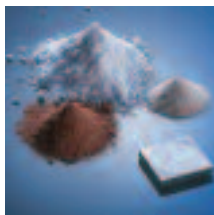


The Sorptomatic from Thermo Electron Corporation provides fast, reliable and simple physisorption and chemisorption analyses. It is available in Basic, Micropore, Krypton and Chemisorption configurations.

Sorptomatic Product Specifications



The specific surface area and the pore size distribution are fundamental parameters for the characterization of porous solids and powders. These properties can be easily investigated by the physisorption technique that can be carried out by the Sorptomatic using inert gases as adsorbates. When it is necessary to evaluate active surfaces, like the ones of supported catalysts, the Sorptomatic can also perform chemisorption measurements. In this last case, a wide range of reactive gases can be put in contact with the pre-activated sample. The Sorptomatic is fully computer controlled with totally new software based upon Windows 2000/XP. This easily controls all the experimental steps in addition to performing data processing and reporting.



The new dimension in the technique of gas adsorption

Sorptomatic Basic Configuration

Sorptomatic in the basic configuration is the ideal analyzer to rapidly and precisely determine the surface area and pore size distribution on porous materials in the mesopore range and above. It applies the static volumetric analytical method, contains two independent built-in sample preparation positions and it is fully computer controlled. Easy, rapid and precise.

ANALYTICAL CAPABILITY	
Physisorption	Specific surface area, mesopore size distribution, total pore volume
SAMPLE STATIONS	
Analysis	One analysis port connected to the manifold
Preparation	Two completely independent preparation stations with separate vacuum access and temperature control
GAS INLETS	
Adsorbate	Two gases are selectable, maximum inlet pressure 2 bar
Servo N ₂	Maximum inlet pressure 3 bar (relative), it is used for liquid coolant refilling
Servo air	Inlet pressure 4 bar (relative), it is used to move the calibrated injection piston
ACCEPTED ADSORBATES	
Physisorption	N ₂ , Kr, Ar, CO ₂ , He, . . .
Chemisorption	H ₂ , O ₂ , CO, CH ₄ , light hydrocarbons, . . .
SAMPLE HOLDERS	
Standard	L1 small size (about 20 cc), inlet diameter 8 mm L2 medium size (about 30 cc), inlet diameter 8 mm
VACUUM SYSTEM	
Rotative first inlet	Final vacuum 5.10 ⁻³ torr for manifold degassing
Rotative second inlet	Final vacuum 0.1 torr, used during the desorption analytical procedure
Vacuum measurement	Thermocouple vacuum gauge with digital display, range 0.1 to 100 Pa
Filters	Active alumina filter before manifold and carbon filter cartridge for oil vapours
PRESSURE MEASUREMENT	
Injection transducer	Absolute capacitive for 0.1 to 1000 torr, accuracy 0.25 % of reading
Equilibrium transducer	Absolute capacitive for 0.1 to 1000 torr, accuracy 0.25 % of reading
A/D converter	Each transducer has a 14 bits A/D converter
Saturation pressure	By temperature sensor, resolution better than 0.01K, pressure resolution 0.1 torr, calibrated for liquid nitrogen and liquid argon boiling temperatures
COOLANT SYSTEM	
Accepted coolants	Liquid nitrogen and liquid argon with automatic level control. Melting ice or other liquid coolants without automatic control
Level control	Measured by a temperature sensor, refilling by servo nitrogen pressurization. Level control +/- 1 mm from set point
Analysis dewar capacity	1 litre
Reservoir capacity	3 litres, can be refilled even during measurement
Lasting time	Multiple refilling provide virtually unlimited lasting
SAMPLE PRE-TREATMENT	
Degassing ports	Two independent degassing ports with direct access to vacuum. Max vacuum degree depends on the vacuum system installed. Vacuum inlet for degassing is separated from the vacuum circuit for the analysis during run
Maximum vacuum for degassing	Final vacuum 5.10 ⁻³ torr
Temperature	From room temperature up to 723 K (450 °C)
Accuracy	+/- 1 % of full scale temperature
Heating procedures	Three heating procedures: 1. ballistic 2. rates from 0.1 to 5 °C/min 3. variable temperature rate at constant degassing pressure
Degassing time	Manual (unlimited) or automatic selectable from 1 to 18 hours
MEASUREMENT RANGES	
Specific surface area	From 0.2 m ² /g (for Sorptomatic base unit and according to the sample nature) using nitrogen or argon. No upper limit.
Specific pore volume	From 0.0001 cm ³ /g
Pore size range	Pore size distribution range depends mainly on the calculation models applied to the experimental data. Typical range is from 2 to 200 nm (depending on sample nature) for Sorptomatic Base Unit. Pore range can be extended by the Micropore Configuration.
Reproducibility	From 1 to 3 % according to sample nature and the calculation model
Analysis time	From 30 minutes to 3 hours for surface area measurement. For a complete isotherm the required time depends by the selected number of experimental points for every cycle and the sample nature (equilibrium time required to reach the equilibrium pressure).
PHYSICAL	
Power supply	220 V +/- 10 %, 50/60 Hz, 2300 VA
Dimensions	82 x 65.5 x 83.5 cm (W x D x H)
Weight	112 kg
Environment	Temperature from 10 to 35 Celsius, humidity from 20 to 80 %
DATA PROCESSING	
Main software	For instrument control and basic data processing

