Boost Control using Nistune

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Making an Adjustable Actuator

Following is an actuator that has been modified to be able to adjust the preload, adjusting the waste gate cracking pressure. This is useful to help reduce waste gate creep and in some circumstances can assist with bringing on boost faster through being able to fight the exhaust gas pressures trying to push it open.

In the picture it shows an actuator that has been cut and threaded. You can buy these off the shelf in most performance shops. In most cases like these require the circlip to be removed of the waste gate to adjust, it kind of burns at 400deg. So in my case I used a right and left hand thread like a steering tie rod so it can be adjusted without removing the clip of the waste gate arm time and time again. Those clips are easy to loose on the street.

Parts

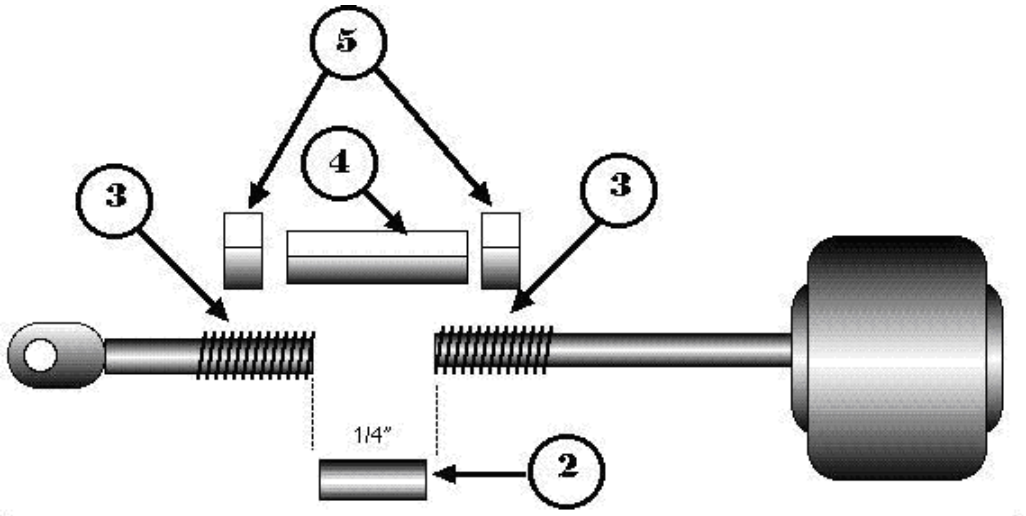
- 2 x ¼" Nuts
- 2" x ¼" ID threaded pipe (1/4" pipe coupler)
- Spare clip for waste gate
- Cutting fluid

or

- ¼" Carburetor linkage (tie rod Type)
- Spare clip for waste gate
- Cutting fluid
- Welding / braising tools

Tools

- ¼ " Tap
- Hacksaw
- Ring spanners
- ¼" die
- Engineering Vice



The Procedure

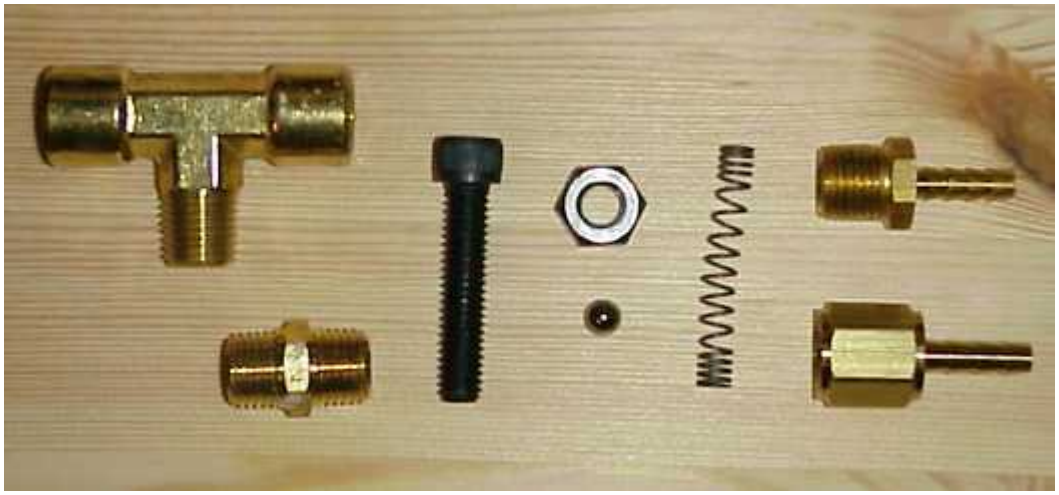
1. Remove the actuator from the car by snapping the clip off the arm and removing the two bolts that hold the actuator onto the compressor housing
2. At about half way up the actuator arm cut a ¼ - ½" section out of the arm with a hack saw.
3. Thread both sides of the arm with 1/4" die depending in actuator shaft size
4. Thread a nut on both sides.
5. Add your pipe coupler to the center to finish off the job .
6. If you want you can thread one side left handed so you don't have to remove the clip again to adjust the actuator, however the left handed nuts and hardware is hard to find.
7. Alternatively can use an old carburetor linkage if you have one just weld the eyelet end onto the left handed thread.
8. WARNING DO NOT WELD OR HEAT UP THE ACTUATOR.

