

World novelty for fine particles  
from minimal sample quantities  
at high yields!

# Nano

## Spray Dryer B-90



# The Nano Spray Dryer B-90 – a pioneering instrument for R&D studies using small sample quantities



*Nano Spray Dryer B-90 with trolley, aspirator and inlet filter in open mode for spray drying of aqueous solutions in air.*

<b>Nano Spray Dryer B-90 – the fine submicron particle expert</b> Key features and benefits	Page 3
<b>A wide variety of applications – a multi-talent spray drying instrument</b> Applications in the pharmaceutical, material and nanotechnology fields	Page 4
<b>Small quantities, fine particles and high yields</b> Application areas	Page 5
<b>The Nano Spray Dryer B-90 – new technology and unique features</b> Operational principle, intelligent details, spray head piezo technology, electrical particle collector	Page 6 – 7
<b>Accessories – maximum flexibility</b> Various accessories and system configurations	Page 8 – 9
<b>Spray dryer application test center</b> Competent lab application	Page 10
<b>Complete line of professional solutions</b> Range of solutions: from R&D lab to industrial production	Page 11
<b>Technical data</b>	Page 12

# Nano Spray Dryer B-90 – the fine submicron particle expert

Since 1979, Buchi Labortechnik AG has been supplying the Mini Spray Dryer B-190, B-191 and B-290 systems and has become the global market leader in laboratory scale spray dryers. Over 2'900 units have been installed at universities, R&D centers and powder specialists around the world. The latest generation of instruments – the Nano Spray Dryer B-90 – revolutionizes today's spray drying possibilities with the unique ability to generate particle sizes in the nano range for milligram sample quantities at high yields.



Spray drying is gaining greater attention as a gentle, continuous and scalable drying process to convert liquids to dry powders.

The new Nano Spray Dryer B-90 is particularly suited to the needs of the pharmaceutical, biotech, material and nanotech markets. These areas show the newest application trends, focusing on effective formulation of complex and valuable drugs (highly active pharmaceutical ingredients) and nanoparticles.

#### Key features and benefits:

- Efficient spray process for minimal quantities (ml, mg)
- Innovative piezoelectric atomizing technology for fine particles in the submicron range
- Narrow particle size distribution
- Novel electrostatic particle collector for the highest possible yields of fine particles
- Modular glass assembly and visible spray process
- Short set-up times and easy cleaning
- Easy to sterilize

#### Markets:

- Pharmaceuticals
- Biotechnology
- Materials
- Nanotechnology

#### Application areas:

- Nanoparticle suspensions/nanoemulsions
- Micro- and nanoencapsulations/englobing
- Nanoparticle agglomerations
- Structural modifications
- Generation of nanoparticles with high recovery rates
- Spray drying of aqueous and organic solvent samples

#### Buchi's lab-scale spray drying competence:

- Professional product training courses and application help
- Feasibility studies for our customers in our spray drying applications test laboratory
- Free online Spray Dryer Application Database ([www.buchi.com](http://www.buchi.com))

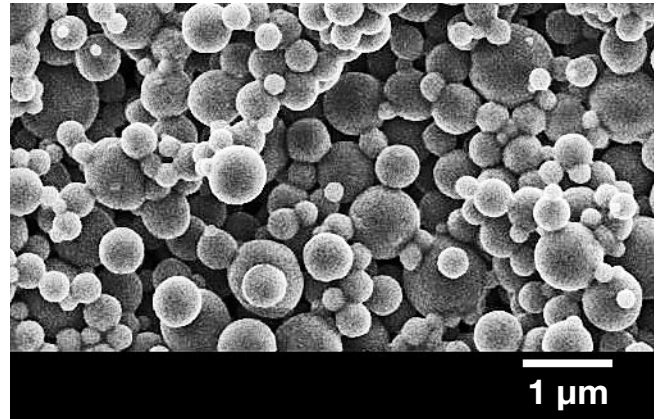
# A wide variety of applications – a multi-talent spray drying instrument

The latest application trends in pharmaceutical formulation and nanotechnology demonstrate the need for fine particles in small powder quantities and with very high yields. The Nano Spray Dryer B-90 is Buchi's 4<sup>th</sup> generation lab scale spray dryer and is particularly designed to evaluate spray drying during the early stages of product development. The modular and flexible glass design makes it easy to spray dry a whole variety of applications and is ideal for feasibility studies in R&D laboratories where only milligrams of powder need to be dried.

