Center for Materials Processing

Catalog of Experimental Equipment

As of September 2017

TICKLE
COLLEGE OF ENGINEERING

CENTER FOR MATERIALS PROCESSING

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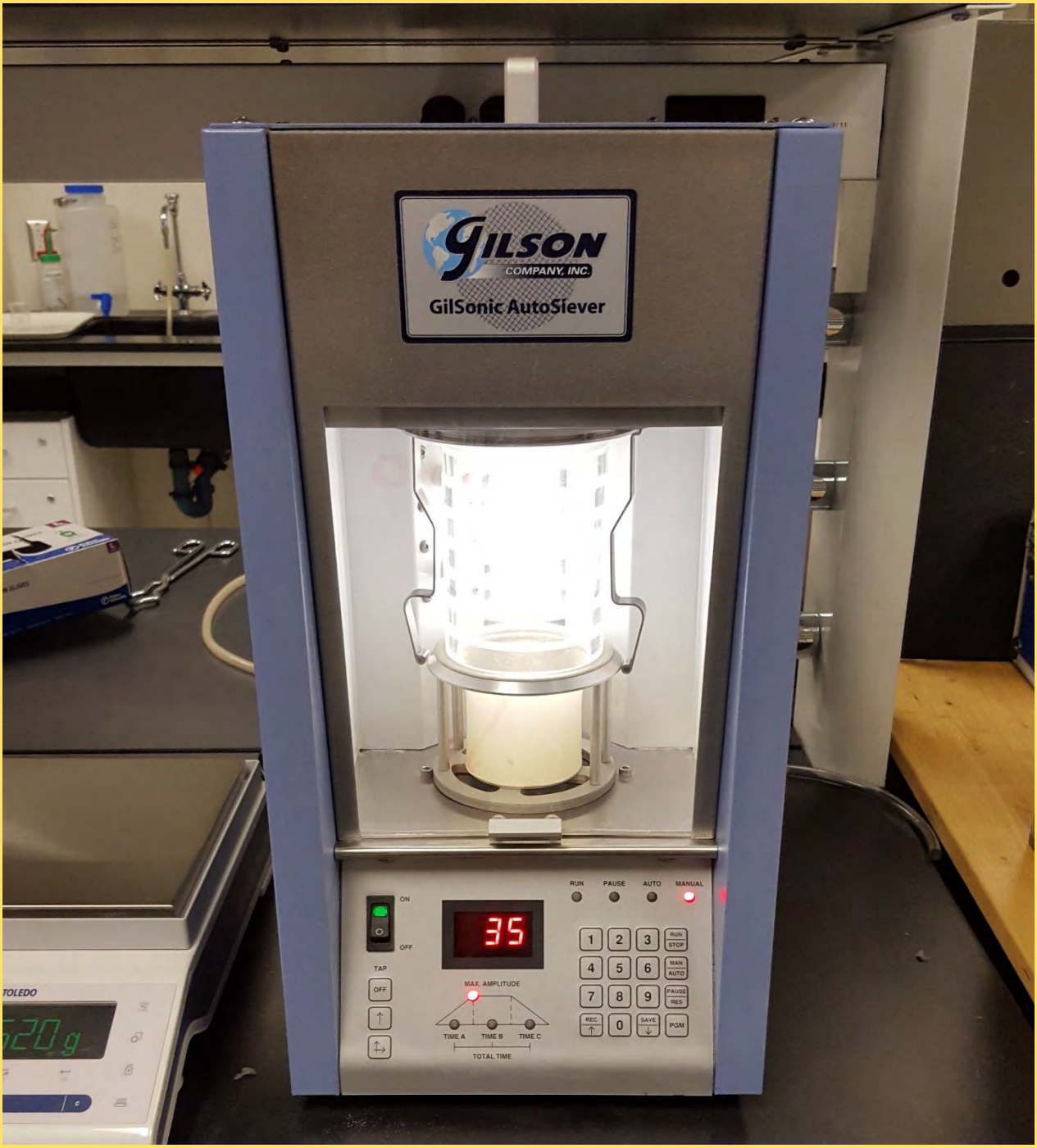
THE UNIVERSITY OF TENNESSEE

