MICROTRAC
a VERDER company

SURFACE AREA AND PORE SIZE DISTRIBUTION ANALYZER

BELSORP MAX X Series

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Product Video

A lot of Science in a little space: BELSORP MAX X. High-End Adsorption. Smallest Footprint. Unrivaled Performance.

Microtrac's BELSORP MAX X is the latest model in the BELSORP MAX series, featuring a more compact design and lower weight. This high-precision gas / vapor adsorption analyzer can measure up to four samples over a wide range of pressures and temperatures. BELSORP MAX X covers a broad array of analysis capabilities from specific surface area, pore size distribution, gas, and vapor adsorption to chemisorption.

Combining high-precision pressure transducers (133.3 kPa, 1.333 kPa, and 0.0133 kPa) with hard-sealing pneumatic valves and metal gaskets, the analyzer has superior technology to minimize gas leakage and enable ultimate vacuum levels. Temperature in the BELSORP MAX X is carefully controlled using state-of-the-art technology, from the heated manifold block (50 °C, optional 80 °C) and air bath to the sample, while electropolished gas / vapor lines prevent surface wetting and corrosion.

Additionally, the new BELCONTROL operation software facilitates understanding of the structure and durability of materials through cyclical stability analysis, improves measurement and maintenance efficiency, and sends measurement results via e-mail – all resulting in maxXimized sample throughput. BELMASTER is the dedicated analysis software for advanced material evaluations. This instrument complies with ISO 9277, 15901-2 and 18852 and can be used for various material morphologies, such as molded bodies, pellets, and fine powders.

STATE-OF-THE-ART TECHNOLOGY IN THE SMALLEST SPACE

MAXXIMIZE YOUR LAB SPACE

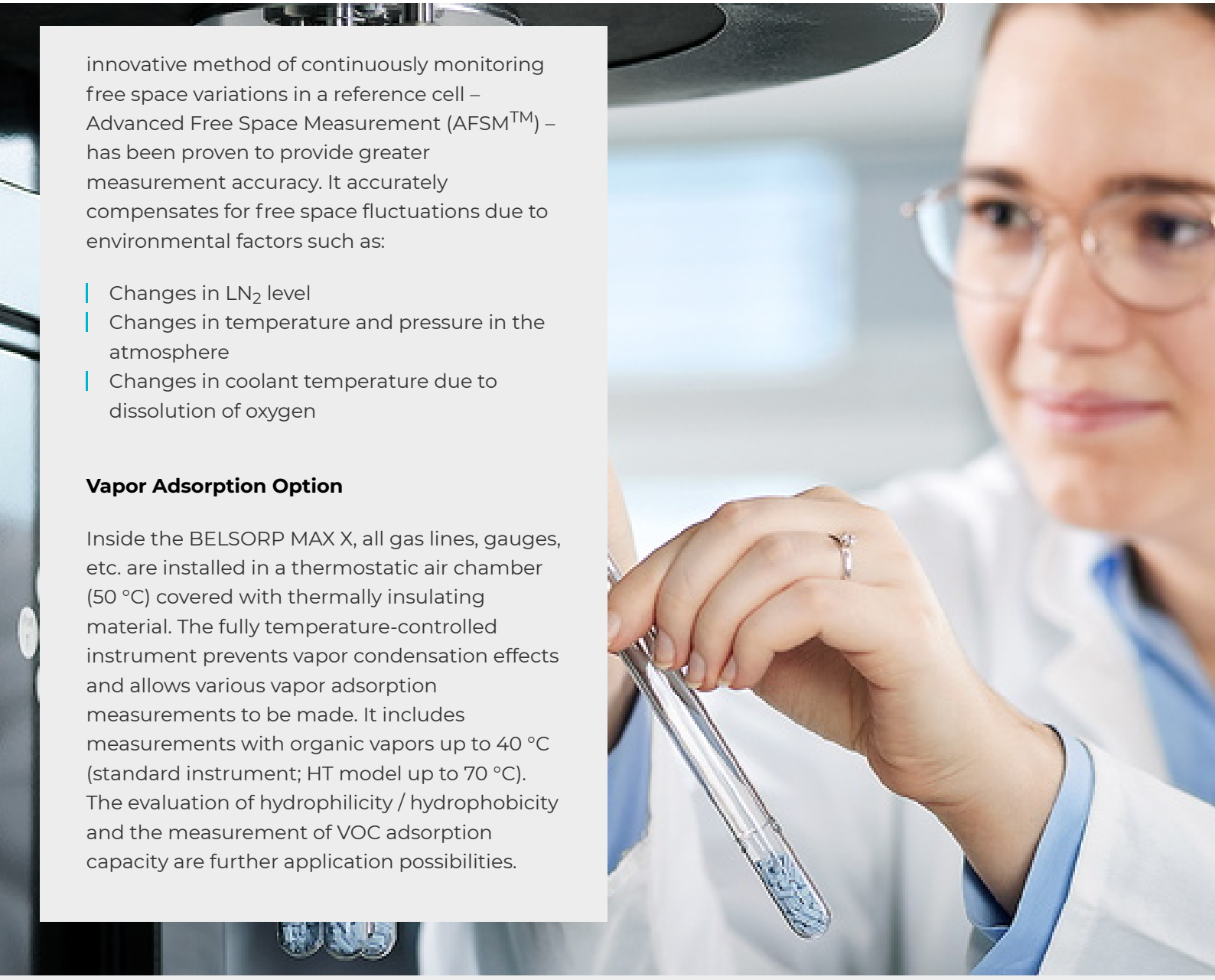
MaxXimize your lab space by minimizing the footprint! The required lab space is reduced by almost **50%** compared to alternative products.

