# Integra AC

*Operator's Handbook*

Issue 2.0

*The Business of Science™*

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# *Welcome*

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We are delighted you selected Oxford Instruments as your supplier and wish you success with your new equipment.

Jim Hutchins, Managing Director, Oxford Instruments NanoScience

# Introduction

## Scope

This manual contains user and technical information pertaining to the Integra AC. It also contains reference information and includes details of your key contacts at Oxford Instruments who are available for help on repair matters and service. Please keep it close to your system.

## Abbreviations and Terms

| | |
|---|---|
| AC | Active Cooling |
| CD | Compact Disc |
| DC | Direct Current |
| IEC | International Electrotechnical Commission |
| MSS | Magnet Support System |
| OI | Oxford Instruments |
| OVC | Outer Vacuum Chamber |
| PC | Personal Computer |
| PPE | Personnel Protection Equipment |
| PTR | Pulse Tube Refrigerator |

# Safety

Full details of the safety precautions required when working with cryogenic liquids and superconducting magnets are given in the *Safety Matters* booklet that accompanies this manual. Additional copies of which may be purchased from Oxford Instruments Direct.

Safety procedures are vital to prevent:

- Serious injury or death
- Serious damage to the equipment.


***Before you attempt to install or operate this system, please make sure that you are aware of all safety precaution listed in this document together with the warnings and cautions listed and the operating procedures set out in the Refrigerator Manual.***

## Safety symbols used in this manual

Symbols are used in this manual to draw your attention to safety procedures that you must follow to protect yourself or the equipment. There are two types of hazard symbol used in this manual:

***Warning: The yellow warning triangle highlights dangers which may cause injury or, in extreme circumstances, death. Warnings and cautions must be followed to ensure your own safety.***

**Caution: The general caution symbol highlights actions that you must take to prevent damage to the equipment. The action is explained in the text.**

Additional safety symbols include:

**This symbol indicates that loose fitting, insulating gloves should be worn, suitable for protection against splashes of liquid helium and nitrogen.**

**This symbol indicates that protective goggles or (for cryogenic use) a face mask should be worn.**

**This is the symbol for protective earth.**

## Disclaimer

Oxford Instruments cannot accept responsibility for damage to the system caused by failure to observe the correct procedures laid down in this manual. The warranty may be affected if the system is misused, or the recommendations in this handbook are not followed.

## Disposal and recycling instructions

**Important Health and Safety Notice**

When returning components for service or repair it is essential that the item is shipped together with a signed declaration that the product has not been exposed to any hazardous contamination or that appropriate decontamination procedures have been carried out so that the product is safe to handle.

Before disposing of this equipment, it is important to check with the appropriate local organisations to obtain advice on local rules and regulations about disposal and recycling.

You **must** contact Oxford Instruments NanoScience Customer Support (giving full product details) before any disposal begins.

## Temperature and voltage limits

If you have bought a cryostat and control box together from Oxford Instruments the control box will have been set up in the factory, to limit the heater voltage to a maximum safe level.

## Warnings

Warnings and cautions must be followed to ensure your own safety.

***The compressor, flexible lines and cold head are supplied already pressurised with pure helium gas at pressures around 15 bar (200 psig). Do not attempt to modify couplings.***

***The wiring for 3 phase compressors must be phased so that the compressor runs in the correct direction. When the compressor is turned on for the first time ensure that the High pressure gauge shows an increase and the Low pressure gauge shows a decrease. If not you must stop the compressor, swap two of the live power lines and re-start.***

***If you do not make the system stable it is possible to cause serious damage.***

***All users of the Integra AC must read the Oxford Instruments booklet Safety Matters that accompanies this manual. Copies are available in languages other than English.***

***Asphyxiation hazard – always wear personal oxygen meters or have alarms installed.***

# Description

## Overview

The Integra AC is a recondensing helium system designed to:

- Reduce your He use during Insert and Magnet Operation
- Remain cold and always ready
- Use low vibration pulse tube refrigerator technology
- Accommodate upgradeable modular components.

The Integra AC system consists of a Cryostat, a pulse tube refrigerator and a Control box. To complete the system you require a magnet and an insert or baffle set.

**Figure 1 Illustration of Integra AC system showing the Cryostat, pulse tube and an example of an insert**

### Cryostat, with pulse tube refrigerator

This is a specially designed Cryostat, incorporating a pulse tube refrigerator (PTR). For details about the PTR refer to the Cryogenic Refrigerator Manual.

### Control Box

This has been configured during installation to monitor the pressure within the helium bath and to supply or reduce heat to the pulse tube refrigerator to maintain the pressure at or around one atmosphere. The control box can also be used to override the recondensing operation for a short period to allow an insert to be loaded or for top ups. The purpose is to prevent air getting in to the system during these operations.

