Tuning the EVO VIII AMS extracts 365whp in no time

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AMS
Stage I EVO kit

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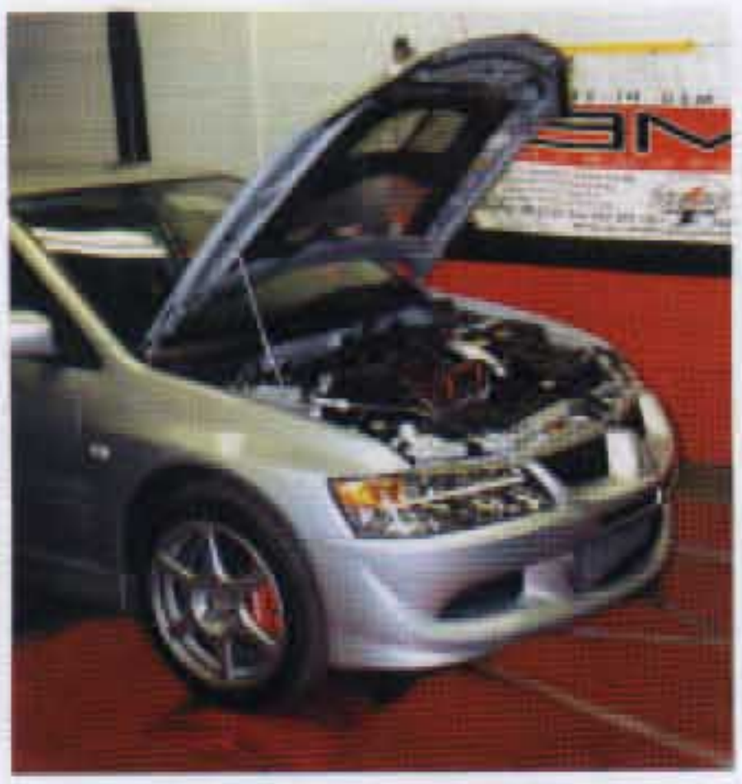
BEING DISAPPOINTED WITH THE SMALL TORQUE INCREASES, WE USED A PATENTED AMS TRICK. LIKE EXPECTED, WE PICK UP 20-FT LBS./ft. OF TORQUE AND DATALOGS SHOW A 4-6 DEGREE INCREASE IN MID-RANGE TIMING.



American car enthusiasts have been anxiously waiting ever since hearing rumors of Mitsubishi bringing the Lancer Evolution VIII stateside. The latest iteration of the Mitsubishi Lancer Evolution packs 271hp at 6,500rpm and 273 lbs./ft. of torque at 3,500rpm. Survival of the fittest indeed! Driving the EVO is an experience, with handling that's best described as 'go-kart' like; and it rips through the 1320 in 13.5 @ 100 mph. Once you get comfortable with the handling of the EVO the 4G63 leaves you wanting more. The problem with adding substantial power to most vehicles is that now you'll have a straight line terror while praying each time you use the brakes or hit the apex of a turn. Fortunately, we're starting with a solid suspension and handling package that we can safely add power to while maintaining safety and drivability.

With a few modifications, we can quickly have the EVO running with most high-dollar sports cars. Further down the horsepower path puts the EVO right into supercar territory. The experience of AMS building numerous 600+hp street DSMs and an exhaustive dyno tuning program, allowed us to build the world's fastest EVO VIII with the stock turbo. We look at any engine as a large pump, constantly taking in air and pumping it out. Eliminating any restriction will free up horsepower, but the trick is finding out where the restrictions are.

The 4G63 is known for its strength and ability to handle massive horsepower increases while still maintaining reliability. When tuned correctly on high octane fuel and using ARP head studs, the EVO 4G63 will handle 450-500 horsepower reliably. To get a baseline we put a few stock EVO VIIIs on the 2WD dyno (using switchable transfer case) and we've seen an average of 250-255 wheel horsepower (at the front wheels). Figuring in about a 10 percent drivetrain loss, that gives the EVO VIII around 280-285 horsepower at the crank. Looks like Mitsubishi was a little conservative on their horsepower figures.