Making an Adjustable Restrictor

All of the following parts should be available at the local hardware store.

Parts

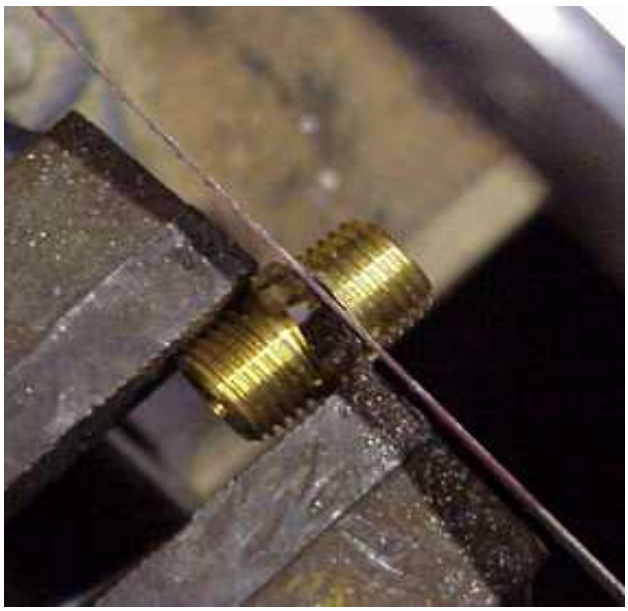
- 1/4" NPT Tee (I'll refer to it as the 'Body')
- 1/4" Male NPT coupling
- 1/4" Female NPT x 3/16" hose barb
- 1/4" Male NPT x 3/16" hose barb
- 5/16"-18 x 1 1/2" SHCS (I'll refer to it as a 'Bolt')
- 5/16-18 Jam Nut
- 1/4" dia ball bearing (I actually purchased mine from a bicycle shop)
- Spring ~ 1.69" lg x 3/16" dia
- Straight thru 3/16" plastic hose barb coupling (commonly used in windshield wiper systems)
- Length of 3/16" I.D. vacuum hose to connect MBC



Tools

- drill
- 1/32" drill bit (to drill vent hole in plastic straight thru coupling)
- 5/16"-18 UNC tap
- hack saw
- Teflon Tape

The Procedure



1. Cut the top part off the coupling using a hacksaw as shown.

I will refer to this piece as the "Cap"

2. This is what the Cap will look like after being cut. Discard the piece you cut off.

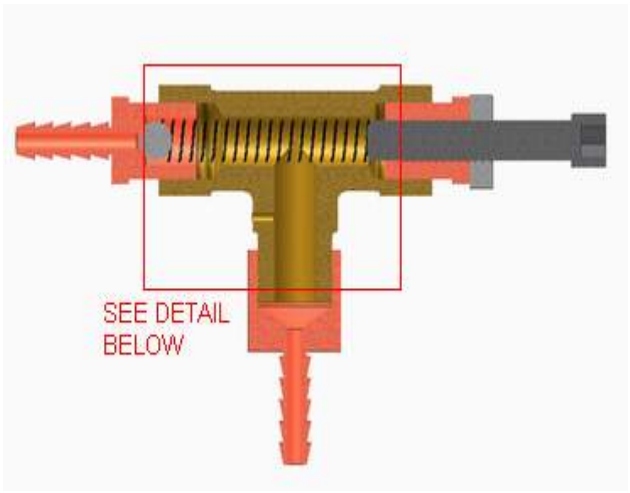
3. Since the hole thru the fitting is already slightly over .257" (required taps size for a 5/16-18UNC thread) drilling to the correct size to tap is not necessary. Tap the Cap all the way thru. Make sure the hole is tapped straight (concentric to the hole)

4. Take the jam nut and thread it part way up the Bolt. Wrap the Bolt with Teflon tape, to prevent air leaking between the threads, and thread the Bolt and nut into the Cap, place aside for now. I will refer to this as the 'Cap Assembly'.

5. Use some teflon tape when threading the following together... take the male hose barb and thread it onto one end of the tee. Take the female hose barb fitting and thread it onto the middle part of the tee.

6. Place the ball bearing into the tee, so that it is now sitting at the bottom against the Base. Gently follow with placing the spring down on top of the bearing. Now take the Cap assembly and using some teflon tape thread it into the tee.

Note: The dimensions I have given for the spring are what worked for me. Your spring will have a different 'rate' and therefore will act differently, a little experimentation for length and compression is required to find what works for you. MAKE SURE the compression on the spring (from the Bolt) is completely released and increase compression on it, which increases boost, gradually.



6.1 Here is a basic cutaway view of what the internals will look like once the controller is completely assembled. Because the spring is sized closely to the inside of the Body, there is no need to modify the Body or spring to eliminate any lateral deflection that might occur if the clearance between the two components been greater.

