The Magazine for Quality & Reliability in Energy-Efficient Blower & Vacuum Systems

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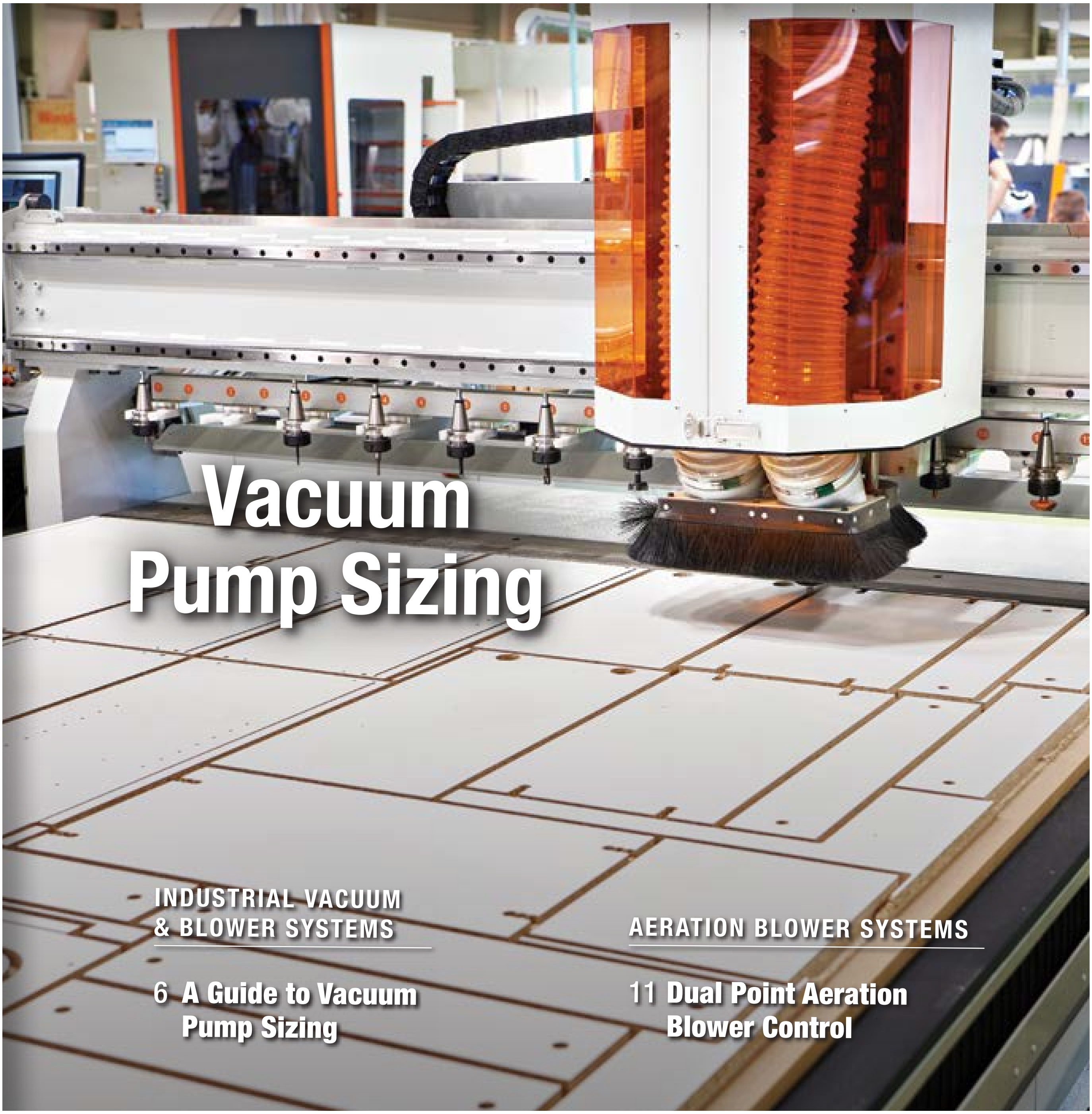
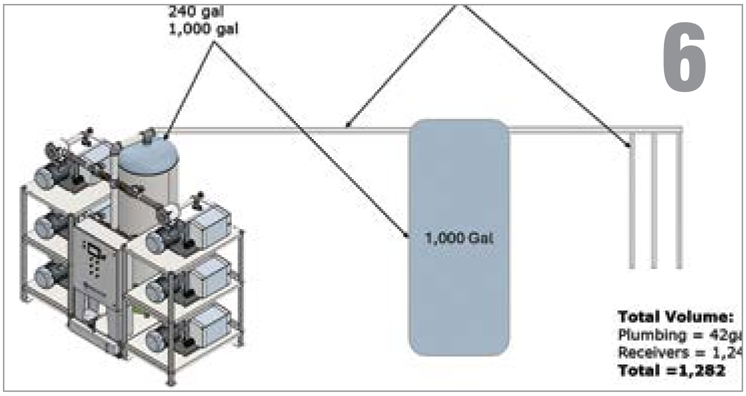
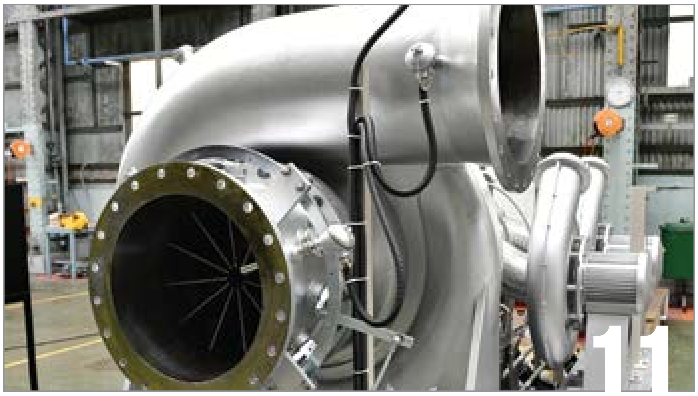
March 2025



