Gemini™ V Series

Surface Area Analyzers

micromeritics®

The Science and Technology of Small Particles™

Superior Results with Unique Features

Gemini V Series *Surface Area Analyzers*

Rapid and Precise Surface Area Analyses

Surface area and porosity are important physical properties that influence the quality and utility of many materials and products. Therefore it is critically important that these characteristics be accurately determined and controlled. Likewise, knowledge of surface area and especially porosity often is an important key in understanding the formation, structure, and potential application of many natural materials. Micromeritics' Gemini V series of surface area analyzers rapidly and reliably produces accurate and repeatable surface area and porosity results. Their simplicity of use, reliability, and ruggedness have earned the Gemini a place in laboratories worldwide as an essential tool in research and quality control environments.

Unique Features

The secret of Gemini's unique capabilities lies in the innovative use of sample and balance tubes. These tubes are identical in every aspect, including their thermal environment, since both tubes share the same cryogenic bath during analysis. Pressures in both tubes follow the same pressure table as well. Therefore, conditions within one tube are exactly reproduced within the other. Each tube is connected by a valve to a precision reservoir that supplies pressurized analysis gas as needed. The sample and reference reservoirs, like their associated tubes, are physically identical and are initially charged to the same pressure. During an analysis, differential pressure between reservoirs is monitored. This common mode technique assures that any differential pressure is solely due to adsorption by the sample and not to factors that lead to variations in free space during an analysis.

- The patented twin-tube design **negates free-space errors** introduced by thermal gradient variations or by initial mismeasurement of free space.
- **Permits low surface area measurements without requiring krypton** by essentially eliminating free-space error, the limiting factor in typical static volumetric systems.
- **Accelerates delivery of the analysis gas** because sample uptake rate is used to control the rate at which the gas is delivered to the sample. This results in a surface area analyzer that is as fast as the physics of adsorption allows.
- The use of a servo valve to control the rate of gas flow into the sample tube **assures accurate attainment of target pressures without pressure overshoot**. Since this is not a 'pulse-and-equilibrate' method, there is no over-dosing in which case the target pressure may be exceeded.

Three Choices of Software Control

- **Embedded software:** The Gemini V series provides a wider range of analysis choices and data reduction capabilities than in previous Gemini models. Embedded software allows the unit to be operated without need for an external PC.
- **Intuitive and powerful Windows®-based software:** The optional Windows-based software allows the Gemini V series to be controlled from a PC, thus providing more versatility in data archiving, networking, and printer options. However, the most powerful features of this software are found in its expanded range of data reduction and reporting.
- **21 CFR Part 11 software:** For applications that fall under FDA's 21 CFR Part 11 rule, the Gemini V Windows ***confirm***™ software option provides the security features and audit trails required by this regulation.

Gemini V Advantages

- ✓ Fully automatic operation
- ✓ High throughput
- ✓ Capable of measuring low surface area materials
- ✓ Windows-driven software
- ✓ Choice of analysis mode (scan or equilibrate)
- ✓ No pressure overshoot
- ✓ Common mode rejection of free-space error effects
- ✓ No thermal-diffusion errors
- ✓ English, French, German, Italian, and Spanish language options
- ✓ 21 CFR Part 11 software option
- ✓ IQ/OQ Validation service (optional)

Typical Gemini Applications

Pharmaceuticals – Surface area and porosity play major roles in the purification, processing, blending, tableting, and packaging of pharmaceutical products as well as the drug's useful shelf life, its dissolution rate, and bioavailability.

Ceramics – Surface area and porosity affect the curing and bonding of greenware and influence strength, texture, appearance, and density of finished goods. The surface area of glazes and glass frits affects shrinkage, crazing, and crawling.

Adsorbents – Knowledge of surface area, total pore volume, and pore size distribution is important for quality control of industrial adsorbents and in the development of separation processes. Surface area and porosity characteristics affect the selectivity of an adsorbent.

