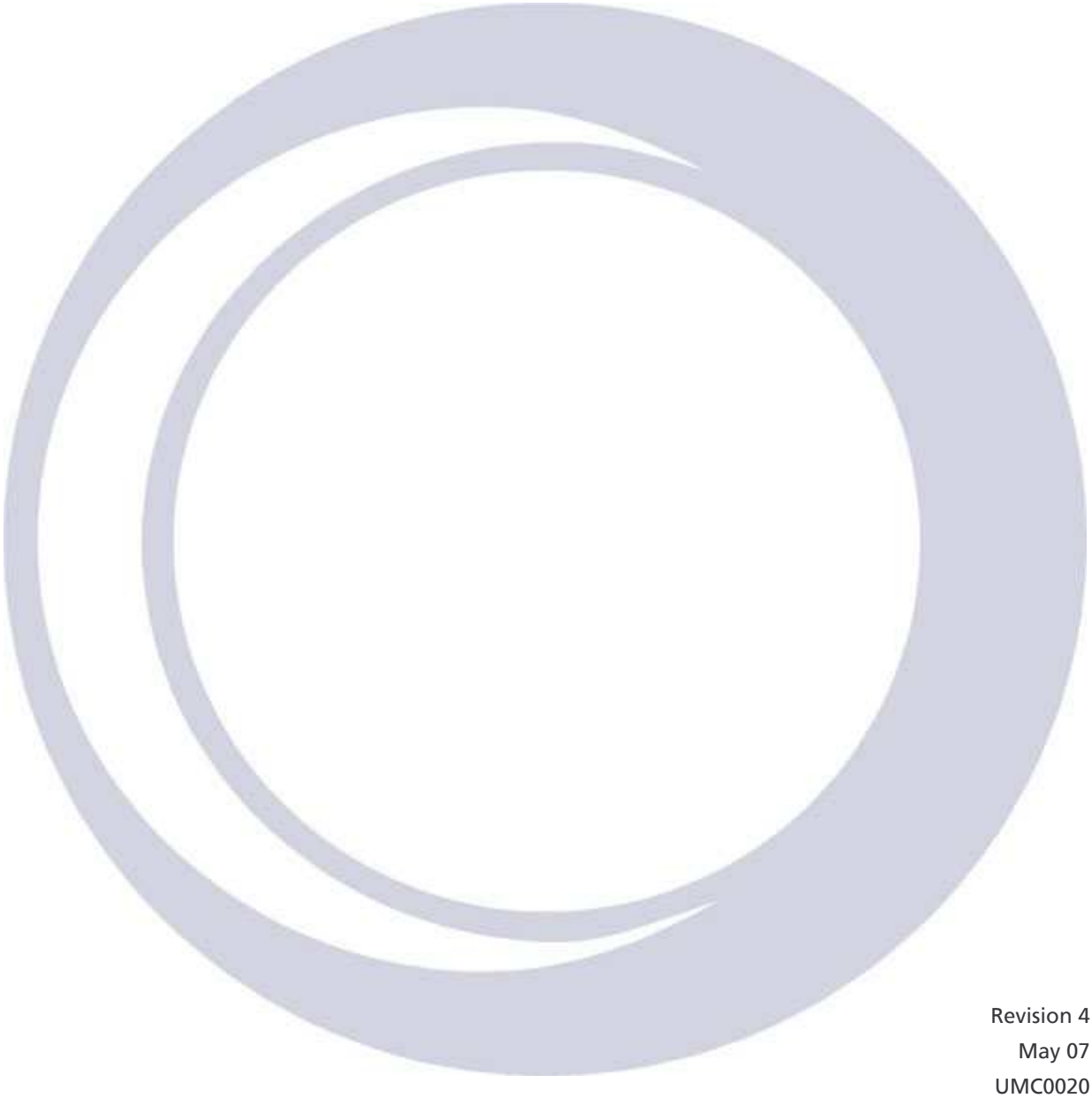
Operator's Handbook

HelioxVL

Insert Data



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Oxford Instruments NanoScience
Tubney Woods, Abingdon,
Oxon, OX13 5QX, England
Tel: +44 (0)1865 393 200
Fax: +44 (0)1865 393 333
E-mail: nanoscience@oxinst.co.uk
www.oxford-instruments.com

OXFORD INSTRUMENTS

Contents

Warnings

Before you attempt to install or operate this equipment for the first time, please make sure that you are aware of the precautions which you must take to ensure your own safety.

