

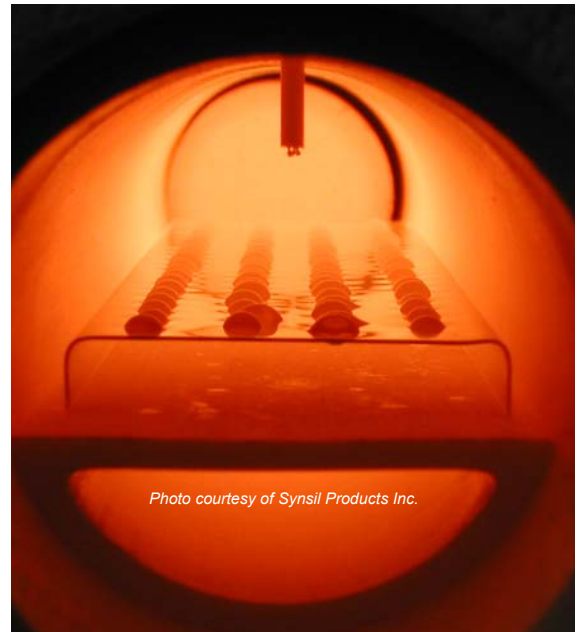
Liquidus Point Furnace



Orton Model GTF-MD Series Gradient Furnaces

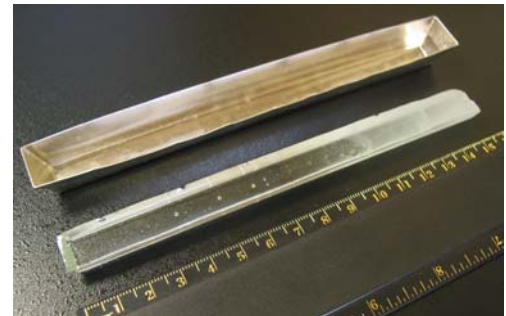
Liquidus Point Determination

(suitable for ASTM C-829 Methods A and B)



A liquidus furnace is useful for determining the maximum temperature at which crystallization will form in a glass, and a minimum temperature at which a glass can be held for extended periods of time without crystal formation and growth.

Samples of glass, frit, or cullet are placed into a platinum tray or boat, then placed into the hot Orton Liquidus Furnace for 1 or 24 hours. The Orton Liquidus Furnace is a specially designed horizontal tube furnace with a known, reproducible, linear thermal gradient of approximately 120°C across a 12" long monitored zone, so the temperature of the glass in the tray or boat corresponds to its position along that 12" zone. The tray or boat are removed hot and allowed to quench cool, freezing the glass in the state it developed inside the furnace. Upon visual or microscopic inspection, the crystal boundary plane is located and the temperature of that plane (the Liquidus Point) is interpolated from the temperature / position relationship of the known gradient.



Glass Batch Studies

Samples of the glass batch, or raw materials are poured into one, or several platinum boats, then placed into the Orton Liquidus Furnace. The boats can be placed into a hot furnace for quench heating, or can be heated according to a specific thermal cycle. The sample boats can be removed hot and allowed to quench cool, freezing the batch in the state it developed inside the furnace. Or the boat can cool inside the furnace. Upon visual inspection, the temperature of the zone of interest is interpolated from the temperature / position relationship of the known gradient.

The Orton Liquidus Point Furnace Series

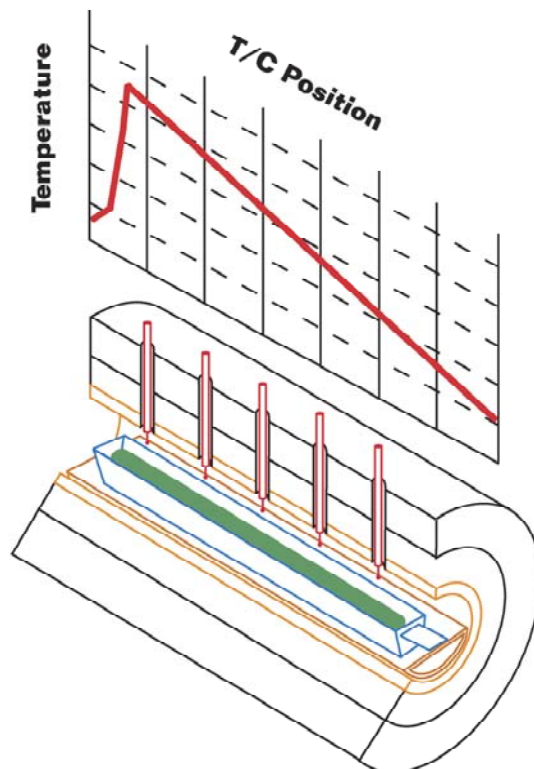
The Orton Liquidus Point Furnace Series is a specially designed horizontal tube furnace system with a known, reproducible, approximately linear thermal gradient across a 12" or 16" long monitored zone. The standard soak gradient at 1,600°C is approximately 10°C/inch. A system with a soak gradient at 1,600°C of approximately 20°C/inch is available. Each system is composed of four main components:

1) The furnace is a rectangular, metal shell structure that houses the refractory fiber insulation and four molybdenum disilicide heating elements that surround one end of the 2.875" ID ceramic heating chamber tube. The samples to be fired are placed on the top of the 2-1/2" wide high alumina D-tube hearth, which rests on the bottom of the ceramic heating chamber tube. Type "S" thermocouples are spaced on 2" centers along the monitored zone and extend vertically through the top of the heating chamber tube. Two specially shaped IFB end plugs are included to close both ends of the furnace. A cross section sketch at the right showing the concept of the Liquidus Furnace.

2) The furnace temperature is controlled by the Universal Temperature Control Console (UTC). The UTC is connected to the main power source and meters the power to the heating elements. The UTC contains the user programmable, multi-segment PID controller, the phase-angle-fired SCR solid state power module, ammeter, ON/OFF power switch, and appropriate electrical receptacles. The PID controller uses the thermocouple at the hot end of the furnace for control, so the monitored gradient falls from this control temperature.

3) Electrical power from the UTC runs through the included step-down transformer and on to the molybdenum disilicide heating elements.

4) The Temperature Display Cabinet contains a digital panel display, rotary selector switch, and appropriate electrical receptacles to display the temperatures of the other thermocouples along the length of the monitored zone. The user manually records the temperatures of the monitoring thermocouples as a function of time.



Real Time Data Logging Option - An optional computer interface can be added to display the temperatures of all the monitoring thermocouples on the user provided PC during the run, and save that data for post firing analysis.

The platinum trays or boats are NOT included.

The GTF-MD-16 system requires 240 VAC, 30 amp, 50 or 60 hertz input power. The Temperature Display Cabinet requires 120 VAC, 5-amp power. Please advise the local power supply so Orton can adjust the power control system to suit the local condition.

Orton Liquidus Furnace Series Specifications

| | GTF-MD-16 | GTF-MD-16L |
|-----------------------------|--------------|--------------|
| Maximum Temperature | 1,600°C | 1,600°C |
| Heating Chamber Tube | High Alumina | High Alumina |
| Monitored Zone Length | 12" | 16" |
| Monitoring T/C's (Type "S") | 6 | 8 |
| Control T/C (Type "S") | 1 | 1 |
| D-tube Hearth Length" | 17" | 21" |

APPROXIMATE Gradient in the Monitored Zone (after reaching equilibrium at 1,600°C)

| Average °C/inch (± 2°C/inch) | 10°C/inch | 10°C/inch |
|------------------------------|-----------|-----------|
| Approximate Temperature Span | 120°C | 160°C |

Note: gradient increases slightly as the equilibrium temperature decreases

| Power Requirements: | |
|-----------------------------|--------------------------------|
| UTC | 240 VAC, 30 Amps, 50/60 hertz |
| Temperature Display Cabinet | 120 VAC, 0.5 Amps, 50/60 hertz |

| Approximate Dimensions & Weight | Dimensions | Weight |
|---------------------------------|-------------------------|-----------|
| GTF-MD-16 Furnace | 17" H x 15" W x 25" D | 70 pounds |
| GTF-MD-16L Furnace | 17" H x 15" W x 28.5" D | 85 pounds |
| UTC Console | 6" H x 18" W x 13" D | 19 pounds |
| Step-down Transformer | 10" H x 10" W x 12" D | 68 pounds |
| Temperature Display Cabinet | 5" H x 10" W x 7" D | 4 pounds |