KAESER COMPRESSORS

Blower System Installation Guide

Layout Considerations for a Reliable, Energy Efficient, and Safe Blower System

By Kaeser's Blower and Engineering Experts

About the Authors

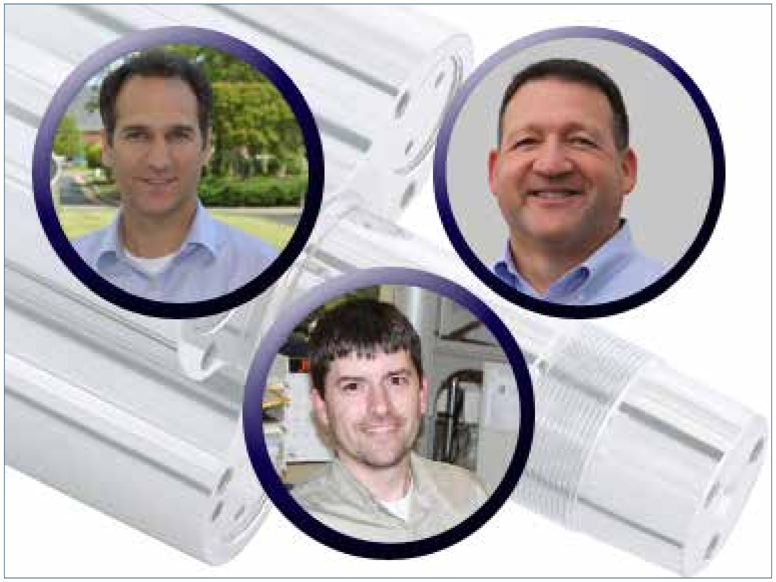
This e-book was written for you by Kaeser's blower system experts.

At Kaeser, we believe the more you know about operating blower systems, the more you'll get out of them. That's why we're committed to offering you the most current information you need to wisely install, operate, and maintain yours.

Our goal is to help you install the most successful blower system possible. The tips, guidelines, and warnings included in this e-book are meant to do just that.

While the information included in this e-book is comprehensive, we recognize that each system and application is unique. Applying the principles you read here is an excellent place to start. For the best in system optimization that is tailored to your needs, contact us for additional support.

Throughout the e-book, there are boxes with efficiency tips and additional resources. The links included in those will take you directly to more information that our engineers and blower system experts have selected specifically to further assist with your blower system.



"Our goal is to help you install the most successful blower system possible. The tips, guidelines, and warnings included in this e-book are meant to do just that."

Tip:
Look for these boxes throughout the e-book for additional tips.

More Resources:
Additional resources are in these boxes. Want to hear the latest Kaeser news?
Visit www.kaeser.com/connect

Table of Contents

Introduction

Blowers are vital pieces of equipment in a variety of different applications. Many plants face shut down when there is any kind of problem or issue with their blower system, that's why proper planning is essential before installing a new system. If you are upgrading an existing system, you may be faced with physical restrictions requiring creative solutions. Whether installing a brand new system or upgrading an existing one, the information contained in this e-book will assist you in identifying the best configuration and in getting the best possible performance from your blower system.

For the purposes of this e-book, it's assumed you have already identified pressure, flow, and blower sizing requirements. If you are unsure how to determine these for yourself, we strongly recommend you contact a blower system specialist to accurately measure these parameters for you.

This e-book should be used as a supplement to the service manuals with your Kaeser blower equipment. These contain installation information pertaining to the specific model(s) purchased.

Diagrams in this e-book are presented only as examples. They are not necessarily the best way of installing your particular system. If you need assistance, consult your local authorized Kaeser representative for expertise installing blower systems.

> "The information contained in this e-book will assist you in identifying the best configuration and in getting the best possible performance from your blower system."

Receiving Equipment

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General Tip

Receiving Equipment

Receiving your shipment is one of the first considerations in preparing your new installation. Freight damage happens. It's important to protect yourself. Be sure to thoroughly inspect your commercial freight before you sign for it. Our freight tips video has everything you need to know to successfully receive any kind of commercial shipment.

In summary:

- Don't sign until you have inspected
- Check the Tip n' Tell indicators
- Open the packaging
- Look for signs of replaced packaging

> "Be sure to thoroughly inspect your commercial freight before you sign for it."

Location

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Placement Affects Performance

Location: General Tip

Kaeser's Com-paK™ blower packages are designed for side-by-side installation—no additional clearance is needed. For integrated and screw blower packages with variable frequency drive, we recommend clearance of 30 - 36 inches on the drive cabinet side only (for access and ventilation).

> "Com-paK™ blower packages are designed for side-by-side installation."

Tip:
Consult your local NEC code for rules and regulations on drive cabinet clearances for packages with variable frequency drive.

Location: Floor

No special foundation or base is needed for Kaeser's blower packages. The blowers should be placed on a level surface able to withstand the combined load of the blower and the equipment used to move it into place.

Location: Anchoring

Though Kaeser blowers have minimal vibration, many customers choose to anchor all their blowers. Anchoring the blower package should be according to the drawing found in the service manual.

Location: Access

The entrance to the blower room must be large enough to accommodate both the blower package and the equipment used to move it into place (such as a forklift, crane, or pallet truck). The space designed for the blower system must provide enough clearance to:

- Maneuver the unit into place
- Open maintenance doors and access panels
- Remove and replace components
- Provide adequate ventilation.

Kaeser has designed its blower packages so that the internal components can be easily accessed from the front. Do not defeat this feature by blocking the maintenance doors. Your service manual includes dimensional drawings for your specific model.

> "Kaeser has designed its blower packages so that the internal components can be easily accessed from the front."

Tip:
Contact us for help planning your installation to ensure proper clearances for service and your plant equipment.

More Resources:
Check out some of our more creative system design solutions in this blog entry.

Location: Environmental Considerations

Be mindful of how the system temperature impacts equipment operation and make sure temperatures remain within the manufacturer's stated temperature ranges.

Low temperature may impede the proper flow of some types of lubricant and promote moisture condensation. For lower ambient temperature applications, Kaeser offers a sound enclosure heater option to protect the blower package.

High ambient temperatures, on the other hand, often result in reduced lubricant life. They may also result in excessively high approach temperatures. Kaeser's lobe blower packages are designed to operate in ambient temperatures up to 104°F and screw blowers, 113°F. Operating the blower packages at higher temperatures than indicated can affect performance, cause component damage, and may also void the warranty.

"Kaeser's lobe blower packages are designed to operate in ambient temperatures up to 104°F and screw blowers, 113°F."

