DYNOMATION™ 6
PROFESSIONAL
Installing Dynomation6 And Cam/Lobe Libraries

NOTE: This QuickStart guide is designed to help you quickly install and use Dynomation6 and Cam File Libraries. When you have time, please review the main Dynomation6 User Manual (open the manual by selecting *User Manual* from the HELP menu in the program).

Note: In most cases, you can install Motion Software products simply by following on-screen prompts. As additional help, the following steps 1 through 8 provide a step-by-step that will guide you through the installation:
(**Note: We recommend all users review the post-installation instructions beginning on the next page.**)

Program Installation Steps

1) Close all other applications before you begin this installation.

2) Insert the Dynomation6 or a Cam File CD-ROM into your CD drive.

3) A *Software Installation Menu* will open on your Desktop within 5 to 30 seconds. From the options provided in the menu, click the *Install* option.

Note: If the *Software Installation Menu* does not automatically appear on your desktop within 30 to 60 seconds, view the contents of the install CD in Windows Explorer and double-click the *Dynomation6_InstallMenu.exe* file on the CD to begin program installation.

4) After you select *Install* from the menu, allow up to two minutes for the program installer to read files from the CD and display an opening window. Click *Next* to view the Motion Software License Agreement. Read the License and if you agree with the terms, click *I Agree*....

5) A Readme file is now displayed that includes information about installation and program updates. After you have reviewed the Readme, click *Next* to proceed with the installation.

6) Important Note: Dynomation6 will be installed on your boot drive, C:\, in the root. This location will ensure that future updates install properly.

7) The *Start Installation* screen gives you a chance to backup and review the license agreement or Readme info. Press *Next* to begin the installation.

8) When the basic installation is complete, a *Setup Complete* dialog will be displayed. Click *Finish* to close this window and start additional helper-software installations:

a) The latest Sentinel-HASP USB Key driver installer will run next. This is required for Dynomation6 to communicate with the USB Security Key provided in your package. No user interaction is required.

b) After the key driver installation is complete, a dialog box may appear and ask for permission to install *Microsoft DirectX* on your system (*DirectX* is required for Dynomation6 3D animations). If you have the same or a newer version of

DirectX already installed, the installer will detect its presence and will not overwrite newer files.

c) After DirectX, the Dynomation6 software installation is complete.

POST-INSTALLATION SETUP
Installing The USB Security Key

9) Plug the USB Security Key (the small USB device supplied with Dynomation) into any available USB port on your computer. This key is licensed to you, the purchaser of this software, and will allow you to run Dynomation6 on any of your computer systems. You are licensed to install Dynomation6 on as many computers as you wish, however, Dynomation6 will only run on one system at a time; the computer with the Security Key installed.

Note: If you do not have an available USB port (your computer must have at least one free USB port to use Dynomation6), you can install a USB Card or Hub to extend the number of available USB ports. The Dynomation6 Security Key will function properly with most external USB Hubs.

Solving USB Security Key Issues

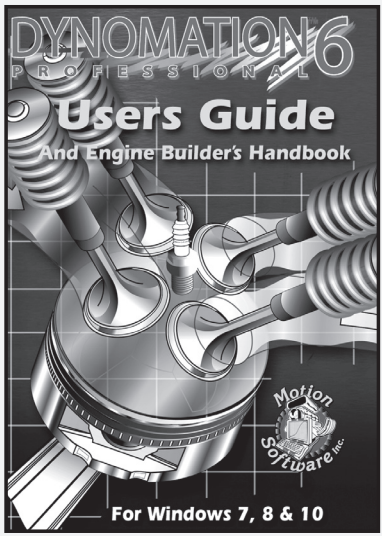
If Dynomation6 displays an error message that the Security Key (or HASP) is missing, here are some quick steps you can follow to isolate and correct this problem:

a) Restart Windows after you install Dynomation6 to make sure the USB Key drivers are loaded and running.

b) Make sure the Security Key is, in fact, properly connected to a functioning USB port on your computer or has been plugged in a USB hub that is connected to your computer. If you plugged the Key into a hub (rather than into a USB port on the computer), try connecting it directly to a port on your computer system.

Note: The Security Key contains a small red LED that illuminates when it is properly connected and communicating with

Dynomation6 Users Manual



This QuickStart guide will get you going, but to explore all the capabilities of this powerful simulation, an on-disk Users Manual is included. After installing Dynomation6, you can access the Users Manual by: 1) Opening the *Help* menu within Dynomation6 and selecting ***User Manual***, or 2) Opening the Windows ***Start*** menu, select ***Programs*** *(or* ***Apps),*** then select ***Motion-Dynomation6 Engine Sim*** and click on the ***Dynomation-Users Manual*** icon that appears within that folder, or 3) double click on the **Dynomation-UsersManual.pdf** file located on the Dynomation6 CD-ROM.

IMPORTANT: If any of these techniques fails to open Dynomation documentation, you need to install *Adobe Reader*. Reader installation links are located in the **Adobe Reader** folder on the Dynomation6 CD-ROM. Simply double click on one of the installer links to install *Adobe Reader* on Windows 7, 8 or 10 systems (internet connection may be required).

the correct software drivers.

c) Make sure your USB port is functioning by disconnecting all other USB devices from your system. Then reconnect the Security Key (try a port you haven't used).

d) Try *reinstalling* the Security Key drivers by reinstalling Dynomation6 from the program CD (you do not need to un-install first), or install the latest driver posted on our Support page (www.motionsoftware.com/support.htm).

e) If your computer is experiencing technical difficulties, such as non-functional devices, spontaneous rebooting, numerous system messages, etc., the device drivers for the Security Key may not function properly on your system. You must have a stable computer system and a clean, virus-free Windows installation to properly use Dynomation6.

f) As a "last resort," try installing Dynomation6 and the Security Key on a second computer system to determine if your original computer is at fault.

