

# Technical Reference

# Cryojet

## Service Manual

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Issue 3

June 2000

File reference: SERVICE.DOC

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## **Warnings**

Before you attempt to install, operate or service this equipment, please make sure that you are aware of the precautions that you must take to ensure your own safety. The booklet "*Safety Matters*", supplied with the Operator's manual gives advice.

# **1      Introduction**

Refer to the Operator's Handbook for a description of the system and troubleshooting advice. See also the controller Technical Handbook. If you concerned that the system is not set up correctly, refer to the section entitled "Configuration and Calibration" in the Technical Handbook.

## 2 Service kit

| Part   | O.I. Part number   | Quantity            | Uses   |
|--|--|---------------------|--|
| Cryojet spares and accessories kit   | CRYOJET98SKIT  | 1                   | All required o-rings   |
| Platinum resistance thermometer PT100  | PRZ0015  | 1                   | Nozzle; shield leg heat exchanger                            |
| 1/8" Watlow cartridge heater, 40 V x 40 W  | PFA0021  | 1                   | Coldhead heat exchanger and shield leg heat exchanger        |
| 1/4" Watlow cartridge heater (40 V x 40 W) with two perforated copper baffles soldered to it | PFA0009 + 2 off PSN0033  | 1                   | Shield leg boiloff heater and sample flow leg boiloff heater |
| Copper crimps  | RCT0002 (Cu tube B 0.093" x 0.022") x 5 mm long, sliced with a scalpel | 10                  | Joining wires to the boiloff heaters                         |
| PTFE coated wire, 0.4 mm   | RCW0012  | 10 m                | Boiloff heaters  |
| PTFE coated wire, 0.25 mm  | RCW0043  | 10 m                | Low N2 level sensor, coldhead heater                         |
| PTFE coated stainless steel wire   | EWM9705  | 10 m                | Nozzle sensor  |
| High temperature sleeving  | EWZ0820  | 20 cm               | To cover leads of boiloff heaters                            |
| Low N2 level sensor  | EQT0590  | 1                   |  |
| Autostick ceramic adhesive   | TGZ0005  | 1 small plastic pot | To pot in heaters and sensors                                |
| PTFE sleeve  | EWZ1586  | 20 cm               | Sleeving platinum sensor leads                               |
| Heat shrink sleeving   | EWT0020  | 20 cm               | Sleeving platinum sensor leads                               |
| Heat shrink sleeving, 1.6 mm   | EWT0011  | 20 cm               | Low level sensor connections and all the connectors          |

### **3 Wiring Information, Connectors and Cables**

#### **3.1 Standard Wiring Sheet Used for Original Wiring**

(See the customer's manual for the actual wiring measurements on his/her system. The sample flow unit and shield unit each have a serial number, engraved on them a few centimetres above the dewar top fitting. These numbers are not the same as the project number.)

##### **Shield Unit: 10-pin Fischer connector**

Sensor type: PT100 platinum resistance sensor

| <b>From pin</b>                          | <b>Wire size</b> | <b>Goes to</b>            |
|--|------------------|---------------------------|
| 1  | 0.25 mm          | Sensor, common with pin 3 |
| 2  | 0.25 mm          | Sensor, common with pin 4 |
| 3  | 0.25 mm          | Sensor                    |
| 4  | 0.25 mm          | Sensor                    |
| 5  | 0.4 mm Cu        | Heat exchanger heater     |
| 6  | 0.4 mm Cu        | Heat exchanger heater     |
| Check all wires to ground > 1 M $\Omega$ |                  |                           |

| <b>From pin</b> | <b>To pin</b> | <b>Reading</b> |
|-----------------|---------------|----------------|
| 1               | 2             | $\Omega$       |
| 1               | 3             | $\Omega$       |
| 1               | 4             | $\Omega$       |
| 2               | 4             | $\Omega$       |
| 5               | 6             | $\Omega$       |
| 7               | 8             | $\Omega$       |

##### **Sample Flow Unit:**

##### **Dewar Leg: 4 pin Fischer connector**

| <b>From pin</b>                          | <b>Wire size</b> | <b>Goes to</b>       |
|--|------------------|----------------------|
| 1  | 0.4 mm Cu        | Boiloff heater       |
| 2  | 0.4 mm Cu        | Boiloff heater       |
| 3  | 0.25 mm Cu       | Low level sensor (-) |
| 4  | 0.25 mm Cu       | Low level sensor (+) |
| Check all wires to ground > 1 M $\Omega$ |                  |                      |

| <b>From pin</b> | <b>To pin</b> | <b>Reading</b> |
|-----------------|---------------|----------------|
| 1               | 2             | $\Omega$       |
| 3               | 4             | V              |

### **Coldhead: 4 pin Fischer connector**

Sensor type: PT100 platinum resistance sensor

| <b>From pin</b>                          | <b>Wire size</b> | <b>Goes to</b>            |
|--|------------------|---------------------------|
| 1  | 7/0.05 mm SS     | Sensor, common with pin 3 |
| 2  | 7/0.05 mm SS     | Sensor, common with pin 4 |
| 3  | 7/0.05 mm SS     | Sensor                    |
| 4  | 7/0.05 mm SS     | Sensor                    |
| Check all wires to ground > 1 M $\Omega$ |                  |                           |

| <b>From pin</b> | <b>To pin</b> | <b>Reading</b> |
|-----------------|---------------|----------------|
| 1               | 2             | $\Omega$       |
| 1               | 3             | $\Omega$       |
| 1               | 4             | $\Omega$       |
| 2               | 4             | $\Omega$       |

