

INDUCTION SOLUTIONS FOR THE 13B

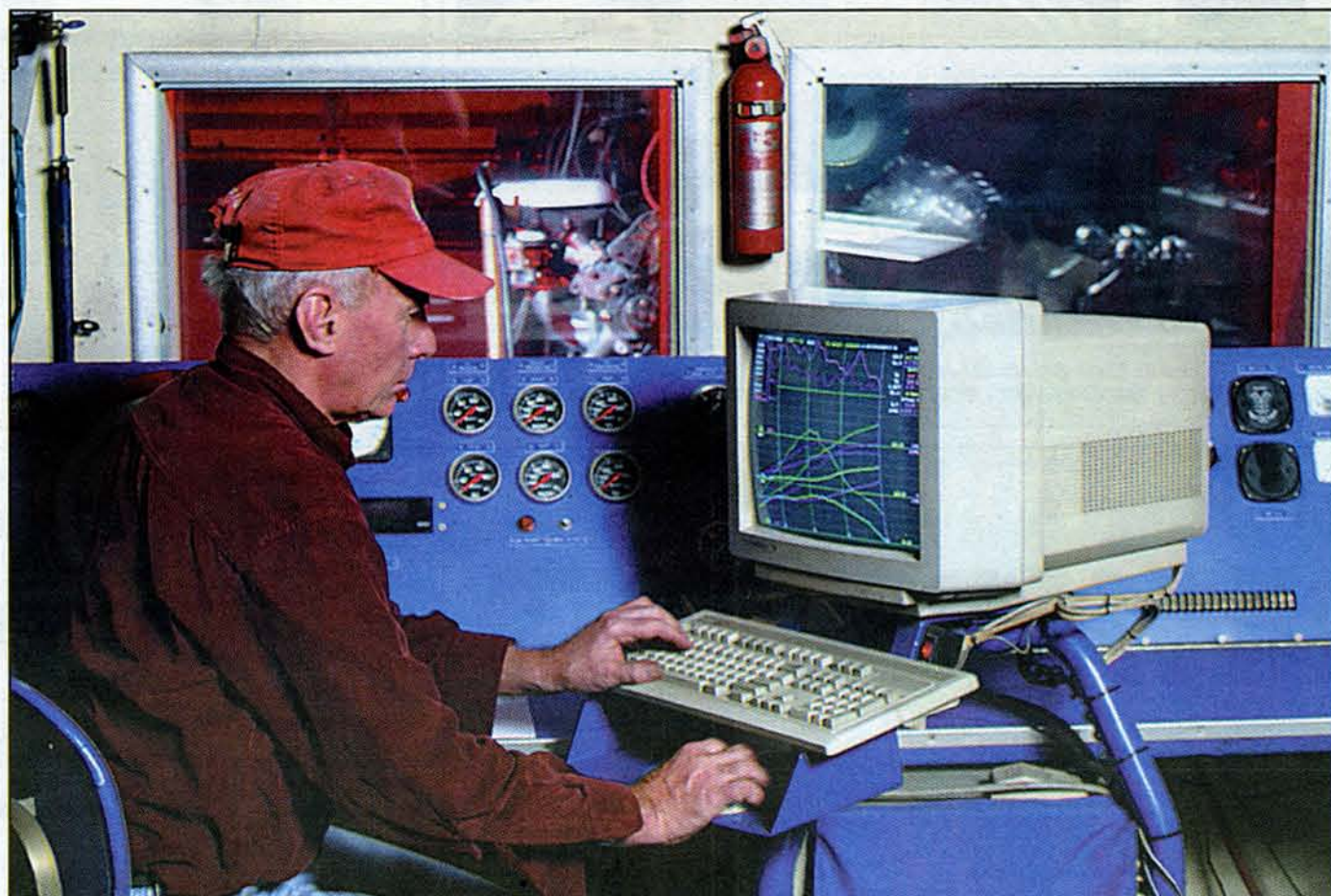
WHICH CARBURETOR & MANIFOLD WILL REIGN SUPREME FOR A STREET-PORTED 6-PORT?

By Jim Mederer / Photos by Jim Langer

Michael Ferrara is a nice guy. He also happens to be the publisher of *DRAG Sport* magazine. Five months ago, he asked if I would be interested in contributing to this new publication and I agreed. Then, not long ago, Michael sent me an email suggesting a topic for this issue's article. The suggested article would involve dyno testing a street-ported 13B 6-port engine with a variety of carburetors. Some further conversation revealed that *DRAG Sport* already had a freshly-assembled '88 6-port 13B (that was street ported by Rotary Power of Gardena, California. This engine was destined for Michael's own '73 Mazda RX-2 (just one of the perks of being the publisher). I agreed to the project, but I did have my reservations.

Our Previous Experience

About 10 years ago, we here at *Racing Beat* tested a street-ported 13B 6-port engine with a 50mm Mikuni, a 50mm Weber and a 48mm Dellorto carburetor. The results we obtained didn't warrant production or further



Mikuni Carburetor



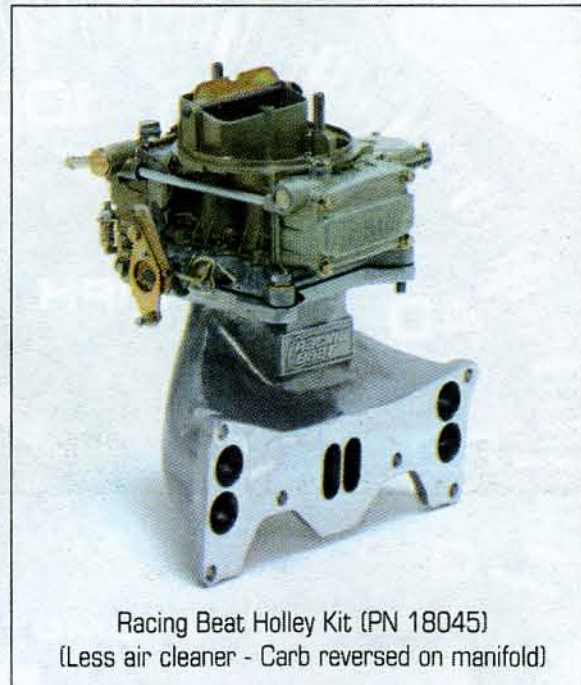
44mm Carburetor on Racing Beat Upper Manifold and Mazda OEM Lower Manifold

Dellorto Carburetor



48 DHLA Carburetor on Racing Beat Upper Manifold and Mazda OEM Lower Manifold

Holley Carburetor



Racing Beat Holley Kit (PN 18045)
(Less air cleaner - Carb reversed on manifold)

development of the carburetor kits or the templates for porting. For years, we advised everyone interested in street porting a 13B to seek out the 4-port carb housings.