As a side note, a second ball bearing can be added between the spring and the Bolt. I've found though, that due to the spring's size, it seats fairly well on the Bolt without binding (which could cause problems with adjustment accuracy) and doesn't require it.

Choosing the right boost control system

1. Do you really want to adjust the boost levels in Nistune for different driving conditions?
2. Do you want your boost control to be a little predictable or to come on as fast as you can get it with spike?
3. Do you have machining capability or will you use off the shelf parts?
4. Will a pneumatic system suffice?

The reason that I ask these questions is because in most circumstances a pneumatic system will be more than adequate for most applications. The difference is that in Nistune you have the ability to manipulate the boost at a given RPM. However in saying this, pneumatic systems can do this as well by the addition of restrictors and bleeds to the boost signal line.

Another point to consider is that the Nistune system is purely based on RPM and although accurate it is not as accurate as high end boost controllers available out on the market today. These have better designed control valves and also read directly off the manifold pressure where Nistune does not. It would be fair to say that it is like the Apexi add on for the power FC. This is taking into account the amount of creep, fade and spike, it is fair to say that a cheap system may be tuned for a certain application quite well however it is a trade off of how well it will perform in all gears at all loads.

Finally to change the tune electronically requires the laptop and time so it is not as easy as turning a knob to a preset, if this is what you are after best go get a boost controller, or if your like me tune it up for the best and just go easy on the gas to control the boost. After all that now if your still convinced lets move on…..

Buy or build the choice is yours

1. There are many devices out there off the shelf in terms of restrictors. These needle valve restrictors can vary from where you turn the adjuster and it clicks, or the adjustment has a lock nut, as a locking mechanism is definitely recommended to avoid a incorrect adjustment made through vibration.
2. Some restrictors even have special flow characteristics where they only flow in one direction or restrict the flow in one direction only.
3. Secure the hoses properly with clamps and secure the valves in place tightly.
4. Don’t buy plastic fittings they won’t last.
5. If you are buying a new solenoid or trying a different one make sure the ECU can handle the new load of the valve.

Installing the boost control (Bleed Method for S15)

Parts

- Adjustable Restrictor
- 'T' piece
- Waste gate actuator modification.
- Nistune Board programmer and cable.

Install Procedure

1. Install the components as per the following diagram.

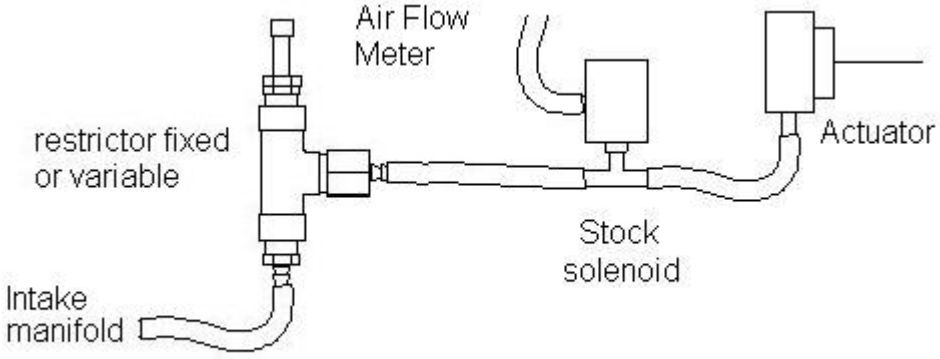


Figure 1

2. Summary, Boost pressure is going into restrictor blowing against ball, air is then branched off into the side of the factory solenoid and along to the actuator. The center of the solenoid goes back to the intake shout just behind the AFM for the return bleed air.
3. Be SURE to REMOVE ALL THE RESTRICTORS in the air lines of the stock system. There will be one on either side of the "T" Piece.

Tuning Procedure

1. Give the actuator a couple of turns in so that there is about 3-5mm of preload on the actuator. This will mean that you will have to pull the actuator 3-5mm out to slip it over the waste gate arm and install the clip.

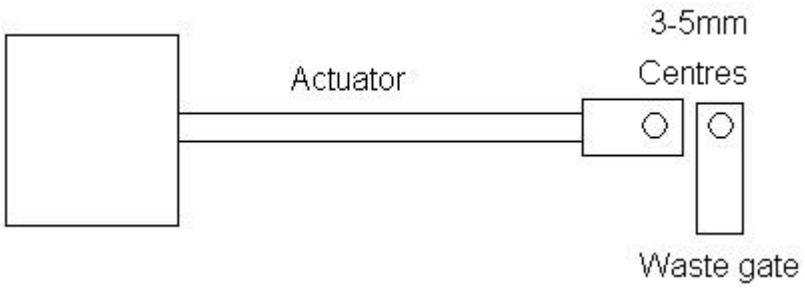


Figure 2

2. Adjust the restrictor so that you have a minimal restriction of airflow. Adjust the screw so that you can just blow air through it by mouth. Remember that airflow will only go one way. Although if you bought a normal needle valve type it does not matter.
3. Grab the laptop and make a map set all with 50PWM in all the cells. Down load it to the ECU and make sure you also do a knock copy just to be on the safe side.