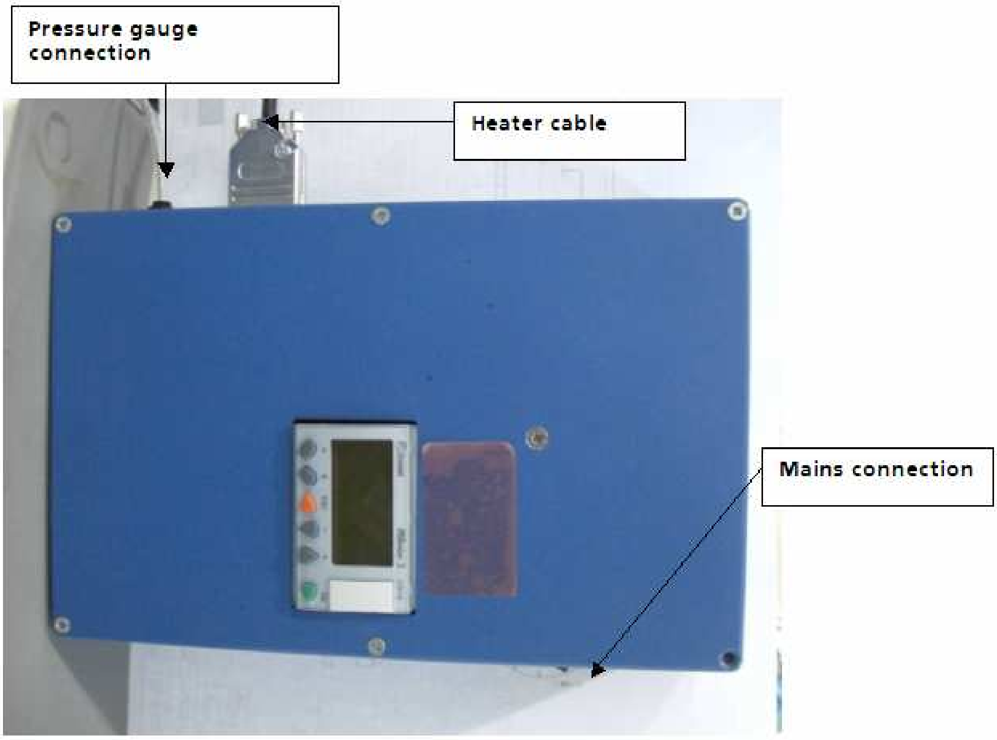


**Figure 2 Integra AC control box**

### Compressor

Refer to the Refrigerator Manual.

### Insert

Ensure that you use an Integra AC compatible insert.

### Typical system

Figure 3 shows the main components of a typical system and their interconnections.


**Figure 3 Illustration of a typical Integra AC system showing the cryostat, pulse tube refrigerator, Compressor and refrigerator unit**

*Note* *The control box is not shown in this figure. The electronics in the figure above are associated with the refrigerator unit.*

# Unpacking

Supplied components are:

- Cryostat, with built-in pulse tube refrigerator (PTR)
- Control Box
- Compressor
- Cables.

Additional components required to run the system are:

- Magnet Support
- Suitable method of lifting the system from the delivery vehicle
- Experimental insert or baffle set.

Documentation supplied:

- This manual
- Safety Matters
- Practical Cryogenics
- Refrigerator Manual.

The system should be unpacked carefully and inspected for any damage that may have been caused during shipment from Oxford Instruments. It should also be checked to ensure that none of the components are missing. If any problems are encountered you should contact Oxford Instruments (through our agent or subsidiary if appropriate).

The dewar is fitted with internal packing to prevent movement of the inner parts during shipment. Retain this packaging in case you need to transport the system again in future.

*Inspect any safety critical equipment (such as the relief valves and lifting eyes) prior to assembly. If any of this equipment shows sign of damage please contact Oxford Instrument NanoScience, Customer Support before assembling the system.*

*PPE must be worn i.e. safety footwear at all times, face shields, goggles and dust masks etc when requested.*

*Only use sufficiently rated lifting equipment. All equipment must be within its test date and be free from damage or defects.*

*This procedure involves the lifting and handling of heavy loads. Under no circumstances must any work be carried out under unsupported loads. This is particularly important when the packing bung is inserted, an appropriate secondary support under the dewar must be used.*

***The Integra AC cryostat is top heavy. It must either be moved by overhead crane or on the specially designed support pallets.***

## Pre-Unpacking checks

- Check that the packing boxes are in good order. There is a bespoke box for the cryostat and sliding seal, and the remaining components are packed in the pulse tube box.
- Check that the packing list is available.

## Unpacking procedure

1. Carefully remove top and side of cryostat box (Figure 4)

**Figure 4 - Cryostat in box with top and side removed**

2. If supplied, remove the ShockLog and blanking plate from top of cryostat (Figure 5)

**Figure 5 - ShockLog and blanking plate**

3. Ensuring that the dewar is only moved by overhead crane or on a side supported pallet, remove the cryostat from the cryostat box
4. Stand the cryostat on a set of support blocks, to allow access to the transit bung (Figure 6) underneath. Ensure the cryostat is still on the crane with the chains slightly slack while working underneath

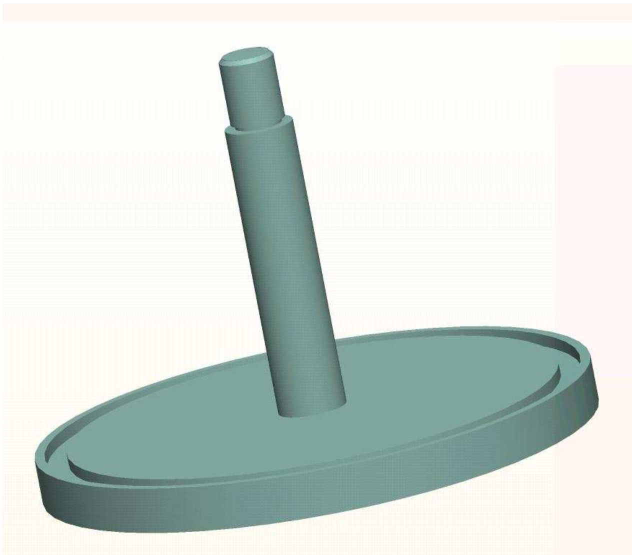

**Figure 6 - Transit bung**

5. Unscrew the transit bung and remove with O-ring
6. Carefully insert the drop off plate.

7. Remove the top and sides from second box (see Figure 7)

**Figure 7 - Second box**

8. Remove the shrink wrap from the compressor and carefully remove from box
9. Remove compressor lines and power cord.

# Preparing for operation

This section details the planning required to install a laboratory scale cryogenic system.

## Safety equipment

- Personnel protection equipment including gloves and goggles
- Hazard warning signs to make sure that anyone approaching the system is aware of the potential hazards.

## Tools and consumables

- Spanners or wrenches (open ended metric set) 5 to 19 mm
- Allen keys (metric set) 1.5 to 12 mm
- Screw drivers, pliers, side cutters etc
- Digital multimeter (with low current ohms range).
- Metal polish and degreasing agent
- Alcohol for general cleaning
- Personal oxygen meter
- Vacuum grease
- Roll of mylar adhesive tape
- Roll of aluminium adhesive tape
- Tube of vacuum grease
- Pair of cotton gloves for handling clean items
- Assorted latex rubber and polythene tubing.

## Lifting equipment

- Suitable hoist or crane for use in the laboratory
- Lifting sling and shackles to suit the lifting points on the system.

