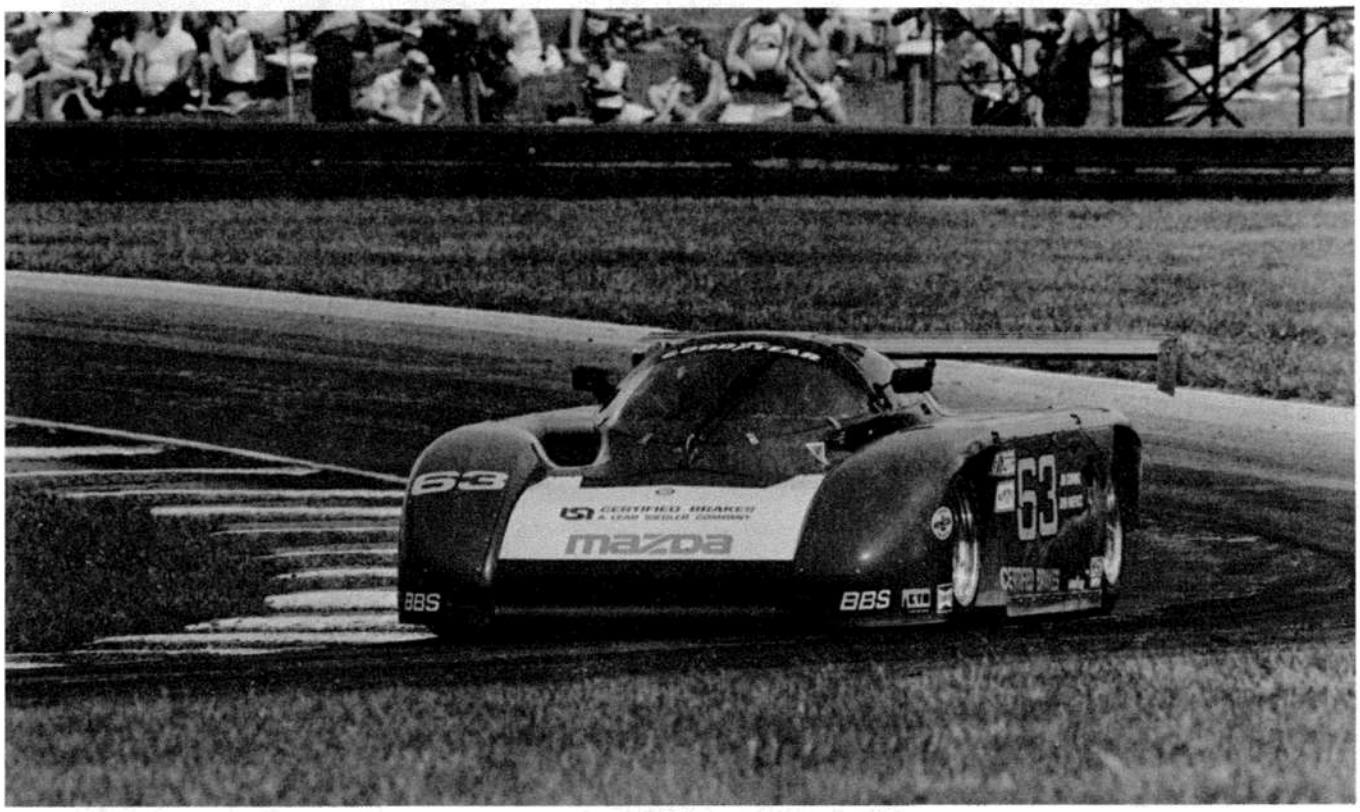
INDUCTION



Race cars such as the Downing/Maffucci/Mazda/Argo develop tremendous horsepower from relatively few cubic inches. Proper matching of intake and exhaust systems is one of the keys to success, whether an engine is to see duty in a street car or race car.

INTAKE SYSTEM

Now that we've "exhausted" the exhaust-system subject, let's take a look at the intake side of the engine. Several types of intake-manifold/carburetor combinations are available through aftermarket suppliers. And as might be expected, all are designed to increase power over the stock systems. But when making a selection, power isn't the only criterion. Many an RX-7 owner has been seduced by a horsepower curve only to discover that the seemingly "best" intake system made the car balky, tempermental and generally unpleasant to drive in a normal street/highway/autocross environment.

There's an old hot-rodding adage, left over from the days when conspicuous consumption was a relative rarity—"if some's good, more's better and too much is just enough." In those days, "some" was actually very little and in truth, "too much" was for the most part, barely adequate. With the considerable advances made by automotive technology in the last 20 years, "too much" is now "too much." The old adage just doesn't hold true any more—especially with respect to carburetors and intake manifolds. Generally, over-carbureting is one of the worst mistakes that can be made when modifying an engine for improved performance.

With that point echoing in your ears, or rather flashing in your eyes, consider other existing and planned engine modifications before selecting an intake manifold and/or carburetor. Installing a race manifold and modified Weber carburetor on a stock engine makes about as much sense as supplying foreign aid to Russia.

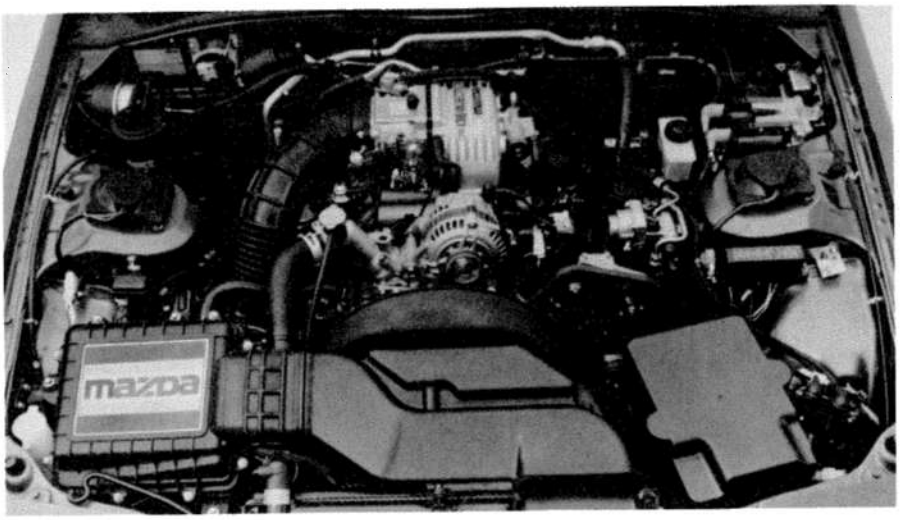
MORE & LESS

Stock Mazda induction systems are actually quite good. Their primary drawback is that they're overly restrictive. Of course, the degree of restriction varies according to model year. In 1974, a host of modifications were made to the 12A engine. One of the improvements was enlarged intake ports. But what the Lord giveth, the Lord taketh away. In 1976, the first "oil crisis" caused virtually every

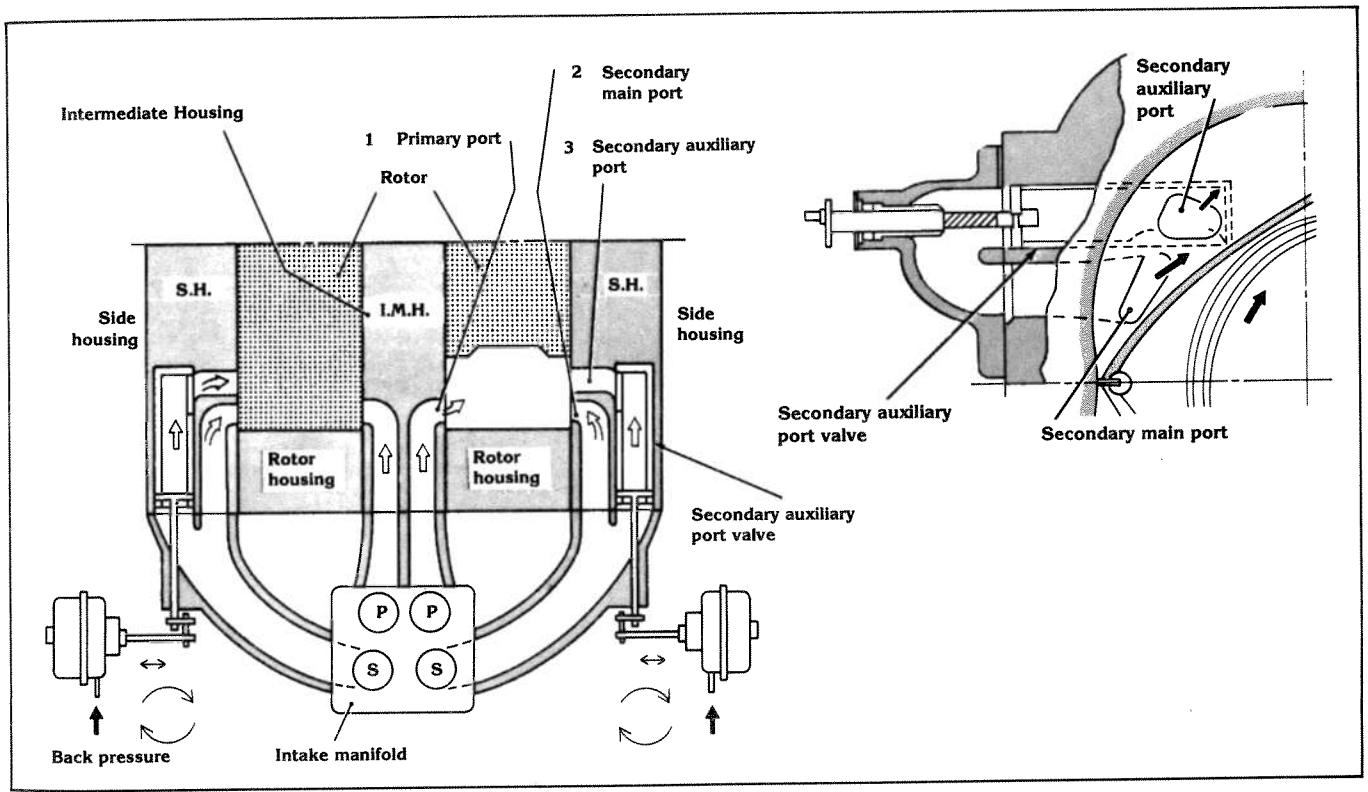
automaker to launch an all-out assault on fuel economy. Mazda met the challenge partially by reducing port size, which did wonders for gas mileage, but choked performance.

By 1984, electronic engine controls had conclusively demonstrated their effectiveness. So Mazda was able to reintroduce the 13B engine—it had been out of production since 1978—while continuing to meet fuel-economy requirements. The latter day 13Bs have all been equipped with electronic fuel injection and "Six Port Induction" which offers variable intake timing.

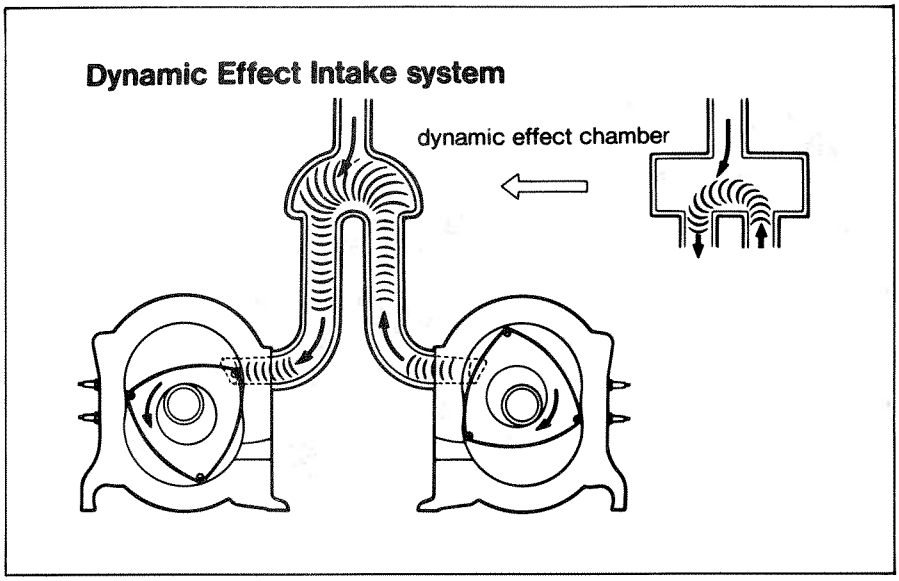
Standard-production induction systems route the intake mixture into the working chambers through ports in the side housings. A two-rotor engine, therefore, typically has four ports, except for the six-port design, in which a secondary



State-of-the-art in production rotary-engine induction systems is reflected in this 13B engine. Fuel injection and six-port induction provides a broad torque curve and excellent throttle response. However, improvements can still be made.

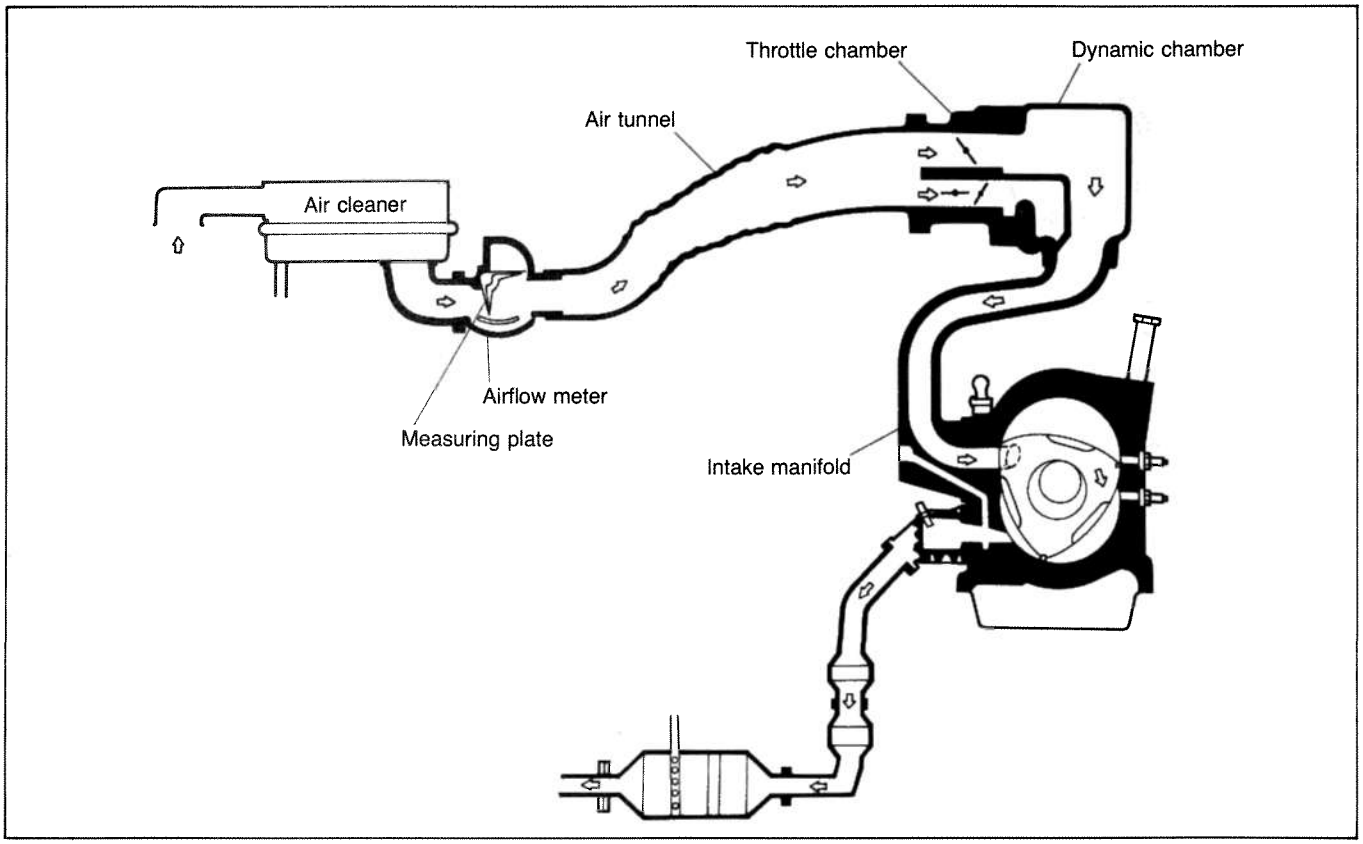


Six-port induction system combines the best of both worlds; low-speed torque and top-end horsepower. Under normal operating conditions, the working chambers receive their intake charge through the primary ports. At wide-open throttle, additional airflow reaches the chambers through the secondary main ports. At higher engine speeds, exhaust back pressure is used to open the rotary valves that control the secondary auxiliary ports. With this arrangement, port timing and flow is referenced to engine demands. Drawing courtesy Rotary Rocket.



Dynamic Effect Intake system, introduced with fuel-injected 13B engine has been refined for 1987. System makes use of pulsations generated by closing of one intake port serve to compress air/fuel mixture flowing into the other. By making use of pulsations that are unique to a rotary engine, slight "supercharging" effect is created and power is increased.

intake port connects to each chamber—for a total of six. Flow through the secondary ports is regulated by rotating valves that are controlled by exhaust pressure. At low speeds and light loads, the valves are closed and the high velocity through the primary ports maintains strong low-speed torque. When exhaust pressure increases, as during wide-open-throttle operation, the valves open, admitting an additional volume of air/fuel mix. This arrangement produces a relatively flat torque curve which extends the engine's power band. While six-port induction is not suitable for racing, it's a very effective means of improving the performance of a stock production engine.



Air-induction system for 13B fuel-injected engine. Drawing courtesy Mazda.

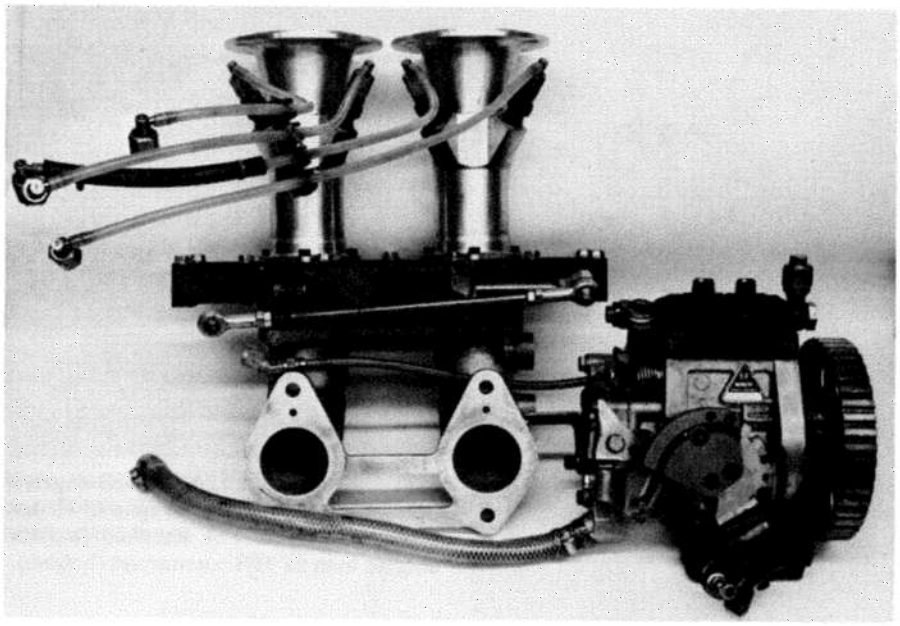
HIGH-PERFORMANCE INTAKE SYSTEMS

First and foremost, a properly designed aftermarket intake system—designed for high-performance street applications—eliminates a major restriction, allowing performance to be improved with virtually no degradation in driveability. However, the same can't be said of most race-oriented intake manifolds and carburetors—or fuel injectors. Intake-system components designed for competition use typically don't increase torque as much as they move peak torque up the rpm range and change the shape of the curve. To take full advantage of this reshaping, all engine subsystems must be designed to operate within the higher rpm band common to racing engines.

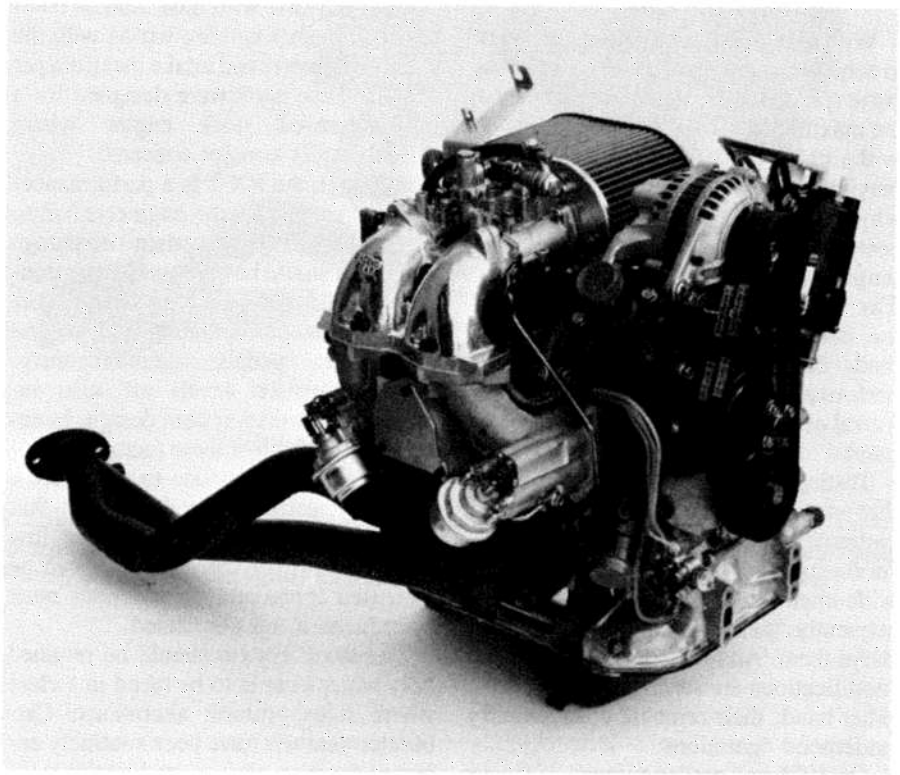
With horsepower being a function of engine speed, as engine output is increased, the power band not only moves higher on the rpm scale, it usually becomes narrower as well. Therefore, top-end horsepower typically increases at the expense of low-speed torque and vice versa.

For maximum effectiveness, the induction system must compliment the degree of port rework performed and it must be consistent with an engine's normal operating speed. It makes no sense to add an induction system that's tuned for a 5,000—8,000-rpm range to an engine with intake ports shaped for a maximum operating speed of 7,000 rpm. And as stated in the previous chapter, *induction system modifications should be made after the exhaust system has been upgraded.*

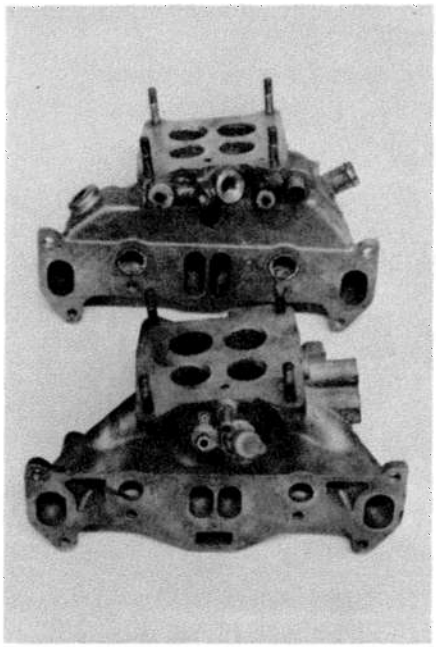
When dealing with a piston engine, the most important point to keep in mind is that tremendous increases in power are not the result of changing a single component; the total combination is what makes the difference between a winner and an also-ran. With a rotary, the overall combination is even more critical. This is because the exhaust system plays such a dominant role in a rotary's operational efficiency. The most successful modification programs, therefore, incorporate a *synergistic* (look it up) approach to selecting and tuning intake-, exhaust- and ignition-system componentry.



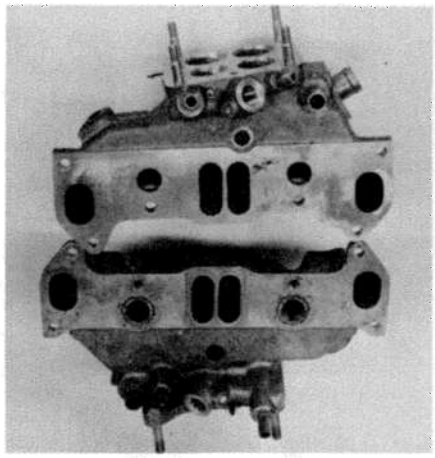
Fuel-injection systems installed on race engines were developed by the Mazda factory. Bosch pump is used along with Mazda developed injection components.



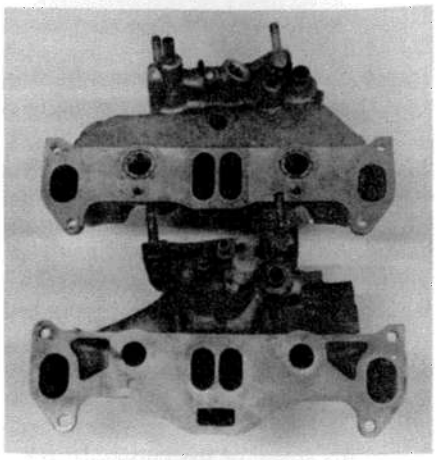
Racing Beat has developed an excellent street package built around an induction system that employs a Dellorto carburetor. This 13B engine has six-port induction.



Although connections for emissions equipment complicates intake manifold, equipment itself imposes relatively little in the way of a performance penalty.



Intake manifolds for 12A and 13B engines are not interchangeable in spite of similar appearance. The 12A manifold (top) is shorter than its 13B counterpart (bottom).



1976 intake manifolds for both 12A and 13B engines contained larger center runners as shown on top manifold. In all other years, center runners were smaller as shown in lower manifold.

With all engine subsystems designed to achieve optimum efficiency within the same rpm range, torque and horsepower are maximized within that range. *Usable* is the operative word here. Except for maximum-effort racing engines, it's always worthwhile to trade off a few horsepower at the peak for an increase in mid-range power.

The Emissions Connection—One of the corollary modifications frequently made during the installation of high-performance induction systems is removal of some emissions-control equipment.

Testing has shown that smog controls that interact with the intake manifold and carburetor have little effect on performance; many do not function during wide-open-throttle operation. Consequently, there's really no reason to remove them. And in certain locales, such modifications are strictly illegal. On the other hand, their removal does simplify underhood operations.

On 1975 and earlier engines, if the air pump is removed, the air nozzles in the rotor housing must either be replaced with blocking nozzles or cut off and welded shut. If the air pump is removed, it would be wise to store it rather than donating it to the trash heap. Should the need arise, it can be reinstalled.

STOCK INTAKE SYSTEM

As is the case with most Mazda components, there's nothing wrong with the stock carburetors and intake manifold per se. But these parts were designed for a mild-mannered stock engine where driveability is a major concern.

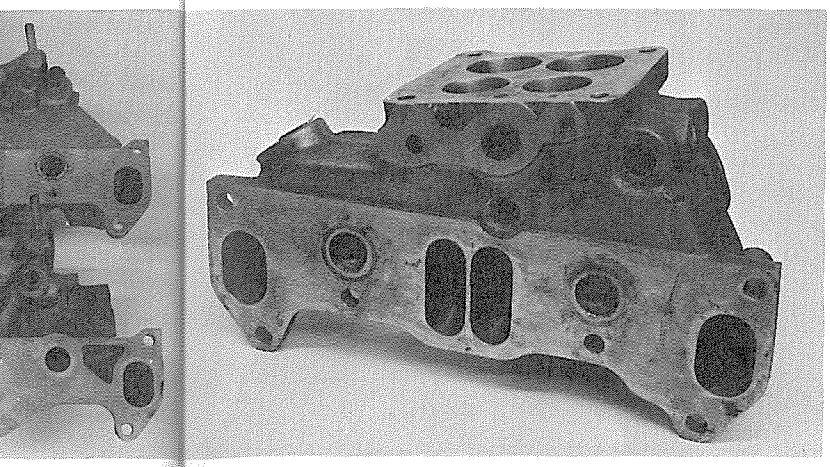
Although the RX-7 is a performance-oriented sports car, the engineers had to accept the fact that a certain percentage of owners would be nerds who have trouble walking and breathing at the same time, let alone operating clutch and accelerator pedals simultaneously. Exhaust-emission levels are also influenced by intake-system design. In designing with both of these factors considered, it is advantageous to construct a relatively restrictive intake system that promotes high-velocity airflow at low speeds. However, before power can be increased appreciably, restrictions must be reduced if not eliminated.

The stock system should be retained only when a car is to be raced in a class where rules prohibit alterations. Carburetor venturis have been routinely enlarged for such classes, and intake manifolds can be ported to increase airflow potential. But why take the difficult route? Replacement carburetors and manifolds provide more power with less trouble and expense.

One bright spot on the stock-equipment scene is the intake manifold used on 1976 12A and 13B engines. It offers significantly better flow characteristics than any other stock intake manifold. Installing one of these in place of another model will provide a noticeable performance improvement. (13B engines will not accept 12A intake manifolds and vice versa.) Another possible stock manifold replacement involves substitution of the 1986—87 13B Electronic Gasoline Injection (EGI) airflow meter on 1984—85 RX-7s. The later flow meter offers slightly higher flow capacity. Consequently, an increase in power may be realized.

An outgrowth of the infinite idiocy of the Federal bureaucracy is "non-adjustable" fuel-metering devices. Actually, adjustability exists, it's just hidden away like a debutante with buck teeth. Although the EGI's oxygen sensor and electronic controls will keep cruise and full-power air/fuel mixtures at *stoichiometric*—chemically ideal—levels in spite of modifications, it may be necessary to adjust idle mixtures. Before this can be done, the *seal* over the idle-mixture screw must be ground away.

