

Disassembly, Service, and Reassembly of a 1231 Oxygen Probe



INTRODUCTION

The 1231 heated oxygen probe is made up of 5 major parts: –



1. Alumina four-bore assembly and compression spring



2. Zirconia sensor, alumina tube, sensor gland and compression spring



3. Heater, inner sheath and gland assembly



4. Filter, outer sheath & nipple assembly



5. Termination Head & circuit board

This service note describes how to disassemble, inspect, repair or replace components, and re-assemble the oxygen probe.

1.0 TOOLS REQUIRED

To carry out these procedures, the following tools are necessary: -

- vice with an 80mm opening, and soft jaws
- 7/16" x 1/2" AF open end spanner
- 7 mm open end spanner
- 7 mm nut driver
- 6.5 mm x 1.5 mm flat bladed screwdriver
- 2.5 mm x 1.0 mm flat bladed screwdriver
- 2 mm Allen key
- 100 mm long nosed pliers

2.0 TESTING

It is recommended that before the probe is disassembled, it should be tested in a workshop.

For the probe to be tested completely –

1. Power must be applied to the heater and controlled to maintain about 720°C at the sensor.

Expected result-

The "SENSOR TEMP" should rise to 720°C ± 15°C within 15 minutes.

The display of "SENSOR TEMP" should fluctuate less than 2°C.

2. A certified gas connected to the "CAL" port of the probe (2 litres per minute), and the sensor EMF / Oxygen measured.

Expected result-

The oxygen reading from the probe should agree with the gas bottle's certified value.

3. The impedance of the sensor measured.

Expected result-

The impedance of the zirconia sensor as read on the analyser should be less than 7kΩ when the sensor is 720°C ±15°C.

The easiest way to do these tests is to use a Novatech oxygen analyser. This provides all the facilities to do a complete electrical test of the probe.

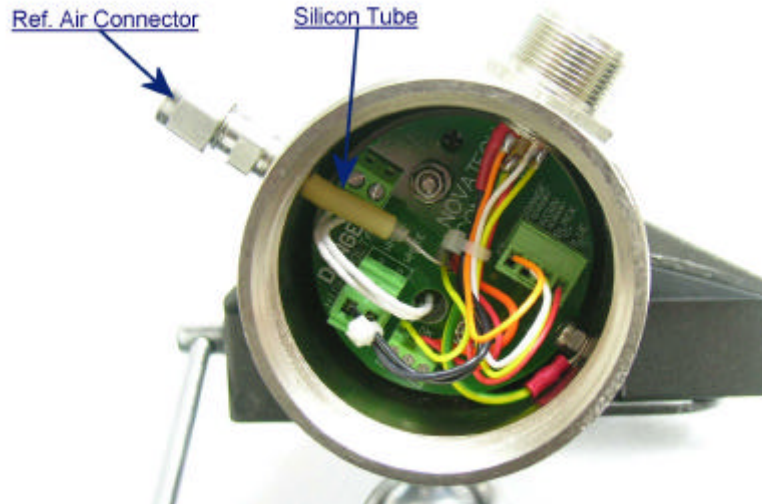
Alternatively, a common temperature controller and a 110VAC transformer could be used to control the temperature. A digital multimeter and the oxygen / EMF tables could be used to determine the oxygen level. This does not give you the impedance of the sensor.

3.0 DISASSEMBLY PROCEDURE

WARNING:
The probe must **NOT** be disassembled while connected to an analyser. The heater terminals in the probe could have the 110 / 240 VAC mains voltages present.

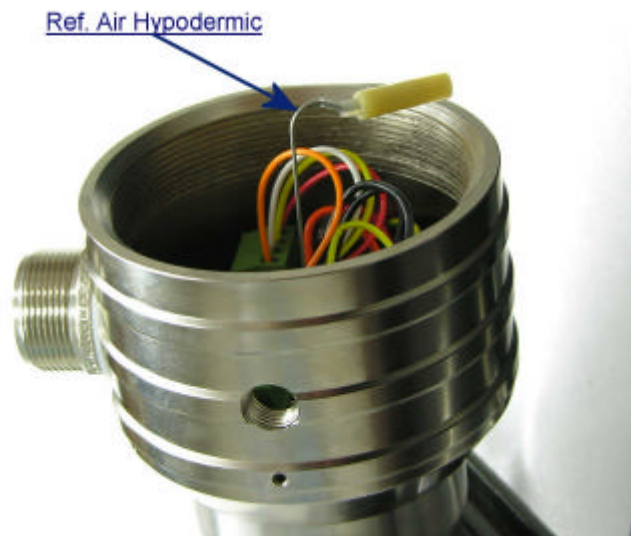
3.1 Hold probe vertically and securely by the hexagonal body in a vice with the probe connector at the rear.

