OKALHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

AIR QUALITY DIVISION

GUIDANCE DOCUMENT **January 16, 2015**

SUBJECT: SCFM VS. ACFM

What Is the Difference Between SCFM and ACFM?

Both standard cubic feet per minute (SCFM) and actual cubic feet per minute (ACFM) are used to describe the volumetric flow rate of a gas. SCFM is based on established standard conditions, while ACFM is based on actual conditions of the gas. There are three sets of standard conditions regularly used in Air Quality: EPA Standard Conditions, EPA Reference Conditions, and American Petroleum Institute (API) Standard Conditions. For flow rates from stacks and stack testing, EPA standard conditions are used to standardize emission calculations, to compare emissions between emission units, and to compare emissions to established emissions limits.

Why Does DEQ Need Stack Flow Data and What Does It Affect If It Is Incorrect?

Stack flow data is used by DEQ, EPA, and other federal agencies to model emissions from stacks to calculate the concentrations of pollutants at ground level. The stack flow rate and temperature are used in dispersion models to calculate the plume height, the height to which pollutants rise before they begin to disperse. If the flow rate is low it will result in lower plume heights and cause a higher pollutant concentration at ground level. Since SCFM is lower than the ACFM it incorrectly results in higher ground level pollutant concentrations. This is misleading for agencies and persons using this information for planning, public review, or testing.

How Does Moisture Contribute to Stack Flow?

For fuel burning emission units, moisture plays a big role in calculating ACFM. Moisture in the stack gases comes from the combustion of hydrocarbon fuels and the moisture in the ambient air used for combustion. Moisture in the stack gases increases the exhaust flow rate and total gas volume. This causes a change NOT in individual volumes of pollutants, but a change in the overall concentration of pollutants in the whole gas volume.

How Does Excess Air Contribute to Stack Flow?

Excess air in the stack also affects the stack flow rate. If more oxygen is present in the stack it adds more gaseous volume and results in a higher stack flow rate. This excess air comes from the combustion process, or sometimes leaks. The exhaust gas from different types of combustion units, such as rich burn engines, boilers, and turbines, contain different percentages of excess oxygen in the gas.

What about the Difference between Stack Pressure and Standard Pressure?

The difference between the standard pressure and actual stack pressure does not contribute significantly to the volume of gas in the stack. Due to the relatively small variation in stack flow related to pressure, the difference in pressure it is not considered.

How Much Does ACFM and SCFM Really Differ?

Below is a table that lists the difference between the SCFM and ACFM of a fuel oil-fired boiler:

SCFM:	500.7	ACFM:	1,220.6
T_{std}:	68^oF	T_{stk}:	650^oF
F_w:	10,320 MMBtu	$\%O_2$:	3%
HI:	2.8 MMBtu/H	B_{wa}:	0.027

Where: HI- Heat Input Rate (Measured during Stack Test)
F_w- Wet F-Factor (Method 19)
T_{stk}- Actual Temperature (Measured during Stack Test)
T_{std}- Standard Temperature (Standard Conditions)
B_{wa}- Moisture % of Ambient Air (Method 19)
$\%O_2$- Concentration of Oxygen on Wet Basis (Measured during Stack Test)

How is (Dry) SCFM or DSCFM Calculated?

Equation:

$$DSCFM = HI \times F_d \times \left(\frac{20.9}{(20.9 - \%O_2)}\right) \times \left(\frac{1\ Hour}{60\ Min}\right)$$

Data from table.

$$DSCFM = 2.8\frac{MMBtu}{Hour} \times 9{,}190\frac{DSCF}{MMBtu} \times \left(\frac{20.9}{(20.9 - 3.0)}\right) \times \left(\frac{1\ Hour}{60\ Min}\right)$$

$$DSCFM = 500.7$$

How is (Wet) SCFM or WSCFM Calculated?

Equation:

$$WSCFM = HI \times F_w \times \left(\frac{20.9}{(20.9 \times (1 - B_{wa}) - \%O_2)}\right) \times \left(\frac{1\ Hour}{60\ Min}\right)$$

Data from table.

$$WSCFM = 2.8\frac{MMBtu}{Hour} \times 10{,}320\frac{WSCF}{MMBtu} \times \left(\frac{20.9}{(20.9 \times (1 - 0.027) - 3.0)}\right) \times \left(\frac{1\ Hour}{60\ Min}\right)$$

$$WSCFM = 580.6$$

How is ACFM Calculated?

Equation:

$$ACFM = HI \times F_w \times \left(\frac{20.9}{(20.9 \times (1 - B_{wa}) - \%O_2)}\right) \times \left(\frac{460 + T_{stk}}{460 + T_{std}}\right) \times \left(\frac{1\ Hour}{60\ Min}\right)$$

Data from table.

$$ACFM = 2.8\frac{MMBtu}{Hour} \times 10{,}320\ \frac{WSCF}{MMBtu} \times \left(\frac{20.9}{(20.9 \times (1 - 0.027) - 3.0)}\right) \times \frac{1{,}110}{528} \times \left(\frac{1\ Hour}{60\ Min}\right)$$

$$ACFM = 1{,}220.6$$

How Is ACFM Calculated from DSCFM?

Equation:

$$ACFM = DSCFM \times \frac{F_d}{F_w} \times \left(\frac{(20.9 - \%O_2)}{(20.9 \times (1 - B_{wa}) - \%O_2)}\right) \times \left(\frac{460 + T_{stk}}{406 + T_{std}}\right)$$

Data from table.

$$ACFM = 500.7\frac{DSCF}{Min} \times \frac{10{,}320}{9{,}190} \times \left(\frac{(20.9 - 3.0)}{(20.9 \times (1 - 0.027) - 3.0)}\right) \times \frac{1{,}110}{528}$$

$$ACFM = 1{,}220.5$$

Reference:
http://www.epa.gov/ttn/emc/methods/method19.html

Who Can I Contact For More Information?

For assistance, contact the Air Quality Division at (405) 702-4100 and ask to speak with a permit writer.