Model 9437-500
Low Level Dissolved Oxygen
Monitoring System

Operating Instructions

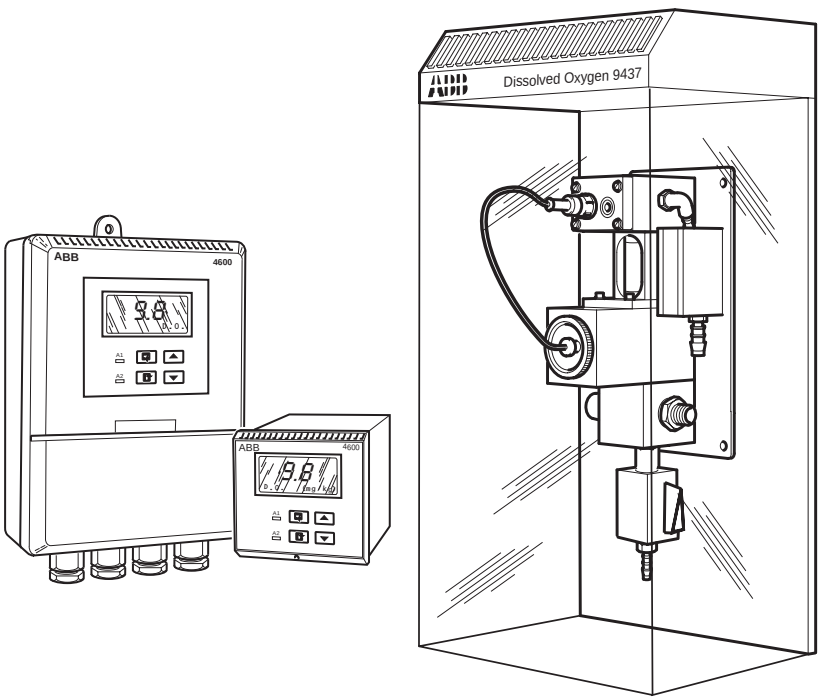


ABB AUTOMATION

The Company

ABB Automation is an established world force in the design and manufacture of instrumentation for industrial process control, flow measurement, gas and liquid analysis and environmental applications.

As a part of ABB, a world leader in process automation technology, we offer customers application expertise, service and support worldwide.

We are committed to teamwork, high quality manufacturing, advanced technology and unrivalled service and support.

The quality, accuracy and performance of the Company's products result from over 100 years experience, combined with a continuous program of innovative design and development to incorporate the latest technology.

The NAMAS Calibration Laboratory No. 0255 is just one of the ten flow calibration plants operated by the Company, and is indicative of ABB Automation's dedication to quality and accuracy.

BS EN ISO 9001

Cert. No. Q5907

EN 29001 (ISO 9001)

Lenno, Italy – Cert. No. 9/90A

Stonehouse, U.K.

Use of Instructions

Warning.
An instruction that draws attention to the risk of injury or death.

Note.
Clarification of an instruction or additional information.

Caution.
An instruction that draws attention to the risk of damage to the product, process or surroundings.

Information.
Further reference for more detailed information or technical details.

Although **Warning** hazards are related to personal injury, and **Caution** hazards are associated with equipment or property damage, it must be understood that operation of damaged equipment could, under certain operational conditions, result in degraded process system performance leading to personal injury or death. Therefore, comply fully with all **Warning** and **Caution** notices.

Health and Safety

To ensure that our products are safe and without risk to health, the following points must be noted:

1. The relevant sections of these instructions must be read carefully before proceeding.
2. Warning labels on containers and packages must be observed.
3. Installation, operation, maintenance and servicing must only be carried out by suitably trained personnel and in accordance with the information given.
4. Normal safety precautions must be taken to avoid the possibility of an accident occurring when operating in conditions of high pressure and/or temperature.
5. Chemicals must be stored away from heat, protected from temperature extremes and powders kept dry. Normal safe handling procedures must be used.
6. When disposing of chemicals ensure that no two chemicals are mixed.

Safety advice concerning the use of the equipment described in this manual or any relevant hazard data sheets (where applicable) may be obtained from the Company address on the back cover, together with servicing and spares information.

CONTENTS

1 INTRODUCTION

This manual describes how to install and operate the 9437 Low Level Dissolved Oxygen Monitoring system. Fig. 1.1 shows the main elements of the system.

The Dissolved Oxygen (D.O.) transmitters and associated flowcell have been designed for continuous monitoring and control of power station boiler feed water/steam condensate.

System status can be assessed remotely using programmable alarm and/or current output diagnostic functions.

The 9437 500 transmitter is a wall-mounted instrument and the 9437 501 model is a panel-mounted, 1/4 DIN-sized instrument. Both instruments have a single programmable D.O. input channel, and a single temperature input channel. The sample temperature is sensed by a Pt1000 resistance thermometer incorporated in the flowcell.

Instrument operation and programming is via four tactile membrane switches located on the front panel. Programs are protected from unauthorized alteration by a five-digit security code.

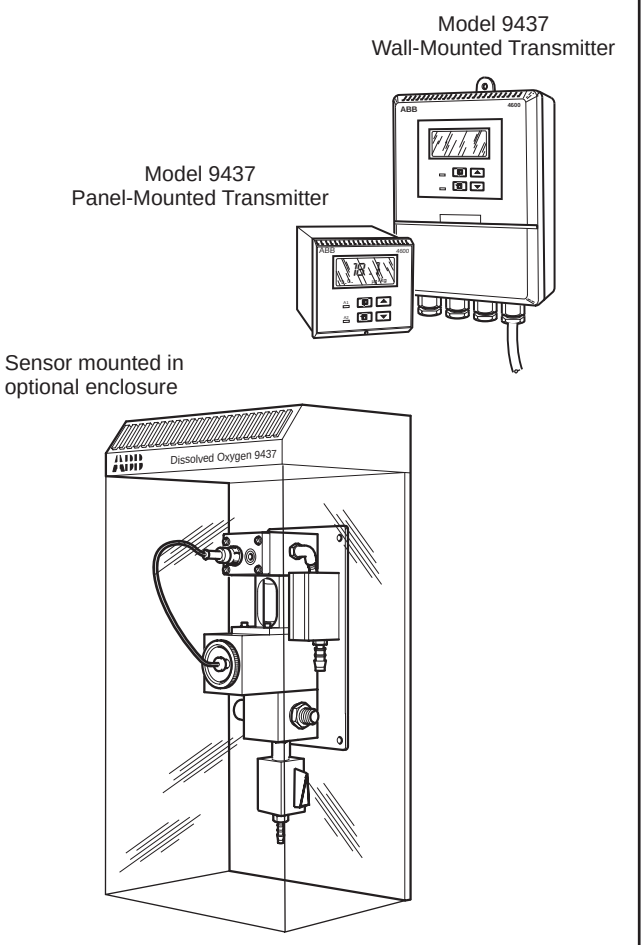


Fig. 1.1 System Elements

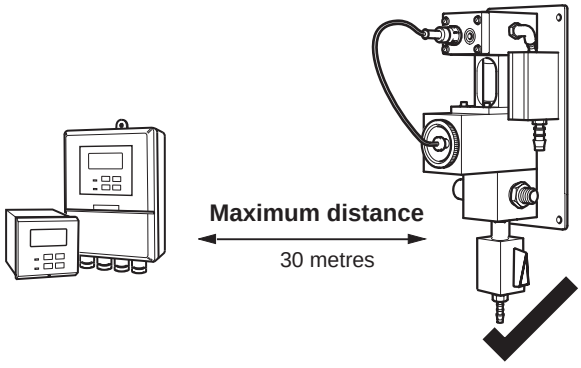
2 MECHANICAL INSTALLATION

2.1 Siting Requirements

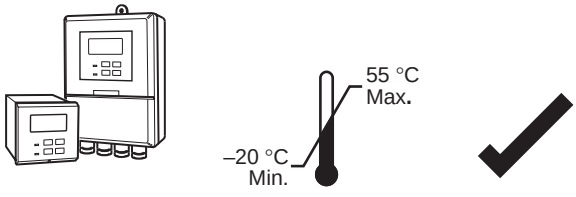
2.1.1 Instruments – Fig. 2.1

Caution.
- Mount instruments in a location free from excessive vibration.
- Mount away from harmful vapours and/or dripping fluids.