Activated Carbons – Surface area and porosity must be optimized within narrow ranges to accomplish gasoline vapor recovery in automobiles, solvent recovery in painting operations, or pollution controls in wastewater management.

Carbon Black – The wear lifetimes, traction, and performance of tires are related to the surface area of carbon blacks used in their production.

Catalyst – The active surface area and pore structure of catalysts influence production rates. Limiting the pore size allows only molecules of desired sizes to enter and exit; creating a selective catalyst that will produce primarily the desired product.

Paints and Coatings – The surface area of a pigment or filler influences the gloss, texture, color, color saturation, brightness, solids content, and film adhesion properties. The porosity of a print media coating is important in offset printing where it affects blistering, ink receptivity, and ink holdout.

Projectile Propellant – The burn rate of propellants is a function of surface area. Too high a rate can be dangerous; too low a rate can cause malfunctions and inaccuracy.

Medical Implants – Controlling the porosity of artificial bone allows it to imitate real bone that the body will accept and allow growth of tissue.

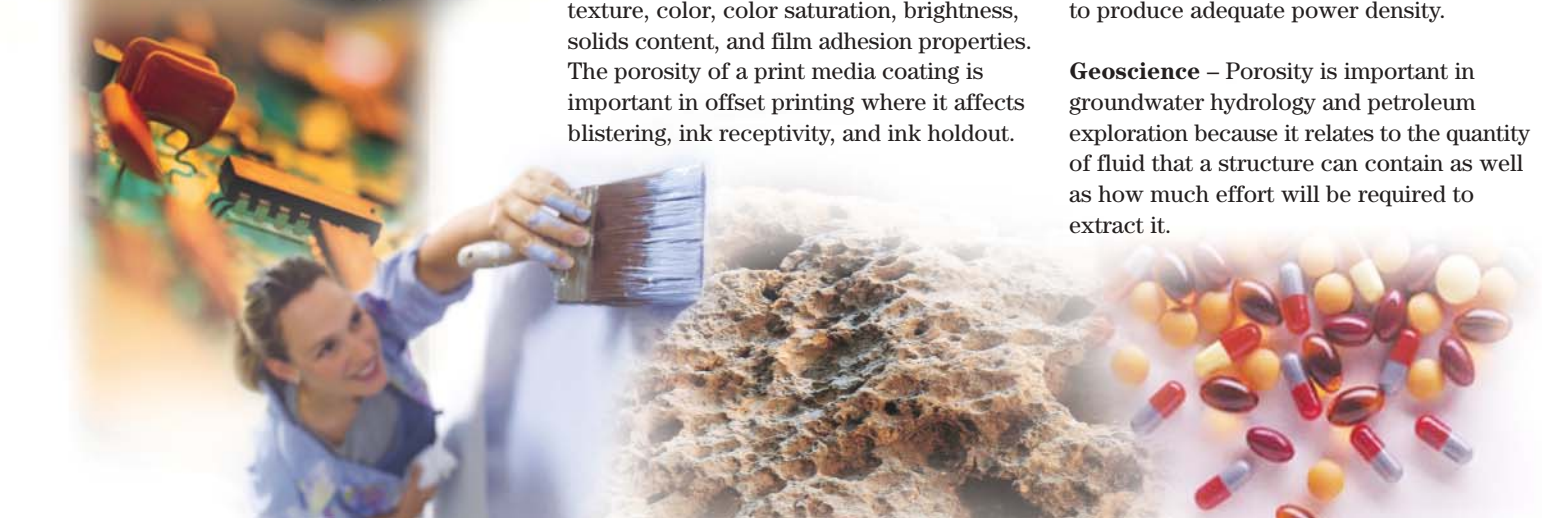
Electronics – By selecting high surface area material with carefully designed pore networks, manufacturers of super-capacitors can minimize the use of costly raw materials while providing more exposed surface area for storage of charge.

Cosmetics – Surface area is often used by cosmetic manufacturers as a predictor of particle size when agglomeration tendencies of the fine powders make analysis with a particle-sizing instrument difficult.

