

Instruction Manual

Modulyo 4K Freeze Dryer

Description

Item Number

*Modulyo 4K Freeze Dryer, Single voltage
(220/240 V, 50 Hz, 1-phase)*

F101-01-000

*Modulyo 4K Freeze Dryer, Single voltage
(90/110 V, 50 Hz, 1-phase, 103-127 V, 60 Hz, 1-phase)*

F101-02-000



CONTENTS

Section	Title	Page
1	INTRODUCTION	1
1.1	Scope and definitions	1
1.2	The Modulyo 4K	2
1.3	The condenser chamber	2
1.4	Condenser extension tube	4
1.5	Control panel and connections	4
1.6	Protection devices	6
1.7	Applications	6
1.7.1	Introduction	6
1.7.2	The freezing process	6
1.7.3	The drying Process	7
1.7.4	Vapour trapping	7
2	TECHNICAL DATA	8
2.1	General	8
2.2	Refrigeration system	8
2.3	Electrical data	9
2.4	Construction details	9
2.4.1	Legislation and standards	9
2.4.2	Construction materials	10
2.5	Vacuum pump requirements	10
3	INSTALLATION	11
3.1	Unpack and inspect	11
3.2	Locate the Modulyo	11
3.3	Connect the Modulyo to the electrical supply	12
3.4	Connect the vacuum pump	12
3.4.1	General	12
3.4.2	Connect an Edwards RV5 or RV8 pump to the Modulyo	13
3.4.3	Pump outlet safety	13
3.5	Test after installation	14
4	OPERATION	16
4.1	Safety	16
4.2	Sequence of operations	16
4.3	Prepare the Modulyo	17
4.4	Fit the product container and other accessories	18
4.5	Pre-cool the Modulyo	18
4.6	Drying	18
4.7	Shut down	20
4.8	Defrost the Modulyo	21
4.9	Operation with no load	22

Section	Title	Page
5	MAINTENANCE	23
5.1	Introduction	23
5.2	Safety	23
5.2.1	Precautions	23
5.2.2	Refrigerant leaks	23
5.3	Electrical faults	24
5.3.1	Fault finding	24
5.3.2	Loose connections and faulty components	24
5.3.3	Remove the top cover and the electrical box	26
5.3.4	Refit the electrical box and top cover	28
5.3.5	Reset the thermal magnetic circuit breaker	29
5.3.6	Replace the pressure gauge fuse	29
5.3.7	Zero the pressure gauge	29
5.4	Refrigeration faults	30
5.4.1	Repeat the installation test	30
5.4.2	Fault diagnosis	30
5.4.3	Leak test the refrigeration system	30
5.4.4	Component replacement	30
5.4.5	Recharge with refrigerant	31
5.5	Poor vacuum performance	33
6	STORAGE AND DISPOSAL	34
6.1	Storage	34
6.2	Disposal	34
7	SERVICE, SPARES AND ACCESSORIES	35
7.1	Introduction	35
7.2	Service	35
7.3	Spares	35
7.4	Accessories	36
7.4.1	Drying accessories	36
7.4.2	Glassware	36
7.4.3	Sealing accessories	36
7.4.4	Trolley accessory	37
7.4.5	Vacuum pumps and accessories	37
8	ENGINEERING DIAGRAMS	38
	RETURN OF EDWARDS EQUIPMENT	

Illustrations

Figure	Title	Page
1	The Modulyo 4K Freeze Dryer	3
2	Controls and connections	5
3	Connect an RV5 or RV8 pump to the Modulyo	15
4	Fit the condenser extension tube	19
5	Remove/refit the top cover	27
6	Schematic diagram of the refrigeration system	32
7	Circuit diagram	38

Tables

Table	Title	Page
1	Controls and connections	4
2	Product containers	6
3	Nominal refrigeration system performance	9
4	Checklist of components	11
5	Electrical supply cable connections	12
6	Sequence of operation	16
7	Electrical fault finding	25
8	Refrigeration fault finding	31

1 INTRODUCTION

1.1 Scope and definitions

This manual provides installation, operation and maintenance instructions for the Edwards Modulyo 4K Freeze Dryer, abbreviated to Modulyo in the remainder of this manual. You must use the Modulyo as specified in this manual.

Read this manual before you install and operate the Modulyo. Important safety information is highlighted as WARNING and CAUTION instructions; you must obey these instructions. The use of WARNINGS and CAUTIONS is defined below.

WARNING

Warnings are given where failure to observe the instruction could result in injury or death to people.

CAUTION

Cautions are given where failure to observe the instruction could result in damage to the equipment, associated equipment and process.

In accordance with the recommendations of IEC1010, the following warning symbols may appear on the freeze dryer:



Caution - refer to accompanying documents.



Caution - risk of electric shock.



Caution - hot surface.

The units used throughout this manual conform to the SI international system of units of measurement.

1.2 The Modulyo 4K

The Modulyo 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 Modulyo only requires the attachment of a suitable vacuum pump and a drying accessory to form a complete freeze drying system. The Modulyo is also suitable for use on other vacuum duties, including evaporation and distillation processes.

The Modulyo has a condenser chamber, a refrigeration system and a control system which has a temperature indicator and a vacuum gauge. The refrigerant used in the Modulyo is CFC free. All of the Modulyo components are all housed in a 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 Modulyo can be used to freeze dry materials in bulk trays, round-bottomed flasks, vials or ampoules. Alternatively, the Modulyo 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 Edwards, these include drying accessories and glassware. Refer to Section 7 for a full list of Edwards accessories.

Two models of the Modulyo are available : a single voltage model and a dual voltage model. Refer to Section 2 for the electrical supplies required for the two models.

