How to Understand, service and modify Bosch Fuel Injection & Management by Charles O. Probst. Robert Bentley Publishers. ISBN 0-8376-0300-5

http://www.hiperformancestore.com/Ljetronic.htm

GREG'S BOSCH L-JETRONIC FUEL INJECTION IDLE ADJUSTMENT, DIAGNOSTIC AND TUNE UP PAGE, Latest revision Sept. 4th 2003 includes changes to the introduction, Step one, testing procedures for the Altitude Compensating Device on Step 10 and the creation of Step 12 which involves advanced Air Flow Meter instructions for adjustments for Max power and best emissions.

The Bosch L-Jetronic system is used on all U.S. Spec Alfa Romeo GTV6s, Milanos, and 1982-1989 Spiders, BMW E12 5 series and various 3 series cars, The Datsun 280Z and 280ZX, All U.S. spec fuel injected Fiats and Lancias, The 1984-1989 Nissan 300ZX, The Toyota Supra Mark 1 and many others.

I am writing this article specifically from the point of view of a U.S. Alfa Romeo GTV6 and Milano, however if you own any car with Bosch L-Jetronic injection the article will still help you. However the components of other cars using L-Jetronic will be located in different locations, but the testing procedures are the same.

The components from the various types of cars DO NOT interchange. This is especially true between the Japanese and European cars.

Introduction, please read this before starting any work on your injection system:

At one time so many People asked questions about idle problems that I decided to write complete idle adjustment instructions. However, with the L-Jetronic system our cars use, about 90% of the complexity deals with about 5% of the running. In other words most of the system's components deal with things like cold starting, warm up, idle, full throttle etc. That means that by the time you have checked and adjusted everything that affects idle you have really checked and adjusted most of the injection system. Just add new plugs, a cap and rotor and you have done a complete tune up. So this article has really turned turned into a complete fuel injection and tune up article.

I am writing this article specifically for the U.S. Alfa Romeo GTV6 and Milano, however if you own any car with Bosch L-Jetronic injection the article will still help you. However the components on an injected Fiat X1/9, Fiat Spider, Lancia or other L-Jetronic car will not be located in the same place they are on a GTV6.

You can use this article in a few ways, first you could follow it through step by step. This would very thoroughly check out your injection system. I recommend this method if you have plenty of time, or if your car has more than one problem or if you

just purchased the car and want to get it running just right. If your car has one simple problem you can use this article as a sort of trouble shooting and testing guide for specific components. To make trouble shooting easier I have included the symptoms associated with a defect for each part of the injection system. The sections showing these symptoms can be found quickly by looking for the * Symbol. If you follow all of these instructions perfectly you will almost certainly gain some horsepower! Even on a perfect car with stock settings you will gain a tiny amount, and on most GTV6s which are not in the best state of tune you could quite probably pick up ten or more horsepower! If your car is in fine tune but you are looking for ways to gain a little power look for the @ symbol.

This article is written with economic realities in mind. I am not going to tell you to go out and buy Bosch testing equipment or to buy expensive new parts you may not need. We will be testing everything with an inexpensive ohm meter and a test light I will also be telling you how to repair most of the parts so you won't need to buy a new $100 hose or sensor. Everything I say or recommend has been done on my own vehicles with great success.

Some people may ask, "Greg, what qualifies you to write this?" Well I should say I have no formal automotive training but you can bet I know more about V6 Alfas then the mechanic at your local Pep Boys. I have been riding in or driving Italian cars my whole life. The first car I ever rode in was a Fiat 600. My father has been working on Italian cars for over 40 years, at one time professionally. I started helping him in the shop and paying attention from a very early age. I have owned many Italian cars and I currently own 4 including one I commute to work in. I am not someone who owns a show Alfa that never leaves the garage and drives a Honda to work. I do all my own work and my cars are very reliable. So if you want to trust me read on, if you don't that's OK too. Of course you should also have and read the official Bosch and Alfa Romeo publications relating to anything you are doing on your car. If anything the official publications contradicts anything I have written then go with the official advice.

9-04-2003 I now consider this article to be complete. I may edit it from time to time, but for the most part it's done. This L-Jetronic article has proven highly successful. At one time on the forum at gtv6.org (where this article started) it seemed there was a question almost every day about a fuel injection problem. Today questions posted there about L-Jetronic are quite rare. That's great because it means more people are successfully fixing their Alfas, Fiats, and Lancias themselves which helps keep ownership costs down which in turn helps the cars survive.

Thanks for visiting,

Greg Gordon

STEP 1 Eliminate Air Leaks.

Air leaks are easily the most common problem on the GTV6. * They can cause all kinds of trouble including difficult starting, lack of power, irregular idle, high emissions, and the famous engines starts, then stalls right away syndrome. A big air leak can cause an explosion in the intake system which can blow the plenum right off

the motor, or in some cases blow the main air intake hose off. You should also check to make sure your hoses are hooked up correctly. Compare your engine compartment to the pictures on this page and make sure your hoses are hooked up like mine.

To eliminate all leaks you need to start by removing the main air intake hose. I know you don't want to but it's for the best. Now use dish soap, warm water and a brush and clean it very carefully and thoroughly inside and out, it will probably have a surprising amount of oil inside. The accordion section tends to trap a lot of oil and debris so pay special attention there. Now inspect the hose very carefully for cracks, they tend to be common on the bottom of the accordion section and the sections where the other hoses join into it. If you find any cracks you need to determine if they go all the way through. To do this shine a flashlight inside the hose and flex the rubber in the area of the cracks and see if any light passes through. If it does then you have an air leak and it needs to be fixed. Now this hose is about $100! That's a lot of money for a hose. I bought a brand new one and it cracked all the way through again in a just a couple of years. I guess it was one of those "new" hoses that sat on the shelf for ten years until someone bought it. Most auto parts vendors equate "new" with not yet sold. However rubber parts deteriorate with age so you have to be careful. Anyway, I don't buy "new" ones any more and unless yours is really bad I don't think you should either. There is an easy and inexpensive way to repair these hoses. Go to a sporting goods store and get a product called "Shoe Goo" or "Shoo Goo 2" which is the same stuff. This is an incredibly strong and thick glue like substance used for repairing the soles of athletic shoes. Fill the accordion section with Shoe Goo and spread it on any other areas with cracks. It dries clear and can be put on smoothly so it will look pretty good. Now put the hose back on the car so the Shoe Goo dries with the hose in its normal position. Spread a little more on the bottom of the accordion section and wait for it to dry. That will probably be the last time you have a problem with that hose, the Shoe Goo lasts a really really long time.

Here my red pointer is touching the accordion section of the main air intake hose which has been treated with Shoe Goo. You can also see the airflow meter (AFM) which the hose connects too at the bottom.

Now we need to check the other hoses. Keep in mind that your hoses may be 20 years old and are probably need of replacement. Every time they are handled there is a chance for a crack to develop into an air leak. The best thing to do is replace all the hoses there with a silicone air hose kit available on page 5 of this site, we have them for every L-Jetronic Italian car ever made. If you want to check and re use your old hoses that's ok too, just read on.The factory used very high quality hoses that are rubber with a cloth like covering on the outside. The problem with them is they can look fine and still leak! This is because you can only see the outer cloth like covering and not the airtight rubber part which could be full of holes. I am afraid you will have to remove them to really properly check them. There are other ways to check the hoses, like spray soapy water on them with the engine running and look for bubbles or other signs of leakage but this does not work very well. Take the hoses off, one at a time, plug one end with your finger and force air into the other, preferably with an air compressor but orally if there is no other option. Listen and feel for leaks. If it does not leak, the ends are not split and the hose clamps are OK, just put it back on and check the next hose. Check them all and do not forget the small hose that attaches to the fuel pressure regulator. These are frequently cracked where they attach to the regulator and a leak here will prevent you car from ever running properly. Of course the little hose going to the vacuum advance is important also so don't miss it. If more then one hose is bad or if all of your hoses are the original ones then I recommend replacing them all. The best thing to do is to replace them all with a silicone hose kit

which is installed on my 85' car's engine pictured below. We have silicone hose kits for all L-Jetronic Italian cars. **Click vacuum hose kit tab.**

Another common source of air leaks are the six plenum to intake runner connection hoses. These short hoses don't really crack to often, however they do warp and deform. Also their clamps tend to loosen up over time. The best thing to do is replace them all. If you don't want too, just loosen the clamps enough to move them up and down, inspect them, and push down on the plenum to make sure it's fully seated. If it all looks OK then it probably is, just retighten the clamps and everything there should be fine.

Ok, just a little more on air leaks. If you have an 84' or later GTV6 you have some air hoses running into the rear upper right corner of the engine compartment and disappearing down a hole. One of these hoses comes from the plenum, one from the intake hose and one from a location that is way beyond the scope of this article. All of these hoses connect to an emissions canister located in a secret compartment behind the right front wheel. To open the secret compartment you will need to drill out the rivets holding its cover in place. Of course just to find the rivets you will need to clean away some dirt and road grime from the area. Once the plate is off, the hoses are available for inspection or replacement. It's important to note that this location collects a lot of dirt and moisture and is the first place to start rotting away on the GTV6 so it's important to clean it out once a year or so. The fact that the sunroof drains into this area does not help. The canister in there must be inspected for leaks since it's exposed to corrosion and rust. If it's damaged just clean it really well and patch it with J.B. weld, not the quick drying kind. Put it all back together and use self tapping screws to re attach the cover so you can take it off again in the future.

If you have an 81'-83' GTV6 your car does not have this canister and you can count yourself lucky. This is one of the small advantages the older models have. If you have a Milano, the canister is located behind the right side of the front bumper.

The worst place to have an air leak is at an injector seal. Fortunately it's also the rarest place for an air leak. Each of the car's six fuel injectors press into a small rubber seal in the intake runner. These seals are often forgotten since they are out of sight below the injectors. However when they get old they can leak. Most people think that a failed lower injector seal will result in an external fuel leak but that's not the case. A failure of a lower injector seal will cause an air leak into the engine not a fuel leak out. There are a few reasons this is the worst air leak to have. Most air leaks are upstream of the intake plenum which means that these air leaks are divided evenly among the cylinders. In those cases the O2 sensor will try to richen the mixture to compensate and during steady driving will do a fairly good job. Your car won't run just right and it will not have full power but at least during normal driving your mixture will be close enough so your engine won't suffer any damage. All of the air leaking in through a bad injector seal will go into just one cylinder. The O2 sensor will try to compensate by richening the mixture in all cylinders which is all it can do. The result will be a mixture that is too rich in five cylinders and too lean in just one. Running the car like this for an extended period of time can result in burned valves, damage to the valve seat area and excessive cylinder and piston ring wear. In short this is the worst air leak to have because not only does it cause the running problems the other air leaks do but over time it can result in ENGINE DAMAGE!

Behind this panel is the secret compartment. There is one on each side but only the right side has anything in it. However both covers should be pulled off and the compartments cleaned at least once a year.

@I should mention that with the intake hoses off, it's an excellent time to adjust the valves. Valve adjustment is beyond the scope of this article but with the hoses out of the way it's a good time to do it. The intakes never really get out of adjustment which is good since you have to remove the cams to adjust them. The exhausts however can be easily adjusted. The book calls for a clearance of .0089" to .0098". That means set them to .0089"! Any extra clearance means reduced lift and duration which means lost power. Extra clearance can also shorten the life of cams and other valve related components. This is a little thing you can do that costs nothing and improves power.

This is an 83' GTV6 engine compartment. You can see that some of the intake plumbing is a little different from the later setup shown in the next photo. This car has a few visible modifications including a second air/oil separator, a manual aux air valve and high capacity modern fans. You can also see that this car has a home made hood catch since the original plastic one was broken.

This is the motor in my 85' GTV6. Its intake plumbing is like all U.S. spec 84' and later GTV6s and Milanos. I replaced most of the air intake hoses as well as three of the coolant hoses with red silicon ones. They should never leak. You can see that this motor also has the second air oil separator and a manual aux air valve although it's a different style then the one on the 83' car. Sharp observers will also notice the after market air flow meter.

STEP 2 ELECTRICAL GROUNDS

Next to air leaks bad grounds are easily the second most common problems on L-Jetronic cars. There are not too many of them to deal with, but they are all critical.

*Bad grounds can cause a huge variety of problems. There are so many in fact that the official Bosch trouble shooting guide lists bad grounds as a possible cause for 80% of the problems they recognize. These problems include driveability problems during warm up, starting problems, the starts and stalls syndrome, irregular idle, lack of power, high emissions and high fuel consumption. The good news is that grounds are easy to find and fix so this won't cost you any money.

When I start working on grounds I start right at the heart of the injection system, the injection ECU.

DANGER WILL ROBINSON DANGER DANGER

It is quite possible to ruin the ECU or other electrical components of the L-Jetronic system so please read carefully and do not skip ahead on any of this electrical stuff.

We will be disconnecting the ECU soon. It is very important that the ignition switch be OFF whenever disconnecting or connecting the ECU. As an added precaution you may want to disconnect the car's battery before proceeding, this will insure the ignition is off. A bad ECU ground can cause every type of running problem the car can have. However the one thing it can't do is stop the car from running at all. Even if the ground is totally removed the car will start fine but will cough if you advance the throttle more then about a millimeter. It's actually possible to drive the car without an ECU ground but your top speed will be about 45 mph and it will take about five minutes to get there, and yes I have tried this!

