



# Supercharging 101

By Benjamin Hunting

Photos courtesy of [chsuperchargers.com](http://chsuperchargers.com), [whipple.com](http://whipple.com), [holley.com](http://holley.com)

Supercharging is a common power-adder in the hot rod world, and many builders make use of this type of forced induction to help squeeze even more output out of their engines. To the uninitiated, the world of superchargers or blowers as they are sometimes called can seem somewhat confusing. This guide should help to get you up and running in terms of understanding blower basics, including what different types of superchargers are out there on the market and a rough idea of what the cost of a typical supercharger installation might run.

A key thing to understand about any internal combustion engine, no matter how many cylinders it might have, is that it is essentially one giant air pump. The more oxygen that you can introduce into the engine, the more fuel you can burn and the more power you can produce. One of the most effective ways to increase the amount of air entering an engine is to compress it. By

compressing air, you are able to pack more oxygen per square inch, which in turn allows for more efficient power generation than simply sucking in air at standard atmospheric pressure. This oxygen-charged air is referred to as boost, and it is measured in pounds per square inch, or psi.

Compressing air is what all superchargers do. That being said, not all superchargers compress air using quite the same technique.

There are three basic designs that are used by most blower manufacturers, with each taking a somewhat different path towards introducing a healthy dose of boost into an engine's intake. Although all three of these

blower designs are driven by a belt

running off of the engine itself, their power delivery, air compression techniques and engineering are quite different.

Most hot rod fans will be familiar with

the Roots-style superchargers that have been a part of custom car culture since the very beginning. If you have ever seen a great big blower sticking out of a dragster's hood, then you know what a Roots-style supercharger looks like. Also known as a fixed-displacement blower, these units which trap a fixed amount of air between spinning rotors or lobes, forcing that air forward into the intake. Since the design of a Roots blower does not allow air to flow back along the path it came through, the air compresses inside the intake itself.

Roots superchargers are beloved by drag racers since they can create a ton of boost right off the line, which translates into explosive launching power. There's no question that a Roots blower has a lot to offer in terms of power, but there are some tradeoffs to be made. The design of a Roots unit means that it usually has to be installed on top of an engine, which can lead to clearance and fitment issues — the primary reason why so many serious drag cars feature hood cutouts to accommodate their superchargers. Side-mount Roots kits are available, but they require a serious amount of free space in the engine bay for installation. Roots blowers are also not all that efficient, which means that they generate a serious amount of heat as their rotors spin compared

to other supercharger designs.

A variation on the Roots blower concept is the twin-screw supercharger (below). Twin-screw units also usually mount on top of an engine, but they are much smaller in size than a typical Roots unit capable of producing the same amount of boost. This is because the two-lobe design rotating inside a twin-screw supercharger is as much as 30 percent more efficient than a comparable Roots blower. These rotating lobes trap air between them and compress it directly inside the supercharger casing, expelling the charged air into the vehicle's intake.

The third type of blower found on the high performance hot rod market is the centrifugal supercharger. Centrifugal units also compress air inside the casing, only instead of using rotating lobes like a twin-screw design they use an impeller that spins extremely fast, accelerating the air into the blower's scroll where compression occurs. Another important difference between centrifugal blowers and their Roots and twin-screw cousins is that centrifugal units are not fixed-displacement designs. This means that the amount of boost being provided by the supercharger can vary widely depending on the engine speed. The faster the engine turns, the faster the impeller in the cen-



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trifugal blower can spin, which translates into more boost. In a sense, centrifugal superchargers share a lot in common with turbochargers, only instead of being driven by exhaust gases they maintain the belt-drive setup of a traditional blower.

How much will installing a blower cost you? Like most projects, the final tally will depend on the vehicle you are boosting and how much power you want to make. Centrifugal units are usually the cheapest, starting at around \$2,400 for a complete kit from a company like Vortech. Roots kits are typically a little bit pricier, with costs in the neighborhood of \$5,500 - \$8,000 for the least expensive models, while twin-screw units often fall somewhere in between for a starter kit.

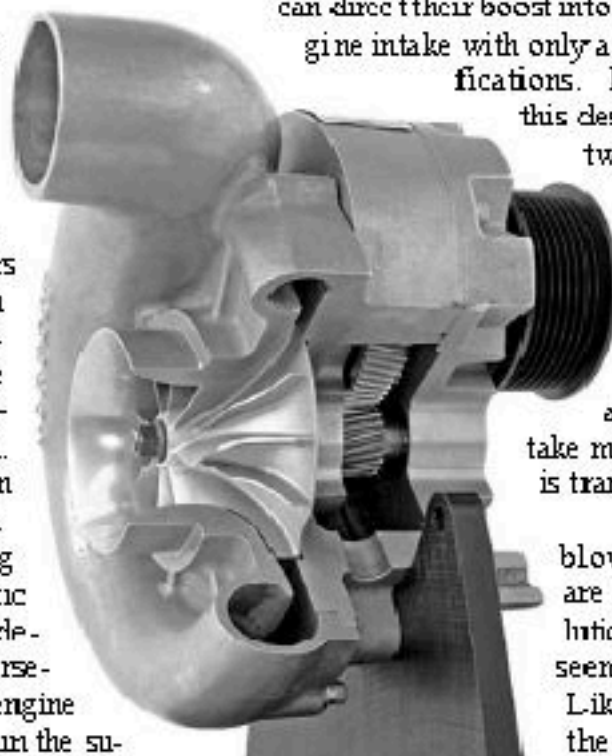
Which type of supercharger is the "best" option for hot rod builders interested in making impressive power? There is no easy answer. Roots-type superchargers provide the instant-on boost favored by straight-line racers, but they take up a lot of room under - or on top of - the hood. Their lower efficiency can also lead to increased parasitic drag when stepping up to larger units. Parasitic drag is the term used to describe the amount of horsepower required for the engine to turn the belt used to run the supercharger.

