID constant values be used. Note that the ramp rate settings do not require any tuning, and may be varied as desired.

This screen allows the operator to specify PID values and/or restore the default PID values, set ramping options, and set the step sizes used by the scrolling arrows and arrow keys in the various test routines.



Control Mode

Lets the operator select the specific control mode that they want to adjust the PID values for. Note that all control modes map to 1 of 2 actual PID value sets, one for load based PID control, and one for speed based PID control. The associated PID set will be identified next to the "PID Mode" identifier.

Current Mode

Shows the current control mode of the throttle controller.

Ramp Mode

May be set to "Units / Second" or "Fixed Time". "Units / Second" means to ramp the PID loop's target from the current value to any new command value at "xxx" units / second. "Fixed Time" means to ramp the PID loop's target from the current value to any new command value in "xxx" seconds, regardless of the step size.

Fixed Time

Specifies the number of seconds it should take to ramp to a new command value. A value of 0 means to not ramp at all, just immediately apply the new command value.

Units / Second

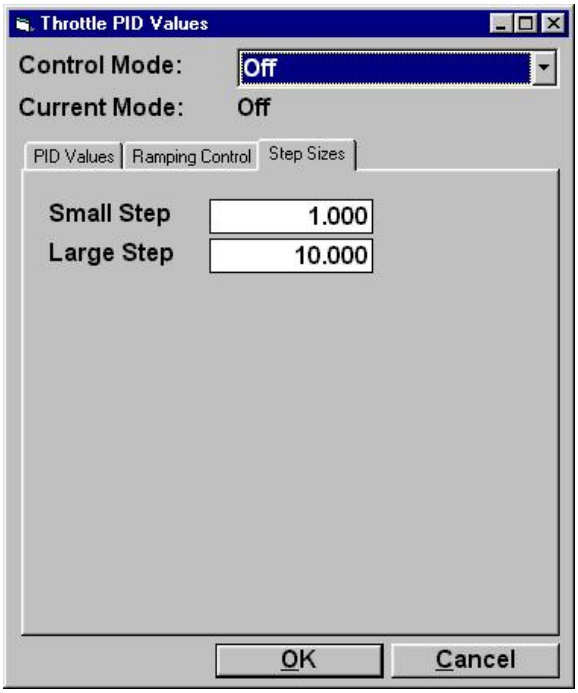
Specifies the number of units / second at which the PID loop's target should be ramped to a new command value. A value of 0 means to not ramp at all, just immediately apply the new command value.

Since a PID closed-loop controller is generally tuned to achieve the fastest response possible with the maximum tolerable long-term instability, the closed-loop control will move from a previously desired value to a newly specified desired value as quickly as possible. In cases where the fastest possible response to a change in the desired loading value is not desired, a ramping function may be used.

Ramping refers to the process of gradually varying the control loop's set-point value from the previously specified value to any newly specified value. For example, the control loop's set-point value will not change from 100 pounds of force to 200 pounds of force instantaneously; rather, the set-point value will be gradually "ramped" from 100 to 200 pounds using the ramping values currently in effect.

Throttle Controller PID Values – Step Size Values

This screen allows the operator to specify PID values and/or restore the default PID values, set ramping options, and set the step sizes used by the scrolling arrows and arrow keys in the various test routines.



Control Mode

Lets the operator select the specific control mode that they want to adjust the PID values for. Note that all control modes map to 1 of 2 actual PID value sets, one for load based PID control, and one for speed based PID control. The associated PID set will be identified next to the "PID Mode" identifier.

Current Mode

Shows the current control mode of the throttle controller.

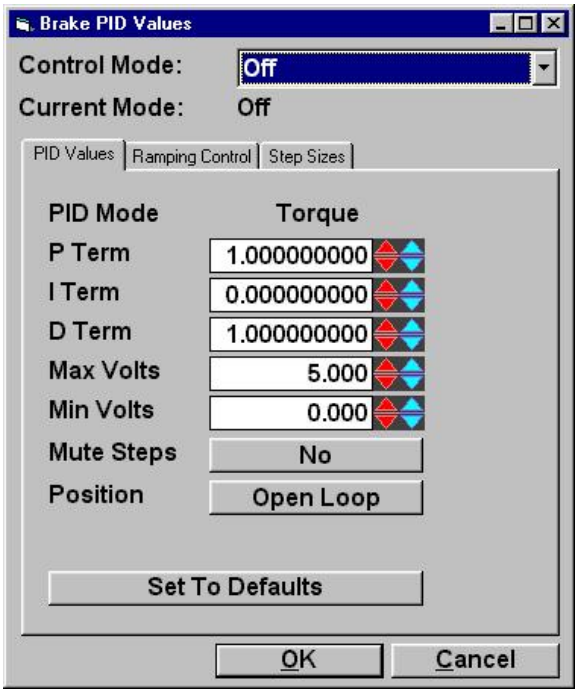
Small Step

The amount that the user-specified command value will change by for each click on the small-step up or down arrows next to a command value, or when the <Ctrl>Up or <Ctrl>Down keystrokes are used during a test.

Large Step

The amount that the user-specified command value will change by for each click on the large-step up or down arrows next to a command value.

This screen allows the operator to specify PID values and/or restore the default PID values, set ramping options, and set the step sizes used by the scrolling arrows and arrow keys in the various test routines.



Control Mode

Lets the operator select the specific control mode that they want to adjust the PID values for. Note that all control modes map to 1 of 2 actual PID value sets, one for load based PID control, and one for speed based PID control. The associated PID set will be identified next to the "PID Mode" identifier.

Current Mode

Shows the current control mode of the brake controller.

P Term

The "P" term for the PID control logic.

I Term

The "I" term for the PID control logic – normally 0.

D Term

The "P" term for the PID control logic.

Max Volts

The maximum output voltage the PID loop can generate. This value should normally be left at 5.0, but can be set to a lower value to reduce the maximum load applied by the brake controller.

Min Volts

The maximum output voltage the PID loop can generate. This value should normally be left at 0.0.

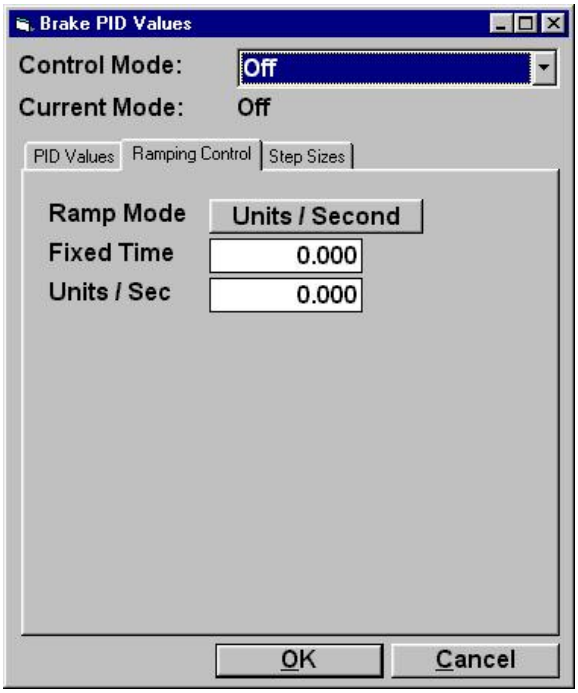
Mute Steps

If this is selected, the PID loop's response to sudden changes to the commanded value will be muted, otherwise full response will be used.

Set To Defaults

Mustang Dynamometer engineers have spent many long hours performing the iterative PID loop tuning described above. The results of their testing sessions are the default PID constants available to operators of this screen by clicking on the "Set To Defaults" button. Mustang Dynamometer recommends that these default PID constant values be used. Note that the ramp rate settings do not require any tuning, and may be varied as desired.

This screen allows the operator to specify PID values and/or restore the default PID values, set ramping options, and set the step sizes used by the scrolling arrows and arrow keys in the various test routines.



Control Mode

Lets the operator select the specific control mode that they want to adjust the PID values for. Note that all control modes map to 1 of 2 actual PID value sets, one for load based PID control, and one for speed based PID control. The associated PID set will be identified next to the "PID Mode" identifier.

Current Mode

Shows the current control mode of the brake controller.

Ramp Mode

May be set to "Units / Second" or "Fixed Time". "Units / Second" means to ramp the PID loop's target from the current value to any new command value at "xxx" units / second. "Fixed Time" means to ramp the PID loop's target from the current value to any new command value in "xxx" seconds, regardless of the step size.

Fixed Time

Specifies the number of seconds it should take to ramp to a new command value. A value of 0 means to not ramp at all, just immediately apply the new command value.

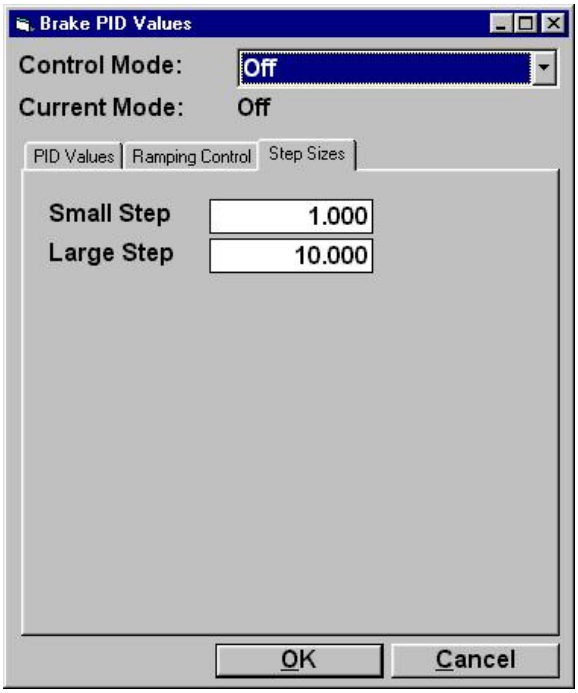
Units / Second

Specifies the number of units / second at which the PID loop's target should be ramped to a new command value. A value of 0 means to not ramp at all, just immediately apply the new command value.

Since a PID closed-loop controller is generally tuned to achieve the fastest response possible with the maximum tolerable long-term instability, the closed-loop control will move from a previously desired value to a newly specified desired value as quickly as possible. In cases where the fastest possible response to a change in the desired loading value is not desired, a ramping function may be used.

Ramping refers to the process of gradually varying the control loop's set-point value from the previously specified value to any newly specified value. For example, the control loop's set-point value will not change from 100 pounds of force to 200 pounds of force instantaneously; rather, the set-point value will be gradually "ramped" from 100 to 200 pounds using the ramping values currently in effect.

This screen allows the operator to specify PID values and/or restore the default PID values, set ramping options, and set the step sizes used by the scrolling arrows and arrow keys in the various test routines.



Control Mode

Lets the operator select the specific control mode that they want to adjust the PID values for. Note that all control modes map to 1 of 2 actual PID value sets, one for load based PID control, and one for speed based PID control. The associated PID set will be identified next to the "PID Mode" identifier.

Current Mode

Shows the current control mode of the brake controller.

Small Step

The amount that the user-specified command value will change by for each click on the small-step up or down arrows next to a command value, or when the <Ctrl>Up or <Ctrl>Down keystrokes are used during a test.

Large Step

The amount that the user-specified command value will change by for each click on the large-step up or down arrows next to a command value.

Chapter

12

Calibration Menu

The Calibration Menu offers access to all of the required calibration functions of the dynamometer. The "Diagnostics" sub-menu is only available when in "Debugging" mode, which can be turned on/off in the "Dyno Parameters" screen.

Load cell calibrations are on a sub-menu, with support for up to 4 load cells. Only load cells that are in use (as determined on the "Dyno Parameters" screen) are enabled.

The "Auxiliary I/O" sub-menu allows access to the configuration screens for the analog outputs that are used to drive signals out to external data acquisition systems.

The "Vehicle Controller" menu item allows access to the vehicle (throttle) controller setup screen.

The following is a list of the menu item that the operator has access to along with any sub menu item:

<table>
<tr><th>Menu Item</th><th>Description</th></tr>
<tr><td>Load Cell Calibrations</td><td>
<table>
<tr><th>Sub Menu Item</th><th>Description</th></tr>
<tr><td>Load Cell #1 Calibration</td><td>This screen allows the operator to calibrate load cell #1.</td></tr>
<tr><td>Load Cell #2 Calibration</td><td>This screen allows the operator to calibrate load cell #2.</td></tr>
<tr><td>Load Cell #3 Calibration</td><td>This screen allows the operator to calibrate load cell #3.</td></tr>
<tr><td>Load Cell #4 Calibration</td><td>This screen allows the operator to calibrate load cell #4.</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><td>Analog Input RPM Calibration</td><td>This screen allows the operator to calibrate the analog engine RPM input.</td></tr>
<tr><td>Smart Tach Setup</td><td>To change the SmartTach RPM system voltage threshold and pulses per revolution, access the SmartTach Setup Menu as shown below.
<table>
<tr><th>Sub Menu Item</th><th>Description</th></tr>
<tr><td>Download Inductive Configuration</td><td>Downloads a canned configuration to the SmartTach for inductive RPM measurement.</td></tr>
<tr><td>Download Optical configuration</td><td>Downloads a canned configuration to the SmartTach for optical RPM measurement.</td></tr>
<tr><td>Download TS-1 Configuration</td><td>Downloads a canned configuration to the SmartTach for RPM measurement using the TS-1 probe.</td></tr>
<tr><td>Download Custom Configuration</td><td>Downloads a custom canned configuration to the SmartTach.</td></tr>
<tr><td>Set Threshold Voltage (Ind)</td><td>Sets the threshold input voltage used for RPM measurements. Lower values are more sensitive, but are also affected more by noise.</td></tr>
<tr><td>Set Pulses/Rev (Ind/TS-1)</td><td>Sets the number of pulses per revolution generated by the inductive or TS-1 probes when used on your engine.</td></tr>
<tr><td>Set Multi-Strike enabled (Ind)</td><td>Enables or disables multi-strike filtering, which can help reduce RPM measurement errors on vehicles with multi-strike ignition systems.</td></tr>
</table></td></tr>
</table>

<table>
<tr><td></td><td><table>
<tr><td>Configuration & Diagnostics</td><td>Opens a window that gives the operator full control over the configuration of the SmartTach device – this is not for casual customer use, but is intended for use with the guidance of a qualified Mustang Dynamometer technician.</td></tr>
<tr><td></td><td></td></tr>
</table></td></tr>
<tr><td>Opacity Meter Calibration</td><td>This screen allows the operator to calibrate the analog exhaust opacity input.</td></tr>
<tr><td>Gas Analyzer Bench</td><td><table>
<tr><th>Sub menu item</th><th>Description</th></tr>
<tr><td>Bench Calibration</td><td>This screen allows the operator to calibrate the optional Andros 5-gas analyzer bench.</td></tr>
<tr><td>Enable Bench</td><td>Enables the bench for use. Setting “sticks” for future software sessions.</td></tr>
<tr><td>Disable Bench</td><td>Disables the bench, to reduce wear on the bench pump, sensors, etc. Setting “sticks” for future software sessions.</td></tr>
</table></td></tr>
<tr><td>Vehicle Controller Setup</td><td><table>
<tr><th>Sub menu item</th><th>Description</th></tr>
<tr><td>Brake / Throttle Controller Setup</td><td>This screen allows the operator to configure the optional integrated vehicle controller.</td></tr>
<tr><td>Brake / Throttle Controller Calibration</td><td>This screen allows the operator to calibrate the feedback channels for the brake / throttle controllers.</td></tr>
</table></td></tr>
</table>

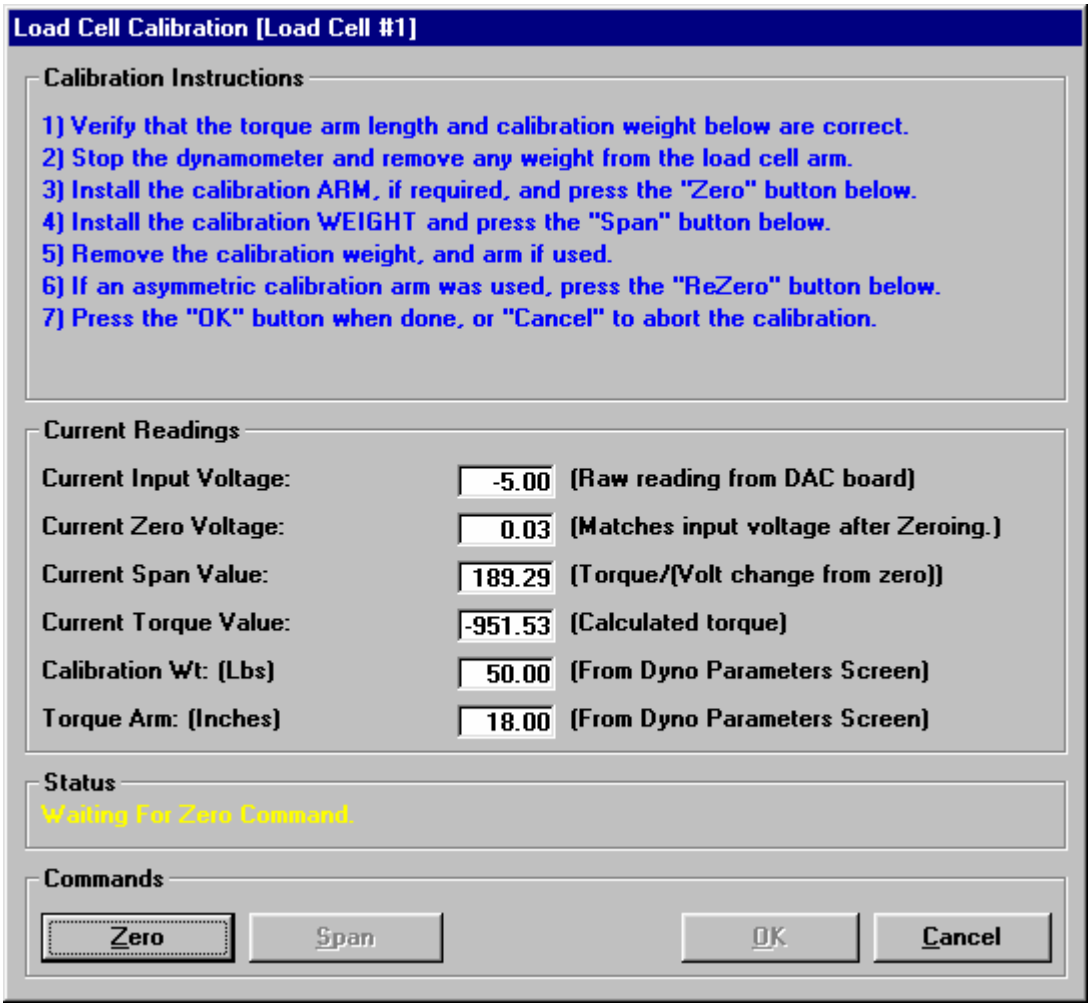
<table>
<tr><td></td><td><table>
<tr><td>Brake / Throttle Controller Hand Pendant Setup</td><td>This screen allows the operator to setup the hand pendant used for manual control of the brake / throttle controllers.</td></tr>
</table></td></tr>
<tr><td>Auxiliary I/O Setup</td><td><table>
<tr><th>Sub menu item</th><th>Description</th></tr>
<tr><td>Auxiliary Analog Input Setup</td><td>This menu item allows access to the setup screen used to configure the auxiliary analog inputs used for extra data acquisition hardware, e.g. exhaust gas oxygen sensors, pressure sensors, etc.</td></tr>
<tr><td>Auxiliary Analog Output Setup</td><td>This menu item allows access to the setup screen used to configure the speed/RPM and torque/force analog outputs supported by the ADA-1100 I/O boards.</td></tr>
<tr><td>External DAC Board Setup</td><td>This menu item allows access to the setup screen used to configure the analog output boards used to drive system values out to external data acquisition systems.</td></tr>
<tr><td>External DAC Channel Setup</td><td>This menu item allows access to the setup screen used to configure the values sent out via the analog outputs to external data acquisition systems.</td></tr>
</table></td></tr>
<tr><td>AWD Base Setup</td><td>This screen allows the operator to setup the various I/O channels used by the all-wheel-drive base hardware.</td></tr>
<tr><td>Throttle/Brake Controller Hand Pendant Setup</td><td>This screen allows the operator to setup the various I/O lines used by the throttle / brake controller hand pendant.</td></tr>
<tr><td>Timing Light Tree Setup</td><td>This screen allows the operator to manually control the drag racing timing lights.</td></tr>
</table>

<table>
<tr><td>Calibration/Verification Routines</td><td>
<table>
<tr><th>Sub menu item</th><th>Description</th></tr>
<tr><td>Warmup</td><td>This screen allows the operator to perform an automatic dynamometer warm-up routine.</td></tr>
<tr><td>Parasitics Measurement</td><td>This screen allows the operator to perform an automatic dynamometer parasitics measurement routine.</td></tr>
<tr><td>Parasitics Viewer</td><td>This screen allows the operator to view the current parasitic losses data as a graph.</td></tr>
<tr><td>Coast Down Check</td><td>This screen allows the operator to perform an automatic dynamometer coast-down test.</td></tr>
<tr><td>Inertia Check Test</td><td>This screen allows the operator to perform an automatic dynamometer inertia measurement routine.</td></tr>
<tr><td>Automatic PID Calculator</td><td>This screen allows the operator to perform an automatic PID tuning routine.</td></tr>
<tr><td>Map Speed Encoder</td><td>This routine allows the operator to create a noise-canceling map of a speed encoder input, which is then used during testing to map the noise generated by the encoder itself out of the speed input.</td></tr>
</table>
</td></tr>
<tr><td>Dyno Parameters</td><td>This screen allows the operator to specify dynamometer-specific parameters.</td></tr>
</table>

<table>
<tr><td>System Parameters</td><td>This screen allows the operator to specify system-level parameters.</td></tr>
<tr><td>Weather Station Parameters</td><td>This screen allows the operator to configure and/or calibrate the weather station facility.</td></tr>
<tr><td>Display Units</td><td>This screen allows the operator to select the units used to display values in this software.</td></tr>
<tr><td>Languages</td><td>This screen allows the operator to select the current language for display and printing.</td></tr>
<tr><td>Diagnostics</td><td>
<table>
<tr><th>Sub Menu Item</th><th>Description</th></tr>
<tr><td>ADA1100 driver setup</td><td>This is the configuration screen for the driver for the ADA-1100 I/O board used to control the dynamometer.</td></tr>
<tr><td>I/O board diagnostic</td><td>Shows a simple diagnostic screen for the I/O board(s) used to control the dynamometer. Not for casual customer use, only for use with guidance from a qualified Mustang Dynamometer technician.</td></tr>
<tr><td>Gas Bench Diagnostic</td><td>Shows a diagnostic screen for the exhaust gas analyzer. Not for casual customer use, only for use with guidance from a qualified Mustang Dynamometer technician.</td></tr>
<tr><td>INI File editor</td><td>This allows the operator to edit the application's main INI file.</td></tr>
<tr><td>Toggle Debug Window</td><td>Shows a small diagnostic message window, only used by Mustang Dynamometer technicians.</td></tr>
<tr><td></td><td></td></tr>
</table>
</td></tr>
</table>

Load Cell #1 Calibration (Load Cells #2, #3, and #4 are identical)

This screen allows the operator to calibrate load cell #1 (torque) input.



Load cell calibration is a very simple two (2) or three (3) step process required to generate a linear calibration. The steps required to perform a load cell calibration are described below.