3.2 Open the probe's screwed head cover by turning the cap anti-clockwise.

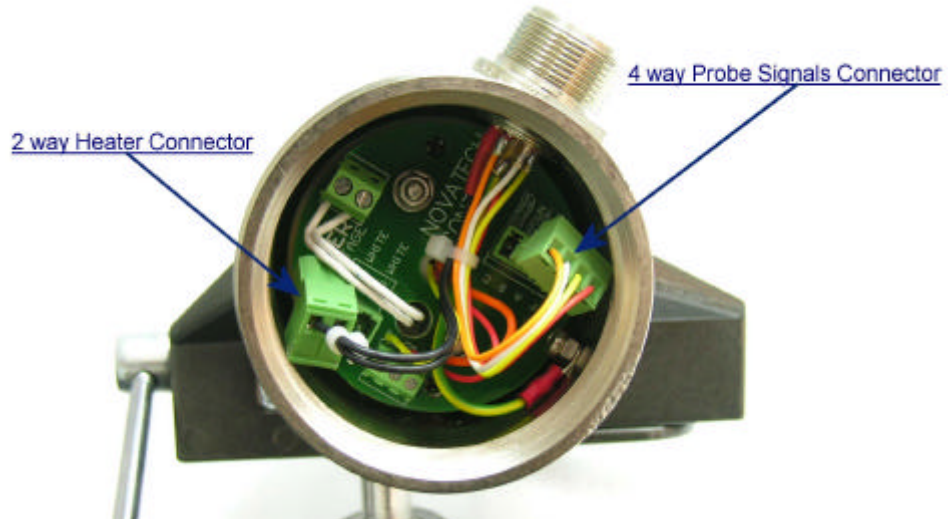


3.3 Hold the reference air hypodermic silicon tube while unscrewing the reference air male tube connector from the head to avoid twisting the silicon tube.

3.4 When the reference air male connector is unscrewed from the head gently remove it from the silicon tube.



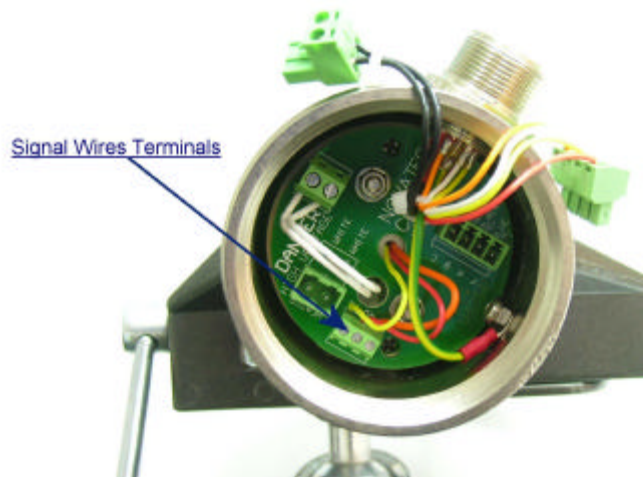
3.5 Remove the reference air hypodermic by lifting straight up. *Do not bend. Sharp bends could cause a blockage in the tube.*



3.6 From the circuit board, lift out the two-way heater wire connector and the 4-way O₂ +ve, O₂ -ve, T/C+ve and T/C-ve connector. Both connectors can be folded back outside the head for clearance.



