

Swapping a B16a engine into a '81 Fiat X1/9



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- The inspiration for this project and the answers to a number of questions I had as I worked through this swap came from Phil Young so I'd like to say thanks to him for making this whole swap possible. Also kudos to my electrician, welding instructor and all around car guru Randy Curley.
- There are several JDM Honda B series engines that will fit in this car. I chose the JDM B16a SIR II OBD1 because it's a proven swap. The engine has a high revving nature, is light in weight, has an excellent supply of aftermarket parts, has a hydraulically operated clutch, and most importantly – puts out 170+ hp. The US version B16a3 from the Del Sol VTEC will also work but they are tough to find (160hp). Another possible USDM candidate is the B18c series found in certain Acura Integra's - though these are harder to find in 'newer' condition, they cost a lot less than their imported JDM brothers and I would think seriously about using this motor. B Series engines are also used in later model US Civics. For more info, check out Wikipedia on Honda's B Series engines. If money is no object, you might also consider the B18C Spec R (200 hp), or the K-Series engines... the K series being more powerful but much more difficult to install.
- To do this swap, the only 'specialized' tools I used were a friend's mig welder for the mounts, exhaust and shift linkage, an angle grinder, a voltmeter, heat gun and soldering iron to do the electricals, and a flare tool to adapt the X's clutch line to the Honda slave cylinder flexible hose. I had the motor mounts professionally welded together.
- My overall thoughts on the swap - Engine swapping and 're-engineering' is a lot of work and takes time (in my case 6 months to get the basic swap done with additional time to work out the bugs), patience and more than a little money. I can't emphasize how important it is to do things right the first time and try to avoid compromises. This 'guide' is not meant to be an instruction manual on how to do the swap, but rather some photos and tips that I hope you'll find useful if you decide to try this for yourself. Hopefully this guide will help you to avoid some of the mistakes I made and help to speed the process along. This is the first swap I've ever attempted and while not without its problems, overall I think the project turned out well. The car, with all of its extra power is a blast to drive and a real sleeper, too. Yet it still retains its excellent handling characteristics thanks to the light weight power plant.

Running total of expenses

• JDM B16a engine and LSD transmission and shipping	2100
• B16a timing belt and bearing	35
• Aftermarket engine mounts	175
• Misc. steel stock for fabbing mounts, exhaust, etc.	45
• Honda shift linkage	25
• Honda instrument cluster (9k tach)	45
• '93 Civic wiring harness and under hood fuse box and main relay	50
• Other electrical supplies	60
• Bosul catalytic converter and Dynomax muffler	155
• Other exhaust supplies (pipes, brackets, etc.)	60
• 2 30" x 1¼" flexible radiator hoses	38
• Hondata intake gasket	50
• Miscellaneous nuts and bolts	20
• Paint and cleaning supplies	30
• Porsche 924 Radiator overflow bottle, hoses and connections	35
• Grinding wheels and cutting wheels, map gas bottle, welding supplies	60
• Miscellaneous fasteners, etc.	20
• '92 Acura Integra throttle cable and Civic clutch flexible hose and fluid	35
• Honda to Fiat driveshaft fitting	632
• Fuel Injection hoses, clamps, fuel filter, pump, etc.	135
• K&N filter and flexible intake tubing	70
• New clutch and lightweight flywheel	240

* As you can see, the two big ticket items are the engine and drive shafts. A B18c1 series motor (180 hp) and tranny in good shape can probably be had for a quarter of what I paid for the JDM B16a and a careful shopper could probably do this swap for under \$3,000.00. Also this cost was spread out over many months while I worked through the swap.

After I thrashed my engine and gearbox one final time, the first thing I did was to pull off the engine cover and trunk lid for easier access. Try to start this project with as little fuel in the gas tank as possible.



It didn't take that long to pull the motor and tranny as I wasn't too worried about breaking things. While waiting for the B16 to arrive I cleaned up the bay and repainted it. Note that I kept the starter wires, throttle link cable, heater hoses, back-up light connections. I'll need those later. The only wires I removed initially were the wires from the ecu to the engine. Later, I removed the wires to the fuel pump and the old ignition wires.



Here's a view from the other side. I'm going to be replacing the stock fuel pump with a Walbro inline unit and replacing the fuel hoses as well. After this pic was taken I disconnected the clutch slave cylinder, drained the hydraulic fluid and then carefully bent the metal piping alongside the firewall towards the right side of the car to mate up with where the Honda's slave cylinder will be. Notice brackets for the overflow bottle have been trimmed off – Later I also removed the main engine mount (highly recommended) and trimmed down the dog bone mount as well.



Now was the perfect time to clean and paint the engine bay. I tried various degreasers and found that acetone seemed to work best. Acetone eats into paint so I wouldn't recommend using it unless you plan to repaint the bay. I also lightly sprayed the firewall insulation with high temp bright silver paint after I cleaned it.



I kept most of my old engine parts until the very end and was glad I did. I reused things like the shift rod, brackets, hoses, etc, and referred to connections from time to time.



It took about two weeks for the engine to arrive. This is the 170 hp JDM B16a with a LSD Y21 transmission which were made primarily for JDM '92 to '95 Honda Civic Type R's. I've already removed the a/c and power steering units as they won't be needed here. The a/c bracket shown here (arrow) also gets removed. Now is a good time to clean, paint and inspect the new engine. Check the condition of all hoses, wires, belts, etc. and replace as necessary. Check for missing and broken parts and check the wiring to the sensors. Be sure to replace the timing belt now, while the engine is out of the car...a simple job that takes an hour or so. Also strongly consider changing out the water pump at the same time (recommended as it is under the front timing belt cover). Now would also be a good time to inspect/change out the clutch, alternator belt and the spark plugs. I changed the oil and transmission fluid with the engine in the car just prior to the big start-up.