Sorptomatic Micropore and Krypton Configuration

The Micropore and Krypton Configuration enhances the instrument performance in terms of pore size distribution and specific surface area measurement. Microporous materials feature pores with a size between 0.4 and 2 nanometers. These types of samples adsorb the measuring gas at extremely low pressures. Furthermore, they need a higher vacuum degree to be completely degassed from pollutant vapours before the measurement. Usually, microporous materials show a very high specific surface area. On the other hand, non-porous samples, like rocks or some pharmaceuticals, show sometimes a specific surface area far below 0.2 square meters per gram. In this case, nitrogen is not very suitable as adsorbate and krypton is preferred. When using krypton for surface area measurement, the saturation pressure at liquid nitrogen boiling temperature (which is used as coolant) is around 2 torr.

ANALYTICAL CAPABILITY	
Physisorption	Specific surface area, mesopore and micropore size distribution, total pore volume
Low surfaces	Extreme low surface area determination on macroporous or non-porous materials using krypton adsorption
SAMPLE STATIONS	
Analysis	One analysis port connected to the manifold
Preparation	Two completely independent preparation stations with separate vacuum access and temperature control
GAS INLETS	
Adsorbate	Two gases are selectable, maximum inlet pressure 2 bar
Servo N ₂	Maximum inlet pressure 3 bar (relative), it is used for liquid coolant refilling
Servo air	Inlet pressure 4 bar (relative), it is used to move the calibrated injection piston
ACCEPTED ADSORBATES	
Physisorption	N ₂ , Kr, Ar, CO ₂ , He, . . .
Chemisorption	H ₂ , O ₂ , CO, CH ₄ , light hydrocarbons, . . .
SAMPLE HOLDERS	
Standard	L1 small size (about 20 cc), inlet diameter 8 mm L2 medium size (about 30 cc), inlet diameter 8 mm
Krypton	For low surface materials (about 65 cc), inlet diameter 8 mm
VACUUM SYSTEM	
Rotative first inlet	Final vacuum 5.10 ⁻³ torr, for manifold degassing
Rotative second inlet	Final vacuum 0.1 torr, used during the desorption analytical procedure
Vacuum measurement	Thermocouple vacuum gauge with digital display, range 0.1 to 100 Pa
Turbo-molecular	Final vacuum better than 1.10 ⁻³ torr (according to manufacturer's specs)
Filters	Active alumina filter before manifold and carbon filter cartridge for oil vapours
PRESSURE MEASUREMENT	
Injection transducer	Absolute capacitive 0.1 to 1000 torr, accuracy 0.25 % of reading
Equilibrium transducer	1. Absolute capacitive 0.1 to 1000 torr, accuracy 0.25 % of reading 2. Absolute capacitive 0.001 to 10 torr, displayed resolution 0.0001 torr, accuracy 0.15 % of reading
A/D converter	Each transducer has a 14 bits A/D converter
Saturation pressure	By temperature sensor, resolution better than 0.01K, pressure resolution 0.1 torr, calibrated for liquid nitrogen and liquid argon boiling temperatures
COOLANT SYSTEM	
Accepted coolants	Liquid nitrogen and liquid argon with automatic level control. Melting ice or other liquid coolants without automatic control
Level control	Measured by a temperature sensor, refilling by servo nitrogen pressurization. Level control +/- 1 mm from set point