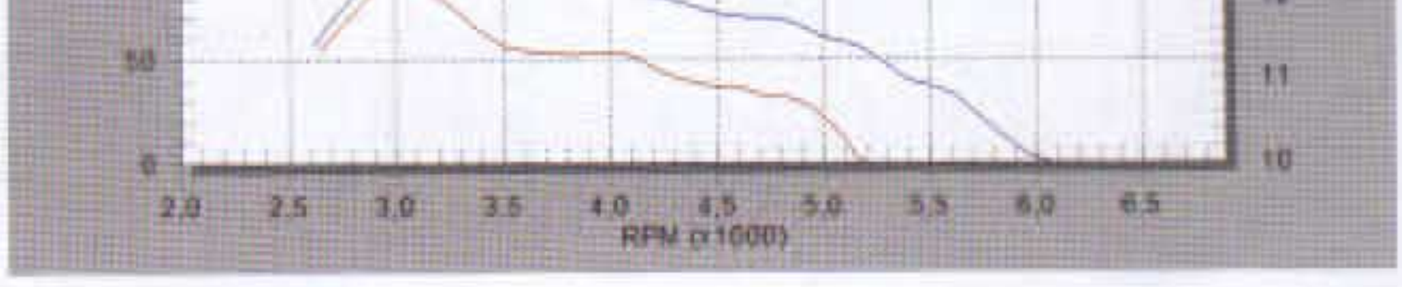
FUEL TO THE FIRE

After a few pulls on the dyno, the air/fuel ratio was very rich, consistently in the upper RPM range. Before we start playing with fuel curves though, it's important that we take a step back to understand how fuel tuning and ignition timing relate to making horsepower. Piggy-back fuel controllers work by intercepting the MAS (mass airflow sensor) or MAP (manifold absolute pressure) sensor signal and modifying it before it goes into the ECU. Mitsubishi uses a Karman-Vortex style airflow-meter in its calculation of mass airflow, and the signal it produces is in Hertz (Hz). For example, we see that our car is running very rich at 6,000rpm and at full throttle we have an MAS signal of 1,800 Hz at that RPM. With the fuel controller we go to the 6,000rpm setting and put in (-5) representing a 5 percent decrease of the airflow signal. Now that 1,800 Hz signal becomes reduced by 5 percent, the ECU gets a reading of 1,710 Hz. A lower MAS reading corresponds to less air going through the engine and thus the ECU decreases the injector pulse width. We must keep in mind that by changing the MAS signal, the ECU will inadvertently change the ignition timing to suit. A lower MAS signal corresponds to a lower engine load and hence the ECU advances ignition timing. Therefore, the more we modify the MAS signal the more you change the ignition timing. When we start increasing airflow through the engine (more HP & torque) the EVO VIII ECU receives high MAS readings and references a high load map in which the ignition-timing advance is reduced to keep things safe. Generally speaking lower ignition advance will yield less torque and horsepower. Again, Mitsubishi did this for a large margin of safety.

To change the stock fuel curve, we chose to use the A'PEXi S-AFC II due to its value and flexibility. With the S-AFC we need to lean out (reduce the MAS signal) in the high RPM range since the stock ECU give excess fuel starting around 4,500rpm and up. You can go leaner than 11.5:1 A/F and make more power but you must be careful and fully understand what you're doing at this point. As we mentioned in the last paragraph, when we reduce the MAS signal at higher RPMs we get back the ignition timing we want to work with. In fact, we actually get a little more than is necessary. The important thing here is to realize what happens to the mid-range ignition timing, when boost hits. As we mentioned before, with increased airflow the ECU drastically reduces ignition advance. The EVO VIII ECU really pulls the plug on fun when we increase airflow and gives as little as 4-degrees

