Quantachrome
INSTRUMENTS
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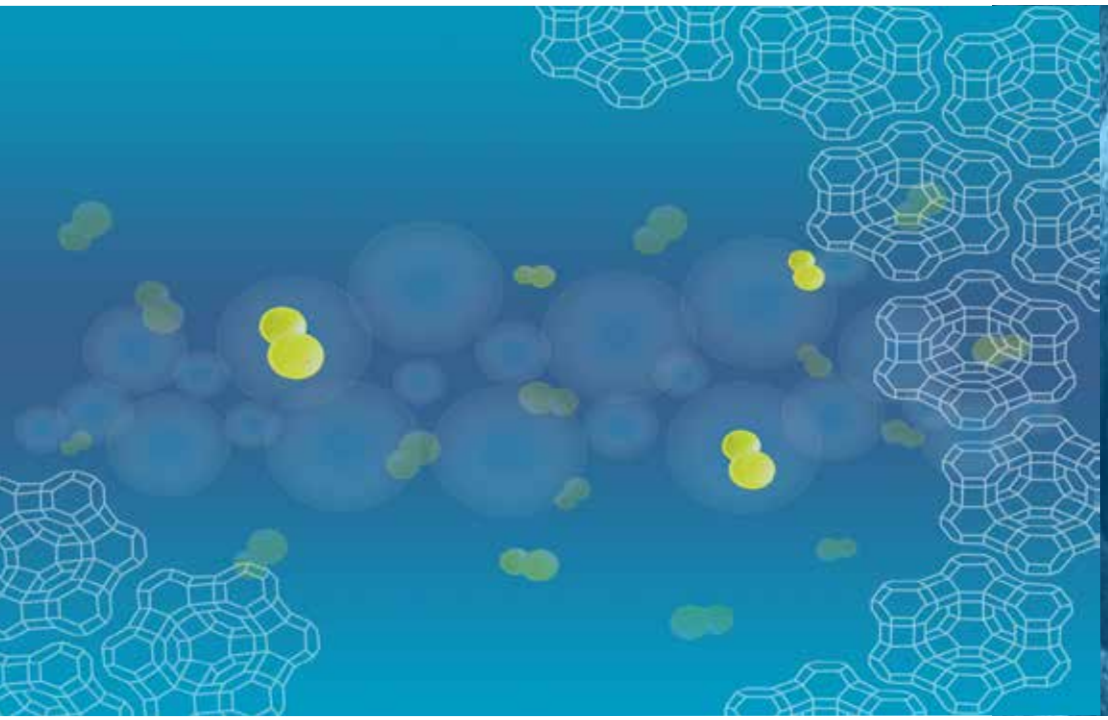
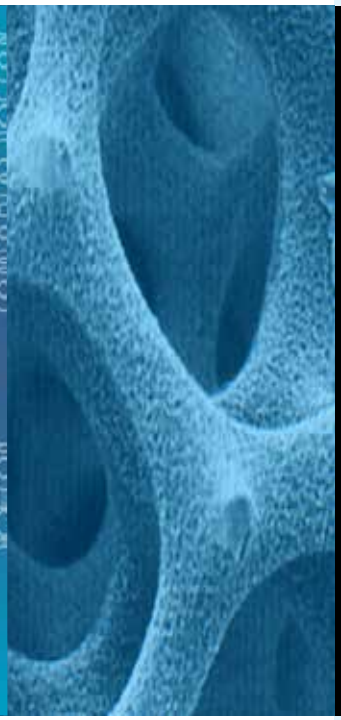
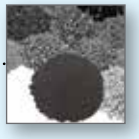
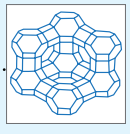
NOVA...touch®

surface area & pore size analyzer





GAS SORPTION

- Catalysts 
- Ceramics 
- Energy 
- Carbons 
- Zeolites 
- Pharma 

NOVAtouch® Overview

Quantachrome's patented NOVAtouch series offers a full line of high-quality, high-performance gas sorption analyzers, with two multi station models to meet the needs of any research or quality assurance laboratory.

