INTRODUCTION

This presentation will supply you with the basic skills necessary to select a centrifugal blower that will satisfy the requirements of your customer.

SELECTION CRITERIA

To properly select a centrifugal blower to satisfy a specific set of requirements we must first understand how job site environmental conditions affect the performance capability of the machine.

Blowers are designed to handle a fluid in the gaseous state which means the fluid is compressible, and therefore sensitive to the density of the gas at the operation site.

Density of a gas is expressed as the weight of the gas with a given volume (normally lbs/ft³ or kg/m³). The environmental factors that determine gas density are pressure, temperature, and moisture content (relative humidity). These factors are the criteria with which we select a centrifugal blower.
Two values of pressure must be known to size the blower. They are the inlet pressure (atmospheric pressure) and the discharge pressure required by your customer.

1- **ABSOLUTE INLET PRESSURE** is the gas pressure at the inlet flange of the blower. If the machine will be handling ambient air from its surroundings, the absolute inlet pressure will equal the barometric pressure corresponding to the altitude at which the blower is operated, less any pressure losses through a filter and / or valving. If the blower is handling a gas in a closed loop process, it may have an absolute inlet pressure either above or below the atmospheric pressure of its job site elevation.

2- **ABSOLUTE INLET TEMPERATURE** is the temperature of the gas entering the blower inlet.

3- **RELATIVE HUMIDITY** is expressed as a percentage of water vapor present in the gas relative to the amount of moisture gas would contain under saturation conditions. It is a property of the gas that affects the density and should always be considered when specified by your customer.

4- **VOLUME** is the amount of air or gas the blower must deliver over a given period of time. It may be expressed in CFM, m³/h, etc. In that case, it is imperative to know precisely the temperature, humidity and pressure conditions of the CFM or m³ considered.
It would be impossible to possess a set of performance curves for each blower model that would be rated for the varying conditions encountered at every job site. Therefore, we rate each blower’s pressure, volume and power capacities against a set of standard conditions: 17.7 PSIA, 68°F, and 36% RH.

Whenever job site conditions vary from these standards, our selection program will correct the job site variables back to standard values that will allow us to select the blower from our family of standard conditions performance curves.

If you refer to the standard curves you will notice that several blowers are available for nearly all kinds of requirements. All possible selections should be considered, offering each some type of advantage: price, efficiency, turndown, non overloading horsepower, steepness of curve, etc. The better you understand the customer’s process, the greater the chance to select the blower that best suits his requirements.
Rotational speed affects the performance of a blower. An increase in speed will increase the flow and pressure capability of the blower. We can use this to our advantage to provide higher discharge pressures that are normally unobtainable at the direct drive speed of 3000 RPM (50 Hz) or 3600 RPM (60Hz). V-belt driven blowers are sized to provide higher than standard pressures at relatively low volume requirements.

It’s essential to know the frequency (Hz) to optimize the use of the blower in direct drive. The use of a gear box or V-belt transmission allows a variation of the blower characteristics according to the following approximate rules.

1- Volume varies as a direct proportion of the speed ratio.
2- Pressure varies as the square of the speed ratio.
3- Horsepower varies as the cube of the speed ratio.

The extent to which we may increase the speed of a blower is determined by one of the following criteria:

1- Critical speed of the rotating assembly (stay 20% under the first critical speed).
2- The calculated bearing life (usually maintained at a maximum life of 10 years).
3- Bursting speed of the impellers.
IMPELLERS TYPE

Two types of impellers are available: backward and radial. Each has its own unique characteristics. With both types of impellers, we can design the shape of the curve to fit the customer's needs.

Backward impellers curves are characterised by:

1- A steep slope caused by their tendency to drop off in pressure as volume increases.
2- A non-overloading horsepower curve,
3- A relatively low surge point.

Radial impellers curves are characterised by:

1- A relatively constant pressure as volume increases.
2- Horsepower curves that are generally straight, increasing proportionally with volume.
3- Higher surge points than backward curves with higher discharge pressures.
IMPELLERS CHOICE

Examples of backward curve applications:

1- Sewage treatment blowers enable a more stable working of the installation.

2- Parralleling - When two or more blowers are discharging into a common header, a steeply sloped curve offers stability when the machines are balanced against each other.

3- Gas boosters - Where a high turn down in volume is often required, the low surge point is of benefit.

Examples of radial curve applications:

1- Vacuum cleaning systems - the more suction available, the more air the system will pull through operating tools, rendering a more efficient system.

2- Process air feeding a delicate system which requires as constant pressure as possible at various volumes.
Adjustments in volume and pressure are accomplished by a throttling of the blower, unless you have a variable speed driver (motor or impeller). Throttling is performed with a butterfly valve located either on the inlet or discharge side of the blower.

**1°. INLET THROTTLING**

Inlet throttling (Fig. 2) is the preferred method to adjust volume and pressure. With the butterfly valve on the inlet side of the machine, the pressure drop across the valve is realized as a reduction of the actual inlet pressure to the blower. Since no appreciable temperature change is experienced, the air will expand, becoming less dense. The lower density allows the blower to put out less pressure, and it will move along the system resistance curve (5) from point A to the design throttled point, thereby creating a throttled curve (4). An infinite number of throttled curves can be generated by varying the degree of valve closure. Since the air is less dense, a new horsepower curve (2) is generated with the resulting HP2 as the horsepower consumed.

In addition to saving power, other advantages of inlet throttling are:

a. A steeper performance curve yielding higher stability for parallel operations with other blowers.

b. The throttled horsepower curve will become non-overloading more quickly (at lower volumes).

c. A small reduction of the surge volume due to air expansion prior to the blower inlet.
**THROTTLING**

**2°- DISCHARGE THROTTLING**

In discharge throttling (Fig. 3). Q1 and P1 represent the design point along the assumed system resistance curve. Since the blower selected offers more pressure than needed at design volume, the machine will move out in volume to point A where it meets the system resistance. Closing the discharge butterfly adds additional pressure to the total system resistance, forcing the blower to increase pressure which drive it back to volume Q1. The blower is now producing pressure HP2 which is being reduced by the pressure drop across the valve to P1. Horsepower consumption will move along the curve from HP1 to HP2.

Notice that no horsepower was saved when HP1 was reduced to HP2.
Very often, total air requirements are greater than the capacity one blower can handle. When this occurs, it is necessary to operate several blowers in parallel, which means the blowers will discharge into a common or main mainfold. Paralleling also offers advantages with regard to standby capability. For example, if a customer has an air requirement of 10 000 m³/h machines is required, he might be inclined to design for three 5.000 blower m³/h blowers (two running and one standby) in lieu of two 10.000 m³/h machines. Some plants may be limited to starting a particular motor size because of electric service. This often leads to installation of several smaller motors and blowers in lieu of fewer larger ones.

All blowers will not parallel successfully, so some knowledge is required when selections are made. There are two requirements a blower characteristic curve must have if the units are be run in parallel. These requirements remains true when we are paralleling two blowers or twenty blowers. They are summarized in one main requirement:

- Adequate slope to the pressure-volume curve which is characterized by a minimum pressure rise of 3.5 KPA when volume is reduced by 30% from the design point.