

Laboratory and Pilot Freeze Dryers
Advanced Processes

CHRIST ®
*Freeze Dryers
Vacuum Concentrators*

Martin Christ Freeze Dryers:
Perfection for First Class Results



Highest level of process-control and reproducibility for rapid, safe freeze drying of your high-quality product.

With 50 years of experience, Martin Christ GmbH is the leading producer of, not only routine-process freeze dryers, but also of a series of product-specific, highly specialized freeze dryers with far reaching potential. This line of equipment is distinguished by its innovative Lyo-Screen-Control (LSC) interface, its exceptional design and the most advanced level of refrigeration and vacuum technology. The freeze dryers are available as laboratory freeze dryers with cylindrical drying chambers and pilot systems with rectangular cross-section drying chambers.

A practical and diverse collection of accessories permits a wide range of tasks.

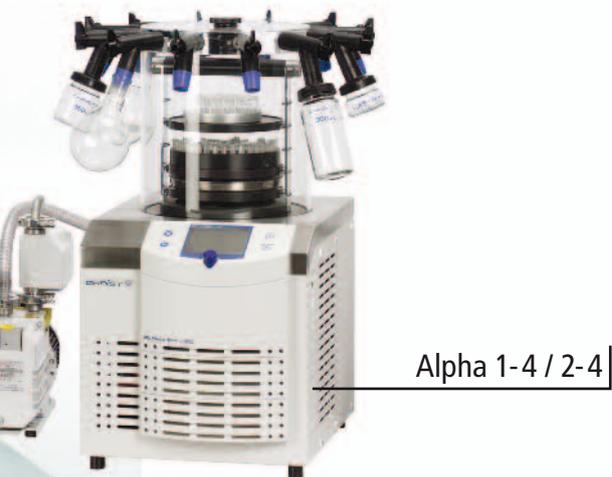
Outstanding products, superior technology and full customer support.

Applying advanced processes to valuable products requires specific system configuration. We offer extensive advice in selecting a system and, on request, will run a freeze-drying test in our applications laboratory.

Martin Christ's high-quality freeze dryers are equipped with a modern, intuitive interface known as the Lyo-Screen-Control (LSC). This interface is used throughout our line of laboratory and pilot freeze dryers. It allows for up to 30 different drying programs with even the smallest machine as well as for the connection to a PC for process documentation and process control (pages 6, 7, 8).

Your valuable products demand the best in specific systems and process monitoring.

Freeze dryers are increasingly being used for small batches whose production involves detailed information to create validation documents (IQ/OQ documentation) and to prepare monitoring tools that ensure flawless product quality. We not only use standard measurements of product temperature and pressure, but also measurements of electrical resistance (Lyo-control, page 7) and weight-change (weighing cell, page 7) during the drying process. Optimal product safety can thus be guaranteed. Unacceptable structural changes including the collapse of the matrix, i.e. possible cross-contamination during the drying phase, can be avoided with confidence.



Alpha 1-4 / 2-4



Gamma 1-16 / 2-16



Delta 1-24 / 2-24

Laboratory Freeze Dryers

The optimal system for advanced applications:

- compact, high-performance laboratory and technical equipment requiring minimal space
- modular systems permit capacity expansion with a wide variety of accessories
- complete processing of entire freeze-drying cycle in ice condenser chamber, program controlled, if desired, from -30°C (prefreezing) with single-stage compressors, to -50°C (prefreezing) with doublestage compressors
- innovative, easy-to-use interface LSC with PC connection for process control and documentation
- freeze-dryer system fulfills FDA and cGMP-Guidelines, interface fulfills the current requirements according to GAMP, Lyo-software LPC-32 also meets US CFR requirements
- drying chamber is located directly above the ice condenser chamber; maximum cross-sectional area results in high sublimation performance and shortest possible process-time
- ice condenser chamber with inner condenser coil of high-quality steel allows for efficient vapour deposition
- thermal insulation of ice condenser chamber avoids power loss and eliminates build-up of water condensation
- ice condenser can be checked visually
- easily accessible ice condenser; rapid, easy defrosting and cleaning (electrical or hot-gas defrosting available); mechanical or electric defrosting drain
- chemically resistant systems for freeze drying solvents (e.g. DMSO, Acetonitrile, Tert-Butanol, Dioxane) are available
- Windows-based software LPC-32 (Lyophilization Process Control) for PC process control and documentation available with all systems
- simple alternative process documentation using Martin Christ Lyolog LL-1 software
- when required, system qualification (IQ/OQ documentation) for validation purposes

Pilot Freeze Dryers

The highest level of research and development for new products

The Epsilon 1-4 / 2-4 and Epsilon 2-6 D set the standard for pilot systems of the highest quality and performance. They share a geometrical likeness with large production machines and use similar temperature-controlling systems.

The Epsilon 1-4 / 2-4 units have an ice condenser temperature with a minimum of -55°C and -85°C respectively and is available with one shelf with 0.11 m^2 usable surface area. The pictures on page 15 show the variety of applications to the freeze drying of products in bulk or vials. The anodized Aluminium shelves can be directly heated or cooled, making the Epsilon 1-4 / 2-4 suitable for both experimental and routine freeze drying.

The larger model, Epsilon 2-6 D, is characterized by their drying potential on a maximum of four shelves with an area of 0.28 m^2 , their distance between shelves can reach 75mm (with three shelves). Due to the temperature control of the stainless steel shelves (via a synthetic heat-transfer medium), these pilot systems fulfill the highest standards of the pharmaceutical and biotech industries.

New cooling techniques allow for shelf temperatures of -40°C and $-55^{\circ}\text{C}/-70^{\circ}\text{C}$ (prefreezing) in the very compact chambers of the Epsilon 1-4 and the Epsilon 2-4 and 2-6 D, respectively. This permits extremely sensitive pharmaceutical and biotech products, e.g. amorphous structures with a low glass transition point, to be freeze dried safely. These pilot dryers are also available with liquid nitrogen cooling.

Simple, process-specific documentation is possible on all systems as a result of the new Lyo-Screen-Control and Lyolog interface. The innovative weighing cell provides the ability to monitor freeze drying in vials and trays, in addition to the standard measurements of product temperature and pressure. An added option is the Windows-based LPC-32 software for PC process control and documentation. LPC-32 is widely used in large freeze-drying production systems and follows the GAMP and cGMP guidelines. Other cGMP guidelines are also followed including maintenance and surface guidelines.

The systems can be H_2O_2 sterilized and can be delivered with an Installation/Operation qualification.

All systems are very flexible; all are available with manual stoppering devices and additional manifolds for lyophilization in round bottom flasks.

These systems will contribute to the success of your small batch production and product development.

Epsilon
1-4 / 2-4



Epsilon
2-6 D



Uncompromising Process Control

The users of laboratory and pilot freeze dryers increasingly demand the high-performance process control that is an integral part of commercial freeze drying in the high-tech industries. Martin Christ's goal for many years has been to supply up-to-date, precise, reproducible, safe and easy-to-use interface systems for each individual use. Our engineering team's most recent development is the LSC (Lyo-Screen-Control). This intuitive, simple to control interface has the following attributes:

- 1/4 VGA-LC-Display
- graphic user interface with turn and push one-button interface
- clear overview of important process data
- up to 30 freeze drying programs can be entered in tabular form (optional)
- recording of process data using documentation Lyolog LL-1 software (optional)
- SCADA-System LPC-32 available as Windows software (optional)

The ease in recording product-specific drying profiles on a PC is greatly improved and can simulate conditions on large production systems (process optimization, scale up).

VALUES	MANUAL	PROGRAM	OPTIONS ?
Shelf Temperature		-20 °C	
Vacuum		Atm mbar	
Safety Pressure		Atm mbar	
Section Time		h:min	
Time h:min	Sec. h:min	Vacuum mbar	
8:01	0:00	0.010	
Condens. °C	Shelf °C	Product °C	
-60	+20	-35	

table of values

VALUES	MANUAL	PROGRAM	OPTIONS ?
Vapour pressure curve above ice			
°C	mbar	°C	mbar
0	0.110	-10	0.560
-1	0.600	-11	0.380
-2	1.170	-12	0.280
-3	1.760	-13	0.210
-4	2.370	-14	0.160
-5	3.000	-15	0.120
-6	3.690	-16	0.090
-7	4.400	-17	0.070
-8	5.100	-18	0.050
-9	5.840	-19	0.040

table for conversion of vacuum/product temperature

VALUES	MANUAL	PROGRAM	OPTIONS ?
01. Christ		◀ Load	
02. < --- >		◀ Modify	
03. < --- >		◀ Copy	
04. < --- >		◀ Delete	
05. Blood Plasma		◀ New	
06. < --- >			
07. < --- >			
08. < --- >			
09. < --- >			
10. < --- >			
11. to 20.			
21. to 30.			

program-creation module PGM-30

VALUES	MANUAL	PROGRAM	OPTIONS ?
Prog.05 Blood Plasma			
abc/Unlock			
◀ Section-No. 01 02 03 ▶			
Phase	Prep	Freeze	Freeze
Section Time		1:00	1:00
Shelf Temp.	+20	-30	-30
Vacuum			
Safety Pressure			
Insert Sec.			
Delete Sec.		Add Set Values	

program-editing window



LSC-Controller with system diagram

Successful Optimization

Weighing system CWS-40: determining the speed and end of a freeze-drying process

The weighing system is an innovative on-line monitor of freeze drying in vials or in trays (bulk ware). It is used in addition to the traditional measuring of product temperature and electrical resistance.

- the weighing cell, able to function in a vacuum and under extreme temperature changes, remains in the freeze dryer throughout the process
- the sample remains in its place, next to the other flasks on the shelf, insuring accurate results
- continual measurements allow for determining drying speeds during the process
- easy recognition, through weight loss, of the end of drying process
- online recording of measurement results using Windows based software
- primarily used in pilot freeze dryers

Lyocontrol LC-1

The freezing range of a substance can be determined with the Lyocontrol measuring system. The measured readings, product temperature, and electrical resistance provide information about the product's reaction to freeze drying, allowing a safe set of parameters to be determined for the process.

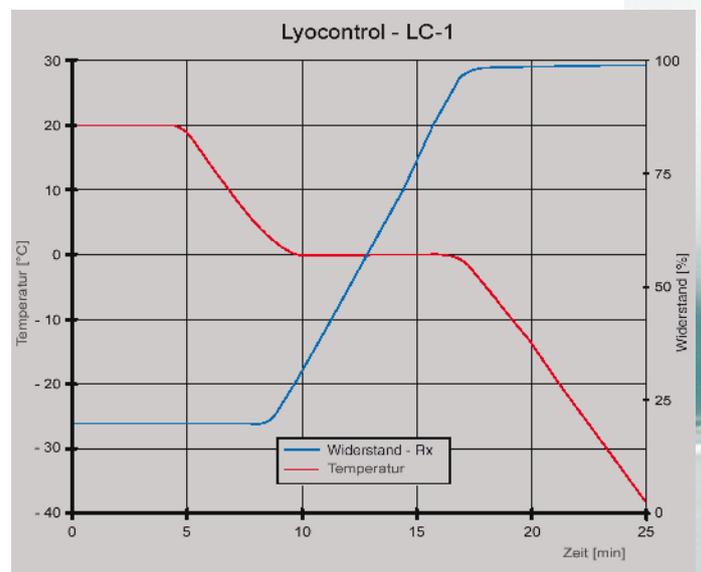
The direct integration of data into the automatic process control is possible.

Documentation software Lyolog LL-1

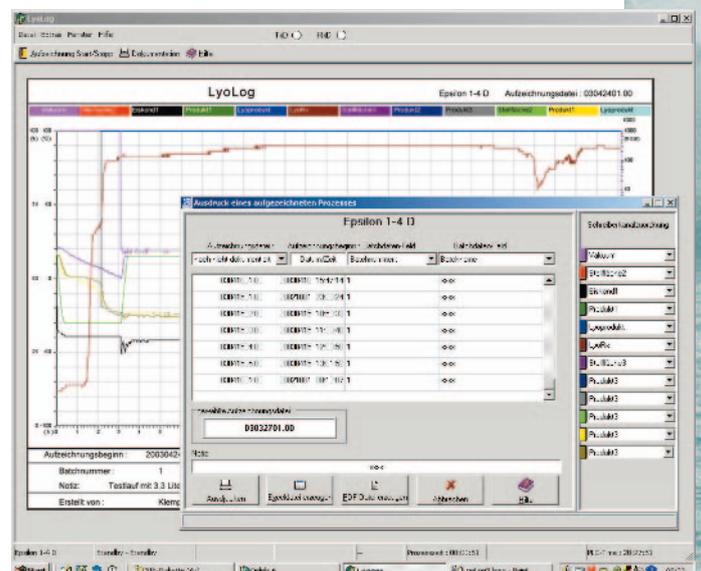
Freeze dryers with the LSC interface system can be directly connected to external hardware including PC's and printers. Our Lyolog LL-1 documentation software allows for direct and precise documentation of batch data and process results.



weighing system CWS-40



Lyocontrol LC-1



Lyolog LL-1

Lyophilization Process Control

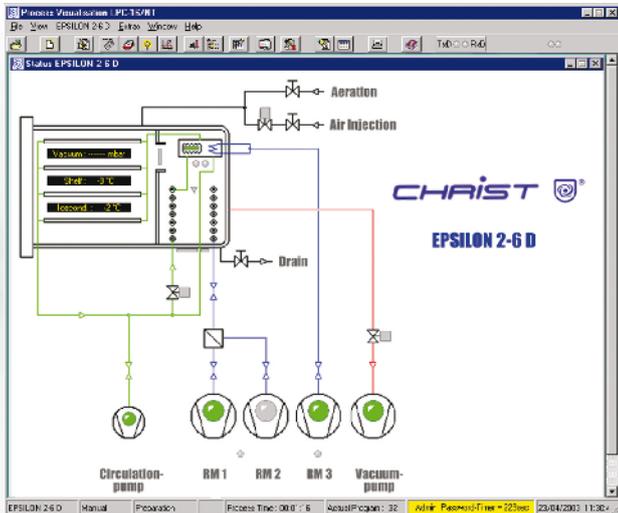
Process-control system LPC-32

The LPC-32 visual processing and interface is for the use, supervision and documentation of the freeze-drying process. It may also be used in complex industrial processes involving large production freeze-drying units. The LPC-32 complies with the relevant GAMP and CFR guidelines.

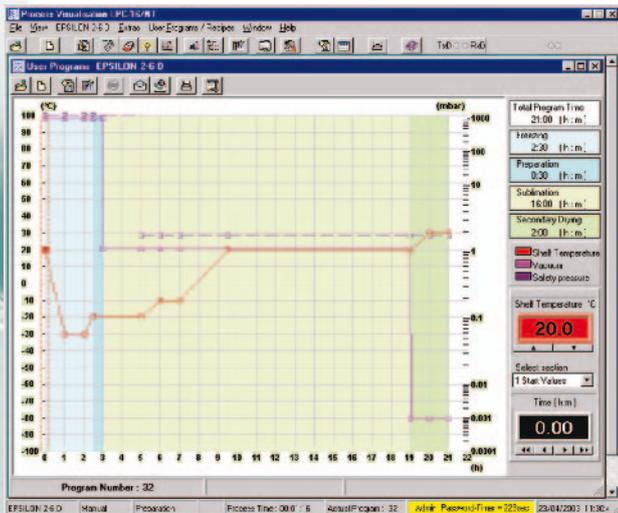
The LPC-32 is compatible with different PC software and customized hardware components (e.g. LSC, Siemens-SPS) for individual process control.

Important features include:

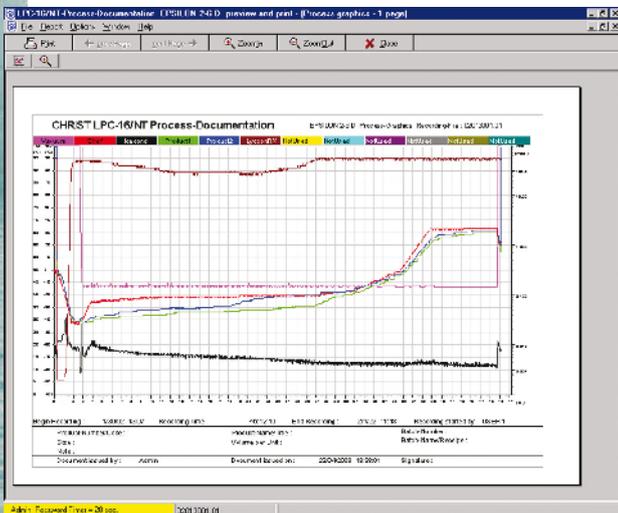
- simple to use interface
- graphical display of system's current position
- free selection of measurement values to be graphically displayed, zoom function
- table with all process events
- graphic support for process programming (recipe)
- input of batch-related information
- archive and process documentation including data export (e.g., into Excel)
- plausibility control and user-code checks at data entry
- system security due to different access levels
- optimal integrity of data through use of binary formats that can not be manipulated
- recording of single assigned process file (audit trail)
- data storage through networks or on portable media



display of system status



program creation



process documentation

Drying Procedures for Laboratory Systems

The freeze dryers with LSC controllers set new standards for flexibility and process control. The varied, modular accessory line allows for individual system configurations adaptable to almost all freeze-drying demands. Two different drying techniques provide a solution to most lyophilization challenges:

Process A (single-chamber system):

Freezing and careful drying of low-freezing, thermally-unstable substances, on cooled shelves (up to -40°C) inside the ice condenser chamber.

Types of vessels used:

- dishes
- injection-vials (stoppering under vacuum)

Shelf capacity:	Alpha	Gamma	Delta
Shelf with \varnothing 200 mm	1	5	10
Shelf with \varnothing 200 mm and stoppering device	1	-	-
Shelf with \varnothing 250 mm and stoppering device, max.	-	2	4

Process B (double-chamber system)

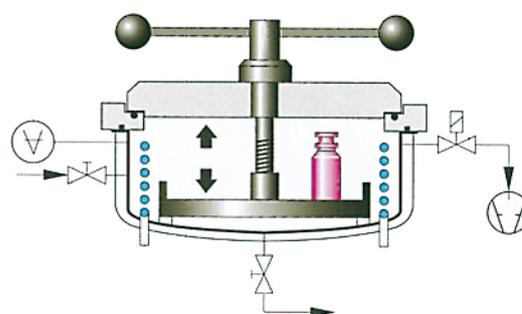
Separate freezing (e.g. using a freezer) and drying outside the ice condenser chamber.

Types of vessels used:

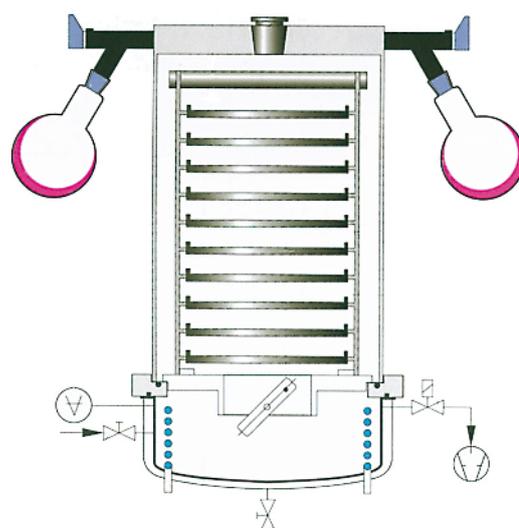
- dishes
- injection-vials (stoppering under vacuum)
- round bottom flasks, wide-neck filter bottles (max. 12 and 24 connections with acrylic glass drying chamber or stainless steel manifold)
- ampoules (connected to special distributors or stainless steel manifold)

Shelf capacity	Alpha	Gamma	Delta
Shelf with \varnothing 200 mm, max.	5/10	5/10	5/10
Shelf with \varnothing 375 mm, max.	5	8	8
Shelf with \varnothing 250 mm and stoppering device, max.	2/4	2/4	2/4

Process A



Process B



System Selection

Incremental condensing performance for every application

In addition to selecting the accessories, the following criteria should be taken into account when choosing a freeze-drying system:

- required ice condenser temperature (-55°C for water-based samples, -85°C for substances with low freezing points or containing solvents)
- number of shelves, i.e. number of flasks needed for the amount of product per batch
- maximum ice condenser performance required (kg/24h) i.e. total quantity of ice produced until defrosted

Configuration tailored to your procedural needs

The adjacent illustrations show examples of the range of system configurations; you can choose the models and accessories that fit your requirements.

Do not hesitate to contact us for an individual configuration of your system. We will gladly provide assistance.

Configurations Alpha 1-4 / 2-4

- 1 freezing and drying inside ice condenser chamber (process A) on one temperature controlled shelf (ø 200 mm, total area = 0.031 m²)
- 2 freezing and drying inside ice condenser chamber (process A) on one temperature controlled shelf with stoppering device (ø 200 mm, total area = 0.031 m²)
- 3 2 drying chambers with 24 ports for flasks, wide-neck filter bottles or distributors for ampoules
- 4 manifold for 8 round bottom flasks, wide-neck filter bottles or distributors for ampoules, specially suited for the drying of solvents
- 5 5 heatable shelves (ø 200 mm, total area = 0.155 m², distance between shelves = 25 mm - can be varied by removing single shelves) additional ports for 12 round bottom flasks, wide-neck filter bottles or distributors for ampoules
- 6 10 heatable shelves (ø 200 mm, total area = 0.31 m², distance between shelves = 25 mm - can be varied by removing single shelves)
- 7 10 heatable shelves (ø 200 mm, total area = 0.31 m², distance between shelves = 25 mm - can be varied by removing single shelves) additional ports for 12 round bottom flasks, wide-neck filter bottles or distributors for ampoules
- 8 2 heatable shelves with stoppering device (ø 250 mm, total area = 0.09 m², distance between shelves = 45 mm - can be increased to 110 mm by removing one shelf) additional ports for 12 round bottom flasks, wide-neck filter bottles or distributors for ampoules
- 9 4 heatable shelves with stoppering device (ø 250 mm, total area = 0.18 m², distance between shelves = 50 mm - can be varied by removing single shelves)
- 10 5 heatable shelves (ø 375 mm, total area = 0.55 m², distance between shelves = 67 mm - made possible with special adapter plate)
- 11 1 drying chamber with additional ports for 12 round bottom flasks, wide-neck filter bottles or distributors for ampoules, additional connection to a rotation vacuum concentrator (e.g. RVC 2-25) available



Configurations Gamma 1-16 / 2-16

- 1 freezing and drying inside ice condenser chamber (process A) on 5 temperature controlled shelves (\varnothing 200 mm, total area = 0.155 m², distance between shelves = 25 mm - can be varied by removing single shelves)
- 2 freezing and drying inside ice condenser chamber (process A) on 2 temperature controlled shelves with stoppering device (\varnothing 250 mm, total area = 0.09 m², distance between shelves = 45 mm - can be increased to 110 mm by removing 1 shelf)
- 3 2 drying chambers with 24 ports for flasks, wide-neck filter bottles or distributors for ampoules
- 4 manifold for 24 round bottom flasks, wide-neck filter bottles or distributors for ampoules, specially suited for the drying of solvents
- 5 5 heatable shelves (\varnothing 200 mm, total area = 0.155 m², distance between shelves 25 mm - can be varied by removing single shelves) additional ports for 12 round bottom flasks, wide-neck filter bottles or distributors for ampoules
- 6 10 heatable shelves (\varnothing 200 mm, total area = 0.31 m², distance between shelves = 25 mm - can be varied by removing single shelves)
- 7 2 heatable shelves with stoppering device (\varnothing 250 mm, total area = 0.09 m², distance between shelves = 45 mm can be increased to 110 mm by removing 1 shelf) additional ports for 12 round bottom flasks, wide-neck filter bottles or distributors for ampoules
- 8 4 heatable shelves with stoppering device (\varnothing 250 mm, total area = 0.18 m², distance between shelves = 50 mm - can be varied by removing single shelves)
- 9 8 heatable shelves (\varnothing 375 mm, total area = 0.88 m², distance between shelves = 48 mm - larger distances can be obtained by special order)





Configurations Delta 1-24 / 2-24

1 freezing and drying inside ice condenser chamber (process A) on 10 temperature controlled shelves (\varnothing 200 mm, total area = 0.31 m², distance between shelves = 25 mm - can be varied by removing single shelves)

2 freezing and drying inside ice condenser chamber (process A) on 4 temperature controlled shelves with stoppering device (\varnothing 250 mm, total area = 0.18 m², distance between shelves = 45 mm - can be increased to 110 mm by removing one shelf)



3 2 drying chambers with 24 ports for flasks, wide-neck filter bottles or distributors for ampoules

4 10 heatable shelves (\varnothing 200 mm, total area = 0.31 m², distance between shelves = 25 mm - can be varied by removing single shelves) additional ports for 12 round bottom flasks, wide-neck filter bottles or distributors for ampoules

5 4 heatable shelves with stoppering device (\varnothing 250 mm, total area = 0.18 m², distance between shelves = 50 mm - can be varied by removing single shelves) additional ports for 12 round bottom flasks, wide-neck filter bottles or distributors for ampoules

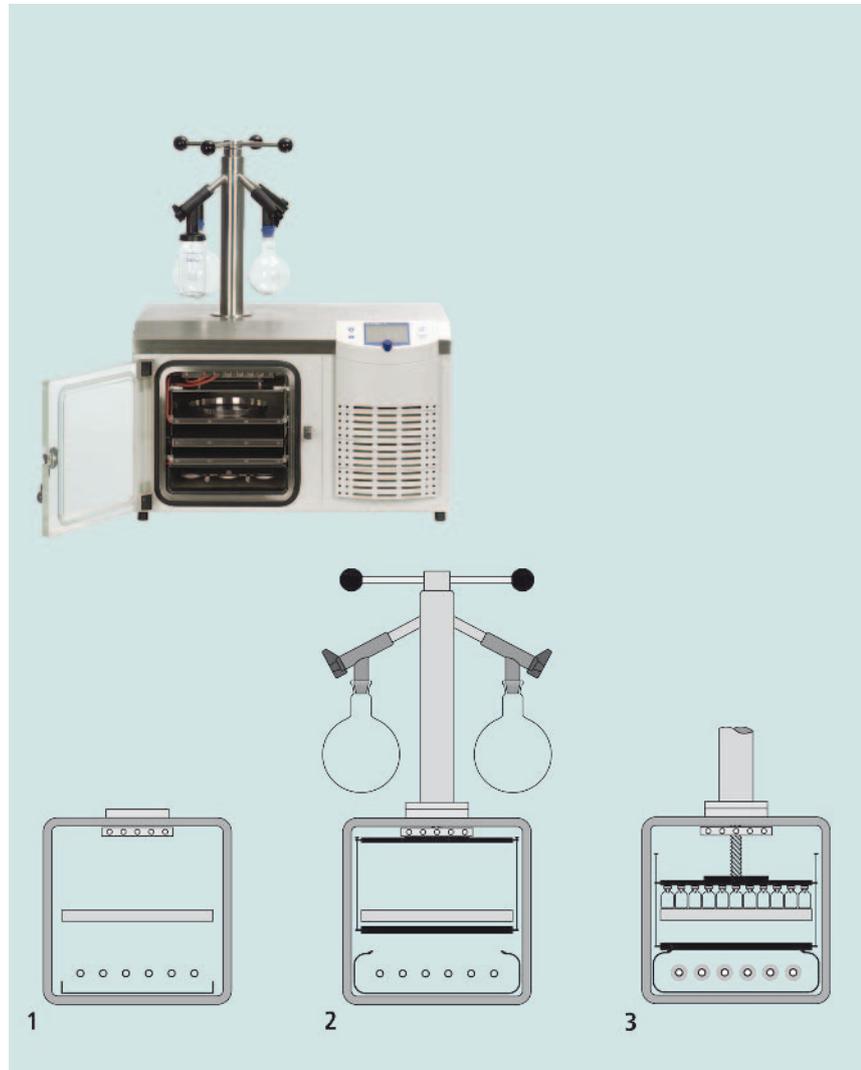
6 8 heatable shelves (\varnothing 375 mm, total area = 0.88 m², distance between shelves = 48 mm - larger distances can be obtained by special order)