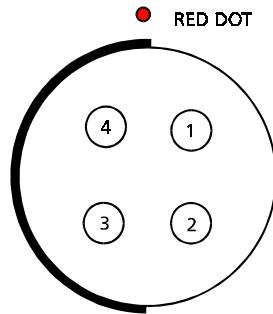
### **Coldhead: 10 pin Fischer connector**

| <b>From pin</b>                          | <b>Wire size</b> | <b>Goes to</b> |
|--|------------------|----------------|
| 1  | 0.25 mm Cu       | Heater         |
| 2  | 0.25 mm Cu       | Heater         |
| Check all wires to ground > 1 M $\Omega$ |                  |                |

| <b>From pin</b> | <b>To pin</b> | <b>Reading</b> |
|-----------------|---------------|----------------|
| 1               | 2             | $\Omega$       |

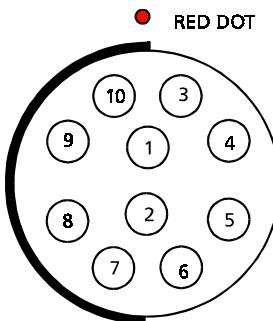
| <b>Wire Type</b>  | <b>Part Number</b> |
|---|--------------------|
| 0.25 mm Copper PTFE Covered   | RCW0043            |
| 0.4 mm Copper PTFE Covered  | RCW0012            |
| 7/0.05 mm SS (i.e. 7 strands of diameter 0.05 mm stainless steel)<br>PTFE Covered | EWM9705            |

### 3.2 4 and 10 way Fischer connector pin labels



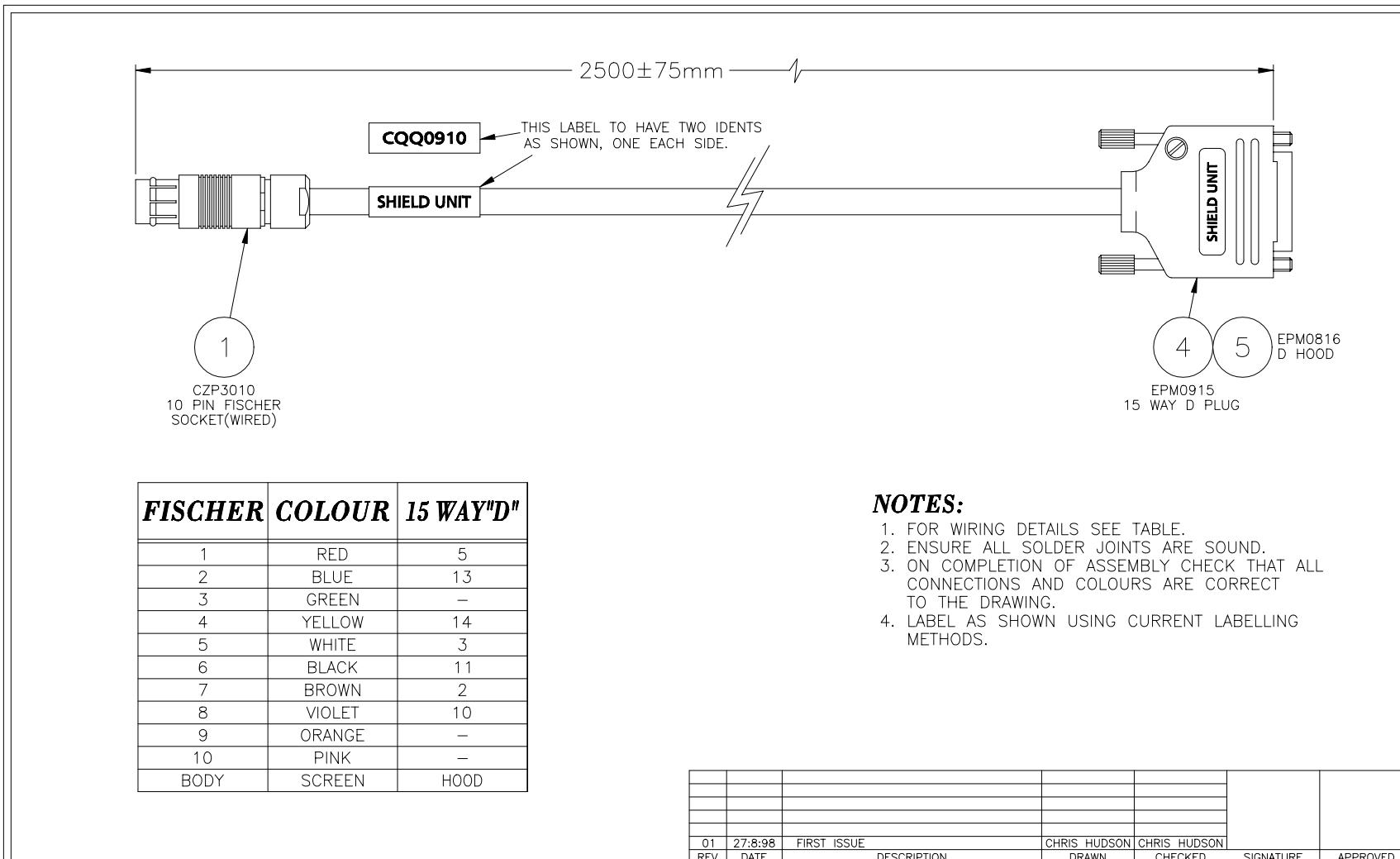
**Figure 1** Pin numbers on a 4 way hermetically sealed Fischer connector viewed onto pins from the outside of the cryostat. Fischer part number 103 Z053 (DBEE).  
(Mating connector Fischer part number SE103 Z053)

**Tip** The connector on the cryostat is a plug and the pins are accessible.



**Figure 2** Pin numbers on a 10 way hermetically sealed Fischer connector viewed onto pins from the outside of the cryostat. Fischer part number 1031 Z010 (DBEE).  
(Mating connector Fischer part number SE1031 Z010)

**Tip** The connector on the cryostat is a plug and the pins are accessible.



#### NOTES:

1. FOR WIRING DETAILS SEE TABLE.
2. ENSURE ALL SOLDER JOINTS ARE SOUND.
3. ON COMPLETION OF ASSEMBLY CHECK THAT ALL CONNECTIONS AND COLOURS ARE CORRECT TO THE DRAWING.
4. LABEL AS SHOWN USING CURRENT LABELLING METHODS.