Vacuum Pump Sizing

INDUSTRIAL VACUUM & BLOWER SYSTEMS





AERATION BLOWER SYSTEMS

EVERY ISSUE

NEWS Blower & Vacuum Industry & Technology

Atlas Copco Group Announces Appointment of Koen Lauwers as President of the Vacuum Technique Business Area

Atlas Copco Group has appointed Koen Lauwers President of the Vacuum Technique business area and member of Group Management.

"Koen is a passionate and respected leader, and he has a broad experience," said Vagner Rego, President and CEO, Atlas Copco Group. "Through the years, he has delivered strong business results and created high value solutions for our customers. I am very pleased that he has agreed to take on this role."

Koen Lauwers has been appointed as President of the Vacuum Technique business area.

Lauwers, a Belgian citizen, joined Atlas Copco in 1997 and has since then built a successful career in the Group, including international assignments in the United States and Germany. In 2023, he was appointed President of the Semiconductor division and prior to this he held the same position for the Industrial Vacuum division, both within the Vacuum business area.

Lauwers holds a master's degree in electro-mechanical engineering from the University of Leuven and an MBA from the Antwerp Management School, both in Belgium.

In 2023, Vacuum Technique had revenues of BSEK 42.8 and approximately 12,600 employees. Lauwers succeeds Geert Follens, who retired at the end of 2024. For more information, visit https://www.atlascopcogroup.com.

Eurus Blower Introduces EBox™ Series to North America Market, a Factory Standard Blower Package

Eurus Blower announced the introduction of the EBox™ Series of blower packages to the North American market. These blower packages are used in pneumatic conveying and other industrial applications.

Features include:

- Pressure to 15 psig (1 bar)
- Airflow to 1,571 cfm
- Separated process and cooling air
- IEC standard UL certified motor, TEFC, IP55, 230/460V, 60HZ, IE3
- Dedicated cooling fan, 460V, 60Hz
- Easy service features
- Extremely low noise (<85 dbA) and low vibration
- Pressure and temperature gauges
- External oil level gauges
- Preinstalled pressure relief and check valves

Eurus Blower has launched the EBox™ Series of blower packages to the North American market.

Roger Blanton, General Manager, Eurus Blower, said, "This exciting EBox Series offers our customers a greater selection of high-quality blower packages. The EBox product introduction complements recent ISB Series Screw Blower, VR Series (steam blower) product introductions and growing success with our multistage centrifugal product. Eurus Blower's customer service focus is unmatched in the North American market as we continue meeting customer needs." For more information, visit https://eurusblower.com.

ROOTS®, America's Oldest Blower Brand, Celebrates 170 Years of Blower and Air Compressor Innovation

ROOTS®, America's original and oldest blower brand, proudly celebrates 170 years of leadership in blower and air compressor technology. Since its founding in 1854, ROOTS has been at the forefront of industrial innovation, shaping the industry with its groundbreaking technology and unmatched expertise.

Today, ROOTS continues to provide industry-leading blower and air compressor solutions to a wide range of industries, including steel manufacturing, food and chemical production, water and wastewater treatment and textile mills. The brand's products, such as positive displacement blowers, centrifugal compressors and truck blowers, are recognized for their durability, reliability and intelligent engineering.

"Reaching 170 years in business is a remarkable achievement for the ROOTS brand," said John Parrish, Vice President of Sales, Process Flow Technologies, North America. "Since the invention of the rotary lobe blower by the Roots brothers in 1854, our mission has remained constant: to deliver innovative products that meet the evolving needs of our customers. Over the decades, generations of employees have proudly built quality products that serve the global marketplace. We look forward to the next 170 years of innovation and service within the Ingersoll Rand umbrella." For more information, visit https://www.rootsblower.com.

ROOTS is celebrating 170 years of blower and air compressor innovation.

Festo Introduces Multistage Pneumatic Vacuum Generator

Festo has expanded its vacuum generation solutions to include a multistage generator and a multistage cartridge. These new vacuum components offer exceptional performance on porous materials, such as paper and corrugated board.

The OASP can be mounted directly on a suction cup for minimum evacuation times, or used with the OVPN, and has a suction flow rate of 160 l/min to 245 l/min, depending on the model.

The OVPN and OASP meet the increasing demand for high suction flow rate in vacuum generation. A medium-sized single-stage vacuum generator, for example, has a suction flow rate of about 100 liters per minute (l/min). On the other hand, the new OVPN multistage generator's suction flow rate ranges from 245 l/min to 960 l/min, depending on the model.

Festo vacuum generators are characterized by their compact design, low weight, choice of mounting position and low maintenance requirements. They range in suction flow rates from 6.2 l/min to 960 l/min. For more information, visit https://www.festo.com.