**Operational areas:** colleges & universities, laboratories, institutes, R&D centers



Dry powder inhalation



Spray dried submicron particles

## Pharmaceutical technology – drug delivery

- Inhalable drugs for dry powder inhalers (DPI's)
- Stabilization of vaccines in matrix materials
- Microencapsulation of liposomes
- Encapsulation of hydrophilic nanoparticles in hydrophobic carrier materials
- Biodegradable/biocompatible polymers (lactides, glycolides, PLGA, polyacrylates)
- Therapeutic carrier materials (insulin, growth hormones)
- Porous drug carriers from nanoparticle suspensions
- Nanocapsules of polymers (poly-caprolactone, eudragit)
- Typically applied drug delivery systems: trehalose, lactose, HPMC, PVA, chitosan, cyclodextrin, maltodextrin, PLGA, starch, gelatine and many more

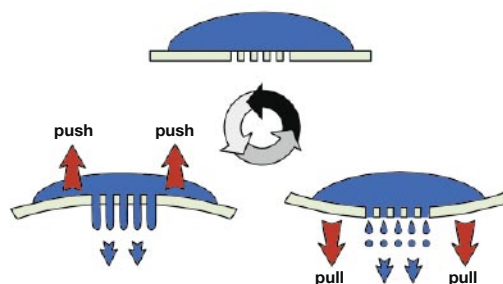
## Materials and nanotechnology

- Fine metal particles for novel catalysts
- Fine magnetic powders for electronic storage media
- Carbon nanotubes as additives for rubbers
- High performance ceramics with high specific surface area
- Nanosuspensions for fuel cell batteries
- Oxide particles for textiles as UV absorbers
- Silicon oxide nanoparticle agglomerates
- Finest pigments for paints and coatings
- Encapsulation of aromas, flavours or perfumes
- Nano food – functional additives

## Principle of spray generation



Piezoelectric driven spray head incorporating a thin vibrating perforated membrane (mesh)



Functional principle of mesh vibration

- The droplet generation is based on a piezoelectric driven actuator, vibrating a thin, perforated, stainless steel membrane in a small spray cap.
- The membrane (spray mesh) features an array of precise micron-sized holes.
- The actuator is driven at an ultrasonic frequency, causing the membrane to vibrate, ejecting millions of precisely sized droplets every second with very narrow droplet size distribution.

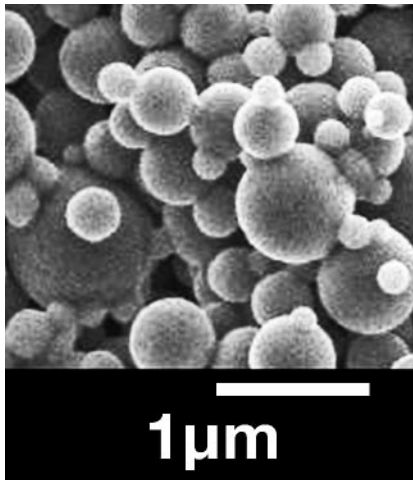
# Small quantities, fine particles and high yields

The key benefits of the Nano Spray Dryer B-90: a fast process for the production of small quantities of homogenous powder products with high yields. The Nano Spray Dryer B-90 is suitable for various applications, including those on a very small scale, e.g. for spray drying solutions, nanoemulsions, nanosuspensions, structural transformations or micro- and nanoencapsulations.