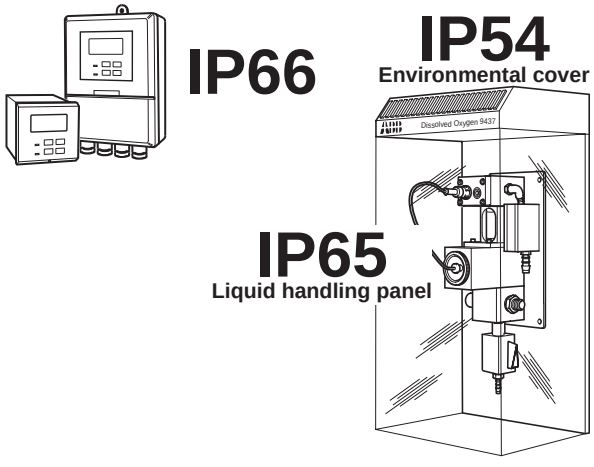
Information. It is preferable to mount the transmitter at eye level thus allowing an unrestricted view of the front panel displays and controls.



A – Maximum Distance of Instrument to Unit



B – Within Temperature Limits



C – Within Environmental Limits

Fig. 2.1 Siting Requirements – Instrument/Sensor

2.1.2 Dissolved Oxygen Flowcell – Fig 2.7

Allow sufficient clearance (200 mm all around) for easy removal of the flowcell assembly for maintenance when not installed in the optional enclosure – see Section 2.3.1 for overall dimensions of units.

Note. To eliminate the risk of bubbles accumulating at the sensor, and hence giving erroneous readings, the flowcell assembly must be mounted vertically.

