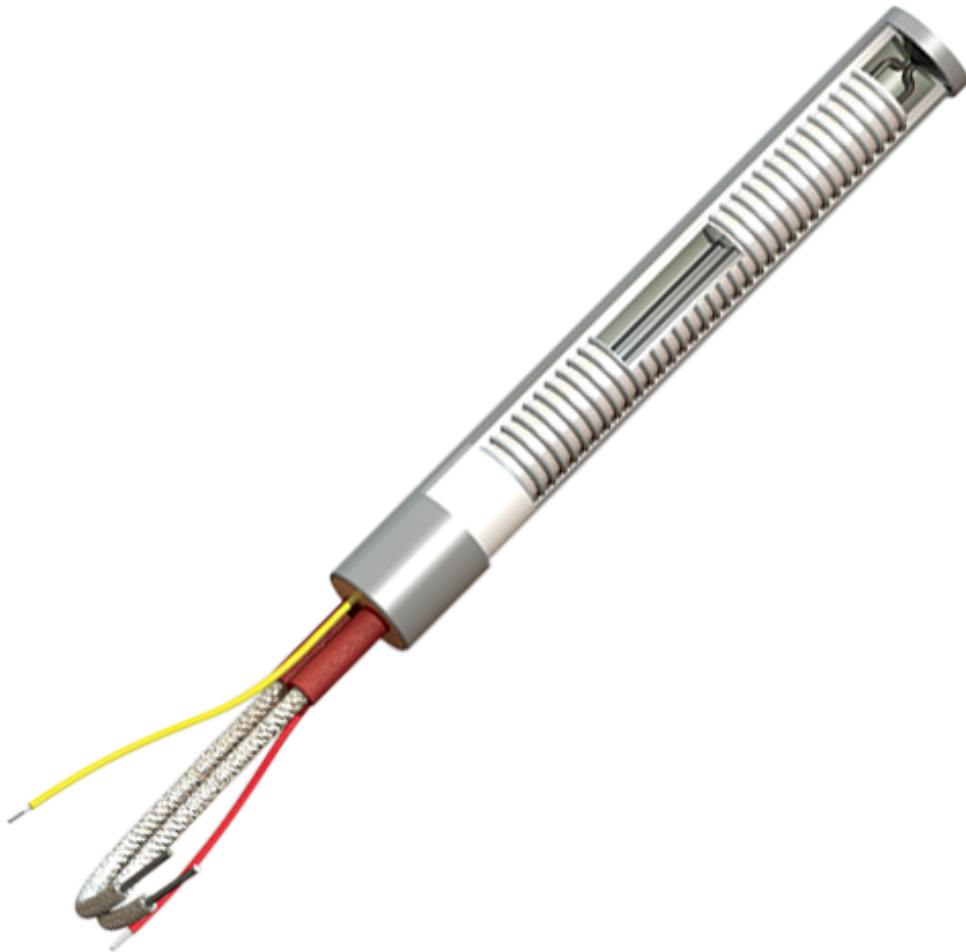


Guide to Determine Insulation Resistance in Electric Heaters

By: - May 16, 2022



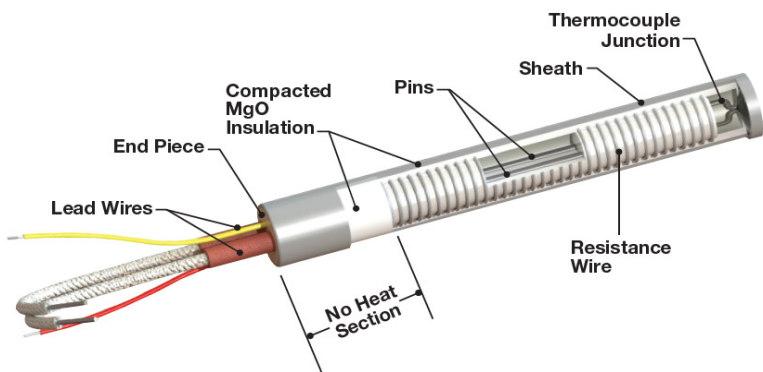
Insulation resistance is a key parameter for any electric heater to operate safely. All Watlow® heaters undergo insulation resistance testing before leaving the manufacturing facilities. However, during shipping and storage, the mineral insulation (magnesium oxide or MgO) material used in metal sheath heaters can absorb moisture rendering the heater unusable until the moisture is purged from the heater.

Moisture impacts the functionality and performance of mineral insulated heaters and increases the likelihood of a short-to-ground episode. Although all heaters should have their insulation resistance tested before installation, heaters held in storage for long periods of time or used in high humidity regions are especially vulnerable to absorbing moisture from the ambient environment and should, therefore, always be tested before use. When too much moisture has been absorbed from the surrounding atmospheric humidity, the heater can become “wet” and must be purged of all moisture prior to use.