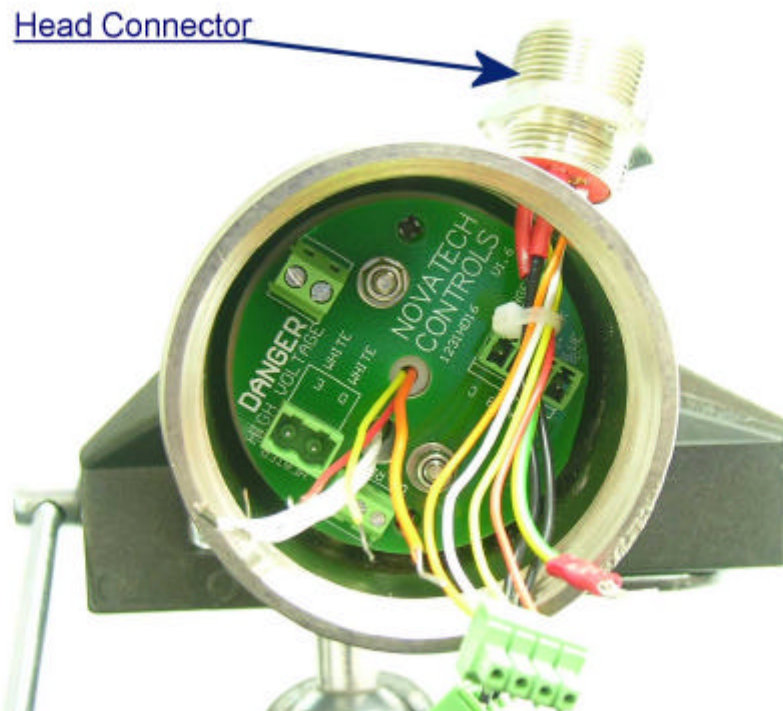
3.7 Remove the heater tail wires from the two way terminal by loosening the two screws.



3.8 Remove the O₂ +ve, T/C+ve and T/C-ve wires from the three way terminal by loosening the three screws.



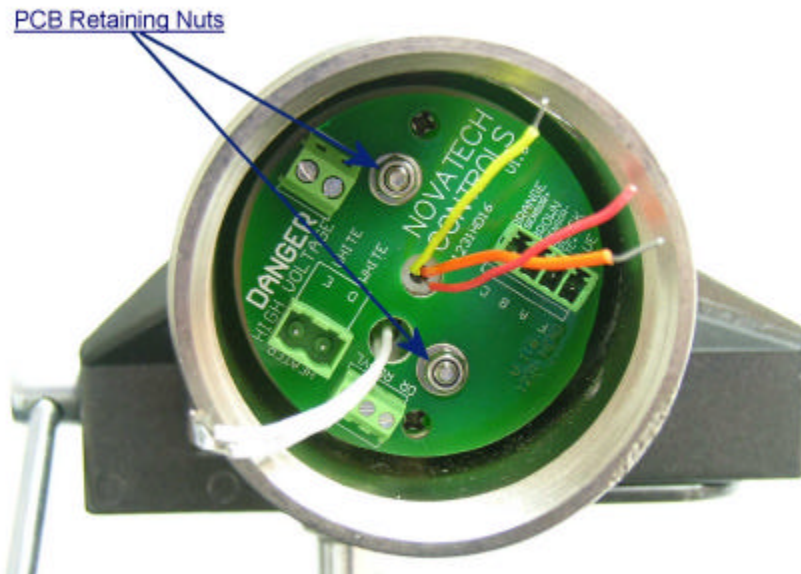
3.9 Remove the earth lead wire. Access the M4 screw through the reference air male connector port.



3.10 If installed, remove the weatherproof plug (head connector) by unscrewing (anti-clockwise). Avoid twisting the wires while unscrewing the connector

WARNING:

The circuit board is held down against spring pressure by the two retaining nuts (M4 Nylock). Release the circuit board evenly upwards to avoid damage to the ceramic four-bore tube. The ceramic tube is brittle and easily broken with sideways movement.



