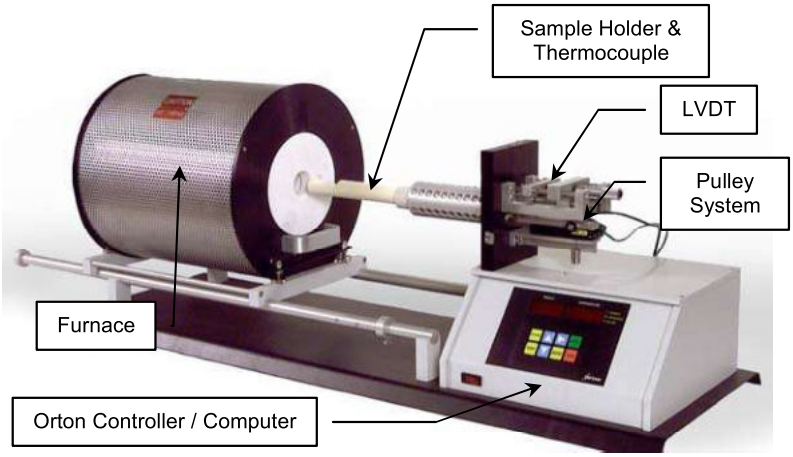
Orton Standard Dilatometers



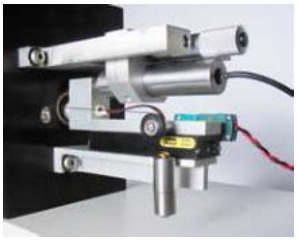
Orton dilatometers are designed to measure the linear dimensional changes of ceramics, glasses, metals, carbon composites, cermets, minerals, and polymers as a function of temperature. The dilatometer records reversible and irreversible changes in length (expansion and shrinkage) during heating and cooling. 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, ASTM C-372, ISO 7991, 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 control board 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. A 1” rod of high purity, polycrystalline, commercial grade, 99.8% high alumina is included to be used as a secondary calibration standard. The standard systems require 240 VAC, 20 amp, 50/60 hertz power. Standard options include exchangeable furnaces for rapid sample turnaround and controlled atmosphere/vacuum components.

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 on-board computer.



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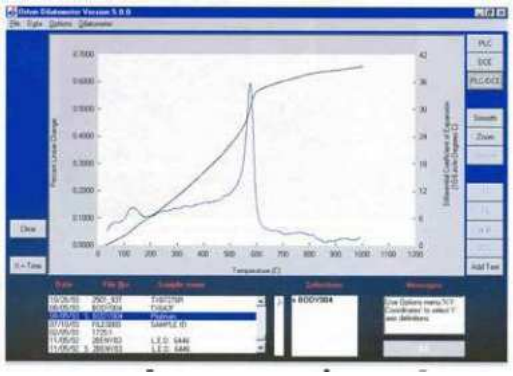
Orton Controller

The Orton on-board computer/controller board was designed to perform dilatometer tests WITHOUT interface to a PC. The Orton controller board controls the thermal cycle of the furnace, 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 stored on the controller board. The operator uses the keypad to input critical test information. Upon completion of the test (without operator attention) the operator uses the key pad to scroll though the PLC and temperature data for manual recording. This data can be manually entered into an independent spreadsheet for independent analysis.

To make dilatometer tests test easier, Orton provides interface software between the Orton dilatometer and the operator's PC. The operator enters critical test information on the PC screen, and the software sends the instructions to the dilatometer controller board. If desired, the operator can monitor the progress of the test in real time on the PC monitor. At the conclusion of the test, the software transfers the data from the Orton controller board to the PC for storage, and for post test analysis by the Orton software.

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 on to the PC system supplied by the user, and communicates with the dilatometer. The operator enters the critical run parameters into the user-friendly screens, and the software sends the information to the controller board inside the dilatometer. The Orton controller board inside the dilatometer still controls the thermal cycle of the furnace and collects the time, temperature, and PLC data. The software extracts data from the dilatometer controller board during the run so the operator can monitor the run in real time. Upon completion of the run, the software extracts the data from the dilatometer and creates a data file for post testing review and analysis. The operator can view and analyze the past run on the same PC, or can transfer the data file 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.