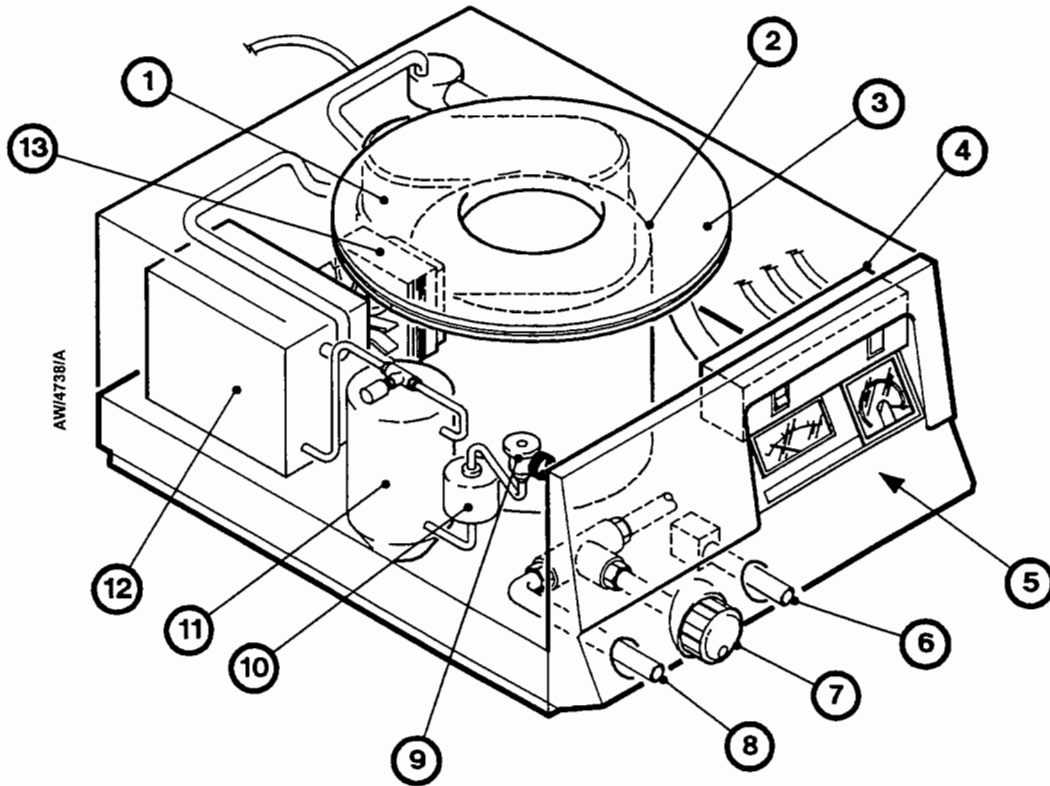
1.3 The condenser chamber

The condenser chamber (2) can trapping 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 °C.

A large diameter accessory-flange (3), which is compatible with the Modulyo 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 (8) on the front of the Modulyo. The drain-valve on the front of the Modulyo (7) 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 (7) on the front of the Modulyo. You can connect a suitable two-stage vacuum pump to this connector to evacuate the condenser chamber.



- | | |
|--------------------------|---------------------------------|
| 1. Compressor | 8. Drain outlet |
| 2. Condenser chamber | 9. Expansion valve |
| 3. Accessory-flange | 10. Refrigerant filter/dryer |
| 4. Electrical box | 11. Liquid refrigerant receiver |
| 5. Front panel | 12. Condenser |
| 6. Vacuum pump connector | 13. Fan |
| 7. Drain-valve | |

Figure 1 - The Modulyo 4K Freeze Dryer

1.4 Condenser extension tube

A condenser extension tube is supplied with the Modulyo. 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.

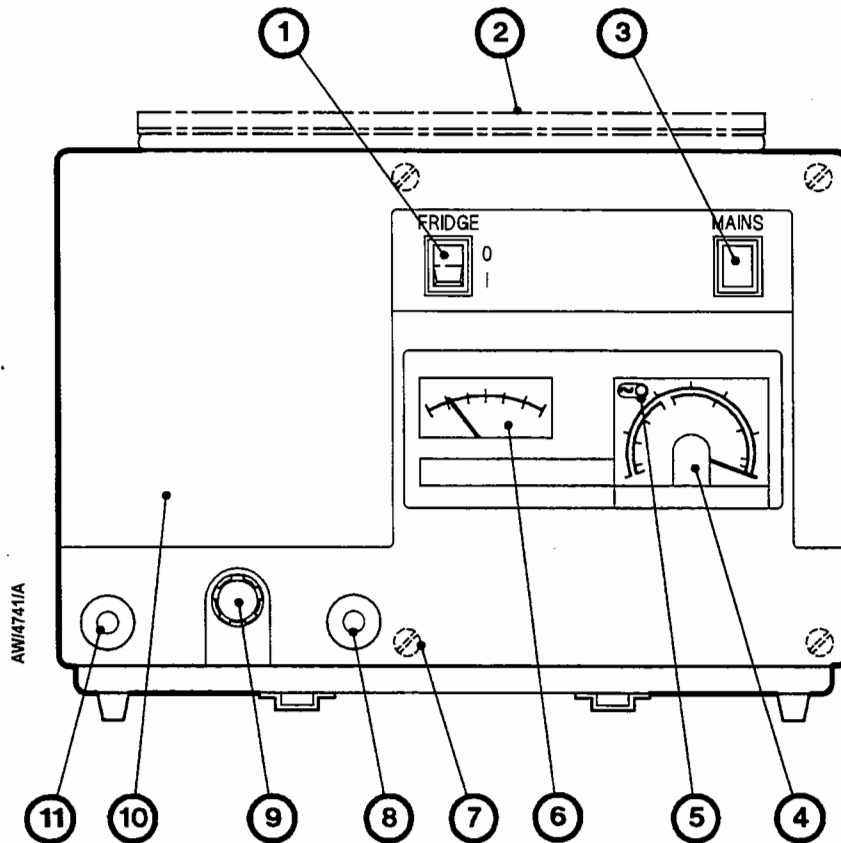
We recommend that you fit the extension tube inside the condenser chamber whenever a load capacity of 2 litre (or more) of condensate will be collected.

1.5 Control panel and connections

Refer to Figure 2. The controls and connection points of the Modulyo are all positioned on the front panel. The use of the controls and connections is described in Table 1.

Control/connection	Use
Fridge switch (1)	This is a rocker-action switch (position 'O' = off, position '1' = on). Use this to switch the refrigeration system on and off. A lamp in the switch is on when the refrigeration system is on.
On lamp (3)	This lamp is on when the Modulyo is connected to the external electrical supply and the electrical supply is on.
Pressure gauge (4)	This gauge shows the pressure in the condenser chamber.
Pressure gauge supply LED (5)	This LED is on when the electrical supply to the pressure gauge is on.
Temperature gauge (6)	This gauge shows the temperature in the condenser chamber.
Vacuum pump connector (8)	Use this to connect your vacuum pump to the Modulyo.
Drain-valve (9)	Close the valve (turn it fully clockwise) to isolate the condenser chamber from the drain-outlet. Open the valve (turn it anticlockwise) to admit air into the vacuum system and to drain water from the condenser chamber after it has been defrosted.
Drain-outlet (11)	This outlet is used to drain water from the Modulyo during defrosting of the condenser chamber and cooling-coil. The outlet is also used to admit air into the vacuum system.

Table 1 - Controls and connections



- | | |
|------------------------------|--------------------------|
| 1. Refrigeration switch | 7. Screws (4 off) |
| 2. Accessory flange | 8. Vacuum pump connector |
| 3. On lamp | 9. Drain-valve |
| 4. Pressure gauge | 10. Fascia |
| 5. Pressure gauge supply LED | 11. Drain outlet |
| 6. Temperature gauge | |

Figure 2 - Controls and connections

1.6 Protection devices

The Modulyo is protected by a thermal magnetic circuit-breaker which is integral to the refrigeration switch. You must manually reset the switch when the circuit breaker trips.

The electrical supply to the Modulyo must be suitably fused (refer to Section 3).

1.7 Applications

1.7.1 Introduction

If you want to use the Modulyo as a freeze dryer, you must connect it to a two-stage vacuum pump and fit a drying accessory. When you use the Modulyo 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.

1.7.2 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 10 mm. A range of product containers is available from Edwards. These include the containers shown in Table 2.

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 freezer or use an Edwards spin-freeze accessory to dry the ampoules.
Flasks	Use an Edwards pre-freeze bath to shell-freeze to a maximum thickness of 10 mm.

Table 2 - Product containers

1.7.3 The drying process

When the condenser has reached a temperature of -40°C (as shown on the temperature gauge), the vacuum pump can be switched on (see Section 4). 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.

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 Modulyo, 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, possibly 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.

1.7.4 Vapour trapping

When the Modulyo is used as a vapour trap (for example, in gel drying applications), its function is significantly different to that when it is used in freeze drying applications. In vapour trapping applications, the Modulyo 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 Modulyo by fitting a restrictor between the vapour source and the Modulyo. The size of restrictor required depends on the system.

2 TECHNICAL DATA

2.1 General

Dimensions (mm): height x width x depth	332 x 595 x 690
Accessory-flange diameter (mm)	370
Mass	45 kg
Enclosure rating (BS 5490)	IP 22
Ambient operating temperature range	5 to 24 °C
Maximum ambient storage temperature	50 °C
Condenser chamber	
Ice capacity in 12 hours	1.2 kg
Ice capacity in 24 hours	2.3 kg
Maximum ice capacity	5 kg
Operating temperature	-55 ± 5 °C
Surface area	0.15 m ²
Volume	7.2 l
Average evaporation rate	95 cm ³ h ⁻¹
Instrumentation	
Refrigeration switch	Rocker switch with integral thermal magnetic circuit breaker (see Section 2.3)
Temperature gauge	Thermocouple gauge
Pressure gauge	Edwards Pirani 501

2.2 Refrigeration system

Compressor type	¹ / ₃ -hp hermetic unit
Compressor model	L'Unité Hermetique CAE 2412ABR
Displacement	14 cc
Refrigerant condenser type	Cantardo - STN 7321
Refrigerant type	ISCEON 69L (R403a)
Refrigerant charge	0.5 kg
Evaporator	6.7 metres, ³ / ₈ -inch (copper)
Normal suction line pressure	0.7 bar (absolute)
Expansion valve	Danfoss TY2, 0.3 mp 30 (Superheat 9 °C)
Heat extraction rate (ambient temperature of 20 °C)	180 kcal.h ⁻¹ at -35 °C
Nominal performance	See Table 3
Thermocouple	
Type	Type E (nickel-chromium/copper-nickel junction)
Resistance (at 20 °C)	14.75 ± 0.25 Ω

Time	Condenser temperature (°C)	Evaporation temperature (°C)	Suction pressure (psi)	Head pressure (psi)	Coldhead temperature (°C)	Oil sump temperature (°C)
Cool-down:						
30 s	32	-20	24	210	28	25
5 min	33	-44	4	185	33	28
10 min	29	-50	1	165	35	32
30 min	29	-55	8	160	38	42
With maximum normal load applied (8 x 1 litre flasks):						
35 min	37	-33	14	215	47	52
≥90 min	36	-37	10	205	50	57

Note: The performance figures given above assume an ambient temperature of 26 °C.

Table 3 - Nominal refrigeration system performance

2.3 Electrical data

	F101-01-000	F101-02-000
Nominal electrical supply	220 to 240 V, 1-phase	110 V, 1-phase
Electrical supply frequency	50 Hz	50 Hz
Allowable voltage range		
Power rating		
Protection		
Internal		Thermal magnetic circuit-breaker, rated at 8 A
External		13 A fuse

2.4 Construction details

2.4.1 Legislation and standards

The Modulyo has been designed in compliance with the following legislation and standards :

- C-P 3-0502-202 (1985-11) IBM Non-Product Equipment Design.
- ESCHLE (1986) Electrical Safety Code for Hospital Laboratory Equipment
- BS 5490 : 1977 Specification for the classification of degrees of protection provided by enclosures

2.4.2 Construction materials

Item	Material
Cabinet	Steel
Condenser chamber	Stainless steel
Vacuum pipeline	Stainless steel
Condenser extension-tube	Nylon

2.5 Vacuum pump requirements

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

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

Type of pump	Two-stage, oil-sealed rotary pump
Ultimate pressure	1×10^{-2} to 3×10^{-2} mbar (1 to 3 Pa)
Pumping rate	50 l.min ⁻¹ or more.
Recommended pump	Edwards RV5 or RV8

3 INSTALLATION

WARNING

The Modulyo is heavy. Use suitable lifting equipment to move the Modulyo, or get someone to help you move it. Do not attempt to lift the Modulyo on your own.

3.1 Unpack and inspect

Remove all packing materials and inspect the Modulyo. If the Modulyo is damaged, notify your supplier and the carrier in writing within three days; state the Item Number of the Modulyo together with your order number and your supplier's invoice number. Retain all packing materials for inspection. Do not use the Modulyo if it is damaged.

Check that your package contains the items listed in Table 4 below. If any of these items is missing, notify your supplier in writing within three days.

Qty	Description	Check (✓)
1	Modulyo 4K Freeze Dryer	<input type="checkbox"/>
1	Condenser extension-tube	<input type="checkbox"/>
Vacuum pump connection kit, which contains:		
1	Elbow	<input type="checkbox"/>
1	Steel tube	<input type="checkbox"/>
1	Vacuum hose	<input type="checkbox"/>
1	Clamp	<input type="checkbox"/>
1	Nozzle connector	<input type="checkbox"/>

Table 4 - Checklist of components

If the Modulyo is not to be used immediately, replace the protective covers. Store the Modulyo in suitable conditions as described in Section 6.

3.2 Locate the Modulyo

The Modulyo is designed for use on a laboratory bench-top. Locate the Modulyo in its required operating position, within convenient access to a suitable electrical supply.

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

When you locate the Modulyo, you should also consider ease of access for maintenance and repair work, when you will need to remove the cover of the Modulyo (refer to Section 5.3.3).

3.3 Connect the Modulyo to the electrical supply

WARNING

Ensure that the electrical installation of the Modulyo conforms with 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 Modulyo is suitable for use with your electrical supply voltage and frequency.
2. The Modulyo is supplied with a two-metre length of 3-core electrical supply cable. Connect the cable to the electrical supply as shown in Table 5 below.
3. Connect a 13 A fuse at the electrical supply outlet to protect the Modulyo.

Core	Electrical supply connection
Brown	Live or Line 1
Blue	Neutral or Line 2
Green/yellow	Earth (ground)

Table 5 - Electrical supply cable connections

3.4 Connect the vacuum pump

3.4.1 General

WARNING

If you intend to freeze dry products which 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

You must use a two-stage vacuum pump with the Modulyo. 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 Modulyo (Figure 2, item 8). The connector is suitable for use with a 10 mm inside diameter pipeline.