Location: Outdoor Installations

While it's best to install any type of blower indoors, if it must be installed outdoors, it should have protection from rain and snow. Note that the integrated and screw blower packages with wye-delta start or variable frequency drive should never be installed outdoors.

Weather hoods: If there is no shelter provided for the blowers or if wind driven rain or snow can reach the packages, weather hoods must be added to the air inlet and exhaust of the cabinet exterior. These are available from Kaeser factory installed or as a retrofit kit.

Sound enclosure heaters: If the ambient temperature drops below 23°F, (but is still above 5°F), a sound enclosure heater must be installed. Sound enclosure heaters are designed to to raise the machine temperature to about 50°F. This ensures proper oil viscosity during start-up and inhibits moisture collecting in the sound enclosure. It is thermostatically controlled to shut off when 41°F is reached within the sound enclosure is reached. They are available from Kaeser factory installed or as a retrofit kit.

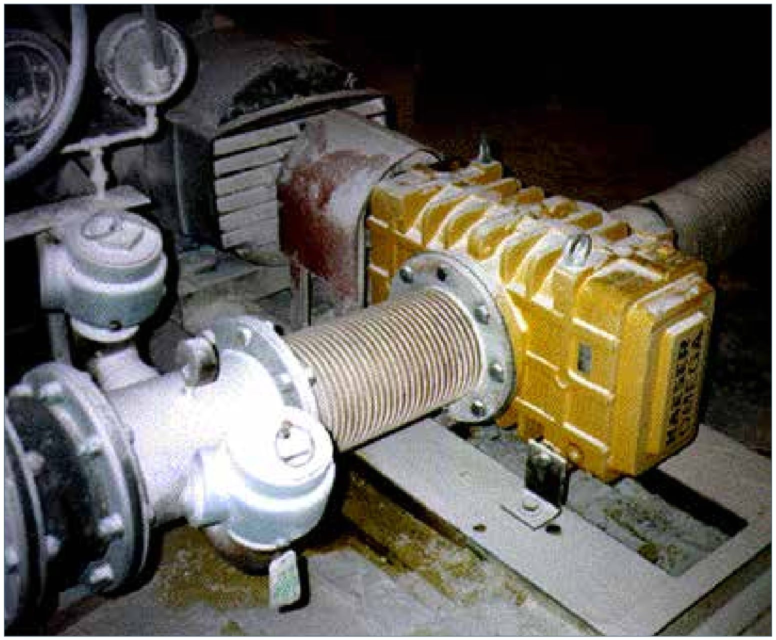
> "Integrated and screw blower packages with wye-delta start or variable frequency drive should never be installed outdoors."

Introduction
Receiving Equipment
Location
Ventilation
Electrical Supply
Piping
Package Integration
Building an Efficient System
Preventive Maintenance
Safety Advisories
Additional Resources
Appendices

Location: High-dust Environments

Blowers are often in dusty areas or applications. Protecting blowers from ingesting particulate and keeping dust/dirt from building up on components will extend service life and maintenance intervals.

Kaeser blower packages come standard with inlet silencers/filters equipped with differential pressure indicators to signal when service is needed. Enclosures are also highly recommended to reduce particle load on inlet air and to prevent particulates from building up on drive components.



"Kaeser blower packages come standard with inlet silencers/filters equipped with differential pressure indicators to signal when service is needed."

More Resources:
Contact your local authorized Kaeser representative for accessories for a high-dust environment.

Introduction
Receiving Equipment
Location
Ventilation
Electrical Supply
Piping
Package Integration
Building an Efficient System
Preventive Maintenance
Safety Advisories
Additional Resources
Appendices

Ventilation

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Ensuring Proper Cooling and Equipment Longevity

Ventilation

Proper ventilation is key to ensuring optimal equipment performance and longevity. Failure to properly plan and ventilate the blower room can cause equipment downtime, increased maintenance intervals, and reduced performance.

The room's ventilation openings should be fitted with louvers or some other silencing device to limit noise in the surrounding environment. An exhaust ventilation fan can be installed in the room to provide forced ventilation. Arrange room ventilation openings so the current of cooling air flowing through the room passes over the blower inlet and exhaust ports. If possible, eliminate stagnant air in the room. Avoid thermal short circuit - discharged cooling air must not find its way to the cooling air inlet. Also, do not position the blower so close to a wall that the cooling air flow inlet is obstructed.

> "Failure to properly plan and ventilate the blower room can cause equipment downtime, increased maintenance intervals, and reduced performance."

Tip:
Check Blower Installation Data Sheets for ventilation recommendations.