## Customer benefits

- Production of submicron- or even nanoparticles with very narrow size distribution for new breakthroughs in R&D
- Only a minimal sample amount of high value product needs to be invested to receive a dry powder
- Benefit from minimal loss of high value products due to uniquely high yields
- Efficient and fast process thanks to simple assembling, easy cleaning and fast product changes
- Simple instrument adjustment for specific needs by taking advantage of the various accessories (e.g. spray drying organic solvents, controlling particle size)

## Experience submicron spray drying



### ■ Small ml quantities

The Nano Spray Dryer B-90 is the ideal laboratory instrument for processing the smallest quantities, typically used in feasibility studies.

Spray drying of valuable substances within the submicron range is possible. Main fields for the innovative spray dryer are found in pharmaceutical, biotech, material- and nanotechnology applications.

### ■ Submicron particles

The innovative piezo crystal driven spray head generates a mist of fine droplets with very narrow size distribution.

Different spray caps with 4.0, 5.5 and 7.0  $\mu\text{m}$  hole sizes are available to tune the average droplet size between 8 to 21  $\mu\text{m}$  precisely.

Nanoparticle suspensions and nanoemulsions are typical applications for the Nano Spray Dryer B-90.

### ■ High yields up to 90%

The unique electrostatic particle collector offers excellent particle separation efficiency for submicron- and nanoparticles of milligram sample amounts.

This ensures the recovery of high value and expensive materials in R&D studies and feasibility tests.

This unique technology is ideal for samples used in pharmaceuticals, medical products, advanced materials and innovative food ingredient industries.

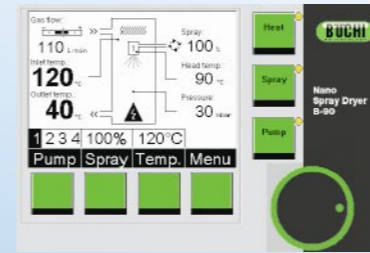
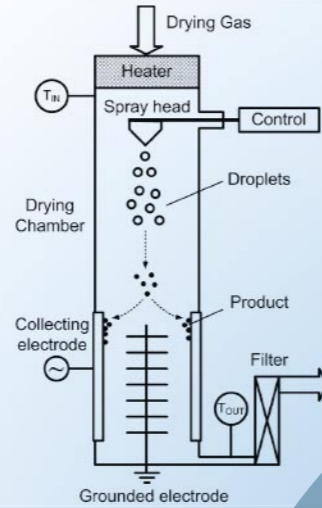
# The Nano Spray Dryer B-90 – a new innovative technology in laboratory spray drying

The Nano Spray Dryer B-90 offers a fast drying process for temperature sensitive materials, excellent product yields and low energy consumption.

Buchi stands for quality in your hands. Customer needs are met with real product innovation, sophisticated design and outstanding technology.

## Principle

- The drying gas enters in laminar flow from the top into the drying chamber and is heated up to the set inlet temperature
- The piezodriven spray head generates ultra-fine droplets, which are gently dried into solid particles
- The dried solid particles are electrostatically charged and collected at the collecting electrode
- The drying gas exits the spray dryer, the outlet temperature is measured and, in addition, the gas is filtered



## Easy operation and instrument control

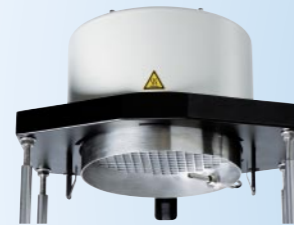
- Visualized process parameters and simple display control
- Convenient setting of inlet/outlet temperature, drying gas flow, spray rate and pressure on the front panel

## PC-software for online data monitoring and storage

- Data storage of experimental runs in a library
- Documentation of process data of experimental trials
- Export of process parameters for further data analysis

## Heating system (patent pending)

- Compact porous metal foam for optimal energy input
- Short heat-up times up to 120 °C
- Generation of laminar gas flow in the drying section
- Convective heat transfer between droplets and gas
- Fast heating control by pluggable PT-1000 temperature sensor