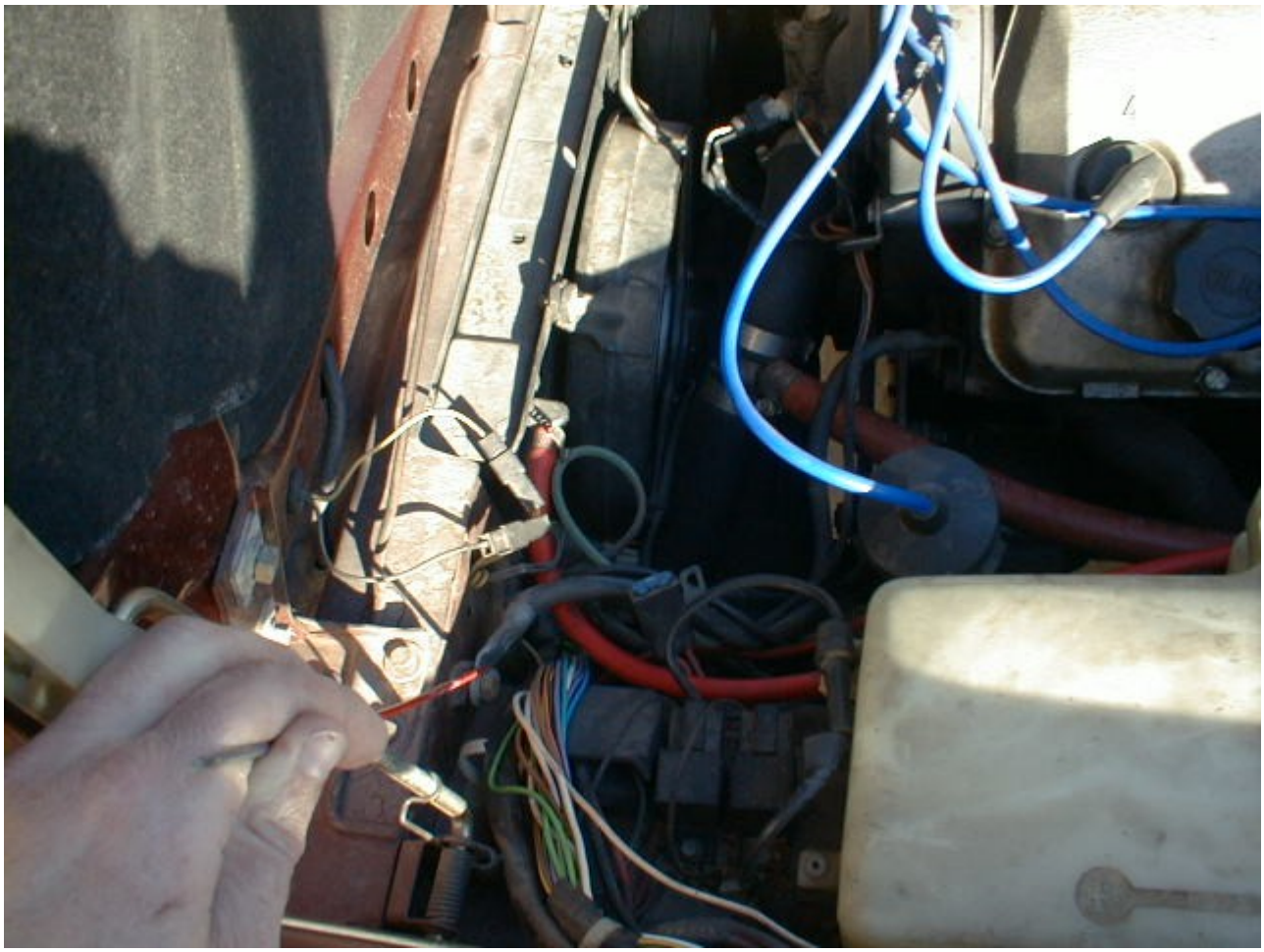
Once the ignition is off we can find the injection ECU behind a vinyl covered panel on the right side of the passenger's footwell. The panel is held in by screws and once removed you will see a black box with a large wiring harness attached to it, that's the injection ECU.

Make sure the ignition is off. Some people say it's also possible to damage the ECU with static electricity from your body. This is the same static that shocks you when you walk on new carpet and touch something metal. I don't know if it can really damage the ECU but I don't take any chances and you shouldn't either. To eliminate this risk, I don't take the ECU out of the car, I work on it right there in the passenger seat, and if I get out I make sure I am not touching the ECU, car, and ground at the same time. Now disconnect the wiring harness from the ECU. There is a little tab to move and then one end of the harness will pull free and it will pivot on an attachment point at the other end. Just unhook it there and it's disconnected. Now just unbolt the ECU from the car so you can hold and inspect it. Look at all the terminals and inspect them for corrosion. The grounding terminal is on an end and is usually the only one to corrode. Clean all the terminals with a toothbrush and electrical contact cleaner. Spray cleaner into the harness too and put it all back together.

Now for the BIG GROUND. The big ground is fun because it's super easy to find and get to. The big ground is the large black covered cable that connects the front of the driver's side cyl. head to the body of the car. Just look at the front of the driver's side head and you can't miss this one.

This ground is not only big in size, it's super important. Everything in the injection system ultimately grounds here. There are other grounds on the motor and they are all important but they are all connected to or rely on this one in some way. Get some wrenches, a solution of soapy water (I use dish soap because it cuts grease and oil like crazy, it's cheap and right there in the kitchen, just don't use it to wash the body because it also eats wax). You also need a small brush and some fine Emory cloth. Unbolt the big ground clean up the area with the brush and soapy water, then remove any corrosion or rust with the Emory cloth. Put it all back together and you should not have any problem with that ground for 10-15 years. If you want to be really professional do what my friend Brian H. does and put some silicone terminal grease over it to protect the ground from corrosion.

Here my pointer is touching the Big Ground's connection at the body. The other end attaches to the head. On a Milano this ground IS the battery's negative terminal. This is the most critical ground on the whole car.



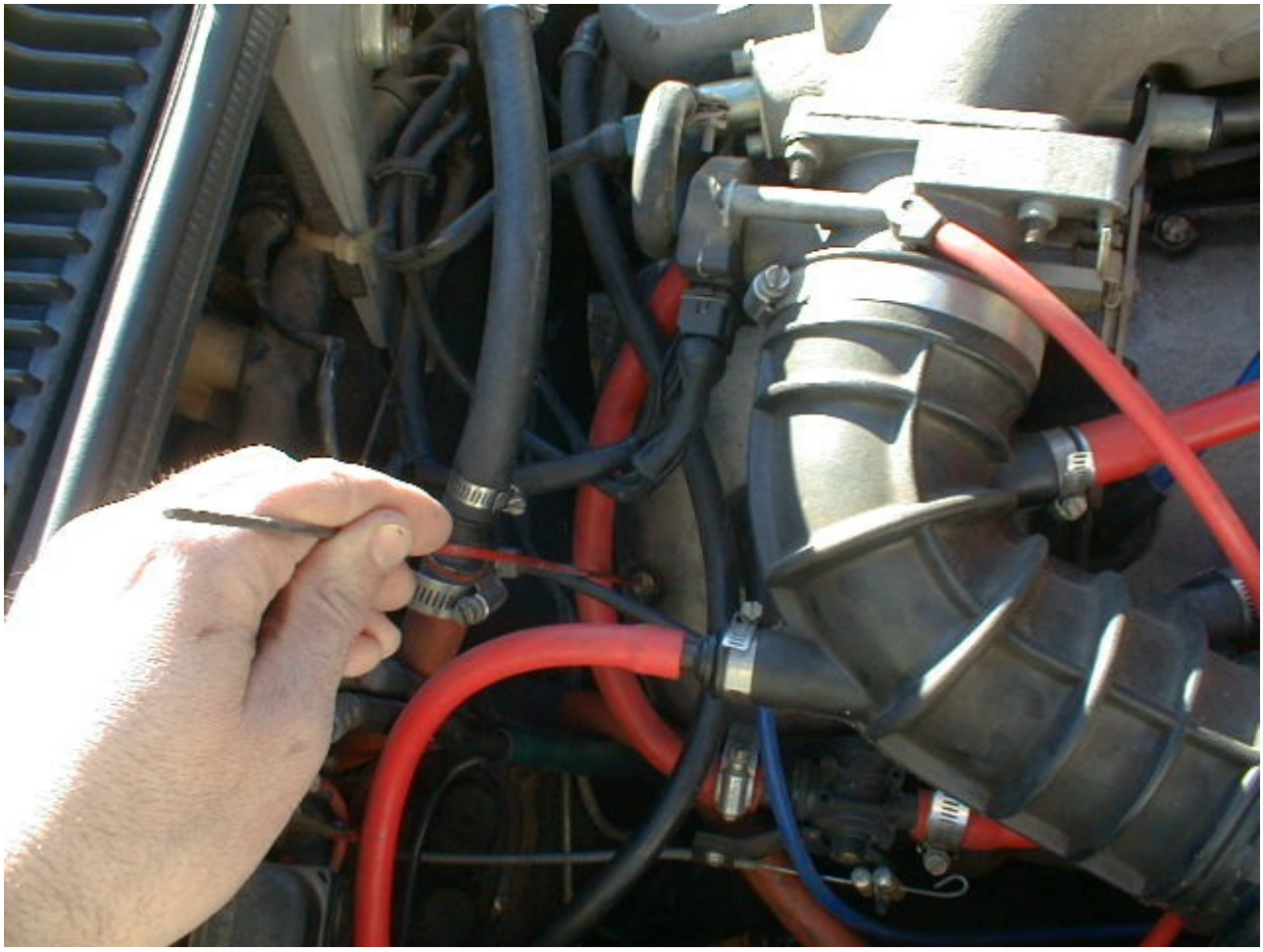
I am afraid the rest of the grounds are not too exciting, buy they are all important. The next ground to check is the one that connects the negative terminal of the battery to the body. This one is actually the "big ground" in a Milano but the GTV6 has its battery in the trunk so it's a little different set up. If your battery terminals are badly corroded poor some Coca Cola or some other brand onto them and wait. The cola will eat the corrosion. Be careful not to use so much that you can create a cola connection going from the positive terminal to anything else, that would be really bad. Now that you can see the bolts that hold on your battery cables, remove them and the battery hold down and pull out the battery. Now using the same procedure we used for the "big ground" clean up the terminals on the battery, the terminals on the cables and especially the often overlooked point where the negative battery cable connects to the body.. That last one is often forgotten but it's probably the most important connection back there so don't miss it. There are two easy ways to prevent corrosion from appearing on your terminals again. First you could buy one of those new expensive Optima batteries. Or you could epoxy a couple of pennies to your cheaper battery about one inch from the terminals.. Be careful not to let the pennies touch the terminals. The pennies will then corrode and nothing else. There are also products you can spray or paint on to prevent corrosion but they make a bigger mess than the corrosion so use one of my methods.

DANGER DANGER Do not connect the battery cables to the wrong terminals or you will wreck the ECU. Put the battery back in carefully. Remember that the negative terminal is the one that grounds to the body, it should be black and the other one should be red but on cars this old they may have been changed so be careful.

Now back to the engine compartment for the injector grounds.

