

## Handling and operation of ThermSys MI-heaters and applications made of them

### I. General

ThermSys heating elements and heating applications may only be tested, mounted and connected by electrically qualified personnel. This leaflet is intended to serve the specialist as a helpful answer for the most typically problems and questions that may occur.

ThermSys MI-heaters are designed and manufactured generally as follows:

One or two conductors are insulated by high compressed mineral oxide (usual: magnesia or alumina) from heaters tubular sheath.

### II. Selection and Design of operating voltage for ThermSys heating elements

The above mentioned design allows as "rule of thumb" depending from exact geometry of the heater 100V/mm outer diameter as operating voltage just respecting the insulation distances.

The specific maximum possible operating voltages for the individual heater is dependent on the max. operating temperature, the heater geometries (length / diameter / internal structure) and its total resistance. Irrespective of this, a heater can basically only be operated with that voltage, which ensures the dissipation of the generated power in accordance with its resistance in the respective installation and operating.

If you have any questions, do not hesitate to contact ThermSys for more details or assistance.

### III. Sheath temperature

Sheath temperature and lifetime of the heaters are closely related.

**The maximum sheath temperature should not be more than 1000°C.**

Lifetime of heaters depend mainly on three points:

1. Temperature of the heater / operating temperature
2. Controlling / operating cycles during service (Controller type / actuator)
3. Power density on the sheath and on the inner conductor(s) in W/cm<sup>2</sup>

The optimal operation of the heating element, to achieve the best lifetime, is by slowly increasing the voltage (AC / DC) to reach operating temperature and then kept at a constant voltage (variable transformer operation). Frequent on-off require a higher electrical and mechanical stress on the heating element and have a negative impact on his life. Usually the variable transformer operation is not economically realizable by operating heaters at supply voltage. For this reason you should ensure to get as close as possible to this Mode.

Suitable are circuit breaker as solid state relay or thyristor controller switching at phase zero crossing are most common. It is important to use actuators which can serve lowest possible switching cycle times (< 0,1sec).

With a voltage amplitude controller, which supplies the heater variable voltage, you reach a maximum life span.

Even using phase angle control in some applications acceptable results are achieved.

**If a heater or a heating application will be used at temperatures higher 600°C, we recommend in case of using long heaters or high power densities the use of an isolation transformer, to respect safety aspects like protection against contact and leak current.**

### IV. Dielectric tests and insulation resistance

Due to the above mentioned design of the heaters the insulation resistance depends in voltage, the insulation material, thickness of insulation and temperature.

To avoid the formation of leakage paths in MgO, only for one time a single dielectric test with maximum 500V(AC)/mm (depends on diameter of cable) for 1 minute is allowed to do. This test is performed by ThermSys as final test before packing the heater. All following dielectric tests should be performed only with test voltage not higher than operating voltage. All tests must be performed in cold state (room temperature) only.

Tests and measurements according VDE, UL, CSA, Ghost etc. are not permitted and may destroy the MgO insulation! For device approvals exceptions have to be made and relevant areas should be excluded from the general tests and measurements. Special test procedures have to be defined and in your manuals clear indications have to be given concerning correct use.

Testing the insulation resistance at room-temperature with higher DC current is possible with appropriate equipment.

Minimum insulation resistances and maximum test voltages for customized tests can be provided by ThermSys acc. your application.

## V. Brazing heaters

When brazing MI-heaters mind the risk of braking the heater at the end of the brazed area (e.g. around a tube, into groves for better heat transfer...). Only in exceptional cases and only by experienced persons you should bend the heaters close to this area. Bend them before starting the brazing process as good as possible in the desired direction. In case of need to bend the ends after brazing, the part coming out of the braze should be hold by a tool or suitable pliers and bend some distance after the braze is fixing the heater. Bending only in areas the sheath is not affected by braze! By design the brazing area can be defused, using a longer groove, not filled by braze, fixing the ends affected by Braze-Stop with clips etc.

Bigger deviations from the above mentioned recommendations may lead to damage or destruction of the heater.

If you have any questions, do not hesitate to contact ThermSys for more details or assistance.

## VI. Electrical grounding of single heaters and heating applications

Single ThermSys heaters have no electrical grounding lead, if not explicitly specified by customer. Heating applications will have electrical grounding acc. customers specification. Customer has to take care to join the application with electrical ground of the machine where the heating application is mounted in accordance with the applicable codes and laws (e.g. VDE100, UL...).

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## VII. Handling of open heater ends

Semi-finished heaters and "sold by meters MI-Cable" is supplied with transport-sealed ends to prevent the ingress of moisture from ambient air. In the case of customer-specific further processing of the product or blank, care must be taken to seal the open ends with suitable sealing for further storage. Open ends (e.g. while manufacturing process) can be stored in suitable ovens at least at 120 °C and should be further processed quickly when removed again from oven to the workshop. If the insulation resistance is reduced to much by penetration of moisture, the moisture can be expelled by suitable measures and sealed again. The re-drying result must be checked by insulation resistance measurements between the inner conductor(s) and the sheath!

If you have any questions, do not hesitate to contact ThermSys for more details or assistance.