Pilot Freeze Dryers
Smart Processes

Powerful and
highly efficient

www.martinchrist.de


EPSILON 2-4 LSCplus

Best equipment for R&D and small production

Pilot freeze dryers from Martin Christ are ideal for R&D or small production systems for new products. All three models are suitable for the freeze drying of solids or liquids in a wide variation of containers, including ampoules, vials, glass flasks, plasma bottles, dishes, etc. The units share a geometrical likeness as production-scale units and use similar temperature control principles.

The Epsilon 1-4 LSCplus and Epsilon 2-4 LSCplus benchtop freeze dryers are single-chamber units with a 4 kg ice condenser integrated in the product chamber. One big shelf – directly cooled by refrigerant – allows approximately 10 °C lower shelf temperatures and twice as fast cooling and heating compared to indirectly cooled shelves.

With temperature-controlled stainless steel shelves using a synthetic heat transfer fluid, these larger 6 kg and 10 kg pilot systems fulfil the highest standards of the pharmaceutical and biotech industries. As double-chamber systems with a separate ice condenser, they allow the integration of even more PAT features for process optimisation and development than the 4 kg system.

Intuitive operation and process-specific documentation is possible with the LSCplus controller combined with LyoLogplus software versions or LPCplus. LPCplus is widely used for all systems from pilot freeze dryers to large-scale production units.

Epsilon 1-4 LSCplus
Epsilon 2-4 LSCplus

4 kg | –55 °C / –88 °C | ~ 430 x 2 ml / ~ 30 x 100 ml

Epsilon 2-6 LSCplus

6 kg | –88 °C | ~ 840 x 2 ml / ~ 42 x 100 ml

Epsilon 2-10 LSCplus

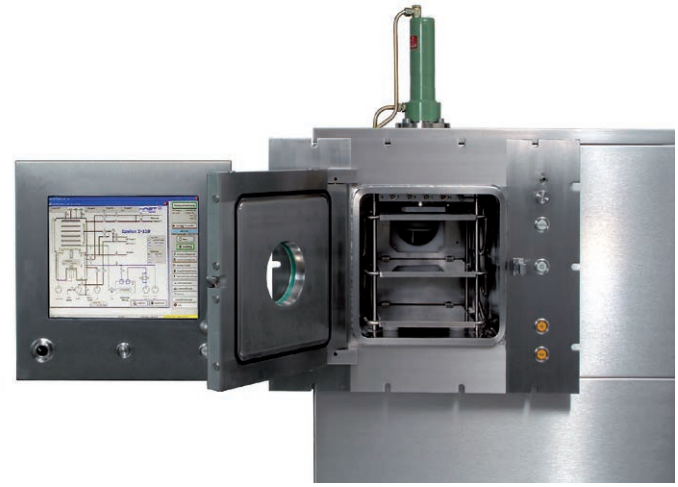
10 kg | –88 °C | ~ 2,450 x 2 ml / ~ 108 x 100 ml

Design features

General features

- **Minimised space requirements:** very compact design with high efficiency and economical operation.
- **Powerful shelf temperature control**
  Actively cooled and heated shelves
  6 and 10 kg units: control range –50 °C or –60 °C to +60 °C, shelf temperature accuracy ±1 K, cool down/heat up benchtop freeze dryers > 1 K (+20 °C to –40 °C)
  4 kg units: control range -45 °C (Epsilon 1-4 LSCplus) or –75°C (Epsilon 2-4 LSCplus) to +60 °C, shelf temperature accuracy better than ±2 K – (temperature distribution can be improved by utilising aluminium thermoblocks), cool down/heat up rate > 2 K (+20 °C to –40 °C)
- **Uncompromising process control**
  with simple and intuitive LSCplus user interface. Can be combined with LyoLogplus documentation software or LPCplus process visualisation.
- **Optimal vapour transport**
  120 mm diameter valve, ice condenser directly behind drying chamber (no pipe connection which results in a pressure drop). 4 kg unit has ice condenser inside the drying chamber.
- **Vial stoppering**
  Easy and safe, manual or automatic operation selectable, optional function "aeration-stoppering-storage".
- **Defrosting without water**
  Fast and efficient hot gas defrosting for 6 kg and 10 kg units. 4 kg unit by shelf radiation or hot gas (option)
- **Eco-version** available, uses environmentally friendly natural refrigerants (only double stage units).
- **Custom configurations**
  A wide range of approved solutions are available for special applications. This includes solvent freeze drying, glove-box and isolator connection and VHP decontamination with certificate.
- **Made in Germany**
  Martin Christ freeze dryers are 100% engineered and manufactured in Osterode, Germany, with an ISO 9001:2008 compliant QMS certified since 1994.