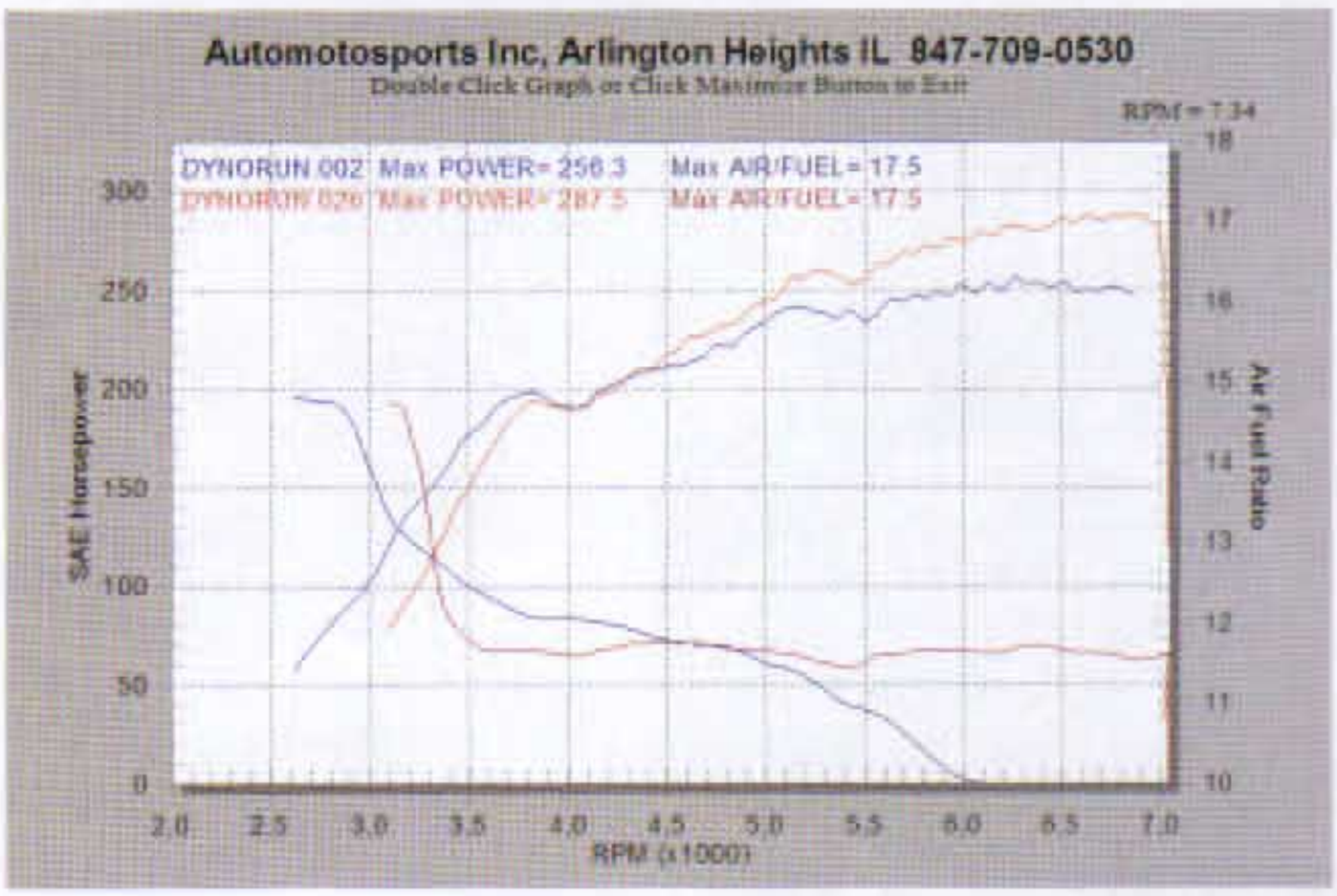
DEEP BREATH

With our fueling issue addressed, we move on to letting the engine breathe easier, or increasing volumetric efficiency (use this term to impress your friends). The MAS pipe is the pipe that goes from the Mass airflow sensor to the turbo inlet. The stock piece is a corrugated rubber tube, which would seem to inhibit airflow. We fabricated a smooth bent 3-inch intake pipe that tapers down to the inlet size of the turbo. You'd assume that this would make more power - not exactly. We ran the MAS pipe with a cone type filter using the S-AFC set to zero settings (factory fuel curve). We were surprised to see only 227whp. Where did almost 30 horsepower go? Looking at this graph tells us what happened. The new MAS pipe must somehow be affecting the airflow readings, which