- If you are calibrating a multiple-PAU dynamometer, make sure that you are working on the primary load cell.
- Verify that the displayed calibration weight and torque arm length values are correct. These values are associated with your dynamometer's physical design, and will not change after initial configuration. You may change these values, if required, using the "Dyno Parameters" screen.
- Remove the PAU cover on your dynamometer to gain access to the load cell area.
- Since the first point in the calibration is at a zero input condition, make sure that there is no weight on the calibration arm or fixture, that the dynamometer's lift is down, and that no vehicle is on the dynamometer.

- If you are using a dynamometer with a separate load cell calibration arm, install the calibration arm on the PAU.

- Visually verify that the current analog input voltage is nearly 0.0 volts (+/- 0.5 volts typical).

- Click the "Zero" button to set the zero calibration point.

- Assuming that the zero command worked (otherwise the message box will indicate that the zero calibration failed due to an invalid input voltage), you may proceed with the span point calibration, or simply click the "OK" button (if you only wish to perform a zero point calibration (not recommended)).

- Install your calibration weight on the calibration arm or fixture. If you are using a built-in calibration arm, make sure that the calibration weight is pushed up against the cross-bar to ensure a correct effective calibration arm length. If you are using a separate calibration arm, the calibration weight should be mounted on a locating pin.

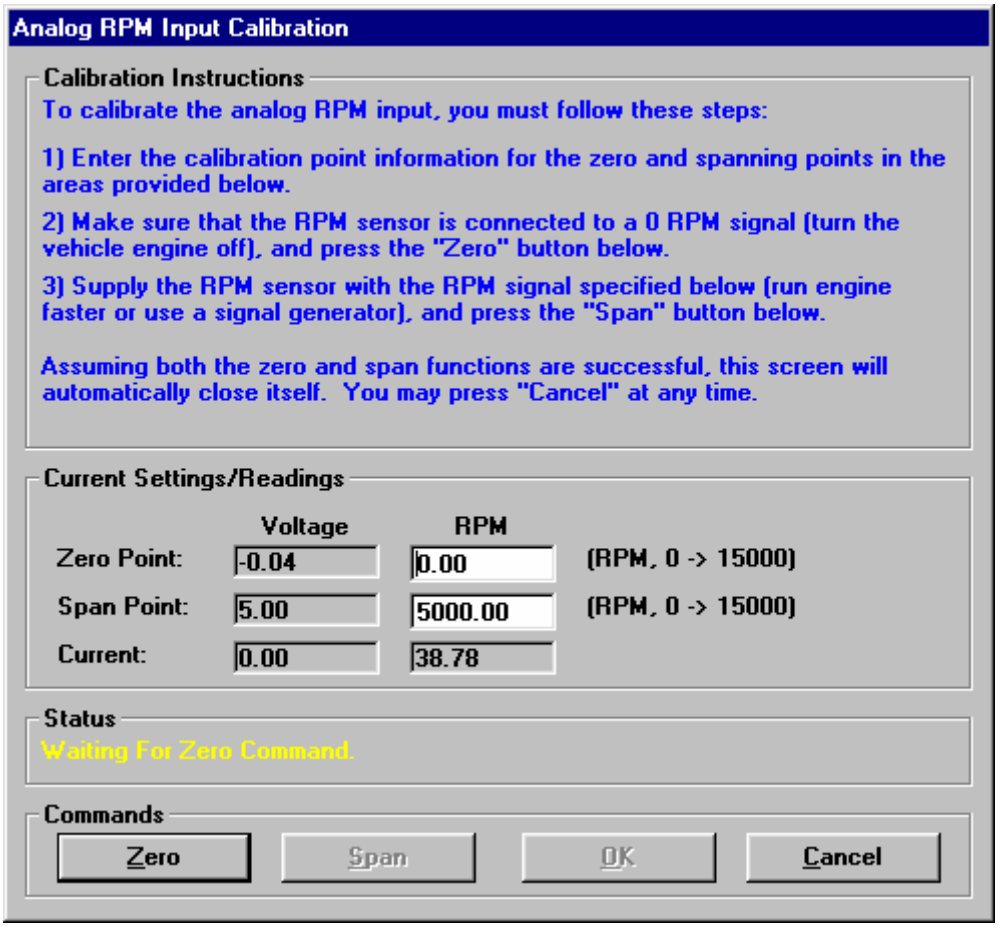
- Click the "Span" button. If the span calibration is successful, you can click the "OK" button to save the calibration values. If the span calibration is not successful, the message box will indicate that the span calibration failed. If the span calibration fails, it is due to too-small voltage change from the zero point calibration. Please note the zero and span point values and contact Mustang Dynamometer for assistance.

- If you are using an asymmetric separate calibration arm (for example, on an MD-1750 dynamometer), you need to perform an additional zero calibration. (The first zero point calibration was only performed to have a known starting point for the span point calibration.) Simply remove the calibration weight and arm, and click the "Re-Zero" button. Assuming that the re-zero function works correctly (check the message box), you can click the "OK" button to save your new calibration values.

- MAKE SURE TO REMOVE BOTH THE CALIBRATION WEIGHT AND (IF YOU ARE USING A SEPARATE CALIBRATION ARM) CALIBRATION ARM FROM YOUR DYNAMOMETER WHEN YOU ARE FINISHED WITH THIS CALIBRATION.

Analog RPM Input Calibration

This screen allows the operator to calibrate the analog engine RPM input.



The analog engine RPM input calibration is a very simple two (2) step process required to generate a linear calibration. The steps required to this calibration are described below.

Using an Analog Input from a Device with No Output Calibration Capability

- Make sure that the "Zero Point" "RPM" value is set to 0.
- Make sure that the "Span Point" "RPM" value is set to an engine RPM value that your calibration vehicle can maintain steadily for several seconds.
- Attach your engine RPM sensor to your calibration vehicle, and make sure that your engine RPM measurement device can properly measure engine RPM on that vehicle.
- Turn your calibration vehicle's engine off. Your device should now be generating an analog output that represents 0 RPM.
- Click the "Zero" button. The "Status" message box will indicate whether the zero point calibration was successful or not.

- Assuming that the zero point calibration was successful, you can perform the span point calibration.

- Start your calibration vehicle, and maintain the engine RPM value you entered in the "Span Point" "RPM" value field.

- Once you have achieved and are steadily maintaining the span point engine RPM value, click the "Span" button. If the span calibration is successful, you can click the "OK" button to save the calibration values. If the span calibration is not successful, the message box will indicate that the span calibration failed. If the span calibration fails, it is due to too-small voltage change from the zero point calibration. Please note the zero and span point values and contact Mustang Dynamometer for assistance.

Using an Analog Input from a Device with Output Calibration Capability

- Make sure that the "Zero Point" "RPM" value is set to the RPM value that your RPM device drives out on its analog output for a zero point (or low calibration point) calibration. This value is typically 0 RPM.

- Make sure that the "Span Point" "RPM" value is set to the RPM value that your RPM device drives out on its analog output for a span point (or high calibration point) calibration. This value may range from 1,000 to 20,000 RPM, and may depend on the currently selected analog output RPM range of your device.

- Configure your RPM device to drive the zero point (or low calibration point) RPM value out on its analog output.

- Click the "Zero" button. The "Status" message box will indicate whether the zero point calibration was successful or not.

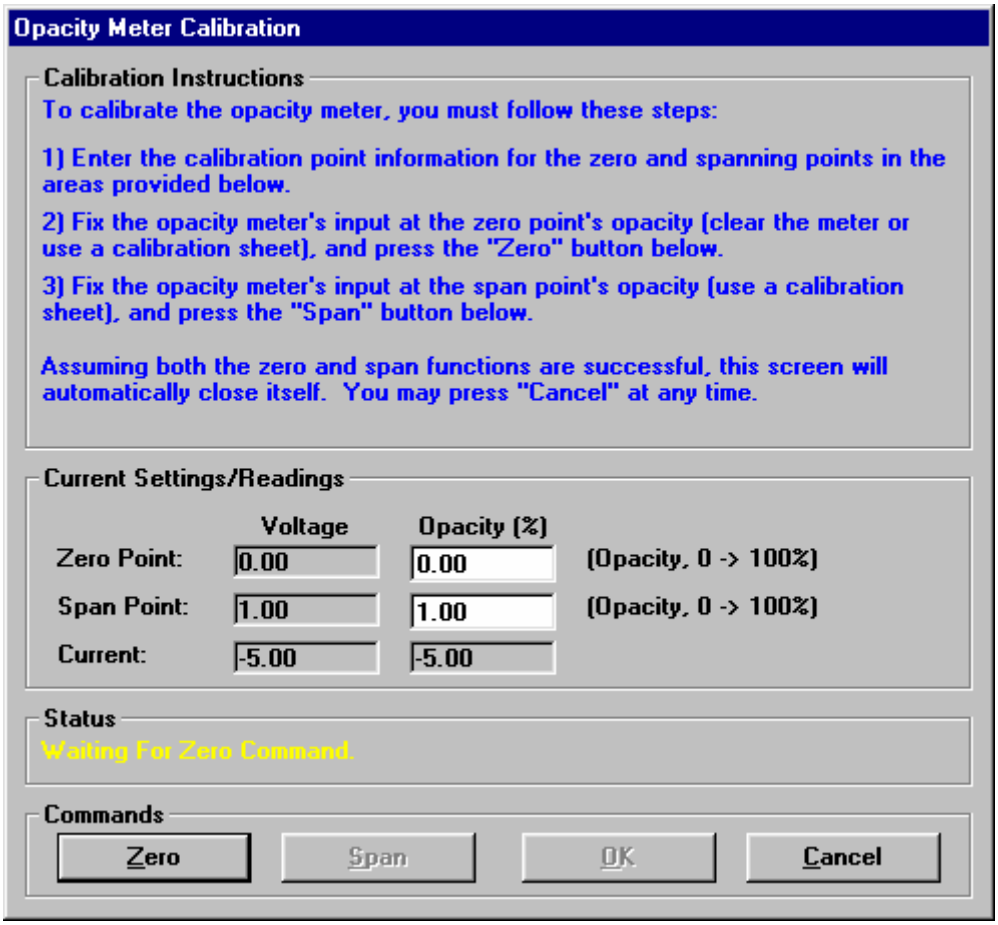
- Assuming that the zero point calibration was successful, you can perform the span point calibration

- Configure your RPM device to drive the span point (or high calibration point) RPM value out on its analog output.

- Click the "Span" button. If the span calibration is successful, you can click the "OK" button to save the calibration values. If the span calibration is not successful, the message box will indicate that the span calibration failed. If the span calibration fails, it is due to too-small voltage change from the zero point calibration. Please note the zero and span point values and contact Mustang Dynamometer for assistance.

Opacity Meter Calibration

This screen allows the operator to calibrate the analog exhaust opacity input.



The analog exhaust opacity input calibration is a very simple two (2) step process required to generate a linear calibration. The steps required to this calibration are described below.

Using an Analog Input from a Device with No Output Calibration Capability

- Make sure that the "Zero Point" "Opacity %" value is set to 0.
- Make sure that the "Span Point" "Opacity %" value is set to the value of a calibration filter/plate that you have available for your opacity meter.
- Remove everything from the measurement path of the opacity meter. Your device should now be generating an analog output that represents 0% opacity.
- Click the "Zero" button. The "Status" message box will indicate whether the zero point calibration was successful or not
- Assuming that the zero point calibration was successful, you can perform the span point calibration.

- Install the calibration filter/plate value you entered in the "Span Point" "Opacity %" value field.

- Click the "Span" button. If the span calibration is successful, you can click the "OK" button to save the calibration values. If the span calibration is not successful, the message box will indicate that the span calibration failed. If the span calibration fails, it is due to too-small voltage change from the zero point calibration. Please note the zero and span point values and contact Mustang Dynamometer for assistance.

Using an Analog Input from a Device with Output Calibration Capability

- Make sure that the "Zero Point" "Opacity %" value is set to the opacity value that your opacity device drives out on its analog output for a zero point (or low calibration point) calibration. This value is typically 0 % opacity.

- Make sure that the "Span Point" "Opacity %" value is set to the opacity value that your opacity device drives out on its analog output for a span point (or high calibration point) calibration. This value may range from 20 to 100 % opacity.

- Configure your opacity device to drive the zero point (or low calibration point) opacity value out on its analog output.

- Click the "Zero" button. The "Status" message box will indicate whether the zero point calibration was successful or not.

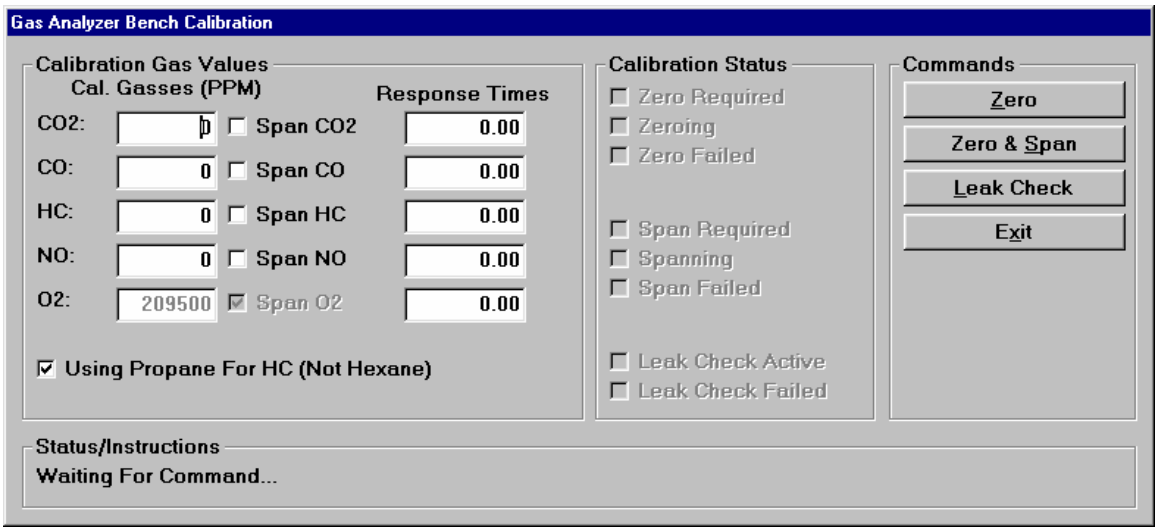
- Assuming that the zero point calibration was successful, you can perform the span point calibration.

- Configure your opacity device to drive the span point (or high calibration point) opacity value out on its analog output.

- Click the "Span" button. If the span calibration is successful, you can click the "OK" button to save the calibration values. If the span calibration is not successful, the message box will indicate that the span calibration failed. If the span calibration fails, it is due to too-small voltage change from the zero point calibration. Please note the zero and span point values and contact Mustang Dynamometer for assistance.

Bench Calibration

This screen allows the operator to calibrate the optional Andros 5-gas analyzer bench.



The optional Andros 5-gas analyzer bench supports 3 fully automated self-calibration routines, using ambient atmospheric air for zeroing and a 4-gas blend in a calibration gas bottle for spanning.

Calibration Status Values

Several check boxes are provided to inform the operator of the need for calibrations, the status of calibrations, and the final results of calibration. These checkboxes are explained below.

Checkboxes	Explanation
Zero Required	Indicates that a zero calibration is required.
Zeroing	Indicates that a zero calibration is in process.
Zero Failed	Indicates that the last zero calibration performed failed.
Span Required	Indicates that a span calibration is required.
Spanning	Indicates that a span calibration is in process.
Span Failed	Indicates that the last span calibration performed failed.
Leak Check Active	Indicates that the leak check test is active.
Leak Check Failed	Indicates that the last leak check test performed failed.

To Perform a Zero Point Calibration

- Ensure that the sample probe is not anywhere near a vehicle exhaust source or a significant concentration of the gasses of interest, as may be found around a recent gasoline or chemical spill.

- Click on the "Zero" button. The calibration will be performed automatically. The "Status/Instruction" box will tell you if the calibration succeeds or fails.

To Perform a Zero & Span Calibration

- Ensure that the calibration gas bottle is connected and turned on, and that the sample probe is not anywhere near a vehicle exhaust source or a significant concentration of the gasses of interest, as may be found around a recent gasoline or chemical spill.

- Ensure that the calibration gas values (all in parts per million (PPM)) match the values printed on the calibration gas bottle. If the concentration values are printed in percent (%), multiply the percentage values by 10,000 to obtain parts per million (PPM) values before entering the PPM values into the on-screen fields.

- If the calibration gas bottle only contains some of the calibration gasses, un-check the corresponding "Span xxx" check boxes for any missing gasses.

- Since most calibration gasses use propane for the HC calibration gas, the "Using Propane For HC (Not Hexane)" check box should normally be left checked.

- Click on the "Zero & Span" button. The calibration will be performed automatically. The "Status/Instruction" box will tell you if the calibration succeeds or fails.

- Close the calibration gas bottle valve.

To Perform a Leak Check Test

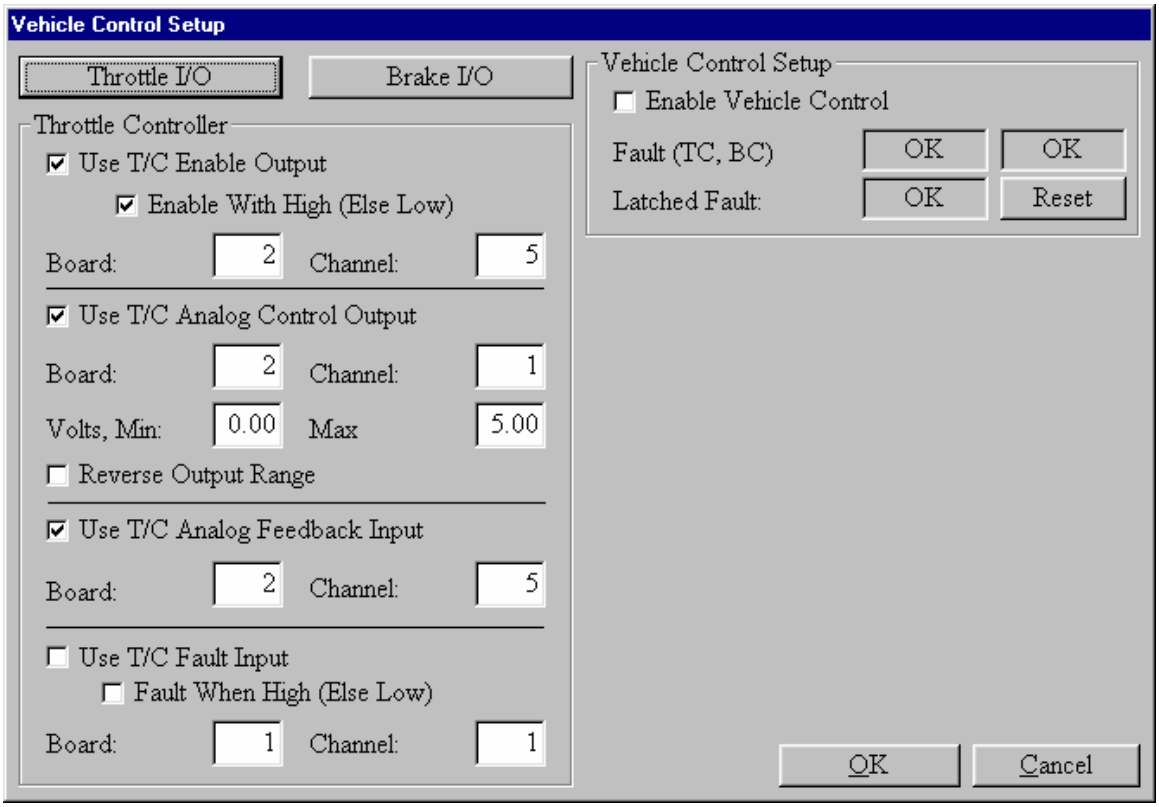
- Cap the end of the sample probe using the supplied cap.

- Click on the "Leak Check" button. The leak check test will be performed automatically. The "Status/Instruction" box will tell you if the test succeeds or fails.

- Remove the sample probe cap and store it.

Vehicle Controller Setup

This screen allows the operator to configure the optional integrated vehicle controller.



Screen Fields	Description
Enable Vehicle Control	This is an overall enable switch for the vehicle controller. If this switch is off (not checked), then no vehicle controller inputs or outputs will be read or written. This box must be checked if the vehicle controller is to be used.
Fault (TC, BC)	This display tells if the vehicle fault digital input is faulted (if the input is enabled) for the throttle / brake controllers.
Latched Fault	This display tells if the vehicle controller has latched a fault condition. Note that a dynamometer E-Stop will cause a latched vehicle controller fault, and that the dynamometer E-Stop condition must be cleared before the vehicle controller latched fault can be cleared.
Reset (Latched Fault)	This button will reset any latched fault of the vehicle controller, providing that the vehicle controller fault digital input is not reporting a fault (or is disabled), and that the dynamometer is not in an E-Stop condition.

Brake / Throttle Controller Setup

Screen Fields	Description
Use T/C Enable Output	If checked, the specified digital output line will be used to drive an enable digital output to the throttle controller during testing.
Enable With High (Else Low)	Tells what voltage level (0 (low) or 5 (high)) will be driven on the specified output channel to enable the throttle controller.
Board	The I/O board number used to write this output (1 -> 2)
Channel	The digital output channel number used to write this output (0 -> 23)
Use T/C Analog Control Output	If checked, the specified analog output line will be used to drive a reference output to the throttle controller during testing.
Board	The I/O board number used to write this output (1 -> 2)
Channel	The analog output channel number used to write this output (0 -> 1).
Volts, Min	The minimum voltage that should be driven out on this channel, normally 0.
Volts, Max	The maximum voltage that should be driven out on this channel, normally 5.
Reverse Output Range	Reverses the motion of the throttle controller, for vehicles where the closed and full throttle positions are reversed.
Use T/C Analog Feedback Input	If checked, the specified analog input line will be used to measure the current actual position of the throttle controller during testing.
Board	The I/O board number used to read this input (1 -> 2)

Channel	The analog input channel number used to read this input (0 -> 7).
Use T/C Fault Input	If checked, the specified analog input line will be used to detect faults from the controller.
Fault When High (Else Low)	If checked, a fault will be generated when the input is at 5 volts, otherwise when the input is at 0 volts.
Board	The I/O board number used to read this input (1 -> 2)
Channel	The digital input channel number used to read this input (0 -> 23).

Brake Controller I/O Setup

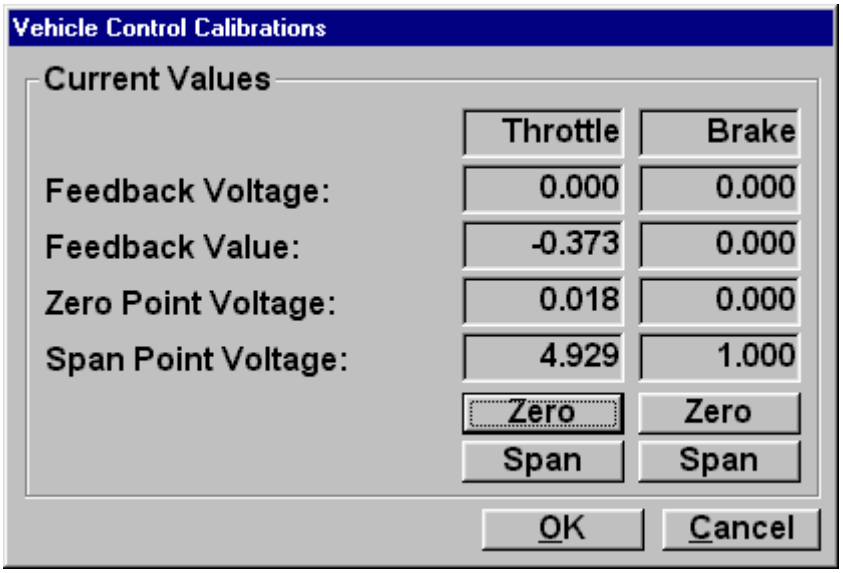
The brake controller panel is identical to the throttle controller panel, please see above.

