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Figure 1: Typical System Resistance Curve - Pressure Drop vs. Flow Rate

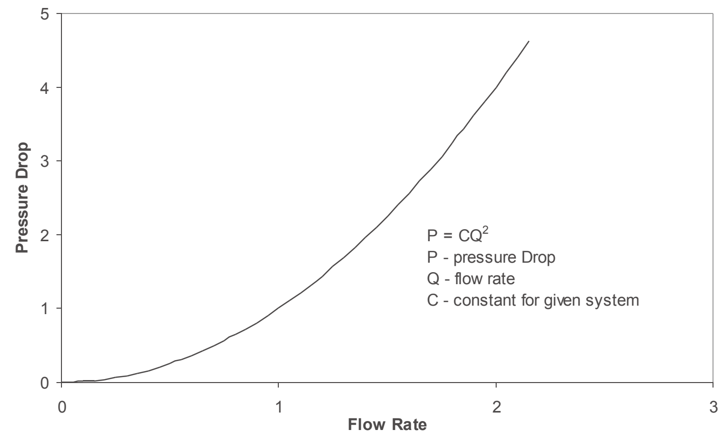
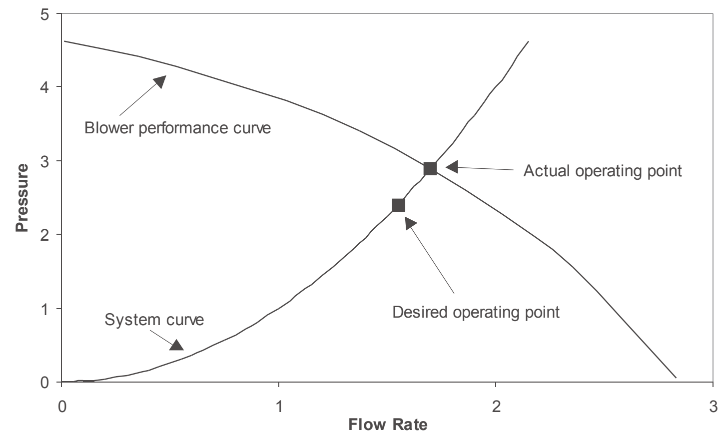


Figure 2: System and Blower Curves - Identifying the Operating Point



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Other questions to consider when selecting a blower:

- Will a blower of this size fit in my application?
- Would I prefer that the blower have an on-board controller or would I prefer to provide an external controller?
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- Is it a problem for the working fluid to come into contact with electronics?
- What are the environmental factors associated with my application?

Blower Performance vs. Speed Changes: Since Ametek's blowers are speed controllable, the speed can be reduced to a desired operating point or

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increased if a different operating point is needed in a dynamic system. Blowers conveniently have very predictable behavior when it comes to changes in speed. Table 1 summarizes these relationships.

Gage Pressure vs. Absolute Pressure:
Before proceeding, it's important at this point to note that this tutorial makes reference to both "absolute pressure" and "gage pressure." Gage pressure is simply the difference above or below atmospheric (or barometric) pressure. Absolute pressure is the sum of atmospheric and gage pressures:

$$P_{absolute} = P_{gage} + P_{atm}$$

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Figure 3 with Example 1 demonstrates how to calculate the power requirement for an operating point that occurs at a reduced speed.

Example 1:
An application calls for air performance of 8 cfm (ft^3/min) at a pressure of 6 inch H_2O. The blower whose performance is shown in Figure 3 has been chosen. What will be the power consumption at 8 cfm, 6 in H_2O?

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$$P_2 = P_1\left(\frac{N_2}{N_1}\right)^2$$

$$\mathcal{P}_2 = \mathcal{P}_1\left(\frac{N_2}{N_1}\right)^3$$

Where,
N → fan rotational speed
$\dot{m}$ → mass flow rate
Q → volume flow rate
P → static pressure (gage)
$\mathcal{P}$ → blower power demand

All other variables constant.

Answer: At full speed, the blower will deliver about 8.8 cfm in this system, whose backpressure is about 7.2 in H_2O at that flow rate (see Figure 3). Since this is delivering too much, the speed must be reduced to achieve the desired operating point.