## Modular glass assembly of the spray cylinder

- Visibility of the complete spray process from droplet generation to particle collection
- Use the short instrument for ultra-fine droplet production and the tall unit for larger droplets and water based samples
- Angular spray head installation for heat sensitive materials and small sample amounts down to 1 ml
- Simple and ergonomic installation of modular glassware
- This table-top instrument is easy to clean and sterilize



Functional principle

Operation control

Heating system

Droplet generation

Modular design

Particle separation



## Height adjustable peristaltic pump

- Sample feeding with pluggable peristaltic pump
- Continuous recirculation of the sample feed, from sample vessel to spray head and back
- Minimal dead volume in the feeding tubes



## Novel piezoelectric driven droplet atomizing technology

- Ultrasonic atomization at 60 kHz driving frequency for gentle and soft droplet generation
- Choice of three different spray caps with 4.0, 5.5 or 7.0 μm mesh hole size
- Very narrow droplet size distribution
- Simple exchange of spray caps
- Easy cleaning of spray head with detergents or in an ultrasonic bath



Spray caps with incorporated meshes of 4.0, 5.5 or 7.0 μm hole size

Hole size	Water droplet size D (4,3)	Span	Water flow rate
4.0 μm	8 μm	< 1.4	20 ml/h
5.5 μm	15 μm	< 1.6	60 ml/h
7.0 μm	21 μm	< 1.6	150 ml/h

## Innovative electrostatic particle collector for submicron- and nanoparticles

- Particle separation rate is independent of particle mass (as in cyclones) and allows collection of fine nanoparticles (separation efficiency > 99 %)
- Excellent product yields: up to 90 % for small sample quantities < 100 mg
- Simple particle collection with manual particle scraper
- Integrated outlet gas filter for the protection of users and the environment



# Instruments

**Nano Spray Dryer B-90 Basic**



For aqueous solutions; includes complete set-up with spray head, heater, electrical particle collector, glassware and all necessary hosing.

Order no. 11055320

**Nano Spray Dryer B-90 Advanced**



Ready to work with organic solvents in combination with the Inert Loop B-295; includes complete set-up, solvent resistant tubings, inert gas regulation and oxygen safety measure.

Order no. 11055321

**Inert Loop B-295**



Cooling unit for safe operation with solvents in closed mode configuration with the B-90 Advanced version; works as trolley on wheels, has pressure control and oxygen gas monitoring, electrical communication with the B-90.

	Order no.
230 V, 50 Hz	<u>044701</u>
230 V, 60 Hz	<u>046344</u>
200 V, 50 Hz	<u>044779</u>
200 V, 60 Hz	<u>046345</u>

**Dehumidifier B-296**



The ideal instrument for reproducible inlet air conditioning or condensation of water in closed loop configuration.

	Order no.
230 V, 50/60 Hz	<u>040188</u>
200 V, 50/60 Hz	<u>040181</u>

## Accessories – maximum flexibility

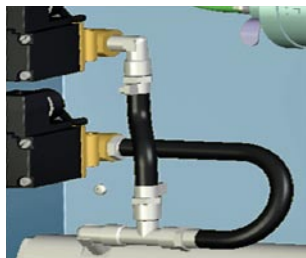
**Aspirator with inlet filter**



Corrosion resistant aspirator to generate the drying gas in open mode or to recirculate the gas in closed mode. Glass fiber filter to prevent contamination of inlet air by any kind of particles from the environment.

Order no. 11055325

**Upgrade set closed cycle**



Sets for closed loop operation with inert gas ( $N_2$  and  $CO_2$ ). Upgrade set Nano Spray Dryer B-90 Basic to Advanced

Order no.	<u>11055748</u>
Upgrade set Inert Loop B-295	
Order no.	<u>051783</u>
Upgrade set Dehumidifier B-296	
Order no.	<u>051780</u>

**Air maintenance unit**



Maintenance unit for clean and oil-free compressed air. Consists of an activated carbon filter, fine particle filter and water separator.