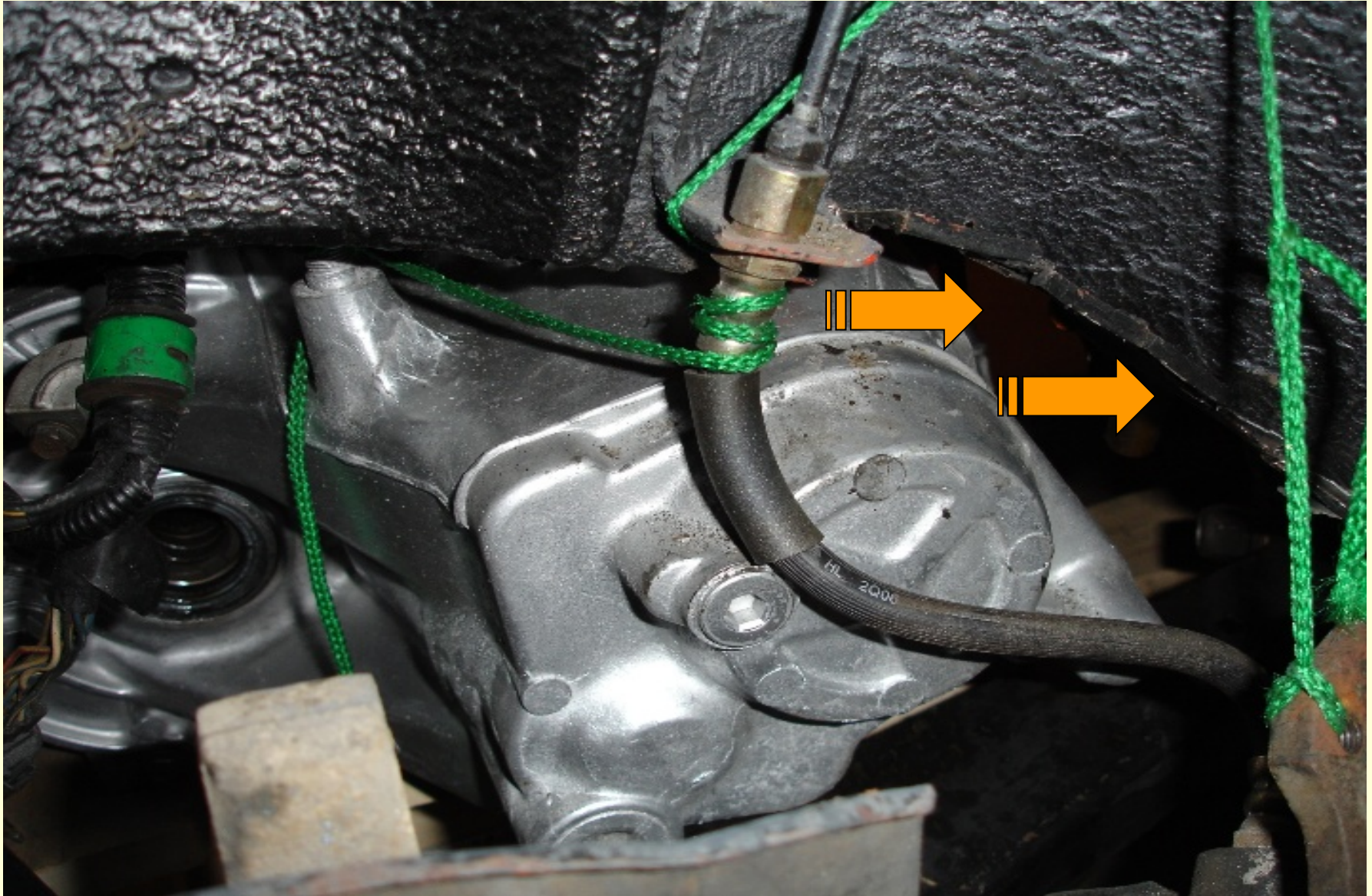
In this photo I've already removed the intake manifold and its support bracket to allow the motor to fit in the car. Hopefully I can figure out where all of these hoses and wires go. Remember to tape over the intake ports and other openings to prevent any foreign objects/dirt from getting into the engine or transmission.



