Jetfire's power potential can be uncorked by...

SUPER TURBOCHARGING THE F-85

by Roger Huntington

IT SEEMS THAT OLDSMOBILE'S radical turbo-supercharged Jetfire sports compact has gotten a reputation for poor performance these last few months. Some of the road tests in the magazines weren't very encouraging. The September, 1962, issue of MOTOR TREND quoted a 0-60-mph time of 10.2 and standing quarter-mile in 18.7 seconds at 80 mph for the 1962 package. The conclusion was that this wasn't much of a performance increase over unblown for the money.

Lansing, Michigan, hop-up expert Dick Griffin agreed 100 per cent. But Dick has great faith in supercharged engines. He thinks they all have potential if you tune them properly. He demonstrated his ability to do the nursing two years ago when he built up a Paxton-supercharged '61 Corvair that turned ETs in the low 13s and up to 106 mph on the drag strip. Last fall he won the G/Stock trophy at the NHRA Nationals with a Corvair turbo Spyder, hitting 15.31 and 89 mph on his final run.

He considered the Jetfire just another challenge to be whipped. When the Demmer Tool & Die Company of Lansing offered to loan him their '63 four-speed for some performance experiments, he jumped at the chance. He's done another excellent hop-up job – and his results should clobber the idea that the Olds F-85 Jetfire won't go.

We've digested his various experiments into eight specific stages of tune, so you can follow the performance development. Dick ran complete acceleration checks on each major change (most of the quarter-mile times were taken on the drag strip), and he took a series of accelerometer readings in each case – from which we were able to calculate the true horsepower output at the clutch on a slide rule. In all cases Dick was alone in the car. The '63 four-speed Jetfire weighs 2880 pounds with a half-tank of gas, so the gross weight in these tests would be about 3050 pounds unless otherwise specified. The car had the standard 3.36-to-1 rear end gears, limited-slip differential, but non-standard 7.00 x 14 tires.

STAGE 1

This was with the car completely standard, just the way it came from the dealer showroom – and with about 300 miles on the odometer. As you can see, the 0-60 time was a modest 9.1 seconds, with an honest output at the clutch in high gear of about 155 hp at 3800 rpm.

