

## **LyoDry Compact Benchtop Freeze Dryer INSTALLATION AND OPERATION MANUAL**



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### **PLEASE READ THIS DOCUMENT BEFORE OPERATING THE MACHINERY**

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INSTALLATION AND OPERATION MANUAL  
LyoDry Compact

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**1. DOCUMENTATION RECORDS**

Issue	Documentation Update Details	Date	Approval
1a	Project version 1a developed and issued for internal review	18/02/13	JH
1	First formal release.	20/02/13	JH
2	Vacuum pump control	20/05/13	JH
3		20/02/15	JH
4		15/07/15	JH

## 2. INTRODUCTION

### 2.1 Purpose

This manual provides installation and operation instructions for the LyoDry Compact Unit.

This manual and all accompanying documentation must be read before operating the vacuum system.

Important safety information is highlighted as **WARNING** and **CAUTION** instructions; you must obey these instructions. The use of WARNINGS and CAUTIONS are defined below.

### 2.2 General safety



**WARNING:** Warnings are given where failure to observe the instruction could result in injury or death to persons.



**CAUTION:** Cautions are given where failure to observe the instruction could damage to the equipment, associated equipment or process. Refer to the accompanying manufacturers' instruction manuals for the technical data on individual components.

### 3. INSTALLATION AND TEST

#### 3.1 Lifting and handling Instructions



**WARNING:** The LyoDry Compact is heavy. Use suitable lifting equipment to move the LyoDry Compact or get someone to help you move it. Do not attempt to lift the LyoDry Compact on your own.

#### 3.2 Unpack and inspect



**CAUTION:** Remove all packing material before operating system. If the equipment is damaged notify your supplier and the carrier in writing within three days.

Remove all packing materials and inspect the LyoDry Compact. If the LyoDry Compact is damaged, notify your supplier and the carrier in writing within three days; state the serial number of the LyoDry Compact together with your order number and your supplier's invoice number. Retain all packing materials for inspection. Do not use the LyoDry Compact if it is damaged. Check that your package contains the items listed in Table 1 below. If any of these items is missing, notify your supplier within three days.

Quantity	Description	Check
1	LyoDry Compact Freeze Dryer	<input type="checkbox"/>
1	Power Cord	<input type="checkbox"/>
1	Condenser Extension Tube	<input type="checkbox"/>
1	Vacuum Pump Connection Hose	<input type="checkbox"/>
1	Nozzle Connector	<input type="checkbox"/>
1	Vacuum Pump Connection Clamp	<input type="checkbox"/>
1	Drain Tube	<input type="checkbox"/>

Table 1 – Checklist of components.

If the LyoDry Compact is not to be used immediately, replace the protective covers. Store the LyoDry Compact in suitable conditions.

### 3.3 Locate the LyoDry Compact

The LyoDry Compact is designed for use on a laboratory bench-top. Locate the LyoDry Compact in its required operating position, ensuring that the surface is adequate to support the equipment, within convenient access to a suitable electrical supply.

We recommend that you leave an air-gap of at least 200mm between all four sides of the LyoDry Compact and any wall or obstruction. If you do not leave a sufficient air gap, poor cooling of the LyoDry Compact may result in poor performance.

When you locate the LyoDry Compact, you should also consider ease of access for maintenance and repair work, when you will need to remove the cover of the LyoDry Compact.

### 3.4 Connecting the LyoDry Compact to the electrical supply



**WARNING:** Failure to refit all panels prior to connecting to mains power may result in injury or death to the operator.



**WARNING:** Ensure that the electrical installation of the LyoDry Compact conforms to your local and national safety requirements. It must be connected to a suitably fused and protected electrical supply and a suitable earth (ground) point.

1. Make sure that the LyoDry Compact is suitable for use with your electrical supply voltage and frequency.
2. Ensure that the main switch (item 1, figure 2) is on the '0' (off) position.
3. The LyoDry Compact is supplied with a two-metre length of 3-core electrical supply cable. Connect the cable to the electrical supply.

### 3.5 Connecting the vacuum pump

#### 3.5.1 General



**WARNING:** If you intend to freeze dry products that contain Sodium Azide, make sure that your vacuum pump and pipeline are suitable for freeze drying these products. If they are not suitable, there is a severe risk of explosion.



**CAUTION:** Exhaust gases must be ducted away from the surrounding atmosphere and suitably disposed of.



**CAUTION:** Do not obstruct any vacuum pump exhaust port (refer to manufacturer's manual before operation).



**CAUTION:** You must use a two-stage pump with the LyoDry Compact. If you do not, the pump will have a very short working life.

Connect your vacuum pump to the vacuum pump connector on the front of the LyoDry Compact. The connector is suitable for use with a 10 mm inside diameter pipeline.

It is recommended that an Edwards model RV5 or RV8 vacuum pump is used with the LyoDry Compact. This pump is suitable for freeze drying products which contain sodium azides. To connect an Edwards RV5 or RV8 pump to the LyoDry Compact, please see below.

If you do not use an Edwards vacuum pump, the pump must meet the requirements specified in Section (9). To connect another type of pump to the LyoDry Compact, refer to the instruction manual supplied with the pump.



### 3.5.2 Connect an Edwards RV5 or RV8 pump to the LyoDry Compact



**WARNING:** The vacuum pump supply outlet has a maximum rating of 6amps. Vacuum pumps which exceed this rating should not be connected to the supply outlet and should be supplied separately.

To connect an Edwards RV5 or RV8 pump to the LyoDry Compact and use the following procedure.

