REFRIGERATED CHAMBER

3 SHELF UNIT

Installation and Operation Manual

EDWARDS

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EDWARDS

10-F 100-01-880
MAY 1990
Issue C

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SAFETY PRECAUTIONS

General Notes on Safety Precautions

Throughout this manual a policy of highlighting special safety precautions has been adopted in the form of WARNING and CAUTION notes, these must be observed during installation, operation and servicing of both the Refrigerated Chamber — 3 Shelf Unit and the Supermodulyo Freeze Drying Unit.

WARNINGS: are given where failure to observe the instruction could result in injury or even death to personnel.

CAUTIONS: are given where failure to observe the instruction could result in damage to equipment.

The WARNING and CAUTION notes are included in the appropriate place within the manual text and as an added precaution are repeated on the following pink coloured pages. The Section(s) of the manual in which the WARNING/CAUTION appears is given at the end of each note.

LIST OF WARNINGS

WARNING: THE RC3S UNIT WEIGHS APPROXIMATELY 180 KG. IT IS THEREFORE IMPORTANT THAT THE CORRECT SITING AND LIFTING PROCEDURES ARE OBSERVED. UNDER NO CIRCUMSTANCES SHOULD THE UNIT BE LIFTED MANUALLY OR WITHOUT THE AID OF EITHER A HYDRAULIC LIFT, WHEN PACKED, OR A CRANE DURING THE ASSEMBLY PROCEDURE. WHEN ASSEMBLED ON TOP OF THE SUPERMODULYO THE COMBINED WEIGHT IS APPROXIMATELY 360 KG. MOVEMENT ON THE CASTORS SHOULD THEREFORE BE KEPT TO A MINIMUM, AND THEN ONLY OVER CLEAN, EVEN FLOOR SURFACES, TO PREVENT THE UNIT FROM TOPPLING. THIS UNIT WILL TOPPLE IF INCLINED AT ANGLES GREATER THAN 10°.

WARNING: THE LIFTING FRAME IS DESIGNED FOR LIFTING THE RC3S UNIT ONLY AND MUST NOT BE USED FOR ANY OTHER PURPOSE. THE BOLTS ATTACHING THE RC3S UNIT TO THE SUPERMODULYO ARE FOR SECURING THE UNIT ONLY. LIFTING THE RC3S UNIT AND THE SUPERMODULYO TOGETHER MUST NEVER BE ATTEMPTED.

WARNING: IT IS ESSENTIAL THAT THE RC3S UNIT IS EARTHED. THE EARTHING PROVIDED BY THE SUPERMODULYO IS NOT SUFFICIENT TO EARTH BOTH UNITS.

WARNING: SODIUM AZIDE EXPLOSION HAZARD

SODIUM AZIDE, WHICH IS SOMETIMES USED AS A STABILISING AGENT IN FREEZE DRYING PROCESSES, IS A TOXIC AND (WHEN DRY) HIGHLY EXPLOSIVE MATERIAL. IN THE PROCESS OF PUMPING PRODUCT CONTAINING THIS CHEMICAL, A POORLY UNDERSTOOD 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 HEAVY METAL AZIDES WHICH ARE HIGHLY UNSTABLE AND PRESENT A VERY SEVERE EXPLOSION HAZARD.

IF SODIUM AZIDE IS TO BE PROCESSED IN THIS EQUIPMENT, THEN THE PRODUCT PROBES AND VACUUM LEADTHROUGH (BOTH OF WHICH CONTAIN COPPER) MUST BE REMOVED FROM INSIDE THE CHAMBER. REFER TO SECTION 5 OF THIS MANUAL FOR MODIFICATION PROCEDURE AND FOR FURTHER DETAILS OF SODIUM AZIDE HAZARDS. (See Section 4).

WARNING: DEPENDING UPON PREVIOUS USES, THE SHELVES INSIDE THE CHAMBER MAY BE EITHER HOT OR VERY COLD. IN ORDER TO PREVENT POSSIBLE INJURY CARE SHOULD BE TAKEN NOT TO TOUCH ANY HOT OR COLD SURFACES. (See Section 4.1).

WARNING: IF IT IS SUSPECTED THAT AZIDE PRECIPITATION OR FORMATION HAS OCCURRED, THE USER SHOULD NOT ATTEMPT TO DECONTAMINATE OR CLEAN THE SUSPECTED AREA; INSTEAD, THE USER SHOULD ISOLATE THE EQUIPMENT AND SEEK EXPERT ADVICE AND ASSISTANCE. (See Section 5.1).

WARNING: DISCONNECT THE ELECTRICAL SUPPLY BEFORE CARRYING OUT ANY REPAIR WORK. THERE ARE NO USER SERVICEABLE PARTS INSIDE THE ELECTRICAL BOX. (See Section 6.2).

WARNING: BEFORE ATTEMPTING TO REPLACE EITHER THE HEATER OR THE THERMOSTAT, MAKE SURE THAT THE UNIT IS NOT HOT FROM PREVIOUS USAGE AND THAT IT HAS BEEN DISCONNECTED FROM THE ELECTRICAL SUPPLY. (See Section 6.6).

WARNING: IF TOXIC, CORROSIVE, FLAMMABLE OR EXPLOSIVE MATERIALS HAVE BEEN USED IN THE REFRIGERATED CHAMBER, ENSURE THAT ADEQUATE PRECAUTIONS ARE TAKEN TO PROTECT PERSONNEL WORKING IN THE VICINITY. IF A REFRIGERATED CHAMBER IS RETURNED TO EDWARDS HIGH VACUUM INTERNATIONAL, CLEARLY IDENTIFY WHAT TOXIC OR HAZARDOUS MATERIALS MAY STILL BE PRESENT IN THE CHAMBER. USE THE HEALTH AND SAFETY CLEARANCE FORM HSC 001 WHICH IS INCLUDED AFTER THIS SECTION OF THE MANUAL. (See Section 11).

LIST OF CAUTIONS

CAUTION: A SHELF TEMPERATURE THAT IS TOO HIGH MAY OVERLOAD THE SUPERMODULYO, AND THIS MAY RESULT IN MELTING THE PRODUCT. DURING THE DRYING PROCESS, THE INDICATED CONDENSER TEMPERATURE ON THE SUPERMODULYO SHOULD NOT RISE ABOVE -35°C. (See Sections 2.4.2 and 4.4).

CAUTION: IF VIALS FALL OFF THE SHELVES AND BREAK, TAKE CARE WHEN CLEANING THAT BROKEN GLASS DOES NOT ACCUMULATE AT THE BOTTOM OF THE CHAMBER. (See Section 4.2.1).

CAUTION: THERE IS NOT AUTOMATIC SHUT-OFF SYSTEM ON THE SHELF MECHANISM, SO TO PREVENT DAMAGE TO THE VIALS AND CHAMBER BY EXCESS PRESSURE A VISUAL CHECK IS REQUIRED TO CONFIRM THAT THE STOPPERS ARE FULLY HOME. IF VIALS DO NOT STOPPER CORRECTLY, DO NOT USE EXCESSIVE FORCE (GREATER THAN 14 KGF) AS THIS MAY DAMAGE THE VIALS AND CHAMBER. (See Section 4.7).

CAUTION: IT IS RECOMMENDED THAT ANY FAULTS INSIDE THE CONTROL BOX ARE REPAIRED BY EDWARDS HIGH VACUUM INTERNATIONAL NOMINATED SERVICE ENGINEERS. (See Section 6.3).

CAUTION: ONLY EDWARDS HIGH VACUUM INTERNATIONAL NOMINATED PERSONNEL SHOULD CARRY OUT REPAIRS TO THE REFRIGERATION SYSTEM. (See Section 6.4).

CAUTION: DO NOT OVERFILL THE OIL TANK AS THE OIL CAN EXPAND BY UP TO 2 LITRES AT HIGH TEMPERATURES. (See Section 6.5).

CAUTION: IF THE STOPPERING ACTION BECOMES STIFF, DO NOT WRENCH THE HANDLE AS THIS MAY PERMANENTLY DEFORM THE CHAMBER OF FRAMEWORK. (See Section 6.7).

CAUTION: DO NOT APPLY A FORCE GREATER THAN 14 KGF (30 LBF) AS THIS MAY CAUSE THE VIALS TO SHATTER OR THE CHAMBER TO DEFORM. (See Section 6.7).

CAUTION: POOR OIL QUALITY WILL GIVE POOR VACUUM PERFORMANCE AND WILL DAMAGE THE VACUUM PUMP. (See Section 7.3).

EDWARDS REFRIGERATED CHAMBER — 3 SHELF UNIT

Installation and Operating Manual

CONTENTS OF MANUAL

APPENDICES

LIST OF ILLUSTRATIONS

1 INTRODUCTION

1.1 General Introduction

The Edwards Refrigerated Chamber — 3 Shelf Unit (RC3S unit) is designed primarily for use as an add-on accessory for the Supermodulyo 12K freeze dryer, but can be used independently as a stand-alone freezing chamber. The 500 mm diameter vacuum chamber contains three stainless steel shelves, whose temperature is evenly regulated by means of a fourth, compensating shelf. The temperature can be controlled between –40 °C and +60 °C, to within 1 °C. Uniform shelf temperatures are achieved by the use of a secondary fluid refrigeration and heating system, which considerably improves the unit's drying characteristics.

When placed on top of the Supermodulyo, the Refrigerated Chamber — 3 Shelf Unit gives a 0.405 m^2 freeze drying capacity suitable for most laboratory and small-scale production work, yet takes up a very small floor area. A manually operated stoppering device is included to seal vials larger than 35 mm under vacuum. The chamber itself is lower than conventional drying chambers, giving a more convenient working height. The controls are both simple to use and easily replaced. Included with the unit are three temperature probes for use in products and also an Edwards Pirani gauge for measuring chamber pressure.

The RC3S unit is not designed for use with Sodium Azide although with certain modifications it can be used. Refer to Section 5 of this Manual for further details of the explosion hazards associated with Sodium Azide and the modifications necessary to the RC3S unit.

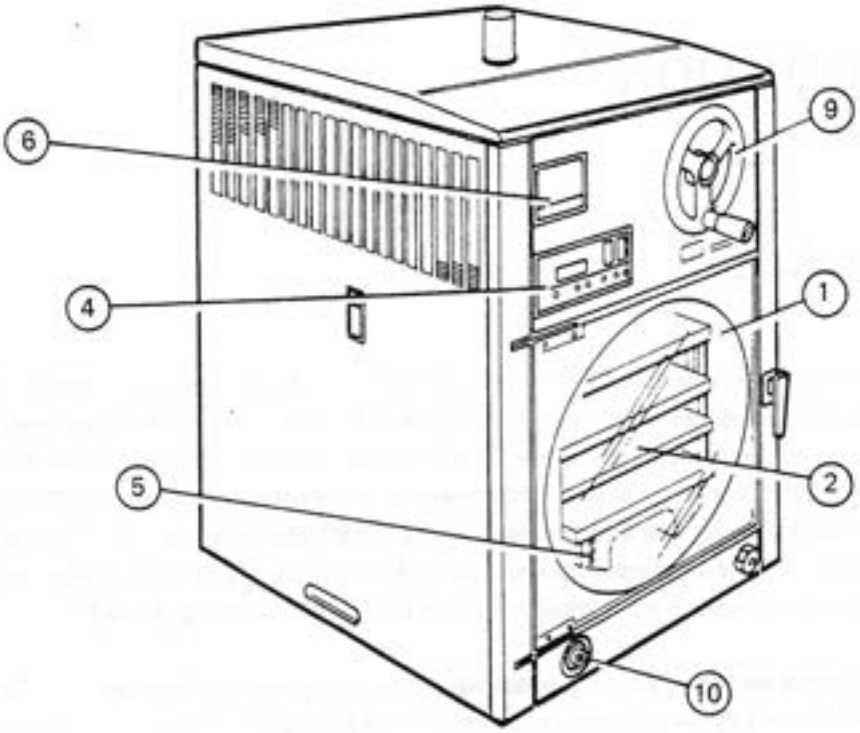

Fig. 1 RC3S unit with covers in place

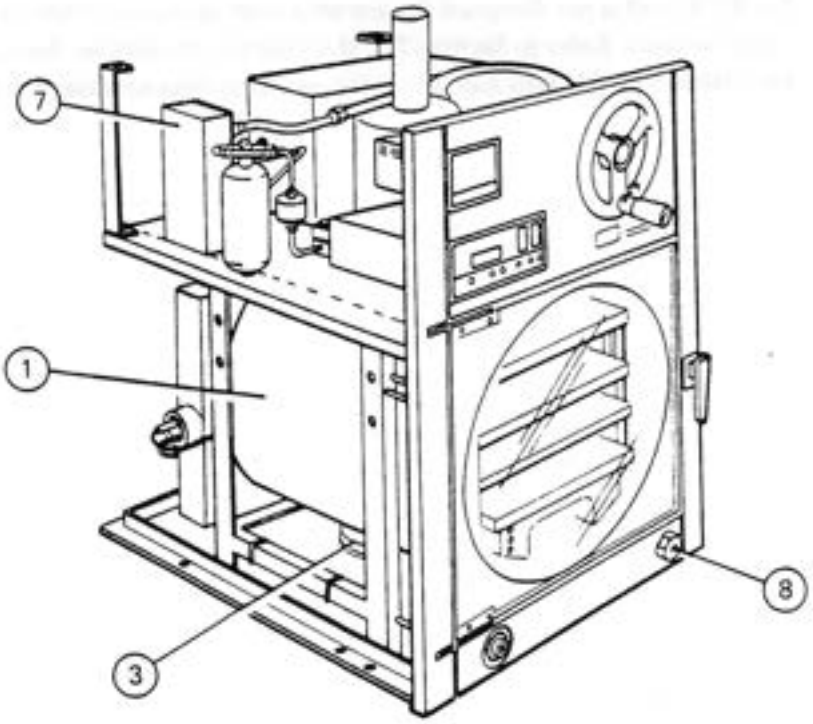

Fig.2 RC3S unit with covers removed

1.2 Component Identification

The Refrigerated Chamber — Shelf Unit comprises the following main components, identified on Figs. 1 and 2:

1.	Vacuum Chamber
2.	Shelf Assembly
3.	Isolation Valve (optional)
4.	Instrument and Control Panel
5.	Temperature Probes
6.	Pirani Pressure Gauge
7.	Regrigeration System
8.	Air Admittance Valve
9.	Stoppering Jack
10.	Pressure Control Valve

1.3 Specification and Data

There are two models available, a 50 Hertz and a 60 Hertz version, but the basic specifications and data are common throughout.

