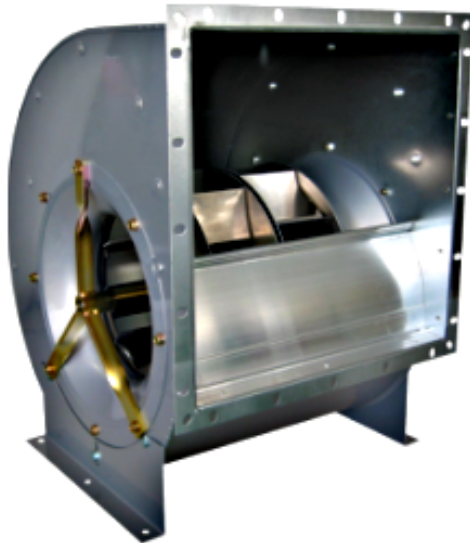


Selecting The Perfect Fan For Your HVAC Appliance

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Whether your company produces air heaters, heat pumps, condensers, cooling units, evaporators, ventilation systems or other HVAC appliance, the fans you specify can significantly influence the performance and reliability of your units.

Initial acquisition cost, long-term operating cost, performance, reliability, and overall efficiency are among the critical factors you need to consider when specifying fans for your products. Obviously, one fan solution does not fit all designs.

Because specifications can differ markedly between appliances, suppliers like Rosenberg provide speed controllable fans in a variety of configurations and performance levels. Design compromises may have to be made as you consider such factors as heat transfer targets, maximum pressure drop, noise levels, size restrictions and acceptable operating efficiency.

Two general guidelines apply. First, make sure the fans you specify are fully compatible with the structure of your appliance. Second, your fan selection must satisfy your product's performance needs - the capacity to generate the level of air movement your unit needs to benefit the end user.

As a full line supplier, Rosenberg offers fan configurations for a wide range of HVAC appliance designs. The Ecofit® fans address many needs. Included are AC or EC (Electronically Commutated) motorized impellers for hot air gas, cross flow fans, double inlet and single inlet blowers with forward curved or backward curved motorized impellers, backward curved impellers with external rotor motors. Also available for HVAC applications are Rosenberg radial fans with forward- and backward-curved impellers - with capacities to 12,000 cfm, and Epsilon axial fans with sickle designed blades that generate up to 16,000 cfm.

HVAC Applications

Air movement is the basic function of the fan in HVAC appliances. System resistance to airflow is caused by friction as well as turbulence. The fan increases total energy content of the air it supplies. That energy involves dynamic pressure and static pressure, which reflects potential energy in the air either at rest or in motion.

"Total Pressure" is the term for the sum of the static and dynamic pressure. Pressure is usually measured in units called Pascals (Pa), mm of water, or inches of water gauge.

"Pressure Drop" reflects the energy loss caused by friction and turbulence.

In the application of fans to air conditioning systems, the overall resistance of the system that the fan must overcome may be made up of two parts:

- internal pressure drop, which represents losses in the air conditioning unit itself
 - external pressure drop, which represents losses imposed on an installed unit by diffusers, inlet and outlet guards, duct, etc.
- Internal pressure losses are well defined by the system resistance curve for the air conditioning unit. External pressure losses depend on the installation. Proper air circuit design can help limit pressure drop.

A system characteristic curve is shown in graph 1. Fan characteristic curves typically cross a system characteristic curve as shown on graph 2. It reflects the airflow given by a particular fan through this particular system. Graph 3 shows a unit air flow curve, determined from fan airflow curve and system characteristics.

Think Fan Fundamentals Early

Several technical issues must be addressed before you can settle on the optimal fan for an HVAC system. These include determining the air

flow curve target for heat transfer, likely maximum pressure drop, maximum size of the appliance, desired noise level of the unit and whether the fan can satisfy your efficiency goals - both immediate as well as over extended usage.

The best appliance design incorporates fan fundamentals early into the design ...

- Define your application and the role the fan will perform.
- Decide whether you will need a single fan or a combination.
- Will the appliance's location [inside or outside] require attention to ambient conditions that influence operation.
- What about enclosure size: Does the fan fit available space with enough room for servicing/replacement of parts?
- What about other limitations such as noise, vibration, power needs and weight of the HVAC appliance?

Other considerations include optimal fan orientation and leakage requirements of the fan or ductwork.

Duty Cycles Critical

Plotting a system duty cycle helps determine which fan would best support your design. You should define your system's operating points, focusing on operating intervals at each point. Operating point considerations include flow rate, temperatures at design and under operation, static pressures (both inlet and outlet), the composition of gas and type of controls. In cases where several operating points are expected, plotting the duty cycle at the same density can help. What results is a performance curve that when expressed on a single graph can point to the right fan choice for your product.