2.2 Mounting the Instrument

2.2.1 Wall-mounted Instrument – Figs 2.2 to 2.4

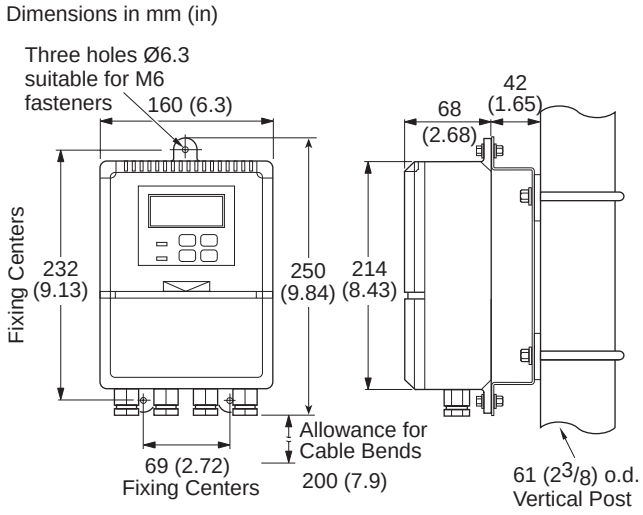


Fig. 2.2 Overall Dimensions

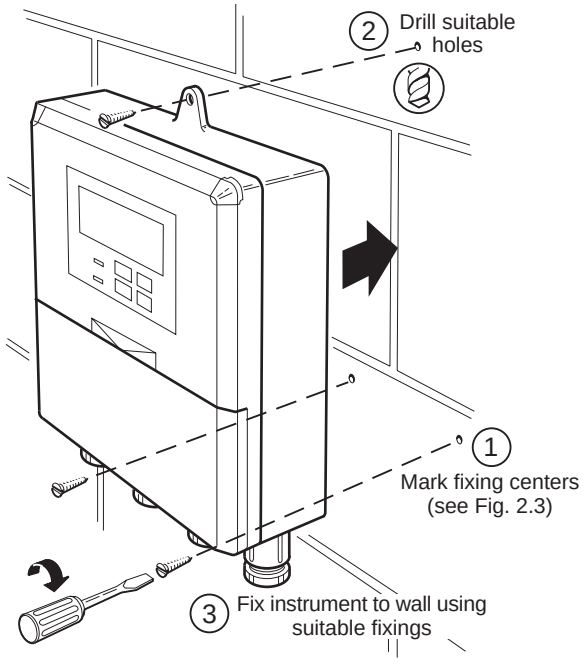


Fig. 2.3 Wall Mounting

…2.2.1 Wall-mounted Instrument – Fig 2.4

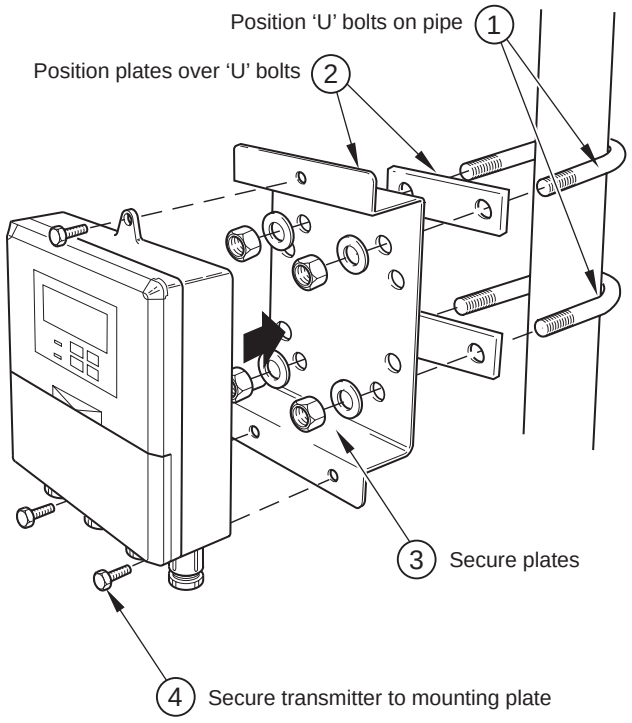


Fig. 2.4 Pipe Mounting

2.2.2 Panel-mounted Instrument – Figs 2.5 and 2.6

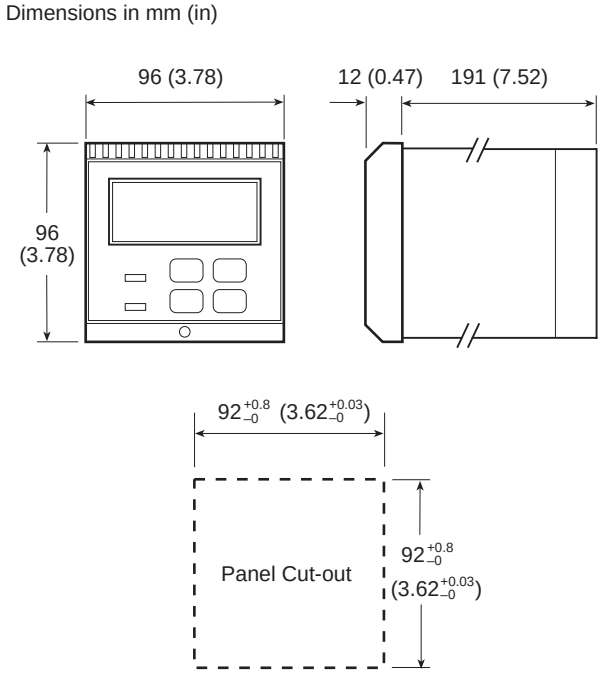


Fig. 2.5 Overall Dimensions

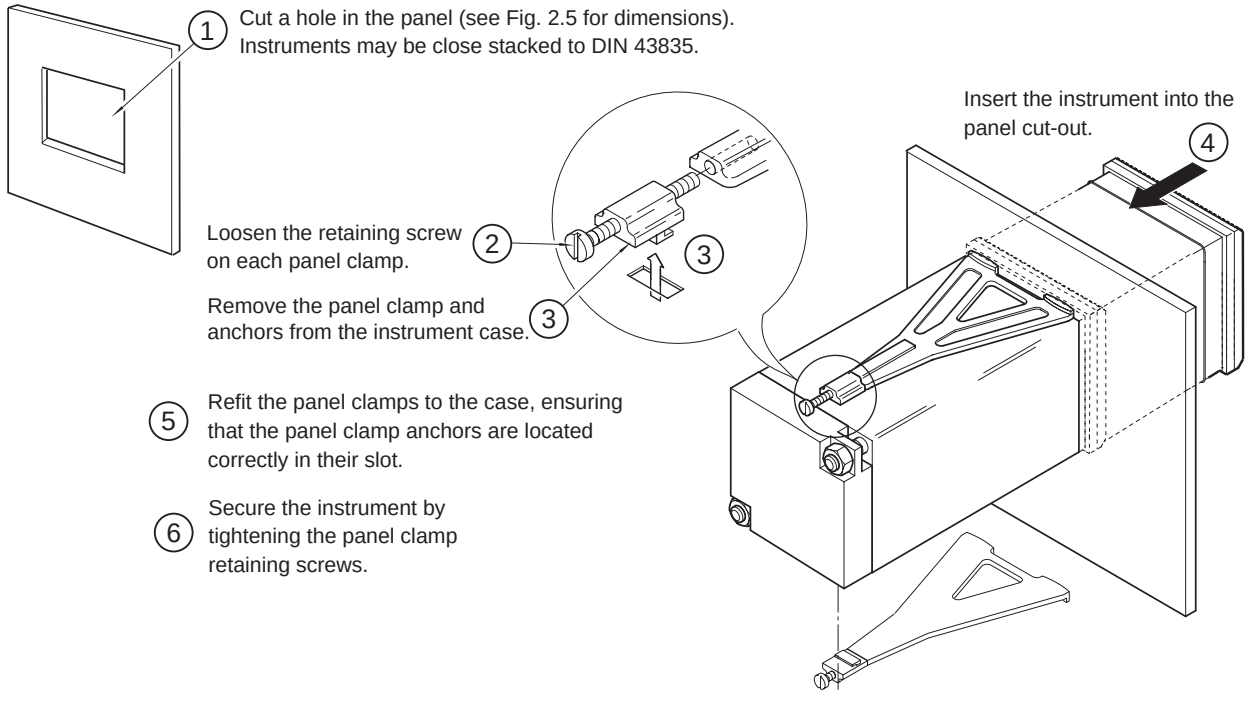


Fig. 2.6 Panel Mounting

2.3 Installing the Dissolved Oxygen Flowcell

2.3.1 Flowcell Dimensions (Overall) – Fig. 2.7

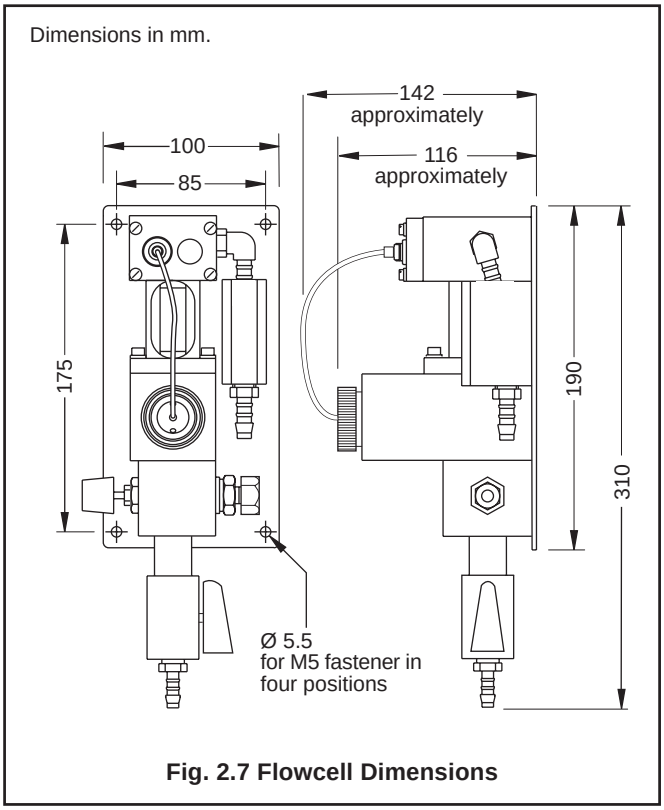


Fig. 2.7 Flowcell Dimensions

2.3.2 Enclosure Dimensions (Optional) – Fig. 2.8

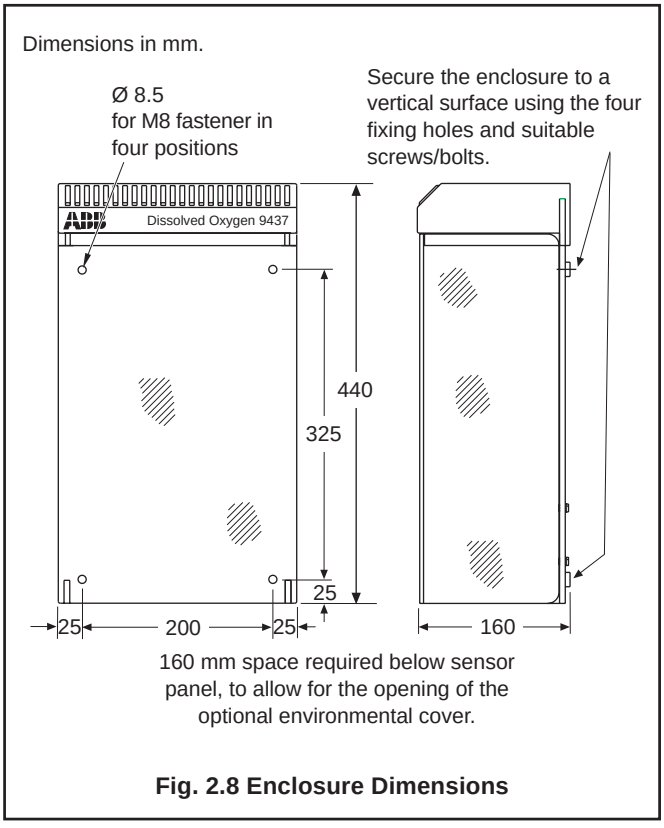
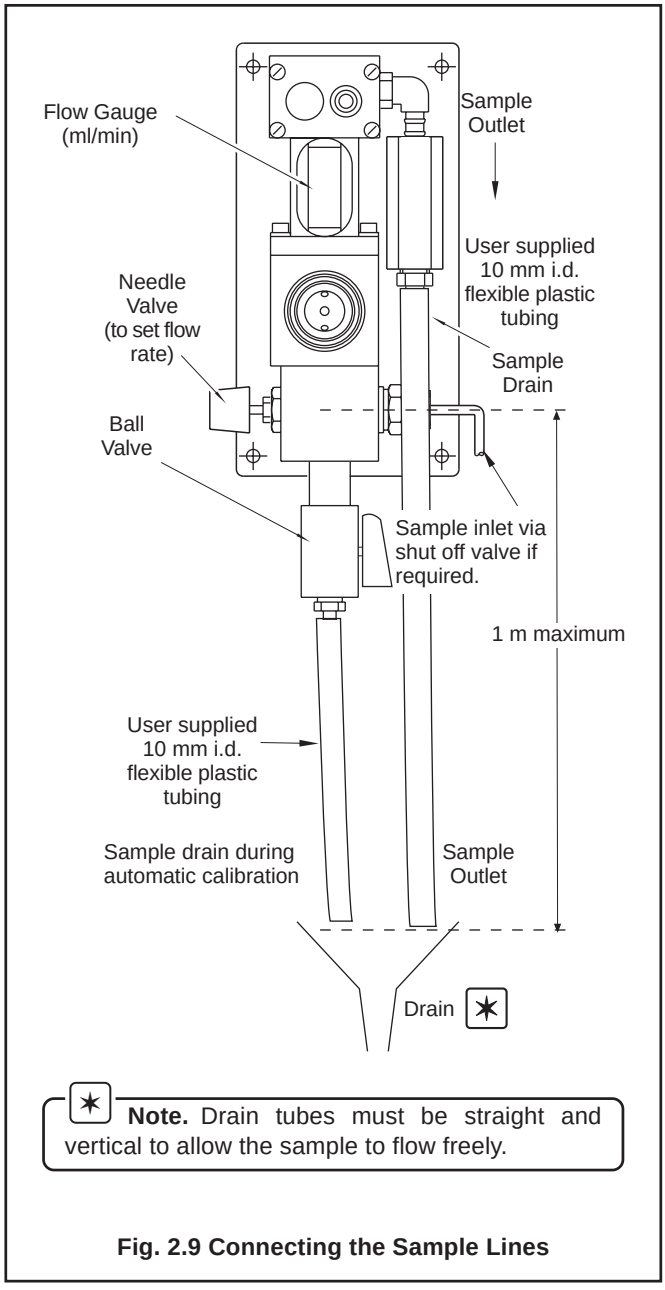


