DYNO 2000™ Advanced Engine Simulation

Install & QuickStart

The Dyno2000 Advanced Engine Simulation Installation

Note: A comprehensive full-color User Guide is provided with the Dyno2000. This on-disk documentation can be viewed with Adobe Acrobat Reader®. See the sidebar on page 2 for help in installing Reader software and viewing the User Guide (**D2000MainUsersGuide.pdf** ***on the CD-ROM).***

The Dyno2000 installation is quick and simple process on virtually all computers. To minimize the likelihood of problems, review the following tips before you begin:

1) The Dyno2000 requires Windows 95/98® or Windows NT and at least 16MB of installed RAM memory.

2) If you encounter problems installing and running the Dyno2000, refer to **Solving Problems** on page 3.

3) The entire installation of the Dyno2000 and DeskTop Videos requires about 110MB of free disk space. If you wish to conserve hard-disk space and not install all the features and extras supplied with the Dyno2000, select the “Compact” option presented during the installation process.

4) If at all possible, choose the defaults provided on the installation screens. This will install the software onto drive C: in a new Dyno2000 folder.

Installing The Dyno2000

The installation programs included with the Dyno2000 will copy the appropriate files to your hard drive. Please read and perform each of the following instructions carefully.

1) Start Windows95/98/2000 (or Windows NT), if necessary.

2) Insert the Dyno2000 CD-ROM into your CD drive.

3) A Welcome screen will appear on your desktop within 5 to 30 seconds (depending on the speed of your CD drive). If the Welcome screen appears, proceed to **step 5**.

4) If the Dyno2000 installation Welcome screen does not automatically display, run the **Setup** program included on the Dyno2000 CD-ROM. (Open the *Windows Explorer*, switch to your CD Drive, then double click on **Setup**. Alternatively, choose ***Settings*** from the ***Start*** menu, select ***Control Panels***, then double click on ***Add/Remove Programs***, finally click the ***Install*** *button*.)

5) Click ***Next*** to proceed to the second Installation screen. Click ***Next*** again to review the Motion Software License Agreement. Read the Agreement and if you agree with the terms, click ***Next***.

6) Enter your name and company name in the **User Information** screen (enter **None** for the Company Name if the Dyno2000 is NOT being registered to a company). Click ***Next*** again to continue the installation.

7) The **Choose Destination Location** window will suggest **C:\Dyno2000** as the installation path. We recommend that you accept this default. However, if you prefer another location for the Dyno2000, click on ***Browse...*** to select a new path. When you are finished, click ***Next*** to continue.

8) The **Setup Type** window will present three installation options:
Typical—Installs Dyno2000, sample files, user manual, and software videos.
Compact—Installs Dyno2000, sample files, and user manual only.
Custom—Allows you to select the installed elements.
We recommend you select **Typical**, then click ***Next*** to continue the installation.

9) The **Select Program Folder** screen indicates that the **Dyno2000** program folder will be added to the list of Windows Program choices displayed on the ***Start***, ***Programs*** menu. Click ***Next*** to continue.

10) The **Start Copying Files** screen gives you a chance to review all the installation choices that you've made. Click ***Back*** to make any changes; click ***Next*** to being copying files to your system.

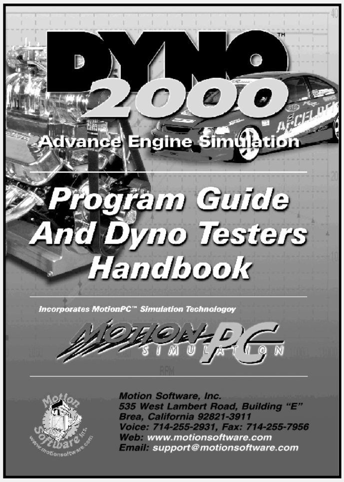
11) When main program installation is complete, the **Setup Complete** screen provides a checkbox option (defaults unchecked) that allows you to start the Dyno2000 immediately after installation. (Note: If you do not check this box and click ***Finish***, you can easily start the Dyno2000 by selecting ***Programs***, ***Dyno2000*** from your Windows ***Start*** menu.) Click ***Finish*** to complete the installation. Note: You may need to restart your computer.

Starting The Dyno 2000

12) To start the Dyno2000, open the Windows ***Start*** menu, select ***Programs***, then choose ***Dyno2000***, and finally click on the ***Dyno2000 Engine Simulation*** icon that appears within the folder. See page 5 thru 16 for more information about Dyno2000 program features.

13) A video of the entire DeskTop line of performance software has been included with the Dyno2000. Start the demo by

90-Page Full-Color Users Manual



The Dyno2000 is packed with features to help you test engines and locate the best parts combinations for virtually any application. This QuickStart guide will get you going, but to help you apply all the capabilities of this powerful engine simulation, a 114-page, full-color, on-disk User Manual has been included with this software. The Users Manual is easy-to-access and will show you how to get the most from the Dyno2000. You'll learn about every menu selection, program function, Iterative testing, and much more.

After installing the Dyno2000, you can read the User Manual by using any of these options: 1) Open the *Help* menu in the Dyno2000 and select ***User Manual***. 2) Open the Windows ***Start*** menu, select ***Programs***, then choose ***Dyno2000***, and finally click on the ***Users Manual*** icon that appears within the folder. Or 3) double click on the file **D2000MainUsersGuide.pdf** located on the Dyno2000 CD-ROM (in the root directory).

IMPORTANT: If any of these techniques fails to open the Dyno2000 on-line documentation, you need to install *Adobe Reader* on your computer by double clicking on the reader installation file that you'll find in the **Acroread** folder on the Dyno2000 CD-ROM. Simply double click on the ***AR3W95.EXE*** file located in the **Acroread** folder to install Adobe Reader on Windows95/98/2000 & NT systems.

opening the ***Start*** menu, select ***Programs***, choose the ***Dyno2000*** folder, then click on ***DeskTop Software***. If you do not see the DeskTop Software icon, read the following note.

Note: If you did not install the videos in Step 8, you can still run the demos by double-clicking on the **DeskTop Software.exe** file located in the *DeskDemo* folder on the Dyno2000 CD-ROM.

14) If you have problems installing or running the Dyno2000, please take a few minutes to look over the following sources of information before you contact technical support:

- The **Solving Problems** section and the remaining information that follows in this QuickStart guide.
- The **FAQs** in the On-Line User Manual (see sidebar on previous page for tips on installing and reading the ***User Guide***).
- Visit the Tech Support section of the Motion Software website at www.motionsoftware.com.

If you cannot find a solution to your problem by reviewing these materials, print out and return the fax-back form in the on-disk User Manual. Fax or mail the completed form to:

Motion Software, Inc.
535 West Lambert, Bldg. E
Brea, CA 92821-3911
Tech Fax: 714-255-7956, or visit our
Web: www.motionsoftware.com

You may also contact Motion Software Tech Support at the email address: support@motionsoftware.com

NOTE: Tech support will only be provided to registered users. If you did not purchase the Dyno2000 directly from Motion Software, make sure you send in your registration card today.

