AMS EVO VIII Upgrade Path PART II

600whp here we come!

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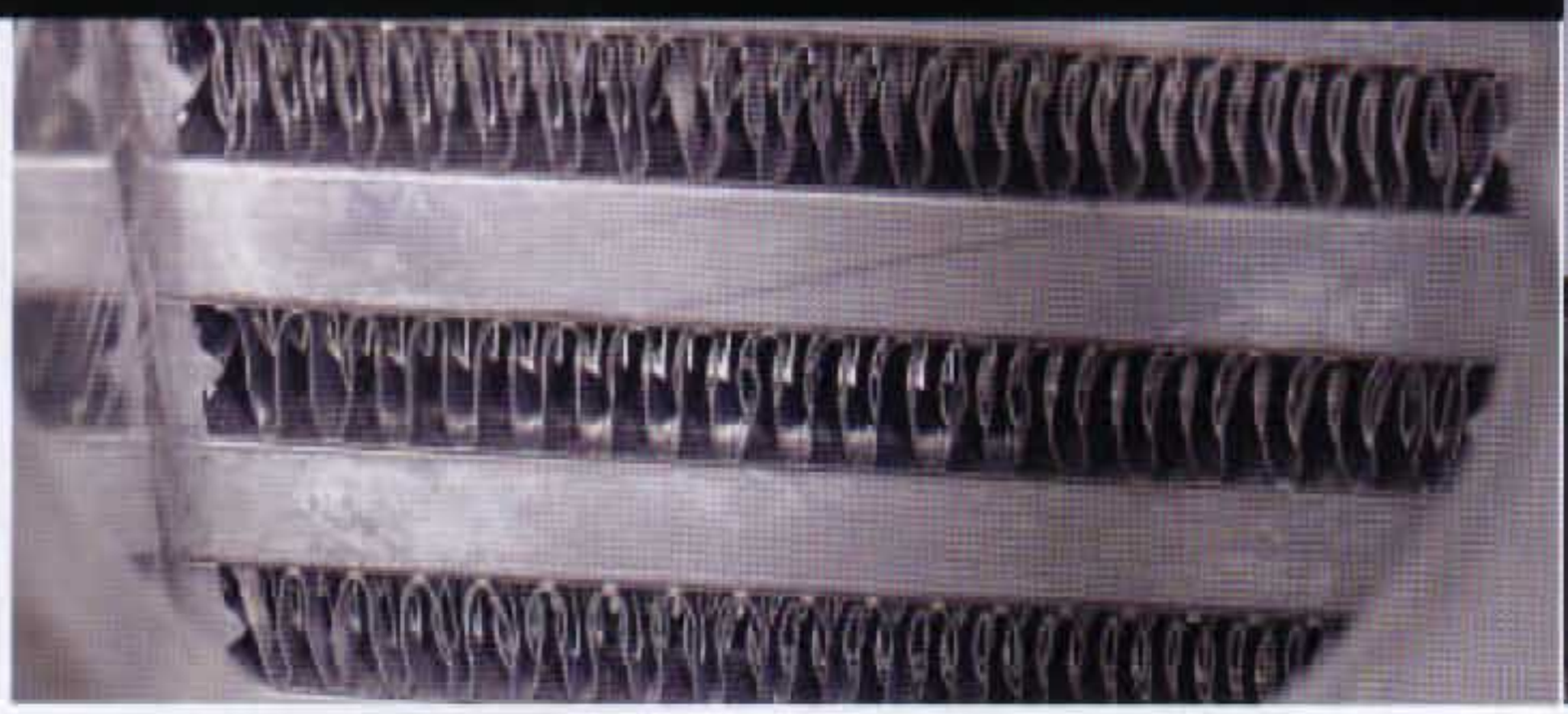

AMS
Stage II EVO kit

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WE LEFT OFF LAST MONTH MAKING ABOUT 365WHP AND RUNNING A BEST OF 12.0 @ 114MPH AT THE TRACK. IT WAS TIME AGAIN TO LOOK AT WHAT WAS GOING ON WITH AIRFLOW AND HOW WE COULD HELP THE 4G63 BREATHE. SETTING OUR GOALS A LITTLE HIGH, WE WERE ON A MISSION TO PUSH THE STOCK TURBO TO 400WHP AND 500WHP WITH OUR CUSTOM TURBO KIT.