Fig. 2.8 Enclosure Dimensions

2.3.3 Connecting the Sample Lines – Fig. 2.9

Mount the flowcell vertically (with or without the enclosure) as shown in Figs 2.7 and 2.8. Connect the sample inlet and outlet tubes as shown in Fig. 2.9.

Note.
- The sample flowrate must be between 100 and 400 ml min^{-1}.
- The Company recommends that stainless steel tubing is used for sample inlet lines.
- All sample drains should be kept as short as possible and be vertical to allow the sample to drain freely.



Note. Drain tubes must be straight and vertical to allow the sample to flow freely.

Fig. 2.9 Connecting the Sample Lines

3 ELECTRICAL CONNECTIONS

Warning.

- Before making any connections, ensure that the power supply, any high voltage-operated control circuits and high common mode voltage are switched off.
- Although certain instruments are fitted with internal fuse protection, a suitably rated external protection device, e.g. fuse or miniature circuit breaker (m.c.b.), must also be fitted by the installer.

3.1 Access to Terminals

3.1.1 Wall-mounted Instruments – Fig. 3.1

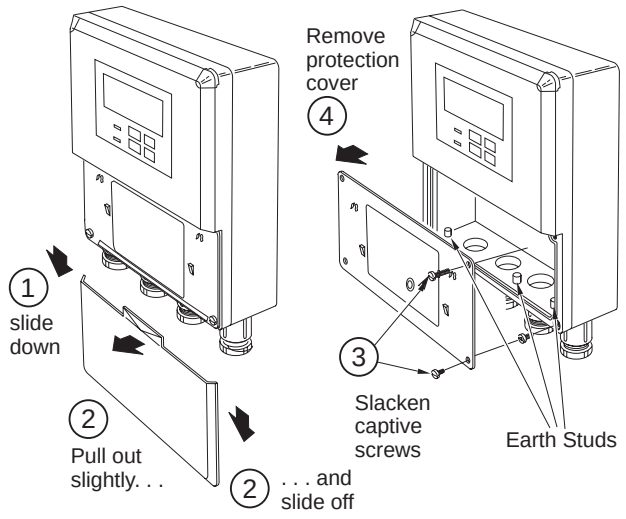


Fig. 3.1 Access to Terminals – Wall-mounted Instrument

3.1.2 Panel-mounted Instruments – Fig. 3.2

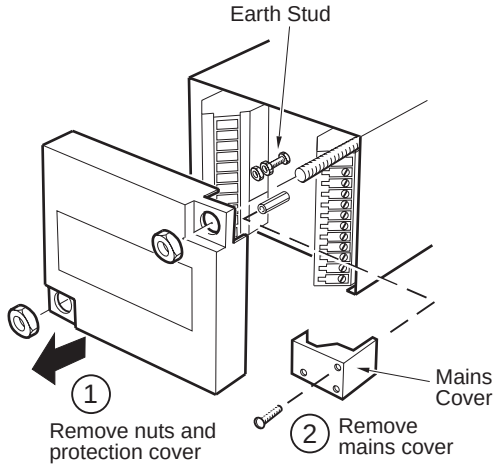


Fig. 3.2 Access to Terminals – Panel-mounted Instrument (Rear View)

3.2 Connections, General

Information.

- **Earthing (grounding) –** stud terminals are fitted to the transmitter case for bus-bar earth (ground) connection – see Fig. 3.1 or 3.2.
- **Cable lengths** – The cable length between the flowcell and the electronics unit is provided as ordered, and suitably terminated at both ends.
- **Cable routing** – always route the signal cable and mains-carrying/relay cables separately, ideally in earthed metal conduit.

  Ensure that the cables enter the transmitter through the glands nearest the appropriate screw terminals and are short and direct. Do not tuck excess cable into the terminal compartment.
- **Cable glands & conduit fittings** – ensure a moisture-tight fit when using cable glands, conduit fittings and blanking plugs/bungs (M20 holes). The M16 glands ready-fitted to wall-mounted instruments accept cable of between 4 and 7 mm diameter.
- **Alarm Relay** –the relay contacts are voltage-free and must be appropriately connected in series with the power supply and the alarm/control device which they are to actuate. Ensure that the contact rating is not exceeded. Refer also to Section 3.2.1 for relay contact protection details when the relays are to be used for switching loads.
- **Retransmission output** – Do not exceed the maximum load specification for the selected current retransmission range – see Section 7.

  Since the retransmission output is isolated the –ve terminal **must** be connected to earth (ground) if connecting to the isolated input of another device.

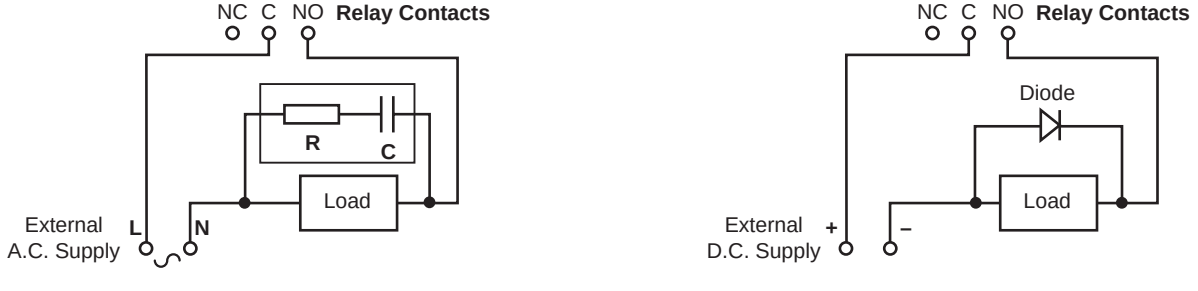
3.2.1 Relay Contact Protection and Interference Suppression – Fig. 3.3

If the relays are used to switch loads on and off, the relay contacts can become eroded due to arcing. Arcing also generates radio frequency interference (RFI) which can result in instrument malfunction and incorrect readings. To minimize the effects of RFI, arc suppression components are required; resistor/capacitor networks for a.c. applications or diodes for d.c. applications. These components can be connected either across the load or directly across the relay contacts. On 4600 Series instruments the RFI components must be fitted to the relay terminal block along with the supply and load wires – see Fig. 3.3.