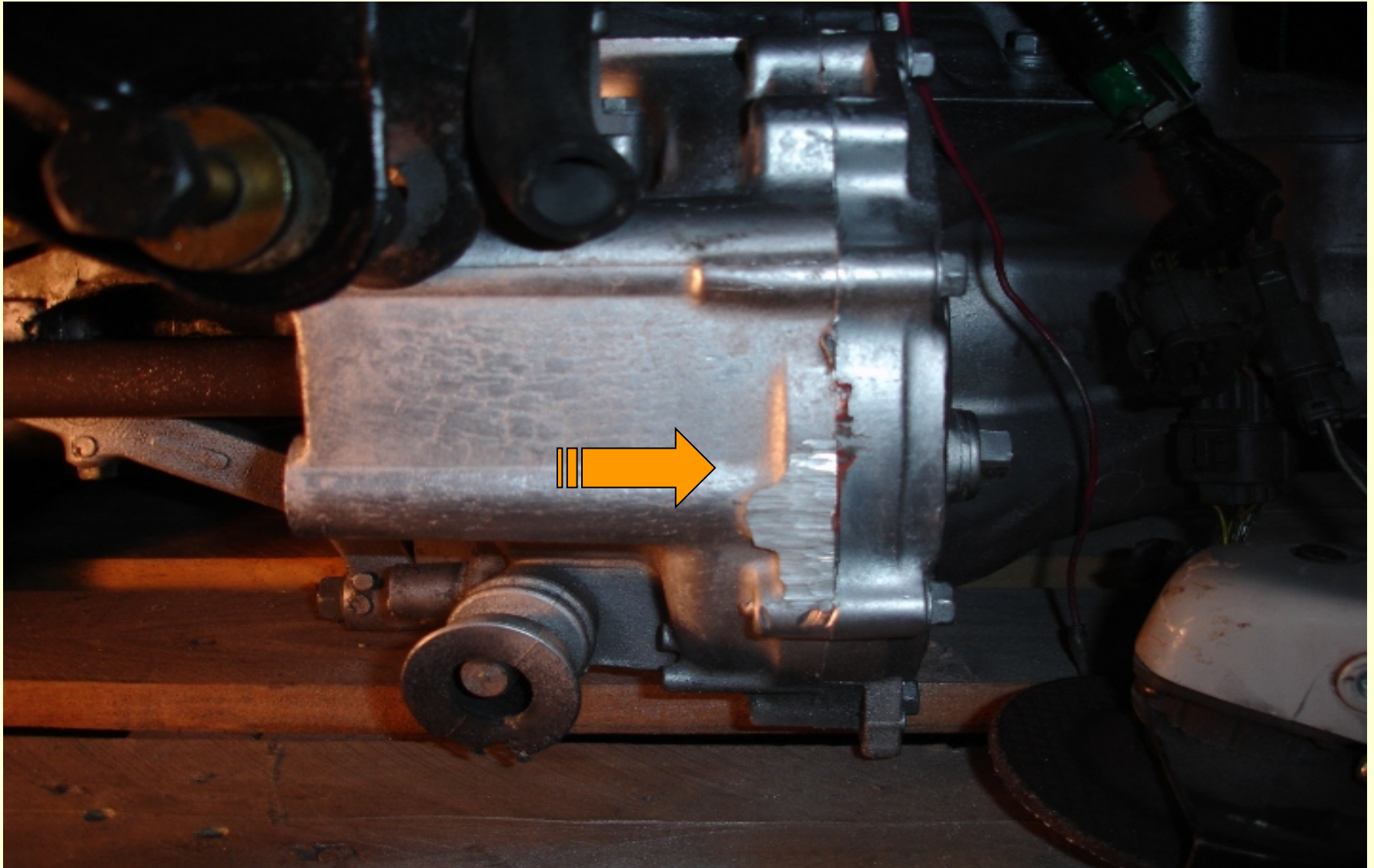
With the Fiat motor out of the way you'll need to cut off the plate that covers the shift linkage tunnel to fit the Honda shift linkage. I used an angle grinder to do the job. Be **extremely** careful you don't cut into the fuel tank or sever the emergency brake cables when you are cutting! I wedged in a piece of plywood to cover the side of the fuel tank. It may be easier and safer to remove the plate and cut it on a bench. BTW, the support stand you see supports no weight and is there 'just in case'. Needless to say, ensure your car is properly and redundantly supported before getting under the car to do work.



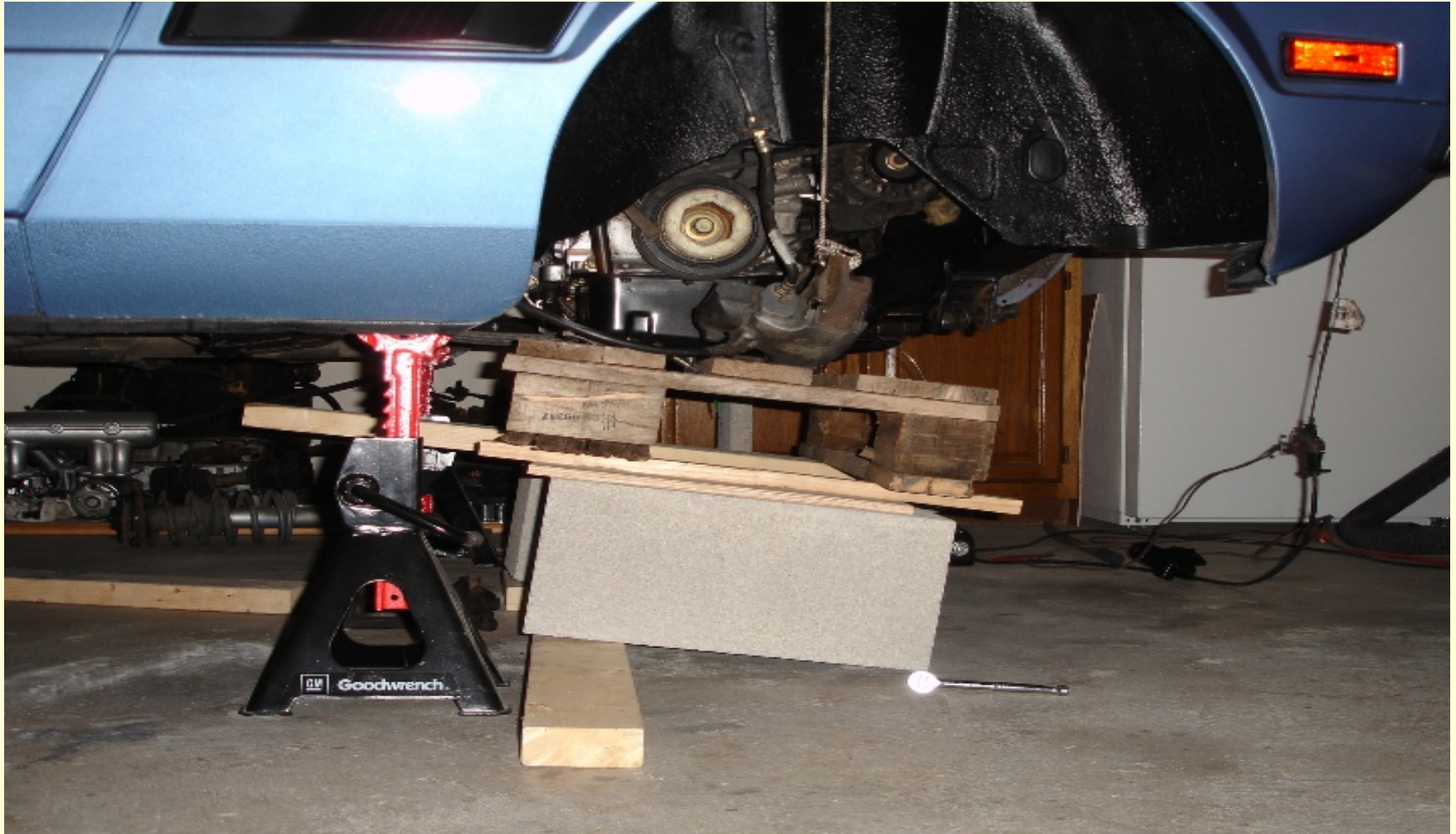
With the engine still out of the car, I cut some notches in the lip of the right (passenger side) inner fender guard and bend the lip outwards. This allows the end of the Honda transmission to be slid in close to the slanted edge which helps to get the drive shafts into proper alignment.. Note: this is not the final position of the transmission.