Unit Dimensions	
RC3S Free Standing	
Height	1025 mm
Width	650 mm
Depth	745 mm
RC3S/Supermodulyo Combined	
Height	1970 mm
Width	655 mm
Depth	795 mm
Weight	
RC3S Free Standing	180 kg
RC3S/Supermodulyo Combined	360 kg
Number of Shelves	3 active plus 1 compensating
Shelf Dimensions	
Width	300 mm
Depth	450 mm
Total Shelf Area	0.405 m^2
Chamber Diameter	500 mm

Stoppering	
Method	Mechanical screw jack rated at 2.5 tonnes
Clearance	80 mm
Maximum Force To Be Exerted On Handle	14 kgf (30 lbf)
Cooling System	
Method	Indirect fluid, single expansion
Minimum Temperature	–40°C
Refrigerant	R502
Compressor	0.75 hp
Heating System	
Method	Indirect fluid, electrically powered thermal input
Maximum Temperature	60°C
Type	Band Type Heater
Heat Load	250 watts
Shelf Heating/Cooling Operation System	
Method	Centrifugal Pump (using Indirect Heat Transfer Fluid System)
Fluid	Baysilone M5 silicon oil
Temperature	
Control	±1°C
Uniformity	±0.5°C
Measurement	4 Temperature Probes (3 for product, 1 for Fluid)
Door Seal Lubricant	Silicone Grease (Edwards No. HO24 00 036)
Electrical Power Requirements	
50 Hertz Version	220 – 240 U alternating current, 1 phase
60 Hertz Version	208 – 220 V alternating current, 1 phase
Maximum Current Demand	8 amps
Lifting Frame Assembly	Edwards F100 01 138

Stoppering	
Method	Mechanical screw jack rated at 2.5 tonnes
Clearance	80 mm
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Electrical Power Requirements	
50 Hertz Version	220 – 240 U alternating current, 1 phase
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Maximum Current Demand	8 amps
Lifting Frame Assembly	Edwards F100 01 138

1.4 Freeze Drying — The Basic Principles

Freeze drying is a means of preserving substances containing water, or solutions in water, that are usually of biological origin. Substances often treated are living micro-organisms for preventive or curative medicine, or for 'banking' in culture collections; starters for fermentation processes, blood fractions, biological standards, hormones, enzymes, antibiotics, vitamins, unstable chemicals and pieces of tissue.

After pre-freezing, the product is exposed to vacuum (supplied here by the Supermodulyo unit) and the contained ice allowed to sumbline, changing directly from the solid to the vapour state without melting. During freeze drying the ice does not evaporate simultaneously from all parts of the material, but a frozen interface continuously moves away from a dry outer boundary. The resulting 'cake' has substantially the same size and shape as the original frozen mass and may usually be stored at room temperature until required. When reconstitution is necessary, the addition of a suitable quantity of water will restore those properties which survived the initial freezing process.

Apparatus for freeze drying consists essentially of a vacuum vessel, a water trap and a mechanical vacuum pump. The water vapour which evolves in the process is trapped before entering the pump. Methods in common use for trapping water are desiccants (drying agents), or refrigerated condensers (as used in the Supermodulyo and Refrigerated Chamber — 3 Shelf Unit combination). Containers of the pre-frozen material are either attached externally to a vacuum manifold or placed in a chamber (as in the case of the RC3S unit), which is then evacuated.

Vacuum is necessary to create the conditions which allow ice sublimation in freeze drying and sublimation only occurs if heat is supplied to the frozen material. Room heat is usually sufficient for manifold or small chamber freeze dryers. However, the RC3S unit provides the heat required via its indirect fluid circulation system.

A more detailed account of freeze drying is given in Appendix 1 at the back of this Manual.

2. DESCRIPTION OF REFRIGERATED CHAMBER

2.1 General Description

The Refrigerated Chamber — 3 Shelf Unit (RC3S) is of similar proportions and complementary design to the Supermodulyo unit so that when mounted in position on top of the Supermodulyo the impression is given of a single, unified assembly. The unit is supported in a fabricated steel framework with removable side and rear panels. A removable lifting frame is provided to allow it to be mechanically lifted into place. Connection is made at the base of the Refrigerated Chamber to the top of the Supermodulyo, either by a flanged spacer or by an isolation valve.

2.2 Shelf Assembly and Pipework

The chamber is permanently fitted with a shelf assembly that comprises three active shelves for the loading of specimens and a fourth, compensating shelf at the top to ensure uniform temperature control. Each shelf is constructed of stainless steel with integral flow-ways for the heat transfer fluid. The shelves are connected in parallel to a pair of flow and return manifolds situated outside the chamber. Provision has been made for venting the shelf assembly on priming the system with the heat transfer fluid.

2.3 Stoppering

The mechanical stoppering of vials within the chamber can be carried out under vacuum, or at atmospheric pressure. When stoppering at atmospheric pressure the chamber may be back filled with an inert gas by using the leak valve option. The shelves are moved by a low-geared screw mechanism which moves 1 mm with each revolution of the hand wheel. This enables the very large forces required for stoppering to be applied by most personnel. (See Fig. 18.)

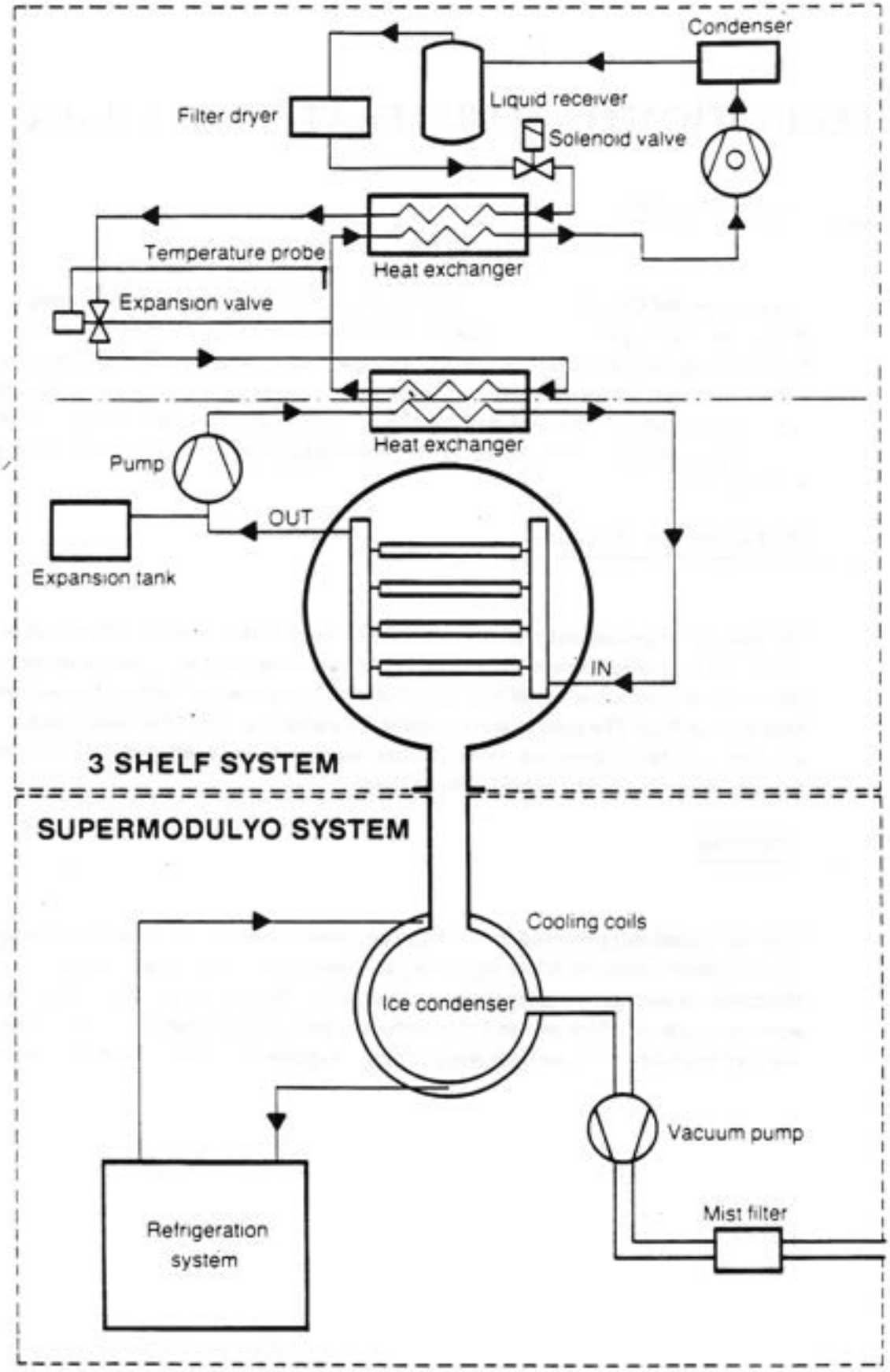


Fig. 3 Flow chart of RC3S and Supermodulyo units

2.4 Refrigeration and Heating Circuits

The refrigeration system is mounted on top of the vacuum chamber. It is capable of reducing the shelf temperature to -40°C from an ambient of 22°C with the chamber evacuated to less than 0.05 mbar. The cooling and heating of the shelves is by means of a pumped, indirect heat transfer fluid system. The electrically powered thermal input heat exchanger is rated for a heat load of 250 Watts. (See Fig. 22.)

2.4.1 The Freezing Process

The time taken to carry out the freezing process, although dependent upon the nature of the product, can be speeded up in some instances by first pre-cooling the shelves prior to loading. Care should be taken if using this method because some products suffer from thermal shock and in these instances a more gradual freezing is recommended.

A temperature recorder can be used to monitor the product condition during the freezing cycle. For further details of the recorder and fitting kit refer to Section 10 EHVI Accessory Range.

2.4.2 The Drying Process

Drying will commence as soon as the product is under vacuum, but once the vacuum falls to less than 0.1 – 0.5 mbar, the drying process becomes very slow. The process can be expedited by applying heat to the product; this is achieved by heating the fluid that circulates around the shelves.

Shelf heating not only depends on the product, but also on the load conditions and plant capacity. The shelf temperature, therefore, should be chosen to suit both the product and the plant.

CAUTION: A SHELF TEMPERATURE THAT IS TOO HIGH MAY OVERLOAD THE SUPERMODULYO AND THIS MAY RESULT IN MELTING THE PRODUCT. DURING THE DRYING PROCESS, THE INDICATED CONDENSER TEMPERATURE ON THE SUPERMODULYO SHOULD NOT RISE ABOVE -35°C.

Shelf heating is usually initiated when the chamber pressure has reached 0.1 – 0.5 mbar (this pressure is typically reached within 30 minutes of starting pump-down). However, before deciding on shelf heating, observe the product. If the product has been correctly frozen then its cake (mass) is usually homogeneous in colour and compact. If the cake is uneven in colour or signs of boiling are visible, then the product has been incorrectly frozen or has undergone some change.

Closely observe the rise in chamber pressure and product temperature and make careful notes of the data as this may prove very useful in optimising the drying cycle.

A temperature recorder can be used to monitor the product condition during the drying process. For further details of the recorder and fitting kit refer to Section 10 EHVI Accessory Range.

2.4.3 Secondary Drying

In some cases it may be necessary to go through a secondary drying process in order to drive off the residual water content after going through the ordinary drying cycle. To facilitate secondary drying, the shelves of the RC3S unit can be heated to +60°C.

Where there is no danger of melting the product and temperature control is not critical, the refrigeration compressor may be switched off at the front panel FRIDGE switch to save electricity.

This may also be possible during the ordinary drying cycle, but this has to be individually assessed according to the nature of the product and determined by experiment.

2.5 Controls

The RC3S unit is controlled by a very simple control module (see Fig. 4) though contained within it are some functions, including a MAINS switch, a FRIDGE switch, and a highly sophisticated 3-term PID temperature controller.