Configurations Epsilon 1-4 / 2-4

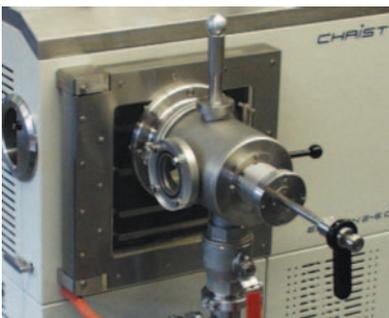
A variety of Epsilon 1-4 / 2-4 configurations are possible due to a very clever and variable system of shelves that serve as an intermediate valve and defrosting plate for the ice condenser. A selection of these combinations is illustrated here.

- 1 base system with combination stainless steel dish for product or for defrosting-water
- 2 system with stoppering device plus integrated manifold
- 3 illustration of closing vials



Configurations Epsilon 2-6 D

While the shelves in the Epsilon 1-4 / 2-4 are cooled directly by the coils of the cooling system; the temperature regulation in the bigger 6 kg model is achieved indirectly through a high-performance, synthetic heat-transfer medium. This guarantees minimum temperature variation at any point on the shelves, less than $\pm 1^\circ\text{K}$, and requires an identical amount of overall energy for the lyophilization.



manipulator for retrieving individual vials during freeze-drying process (sample thief)



Technical Data Alpha and Gamma

	Alpha 1-4	Alpha 2-4	Gamma 1-16	Gamma 2-16
Ice condenser capacity				
- capacity (max. kg)	4	4	16	16
- performance (max. kg/24h)	4	4	12	12
- temperature (approx. °C)	ca. -60	ca. -85	ca. -60	ca. -85
Shelf temperature (T in °C) when freezing inside ice condenser chamber	ca. -25	ca. -35	ca. -40	ca. -55
Max. shelf surface area when drying inside the ice condenser chamber (process A)	1 shelf ø=200 mm, △ 0.031 m ²	1 shelf ø=200 mm, △ 0.031 m ²	5 shelves ø=200 mm, △ 0.155 m ²	5 shelves ø=200 mm, △ 0.155 m ²
Max. shelf surface area when drying inside the ice condenser chamber in injection vials with stoppering under vacuum or inertgas (process A)	1 shelf ø=200 mm, △ 0.031 m ²	1 shelf ø=200 mm, △ 0.031 m ²	2 shelves ø=250 mm, △ 0.09 m ²	2 shelves ø=250 mm, △ 0.09 m ²
Max. shelf surface area when drying outside the ice condenser chamber (process B)	5 shelves ø= 375 mm, △ 0.55 m ²	5 shelves ø=375 mm, △ 0.55 m ²	8 shelves ø=375 mm, △ 0.88 m ²	8 shelves ø=375 mm, △ 0.88 m ²
Max. shelf surface area when drying outside the ice condenser chamber in injection vials with stoppering under vacuum or inert gas (process B)	4 shelves ø= 250 mm, △ 0.18 m ²			
Drying in round bottom flasks or wide-neck filter bottles	12/24 pieces	12/24 pieces	12/24 pieces	12/24 pieces
Dimensions of base unit	width: 390 mm height: 415 mm depth: 555 mm	width: 390 mm height: 415 mm depth: 555 mm	width: 860 mm height: 485 mm depth: 650 mm	width: 860 mm height: 485 mm depth: 650 mm
Weight	ca. 48 kg	ca. 60 kg	ca. 135 kg	ca. 160 kg
Electrical connection (other voltages available)	230 V, 50 Hz			
Max. power consumption	ca. 1.6 kVA	ca. 1.8 kVA	ca. 2.1 kVA	ca. 2.3 kVA
Max. ambient temperature (unit is air-cooled, higher temperatures upon request)	climate category SN +10°C to +25°C			