If the engine idles roughly or runs erratically just off idle, adjusting the idle mixture richer or leaner may smooth out



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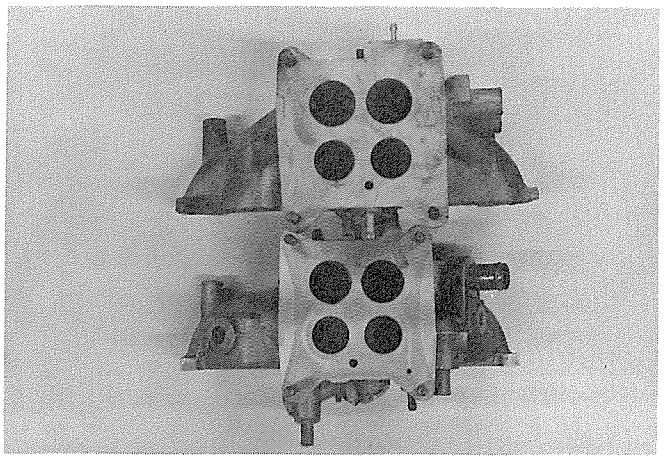
owning crew has experimented with stock intake manifolds in certain high-performance and race applications. Manifold has been ported and extraneous material around carburetor flange has been milled off.



Viewed from above, difference in intake-manifold length is obvious; 13B manifold is at top; 12A is below.

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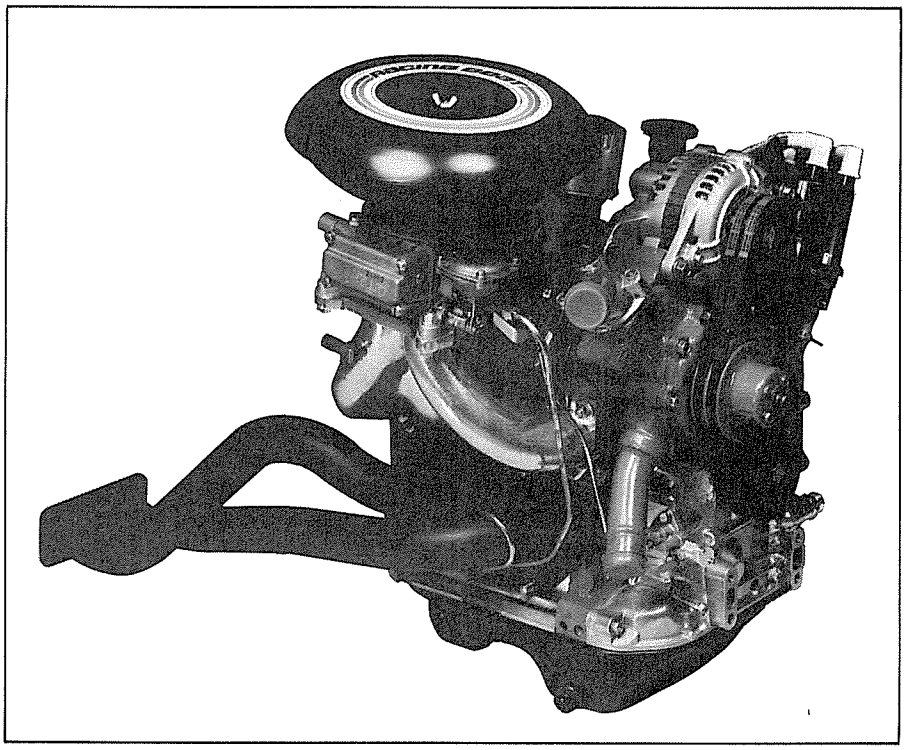
things. However, idle-mixture adjustments do affect exhaust emissions, so before turning the screw, mark the original position. This way you can return the screw to its original setting if necessary. It should be noted that small adjustments produce big changes, so the mixture screw should be rotated in increments of a few degrees as opposed to a 1/4 or 1/2 turn at a time. Once the desired idle quality is achieved, set the idle speed to approximately 750 rpm.

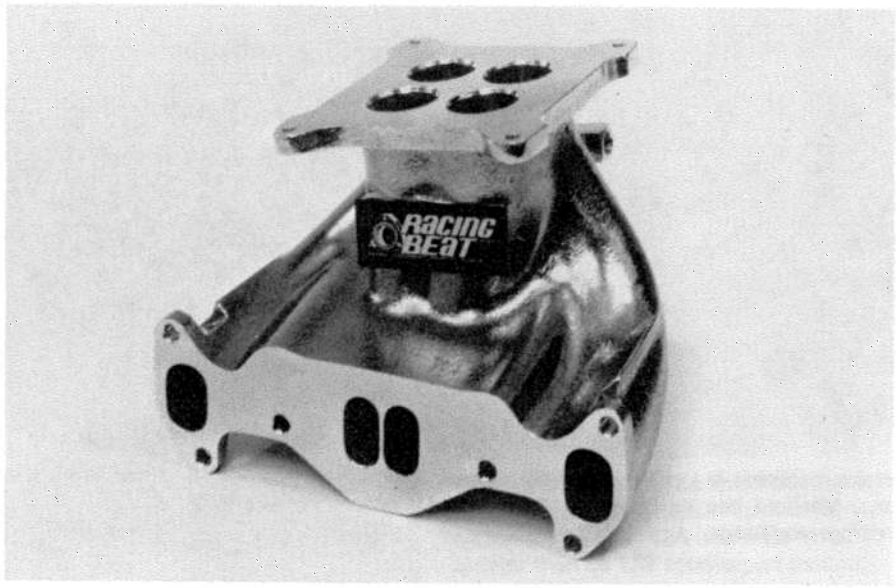
HOLLEY 4-BARREL

One of the most popular high-performance induction systems for Mazda rotary engines consists of a Holley four-barrel carburetor and special intake manifold. Although other systems allow a rotary to hum a higher horsepower tune, a Holley carburetor is easy to service and modify. Many people who are uncomfortable with a Weber or Dellorto feel at ease with a Holley and, therefore, achieve better results. And in classes where venturi or throttle-bore size is restricted, a Holley four-barrel will frequently perform on a par with a Weber. It is also generally true that a Holley-based induction system offers better fuel economy and low-speed response than one oriented around a Weber.

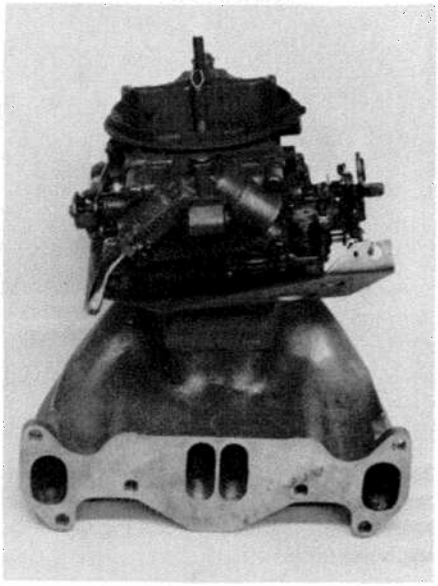
Racing Beat markets several Holley intake systems. Each carb is calibrated according to engine year and size. For 12A engines, the carburetor of choice



One of the most popular rotary engine high-performance induction systems incorporates Racing Beat's modified Holley four-barrel carburetor and special intake manifold.



Holley four-barrel intake manifolds are available for stock, street-ported and bridge-ported engines. Photo courtesy Racing Beat.



For racing applications, "double-pumper" Holley with mechanically actuated secondary throttles and two accelerator pumps is the norm. Carburetor also has center-inlet fuel bowls that provide better fuel-level control during cornering.

carries part number 0-1848-1 and an airflow rating of 465 cfm; 13B engines receive a number 0-1849-1 carburetor that is rated at 550 cfm. Considering Racing Beat's experience with Mazda rotary engine's, it's probably unnecessary to make any carburetor modifications when purchasing one of their systems. The same can't be said for previously owned or home-built systems.

Both the 0-1848-1 and 0-1849-1 carburetors are equipped with vacuum-actuated secondary throttles that open on demand, according to airflow requirements. When the accelerator pedal is pushed to the floor, the primary throttles are immediately rotated to wide-open position; but not the secondaries. As airflow through the primary barrels increases with rpm, venturi vacuum increases. When it becomes strong enough to overcome the force of the secondary-diaphragm spring, the secondary throttles open—gradually.

The secondary opening rate is referenced to airflow, so with a spring that applies the correct force, the secondary opening is precisely tailored to engine requirements. Holley offers a secondary-diaphragm-spring kit (part no. 20-13) that allows the opening rate to be tuned for optimum performance. Each spring is color coded according to relative stiffness.

For street driving—and even some forms of racing—vacuum secondaries are tough to beat. With the opening rate correctly calibrated, carburetor airflow is consistently close to optimum levels across a wide range of operating conditions. Holley carburetors with mechanically actuated secondaries and dual accelerator pumps are advantageous only for high-speed operation where an engine's operating range is relatively narrow and positive secondary-throttle control is desirable.

On reciprocating engines, Holley mechanical secondary carbs—known as *double-pumpers* by virtue of their two accelerator pumps—are widely used in circle-track, drag and road racing. Double-pumpers are also compatible with bridge-ported rotary competition engines. Racing Beat's double-pumper-based intake systems feature a 600-cfm carburetor (Holley part no. 0-4776) for 12A engines and a 650-cfm carb (0-4777) for 13B engines. These systems are designed strictly for bridge-ported engines. Use of a double-pumper carburetor on a stock or street-ported engine will result in poor throttle response and reduced wide-open-throttle power levels at lower engine speeds.

For improved fuel-level control during acceleration and cornering, install center-inlet fuel bowls—standard on Holley double-pumpers—on any Holley originally fitted with side-inlet bowls. Although the improvement won't be as great as on engines where the carburetor is mounted with the float bowls front and rear—as opposed to one on the right and left sides—it will be noticeable. Holley kit #34-2 contains two float bowls complete with inlet fittings and needle-and-seat assemblies. A new fuel line must be fabricated to deliver fuel directly to both bowls.