The control system can maintain a set point temperature adjustable between -40°C to +60°C, with a permissable variation during operation of 1°C.

The module panel consists of the following features:

1. MAINS — This switches mains supply on and off to the circulation pump, Pirani gauge and temperature controller

2. FRIDGE — An independant power switch for the refrigeration unit

3. TEMPERATURE DISPLAY — Whenever the unit is switched ON this display lights up showing the circulation fluid temperature in degree Centrigrade, the set point temperature when the ☆ switch is depressed or the probe temperature when switches 1, 2 or 3 are depressed

4. SWITCH [☆] — When pressed, display shows set point temperature

5. SWITCH [▲] — Raises the set point temperature when pressed at the same time as SWITCH [☆]

6. SWITCH [▼] — Lowers the set point temperature when pressed at the same time as SWITCH [☆]

7. SWITCH 1 — When pressed, display shows temperature of Probe 1 inside the chamber. On release, the display reverts back to fluid temperature

8. SWITCH 2 — When pressed, display shows temperature of Probe 2 inside the chamber. On release, the display reverts back to fluid temperature

9. SWITCH 3 — When pressed, display shows temperature of Probe 3 inside the chamber. On release, the display reverts back to fluid temperature

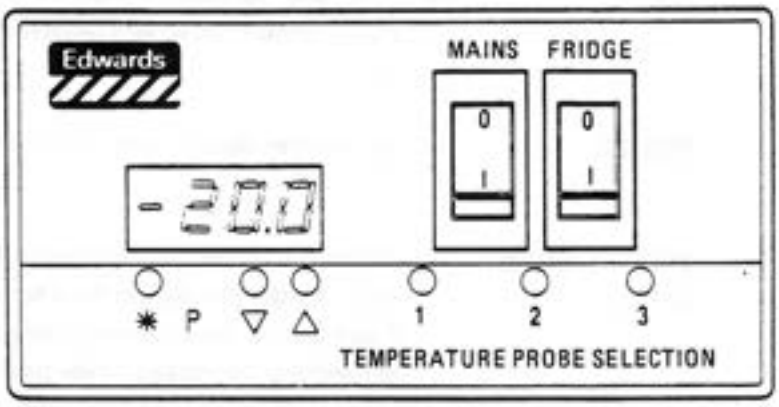


Fig. 4 Control panel layout

3. INSTALLATION

3.1 Unpacking and Inspection

3.1.1 General Notes and Packed Items

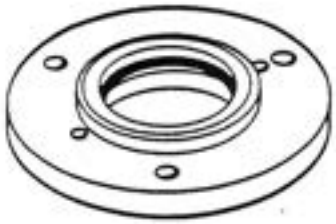
On receipt of the Refrigeration Chamber — 3 Shelf Unit, remove the packaging and check for any damage that may have occurred in transit. Notify both the carrier and Edwards High Vacuum International of any damage immediately and do not proceed with the installation of the unit until a thorough check has been made. The following items (see Fig. 5) should be packed with the unit and these should be checked off against the list:

1. Flanged Spacer
2. Lower Adaptor Flange Assembly
3. Control Ring
4. Chamber Gasket
5. Shelf Latching Clips (2 off)
6. Product Probe Assembly (3 off)
7. Lifting Frame Assembly
   Comprising:- End Frame (2 off)
   Connecting Bars (2 off)
   M8 Bolts (8 off)
   M8 Nuts (8 off)
   M6 Bolts (4 off)
   M6 Nuts (4 off)
   M12 Eye-bolts (4 off)
8. Spare Fuses (2 off)
9. Bolt M6 x 25 (2 off)
10. Bolt M6 x 20 (3 off)
11. Bolt M6 x 55 (4 off)
12. Nut M6 (5 off)
13. Washer (Spring Coil) M6 (3 off)
14. Washer (Standard) M6 (4 off)
15. Recorder fitting kit (see page 55). F10005000.

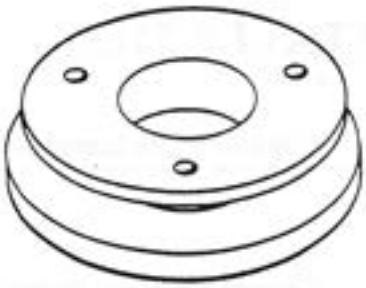
Should any of these items be missing, please notify Edwards High Vacuum International and the carriers before proceeding further.

IMPORTANT

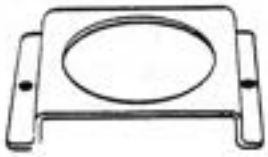
During installation or subsequent re-location ensure that the hoses do not become trapped or kinked. This will prevent damage and subsequent leaks.



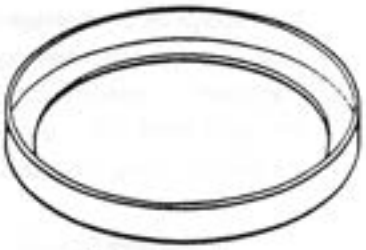
Lower adaptor flange assembly



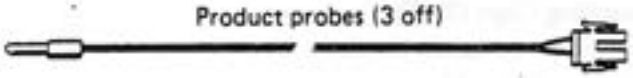
Flanged spacer

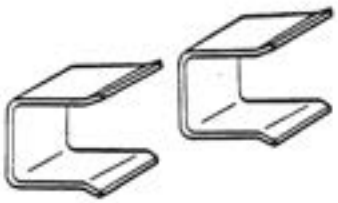


Control ring



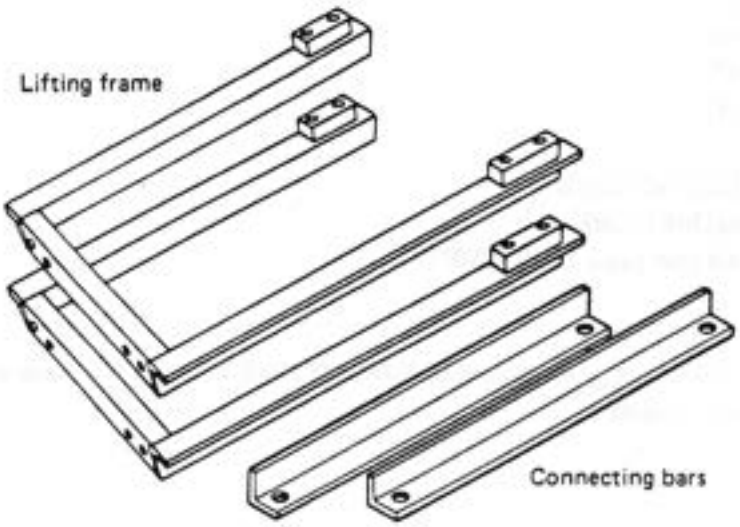
Chamber gasket





Shelf latching clips

Lifting frame



Connecting bars

ITEM	QTY
Fuse (spare)	2
M6 X 25 Bolts	2
M6 X 20 Bolts	4
M6 Nuts	3
M6 Washers S/C	3
M6 Washer Std	4
LIFTING FRAME	
M8 Bolts	8
M8 Nuts	8
M6 Bolts	4
M6 Bolts	4
M12 Eyebolts	4

Fig.5 Packed items

3.2 Installation Procedures

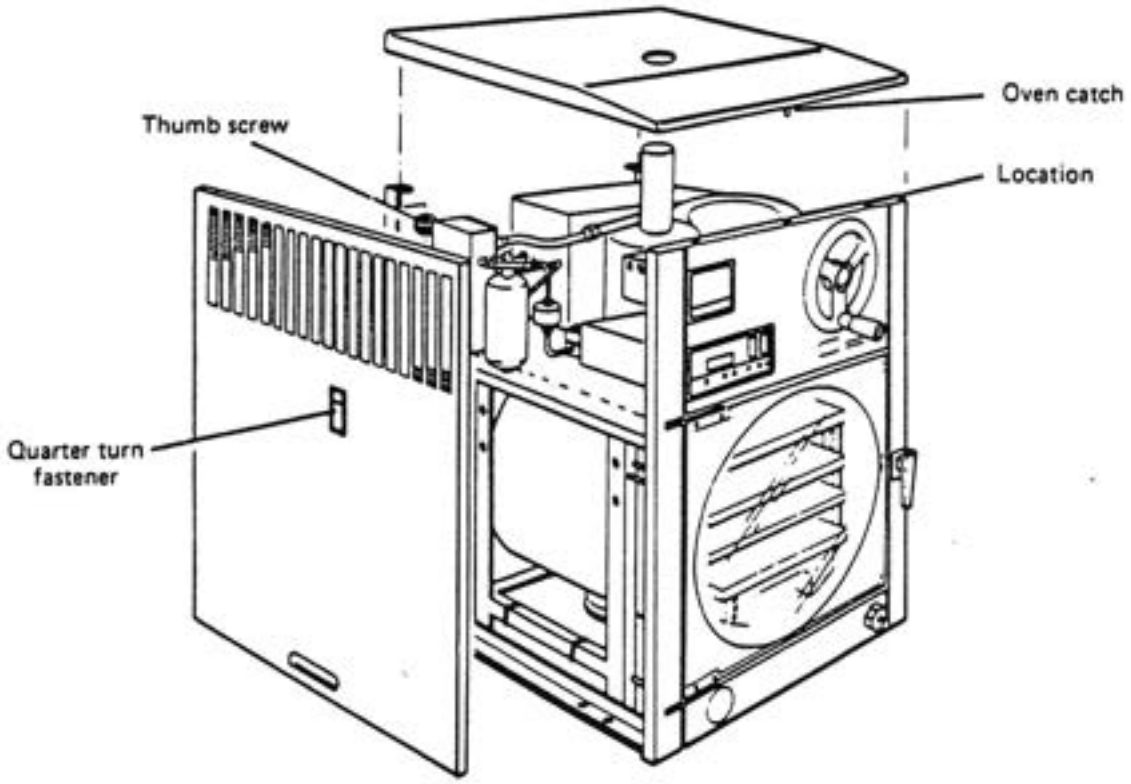


Fig.6 Removal of side and top panels

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3.2.1 Siting the Unit

Before attempting to mount the RC3S unit on top of the Supermodulyo, ensure that there is sufficient height for the crane and lifting gear required. A hook height of at least 2.5 metres is required.

Free and easy access should be allowed for the removal of the top and side panels.

Whenever possible, the unit should be sited on a clean, even floor surface for reasons of stability and general safety during operation.

Both the RC3S unit and the Supermodulyo require air cooling for their respective refrigeration systems and so they should be sited at least 200 mm from any walls or obstructions.

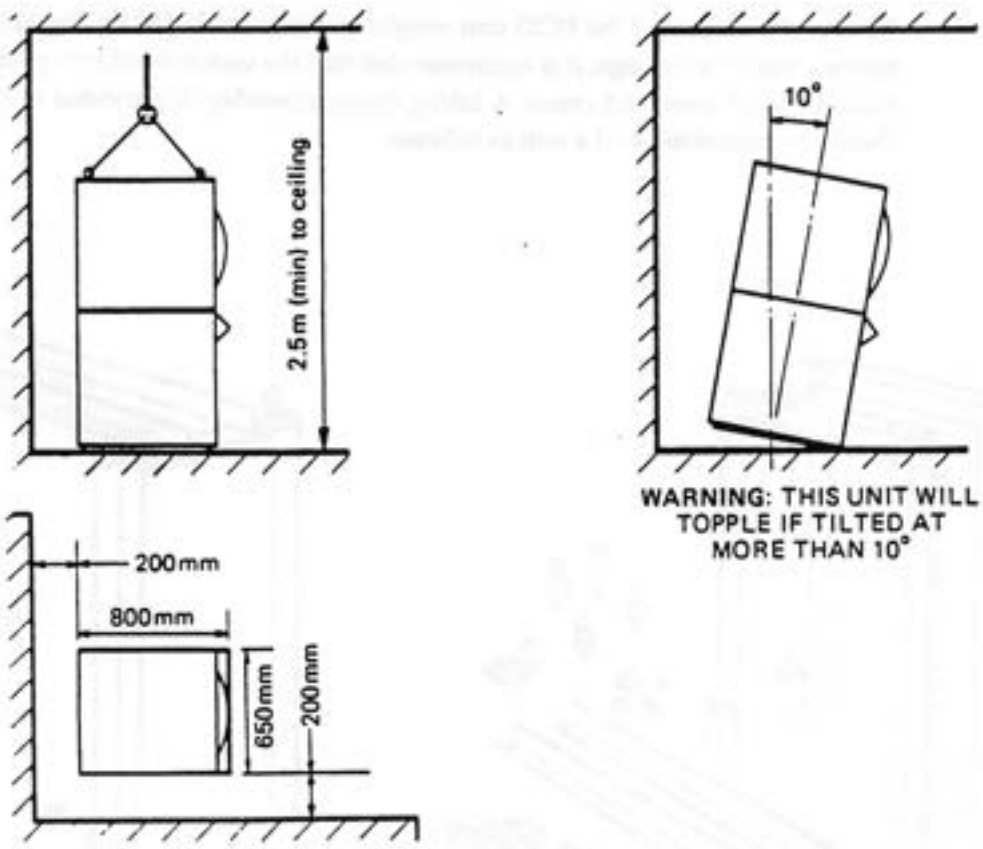

Fig.8 Siting the unit — clearance distance

WARNING: THE RC3S UNIT WEIGHS APPROXIMATELY 180 KG. IT IS THEREFORE IMPORTANT THAT THE CORRECT SITING AND LIFTING PROCEDURES ARE OBSERVED. UNDER NO CIRCUMSTANCES SHOULD THE UNIT BE LIFTED MANUALLY OR WITHOUT THE AID OF EITHER A HYDRAULIC LIFT, WHEN PACKED, OR A CRANE DURING THE ASSEMBLY PROCEDURE. WHEN ASSEMBLED ON TOP OF THE SUPERMODULYO, THE COMBINED WEIGHT IS APPROXIMATELY 360 KG. MOVEMENT ON THE CASTORS SHOULD THEREFORE BE KEPT TO A MINIMUM, AND THEN ONLY OVER CLEAN, EVEN FLOOR SURFACES, TO PREVENT THE UNIT FROM TOPPLING. THIS UNIT WILL TOPPLE IF INCLINED AT ANGLES GREATER THAN 10°.

3.2.2 Lifting Procedure

When fully assembled the RC3S unit weighs approximately 180 kg. For safety reasons, and to prevent possible damage, it is recommended that the unit is lifted into position by means of a suitably rated overhead crane. A lifting frame assembly is provided in flat pack form and should be connected to the unit as follows:

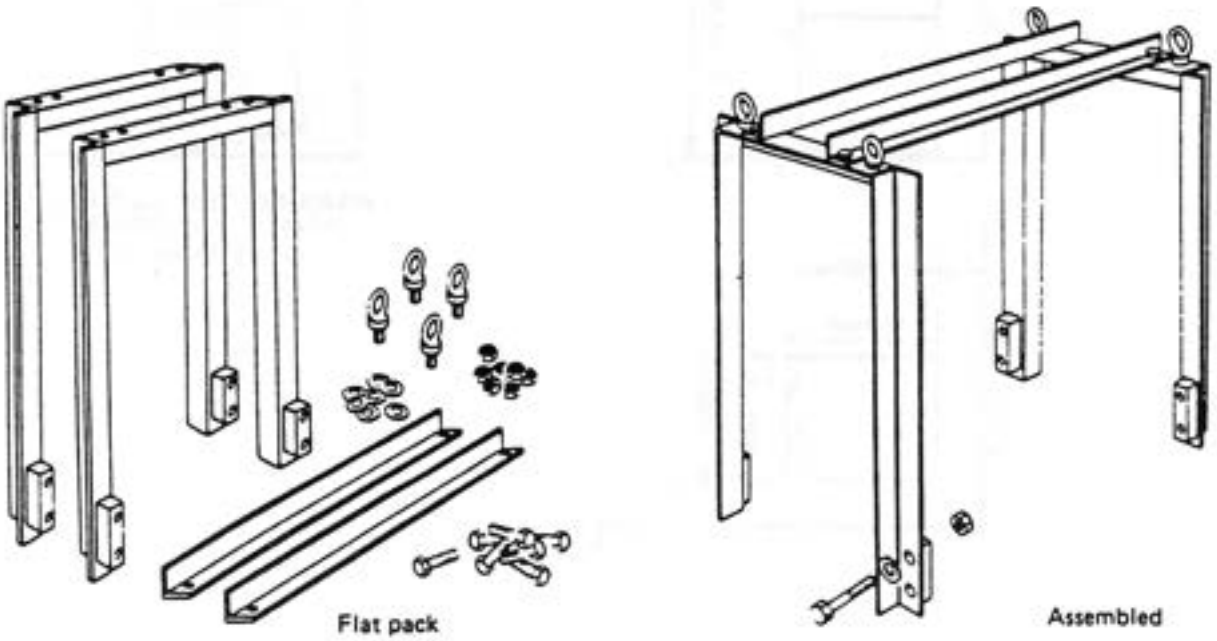

Fig.9 Lifting frame assembly

WARNING: THE LIFTING FRAME IS DESIGNED FOR LIFTING THE RC3S UNIT ONLY AND MUST NOT BE USED FOR ANY OTHER PURPOSE. THE BOLTS ATTACHING THE RC3S UNIT TO THE SUPERMODULYO ARE FOR SECURING THE UNIT ONLY. LIFTING THE RC3S UNIT AND THE SUPERMODULYO TOGETHER MUST NEVER BE ATTEMPTED.

1. a) Remove the side and top covers from the RC3S unit. (See Fig. 6)

   b) Attach the lifting frame side pieces to the RC3S internal frame using the eight M8 bolts provided. High tensile bolts MUST be used

   c) Attach the cross-pieces using four M6 bolts and nuts and then attach to them the four M12 eye-bolts (High tensile bolts MUST be used). It is essential that all bolts are securely fixed — see Fig. 10

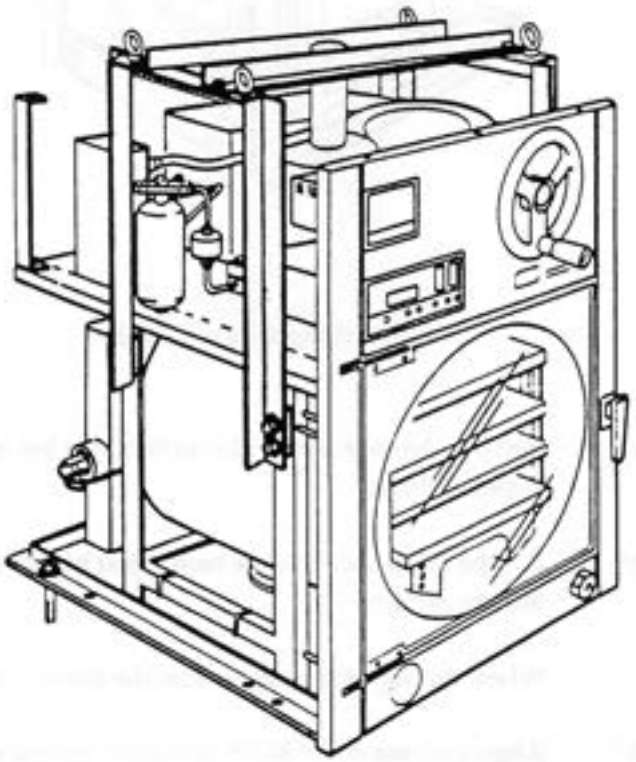

Fig.10 Lifting frame assembled onto RC3S unit

2. Attach lifting slings, rated at a maximum load greater than 200 kg., to all four eye-bolts. (See Fig. 11)

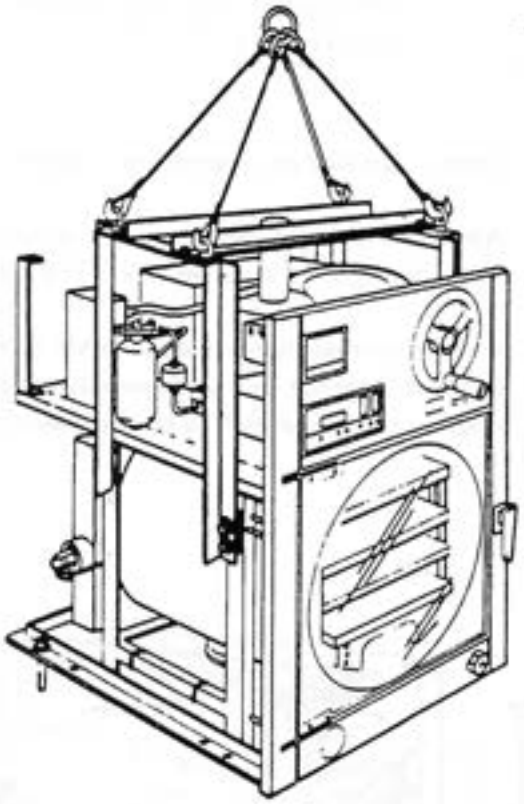

Fig.11 Lifting sling attached

3. a) Remove the four plastic blanks from the top cover of the Supermodulyo

b) Lift the RC3S unit until its base is just higher than the top of the Supermodulyo

c) Wheel the Supermodulyo under the suspended RC3S unit

d) Align the base of the RC3S unit with the rear edge of the Supermodulyo

e) Gently lower the RC3S unit onto the Supermodulyo, aligning the four bolt holes. (See Fig. 12)

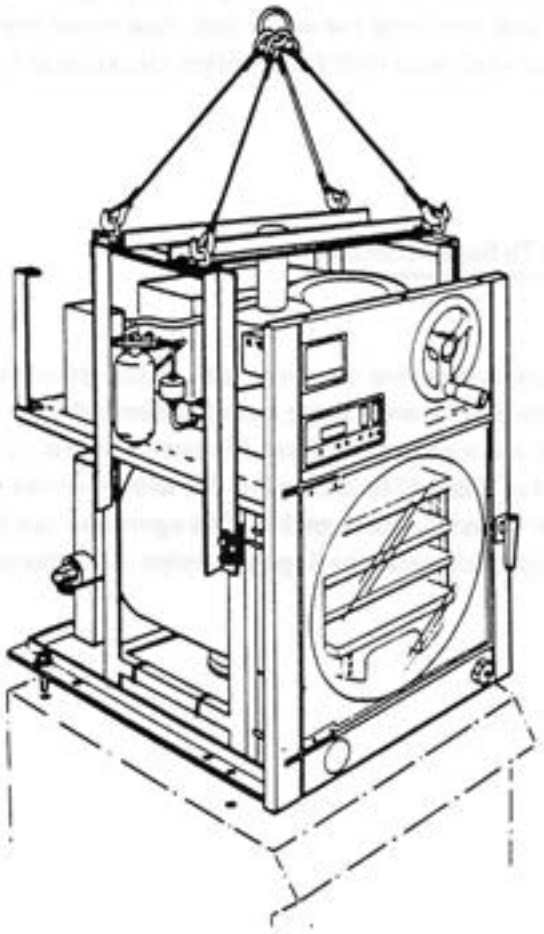

Fig.12 Aligning rear corners

4. Using the four M6 x 55 bolts provided, secure the two units together by bolting the base of the RC3S unit to the top of the Supermodulyo unit

5. Remove the lifting frame assembly

6. Replace the top and side panels of the RC3S unit

7. The combined unit can now be wheeled to its working location

Although the unit is very stable when in position, the castors on the base of the Supermodulyo are only suitable for flat, smooth floor surfaces. For reasons of safety and stability, therefore, the fully assembled unit should NOT be wheeled over or located on rough, uneven floors.

Care should also be taken when connecting the two units that, once fully assembled, they will not have to pass beneath low doorways. The height can be reduced a little by winding down the shelves and removing the screw-jack dust cover, but whenever possible the units should be assembled as close to their final working location as is practical. The minimum door height is 1970 mm.

3.2.3 Connection To Supermodulyo

The RC3S unit is supplied complete with all components necessary for its connection directly to the Supermodulyo unit. These include a flanged spacer, a lower adaptor flange assembly, a control ring and a chamber gasket. However, certain applications of the chamber require an isolation valve (F056 43 000) (See Fig. 13) to be inserted between the two units, replacing the flanged spacer and chamber gasket. This operation can be carried out after the RC3S unit has been assembled on top of the Supermodulyo — see Section 3.2.3.2.

