

The Tools of the Trade

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What You Need To Do an Effective Dryer Audit

Let's share some insider information. Performing a "dryer audit" is a mainstay of any drying specialist, and every reputable company that sells equipment has people specifically trained to perform these audits. Even with vast experience and all the necessary equipment, it takes someone skilled in the art significant time to capture all of the pertinent field data. Thereafter, another considerable investment is made into analyzing the data to manipulate it into a meaningful form.

A few years ago, I questioned my accountant on what I considered to be high fees for his services. His response was classic and something that made a meaningful impact on me. He nonchalantly responded, "My fees for my services are extremely low," he said. "I am only charging you one penny for all of my services. The rest of the money you are paying is for me knowing how to perform these services!"

The same is true for any professional service -- especially if the true value of what you receive will save you significantly more than your investment. If you, however, can perform these services in-house, you will save the investment for the specialist and reap the rewards of the audits conclusions.

So, I am going inside to share with you some of the methods of obtaining the required field data to enable an effective dryer audit. So much more than simply obtaining the data from the dryer itself is involved in a system analysis. Each system is different, so I will be focusing exclusively on obtaining the data from the dryer.

To do this, you need specific tools. These tools include a screw driver, flashlight, drill (preferably cordless) and other hand tools. However, the most noteworthy tools are more sophisticated, will likely cost more and are referred to as instruments. This is the topic of this Drying File -- tools of the trade. There are more instruments available than you can begin to imagine, and they are designed to measure anything you can think of. They all have their target applications. So, without going overboard in sophistication, cost or need, I will detail the basic types of instruments used in performing a dryer audit and discuss how they are used to gather meaningful information. Please note that I am offering no endorsement of any instrument, and any manufacturer or model is referenced purely to illustrate the technology.

Multimeters



The two most functional uses of the multimeter for

Numerous manufacturers offer multimeters that vary in sophistication from simple to "awesome." Awesome multimeters are of real value for instrument technicians and the electronics industry. As a plant requirement, a simple instrument is sufficient for almost everything that is required. The two most functional uses of the multimeter for this application are voltage and resistance.

a dryer audit are measuring voltage and resistance.

Most industrial high voltage applications are moving away from direct current (DC), so you typically will use the alternating current (AC) setting on the meter. Voltage or potential difference will tell you if the component has "juice," or power. This is important for confirming that motors and other field devices are powered.

As a direct measure, resistance is meaningful in determining such things as electric element condition. More commonly, the resistance feature of the instrument is used to determine continuity -- that is that there is no break in a wire or that a switch is closed when it needs to be. By applying the probes across the terminations, the instrument typically will emit a sound confirming the continuity. This is used to ensure that all switches and output signals are operating as they are required to do.

A feature that is nice to have on a multimeter is analog field reading capability. Analog transmitters commonly are 4 to 20 mA or 0 to 5 mV. You can test discrete or digital field signals with a DC (low voltage) or AC (120 VAC) volt setting, depending on the system configuration. This will validate that the correct inputs and outputs (I/O) are being sent and received from the control system.

A really cool instrument also will provide an analog output (although this typically is done with a separate instrument). This feature is another nice to have. With it, you can verify positions and conditions of field devices by changing the signal incrementally to illustrate whether each device is working properly.

Remember that working with multimeters requires that you work on "hot" panels and devices. Electricity is extremely dangerous, and only qualified individuals should be performing these tests.

Ammeter

An ammeter, or "amp clamp" as it is endearingly referred to, measures the current that a device draws. Most commonly, the device is a motor that is powering a rotating mechanical component such as a fan, valve or conveyor.

To obtain the current, a ring (coil) is placed around the conductor that creates a magnetic field, and by flux (that's magic in English) measures the current. On three-phase systems, each leg should be measured to check for balance and to obtain the average amp draw. The amount of current a device draws can be used to estimate the performance of the device.

Manometer

A manometer is used to read the pressure of a fluid within a system. Pressure can be static or dynamic and, for certain applications, you need both. Most the pressure readings of interest to us are differential pressure readings. What this means is that the pressure obtained from the instrument will indicate the pressure at the process point relative to another pressure. If the other pressure is atmospheric pressure, the differential pressure obtained is called the gauge pressure.

Manometers come in a variety of instruments. The most simple is the U-tube manometer, where a fluid of known density is used to measure the pressure. One leg of the tube is connected to the process point, and the other is left open to atmosphere. For a pressure drop or loss measurement (differential pressure), one leg would be connected before the equipment and the

other after the equipment. The difference in the two heights is measured and the resultant pressure is the difference in height (a distance) for that fluid.

If the fluid is water, the reading would be millimeters or inches of water. If the fluid is mercury, the reading would be millimeters (i.e., torr) or inches of mercury. These are the two most common fluids, and conversions for these fluids to kPa (kiloPascals) or psi (pounds per square inch) are available.

