Orton Standard Dilatometers

Orton dilatometers are designed to measure the dimensional changes of ceramics, glasses, metals, carbon composites, cermets, minerals, and polymers as a function of temperature. The dilatometer records reversible and irreversible changes in length (expansion and shrinkage) during heating and cooling. Samples are measured for determining firing ranges and firing schedules, measuring thermal expansion ranges for glaze fits, and measuring thermal expansion ranges for R&D, QC or product certification. Orton standard dilatometers are used for ASTM E-228, C-372, and other testing procedures to measure the Coefficient of Thermal Expansion (CTE), softening point, glass transition temperature, curie point, crystalline transformation, phase transition, shrinkage, warping, bloating, sintering rate, isothermal creep, stress relaxation.

System Description

The standard Orton dilatometer is a digital, horizontal, single sample, compact, benchtop system comprised of a furnace (for a variety of temperature ranges, including sub-ambient); a sample holder system (fused quartz or high alumina); a control/sample thermocouple; a sample displacement measuring system (probe rod and LVDT sensor); a user-adjustable counterweighted pulley system to provide a constant and uniform contact load on the test sample; the Orton process controller for furnace control and data acquisition; and the Orton dilatometer software.

All Orton standard systems are factory calibrated against a 1” rod of high purity, platinum, thermal expansion standard. The standard systems require 120-VAC, 15-amp, or 240-VAC 20-amp, 50/60 hertz power. Standard options include controlled atmosphere/vacuum components, over-temperature protection, and exchangeable furnaces for rapid sample turnaround.

Principle of Operation

A sample specimen is placed between the end of the sample holder and the end of the movable probe rod. The furnace is placed over the sample, and heated according to a user defined thermal cycle. As the sample heats and cools, the sample expansion pushes against the probe rod, or the sample shrinkage pulls away from the probe rod. The probe rod is kept in constant contact with the sample by the pulley system. The probe rod transmits the amount of sample movement to the electronic displacement sensor (LVDT) which is located outside of the heated chamber. The LVDT generates an electronic signal corresponding to the change in sample length and continuously sends that signal to the Orton process controller. The process controller calculates and saves the length change data along with the sample temperature from the thermocouple located next to the sample. The PLC and temperature data is downloaded to an independent computer system for real time observation and for post testing analysis.

(continued on the next page)
Orton Standard Dilatometer Software

The Orton Standard Dilatometer Software (Version 5.2.1) is an executable program that is included with every new standard dilatometer. The software is loaded onto the PC system supplied by the user, and communicates with the dilatometer. The operator enters the test parameters into the user-friendly screens, and the software sends the information to the process controller inside the dilatometer. The software extracts data from the dilatometer during the test so the operator can monitor the data in real time. Upon completion of the test, the software creates a data file for post testing review and analysis. The operator can view and analyze the data files on the same PC, or can transfer the data files to another PC for independent viewing and analysis.

The software collects and displays time, temperature, and percent linear change data, and stores it in a binary file. PLC data is displayed on the PC monitor in temperature or time based modes. Data can be printed graphically or in tabular form, or exported as an ASCII file. Software features include comparisons against temperature or time of up to six runs; zoom into part of the curve; display differential or alpha CTE curves; Tg (between 400 and 850°C) softening point temperatures; α-β quartz transition temperature, and coefficient of expansion calculation for any temperature range.

The Orton Dilatometer Software (Version 5.2.1) is supplied on a CD, and is compatible with the operator’s PC using the English language version of Windows 95/98/2000/XP/Vista.

### Typical Specifications

<table>
<thead>
<tr>
<th>Model Number</th>
<th>DIL 2010 STD</th>
<th>DIL 2012 STD</th>
<th>DIL 2016 STD</th>
<th>DIL 2010 C</th>
<th>DIL 2010 B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature Range</td>
<td>RT to 1,000°C</td>
<td>RT to 1,200°C</td>
<td>RT to 1,600°C</td>
<td>RT to 1,000°C or -190°C to +500°C</td>
<td>RT to 1,900°C</td>
</tr>
<tr>
<td>Furnace</td>
<td>Kanthal Wire</td>
<td>Kanthal Wire</td>
<td>Silicon Carbide</td>
<td>Nichrome Wire or Cryogenic Chamber</td>
<td>Kanthal Wire</td>
</tr>
<tr>
<td>Thermocouple</td>
<td>Type &quot;S&quot;</td>
<td>Type &quot;S&quot;</td>
<td>Type &quot;S&quot;</td>
<td>Type &quot;N&quot;</td>
<td>Type &quot;N&quot;</td>
</tr>
<tr>
<td>Sample Holder and Probe Rod</td>
<td>Fused Quartz</td>
<td>High Alumina</td>
<td>High Alumina</td>
<td>Fused Quartz</td>
<td>Fused Quartz</td>
</tr>
<tr>
<td>Sample Size (max)</td>
<td>50 mm long by 20 mm diameter</td>
<td>50 mm long by 20 mm diameter</td>
<td>50 mm long by 20 mm diameter</td>
<td>50 mm long by 10 mm diameter</td>
<td>50 mm long by 20 mm diameter</td>
</tr>
<tr>
<td>LVDT Displacement Range</td>
<td>±100 inch (±2.54 mm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Displacement Resolution**

0.0000009 inch or 0.00002 millimeter or 0.02 microns

**PLC Resolution for a 1" Sample**

0.00009%

**Reproducibility Range**

| ±0.004 PLC (±1 µm / ±40 µ-inches) | ±0.008 PLC (±2 µm / ±80 µ-inches) | ±0.008 PLC (±2 µm / ±80 µ-inches) | ±0.004 PLC (±1 µm / ±40 µ-inches) | ±0.004 PLC (±1 µm / ±40 µ-inches) |

| Contact Load | Adjustable minimum 4 grams | Adjustable minimum 4 grams | Adjustable minimum 4 grams | Adjustable minimum 4 grams | Fixed - 113 grams |

**Temperature Control**

Orton User Programmable, 20-segment, PID Controller with Melting Point Protection

**Heat-up Rate**

1 to 30°C/minute at 0.01°C increments

**Data Acquisition**

Orton On-board Computer (data stored in on-board computer at 1°C increments, downloaded to independent PC system)

**Data Analysis**

Orton Dilatometer Software Version 5.2.1 (Requires English Language Version of Windows 95/98/2000/XP/Vista)

**Computer Interface**

RS232 Cable for user’s PC (Requires English Language Version of Windows 95/98/2000/XP/Vista)

**Factory Calibration**

1" rod of high purity platinum (1" platinum and 1" copper for cryogenic system)

**Calibration Sample**

Pt available as an Option

**Secondary Calibration Sample**

1" high alumina included

**Water Cooled Bulkhead**

(circulation system not included)

Included

**Measuring Head Cover**

Available as Option

**Controlled Atmosphere Option**

Available as Option

**Bench-top Footprint (open)**

49" x 14" x 17" (1,250 x 360 x 430 mm)

**Length x Depth x Height**

49" x 14" x 17" (1,250 x 360 x 430 mm)

**Transformer Footprint**

N/A

**Power Requirements**

240 VAC available

120 VAC, 15 A, 50/60 Hz

120 VAC, 15 A, 50/60 Hz

120 VAC, 15 A, 50/60 Hz

120 VAC, 15 A, 50/60 Hz

120 VAC, 15 A, 50/60 Hz

120 VAC, 15 A, 50/60 Hz

120 VAC, 15 A, 50/60 Hz

120 VAC, 15 A, 50/60 Hz

1 - contact Orton for a description and discussion of these specifications.