Order no. 004366

**Trolley**



Sturdy trolley for mobile and flexible installation of the Nano Spray Dryer B-90 in the lab. The shelf board offers space to place accessories e.g. the aspirator with inlet filter.

Order no. 041257

**Spray cylinder**



Spray cylinder with sideways flange for spray head installation. For spray drying of temperature sensitive samples and minimal sample quantities with spray caps 4.0 and 5.5  $\mu m$ .

Order no. 051511

**Glass cylinder**



Glass cylinder to elongate the drying section. Suitable to dry bigger droplets (5.5 and 7.0  $\mu m$  mesh) of aqueous samples and higher solvent throughput up to 200 ml/h.

Order no. 051549

**Particle scraper**



Manual cleaning tool for efficient particle recovery from the electrical particle collector.

Order no. 11055338

**Particle collecting paper**



Weighing paper in A4 format for simple particle collection.

Order no.  
Block with 100 pages 11055339

## Spray head



Spray head for vertical and angular positioning in the spray cylinder. Ready to use with the 4.0, 5.5 and 7.0  $\mu\text{m}$  mesh sizes for different applications.

	Order no.
Spray head	051510
Spray head holder	051508

## Spray caps



High-precision spray meshes embedded in handy spray caps.

	Order no.
Set of 3 Spray caps	
4.0 $\mu\text{m}$	051747
Set of 3 Spray caps	
5.5 $\mu\text{m}$	051748
Set of 3 Spray caps	
7.0 $\mu\text{m}$	051749