INTERCOOLER ACTION

The stock tube-fin style intercooler is one of the best OEM pieces around. Only testing and instrumentation would tell us if it's choking out the 4G63T. Thermocouple readings at the throttle body suggests a very efficient intercooler with inlet temps rarely breaking 120° during full throttle high-boost dyno pulls. Besides efficiency, we also need to know how restrictive the intercooler is (the pressure drop across the core).

With some higher-octane fuel in the tank we turned the boost up and measured the pressure on each side of the intercooler. At 20psi of intake manifold pressure, we recorded up to 3psi of pressure difference across the core! There are airflow restrictions (pressure drops) along the entire path from the turbo to the intake manifold, and our goal is to reduce those so the turbo works more efficiently.

We fabricated a new bar and plate style intercooler that has over twice the internal flow area than the stock unit and fits right into the stock location utilizing the factory piping. The intercooler core dimensions are 3.625-inches thick by 12.4-inches tall and 28-inches long and rated at only 1psi of pressure drop at 1,250cfm of airflow, enough for well over 600hp (this is also the same core that we use on most of our racecars).

Endtank design is also important when choosing an intercooler and we designed a setup that allows for even air distribution and a smooth flow path from inlet to outlet. Making power is good but you have to do it with some style. The intercooler fits right in with almost no modification (slight trimming of under tray required) and fills the front mesh with shiny aluminum goodness. On the dyno, we show almost no pressure drop and are able to hold 2psi more boost to redline. How does a 20whp gain (yielding 383whp) and killer power-band sound? A Walbro 255lhp high pressure pump was also installed at this point to ensure an adequate supply of juice.

Shiny new Walbro Fuel Pump ready for installation

NOT QUITE 400 PONIES

The 400whp mark is slowly becoming a reality as this engine setup is massaged. The next step is to look for the next bottleneck in the system.

After carefully studying the remaining stock intake and exhaust parts, we decide that the stock lower intercooler pipe needs upgrading along with a custom O2 housing coming off the turbo. The stock lower intercooler pipe has a beaded end that actually necks down to less than 1.5-inch diameter at the inlet. The new lower aluminum intercooler pipe inlet is a full 2-inches in diameter, which then has a long taper transition to 2.5-inch diameter piping that feeds the intercooler. It's important to make gradual changes in tubing diameter (try to keep a taper angle of 20° or less) because sudden changes lead to turbulence in the airflow and cause a restriction. The upper intercooler pipe is actually a very decent piece with nice smooth turns and never necks down to restrict airflow. It does have a few extra bends in it that we'd like to eliminate. So just to try things out we fabricated a new short route 2.5-inch system with a trick TiAL BOV. The short route piping required yanking the heavy stock battery out and putting in one of our battery kits which saves a whopping 25 pounds and comes with new mounting hardware. The stock O2 housing is a cast piece that bolts onto the back of the turbo and directs the exhaust gas into the down pipe via a sharp 90° bend. Although the stock unit looked fairly decent and had almost a 2.5-inch outlet we decided to fabricate a full 3-inch tubular piece to help expel exhaust gases.

Dyno testing showed minimal gains for the upper intercooler pipe upgrade just as we suspected. The lower intercooler pipe and tubular O2 housing brought in the extra power we were looking for and netted many 395whp+ runs. The trouble at this point is that the stock turbo is so out of breath that it was hard to achieve consistent dyno runs and each one varied by 5whp or more as the undersized turbo struggled to flow the massive volume of air at 22psi. With the boost controller cranked, the EVO would hit 26psi but drop consistently to 22psi by the time the tachometer was dancing in the red zone.

We reached the point of diminishing returns and a lot of time and money could be spent tweaking more parts, but our horsepower returns would be minimal. With the 400whp barrier staring us straight in the face we throw off the gloves and stick a Garrett GT-series turbo on it.

