

# AutoFlow BET+<sup>®</sup>

surface area analyzer



Dynamic Flow System

High Throughput Surface Area Analyzer



Catalysts



Ceramics



Energy



Carbon



Pharma



Instrument appearance and colors subject to change.

## Dynamic Flow BET Analysis

### Accelerating the Pace of Dynamic Flow BET Analysis

The **AutoFlow BET+<sup>®</sup>** is a state-of-the-art dynamic flow system designed to enable an extremely rapid evaluation of the surface areas of solid samples. Single-point or multi-point determination of surface areas using different standard methods (such as BET and STSA) is easily carried out without the need for measuring system void volumes or recalibrating signal responses.

### Achieving Highest Throughput via Modular Design

High throughput matching your analytical needs is achieved with one, two or three independent analysis stations. Each **AutoFlow BET+<sup>®</sup>** analysis station provides highly accurate data by the implementation of: (a) two built-in mass flow controllers, making the use of premixed gases unnecessary; (b) a high-resolution MEMS-TCD sensor developed by Quantachrome Instruments; and (c) precisely defined operating protocols. The **AutoFlow BET+<sup>®</sup>** references all measurements to standard temperature and pressure (STP) conditions, thereby making them calibration-free and independent of ambient conditions. The design of the instrument and its control software makes the operation very robust and user-friendly, making it ideal for both QA and academic lab applications.

### Assuring Extremely Rapid Surface Area Evaluations

The **AutoFlow BET+<sup>®</sup>** can perform a typical 3-point BET measurement in less than 15 minutes per analysis station. Up to three independent analysis stations can be operated simultaneously for high throughput. The instrument can perform analyses with either nitrogen or krypton as the adsorbate and helium as the carrier gas. The **AutoFlow BET+<sup>®</sup>** incorporates three different flow paths in order to optimize the analysis speed and resolution of samples covering an extremely wide range of surface areas. The **AutoFlow BET+<sup>®</sup>** also incorporates a 3-station sample preparation module where three samples can be degassed under dry gas flow independently and simultaneously with analyses, using multi-step user-programmable temperature ramp-and-hold protocols for each sample.



**Figure 1.** AutoFlow BET+<sup>®</sup> with One Modular Analysis Station.



**Figure 2.** AutoFlow BET+<sup>®</sup> with Three Modular Analysis Stations.

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## Features

### Exceptional Speed

- Single point BET surface areas in < 5 min per sample.
- Multi-point BET areas in < 15 min per sample.
- Advanced design eliminates need for pre- or post-calibration.

### Superior Throughput

- Up to three single point BET areas in < 5 minutes.
- Up to three multi-point BET areas in < 15 minutes.
- Up to 36 BET surface area analyses per hour.

### Outstanding Precision

- Repeatability (same sample) +/- 0.2%
- Reproducibility (different units) +/- 0.5%
- Accuracy (vs. vacuum volumetric standard) +/- 1%

### Simple Operation

- Highly intuitive click-and-start operation.
- No warm-up delay (ready to go when you are).
- Customized analysis reports generated automatically.

### Accurately Pre-Calibrated

- Saves analysis time (avoids calibration step).
- Improves analytical precision (eliminates operator variability).
- Saves cost (no need for syringes or loops).

### Widest Analytical Range

- Surface areas between 0.1 and >3,000 m<sup>2</sup>/g (with N<sub>2</sub>/77 K).
- Isotherm data from 0.005 to 0.95 P/P<sub>0</sub> (with N<sub>2</sub>/77 K).

### Maximum Versatility

- Each module has two built-in mass flow controllers.
- Modules can handle pure gases or mixed gas inputs.
- Each module has an independent MEMS-TCD sensor.

### Robust and Reliable Design

- Compact size (as little as 16-inch bench width needed).
- MEMS-TCD Sensors unaffected by flow interruptions.
- Virtually maintenance-free.

### Built-in Sample Preparation

- 3 independently programmable degassers.
- Adjustable flows and fast-cooling slots.
- Standard max. temp. = 350 °C (high temp. option to 450 °C).

### Unique Software Capabilities

- Supports 21 CFR Part 11 compliance.
- Ethernet and Remote Access.
- Multiple Language Options.