Twin-screw units can avoid much of the heat and drag produced by a Roots blower, but their standard top-mount design can still introduce space concerns inside

tight engine bays. The proximity of the twin-screw blower to the engine's intake - after all, it is usually bolted right on top - unfortunately also makes it quite effective at transferring what heat does get produced by the spinning lobes inside the casing.

Centrifugal superchargers have the advantage of being available in much smaller sizes than either a Roots or a twin-screw design. Their compact form factor means that they are also much easier to fit into cramped engine bays, with these types of blowers often being crammed into whatever gaps are convenient enough to accommodate their belt drive systems. Centrifugal blowers also lack the specialized intake requirements of other superchargers, as they can direct their boost into a nearly stock engine intake with only a few piping modifications. Finally, although this design usually spins twice as quickly as a twin-screw unit (in some cases surpassing 50,000 rpm), its location farther away from the intake means that less heat is transferred.

Centrifugal blowers (like below) are not the magic solution that they would seem to be, however. Like a turbocharger, the speed of the engine determines the speed of this particular supercharger's impellers, which means that at low rpm's boost is not nearly as impressive as a twin-screw or Roots blower.



As you can see, each of the three different types of blowers offer their own unique strengths and weaknesses. However, supercharger design is only one aspect of installing this type of power adder in your vehicle.

We have mentioned heat quite a few times during the course of our supercharger discussion. One of the most effective ways to mitigate the heating effects of a supercharger's rapid internal spinning or rotation is to make use of an intercooler. An intercooler can be thought of as an additional radiator that is specifically designed to reduce the temperature of boosted air before it hits the intake. Cooler air = denser air, and the denser the air, the less risk of detonation inside a boosted engine.

Another important tool for fighting detonation and getting the most out of your blower setup is to seek out a custom tune for your particular installation. If you own an electronically fuel injected automobile, then

you will want to make sure that your vehicle's software is tuned to provide the additional fuel and timing changes required to make maximum power within safe parameters. If you are running a carburetor setup, you will have to dial-in the ignition timing and fuel delivery mechanically to achieve the same effect.

A good tune is the single most effective method for achieving a long-lasting and reliable supercharger setup. In fact, with a solid tune and boost that is dialed in to provide excellent streetability there is no reason why a supercharged car or truck won't give you as many trouble-free miles as a normally-aspirated solution. If your goal is to win dyno day competitions, however, and you choose to pursue huge spikes of boost to achieve your goals, you will undoubtedly have a harder time keeping your engine together. Keep this in mind when planning out your expectations for your supercharged project.

## THE GEARHEAD ROVING REPORTER...

asks the Guys in the Towers... "How did this year's season go?" and "What are you going to do this winter?"

### DAVE GAIL

"Big Dave" has built race cars, driven them, crewed on them, but is most famous as the guy with the booming voice that has been announcing races for four decades. "Well guys, most tracks have seen lower car counts, undoubtedly due to the economy, however I have seen a big increase in street cars coming up during the week. Kind of like the old days, guys are taking their new Camaros, Mustangs and Challengers to see what they will do. It's refreshing to see younger guys getting into the sport. As far as this winter, as you know I am an avid helicopter pilot, so I hope to be getting in a little more seat time."

### AL TUCCI

He is the voice of the ADRL and NMCA. This guy should have his own comedy show, you can't help but laugh when he keys the mic, and if you don't find this guy hysterically funny you are probably a manic depressive. "The ADRL is coming off a great year we have seen a lot of interest not just from racers but corporate sponsors as well! The NMCA did ok, but many of these guys don't have the funding that the pros do so it's a lot harder for them. This winter I will be doing the MavTV shows for the ADRL on Dish Network and I plan to take the family to Florida for a little fun in the sun."

### PAT HART

He has the experience of over 40 years in the booth! Pat is truly a legend and is one of the most knowledgeable guys in the business so, if you have never heard this dude's voice you are only a wannabe gear head and should immediately turn in your official gear head card and decoder ring. "This year has had its share of ups and downs. Like most businesses, drag racing is feeling the effects of a lame economy but there is a lot of cool things in the works for next year. The Drag Radial Series that Scotty K is putting together looks to be a good deal. I can tell you we are not going to give up cause, we are having too much fun. As far as the off season is concerned, I will be doing the Monster Truck races and maybe World Of Wheels. For sure, my wife and I will spend some time on our farm in Kentucky. It's amazing what a few days in the woods without cell phones and computers will do for your mind."

### MARK DIETRICH

You know him as a co-announcer at (heath takes) Dragaway. "I herallure have experienced