For **a.c. applications** the value of the resistor/capacitor network depends on the load current and inductance that is switched. Initially, fit a 100R/0.022 µF RC suppressor unit (part no. B9303) as shown in Fig. 3.3A. If the instrument malfunctions (incorrect readings) or resets (display shows 88888) the value of the RC network is too low for suppression – an alternative value must be used. If the correct value cannot be obtained, contact the manufacturer of the switched device for details on the RC unit required.

For **d.c. applications** fit a diode as shown in Fig. 3.3B. For general applications use an IN5406 type (600 V peak inverse voltage at 3 A – part no. B7363)

Note. For reliable switching the minimum voltage must be greater than 12 V and the minimum current greater than 100 mA.



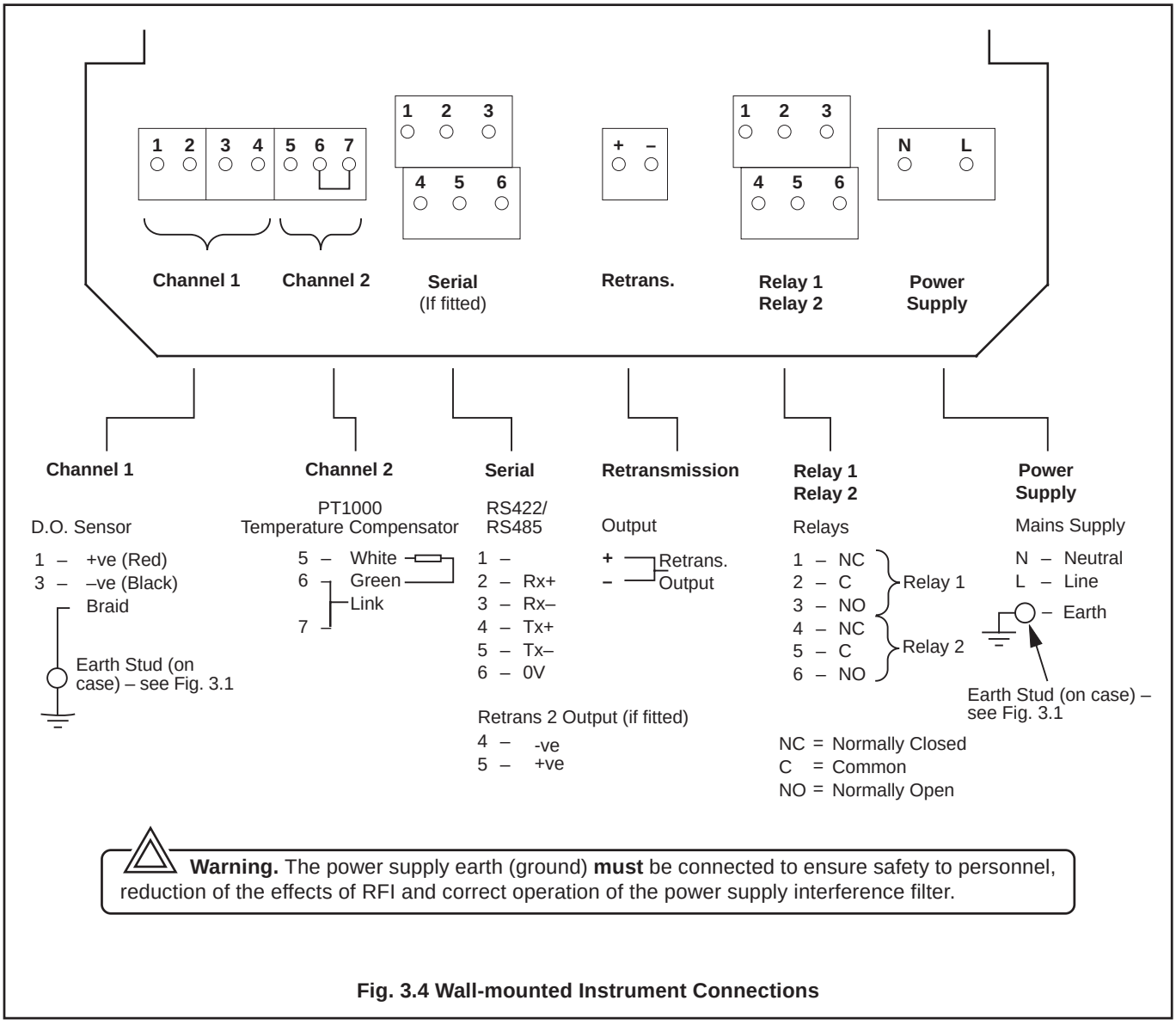
A – A.C. Applications **B – D.C. Applications**

Fig. 3.3 Relay Contact Protection

3.3 Wall-mounted Instrument Connections – Fig. 3.4

Note. Refer to Fig. 3.1 for access to terminals.

Caution. Slacken terminal screws fully before making connections.



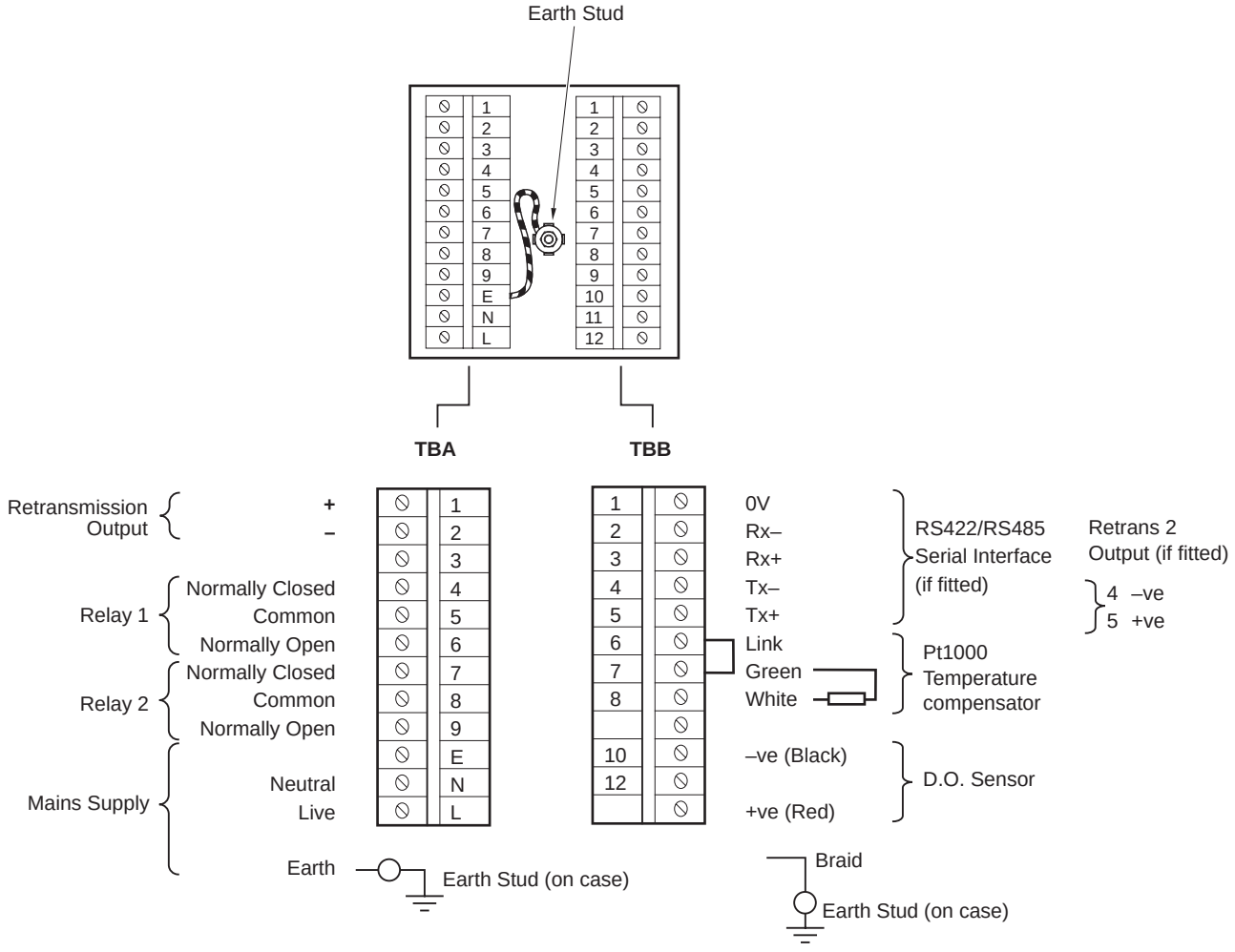
Warning. The power supply earth (ground) **must** be connected to ensure safety to personnel, reduction of the effects of RFI and correct operation of the power supply interference filter.

