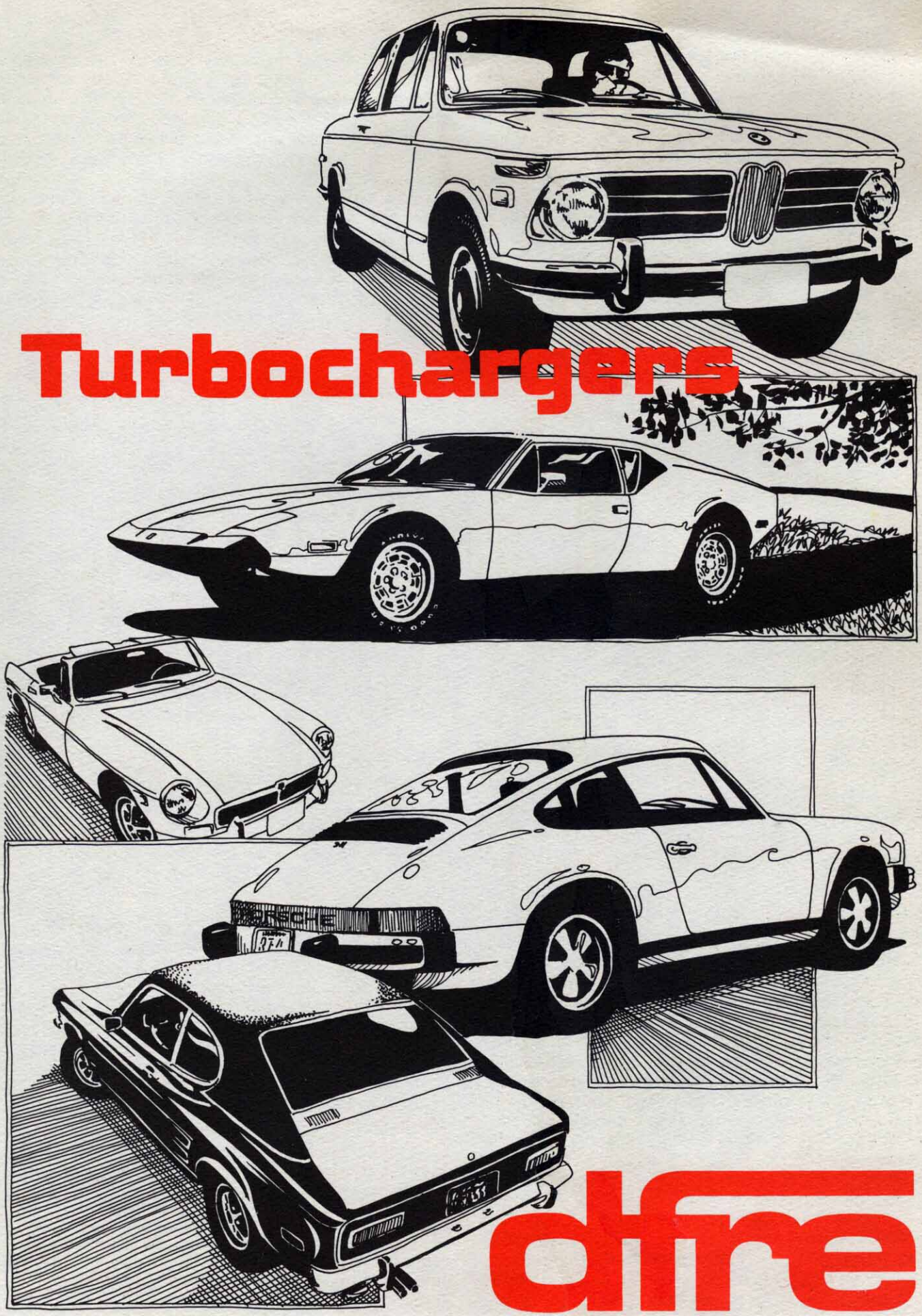
Turbochargers



dfre

WE HAVE SEEN THE FUTURE AND IT'S TURBOCHARGED

DFRE has been building engines for the street and track since 1968 and we've had our share of winners. Our experience along the way has given us a pretty clear understanding of the performance increases that can be expected of conventional engine modifications. Frankly, turbocharging is a better way to go. The only exception is racing classes where rules may prohibit it or factor it unfavorably. For the street, only a turbo can increase power more than 100 per cent yet retain the driveability, economy and silence of a stock engine for those times when you're not in a hurry. And the price is comparable to a modified engine with the same output. We've seen the future and it's definitely turbocharged.