## Vacuum equipment

High vacuum pumping system to evacuate the insulating vacuum spaces, including a diffusion or turbo molecular pump and a liquid nitrogen cooled trap, flexible metal pumping lines for connection to the cryostat and a two stage backing pump. It should be capable of reaching a pressure of $10^{-6}$ mbar.

A mass spectrometer leak detector system is required sometimes, especially when the system is commissioned, for routine leak testing operations.

Oil mist filters fitted to all rotary pump exhausts.

A range of ISO KF vacuum fittings (also known as NW or DN), are used as standard).

Clean pumping line, which has not previously been used for helium gas.

***It is important to remember that turbo-molecular pumps have a low compression ratio for helium gas. Therefore you should always use a two stage rotary pump as a backing pump.***

## Cryogens and gas supplies

- A supply of clean helium gas as provided by the optional storage dewar heater probe.

## Other equipment

- Helium transfer tube (or 'siphon')
- Level meters for cryogen reservoirs (if required) or a suitable 'dipstick'
- Suitable gas flow meters may be useful sometimes
- Flexible line for supplying high purity gas for pre-cool.

### Fischer connectors

To remove the Fischer connector from its mating part on the cryostat it is important to pull the correct piece. You will notice that part of the outside of the connector seems to be loose on the body of the connector. This is the locking mechanism. Pull this part away from the mating connector to break the connection. However, if you try to pull the connector out using the cable or another part of the body the connector and it's mating part will remain locked together.

## Summary of preparation

There are several steps required to prepare the Integra AC for operation. These are:

- Prepare an insert
- Prepare magnet support
- Connect compressor
- Connect the control box
- Cool down the system.

### Prepare an Insert

Refer to the manual, provided with your Insert, for detail of its preparation for use.

***You must only use the Integra AC sliding seal when loading an insert in to a cold dewar.***

The piping configuration for the inserts should be as shown in the figures below.