Solving Problems

Question: Received an "Error Reading Drive D" (or another drive) message when attempting to install the Dyno2000. What does this mean?

Answer: This means your computer cannot read the disk in your CD-ROM drive. The disk may not be properly seated in your drive, the drive may be defective, or the disk may be damaged. If you can properly read other CD-ROM disks, but the Dyno2000 distribution disk produces error messages, contact Motion Software, Inc., for a free replacement (address above).

Question: An error message was displayed during the installation process. What should I do?

***Answer*:** Turn off all virus protection software, restart your computer, then retry Dyno2000 installation.

Question: The Dyno2000 displayed an *Assertion Failure* error while I was performing an engine simulation.

***Answer*:** Please note down all of the information presented in the message box, provide a quick synopsis of what lead up to the error, then send this information to Motion Software. Visit the Motion Software website to check for periodic Dyno2000 updates and patches (www.motionsoftware.com). Thank you for your assistance in improving the Dyno2000.

Question: What do I do when I receive an error message when starting the Dyno2000?

***Answer*:** The issue you have is due to a bug in the early versions of Windows95. We have sidestepped this issue with release 3.08+. You can upgrade your version of the Dyno2000 to the latest version by visiting our website (www.motionsoftware.com). Assuming your version of the Dyno2000 is 3.05: Download and run the 3.05-to-3.06 patch to upgrade to 3.06, then download the 3.06-to-3.07 patch to upgrade to 3.07, and finally download the 3.07-to-3.08 patch to upgrade to 3.08.

Question: The Dyno2000 calculated the total Combustion Volume at 92ccs. But I know my cylinder heads have only 75ccs. What's wrong with the software?

***Answer*:** This confusion comes from assuming that the calculated **Total Combustion Volume** displayed in the component-selection screen is the same as your measured combustion-chamber volume. The Total Combustion Volume is the <u>entire volume</u> that remains in the cylinder when the piston reaches top dead center. See the User Manual for more information about compression volumes.

Question: When I choose a carburetor that is too large for an engine (for example 1200cfm on a 283 Chevy), why does the power increase without a "bog" at low speeds?

***Answer*:** The Dyno2000 cannot model over-carburetion and show the usual reduction in low-end performance that this causes. In reality, carburetors that are too large for an engine develop fuel atomization and air/fuel ratio instabilities, phenomena that is carburetor specific and extremely difficult to model. The Dyno2000 assumes an optimum air/fuel ratio regardless of the selected CFM rating. While the program produces positive results from larger-and-larger induction flows (by the way, this is not far from reality when optimum air/fuel ratios can be maintained, as is the case with many fuel-injection systems), you can't go wrong if you use common sense when selecting induction/carburetor flow capacities.

Question: The engine I am building uses two 660-cfm Holley carburetors. How can I simulate this airflow?

***Answer*:** To simulate two, 660cfm, 4-barrel carburetors, simply add the airflow and enter the total 1320cfm value into the component-selection screen at 1.5-inHG pressure drop.

Question: The horsepower predicted when I enter the seat-to-seat timing on my cam card does not match the horsepower when I enter the 0.050-inch timing figures for the same camshaft. Why are there differences?

***Answer*:** The Dyno2000 uses the timing specs found on your cam card, and in cam manufacturer's catalogs, to develop a valve-motion curve (and from this, develops the instantaneous airflow for each port). Whenever possible use seat-to-seat timing figures (called advertised duration). They provide the Dyno2000 more information about valve motion at low lifts, and will produce more accurate simulated power levels.

Question: The Dyno2000 displayed an error message "The Dyno2000 was unable to complete the simulation..." What went wrong?

***Answer*:** The combination of components you have selected produced a calculation error. Try reducing the EVO timing specs, increasing the induction or supercharger flow, lengthening the stroke, selecting a cam with less duration, or reducing the compression ratio. A balanced group of components should not produce this error.

Question: When I run a simulation, part of the graph curves don't appear on my screen. What can I do to correct the display?

Answer*:** Open the *Graph Options* menu (right-click on the graph) and select ***Auto Range for the **Y1** and **Y2** variables. See the pages 9 & 10 for more information about graph scaling and plotting variables.

Question: I cannot get Desktop Drag version 2.8.7 to properly import an engine file from the Dyno 2000 version 3.08.

***Answer*:** To import an engine from the Dyno2000 into the DragStrip (all Dos versions), you must first EXPORT it using the EXPORT-TO-DOS function located in the File pull-down menu within the Dyno2000. This converts the DYN file to a format that is readable by the (Dos) DragStrip program (see page 13 for more information). These steps will not be necessary when importing Dyno2000 engines into the Drag2000 Windows dragstrip simulation (scheduled release 5/1/00).

Question: I recently ordered your Dyno 2000 software. When I tried to install Quicktime 4.0 from the CD, I was prompted to enter a Registration Number. What number to I enter?

***Answer*:** The request for a registration number is an Apple Computer request. It allows individuals that have purchased the "Pro" version of QuickTime to activate those features (these features are not required to view the video files on the Dyno2000 CD). When you are presented with the request for a name and registration number, just leave all fields empty and proceed with the installation. A free version of QuickTime will be installed.

Dyno2000 Features

The Dyno2000 Feature Overview

Note: A comprehensive full-color User Guide is provided with the Dyno2000 that details program features and usage. This on-disk documentation can be viewed with Adobe Acrobat Reader®. See the sidebar on page 2 for help in installing Reader software and viewing the User Guide (**D2000MainUsersGuide.pdf** ***on the CD-ROM).***

THE MAIN PROGRAM SCREEN

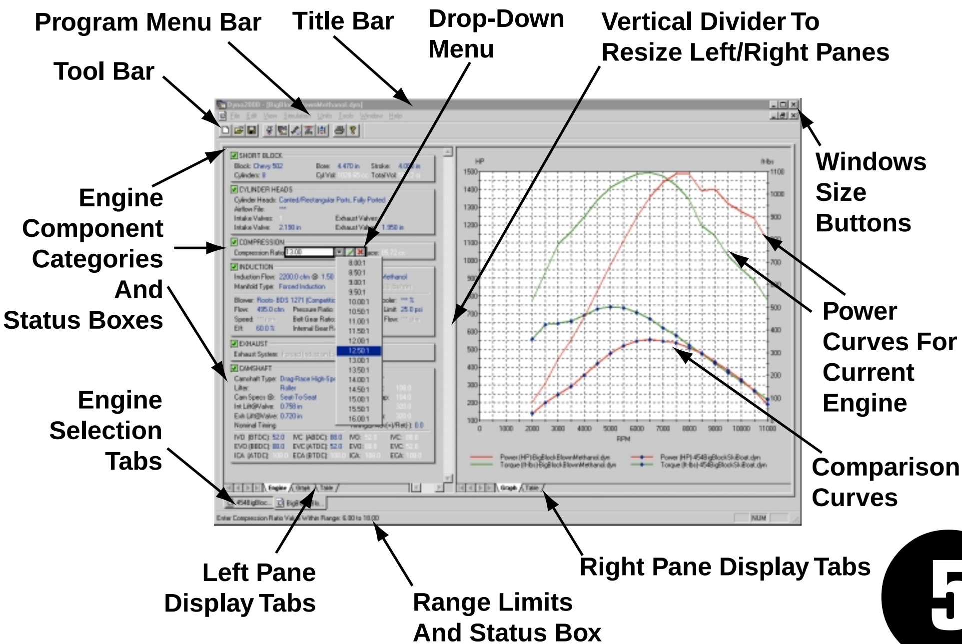
The **Main Program Screen** allows you to select engine components, dimensions, and specifications. In addition, engine power curves and/or simulation data is displayed in graphical and chart form. The Main Program Screen is composed of the following elements:

1) The **Title Bar** displays the program name followed by the name of the currently-selected engine.