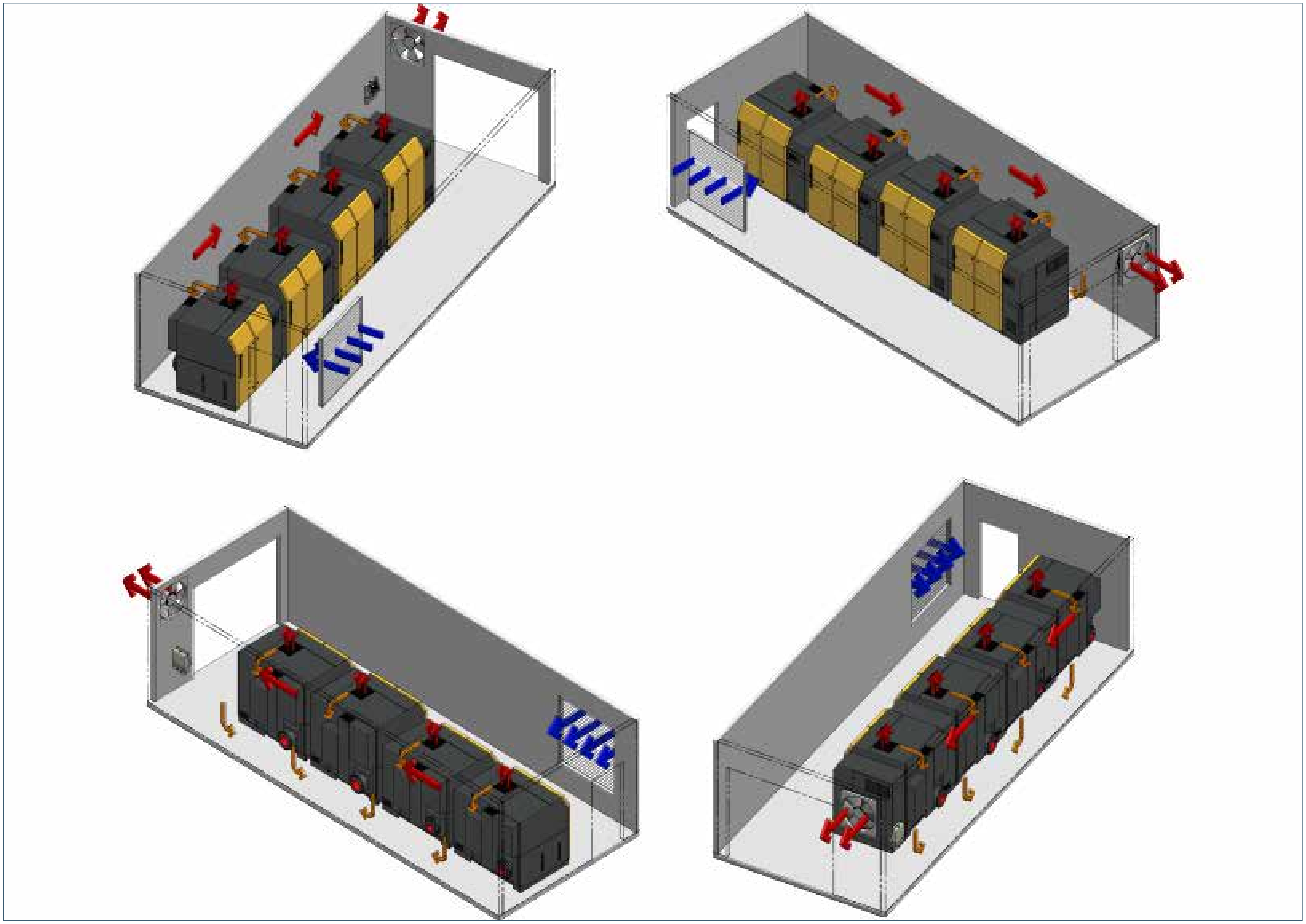
Ventilation

If the blower is located in the middle of a large room, its exhaust air can be extracted by a duct above the exhaust port. While this air is not likely to be warm enough for process use, it could be recovered and used to warm other areas of the plant and reduce heating costs. If no duct is required, extract the exhaust air from the upper third of the room as this is where the heat collects.

The installation diagrams on the following pages show examples of proper blower room ventilation. For formulas for calculating the volume flowing into the room, ventilation fan capacity, and effective cross-section of ventilation openings, see Appendix B.

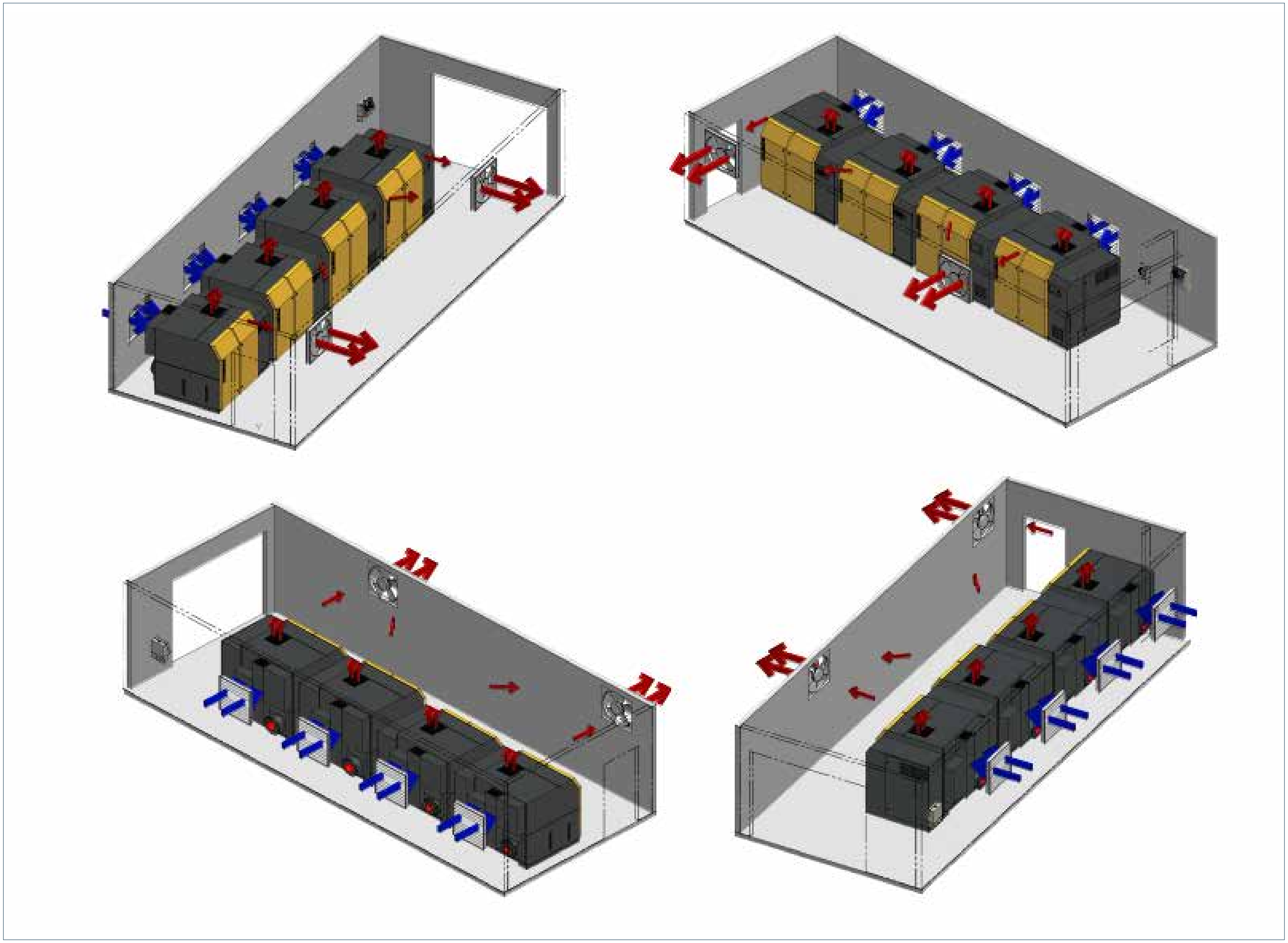
Ventilation

This example shows a poorly ventilated blower room. The orange arrows indicate air that is short circuiting or preheated cooling air at the blower inlets.



Ventilation

This example shows a properly ventilated blower room. The airflow is properly pulled across the blower packages and preheating of the air is prevented. Although not shown here, it is also important to insulate any exposed discharged piping.