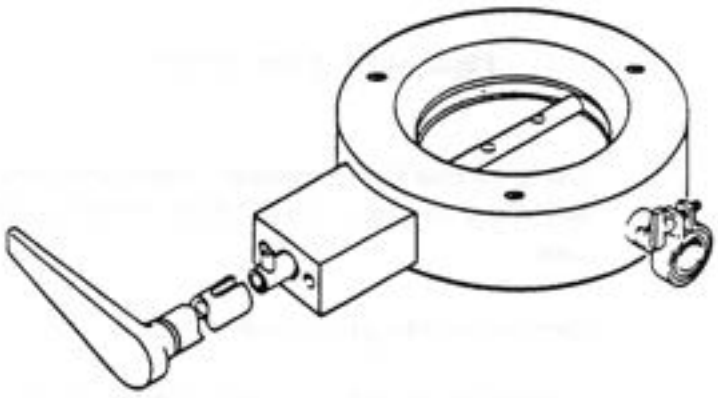

Fig.13 Isolation valve

3.2.3.1 Step-by-Step Guide to Direct Connection

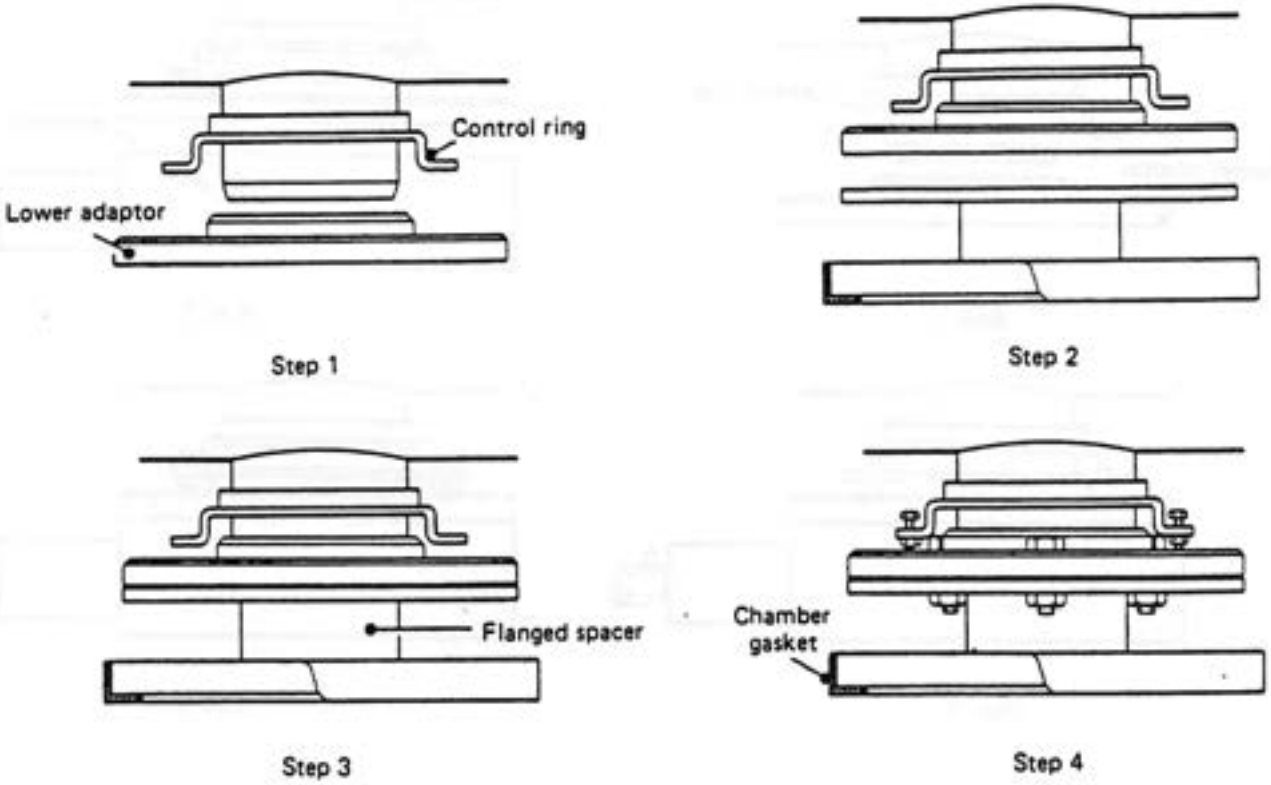

Fig.14 Step-by-step guide to direct connection

Step 1 — Place the control ring on the chamber outlet tube. Ensuring that the lower adaptor flange assembly has two 'O' rings in position and that they are clean and free from dust particles, slide the lower adaptor flange assembly onto the chamber outlet tube.

Step 2 — Assemble the chamber gasket onto the larger flange of the flanged spacer and slide both together onto the Supermodulyo flange, beneath the RC3S unit.

Step 3 — Bring the lower adaptor flange assembly down onto the top of the flanged spacer and align.

Step 4 — Bolt the two flanges together using the nuts and screws provided. Finally, thread the two M6 x 25 bolts provided through the control ring and tighten them through the projecting flanges onto the flange of the lower adaptor flange assembly, aligning them with the countersinks provided.

3.2.3.2 Step-by-Step Guide to Connection using the Isolation Valve

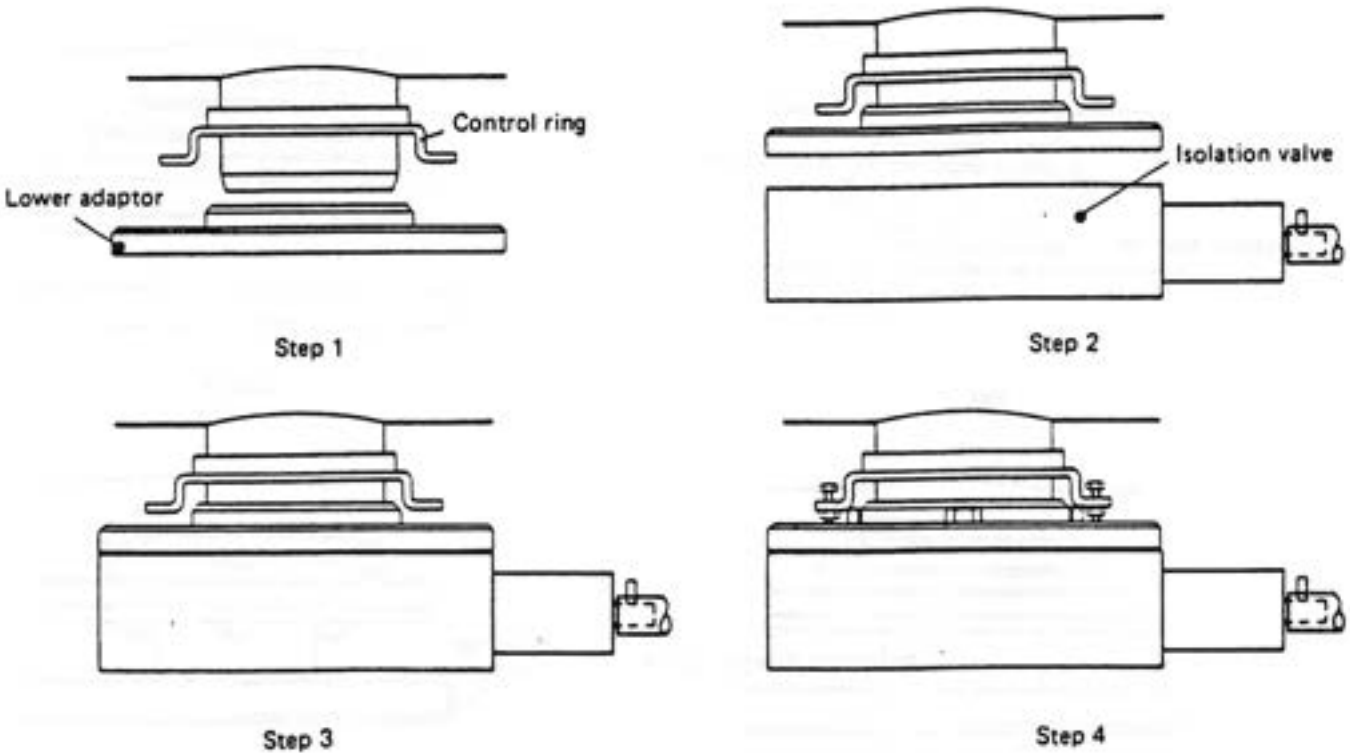

Fig.15 Step-by-step guide to connection using the isolation valve

Step 1 — Place the control ring on the chamber outlet's tube. Ensuring that the lower adaptor flange assembly has two 'O' rings in position and that they are clean and free from dust particles, slide the lower adaptor flange assembly onto the chamber outlet tube.

Step 2 — Remove the isolation valve from its packing and three bolts from the flange packing — the flange itself is not required for this operation. Slide the isolation valve onto the Supermodulyo flange beneath the RC3S unit. Align the isolation valve handle so that it points to the left or right hand side of the RC3S unit as preferred by the operator.

Step 3 — Bring the lower adaptor flange assembly down onto the top of the isolation valve and align.

Step 4 — Bolt the flange to the isolation valve using the three bolts provided. Finally, thread the two M6 x 25 bolts through the control ring and tighten the two bolts through the projecting flanges onto the flange of the lower adaptor flange assembly, aligning them with the countersinks provided.

3.2.4 Electrical Connections

The RC3S unit has been designed as a stand-alone unit, even if connected to the Supermodulyo unit, and only requires direct connection to the correct electrical supply to be operation — 208-220 V for the 60 Hertz model or 220-240 V for the 50 Hertz model. A three-core mains lead is supplied with the unit which should be connected as follows:

Brown . . . . . Live or Line 1

Blue . . . . . Neutral or Line 2

Green/Yellow . . . . . Earth

WARNING: IT IS ESSENTIAL THAT THE RC3S UNIT IS EARTHED. THE EARTHING PROVIDED BY THE SUPERMODULYO IS NOT SUFFICIENT TO EARTH BOTH UNITS.

The unit is internally fused by two 10 amp fuses located, for convenience, behind the front panel of the control module. However, when used in countries where mains plugs are fused, a 13 amp fuse should be used.

3.3 Installation Tests

Once installation has been completed, all top covers and side covers replaced and all preliminary safety checks observed, it is advisable to carry out a number of routine tests before proceeding to use the unit to dry out any products. These tests are:-

3.3.1 Vacuum Test

Before commencing with this test, carry out three simple checks:

1. Ensure that both the RC3S and the Supermodulyo units are dry. If they are then close both doors

2. Ensure that the air admittance valves are closed

3. Ensure that the isolation valve, if fitted, is open

Once all these checks have been made, proceed to switch the vacuum pump on the Supermodulyo ON by pressing the orange button on the control panel. Both units should now be under vacuum. This can be checked by trying to open the door on the refrigerated chamber. The door cannot be opened under vacuum. If either of the two units do not seal, check that there is no dirt on the door seals and retry the operation. If the units still do not seal, check the seals between the two units and the inlet tubes at the rear of the units. If the vacuum seal is still not achieved, switch the unit OFF and contact Edwards High Vacuum International. Do not use the unit.

3.3.2 Refrigeration/Heating Test

1. Switch on the RC3S unit at the MAINS switch (press to position 1) and then switch on the refrigeration unit at the FRIDGE switch (press switch to position 1).

2. Adjust the set point to -20°C and check that the temperature reduces

3. If it does, then adjust the set point to 40°C and check that the temperature rises. (For set point adjustment see Section 4 – Operation)

Should either of these tests prove unsatisfactory, switch the unit OFF and contact Edwards High Vacuum Internationl. Do not use the unit.

4. OPERATION

WARNING: SODIUM AZIDE EXPLOSION HAZARD

WARNING: SODIUM AZIDE EXPLOSION HAZARD.

SODIUM AZIDE, WHICH IS SOMETIMES USED AS A STABILISING AGENT IN FREEZE DRYING PROCESSES, IS A TOXIC AND (WHEN DRY) HIGHLY EXPLOSIVE MATERIAL. IN THE PROCESS OF PUMPING PRODUCT CONTAINING THIS CHEMICAL, A POORLY UNDERSTOOD 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 HEAVY METAL AZIDES WHICH ARE HIGHLY UNSTABLE AND PRESENT A VERY SEVERE EXPLOSION HAZARD.

IF SODIUM AZIDE IS TO BE PROCESSED IN THIS EQUIPMENT, THEN THE PRODUCT PROBES AND VACUUM LEADTHROUGH (BOTH OF WHICH CONTAIN COPPER) MUST BE REMOVED FROM INSIDE THE CHAMBER. REFER TO SECTION 5 OF THIS MANUAL FOR MODIFICATION PROCEDURE AND FOR FURTHER DETAILS OF SODIUM AZIDE HAZARDS.

4.1 General Notes on Unit Operation

The RC3S unit is designed for drying products in vials and/or in bulk trays. Vials can be loaded using either Edwards Vial Loading Tray (F100 03 000), which gives direct vial/shelf contact or Edwards Bulk Loading Trays (F100 04 000), which do not give direct contact. Vials of up to 70 mm can be dried on all three active shelves. Should larger size vials be required it is possible to convert the unit into a single-shelf drying chamber by latching the two upper shelves and the top compensating shelf together. (See Section 4.2 — Product Loading. See also Fig. 17).

WARNING: DEPENDING UPON PREVIOUS USES, THE SHELVES INSIDE THE CHAMBER MAY BE EITHER HOT OR VERY COLD. IN ORDER TO PREVENT POSSIBLE INJURY CARE SHOULD BE TAKEN NOT TO TOUCH ANY HOT OR COLD SURFACES.

4.2 Product Loading

4.2.1 Loading of Vials

The loading of vials into the RC3S unit is carried out by means of Edwards Vial Loading Tray (F100 03 000). The chamber is situated at a convenient height for loading by most personnel, but care should be taken in ensuring that the loading tray is horizontal before insertion to prevent vials toppling over. (See Fig. 16).

1. Lift the loading tray to the required shelf
2. Resting the two lugs on the shelf, push the tray evenly against the shelf
3. Slide the 'fence' around the vials forward into the chamber until all vials are safely on the shelf
4. Lower the other half of the loading tray and store until the vials are removed

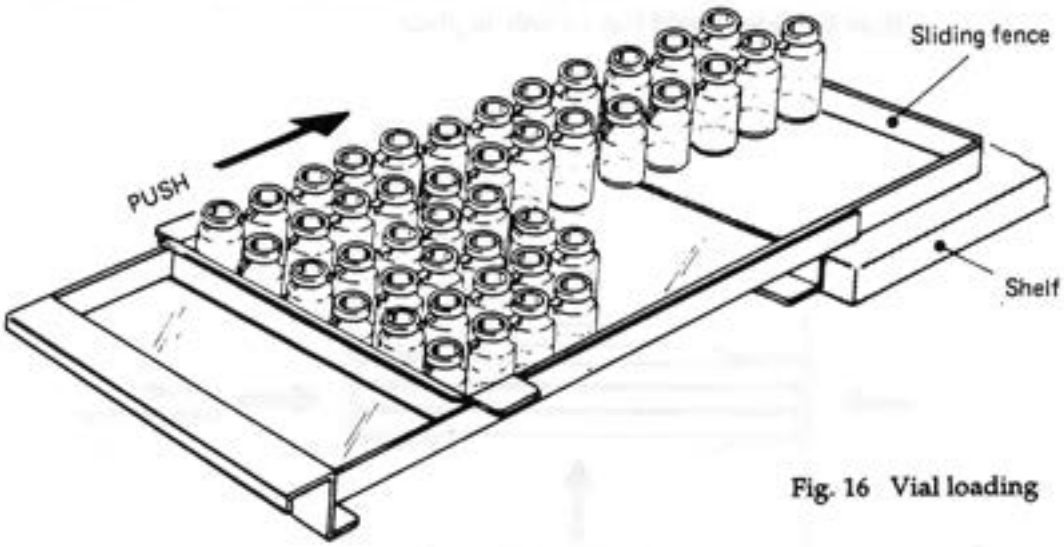

Fig. 16 Vial loading

CAUTION: IF VIALS FALL OFF THE SHELVES AND BREAK, TAKE CARE WHEN CLEANING THAT BROKEN GLASS DOES NOT ACCUMULATE AT THE BOTTOM OF THE CHAMBER

4.2.2 Bulk Loading

Bulk loading trays slide easily onto the chamber shelves, but again care should be taken to keep the trays horizontal. Edwards Bulk Loading Trays (F100 04 000) are recommended for use.

