

AccessECU Software Calibration & Tuning Guides for Subaru

This document is intended to assist you with the calibration and tuning of your Subaru motor using the Cobb Tuning AccessECU software. This document has broken down the process into 8 basic steps. Please read through this guide before you attempt to tune your Subaru with the AccessECU software. This document will break down the calibration and tuning process into *what tables* you will be tuning in each section, *what engine variables* you will want to datalog to tune each section, and *what adjustments* should be made to your calibration. We have also written table Descriptions and Tuning Tips for most tables in the software, you can access these help documents by pressing the “F1” key while that table is highlighted in the Table List using the AccessECU StreetTUNER or ProTUNER software.

Now we are going to walk you through establishing your initial calibrations for your base map. Establishing calibrations are different from tuning. Please read through this document and establish proper calibrations for your vehicle before you begin to tune for power. You want to determine and establish calibrations without creating excessive stress or damaging your motor assembly. These 8 steps have been put in this particular order to assist you with establishing a safe calibration for your vehicle without over stressing the motor.

During your tuning session please make sure that your Intake Air Temperature and Coolant Temperature values are stabilized prior to your power runs. This will make tuning much easier for you if these two values are always the same when you start your power run. Otherwise, you can chase your tail trying to tune boost or timing if your ECU is in a different compensatory table due to the change in either of these temperatures. You can also turn the motor off (then cycle the key back to the “ON” position so you do not loose the connection to your ECU) for a short period of time with a fan blowing on the vehicle. Shortly after you start your vehicle, free rev the motor to ~5500 RPM six to eight times; this will spin the water pump pulling the hot coolant out of the block and replacing it with the colder coolant from the radiator.

1st – Calculate and establish, or verify the proper **Fuel Injector Scale** value for the fuel injectors that will be used for calibrating the engine. You will also want to make sure the **Fuel Injector Latency**, **Fuel Injector Boost Trim Error (FIBTE)**, & **Tip-in Enrichment** tables have been properly calibrated. Please see Appendix A for various fuel injector values and properties. The Fuel Injector Scale is a singular value used to represent the fuel injector size or flow rate. Any changes to this value will affect ALL tables within the ECU related to fuel delivery. When using stock fuel injectors, this value DOES NOT need to be altered. When adjusting this value, a lower number represents an LARGER injector whereas a larger scale value represents a SMALLER fuel injector.

You will not need to adjust this value when using stock fuel injectors. To calculate a starting value for a different injector size, use the following formula: $\text{New Scale Value} = (\text{Original Injector Size} / \text{New Injector Size}) * \text{Original Scale Value}$. For example, let's say you are replacing your factory WRX injectors (420cc) for aftermarket 650cc injectors. The formula would look like:

$$\text{New Scale Value} = (420\text{cc} / 650\text{cc}) * 6442;$$

$$\text{New Scale Value} = 4162$$

For another example, let's say you are replacing your factory 2004+ USDM STi injectors (500cc) for aftermarket 850cc injectors. The formula would look like:

$$\text{New Scale Value} = (500\text{cc} / 850\text{cc}) * 5372;$$

$$\text{New Scale Value} = 3160$$

Input this value as a starting point. You will likely need to tune from there. To fine tune the scale value *if you are running a stock intake system*, you can display the A/F Trim Immed. and A/F Trim Learned values with the Dashboard. With the engine idling at full temperature, make adjustments to the scale value until the A/F Correction + A/F Learning are as close to zero as possible, +/- 5% is generally acceptable. The closer you can get to 0% is ideal, but do not begin tuning any other fuel tables until you at least have it within the +/- 5% window of total correction. Do not attempt to tune for an aftermarket Intake and aftermarket injectors at the same time. An aftermarket intake will affect your A/F Trim Immed. and A/F Trim Learned values at idle, making it nearly impossible to find an accurate Injector Scale Value. ***If you have an aftermarket intake*** please use the above equation to establish your Fuel Injector Scale value then proceed to the Intake Calibration section. For setting the Fuel Injector Scale value, we advise you do this tuning using a stock intake when possible. If you plan to use an aftermarket intake, it can be installed and the necessary tuning can be performed AFTER you have found the optimal Fuel Injector Scale value.

Fuel Injector Latency, all fuel injectors require a certain amount of time to open fully which is referred to as Injector Latency. This property may also be referred to as injector dead time or dwell time. The amount of latency an injector has is dependent on several factors such as Battery Voltage and Fuel Pressure. Lower battery voltage will increase the injector's latency (dead time). Likewise, higher Fuel Pressure may also increase the injector's latency. The factory ECU has an Injector Latency adjustments table based on Battery Voltage. The data in this table is represented in milliseconds. This is the only table that exists for the sole purpose of adjusting injector latency values.

Tuning this table will consist largely of trial and error. If the engine is using STI (pink) fuel injectors on the 2002-2005 WRX or modified factory injectors, these values do not need to be altered. For other brand injectors, try and contact the manufacturer of the injector and ask them for "on-time" delay values. Most will be able to provide you with this data and the Voltage they are referenced at. Use that as a starting point and modify from there. Don't be afraid if your final values differ from what the manufacturer provided. To tune this table, we suggest that you first establish a good Injector Scale value. Adjust the latency values with the car at idle. If the car is running lean (positive fuel trim correction values) you should try increasing the latency value. Doing so will extend your total injector on-time. If the car is running rich (negative fuel trim correction values), try decreasing your latency values. In most cases, aftermarket injectors are slower than the factory injectors and thus need higher fuel injector latency values. The above tuning procedures for Fuel Injector Latency cannot be used if an aftermarket intake is in place. Be sure to save these settings in your base map.

We provide a worksheet, the **AccessECU Calibration & Tuning Guide Worksheet**, which already has suggested fuel injector latency values for various aftermarket fuel injectors. How well these latency values work all depend on the fuel pressure, alternator condition, and, charging system used on the vehicle.

Fuel Injector Boost Trim Error (FIBTE) This table is used to inject additional fuel according to the rate of positive manifold pressure change. This table works similar to the Throttle Pump adjustment, but reacts to changes in manifold pressure instead of Throttle Position change. Not necessary to change unless dramatic changes to the inlet manifold design or fuel injector size have been made (ie: racing intake manifold or larger-than-stock fuel injectors).

Calibrating this table consists of a simple mathematic calculation. You will not need to adjust this value when using stock fuel injectors. The below formula will show you how to calculate the multiplier which will be applied to all settings in the table. To calculate the multiplier value when using a different injector size, use the following formula: FIBTE Multiplier Value = (Original Injector Size / New Injector Size). For example, let's say you are replacing your factory 2004+ USDM STi injectors (500cc) for aftermarket 850cc injectors. The formula would look like:

$$\text{FIBTE Multiplier Value} = (500\text{cc} / 850\text{cc})$$

$$\text{New FIBTE Multiplier Value} = 0.588235$$

0.00	2.52	5.04	7.56	10.08	12.60	15.12	17.64	20.16
128	128	128	128	128	128	128	128	128

The easiest way make this adjustment is to highlight all of the values in the lower portion of this table, press the "M" key, then you will be prompted to enter a floating point value. Simply enter the calculated FIBTE Multiplier Value and hit enter. The New FIBTE Multiplier Value = 0.588235 would modify the above table settings to

0.00	2.52	5.04	7.56	10.08	12.60	15.12	17.64	20.16
75	75	75	75	75	75	75	75	75

Tip-in Enrichment. This table affects the amount of enrichment used during throttle "tip in" conditions. This is the situation when the throttle is opened quickly, an extra burst of fuel must be injected to maintain a correct A/F Ratio. Table values are arbitrary values referenced against a delta (change) in throttle position. The higher the values, the more fuel will be injected. These values should only need adjusting when using aftermarket (larger) fuel injectors. As the injector size increases, the amount of Tip-In enrichment required typically decreases. The goal in tuning these values will be to provide a clean throttle response when the throttle is suddenly opened from a cruise condition. In addition, you should watch your A/F Ratios to verify the A/F ratio does not suddenly increase/decrease from expected values while quickly opening the throttle. You can datalog TPS Delta, A/F Trim Immed., and A/F Trim Learned to see how the Tip-in Enrichment table needs to be calibrated in order to give you your desired output.