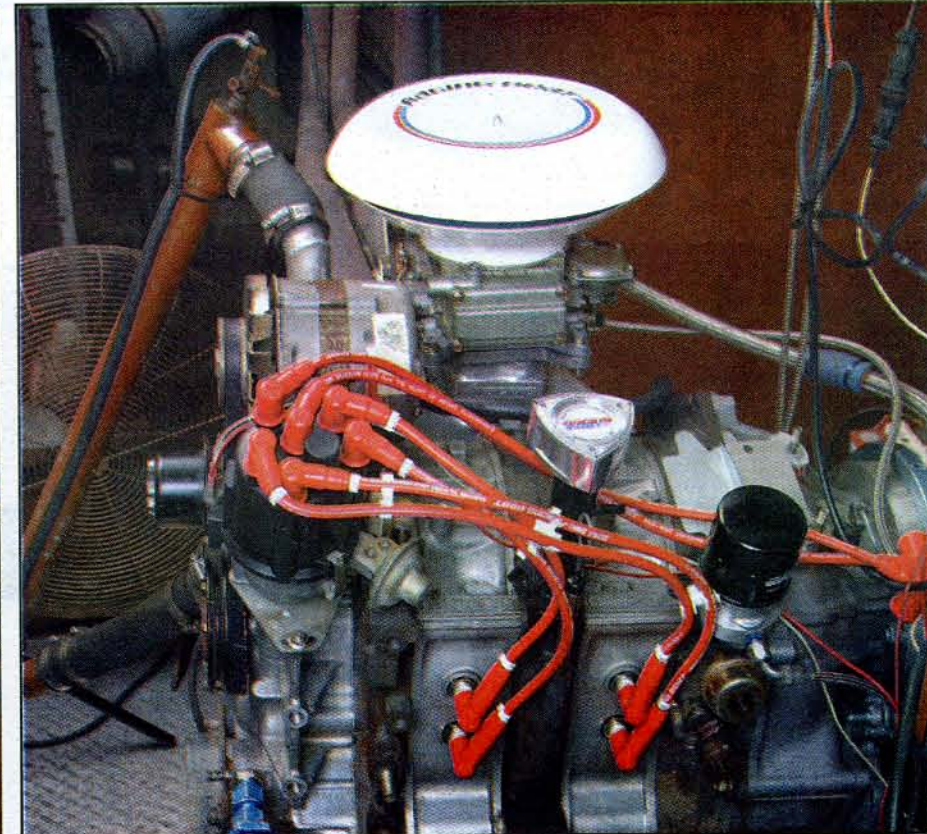
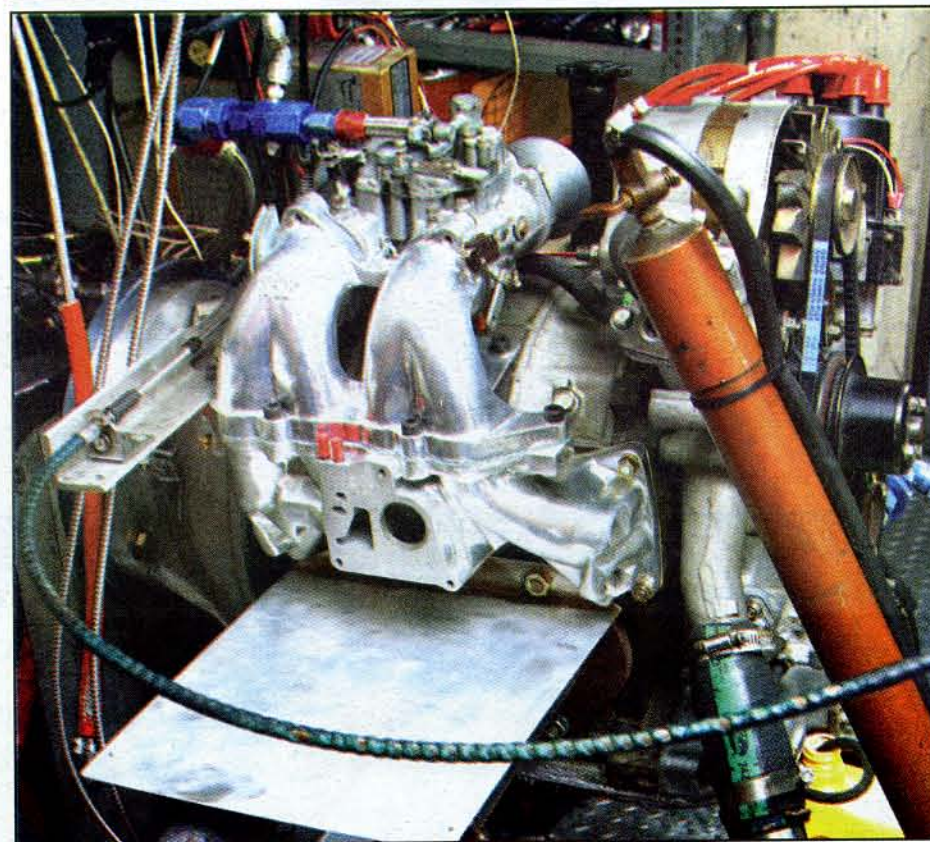
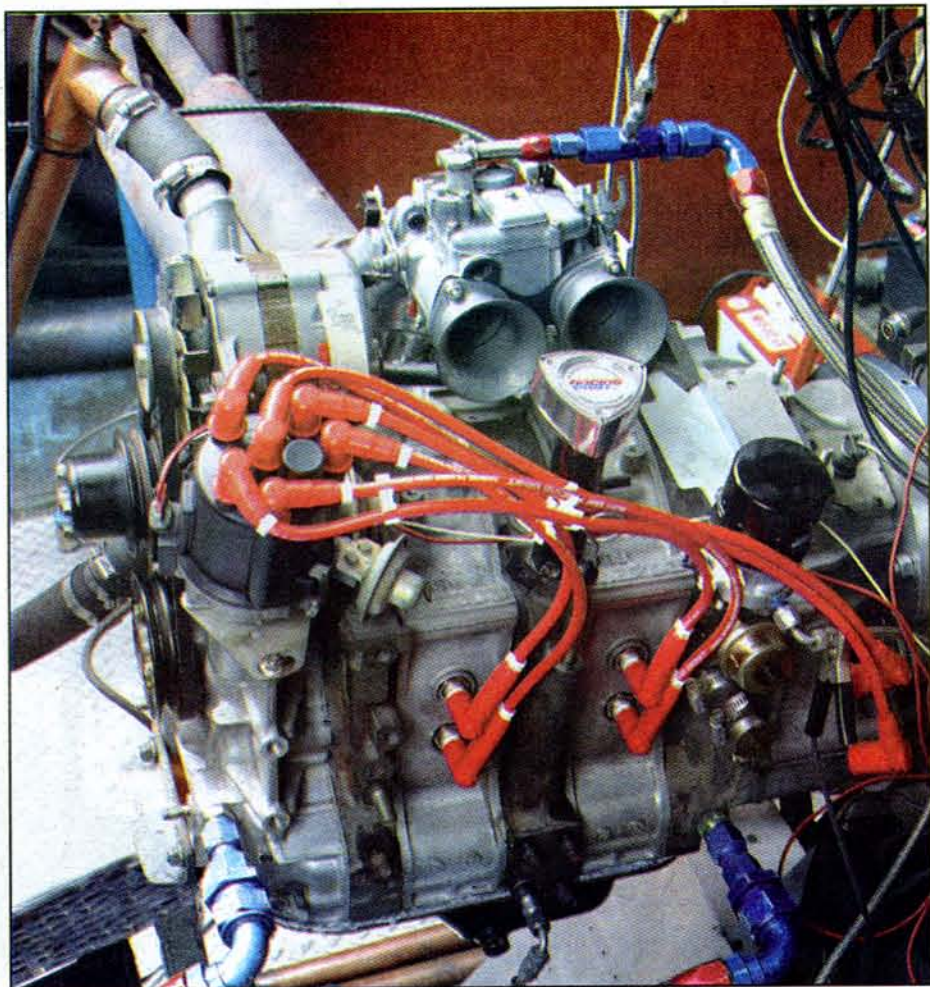
In any case, I was stuck with a 6-port 13B with a street-port that was a complete mystery to me. On top of that, I had also been asked to try three different carburetor and intake combinations. The first combination