Stock intercooler pipe vs AMS intercooler pipe

AMS hogged out O2 housing vs Stock EVO housing

CLUTCH HITTER

The upgraded six-puck clutch disc has served us well to this point, but with serious power in our future we need a serious clutch. Exedy is renowned for making quality clutch kits and we chose to go with the Exedy twin plate SD type. The problem with many multi-disc clutches is that drivability and clutch engagement suffers at the expense of higher clamping loads. The Exedy twin plate SD clutch cures these problems by using sprung hub discs and a patented clutch cushioning function to allow for smooth and controlled clutch engagement.

Upon installation of the clutch we noticed that the EVO crank has provision for a locating dowel and so does the Exedy flywheel. Even though the stock EVO doesn't come equipped with this dowel pin we highly suggest installing one with any clutch to provide a more secure flywheel installation. Once installed, this clutch drives like butta! With a feel very similar to stock this is the most driver-friendly twin disc clutch we've ever used.

WIDEBAND

Crucial to proper engine tuning is the ability to accurately measure the air / fuel ratio. The best way to do this is with one of the many affordable wideband O2 units on the market today. Ranging from $350-$800, these systems have become almost mainstream. The unit we chose is the Innovate Motorsports LM-1 wideband kit. This inexpensive unit has a nice green backlit LCD display that shows the A/F ratio in both bar graph format and numerically.

An inside look at the Garrett GT series turbo

TURBO UPGRADE

Ditching the stock manifold and turbo for one of the AMS GT series turbo kits not only makes the engine compartment look good, but adds a whole new power level to the EVO VIII. The exhaust note immediately changed as the engine cracked to life. Exhaust gases traveling though the 321 SS tubular runners and out a Garrett GT series turbo bring a deep smooth sound that lets you know that something powerful is lurking.

First pull at a low 14psi lays down 340whp, and then 20psi brings the magical 400whp. A turn of the GReddy PRofec-B spec II brings us to 25psi and 443whp! With just a few pulls and little tuning horsepower, it was greatly improved over the stock turbo with only a 300-400rpm loss in spool-up. Some more tuning time would have resulted in 450whp but we have more important things to do like installing a larger turbo and cracking the whip!

Monitoring different parameters of the turbo, like compressor outlet temps and exhaust manifold pressure for example, tell us what direction we need to move in to make more horsepower while maintaining quick turbo response.

Our tests show we need a larger compressor side and so be it. With a new iteration of the GT32, we pull off 470whp at 26psi with only a 100rpm increase in turbo lag over the previous turbo. The latest turbo makes the perfect street turbo as it still has quick spool-up and grunt down low while still able to stack on about 90-100hp more to the engine.

Compiling our data, we spec out a turbo for our street / strip kit. When our custom Garrett GT35R beauty hits my desk I realize that this is the weapon of choice for the ultimate EVO pilot. Having tested and experienced the Garrett GT series turbos in our DSMs, I know what the GT35R ball bearing is capable of. I immediately notice how fast the turbo comes on and how responsive it is as I make a few part-throttle pulls to check the straps. The following numbers show how well this turbo works: 366whp @ 14.5psi; 400whp @ 18psi; 440whp @ 22psi; 480whp @ 25psi. The urge to keep going is more than I can resist and with a final pull at 29psi the dyno produced 525whp. An amazing feature is that this power level is achieved with the turbo only spooling about 600rpm later than the stock turbo.

Taking a deep breath I now realize we're pushing over 600hp at the engine and rods are not flying out the side of the motor, nor are valves melting and pistons hitting the hood. There must be some sort of excessive wear or slight damage from all this outrageous abuse right?

Through careful monitoring of A/F ratios, logging ignition timing and engine parameters, and most importantly keeping detonation from making an unwelcome appearance we have successfully raised the bar of EVO VIII performance.

Since the dyno runs have been completed, the EVO was converted back to AWD and given a flogging on the street. Unrelenting horsepower and quick power delivery pin passengers in their seat and leave them breathless. With this much horsepower under the hood, the EVO has 10-second potential in its blood.

ON DYNO

After over 450 documented dyno pulls and many trips to the dragstrip, our EVO passes the leak-down test with flying colors and a mere 2-3 percent across the board! This is lowest leak-down numbers I've seen on any motor and just shows how well the EVO 4G63T is engineered and manufactured.