If necessary, use an Edwards model RV5 or RV8 vacuum pump with the Modulyo. This pump is suitable for freeze drying products which contain sodium azides (see Section 4.1). To connect an Edwards RV5 or RV8 pump to the Modulyo, refer to Section 3.4.2.

If you do not use an Edwards vacuum pump, the pump must meet the requirements specified in Section 2.5. To connect another type of pump to the Modulyo, refer to the instruction manual supplied with the pump.

3.4.2 Connect an Edwards RV5 or RV8 pump to the Modulyo

To connect an Edwards RV5 or RV8 vacuum pump to the Modulyo, refer to Figure 3 and use the following procedure.

1. Remove the vacuum pump connection kit from its packing material. As shown in Table 4 and in Figure 3, the kit contains a nozzle connector, clamp, vacuum hose and an elbow.
2. Refer to Figure 3. Fit the centring-ring and inlet filter assembly (6) to the inlet-port of the pump (8), then use the clamp (7) to secure the nozzle connector (5) to the inlet-port.
3. Push one end of the vacuum hose (4) onto the nozzle connector (5).
4. Fit the elbow (2) onto the vacuum pump connector (1) on the front of the Modulyo.
5. Fit the steel tube (3) into the end of the vacuum hose (4), then fit the tube into the elbow (2).

Alternatively, fit the end of the vacuum hose (4) directly to the vacuum pump connector on the Modulyo, fit the elbow (9) and steel tube (10) to the other end of the hose, then fit the elbow to the nozzle connector (5) on the pump-inlet.

3.4.3 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.

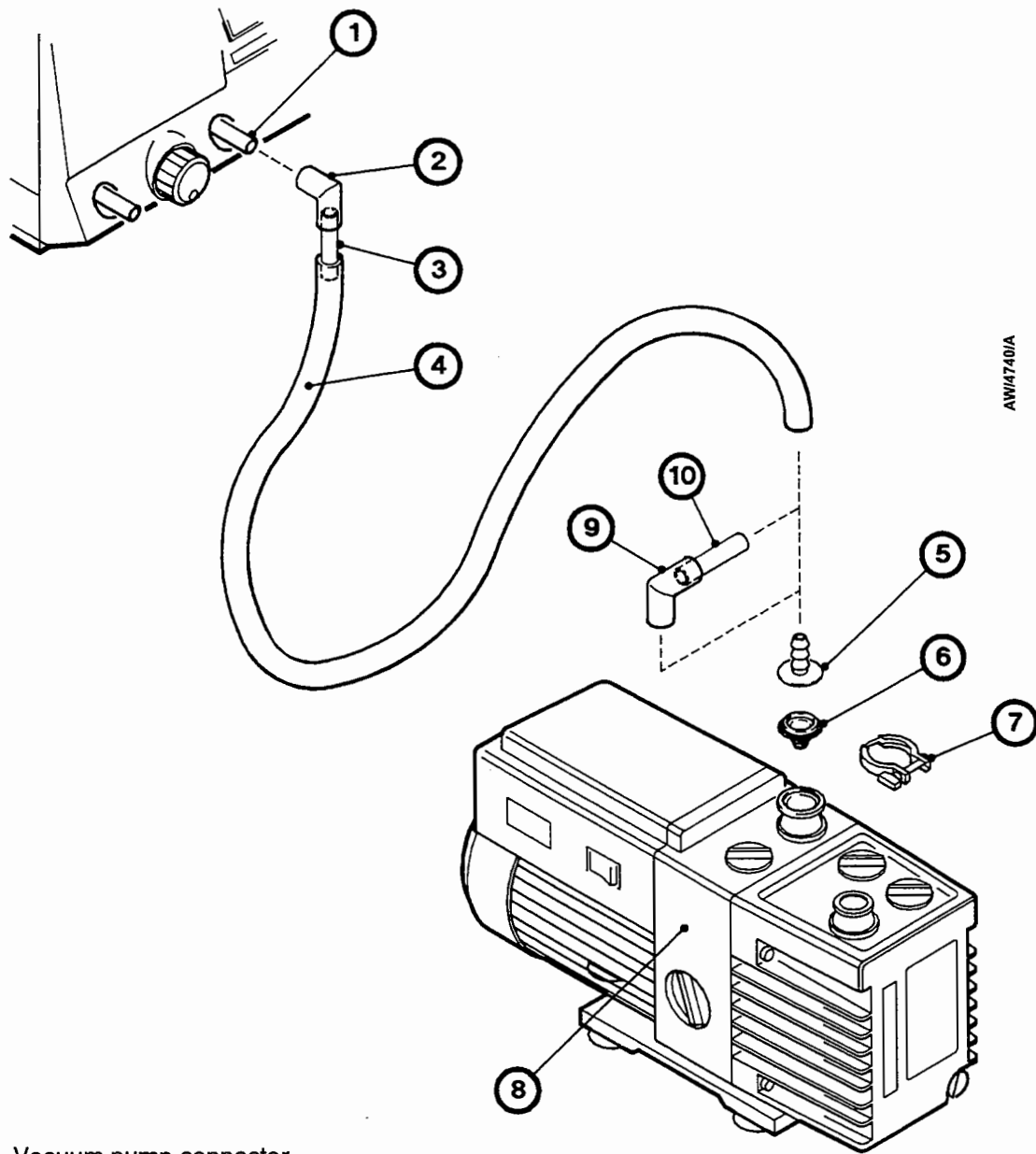
CAUTION

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

When you have installed the Modulyo, 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 Modulyo with the chamber empty (that is, with no product in the chamber), the temperature of the chamber can cycle between -40 and -50 °C.

Use the following procedure to test the Modulyo:

1. Refer to Figure 2. Ensure that the refrigeration switch (1) is on the '0' (off) position.
2. Switch on the electrical supply. If the on lamp (3) goes on, continue at Step 3. If the on lamp does not go on, continue at Step 10.
3. Move the refrigeration switch (1) to the '1' (on) position. If the pressure gauge supply LED (5) goes on, continue at Step 4. If the LED does not go on, continue at Step 10.
4. Watch the cooling-fan (Figure 1, item 13) through the grill on the rear of the Modulyo. If the fan rotates, then it is operating correctly: continue at Step 5. If the fan does not rotate, 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 Modulyo on for approximately 40 minutes, then check that a temperature of -45 °C or lower is shown on the temperature gauge (6). 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 (2) (refer to Section 4.4).
8. Turn the drain-valve (9) fully clockwise to close it, 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 7×10^{-2} mbar or lower is shown on the pressure gauge (4). If the pressure is correct, the Modulyo is ready for use: refer to Section 4. If the pressure is not correct, continue at Step 10.
10. If any of the checks in Steps 3 to 9 above fail, move the refrigeration switch (1) to the '0' (off) position, then switch off the external electrical supply and disconnect the supply from the Modulyo. Contact your supplier for advice. Do not attempt to use the Modulyo.



