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

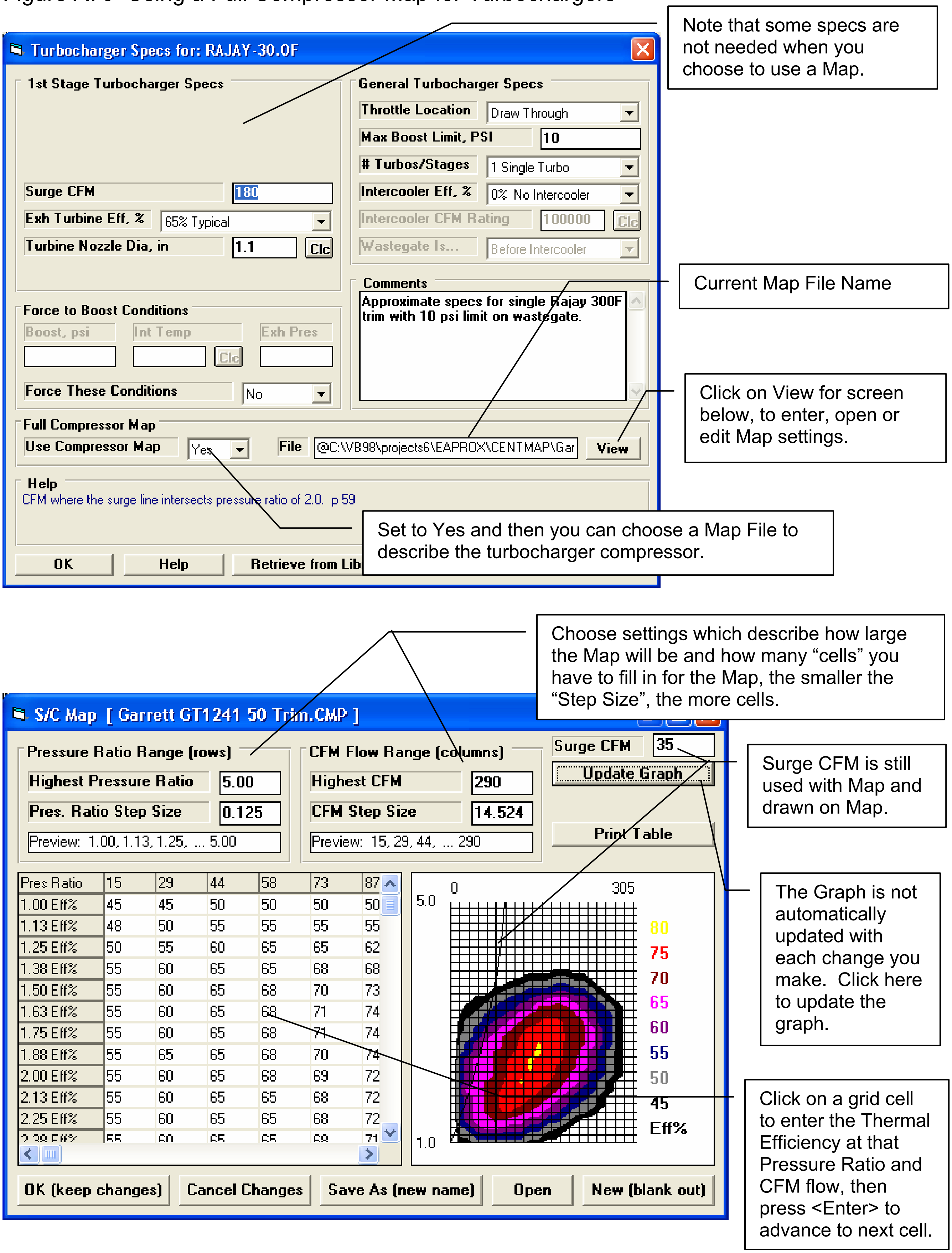


Figure A71 More Compressor Map Features

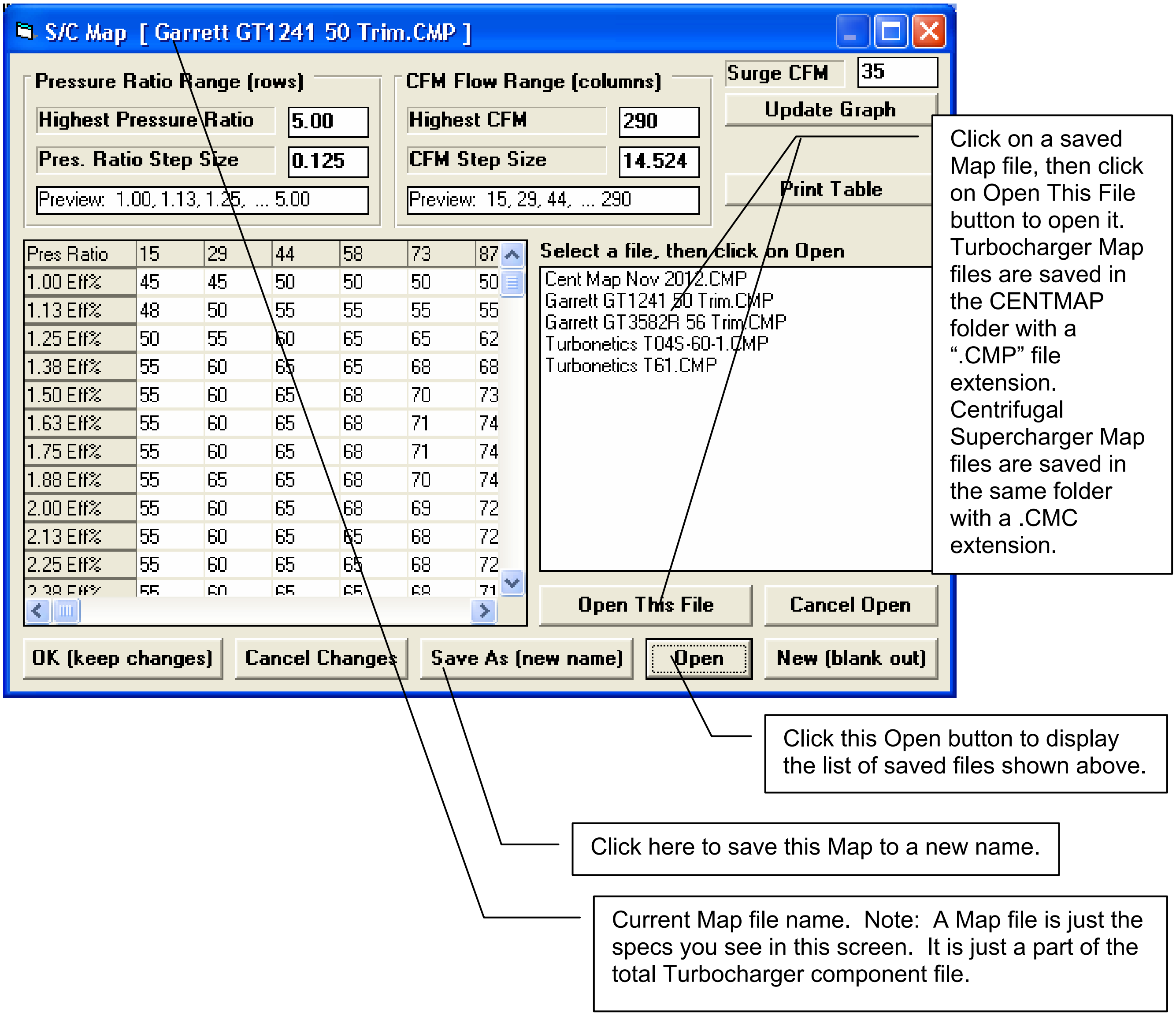
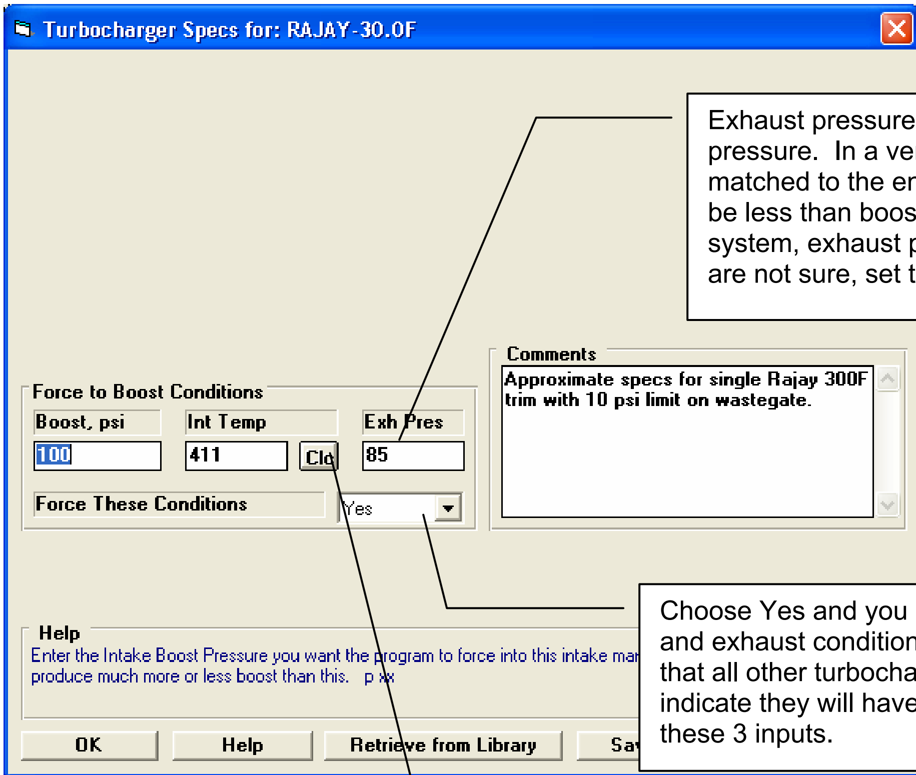


Figure A72 User Specified Turbo Boost and Backpressure



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.