EASY DATA MANAGEMENT & MORE QUALITY INSIGHTS

MAXXIMIZE YOUR ACCURACY

AFSM™: Highest Reproducibility Available on Any Adsorption Instrument

Rather than attempting to control the approximate level of liquid coolant, our



innovative method of continuously monitoring free space variations in a reference cell – Advanced Free Space Measurement (AFSM™) – has been proven to provide greater measurement accuracy. It accurately compensates for free space fluctuations due to environmental factors such as:

- Changes in LN_2 level
- Changes in temperature and pressure in the atmosphere
- Changes in coolant temperature due to dissolution of oxygen

Vapor Adsorption Option

Inside the BELSORP MAX X, all gas lines, gauges, etc. are installed in a thermostatic air chamber (50 °C) covered with thermally insulating material. The fully temperature-controlled instrument prevents vapor condensation effects and allows various vapor adsorption measurements to be made. It includes measurements with organic vapors up to 40 °C (standard instrument; HT model up to 70 °C). The evaluation of hydrophilicity / hydrophobicity and the measurement of VOC adsorption capacity are further application possibilities.

FULLY CUSTOMIZABLE & UPGRADEABLE

MAXXIMIZE YOUR FLEXIBILITY

Extensive Product Range

BELSORP MAX X is available in different models for a wide range of applications. Microtrac offers the perfect solution for each customer's individual needs.

Gas Selector for Different Adsorbents

Three gas ports (corrosion resistant) are available in the standard configuration. To expand one standard line to four gas lines, a gas seector can be addded. The gas lines can be expanded from 3 to 6, 9 and 12 lines.

Measurement Temperature Control

Dewars, water baths and heaters are available covering a wide range of measurement temperatures. The heater can be used for measurements as well as for sample preparation.

SPECIAL MODELS OF THE BELSORP MAX X SERIES

BELSORP MAX X HT

The BELSORP MAX X HT is a special model enabling various types of vapor adsorption (water vapor, VOCs, and more) at higher temperatures than the regular version. The manifold block can be heated up to 80°C, enabling a wider application range under more realistic conditions. The instruments is used in application fields such as:

- Cement, concrete and building materials
- Heat transformation / air conditioning
- Electrode battery (LiB) & GDL fuel cells

BELSORP MAX X HP

The BELSORP MAX X HP has been added as a custom solution to the BELSORP MAX X product line to enable gas adsorption, BET surface area, pore size distribution, vapor adsorption, and the evaluation of adsorption rates at high pressure up to 900 kPa. The instrument is used in application fields like:

- Efficient utilization of CO_2
- Energy storage (CH_4 / $CH_3C_6H_{11}$ / H_2)
- Heat pumps
- Air separation material used in PSA / TSA

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QUALITY & REPRODUCIBILITY

HIGH PRECISION MODE

The high-precision mode allows the simultaneous acquisition of adsorption / desorption isotherms for up to three samples. The fourth port uses an empty sample cell as a reference for the precise measurement of free space/dead volume changes (patented AFSM™ technology). In addition, a special port allows accurate measurement of the saturation vapor pressure at any time. This mode is recommended for research and development purposes, e.g. for evaluating small sample volumes in material development.