4.2.3 Adjustment of Shelves

If an inter-shelf measurement greater than 80 mm is required, the two upper shelves may be latched to the top compensating shelf to give a single shelf with a maximum vial height of 240 mm. (See Fig. 17). Observe the following procedure when latching shelves:

1. Ensure that the shelves are clean and dry

2. Lift the second and third shelves upwards until they touch the top shelf

3. Whilst holding the three upper shelves together, insert the two latching clips from the side to hold them firmly in place

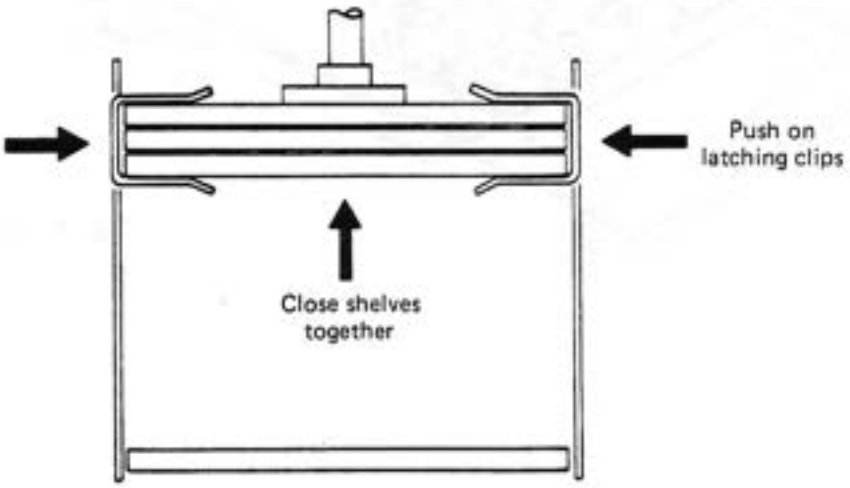

Fig. 17 Latching shelves

4.3 Product Freezing

To freeze any product placed inside the chamber:

1. Switch ON the RC3S unit at the MAINS switch (press switch to position 1).

2. Switch on the refrigeration unit at the FRIDGE switch (press switch to position 1).

3. Adjust the set point to the desired freezing temperature (normally between -20°C and -35°C, depending on the type of product being treated) by pressing the [☆] switch at the same time as the [▲] or [▼] switch until the desired temperature is displayed on the control panel

4. It is advisable to close the door on the RC3S unit during freezing operations to avoid frost build-up inside the chamber

4.4 Drying

Once the freezing process is complete, drying may commence.

1. Ensure that the product is completely frozen by checking visually and by using the in-chamber probes

2. Close the doors on both the RC3S and the Supermodulyo units and ensure that the air admittance valves on both units are closed. (The air admittance valve on the RC3S unit is located on the front panel at the bottom right-hand corner)

3. With the Supermodulyo condenser temperature less than -45°C, switch the Supermodulyo vacuum pump ON by pressing the orange button

4. Check that a seal has been made by attempting to open the door on the RC3S unit. This will not be possible if the units are under vacuum

Drying will commence as soon as the product is under vacuum, but once the vacuum falls to less than 0.1 – 0.5 mbar, the drying process becomes very slow. The process can be expedited by applying heat to the product; this is achieved by heating the fluid that circulates around the shelves

The shelf temperature is maintained by the temperature controller and must be set by the operator. The heater is regulated by the temperature controller

CAUTION: A SHELF TEMPERATURE THAT IS TOO HIGH MAY OVERLOAD THE SUPERMODULYO AND THIS MAY RESULT IN MELTING THE PRODUCT. DURING THE DRYING PROCESS, THE INDICATED CONDENSER TEMPERATURE ON THE SUPERMODULYO SHOULD NOT RISE ABOVE -35°C.

4.5 Determination of End Point

The end of the drying cycle can be determined by one of two different methods:

1. If the isolation valve (F056 43 000) is fitted, a 'Chamber Pressure Rise Test' may be conducted. This is done by:

a) Quickly closing the isolation valve between the RC3S unit and the Supermodulyo

b) Closely monitoring the pressure rise in the RC3S unit. The pressure rise is directly proportional to the dryness or residual moisture of the product

If the pressure rise is large, open the isolation valve and continue the drying process

IMPORTANT:

1. THE CHAMBER MUST BE LEAK TIGHT FOR THIS TEST TO BE VALID

2. THE ISOLATION VALVE MUST NOT REMAIN CLOSED FOR TOO LONG A PERIOD OTHERWISE THE PRODUCT MAY START TO MELT

2. Monitor the product temperature, chamber pressure and condenser temperature. Towards the end of the cycle, the chamber pressure will reduce and the Supermodulyo condenser temperature will reduce to less than -45°C. In addition, the product temperature will also begin to rise

4.6 Ending the Cycle

Once the dryness of the product has been confirmed, the cycle may be terminated.

If the vials inside the chamber are to be stoppered under vacuum, continue as outlined in Section 4.7, otherwise follow the procedure set out below to terminate the cycle:

1. Switch the vacuum pump on the Supermodulyo unit OFF by pressing the orange button

2. Switch off the RC3S unit by pressing the FRIDGE switch to position O and also the MAINS switch to position O

3. Admit air to both the RC3S and the Supermodulyo units by opening the air admittance valve, situated in the lower right-hand corner of the RC3S unit

4. When the chamber attains atmospheric pressure, open the chamber door and remove the dry product. (See Section 4.8. – Unloading)

5. Defrost the Supermodulyo by referring to the seperate working instructions pertaining to that unit

6. Clean both units thoroughly in readiness for the next drying cycle

4.7 Stoppering

If the vials within the chamber are to be stoppered, (See Fig. 18) using the mechanical stoppering device, the following procedure should be observed:

1. Ensure that the vials are evenly loaded on all three shelves and that the stoppers are aligned correctly

2. Bring the shelves into contact with the vials by rotating the hand-wheel in an anti-clockwise direction

3. Continue rotating the hand-wheel anti-clockwise with slightly more force until all stoppers are fully in place on each of the shelves

4. Open the shelf stack by rotating the hand-wheel in a clockwise direction until the shelves are fully open

CAUTION: THERE IS NO AUTOMATIC SHUT-OFF SYSTEM ON THE SHELF MECHANISM, SO TO PREVENT DAMAGE TO THE VIALS AND CHAMBER BY EXCESS PRESSURE A VISUAL CHECK IS REQUIRED TO CONFIRM THAT THE STOPPERS ARE FULLY HOME. IF VIALS DO NOT STOPPER CORRECTLY, DO NOT USE EXCESSIVE FORCE (GREATER THAN 14 KGF) AS THIS MAY DAMAGE THE VIALS AND CHAMBER.

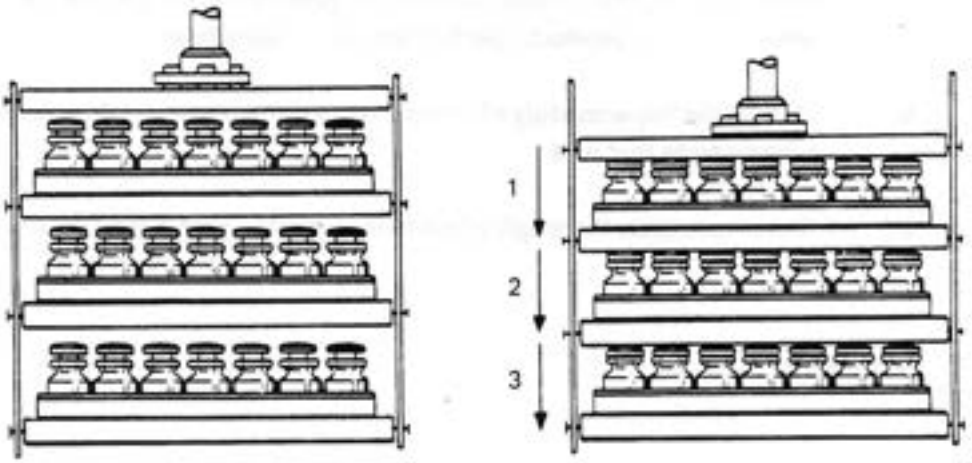

Fig. 18 Stoppering

4.8 Unloading

To unload the vials from the chamber, using the Edwards Vial Loading Tray:

1. Bring the lower tray up to the shelf and rest the tabs on the shelf
2. With the lower tray held firmly against the shelf, and in a horizontal position, pull the framework around the vials into the lower tray
3. Remove both upper and lower trays together
4. Repeat the process described in Steps 1 to 3 above for each shelf

4.9 Preparation for the Next Operational Cycle

After each use of the RC3S unit and the Supermodulyo, the units should be thoroughly cleaned in preparation for the next cycle. The probes and door seal should also be checked for damage. For a more detailed description of all maintenance procedures, see Section 7.

5. SODIUM AZIDE

5.1 Explosion Hazard of Sodium Azide

Sodium Azide, which is sometimes used as a stabilising agent in freeze drying processes, is a toxic and (when dry) highly explosive material. In the process of pumping product containing this chemical, a poorly understood 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 heavy metal azides which are highly unstable and present a very severe explosion hazard.

For this reason, all components in the chamber, vacuum pipework and pumps should be free of copper, lead, zinc and cadmium. Stainless steel, aluminium, cast iron and most elastomers/polymers are suitable materials of construction to prevent heavy metal azide formation. Cadmium and zinc plating must be avoided; the situation regarding alloys is not entirely clear and they should also be avoided. Advice concerning suitability of vacuum components and accessories can be obtained from Edwards High Vacuum International.

The areas where problems have most often been identified are as follows:

a) The exhaust system

b) The gas ballast piping where copper tubing has been fitted

c) Inappropriate vacuum pumps (i.e. other than those specifically recommended by EHVI)

If Sodium Azide is to be processed in this equipment, then the product probes and vacuum leadthrough (both of which contain copper) must be removed from inside the chamber — refer to Section 5.2 for recommended procedure. The remainder of the RC3S unit has been constructed using safe materials.

WARNING: IF IT IS SUSPECTED THAT AZIDE PRECIPITATION OR FORMATION HAS OCCURRED, THE USER SHOULD NOT ATTEMPT TO DECONTAMINATE OR CLEAN THE SUSPECTED AREA; INSTEAD, THE USER SHOULD ISOLATE THE EQUIPMENT AND SEEK EXPERT ADVICE AND ASSISTANCE.

5.2 Procedure for Removing Product Probes and Vacuum Leadthrough

Before processing Sodium Azide the product probes and vacuum leadthrough must be removed because they contain copper.

To remove the probes and leadthrough proceed as follows:

1. Ensure that the RC3S unit is switched off and is isolated from the electrical supply.
2. Disconnect the probes from below the bottom shelf.
3. Remove the plastic sockets from the fascia below the bottom shelf. The sockets clip into place from the rear of the fascia.
4. Using a small screwdriver, push the pins out of the plastic sockets.
5. When the pins have been removed from all three sockets unscrew the nut holding the vacuum leadthrough in place. This is located on the inside rear of the chamber.
6. Carefully pull the vacuum leadthrough and attached wires from the rear of the chamber.
7. Plug the hole at the rear of the chamber with a suitable size rubber bung (plug).

NOTE: The removal of the product probes will leave the RC3S unit without temperature indication for the inside of the chamber.

6. FAULT FINDING

6.1 General Note on Servicing

The following section deals with possible performance problems and their diagnosis. Some of the solutions can be carried out by the user, which are clearly identified, but others *must* be carried out by an Edwards High Vacuum International nominated service engineer.