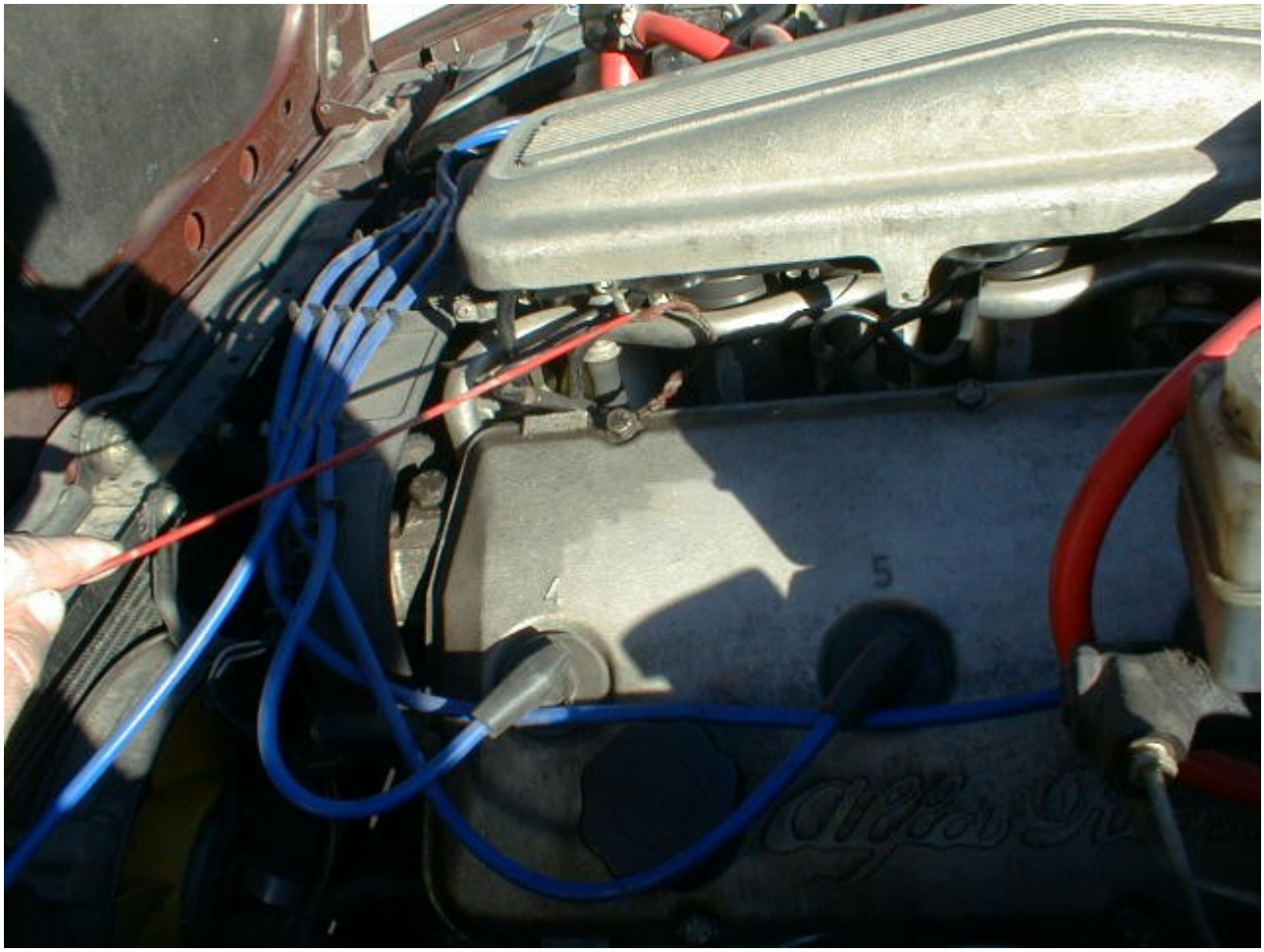
Most of the injection system grounds to the engine through the passenger side valve cover (actually called a head cover by Alfa). The head cover is attached by a number of bolts, or Allen fittings on later cars. At the back of the head cover there are some black wires attached to the head cover with these bolts. The actual number of wires and connections varies by year. Your car will probably have 2 or 3 connection points to the head cover with 2 or 3 wires each. These grounds are very important. They ground the injectors and ECU through the engine and to the car via the big ground we cleaned earlier. Remove the bolts securing the wires to the head cover, and clean the connection points using the methods used earlier. When reassembling be careful not to cross thread the bolts. They just screw into aluminum and they are small so it's easy to do. These bolts need to be fairly tight to provide a secure ground but don't over tighten them and strip the bolts or the holes, just be careful and take your time.

Here my pointer is touching one of the injector grounding bolts at the head cover. You can also see the main air intake hose connecting to the throttle body which is bolted to the intake plenum. The red hose at the bottom is heading off to the "secret compartment". My special improved Aux Air valve is also visible and a worthy modification.



Just one more ground for the injection system! On the driver's side of the intake plenum is a short braided copper strap connecting the plenum to the driver's side head cover. This ground is the least important. This ground simply insures that the plenum mounted electrical items like the cold start injector and throttle position switch ground properly. Clean this one up using the same method as before and make sure the bolts are tight.

Here I am pointing out the plenum to head cover ground. You can also see two of the six short hoses that connect the plenum to the intake runners. One of them is just to the right of my pointer.



Ok, the next thing is not really a ground but it's a related and very important electrical item. What's more it can stop your car dead, right now with no warning. I am talking about the fusebox. . ANYTIME something goes wrong with your GTV6 check all the fuses. If they all look OK rotate them and make sure they are seating well. Today we are only concerned with fuses number 5 and 8 as counted on a GTV6 from left to right. These are both 8 amp fuses and are critical to the operation of the fuel injection system. They are number 5 and 8 on all U.S. GTV6s and probably all GTV6s period, except of course for the South African 3 liter models which have carbs.

You should have spare fuses in your Alfa, especially spare 8 amp fuses since those are the ones that make you car go! It's possible and not too uncommon for fuse #5 and #8 to blow in such a way that they make contact and look fine but are not

really carrying enough current. If you have any injection problems you should replace these fuses. Of course the fuses's contact in the fuse box itself could have problems too so it's a good idea at this point to disconnect the battery, remove fuses #5 and #8 and any others that look suspect or are associated with a system that is not working properly and clean out the contacts with electrical cleaner and a small toothbrush. Then put the fuses back in wait for the contact cleaner to dry and reconnect the battery.

Air leaks and grounds are easily 90% of all L-Jetronic problems so if you have followed along your car is probably fine now. Next we will be testing all the components and making a few changes and adjustments to improve things.

Step 3 Comply with Alfa tech bulletins 87,01 and 89,02!

Both of these bulletins deal with the same thing, the evil coolant temp to ignition retard sensor.

In the early 80's various govt. agencies became concerned about vehicle emissions during the engine's warm up period. It was decided that the best way to lower these emissions would be to create a device that would retard ignition timing until the engine warmed up. They were so serious about this idea that in some areas like The People's Republic of California they made people with older cars from the 60's and 70's install something called an NOX device which would do just that. On our Alfas and other L-Jetronic cars the manufactures complied with the govt.'s directives by installing a sensor in the thermostat housing that would retard ignition timing until the coolant temp. reached 95F/35C.

Well, guess what? It did not work! It turned out this whole program did nothing good for emissions and only harmed the engine's cold running characteristics. In a very very rare bout of reasonableness the EPA, CARB and others admitted that this whole program was actually bad for the environment and bad for cars and they canceled the whole program and issued directives that these stupid devices be disconnected. Of course they never gave people like me any money back for the NOX devices they made me buy for my Buick GS or Dodge Challenger.

Now it's highly unlikely you will ever see an old muscle car running around with an NOX device. As soon as it became legal everyone removed them. However in spite of Alfa issuing two service bulletins on the subject, for some reason few people ever got around to disconnecting these things on their Alfas.

I should point out that not all Alfa V6s have the coolant temp to ignition sensor. No GTV6 prior to 1984 has it. All 84'-86' GTV6s do have it and if you own a Milano you just have to look and see if it's there. Officially they stopped putting them on Milanos in 1987 however I have heard of some 1988s having it. To add even more confusion the factory admits "inadvertently " installing them on some Milanos in 1989!

Some people may ask, why should I disconnect this thing? Well there are a few reasons. First of all the Alfa Romeo factory says you should and they built the car, the E.P.A. says you should and this whole thing was their idea in the first place. However if that's not enough reason for you I can provide a few more. First of all the

factory says it will "improve cold driveability". *Second of all these things have two failure modes, both of which are not good. The first is a failure to advance the timing upon reaching 95F. This of course will mean your car will be driving around with retarded ignition timing and will not have the power or fuel economy it should. In its other failure mode it can't make up its mind and retards and advances the timing whenever it wants too. If your car has an irregular idle, high emissions or is powerful one minute and slow the next then odds are this is your problem.

@The official tech bulletins say to disconnect it. This is a simple task, just find the sensor, it's on the thermostat housing and has just one wire going to it which is usually purple and white. the wire is connected via a simple male/female connector. Just pull the wire off the sensor, put something on it to make sure it can't ground on anything, electrical shrink tubing is a good way, and tuck the wire away somewhere it safe so it does not get caught in anything. That's about it for this procedure. You may need to adjust your ignition timing but we will be doing that later anyway.

This is a photo of the 85' GTV6's thermostat housing. In This Photo my pointer is touching the coolant temp to ignition sensor. It should be disconnected according to Alfa, Me, and the EPA. Just to the left of it with the two white wires and black connector is the Fuel Injection's coolant temp sensor. To the right and blocked from view by the coolant hose is the thermo time switch. You can see the wires going to it, they are the green ones connected to the white ones. The sensor to the left of the Injection's temp sensor is the Dashboard temp gauge's sensor.

Step 4 The cold start and warm up system.

Now we will test all of the components involved in cold starting and warm up. These two phases of operation are the reasons for a lot of the L-Jetronic's complexity. The components involved in these phases are the cold start injector or CSI, the injection's coolant temp sensor or CTS, the thermo time switch or TTS, and the aux. air valve or AAV.

Before we go any further I think it's quite important to back up and review some basic concepts common to automotive engines. Cold engines require three things to start that they do not require at other times. They are a squirt of fuel directly into the manifold, a richer then normal mixture for staring and warm up, and an idle position for the throttle that is a little farther open then normal. Lets consider how the cold starting procedure works on an older carburated car with a manual choke. First we step on the gas pedal at least once, then pull out the choke cable, and then turn the key to start it. That first step, stepping on the gas pedal, causes the accelerator pump to squirt fuel into the manifold. The second step, pulling out the choke cable does two things. It richens the mixture by cutting off air which is why it's called a "choke" (a very small number of carbs do not cut off air when choked but bleed extra fuel into the motor instead) and it activates the fast idle function of the idle stop by holding the throttle open a little extra at idle. As soon as the engine starts the choke will open

slightly and be opened more and more until the engine is warmed up when it will be all the way open.

The L-Jetronic system does all these exact same things the old carburated cars did, it just does them automatically and in a different way. First it squirts fuel into the manifold using the CSI instead of an accelerator pump. This happens automatically under certain conditions and you have no control over it. Next the designers needed a way to richen the mixture during cold start and warm up and they did this in a simple and clean way which involves no moving parts. They did this with the CTS. This little sensor mounted on the thermostat housing measures coolant temp and sends the information to the injection ECU. The ECU then adjusts injector duration to richen the mixture during cold running. The thing was to come up with a fast idle position for the warm up period. This problem caused a real headache for the designers of the L-Jetronic system. They knew they needed to have a way to advance the throttle during the warm up period but they could not do that for two reasons. First they were trying to minimize the number of moving parts in the system and a fast idle stop would complicate the linkage. However the biggest reason was they could not move the throttle off its normal idle stop during idle was because then the throttle position sensor, or TPS (which we will cover later in this article) would tell the ECU that the engine was no longer at idle. This would have caused a lot of problems including a loss of fuel economy and an increase in emissions. To solve this problem the designers used a device new to the automotive world, the AAV. The AAV opens up when the engine is cold to allow extra air which is metered by the air flow meter to enter the engine. The air flow meter then signals the ECU for more fuel and thus when the AAV is open the engine gets more air and more fuel and thus idles faster. This does the exact same thing as pushing down on the gas pedal slightly except it does it without taking the TPS off its idle position.

We will test the CTS first. The CTS is a critical item, if it is not connected the car will not run. They rarely fail and about the only thing that does go wrong is corrosion on the probe or a bad electrical connection. *CTS problems can cause all types of starting problems, poor fuel economy, and or high emissions

Now it's time to test the CTS, so go and get your ohm meter. ***DANGER DANGER DANGER*** do not ever touch an ohm meter or anything else that sends current to the terminals on the wiring harness. That will send current into the ECU where it is not expecting and it could damage or destroy the ECU or other components. All testing procedures we will be doing involves touching the ohm meter to the component being tested like the CTS itself, NEVER to the wiring harness. If anyone is unclear about this ask before you proceed, this is critical.

When your car is fully cooled off, like after sitting overnight, get your ohm meter open the hood and disconnect the CTS. The CTS is connected to the wiring harness via a standard Bosch connector, it WILL NOT just pull off, you need to get a tiny screw driver and release the metal clips that secure it, then it can come off. Be careful and take your time removing these connectors to avoid breaking them. Once it's free, tuck the connector away somewhere safe so you will not be tempted to touch it with your ohm meter. Once the connector is off and tucked look at the CTS and you will see it only has two terminals. Make sure they are fairly clean and connect one to each of the probes on the ohm meter and read the resistance.

between the two terminals. If the temp. is 14F/-10C you should read 7-12K ohms. If the temp is 68F/20C you should read 2-3k ohms, and the car is fully warmed up to 176F/80C you should only read 250-400 ohms. I like to check the car when it's cold, then after it warms up I check it again. If the values look good put your ohm meter away, spray all the terminals on the CTS and its wiring harness plug with contact cleaner and hook it back up.

Next we will check the Thermo Time Switch. *A bad thermo time switch can only cause two problems, either difficult or impossible cold starting or difficult or impossible hot starting, depending on how it fails. The TTS is also mounted on the thermostat housing. It sends a signal to the ECU telling it if the coolant temp is at least 86F/30C or above. If the temp is below this value then the ECU will fire the cold start injector if the starter motor is turning. Otherwise it will not fire the CSI, simple! To test the TTS we remove it's connector just like we did with the CTS. Again you will see it has two terminals. Connect your ohm meter to them and you should read ZERO if your coolant temp is below 86F/30C. At 104F/40C it should read 100 to 160. If it checks out OK, clean the plug and terminals with contact cleaner and hook it back up.

If these components tested fine odds are you should just move on, however it's possible for these components to test fine but be nearing their death due to corrosion. To really make sure they are OK, it's best to pull them out and clean off their probes with a rotating wire brush. Of course when you remove them coolant will come pouring out of the thermostat housing so it's best to do this when you have to change the coolant anyway.

