



Freeze Drying in the laboratory

Solutions from the market leader in lab evaporation

As market leader in laboratory evaporation, BUCHI offers the first laboratory Freeze Dryer with Infinite-Technology™ and Infinite-Control™. The applications range from research and development to quality control within a broad spectrum of market segments. The BUCHI solutions are distinguished by efficiency and practical capability.



Core messages to our customers

BUCHI creates added value with “Quality in your hands”

“Quality in your hands” is the guiding principle that shapes our philosophy and our actions. It challenges us to provide outstanding services that are precisely tailored to your needs. This means that we must stay in close contact with our customers. That is why we keep in touch and continue to work very hard to understand you and your business even better.

We help you by providing high-quality products, systems, solutions, applications and services that offer you added value. This allows you to focus entirely on your processes and your work.



Easy

You handle complex processes, do challenging work and want to focus on what is essential. We support you by providing carefully designed solutions as well as instruments and systems that are easy to operate.



Competent

You need products, systems, solutions, applications and services that are precisely tailored to your needs. We have the technological expertise and decades of experience needed to provide competent support and work with you to continually improve our market services.



Reliable

You want to be able to rely completely on your partner for products, systems, solutions, applications and services. We guarantee the quality and functionality of our equipment and will continue to help you quickly and efficiently whenever something does not operate to your satisfaction.



Cost-effective

You want to achieve the best possible results using efficient solutions. We help you to handle your jobs and processes economically. We strive to create a high level of economic benefit and maximum added value for you.



Safe

You are working in an environment in which safety is a high priority. By collaborating closely with you, we do everything in our power to make our products, systems, solutions, applications and services as safe as possible for people and the environment.



Global

You value personalized service and short communication channels. As an international family-owned business with our own subsidiaries and qualified distributors, we have a presence wherever our customers are located. Our local staff and the large number of satisfied customers around the world give you the assurance that you are working with the right partner.



Sustainable

You prefer a partner who acts responsibly when it comes to current environmental challenges. We support environmentally friendly processes and manufacture products that have a long service life. We utilize advanced technologies in order to conserve energy and water and leave the smallest environmental footprint possible.



Freeze Drying with Infinite-Technology™ and Infinite-Control™

Maximum control and unlimited capacity

Convenience with Infinite-Control™

Maximum control of your Freeze Dryer anywhere and anytime



Control of Lyovapor™

- All process parameters at a glance
- Safety due to sample protection state
- End point detection possible



Control at your work station

- Data recording and customized reporting possible
- Quick design, easy handling and starting methods
- Real time process schematic and diagram



Monitor anywhere, anytime

- Remote monitoring on mobile device
- Stay informed with push notifications
- Track several BUCHI products at the same time

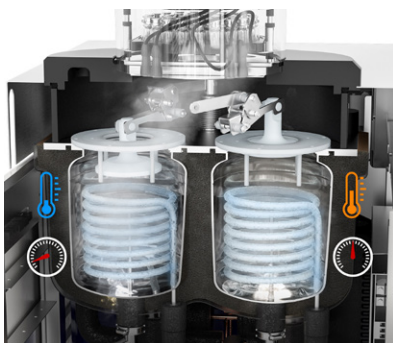
Efficiency with Infinite-Technology™

The first dual condenser Freeze Drying system for unlimited capacity



Technology with two condensers

- Infinite ice capacity, due to alternating condenser loading
- Stable pressure with Smart-Switch
- Lyophilization of water and organic based solvents allows for sample flexibility -105 °C



Technology to save time and cost

- Automated, hygienic steam cleaning
- Overcome down time due to ready to use condensers
- Less energy consumption due to smaller condensers



Technology with high flexibility

- Be prepared for increasing sample volume
- Upgradeable system (Interface, Software, T and P sensors)
- Various drying chambers allows for sample flexibility



Innovative solutions for Freeze Drying in the laboratory

From standard application to unlimited ice capacity

BUCHI has been producing user-friendly and highly beneficial solutions in the area of laboratory evaporation for more than 55 years. Those decades of experience and high quality demands feed directly into innovative solutions for Freeze Drying. For the first time, continuous Freeze Drying is available to a broad spectrum of applications from research and development to quality control in a wide variety of market segments.

Pharmaceutical



For various applications in QC as well as laboratory scale synthesis and formulation in R&D departments

- Drying of peptides, proteins of amorphous and crystalline solutions

Biotechnology



Used in biotechnology development for drying biologically active products:

- Drying and stabilization of small quantities in micro titer plates or small flasks

Education



For a wide range of applications in academic education

- Complete temperature sensitive drying

Chemical



For gentle and lossless drying in QC and R&D laboratories

- Drying of most minute quantities in micro titer plates as well as small and large flasks or bulk drying is possible

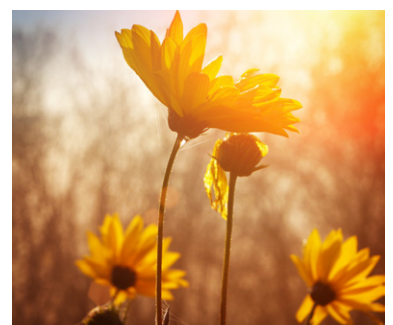
Foods / Natural extracts



Used for developing functional food and analytics

- Solvent is removed during drying without destroying the natural substances such as proteins, minerals or vitamins

Environmental Analysis



Required for sample preparation and stabilization to monitor environmental pollution

- During storage of samples in order to destroy micro-organisms
- Drying, e.g. for SpeedExtractor

BUCHI laboratory Freeze Drying for your specific needs

BUCHI offers two different platforms for Freeze Drying, the Lyovapor™ L-300 and L-200. Based on those platforms the individual solution can be specifically and precisely adapted to the various requirements in order to achieve the greatest possible efficiency.

	Continuous Freeze Drying		Traditional Freeze Drying	
Solutions by BUCHI	Lyovapor™ L-300 Pro «Modular»	Lyovapor™ L-300 «Continuous»	Lyovapor™ L-200 Pro «Control»	Lyovapor™ L-200 «Classic»
Process				
Information anytime, anywhere	●	●	●	●
Drying with methods	●		●	
Vacuum control		●		●
Automatic cleaning without stopping	●	●		
Solvent				
Commonly used organic solvents	●	●		
Water based solvents	●	●	●	●
Characteristics				
Condenser temperature	-105 °C	-105 °C	-55 °C	-55 °C
Sample throughput	Infinite	Infinite	Max. 6 L	Max. 6 L
Maximum sublimation	12 kg / 24 h	12 kg / 24 h	6 kg / 24 h	6 kg / 24 h
Automatic cleaning without stopping	●	●		
Drying chambers				
Heated shelves/ Stoppering	●		●	
Manifold rack/ Non-heated shelves		●		●
Applications				
Vial drying	●		●	
Manifold drying		●		●
Bulk drying	●		●	
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Solution «Lyovapor™ L-300 Pro Modular» For your larger volume demands

Looking for a device that is always ready to use, that carries easy and verifiable methods and does not have to be cleaned afterwards? Our «Lyovapor™ L-300 Pro Modular» solution offers fully automated execution of methods, data logging and chart recording in real time, plus automatic hygienic cleaning of the ice condenser.

Pirani gauge



Integrated vacuum control



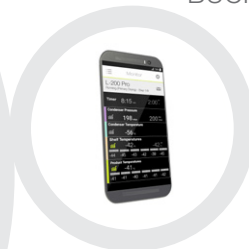
Capacitive gauge



Vacuum pump Duo 11



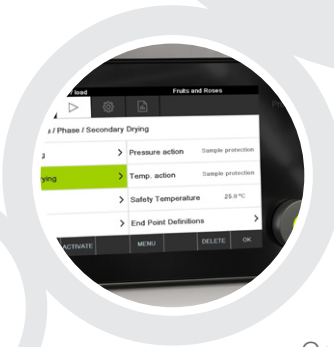
BUCHI Monitor App



Lyovapor™ L-300
-105 °C / ∞ kg



Drying chamber



Control unit Pro



Software

Your most important benefits

Convenient

- User-friendly and clearly arranged touch-screen control panel
- Timer-controlled, programmable methods (pressure and product temperature)
- User-friendly software for creating and managing methods, data recording and reporting
- Push notifications on mobile devices for process status

Reproducible

- Comprehensive logging of important process parameters on SD card
- Sample end-point determination
 - Temperature difference test
 - Pressure difference test
 - Pressure rise test
- Reproducible process due to stable parameters
 - Cooling temperature -105 °C
 - Shelf temperature variation ± 1 °C
 - Vacuum pressure

Economical

- Always ready to use due to dual condensers
- Fully automatic, hygienic cleaning of ice condensers
- Drying chamber enables stoppering under atmospheric conditions using inert gas

Your solution «Lyovapor™ L-300 Pro Modular»



- Condenser: Lyovapor™ L-300
- Control unit: Interface Pro
- Software
- Vacuum pump: Duo 11
- Vacuum regulation by sensors
- Connection of additional external vacuum sensors possible
- Choice of several drying chambers and heated shelves

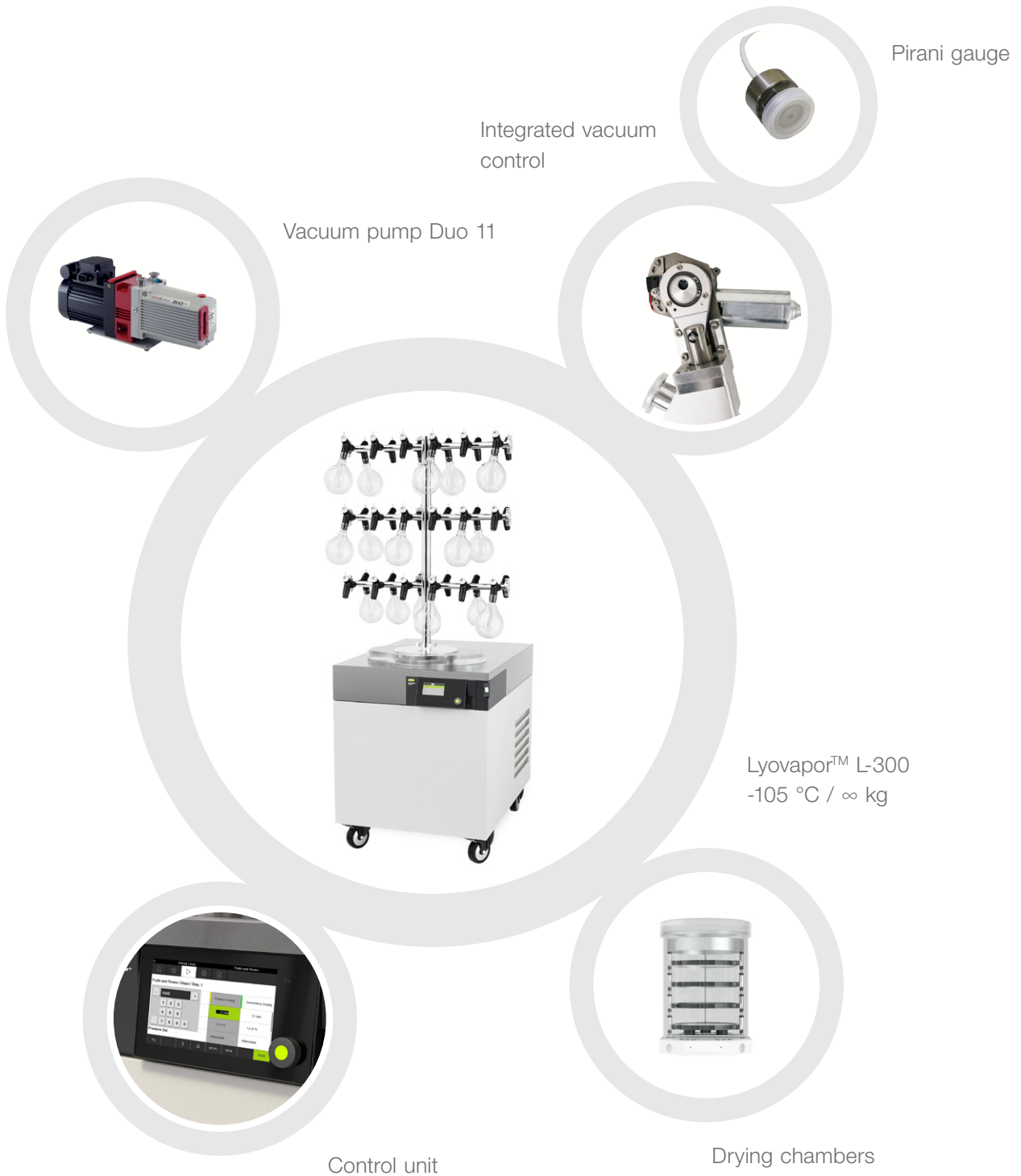


- Application support
- Method support
- Training workshops
- Service hotline
- Preventive maintenance
- GMP-compliant components
- Service and documentation (IQ/OQ)



Solution «Lyovapor™ L-300 Continuous» Convenient with unlimited sublimation capacity

Looking for a device that is permanently ready to use, delivers infinite ice capacity, can be used by several people at once and does not have to be cleaned? Our «Lyovapor™ L-300 Continuous» solution offers essential Freeze Drying for water and organic based solvents regardless of how large your sample throughput will be in future.



Your most important benefits

Efficient

- Dual condensers for unlimited ice loading
- Reproducible process due to stable parameters
 - Cooling temperature -105 °C
 - Vacuum pressure
- Sublimation of water and organic based solvents
- Constantly ready to use; never requires cleaning

Economical

- Save electricity by using a smaller vacuum pump
- Infinite sublimation capacity
- Just one device needed for different users

Convenient

- Process parameters can be checked anytime, anywhere using the BUCHI Monitor App
- Automatic hygienic steam-cleaning
- Maximum flexibility regarding display positioning (at front or side)

Your solution «Lyovapor™ L-300 Continuous»



- Condenser: Lyovapor™ L-300
- Control unit: Interface
- Vacuum pump: Duo 11
- Vacuum regulation by sensors
- Possibility of additional external vacuum sensors
- Choice of several drying chambers



- Application support
- Training workshops
- Service hotline
- Preventive maintenance
- GMP-compliant components
- Service and documentation (IQ/OQ)



Solution «Lyovapor™ L-200 Pro Control» Freeze Drying for advanced configurations

Looking for a compact unit for high-quality Freeze Drying with a high level of automation? Our «Lyovapor™ L-200 Pro Control» solution offers easy method creation, fully automated process, data logging and chart recording in real time.

Pirani gauge



Capacitive gauge



Vacuum regulator



Vacuum pump Duo 6



BUCHI Monitor App



Lyovapor™ L-200
-55 °C / 6 kg



Drying chambers

Control unit Pro



Software



Your most important benefits

Convenient

- User-friendly touch-screen control panel shows all process parameters at a glance
- Easily programmable methods and reports (time-dependent control of vacuum pressure and product temperature)
- Pressure and product temperature data recorded in real time
- Push-notifications on mobile devices to decide if manual intervention is required

Economical

- Cost-effective system for advanced Freeze Drying
- Space-saving due to compact design
- Drying chamber enables stoppering under inert atmosphere
- Simple cleaning

Reproducible

- Comprehensive logging of important process parameters to SD card or software
- Reproducible process due to stable parameters
 - Cooling temperature
 - Shelf temperature variation ± 1 °C
 - Vacuum pressure

Your solution «Lyovapor™ L-200 Pro Control»



- Condenser: Lyovapor™ L-200
- Control unit: Interface Pro
- Software
- Vacuum pump: Duo 6
- Vacuum regulation by sensors
- Connection of additional external vacuum sensors possible
- Choice of several drying chambers and heated shelves



- Application support
- Method support
- Training workshops
- Service hotline
- Preventive maintenance
- GMP-compliant components
- Service and documentation (IQ/OQ)



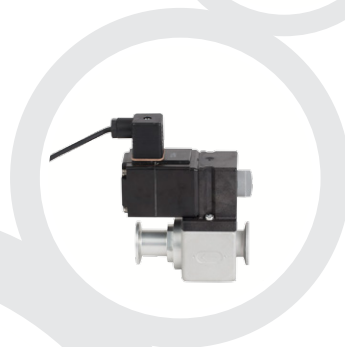
Solution «Lyovapor™ L-200 Classic» Freeze Drying for essential requirements plus control

Looking for an economical, complete and high-quality Freeze Drying solution that can be upgraded? A 6 kg/-55 °C condenser, control unit, vacuum pump and vacuum regulation, our «Lyovapor™ L-200 Classic» efficiently covers the main requirements of Freeze Drying.

Pirani gauge



Vacuum regulator



Vacuum pump Duo 6



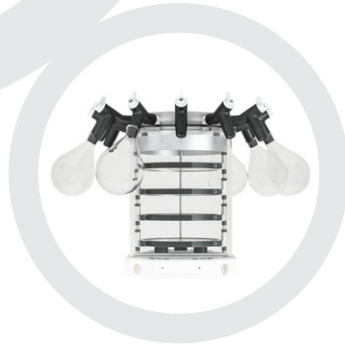
BUCHI Monitor App



Lyovapor™ L-200
-55 °C / 6 kg



Control unit



Drying chambers

Your most important benefits

Economical

- Cost-effective system for daily needs
- Modular platform; further upgrades are possible
- Space-saving – can be set up on the bench or on the trolley

Efficient

- Fast cooling and pressure regulation
- Semi automated cleaning due to electronic drain valve
- Reproducible process due to stable parameters
 - Cooling temperature
 - Vacuum pressure

Convenient

- Simple operation due to guided process
- Status messages on process and service intervals
- Process can be checked anytime, anywhere using the BUCHI Monitor App

Your solution «Lyovapor™ L-200 Classic»



- Condenser: Lyovapor™ L-200
- Control unit: Interface
- Vacuum pump: Duo 6
- Vacuum regulation by sensors
- Connection of additional external vacuum sensors possible
- Choice of several drying chambers



- Application support
- Training workshops
- Service hotline
- Preventive maintenance
- GMP-compliant components
- Service and documentation (IQ/OQ)

The best solution for your need

Product comparison based on your needs and applications



Needs / Solutions	Page	Ice condenser		Control unit		Software
		L-300	L-200		Pro	Optional
«Lyovapor™ L-300 Pro Modular»	8	●			●	●
«Lyovapor™ L-300 Continuous»	10	●		●		
«Lyovapor™ L-200 Pro Control»	12		●		●	●
«Lyovapor™ L-200 Classic»	14		●	●		

Ice condenser Performance

Temperature	-105 °C	-55 °C			
Maximum sublimation	12 kg / 24 h	6 kg / 24 h			
Ice capacity	Infinite	6 kg			

Characteristics

Heated shelves up to 60 °C (±1 °C)				●	●
Product temperature control (Pt1000)				●	●
Pressure control by Pirani gauge			●	●	●
Pressure control by capacitive gauge				●	●

End point determination by

Temperature difference test $T_{shelf} \approx T_{product}$	●	●		●	●
Pressure difference test $P_{capacitive} \approx P_{pirani}$	●			●	●
Pressure rise test	●			●	●

Operation

Drying of organic based samples	●		●	●	
Drying of water based samples		●	●	●	
Drying status via App			●	●	
Methods and reporting				●*	●

*Data can be saved to SD card



Drying chambers

Vacuum pump

Duo 11 Duo 6

•	•				•		«Lyovapor™ L-300 Pro Modular»
				•	•		«Lyovapor™ L-300 Continuous»
•	•					•	«Lyovapor™ L-200 Pro Control»
		•	•	•		•	«Lyovapor™ L-200 Classic»

Ice condenser Performance

							Temperature
							Maximum sublimation
							Ice capacity

Characteristics

•	•						Heated shelves up to 60 °C (±1 °C)
•	•						Product temperature control (Pt1000)
•	•	•	•	•			Pressure control by Pirani gauge
•	•						Pressure control by capacitive gauge

End point determination by

•	•						Temperature difference test $T_{shelf} \approx T_{product}$
•	•						Pressure difference test $P_{capacitive} \approx P_{pirani}$
•	•						Pressure rise test

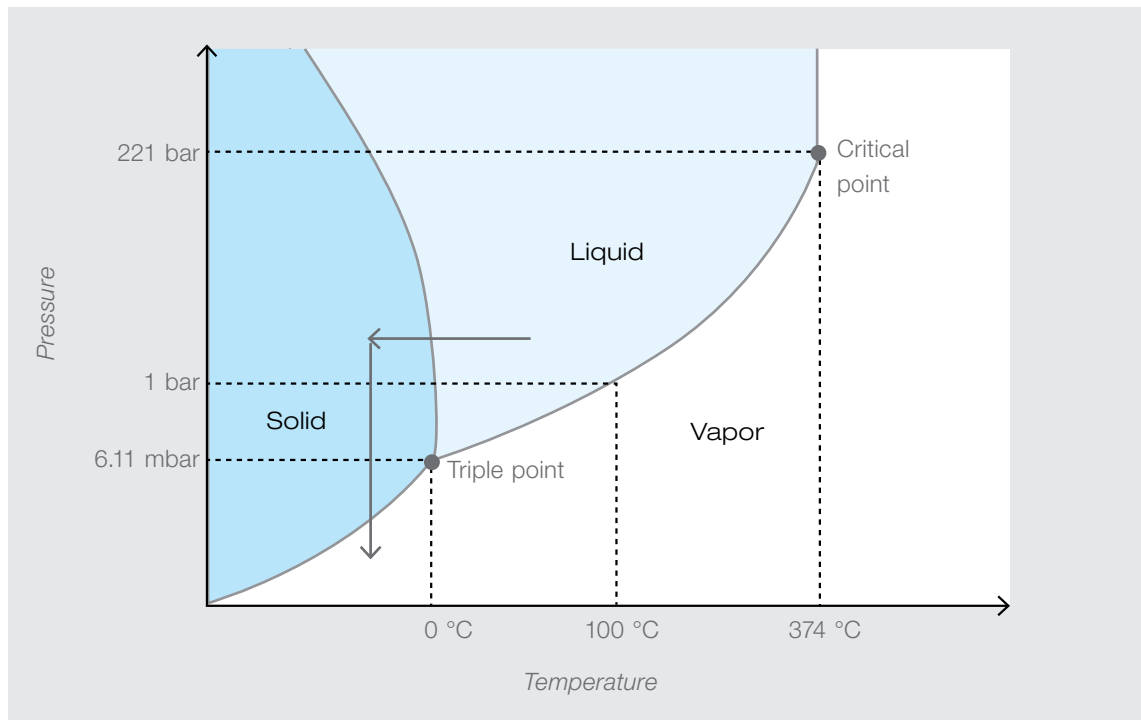
Operation

				•			Drying of organic based samples
•	•	•	•	•			Drying of water based samples
							Drying status via App
•	•						Methods and reporting

BUCHI Freeze Drying solution

Functional principle

Freeze Drying or Lyophilization is a gentle drying process that is particularly suitable for heat-sensitive, high-value products. The drying process involves first freezing the liquid formulation, usually a water-based solution, and then removing the frozen solvent by sublimation at a low temperature and pressure. Low temperature is required for sublimation to occur. The dependence of the states of matter and phase transitions on pressure and temperature can be illustrated by a phase diagram.

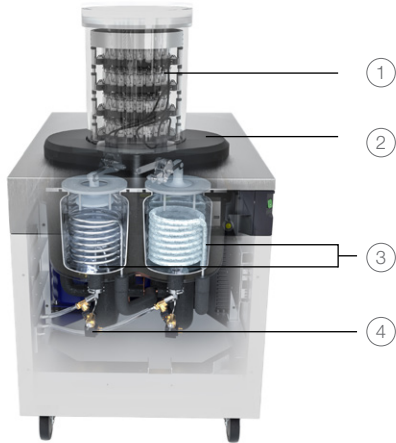


The Freeze Drying of water-based formulations is physically enabled by the fact that water still possesses an adequately high vapor pressure in its frozen state. That vapor pressure is 6.11 mbar (= 6.11 hPa) at the triple point. That means that between ice and the surrounding atmosphere, i.e. between the solid and gaseous phases, there is still a lively exchange of water molecules taking place. If the water vapor molecules passing over into the gaseous phase are then removed by condensation on cooling surfaces, as occurs in a freeze-dryer, the quantity of ice continually diminishes. In order to maintain the process of sublimation drying, heat losses have to be counterbalanced by heat input. This heat input is achieved by temperature regulated shelves, where the product is housed.

A typical Freeze Drying process can be subdivided into three phases – freezing, primary drying and secondary drying. In a well-controlled Freeze Drying process, the temperature of the product is kept low enough throughout the entire process to prevent structural changes in the dried product matrix that could have a negative effect on the appearance and properties of the end product.

Method of operation

L-300 Continuous Freeze Drying method



- ① Drying chamber with heated and non-heated shelves with stoppering mechanism for dishes or vials. Manifolds can be used for connecting both round flasks or wide-neck flasks.
- ② Valve connecting plate for alternating between the two condenser chambers which enables continuous operation.
- ③ Condenser chambers – one side is regulated to $-105\text{ }^{\circ}\text{C}$ ready for ice loading, while the other side is automatically and hygienically cleaned by means of a steam generator. After a certain time the loaded ice condenser switches over to the empty one.
- ④ Vacuum regulation valve with Pirani gauge
- ⑤ Vacuum pump

L-200 Classic Freeze Drying





- ① Drying chamber with heated and non-heated shelves and stoppering mechanism for drying in dishes or vials. Manifolds can be used for connecting round flasks or wide-neck flasks, etc.
- ② Condenser chamber with ice capacity of 6 kg regulated to $-55\text{ }^{\circ}\text{C}$. After the process, the chamber is defrosted by warm water.
- ③ Optional vacuum regulation valve with Pirani gauge
- ④ Vacuum pump



BUCHI Freeze Drying solution Features

Control Unit

		
	Interface Pro	Interface
«Easy Start» function	●	●
Maintenance menu (vacuum test, oil change interval for vacuum pump displayed)	●	●
Monitoring of ice condenser temperature	●	●
Monitoring of pressure in drying chamber	●	●
Monitoring App	●	●
Method Editor with graphical display	●	
Touch-screen display	●	
Shelf temperature control	●	
Product temperature sensors	●	
SD card	●	
End-point determination	●	
Direct connection to sophisticated software	●	

Software: for more convenience

To create and manage methods and handle data even easier, BUCHI offers the Lyovapor™ software. This software has a graphic method editor, option to import and manage methods easily and records sensor data continuously. The software offers an additional reporting tool.



App: be informed anywhere, anytime

BUCHI offers laboratory users a unique App to keep you informed about the important parameters of the Freeze Drying process.

In combination with the freeze-dryer, it provides updates about the process status by notifications on a smartphone or tablet: time progression, the vacuum in the chamber, the shelf temperature, the condenser temperature and the product temperature.

A smartphone can be connected to all L-300, L-200 or R-300 systems installed on site. The user is able to be informed about the availability of each dryer at anytime, anywhere.



Sensors: more safety for your process


Various optional sensors for monitoring the Freeze Drying process and determining the end point are offered:

- Pirani gauge for pressure measurement
- Capacitive gauge for highly accurate pressure measurement
- RTD thermocouple for precise product temperature measurement



Configurator: get your tailored solution

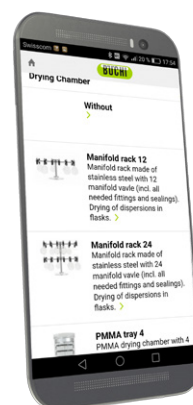
To support you in choosing the correct solution of the Lyovapor™ BUCHI offers a web based configurator. In just a few clicks it will guide you to the proper product for your application.



Lyovapor L-200

The Lyovapor L-200 is an economical and high quality freeze dryer for classical applications with -55 °C and 6 kg condenser capacity. It can be bundled with non heated drying chambers for your needs.

[Configure >](#)



www.buchi.com/Lyovapor_configurator

Filling capacity of vials and positioning of temperature sensor

The following points should be observed when drying formulations in vials:

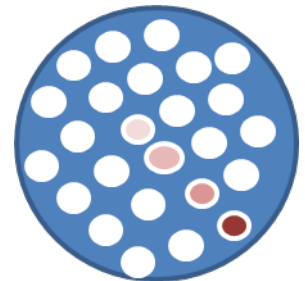
- Choose a vial size such that the product depth does not exceed 2 cm. Usual filling depths are approx. 1 cm.
- The sublimation front in the product migrates from top to bottom, i.e. above the ice boundary surface is the dried product and underneath it is the frozen product containing ice crystals that have not yet been sublimated.
- Sublimated ice molecules migrate through the dried product from bottom to top in the course of the drying process.
- For precise determination of the end point, the product sensor should be placed in the centre of the vial near the bottom.