For tuning the Tip-in Enrichment table you will want to datalog and/or view your Throttle Position, TPS Delta, A/F Trim Immed., and A/F Trim Learned values so you can see what your ECU is actually doing to achieve its closed-loop fuel targets. If your combined A/F Trim Immed. and A/F Trim Learned are -20% for a particular TPS Delta then you will want to make an adjustment. You can highlight the Enrichment cell for that particular TPS Delta point and hit the “M” key; you will then be prompted to enter a floating point value. The correct value for this particular situation would be .80; this adjustment will now tell your ECU for that particular TPS Delta you now want a 20% less MASS of fuel burst to enter the motor. After this adjustment is made your combined A/F Trims should be closer to zero. The further the sum of A/F Trim Immed. and A/F Trim Learned % is from zero, the further off your Tip-in Enrichment settings are from ideal. We suggest you tune so that your combined A/F Trim Immed. & A/F Trim Learned % is a small (10% or less) number.

2nd – Fine tune your **Intake Calibration** table. This table is used to tell your ECU the mass of air that is entering your engine so that you can properly calculate the mass of the fuel it needs to inject into the motor to get the air/fuel value dictated in the Primary Fuel table or by the closed loop control, 1 Lambda. Under closed loop conditions the ECU is always going to try and hit 1 Lambda or 14.7:1 A/F, which is an air mass of 14.7 to every 1 fuel mass.

Start the vehicle, let it idle, and come to temperature...it may not perfectly idle, but just deal with it until it comes to temperature, 180-190 F. Use the dashboard to pull up your A/F Trim Immed., A/F Trim Learned, MAF Voltage, and Coolant Temp. After the vehicle has come to temperature, re-set the ECU (you will be prompted to turn the vehicle off then back on). Start the motor again, and then watch your MAF voltage and A/F trims. You want the combination of your A/F trims to be as close to 0 as possible. EX = If your A/F Trim Immed. is +5% and A/F Trim Learned is 0, then simply look up the MAF Voltage, which should be close to 1.2-1.28 volts at idle, on the Intake Calibration table and adjust the grams/sec value for that voltage up (+) until your combined fuel trims are 0 or close to zero. These adjustments can be made very easily by looking at the combined % correction of the A/F Trim Immed. & A/F Trim Learned. If that total is +6% then you can highlight the Intake Calibration cell for that particular MAF voltage and hit the “M” key, you will then be prompted to enter a floating point value. The correct value for this particular situation would be 1.06; this adjustment will now tell your ECU for that particular MAF voltage you now have a 6% greater MASS of air entering the motor so 6% more mass of fuel should be injected. After this adjustment is made you’re A/F Trims should be close to zero. *(If that total is -6% then you can highlight the Intake Calibration cell for that particular MAF voltage and hit the “M” key, you will then be prompted to enter a floating point value. The correct value for this particular situation would be 0.94; this adjustment will now tell your ECU for that particular MAF voltage you now have 6% less MASS of air entering the motor so 6% less mass of fuel should be injected, bringing your fuel trims close to zero.)* I would shoot for a A/F Trim Learned value of +/- 5% max. You may have to re-set your ECU throughout this process to remove any learned trims. To re-set your ECU while live tuning, close down any tracing or dashboard, then you can go to the “ECU” drop down menu and select the Reset ECU option. You will be prompted to turn your vehicle fully off and back on again. When you do this, you should notice that your DAM (Dynamic Advance Multiplier) will be set back to the default value. Make sense?

Do this along the Intake Calibration table up to 2.6 volts or so ON A LOAD-BASED CHASSIS DYNO at part-throttle. Be sure to run the vehicle with the A/C on as well to make sure your calibrations are consistent. If you have a properly designed intake system the Intake Calibrations should look very similar to your stock Intake Calibration graph under the table data. Be sure to keep your throttle movement as steady as possible during this process. Rapid movements of the throttle will employ adjustments from the Tip-in Enrichment table and may skew your fuel trims.

Your trim values will always adjust back and forth (+/-); let them, that is what they are supposed to do. Do not beat yourself up trying to get them at exactly 0...it is impossible (temperature, weather, gasoline, etc. changes will not keep anything constant while you are tuning).

If you are seeing plateaus, spikes, dips, or flat spots in the graph for the Intake Calibration table then you know something is wrong...replace the intake system with a properly designed one.

NOTE: Changing the **Intake Calibration** table will change your calculated load output. If all other variables remain constant, the less airflow you calibrate in the ECU for a given MAF voltage; the less engine load will be calculated.

3rd – Part throttle **Primary Fuel** and **Primary Ignition** calibration. Please make sure that the Weighted Interpolation box has been checked. This setting is found in the Display tab of the Configure Options menu, which can be accessed in the software by hitting CTRL+F key. The fuel targets at idle and at part throttle will and should always

be 1 Lambda or 14.7 AFR. When you increase your engine load from idle or part throttle you should always see a smooth transition from 1 Lambda (14.7 AFR) to the dictated fuel target in your Primary Fuel table. If steps 1, 2, and 3 have been properly performed then you should not need to modify much of your part throttle fuel targets because the transition will always go from ~1 Lambda down to the desired Lambda or ARF for WOT (Wide Open Throttle) which we will go over in step 6.

CAUTION: If you re-scale your load to have resolution beyond the stock calibrations then you will need to make sure the ignition advance is not too aggressive for the breakpoints at which you changed the load.

Part throttle **Primary Ignition** calibration and **Dynamic Advance** calibration. The objective of part throttle tuning is to find MBT, which is Minimum spark advance for Best Torque output. Finding MBT can be done with a good load based chassis dyno that has the ability to load the vehicle and measure the torque output at the same time. Chassis dynos such as Mustang Dynamometer, Bosch, and Dyno Dynamics have this ability. You can start off in the higher gears (lower engine RPM) and have the chassis dyno to hold the vehicle and give you the torque output of the vehicle at a RPM breakpoint on your ECU calibration. You can start out at very light (low TPS) loads holding the vehicle in one specific cell in the Primary Ignition table and slowly add ignition advance until the vehicle does not make any more torque or gets close to the knock threshold for the motor. Tuning for MBT will take a very, very long time and is not suggested unless you are very experienced with the particular chassis dyno you are using and the engine you are tuning.

4th – Boost Targets, Wastegate Duty Cycles, & Turbo Dynamics calibration. First, PLEASE READ Addendum 1, “How Subaru’s Factory Boost Control System Works” before you continue. You must be made aware that tuning the boost control system is the most difficult tuning you will perform on your Subaru. TUNING THE BOOST CONTROL SYSTEM IS ALSO GOING TO TAKE THE LONGEST TIME TO COMPLETE. Although, once you are finished tuning your boost control system you will be very appreciative of the complexity and capability of the OEM boost control system. The OEM boost control system is much faster than any human input so we highly suggest you start with lower wastegate duty cycles than you may need and work your way up from there. The boost curve and the stability of the boost curve must be established in order to allow you to properly tune all tables from this point on. The MAF signal has a major influence on the ignition advance and fuel curve since this signal is the major component used by the ECU to calculate engine load.

Subaru boost control system employs a closed-loop, targeting system for tuning boost. You must first establish your boost targets in the **Boost Targets** table. Running these boost targets is going to be the primary goal for the ECU. The ECU will start of using the wastegate duty cycles established in the **Wastegate Duty Cycles (Low & High)** table(s). Some Subaru ECUs use a single Wastegate Duty Cycles table and some use two, Wastegate Duty Cycles Low and Wastegate Duty Cycles High. *If your ECU uses the Low and High Wastegate Duty Cycles tables we suggest you set your Wastegate Duty Cycles Low table ~8% lower than the Wastegate Duty Cycles High table for the corresponding Throttle Position and RPM. We have composed a worksheet called the “AccessECU Calibration & Tuning Guide Worksheet for Subarus” which has various tabs set up to assist you with the Low and High WGDC calculations.* The ECU will then use the **Turbo Dynamics** tables adjust the wastegate duty cycle in order to achieve the dictated boost target. Other compensatory boost and wastegate tables are also used by the ECU to fine tune boost for environmental changes, temperature, barometric pressure, etc. If the wastegate duty cycle values are too low, you will not achieve your target boost pressure. If the wastegate duty cycle values are too high, you will overshoot your boost targets and potentially damage the engine. We do not suggest you run a wastegate duty cycle of more than 95% to prevent overheating or lock-up of the wastegate solenoid, and to promote the longevity of the wastegate solenoid.