would be a Mikuni PHH 44mm sidedraft carburetor; the second would be a Dellorto DHLA 48mm sidedraft carburetor; and the third would be a Holley 600cfm four-barrel carburetor. What fun! The Holley is not easy to work on for development work since many of its tuning components are not easily replaced. Enough complaining, it's time to get to work.

Theory of the Street Port

Before jumping into the dyno results, it's important to understand "streetable" porting in general. Porting is especially critical with respect to the rotary engine's intake ports. There are essentially two families of 13B engines, 4-ports and 6-ports. Either type can be "street-ported." Thus, the port area and port timing can be changed by grinding (see Figures A, B and C). The equivalent modification in a

piston (reciprocating) engine is accomplished by porting the cylinder heads and changing the lift, duration and timing events of the camshaft. On a rotary engine, all of this is accomplished with a grinder. In a 4-port engine, it is typical that all four intake ports (two on intermediate housing and one on each of the end housings) are enlarged and shaped to the same size. However, on 6-port engines it is impossible to get the



two ports on the intermediate housing to match in size and shape to the ports on the end housings. There just is not enough material on the intermediate housing to allow the port to be opened as large as the ports on the end housings. Trying to match these intermediate ports to the end-housing ports will result in breaking through to the water jacket and rendering the intermediate housing useless. With these limitations in hand, many engine builders start making poor choices. Because these engine builders want to go really fast, they enlarge the top of the upper port in the front and rear housings, regardless of the fact that these ports are already larger than traditional 4-port street ports. This

process is then followed by enlarging the ports of the intermediate housings as much as one dares without breaking into the water jackets. This process leaves the porting seriously unbalanced between the intermediate and end housings. When the 6-port actuators and valves are removed from the engine (as they had been in this case), the problem becomes even worse.

Closing the Intake Event & 6-port Actuators

We have compiled Figure D to offer a direct comparison of the "intake" closing events of various porting methods. As shown, raising the top of the upper port

in the "6-port Street Port" view can get pretty extreme, especially when you consider that the ports in the intermediate housing can't match the timing of the 6-ports end housings. Using the 6-port valves and actuators helps the situation when not at full throttle. However, at full throttle the unbalance remains.

Regarding the 6-port valves and actuators, our testing has shown that the factory 6-port valves open between 4000 and 5000 rpm at full throttle. Below 4000 rpm, power is optimized with the valves closed. Above 5000 rpm, power is best with the valves open. Between 4000 and 5000 rpm, there is no appreciable difference with the valves open or closed.

Four Barrel versus Two Barrel

With respect to the Holley carburetor and intake manifold, the unbalanced port timing doesn't allow this four-barrel carburetor to work at its best on a street-ported 6-port. With each of the ports being fed through an individual barrel on the carburetor, the intermediate housing ports pull a lower flow than the end housing ports. In contrast, the two-barrel carburetors (Mikuni and Dellorto) have their flow blended into the primary and secondary passages based on moment-by-moment engine demand. The optimal configuration for the Holley carburetor is either on a stock port 6-port engine or on a street-ported 4-port engine. Street-ported

Holley Primary Metering Body

Drill with #54 bit in two (2) places.

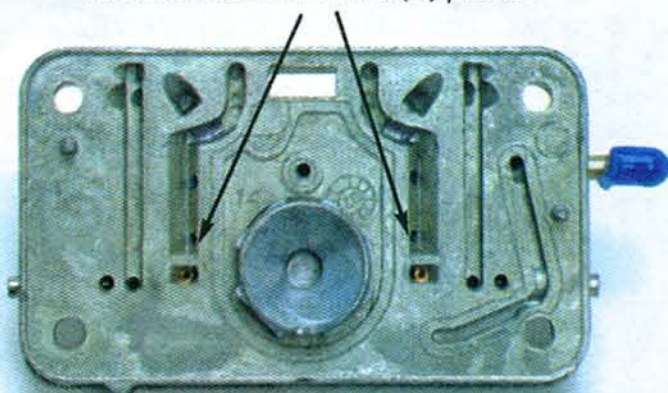


Figure F

Holley Secondary Metering Plate

Grind passage with 1/8" diameter cutter.

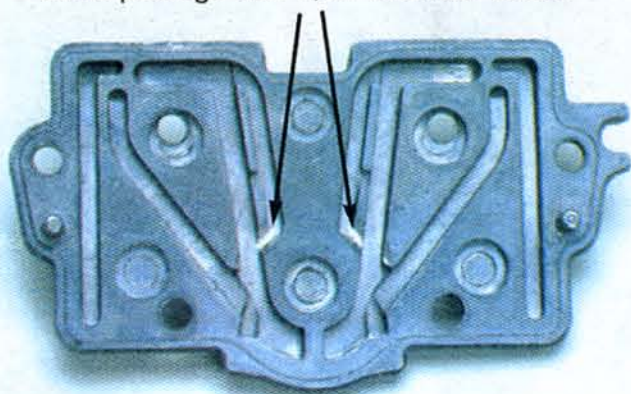


Figure G



"Turbo II" side housings and Racing Beat's new Holley manifold for that configuration would allow the carburetor to work its best and produce additional power.