Heat distribution across drying shelves

The BUCHI drying shelves have very accurate heat distribution to within ± 1 °C across the entire shelf. Nevertheless, the vials on the outside of the shelves dry more quickly than those in the middle. The reason is the ambient heat input through the acrylic dome. This can be minimized by a protective jacket. Accordingly, it is advisable to place the temperature sensor for determining the end point in a vial in the middle of the drying shelf.

However, it is also important to be aware that the thermocouple transmits additional heat to the product. Therefore, extending the drying time by between 30 min and 2 hrs depending on the product is recommended in order to ensure that all ice is removed from the entire batch.



Vacuum pump service interval

The inspection window of the rotary vane pump should be checked every 24 hours. If a change in the colour of the oil is discernible, it is advisable to change the oil. Normally, the oil in the rotary vane pump is changed every 500 hrs. After every 1,000 hours of duty it is advisable to check and clean the motor fan grille, the gas ballast valve and the pump as a whole. The slide valve should be replaced every 10,000 hours of duty.



Methods for determining the end point of primary drying

Comparative pressure measurement between a capacitive pressure gauge and a Pirani sensor can define the endpoint. Whereas the capacitive pressure gauge functions independently of the gas type and always indicates the true pressure in the drying chamber, the Pirani sensor is calibrated to a specific gas and measures only relative figures according to gas type. Calibrated to N_2 , the Pirani sensor indicates higher values than the capacitive pressure gauge in response to the presence of water molecules in the chamber. As the concentration of water molecules decreases, the detected value of the Pirani sensor reading progressively becomes closer to that of the capacitive pressure gauge until they become equal at the end point.



Pressure rise test is accomplished by closing the valve between the product and condenser chambers. When the two chambers are isolated, the pressure in the product chamber rises due to the on-going sublimation of the water molecules. The pressure rise curve progressively levels off as the water molecule concentration decreases. The end point is the point at which no further pressure rise is discernible.

Stopping to close your vials under required conditions

The height of the shelves in the BUCHI top-mounted Freeze Drying rack is adjustable in a wide range. That enables the use of a unique stoppering system for all shelf drying racks. The system has a self-sealing mechanism and stoppering can be achieved under vacuum and ambient pressure conditions even with inert gas. In contrast to conventional systems, the shelves therefore do not need a hole in the middle of the round shelves.



Cleaning and waste-water handling

Cleaning of the double condensers is carried out automatically when fully loaded. Thus, that the waste water is directly discharged into a drain or collecting vessel. There is a fill level sensor in the collecting vessel that informs the user when the vessel needs to be emptied.

Drying chambers



The Lyovapor™ has a large choice of drying chambers that can be used in any combination

Software



The sophisticated Lyovapor™ software offers an easy way of controlling and monitoring the Freeze Drying process and generating reports.

Sensors



There is a choice of product temperature sensors, vacuum sensors and vacuum valves for expanding the Lyovapor™.

Trolley



The Lyovapor™ has a trolley for setting up the unit next to a laboratory bench.

Various accessories



BUCHI offers a variety of glassware and other accessories to meet your everyday laboratory needs.

Vacuum pumps



A stable and high-quality upright vacuum pump makes everyday Freeze Drying much easier.

Laboratory Rotavapor®



The Rotavapor® R-300 is a comprehensive rotary evaporation solution for lab-scale applications up to 5 liter flasks.

Spray Drying



The Mini Spray Dryer B-290 is the instrument of choice for the quick and gentle drying to powder of liquid solutions.

Extraction units



The SpeedExtractor E-914 and E-916 excels in pressurized extraction for residue and contaminant determination in food, soils or consumer products.

Encapsulator



Immobilize flavors & fragrances, vitamins or oils using the Encapsulator B-390 and B-395 Pro.

Parallel evaporation



The Syncore® Analysts R-6 / R-12 evaporates extracts to pre-defined residual volumes. Optionally, it combines SPE clean-up with concentration of the elutes.

Separation & purification



The combined UV and ELS detection technology and advanced signal processing recognizes previously undetectable compounds. This enables optimized fraction collection without losing any compounds.



Support and customer service

From feasibility to preventive maintenance

You value an efficient and personalized service. Our network of professional application specialists and service technicians as well as a large number of satisfied customers around the world give you the assurance that you are working with the right partner.



Improve your applications

A team of highly qualified specialists continuously improve reference applications. The corresponding application notes include a detailed description of the entire procedure. A comprehensive list of applications is available on our website.

Find out more about our applications:
www.buchi.com/applications



Learn about freeze drying

As market leader in laboratory evaporation, BUCHI offers the first laboratory Freeze Dryer with Infinite-Technology™ and Infinite-Control™. Learn more and watch the Lyovapor™ video.

Find out more:
www.buchi.com/freeze-drying



Profit from workshops, trainings and seminars

We regularly offer practical seminars and workshops, often in cooperation with other partners in the field of sample preparation and analysis. Customer contributions thereby underline how our solutions facilitate the daily routine. We also attend many local and international scientific and industrial congresses.