is telling the ECU that there is more air going through the engine than with the stock rubber pipe. The A/F ratio showed a very rich condition which robbed us of horsepower. Using the S-AFC we tuned the fuel curve and gains and found about 5 horsepower at the wheels. This clearly shows that the MAS pipe needs to be developed and tuned so as not to affect the A/F ratio. And it looks like most manufacturers are taking this into consideration.



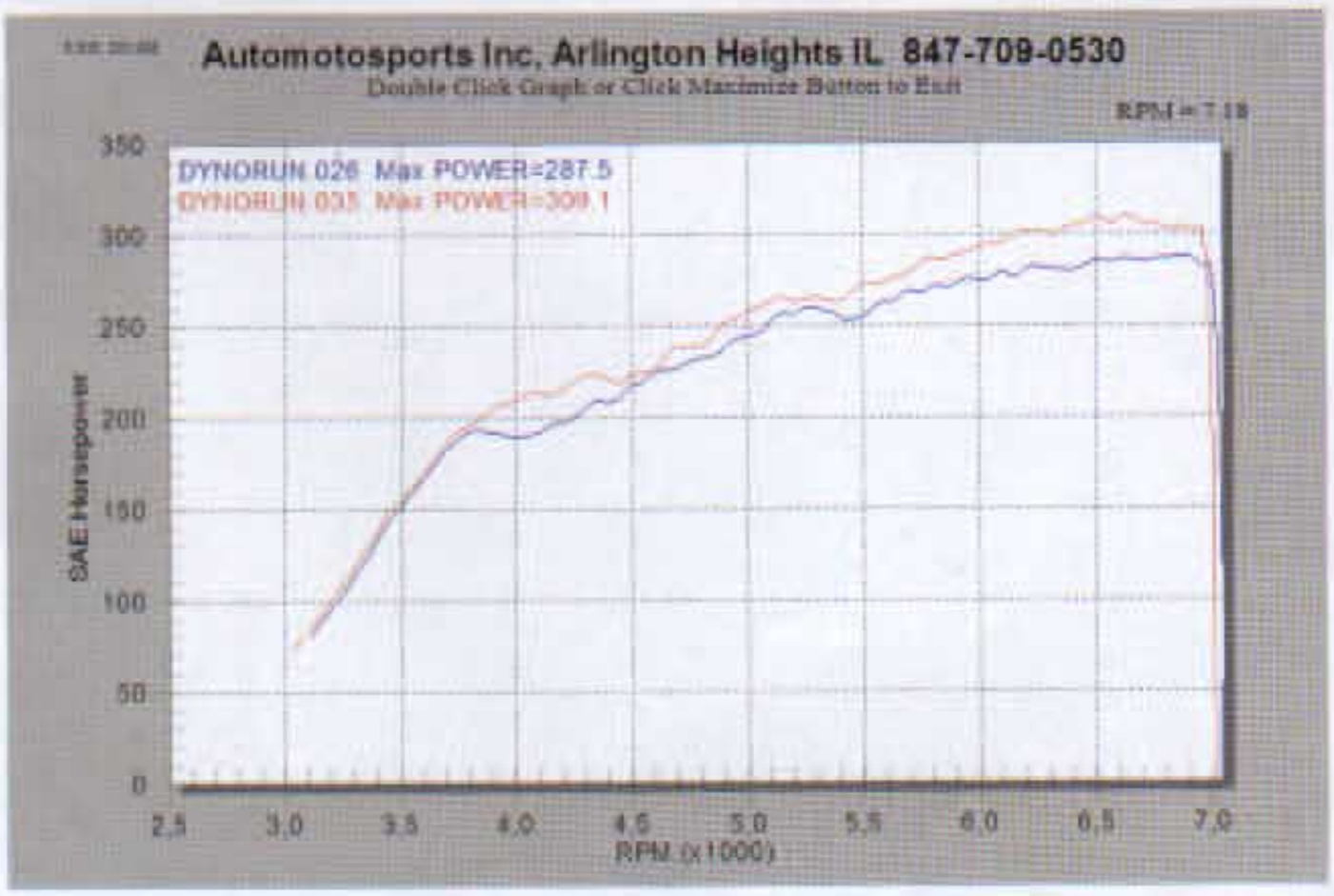
of ignition advance upon peak torque. Because of this ECU feature, we really don't see large increases in torque with each upgrade. We could safely get another 20 to 30 lbs./ft. of torque by adding 4 or 5 degrees of ignition advance in this region. This will be achieved with a more advanced engine management system in future upgrades.