An insulation resistance test, or megohm (<https://es.watlow.com/Blog/Posts/How-to-determine-if-an-electric-heater-is-good-or-bad-using-an-ohmmeter>) test, is required to determine the quality of the insulation within the heating elements. This test is easy to perform and should be completed before putting any electric heater into service. This critical step will help avoid the installation of a “wet heater” that will have a higher chance of causing damage or shorting out.

What is Insulation Resistance?

For an electric heater to work correctly, current needs to flow directly through the coil wires within the heating element and not be able to short to the outer sheath through the absorbed moisture. The greater a heater’s insulation resistance, the greater the heater’s ability to handle the voltage and operate correctly. As current travels through the heating element, low insulation resistance can allow the voltage to arc across the dielectric material and ground out to the sheath, which can destroy the heater or cause broader system damage.



FIREROD cartridge heater assembly

Magnesium oxide (MgO) is typically used as a dielectric material to insulate the element wire from the heating surface or outer sheath. As long as the insulation resistance of the MgO remains high, the heater can function correctly.

While MgO is an excellent high-temperature insulator, it also is hygroscopic, meaning that it likes water and actively draws moisture out of the surrounding atmosphere, effectively lowering the insulation resistance. If too much moisture is present when the heater is fully powered up, the current will find the shortest path out by arcing to the sheath and shorting out the heater.

A heater arcing and grounding out can have a range of consequences, from a nuisance trip of a breaker to an explosive event. Depending on the voltage and type of material being heated, a short to ground can result in a more significant explosive event generating damage, injury or even death, so

understanding how to perform a megohm test properly is essential to safe operation.

Understanding the Value of a Megohm Check

Not all heaters have the same megohm rating. Depending on the heater's construction, operating environment, type of seal, etc., a heater's megohm value may be higher or lower. Knowing the acceptable insulation resistance for your heater is critical to maintaining a high-performing environment. Although each Watlow heater runs through rigorous testing before it leaves the factory, the insulation resistance of a heater can drop over time, especially if the heater is offline or spends time in storage. MgO is hygroscopic, meaning it is sensitive to the moisture in the air. Over time, the MgO will absorb more water from the air, which lowers the resistance of the MgO.

A megohm check confirms that the insulation resistance is still within an acceptable range. If the value is too low, the heater is considered a "wet heater." As a general rule, if a heater has an insulation resistance of 500 megohms or greater at 500VDC, then the heater is acceptable to be put into service.

While using a multimeter to test for insulation resistance is possible, it is essential to always check for insulation resistance using a proper megohm tester.

What if the Megohm is Too Low?

So what if you measure your heater's insulation resistance and the megohm is too low? Time to trash that heater? Luckily, no. Users can restore wet heaters to their proper working condition.

Wet heaters should never be put into operation until their insulation resistance has been increased. The heater will not be able to contain high voltages and high currents. Putting a wet heater into service runs a high likelihood of a direct short to ground occurrence.

Because the moisture in the magnesium oxide is lowering the insulation resistance, to return the heater to its proper form, the water will need to be "baked out" to purge the internal moisture. As magnesium oxide is exposed to water, it becomes magnesium hydroxide. Magnesium hydroxide has a lower resistance and does not work as well as an insulator.

To perform a heater bakeout, the heater is typically placed in a special processing oven to dry out the heater and remove all remaining moisture. A bakeout (<https://www.watlow.com/blog/posts/what-is-heater-bakeout-and-why-is-it-important>) temperature of the heater at 120 degrees Celsius is required for at least six hours. The warm air is enough to convert the magnesium hydroxide back into magnesium oxide and water. If a bakeout oven is unavailable, some Watlow controllers feature a heater bakeout setting to accomplish the same outcome before powering up the heater for full operation.

After performing the bakeout process, check the heater's insulation resistance again with a megohm tester. If the insulation resistance still remains too low, perform the bakeout procedure again. In extreme examples, the bakeout process may have to be performed for up to 40 hours to remove

enough moisture from the heater.

What if the Megohm is Too High?

So you know what to do if the megohm reading is too low, but what if it is too high? What do you do then? Celebrate. There is no such thing as a megohm test or reading being too high. A high insulation resistance means the heater is in proper working order and can safely be put into service.

A wet heater does not mean you have lost that heater for good. Conditioning your heater through a proper bakeout process and confirming that the required insulation resistance has been restored through a megohm test will have your heater online and working as required.

Keep your work environment safe by performing an insulation resistance test before every heater install.