Epsilon 2-6D LSCplus
Compact design with powerful compressor and vacuum system



Example:
System for Cleanroom integration with touchscreen control

Widest range of custom solutions

The Epsilon Pilot range from Martin Christ sets the standard for high quality and productive pilot systems. These freeze dryers look and operate nearly the same as large production freeze dryers.

They provide the highest level of functions for successful research and process development. Pilot systems with custom configurations have been supplied to global pharmaceutical companies and biotech start-ups. Modifications include:

- **Cleanroom integration**
- **Isolator/glove box integration**
- **Process optimisation tools**
  Process Analytical Technology (PAT)
  - LyoControl
  - LyoBalance – weighing system
  - Sample thief/manipulator
  - Comparative pressure measurement (Pirani / capacitive)
  - Wireless product temperature probes WTMplus
- **H_2O_2-sterilisation (VHP)**
- **LN_2-Booster**
- Special systems for solvents
- Heat radiation shield: a special transparent film coating (patent pending) reduces radiation impact through acrylic chamber doors.

Example:
Sample thief/manipulator with camera monitoring

Example:
Glove box integration

Advanced system technology

Martin Christ freeze dryers are high performance universal units for the freeze drying of solid or liquid products in a wide variety of vials, trays or other containers.

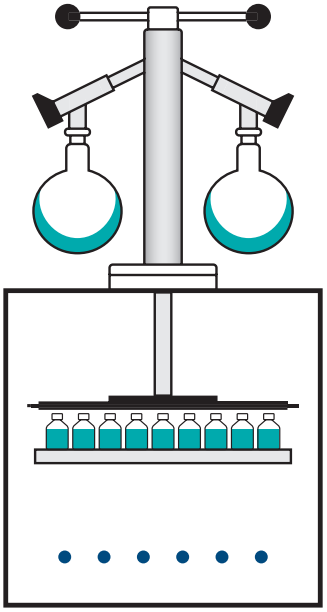
Typical applications for freeze drying are materials such as bacterial and virus cultures, blood plasma, serum fractions, antibodies, sera, vaccines, biopharmaceutical complex proteins, plant extracts and diagnostic test kits.

All operations are possible inside our single and double chamber systems:

- Pre-freezing of products on liquid-controlled shelves down to a shelf temperature of –75 °C (depending on model) to +60 °C according to preselected desired time and temperature limits.
- Freeze drying (sublimation) of products according to set values for time, temperature and pressure limits. Shelf temperature at the initial phase of the sublimation process is max. –75 °C (depending on model). This allows extremely sensitive pharmaceutical and biotech products, e.g. amorphous structures with a low glass transition point, to be freeze dried safely.
- Final drying of products with preselected desired time and temperature limits and high final vacuum to remove capillary and molecular bonded water. Final vacuum is approximately 0.005 mbar (depending on vacuum pump performance).