Aerospace – Surface area and porosity of heat shields and insulating materials affect weight and function.

Fuel Cells – Fuel cell electrodes require high surface area with controlled porosity to produce adequate power density.

Geoscience – Porosity is important in groundwater hydrology and petroleum exploration because it relates to the quantity of fluid that a structure can contain as well as how much effort will be required to extract it.



Superior Data Presentation Capability

Operating Software

Gemini analyzers can be operated from a keypad by way of embedded software or, optionally, from a computer using the more-powerful and versatile Gemini Windows software.

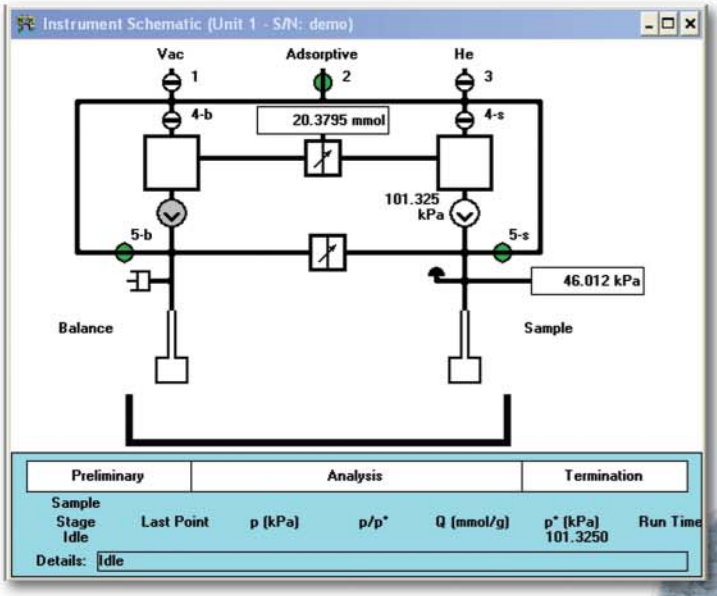
The embedded software includes:
- Adsorption isotherm (up to 1000 data points)
- Single- and Multipoint BET (Brunauer, Emmett, and Teller) surface area
- Langmuir surface area
- Total pore volume
- Total micropore volume and area by the t-Plot method using Halsey, Harkins-Jura, or Carbon Black STSA thickness curves
- Desorption isotherm, 1000 data points (Gemini 2380 only)
- BJH pore size distribution using adsorption or desorption isotherm (Gemini 2380 only)

Optional Gemini Windows Software

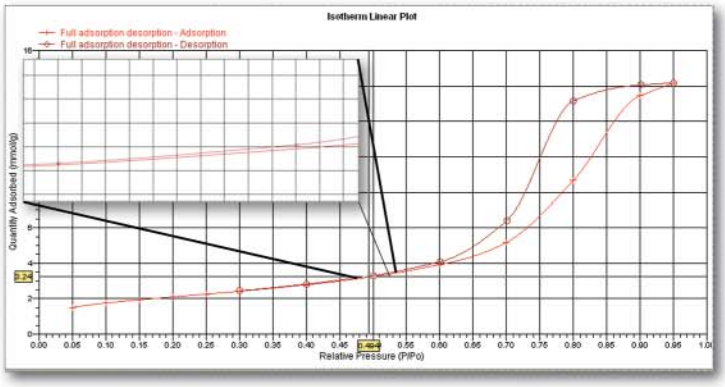
The easy-to-use Gemini Windows interface enhances the capabilities to plan, launch, and control the analysis. You can collect, organize, archive and reduce raw data, and store standardized sample information and analysis conditions for easy access during later applications. Finished reports may be generated to screen, paper, or to files in various formats. Features include cut-and-paste graphics and tables, scalable-and-editable graphs, and customizable report formats. Using computer control, you can operate multiple Gemini analyzers simultaneously from a single computer.