OTHER INSTALLATIONS

Installing A 10-Point CamDisk Library (Any Version)

10) CamDisks are additional libraries of 10-Point camfiles. If you wish to install a 10-point library (may be on a separate disk or can be included on the Dynomation6 CD), click the *Install* option on the *Program Installation Menu* (see page 1). CamDisk camfiles can only be installed ***after*** Dynomation6 has been successfully installed on your system.
Note: *10-Point* camfiles are NOT the same as *Lobe-Profile* files; see page 11 for more information on camfile types and valve-motion modeling techniques in Dynomation6.

Installing A *Lobe-Profile* Library

11) Motion Software offers libraries of cam-lobe profiles that allow Dynomation6 to model exact valve motion and predict engine power with the highest accuracy. Lobe-Profile Files consist of data that "maps" the entire shape of the lobe, not simply the valve opening, closing, and maximum lift points; see page 11 for more information on Cam-Lobe Profile usage in Dynomation6. If you wish to install a Lobe-Profile library, click on the *Install* option on the *Program Installation Menu* that will appear on your desktop after you insert the Profile CD into your CDROM drive. Profile Libraries can only be installed ***after*** Dynomation6 has been successfully installed on your system.

STARTING DYNOMATION v6

12) To start Dynomation6, double-click the *Dynomation6* program icon that was installed on your Desktop. Alternatively, you can open the Windows *START* menu, select *All Programs* or *Apps*, then choose *Motion-Dynomation6 Engine Sim*, and click on the *Dynomation6* icon displayed in that folder.
USB Security Key Issues: If Dynomation6 displays an error message indicating that the Security Key (HASP) is missing or cannot be found, refer to the information on page 2 (Solving USB Security Key Issues).

Automatic Program Updates

13) Dynomation6 incorporates an automatic program updater that will keep your software current with the latest simulation developments. Before you put Dynomation6 to work, make sure you allow the *Motion Updater* to check our servers and install the latest program updates (requires Internet connection). The *Motion Updater* will run automatically after initial program installation and then approximately every 30 days thereafter. You can check for a new update at any time by selecting *Check For Newer Version...* from the HELP menu within Dynomation6. If the automatic update was unsuccessful, in most cases you can manually download the latest Dynomation6 program updates from our support page at: www.motionsoftware.com/support.htm.
Important: Don't assume you are running the latest version if you just installed the

4 software from the Dynomation6 CD. CD's are NOT updated each time new releases are issued. The ONLY way to make sure you are running the latest version is to use the *Check For Latest Version* feature (in the HELP menu).

Registering Dynomation6

14) When you first start Dynomation6, a *Registration* dialog will be displayed. Please fill in the requested information, including your Serial Number found below. Then press the *Register Now!* button. If you have an Internet connection, your registration will be submitted to Motion Software, Inc. If you do not have an Internet connection, you will be presented with other registration options. If you do not register this simulation, you may not qualify for tech support or free updates.

If you move or change your email address, you can update your registration information at any time simply by selecting *Registration* from the HELP menu in Dynomation6. Keep up to date with the latest Dynomation advances by keeping your registration information current.

Tech-Support Options

Important Note: You can obtain technical support by sending an email to: *support@motionsoftware.com*. We are here to help you get the most from Dynomation6!

1) Dynomation6 requires the entry of detailed information about your engine in order to perform a simulation. Input errors can generate invalid simulation results. Carefully review the data you have entered in the program (you can generate a *ProPrint*™ printout to make the review somewhat easier).

2) Make sure you are running the latest version of Dynomation6. Select *Check For Latest Version...* from the HELP menu in the program.

3) Select *Show Simulation Log* in the VIEW menu in the program. The log may help you track down out-of-range data or other non-fatal program errors.

4) Refer to FAQ's later in this QuickStart Guide and in the Dynomation6 User Manual.

5) Contact technical support by sending an email to: *support@motionsoftware.com*. Include a detailed explanation of the problem and what steps lead up to the fault so we can duplicate the error. Also, please attach the engine file that you were working on when the error occurred. Thank you for you help!

Serial Number Required For Program Installation:

DYNOMATION6™ PROFESSIONAL

Dynomation6 And Cam/Lobe Data QuickStart And Pro User Tips

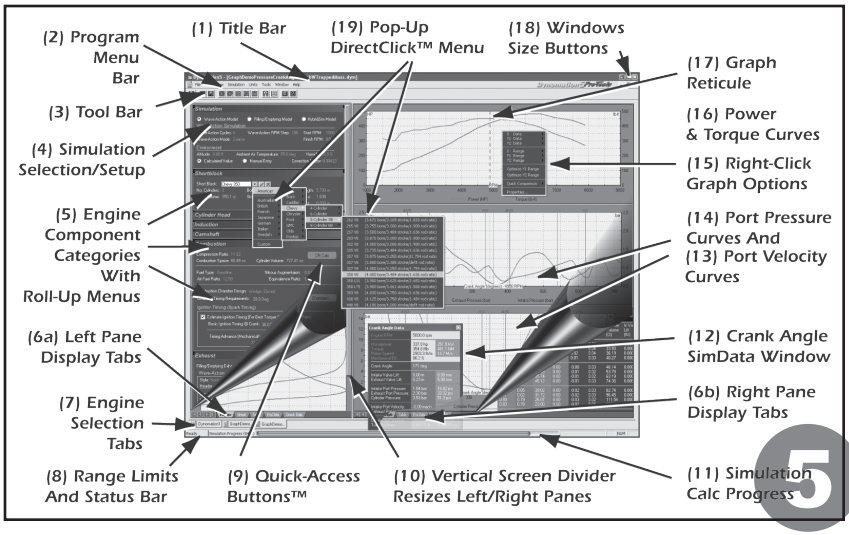
NOTE: This QuickStart guide is designed to help you quickly install and use Dynomation6 and Cam File Libraries. When you have time, please review the main Dynomation6 User Manual (open the manual by selecting *User Manual* from the HELP menu in the program).