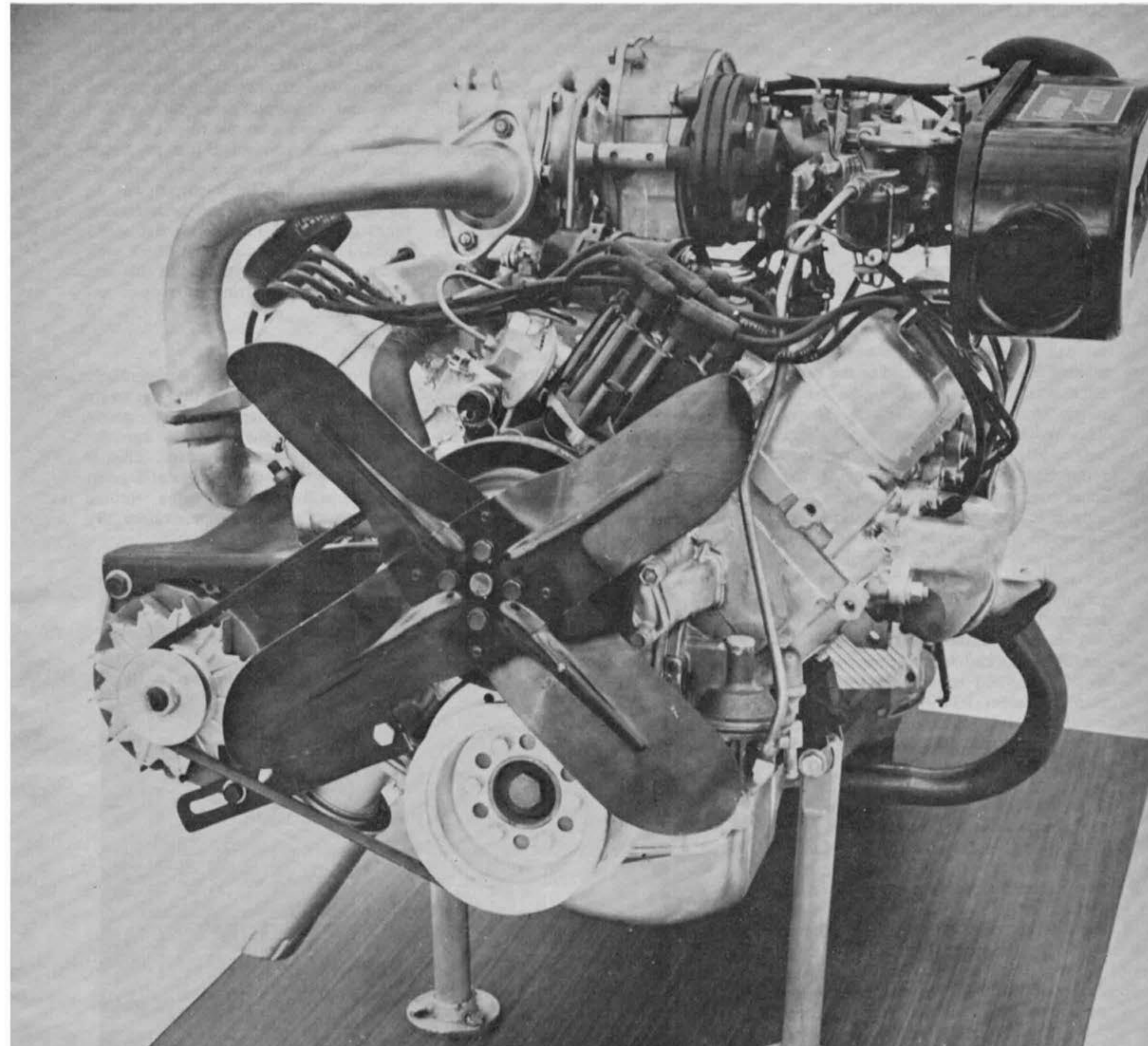
(RIGHT) *Dick Griffin, Michigan blower artist and drag enthusiast, put more punch in his '63 F-85 by modifying turbocharger.*

This agrees fairly well with the MOTOR TREND test figures on the '62, since the total weight on that test was considerably higher, and the Hydra-Matic transmission probably gave a bit less dig than the four-speed. This could also account for Griffin's better quarter-mile times of 17.0 seconds at 83 mph. On this test the maximum supercharger boost pressure of 5½ psi (read on a calibrated aircraft gauge) came at between 2200 and 2500 rpm – and this gradually fell off to about four pounds at 5000 rpm (because of increasing carburetor restriction).

STAGE 2

Oldsmobile engineers say these aluminum engines need a relatively long break-in before they reach peak performance. Apparently the harder material used for the cylinder sleeves doesn't bed in as quickly. Anyway, this engine certainly responded to an additional 2000 miles of highway driving – a lot of it "whipping" from 60 to 90 mph at full throttle in high gear, then backing down immediately. (This is similar to the break-in schedule used by Olds Engineering at the proving grounds.) At the same time, Dick broke the seal on the exhaust bypass diaphragm case (which voids the warranty), went inside and shimmed up the diaphragm spring so the bypass would "control" at 6½ pounds instead of 5½. This is the top limit of the boost tolerance specified in the Jetfire spec sheets.

Results were pretty impressive. Zero to 60 was down to 8.4, with quarter-mile ET well down in the 16s at 85 mph. The change also gained an honest 15 horses at the clutch, and put peak revs up from 3800 to 4000.