From a pure flow standpoint, the 600cfm Holley (65-4548) modified to

Racing Beat's specifications features the highest throttle plate area and venturi area of the three carburetors used in the evaluation. The Holley has four 38.1mm throttle plates and four 30.5mm venturis. This puts the total throttle area

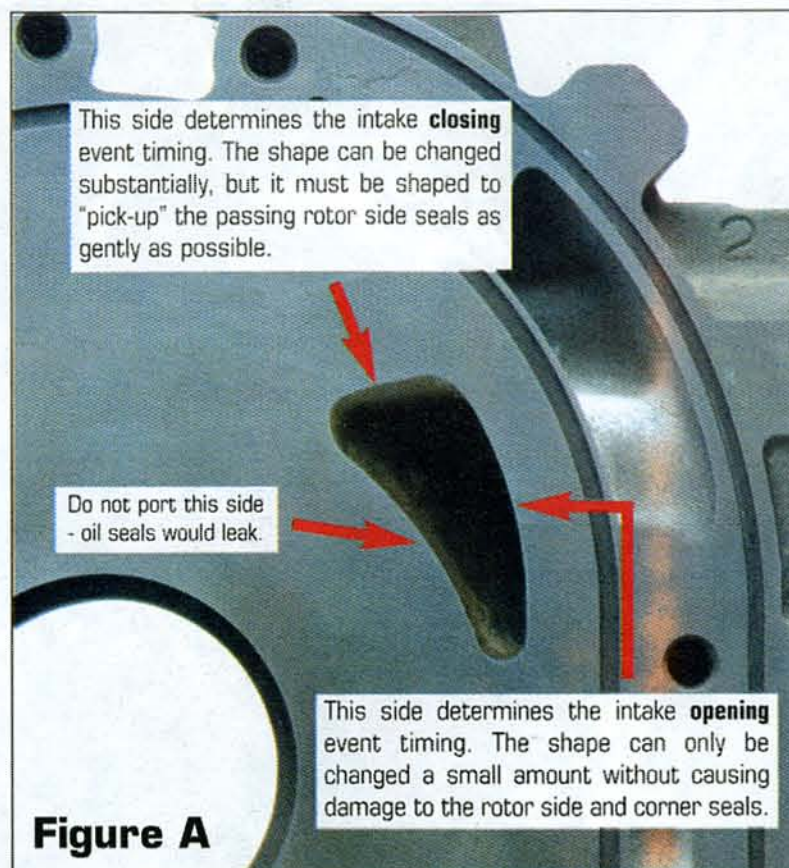


Figure A

Holley Carburetor

(Racing Beat PN. 16637)

Primary Metering Body

Primary Main Air Jets

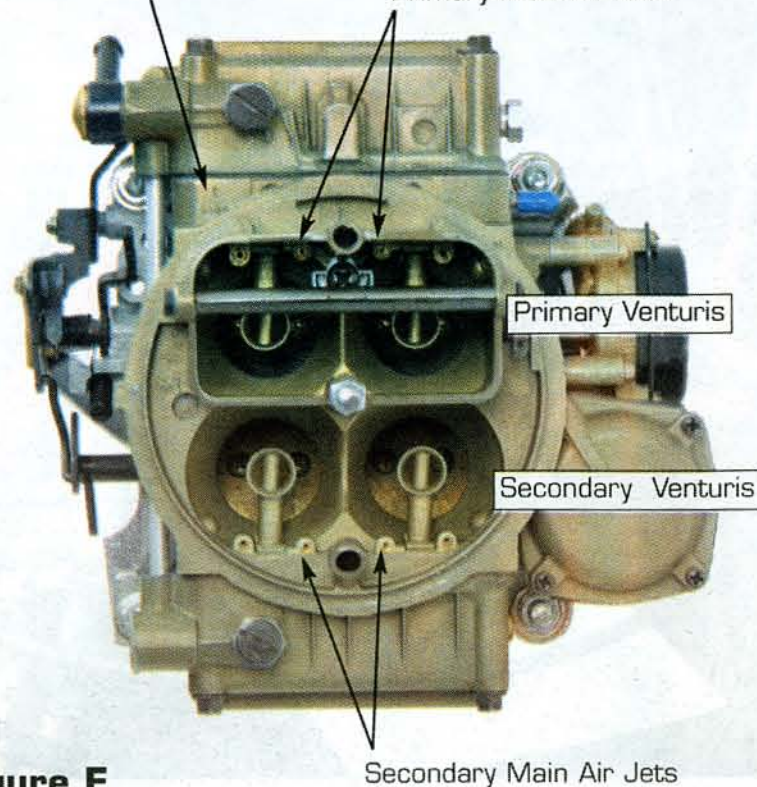


Figure E

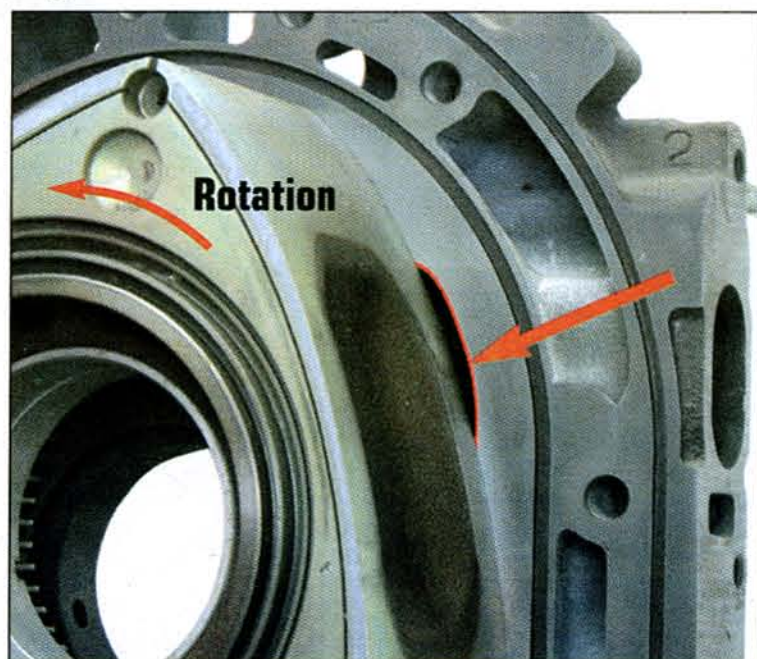
at 4560 square millimeters and the venturi area at 2922 square millimeters. The Dellorto DHLA 48mm two barrel carburetor uses two 48mm throttle plates and two 43mm venturis. The Dellorto is nearly identical in venturi area measuring in at 2904 square millimeters, while the throttle plate area is roughly about 80 percent of the Holley's throttle plate checking in at 3619 square millimeters. The smallest of the three carburetors used was the Mikuni PHH 44mm. This carburetor relies on a pair of 44mm throttle plates and a pair of 41mm venturis. Total throttle area checks in at 3041 square millimeters (just 67% of the Holley's throttle area),

with venturi area measuring 2641 square centimeters (90% of the Holley's venturi area).