1 Introduction

The HelioxVL Insert Manual explains how to set up and run the insert. This HelioxVL Insert Data manual gives more details and specifications of the insert. It also gives information about any options that may have been selected. For example, any options for services fitted to the line-of-sight spare ports.

1.1 Safety

Please refer to the separate booklet, "Safety Matters". This includes information about the properties of liquid nitrogen and liquid helium, and detailed recommendations about the precautions you should take. It is your responsibility to ensure your own safety, and the safety of people working around you.

2 HelioxVL base system

2.1 Components

This section lists the components that are included with the HelioxVL. Similar lists for items supplied with system options can be found in the relevant sections elsewhere in this manual.

All HelioxVL systems include:

- HelioxVL insert
- IVC
- ^{3}He charge
- Auto needle valve drive for 1 K plate
- Clamp for sliding seal tube
- System manual
- Spares kit toolbox containing
    - 24 way Fischer plug (SE 105 A)
    - Charcoal cloth and copper gauze for IVC sorb
    - Silicone vacuum grease
    - Rubber bladder
    - Hose connector (NW16)
    - Clamps and 'O' rings (NW16 $\times$ 1)

If the insert has been selected as part of a B-T environment system then the following items are included in addition to those above.

- Baffle set with NW50 clamp and co-seal
- Neck extension tube with NW50 clamp and 'O' ring
- Dummy baffle stick
- ^{4}He recovery kit for B-T environment systems
    - 'Tee' piece (NW40/40/16)
    - Plastic recovery tube (NW16, 2.5 m long)
    - Clamps and 'O' rings (NW40 $\times$ 1, NW16 $\times$ 2)

If the insert has been selected as part of a liquid helium storage-vessel system then the following items are included in addition to those at the top of this page.

- NW50 clamp and co-seal
- Dummy baffle stick

(A ^{4}He recovery kit is supplied separately with the cryostat)

2.2 Specification

This is the specification of the HelioxVL insert. Some specifications may be affected by the insert options that have been selected. The changes, if any, will be detailed in the relevant section below. The specifications quoted assume that the HelioxVL is run with the ITC503 temperature controller and the 1 K plate pumping options.

Base temperature	≤ 245 mK for ≥ 90 hrs
Cooling power	≤ 290 mK for ≥ 10 hrs with 40 μW applied
Temperature range	Base temperature to 1.5 K
Temperature stability	± 3 mK at $T \leq 1.5$ K
Thermometers	Uncalibrated RuO_2 sensor on the ^{3}He pot and the 1 K stage Uncalibrated carbon sensor on the ^{3}He sorb
^{3}He regeneration time	≈ 30 min
Liquid helium consumption	≈ 3 l to cool the insert from room temperature to 4.2 K ≈ 0.04 l hr^{-1} running at base temperature
Sample space	Diameter 41 mm Length – see section 3.3 Access by removal of IVC (at room temperature)
Spare ports	Two line-of-sight ports to the sample space 6.0 mm clear internal diameter NW16 flanges at room temperature Spare port options – see section 3.2.
Experimental wiring	24 way Fischer connector at room temperature (DBEE 105 A) Mating plug for Fischer connector (SE 105 A) Nomex woven ribbon cable of 12 twisted pairs (24 wires) 0.1 mm diameter constantan wires with polyester insulation 25 way miniature D-type connector on ^{3}He pot top Mating D-type connector
Insert mass	10 kg nominal

3 HeliosVL options

3.1 System options

This section gives details about options that may have been chosen for the Heliox system. See section 4 for information about the minimum equipment required to commission a system. This section gives details of options that may have been chosen for the Heliox insert. Each option is described and a list of items included when that option is chosen is given. Any change in the system performance due to the option is also specified.