MULTI-SAMPLE MODE

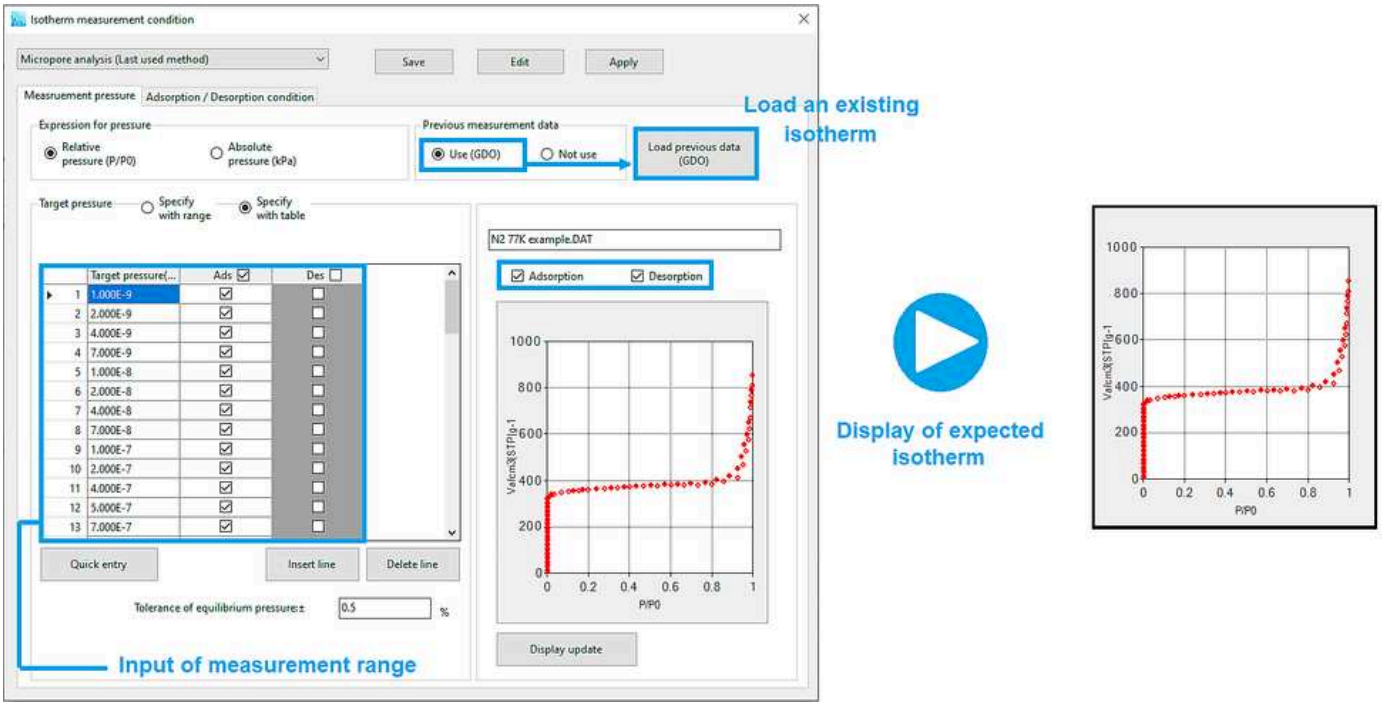
The multi-sample mode allows the user to obtain adsorption / desorption isotherms of up to four samples simultaneously, while the saturation vapor pressure is determined at any time via a dedicated port. Unlike the high precision mode, the calculation of the free space change in the sample tube is based on a pre-loaded measurement file. This mode is recommended for applications such as quality control, when samples were already characterized in large quantities.

REDUCTION OF MEASUREMENT TIME

The two following features reduce the measurement time by about 50-70%:

GAS DOSING OPTIMIZATION

By uploading a previously measured adsorption isotherm, the optimum measurement conditions for the samples are automatically determined. Each measuring point can be conveniently added or deleted, allowing the user to easily determine the gas injection quantity.



FEEDBACK CONTROL OF GAS INLET VALVE

By determining the gas inlet pressure according to the installation environment (secondary pressure of the gas cylinder) before measurement, the control valve is automatically optimized for speed and performance, successfully reducing the measurement time.