At full speed, Figure 3 shows the blower speed to be about 19.8 krpm and the power consumption is 18.3 W. Using the fan laws shown in Table 1 yields:

$$8\text{ cfm} = 8.8\text{ cfm}\left(\frac{N_2}{19.8\text{ krpm}}\right)$$

$$N_2 = 18.0\text{ krpm}$$

So, the power consumption at the reduced speed is:

$$\mathcal{P}_2 = 18.3\text{ W}\left(\frac{18.0\text{ krpm}}{19.8\text{ krpm}}\right)^3$$

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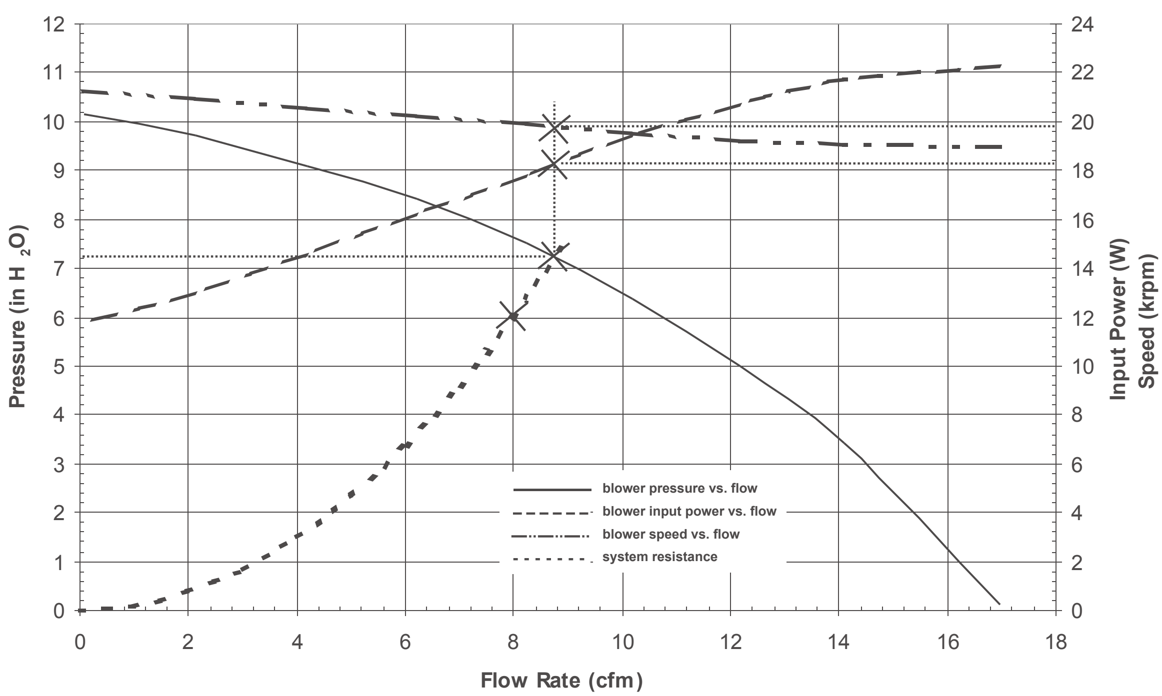
Figure 3: Speed Change Calculation Example



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Note: There is some minor error in this calculation because there will likely be some small change in motor efficiency at the different operating point. This can usually be neglected for estimating power requirements.

Static and Velocity Pressure: The energy of a fluid can be viewed as having two types of pressure: static pressure and velocity pressure.

Static pressure is the force per unit area exerted by the fluid on its surroundings, and is independent of the fluid's motion. This is the pressure that would be measured by a pressure sensor ported normal to the direction of flow. Dividing this pressure by the fluid density yields an energy term (per unit mass) often referred to as "pressure head."

Velocity pressure is essentially the kinetic energy content, or velocity head, of the fluid. It is the pressure that would result from slowing down the streamline velocity to zero, converting the kinetic energy into pressure head. Mathematically, it takes the form $P=\frac{1}{2}\rho V^2$, where ρ is the fluid density and V is the fluid velocity (including the density value maintains force per area, i.e., pressure units).

The sum of the static pressure and velocity pressure is the total pressure.

Within a flow system, there are also likely to be changes in elevation (potential energy or elevation head) that contribute to the energy content of the stream at a given point. But the changes in elevation head for gas flow are usually small enough to be safely ignored.

The blower performance curves herein are plotted as static pressure (or vacuum) rise vs. flow rate. The velocity pressure is typically not a useful energy quantity for overcoming resistance to flow. In other words, in most cases the resistance to flow results in a loss of static pressure of the streamline and not to a loss of velocity pressure. Technically, a diverging nozzle could be used to convert velocity pressure to static pressure, thereby increasing the blower's ability to provide flow against backpressure, but this is not a common practice.