The following is a list of buttons at the bottom of the screen and the functions that they perform.

Buttons	Function
OK	This button will cause all on-screen values to be applied to the controller and written to the software's configuration ("Ini") file, and the screen will close.
Cancel	This button will cause all controller parameters to return to their pre-editing values, and the screen will close.

Brake / Throttle Controller Calibration

This screen allows the operator to calibrate the feedback values for the throttle and brake controllers.



Feedback Voltage

Shows the current analog input voltage for the channel.

Feedback Value

Shows the current calibrated value measured by the analog input.

Zero Point Voltage

Shows the analog input voltage at the zero calibration point.

Span Point Voltage

Shows the analog input voltage at the span calibration point.

Zero Buttons

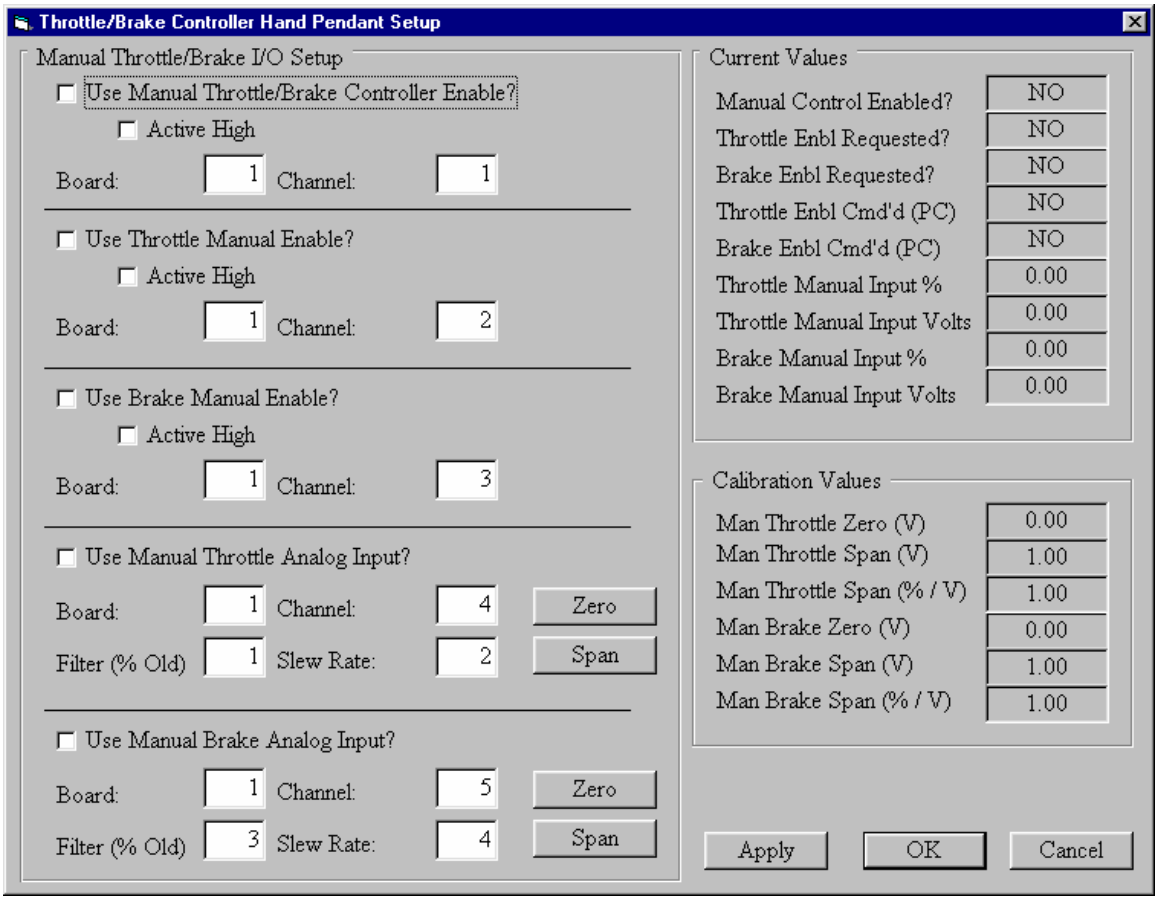
The throttle / brake controller must be positioned at a "zero" position, ie zero throttle or zero brake application, then the "Zero" button should be clicked, to set the calibration at the zero point.

Span Buttons

The throttle / brake controller must be positioned at a "span" position, ie full throttle or full brake application, then the "Span" button should be clicked, to set the calibration at the span point.

Throttle / Brake Controller Hand Pendant Setup

This screen allows the operator to configure the hand pendant used for manual control of the throttle and brake controllers.



Screen Fields	Description
Use Manual Throttle/Brake Controller Enable	Tells if the digital input that indicates that the operator wants to use the hand pendant to control the throttle/brake controllers should be used.
Active High	If checked, 5 volts indicates a "True" value, otherwise 0 volts.
Board	The board this input is on (1-2)
Channel	The channel this input is on (0-23)
Use Throttle Manual Enable	Tells if the digital input that indicates that the operator wants to enable the throttle controller via the hand pendant should be used.

Active High	If checked, 5 volts indicates a "True" value, otherwise 0 volts.
Board	The board this input is on (1-2)
Channel	The channel this input is on (0-23)
Use Brake Manual Enable	Tells if the digital input that indicates that the operator wants to enable the brake controller via the hand pendant should be used.
Active High	If checked, 5 volts indicates a "True" value, otherwise 0 volts.
Board	The board this input is on (1-2)
Channel	The channel this input is on (0-23)
Use Manual Throttle Analog Input	Tells if the analog input that reports the selected throttle position from the hand pendant should be used.
Board	The board this input is on (1-2)
Channel	The channel this input is on (0-7)
Filter (% Old)	A value between 0 and 99 telling how heavily the input should be filtered – 0 means no filtering, 99 means a very heavy filter. Typically between 50 and 95.
Slew Rate	A value between 0 and 10000 telling how many percent the input can change by per 0.01 second sample – typically between 1 and 10.
Zero	This button is used to set the zero point calibration for this input. The controller must have the command value knob set to the zero (0%) point, then this button can be pressed to set the calibration point.
Span	This button is used to set the span point calibration for this input. The controller must have the command value knob set to the span (100%) point, then this button can be pressed to set the calibration point.
Use Manual Brake Analog Input	Tells if the analog input that reports the

	selected brake position from the hand pendant should be used.
Board	The board this input is on (1-2)
Channel	The channel this input is on (0-7)
Filter (% Old)	A value between 0 and 99 telling how heavily the input should be filtered – 0 means no filtering, 99 means a very heavy filter. Typically between 50 and 95.
Slew Rate	A value between 0 and 10000 telling how many percent the input can change by per 0.01 second sample – typically between 1 and 10.
Zero	This button is used to set the zero point calibration for this input. The controller must have the command value knob set to the zero (0%) point, then this button can be pressed to set the calibration point.
Span	This button is used to set the span point calibration for this input. The controller must have the command value knob set to the span (100%) point, then this button can be pressed to set the calibration point.

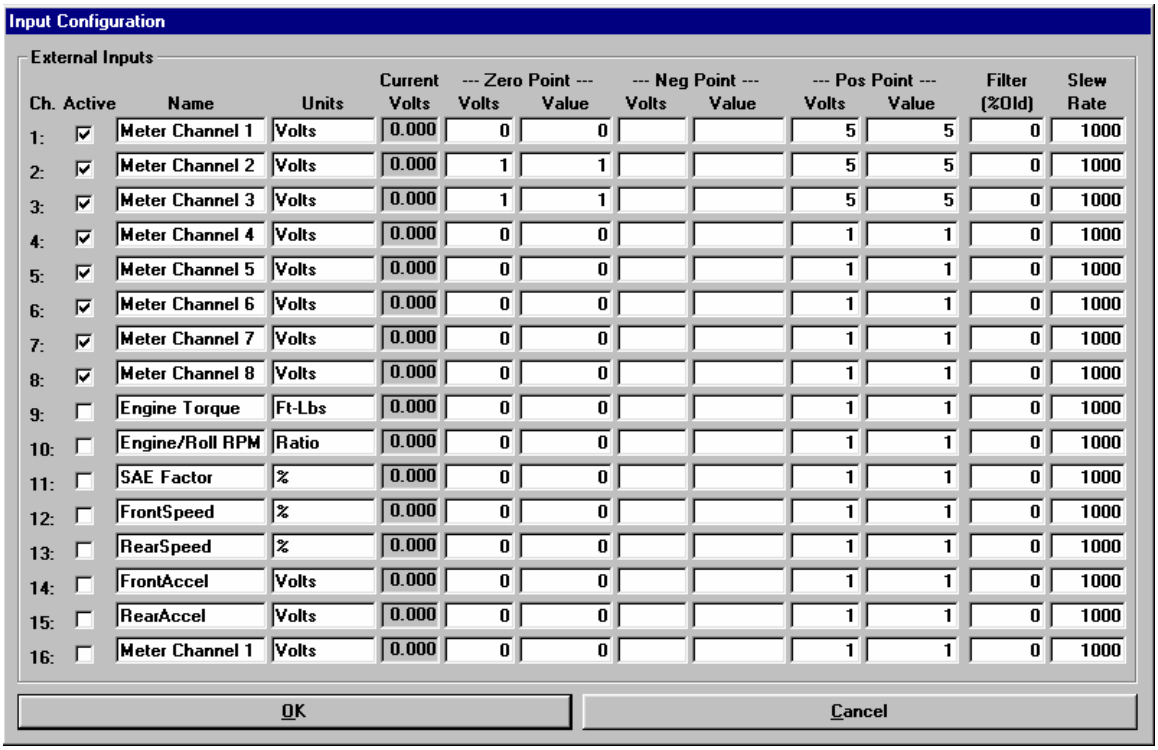
Current Values	Description
Manual Control Enabled	Tells if the hand pendant control enable input is on.
Throttle Enable Requested	Tells if the hand pendant throttle enable input is on.
Brake Enable Requested	Tells if the hand pendant brake enable input is on.
Throttle Enable Commanded	Tells if the software has actually enabled the throttle controller based on the request above.
Brake Enable Commanded	Tells if the software has actually enabled the brake controller based on the request above.
Throttle Manual Input %	The throttle position request value read on the

	analog input from the hand pendant.
Throttle Manual Input Volts	The analog input voltage read from the throttle position request analog input from the hand pendant.
Brake Manual Input %	The brake position request value read on the analog input from the hand pendant.
Brake Manual Input Volts	The analog input voltage read from the brake position request analog input from the hand pendant.

Calibration Values	Description
Man Throttle Zero (V)	The zero calibration point voltage.
Man Throttle Span (V)	The span calibration point voltage.
Man Throttle Span (% / V)	The %-per-volt calibration value for the input.
Man Brake Zero (V)	The zero calibration point voltage.
Man Brake Span (V)	The span calibration point voltage.
Man Brake Span (% / V)	The %-per-volt calibration value for the input.

Auxiliary Analog Input Setup

The "Auxiliary Analog Input Setup" menu item allows access to the setup screen used to configure the auxiliary analog inputs used for extra data acquisition hardware, e.g. exhaust gas oxygen sensors, pressure sensors, etc.



Your electronics system provides for several additional analog inputs that can be connected to additional data acquisition sensors. For example, various pressures and temperatures may be monitored during testing.

Note

Most electronics systems sold are capable of handling up to seven (7) auxiliary analog inputs, although options such as a 2nd PAU, analog engine RPM, opacity and/or weather station inputs may reduce the number of available analog inputs. If you purchased a second data acquisition board with your system, you will have an additional eight (8) analog input available for monitoring additional sensors.

By double-clicking on the "Name" column, a drop-down list of predefined channels names can be displayed. These are "magic" names that the system looks for; if any of these names is used for a channel name, then the value of that channel will be over-written with the value described by the "magic" name, even if the channel is active and reading an analog input channel. These named channels are generally used only on analog input channels that are not physically present, ie channels 9-16, which are read from the second I/O board, which is frequently not installed.

It is important to note that any sensor connected to an auxiliary analog input must meet the following conditions:

- The input voltage must fall in the range –5.0 to +5.0 volts.
- The input voltage must represent a linear input value (non-linear inputs are not yet supported).
- Any electrical isolation required to prevent hardware damage is the operators responsibility, unless Mustang Dynamometer provides the sensor.

Configuring an Auxiliary Analog Input

To configure and/or calibrate an auxiliary analog input, the name of the input channel, the units monitored, and several calibration values must be entered. The process for configuring and calibrating an auxiliary analog input is shown below.

- Select an input channel. The "Channel" column lists the available analog input channels. If you have only one (1) data acquisition board installed, you only actually have channels 1-8; channels 9-16 require the 2nd data acquisition board be installed.
- Make sure that the analog input channel is actively being read by checking the "Active" box.
- Enter the name of the input channel in the "Name" field (for example, "Oil Pressure").
- Enter the units that the input channel will be measured in the "Units" field (for example, "PSI").
- The "Current Volts" field reports the current input voltage for each channel.
- In the "Lo Cal Point" "Volts" field, enter the input voltage measured at (or known to be present at) the zero/low calibration point value (for example, 0.0 volts).
- In the "Lo Cal Point" "Values" field, enter the input value for the zero/low calibration point.
- In the "Hi Cal Point" "Volts" field, enter the input voltage measured at (or known to be present at) the span/high calibration point value (for example, 5.0 volts).
- In the "Hi Cal Point" "Values" field, enter the input value for the span/high calibration point.

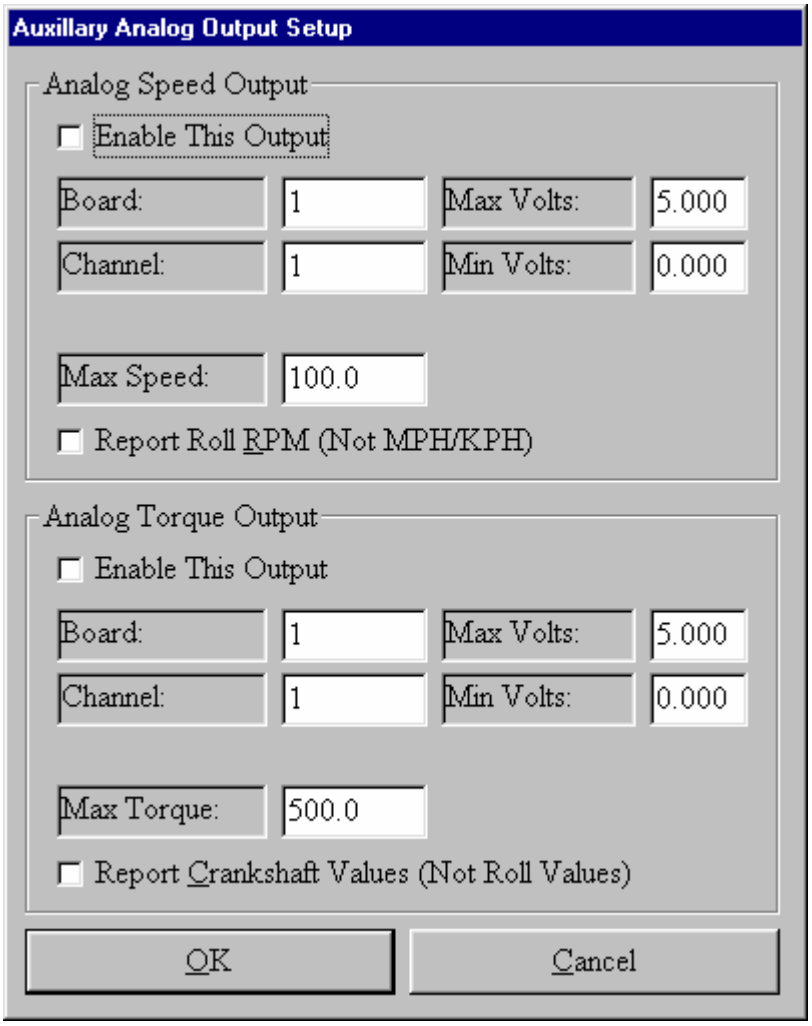
- To apply a FIR type filter to the input value, you can specify a value between 0 (no filtering) and 100 (solid filter, value will never change) in the "Filter (% Old)" field. Since the analog inputs are normally updated at 100 Hz, a filter value of 90 will result in a 90% response to a step change in 0.2 seconds, while significantly reducing noise. A filter value of 50 will result in a 90% response to a step change in 0.03 seconds, while reducing noise by approximately 50%.

To apply a slew rate (clipping) filter to the input, you can enter a maximum slew rate value in the "Slew Rate" field. These values represent the maximum value by which any two consecutive values may differ; if the difference between two consecutive measurements varies by more than this amount, the reported value is clipped off at the maximum allowed change. These values are between-samples values, so the update rate is important consideration for selecting these values. Since the normal update rate of our systems is 100 Hz, simply take the maximum valid rate of change that you believe your sensor will ever report (in units per second), and divide that value by 100 to determine the value to enter for your "Slew Rate" value. For example, if you believe that a temperature sensor will not change by more than 50 degrees per second, then your "Slew Rate" value would be (50 / 100) = 0.5.

Magic Auxiliary Analog Input Names

For those familiar with the MD-7000 series software, the list of "magic" names ("SAE Factor", "Engine Torque", etc) is no longer used – all of the related values are now available as system channels.

The "Auxiliary Analog Output Setup" menu item allows access to the setup screen used to configure the speed/RPM and torque/force analog outputs supported by the ADA-1100 I/O boards.



Since some dynamometer operators use external data acquisition systems, your system can be configured to drive two (2) analog outputs proportional to the speed and torque measured by your dynamometer. These outputs can be fed to the analog inputs of a data acquisition system.

Note

Since the data acquisition boards that we currently use are limited to two (2) analog outputs per board, and our PAU control uses one of them, you must purchase a second data acquisition board if you wish to drive both of these channels simultaneously. Also, if you have a multiple PAU dynamometer, you will need the second data acquisition board to drive either of these channels.

Analog Speed Output

This output is proportional to the dynamometer's roll speed, in either MPH/KPH or RPM. Configuration is as described below.

Screen Field	Description
Enable This Output	This option must be checked for the output to be driven.
Board	The data acquisition board to be used. Normally board #2, although board #1 can be used for single PAU systems where only one auxiliary analog output is required.
Channel	The data acquisition analog output channel to be used. Values for output channels are either 0 or 1. Note that board #1, channel #0 is always reserved for the PAU reference output.
Max Volts	The maximum voltage to be driven out, when the maximum reportable speed is measured. This value must be less than or equal to 5.0 volts.
Min Volts	The minimum voltage to be driven out, when the minimum reportable speed is measured. This value must be greater than or equal to -5.0 volts if the analog output is configured as a bi-polar output, or greater than or equal to 0.0 volts if the analog output is configured as a uni-polar output.
Max Speed	The maximum reportable speed. This value may be in MPH/KPH (depends on "Use Metric Units" setting in "System Parameters") or RPM, depending on the setting of the "Report Roll RPM (Not KPH/MPH)" option.
Report Roll RPM	Determines if this output is scaled against dynamometer shaft RPM or (Not KPH/MPH) MPH/KPH.

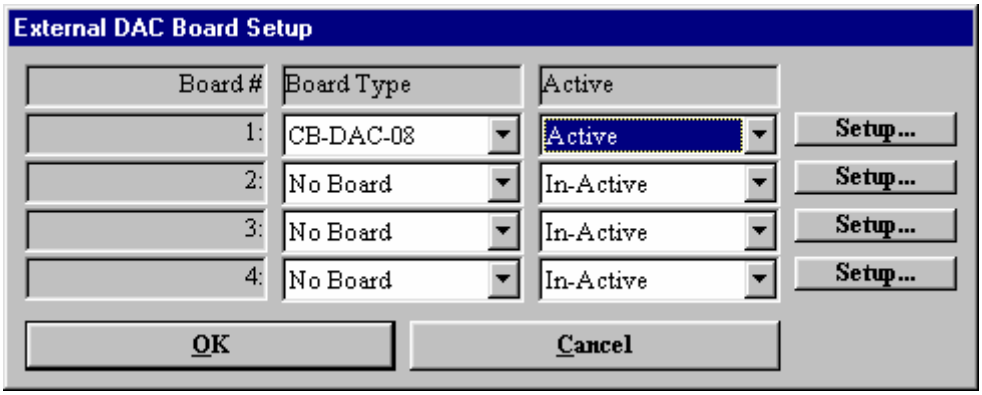
Analog Torque Output

This output is proportional to the total torque measured by the dynamometer, in either Ft-Lbs/N-M. Configuration is as described below.

Screen Fields	Description
Enable This Output	This option must be checked for the output to be driven.
Board	The data acquisition board to be used. Normally board #2, although board #1 can be used for single PAU systems where only one auxiliary analog output is required.
Channel	The data acquisition analog output channel to be used. Values for output channels are either 0 or 1. Note that board #1, channel #0 is always reserved for the PAU reference output.
Max Volts	The maximum voltage to be driven out, when the maximum reportable torque is measured. This value must be less than or equal to 5.0 volts.
Min Volts	The minimum voltage to be driven out, when the minimum reportable torque is measured. This value must be greater than or equal to -5.0 volts if the analog output is configured as a bi-polar output, or greater than or equal to 0.0 volts if the analog output is configured as a uni-polar output.
Max Torque	The maximum reportable torque. This value may be in Ft-Lbs or N-M (depends on "Use Metric Units" setting in "System Parameters").
Report Crankshaft Values (Not Roll Values)	Determines if this output is scaled against dynamometer shaft torque or engine crankshaft torque. Please see the section on Values Reported by a Chassis Dynamometer for more information on this important difference. The torque values reported include ALL torque measured by the dynamometer, not any single component (such as PAU torque, etc).

External DAC Board Setup

The "External DAC Board Setup" menu item allows access to the setup screen used to configure the analog output boards used to drive system values out to external data acquisition systems.



This screen is used to configure any I/O boards that have been installed to drive system values out to external data acquisition systems via analog outputs.

Up to four (4) I/O boards are supported.

Currently, only the Computer Boards CIO-DAC-08 (ISA) 8 channel, 12-bit analog output I/O board is supported.

Each of the possible four (4) I/O boards can be configured as "No Board" or as a valid board type. Additionally, each I/O board can be enabled ("Active") or disabled ("In-Active").

Once a valid board type (other than "No Board") has been selected, the I/O board can be configured using the "Setup…" button beside the board definition fields.

<UPDATE_ME: Screen snap shot missing – this portion of the software is currently under revision>

This screen allows the operator to configure a Computer Boards CIO-DAC-08 (ISA) 8 channel, 12-bit analog output I/O board.

The "DLL Version" and "Driver Handle" displays tell which version of the I/O board interface DLL is in use, and the driver handle that has been allocated for communicating with the board that is currently being configured.

The "Base Address" field displays the base port address of the selected board in decimal notation (768 decimal = 300 hexadecimal). The operator may enter base port address values in either decimal (768) or in hexadecimal (in which case the value must be entered as &h300, or &h240, or &hXXX in general).