1. Vacuum pump connector
2. Elbow
3. Steel tube
4. Vacuum hose
5. Nozzle connector
6. Centring-ring and inlet filter assembly
7. Clamp
8. RV5 or RV8 pump
9. Alternative elbow position
10. Alternative steel tube position

Figure 3 - Connect an RV5 or RV8 pump to the Modulyo

4 OPERATION

4.1 Safety

WARNING

If you intend to freeze dry products which 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.

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 which 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 Modulyo 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 (see Section 7).

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.

4.2 Sequence of operation

Operation of the Modulyo can involve a number of different steps, as shown in Table 6 below.

Operation step	Refer to Section
Prepare the Modulyo	4.3
Fit the product container and any other necessary accessory	4.4
Load the product(s)	-
Pre-cool the Modulyo	4.5
Dry the product	4.6
Shut down	4.7

Table 6 - Sequence of operation

Before you freeze dry a product, you must always prepare the Modulyo as described in Section 4.3. Always dry the product and shut down the Modulyo as described in Sections 4.6 and 4.7.

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 Modulyo with the accessory-flange open to atmosphere; in other circumstances, you fit the product container, then pre-cool the Modulyo 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.

4.3 Prepare the Modulyo

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

Before you first use the Modulyo, and between freeze drying cycles, prepare the Modulyo, 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 Modulyo 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 Modulyo will be poor.
5. Check the vacuum connection on the front of the Modulyo. Check the connection at the vacuum pump.
6. If a load of more than two litres of ice will be condensed in the Modulyo, we recommend that you fit the condenser extension tube: refer to Figure 4 and fit the extension tube (1) in the condenser chamber, so that the short end of the tube fits over the vacuum pumping pipe (2), 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.

4.4 Fit the product container and other accessories

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

4.5 Pre-cool the Modulyo

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 Modulyo with no product in the chamber, the chamber temperature will cycle between approximately -40 and -50 °C, as described in Section 3.5.

Pre-cool the Modulyo condenser chamber as follows :

1. Refer to Figure 2. Ensure that the on lamp (3) is on (that is, that the Modulyo is connected to the electrical supply and that the supply is switched on).
2. Move the refrigeration switch (1) to the '1' (on) position.
3. Leave the Modulyo on until the temperature shown on the temperature gauge (6) is -45 °C or lower.
4. Wait a further 10 minutes.

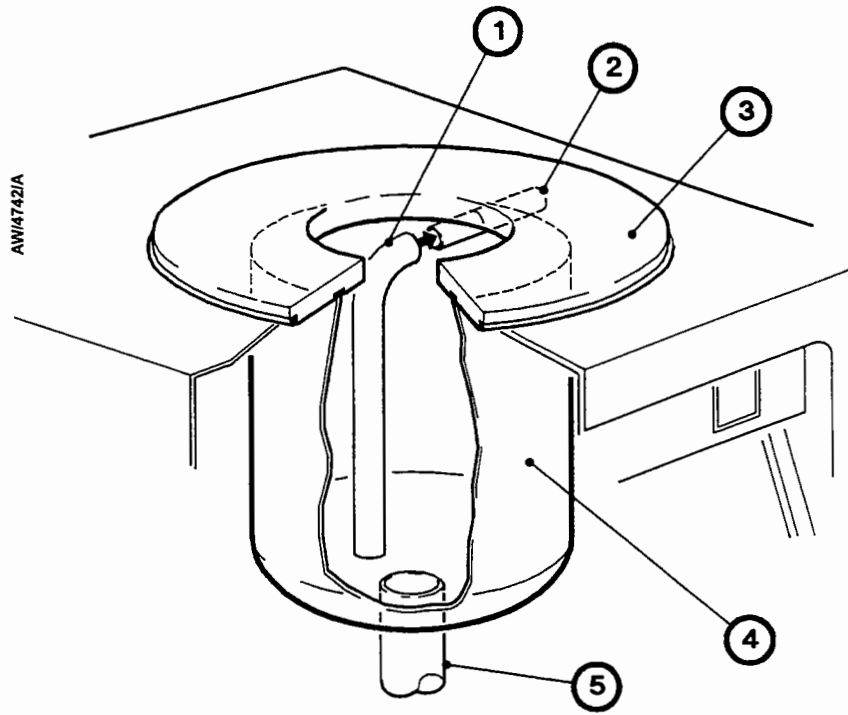
4.6 Drying

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.

(Continued on page 20)



1. Extension tube
2. Vacuum pumping pipeline
3. Accessory flange
4. Condenser chamber
5. Chamber drain outlet

Figure 4 - Fit the condenser extension tube

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 Modulyo, 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°C or below within a few minutes, the Modulyo is overloaded. Reduce the amount of product in the freeze drying system to prevent the product from melting or, when you use the Modulyo as a vapour trap, restrict the flow of vapour to the Modulyo.
- 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 Modulyo continues to leak, contact your supplier or Edwards.

4.7 Shut down

CAUTION

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

Look at the pressure shown on the pressure gauge and the appearance of the product and consult data gathered from previous freeze drying operations (refer to Sections 1.7.2 and 1.7.3) to determine when the freeze drying process has finished. Note that the pressure shown on the pressure gauge will fall significantly when vapour is no longer being released from the product.

Once the process has finished, shut down the Modulyo 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.
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. Move the refrigerator switch to the '0' (off) position.
6. Remove the drying accessory.

4.8 Defrost the Modulyo

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 Modulyo switched off at ambient temperature to defrost it. Make sure that all water is drained from the condenser chamber before you switch the Modulyo 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 Modulyo again immediately. Use the following procedure.

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 (Figure 4, item 2).
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 Modulyo for the next operational cycle as described in Section 4.3.

4.9 Operation with no load

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

If you see water dripping out of the Modulyo, 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 Modulyo. Always check this carefully before you contact your supplier or Edwards for advice.

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

5 MAINTENANCE

5.1 Introduction

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

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 Edwards service engineers.

5.2 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.

5.2.1 Precautions

- Switch off the Modulyo, 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 Modulyo conforms with your local and national safety requirements. It must be connected to a suitably fused and protected electrical supply and a suitable earth (ground) point.

5.2.2 Refrigerant leaks

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

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.

At normal atmospheric pressure, the refrigerant will evaporate at -40°C . 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.

5.3 Electrical faults

5.3.1 Fault finding

If an electrical fault is suspected, use Table 7 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 or Edwards before you use the Modulyo again.

5.3.2 Loose connections and faulty components

The circuit diagram for the Modulyo is shown in Figure 7. Wiring diagrams for the vacuum pump motor are included in the instruction manual for the pump. Use these diagrams to check for and rectify loose connections or faulty electrical components.

To access electrical connections on the compressor and the fan, remove the top cover (refer to Steps 1 to 3 of Section 5.3.3), then remove the terminal-box cover on the compressor (Figure 1, item 1).