Electrical Supply

Important Warnings to Follow

Electrical Supply

Before installing the blower package, check to ensure that your electrical service voltage matches the voltage on the blower nameplate (located inside the electrical cabinet or the tag on the outside of the machine). Whether your blower is a dual or a tri voltage model, ensure it is internally wired for the proper voltage.

WARNING: Actual operating voltage must be within +/- 10% of blower nameplate voltage. Damage or failures due directly or indirectly to insufficient or excessive voltage may not be covered under warranty. Consequently, Kaeser does not recommend operating a 230-volt system on a 208-volt circuit, for example.

Kaeser recommends that each blower have its own dedicated electrical circuit and disconnect panel. This makes it possible to lock out and tag out an individual piece of equipment without having to shut down other equipment that may be on the same panel. Disconnects should eliminate power from the entire machine including all accessory equipment and instruments.

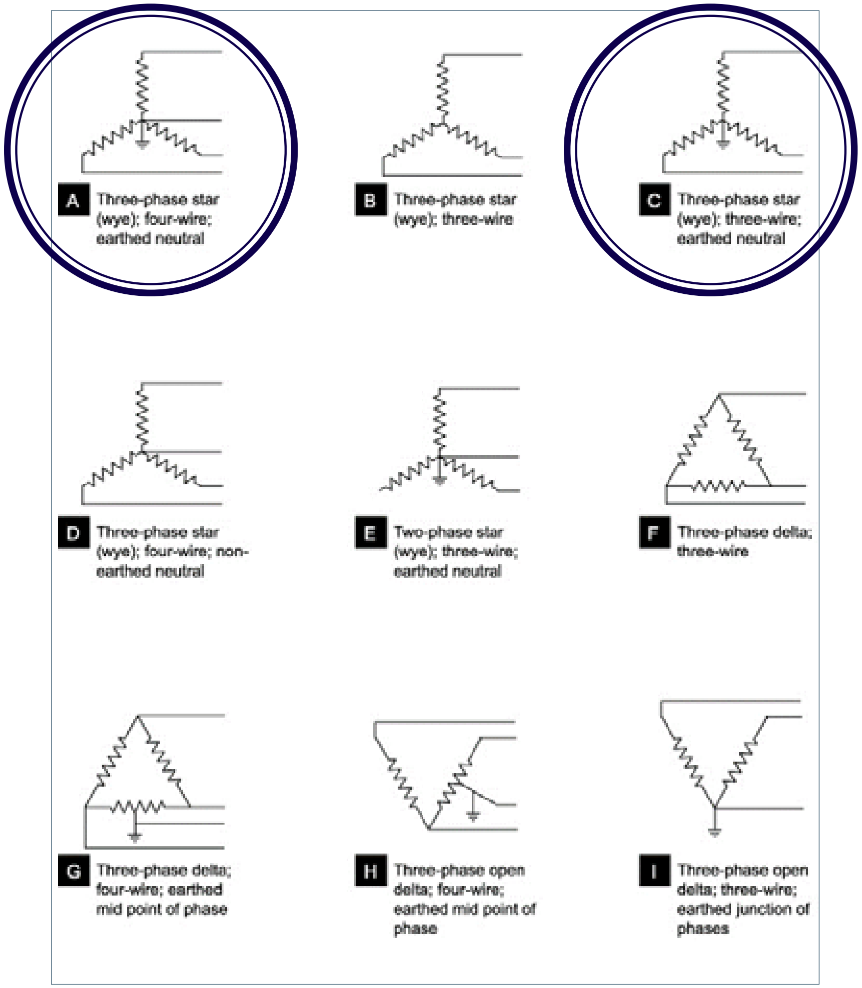
Electrical planning should include wiring for a master controller (multi-unit control device) if it is to be installed.

The blower should be properly grounded. Install an appropriately sized fuse or circuit breaker between the blower and main electric service. Consult the NEC and local electrical codes regulations for sizing guidelines.

Electrical Supply

For variable frequency drive units, make sure that the power supply transformer has a symmetrical, three-phase supply. In a symmetrical three-phase supply, the phase angles and voltages are all the same.

Kaeser's VFD units require a symmetrical power supply transformer with a wye configuration output. The circled configurations indicate the two acceptable options for Kaeser's VFD packages. Ground wire should be equally sized to the power conductors.



Tip:
Consult the NEC Code and local regulations for guidance in determining the acceptable limits for ground electrode impedance.

Electrical Supply

WARNING: Insufficient and/or improper grounding practices may lead to premature motor or VFD component failure.

WARNING: Never use air piping or electrical conduit as a means of grounding.

WARNING: All wiring and electrical connections must be performed by a qualified electrician in accordance with NEC and local electrical codes. Supply conductors must be properly sized in accordance with all applicable national and local codes.

WARNING: The electrical service disconnect should be within sight of the blower and have an easily recognizable lock-out tag.

WARNING: Some projects/installations will have limits on Total Harmonic Distortion (THD). THD limits must be clearly defined by the methods outlined in IEEE 519. To achieve a desired THD value, additional external ancillary devices may be required. These devices may either be a passive harmonic filter or an active harmonic filter. All Kaeser packages include passive harmonic filters, but may not meet stringent project requirements.

Piping

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Impact of Pressure Drop and Piping Materials

Piping

Pressure drop directly affects blower temperature, and consequently, blower efficiency. Positive displacement blowers use external compression. This means the more resistance there is to airflow, the more energy they will consume. Additionally, while a blower may be designed for 15 psig, it will only operate at 15 psig if there is enough resistance to the airflow that would require 15 psig pressure from the blower.

Limiting pressure losses between the blower and the point of use reduces the load on the blower as well as the kW consumption of the machine, leading to lower operating temperatures and lower electrical costs.

Using larger diameter piping and eliminating elbows and T's whenever possible will help keep pressure drop as low as possible.

Above image shows an ample sized header with insulation to limit heat transfer to the package cooling air.

> “Reducing pressure losses leads to lower operating temperatures and lower electrical costs.”

Piping: Materials

Piping materials can also impact pressure drop as some materials are more prone to contaminant build-up.

Kaeser strongly cautions against using PVC piping. While it is a cheap, readily, available material, it's important to understand its limitations. PVC piping is not recommended for operating temperatures above 140°F—this includes Schedule 40 and 80 piping. In fact, any time the temperature is above 20°C (68°F), a thermal derating factor must be applied to determine the maximum allowable working pressure. Additionally, pipe diameter affects the derating factors as larger diameters are de-rated faster.