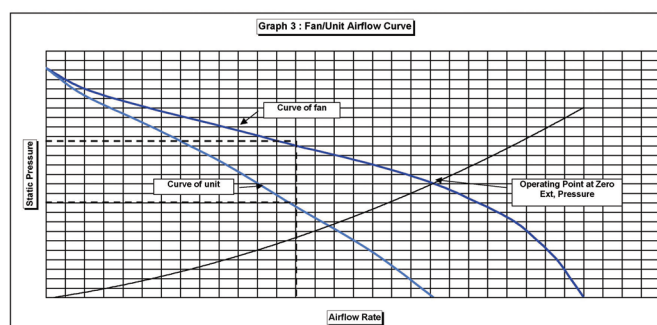
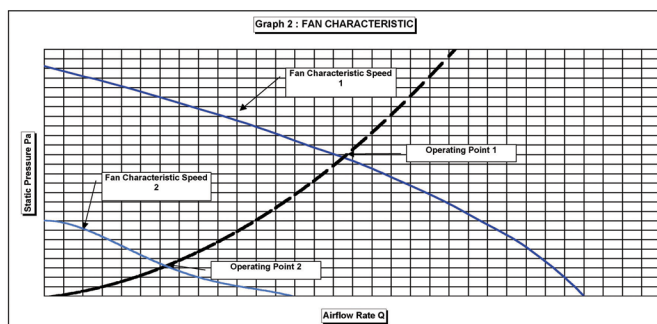
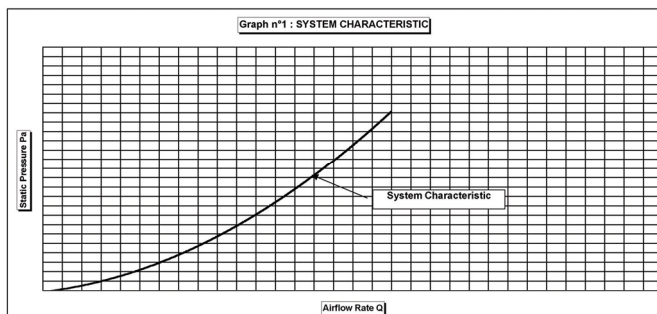
Life Cycle Considerations

Beyond a fan's likely duty cycle, designers must take into account life cycle characteristics - indications of fan functions initially and over an extended service life. These include:

- Annual operating cost of the fan
- Required maintenance
- Reliability
- Spare parts readily availability
- Expected life - how long will the unit operate before replacement

Size Does Matter

While using a smaller model fan that complies with your performance requirements may save you money during initial purchase, a small fan
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typically will need to run faster. This will alter the fan curve. When run at higher speeds, the small fan tends to operate less efficiently and is prone to produce more noise and fail much sooner.

In conclusion, finding the perfect fan for your HVAC appliance requires both an engineering perspective and smart business practices. The industry offers you many choices in fans. These products reflect the whole spectrum of performances and efficiencies, available in a range of sizes and qualities.

Finding the fans most suitable for your design - delivered at a price that makes sense - requires

careful planning and comprehensive information. But take heart. In most cases, you won't have to go over it alone.

The leading suppliers of fans and fan controls support their OEM customers in many ways. In addition to maintaining a wide selection of standard fans for delivery from stock, the best suppliers offer engineering assistance and the ability to work directly with customers to design customized solutions to their air movement problems. They're skilled at enhancing fans with extended lubrication ranges for harsh environments, supplying special finishes and producing fans with different voltages and frequencies. Be sure to check supplier websites for on-line assistance.

Applying Fan Laws

The following formulas are used to determine possible speed and wheel or impeller size variations at normal constant air density.

Speed variation at constant fan size

flow rate varies as the speed ratio:

pressure varies as the square of the speed ratio:

power varies as the cube of the speed ratio:

noise level variation

$$Q_2 = Q_1 \cdot N_2 / N_1$$

$$P_{s2} = P_{s1} \cdot (N_2 / N_1)^2$$

$$P_2 = P_1 \cdot (N_2 / N_1)^3$$

$$dB_2 = dB_1 + 50 \log(N_2 / N_1)$$

Wheel diameter variation (geometrically similar) at constant speed:

flow rate varies as the cube of the diameter ratio:

pressure varies as the square of the diameter ratio:

power varies as fifth power of the diameter ratio:

$$Q_2 = Q_1 \cdot (D_2 / D_1)^3$$

$$P_{s2} = P_{s1} \cdot (D_2 / D_1)^2$$

$$P_2 = P_1 \cdot (D_2 / D_1)^5$$

