AUTOTUNE PROMPT TO CAP OR SCALE

AFTER AN AUTOTUNE SESSION, I AM PROMPTED TO CAP OR SCALE. WHAT DOES THAT MEAN?

If you are prompted to Cap or Scale after an AutoTune session, this means that AutoTune wants to increase one cell or more, in the VE tables, beyond the maximum value of 127.5. If this happens, AutoTune will prompt you to make a choice. Cap will raise that cell or cells to 127.5 and stop there. Scale will increase the engine displacement by a percentage, and then decrease all of the VE cells by that same percentage; effectively giving you the exact same amount of fuel. Then AutoTune will apply the changes it learned during the session. It is usually safe to choose Scale once or twice, and then choose Cap thereafter.

Above is our standard FAQ about this prompt, and should be considered a good starting point for casual tuners. To really know whether you should choose Cap or Scale, it becomes a little more involved.

Keep in mind the basic purpose of running an AutoTune session is to improve the tune. As a tuner, you need to have a pretty good idea of how a bike runs with a given tune, before running an AutoTune session. Don't flash a new tune to the bike, and immediately start an AutoTune session. You missed the first step; getting a feel for how this tune works on this bike. Once you complete an AutoTune session, and flash the resulting tune to the bike, the critical thing is to compare how it runs with the new tune, to how it ran before. If the bike runs better than it did before, great. If the bike runs worse, go back to the previous tune, and try to figure out why AutoTune didn't work. This would be rule#1 of AutoTune, comparing the before and after tunes.

When tuning and running AutoTune against a tune, you really need to have a pretty good idea what the VE tables look like, and how the engine is running before you start an AutoTune session. If the bike runs very lean, you should expect to get the prompt **Cap or Scale.** If you have VE tables with a bunch of very large cells like the below table, and the bike was running lean during wide open runs, you should expect to be prompted to **Cap or Scale.**

RPM	MAP (KPa)											
	15	20	30	35	40	50	60	70	80	90	95	100
750	92.5	91.0	95.0	94.0	92.0	90.0	93.4	94.4	95.3	95.6	93.2	94.5
1000	92.3	90.6	95.2	94.4	92.7	90.0	94.0	96.0	96.8	96.3	94.5	95.9
1125	93.3	92.6	97.3	96.4	93.9	90.6	95.2	97.2	97.4	97.4	96.5	98.5
1250	93.3	93.2	97.9	97.8	95.2	91.5	96.8	99.0	99.2	98.7	98.5	101.9
1500	84.2	91.3	100.5	116.0	112.4	112.0	109.6	110.6	109.7	111.0	114.4	118.2
1750	81.7	89.9	92.4	109.0	109.3	110.2	111.6	107.5	108.8	113.9	116.7	116.9
2000	79.7	88.3	92.0	106.0	103.8	96.5	103.6	101.7	99.2	112.1	116.6	119.0
2250	80.7	90.8	94.1	108.3	104.8	103.7	100.8	115.2	114.4	116.0	121.1	125.7
2500	83.5	94.0	97.5	115.0	113.5	111.4	105.9	120.4	117.3	125.8	124.3	127.0
2750	81.9	88.8	91.3	109.2	109.8	108.1	106.2	120.6	119.5	119.8	123.8	127.5
3000	84.0	93.6	99.3	115.5	112.3	112.6	108.8	116.7	116.9	125.4	127.5	127.5
3500	82.2	94.9	98.4	122.3	124.7	118.6	117.3	122.6	121.1	125.7	127.5	127.5
4000	81.4	87.3	87.0	105.8	107.5	108.5	113.7	110.9	114.0	116.6	123.9	125.7
4500	82.2	80.4	84.6	108.1	108.5	111.1	110.0	106.8	109.2	110.8	121.8	121.9
5000	85.2	84.9	88.7	111.4	112.6	112.9	111.4	112.4	112.9	111.1	116.5	117.7
5500	84.7	81.4	85.7	109.3	108.6	112.0	109.0	108.5	108.3	114.0	114.0	113.4
6000	83.5	83.6	81.7	91.3	92.7	109.4	105.7	104.3	100.9	103.9	108.7	107.7
6500	83.5	83.6	81.7	91.3	92.7	108.9	105.1	103.8	100.4	105.1	100.3	102.3
7000	83.5	83.6	81.7	91.3	92.7	108.9	105.1	103.8	100.4	99.1	100.3	102.3

For either of these reasons **you may be prompted to Cap or Scale** because AutoTune wants to add fuel in some cells, but it can't because the cell already is, or will be maxed out at 127.5. If you **select Cap**, those cells will be capped at 127.5. You will not get much, if any more fuel in the needed cells. **If the engine is fairly lean in that area, this would not be acceptable.**

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CASE#1

In the example below we have a bike that seems to be lean on wide open runs. **We run an AutoTune session and are prompted to Cap or Scale.** If we choose to **Scale** the tune, the AutoTune process will pick a percentage to increase the engine displacement, and decrease both VE tables by that same percentage. Below is the engine displacement field before, and after Scaling up by 7.5%.