Gemini Windows Features

The new Gemini Windows software contains additional features not included with the embedded software. As examples:
- Reduction of user-entered data
- Automatically generated pressure tables with user-selected endpoints
- User-defined pressure table
- Summary report
- Sample log
- Linear and log isotherm plots
- Isotherm plot overlays
- Autoscaling x- and y-axes
- Cut-and-paste graphics and tables
- Data export to ASCII and spreadsheet formats
- Broekhoff-de Boer thickness curve
- Temkin and Freundlich isotherm analyses



New to the Gemini but familiar in other Micromeritics instruments, is the schematic screen which shows in detail the current status of the instrument and the analysis in process



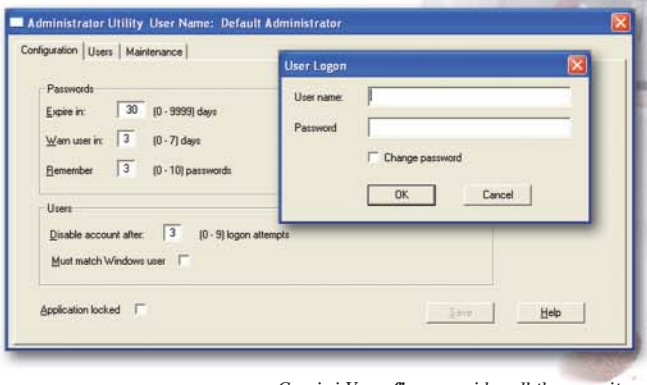
The Gemini Windows report system now has useful features such as cut-and-paste graphics, zoom, scaling, and customizable report headers for professional presentation

The 2380 model also includes:

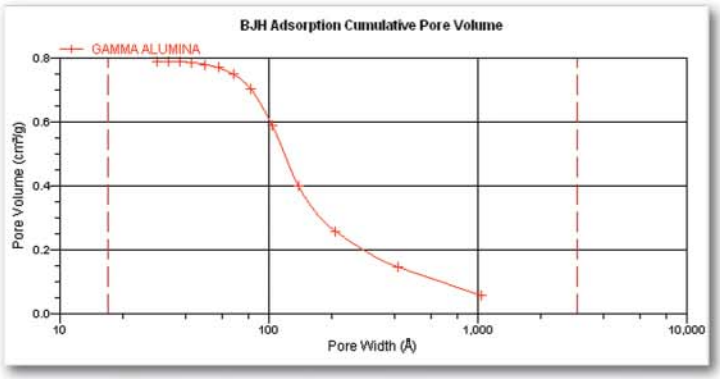
- Desorption isotherm, 1000 data points
- Dubinin-Radushkevich for micropore surface area and monolayer capacity
- Dubinin-Astakhov for micropore surface area and volume
- MP-Method for cumulative surface area and pore volume and average pore hydraulic radius
- BJH pore size (volume and width) distribution using adsorption or desorption isotherm
- User-defined thickness curve (manually entered or from data file)
- Fixed pore size tables
- Linear and log plots (isotherm, pore volume, pore area)
- Cumulative and differential data
- Plot overlays, any type

21 CFR Part 11 Option

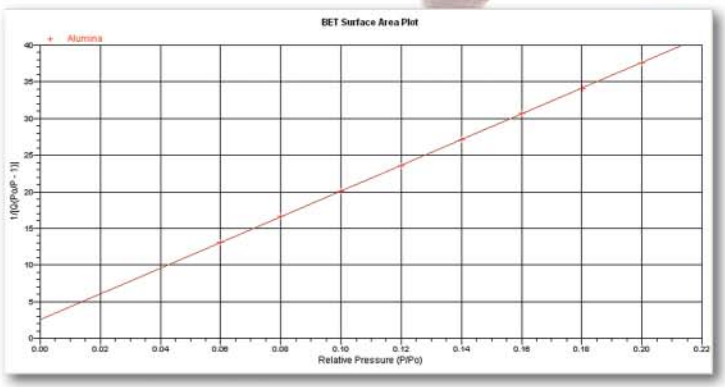
Also available is ***confirm***™ software, which addresses the many requirements specified by 21 CFR Part 11 validation, security, audit trails, reporting, and more.