NOVAtouch® LX² rapid two sample surface area and pore size analyzer

- Perform fully automated multi-point B.E.T. analysis in as little as eight minutes.
- Eliminate the need for helium with patented NO Void Analysis™ (NOVA) technology.
- Analyze up to 2000 data points (1000 adsorption points and 1000 desorption points).
- Prepare four samples by vacuum or flow methods simultaneously with sample analysis.
- Access degasser during analysis to start / stop degassing.
- View data "on the fly" locally on the color touchscreen.
- Eliminate cell calibration with classical helium-void-volume mode.
- Transfer data via Ethernet connection.
- Enhance performance with Windows®-compatible software.
- Verify performance with rapid calibration check.
- Dedicated Po cell and transducer for greater analysis resolution and speed.
- Meets the special needs of busy research laboratories.

NOVAtouch® LX⁴ measures up to four samples simultaneously

- Analyze up to four samples at one time in addition to Po updates on a dedicated Po cell and transducer.
- Save space with four on-board sample preparation ports.
- Plus all the capabilities of the NOVAtouch LX².

NOVA...touch®

surface area & pore size analyzer

Quantachrome INSTRUMENTS

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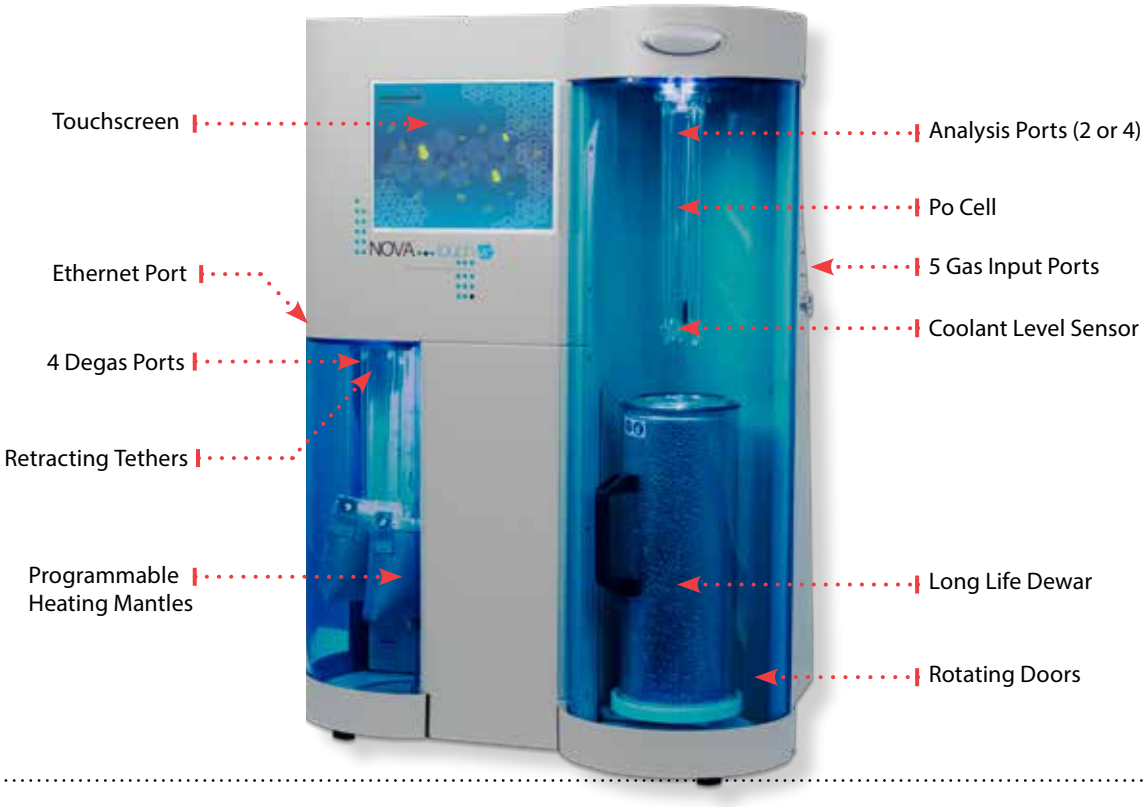
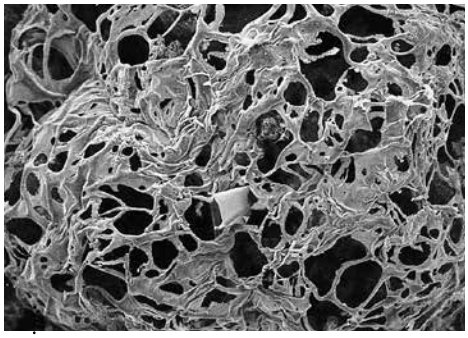
NOVAtouch® Features



