

# ASAP™ 2020

Accelerated Surface Area and Porosimetry System

# Analytical Versatility

## ASAP 2020 Accelerated Surface Area and Porosimetry System

### High Performance in a Compact Footprint

Accurate and precise surface area and porosimetry measurements are essential to the determination of the effectiveness and quality of a wide variety of materials. The Micromeritics ASAP 2020 Accelerated Surface Area and Porosimetry system integrates multiple gas sorption techniques into a single, convenient tabletop instrument.

### Intelligent Design

The ASAP 2020 provides maximum versatility over a remarkable range of applications. Sophisticated system features include:

- **Two independent vacuum systems** allowing simultaneous preparation of two samples and analysis of another
- **A two-station intelligent degas system** for fully automated degassing with precisely controlled heating profiles
- **Intuitive and powerful Windows®-based software** that includes easy-to-use interactive Wizards™ to help guide you through even the most challenging experiments
- **A highly flexible and interactive reporting system** that includes an extremely versatile graphic user interface allowing custom presentation of results



The ASAP 2020 is fully automated and is available with a wide range of options to suit your applications.



### Advanced Capabilities

Surface area and porosimetry experiments can be highly varied depending on the analytical applications of interest. The standard ASAP 2020 comes equipped with six analysis gas inlets and a 1000-mmHg transducer for analysis of most routine samples, and is available with a complete line of options allowing you to tailor the system to precisely fit your needs.

### ASAP 2020 Features

- HighVac™ (high vacuum, adds 10-mmHg transducer)
- Micropore (adds 1-mmHg transducer, requires HighVac)
- Enhanced Chemical Resistance (for use with hydrocarbons)
- Water Vapor Adsorption
- Chemical Adsorption (Chemisorption)\*

*\*The Chemisorption option includes an additional six gas inlets and an integrated connection for use with a mass spectrometer or gas chromatograph. The additional inlets are also available as an option with the standard system.*

## A World of Applications

The all new, fully automated ASAP 2020 is an essential tool for providing surface area and porosity measurements on a wide variety of materials. Here are just a few of the most commonly used applications:

**Pharmaceuticals** – Surface area and porosity play major roles in the ability to purify, process, blend, tablet, and package a drug substance. The useful shelf life and the dissolution rate (governing how rapidly the medicine becomes available to the body) depend upon the surface area and porosity of the material.

**Ceramics** – Surface area and porosity information helps to determine curing and bonding procedures, ensure adequate green strength, and produce a final product of desired strength, texture, appearance, and density.

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

**Carbon Black** – Tire manufacturers have discovered that the surface area of carbons affects the wear lifetime, traction, and performance of tires. The intended use of the tire, or the type of vehicle on which it will be placed, determines whether low or high surface area carbons will be required.

**Paints and Coatings** – The surface area of the pigment or filler influences the gloss, texture, color, color saturation, brightness, solids content, and film adhesion properties. Porosity can control application properties such as fluidity, drying or setting time, and film thickness.

**Catalysts** – The active surface area and the porous structure of catalysts have a great influence on production rates. Limiting the pore size allows only molecules of desired sizes to enter and leave, creating a selective catalyst that will produce primarily the desired product. Chemisorption experiments are valuable for the selection of catalysts for a particular purpose, qualification of catalyst vendors, and the testing of a catalyst's performance over time to establish when the catalyst should be reactivated or replaced.

**Projectile Propellant** – The surface area of propellants used in the manufacture of munitions directly affects the burn rate. Too high a rate can be dangerous; too low a rate can cause malfunctions and inaccuracy.

**Medical Implants** – The surface area and porosity of the materials used in medical implants influence the adhesion of the material to bone or natural tissue.

**Electronics** – The manufacture of compact, miniature capacitors using a minimum of costly raw material requires the development of controlled, high surface area material with a carefully designed pore network.

**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 both weight and function.

**Nanotubes** – Nanotube surface area and microporosity are used to predict the capacity of a material to store hydrogen.

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



# Hardware Versatility

## ASAP 2020 Hardware Advantages

The ASAP 2020 uses **two independent vacuum systems**, one for sample analysis and one for sample preparation. This allows preparation and analysis to proceed concurrently without the inherent delay found in single vacuum system analyzers that must share a pump. Moreover, independent systems completely eliminate the possibility of cross-contamination between the degas and analysis manifolds.

A **two-station intelligent degas system** option provides fully automated degassing with controlled heating time profiles. The degas treatment information is saved as part of the sample file, included in analysis reports, and can be conveniently copied and reused for other samples to ensure repeatability and reproducibility.

