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# ROOTS BLOWER

Model: **HDSR1200**



**VACPAC**

**RELIABLE SUPPLIER OF VACUUM PUMPS**

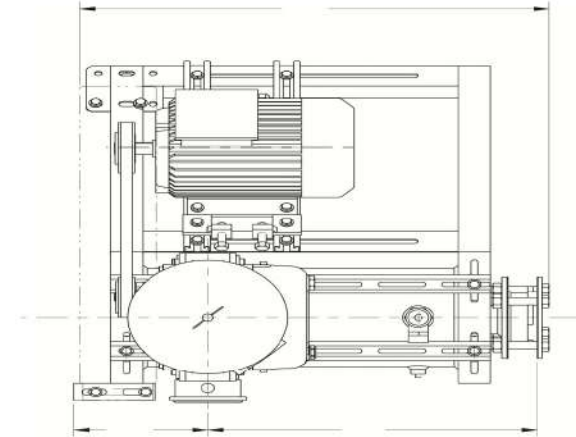
*VACPAC is an engineering company that manufacture a customize industrial machines according to client needs and wants. We are also a reliable supplier of vacuum pumps all over the world. Providing products and services with high quality standards, and has a necessary expertise and ability to deliver within delivery schedule.*

## Introduction

The Roots blower is a positive displacement lobe pump which operates by pumping a fluid with a pair of meshing lobes not unlike a set of stretched gears. Fluid is trapped in pockets surrounding the lobes and carried from the intake side to the exhaust. It is frequently used as a supercharger in engines, where it is driven directly from the engine's crankshaft via a belt or, in a two-stroke diesel engine, by spur gears.



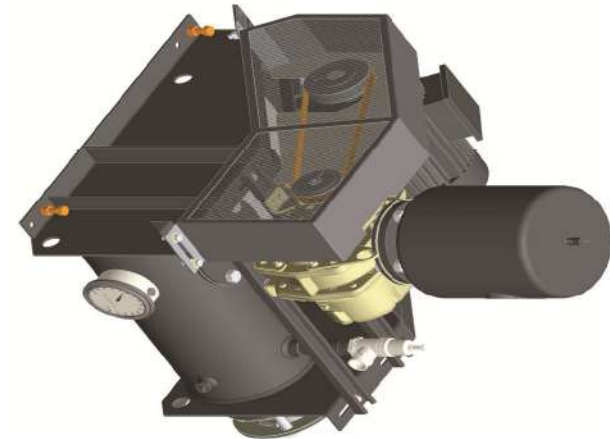
## Actual Picture for Reference



## Application

The Roots blower is simple and widely used. It can also be more effective than alternative superchargers at developing positive intake manifold pressure (i.e., above atmospheric pressure) at low engine speeds, making it a popular choice for passenger automobile applications. Peak torque can be achieved by about 2000 rpm. Unlike the basic illustration, most modern Roots-type superchargers incorporate three-lobe or four-lobe rotors.

Accumulated heat is an important consideration in the operation of a compressor in an internal combustion engine. Of the three basic supercharger types, the Roots design historically possessed the worst thermal efficiency, especially at high pressure ratios.[3] In accordance with the ideal gas law, a compression operation will raise the temperature of the compressed output. Additionally, the



TECHNICAL DATASHEET	
Model #: HDSR 1200	
<b>Capacity</b>	1200 m <sup>3</sup> /hr
<b>Differential pressure</b>	150 mBar
<b>Blower Speed</b>	1400 RPM
<b>Shaft Power</b>	12.12 kW
<b>Motor Power</b>	4P-15 kW
<b>Cooling type</b>	Air cooling
<b>Medium</b>	Air
<hr/>	
<b>Applicable above sea level</b>	Under 2000 m
<b>Vapour temperature</b>	<40°C
<b>Standard accessories</b>	Inlet silencer, discharge silencer, common base, safety valve, pressure gauge, check valve, flexible joint, V-belts, pulley, belt cover, bolts & nuts
<b>Packing size</b>	1550 x 1050 x 760 mm (blower with motor)
<hr/>	
<b>Casing, side plate</b>	Grey Cast Iron
<b>Rotary lobe</b>	Nodular Cast Iron
<b>Shaft</b>	40Cr
<b>Bearings</b>	GCr15 (SKF or NSK)
<b>Gear</b>	20CrMnTi
<b>Belt Rubber</b>	USA Gates V-belt
<b>Belt cover</b>	Carbon Steel
<b>Pulley</b>	HT200
<b>Oil seal Viton</b>	Taiwan TTO
<b>Silencer</b>	Carbon steel