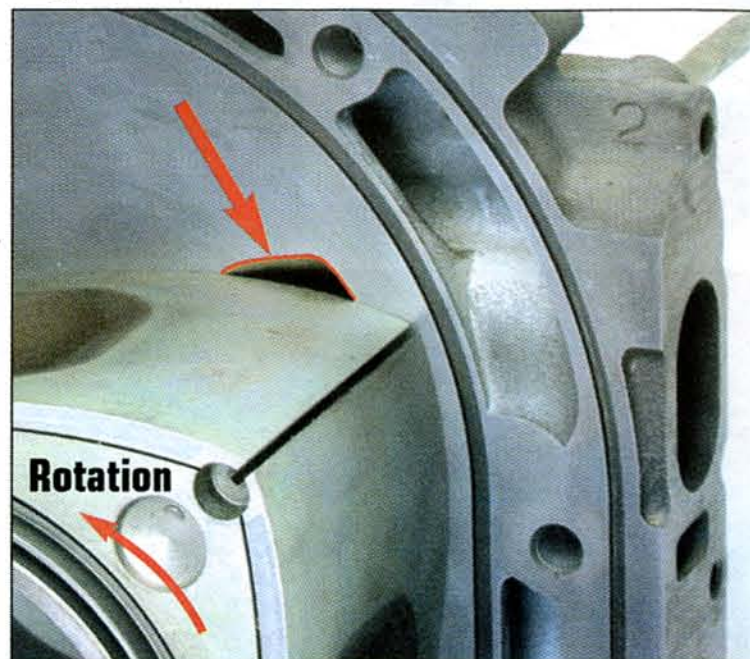
To The Dyno

To begin, we broke in the supplied engine for about three-and-a-half hours, gradually increasing the load and rpm until the engine was running at a fairly high load and power output. The fuel used for all testing was 91-octane Shell pump gasoline; although we feel we could have used 87 octane and had similar results.

Bolted to the dyno, the engine was mated to a Racing Beat Street Port Exhaust system which was configured to

Figure B

The intake port **OPENS** at the outer edge.

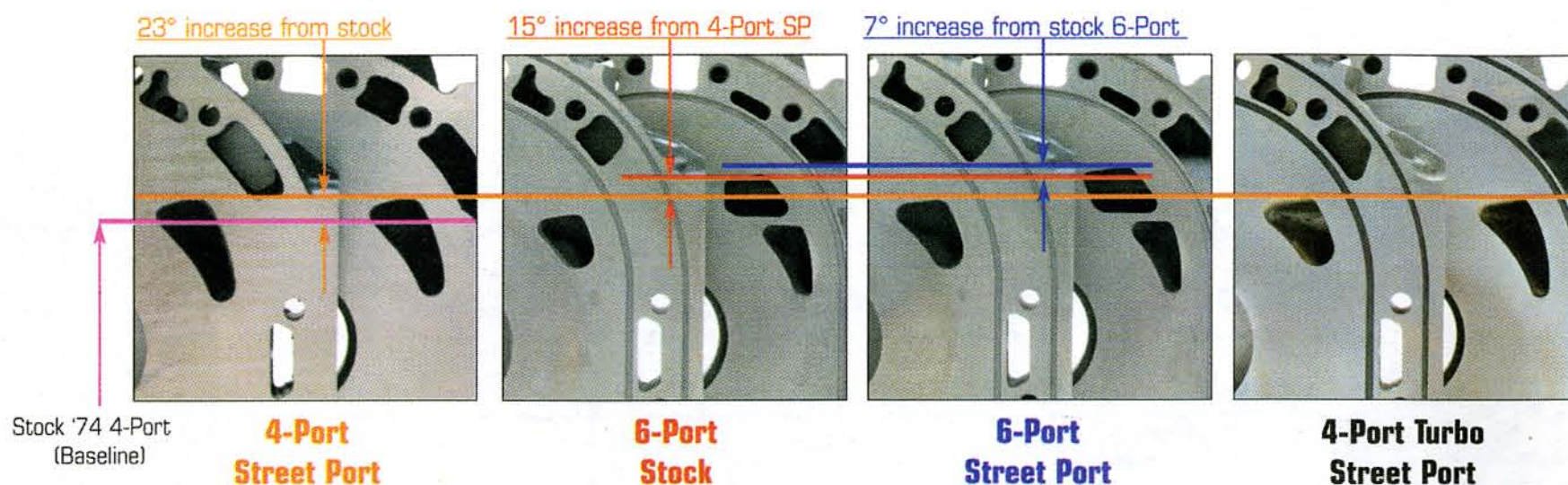
Figure C

The intake port **CLOSES** at the upper edge.

Figure D

Comparison Of "Intake Closing" Event Timing

Intermediate Housing (left) / Front Housing (right)



Delaying the "intake closing" event can cause problems - especially loss of low-rpm power.

fit in the dyno room. A pair of MSD 7AL ignition boxes was wired to be triggered by the distributor's ignitor. NGK B10EVX plugs were gaped to .020" for the test. If you choose to use these plugs, please make sure you get the special spark plug socket from Racing Beat that allows these plugs to be easily installed and removed from 1986 and later engines.

We found that 24 degrees BTDC of total advance (above 5000 rpm) was optimum when triggering the leading and trailing plugs at the same time. In most cases, we prefer to run a 10 or 12 degree split between the leading and trailing plug timing. For this case, we may have run the leading timing at 25 degrees with the trailing timing at 13 to 15

degrees. However, for development work we use a very powerful ignition system to avoid being misled about gains or losses related to ignition deficiencies. These powerful ignitions can on occasion cross trigger on the applications and cause the trailing plug to be fired at the same time as the leading. The results can be engine-damaging detonation. Thus, the safest choice for our development is to fire both the leading and trailing plugs together. In most cases, there is little or no power difference between the two techniques.

