

Exhaust Manifold Replacement

What started out to be an addition of an exhaust gas pyrometer turned out to be a much more major project. The Barth had been sitting for a few months and it has been extremely cold for this time of year here in Sunny California. Starting the Barth wasn't eventful as I had the batteries on a tender while it has been sitting.

The intent was to move the Barth to a more convenient location so that I could get the welder near enough to weld in the bung for the thermocouple.

When I lifted the bed and got into the "engine room", I noticed a black smudge on the exhaust manifold that I had not seen before. Looking closely at this area revealed a crack, looking at the other side of the manifold, there was another. It is interesting to note that I had seen the "line" on the manifold before but dismissed it as just a casting mark. Going back to the original pictures I took while inspecting the Barth for purchase, I noticed in the picture that the line was there also!

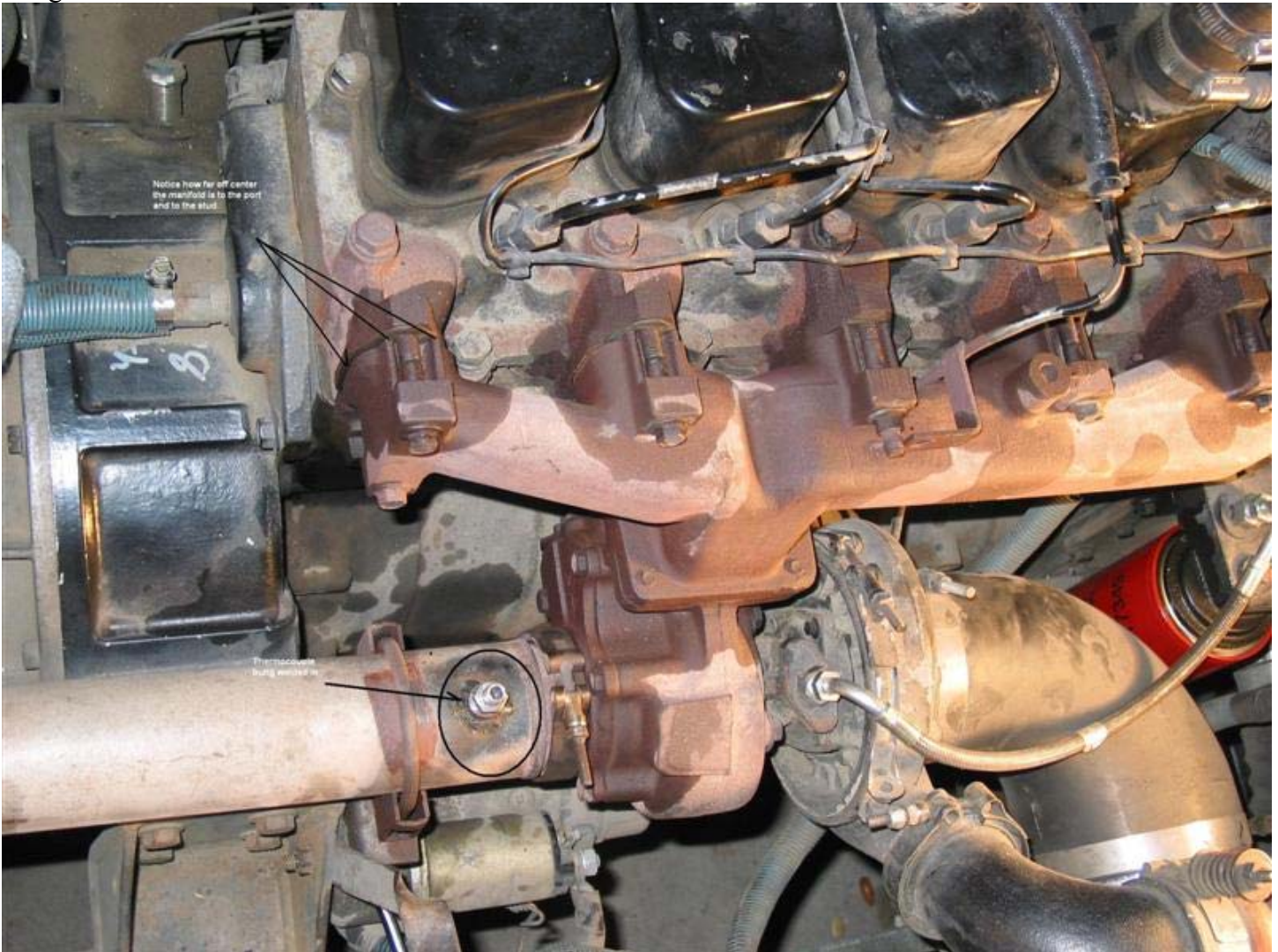
Purchase Inspection picture.



The engine was very dirty and dusty and that is the only thing that I noticed but the crack was there and leaking!

I removed the exhaust pipe from the turbo, sealed off the turbo and proceeded to weld on the bung for the pyrometer.

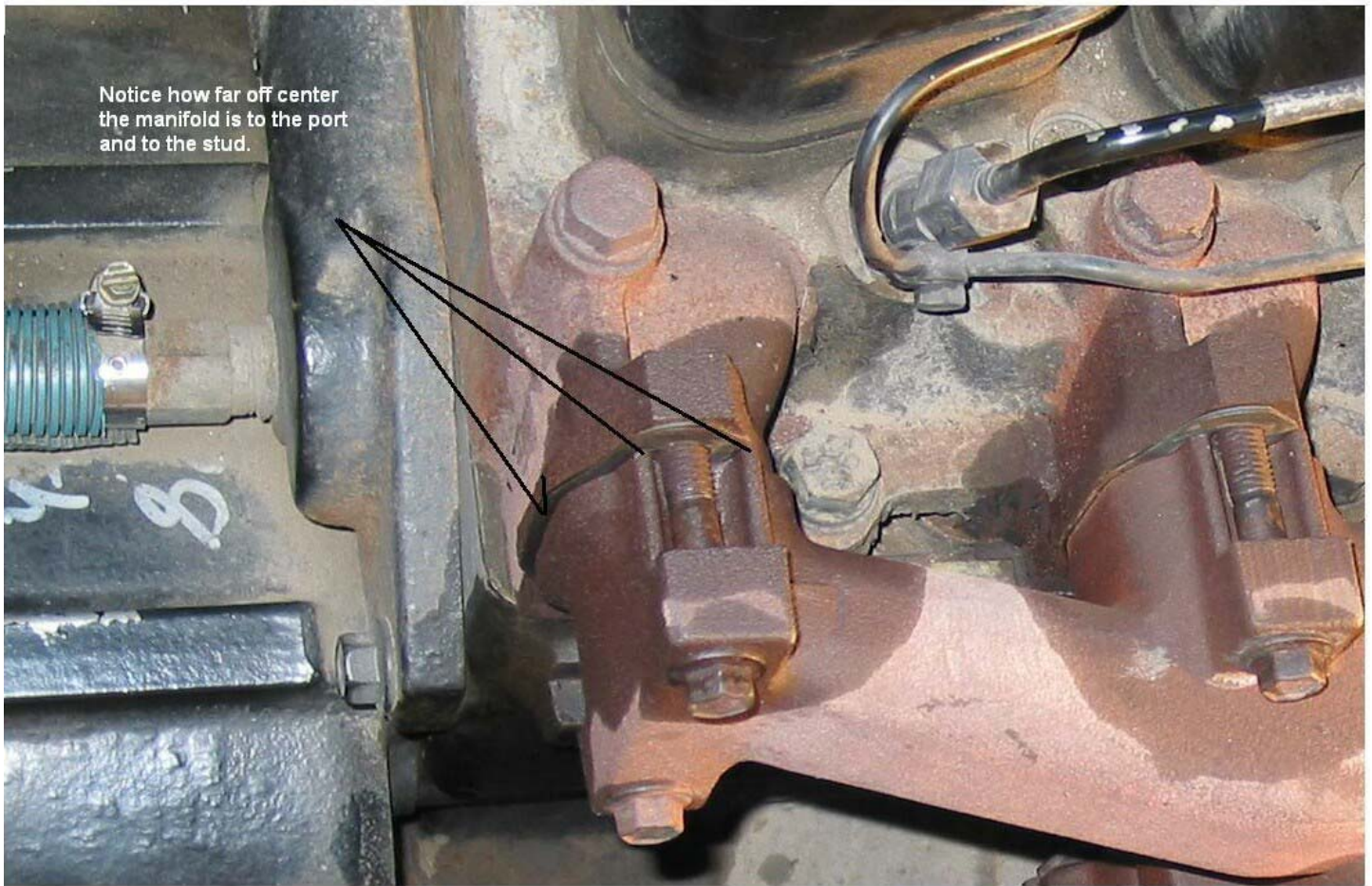
Bung welded on:



I kept looking at the crack, now knowing that it had been there for a long time and seemingly hasn't gotten worse---but---I can't leave things undone or not done correctly.

I called the local Cummins shop and they had new manifolds in stock, they also had a write-up of a series of revisions since my engine was manufactured; now Cummins uses a new type of material that resists cracking. Still debating if I should proceed with the change, I had oiled up the bolts with Kroil, an oil that I use for rusted nuts and bolts with the idea that I would change the manifold.

Then I noticed one other thing, The manifold appears to have shrunk!



That did it!! Went to get the new manifold, gaskets and new air supply line to the turbo as the old one was very rusty. I really was apprehensive about the change out, I had changed gaskets once before right after picking up the Barth so I know the header –to – head bolts would be OK.

Gaskets previously replaced:



I was worried about the turbo nuts, I don't think they have ever been off. Much to my surprise, everything came off easily! I did notice that the end cylinder header bolts both #1 and #6 were binding on the side of the header hole while being removed, a clear indication that the manifold had indeed shrunk. Total time to change for start to finish was just under 2 hours.

New manifold installed.



Thermocouple was installed and now waiting on better weather to run the cable to the pyro gauge. Of course that is another matter because now, I have to revise the instrument panel to accommodate extra gauges. I have been looking at the dash for many months thinking about this as I have intended to install a boost gauge, Pyrometer, and trans temp gauge. The plastic dash panel is developing some cracks, while not serious, still bugs me a bit, so I will make up a new panel probably in three sections. Center section will be first to accommodate the extra gauges.

Here are few extra pictures to show how far the old manifold had shrunk, certainly this has not help the power output of the engine but I don't expect a real noticeable gain either. It might help the fuel economy a bit thou.

I rejected the idea of drilling and tapping the new manifold to install the thermocouple before the turbo (ideally it should be at the inlet of the turbo) because I have lost turbochargers in the past when the pyrometer failed and pieces of it were ingested in the turbo. I will just add 200-300 degrees to the reading to compensate for the heat loss in the turbo.

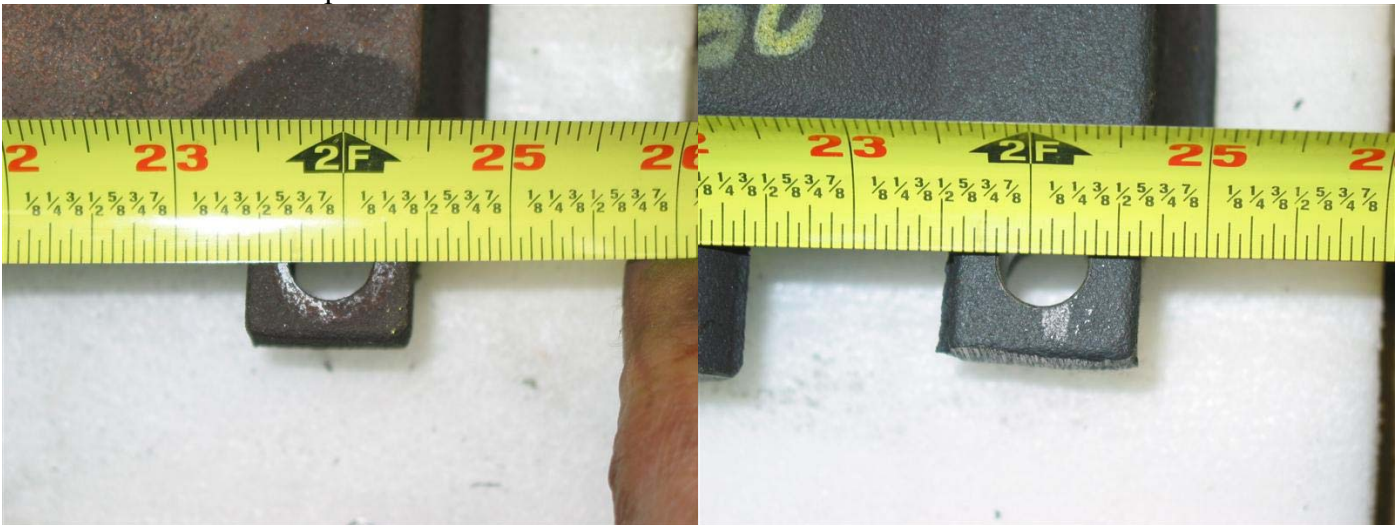
Cylinder #1 port mismatch:



Cylinder #6 port mismatch:



End to end bolt hole comparison of old manifold to new manifold:

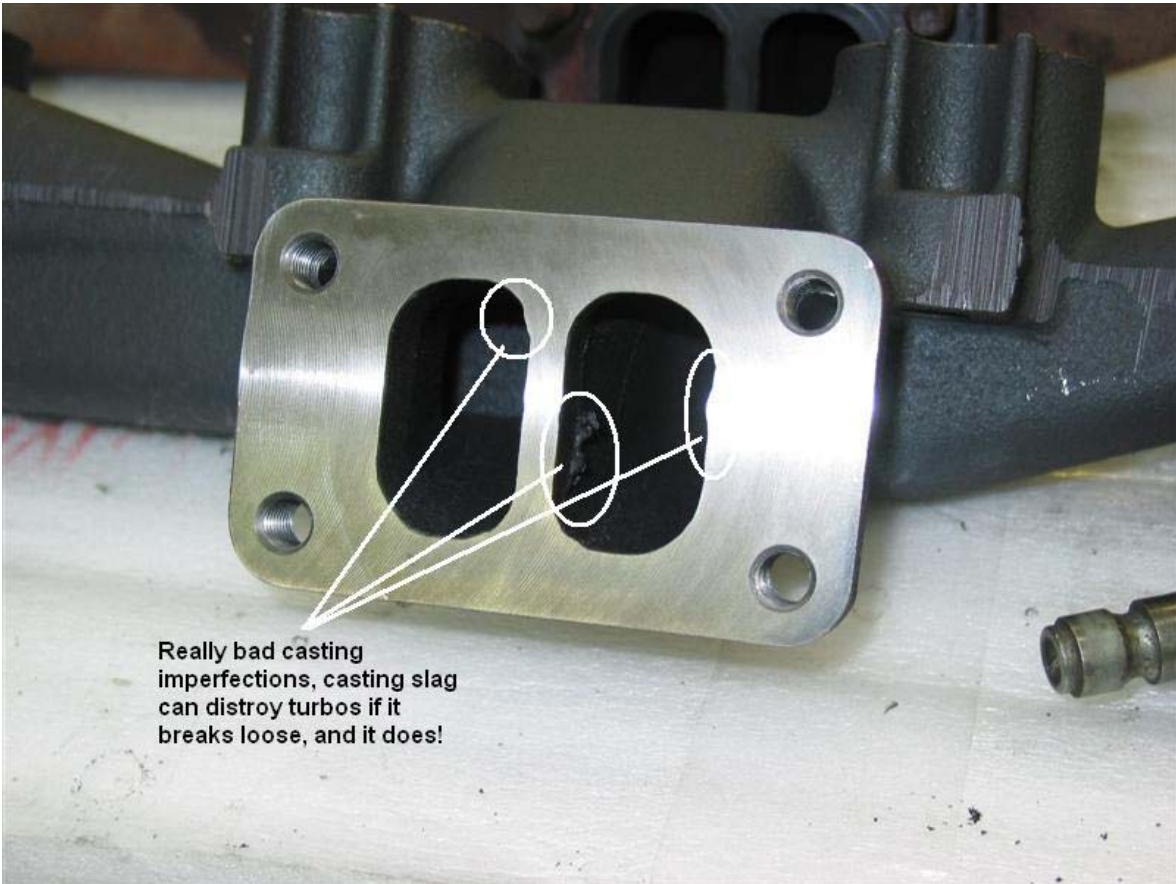


New manifold is almost 1/4 inch longer then the old one.

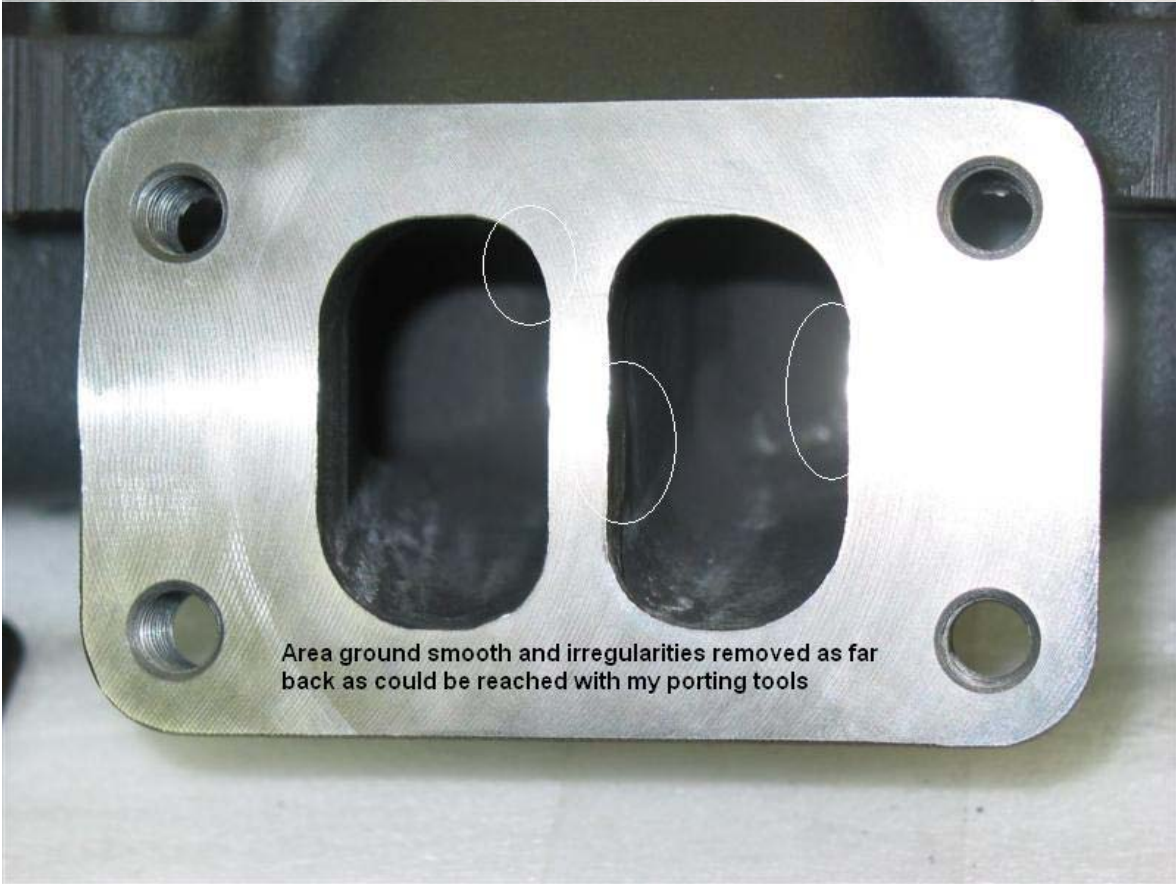
While inspection the new manifold I saw a lot of casting slag right at the mouth that feeds the turbo, this is NOT good. There are many reports of this casting slag breaking off and being ingested into the turbo which will result in a catastrophic failure of the turbo. The walls of the casting were a lot rougher then I thought was good so I decided to “port” the casting a bit to remove all accessible casting slag and smooth things up a bit. Short of sending this out for “extrudehone” it is the best that I could do with my porting tools. I was very surprised at the poor quality of the manifold as received!

One other thing that stuck in my mind was how badly the ports lined up with the old manifold and even thou the new manifold was better it was far from perfect, furthermore, the turbo housing has a really small inlet area compared to the gasket and the size of the outlet of the manifold. This will cause quite a bit of turbulence and localized heat build up where the ports are not sized correctly to match each other, particularly where the outlet of the manifold is larger then the turbo inlet.

Sometime next year I will be reworking the turbo and at that time I will get a new turbo housing and port match it to the manifold, then, send it away to have assembled into the final rebuilt product. I will probably go one size down in the housing size to help with the slow response of boost build when accelerating in first gear.



Really bad casting imperfections, casting slag can distroy turbos if it breaks loose, and it does!



Area ground smooth and irregularities removed as far back as could be reached with my porting tools

Next project-Dash reconstruction!