Engine Displacement
13T103_259E_58mmTB.pvt

Units	Value
Cubic Inches	103.3

Engine Displacement
13T103_259E_58mmTB.pvt

Units	Value
Cubic Inches	111.0

VE (MAP based/Front Cyl)
13T103_259E_58mmTB.pvt

RPM	MAP (KPa)											
	15	20	30	35	40	50	60	70	80	90	95	100
750	85.6	84.2	87.9	87.0	85.1	83.3	86.4	87.3	88.2	88.4	86.2	87.4
1000	85.4	83.8	88.1	87.3	85.7	83.3	87.0	88.8	89.5	89.1	87.4	88.7
1125	86.3	85.7	90.0	89.2	86.9	83.8	88.1	89.9	90.1	90.1	89.3	91.1
1250	86.3	86.2	90.6	90.5	88.1	84.6	89.5	91.6	91.8	91.3	91.1	94.3
1500	77.9	84.5	93.0	107.3	104.0	103.6	101.4	102.3	101.5	102.7	105.8	109.3
1750	75.6	83.2	85.5	100.8	101.1	101.9	103.2	99.4	100.6	105.4	107.9	108.1
2000	73.7	81.7	85.1	98.1	96.0	89.3	95.8	94.1	91.8	103.7	107.9	110.1
2250	74.6	84.0	87.0	100.2	96.9	95.9	93.2	106.6	105.8	107.3	112.0	116.3
2500	77.2	87.0	90.2	106.4	105.0	103.0	98.0	111.4	108.5	116.4	115.0	117.5
2750	75.8	82.1	84.5	101.0	101.6	100.0	98.2	111.6	110.5	110.8	114.5	117.9
3000	77.7	86.6	91.9	106.8	103.9	104.2	100.6	107.9	108.1	116.0	117.9	117.9
3500	76.0	87.8	91.0	113.1	115.3	109.7	108.5	113.4	112.0	116.3	117.9	117.9
4000	75.3	80.8	80.5	97.9	99.4	100.4	105.2	102.6	105.5	107.9	114.6	116.3
4500	76.0	74.4	78.3	100.0	100.4	102.8	101.8	98.8	101.0	102.5	112.7	112.8
5000	78.8	78.5	82.0	103.0	104.2	104.4	103.0	104.0	104.4	102.8	107.8	108.9
5500	78.3	75.3	79.3	101.1	100.5	103.6	100.8	100.4	100.2	105.5	105.5	104.9
6000	77.2	77.3	75.6	84.5	85.7	101.2	97.8	96.5	93.3	96.1	100.5	99.6
6500	77.2	77.3	75.6	84.5	85.7	100.7	97.2	96.0	92.9	97.2	92.8	94.6
7000	77.2	77.3	75.6	84.5	85.7	100.7	97.2	96.0	92.9	91.7	92.8	94.6

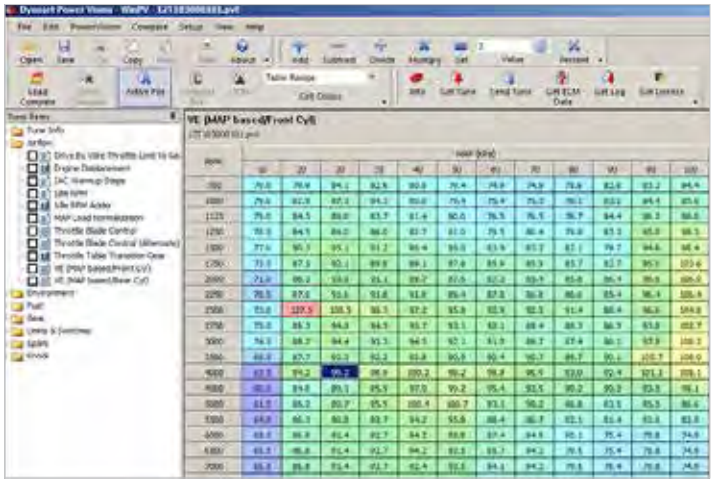
This is the same VE table after scaling down by -7.5%, but before the AutoTune results have been applied.

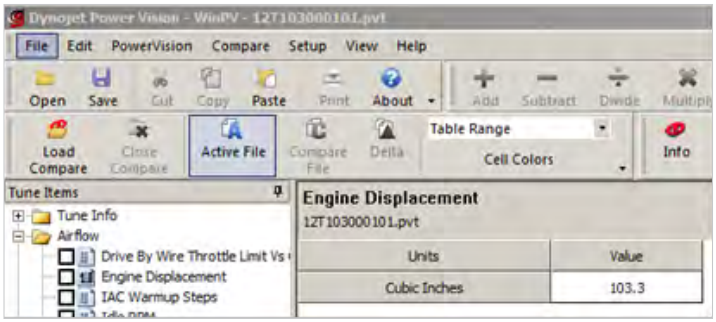
Note: *the entire VE table cells are smaller, allowing AutoTune to add fuel where it is needed. This is an example where* ***Scale*** *was the correct choice*

CASE#2

What follows is an example of being prompted to Cap or Scale, and **Cap** would be the correct choice.

You have a bike that seems to run pretty well. You have monitored air fuel ratio, and see the bike is fairly close to the numbers you would expect to see. You run an AutoTune session, and are prompted to **Cap or Scale.** You choose **Cap** and look at the resulting tune in WinPV. You look at engine displacement, and it matches the actual engine displacement of this bike at 103.3.





You look at the VE tables, and notice there is one cell that has been capped at 127.5.

This is the only cell that has been capped at 127.5 in either VE table. This cell is at 20 kpa, and 2500 rpm. This would be the deceleration area of the table. **Choosing Cap was the correct choice here.**

CASE#3

What follows is an example of when selecting Scale would be the wrong choice, and Cap should have been chosen. The tables below are not real tables from AutoTune sessions, but made up to display similar results we have seen in the real world.

You have a bike that seems to run well. **You run AutoTune over and over again, and are prompted to Cap or Scale.** You **select Scale** each time, and the bike runs worse each time. You have ignored rule#1.

RPM	MAP (KPa)											
	10	20	30	35	40	50	60	70	80	90	95	100
750	83.0	83.6	88.0	86.9	83.5	79.6	75.8	75.0	75.9	84.3	84.8	86.0
1000	83.0	86.5	91.1	93.8	83.5	80.2	76.9	75.5	76.5	84.3	86.0	87.9
1125	83.0	87.6	92.2	90.2	84.5	81.2	77.9	76.6	77.0	85.4	87.3	89.0
1250	82.5	89.8	94.5	91.7	86.2	82.7	79.4	78.8	78.1	81.5	88.4	90.3
1500	81.0	86.6	91.2	91.5	87.5	86.1	84.5	81.4	81.5	81.6	89.0	91.5
1750	75.5	84.7	89.2	89.2	88.1	87.1	84.5	84.1	81.8	82.4	90.2	96.7
2000	69.0	86.0	90.5	90.4	89.9	89.5	88.8	84.2	83.2	81.5	97.4	104.0
2250	66.0	85.4	89.9	91.5	90.3	91.2	89.3	86.3	83.9	76.0	99.7	104.0
2500	70.0	90.6	95.4	95.6	96.8	96.6	95.3	88.8	89.2	87.9	96.8	104.2
2750	75.0	88.3	92.9	95.4	92.9	94.3	90.3	88.2	84.4	77.5	96.1	104.5
3000	78.5	87.7	92.3	93.3	93.7	92.8	90.2	86.8	86.1	84.3	94.0	101.9
3500	77.0	88.0	92.6	95.0	97.1	98.8	95.1	89.9	89.9	91.3	96.5	100.7
4000	69.5	90.3	95.0	98.4	100.6	103.5	96.2	92.8	91.8	92.1	96.0	97.8
4500	62.5	89.6	94.3	98.0	100.1	103.4	98.6	94.4	90.1	89.0	89.7	90.7
5000	60.0	86.3	90.8	98.8	100.3	99.8	95.5	90.3	88.3	87.1	87.9	87.9
5500	65.0	86.3	90.8	91.0	93.5	94.7	90.5	84.7	82.6	81.5	83.9	82.2
6000	72.0	86.3	90.8	91.6	89.1	94.0	88.0	82.6	82.6	78.9	75.0	73.1
6500	76.5	86.3	90.8	91.6	89.1	94.0	88.0	82.6	82.6	78.9	74.5	73.1
7000	77.0	85.6	90.1	90.6	89.1	93.1	86.3	81.0	80.1	77.4	77.1	75.6
7500	77.0	84.7	89.2	89.8	89.1	91.3	89.8	80.0	80.1	77.4	77.1	75.6

You start with a tune, the actual engine displacement is 103, the field in the tune is currently 103.3. The VE rear table looks like this.