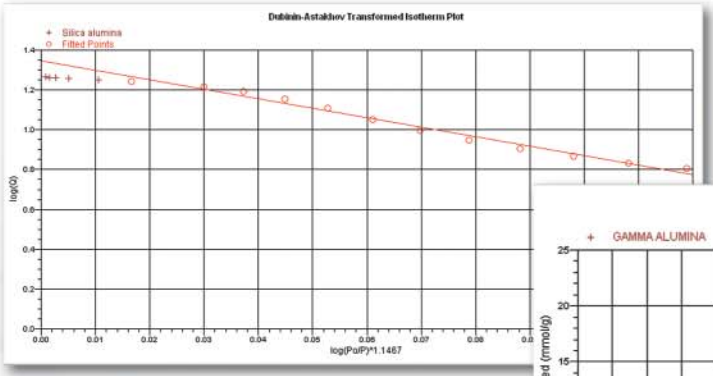
*Gemini V **confirm** provides all the security features required by the Pharmaceutical industry to comply with the FDA 21 CFR Part 11 rule*

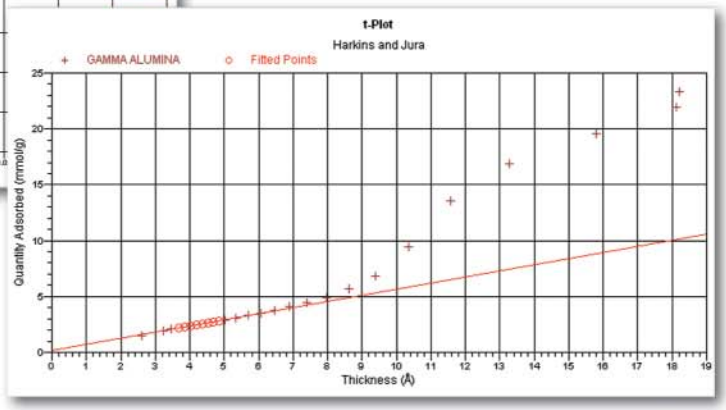


Pore size distributions are available on the Gemini V 2380 for manufacturers of porous materials looking for fast, accurate, and cost-efficient data



This BET plot of a 0.5 m²/g alumina illustrates the Gemini's ability to measure very low surface area materials without the use of krypton



