KENNE BELL

TWIN SCREW vs ROOTS

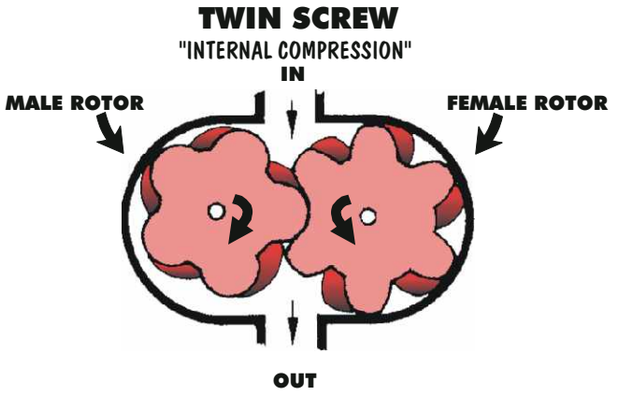
Because of their ability to produce an abundance of boost (HP and torque) at virtually any engine rpm, the Twin Screw and Roots type are the two most logical choices for supercharging. Both are essentially positive displacement SUPERCHARGERS (each revolution produces "X" cfm regardless of engine rpm). Although their appearance is similar, one should not confuse the two. Internally they are as different as night and day.

❶ **LOWER POWER CONSUMPTION**: The Twin Screw requires 10-16 less HP (depending on boost) to drive, leaving more horsepower for the engine to transmit to the vehicle wheels for increased acceleration, passing, towing, hill climbing.

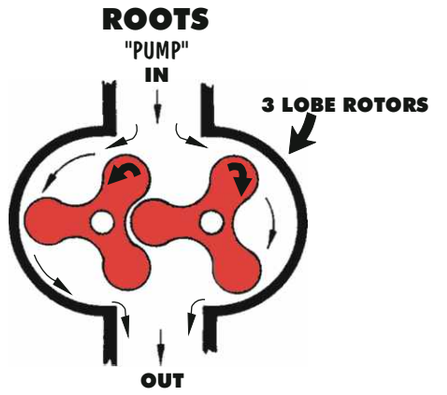
❷ **COOLER CHARGE TEMP:** It also discharges air into the engine at a much lower temperature. The cooler denser air charge from the Twin Screw equates to even more engine horsepower and torque potential with less thermal stresses on the engine.

❸ **INTERNAL COMPRESSION**: The Twin Screw compresses the air *between the rotors*. This "internal compression" means less work to boost the air pressure and quicker boost delivery to the engine. The compressed (boosted) air resides in the supercharger and makes it behave like an air tank . . . squeeze the throttle and out comes the boosted air. The amount and boost level depends on throttle depression.

Eaton Corp. who is currently manufacturing the Roots type - and is also licensed to produce the Twin Screw - has this to say in their literature when comparing them: ***"A Screw Compressor [Twin Screw] also provides more air for an engine's cylinders but it first compresses the air, thus providing more boost than a Roots [Eaton] type supercharger. The additional boost allows engine manufacturers to extract more power from an engine."*** **Eaton Corporation**

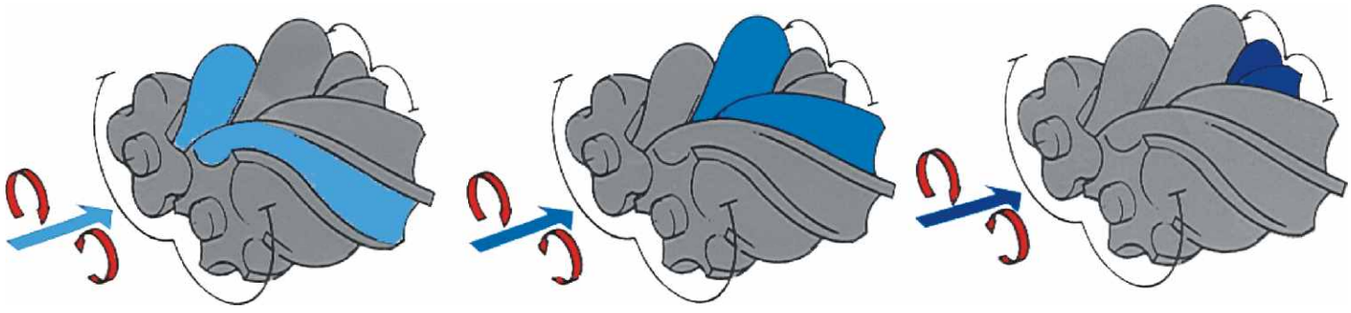


Air enters the supercharger through the rear or top rear and is "compressed" internally between the rotors. The male rotor rotates clockwise while the female rotor rotates counter clockwise trapping and compressing the air between them and then channeling ("screwing") the air toward the front where it is discharged. Note how the air is not pumped the long way around the rotors as with the Roots. The shortest smoothest path between two points is always best for optimum air flow.