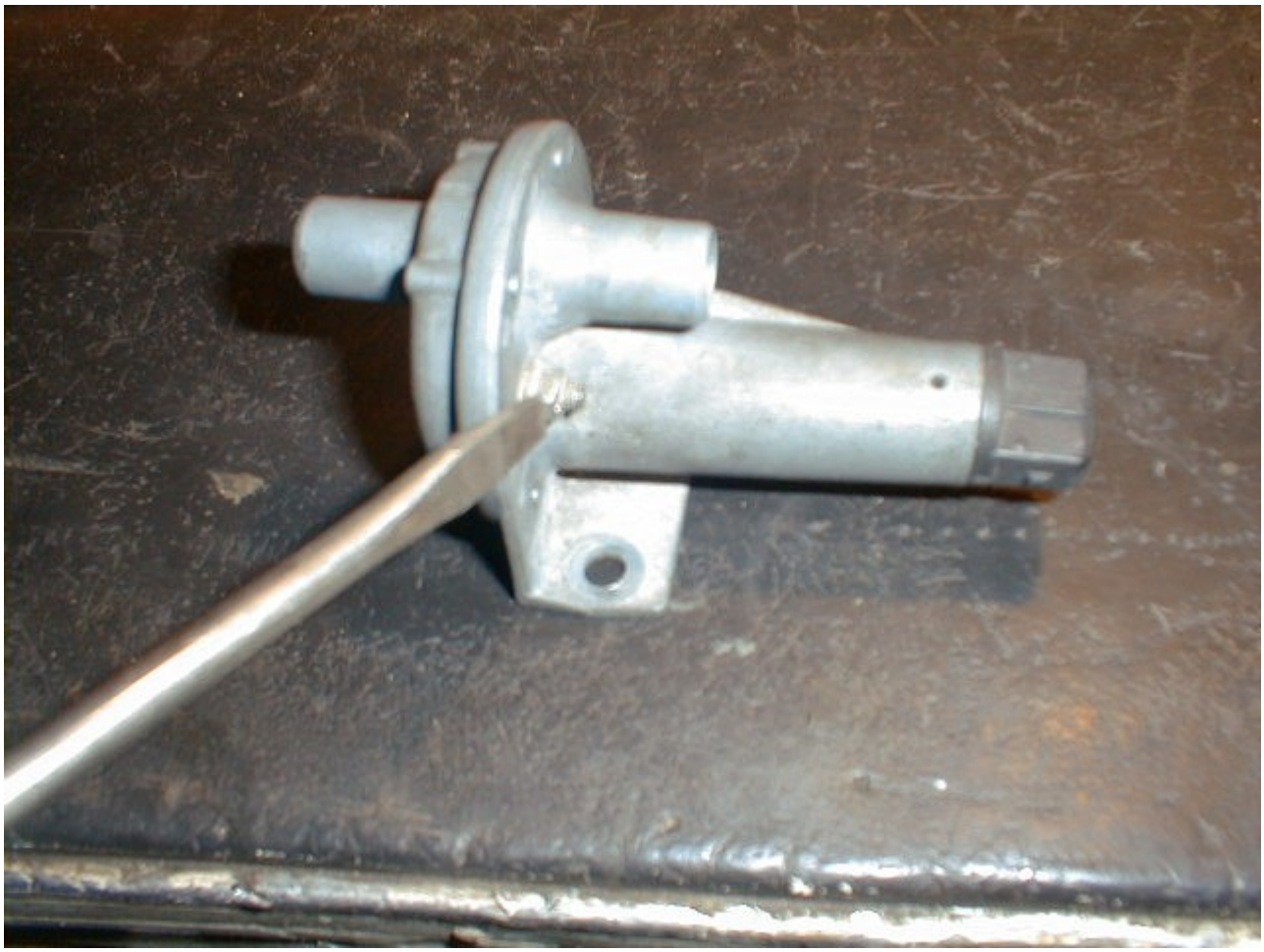
Next we need to check the cold start injector and in doing so will also be double checking the function of the TTS. The cold start injector is a 7th fuel injector (or a 5th on a 4 cyl car) that injects fuel into the intake plenum under the following conditions. First the starter motor has to be cranking the motor and two the TTS has to be closed which means if it's working properly the coolant temp has to be below 86F/30C. The cold start injector is located on the passenger side of the intake plenum at the rear. It has a hose going to it and a Bosch electrical connector similar to the ones for the CTS and TTS except it's usually blue. Testing it will be simple you just need an Allen wrench to unbolt it a small can, and a competent helper to try and start the car. *A bad CSI can cause starting problems, high emissions, poor fuel economy and poor idling qualities.

When the car is cool, and that means a coolant temp of below 80F, and colder is better, unbolt the CSI. Be careful not to drop the little Allen bolts and washers that hold it in, they can be hard to find if they fall. Next hold the CSI away from the motor and pointing into the small can. Plug the hole in the Plenum where the CSI normally goes with something that can't get sucked it. If your car has air leaks using your finger could be dangerous so hold a piece of rubber or something against the hole. Anything is OK as long as the hole is fairly airtight and nothing can get sucked into it. Now have a friend crank the motor over for a few seconds, the car may start, but that's OK (obviously take precautions here, car in neutral, clutch in etc.). Watch the CSI, it should spray a nice stream of fuel into the can and stop the second your friend stops cranking the starter. If it does both the CSI and TTS are working properly for

cold starting. Perform this same test again with the car warmed up and make sure the CSI does not spray any fuel. If it does not then your CSI and TTS are working properly for warm starting. Now as an advanced check (this is not really necessary) you can disconnect your ignition and perform the same test. This time the engine will not start but watch the CSI, it should start spraying but stop on its own in a few seconds even with the engine cranking. This is a design feature intended to prevent flooding.. It should not fire for any more then 8 second before stopping.

The last and most troublesome part of the cold starting system is the Aux Air Valve. I hate the Bosch Aux Air Valve. *A faulty AAV can cause the following problems. Difficult or impossible cold starting, the starts and stalls right away syndrome, poor running during warm up, irregular idle, and last and worst horsepower loss.

Here on my tool bench is a GTV6's AAV. My screwdriver is touching the adjustment nut.



The AAV is located on the passenger side head cover. It has a standard Bosch electrical connector and a hose connecting to it at each end. It is simple in theory. It has a bimetalic strip inside that expands and contracts when it gets hot or cold. When cold it contracts and opens up a passage inside the AAV which allows more air to pass through it and and into the intake plenum. This causes the AFM to increase injector duration and it increases the idle speed. As the car warms up the AAV's

passage closes slowing down the idle. I should note that the idle speed should never really changes much during warm up. The engine will idle at a higher speed as it warms up with a given amount of airflow so what the AAV is actually doing is providing extra air when cold and then cutting off the extra airflow as it warms up to keep the idle about the same. The electrical connection has nothing to do with any other system. It is simply provides electrical current to the AAV to cause it to warm up and close a little faster then it otherwise would. The AAV's most common problem is it gets jammed either open or closed. This happens because the expansion and contraction of the bimetallic strip is not too powerful and it can be easily overcome by oil and crap that gets into the intake system. There are a few ways to check the AAV but only one way is reliable. I am afraid you are going to have to pull the thing off the car. With it off the car clean it out with carb cleaner or something else and then clean out all the carb cleaner with dish soap and water. This cleaning process is needed about once a year on a GTV6 in order to keep an AAV operating in top form. When it's really clean put it in the freezer and when it gets cold look through it and you should see a large opening inside. Now heat it up to about 150F and it should be fully or very very nearly fully closed. If it does not open up fully you will have cold starting and running problems. If it does not close fully you will have an irregular idle and power loss.

Cleaning the AAV almost always seems to fix them. If it doesn't you may try playing with the little adjustment nut on it. It seems that some AAVs close fully, but don't open very far. This is optimum for horsepower but not for starting in near freezing temperatures. Others open a lot giving great cold starting but don't close all the way which robs some horsepower. With the adjustment nut and a lot of patience you can set up your AAV to suit your needs...well, sometimes...maybe. Furthermore if you adjust the AAV you will probably need to re adjust your idle speed. To optimize it for cold starting take a cool AAV that is at least partially open and jam something inside it to keep it from closing. Now loosen the adjustment nut and then force the AAV to open up a little more. Now while holding it open tighten the nut. That will bias the AAV toward effective cold starting. @To bias it toward more horsepower you can just loosen the nut on a warm AAV, it should then close fully. At this point tighten the nut. You will gain a little power but cold starting will suffer. If you fiddle with it enough you can get it to open most of the way and close most of the way which is how most of them work from the factory. If you have cleaned it, adjusted it and still can't get it to open and close properly you will have to buy another. They cost about $70 for a GTV6 and as much as $130 for some other cars.@ If you want you can buy a manual valve from me. It's a permanent fix and will never need to be replaced or cleaned. It also provides even better cold starting and slightly more power then a perfectly functioning Bosch AAV. It's operated by a manual cable, pull it out for starting and push it in after a few minutes of running. The manual AAVs are for sale at the bottom of this page.

Step 5 Fuel Pump and Fuel Pressure Regulator.

Fuel Pressure in the L-Jetronic system is quite critical. *A fuel pressure problem can cause about every possible problem you can think of. Fortunately there are only

two components involved and they are both easy to check and reliable. However if they are bad you will need to replace them. I don't have any Shoo Goo tricks for this part of the system. I do suggest replacing the fuel filter before performing the tests on the fuel pump and pressure regulator if you are unsure of its age. It's recommended that you change the fuel filter every time you change spark plugs

First we will check the pump. The pumps usually either work or they don't. The pump runs whenever the ignition switch is in the on or start position and the engine is turning. The AFM has a microswitch which is activated as soon as the AFM's door moves. This microswitch allows the fuel pump to run. This is a feature designed to prevent flooding and for safety. The idea here is that if the engine is not running then the AFM door will be closed and the fuel pump will not run regardless of ignition switch position.

Checking the pump is simple. Unhook the air cleaner cover and shove a large screw driver into the AFM jamming its door open. Now go turn the ignition switch to on, NOT TO START and go near the pump and listen to it. The fuel pump is located on the passenger side just forward of the right rear wheel. If you can't hear it running it's not working. If the pump does not run check your fuses, if they are good check for electrical current at the pump with a test light. If it does not have current the problem is probably the relay set located on upper rear corner of the passenger side firewall or the microswitch in the AFM, if it does have current and does not run you need a new or rebuilt fuel pump. The rebuilt ones are just as good.. If it is running, move on to the fuel pressure test.

Now we will check fuel pressure. This injection system requires 35.6 psi. It seems that most fuel pressure gauges that measure values that high are really expensive. There is however an inexpensive way to check. Remove the cold start injector's fuel line at the injector. Be careful since fuel there is under pressure.and will spray out for a second or so when you remove the line. We will be using a cyl. compression tester to check the pressure. It can measure fuel pressure in this range just fine and it's made to have oil, fuel and other contaminants forced into it under pressure so this probably will not damage it. Next you will put that screw driver back in the AFM to jam its door open again. While you hold the compression tester into the CSI's fuel line, have a friend turn the ignition switch to on, which will make the fuel pump run. Now of course if you are not holding it really tight you will get fuel everywhere so be careful and have rags ready to soak up any spilled fuel. If it does not read about 35 PSI your fuel pressure regulator is bad. Now I just know there are some of you out there who don't have a compression gauge. Well there is another way to check pressure, well sort of. This is not as accurate terribly accurate but it's a lot better then nothing. Put the CSI's fuel line into a empty and clean one gallon milk jug and run the pump using the previously described method. A properly functioning pump and regulator will fill the gallon jug in just about two minuets. Now take that screw driver out of the AFM and put the air cleaner assembly back together.

Step 6 Throttle Position Switch!

The throttle position switch, sometime called a full throttle switch or just throttle switch is a reliable item rarely needing replacement. There are two types, one on the

81'-83' cars and another for the 84' and later cars. *According to Bosch a faulty or maladjusted full throttle switch can cause a couple of problems, either an irregular idle or a lack of power. Although Bosch does not acknowledge it I think we can safety say it could also cause high emissions. The full throttle switch is located on the firewall side of the throttle body which is the area connecting the main air intake hose to the plenum. The early type has a black plastic cover which is usually missing and two wires going to it. The later type is black and has a Bosch electrical connector on it. The switches on all GTV6s and Milanos are in the same location however the switches on the early cars are completely different from the later cars and require a different testing procedure. These switches are not easily repairable so if yours is inoperative it's best to replace it. We will be testing the early type first so if you car is an 84 or later just move on down past the next picture.

If you own an 81'-83' GTV6 you are in luck, your car's switch is easier to test plus we can check the full throttle system as well as the switch, something we can't do in the later cars without some very special equipment. The switch is very simple, it is activated at about 60 percent throttle and sends a signal to the injection ECU saying the driver want to go fast. At this point the ECU does two things, it increases injector duration and thus fuel to the engine and it stops listening to the Lambda Sensor. In other words it triggers the emissions and fuel economy be damned full speed ahead mode.

