



PERFORMANCE AND LUXURY MOTORSPORTS

Tuning Division – Jorge M. Carrillo

Caring for and modifying your vehicle

PERFORMANCE AND LUXURY MOTORSPORTS – TUNING DIVISION – JORGE M. CARRILLO

Caring for and modifying your vehicle

© Performance and Luxury Motorsports
3847 Carnation Street, Franklin Park, IL. 60131
Phone 847.678.4311 • Fax 847.678.4313
www.pandlmotorsports.com

Table of Contents

So then, why this guide?	2
So what can I do?	2
Sounds intimidating! Who should I talk to?	5
But you still haven't told me what I should buy?	5
So where does the tuner come into the picture?	6
Sounds simple... what's the catch?	6
Anything I should do before my tune?	6
What sets tuners apart?	9
My friend made more power, why?	10
"My car is acting up after being tuned..."	11
So what should I look for then?	12

Why we modify our cars?

As the old saying goes: “Your car never felt faster, then right before it blew up!”

To most people, their vehicle is an extension of their personality. It’s a symbol of pride, an example of the most eclectic of tastes, and a proverbial pit of money that is endless for some.

Despite that, it’s entirely possible to not only achieve a balance between your finances and goals, but also make that investment last for a long period of time!

...There’s hope!!!

So then, why this guide?

In many years of collaboration with not only enthusiasts, but professionals, I’ve realized that there is a diametric opposite understanding of vehicles. Misinformation, bad advice, blatantly wrong advice, how ever you want to term it. What this leads to is a disproportionately large base of people who are completely ill-equipped to care for their vehicles.

This is evident in even the new owner who doesn’t do anything to their car. When they put off oil changes till they’re 2 quarts low, and 5,000 miles later. They proceed to attempt to care for their vehicles using the same poor habits, and then proceed to blame the tuner and/or install shop.

It’s incredible what actually causes failures sometimes. Unfortunately, simple care and discipline could have prevented the issue in the first place.

So what can I do?

By reading this, you’ve already taken the first best step! By indulging your curiosity on what makes the car tick, you’ll be able to further your own understanding; ultimately increasing the satisfaction that you’ll have with your vehicle.

Chapter 2 will break the tuning and parts selection process down into a manner that will be easily digestible for the average person, while chapter 3 will concentrate on the simple disciplines you'll need to master for the continued enjoyment of your vehicle.

What is tuning, and why is it important to me?

“I need two of the big ones! By tonight!”

I’d say that the most asked question I have is: “So what should I do to my car?”. The answer has been pretty similar across the years. It’s based on 3 questions I need to ask first.

1. What is the purpose of the vehicle? Do you plan on road racing it? Auto cross? Drag racing? Street racing?
2. How successful do you want to be in that endeavor? Do you want to run STX in the SCCA? Want to run 11’s down the track? Beat up on Viper’s at the light down the street?
3. How much are you willing to invest in the inevitable up keep of the vehicle.

People so often overlook that 3rd question. Most of the time people aspire and plan to afford their shiny new exhausts, turbochargers, and boost controllers. Never considering the supporting and ancillary modifications required much less the upkeep of the vehicle from the extra wear and tear down the road.

I fondly remember one of the east coast Subaru shootouts, where Jamie Rigoli was talking to an enthusiast who was asking about what it took to build a nine second drag car. I took pretty gleeful delight watching the poor car owners face twist in shock as Jamie was throwing out numbers in the tens of thousands of dollars, quickly adding up into six digit territory.... For about a year of vehicle expenses, not even delving into travel, and other needs of crew and staff.

That is the reality of how things work though. In the Subaru community at least, there are pretty understood milestones that represent leaps in cost. For a 2.0L based vehicle, there are three major groups of investment. Stock turbo, any turbo under 300WHP, everything else.

For 2.5L based vehicles, there are also 3 major categories. Anything under 350 WHP, anything from 350-400WHP, and everything else.

Simply put, category one on both displacements will allow for a fairly reliable driving experience. Category two on both displacements starts to delve into driveline issues on both the manual and automatic transmissions. Category three on both displacements really delves into the whole hog. Engine, transmissions, cooling systems, etc., they all need to be looked at...

Sounds intimidating! Who should I talk to?