If you have PVC piping or are considering using it, make sure to understand how your particular installation's operating conditions will affect it. From a pressure drop, as well as a safety standpoint, it's probably best to use a different material.

“PVC piping is not recommended for operating temperatures above 140°F—this includes Schedule 40 and 80 piping.”

Burst PVC piping from a compressed air installation.

More Resources:
For more information on the dangers of using PVC piping, read our blog entry.

Package Integration

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Blower and System Controls

Package Integration

The most significant recent advances in blower technology have been in package integration. A complete package design reduces time spent engineering and purchasing individual components. Additionally, each component is selected for optimal efficiency and to work together to achieve the best package performance. Integrated machines are often equipped with a suite of sensors and onboard controller which monitor package performance and health. As factory built machines, they come with full documentation, testing, and stated performance values, e.g. CAGI data sheets.

Since energy management is an important consideration for any plant, proper controls should always be addressed in any blower system. When addressing the issue of controls, there are individual unit controls to consider as well as broader system controls that manage and coordinate the overall low pressure air system.

> "A complete package design reduces time spent engineering and purchasing individual components."

More Resources:
Visit CAGI's website for more information on their testing standards.

Package Integration: Blower Controls

Individual unit controls can range from very basic packages with essential pressure and vacuum gauges, to more comprehensive packages that also include temperature, oil level and filter monitoring sensors, as well as remote monitoring capabilities.

The choice depends greatly on the application and overall sophistication level of the installation. Smaller, individual unit applications may require only basic controls. These local or individual unit control options are often either a fixed speed mode or pressure regulation (VFD) where the unit maintains a desired discharge pressure which is set locally. However, larger multiple unit installations will want to take full advantage of the benefits more in-depth controls provide. Especially if they are incorporating variable frequency drive units, master controllers, or if they will be integrating the system into larger plant management systems. Adaptive control schemes often offer the best efficiency and performance and require more extensive unit controls.

> “The choice of control depends greatly on the application and overall sophistication level of the installation.”

Package Integration: System Controls

System controls vary in scope as well. When looking for a master controller, consider its overall ability to integrate with your existing network communications. Does it have communications interfaces that will easily connect with your SCADA system? If your blower system is in an isolated location, consider looking for a master controller with advanced remote monitoring and also maintenance tracking and notification capabilities. As the Internet of Things continues to expand, package and communication integration will become even more important to a plant's energy and asset management strategy.

For more information, see the Master Controllers section.

> "When looking for a master controller, consider its overall ability to integrate with your existing network communications."

More Resources:
Click here to read our blog entry on the benefits of adaptive control systems.

Introduction
Receiving Equipment
Location
Ventilation
Electrical Supply
Piping
Package Integration
Building an Efficient System
Preventive Maintenance
Safety Advisories
Additional Resources
Appendices

Building an Efficient System

Package vs. System Efficiency

Building an Efficient System

System engineers do their best to combat wasted energy by selecting energy efficient equipment. This has led to an increased focus on energy and has helped spur innovations in blower technology. Blower manufacturers are taking advantage of the increasing interest in “wire-to-air efficiency” to promote these new technologies, which can produce more efficient blowers for certain performance points.

Wire-to-air efficiency is simply the total energy used to provide the specified flow and pressure and is expressed as a ratio of the power to the flow. While this metric is relatively new to the blower market, it is widely used for industrial compressors and compressed air systems and is often referred to as specific performance. Standards developed by groups like ISO, CAGI, PNEUROP, and ASME provide testing guidelines for specific performance comparison.

“Wire-to-air efficiency is simply the total energy used to provide the specified flow and pressure and is expressed as a ratio of the power to the flow.”

More Resources:
Click here to download a copy of our whitepaper on energy efficient system design for wastewater treatment plants.

Introduction
Receiving Equipment
Location
Ventilation
Electrical Supply
Piping
Package Integration
Building an Efficient System
Preventive Maintenance
Safety Advisories
Additional Resources
Appendices

Building an Efficient System

Whether using the term wire-to-air or specific power, it is important to differentiate between each individual piece of equipment's efficiency and the overall system efficiency. Be careful of focusing on individual blowers instead of considering how each piece will work with one another. Even if you select the most energy efficient blowers, if they aren't properly applied and controlled, they won't yield the anticipated energy savings. This is why system specific power is crucial in system design.

System specific power takes into account the combined efficiency of all package, component, and in the case of variable frequency drive units, drive losses. With this machine information, the combined performance of these machines can be allocated to selected operating points of system demand to determine the overall blower system performance. From here, these results can be compared from solution to solution and across blower technologies.

Don't be fooled by the efficiency curves of an oversized blower. If the blower will not be operating in its optimum performance curve for your application, it will not deliver the energy efficient savings you are expecting.

> "Even if you select the most energy efficient blowers, if they aren't properly applied and controlled, they won't yield the anticipated energy savings."

More Resources:
Our System Splitting video explains how to design an energy efficient blower system. Click here to view it.

Building an Efficient System: Avoiding Control Gap

Using variable frequency drives (VFD's) to optimize process low pressure air systems offers many advantages. When properly applied, VFDs are an excellent choice in variable flow applications. Blowers with VFDs can be used as stand-alone units and also have an important role to play in larger more complex control schemes. However in either case, sufficient attention must be paid to factors such as proper connection methods, grounding, managing electromagnetic interference (EMI) with communications, and proper parameterizing.

Additionally, care must be taken in sizing the system to avoid control gap, which causes system fluctuations and leads to unnecessary energy inefficiencies.

