Air consumption for an air actuator can be converted into standard cubic feet by using the following equation:

SCF = ACF x (P_{abs}/P_{std}) where:

P_{std} = Standard Pressure = 14.7psi

P_{abs} = Absolute Pressure = Gage Pressure + Standard Pressure

ACF = Actual Cubic Feet of compressed air consumed by the air-powered device

SCF = Standard Cubic Feet

Discussion

Air consumption is commonly measured in volumetric flow, e.g. cubic feet per minute (CFM).

However, because air is a gas the amount of air in a given volume varies depending on temperature and pressure. Higher pressure air will be more dense than lower pressure air. Conversely, lower *temperature* air is more dense than higher temperature air.

So even if CFM is the same, the amount of air flowing will vary depending on temperature and pressure.

In order to normalize this, compressor manufacturers typically rate their equipment based on standard cubic feet per minute (SCFM). In the U.S. a "standard" cubic foot (SCF) is the amount of air in one cubic foot at one atmosphere of pressure (14.7psi) and standard temperature (68F).

Air-powered equipment uses compressed air, not standard pressure air, so the actual cubic feet (ACF) can be significantly different than SCF. The ACF of compressed air can be converted to SCF by the following equation, assuming standard temperature:

SCF = ACF x (P_{abs}/P_{std}) where:

P_{std} = Standard Pressure = 14.7psi

P_{abs} = Absolute Pressure = Gage Pressure + Standard Pressure

ACF = Actual Cubic Feet of compressed air consumed by the air-powered device

For Valworx air actuators we recommend a pilot supply pressure between 80 – 120psig.

For Example

Let's determine SCF and SCFM for a Valworx actuator using the following example:

Model: 530197

Actual Cubic Inches/cycle: 150 in^3 (from our datasheet)

First, we need to convert cubic inches to cubic feet:

Therefore, ACF = Actual Cubic Inches x 1 Ft^3 / $(12\ In)^3$ = 150 x $(1/12)^3$ = 150 x (1/1728) = 0.087 cubic feet.

Then we convert ACF to SCF:

SCF = ACF x (P_{abs}/P_{std})

P_{std} = Standard Pressure = 14.7psi

P_{abs} = Absolute Pressure = Gage Pressure + Standard Pressure = 80 + 14.7 = 94.7

Note: be sure to use absolute pressure, not gauge pressure

So SCF = 0.087 x (94.7/14.7) = 0.56 SCF

This is the amount of air consumed per actuator cycle.

Air consumption over a given period of time can then be determined knowing the cycle frequency.

Correcting for Temperature

The above example assumes standard temperature. We can account for the difference from standard temperature with the following equation:

SCF = ACF x (P_{abs}/P_{std}) x (**T_{std}/T_{abs}**)

Note the first part of the equation is exactly as before, with the addition of the temperature variables in bold. The temperature variables are as follows:

T_{std} = Standard Temperature on absolute scale (Degrees Rankine)

T_{abs} = Absolute Temperature (Degrees Rankine)

The obvious question is, what is degrees Rankine? The Rankine scale is the same as the Fahrenheit scale except it starts at Absolute Zero, or -460 F. So, to convert Fahrenheit to Rankine simply add 460.

Using the previous example, let's assume it's a warm day in the shop, and the compressed air is at a temperature of 98F.

Then:

T_{std} = Standard Temperature (R) = 68F + 460 = 528R

T_{abs} = Absolute Temperature (R) = 98F + 460 = 558R

Plugging this into the formula (values for temperature are in bold),

SCF = ACF x (P_{abs}/P_{std}) x (T_{std}/T_{abs}) = 0.087 x (94.7/14.7) x (**528/558**) = 0.53 SCF

Correcting for temperature changes the answer very little (0.53 vs 0.56 SCF). This because a 30 degree difference on the Fahrenheit scale (say, from 68F to 98F) feels like a tremendous difference, but it is not a large difference on the absolute, or Rankine scale (528R to 558R).

The additional complexity is rarely warranted unless the temperature is significantly different from Standard Temperature.

Conclusion

Air compressor capacity is typically stated in standard cubic feet (SCF), e.g. the volume of air at standard conditions. Actual conditions, of course, vary by temperature and pressure. With a few simple conversions actual cubic feet (ACF) can be converted to SCF. This conversion allows the user to accurately estimate the required air compressor capacity based on actual conditions.