Feature Highlights of the NOVAtouch® Series*

Function Capability by Model	LX²	LX⁴
Surface Area Analysis	✓	✓
Mesopore Size Distribution	✓	✓
Standard Micropore Analysis	✓	✓
Degassing Ports	4	4
Analysis Stations	2	4
Color Touchscreen	✓	✓
Live Graphical/Tabular Display of Analyses	✓	✓
Local and Remote PC Control	✓	✓
Extended Life Dewar	✓	✓
Robust Coolant Level Sensor	✓	✓
Flow Degassing	✓	✓
Vacuum Degassing	✓	✓
Dedicated Po Cell	✓	✓
Dedicated Po Transducer	✓	✓
Dedicated Backfill Transducer	✓	✓

NOVAtouch® Applications



Coal ash

Carbon for rubber, adsorbents (gas separation and water purification), gas masks, inks, laser printers and copiers.

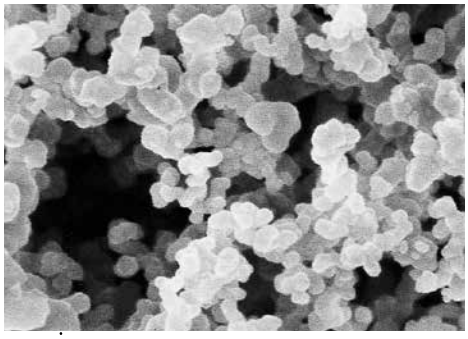
Catalysts for the automotive, fertilizer, fuel cell and petrochemical industries.

Organic materials for adhesives, chromatography, cosmetics, foodstuffs, detergents, explosives, ion exchange resins, pharmaceuticals and plastics.

Natural Zeolite

Minerals such as alumina, clays, hydroxyapatite, pigments, phosphates, silicas, zirconia, etc., used for abrasives, adsorbents, biomaterials, ceramics, cements, desiccants, fillers, papers and paints.

Powdered metals and ferrites for batteries, pressure formed/ sintered products, electronics, magnets and magnetic tape.



Carbon Black

Other applications related to bone, composite materials, fibers, rigid foams, soil, sludge, slurries, suspensions, well cores, and many more. Additional applications, along with in-depth discussions, literature references, standard test methods, and technical notes, can be found in Quantachrome's Applications webpage.

