

## Spray Freeze Drying Granulation Unit Enables preparation of porous samples with extremely high solubility

### Model SFD-1000 / 1100

This product was jointly developed with Professor Koichi Okamoto and Researcher Takehiro Noda of Meijo University's Faculty of Pharmaceutical Sciences.



See the video here

#### The spray freeze drying granulation method

This is a method of obtaining porous fine particles by spraying a sample (aqueous solution) in liquid nitrogen, freezing it, and then (freeze) drying it. The freezing process takes place in an instant, and a granulation effect is achieved. Since no heat is applied, no shrinkage occurs in the fine particles. Compared to the spray-drying method, this method produces samples that are more porous, more soluble, more dispersible, and less cohesive.



Spray drying



Freeze drying



#### Spray freeze drying granulation method (SFD)

It takes **longer time**, but requires **less heat**, has a **better yield**, and more **porous fine particle** samples can be prepared.

Fine particle	Yield	Thermal effects	Drying time
Good	Excellent	No	Average

#### Difference in drying methods



Spray drying method

It takes **more heat** and has a **lower yield**, but it takes **less time** and allows for the **preparation of fine particle** samples.

Fine particle	Yield	Thermal effects	Drying time
Good	Average	Yes	Excellent



Freeze drying method

It is **time consuming** and **does not produce fine particles**, but it is possible to prepare samples with **good yields without heat**.

Fine particle	Yield	Thermal effects	Drying time
N/A	Excellent	No	Average



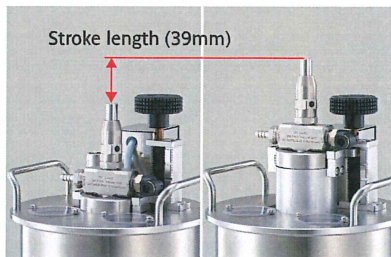
SFD-1000 (full system for pre- and post-process)  
 ※Air compressor is not included.

## By spraying the sample solution in liquid nitrogen, freezing it, and then (freeze) drying it produces porous fine particles.

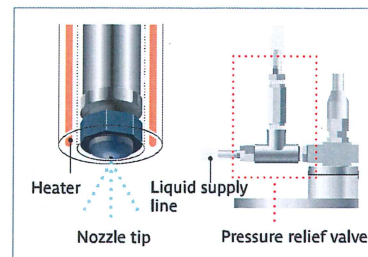
Compared to the spray drying method, this method produces samples that are more porous, more soluble, more dispersible, and less cohesive.

### Advantage of Porous Particles

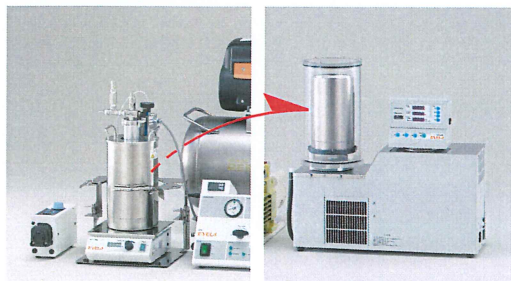
Because of the larger surface area of the particles, the area in contact with the water is larger, making them more easily dissolvable when the particles are dissolved in water. This can be expected in research applications for medicines and food that need to dissolve quickly.



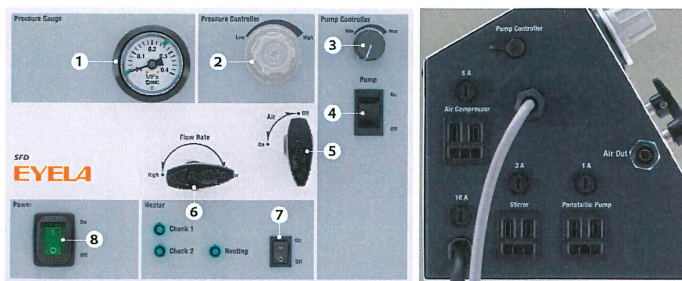
The height of the spray nozzle (two-fluid nozzle) can be adjusted with a knob bolt (PAT.P) to adjust the recovery rate and particle size. A scale is provided for adjusting the height position, allowing for highly reproducible experiments. The exhaust nozzle on the top of the lid can be used to exhaust nitrogen gas all at once, allowing operation outside the fume hood.