Getting the Numbers

Initial testing of the Mikuni and Dellorto carburetors looked pretty

normal. Both of the carburetors performed well but both seemed to choke a bit on the top end. With both carburetors using the same manifold and sharing similar two-barrel sidedraft designs, we were able to see the results of having more throttle area and more venturi area on this engine. From 5000 rpm and beyond, the larger Dellorto outperformed the smaller Mikuni by up to 10 horsepower.

When it came to the Holley carburetor, our first run was well below expectations. We tried the traditional jet changes, emulsion changes and even tuned length changes with little difference in the results. With desperation mounting, we changed from our exhaust

system to an open header. The reward was a very small increase in power. From all previous testing, making 220 horsepower on an open-header, streetported 13B with a Holley should be a given. We were stuck at about 200 horsepower with the frustration mounting. Nothing that should have worked was making a difference.

At about this time, my right-hand man Damon Wong suggested that we try turning the carburetor around 180 degrees. Already frustrated and now hit by a suggestion that for all intensive purposes should be a waste of time, I resisted my temptation to lock Damon in the dyno cell. With no other ideas coming to fruition, we decided to give it a try.

What the heck? Wow! With the carburetor swapped around the engine suddenly made 9 more average horsepower from 4000 to 8000 rpm and it picked up 17.6 more horsepower at 8300 rpm (see Graph A). In addition, from this point forward the engine responded to our tuning efforts that had done nothing up to now. We could now dial in the jetting and get some measurable improvements. We kept going forward until we found all the power that we could in the time that we had (Graph B). We reran the tests on the Mikuni and Dellorto just to be sure. Looking at these results, the smaller size of the Mikuni is a slight handicap, the larger Dellorto does very well in the 4500 to 7500 rpm range, but the larger throttle area of the Holley keeps the power curve on the climb from 7500 to 8500 rpm. With the open-exhaust results complete, we ran the tests again under the muffled conditions. While the results were nearly the same, the Holley did begin to work even sooner. The Holley outperformed the others from 7000rpm and beyond. The Holley also lost the least amount of peak horsepower with the muffler system in place, just a three horsepower difference. The Dellorto and Mikuni lost about 8 to 9 peak horsepower with the exhaust in place.

Making the Holley Work

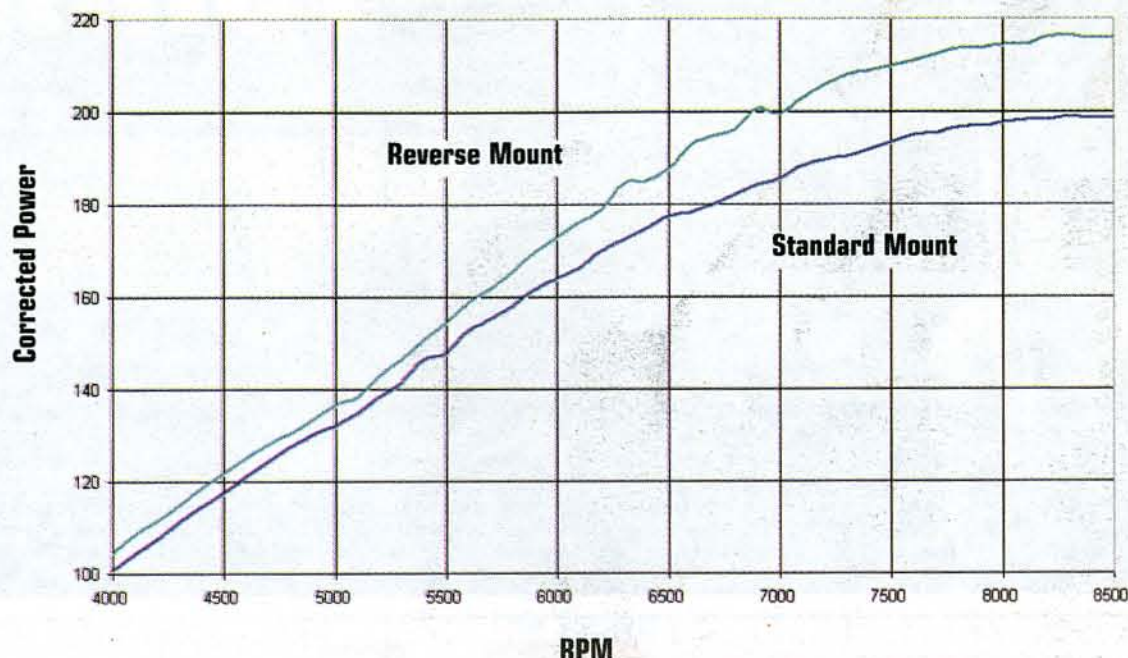
For this application, the key was spinning the Holley a complete 180 degrees. From this point, we changed the primary jets to #54s; we drilled the primary body's lower emulsion hole with a #54 drill; and we drilled the primary air jet with a #53 drill. On the secondary side, we changed to a #8 on the metering plate; we ground the plate with an 1/8-inch cutter as shown; and we drilled the secondary air jets to a #49. This resulted in an improved air-fuel mixture and more power.

We also tried a bunch of changes that offered no improvement. This included trying a single and a pair of inch carburetor spacers; adding a K&N plastic air horn extension; modifying the booster venturis; played with carburetor gaskets to change emulsion characteristics; plugged equalizer slots in carb base to keep runner isolated; and finally, tried a set of NGK BR10EXIX Iridium plugs at both a .020" and .028" gap. All of these changes proved to offer no improvements. To sum it all up, we did a lot of things that MIGHT have worked, but very few did.