NOVAtouch® Specifications

Performance:	LX²	LX⁴
Analysis stations	2	4
Measurement types	B.E.T., STSA, adsorption isotherm, desorption isotherm	
Surface area range	0.01 m^2 / g to no known upper limit	
Pore size range	0.35 to 500 nm (3.5 to 5000 Å)	
Minimum pore volume (liquid)	2.2 x 10^{-6} ml / g	
Minimum pore volume (STP)	0.0001 cc / g	
Adsorbates:	**LX²**	**LX⁴**
Nitrogen	✓	✓
Other non-corrosive gases (Ar, CO_2, H_2, C_4H_{10}, etc.)	✓	✓
Degassing:	**LX²**	**LX⁴**
Preparation ports	4	
Temperature range	ambient - 450°C*, 1°C intervals	
Programmable heating protocols	Multi-step ramp rates / hold times	
Pressure Transducers:	**LX²**	**LX⁴**
Accuracy (% of span)	±0.1	
A/D converter	24-bit	
Minimum pressure (mm Hg) resolution	6 x 10^{-5}	
Minimum relative pressure P/Po (N_2) resolution	6 x 10^{-8}	
Physical:	**LX²**	**LX⁴**
Dimensions (WxDxH)	61.6 cm x 49.2 cm x 82.9 cm	
Weight	43 kg (95 lbs.)	
Electrical	100-240 V, 50/60 Hz	

*350°C standard; 450°C with optional heating mantles and quartz glassware.

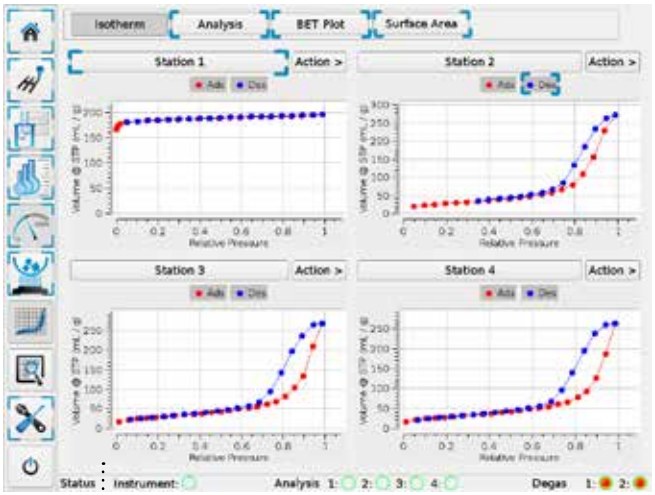
NOVAtouch® Benefits

Operational Conveniences

- Simultaneous analysis of up to four samples with NOVAtouch LX⁴ for dramatic increase in productivity.
- Degas up to four samples while analysis is in progress for maximum throughput.
- Automatic analysis including real time display of isotherm data and BET computations.
- Perform instrument operations locally (via touch-screen) or remotely (via Ethernet-linked PC).

Meets Technical Demands

- Full equilibration technology with choice of pressure tolerance, equilibration time and relative pressure (P/Po) points.
- Dedicated Po cell frees all sample ports for full analyses. Po values may be updated continuously using a dedicated Po transducer. Additional Po options (user-entered, calculated, daily) are also available.



Live display of analyses

- Wide variety of sample cells to accommodate any sample.
- Compact, bench-top design with built-in degas capabilities conserve valuable lab space.
- Protective rotating doors for added insulation, compactness, and safety.

NOVAtouch Interface

- Built-in microprocessor guided calibration for optimum performance consistent with ISO-9000 requirements.
- Manual mode diagnostics for performance verification and maintenance.
- Real-time display of analysis status for instant user update of analysis progress.
- Calibration verification is simple and fast. Calibration is performed in just a few minutes.
- Programmable multi-step heating profiles for degassing operations.
- Choice of backfill gas (helium, adsorbate or vent/air) following degassing and analysis, with backfill gas transducer on LX models for increased analysis speed.
- Speed up operation by reducing entries needed to start each run.

NOVAtouch® Benefits

Revolutionary Ease-of-Use, Speed, and Accuracy

- Patented NO Void Analysis™ (NOVA) technology eliminates helium, reducing analysis costs.
- Alternatively, use classical helium void-volume mode to match your existing SOPs.
- New and robust coolant level sensor (CLS) provides constant void volume and minimizes cold zone volume to yield high accuracy data as coolant evaporates.
- MaxiDose™ algorithm and enhanced dosing protocols reduce analysis time without compromising accuracy.
- Low surface area capabilities with compensation for adsorption on cell walls.
- Access degasser during an analysis to start/stop flow or vacuum degassing.
- Get data "on the fly" via touchscreen displays or by uploading data to a PC from the current analysis with TouchWin Software.