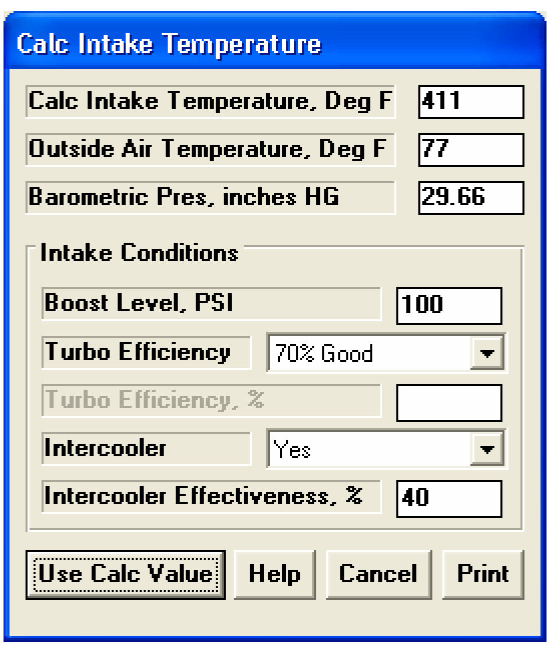


Figure A73 Watching the Compressor Map during Calculations

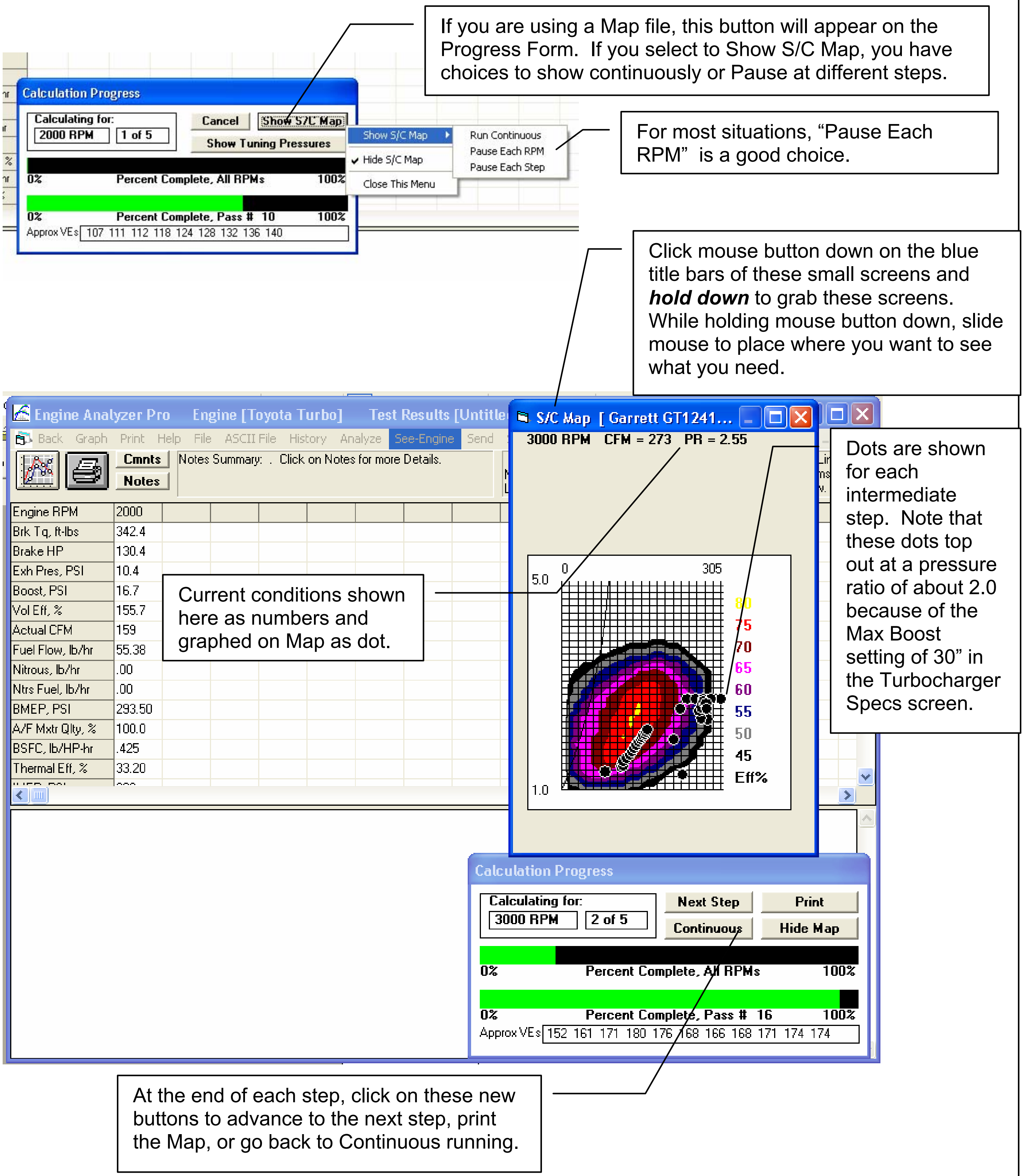


Figure A74 Centrifugal Supercharger using Full Compressor Map

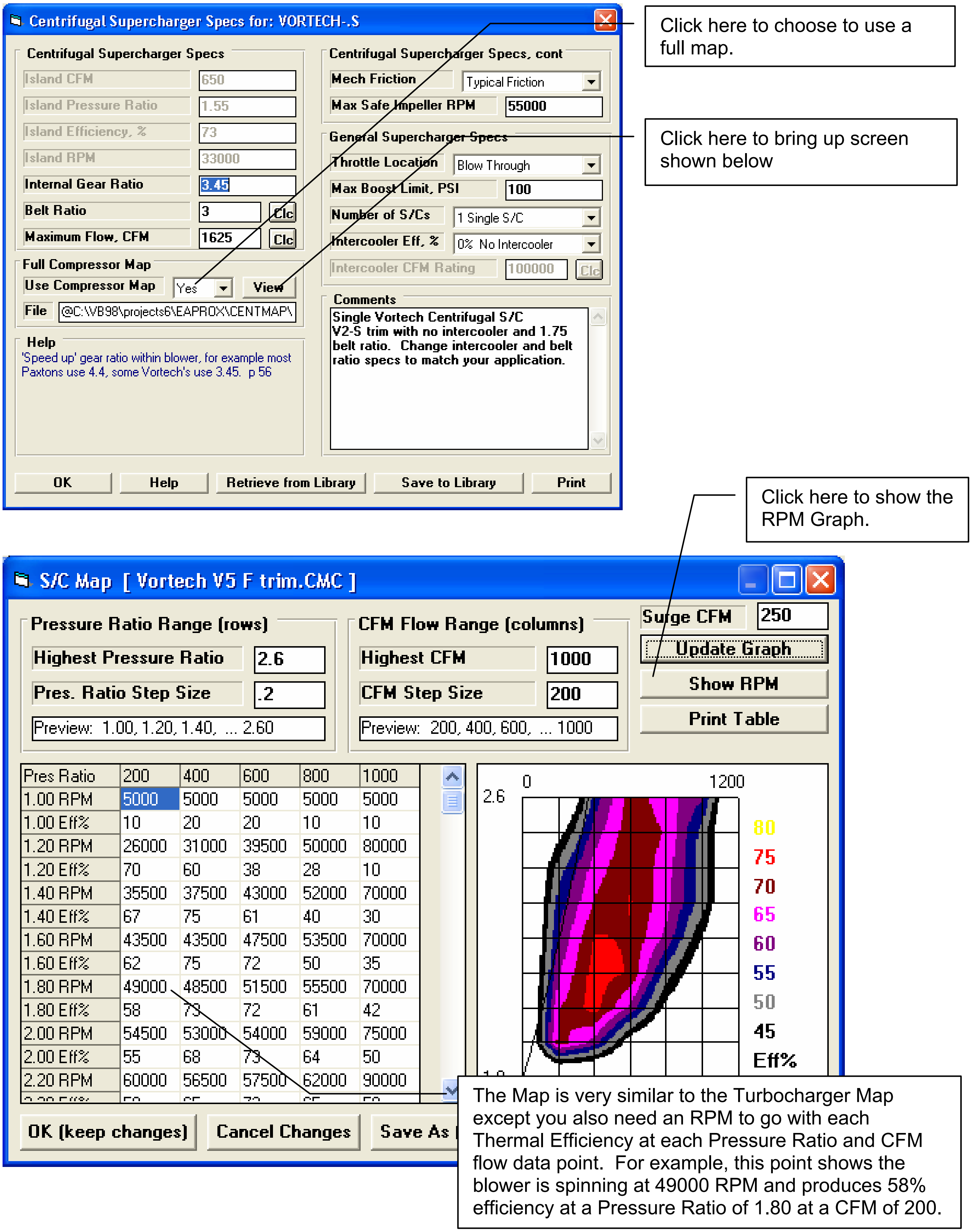


Figure A75 Centrifugal Supercharger using Full Compressor Map, RPM Graph

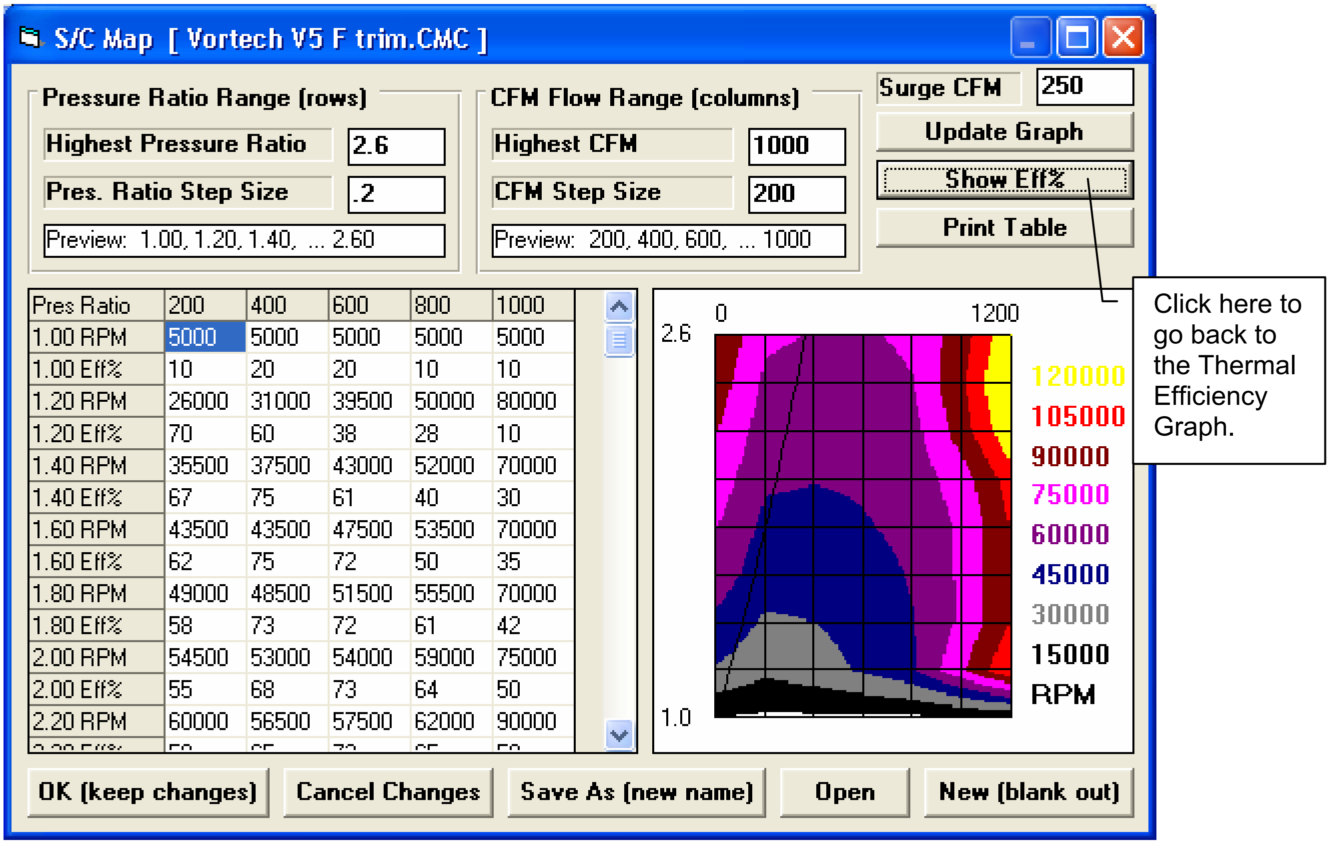


Figure A76 New Supercharger Type, Centrifugal Feeding into a Roots Supercharger