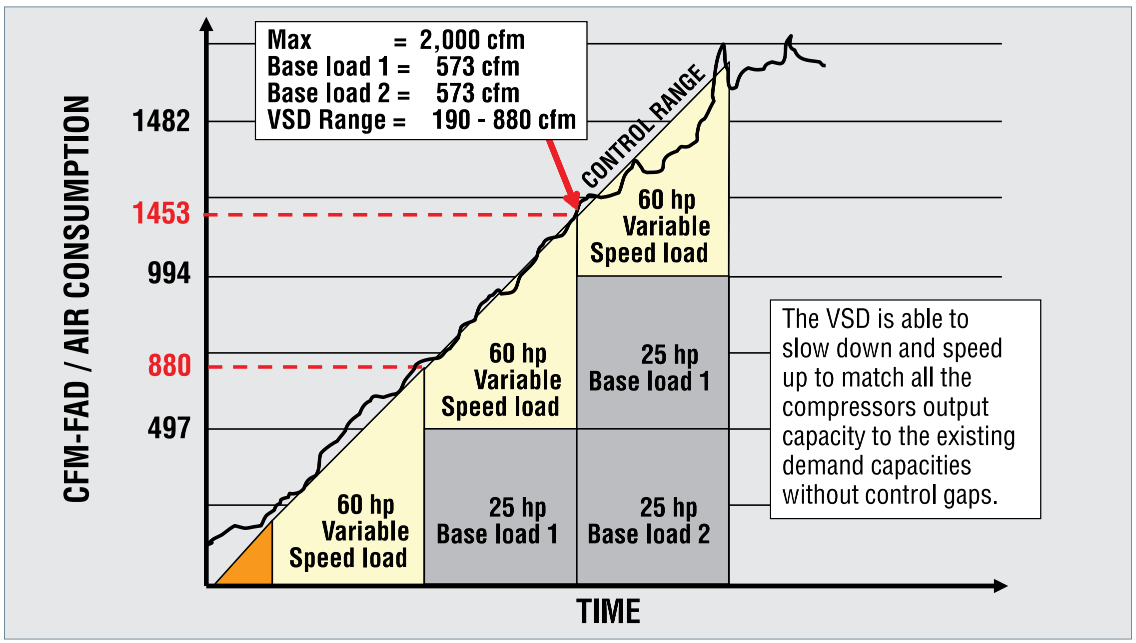
> “Blowers with VFDs can be used as stand-alone units and also have an important role to play in larger more complex control schemes.”

Building an Efficient System: Avoiding Control Gap

Control gaps are flaws in the system design that occur when the control range of the variable frequency blower is not considered. The majority of the time, this happens because a variable frequency drive blower is selected that is the same size or smaller than the fixed speed blowers in the system.

This graph shows a system designed to avoid a control gap. It can provide a steady airflow to meet a system design variable (e.g. DO, pressure) through the flow range of the system since it is properly sized and controlled by a system master controller, like Kaeser's Sigma Air Manager (SAM).

"Control gaps are flaws in the system design that occur when the control range of the variable frequency blower is not considered."



More Resources:
Control gaps can happen in any type of installation with a VFD and multiple fixed speed units.
Click here to read our "Mind the Gap" blog entry.

Introduction
Receiving Equipment
Location
Ventilation
Electrical Supply
Piping
Package Integration
Building an Efficient System
Preventive Maintenance
Safety Advisories
Additional Resources
Appendices

Building an Efficient Sytem: Master Controllers

If you have more than one blower feeding the same system, you should consider system master controls. Master controllers control multiple blowers more efficiently while maintaining pressure stability and rotating like-sized units to equalize service hours.

A master controller's computing capacity enables it to rapidly recognize changes in demand and always select the most efficient combination of blowers to meet it.

Tip:
Advanced master controllers can monitor a specific system variable (such as dissolved oxygen) and trigger an alarm it the variable falls below a specific threshold value.

Building an Efficient System: Master Controllers

Benefits of Master Controllers:

Save Energy:
- Run blowers less
- Match air production to demand
- Reduce kW/cfm production
- Maintain blower package rotation schedule
- Minimize system pressure (if pressure regulating)

Reduced Maintenance Costs:
- Less cycling and switching = longer valve life
- Fewer motor starts = longer motor life
- Balanced blower package operating hours and fewer PM visits

Improve Operations with More Stable System Design Variable:
- Improve production equipment performance
- Less downtime due to pressure alarms
- Less scrap and product quality problems

Kaeser's Sigma Air Manager (SAM) makes it easy to control and monitor up to 16 blowers. There are numerous control schemes that you can easily customize to best meet your needs. The controls you implement will directly impact your facility's productivity and energy efficiency.

“ The controls you implement will directly impact your facility's productivity and energy efficiency. ”

More Resources:
Contact your local authorized Kaeser representative for sample control schemes and for help customizing a solution for your system.

Preventive Maintenance

{ *Keeping Your System Up and Running*

Preventive Maintenance

All mechanical and electrical equipment requires varying degrees of attention to ensure it operates efficiently. Since most systems rely heavily on an uninterrupted supply of flow, it makes sense to invest in preventive maintenance rather than suffer downtime and repairs.

It's highly recommended to establish a regular maintenance routine to ensure proper operation of all parts of your blower system and maintain a service log for each component. Regular preventive maintenance will ensure optimal performance and longer equipment life.

Your blower service manual has specific service recommendations. Follow all recommended maintenance procedures. Taking the few minutes to perform these checks will maintain the quality of your flow and equipment, reducing the costs associated with repairs and lost production.

Kaeser's integrated and screw blower packages come equipped with computerized controllers which monitor equipment health and operation in real time, as well as provide maintenance interval reminders. They offer the capability to send these messages to plant control systems or provide messaging to plant personnel responsible for the equipment.

> "Regular preventive maintenance will ensure optimal performance and longer equipment life."

Tip:
Need a service manual? Contact your local authorized Kaeser representative.

More Resources:
Click here to take flight and explore our screw blower packages.

Preventive Maintenance: General Guidelines

Below is a general list of maintenance items to monitor. Check your service manual for more recommendations. Keep in mind that, based on your application and operating environment, you may need to adjust the frequency. Contact your local authorized Kaeser representative with any additional questions.

- Check oil level via sight glasses: at least monthly
- Check belt tension visual indicator: at least monthly
- Tighten electrical connections: after first 50 hours and annually thereafter
- Change oil: after first 500 hours and at least annually thereafter
- Check diff pressure indicator on silencer and enclosure at least monthly
- Replace air inlet filter/silencer: at least annually
- Check safety valve and other safety device operation: annually
- Lubricate/replace motor bearings: at least every three years (permanent)/ five years (regreasable)
- Replace belt set: at least every three years
- Install check plate kit: every three years
- Install start valve kit: every three years (if applicable)
- Check compensator/ hose lines: every eight years

"Keep in mind that, based on your application and operating environment, you may need to adjust the frequency of the service intervals."

Preventive Maintenance: General Guidelines

In addition to regular checks by your plant personnel, an effective preventive maintenance program should include regular professional servicing. Standard services are usually performed at manufacturer recommended intervals, but may be recommended more often depending on the usage and operating environment.

Kaeser has a factory-trained, national distribution network that is always ready to assist you with your maintenance needs. Contact your local authorized Kaeser representative to schedule a service appointment.

WARNING: Lack of proper maintenance may invalidate any warranty claims if failures are directly related to a failure to perform routine preventive maintenance. A preventive maintenance contract with your local Kaeser representative is a means of having this work carried out properly.

CAUTION: Before performing any work, be sure to follow OSHA recommendations for electrical lock-out/tag out.