Fluid Density: The density of the working fluid has a significant influence on blower performance, as can be seen in the relationships listed in Table 2. Because fluid density is a variable that is independent of the blower, the density must be stated as part of any blower performance specification. In the previous example, the density was ignored for simplicity. But the performance curves for all blowers in this catalog have the statement *"normalized to air density = .075 lb/ft³,"* or equivalent statement. So, in the previous example, it was assumed that the desired performance of (8 cfm, 6 in H_2O) had also been normalized to .075 lb/ft³.

The density value of **.075 lb/ft³** is a somewhat arbitrary selection, but it is close to typical air density at sea level. It is commonly referred to as "Standard Density" in the fan and blower industry. Any target operating point must be normalized to .075 lb/ft³ when evaluating blower performance curves in this catalog. Examples hereafter demonstrate how to do this.

The vast majority of blower applications are designed to move air, but Ametek blowers can be used with any non-explosive, non-corrosive gas mixture (exception - see Ametek's Nautilair series for blowers designed for combustion pre-mix applications). <u>Caution: most of the blowers in this catalog are not designed to be leak-proof, and many vent some working fluid to cool the motor</u>. At the temperature and pressure ranges for most blower applications, the gas mixture can be considered an ideal gas, and it will behave according to the relationship:

$$\rho = \frac{PM}{R_u T}$$

Where, **P** is the absolute pressure
ρ is the density
R_u is the universal gas constant
T is the absolute temperature
M is the molar mass

For gas mixtures, the molar mass of the mixture can be determined from the weighted average of the component gases. Refer to texts on thermodynamics or contact Ametek engineering for help in calculating density for gas mixtures. Because of the difference in viscosity between air and other gases at the same conditions, the blower performance curves herein will have some error when evaluating non-air performance, even if the operating point is normalized to standard density. Contact Ametek engineering for help in selecting a blower for non-air applications.

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$$P_2 = P_1\left(\frac{\rho_2}{\rho_1}\right)$$

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Where, $\rho \rightarrow$ fluid density
$P \rightarrow$ static pressure (gage)
$\mathcal{P} \rightarrow$ power demand
$\dot{m} \rightarrow$ mass flow rate

Note: volume flow rate, Q, is independent of density for gases.

Determining air density requires knowing the temperature, barometric pressure, and humidity of the working environment. Measuring temperature is relatively easy, but barometric pressure requires a barometer, and humidity requires either a wet bulb thermometer, a hygrometer, or a dew point detector. (Note: be careful if using barometric values obtained from weather services - they are normalized for altitude and are not the actual barometric pressure measurements.

Once these values are known, the easiest way to determine density is to use a psychrometric chart, which gives the properties of air for large ranges of temperature and humidity. (There are also on-line calculators available). Some notes on using a psychrometric chart:

1) Instead of density, the specific volume, which is the reciprocal of density, usually is plotted.
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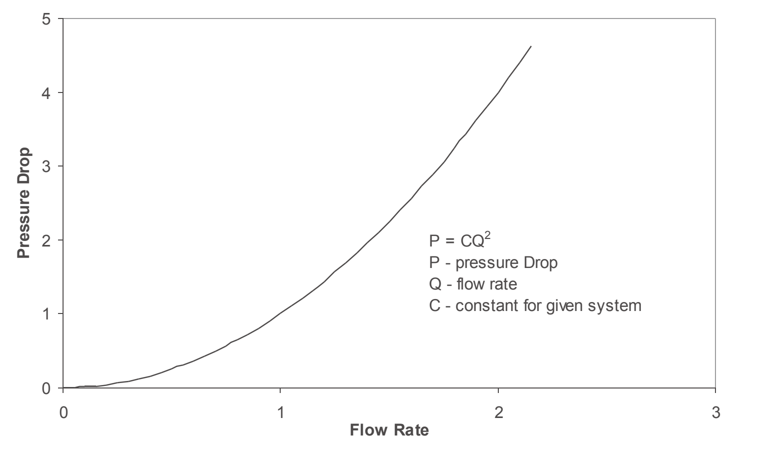