The Roots inlet air is caught by the rotors and then "pumped" circumferentially between the supercharger case and rotors and then discharged. All this surface area (rotors and case) coupled with the relatively long torturous air path creates more turbulence, friction, heat and pumping (HP) losses than the Twin Screw "compressor." Follow the air flow around the rotors and case and one can easily see why the Roots is clearly not as efficient as the Twin Screw.

TWIN SCREW OPERATION



INTAKE

Incoming air is sucked into the rear of the supercharger. Note the rotor rotation is the opposite of the Roots to avoid pumping air between the rotors and case. This more efficient "internal compression" of air reduces the high turbulence, friction, heat and pumping losses found in the Roots.

INTERNAL COMPRESSION

The air is then compressed internally between the rotors. The male rotor rotates clockwise while the female rotor rotates counter clockwise compressing the air between them and "screwing" or forcing the air to the front of the supercharger where it resides.

DISCHARGE

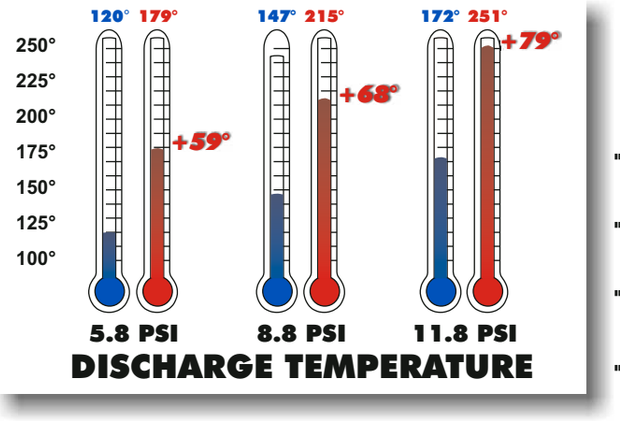
Once the air is "screwed" and compressed the full length of the rotors - it exits the supercharger and/or remains in a compressed state between the rotors until the engine demands the boosted air. The final result is a cooler denser air charge, lower parasitic loss - and more engine horsepower.

It has come to our attention that our potential customers, enthusiasts and the media often confuse the "Roots" style superchargers with the "Twin Screw." They all labor under the false misconception that both of these positive displacement superchargers are identical in operating principle and efficiency! Frequently the Twin Screw is referred to as a "Roots." It ***IS NOT*** a Roots. These products ***ARE NOT THE SAME!*** (see Twin Screw vs. Roots Operation).

It has been well documented in numerous tests by automotive engineers around the world that the Twin Screw concept is, unquestionably, more efficient (cooler air charge temperature and lower parasitic loss). Today, the preferred choice is the Twin Screw. It was selected by Ford for their most powerful and prestigious production car ever - the fabled GT. Mercedes switched to the Twin Screw. Then there's Mercury Marine. What does that tell you?

It is not our intent to knock the Roots type. Both are proven, reliable OEM quality superchargers. However, the Twin Screw is clearly more efficient. Over 80 companies, including Eaton, have been licensed to produce the patented highly efficient Twin Screw rotors for compressors and superchargers. Millions have been produced. The Twin Screw is a product who's time has come.

The superchargers tested were the Kenne Bell/Autorotor 3150 (Twin Screw) and a popular comparable Roots type. Both are rated at 1.5L and recommended for applications up to 450HP. They were tested at 12000 rpm and 70° at sea level with the 3 boost levels indicated. Both are commonly used superchargers. Two larger superchargers - a Roots type and a Kenne Bell/Autorotor 420 Twin Screw with ratings of 600HP - were also tested. Again the test results confirmed the Twin Screw enjoyed up to 30% lower air charge temp and 30% less parasitic loss at all 3 boost levels.

