The Case for Vacuum Boosters, and the Case for Tuthill

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Vacuum boosters are positive-displacement dry pumps that use two two-lobe rotors rotating at high RPMs in opposite directions to remove gas. When they are used separately to discharge atmosphere they are typically limited to inlet pressures of ½ an atmosphere. The vacuum booster's advantage is when it is placed in series with another vacuum pump. The booster then provides higher pumping capacity and lower pressures typically at lower cost and power consumption. The backing pump can be an oil-sealed piston or vane pump, a liquid ring pump sealed with a variety of different sealants from water, solvents, or oil, or a dry vacuum pump.

Here, Senior Engineer Phil Vibert and Northeast Regional Sales Manager Peter Rescsanski share their views on the use of vacuum boosters in industry, and why Tuthill is the preferred supplier.

Q: Why are vacuum boosters used in industry?

Vibert: Tuthill boosters have a reputation in industry for simplicity and reliability. If you take a booster and put a backing pump behind it, you can run the booster at low pressures and derive the needed pumping capacity with lower overall horsepower, compared to opting for a larger backing pump alone. Most industrial applications for vacuum boosters are those that require a deeper vacuum and increased volumetric flow. Typical pressures can vary from 0.1 to100 mmHg. Typical industrial sectors are chemical, pharmaceutical, vacuum furnace, and steel degassing with applications which include degassing, distillation, drying, freeze drying, transformer drying, metallurgical treatment, and CVD.

A good example is higher-capacity pumping of solvent vapors, for recovery purposes. Vacuum boosters enhance the performance of a dry vacuum pump when used in combination and provide a lower cost alternative compared to a larger dry pump. This can be an advantage in the chemical processing industry when dealing with multiple volatile solvent vapor loads, where the dry vacuum system with aftercondenser can transport the solvent vapor and selectively condense it in the exhaust condenser.

Rescsanski: Our customers rely on Tuthill booster pumps for their unique performance characteristics, and for an optimized blend of cost, reliability, and quiet operation. For example, we use helical gears on our boosters rather than the industry-standard straight-cut gears. And, we sell a five-bearing booster while most others use four bearings. These design options provide for smoother operation while optimizing durability and minimizing noise. The boosters are so well-accepted in the market that other pump manufacturers private-label our vacuum boosters.

Boosters also allow our customers to pump down to the required vacuum more quickly, while minimizing pump and motor size. For example, I had a customer that recently retrofitted nine vacuum furnaces with new Tuthill boosters (model KMBD1600-92L2CM) in tandem with our rotary-piston vacuum pumps. Those boosters are rated to 1600 CFM, provide vertical flow, are left-hand drive, and have labyrinth slinger-style seals.

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The furnaces, used to dry calcium, are large box-style units measuring 20 ft. by 8 ft. by 6 ft., and the customer had been pumping them down with stand-alone oil-vapor diffusion pumps. Pump down (from 10 torr to 0.05 torr) took 4 hours, while our solution reduced that to 3 hours. That dramatic time savings resulted in a return on investment in just 2-3 months.

Q: Why would a chemical/petrochemical processing company use boosters, and in particular why would they use Tuthill boosters?

Vibert: In addition to the benefits of Tuthill boosters described above, Tuthill offers the boosters in various metallurgy including 304 and 316 stainless steel for additional corrosion resistance, as well as its BiProtect coating as a lower cost corrosion resistant alternative.

We also are one of the few manufacturers offering mechanical face seals for our vacuum boosters, in addition to non-contacting slinger seals. In recent years we've improved the carbon composition of our face seals so that they last significantly longer and withstand higher operating temperatures over previous generations of face seals.

Rescsanski: There's another reason customers—chemicalpetrochemical and others—select Tuthill vacuum boosters, and that's our engineering acumen. We sell more than just equipment; we sell solutions. As evidenced by the customer noted above, drying calcium in vacuum furnaces, many companies have cut back on their engineering staffs, as well as on their maintenance departments. They have come to rely on Tuthill as technical experts and for applications support. And they see our durable and high-performing vacuum boosters as a way to optimize reliability while driving down operating costs and reducing the number of service calls needed to keep the systems running.

Q: Energy efficiency has become a significant concern throughout industry. What are the benefits of using boosters in combination with variable-frequency drives (VFDs)?

Vibert: We see the use of VFDs with vacuum boosters as an energy savings method compared to control valves for pressure control, as well as an alternative for faster evacuations where the booster runs continuously with its backing pump. A constant-torque VFD with current feedback allows you to adjust the speed of the motor and prevent the motor from overloading. We can start the booster at atmospheric pressure and the motor will operate at a very low RPM to minimize the pressure differential across the booster. As the pressure is reduced the booster then speeds up to maintain power demand on the motor (since HP \approx torque x RPM) until it reaches the full load RPM of the motor. The VFD can even be used to set the limit on both the maximum and minimum RPM so that C-face motors can be used to direct drive boosters at non-synchronous motor speeds.

Rescsanski: We can even install pressure sensors in the vacuum line and send the signal to the VFD controller, constantly monitoring the vacuum level and adjusting motor speed accordingly. This can dramatically reduce energy consumption, anywhere from 30 to 80 percent.

What Tuthill Brings to Market

Tuthill's booster models range from 3.25- to 12-in. gear diameter and 2.5 to 48-in. rotor length. The standard construction materials are cast-iron for the housing, end plates, end covers, and port fittings, and ductile iron for the rotors and shafts. Also offered are stainless-steel components for more severe duty. The boosters are designed to operate at 82 dB(A) or less at blank-off (open field; motor and background noise excluded), and are supplied with a heavy-duty driveshaft for either direct-coupled or belt-driven applications.

Match the booster to the application by selecting a model that operates within a performance range of 50 to 12,700 CFM. To help customers select the right vacuum booster for the specific applications, Tuthill also offers a variety of testing services, including special testing available to ASME PTC-9 (1 PSIG slip method), hydrostatic testing to 150 PSIG(10.35 bar g), and pressure gas testing to 100 PSIG (6.9 bar g). We also perform seal leakage and noise testing.

Finally, Tuthill offers its VBXpert software to help customers size the appropriate blower, vacuum booster, or vacuum pump for their application. It's available as a free download: http://www.tuthillvacuumblower.com/index.cfm/sizing-pricing/sizing-tool.

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ABOUT TUTHILL

Tuthill Vacuum & Blower Systems, manufacturer of Kinney® vacuum pumps and M-D Pneumatics™ blowers & vacuum boosters, is a leader in the design and manufacture of high performance, reliable positive displacement blowers, mechanical vacuum pumps, vacuum boosters and engineered systems ready to install and run.

Our vacuum pumps and pressure blowers can provide vacuum as low as .2 micron to pressures up to 100 PSI. Thousands of vacuum, air and gas applications exist. Customized options and systems are available. We specialize in helping our customers in difficult applications, and are expert at serving after the sale to keep their systems running at peak performance; long after the product is delivered.

Online at: www.tuthill.com