RPM	MAP (KPa)											
	10	20	30	35	40	50	60	70	80	90	95	100
750	77.2	77.7	81.8	83.8	77.7	74.0	70.5	69.8	70.6	78.4	78.9	80.0
1000	77.2	80.4	84.7	90.2	80.7	74.6	71.5	70.2	71.1	78.4	80.0	81.7
1125	77.2	81.5	85.7	86.9	81.6	75.5	72.4	71.2	71.6	79.4	81.2	82.8
1250	76.7	83.5	87.9	88.3	83.2	79.9	73.8	73.3	72.6	78.8	82.2	84.0
1500	75.3	80.5	84.8	85.1	81.4	83.1	78.6	75.7	75.8	75.9	82.8	85.1
1750	70.2	78.8	83.0	83.0	81.9	81.0	78.6	78.2	79.1	76.6	83.9	89.9
2000	64.2	80.0	84.2	84.1	83.6	83.2	82.6	81.3	77.4	75.8	90.6	96.7
2250	61.4	79.4	83.6	85.1	84.0	84.8	83.0	80.3	78.0	70.7	92.7	96.7
2500	65.1	121.2	88.7	88.9	90.0	89.8	88.6	82.6	86.0	81.7	90.0	96.9
2750	69.8	82.1	86.4	88.7	86.4	87.7	84.0	82.0	75.5	72.1	89.4	97.2
3000	73.0	81.6	85.8	86.8	87.1	86.3	83.9	80.7	80.1	75.4	87.4	94.8
3500	71.6	81.8	86.1	88.4	90.3	91.9	88.4	83.6	83.6	84.9	89.7	93.7
4000	64.6	84.0	88.4	91.5	93.6	96.3	89.5	83.3	85.4	85.7	89.3	91.0
4500	58.1	83.3	87.7	91.1	93.1	96.2	91.7	87.8	83.8	82.8	83.4	84.4
5000	55.8	80.3	84.4	91.9	93.3	92.8	88.8	84.0	79.1	81.0	78.7	81.7
5500	60.5	80.3	84.4	84.6	87.0	88.1	84.2	78.8	76.8	75.8	78.0	76.4
6000	67.0	80.3	84.4	85.2	82.9	87.4	81.8	76.8	76.8	73.4	69.8	65.0
6500	71.1	80.3	84.4	85.2	82.9	87.4	81.8	76.8	76.8	73.4	69.3	68.0
7000	71.6	79.6	83.8	84.3	82.9	86.6	80.3	75.3	74.5	69.0	71.7	70.3
7500	71.6	78.8	83.0	83.5	82.9	84.9	83.5	74.4	74.5	72.0	71.7	70.3

You run an AutoTune session, **are prompted to Cap or Scale,** and you choose Scale. The engine displacement has been scaled up to 110.5. The rear VE table looks like this.

RPM	MAP (KPa)											
	10	20	30	35	40	50	60	70	80	90	95	100
750	73.3	73.8	74.7	70.6	70.8	70.3	67.0	66.3	67.1	74.5	75.0	76.0
1000	73.3	76.4	71.5	70.7	67.7	70.9	67.9	66.7	67.5	74.5	76.0	77.6
1125	73.3	77.4	78.4	73.6	74.5	71.7	68.8	67.6	68.0	75.4	77.1	78.7
1250	72.9	79.3	80.5	80.9	76.0	75.9	70.1	69.6	69.0	74.9	81.1	79.8
1500	71.5	76.5	80.6	80.8	77.3	78.9	74.7	71.9	72.0	72.1	78.7	80.8
1750	66.7	74.9	78.8	78.8	77.8	77.0	74.7	74.3	75.1	75.8	79.7	85.4
2000	61.0	76.0	80.0	79.9	79.4	79.0	78.5	77.2	73.5	72.0	86.1	94.9
2250	58.3	75.4	79.4	80.8	79.8	80.6	78.8	76.3	74.1	70.2	91.1	91.9
2500	61.8	118.9	84.3	84.5	85.5	85.3	84.2	78.5	84.7	77.6	85.5	92.1
2750	66.3	78.0	82.1	84.3	82.1	83.3	79.8	80.9	71.7	68.5	87.9	92.3
3000	69.3	77.5	81.5	82.5	82.7	82.0	79.7	76.7	76.1	71.6	83.0	90.1
3500	68.0	77.7	81.8	84.0	76.8	84.3	84.0	79.4	79.4	80.7	85.2	89.0
4000	61.4	79.8	84.0	86.9	88.9	91.5	85.0	79.1	81.1	84.4	87.8	86.5
4500	55.2	79.1	83.3	86.5	85.4	91.4	87.1	83.4	79.6	78.7	79.2	80.2
5000	53.0	76.3	80.2	87.3	88.6	88.2	84.4	79.8	72.1	77.0	77.8	77.6
5500	57.5	76.3	80.2	80.4	82.6	80.7	80.0	74.9	73.0	72.0	74.1	75.6
6000	63.6	76.3	80.2	80.9	78.8	83.0	77.7	73.0	73.0	69.7	66.3	64.8
6500	67.5	76.3	80.2	80.9	78.8	83.0	77.7	73.0	73.0	69.7	68.8	64.6
7000	68.0	75.6	79.6	80.1	78.8	82.3	76.3	71.5	70.8	65.5	68.1	66.8
7500	68.0	74.9	78.8	79.3	78.8	80.7	79.3	70.7	70.8	68.4	68.1	66.8