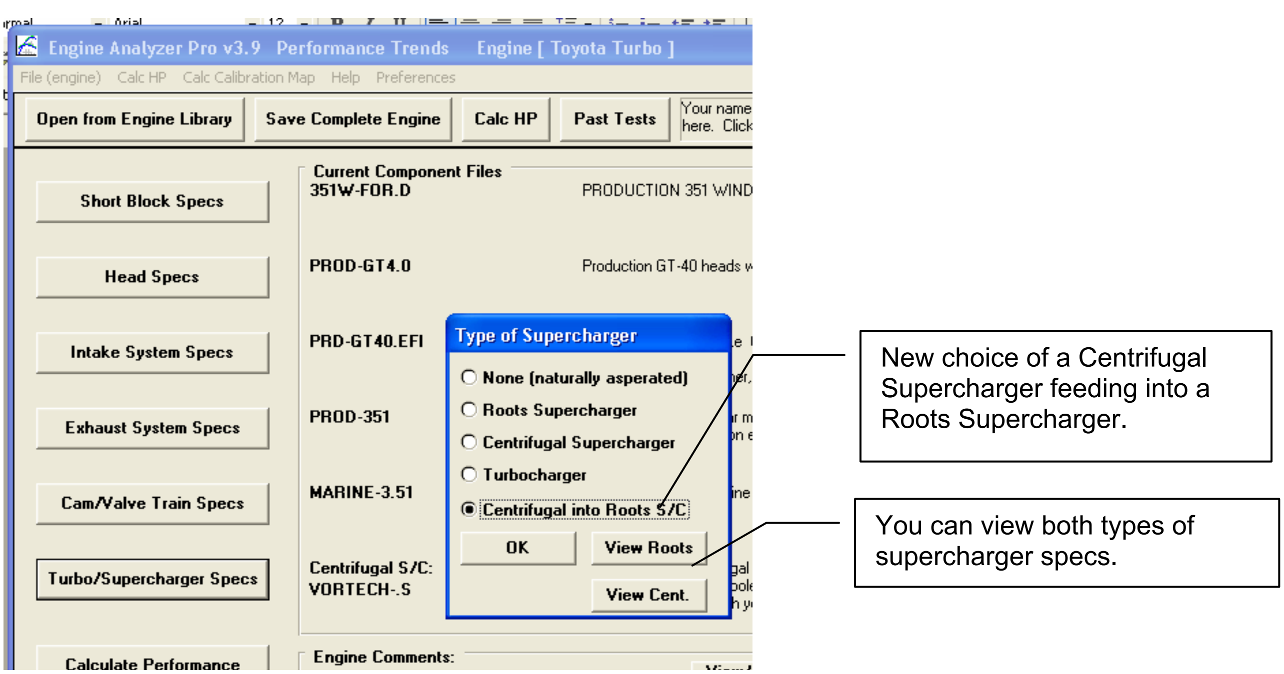
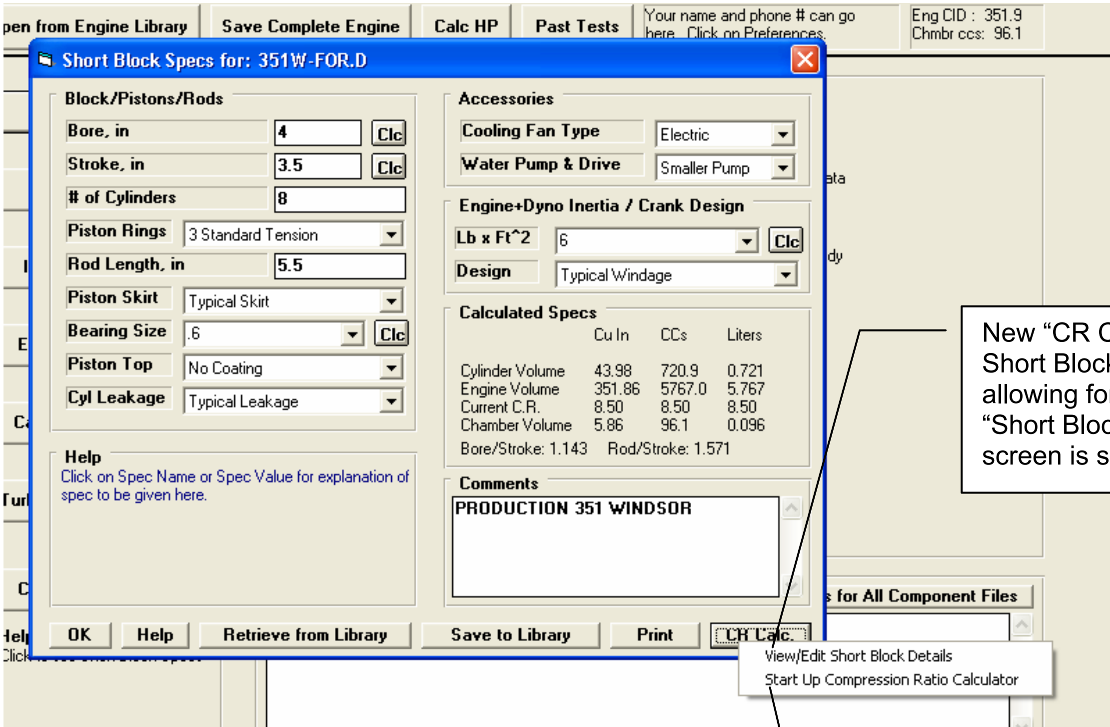
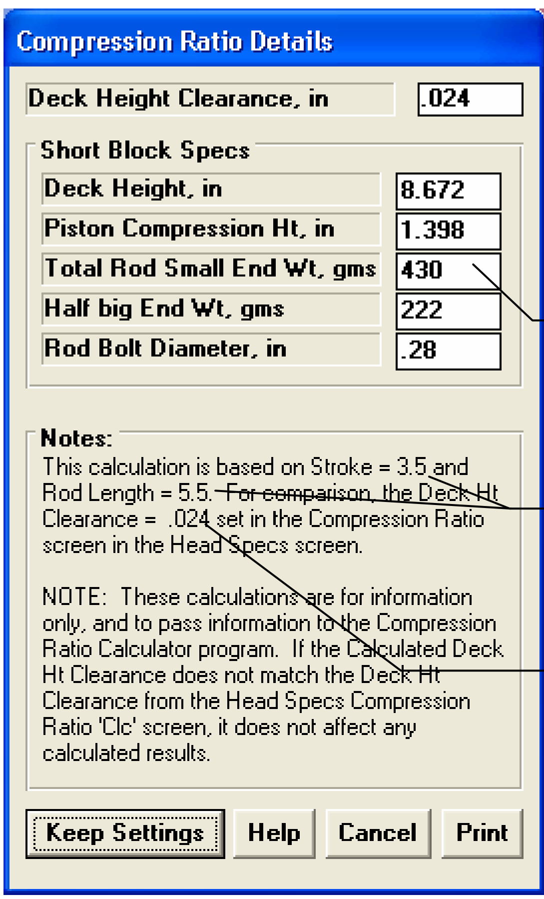


Figure A77 “Talking” to the Compression Ratio Calculator, Short Block Specs



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

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

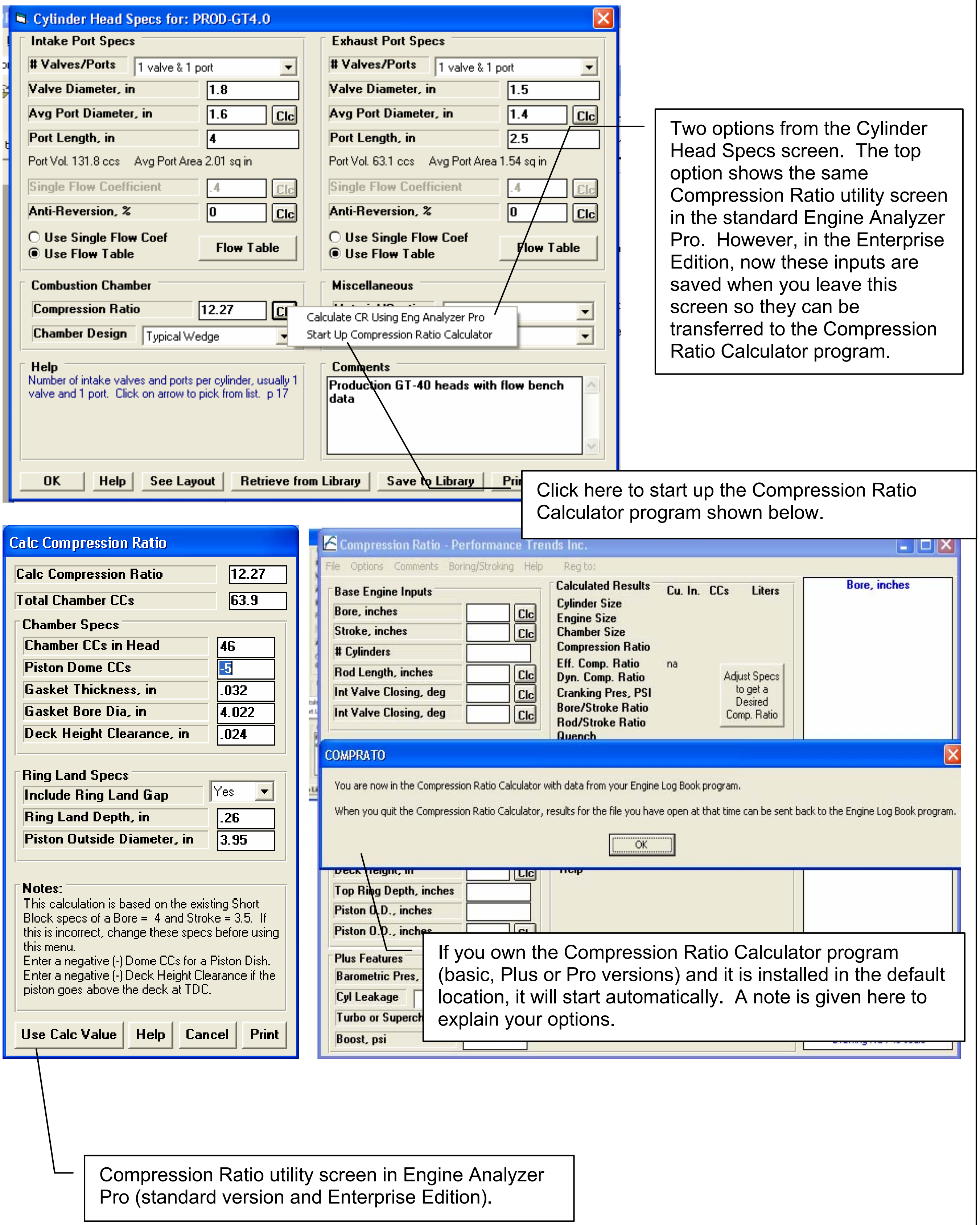


Figure A79 Actual Compression Ratio Calculator Program Called from Engine Analyzer Pro Enterprise Edition