3.1.1 Temperature controller

The following items are included when this option is selected.

- ITC503 temperature controller (with 3 channel upgrade)
- Mains electricity cable for ITC503
- Heliox heater controller box
- Two dual-input cables
- ITC503 handbook
- Setting up sensors on an ITC
- ITC503 Quick Start manual
- Object Bench software V2.8.7 (2 disks)
- Object Bench handbook
- ITC RAM backup disk

3.1.2 1 K plate pumping system

The following items are included when the manifold only option is selected.

- Manifold 'tee' piece (NW25/25/16)
- Vacuum gauge (0 to 125 mbar)
- Manual valve (NW25)
- Flexible pumping line (NW25, 2.5 m long)
- Adapter for IVC pumping line (NW25/16)
- Clamps and 'O' rings (NW25 $\times$ 3, NW16 $\times$ 2)

In addition, the following items are included when a complete 1 K plate pumping system has been selected

- Pump (Edwards RV12 rotary vane pump)
- Oil mist filter (NW16)
- Clamps and 'O' rings (NW25 $\times$ 1, NW16 $\times$ 1)
- Pump manual

3.1.3 High temperature upgrade

A calibrated high-temperature thermometer is mounted on the bottom of the ^{3}He pot and wired to the diagnostic wiring loom, and its calibration data is loaded into the ITC503. The upper limit of the temperature range is extended from 1.5 K up to 300 K.
The following items are included when this option is selected

- Calibrated Cernox thermometer on the ^{3}He pot
- Calibration documentation

Temperature range	Up to 300 K in zero field Up to 100 K in magnetic field
Temperature stability	$\pm$ 100 mK at $T > 1.5$ K

Note: It is necessary to raise the insert (using the sliding seal) into the neck of the dewar to prevent large quantities of ^{4}He being boiled away when the ^{3}He pot is at high temperatures. The maximum recommended temperature of the ^{3}He pot for operation while the insert is fully inserted and in the magnetic field is 100 K.

3.1.4 Universal housing wiring

As standard the universal housing contains the diagnostic wiring, on two 10-pin Fischer connectors, and the experimental wiring (specified in section 2.2). If this option has been selected this housing will have, in addition, four flexible stainless steel coaxial cables wired to the sample space. See section 3.2.3.

3.1.5 Calibrated thermometers

If a calibrated sensor is selected it is mounted on the bottom of the ^{3}He pot and wired instead of the usual chip RuO_2 sensor, and its calibration data is loaded into the ITC503. Two types can be chosen: a RuO_2 sensor with a generic calibration, or a RuO_2 sensor with a full, 30 point, calibration. Both have identical sensors and packaging.

The following items are included when either option is chosen

- Calibrated RuO_2 thermometer on the ^{3}He pot
- Calibration documentation

Please see separate information supplied for sensor specification.

3.1.6 Liquid helium storage vessels

If a liquid helium storage vessel has been selected then the following items are included

- 120 l liquid helium storage dewar with NW16 fittings for recovery
- ^{4}He recovery kit for LHe storage vessel systems
  - 'Tee' piece (NW16)
  - Plastic recovery tube (NW16, 2.5 m long)
  - Clamps and 'O' rings (NW16 $\times$ 3)

3.2 Spare port options

Both spare ports are identical except that the room temperature ports are terminated at different heights above the insert top plate to make room for the NW16 clamps. The options for each spare port are the same. However, depending on which combination of services are chosen for each port the orientation of the room temperature housings may be different – see the example drawings elsewhere in this manual set.

None of the spare port options below affect the insert specifications. However, as a general rule, the more heat load applied to the ^{3}He pot the higher the base temperature and the shorter the hold time.

3.2.1 Blanked off and empty

At room temperature the port is capped with an NW16 blank. The port is left as a clear line-of-sight to the sample space. At the 4.2 K flange the port may be taped off temporarily to prevent thermal radiation from room temperature reaching the colder parts of the insert.

3.2.2 UT-85-SS-SS semi-rigid coax

A single semi-rigid UT-85-SS-SS coaxial cable is wired to the 1 K plate. Both ends are terminated with SMA connectors. The outer conductor of the cable is grounded to the insert. See section 5.1 for the cable specification. No mating connectors are supplied.