Stock Jetfire engine gets 215 hp at 4600 rpm. One of America's most efficient stock powerplants, it's lightweight, has plenty of potential to compete with big-bore V-8s.

STAGE 3

Olds engineers admit they made an ill-advised change on the 1963 Jetfire exhaust system that *hurt* performance as compared with the '62 setup. The main exhaust outlet tube from the turbine is 2¼ inches. Originally this tube flanged to a 2¼-inch tailpipe leading back to the muffler at the rear of the body. For '63, the diameter of this tailpipe was reduced to two inches to give more clearance for some chassis parts. Unfortunately, the spot where the duct diameter necked down at the flange created a substantial restriction. Just about the time Dick was running his initial experiments, Olds was switching back to the original 2¼-inch tailpipe on '63 production Jetfires (only a few of the early '63s have the small pipe).

Dick got one of the new tailpipes – and another five hp. The 0-60 time dropped into the sevens for the first time. Just to check the difference in exhaust restriction, he tapped a pressure gauge into the headpipe just down-

SUPER TURBOCHARGING

continued

stream of the turbine. At full throttle at 4500 rpm in high gear, the back pressure dropped from about seven to 5½ pounds. Most of the 5½ pounds, of course, was due to the standard reverse-flow muffler.

STAGE 4

Which suggested the next logical change: Set the car up strictly for the drag strip, and see what it could do in competition trim. The first move, of course, was to tap a "lakes" outlet into the exhaust duct below the turbine. By placing this at a slight bend in the pipe, Dick was able to give the gas flow a nearly straight shot to the atmosphere. This reduced back pressure to about half a psi. The weight of the car was reduced 80 pounds by removing the spare tire, front anti-roll bar, and running a low tank of gas. Traction was improved by going to 8.50 x 14 Atlas Bucron rear tires. Spark advance was set a couple of degrees ahead of the factory point, and the fan belt was loosened a little.

You can see the amazing results in the table. The clutch horsepower jumped to 205 at 4200 rpm, and Griff could turn consistent ETs on the drag strip around 15.4 at 91 mph. The improved traction dropped the vital 0-30-mph times from 3.1 to 2.7 seconds. (This was a key factor in the lower ET – though it had little effect on the five-mph increase in trap speed. That took brute horsepower, and the key factor here was getting rid of muffler restriction.) The manifold boost pressure, of course, stayed at 6½ pounds – since this is controlled through the exhaust bypass by the spring-loaded diaphragm.

Note: Dick stuck with the original 3.36 axle gears for these drag strip experiments. Undoubtedly the optional 3.90 or 4.10 gears would have been better with the big tires. But the Michigan drag season was just ending at this time, and car owners would have to drive the cars on the streets all winter; so it was decided to keep the standard gears until spring.

STAGE 5

This next move was inevitable, of course. He shut off the exhaust bypass system! The Jetfire turbo system has a diaphragm-operated poppet valve just upstream of the turbine that opens when the manifold boost pressure reaches about six pounds. This bypasses part of the exhaust gas *around* the turbine, and prevents the boost from going any higher at the top end. In fact, the boost actually drops off a little at higher speeds due to increasing restriction across the carburetor venturi. This deal permitted the engineers to design a small, highly responsive turbo unit that would give maximum boost as low as 2000-2200 rpm – with accompanying tremendous mid-range torque – without all the complications of overboosting at the top end.

But the significant fact is that the Olds-AiResearch turbo unit has a lot more potential than is being utilized in the stock setup.