While tuning the boost control system you will want to datalog and/or view your RPM, Throttle Position, Wastegate Duty Cycle, Relative Pressure, and Turbo Dynamics % values so you can see what your ECU is actually doing to achieve its boost targets. The further your turbo dynamics % is from zero, the further off your wastegate duty cycles are from ideal. Your boost targets are too high or too low for that particular RPM and TPS point to achieve your boost target; your wastegate duty cycles are not close enough to where they need to be. We suggest you tune so that your turbo dynamics % is a small (10% or less) positive number across the RPM range.

If your datalogged turbo dynamics value is a negative value then your ECU is removing wastegate duty cycles to hit your boost targets because the engine is over-boosting; the pressure measured at your intake manifold is higher than what is dictated in the Boost Targets table for the given RPM and TPS values. If your boost is surging up and down or then your boost control is searching because it is grossly overshooting its target. If your datalog

shows a negative value for turbo dynamics then the ECU will use the additional authority in the negative portion of the **Turbo Dynamics** tables to lower WGDC until the target boost is achieved.

If your datalogged turbo dynamics value is positive value then your ECU is adding wastegate duty cycles to hit your boost targets because the engine is under-boosting. If your turbo dynamics % is a negative value then your ECU is removing wastegate duty cycles to hit your boost targets because the engine is over-boosting; the pressure measured at your intake manifold is higher than what is dictated in the Boost Targets table for the given RPM and TPS values. If your boost is surging up and down or then your boost control is searching because it is grossly overshooting its target. If your datalog shows a positive value for turbo dynamics then the ECU will use the additional authority in the positive portion of the **Turbo Dynamics** tables to increase WGDC until the target boost is achieved.

If you are increasing or holding wastegate duty cycles steady and boost is dropping then you have most likely reached the threshold of the mechanical efficiency of the turbo or your exhaust gas back pressure prior to the turbo is too high and is forcing the wastegate valve to open.

If you are having a small boost spike you may need to decrease the WGDC percentage a few hundred RPM prior to the overboosting event to allow the exhaust energy to be released past the turbine wheel.

NOTE: With porting a wastegate, you are trying and make the wastegate valve function potentially work better which means that your turbo is going to lower boost super fast when the wastegate door/valve opens or not run as much boost as it was engineered to. If you make your wastegate react quicker then boost will be very difficult to stabilize and reach peak #s at an earlier RPM. If you make the wastegate flow better, then the exhaust energy your turbo needs to make and maintain boost will have less opportunity to flow across the turbine wheel. Generally speaking, air/pressure/exhaust gases will always flow along the path of least resistance. Not bashing, just trying to give you a different perspective.

5th – Mass Air Flow limits, breakpoint calibration, and **Load Scaling**. The Airflow (Max) table is the table which tells your ECU the maximum limit it will allow fuel calculations to be made. You can tell if you are exceeding the limit if your datalog show the MAF Airflow value hitting a ceiling at 300 grams/sec while your MAF voltage is still increasing.

NOTE: This MAF calculation limit is not adjustable on the 2002-2005 WRX. If your 2002-2005 WRX is exceeding the 300 gram/sec limit you will need to dictate a richer than dictated (or desired) Lambda or A/F ratio in the Primary Fuel table to get what you want out the exhaust stream. The more the motor exceeds the 300 grams/sec MAF calculation limit the further you will need to skew the settings in the Primary Fuel table. For instance, at 350 WHP you may need to dictate a Lambda of .68 (10.0:1 A/F Ratio) to achieve a Lambda of .75 (11.0:1 A/R Ratio) out the exhaust stream; at 400 WHP you may need to dictate a Lambda of .61 (9.0:1 A/F Ratio) to achieve a same Lambda of .75 (11.0:1 A/R Ratio) out the exhaust stream.

Break-points are the index values on the X and Y axis of the tables. Generally speaking, you want to have as much resolution in the areas where load changes at WOT. With all of the boost control tables you will want to make sure that you are focusing the resolution where it needs to be. You would have no reason to have any breakpoints where the vehicle does not make any relative pressure in the lower RPM ranges. Try to calibrate your ECU settings so they best match the hardware on your vehicle. The same goes with fueling, if you see that the interpolation between two RPM point is not what you want to see out of the exhaust stream you can move some of the resolution from the lower or upper RPM ranges to where you want it. Please take into account that the OEM settings are very good for most applications.

Load Scaling is also very important. Load Scaling is adjusting your breakpoints on the X axis for your Primary Fuel & Primary Ignition tables. You can keep the breakpoints the same as the factory calibration in the areas for your closed-loop operations. In the previous section you have been tuning boost on very conservative fuel and ignition settings. In steps 8 and 9 you will be tuning your Primary Fuel, Primary Ignition, and Dynamic Advance tables for Wide Open Throttle (WOT). During this initial tuning you will be able to see what the maximum load your vehicle is seeing. You should adjust the Load Scaling for open-loop sections of the Primary Fuel, Primary Ignition, and Dynamic Advance tables so that your ECU calibrations are within the load environment your motor is seeing. You can also reserve the last load column as a safety area if the motor experiences load levels beyond what the motor has been tuned for.

6th – WOT Primary Fuel calibration. We suggest you start of with excess fuel and run the motor richer than you want for your final tune, something around 0.68 Lambda (the lower 10:1 AFR). Leaning the motor out from a richer fuel curve is a much safer approach to tuning your fuel curve. Once all of the above tables, breakpoint, and load scaling have been calibrated, you will want to datalog your actual Lambda (A/F) and dictated Lambda (A/F) in your Primary Fuel table @ WOT; you can make your adjustments from there. We highly advise that you start your WOT pulls by focusing on the lower RPM ranges then working your way up to redline. EX: Start your pulls on the dyno from 2,500 RPM and go to 3,500 RPM. Check the values dictated in your Primary Fuel table against the Lambda (A/F Ratio) as measured in the exhaust stream. This only relates if you have an intake system that is other than stock; if your dictated A/F is 11.0 and you hit 12.0, then you will want to add (+) grams/sec for the MAF voltage that corresponds for that RPM and load point. The specific adjustment for the above situation should be multiplying the MAF voltage by $1.0909 = 12/11$. You should be measuring very close to the same Lambda (A/F Ratio) out your exhaust stream that you have dictated in your Primary Fuel table. Your trim values will always adjust back and forth (+/-); let them, that is what they are supposed to do. You should not have to modify the Intake Calibration table if you have a stock intake. We highly suggest you do not spend excessive time tuning your Intake Calibration table just so the A/F output matches exactly what is dictated in the Primary Fuel table. You will chase your tail getting it spot on...then you will fill up at a different gas station that will have a different quality fuel and the targets may be slightly off.

7th – WOT Primary Ignition, Dynamic Advance, & Dynamic Advance Multiplier calibration. Before we go into establishing a calibration for the ignition advance you will need to read Addendum 2, “Dynamic Advance and Dynamic Advance Multiplier Explained”, at the bottom of this document. You will want to start of with less ignition advance than you are going to run for your final tune. Too much ignition advance for any given RPM and calculated load point can destroy a motor very quickly.

To tune the ignition advance curve for WOT, you must tune boost first, while running a excessively rich fuel curve (something around Lambda of 0.68 or a low 10 AFR). You will need to datalog the following variables: RPM, Engine Load, Dynamic Advance, Dynamic Advance Multiplier, Ignition Timing, Throttle Position, and a Wideband O2 input. For tuning of **Primary Ignition, Dynamic Advance, & Dynamic Advance Multiplier** we suggest you start of with less ignition advance than the motor needs, that way you can work your way up from there. Generally speaking, a turbo-charged Subaru motor will run the least amount of ignition advance near peak torque and ignition advance will generally rise as RPM rise in order to keep up with the increasing piston speed. This trend is normal for most internal combustion spark ignition motors; as VE (Volumetric Efficiency) increases the amount of ignition advance a motor needs will decrease. As you cruise a motor's VE will not be the highest on a turbo-charged motor because the turbo is not producing much boost under cruise conditions so ignition advance will usually be higher. As VE increases at WOT (when the turbo is producing boost) ignition advance will go down to its lowest point by peak torque then it will slowly increase during the torque plateau. This is not due to decreasing VE, this is done in order to keep up with the increasing piston speeds. Once torque begins to fall off you will see ignition advance increase at higher rates. This is due to the decreasing VE and is also done in order to keep up with the increasing piston speeds; you have to start the burn earlier so that the pressure wave expansion occurs at the optimal time.

