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.

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

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

Temp °F t	Press PSIA p	Temp °F t	Press PSIA p	Temp °F t	Press PSIA p	Temp °F t	Press PSIA p	Temp °F t	Press PSIA p	Temp °F t	Press PSIA p
32	.08859	47	.15909	63	.2850	79	.4909	95	.8162	111	1.3133
32.018	.08866	48	.16520	64	.2952	80	.5073	96	.8416	112	1.3516
33	.09223	49	.17151	65	.3057	81	.5241	97	.8677	113	1.3909
34	.09601	50	.17803	66	.3165	82	.5414	98	.8945	114	1.4311
35	.09992	51	.18477	67	.3276	83	.5593	99	.9220	115	1.4723
36	.10397	52	.19173	68	.3391	84	.5776	100	.9503	116	1.5145
37	.10816	53	.19892	69	.3510	85	.5964	101	.9792	117	1.5578
38	.11250	54	.20635	70	.3632	86	.6158	102	1.0090	118	1.6021
39	.11700	55	.2140	71	.3758	87	.6357	103	1.0395	119	1.6475
40	.12166	56	.2219	72	.3887	88	.6562	104	1.0708	120	1.6940
41	.12648	57	.2301	73	.4021	89	.6772	105	1.1029	121	1.7417
42	.13146	58	.2386	74	.4158	90	.6988	106	1.1359	122	1.7904
43	.13662	59	.2473	75	.4300	91	.7211	107	1.1697	123	1.8404
44	.14196	60	.2563	76	.4446	92	.7439	108	1.2044	124	1.8915
45	.14748	61	.2655	77	.4596	93	.7674	109	1.2399	125	1.9438
46	.15319	62	.2751	78	.4750	94	.7914	110	1.2763	126	1.9974

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:

$$ACFM = 1000 \cdot \frac{14.5 - (0 \cdot 0.3391)}{14.18 - (0.70 \cdot 0.5073)} \cdot \frac{(80 + 460)}{(68 + 460)} \cdot \frac{14.18}{13.88}$$

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. Based on 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.