To repair faults in the electrical box, you must first remove the electrical box from the Modulyo: refer to Section 5.3.3. After you have completed any repairs, refit the electrical box and cover: refer to Section 5.3.4.

Symptom	Check	Action	By
The external electrical supply is on but the on lamp is off and there is no electrical supply to any components.	Has the thermal magnetic circuit-breaker tripped ?	If so, identify and rectify the cause of the problem, then reset the circuit breaker: refer to Section 5.3.5 If the circuit-breaker trips 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 on lamp is on, the refrigeration switch and lamp are on, but the compressor does not start.	Is the electrical supply voltage too low ?	Use an alternative electrical supply and/or remove any extension cables which can cause small voltage drops.	U
	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.	SE
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 if necessary.	SE
The on lamp is on, but the electrical supply lamp on the pressure gauge is off.	Has the gauge fuse failed ?	If so, identify and rectify the cause of the problem, then replace the fuse: refer to Section 5.3.6.	U
	Is there an electrical fault ?	Repair the electrical fault.	SE
The temperature shown on the temperature gauge does not change.	Is the plug disconnected from or loosely connected to the rear of the gauge ?	Inspect the electrical system and repair any fault found.	SE
	Has the thermocouple failed ?	Check and replace the thermocouple.	SE

Table 7 - Electrical fault finding

Symptom	Check	Action	By
The temperature shown on the temperature gauge rises when the refrigeration switch is switched on.	Is the thermocouple polarity incorrect ?	Interchange the thermocouple wires on the rear of the temperature gauge.	SE
Incorrect temperatures are shown on the temperature gauge.	Does the gauge need to be zeroed ?	Zero the temperature gauge.	SE
	Is the incorrect type of thermocouple fitted ?	Check and replace the thermocouple, if necessary.	SE
The pressure gauge does not operate correctly.	Does the gauge need to be zeroed ?	Zero the pressure gauge: refer to Section 5.3.7.	U
	Is the plug disconnected from or loosely connected to the rear of the gauge ?	Inspect the electrical system and repair any fault found.	SE
	Is the gauge head faulty ?	Replace the Pirani gauge head.	SE

Table 7 - Electrical fault finding (continued)

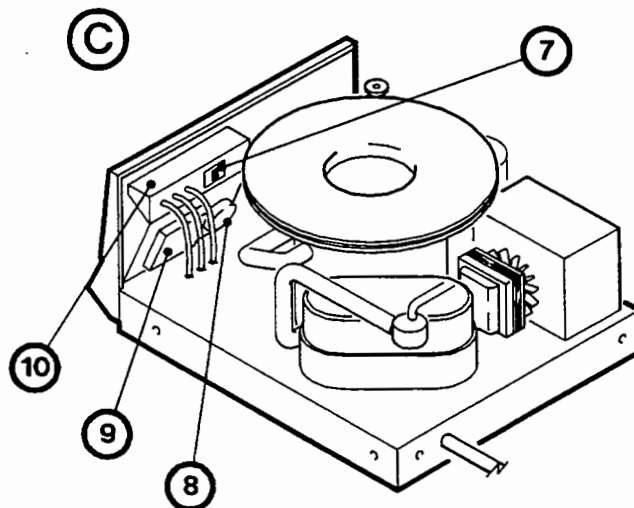
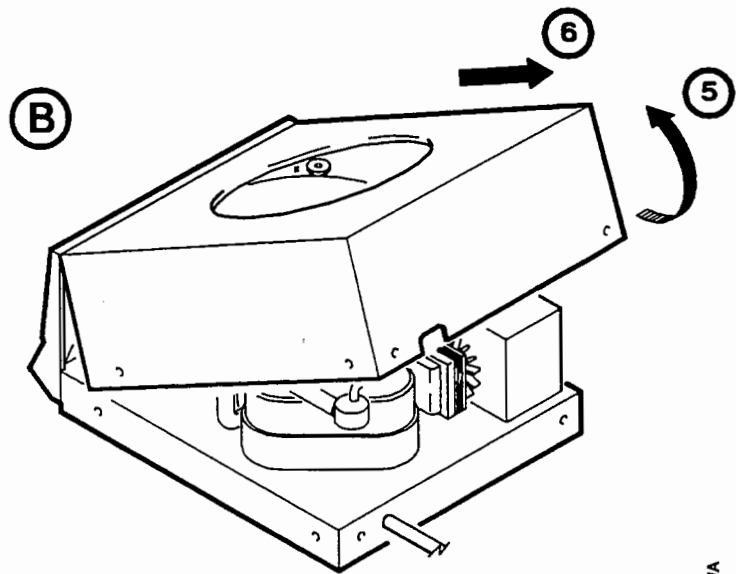
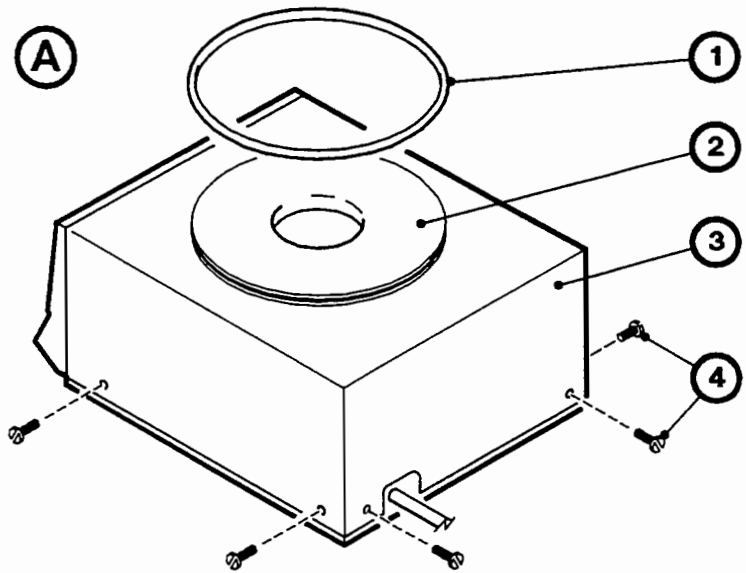
5.3.3 Remove the top cover and the electrical box

WARNING

Disconnect the Modulyo from the electrical supply before you remove the top cover. If you do not, you may accidentally touch live electrical components.

1. Switch off the external electrical supply and isolate it from the Modulyo.
2. Refer to Figure 5, detail A. Remove the 'O' ring (1) from the accessory flange (2), then undo and remove the six screws (4) which secure the top cover (3).
3. Refer to detail B. Lift the rear of the cover (5), then pull the cover back (6) to remove it from the base of the Modulyo and place the cover on the bench next to the base; if necessary, disconnect the earth (ground) wire from the top cover.
4. Refer to Figure 2. Use a small screwdriver to prise the cover cap off of the front of the drain-valve (9).
5. Undo the grubscrew which secures the drain-valve to the shaft, then remove the drain-valve.
6. Pull out the four plunger fasteners at the rear of the plastic fascia (10), then pull the fascia forwards and remove it.