You must also be made aware of a special function in the StreetTUNER and ProTUNER software. The ECU contains a “Learned Ignition” table called Knock Learning. This table can be found in the Table List on the left hand side of the AccessECU software under the Dynamic Advance section. By pressing the F5 key (the software must be connected to the ECU for Live Tuning in order for this function to work) you can re-fresh the contents of this table and you should continue to do so while tuning your vehicle. You can verify this table is refreshing by watching the little green box in the bottom, right hand section of the AccessECU software immediately after you press the F5 key; the box should change color from green to red and back to green as it is querying the ECU for the Knock Learning table information. When you refresh (F5) this table the ECU will show you any permanent ignition advance changes it has made and stored in this table. If you see a negative value in this table it means the ECU is consistently hearing too much engine noise for the given RPM and Engine Load range and it is removing ignition advance to remedy the situation. If you see a positive value in this table it means the ECU is consistently hearing too little engine noise for the given RPM and Engine Load range and it is adding ignition advance to remedy the situation. If you see a small adjustment such as -1.5 or +1.5 being made by the ECU then I would not be too concerned about changing your Primary Ignition value to compensate...these minor corrections are a normal operation for the ECU. I would be concerned and suggest you make revisions to your Primary Ignition table if you see values such as -4 or +4.

In your datalogs you should be able to see when the ECU has made a revision to this table. If your Dynamic Advance Multiplier is at 16 on a DBC vehicle and 1.00 on a DBW vehicle and the Dynamic Advance value in your datalog is less than (or more than) what is allowed in your Dynamic Advance table for that given RPM and Engine Load point; this is telling you that the ECU has made a final adjustment to the total ignition advance running the motor. After you see this in your datalog you can press the F5 key to see if the ECU has made this adjustment permanent.

It is advisable that you re-set your ECU if you see that the ECU has made a large adjustment in this table. For the ECU to “learn” this adjustment back to zero will most likely take too long. After you re-set your ECU, it may take several WOT pulls for the DAM to move back up to 100% satisfied, 16 for DBC vehicles and 1.00 for DBW vehicles.

We have found that one must have a chassis dyno to help find the thresholds for maximum ignition advance for a particular motor and the fuel that is being used. The following section should give you a much better understanding as to how the factory ignition system works and what you are trying to do by tuning your ignition curve. The objective of ignition tuning is very simple. You are trying to start the flame front, BEFORE TDC, so that the peak of the combustion chamber pressure wave pushes down on the piston AFTER TDC. This is why values in the Primary Ignition and Dynamic Advance tables are in degrees of ignition advance *before* TDC. We must first go over how the ECU calculates total ignition advance before we can attempt to tune the ignition advance curve:

Total Ignition Advance =

Primary Ignition table value for the corresponding RPM and Calculated Load breakpoint.

+ (DAM percentage * DA table value) for the corresponding RPM and Calculated Load breakpoint.

+/- value in **Knock Learning** table for the corresponding RPM and Calculated Load breakpoint. This adjustment is made to the Dynamic Advance value and can be seen in a datalog. If your DA value for a particular load point is 8 and your DAM is showing as .50, then you should log a 4 as your DA value. If you do not see 4 in the logged value for DA, this means the Knock Learning table has been populated with a value or your ECU made a final adjustment to ignition advance because the ignition advance for that particular condition (RPM & Calculated Load) is too close to threshold.

+/- **adjustment make by ECU within Knock Detection range.** Within the Knock Detection range, the ECU can make a final adjustment to remove ignition advance is it hears the engine noise is getting too close threshold.

With the above said, what you will be trying to do is to get the total ignition advance curve as close to optimal for your motor and the fuel you are using. If your ECU and motor are happy with your calibration you will generally see that your DAM grows to the highest level possible with a few WOT pulls, which is 16 for the DBC vehicles and 1.00 for the DBW vehicles.

I would be satisfied with the ignition advance curve if while at WOT for several runs, hot ones even, the DA is a positive value across the RPM range and the ignition is a smooth predictable curve. This is not the only way to tune, just another perspective. I will sometimes allow more authority in the DA A table (if it is a Realtime table) so that the ECU will show me if the motor wants more ignition timing. I would increase the authority of Dynamic Advance in small increments, 1-2 degrees of ignition advance. Once you are able to find the ignition advance curve your motor wants for the particular fuel you are using you should see that your total ignition advance curve is the sum of the values in your Primary Ignition advance table and the Dynamic Advance table.

8th – Advanced calibration, **Idle, Idle Speeds, Ignition Air Temp. Compensation,** , etc. We have written a detailed description for all tables and tuning tips for most tables. You can access this information by pressing the “F1” key while the particular table you want to learn about is highlighted in the table list located on the left hand side of the software. Please take into consideration that the engineers who established these calibrations did this in a very scientific manner and most of these calibrations are optimal already.

When running larger fuel injectors we have found it has been helpful to maintain an Idle Speed which is 100-300 RPM higher than the factory calibration. At idle, the vehicle is in closed-loop operation trying to maintain an AFR of 14.7:1 or 1 Lambda and the ECU might modify the IPW to a point where it will not allow a fuel injector to open. Larger fuel injectors need a minimum injector pulse width in order to fully open and close; if the motor is

idling too low then the pulse width is too short to allow the injector to work properly and an occasional miss-fire can occur.

If your idle RPM or AFR at idle has a slight fluctuation then you may need to modify your intake calibration table settings around the MAF voltage the vehicle idles at. We have found that the stock calibration settings at idle can be too far apart and they may need to be adjusted so they are closer together at the MAF voltage where the vehicle idles. For this example we will say that the vehicle is idling around 1.29 MAF volts, please refer to the below pictures to see how the settings may be optimized.

Fuel Tables: Intake Calibration											
MAF Voltage											
0.94	0.98	1.02	1.05	1.09	1.13	1.17	1.21	1.25	1.29	1.33	1.37
1.30	1.49	1.70	1.93	2.18	2.45	2.76	3.11	3.47	3.86	4.29	4.73

Stock Settings
Vs.

Fuel Tables: Intake Calibration											
MAF Voltage											
0.94	0.98	1.02	1.05	1.09	1.13	1.17	1.21	1.25	1.29	1.33	1.37
2.04	2.23	2.44	2.67	2.92	3.19	3.50	3.66	3.74	3.86	4.29	4.73

Modified Settings

Notice how the settings from 1.29 volts and lower are closer to each other. This helps stabilize the pulse width dictated by the ECM at idle and can help control the slight RPM or AFR fluctuations at idle you may see on larger than stock fuel injectors.

Addendum 1 How Subaru's Factory Boost Control System Works

This document is intended to assist you with the understanding of how turbo boost pressure is controlled on an internally (or externally) wastegated turbocharger through the factory boost control system. This document will show how to properly set-up or calibrate your internally or externally wastegated turbocharger so that the boost pressure can be properly controlled by the stock boost control system. This document is broken down into four chapters; Hardware, Plumbing, Hardware Function, & Mechanical Calibration. Please read the following thoroughly before you attempt to tune your Subaru with the AccessECU software. In the AccessECU StreetTUNER or ProTUNER software, Descriptions and Tuning Tips for most of the tables are provided and can be accessed by pressing the "F1" key while that table is highlighted in the Table List.

We would like to go into further detail about the safeguards and advanced tuning features that are available through the AccessECU software. The boost control system uses a closed-loop targeting system which does everything it can to make the boost control system consistent. By employing this closed-loop boost control system the electronic control unit (ECU) can use its speed to bring down boost in overboost situations and raise the wastegate duty cycles for underboost situations. The stock boost control system is much faster than any human analysis and input; we highly suggest you use it to your advantage. In some vehicles, the boost control system can set higher boost targets up to a certain miles per hour (MPH) or bring boost targets down after a set MPH. Some vehicles allow you to tune boost by the different gears you are operating the motor in. Most critical is the fact that the ECU (on DBW vehicles) **forces the boost control system to shut down completely** (so the vehicle runs mechanical boost pressure) **if detonation events are continuing to occur**. This bit of safeguard makes the factory boost control system far superior to any aftermarket boost control system, IMO. Once the stock boost control system is fully understood, you will find it easy to tune on internally or externally wastegated turbos.