Fig. 3.4 Wall-mounted Instrument Connections

3.4 Panel-mounted Instrument Connections – Fig. 3.5

Note. Refer to Fig. 3.2 for Access to Terminals.

Caution. Slacken terminal screws fully before making connections.



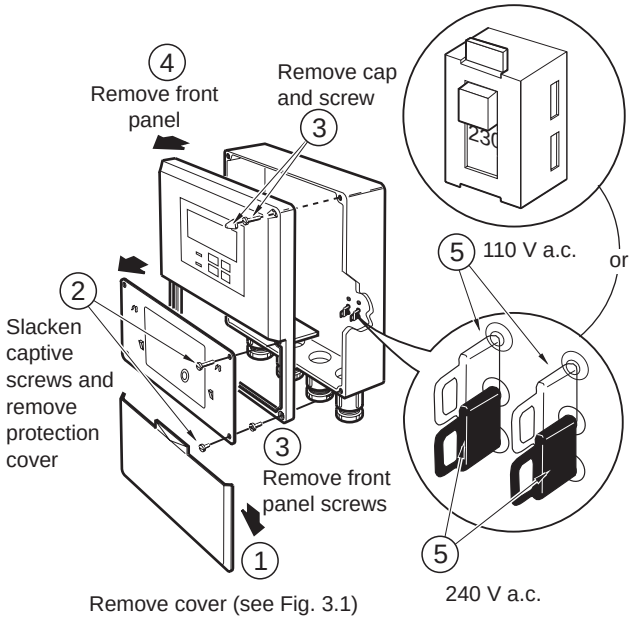
Warning. The power supply earth (ground) **must** be connected to ensure safety to personnel, reduction of the effects of RFI and correct operation of the power supply interference filter.

Fig. 3.5 Panel-mounted Instrument Connections

3.5 Selecting the Mains Voltage

3.5.1 Wall-mounted Instrument – Fig. 3.6

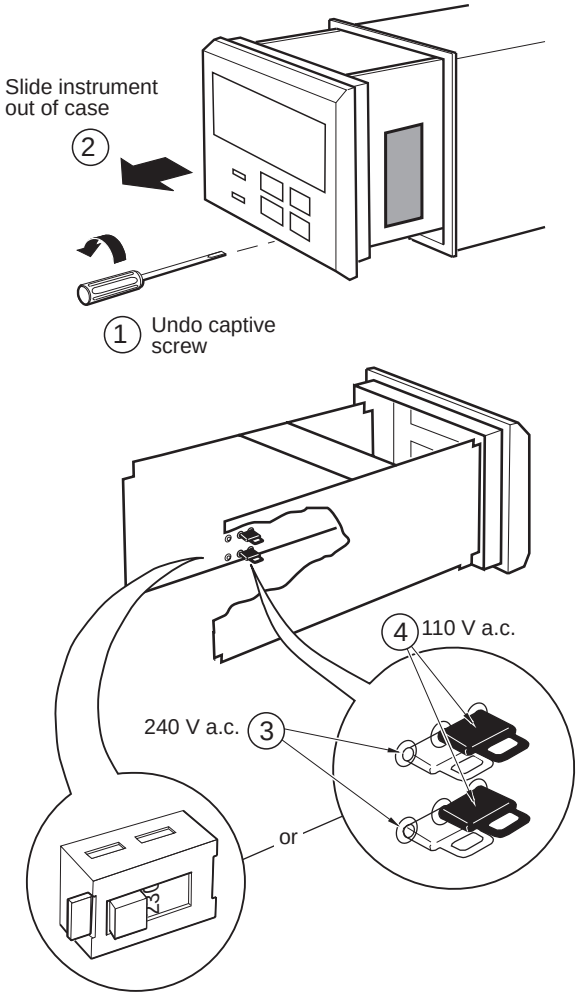
✶ **Note.** Some versions are fitted with a switch in place of links. The applied voltage should be as indicated on the switch, when positioned.



i **Information.** Use a small, flat-blade screwdriver to remove the screw caps from the case.

Fig. 3.6 Selecting the Mains Voltage – Wall-mounted Instrument

3.5.2 Panel-mounted Instrument – Fig. 3.7



✶ **Note.** Some versions are fitted with a switch in place of links. The applied voltage should be as indicated on the switch, when positioned.

Fig. 3.7 Selecting the Mains Voltage – Panel-mounted Instrument

4 SETTING UP

4.1 Fitting the Dissolved Oxygen Sensor – Fig. 4.1

Caution.

- Only install the oxygen sensor immediately prior to use, otherwise leave it stored in its protective container.
- Take special care to line up the two pins in the oxygen sensor with their respective sockets before making the connection and tightening.
- Take care not to damage the delicate membrane on the end of the oxygen sensor.
- Ensure that the mating surfaces (carrying the electrical connection) of the oxygen sensor and connector body are clean and **completely** dry.

