TURBOCHARGERS & EXHAUST

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EXHAUST MANIFOLDS

There isn't a lot available from the aftermarket to turbocharge a small-block, and what is available will not support the power I was looking to make. Banks offers a compact set of manifolds for about $1000 a pair, but they are based from stock castings and will not flow enough for my needs. Even if they could, I could make them for much less and put the turbos where I want them.

I am a firm believer in equal length headers, but taking everything into account, they are not a benefit for my application. For an equal length header to be tuned for my rpm range, the primary tubes would have to about around 32" long. Even stainless steel headers will have a lot of heat loss in 32". With a turbo system, heat loss before the turbine reduces efficiency. More power will be lost than gained from tuned equal length headers. I can make headers quite easily myself, so cost had nothing to do with my choice. Headers would need additional support for the weight of the turbos and they also have more heat expansion which can leak to cracks or leaks. A good set of stainless headers can work just fine, but I believe that thicker manifolds with the turbos close to the head will simply make more power in a smaller package, providing they can flow the same. A log type manifold is not an option; they simply will not flow well.

I decided to make a pair of manifolds from sch. 40 butt weld pipe fittings. It is a functional 4 into 1 header system, but built as strong as manifolds. Anyone who is good at fabricating and welding can easily make their own; you will save a lot of money doing it yourself.

Just about all major header manufacturers offer flanges for all popular applications and many will custom make flanges to your specs. With a little fabrication, any engine can be turbocharged quite easily. The stock small-block Chevy bolt pattern limits outside tube diameter to about 1 ¾" if the tubes are squared up. To get larger tubes, you'll need adapter flanges, which are very common in race engines. The inner flanges get bolted to the heads with flat head bolts, and then must be port matched to the exhaust ports. The flanges have a wider 7 bolt pattern that allows larger tube headers to be used.

Here's the flanges needed to use big tube headers with a small-block Chevy pattern.

Fitting the pipes together takes a lot of time and patience, but well worth the effort. In the end, it is much more satisfying when the work was done yourself. Once I had all the pieces cut, I tacked them all together and trial fitted the manifold on the engine before final welding. The spark plugs were all very easy to get at and there was plenty of room for the turbos next to the valve covers. I made the manifold as low as I could to get as much hood clearance as possible. I didn't want them melting my fiberglass hood. Now that the engine is in the car, I have about 4" between the turbine housings and the hood. I heat wrapped the housings to be on the safe side. After driving I can hold by hand on the hood over the turbos without burning it, so I know I'm not going hurt the paint. The paint gets hotter than that just sitting in the sun.

This is what the adapter flanges look like when port matched to the heads. It's hard to see in this picture, but some of the bolt heads need to be ground off. This is normal for large ports.

After all the welding was done, I went back and heated the welds with a rose bud red hot and let them slow cool. This was done to relieve them of some of the internal stress from welding. This greatly reduces the changes of them warping after they've been run a while.

Here's a look down the collector before the turbo flanges and waste gate piping was welded on.

The next step was to mill the flanges flat for a good seal. They clean up with a 0.020" cut. Then I could grind all the welds smooth, just for cosmetic reasons, and send them to Jet Hot for their 2000 degree coating. I had them coated inside and out and at the same time I had the turbine housings coated n the outside only. The coating will not only keep them from rusting, it is also a thermal barrier, holding in more heat. The only concern from rust is the looks, the fittings are 0.125" thick, and there is no fear of them rotting out anytime soon, I just didn't want them to look bad. If they were made from mild steel thin wall header tubing, they would not last long at all uncoated.

These are the completed headers with the welds ground smooth ready to be sent to Jet Hot for coating.

This is the head flanges after milling.

Hear are the headers coated & installed on the engine.

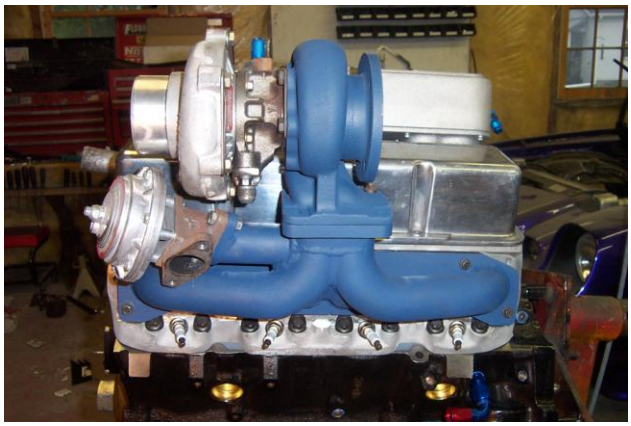
I am very happy with the way they turned out and they should last a very long time. What I basically have are thick shorty headers they are compact and strong Total investment for the parts to make them came to a little under $400, which is less than ½ the cost of cast iron manifolds that will not flow nearly as much. Jet-Hot charged me $190 to coat them inside and out.

TURBOCHARGERS

There is a lot involved with selecting the right turbo. I chose Garrett TO4B turbos because they are very popular and can be set of for many applications from around 300 to over 500 hp each. There are many turbine & compressor trims as well as several A/R ratios available for the compressor and turbine sides.

Here are the turbochargers & waste gates as I go them from Turbonetics. These are with the original 0.69 A/R housings.

For the first build I stayed conservative on turbine A/R ratio with a 0.69, which worked well. There was virtually no lag and traction was a big problem even with the car tubbed. This time around I decided to free up some top-end power by going to a larger turbine and hopefully help traction with a softer hit. Lag is something I don't worry about, I always nitrous to spool the turbos up fast. I went with 0.81 A/R ratios on the turbines and there is still hardly any lag so traction is still an issue, but I do have more top-end power now. I just decided to work on the suspension to plant the power instead.



This was the first mock up just to make sure everything was going to fit like I intended, which it did.

On the compressor side I went with super-V trims that have a 2.18" inducer diameter and a 3" major diameter. Picking compressors is not a simple task; I have a long time in figuring out what my engine will need. My goal was to use a compressor that will be most efficient at 15-18 psi in the 5000-5500 rpm range, which is right in the middle my power band. To do that I had to get a good estimate of how much air flow my engine will need. The compressors I picked will work best for the application and still be very efficient at lower boost levels for street driving.

The waste gates are Turbonetics Deltagates. They will flow more than enough for my application. They are adjustable from 5-7 psi. I will get higher boost levels by using a solenoid to bleed boost signal off before the port feeding the waste gates. This way I can flip a switch in the car to go from low to high boost. The pair of turbos and waste gates came in at just over $1600.

Getting oil to the turbos is not a problem; you can tap off any place that has oil pressure. I tapped off the oil pressure sending unit port. Most people don't realize that turbos no not need a lot of oil, actually too much oil is bad. 15-20 psi at the turbo is plenty, much more than that and oil can get past the seals. For oil feed lines I used #4 hoses to ¼" pipe fittings.

This picture shows the left side of the pan where I welded in the drain fitting.

Returning the oil to pan took some thought because there were a few options. Since the turbochargers are both higher than the valve covers, I could have drained them there, but that would more oil in the heads where it's not needed and just cause more windage as it runs down to the pan. I decided to just tap into the pan on both sides. I welded in a tube to get the drain away from the spinning crank; I didn't want to take

the chance of the crank throwing oil up the drain tube, so I put the drains in line with the center main bearing cap so that they were not in line with any rotating parts. I used #10 hoses with ½" pipe fittings. You don't want to go any smaller than #10 hose for drains, restrictive drain can cause the turbos to fill up with oil and oil will get past the seals.

EXHAUST SYSTEM

From the waste gate dumps, I also used butt weld pipe fittings to go to the rear of the turbos, where I used 3 ½" fittings, which is also where I mounted the oxygen sensor. I made this all from weld ells so that it can be heat wrapped without worrying about it rotting out. The drivers' side comes close the master cylinder, so I am going to have to wrap it. I've seen a lot of headers get ruined form wrapping them. From there I used two bolt ball flanges to go to regular 3" exhaust tubing.

The rest of the exhaust system was already made and I didn't see any reason not to use it. I simply made some down pipes with the 3 bolt header collector flanges to connect to what was already there. The down pipes also make it easy to service.

The entire exhaust stem was fabricated by me. I bought several 180 degree 3" mandrel bends, cut and welded them together how I needed them. I've built a lot of headers myself, and this is no different, just larger diameter, which actually made it easier to fit and weld together.

Just about at the rear of the transmission, I made an X-pipe. I'm not sure how much it will help in a turbo application, but chances are that it won't hurt. I may have to go bigger, or change the placement of the X-pipe. It's a lot easier and cheaper to do that with mild steel. Once I settle on a system, I can make it from stainless, for right now this works just fine.

The mufflers are 3" Flowmaster 2 chambers. The old engine with the tunnel ram on it was too loud for my liking for a street car, but I wanted to hear them with turbochargers before I got something else. The turbos quieted it down and gave it a deeper, less tinny sound, so I kept the mufflers.

I ended the exhaust system at the rear axle and used turn downs after the mufflers. Tail pipes would be nice, and make it even quieter, but there is no room to get 3" exhaust over the rear without moving the panhard bar. With the coil over shocks, panhard bar and 3 ½" axle tubes, there just isn't much room for exhaust.

INTERCOOLER

I was toying with the idea of putting an intercooler facing down just in front of the chin spoiler, because there was not much room in front of the radiator, but I never really liked the idea and couldn't bring my self to cutting a big hole in the fiberglass nose.

I ended up making a lower radiator support bar and new upper mount brackets to move the radiator about 2" back. This gave me enough room to put a 3" deep Spearco intercooler.

With the radiator moved back, the intercooler fit in with little problem.

Electric fans were the only option; I still needed room to run a 3" pipe from the intercooler to the throttle body. The turbochargers have 2" compressor outlets, so I ran 2" piping into a 3" Y, then to the intercooler. I also run 3" piping to extend the air cleaners up next to the radiator so they are not sucking in heated air from the radiator.

The blow off valve is an Autotechnics 1 ½" and is mounted just before the throttle body. The vacuum port is hooked to plenum vacuum, so it snaps open quick when I let off the throttle.