3.11 Removed both circuit board retaining nuts.



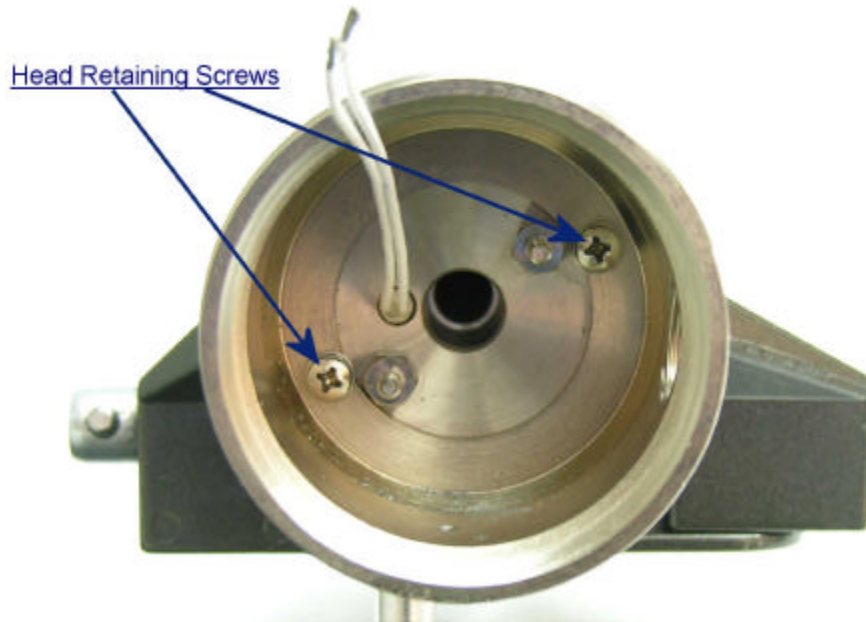
3.12 Lift the circuit board over the heater, O₂ +ve, T/C +ve and T/C -ve wires.



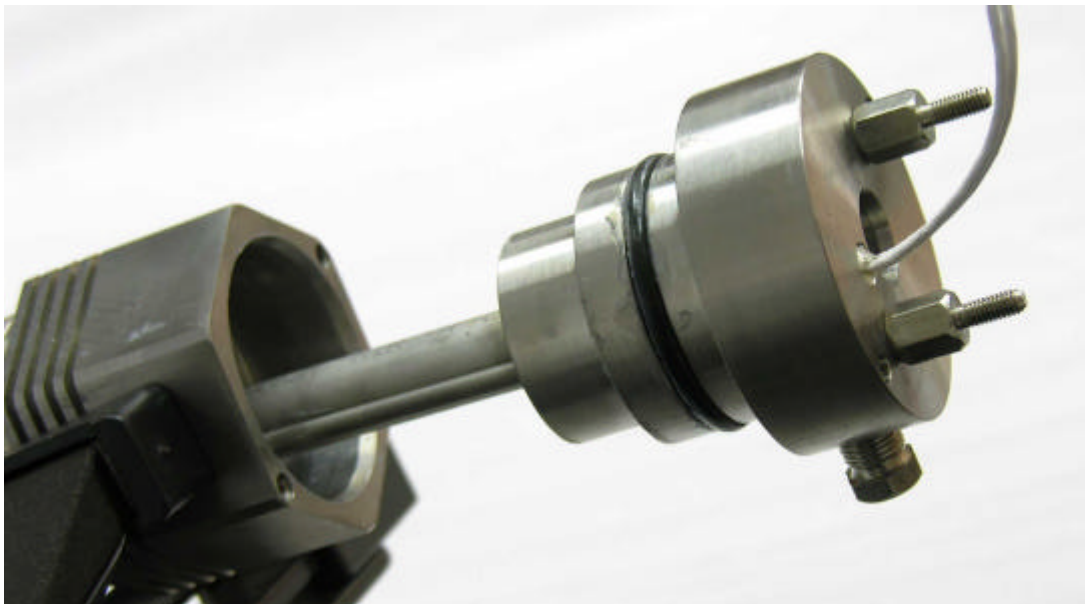
- 3.13 Gently lift the ceramic four-bore straight up (avoid bending) until clear of the probe body.
- 3.14 Set aside the four-bore in a safe place to avoid damage and contamination.
- 3.15 Remove the sensor compression spring by gently working it from the sensor gland.



- 3.16 Remove the sensor by holding the sensor gland with pliers and gently lifting it straight up (avoid bending) until clear of the probe body. *Resistance will be felt removing the sensor due to the sensor gland o-ring seal. The sensor must not be forced, as it is brittle and easily broken.*
- 3.17 Set aside the sensor in a safe place to avoid damage and contamination.



- 3.18 Remove the probe head from the probe body by unscrewing the two retaining screws.



- 3.19 Lift the inner sheath straight up and out of the outer sheath. *Resistance will be felt removing the inner sheath due to the o-ring seal inside the hexagonal nipple. Once the o-ring is clear of the hexagonal nipple, care must be taken removing the inner sheath. It must not be forced, but gently worked until clear of the outer sheath.*
- 3.20 Set aside the inner sheath in a safe place. *The heater insulation must be protected from damage and contamination.*

The probe is now disassembled to the major subassemblies.