Analysis dewar capacity	1 litre
Reservoir capacity	3 litres, can be refilled even during measurement
Lasting time	Multiple refilling provide virtually unlimited lasting
SAMPLE PRE-TREATMENT	
Degassing ports	Two independent degassing ports with direct access to vacuum. Max vacuum degree depends on the vacuum system installed. Vacuum inlet for degassing is separated from the vacuum circuit for the analysis during run
Maximum vacuum for degassing	Final vacuum better than 1.10 ⁻³ torr (according to manufacturer's specs) by turbo molecular pump
Temperature	From room temperature up to 723 K (450 °C)
Accuracy	+/- 1 % of full scale temperature
Heating procedures	Three heating procedures: 1. ballistic 2. rates from 0.1 to 5 °C/min 3. variable temperature rate at constant degassing pressure
Degassing time	Manual (unlimited) or automatic selectable from 1 to 18 hours
MEASUREMENT RANGES	
Specific surface area	From 0.005 m ² /g (using Krypton gas as adsorbate and according to the sample nature). From 0.2 m ² /g using nitrogen or argon. No upper limit.
Specific pore volume	From 0.0001 cm ³ /g
Pore size range	Pore size distribution range depends mainly on the calculation models applied to the experimental data and on the sample nature. Typical range is from the molecular dimension of the adsorbate (i.e. for nitrogen 0.35 nm) up to 200 nm (depending on sample nature)
Reproducibility	From 1 to 3 % according to sample nature and the calculation model
Analysis time	From 30 minutes to 3 hours for surface area measurement. For a complete isotherm the required time depends by the selected number of experimental points for every cycle and the sample nature (equilibrium time required to reach the equilibrium pressure).
PHYSICAL	
Power supply	220 V +/- 10 %, 50/60 Hz, 2300 VA
Dimensions	82 x 65.5 x 83.5 cm (W x D x H)
Weight	112 kg (excluding the turbo-molecular pump that is separate)
Environment	Temperature from 10 to 35 Celsius, humidity from 20 to 80 %
DATA PROCESSING	
Main software	For instrument control and basic data processing
Additional software	Advanced Data Processing with more calculation models and report formats

Sorptomatic Chemisorption Configuration

Chemisorption measurements can be easily performed when the Sorptomatic is in configuration. The Sorptomatic uses the static volumetric adsorption method, which is one of the most precise techniques for a reliable measurement of metal specific surface and metal dispersion in supported catalysts. The pre-treatment unit allows connecting up to six gases to the special design flow gas burette to properly activate the sample before the analysis. Two samples can be prepared concurrently using different gases, temperature and flow conditions. The final degassing before the analysis can be performed in flow of inert gas or under very high vacuum conditions to clean completely the activated sample surface and to perform reliable and reproducible measurements. The kit is completed with suitable software for the determination of metal specific surface and dispersion in supported catalysts from chemisorption isotherms.

