

Beauty and the Beat

Racing Beat's Research into RX-8 Performance

By **JIM MEDERER**
Contributing Writer

IN 1971, RYUSUKE OKU AND I (JIM MEDERER) started Racing Beat in Anaheim, California. Our goal was to design, manufacture and sell the best rotary engine parts possible—and prove this by entering races ourselves. For the past 33 years, that is what we have been doing. During that time, we have set four Land



Oku and Jim

Speed Records at the Bonneville Salt Flats, captured the drag racing Modified Eliminator title in an RX-3 at the 1978 NHRA WinterNationals, and won the first IMSA GTU Championship for Mazda in road racing. We intend to continue that this racing tradition, but right now, we have our hands full with new product development for the RX-8!

This article is an update on the progress of our development of RX-8 performance products.

From our point of view, the new RX-8 is an excellent vehicle with only one serious “problem” – it is so good as it comes from Mazda that it is very difficult to improve it! For example, back in 1971 a well-designed header on an RX-2 could add nearly 20 hp. On the RX-8, we have tried many header designs, but we still haven't found more than 4 hp! We hope to find more in the future, but even after a strong effort, that is the best to date.

We have seen the above pattern repeated in many areas around the car—we work hard, but the improvements are not as large as we expected. In order to obtain the maximum improvements, we have had to resort to some very sophisticated technology. For example, in order to better analyze the handling of the RX-8 we used the Racelogic V-BOX System. This sophisticated component utilizes GPS (Global Positioning Satellite) to measure the position of a car within inches! Once the system calculates its exact position, it can calculate speed, acceleration, and distance—all the parameters we need to know—and record this information for later review. It is an incredible device—very accurate and easy to use—and it has allowed us to understand “handling” in an entirely new way.



For engine testing, we upgraded our engine dynamometer DEPAC Data Acquisition System to allow us to record more variables so that we can better understand “why” we get the results we do. We also have adopted engine



Renesis 4 PI on the dyno.

“sweeps” when testing—that is, we set full throttle at 2000 rpm, and then allow the engine to slowly accelerate (about 100 rpm per second) to maximum rpm. The slow acceleration allows the engine to stabilize so that we can record more accurate results. Even so, we find that we need to perform these same tests two or three times using the same setup in order to get the most correct results. If we do not undertake this extra effort, it would be possible to allow ourselves to be misled into thinking a particular change was good (or bad) when this was not the case. By comparing multiple runs, we increase our confidence that our analysis of the test is correct. Since we are often looking for changes of less than one hp, any error in testing technique can lead to erroneous results.

Along with the engine testing equipment upgrade, we realized that we had to learn more about the electronics that are the heart of the engine. To do this, we built a test bench that can operate the Powertrain Control Module (PCM) much the same as it would be used in the car—but under conditions that we control, away from the danger and variables involved in actually running an engine. This sophisticated test bench is still undergoing construction, but even in this early stage of development it has already revealed many items of interest—some of which I will reveal later.

Here is a summary of some of the observations and results we have obtained so far:

Suspension

The stock suspension design is excellent, but we have found that we can make some real changes in cornering power and control for those who are willing to give up a little ride comfort. The largest improvement comes from changing to larger front and rear sway bars. The cornering power is increased from .89G to .92G, and the steering response is more direct. In order to get the most from this change, we recommend that you also upgrade the front bar links to our heavy-duty endlinks.

Espeir Co. LTD of Japan has produced performance suspension springs to our specifications in order to lower the car (about .5 inch) and stiffen the suspension (about 10%) both front and rear. These upgraded springs



RX-8 suspension components

Tokico in the near future) and have found a small amount of improvement, but the stock shock absorbers are so good it is hard to make significant gains. We will continue to test in hopes of finding a better setup through the use of an aftermarket shock.

As for tires, we have only tested four or five models so far. Overall, the tire that we have tested and like best for street use is the Bridgestone RE040 that is equipped on the stock high power RX-8. Other tires we have tested have nearly the same cornering power, and some have better steering response, (especially those with very short sidewalls) but none of these other performance tires we have tested to date offer the combination of cornering power, response, smooth ride AND long life that we have found with the stock Bridgestone tires. Be careful if you choose to change tires - you may end up going slower, not faster!