Find an overview of our activities:
www.buchi.com/events



Use your product most effectively

We help you to set your product properly into operation. We provide thorough Installation/Operation Qualification (IQ/OQ) services to ensure compliance with FDA, GLP/GMP standards or GAMP guidelines. Whether it is because of an initial installation, requalification or relocation, we provide professional compliance verification.

Find out more about our services:
www.buchi.com/service-support



Minimize downtimes

Avoid products' downtimes with preventative maintenance and tailored service packages. We offer a product warranty of two years and guarantee ten years of spare parts availability.

Get in touch with us:
www.buchi.com/warranty



Global Network

Our subsidiaries and qualified distribution partners ensure proximity where ever you are. Since we are familiar with your requirements, we use our experience and knowledge to provide first-rate solutions.

Get in touch with us:
www.buchi.com/worldwide

BUCHI Affiliates:

Europe

Switzerland/Austria

BÜCHI Labortechnik AG
CH – 9230 Flawil
T +41 71 394 63 63
F +41 71 394 64 64
buchi@buchi.com
www.buchi.com

Benelux

BÜCHI Labortechnik GmbH
Branch Office Benelux
NL – 3342 GT Hendrik-Ido-Ambacht
T +31 78 684 94 29
F +31 78 684 94 30
benelux@buchi.com
www.buchi.com/bx-en

France

BUCHI Sarl
FR – 94656 Rungis Cedex
T +33 1 56 70 62 50
F +33 1 46 86 00 31
france@buchi.com
www.buchi.com/fr-fr

Germany

BÜCHI Labortechnik GmbH
DE – 45127 Essen
T +800 414 0 414 0 (Toll Free)
T +49 201 747 49 0
F +49 201 747 49 20
deutschland@buchi.com
www.buchi.com/de-de

Italy

BUCHI Italia s.r.l.
IT – 20010 Cornaredo (MI)
T +39 02 824 50 11
F +39 02 575 12 855
italia@buchi.com
www.buchi.com/it-it

Russia

BUCHI Russia/CIS
Russia 127287 Moscow
T +7 495 36 36 495
russia@buchi.com
www.buchi.com/ru-ru

United Kingdom

BUCHI UK Ltd.
GB – Oldham OL9 9QL
T +44 161 633 1000
F +44 161 633 1007
uk@buchi.com
www.buchi.com/gb-en

Germany

BÜCHI NIR-Online
DE – 69190 Walldorf
T +49 6227 73 26 60
F +49 6227 73 26 70
nir-online@buchi.com
www.nir-online.de

America

Brazil

BUCHI Brasil Ltda.
BR – Valinhos SP 13271-200
T +55 19 3849 1201
F +55 19 3849 2907
brasil@buchi.com
www.buchi.com/br-pt

USA/Canada

BUCHI Corporation
US – New Castle, DE 19720
T +1 877 692 8244 (Toll Free)
T +1 302 652 3000
F +1 302 652 8777
us-sales@buchi.com
www.buchi.com/us-en

Asia

China

BUCHI China
CN – 200052 Shanghai
T +86 21 6280 3366
F +86 21 5230 8821
china@buchi.com
www.buchi.com/cn-zh

India

BUCHI India Private Ltd.
IN – Mumbai 400 055
T +91 22 667 75400
F +91 22 667 18986
india@buchi.com
www.buchi.com/in-en

Indonesia

PT. BUCHI Indonesia
ID – Tangerang 15321
T +62 21 537 62 16
F +62 21 537 62 17
indonesia@buchi.com
www.buchi.com/id-in

Japan

Nihon BUCHI K.K.
JP – Tokyo 110-0008
T +81 3 3821 4777
F +81 3 3821 4555
nihon@buchi.com
www.buchi.com/jp-ja

Korea

BUCHI Korea Inc.
KR – Seoul 153-782
T +82 2 6718 7500
F +82 2 6718 7599
korea@buchi.com
www.buchi.com/kr-ko

Malaysia

BUCHI Malaysia Sdn. Bhd.
MY – 47301 Petaling Jaya,
Selangor
T +60 3 7832 0310
F +60 3 7832 0309
malaysia@buchi.com
www.buchi.com/my-en

Singapore

BUCHI Singapore Pte. Ltd.
SG – Singapore 609919
T +65 6565 1175
F +65 6566 7047
singapore@buchi.com
www.buchi.com/sg-en

Thailand

BUCHI (Thailand) Ltd.
TH – Bangkok 10600
T +66 2 862 08 51
F +66 2 862 08 54
thailand@buchi.com
www.buchi.com/th-th

BUCHI Support Centers:

South East Asia

BUCHI (Thailand) Ltd.
TH-Bangkok 10600
T +66 2 862 08 51
F +66 2 862 08 54
bacc@buchi.com
www.buchi.com/th-th

Middle East

BÜCHI Labortechnik AG
UAE – Dubai
T +971 4 313 2860
F +971 4 313 2861
middleeast@buchi.com
www.buchi.com

Latin America

BUCHI Latinoamérica S. de R.L. de C.V.
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