Leybold Launches DURADRY Dry Screw Vacuum Pump for Medium-Harsh Industrial Production Processes

Leybold's DURADRY is a dry screw vacuum pump designed for medium-harsh industrial production processes where high temperatures, high oxygen contents and corrosive conditions prevail. Its features make it the perfect solution for applications like crystal pulling, plasma cleaning, heat treatment, coating and battery production.

Leybold rounds out its new series with a powerful DURADRY that's available as an option with a full or partial housing unit.

"The pump's main advantages are its ease of operation and low maintenance requirements," said Darong Li, Product Manager, Leybold, highlighting the strengths of the two models in the 160 and 250 m³/h pump speed classes.

Equipped with sensors and a dynamic seal, the hermetically tight system prevents the introduction of oil particles and contamination. Additionally, the DURADRY impresses customers with its quiet, ergonomic operation. Noise and vibration levels in the vicinity of the vacuum pump are less than 64 dB. For more information, visit https://www.leybold.com/en.

A Guide to Vacuum Pump Sizing

By Michael Ruff, Business Development & Technology Director, Becker Pumps Corporation

Sizing a vacuum pump can seem daunting, but it doesn't have to be. Learn these tricks to make the process easier and less stressful. Keep in mind, you don't need to be exact. A rough estimate is often good enough. Focus on the key factors.

Know Your Vacuum Pump Application

When starting your vacuum pump selection, think about the following:

- **Flow Rate:** What volume of air or gas needs to be moved per unit of time?
- **Vacuum Level:** What is the desired pressure?
- **Gas Properties:** What are the characteristics of the gas being managed?
- **Duty Cycle:** Will the pump operate continuously or intermittently?
- **Environmental Factors:** Are there temperature, humidity or noise restrictions?
- **Total System Volume:** What is the total volume of the space being evacuated?

Key Vacuum Pump Sizing Terms

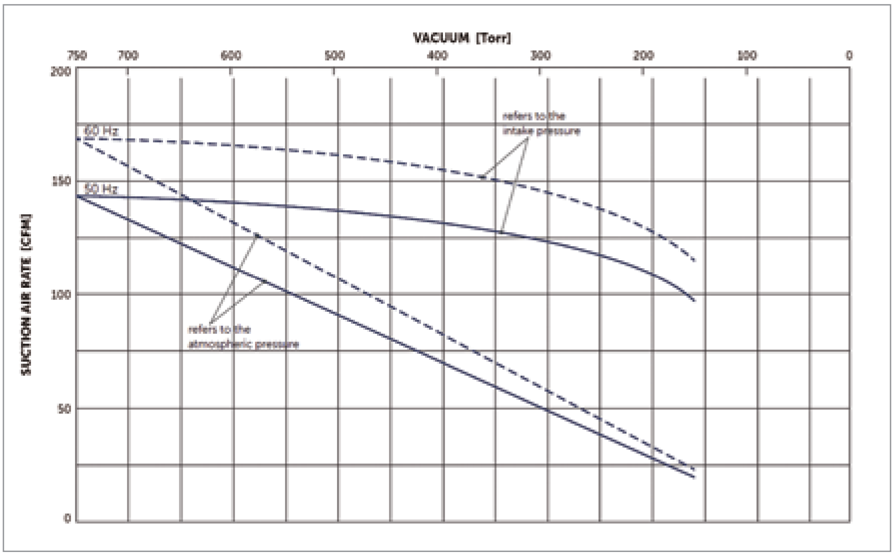
Flow Rate: Are you looking for actual cubic feet per minute (acfm) or standard cubic feet per minute (scfm)?

acfm measures the actual volume of air the vacuum pump can remove in one minute under specific conditions (including temperature, pressure and altitude). scfm measures the volume of air the vacuum pump can remove in one minute under standard conditions (usually 68°F [20°C], 14.7 psi [1 bar], and 0% relative humidity). Standard conditions vary by pump manufacturer.

A vacuum pump removes air from a space. acfm tells you how much air it can remove right now, while scfm tells you how much it can remove under ideal conditions. This is important because the performance of a vacuum pump can be affected by factors such as the size of the space it's evacuating, the type of air it's removing and the altitude.

acfm gives you the real-time performance of a vacuum pump, while scfm provides a standardized measurement for comparison.

It's crucial to specify whether you're working with acfm or scfm measurements when discussing vacuum pump requirements with a supplier. Using the wrong measurement can lead to oversizing or undersizing the



This graph shows the relationship between scfm and acfm on a V/P curve used by vacuum pump manufacturers. It illustrates the relationship between suction air rate (cfm) and vacuum level (torr) at different frequencies (60 Hz and 50 Hz), showing how the suction air rate decreases as the vacuum level increases for both frequencies, with the 60 Hz curve exhibiting a higher suction air rate than the 50 Hz curve at a given vacuum level.

vacuum pump. Volume flow vs. pressure curves are often presented in both acfm and scfm. Using the correct curve ensures an accurate performance evaluation. Also, when comparing vacuum pumps, it's essential to use the same unit for a fair comparison.

When contacting a vacuum pump supplier, state whether you are interested in acfm or scfm flow rates. This will help them provide you with accurate recommendations and ensure the selected vacuum pump meets your needs.

Ambient and Atmospheric Pressure: These are the same thing. Both refer to the pressure of the air around you.

Absolute Pressure: The total pressure, including atmospheric pressure. It's measured relative to a perfect vacuum.

