



SD-05 SPRAY DRYER

ASSEMBLY & OPERATING INSTRUCTIONS

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1) INTRODUCTION

The Lab-Plant SD-05 Laboratory Scale Spray Dryer is based on more than 30 years of continuous production and development.

The SD-05 has been designed primarily for simplicity and ease of use, rapid assembly and disassembly for cleaning, minimal maintenance, efficiency of operation and reproducibility of previous conditions.

2) SAFETY IN THE USE OF EQUIPMENT SUPPLIED BY LAB-PLANT LTD

Before proceeding to install, commission or operate the equipment supplied you should be aware of potential hazards so that they may be avoided.

Although designed for safe operation, any equipment may involve processes or procedures which are potentially hazardous. The major potential hazards associated with this particular equipment are listed below.

- INJURY THROUGH MISUSE
- INJURY FROM ELECTRIC SHOCK
- RISK OF INFECTION THROUGH LACK OF CLEANLINESS

Accidents can be avoided provided that equipment is regularly maintained and operators are aware of potential hazards. A list of general safety rules is included in this manual, to assist in this regard. The list is not intended to be fully comprehensive but for guidance only.

The COSHH Regulations (1988) - The Control of Substances Hazardous to Health

The COSHH regulations impose a duty on employers to protect employees and others from substances used at work which may be hazardous to health. The regulations require that you assess all operations which are liable to expose any person to hazardous solids, liquids, dusts, vapours, gases or micro-organisms. You are also required to introduce suitable procedures for handling these substances and to keep appropriate records.

The equipment supplied by Lab-Plant Ltd may involve the use of substances which can be hazardous (for example, cleaning fluids used for maintenance or chemicals used for particular demonstrations) and it is essential that some person in authority is responsible for implementing COSHH regulations.

Part of these regulations are to ensure that the relevant Health and Safety Data Sheets are available for all hazardous substances used in the laboratory. Any person using a hazardous substance must be informed of the following:

- Physical Data about the substances
- Any hazard from fire or explosion
- Any hazard to health
- Appropriate First Aid treatment
- Any hazard from reaction with other substances
- How to clean/dispose of spillage
- Appropriate protective measures
- Appropriate storage and handling

Although these regulations may not be applicable in your country, it is strongly recommended that a similar approach is adopted for the protection of staff operating the equipment. Local regulations must also be considered.

3) GENERAL SAFETY RULES

FOLLOW RELEVANT INSTRUCTIONS

- a) Before attempting to install, commission or operate equipment the manufacturers instructions should be understood and implemented.
- b) It is dangerous to misuse equipment or ignore instructions, regulations or warnings.
- c) Do not exceed specified maximum operating conditions (e.g. temperature, pressure, speed etc.).

INSTALLATION

- a) Use lifting tackle where possible to install heavy equipment.
- b) Care should be exercised to avoid damage to the equipment during handling and unpacking. Damage may go unseen during commissioning creating a potential hazard to subsequent operators.
- c) Equipment involving inflammable or corrosive liquids should be sited in a containment area or bund with a capacity 50% greater than the maximum equipment contents.
- d) Ensure that all services are compatible with the equipment and that independent isolators are always provided and labelled. Use reliable connections in all instances, do not improvise.
- e) Ensure that all equipment is earthed and connected to an electrical supply at the correct voltage. The electrical supply must incorporate an Earth Leakage Circuit Breaker (ELCB) or Residual Current Circuit Breaker (RCCB) to protect the operator from electric shock in the event of misuse or accident.
- f) Potential hazards should always be the first consideration when deciding on a suitable location for equipment. Leave sufficient space between equipment and between walls and equipment

COMMISSIONING

- 1) Ensure that equipment is commissioned and checked by a competent member of staff.
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4) COMPONENTS INCLUDED

The SD-05 is supplied complete and ready for operation without any extra equipment normally being required. Options are available such as alternative jet nozzle spray assembly sizes, exhaust wet scrubber, bench type mobile trolley, protective screen, large main chamber, inert gas inlet etc.

The unit comprises:

Main Cabinet Including control panel, inlet air filter, spares drawer, top chamber, peristaltic pump, side support tray, outlets from compressors to jet de-blocker and jet nozzle, doors to interior on side and rear.

Spray Assembly Main chamber, cyclone, collection bottle and bottom collection tube.

Other Items All necessary silicone pump tubing, exhaust tubing, connectors, PTFE gaskets.

5) PACKING LIST

The apparatus should be carefully unpacked and the components checked against the Delivery Note.