Thank you for purchasing Dynomation6™! This advanced engine simulation is the result of thousands hours of simulation and programming development and over twenty years of practical testing and validation. We are confident that this simulation package will help you further your understanding of engine pressure-wave dynamics and extend your ability to improve the performance of a wide variety of engines used in transportation, performance, and professional racing applications.

WHAT IS DYNOMATION6?

Dynomation is a engine-power (dynamometer) simulation for Windows 7, 8 & 10. It consists of two distinct engine simulation models: 1) A *Filling-And-Emptying (FE)* simulation that provides extremely fast mathematical solutions to engine physics, and 2) A full *Wave-Action (WA)* simulation that accurately predicts the complex pressure-wave dynamics and particle flows in intake and exhaust passages.

The *Wave-Action* model can "home in" on the best port sizes, shapes, runner lengths, header-tubing configurations, and more, offering engine analysis for the serious engine designer and builder. While



not utilizing such a thorough mathematical analysis, the *Filling and Emptying* model is considerably faster than the WA, offers quick-and-easy engine setup and remarkable overall accuracy.

In addition to incorporating two simulation methods, Dynomation6 includes advanced graphic and tabular results displays, a unique and easy-to-use data-entry interface, automated testing with *Quick* and *Pro Iterators*™*, ProPrinting*™ multi-page dyno test reports*,* and many other advanced features.

DYNOMATION6 REQUIREMENTS

Here are the basic hardware and software requirements to run Dynomation6:

- A Windows-compatible PC with a CD-ROM drive.
- A USB Port for the Security Key is required to run Dynomation6 (see page 2).
- A minimum of 2GB of RAM (random access memory) and Windows 7, 8 or 10.
- Dynomation6 may run on older versions of Windows, however, these installations are not supported.
- A video system capable of 1280 x 1024 or higher to optimize the display of engine components and performance-analysis graphics.
- A fast system processor (2GHz or faster) will improve processing speeds; especially helpful for *Wave-Action* and *Iterative*™ testing. However, Dynomation6 will operate on any qualified Windows system, regardless of processor speed.
- A mouse.
- Windows compatible printer (to obtain *ProPrint*™ dyno-test printouts).

THE MAIN PROGRAM SCREEN

The left side of the **Main Program Screen** is where you configure the simulation and enter engine components, dimensions, and specifications. The right side of the screen displays engine simulation results in graphical and chart form. The full program screen is composed of the following elements (the numbers in this list refer to the callouts in the photo on page 5):

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

2) The **Program Menu Bar** contains pull-down menus that control various program functions. Here is an overview of these menus, from left to right:

File—*Opens* and *Saves* Dynomation6 test files, *Imports* other simulation files (including Dynomation5 and earlier program versions), *Exports* crank-angle and rpm-based engine test data, generates *ProPrint*™ reports, and contains a program-exit function.

Edit—Clears all component choices.

View—Allows you to display the *Toolbar(3)*, *Status Bar(8)* and *Workbook features*. Also, a menu choice resets all graphs to program defaults.

Simulation—*Run* forces an update of the current simulation. *Auto Run* enables or disables (toggles) automatic simulation calculation when a component is changed. You can also display a *Simulation Log* that contains diagnostic information about the simulation just completed. A *Blower Map Window* can be displayed that shows the compressor map and engine demand line in Turbo and Centrifugally supercharged engines. The Simulation menu also includes a *User Preferences* selection that lets you personalize Dynomation6 startup settings.

Units—Selects between US/Domestic and Foreign/Metric units. A hybrid units system also is available that displays components in metric units with Power/Torque in US units.

Tools—Opens the *Iterative Testing* window, the *Cam Manager*™ screen, or one of several built-in, engine component calculators.

Window—A standard Windows menu for arranging and selecting

program windows.

Help—Gives access to the program *Users Guide*, *Registration*, and related program *Update* and *Help* features.

3) The **Tool Bar** contains a series of twelve (12) icons that speed up the selection of commonly used program functions and features.

4) The **Simulation/Setup Category** appears at the top of the *Engine Component Categories (see **5**, next)*. Use this category to select a simulation model and make simulation-specific setup choices, like rpm range and atmospheric conditions.

5) The **Engine Component Categories** are made up of the following groups (Wave-Action specific component entry fields are dimmed when you use the FE, and vice versa):

Shortblock—Enter the bore, stroke, number of cylinders, piston pin-offset, and rod-length measurements in this category.

Cylinder Head—Select the cylinder-head type from generic choices or enter custom port-flow data using the *Port Flow* dialog (click the *Port Flow* button).

Induction—Select intake manifold designs, airflow rates and pressure drop for the induction system. Also select intake runner dimensions for the Wave-Action simulation. At the bottom of the *Induction* category you can select and configure several types of forced-induction systems.

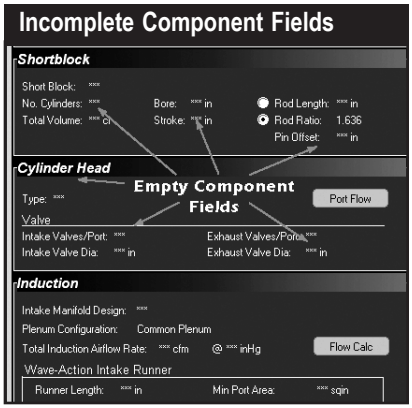
Camshaft—Select the camshaft type, activates V-V-T (variable valve timing, similar to Honda's VTEC), sets various cam timing/specifications, and displays the *True Timing* used by the simulation. Buttons open the *CamManager*™, *Rocker-Math*™ dialog, and the *Lobe-Profile Import* dialog.