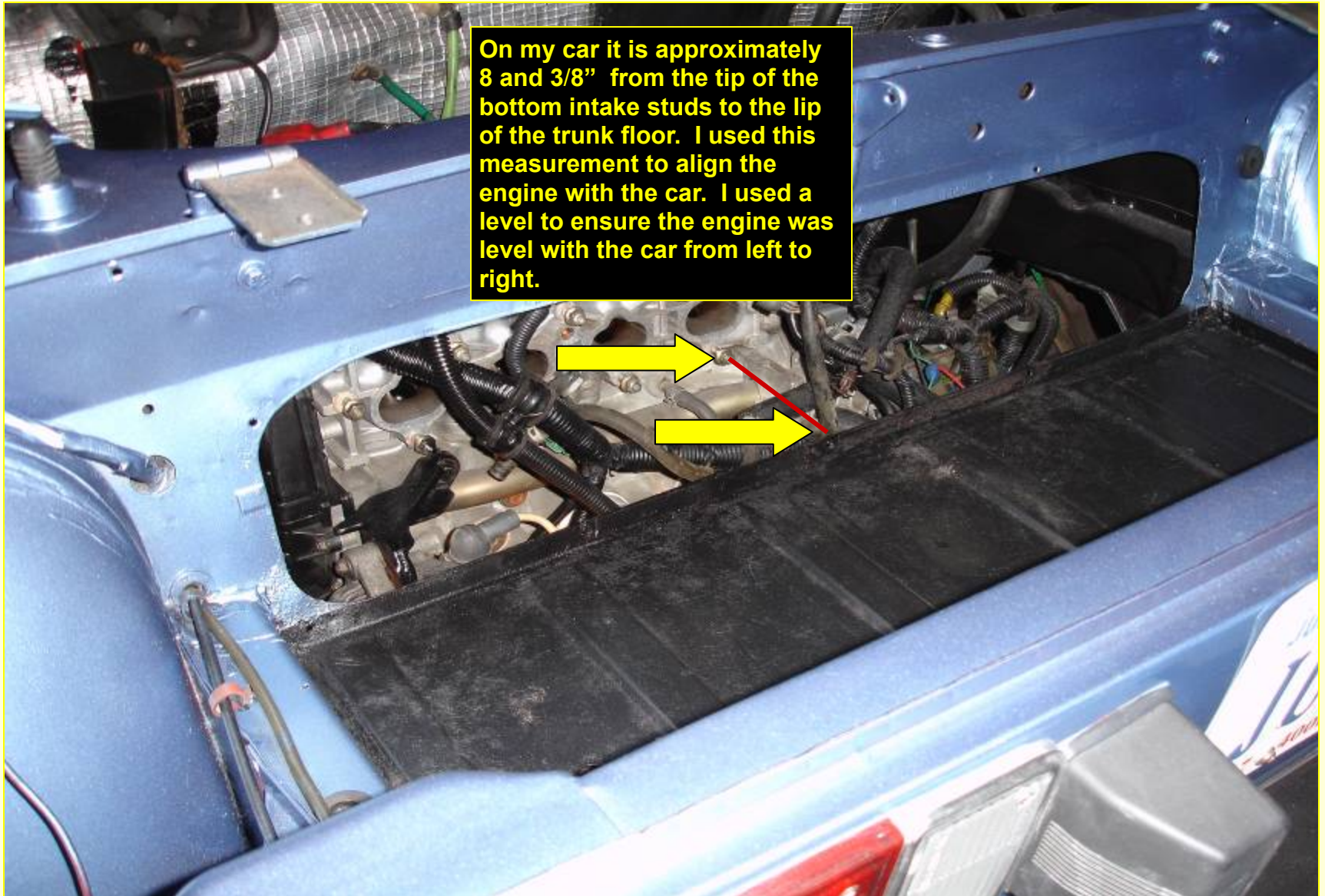
With an angle grinder or similar tool, I removed the unused lug on the right side of the transmission next to the gear shift linkage connector. I also had to cut/grind down the boss for the left side tranny mount so it didn't come into contact with the Fiat's firewall. When grinding or cutting aluminum, cover the rest of the engine with a drop cloth or something similar as it can be a very messy job with aluminum dust everywhere. NOTE: THIS STEP WAS LATER FOUND TO BE UNNECESSARY.