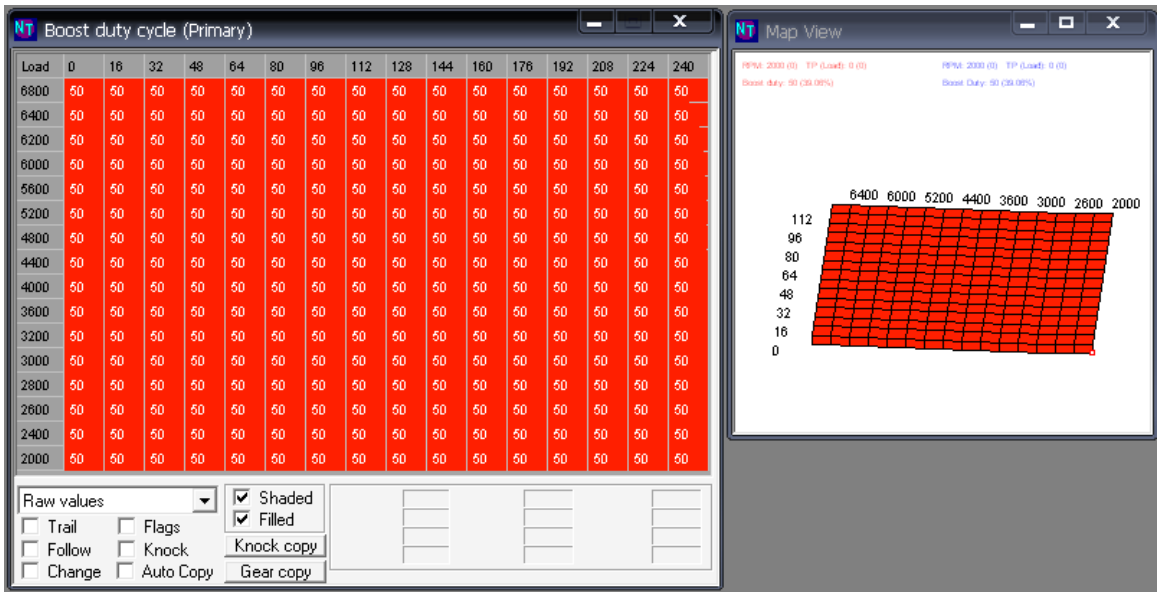


Figure 3

4. Find a hill somewhere and give it a hit in 3rd gear. This will then be able to find out where you Base boost setting will be. It should only be a little above stock if not below that.
5. Now slowly increase the restrictor until you reach the desired boost (Peak) level.
6. You should not get any spike in boost maybe a slight rise and taper off, and you may have to adjust the restrictor a lot. Go a bit at a time and test each adjustment.
7. Now go into the boost maps and adjust the top end. Top end is considered after where your peak level is.

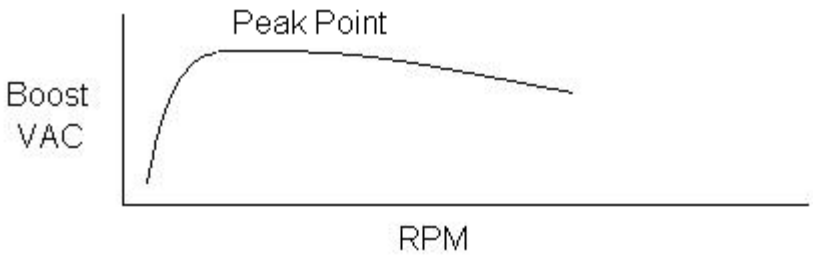


Figure 4

8. This is easily done with a co – pilot in the passenger seat, on a dyno, or like me with a three button wireless mouse.
9. Go through the maps point by point at each RPM level slowly increasing the bleed in the top end. You will see the boost levels rise in that area. If for any reason the boost level does not move then leave the setting where it IS.