3.2.3 Four S1 flexible coax

Four flexible stainless steel coaxial cables are wired to the sample space. At room temperature they are terminated with SMB connectors. At the sample space the cables are unterminated and left for customer connection. See section 5.2 for the cable specification. No mating connectors are supplied.

3.2.4 24 way constantan loom

A 24 way constantan loom identical to that specified for the standard experimental wiring in section 2.2 is wired to the sample space. It is unterminated at the sample space and left for customer connection. A mating 24 way Fischer plug (SE 105 A) is supplied.

3.2.5 24 way loom and four S1 coax combination

A combination of the two options above wired down a single spare port.

3.3 Sample space options

3.3.1 Clear space

The sample space below the ^{3}He pot is left entirely free for customer use. It may contain a length of coiled wiring from a spare port option or a calibrated thermometer if one has been selected. These items can be moved to suit whatever else has to be accommodated here.

For B-T environment systems the clear sample space will be 100 mm, 150 mm or 200 mm. This is defined as the distance from the base of the ^{3}He pot to the magnetic field centre line. There is a standard length of 80 mm from the magnetic field centre line to the inside end of the IVC for all three lengths.

For LHe storage vessel systems, the clear sample space will be 150 mm from the base of the ^{3}He pot to the inside end of the IVC (there is no magnetic field and therefore no magnetic field centre line to reference).

A clear sample space on any system does not affect the insert specifications.

3.3.2 Low eddy-current sample holder

A low eddy-current sample holder allows a small sample to be mounted in the centre of a magnetic field while minimising the heating caused by eddy-currents induced by sweeping the field. The sample is mounted on a copper slug that can be removed from the end of the holder. The slug presents a flat surface 10.0 mm long by 6.5 mm wide, centred on the magnetic field. The long dimension is aligned parallel to the direction of the field – the 'Z' direction.

For B-T environment systems the sample holder is 200 mm long from the bottom of the ^{3}He pot to the field centre line. This therefore defines the sample space length automatically.

Low eddy-current sample holders are not available for LHe storage vessel systems (there is no magnetic field to induce eddy currents).

A low eddy-current sample holder on any system does not affect the insert specifications if the magnetic field remains static. Some warming will be experienced while sweeping the field. The amount of warming depends on the rate of the sweep.

3.3.3 Swedish rotators

Swedish rotator options are not yet available as configured options for HelioxVL systems.

3.3.4 Integral magnets

Integral magnet options are not yet available as configured options for HelioxVL systems.

4 Requirements for commissioning

The following equipment will be required for the successful commissioning of a HelioxVL system.

4.1 Electronics

The HelioxVL is designed to be controlled by the temperature controller described in section 3.1.1. If this option has not been selected another equivalent temperature controller may be used.

A multimeter for general testing of diagnostic and experimental wiring.

4.2 Pumping system

A pumping system for the 1 K plate is required. If the 1 K plate pumping option (section 3.1.2) has not been selected then an equivalent may be used. A rotary vane pump with a speed of at least 12 m^3 hr^{-1} along with the valves and interconnecting line as shown in the insert manual is suitable. This pump may also be used to evacuate the IVC before cooling the system.

A ^{4}He mass spectrometer leak detector is not required for routine operation of the system, but access to one may be useful if a leak is suspected.

4.3 Cryostat

If the HelioxVL has not been purchased as part of a system with a liquid helium cryostat a suitable one will be required. It must have a clear neck diameter of at least 50 mm and enough depth to ensure that the 1 K plate liquid helium pick-up is immersed at all times. If the sliding seal is to work effectively there must be sufficient length in the neck of the cryostat such that the tip of the IVC does not touch the surface of the liquid helium before the NW50 clamp can be connected to the sliding seal.

4.4 Consumable materials and electrical power

Liquid helium and possibly liquid nitrogen will need to be available.

Mains electrical power sufficient to supply the temperature controller and 1 K plate pumping system will need to be provided.