The bike seems to run ok, maybe worse, but you decide to run AutoTune again. Y**ou are prompted to Cap or Scale, and you choose Scale.** The engine displacement is now 116.0, the rear VE table looks like this.

RPM	MAP (KPa)											
	10	20	30	35	40	50	60	70	80	90	95	100
750	62.3	62.7	63.5	55.0	60.2	59.8	56.9	56.4	57.0	63.3	63.8	64.6
1000	62.3	64.9	60.8	60.1	52.5	55.3	57.7	56.7	57.4	63.3	64.6	66.0
1125	62.3	65.8	66.6	57.6	58.3	60.9	58.5	57.5	57.8	64.1	65.5	66.9
1250	62.0	67.4	68.4	68.8	64.6	59.5	59.6	59.2	58.6	63.7	68.9	67.8
1500	60.8	65.0	63.5	68.7	65.7	67.1	63.5	61.1	61.2	61.3	66.9	68.7
1750	56.7	63.7	67.0	67.0	66.1	65.5	63.5	63.2	63.8	64.4	67.7	72.6
2000	51.9	64.6	63.0	67.9	67.5	67.1	66.7	65.6	62.5	61.2	83.2	75.7
2250	49.6	64.1	67.5	68.7	67.8	68.5	72.0	59.9	63.0	59.7	82.4	78.1
2500	52.5	117.2	71.7	71.8	77.7	72.5	66.6	66.7	72.0	81.0	72.7	73.3
2750	56.4	66.3	69.8	71.7	69.8	70.8	67.8	68.8	60.9	68.2	74.7	88.5
3000	58.9	65.9	69.3	70.1	70.3	74.7	62.7	65.2	64.7	60.9	70.5	76.6
3500	57.8	66.0	69.5	71.4	65.3	71.7	71.4	67.5	67.5	68.6	72.4	75.6
4000	52.2	67.8	71.4	73.9	70.6	77.8	72.3	67.2	68.9	71.7	74.6	73.5
4500	46.9	67.2	70.8	73.5	72.6	77.7	74.0	70.9	67.7	66.9	67.3	68.2
5000	45.0	64.9	68.2	69.2	75.3	75.0	71.7	67.8	56.3	65.5	66.1	66.0
5500	48.9	64.9	68.2	68.3	70.2	68.6	68.0	63.7	62.0	61.2	58.0	64.3
6000	54.1	64.9	68.2	63.8	62.0	70.5	66.0	62.0	62.0	59.2	56.4	55.1
6500	57.4	64.9	68.2	68.8	67.0	70.5	66.0	62.0	62.0	64.2	58.5	54.9
7000	57.8	64.3	67.7	68.1	67.0	70.0	64.9	60.8	60.2	60.7	57.9	56.8
7500	57.8	63.7	67.0	67.4	67.0	68.6	67.4	60.1	60.2	58.1	57.9	56.8

Now the bike seems to run a little worse, but you decide to run AutoTune again against the last tune. **You are prompted yet again to Cap or Scale, you choose Scale.** The engine displacement is now 133.4. Below is the rear VE table.

Now using this tune the bike runs very poorly. The VE cells around idle are in the 50's and 60's. There is only one cell at 20 kpa and 2500 rpm that is fairly large. **This one cell is what prompted the Cap or Scale message**, The injectors are shutting off under deceleration on this bike, causing a lean reading, and AutoTune to try to add fuel. This tune has been scaled too far. The only solution would be to go back to one of the tunes before you scaled, and start over. **Remember to Cap each time you run AutoTune on this bike.**