Two 100W heaters are installed at the tip of the spray nozzle (PAT.P) to prevent freezing and blockage of the tip. Even in the unlikely event of a freezing blockage at the tip, the pump line is equipped with a pressure relief valve to prevent the tube from falling out or being damaged.



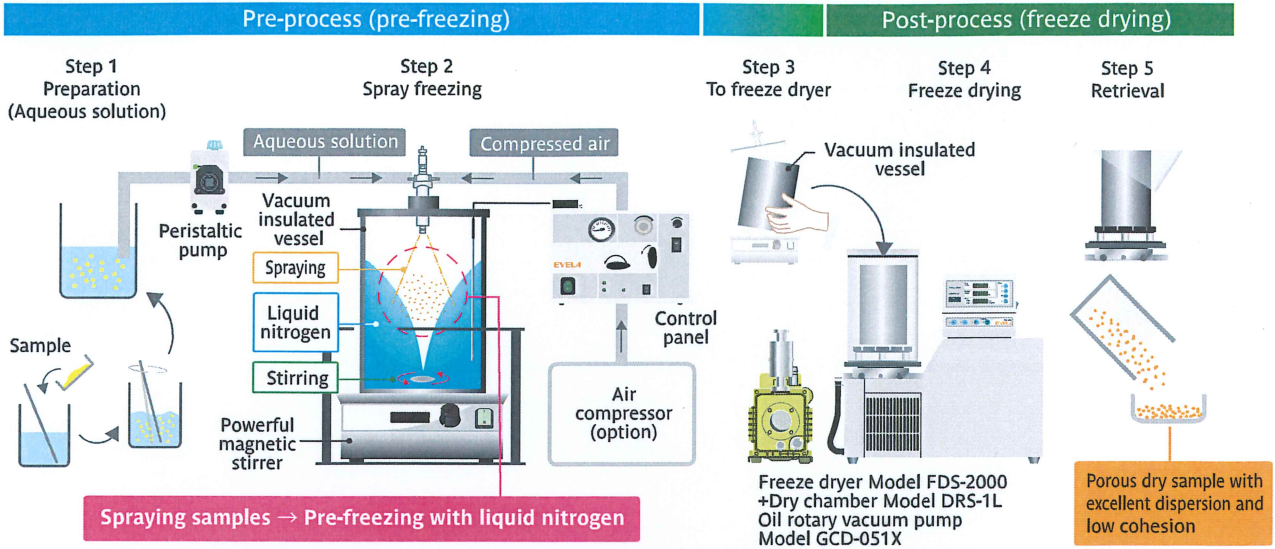
After spray freezing, the vacuum-insulated vessel can be placed directly into the dry chamber of the freeze-dryer, allowing a series of drying processes to be easily carried out without changing vessels.



Operation and setting are easy since the controls and power supply are integrated in the control panel. Particle size can also be controlled by adjusting the liquid pumping volume and atomizing pressure.

- ①Spray pressure gauge ②Regulator (spray pressure regulator) ③Pumping volume adjustment ④Pump power switch ⑤Air flow path switching valve
- ⑥Air pressure control valve ⑦Anti-freeze heater power switch ⑧Power switch

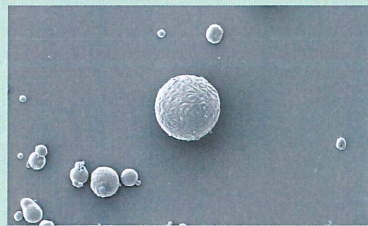
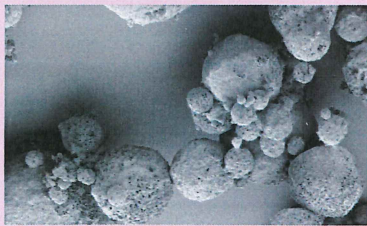
## Spray freeze drying granulation process (SFD)