It may also be useful to have a supply of general laboratory consumables available; e.g. paper towels etc.

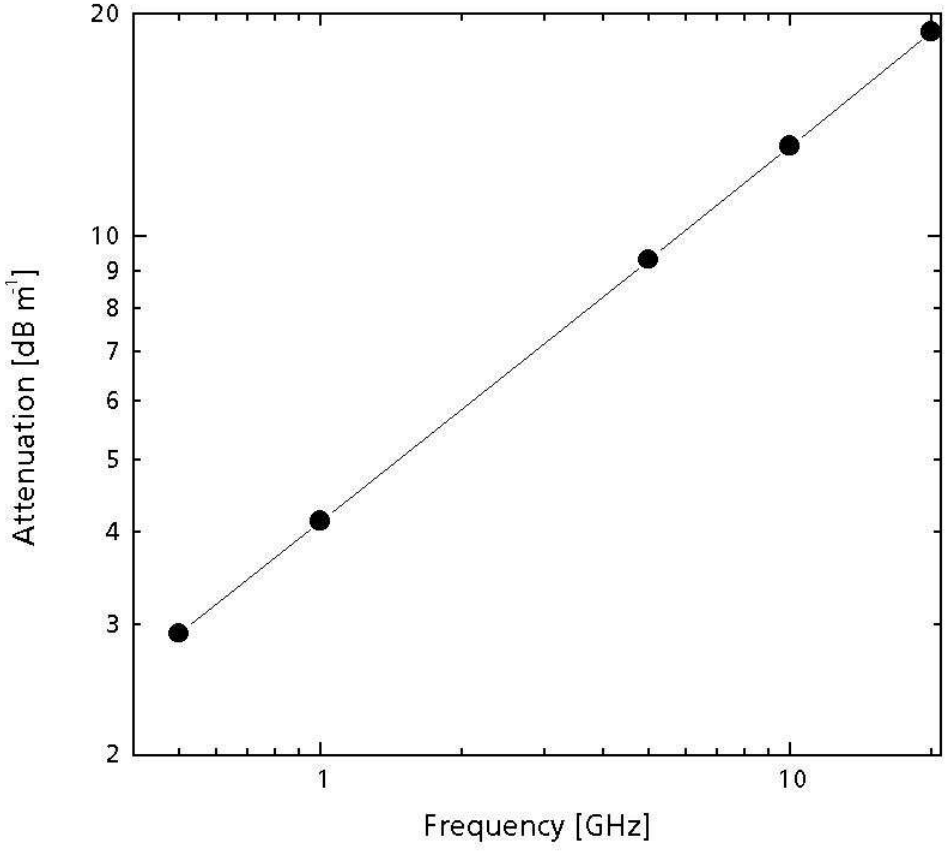
5 Appendix – coaxial cable

This appendix contains the manufacturer's specification for the coaxial cables used on the HelioxVL options.

5.1 UT-85-SS-SS Semi-rigid

Shield	304 stainless steel OD 2.2 mm
Dielectric	PTFE OD 1.7 mm
Centre conductor	304 stainless steel OD 0.51 mm
Inside bend radius	3.2 mm minimum
Mass	0.0186 kg m^{-1}
Characteristic impedance	50 Ω
Capacitance	95 pF m^{-1}
Corona extinction voltage	1500 Vrms @ 60 Hz
Voltage withstanding	2500 Vrms @ 60 Hz
90% higher order mode	61 GHz

Frequency response



5.2 S1 Flexible

Jacket	Teflon (FEP, grey) OD 1.0 mm
Shield	Braided stainless steel 12 × 4 matrix of 51 μm wire OD 0.71 mm 3.61 Ω m^{-1} at 296 K
Dielectric	Teflon OD 0.41 mm
Centre conductor	304 stainless steel 64 strands of 25 μm wire OD 0.20 mm 23.62 Ω m^{-1} at 293 K 600 V DC maximum 200 mA DC maximum
Characteristic impedance	40 Ω at 10 MHz
Capacitance	173.9 pF m^{-1} at 5 kHz
Magnetic properties	Paramagnetic

Frequency response