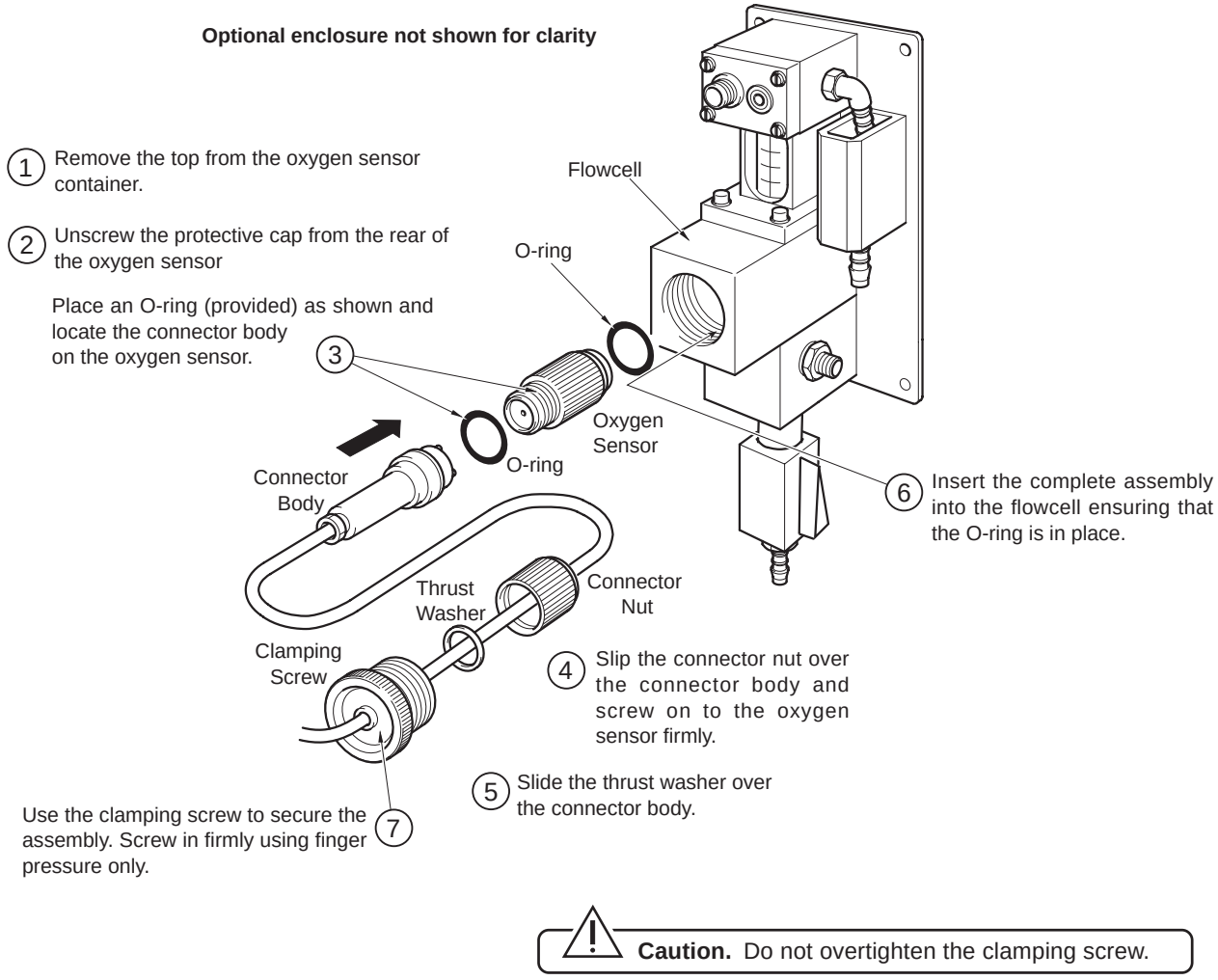
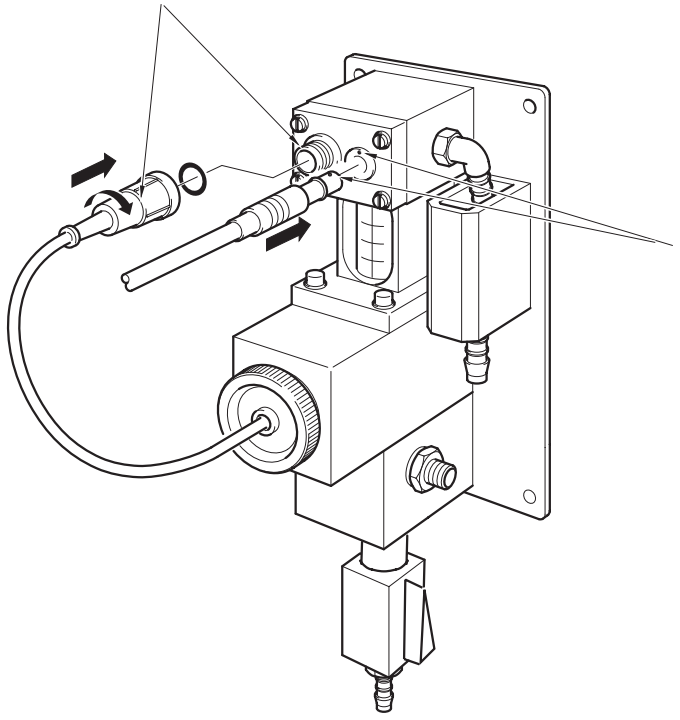


Fig. 4.1 Fitting the Dissolved Oxygen Sensor

4.2 Connecting the Flowcell – Fig. 4.2



Note.
- The plug is a latching type to prevent it's accidental removal. To remove, hold the plug at its widest point and pull out.
- The plug is protected against spillage and corrosion by a sleeve which slides over it.

Fig. 4.2 Electrical Connections at the Flowcell

4.3 Checking Sample Flow – Fig. 4.3

Check that the sample flows correctly in both normal operation and during a calibration or thermal overload.

To simulate a calibration manually, open the valve – see Section 6.2.1 **Operating Page.** After approximately 30 seconds carefully remove the dissolved oxygen sensor and check that the flowcell is empty. If sample still flows, check that the installation complies with Section 2.3.3.

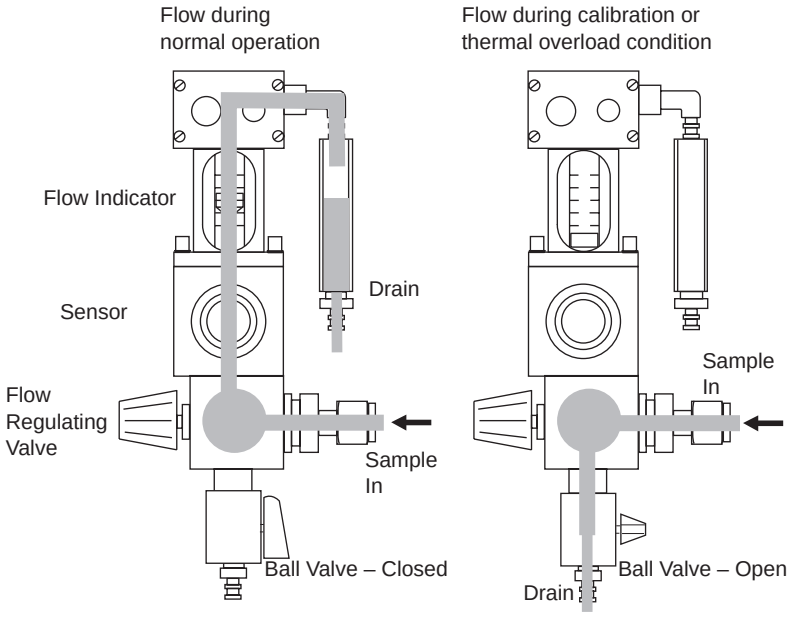


Fig. 4.3 Sample Flow Schematic

5 CONTROLS AND DISPLAYS

5.1 Displays – Fig. 5.1

The display comprises a 5-digit, 7-segment digital upper display line and a 16-character dot-matrix lower display line. The upper display line shows numerical values of dissolved oxygen concentration, temperature, alarm set points or programmable parameters. The lower display line shows the associated units or programming information.