Introduction
Receiving Equipment
Location
Ventilation
Electrical Supply
Piping
Package Integration
Building an Efficient System
Preventive Maintenance
Safety Advisories
Additional Resources
Appendices

Safety Advisories

Health and Safety Considerations

Safety Advisories: Health and Safety Considerations

Installation should be conducted in a safe manner in accordance with OSHA and appropriate local regulations. Compressed air can be dangerous and should never be directed towards people. Improper and unsafe contact with compressed air can cause eye damage, subcutaneous embolisms, and other serious injuries, including death.

When working in a lift, technicians should use a proper harness and rigging.

Qualified technicians must perform electrical work in a safe manner using UL approved materials and properly insulated tools, equipment, and appropriate personal protective equipment (PPE) for the work. All applicable local, state, and national regulations must be followed.

The blower system must be installed so that normal operation poses no threat to work health or safety. The system must be sufficiently ventilated so that it poses no health threat to persons nearby.

Hearing protection must be worn in accordance with OSHA standards. Where applicable, prominently display signs warning of noise hazards. Blower operating sound levels are listed in Kaeser service manuals.

Follow OSHA recommendations for electrical lock-out/tag out.

Follow all safety recommendations in the manufacturer's service manual.

Additional Resources

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More Tips and Resources

Additional Resources

- www.kaesertalksshop.com: Our company blog features posts on a wide range of compressed air topics written by our subject matter experts and is updated regularly. You can also sign up to follow the blog to receive updates whenever there is a new post.

- www.kaeser.com/cagi: Kaeser is a member of the Compressed Air and Gas Institute (CAGI), a non-profit organization of competitive companies that manufacture air and gas compressor and related equipment.

- www.kaeser.com/resources: This webpage has a collection of technical articles, material safety data sheets (MSDS), tools, presentations, and much more.

- www.kaeser.com/whitepapers: Our collection of whitepapers provide in-depth technical information on challenges those in the compressed air industry are currently facing.

- Our online Kaeser Toolbox has a number of handy tools for making common compressed air calculations.

Appendices

Charts and References

Appendix A: Elevation Derate Chart for Motors

Altitude (ft.)	1.0 SF	1.15 SF
3,300 - 9,000	93%	100%
9,000 - 9,900	91%	98%
9,900 - 13,200	86%	92%
13,200 - 16,500	79%	85%
13,200 - 16,500	79%	85%
over 16,500	Consult Manufacturer	

Appendix A: Elevation Derate Chart for Motors

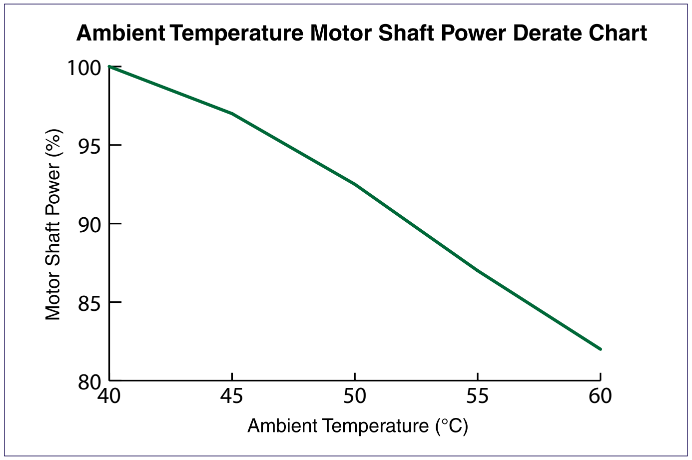
Motor derating:
Three-phase asynschronous motors Class F windings are designed by Kaeser so that they are loaded to Class B at air cooling temperatures up to only 40°C, elecations up to 1000m above sea level and their mentioned rated power.

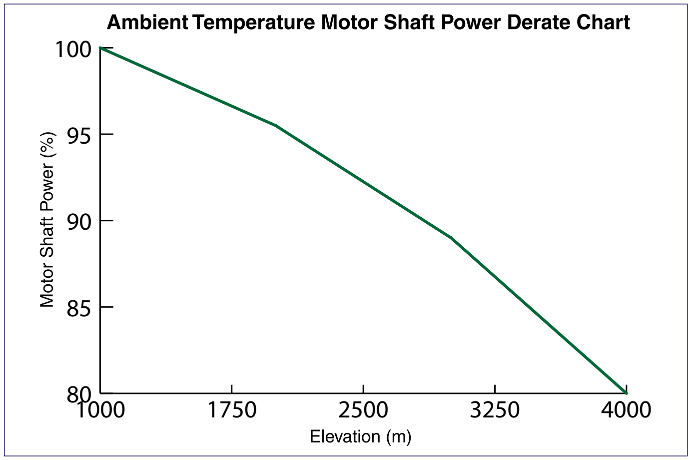
If these limitations are exceeded, the motor must be de-rated so that the motor windings used are Class F and not Class B.

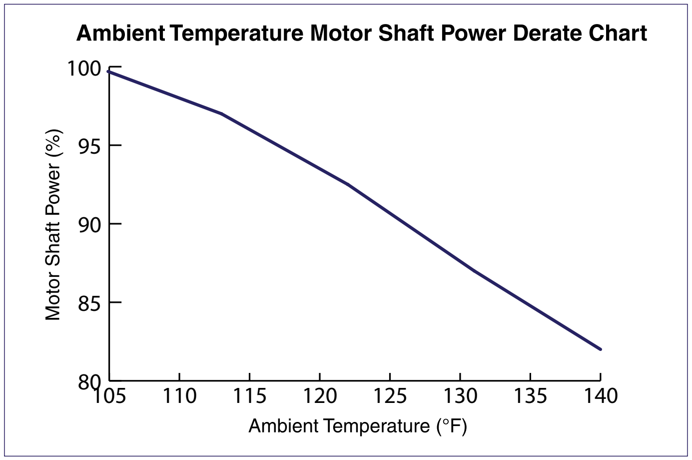
Mains voltage fluctuations, particularly under-voltage, can then lead to motor overheating, as there is no longer a reserve.