Well, ultimately, you're going to have money to burn, and you're going to need a place to burn it. But, before jumping head first at your closest PIAA Super White peddler, ask around. Talk to other owners, check the better business bureau, walk in and ask to tour the facility, perhaps even asking to sit in on a tuning session (assuming your shop offers such services).

If the place you're looking to spend thousands of dollars at won't even indulge your most simple requests, take that as a warning sign. A shop should be an open book with no secrets and nothing to hide. Unless of course it's race season and they're working on project cars. If so, cut them a break and be a touch patient. ☺

But you still haven't told me what I should buy?

Nor will I attempt to. That conversation far exceeds the scope of this missive, and is extremely affected by not only the platform in question, but its ultimate goal. The key things to keep in mind though is to THOROUGHLY think out the part selection process, especially considering how one part will affect the system as a whole.

Case in point, Subaru's 2.5L "world engine" has now been installed in all USDM offerings. The biggest problem is that a lot of the aftermarket offerings for a mid-level, affordable upgrade, are still based on 2.0L R&D. So, when you have a cat-less exhaust with a turbocharger that has an exhaust housing that was optimized for the 2.0L, you immediately run a huge risk of suffering from catastrophic boost creep.

Or people who choose to run aftermarket turbochargers that are not water cooled don't stop to consider that the factory oil/water cooler is going to be taxed tremendously since they still have a factory radiator setup.

...add to that the fact that they still run 5w30, and no turbo timer, toss in a track day, and you have oil temperatures that are so hot you're effectively using something as thin as water to lubricate your motor (read: spun bearings), and at the least you are going to destroy that nice shiny turbocharger due to severe oil coking.

Little things... they add up.

So where does the tuner come into the picture?

Frankly, the tuner comes in at the end of the equation. A parts specialist and the owner come up with a game plan. Then a qualified installer puts the proper care into producing a properly prepped vehicle. Finally it's the tuner's responsibility to meld everything together into a properly running, SMOOTH, REPEATABLE, and enjoyable experience.

Sounds simple... what's the catch?

The catch is that tuning is an often misunderstood paradox.

Let me explain. Most people want a tuner to get the job done in as little time as possible. As a result, the majority of tuners will rely on maps that have been refined over time, and use those as foundations, then concentrating the majority of the consumers' dollar into the critical WOT (wide open throttle for those wondering) aspect of the engine management system.

If your tuner is worth his weight in salt, you'll actually end up with something that is 90-95% acceptable in the idle/part throttle ranges, and perfectly repeatable in the WOT ranges.

The paradox comes in that some people still want that 100% everywhere, but never want to pay for it. So it makes it very difficult from a support standpoint since it could very realistically take DOZENS of hours to properly dial in ALL functions of the EMS.

Granted, some EMS solutions don't offer nearly the adjustability of others. That being said, it's extremely important for a consumer to properly discuss these details with their chosen tuner, PRIOR to purchasing parts.

The second biggest misconception is that people think that one EMS solution will make more power than another. That's completely false!!!! Fuel is fuel, timing is timing, boost is boost. The syntax of the interface will not affect the outcome, only the individual behind the keyboard can. So get into your tuners head, communicate to them what it is you're looking for, and come to an understanding on what is realistic and what isn't.

That point boils back down to the "misinformation" that's so prevalent amongst enthusiasts. If I had a dollar for every person that heard, read, saw, someone who has a car that their G-tech is running 11's on a TD04, I'd be rich! Unfortunately, reality is different for us back on earth.

Anything I should do before my tune?

The most important part is to make sure you have a SOLID platform for your tuner to work off of. Tuners are not mechanics, and vice versa. So you can't realistically expect your tuner to spend your dyno time trying to diagnose and fix your car. If most tuners are like me, they're busy, always busy....

Thankfully, there is a very simple list of things you should look into prior to your tune. I've updated this list over the years, and I'll include it here for reference.

1: Pressure test your system.



Build a small compression tester by taking a PVC cap the size of your inlet hose, drilling a hole large enough for a tire valve stem, and cementing it to it. Then you can simply clamp it to the inlet hose and plug off your evaporative purge lines. As you fill the system with air, you want to make sure you don't have any air escaping at all from the inlet hose, BOV return line, BOV itself, etc. If you hear a leak in a congested area, grab a spray bottle of soapy water, and mist the area. See bubbles? Fix or repair the clamp. One important detail to note is that you should leave the oil cap off so in the event you do this wrong, you're not going to blow the cam seals right out of the motor (wouldn't be the first time I've seen that happen).