Gauge Pressure: The pressure measured relative to atmospheric pressure. It's what you would see on a typical pressure gauge.

Imagine a jar:

- Atmospheric pressure is the weight of the air pushing down on the jar.
- Absolute pressure is the total pressure inside and outside the jar.
- Gauge pressure is like measuring how much pressure there is inside the jar compared to the outside.

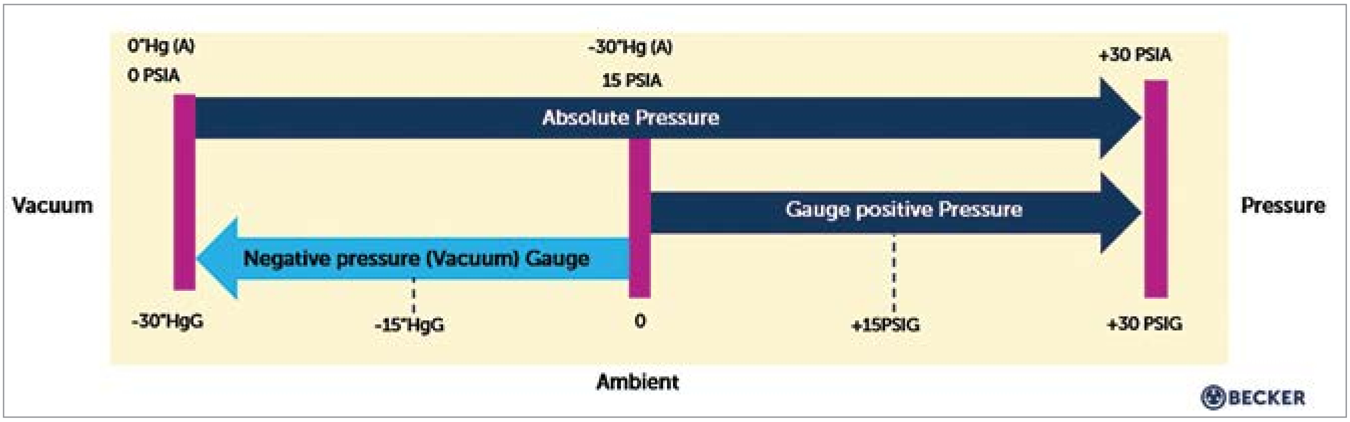
If you remove the air from the jar, the gauge pressure becomes negative. This is because the pressure inside is lower than the pressure outside.

In vacuum applications, absolute pressure is the total pressure, including the atmospheric pressure. Gauge pressure is the pressure difference between the inside and outside of the vacuum chamber. It's negative in a vacuum because the pressure inside is lower. Here's a simple formula to remember: Absolute pressure = gauge pressure + atmospheric pressure.

For example, If atmospheric pressure is 14.7 psi (1 bar) and gauge pressure is -10 psi (-0.7 bar meaning 10 psi or 0.7 bar below atmospheric pressure), the absolute pressure would be 14.7 psi plus -10 psi [1 bar plus -0.7 bar]), or 4.7 psi (0.3 bar).

In vacuum applications, absolute pressure is often used to measure the pressure inside a vacuum chamber. Gauge pressure is often used to measure the difference between the pressure inside the chamber and the atmospheric pressure. Gauge pressure tells you how empty the vacuum chamber is,

A Guide to Vacuum Pump Sizing



Absolute pressure is measured relative to a perfect vacuum, while gauge pressure is measured relative to atmospheric pressure.

while absolute pressure tells you the total pressure inside.

Just as with volume flow, you need to specify whether you are working with relative (gauge) or absolute pressures when discussing vacuum pump requirements with a supplier.

If a customer says, "I need a vacuum pump that can provide 28 cfm and 14"Hg," without asking more, the vacuum pump supplier might size and quote based on these units, as shown in **Figure 1**.

However, the customer could later say the vacuum pump is not working for their application. That's because the customer requires a pump able to maintain a flow rate of 28 cfm while achieving a gauge pressure of 14"Hg, as shown in **Figure 2**.

The first vacuum pump was undersized due to a lack of clarity. By providing additional information, you ensure the selected vacuum pump meets your needs and performs as required.

Moving Different Gasses with a Vacuum Pump

When dealing with gases other than the air we breathe, several factors must be considered. While vacuum pump manufacturers can provide guidance, understanding gas composition is crucial. Incorrect use of equipment could lead to major safety concerns.

The air we breathe is primarily composed of nitrogen, oxygen and argon, with trace amounts of other gases including carbon dioxide, water vapor and ozone. Different gases have different molecular weights and

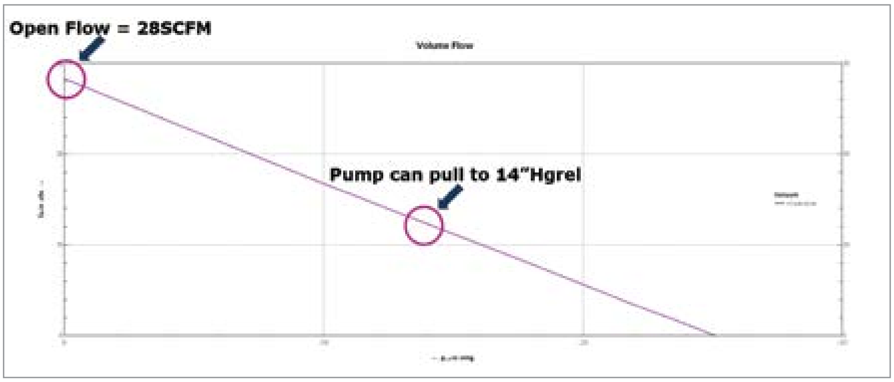


Figure 1. This graph illustrates the performance of a vacuum pump, showing that as vacuum level increases (lower pressure), the volume flow rate decreases.