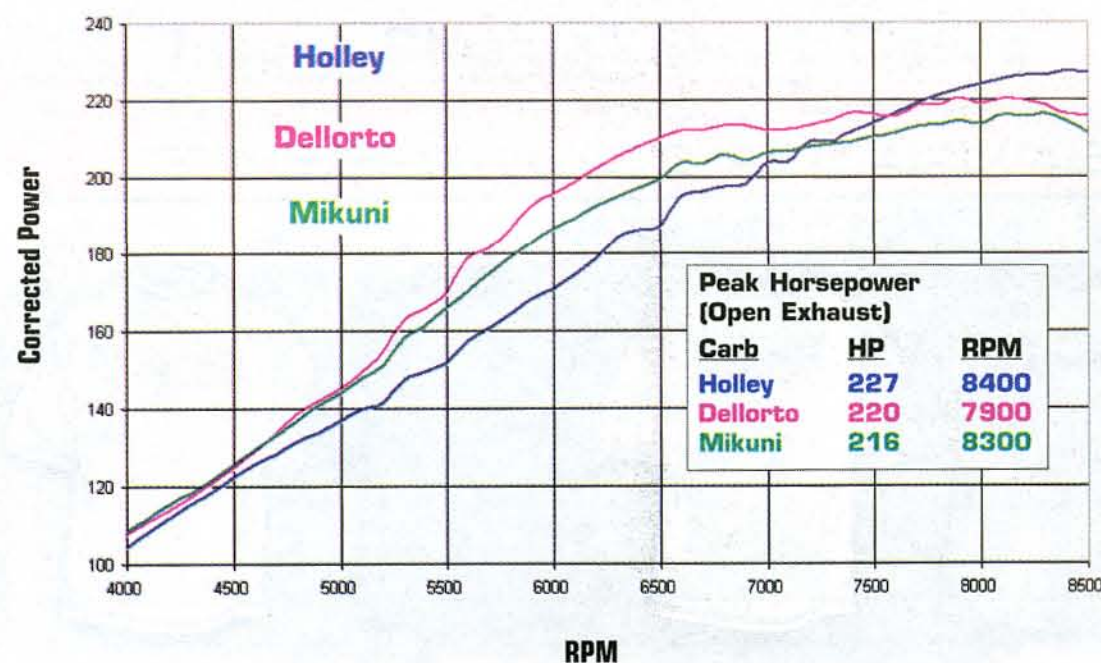
The Conclusion

So what does it all mean? What do we know after burning 50 gallons of fuel and spending 16 hours on the dyno? While it is dangerous to draw too many conclusions from limited data, it is probably safe to say that the "lop-sided"/unbalanced intake porting of the 6-port street-ported engine complicated the tuning of the Holley carburetor. This brings us to the next question, "Would

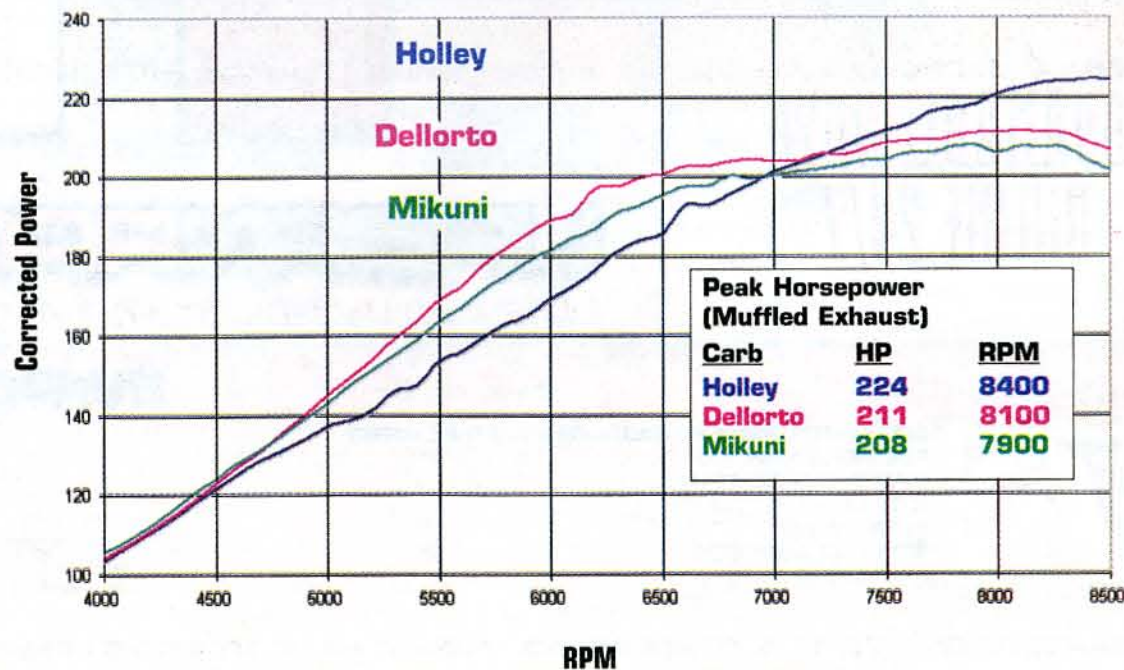
Graph A
Holley - Standard Mount vs. Reverse Mount