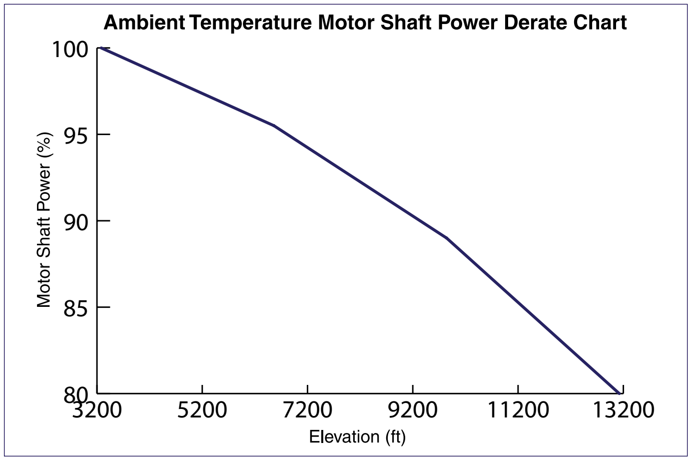
These diagrams should help in determining the motor shaft power depending on ambient temperature and elevation.

If derating is necessary because of simultaneously higher ambient temperature and elevation, the motor shaft power values must be multipled together.









Introduction
Receiving Equipment
Location
Ventilation
Electrical Supply
Piping
Package Integration
Building an Efficient System
Preventive Maintenance
Safety Advisories
Additional Resources
Appendices

Appendix B: Helpful Formulas and Calculations

Thermal Outout of Rotary Blowers:

$Q_{MOT.}$ Thermal output of the drive motor

Motor power:

3 - 7.5 kW	ca. 14%
11 - 18.5 kW	ca. 10%
22 - 55 kW	ca. 7%
75 - 200 kW	ca. 5%

The percentage values relate to the corresponding shaft power of the motors. Because of the V-belt transmission loss, these can be calculated as 1.03 times the block power consumption.

The thermal output of the motor increases by about 1% when under partial load down to half rated power.

Of the motor is driven from a frequency converter, the thermal output increases a further 3 - 6%.

Q_{KR} Thermal output of V-belt transmission: ca. 3% of motor shaft power

Q_B Blower block thermal output: 1 - 2% of block power consumption

Q_{SD} Silencer thermal output: 1 - 2% of block power consumption

Overall thermal output:

$$Q_{COMBINED} \approx \sum_{i=1}^{n} Q_{MOT.} + Q_{KR} + Q_B + Q_{SD} \text{ [kW]}$$

Pipework Thermal Output (not insulated):

$Q_{LINE} \approx 3.2 \cdot 10^{-5} \cdot d \cdot l \cdot (0.6 \cdot T_2 - T_{AMB})$ [kW]

Because of the high flow velocity, the heat take-up of the gas is insignificant and can be ignored.

d = pipe diameter in [mm]
l = pipe length in [m]
T_2 = blower discharge temperature in [°C]
T_{AMB} = ambient temperature in [°C]

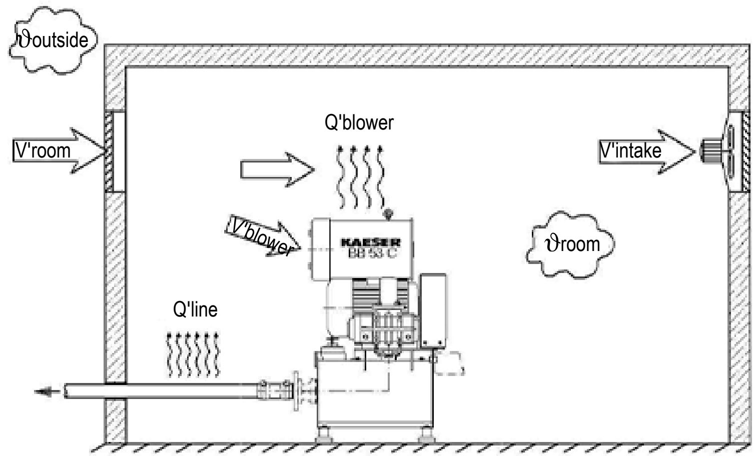
Introduction
Receiving Equipment
Location
Ventilation
Electrical Supply
Piping
Package Integration
Building an Efficient System
Preventive Maintenance
Safety Advisories
Additional Resources
Appendices

Appendix B: Helpful Formulas and Calculations

Volume flowing into the blower room:

$$V'_{BLOWER\ ROOM} = \frac{3600 \cdot (Q_{COMBINED} + Q_{LINE})}{\rho \cdot c_\rho \cdot \Delta T}$$

ρ = Cooling air density (1.19 kg/m³ at 20°C, 1 bar)
c_ρ = Thermal capacity of air 1.0 kJ/kgK
ΔT = Room temperature rise 5-10 K



Airflow into the room not necessary if:

$$V'_{BLOWER\ ROOM} \leq \sum_{i=1}^{n} V'_{1\_Blower}\ [m^3/h]$$

Airflow into the room necessary if:

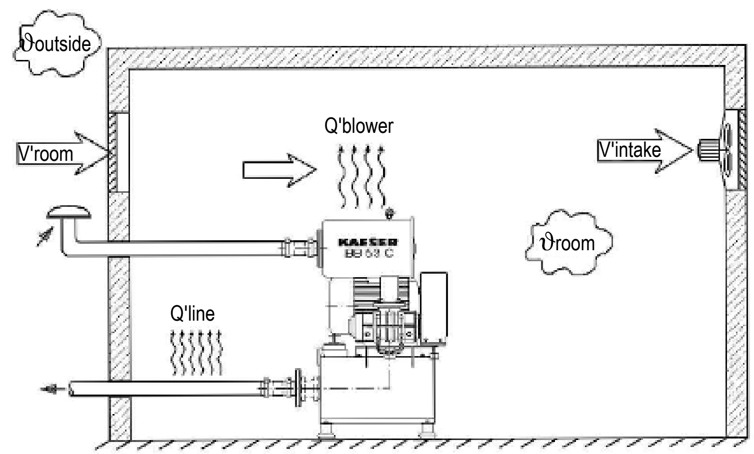
$$V'_{BLOWER\ ROOM} > \sum_{i=1}^{n} V'_{1\_Blower}\ [m^3/h]$$

Exhaust airflow from the room:
Blower air intake from the room (Figure 1):

$$V'_{INTAKE} = V'_{BLOWER\ ROOM} - \sum_{i=1}^{n} V'_{1\_Blower}$$

(If $V'_{INTAKE} = 0$, then $V'_{BLOWER\ ROOM} = V'_{1\_Blower}$)

Blower air intake from outside the room (Figure 2):
$V'_{INTAKE} = V'_{BLOWER\ ROOM}$



Effective cross-section areas of ventilation openings:

$$A_{EFF} = \frac{V'_{BLOWER\ ROOM}}{10800}\ [m^2]$$

Based on the recommended airflow rate of 3 m/s.

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