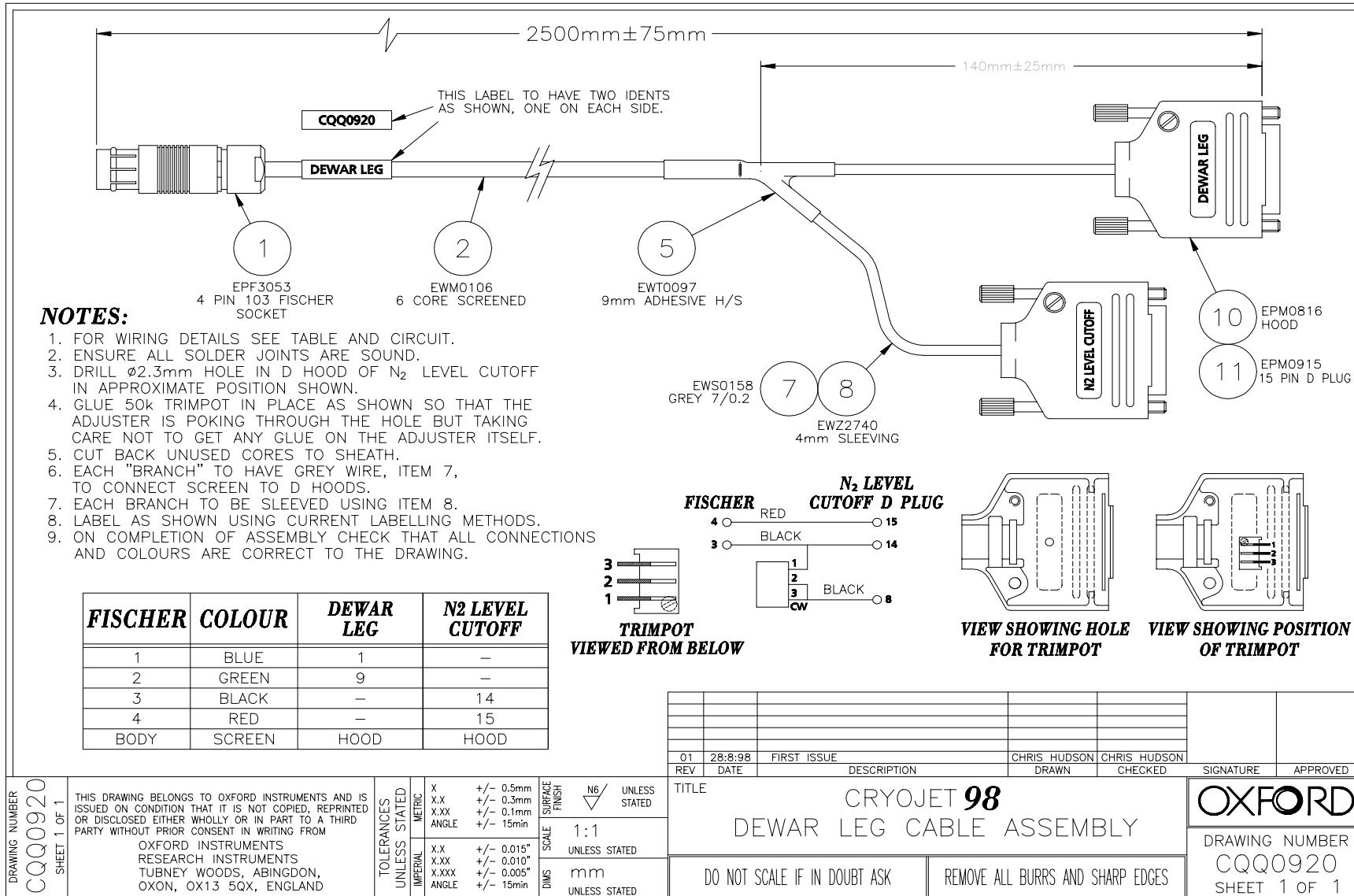
|  |         |             |              |              |           |
|--|---------|-------------|--------------|--------------|-----------|
| 01   | 27/8/98 | FIRST ISSUE | CHRIS HUDSON | CHRIS HUDSON |           |
| REV  | DATE    | DESCRIPTION | DRAWN        | CHECKED      | SIGNATURE |
| TITLE<br>CRYOJET 98<br>SHIELD UNIT CABLE ASSEMBLY                  |         |             |              |              | APPROVED  |
| DO NOT SCALE IF IN DOUBT ASK      REMOVE ALL BURRS AND SHARP EDGES |         |             |              |              |           |

DRAWING NUMBER  
CQQ0910  
SHEET 1 OF 1

THIS DRAWING BELONGS TO OXFORD INSTRUMENTS AND IS ISSUED ON CONDITION THAT IT IS NOT COPIED, REPRINTED OR DISCLOSED EITHER WHOLLY OR IN PART TO A THIRD PARTY WITHOUT PRIOR CONSENT IN WRITING FROM  
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| TOLERANCES<br>UNLESS STATED | IMPERIAL | METRIC | X          | +/- 0.5mm | SURFACE FINISH<br>N6 / UNLESS STATED |
|-----------------------------|----------|--------|------------|-----------|--------------------------------------|
|                             |          | X.X    | +/- 0.3mm  |           |                                      |
|                             |          | X.XX   | +/- 0.1mm  |           |                                      |
|                             |          | ANGLE  | +/- 15min  |           |                                      |
|                             |          |        |            | 1:1       | SCALE<br>UNLESS STATED               |
|                             |          | X.X    | +/- 0.015" |           |                                      |
|                             |          | X.XX   | +/- 0.010" |           |                                      |
|                             |          | X.XXX  | +/- 0.005" |           |                                      |
|                             |          | ANGLE  | +/- 15min  | mm        | UNLESS STATED                        |