Output Capabilities

- Touchscreen display of results during analyses in progress.
- Analysis reports include programmed degassing protocols to facilitate their tracking.
- Communication with PC for analysis set up, data acquisition and reporting.

Analysis Presets

- Allows the user to establish predefined analysis protocols.
- Speed up operation by reducing entries needed to start each run.

System Manager

- Exclusive control of key settings such as IP address for remote PC communications, and selection of display language (English, German, Chinese, and many more).

Retractable Tether System
for Heating Mantle

High Throughput Capabilities

NOVAtouch® Software

TouchWin Windows® Based Software for Operation from PC

TouchWin™ is a PC based program for operation of the NOVAtouch® series of instruments utilizing the familiar features of the Microsoft Windows® operating system. NOVAtouch® operators will find this to be a user-friendly, graphical environment to work in.

TouchWin™ incorporates Quantachrome Instruments' many years of experience in particle analysis through the inclusion of our extensive methods of data reduction and report generation in this versatile software package.

- PC based degas and analysis protocol generation, download, and control of NOVAtouch® analysis.
- View isotherms and BET calculations in "real-time" during analysis.
- Store analysis configurations for fast recall.
- Compatible with virtually any printer via Windows operating system.
- Zoom into any part of a graph and perform a linear best fit for any set of data points.

Choose from many methods of data reduction

- Adsorption and desorption isotherms (linear and logarithmic scales)
- BET surface area
- Langmuir surface area
- Micropore volume and surface area by t-plot method (Halsey, deBoer or carbon STSA equations).
- Micropore volume and surface area by Alpha-s method * .
- Dubinin Radushkevich micropore surface area
- Dubinin Astakhov micropore area and size distribution
- Mesopore size distribution by BJH method
- Mesopore size distribution by DH method
- Micropore size distribution by MP method
- Density functional theory for unified micropore and mesopore size distribution including library of adsorbates and adsorbent pairs, e.g., argon on zeolite, nitrogen on silica, CO_2 on carbon, etc.
- Fractal dimension by NK and FHH methods.

* Heats of adsorption analysis.

21 CFR Part 11 compliant features available

The NOVAtouch®, when configured for security and used with its 21 CFR Part 11 version of TouchWin software, is designed to allow the user to meet the regulatory requirements for electronic records within the pharmaceutical and allied industries as set forth by the US Food and Drug Administration (FDA). The FDA intends to enforce Part 11* compliance under FDA Regulations, the Federal Food, Drug, and Cosmetic Act and the Public Health Service Act as outlined in its 2003 Guidance for Industry "*Part 11, Electronic Records; Electronic Signatures — Scope and Application,*" prepared by the Office of Compliance in the Center for Drug Evaluation and Research (CDER). This version of the TouchWin software adopts software design features to allow for easy integration into pharmaceutical and other GLP laboratories.

* Final Rule, Federal Register / Vol. 62, No. 54, pp13429-13466, 1997.

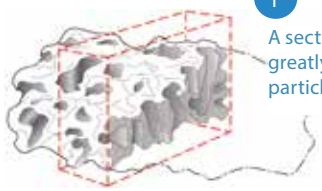
NOVAtouch® Software

The NOVAtouch's associated software (TouchWin) provides user- friendly and guided access to the largest variety of state-of-the-art statistical mechanics-based methods (NLDFT, QSDFT, GCMC) available in the field. This includes no less than 26 peer-reviewed density functional theory (DFT) models for accurate pore size calculations of carbons, zeolites and silicas of different geometries (e.g., slit, cylindrical, spherical, plus some combinations thereof) and a variety of adsorbate / temperature combinations. Representative examples are listed below; for additional options contact our Applications Support group.