Single-chamber systems

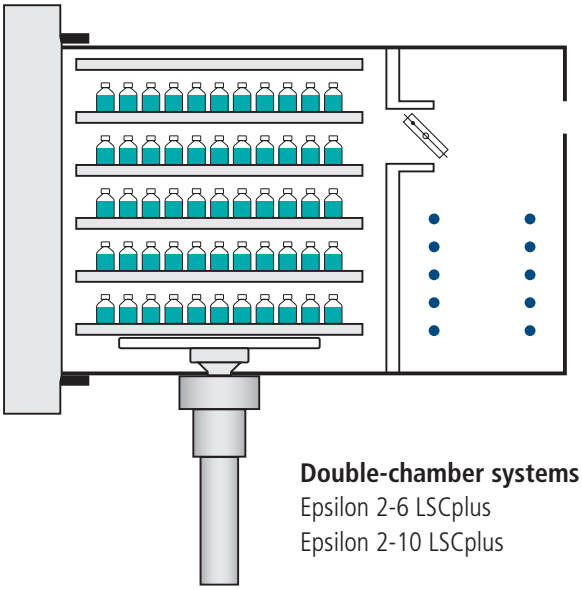
- **Most efficient ice condenser design**
  Ice condenser coils directly inside drying chamber improve drying time and avoid vapour bypass to vacuum pumps.
  The condenser has a minimum temperature of –55 °C (Epsilon 1-4 LSCplus) or –88 °C (Epsilon 2-4 LSCplus).
- **Powerful shelf temperature control**
  Refrigerant cooled and heated shelves, control range –45 °C (Epsilon 1-4 LSCplus) or –75 °C (Epsilon 2-4 LSCplus) to +60 °C, cooling/heating rate up to 2 K/min (+20 °C to –40 °C), shelf temperature accuracy better than ±2 K (can be improved by using aluminium thermoblocks).
- **Vial stoppering plus flask drying**
  Multi-purpose device with one large shelf with 0.11 m² surface area and optional connections for up to 4 flasks. Controlled and safe vial stoppering with manual operation (automatic as option).



Single-chamber systems
Epsilon 1-4 LSCplus
Epsilon 2-4 LSCplus

Double-chamber systems

- **Ice condenser** directly **behind** the drying chamber
- **Large cross-section** between drying and ice condenser chambers
- Nearly **no pressure drop** between both chambers. **Excellent drying rates** for sensitive materials and products with low eutectic points or low collapse temperatures
- **Powerful shelf temperature control** Liquid cooled and heated shelves, control range –50 °C to +60 °C (Epsilon 2-6D LSCplus) or –60 °C to +60 °C (Epsilon 2-10D LSCplus), cooling/heating rate up to >1 K/min (+20 °C to –40 °C), shelf temperature accuracy better than ±1 K
- **Intermediate valve** for determination of transition from primary to secondary drying phase
- Manual and hydraulic **vial stoppering**
- **Flask drying** available as an option



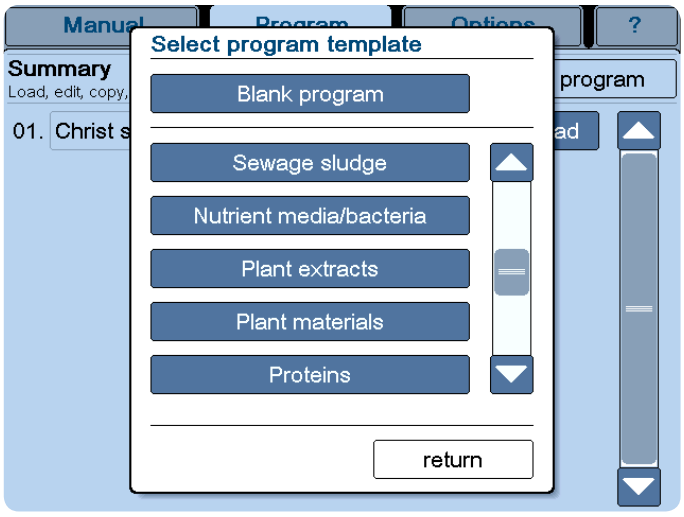
Double-chamber systems
Epsilon 2-6 LSCplus
Epsilon 2-10 LSCplus

LSCplus controller

To aid in designing your process sequences, we have integrated our highly regarded LSCplus controller with its production-oriented user interface into every model. All of the accessories are also integrated. Automatic process sequences ensure reproducible results.

- Symbol driven colour touchscreen control
- Automatic or manual freeze drying sequence
- Intuitive input of programs based on different pre-installed freeze drying sequences or recipes
- Graphical diagram of the freeze drying process
- Automatic program adaptation according to actual product conditions
- Memory for up to 32 user-defined programs with 64 steps
- Detailed messages
- Wide selection of languages already integrated
- Definable units for temperature (°C/°F) and pressure (mbar/hPa/Torr)
- Password protection possible (up to 3 levels)
- Process data acquisition and convenient data exchange via USB or Ethernet

LSCplus colour touchscreen



Sample programs for various applications

Unique controller:
Convenient and intuitive

Process monitoring and documentation

We realise that process monitoring and documentation are crucial for the validation of many applications regardless of recipe and batch size.