2: Check plugs and gap.

What you have to know is this: You want to run the widest gap you possibly can without misfiring. You misfire because you simply do not have the joules (a measure of energy) necessary to jump the gap on a spark plug in a high pressure environment.

Factory ignition:

What we've found is that stock turbo WRX's are fine with their factory gaps, but anything over the stock turbo should be at .028-.033" gap. Any turbo over 650 CFM should seriously consider

running as far down as a .025-.031" gap. 2.5L's are different. Seriously consider running at least .028-.032" on any car setup aggressively with their stock turbo's (FXT's, Baja's, STI's, etc.) Same rule applies to turbos over 650 CFM. They've been shown to work better at a .025"-.030" gap. Something else to keep in mind about plugs is that tuners are embracing copper plugs for high pressure environments. Frankly, if you're pushing 22+ PSI, seriously consider them. Reason being that the electrode on a Iridium or Platinum plug is so small that it will continue to glow after the combustion event, setting the cylinder up for a pre-ignition issue on the next stroke. Avoid this situation at all costs! High RPM misfire, and pre-ignition will quickly spell the end of an engine. Work with your tuner to properly select the spark plug for your application.

Aftermarket plugs:

At the time of this revision, aftermarket coils and ignition amplifiers are becoming common place. Ideally, start with the widest gap listed on the ranges for a factory ignition, and bump them up by about .005". Then, proceed to tune the car and if you have any high RPM misfire, you back the gap down. If you are not in a position to do that (consult with your tuner), then it be relatively safe to simply stick with the high range on the listed gaps under 'Factory ignition:'.

Plugs: As stated above, Coppers really are your best bet. In the case of the 2.0, consider the Champion racing series plug (Extended tip, J-gapped plug), part # C59YC. The important part is to index the plug. Indexing is the process of orienting the ground strap of the plug at a certain position on the clock.

What we tell people is to try and shoot for as close to 12-1PM as possible. What you'd want to do is put some white-out or something similar on the extension to the plug socket, and then orientate the ground strap so that the back of it is on that mark. Proceed at that point to tighten (be careful!) the plug so that the mark ends up at that 12-1PM mark if you're looking down the extension itself.

3: Check coils.

If the car suffers from misfires, stutters, etc, and a plug swap hasn't cleaned them up, consider swapping coils around. This is especially valid if the problem persists in one cylinder. Misfires and detonation cause the electrical energy of the coil to go to ground, and as a result it can quickly overheat and damage a coil. Try swapping the coil first with a cylinder known to be OK. If the problem follows it, you know it's a coil. If not, check the back of the plug with a volt meter on the supply wire. It should have around 12 volts. If it does, and the front of the plug doesn't, you may need to rebuild the weather pack. I've seen at least half a dozen examples of corroded pins in the weather packs themselves.

4: Check Compression.

If the car is erratic, and #3 was fruitless, check your compression. If you find that you have good ring seal, and you've not successfully found your problem, do a leak down test. I've seen a few cars skip teeth on their belts, which wouldn't necessarily affect the compression numbers too bad, but dramatically affect performance.

5: Consider your mod path, and how it relates to boost control.

Subaru superceded the parts used for their boost control restrictor pills sometime for the '05 MY. What this means, is that it's VERY difficult for turbochargers on said vehicles to exceed 15-17 PSI on a factory equipped IHI. Stock WRX's will achieve even less. If you've found that you're in this category. You have 3 options. (If you are trying to sustain over 20PSI at redline, just go to option C)

A: Leave it alone and tune the car for what you can get out of it.

B: If you have an adjustable waste gate arm, you can preload it based on conversations with your tuner.

C: Install a GM boost control solenoid (part number 1997152). A search on NASIOC can yield quite a few threads on the proper installation of this part. Again, it's very important that you do this with the guidance of your tuner. If not, you WILL suffer from boost spiking, or worse.

6: Check all fluids and ancillary items.

Oil, coolant, radiator cap, alcohol for injection kits, fuses, tire pressures, leaks, etc. Imagine you're going on a huge cross country road trip, and the LAST thing you want is to break down in the middle of no where.

Again, remember the old computer saying... *"Garbage in, garbage out..."* If you present your tuner with a car in poor shape, you're going to get a tune that is also going to be in poor shape. If you're tuner is a god, at best you'll have a band-aid over a bullet wound, and the car will drive fine. But if you wrench on the car later, and fix whatever was wrong, you'll compromise your tune. Finally, in my opinion, no... it's **NOT** the tuners fault either, when it blows up!