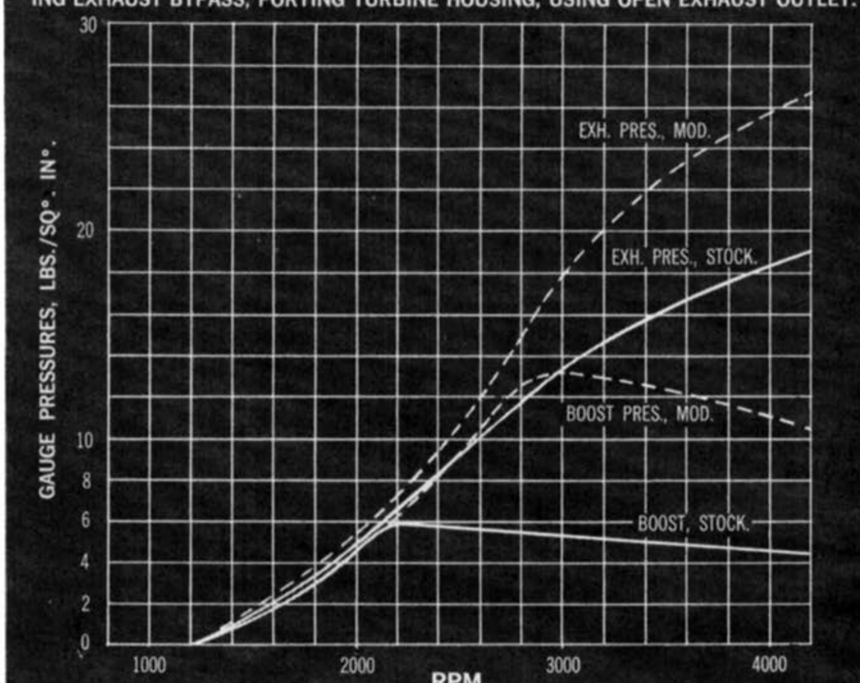
There are several ways you can easily block off the bypass system. Dick just wedged a wire clip in the plunger shaft leading from the diaphragm to the poppet valve, between the collar and dust sleeve. He could have drilled down through the sleeve and shaft, and pinned it. Or possibly blocked the pressure bleed holes from the manifold to the diaphragm casing.

Needless to say, the move did dramatic things for the blower pressure curve. The boost still reached the usual six pounds or so at 2200 rpm – but it kept right on going up with engine speed. Pressure peaked out about *11½ psi* at around 3000 rpm. At higher speeds the combination of increasing back pressure and carburetor restriction pulled the boost down a couple of pounds. But the net gain was some five psi boost from 3000 to 5000 rpm. And performance showed it. Clutch output was up 20 hp at 4400 rpm, and quarter-mile times jumped to 15 seconds flat at 95 mph. The car could turn 0-60 well down in the sixes anytime. But this was still in drag strip trim with open exhaust, etc.

STAGE 6

A conventional turbine is essentially a *heat* machine. The fact that the waste exhaust gas is at a temperature far above atmospheric means that it can be *expanded* to do useful work. This is because a given weight of gas at a given pressure will occupy a large volume when it's at a higher temperature. By

BEFORE-AND-AFTER CURVES FOR MANIFOLD PRESSURES, SHOWING EFFECT OF BLOCKING EXHAUST BYPASS, PORTING TURBINE HOUSING, USING OPEN EXHAUST OUTLET.



PERFORMANCE SUMMARY ON THE JETFIRE

STAGE	CONDITIONS	0-30 mph	0-60 mph	¼ mile E.T. and Speed	True H.P. At Clutch @ R.P.M.	Max. Boost Press. lbs./sq. in.
Stage 1	Showroom stock (300 mi.)	3.5	9.1	17.0 @ 83	155 @ 3800	5½ lbs.
Stage 2	Broken in (3000 mi.); up to factory specs	3.2	8.4	16.5 @ 85	170 @ 4000	6½
Stage 3	2¼-in. exhaust tailpipe (as '62)	3.1	7.9	16.3 @ 86	175 @ 4000	6½
Stage 4	Set up for strip (lakes outlet, loose fan belt, 80 lbs. out, 8.50 x 14 Bucrons)	2.7	7.1	15.4 @ 91	205 @ 4200	6½
Stage 5	Exhaust bypass blocked off	2.6	6.4	15.0 @ 95	225 @ 4400	11½
Stage 6	Insulated crossover pipe	2.5	6.3	14.9 @ 96	230 @ 4400	13
Stage 7	Turbine nozzle width increased 3/16 inch	2.5	6.1	14.8 @ 97	235 @ 4400	13½
Stage 8	As above, but set up for street (muffler, spare tire, half tank, etc.)	2.9	7.4	15.6 @ 89	200 @ 4000	10