Documentation and archiving of all process data is possible with the LyoLogplus software, which can be installed on a separate PC. The data can be transferred from the freeze drying system to the PC on a USB stick or directly over Ethernet. LyoLogplus enables seamless documentation and post-process analysis with an intuitive user interface.

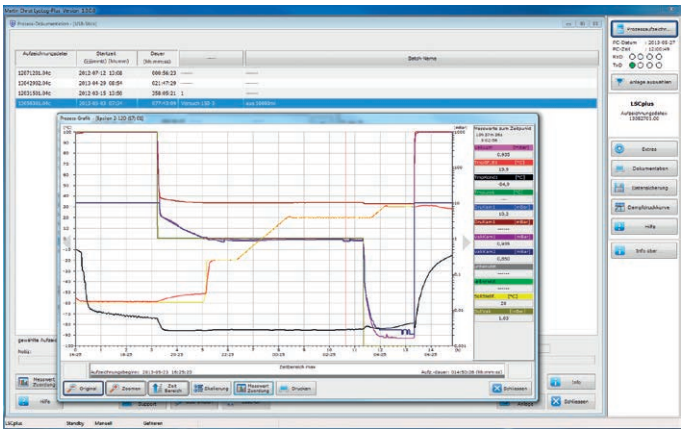
LPCplus can also be used. With LPCplus you can develop programs for freeze drying and view process data in real time on a graphical display. LPCplus additionally offers the same capabilities as LyoLogplus. Consistent and uniform operation over all system sizes is ensured by the fact that LPCplus is also used in pilot and production freeze drying systems.

Need to scale up?
Enjoy easy platform migration from pilot to production scale with uniform interface and software solutions.

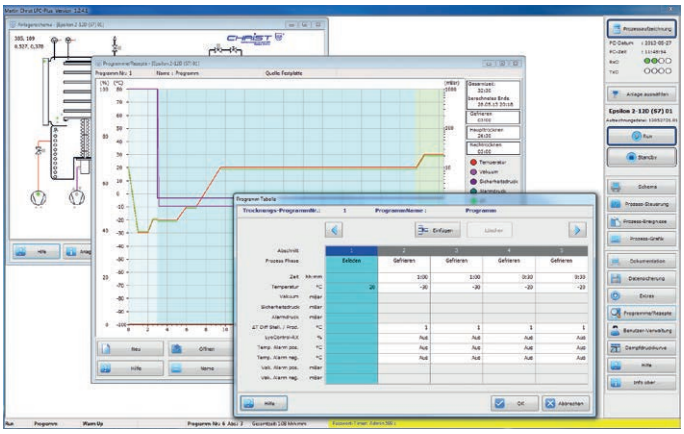
- Data storage on a USB memory stick
- Easy process documentation with LyoLogplus
- LPCplus for process control and documentation
- Avoid unwanted thawing thanks to our reliable process monitoring and innovative LyoRx sensor
- Automatic determination of the freezing point with LyoControl for secure process control
- WTMplus wireless sample temperature measurement for easy handling with improved sensor technology
- LyoLogplus and LPCplus with a multilingual user surface

We design and craft our freeze dryers to follow the published cGMP/GLP guidelines. The optional LPCplus software complies with current GAMP standard guidelines.

System qualification (IQ/OQ) is executed upon request.



LyoLogplus process documentation software



LPCplus process control and documentation software

Process optimisation – in detail

The LSCplus series offers a variety of options to optimise your freeze drying processes, including automatic determination of critical product data.

AutoLyo
Using pre-defined programs/recipes and
intelligent interactions of product-related parameters such as

- Product temperature
- Ice condenser temperature
- LyoRx (electrical resistance)
- Pressure data (pressure increase test,
  comparison between Pirani and capacitive sensor)

a self-optimising cycle mode AutoLyo can be defined.