Another helpful fuel-control modification is the installation of a vent baffle, or *whistle,* (Holley part no. 26-40) to prevent fuel from sloshing out of the vent tube. However, if float-bowl fuel level is too high, it is still possible for fuel to slosh out of the main discharge nozzles in the booster venturis.

While it is common practice to set the level so that fuel just drips out of the

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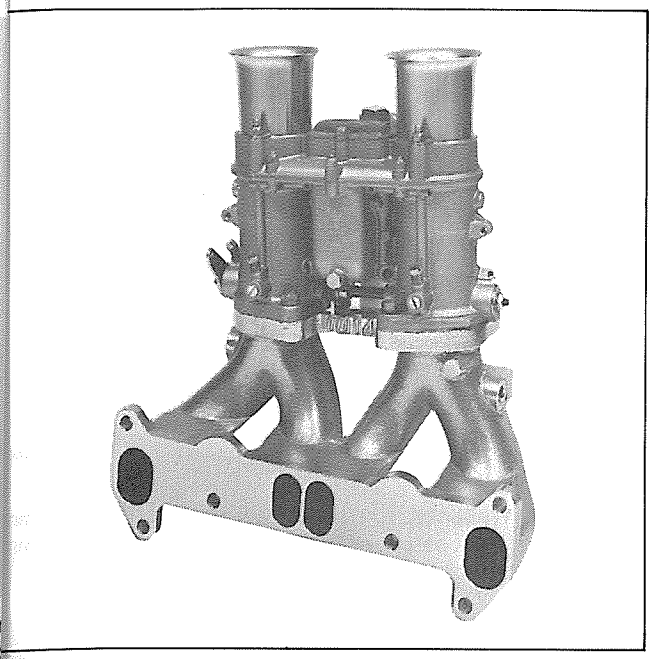
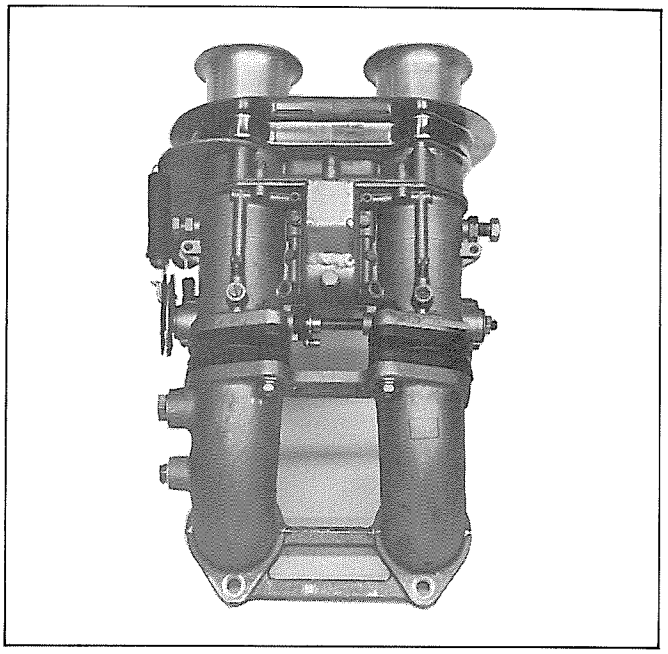
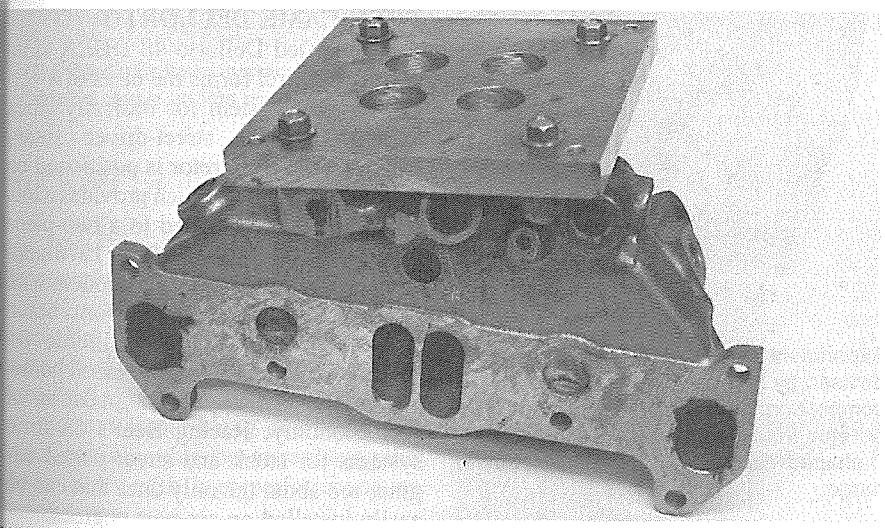


Weber carburetor and special intake manifold will provide impressive performance provided exhaust system is compatible. Both 48mm and 51mm carburetors are available. Photo courtesy Racing Beat.



Weber system is used on peripheral-port race engine. Note rubber spacers between carburetor and manifold. In addition to isolating carb from heat and vibration, spacers also lengthen intake tract for improved performance. Velocity stacks provide additional length. Plate at top of carburetor is for air-cleaner mounting.



Hard way to do things: Rick Engman experimented with converting stock intake manifold to accept Holley carburetor. Although it would have been easier to install an aftermarket manifold, such exercises frequently lead to discoveries that improve performance.

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inspection hole, this can be too high for aggressive driving styles. In such cases, simply lowering the level to 1/16—1/8 in. below the inspection hole may eliminate fuel-slosh problems.

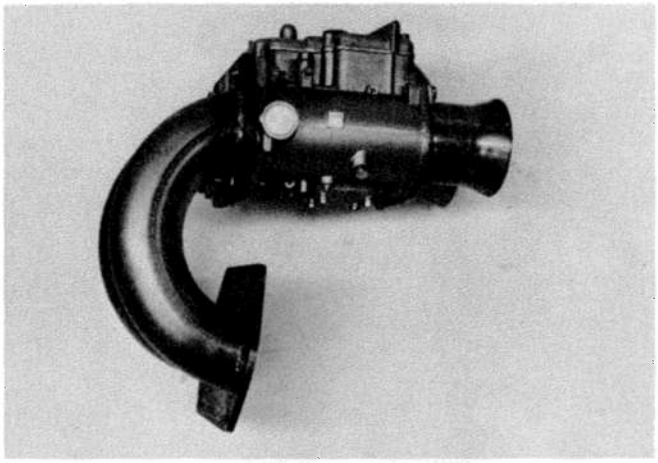
WEBER ALTERNATIVE

Weber carburetors and sports cars go together like wine and cheese. Mazda sports cars are no exception. The Weber carb most commonly used on rotary engines is the 48 IDA down-draft. Both Racing Beat and Rotary Engineering offer Weber based manifold/carburetor packages. However, this carburetor is not equipped with a choke, so poor driveability after a cold-start can be a problem.

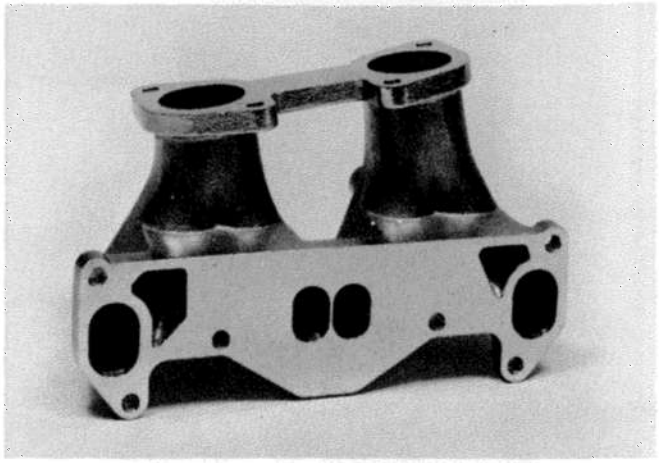
The 48 IDA was originally calibrated for use on a certain German performance engine, so it must be recalibrated prior to installation on a Mazda rotary. On street-ported 12A engines with headers and muffler, Racing Beat suggests a 37mm venturi, #170 fuel jet, #150 air jet, an F-11 emulsion tube and a #250 needle valve. Similarly modified 13B powerplants call for a 48 IDA with 38mm venturis, a #190 fuel jet, #160 air jet, F-11 emulsion tube and #250 needle valve.

While these components won't prove to be the optimum combination for all engines, testing at Downing/Atlanta has shown that the resulting calibrations provide an excellent starting point. Only minor changes will be required for fine tuning.

Bridge-ported engines operate at higher speeds and produce more horsepower



Another Rick Engman experimental system: Along with fabricated intake manifold, 55mm side-draft Weber showed excellent performance potential for racing applications. However, advent of fuel injection consigned this system to the parts shelf.

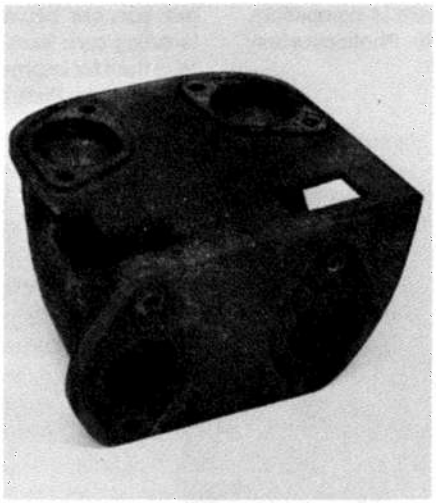


As supplied, Weber intake manifold will accommodate a 48mm carburetor. It must be ported to match a carburetor with 51mm throttle bores. Photo courtesy Racing Beat.

than their street-ported counterparts. They are also typically run with open exhaust pipes or with special racing mufflers. Consequently, a larger carburetor and greater fuel-handling capability are required. Recommended components for a 48 IDA installed on a 12A bridge-ported engine include 42mm venturis, #240 fuel jet, #170 air jet, F-11 emulsion tube and #300 needle valve. With its greater displacement, a 13B engine requires higher airflow capacity than a similarly modified 12A. A 48 IDA Weber is therefore inappropriate for use on a bridge-ported 13B engine unless its throttle-bore diameter is increased to 51mm.