1. Remove the vacuum pump connection kit from its packing material. As shown in Table 4, the kit contains a clamp, a one-metre vacuum hose and a nozzle connector.
2. Fit the centring-ring and inlet filter assembly to the inlet-port of the pump, and then use the clamp to secure the nozzle connector to the inlet-port.
3. Push one end of the vacuum hose onto the nozzle connector.
4. Push the free end of the vacuum hose onto the vacuum pump connector on the front of the LyoDry Compact.
5. The LyoDry Compact is supplied with a 1.5 metre length of 3-core electrical supply cable. Connect the cable to the vacuum pump and the LyoDry Compact pump power outlet on the rear of the LyoDry Compact (item 2, figure 2).

### 3.5.3 Pump outlet safety

Fit an oil mist filter or pipe the exhaust gases of the vacuum pump to a suitable treatment plant.

An Edwards EMF Oil Mist filter is available as an accessory and can be fitted to trap oil mist exhausted from the pump.

### 3.5 Test after installation



**CAUTION:** Do not attempt to use the LyoDry Compact if it fails the installation test. If you do, poor performance may result in the loss of the product being freeze dried.



**CAUTION:** Never engage the vacuum pump when water is present in the Ice Condenser. The introduction of water directly into the internal mechanism of the vacuum pump will cause significant damage to the pump.

When you have installed the LyoDry Compact, test that it works correctly. Note that the refrigeration system uses a thermostatic expansion valve which contains a spring-loaded needle valve; the expansion valve automatically regulates the amount of refrigeration, according to the load on the refrigeration system. The needle valve is optimised for load conditions and when you test the LyoDry Compact with the chamber empty (that is, with no product in the chamber), the temperature of the chamber can cycle between  $-40^{\circ}\text{C}$  and  $-50^{\circ}\text{C}$ .

Use the following procedure to test the LyoDry Compact:

1. Switch on the electrical supply and then turn the main switch (Figure 2) to the '1' (on) position.
2. The display (item 3, Figure 1) on the front panel should be illuminated.
3. Press the button directly below 'Start' on the control panel.
4. Hold an A4 size piece of paper against the grill on the left side of the LyoDry Compact. If the paper is drawn towards the grill then the cooling fan is rotating correctly: continue at Step 5. If the fan is not rotating, continue at Step 10 below.
5. Check that the compressor operates. If it operates, you will hear a low hum: continue at Step 6. If you cannot hear the compressor, continue at Step 10 below.
6. Leave the LyoDry Compact on for approximately 40 minutes, and then check that a temperature of  $-45^{\circ}\text{C}$  or lower is shown on the temperature gauge. If the temperature is correct continue at Step 7 below. If the temperature is not correct, continue at Step 10 below.
7. Attach an empty drying accessory to the accessory flange (item1, Figure 1).
8. Turn the drain-valve fully clockwise to close it, and then switch on the electrical supply to the vacuum pump.
9. Leave the pump to operate for at least 30 minutes, then check that a pressure of  $1 \times 10^{-1}$  mbar or lower is shown on the pressure gauge. If the pressure is correct, the LyoDry Compact is ready for use. If the pressure is not correct, continue at Step 10.
10. If any of the checks in Steps 3 to 9 above fail, turn the main switch to the '0' (off) position, then switch off the external electrical supply and disconnect the supply from the LyoDry Compact. Contact your supplier for advice. Do not attempt to use the LyoDry Compact.

## **4. OVERVIEW**

### **4.1 General description**

The LyoDry Compact is the ice condenser section of a freeze drying system. It is a low-cost unit suitable for freeze drying biological and pharmaceutical preparations in a laboratory. The LyoDry Compact only requires the attachment of a suitable vacuum pump and drying accessory to form a complete freeze drying system. The LyoDry Compact is also suitable for use on other vacuum duties, including evaporation and distillation processes.

The LyoDry Compact has a condenser chamber, a refrigeration system and a control system which includes temperature and pressure indication and user controls. The refrigerant used in the LyoDry Compact is CFC free. All of the LyoDry Compact components are all housed in a stainless steel cabinet which is designed for bench-top use. The components are described in the following sections (see figure 1 for the locations of components).

When used with suitable accessories, the LyoDry Compact can be used to freeze dry materials in bulk trays, round-bottomed flasks, vials or ampoules. Alternatively, the LyoDry Compact can be used as a low-temperature vapour trap (or cold trap) that may be attached to an existing evaporation facility. A number of accessories are available from MechaTech Systems; these include vacuum pumps, drying accessories and glassware.

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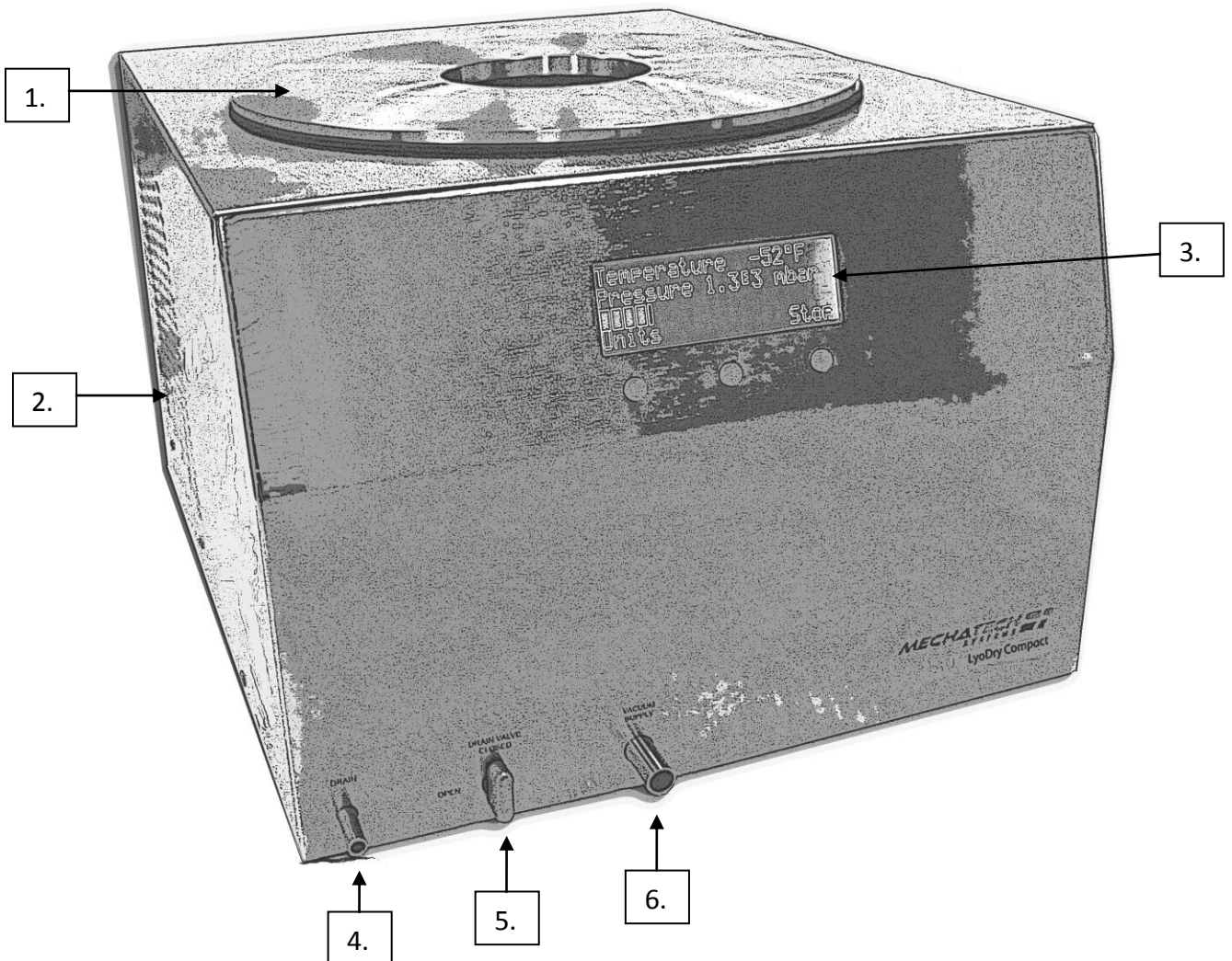


Figure 1 – LyoDry Compact.

1. Condenser Chamber Accessory Flange & Condenser Chamber
2. Steel Cabinet
3. Display
4. Drain Outlet
5. Drain Valve
6. Vacuum Port

#### 4.2 The condenser chamber

The Condenser Chamber can trap up to 4.5 litres of ice. It contains a cooling-coil which condenses water vapour, to form ice. The temperature of the cooling-coil under normal operating conditions with no load applied is  $-55^{\circ}\text{C}$ .

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A large diameter accessory flange, which is compatible with the LyoDry Compact accessory range, is at the top of the condenser chamber. The large top opening allows easy inspection, cleaning and defrosting of the condenser chamber and enables high vacuum-pumping rates to be attained.

A valved drain-pipe runs from the base of the condenser chamber to the drain-outlet on the front of the LyoDry Compact. The drain-valve on the front of the LyoDry Compact controls the operation of the valve in the drain pipe. The drain-pipe is used to drain liquid condensate from the chamber and to admit air into the system.

A vacuum pipeline connects the chamber to a vacuum pump connector on the front of the LyoDry Compact. You can connect a suitable two-stage vacuum pump to this connector to evacuate the condenser chamber.

#### 4.2.1 Condenser extension tube

A condenser extension tube is supplied with the LyoDry Compact. The extension tube can be installed inside the condenser chamber to extend the vacuum pumping pipeline further into the condenser chamber. This results in an improved distribution of ice.

We recommend that you fit the extension tube inside the condenser chamber whenever a load capacity of 2 litre (or more) condensate will be collected.

#### 4.3 Control panel and connections

The use of the controls and connections are described in Table 2 and Table 3.

<b>Control/Connection</b>	<b>Use</b>
Display / buttons	The display in conjunction with the three push buttons is used to fully operate and monitor the LyoDry Compact. The pressure reading shows the pressure in the condenser chamber. The temperature reading shows the temperature in the condenser chamber.
Vacuum pump connector	Use this to connect your vacuum pump to the LyoDry Compact.
Drain-valve	Close the valve (turn it fully clockwise) to isolate the condenser chamber from the drain-outlet. Open the valve (turn it fully anticlockwise) to admit air into the vacuum system and to drain water from the condenser chamber after it has been defrosted.
Drain-outlet	This outlet is used to drain water from the LyoDry Compact during defrosting of the condenser chamber and cooling-coil. The outlet is also used to admit air into the vacuum system.

Table 2 – Front Controls and Connections.

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Control/Connection	Use
Power inlet	To connect the LyoDry Compact to an external power supply. Switch power on and off.
Auxiliary power	To connect your vacuum pump. This will enable the pump to be operated directly from the LyoDry Compact.

Table 3 – Rear Controls and Connections.