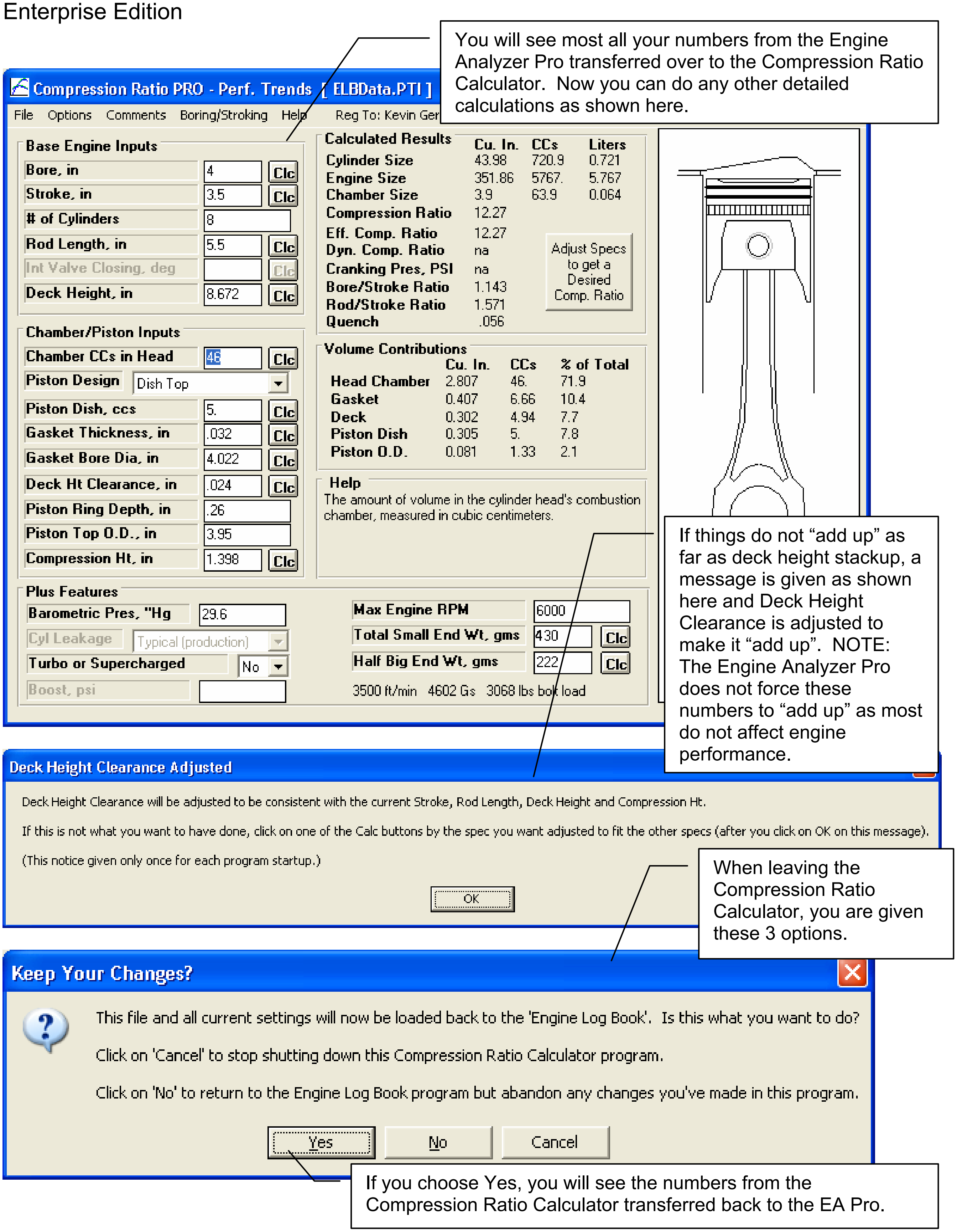


Figure A80 Some of the Advanced Features in the Actual Compression Ratio Calculator

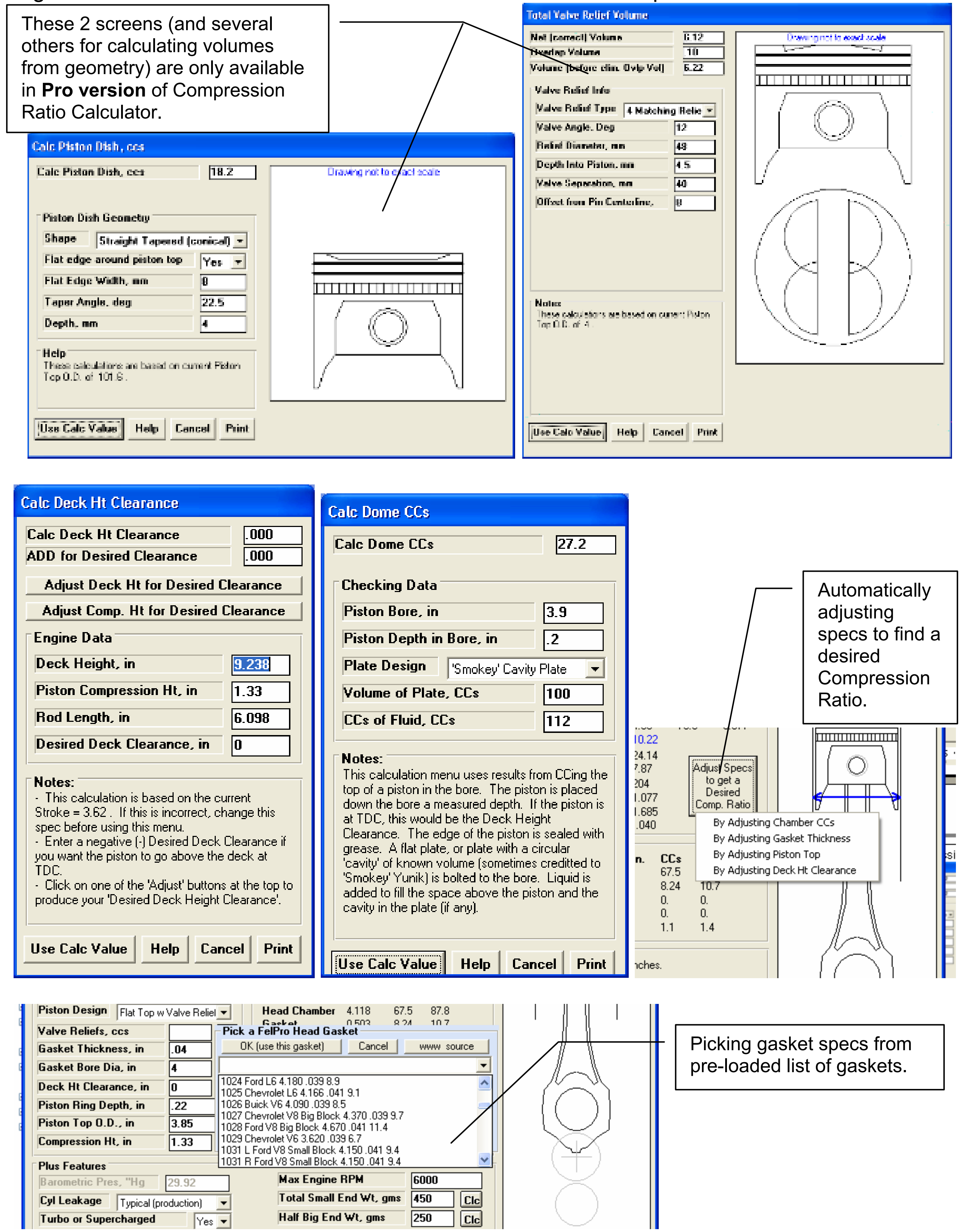
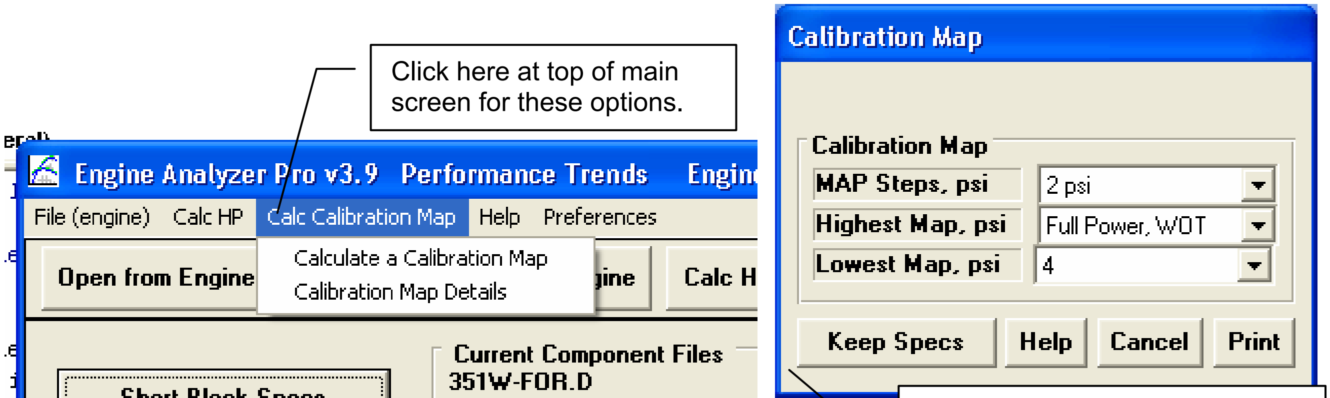
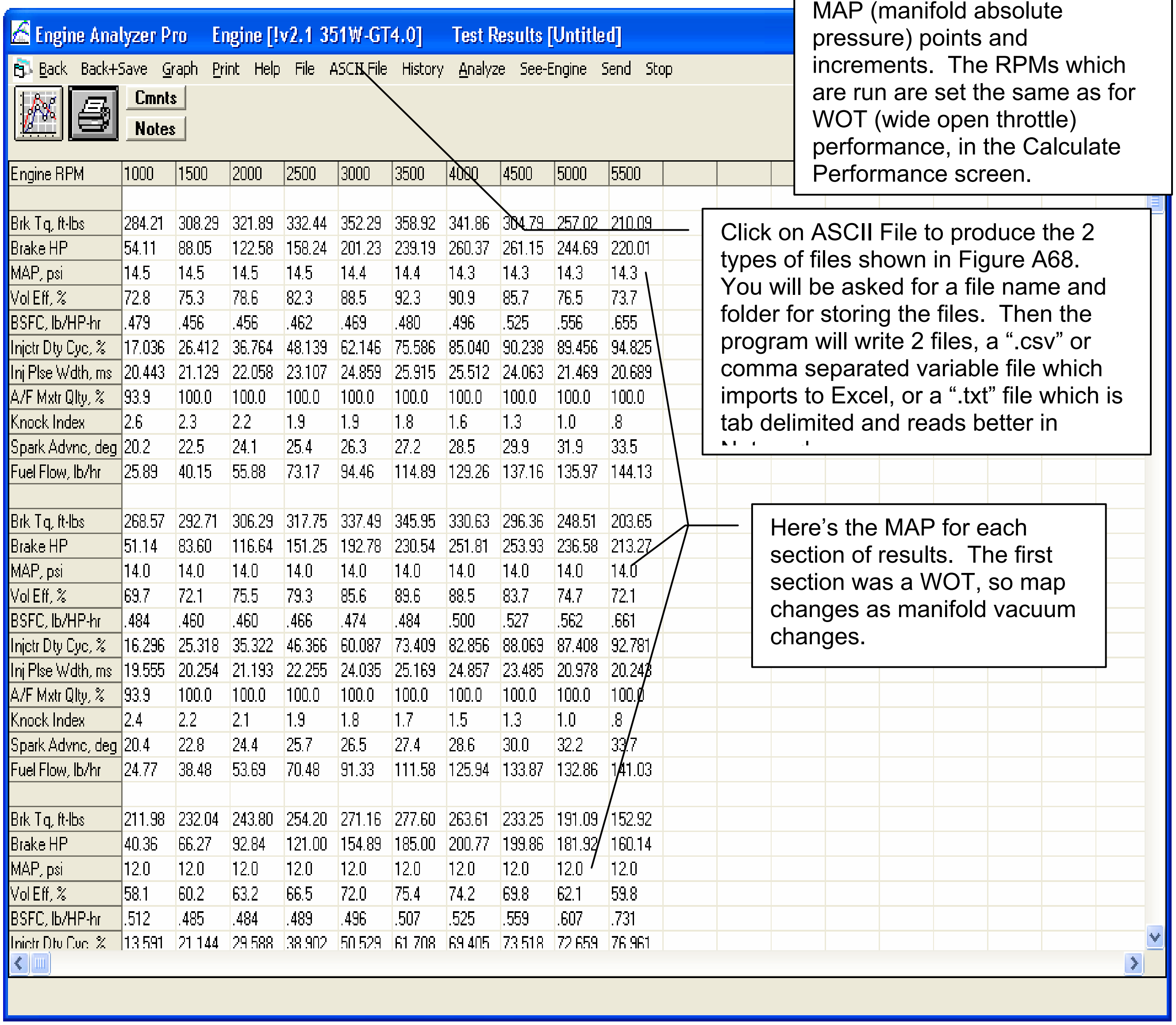