Chapter 1 – Hardware

Turbo - An exhaust driven air compressor which consists of four basic sections or components. The compressor section consists of the compressor housing and the compressor wheel. This section acts as the inlet or intake for the

turbo, compressing the intake charge and generating relative pressure (boost). Generally speaking the inlet is always in a vacuum, sucking air in and the outlet is pressurized with the intake charge. Next is the center section which contains the bearings, shaft, and the oil and anti-freeze passage ways; the compressor and turbine wheels are also attached to the shaft in this section. The third section is the turbine section which consists of the turbine wheel and turbine housing. This section also contains a machined by-pass for the wastegate valve to seat against. The last component of a turbo charger is the wastegate valve and wastegate actuator which control the wastegate valve's movement. We highly recommend that you use a turbocharger which has both an oil and water cooled center section; turbocharger longevity is compromised when only oil is used to cool the turbocharger center housing.

Wastegate Actuator - A spring/diaphragm based mechanism which controls the movement of the wastegate valve. A turbo wastegate is normally closed, forced shut by a compressed spring inside the actuator canister. As pressure is applied to the nipple of the canister, the wastegate shaft moves away from the actuator, swinging open the wastegate valve.

Wastegate Solenoid Valve - An electromagnetic solenoid which controls the air flow from the wastegate actuator to the turbo inlet. This device is normally closed when no voltage is applied. When 12V direct current (DC) voltage is applied, by the drivers in the electronic control module (ECM), to the wastegate solenoid valve, it fully opens allowing air to pass through the device. A 0% Wastegate Duty Cycle (WGDC) setting will allow the solenoid to stay fully closed; which will force the turbo to run mechanical boost pressure. A 100% WGDC setting will force the solenoid to stay fully open; which will force the turbo to run maximum boost pressure.

Vacuum Lines - Rubberized or silicone tubes attached to various components in the engine assembly. For this article we will be concerned with the six attachment point and the four sections of vacuum line plumbing and adapters which we will cover in Chapter 2.

Restrictor Pill - A small pill made of brass which contains a precision machined lengthwise hole in the center.

ECU - Also known as an ECM, PCM, EEC, EMS. The Engine Control Unit contains the processors, drivers, and logic which is calibrated to control the relative pressure (boost) via wastegate solenoid duty cycle.



Chapter 2 – Plumbing

We will break down the plumbing of the factory boost control system into four sections of vacuum lines/adapters and six attachment points. Please look at the following picture where we have four basic lengths of vacuum line and six attachment points labeled. Three of the lines are pressurized while the vehicle is under load, and one vacuum line, which goes to the turbo inlet tube, is under vacuum while the turbo sucks in air.



Line 1 plumbs the compressor housing to one end of the T-fitting. This line contains the brass restrictor pill.
 Line 2 plumbs the wastegate actuator to the opposite end of the T-fitting.
 Line 3 plumbs the middle of the T-fitting to the wastegate solenoid valve.
 Line 4 plumbs the other side of the wastegate solenoid valve to the turbo-inlet pipe.

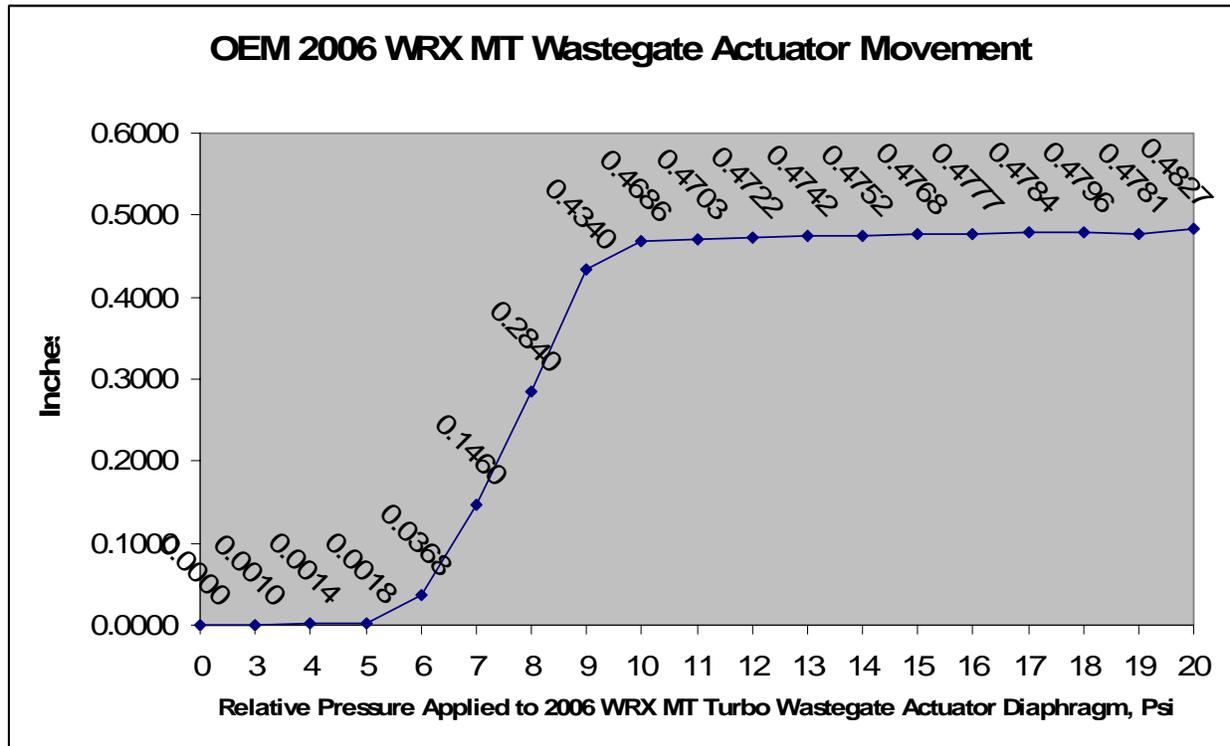
NOTE: You will notice your factory boost control system has more than four vacuum lines, because the factory uses couplers to connect the different size nipples to one section of line. For all intensive purposes you still only have four sections of line.

Chapter 3 – Hardware Function

Turbo - The function of a turbo is to compress the intake charge, creating a greater volumetric efficiency for the internal combustion motor.

Wastegate Actuator & Wastegate Valve - A wastegate actuator's function is to control the wastegate valve. The wastegate valve manages the exhaust energy being directed into or by-passing the turbine housing. If the wastegate valve is fully closed, more exhaust energy is directed into the turbine housing causing the shaft speed of the turbo charger to increase and the relative pressure (boost) to increase, all within the efficiency range of the turbo. If the

wastegate valve is opened the exhaust energy by-passes the turbine wheel and goes into the downpipe so that the turbo shaft speed decreases or remains constant. Opening the wastegate valve will generally lower relative pressure (boost) produced by the turbo. Below is a line graph demonstrating the rod movement of the wastegate actuator arm as pressure is applied to the canister nipple.



NOTE: The MORE boost you run, the LESS wastegate you need/use. So unless you want to run less pressure than stock and/or have un-tunable boost problems, we suggest that you do not port your wastegate by hand. We suggest you leave your wastegate, the area around it, the turbine housing, etc. alone and tune your boost curve through the proper means.

Wastegate Solenoid Valve - The function of this device is to control the amount of air pressure being bleed away from the wastegate actuator.

Restrictor Pill - This component limits the amount of pressurized air flowing from the turbo compressor housing. The restrictor pill restricts the air flow so the wastegate solenoid valve and wastegate actuator are not overdriven, which would force the wastegate valve to open prematurely.

Vacuum Lines - Vacuum lines plumb pressurized air to the proper components so the Subaru boost control system works properly.

ECU - This is the master device which controls the wastegate solenoid valve, the slave device, so that the targeted relative boost pressure is obtained.