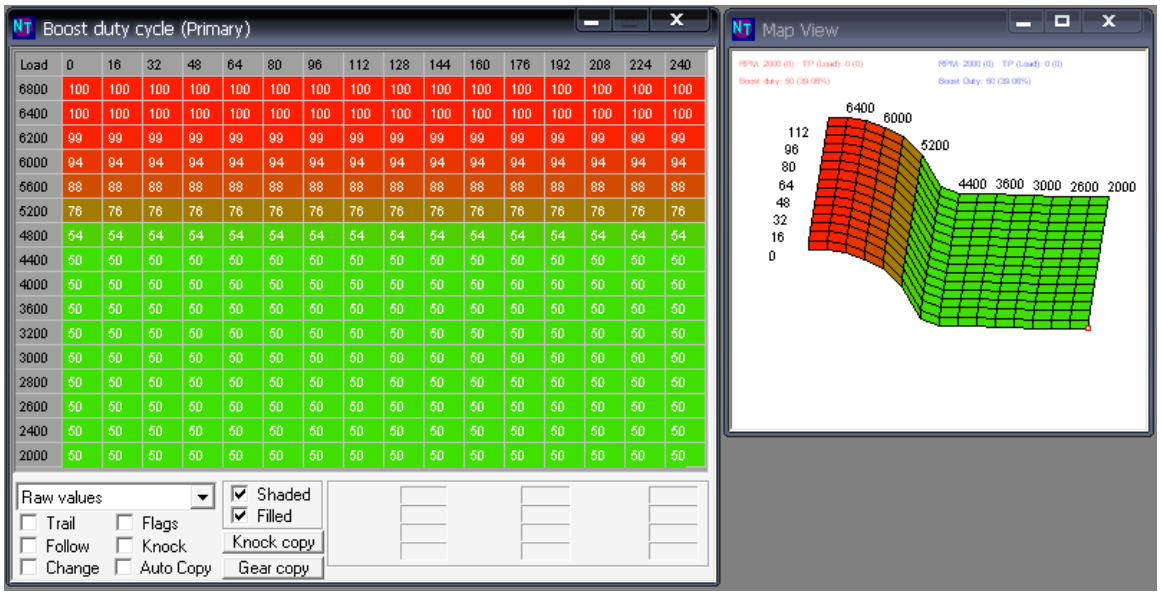


Figure 5

10. Increasing the values will reduce the amount of air to the actuator allowing the spring to close the waste gate and hence the turbo build more boost. You can even run the bleed air into the cabin and note the difference in the bleed air. Be sure to block up the line from the AFM though.
11. Increasing values beyond where they need to be will ruin the stability of lower gear boost control. In my opinion is very important.
12. Now move top the lower end below the peak level. This area you can tune to delay the max pressure signal to the actuator. The idea is that if your base setting is at 1 bar your waste gate will be cracked open at about ¾ bar not fully open but will be routing some exhaust gas away from your turbo.
13. Once again find a hill and maybe a taller gear like 4th and slowly adjust the values upward from 50. Watch the vacuum gauge it should slightly move as you adjust the values, increase them till the manifold pressure stops rising at that point, move on all the way to your peak point. Don't increase them if it does not change anything because excess bleed in the lower parts of the map

leads to boost spike. In testing it you should be able to generate a spike in 2nd gear by manipulating these values. However if your restrictor / actuator pressure is a good combo adjusting these lower values will not do much at all as the restrictor is controlling the speed at which the actuator opens.

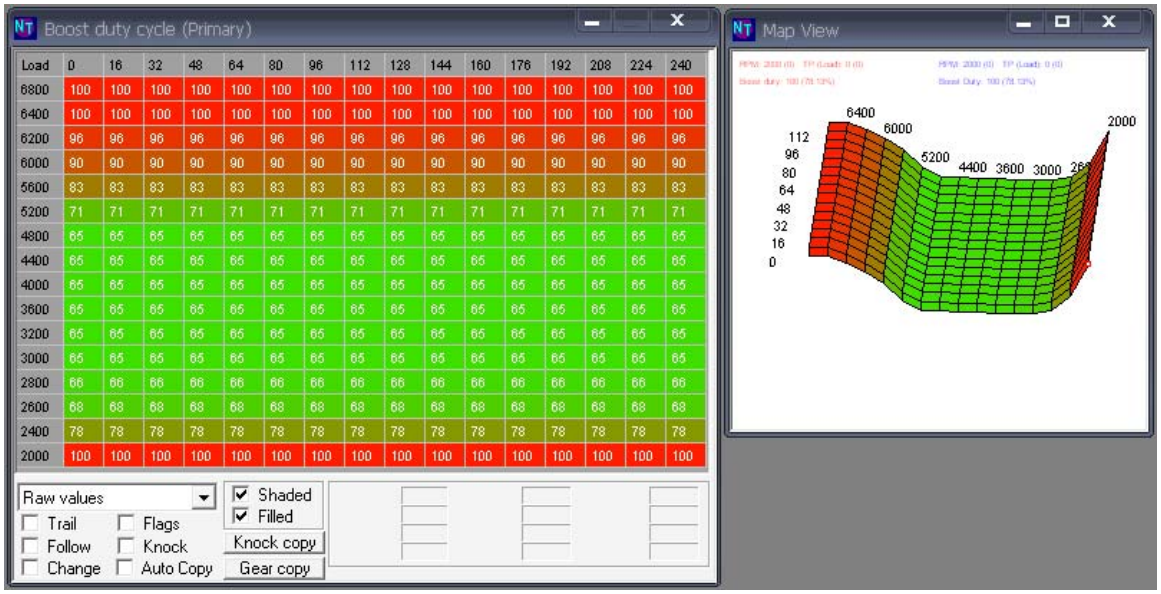


Figure 6

14. Now this is a little more aggressive note the convex shape after the midpoint making the valve bleed more air more quickly to the actuator and the front of the map convex making it stop bleeding air as quick as it can when it reaches the midpoint to get the actuator to slam open quickly.