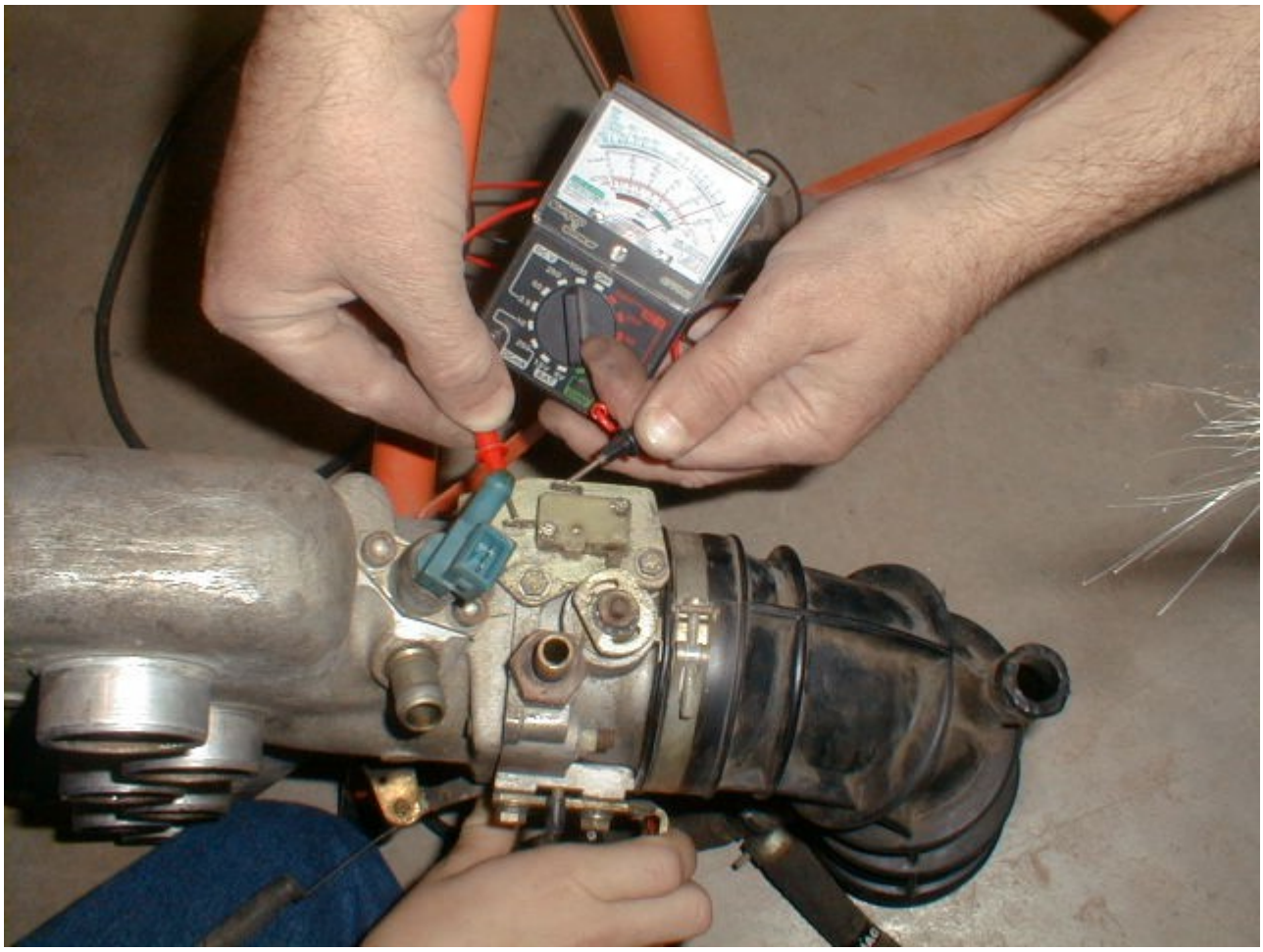
First remove the black plastic cover if you car still has it. You can now see the switch. Its a little off white rectangle with two electrical connectors pointing to the driver's side of the car and a button pointing down out of the bottom of the switch on the passenger's side. That button is the on/off button for the switch. The button should not be pressed with the car at idle. Now watch the button as you or someone else advance the throttle. At about 60 percent travel the button should be depressed by the oval piece of metal which rotates as the throttle is advanced. If the button is not depressed at about 60 percent travel and released at lower throttle settings, you will need to adjust the switch. This is easy, loosen, but don't remove the switch's mounting bolts and then grab and turn the switch until it's in a position where it will be activated at the proper time.

Now that you have found your switch and adjusted it, it's time to find out if it works. First, remove the two electrical wires from the switch or you may damage the ECU. Now this is really simple, just get either an ohm meter or a test light and make sure you removed the wires from the connectors on the switch. Connect each of the ohm meter's probes onto the two terminals on the switch as shown in the picture below. It does not matter which probe connects to which terminal. Now with the throttle closed you should be reading infinite resistance. Next have a friend advance the throttle, as it passes the 60 percent mark and presses the little button, resistance should go to zero. If you are using a test light the procedure is the same, the light should be off until 60 percent throttle and then it should turn on.

Now that we know the switch is adjusted and it works we can make sure the ECU knows what to do when it receives the full speed ahead signal. This is easy to test. With the car at idle remove the two electrical connectors from the switch's terminals. Touch the two wires together and the ECU should start sending so in so much fuel that the idle speed changes. It usually slows down due to excess fuel however it is

possible it could speed up depending on how everything else is adjusted. The important thing is it changes. If the idle speed does not change you have a broken wire, bad ECU or most likely a bad connection at the ECU. That's it for the early type of switch, head on down to step 7.

In this photo I am testing an 81'-83' throttle position switch. My son is holding the throttle in the full open position and the ohm meter is reading 0 which is correct. With the throttle closed the ohm meter should show infinite resistance. NOTE !! Most cheap ohm meters like the one I am using are not perfect. You may notice that my ohm meter is actually pointing to 1 in this photo. However my ohm meter points to 1 when it should point to 0. You can test your ohm meter by touching the two probes together, if they point to 0 it's working great, if it points to 1 or 2 don't throw it out, just use that value as 0.



If you have an 84' to 86' GTV6 or a Milano you have the newer type of full throttle switch. This is a three position switch which senses idle, all intermediate settings, and full throttle. The idle position signals the ECU to cut off fuel entirely between 1600 and 1100 rpm. The official reason for this is too increase fuel economy and reduce emissions. I think the true reason is quite different. The intermediate setting sends a signals to the ECU telling it that you are driving like a normal human being and in this condition mixture is largely controlled by the Lambda sensor thus keeping fuel economy to a maximum and emissions to a minimum. The full throttle

position.....well actually Bosch never really said exactly what is does on the 84' and later cars. They vaguely hint that it increases injector duration but say nothing about the Lambda sensor. I have not done any testing to verify it but I am quite certain it increases injector duration.

First the adjustment. When the throttle comes on or off idle you should hear a faint click. There should be no other noise coming from the switch during throttle travel, it only clicks when coming on or off idle. If it does not click you can adjust the switch by loosening its mounting bolts and turning it. Adjust it so that as the throttle closes you hear the click just before the throttle plate reaches its idle stop. If you can't get it to click you probably need a new switch although it's possible it's just too faint to hear it so proceed with the next checks before buying a new one.

You will need your ohm meter for this procedure. Remove the Bosch electrical connector from the full throttle switch being careful not to damage it. If you don't know how to remove Bosch connectors go up to Step four, paragraph six and read the procedure. Move the connector out of the way and DO NOT TOUCH IT with the ohm meter. Now look at the switch's electrical terminals. There are three of them arranged vertically. The top one is terminal #2, the middle is #18 and the bottom is #3. Hey I didn't number these things, if I did they would have been 1,2,3 from top to bottom. Now with the throttle closed you need to check the resistance between terminals 2 and 18. The resistance should be zero. Now with the throttle still closed check the resistance between terminals 3 and 18 and resistance should be infinite. Next we have to do the same checks at full throttle. Have a friend hold the throttle fully open. Check resistance between terminals 2 and 18 and you should read infinite resistance, the opposite of what you had at idle. Check resistance between 3 and 18 and it should be zero. If you do not get these values try adjusting the position of the switch, sometimes just a little adjustment will fix everything. If you can't get the correct resistance values by adjusting it you probably need a new switch. Unfortunately you may need to adjust this switch again if you adjust the throttle's idle stop which you may have to do later in order to get the idle just right.

In this photo I am testing a throttle position switch on my 85' GTV6. In this test I am connecting my ohm meter to terminals 3 and 18 with the throttle closed. The needle on the ohm meter is pointing to infinity which is correct. Note: In this photo my ohm meter is actually turned off. The selector should be selected to ohms like in the photo above.

Step 7 Injectors

Like all cars with L-Jetronic our Alfas have one injector per cylinder. These six injectors all open and close at the same time when commanded to do so by the ECU. It's important to understand that the injectors do not really spray fuel, they are just valves that open and close. They are needle valves that plug a small hole when closed. They are opened by a tiny electromagnet in each injector that pulls the needle away from its hole enabling fuel to pass into the intake system. When they are open fuel sprays in as a result of fuel pressure, so it's really the pump and fuel pressure regulator that control how much fuel sprays in for a given amount of time when injectors are open. The ECU regulates how much fuel is sprayed in by controlling the amount of time the injectors are open. Your ECU assumes your car has the correct amount of fuel pressure. If you have more or less it will effect your ECU's calculations. The injectors are located under the intake plenum. They each have a short black fuel line connecting them to the fuel rail and a Grey colored Bosch electrical connector plugged into them. It's not possible to fully test your injectors with them on the car, although the tests that are possible are described here.

An injector can go bad in a number of ways. *They can have external leaks, internal leaks, fail to open, or fail to close or be clogged with combustion debris. Symptoms of a bad injector or injectors can include difficult or impossible cold or

warm starting, irregular idle, lack of power, poor fuel economy, missing, high emissions and external fuel leakage.

Most external leakage is caused by a failed "O" ring inside the injector. This ring seals the plastic part of the injector to the metal part and it is not replaceable. I have heard of people sealing these leaks by coating the outside of the injector with epoxy but I would just buy a new injector. It's a shame Bosch designed the injector so you can't get at this seal without destroying the injector.

It's important to check the injectors internal electrical coil. This is simple, just get out your trusty OHM meter, remove the injector's electrical connector and check the resistance between the injector's terminals. It should be 2-3 OHMs. If it's not you will have to buy a new injector because there is no way to replace the coil.

If your injector is leaking internally or failing to close fully the car might run OK depending on just how bad the problem is. The way to check for this problem is simple. When you change spark plugs inspect them. If one or two are a lot blacker then the others you probably have a leaking injector on those cylinders.. If the leak is bad or the injector never closes, the car will run poorly at low RPM but improve at high RPM when the engine is sucking in enough air to burn the fuel.

The GTV6 can run pretty well with one injector stuck closed, it can even run with three injectors stuck closed although you will know something is wrong. It's a little tougher to tell if an injector is stuck closed by looking at the plugs so let's use another method. An injector failing to open can be revealed by pulling the spark plug wires one at a time. Simply let the car idle and disconnect the spark plug wires from the plugs one at a time. You will notice an RPM drop on the cylinders with a properly working injector, if you find a plug wire that does not cause an RPM drop when it's pulled then you have a bad injector on that cylinder. Most likely the injector is stuck closed but it's also possible that it's stuck fully open and flooding the cylinder, in either case it's a bad injector. Of course before you go and remove the injector you should make sure the cylinder in question is getting a spark. To do this hook up the timing light as described in Step 8 only connect it to the spark plug wire going to the cylinder in question. Have a friend start the car and blip the throttle. Watch the light on the timing light. It should flash in a consistent pattern and increase in frequency with an increase in RPM. If it does and your spark plug is sparking then the problems is almost certainly the injector.

The most common injector problem and the most difficult to detect is the partially clogged or "dirty" injector. Unfortunately there is no practical way to check for this problem without pulling out the injectors so we need to use the process of elimination. If you have checked everything else out and your car still has some running problem then it's probably one or more dirty injectors. Putting injector cleaner in the fuel tank will not clean the injectors. To clean them they need to be pulled out and sent to an injection shop. Most injection shops have a service that will include ultrasonic cleaning, new tips and intake screens for about $25-$35 dollars for each injector.

Here we see an example of a good injector spraying in fuel.

Here is a picture of a clogged injector. An engine with one or more clogged injector will never develop full power, and will have high emissions and running problems.

If you find one or more bad injector there is little choice but to buy new ones. Let's get one thing clear, THERE IS NO SUCH THING AS A REBUILT L-JETRONIC INJECTOR! Now I know a lot of people claim they are selling rebuilt injectors, and I don't know what they are doing. However I do know that only a few things can be done to them. They can be cleaned, the fine intake screen can be replaced and the ceramic tip can be replaced. That's it! The life limiting component is the internal "O" ring and it can't be changed.

Since it's not possible to completely check the injectors with them on the car it's best to check everything else before assuming they are bad. If you suspect one or more injectors are bad then it's best to replace them all. I have new matched sets of fuel injectors for the GTV6 for sale on page five at a very good price. Replacing all the injectors with our new ones does not cost much more then pulling them all out sending them to an injection shop and having them sent back. Plus with my injector kit you will have all NEW injectors and not have to worry about injector problems again for a long time. Our injector kits also include new lower seals and hoses.