SUPPORT OF A WIDE RANGE OF ADSORBENTS & MEASUREMENT CONDITIONS

Various gas and vapor adsorption measurements are possible. With dedicated accessories, a wide temperature range can be maintained during analysis or pre-treatment.

- N_2 / Ar evaluation of specific surface area and pore distribution by adsorption measurements from very low to high relative pressures
- CO_2 ultra-micropore evaluation by adsorption measurements up to high pressures (optional)
- Evaluation of low specific surface areas by Kr adsorption measurements
- Adsorption measurement of NH_3, H_2, CO_2, O_2, CH_4 and other non-corrosive gases
- Evaluation of hydrophilicity and hydrophobicity by water vapor adsorption measurement
- Adsorption measurement of alcohol, benzene, and other non-corrosive vapors (VOCs)
- Measurement of adsorption rate of various gases and vapors (kinetic analysis)

SUITABLE FOR MEASURING MATERIALS OF DIFFERENT SHAPES

Measurements can be made on a variety of materials, including pellets, molds, substrates, as well as powders and other materials that should not be exposed to the atmosphere. The connector is equipped with a sample tube with an outer diameter of φ9 mm or φ14 mm. Special sample tubes can be provided for larger samples, such as pellets, and smaller fine powder samples can also be easily measured with the appropriate sample tubes.

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BELCONTROL: NEW OPERATION SOFTWARE

The versatility of BELSORP equipment is truly world leading. The numerous features and capabilities are complemented by BELCONTROL the intuitive and user-friendly operation software. It guides the user step-by-step through the analysis process. This includes the setup of analysis conditions, executing the measurements, when to fill and setup the liquid nitrogen or other bath, when to replace the gas cylinder, the degassing steps, and much more. The software is designed to make the instrument accessible and operable to everyone, including inexperienced users.

For inexperienced users or for measurements of unknown samples, BELCONTROL only requires basic sample information (name, mass, etc.), pre-treatment conditions (if not performed externally) and the measurement range.

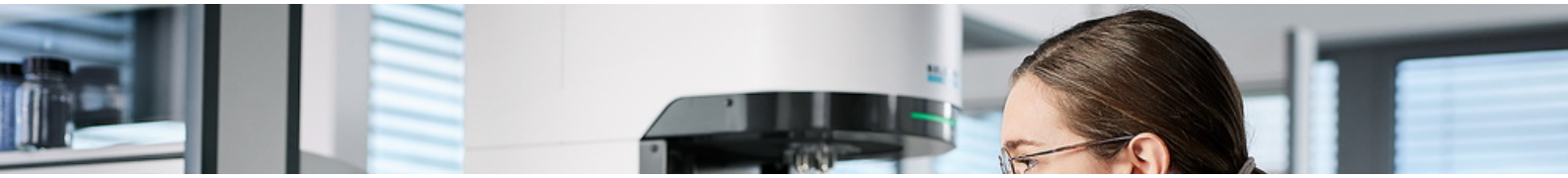
Detailed control of the configuration and measurement settings is possible to optimize the measurement

conditions (e.g. dosing settings, equilibrium criteria, leak test option, etc.). This allows the user to fully customize the sample analysis to his needs.

	BELCONTROL	
Quick BET	yes	Multi-point BET surface area in less than 20 minutes
Helium-Free Measurement	yes	AFSM™ 2 enables He-free measurements with unmatched accuracy
Adsorption Kinetics	optional	Rate of adsorption measurements for diffusion analysis

MORE BELCONTROL FEATURES

- Overlaying adsorption / desorption isotherms and comparing the measured data between the various ports during measurement
- All pressures, temperatures, valve actuations, etc. are stored in trend data, allowing for immediate examination
- A system check function is available for diagnosing the instrument status
- E-mail notification automatically transmits measurement status and results
- Interactive program in Japanese or English ensures easy, reliable operation
- Extensive help functions, including step-by-step instructions during operation



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BELMASTER ANALYSIS SOFTWARE

Data can be analyzed by drag-and-drop. Graph overlay, X-Y axis scaling, and unit conversion, point markers, and colors can be easily changed. Color can be set for individual data to improve visibility of the same data across different analysis types. The screen with the analysis results can be saved. Even if the PC is shut down, the analysis can be performed again from the saved state when the PC is restarted. The analysis results can be easily converted to MS Excel format by drag & drop.