2) The **Program Menu Bar** contains eight pull-down menus that control overall program function. Here is an overview of these control menus, from left to right (additional information on menu functions is provided elsewhere in this guide):

File—Opens and Saves dyno test files, exports DOS Dyno files to other Desk-Top software, prints engine components and power curves, allows the quick selection of recently used Dyno files, and contains an exit-program function.

Edit—Clears all component choices from the <u>currently-selected</u> engine (indicated



Program Menu Bar

The Program Menu Bar contains drop-down menus that control Dyno2000 function. Each menu is described below.

by the *Engine Selection Tab* currently in the foreground; see Engine Selection Tabs on page 7).

View—Allows you to turn the ***Toolbar***, ***Status Bar*** and ***Workbook*** layout on or off.

Simulation—***Run*** forces an update of the current simulation. ***Auto Run*** enables or disables (toggles) automatic simulation updates when any engine component is modified.

Units—Selects between US and Metric units.

Tools—Opens the *Iterative Testing* window or selects one of the built-in, engine-math calculators.

Window—A standard Windows menu for arranging and selecting engine display screens.

Help—Gives access to the Users Guide, and other program help features.

3) The **Engine Component Categories** are made up of the following groups:

SHORTBLOCK—Select the bore, stroke, and number of cylinders in this category.

CYLINDER HEADS—Select the cylinder head type, port configuration, and valve diameters. Direct entry of flow-bench data is also supported.

COMPRESSION—Select the compression ratio.

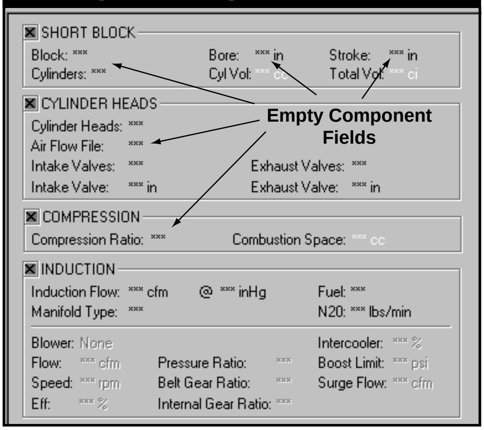
INDUCTION—Selects the airflow rate through the induction system, the type of fuel, nitrous flow rate, intake manifold, and a forced induction system.

EXHAUST—Selects the exhaust-system configuration.

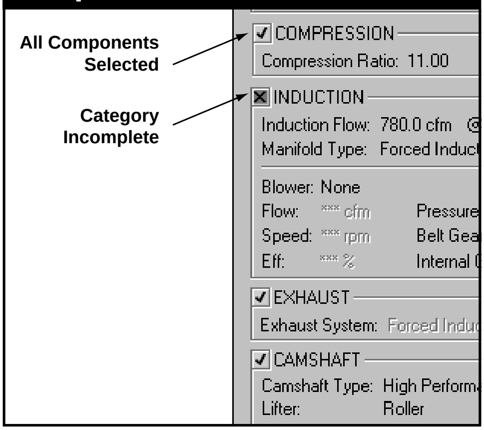
CAMSHAFT—Selects the camshaft type, lifter type, and allows direct entry of valve timing and lift data.

NOTE: Each component category contains a **Status Box** located in the upper left corner. These boxes either contain a red boxed **X**, indicating that the category is not complete (inhibiting a simulation run), or a green-boxed check-mark ✔, indicating that all components in that category have been selected. When all component categories have green checks, a simulation will be performed using the current data values and the results will be displayed in the graphs on the the Main Program Screen (the simulation and data plot will occur auto-

Incomplete Component Fields

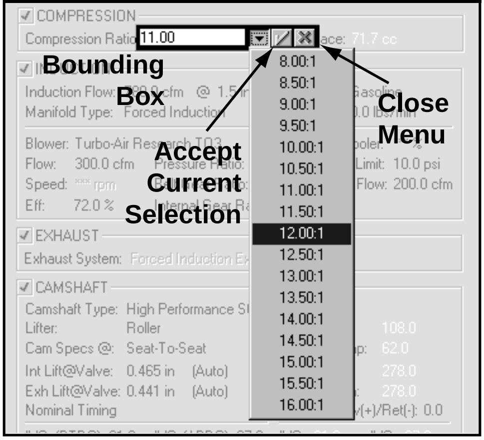


Component Status Boxes



All component categories start off empty, indicated by strings of asterisks (***) next to each incomplete selection. Move the mouse cursor into any category and double click the left mouse button on the asterisks to open the component-menu bounding box. When all selections within a category are complete, the red X will change to a green checkmark.

Drop-Down Component Menu



A component-bounding box will permit direct numeric entry or drop-down menu selection. Click on the red-X to close the box without making a selection.

matically providing **Autorun** is checked in the **Simulation** drop-down menu, see **Simulation Menu** description, above).

4) The **Drop-Down Component Menus** contain components and specifications for each of the Component Category choices. Click on any component specification to open its menu. The menu will close when selection is complete. If you wish to close the menu before making a new selection, click the red **X** or press the **Escape** key until the menu closes.

5) Several Component Category menus allow direct numeric entry (see photos on page 8). During this data entry, the range of acceptable values will be displayed in a **Range Limit Line** within the **Status Box** at the bottom of the screen.

6) The Dyno2000 can simulate several engines at once. Switch between "active" engines by selecting a Tab from the **Engine Selection Tabs**, just above the **Status Box**. The currently-selected engine is indicated on the foreground Tab. The name of the currently-selected engine is also displayed in the **Title Bar**.

7) The Main Program Screen window is divided into two panes (the width of these panes is adjustable; drag the vertical screen divider to resize). Each pane contains a **Screen Display Tab** group (Both right and Left Pane Display Tabs are provided). Use these tabs (see illustration on page 5) to switch the display in each pane to component lists and/or various graphic data displays.

8) Use the **Vertical Divider** to resize the right and left panes. By dragging this divider to the right or left border, you can display any graph in a "full-screen" mode (see photo, page 8).