4.0 INSPECTION

4.1 Outer Sheath

Check for corrosion inside and outside especially near the hex nipple. This is where the condensation of process gasses will cause the worst corrosion.

4.2 Inner Sheath / Heater

Check the heater continuity (approx. 110Ω).
Check the heater insulation resistance (greater than $10M\Omega$).
Check for signs of corrosion along the heater sheath.
Check the o-ring for damage or wear.
Check the tubular heater insulation for damage and degradation.

4.3 Zirconia Sensor and Alumina tube

Inspect the oxygen sensor for physical damage and loss of electrode paste.
Check the o-rings for damage or wear.
If the sensor is to be replaced use a flat faced drill (8mm) to remove any scale from the sensor seat to ensure a good electrical contact between the sensor and seat (O_2 -ve).

4.4 Thermocouple 4-bore

Inspect the 4-bore for physical damage. Check the thermocouple and O_2 +ve conductor for continuity, and brittleness or oxidation of the wires.

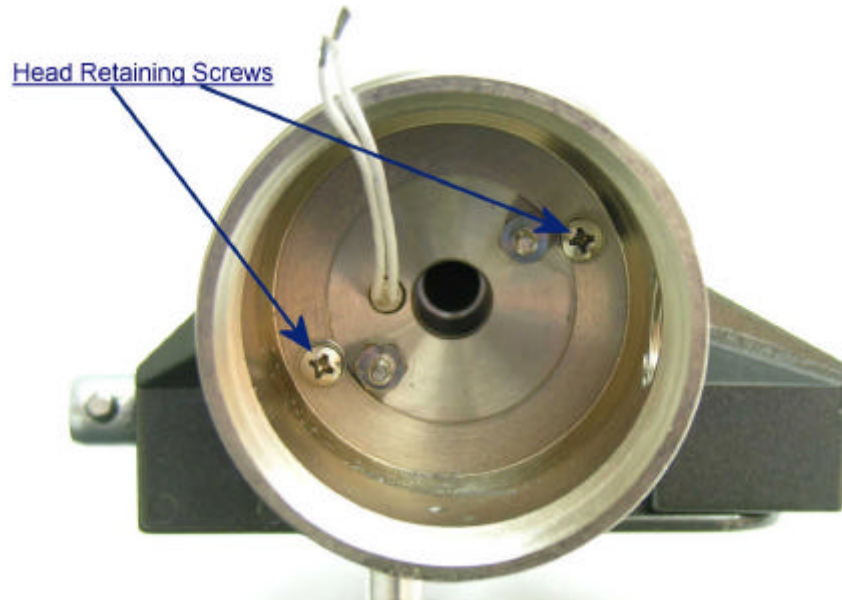
4.5 Head Assembly

Check the reference air hypodermic for blockages.

5.0 RE-ASSEMBLY



- 5.1 Wipe a small amount of o-ring grease (such as Molykote FS3451) around the o-ring on the gland body. Push the inner sheath straight into the outer sheath aligning the holes in the inner sheath assembly with the threaded holes in the outer sheath's hexagonal nipple. *Resistance will be felt replacing the inner sheath due to the o-ring seal inside the hexagonal nipple. Care must be taken replacing the inner sheath to prevent damaging the heater insulation and o-ring. It must not be forced, but gently worked into position.*



- 5.2 Align the reference air male connector port in the head opposite the 1/8" NPT calibration port on the inner sheath assembly; screw the probe head to the probe body with the two retaining screws.



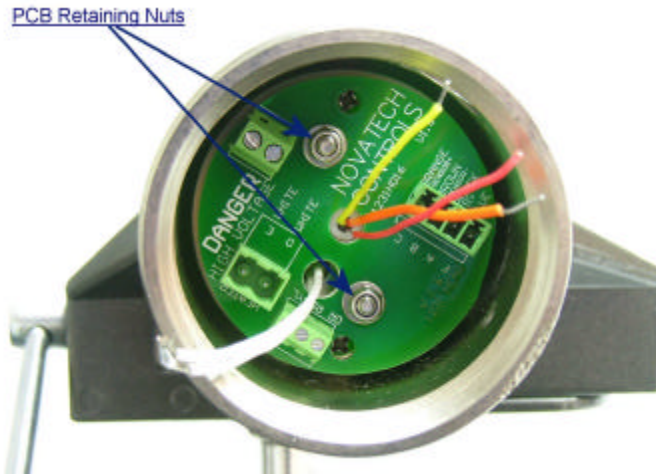
- 5.3 Wipe a small amount of o-ring grease (such as Molykote FS3451) around the top of the sensor and outer o-ring on the sensor gland. Carefully insert the sensor into the inner sheath. **Do not allow the tip of the sensor to contact the o-ring grease or the sensor will become contaminated.** Use long nosed pliers to work the sensor gland and o-ring into the seal, do not use excessive force as this could damage the sensor.
- 5.4 Replace the sensor compression spring onto the sensor gland.