The routine analysis setting function is useful when performing the same analysis over and over again. User-defined data can be saved as reference isotherms for pore distribution analysis, t-plot and αs. All operations can be viewed with a single right-click. BELSIM (NLDFT / GCMC) software for pore distribution analysis by simulation is included. Easy conversion to MS Excel is done with just one mouse click.

BELMASTER SOFTWARE

BELMASTER Analysis Programs

- Adsorption / desorption isotherm
- PCT curve
- BET specific surface area and Type I (ISO9277) BET automated analysis
- Langmuir specific surface area
- BJH, DH, CI, and INNES methods (mesopore distribution)
- HK, SF and CY methods (micropore distribution)
- t-plot method (micro to mesopore analysis)
- αs plot method (micro- to mesopore analysis)
- MP method (micropore distribution)
- Dubinin-Astakhov method (micropore volume)
- Equivariant differential heat of adsorption
- Differential adsorption isotherm
- Fractal dimension
- Molecular probe method (ultra-micropore analysis)
- Adsorption rate analysis

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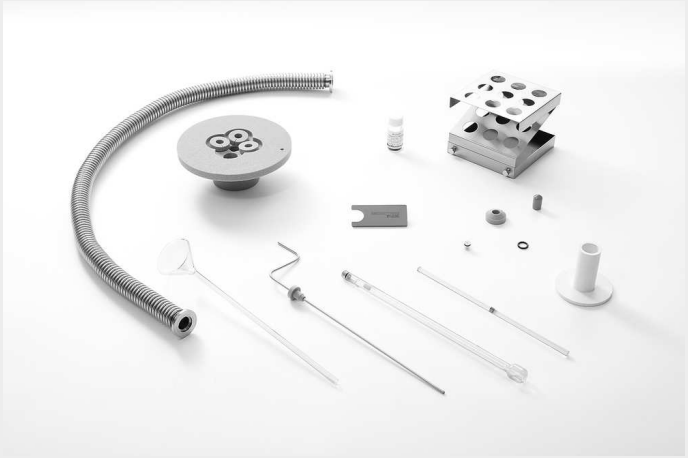
FURTHER OPTIONS & ACCESSORIES



Standard Accessories
The BELSORP MAX X is delivered with a wide range of standard accessories like Dewar vessel, thermal insulation cover / sleeve, P_0 tube, sample cells, glass rods, sample funnel, sample cell holders, sample scattering prevention filter, reference sample, O-rings and more./p>

Extensive Product Line-up
Various models are available for a variety of gas and vapor adsorption measurements. Microtrac proposes the most suitable model by combining pressure sensors according to the number of samples and pore distribution evaluation range.

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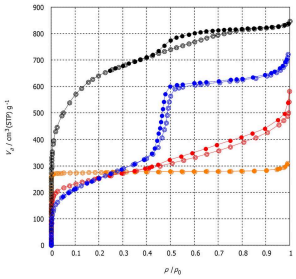
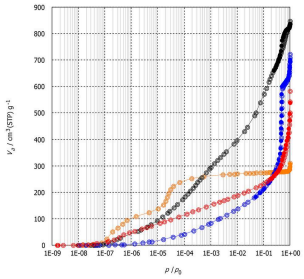
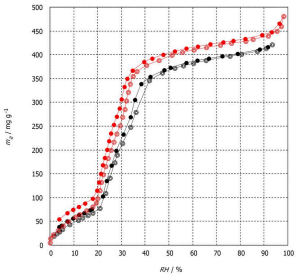
MEASUREMENT EXAMPLES



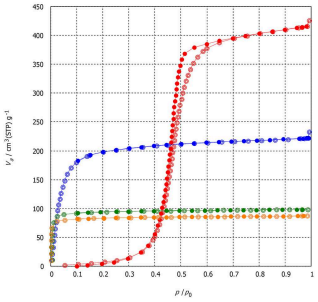
Nitrogen adsorption measurements at 77K of activated carbon fibre (black), MCM-41 (blue), metal-organic framework MIL-160 (orange) and PdC catalyst (red)



Logaritmic scaled nitrogen adsorption measurements at 77K of activated carbon fibre (black), zeolite MCM-41 (blue), metal-organic framework MIL-160 (orange) and PdC catalyst (red)



Water sorption measurements of metal-organic framework UiO-66 at 25 °C (red) and 40 °C (black)



Various vapor adsorption measurements of activated carbon fibre H_2O at 20 °C (red), CH_3OH at 15 °C (blue), C_6H_6 at 20 °C(green), and CCl_4 at 20 °C (orange)

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TYPICAL APPLICATIONS

BELSORP MAX X can be used in a wide range of applications including catalysts, batteries, fibers, polymer materials, pharmaceuticals, pigments, cosmetics, magnetic powders, separation membranes, filters, toners, cement, ceramics, and semiconductor materials.