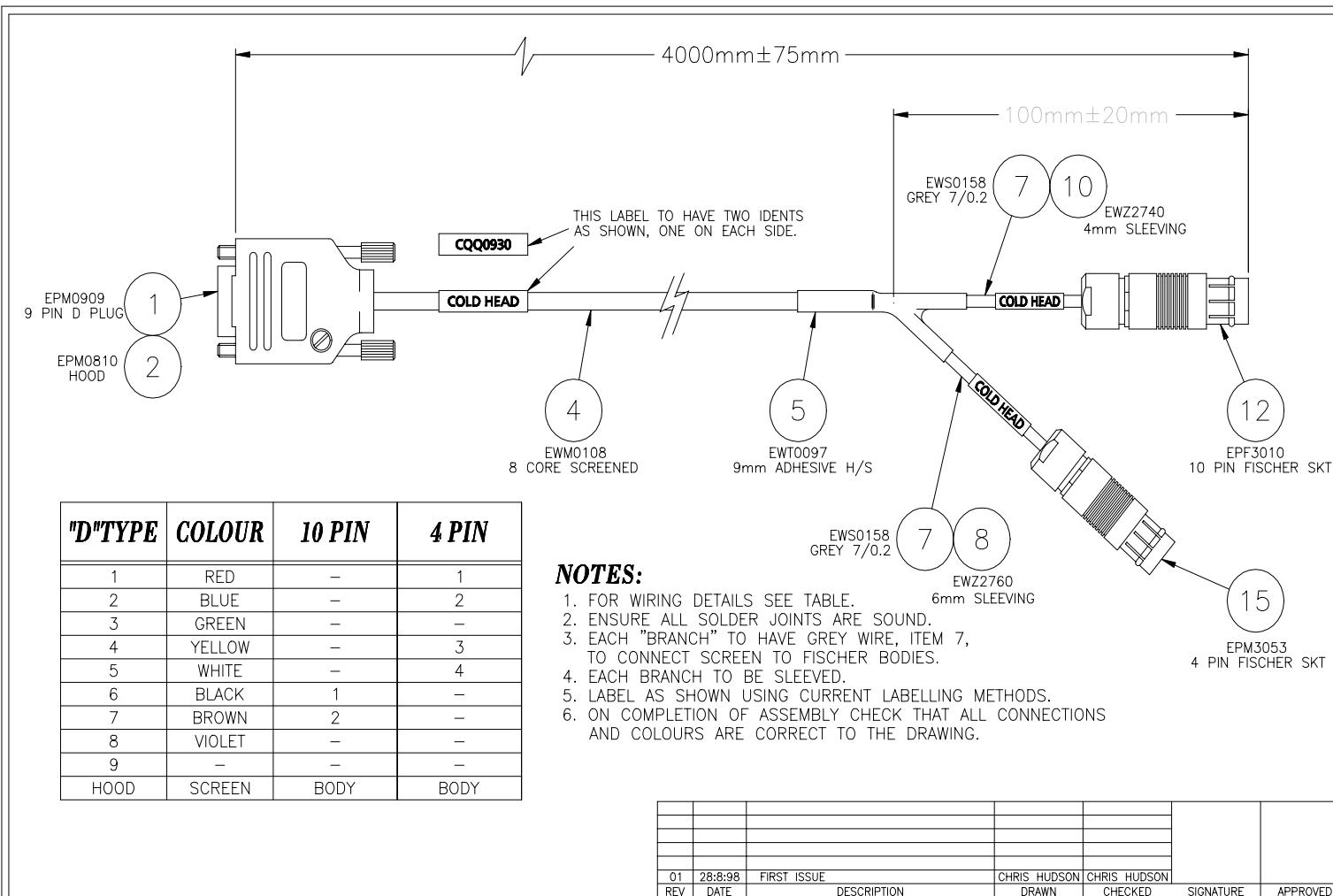
OXFORD  
DRAWING NUMBER  
CQQ0910  
SHEET 1 OF 1



DRAWING NUMBER  
CQQ0920  
SHEET 1 OF 1

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OXON, OX13 5QX, ENGLAND

| TOLERANCES UNLESS STATED |  | Metric   | X     | $+/- 0.5$ mm  | Surface Finish | N6  | UNLESS STATED |
|--------------------------|--|----------|-------|---------------|----------------|-----|---------------|
|                          |  | IMPERIAL | X.X   | $+/- 0.3$ mm  |                |     |               |
|                          |  |          | X.XX  | $+/- 0.1$ mm  |                |     |               |
|                          |  |          | ANGLE | $+/- 15$ min  |                |     |               |
|                          |  |          | X.X   | $+/- 0.015$ " | SCALE          | 1:1 | UNLESS STATED |
|                          |  |          | X.XX  | $+/- 0.010$ " |                |     |               |
|                          |  |          | X.XXX | $+/- 0.005$ " |                |     |               |
|                          |  |          | ANGLE | $+/- 15$ min  | DIMS           | mm  | UNLESS STATED |