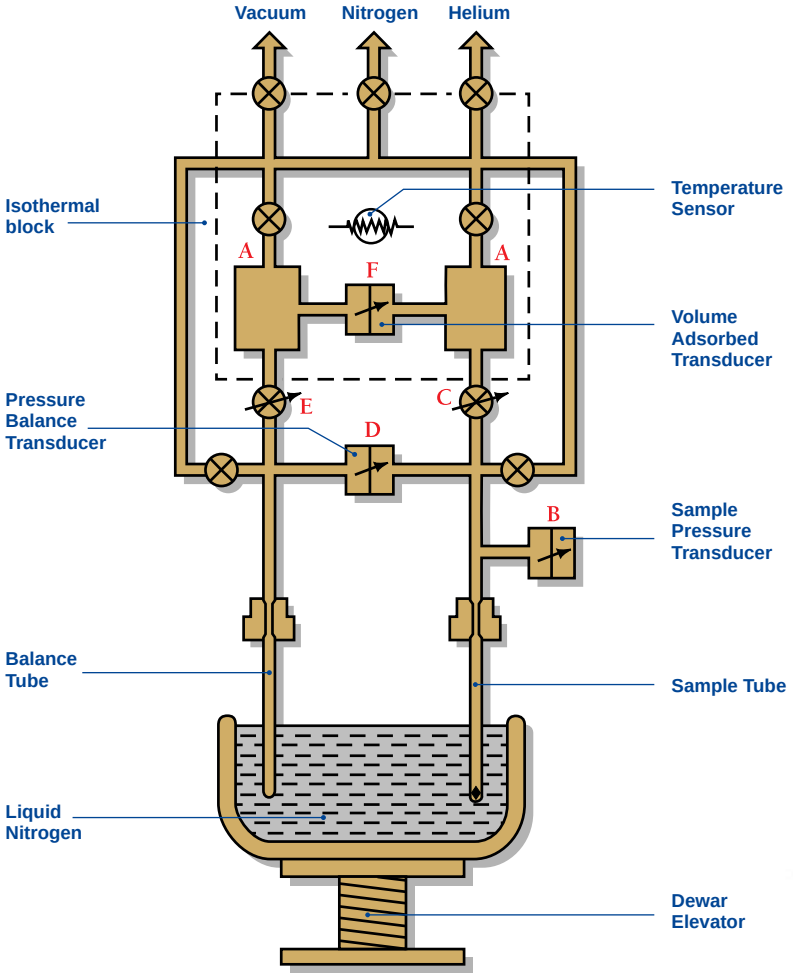


Available on the Gemini are t-plots used for pore volume and external surface area and the Dubinin plots which are useful for analyses using CO_2

Unique Design

The Gemini Technique

Micromeritics' Gemini utilizes an adaptive rate, static volumetric technique. It is the first gas sorption method that adapts the rate at which gas is delivered to the sample to the rate at which it is adsorbed. Each pressure point is allowed to equilibrate before the next point is taken. The Gemini has, as illustrated below, two gas reservoirs (A) which are filled with equal volumes of the desired adsorptive, usually nitrogen. From the reservoirs, gas is metered into the sample and balance tubes by way of a servo valve that reacts to the rate of adsorption. A transducer (B) monitors pressure within the sample tube. In a typical dose-and-wait analytical system, pressure within the sample tube decreases after each dose as the sample adsorbs gas. This is not the case with the Gemini. Transducer (B) causes a fast response servo valve (C) to increase or restrict the flow of gas to the sample tube as necessary to maintain a constant equilibrium pressure within the sample tube as adsorption occurs. Transducer (D) located between the sample and balance tubes detects any pressure difference between the two tubes and causes another servo valve (E) to adjust the pressure within the balance tube to negate any pressure differential. A third pressure transducer (F) monitors the pressure between the two reservoirs to determine the differential quantity of gas, the difference being the quantity that is adsorbed on the sample. These methods of dosing and differential quantity detection enable the Gemini to accurately determine adsorption volumes at a speed and sensitivity level unsurpassed by other static volumetric instruments.



Gemini Models

There are two models of Gemini available allowing you to get the analyzer that best suits your specific needs. Capabilities are further expanded on each model if the Windows software option is included.

Gemini 2365

The Gemini 2365 determines single-point and multipoint BET and Langmuir surface areas, total pore volume, and micropore analysis by the t-method. Also included is the capability to determine statistical thickness surface area (STSA) of carbon blacks. (Refer to ASTM D 6556, ASTM D 3765, ISO/DIS 18852.2, or ISO/CD 4652-2/3.)

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Gemini 2380

The Gemini 2380 has all the abilities of the Gemini 2365 and additionally can provide BJH pore volume distributions. Up to one thousand isotherm data points may be collected.