## Typical Applications

Material(s)	Standard Method(s)
Metal Powders	ASTM B900
Alumina, Silica	ASTM C1069
Advanced Ceramics	ASTM C1274
Catalysts, Catalyst Supports	ASTM D4567
General	ISO 9277
Pharma (Active Pharmaceutical Ingredients (API) and Excipients)	USP <846> Method I, European Pharmacopoeia 2.9.26 Method I

<sup>a</sup> **Note:** Carbon Black Total (BET) and external (STSA) Surface Area evaluated by ASTM D6556 can also be determined by the **AutoFlow BET+**<sup>®</sup>'s Dynamic Flow Method and can yield equivalent results in extremely short analysis times.

**Table 1.** Selected Examples of Dynamic Flow Test Methods for Various Materials.



**Figure 3.** Control Module and Analysis Station Features.

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## FloWin™ Software

Designed to maximize operator convenience with simple pre-set or user-defined measurement protocols and speedy analysis startup. FloWin™ software features real time displays and continuous updates of surface area measurements. Both automated and manual control of all system functions are available. Displays calculations in both graphical and tabular forms include isotherms, single- and multi-point BET analyses, t-Plot analyses with user-selectable or user-definable t-curve, all with standard or user-definable data reduction parameters and editable analysis tags. Reports are automatically generated and can be customized to seamlessly blend with your lab operations.

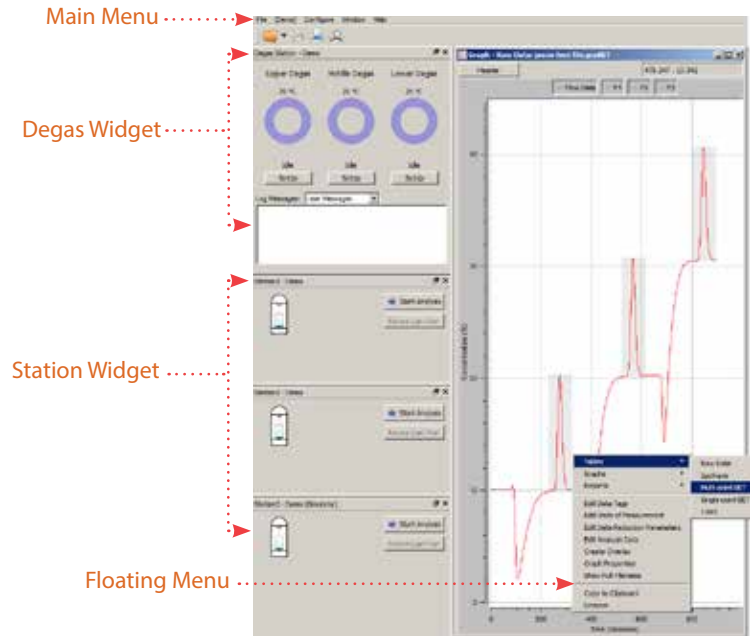


Figure 4. FloWin™ Software Features.

## Data Acquisition and Reduction

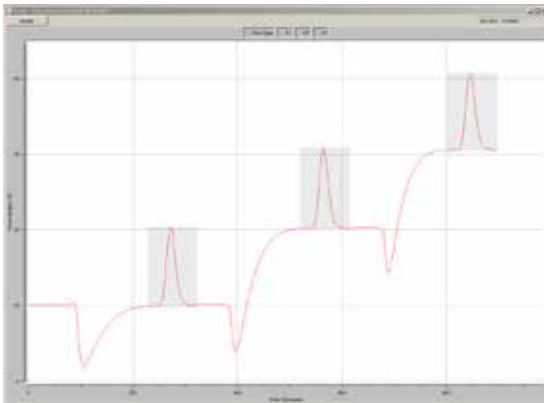


Figure 5. Extremely Fast Multi-Point BET Surface Area Analyses.