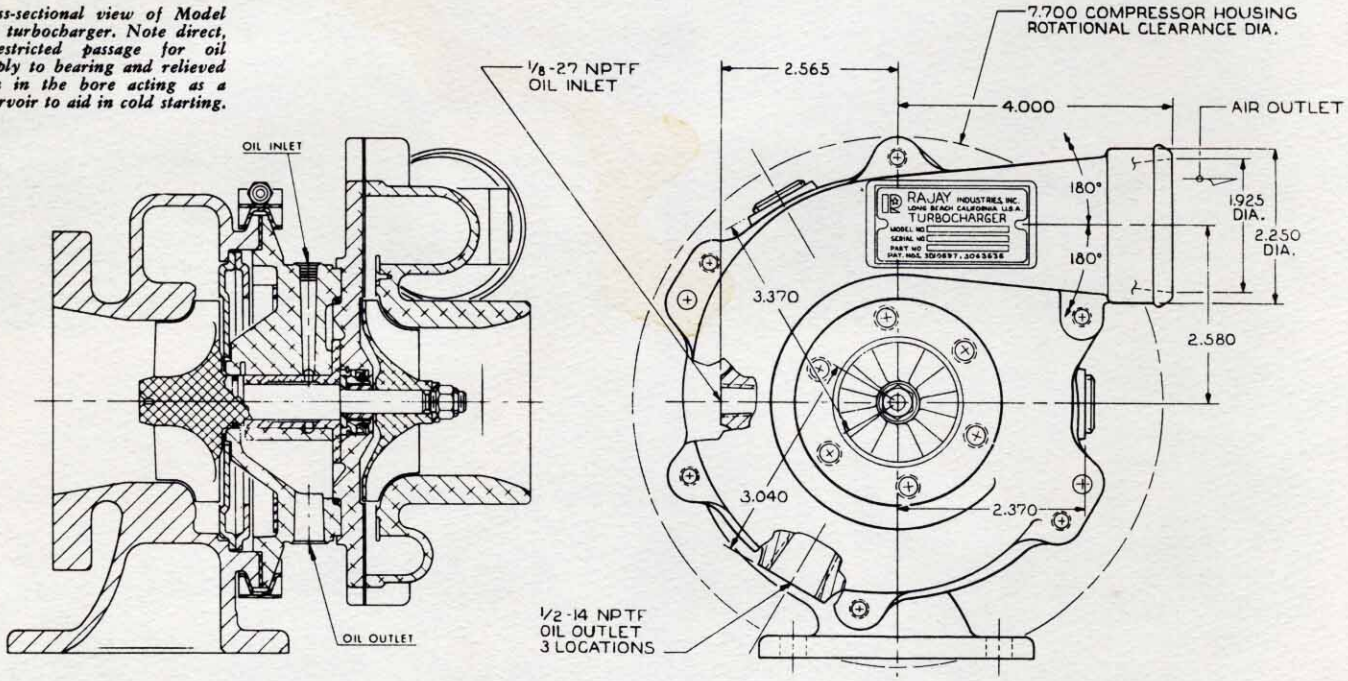
Because we believe in turbos, we've invested a substantial sum to become the eastern distributor for Rajay, the finest turbocharger on the market. We also build bolt-on kits for popular cars and can supply you with adapters, gauges, gaskets and various other components should you decide to make your own installation.

Just as important, we provide personal service. The turbocharger business is booming and we could easily become a big systems house. But we refuse to go that route. We are already big enough to satisfy all your needs; we want to stay small enough so that your problems and inquiries don't get lost in the office shuffle. So, whether you need a turbo or just some advice, give us a call. We've got both.