Step 8 Air Flow Meter (note: I have enhanced adjustment instructions for the AFM on step 12)

The Air Flow Meter or AFM is one of the most expensive components of the L-Jetronic system. Fortunately they rarely wear out or fail and there are plenty of inexpensive used ones available. The AFM is simple in operation. Air entering from the air filter side pushes a little door open. As the volume of air increases it pushes the door open farther. The AFM measures how far the door opens to determine the volume of air. The AFM also measures the temperature of the air. These two bits of information are combined to determine the total number of air molecules entering the engine and that information is sent to the ECU. The ECU then uses this information to help decide how much fuel the engine needs and adjusts injector duration

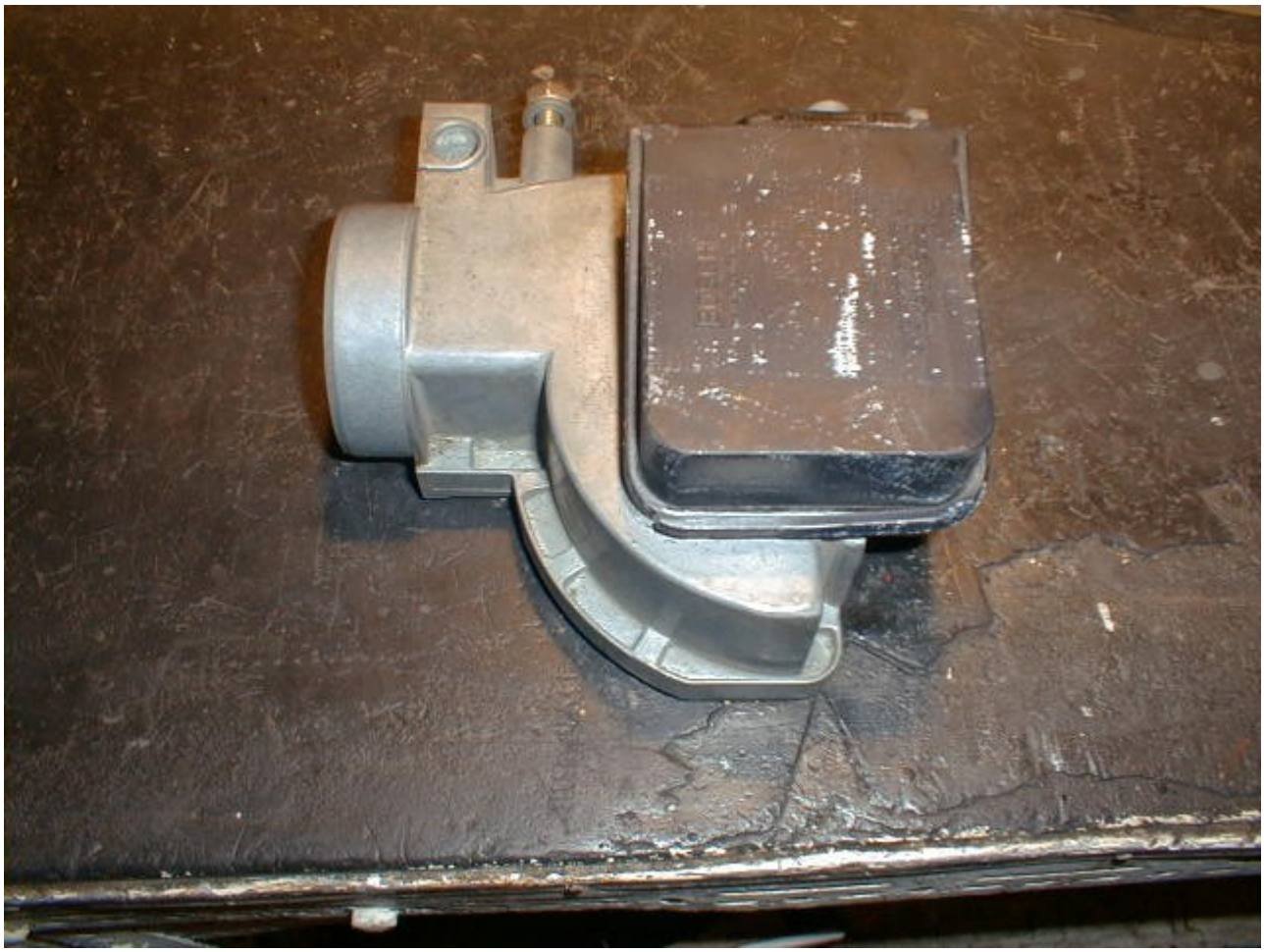
accordingly. Of course the ECU gets information from many sensors but at full throttle the AFM's signal is primary. That means if you want max power a properly operating AFM is critical.

* A bad AFM can cause the following problems: Difficult or impossible hot or cold starting, the starts and stalls syndrome, lack of power, high emissions, and irregular idle.

I am afraid the official Bosch procedures for checking these things are not too good. They recommend using a Bosch tester which I don't have, or probing with a volt meter. The problem with the volt meter method is the chance of damaging something is greater then the chance of finding a faulty AFM. There is a test involving our trusty ohm meter but it is entirely unreliable. This means we are down to basics here.

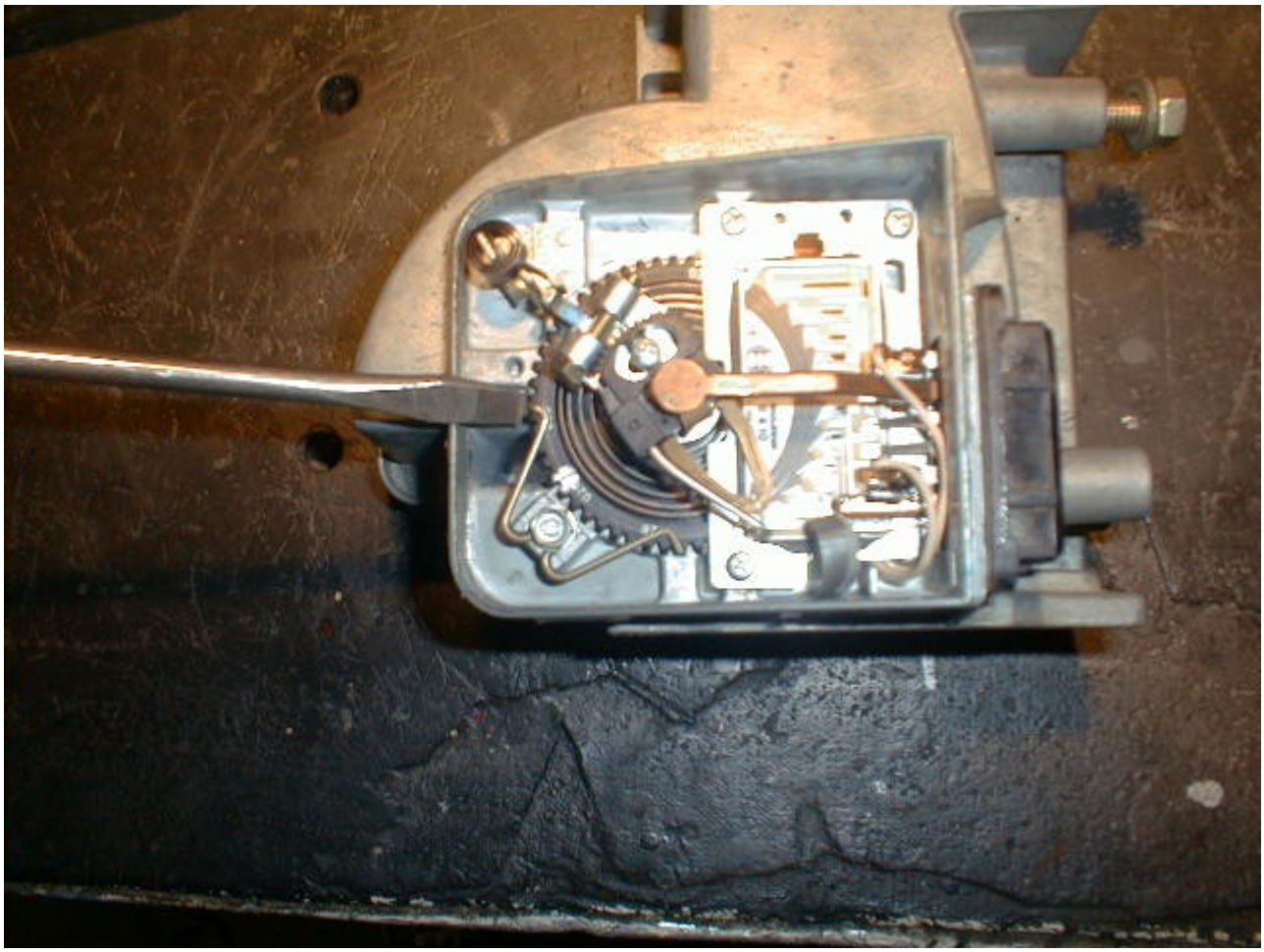
First, find the AFM's electrical connector. It's on the side closest to the driver and is basically just like the Bosch connectors you have dealt with on other components but it's bigger. Remove this connector and spray the connecting points with electrical contact cleaner and then reconnect it. Next, if you did not already do it, read Step 5 paragraphs 2 and 3 and make sure the microswitch enables the fuel pump to run. This also provides a nice opportunity to change air filters. Next you will need to remove the AFM's black plastic cover. The cover is sealed to the body of the AFM with a strong clear glue, probably an epoxy of some kind. Carefully cut away the glue with a sharp hobby knife and then pull the cover off. This is a time consuming process, just work slowly and carefully and don't break the plastic cover. Once the cover is off inspect the internal components for obvious damage and clean out any contaminants. If everything in there looks Ok it probably is. If you want to keep your AFM's stock settings put the cover back on and seal it with RTV silicone, preferably clear or black. If you are looking for a little more performance scroll down to the next paragraph.

Here is a stock GTV6 AFM sitting on my tool bench. This AFM is used on all GTV6 and 2.5 Milanos. The 3.0 Milanos have a similar AFM but it's a different part number.



@It's fairly easy to adjust the AFM to signal the ECU to send in a little more fuel. This mod gives a minor increase in power and better throttle response. It does not effect fuel economy but it can increase emissions. It's a simple reversible procedure. The AFM's door is held shut by spring pressure. We can reduce that spring pressure which will cause the door to open farther for a given amount of air volume. This will cause the AFM to signal the ECU for a little extra fuel. The procedure is simple. With the cover off look at the workings of the AFM and find the large wire shaped like a "W" and secured with a little bolt. That wire secures a gear and keeps the gear from turning. Mark the gear where it is secured by the wire (that's where my screwdriver is touching it in the photo below). Try to make the mark with a sharp knife so it will not wear off. Now hold the gear still and loosen the bolt securing the "W" shaped wire. Once the wire is free of the gear's teeth rotate the gear counter clockwise five or six teeth and secure it in that position by bolting the "W" shaped wire back into place. That's it! put the cover back on, secure it with silicone and you are done with the AFM.

This AFM's spring tension has been loosened five teeth. You can see the original setting on the gear which is marked by silver paint. Paint wears off, so be sure to make a little notch with a hobby knife so you can return it to its original setting if you need too.



Step 9 Ignition Timing:

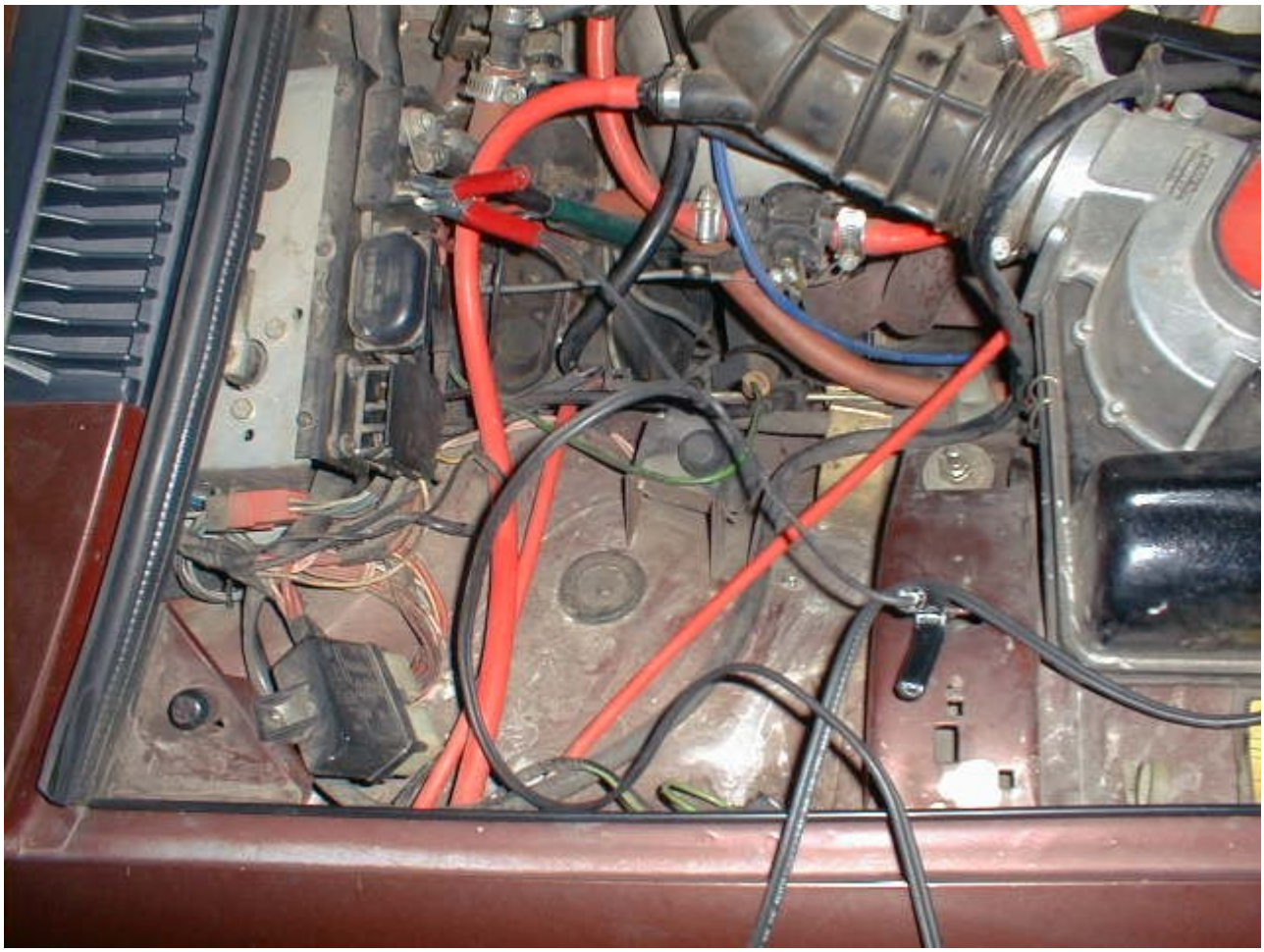
Ignition timing is one of the most important adjustments on any engine. * If it's not set correctly the car can have high emissions, low power, difficult starting and many other problems. It is not at all unusual for it to be set incorrectly so it's a good idea to check it.