To position the motor in the car I left it on its (trimmed) pallet and rolled it under the car after taking off the X's control arms. I then shimmed it to the 'proper' height and angle with 2 x 4s and scraps and solid concrete blocks. This gave me maximum control of engine placement. The engine was positioned so that the drive shafts aligned as closely as possible to the Fiat's hubs as they are located under full load. Also, the engine must be angled so that the intake manifold can fit through the trunk access panel though I had to trim a fair amount of the top edge of the hole to get it all the way seated. My end result was an engine whose valve cover is almost horizontal, with the exhaust manifold very close to the firewall. Once I was certain of the engine and tranny's proper position in the bay it was time to design the motor mounts. Remember to take note of your blocking setup if going this route as you'll have to use the same setup when putting the motor back in the car.



With the engine out of the car, I cut out the metal plate that blocks full access to the engine via the trunk. Do a careful job cutting and you'll never know it was there. I find that blue painter's masking tape makes a good guide for cutting straight lines with the grinder. Eventually I'll need to cut and grind more in this area when I finally install the intake manifold but this is a good start and is essential to properly position the new motor into the car prior to making the mounts.



On my car it is approximately 8 and 3/8" from the tip of the bottom intake studs to the lip of the trunk floor. I used this measurement to align the engine with the car. I used a level to ensure the engine was level with the car from left to right.

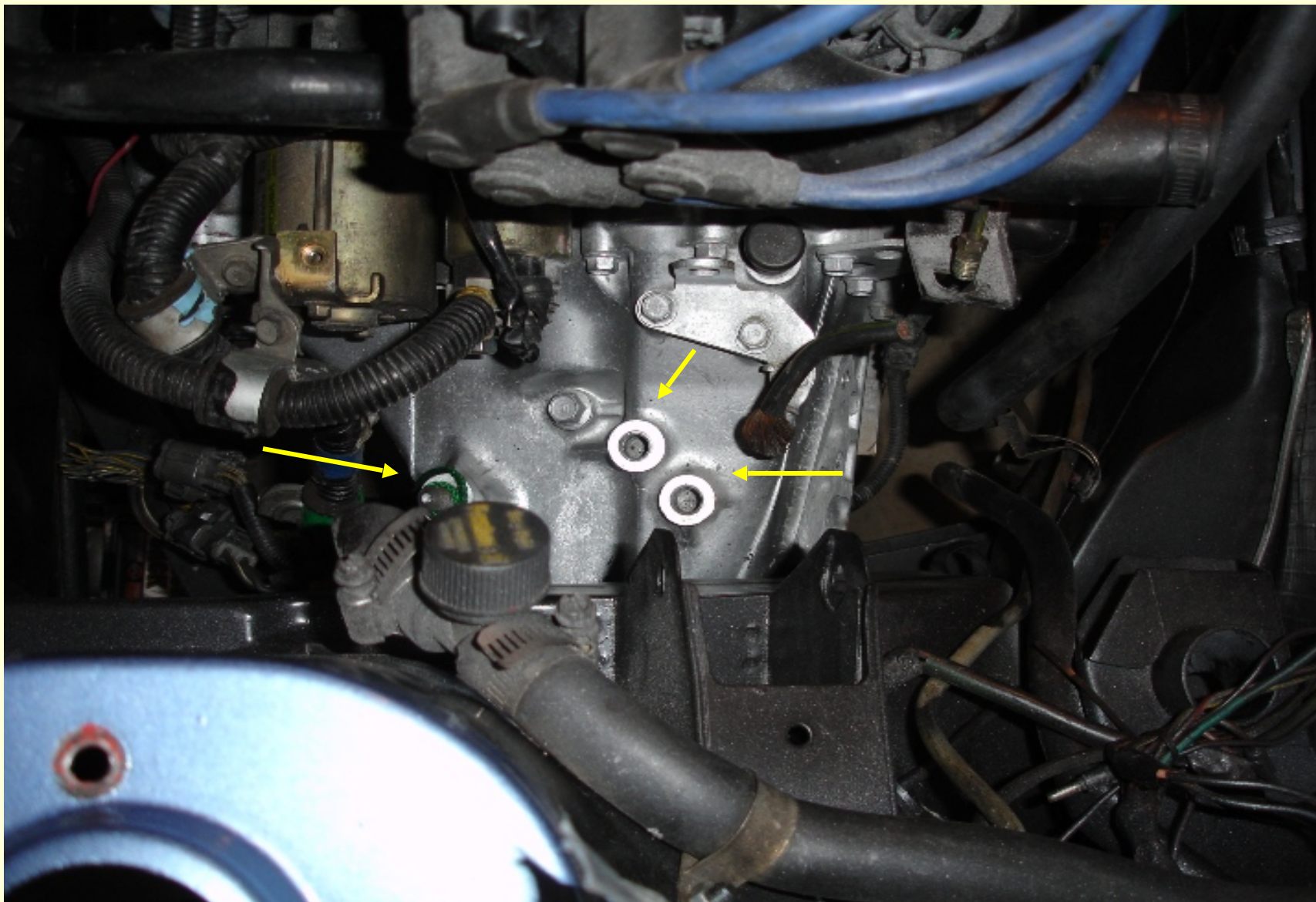
On my car the front engine mount bracket hangs over the frame rail. This is not the final position...it actually hangs over a tad bit more and is higher, too. Notice the blue tape which outlines the section of metal I'll need to cut out in order for the engine mount to fit. I used cardboard to mock up the mounts and then converted those patterns to steel. When I was done fabricating the mounts, I tacked them into place with the motor properly positioned and bolted in the car, then I removed the motor and finished welding. I would recommend designing your mounts to be stronger than necessary. I added additional fore and aft gussets to my mounts to strengthen them.