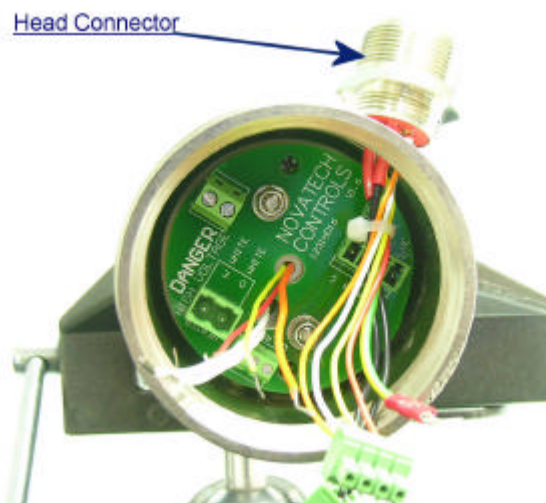
5.5 Carefully insert the four-bore assembly into the sensor.



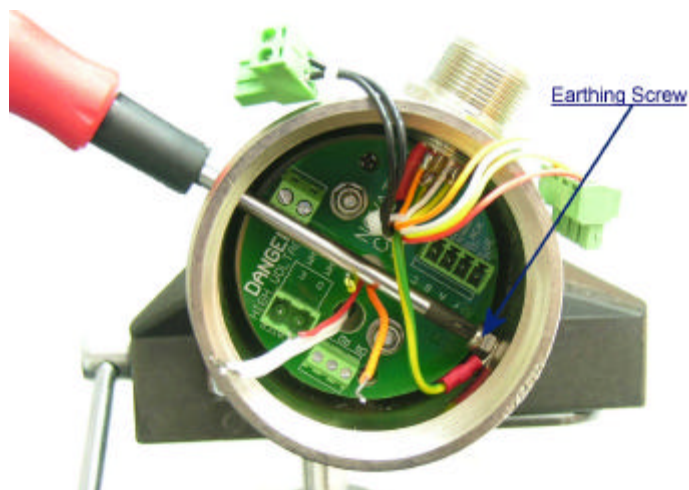
5.6 Feed the four-bore wires through the circuit board centre hole and the heater wires through the hole adjacent to the three-way connector. Install the reference air hypodermic into the four-bore insulator. While pushing the circuit board into position take extreme care lining up the four-bore spring and sensor compression spring to avoid breaking the four-bore insulator.



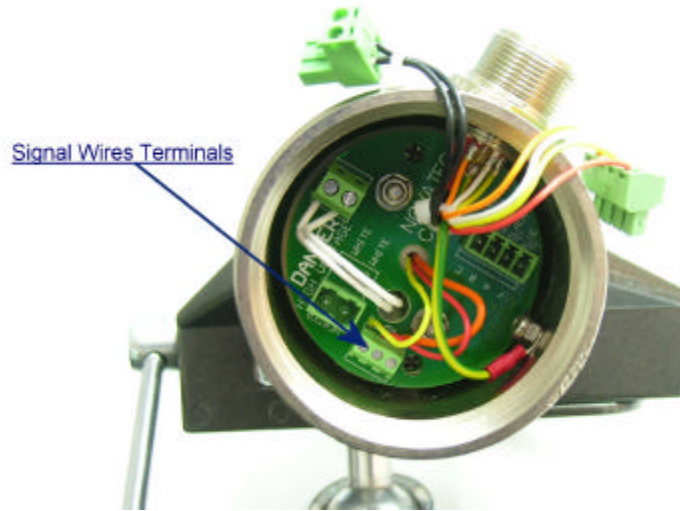
5.7 Replace both circuit board retaining nuts and flat washers.