The adjacent graph shows a baseline stock EVO VIII versus the same car with an S-AFC installed and the fuel curve altered for more power (while still running safely). We leaned out the fuel to about 12.0:1 A/F which picked up a solid 30whp. Again, you can run a turbo car to about 12.5:1 A/F for more power but taking safety into consideration and the fact that most readers run on pump gas, we'd prefer the average street car to run about 11.5-11.8 A/F ratios. These runs were done on 93 Octane pump gas and everything else on the car was stock (including boost).



MO' BOOST

Now we're breathing on 300whp and it's only the beginning! We need more boost! The stock EVO VIII already runs a hefty 18-19psi peak and drops down to mid 16psi as the RPMs climb. Wonder what would happen if you could hold 18-19psi of boost throughout the RPM range? The graph below shows what happens when a boost controller is added to the mix and boost is held at 18psi. The car picked up about 20whp (up to 309whp total) with the extra 2psi of boost compared to the run with just an S-AFC and over 50whp compared to the completely stock EVO VIII. On 93 Octane pump gas this boost level is the max we'd consider safe; and the best for power since anything much over 20psi results in the knock sensor becoming more active and timing being pulled (thus making less power).



TOTALLY EXHAUSTED

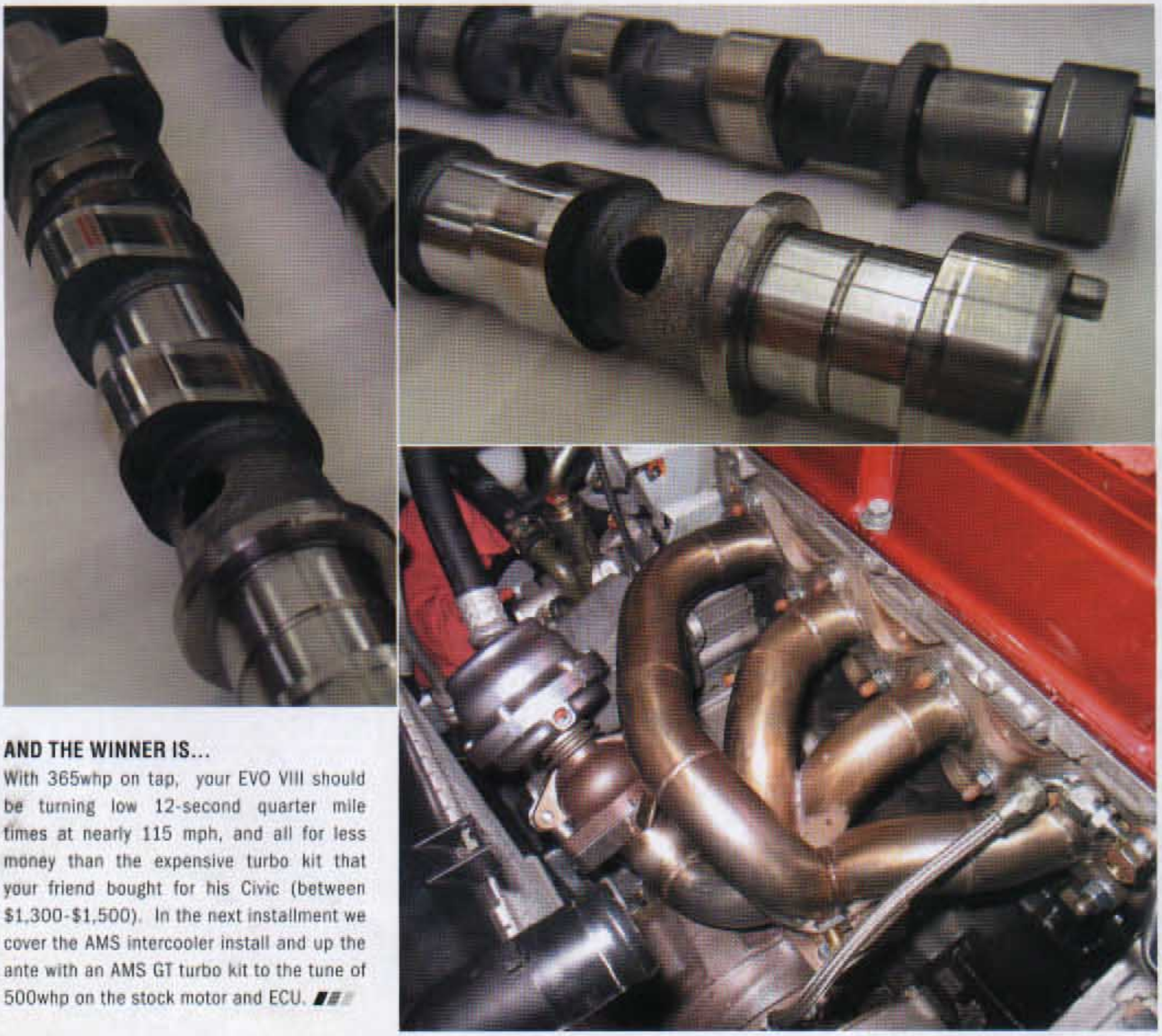
At this point the car still looks and sounds completely stock, with unsuspecting opponents not even realizing that 60 extra horses are waiting to be unleashed on them. Knowing that the best exhaust on a turbo car is no exhaust, we set out to make a free-flowing exhaust setup. The AMS cat-back exhaust is crafted out of mandrel bent 304 SS with some solid TIG welds. Utilizing a 3-inch large diameter straight through muffler, we reduced the back pressure while keeping noise levels subdued. The cat-back system also includes a trick adapter piece that allows it to be used with the stock catalytic converter and future downpipe upgrades. On the dyno, we saw immediate results, 325whp on the first pull. After fabricating and installing a 3-inch downpipe and test-pipe the horsepower figure climbed to 330whp.