Precision machined from a monolithic block of stainless steel, ASAP 2020 **stainless-steel, temperature-monitored analysis manifolds** are designed for optimal internal volumes and superior vacuum performance. These optimized manifolds, in combination with temperature monitoring, ensure highly accurate measurements of sorbed gas volumes.

The standard ASAP 2020 manifold uses high-performance polymer seals combined with the superb properties of stainless steel. Many types of saturated hydrocarbon vapors and mild organic vapors can be used as adsorptives in addition to common gases such as N<sub>2</sub>, Ar, Kr, CO, CO<sub>2</sub>, H<sub>2</sub>, and He. High-performance manifolds using specialized sealing materials are available for use with more aggressive gases and vapors.

Programmable two-station degas system

Isothermal jacket

Vacuum cold trap

Long-duration Dewar (more than 72 hours)

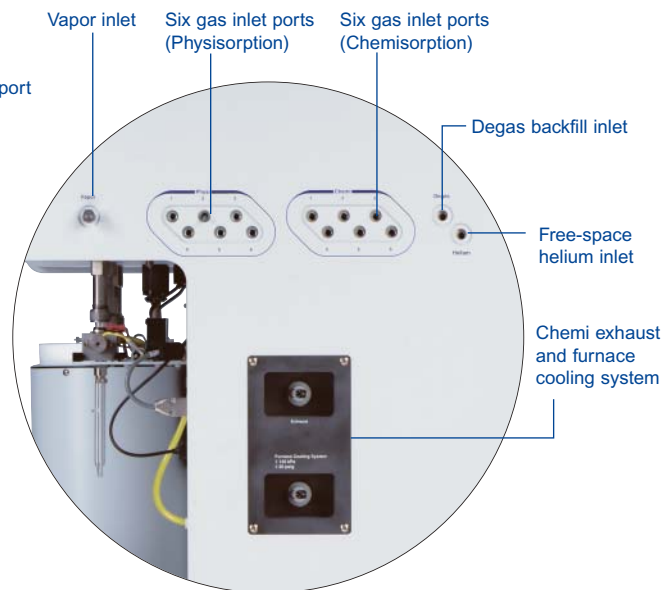


**Long-duration Dewars** combined with Micromeritics' patented **Isothermal Jackets** which are guaranteed against failure for the life of the instrument, assure a constant thermal profile along the full length of both the sample and the saturation pressure ( $P_0$ ) tubes throughout extended analyses.

The use of a **single high-quality, stable, low-noise transducer system** for all measurements eliminates the possibility of progressive offset and drift between separate transducers covering the same range.

The **optional oil-free dry vacuum system** is available for systems that utilize a mass spectrometer.





The ASAP 2020 comes equipped with **six analysis gas inlets for Physisorption experiments. A vapor inlet and helium inlet for free-space are also included. Six additional inlets are available with the Chemisorption option.** This provides greater flexibility and allows for automated selection of pretreatment, backfill, and analysis gases. This eliminates the need for external gas-select manifolds or for the removal of one gas to make room for another.

### Designed for Expanding Needs

The standard ASAP 2020 system can be readily upgraded to perform a full range of surface characterization analyses. All options, including the degas and chemisorption systems, are designed to be integrated into the ASAP 2020 cabinet and require no additional bench space.

#### HighVac Option

When equipped with a 10-mmHg transducer and a high vacuum pump, the standard system becomes a HighVac system. This system provides the low-pressure capability and pressure-measurement resolution required for low surface area analyses using krypton as the adsorptive.

#### Micropore Option

The HighVac system upgraded with a 1-mmHg transducer becomes the powerful Micropore system. The Micropore system delivers accurate porosity data on pores between 0.35 and 3 nanometers and provides a comprehensive selection of micropore reports.

#### Chemisorption Option

A chemisorption upgrade added to a HighVac or Micropore system provides surface characterization analysis of catalytic materials. An integrated mass spectrometer port is included.

#### Enhanced Chemical Resistance Option

The ASAP 2020's stainless-steel manifold is available with chemically resistant Kalrez® seals to support analyses using aggressive gases or vapors as the adsorptive. This option is ideal for experiments with unsaturated hydrocarbons such as benzene and toluene.

#### Water Vapor Adsorption Option

Studies using water vapor as the adsorptive can also be performed on any ASAP 2020 with the optional water vapor accessory.