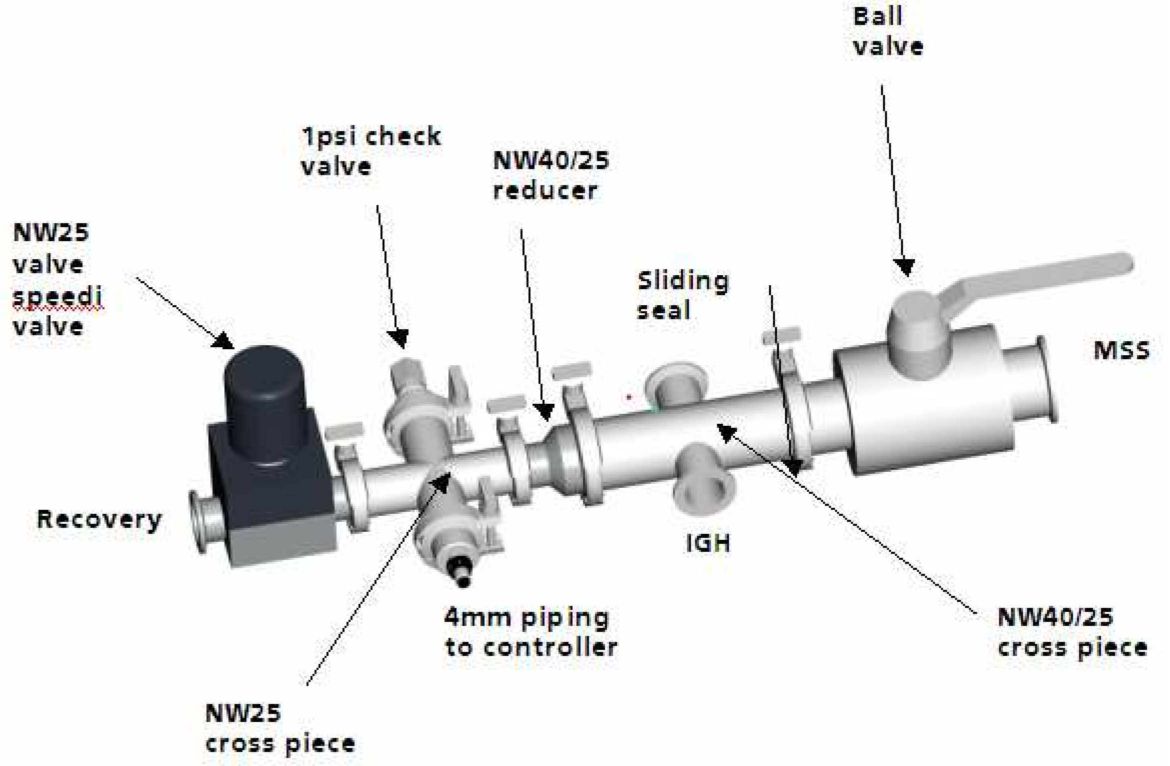


**Figure 8 Integra AC piping configuration (including magnet support valve)**

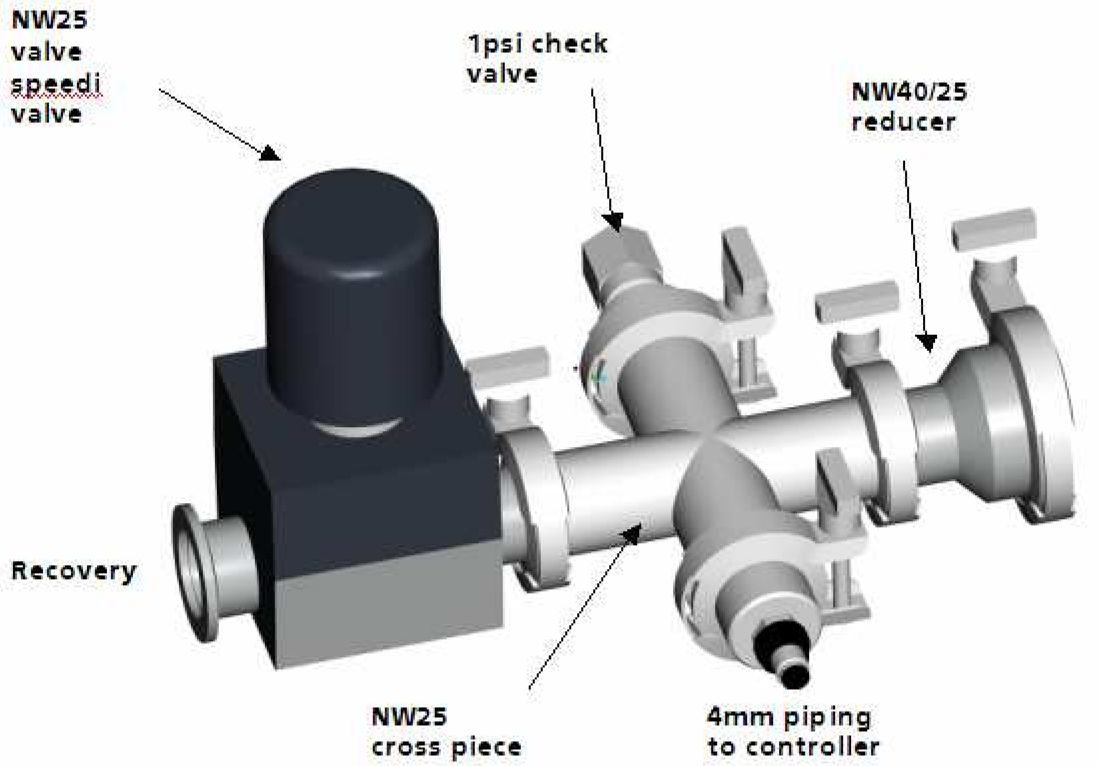


**Figure 9 Integra AC piping configuration (excluding magnet support valve)**

## Prepare Magnet support

***Do not machine the baffles, as the dust is hazardous.***

If you are retrofitting an existing Magnet Support it is necessary to remove the foam between the top three baffles of the Magnet support. To do this, carefully cut the foam with a sharp knife, avoiding damage to the tubes and wiring. The second and third baffles down will then need to be secured by gluing the clips, provided in the installation kit, in to place.

**Figure 10 – Baffle: without clips**

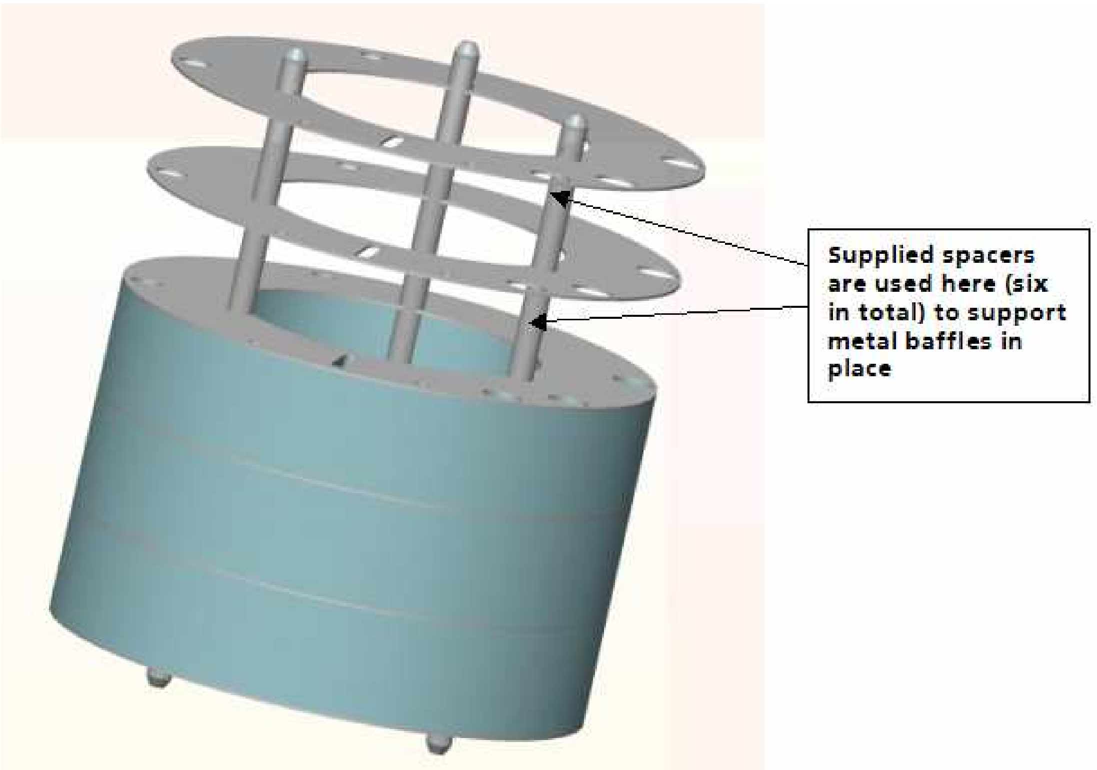


**Figure 11 – Baffle: with clips shown**

### Connect Compressor

Refer to the manual supplied with your compressor for details of how to set up your Compressor and connect it to the Integra AC.

### Connect the Control Box

The control box is connected to the Integra AC using the cable and pressure tube provided.

### Cool down the system

Prior to the cool down it is necessary to:

- Evacuate the OVC, if not already done or if it has been let up
- Pump and flush the helium reservoir.

#### *Evacuating the OVC*

*Note* *If you want the optimum boil off performance it is important to pump the OVC with a high vacuum pump, not just a rotary pump.*

If not already under vacuum, evacuate the Outer Vacuum Chamber (OVC) of the dewar for at least 24 hours before you cool the system.

***Always use pumping lines which are at least 25 mm diameter and as short as possible.*** *Do not use lines that have previously been used to carry helium gas.*

It is recommended to use a diffusion pump with a 50mm (or larger) diameter inlet port and a cold trap, to collect condensable vapours, as it pumps all gases well, (including helium). A turbo molecular pump with a cold trap (and backed by a two stage rotary pump) can be used but if there is any helium in the vacuum space it will take a long time to pump it away because these pumps have a low compression ratio for light molecules.

Load the other parts of the system into the helium reservoir of the dewar as shown in the general assembly drawing of the system.

*Cooling the system*

Liquid helium has a very low latent heat of evaporation but the gas has high enthalpy. This means that it is very easy to evaporate the liquid but it is difficult to warm up the gas so produced. Liquid helium therefore has to be transferred very carefully. If you do not transfer it properly you may lose all the liquid from your storage dewar without collecting any in your system. Follow these instructions to get an efficient liquid helium transfer.

