SCFM (Standard CFM) vs. ACFM (Actual CFM)

Let the controversy begin!!

I've been in the air and gas handling business since 1982 and I think this topic causes the most confusion of any I've seen in this business.

I will plagiarize the Roots SCFM vs ACFM Guidebook to offer the correct calculation for air.

In specifying blower performance, major problems occur in distinguishing ACFM from SCFM, and in correctly converting from one to the other. Some people even use SCFM and ACFM interchangeably.

SCFM is normally used to designate flow in terms of some base or reference pressure, temperature and relative humidity. Many standards are used, the most common being the Compressed Air & Gas Institute (CAGI) standards, which are 14.5 PSIA, 68°F and 0% relative humidity (RH). This converts to a density of 0.074 lbs/cu.ft. for air.

SCFM is usually established from a weight flow corresponding to some system requirement for oxygen. Therefore, if actual site conditions are different from the standard or reference conditions, corrections must be made to reflect the actual conditions of pressure, temperature and relative humidity (i.e. convert to ACFM). Blower performance calculations, including head (used for centrifugal compressors) and horsepower, are based on actual (not standard) conditions existing at the inlet and outlet connections of the blower.

These corrections must, therefore, be made to assure that the blower furnished will provide the proper amount of oxygen or other elements for the process to function properly.

The formula below is strictly for ambient air, if another gas is required, additional considerations are required.

\[
\text{ACFM} = \frac{\text{SCFM} \cdot \frac{P_S - (RH_S \cdot PV_S)}{P_B - (RH_A \cdot PV_A)} \cdot \frac{T_A}{T_S} \cdot \frac{P_B}{P_A}}{1}
\]

where:
PS = Standard pressure (PSIA)
PB = Atmospheric pressure – barometer (PSIA)
PA = Actual pressure (PSIA)
RHS = Standard relative humidity
RHA = Actual relative humidity
PVS = Saturated vapor pressure of water at standard temperature (PSI)\(^1\)
PVA = Saturated vapor pressure of water at actual temperature (PSI)\(^1\)
TS = Standard temperature (°R) NOTE: °R =°F+460
TA = Actual temperature (°R)

1: See vapor pressure chart below
Let’s put the equation to the test with the following criteria:

- **Location:** Atlanta, GA
- **Elevation:** 960 feet above sea level
- **SCFM:** 1,000
- **Ambient Temperature:** 80°F
- **Relative Humidity:** 70%
- **Inlet Pressure Drop:** 0.3 psi (due to filter and silencer)
- **Standard Conditions:** CAGI Standards (14.5 psia, 0% RH and 68°F)

We can use our elevation table to get our barometric pressure which can be interpolated as 14.18 psia. Let’s plug these numbers into our equation:

\[
ACFM = \frac{1000 \cdot \frac{14.5 - (0 \cdot 0.3391)}{14.18 - (0.70 \cdot 0.5073)}}{\frac{80 + 460}{68 + 460}} \cdot 14.18
\]

Do the math and the answer is 1,095.86 acfm.

As you can see, if flow is not corrected for actual conditions, you would miss your requirement by 11.1%. This would be a greater miss if all parameters stayed the same but we assume a 100°F day, the flow would be 1,136 acfm.

A more detailed calculation is available in our Tech Talk Article titled "Volume and Mass Flow Calculations for Gases." This article shows how you can convert mass flow to either SCFM or ACFM and volume into mass flow.