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CC:

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The Roots blower is the simplest of all blowers and therefore is also the least expensive. A Roots blower does not compress the air inside the supercharger. It is actually an air pump. The compression of the inlet charge (creation of boost) actually takes place in the cylinders and the manifold. Centrifugal superchargers and screw type superchargers are called "internal compression" blowers because the air compression takes place inside the supercharger. Roots superchargers are "external compression" blowers because the air compression takes place outside of the supercharger. Roots type superchargers first appeared in automotive applications as far back as the 1930s. The basic design of a Roots supercharger has been developed over many years and has resulted in a highly refined product offered by Holley under the Weiand brand.

Roots blowers have been used on GMC diesel engines for many years. In the late 1950s, Phil Weiand was in the forefront of the development and adaptation of these superchargers for racing and performance applications. The company was active in producing manifolds and drive systems for adapting GMC diesel superchargers, such as the 4-71 and 6-71, followed by the development of its own superchargers that are completely manufactured by Weiand (including 8-71 through 14-71 models).

What a Supercharger Does

An internal combustion gasoline engine draws in air which is mixed with gasoline. This "fuel/air charge" is drawn into the cylinders as a result of the vacuum created when the piston travels down the cylinder. When the piston goes back up, this fuel/air charge is compressed to a fraction of its original volume. If an engine has a 9:1 compression ratio, the fuel/air charge will be compressed to 1/9th of its original volume. When the spark plug ignites this compressed fuel/air charge, the resulting combustion causes an expansion of the charge which forces the piston down.

As you pack more fuel and air into the cylinder, the combustion charge becomes more powerful and the engine produces more power and torque. In an unblown engine, when the piston goes down on the intake stroke, atmospheric pressure tries to fill the void now present in the cylinder. If the cylinder filled completely with air, the engine would have a volumetric efficiency of 100%. Due to the restrictions in any engine created by the air cleaner, cylinder head and cam timing, all of the air that should get into the cylinder can't, so the typical engine's volumetric efficiency is less than 100%. By removing these restrictions, or at least reducing them by improving the cylinder heads and cam timing and using a larger carburetor, the volumetric efficiency of an unblown engine can be improved.

With a supercharger, the amount of air and fuel that can be packed into the cylinders greatly exceeds the 100% volumetric efficiency of a highly refined unblown engine. Since the air is now being forced into the engine, you can put a substantially denser fuel/air charge into the cylinders. On most street type blown applications running 6 to 7 pounds of boost, approximately 40 to 50% more fuel and air can be packed into the cylinders than in a comparable unblown engine.

The reason that larger displacement engines make more power and torque than smaller ones is that more fuel and air are available for combustion. As a result of supercharging, a small displacement supercharged engine can produce similar horsepower and torque to a naturally aspirated larger displacement engine.

With a Roots blower, the carburetor functions basically the same as it would on an unblown engine, except it now sits on top of the supercharger. Although this is somewhat of a simplification, you can think of a roots supercharger installation as removing the carb and intake manifold from the engine and reinstalling the blower and blower manifold in its place and then bolting the carb on top of the blower. Then a belt is attached to pulleys on the blower and the crankshaft to turn the supercharger.

Explaining Boost
Boost is the amount of air pressure created by the supercharger. Supercharger boost is largely misunderstood, even by some experienced performance enthusiasts.

One important thing to keep in mind with respect to Weiand roots superchargers is that throughout the rpm range, the air ratio of the supercharger is consistent with the engine displacement. Supercharger boost, however, is not totally constant.

This is because at lower blower speeds, the clearances between the supercharger case and the rotors allows for air "leakage" with some loss of boost efficiency. If your engine is not as free-breathing as it could be (because it has a stock or low performance cam, small valves, restricted ports, etc.) you will typically see the boost readings go up in the higher rpm ranges. This is because the boost the blower is making cannot fully get into the cylinders due to these restrictions, and the boost pressure starts building up in the manifold, which is typically where the boost readings are taken, therefore, artificially high readings will be observed. Interestingly, this means a supercharged engine can make more power with lower reading on the boost gauge.