To find the best solution for your particle characterization needs, visit our application database

BET SPECIFIC SURFACE AREA & PORE SIZE ANALYZER BELSORP MAX X

TECHNICAL DATA

Please note that the specifications below are just an examplary configuration.
Please contact us to discuss your individual requirements.

Measurement principle	Manometric method (volumetric method) + AFSM™ or AFSM™2
Adsorption gas	N_2, Ar, CO_2, H_2, Kr, O_2, NH_3, NO, CO, CH_4, C_2H_6, C_3H_8, n-C_4H_{10} , iso- C_4H_{10} and further (non-)corrosive gases
Adsorption vapor	H_2O/water, C_6H_6/benzene, $C_6H_5CH_3$/toluene, CH_3OH/ methanol, C_2H_5OH/ethanol, n-C_5H_{12}/n-pentane, n-C_6H_{14}/n-hexane, c-C_6H_{12}/c-hexane, CH_2Cl_2/dichloromethane, CCl_4/carbon tetrachloride and other organic vapors
Gas ports	3 ports (optional: up to 12 ports)
Number of measurements	MAX X: max. 4 ports simultaneously MAX X-HT: max. 4 ports simultaneously MAXX-HP: max. 3 ports simultaneously
Measurement range (specific surface)	0.01 m^2/g and above (N_2) 0.0005 m^2/g and above (Kr) (depending on sample density)
Measurement range (pore size distribution)	0.35 - 500 nm
Measurement range (gas adsorption isotherm)	MAX X: P/P0 = 10-8~0.997 (N2@77.4K, Ar@87.3K) MAX X-HT: max. P/P0 = 10-6~0.997 (N2@77.4K, Ar@87.3K) MAXX-HP: P/P0 = 10-8~0.997 (N2@77.4K, Ar@87.3K)
Measurement range (vapor adsorption isotherm)	MAX X: P/P0 = ~0.95 @40°C MAX X-HT: P/P0 = ~0.95 @80°C MAXX-HP: P/P0 = ~0.95 @40°C
Measurement range (high pressure gas adsorption isotherm)	MAX X: - MAX X-HT: - MAXX-HP: 10Pa~900kPa
Pressure transducer (1MPa: 7500 Torr)	MAX X: - MAX X-HT: - MAXX-HP: 1 unit
Pressure transducer (133 kPa: 1000 Torr)	MAX X: 6 units MAX X-HT: 6 units MAXX-HP: 5 units

Pressure transducer (1.33 kPa: 10 Torr)	MAX X: max. 4 units MAX X-HT: 4 units MAXX-HP: 3 units
Pressure transducer (0.0133 kPa: 0.1 Torr)	MAX X: max. 3 units MAX X-HT: - MAXX-HP: 2 units
Thermostatic air oven	MAX X: 50°C MAX X-HT: 80°C MAXX-HP: 50°C
Vacuum gauge / pump	Cold cathode gage (Optional)/Turbo molecular pump + rotary pump (or diaphragm pump)
Measurement temperature (Dewar vessel)	LN_2, LAr temperature; Holding time: 80 h
Measurement temperature (Pretreatment heater)	50 - 550°C
Measurement temperature (Water bath)	-10 - 80°C (constant temperature circulator)
Dimensions (W x H x D)	360 x 870 x 590 mm
Weight (main body)	50 kg
Utility - Gas	He, adsorption gas pressure: 0.1MPa (G) Joint: 1/8" Swagelok joint Valve operan gas pressure: 0.5 - 0.6 Mpa (G) Joint: 1/4" one-touch pipe contact
Utility - Power	AC 100 - 240 V/400W (rotary pump not included)
CE certified	yes
Operating software	Windows 10 operating system or higher, CPU Intel(R) Core i5 or higher 2 GB of memory or more, 5 GB HDD space or more
Recommended Monitor	Full HD monitors

www.microtrac.com/belsorp-max-x