NOTE

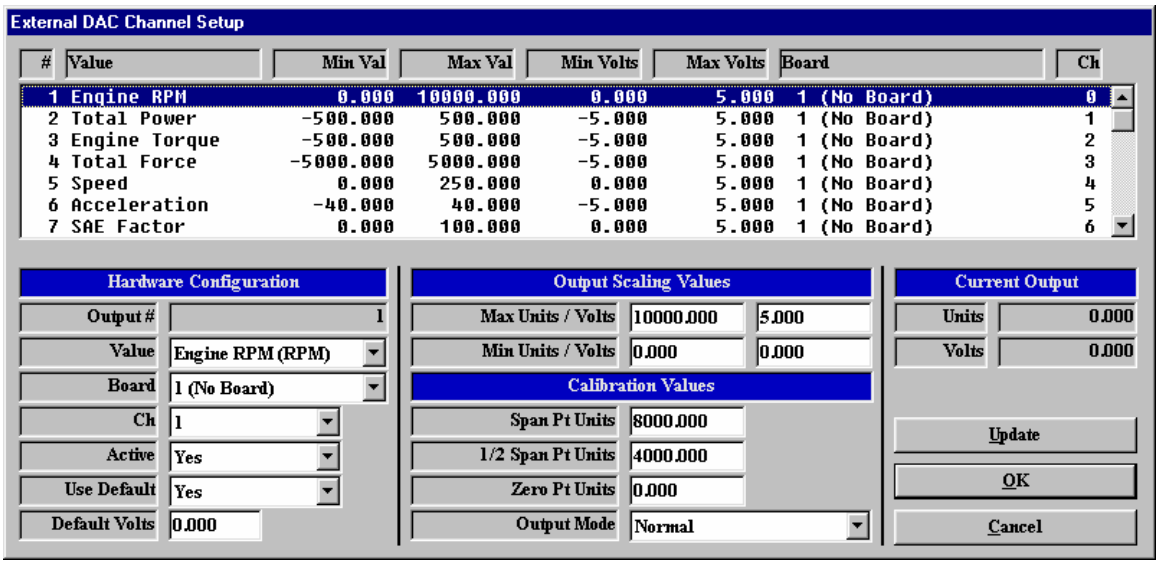
SETTING THE BASE PORT ADDRESS INCORRECTLY WILL CAUSE THE I/O BOARD TO NOT WORK, AND MAY PREVENT OTHER BOARDS FROM WORKING CORRECTLY.

For each output channel the following parameters may be set:

Parameter	Description
Max Voltage	The maximum voltage (magnitude, positive or negative) that the output is configured to drive.
Uni-/Bi-Polar	Tells if the output is configured as a uni-polar or bi-polar output.

External DAC Channel Setup

The "External DAC Channel Setup" menu item allows access to the setup screen used to configure the values sent out via the analog outputs to external data acquisition systems.



This screen allows the operator to configure the external DAC channels used to drive system values out to external data acquisition systems via analog outputs.

Up to 32 system values can be driven to external D/A systems (if sufficient I/O boards are installed), and each output can be written to any desired analog output I/O board/channel.

By clicking on an entry in the list box, the complete configuration for the selected system value output can be specified. Clicking on any item in the list box will cause the currently displayed configuration data to be updated.

Hardware Configuration Items	Description
Output #	The number (1 -> 32) of the system output that is being displayed.
Value	The system value that will be driven out, available from a drop-down list.
Board	The analog output I/O board (from the "External DAC Board Setup" screen that the system value will be driven out on.
Ch	The analog output channel on the selected I/O board that the

	system value will be driven out on. Note that the value displayed in this box will be 1 greater than the value displayed in the list box.
Active	If this value is set to "Yes", the selected system value will be written out on the selected I/O line, otherwise the system value will not be written out.
Use Default	If this value is set to "Yes", the default value (specified in volts, below) will always be written out on the selected output line.
Default Value	The default voltage to write out when the output is not active, if desired. This simply allows the system to drive a constant, specified voltage out to any external D/A system when the operator does not want to drive the selected system value out.

Output Scaling Values	Description
Max Units / Volts	These values establish the maximum voltage (within the analog output's capabilities) which will be driven on the selected analog output line, and the system value that will correspond to that voltage.
Min Units / Volts	These values establish the minimum voltage (within the analog output's capabilities) which will be driven on the selected analog output line, and the system value that will correspond to that voltage.

Calibration Values	Description
Span Pt Units	The system units value (not voltage) that will be driven on the selected analog output line when the selected channel is put into "Span" mode. The voltage that will be driven out will be determined by scaling the specified system value using the min/max voltage/values data pairs entered above.
1/2 Span Pt Units	The system units value (not voltage) that will be driven on the selected analog output line when the selected channel is put into "Half Span" mode. The voltage that will be driven out will be determined by scaling the specified system value using the min/max voltage/values data pairs entered above.

Zero Pt Units	The system units value (not voltage) that will be driven on the selected analog output line when the selected channel is put into "Zero" mode. The voltage that will be driven out will be determined by scaling the specified system value using the min/max voltage/values data pairs entered above.
Output Mode	The output mode that the channel is to be in. When this field is changed, the output voltage will NOT change until the operator either: a) Clicks on another entry in the list box, or b) The clicks the "Update" button. By placing an output channel in "Zero", "Half Span" or "Span" mode, any of three (3) calibration point values can be driven out on the selected analog output line to allow for calibration of any external data acquisition system inputs. NOTE: All analog output channels will be returned to "Normal" output mode when this screen is exited.

Current Output Values	Description
Units	The current system value that is being driven out on the selected output channel. This value will be one of the following: (Normal mode) The selected system value, (Zero mode) the specified "Zero" point value, (Half Span mode) the specified "Half Span" point value, or (Span mode) the specified "Span" point value.
Volts	The current voltage that is being driven out on the selected output channel. This value will be the scaled value of the displayed "Units" value, using the min/max units/volts data values entered above.

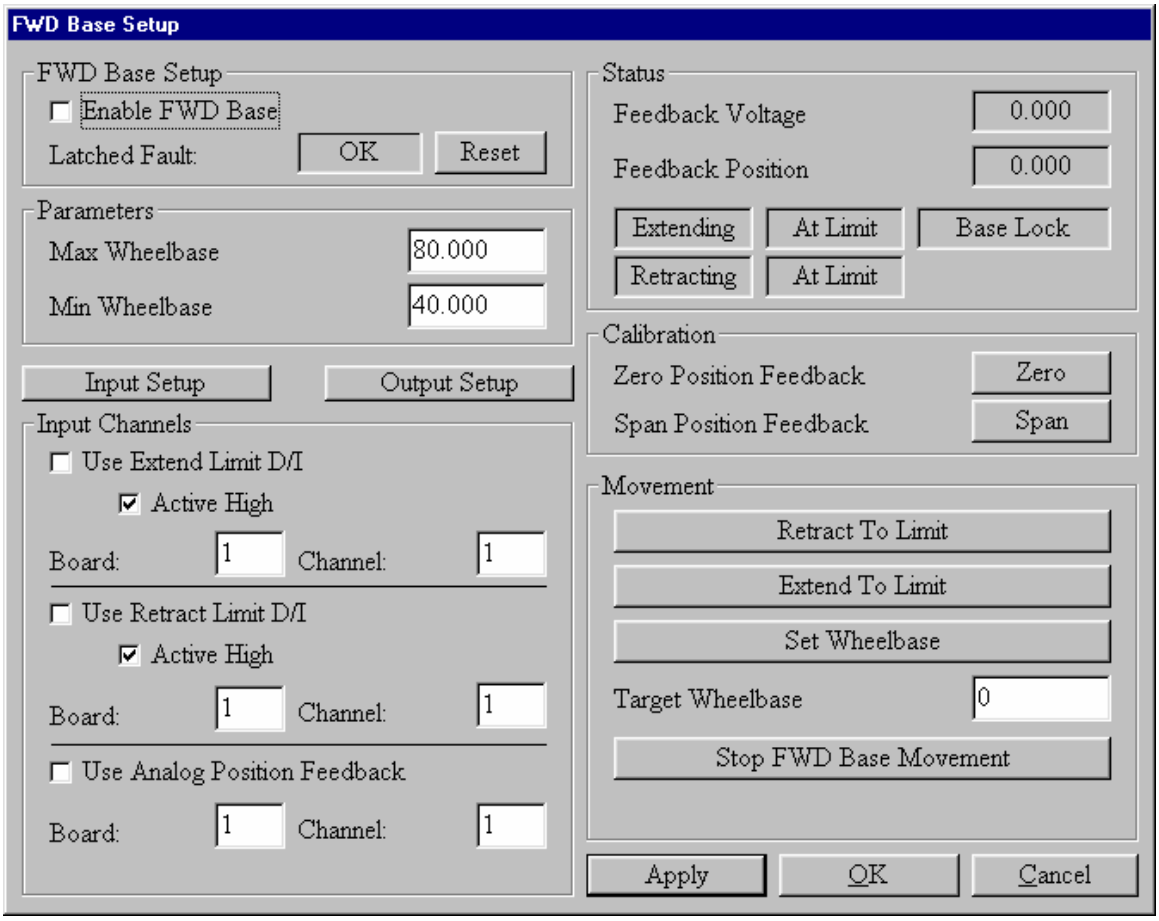
The following is a list of buttons that appear at the bottom of the screen along with a description of their functionality:

Buttons	Function

The "Update" button	Can be used to manually update the selected channel's calibration values. This button will normally be used to update the "Output Mode" value during calibration of external D/A systems, since all fields (including "Output Mode") are updated when the operator clicks on any item in the main list box on this screen (for example, when moving on to configure another channel).
The "OK" button	Will cause all editing values to be updated and written to the software's calibration ("Ini") file.
The "Cancel" button	Will cause all calibration values to revert to their pre-editing values.

AWD Base Setup

This screen allows the operator to setup the various I/O channels used by the all-wheel-drive base hardware.



Screen Fields	Description
Enable FWD Base	Tells if the Four Wheel Base control sub-system should be used or not.
Latched Fault	Shows if the sub-system has encountered a fault condition.
Reset	Use this button to clear any latched faults from the sub-system.
Max Wheelbase	The maximum wheelbase distance the dynamometer is physically capable of.
Min Wheelbase	The minimum wheelbase distance the dynamometer is physically capable of.

Input Setup	Use this button to view the input channel setup panel.
Output Setup	Use this button to view the output channel setup panel.
INPUT CHANNEL VALUES	
Use Extend Limit D/I	Tells if the extend limit switch digital input should be used.
Active High	If checked, 5 volts indicates a "True" value, otherwise 0 volts.
Board	The board this input is on (1-2)
Channel	The channel this input is on (0-23)
Use Retract Limit D/I	Tells if the retract limit switch digital input should be used.
Active High	If checked, 5 volts indicates a "True" value, otherwise 0 volts.
Board	The board this input is on (1-2)
Channel	The channel this input is on (0-23)
Use Analog Position Feedback	Tells if the wheelbase measuring analog input should be used.
Board	The board this input is on (1-2)
Channel	The channel this input is on (0-7)
OUTPUT CHANNEL VALUES	
Use Base Extend D/O	Tells if the extend digital output should be used.
Enable With High (Else Low)	If checked, 5 volts will be driven out to enable the device, otherwise 0 volts.
Board	The board this input is on (1-2)
Channel	The channel this input is on (0-23)
Use Base Retract D/O	Tells if the retract digital output should be used.

Enable With High (Else Low)	If checked, 5 volts will be driven out to enable the device, otherwise 0 volts.
Board	The board this input is on (1-2)
Channel	The channel this input is on (0-23)
Use Base Lock Brake D/O	Tells if the base locking brake digital output should be used.
Enable With High (Else Low)	If checked, 5 volts will be driven out to enable the device, otherwise 0 volts.
Board	The board this input is on (1-2)
Channel	The channel this input is on (0-23)

Status Values	Description
Feedback Voltage	The voltage measured on the wheelbase measuring analog input.
Feedback Position	The calibrated wheelbase distance measured on the wheelbase measuring analog input.
Extending	Indicates if the base is in motion, extending.
At Limit	Indicates that the base has encountered the extend limit switch.
Base Lock	Indicates that the base locking brake is enabled.
Retracting	Indicates if the base is in motion, retracting.
At Limit	Indicates that the base has encountered the retract limit switch.

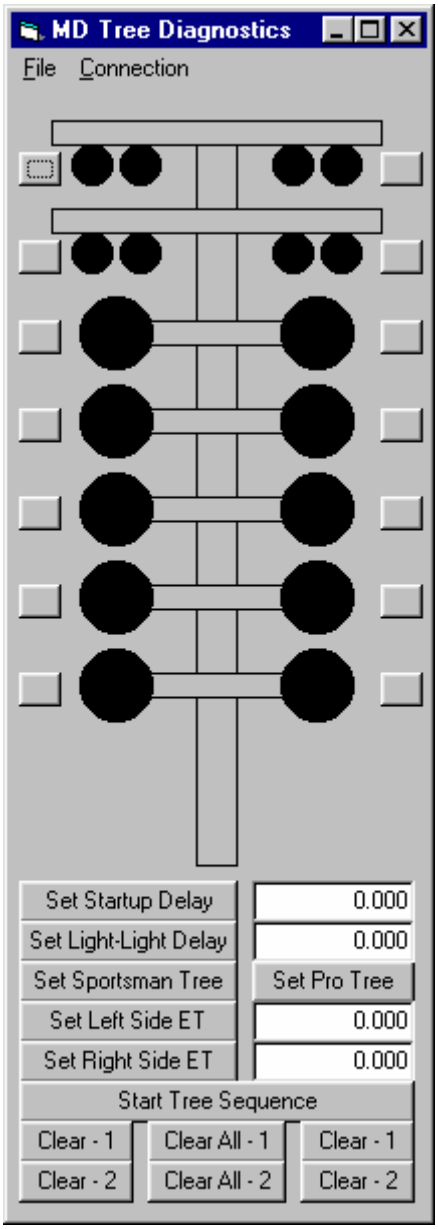
Calibration Commands	Description
Zero	Click this button to set the zero calibration point, after positioning the base to the minimum achievable wheelbase.
Span	Click this button to set the span calibration point, after positioning the base to the

	maximum achievable wheelbase.

Movement Commands	Description
Retract To Limit	Starts moving the base to the retract limit (minimum wheelbase).
Extend To Limit	Starts moving the base to the extend limit (maximum wheelbase).
Set Wheelbase	Starts moving the base to the target wheelbase.
Target Wheelbase	The target wheelbase to move the base to.
Stop FWD Base Movement	Immediately stops all movement of the FWD base.

Timing Light Tree Setup

This screen allows the operator to manually control the drag racing timing lights.



You can turn individual lights on/off by clicking on the small buttons beside each light.

The "File" menu lets you run a little "dancing tree" routine that makes the timing lights flash through various patterns, and it lets you exit this screen.

The "Connection" menu lets you connect or disconnect from the timing lights.

NOTE: If you successfully connect to the timing lights using this screen, the PowerDynePC software will remember the serial port that you connected on.

Set Startup Delay

Lets you set the startup delay (time from when the tree sequence is started to when the lights start moving down the tree).

Set Light-Light Delay

Lets you set the light-to-light delay used in the tree sequence. Sportsman tree is 0.5 seconds light-to-light, a pro tree is run at 0.4 seconds light-to-light.

Set Sportsman Tree

Sets the tree to use the sportsman tree sequence (yellow-yellow-yellow-green).

Set Pro Tree

Sets the tree to use the pro tree sequence (yellow- green).

Set Left Side ET

Sets the estimated ET for the driver using the left side of the tree, in seconds, for staggered timing.

Set Right Side ET

Sets the estimated ET for the driver using the right side of the tree, in seconds, for staggered timing.

Start Tree Sequence

Starts the tree sequence.

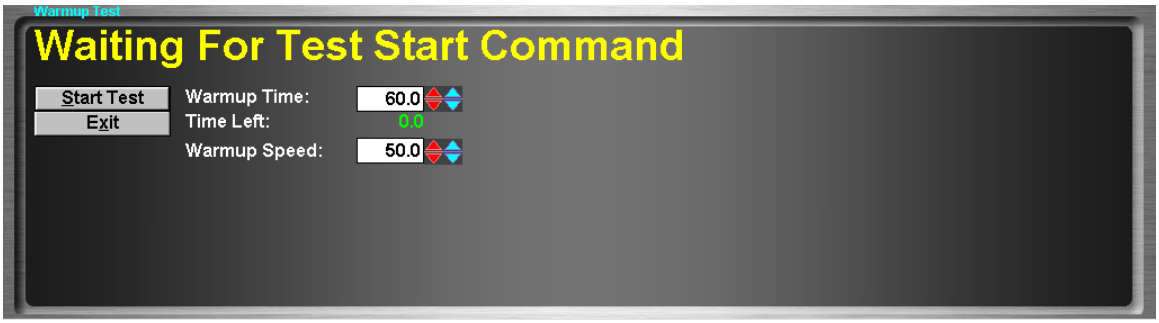
Clear – 1 / Clear All – 1 / Clear – 1

Clear – 2 / Clear All – 2 / Clear – 2

Various ways to turn the lights on the tree off.

Warmup

This screen allows the operator to perform an automatic dynamometer warm-up routine.



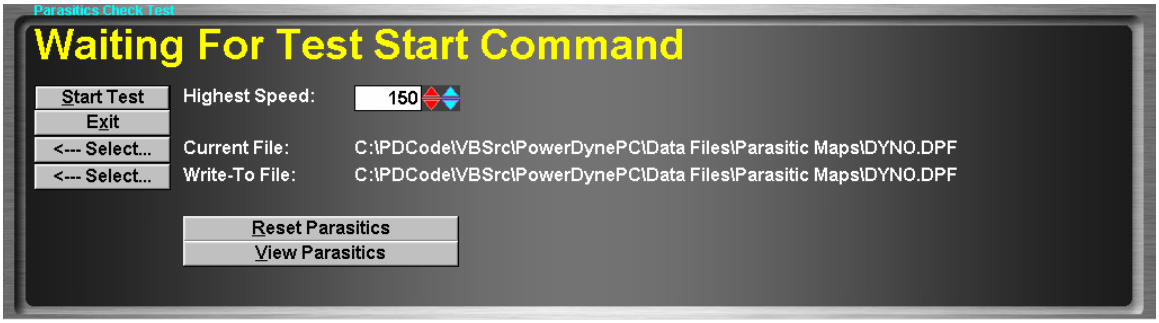
This test is used to bring the dynamometer' s bearings, belts, etc. up to a warmed up condition.

To perform a warmup test, follow the procedure below.

- Enter the desired warm-up time, in seconds.
- Click the "Start Test" button.
- The dynamometer will automatically enable its built-in warm-up motor, and run for the specified time. When the warm-up period is expired, the dynamometer will automatically stop.

Parasitics Measurement

This screen allows the operator to perform an automatic dynamometer parasitics measurement routine.



This test is used to measure and record the dynamometer' s parasitic losses due to bearings, belts, etc. The recorded data is reported as "Parasitics Torque", "Parasitics Force", etc., and is a component in the "Static Torque", "Static Force", etc. and "Total Torque", "Total Force", etc. values.

There are two (2) methods for keeping track of parasitic losses of a dynamometer. The traditional and simplest method is to measure the parasitic losses of the dynamometer with no vehicle on the dynamometer. This provides a consistent value that can be used with all vehicles tested. A second method, which accounts for increased dynamometer bearing loadings, tire-to-roll interface losses, etc. is to perform a parasitic losses measurement test with the vehicle to be tested on the dynamometer. This second method is more convenient for those using dynamometers without built-in calibration motors, and leads to greater repeatability and higher reported power values for the vehicles tested.

Since the parasitic losses data measured with a vehicle on a dynamometer is specific to the vehicle that was on the dynamometer when the test was performed, we have provided a method for storing and using as many parasitic losses data sets as required.

To Zero The Parasitic Losses Data

It is occasionally desirable to set the parasitic losses data to all 0 values. This can be accomplished by clicking on the "Reset Parasitics" button. This will create a new parasitic data set that indicates no parasitic losses at any speed, and it will save the all-zero data in a parasitic data set file name "Zero.DPF".

To Select a Parasitic Losses Data Set from the Existing Data Sets

In the event that vehicle-specific parasitic losses data is being used, a method is required to recall the parasitic losses data for a specific vehicle. This screen may be used for this purpose, by simply clicking on the "Select..." button next to the "Current File" field, and using the typical Windows file-open dialog box to select the parasitic losses data file to be used. Once a data file has been selected, the dynamometer will report the parasitic losses for that vehicle.

To Perform a Parasitic Losses Measurement Test

Whether dynamometer-only or dynamometer-vehicle parasitic losses data is in use, a parasitic losses measurement test must be performed at some point in order to measure the parasitic losses of the dynamometer or the dynamometer-vehicle system.

To perform a parasitics measurement test, follow the procedure below.

- Enter the maximum speed for which parasitics data should be measured and recorded.

- Use the "Select..." button to specify the "Write-To File". You may name your file anything you desire, but you may wish to name a dynamometer-only parasitic losses file "Dyno.DPF", and vehicle-specific parasitic losses data files "<LicensePlate>.DPF", "<CustomerName>.DPF", "<VIN>.DPF", etc., to make finding old data files easier.

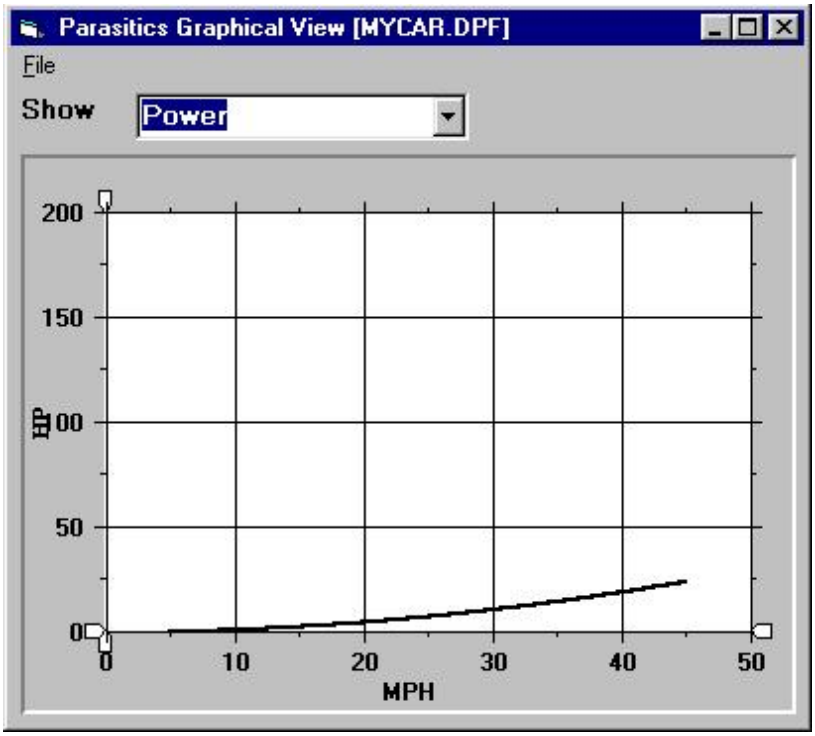
- Click the "Start Test" button to start the test. The software will wait until the measured speed goes above the maximum testing speed + 5.0 MPH, and then indicate that it has started measuring the parasitic losses of the dynamometer (and vehicle). If the vehicle is left on the dynamometer during testing, the transmission must be placed in neutral, and the brakes must not be touched during the coast-down phase of testing.

- Once the system's speed decreases to <= 2.5 MPH, the test will automatically complete and save the recorded data to the selected "Write-To" file.