Boost is a function of three things: the displacement of the engine, the displacement of the blower, and the speed that the blower is turned in relationship to the engine speed. There are a few basics to remember. Assuming a constant speed ratio between the engine and the blower, a larger blower will make more boost than a smaller one on the same size engine. As engine size goes up, boost goes down if the blower speed and blower size remain constant. Conversely, as engine size goes down, boost goes up. On a given size blower and a given size engine, boost can be increased by running the blower faster in relation to the engine's speed (overdriving) or it can be decreased by running it slower (underdriving).

As a very rough rule of thumb, you typically want to run larger blowers on larger engines. However, there is no reason you can't run a larger blower on a small engine, such as a 6-71 on a small block 327, as long as you adjust your drive pulleys to get the blower to run slow enough to keep the boost down to a level that is appropriate for the compression ratio you are running. Conversely, it is not practical to run a small blower on a big engine, because you would have to turn the blower so fast to make a reasonable amount of boost that the blower would become very inefficient, particularly at higher engine speeds. When Roots blowers are turned at very high speeds, they actually can heat up the inlet air to such an extent that the air expands substantially. This overheated expanded air loses so much density that even though your boost gauge says the blower is making boost, in reality you aren't putting any more air into the engine than an unblown engine would get.

Running the blower very slowly in relation to engine speed, such as would occur in our example above of a 6-71 on a 327, would result in inefficiencies at lower engine speeds. A slow turning blower, especially a larger one like a 6-71, would have a lot of low speed "leakage" of boost pressure past the clearances between the rotors and the blower case. This leakage reduces low speed boost pressure, with a resultant decrease in the amount of additional power produced. This is why it is important to have a blower that is sized in relationship to the engine displacement. In this instance, if the blower pulleys were selected to make decent boost at low engine speed, you would end up with excessive boost at higher engine speeds. Additionally, keep in mind that the larger the blower, the more potential for low speed boost "leakage" to the larger the blower, the more potential for low speed boost "leakage" to occur because the total clearance path is much longer on a larger blower.

Many people assume a blower is making boost 100% of the time. In actuality, the blower normally only goes into boost when the throttle is opened substantially or when the vehicle is under load, such as going up a steep hill or pulling a trailer. In order to make boost, the blower must get air, and during most driving you will only have the throttle open a slight amount. Interestingly enough, even when not making boost, the spinning rotors improve the volumetric efficiency of the engine to the point where you can maintain high cruising speeds at lesser throttle openings, and in normal driving around town, you will notice that the vehicle is much livelier even when not making boost. This phenomenon can improve gas mileage under certain circumstances, although typically on an overall basis fuel economy will decrease about 3%. This isn't much of a factor. If your car was getting 20 mpg before the blower that means you will be getting 19.4 mpg after the blower installation but with a 40 to 50% increase in horsepower.

Weiand Pro-Street 6-71 and 8-71 supercharger kits come with drive ratios that will typically produce 5 to 7 pounds of boost. These boost levels are based on 350 or 454 cid engines. The 10-71 through 14-71 supercharger kits come with drive ratios that will produce 5 to 8 pounds of boost. These levels are based on a 502 cid engine. See our additional drive ratio charts at the end of this section. If your engine is smaller than this, your boost will be higher. If your engine is larger, your boost will be lower.

We state that your boost will fall within a particular range, such as from 5 to 8 pounds, because a lot of factors can cause boost to vary. Depending upon how well your engine breathes, the amount of observed boost on a gauge can vary substantially. If you install a Weiand blower and your observed boost comes up on the low end of our estimated range, it means you have a really good breathing engine. Another factor that can contribute to low boost is a restricted air inlet or too small of a carburetor. Remember that at full throttle your engine is going to need about 50% more air than it did before the blower was installed. Are your air cleaner and carburetor capable of letting in 50% more air? If not, you won't make the boost that the blower is capable of.

The amount of boost that can safely be run is primarily determined by the compression ratio of your engine and the gas that you are using. As a basic rule of thumb, the 5 to 8 pound boost range that is provided by the standard pulleys supplied in Weiand's supercharger kits is suitable for compression ratios in the 8 to 9:1 range when used with 92 octane gasoline. If your compression ratio is higher than this, you will have to run less boost. If it is lower than this, you can run more boost. The key to any supercharger

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installation is that detonation must be controlled. Detonation in a blown engine is more destructive than in an unblown engine, and damage to piston ring lands (or worse) will occur if you continue to drive a blown engine that is detonating.

