DETERMINING AIRFLOW USING A VOLTMETER AND AMMETER

Measuring airflow has always been one of the more difficult and time consuming tasks a service person does. In fact, it is not generally done because it is too time consuming, requires special tools, and is not always so easy to do. In addition, airflow measurement is not usually taught to service people unless they are going to specialize in air balancing. Nevertheless, knowing the airflow in cfm can be useful to troubleshooters.

Most service technicians check the airflow by measuring the temperature drop across the cooling coil or the temperature rise across a heating system. If the air temperature drop or rise falls within an expected range, the assumption is the airflow is acceptable. Here is an easy method of measuring the airflow through a system that uses electric heaters. This method applies wherever electric heat is found. Electric heaters are often utilized for reheat as well as for emergency heat on heat pumps.

Assume you have an electric reheat coil that draws 25 amps at 240 volts. You take the temperature rise of the air as it passes through the electric heater and find that the air is heated from 50 degrees to 80 degrees. That is a 30-degree rise in air temperature.

Now you multiply the 25 amps by the 240 volts to find that the wattage output of the heater is 6,000 watts. Since there are 3.42 Btu per watt, you multiply the 6,000 watts by 3.42 to find that the electric heater is adding 20,520 Btuh to the air. This amount of heat is increasing the air temperature by 30 degrees.

Next you multiply the 30 degrees by the constant 1.08 to get a number, which can be divided into the 20,520 Btuh, to find the airflow in cfm.

Multiplying the 1.08 by 30 degrees of rise gives you a number of 32.4. Divide the 20,520 by this factor of 32.4 and you find that the airflow is 633 cfm.

cfm = Btuh/1.08 x Temperature Rise

cfm = 20,520 Btuh/1.08 x 30

cfm = 20,520 Btuh/32.4

cfm = 633

The 1.08 multiplier is not some mysterious magic number. This number includes the specific heat of air (0.24 Btu per pound per degree F). It takes 0.24 Btu of heat to change the temperature of one pound of air by 1 degree Fahrenheit. The 1.08 also contains the specific density of air (0.075 pounds per cubic foot). The air is measured in cfm yet the specific heat is per pounds of air. The weight per cubic foot of air (0.075 pounds) is needed to convert between the air volume and weight. Also contained in the 1.08 factor is the number of minutes in an hour (60 minutes per hour). This is required to convert between Btu per *hour* and cubic feet per *minute*. The factor of 1.08 is the product of the specific heat (0.24 Btu) times the density (0.075 pounds per cubic foot) times the number of minutes per hour (60 minutes).

Altitude (ft.)	Factor
0	1.08
1,000	1.04
2,000	1
3,000	0.96
4,000	0.93
5,000	0.9
6,000	0.86
7,000	0.83
8,000	0.8
9,000	0.77

Table 1. Factors for different altitudes.

The factor 1.08 assumes standard air at 70 degrees F at sea level. For practical purposes on most air conditioning and heating systems, the specific heat of 0.24 will remain a good useable constant. Since there will always be 60 minutes in each hour, this too is a fixed constant. Should we find ourselves at an altitude other than sea level, however, the density of the air may change enough to affect the accuracy of our formula. Table 1 supplies a list of factors for different altitudes, providing the adjusted factor due to the change in the air density for that altitude.

Be careful when taking the temperature readings so as not to allow the thermometers to be in the line of sight of the heaters. If the thermometers are placed in sight of the heaters, radiant heat from the heaters will increase the temperature readings and give a false airflow rate. It is the temperature rise of the air that we are looking for, not the temperature of the heaters.

Remember, this method of determining the airflow through a heat pump can be used to determine the cfm with the heaters turned on, and the cfm will be the same when the heat pump is in the heating or cooling cycle. Whether the air is being heated or cooled, the

airflow rate in cfm is the same. The air density in pounds per cubic foot changes but the cfm does not.

The formula used here for determining cfm comes from the sensible heat formula: **Btuh = 1.08 x cfm x Temperature Change**.