DFT / GCMC Kernel File	QSDFT
NLDFT– N_2 carbon equilibrium transition kernel at 77K based on a slit-pore model.	QSDFT -N_2-carbon equilibrium transition kernel at 77K based on a slit-pore model.
NLDFT- N_2 carbon equilibrium transition kernel based on a cylindrical pore model.	QSDFT –N_2-carbon equilibrium transition kernel at 77K based on a cylindrical pore model.
NLDFT– N_2 carbon equilibrium transition kernel at 77K based on a slit-pore model for pore widths < 2nm, and a cylindrical model for pore widths > 2nm.	QSDFT – N_2 – carbon adsorption branch kernel at 77K based on a cylindrical pore model.
NLDFT– N_2 silica equilibrium transition kernel at 77K based on a cylindrical pore model.	QSDFT – N_2 – carbon equilibrium transition kernel at 77K based on a slit-pore model (pore diameter < 2 nm) and a cylindrical pore diameter (pore diameter > 2 nm).
NLDFT-N_2 silica adsorption branch kernel at 77K based on a cylindrical pore model for pores of diameter <5nm, and spherical pores of diameter > 5nm.	QSDFT – N_2 – carbon adsorption branch kernel at 77K based on a slit-pore model (pore diameter < 2 nm) and cylindrical pore model (pore diameter > 2 nm).
NLDFT– N_2 silica adsorption branch kernel at 77K based on a cylindrical pore model.	QSDFT – N_2 – carbon adsorption branch kernel at 77K based on a cylindrical pore model (pore diameter < 5 nm) and spherical pore model (pore diameter > 5 nm).
NLDFT–Ar zeolite/silica equilibrium transition kernel at 87K based on a cylindrical pore model.	QSDFT – N_2 – carbon adsorption branch kernel at 77K based on a slit-pore model (pore diameter < 2 nm) and a cylindrical pore model (pore diameter 2-5 nm) and a spherical pore model (pore diameter > 5 nm).
NLDFT – Ar zeolite/silica adsorption branch kernel at 87K based on a cylindrical pore model.	QSDFT -Ar-carbon equilibrium transition kernel at 87K based on a slit-pore model.
NLDFT – Ar zeolite/silica equilibrium transition kernel at 87K based on a spherical pore model (pore diameter < 2nm) and cylindrical pore model (pore diameter > 2 nm).	QSDFT - Ar-carbon equilibrium transition kernel at 87K based on a cylindrical pore model.
NLDFT – Ar zeolite/silica adsorption branch kernel at 87K based on a spherical pore model (pore diameter < 2 nm) & cylindrical pore model (>2 nm).	QSDFT - Ar-carbon adsorption branch kernel at 87K based on a cylindrical pore model.
NLDFT Ar carbon equilibrium transition kernel at 87K based on a cylindrical pore model.	QSDFT -Ar-carbon adsorption branch kernel at 87K based on a cylindrical pore model (pore diameter < 5 nm) and spherical pore model (pore diameter > 5 nm).
NLDFT – Ar - carbon equilibrium transition kernel at 77K based on a slit-pore model.	
NLDFT – Ar - carbon equilibrium transition kernel at 87K based on a slit-pore model.	
NLDFT - CO_2 - carbon equilibrium transition kernel at 273K based on a slit-pore model.	
GCMC-CO_2 -carbon equilibrium transition kernel at 273K based on a slit-pore model.	

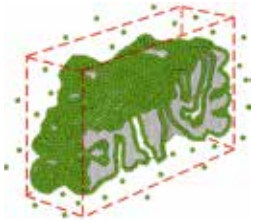
The Gas Sorption Process

Before performing gas sorption experiments, solid surfaces must be freed from contaminants such as water and oils. Surface cleaning (degassing) is most often carried out by placing a sample of the solid in a glass cell and heating it under vacuum or flowing gas. **Figure 1** Illustrates how a solid particle containing cracks and orifices (pores) of different sizes and shapes may look after its pretreatment.