Many enthusiasts will experiment with increasing the boost until detonation occurs and then back down to the last boost level achieved without detonation. This requires purchasing additional optional pulleys. Remember that rarely are any two modified engines similar in how they react to boost and compression ratio combinations, so don't expect to copy what someone else may have done and achieve a successful installation. Unfortunately, as in many aspects of dealing with modified engines, trial and error is about the only way to achieve your ideal combination.

Please consult the charts in this Technical Section and the replacement pulley section for help in determining the pulleys and blower sizes that will best suit your specific application. In most instances, this will provide you with enough information to provide a workable and safe combination that will provide substantial performance improvements. For those of you who would like to achieve the ultimate in performance from your particular setup, the data provided in our charts will give you an excellent starting point on which you may build to reach your goals.

Compression Ratio/Boost Pressure

The compression ratio of your engine has a direct relationship to how much boost you can run. If you have a high compression ratio, such 9.5:1 or 10:1, you will only be able to run a small amount of boost.

The compression ratio that is built into your engine is called "static compression." When you combine the boost you are running in conjunction with your compression ratio, the result is known as the "Effective Compression Ratio." Formulas have been developed that convert your static compression and supercharger boost to the effective compression ratio. Table 1 provides this information.

You can find your static compression ratio on the left side of the chart. Then read across to the right under the boost you want to run and the number in the box will be your "effective" compression ratio. Experience has shown that if you attempt to run more than about a 12:1 effective compression ratio on a street engine with 92 octane pump gas, you will have detonation problems. To some degree, this can be controlled with boost retard devices, but we do not recommend that you set up your engine and supercharger to provide more than a 12:1 effective compression ratio. Please note that all engines differ in their tolerance to detonation. You can build what appear to be two identical

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their tolerance to detonation. You can build what appear to be two identical engines and one will detonate and the other one won't, so the numbers given in this chart are not absolute hard and fast figures. However, if you follow this chart, you will be close enough that if you do experience some detonation, you should have no trouble controlling it with one of the aftermarket boost retard ignition systems (such as the such as the Holley Ignition P/N 800-450).

Table 1 shows that you obviously can't try to run 10 pounds of boost on a 9.0:1 compression ratio engine. This gives you an effective compression ratio of 15.1:1, way beyond our 12:1 figure. If you are building your engine from scratch, it is a good idea to try to build it with a relatively low compression ratio, such as 7.5 or 8.0:1. It is fairly easy to change the boost to get the best combination of performance and power, but it is extremely difficult to change the compression ratio, especially if you want to lower it. Additionally, you will make more total power with a low compression, high boost engine than you will with a high compression, low boost engine.

TABLE 1: Effective Compression Ratio Chart

Static Compress. Ratio	Blower Boost Pressure (psi)											
	2	4	6	8	10	12	14	16	18	20	22	24
6.0:1	6.8:1	7.6:1	8.4:1	9.3:1	10.1:1	10.9:1	11.7:1	12.5:1	13.3:1	14.2:1	15.0:1	15.8:1
6.5:1	7.4:1	8.3:1	9.2:1	10.0:1	10.9:1	11.8:1	12.7:1	13.6:1	14.5:1	15.3:1	16.2:1	17.1:1
7.0:1	8.0:1	8.9:1	9.9:1	10.8:1	11.8:1	12.7:1	13.7:1	14.6:1	15.6:1	16.5:1	17.5:1	18.4:1
7.5:1	8.5:1	9.5:1	10.6:1	11.6:1	12.8:1	13.6:1	14.6:1	15.7:1	16.7:1	17.7:1	18.7:1	19.7:1
8.0:1	9.1:1	10.2:1	11.3:1	12.4:1	13.4:1	14.5:1	15.6:1	16.7:1	17.8:1	18.9:1	20.0:1	21.1:1
8.5:1	9.7:1	10.8:1	12.0:1	13.1:1	14.3:1	15.4:1	16.6:1	17.8:1	18.9:1	20.1:1	21.2:1	22.4:1
9.0:1	10.2:1	11.4:1	12.7:1	13.9:1	15.1:1	16.3:1	17.6:1	18.8:1	20.0:1	21.2:1	22.5:1	23.7:1
9.5:1	10.8:1	12.1:1	13.4:1	14.7:1	16.0:1	17.31	18.5:1	19.8:1	21.1:1	22.4:1	23.7:1	25.0:1
10.0:1	11.4:1	12.7:1	14.1:1	15.4:1	16.8:1	18.2:1	19.5:1	20.9:1	22.21	23.6:1	25.0:1	26.3:1
10.5:1	11.9:1	13.4:1	14.8:1	16.2:1	17.6:1	19.1:1	20.5:1	21.9:1	23.41	24.8:1	26.21	27.6:1
11.0:1	12.5:1	14.0:1	15.5:1	17.0:1	18.5:1	20.0:1	21.5:1	23.0:1	24.51	26.0:1	27.51	29.0:1