Doug Fraser

Doug Fraser, *President*

Cross-sectional view of Model 301 turbocharger. Note direct, unrestricted passage for oil supply to bearing and relieved area in the bore acting as a reservoir to aid in cold starting.



RAJAY BUILDS SUPERIOR TURBOCHARGERS

All turbos operate according to the same principles of physics and all have comparable efficiency. But Rajay has a number of unique design features that make it the best choice for automotive use.

1. Rajay turbochargers have an extremely effective seal behind the compressor impeller. This seal is absolutely necessary for installations that draw through the carburetor, which is the recommended set-up. Otherwise, manifold vacuum in the compressor under part-throttle operation will draw lubricating oil into the intake charge. Switzer turbochargers do not have this seal.
2. Rajay Turbochargers are very compact. Careful engineering of the bearing housing between the intake and exhaust turbines has allowed the overall length of Rajay turbos to be substantially shorter than those from AiResearch. This can make the difference between go and no-go in crowded engine compartments.
3. Rajay turbochargers are now available with the new 301 bearing housing which can be rotated to put the oil drain on the bottom, regardless of the position in which the turbo is mounted. This makes the Rajay readily adaptable to almost any engine compartment.
4. Rajay turbochargers are simple and easy to service. The model 301 turbo can be completely disassembled with only a 3/8" and 7/16" end wrench and a 5/32" Allen. The advantages of this simplicity is passed on to you in the form of lower prices.

So before you buy, take a close look at the competition. We're sure you'll choose Rajay.

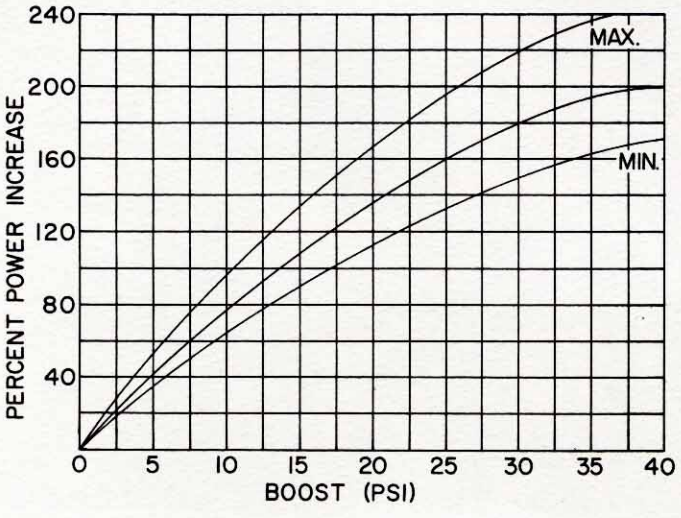
TURBOCHARGERS ARE THE MOST EFFICIENT TYPE OF SUPERCHARGERS

Any internal combustion engine, either spark ignition or diesel, can be supercharged. The principles are the same for all. By compressing the intake charge, more fuel and air can be inducted into the cylinders. Therefore more power will be produced.

A turbo is the most efficient method of supercharging for a number of reasons. First, the device itself is compact and light; it can be adapted to almost any engine compartment with minimum modifications. Second, the turbo uses energy in the exhaust gases that would normally be wasted to drive the compressor. Mechanically driven blowers draw their power from the crankshaft. With a turbo, the engine power increase due to supercharging is available at the flywheel to do useful work. Finally, because a turbo is fed by exhaust gas, it is inherently sensitive to engine load. At light-throttle operation it coasts, allowing the engine to operate economically and without added strain. When more power is necessary, opening the throttle increases the flow of exhaust gases which, in turn, speeds up the turbine to boost the intake. All of this takes place automatically, without belt drives or mechanical linkages to go wrong. Consequently, turbochargers deliver more power with fewer problems than any other type of supercharging.