5.8 Replace the weatherproof plug (head connector). Avoid twisting the wires while screwing in the connector.



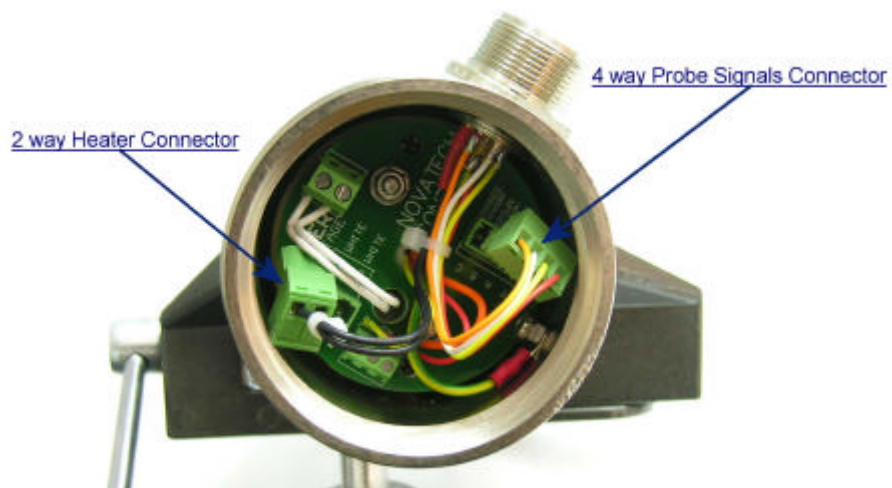
5.9 Pass a Philips head screwdriver through the reference air male connector port and attaché the earth lead wire to the opposite side of the head with the M4 screw. Tighten securely.



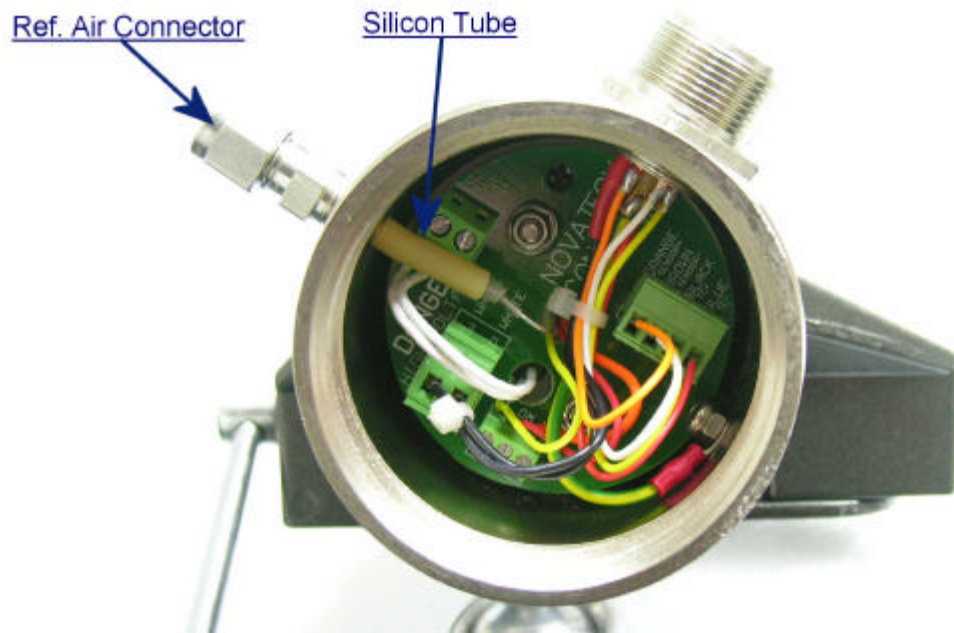
5.10 Replace the O₂ +ve (orange), T/C +ve (yellow) and T/C -ve (red) into the three way terminal block. The terminals are marked "O", "R", and "Y".



5.11 Replace the heater wires into the two-way terminal block. These leads are not polarised.



5.12 Plug in the two wire heater connector and four way sensor / T/C connector.



- 5.13 Before screwing the reference air male connector into the head be sure the hypodermic is inserted into the barb's hole. Tighten the male connector and then slide the silicon sleeve over the barb connector to form a seal.
- 5.14 Install the screw top lid and tighten using the castellated slots on the lid.

The probe can now be tested as in section 2.0