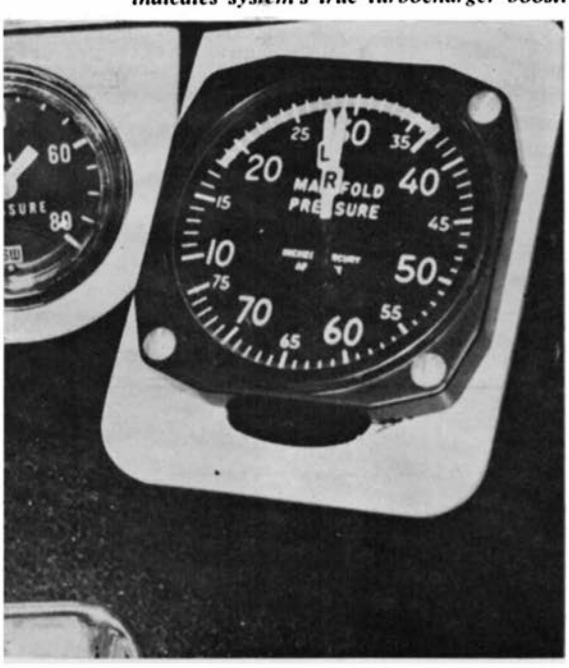
the same token, it's obvious that the higher the exhaust gas temperature at the turbine inlet, the more work we can get out of it. Theoretically a drop in gas temperature from, say, 1500° F. to 1000° would reduce the potential work by 26 per cent.

Griff felt he was getting considerable heat loss in the crossover tube leading from the left bank exhaust manifold to the right. This is right in the air stream under the car, and would get a lot of cooling even at low speeds. So it was a simple matter to wrap this tube with several layers of asbestos cloth, covered with aluminum foil to reduce heat radiation, and wired up to hold it firm. Dick had had excellent results by wrapping his Corvair Spyder exhaust.

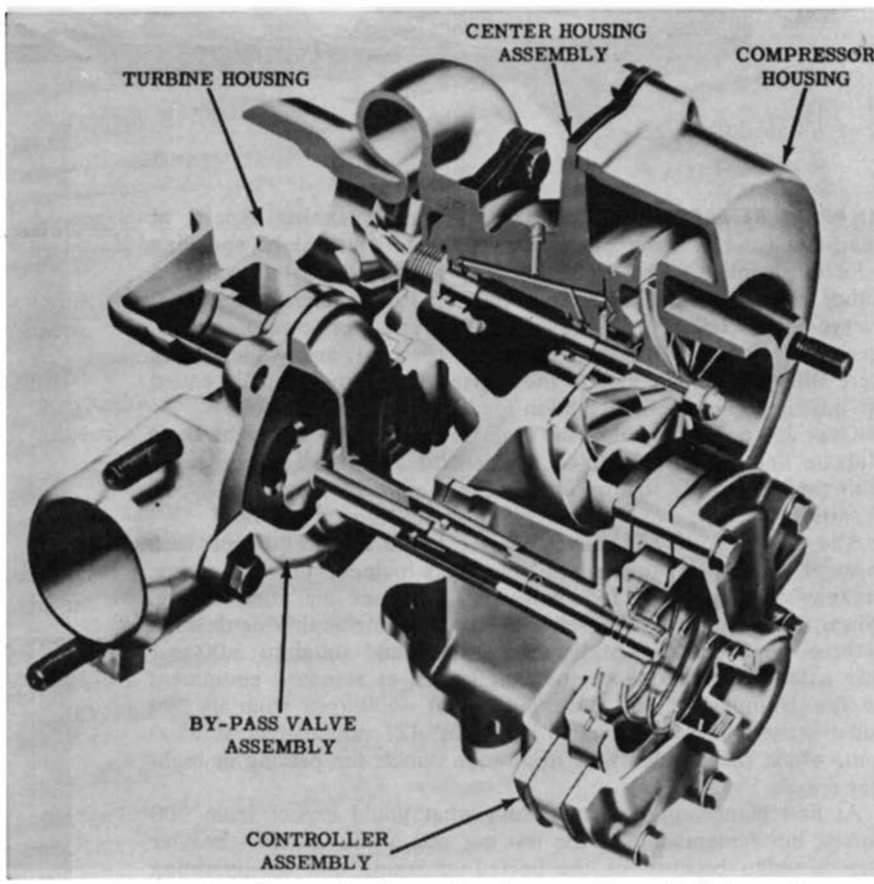
Results weren't quite so impressive on the Jetfire — but this change was certainly more than worth the bother. Maximum blower pressure jumped 1½ pounds (to 13 psi), horsepower went to 230, and quarter-mile ETs dropped into the 14s at 96 mph. Any owner of a turbo-supercharger should seriously consider this simple wrapping process, either for the street or drag strip.