The procedure is fairly simple however it must be done carefully and correctly to achieve the best results. First of all you will need an inductive timing light, an 11mm wrench and a small rubber cap with a small enough inner diameter to plug the vacuum advance's port on the throttle body. You may also need a small wire brush.

The first thing you need to do is start the car, let it warm up, and shut it off. Now on 84' and later cars disconnect the small vacuum line that runs from the throttle body to the vacuum advance unit on the distributor and plug it. I always disconnect and plug it at the throttle body end as shown in the next picture. If you have an 83' or earlier car leave this line on. Now hook up the timing light. The GTV6's battery is in the trunk so you will need to hook its red alligator clip to a positive power source in the engine compartment. There is a junction box on the firewall which is ideal for this purpose. Hook the black negative alligator clip to a ground and then clip the inductive pickup onto the spark plug wire for cylinder #1.

Notice I have pulled off the small vacuum line on the throttle body and put a cap on the vacuum port. The cap can be seen just below the handle of my screwdriver. This part of the procedure is often forgotten but it's very important. If your car is an 83' or earlier leave this line on. You can also see my hand putting the inductive pickup onto the spark plug wire. Obviously it's super critical to hook up to the correct spark plug wire and that all your plug wires be hooked up correctly.

Here you can see the timing light's red alligator clip hooked up to the junction box on the firewall. If you have a Milano just hook it up to the positive terminal on the battery. the Black alligator clip is grounded on the shock tower but any good metal location can be used.



Now that you have your timing light hooked up make sure it and all of its wires are free of any moving parts in the engine compartment. Start the engine and make sure it's still warmed up, if its not just wait until it is. Check your idle speed. The timing must be set with then engine idling from 900-1000rpm. If the idle speed is incorrect, adjust the idle using the double nut adjustment as described in the next section. Setting the timing is dependent on the idle speed being correct, so if you have any doubts about your tachometer check the idle speed with a dwell tach.

Now grab the timing light and pull the trigger. It should flash in a steady rhythm. Aim it at the crank shaft pulley and note the position of the timing marks. Now is an excellent time to check the distributor's advance and retardation mechanisms. On early cars disconnect and plug the vacuum port on the throttle body and the timing should advance. On later cars hook the line back up and the timing should advance. Yes that's right, the early cars have a vacuum retardation device, the later cars have the opposite's, a vacuum advance. If either type is inoperative it should be replaced. You should also rev the engine up and watch the timing advance as RPM increases and retard as RPM declines. If it doesn't your distributor needs work. Now shut the engine off.

Here I am aiming the timing light at the crankshaft pulley. If it's set up properly the light flashes when the number one spark plug fires. This has the effect of putting a strobe light on the crankshaft pulley enabling us to see when the plug fires in relation to piston position.

Sometimes the pulley is so dirty you can't see the timing marks. In these cases use a small wire brush to clean away any grime. I should take a moment to explain the markings relevant to this procedure. The early cars have a mark labeled "R", and another labeled "PF" and yet another labeled "M". We will be using all of these marking to set the timing and verify proper ignition advance. Note: exactly when they changed the markings is not clear. If you have an early car without the "R" mark then use the procedure for the later cars. The later cars have a mark labeled "P" and "F", the line closest to the "F" is the timing setting on these cars.

In this photo my big red pointer is touching the crank pulley. The "F" and "P" timing marks are just to the right of my pointer's tip. Just below and to the right of the tip you can see the block' metal pointer.

Now, to set the timing you need to rotate the distributor. Take your 11mm wrench and loosen the distributor's hold down nut, be careful not to take it off, just loosen it. Now start the engine and aim the timing light at the crankshaft pulley again. Rotate the distributor to adjust the timing. It might be best to grab the distributor with a rag since they occasionally shock people. The shock is not harmful, but it sure hurts. As you rotate the distributor the timing will change and the timing marks will move in relation to the metal pointer. As the timing advances the engine will speed up, and it will slow down as the timing is retarded. Rotate the distributor until the metal pointer is lined up with the "R" line on the crank pulley or the "F" on the later cars. The early cars require an extra step. Once timing is set at "R" you will need to disconnect the vacuum line going from the top of the throttle body to the distributor and the timing should advance to the "PF" mark. If it doesn't you need a new vacuum retardation mechanism. Next rev the engine up to 5000 rpm, at which point the timing should advance to the "M" mark. If it doesn't you have a problem with you advance mechanism.

Now if the idle speed changed, that will effect the timing. That means if the idle speed is no longer within 900-1000rpm you need to adjust the idle to bring it back within limits then check the ignition timing again. You may need to do this cycle a few times to get the timing right on the mark and the idle within limits. Once your idle speed is within limits and the pointer lines up with the "F" line on the pulley tighten the distributor's hold down nut. Disconnect the timing lights and you are done!

Here is an 11mm wrench on the distributor's hold down nut. Most are 11mm but yours could be different.

@When setting ignition timing there is a nice opportunity to increase the engines power output when emissions are not a concern. The factory setting is ideal for emissions but not power. The timing can be advanced about six degrees for a nice improvement in engine power and response with no increase in the engine's octane requirement. Six degrees is an easy amount to see on these engines. On the early cars six degrees is about double the width of the letter R on the pulley so advance the timing about that distance away from the line. On the later cars six degrees is about equal to three times the distance from the "P" line to the "F" line. Visualize where that would be on the pulley and set the timing there. When you advance the timing the engine speeds up, be sure to advance, not retard the timing. Since the timing effects the idle speed and vice versa you may need to slow the idle after you advance the timing and then check the timing again and adjust as needed and so on. After a two or three cycles you should have it just right.

Step 10 Altitude Compensating Device

If your car is an '84 or later model it probably has an Altitude Compensating Device. This is an interesting little device. It senses changes in altitude by measuring atmospheric pressure. It's not a factor at cruising speeds or at full throttle, it's primarily to help the car idle when driving from low to high altitudes.

Testing this device is simple. Remove its connector and you will find it has three electrical terminals. They are numbered 3,2,1, left to right as viewed from the front of the car. In other words terminal 1 is closest to the steering wheel on U.S. spec cars. Get out the OHM meter and check resistance between 2 and 3. The resistance there should be 2000-3000 ohm. Now measure between 1 and 2. The resistance value will depend on you altitude. If you are between sea level and 4000 feet the value should be 500-4500 ohms. If you are over 4000 feet (and few of us are) the resistance between 1 and 2 should be 2500-6000 ohms.

Step 11 Idle Adjustment

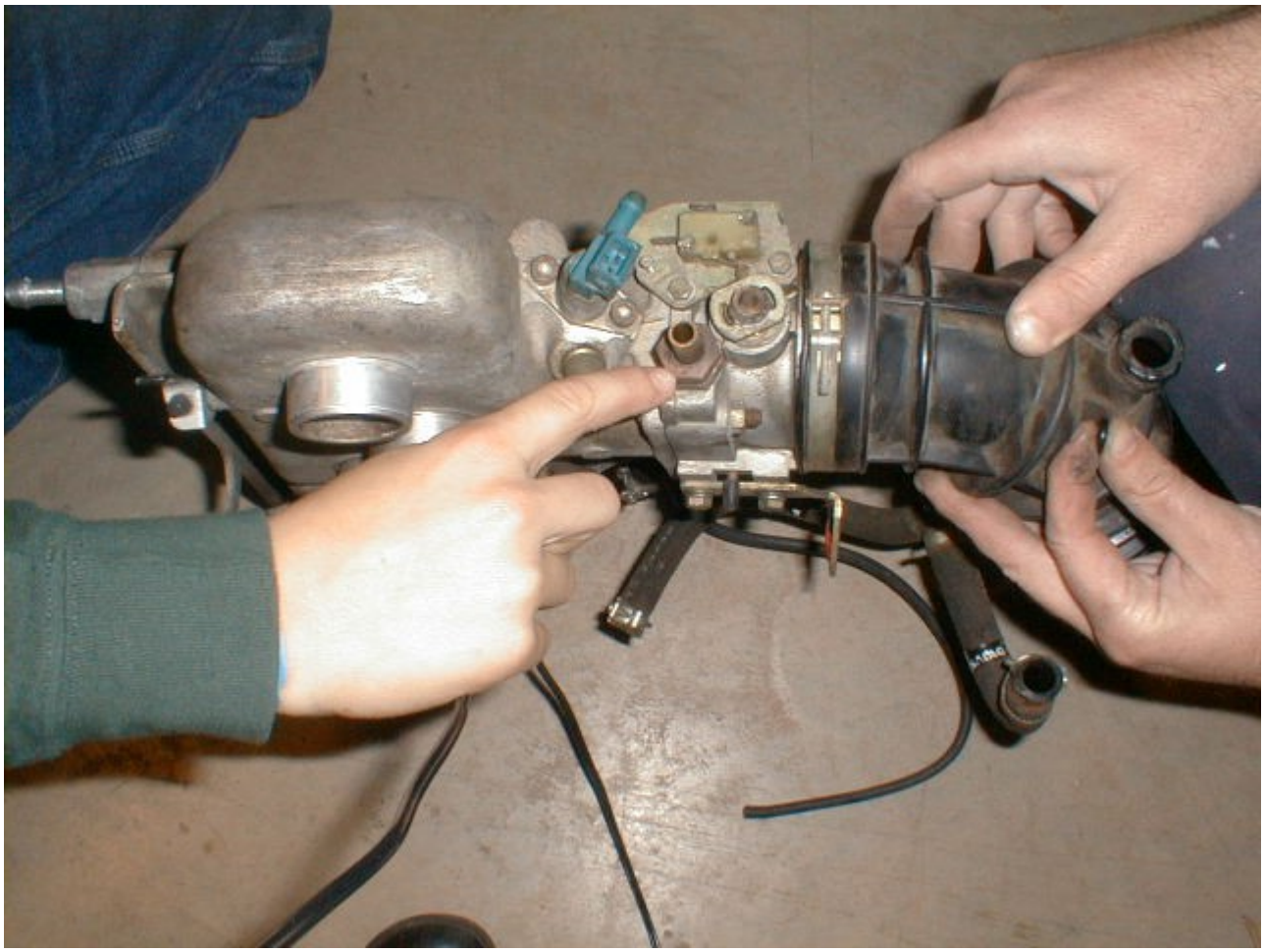
The idle adjustment is fairly easy if everything else in the system is in good working order and set correctly. To set the idle you will need some wrenches. A 17mm and 19mm for the 84' and later cars and a pair of 21mm wrenches for the earlier cars. Locate the idle adjustment double nut on your car. They are large brass nuts usually same size as the wrenches you just found and are located on the right side of the intake plenum. The exact location is shown in the pictures below. They are just aft of the throttle body on the 83' and earlier cars and forward of it on the later ones. There are two nuts. The outer one is the adjustment nut and the inner one is the lock nut.

The idle speed is adjusted by turning the outer adjustment nut which is then locked in place by the inner lock nut. Before turning the outer adjustment nut you must free it. To do this hold the outer nut still with one wrench and turn the other counter clockwise to loosen it. Once the lock nut is loosened you can turn the outer adjustment nut. As you turn it clockwise you will tighten it and slow down the idle speed. Turning it the other way will increase the idle speed. It's important to understand just how this system works so I will explain it. Nearly all the air the engine uses at idle comes through this nut. The amount of air controls the idle speed. The amount of air is regulated by a tiny rubber donut. This critical donut is compressed as you tighten the adjustment nut and its hole gets smaller. Loosening the adjustment nut allows the donut to expand thus increasing the size of the hole and increasing the idle speed. *As these donuts get old they sometimes refuse to compress and more often refuse to expand. If this is the case the engine will not respond properly and consistently to the idle adjustment and may suffer from an irregular idle. If you have any doubt about the condition of your donut just replace it, it's a very inexpensive part.

If your engine is responding properly to the adjustment then just set the idle between 900 and 1000 rpm. If you are not sure about the accuracy of you tachometer hook up a good dwell tach. The idle must be within the specified range or fuel economy, emissions, and even engine life may be adversely effected. I personally set it to 1000 rpm.