There are more refined instruments to read pressure. Note that refined does not equate to more accurate -- the simple U-tube or inclined-tube manometers still provide reliable and accurate measurement of pressure. I'll look at those as well as other devices you need to perform a dryer audit in my next column.

The Tools of the Trade, Part 2

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In my [last column](#), I began to share with you some of the methods of obtaining the required field data to enable an effective dryer audit. I left off with the more refined instruments to read pressure, so I'll pick it up there.

Remember, refined does not equate to more accurate -- the simple U-tube or inclined-tube manometers still provide reliable and accurate measurements of pressure. Several manufacturers offer low cost instruments for measuring pressure in both hand-held analog and digital manometers. These types of instrument range in pressure from a few inches of water to several thousand psi. For most drying applications, process gas pressures in excess of 40 inches of water are rare.

Pressure in drying systems is fundamental. Note that vacuum is negative pressure, so when I refer to pressure, I am talking about an absolute value. Because gas is being moved around the dryer, there is a requirement for the primary and secondary movers to be able to produce sufficient pressure to overcome all of the losses as the gas moves across the system. A manometer is used to establish the static pressure across the system, and a static pressure profile can be developed to illustrate the losses across the system.

There are other pressures in systems that require more accurate measurement than a standard manometer can accurately read. For these pressures, a special type of manometer is required.

Micro-Manometer



There are various methods to obtain the velocities of a gas in a dryer. One of the most common and accurate is to use a pitot tube, which measures the difference between the static and the dynamic pressure of the gas as you traverse the duct or cross-section. This differential, coupled to the true gas density at the ensuing pressure and temperature conditions, will yield the velocity of the gas in the duct.

A manometer is used to establish the static pressure across the system, and a static pressure profile can be developed to illustrate the losses across the system. (Courtesy of FlowKinetics LLC)

This pressure difference can be small at lower velocities, and an inclined manometer or digital micro-manometer with a much lower range may be required to take the readings. In addition, without obtaining the true density of the gas, the velocity and resulting volume and mass are only estimates.

To measure an accurate velocity in a processing system is really a challenge with a digital instrument because there is almost always some turbulence in the system. This causes the readings to bounce erratically and fluctuate dramatically. Accuracy here is paramount, and the instrument must have damping abilities if it is to be of any real use.

Various companies manufacture digital micro-manometers. The cost of these instruments is higher -- sometimes significantly so -- than regular manometers but is needed to obtain meaningful data.

Velometers

Most velometers are basically micro-manometers calibrated to a specific pitot tube. Their packaging and displays vary and often are integrated into a convenient box. They have been used almost exclusively in the HVAC industry for balancing air-conditioning ducts.

Anemometers

Another valuable instrument for measuring gas velocity is an anemometer. There are two primary types available. The first of these is the vane anemometer, which is essentially a propeller that is driven by the gas flow. A sensor counts the revolutions per minute (rpm) of the propeller, and algorithms extrapolate this to give a velocity.

A hot wire anemometer provides a head with an exposed wire concealed in a protective loop. Most hot wire anemometers are termed constant temperature anemometers. The sensor (wire) forms one leg of a wheatstone bridge. The anemometer's feedback circuitry keeps this wire at a fixed temperature, which is above atmospheric. Changing velocity and, consequently, heat transfer rates from the wire cause the anemometer electronics to vary the voltage supplied to the wire to maintain its temperature. Calibration of the instrument then yields a relationship between this voltage and gas velocity.

The neat thing about anemometers is that the velocity obtained is independent of the gas density. However, to perform a heat and mass balance across the dryer, you need the true density, so this benefit is only short lived. Anemometers have other limitations, specifically as they relate to dryers. Gases flowing in dryer ducts often have solid particles at the location of the traverse. Solids damage anemometers and affect their performance. Additionally, vane anemometers have large heads, and it is difficult to get them into ducts.

They are of most value if they are used outside of the system such as at filter inlets and exhausts -- but be careful of the high temperatures.

Thermometers

Simple mercury bulb thermometers are versatile when auditing a dryer. They are suitable for performing both dry and wet bulb temperature measurements and are reliable.

Dial thermometers also are useful. They can be placed in a suitable process-measuring port and provide information from some distance. Newer digital thermometers provide great flexibility, and the temperature-sensing elements can be designed for gas, liquid, surface or penetration measurement. They also can be designed for high-speed response or reading. There are numerous manufacturers of digital thermometers, and they all function within an acceptable range.

Another valuable type of thermometer that is becoming more available is the infrared (IR) thermometer. This device measures the surface temperature, and units with laser pointers allow you to target and focus



An infrared thermometer measures the surface temperature, and units with laser pointers allow you to target and focus. (Courtesy of Raytek Corp.)