|   |  |  |  |  |   |                                    |
|---|--|--|--|--|---|------------------------------------|
| DRAWING NUMBER<br>CQQ0930<br>SHEET 1 OF 1 | THIS DRAWING BELONGS TO OXFORD INSTRUMENTS AND IS ISSUED ON CONDITION THAT IT IS NOT COPIED, REPRINTED OR DISCLOSED EITHER WHOLLY OR IN PART TO A THIRD PARTY WITHOUT PRIOR CONSENT IN WRITING FROM OXFORD INSTRUMENTS<br>RESEARCH INSTRUMENTS<br>TUBNEY WOODS, ABINGDON,<br>OXON, OX13 5QX, ENGLAND |  |  | TOLERANCES<br>UNLESS STATED  | METRIC<br>X X +/- 0.5mm<br>X.X +/- 0.3mm<br>X.XX +/- 0.1mm<br>ANGLE +/- 15min | SURFACE FINISH<br>N6 UNLESS STATED |
|   |  |  |  | IMPERIAL<br>X.X +/- 0.015"<br>X.XX +/- 0.010"<br>X.XXX +/- 0.005"<br>ANGLE +/- 15min | SCALE<br>1:1 UNLESS STATED  |                                    |
|   |  |  |  | DIMS<br>mm UNLESS STATED   | TITLE<br><b>CRYOJET 98</b><br>COLD HEAD CABLE ASSEMBLY                        |                                    |
|   |  |  |  |  | DO NOT SCALE IF IN DOUBT ASK  | REMOVE ALL BURRS AND SHARP EDGES   |
|   |  |  |  |  | CHRIS HUDSON<br>DRAWN   | CHRIS HUDSON<br>CHECKED            |
|   |  |  |  |  | SIGNATURE   | APPROVED                           |
|   |  |  |  |  | <b>OXFORD</b>   |                                    |
|   |  |  |  |  | DRAWING NUMBER<br>CQQ0930<br>SHEET 1 OF 1                                     |                                    |

## **4 Instructions for Replacement of Electrical Components**

No thermal dumping or anchoring is required for any of the wires in this product.

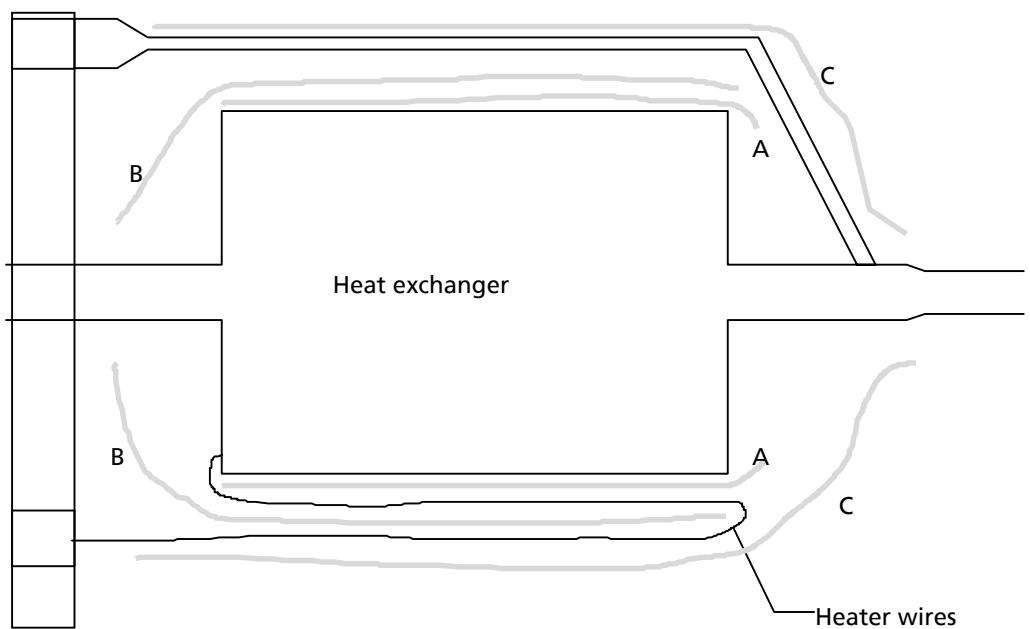
### **Removal from the dewar:**

Remove all the electrical connectors. Undo the three M6 screws holding the dewar top fitting to the dewar. Undo the 4 M4 screws holding the coldhead to the stand. Remove the entire assembly from the dewar and from the stand. Before you lift the dewar legs away from the mouth of the dewar, wait until all the liquid nitrogen has drained out of them. Warm the assembly up to room temperature. If the dewar is empty and at room temperature, it is also possible to remove the sample flow leg and the shield leg separately from the dewar top fitting, without removing the top fitting from the dewar. To do this, first loosen the three small screws in the dewar top fitting, which clamp the assembly together.

### **4.1 Coldhead Heater**

It is very difficult to remove the coldhead heater: only do so if absolutely necessary.

1. If the heat exchanger is cold, first set the controller to 300 K, and the sample flow to 2.1 l/min. Turn on the heat exchanger, and wait until the temperature displayed reaches 300 K.
2. Remove from the dewar (see above) and when warm, open the vacuum valve on the sample flow leg.
3. Serial numbers 51 - 55: remove the screws holding the shield tube to the coldhead flange, and bend the shield tube out slightly to allow the coldhead flange to be removed.
4. Serial numbers after 55: This is not required, as the shield tube is attached to the main body of the coldhead
5. Remove the screws holding the coldhead flange. Pull the coldhead body away from the flange. Do not twist. There are two sliding o-rings holding the coldhead body onto the nozzle, so a substantial force is needed.
6. Carefully remove the aluminised mylar wrapped around the heat exchanger, wearing gloves. Keep the mylar so you can put it back afterwards (see sketch and notes below)
7. There is one 'spare' heater hole in the heat exchanger. If this has not been used you can pot the new heater into this hole using Autostick. Leave it to set overnight. Solder the wires back. Wrap with aluminised mylar, as shown below.
8. If you have to remove the old heater soak the heat exchanger in hot water for at least 30 minutes. Desolder the heater connections and pull the heater out of its hole. Pot a new heater in using Autostick. Leave it to set overnight. Solder the wires back. Wrap with aluminised mylar, as shown overleaf.