Note: The *CamManager*™ is strictly a *10-Point* cam-timing tool (see page 12) and is not used with lobe-profile lift data.

COMBUSTION—Select the compression ratio, type of fuel, air/fuel ratio, nitrous flow rate, combustion chamber design, and ignition timing.

EXHAUST—Select the exhaust-system configuration, runner and tubing dimensions and interconnection specifications.

NOTES—Attach any comments/notes about the current simulation in this category. Notes are saved with the engine *.DXML* file.



All component categories start off empty, indicated by strings of asterisks (***) next to each incomplete component field. Move the mouse cursor into any category and click the left mouse button on the asterisks to open a component-specific menu and/or direct-entry box. When all selections within a category are complete, the red tone *Category Title Bar* will change to dark-tone.

The status of each Engine Component Category is shown by the color of its **Category Title Bar**. The Title Bars are either a red tone, indicating that the category is not complete (inhibiting a simulation run), or a **dark-tone** indicating that all components in that category have been selected.

6a & 6b) The Main Program Screen window is divided into two panes (left and right). The bottom of these panes include a set of **Screen Display Tabs**. Use these tabs to switch the left or right pane displays to component

lists, tables, graphics, or other data displays.

7) Dynomation6 can work with several engines at once (simultaneously open multiple documents). Switch between open engines by clicking any ***Engine Selection Tab*** located at the bottom-left of the screen near the Status Bar.

8) During data entry, the range of acceptable values and other helpful information will be displayed in a ***Range Limit Line*** located at the bottom-left corner of the screen.

9) Several component categories contain ***QuickAccess Buttons***™ that give "one-click" access to important data-entry functions, dialogs, and calculators.

10) The widths of all program panes are adjustable with ***Vertical*** and ***Horizontal Screen Dividers***. Just click and drag the dividers to suit your needs.

11) The ***Simulation Progress Indicator*** displays the progress of the selected simulation model as it computes engine flow at each hundredth or thousandth of a crank degree throughout 720-degrees of piston movement (the entire four-stroke process) for each rpm point.

12) The ***Crank-Angle SimData™ Window*** displays the values of port pressures, flow rates, horsepower, and more at the rpm and crank-angle points selected by the positions of the reticule lines on the graphs (open the ***SimData Window*** from the **Tools** drop-down menu).

13) The lower, right-hand ***Port Velocity*** graph shows intake and exhaust port velocities at various rpm and crank-angle values (velocity is the default display—can be customized using the right-click menu).

Important: Click on the topmost horsepower/torque graph to display a reticule line that can be positioned left and right, establishing the rpm point at which velocity and pressure data is obtained and displayed in the center and lower graphs.

14) The center ***Port Pressures*** graph (pressure is the default display—can be customized using the right-click menu) shows port pressures at various rpm and crank-angles for the current simulation.

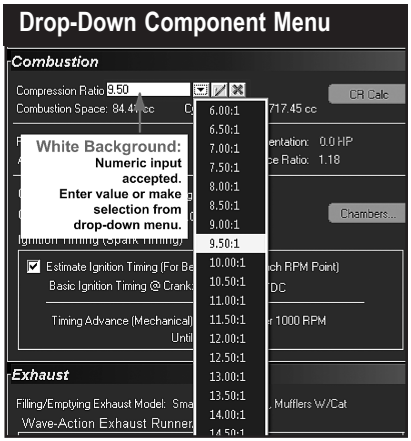
15) The graphs in Dynomation6 display horsepower, torque, port pressures, flow rates, valve lift, and more for the currently-selected engine. These graphic displays can be customized to display additional data in many formats using ***Graph Options Boxes***. To display an **Options Box**, *right-click* on any graph and select *Properties*.

16) The **Horsepower And Torque** graph displays engine power and torque by default—can be customized using the right-click menu. The results displayed are for the *rpm range* chosen in the *Simulation Category*. Click on this graph to display a reticule line that establishes the rpm point from which pressure and velocity data is obtained and displayed in the center and lower graphs.

17) Each of the four graphs (the fourth is located "under" the Component Categories—to view this graph, click on the ***Graph Tab*** at the bottom-left-side of the main program screen). A ***Reticule Line*** appears when you click on the graph. You can drag the line left and right with your mouse between the lowest and the highest test rpm (for the top, rpm-based graph), or between 0- and 720-degrees (for crank-angle based graphs). The values of the data directly under the reticule lines are displayed in the ***SimData™ Window*** (see item 12, above).

18) The Main Program Screen incorporates ***Windows Size Buttons***. These buttons provide standard maximizing, minimizing, and closing functions.

19) The ***Pop-Up*** **DirectClick™** ***Component Menus*** let you enter engine specs in *Component Categories*. Click on any component specification to open its menu. If you wish to close the menu before making a new selection, click the red **X** next to the drop-down box or click anywhere outside the menu box.



A component box with a white background will permit direct numeric entry or a selection from the drop-down menu. A light-gray box will only accept a selection from the drop-down menu. Click on the red-X if you wish to close the data-entry box without making a selection.

Direct-Input And *Menu-Input* Component Categories

Direct-Click™ component menus fall into three types: 1) Those that accept direct input (your custom values), 2) those that only accept a selection from their attached drop-down menu, and 3) those that will accept either a direct entry or menu choices.

For example, the **Compression Ratio** menu in the *Combustion Category* will accept direct input (any value from 3.0 to 30.0), but you can also select a compression ratio from the drop-down menu. On the other hand, the **Pressure Drop** menu in the *Induction Category,* will only accept one of the two selections from its attached menu (1.5- or 3.0-inHg).

THE MEANING OF SCREEN COLORS IN DATA FIELDS

Here is a quick reference to basic screen color functionality for *Component Fields*:

White: Most engine component field ***names*** (not the component *values*) are displayed in white. This indicates that their associated data fields are required for a simulation to be performed.

