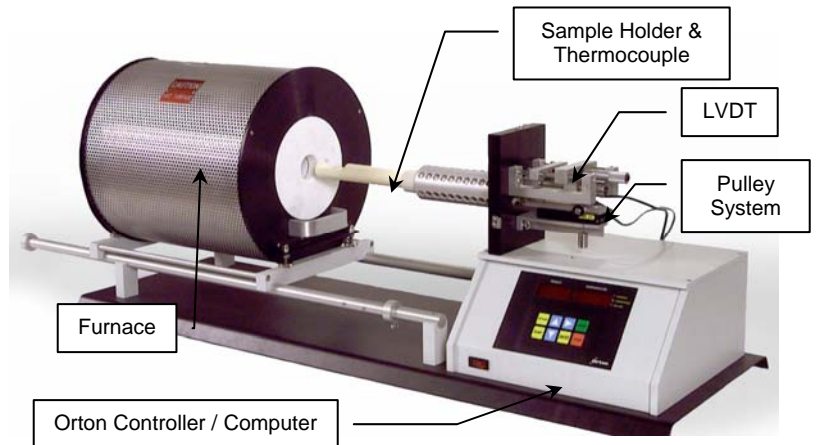


Orton Standard Dilatometers

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.



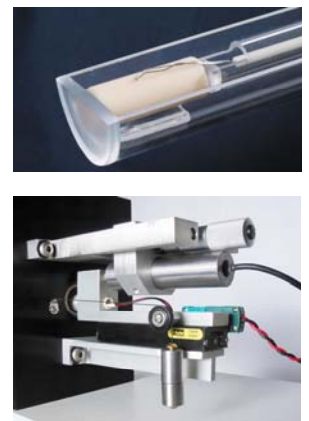
System Description

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

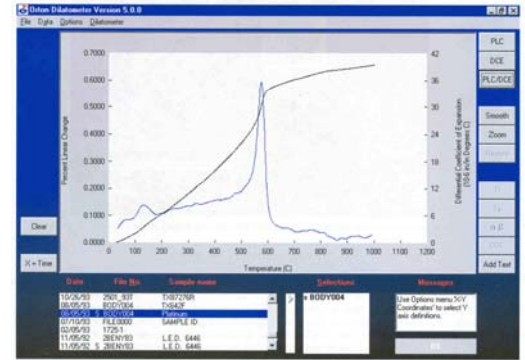
A sample specimen is placed between the end of the sample holder and the end of the movable probe rod. The furnace is placed over the sample, and heated according to a user defined thermal cycle. As the sample heats and cools, the sample expansion pushes against the probe rod, or the sample shrinkage 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; 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 (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



Model Number	DIL 2010 STD	DIL 2012 STD	DIL 2016 STD	DIL 2010 C	DIL 2010 B
Temperature Range	RT to 1,000°C	RT to 1,200°C	RT to 1,600°C	RT to 1,000°C or -190°C to +500°C	RT to 1,000°C
Furnace	Kanthal Wire	Kanthal Wire	Silicon Carbide	Nichrome Wire or Cryogenic Chamber	Kanthal Wire
Thermocouple	Type "S"	Type "S"	Type "S"	Type "N"	Type "N"
Sample Holder and Probe Rod	Fused Quartz	High Alumina	High Alumina	Fused Quartz	Fused Quartz
Sample Size (max)	50 mm long by 20 mm diameter	50 mm long by 20 mm diameter	50 mm long by 20 mm diameter	50 mm long by 10 mm diameter	50 mm long by 20 mm diameter
LVDT Displacement Range	±0.100 inch (±2.54 mm)				
Displacement Resolution¹	0.000009 inch or 0.9 micro-inch (0.00002 millimeter or 0.02 microns)				
PLC Resolution for a 1" Sample¹	0.00009%				
Reproducibility Range¹	± 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	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	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	Pt available as an Option	Pt available as an Option	1" copper standard Pt available as an Option	Pt available as an Option
Secondary Calibration Sample	1" high alumina included	1" high alumina included	1" high alumina included	1" high alumina included	1" high alumina included
Water Cooled Bulkhead (circulation system not included)	Included	Included	Included	Included	Not Available
Measuring Head Cover	Available as Option	Available as Option	Available as Option	Included	Not Available
Controlled Atmosphere Option	Available as Option	Available as Option	Available as Option	Included	Not Available
Bench-top Footprint (open) Length x Depth x Height	49" x 14" x 17" (1,250 x 360 x 430 mm)	49" x 14" x 17" (1,250 x 360 x 430 mm)	49" x 14" x 17" (1,250 x 360 x 430 mm)	49" x 14" x 24" (1,250 x 360 x 600 mm)	28" x 14" x 15" (710 x 360 x 380 mm)
Transformer Footprint	N/A	N/A	14.5" x 9.25" x 9.62" (365 x 230 x 245 mm)	N/A	N/A
Power Requirements (240 VAC available)	120 VAC, 15 A, 50/60 Hz	120 VAC, 15 A, 50/60 Hz	240 VAC, 20 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