When you are cooling down a system to 4.2 K it is very important to transfer the liquid helium to the lowest point in the helium reservoir. If the system is warmer than 4.2 K the liquid boils almost immediately as it leaves the vacuum insulated transfer tube (or siphon). Very little cooling is obtained from this evaporation. However, this gas then has to pass over the equipment in the helium reservoir to reach the exhaust line, and this provides very useful cooling power. If you transfer the liquid helium into the system slowly you can make sure that the gas emerging from the exhaust line is not too cold. This ensures that you do not waste any cooling power. If you do transfer the liquid too quickly you may see liquid air running from the recovery line, indicating that the cooling power is being wasted.

The following procedure assumes that you are using the optional Oxford Instruments storage dewar heater to provide clean helium gas for pumping and flushing. However the procedure can be modified to use an alternative supply of helium gas (consult with Oxford Instruments prior to using an alternative supply).

The helium gas supply must be very clean in order to avoid contamination of the heat exchangers. Its pressure should be regulated to a maximum of approximately 20mbar above atmosphere.

## Preparation for cool down

1. Connect one end of a clean flexible line to the ‘recovery’ speedivalve
2. Connect the other end to a T-piece on a transport dewar
3. Put a valve on the other port of the T-piece for attaching a pump for the pump and flush process
4. Attach one end of the 4mm flexible line to the port on the ‘recovery’ manifold and attach the other end to the control box
5. Switch on the control box and confirm that the pressure is reading on the display
6. Fit a dewar heater in to the transport dewar
7. Connect the dewar heater to the control box with the customer lead
8. Using a rotary pump, pump out the cryostat. Check for air leaks in to the helium bath by isolating the pump and checking that the helium space can hold a pressure of less than 1mbar for 15 minutes
9. Pump and flush the main bath twice with helium gas evaporated from a dewar. Providing there are no air leaks in to the helium it is ready for cool down.

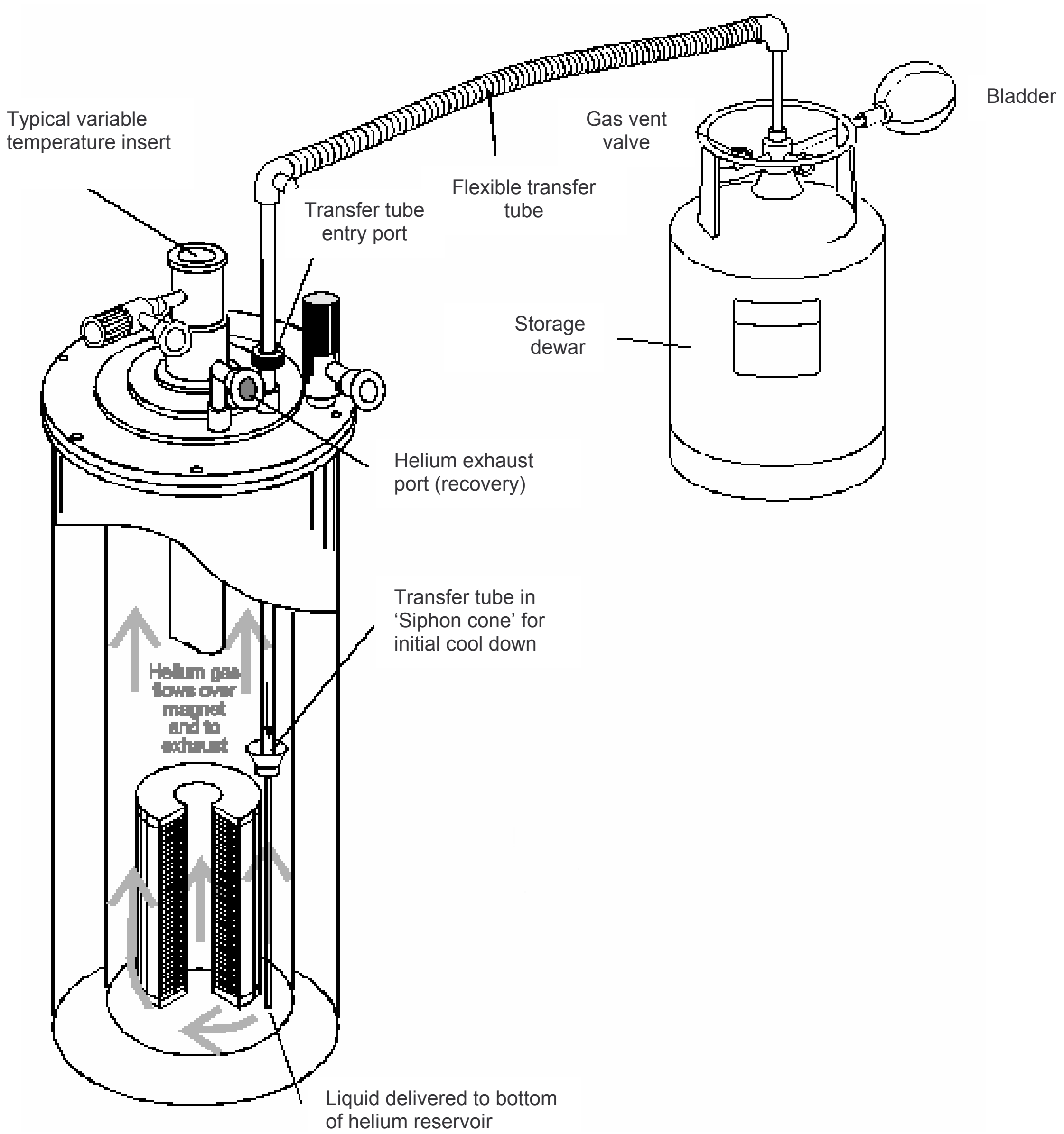


**Figure 12 Transferring liquid helium into a typical laboratory cryostat.**

*Note* *Your system may not look like the one shown in the diagram.*

#### Gas cooling

1. Start the pulse tube. Ensure that the chiller is working and supplying cooling water
2. Check that the low and high pressure gauges on the compressor are reading the correct pressure. Refer to the Refrigerator Manual for more details
3. Check that the gas supply is connected from the transport dewar, directly on to the helium recovery connection on the cryostat
4. Leave the system to cool automatically overnight. The pulse tube will start to cool down the cryostat, contracting the gas inside the helium can. This gas will be topped up with boil off gas from the dewar. The gas supply will be maintained at a constant pressure by the control box, which will monitor the pressure inside the cryostat and will energise the heater to ensure that the pressure is maintained.
5. Monitor the cool down until the temperature on the magnet is below 100K. If present, check the temperature of the sensors on the magnet. Provided these too have cooled to around 100K, the cryostat may be cooled with liquid helium.