Light Blue (Cyan): All engine component ***values*** are displayed in light blue. These are engine specs that can be entered and modified. For example, the ***Bore*** value in the *Shortblock* category is shown in Cyan and can be changed to any value within the limits of the simulation.

Light Gray: These "display only" ***values*** have been automatically calculated by program and cannot be directly modified. For example, the ***Fuel Calorific Value*** in the *Combustion Category* is a display-only value that is determined by the type of fuel selected for the simulation (your choice from the ***Fuel Type*** menu).

Note: The basic color functionality described here applies to the Dynomation6 default color scheme. While other color schemes may use some of these colors, not every color scheme uses the default colors for data inputs. However, the *differences* in display colors within each color scheme will always reflect the functionality described above.

BUILDING YOUR FIRST ENGINE

A *Five-Minute Tutorial* is provided in the Main User Guide. Follow along using a step-by-step introduction to simulating your first engine. Also refer to videos that may be supplied on the CD or are available at www.MotionSoftware.com for additional program assistance.

ADDITIONAL DYNOMATION6 FEATURES

The *Quick* And Pro *Iterators*™

Dynomation6 incorporates the "ultimate" rapid-testing tools. ***The Quick Iterator***™ (pronounced *IT-TER-A-TOR) and* ***ProIterator***™. By clicking a single button, Dynomation6 can perform a comprehensive series of engine tests to find optimum horsepower or torque for many applications. Refer to the main User Manual for

more information on using Motion Software *Iterators* built into Dynomation6.

Compression-Ratio Calculator

Dynomation allows the selection and testing of a wide range of compression ratios. You can directly enter combustion-chamber volumes, head-gasket thickness, etc., to determine their effects on engine compression. The ***Compression-Ratio Calculator*** quickly performs these functions, plus it "intelligently" adjusts itself to the needs of the engine builder by changing the way it accepts either *known combustion volumes* or displays alternate data inputs when these *volumes must to be measured* directly from engine components (open the *Compression-Ratio Calculator* using the ***CR Calc*** button in the *Combustion Category*).

Rocker-Math™ Calculator

The Camshaft Category includes a powerful **Rocker-Math™ Calculator** that will help you determine how and why changes in Rocker Ratio can affect engine output (open the *Rocker Math Calculator* using the ***Rocker Math*** button in the *Camshaft Category)*.

Important Rocker-Math Usage Note: Enter the cam manufacturer's (baseline) specifications for Rocker-Ratio in the Camshaft Category FIRST! Then use the *Rocker Math Calculator* to determine how CHANGES to stock specifications will affect cam timing and engine power. If you wish to "undo" changes made in the *Rocker-Math Calculator* (after they have been applied to the simulation), reopen the calculator and re-enter the original rocker ratio. More information on this calculator is available in the Dynomation6 User Manual.

Cam-Math™ Calculator

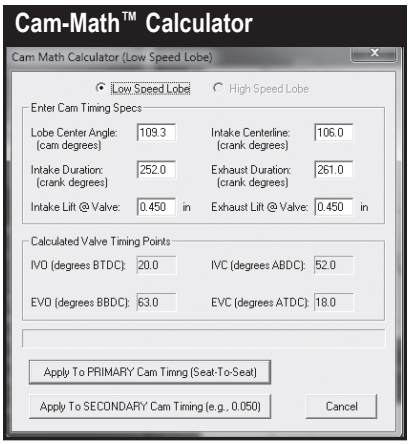
The ***Tools Menu*** (located at the top of the main program screen) includes a number of additional calculators and other helpful engine-building tools. The User Manual details how to use each of these program features. The ***Cam-Math™ Calculator*** can be especially helpful if you need to convert valve-duration values to event-timing (*IVO*, *EVO*, *IVC*, and *EVC* for both the *Seat-to-Seat* and *0.050-inch* timing methods) that are required for engine modeling in the *Camshaft Category*.

You can start with cam data commonly found on cam manufacturer's cam cards and websites, such as: *Intake Duration, Exhaust Duration, Intake Centerline,* and the *Lobe Center Angle*. Using this data, the calculator will output the IVO, EVO, IVC and EVC. You can automatically transfer these values to the *Camshaft Category* into either the Seat-To-Seat or 0.050 Timing data fields with a mouse click.

CAM & LOBE DATA IN DYNOMATION6

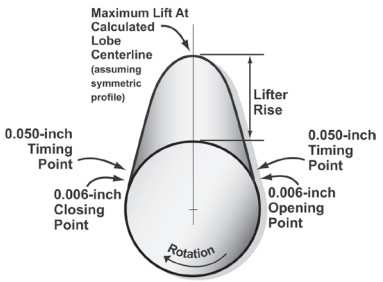
Dynomation now includes new mathematical *"Fitter"* routines ensuring all valve-event timing, regardless of their values, are precisely used by the simulation. Dynomation6 also uses exact measurements of each lobe, called *Lobe Profiles*, to generate precise lift-curves (also see *Lobe-Profile Libraries*, on page 13).

10-Point And Lobe-Profile Timing:



The CamMath™ Calculator is just one of the tools you can use to help model engines in Dynomation6. Enter readily available cam duration and centerline values and the Calculator will determine valve-event timing needed to complete the simulation.

10-Point Cam Timing



10-Point Cam Timing Is Derived From Seat-To-Seat and 0.050-Inch Opening and Closing Points, Plus The Maximum Lift Of Each Lobe

10-Point Cam Data is a set of cam specs that describe both the intake and exhaust characteristics of any particular cam. It includes seat-to-seat and 0.050-inch valve-event timing points. These eight values, plus the maximum lift of each lobe, add up to 10-data points for each intake and exhaust lobe pair. Dynomation6 can use 10-Point data to extrapolate a valve-motion curve for any camshaft.

What Are They?