Figure A81 Calculating a Part Throttle "Calibration" Map





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)

Notepad displaying the .txt format file.

Microsoft ™ Excel displaying the .csv format file.

Figure A83 Language Translation and Other Preferences

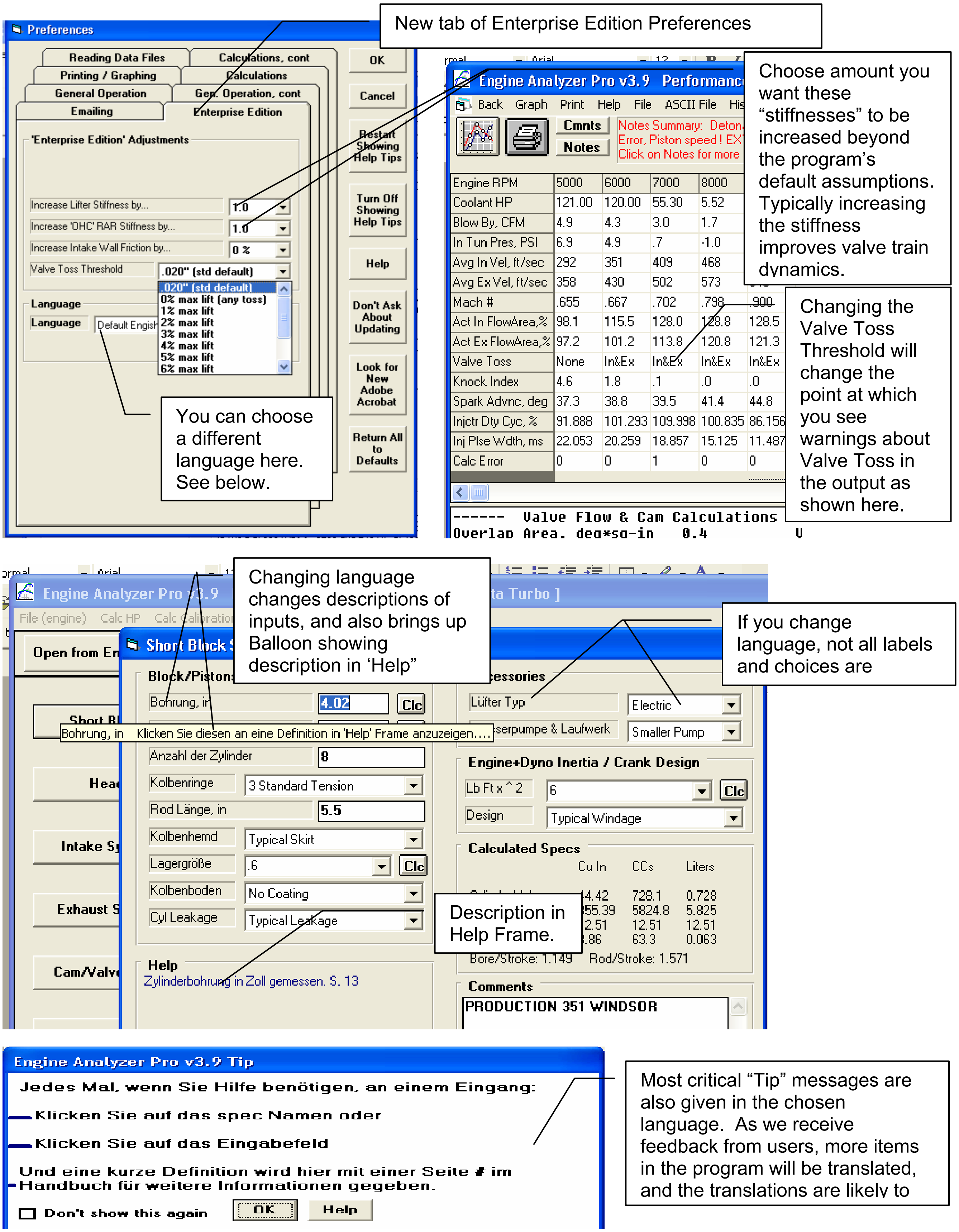
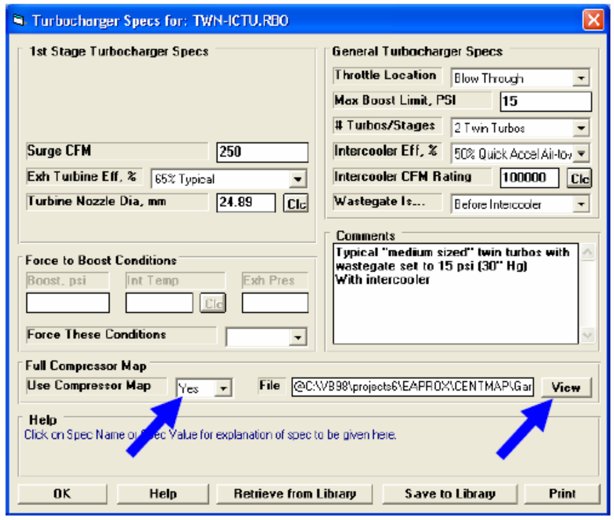


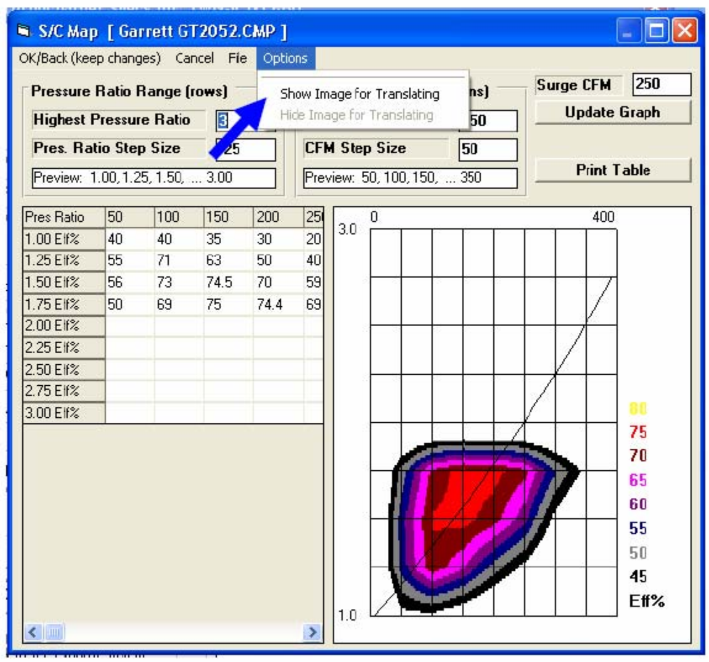
Figure A84 Compressor Map – Translating from .jpg File

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



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.

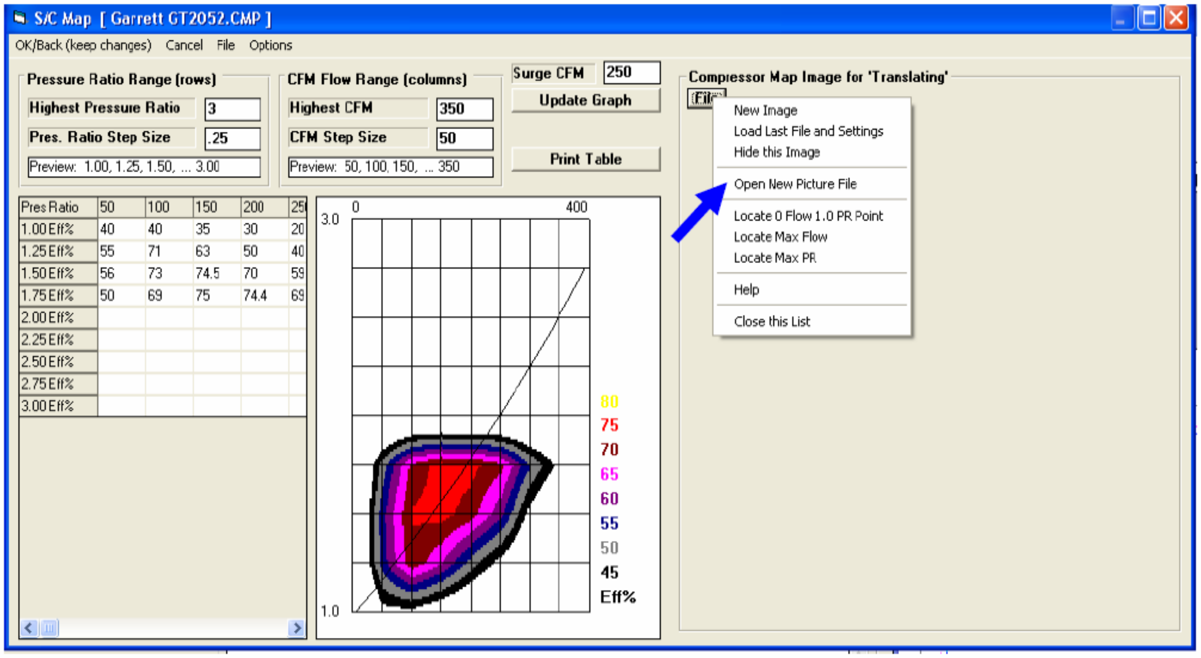
Click on Options, then Show Image for Translating for screen on next page.