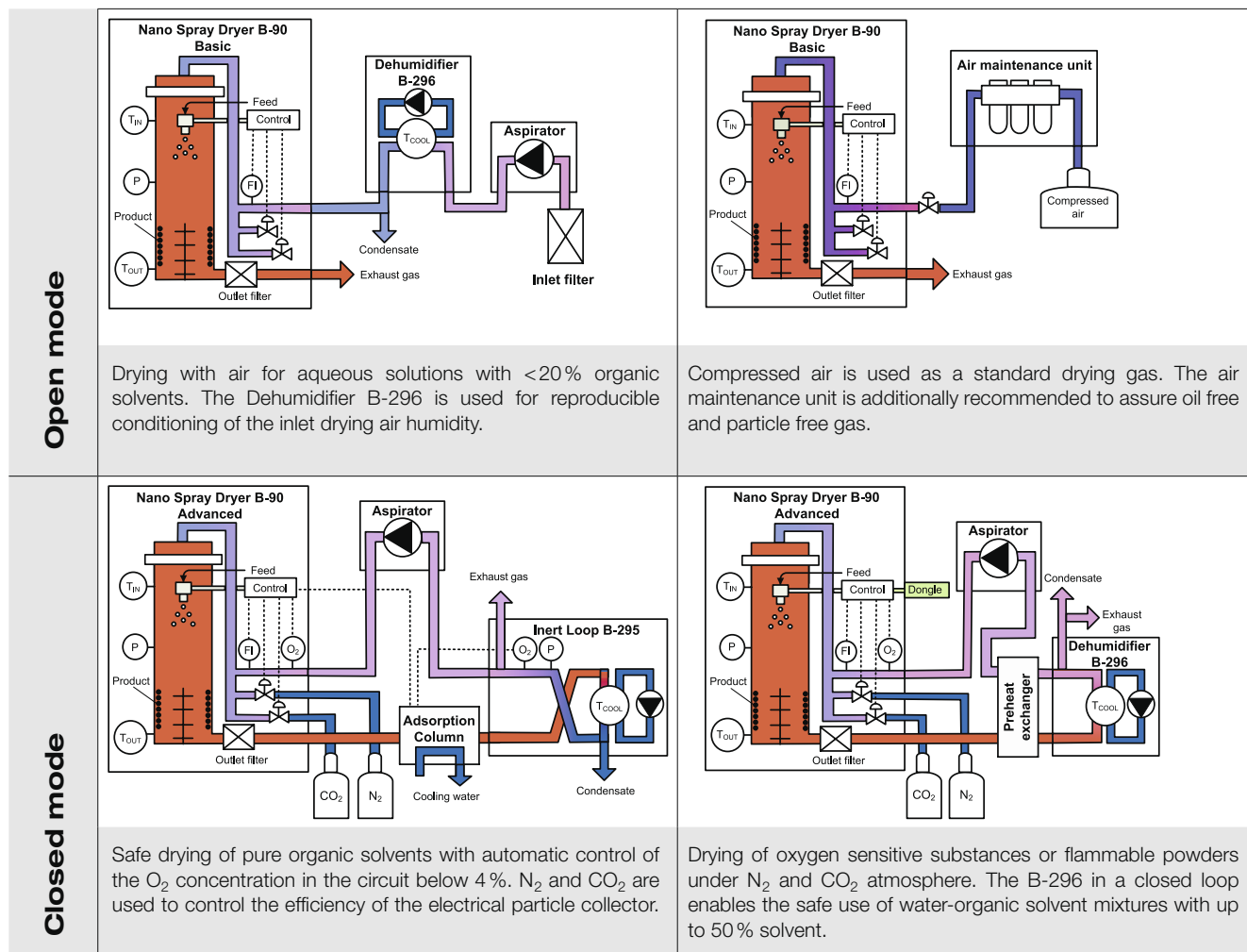
## Stand plate



Height adjustable stand plate as holder for sample vessel and magnetic stirrer.

Order no.	051775
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# Nano Spray Dryer B-90 system configurations



The following organic solvents have been tested:

- Methanol, ethanol, propanol
- Acetone, dichloromethane, toluene, ethylacetate
- For water, the use of the B-296 is recommended

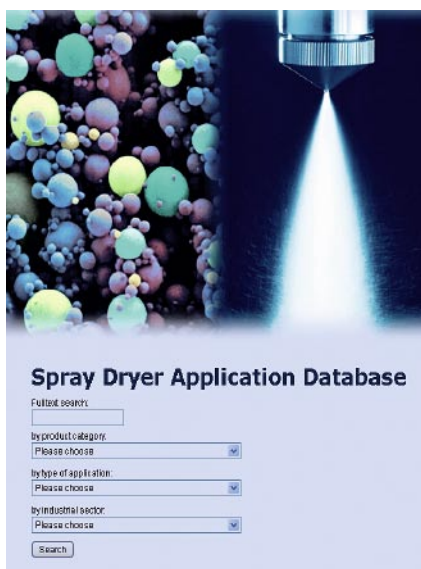
# Spray dryer application test center – competence in the lab

With over 30 years of experience, Buchi is the expert in both lab-scale spray drying and spray chilling processes with the innovative Mini Spray Dryer B-290 and Nano Spray Dryer B-90 systems and their full complement of accessories.



## Are you unsure whether spray drying is the right method for drying your sample?

- Buchi's application experts in our lab offer first-hand advice and service on lab-scale spray drying for fine particles and small sample amounts!
- We do feasibility tests for and with you. Send us your substance, or meet us directly at Buchi's test center.
- Our competent specialists show you directly how to dry your sample. Take the opportunity to discuss process optimization with our application experts.



## We share our experience with you!

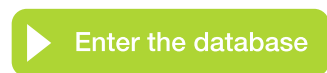
Take advantage of Buchi's new free on-line Spray Dryer Application Database on [www.buchi.com](http://www.buchi.com) to find out if your product has already been spray dried.