10-Point cam-timing data is obtained or extrapolated from typical "cam-card," published data. *10-Point* cam data defines the essential valve event timing used by the simulation. It consists of 5 discrete data points for the intake lobe and 5 for the exhaust lobe. (The *10-Point* name was originally coined by Motion Software developers in the 1990's.)

Cam timing data based on precise measurements of the shapes of the cam-lobes is called *Lobe-Profile Timing*. It typically consists of a series of 360 lobe-lift points measured at each cam degree (in most cases, fewer than 180 points actually measure lobe lift; the remaining points indicate zero or any deviation from the base-circle diameter).

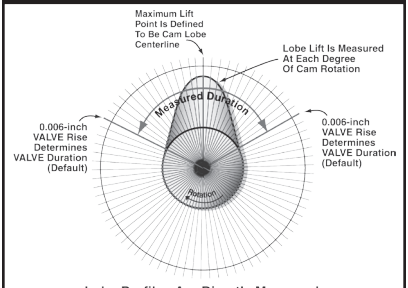
Cam Timing Details

10-Point Timing, (referring to the cam-modeling *method*, as used in the simulation), indicates that the intake and/or the exhaust lift curve is being derived from ten, discrete data points: The *Intake* and *Exhaust Opening* (IVO, EVO) and *Closing* points (IVC, EVC) specified at both the *Seat-to-Seat* and *0.050-inch* lift points (that's 8 points) and the *Maximum Valve Lift* generated by the intake and exhaust lobes (that's a total of 10 points of data). While this may seem like hardly sufficient data, by using mathematical routines to "fit" these known points to a dynamically stable lift curve, it's possible to generate accurate valve-motion data for both the intake and exhaust lobes of virtually any camshaft!

Lobe-Profile Timing, on the other hand, consists of multiple lift points per lobe, and is derived from actual lobe measurements. This provides the most accurate representation of valve motion for a particular camshaft. Profile data can be considered the "final word" when it comes to modeling a particular lobe for real-world valve motion and dynamics.

Each of these cam-timing methods have their own advantages and disadvantages in engine simulation modeling. For example, the 10-Point method, while "data-limited," offers advantages during engine simulation testing:

Lobe-Profile Timing



Lobe Profiles Are Directly Measured At Each Degree Of Camshaft Rotation

Profile data is made up of lobe-lift data recorded at, usually, each degree of camshaft rotation (by installing the cam in a special measuring fixture). Dynomation6 can use this data to very accurately determine valve positions at any point during the simulation.

1) You simply may not have access to cam-profile data. Whereas, 10-Point Timing is often easily found and allows accurate modeling.
2) If you have profile data, it is not possible to alter individual valve timing points, since the Lobe Profile defines the entire lift curve with a set of, essentially, fixed data points. So, to modify valve timing (without grinding a new cam and measuring its profile), you must convert the cam data to 10-Point timing (fortunately, the conversion process takes only a mouse click in Dynomation6).

A Quick Cam-Timing Recap

Profile data, while containing greater data resolution, can be less flexible, since valve opening and closing points are "baked-into" the profile curve. With 10-Point Timing, it's possible to: a) manually alter any valve-event point, b) search for matches within 10-point camfile libraries, or c) use the built-in *Iterator*™ to automatically test 10-Point cam timing values to determine what works for the simulated engine.
Note: While you can not change individual valve-event timing points while using Lobe-Profile Timing, you *can* change lobe-profile centerlines. You can also "scale" lobe-profile data and change valve duration somewhat by altering the rocker ratio and valve lash. For more about this, see Rocker-Math functions described in the Dynomation6 User Manual.

10-POINT CAM LIBRARIES

Note: If necessary, refer to page 1 for help installing any Motion Software 10-Point CamData Library.

A Motion Software *CamDisk* is a 10-Point cam-data library (one is supplied free with Dynomation6 on the Dynomation CD). This library provides more than 6000, 10-Point camfiles that you can search and use in any engine.

The 10-Point CamManager™

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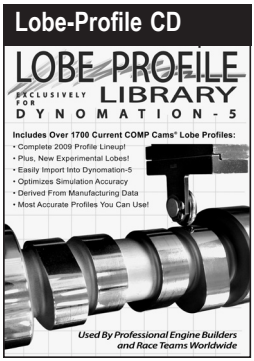
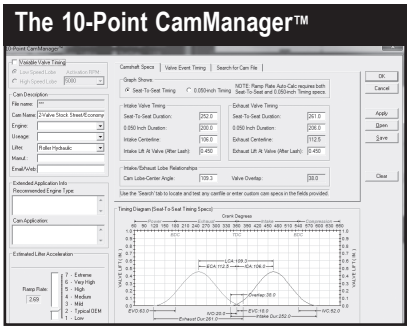
Dynomation6 incorporates a powerful valve-event manipulation tool: ***The 10-Point CamManager™***. This feature was designed exclusively for working with 10-Point CamFiles. It can help you analyze, create, and modify valve-event data for any engine application. Use the *CamManager* to load, import, save, and search for 10-Point *CamFiles*™. These procedures are covered in detail in the main User Manual, but here are some basic steps to importing and using 10-Point Camfiles (in addition to manually entering valve event-timing points directly in the *Camshaft Category)*:

1) **Open The CamManager™:** The *Cam Manager* is the "central clearing house" through which you can load, save, and search for 10-Point CamFiles. Open the CamManager by clicking the ***10-Point CamManger*** button in the *Camshaft Component Category*; it will display timing data for the cam currently used in the simulation. To load a Camfile, click the *Open* button and select the desired file from the File Open dialog box (.DCM, .SCM, and .CAM Camfiles—various Motion Software 10-Point CamFiles—are all supported).
Note: The CamManager only works with 10-point camfiles. If you would like to load a lobe-profile file, click the ***Import Lobe Profile*** button in the *Camshaft Category* to open the *Lobe Profile Import Dialog* (also see page 14).