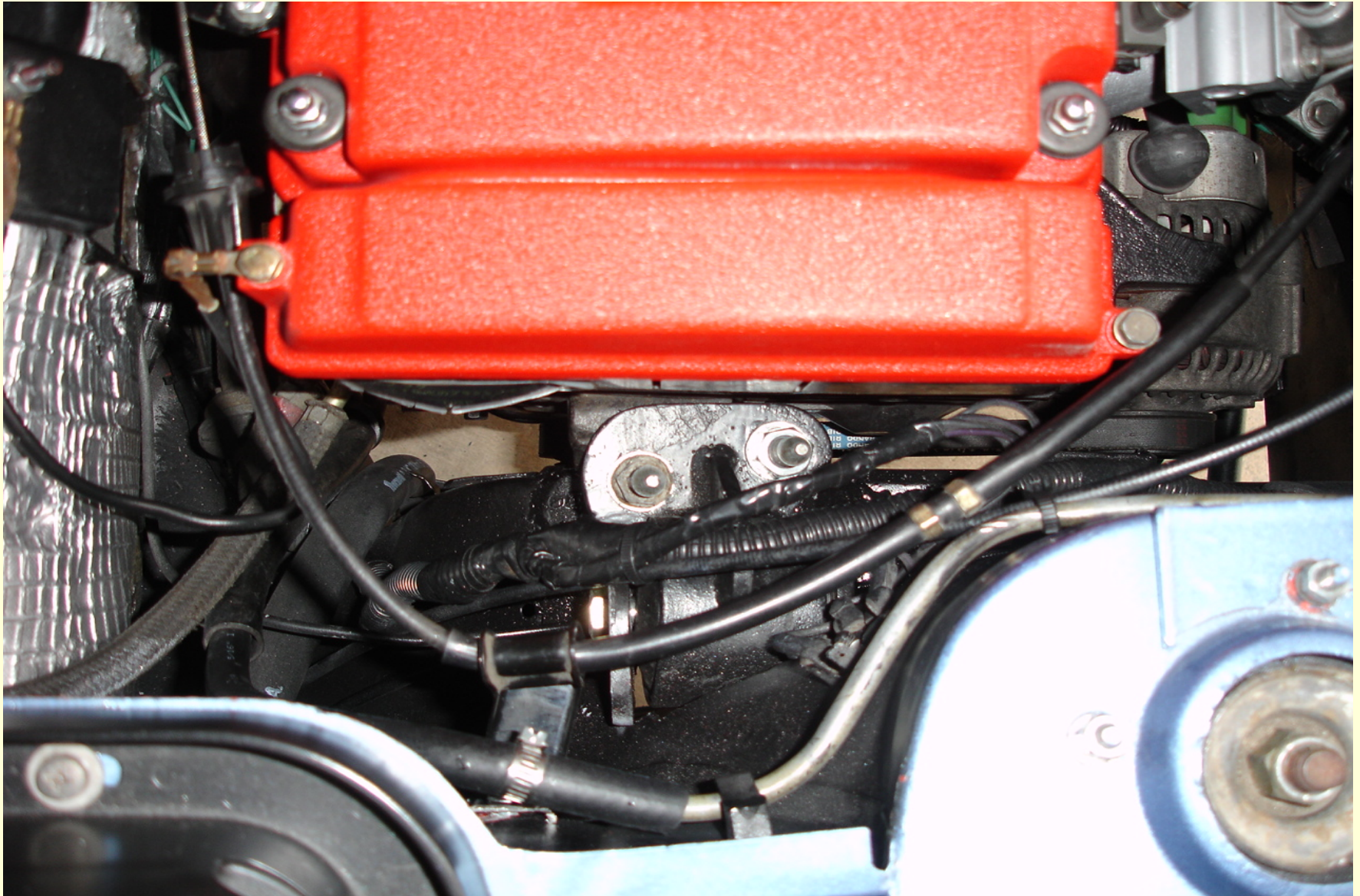
This photo shows my torque mount and transmission mount, both professionally welded together after I cut them to size. I didn't want to trust my beginner's welding skills on something this critical. I'll stick to welding things like the shift lever and shift rods. Notice the gussets added to the tranny mount for additional strength.