- If a vehicle is used to spin the dynamometer, and the vehicle is not to be left on the dynamometer during testing, EXTREME CAUTION MUST BE USED. LIFT-OFF TYPE PARASITIC TESTING IS EXTREMELY DANGEROUS AND MAY CAUSE EQUIPMENT DAMAGE, VEHICLE DAMAGE, FACILITY DAMAGE, PERSONAL INJURY AND/OR DEATH. IF YOU CAN NOT ENSURE THE SAFETY OF YOURSELF, THOSE AROUND YOU AND ALL MATERIAL ITEMS WITHIN THE TESTING FACILITY, DO NOT ATTEMPT LIFT-OFF TYPE PARASITIC MEASUREMENTS.

Parasitic Losses Viewer

This screen allows the operator to view the current parasitic losses data as a graph.



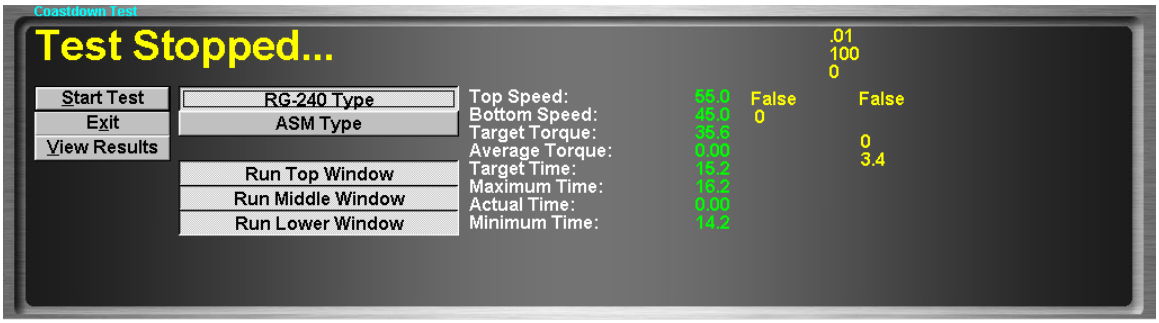
This screen allows the operator to view the current parasitic losses data in a graphical format. The parasitic losses data may be viewed as torque (dynamometer roll shaft torque), power (hp) or force versus system speed.

You can also print the graph using the "File – Print" command on the menu.

Note: Several of these screens can be visible at one time, so that the operator can compare different parasitic losses data sets.

CoastDown Check

This screen allows the operator to perform an automatic dynamometer coast-down test.



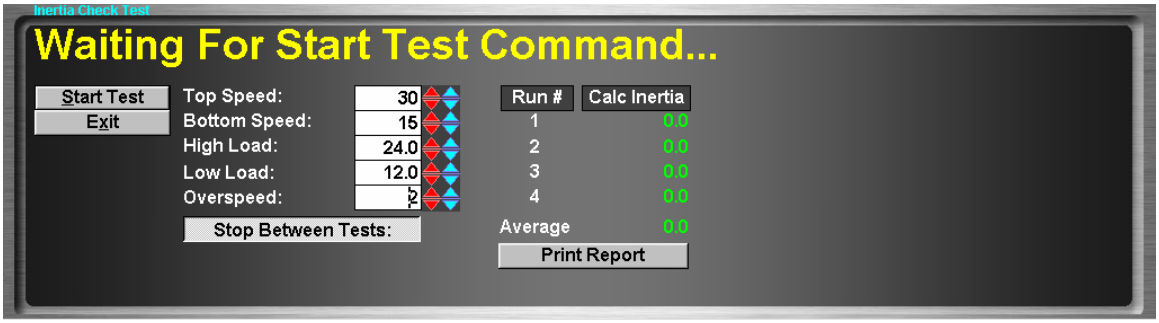
This test is used to perform an automatic coast-down verification test. Coast-down tests are used to verify that the dynamometer is properly calibrated by decelerating the dynamometer's inertia using the dynamometer's PAU. The time required to decelerate a known mass by a known amount using a known force can be calculated, and the actual time required is compared against the calculated time.

To Perform a CoastDown Test

- Select the desired coast-down test type, either RG-240 type or ASM type.
- Select the desired windows to be run using the "Run xxx Window" check boxes.
- Click the "Start Test" button.
- This test requires a built –in warm-up motor. Attempting to perform vehicle-lift-off coast-down tests is EXTREMELY DANGEROUS (SEE THE WARNINGS IN THE PARASITIC MEASUREMENT TEST AND ELSEWHERE IN THIS DOCUMENT), and it is very difficult to achieve repeatable results in that fashion.
- The dynamometer will automatically engage its built-in warm-up motor, accelerate to the highest required speed, apply the required load, and time the system's deceleration through the selected windows.
- Once the dynamometer has come to a stop, the test results can be viewed, partially on this screen, and in more detail by viewing the screen available via the "View Results" button.

Inertia Check Test

This screen allows the operator to perform an automatic dynamometer inertia measurement routine.



This test is used to measure the inertia (actually, vehicle-equivalent weight) or the dynamometer. This test is used in manufacturing and test-out at Mustang Dynamometer, and is not normally used in the field, unless mechanical changes are made to the dynamometer.

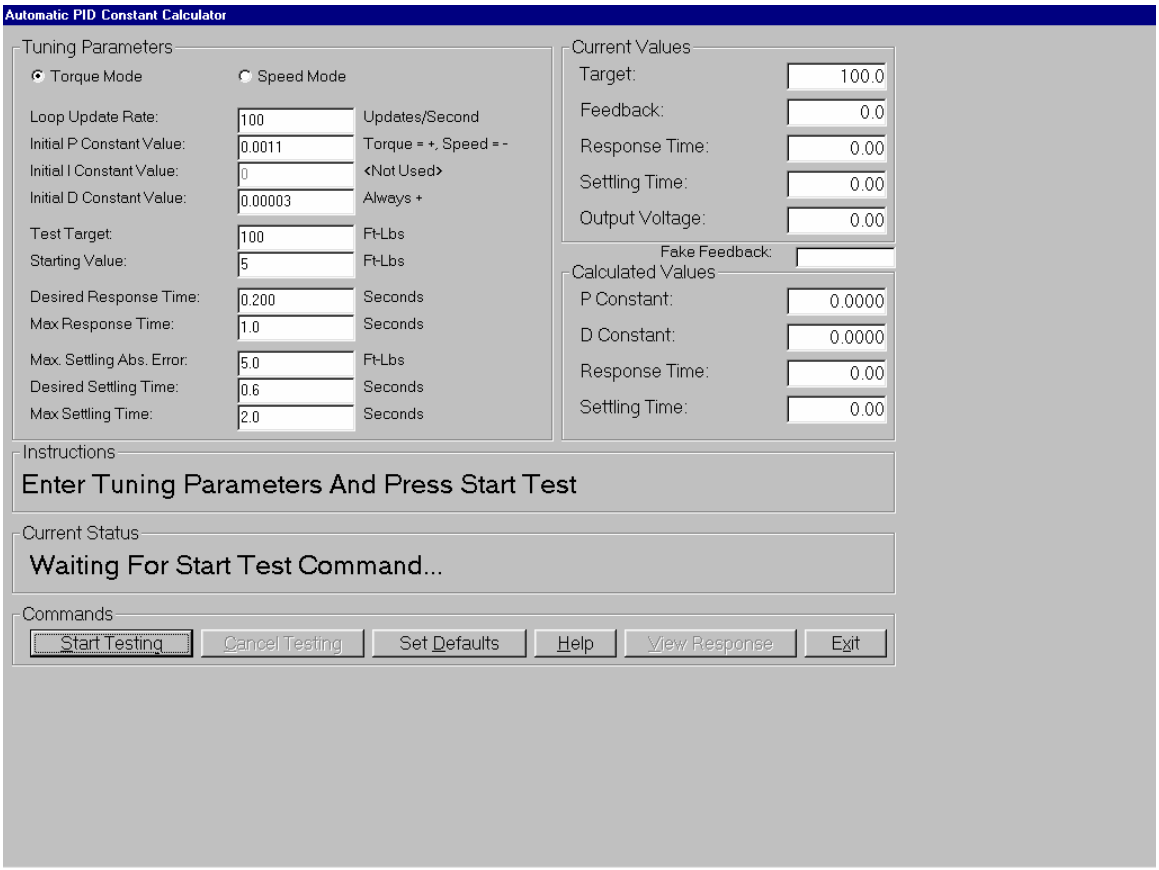
This test performs 4 sets of 2 coast-down test pairs, and uses the measured differences in deceleration at various loading forces to determine the inertia of the dynamometer.

To Perform an Inertia Check Test

- Enter the desired coast-down window top speed, in MPH. (Please use the default value, 30)
- Enter the desired coast-down window bottom speed, in MPH. (Please use the default value, 15)
- Enter the desired coast-down window high load value, in HP. (Please use the default value, 24)
- Enter the desired coast-down window low load value, in HP. (Please use the default value, 12)
- Enter the desired over-speed value for the coast-down window (Please use the default value, 10)
- Click the "Start Test" button.
- This test requires the built-in warm-up motor option. DO NOT ATTEMPT TO PERFORM THIS TEST USING VEHICLE-LIFT-OFFS, AS THEY ARE EXTREMELY DANGEROUS.
- Four (4) sets of two (2) coast-down windows will be performed. When the final coast-down test has been performed, the dynamometer's inertia (vehicle-equivalent-weight) value will be known.

Automatic PID Calculator

This screen allows the operator to perform an automatic PID tuning routine.



This routine allows a knowledgeable operator to calculate appropriate PID constant values for the dynamometer at hand. This routine is normally only used by Mustang Dynamometer personnel, since considerable knowledge is required to successfully use this routine.

Screen Fields	Description
Torque / Speed Mode Selection	Determines if the PID values for torque or speed mode will be tunded.
Loop Update Rate	The loop update time, expressed as the number of updates per second, typically 100.
Initial P Constant Value	The starting value for the P constant.
Initial I Constant Value	The starting value for the I constant (0)
Initial D Constant Value	The starting value for the D constant.
Test Target	The target loading value to be used during step

	testing.
Starting Value	The starting loading value to be used during step testing.
Desired Response Time	The desired control loop response time, in seconds (torque ~= 0.1 to 0.6 seconds, speed ~= 1 to 10 seconds).
Max Response Time	The maximum time that the control loop will be given to achieve a 90% step response before the next loop of the test routine is started – should be several times the desired response time.
Max Settling Abs. Error	The maximum absolute error between the feedback value and the target value that can be considered part of a settled response (typically a few percent of the target value).
Desired Settling Time	The desired control loop response time, in seconds (torque ~= 0.1 to 0.6 seconds, speed ~= 1 to 10 seconds).
Max Settling Time	The maximum time that the control loop will be given to achieve a 90% step response before the next loop of the test routine is started – should be several times the desired response time.

Current Values	Description
Target	The current target for the control loop – may be the starting value or the actual target value.
Feedback	The current feedback value for the control loop.
Response Time	The measured 90% step response time from the last test loop.
Settling Time	The measured step settling time from the last test loop.
Output Voltage	The current control loop output voltage (to the PAU amplifier).

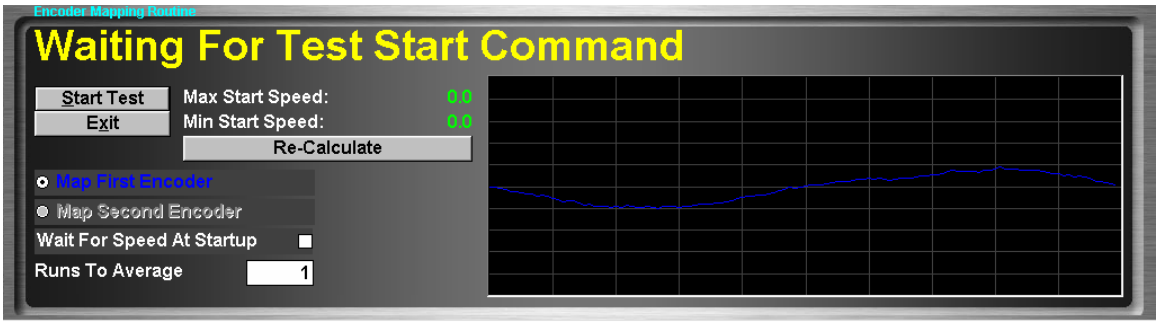
Calculated Values	Description
P Constant	The calculated P constant for the control loop.
D Constant	The calculated D constant for the control loop.
Response Time	The measured response time using the P/I/D constants above.
Settling Time	The measured settling time using the P/I/D constants above.

To Perform Automatic PID Tuning

- Two (2) operators are required to perform this routine.
- Select either "`Torque`" or "`Speed`" mode tuning.
- Enter the initial values for the PID constants.
- Enter the testing routine parameters (not described here; if you don't know how to do this, please don't try as you may cause yourself more trouble than benefit).
- Start a SECURELY RESTRAINED vehicle with AN EXPERIENCED DRIVER running on the dynamometer.
- Click the "`Start Testing`" button. The software will perform numerous step-response tests to obtain PID values that meet the specified response criteria.
- The "`View Response`" button may be used to view a graph of the actual response achieved.

Map Speed Encoder

This routine allows the operator to create a noise-canceling map of a speed encoder input, which is then used during testing to map the noise generated by the encoder itself out of the speed input. Use of these speed-canceling maps can greatly reduce speed/acceleration/force/torque/power noise during testing, particularly on dynamometers with large diameter rolls.



Map First Encoder	These select which encoder should be mapped during the routine. The first encoder is Map Second Encoder associated with the primary roll set of the dynamometer (the TWD roll set for configurable AWD systems).
Wait For Speed At Startup	If checked, the test routine will allow several seconds for the operator to accelerate ate the system up to an appropriate testing speed. 50 MPH is generally ideal for encoder mapping.
Runs To Average	Tells the mapping routine how many data sets to acquire and average into the final noise-canceling map. This value should generally be set to 5.
Min Start Speed	These values show the operator the minimum and maximum speeds that can be used Max Start Speed during the mapping routine.
Re-Calculate	Tells the software to re-calculate the minimum and maximum start speed values. These values depend on the physical configuration of the dynamometer, as well as on the I/O speed of your computer system.

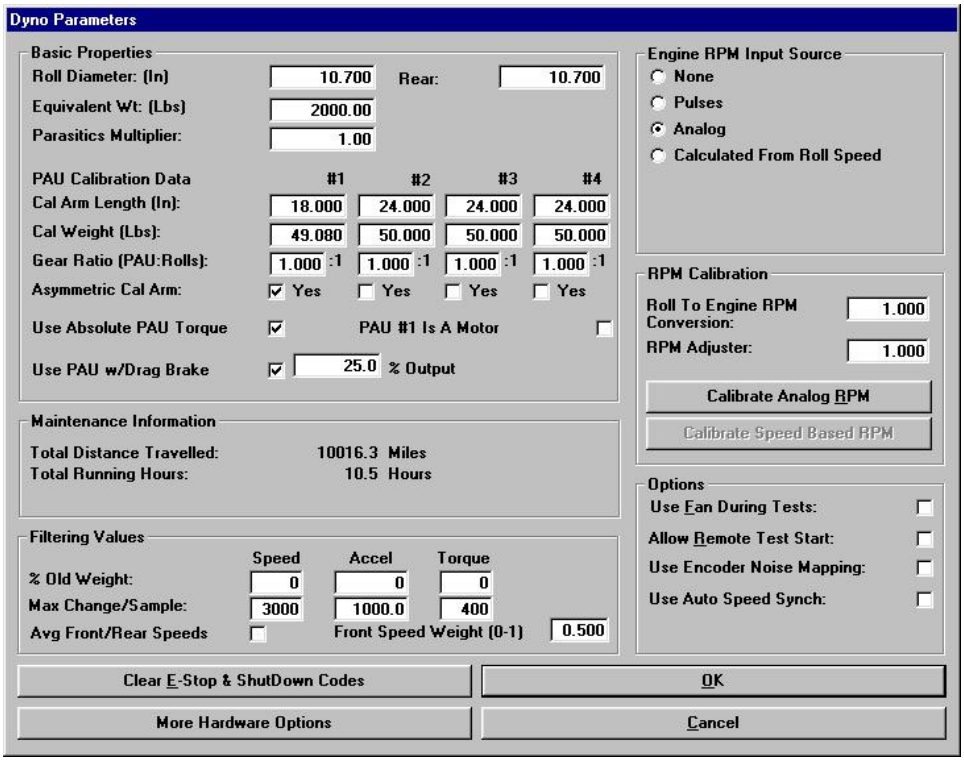
Running A Mapping Routine

Ideally, noise mapping should be done without a vehicle present on the dynamometer, to avoid measurement errors due to vehicle inputs. However, vehicle-on-dynamometer mapping is possible, and generally works well. The routine is to simply accelerate the system up to approximately 50 MPH, click the "Start Test" button, and place the vehicle in neutral (or hold the clutch firmly to the floor). The test display will prompt the operator during testing, but the only requirement is that the system start at approximately 50 MPH, and that the system be freely

coasting during the mapping routine. Once the mapping routine has completed, a graph of the newly acquired noise-canceling map will be displayed, and the new data will be saved to disk.

Dyno Parameters

This screen allows the operator to specify dynamometer-specific parameters.



This screen is used to enter the dynamometer-specific information for the dynamometer in use. Various physical properties, along with several option values, can be entered on this screen.

Screen Fields	Description
Roll Diameter	The diameter of the dynamometer's rolls, in inches/CM. Normally 8.575, 10.7 or 17.8, 30.0 or 50.0 inches.
Equivalent Weight	The vehicle-equivalent weight of the dynamometer, in pounds/Kg, usually 2000 pounds.
Parasitics Multiplier	A multiplier applied to the measured parasitic losses of the dynamometer. This value should be left at 1.0 for all dynamometers except those with very unusual designs (custom units only).
Torque Arm Length	The length of the PAU load-cell calibration arm, in inches/CM, usually 12.0, 18.0 or 24.0 inches.
Calibration Weight	The calibration weight value, normally stamped into the calibration weight at manufacture time, in pounds/Kg. The

	nominal value is typically 50.0 pounds.
Gear Ratio	The gear ratio between the dynamometer's rolls and the dynamometer's PAU(s). This value is normally 1.0, except on MD-1750 dynamometers, for which the value is 2.769. The value is (PAU-shaft revolutions per roll-shaft revolution).
Asymmetric Cal Arm	If an asymmetric external calibration fixture is used for the PAU load-cell calibration, then this box should be checked. This box is normally un-checked, except for MD-1750 dynamometers.
Use Absolute PAU Torque	If checked, the torque measured by the PAU load-cells is taken as its absolute value. This box is normally left checked, unless specific customer requirements involve directional torque measurement.
Total Distance	The total distance driven on the dynamometer, in miles/KM.
Total Running Hours	The total running time on the dynamometer, in hours.
Slave Version	In the extremely unlikely event that a serial interface dynamometer controller is in use (rather than the normal PC/IO-Board configuration), the software version executing on the dynamometer controller will be shown.
% Old Weight	For the speed/torque/acceleration inputs, an FIR filter constant used to filter the associated input values. This value must be in the range 0 to 99. 0 represent no filtering, while 99 represent a very heavy filter. These values should normally be left at 0, although values up to approximately 90 can be used to smooth measured values.
Max Change / Sample	For the speed/torque/acceleration inputs, a clipping value that limits the amount by which the associated input value can change per sample. Since the normal sampling rate is 100 Hz, you can establish these values by taking the maximum expected rate of change for a channel and dividing by 100. These values should normally be left at the default values, which are very large, and therefore do not impose any clipping on the input values.
Avg Front/Rear Speeds	If enabled, a second speed input will be used to create a weighted average speed input for the dynamometer. This is generally only used for shaft-coupled AWD dynamometers

	while in AWD mode to eliminate measurement noise due to driveshaft flex. Note that the second ADA-1100 board must be installed and connected to a second speed encoder for this to be available.
Front Speed Weight	This value is used in creating the weighted average speed value discussed above. For a dynamometer with equal inertia values for each axle, this value should be nominally set to 0.500; for systems with different front/rear inertia values, this should be set to the fraction of the total inertia value accounted for by the front axle of the dynamometer. In practice, this value must be set to a slightly different value based upon tire/wheel/drive train inertia as applied to the front and rear roll sets. The ideal value for this parameter can be established by monitoring the "Front Accel" and "Rear Accel" 'magic name' values available via the auxiliary analog input channels, along with the "Primary Accel MPH/sec" value. When this value is set correctly, the "Primary Accel MPH/sec" value will track directly between the "Front Accel" and "Rear Accel" values, as can be seen using the Trace Graph Viewer.

Engine RPM Input Source

Several input methods are supported for engine RPM measurement.

Engine RPM Input Source	Description
None	No engine RPM source is available.
Pulses	An engine RPM pulse train is routed through an on-board pulse train input. This input is not currently supported.
Analog	An analog input representing engine RPM is provided from an external RPM measurement device.
Calculated From Roll Speed	The engine RPM value is computed based on the dynamometer's measured speed. This input yields a very high quality engine RPM value, but may not be accurate if wheel slip is encountered, and can only be used in a single gear, and only with manual transmissions.

RPM Calibration	Description
Roll To Engine RPM Conversion	If engine RPM is being calculated from the dynamometer's speed input, then this value represent the multiplier used to go from dynamometer roll-shaft RPM to engine crankshaft RPM. This value is the calibration value resulting from the calibration routine discussed below.
RPM Adjuster	This value is a "fix-all" multiplier applied to the raw engine RPM value, to account for various problems encountered in engine RPM measurement.
Calibrate Analog RPM	This button will display a calibration screen used to calibrate the analog engine RPM input. Please see the section titled "Analog RPM Input Calibration" for information on this calibration screen.
Calibrate Speed Based RPM	This button will display a calibration screen used to calibrate the dynamometer's roll shaft speed to the engine's RPM. The operator has only to specify the engine RPM value to calibrate to, drive the vehicle in the gear that will be used for testing at the specified RPM, and click the "OK" button.

Options

The Options	Description
Use Fan During Tests	If checked, the optional vehicle-cooling fan will be automatically turned on/off at the beginning/end of tests.
Allow Remote Test Start	If checked, a digital input may be configured to automatically start the current test remotely. This option is used in synchronizing multiple dynamometers, etc.
Use Encoder Noise Mapping	Noise on speed/accel/torque/power/force values can be greatly reduced (particularly on dynamometers with large diameter rolls) by using noise canceling maps for the encoders. If you enable this feature, you must create maps of the various speed encoders, using the mapping routine in this software. Also, at the start of any test routine, you will have to synchronize the encoder with the speed maps, either manually (by aligning the rolls with a mark on the dynamometer's frame) or automatically (by using the auto-synch feature described below).
Use Auto Speed Synch	Enables automatic synch detection for the encoder noise canceling logic, using a second one (1) pulse per revolution speed input associated with each (1 or 2) normal speed input. This will cause the auto-synch to pop up a small screen whenever a test routine is started anytime the dynamometer's speed has fallen below 2 mph.