(continued on the next page)

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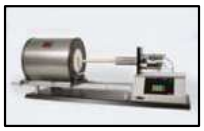
Standard Dilatometers

(Single Sample, Horizontal)

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 -170°C to +500°C	RT to 1,000°C
Furnace	Kanthal Wire	Kanthal Wire	Silicon Carbide	Nichrome Wire or Cryogenic Chamber	Kanthal Wire
Isothermal Zone for a 1" Sample	±1.5	±1.5°C	±1.5°C		±2.5°C
Thermocouple	Type "S"	Type "S"	Type "S"	Type "N"	Type "N"
Sample Holder and Probe Rod	Standard: Fused Quartz	Standard: High Alumina Optional: Fused Quartz	Standard: High Alumina Optional: Fused Quartz	Standard: Fused Quartz	Standard: Fused Quartz
Sample Size (maximum)	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 Linear Range	±0.100 inch or ±100,000 µ-inches or ±100,000,000 nano-inches (±2.54 mm or ±2,540 µm or ±2,540,000 nm)				
LVDT Resolution	Infinite - <0.1 nanometer				
Practical Resolution	0.0000009 inch or 0.0009 micro-inch or 0.9 nano-inch (0.000022 mm or 0.022 µm or 22.8 nm)				
Practical PLC Resolution (for a 1" Sample)	0.00009%				
Reproducibility	Limited by sample preparation and ability to reproduce testing conditions				
Practical 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)	± 0.008 PLC (± 2 µm / ± 80 µ-inches)
Contact Load	Adjustable 4 to 100 grams (or more)	Adjustable 4 to 100 grams (or more)	Adjustable 4 to 100 grams (or more)	Adjustable 4 to 100 grams (or more)	Fixed - 113 grams (approximately)
Temperature Control	Orton Controller Board: PID control, User Programmable, 20-segment maximum, and Automatic Melting Point Protection				
Controller Heating Rates	Heating Rates from 0.1 to 999°C/minute at 0.1°C/minute increments				
Furnace Heating Rates	0.1°C/minute to 120°C/minute	0.1°C/minute to 120°C/minute	0.1°C/minute to 185°C/minute (average 50°C/minute)	0.1°C/minute to 10°C/minute	0.1°C/minute to 12°C/minute
Contact Load	Adjustable 4 to 100 grams (or more)	Adjustable 4 to 100 grams (or more)	Adjustable 4 to 100 grams (or more)	Adjustable 4 to 100 grams (or more)	Fixed - 113 grams
Data Acquisition	Data stored in Orton Controller Board at 1°C increments. Data can be downloaded manually or via PC Software. Data saved until next run.				
Data Analysis	Orton Dilatometer Software Version 5.2.1 is included. Requires English Language Version of Windows 95/98/2000/XP/Vista.				
Computer Interface	RS232 Cable included - User can attached USB converter to RS232 cable				
Factory Calibration	All systems are calibrated with 1" rod of high purity platinum. The Cryogenic system is calibrated with a platinum rod and a copper rod. Calibration with a 2" rod is available upon request.				
Secondary Calibration Sample	All systems are shipped a 1" rod of 99.8% high purity, polycrystalline high alumina. A 2" rod can be substituted upon request.				
Calibration Sample	Platinum Rod is available as an Option	Platinum Rod is available as an Option	Platinum Rod is available as an Option	1" copper standard is included. Platinum Rod is available as an Option	Platinum Rod is available as an Option
Water Cooled Bulkhead (circulation system not included)	Included	Included	Included	Included	Not Available
Measuring Head Cover	Available as Option (included with a controlled atmosphere option)	Available as Option (included with a controlled atmosphere option)	Available as Option (included with a controlled atmosphere option)	Included	Not Available
Controlled Inert Atmosphere	Available as an option				Not Available
Controlled Reactive Atmosphere	Available as an option				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	Transformer not Required	Transformer not Required	14.5" x 9.25" x 9.62" (365 x 230 x 245 mm)	Transformer not Required	Transformer not Required
Power Requirements	240 VAC, 20 A, 50/60 Hz	240 VAC, 20 A, 50/60 Hz	240 VAC, 20 A, 50/60 Hz	240 VAC, 20 A, 50/60 Hz (120 VAC available)	240 VAC, 20 A, 50/60 Hz (120 VAC available)

Descriptions and specifications contained in this table are typical values. Descriptions and specifications are subject to change without notice. Please contact Orton for a thorough discussion of the current descriptions, specifications, operation, maintenance, and performance for the dilatometer most appropriate for your application.