As a result, time and costs for cycle development and transfer to production can be reduced by at least a factor of 3 compared to conventional freeze dryers.

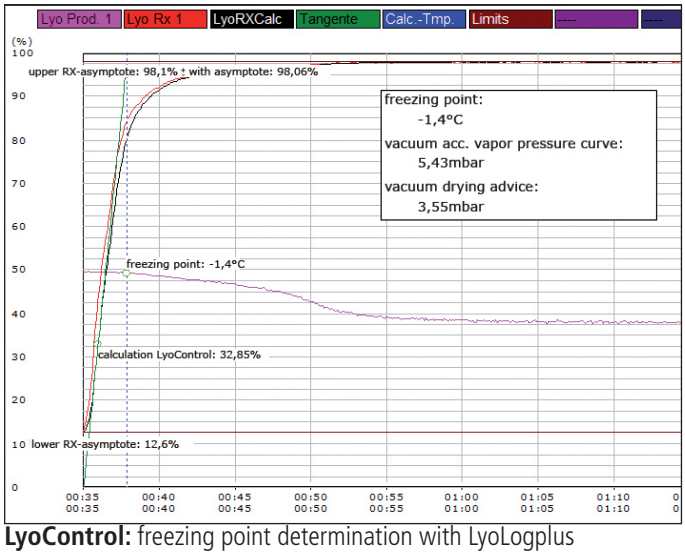
Freezing point determination
Our LyoRx sensor monitors electrical resistance as well as the product temperature. The resulting profile data can be utilised by our LyoControl software for the automatic determination of your product freezing point. The benefit to your process is reliable estimation of the critical product temperature tolerances during the main drying phase to prevent product melting.

Product resistance
The LyoRx sensor enables the automatic control of the energy supply to the individual shelves during the main drying phase, which makes it possible to limit the thawing effects of the product, for example.

Product temperature
In order to measure the product temperature, every shelf can be equipped with WTMplus and/or a Pt100 sensor. The product temperatures on the various shelves can be monitored in the LSCplus controller.

Pressure increase test (6 and 10 kg systems)
The transition from the main drying phase to the final drying phase can be initiated with our automatic pressure increase test. Christ solutions include an integrated valve between the product chamber and the ice condenser. This valve is briefly cycle during the main drying phase. If the pressure increase in the product chamber remains below set limits whilst the valve is closed, our system can determine that no further sublimation water is left in the product and the final drying phase can be initiated.

Comparative pressure measurement
The use of two different vacuum sensors (Pirani and capacitive) allows conclusions to be drawn about the end of the main drying phase. When the differential pressure measurement falls below a predefined limit, the final drying phase can be started automatically.



LyoControl: freezing point determination with LyoLogplus

Process optimisation – innovative tools

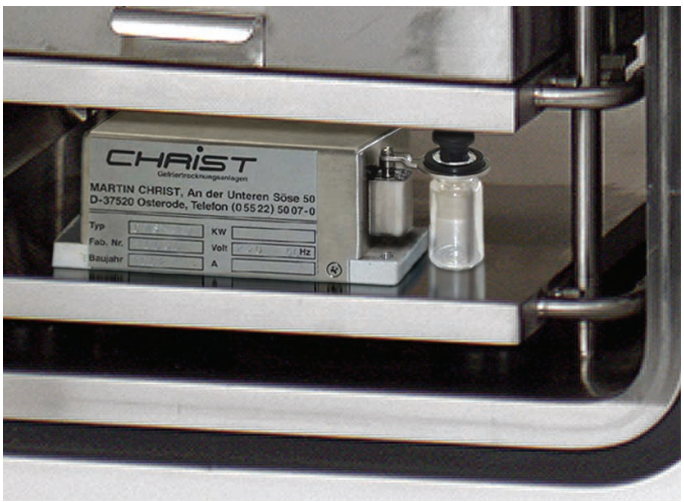
WTMplus in Martin Christ pilot units

Wireless temperature measurement WTMplus for up to 16 sample sensors is available as an option. Special features include:

- Fully integrated system within LSCplus controller
- No separate modules necessary for monitoring and visualisation
- Antenna inside drying chamber for maximum coverage of all vial positions
- Improved sensor technology, compact and robust design
- High accuracy ±0.5 K (max. ±1 K)
- No heat input to samples as with wired probes, therefore measurement of real values
- Excellent value for money

LyoBalance – exact determination of drying rate

The LyoBalance microbalance provides the ultimate direct measurement of the drying advancement. As an innovation, operation is integrated into LSCplus with data monitoring via the LyoLogplus or LPCplus software of the pilot unit. No need for extra software for logging the weight loss. Furthermore, the drying rate is documented. Comparative trials can be assessed instantaneously.



Technical specifications

Specifications	Epsilon 1-4 LSCplus	Epsilon 2-4 LSCplus
Ice condenser: • Max. capacity • Max. performance • Temperature • Chamber volume	One chamber 4 kg 3 kg/24 h approx. –55 °C approx. 41 l	One chamber 4 kg 3 kg/24 h approx. –88 °C approx. 41 l
Shelf system: • Dimensions (W x D) • Temperature range • Temperature accuracy	 270 x 400 mm approx. –45 °C to +60 °C <±2 K	 270 x 400 mm approx. –75 °C to +60 °C <±2 K
Refrigeration system Refrigerant	1x 0.51 kW CFC-free	2x 0.51 kW CFC-free
Dimensions (W x H x D) with stoppering device and manifold	780 x 975 x 550 mm	780 x 975 x 550 mm
Weight	approx. 110 kg	approx. 140 kg
Power supply (other voltages upon request)	230 V / 50 Hz 230 V / 60 Hz 208 V / 60 Hz	230 V / 50 Hz 220 V / 60 Hz 208 V / 60 Hz
Nominal power of basic unit	1.0 kVA	1.9 kVA
Noise level as per DIN 46535	54 dB(A)	54 dB(A)
Defrosting function	Hot shelf radiation	Hot shelf radiation
Vial stoppering: • Manual • Hydraulic • Automatic function "aeration-stoppering-storage"	 ● ○ ○	 ● ○ ○
Process control and safety features: • Pressure rise test • Safety pressure • LyoRx – resistance safety value • Product and shelf temperature	 – ● ● ●	 – ● ● ●
Process Analytical Technologies (PAT) tools: • **LyoControl** (freezing point determination, measurement of product resistance) • Product temperature measurement • **WTMplus** Wireless Temperature Measurement • Capacitive pressure measurement • Comparative pressure measurement • **LyoBalance** weighing system	 ● ● ○ ○ ○ ○	 ● ● ○ ○ ○ ○
Programmer module for up to 32 recipes with 64 sections each	●	●
Communication interface	Ethernet	Ethernet
USB	○	○
LyoLogplus process documentation software	○	○
LPCplus process control and documentation software	○	○

● = standard ○ = option

Subject to change without prior notice.

These specifications apply to the basic unit with standard shelf configuration and ambient temperature from +10 °C to +25 °C.