A : 80 cm x 10 cm aluminised mylar, 8 turns, under the heater wire and under the 1/8" tube.

B : 28 cm x 13 cm, 2 turns, inside the heater wire loop, under the 1/8" tube.

C : 355 cm x 13 cm, 30 turns, outside the heater wires and outside the 1/8" tube.

**Notes:** Technique used:

The ends should be nipped in using tape or fishing line, but ensuring that the outer layers do not touch the heat exchanger or the inlet or outlet tubes.

Tape used:

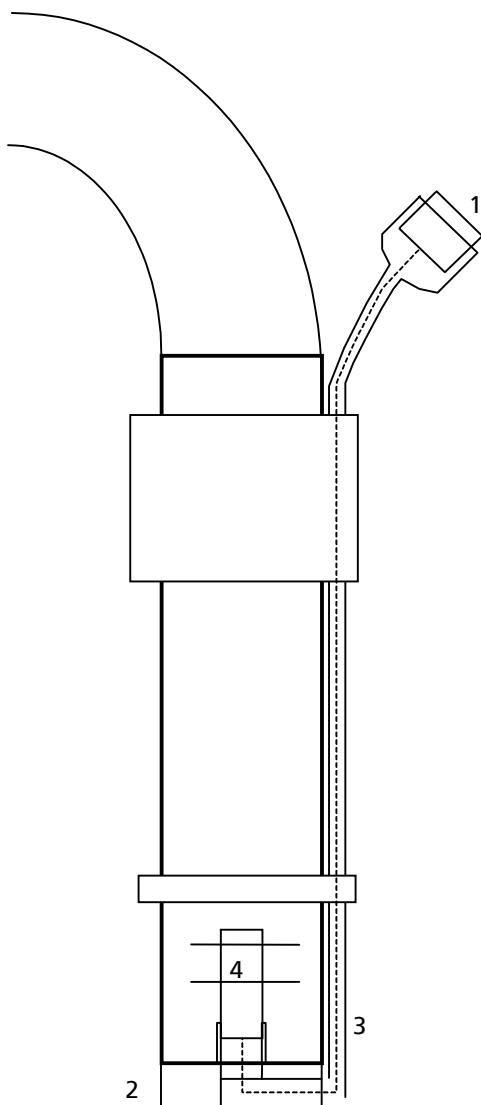
Aluminised mylar self-adhesive tape. Kapton tape can also be used if mylar tape is not available. Use as little as possible.

The aluminised mylar should be applied as loosely as possible. The outer layer will inevitably touch the OVC - this is not a problem.

Replace the coldhead body, and repump the vacuum, following the procedure in the manual to degas the sorb.

## 4.2 Sample Flow Unit: Dewar leg heater

Remove from the dewar as above.



You can remove this heater without breaking the vacuum. Remove the Fischer connector (1) and desolder the two heater wires (pins 1 and 2, 0.4 mm Cu, coated with PTFE).

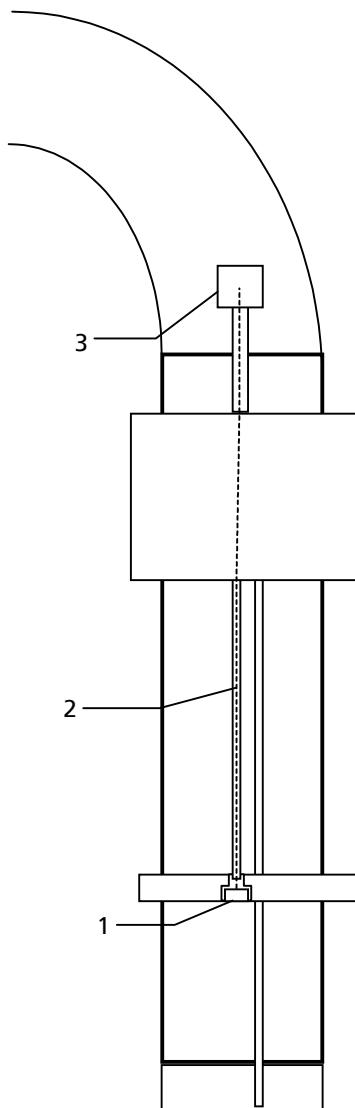
Remove the 3 screws holding the heater flange (2) to the dewar leg, and remove the heater flange carefully pulling the wires out of their protective tube (3). Soak the heater assembly in hot water for at least 30 minutes, then remove the heater (4) with its wires from the flange. Disconnect the wires from the heater by squashing the crimps in the other direction to release the wires. Reconnect the wires to the new heater (with baffles attached) using new crimps. Feed the wires through the flange and use Autostick to glue the new heater in place

Use the high temperature sleeving to cover the crimps. Refit the heater flange into the bottom of the dewar leg and feed the wires carefully up their protective tube until they appear in the connector housing. Resolder the wires to the connector and refit the connector.

Put the system back in the dewar. Plug in the cable to the sample flow dewar leg. Measure the resistance of the new heater when in liquid nitrogen by measuring the resistance between pins 1 and 9 of the 15-way D-plug labelled "Cryojet dewar leg" before you plug it into the controller. Now switch on the controller and configure it for the new heater using test t 05 ("Configure"), subtest C 01. See the Technical Handbook for details. Make sure you store the configuration by holding CAL/STORE pressed while pressing SET.

### 4.3 Low level sensor (sample flow unit).

Pull hard on the low level sensor (1) to remove it from its hole. Pull out the wires just far enough to allow replacement of the sensor. Connect a new sensor, using heat shrink to cover the joints, and push it back into the hole.