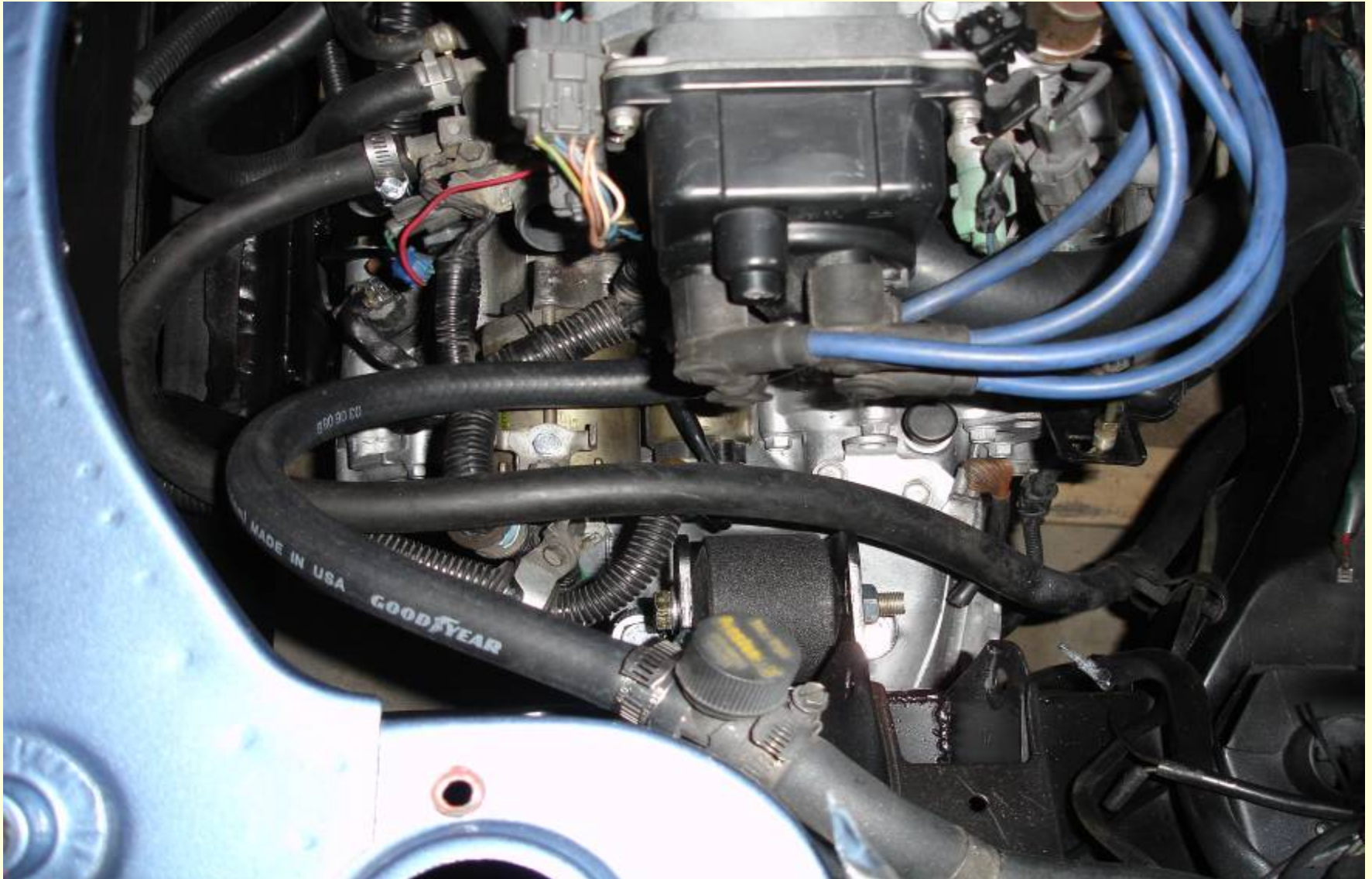
A view from the passenger side shows the 3 holes for the main transmission mount, clear of the frame rail side to which I attached the mount. Optionally, you could extend the mount upwards and mount to the top of the frame rail. The original main engine mount is still visible in this view but later I drilled out the spot welds to get it out of the way.



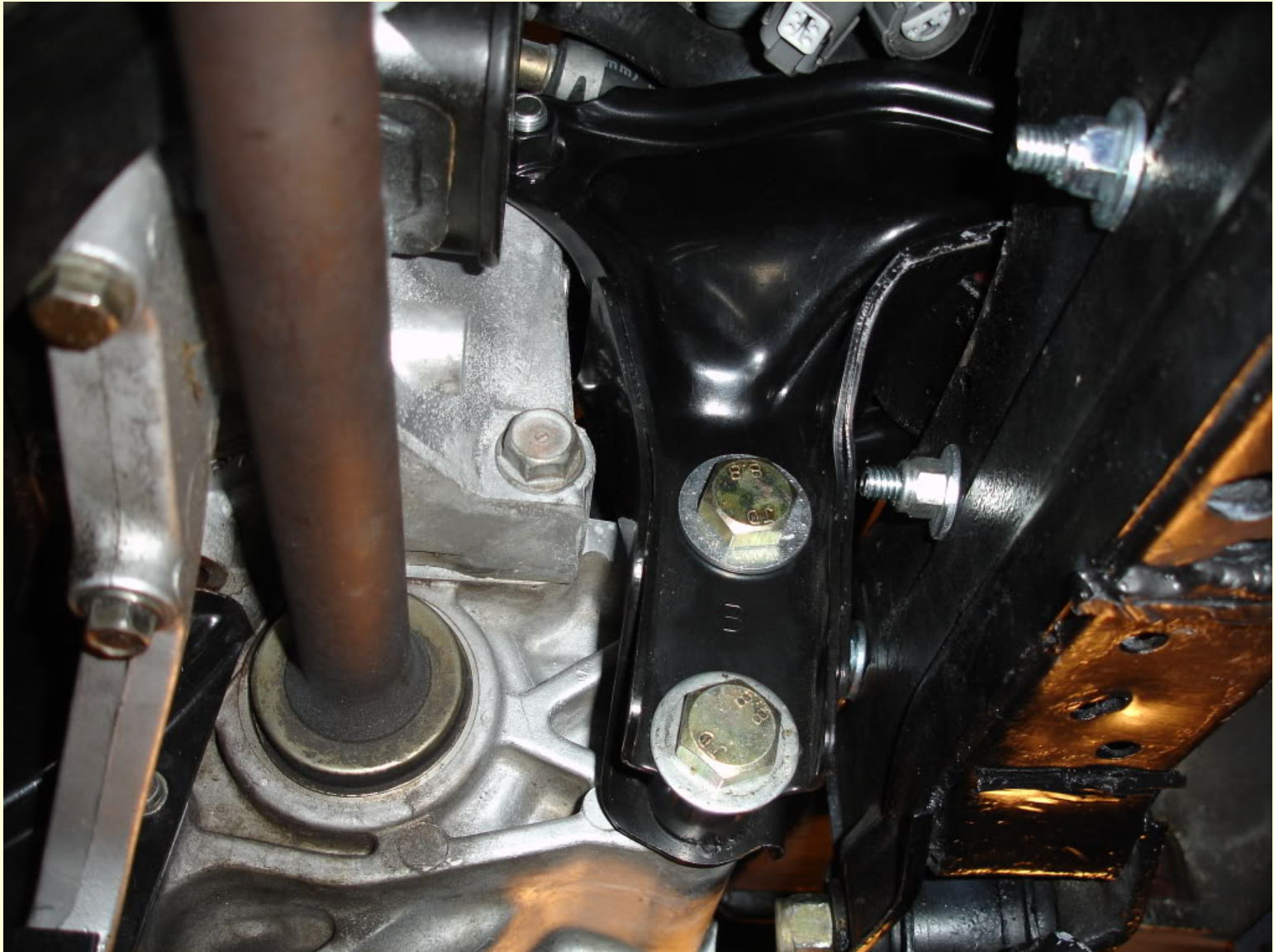
My motor didn't come with mounts so I purchased aftermarket units and cut, then welded them to fit. The mounts are from Innovative and are of steel construction (which means they are easy to weld on and strong). They are also stiffer than the OEM mounts which is important because there is little room for engine movement in the X's bay. Here's the front mount .