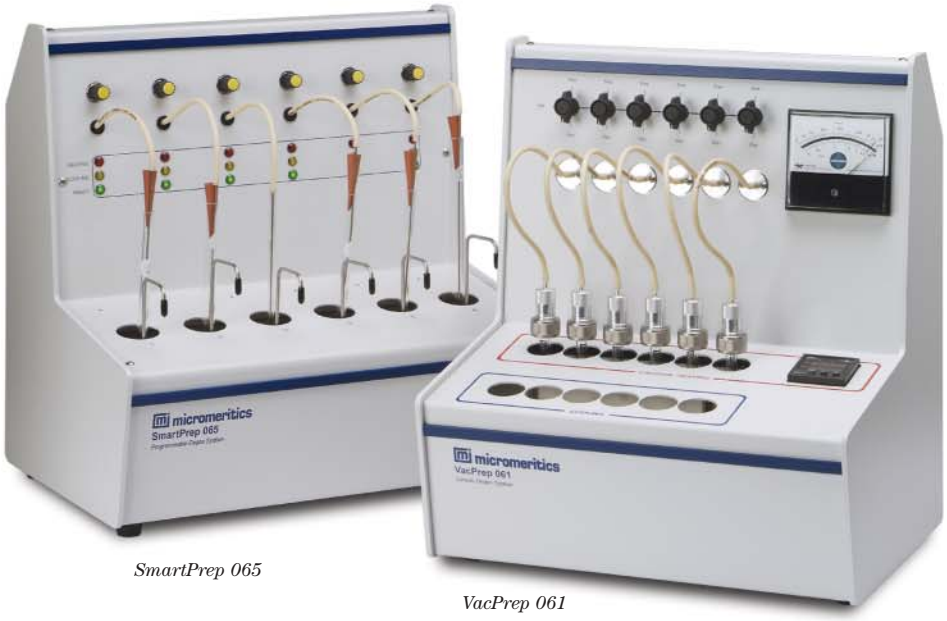
Accessories

Sample Preparation Devices

Micromeritics' sample preparation devices prepare batches of samples for surface area and pore volume analysis. They combine flowing gas and/or vacuum with heat to remove atmospheric contaminants, such as water vapor and adsorbed gas, from the surface and pores of the sample. The quality of the data produced by surface area and pore volume analyses depends greatly on the cleanliness of the sample surface. All Micromeritics' sample preparation devices accept He, N_2, Ar, and other non-corrosive gases.

The **SmartPrep™ 065** is a flowing-gas degassing unit which removes adsorbed contaminants from the surface and pores of your sample in preparation for analysis. It contains six sample ports, each one independently temperature-controlled for greater flexibility. It contains two serial ports, one for connecting to the computer and the other available for connection of an additional SmartPrep. The temperature, ramp rates, and soak times of each sample are individually controlled by the computer. Up to five ramps and soaks are allowed. All degas information is integrated into the sample data file for easy reference in the future.

The **FlowPrep™ 060** applies both heat and a stream of inert gas to the sample. The heat causes contaminants to desorb from the surface and the stream of inert gas sweeps them out of the sample tube. It lets you choose the temperature, gas, and flow rate best suited for your sample material and application. Needle valves allow you to introduce the flowing gas slowly to prevent fluidization of samples.



SmartPrep 065

VacPrep 061

The **VacPrep™ 061** offers two methods for removing contaminants. In addition to flowing gas, it provides vacuum to prepare samples by heating and evacuation. This combination allows you to choose the preparation method that is best suited to your material or application. You can also choose the StepPrep method. This method, which is best for removing water vapor from certain samples, allows repeated evacuate-backfill-evacuate cycles. The VacPrep features six degassing stations, and a choice of vacuum or gas flow preparation on each of the six stations. Needle valves are also provided allowing you to introduce the flowing gas or vacuum slowly to prevent fluidization of samples.

Model 021 LN_2 Transfer System

The Model 021 LN_2 Transfer System allows you to transfer liquid nitrogen or liquid argon from a nonpressurized storage Dewar into smaller containers used in laboratory experiments.

The system was specifically developed for conveniently filling Dewars for gas adsorption instruments but also can be used for other cryogen applications. The Model 021 can discharge cryogens at adjustable rates up to 3 liters/min. The roller base makes it easy to move the 021 System to the location where the cryogen is needed. The spigot and insulated, flexible hose enable convenient filling and refilling of analysis Dewars. The system can hold liquid nitrogen or liquid argon up to 30 days allowing cost-efficient use of your cryogen.

Additional accessories are available for special applications. Contact Micromeritics' Sales Department for details. For more comprehensive information on the Gemini V Series, visit our web site at **www.micromeritics.com.**

To request a quote or additional product information, visit Micromeritics' web site at www.micromeritics.com, contact your local Micromeritics sales representative, or our Customer Service Department at (770) 662-3636.

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