Dyno testing of bridge-ported 13B engines at Downing/Atlanta has produced power levels of 275—280 HP with a 51mm Weber 48 IDA carburetor. By way of comparison, these engines managed readings of only 260—265 HP when fitted with a Holley 650-cfm four-barrel. It seems as though the Mazda rotary is much more receptive to the air/fuel mixture when it's delivered through a manifold that connects to two large, rather than four smaller throttle bores.

Modified Webers—with 51mm throttle bores—are available from a number of suppliers. It is possible to build your own by boring the body out on a lathe and fabricating an appropriate throttle plate.



Experimental phenolic intake manifold was devised by Rick Engman and used in GTU competition. In addition to isolating carburetor from heat, manifold incorporates D-shaped runners that extended power range.

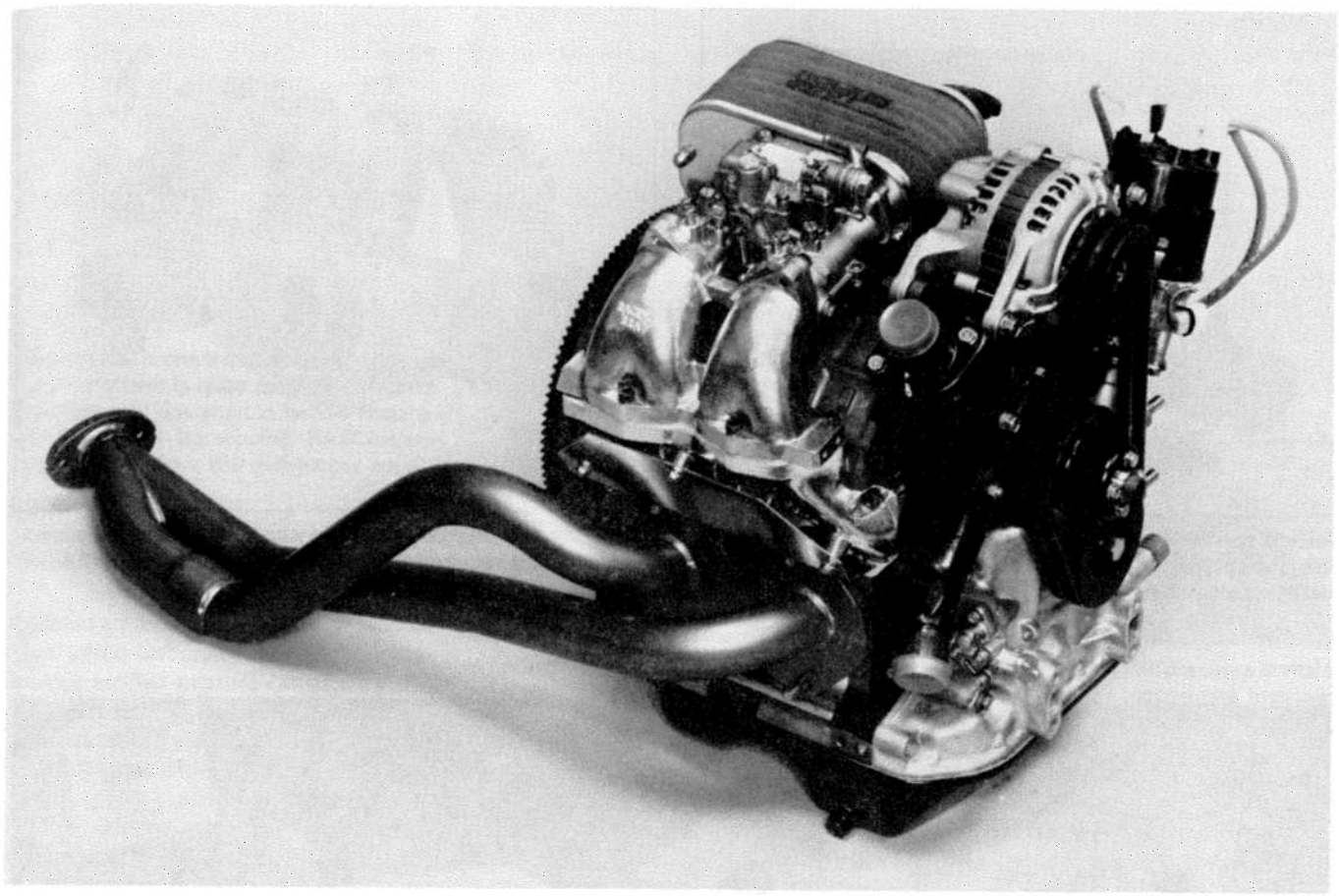
A locating screw must also be installed to retain the venturi. But due to the precise machining required, building a "51 IDA" Weber is best left to experienced hands.

For a bridge-ported 13B engine, a typical "ballpark" calibration of a 48 IDA with 51mm throttle bores includes 45mm venturis, #235 fuel jet and #165 air jet. Perpheral-port engines typically respond better to a calibration that includes 46mm venturis, #240 fuel jets and #110 air jets. Or, if additional mid-range power is desired, go to 43mm venturis, #240 fuel jets and #130 air jets.

THEN CAME DELLORTO

A modified Dellorto 48 DHLA side-draft two-barrel forms the basis of a versatile intake system for basically stock high-performance street-driven rotary engines. The carburetor is positioned on top of the engine—which provides a low profile—and is attached to a two-piece intake manifold. Designed for 1976-and-later engines and '74—75 models with minor modifications, the Dellorto based systems provide excellent throttle response and driveability, increased horsepower and virtually no degradation of fuel economy. Racing Beat's Dellorto systems for stock and street-ported engines are about the only ones that can be easily installed on six-port engines.

When the electronic fuel injection is replaced by a Dellorto carburetor, the stock lower section of the intake manifold is retained. Only the upper portion is replaced. This arrangement allows the stock six-port valve mechanism to be retained. The Dellorto system along with a header and low-restriction muffler will boost the output of a late-model 13B engine by approximately 40 HP.

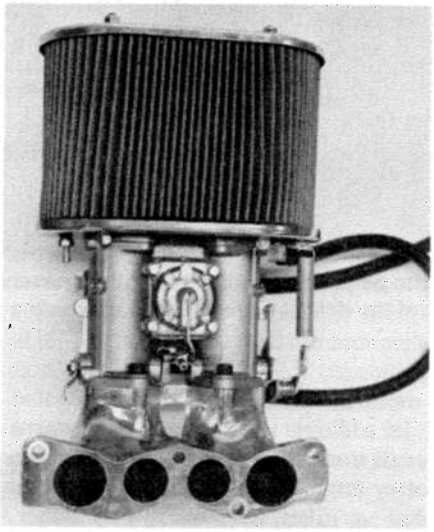


Racing Beat's Dellorto system is ideally suited to stock engines and utilizes a two-piece intake manifold. Significant power increases are obtainable, even on late models.

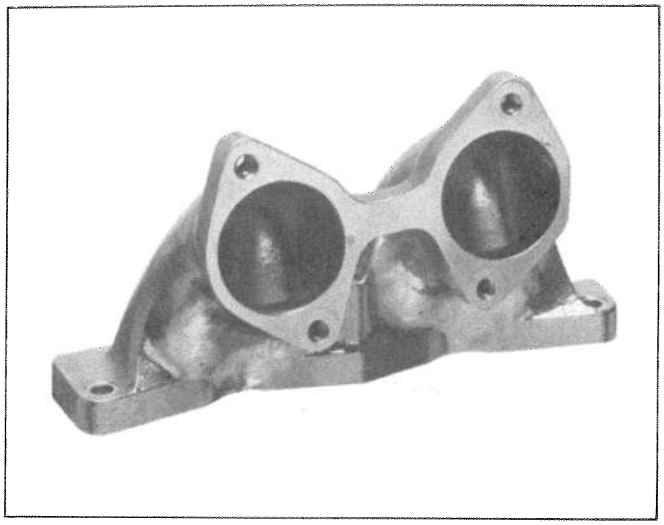
THE REST OF THE STORY

Air Filter—Irrespective of the intake system selected, both components of the air/fuel mixture must be properly filtered. But clean air and fuel must not come at the expense of flow; filters should effectively remove dirt and foreign matter without being overly restrictive. Generally, this means replacing the stock filters with high-performance or racing types.

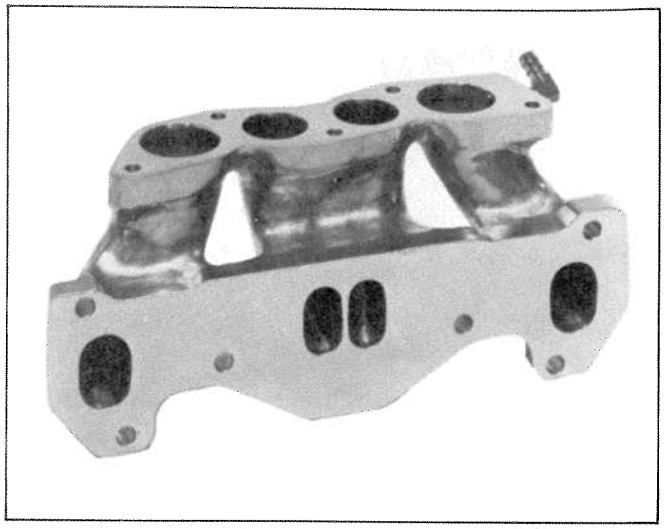
Within the constraints imposed by carburetor position and hood clearance, the air filters supplied with high-performance intake systems are certainly adequate, and in many instances they are difficult to improve upon. However, a K&N element is generally preferable to other types as it is an excellent filtration medium, yet offers minimal airflow restriction.



Dellorto kit features 48mm carburetor and is designed to bolt directly to lower half of a late-model fuel-injection intake manifold. K&N air-filter element is included.



Dellorto manifold upper section is same for 12A and 13B engines. This is the piece that bolts to either a Racing Beat or lower stock fuel-injection manifold. Photo courtesy Racing Beat.

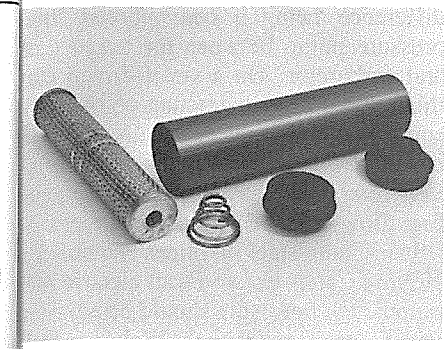


For engines not originally equipped with fuel injection, lower manifold section is required. These are available for standard 4-port engines.