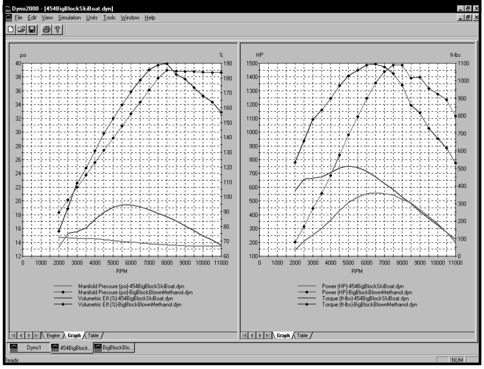
9) The **Current Engine Power Curves** display the horsepower and torque for the currently-selected engine. Horsepower and torque are the default curves, however, the data displayed can be changed by right-clicking on the graph and reassigning each curve in the **Graph Options Box**. Use the **Properties...** in the Options Box to setup comparisons between any "active" engine.

10) The Main Program Screen also incorporates **Windows Size Buttons**. These buttons provide standard maximizing, minimizing, and closing functions common to all windows. Refer to Windows documentation for more information on the use of these features.

DIRECT-ENTRY MENU CHOICES

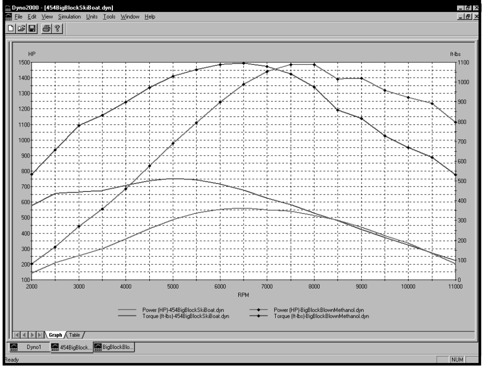
The Bore, Stroke, Number Of Cylinders, Valve Size, Compression Ratio, Induction Air-

Pane Display Tabs



Use the Right and Left Pane Display Tabs to select component lists, tables of results, or graphic data listings. Here the left and right panes have been set to display graphs, each with unique engine variables (HP and Torque in the right graph and Manifold Pressure and Volumetric Efficiency in the left graph).

Vertical Divider Resizes Display



Use the Vertical Divider to resize the right and left pane displays. To view either pane in full-screen mode, move the divider to the right or left margins.

flow, and several other menus permit direct numeric entry. When a component field supports direct entry, the bounding box will have a white interior. If the only selection possible is a choice from the drop-down menu, the bounding box will have a gray interior (see photos). Choosing a new value will replace the currently displayed value. When you press **Enter** (or click on another component) the new value will be tested for acceptability, and if it passes, it will be used in the next simulation run. If you press **Enter** without entering a new value, the currently displayed value is left unchanged.

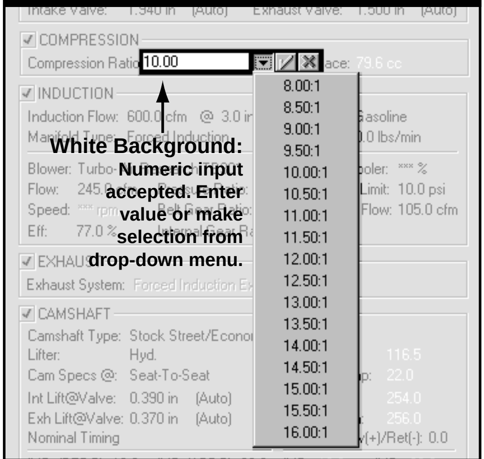
Data entry into any field in the component-selection screen is limited to values over which the Dyno2000 can accurately predict power. The range limits are displayed in the **Range Limit Line** within the **Status Box** at the bottom-left of the Main Program Screen. If you enter an invalid number, the Dyno2000 will play the Windows error sound and wait for new input.

For example, to make direct numeric entry for engine Bore, double-click on the current Bore value (or use the **Tab** and **Shift-Tab** keys to move the bounding box to the Bore field and press **Enter**). The range limits for Bore will be displayed in the **Range Limit Line** (2.800- to 7.000-inches). Make an entry within the acceptable range followed by **Enter**. If you selected an invalid number, the Dyno2000 will sound an error tone and wait for a new numeric entry.

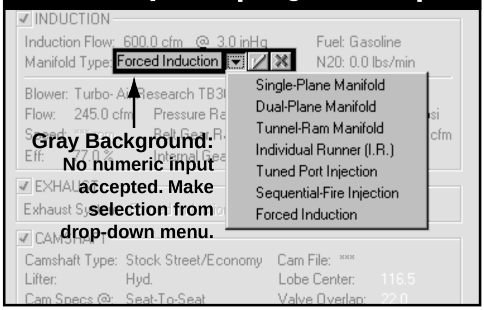
THE RESULTS DISPLAYS

The speed and ease of engine component entry in the Dyno2000 is complemented by the power and versatility of the simulation results displays. Almost the same instant that all the component categories have been completed (all categories have green Status Boxes) the simulation results will be displayed on fully-scalable precision graphs. The display graphs are customizable to plot virtually any engine variable on any axis. Auto scaling or manual axis scaling is easily setup by right-clicking on the graph. Up to four engines can be compared at once. And a comprehensive “table” display shows exact horsepower, torque, rpm, induction pressure, cylinder pressure, engine friction, and more! The

Fields Accepting Numeric Input

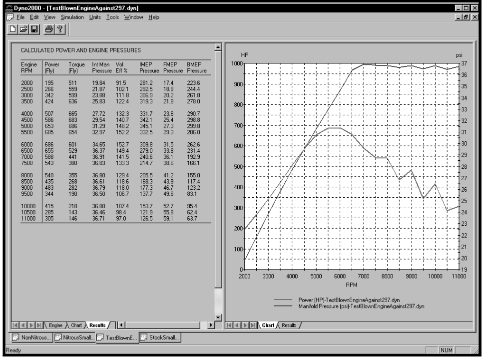


Fields Only Accepting Menu Input



The bounding boxes, activated when you double click on any component field, will accept direct numeric entry (top) or only menu selections (above).

Simulation Results Displays



Simulation results can be displayed in chart or graph form. Either pane (the left or right) can be selected to display results using the Pane Display Tabs.

Dyno2000 will show you what you are looking for, fast!

The **Simulation Results** display is composed of several elements that will help you retrieve the most information from any simulation as quickly and easily as possible:

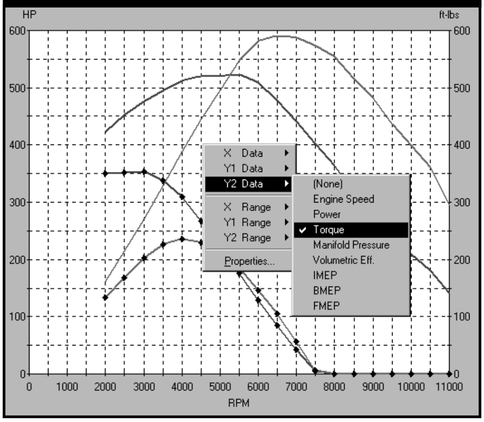
1) The Main Program Screen is divided into two sections (called panes), with the component selection categories on the left and the results screen on the right (by default). The center divider between each pane can be moved (click and drag) to increase the size of the results screen to suit your requirements. The graph will redraw and rescale to take advantage of changes in display area.

