AIR VOLUME CONVERSIONS

Technical Presentation

All aeration calculations require the volume of air to be determined:

a. To calculate number and/or size of diffusers.
b. To determine number and size of air supply blowers.

To simplify the data and communications air volumes have been reported with standard nomenclature and standardized units of measure. There are 2 basic standards or reporting/calculating methods which create confusion:

1. What is the “standardized” volume condition?
2. Metric units vs. “English” units.

I “Standardized” Volumes –
For much of the world the standardized volume of air conditions are based on an accepted standard condition with standardized calculating procedures applied to convert plant or site conditions to “standard” for the industry. Two conditions are commonly employed and may be used depending upon country. Since these industry conditions are widely recognized it is an easy conversion between these reported conditions.

a. Standard Conditions
Typical nomenclature for USA and many other countries particularly those reporting values in “English” units. Standard conditions are defined as the following conditions:

1. Air is the gas.
2. Temperature as 20˚ C. (68˚ F)
3. Elevation at sea level.
4. Relative humidity at 36%.
5. Pressure absolute 1 bar (14.7 psi)

b. Normal Conditions –
Typical nomenclature for most parts of the world using “metric” units of volume. Normal conditions are defined the same as standard conditions of Item “a”: except measured and reported at “0˚ C”.

c. A few exceptions always exist such as a few places using values at 10˚ C but is very limited.

d. To convert between "standard" or "normal" air volumes or air volumes at any other temperature is world recognized as Air Volume@ absolute temperature #2 (˚C) = Volume @ Temperature #1 (˚C) (absolute temp #1)

Absolute temperature = 272˚ C + temperature ˚C

EXAMPLE:

T_1 = "Standard" conditions at 20˚ C typical of USA values.
T_2 = Normal conditions at 0˚ C typical metric value.
Volume air at $T_1 = V_1$
Volume air at $T_2 = V_2$

Then

$$V_2 \text{ air} = V_1 \quad \frac{(272^\circ + T_2)}{(272^\circ + T_1)}$$

$$V_2 \text{ air} = V1 \quad \frac{(272 + 0)}{(272 + 20)}$$

V_2 air = V1 (0.9315) as volume of air at 0˚ C less than air volume at 20˚C.

To convert "standard" conditions volume at 20˚ C to "Normal" condition volume.
"Normal" volume = "standard" volume (0.9315).

II Units of Air Volume for Aeration–

Typically aeration volume of air is expressed per unit of time. The 2 most common units of volume are:

a. Standard cubic feet of air/minute abbreviated as scfm,
b. Normal cubic meters of air per unit time typically abbreviated as
   1. Nm^3/hr.
   2. Nm^3/min.

III Conversion between scfm and m^3 metric values:

$1m^3 = 35.31\ ft^3$
1 hr = 60 minutes

Example #1

If at same temperature of 20˚ C
1 standard m^3/min = 35.31 standard ft^3/min
1 standard m^3/hr = $\frac{35.31}{60}$ cfm = 0.5885 scfm

This is typically reported as 1 scfm = 1.7 standard m^3/hr.

Example #2

To convert from scfm to Normal m^3/hr must address temperature change as shown in I – D above.

Then 1 standard cfm at 20˚ C = less Nm^3 at 0˚ C because of the change in temperature.

1 scfm = 1.7S m^3/hr $\frac{(272)\ Nm^3}{(292)\ Sm^3}$

1 scfm = 1.584 Normal m^3/hr
1 Nm^3/hr = 0.6315 scfm

For specific information on aeration system selection considerations, contact EDI at 573-474-9456.