The above chart shows the effective compression ratio of your engine, which combines the static compression ratio with the amount of supercharger boost. Note that for most street applications with 92 octane pump gas, you should keep your effective compression ratio below about 12.0:1.

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Weiand 6-71 Drive Ratio & Estimated Boost Chart (PSI)

	Drive Ratio (Overdriven)												
	1.30:1	1.25:1	1.20:1	1.15:1	1.10:1	1.05:1	1:1	0.95:1	0.90:1	0.85:1	0.80:1	0.75:1	0.70:1
Engine	30%	25%	20%	15%	10%	5%	0%	-5%	-10%	-15%	-20%	-25%	-30%
327	27.1	25.5	23.9	22.3	20.7	19.1	17.5	15.8	14.2	12.6	11.0	9.4	7.8
350	24.3	22.8	21.3	19.8	18.3	16.8	15.3	13.8	12.3	10.8	9.3	7.8	6.3
383	21.0	19.6	18.2	16.9	15.5	14.1	12.8	11.4	10.0	8.6	7.3	5.9	4.5
392	20.2	18.8	17.5	16.1	14.8	13.5	12.1	10.8	9.4	8.1	6.8	5.4	4.1
400	19.5	18.2	16.8	15.5	14.2	12.9	11.6	10.3	9.0	7.6	6.3	5.0	3.7
454	15.4	14.2	13.1	11.9	10.8	9.6	8.5	7.3	6.1	5.0	3.8		
502	12.5	11.5	10.4	9.4	8.3	7.3	6.2	5.2	4.1	3.1			
540	10.6	9.6	8.7	7.7	6.7	5.7	4.8	3.8					

Weiand currently offers the following size blowers for four different types

of engines:

- Small Block Chevrolet V-8
- Pro-Street 142
- Pro-Street 177
- 6-71 & 8-71 Street
- Big Block Chevrolet
- Pro-Street 177
- Pro-Street 256
- 6-71 Street & 8-71 Street
- 10-71, 12-71 & 14-71 Street
- Chrysler Hemi
- 6-71 Street (392)
- 8-71 Street (426)

The numbers related to these blower sizes, such as 142, 177, and 256, relate to the amount of air in cubic inches that is pumped by the blower in one blower revolution. The 6-71 and 8-71 designations refer to the original GMC diesel engines. Table 2 shows the amount of air per blower revolution the Weiand blowers pump.

TABLE 2: Supercharger Volumes

Supercharger Type	Approximate CID or Air Per Revolution
Pro-Street 142	142
Pro-Street 177	177
Pro-Street 256	256
Weiand 6-71	411
Weiand 8-71	436
Weiand 10-71	469
Weiand 12-71	497
Weiand 14-71	522

In selecting the proper supercharger for your application, you also need to take into consideration how you plan to drive your vehicle and the approximate boost level desired. How you plan to drive your vehicle is important because you can set up your blower to be more efficient at high engine speeds or more efficient at low engine speeds, or you can arrange for the best compromise for the full engine rpm range.

For example, if your vehicle typically will be driven at speeds under 4,500 rpm and will never, or infrequently, see high engine speeds, you may want to select one of Weiand's smaller blowers. A smaller blower can be driven at a higher speed, which will produce a substantial amount of boost, particularly at lower engine speeds. However, this high blower speed will be less effective at higher engine speeds due to the overheating of the inlet air as discussed earlier. Conversely, if you choose a larger blower for this same application, in order to achieve the same boost level, the larger blower will have to be turned