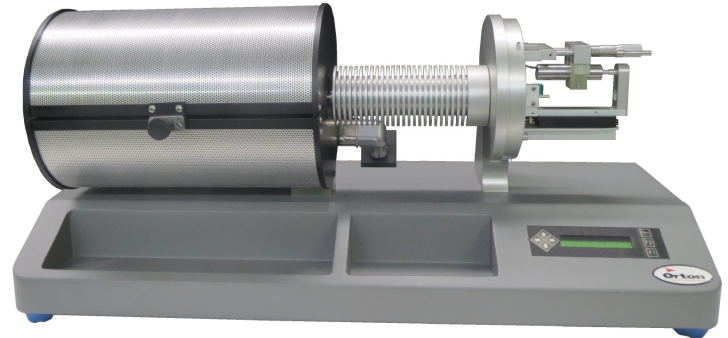


Orton Standard Dilatometers

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.



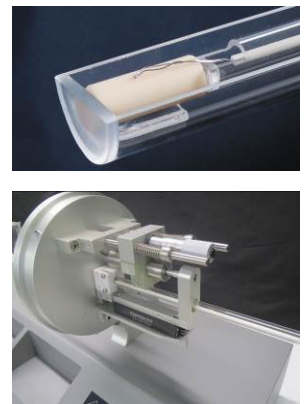
System Description

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 spring tension or user-adjustable counterweighted pulley system to provide a 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 120VAC or 240VAC, 50/60Hz power. Standard options include controlled atmosphere/vacuum components, over-temperature protection, split-tube furnaces for rapid cooling or exchangeable furnaces for rapid sample turnaround.

Principle of Operation

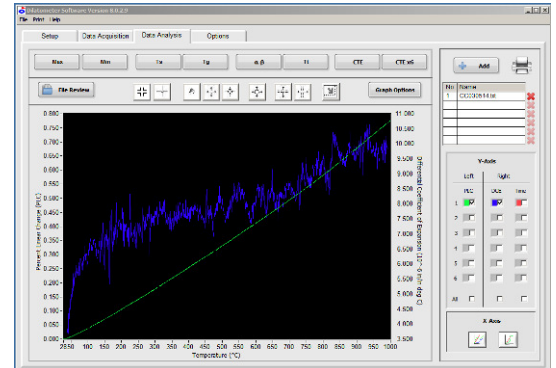
A sample specimen is placed between the end of the sample holder and the end of the movable probe rod. The furnace is placed over the test sample and heated according to a user defined thermal cycle. As the sample heats and cools, the sample expansion pushes against the probe rod, or the sample shrinkage pulls away from the probe rod. The probe rod is kept in constant contact with the sample. 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 are downloaded to an independent computer system for real time observation and for post testing analysis



(continued next page)

Orton Standard Dilatometer Software

The Orton Standard Dilatometer Software (Version 8.0.x) 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 at 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 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; T_G (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 is supplied on a CD/DVD and is compatible with the operator's PC using the English language version of Windows OS.

Typical Specifications



Model Number	DIL 1410B	DIL 1410STD	DIL 1412STD	DIL 1416STD	DIL 1410C
Temperature Range	RT to 1000°C	RT to 1000°C	RT to 1200°C	RT to 1600°C	RT to 1000°C or -190°C to +500°C
Furnace	Kanthal wire, tube	Kanthal wire, split tube	Kanthal wire, split tube	Silicon Carbide, tube	Kanthal wire, split tube
Thermocouple	Type "N"	Type "S"	Type "S"	Type "S"	Type "N"
Sample Holder and Probe Rod	Fused Quartz	Fused Quartz	High Alumina	High Alumina	Fused Quartz
Sample Size (max)	50 mm long by 25 mm diameter	50 mm long by 10 or 20 mm diameter	50 mm long by 10 or 20 mm diameter	50 mm long by 10 or 20 mm diameter	50 mm long by 10 mm diameter
LVDT Displacement Range	±0.125 inch (±3.17 mm) or ±0.050 inch (±1.27 mm)				
Displacement Resolution ¹	0.0000036 inch or 0.36 micro-inch (0.000009 millimeter or 0.009 microns)				
PLC Resolution for a 1" Sample ¹	0.00009%				
Reproducibility Range ¹	± 0.004 PLC (± 1 µm / ± 40 µ-inches)	± 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)
Contact Load	Fixed - 113 grams	Adjustable - minimum 4gram weight	Adjustable - minimum 4gram weight	Adjustable - minimum 4gram weight	Adjustable - minimum 4gram weight
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	1 to 30°C/minute at 0.01°C increments	1 to 30°C/minute at 0.01°C increments	1 to 15°C/minute at 0.01°C increments	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 8.0.x (Requires English Language Version of Windows7/10)				
Computer Interface	USB Cable				
Factory Calibration	1" or 2" rod of high purity platinum (platinum and copper for cryogenic system)				
Secondary Calibration Sample	high alumina included	high alumina included	high alumina included	high alumina included	high alumina and copper included
Water Cooled Bulkhead (circulation system not included)	Not Available	Available as Option	Available as Option	Available as Option	Available as Option
Measuring Head Cover	Not Available	Included	Included	Included	Included
Controlled Atmosphere	Not Available	Available as Option	Available as Option	Available as Option	Included
Bench-top Footprint (open) Length x Depth x Height	31" x 12" x 14" (788 x 305 x 368 mm)	31" x 12" x 14" (788 x 305 x 368 mm)	31" x 12" x 14" (788 x 305 x 368 mm)	31" x 12" x 14" (788 x 305 x 368 mm)	31" x 12" x 14" (788 x 305 x 368 mm)
Transformer Footprint	N/A	N/A	N/A	14.5" x 9.25" x 9.62" (365 x 230 x 245 mm)	N/A
Power Requirements	120 or 240 VAC, 15 A, 50/60 Hz	120 or 240 VAC, 15 A, 50/60 Hz	120 or 240 VAC, 15 A, 50/60 Hz	220-240 VAC, 20 A, 50/60 Hz	120 or 240 VAC, 15 A, 50/60 Hz

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