The same caution applies to wheels. Try to select a wheel that is lighter than stock. We are currently working with Takechi Project (Racing Hart) to develop a super-lightweight, forged-aluminum CP Series wheel for the RX-8.

Engine

The new Renesis engine in the RX-8 has been slow to reveal its secrets. All our testing so far has focused on “external” changes—header, muffler, air intake, etc.

We have tried quite a few header designs (including “adjustable length” models for dynamometer testing) and have found very little improvement. The maximum increase in power comes at high rpm and is not more than 4hp. We will continue testing but do not expect a large change in power.

My partner Ryusuke Oku has been in charge of muffler development and has finally settled on a design that adds a maximum of 3hp at about 8500

rpm and has a pleasant, throaty sound that is nicely balanced across the rpm range. If you wonder why we only achieved a 3 hp increase, you should consider that, when we removed the stock muffler completely, the peak power only increased about 4 hp. The Renesis engine is a lot

do improve handling and steering response slightly—and also make the car look better by lowering it! Of course, if you lower the car, you must also shorten the bump rubbers to avoid bottoming the suspension. We have undertaken quite a bit of initial shock testing in co-operation with Koni USA (and hope to continue this development with



Endlink demo



Prototype headers

different from the previous peripheral exhaust port engines Mazda has made. It is not very sensitive to exhaust system changes. Even removing the catalytic converter only added about 7 peak hp—and the noise was tremendous!

Other aftermarket performance shops have produced open-element filter assemblies that offer modest power increases, but the main problem is noise. These traditional open element filter systems on the RX-8 are so uncomfortably loud that it ruins the joy of driving an RX-8!

We have spent considerable time developing a new air filter intake assembly that not only offers improved power output, but also reduces the intake noise to a tolerable level. The system is in the final testing stage and, based on results so far, it should add 4 to 5 hp while offering a comfortable intake sound level.

In addition to the inlet filter assembly, we have developed a Ram Air Duct that replaces the stock Variable Fresh Air Duct (VFAD) located under the front bumper. Testing has shown an increase in inlet air pressure and a reduction in air temperature that should add a few more horsepower at high speed.

We are also working hard to understand the operation of the PCM. Our research has shown that at full throttle and high rpm the fuel mixture is roughly 5% rich, thereby wasting some fuel and power. This may have been done to reduce exhaust gas temperatures in the catalytic converter, but our testing has shown that it may not be necessary. We are developing computer programs that optimize the mixture, timing and other adjustable parameters in the PCM.

While building the test bench and studying the PCM we have learned some interesting information. As an example, at low engine speeds, if you step on the throttle rapidly to accelerate, the PCM doesn't simply increase the injector “on” time to temporarily increase fuel flow. Instead, it adds a number of “pulses” of fuel in addition to the calculated basic fuel flow. By adding multiple small pulses instead of delivering a single long pulse, this technique probably gives better throttle response and uses less fuel by creating a more uniform mixture.

Here's some of information that we uncovered that we really found amusing! When you look at the instrument panel, it appears that you have an Oil Pressure Gauge. Well, not really! During our research we found that there is no Oil Pressure Sender on the engine—only an Oil Pressure Switch that turns on and off at about 0.5 kg/cm². When you start the engine and the oil pressure reaches that amount, the switch sends a signal to the PCM - which sends a signal to the Instrument Cluster to display a fixed reading of about 60% of full scale on the “Oil Pressure Gauge”. From then on, unless the pressure falls below 0.5kg/cm², the Gauge reading doesn't change - it has no way of knowing the actual oil pressure! This is not a problem since rotaries rarely have oil pressure problems, but it is a little misleading to the driver—he thinks he knows what the oil pressure is, but he doesn't!

For those who are interested, we are investigating supercharged/turbocharged applications. However, we are a still a long way from deciding which method of boosting the engine is best for the RX8.

As you can see, we have only begun to understand this extraordinary car. The RX-8 certainly has much more to tell us. Rest assured that we will be listening intently to what it says! **RX**



The ECU bench