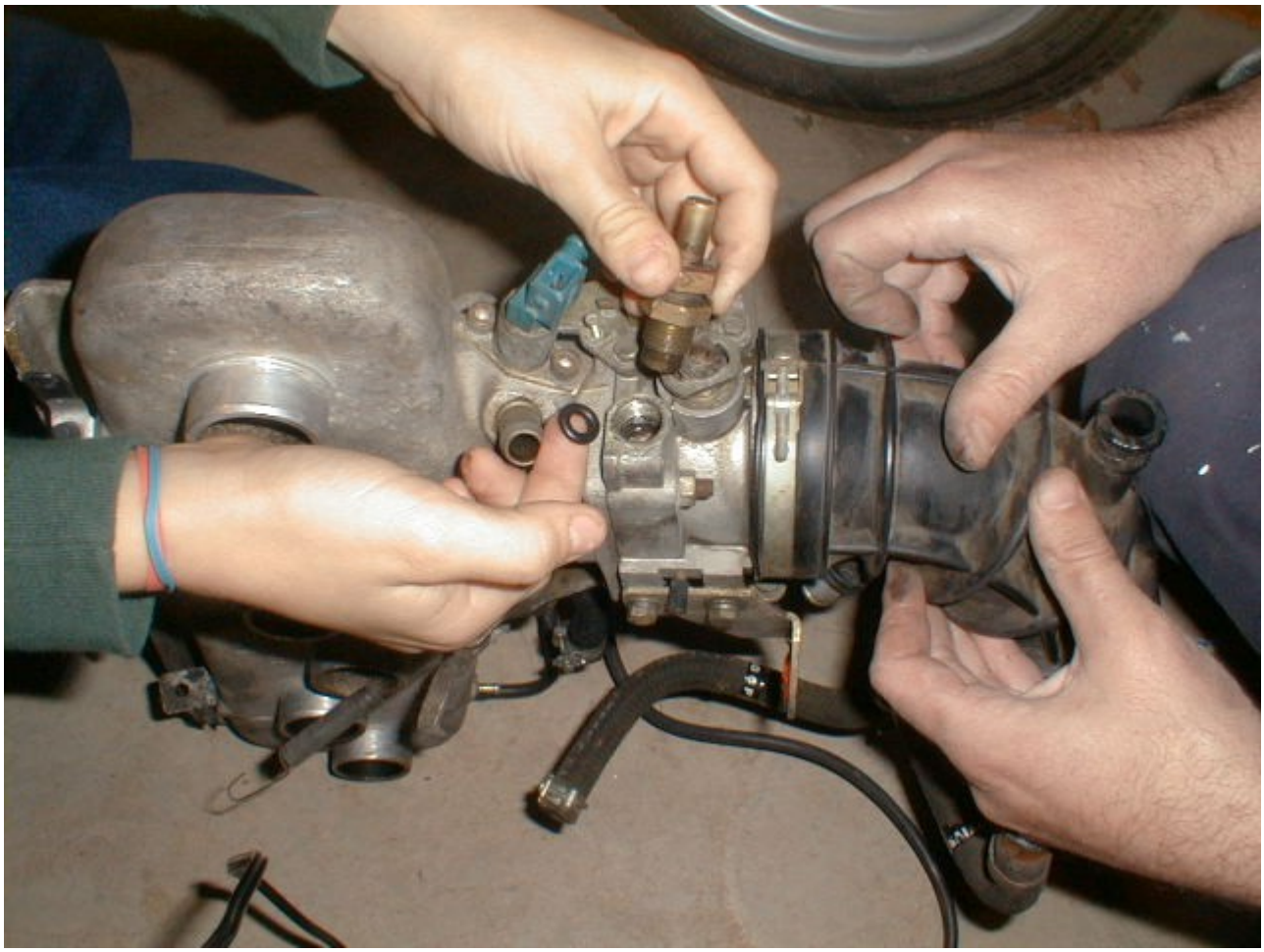
Now if your idle is set properly, you are done! However, sometimes the idle adjustment nut does not have enough authority to slow the idle down into the specified range. This usually means something else is not set properly, it's no big deal, just read on and we will straighten this out.

This is the idle adjustment double nut on a 81'-83' intake plenum. These nuts are typically 21mm and awkward to get to, plus 21mm is not a super common wrench size.



Here is the idle adjustment double nut the 84'-86' GTV6. It's in a much better location and the nuts are 17mm and 19mm which are a much more common wrench size.

Here on my son's fingertip you can see the critical donut that resides behind the idle adjustment double nut on all L-Jetronic systems. If this $1 donut is bad you will never get your car to idle properly. It's not unusual for people to spend $300 chasing an idle problem caused by this hidden donut, I strongly recommend you spend the $1 first and replace this part.



Ok, so you tried to adjust the idle but it would not come within 900 to 1000 rpm using the adjustment nut. Well you problem could be one of just a few things. First of all, replace your critical donut if it's not in great shape. If that does not fix it, and everything else in you system is operating properly then you will need to adjust the throttle plate and possibly, but hopefully not, the air bypass in the AFM.

Lets start with the throttle plate. This is the large round plate located within the throttle body. Every time you push down on the throttle you cause this plate to pivot and allow more air into the motor. You can only see the plate if you remove the main air intake, but we don't need to see it to adjust it properly. The position of this plate at idle has a direct effect on idle speed. The plate's idle position is adjusted by turning a screw which acts as an idle stop and is located on the throttle body. To find this screw look at the forward section of the throttle body and move the throttle and see what causes it to stop at idle. Turning the screw clockwise increases the idle speed and vice versa. To set the throttle plate back the screw out until it is no longer in contact with the throttle mechanism. The throttle plate is now about where you want it. It is supposed to be very nearly closed at idle, but not jammed closed by the throttle return spring so we need to open it just enough so it is not at risk of becoming jammed. Now screw it in until it just barely starts to advance the throttle. Remember we just want to open it a little. Now unless your AAV is stuck open or there is some other problem the double nut should easily be able to bring the idle speed down to the desired value.

If you are unable to get the idle speed up to the correct value and everything in your car is operating correctly then just advance the throttle plate until the idle approaches the desired speed and fine tune it with the adjustment nut. If you have an AAV that closes all the way you will need to advance the plate a little extra, but this is not a problem.

Now that you have moved the throttle plate you have screwed up your throttle position switch adjustment! You must adjust it again in accordance with step 6, or emissions, economy and power will suffer. It's possible that it won't need to be adjusted if you only made a small change to the throttle plate but I am afraid you will still have to check.

Now if you have done EVERYTHING else and you still can't get the car to idle correctly you can make an adjustment to the idle air bypass in the AFM. I have never messed with this adjustment. I really really recommend you don't do this, or at least make sure everything else is OK before you do it. This is a LAST RESORT only and will effect your emissions at idle. With the AFM mounted on the car you will see a small round metal plug at the rear and on the driver's side. This plug is there to stop you from adjusting the idle air bypass screw located below. If the plug is missing that probably means someone else has removed it and adjusted it before. If the plug is intact you should really consider leaving it alone since if nobody has removed it then the setting should still be the way it was when it left the factory. Anyway if you are sure you need to adjust this then remove the cover and use an Allen wrench to turn the screw located at the bottom. This screw adjusts the idle mixture and thus has a small effect on idle speed but a bigger effect on mixture and idle quality. It has a huge effect on emissions at idle. To adjust it properly you need a device to read the output of the oxygen sensor, then adjust the mixture for best emissions. For instructions on just how to do this go to step 12.

Step 12 Advanced Air FLOW Meter adjustments for best emissions and power. (note: This procedure is for all L-Jetronic Alfa Romeos, Fiats and Lancias.)

Many of our friends in the Italian car community are buying and using Air Fuel Meters (don't confuse that with the Air FLOW Meter). These devices are worthwhile because they allow you to accurately monitor you fuel mixture. However it's important to understand these devices read out put information from the O2 sensor and are entirely dependent on a good O2 sensor for accurate data. That's one reason most come with a disclaimer saying they should only be used to monitor mixture and or note changes to the mixture after engine modifications. It's also the reason most only display a range of readings (i.e. lean, good, rich or something like that). They almost never have a line on them saying "best power here". I am not going to leave you wondering exactly where the best power setting is, but, like them I need to make a similar disclaimer. Unless your O2 sensor is really really good, as in like new condition it may give incorrect readings which could cause this whole procedure to be harmful to you engine's performance. The good news is that with an excellent O2 sensor and a high quality DIGITAL voltmeter you can set mixture very accurately. In fact, the only way to do it better would be with a chassis dyno with an exhaust gas analyzer.

Since we will be measuring mixture by reading the output voltage of the O2 sensor we will need two things. First a good DIGITAL voltmeter. A cheap one won't do it, we need a good one with a digital readout. Next we need to make sure our car has a good O2 sensor. If your O2 sensor is questionable there isn't much point in trying to set mixture using information it provides.

Before I go any further I need to discuss the O2 sensor. This device measures exhaust emissions and sends a signal to the ECU to lean or richen the mixture. It only has an effect at part throttle. At full throttle it's signal is locked out by the Throttle Position Switch, and at idle it can't generate a signal because it doesn't have enough heat. The problem is it's self powered, it makes its own electricity from the heat in the exhaust. If there is not enough heat in the exhaust because the car is at idle it can't quite generate a signal. It also has problems generating a signal during the car's warm up period. Later cars have a 3 wire O2 sensor that receives electricity from the car's electrical system to heat it up. Those later 3 wire O2 sensors work a little better, but not much. *O2 sensors last a long time but they can deteriorate and when they do it will have an adverse effect on part throttle emissions and fuel economy. If your car won't pass an emissions test at cruise RPM then it could be the O2 sensor. Bosch says to buy a new one every 50,000 miles. I don't think that's really necessary. I have had pretty good luck removing and cleaning O2 sensors. However they can be damaged by contamination in the exhaust and other things so if in doubt buy a new one.

Now that I have stated the need for a good voltmeter and O2 sensor I will explain how to set your mixture for max power. It's really simple. First warm up the car. Next Connect your voltmeter to the output wire from the O2 sensor (the connection is on the right side of the engine bay toward the back, it's the only wire coming up from the exhaust area.) To do this you may need to disconnect the sensor but that's OK for the short amount of driving we will do to make the adjustments. If you did disconnect the O2 sensor ground the other connector (the one going to the ECU). This isn't that critical and will be temporary so just use tape or whatever you can find. Put the voltmeter in the car by having it's wires pass through the window and have a friend hold it for you and take the readings. Now go drive you car around and make a few full throttle max RPM runs while your helper notes the voltage. You may notice the voltage fluctuates a lot at low RPM but at full throttle above 2500 it should be steady, if not check your voltmeter connection and if it's good get a new O2 sensor. The voltage should be .88-.92 Volts. If the voltage is less your mixture is a too lean for max power, if it's the voltage is too high your mixture is too rich. If your mixture is below .75 it's dangerously lean because of a problem with the injection system. Most likely it's an air leak, throttle position switch problem or bad fuel injector or injectors. It could be other things but those three are the most likely. To adjust the full throttle mixture we have to adjust the Air FLOW Meter's spring tension as described in step 8. It's pretty simple, loosen the spring to richen the mixture and tighten it to lean it. Test drive the car after each change until you get a voltage reading in the correct range. Then remove the voltmeter hook the O2 sensor back up and secure the AFM's cover.

Ok, it's time for the idle mixture adjustment. *If your car has strange idle problems including a change in idle speed when idling for a long time after some higher speed

driving, or the inability to pass a smog check at idle they you probably need to adjust your idle mixture. To do this you will need to hook up a good quality DIGITAL voltmeter to the O2 meter's out put wire, just like when we adjusted mixture for max power. Now start the car up and let it fully warm up. Once it's fully warmed up we need to read the output voltage of the O2 sensor at idle. But Wait! At idle the O2 sensor doesn't have enough heat to generate a signal. No problem, just rev the motor up above 2500 rpm for about a minute and there will be enough heat at the O2 sensor for a reliable signal for 30-45 seconds. That means you need to take the reading quickly but not too quickly. The voltage reading we want is .45. Of course it's not quite that easy to read, the voltage will appear to be all over the place, perhaps it will be .65 one second and .25 the next. If it is, that's OK, as long as the variations average out to .45, idle mixture is set correctly. If not we need to adjust idle mixture. This is fairly simple. On top of the Air FLOW Meter, near the output section is a round plug. This plug can be removed giving us access to the Idle Bypass Screw. The screw is at the bottom of the hole which is accessible once you remove the plug. It's usually an Allen fitting. Turning this screw adjusts idle mixture and nothing else. Make an adjustment, and then take another voltage reading, don't forget the rev the car up again first. Keep repeating this until your voltage reading fluctuations average out to .45. Then put the plug back in the Idle Bypass Screws access hole, put everything back together and you are good to go.

Last Step:

Well, if you went all the way through this, congratulations. Hopefully your car is running quite well now. Your car should now be able to get 30 mpg at low speeds on the highway, and more if you have an 82' or 83' car. Your car should be a bit more powerful then it was too. The performance adjustments I recommended are worth about five horsepower which is is about what you get from a $700 set of 164S cams. A 81' 84' or 85' GTV6 set up this way can burn rubber all the way across an intersection, although that's not what GTV6s are designed for.

I truly hope you found this article to be usable and helpful. If you have found any errors, just let me know and I will fix them. Please visit my other pages!

Supercharging and Turbocharging:

If you plan to supercharger or turbocharge your vehicle using the stock L-Jetronic fuel injection system I can assure you it can be done with minimal work and expense. It won't be as good as a modern fuel injection system like Motec, but it will work.

The biggest problem will be the engine leaning out at high rpm. I now have a device that takes care of that. It will add additional fuel up to the limit of the injectors at the point where you need it. For example on my GTV6 with 10 pounds of boost and Stage 2 injectors it starts to get lean at about 5200 rpm so that' when I have the device cut in. It can be found on our fuel injector page.

If you have any questions e mail me at
greg@hiperformancestore.com