

1987 VW 16 VALVE TURBOCHARGER DESIGN PHILOSOPHY

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This project for VW is the third generation of systems for the water-cooled platform. Our first attempts were for the early Rabbit style. It incorporated the same basic engine as today but with a different configuration. We had the intercooler mounted far from the engine with a great deal of extra plumbing. A big Rotomaster turbo was used in this application with a cast iron manifold and our microfueeler system. The cars ran very well but generated their power at a very high engine RPM and had poor low-end response. They were the classic "rubber band" kind of turbo cars. They were exciting to drive. No accurate dyno runs were made with this particular combination, but early on testing was done, and 250 hp had been obtained with a specially prepared engine. This was obtained, however, with big valve heads, with a VERY large turbo with poor response, a big intercooler, and a large microfueeler nozzle. Many other minor changes were made in the search for additional power including high boost.

The second generation we worked on was based on an IHI turbo, which is a much smaller turbo with good response. It has, however, high backpressure, which limits top end power. It is a "low end" kind of turbo. We started using this particular turbo at a time when people were unsatisfied with the response of a turbo engine. We felt that the correct move was for a smaller turbo with good response in the low end, which would ultimately augment the torque and horsepower curves as low as possible in the RPM range. In this application we were not as concerned with the top end power as much as its overall versatility. This was done in the 1985 and 1986 model GTI autos based on the Golf platform. Because of other restraints we decided to place the intercooler as close to the engine as possible. This helps performance considerably in the area of response, it eliminated a lot of plumbing, and it made the kit less complicated. The only hassle to the kit buyer was the fact that he needed to put a hood scoop on the car in order to get air to move across the intercooler. Negative points of the earlier systems included the need to have a great deal of plumbing.

We then decided to rethink our successful configuration to advance to the next step in turbocharger evolution for the Volkswagen. The IHI turbos offered great response on the low end, but it was thought that this was a limiting factor in creating additional top end performance. Did this new 16 valve technology mean that we could increase the turbo size and get better top end response while retaining excellent mid range performance? Rotomaster felt that they had a turbo, which would meet our requirements.

Another area of concern was the oil drain location, which we have used, in past kits. A return hole was drilled into the base of the cylinder block between the number three and four journals and fitted with a special 45° fitting in order to accept an oil return fitting from the turbo. A continuous downhill slope of no less than 15° was necessary in order to prevent a lack of return oil feeding in all conditions. In this configuration the turbo was mounted very low in the chassis, which required pounding holes in the firewall due to its

proximity. A brake line had to be rerouted, the exhaust had to be modified considerably, and the casting from the turbo to the exhaust could have been a better piece. This configuration forced the kit buyer to do fabrication work at difficult angles and in very difficult locations. Many drive train parts had to be removed in order to install the kit. Most of the installation had to be performed from underneath the car.

The design philosophy behind the phase three-turbo installation was many fold. Of great concern was the desire to achieve a respectable amount of power. With the advent of the new 16 valve cylinder head Volkswagen offered a new means to achieve these goals. We honestly felt that we could top the 200 hp level with little difficulty using a catalytic converter and in production trim. As design engineer in this project I felt that we should address some of the problem areas, which have appeared in the past. Initial calculations were made to verify what was needed; then I tried to think about what was needed by the kit installer to make his job easier without sacrificing system integrity.

It was decided to change the oil drain to a more favorable position. The turbocharger was mounted in a position where it was high enough to drain back to a different location. It was then decided to drain back to the now unused distributor hole in the cylinder block. This solved a big problem about getting under the engine to drill a hole for the drain-back fitting. The existing downpipe was also going to be used in this application rather than fabricating a new piece. This is a beautiful articulated joint with a dual downpipe and excellent six bolt flange. Why add to the expense of the kit when the factory has already done an excellent design for this piece of hardware. For 1987 parts are made of stainless steel, and VW systems have never been a problem and have been low in backpressure.

The next problem was designing the intercooler so that there was not a lot of plumbing for the sake of response as well as complexity with a special consideration made for inlet charge cooling. In the end the package needs to fit under the hood. The integrated intercooler setup was a logical choice. It provides a position close to the engine for the sake of response, and it looks great!!! We can run a hood scoop in order to direct air to the intercooler location to solve that problem.

All other design considerations were made involving the plumbing of critical components. This job was tackled as an integrated package because the changing of one component creates a problem with another. Although it was difficult to envision considerations were attempted to climate any problems with air-conditioned cars even though our engineering auto had no provisions for this option. The final decision for location of the major components was made due to the physical restraints in the package with as few compromises as possible. The cruise control solenoid was the only possible problem area with our current system.

Calculations were done on the normally aspirated compression ratio. We know from experience that a ratio of 8:1 works well in turbo use in order to run 10 to 15 psi of boost with 92 to 93 octane fuel without incurring detonation. We used a 0.030" copper spacer between two head gaskets, which is a combination that we have used successfully in the past.

One of the nicer design features of the system is the fact that you no longer need to remove the CV joints from the car as well as the exhaust system in order to mount the assembly. The only thing which is required to do from beneath the car is tighten the six stainless nuts that hold the downpipe to the turbine outlet casting. All of the rest of the installation can be done from the top of the car which is a real triumph because it makes the kit much more affordable due to the decrease in complexity and simplicity of design. We have used proven design features, which we have used on other vehicles and a product of knowledge we have generated from years of experience with turbo systems. The basic integrity of the system is a proven one.