6.2 Electrical

FAULT	POSSIBLE CAUSES	SOLUTION
1. No power to electrical box	a. Fuse(s) blown	a. Remove front panel and replace fuse
	b. Unit not connected to mains	b. Check mains connection
	c. Mains supply defect	c. Check mains supply is correct
	d. Mains inlet plug loose	d. Check rear panel of electrical box
2. Circulation pump failure	a. Pump plug loose/ faulty	a. Check rear panel of electrical box

FAULT	POSSIBLE CAUSES	SOLUTION
	b. Air pocket in system	b. Bleed air out of top inlet and outlet manifolds
3. Fridge switch tripped	a. Fridge compressor overload	a. See Section 6.4 REFRIGERATION
4. Digital display does not light but MAINS does	a. Circuit breaker tripped	a. Reset circuit breaker at rear of electrical box
5. Heater and solenoid valve inoperative	a. Circuit breaker tripped	a. Reset circuit breaker at rear of electrical box

WARNING: DISCONNECT THE ELECTRICAL SUPPLY BEFORE CARRYING OUT ANY REPAIR WORK. THERE ARE NO USER SERVICEABLE PARTS INSIDE THE ELECTRICAL BOX.

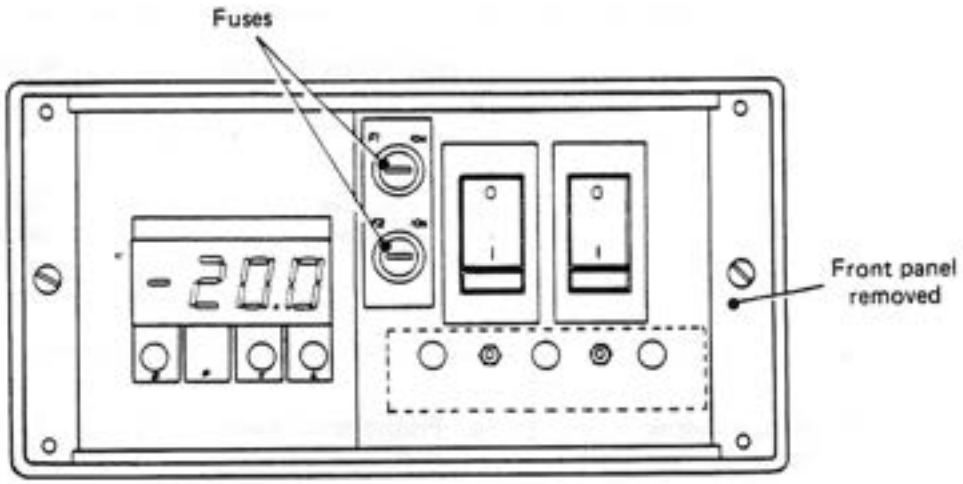

Fig. 19 Control panel fuses

6.3 Instrumentation

FAULT	POSSIBLE CAUSES	SOLUTION
1. Digital display reads EE1 and flashes, indicating open circuit	a. Loose connection at rear of electrical box	a. Check fluid probe plug at electrical box
2. Temperature control poor	a. Solenoid valve or heater inoperative	a. Check valve and heater operate

FAULT	POSSIBLE CAUSES	SOLUTION
	b. Air pocket in system	b. Bleed air out of top inlet and outlet manifolds
3. Fridge switch tripped	a. Fridge compressor overload	a. See Section 6.4 REFRIGERATION
4. Digital display does not light but MAINS does	a. Circuit breaker tripped	a. Reset circuit breaker at rear of electrical box
5. Heater and solenoid valve inoperative	a. Circuit breaker tripped	a. Reset circuit breaker at rear of electrical box

WARNING: DISCONNECT THE ELECTRICAL SUPPLY BEFORE CARRYING OUT ANY REPAIR WORK. THERE ARE NO USER SERVICEABLE PARTS INSIDE THE ELECTRICAL BOX.

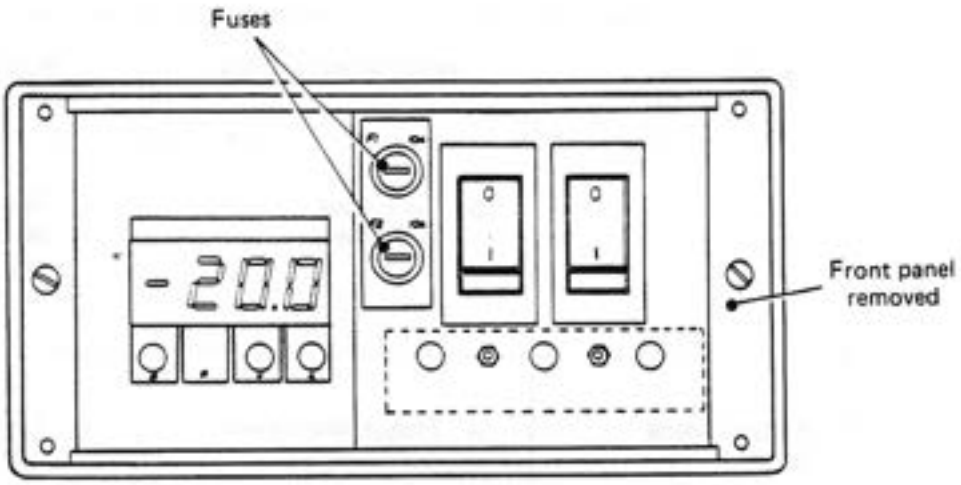

Fig. 19 Control panel fuses

6.3 Instrumentation

FAULT	POSSIBLE CAUSES	SOLUTION
1. Digital display reads EE1 and flashes, indicating open circuit	a. Loose connection at rear of electrical box	a. Check fluid probe plug at electrical box
2. Temperature control poor	a. Solenoid valve or heater inoperative	a. Check valve and heater operate

FAULT	POSSIBLE CAUSES	SOLUTION
	b. Control parameters incorrectly set	b. Contact Edwards High Vacuum International for correct setting
3. Product temperature probe(s) inoperative	a. Loose connection	a. Check product probe plug and plug at rear of chamber
	b. Product probe(s) burnt out	b. Check probe resistance and replace
4. Pirani gauge no power	a. Loose connection	a. Check plugs at rear of electrical box and Pirani gauge
	b. Pirani gauge fuse blown	b. Refer to Pirani gauge Instruction Manual

FAULT	POSSIBLE CAUSES	SOLUTION
5. Pirani gauge reads incorrectly	a. Gauge head lead loose	a. Check plug at rear of gauge
	b. Gauge head out of calibration	b. Refer to Pirani gauge Instruction Manual

CAUTION: IT IS RECOMMENDED THAT ANY FAULTS INSIDE THE CONTROL BOX ARE REPAIRED BY EDWARDS HIGH VACUUM INTERNATIONAL NOMINATED SERVICE ENGINEERS.

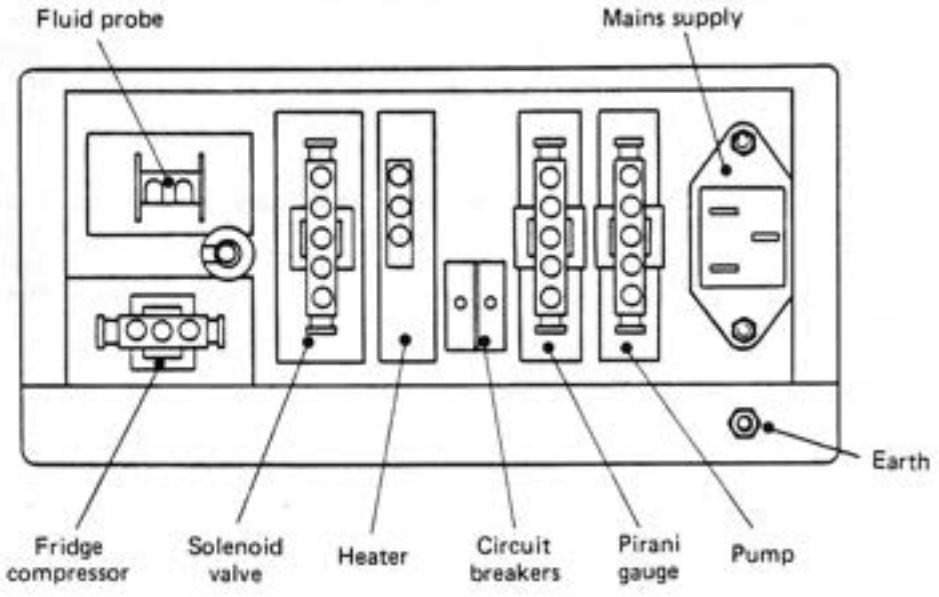

Fig. 20 Control panel (rear) — circuit breakers and plugs

6.3.1 The Fluid Probe

Should the fluid probe need changing, it is a relatively simple task to replace it (See Fig. 21). Acquire a spare Fluid Probe Assembly (F100 01 154) from Edwards High Vacuum International. Leave the damaged probe in place, but disconnect it from the rear of the electrical box. Take the new probe and smear it with heat transfer paste or an anti-freeze solution. Insert the probe into the 'spare fluid probe socket', situated on the inlet manifold next to the original probe and connect it to the rear of the electrical box. Ensure that the probe is well insulated. The replacement procedure is now complete and the new probe should operate normally. However, because of poorer thermal contact with the fluid, the new probe will read approximately 1 °C higher then the original. Should the probe require subsequent replacement, the above procedure can be repeated after removing the first replacement probe.

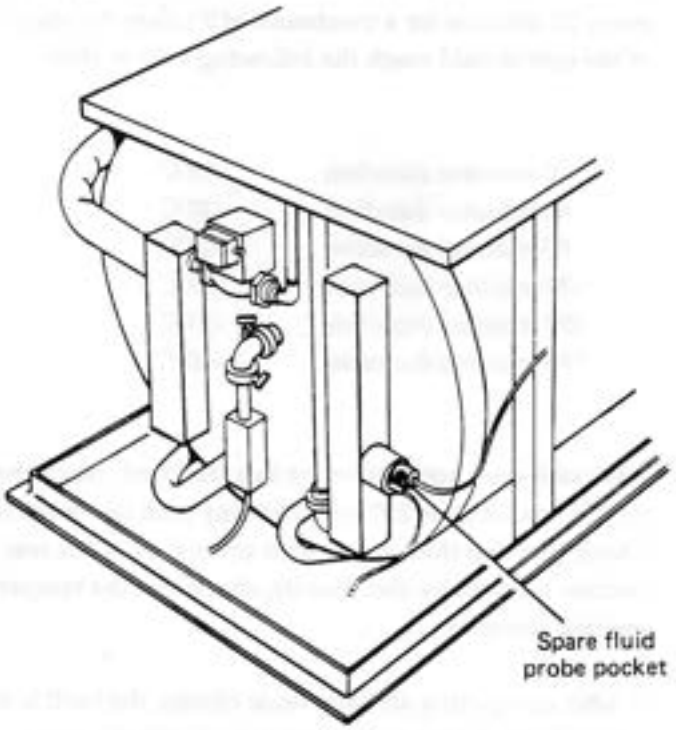

Fig. 21 Replacing fluid probe

6.4 Refrigeration

The accurate diagnosis of a fault in the refrigeration system requires a series of short checks. To correctly ascertain whether there is a refrigeration fault the RC3S unit must be run empty with no products on the shelves and the following procedure observed:

1. First, thoroughly clean the inside chambers of both the RC3S unit and Supermodulyo unit. Switch the Supermodulyo fridge ON and wait until the condenser temperature reaches -45°C. Then, switch the vacuum pump ON and evacuate both units.

2. Switch on the RC3S unit at the MAINS switch (press switch to position 1) and then switch on the refrigeration unit at the FRIDGE switch (press witch to position 1). Adjust the set point to -50°C and check that the refrigeration compressor starts. If the compressor fails to start, first check the plug at the rear of the electrical control module. If this seems to be in order, next ascertain whether there are any significant voltage drops in the mains supply. If neither of these are the cause of the fault, contact Edwards High Vacuum International.

3. Leave the machine switched on and make notes of the temperature reached every 30 minutes for a maximum of 3 hours duration. The temperature of the unit should reach the following values after:

30 minutes duration	-15°C
60 minutes duration	-30°C
90 minutes duration	-35°C
120 minutes duration	-38°C
150 minutes duration	-39°C
180 minutes duration	-40°C

4. If the unit does not perform to this standard, check that there is adequate ventilation (at least 200 mm from any wall or obstruction — See Fig. 8). Check also that the refrigeration condenser at the rear of the unit has not become blocked by dirt. Finally, check that the temperature display is reading correctly.

5. If, after completing all these basic checks, the fault is still not revealed, contact Edwards High Vacuum International with the data acquired.

CAUTION: ONLY EDWARDS HIGH VACUUM INTERNATIONAL NOMINATED PERSONNEL SHOULD CARRY OUT REPAIRS TO THE REFRIGERATION SYSTEM.

6.5 Fluid Circulation

The cooling and heating of the shelves inside the RC3S unit chamber is achieved by the circulation of a low viscosity oil. A centrifugal pump is used to circulate the oil (a silicone oil) via a system of pipework inside the shelf construction (See Fig. 22).

Because the oil has an extremely low viscosity at temperatures of around 60°C, it can leak through joints that normal oils would not. The fluid circulation system, therefore, should be checked periodically for leaks and the level of oil in the expansion tank checked. To check the oil level, remove the top cover of the unit and locate the oil expansion tank. Unscrew the cap marked 'OIL' on the tank and check the level, which should be 1/3 to 1/2 full at a unit temperature of 20–30°C.