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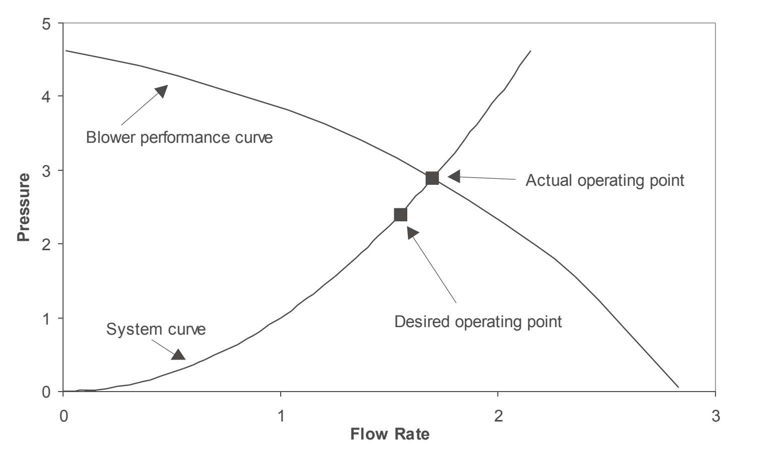

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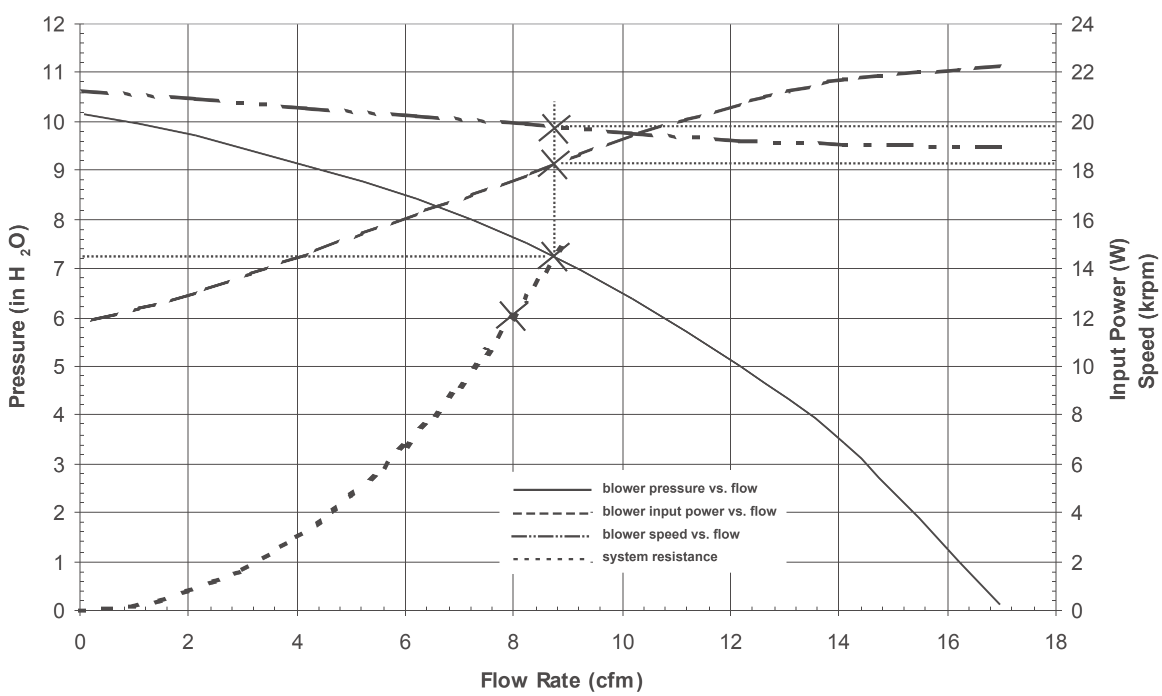

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PRECISION MOTION CONTROL

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1) Instead of density, the specific volume, which is the reciprocal of density, usually is plotted.
2) The specific volume is typically given in terms of volume per unit mass of *dry air*. But the working fluid is a mixture of air and water vapor (except at 0% humidity, of course). See the example

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hereafter for calculating the actual specific volume, i.e., volume per unit mass of the air-water vapor mixture.

3) Dry bulb temperature is simply the temperature measured using a regular thermometer.

4) For humidity, the wet bulb temperature can be used directly without having to convert to another type of humidity quantity. As an alternative, relative humidity or humidity ratio can be used.

5) Psychrometric charts are plotted at a single barometric pressure which is noted in the heading of the chart. A correction is needed to adjust density values to the actual barometric pressure.

Example 2: A laboratory makes the following measurements of the ambient air conditions:

Barometric pressure = 28.60 in Hg
Dry bulb temperature = 72 °F
Wet bulb temperature = 65 °F

What is the ambient density?