1 A section of one greatly enlarged particle of a solid.

Once clean, the sample is brought to a constant temperature by means of an external bath. Then, small amounts of a gas (the adsorbate) are admitted in steps into the evacuated sample chamber. Gas molecules that stick to the surface of the solid (adsorbent) are said to be adsorbed and tend to form a thin layer that covers the entire adsorbent surface. Based on the well-known Brunauer, Emmett and Teller (B.E.T.) theory, one can estimate the number of molecules required to cover the adsorbent surface with a monolayer of adsorbed molecules, N_m (see **Figure 2**). Multiplying N_m by the cross-sectional area of an adsorbate molecule yields the sample's surface area.



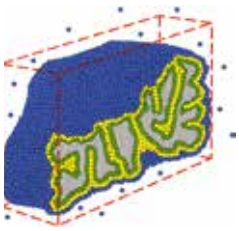
2 The monolayer of adsorbed molecules; approximately 20% saturation.

Continued addition of gas molecules beyond monolayer formation leads to the gradual stacking of multiple layers (or multilayers). Their formation occurs in parallel to capillary condensation (see **Figure 3**). The latter process is approximated by the Kelvin equation, which quantifies the proportionality between residual (or equilibrium) gas pressure and the size of capillaries capable of condensing gas within them.

3 The multilayer / capillary condensation stage; approximately 70% saturation.

Methods such as the classical one by Barrett, Joyner and Halenda (B.J.H.), or the more accurate Density Functional Theory (DFT) models, allow the computation of pore sizes from equilibrium gas pressures. Experimental isotherms of adsorbed gas volumes versus relative pressures (at equilibrium) are converted to cumulative or differential pore size distributions.

As the equilibrium adsorbate pressures approach saturation, the pores become completely filled with adsorbate (see **Figure 4**).



4 Total pore volume filling; approximately 100% saturation.

Knowing the density of the adsorbate, one can calculate the volume it occupies and, consequently, the total pore volume of the sample. If at this stage the adsorption process is reversed by withdrawing known amounts of gas from the system in steps, one generates desorption isotherms. The resulting hysteresis leads to isotherm shapes that can be related to those expected from particular pore shapes.

Industries Served

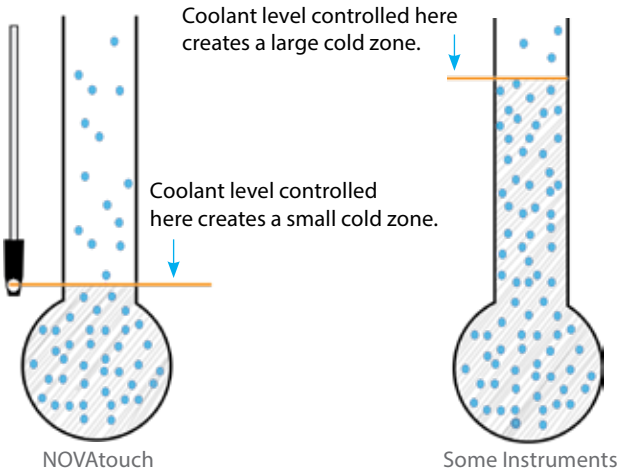
Particle characterization technology serves a wide variety of industries, including:

- Aerospace
- Agriculture
- Automotive
- Aviation
- Batteries
- Building Materials
- Ceramics
- Chemicals
- Communications
- Construction
- Consumer Goods
- Cosmetics
- Electrical
- Electronics
- Environmental
- Foods
- Food Processing
- Fuel Cells
- Manufacturing
- Marine
- Medical Devices
- Metals
- Mining & Minerals
- Munitions
- Oil Exploration
- Optics
- Paints & Coatings
- Paper & Packaging
- Petrochemicals
- Pharmaceuticals
- Plastics
- Rubber
- Textiles
- Water Treatment

Small Cold Zone For Increased Sensitivity

The sensitivity of a manometric sorption analyzer depends on the internal volume of the measurement zone (free space) and how many adsorbate molecules remain unadsorbed. The goal always therefore is to minimize the amount of unadsorbed gas occupying the free space. For that purpose, filler rods that occupy the stem portion of the sample cell are commonly employed. Additionally the bulbous portion of the sample cell can be selected to minimize the free space that is consistent with the bulk volume of the sample and its adsorption capacity.