MORE JUICE

Being disappointed with the small torque increases, we used a patented AMS trick. Installing larger injectors means that now you'll have to go into the S-AFC and lean things out. When the S-AFC reduces the MAF signal we are tricking the ECU into thinking the engine is at a lower load and now gives more timing advance. Like expected, we pick up 20 lbs./ft. of torque and datalogs show a 4 to 6-degree increase in mid-range timing.

CAM JAM

Yet another way to increase volumetric efficiency is to change the cam timing events and lobe profiles. Having good results with HKS cams in DSMs, we chose the HKS 272 grinds for both the intake and exhaust side. Besides a wicked sounding exhaust note at idle and full throttle, the cams also increased power up to 353whp. At the same time, we installed ARP head studs for added security as the stock head bolts are known to stretch. We had some custom cams ground with a little more aggressive profile than the HKS 272s. It took some time to get these but it was worth the wait; horsepower climbed to 363whp with idle quality only slightly suffering - but who cares? The Dyno graphs shows the current mods versus the stock EVO VIII. We've put these cams into production and they should be available in early 2004.



AND THE WINNER IS...

With 365whp on tap, your EVO VIII should be turning low 12-second quarter mile times at nearly 115 mph, and all for less money than the expensive turbo kit that your friend bought for his Civic (between $1,300-$1,500). In the next installment we cover the AMS intercooler install and up the ante with an AMS GT turbo kit to the tune of 500whp on the stock motor and ECU.