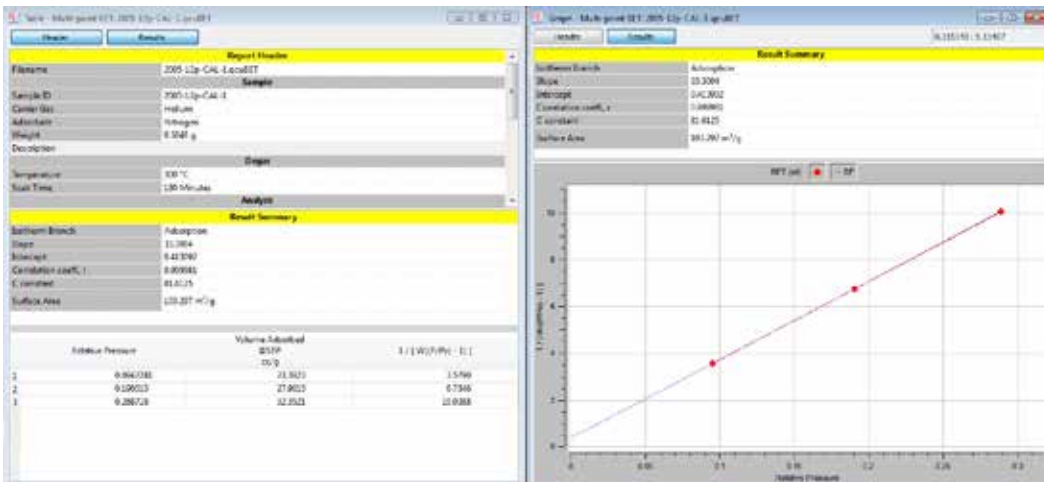


Figure 6. Automated and Customizable Analysis Reports.



## Specifications - Physical

Features	Description	1 Module	2 Modules	3 Modules
Sample Analysis	No. of Analysis Stations	1	2	3
	Pre-Programmed Analysis Setups	Yes		
	User-Programmable Analyses	Yes		
Sample Preparation	No. of Preparation Stations	3	3	3
	User-Programmable Target Temp./ Ramp Rate/Soak Time Steps	Up to 6 Steps per Station (18 Total)		
	User-Adjustable Degas Flow Rates	Yes		
	Built-In Fast-Cooling Slots	Yes		
	Maximum Degassing Temperature	350 °C (450 °C Optional)		
	Maximum Heating Rate	80 °C/min		
	Degas Time Range	0-500 hours		
Analysis System	TCD Sensors	1	2	3
	Mass Flow Controllers	2	4	6
	Pressure Transducers	1	2	3
	Handles Pure Gases	Yes		
	Handles Gas Mixture Inputs	Yes		
	Automatic Multi-Path Selection	Yes		
	Isotherm Data Collection Range	0.005 to 0.95 P/P <sub>0</sub> (with N <sub>2</sub> /77K)		
	Time-Saving Precalibrated Responses	Yes		
	Manual Mode Operation	Yes		
Dimensions (Including CPU)	Height	62 cm (24 in)		
	Depth	55 cm (22 in)		
	Width	41 cm (16 in)	60 cm (23 in)	78 cm (31 in)
	Weight	34 kg (75 lb)	50 kg (111 lb)	67 kg (147 lb)
Electrical	Voltage	100-200 VAC or 220-240 VAC		
	Frequency	50/60 Hz		
	Power (max.)	350 VA		

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## Specifications - Technical

Features	Description	1 Module	2 Modules	3 Modules
Surface Area	Single Point BET		Yes	
	Multi-point BET		Yes	
	Accuracy (vs. Reference Standard)		± 1%	
	Repeatability (Same Station)		± 0.2%	
	Reproducibility (Among Stations)		± 0.5%	
	Range Limits [m <sup>2</sup> /g]		0.01 to >3,000	
	Range Limits [m <sup>2</sup> ] (with N <sub>2</sub> /77K)		0.1 to 350	
Analysis Speed	Avg. Run Time per Sample (1-Pt. BET)	< 5 minutes	< 3 minutes	< 2 minutes
	Avg. Run Time per Sample (3-Pt. BET)	< 15 minutes	< 8 minutes	< 5 minutes
	Max. Analyses per Hour (1-Pt. BET)	12	24	36
	Max. Analyses per Hour (3-Pt. BET)	4	8	12
Other Parameters	Statistical Thickness Area (STSA)		Yes	
	Micropore Surface Area (t-method)		Yes	
	Micropore Volume (t-method)		Yes	
	Adsorption Isotherm Data for Total Pore Volume and Average Pore Size		Yes	
Data Reduction	Automated Reporting		Yes	
	Dedicated FloWin™ Software		Yes	
	Multiple Language Options		Yes	
	Ethernet and Remote Access		Yes	
	User-Selectable Data Tagging		Yes	
	Touchscreen-Accessible Functions		Yes	
	Supports 21 CFR Part 11 Compliance		Yes	



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Quantachrome has a scientific research department consisting of world renowned experts in material characterization. Our staff, led by Dr. Matthias Thommes, 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.

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