Any omissions or breakages should be notified to Lab-Plant Ltd within three days of receipt.

The check-list for unpacking is as follows:

<u>DESCRIPTION</u>	<u>QTY</u>
Main SD-05 unit	1
Main Chamber	1
Cyclone	1
Collection Bottle	1
Collection Tube	1
Screw Joint Connectors	2
PTFE Gaskets	2
Clamp for Chamber/Cyclone	1
Jet Assembly with 0.5 mm jet	1
Side Mounting Tray	1
Silicone Tube 4mm bore x 2mm wall	2.0 m
Exhaust Tube	1.7 m
Nylon Tube 4mm Ø	1.0 m
Nylon Tube 6mm Ø	1.0 m

The above comprises the unit SD-05.

Any accessories or spares ordered will be additional to the above.

6) CONNECTION TO ELECTRICAL SUPPLY

The Lab-Plant SD-05 Spray Dryer is supplied for 220/240V, 50/60Hz operation.

A 110/120V primary 240V secondary step down transformer is supplied for 110V operation.

The power requirement for the 240 volt unit is 13 amp and for the 110 volt unit is 30 amps.

IMPORTANT

The mains cable is connected as follows:

Brown = Live
Black = Neutral
Green/Yellow = Earth

The SD-05 must always be connected to suitable earthing.

7) ASSEMBLY AND PREPARATION

Ensure the SD-05 is on a strong level bench top and, if not being used with an exhaust wet scrubber, the unit must be positioned near an outside window if exhausting to atmosphere or to the main laboratory fume cupboard. Do not connect direct to any extraction system as this will affect the air flow. If using with a wet scrubber the SD-05 may be positioned as required but careful examination at the exhaust outlet must be made to determine if the product being sprayed is being entirely cleaned by the scrubber system.

Open the main chamber clamp which is fastened to the chamber head and, carefully supporting the main chamber, fit it into position and tighten the clamp sufficiently to hold the chamber whilst also allowing it to be rotated to line up with other components.

Loosen the knurled screw ring at the base of this assembly and slide the top tube of the cyclone upwards into the assembly. Rotate the cyclone so that the flange of the cyclone and the flange of the main chamber are in line. Using the small black anodised clamp connect these flanges together and tighten the clamp. Carefully tighten the main chamber clamp, connecting clamp and the knurled screw whilst ensuring that all of the glass components are lined up correctly and are not under any strain.

The exhaust assembly has adjustments which are factory set to match the glassware supplied and should not require attention.

When all parts have been secured as described, the stainless steel exhaust assembly can also be secured in position using the grub screws provided and, if the glassware is correctly fitted, this part should not require to be altered or moved in future assembly/disassembly unless new glass parts are used.

When any new glass components (main chamber or cyclone) are used some adjustments may be necessary. The exhaust assembly slides in the direction shown and this is sufficient to allow for adjustments.

Using the black plastic screw connectors and the PTFE gaskets, connect the tube to the base of the main chamber and the collection bottle to the cyclone.

Tighten these parts so that they are firm against the gasket seals but not over-tightened.

Connect the exhaust tube to the tapered stainless steel exhaust assembly by simply sliding it over the top. For most applications this will be sufficient. However, adhesive tape may be used as an added precaution.

Direct the other end of the exhaust tube to an outside vent or to a fume cupboard as required.

(If using the wet scrubber see Note I).

8) JET SPRAY ASSEMBLY

The stainless steel spray assembly is a two fluid nozzle where the inner nozzle develops the liquid jet and the outer the compressed air outlet. The compressed air atomises the liquid as it emerges from the jet to form the required fine spray.

The jet and outer nozzle can be unscrewed from the main assembly for cleaning if required.

Always be careful not to damage the inner jet nozzle (which is only 0.5mm \varnothing thin wall stainless steel tubing) as any slight misalignment will affect the efficiency of the spray.

The jet assembly is easy to disassemble by unscrewing the knurled rings.

Instructions for testing the jet spray assembly outside the main chamber

Before fitting the jet into the top chamber it is useful to operate it outside, with water, to see the actual spray formation and to examine the changes caused by reducing and increasing the compressed air pressure.

The procedure is detailed below:

Connect to mains and the green 'Mains' indicator will illuminate. Switch on the main switch next to the mains indicator lamp. Press the green 'On' position for the pump and set the pump rotation speed so that it is very slow.

Open the hinged plastic cover of the pump and leaving sufficient tube to connect to the jet when it is in the top chamber, insert the tube so that it is fed into the peristaltic pump rollers.