Answer: Using a psychrometric chart plotted at 29.921 in Hg, the intersections of the curves corresponding to the dry bulb and wet bulb values above yields a specific volume of 13.64 $ft^3/lb_{dry\ air}$ and a humidity ratio of .0116 $lb_{water\text{-}vapor}$ per lb_{air}. Correct the specific volume per lb air-water vapor mixture:

$$\frac{m_{wv}}{m_{air}} = .0116$$

$$m_{mixture} = m_{wv} + m_{air} = .0116m_{air} + m_{air} = 1.0116m_{air}$$

$$\frac{m_{air}}{m_{mix}} = .989$$

$$.989(13.64\ ft^3/lb_{air}) = 13.49\ ft^3/lb_{mix}$$

Finally, correcting this value for the actual barometric pressure yields:

$$13.49\ ft^3/lb_{mix}\left(\frac{29.921\text{ in Hg}}{28.60\text{ in Hg}}\right) = 14.12\ ft^3/lb_{mix} = .0708\ lb_{mix}/ft^3$$

The density of air varies substantially with weather and altitude. The Standard Atmosphere Table (not included herein, but widely available in reference texts and internet sites) gives a good estimate for typical outdoor ambient conditions as a function of altitude. The following example demonstrates how to account for the lower density at high altitude:

Example 3: An application calls for a blower to deliver 50 cfm of air at 30 inch H_2O at an altitude of 7000 ft above sea level where the average air density is 0.062 lb/ft³, according to the Standard Atmosphere Table. For the purpose of selecting a blower from this catalog, what operating point should be used?

Answer: Refer to Table 2. Since volume flow rate does not change with density, the flow rate remains at 50 cfm. The pressure does change in proportion to density:

$$P_2 = 30\text{ inch }H_2O\left(\frac{.075\ lb/ft^3}{.062\ lb/ft^3}\right)$$

$$P_2 = 36.3\text{ inch }H_2O$$

So, the operating point normalized to standard density is 50 cfm, 36.3 inch H_2O.

Example 3 continued: A blower is selected from the catalog that can deliver the above performance with a power demand of 600 W at standard density, as shown on the published performance curves. What will be the power demand at the intended location at 7000 ft altitude?

Answer: Refer to Table 2 for correcting power demand for a change in density.

$$\mathcal{P}_2 = 600\text{ W}\left(\frac{.062\ lb/ft^3}{.075\ lb/ft^3}\right)$$

$$\mathcal{P}_2 = 496\text{ W}$$

Example 3 continued - Redefining the problem in terms of mass flow rate: The application requires a mass flow rate of 3.1 lb/min of air regardless of altitude.
A) How much must the speed be reduced if the application is moved from a location at 7000 ft (.062 lb/ft³) to sea level (.075 lb/ft³)?
B) If the speed is not adjusted to compensate for the change is density, what will be the change in volume flow rate between the two locations?
C) How much will the power demand change?

Answer:
A) Table 2 shows that the change in mass flow rate is a simple ratio of the densities. If the blower speed is maintained between the two locations, the mass flow rate delivered at sea level will be:

$$\dot{m}_2 = 3.10\ lb/min\left(\frac{.075\ lb/ft^3}{.062\ lb/ft^3}\right)$$

$$\dot{m}_2 = 3.75\ lb/min$$

Mass flow rate is directly proportional to a change in speed (Table 1), so to maintain 3.1 lb/ft³, the speed must be reduced by:

$$3.10\ lb/min = 3.75\ lb/min\left(\frac{N_2}{N_1}\right)$$

$$\left(\frac{N_2}{N_1}\right) = .827 = 17.3\%\text{ reduction}$$

B) Since volume flow rate is independent of density, the volume flow rate will not change between the two locations if the speed remains constant. This illustrates the difference between the quantities of volume flow and mass flow - a factor that must be kept in mind when evaluating an application's air performance needs.

C) Tables 1 and 2 show that the power demand is directly proportional to both density and speed, although a speed change has a much larger influence. Combining both relationships yields:

$$\mathcal{P}_2 = \mathcal{P}_1\left(\frac{\rho_2}{\rho_1}\right)\left(\frac{N_2}{N_1}\right)^3$$

$$\mathcal{P}_2 = \mathcal{P}_1\left(\frac{.075\ lb/ft^3}{.062\ lb/ft^3}\right)\left(.827\right)^3$$

$$\mathcal{P}_2 = .684\ \mathcal{P}_1 = 31.6\%\text{ reduction}$$

Incompressible Flow: Although the density of the working fluid is a variable that must be accounted for, in a given application the density is assumed to be constant for applications involving the blowers herein. In other words, for a given blower in operation the fluid entering the blower has the same density as the fluid leaving the blower. Another term for this is "incompressible flow." Density variations are less than one