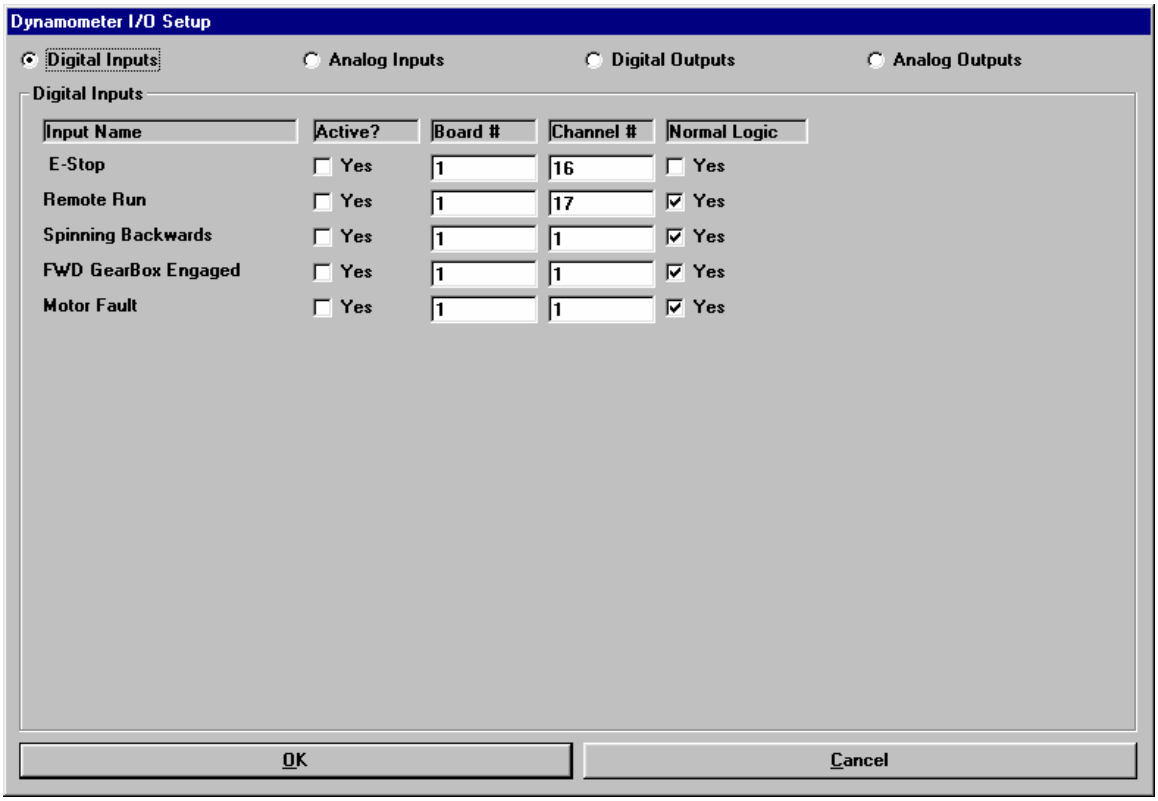
Buttons

The following is a list of buttons that appear at the bottom of the screen along with the brief description of their functionality:

The Buttons	Functionality
Clear E-Stop & Shutdown Codes	This button will attempt to clear any E-Stop or shutdown codes.
More Hardware Options	Clicking on this button allows access to the hardware I/O channel assignments for the digital inputs and outputs used by the dynamometer control system.
OK	Save away any changes and close out of this screen.
Cancel	Just close out of this screen, nothing will be saved.

Digital Input Setup

This view of this screen allows the operator to specify the I/O channels used by the dynamometer control system for digital inputs.



Digital Inputs	Description
Name	The logical name for the signal
Active?	If checked, then the output will be read, otherwise the default value specified in the software's configuration ("Ini") file will be used.
Board	The I/O board used to read the input (1 -> 2)
Channel	The I/O channel used to read the input (8 -> 23)
Normal Logic	If this box is checked, the input will be taken to be active when the input voltage level is high, and inactive when the input level is low; otherwise, these levels will be reversed.

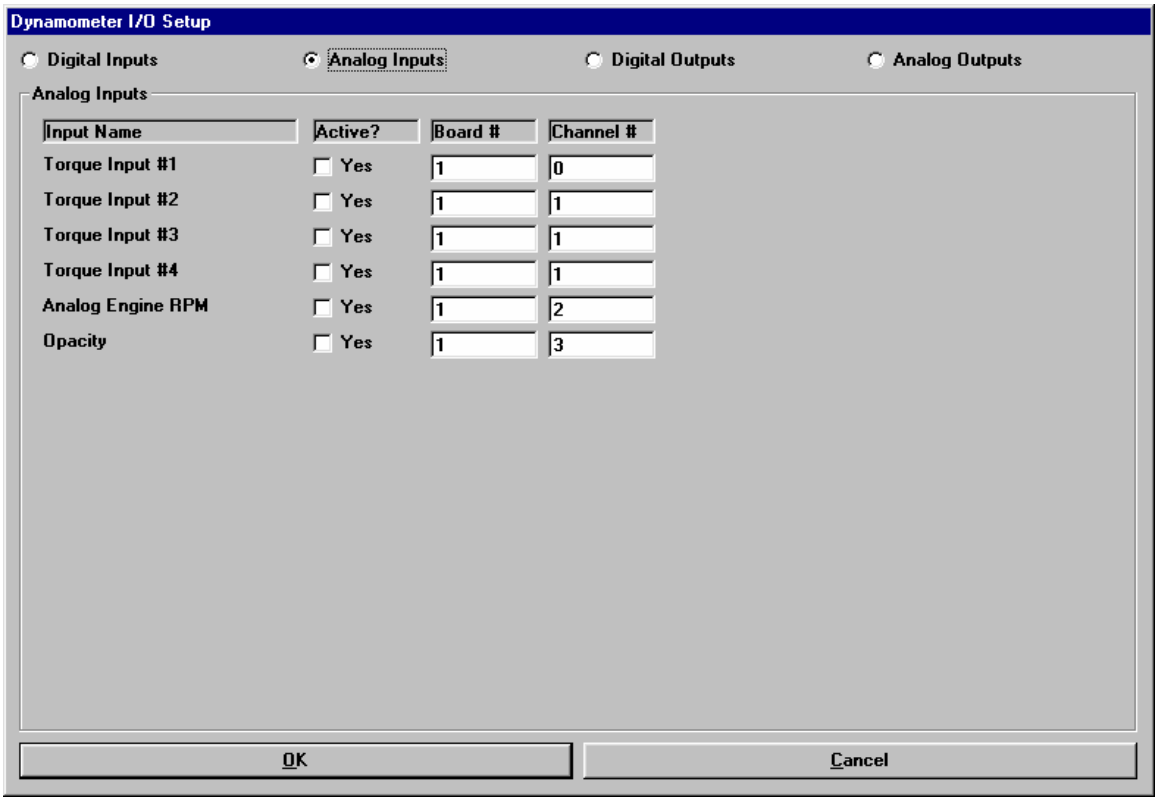
Digital Input Channels

The following is a list of Digital Input Channels along with a description of their functionality:

Digital Input Channels	Description
Estop	This input tells the control software that an E-Stop condition has occurred, which will put the dynamometer into an unloaded coast-stop, disable and set to 0% reference the throttle controller (if connected), and prevent further testing until the E-Stop condition is resolved.
Remote Run	This input can be used to trigger the start of a test via an external signal. For this functionality to work, the test to be started must be active in the software (i.e. the test screen must be showing), and all required parameters must be set to acceptable values. When this input is triggered, the test will begin, and will run until this input returns to a "false" condition.

Analog Input Setup

This view of this screen allows the operator to specify the I/O channels used by the dynamometer control system for analog inputs.



Analog Inputs	Description
Name	The logical name for the signal
Active?	If checked, then the output will be read, otherwise the default value specified in the software's configuration ("Ini") file will be used.
Board	The I/O board used to read the input (1 -> 2)
Channel	The I/O channel used to read the input (0 -> 7)

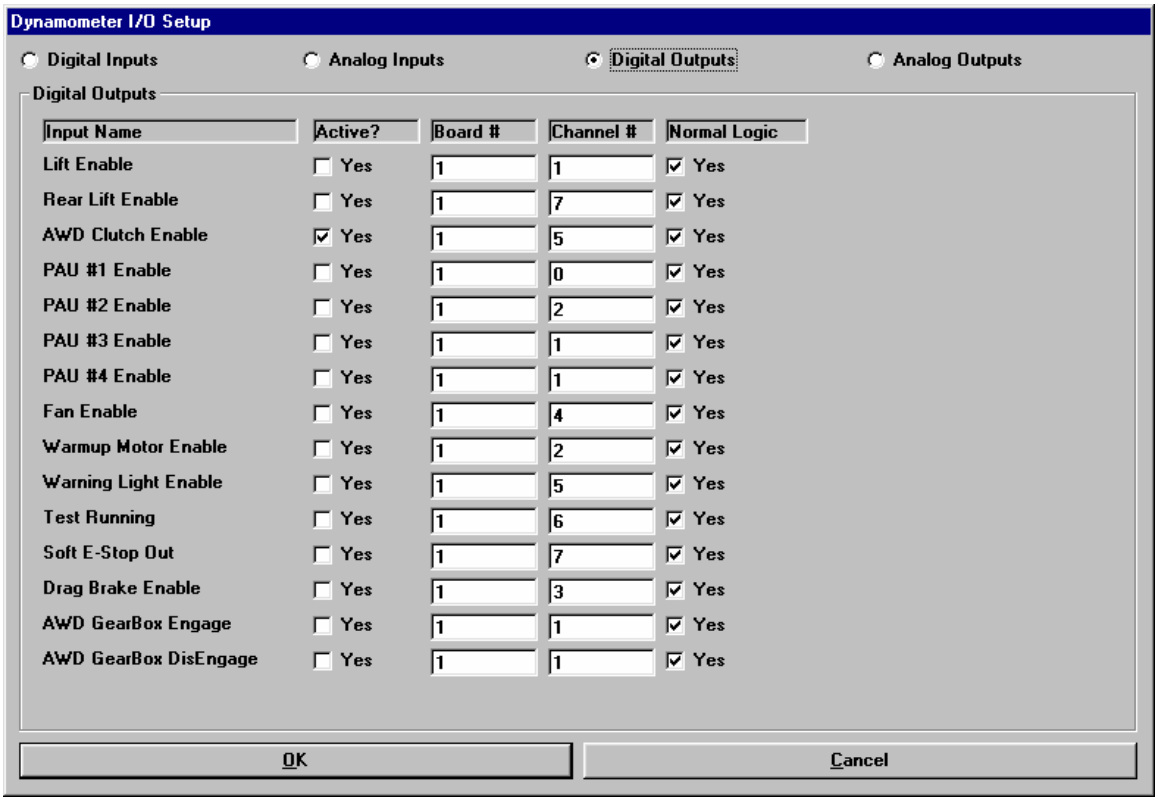
Analog Input Channels

The following is a list of analog input channels along with a description of their functionality:

Analog Input Channels	Description
Torque #1	This input is used to measure the torque applied to the dynamometer's roll shaft by the loading brake (PAU).
Torque #2	Similar to "Torque Input #1", but for an additional PAU.
Torque #3	Similar to "Torque Input #1", but for an additional PAU.
Torque #4	Similar to "Torque Input #1", but for an additional PAU.
Analog Engine RPM	This input is used to read engine RPM from an external engine RPM measurement system, such as MD's own MD-RPM-2000 system.
Opacity	This input is used to measure diesel exhaust opacity using an external opacity-measuring device.

Digital Output Setup

This view of this screen allows the operator to specify the I/O channels used by the dynamometer control system for digital outputs.



Digital Outputs	Description
Name	The logical name for the signal
Active?	If checked, then the output will be read; otherwise the default value specified in the software's configuration ("Ini") file will be used.
Board	The I/O board used to read the output (1 -> 2)
Channel	The I/O channel used to read the output (0 -> 7)
Normal Logic	If this box is checked, the output will be driven high when the signal value is true, and low when the signal value is false; otherwise, these levels will be reversed.

Digital Output Channels

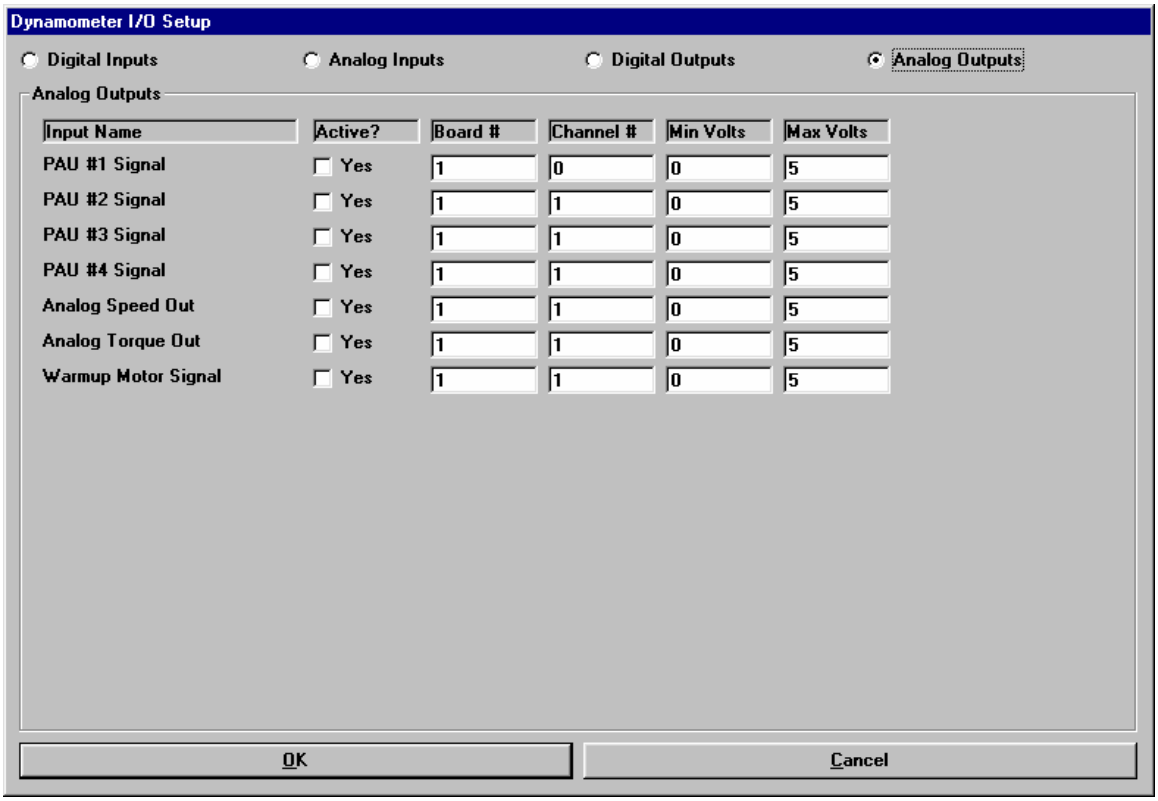
The following is a list of digital output channels along with a description of their functionality:

Digital Output Channels	Description
Lift Enable	This output drives the dynamometer's lift up and down.
Rear Lift Enable	This output will drive the rear lift of a 4WD dynamometer up and down. If this output is active, the "Rear Lift" control sub-menu will appear on the main menu bar of the software.
PAU #1 Enable	This output turns the loading PAU of the dynamometer on/off.
PAU #2 Enable	Similar to "PAU #1 Enable", but for an additional PAU.
PAU #3 Enable	Similar to "PAU #1 Enable", but for an additional PAU.
PAU #4 Enable	Similar to "PAU #1 Enable", but for an additional PAU.
Fan Enable	This output will drive a vehicle-cooling fan. If this output is active, the "Fan" sub-menu will appear on the main menu bar of the software.
Warmup Motor Enable	This output will drive a dynamometer warm-up motor during the warm-up, parasitic and coast-down tests, if the dynamometer is so equipped.
Warning Light Enable	This output will drive a warning light any time the dynamometer is actively running a test or the system's speed is above 0.1 MPH.
Test Running	This output would be driven high any time the dynamometer is actively running a test. This can be used to trigger external data acquisition software.
Soft E-Stop Out	This output will send an E-Stop signal to external systems to

	indicate that the dynamometer is in an E-Stop condition.
Drag Brake Enable	This output will drive the drag brake used on our MD-1750 model dynamometer, which is used to apply a light load to the dynamometer's rolls using the roll-

Analog Output Setup

This view of this screen allows the operator to specify the I/O channels used by the dynamometer control system for analog outputs.



Analog Output	Description
Name	The logical name for the signal
Active?	If checked, then the current output will be written, otherwise the default value specified in the software's configuration ("Ini") file will be used.
Board	The I/O board used to write the output (1 -> 2)
Channel	The I/O channel used to write the output (0 -> 1)
Min Volts	The minimum voltage that will ever be written to the output channel. Useful for limiting the range of voltages that will be presented to the connected actuator.

Max Volts	The maximum voltage that will ever be written to the output channel. Useful for limiting the range of voltages that will be presented to the connected actuator.

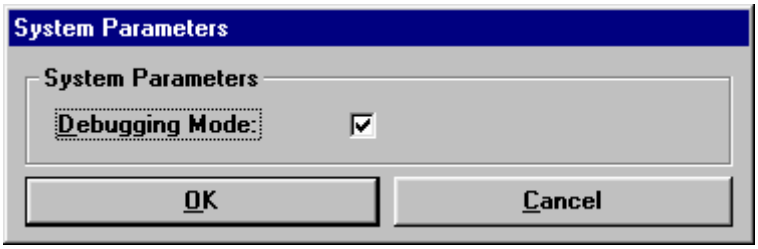
Analog Output Channels

The following is a list of analog output channels along with a description of their functionality:

Analog Output Channels	Description
PAU #1 Signal	This output drives the amplifier that is used to drive the loading brake (PAU) of the dynamometer.
PAU #2 Signal	Similar to "PAU #1 Signal", but used to drive an additional loading brake (PAU).
PAU #3 Signal	Similar to "PAU #1 Signal", but used to drive an additional loading brake (PAU).
PAU #4 Signal	Similar to "PAU #1 Signal", but used to drive an additional loading brake (PAU).
Analog Speed Out	This output can be used to drive the system's measured speed (or RPM) value out to external data acquisition systems.
Analog Torque Out	This output can be used to drive the system's measured torque (or force) value out to external data acquisition systems.
Warm-up Motor Signal	This output is used to provide an output level reference for the warm-up motor, if the dynamometer is so equipped.

System Parameters

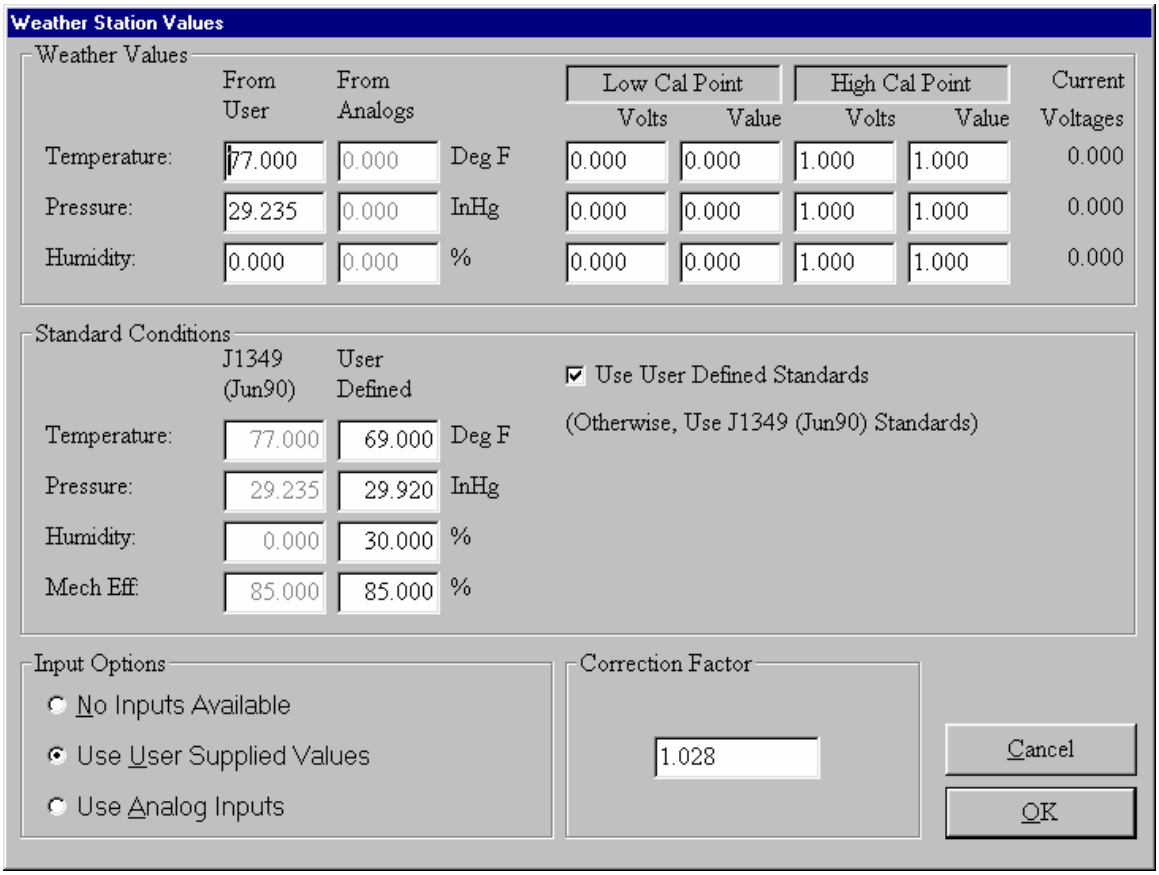
This screen is used to view and/or set the system-level parameters.



Parameter	Description
Debugging Mode	If selected, numerous debugging/diagnostic display values will be enabled, along with access to several normally disabled diagnostic forms.

Weather Station Parameters

This screen allows the operator to configure and/or calibrate the weather station facility.



In order to perform SAE J-1349 atmospheric corrections for torque/power values, the ambient atmospheric conditions must be known. This screen allows the operator to configure and/or calibrate the weather station facility of this software.

To Specify a Weather Station Input Type

Select on of the available options:

Options	Meaning
No Inputs Available	When selected means that No weather station values are available, no corrections can be performed.
Use User Supplied Values	The operator will manually enter the ambient atmospheric values.
Use Analog Inputs	An analog interface to weather station sensors is connected.

To Specify User-Supplied Weather Station Values

If no weather station hardware is connected, the operator may manually enter the ambient atmospheric condition values, in the "From User" column in the "Weather Values" group.

To Specify User-Defined Standard Conditions

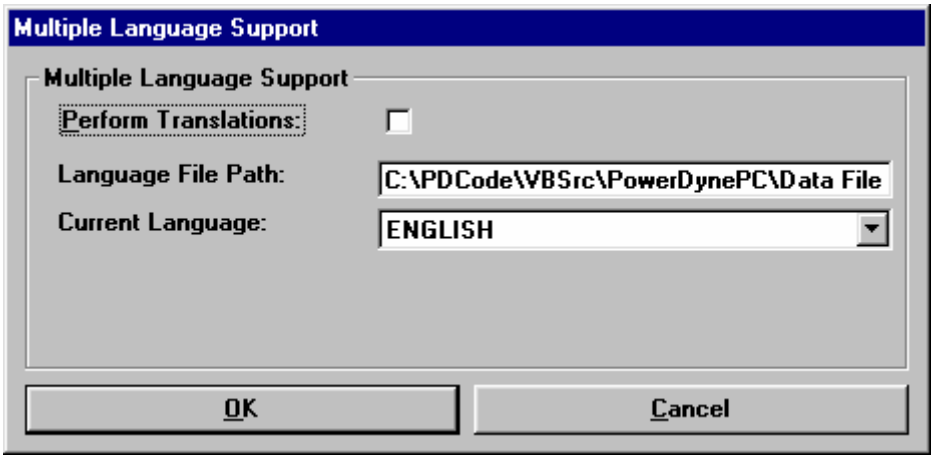
If you do not wish to use the SAE J-1349 JUN90 standard conditions, you may specify alternate standard condition values, in the "User Defined" column in the "Standard Conditions" group. If the "Use User Defined Standards" check box is checked, the user defined values will be taken as the standard conditions values, otherwise the SAE J-1349 JUN90 values will be used.