Figure 7

15. That's it good luck..

Installing the boost control (Block Method for S15)

Parts

- Adjustable Restrictor
- 'T' piece
- Waste gate actuator modification.
- Nistune Board programmer and cable.

Install Procedure

1. Install the components as per the following diagram.

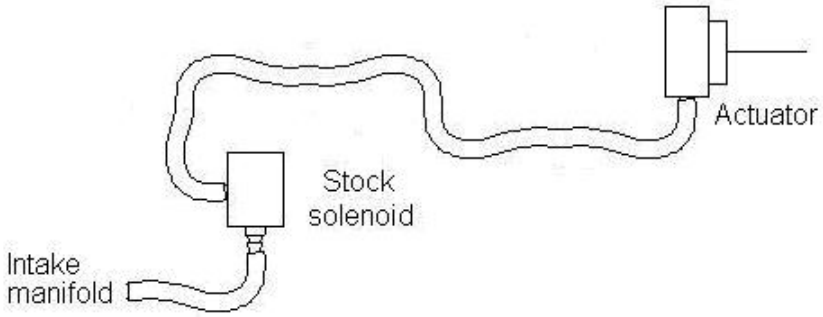


Figure 8

2. Summary, Boost pressure is now going to be blocked by the solenoid this will limit the air going into the actuator and stop is from pushing against the waste gate and build boost pressure. Its performance is only limited by the amount of boost pressure that the solenoid can hold off. No air is bled or lost in this system. Precautions should be taken to ensure adequate guards against over boosting as if the solenoid fails or a broken wire boost becomes only limited by the size of the turbo.
3. Be SURE to REMOVE ALL THE RESTRICTORS in the air lines of the stock system. There will be one on either side of the "T" Piece.

Tuning Procedure

1. Give the actuator a couple of turns in so that there is about 3-5mm of preload on the actuator. This will mean that you will have to pull the actuator 3-5mm out to slip it over the waste gate arm and install the clip.

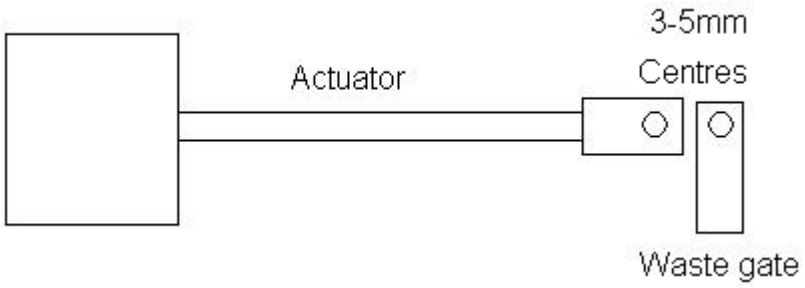


Figure 9

2. Give the actuator a couple of turns in so that there is about 3-5mm of preload on the actuator. This will mean that you will have to pull the actuator 3-5mm out to slip it over the waste gate arm and install the clip.
3. Give the actuator Grab the laptop and make a map set all with 100PWM in all the cells. Down load it to the ECU and make sure you also do a knock copy just to be on the safe side.

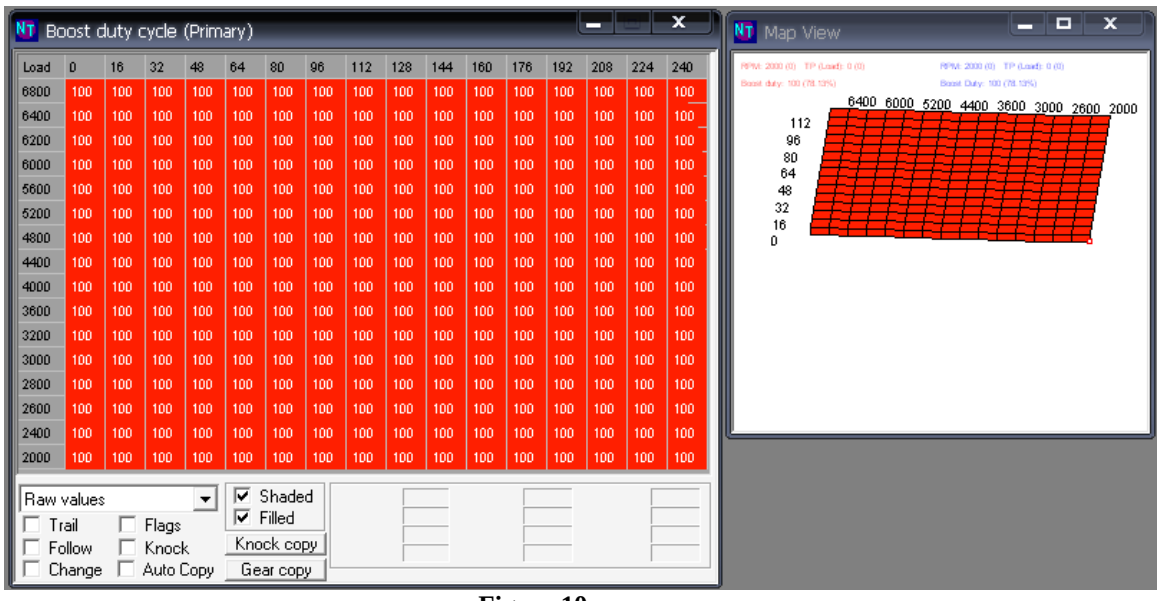


Figure 10

4. Find a hill somewhere and give it a hit in 3rd gear. This will then be able to find out where your Base boost setting will be. It should only be a little above stock if not below that.

