UNDERSTANDING GAS FLOWRATE CONVERSION

A Practical Guide for Engineers

1. How to convert SCFM to ACFM and back?

There's many sites and calculators online that cover this topic but I believe a number of them miss a few key points that help illustrate and understand this.

$$ACFM = \frac{\rho_{standard}}{\rho_{actual}} \times SCFM$$

When referring to compressor inlet conditions this relationship describes what the CFM at actual conditions would need to be in order to move the same mass flow at standard conditions. IT DOES NOT GIVE YOU A CONVERSION OF THE COMPRESSOR PERFORMANCE!!! Compressor CFM is the same regardless of the inlet conditions. After doing the calculation to determine ACFM you would need to find a compressor with that rated SCFM to meet that mass flow rate requirement.

The following relationship can be used to describe the reduction in compressor output $\dot{V}$.

$$\dot{m}_{in} = \dot{m}_{out}$$
$$\rho_{actual.in} \times \dot{V}_{standard.in} = \rho_{actual.out} \times \dot{V}_{actual.out}$$

Note: $\dot{V}_{standard.in}$ is the same for a compressor regardless of inlet conditions

$$\dot{V}_{actual.out} = \frac{\rho_{actual.in}}{\rho_{actual.out}} \times \dot{V}_{standard.in}$$

2. How to convert SCFM to mass flow and back?

Mass flow @ standard conditions $\dot{m} = SCFM \times \rho_{standard}$
Mass flow @ actual conditions $\dot{m} = SCFM \times \rho_{actual}$

3. How to convert SCFM between different gases?

By using Graham's law! Graham's law is an empirical relationship that states that the ratio of the rates of diffusion or effusion of two gases is the square root of the inverse ratio of their molar masses.

$$\frac{rate_1}{rate_2} = \sqrt{\frac{M_2}{M_1}}$$

4. Confusion that inevitably happens

4.1. What are standard conditions?

There is no agreed upon standard condition. Always ask/find the temperature/pressure/humidity (if applicable) of the volumetric flow rate that you are referring to.

4.2. How does humidity affect SCFM?

It is not intuitive but humid air is LESS dense than dry air. It affects the density and if you are using coolprop/refprop for material properties you can include the humidity when determining the density.

4.3. Compressor performance vs. condition conversion

COMING SOON!

5. Examples

COMING SOON!