## Characteristics of fine particles dried by each method

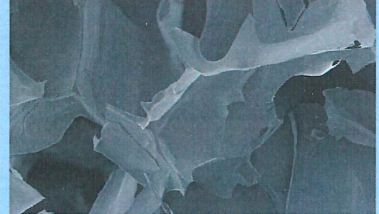
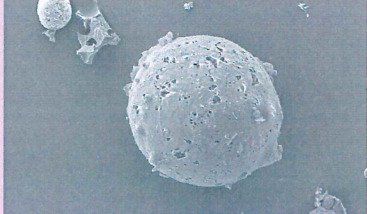
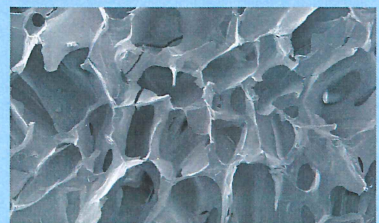
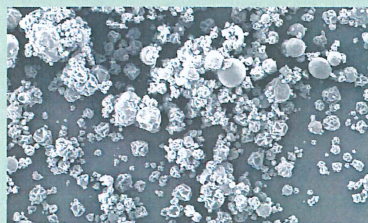
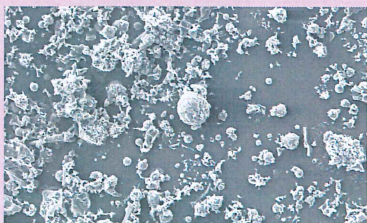
Spray freeze drying granulation method (SFD)	Spray drying method	Freeze drying method
<p><b>Particle cross-section image</b></p> <p>Because it is sprayed in the pre-process, a granulation effect is obtained, and since no heat is applied, no shrinkage occurs in the fine particles. In addition, the dried product is formed in a porous state, so it is difficult to aggregate and easy to disperse.</p>	<p><b>Particle cross-section image</b></p> <p>High heat of 100°C or more is applied instantaneously during drying, which causes shrinkage of fine particles, resulting in empty (hollow) particles. Since they do not become porous, they easily aggregate and are difficult to disperse.</p>	<p><b>Particle cross-section image</b></p> <p>Since it is dried without heat, no shrinkage occurs, but since it is not processed into fine particles at the pre-freezing stage, no granulation effect is obtained and the shape of the fine particles is uneven.</p>

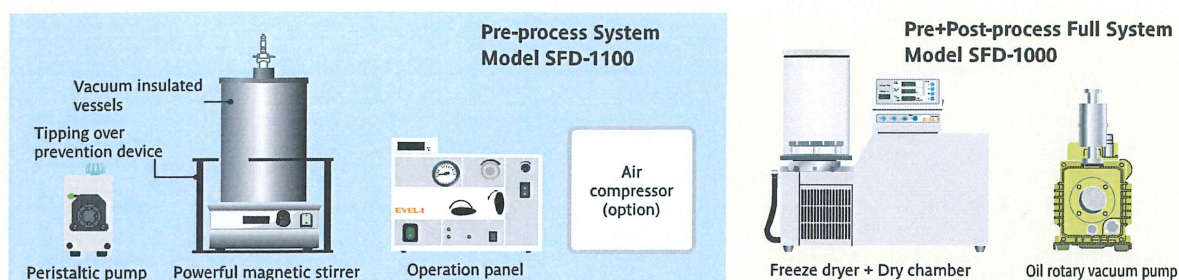
D-Mannitol (a type of sugar alcohol and a versatile sample in the field of pharmaceutical formulation research) ※Electron microscope 2000x



Coffee

※Electron microscope 500x (upper), 1000x (lower)

