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Air Components, Inc.

M & P Air Components, Inc. provides Components, Technologies, Guidelines, Sales and Technical Services for Industrial Air and Dry Solids Processes.

Our Goal is to provide Clients with the correct components selection and system design to achieve the best Utilization, Reliability, Safety and Economy for their plant processes.

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Technical Bulletin

Fan System Effects **TB.30.0.04**

Fan System Effects represent effects that the system design can have on expected fan performance.

While AMCA Standard 210 is the basis of rating fan performance for standard conditions, actual fan performance is often different due to the interaction between the fan and the system.

AMCA Publication 201, Fans and Systems, introduces the *System Effect Factor (SEF)* for quantifying system design effects on fan performance ratings. The *SEF* is stated as a percentage, or factor of the fan inlet vp.

Fan ratings are based on AMCA Standard 210, Type B Configuration, and consist of a free unobstructed fan inlet and a full recovery fan discharge. As such, the inlet loading is symmetrical and evenly distributed along the axis of the wheel, and the discharge is ideal by use of the full recovery duct.

Air is normally stated by its volumetric capacity, cfm. However, air has mass and should also be noted by its mass capacity, lbm/min. Since standard air has a density of 0.075 lbm/cu ft, then 10,000 scfm has a mass capacity of 750 lbm/min. Although fans are normally rated by volume, fan performance is often effected by its mass flow.

In virtually all industrial processes, air moves through the system and fan in *turbulent flow*. Since air is also compressible and easily distorted, it has the potential for developing a *mass imbalance*, which when entering the fan can cause an unexpected change in performance.

System Inlet Effects have the potential to cause the greatest deficiency in fan performance ratings. Inlet effects often act on the fan performance similar to an inlet damper.

System Outlet Effects occur when the outlet conditions create a backpressure on the fan discharge. Outlet effects are not as pronounced as inlet effects, and tend to act on fan performance similar to an outlet damper.

Non-uniform flow into the fan by a 2.0 centerline radius, 90 degree round elbow, without turning vanes can result in an additional loss of 0.8 to 1.0 of the inlet vp.

Same as above, but with elbow turning vanes, the loss is reduced to between 0.25 and 0.5 of the inlet vp.

Inlet losses resulting from a poorly designed inlet box cannot be quantified, but capacity losses up to 45 % have been observed. Inlet losses from inlet boxes provided by the fan manufacturer are reliable, and normally have losses of 0.4 to 0.8 in wg, SP.

Non-uniform flow into the fan can be induced by an upstream vortex or spin of the airstream. Pre-spin (spin with the rotation of the fan) acts similar to an inlet damper and can result in capacity losses of up to 45 %, with a corresponding drop in hp. Counter-spin increases both the fan capacity and hp consumption, as energy is necessary for the fan to reverse the mass flow.

An obstructed inlet, either from an off-center location of an open inlet fan or from an abrupt reduction of the inlet duct at the fan inlet, can result in an additional loss of about 0.8 of the inlet vp (depending on design).

Fans without a proper length of straight duct on the fan discharge can have additional losses of up to 0.8 of the inlet vp. As a rule, 2.5 equivalent duct diameters are required for outlet velocities up to 2500 fpm, with 1 additional equivalent diameter added for each 1000 fpm increase in outlet velocity.

An elbow placed at the fan discharge, depending on direction of turn and the length of ducting between the fan outlet and the elbow inlet, can have an additional loss of up to 1.98 of the inlet vp.

Fan System Effects can have a substantial impact on fan performance ratings. This should be considered by both the System Designer and Installation Contractor to ensure that the fan will meet its intended capacity.

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