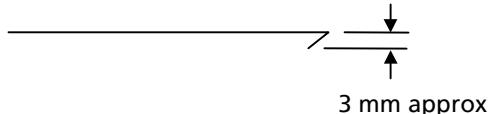


If you need to replace the wires (2), use 0.25 mm PTFE coated wire. Push it up from the sensor mounting hole, until it appears at the connector housing (3). Connect to pins 3 and 4 of the Fischer connector.

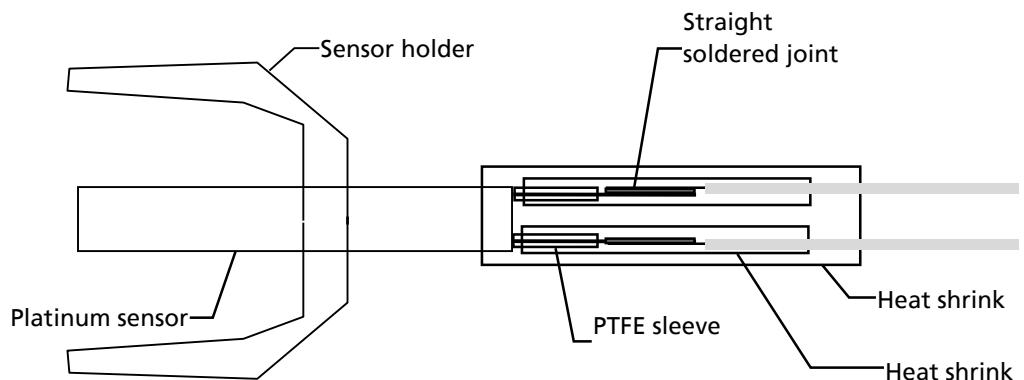
When you have reassembled the system and put it back into the dewar, adjust the potentiometer as follows. Remove the cover from the D-plug labelled "low nitrogen level cut-off". Plug it into the controller. Measure the voltage between pins 14 and 8 of the plug while it is plugged in. Adjust the potentiometer which is glued into the plug until the voltage is 2.30V +/- 0.02V. Confirm that this reading is steady. If it is slowly drifting, the sensor has not yet fully cooled to 77K and should be allowed longer to do so, before resetting the potentiometer.

#### 4.4 Nozzle Sensor (coldhead)

Make a hook using a paperclip:



Carefully insert the hook about 5 cm into the nozzle, and pull out the sensor holder. Desolder the sensor. Soak the sensor and its holder in hot water for at least 30 minutes. Pull out the sensor. Stick a new sensor into the mount using Autostick. Heat the Autostick gently with a hot air gun for at least 5 minutes. Reconnect the wires as follows:



If you need to replace the wiring, use the 7-strand PTFE sleeved stainless steel wire, pushing it in from the connector end.

Push the sensor holder back into the nozzle, until the front of the sensor is 5 cm from the nozzle. The tapered end of the holder is inserted first. While you are pushing the sensor into the nozzle, pull gently on the wires at the connector end to prevent the sensor holder becoming tangled in the wires. Removing the connector from the coldhead does not break the vacuum.

## 4.5 Shield Unit Platinum Sensor and Heater

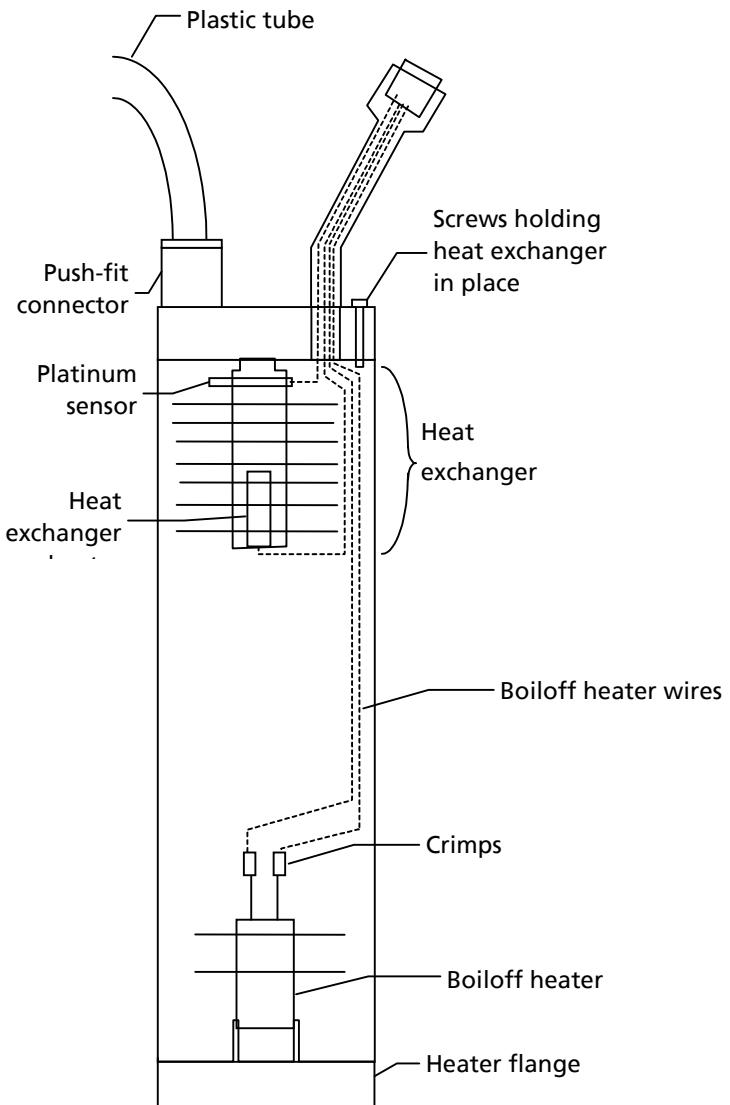
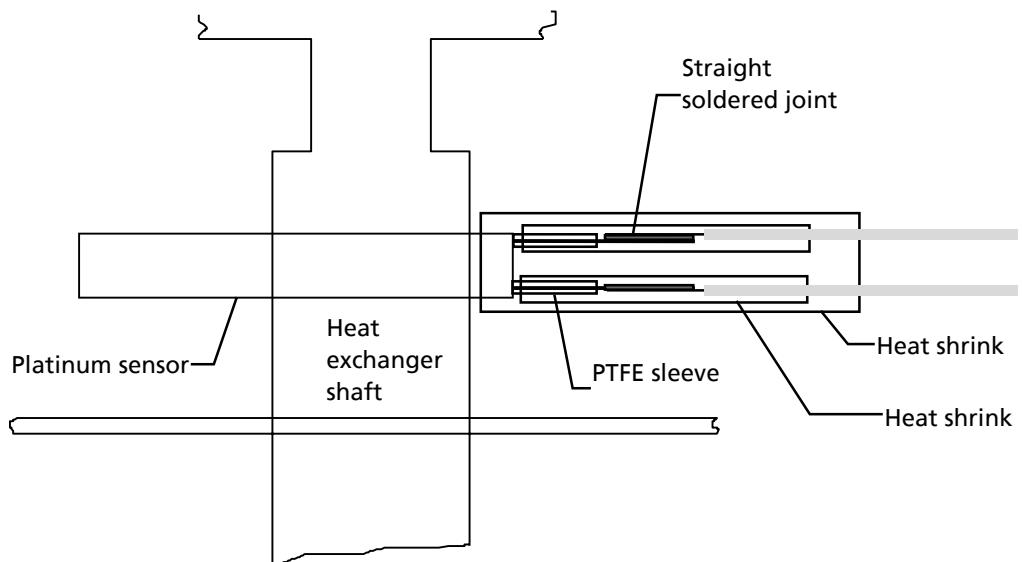