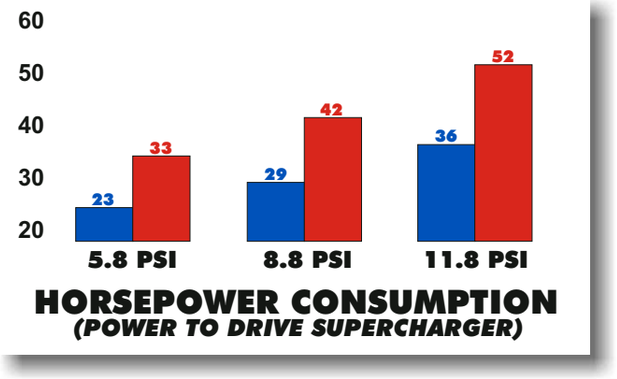


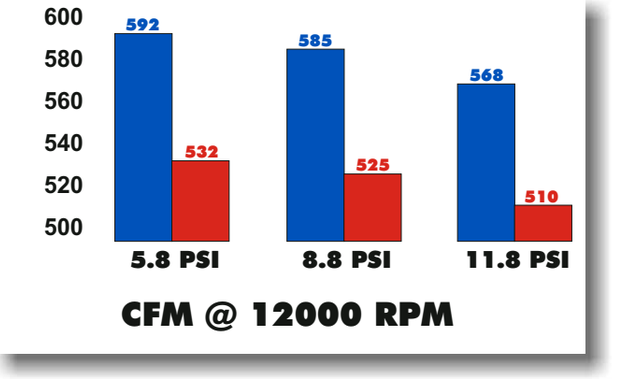
"TEMP" - Air discharge temperature °F with 70° inlet at sea level elevation.

"POWER" ***(Horsepower)*** - Required of engine to drive supercharger at 12000 rpm.

"CFM" - Cubic feet per minute of air discharged at 12000 rpm supercharger speed.

"PSI" - Boost developed by supercharger (5.8, 8.8 and 11.8 psi).





INTERCOOLING

Intercoolers are not for everyone or all boost levels. Since the air charge temp of the Twin Screw is 68° -79° cooler at 8.8 and 11.8 psi respectively, it should be obvious why Kenne Bell Twin Screw Kits do not require intercoolers and many Roots type do, should or must run lower boost levels. The comparison below says it all. Intercooling with the Twin Screw is not a necessity as the air charge temperature is clearly cooler. Kenne Bell has thousands of totally satisfied Ford, Dodge and GM Twin Screw non-intercooled customers. Most air to water intercoolers typically reduce air charge temperature approximately 65°-75°. That is not to say intercooling does not help. It does, but it adds considerable complexity and cost to a kit at lower boost levels. At Kenne Bell, we prefer to cool the air at the source - the supercharger itself. However, at higher boost levels, we offer intercoolers with our kits.

TEMPERATURE RISE FROM BOOST
(70° ambient)

SUPERCHARGER	BOOST 5.8 psi	8.8 psi	11.8 psi
TWIN SCREW F° TEMP PER PSI	+50° 8.6°/ psi	+77° 8.7°/psi	+102° 8.6°/psi
ROOTS F° TEMP PER PSI	+109° 18.7°/ psi	+145° 16.4°/psi	+181° 15.2°/psi

Here's an exercise that will help you to better understand the basic supercharger differences. Let's all design a supercharger kit. As always, temperature rise from boost is our number one concern. The Parameters are: ***1.)*** *The Twin Screw increases air charge temperature approximately 8.6° per psi of boost.* See comparison. ***2.)*** *The Roots temperature rise from boost is approximately DOUBLE the Twin Screw (15-18° per psi of boost).* See comparison. We know from experience that we can safely run 5-6 psi of boost on 91 octane with a Twin Screw supercharger kit. It's temperature rise above 70° ambient is 50°. Now look at the Roots temp rise of 109° at the same 5.8 psi. It's 59° hotter and therefore requires an intercooler to match the efficiency of the Twin Screw. Also let us not overlook losing 1.5 psi through even a well designed intercooler. Unfortunately, the Roots must now develop more boost (7.3 psi) to overcome the 1.5 psi intercooler loss (5.8 + 1.5 = 7.3 psi). However, since the Roots boost has been raised to 7.3, the temperature also increases to approx. 132° (109° + 23°)! The Twin Screw looks even better for our 5.8 psi kit. Twin Screw 50°/5.8 psi vs Roots 132°/7.3 psi = 82° cooler. Conclusion? The Roots kit must add the expense and complexity of an intercooler, pump, heat exchanger and plumbing to remove the 82° higher air temp. And don't overlook yet another 5HP the Roots robs from your engine from the higher +1.5 psi boost (7.3 vs 5.8 psi = 1.5 psi and +5HP).