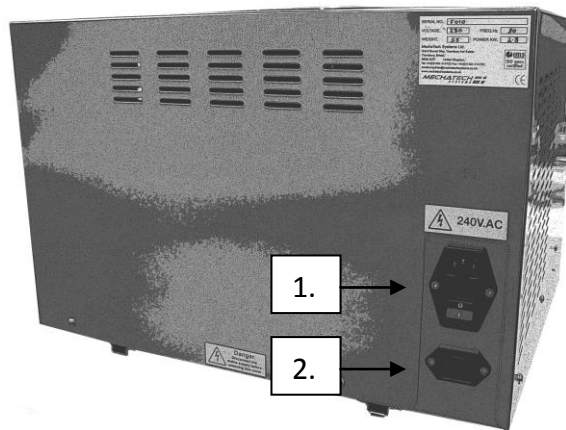


Figure 2 – LyoDry Compact Rear connections.

1. Power inlet with switch
2. Auxiliary vacuum pump power

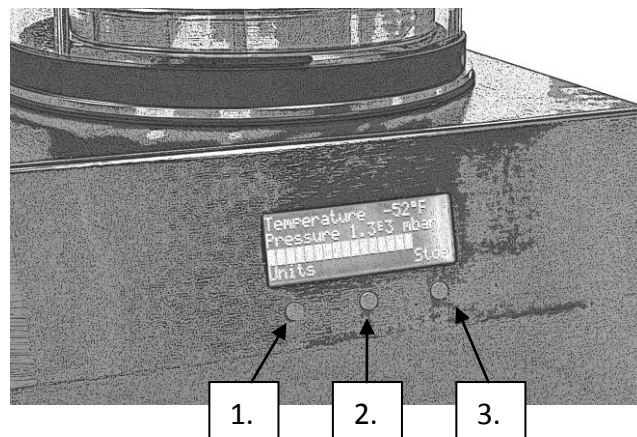


Figure 3 – LyoDry Compact Control Panel.

1. Units Button and Temperature Units Toggle Button
2. Pump On/Off Button and Pressure Units Toggle Button
3. Start/Stop & Return Button

## 5. APPLICATIONS

### 5.1 Introduction

If you want to use the LyoDry Compact as a freeze dryer, you must connect it to a two-stage vacuum pump and fit a drying accessory. When you use the LyoDry Compact as part of a freeze drying system, we recommend that you keep accurate records of all operating parameters (that is: load, drying times, and so forth). This data will help you to determine the optimum cycle for efficient operation with various products.

Some factors which affect the freeze drying process are described in the following sections.

### 5.2 The freezing process

You must pre-freeze the product to be freeze-dried before you place it in (or on) the drying accessory. The thickness of the ice (and hence the product) will affect the length of time needed to dry a given sample. In general, the thickness should be less than 10mm. A range of product containers is available from MechaTech Systems. These include the containers shown in Table 4.

Container	Method of freezing
Bulk tray	Use a cabinet freezer to freeze the bulk tray. The maximum recommended depth is 10 mm.
Vials	Use a cabinet freezer to freeze the vials. The maximum recommended depth of fill is 10 mm.
Ampoules	Pre-freeze in a cabinet or use a spin-freeze accessory to dry the ampoules.
Flasks	Use a pre-freeze bath to shell-freeze to a maximum thickness of 10 mm.

Table 4 – Product containers

### 5.3 The drying process

When the LyoDry Compact is Ready (condenser has been cooling for 40 minutes and it has reached a temperature of less than -40°C, as shown on the display), the vacuum pump can be switched on. The pressure in the condenser chamber then starts to drop, producing the conditions necessary for freeze drying to occur. The pressure gauge will show the pressure in the condenser chamber.

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The time required to dry a product varies and is determined by a number of factors; these include the type of product, its mass and thickness, the type of container used, the temperatures of the product and the condenser and the system performance.

Freeze drying requires an input of heat energy to the product to change the ice into water vapour. When using the LyoDry Compact, this energy may be absorbed solely from the surroundings or, alternatively, a heated accessory may be used to supplement this heat input. If you use a heated accessory, the accessory should not be switched on until the pressure in the condenser chamber has fallen to 1 mbar or lower.

When you decide on the quantity of heat input required, or when you try to optimise the drying cycle for a particular product, it is important to observe the physical appearance of the product whenever possible during the drying process. If the product has been correctly frozen, it will usually appear to be uniform in colour and compact. If the product is uneven in colour, or if signs of boiling are visible, then the product may have been incorrectly frozen or may have undergone some physical change, possible from the application of too much heat.

A wide range of factors has to be considered when trying to optimise the drying cycle for a given product. To assist in this optimisation, we therefore recommend that you take note of the rate of change of both temperature and pressure within the condenser chamber during the freeze drying process.

#### **5.4 Vapour trapping**

When the LyoDry Compact is used as a vapour trap, its function is significantly different to that when it is used in freeze drying applications. In vapour trapping applications, the LyoDry Compact acts solely to protect the rotary pump; in freeze drying applications, it actually pumps the water vapour from the product.

In vapour trapping applications, it is often necessary to limit the vapour flow from the system to the LyoDry Compact by fitting a restrictor between the vapour source and the LyoDry Compact. The size of the restrictor depends on the system.



## 6. OPERATION



**WARNING:** If you intend to freeze dry products which contain sodium azide, make sure that your vacuum pump and pipeline are suitable for freezing these products. If they are not suitable, there is a severe risk of explosion.

Sodium azide is sometimes used as a stabilizing agent in freeze drying processes. Sodium azide is toxic and, when dry, is highly explosive.

If you freeze dry a product that contains Sodium azide, a chemical reaction can occur in the presence of heavy metals such as copper, lead, zinc and cadmium. The result of this reaction is the formation of metallic azides which are highly unstable and explosive.

The LyoDry Compact contains no heavy metals and is suitable for freeze drying products which contain Sodium azide. The Edwards RV5 and RV8 pumps are also suitable for this purpose.

