

How to Prevent Moisture-Induced Failures in MgO-Insulated Electric Heaters



Moisture might seem harmless, but in the world of industrial electric heaters, it's a silent saboteur. Magnesium oxide (MgO) insulation is used in most electric heating elements due to its excellent dielectric properties when dry. However, MgO is also hygroscopic, meaning it eagerly absorbs moisture from the air. That absorption can lead to ground faults, failed hi-pot tests, and premature heater breakdowns.

Let's explore how to keep your heaters dry, safe, and reliable.

Why Moisture Is a Problem

MgO insulation absorbs moisture through capillary action or exposure to humid environments. Once wet, its dielectric strength plummets, creating pathways for current leakage. This can lead to:

- Ground fault trips
- Failed insulation resistance (IR) and hi-pot tests
- Reduced heater lifespan



Electrical Testing: Your First Line of Defense

Insulation Resistance (IR) Testing

- Use a 500 - 1000 VDC megohmmeter.
- Test between the heater element and sheath.
- Pass Criteria:
 - New heaters: $\geq 5 \text{ M}\Omega$
 - $< 1 \text{ M}\Omega$: Requires bake-out or conditioning

Dielectric (Hi-Pot) Testing

- 120-240 V heaters: 1000 VAC or 1414 VDC
- Higher voltage: 1500 VAC
- Test duration: 1 second min.
- Pass Criteria:
 - No breakdown or flashover
 - Leakage current $< 5 \text{ mA}$

Bake-Out Procedures: Drying Done Right

Field Oven Bake-Out (Removable Units)

- Temperature: 121 - 204 °C
- Duration: 6 - 40 hours. The amount of time will depend on the size of the heater.
- Goal: IR $\geq 5 \text{ M}\Omega$ post-bake

In-Place Electrical Bake-Out (Installed Units)

- Start at 25 - 50% rated voltage
- Use SCR controllers with soft-start modes
- Temperature Profile:
 - Ramp to 80 °C → Release surface moisture
 - Hold at 150 °C → Dehydrate binders
 - Dwell near 200 °C → Deep drying



Preventative Measures for Long-Term Reliability

- Storage: Keep heaters in $\leq 55\%$ RH environments with desiccants.
- Inspection: Perform quarterly IR checks and trend the data.
- Grounding: Use dedicated grounding leads for safety.

Quick Engineer's Checklist

Step	Action
On Receipt	Keep packaging sealed; tag units stored >30 days
Before Power-Up	Megger test; condition if IR <1 M Ω
Installed Units	Use bake-out controller; monitor IR
Final Verification	Confirm hi-pot specs; check leakage current and ground continuity

Moisture doesn't have to be a mystery. With proactive testing, controlled bake-outs, and smart storage practices, you can eliminate moisture-related failures and keep your heaters, and your operations, running smoothly.