*Note* *The system may be cooled below 100K via the above method. The colder the cryostat is before helium transfer, the less helium will be lost in the transfer process.*

#### Liquid helium cooling

***When switching to liquid cooling, it is important to keep a positive pressure of helium gas inside the Integra AC cryostat. Failure to do so may cause air to be condensed on the heat exchanger surface, impairing the performance of the system.***

1. Close the ‘recovery’ speedivalve
2. Disconnect the dewar heater from the control box and remove the heater from the storage dewar
3. Disconnect the gas supply line from the transport dewar and connect it to recovery, i.e. one end should be on the Integra AC ‘recovery’ speedivalve and the other end be on the check valve on the recovery system
4. Open the ‘recovery’ valve

*Note* *Liquid helium transfer must start immediately after this valve has been opened.*

5. Start conventional helium first fill. Refer to ‘Practical Cryogenics’ Booklet and your Helium recovery supervisor
6. Once the transfer has started, the heater override can be switched off
7. Fill the dewar to 80% full (or 30% full if pumping exchange gas from insert)
8. Once the boil off has stabilised and the valve warmed up, close the ‘recovery’ speedivalve.
9. Attach a flow meter to the outlet of the 1psig relief valve to monitor the boil off. Over several hours the boil off will slowly reduce to zero. At this point the control box will adjust the heat applied to the second stage on the pulse tube to maintain a constant pressure of 20mbar above atmospheric pressure.

# Operation

## Introduction

This chapter describes how to operate the Integra AC system. If you encounter any problems during operation please refer to Faultfinding and Servicing on page 33.

## Running the system unattended

If you plan to leave the system to run unattended you must take the following precautions. Remember that it is your responsibility to make sure that no one is put into danger by the system. Read and learn the contents of the Safety section of this manual and take appropriate actions.

- Make sure someone knows how to restart the water chiller if the power goes off
- Erect suitable warning signs to prevent tampering by other people
- Try to make sure that only competent people have access to the system
- Make sure that there are sufficient cryogens in the system, allowing for consumption by the insert
- Make sure that the system can vent safely, even if it is accidentally warmed up or the compressor stops running unexpectedly
- Leave a telephone number so that you can be contacted in an emergency
- Make sure that there is sufficient ventilation in the laboratory to avoid a potential asphyxiation hazard when you return
- Label the electrical and water connections as “Do Not Disconnect”.

***If there are any closed volumes that are pumped during normal operation make sure that they are free to vent either into the cryostat reservoirs or through the pumping line. If there are valves in the pumping line and on the inlet to these volumes make sure that you do not leave them both closed.***

## Leaving the system static

If you are not using the system for a few days (for example over the weekend) it is often possible to close it down and leave it in a static condition. This could reduce some of the potential hazards associated with the system. To leave a typical system in static mode:

- Make sure someone is available who knows how to restart the water chiller if the power goes off
- De-energise the superconducting magnet (if fitted)
- Close down the lambda point refrigerator (if fitted) and vent it safely
- Close down the Insert
- Label the electrical and water connections as “Do Not Disconnect”.

### Re-filling the liquid helium

***This describes the easiest method of transferring liquid into a cold system for beginners. However, some laboratories have strict rules about recovering all helium gas. If you have a helium recovery system ask the administrator to show you the preferred method of transferring helium.***

***If your system contains a superconducting magnet:***

- ***Make sure that the liquid helium level does not drop below the minimum level shown on the drawing while it is energised.***
- ***Run down the magnet, if in doubt***
- ***Beware of the stray magnetic field while you are working close to the cryostat.***

When the liquid helium level drops close to the minimum working level you should carefully re-fill it. When you refill the liquid helium you should take care to pre-cool the transfer tube thoroughly before you put it into the system. Otherwise the warm gas passing through the tube will evaporate liquid in to the helium reservoir.

***Only fill the Helium bath up to 90% capacity. Overfilling will stop the recondensing operation.***

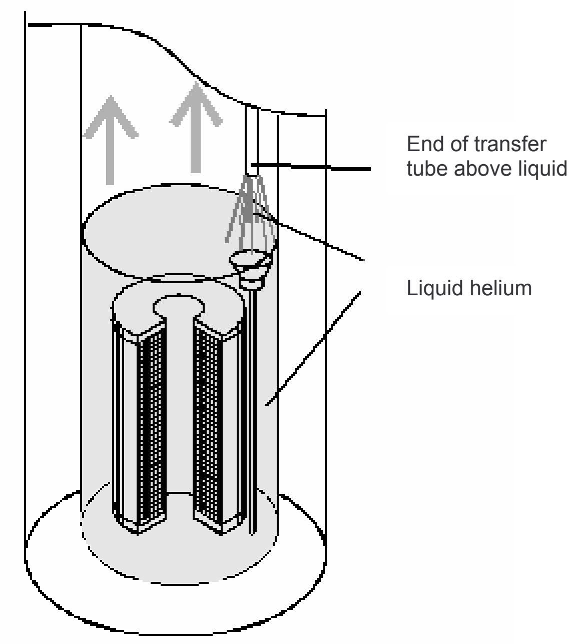


**Figure 13 Topping up liquid helium into a typical laboratory cryostat.**

Note Your system may not look like the one shown in the diagram.

The booklet *Practical Cryogenics* contains a list of practical solutions to the problems commonly encountered in liquid helium transfers.

Some transfer tubes are supplied with special fittings for refilling the liquid helium. These fittings are screwed onto the end of the transfer tube and divert the gas and liquid from the transfer tube up and away from the liquid surface. The gas passes out of the cryostat and the heavier liquid falls into the reservoir.