However, if you do not use an Edwards pump, your vacuum pump and vacuum pipeline may not be suitable for freeze drying products containing Sodium azide. Check with your vacuum pump's manufacturer to determine its suitability if you intend to freeze dry products containing Sodium azide.

### 6.1 **Sequence of operation**

Operation of the LyoDry Compact can involve a number of different steps:

- Prepare the LyoDry Compact
- Fit the product container and any other necessary accessory
- Load the products
- Pre-cool the LyoDry Compact
- Dry the product
- Shut down

Before you freeze a product, you must always prepare the LyoDry Compact as described. Always dry the product and shut down the LyoDry Compact as described.

However, the order in which the remaining three steps are carried out depends on the type of product container or other accessory you use and the type of product to be freeze dried. In some circumstances you will need to pre-cool the LyoDry Compact with the accessory-flange open to atmosphere; in other circumstances, you fit the product container, then pre-cool the LyoDry Compact and then load the product to be freeze dried.

If the correct sequence of operations to follow is not clear to you, refer to the instruction manual supplied with the product container or other accessory which you will use.

## 6.2 Prepare the LyoDry Compact



**CAUTION:** Use only mild detergents to clean the condenser chamber, accessories and connecting pipeline. Some of the MechaTech Systems accessories are made from acrylic materials and must not be cleaned with organic solvents.

Before you use the LyoDry Compact, and between freeze-drying cycles, prepare the LyoDry Compact, as follows:

1. Turn the drain-valve fully anticlockwise to open the valve and to remove any water left in the bottom of the condenser chamber. When the chamber is completely drained, turn the drain-valve fully clockwise to close it.
2. If acidic or corrosive products have been processed, flush through the condenser chamber and drain-line with clean water.
3. Make sure that the condenser chamber is dry.
4. Make sure that the LyoDry Compact is clean, particularly the accessory-flange. If the flange is not clean, you will not get a good vacuum seal and the performance of the LyoDry Compact will be poor.
5. Check the vacuum connection on the front of the LyoDry Compact. Check the connection at the vacuum pump.
6. If a load of more than 2 litres of ice will be condensed in the LyoDry Compact, we recommend that you fit the condenser extension tube: fit the extension tube in the condenser chamber, so that the short end of the tube fits over the vacuum pumping pipe, and so that the end of the tube points directly downwards towards the bottom centre of the condenser chamber.

If you do not fit the extension tube, the vacuum pump connection may become blocked with ice; this may cause a loss of vacuum and the product may melt.

7. Select a suitable drying accessory for the product. Wipe clean the sealing-ring of the accessory and check the sealing-ring for damage; if it is damaged, fit a new sealing-ring.

The accessory sealing-ring should not need lubricating, but if it is excessively dry, apply a light wipe of high vacuum grease.

### 6.3 Fit the product container and other accessories

A drying accessory may be connected to the LyoDry Compact accessory flange. Accessories have a rubber sealing-ring to seal the accessory to the LyoDry Compact accessory flange. Once positioned, the weight of the accessory is sufficient to produce an airtight seal under vacuum conditions.

### 6.4 Pre-cool the LyoDry Compact



**WARNING:** Do not touch any part of the condenser chamber during or immediately after the cooling process. The condenser chamber is at a very low temperature and can cause tissue damage.

***Note:** if you cool the LyoDry Compact with no product in the chamber, the condenser temperature will cycle between approximately -40 °C and -50 °C.*

Pre-cool the LyoDry Compact condenser chamber as follows:

1. Switch on the electrical supply and then turn the main switch (Figure 2) to the '1' (on) position.
2. The display (item 3, Figure 1) on the front panel should be illuminated.
3. Press the 'Start' button on the control panel. 'COOLING' is displayed.
4. Wait for 40 minutes. A bar graph advances from left to right indicating the timer progress. After 40 minutes 'READY – PUMP OFF' is displayed.
5. The temperature shown on the display should read -40 °C or lower.

## 6.5 Dry the product



**CAUTION:** Use gas-ballast on the vacuum pump when drying. If you do not, water may condense in the pump.

1. On RV5 or RV8 pumps, turn the gas-ballast control to position 'II': refer to the pump instruction manual. On other pumps, fully open the gas-ballast valve: refer to the pump instruction manual.
2. Switch the pump on by pressing the 'Pump' button (item 2, Figure 3) if the pump is electrically connected to the LyoDry Compact vacuum pump power outlet (Figure 2). 'READY – PUMP ON' is displayed.

Take note of the following when freeze drying products:

- Only switch on a heated accessory when the pressure is 1 mbar or less.
- When a load is first applied to the LyoDry Compact, the temperature may rise for a few minutes. This is because the evaporation rate from the product is initially high. If the temperature does not fall to  $-45^{\circ}\text{C}$  or below within a few minutes, the LyoDry Compact is overloaded. Reduce the amount of product in the freeze drying system to prevent the product from melting or, when you use the LyoDry Compact as a vapour trap, restrict the flow of vapour to the LyoDry Compact.
- If you wish to dry a number of flasks, first attach one flask, then evacuate the flask until the pressure (shown on the pressure gauge) falls to 1 mbar or less. Then attach and evacuate the remaining flasks in the same way.

If you use this procedure, you can identify any flasks that leak. This procedure also prevents rapid pressure increases, which might cause flasks to fall off of the drying accessory.

- If there appears to be a leak, check that the drain-valve is fully closed and that all seals are clean. If the LyoDry Compact continues to leak, contact your supplier.

## 6.6 Shut down



**CAUTION:** If you use a manifold assembly, do not admit air into the LyoDry Compact through the drain-valve until all flasks have been removed, otherwise the flasks may fall off the manifolds.