This photo shows the fabricated tranny mount which attaches to a steel plate with 'dog ears', welded to the side frame rail. Flaps at the top of the steel plate weld to the top of the frame rail for added strength and support (you can see the weld bead inside of the original engine mount of one of the two flaps). All mounts were made with 3/16 inch steel. After this photo was taken I welded in gussets to the sides of the dog ears to further reinforce them. Ditto with the primary engine mount in the previous photo.



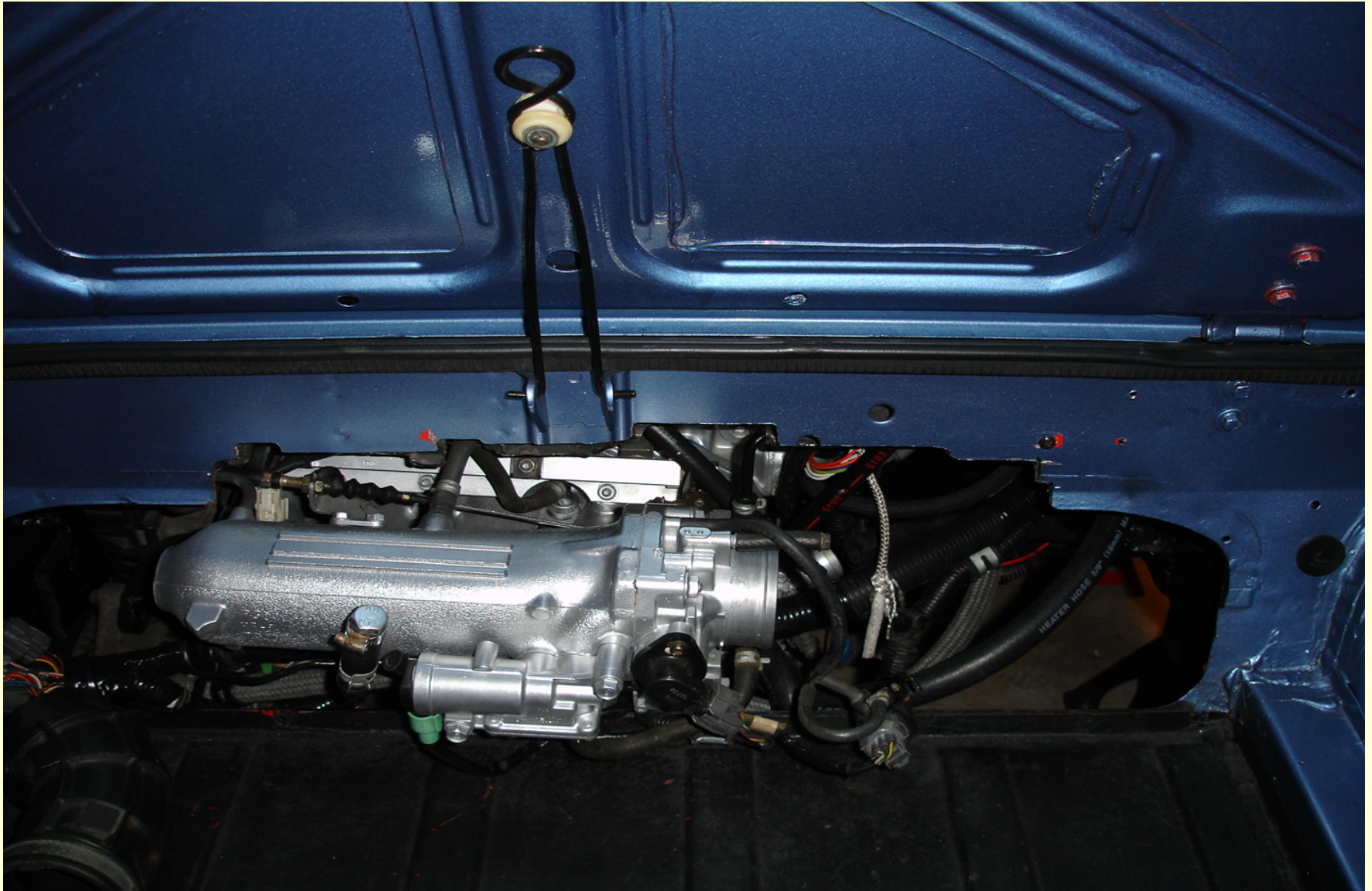
The torque mount bracket is a stock Civic Si unit.



Here's a photo of the engine mounted into the car. This is certainly the hardest part of the job - at least physically, since you'll install it and remove it several times. The engine fits very well (albeit snugly) into the X's bay and accessibility for maintenance and teardown is really better than the original X motor - with the exception of the timing belt and water pump. The only 'part' on the firewall side is the exhaust manifold - and the oil dip stick. Everything else is on top or on the intake side.



In this pic I'm test fitting the intake which is pulled away a bit for the photo. I trimmed enough to allow clearance for some engine movement. I left about a ¼" gap. BTW, the intake goes in a downward direction under hard acceleration. The large vacuum line that is plugged went to the Honda brake booster. I had to trim the top end of the throttle body's support bracket slightly to allow for its use though it's not visible in the photo. You may decide that the throttle body doesn't really need a support bracket...I eventually removed mine with no issues.



With trimming finished my intake manifold looks like this.