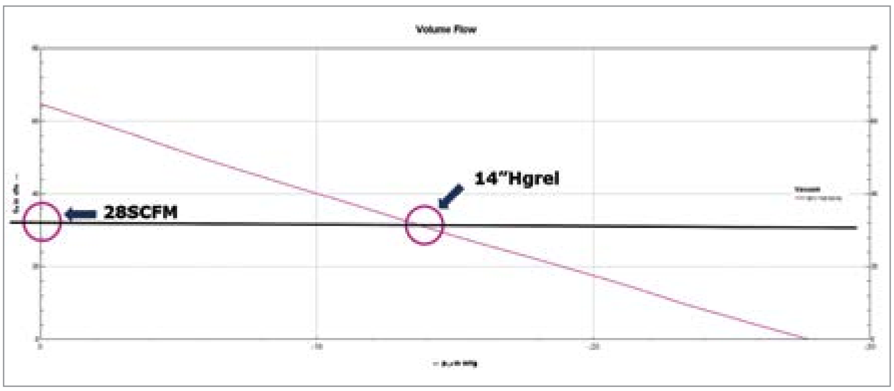


Figure 2. The graph depicts the performance of a vacuum pump, showing an open flow of 61 scfm, an end vacuum of 28"Hg. When running at 14"Hg, the available scfm is 28.

viscosities. Heavier gases like carbon dioxide may need higher pumping speeds.

When working with a mixture of gases, the dominant gas dictates the overall pumping requirements. However, the presence of other gases, especially those with low boiling points or flammable properties, can significantly impact the achievable vacuum level and introduce safety risks.

If a gas mixture contains flammable components, there is a risk of fire or explosion if proper precautions are not taken. Vacuum pumps must be selected and operated in a manner that minimizes the risk of ignition.

Flammable gas types:

- Hydrocarbons: Methane, propane, butane, ethylene and acetylene.
- Solvents: Gasoline, benzene and toluene.
- Natural gas: A mixture primarily composed of methane.

Some gases can react with other substances or with the vacuum pump itself, leading to hazardous conditions. It is essential to consult with the manufacturer to choose a pump compatible with the specific gases being managed.

Reactive gases:

- Halogens: Chlorine, fluorine and bromine.
- Hydrogen: A highly reactive gas.
- Oxygen: It can react with many substances, especially in the presence of a heat source or catalyst.
- Ammonia: A highly reactive gas that can form explosive mixtures with air.
- Nitrous oxide: A strong oxidizing agent that reacts with many substances.

Vacuum Pump Size and Total Volume

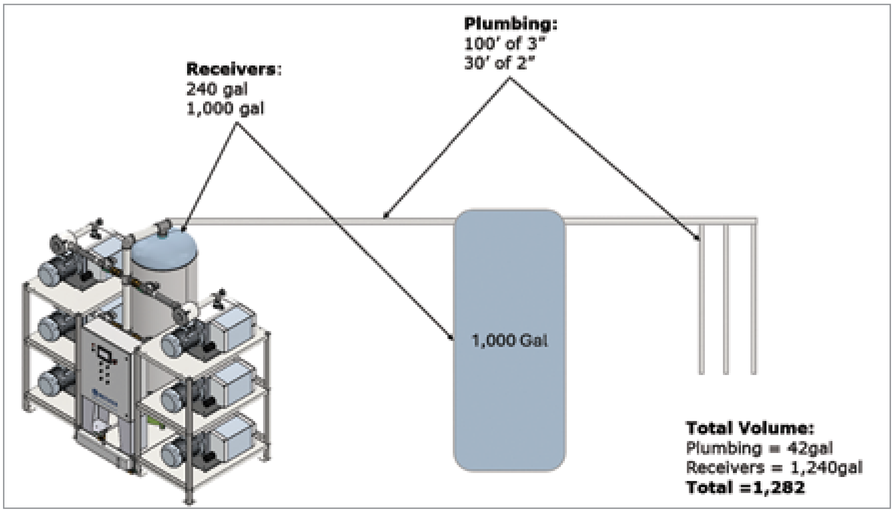
Once we've established the gas properties, flow rate and desired vacuum level, we can focus on vacuum pump size. Vacuum pump manufacturers offer a wide range of vacuum pump sizes, each capable of managing a specific volume of air within a given time.

The system the vacuum pump is connected to represents the total volume that needs to be evacuated each time the pump is activated. This total volume directly influences the pump's required cfm.