ANALYTICAL CAPABILITY	
Physisorption	Specific surface area, mesopore size distribution, total pore volume
Chemisorption	Catalyst metal dispersion, metal specific surface area, average size of metal crystallite, acid/base sites determination
SAMPLE STATIONS	
Analysis	One analysis port connected to the manifold
Preparation	Two completely independent preparation stations with separate vacuum access and temperature control
GAS INLETS	
Adsorbate	Two gases are selectable, maximum inlet pressure 2 bar
Servo N ₂	Maximum inlet pressure 3 bar (relative), it is used for liquid coolant refilling
Servo air	Inlet pressure 4 bar (relative), it is used to move the calibrated injection piston
ACCEPTED ADSORBATES	
Physisorption	N ₂ , Kr, Ar, CO ₂ , He, . . .
Chemisorption	H ₂ , O ₂ , CO, CH ₄ , light hydrocarbons, . . .
SAMPLE HOLDERS	
Standard	L1 small size (about 20 cc), inlet diameter 8 mm L2 medium size (about 30 cc), inlet diameter 8 mm
Flow gas	Micro-reactor for catalysts activation and chemisorption
VACUUM SYSTEM	
Rotative first inlet	Final vacuum 5.10 ³ torr, for manifold degassing
Rotative second inlet	Final vacuum 0.1 torr, used during the desorption analytical procedure
Vacuum measurement	Thermocouple vacuum gauge with digital display, range 0.1 to 100 Pa
Turbo-molecular	Final vacuum better than 1.10 ³ torr (according to manufacturer's specs)
Filters	Active alumina filter before manifold and carbon filter cartridge for oil vapours
PRESSURE MEASUREMENT	
Injection transducer	Absolute capacitive for 0.1 to 1000 torr, accuracy 0.25 % of reading
Equilibrium transducer	1. Absolute capacitive 0.1 to 1000 torr, accuracy 0.25 % of reading 2. Absolute capacitive 0.01 to 100 torr, displayed resolution 0.001 torr, accuracy 0.15 % of reading
A/D converter	Each transducer has a 14 bits A/D converter
Saturation pressure	By temperature sensor, resolution better than 0.01K, pressure resolution 0.1 torr, calibrated for liquid nitrogen and liquid argon boiling temperatures
COOLANT SYSTEM	
Accepted coolants	Liquid nitrogen and liquid argon with automatic level control. Melting ice or other liquid coolants without automatic control
Level control	Measured by a temperature sensor, refilling by servo nitrogen pressurization. Level control +/- 1 mm from set point
Analysis dewar capacity	1 litre
Reservoir capacity	3 litres, can be refilled even during measurement
Lasting time	Multiple refilling provide virtually unlimited lasting
SAMPLE PRE-TREATMENT	
Degassing ports	Two independent degassing ports with direct access to vacuum. Max vacuum degree depends on the vacuum system installed. Vacuum inlet for degassing is separated from the vacuum circuit for the analysis during run
Maximum vacuum for degassing	Final vacuum better than 1.10 ³ torr (according to manufacturer's specs) by turbo molecular pump
Temperature	From room temperature up to 723 K (450 °C)
Accuracy	+/- 1 % of full scale temperature
Heating procedures	Three heating procedures: 1. ballistic 2. rates from 0.1 to 5 °C/min 3. variable temperature rate at constant degassing pressure
Degassing time	Manual (unlimited) or automatic selectable from 1 to 18 hours
CATALYST ACTIVATION MODULE	
Gas lines	Two independent for two simultaneous catalysts preparation
Flow control	By independent rotameters
Total gas ports	Up to six gas lines can be connected to the preparation module
MEASUREMENT RANGES	
Specific surface area	From 0.2 m ² /g using nitrogen or argon. No upper limit.
Specific pore volume	From 0.0001 cm ³ /g
Pore size range	Pore size distribution range depends mainly on the calculation models applied to the experimental data and on the sample nature. Typical range is from 2 up to 200 nm (depending on sample nature)
Reproducibility	From 1 to 3 % according to sample nature and the calculation model
Analysis time	From 30 minutes to 3 hours for surface area measurement. For a complete isotherm the required time depends by the selected number of experimental points for every cycle and the sample nature (equilibrium time required to reach the equilibrium pressure).
PHYSICAL	
Power supply	220 V +/- 10 %, 50/60 Hz, 2300 VA
Dimensions	82 x 65.5 x 83.5 cm (W x D x H)
Weight	112 kg (excluding the turbo-molecular pump that is separate)
Environment	Temperature from 10 to 35 Celsius, humidity from 20 to 80 %
DATA PROCESSING	
Main software	For instrument control and basic data processing
Additional software	Advanced Data Processing with more calculation models and report formats

Sorptomatic Full Option Configuration

Sorptomatic in Full Option Configuration is the top of the line model as it can perform, comprehensively, physisorption isotherms on all kind of materials (micro, mesoporous samples with regard to surface area and pore volume pore size and very low surface area macroporous and non-porous samples) and chemisorption isotherms on activated solids and catalysts.