Open the white plastic clips which retain the tube in position, insert the tube fully and release the clips. The tube should now be regularly compressed by the pump rotors. Fit one end of the tube to the rifflled tubular on the jet tube body.

Using the larger 6mm diameter hard nylon tube push one end into the appropriate connector at the top left side of the cabinet and the other end in the connector in the jet. This is the main compressed air feed line to the jet nozzle.

Then connect the small diameter nylon tube into the appropriate connector at the cabinet and the top of the jet. This is the compressed air supply for the jet de-blocking system. There is no possibility of connecting these tubes incorrectly as the connectors are of different sizes. To release these tubes simply push in the black ring on the connector and pull the tube out.

When the three tubes are connected to the jet assembly place the open end of the silicone pumping tube into a beaker of clean water and switch on the pump.

Increase the speed and watch the water travel through the tube.

8) JET SPRAY ASSEMBLY (continued...)

When the water reaches the jet assembly it will emerge from the jet nozzle in a fine stream. Switch on the compressor touch switch on the main panel and the liquid emerging from the jet should immediately form a fine spray mist. (Note: switching on the compressor also activates the jet de-blocking system. This can be turned to low or frequent, as required, using the de-blocker control knob).

Set the multi-indicator knob to 'Pump Flow' and then adjust the 'Pump Speed' knob at the same time observing the digital indicator. The digital numerals will alter as the pump speed is changed.

The information indicates pump speed on a nominal 10-50 scale. For appropriate flow rates in ml/hr please see the chart on Note II.

Now set the multi-indicator to the 'Compressor Air Pressure' setting. The digital indicator will now show the pressure to the jet in bar.

Whilst observing the digital indicator and the actual spray formation alter the air pressure using the 'Compressor Air Pressure' knob at the top of the integral panel. The maximum air pressure when using a 0.5mm jet is approximately 2.0 bar. This setting produces a fine spray.

As pressure is reduced you will see the spray become progressively coarser. This is producing larger liquid droplets and some products require reduced pressure settings to spray dry successfully.

Note that the maximum air pressure available is considerably reduced when larger jet diameters are used so that, for example, if using the 1mm jet the maximum compressor pressure available may be as low 0.6 bar. This is normally sufficient for the larger jets.

When you have become familiar with the operation of the jet system look closely at the jet nozzle to see the fine jet de-blocking needle in operation. The frequency of the de-blocking action is controlled by the 'De-blocker' knob. If de-blocking is not required simply remove the small diameter (4mm) nylon tube from the top of the jet assembly and from the outlet at the top left of the main unit. The internal de-blocker controls will continue to operate but will not affect the jet

Now place the jet assembly in the top chamber and secure with the knurled screw.

The SD-05 unit is ready for operation.

9) OPERATION

Select the product you wish to spray dry but always start and end the process by using clean or distilled water.

Place the pump tube in the water.

Switch on the mains switch on the SD-05 and then switch on the blower and the heater using the appropriate green touch contacts.

Note: the heater will not operate unless the blower is running.

Using the σ button on the air flow increase to maximum.

This is indicated by setting the multi-indicator switch to 'Air-flow'.

9) OPERATION (continued...)

The digital indicator will then show the flow on a scale of 10-50. When the unit is cold approximately 46 may be the maximum indicated. This does not matter - simply press the σ button briefly until the digits do not increase any more. (Note: The 10-50 scale is shown as m^3/hr on the graph on Note III).

When the air flow is at maximum setting, using the 'inlet temperature' controller set the temperature as required.

To see the set temperature press the Ξ button. The set level is then indicated. Keeping the Ξ button pressed adjust the σ or τ button as required until the desired setting indicates. Release the buttons and the temperature will rapidly increase until the set level is achieved.

A variable overtemperature protection cut-out is included. Open the rear door and on the panel facing is a dial control. Using a screwdriver set the max operating temperature to any level required. In the event of the overtemperature cut-out operating it will switch off the heater. The overtemperature control will require re-setting. To do this press the red button through the hole below the setting dial.

Switch on the compressor and then the pump using the appropriate green touch contacts.

Using the 0.5mm jet maximum back pressure is approximately 2.0 bar and this reduces when larger diameter jets are used.

Using the 'multi-indicator' knob set the compressor flow to maximum.

Then set the pump to a fairly slow rate e.g. 15 or 20.