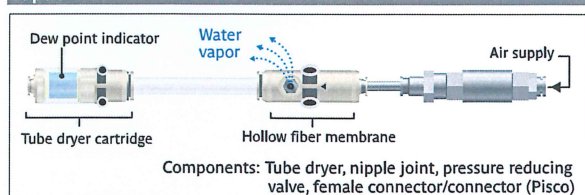




Product name	Spray Freeze Drying Granulation Unit	
Set format	Pre+Post-process Full System	Pre-process System
Model	SFD-1000	SFD-1100
Cat. No.	279490	279500
Processing volume	Max.0.15L/batch	
Spraying air pressure adjustment range	20 to 250kPa	
Pump flow rate range	51 to 900mL/h (Peristaltic pump NRP-1000)	
Sample stirring speed range	50 to 1600rpm (Powerful magnetic stirrer RCX-1100D)	
Spray nozzles	Two-fluid nozzle (nozzle hole diameter 0.71mm: nominal diameter 2)	
Air compressor	Option: Discharge air volume 20/24L/min (50/60Hz), control pressure 350 to 500kPa	
Freeze dryer trap temperature	-80°C	-
Freeze dryer dehumidification volume	750mL/batch	-
Control panel	Spray air valves (x 2), Bourdon tube vacuum gauge, Flow control knob, AC outlet (for spray air pump, Peristaltic pump, and Powerful magnetic stirrer), Power connector for anti-frost heater, Power switch (for liquid feed, heater, and overall), Fuses (x 3)	
Vacuum insulated vessel	Standard 3L stainless steel vessel (Outer diameter 148mm x height 243mm)	
Vacuum insulated vessel lid	Vertical nozzle mechanism for spraying, Liquid nitrogen gas exhaust nozzle (outer diameter 16 mm), Heater (100W x 2) for frost prevention	
Stroke length range	39mm	
Tube diameter	Inner diameter 3.15mm x outer diameter 5.2mm (silicon tube)	
Atomizing air connection diameter	Inner diameter 4mm x outer diameter 6mm (union joint for flexible urethane tube)	
Exhaust connection diameter	Outer diameter 20.5mm	
Ambient operating temp./humidity range	5 to 35°C / 30 to 70%RH (no condensation)	
Power input and supply voltage	16A 100VAC 50/60Hz	7.5A 100VAC 50/60Hz
Configuration	Freezing and granulation unit (lid + control panel), Vacuum-insulated vessel (3L), Tip-over prevention device, Peristaltic pump NRP-1000, Air/pump tubing, exhaust hose, Pressure relief valve for connection to facility air piping, Powerful magnetic stirrer RCX-1100D, Sample temperature sensor, Sample temp. display unit	
	Freeze Dryer FDS-2000, Dry chamber DRS-1L, Oil-sealed rotary vacuum pump GCD-051X, Vacuum hoses	-

※The liquid evaporates in about 10 minutes when 1L of liquid nitrogen is added in the insulated vessel (3L). The volume of sample that can be pumped in 10 minutes when the peristaltic pump NRP-1000 is operated at the maximum pumping rate is defined as one batch processing volume. ※The lower limit of the air pressure adjustment range for spraying is set at 0. However, spraying at 100 kPa or lower tends to cause frozen particulates to adhere to the sides of the insulated vessel in "large snowflakes," and the recovery rate tends to be poor because the sample cannot be utilized as particulates. ※The power input value for Model SFD-1000 includes all power input values for the freeze dryer and oil rotary vacuum pump in the subsequent process.

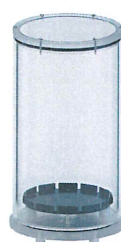
#### Option



**Tube dryer set** (Ambient operating humidity Max.70%RH)  
Cat. No. 280200

During sample spray, water in the insulated vessel is also frozen. Tube dryer uses hollow fiber membrane to separate water vapor from compressed air. To transfer frozen samples from insulated vessels to trays or petri dishes in the post-process (freeze-drying process) after spraying, please purchase a tube dryer. Simply attach to the air inlet of the spray nozzle. When the dew point indicator turns red, it is time to replace it. Since the tube dryer cannot be disassembled, it is required to replace the tube dryer cartridge with new one.

**Tube dryer cartridge**  
Cat. No. 280190



#### Dry chamber for 3L vacuum insulated vessels

This is a special long-tube dry chamber that can hold the standard accessory of 3L vacuum insulated vessel and can be set directly inside the dry chamber after sample spraying.

Model DRS-1L (For Model FDS-1000/2000)  
Cat. No. 279310

Model DRC-1LL (For Model FDM-FDL)  
Cat. No. 2279400



#### Air compressor

Model 0.2LE-8SBA

Specification

- Discharge air volume: 20/24L/min (50/60Hz)
- Tank Capacity: 30L
- Control pressure: 3.5 to 5.0kgf/cm<sup>2</sup>
- Power input: 4.1A
- Supply voltage: 100VAC 50/60Hz

※This product cannot be exported from Japan. Please source in your country.

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※The appearance and specifications of the products are subject to change without notice.