(Continued on page 28)



1. 'O' ring
2. Accessory flange
3. Top cover
4. Screws (6 off)
5. Lift the rear of the cover
6. Pull the cover out
7. Reset switch
8. Temperature gauge
9. Pressure gauge
10. Electrical box

Figure 5 - Remove/refit the top cover

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7. Undo and remove the four screws (7).
8. Pull the electrical box (Figure 1, item 4) forwards out of the Modulyo.
9. Remove the four screws which secure the cover on the electrical box and remove the cover.

5.3.4 Refit the electrical box and top 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 Modulyo.

1. Refit the cover to the electrical box (Figure 1, item 4) and secure with the four screws (removed in Section 5.3.3).
2. Refer to Figure 2. Refit the electrical box into the front of the Modulyo and secure with the four screws (7).
3. Refit the plastic fascia (10) to the front of the Modulyo; ensure that the four plunger fasteners are fully secured in the Modulyo.
4. Refit the drain-valve (9) to the shaft at the front of the Modulyo and secure with the grubscrew (removed in Section 5.3.3).
5. Refit the cover cap to the drain-valve.
6. If necessary, reconnect the earth (ground) wire to the top cover.
7. Refer to Figure 5. Tilt the cover upwards as shown in detail B, fit the top front edge of the cover under the top lip of the front of the Modulyo, then lower the rear of the cover.
8. Refit the six screws (4) to secure the top cover in place.
9. Refit the 'O' ring (1) to the accessory flange (2).

5.3.5 Reset the thermal magnetic circuit 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 cause of the trip.

1. Remove the top cover from the Modulyo: refer to Steps 1 to 3 of Section 5.3.3.
2. Refer to Figure 5, detail C. Press the reset button (7) to reset the thermal magnetic circuit breaker.
3. Refit the top cover: refer to Steps 6 to 9 of Section 5.3.4.

5.3.6 Replace the pressure gauge fuse

Use the following procedure to check the pressure gauge fuse and to replace it if it has failed. Only replace the fuse once you have identified and rectified the cause of the failure.

1. Remove the top cover from the Modulyo: refer to Steps 1 to 3 of Section 5.3.3.
2. Refer to Figure 5, detail C. Remove the fuse from the pressure gauge (8) and check its electrical continuity. If there is no electrical continuity, continue at Step 3, otherwise call a qualified service engineer to inspect the Modulyo.
3. Replace the fuse with a fuse of the correct type and rating: refer to the Pirani gauge instruction manual.
4. Refit the top cover to the Modulyo: refer to Steps 6 and 9 of Section 5.3.4.

5.3.7 Zero the pressure gauge

1. Remove the top cover: refer to Steps 1 to 3 of Section 5.3.3.
2. Zero the pressure gauge: refer to the Pirani instruction manual.
3. Refit the top cover to the Modulyo: refer to Steps 6 and 9 of Section 5.3.4.

5.4 Refrigeration faults

Note: Refer to Table 3 for nominal refrigeration system performance. Figure 6 shows a schematic diagram of the refrigeration system.

5.4.1 Repeat the installation test

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

1. Defrost the condenser chamber (refer to the instructions given in Section 4.8).
2. Repeat the installation tests of Section 3.5. Note the results at each step and then contact an Edwards Service Centre.

5.4.2 Fault diagnosis

Some possible causes of refrigeration faults, together with suggested actions to cure the faults, are shown in Table 8. 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 a fault cannot be identified, contact your supplier or Edwards for advice.

5.4.3 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 Modulyo.

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

5.4.4 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 this is likely to have been contaminated.
5. Dehydrate the system and recharge the Modulyo with refrigerant (refer to Section 5.4.5). 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 Section 5.3.2 and rectify any fault found.	SE
The compressor starts but the temperature does not reach -50 °C.	Is there sufficient ventilation ?	If not, relocate the Modulyo. There must be no restrictions to air-flow to the sides and rear of the Modulyo.	U
	Is the refrigerant charge low ?	Find the leak (refer to Section 5.4.3), then repair the leak and recharge the system with refrigerant.	SE
The compressor starts but the temperature does not reduce.	Is the temperature gauge or thermocouple faulty ?	Check the gauge and the thermocouple and replace if necessary.	SE
	Is there a leak in the refrigeration system ?	Find the leak (refer to Section 5.4.3), 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 Modulyo too high ?	Reduce the amount of product being freeze dried or restrict the vapour load to the Micro- modulyo.	U

Table 8 - Refrigeration fault finding

5.4.5 Recharge with refrigerant

If you need to recharge the Modulyo 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 (refer to Section 2.2) to recharge the refrigeration system. We recommend that you use the recharging valve on the liquid receiver to recharge the Modulyo.

6 STORAGE AND DISPOSAL

6.1 Storage

Store the Modulyo as follows :

1. If applicable, ensure that the Modulyo has been shut down as described in Section 4.7.
2. Disconnect the electrical supply and vacuum connections and clean the Modulyo (see Section 4.3).
3. Replace any protective covers supplied with the Modulyo.
4. Store the Modulyo in clean dry conditions until required.
5. When required for use, prepare and install the Modulyo as described in Section 3 of this manual.

6.2 Disposal

Dispose of the Modulyo and any components safely in accordance with all local and national safety and environmental requirements.

7 SERVICE, SPARES AND ACCESSORIES

7.1 Introduction

Edwards products, spares and accessories are available from Edwards companies in Belgium, Brazil, Canada, France, Germany, Hong Kong, Italy, Japan, Korea, Switzerland, United Kingdom, U.S.A, and a world-wide network of distributors. The majority of these centres employ Service Engineers who have undergone comprehensive Edwards training courses.

Order spare parts and accessories from your nearest Edwards company or distributor. When you order, please state for each part required:

- Model and Item Number of your equipment
- Serial number (if any)
- Item Number and description of part.

7.2 Service

Edwards products are supported by a world-wide network of Edwards Service Centres. Each Service Centre offers a wide range of options including: equipment decontamination; service exchange; repair; rebuild and testing to factory specifications. Equipment which has been serviced, repaired or rebuilt is returned with a full warranty.

Your local Service Centre can also provide Edwards engineers to support on-site maintenance, service or repair of your equipment.

For more information about service options, contact your nearest Service Centre or other Edwards company.