The application database features:

- an outstanding and helpful search tool to optimize your spray drying process in a quick and successful way
- a focused knowledge database with over 400 application notes to produce initial trials with small powder quantities





- knowledge pool of R&D pioneers, studies from different market sectors (pharma, biotech, chemicals, food or nanomaterials)

## Already a database user?



Login on [www.buchi.com](http://www.buchi.com)

**Buchi Labortechnik AG is the leading manufacturer of laboratory scale spray dryers and offers the most extensive application expertise obtained over many years. Our partnership with GEA Process Engineering A/S makes scale-up possible and extends the entire process range from the first lab trials to industrial production. Suitable equipment is available for various applications, sample volumes and feed rates.**

	<b>Nano Spray Dryer B-90</b>  <b>BUCHI</b>	<b>Mini Spray Dryer B-290</b>  <b>BUCHI</b>	<b>Mobile Minor™</b>  <b>GEA Niro</b>
<b>Scale-up</b>			
<b>Main benefit</b>	for minimal sample quantities, submicron particles and high yields	for classical spray drying at laboratory scale	the next step pilot plant for scale-up and production
<b>Particle size</b>	300 nm – 5 µm	2 – 25 µm	2 – 80 µm
<b>Typical yield</b>	high, up to 90 %	good, 60 – 70 %	good, 80 %
<b>Evaporation capacity (water)</b>	0.2 kg/h, higher for organic solvents	1.0 kg/h, higher for organic solvents	0.5 – 6.0 kg/h, higher for organic solvents
<b>Sample volume</b>	1 mL – 200 mL	30 mL – 1 L	100 mL – 10 L
<b>Drying gas</b>	up to 10 m <sup>3</sup> /h	up to 35 m <sup>3</sup> /h	80 m <sup>3</sup> /h at 200 °C
<b>Atomization gas</b>	no	0.1 – 1.0 m <sup>3</sup> /h	4 – 25 m <sup>3</sup> /h
<b>Heating power</b>	1.4 kW	2.3 kW	9 kW
<b>Max. inlet temperature</b>	120 °C	220 °C	350 °C
<b>Dimensions (W x H x D)</b>	58 x 110/150 x 55 cm	60 x 110 x 50 cm	250 x 200 x 230 cm
<b>Weight</b>	65/70 kg	48 kg	250 kg
<b>Nozzle types</b>	Spray head (piezo technology, ultrasonic)	two-fluid nozzle with cleaning mechanism	rotary atomizer, two-fluid nozzle, fountain mode
<b>Particle separation principle</b>	Electrostatic particle collector	Cyclone	Cyclone

## Scale-up of spray drying processes

Scale-up is an important aspect in spray drying processes to easily translate results from initial trials in the research lab to full-scale industrial production.

The two leading suppliers of spray drying systems, Buchi Labortechnik AG (laboratory scale) and GEA Process Engineering A/S (industrial scale) collaborate to offer customers their combined and comprehensive expertise.

Based on decades of experience and thousands of installations worldwide we simply help you to scale your spray drying process to any level – easily, efficiently and fast.



# Technical data

## Nano Spray Dryer B-90

Power consumption	max. 1500 W
Connection voltage	100–240 VAC ± 10 %
Frequency	50/60 Hz
Heating capacity	max. 1400 W
Heating control	± 1°C
Max. inlet temperature	120°C
Evaporating capacity	max. 0.2 l/h H <sub>2</sub> O, higher for solvents
Drying gas flow	80–160 l/min
Spray caps (hole diameters)	4 µm, 5.5 µm, 7 µm
Mean droplet size range	8–21 µm
Mean particle size range	300 nm–5 µm
Mean residence time	1–4 sec.
Interface	USB II
Protection rating	IP 42
Pollution degree	2
Environmental conditions	for indoor use only
Temperature	5–40°C
Altitude	up to 2000 m
Humidity	max. relative humidity 80 % for temperatures up to 31 °C, and then linearly decreasing to 50 % at 40 °C
Dimensions (W x H x D)	58 x 110 x 55 cm (short set-up)/58 x 150 x 55 cm (tall set-up)
Weight	65 kg (short set-up)/70 kg (tall set-up)