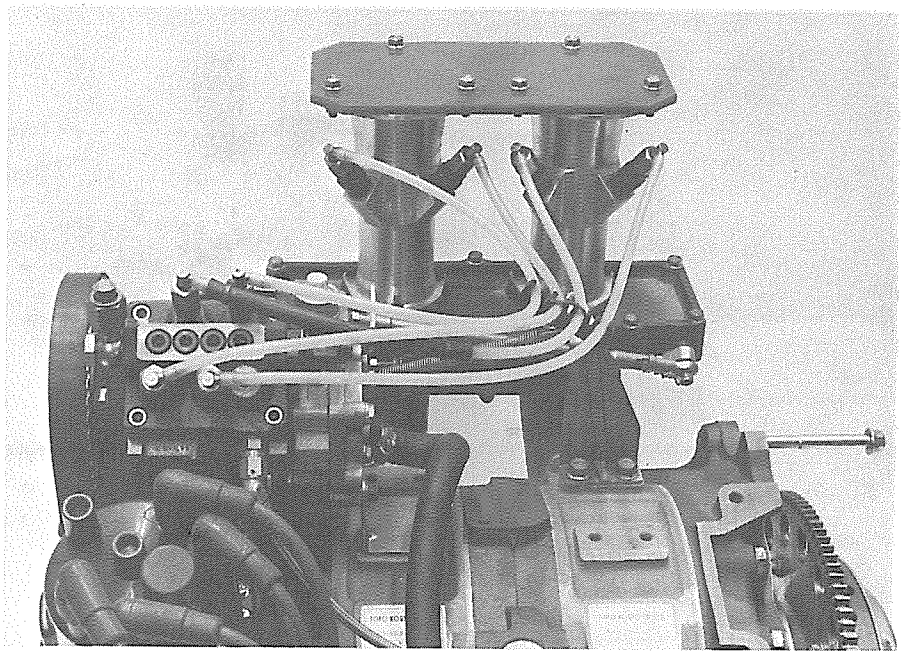
For maximum engine life, it is imperative that air be properly filtered before entering an engine. The dirtier the environment, the greater the need for filtration. Rallying qualifies as one of the dirtiest environments; off-roading is worse.

In addition to replacement elements for all stock air cleaners found on Mazda rotary engines, K&N also offers complete air-filter assemblies for Weber, Dellorto and Holley carbs. The big drawing card of the K&N element is its oil-wetted cotton-fabric filtration medium that has minimal airflow restriction along with excellent filtration characteristics. The elements are also washable, so they can be cleaned and reused.

Like other pleated element materials, the K&N fabric, with its reinforcing mesh, *quiets* the incoming air, but without the excessive restriction that characterizes standard paper elements.



Filtering fuel is one thing; filtering it without restricting flow is quite another. Bo Laws fuel filter was designed to handle requirements of 600+ horsepower NASCAR engines and will flow 750 gallons per hour.



Whether engine is carbureted or fuel injected, maintaining correct fuel pressure is vital to achieving top performance. Even though fuel-injection systems incorporate their own high-pressure pumps, they must receive an adequate supply of fuel if the injectors are to provide "full squirt."

Quieted air promotes a relatively smooth flow to the carburetor that aids in maintaining air/fuel-mixture consistency.

Although the standard formula for computing required filter area (Area = displacement X rpm/25,500) is relatively accurate with regard to piston engines, it comes up short when applied to rotary powerplants.

For optimum performance, install the largest diameter, tallest filter that will fit beneath the hood. The idea is to provide the greatest possible filter-element area, which is a function of diameter and height. Keep in mind that when you're seeking to increase area for maximum airflow, larger diameter is preferable to greater height. Filter area equals circumference multiplied by height, or $0.785 \times D^2 \times H$ where D is diameter and H is height, both in inches. Note that area is a function of the diameter squared; the height-to-area relationship is *linear*.

Fuel Filter—The same considerations that govern air-filter selection also apply to the fuel filter—specifically, proper filtration without excessive restriction.

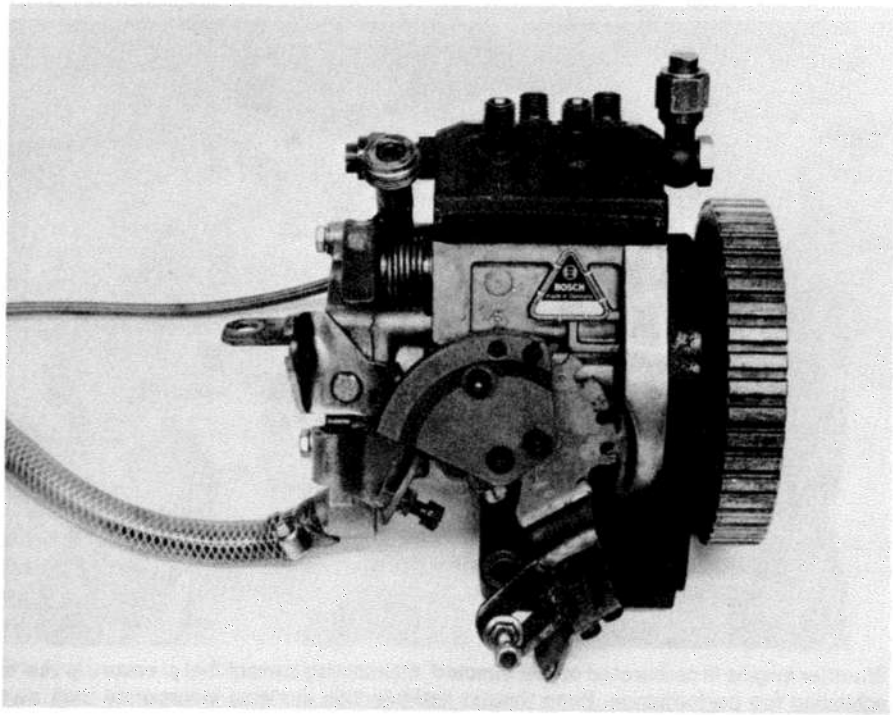
Several options are available. Any number of high-flow, inline filters (originally intended for large-displacement V8s) can be spliced into a rotary engine's fuel line, as can a Fram HPG-1 canister filter. The HPG-1 is routinely used on racing engines, so it obviously offers minimal restriction. Another racing filter that is suitable for high-performance use is the inline model by Bo Laws Automotive. Originally designed for NASCAR type oval-track racing, it employs a replaceable element that fits inside a 2-1/2-in.-diameter, 10-in.-long housing. The 7-micron filter element flow rating is 750 gallons of fuel per hour—more than enough for just about any automotive engine imaginable; rotary or reciprocating.

Obviously, the restriction represented by the fuel filter becomes more critical as an engine's power output increases. Mildly modified engines have considerably lower fuel-flow requirements than their race-oriented counterparts, so standard-type filters are usually acceptable. The drawback is that dirt accumulation can easily reduce flow capacity to below acceptable levels. It's therefore a much wiser decision to install a high-performance filter and eliminate a potential problem source.

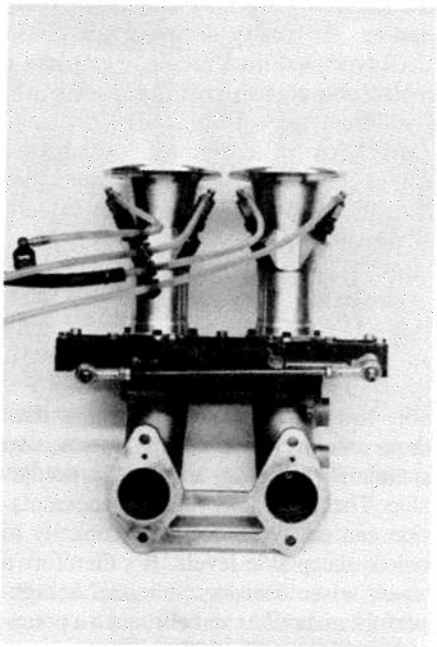
Low fuel pressure is one of the most commonly overlooked causes of alleged "carburetor problems." That's not quite correct—insufficient *fuel volume* is the cause. However, pressure is the common fuel-flow reference because it's easier to measure and it does affect volume; within a given system, volume increases as pressure is increased. But if the system is too small, volume will reach a point where it's insufficient regardless of pressure. Therefore, to guarantee adequate volume under virtually all operating conditions, a high-volume pump(s) must be used in conjunction with generously proportioned fuel lines.

On the Downing Camel Lights cars two RX-7 fuel pumps deliver fuel from the fuel cell through -6 (read *dash-six* for 6/16-in. ID) lines to a surge tank. Either a Walbro or Bosch high-pressure pump (30—35 psi) draws fuel from the surge tank and supplies it to the injectors—which require high-pressure fuel. Connected to the surge tank is an air-bleed line that leads back to the fuel cell. With this arrangement, air in the system is eliminated, fuel aeration is minimized and a pressure of approximately 4 psi is developed at the inlet side of the high-pressure pump.

Race cars equipped with carburetors run a similar fuel system with the major



To ensure an adequate fuel supply, high-pressure injector pump is connected to a surge tank. Fuel-injection pump is mechanically driven.



Mazda's fuel-injection system incorporates a slide-valve throttle arrangement that is housed in rectangular box positioned between injector stacks and intake manifold. At wide-open throttle, nothing is in the way of incoming air.