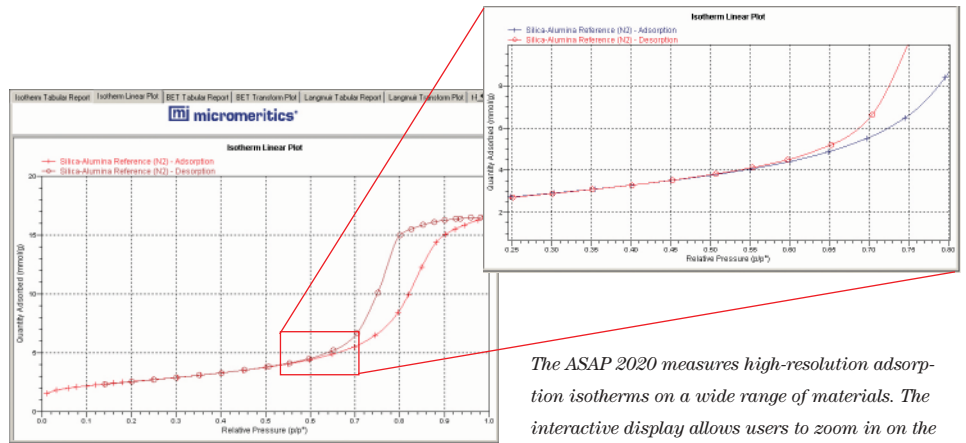


# Software and Reporting Versatility

## ASAP 2020 Software Features

The easy-to-use ASAP 2020 software utilizes a Windows interface that includes Wizards and applications to help 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 data transfer channels. Features include cut-and-paste graphics, scalable-and-editable graphs, and customizable reports. Additional capabilities include:

- Degas temperature profiles and treatment time data are integrated with the sample file for future reference and verification of SOP compliance.
- The Instrument Schematic screen displays the instrument's current operating status, including the real-time isotherm, and allows the operator to assume manual control of the instrument if desired.
- One computer can control two Micromeritics ASAP analyzers of the same or different model making efficient use of valuable lab space. Other types of Micromeritics instruments can also be connected.
- The graphics module can display up to nine overlaid graphs for easy comparison of different samples or for comparison of different data reduction techniques applied to the same sample.
- Exportable data tables provide for merging and comparing data from other sources in a unified single spreadsheet file.
- Three modes of gas dosing routines provide effective choices to ensure maximum speed with full accuracy for samples with widely differing isotherm shapes.

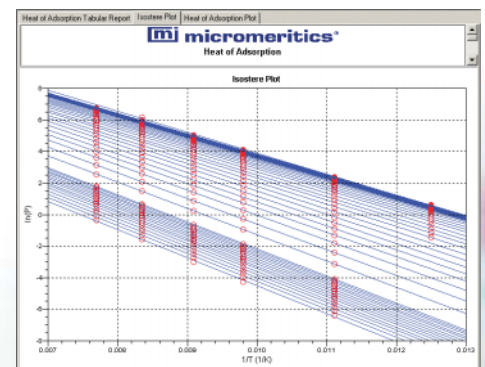
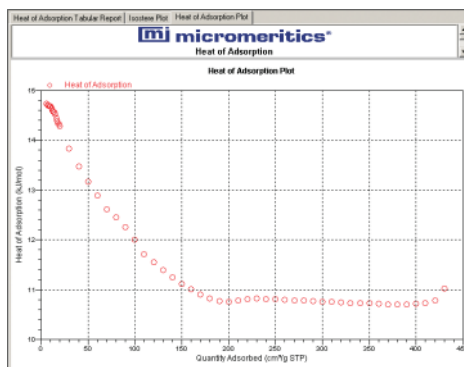


The ASAP 2020 measures high-resolution adsorption isotherms on a wide range of materials. The interactive display allows users to zoom in on the fine details of the isotherm. The expanded graph shows the precise closure of the adsorption and desorption isotherms.

- The patented Smart Dosing™ routine actually learns about the sample's potential to adsorb gas and adjusts the adsorptive doses accordingly. This helps prevent over-dosing the sample and obscuring porosity information.
- The user can enter any reference isotherm into the system by way of a data file or table. This isotherm can be used in place of the pre-programmed thickness curves when calculating thickness for t-Plots,  $\alpha_S$  (Alpha-S) Plots, and BJH pore size distribution. The reference isotherm can also be overlaid with other plotted data for comparisons.

## Analyses and Reports

The ASAP 2020 includes powerful data reduction software to provide a variety of easy-to-interpret report options. This allows tremendous flexibility in the selection of analysis constants to best fit your specific application. All ASAP 2020 models have the capability to collect data over a prescribed segment of the pressure range, or to perform adsorption and desorption analyses over the entire pressure range, providing extensive surface area and porosity information.