## Inert Loop B-295

Power consumption	max 1.4 kW
Connection voltage	200–230 V ± 10 %
Frequency	50/60 Hz
Min. outlet temperature	down to –25 °C
Rate of cooling	800 Watt at –10 °C
Dimensions (W x H x D)	60 x 70 x 84.5 cm
Weight	95 kg

## Dehumidifier B-296

Power consumption	700 W
Connection voltage	200–230 V ± 10 %
Frequency	50/60 Hz
Min. outlet temperature	+ 2 °C
Rate of cooling	600 Watt at 0 °C
Dimensions (W x H x D)	35 x 40 x 60 cm
Weight	36 kg

BÜCHI Labortechnik AG  
Postfach  
9230 Flawil 1  
Schweiz  
T +41 71 394 63 63  
F +41 71 394 65 65  
buchi@buchi.com  
www.buchi.com

BÜCHI Labortechnik GmbH  
Postfach 10 03 51  
45003 Essen  
Deutschland  
Freecall 0800 414 0 414  
T +49 201 747 490  
F +49 201 237 082  
deutschland@buchi.com  
www.buechigmbh.de

BÜCHI Labortechnik GmbH  
Branch Office Netherlands  
Postbus 142  
3340 AC Hendrik-Ido-Ambacht  
The Netherlands  
T +31 78 684 94 29  
F +31 78 684 94 30  
netherlands@buchi.com  
www.buchi.nl

BÜCHI Italia s.r.l.  
Centro Direzionale, Milano Fiori  
Pal. A-4, Strada 4  
20090 Assago (MI)  
Italia  
T +39 02 824 50 11  
F +39 02 57 51 28 55  
italia@buchi.com  
www.buchi.it

BUCHI India  
Private Ltd.  
201, Magnum Opus  
Shantinagar Industrial Area  
Vakola, Santacruz (East)  
Mumbai 400 055,  
India  
T +91 22 667 18983 / 84 / 85  
F +91 22 667 18986  
www.buchi.com

BUCHI (Thailand) Ltd.,  
77/121, Sin Sathon Tower,  
28th FL, Unit C  
Krungthoburi Rd.  
Klongtong, Klongsan  
Bangkok 10600  
Thailand  
T +66 2 862 08 51  
F +66 2 862 08 54  
bacc@buchi.com  
www.buchi.com

BUCHI Corporation  
19 Lukens Drive, Suite 400  
New Castle  
Delaware 19720  
USA  
T +1 302 652 3000  
F +1 302 652 8777  
Toll Free: +1 877 692 8244  
us-sales@buchi.com  
www.mybuchi.com

BUCHI Hong Kong Ltd.  
14<sup>th</sup> Floor South China Building  
1-3 Wyndham Street  
Central, Hong Kong  
China  
T +852 2389 2772  
F +852 2389 2774  
china@buchi.com  
www.buchi.com.cn

BUCHI Shanghai Trading LLC  
21/F Shanghai Industrial  
Investment Building  
18 Caoxi Bei Road  
200030 Shanghai  
China  
T +86 21 6468 1888  
F +86 21 6428 3890  
china@buchi.com  
www.buchi.com.cn

BUCHI UK Ltd  
5 Whitegate Business Centre  
Jardine Way  
Chadderton  
Oldham OL9 9QL  
United Kingdom  
T +44 161 633 1000  
F +44 161 633 1007  
uk@buchi.com  
www.buchi.co.uk

BUCHI Sarl  
5, rue du Pont des Halles  
Z.A. du Delta  
94656 Rungis Cedex  
France  
T +33 1 56 70 62 50  
F +33 1 46 86 00 31  
france@buchi.com  
www.buchi.fr

Nihon BUCHI K.K.  
3F IMON Bldg.,  
2-7-17 Ikenohata, Taito-ku,  
Tokyo 110-0008  
Japan  
T +81 3 3821 4777  
F +81 3 3821 4555  
nihon@buchi.com  
www.nihon-buchi.jp

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