5. Now slowly increase the pre load on the actuator until you reach the desired boost (Peak) level. (Wind it in a bit more)

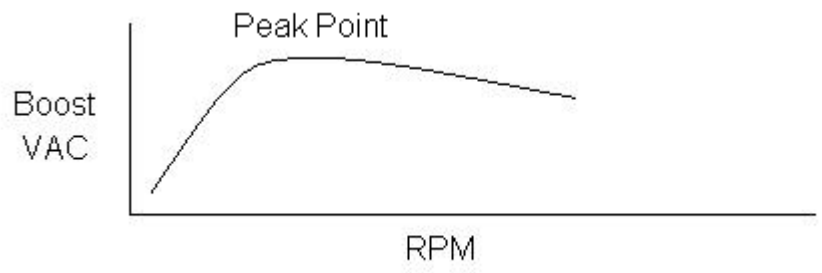
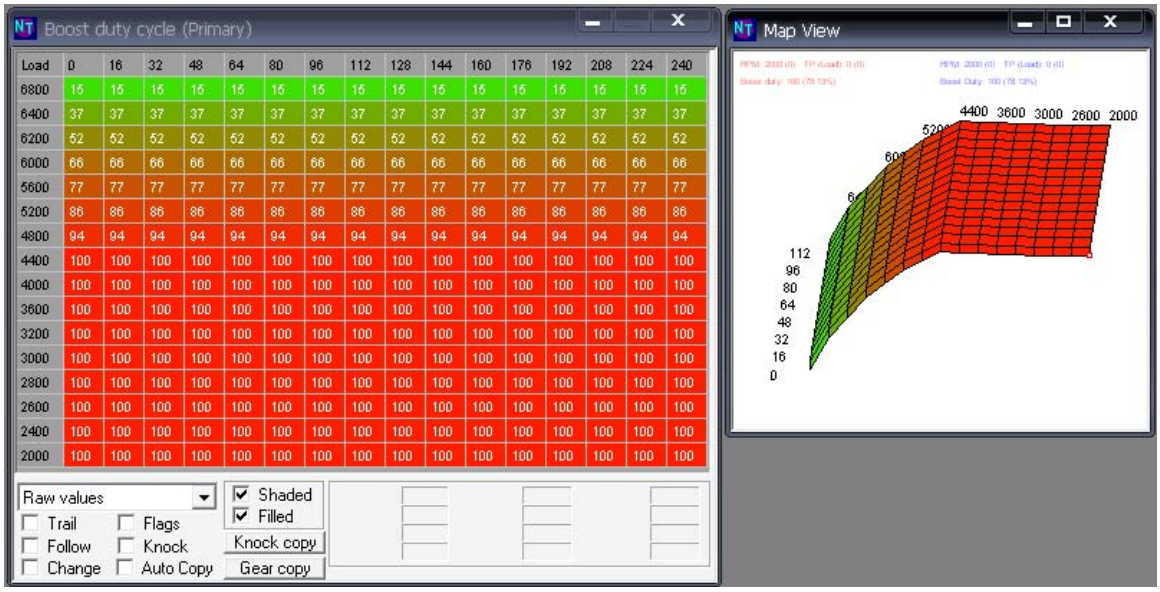