ANALYTICAL CAPABILITY	
Physisorption	Specific surface area, mesopore and micropore size distribution, total pore volume
Chemisorption	Catalyst metal dispersion, metal specific surface area, average size of metal crystallite, acid/base sites determination
Low surfaces	Extreme low surface area determination on macroporous or non-porous materials using krypton adsorption
SAMPLE STATIONS	
Analysis	One analysis port connected to the manifold
Preparation	Two completely independent preparation stations with separate vacuum access and temperature control
GAS INLETS	
Adsorbate	Two gases are selectable, maximum inlet pressure 2 bar
Servo N ₂	Maximum inlet pressure 3 bar (relative), it is used for liquid coolant refilling
Servo air	Inlet pressure 4 bar (relative), it is used to move the calibrated injection piston
ACCEPTED ADSORBATES	
Physisorption	N ₂ , Kr, Ar, CO ₂ , He, . . .
Chemisorption	H ₂ , O ₂ , CO, CH ₄ , light hydrocarbons, . . .
SAMPLE HOLDERS	
Standard	L1 small size (about 20 cc), inlet diameter 8 mm L2 medium size (about 30 cc), inlet diameter 8 mm
Flow gas	Micro-reactor for catalysts activation and chemisorption
Krypton	For low surface materials (about 65 cc), inlet diameter 8 mm
VACUUM SYSTEM	
Rotative first inlet	Final vacuum 5.10 ⁻³ torr, for manifold degassing
Rotative second inlet	Final vacuum 0.1 torr, used during the desorption analytical procedure
Vacuum measurement	Thermocouple vacuum gauge with digital display, range 0.1 to 100 Pa
Turbo-molecular	Final vacuum better than 1.10 ⁻⁸ torr (according to manufacturer's specs)
Filters	Active alumina filter before manifold and carbon filter cartridge for oil vapours
PRESSURE MEASUREMENT	
Injection transducer	Absolute capacitive for 0.1 to 1000 torr, accuracy 0.25 % of reading
Equilibrium transducer	1. Absolute capacitive 0.1 to 1000 torr, accuracy 0.25 % of reading 2. Absolute capacitive 0.01 to 100 torr, displayed resolution 0.001 torr, accuracy 0.15 % of reading 3. Absolute capacitive 0.001 to 10 torr, displayed resolution 0.0001 torr, accuracy 0.15 % of reading
A/D converter	Each transducer has a 14 bits A/D converter
Saturation pressure	By temperature sensor, resolution better than 0.01 K, pressure resolution 0.1 torr, calibrated for liquid nitrogen and liquid argon boiling temperatures
COOLANT SYSTEM	
Accepted coolants	Liquid nitrogen and liquid argon with automatic level control. Melting ice or other liquid coolants without automatic control
Level control	Measured by a temperature sensor, refilling by servo nitrogen pressurization. Level control +/- 1 mm from set point
Analysis dewar capacity	1 litre
Reservoir capacity	3 litres, can be refilled even during measurement
Lasting time	Multiple refilling provide virtually unlimited lasting
SAMPLE PRE-TREATMENT	
Degassing ports	Two independent degassing ports with direct access to vacuum. Max vacuum degree depends on the vacuum system installed. Vacuum inlet for degassing is separated from the vacuum circuit for the analysis during run
Maximum vacuum for degassing	Final vacuum better than 1.10 ⁻⁸ torr (according to manufacturer's specs) by turbo molecular pump
Temperature	From room temperature up to 723 K (450 °C)
Accuracy	+/- 1 % of full scale temperature
Heating procedures	Three heating procedures: 1. ballistic 2. rates from 0.1 to 5 °C/min 3. variable temperature rate at constant degassing pressure
Degassing time	Manual (unlimited) or automatic selectable from 1 to 18 hours
CATALYST ACTIVATION MODULE	
Gas lines	Two independent for two simultaneous catalysts preparation
Flow control	By independent rotameters
Total gas ports	Up to six gas lines can be connected to the preparation module
MEASUREMENT RANGES	
Specific surface area	From 0.2 m ² /g using nitrogen or argon. No upper limit.
Specific pore volume	From 0.0001 cm ³ /g
Pore size range	Pore size distribution range depends mainly on the calculation models applied to the experimental data and on the sample nature. Typical range is from the molecular dimension of the adsorbate (i.e. for nitrogen 0.35 nm) up to 200 nm (depending on sample nature).
Reproducibility	From 1 to 3 % according to sample nature and the calculation model
Analysis time	From 30 minutes to 3 hours for surface area measurement. For a complete isotherm the required time depends by the selected number of experimental points for every cycle and the sample nature (equilibrium time required to reach the equilibrium pressure).
PHYSICAL	
Power supply	220 V +/- 10 %, 50/60 Hz, 2300 VA
Dimensions	82 x 65.5 x 83.5 cm (W x D x H)
Weight	112 kg (excluding the turbo-molecular pump that is separate)
Environment	Temperature from 10 to 35 Celsius, humidity from 20 to 80 %
DATA PROCESSING	
Main software	For instrument control and basic data processing
Additional software	Advanced Data Processing with more calculation models and report formats