7.3 Spares

Spare	Item Number
Modulyo spares kit	F101-01-000

7.4 Accessories

7.4.1 Drying accessories

Accessory	Item Number
8-port column manifold	F056-56-000
Bell jar	F029-60-000
Stoppering shelf unit	F056-23-000
Heater kit for stoppering shelf unit	F056-55-000
Spin freezer 96 (220 V)	F056-37-000
Spin freezer 96 (110 V)	F056-38-000
Secondary drying manifold	F029-64-000
Cold trap adaptor	F056-60-000

7.4.2 Glassware

Accessory	Item Number
Vials	2 ml (approximately 1000 off) H014-30-008
	5 ml (approximately 100 off) H014-30-048
	10 ml (approximately 100 off) H014-30-042
	20 ml (approximately 94 off) H014-30-043
Ampoules	0.5 ml (approximately 1000 off) H014-30-081
	2.5 ml (approximately 500 off) H014-30-092
	5.0 ml (approximately 200 off) H014-30-083
Wide-mouth flasks	1000 ml F056-57-000
	500 ml F056-50-000
	250 ml F056-58-000

7.4.3 Sealing accessories

Accessory	Item Number
Stoppers	13 mm (1000 off) H014-30-121
	20 mm (1000 off) H014-30-122
Caps	13 mm (1000 off) H014-30-161
	20 mm (1000 off) H014-30-162
	Wide-mouth flasks (all) F056-59-000
Ampoule constrictor	F041-01-000

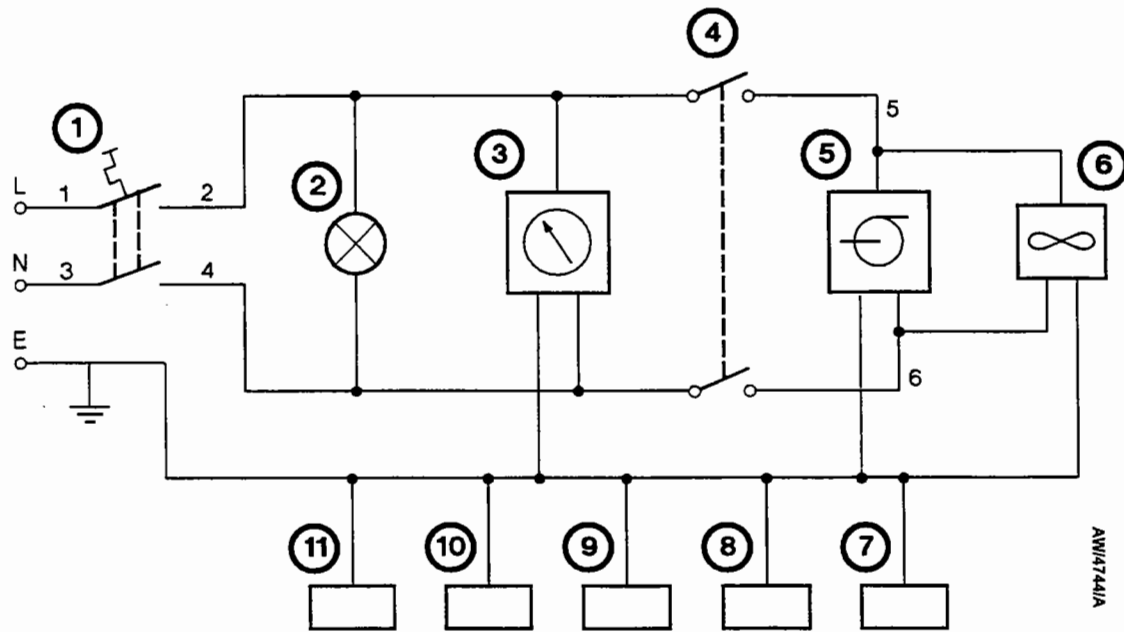
7.4.4 Trolley accessory

Mount the Modulyo on a trolley accessory, where the Modulyo cannot be mounted on an existing bench-top, or when you need to regularly move the Modulyo.

Accessory	Item Number
Trolley accessory	F101-05-000

7.4.5 Vacuum pump and accessories

The Edwards RV5 and RV8 vacuum pumps are suitable for use with the Modulyo. The pumps are also suitable for freeze drying products which contain sodium azide. Vacuum pump accessories such as oil mist filters are also available. Please contact Edwards or your supplier to discuss your vacuum pump requirements.



- | | |
|-------------------------------------|--------------------------|
| 1. Thermal magnetic circuit breaker | 7. Accessory flange |
| 2. On lamp | 8. Top cover |
| 3. Pressure gauge | 9. Base |
| 4. Refrigeration switch | 10. Electrical enclosure |
| 5. Compressor | 11. Front panel |
| 6. Fan | |

Figure 7 - Circuit diagram

Return of Edwards Equipment - Procedure (Form HS1)

Introduction

Before you return your equipment you must warn your supplier if the substances you used (and produced) in the equipment can be dangerous. You must do this to comply with health and safety at work laws.

You must complete the Declaration (HS2) on the next page and send it to your supplier before you dispatch the equipment. If you do not, your supplier will assume that the equipment is dangerous and he will refuse to accept it. If the Declaration is not completed correctly, there may be a delay in processing your equipment.

Guidelines

Take note of the following guidelines:

- Your equipment is 'uncontaminated' if it has not been used or if it has only been used with substances that are not dangerous. Your equipment is 'contaminated' if it has been used with any dangerous substances.
- If your equipment has been used with radioactive substances, you must decontaminate it before you return it to your supplier. You must send independent proof of decontamination (for example a certificate of analysis) to your supplier with the Declaration (HS2). Phone your supplier for advice.
- We recommend that contaminated equipment is transported in vehicles where the driver does not share the same air space as the equipment.

PROCEDURE

Use the following procedure:

1. Contact your supplier and obtain a Return Authorisation Number for your equipment.
2. Turn to the next page(s), photocopy and then complete the Declaration (HS2).
3. Remove all traces of dangerous gases: pass an inert gas through the equipment and any accessories which will be returned to your supplier. Drain all fluids and lubricants from the equipment and its accessories.
4. Disconnect all accessories from the equipment. Safely dispose of the filter elements from any oil mist filters.
5. Seal up all of the equipment's inlets and outlets (including those where accessories were attached). You may seal the inlets and outlets with blanking flanges or heavy gauge PVC tape.
6. Seal contaminated equipment in a thick polythene bag. If you do not have a polythene bag large enough to contain the equipment, you can use a thick polythene sheet.
7. If your equipment is a large pump (or any other large piece of equipment), strap the equipment and its accessories to a wooden pallet. Preferably, the pallet should be no larger than 510mm x 915mm (20" x 35"); contact your supplier if you cannot meet this requirement.
8. If your equipment is too small to be strapped to a pallet, pack it in a suitable strong box.
9. If the equipment is contaminated, label the pallet (or box) in accordance with laws covering the transport of dangerous substances.
10. Fax or post a copy of the Declaration (HS2) to your supplier. The Declaration must arrive before the equipment.
11. Give a copy of the Declaration to the carrier. You must tell the carrier if the equipment is contaminated.
12. Seal the original Declaration in a suitable envelope; attach the envelope securely to the outside of the equipment package. **WRITE YOUR RETURN AUTHORISATION NUMBER CLEARLY ON THE OUTSIDE OF THE ENVELOPE OR ON THE OUTSIDE OF THE EQUIPMENT PACKAGE.**