Figure 11

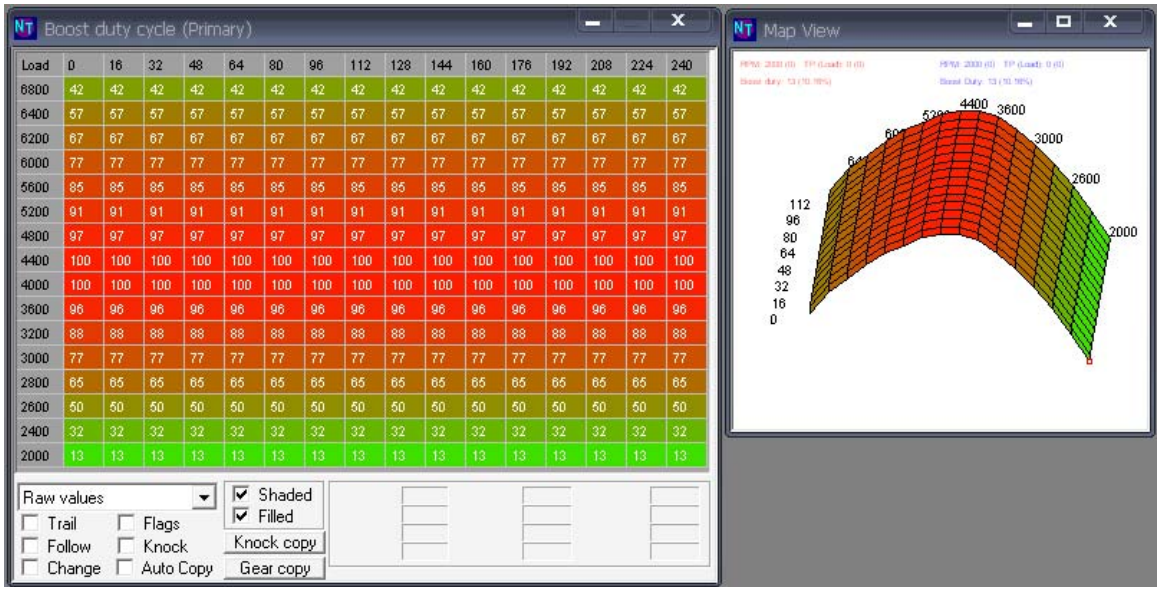
6. Now go into the boost maps and adjust the top end. Top end is considered after where your peak level is.
7. This is easily done with a co – pilot in the passenger seat, on a dyno, or like me with a three button wireless mouse.
8. Go through the maps point by point at each RPM level slowly decreasing the PWM in the top end. You will see the boost levels rise in that area. If for any reason the boost level does not move then leave the setting where it IS.



9. Figure 12

10. Decreasing the values will reduce the amount of air to the actuator allowing the spring to close the waste gate and hence the turbo build more boost. Decreasing values beyond where they need to be will ruin the stability of lower gear boost control. In my opinion is very important.
11. Now move top the lower end below the peak level. This area you can tune to delay the max pressure signal to the actuator. The idea is that if your base setting is at 1 bar your waste gate will be cracked open at about ¾ bar not fully open but will be routing some exhaust gas away from your turbo.

12. Once again find a hill and maybe a taller gear like 4th and slowly adjust the values downward from 100. Watch the vacuum gauge it should slightly move as you adjust the values, increase them till the manifold pressure stops rising at that point, move on all the way to your peak point. Don't increase them if it
13. does not change anything because excess bleed in the lower parts of the map leads to boost spike. In testing it you should be able to generate a spike in 2nd gear by manipulating these values.



14. Figure 13

15. Now if your happy you can start making the boost profile a little more aggressive by making it concave, same principle hold the boost pressure off the waste gate till the last possible moment then slam it open

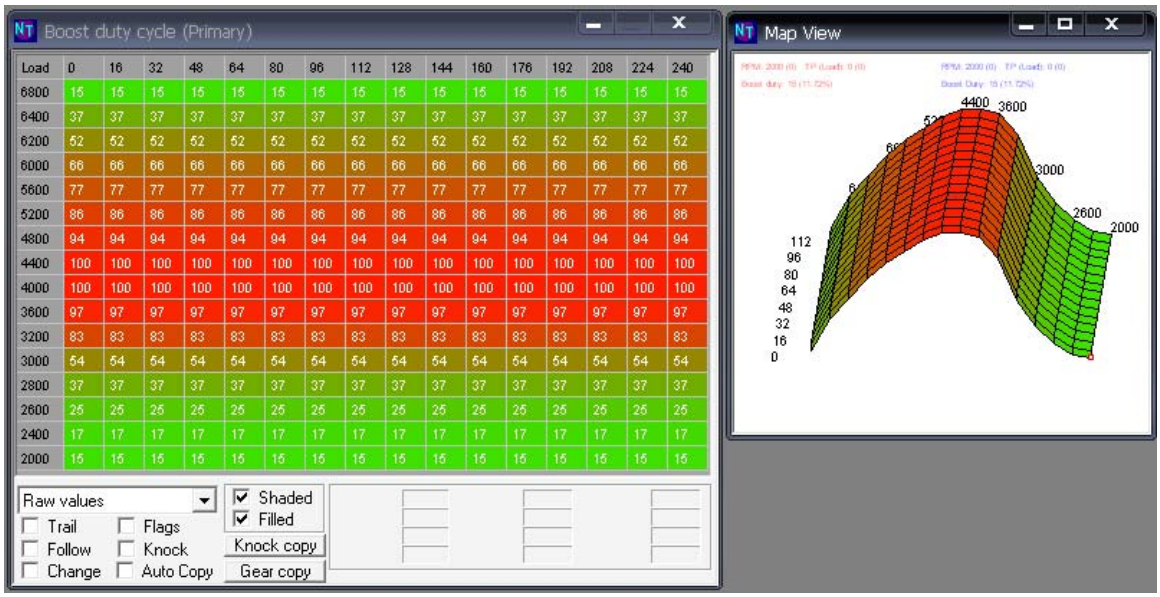


Figure 14