Caveat Emptor...

What sets tuners apart?

This is a highly debated and contested topic. Fundamentally understand this much about it. You'll have others contest that the internal combustion engine is such a complicated tool, that anyone without a mechanical engineering degree is unqualified to do the job.

To those people, I laugh! Fact remains; there are a finite amount of things that you need to understand. Learning to use the tools of the trade properly is 1000x more important then understanding thermodynamics and flame font propagation. That's not to say that having even a basic knowledge doesn't behoove a tuner, but it's by far not critical. Hundreds of people successfully tune and enjoy their own personal vehicles. Some of our most looked upon tuning shops have naturally talented individuals who live in a state of symbiosis with the vehicle they're working on. Feel, sound, sensation, all go a long way to delivering a product that is just as much an extension of their personalities, then anything else.

That is what sets a tuner apart. Because in it's simplest form, tuning is three parts art, and one part science. What works for one tuner, will not work for another, but that doesn't necessarily mean it's a bad thing.

My friend made more power, why?

First off, you can never, EVER, compare numbers on a dyno. Not even across the same dyno on different days. On top of that, I try hard to tell people that it's actually possible to make a lateral move on a tune, not even making any more power. That being said, there are only 2 things I can promise them, and that is a safer and more consistent tune.

Secondly, I tell people all the time that a dyno is a tool, curves and trends are what matter. If it so happens to produce a hard-on inducing number, so be it!

You're paying a tuner for his knowledge and understanding, if he feels that the car should be left at a certain point, why question it? If you had the proper answer in the first place, I'd expect you would have been the one tuning your car in the first place.

See, there are a few tricks a dyno operator can do to make you believe you're making more power, but I don't agree with that.

If I have to cool the car down for 20 minutes, jack up the tune so it's aggressive, and get you one power run just so you can brag, I've done you no favors. Especially when on the second run, it's so hot, and on the verge of detonation, that the car is pulling out timing like mad.

If I can't do at least 2-3 back to back runs with the temperatures stabilized, and the car not pulling timing, etc. I will re-evaluate and back down the tune if need be. As chapter 3 will soon touch, you'll be surprised just how little abuse a motor can take. You don't need the tune to be setup at a point where it accelerates the inevitable failure of your car.

So let me close with this. Everything has a lifespan, eventually, inevitably it will fail. Someone trying to tell you other wise is lying.

In regards to dyno usage... It is a tool, nothing else, it's to be referenced at that moment in time, nothing more, and the repeatability of the results during the session are paramount, nothing less.

Caring for your investment

“The car did idle pretty good at BR. Further down the road it got worse and worse. That is how this entire thing happened...” - Anonymous

The other day I was talking with some enthusiasts and a vendor who had problems before, during, and after the tune. Frankly, it was that whole conversation that sparked this entire document. Since it's such a good example, I thought I'd bring it up as it's the stereotypical situation we as tuners and providers need to deal with.

“My car is acting up after being tuned...”

“...But I took it home anyways and beat on it to see if it would get better.”

This is why I put the fear of god in my customers.... Because no matter how hard I try to educate, there will always be someone who follows that pattern.

To play devil's advocate, it's a paradox. I can't blame a customer for being ignorant (I use that term for lack of a better one only). After all, that's why they take their cars to those who are more knowledgeable. But that's the paradox.

Tuner is all knowing and careful.

End-user shouldn't have to be.

But without the tuner being there 24/7, it's impossible to baby-sit small problems that ALWAYS WILL CREEP UP, and prevent large ones.

Had I gotten a phone call saying it was acting up on the way home, my first words would have been to turn around, at the LEAST to NOT beat on it AT ALL, until some form of scientific discovery process could be invoked.

But that's in a perfect world, reality is that myself, and other tuners have to go on faith that our customers will exercise **common sense**, when typically mundane and simple things that can go wrong, do. Not ignore simple warning signs, and then go racing.

This is a common frustration from the service provider's point of view.

In the end, all we can do is our due diligence and *attempt* to impart at least enough of our knowledge and fears, to turn the customer in to an extension of ourselves.

Only then, can the tuning cycle really be effective.

So what should I look for then?

