

1991 ZR1 Intake Manifold and Injector Housing Gasket-Port Matching

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The intake manifold and injector housing ports of the LT5 engine in my 1991 C4 ZR1 are small in size at the mating face and mismatched with the gasket that is between the two. The ports are about 32mm in diameter while the gaskets are a little less than 37mm in diameter. Many LT5 experts offer services to port the intake manifold, injector housing, and heads to between 36mm and 39 mm in diameter but my build plan and wallet aren't ready for that.

My goal was to simply align and match the intake manifold and injector housing mating surfaces with a nominal diameter of 36mm. I did not want to go into the ports more than necessary to align and match the ports to the gasket. The intake manifold was already off the engine to repair a broken secondary system vacuum fitting, replace the injectors with Fuel Injector Connection Delphi Stainless Steel Injectors, and install new spark plug wires.

This is not the first minor porting or gasket matching I've done but this was the most complicated because the injector housing was still on the engine. A method to keep metal particles from entering the ports and ultimately the combustion chamber had to be devised. Tools used were basic:

- Pneumatic die grinder (at least 30 years old that belonged to my father)
- 60 grit abrasive cartridges, drum and conical shaped, and cartridge mandrel for the die grinder
- Craftsman model electric rotary "Dermal" tool
- Metal cutting head for the rotary tool
- Layout fluid
- Metal scribe
- Inside caliper set at 36mm.

The first step was to coat the manifold mating surface with the layout fluid. Each gasket was labeled with chalk for side of engine, forward direction, and manifold or injector housing face. They were then put into position ensuring they were located as they would be when installed. The manifold was then scribed to identify the material to be cut and ground away and the gasket removed. Care was taken to not damage the gasket during the entire job.



Mismatch of gasket and intake manifold ports.

It's easy to see in the previous picture how misaligned the intake manifold ports are and how small they are near the mating surface. Later pictures of the gasket on the injector housing mating surface show how air flowing through these ports was hitting the flat surface of the injector housing where misaligned. There was also pitting in the manifold and injector housing mating surfaces where they were misaligned that may be caused by turbulence instead of a smooth flow.



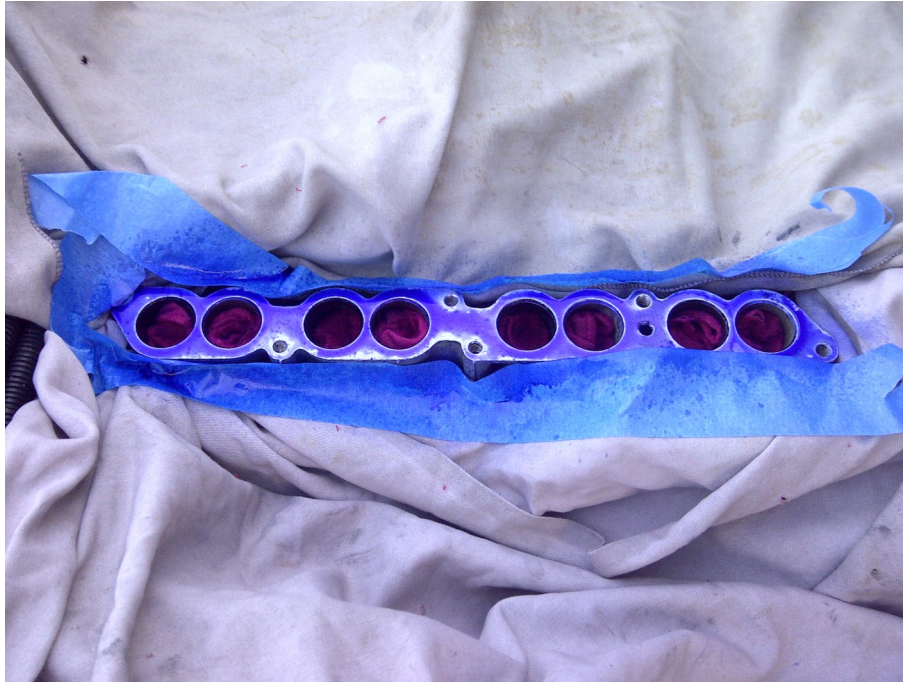
Scribe marks in the layout fluid. Note the radial misalignment.

All of the metal removal on the intake manifold was done with abrasive cartridges on a 6 inch mandrel in the air grinder. The cartridges were kept lubricated with WD-40 to prevent them from loading up with the aluminum. It took one to two cartridges for each port. Metal was removed to just match the surface scribe on the outboard side of the port and down to the turn of the inboard side of the port. The turn was blended into the port. The calipers were used to insure a constant 36mm through the bore of the port near the mating surface.



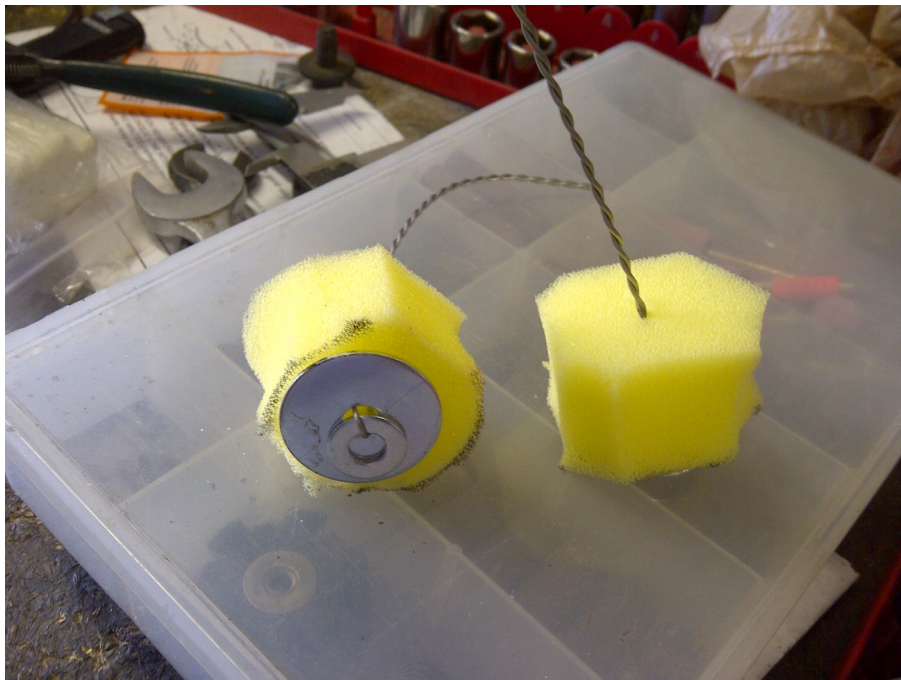
Intake manifold after grinding with gasket demonstrating the alignment and diameter increase of the port at the mating surface.

The injector housing on the engine was next. The engine was draped to prevent the scattering of aluminum as it was cut away. The layout and scribing process was repeated on the injector housing. The misalignment of the ports on the injector housing was worse than on the intake manifold. It's important to keep the gasket used for layout consistently placed on the appropriate mating surface side and forward orientation. If not the alignment of the ports from the cutting and grinding will be off.

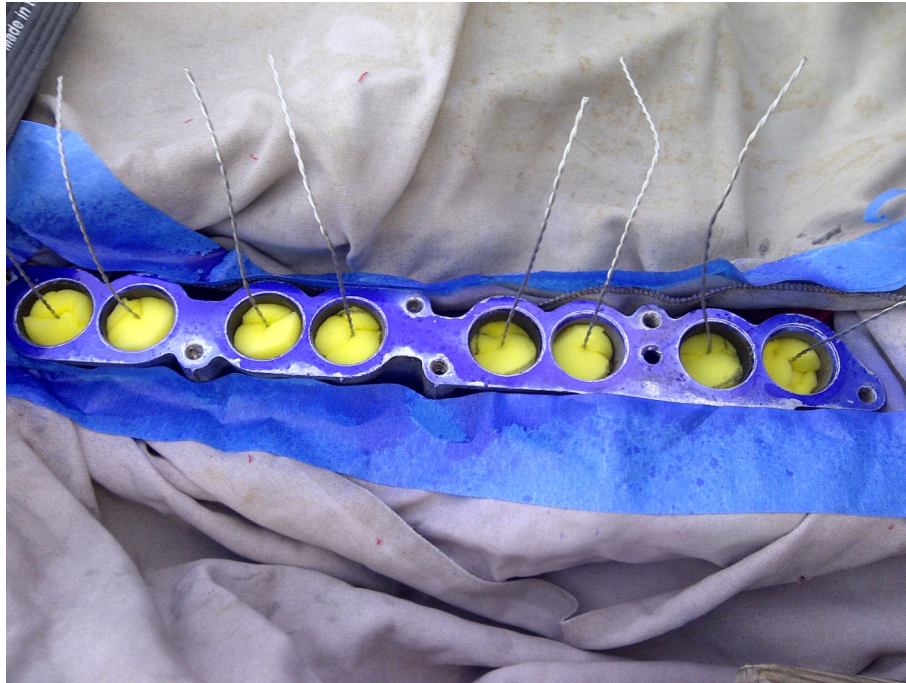


Injector housing mating surface with layout die and draping. Shop towels are in the ports as the first layer of the plug.

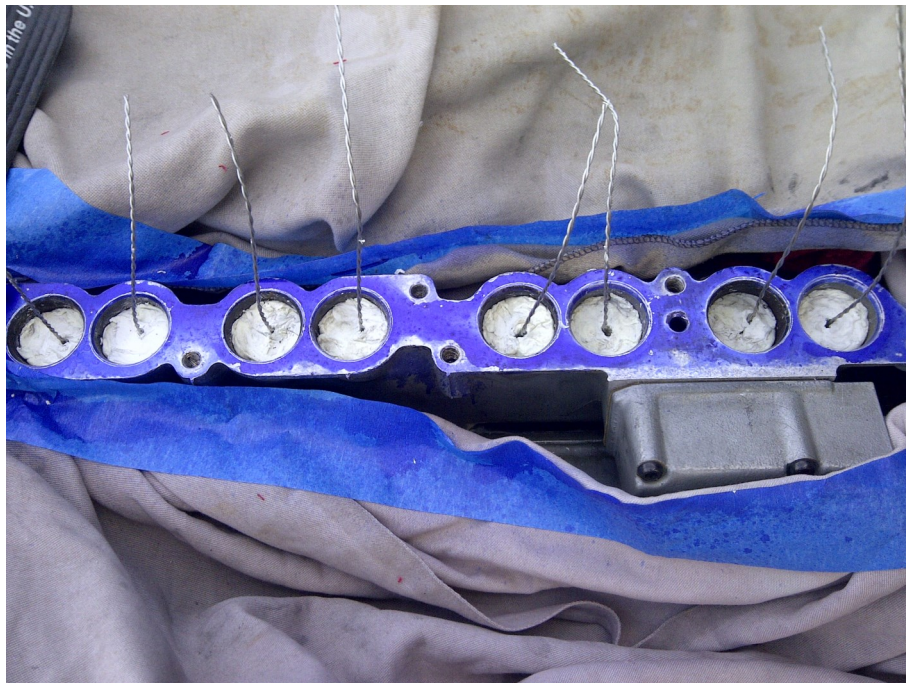
Preventing metal from entering the ports was accomplished by multi-layering a port plug. Deepest in the port was half of a clean shop towel. Next was a 1^{1/4} inch flat fender washer held by a small washer and wire in order to be able to pull the plug out of the port when finished. Third in the layer was a foam sponge cut slightly larger in diameter of the port and 10mm—20mm thick. Finally, non-hardening modeling clay was formed into the port on top of the installed sponge-washer-wire assembly.



Fender washer, small washer with wire, and sponge.



Washer and sponge inserted into ports.

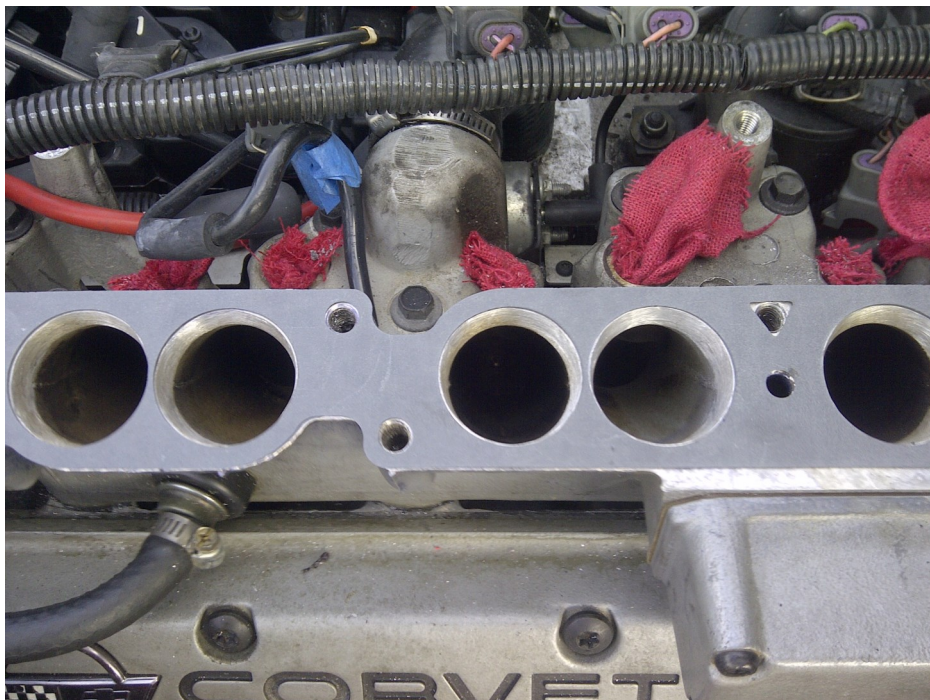


Modeling clay as the cap of the plug. Wires will be used to pull the plug out.

The electric rotary tool was used to remove most of the metal. Then the 60 grit abrasive cartridges were used to smooth out the cut. Cuts and grinding extended about 10mm—15mm into the ports. It was important to keep the cutting head and cartridges in motion to prevent gouging the surface. The cutting and grinding was done without WD-40 in order to prevent metal particles from being carried into the bore. The cutting head stayed clean of aluminum build up but the cartridge loaded up quickly requiring frequent changing.



Injector housing port almost finished. Note the pitting on the edge probably caused by misalignment air flow turbulence.



The finished injector housing with the gasket overlaid shows how much metal had to be removed to align the ports.

The intake manifold took about four hours to complete, primarily because of the amount of metal removed on the inboard side of the ports to the turn. The injector housing took about an hour to set up each side and 90 minutes to port each side for a total of five hours. Cleanup took another hour. All-in-all, I don't expect this to provide more than a few horsepower. If it produces five more horsepower I'd be surprised. Still, it's the little incremental increases that add up.