

# Appendix 13: New Features in v 3.9 (A & B) Enterprise Edition

The Enterprise Edition of Engine Analyzer Pro has some very advanced features the typical user would not use. These include:

- You can use a full compressor map to define the performance of a turbocharger compressor. Figs A70 and A71.
- You can specify a particular turbocharger boost level, intake manifold temperature (after the turbocharger compressor), and exhaust backpressure level. This gives you more freedom to simulate some particular situation which may be difficult to simulate using the turbocharger compressor and turbine model specs in the program. Fig A72.
- You can view the compressor map when calculations are being performed to see what area of the map is being used. Fig A73.
- You can use a full compressor map to define the performance of a centrifugal supercharger compressor. Figs A74 and A75.
- You can design a system where a centrifugal supercharger feeds into a roots blower supercharger. Fig A76.
- You can interface to the Compression Ratio Calculator program and transfer data back and forth between them. Figs A77 through A80.
- You can run a part throttle performance “map”. This map can be useful for calibrating electronic engine controllers, or just understanding part throttle performance. Fig A81 and A82.
- There is a new Preference which lets you choose a different language for certain labels in the program. Fig A83.
- Two new Preferences are provided to adjust the valve train dynamics calculations. One allows you to increase the stiffness of the lifter/cam interface. The other allows you to increase the stiffness of the rocker arm for Overhead Rocker Arm styles of valve trains. The factor you pick is multiplied by the default stiffness. For example, if you pick 1.5, the default stiffness is increased 50%. Fig A83.
- A Preference has been added to allow for adjusting intake runner wall friction for the Intake Runner and Port. The program picks a certain amount of wall friction based on manifold type, Runner Flow Coef, etc. Your choice here will change it by the percentage you pick. Fig A83.
- A Preference has been added to let you adjust how much valve toss (separation between follower and cam) will be called Valve Toss in the tabular results. The default used by the program for many years. is .020”. If the program sees more than .020” separation between cam lobe and follower, it is flagged as Valve Toss in the calculated results. Your choices will let you pick a certain percentage of the lobe’s maximum lift. Fig A83.

## New Features in v3.9 B

New features added in v3.9 B include:

You can now import a .jpg graphics file of a turbo map to assist in translating the data from the .jpg file into the tabular data required by the program. Fig A84 – A86.

Additional features have been added to the Compressor Map screen to allow for easier entering and editing of data. Fig A87.

You can now enter details about the valve springs to simulate valve spring dynamics. These inputs are very similar to the inputs used in Performance Trends’ Spring Wiz program. Check out our Spring Wiz program for more info on the specifications used for the Valve Spring Dynamics inputs. (At this time, the inputs on this screen must be entered in English units.)



Figure A70 Using a Full Compressor Map for Turbochargers

**Turbocharger Specs for: RAJAY-30.OF**

**1st Stage Turbocharger Specs**

Surge CFM: 180

Exh Turbine Eff. %: 65% Typical

Turbine Nozzle Dia, in: 1.1

**General Turbocharger Specs**

Throttle Location: Draw Through

Max Boost Limit, PSI: 10

# Turbos/Stages: 1 Single Turbo

Intercooler Eff. %: 0% No Intercooler

Intercooler CFM Rating: 100000

Wastegate Is...: Before Intercooler

**Force to Boost Conditions**

Boost, psi: [ ] Int Temp: [ ] Exh Pres: [ ]

Force These Conditions: No

**Full Compressor Map**

Use Compressor Map: Yes

File: @C:\WB98\projects6\EAPROX\CENTMAP\Gar

View

**Comments**

Approximate specs for single Rajay 300F trim with 10 psi limit on wastegate.

**Help**

CFM where the surge line intersects pressure ratio of 2.0. p 59

OK Help Retrieve from Lib

Note that some specs are not needed when you choose to use a Map.

Current Map File Name

Click on View for screen below, to enter, open or edit Map settings.

Set to Yes and then you can choose a Map File to describe the turbocharger compressor.

**S/C Map [ Garrett GT1241 50 Trim.CMP ]**

**Pressure Ratio Range (rows)**

Highest Pressure Ratio: 5.00

Pres. Ratio Step Size: 0.125

Preview: 1.00, 1.13, 1.25, ... 5.00

**CFM Flow Range (columns)**

Highest CFM: 290

CFM Step Size: 14.524

Preview: 15, 29, 44, ... 290

Surge CFM: 35

Update Graph

Print Table

Pres Ratio	15	29	44	58	73	87
1.00 Eff%	45	45	50	50	50	50
1.13 Eff%	48	50	55	55	55	55
1.25 Eff%	50	55	60	65	65	62
1.38 Eff%	55	60	65	65	68	68
1.50 Eff%	55	60	65	68	70	73
1.63 Eff%	55	60	65	68	71	74
1.75 Eff%	55	60	65	68	71	74
1.88 Eff%	55	65	65	68	70	74
2.00 Eff%	55	60	65	68	69	72
2.13 Eff%	55	60	65	65	68	72
2.25 Eff%	55	60	65	65	68	72
2.38 Eff%	55	60	65	65	68	71

OK (keep changes) Cancel Changes Save As (new name) Open New (blank out)

Choose settings which describe how large the Map will be and how many "cells" you have to fill in for the Map, the smaller the "Step Size", the more cells.

Surge CFM is still used with Map and drawn on Map.

The Graph is not automatically updated with each change you make. Click here to update the graph.

Click on a grid cell to enter the Thermal Efficiency at that Pressure Ratio and CFM flow, then press <Enter> to advance to next cell.

Figure A71 More Compressor Map Features

S/C Map [ Garrett GT1241 50 Trim.CMP ]

Pressure Ratio Range (rows)  
 Highest Pressure Ratio: 5.00  
 Pres. Ratio Step Size: 0.125  
 Preview: 1.00, 1.13, 1.25, ... 5.00

CFM Flow Range (columns)  
 Highest CFM: 290  
 CFM Step Size: 14.524  
 Preview: 15, 29, 44, ... 290

Surge CFM: 35  
 Update Graph  
 Print Table

Pres Ratio	15	29	44	58	73	87
1.00 Eff%	45	45	50	50	50	50
1.13 Eff%	48	50	55	55	55	55
1.25 Eff%	50	55	60	65	65	62
1.38 Eff%	55	60	65	65	68	68
1.50 Eff%	55	60	65	68	70	73
1.63 Eff%	55	60	65	68	71	74
1.75 Eff%	55	60	65	68	71	74
1.88 Eff%	55	65	65	68	70	74
2.00 Eff%	55	60	65	68	69	72
2.13 Eff%	55	60	65	65	68	72
2.25 Eff%	55	60	65	65	68	72
2.38 Eff%	55	60	65	65	68	71

Select a file, then click on Open

- Cent Map Nov 2012.CMP
- Garrett GT1241 50 Trim.CMP
- Garrett GT3582R 56 Trim.CMP
- Turbonetics T04S-60-1.CMP
- Turbonetics T61.CMP

Open This File    Cancel Open

OK (keep changes)    Cancel Changes    Save As (new name)    **Open**    New (blank out)

Click on a saved Map file, then click on Open This File button to open it. Turbocharger Map files are saved in the CENTMAP folder with a ".CMP" file extension. Centrifugal Supercharger Map files are saved in the same folder with a .CMC extension.

Click this Open button to display the list of saved files shown above.

Click here to save this Map to a new name.

Current Map file name. Note: A Map file is just the specs you see in this screen. It is just a part of the total Turbocharger component file.

Figure A72 User Specified Turbo Boost and Backpressure

Turbocharger Specs for: RAJAY-30.0F

Force to Boost Conditions

Boost, psi	Int Temp	Exh Pres
100	411	85

Force These Conditions: Yes

Comments: Approximate specs for single Rajay 300F trim with 10 psi limit on wastegate.

Buttons: OK, Help, Retrieve from Library, Save

Exhaust pressure is typically close to the Boost pressure. In a very efficient, turbo which is well matched to the engine, the exhaust pressure can be less than boost pressure. In an inefficient system, exhaust pressure will be higher. If you are not sure, set this equal to Boost pressure.

Choose Yes and you can produce most any intake and exhaust conditions you want. You will notice that all other turbocharger settings are not shown to indicate they will have not affect on the results, just these 3 inputs.

Click on this Clc button for the screen to the left, where you can enter some inputs about the turbo system and get a good estimate of the Intake Air Temperature going into the engine after the turbocharger.

Calc Intake Temperature

Calc Intake Temperature, Deg F: 411

Outside Air Temperature, Deg F: 77

Barometric Pres, inches HG: 29.66

Intake Conditions

Boost Level, PSI: 100

Turbo Efficiency: 70% Good

Turbo Efficiency, %: [ ]

Intercooler: Yes

Intercooler Effectiveness, %: 40

Buttons: Use Calc Value, Help, Cancel, Print

Figure A73 Watching the Compressor Map during Calculations

If you are using a Map file, this button will appear on the Progress Form. If you select to Show S/C Map, you have choices to show continuously or Pause at different steps.

For most situations, "Pause Each RPM" is a good choice.

Click mouse button down on the blue title bars of these small screens and **hold down** to grab these screens. While holding mouse button down, slide mouse to place where you want to see what you need.

Current conditions shown here as numbers and graphed on Map as dot.

Dots are shown for each intermediate step. Note that these dots top out at a pressure ratio of about 2.0 because of the Max Boost setting of 30" in the Turbocharger Specs screen.

At the end of each step, click on these new buttons to advance to the next step, print the Map, or go back to Continuous running.

Engine RPM	2000				
Brk Tq, ft-lbs	342.4				
Brake HP	130.4				
Exh Pres, PSI	10.4				
Boost, PSI	16.7				
Vol Eff, %	155.7				
Actual CFM	159				
Fuel Flow, lb/hr	55.38				
Nitrous, lb/hr	.00				
Ntrs Fuel, lb/hr	.00				
BMEP, PSI	293.50				
A/F Mxtr Qty, %	100.0				
BSFC, lb/HP-hr	425				
Thermal Eff, %	33.20				

Figure A74 Centrifugal Supercharger using Full Compressor Map

**Centrifugal Supercharger Specs for: VORTECH--S**

**Centrifugal Supercharger Specs**

Island CFM: 650  
 Island Pressure Ratio: 1.55  
 Island Efficiency, %: 73  
 Island RPM: 33000  
 Internal Gear Ratio: 3.45  
 Belt Ratio: 3  
 Maximum Flow, CFM: 1625

**Centrifugal Supercharger Specs, cont**

Mech Friction: Typical Friction  
 Max Safe Impeller RPM: 55000

**General Supercharger Specs**

Throttle Location: Blow Through  
 Max Boost Limit, PSI: 100  
 Number of S/Cs: 1 Single S/C  
 Intercooler Eff, %: 0% No Intercooler  
 Intercooler CFM Rating: 100000

**Full Compressor Map**

Use Compressor Map: Yes **View**

File: @C:\VB98\projects6\VEAPROX\CENTMAP\

**Help**  
 \*Speed up\* gear ratio within blower, for example most Paxtons use 4.4, some Vortech's use 3.45. p 56

**Comments**  
 Single Vortech Centrifugal S/C V2-S trim with no intercooler and 1.75 belt ratio. Change intercooler and belt ratio specs to match your application.

OK Help Retrieve from Library Save to Library Print

Click here to choose to use a full map.

Click here to bring up screen shown below

Click here to show the RPM Graph.

**S/C Map [ Vortech V5 F trim.CMC ]**

**Pressure Ratio Range (rows)**

Highest Pressure Ratio: 2.6  
 Pres. Ratio Step Size: .2  
 Preview: 1.00, 1.20, 1.40, ... 2.60

**CFM Flow Range (columns)**

Highest CFM: 1000  
 CFM Step Size: 200  
 Preview: 200, 400, 600, ... 1000

Surge CFM: 250  
 Update Graph  
 Show RPM  
 Print Table

Pres Ratio	200	400	600	800	1000
1.00 RPM	5000	5000	5000	5000	5000
1.00 Eff%	10	20	20	10	10
1.20 RPM	26000	31000	39500	50000	80000
1.20 Eff%	70	60	38	28	10
1.40 RPM	35500	37500	43000	52000	70000
1.40 Eff%	67	75	61	40	30
1.60 RPM	43500	43500	47500	53500	70000
1.60 Eff%	62	75	72	50	35
1.80 RPM	49000	48500	51500	55500	70000
1.80 Eff%	58	73	72	61	42
2.00 RPM	54500	53000	54000	59000	75000
2.00 Eff%	55	68	73	64	50
2.20 RPM	60000	56500	57500	62000	90000
2.20 Eff%	50	65	70	65	55

OK (keep changes) Cancel Changes Save As

The Map is very similar to the Turbocharger Map except you also need an RPM to go with each Thermal Efficiency at each Pressure Ratio and CFM flow data point. For example, this point shows the blower is spinning at 49000 RPM and produces 58% efficiency at a Pressure Ratio of 1.80 at a CFM of 200.