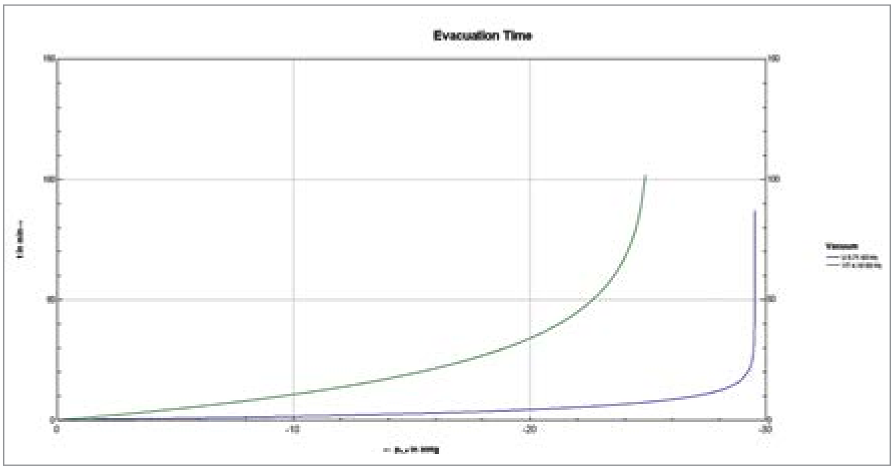
We need to account for all volumes the vacuum pump must evacuate. In this image, we have a total of 1,282 gallons to remove before the vacuum becomes available to the user.

Vacuum and Flow Relationship

Vacuum and flow are inversely proportional. A higher flow rate leads to a lower achievable vacuum level. During startup, the time to reach a specific vacuum level is typically short. However, as the vacuum level decreases, it takes longer for the vacuum pump to remove the remaining volume.



The image depicts a system with two receivers, totaling 1,240 gallons, connected to a plumbing system with 100 feet of 3-inch pipe and 30 feet of 2-inch pipe, resulting in a total system volume of 1,282 gallons.



The evacuation time for the total system volume decreases with increasing pump capacity. A higher capacity pump achieves faster evacuation times compared to a lower capacity pump.

A Guide to Vacuum Pump Sizing

If you have a specific time requirement to reach a desired vacuum level, be sure to communicate this to the vacuum pump manufacturer.

Selecting a Vacuum Pump

Once we have established the essential factors for vacuum pump sizing, we can select the most suitable vacuum pump type. There's an array of vacuum pump styles available, each with unique characteristics.

Common technologies used for vacuum pumps:

- Rotary vane: A rotating rotor with vanes (flat, blade-like components made of a carbon-resin blend) creates a vacuum by displacing air.
- Screw: Two intermeshing screws create a vacuum by compressing and displacing air.
- Claw: Two intermeshing claw-shaped rotors create a vacuum by trapping and compressing air.
- Diaphragm: A diaphragm oscillates to create a vacuum by displacing air.
- Rotary piston: A rotating piston creates a vacuum by displacing air.
- Liquid ring: A rotating impeller creates a liquid ring that traps and compresses air.
- Dry scroll: Two intermeshing scroll-shaped elements create a vacuum by trapping and compressing air.
- Regenerative blower: This uses a rotating impeller with vanes to create a centrifugal force drawing air into the pump and forcing it out.
- Radial blower: This is a type of dynamic vacuum pump. It uses a centrifugal impeller with radial blades to create a high-velocity flow of air or gas.

Equivalent Pipe Length of 90-Degree Elbows

90-degree elbow (inches)	1/2	3/4	1	1 1/4	2	2 1/2	3	4	5	6
Equivalent length (feet)	0.8	1.2	2	2	3	4.4	5	7	9	10

Tips to Consider When Choosing a Vacuum Pump

Vacuum pipe loss starts to occur around 100 feet of length. Keep the plumbing diameter equal to the inlet port of the vacuum pump for as far as possible. Increase the plumbing diameter by one increment (for example, from one inch to two inches) every 100 feet. For exhaust plumbing, avoid backpressure by increasing the diameter every 30 feet.

When calculating total system length, consider the equivalent pipe length of 90-degree elbows. These can introduce additional resistance to airflow, effectively increasing the system's length. This impacts the overall pressure drop and flow rate.

Altitude significantly impacts the performance of vacuum pumps, especially those relying on atmospheric pressure for their operation. At higher altitudes, atmospheric pressure is lower, which can affect the achievable vacuum level. For every 1,000 feet above sea level, the vacuum level is lowered by approximately one inch of mercury. Higher altitudes can affect the cooling efficiency of the pump's motor, leading to increased temperatures and potentially shortening the motor's lifespan. If you are operating at a significant altitude, it is a good idea to let the pump manufacturer know.

A vacuum pump selection checklist:

- Choose a pump that can achieve the required vacuum level.
- Select a pump with a sufficient flow rate to manage the required volume of gas.
- Consider the gas type, composition and any potential contaminants.
- Evaluate the pump's maintenance needs and costs.
- If noise is a concern, choose a pump with noise-reduction features.
- Consider the initial purchase cost and ongoing operating expenses.

By carefully evaluating these factors, you can select a vacuum pump that provides the best performance, reliability and customer experience for your application. BP

About the Author

Michael Ruff has over 17 years of industrial vacuum pump experience. He specializes in providing clear solutions for complex vacuum pump challenges.

About Becker Americas

Becker is a leading provider of vacuum pumps, air compressors and regenerative blowers. Its global headquarters is in Wuppertal, Germany, and its American headquarters is in Cuyahoga Falls, OH. For more information, visit https://beckerpumps.com.

The Kawasaki Heavy Industries MAG Turbo M55 connected to a blower test stand for a wastewater plant project.