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Look at the pressure shown on the pressure gauge and the appearance of the product and consult data gathered from previous freeze drying operations to determine when the freeze drying process has finished. Note that the pressure shown on the display will fall significantly when vapour is no longer being released from the product.

Once the process has finished, shut down the LyoDry Compact as follows:

1. If you use a manifold accessory, use the manifold valves to vent each flask in turn. Remove and seal each flask.
2. Switch the vacuum pump off by pressing the 'Pump' button (item 2, Figure 3) if the pump is electrically connected to the LyoDry Compact vacuum pump power outlet (Figure 2).
3. If you use other accessories, slowly open the drain-valve to admit air to the system.
4. Remove the product when the pressure shown on the pressure gauge has reached atmospheric pressure.
5. Switch the refrigeration off by pressing the 'Stop' button (item 3, Figure 3).
6. Remove the drying accessory.

#### 6.7 Defrost the LyoDry Compact



**WARNING:** Do not touch any part of the condenser chamber during or immediately after the cooling process. The condenser chamber is at a very low temperature and can cause tissue damage.



**WARNING:** Do not pour water at a temperature greater than 50 °C into the ice condenser when it is cold. This may result in a dangerous rise in pressure in the refrigeration system.

Leave the LyoDry Compact switched off at ambient temperature to defrost it. Make sure that all water is drained from the condenser chamber before you switch the LyoDry Compact on again. This method takes up to 36 hours to complete; this depends on the ambient temperature.

Alternatively, you can pour warm water into the ice condenser to speed up the defrosting process. This method is useful if you wish to use the LyoDry Compact again immediately. Use the following procedure.

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1. Remove the drying accessory from the accessory-flange.
2. Close the drain-valve.
3. Pour warm water, at a maximum temperature of 50 °C, into the condenser chamber. Do not fill the chamber above the level of the vacuum pipeline.
4. Wait for a few minutes to allow the ice to melt.
5. Fully open the drain-valve and allow the water to drain out of the condenser chamber.
6. Remove the condenser extension tube (if fitted). Clean and dry both the extension tube and the inside of the condenser chamber.

Prepare the LyoDry Compact for the next operational cycle as described.

#### **6.8 Operation with no load**

If you operate the LyoDry Compact with no load for several hours, the internal components of the LyoDry Compact get very cold. Atmospheric water vapour will then condense onto the cold surfaces and may drip out of the bottom of the LyoDry Compact. You may therefore see puddles of water under the LyoDry Compact, which give the impression that water is leaking from the condenser chamber.

If you see water dripping out of the LyoDry Compact, inspect the condenser chamber: if there is ice in the chamber, the water is probably not leaking from the chamber, but is dripping from the cold surfaces inside the LyoDry Compact. Always check this carefully before you contact your supplier for advice.

To avoid this problem, we recommend that you shut-down the LyoDry Compact if you will not use it for three or four hours. This is particularly important if the use of the LyoDry Compact is in a high humidity environment.

#### **6.9 Changing the temperature and pressure units**

From the factory, the temperature units are displayed as degrees centigrade (°C) and the pressure units are displayed as mbar. Alternatively, the temperature can be displayed in degrees Fahrenheit (°F) and the pressure can be displayed in Torr. The current display units are always retained when the LyoDry Compact is switched off.

##### **6.9.1 Changing the temperature units**

Change the temperature display units as follows:

1. Switch on the electrical supply and then turn the main switch (Figure 2) to the '1' (on) position.
2. The display (item 3, Figure 1) on the front panel should be illuminated.
3. Press the 'Units' button on the control panel.

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4. Press the '°C/°F' button to toggle the display units between °C and °F.
5. Press the 'Retn' button

### **6.9.2 Changing the pressure units**

Change the pressure display units as follows:

1. Switch on the electrical supply and then turn the main switch (Figure 2) to the '1' (on) position.
2. The display (item 3, Figure 1) on the front panel should be illuminated.
3. Press the 'Units' button on the control panel.
4. Press the 'mbar/Torr' button to toggle the display units between mbar and Torr.
5. Press the 'Retn' button

## 7. MAINTENANCE



**WARNING:** Ensure that the electrical supply is isolated before starting any maintenance work.

### 7.1 Introduction

*Note: you must obey the maintenance procedures defined in the instruction manuals supplied with your accessories and vacuum pump.*

*Note: there are no user-serviceable parts inside the LyoDry Compact refrigeration system.*

The following sections describe possible problems and their possible solutions and are intended as a guide to the user and to qualified service engineers. Some of the solutions can be carried out by the user, but others (which are clearly identified) must be carried out only by approved MechaTech Systems service engineers.

### 7.2 Calibration

It is recommended that the vacuum and temperature gauges fitted to this unit be returned to MechaTech Systems (or a relevant competent body) for service and calibration at least every 12 months. The time interval between services must to be reviewed by the customer during the units operating life.

### 7.3 Safety



**WARNING:** Obey the safety instruction given below and take note of appropriate precautions. If you do not, you can cause injury to people and damage to equipment.



#### 7.4 Precautions

- Switch off the LyoDry Compact, isolate it from the electrical supply and defrost it before you start maintenance.
- Do not touch any part of the condenser chamber during or immediately after the cooling process. The condenser chamber is at a very low temperature and can cause tissue damage.
- Do not pour water at a temperature greater than 50° C into the condenser chamber when it is cold. If you do, this may result in a dangerous pressure rise in the refrigeration system.
- Ensure that you do fault finding in a well-ventilated area.
- After you have rectified a fault, ensure that the electrical installation of the LyoDry Compact conforms to your local and national safety requirements. It must be connected to a suitable fused and protected electrical supply and a suitable earth (ground) point.