AutoSiever


GILSON
COMPANY, INC.
GilSonic AutoSiever
RUN
PAUSE
AUTO
MANUAL
ON
OFF
35
TAP
OFF
MAX. AMPLITUDE
TIME A
TIME B
TIME C
TOTAL TIME
1
2
3
RUN STOP
4
5
6
MAN AUTO
7
8
9
PAUSE RES
REC
0
SAVE
PGM
TOLEDO

2 GILSON COMPANY: GILSONIC AUTOSIEVER

Overview:
An auto-sieve is a device used to separate powders or fine granular materials based upon particle size. Device uses sonic and air agitation to achieve separation through filters.

Important Limitations:
- Dry powders or grains only; cannot separate particles in solution
- Uses room air to agitate particles (no gas input)

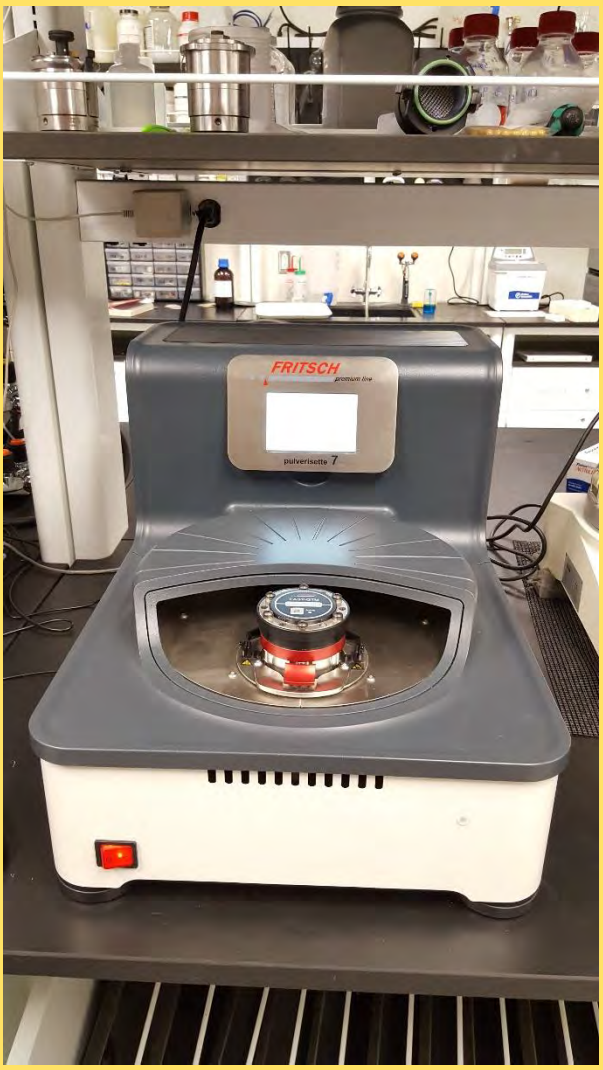
Compliancy:
ASTM and AASHTO standards compliant

Specifications:

Sieve Frame Diameter	3in (76mm)
Particle Size Range	#20 to #635 (woven wire) 150 Micron to 5 Micron (Precision)
Motion/Agitation	Sonic & Air
Full Height Sieve Capacity (including pan)	7 Woven-Wire or 3 Precision Electroformed Sieves
Timer Range	Up to 99 Minutes
Program Memory	10 Preset options
Electrical	115/230V, 50 or 60Hz, 40 Watts maximum
Product Dimensions	10 x 10 x 20in (254 x 254 x 508mm), W x D x H

Product Manual:
https://www.globalgilson.com/Attachment/DownloadFile?downloadId=9