Plenty! The key is to understand, at the least, the most critical systems of your platform. Learn to at least troubleshoot that much. It will go a long way to prolonging your investment. I'm going to get specific to the Subaru platform, but the same context can be applied to ANYTHING.

At its core, an engine management system works by using a combination of references to determine items like fuel and timing. By and large, if the tune itself was correct, you'd be surprised just how broke the car could be, and still run right, so long as those load reference inputs are not compromised.

There are three common types of load reference employed by the majority of EMS manufacturers (including OEM). MAF based, MAP based, and speed density based.

MAF (Mass air flow) based references use a sensor that measures the airflow that is actually entering into the engine's induction system. Obviously, any compromise to the induction system will cause a draw (or push in post compressor areas of a forced induction car) that is throwing off the systems metering. A minor leak will throw off the entire tune of the vehicle. Inlet hoses, intercooler hoses, their clamps, IC gaskets, BOV's, BOV gaskets, TGV gaskets, manifold gaskets, etc. can all lead to a catastrophic engine failure if left unchecked.

MAP (Manifold absolute pressure) based references use the intake manifold pressure as a means of determining engine load. The benefit of this system is that the areas of failure really only happen after the throttle body, in the intake manifold itself. Not a common type of load reference in the Subaru world anymore, MAP based referencing is only used by a small amount of aftermarket EMS solutions today.

Speed density references use a combination of air temperature and MAP sensor inputs to determine the volumetric efficiency of the vehicle. This is becoming a very popular system in not only the aftermarket, but even in systems that reflash the factory ECU. Like MAP based systems, there are very few things that could fail that will affect how the vehicle will drive.

Since MAF based is still the predominant system used today, it's very important that customers familiarize themselves under the hood of their vehicle.

The next major area of failure is in the fuel system. On Subaru's, the fuel pressure regulator is fed by a fitting located on the intake manifold. The major problem is that since it's not a barbed fitting, there is nothing for a hose to grip onto. When that hose flies off, you're going to have a

catastrophic drop in fuel pressure. Within a short period of boost events, the vehicle will start to detonate to the point where inevitable piston damage occurs.

Frankly, I keep referring to these as major areas, but the reality is that they're all interrelated.

A boost leak in a intercooler pipe will cause a dramatic enrichment of fuel that will also cause rich misfire situations. These rich misfires will eventually burn out your ignition coils, cause pre-ignition, clog catalytic converters, foul plugs, wash out rings and cylinder walls, and everything else under the sun.

Check your fluids, DAILY! For people who are advocates of chemical augmentation (alcohol, water injection, NO2), it's YOUR responsibility to check those fluids daily. In terms of oil, what I've always told people is that you have two inspection holes on your dipstick. Look through it, if you can't see through them because the oil is that dirty, change it. That could be at 1000 miles if you beat on the car hard, or 5000 miles if you don't. So long as the level is fine, and the cleanliness is there, that is what really matters if you're changing it or not.

Finally, the single most important thing is to understand is how the car SHOULD drive.

For example, I pride myself in delivering cars that actually drive perfectly smooth, with progressive power delivery. All customers get a comprehensive test drive, as well as explanation of what's been done, and how the car will react.

That being said KNOW YOUR CAR! If you start to notice a stark change in the drivability of your vehicle, COMMUNICATE with your service provider. Even if you don't have the mechanical ability to comprehend or follow some of what this guide discusses, it doesn't matter. We ALL know how to pick up a phone. If the tuner you're talking to doesn't encourage follow-up calls, etc. Find another tuner. I'd rather be bugged at 2 AM for someone erring on the side of caution, then someone who waits till the next day, because the car is driving poorly and they decided to just drive it as opposed to waiting.

Your individual tuner will undoubtedly have more things you should remember after your tune, so talk to them in depth.

But if there's one lesson to be learned, it's that the tuner is really only 20% of the equation. We can prove over and over and over that the car was consistent in our care. After that, it's in the owners hand to properly care for, and communicate any concerns to the appropriate individuals. To the same token, it's the owners responsibility to consider the history and longevity of their vehicle prior to going down the modification road. The owner of a car with 80k miles on their sole form of transportation, wanting to toss in a 400WHP turbo is going to get a stern talking to.

I hope this has at least enlightened those doing the research into getting more out of their vehicle, while helping those already at that level to enjoy their investment longer.

Jorge M. Carrillo
-Tuner
Performance and Luxury Motorsports