### *Pre-cooling the transfer tube (or siphon)*

1. Insert one leg of the transfer tube into the helium storage vessel, but leave the other leg outside the cryostat
2. On the Cryostat 'siphon entry' fittings, unscrew the ‘O’ ring and the knurled nut and slide it onto the leg of the transfer tube, which will go into the cryostat
3. Put the bung loosely in the transfer tube entry port on the system to prevent gross contamination with air
4. Pressurise the transport dewar slightly. After about 20 seconds you should hear oscillations in the tube, gradually increasing in frequency and intensity. When these stop you should see white vapour and when liquid starts to emerge you may see a white cone (like a gas flame).

### *Running the by-pass heater*

1. Switch on the ‘Heater Override’
2. Wait until the pressure exceeds 65mbar and the Cryostat starts to boil off
3. Open the ‘recovery’ Speedivalve
4. Once the boil off has stabilised and the valve warmed up, close the ‘recovery’ Speedivalve
5. Attach a flow meter to the outlet of the 1psig relief valve to monitor the boil off. Over several hours the boil off will slowly reduce to zero. At this point the control box will adjust the heat applied to the PT2 plate to maintain a constant pressure of 20mbar above atmospheric pressure
6. Switch off the ‘Heater Override’.

### *Transferring the liquid helium*

If you have a rigid transfer tube:

1. Quickly release the pressure in the transport dewar
2. Lift the transfer tube and insert the open end into the cryostat.

If you have a transfer tube with a flexible section:

***Do not push the transfer tube below the maximum helium level if you have a superconducting magnet in the system. You may quench the magnet.***

1. Push the transfer tube into the system to approximately the maximum helium level.

2. Quickly increase the pressure in the storage dewar again. It is most efficient to transfer the liquid quickly to reduce the losses in the transfer tube. However, 200 mbar is usually sufficient pressure to do this.

*Note:* *The reading on the helium level probe may be affected when using the siphon entry on the dewar to top up with helium. For best results use the siphon entry on the insert (if fitted).*

## Warming up the system

### *Preparations*

Before you start to warm up the system you must make sure that it is safe. The Safety section of this manual gives some guidelines.

Make sure that there are no trapped volumes of liquid, gas or condensed solids inside the system. You may not know that they are there if they have accidentally been condensed into the system while it has been cold. Therefore you must make sure that all closed volumes are free to vent or that they are pumped continuously as the system warms up.

Close down any other parts of the system. In particular if your system contains any of the following items prepare them properly.

- Superconducting magnets must be de-energised
- Lambda point refrigerators must be closed down and pumped out (and pumped continuously during warm-up) or vented to the main helium reservoir
- Variable temperature inserts must be closed down and vented (or pumped continuously during warm-up).

### *Allowing the system to warm naturally*

When you have prepared the system you can leave it to warm up naturally. When the cryogens have all evaporated, the system will warm slowly to room temperature. If you do not need to use it again soon this is the easiest and best way to warm the system up.

### *Warming the system quickly*

Avoid warming the system quickly if possible. However, if you know that you will often have to warm the system quickly, contact Oxford Instruments for further advice. Systems can be designed to do this but they are unnecessarily complex for most users.

If you want to warm up the system more quickly you have to blow out the cryogens. The liquid helium can be blown out of the system either into a storage vessel for use elsewhere or into a helium gas recovery system. The system will then begin to warm up. There is no wholly satisfactory way of warming up more quickly than this for the following reasons:

- If you vent the OVC with clean dry nitrogen gas (even very slowly) there is a risk of causing mechanical damage
- If you vent it with helium gas the superinsulation will also be badly contaminated and will have to be replaced
- If you circulate warm gas through the helium reservoir it will take a long time to warm the system unless you heat the gas to above room temperature as it enters the system. If you do this, you risk overheating the system and causing damage before you realise that the system has reached room temperature
- If you lift the contents out of the system while they are cold they may be damaged by the thermal shock or by the ice condensed from the atmosphere.

1. Turn off the pulse tube refrigerator (PTR)

***Do not disconnect the pulse tube lines until the system has fully warmed up***

2. Blow away the liquid helium from the main bath. If possible this should be transferred into another dewar for re-use, otherwise it must be blown away into recovery
3. With the PTR off, the dewar will start to warm up quickly

4. ***Do not overheat the pulse tube beyond 315K***

5. Once the temperature on the PT2 plate exceeds 285K, the pulse tube lines can be disconnected.

## Changing the Insert when the system is cool

***This can only be undertaken if you insert comes with a sliding seal***

1. Prepare the insert for loading in to a cold bath and carry out any checks as defined in the manual that came with the insert
2. Bolt the insert in to its sliding insert
3. Switch on the ‘Heater Override’. Wait until the pressure exceeds 65mbar and the Cryostat starts to boil off
4. Remove the baffle stick from the magnet support, there will be a slight puff of cold gas as the seal is broken
5. Locate the bottom of the sliding seal in to the inner seal of the Cryostat and form a seal
6. Shut the ‘sliding seal recovery’ valve on the Cryostat recovery
7. Open the ‘recovery Speedivalve
8. Slowly lower the insert in to the helium bath. Try and keep the pressure in the bath below 65mbar on the controller. This will ensure that the entire boil off generated during loading is captured by the recovery system
9. Once the insert is fully loaded and bolted in to place, stop the ‘heater override’
10. As soon as the valve has warmed up and the boil off has stabilised, close the ‘recovery’ Speedivalve.

# Technical Data

| Item | Wiring check | Specified Measurement / Ω |
|---|---|---|
| PT2 heater | Pin 1 to Pin 2 | 447 ± 10 |
| | Pin 1 to GND | ∞ |
| PT2 sensor | Pin 3 to Pin 4 | 650 ± 25 |
| | Pin 3 to Pin 5 | 650 ± 25 |
| | Pin 3 to Pin 6 | 380 ± 10 |
| | Pin 4 to Pin 5 | 380 ± 10 |
| | Pin 3 to GND | ∞ |
| | Pin 1 to Pin3 | ∞ |

# Faultfinding and Servicing

This section provides advice on simple faults and operational errors and gives an immediate solution where possible.

