

What is Heater Bakeout and Why is it Important?

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Watlow® has encouraged customers for many years to perform moisture tests on heaters before use. The process of conditioning or “baking out” a heater can be a costly and complex process requiring additional equipment. However, failure to perform this critical step prior to applying full power to a heater could have catastrophic effects if moisture is present.

Watlow controllers offer a new feature designed to expedite this process ensuring that your heaters are ready when you need them. Our built-in heater bakeout functionality provides users with the confidence needed to operate their process without the hassle and additional expense associated with conditioning ovens. It is an important advancement that continues to show the world-class engineering expertise of Watlow’s team.

The moisture problem with heaters

A common issue with heaters is the likelihood of moisture being drawn into the element from the atmosphere. This phenomenon typically occurs when heaters are stored for an extended period prior to use. Metal sheath heaters are hygroscopic, meaning that they will absorb moisture from the surrounding atmosphere. When enough moisture has accumulated in the heater, a condition known as a “wet heater” will occur. Wet heater problems are more common in locations with relative high humidity, but they can also occur if heaters are stored and unused for extended periods of time (about 30 days).

In some instances, heaters can become so “wet” that it is possible to observe water exiting the heater during a conditioning cycle. In addition to location, higher line voltage heaters and large process heater bundles are more prone to absorbing moisture.

How moisture is absorbed by a heater

Water forms in a heater through natural chemical and atmospheric processes. Take a tubular mineral insulated heater, for example. Magnesium oxide is used as insulation in a tubular mineral insulated heater because it has high thermal conductivity and low electrical conductivity. The chemical compound is used to transfer heat from the element to the sheath.

Magnesium oxide readily absorbs moisture to form magnesium hydroxide. As the unit cools after use, the pressure inside the heater falls and air is driven into the heater. Once inside, the moisture in the air can exist as dihydrogen monoxide – commonly known as water – in liquid or vapor form, or as magnesium hydroxide.

How to check for a wet heater

If a user suspects a wet heater is present or is unsure, it is best to run a meg-ohm precheck on the heater to avoid potential damage to the heater. A meg-ohm precheck is conducted with a Megger test instrument, which provides a measure of insulation resistance in ohms or meg-ohms. A lower Megger reading indicates that the user should condition the heater prior to use. Please refer to the installation and maintenance manual provided with your heater for the recommended meg-ohm level prior to applying full power to your heater.

Other indications that moisture may be present in the heater include tripping the ground fault circuit interrupter (GFCI), the heater element experiencing a “burn through” fault, high speed fuses open in the power controller and branch circuit fuses or circuit breakers open.

How to remove water from a heater

If moisture is in the heater, the concentration of magnesium hydroxide will increase as the temperature rises. At 100 degrees Celsius, the chemically bonded water is maximized. As the temperature increases to more than 330 degrees Celsius, the magnesium hydroxide starts to decompose. At 430 degrees Celsius, the chemical compound is converted back to magnesium oxide and water.

A “bakeout” process is used to remove this moisture. A bakeout is the use of high temperature and sometimes a vacuum to remove moisture or water vapor from the heater. A bakeout artificially accelerates a process known as outgassing, which is the release of water vapor trapped or absorbed in the heater.

Heater conditioning can be an expensive, complicated process. In its simplest form, a conditioning process is performed by placing the heater in a specialized oven running at 120 degrees Celsius for up to 40 hours. Some heaters require only a cycle of six to eight hours. After the cycle is complete, the heater should be retested with a Meggers instrument to determine if the required meg-ohm level has been attained.

It is important to note, the moisture released from within the magnesium oxide does not appear to contribute to the heater failure. As such, 120 degrees Celsius is sufficient to remove water from the heater and is a safe temperature for the other components of the heater, including terminations, wires and seals.

A new, built-in bakeout solution

Watlow now offers heater bakeout feature in several of our control devices. This feature protects the heater upon startup by removing excess moisture from inside the heater before applying full power, safeguarding the heater from permanent damage.

Watlow's ASPYRE DT® SCR smart power controller is one such device with the built-in heater bakeout option. With a 9,999-minute program, ASPYRE power switches are designed such that the current setting will determine the max root mean square (RMS) heater current that can be reached at the end of the bakeout. A bakeout can be initiated if enough time has passed since the heater was last operational. In addition, a bakeout will activate after a power cycle of the controller. Watlow's F4T® multi-function controller also offers a heater bakeout function.

Power controllers with built-in heater bakeout illustrates Watlow's commitment to its customers of providing superior products and services to meet their unique business needs. With this innovation, customers can improve performance and efficiency by eliminating the need to test for or condition wet heaters. Let Watlow's experience in numerous industries assist you, and visit our power controller product page (<https://www.watlow.com/products/controllers/power-switching-devices>) or contact a Watlow sales representative (<https://www.watlow.com/contact-us>) to learn more.