Figure 3. Shield unit

It is not absolutely necessary to remove the shield unit from the dewar, but it is advisable, to prevent moisture condensing inside the shield unit. Unplug the electrical connector and remove the plastic tube from the push-fit connector by pushing down on the spring-loaded ring while pulling on the tube. (Serial numbers 51 - 55: pull the plastic tube off the metal spigot.) Remove the 4 screws holding the heat exchanger in place. This will not break the vacuum. Carefully lift out the heat exchanger by the minimum amount, taking care not to stretch the wires running down to the boiloff heater at the bottom. Desolder the wires from the heater and sensor. Unscrew the heat exchange rod from the flange. Soak the component you want to remove in hot water for at least 30 minutes. Use Autostick to glue in the replacement heater or sensor. Heat it gently with a hot air gun for 5 minutes. Screw the heat exchange rod back into the flange. Reconnect the heater and sensor to the wires.

Note that the sensor is potted into the hole provided so that at least half of it sticks into the gas flow passing through the exit tube, and connected as follows:



**Figure 4**

If you need to replace the wires to the heater pass the wires through the notches in the mesh discs.

When you put the heat exchanger back on the shield unit, align it so that the connector stalk is lined up with the vacuum valve knob.

## 4.6 Shield Unit: Boiloff heater (bottom of leg).

Remove from the dewar as above. See Figure 3.

Remove the 3 screws holding the heater flange to the dewar leg, and remove the heater flange. Disconnect the wires from the heater by squashing the crimps in the other direction to release the wires.. Soak the heater flange in hot water for at least 30 minutes, then remove the heater with its copper baffles. Use Autostick to glue in the new heater assembly. Heat gently with a hot air gun for 5 minutes. Reconnect the wires to the heater, using crimps rather than solder: slide the ends of the wires into a copper crimp and squash it with a pair of pliers. Use the high temperature sleeving to cover the crimps.

If you need to replace the wires, use 0.4 mm PTFE coated wire.

Put the system back in the dewar. Plug in the cable to the shield unit. Measure the resistance of the new heater when in liquid nitrogen by measuring the resistance between pins 2 and 10 of the 15-way D-plug before you plug it into the controller. Now switch on the controller and configure it for the new heater using test t 05 ("Configure"), subtest C 02. See the Technical Handbook for details. Make sure you store the configuration by holding CAL/STORE pressed while pressing SET.

## 5 Screws and O-rings used

| Description                            | Number used |
|--|-------------|
| XYZ Stage                              |             |
| Screw stainless cap M10 x 60           | 1           |
| Screw stainless cap M3 x 10 set        | 12          |
| Screw stainless cap M4 x 10 set        | 4           |
| Screw stainless cap M4 x 12 set        | 2           |
| <b>Dewar Top Fitting</b>               |             |
| Screw st. tamperproof M4 x 10          | 1           |
| O Ring R03062 BS114                    | 1           |
| Screw stainless cap M6 x 16 set        | 3           |
| Screw stainless cpa M4 x 35 set        | 3           |
| O Ring R2012 BS006                     | 3           |
| O Ring R03200 BS136                    | 2           |
| O Ring R04425 BS244                    | 1           |
| O Ring 1.5 x 0.103 BS128 VIT           | 2           |
| <b>Sample Flow Leg Heater assembly</b> |             |
| Screw stainless cap M2.5 x 10 set      | 3           |
| <b>Vacuum valves</b>                   |             |
| O Ring 0.437 x 0.07 60 shore           | 2           |
| <b>Sample Flow leg</b>                 |             |
| Screw stainless cap M3 x 6 set         | 6           |
| Screw stainless cap M3 x 16 set        | 2           |
| O Ring R02050 BS014                    | 2           |
| O Ring R03225 BS140                    | 1           |
| <b>Shield Leg</b>                      |             |
| Screw stainless cap M2.5 x 16 set      | 4           |
| Screw stainless cap M2.5 x 10 set      | 3           |
| O Ring R02106 BS023                    | 1           |