Dual Point Aeration Blower Control

By Tom Jenkins, President, JenTech Inc.; Jun Inai, Senior Design and Project Engineer, and Hayato Sakamoto, Principal Project Leader, Kawasaki Heavy Industries

A significant objective for aeration system blowers is matching the air supplied to the process demand. Because of variability in process demand, turndown of the aeration blower system is a critical parameter. Of course, it is also important to provide the required air flow at a high efficiency. These two parameters – efficiency and turndown – are critical to system optimization.

Process variability causes system demand to frequently deviate from the design points for flow and pressure. It is common for an aeration system to need a turndown in flow rate of 5:1 or more. This is often accompanied by variations in the discharge pressure. It is not unusual for the actual discharge pressure to be 1.0 psig lower than the design point.

Aeration blowers must operate across a wide range of inlet densities, and the changes in inlet conditions impact aeration blower performance. Density variations are primarily due to differences in ambient temperatures encountered.

The Kawasaki Heavy Industries MAG Turbo M55

This combination of varying demands presents a challenge to aeration blower suppliers. The design point is usually selected to ensure operation in worst case conditions. However, evaluating performance at the design point is only one consideration. During aeration blower selection it is also common to evaluate performance at multiple air flows, discharge pressures and inlet conditions. The assumed duty cycle is intended to reflect the anticipated operating range. This, in turn, is used to estimate the life cycle cost of operating the aeration blower.

The Difference in Single Point and Dual Point Control

Single stage centrifugal aeration blowers have established a reputation for reliability and efficiency. They are commonly applied to supply air to wastewater aeration basins. These aeration blowers are available in both geared and direct coupled (turbo) configurations.

There are a number of methods employed in modulating the airflow of centrifugal aeration blowers, including:

- Inlet throttling, typically using a butterfly valve (BFV)
- Variable inlet guide vanes (IGV)
- Variable discharge diffuser vanes (VDV)
- Variable speed, typically using a variable frequency drive (VFD)

Dual Point Aeration Blower Control

Each of these methods is typically employed separately. This is referred to as single point control. It is also possible to combine two of these methods in a single blower. This is referred to as dual point control. The objectives of dual point control are to provide high turndown and good efficiency while operating at flows and pressures differing from the design point.

Historically, the most common dual point control has been combining inlet guide vanes and variable discharge diffuser vanes. These are both mechanical systems and predate the availability of economical variable speed control.

Recent advances in power electronics technology and improved VFD economics have led to implementing other combinations for dual point control. These include combining VFD control with either VDVs or IGVs.

Aeration Blower Control Techniques

A common aeration blower performance curve plots discharge gauge pressure and inlet volumetric flow at a specific set of conditions. All control methods shift and change this aeration blower performance curve. This results in changing the intersection point of the performance curve with the system pressure curve, modulating the flow rate. Each method has a different effect on the performance curve.

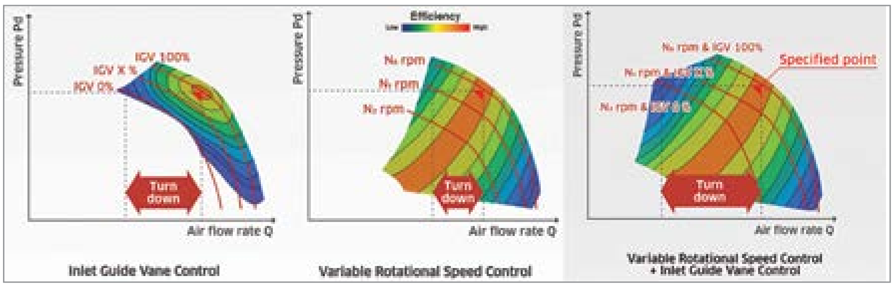
Throttling with a BFV results in a lower and steeper curve. This method is inherently inefficient. It wastes power by creating a pressure drop across the inlet valve. However, it has the lowest initial cost.

The result of IGV control is lower pressure and air flow rate, shifting the blower curve downward and to the left. IGVs change the operating characteristics of the impeller by swirling the air ahead of the impeller. As the IGVs close they present a growing obstruction to air flow, resulting in a throttling effect. This results in some inefficiency and also makes the curve steeper.

VDVs change the conversion of velocity pressure to static pressure in the aeration blower volute. VDV control shifts the aeration blower curve to the left, resulting in a lower airflow for a given pressure.

Using a VFD for control moves the performance curve down and to the left but does not induce any throttling. Varying the blower operating speed is the most efficient method of flow modulation. Centrifugal blowers follow the affinity laws. These dictate that flow is proportional to speed, pressure is proportional to the square of the speed, and power is proportional to the cube of the speed. With VFD control, minimum speed is often limited by the discharge pressure capability at reduced speed.

An aeration turbo blower with dual point control



The effect of combining control techniques on aeration blower performance curves

Calculating the Benefits of Dual Point Control

One example of advanced dual point control is the MAG Turbo from Kawasaki Heavy Industries. This design combines IGV and VFD control. It uses a proprietary control algorithm to coordinate the two mechanisms in the dual point control system. The algorithm optimizes the combination of rotational speed and IGV opening in response to fluctuations in flow rate, inlet conditions and discharge pressure. The effect of combining IGV and VFD into dual point control is improved turndown while maintaining high efficiency.