The factory boost control system bleeds pressure away from the wastegate actuator to the intake or turbo inlet pipe. With this device set at 0% wastegate duty cycle through the ECM calibration, all of the air pressure generated at the compressor housing will be applied to the wastegate actuator forcing the wastegate valve to fully open. When the wastegate actuator is fully open, the vehicle will run mechanical boost pressure which can be anything from 7-11psi on original equipment manufacturer (OEM) turbochargers. When this device is programmed to 100% wastegate duty cycle through the ECM calibration, all of the air pressure generated at the compressor housing will be allowed to by-pass to the wastegate actuator allowing the wastegate valve to close. The flow is limited by the size of the hole in the restrictor pill located in the first vacuum line attached to the turbo compressor housing. The wastegate valve will only close as much as it can (taking into consideration that the exhaust gas pressure between the exhaust port and the turbocharger is generally greater than the manifold pressure the turbo is generating) with the exhaust gas pressure pushing on the wastegate valve.

NOTE: If you run a turbocharger beyond its compressor efficiency range, it will turn into a flame thrower.

Chapter 4 – Mechanical Calibration; Mechanical Tuning and Boost Control System Calibration Using the AccessECU StreetTUNER Software

Mechanical Tuning

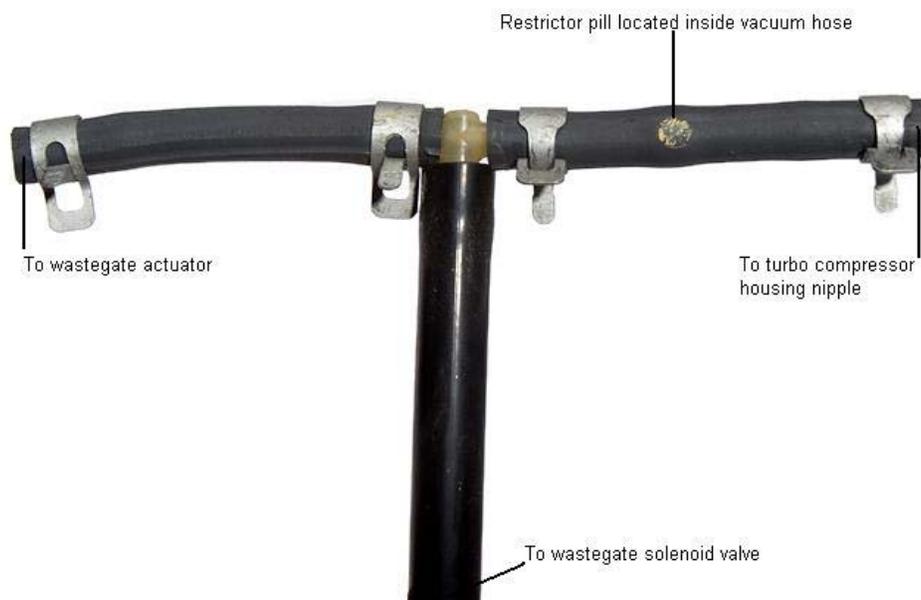
Changing the size of the center hole in the restrictor pill; the vacuum lines for the factory boost control system contain a small brass restrictor pill located in the short vacuum line coming off the turbo compressor housing. The middle of this restrictor pill has a lengthwise hole precisely machined to a certain specification so that it works with the factory wastegate actuator and the wastegate duty cycle settings in the stock ECU. The size of this center hole can be changed in order to mechanically assist boost control.

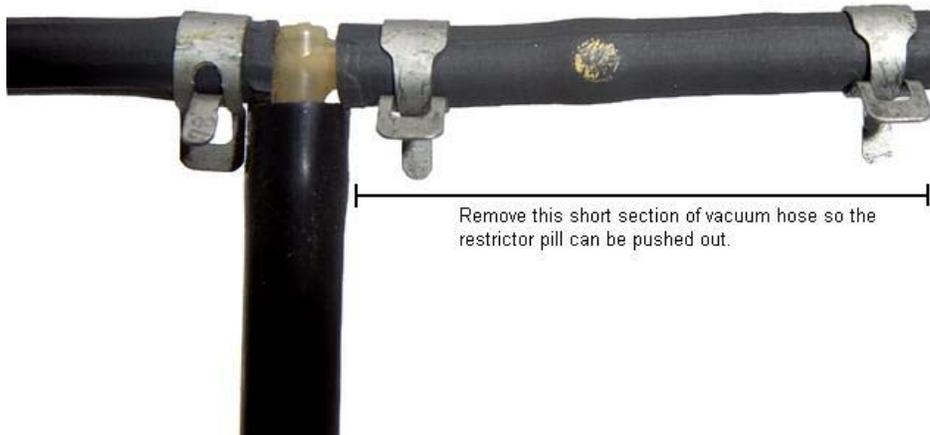
A smaller diameter hole in the center of the brass restrictor pill will have a higher tendency to create boost spike in the system and require less wastegate duty cycle to run higher boost. The larger the diameter hole in the center of the restrictor pill, the less chance the boost control system will boost spike and greater wastegate duty cycle will need to run in order to produce higher boost. If you have a stock turbo and are running an AccessPORT map, you have no reason to modify your restrictor pill. If you have installed a new turbocharger and you are using the stock boost control system to tune boost, please verify that the vacuum line coming off the turbo compressor housing (prior to the T-fitting) contains a restrictor pill with a hole machined in the center of the pill.

The stock boost control system most commonly uses a restrictor pill with a center hole size of 0.040"-0.048" +/- 0.001"

For larger-than-stock turbochargers or turbochargers with a stronger mechanical spring in the wastegate actuator you will need to use a restrictor with a larger center hole, something along 0.050"-0.055" +/- 0.001"

For similar-to-stock-sized turbochargers with a weaker mechanical spring in the wastegate actuator you will need to use a restrictor with a smaller center hole, something along 0.030"-0.040" +/- 0.001". Be very careful when using a restrictor with a center hole of this size, there is a higher tendency for the system to boost spike and you will need less wastegate duty cycle to run higher boost.





Carefully insert straight pick into the center of the restrictor pill and gently push out the brass restrictor pill. Be sure not to poke or rip the vacuum hose.



After the restrictor pill has been properly modified, be sure to insert the pill so that it does not block the air path. If this vacuum line is blocked the turbo will very quickly overboost and potentially cause severe engine damage.

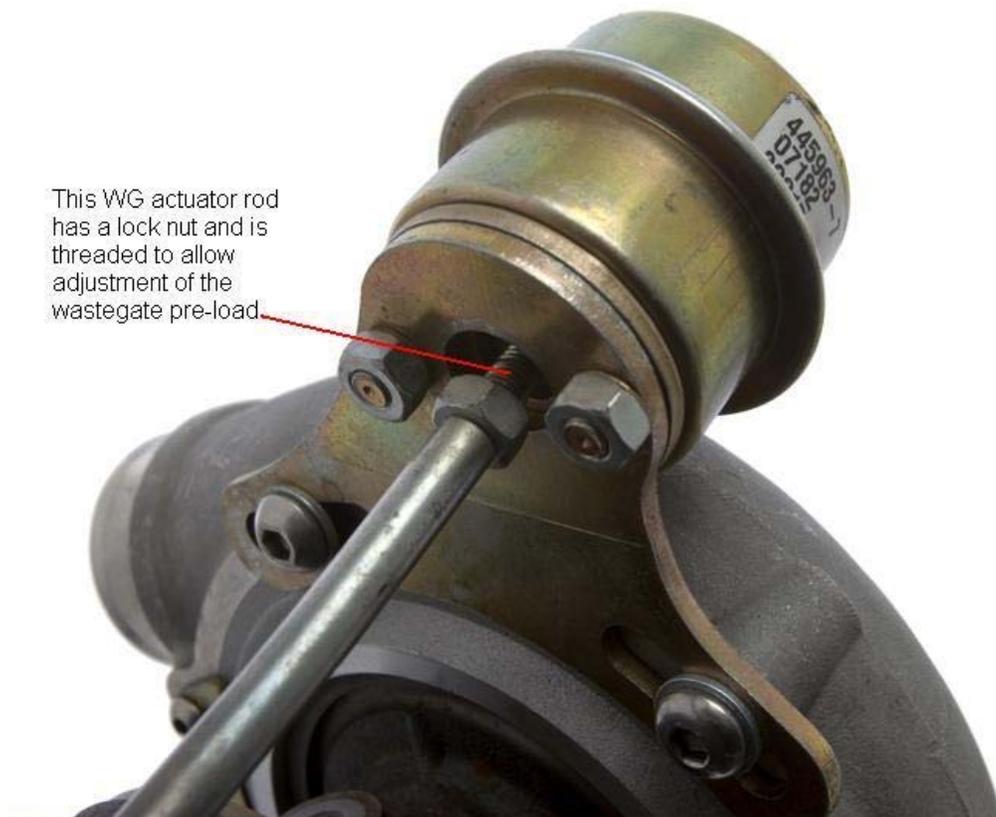


The restrictor pill should fit tightly inside the vacuum line and should have the hole machined in the center of the pill.