Another first for Dynomation users are Lobe-Profile Libraries containing thousands of lobe profiles. They allow Dynomation to predict power with the highest accuracy.



The 10-Point CamManager is the "central clearing house" through which you can load, save, and search for 10-Point CamFiles.

2) Searching For 10-Point CamFiles:
There are three *Tabbed Data Pages* (upper-center within the CamManager, see photo, below). The third tabbed data page allows you to search for CamFiles that meet your criterion. For example, you can find all Honda cams, or locate cams that closely match the valve-event specifications of the current engine. If you would like to search for specific filenames or cam descriptions, enter search terms into the *Search For* fields (multiple words should be separated by spaces). If you would like to locate CamFiles that fall within a range of timing values centered around the current camshaft timing, check the *Find The Following Specs* checkbox. Click the *Search* button to locate all CamFiles starting in the folder listed in the *Look In* field and in any folders that are nested below that folder (a full recursive search for all .DCM, .CAM, and .SCM files is performed).
Note: If you change any cam specification or load a new CamFile, the new timing WILL be saved in the engine file (the .DXML file) but will NOT be saved in a separate CamFile unless you specifically perform a ***Save*** in the CamManager.

LOBE-PROFILE LIBRARIES

Note: If necessary, refer to page 1 for help installing a Motion Software Lobe-Profile Library.

Lobe-Profile data, consisting of 180 or more data points measured from each cam lobe, provides the simulation with the greatest resolution of cam-lobe shapes. Since airflow into and out of the engine is sensitive to valve position, especially at low valve lifts, profile data can optimize accuracy in your simulations.

Importing profile data into Dynomation6 takes only seconds. Here are some suggestions and tips that you may find helpful when using Lobe-Profile Files and Libraries:

1) Where To Start: Motion lobe-profile libraries include *Lobe-Specification DataSheets* (Excel Spreadsheets) that contain detailed information about each lobe. The DataSheets are installed in the *Manuals & Videos* directory under the main program directory (C:/ Dynomation6/Manuals & Videos). You'll also find links in the Windows program menu (*START, All Programs (or Apps)*, *Motion-Dynomation6 Engine Sim*, *Lobe Profiles).* The DataSheets contain design specifications and recommended applications for each lobe group or family. Use the spreadsheets as your starting point for locating an appropriate lobe combination for your application.

2) Practical Advice And Pro-Tips For Picking A Lobe Set:

a) Intake or Exhaust: Some lobes may be exhaust-specific and, because of the slower closing ramps used on many exhaust profiles, may not function well on the intake side. However, intake profiles often work well on the exhaust side, in fact, engine builders regularly use intake profiles for exhaust-valve actuation. In general, many of the most popular lobe profiles work well on both intake and exhaust valves.

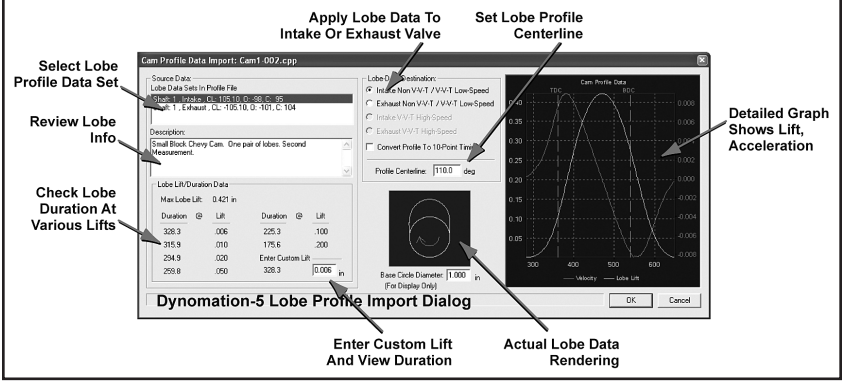
b) Family Matters: Typically the best cams are a mix of lobe profiles from two "families," with a slightly quicker lobe on the intake side. However, many excellent cams are built from lobes within a single

family (refer to the *Lobe-Specification DataSheets* for details on lobe families). There are no hard-and-fast rules when it comes to lobe selection across all applications.

c) Take It Slow: Top-performing lobe combinations have made their way into cam-manufacturer's catalogs, and many list the lobe part numbers used to "build" their best cams (the extensive catalog from COMP Cams includes Lobe-Profile data for many cams). While it may seem that cam companies would rather produce off-the-shelf "catalog grinds," in reality many race-only and high-performance street grinds started off as custom lobe sets that worked extremely well. We suggest that you start with baseline catalog grinds and then try a different intake or exhaust lobe, or change lobe centerlines. Start with something that is known to work well and make incremental changes.
Using Lobe-Profile Libraries will not only give you the opportunity to optimize camshaft selection, but also you'll be able to map out the sensitivity of your engine to various timing changes. Taking modifications slowly will give you a much better feel for the "sweet spot" in your application. The way to optimize performance is not to start from scratch, but to start with something very good and then tweak it to make it great! Making well-documented, incremental changes through several iterations is what separates the very best engine builders (or cam guys) from the rest of the pack.

3) Importing A Lobe: Press the ***Import Lobe Profile*** button in the *Camshaft Category* to begin the import process. When the file-open dialog appears, locate the lobe-library profile folder (typically: C:\Dynomation6\Cam Files\CamFiles (other)\CamProfileFiles) and then the specific folder containing library files (e.g., CompProfiles (.ecp)), then select a lobe and click OK. The *Lobe Pro-*

Lobe Profile Import Dialog



The *Import Lobe Profile Dialog* will help you select lobe data, adjust centerlines, and make other determinations before you import lobe data into the simulation. The *Lobe Source-Data List* (upper left) displays all data sets in the file. If more than one is displayed, the specifications from the one you select is displayed in the dialog. The *Lobe Lift/Duration* group (lower left) lets you check the LOBE duration at various lift points. Use the *Lobe-Rendering* image to confirm the validity of the data set (shows if points are missing, etc.). The *Lobe-Data Destination* group (middle, top) lets you assign the selected lobe data to either an intake or exhaust valve. The *Lobe Centerline* (middle, center) allows you set the profile rotational index, in crank degrees, from the point of maximum lift to Top-Dead-Center crank index. The Graph on the right of the dialog displays the lift and acceleration curves for the selected Profile Data Set.

file Import dialog will open to help you assign lobe data, adjust centerlines, and make other determinations about the data contained in the lobe profile.
Here are key features of the *Lobe Profile Import Dialog* (see photo on previous page):
Lobe Source-Data List—A list of lobe data sets within the selected Lobe-Profile file are displayed in the top-left *Source Data* list. Some file types (like .S96, .ecp) will only contain data from a single lobe, while other files (like CamProPlus files) may have multiple lobe profiles included in the file.
Lobe Duration—*Duration Data* lets you check *Lobe Duration* at various lobe-lift points (please note that this often is ***not*** the same as *Valve Duration* since lash and rocker ratio are not applied to lobe data). Values shown here should match the data in the accompanying Data-sheets.
Lobe-Rendering—The lobe-profile image is rendered from the data recorded in the file. Use this image to confirm the validity of the data set (shows if data is corrupted, points are missing, etc.).
Lobe-Data Destination—The lobe data can be transferred to either an intake or exhaust valve using the *Lobe-Data Destination* group. This data-entry area contains either two or four radio buttons, depending on whether *Variable Valve Timing* is being used.
Lobe Centerline—Lobe-lift data is useless until it is "synchronized" with crankshaft and piston movement. The *Lobe Centerline* indicates the rotational index, in crank degrees, from the center of the lobe-profile data (point of maximum lift) to the Top-Dead-Center piston position.
Note: You can change lobe centerlines after the lobe has been imported into the Camshaft Category.
Convert To 10-Point Timing—Lobe-profile data can be "handed over" to the simulation in two ways: **1)** You can directly import the "raw" valve-lift data into the simulation (this is the default method), or **2)** by checking *Convert Profile Data To 10-Point Timing*, you can force the conversion of Profile information into 10-Point timing data (see info about the differences between profile and 10-point timing on page 11).

Note1: After you have imported profile data, you can still convert to 10-Point Timing by simply clicking either of the *Convert-To-10-Point* buttons in the Camshaft Category.
Note2: The *Profile Import Dialog* will only import one lobe at a time; reopen the dialog to import additional lobes.

General Troubleshooting

If you experience problems installing or using Dynomation6, please make sure you are using the latest version of the simulation (see #13 on page 3). You can contact technical support by sending an email to: *support@motionsoftware.com*. Include a detailed explanation of the problem and what lead up to the fault.

Dynomation has many data entry fields, and it's easy to overlook errors. Here are just a few of the things you might think about when trying to resolve issues:

a) Take a few minutes to *carefully* review all your component selections (do a printout to get a "fresh look" at your engine data). You may find that reviewing component selections helps you see the source of the problem.
b) If there is poor correlation between the *Wave-Action* and *Filling-And-Emptying* simulation models, make sure you are using similar exhaust systems. Keep in mind that the *Wave-Action* model does not simulate mufflers (only open headers), so if you are using mufflers in the *Filling-And-Emptying* model, WA power values will not match.
c) If power values are higher for the *Filling-And-Emptying* model, try "tuning" the induction and exhaust systems in the *Wave-Action* simulation. The *Filling-And-Emptying* model always assumes optimum intake runner dimensions, so it often predicts "near optimum" power.
d) If a turbocharging or belt-driven supercharging system is not developing the boost or power you expect, remember that *Boost Limit* is an upper limit. Setting this value does not force a too-large tur-

bo to spin up more quickly or generate the desired boost. You need to select the correct size turbo, turbine, belt ratio, A/R ratio, etc., to obtain the desired boost curve.

Installation And General Operation

Question: Encountered *Could not locate HASP Key* error message when trying to run Dynomation.

***Answer*:** If Dynomation displays an error message indicating that the Security Key is missing or cannot be found, refer to page 3 for more information.

Question: Dynomation produced an *Assertion Failure* error. What should I do?

***Answer*:** Please note down all of the information presented in the error-message box, provide a quick synopsis of what lead up to the error, then send this information, along with the engine file that generated the problem, to Motion Software (support@motionsoftware.com). Thank you for your assistance in helping us improve Dynomation.

Question: When I run a simulation, the values of horsepower and torque on the graph are "off 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 **X**, **Y1** or **Y2** variable. See the main Users Manual for more information about graph scaling.

Question: My cam manufacturer's catalog does not list seat-to-seat, valve-event timing. But it does list seat-to-seat intake and exhaust duration, lobe-center angle, and intake centerline. How do I calculate the valve-event timing?

***Answer*:** Use the *CamMath Calculator*™ built into Dynomation (in the **Tools** Menu) to calculate the intake and exhaust opening and closing points from typical cam-card data.

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

***Answer*:** The combination of components you have selected produced a calculation error in the simulation process. This can be caused by restrictive induction flow on large-displacement or supercharged engines, or by using race-only cam timing on otherwise stock engines. A balanced set of engine components should not produce this error.

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Email: support@motionsoftware.com
Tech Support Fax: 714-974-5389

Tech Support: Contact us via email: **support@motionsoftware.com.** This is the best way to reach Dynomation6 tech support quickly. Attach any .DXML engine files that may help diagnose problems. Include a thorough explanation of the issues you encountered.

Note: Tech support will only be provided to registered users. Please complete the Registration Form that appears when you first start your software to qualify for technical support from the Motion Software staff.