Pres Ratio	50	100	150	200	25
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%					

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.

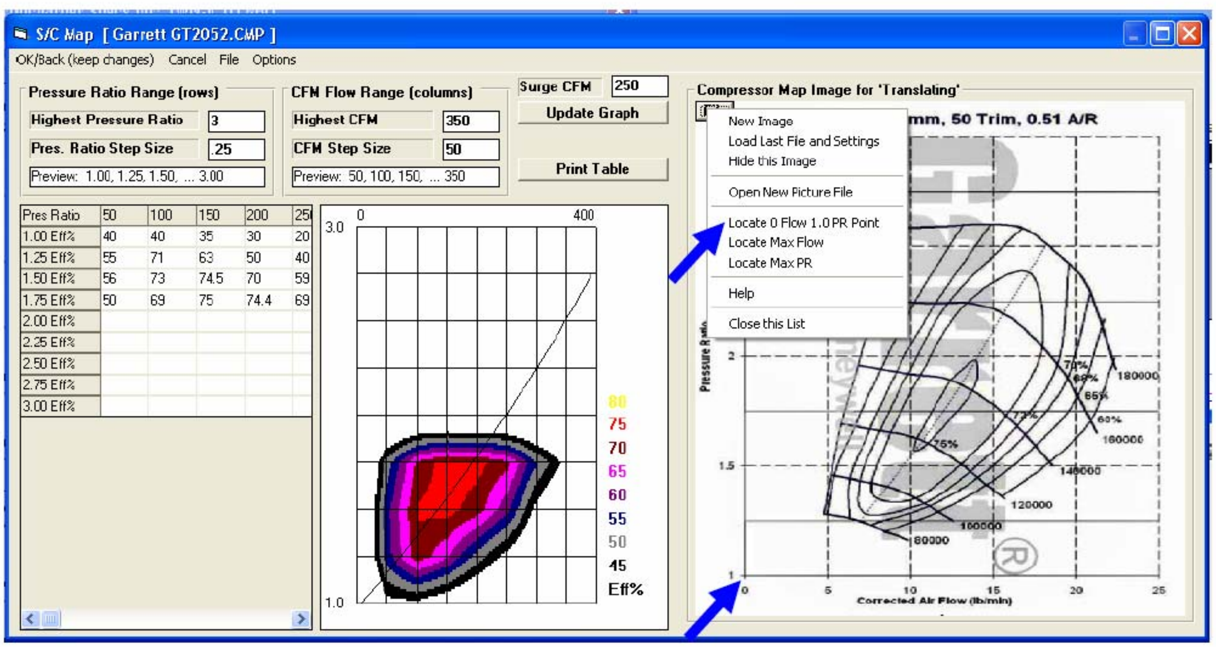
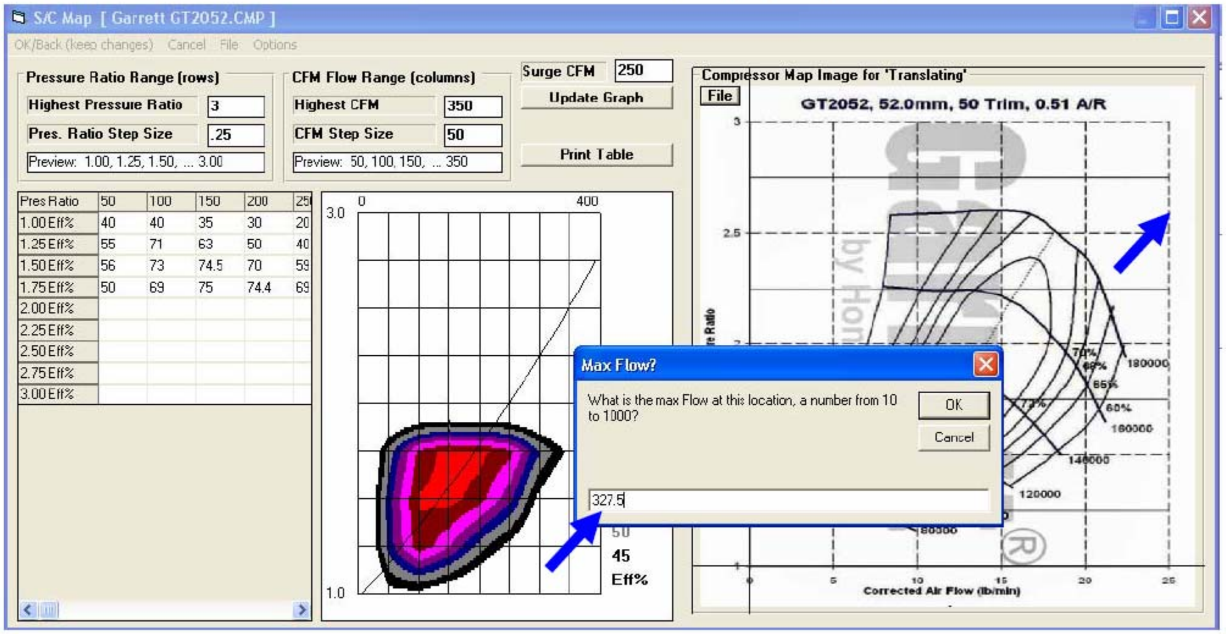


Figure A86 Compressor Map – Translating from .jpg File, cont

After left and bottom limit lines are drawn, click on “Locate Max Flow” option and then click n 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 t 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.

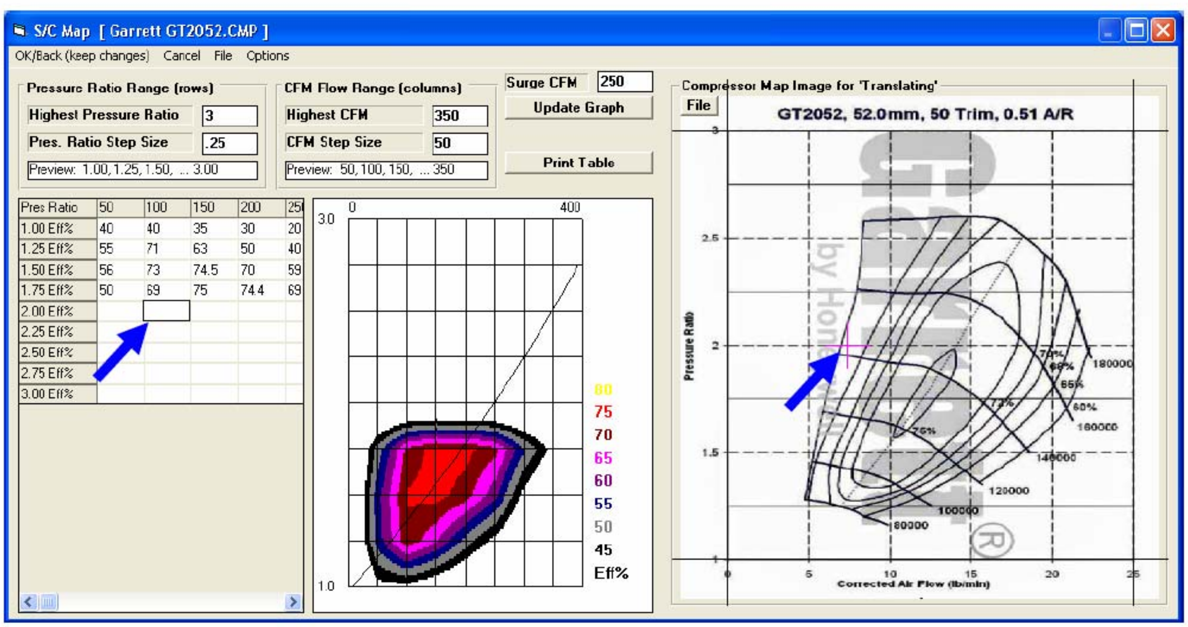
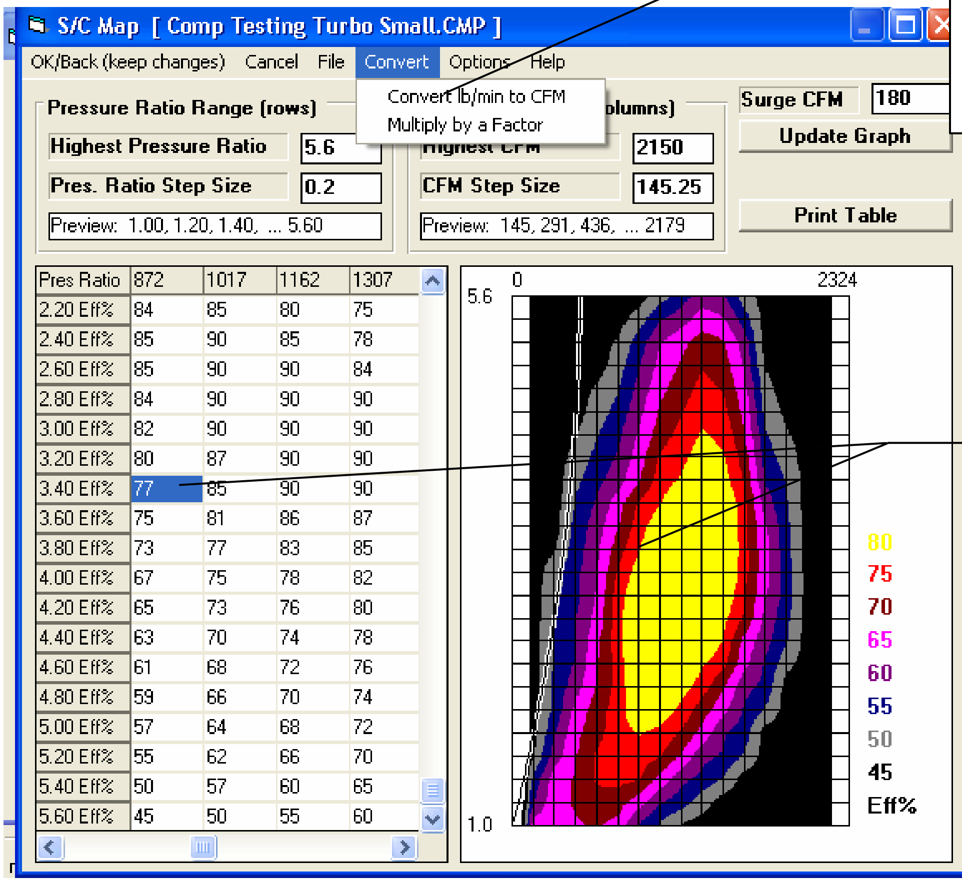


Figure A87 Compressor Map – New Features



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)