The isosteric heat of adsorption report uses classic thermodynamics to determine the heterogeneity of a surface. This full-featured report displays the adsorption isosteres and the heat of adsorption as a function of surface coverage.

### All ASAP 2020 Models include:

- Single- and Multipoint BET (Brunauer, Emmett, and Teller) surface area
- Langmuir surface area
- Temkin and Freundlich isotherm analyses
- Pore volume and pore area distributions in the mesopore and macropore ranges by the BJH (Barrett, Joyner, and Halenda) method using a variety of thickness equations including a user-defined, standard isotherm
- Pore volume and total pore volume in a user-defined pore size range
- Micropore distribution by the MP method and total micropore volume by the t-Plot and  $\alpha_s$  Plot methods
- f-Ratio plots that illustrate the difference between theoretical and experimental isotherm data
- Heat of Adsorption

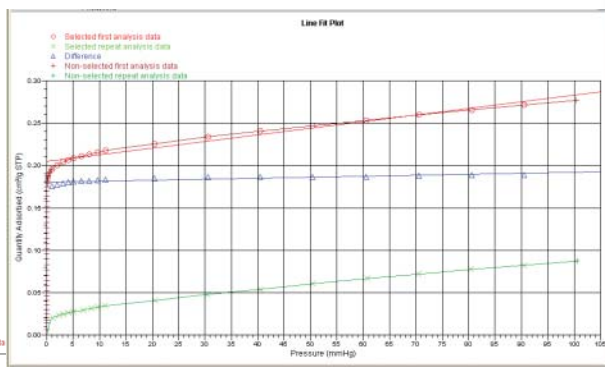
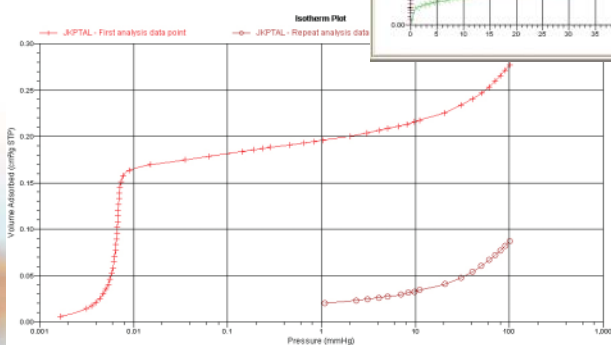
With the **Micropore** option, the report set is expanded to include high-resolution distributions of micropore volume and area by pore size using the methods of:

- Dubinin-Radushkevich (D-R)
- Dubinin-Astakhov (D-A)
- Horvath-Kawazoe (H-K)
- H-K with Cheng & Yang correction for slit-shaped pores
- H-K with Saito & Foley model for cylindrical pores

With the **Chemisorption** option, data also include:

- Active metal area
- Heat of chemical adsorption
- Crystallite size
- Strong and weak chemisorption
- Active metal dispersion

*The ASAP 2020 Chemi system measures adsorption isotherms using active gases on metal surfaces, acid sites, and basic sites. The high-resolution transducers can quantify chemisorption below 0.01 mmHg and report total and strong chemisorption.*



### DFT Plus®

DFT (Density Functional Theory) uses the entire experimental isotherm to determine both microporosity and mesoporosity as a continuous distribution of pore volume with respect to pore size. Micromeritics' exclusive DFT Plus for Windows calculates pore volume, surface energy, and surface area distribution. An independent library provides models for different pore shapes. As new models are created, the library can be easily updated without having to reload the DFT Plus program.

### Repetitive Isotherm Cycling (Optional)

This option allows you to perform up to 500 adsorption/desorption cycles over user-defined ranges along the adsorption isotherm.

### Optional Rate of Adsorption (ROA)

Rate of physical adsorption capability is available to measure the rate at which various gases adsorb to the surface of porous materials at selected target pressures. This information is valuable in gauging how accessible the adsorbing surface is and how energetically the surface collects and holds gas.

### DataMaster™

DataMaster is an off-line data reduction package that can be used with data collected from most Micromeritics gas adsorption instruments. It provides most of the data reduction techniques found in the ASAP 2020 operating program but gives you the added advantage of being able to use it on computers other than the one controlling the instrument. Now you can easily merge data or generate overlay plots from different Micromeritics gas adsorption instruments.

### Service and Support

Micromeritics provides global on-site service as well as factory support and service of all its instruments. We offer a variety of service plans designed to assure top performance and validation of our instruments. Our extensive staff of applications scientists is on hand to assist in establishing analysis conditions and protocols for individual applications. When you invest in a Micromeritics instrument, you are purchasing a superb combination of hardware, software, and technical support.



*The Science and Technology of Small Particles™*

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