Allow a small amount of water to be pumped into the silicone tube to clean the tube and the jet and then transfer the tube to the sample. When the sample reaches the jet the Spray Drying Operation should commence and dried powder should be observed spiralling down the cyclone into the collection bottle.

Once spray drying has commenced variations in temperature, air flow, pump speed, compressed air pressure etc may be tried to improve the process.

10) GENERAL ADVICE AND USEFUL HINTS

- 1) Always start a trial with a low to medium inlet temperature (120-180°C), maximum air-flow, maximum compressor air-pressure and a slow pump rate. Observe the bottom of the main chamber for wetting and either reduce the pumping rate or increase the temperature if the product is not completely drying. The optimum pumping/temperature rates are achieved when no wet spotting of the product is observed.
- 2) If the sample is a liquid with solids in suspension it may be necessary to keep it continually agitated with a magnetic or overhead stirrer. Heavy suspensions are best pumped from the sample container when it is positioned on the side shelf as this shelf, the pump and the jet are all at a similar height. If the sample is pumped from the bench top the product may separate as it is being pumped upwards in the silicone tube.

10) GENERAL ADVICE AND USEFUL HINTS (continued...)

- 3) Most spray drying processes lose fines in the exhaust. The amount lost usually depends on air flow and particle weight. The air flow can be reduced using the panel controls and the particle size/weight can often be increased by using a larger jet size and/or by reducing the compressed air pressure.
- 4) At the commencement of spray drying give the main chamber a few minutes to warm up. The inlet temperature may show the required setting but the glassware and main chamber will be quite cool for a few minutes.
- 5) If the sprayed sample is light coloured it may be more easily observed by placing a dark card behind the cyclone.
- 6) The ideal flow path through the cyclone should be a continuous spiral. If product accumulates on the cyclone wall try alterations to the air flow or the compressor jet pressure or the jet size.
- 7) Only change one parameter at a time e.g. temperature, air flow etc.
- 8) Some samples may require pre-heating before spraying.
- 9) In rare instances the use of a suitably supported separating/dropping funnel positioned as near as possible to the jet assembly has been found to be effective rather than using the pump. This gravity feed method is effective where e.g. abrasive ceramics may cause the pump tube to wear exceptionally quickly.
- 10) Peristaltic pumping always creates a pulsing liquid flow. If this is a problem the pulsing effect can be reduced by connecting a small glass expansion bulb in the tube between the pump and the jet.
- 11) Generally the most efficient drying is achieved using the highest temperatures compatible with the product but temperatures as low as ambient may be used with e.g. non-flammable solvents.
- 12) If spraying with an inert gas is necessary a back plate with gas connectors may be fitted to cover the air inlet position at the rear of the SD-05. However, if using with inert gases we recommend that the SD-05 should be used in a fume cupboard and that precautions are taken against the possibility of any gas leaks. The SD-05 is not designed as an Ex. System. For inert gas supply please consult the table in Note III.
- 13) The SD-05 successfully dries encapsulated products.
- 14) If agglomerated trials are required it is necessary to purchase an additional full spray assembly (SDS 2046) and to use this with the counter current spraying adapter and a separate peristaltic pump. Fit the counter current spraying assembly to the bottom of the main chamber using the standard double screw adapter and PTFE seal. Using a simple T or Y connector and the standard tubing connect to the compressed air supply for the main jet but do not connect to the de-blocking system. Using a separate peristaltic pump direct the agglomerating spray onto the main sprayed product.

11) OPTIONAL ACCESSORIES

- 1) 0.5mm jet is supplied as standard. 1.0mm and 1.5mm jets are optional.
 - 2) Amber stained low actinic glassware is available for products which are light sensitive.
 - 3) An exhaust air wet scrubber unit.
 - 4) Magnetic stirrer hotplate MR 3001 for maintaining liquids in suspension and for heating. The side tray is designed to accept this stirrer.
 - 5) Magnetic hotplate MR 3000 when heating is not required.
 - 6) Mobile bench - when standard bench space is not available or when the unit is stored between projects or may be moved to different departments.
 - 7) Large main chamber - 800 mm long. Gives added spray drying efficiency but must be positioned to overhang the bench due to the extra length. Supplied with a connection tube between the cyclone and the stainless steel exhaust assembly.
 - 8) Inert gas connection plate. Designed to cover the air inlet filter and with a riffled tubular for gas connection.
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12) SPARE PARTS LIST