#### 7.5 Electrical faults

If an electrical fault is suspected, use Table 5 to identify the possible causes and actions to cure the fault. The 'By' column of the table identifies whether the checks and actions can be done by a user (a 'U' entry in the column), or whether they must be done by a qualified service engineer (an 'SE' entry in the column).

If the fault persists after you complete the recommended action, contact your supplier before you use the LyoDry Compact again.

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Symptom	Check	Action	By
The external electrical supply is on but the display is off and there is no electrical supply to any components.	Has the fuse in the main switch failed?	If so, identify and rectify the cause of the problem, then replace the fuse.  If the fuse fails repeatedly, check the electrical system and rectify any fault found.	U  SE
	Has the external fuse in the electrical supply failed?	If so, identify and rectify the cause of the problem, then replace the fuse.  If the fuse fails repeatedly, check the electrical system and rectify any fault found.	U  SE
The display is on, the display shows 'COOLING' and bar graph has started, but the compressor does not start.	Has the thermal magnetic circuit-breaker tripped?	If so, identify and rectify the cause of the problem, then reset the circuit breaker.  If the circuit-breaker trips repeatedly, check the electrical system and rectify any fault found.	U  SE
	Is the electrical supply voltage too low?	Use an alternative electrical supply and/or remove any extension cables which can cause small voltage drops.	
	Is there a loose connection?	Inspect the electrical system and repair any loose connection. If there are no loose connections, the compressor may be faulty.	
The compressor starts but only operates for a short time before it stops.	Have the motor windings failed?	Check the windings and replace the compressor is necessary.	SE
The temperature shown on the display does not change or error is displayed.	Is the plug disconnected from or loosely connected to the rear of the display?	Inspect the electrical system and repair any fault found.	SE
	Has the thermocouple failed?	Check and replace the thermocouple.	SE
The temperature shown on the display rises during 'Cooling'.	Is the thermocouple polarity incorrect?	Interchange the thermocouple wires on the rear of the display.	SE
Incorrect temperatures are shown on the display.	Does the thermocouple need to be calibrated?	Calibrate the thermocouple.	SE
	Is the incorrect type of thermocouple fitted?	Check and replace the thermocouple, if necessary.	SE
The pressure shown on the display does not change or error is displayed.	Does the gauge need to be calibrated?	Calibrate the pressure gauge.	U
	Is the plug disconnected from or loosely connected to the rear of the display?	Inspect the electrical system and repair any fault found.	SE
	Is the gauge head faulty?	Replace the Pirani gauge head.	SE

Table 5 – Electrical Fault Finding

### 7.5.1 Remove the top cover and the electrical box



**WARNING:** Disconnect the LyoDry Compact from the electrical supply before you remove the top cover. If you do not, you may accidentally touch live electrical components.

To access electrical connections on the compressor and the fan, remove the top cover, then remove the terminal-box cover on the compressor.

To repair faults in the electrical box, you must first remove the electrical box from the LyoDry Compact. After you have completed any repairs, refit the electrical box and cover.

1. Switch off the external electrical supply and isolate it from the LyoDry Compact.
2. Remove the 'O' Ring from the accessory flange, then undo and remove the six screws which secure the top cover.
3. Lift the rear of the cover, then pull the cover back to remove it from the base of the LyoDry Compact and place the cover on the bench next to the base; if necessary, disconnect the earth (ground) wire from the top cover.
4. Undo and remove the two screws securing the electrical box.
5. Pull the electrical box forwards and out of the LyoDry Compact.
6. Remove the four screws which secure the cover on the electrical box and remove the cover.

### 7.5.2 Refit the electrical box and cover



**WARNING:** Ensure that the earth (ground) cable is correctly fitted to the top cover. If you do not, there will be a risk of electric shock when you switch on the LyoDry Compact.

1. Refit the cover to the electrical box and secure with the four screws.
2. Refit the electrical box into the front of the LyoDry Compact and secure with the two screws.
3. Refit the cover cap to the drain-valve.
4. If necessary, reconnect the earth (ground) wire to the top cover.
5. Tilt the cover upwards, fit the top front edge of the cover under the top lip of the LyoDry Compact, and then lower the rear of the cover.

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6. Refit the six screws to secure the top cover in place.
7. Refit the 'O' Ring to the accessory flange.

### **7.5.3 Reset the thermal magnetic breaker**

Use the following procedure to reset the thermal magnetic circuit-breaker if it has tripped. Only reset the circuit-breaker once you have identified and rectified the source of the trip.

1. Carry out the procedure in **7.5.1** above
2. Press the reset button to reset the thermal magnetic circuit-breaker.
3. Carry out the procedure in **7.5.2** above
4. Refit the top cover.

## **7.6 Refrigeration faults**

### **7.6.1 Repeat the installation test**

If you suspect that there is a fault in the refrigeration system in the LyoDry Compact, then:

1. Defrost the chamber.
2. Repeat the installation tests. Note the results at each step and then contact MechaTech Systems.

### **7.6.2 Fault diagnosis**

Some possible causes of refrigeration faults, together with suggested actions to cure the faults, are shown in Table 6. The 'By' column of the table identifies whether the checks and actions can be done by a user (a 'U' entry in the column), or whether they must be done by a qualified service engineer (an 'SE' entry in the column).

If other symptoms occur, or the cause of the fault cannot be identified, contact your supplier for advice.

### **7.6.3 Refrigerant leaks**

The refrigerant used in the LyoDry Compact is heavier than air and is an asphyxiant by the displacement of oxygen. If a refrigerant leak is suspected, place the LyoDry Compact in a well-ventilated area. Do not allow naked flames or smoking near the LyoDry Compact, as products of combustion of the refrigerant include dangerous fluorides and chlorides.