High Energy Ball Mill



3 FRITSCH PULVERISETTE 7 PREMIUM LINE

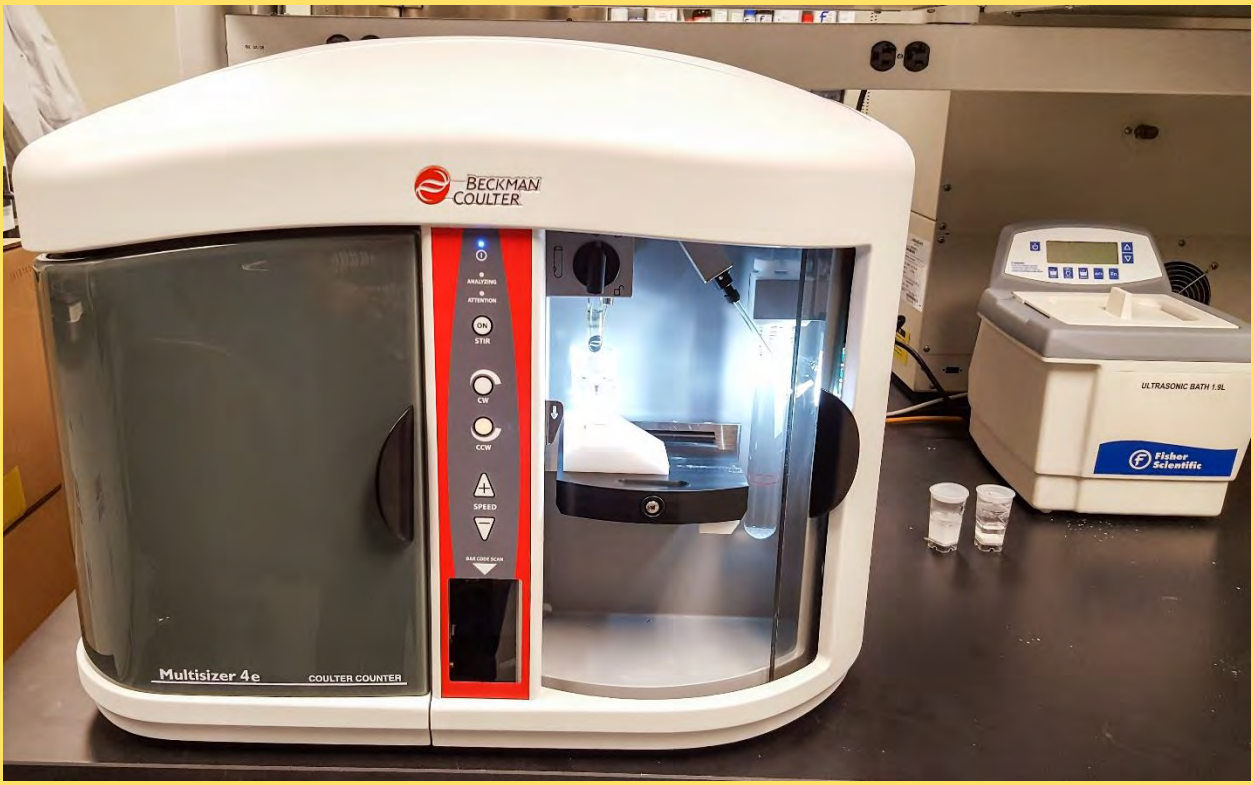
Overview:
The Fritsch Planetary ball mill is used for contained grinding of materials over a range of hardnesses. It may also be applied to mixing and homogenizing. It is based on a centrifugal motion principle, using grinding balls to impact the sample material.

Specifications:

Working principle	impact force
Optimal for material type	hard, medium-hard, brittle
Number of milling stations	2
Grinding tools	grinding bowls and grinding balls
Materials of the grinding tools	agate, sintered corundum, silicon nitride, zirconium oxide, hardened stainless steel, hardmetal tungsten carbide
Grinding bowl sizes	20, 45, 80 ml
Grinding ball diameter	0.1 - 20 mm
Max. feed size (depends on material)	5 mm
Final fineness (depending on material)	< 0.1 µm
Typical grinding time down to analytical fineness	3 min
Grinding process	dry/wet
Grinding in inert gas	yes
Gas pressure and temperature measurement	yes
Rotational speed of main disk	100-1100 rpm
Transmission ratio planetary disk / grinding bowl	i relative = 1 : -2
Effective diameter of main disk	140 mm
Centrifugal acceleration (g = 9.81 m/s²)	95 g
Interfaces	USB
Electrical details	100-120 V / 200-240 V/1~, 50-60 Hz, 1200 Watt
Emission sound pressure level at the workplace according to DIN EN ISO 3746 - depending on the material to be ground, grinding bowls/balls, selected rotational speed	up to approx. LpAd = 80 dB