You can easily see the effect of exhaust temperature by dragging the brakes and lugging the engine at more or less constant speed for a few seconds. The boost will gradually come up as the exhaust ducting warms up. Or if you're hauling a trailer or climbing a long grade with a turbo under heavy load, you'll note that you have a considerably higher "standby" pressure when you mash the throttle. This is nothing more than the temperature of the exhaust ducts inside the engine compartment. *continued on page 88*

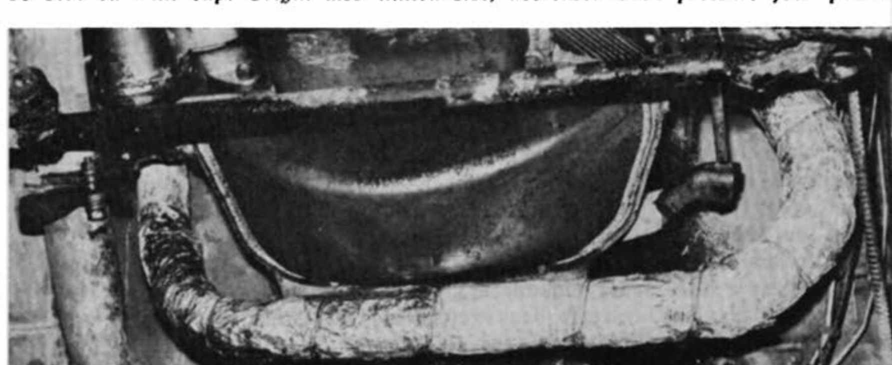
***(BELOW)** Manifold pressure gauge, taken from airplane, has two hands. One tells pressure at intake manifold, the other taps between carb and blower. Difference indicates system's true turbocharger boost.*



Griffin's Jetfire has gauges to show pressure between the carburetor and the blower.



Cutaway shows spring that can be shimmed to increase "controlled" boost. Bypass can be blocked with clip. Griffin also milled slot, decreased back pressure four pounds.



Lakes outlets and tin-foil-wrapped crossover pipe are relatively simple alterations.

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STAGE 7

We mentioned that a turbine is a heat machine. It's also a *pressure* machine. That is, the hot gas has to be jetted through a nozzle of some sort to increase its velocity enough to efficiently drive the turbine blades at rotational speeds up to 110,000 rpm. (The Jetfire turbo is normally limited to 90,000 rpm; but when you block the bypass, the extra exhaust gas pushes the speed up further.) Anyway, a nozzle can only increase velocity if there's *pressure expansion* across it. In the case of the Jetfire turbo, the annular slot between the spiral volute housing and the turbine itself is curved to form a continuous nozzle that jets the gas onto the turbine blades. In effect, it creates a high restriction to the exhaust flow and, in so doing, gives a broad expansion to atmospheric pressure at the turbine outlet.