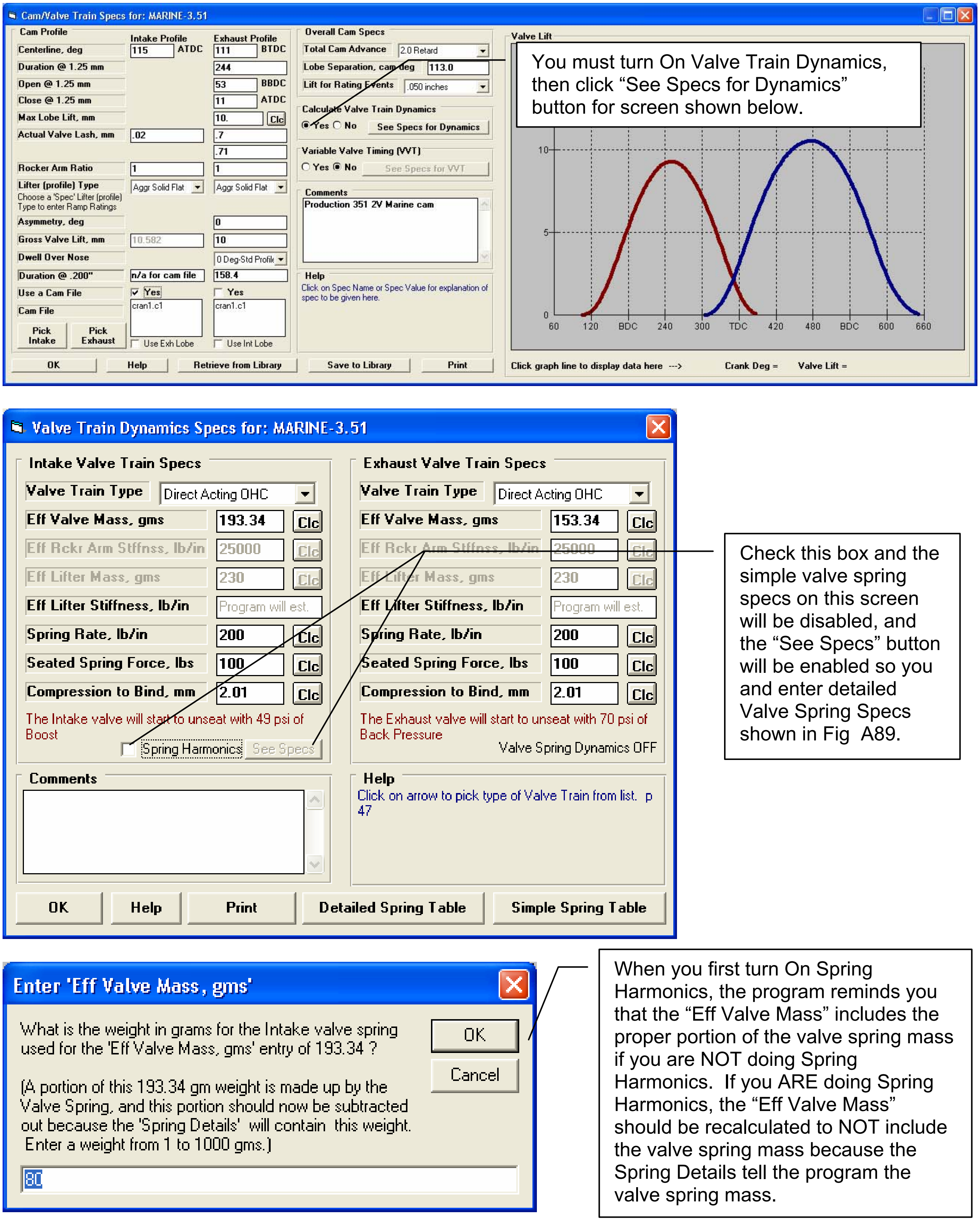


Figure A89 Valve Spring Dynamics, cont

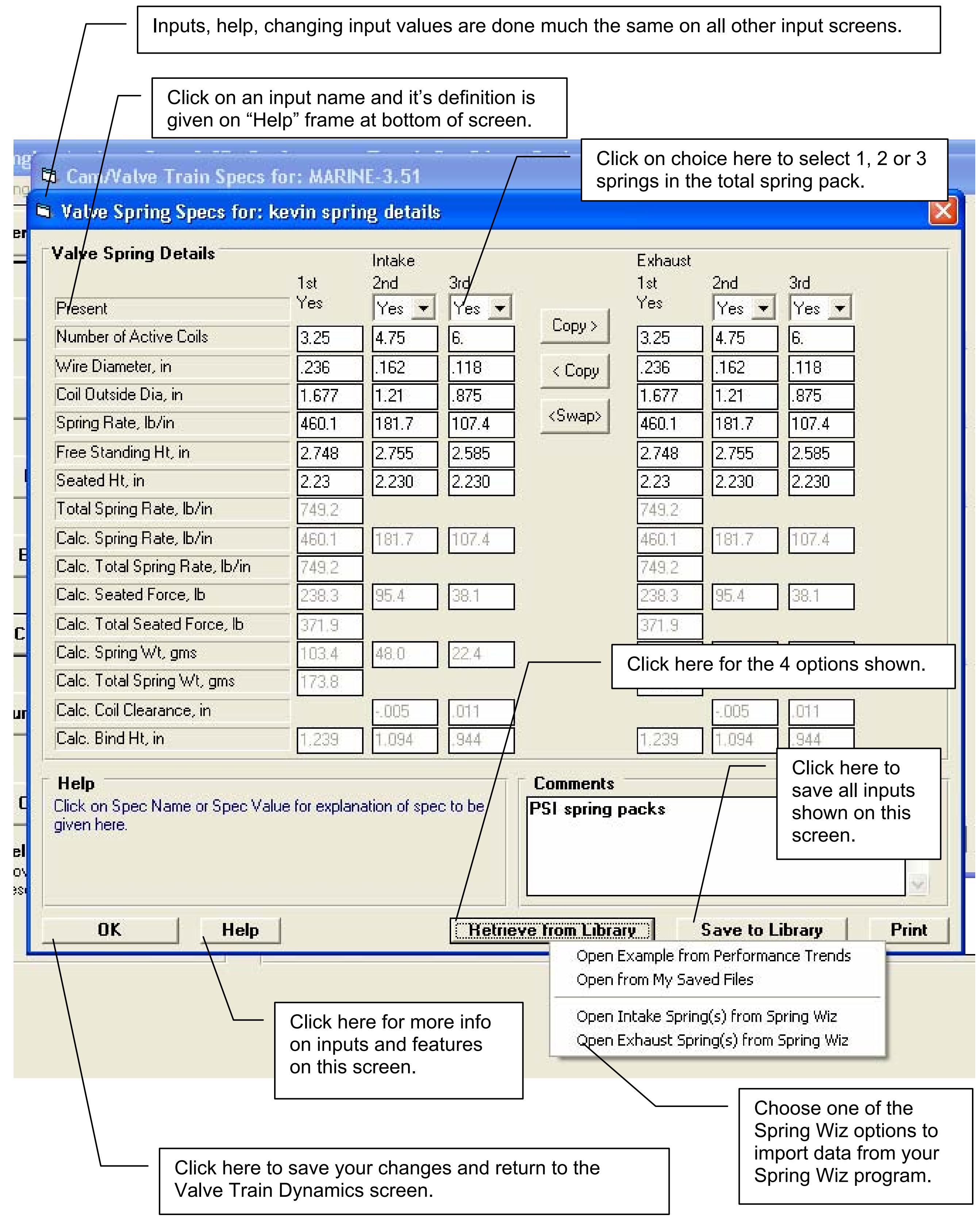
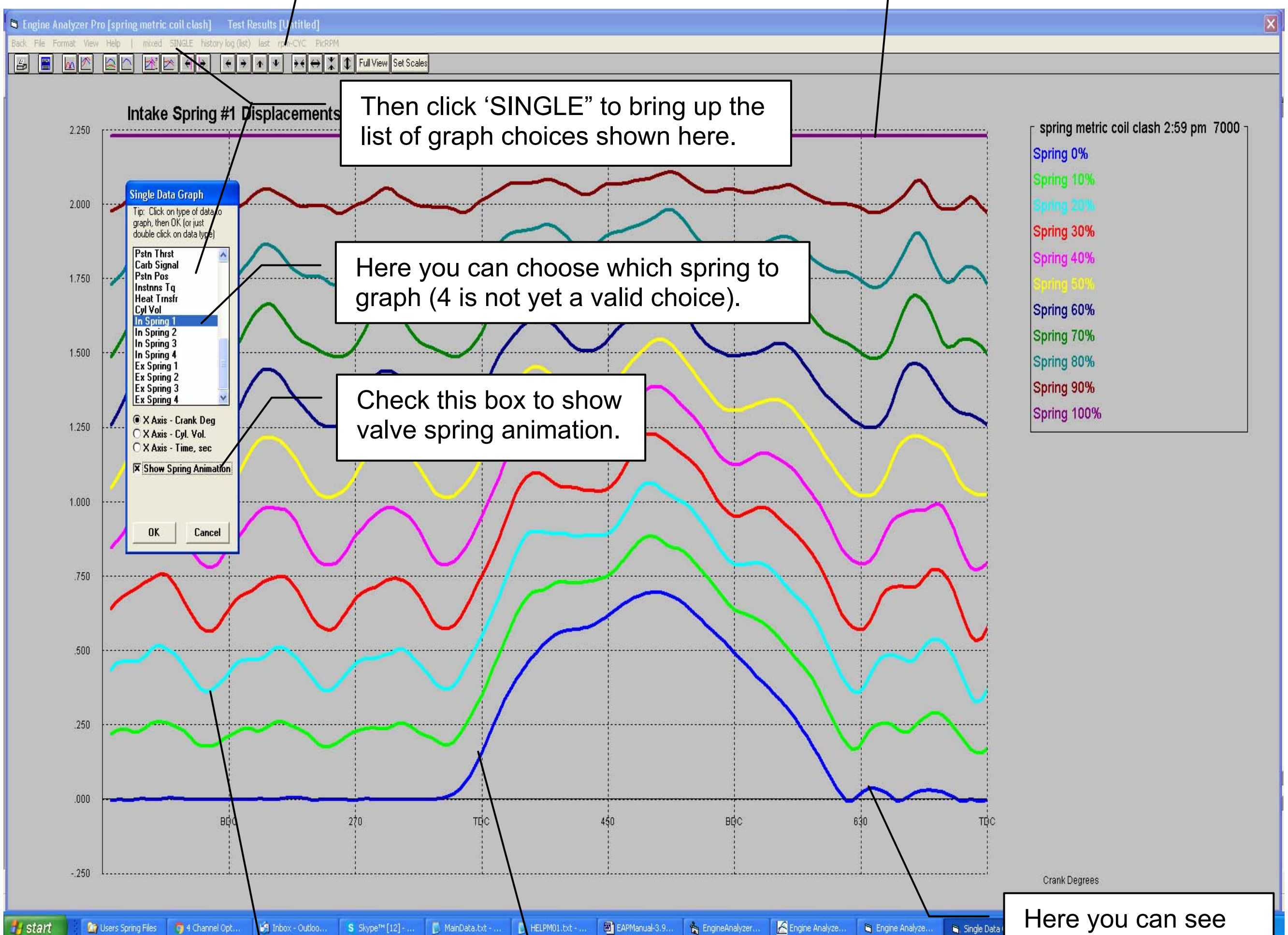


Figure A90 Valve Spring Dynamics, cont

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).