Product Manual:
http://www.fritsch-international.com/sample-preparation/milling/planetary-mills/details/product/pulverisette-7-premium-line/downloads/

Particle Sizer and Counter



4 BECKMAN COULTER MULTISIZER 4E

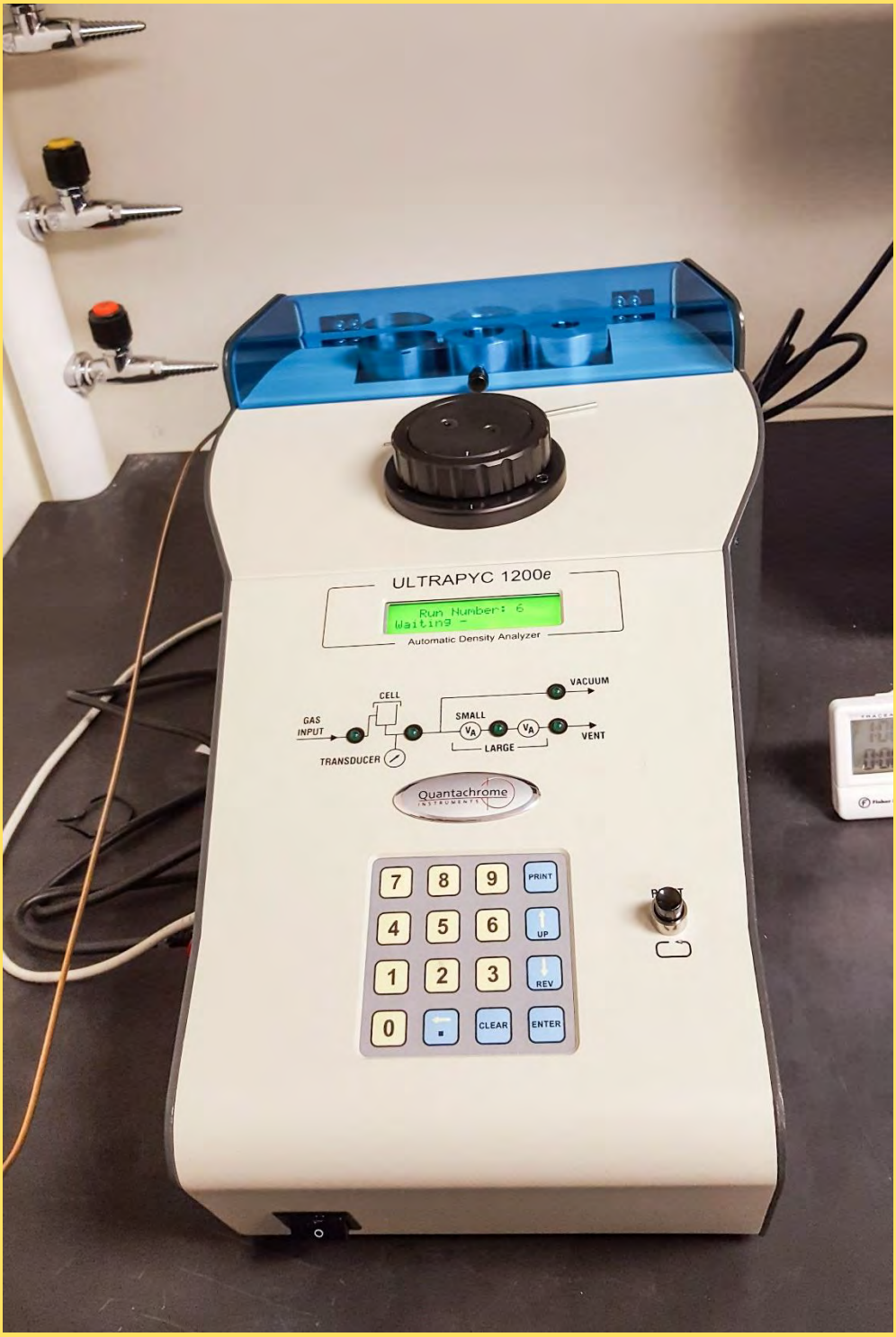
Overview:
The Mulitsizer is a useful tool for measuring the number and size of particles in a solution. It works via the Coulter Principle (info HERE), thus optical and compositional properties are irrelevant in measurement. Biological samples, powders, proteins, nanoparticles, abrasives and emulsions are some of the sample compatibilities. Particle size is limited by aperture size (2% Aperture size ≤ Particle size ≤ 60% Aperture size)