These turbine inlet pressures are probably higher than you think. The Jetfire turbo was designed to give most efficient operation in the mid-speed range, around 3000 rpm. At this point, with the stock setup, blower boost pressure is around 5½ or six psi — and the turbine back pressure is up to *13 psi.* And it goes up from here. At 4500 rpm it's 20 pounds.

Furthermore, when you block the exhaust bypass, you get that much more exhaust flow — and that much more back pressure. Even with open exhaust (no appreciable muffler restriction), Griffin's gauges showed an exhaust pressure of 30-32 psi at 4500 rpm with the blocked bypass!

Obviously, this is a lot of pressure for the pistons to push against on the exhaust stroke. Not only does it subtract horsepower in the form of a pumping loss, but having a much higher pressure in the exhaust manifold than in the intake prevents efficient scavenging of the burned exhaust gases at the beginning of the intake stroke. A lot of this gas stays in the cylinder, and this reduces power by cutting the amount of fresh fuel/air mixture burned. The overall result is that the horsepower nose-dives on the Jetfire engine above about 4500 rpm. It's as though you turned off a faucet. It takes ages to go from 4500 to 5200 rpm in third gear. This is why gearing and shift points should be selected to keep well under 5000 at all times. The engine just won't haul up in the high ranges.

Dick thought maybe he could reduce this top-end back pressure by increasing the effective nozzle area in the turbine

continued

housing. The width of the nozzle slot in the stock housing is a quarter-inch. The Demmer machinists chucked up the housing and cut out another 3/16-inch. This helped some, but not so much as expected. Exhaust pressure at 4500 rpm dropped about four pounds (to 27-28 psi), and blower pressure crept up another half-pound. Maximum engine output went to 235 hp at 4400 rpm, and Dick got his best strip times in this trim, at around 14.8 ET and 97 mph. The 0-60 dropped to the low sixes. Another junk turbine housing was chopped up even more (including opening up the outlet duct), but there didn't seem to be much more to be gained here. Much of the back pressure builds up right in the turbine wheel itself. Also, any decrease of flow restriction hurts the torque and response at low speeds.

Note that this Stage 7 performance is extremely competitive in its class on the drag strip. With the factory shipping weight of 2774 pounds and advertised horsepower of 215, the '63 Jetfire would fall in the new NHRA F/Stock class (equivalent to the old D/S class). This class was won at last fall's NHRA Nationals at Indianapolis by Dennis Maurer in a '58 Chevrolet at 15.01 ET and 93.95 mph. Griffin's Jetfire should be competitive in this performance class. The car is presumably entirely legal. The NHRA stock rules permit free modification of the exhaust system — which is all Griffin has done. Whether they would consider widening the turbine nozzle slot as "porting" is debatable. The tech crews never check regulated blower pressure on supercharged models. Those Paxton-blown '57 Ford powerpacks get away with murder! So we assume all the changes listed here are legal for the stock classes at the drag strip.

STAGE 8

To cap the project, Griffin ran some performance checks with the car in street trim — lakes outlet capped, half-tank of gas, spare tire in, etc — just to see how much "bread-and-butter" performance he'd gained. The tables show it: He dropped 35 hp by adding the muffler restriction, lost 3½ pounds of boost. But he still gets a very creditable 0-60 time of 7.4 and quarter-mile times of 15.6 ET at 89 mph. That will handle the situation on most streets these days! And he still has good low-speed torque and response, smooth idle, good mid-range torque (much better than before), and the car is very smooth and quiet in normal driving. **/MT**