SDS 2018	Standard Main Spray Chamber - 500mm long x 215mm OD
SDS 2020	Large Main Spray Chamber - 800mm long x 215mm OD
SDS 2022	Cyclone
SDS 2001	Exhaust Tube - 3.5 metre length
SDS 2002	Exhaust Tube - 1.75 metre length
SDS 2031	Peristaltic Pump Silicone Tube 4mm ID x 1.6mm wall
SDS 2004	Peristaltic Pump Silicone Tube 2.5mm ID x 2.0mm wall
SDS 2056	Nylon Tube (for de-blocker)
SDS 2057	Nylon Tube (for atomiser)
SDS 2006	Sample Collection Bottle - 500 ml
SDS 2021	Sample Collection Bottle - 1000 ml
SDS 2046	Jet assembly complete with any specified standard jet size required
SDS 2010	Sample Collection Tube
SDS 2011	Double Plastic Screwcap Adapter
SDS 2012	PTFE Gasket Seal
SDS 2040	Plunger De-Blocking Needle Assembly
SDS 2042	Needle 0.5mm
SDS 2033	Pack of Assorted O Rings for Jet Assembly
SD 1004	0.5mm Stainless Steel Jet Nozzle Assembly (Inner Jet and Outer Nozzle)
SD 1006	1.0mm Stainless Steel Jet Nozzle Assembly (Inner Jet and Outer Nozzle)
SD 1007	1.5mm Stainless Steel Jet Nozzle Assembly (Inner Jet and Outer Nozzle)

13) NOTES

Note I Wet Scrubber

The SD 5002 Wet Scrubber effectively washes the exhaust and is particularly useful when spray drying harmful substances e.g. fine ceramics etc or products which may cause some nuisance e.g. colour pigments and products with strong flavours.

The scrubber unit is designed to be placed on top of the SD-05 and a small section of the standard exhaust tube is used to connect the stainless steel exhaust outlet to the bent tube inlet on the scrubber. The remaining exhaust tube is connected to the top outlet and directed to a convenient window or to a nearby fume extraction cupboard.

The scrubber requires a continuous supply of mains water at approximately 6-8 litres per minute and minimum pressure of approximately 3 bar (44 psi). This is connected to the top inlet and a separate tube from the bottom outlet should be directed to drainage or, if required, to a settler tank and recycled by pump rather than using mains supply.

The wet scrubber is constructed entirely in PVC and the double spray assembly in the scrubber is 316 stainless steel.

Note II Pump Flow Rate

The digital information on the multi-indicator, when set at 'Pump Flow', shows the pump speed on a numerical scale of 0 to 50.

Note III Air Flow Rate

The multi-indicator shows the air flow at the exhaust outlet on a 10-50 digital scale. Approximate values at the exhaust assembly outlet are shown as follows:

Scale	ml/hr
0	0
10	350
20	600
30	1000
35	1500
40	1900
45	3200
50	4600

Scale	M ³ /hr
10	38
15	44
20	47
25	50
30	54
35	57
40	62
45	64
50	73

Air Flow Rate

The maximum '50' indicator is set without any flexible exhaust tube attached e.g. for when used in a fume cupboard. Long lengths or bends in the exhaust tube will reduce the volume of drying air which is blown through the system.

Dependant on the length of exhaust tube used or the severity of bends in its length the maximum reading may be reduced to as low as 40-45 on the digital indicator.

Please also note that when used in a fume cupboard the air suction may actually increase the normal maximum air flow through the SD-05.

13) NOTES (continued...)

Note IV Counter-Current Spraying

Often useful when a longer resonance time of the product in the main chamber may assist in the drying process.

Also useful for agglomeration work when the standard jet may be used to spray the product and an additional jet assembly together with the PTFE/stainless steel adapter can be used to spray the agglomerator.

An additional peristaltic pump and compressed air supply is necessary if two jet assemblies are used.

Sketch 1 Shows the unit set for counter-current spraying when the spray is directed against the air flow.

Sketch 2 Shows the unit set for agglomeration work where the top jet sprays the product and the bottom jet sprays the agglomerator.

Sketch 1

Sketch 2

Note V Maintenance

Regular maintenance of any equipment ensures maximum trouble-free life.

Customers are recommended to carry out simple maintenance at regular intervals - the most basic of which is to keep the equipment clean! No matter how regularly your equipment is in use always find time to thoroughly clean it.

Periodically remove the AIR FILTER in the rear door and wash.

Maintenance contracts are available for most products.



Thank you for reading this data sheet.

For pricing or for further information, please contact us at our UK Office, using the details below.



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Please note - Product designs and specifications are subject to change without notice. The user is responsible for determining the suitability of this product.