Calculation Models for Sorptomatic

STANDARD SOFTWARE	
Main function	Control the instrument, set the analytical parameters, display the isotherm during the analysis and performs basic calculations and reporting
Specific surface area	BET 2 parameters Dubinin-Radushkevitch-Kaganer
Pore size distribution	Dollimore-Heal Barrett-Joiner-Halenda Horvath-Kawazoe
Available graphs	Isotherm Surface area Pore size distribution (histograms or derivative)
Available reports	20 different report types can be memorized in the software
Available data format	Data can be exported in text, Excel or other electronic formats
ADVANCED DATA PROCESSING SOFTWARE	
Main function	Advanced Data Processing software encloses the most up-to-date calculation models for surface area and pore size determination. It also permits the creation of customized graphics format to be enclosed directly in scientific publications
Specific surface area	BET 2 parameters BET full equation (3 parameters) with non linear regression function Langmuir model Dubinin-Radushkevitch-Kaganer Excess Surface Work (ESW) model t-Plot alpha-Plot MP-Plot (Mikhail-Brunauer-Bodor)
Standard isotherms for t calculation	Halsey, Fransil, Harkins-Jura, De Boer, Halenda, Lecloux, Hydroxylated silica, User defined standard
Mesopore size distribution	Barrett-Joyner-Halenda Dollimore-Heal Cranston-Inkley Modelless method
Micropore size distribution	Horvath-Kawazoe Saito-Foley Dubinin-Stoekli
Available potential functions	Nitrogen – Graphite (@ 77K), Argon – Graphite (@ 77K, 87K), Carbon dioxide – Graphite (194K, 273K, 298K), Argon – Zeolite (@ 87K, 77K), Nitrogen – Zeolite (@ 77K), User defined
Chemisorption	Subtraction procedure of isotherms for strong and weak chemisorption Back extrapolation to zero pressure for metal surface and dispersion calculation Langmuir model at variable exponent
Available graphs	All calculations are applicable in graphic format. All graphs can be edited in almost all their components and exported in high resolution graphic file
Available reports	Three main reports are available: summary, standard and extended. Each report type can be manually edited by the user

Certified Reference Materials (CRM) for specific surface area and pore size

Reference materials are samples that have been measured and certified by Round Robin tests. They are officially recognized and can be used for the Sorptomatic certification. Furthermore, the Sorptomatic analytical reliability can be checked periodically by analyzing these materials. All the reference samples are comprehensive of the characterization certificate, the instruction manual related to the preparation procedure and analytical parameters.

CRM BCR 171	Specific surface area: 3 m ² /g	bottle of 10 g
CRM BAM-PM 102	Specific surface area: 5.41 m ² /g +/- 0.04 m ² /g	bottle of 10 g
CRM BAM-PM 104	Specific surface area: 79.8 m ² /g +/- 0.4 m ² /g Specific pore volume: 0.210 ml/g +/- 0.002 (at P/Po = 0.99) Mean pore radius: 5.31 nm +/- 0.05 nm Most frequent pore radius: 3.23 nm +/- 0.05 nm	bottle of 10 g
CRM BAM-PM 103	Specific surface area: 156.0 m ² /g +/- 1.3 m ² /g Specific pore volume: 0.250 ml/g +/- 0.002 (at P/Po = 0.99) Mean pore radius: 3.18 nm +/- 0.02 nm Most frequent pore radius: 1.93 nm +/- 0.04 nm	bottle of 10 g

The above reference materials are not enclosed in the Sorptomatic standard outfit, therefore they must be ordered separately.