Measurements at lower absolute pressures can also be very effective in this regard, and this is why krypton (whose saturation pressure at liquid nitrogen temperature is approximately 1/300th that of nitrogen at the same temperature) is often employed when measuring extremely low surface areas (less than one square meter total for example). The amount of unadsorbed gas is also a function of the temperature of the free space: the higher it is the fewer molecules it contains for a given pressure, and the lower it is the more molecules are present at the same pressure. In any manometric instrument part of the free space is "warm" (not in coolant), and part is "cold" (submerged in coolant). Therefore it is advantageous to minimize the volume of free space that is cold, since every cm^3 at liquid nitrogen temperature (77.4K) contains almost four times as many unadsorbed molecules as every cm^3 does around room temperature (e.g., 298K). It is true that for any cell geometry more of it should be warm and less should be cold for maximum sensitivity.



Accessories

Gas Regulator Assembly

Proper NOVAtouch functioning is assured when high-quality gas regulators are used. Quantachrome supplies complete assemblies which include two-stage regulators with dual gauges, cylinder connector, isolation valve and 1/8" gas line connector. The regulators feature stainless steel, non-venting diaphragms and the appropriate CGA fitting for specific gases. Different assemblies are available for nitrogen (and other inert gases including helium), hydrogen, carbon monoxide, oxidizing gases, etc.

Rotary Micro Riffler

As in most powder and porous materials characterization studies, surface area and pore size determinations generally require sub-samples much smaller than the original samples. The Rotary Micro Riffler uses the most accurate way of splitting a powder sample into smaller fractions - spin riffling. Its vibrating hopper features adjustable feed rates and its variable-speed collector uses standard or micro test tubes for representative sub-sample collection.

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Renowned innovator for today's porous materials community.

The quality of Quantachrome's after sales service support is the reason we are proud to maintain life time relationships with our customers.

Field Service

Our global service staff assure you that Quantachrome Instruments will continue to be the reliable engines of material characterization laboratories. We offer you the flexibility of choosing from service contracts tailored to provide you with the response time, service package, and spare parts discounts that best fit your needs.

Spare Parts

Quantachrome spare parts are certified to work with our instruments. We provide rapid response spare parts orders, and keep large inventories of replacement parts and hardware available.

Application Lab

Our fully equipped, state-of-the-art powder characterization laboratory (email: application.qt@anton-paar.com), provides the option of contracting for expert testing services. Laboratory services are also available to validate the applicability of our products prior to your purchase using your actual samples.

Lifetime Application Support

We view the field support of our instruments as an essential component of our business strategy. Our expert scientists are always available to answer questions on applications, or the use of our instruments. We do this as a standard service regardless of whether you have a service contract with us or not.

Partners in Science

Quantachrome has a scientific research department consisting of world renowned experts in material characterization. Our staff, led by team conducts collaborative research projects with leading material research labs around the world. They regularly publish articles in leading peer reviewed journals, and speak at technical symposiums around the world.

For almost half a century Quantachrome's scientists and engineers have revolutionized measurement techniques and designed instrumentation to enable the accurate, precise, and reliable characterization of powdered and porous materials. We have an unwavering commitment to providing state of the art technology, along with superior and unparalleled customer service and support.

Our commitment to customers is to support you before, during, and after the sale throughout the lifetime of our instruments. This is a big commitment because our products are so robust and reliable that we regularly find many still in use for decades.

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Serving Porous Materials and Powder Characterization Needs Since 1968