Figure A75 Centrifugal Supercharger using Full Compressor Map, RPM Graph

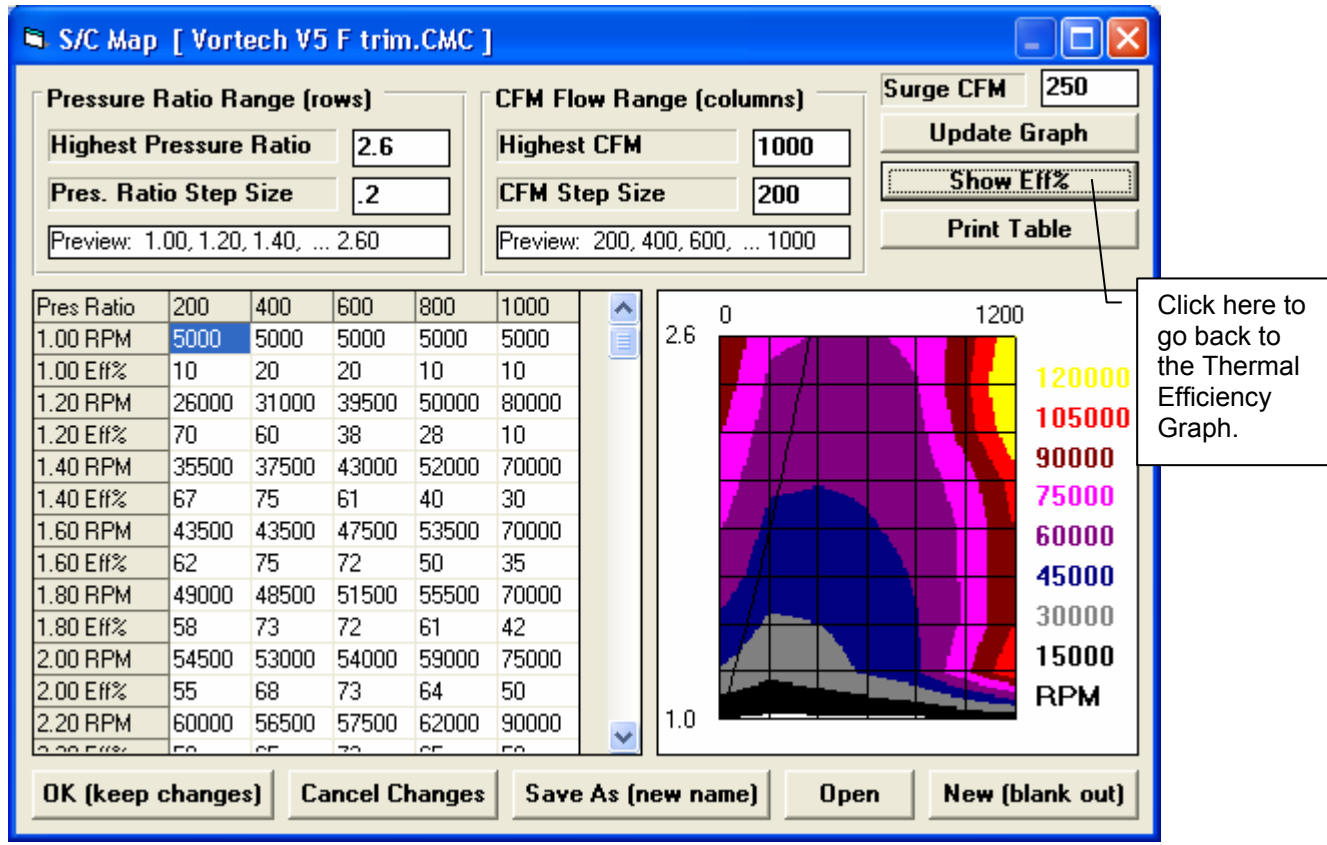


Figure A76 New Supercharger Type, Centrifugal Feeding into a Roots Supercharger

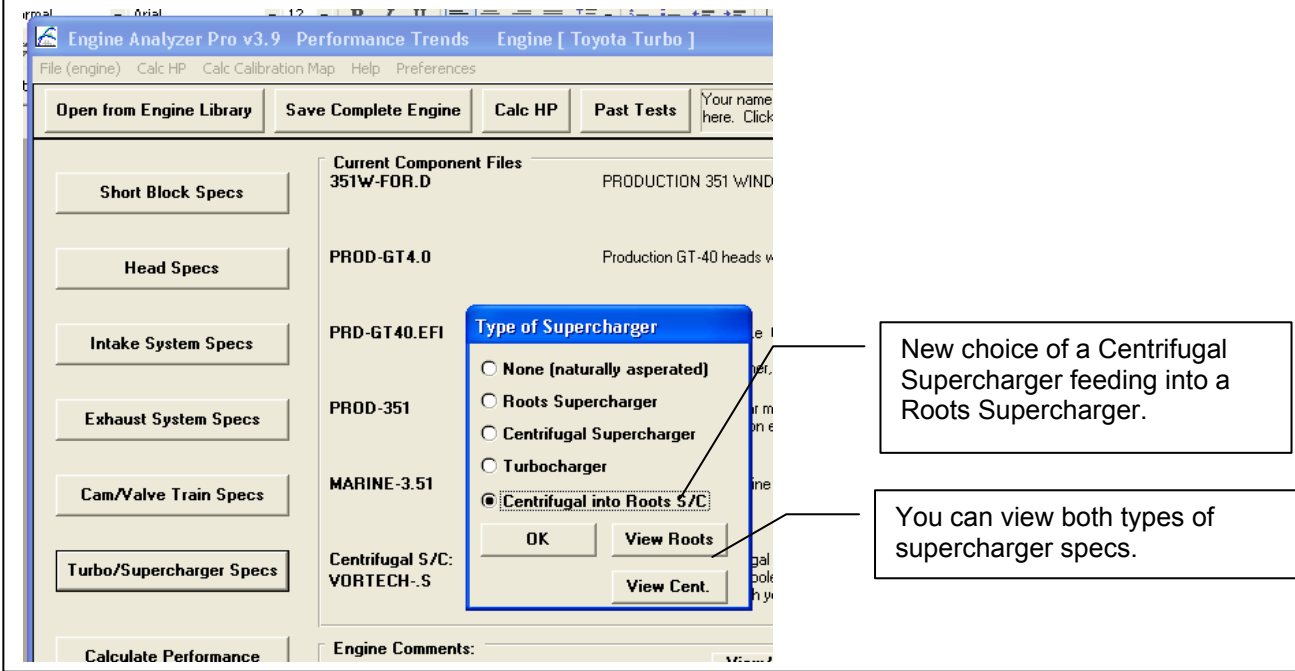
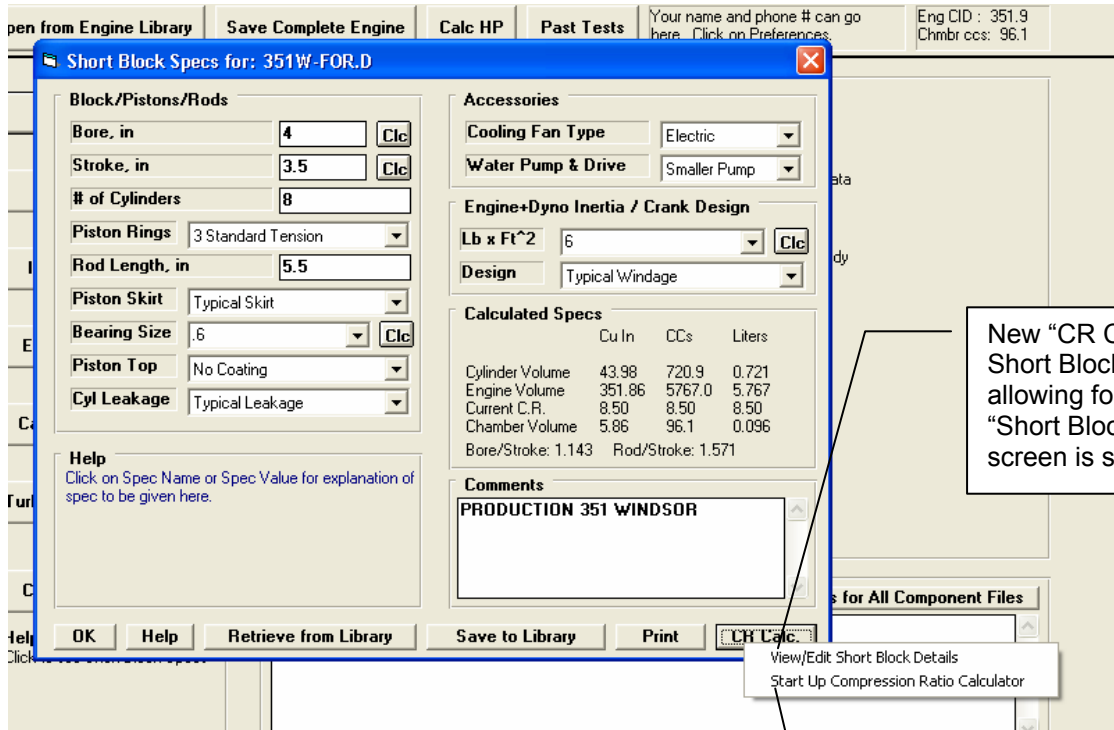




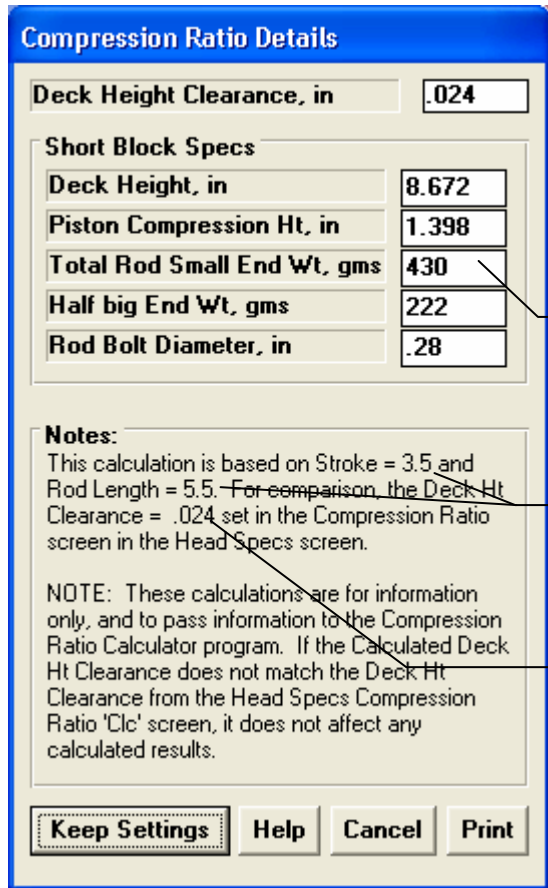
Figure A77 "Talking" to the Compression Ratio Calculator, Short Block Specs



New "CR Calc" button in Short Block Specs, allowing for 2 options. The "Short Block Details" screen is shown below.

View/Edit Short Block Details  
Start Up Compression Ratio Calculator

Starting up the Compression Ratio Calculator is shown if Figures A65 and A66



Total Small End Weight includes the piston, wrist pin and keepers, and rings in addition to just the small end of the rod. This is used in the Compression Ratio Calculator to estimate loads on the rod bolts at a particular RPM.

Current Stroke and Rod Length used for the Deck Height Clearance calculation.

Current Deck Height Clearance which has been set in the Compression Ratio utility menu in the Heads Specs screen. See Figure A64. Ideally you will adjust specs either on this screen or the Compression Ratio utility screen to get these to match each other.

Figure A78 "Talking" to the Compression Ratio Calculator, Cylinder Head Specs

Two options from the Cylinder Head Specs screen. The top option shows the same Compression Ratio utility screen in the standard Engine Analyzer Pro. However, in the Enterprise Edition, now these inputs are saved when you leave this screen so they can be transferred to the Compression Ratio Calculator program.

Click here to start up the Compression Ratio Calculator program shown below.

Compression Ratio utility screen in Engine Analyzer Pro (standard version and Enterprise Edition).

If you own the Compression Ratio Calculator program (basic, Plus or Pro versions) and it is installed in the default location, it will start automatically. A note is given here to explain your options.

Figure A79 Actual Compression Ratio Calculator Program Called from Engine Analyzer Pro Enterprise Edition

**Compression Ratio PRO - Perf. Trends [ ELBData.PTI ]**  
 File Options Comments Boring/Stroking Help Reg To: Kevin Ger

**Base Engine Inputs**

Bore, in	4	Clc
Stroke, in	3.5	Clc
# of Cylinders	8	
Rod Length, in	5.5	Clc
Int Valve Closing, deg		Clc
Deck Height, in	8.672	Clc

**Calculated Results**

Cylinder Size	Cu. In.	CCs	Liters
Engine Size	43.98	720.9	0.721
Chamber Size	351.86	5767.	5.767
Compression Ratio	3.9	63.9	0.064
Eff. Comp. Ratio	12.27		
Dyn. Comp. Ratio	12.27		
Cranking Pres. PSI	na		
Bore/Stroke Ratio	na		
Rod/Stroke Ratio	1.143		
Quench	1.571		
	.056		

**Volume Contributions**

	Cu. In.	CCs	% of Total
Head Chamber	2.807	46.	71.9
Gasket	0.407	6.66	10.4
Deck	0.302	4.94	7.7
Piston Dish	0.305	5.	7.8
Piston O.D.	0.081	1.33	2.1

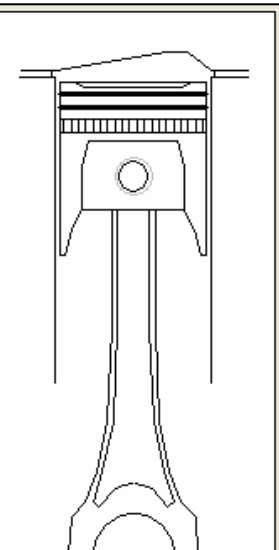
**Help**  
 The amount of volume in the cylinder head's combustion chamber, measured in cubic centimeters.

**Plus Features**

Barometric Pres. "Hg	29.6
Cyl Leakage	Typical (production)
Turbo or Supercharged	No
Boost, psi	
Max Engine RPM	6000
Total Small End Wt, gms	430 Clc
Half Big End Wt, gms	222 Clc

3500 ft/min 4602 Gs 3068 lbs bolt load

**Adjust Specs to get a Desired Comp. Ratio**



You will see most all your numbers from the Engine Analyzer Pro transferred over to the Compression Ratio Calculator. Now you can do any other detailed calculations as shown here.

If things do not "add up" as far as deck height stackup, a message is given as shown here and Deck Height Clearance is adjusted to make it "add up". NOTE: The Engine Analyzer Pro does not force these numbers to "add up" as most do not affect engine performance.

**Deck Height Clearance Adjusted**

Deck Height Clearance will be adjusted to be consistent with the current Stroke, Rod Length, Deck Height and Compression Ht.

If this is not what you want to have done, click on one of the Calc buttons by the spec you want adjusted to fit the other specs (after you click on OK on this message).

(This notice given only once for each program startup.)

OK

When leaving the Compression Ratio Calculator, you are given these 3 options.

**Keep Your Changes?**

This file and all current settings will now be loaded back to the 'Engine Log Book'. Is this what you want to do?

Click on 'Cancel' to stop shutting down this Compression Ratio Calculator program.

Click on 'No' to return to the Engine Log Book program but abandon any changes you've made in this program.

Yes No Cancel

If you choose Yes, you will see the numbers from the Compression Ratio Calculator transferred back to the EA Pro.

Figure A80 Some of the Advanced Features in the Actual Compression Ratio Calculator

These 2 screens (and several others for calculating volumes from geometry) are only available in **Pro version** of Compression Ratio Calculator.

**Calc Piston Dish, ccs**

Calc Piston Dish, ccs: 18.2

Drawing not to exact scale

**Piston Dish Geometry**

Shape: Straight Tapered (conical)

Flat edge around piston top: Yes

Flat Edge Width, mm: 0

Taper Angle, deg: 22.5

Depth, mm: 4

Help: These calculations are based on current Piston Top O.D. of 101.6.

Use Calc Value Help Cancel Print

**Total Valve Relief Volume**

Net (correct) Volume: 6.12

Headroom Volume: 110

Volume (before cham. Only Vol): 6.22

**Valve Relief Info**

Valve Relief Type: 4 Matching Retes

Valve Angle, Deg: 12

Pin End Diameter, mm: 48

Depth Into Piston, mm: 4.5

Valve Separation, mm: 40

Offset from Pin Centerline: 0

Notes: These calculations are based on current Piston Top O.D. of 4.

Use Calc Value Help Cancel Print

**Calc Deck Ht Clearance**

Calc Deck Ht Clearance: .000

ADD for Desired Clearance: .000

Adjust Deck Ht for Desired Clearance

Adjust Comp. Ht for Desired Clearance

**Engine Data**

Deck Height, in: 9.238

Piston Compression Ht, in: 1.33

Rod Length, in: 6.098

Desired Deck Clearance, in: 0

Notes:

- This calculation is based on the current Stroke = 3.62. If this is incorrect, change this spec before using this menu.
- Enter a negative (-) Desired Deck Clearance if you want the piston to go above the deck at TDC.
- Click on one of the 'Adjust' buttons at the top to produce your 'Desired Deck Height Clearance'.

Use Calc Value Help Cancel Print

**Calc Dome CCs**

Calc Dome CCs: 27.2

**Checking Data**

Piston Bore, in: 3.9

Piston Depth in Bore, in: .2

Plate Design: 'Smokey' Cavity Plate

Volume of Plate, CCs: 100

CCs of Fluid, CCs: 112

Notes:

This calculation menu uses results from CCing the top of a piston in the bore. The piston is placed down the bore a measured depth. If the piston is at TDC, this would be the Deck Height Clearance. The edge of the piston is sealed with grease. A flat plate, or plate with a circular 'cavity' of known volume (sometimes credited to 'Smokey' Yunik) is bolted to the bore. Liquid is added to fill the space above the piston and the cavity in the plate (if any).

Use Calc Value Help Cancel Print

Automatically adjusting specs to find a desired Compression Ratio.

Adjust Specs to get a Desired Comp. Ratio

- By Adjusting Chamber CCs
- By Adjusting Gasket Thickness
- By Adjusting Piston Top
- By Adjusting Deck Ht Clearance

10.22	
24.14	
7.87	
204	
1.077	
1.685	
.040	
n. CCs	
67.5	
8.24	10.7
0.	0.
0.	0.
1.1	1.4

Piston Design: Flat Top w Valve Relief

Head Chamber Gasket: 4.118 67.5 87.8

Pick a FelPro Head Gasket

Gasket Thickness, in: .04

Gasket Bore Dia, in: 4

Deck Ht Clearance, in: 0

Piston Ring Depth, in: .22

Piston Top O.D., in: 3.85

Compression Ht, in: 1.33

Plus Features

Barometric Pres., "Hg: 29.92

Cyl Leakage: Typical (production)

Turbo or Supercharged: Yes

Max Engine RPM: 6000

Total Small End Wt, gms: 450

Half Big End Wt, gms: 250

1024 Ford L6 4.180 .039 8.9
1025 Chevrolet L6 4.166 .041 9.1
1026 Buick V6 4.090 .039 8.5
1027 Chevrolet V8 Big Block 4.370 .039 9.7
1028 Ford V8 Big Block 4.670 .041 11.4
1029 Chevrolet V6 3.620 .039 6.7
1031 L Ford V8 Small Block 4.150 .041 9.4
1031 R Ford V8 Small Block 4.150 .041 9.4

Picking gasket specs from pre-loaded list of gaskets.

Figure A81 Calculating a Part Throttle "Calibration" Map

Click here at top of main screen for these options.

**Calibration Map**

Calibration Map

MAP Steps, psi: 2 psi

Highest Map, psi: Full Power, WOT

Lowest Map, psi: 4

Keep Specs Help Cancel Print

Here's the Map Details, which is basically the starting and ending MAP (manifold absolute pressure) points and increments. The RPMs which are run are set the same as for WOT (wide open throttle) performance, in the Calculate Performance screen.

Click on ASCII File to produce the 2 types of files shown in Figure A68. You will be asked for a file name and folder for storing the files. Then the program will write 2 files, a ".csv" or comma separated variable file which imports to Excel, or a ".txt" file which is tab delimited and reads better in

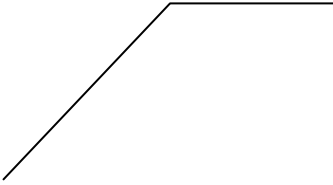
Here's the MAP for each section of results. The first section was a WOT, so map changes as manifold vacuum changes.

Engine RPM	1000	1500	2000	2500	3000	3500	4000	4500	5000	5500
Brk Tq, ft/lbs	284.21	308.29	321.89	332.44	352.29	358.92	341.86	304.79	257.02	210.09
Brake HP	54.11	88.05	122.58	158.24	201.23	239.19	260.37	261.15	244.69	220.01
MAP, psi	14.5	14.5	14.5	14.5	14.4	14.4	14.3	14.3	14.3	14.3
Vol Eff, %	72.8	75.3	78.6	82.3	88.5	92.3	90.9	85.7	76.5	73.7
BSFC, lb/HP-hr	.479	.456	.456	.462	.469	.480	.496	.525	.556	.655
Injctr Dty Cyc, %	17.036	26.412	36.764	48.139	62.146	75.586	85.040	90.238	89.456	94.825
Inj Plse Wdth, ms	20.443	21.129	22.058	23.107	24.859	25.915	25.512	24.063	21.469	20.689
A/F Mxtr Qlty, %	93.9	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Knock Index	2.6	2.3	2.2	1.9	1.9	1.8	1.6	1.3	1.0	.8
Spark Advnc, deg	20.2	22.5	24.1	25.4	26.3	27.2	28.5	29.9	31.9	33.5
Fuel Flow, lb/hr	25.89	40.15	55.88	73.17	94.46	114.89	129.26	137.16	135.97	144.13
Brk Tq, ft/lbs	268.57	292.71	306.29	317.75	337.49	345.95	330.63	296.36	248.51	203.65
Brake HP	51.14	83.60	116.64	151.25	192.78	230.54	251.81	253.93	236.58	213.27
MAP, psi	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
Vol Eff, %	69.7	72.1	75.5	79.3	85.6	89.6	88.5	83.7	74.7	72.1
BSFC, lb/HP-hr	.484	.460	.460	.466	.474	.484	.500	.527	.562	.661
Injctr Dty Cyc, %	16.296	25.318	35.322	46.366	60.087	73.409	82.856	88.069	87.408	92.781
Inj Plse Wdth, ms	19.555	20.254	21.193	22.255	24.035	25.169	24.857	23.485	20.978	20.248
A/F Mxtr Qlty, %	93.9	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Knock Index	2.4	2.2	2.1	1.9	1.8	1.7	1.5	1.3	1.0	.8
Spark Advnc, deg	20.4	22.8	24.4	25.7	26.5	27.4	28.6	30.0	32.2	33.7
Fuel Flow, lb/hr	24.77	38.48	53.69	70.48	91.33	111.58	125.94	133.87	132.86	141.03
Brk Tq, ft/lbs	211.98	232.04	243.80	254.20	271.16	277.60	263.61	233.25	191.09	152.92
Brake HP	40.36	66.27	92.84	121.00	154.89	185.00	200.77	199.86	181.92	160.14
MAP, psi	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
Vol Eff, %	58.1	60.2	63.2	66.5	72.0	75.4	74.2	69.8	62.1	59.8
BSFC, lb/HP-hr	.512	.485	.484	.489	.496	.507	.525	.559	.607	.731
Injctr Dty Cyc, %	13.591	21.144	29.588	38.902	50.529	61.708	69.405	73.518	72.659	76.961


Figure A82 Part Throttle "Calibration" Map Written to ASCII Files (see Fig A81)

EAP

Two (2) files:



Notepad displaying the .txt format file.



Microsoft™ Excel displaying  
the .csv format file.

Figure A83 Language Translation and Other Preferences

New tab of Enterprise Edition Preferences

Choose amount you want these "stiffnesses" to be increased beyond the program's default assumptions. Typically increasing the stiffness improves valve train dynamics.

You can choose a different language here. See below.

Changing the Valve Toss Threshold will change the point at which you see warnings about Valve Toss in the output as shown here.

Engine RPM	5000	6000	7000	8000
Coolant HP	121.00	120.00	55.30	5.52
Blow By, CFM	4.9	4.3	3.0	1.7
In Tun Pres, PSI	6.9	4.9	.7	-1.0
Avg In Vel, ft/sec	292	351	409	468
Avg Ex Vel, ft/sec	358	430	502	573
Mach #	.655	.667	.702	.798
Act In FlowArea, %	98.1	115.5	128.0	128.8
Act Ex FlowArea, %	97.2	101.2	113.8	120.8
Valve Toss	None	In&Ex	In&Ex	In&Ex
Knock Index	4.6	1.8	.1	.0
Spark Advnc, deg	37.3	38.8	39.5	41.4
Injctr Dty Cyc, %	91.888	101.293	109.998	100.835
Inj Plse Wdth, ms	22.053	20.259	18.857	15.125
Calc Error	0	0	1	0

Changing language changes descriptions of inputs, and also brings up Balloon showing description in "Help"

If you change language, not all labels and choices are

Description in Help Frame.

Calculated Specs	Cu In	CCs	Liters
	4.42	728.1	0.728
	55.39	5824.8	5.825
	2.51	12.51	12.51
	1.86	63.3	0.063

Comments  
PRODUCTION 351 WINDSOR

Engine Analyzer Pro v3.9 Tip

Jedes Mal, wenn Sie Hilfe benötigen, an einem Eingang:

- Klicken Sie auf das spec Namen oder
- Klicken Sie auf das Eingabefeld

Und eine kurze Definition wird hier mit einer Seite # im Handbuch für weitere Informationen gegeben.

Don't show this again

Most critical "Tip" messages are also given in the chosen language. As we receive feedback from users, more items in the program will be translated, and the translations are likely to

## Figure A84 Compressor Map – Translating from .jpg File

In the Turbo specs screen, set Use Compressor Map to Yes. Then click on the View button

**Turbocharger Specs for: TWN-ICTU.RBO**

**1st Stage Turbocharger Specs**

Surge CFM: 250  
 Exh Turbine Eff. %: 85% Typical  
 Turbine Nozzle Dia, mm: 24.89

**General Turbocharger Specs**

Throttle Location: Blow Through  
 Max Boost Limit, PSI: 15  
 # Turbos/Stages: 2 Twin Turbos  
 Intercooler Eff. %: 50% Quick Accel/Air-Flow  
 Intercooler CFM Rating: 100000  
 Wastegate Is...: Before Intercooler

**Force to Boost Conditions**

Boost, psi: [ ] Int Temp: [ ] Exh Pres: [ ]  
 Force These Conditions: [ ]

**Full Compressor Map**

Use Compressor Map:  Yes File: @C:\V898\projects\VE\APPROX\CENTMAP.Gai **View**

**Help**  
 Click on Spec Name or Spec Value for explanation of spec to be given here.

Buttons: OK Help Retrieve from Library Save to Library Print

Fill in the Pressure Ratio Ranges and CFM Flow Ranges specs to tell program how many data points you want to enter for your particular map.

Click on Options, then Show Image for Translating screen on next page.

**S/C Map [ Garrett GT2052.CMP ]**

OK/Back (keep changes) Cancel File Options

Pressure Ratio Range (rows): Highest Pressure Ratio: 50, Pres. Ratio Step Size: 25, CFM Step Size: 50, Surge CFM: 250, Update Graph, Print Table

Options: Show Image for Translating (selected), Hide Image for Translating

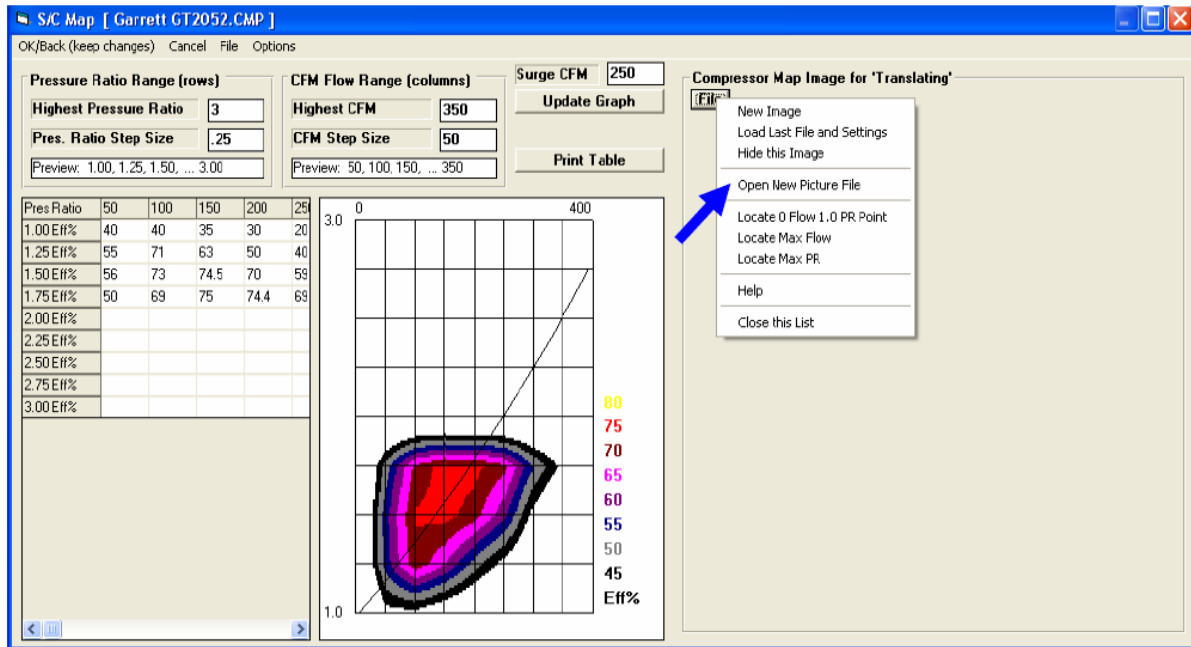
Pres Ratio	50	100	150	200	250
1.00 Eff%	40	40	35	30	20
1.25 Eff%	55	71	63	50	40
1.50 Eff%	56	73	74.5	70	59
1.75 Eff%	50	69	75	74.4	69
2.00 Eff%					
2.25 Eff%					
2.50 Eff%					
2.75 Eff%					
3.00 Eff%					

Graph: Efficiency (Eff%) vs. Pressure Ratio (Pres Ratio). The graph shows a compressor map with efficiency contours ranging from 45% to 88%.



Figure A85 Compressor Map – Translating from .jpg File, cont

A new section of screen opens to the right. Click on the File button for a list of options. Click on the Open New Picture File and browse to a graphic image file of the turbo map you want to Translate to the Engine Analyzer program. These are typically .jpg files which you can get from the internet.



Once the image is loaded, you need to define the max limits of the turbo map image. Click on "Locate 0 Flow and 1.0 PR Point" option and then click on that point in the lower left corner of the map. Lines will be drawn for the lower and left boundaries of the map image.

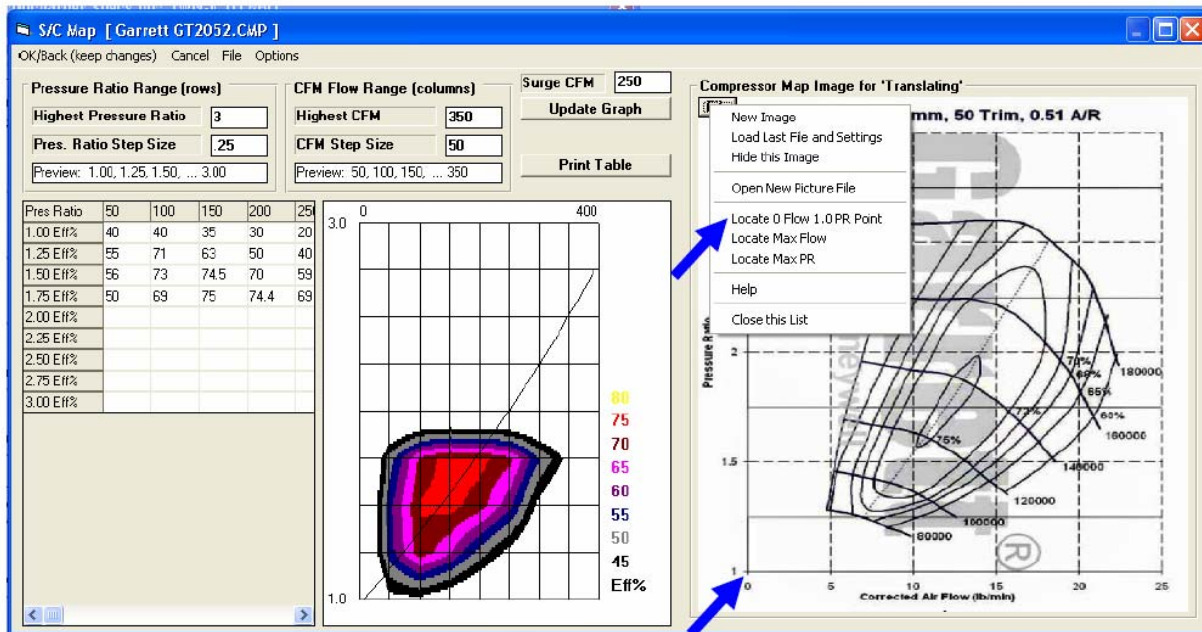
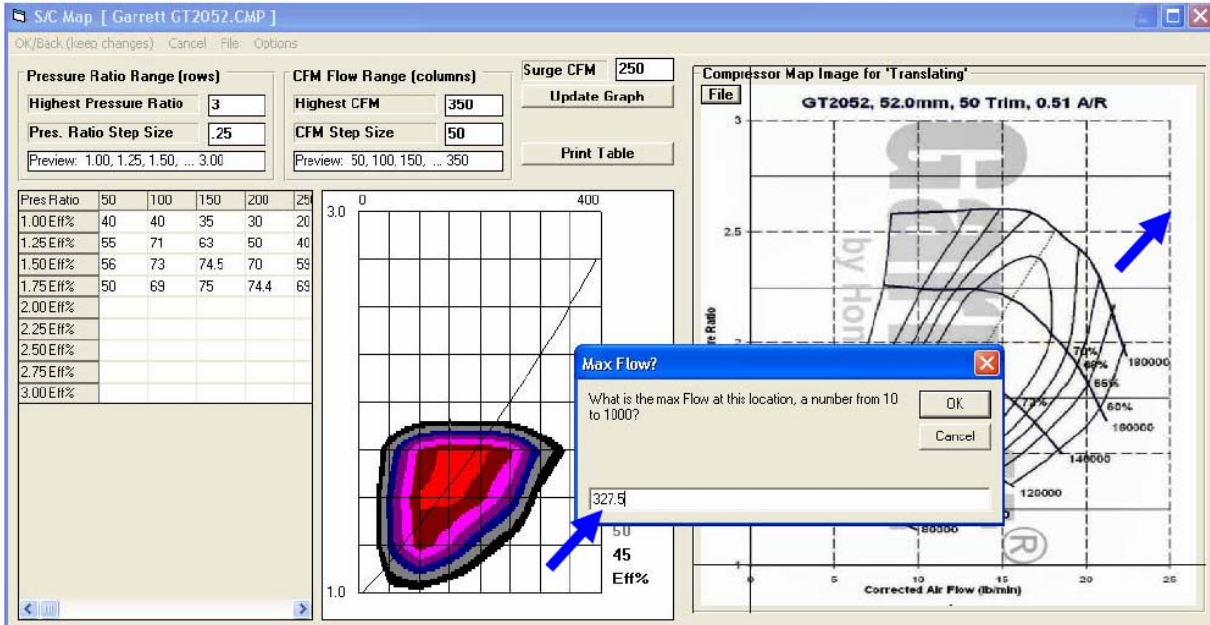


Figure A86 Compressor Map – Translating from .jpg File, cont

After left and bottom limit lines are drawn, click on “Locate Max Flow” option and then click on the right limit of the image. In this case, the right limit of flow is 25 lb/min. Click any place on the vertical 25 lb/min line. The program asks you what is the flow at this line. To convert lb/min to CFM, multiply by 13.1, which is 327.5.



Do the same to identify the Max PR line. Click on the “Locate Max PR” option in the list, then click on the 3 PR line and enter the value of 3. The image below shows the image with boundary lines show on all 4 sides.

Now when you click in the grid to enter an efficiency value, a pink cross hair is drawn on the image so you can precisely read the efficiency value off the image.

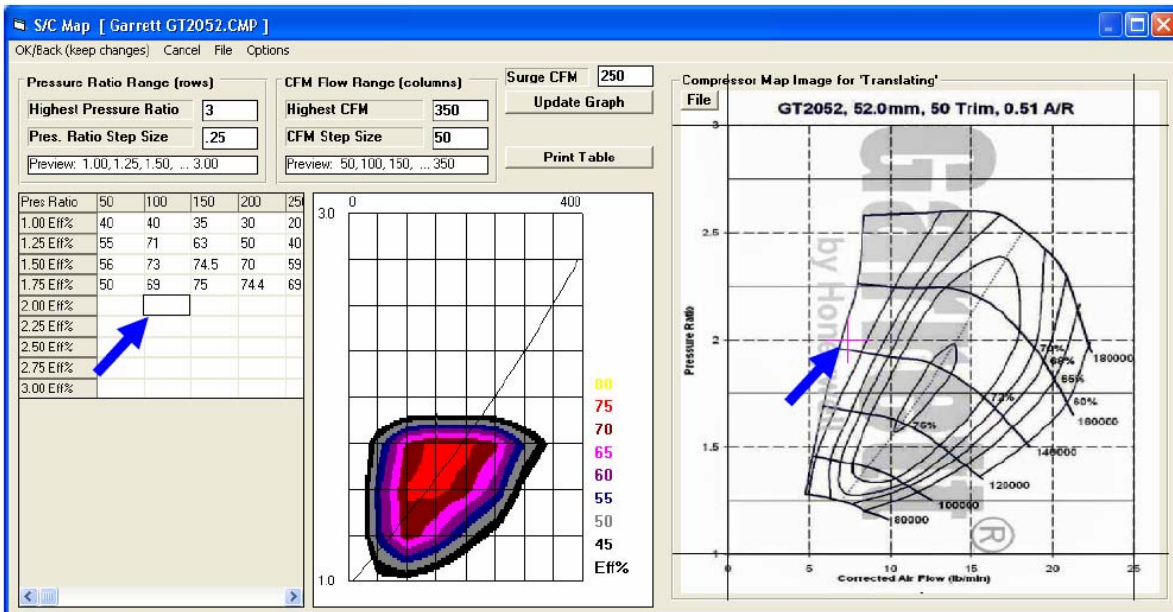
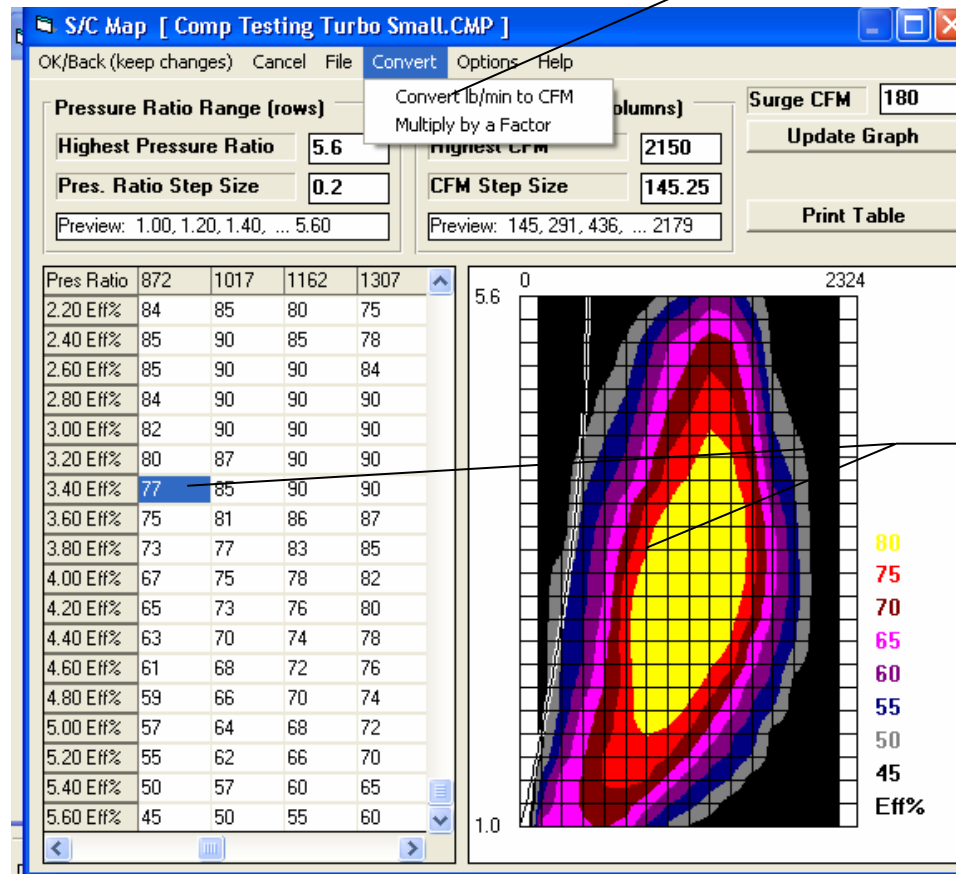


Figure A87 Compressor Map – New Features



New "Convert" options to factor the CFM you've entered up or down, or convert from lb/min to CFM

You can click on a point on the map and have the cell containing that data highlighted. This lets you quickly track down points on the map which may have errors.

Figure A88 Valve Spring Harmonics (Dynamics)

Cam Profile

Centerline, deg	Intake Profile: 115 ATDC	Exhaust Profile: 111 BTDC
Duration @ 1.25 mm		244
Open @ 1.25 mm		53 BBDC
Close @ 1.25 mm		11 ATDC
Max Lobe Lift, mm		10.0 Clc
Actual Valve Lash, mm	.02	.7
		.71

Overall Cam Specs

Total Cam Advance: 2.0 Retard

Lobe Separation, cam deg: 113.0

Lift for Rating Events: .050 inches

Calculate Valve Train Dynamics

Yes  No See Specs for Dynamics

Variable Valve Timing (VVT)

Yes  No See Specs for VVT

Comments

Production 351 2V Marine cam

Valve Lift

You must turn On Valve Train Dynamics, then click "See Specs for Dynamics" button for screen shown below.

Click graph line to display data here --> Crank Deg = Valve Lift =

Valve Train Dynamics Specs for: MARINE-3.51

Intake Valve Train Specs

Valve Train Type: Direct Acting OHC

Eff Valve Mass, gms: 193.34 Clc

Eff Rckr Arm Stffnss, lb/in: 25000 Clc

Eff Lifter Mass, gms: 230 Clc

Eff Lifter Stiffness, lb/in: Program will est.

Spring Rate, lb/in: 200 Clc

Seated Spring Force, lbs: 100 Clc

Compression to Bind, mm: 2.01 Clc

The Intake valve will start to unseat with 49 psi of Boost

Spring Harmonics See Specs

Exhaust Valve Train Specs

Valve Train Type: Direct Acting OHC

Eff Valve Mass, gms: 153.34 Clc

Eff Rckr Arm Stffnss, lb/in: 25000 Clc

Eff Lifter Mass, gms: 230 Clc

Eff Lifter Stiffness, lb/in: Program will est.

Spring Rate, lb/in: 200 Clc

Seated Spring Force, lbs: 100 Clc

Compression to Bind, mm: 2.01 Clc

The Exhaust valve will start to unseat with 70 psi of Back Pressure

Valve Spring Dynamics OFF

Comments

Help

Click on arrow to pick type of Valve Train from list. p 47

OK Help Print Detailed Spring Table Simple Spring Table

Check this box and the simple valve spring specs on this screen will be disabled, and the "See Specs" button will be enabled so you can enter detailed Valve Spring Specs shown in Fig A89.

Enter "Eff Valve Mass, gms"

What is the weight in grams for the Intake valve spring used for the 'Eff Valve Mass, gms' entry of 193.34 ?

(A portion of this 193.34 gm weight is made up by the Valve Spring, and this portion should now be subtracted out because the 'Spring Details' will contain this weight. Enter a weight from 1 to 1000 gms.)

180

OK Cancel

When you first turn On Spring Harmonics, the program reminds you that the "Eff Valve Mass" includes the proper portion of the valve spring mass if you are NOT doing Spring Harmonics. If you ARE doing Spring Harmonics, the "Eff Valve Mass" should be recalculated to NOT include the valve spring mass because the Spring Details tell the program the valve spring mass.

Figure A89 Valve Spring Dynamics, cont

Inputs, help, changing input values are done much the same on all other input screens.

Click on an input name and it's definition is given on "Help" frame at bottom of screen.

Click on choice here to select 1, 2 or 3 springs in the total spring pack.

Cam/Valve Train Specs for: MARINE-3.51

Valve Spring Specs for: kevin spring details

### Valve Spring Details

	Intake			Exhaust		
	1st	2nd	3rd	1st	2nd	3rd
Present	Yes	Yes ▾	Yes ▾	Yes	Yes ▾	Yes ▾
Number of Active Coils	3.25	4.75	6.	3.25	4.75	6.
Wire Diameter, in	.236	.162	.118	.236	.162	.118
Coil Outside Dia, in	1.677	1.21	.875	1.677	1.21	.875
Spring Rate, lb/in	460.1	181.7	107.4	460.1	181.7	107.4
Free Standing Ht, in	2.748	2.755	2.585	2.748	2.755	2.585
Seated Ht, in	2.23	2.230	2.230	2.23	2.230	2.230
Total Spring Rate, lb/in	749.2			749.2		
Calc. Spring Rate, lb/in	460.1	181.7	107.4	460.1	181.7	107.4
Calc. Total Spring Rate, lb/in	749.2			749.2		
Calc. Seated Force, lb	238.3	95.4	38.1	238.3	95.4	38.1
Calc. Total Seated Force, lb	371.9			371.9		
Calc. Spring Wt, gms	103.4	48.0	22.4			
Calc. Total Spring Wt, gms	173.8					
Calc. Coil Clearance, in		-.005	.011		-.005	.011
Calc. Bind Ht, in	1.239	1.094	.944	1.239	1.094	.944

Buttons: Copy >, < Copy, <Swap>

Buttons: OK, Help, Retrieve from Library, Save to Library, Print

Help: Click on Spec Name or Spec Value for explanation of spec to be given here.

Comments: PSI spring packs

Click here for the 4 options shown.

Click here to save all inputs shown on this screen.

Click here for more info on inputs and features on this screen.

Click here to save your changes and return to the Valve Train Dynamics screen.

- Open Example from Performance Trends
- Open from My Saved Files
- Open Intake Spring(s) from Spring Wiz
- Open Exhaust Spring(s) from Spring Wiz

Choose one of the Spring Wiz options to import data from your Spring Wiz program.

Figure A90 Valve Spring Dynamics, cont

To show Valve Spring Dynamics, you must first set the graph screen to doing "Cycle" graphs by clicking on the "RPM-cyc" choice here. If this choice is shown as "rpm-CYC", the graph is already doing Cycle graphs.

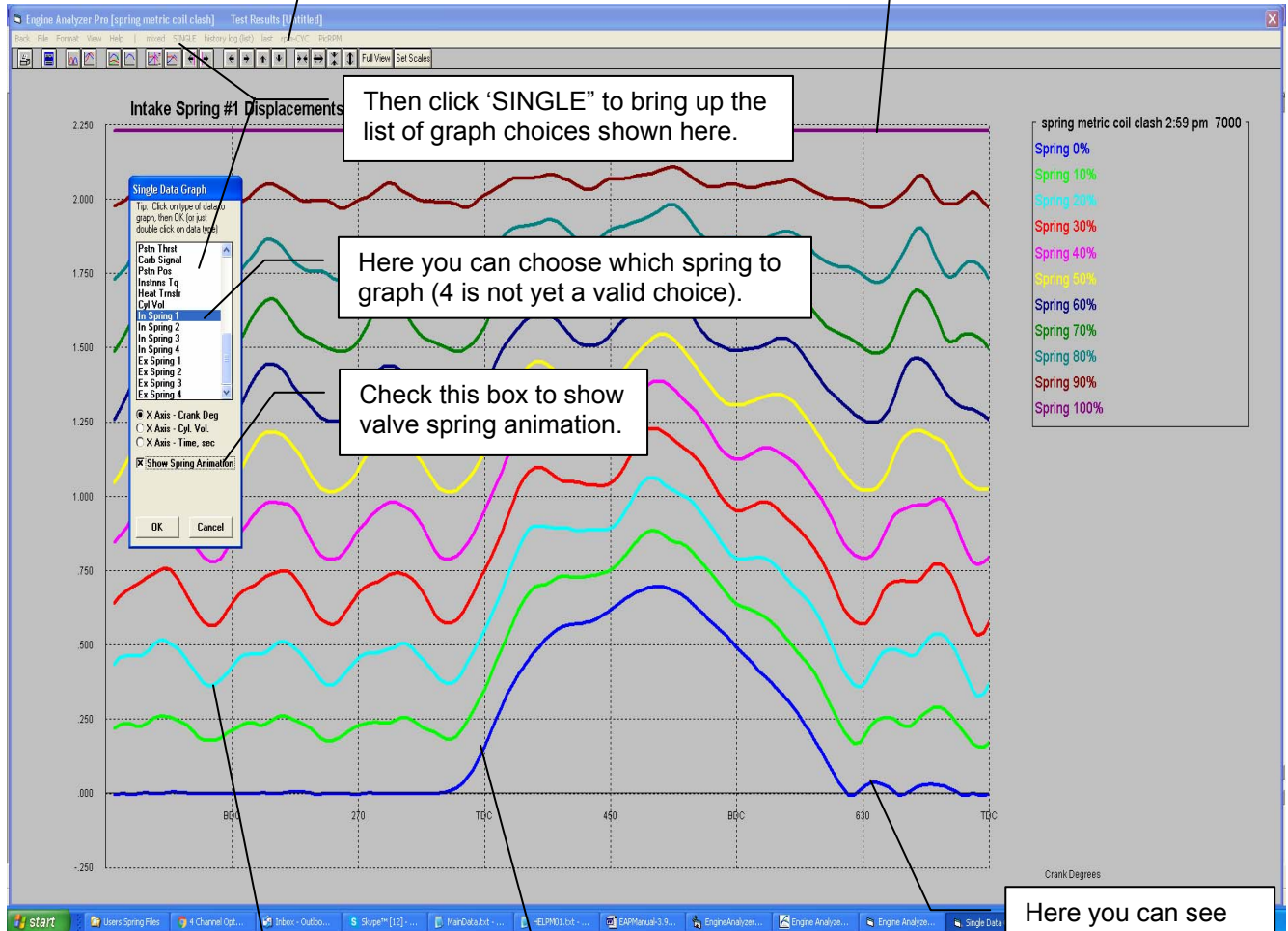
The "100%" spring position is on the head and does not move. In this graph, it is about 2.25" from the retainer.

Then click 'SINGLE' to bring up the list of graph choices shown here.

Here you can choose which spring to graph (4 is not yet a valid choice).

Check this box to show valve spring animation.

- spring metric coil clash 2:59 pm 7000
- Spring 0%
- Spring 10%
- Spring 20%
- Spring 30%
- Spring 40%
- Spring 60%
- Spring 60%
- Spring 70%
- Spring 80%
- Spring 90%
- Spring 100%

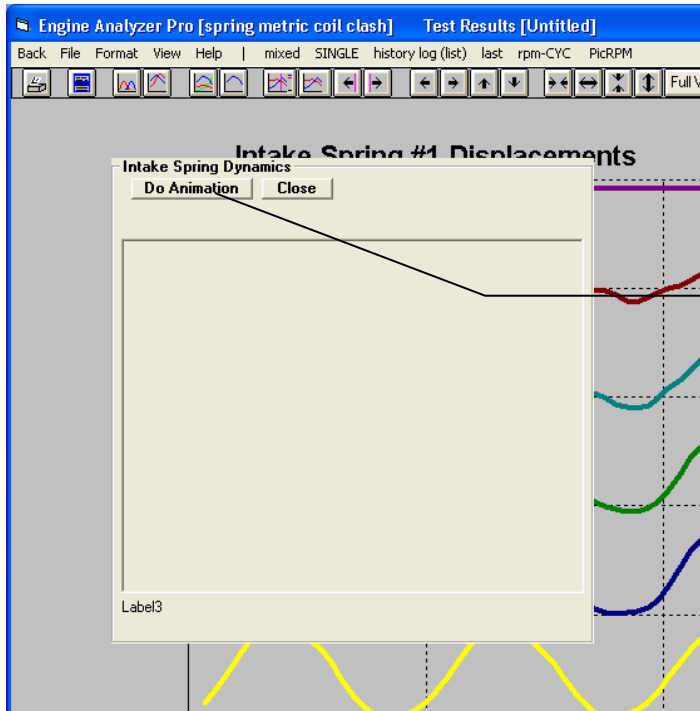


Here you can see the valve is actually bouncing slightly when it reseats.

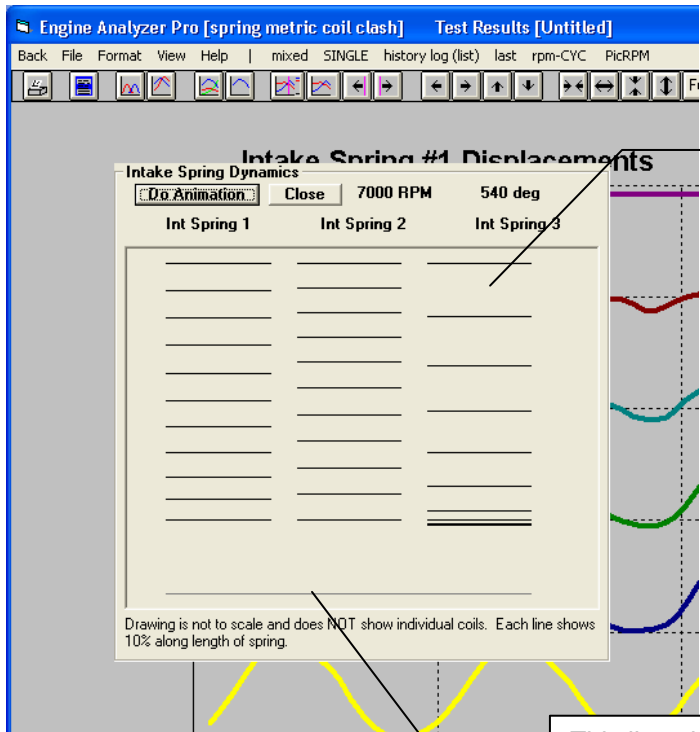
This is the spot (0 %) on spring which is touching the valve retainer, which is also indicating what the valve itself is doing. The program assumes the retainer and valve follow the same motion.