WHAT YOU SHOULD EXPECT FROM TURBOCHARGING

The power increase from turbocharging depends almost entirely upon manifold pressure. A boost level of 15 psi over atmospheric will approximately double horsepower, as you can see in the accompanying graph. But even more important for street use is the improvement in torque. Conventional engine modifications (carburetion, camshafts, etc.) tend to sacrifice torque in the low and medium speed ranges to gain at the high end. Turbochargers increase torque over the entire speed range. Not only does this give the engine greater flexibility but it has important implications for durability. The high engine speeds necessary with conventional performance modifications greatly increase the inertia loading on the bearings, crankshaft, connecting rods and pistons. These inertial loads are far more damaging than the gas pressure forces associated with turbocharging. And since turbocharged engines develop much more power in the normal speed range, there is no need to operate them at high revs. Therefore turbocharged engines tend to be more durable than normally aspirated engines of the same power output, provided there is no detonation.

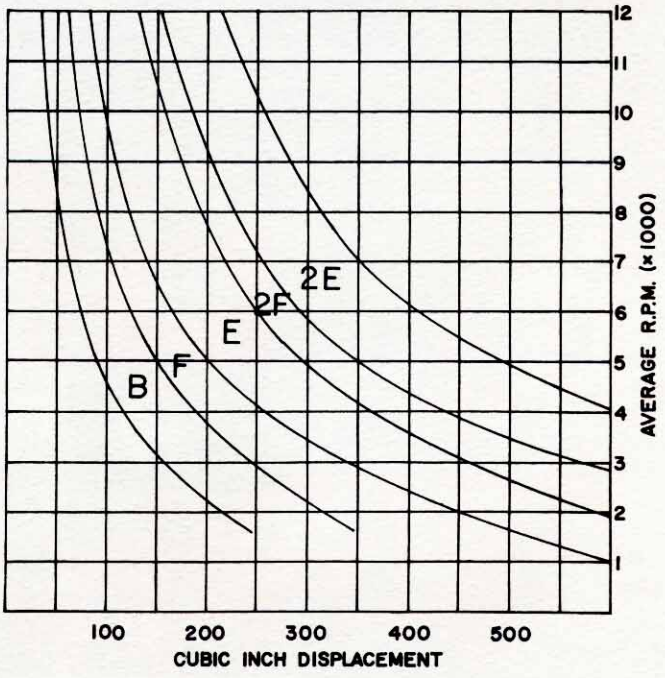


A properly designed turbo installation can also have a beneficial effect on economy in normal driving. A basic source of engine inefficiency is the power lost in pumping the intake charge past a nearly closed throttle. A turbocharger takes over a part of this pumping job using power from the exhaust, thereby reducing the load on the engine. Less than optimum distribution can also be improved by the mixing action of the compressor. The net results can be substantial. *CAR AND DRIVER,* in a test of its turbocharged Opel 1900, reported an improvement of 3.5 mpg in the EPA driving cycle. The exhaust emissions of this car, a 1972 model, were also improved over their original level.

By far the most important point to be made about turbocharging is that you can enjoy its advantages—more power under load, better economy in normal driving—while retaining good driveability. If the installation is done correctly, the engine will start and respond as well as it did when stock. The only time you'll feel the difference is when you step on the gas.

A GOOD INSTALLATION BEGINS WITH THE RIGHT TURBOCHARGER

Rajay turbochargers come in three basic sizes. All have approximately the same external appearance and dimensions; they will fit into a 7¾" cube and weigh about 14 pounds. The difference is a matter of flow capacity: the "B" Flow model is usually recommended for engines displacing 90-145 cubic inches; "F" Flow for 145-180 cubic inches; "E" Flow for 180-310 cubic inches and up to 500 cubic inches with two turbos. There is some latitude in this, depending upon engine design. High speed motorcycle engines as small as 30 cubic inches have been successfully turbocharged with the "B" Flow.