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hereafter for calculating the actual specific volume, i.e., volume per unit mass of the air-water vapor mixture.
3) Dry bulb temperature is simply the temperature measured using a regular thermometer.
4) For humidity, the wet bulb temperature can be used directly without having to convert to another type of humidity quantity. As an alternative, relative humidity or humidity ratio can be used.
5) Psychrometric charts are plotted at a single barometric pressure which is noted in the heading of the chart. A correction is needed to adjust density values to the actual barometric pressure.

Example 2: A laboratory makes the following measurements of the ambient air conditions:

Barometric pressure = 28.60 in Hg
Dry bulb temperature = 72 °F
Wet bulb temperature = 65 °F

What is the ambient density?

Answer: Using a psychrometric chart plotted at 29.921 in Hg, the intersections of the curves corresponding to the dry bulb and wet bulb values above yields a specific volume of 13.64 $ft^3/lb_{dry\ air}$ and a humidity ratio of .0116 $lb_{water-vapor}$ per lb_{air}. Correct the specific volume per lb air-water vapor mixture:

$$\frac{m_{wv}}{m_{air}} = .0116$$

$$m_{mixture} = m_{wv} + m_{air} = .0116m_{air} + m_{air} = 1.0116m_{air}$$

$$\frac{m_{air}}{m_{mix}} = .989$$

$$.989(13.64\ ft^3/lb_{air}) = 13.49\ ft^3/lb_{mix}$$

Finally, correcting this value for the actual barometric pressure yields:

$$13.49\ ft^3/lb_{mix}\left(\frac{29.921\text{ in Hg}}{28.60\text{ in Hg}}\right) = 14.12\ ft^3/lb_{mix} = .0708\ lb_{mix}/ft^3$$

The density of air varies substantially with weather and altitude. The Standard Atmosphere Table (not included herein, but widely available in reference texts and internet sites) gives a good estimate for typical outdoor ambient conditions as a function of altitude. The following example demonstrates how to account for the lower density at high altitude:

Example 3: An application calls for a blower to deliver 50 cfm of air at 30 inch H_2O at an altitude of 7000 ft above sea level where the average air density is 0.062 lb/ft³, according to the Standard Atmosphere Table. For the purpose of selecting a blower from this catalog, what operating point should be used?

Answer: Refer to Table 2. Since volume flow rate does not change with density, the flow rate remains at 50 cfm. The pressure does change in proportion to density:

$$P_2 = 30\text{ inch }H_2O\left(\frac{.075\ lb/ft^3}{.062\ lb/ft^3}\right)$$

$$P_2 = 36.3\text{ inch }H_2O$$

So, the operating point normalized to standard density is 50 cfm, 36.3 inch H_2O.

Example 3 continued: A blower is selected from the catalog that can deliver the above performance with a power demand of 600 W at standard density, as shown on the published performance curves. What will be the power demand at the intended location at 7000 ft altitude?

Answer: Refer to Table 2 for correcting power demand for a change in density.

$$\mathcal{P}_2 = 600\text{ W}\left(\frac{.062\ lb/ft^3}{.075\ lb/ft^3}\right)$$

$$\mathcal{P}_2 = 496\text{ W}$$

Example 3 continued - Redefining the problem in terms of mass flow rate: The application requires a mass flow rate of 3.1 lb/min of air regardless of altitude.
A) How much must the speed be reduced if the application is moved from a location at 7000 ft (.062 lb/ft³) to sea level (.075 lb/ft³)?
B) If the speed is not adjusted to compensate for the change is density, what will be the change in volume flow rate between the two locations?
C) How much will the power demand change?

Answer:
A) Table 2 shows that the change in mass flow rate is a simple ratio of the densities. If the blower speed is maintained between the two locations, the mass flow rate delivered at sea level will be:

$$\dot{m}_2 = 3.10\text{ lb/min}\left(\frac{.075\ lb/ft^3}{.062\ lb/ft^3}\right)$$

$$\dot{m}_2 = 3.75\text{ lb/min}$$

Mass flow rate is directly proportional to a change in speed (Table 1), so to maintain 3.1 lb/ft³, the speed must be reduced by:

$$3.10\text{ lb/min} = 3.75\text{ lb/min}\left(\frac{N_2}{N_1}\right)$$

$$\left(\frac{N_2}{N_1}\right) = .827 = 17.3\%\text{ reduction}$$

B) Since volume flow rate is independent of density, the volume flow rate will not change between the two locations if the speed remains constant. This illustrates the difference between the quantities of volume flow and mass flow - a factor that must be kept in mind when evaluating an application's air performance needs.