NOTE: The hole in the restrictor pill can always be machined to a larger diameter. Be sure to make very small increases in the diameter of the hole. If the center hole is machined too large you will not be able to hit your boost targets...even with 100% wastegate duty cycle.



The location of the threads can be located at either end of the wastegate actuator rod, see the below picture where it demonstrates the threaded section is closest to the WG actuator diaphragm.



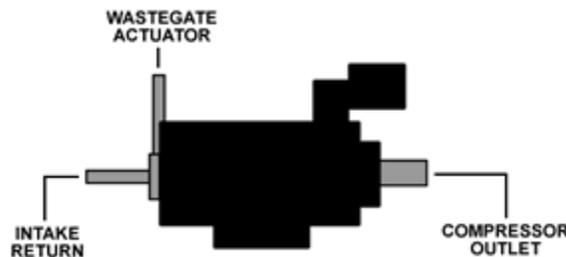
Pre-loading the wastegate actuator arm; adjustment of the wastegate actuator rod (if the rod length is not fixed and adjustments can be made) will allow proper calibration and some additional tuning as well. All IHI turbochargers have a fixed wastegate actuator rod that cannot be adjusted, while all MHI turbochargers have an adjustable wastegate actuator rod. If the rod coming out of the wastegate actuator is shortened, it will pre-load the spring inside the wastegate actuator increasing the pressure level at which the actuator will allow the wastegate valve to open and the total boost pressure that the turbo can generate will increase (as long as the turbo is still within its efficiency range). This pre-load will also limit how far the wastegate valve can open. Pre-loading (shortening) the wastegate actuator rod too much CAN POTENTIALLY CREATE A MECHANICAL BOOST CREEP ISSUE THAT CANNOT BE TUNED OUT! If the wastegate actuator rod is lengthened, the actuator will decrease the load on the spring and decrease the pressure level at which the actuator will open and the total boost pressure the turbo can generate will decrease. If the wastegate actuator rod does not put enough pre-load on the wastegate valve, then you could see boost fluctuations of + or - 2psi even when the wastegate solenoid duty cycles are constant. If you have a stock turbocharger then you should not have to adjust the wastegate rod length.

NOTE: The larger diameter wastegate valve a turbo has, the more difficult it is to stabilize boost pressure as the valve initially opens. This is also true for greater exhaust gas back pressures created by a smaller A/R on the turbine housing.

Electronic Tuning Through ECU Calibration

The stock boost control system can be used to control boost on properly designed internal and external wastegated systems. If you have a turbocharger with a properly designed internal wastegate valve/actuator that has been properly calibrated using the correct size restrictor pill and wastegate pre-load you will be able to use the factory boost control solenoid.

NOTE: If you are tuning with an external wastegate, we have found that the Pro Drive electronic boost control solenoid (EBCS) works perfectly with the stock compensatory wastegate calibrations (coolant, intake air temperature, etc.). This solenoid is a replacement for the stock EBCS and plugs in to the factory wiring harness. Tuning external wastegates with the factory boost control system (ECU) has worked very well as long as you use the Pro Drive EBCS. Please refer to the below picture so you know how the plumbing of the Pro Drive EBCS should be set-up. With the Pro Drive EBCS you WILL NOT NEED TO USE ANY RESTRICTOR PILL!



You must be made aware that tuning the boost control system is the most difficult tuning you will perform on your Subaru. TUNING THE BOOST CONTROL SYSTEM IS ALSO GOING TO TAKE THE LONGEST TIME TO COMPLETE. Although, once you are finished tuning your boost control system you will be very appreciative of the complexity and capability of the OEM boost control system. The OEM boost control system is much faster than any human input so we highly suggest you start with lower wastegate duty cycles than you may need and work your way up from there. The boost curve and the stability of the boost curve must be established in order to allow you to properly tune all tables from this point on. The mass air flow (MAF) signal has a major influence on the ignition advance and fuel curve since this signal is the major component used by the ECU to calculate engine load.

Subaru boost control systems employ a closed-loop, targeting system for tuning boost. You must first establish your boost targets in the **Boost Targets** table. Running these boost targets is going to be the primary goal for the ECU. The ECU will start by using the wastegate duty cycles established in the **Wastegate Duty Cycles (Low & High)** table(s). Some Subaru ECUs use a single Wastegate Duty Cycles table and some use two, Wastegate Duty Cycles Low and Wastegate Duty Cycles High. *If your ECU uses the Low and High Wastegate Duty Cycles tables, we suggest you set your Wastegate Duty Cycles Low table ~8% lower than the Wastegate Duty Cycles High*

table for the corresponding Throttle Position and revolutions per minute (RPM). We have composed a worksheet called the "AccessECU Calibration & Tuning Guide Worksheet for Subaru" which has various tabs set up to assist you with the Low and High WGDC calculations. The ECU will then use the **Turbo Dynamics** tables to adjust the wastegate duty cycle in order to achieve the dictated boost targets. Other compensatory boost and wastegate tables are also used by the ECU to fine tune boost for environmental changes, temperature, barometric pressure, etc. If the wastegate duty cycle values are too low, you will not achieve your target boost pressure. If the wastegate duty cycle values are too high, you will overshoot your boost targets and potentially damage the engine. We do not suggest you run a wastegate duty cycle of more than 90% to prevent overheating or lock-up of the wastegate solenoid, and to promote the longevity of the wastegate solenoid.

While tuning the boost control system you will want to datalog and/or view your RPM, Throttle Position, Wastegate Duty Cycle, Relative Pressure, and Turbo Dynamics % values so you can see what your ECU is actually doing to achieve its boost targets. The further your turbo dynamics % is from zero, the further off your wastegate duty cycles are from ideal. When your boost targets are too high or too low for that particular RPM and throttle position sensor (TPS) point to achieve your boost target, your wastegate duty cycles are not close enough to where they need to be. We suggest you tune so that your turbo dynamics % is a small (10% or less) positive number across the RPM range.

If your datalogged turbo dynamics value is a negative value, then your ECU is removing wastegate duty cycle to hit your boost targets. This is due to the engine over-boosting; the pressure measured at your intake manifold is higher than what is dictated in the Boost Targets table for the given RPM and TPS values. If your boost is surging up and down, then your boost control is searching because it is grossly overshooting its target. If your datalog shows a negative value for turbo dynamics, the ECU will use the additional authority in the negative portion of the **Turbo Dynamics** tables to lower WGDC until the target boost is achieved.

If your datalogged turbo dynamics value is a positive value, your ECU is adding wastegate duty cycles to hit your boost targets because the engine is under-boosting. If your datalog shows a positive value for turbo dynamics then the ECU will use the additional authority in the positive portion of the **Turbo Dynamics** tables to increase WGDC until the target boost is achieved.

If you are increasing or holding wastegate duty cycles steady and boost is dropping, then you have most likely reached the threshold of the mechanical efficiency of the turbo or your exhaust gas back pressure prior to the turbo is too high and is forcing the wastegate valve to open.

If you are having a small boost spike, you may need to decrease the WGDC percentage a few hundred RPM prior to the overboosting event to allow the exhaust energy to be released past the turbine wheel.

NOTE: With porting a wastegate, you are trying to make the wastegate valve function potentially work better. This means that your turbo is going to lower boost super fast when the wastegate door/valve opens or not run as much boost as it was engineered to. If you make your wastegate react quicker, boost will be very difficult to stabilize and reach peak #s at an earlier RPM. If you make the wastegate flow better, then the exhaust energy your turbo needs to make and maintain boost will have less opportunity to flow across the turbine wheel. Generally speaking, air/pressure/exhaust gases will always flow along the path of least resistance. Not bashing, just trying to give you a different perspective.

v1.01

Addendum 2

Dynamic Advance & Dynamic Advance Multiplier Explained

I would like to start out with some initial table definitions. These tables are in the factory Engine Control Module (ECM, also known as the ECU) and are used to tune the motor. You can access these table descriptions and tuning tips by pressing the "F1" key while that table is highlighted in the Table List using the AccessECU StreetTUNER or ProTUNER software.