Specifications	Epsilon 2-6D LSCplus	Epsilon 2-10D LSCplus
Ice condenser: • Max. capacity • Max. performance • Temperature • Chamber volume	Two chambers 6 kg 3.5 kg/24 h approx. –88 °C approx. 23 l	Two chambers 10 kg 8 kg/24 h approx. –88 °C approx. 50 l
Shelf system: • Dimensions (W x D) • Temperature range • Temperature accuracy	 225 x 300 mm approx. –50 °C to +60 °C <±1 K	 350 x 400 mm approx. –60 °C to +60 °C <±1 K
Refrigeration system Refrigerant	2x 0.6 kW + 1x 0.6 kW CFC-free	2x 1.2 kW + 1x 0.9 kW CFC-free
Dimensions (W x H x D) of the basic unit	860 x 1267 x 650 mm	1190 x 1295 x 850 mm
Weight	approx. 330 kg	approx. 750 kg
Power supply (other voltages upon request)	3 x 400 V/50 Hz 3 x 208 V/60 Hz 3 x 230 V/60 Hz	3 x 400 V/50 Hz 3 x 208 V/60 Hz 3 x 230 V/60 Hz
Nominal power of basic unit	3.45 kVA	6.8 kVA
Noise level as per DIN 46535	61 dB(A)	64 dB(A)
Defrosting function	Hot gas	Hot gas
Vial stoppering: • Manual • Hydraulic • Automatic function "aeration-stoppering-storage"	 ● ○ ○	 – ● ○
Process control and safety features: • Pressure rise test • Safety pressure • LyoRx – resistance safety value • Product and shelf temperature	 ○ ● ● ●	 ○ ● ● ●
Process Analytical Technologies (PAT) tools: • **LyoControl** (freezing point determination, measurement of product resistance) • Product temperature measurement • **WTMplus** Wireless Temperature Measurement • Pressure rise test • Capacitive pressure measurement • Comparative pressure measurement • **LyoBalance** weighing system	 ● ● ○ ● ○ ○ ○	 ● ● ○ ● ○ ○ ○
Programmer module for up to 32 recipes with 64 sections each	●	●
Communication interface	Ethernet	Ethernet
USB	○	○
LyoLogplus process documentation software	○	○
LPCplus process control and documentation software	○	○

● = standard ○ = option

Subject to change without prior notice.

These specifications apply to the basic unit with standard shelf configuration and ambient temperature from +10 °C to +25 °C.

Capacities / Shelf dimensions

Epsilon 1-4 LSCplus & Epsilon 2-4 LSCplus

Vial volume (total)									
Shelf width	Shelf depth	Shelf height	Vials	2 ml	6 ml	10 ml	20 ml	50 ml	100 ml
270 mm	400 mm	20 mm	↕ mm	35	40	45	55	73	95
			⌀ mm	16	22	24	30	43	52
Number of shelves	Area (m²)	Spacing (mm)	Number of shelves	Max. number of vials [a]					
1	0.108	140	1	430	225	180	120	50	30

Epsilon 2-6D LSCplus

Vial volume (total)									
Shelf width	Shelf depth	Shelf height	Vials	2 ml	6 ml	10 ml	20 ml	50 ml	100 ml
225 mm	300 mm	15 mm	↕ mm	35	40	45	55	73	95
			⌀ mm	16	22	24	30	43	52
Number of shelves	Area (m²)	Spacing (mm)	Number of shelves	Max. number of vials [a]					
1	0.07	250	1	280	130	115	72	36	21
2	0.14	117	2	560	260	230	144	72	42
3 [b]	0.21	73	3	840	390	345	216		
4	0.27	51	4						
5	0.34	40	5	For bulk, MTP/deepwell plates, etc.					
6	0.40	31	6						

Epsilon 2-10D LSCplus

Vial volume (total)									
Shelf width	Shelf depth	Shelf height	Vials	2 ml	6 ml	10 ml	20 ml	50 ml	100 ml
350 mm	400 mm	15 mm	↕ mm	35	40	45	55	73	95
			⌀ mm	16	22	24	30	43	52
Number of shelves	Area (m²)	Spacing (mm)	Number of shelves	Max. number of vials [a]					
1	0.14	354	1	613	326	266	165	83	54
2	0.28	170	2	1226	652	532	330	166	108
3	0.42	108	3	1839	978	798	495	249	
4	0.56	77	4	2452	1304	1064	660		
5 [b]	0.70	59	5	3065	1630				
6	0.84	47	6	For bulk, MTP/deepwell plates, etc.					
7	0.98	38	7						

[a] Figures for maximum load; subtract 10% when using racks
[b] Standard configuration

Our Product Spectrum

With a unique and broad graduated range of equipment and accessories, we can supply freeze drying systems and vacuum concentrators for every application. Let us show you what we can do!

1. Freeze drying systems for industrial production with ice condenser capacity from 20 to 500 kg; custom system design including loading and unloading system.
2. Pilot freeze drying systems for process development or process optimisation with ice condenser capacity from 4 to 16 kg.
3. Freeze drying systems for routine applications or R&D with ice condenser capacity from 2 to 24 kg.
4. Rotational vacuum concentrators for applications extending from routine to evaporation concentration in the high-end range of pharmaceutical research.

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