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If refrigerant vapour is inhaled, summon medical help immediately. Take the victim to a well-ventilated, uncontaminated area; if the victim's breathing is weak or has stopped, apply artificial ventilation, preferably using an oxygen resuscitator. Do not use adrenalin or other cardiac stimulants.

Refrigerant in contact with skin or eyes can cause cold burns. If contact has taken place, seek medical help immediately and carry out the following: remove clothing from the affected area; carefully irrigate the affected area with tepid water for at least 15 minutes; apply a sterile dressing and treat the wound as you would a heat burn.

#### 7.6.4 Leak test the refrigeration system

Leak test the refrigeration system with a halogen leak detector, which is sensitive to all refrigerants. Before you start leak tests, check the operation of the leak tester with refrigerant from the cylinder which you will use to recharge the LyoDry Compact.

The refrigerant used in the LyoDry Compact is heavier than air, so you must check the highest joints in the system first.

#### 7.6.5 Component replacement

*Note: The refrigeration system should be left open to atmosphere for as short a time as possible.*

Only replace a component when you are sure that it is the cause of the fault. Components (particularly compressors) are often replaced unnecessarily and it is therefore recommended that you recheck your findings before you replace a component.

Use the following procedure to replace a component in the refrigeration system.

1. Recover the refrigerant from the system.
2. Remove the faulty component. You must use suitable pipe cutters if you cut a pipe. If heat has to be applied to a joint, pass an inert gas through the system while you heat the joint, and again while you cool the joint.
3. Replace the component.
4. When repairs on the refrigeration system have been completed, replace the filter-dryer as that is likely to have been contaminated.
5. Dehydrate the system and recharge the LyoDry Compact with refrigerant. Before the unit is completely recharged, check that any new or repaired joints do not leak.

Symptom	Check	Action	By
The compressor does not start.	Is there an electrical fault?	Refer to electrical faults section and rectify any fault found.	SE
The compressor	Is there sufficient	If not, relocate the LyoDry Compact.	

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starts but the temperature does not reach -50 °C.	ventilation?	There must be no restrictions to air-flow to the sides and rear of the LyoDry Compact.	U
	Is there a leak in the refrigeration system?	Find the leak, then repair the leak and recharge the system with refrigerant	SE
The compressor starts but the temperature does not reduce.	Is the thermocouple faulty?	Check the gauge and the thermocouple and replace if necessary.	SE
	Is there a leak in the refrigeration system?	Find the leak, then repair the leak and recharge the system with refrigerant.	SE
The temperature rises to above -40° C during drying and does not fall to below -45° C again.	Is the load on the LyoDry Compact too high?	Reduce the amount of product being freeze dried or restrict the vapour load to the Micro-LyoDry Compact.	U

Table 6 – Refrigeration fault finding

### 7.6.6 Recharge with refrigerant

If you need to recharge the LyoDry Compact due to a refrigerant leak, locate and repair the leak before you start to recharge the refrigeration system.

Use the correct type and quantity of refrigerant to recharge the refrigeration system.

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**8. SPARES AND ACCESSORIES**

**8.1 General**


Description	Part No	Supplier
Edwards APG100-XM, NW16	D026-01-000	 MechaTech Systems Ltd Unit 9 Brunel Way Thornbury Bristol BS35 3UR  +44 (0)1454 414723 enquiries@mechatechsystems.co.uk www.mechatechsystems.co.uk
Temperature sensor	LSTC	
Edwards RV5 vacuum pump	A653-01-903	
Edwards EMF10 outlet mist filter	A462-26-000	
Edwards clean application oil return kit	A504-19-000	
Ultragrade 19 vacuum pump oil, 4 litres	H110-25-013	
Dow Corning silicone high vacuum grease, 50g tube	HVGREASE	
Acrylic drying chamber 350mm x 435mm, lid and 2 x L-gaskets	LSDC	
6-tray drying rack assembly, SS (for use inside acrylic chamber)	LSD6	
Heated tray drying accessory	LSAD6H	
14" L-gasket for acrylic chamber	L-GASKET14	

Table 7: Spare Parts and Accessories

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**9. TECHNICAL SPECIFICATIONS**

<b>LyoDry Compact</b>	<b>TECHNICAL SPECIFICATION</b>
Part number and model	LSBC50 LyoDry Compact
Maximum condenser chamber capacity	5 litres
Ice removal capacity (in 12 hours)	1.2kg (2.6 lbs)
Ice removal capacity (in 24 hours)	2.3kg (5.1 lbs)
Maximum ice capacity	4.5kg (9.9 lbs)
Operating temperature	~ -50°C
Temperature display range	Ambient to -60 °C
Pressure display range	0.01 mbar to 1000 mbar
Refrigeration compressor type	2/3 hp hermetic unit
Dimensions (H x W x D)	332 x 455 x 600 mm
Weight	55kg (121 lbs)
Power requirements	LSBC50-230: 220/240VAC/50 Hz, 10.0 A LSBC50-115: 110/120VAC/60 Hz, 10.0 A

Table 8: Technical Specification

**9.1 Vacuum pump requirements**

**Note 1:** your vacuum pump must have a gas-ballast facility to prevent water build up in the pump.

**Note 2:** the pump power output is limited to 3.5Amp.

For freeze drying, your vacuum pump must meet the following specification;

<b>Vacuum Pump</b>	<b>TECHNICAL SPECIFICATION</b>
Type of pump	Two-stage, oil-sealed rotary pump
Ultimate pressure	0.01 to 0.03 mbar
Pumping speed	3 m <sup>3</sup> /h or greater
Recommended pump	Edwards RV pump

Table 9: Vacuum pump requirements