To Calibrate a Hardware Weather Station

If a hardware weather station is connected to the analog input interface, the operator must supply calibration values for each of the inputs. The appropriate calibration values are supplied with the sensors, and must be entered in the "Weather Values" group, under the "Low Cal Point" and "High Cal Point" headers. The "Low Cal Point" voltages are normally 0.0 volts, and the "High Cal Point" voltages are normally 5.0 volts. The low and high calibration point values for each sensor are sensor dependant.

Languages

This screen allows the operator to select the current language for display and printing.

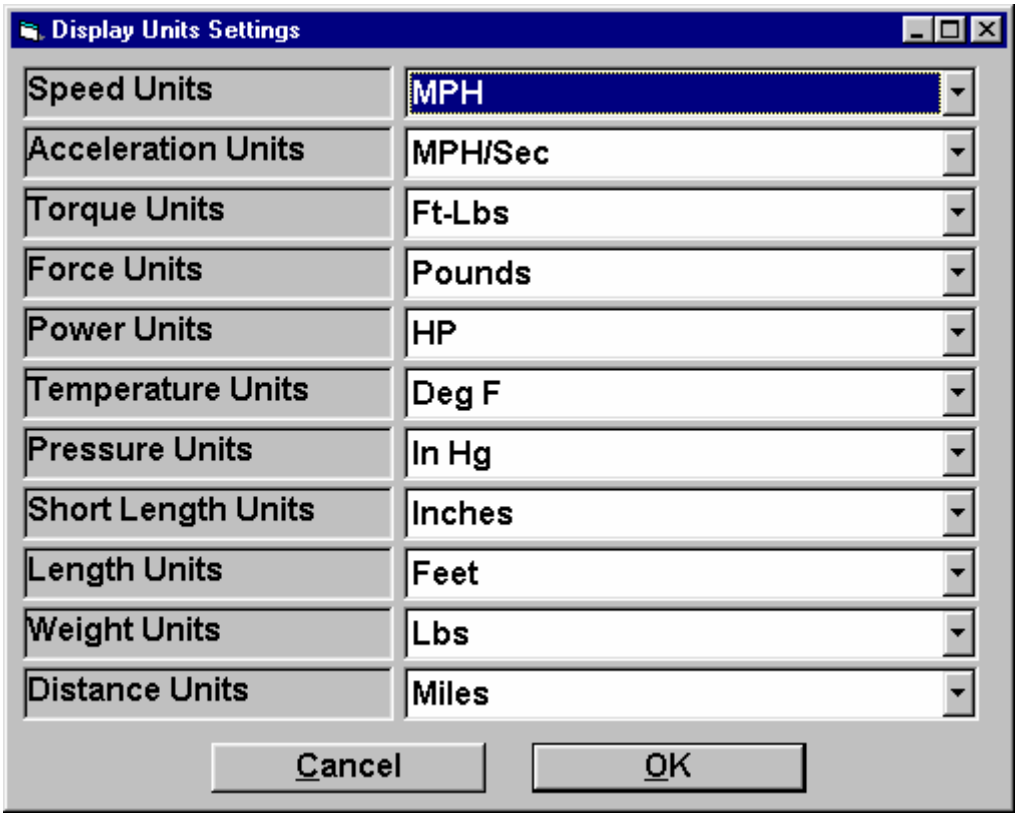


This software supports several languages in addition to English. This screen allows the operator to select a language for the operator interface.

Perform Translations	If selected, language translations will be performed to the selected language.
Language File Path	Specifies the directory path to the foreign language files used for non-English translations.
Current Language	Indicates the language currently selected for the operator interface. If operator can change to language by selecting from the list of available languages from the drop-down.

Display Units

This screen allows the operator to specify different units of measure for the following units:

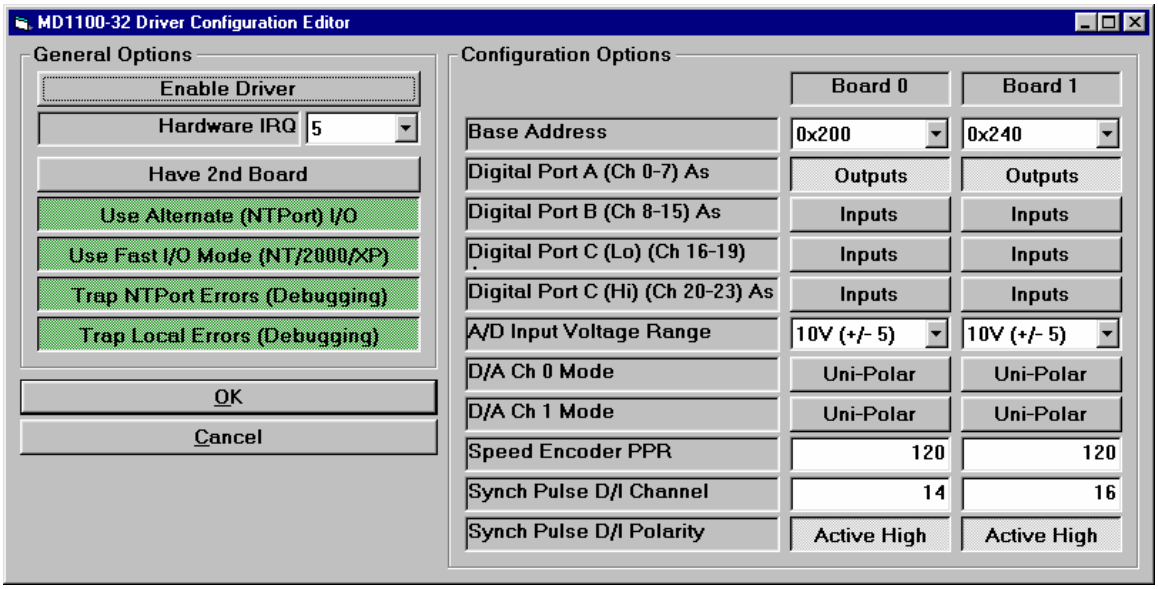


The following is a list of units and all the corresponding units of measure:

Units	Unit Of Measure
Speed	MPH, Ft/Sec, KPH, M/Sec
Acceleration	MPH/Sec, Ft/Sec/Sec, KPH/Sec, Meters/Sec/Sec, Gs
Torque	Ft-Lbs, In-Lbs, In-Oz, Kg-M, Kg-CM, N-M, N-CM
Force	Pounds, Kg, Newtons
Power	HP, KW, Watts, PS
Temperature	Deg F, Deg R, Deg C, Deg K
Pressure	In Hg, In H2O, PSI, mm Hg, mm H2O, Kg/M, Kg/CM, Pascals, Kpascals, Bar, Atmospheres

Length	Inches, CM, Feet, Meters
Weight	Lbs, Kg
Distance	Miles, KM

ADA-1100 I/O Board Driver Configuration Editor



This is the configuration screen for the driver for the ADA-1100 I/O board used to control the dynamometer. This screen is generally only used once, to configure the driver for your particular hardware.

NOTE:

Use of this screen should be restricted to operators with the knowledge required to correctly configure this driver. Invalid settings may render your equipment inoperative, and may require a service call or reinstallation of your software to correct the problem.

Enable Driver	Should be enabled; the sole exception is when the software is configured in "Demo" mode. If not enabled, the I/O driver will not work at all.
Hardware IRQ	Must be set to match the physical IRQ jumper setting on the ADA-1100 I/O board. Note that for systems with two (2) I/O boards, only the first board will have an IRQ jumper installed; the second board must NOT have the jumper installed. Note that the selected IRQ must not be in use by any other I/O boards (sound board, parallel port, etc), and must not be reserved by the operating system for PCI boards (if your BIOS supports this, it should be reserved for ISA boards).
Have 2nd Board	Must be enabled if and only if you have two (2) ADA-1100 I/O boards installed, typically to gain an additional 8 analog inputs,

	or for a second speed channel on AWD dynamometers.
Use Alternate (NTPort) I/O	Configures the driver to use an alternative method of accessing the I/O board. The alternative method is faster on Windows 98 systems, and may or may not be faster on NT/2000/XP systems.
Use Fast I/O Mode (NT/2000/XP)	If the alternate (NTPort) I/O configuration is used, this option will increase I/O speed on NT/2000/XP systems.
Trap NTPort Errors (Debugging)	Enables message boxes for any errors encountered when using the alternate (NTPort) I/O routines.
Trap Local Errors (Debugging)	Enables message boxes for internal driver errors.

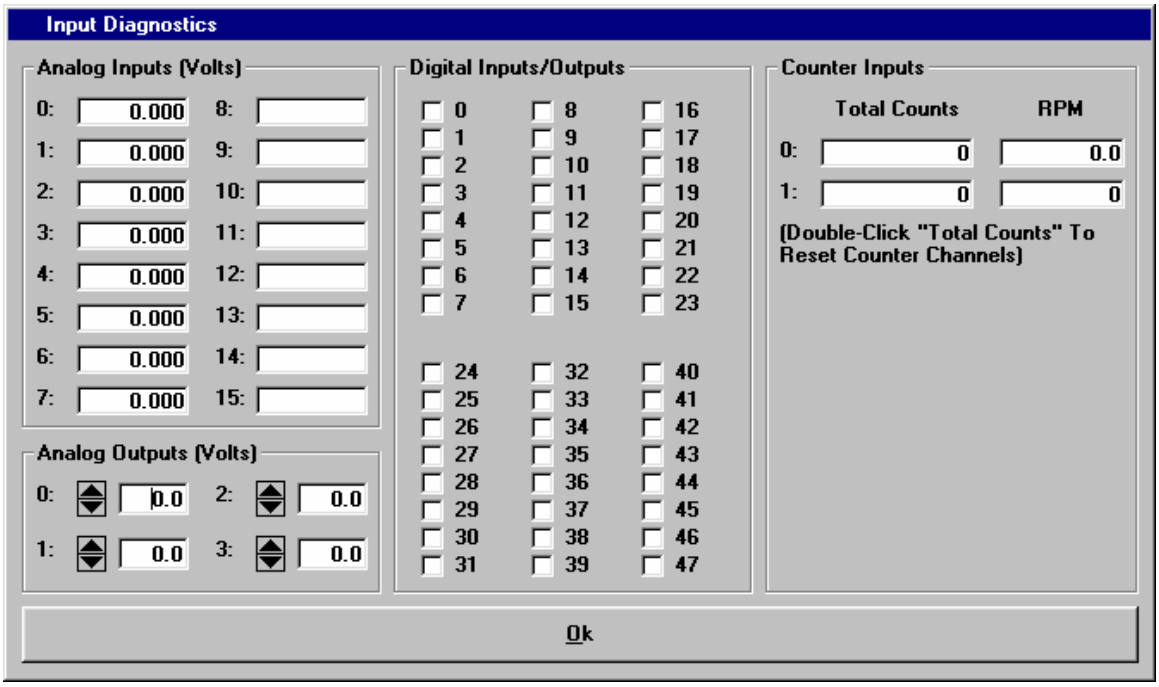
Buttons

OK	Saves the current configuration values and closes this screen.
Cancel	Closes this screen without saving any changes.

ButtonBase	Address Sets the base port address for the I/O board(s). MUST be set correctly, ie this value must match the physical jumper setting on the I/O board(s).
Digital Port A (Ch 0-7) As	Configures this group of digital I/O lines as inputs or outputs.
Digital Port B (Ch 8-15) As	Configures this group of digital I/O lines as inputs or outputs.
Digital Port C (Lo) (Ch 16-19) As	Configures this group of digital I/O lines as inputs or outputs.
Digital Port C (Hi) (Ch 20-23) As	Configures this group of digital I/O lines as inputs or outputs.
A/D Input Voltage Range	Sets the analog input voltage range. MUST match the physical jumper setting on the I/O board(s).
D/A Ch 0 Mode	Sets the analog output mode for this channel. MUST match the physical configuration of the I/O board(s).
D/A Ch 1 Mode	Sets the analog output mode for this channel. MUST match the physical configuration of the I/O board(s).
Speed Encoder PPR	Sets the number of pulses per revolution for the speed input

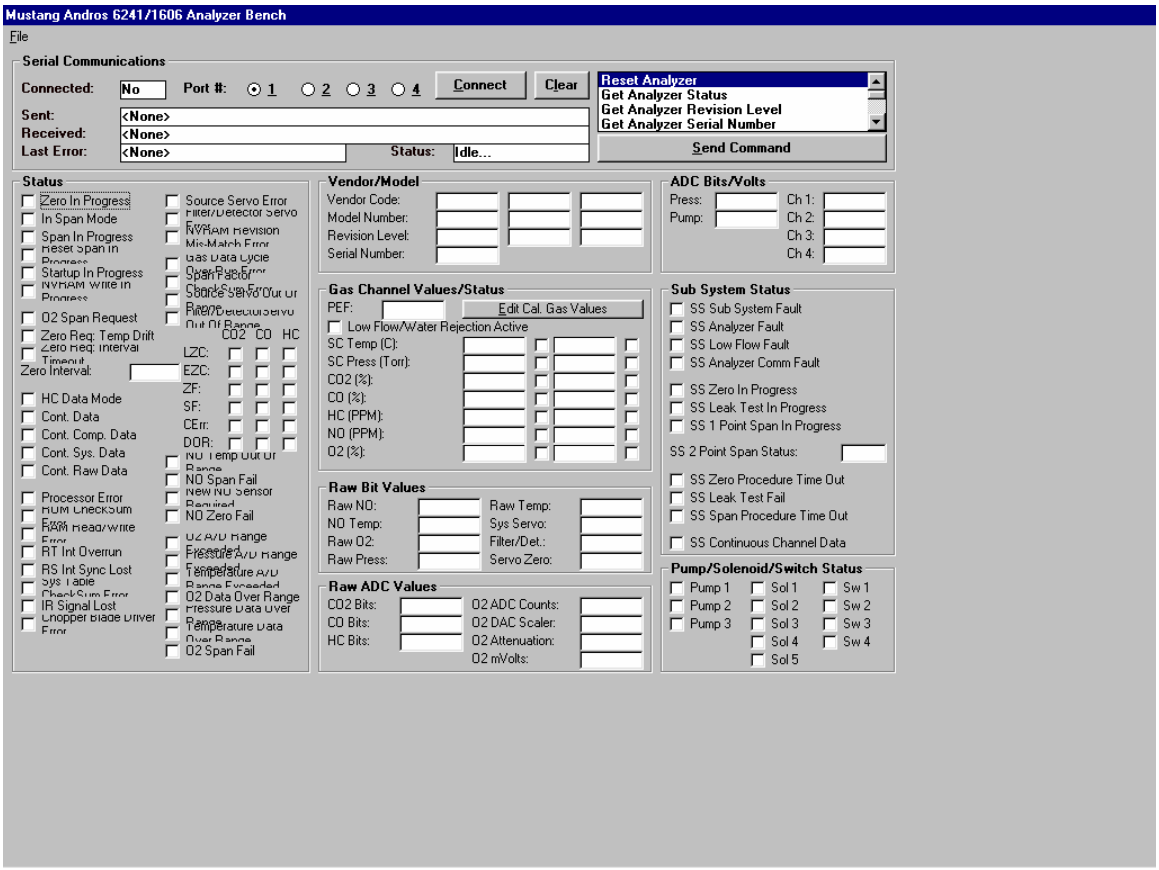
	encoder connected to the I/O board(s).
Synch Pulse D/I Channel	Sets the digital input channel used for a one (1) pulse per revolution speed input used to synchronize encoder noise mapping values to the current encoder position. Only used when the one (1) pulse per revolution input is installed for auto-synch use.
Synch Pulse D/I Polarity	Sets the polarity of the digital input channel used for a one (1) pulse per revolution speed input used to synchronize encoder noise mapping values to the current encoder position. Only used when the one (1) pulse per revolution input is installed for auto-synch use.

This is the diagnostics screen for the ADA-1100 I/O board used to control the dynamometer.



Panel	Values
Analog Inputs (Volts)	Channels 0-7 are on the 1st I/O board, channels 8-15 are on the 2nd I/O board. The displayed values are in volts.
Analog Outputs (Volts)	Channels 0-1 are on the 1st I/O board, channels 2-3 are on the 2nd I/O board. The displayed values are in volts, and can be set to any (valid) desired value by the operator.
Digital Inputs/Outputs	Channels 0-23 are on the 1st I/O board, channels 24-47 are on the 2nd I/O board. In most applications, channels 0-7 and 24-31 are outputs while the remainder are inputs.
Counter Inputs	Channel 0 is on the 1st I/O board, channel 1 is on the 2nd I/O board. The total counts fields represent the number of gear/encoder pulses counted since the last reset.

This is the diagnostics screen for the Andros gas analyzer bench.

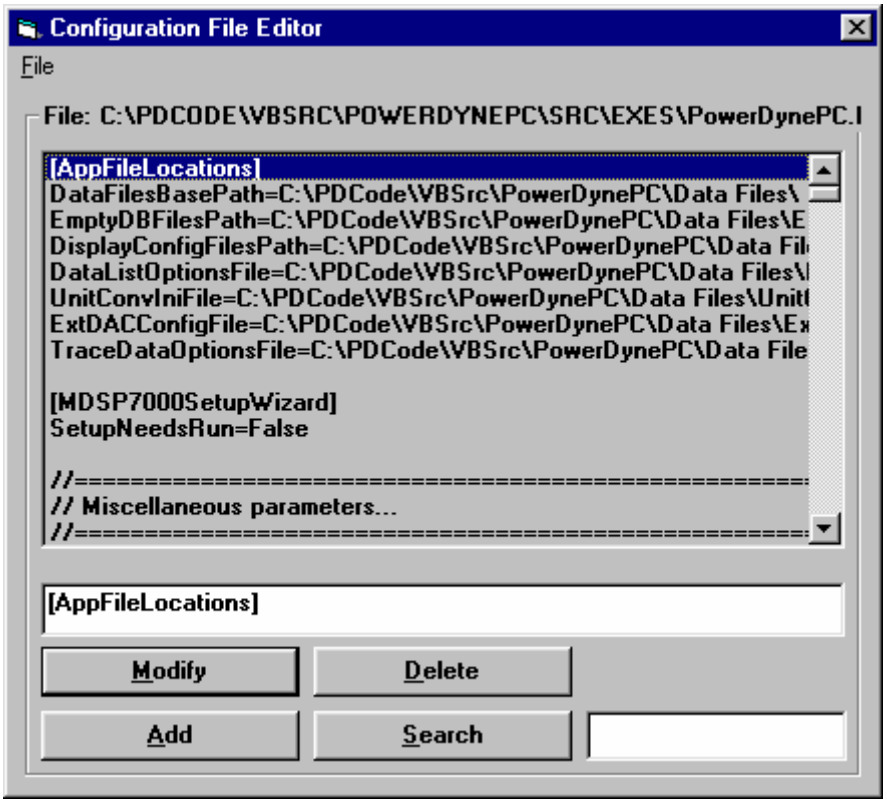


Due to the complexity of this screen, casual use by the operator is not encouraged.

Generally, this screen is only used with the supervision of a qualified Mustang Dynamometer technician.

INI File Editor

This screen allows the operator to edit the PowerDynePC.INI file which is the main application file.



The operator can point and click with the left mouse button on the line that they wish edit, when this is done, the line will be highlighted in blue. The line will be displayed in a textbox underneath where the file is displayed. The operator can then edit the line by typing whatever they want in this textbox and then either press the modify button, or press the <ENTER> key to accept this new value. The operator can also delete a line in the file by pressing the "Delete" button, when this is done, the data will be cascaded upwards. The operator can also add a new line by pressing the button "Add" button, when this is done then a copy of the line that you are on will be made and the remaining lines in the file will be cascaded downwards.

> **Note**
>
> The operator can edit the section and the values for the entries in the file but not the entries themselves.

The following is a list of Buttons that the operator has reference to along with the meaning:

Buttons	Meaning
Modify	Allows the operator to modify the line, the operator can also

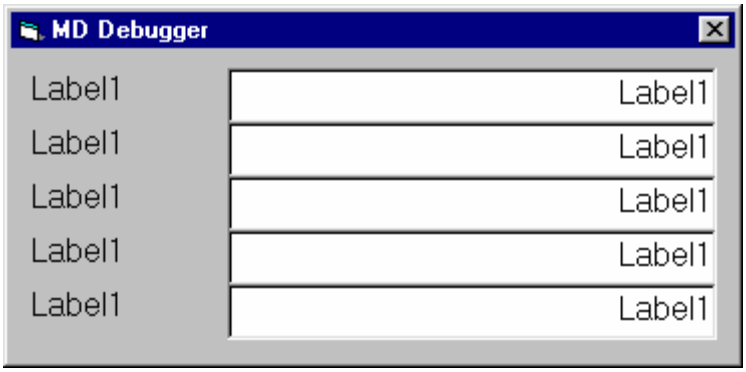
	press the <ENTER> key to modify a line in the file.
Delete	Allows the operator to delete a line, and all the remaining line underneath are cascaded upwards.
Add	Allows the operator to add a new line to the file by making a copy of the line that is highlighted, and then the operator can modify this line.
Search	Allows the operator to search the file for any line

The following is a list of menu items that the operator can reference along with their meaning:

Menu	Meaning
File	<table><tr><th>Menu Item</th><th>Meaning</th></tr><tr><td>Save</td><td>Allows the operator to save any changes made to the INI file.</td></tr><tr><td>Exit</td><td>Close out of the screen. If any changes where made to the data upon exiting, then the operator will be prompted if they should want to save any changes or not.</td></tr></table>

Toggle Debug Window

This small screen may be displayed to help in unusual diagnostic circumstances.



Generally, this screen is only used with the supervision of a qualified Mustang Dynamometer technician.

Chapter

13

Lift

This menu allows the operator to control the lifts. The operator can select from the following menu items

Menu	Meaning
Up	Allow the lifts to go up.
Down	Allow the Lifts to go down.

Chapter

14

AWD Clutch

This menu controls the front/rear coupling clutch in configurable all-wheel-drive dynamometers.

This menu will ONLY appear when your dynamometer is configured to drive a digital output to control this clutch.

DANGER: The dynamometer must not be moving when the clutch position is changed.

Menu	Meaning
AWD Mode	Click on this option to enable the front/rear coupling clutch.
2WD Mode	Click on this option to disable the front/rear coupling clutch
(Inertia Value)	This item will display the dynamometer's equivalent vehicle weight (inertia) value as **currently** configured.

Chapter

15

Display

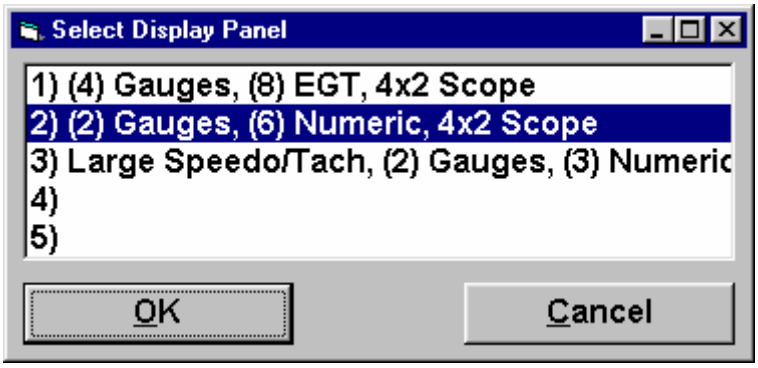
This menu allows the operator to configure the display to their liking. The operator can select from a list of predefined configurations to choose from and also modify the display formats and display colors for the indicators that make up the configurations.