2) The results graph consists of three axis, a left, right, and bottom (horizontal) axis. Each of these axis can be assigned an engine variable. Currently the Dyno2000 will graph the following variables: Rpm, Horsepower, Torque, Intake Manifold Pressure, Volumetric Efficiency, Imep (Indicated Mean Effective Pressure), Bmep (Brake Mean Effective Pressure), and Fmep (Friction Mean Effective Pressure). Right click on the graph to display the **Graph Options** menu to assign engine variables to graph axis.

3) The results graphs support several methods of axis scaling. Each axis will scale to a low, medium, and high value. Plus auto-scaling can be enabled for any axis. By default, auto-scaling is turned off. This maintains the axis values constant, establishing a fixed baseline so that changes in power or torque are easily distinguished. However, when component changes dramatically alter power (like Nitrous Oxide or forced induction), the auto-scaling feature will ensure that the data curves are always visible and display at 80 to 90% of full graph height for maximum resolution.

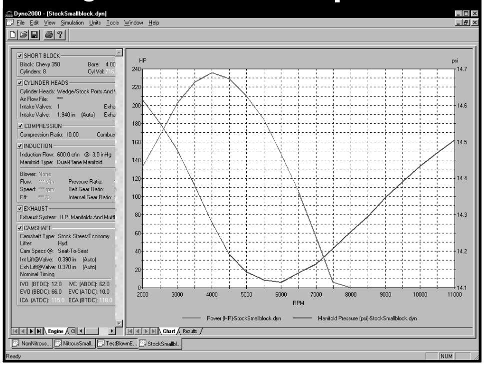
4) The **Graph Properties** dialog screen

Simulation Results Display



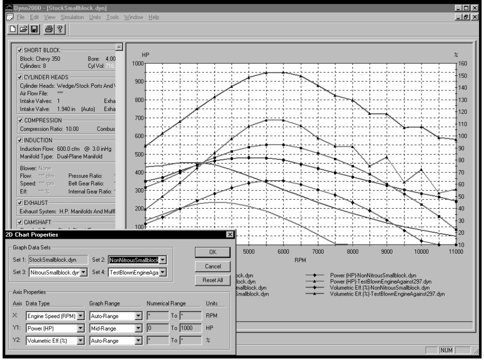
The results graphs each consist of three axis, a left, right, and bottom (horizontal) axis. Right click either graph to assign any variable to any curve.

Assign Variables To Graph Curves



This graph shows how horsepower (red) and manifold pressure (green) varied as engine speed changed throughout a test run. Also note that the screen divider has been moved to allow the graph to draw a more detailed display.

Compare Up To 4 Engines



A comparison of four engines was setup using the Properties Box. Up to four "open" engines can be compared on any graph. This graph shows how horsepower and volumetric efficiency varied for four test engines.

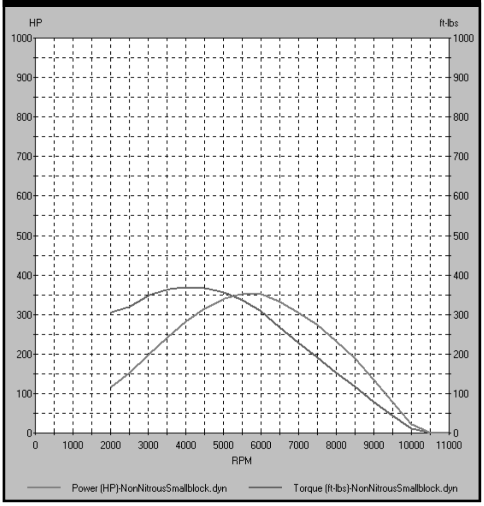
allows on-graph comparison of up to four engines at once. The engines you wish to include in the comparison must be "open" with active tabs in the Engine Selection Tabs display. Right click the graph to display the **Graph Options** menu then select **Properties**. Use the Graph Data Sets drop-down menus to select from currently-open engines. When you click on **OK**, the graph will redraw with the desired data comparisons. A legend at the bottom of the graph provides a key to all graph curves.

5) In addition to 2D graphing capability described above, a chart display is available by clicking on **Table** tabs located at the bottom of the right and left panes. The table lists all engine variables recorded during the simulated dyno run. The exact data values are displayed in 500rpm increments from 2000 to 11,000rpm.

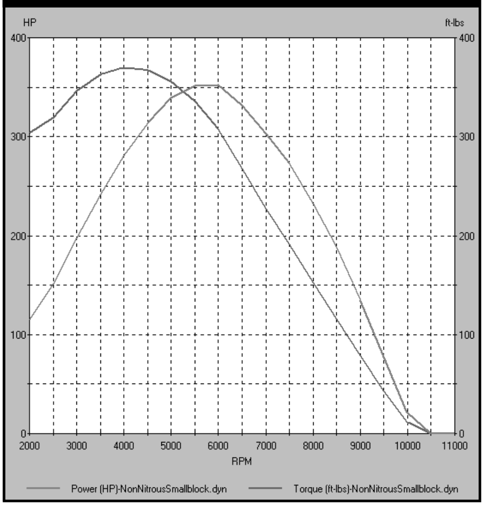
THE DYNO2000 ITERATOR™

The Dyno2000 brings not only the awesome power of engine simulation computations to the desktop, but also the ability to sort, compare, and select from hundreds, thousands, even millions of dyno tests and isolate the best combinations based on your selection criterion. Using powerful, built-in

Default Scaling

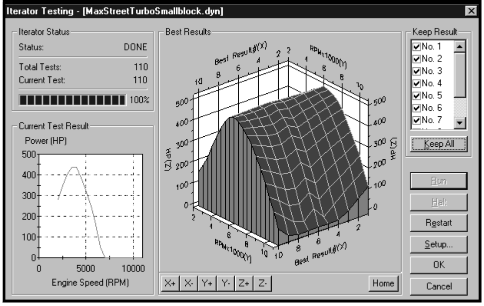


Auto Scaling Option



The results graphs support several methods of axis scaling. Each axis will scale to a low, medium, high, and auto-scale ranges. Fixed-axis scaling maintains the axis values, establishing a fixed baseline so that changes in power or torque are easily distinguished. When changes dramatically alter power, the auto-scaling feature ensures that the data curves will always be visible and display at 80 to 90% of full graph height.

The Dyno2000 *Iterator™*



Using powerful, built-in *Iterative Testing™*, the Dyno2000 can test more parts combinations than any human could sort and file. It will carefully analyze all the results and present the best for you to review.

Iterative Testing, the Dyno2000 can test more parts combinations than any human could sort and file. It will carefully analyze all the results and present the best-of-the-best for you to review. The Dyno2000 Iterator handles all testing details. In fact, you can start a series of tests and simply walk away from the computer until the task is complete. Or you can continue to use your computer for other tasks while it performs dyno testing and analysis in the background.