We reserve the right to make technical changes without prior notice

Technical Data Delta

	Delta 1-24	Delta 2-24
Ice condenser capacity		
- capacity (max. kg)	24	24
- performance (max. kg/24h)	18	18
- temperature (approx. °C)	ca. -55	ca. -85
Shelf temperature (T in °C) when freezing inside ice condenser chamber	ca. -40	ca. -55
Max. shelf surface area when drying inside the ice condenser chamber (process A)	10 shelves ø=200 mm, △0.31 m ²	10 shelves ø=200 mm, △0.31 m ²
Max. shelf surface area when drying inside the ice condenser chamber in injection vials with stoppering under Vacuum or inertgas (process A)	4 shelves ø=250 mm, △0.18 m ²	4 shelves ø=250 mm, △0.18 m ²
Max. shelf surface area when drying outside the ice condenser chamber (process B)	8 shelves ø= 375 mm, △ 0.88 m ²	8 shelves ø= 375 mm, △ 0.88 m ²
Max. shelf surface area when drying outside the ice condenser chamber in injection vials with stoppering under vacuum or inert gas (process B)	4 shelves ø= 250 mm, △ 0.18 m ²	4 shelves ø= 250 mm, △ 0.18 m ²
Drying in round bottom flasks or wide-neck filter bottles	12/24/36 pieces	12/24/36 pieces
Dimensions of base unit	width: 860 mm height: 1050 mm depth: 650 mm	width: 860 mm height: 1050 mm depth: 650 mm
Weight	ca. 215 kg	ca. 250 kg
Electrical connection (other voltages available)	3 x 400 V, 50 Hz	3 x 400 V, 50 Hz
Max. power consumption	ca. 1.8 kVA	ca. 3.0 kVA
Max. ambient temperature (unit is air-cooled, higher temperatures upon request)	climate category SN +10°C to +25°C	climate category SN +10°C to +25°C

We reserve the right to make technical changes without prior notice

Technical Data Epsilon

	Epsilon 1-4	Epsilon 2-4	Epsilon 2-6 D
Ice condenser			
-capacity (max. kg)	4	4	6
-performance (max. kg/24h)	3	3	4
-Temperature (approx. °C)	-55	-85	-85
Shelf temperature control (T in °C)	-40 (prefreezing) to +60	-70 (prefreezing) to +60	-50 (prefreezing) to +60
Shelves - quantity	1	1	4+1 max.
Shelf measurements (w x d, mm)	270 x 400	270 x 400	225 x 300
Area (m ²)	0.11	0.11	0.07 - 0.28
Distance between shelves (mm)	135	135	73 mm (3+1)
Sealing of vials in vacuum / N ₂	•	•	•
Flask drying	Manifold with e.g. 4 controllable vacuum connections each (optional)	Manifold with e.g. 4 controllable vacuum connections each (optional)	Manifold with e.g. 8 controllable vacuum connections each (optional)
Sterilization (H ₂ O ₂)	•	•	•
Refrigeration compressor			
Number x KW	1 x 0.6	2 x 0.6	1 x 0.5 +2 x 0.6
Type	air-cooled	air-cooled	air-cooled
Dimensions (w x d x h, mm)	780x480x ca.520	780x480x ca.520	860x650x ca.1100
Electrical connection (V /Hz / kVA)	230/50/3	230/50/3	3x400/50/3
Weight (kg)	ca. 175	ca. 205	ca. 330
Interface	LSC	LSC	LSC
Vacuum display	✓	✓	✓
Vacuum control function	✓	✓	✓
Temperature display:			
- Ice condenser (display)	✓	✓	✓
- Shelves (display and control)	✓	✓	✓
- product (measurement of 3 probes max.)	✓	✓	✓
Lyo Control	•	•	•
Determining end of drying:			
- Product temperature measurement	✓	✓	✓
- Pressure-increase measurement	—	—	•
Weighing cell	•	•	•
Manipulator for sample-retrieval during process	—	—	•
Programmer module	✓	✓	✓
PC-Interface	✓	✓	✓
PC-Documentations software	✓	✓	✓
Lyo LL-1	•	•	•
Process-control system LPC-32	•	•	•

• = optional ✓ = standard

We reserve the right to make technical changes without prior notice

Product Spectrum

The comprehensive product range of freeze dryers and vacuum concentrators for every application

Freeze dryers for industrial production

Pilot systems for process development

Freeze dryers for research and development

Rotational vacuum concentrators, available in 4 sizes, covering the gamut from solving routine laboratory problems to the evaporation in high-end pharmaceutical research

Freeze dryers for routine laboratory use



CHRIST 
Freeze Dryers
Vacuum Concentrators



Martin Christ Gefriertrocknungsanlagen GmbH
P.O. Box 17 13 · D-37507 Osterode am Harz, Germany
Tel. +49 (0) 55 22/50 07- 0 · Fax +49 (0) 55 22/50 07-12
www.martinchrist.de e-mail: info@martinchrist.de