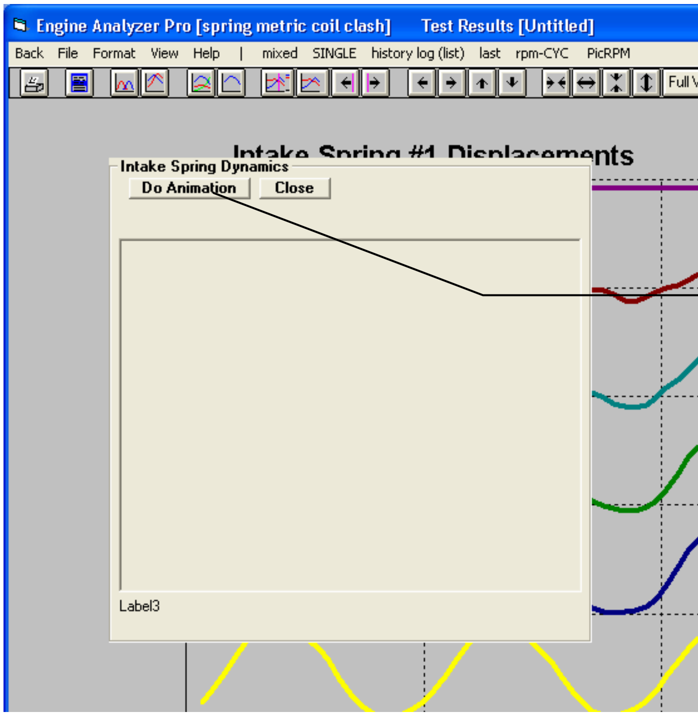
Check this box to show valve spring animation.

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

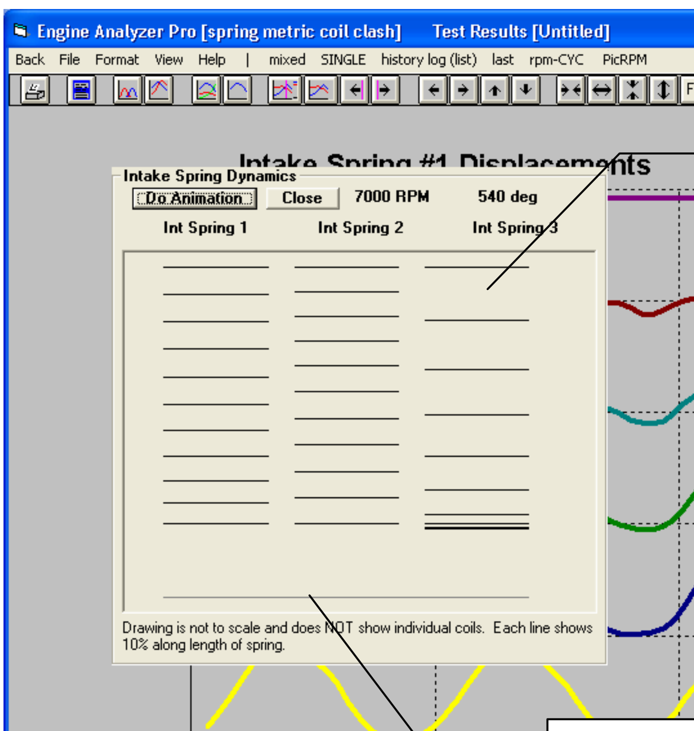
This is the spot (0 %) on spring which is touching the valve retainer, which is also indicating what the valve itself is doing. The program assumes the retainer and valve follow the same motion.

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 3rd 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

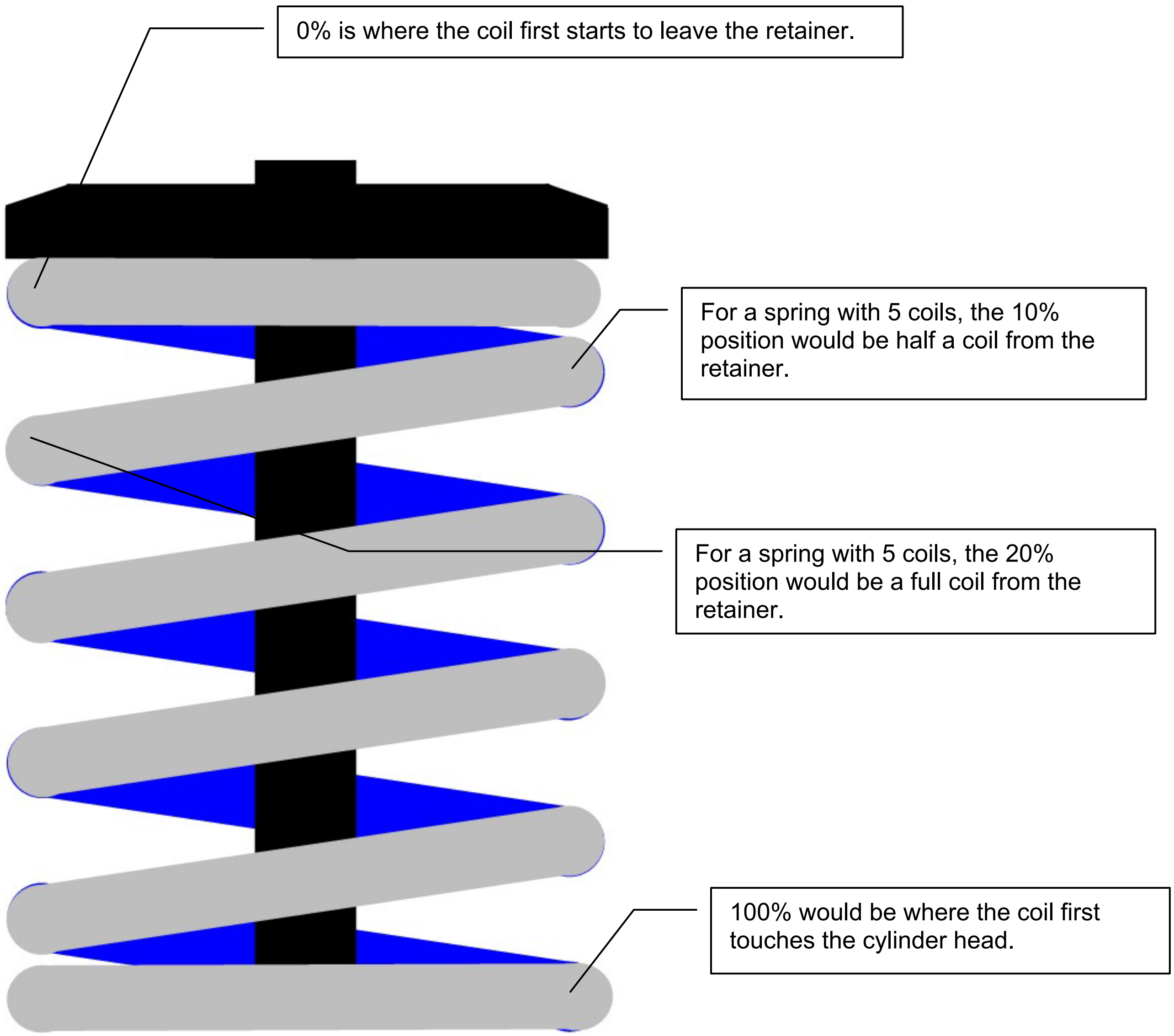
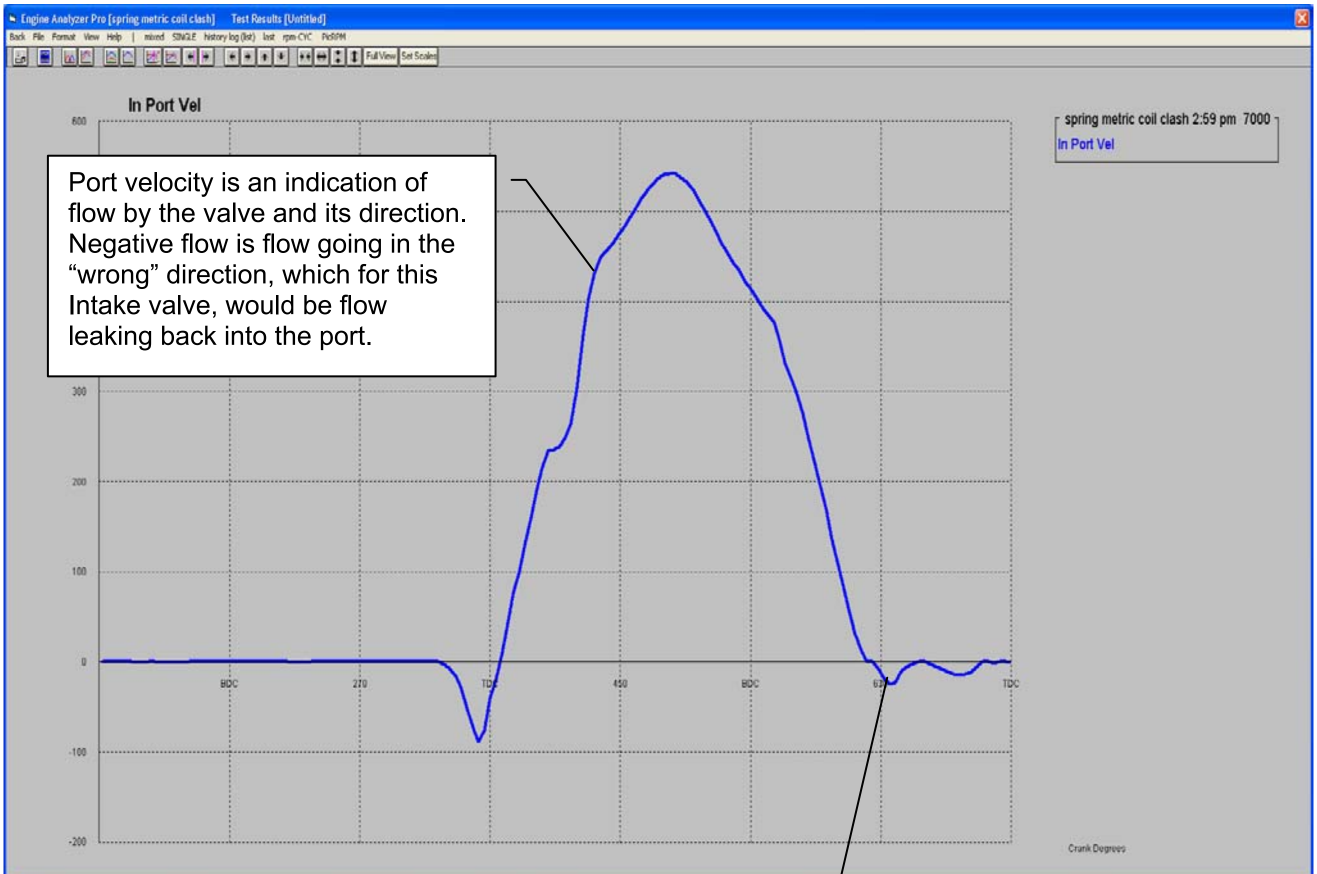


Figure A93 Checking Effect of Valve Bounce on Performance



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.