Setting Up Iterative Testing

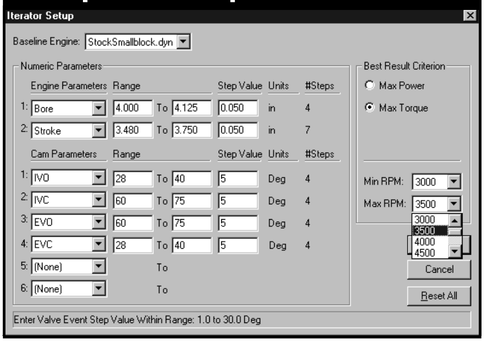
After all components have been selected and at least one dyno test has been performed, you may setup ***Iterator Testing*** by selecting it from the **Tools** menu. Initially, the Main Iterator Screen is displayed (it will be empty if this is the first time you've opened the Iterator since you started the Dyno2000). Select the **Setup** button to open the **Iterator Setup** dialog box. The Setup box allows you choose the range of components to use for Iterative testing. Start off by selecting a baseline engine from the **Baseline Engine** drop-down box. Every "open" engine that has all component categories completed is available for Iterative testing. When you have selected a baseline engine, the **Numeric Parameters** menus will become active. Select an Engine Parameter to test (bore, stroke, and compression, etc.) and/or select any of the **Cam Parameter** menus.

When you select a testing parameter, range boxes are displayed and loaded with the current component value. Enter the value range for each engine parameter (always enter the smaller value in the left box and the larger value in the right box) and the **Step Value** to use throughout the test run. The smaller the Step Value, the more tests will be performed. The **Number Of Steps** (#Steps) for each parameter is displayed to the right of each parameter field. The *total number of steps* for the Iterative test can accumulate quickly, since it is determined by *multiplying together all the Number-Of-Step values*.

Cam timing values are selected from the **Cam Parameters** category. Again, when each timing value is selected, such as IVO, the current value for that timing point is loaded into the parameter range boxes. Select the minimum and maximum values for each timing point (always enter the smaller value in the left box and the larger value in the right box), then select a step value. **#Steps** will be displayed.

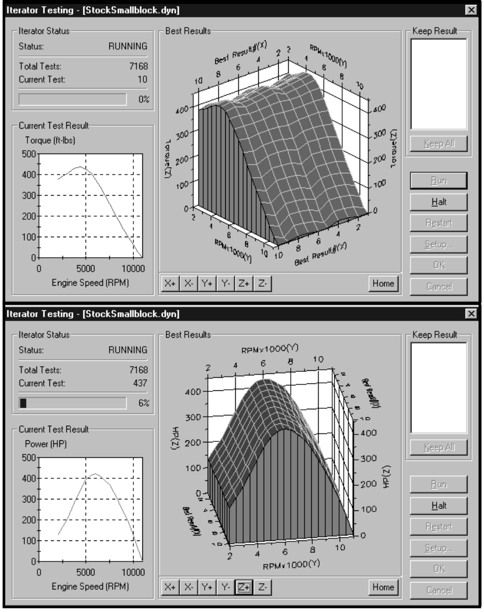
When all components, ranges, and step values have been selected, next choose whether you would like to search for Maximum Power or Maximum Torque in the **Best Results Criterion** box. Then, select the **Minimum** and **Maximum RPM** values that the

Completed Setup Screen



After selecting a baseline engine the *Numeric Parameters* menus become active. Select *Engine Parameters*, a testing *Range*, and the *Step Values* to use for the test series. Then select whether you would like to search for peak Power or Torque in the *Best Results Criterion* box. Finally, select the Minimum and Maximum RPM range through which engine output will be evaluated.

Testing In Progress



Begin Iterative testing by clicking the Run button. As each test is completed, the engine power or torque curve will be displayed in the small *Current Test Result* graph. As testing proceeds, the ten component combinations that produce the best power or torque within the selected rpm range are "stored" in the *Best Results* 3D graph. View the curves (red curves indicate Horsepower; green curves indicate Torque) from any prospective using the X+, X-, Y+, Y-, Z+, and Z- buttons (Home returns the graph to original position).

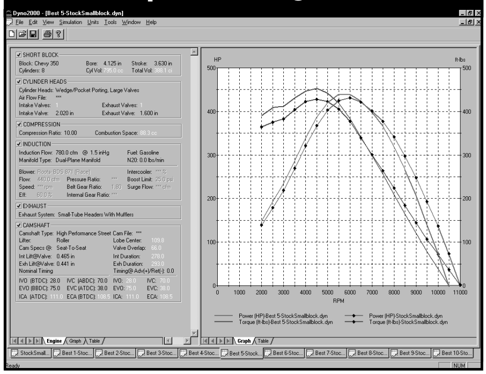
Dyno2000 should use to search for the best horsepower or torque (rpm range must span least 500rpm). For example, you might select 2500-3000rpm in a search for maximum torque on a powerplant for a heavy vehicle or for towing applications. On the other hand, a selection of 7000-7500rpm might be used in a search for maximum horsepower on a race engine.

When you have completed all the selections on the Setup dialog, click **OK** to close the box and return to the Main Iterator Screen. Notice that the total number of tests in the current Iterator run is displayed in the **Iterator Status** box (upper left). Begin Iterative testing by clicking on the ***Run*** button. As each Iterative test is completed, the engine power or torque curve will be displayed in the small **Current Test Result** graph (red curves indicate Horsepower; green curves indicate Torque). As testing proceeds, the ten component combinations that produce the best power or torque within the selected rpm range are "stored" in the **Best Results** 3D graph.

When Iterative testing is complete (you can stop testing at any time by pressing the **Halt** button; press **Run** again to continue testing), the **Best Results** graph will contain the ten engine combinations that achieved the highest horsepower or torque within the selected parameter and rpm ranges. View the curves from any prospective using the **X+**, **X-**, **Y+**, **Y-**, **Z+**, and **Z-** buttons (**Home** returns the graph to original position), then place check marks next to the curves you wish to keep in the **Keep Result** box. You can keep all ten curves by clicking on **Keep All**. When all curves you wish to keep have been selected, click **OK** to close the Iterator. In a few seconds, the Dyno2000 will spawn dyno-test engines with component combinations that produce the power or torque of the selected curves.

When the Iterator closes, the new spawned engines will be displayed in the **Engine Se-**

Iterator Spawned Engines



When the Iterator closes, spawned engines will be created and displayed in the Engine Tabs at the bottom of the Main Program Screen. The comparison test shown here between the Baseline engine and one of the ten test results illustrates the increase in power and torque that was "found" by the Iterator.

lection Tabs at the bottom of the **Main Program Screen** (see page 7 for more information on Engine Tabs). Each test engine can be brought into the foreground by clicking on its Tab. Iterator-spawned engines can be analyzed, tested, and modified in any way, just like any other engine in the Dyno2000. In fact, it is possible to begin a *new* Iterator test using any of the spawned engines as a Baseline Engine to further “home in” on the desired results.

Tips For Running Iterative Testing

The best way to find optimum components, especially cam timing, is to use large step values (5 degrees or more) to “get in the ballpark” of the right values. Then run a second Iteration series keeping the range of values narrow (perhaps just a 5 or 10 degree range) but using smaller (perhaps 1 degree) step values to zero-in on precise timing.