operation of the compressor itself requires energy input, which is converted to heat and can be transferred to the gas through the compressor housing, heating it more. Although intercoolers are more commonly known for their use on turbochargers, superchargers may also benefit from the use of an intercooler. Internal combustion is based upon a thermodynamic cycle, and a cooler temperature of the intake charge results in a greater thermodynamic expansion and vice versa. A hot intake charge robs the engine of efficiency and produces diminishing returns from the compression process, while an intercooling stage adds complexity but can improve the efficiency by releasing some of the unneeded heat. Above about 5 psi (0.3 bar) the intercooling improvement can become dramatic.[citation needed] With a Roots-type supercharger, one method successfully employed is the addition of a thin heat exchanger placed between the blower and the engine. Water is circulated through it to a second unit placed near the front of the vehicle where a fan and the ambient air-stream can dissipate the collected heat.

## Technical Areas

The simplest form of a Roots blower has cycloidal rotors, constructed of alternating tangential sections of hypocycloidal and epicycloidal curves. For a two-lobed rotor, the smaller generating circles are one-quarter the diameter of the larger. Real Roots blowers may have more complex profiles for increased efficiency.

Because rotary lobe pumps need to maintain a clearance between the lobes, a single stage Roots blower can pump gas across only a limited pressure differential. If the pump is used outside its specification, the compression of the gas generates so much heat that the lobes expand to the point that they jam, damaging the pump.

Roots pumps are capable of pumping large volumes but as they only achieve moderate compression, it is not uncommon to see multiple Roots blower stages, frequently with heat exchangers (intercoolers) in between to cool the gas. The lack of oil on the pumping surfaces allows the pumps to work in environments where contamination control is important. The high pumping rate for hydrocarbons also allows the Roots pump to provide an

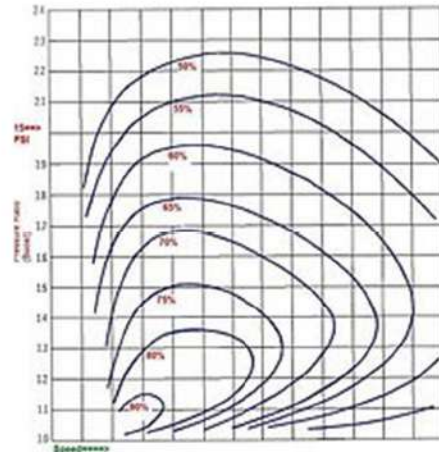
effective isolation between oiled pumps, such as rotary compression pumps, and the vacuum chamber.

A variant uses claw-shaped rotors for higher compression.

The Roots-type blower may achieve an efficiency of around 70% while achieving a maximum pressure ratio of two. Because a Roots type blower pumps air in discrete pulses (unlike a screw compressor), pulsation noise and turbulence may be transmitted downstream. If not properly managed (through outlet piping geometry) or accounted for (by structural reinforcement of downstream components), the resulting pulsations can cause fluid cavitation and/or damage to components downstream of the blower.

### Efficiency

For any given Roots blower running under given conditions, a single point will fall on the map. This point will rise with increasing boost and will move to the right with increasing blower speed. It can be seen that, at moderate speed and low boost, the efficiency can be over 90%. This is the area in which Roots blowers were originally intended to operate, and they are very good at it.



Boost is given in terms of pressure ratio, which is the ratio of absolute air pressure before the blower to the absolute air pressure after compression by the blower. If no boost is present, the pressure ratio will be 1.0 (meaning 1:1), as the outlet pressure equals the inlet pressure. Fifteen psi boost is marked for reference (slightly above a pressure ratio of 2.0 compared to

atmospheric pressure). At 15 psi (1.0 bar) boost, Roots blowers hover between 50% and 58%. Replacing a smaller blower with a larger blower moves the point to the left. In most cases, as the map shows, this will move it into higher efficiency areas on the left as the smaller blower likely will have been running fast on the right of the chart. Usually, using a larger blower and running it slower to achieve the same boost will give an increase in compressor efficiency.

The volumetric efficiency of the Roots-type blower is very good, usually staying above 90% at all but the lowest blower speeds. Because of this, even a blower running at low efficiency will still mechanically deliver the intended volume of air to the engine, but that air will be hotter. In drag racing applications where large volumes of fuel are injected with that hot air, vaporizing the fuel absorbs the heat. This functions as a kind of liquid after cooler system and goes a long way to negating the inefficiency of the Roots design in that application.

### Advantage

Rotary lobe blowers, commonly called boosters in high vacuum application, are not used as a standalone pump. In high vacuum applications, the boosters pumping speed can be used towards reducing the end pressure and increasing the pumping speed.

### HDSR1 200 Drawing