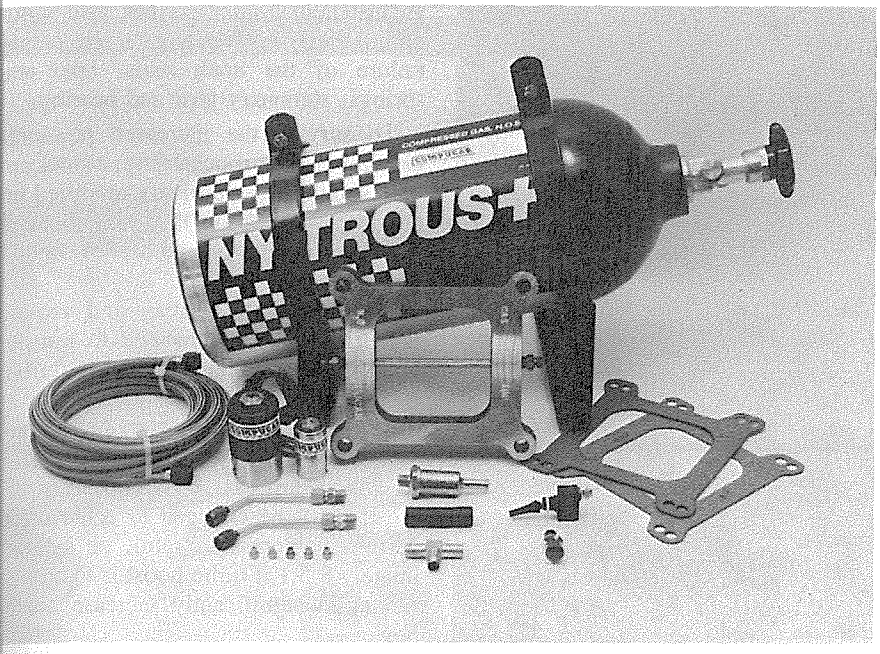
difference being a conventional low-pressure pump between the surge tank and carburetor. On a street-driven car, this type of system amounts to overkill; somewhat like connecting a fire hose to a drinking fountain. Most high-performance rotary engines will receive adequate fuel flow with -6 braided stainless or 5/16-in. hard steel fuel lines and either a Holley, Carter or two Facet electric fuel pumps. Fuel pressure should be adjusted to 4.5—5 psi with stock, Weber or Dellorto carburetors, and 5—6 psi with Holley four-barrel carbs. With stock carburetors, fuel pressure in excess of 4.5 psi tends to overpower the inlet needle valve, leading to erratic operation.

Developing adequate fuel pressure at idle is one thing; maintaining it at 6,000 rpm or more in high gear is quite another. While a slight drop in pressure is to be expected under maximum load, maximum-rpm operation, if it falls over 1/2 psi, either the pump is inadequate, or the fuel line or filter is overly restrictive. If the size and condition of all fuel-system components are acceptable, a kinked or tightly bent fuel line or undersized fittings may be the problem.

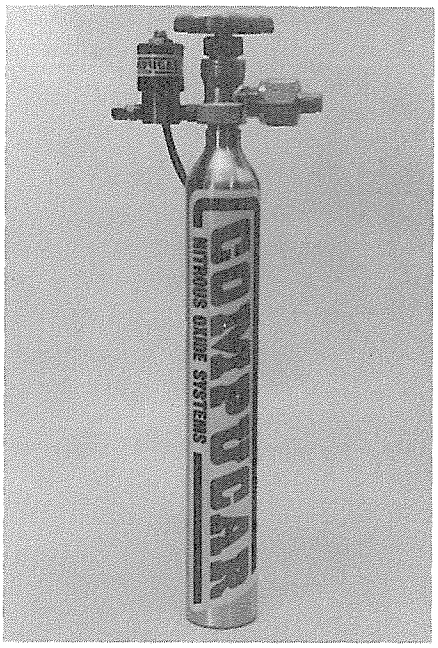
HORSEPOWER IN A BOTTLE

While jockeying with induction systems will provide definite power increases, the easiest method of kicking horsepower up the scale is through the use of a nitrous-oxide-injection system. A nitrous system is really nothing more than a chemical supercharger. In essence, nitrous oxide serves a very simple function—it force-feeds an engine with an additional quantity of oxygen.

Just as with a turbo or supercharger, nitrous oxide packs more oxygen into the combustion chambers so more power is produced when the air/fuel mixture is ignited. However, unlike a mechanical- or exhaust-driven supercharger, a nitrous system neither pushes nor pulls this additional oxygen through the induction system. Rather, it injects it directly into the intake manifold. Because of this, additional fuel must also be injected to keep the air/fuel ratio in the correct proportions, or about 14.7:1. Note also that as horsepower increases, the need to maintain the correct air/fuel and nitrous/fuel ratios becomes more critical.



Pushbutton horsepower—nitrous-oxide-injection systems are available for any rotary engine. When activated, they produce an immediate increase in horsepower. This system injects nitrous oxide between Holley carburetor and intake manifold.



Compucar's "Baby Bottle" is a cheater's delight. Supply tank measures a mere 13-in. long and 2-in. round, making it easy to conceal. Although such systems aren't designed to produce large power increases, they are useful in gaining an edge coming out of a corner or sprinting to the finish line. Of course, no Mazda racer would ever cheat.

When choosing a nitrous system, careful attention must be given to the solenoid valves that control nitrous and fuel flows. Solenoid construction is one of the major differences between high- and low-quality systems. Some nitrous companies use solenoids originally designed to handle carbon-dioxide (CO_2) in soft-drink vending machines. They're certainly cheap, but they're more prone to sticking than solenoids designed specifically for use with nitrous oxide.

Although nitrous oxide is most commonly thought of as a gas, when compressed, as it is in a storage tank at approximately 900 psi, it is actually in liquid form.

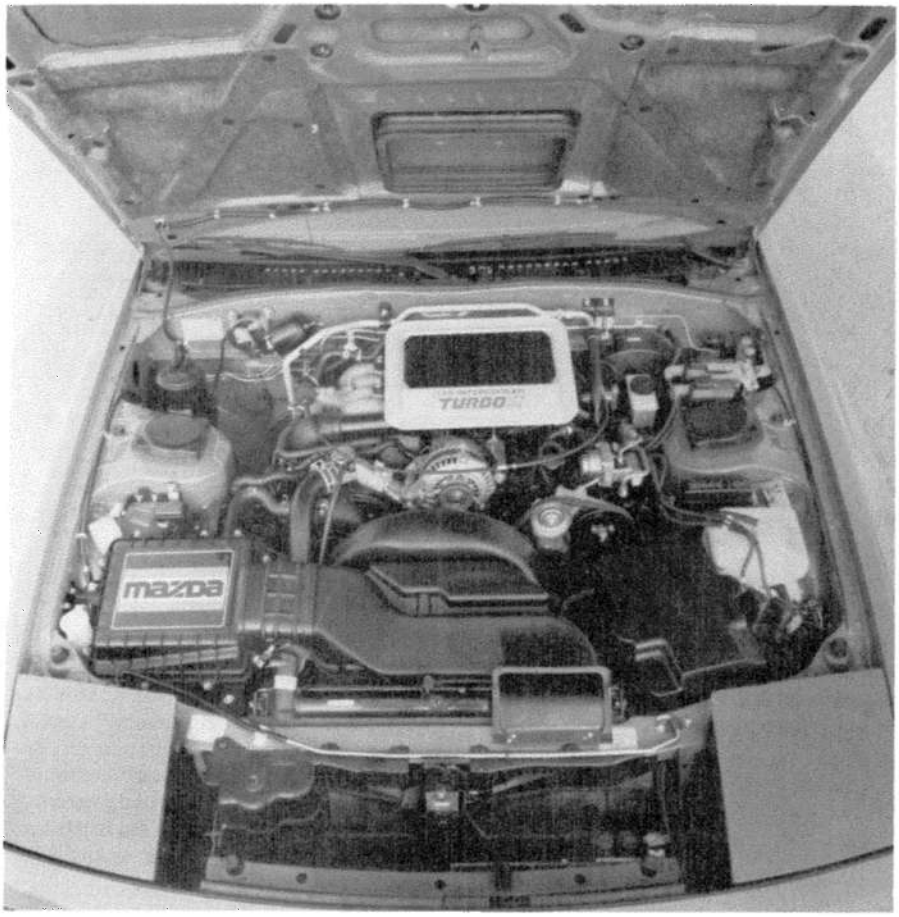
One of the keys to developing maximum power with any nitrous system is to keep the nitrous in a liquid state until it reaches the discharge nozzle. The reason for this is quite simple, but often overlooked. When nitrous vaporizes, it becomes extremely cold. (As part of the vaporization process, it actually "steals" heat from whatever is around it.) If vaporization takes place in the intake manifold, rather than within the lines or nozzles, the temperature of the incoming air and gas is lowered dramatically. That makes for a denser and, consequently, more powerful intake charge. Keeping the nitrous in liquid form all the way through the system also results in more consistent operation.

Nitrous-oxide systems are available for both carbureted and fuel-injected rotary engines.

TURBOCHARGING

The introduction of a Mazda factory turbo engine boosted output of the 13B to 182 HP at 6500 rpm, and 183 ft-lb of torque at 3500 rpm. It also laid to rest claims that a rotary powerplant couldn't be successfully turbocharged. But there's a tremendous difference between the factory system and those manufactured by aftermarket suppliers. Among other considerations, with the Mazda original-equipment system, the engine has been designed with turbocharging in mind. In addition, electronic engine controls are calibrated to precisely regulate ignition timing and fuel delivery.

The primary problem with aftermarket turbocharger systems is that when they



Mazda factory turbo system, introduced in 1986, is highly sophisticated—and for good reason. Turbocharging presents unique problems for rotary engines; precise engine-management control is a must to avoid engine damage.

are installed on stock engines, heat build-up is excessive. This leads to premature failure of the apex seals, apex-seal springs, stationary gear and bearings.

To survive the increased pressures brought on by turbocharging, a stock engine should be extensively modified internally. Understandably, these modifications channel a good deal of "boost" into the cost column.

Specifically, the oiling and cooling systems must be enhanced to transfer additional heat generated by the turbo. Mild porting is also virtually essential as it both increases airflow potential and reduces the amount of heat retained in the working chambers. Along with this, the rotors must be changed to achieve the desired compression ratio, or approximately 8.5:1 if turbo boost is to be sufficient to significantly increase horsepower.

Rather than attempting to go it alone with a turbo installation, contact a rotary-engine modification specialist like Racing Beat or a turbo specialist like CarTech for detailed information and guidelines. CarTech's RX-7 turbo package for 1986 and later 13B engines is rated at 238HP. The system features an intercooler and Garrett turbo.