The impact of dual point aeration blower control on off-design operation can be illustrated by an example application. The design point provided by the end user for aeration blower selection was 25,000 scfm (708 sm³/min) at 9.5 psig (0.7 barg) discharge pressure with 14.7 psia (1.014 bar) ambient pressure. Design point inlet conditions were 98°F (37°C), 14.4 psia (0.993 bar), and 40% relative humidity corresponding to the worst case.

The end user also provided a variety of anticipated flows, pressures and inlet conditions for evaluating life cycle cost.

A set of dimensionless performance parameters were developed by the manufacturer from test data. These parameters were interpolated to calculate the performance at the design point and alternate evaluation points. Separate calculations were made for IGV control, VFD control and dual point control. (See **Table 1**.)

Table 1: Performance Data at 14.7 psia (1.014 bar) Ambient Pressure, 40% Relative Humidity

Flow, scfm	12,500	15,625	18,750	21,875	25,000
Inlet temperature, °F	23	32	50	50	68
Inlet press. psia	14.6	14.6	14.6	14.5	14.4
Discharge press. psig	9.5	9.5	9.5	9.5	9.5
Input power with IGV alone, kW	659 Blow-off Open	644 Blow-off Open	701	784	892
Input power with VFD alone, kW	649 Blow-off Open	655 Blow-off Open	672 Blow-off Open	737	868
Input power with dual point control, kW	469	557	654	737	868

Centrifugal aeration blower turndown is limited by the possibility of surge. Surge is a damaging pulsation in flow rate and pressure that occurs when the system pressure is greater than the aeration blower is able to produce. If the aeration blower's minimum flow exceeds the process demand it is necessary to waste the excess air by venting it to atmosphere through a blow-off valve. This is an inefficient method of flow control. As indicated in the table, opening the blow-off was required for several evaluation points when controlling with only IGV or VFD. Because of the improved turndown with dual point control, the blow-off was not needed.

The results demonstrate that dual point control combining an IGV and a VFD provides more turndown than either IGV or VFD control alone. The data also shows power consumption at the alternate evaluation points is improved by dual point control. This is particularly true in the low

Dual Point Aeration Blower Control

flow range because the improved turndown eliminates opening the blow-off valve.

The end user provided an assumed time of operation for each alternate evaluation point. This information was used to estimate the total annual power consumption for each point. (See **Table 2**.)

Dual point control reduces the calculated annual power consumption by 8% compared to IGV alone. Compared to VFD control alone the savings are 5%. If electricity cost is $0.10/kWh, dual point control reduces the annual cost of electricity by $30,000 compared to VFDs alone and by $50,000 compared to IGVs alone.

Conclusion

Aeration blowers are critical process equipment in aeration applications. Optimizing energy consumption is a significant objective in selecting aeration blower system technology. Reduced energy use lowers operating costs while enhancing sustainability through reduced CO_2 emissions from power generation.

Turndown is key to matching aeration blower output to process demand. Good turndown is essential for both process performance and energy efficiency.

In addition to supporting variations in air flow demand, the aeration blower must accommodate a wide range of operating conditions. The variations in inlet density from ambient temperature changes add to the difficulty of optimizing performance. The control system design will influence turndown and efficiency when the aeration blower operates off the design point.

Dual point control has been used for many years. Originally dual point control was mechanical, combining IGV and VDV. Advancements in technology have resulted in the availability of low-voltage and medium-voltage VFDs for economical speed control. These improvements have led to the use of variable speed operation as part of dual point control strategies. A dual point control system provides excellent turndown

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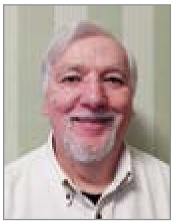
at high efficiency, both keys to optimizing aeration blower applications. Innovative systems that combine variable speed and guide vanes provide better performance, improved turndown and higher efficiency than older systems with mechanical controls alone. BP

Table 2: Estimated Annual Power Consumption						
Hours per year	438	1752	3066	2190	1314	**Total kWh**
Annual kWh, IGV alone	289,000	1,128,000	2,149,000	1,717,000	1,172,000	**6,455,000**
Annual kWh, VFD alone	284,000	1,148,000	2,060,000	1,614,000	1,141,000	**6,247,000**
Annual kWh, dual point control	205,000	976,000	2,005,000	1,614,000	1,141,000	**5,941,000**

About the Authors



Tom Jenkins has over 40 years of experience in aeration blowers and blower applications. As an inventor and entrepreneur, he has pioneered many innovations in aeration blower control. He is an Adjunct Professor at the University of Wisconsin at Madison and a Fellow of the Water Environment Federation. For more information, visit http://www.jentechinc.com/.

Jun Inai is a Senior Design and Project Engineer with over 30 years of experience in R&D and the design of turbomachinery including compressors for air and other gases, blowers and turbines at Kawasaki Heavy Industries. In recent years, he has focused on energy conservation and plant optimization using the MAG Turbo aeration blower.

Hayato Sakamoto leads the Kawasaki MAG Turbo aeration blower project. With over two decades of experience in the development and applications of blowers, compressors for air and other gases, and natural refrigerant chillers, he specializes in the aerodynamic technology of rotating machinery. He designed the highly efficient impellers and diffusers forming the core technology of the MAG Turbo.

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With about 100 group companies in Japan and overseas, Kawasaki Heavy Industries is a technology corporate group. Through the development of unique and broad businesses, it solves issues facing customers and society. For more information, visit https://global.kawasaki.com.

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