These lines do not represent individual coils, but portions of the spring coil along its total length. For example, for a spring with 5 coils, this "20%" line would be at a position 1 full coil from the retainer.

Figure A91 Valve Spring Dynamics, cont



If you have chosen to Do Animation, this "Spring Dynamics" frame will appear on top of the graph. Click the Do Animation button to start animation as shown below.



It is difficult to see dynamics in this still picture, but this 3<sup>rd</sup> spring shows a big separation of the coils here at the position closest to the head.

It also shows the coils likely touching here at the position closest to the retainer, at the bottom of this animation screen.

The #1 and #2 spring are maintaining the coils spacing relatively well, showing spring "surge" is unlikely in those springs.

This line shows valve seat position. When lowest spring line is on this line, the valve is seated. Shown here, the valve (and the coil on the retainer) are lifted off the seat.

Figure A92 Valve Spring Dynamics, cont

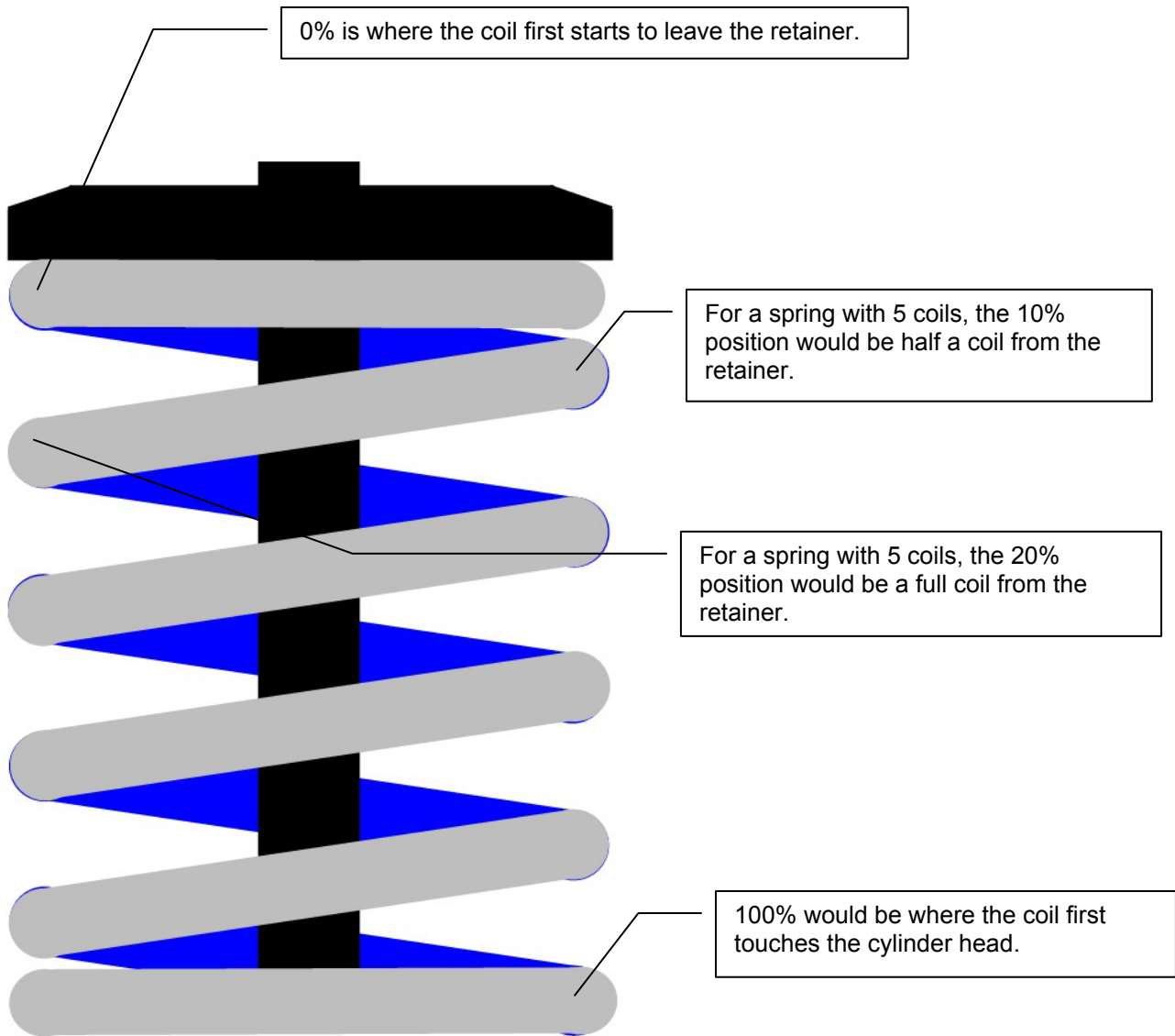
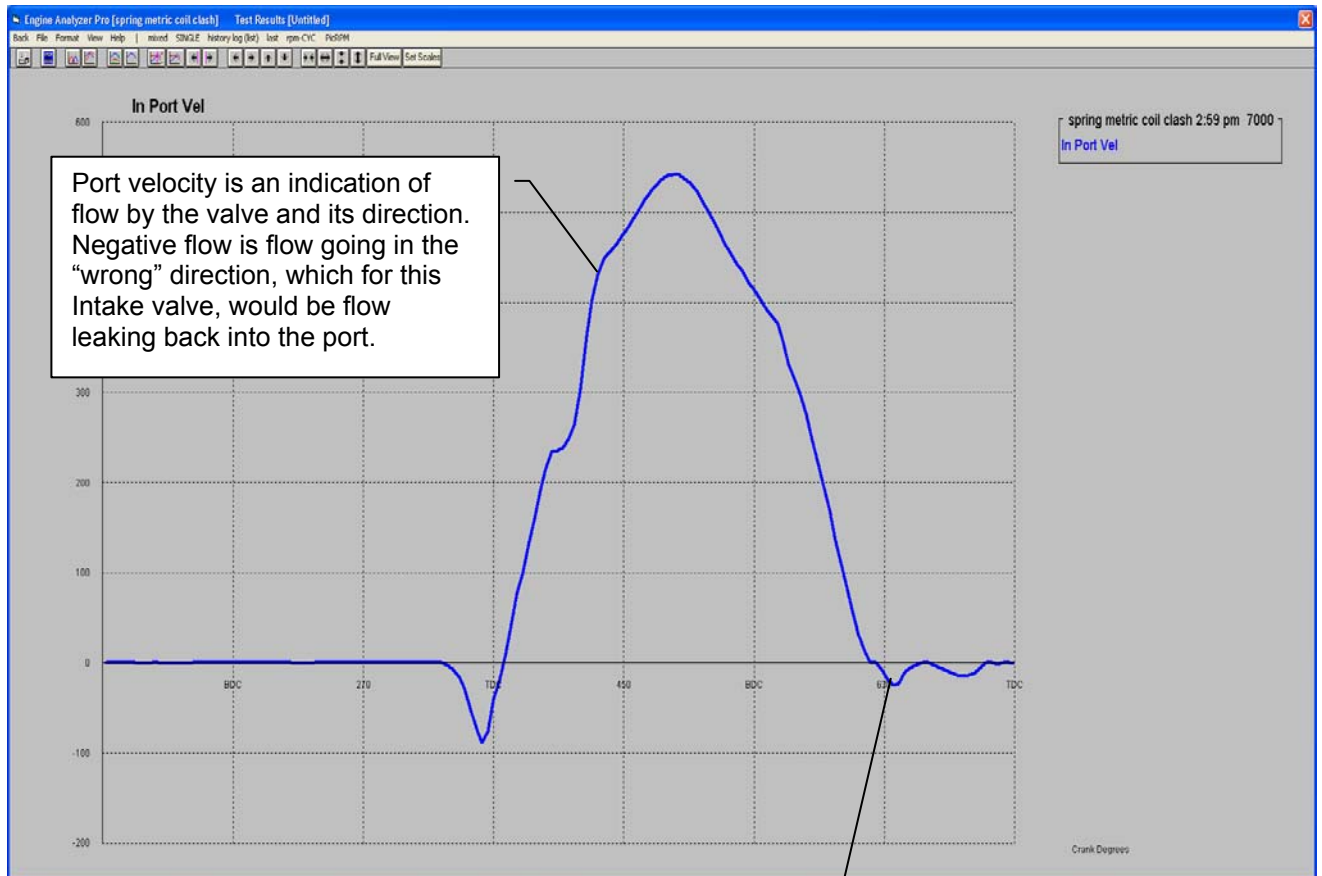




Figure A93 Checking Effect of Valve Bounce on Performance



These negative flows shown here are from the valve bouncing on the seat, and flow leaking back into the intake port from the cylinder. This "leaking" would result in a loss of performance.

With the standard version Engine Analyzer Pro, the program assumes all flow stops (the valve seats and stays seated) at the valve seat closing event, even if valve train dynamics show the valve could be bouncing.

Only the Enterprise Edition lets the valve flow continue past the seat closing event.