Narrowly-focused tests may still require several thousand test cycles to complete. A series this large may require an hour or two—or even a day or two—of calculation time depending on the speed of your computer. In these cases, you may continue to use your computer to perform other tasks. Simply use the Start menu to begin other applications and use Alt-Tab to switch between applications (see your Windows documentation for more information on program switching). If you are running Windows98, you may select the “DeskTop” icon in the task bar (usually located two or three icons to the right of the Start menu on the task bar) to “minimize” the Dyno2000 and regain your desktop.

EXPORTING DYNO FILES

Programs within the DeskTop Software series allow you to simulate building and dyno testing an engine, then you can install any (simulated or real) engine in a vehicle and test the combination in 1/8- or 1/4-mile drag events in the DeskTop DragStrip and Drag2000. You can even load simulated engines into DeskTop ProDrag Racing, Intense Imports, and X-Car Road Racing games. It is Motion Software’s goal to maintain this compatibility throughout the entire DeskTop line.

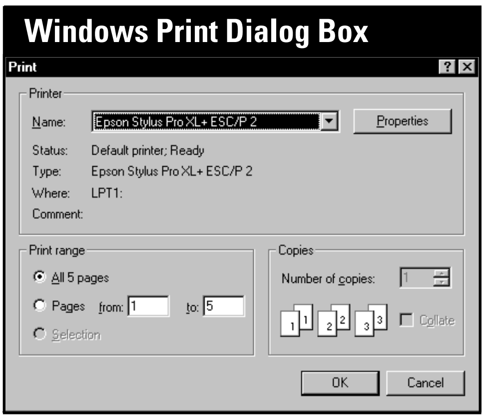
The Dyno2000 has many new options, like forced induction, that are not supported in older Desktop products. Even so, a DOS file export feature has been incorporated into the Dyno2000 that allows you to exchange many simulated engines with the DeskTop Dragstrip, the DeskTop Full Throttle Reaction Timer, and even DeskTop racing games.

However, to maintain this compatibility, export limits must be imposed on Dyno2000 engines (except for engines exported to Intense Imports which supports all features in the Dyno2000). The following exports limits are required:

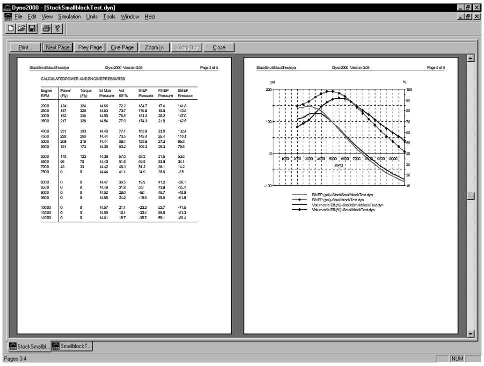
1) Engines using **Forced Induction** cannot be exported.
2) Engines that have **Auto Calculate Valve Size** or **Auto Calculate Valve Lift** cannot be exported until these features are turned off.
3) The **Unit** system (use the ***Units*** menu in the Dyno2000) must be set to the US measurement system.

PRINTING DYNO DATA AND POWER CURVES

The Dyno2000 is capable of printing a complete list of engine components, cylinder head airflow data, exact engine test result values, and 2D graphic curves of several engine-test variables. Each of these data sets print on separate pages that comprise a complete 5-page, dyno-test report of the currently-selected engine. Here is description of each page:



The print dialog box, accessible from the *File* menu, allows the selection of a printer, access to printer Properties, and you can select exactly the dyno-test report pages that you would like to print.



The Dyno2000 will print a complete list of engine components, cylinder head airflow data, exact engine test result values, and graphic curves of engine-test variables. Each page is shown in the print preview function available from the *File* menu.

Page 1—This page prints the components selected for the current dyno test. The appearance of the report is similar to the Component Selection pane of the Main Program Screen.

Page 2—This page displays the cylinder head airflow data used for the test run.

Page 3—All calculated engine power and pressures are provided in table form. A calculated value is listed for each 500rpm test point throughout the full test range (2000 to 11,000rpm).

Page 4—The first of two graphs of engine output is reproduced on this page (this is the graph that is setup on the left side of the Main Program Screen; select the **Graph Tab** at the bottom of the Component-Selection screen to view and setup this graph). Full color printing is supported.

Page 5—The second of two graphs of engine output is reproduced on this page (this is the graph that is setup on the right side of the Main Program Screen; this graph displays by default). Full color printing is supported.

BUILT-IN CALCULATORS

Note: The built-in calculators and other program functions are described in greater detail in the 114-page, on-disk Users Guide, see page 2 for more information.

The Cam Math Calculator

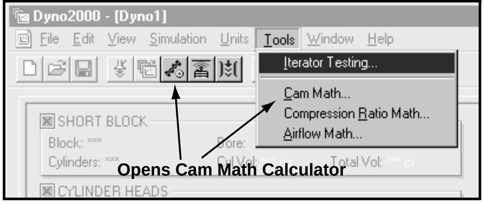
The basic four valve timing events (IVO, IVC, EVO, EVC) are required by the Dyno2000 to pinpoint when the intake and exhaust valves open and close. The **Cam Math Calculator,** included in the Dyno2000, instantly converts the lobe-center angle, intake centerline, and the duration values into IVO, IVC, EVO, and EVC events. These values can be loaded into the main Component Selection screen (in the CAMSHAFT Catetory) and used in the next simulation. In order for the Cam Math Calculator to determine all four valve events, BOTH the lobe-center angle AND the intake centerline must be available. Many, unfortunately not all, cam manufacturer catalogs provide sufficient information to use the Cam Math Calculator to determine valve event timing. If you have a catalog that does not provide this information, try another cam manufacturer.

Note: You can now obtain cam (and flow and engine) files from several sources on the Internet (including the Motion Software website). The popularity of the Dyno2000 has engendered "unofficial" support sites that you may find helpful in your engine development (Motion Software, Inc., does not endorse, guarantee, or accept any responsibility for the accuracy or usability of any of the information obtained from "non-official" sources.)

Before you open the Cam Math Calculator, select the cam timing method from the **Cam Specs** @ menu located in the CAMSHAFT category on the main Component Screen. This will establish how the timing points are applied to the simulated engine.

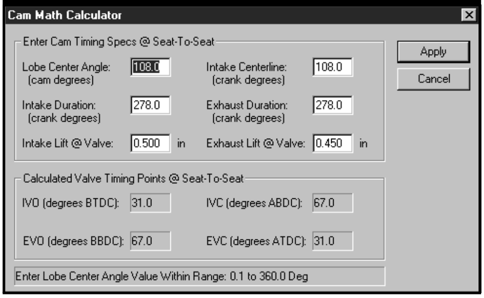
The Cam Math Calculator is activated by selecting **Cam Math** from the **TOOLS** drop-down menu or by clicking on the Cam Math Calculator button on the Toolbar. If the valve timing points were already entered in the CAMSHAFT category (on the main Component Selection Screen), the Cam Math Calculator will display the lobe-center angle, intake centerline, and duration values for the current cam and accept any changes. On the other hand, if you have not yet entered valve-event timing, the Cam Math Calculator will display blank fields, and allow the input of centerline, duration, and valve-lift specs. As you fill in the fields, the corresponding IVO, IVC, EVO and EVC points will be calculated and displayed. You may then either accept the calculated values, transferring them to

Starting The Cam Math Calculator



Open the calculator by selecting Cam Math from the Tools menu or clicking on the Cam Math Calculator button in the Toolbar.