Primary Ignition -

This is the primary ignition table which uses engine RPM for the vertical (Y) axis and calculated load for the horizontal (X) axis. All, if any, corrections made to ignition timing will be based on the values looked up originally

in this table. These values are in degrees BTDC (before top dead center); the higher value the more ignition advance, the lower value, the lower the ignition advance.

Tuning Tips = Variables such as octane rating, spark plug temperature & gap, intake air temperature, and application (street driving, road racing, rally racing, drag racing, etc.) must be taken into account when tuning this timing table. When tuning Ignition Advance, keep in mind that your final actual ignition advance value will also include a portion of the Dynamic Advance table, as well as any corrections. If your boost and fuel table adjustments are ideal for your configuration, you can datalog your Dynamic Advance, Dynamic Advance and DAM values to determine if you are using too much (or too little) timing accordingly. There are two popular schools of thought with regards to Dynamic Advance tables, one which utilizes the Dynamic Advance table to add in a majority of the ignition timing and the other philosophy of reducing the dynamics of the Dynamic Advance table by reducing its values and adding them instead into this main Ignition Advance table. Use whichever philosophy best meets your goals and comfort level. It is advised you make small adjustments when tuning your Primary Ignition advance table. Keep in mind you will need less Ignition Advance as the engine's Volumetric Efficiency increases. This means you will typically use less ignition advance near or at peak torque. After your torque peak, you typically will want an increasing ignition advance. Best power typically is found near the threshold of knock, so use care when tuning. However, it is also possible to make less power with more ignition advance without actually reaching the knock threshold. This is where tuning on a load-based dyno with realtime feedback can be very beneficial.

Dynamic Advance -

This is a dynamic ignition advancing table which uses engine RPM for the y-axis and calculated load for the x-axis. This table is a closed-loop ignition advance table that allows the ECU to advance ignition timing beyond the main ignition table values as long as the engine "noise" heard by the knock sensor is not too high for that RPM & load point, as determined by the ECU. In other words, as long as the engine is happy the ECU will allow the ignition to advance beyond the main Primary Ignition table values. The freedom for the ECU to add additional degrees of ignition timing is determined by the values in this table. Even if additional ignition timing could be added the ECU will not advance ignition timing beyond these values. If the ECU hears noise which it finds unacceptable, the ECU will not allow any additional ignition advance. If the ECU hears too much noise through the knock sensor and determines that detonation is occurring or is about to occur then the ECU will pull timing until it is satisfied with the engine noise for that RPM & load point. If the Primary Ignition table has a timing value which is too high for the current conditions the ECU will get pissed off and try to pull timing until it is happy again. All values are in degrees BTDC (before top dead center). The amount of timing to be added to the Primary Ignition table is determined by the values in this table along with the Dynamic Advance Multiplier value. The ECU will take the looked up value from this table and then use a percentage of that value based on the value in the Dynamic Advance Multiplier.

Tuning Tips = We suggest you tune this dynamic timing table so that the ECU is not given too much authority to change (or add) timing. We also suggest that this dynamic timing curve is mapped for consistency and smoothness. If knock correction is always adding the maximum allowable additional ignition advance from this table then timing needs to be added to the Primary Ignition table.

Dynamic Advance Multiplier -

Singular value used to determine the value for the Dynamic Advance Multiplier that the ECU will start with upon resetting the ECU. The higher the value, the greater the proportion of the Dynamic Advance values will be added to the Primary Ignition. The total of these two values will be the total ignition advance for the motor.

Knock Learning -

The ECU uses this table and populates it with adjustments made against the amount of Dynamic Advance used by the ECU (total ignition advance). The Load values define the X-axis of a learning table related to knock events. This assist the ECU in learning at what conditions the engine tends to make noise (knock) and attempts to be pre-active in its Dynamic Advance advancements based on values in this table.

Tuning Tips = This table can be refreshed while you are connected live to the ECU by hitting the F5 key. A negative value in this table means the ECU has found that engine noise is too high for that particular load and RPM group and it has removed some of the Dynamic Advance that can be used (for that section of load and RPM cells). Given this information you can remove this amount of ignition advance from the Primary Ignition table. A positive value in this table means the ECU has found that engine noise is too low for that particular load and RPM group and it has added some additional authority to the Dynamic Advance that can be used (for that section of load and RPM cells). Given this information you can add this amount of ignition advance from the Primary Ignition table.

NOTE: Having this table populated with small adjustments such as +2 or -2 is normal activity. Although, if a larger negative value is in the WOT load column, you may want to remove some ignition from your Primary Ignition table (for those load and RPM sections).

Dynamic Advance Multiplier (DAM) can be seen as a measurement of how happy the ECU is:

The Drive-By-Cable (DBC) vehicles are rated from 0 to 16, measured in increments of ~1. 0 meaning the vehicle is seeing continuous detonation and 16 being the ECU is happy with the tune and allowing a more aggressive total ignition advance curve.

The Drive-By-Wire (DBW) vehicles are rated from 0 to 1.0, measured in increments of ~.05. 0 meaning the vehicle is seeing continuous detonation and 1.00 being the ECU is happy with the tune and allowing a more aggressive total ignition advance curve.

For ignition advance calculations, the factory ECU looks up the value in the Primary Ignition table for that particular RPM and load point, then it will use the DAM to determine the proportion of additional ignition advance it will add to the Primary Ignition value to create the total ignition for the motor. The ECU is constantly listening to the motor through the knock sensor and watching crankshaft fluctuation. If the ECU does not hear too much engine noise for that given RPM and load point, then it will allow the DAM to grow. If too much noise is heard, then the DAM will move down or stay steady...depending on how much excessive noise is heard. It will stay constant on some poorer gases or if you have tuned close to threshold.

When you reset the ECU, the DAM will be reset to whatever is dictated in the AccessECU software through the **Dynamic Advance Multiplier (Default)** table. The ECU will use the ignition advance value in the Primary Ignition table's cell, according to the RPM and load point it is in. The ECU will then reference the DAM, if the DAM for an STi is .8, then the STi ECU will use the timing value in the Primary Ignition table (for that load and RPM point) and add 80% (.8 divided by 1.0) of the value in the DA table (for the same load and RPM point) as the total ignition timing.

Total Ignition Advance =

Primary Ignition table value for the corresponding RPM and Calculated Load breakpoint.

+ (**DAM percentage** * **DA** table value) for the corresponding RPM and Calculated Load breakpoint.

+/- value in **Knock Learning** table for the corresponding RPM and Calculated Load breakpoint. This adjustment is made to the Dynamic Advance value and can be seen in a datalog. If your DA value for a particular load point is 8 and your DAM is showing as .50, then you should log a 4 as your DA value. If you do not see 4 in the logged value for DA, this means the Knock Learning table has been populated with a value or your ECU made a final adjustment to ignition advance because the ignition advance for that particular condition (RPM & Calculated Load) is too close to threshold.

+/- **adjustment make by ECU within Knock Detection range.** Within the Knock Detection range, the ECU can make a final adjustment to remove ignition advance is it hears the engine noise is getting too close threshold.

Make sense?

The ECM does all of the above and it also has a hidden "Learned Ignition" table called Knock Learning where it will store a final correction value that is made to dynamic advance for a given load and RPM point. If the ECU hears detonation it has the authority to immediately remove timing for a particular load and RPM point so that detonation event does not occur again. The rate at which the ECM can make adjustments to DAM and the load range it can look at can all be edited in the ECM using the AccessECU software. In other words, the ECM is doing everything it can to constantly fine tune the motor and assist in the consistency of the motor's performance. I hope this helps.

If it does then the DA value will be higher in the datalog, as well as total ignition timing. This would indicate to me that the value in the Primary Ignition table is not aggressive enough. Be cautious when tuning timing. If the DA is recorded as 12 degrees, that does not mean that you can add 12 degrees more ignition advance to the Primary Ignition table for that particular load and RPM cell. I would increase ignition advance in small increments (1-3 degrees) for that point and reduce the authority in the Dynamic Advance table. Run the car again, then look at the datalog for DA at that load and RPM point and it should have gone down to 4 to 7. Make sense?