Specifications:

Overall Particle Size Range	0.2 µm to 1600 µm in diameter
Aperture Diameter	10 µm to 2000 µm apertures (nominal diameters)
Aperture Range	Standard 2% - 60% (80% extendable)
Resolution	User selectable
Number of Channels	Binning from 3 - 400 channels. (Number of channels and range can be reprocessed as necessary)
Electrolyte Solutions	All aqueous and non-aqueous electrolyte solutions recommended for use with aperture technology will be suitable for use with the Multisizer 4e. Electrolytes should be compatible with glass, fluoropolymers, fluoroelastomers and stainless steel
Digital Pulse Processor	Proprietary high-speed digitization of the signal
Pulse Data	Time stamped pulses up to 525,000 per signal analysis
Size Distribution Data	Size distribution by diameter, volume and area for number, number%, number/ml, volume, volume%, volume/ml, surface area, surface area% and surface area/ml
Pulse Distribution Data	Pulse distribution by time, sequence and width for pulse height diameter, pulse height volume, pulse height volt, pulse width, pulse area, average pulse height diameter, average pulse height volume and average pulse width. Number distribution by width.
Linearity	± 1% for diameter ± 3% for volume
Total Count Mode	Up to 500,000 counts
Modal Count Mode	Up to 100,000 counts
Volumetric Mode	Continuously selectable from 50 µl to 2000 µl
Volumetric Pump Accuracy	Better than 99.5%
Regulatory Compliance	The software enables 21 CFR Part 11 compliance

Product Manuals and Documents:
http://www.beckman.com/particle/instruments/cell-sizing-and-processing/multisizer-4e

Density Measurement Autopycnometer



5 QUANTACHROME ULTRAPYC 1200E

Overview:
Using volume measurements to achieve density, a gas pycnometer obtains data by pressurizing the sample cell (stainless steel) with Helium. A valve is then opened to a separate chamber, and the pressure changes within the chamber. Boyles law is then applied for sample volume calculations (info HERE). User inputs mass before experiment. Non-elutriating sample cells are available. Samples must be in solid state to be compatible.

Important Limitations:

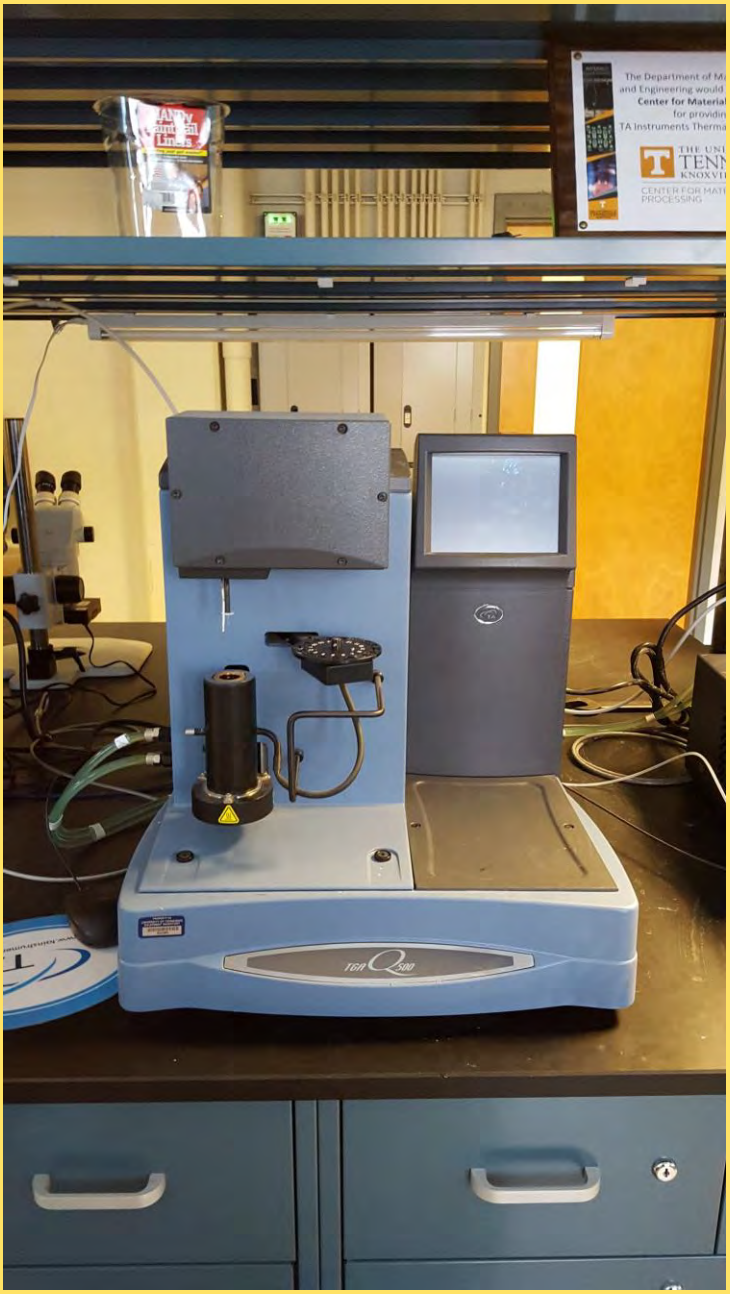
- Solid samples only
- Ultrahigh purity compressed gas regulated to a pressure of 20 psig (see accessories). Helium is recommended.
- Mass must be entered by user
- Digital pressure display resolution of 0.0001 pounds per square inch (psi).

Specifications:

Sample Cell Sizes	**Nominal Volume**	**Internal Diameter**	**Internal Depth**
Standard sample cells	135 cm^3 50 cm^3 10 cm^3	49 mm 40 mm 24 mm	75 mm 39 mm 23 mm
Optional micro cell	4.25 cm^3	15 mm	24 mm
Optional meso cell	1.8 cm^3	13 mm	13 mm
Optional nano cell	0.25 cm^3	8 mm	6.5 mm

Product Manual and Documentation:
http://www.quantachrome.com/pdf_brochures/07171_Gas_Pyc.pdf

Thermogravimetric Analysis



6 TGA

Overview:
Thermogravimetric analysis manipulates a closed environment to subject a sample to thermal variations within a closed environment. This method of characterization provides a curve of temperature vs. mass, and is typically used to determine phase transitions, melting points, latent heat measurements, moisture content, vaporization and compositional analysis. Non-traditional uses also include Curie temperature measurements for magnetic materials.

Specifications:

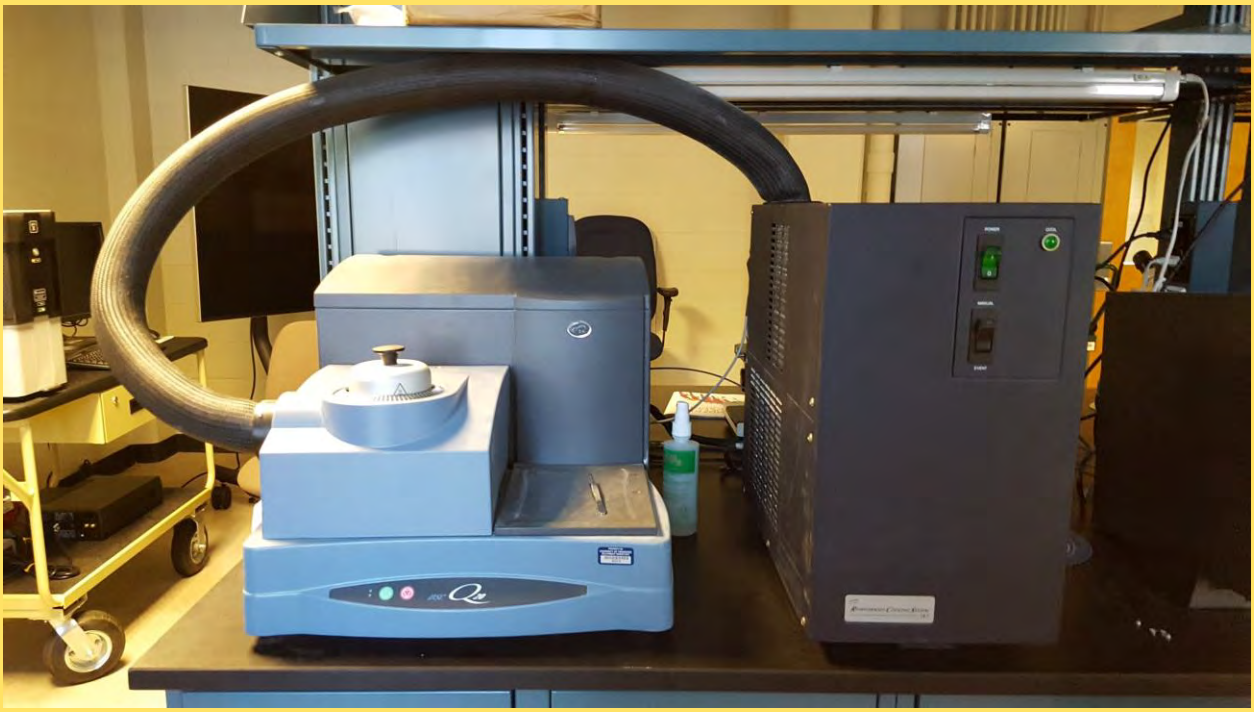
Temperature Compensated Thermobalance Included	Temperature Compensated Thermobalance Included
Maximum Sample Weight	1 g
Weighing Precision	+/- 0.01%
Sensitivity	0.1 µg
Baseline Dynamic Drift	< 50 µg
Furnace Heating	Resistance Wound
Temperature Range	Temperature Range Ambient to 1 000°C
Isothermal Temp Accuracy	+/- 1°C
Isothermal Temp Precision	+/- 0.1°C
Controlled Heating	0.1 to 100°C/min
Furnace Cooling	forced air/N2) 1000 to 50°C < 12 min
Temperature Calibration	Curie Point

Note:
Sample pans are platinum

Documentation:

http://www.tainstruments.com/pdf/TGA%20Brochure.pdf

Differential Scanning Calorimetry



7 DSC

Overview:
Differential Scanning Calorimetry measures the heat input required to raise the temperature of a material. Similar to TGA, it provides a curve of energy input (heat flux) vs. temperature or temperature vs. time. Based off of a reference sample, a constant input of energy is used to increase the temperature, typically with a calibration cycle beforehand to remove any processing effects (although this can be bypassed). This technique is typically used for polymers, and is especially useful in material characterization of composites due to differing melting temperatures within composite components.

Specifications:

Temperature Range	Amb to 725°C
With Cooling Accessories	-180 to 725°C
Temperature Accuracy	+/- 0.1°C
Temperature Precision	+/- 0.05°C
Calorimetric Reproducibility (indium metal)	+/- 1%
Calorimetric Precision (indium metal)	+/- 0.1%
Dynamic Measurement Range	+/- 350 mW
Digital Resolution	>0.04 µW
Baseline Curvature (-50 to 300°C)	<0.15 mW
Baseline Reproducibility	< 0.04 mW
Sensitivity	1.0 µW
Indium Height/Width*	8.0 mW/°C

Documentation:
http://www.tainstruments.com/pdf/brochure/2012%20DSC%20Brochure%20r1.pdf

Scanning Electron Microscope

8 SEM

Overview:

The scanning electron microscope uses the scatter from a focused beam of electrons impacting a target to produce an image of the sample to very high magnifications. This leads to some electronic charging of samples, which can lead to sample degeneration at high beam intensities. Both organic and non-organic samples may be imaged, provided they can withstand a low vacuum required to maintain an electron beam. Energy-dispersive X-ray spectroscopy is also possible with this instrument.

Specifications: