

Air Flow Definitions

SCFM (Standard) vs. ACFM (Actual) vs. P.D. (Piston Displacement)

In applying air as a utility in a plant, the prime result desired is Work. Work is known as a force through a distance. The force in relation to air is the weight of the air, the weight performing the Work.

Once the weight of air required to perform the work is determined the required compressor capacity, stated in terms understandable by all compressor vendors, must be determined.

As the weight of air at different altitudes, temperatures and relative humidities varies, a common datum point must be established for continuity in equipment selection. This datum point is known as Standard Cubic Feet Per Minute. There are several definitions of SCFM. However, the most commonly used definition is air at 14.7 PSIA ambient pressure, 60°F ambient temperature and 0% relative humidity.

Once the SCFM requirement is determined, it is the responsibility of the compressor supplier to apply the proper machine selection to perform the required work.

As compressors are normally rated in Actual Cubic Feet Per Minute capacities (ACFM), the compressor vendor must convert the SCFM to ACFM. It should be realized here that in the air compressor industry, ACFM is the volume of air in the first stage actually compressed, i.e., in the case of a positive displacement machine, the cylinder volume times the volumetric efficiency. In order to convert SCFM to ACFM, the following calculations must be performed:

$$\text{ACFM} = \text{SCFM} \times \frac{P_{\text{std}} - (P_{\text{vpstd}} \times \text{RH}_{\text{std}})}{P_1 - (P_{\text{vp}} \times \text{RH}_1)} \times \frac{T_{1\text{OR}}}{T_{\text{stdOR}}}$$

When SCFM is defined 14.7, 60 dry, this is shortened to: $\frac{P_{\text{std}}}{P_1 - (P_{\text{vp}} \times \text{RH}_1)} \times \frac{T_{1\text{OR}}}{T_{\text{stdOR}}}$

ACFM = 14.7 PSIA

P1 = Inlet Pressure in PSIA

Pvp = Partial Vapor Pressure of air at P1 & Ti

RH = Relative Humidity at Site Conditions

T1 = Inlet Temperature OR = 0F + 460

Tstd = 600F + 460 = 520 OR

It should be apparent that when SCFM is specified, care should be taken to assure that all suppliers are quoting on the same basis, that being Standard Cubic Feet per minute and not Actual Cubic Feet per minute or piston displacement. Care must also be taken relative to the definition of SCFM.

When selecting the proper air compressor, the ACFM should be calculated at the highest ambient temperature and RH the machine will be subjected to, assuring the required SCFM at all times.

In the case of centrifugal compressors, one must also account for seal losses. These must be added to the required discharge SCFM in order to arrive at the required capacity at the inlet flange or ICFM, as this is the standard for rating centrifugal compressor.

When selecting an air dryer for the above compressor, the dryer should be sized to handle the SCFM the selected compressor will supply at the coldest ambient temperature and lowest RH resulting in the highest SCFM.

When you are working to determine compressed air requirements for specific locations, you may need to determine the altitude, barometric pressure, and relative humidity for that location. There are some online resources to assist you.