## Faultfinding

Only skilled personnel, who are aware of the hazards involved, may carry out work that requires the AC power supply to be connected.

*Note* *If in doubt, or if you need further advice, please contact Oxford Instruments NanoScience Customer Support giving the results of the checks you have performed.*

| Symptom | Diagnosis and suggestions |
|---|---|
| Poor vacuum in OVC | Leak on pumping system:<br>• Close the cryostat OVC valve and check pumping system base pressure.<br>Leak on dewar:<br>• Obtain a mass spectrometer leak detector and identify the source of the leak. The booklet *Practical Cryogenics* gives advice on this subject.<br>Excessive moisture in OVC:<br>• Pump and flush the OVC with dry nitrogen several times, then pump to high vacuum again. |
| Condensation or frost on the OVC when the system is cooled down | Poor vacuum in the OVC:<br>• Pump the OVC again. Check with a mass spectrometer leak detector for leaks including leaks from the helium reservoir. |
| Transfer tube gets frosty | Poor transfer tube vacuum:<br>• Pump its vacuum space to high vacuum again. |
| Transfer tube shows ice "spots" | Internal capillary touches outer tube:<br>• If the transfer tube is still under warranty and it has not been damaged contact Oxford Instruments for a replacement. Otherwise consider replacing the transfer tube if the liquid helium consumption is unacceptably high. |
| Difficulties transferring liquid helium into the system. | See the chapter on this subject in the booklet *Practical Cryogenics.* |

| Symptom | Diagnosis and suggestions |
|---|---|
| Cryostat outer vacuum chamber (OVC) cannot be pumped to high vacuum<br>or<br>Water condenses on the cryostat body when it is cold | Check the OVC for leaks. In particular check Cryostat top plate OVC joint O-rings<br>• Fit a blanking plate with a pumping port to the helium bath entry. Pump out the helium bath with a roughing pump to below 1mbar<br>• Flush the helium bath with balloon grade helium gas up to atmospheric pressure.<br>• Pump the gas away using a rotary pump to below 1mbar. |
| Cryostat will not cool down | Check PTR pressures and OVC vacuum. |
| Cryostat cannot be warmed up. | Check that PTR compressor is off. |
| Helium runs out | Check performance of pulse tube and re-fill Helium |
| Boil off starts | Check PTR performance<br>Check heater override is not switched on<br>Ensure that there is not excess wiring. |

## Servicing

### *Outer Vacuum Chamber (OVC) servicing*

Check O-rings and Drop off plate.

### *Pulse Tube servicing*

Refer to the Refrigerator Manual.

### *Control Box servicing*

The control box should not need to be serviced. If you are having problems with the control box, please contact Customer Support.

### *Compressor and Cold Head servicing*

You are advised to renew the compressor adsorber at the recommended interval (refer to the Refrigerator Manual) in order to maintain optimum performance and reliability.

Earlier servicing may be required for either the Compressor or Cold Head if you observe a drop in performance, usually the result of helium contamination or a leak. Normal wear causes a gradual degeneration and servicing is also required when the system no longer performs satisfactorily.

For these reasons we suggest that you keep a log of system performance.

### Checking connectors

| Pins of Fischer connector | Expected resistance **(Ω)** |
|---|---|
| Pin 1 to Pin 2 | 447 ± 10 |
| Pin 1 to GND | ∞ |
| Pin 3 to Pin 4 | 650 ± 25 |
| Pin 3 to Pin 5 | 650 ± 25 |
| Pin 3 to Pin 6 | 380 ± 10 |
| Pin 4 to pin 5 | 380 ± 10 |
| Pin 3 to GND | ∞ |
| Pin 1 to Pin 3 | ∞ |

### Spare parts

The following spare parts are available:

- ¼ inch Aeroquip flat gasket (4)
- ½ inch Aeroquip flat gasket (4)
- Dewar Heater
- Sliding seal
- O-rings for Magnet Support.

# Customer Support

## Warranty

The Oxford Instruments customer support warranty is available to all our customers during the first 12 months of ownership from date of delivery. This warranty:

- Provides repairs to faults that are a result of manufacturing defects at Oxford Instruments
- Only applies if Oxford Instruments engineers have undertaken the installation.

## Technical Support

To obtain technical support you will need to quote your Oxford Instruments order number. Please contact your nearest Customer Support centre as follows:

**Europe, RoW, Main Office**
Tel: +44 (0)1865 393 311
E-mail: helpdesk.nanoscience@oxinst.co.uk
Fax: +44 (0)1865 393 311

**Americas**
Tel: +1 978 369 9933
E-mail: csg@ma.oxinst.com
Fax: +1 978 369 6616

**Japan**
Tel: +81 (0) 3 5245 3261
E-mail: Oikkcsri@oxinst.co.jp
Fax: +81 (0)3 5245 4477

To obtain additional copies of this document please contact Oxford Instruments NanoScience Customer Support quoting the appropriate part number as shown within the text in the format (Axxxxx).

## Additional services available from Oxford Instruments

**Oxford Instruments Direct** – provides one-stop shopping for cryogenics, magnetic, vacuum and associated laboratory products as well as hard to find reference for low temperature physics, optics, thermometry and laboratory safety practices. You can also visit on-line at www.oxinstdirect.com. Ordering parts is easy via phone, fax or email. Online ordering is available in North America.

## About Oxford Instruments

Oxford Instruments specialises in the design, manufacture and support of high-technology tools and systems for industry, research, education, space, energy, defence and healthcare.

We combine core technologies in areas such as low temperature and high magnetic field environments; X-ray, electron and optical based metrology; nuclear magnetic resonance, advanced growth, deposition and etching. Our aim is to be the leading provider of tools and systems for the emerging nanotechnology and bioscience markets.

### Oxford Instruments NanoScience Limited

Oxford Instruments NanoScience creates high performance environments for low temperature and high magnetic field applications in physical science research and process development down to the atomic scale.

The business has a strong capability in advanced cryogenics and applied superconductivity. Through the application of these technologies we deliver solutions that meet the exacting needs of scientists working at the forefront of fundamental physics, applied physics, materials science and next generation device development. With an extensive customer network, a strong reputation for performance and quality, we value the support we have provided to world leading research scientists in their pursuit of excellence.