The operator can select from the following menu item in order to configure their display settings:

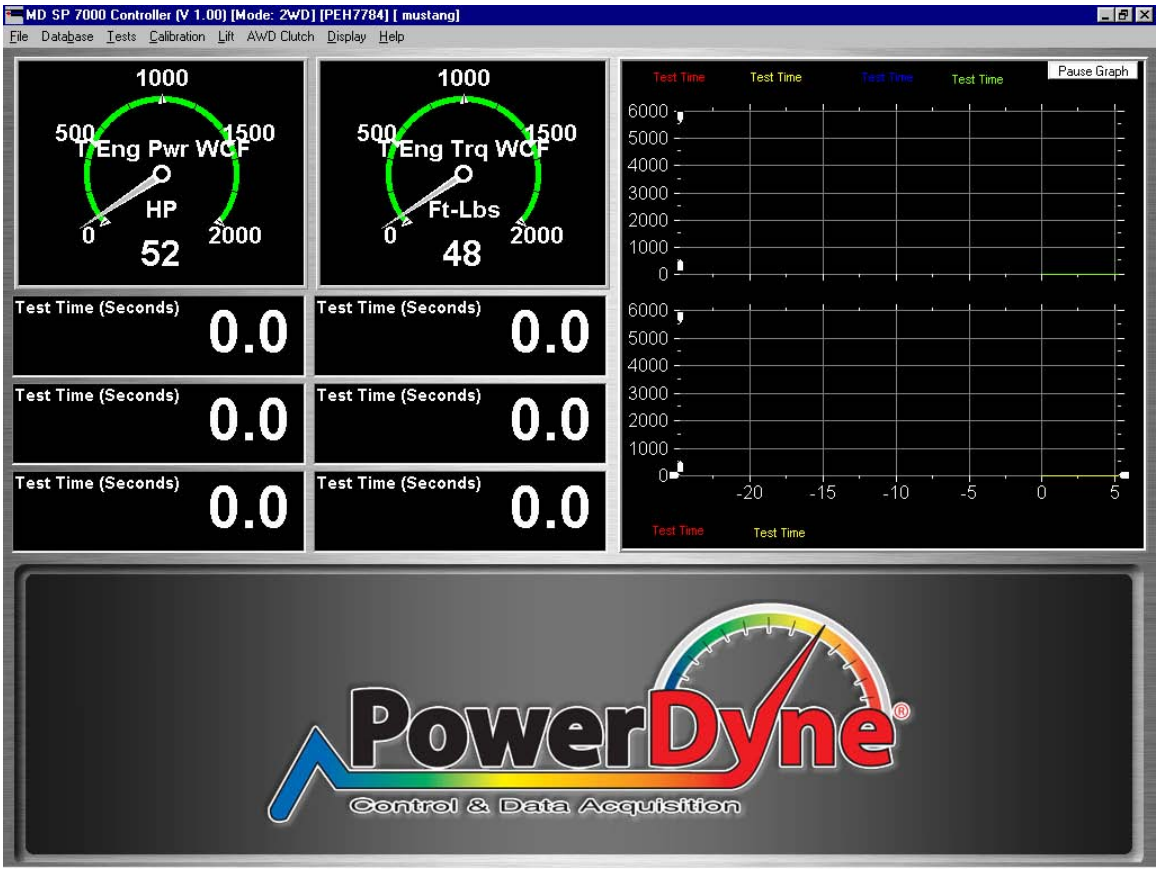
Menu	Meaning
Select Display Panel	Allows the operator to select from a predefined list of indicators; these indicators can be angular or linear gauges, graph or textboxes that display values.
Edit Display Configuration	Allows the operator to configure the display formats as well as the display colors for the different indicators that make up the display.
Dyno Load Controller Status	Displays a window that can be used to see how well the dyno load controller is operating, chiefly for diagnostic and PID tuning use.
Throttle Controller Status	Displays a window that can be used to see how well the throttle controller is operating, chiefly for diagnostic and PID tuning use.
Brake Controller Status	Displays a window that can be used to see how well the brake controller is operating, chiefly for diagnostic and PID tuning use.
Throttle Controller	Displays the window used to manually control the throttle controller.
Brake Controller	Displays the window used to manually control the brake controller.

Select Display Panel

This menu item when selected allows the operator to select from a predefined list of indicators used to display channel data in real-time.



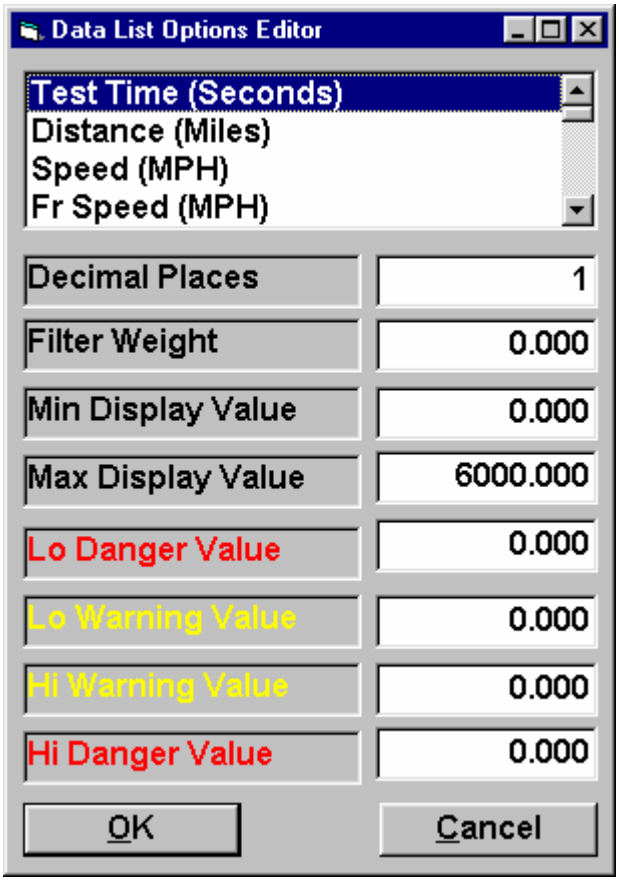
The operator can point and click on any items in the predefined list to display, after the operator has made their select and press the "OK" button, then that will be displayed on the top part of the screen.



Note

The display panels can only be configured at Mustang Dynamometer, once one is created, then a new version would be sent to the customer that requested the change.

The screen allows the operator to select anyone of the different channels and modify how the data gets displayed.



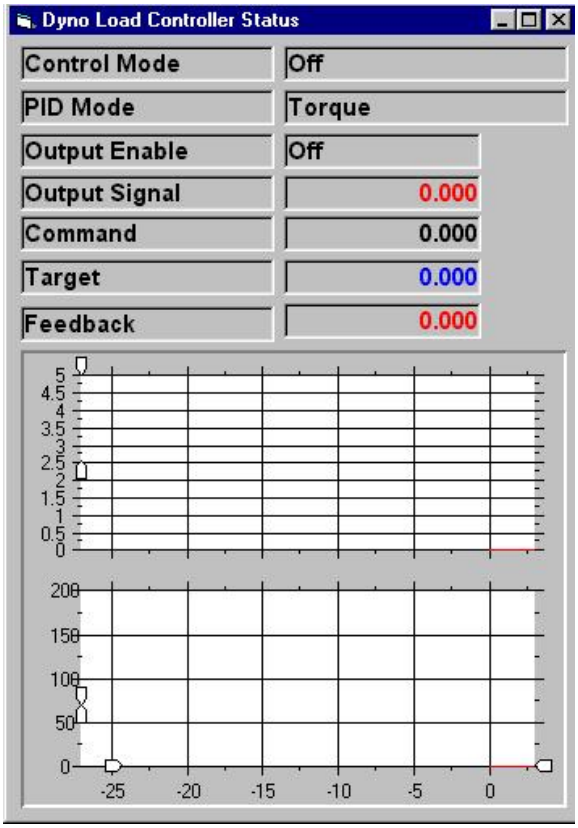
The list at the top of this screen shows the operator the complete list of channels available for display and recording in this system. Each channel can be selected, then configured, as shown below.

Screen Field	Meaning
Decimal Places	The number of decimal places to the right of the decimal point.
Filter Weight	This value will filter out any spikes and smooth out the data. This value must be between 0.000 and 0.999.
Min Display Value	The minimum value displayed on graphical displays (does not affect numeric displays).
Max Display Value	The maximum value displayed on graphical displays (does not affect numeric displays).
Lo Danger Value	This defines the minimum danger value displayed and is represented as a RED band on an angular, circular, or linear

	gauge.
Lo Warning Value	This defines the minimum warning value displayed and is represented as a YELLOW band on an angular, circular, or linear gauge.
Hi Warning Value	This defines the maximum warning value displayed and is represented as a YELLOW band on an angular, circular, or linear gauge.
Hi Danger Value	This defines the maximum danger value displayed and is represented as a RED band on an angular, circular, or linear gauge.

Dyno Load Controller Status

This window can be used to see how well the dyno load controller is operating, chiefly for diagnostic and PID tuning use.



Note: Output signal is graphed in the top track, command, target and feedback are graphed in the bottom track, each in the same color as the numeric values are displayed in.

Control Mode

Shows the active mode of the controller.

PID Mode

Shows the PID mode that the active control mode uses.

Output Enable

Shows if the controller's output is enabled (should be enabled anytime a test is running, unless there is a system fault).

Output Signal

Shows the output value of the controller, normally a value between 0.000 and 5.000.

Command

The commanded value for the current mode, as specified by the operator.

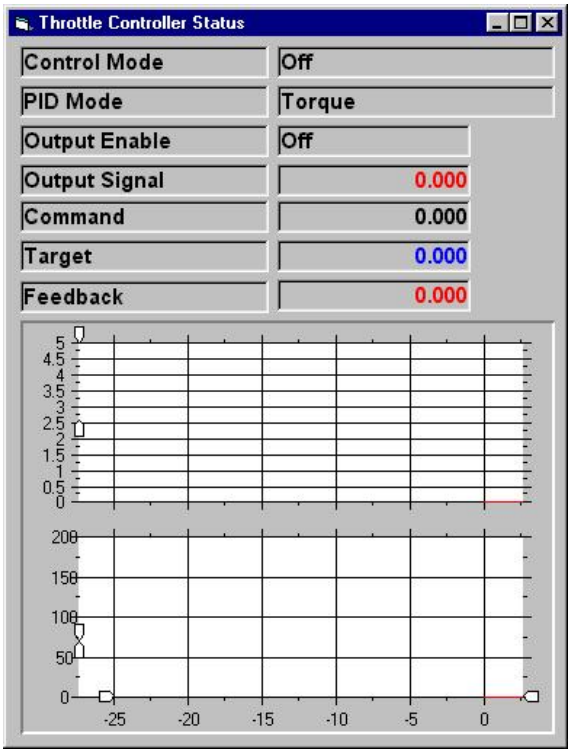
Target

The ramped target for the controller – will approach the commanded value using the current ramping values.

Feedback

The feedback for the controlling PID loop. Should match the "Target" value.

This window can be used to see how well the throttle load controller is operating, chiefly for diagnostic and PID tuning use.



Note: Output signal is graphed in the top track, command, target and feedback are graphed in the bottom track, each in the same color as the numeric values are displayed in.

Control Mode

Shows the active mode of the controller.

PID Mode

Shows the PID mode that the active control mode uses.

Output Enable

Shows if the controller's output is enabled (should be enabled anytime a test is running, unless there is a system fault).

Output Signal

Shows the output value of the controller, normally a value between 0.000 and 5.000.

Command

The commanded value for the current mode, as specified by the operator.

Target

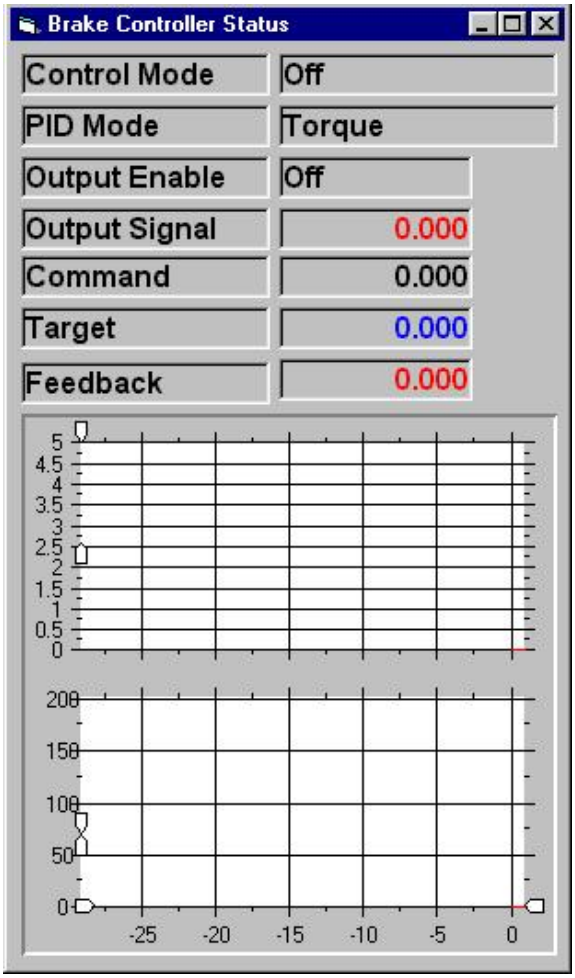
The ramped target for the controller – will approach the commanded value using the current ramping values.

Feedback

The feedback for the controlling PID loop. Should match the "Target" value.

Brake Controller Status

This window can be used to see how well the brake load controller is operating, chiefly for diagnostic and PID tuning use.



Note: Output signal is graphed in the top track, command, target and feedback are graphed in the bottom track, each in the same color as the numeric values are displayed in.

Control Mode

Shows the active mode of the controller.

PID Mode

Shows the PID mode that the active control mode uses.

Output Enable

Shows if the controller's output is enabled (should be enabled anytime a test is running, unless there is a system fault).

Output Signal

Shows the output value of the controller, normally a value between 0.000 and 5.000.

Command

The commanded value for the current mode, as specified by the operator.

Target

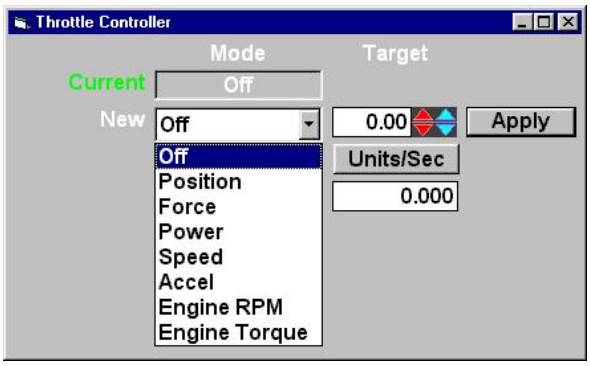
The ramped target for the controller – will approach the commanded value using the current ramping values.

Feedback

The feedback for the controlling PID loop. Should match the "Target" value.

Throttle Controller

This window can be used to control the throttle controller.



NOTE: This windows must NOT be displayed when the programmed force, programmed speed, or PRO Script tests are running, as interference between the programmed commands and the manual commands can occur.

Current

Shows the current control mode of the controller.

New

Lets the operator specify a new control mode.

Target

Lets the operator specify a target for the selected control mode.

Apply (button)

Lets the operator put the controller in the selected control mode, using the specified command value and ramping values.

Ramp By

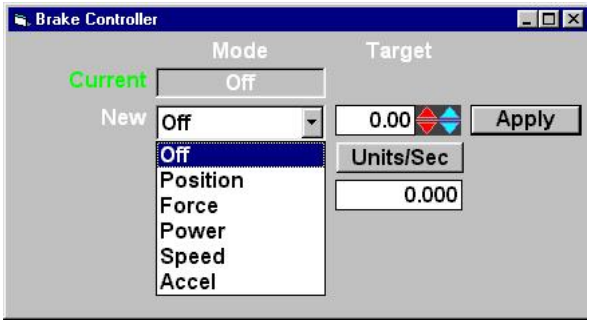
Lets the operator specify ramping mode (units / second or fixed-time).

Units /Sec

Lets the operator specify ramping values (units / second to ramp at, or seconds to ramp over).

Brake Controller

This window can be used to control the brake controller.



NOTE: This windows must NOT be displayed when the programmed force, programmed speed, or PRO Script tests are running, as interference between the programmed commands and the manual commands can occur.

Current

Shows the current control mode of the controller.

New

Lets the operator specify a new control mode.

Target

Lets the operator specify a target for the selected control mode.

Apply (button)

Lets the operator put the controller in the selected control mode, using the specified command value and ramping values.

Ramp By

Lets the operator specify ramping mode (units / second or fixed-time).

Units /Sec

Lets the operator specify ramping values (units / second to ramp at, or seconds to ramp over).

Chapter

16

Files Used By The System And Menu Hierarchy

The following is a detailed description of the menu hierarchy along with the files that go into each folder.

NOTE: All "Sub-Folder" values are relative to the main software installation folder, normally:

C:\Mustang\Chassis\PowerDynePC

The main application folder

File	Description
PowerDynePC	The main program executable.
MD110032.DLL	A library used to communicate with the ADA-1100 I/O board driver.
MD7KDisplay.DLL	A library used to provide the various display panels.
MDPopupMenu.DLL	A library used to provide pop-up menus.
MDSDATISmartTachDriver.DLL	A library used to communicate with the ATI SmartTach via the serial interface.
MDSDMDTreeDriver.DLL	A library used to communicate with the Mustang Dynamometer drag racing lights (tree).
MDSPDataList.DLL	A library used to provide data list functions.
MDTypeTools.DLL	A library used in serial communications.
PD7000DataConvert.DLL	A program that imports test data files from an existing MD-7000 software installation.

The "Test Files" sub-folder

File	Description
PowerDynePC Test Index.MDB	A Microsoft Access database file used as an index to all existing test records. Can be replaced with a blank file without losing any test data – simply re-scan your test files to rebuild this index.
(yyyy-mm) Sub-Folders	All test results are kept in sub-folders named "yyyy-mm". Each test file is named "Type-xx yyyy-mm-dd hh-mm-ss.TRB", where "xx" = the numeric identifier for each type of test the system can perform

	"yyyy-mm-dd hh-mm-ss" = the year, month, day, hour, minute and second the test was performed.

The "Data Files" sub-folder

File	Description
PowerDynePC.Ini	The main configuration file for this application. Contains many different values, and is similar to the "MDSP7000.Ini" file used by the MD-7000 software.
ASM_CP01.INI	A small data file used by some library routines.
ASM_Hdr.Txt	A small data file used by some library routines.

The "Data Files\Control Scripts" sub-folder

File	Description
*.FCV	Programmed force curve files, used by the programmed force test.
*.SCV	Programmed speed curve files, used by the programmed force test.

The "Data Files\DB Files" sub-folder

File	Description
PowerDynePC Cos Owners Vehicles.MDB	A small database used to keep the lists of companies, customers and vehicles used. This file can be replaced by a blank database and all existing test records re-scanned to re-generate this index database.

The "Data Files\Display Configs" sub-folder

File	Description
*.Ini	These files all contain the settings for various display panels used by this software. Channel selections, display options, etc.

The "Data Files\Drivers Traces " sub-folder

File	Description
*.Trc	Driver's trace files for emissions testing, for example IM-240, FTP, etc.

*.Txt	Prompt files that are used with the *.Trc files to show the operator specific prompts at specific times during an emissions test. Generally, these should be named something like "IM-240 Prompts.Txt", so it is obvious that the prompt file is associated with "IM-240.Trc".

The "Data Files\Dyno Configs" sub-folder

File	Description
DynoConfig2WD.Cfg	Dynamometer settings specific to operation in 2WD mode. Contains copies of various dynamometer parameters.
DynoConfig4WD.Cfg	Dynamometer settings specific to operation in 4WD mode. Contains copies of various dynamometer parameters.
DynoConfigBike.Cfg	Dynamometer settings specific to operation in bike mode. Contains copies of various dynamometer parameters.

The "Data Files\Emissions Standards" sub-folder

File	Description
ASM_CP01.INI	A data file containing ASM cut-point information, used by library routines, but not by this software directly.

The "Data Files\Empty DB Files" sub-folder

File	Description
PowerDynePC Cos Owners Vehicles.MDB	A blank database file provided in the event that the companies, customers & vehicles database file becomes corrupted.
PowerDynePC Test Index.MDB	A blank database file provided in the event that the test index database file becomes corrupted.

The "Data Files\Graph Viewer" sub-folder

File	Description
TraceGraphViewer.Ini	A configuration file for the graph viewing screen – contains the default viewing options for that screen.
*.Ini	Optional other configuration files for the graph viewing screen – these options are not loaded automatically, but can be loaded manually using the options on the "File" menu.

The "Data Files\Hardware Configs" sub-folder

File	Description
110032BitConfig.Ini	The configuration file for the ADA-1100 I/O board driver.
BrakeController.Ini	The configuration file for the vehicle brake controller – includes PID, ramping and step-size values.
DynoLoadController.Ini	The configuration file for the dynamometer's load controller – includes PID, ramping and step-size values.
ExtDACConfig.Ini	The configuration file for the optional I/O board used to drive various system channel values out on analog output s to an external data acquisition system.
ThrottleController.Ini	The configuration file for the vehicle throttle controller – includes PID, ramping and step-size values.

The "Data Files\Icons" sub-folder

File	Description
*.ICO	Various icons used by this software.

The "Data Files\Images" sub-folder

File	Description
*.BMP, *.JPG, *.JPEG, *.GIF	Various images used by this software.

The "Data Files\Language Files" sub-folder

File	Description
*.LNG	Language translation files used by this software.

The "Data Files\Misc" sub-folder

File	Description
DataListOptions.Ini	Display and filtering options applied at the data-list layer (these affect all displayed and recorded values).
TestPicker.Ini	Configuration values used by the (old MD7000 style) test picking screen.
TraceDataOptions.Ini	Configuration values for the data recording facility – includes the maximum number of points to record, and which channels to record.

UnitConversionOptions.Ini	Configuration values relative to the display units that should be used for various types of values.

The "Data Files\Parasitic Maps" sub-folder

File	Description
*.DPF	Dynamometer Parasitics Files – these files contain descriptions of the parasitic losses of the dynamometer in various configurations. We recommend that you use "Dyno.DPF" for dyno-only data, "Zero.DPF" for a blank parasitic losses file, and "<Vehicle_Name>.DPF" for vehicle-on-dyno parasitic losses data specific to a vehicle.

The "Data Files\PRO Script Files" sub-folder

File	Description
*.CSV	Spreadsheet-friendly "Comma Separated Values" format text files containing command scripts for the PRO Script Test routine.

The "Data Files\SmartTach Config Files" sub-folder

File	Description
All other *.Ini files	Configuration files used to configure the ATI SmartTach in various ways. The operator can create new configuration files specific to their needs.
SmartTachConfig.Ini	Configuration values for our serial connection to the ATI SmartTach.
Inductive.Ini	Contains configuration values that will be downloaded to the device when "Download Inductive Configuration" is selected in the menu system.
Optical.Ini	Contains configuration values that will be downloaded to the device when "Download Optical Configuration" is selected in the menu system.
TS1.Ini	Contains configuration values that will be downloaded to the device when "Download TS-1 Configuration" is selected in the menu system.

The "Data Files\SpeedGradeDriversTraces" sub-folder

File	Description
*.Txt	Text files containing grade-vs-distance information used to drive the driver's aid during the programmed force test routine (only in use by 1 customer at present).

<END>