C) Tables 1 and 2 show that the power demand is directly proportional to both density and speed, although a speed change has a much larger influence. Combining both relationships yields:

$$\mathcal{P}_2 = \mathcal{P}_1\left(\frac{\rho_2}{\rho_1}\right)\left(\frac{N_2}{N_1}\right)^3$$

$$\mathcal{P}_2 = \mathcal{P}_1\left(\frac{.075\ lb/ft^3}{.062\ lb/ft^3}\right)\left(.827\right)^3$$

$$\mathcal{P}_2 = .684\ \mathcal{P}_1 = 31.6\%\text{ reduction}$$

Incompressible Flow: Although the density of the working fluid is a variable that must be accounted for, in a given application the density is assumed to be constant for applications involving the blowers herein. In other words, for a given blower in operation the fluid entering the blower has the same density as the fluid leaving the blower. Another term for this is "incompressible flow." Density variations are less than one

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AMETEK PRECISION MOTION CONTROL

percent for flow speeds less than Mach = 0.2, which is greater than typical applications for these blowers.

Blower Life: Brushless DC blowers have the advantage of long life compared to blowers driven by brush motors. Since the motor is electronically commutated there are no brushes to wear out, so the end of life scenario for brushless blowers is normally bearing failure.

Since long life is one of the main attributes of brushless technology, the question "How long will it last?" is common. Unfortunately, there is no simple answer to this question. There are a number of factors that influence life, and we currently have no way to account for every possible application. The primary factors that influence life are:

- temperature
- bearing contamination
- mechanical shock
- operating point

Temperature: The deterioration of bearing grease is directly proportional to its temperature. So, the higher the temperature, the shorter the bearing life. There is no hard limit on bearing temperature, but just a general rule that cooler is better. There is a point of diminishing returns that is application dependent - reducing temperature is unnecessary if the blower life is adequate for the application. A rule of thumb for Ametek blowers is 45 ^{o}C maximum ambient temperature, but this can be exceeded under certain circumstances. Please consult Ametek engineering for applications a high temperatures. Ultimately, it is up to the customer to determine whether or not a blower can provide adequate life. Thorough testing is recommended. Also keep in mind that extreme temperature can cause premature failure of electronics or the motor winding.

Bearing Contamination: The introduction of particulate matter increases the rolling friction of the bearing, which increases temperature. Particulates also scar the surface of the bearing raceways and balls, which increases pitting and flaking, further exacerbating the condition. Corrosive gases can react negatively with grease or cause corrosion of the steel in the bearings. Liquids of any kind should be avoided. Water vapor is not a problem as long as it does not condense into liquid water inside the blower.

Mechanical Shock: Mechanical shock can cause denting of the bearing's rolling elements. This results in unwanted noise and can lead to flaking and pitting inside the bearing. Applications that subject the blower to mechanical shock should be thoroughly tested to ensure adequate life.

Operating point: The amount of backpressure a blower works against is another influencing factor in some blower models. The backpressure results in a pressurized blower housing, putting a pressure gradient across the adjacent bearing. The pressure gradient tends to push the grease out and contamination in. Ametek has implemented design features to minimize this effect, and the customer should not be hesitant to operate at high pressure if the application calls for it.

Again, blower life is highly application dependent. Customer requests for MTTF (Mean Time To Failure) information are difficult to answer. Moreover, what constitutes a failure is often open to interpretation. For example, there can be situations where a blower is delivering air performance as required, but it has deteriorated bearings that produce unacceptable noise for sound-critical applications.

Ametek does conduct an ongoing life test program to gather life information and to improve the durability of our blowers. Tests are conducted on blowers that represent all model families. History has shown that Ametek blowers survive beyond 10,000 hours of continuous running in typical applications. It is common for blowers to endure more than 20,000 hours, and some blowers have accumulated 30,000+ hours. But again, it must be stressed that blower life is application dependent, and the customer is encouraged to conduct a life test in-situ under the application's most rigorous conditions. The life values mentioned above are not to be used as a basis for warranty claims.