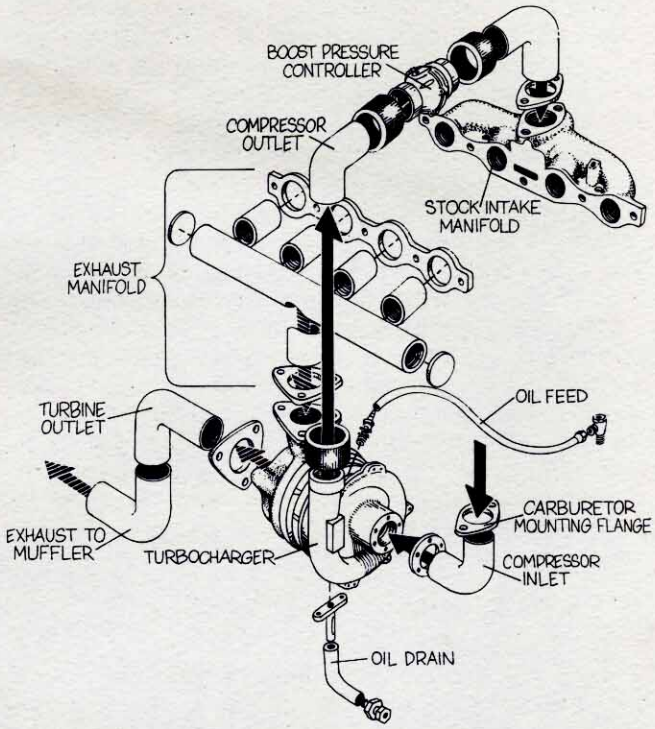
Selecting the proper size turbocharger depends upon two things; displacement of the engine and the desired boost. While it is true that more boost makes more power, there are limits that should not be exceeded in the interest of reliability. Generally, we feel that engines with compression ratios of 9.0-to-one or less may safely use 5-7 psi of boost. Pressures may be increased to 10-12 psi with 7.0-to-one compression and as high as 15-18 psi if water injection is used. For pressures much over 12 psi, however, most engines need to be rebuilt with O-ringed heads, forged pistons, high-strength rings and special valve springs.

Once the basic turbocharger size is established, the final tailoring of boost level must be done on the car. This can be accomplished by adjusting intake and exhaust restriction, using turbine housings of different A/R ratio, fitting a boost pressure control valve or some combination of all of these. The job is not difficult and we will be happy to assist you when you reach this point.

TURBOCHARGERS FIT ALL ENGINES

Any engine from an air-cooled VW right up to a big-block Detroit V-8 can be turbocharged. For popular models, we have our own DFRE-engineered kits. They come with everything you need and can be bolted on in a weekend if you have reasonable skills and access to a good toolbox. Or you can make your own installation. We can supply tubing bends, flanges, fittings, high-pressure hoses, oil lines; everything it takes to make the job easy.

If you are planning your own installation, we can offer a few recommendations. Most important, we think, is that you draw through the carburetor. It is possible to blow through but carburetors were designed to operate at atmospheric pressure and it's best if you leave them that way. You should also keep the exhaust and intake passages from the head to the turbocharger as short as posible to minimize turbo lag. In cold climates, it may be necessary to add manifold heat for quick warm-ups and good driveability. A combination of heated intake air, as used on all emission-controlled cars, and a water-heated intake manifold next to the carburetor assures good results. Also, don't take short cuts with the oiling system. The turbo is lubricated by a pressure line from the engine's main oil gallery. The oil then drains by gravity into the engine's pan. To allow adequate drainage, the line to the pan should be at least 5/8" I.D. and have no sharp bends. Finally, don't be tempted to drive your newly turbocharged vehicle until every part of the system, from the air cleaner to the muffler, is in place. Just the lack of an air cleaner can greatly increase boost and countless engines have been damaged in the euphoria of the first-time-around-the-block test for just that reason.



If you are interested in reading more about turbochargers, we have suggestions for that too. The November, 1975 issue of *CAR AND DRIVER* (available from *CAR AND DRIVER,* One Park Avenue, New York, N.Y. 10016) has an excellent article on the basics of turbocharging. More indepth information can be found in the book *"How to Select and Install Turbochargers"* by Hugh MacInnes, available from us.