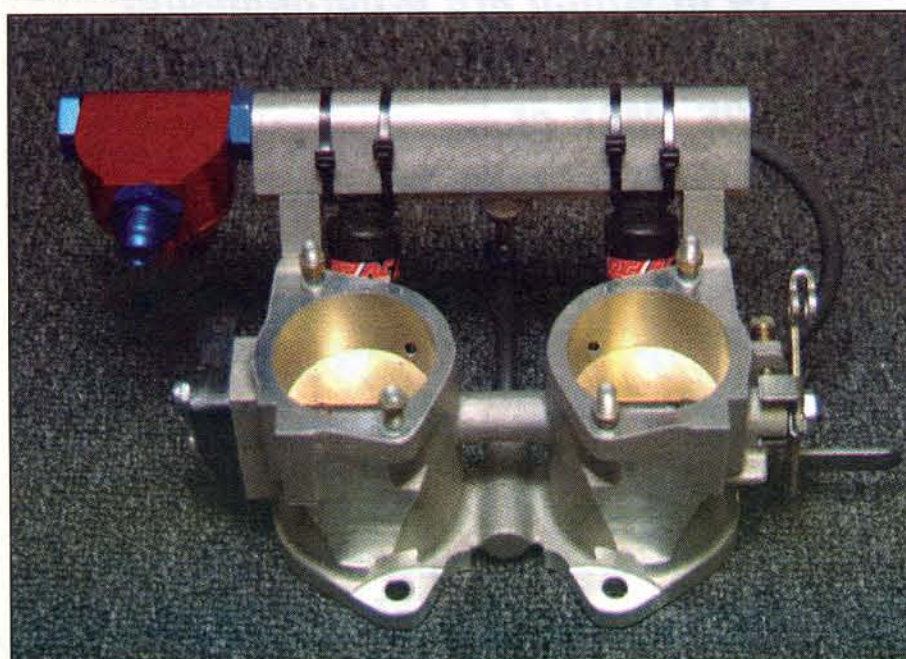
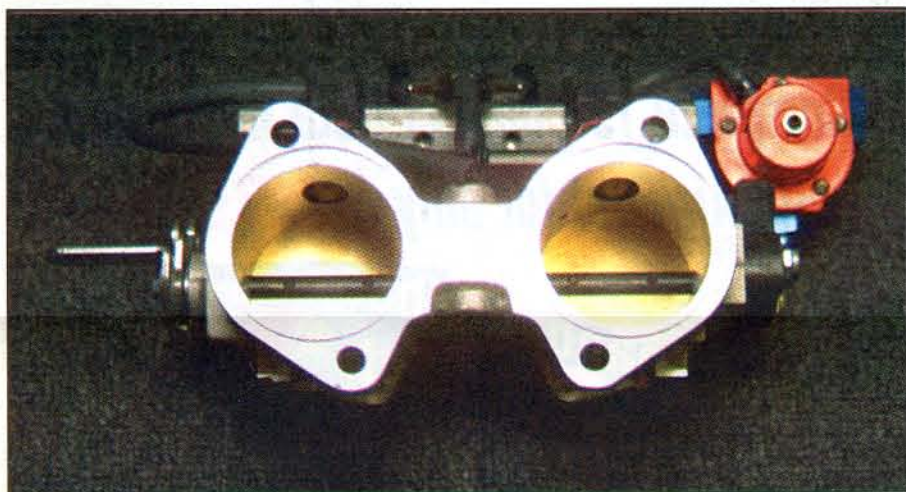
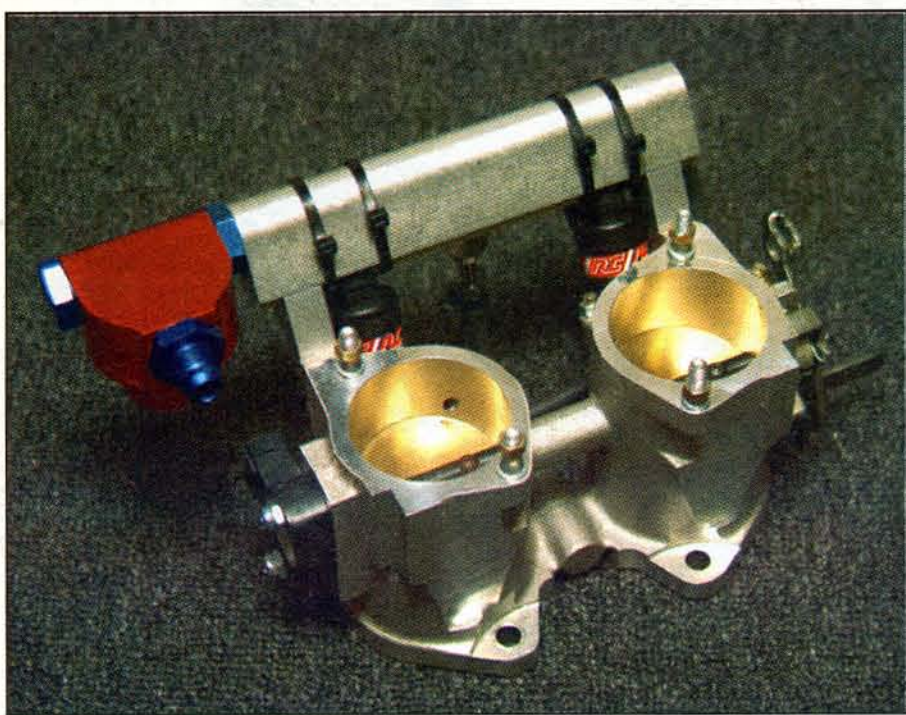


Graph B
Holley vs. Dellorto vs. Mikuni - Open Exhaust



Graph C
Holley vs. Dellorto vs. Mikuni - Muffled Exhaust





other Holley-equipped engines benefit from reversing the usual primary-to-secondary arrangement, as we did here?" In our opinion, if the engine has all of the intake ports the same, you would probably not see a difference by rotating the carburetor. However, there is a chance that even a stock-port 6-port may benefit from turning the carburetor 180-degrees. While we don't have the time to test this ourselves, please feel free to do

so yourselves. As to why the Holley made more power when reversed, we can only guess that the "quality" of the mixture (the amount of emulsification or "pre-mixing") delivered by the primaries is better than that delivered by the secondaries. With the carburetor reversed, the high-quality mixture coming from the primary side of the carburetor was consumed by the larger end housing ports. If you don't like that explanation,

WHY AN '88 6-PORT STREET-PORT 13B?

By Michael Ferrara

I know that I own too many cars. Here's my list: a '69 Camaro, a '73 Mazda RX-2, a '90 Eagle Talon Tsi, a '93 Dodge RAM 350 dually, a '96 Skyline GT-R and a '99 Honda Civic Si. There is no reason to be jealous (well, maybe just for my second mortgage--the GT-R). In my defense, I can only keep about two of the cars running at any one time.

I'm not the type of person that can leave good enough alone. For me, it's all about more power. When I purchased the RX-2 a few years ago, someone had already taken out the 12A engine. This engine had been replaced with a very tired early 4-port 13B. After a few months of neglect and abuse, the engine finally let go. However, being affectionately known as the "Golden Nugget," I wasn't really in any rush to put it back together anytime soon. When XS Engineering was planning to relocate from Fullerton to Huntington Beach, I asked Eric Hsu if he had any 13B engines for sale. He had a '88 6-port with low mileage and for \$300, it was a fair price. As I made my way through my stack of Racing Beat technical manuals, I brushed up on my knowledge of rotary engine performance. The engine would be capable of roughly 180 horsepower with the right intake and exhaust system in place. While the engine was probably good enough to put into the Golden Nugget "as is," my plan was to have the engine rebuilt to be safe. While visiting a few Pick-your-Part salvage yards in the South Bay area, I decided to pay a visit to Jeff McCall of Rotary Power in Gardena. Jeff had been a friend since the days I had attended the Compton and Hacienda Heights street races back in 1989 and 1990 (I don't advocate street racing, but I did it). Jeff had worked on Virgil Ward's R-100 and two of Abel Ibarra's early projects, including a supercharged RX-2 and the Flaco Racing R-100. After a bit of bench racing, I was convinced that I might as well have Rotary Power "street port" the engine and freshen it up. After all, it should help it make a few more horsepower.

So that's how it happened. There was no malicious intent to drive Jim and his right-hand man crazy at Racing Beat, that was just the result. However, I don't believe anyone could have been happier with the testing and results. Everyone learned a great deal, especially me. Here's a word to the wise, if you are looking to build a maximum performance 13B street port engine, use the Turbo II end housings along with the '89-up high-compression, lightweight rotors (9.7:1 versus the 9.4:1 of the '88 engine). All in all, that could have probably made an extra 20 horsepower. If you already have a healthy 6-port and don't need the extra 20 ponies, we've already done the development work for you. Getting an extra 50 horsepower over the stock porting from the 6-port is still a great accomplishment in my book. Thanks to both Racing Beat and Rotary Power for their efforts. As for the Golden Nugget, she'll be happy just to be running again. With 230 horsepower under the hood, she should have no problem getting from point A to point B. That is as long as she doesn't turn to rust in between.