Safety Bulletin: In the application of Ametek, Inc. motors and/or blowers as a component in your product, you must exercise the following minimum precautions:

THE FAILURE TO OBSERVE THE FOLLOWING SAFETY PRECAUTIONS COULD RESULT IN SERIOUS BODILY INJURY, INCLUDING DEATH IN EXTREME CASES. We recommend that *adequate instructions and warnings by the original equipment manufacturers (OEM)* include labels setting forth the precautions listed below to the end user.

The motors and/or blowers must be connected to a proper and effective ground or mounted in a manner that will guarantee electrical isolation and insulate the user and others from electric shock. End product design should not rely solely on the primary insulation of the motor.

Standard blowers and/or motors are not designed to handle volatile or flammable materials through the fan system unless specifically designed. Passing combustible gases or other flammable materials through the fan system could result in leakage which could cause a fire or explosion.

These products must not be used in an area contaminated by volatile or flammable materials since sparking is predictable in the normal operation of the motor and may ignite the volatile causing a dangerous explosion.

The Technical and Industrial Products Division of Ametek, Inc. can supply specifically designed motors and blowers for use in handling combustible gases or for use in hazardous duty locations. These specially designed units should only be used in conjunction with combustible gases, which they were specifically designed to handle. The type of gases must be so noted on the product label and in the instructions.

The rotation of the motor shaft, or anything mounted on the shaft, is a potential source of injury and must be taken into account in the design of your end product. You must provide the necessary guarding or housing as required by the finished product and you must indicate to the user the direction of rotation. Do not remove guard as severe bodily injury may occur to fingers or appendages.

Products incorporating vacuum motors/blowers must be designed so as to prevent the vacuum or air pressure from being concentrated in a manner that can expose the user to injury by coming into contact with any body area, such as eyes, ears, mouth, etc.

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Unit Conversions

Length: 1 ft = 12 inch
= .3048 m
= 30.48 cm
= .0001894 mile

Volume: 1 ft^3 = .02832 m^3
= 28.32 L
= 7.481 gal

Mass: 1 lb_m = .4536 kg

Force: 1 lb_f = 32.174 lb_m•ft/s^2
= 4.448 N

Volume Flow Rate: 1 cfm (ft^3/min) = 28.32 L/min
= 1.699 m^3/hr

Pressure: 1 inch H_2O = .249 kPa
= 2.49 mbar
= .0361 psi (lb_f/in^2)
= .0735 inch Hg

Density: 1 lb_m/ft^3 = 16.03 kg/m^3
= .01602 g/cm^3

Energy: 1 ft•lb_f = 1.356 J
= 1.356 N•m
= .001285 Btu

Power: 1 W = .00134 hp
= 3.413 Btu/hr
= 550 (ft-lb_f)/s

Temperature: T (°R) = T(°F) + 459.7
= 1.8[T(°C + 273.15]
= 1.8T(K)

Universal Gas Constant, R_u: = 10.73 psia•ft^3/(lbmol•°R)
= 1545 ft•lb_f/(lbmol•°R)
= 8.314 kJ/(kgmol•K)
= 8.314 kPa•m^3/(kgmol•K)

The motors and/or blowers must not be exposed to moisture or liquid or used outdoors, except in equipment which is specifically designed for outdoor use and meets the appropriate regulatory agency requirements for outdoor use. Moisture or liquid can damage the motor/blower and defeat the electrical insulation resulting in a severe electrical shock to the user.

Ametek motors/blowers must not be operated above the design voltage. Over voltage conditions can cause excessive speed of the motor and can result in severe electrical shock and/or other traumatic injury to the operator.

Precautions must be exercised to ensure motor leads are properly routed and connected in your equipment. Lead wires must be routed and retained to ensure that they do not become pinched or come in contact with rotating parts during assembly or subsequent operations. Connections must be designed so that proper electrical contact is established and the connections must be properly insulated.

Disassembly or repairs of Ametek products should not be attempted. If accomplished incorrectly, repairs can create an electrical shock and/or operational hazard. It is recommended that repairs be made only by Ametek and not by others.

In the event that the motor or blower ceases to operate, power must be disconnected before examination and/or removal from the system.

Contact Ametek, Inc. to discuss any questionable application before selecting a standard motor or blower.

In setting forth the above listed recommendations with regards to precautionary steps that must be considered, we in no way intend to imply that if these steps are taken a product will meet the applicable safety standards. We, at Ametek, are not sufficiently conversant with the specific safety hazards which may be associated with particular products. We can only advise precautions to be employed generally for the safe use of Ametek products as components. For testing specifically related to the safety of the product, we recommend that you contact the appropriate regulatory agency as indicated by the type of product being manufactured.

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