CAUTION: DO NOT OVERFILL THE OIL TANK AS THE OIL CAN EXPAND BY UP TO 2 LITRES AT HIGH TEMPERATURES

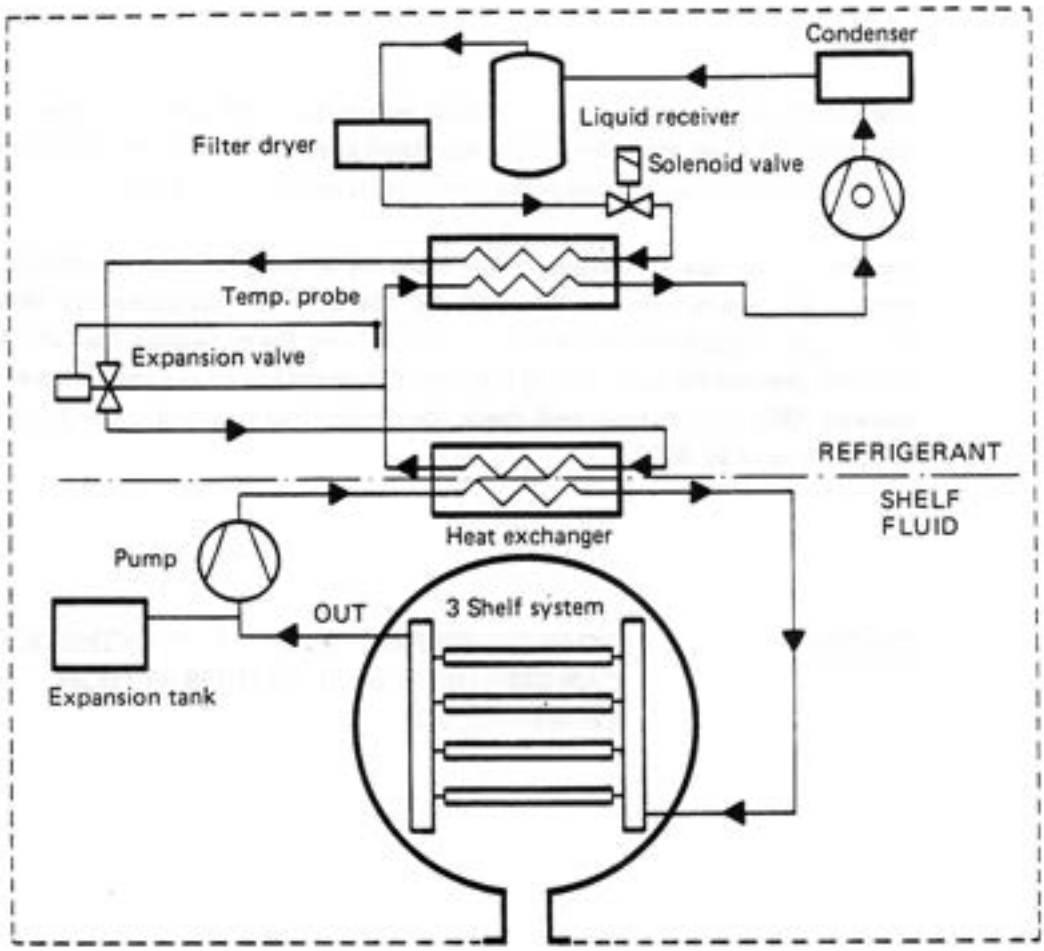

Fig. 22 Flow diagram showing refrigerant and shelf fluid circuits

6.6 Heating

The heater for the fluid is located on the outside of the fluid downflow pipe. It is protected from overheating by a thermostat, connected in series with the heater and attached to the outside of the fluid pipe. If a fault occurs in the heating system, both the heater and thermostat may be replaced (See Fig. 24).

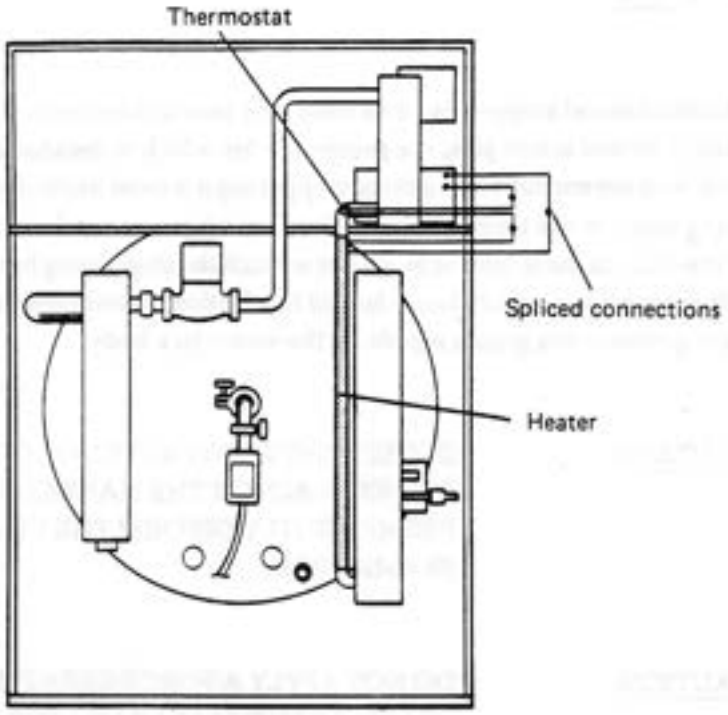

Fig. 23 Draining the fluid system

If only the thermostat requires replacement, it is not necessary to remove the heater. To replace the thermostat:

1. Remove the insulation from around the thermostat and disconnect it from the heater

2. Remove the thermostat

3. Replace with the new thermostat using epoxy adhesive to fix in place and reconnect to the heater, being sure to re-insulate the joint and the inlet manifold

WARNING: BEFORE ATTEMPTING TO REPLACE EITHER THE HEATER OR THE THERMOSTAT, MAKE SURE THAT THE UNIT IS NOT HOT FROM PREVIOUS USAGE AND THAT IT HAS BEEN DISCONNECTED FROMTHE ELECTRICAL SUPPLY.

6.7 Stoppering

The mechanical stoppering of all vials held inside the chamber of the RC3S unit is achieved by a hand turned screw jack, the procedure for which is detailed in Section 4.7 of this manual. If problems are encountered during stoppering it is most likely due to the incorrect size of stopper being used, or the stoppers themselves have become hard or dry and are no longer a good fit in the vials. In these instances, do not wrench the stoppering handle. Sometimes the stoppering action may become stiff due to lack of lubrication of the screw jack. If this happens, apply some light grease to the grease nipple on the screw jack body.

CAUTION: IF THE STOPPERING ACTION BECOMES STIFF, DO NOT WRENCH THE HANDLE AS THIS MAY PERMANENTLY DEFORM THE CHAMBER OR FRAMEWORK.

CAUTION: DO NOT APPLY A FORCE GREATER THAN 14 KGF (30 LBF) AS THIS MAY CAUSE THE VIALS TO SHATTER OR THE CHAMBER TO DEFORM.

7. MAINTENANCE PROCEDURES

7.1 General Note on Unit Maintenance

The RC3S unit has been designed to be easily maintained and give the user many years of trouble-free service. However, to ensure that the unit is performing correctly and to facilitate the early detection of faults, a number of regular checks and inspections should be carried out at periodic intervals. If the following schedule is adhered to the RC3S/Supermodulyo combination unit should give a reliable service of proven quality.

7.2 Cycle Maintenance

Between each cycle, and after use, the following operations should be carried out:

1. Clean both the RC3S unit chamber and the Supermodulyo unit thoroughly, particularly if there are any deposits left behind by broken or spilled vials. Ordinary domestic detergents are quite suitable for cleaning the units, but any organic-based solvents may attack the acrylic door. The chamber and the Supermodulyo may be sterilized using Formalin gas, but the gas must be suitably vented. Contact Edwards High Vacuum International for more information or any queries regarding the removal of persistent and stubborn deposits

2. Check that both door seals are clean and free from foreign matter. If necessary, lightly grease the seals with silicone grease (Edwards H024 00 036)

3. Inspect the product probes for damage and replace if necessary

7.3 Weekly Maintenance

The following checks should be carried out at the end of a week's continuous use of the unit or if the unit has been standing idle for any length of time.

1. Carry out all of the routine operations for the end of cycle maintenance procedure

2. Inspect the vacuum pump oil quality and level by opening the lower door on the Supermodulyo. The oil level should be between the MIN and MAX marks and the oil itself clear and free from froth or water. If it becomes necessary to change the oil:

a) Use the oil drain facility supplied with the Supermodulyo by unscrewing the oil mist filter and screw in the oil drain tube

b) Switch the vacuum pump on until all the oil is removed, catching it in a suitable container.

c) Refill the vacuum pump with clean vacuum oil

CAUTION: POOR OIL QUALITY WILL GIVE POOR VACUUM PERFORMANCE AND WILL DAMAGE THE VACUUM PUMP.

3. The oil mist filter should be emptied, if required. Unscrew the drain plug at the bottom of the mist filter and catch the oil in a suitable container. Inspect the oil for quality, as in (2) above and dispose of it if necessary. If the quality is satisfactory, return the oil to the pump. Replace the drain plug in the oil mist filter

4. Clean the refrigeration condenser at the back of the RC3S unit. A dirty condenser not only reduces the air flow but also reduces the refrigeration capacity

5. Check that the stoppering mechanism is operating freely, applying a little grease to the screw jack nipple if necessary — see Section 6.7

8. ELECTRICAL DATA AND CIRCUIT DIAGRAM

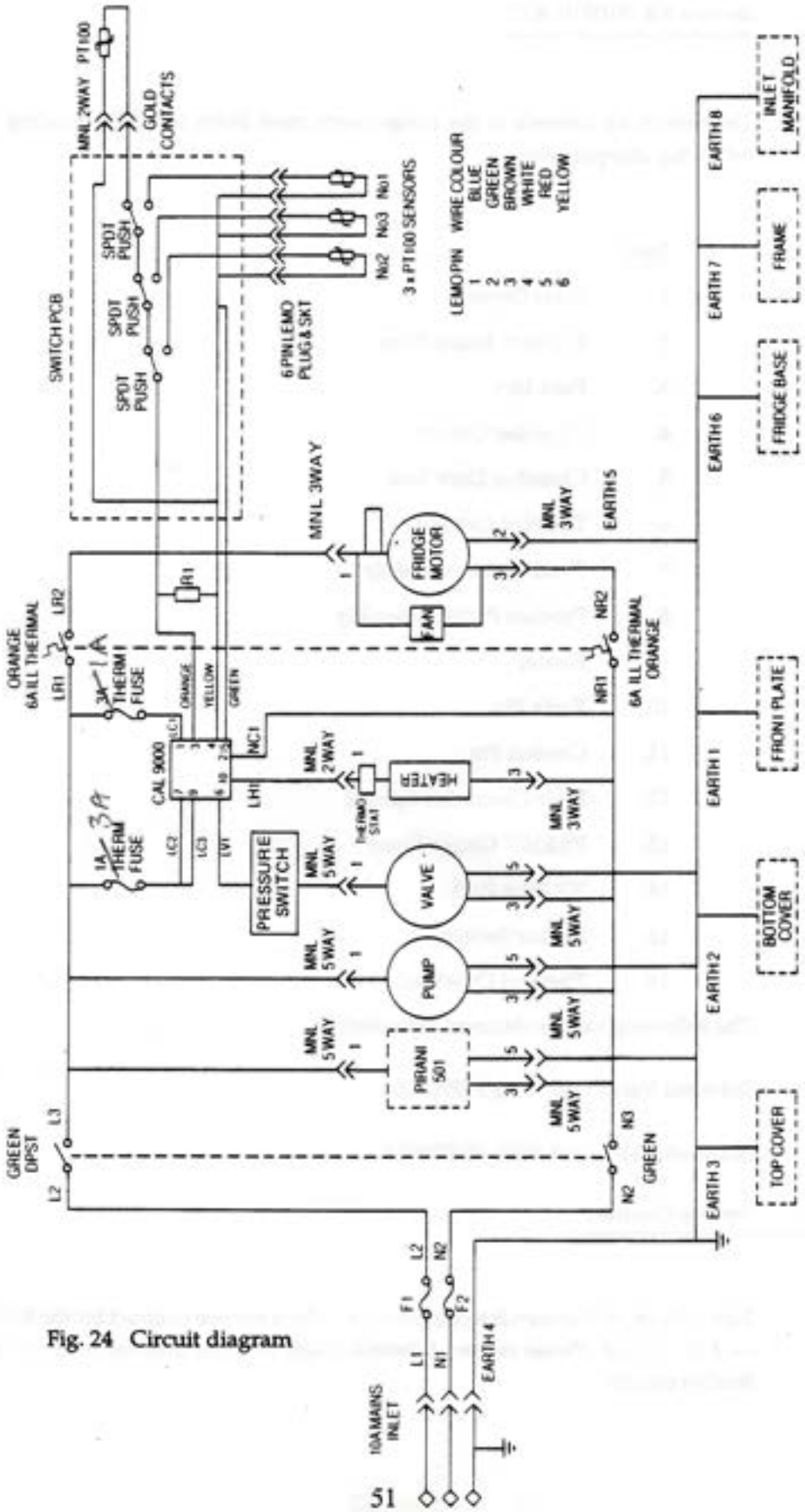

Fig. 24 Circuit diagram