Cam Math Calculator



The *Cam Math Calculator* allow direct entry of cam data from many cam manufacturer's catalogs. It also simplifies changing lobe-center angle, intake centerline, intake and exhaust duration, and valve lift specifications.

the CAMSHAFT catetory (on the Component Selection Screen) by pressing the **Apply** button or discard the values and close the Calculator by pressing **Close**.

The Compression-Ratio Math Calculator

The Dyno2000 includes the ability to directly enter combustion-chamber volumes, head-gasket thickness, etc., in order to determine how changes to these components affect compression ratio and engine power.

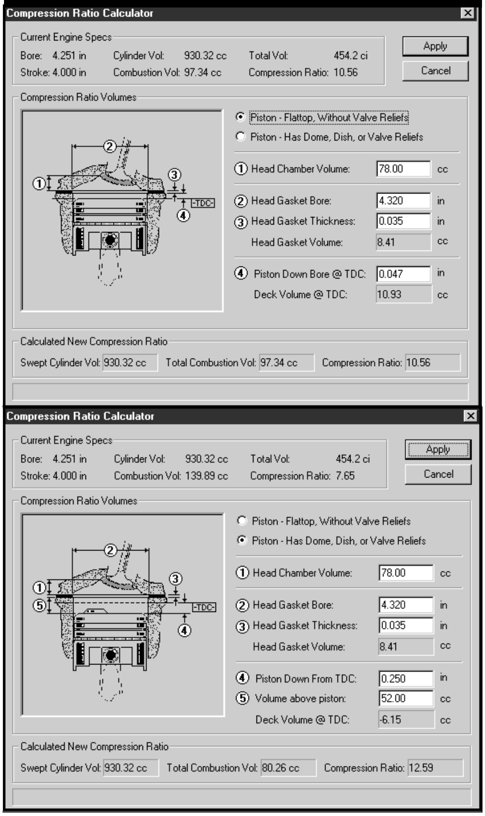
After you have specified the bore, stroke, and number of cylinders for the engine under test, activate the **Compression-Ratio Math Calculator** by selecting either *Compression-Ratio Math* from the Tools menu or by clicking on the Compression-Ratio Math Icon in the Toolbar.

When the compression-ratio calculator is first activated, it defaults to flattop pistons. This is the simplest model for calculating compression ratio. Flattop pistons do not require measuring or calculating the volume of any domes, dishes, or valve-head clearance reliefs.

Pistons with domes, pockets, or valve reliefs complicate the compression ratio issue. Each of these volumes must be accurately determined so that the net effect of all "positive" (domes) and "negative" (pockets, reliefs) can be taken into account.

First, verify that the calculator is in either the *Flattop Piston* or *Domed Mode* by checking the radio buttons in the *Compression Ratio*

C/R Math Calculator



When the Compression-Ratio Math Calculator is first activated, it defaults to the Flattop Piston Mode. When the Compression-Ratio Math Calculator is switched to the Domed Piston Mode, field (4) is redefined and an additional field (5) is displayed.

Volumes Area. Next, enter the combustion chamber volume (in cubic centimeters—cc's) in the first **(1)** *Head Chamber Volume* data box. Combustion chamber volume is typically measured with a burette.

The next two data-entry boxes allow the program to calculate the head gasket volume. The data box marked **(2)** accepts the *Head Gasket Bore* diameter. Most head gaskets have a bore-circle larger than the cylinder-bore diameter. For gaskets with bore-circle diameters of odd shapes, estimate the bore size by averaging the larger and smaller dimensions. Next, enter the gasket compressed thickness in the **(3)** *Head Gasket Thickness* field; the *Head Gasket Volume* is calculated.

The next entry field **(4)** accepts different data depending on whether the Flattop piston mode or Domed piston mode is selected. For the Flattop mode, enter the piston position (relative to the deck surface) when the piston is positioned at TDC (positive numbers for below the deck; negative numbers for above the desk).

For the Domed piston mode, **(4)** *Piston Down From TDC* allows you to enter a distance down the bore (measured from the deck surface) that <u>positions the highest part of the piston dome below the deck</u>. Typical values may be 0.100-inches or 0.250-inches depending on the height of the piston dome (any distance is acceptable as long as the entire dome resides below the deck surface). At this depth, a <u>direct measurement</u> (with a burette) is made of the *Volume Above The Piston* in the cylinder. The volume is entered in field **(5)** *Volume Above Piston*.

Note: A negative calculated *Deck Volume At TDC* indicates that the dome reduces the combustion space volume and will increase the compression ratio over a flattop piston.

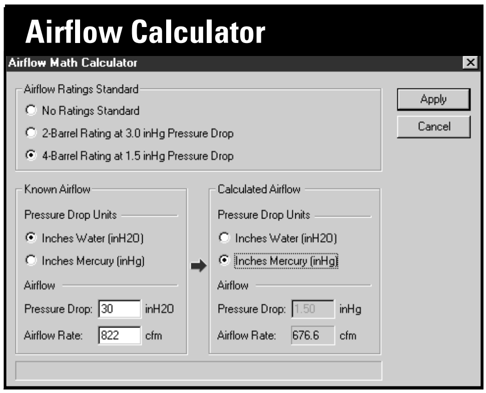
Airflow Calculator

The Dyno2000 will simulate virtually any engine with an induction airflow rating measured at a pressure drop of either 1.5-Inches of mercury (InHg), widely accepted as the standard 4-barrel airflow pressure-drop rating system, or at 3.0-InHg, the standard pressure drop used to rate 2-barrel carburetors. For those instances where an induction system, injector, or carburetor was flow tested at a different pressure drop, or if you would like to convert flow values from one pressure-drop rating to another, the Dyno2000 includes an **Airflow Math Calculator** that easily performs these conversion functions.

Note: A pressure drop of 1.5-inHg is equivalent to 20.3-inH_2O.

The **Airflow Math Calculator** has three basic modes: convert to 4-Barrel Standard, 2-Barrel Standard, and No Fixed Standard.

Activate the Airflow Math Calculator by either selecting *Airflow Math* from the **Tools** drop-down menu or click on the **Airflow Icon** located in the Toolbar. Select the desired *Airflow Ratings Standard* from the three "radio button" choices provided. Entered the measured airflow and pressure drop in the *Known Airflow* category (you can switch between Inches-of-Mercury [Hg] and Inches-of-Water [H_2O] buy clicking on the appropriate radio buttons). The calculated airflow will be displayed in the *Airflow Rate* field. You can move to any of the previous fields (by clicking in them or using the Tab or SHIFT-Tab keys) and make changes to analyze their effect on the calculated airflow. At any time, you can click on the **Apply** button to load the new calculated airflow into the Component Selction Screen (in the Induction Flow field). Alternately, you can press the **Cancel** button to discard all entries and leave any previously entered values intact.



The Airflow calculator can convert any measured airflow and pressure drop to any other pressure drop and equivalent flow.