5.2 Switch Familiarization

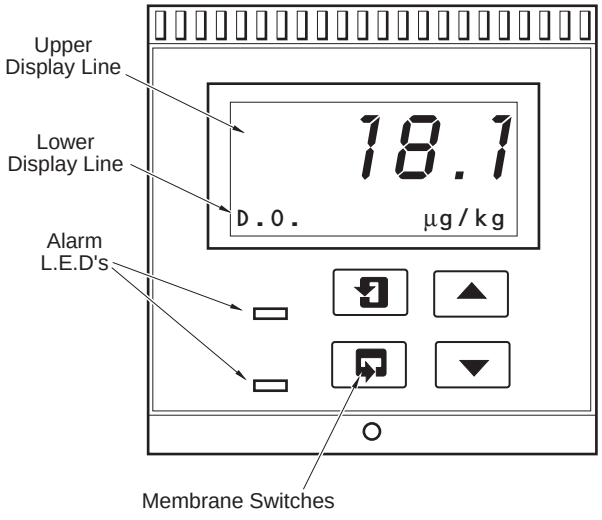
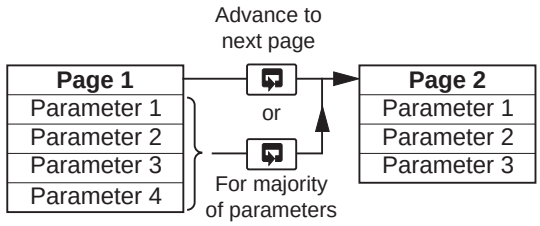
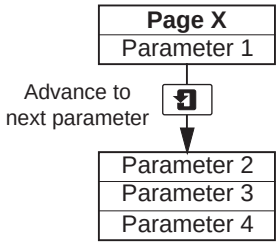


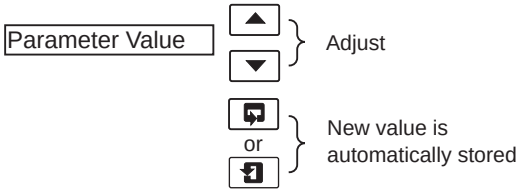
Fig. 5.1 Location of Controls and Displays



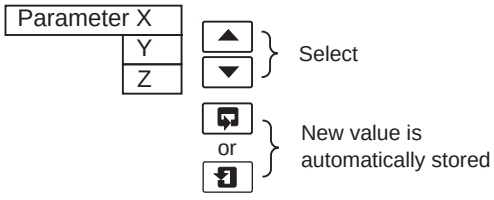
A – Advancing to Next Page



B – Moving Between Parameters



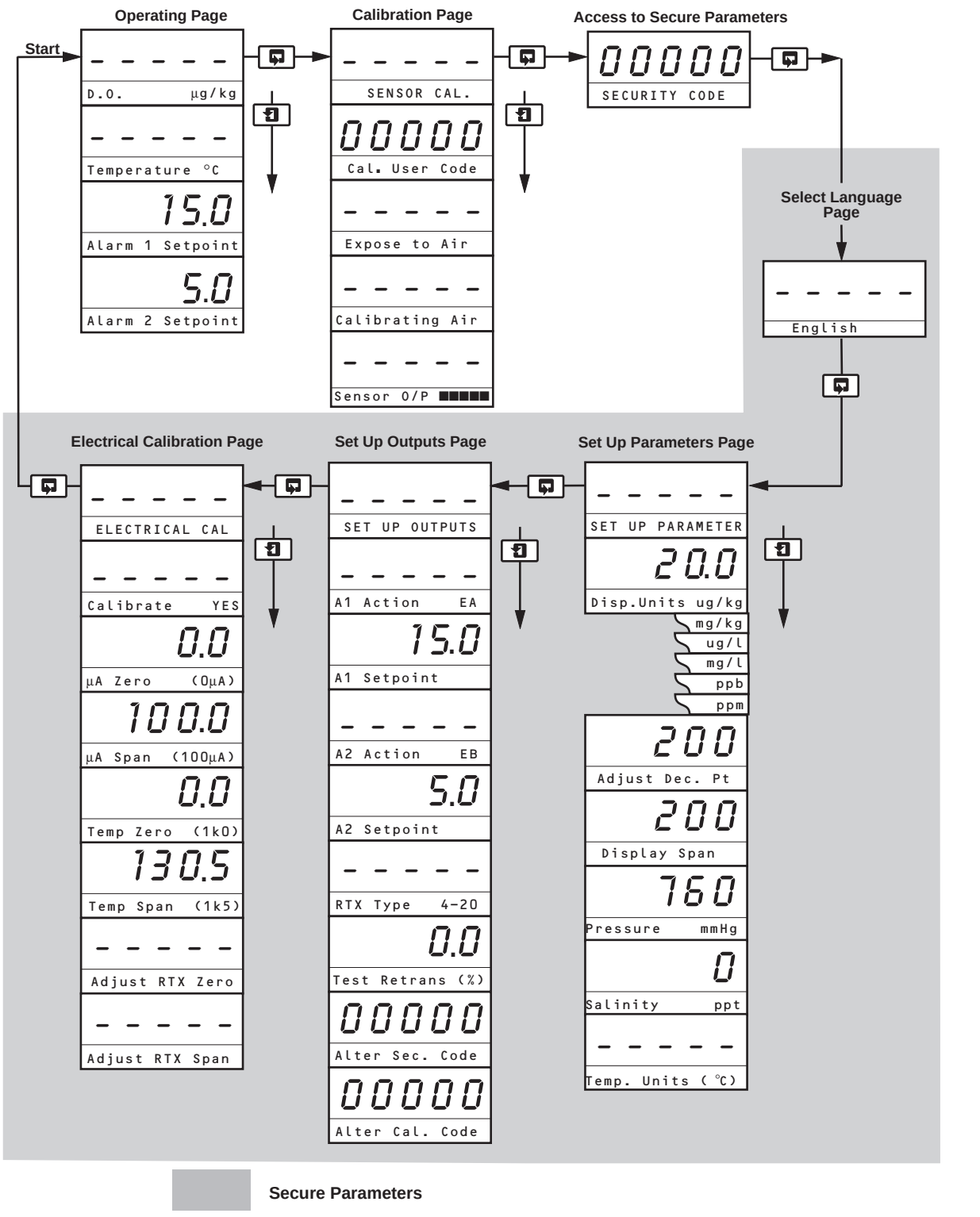
C – Adjusting and Storing a Parameter Value



D – Selecting and Storing a Parameter Choice

Fig. 5.2 Membrane Switch Functions

6 START UP AND OPERATION



Note. The values shown on the pages in this illustration are the factory default values.

Fig. 6.1 Overall Programming Chart

6.1 Instrument Start-up – Fig. 6.1

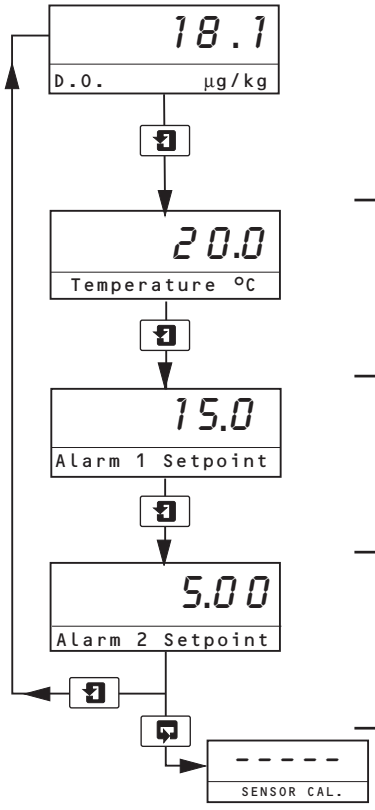
Ensure all electrical connections have been made and switch on the power supply. If the instrument is being commissioned for the first time, calibration and programming of parameters is required.

The overall operating and programming chart is shown in Fig. 6.1.

6.2 Operation – Dissolved Oxygen Measurement Mode

Operation in the Dissolved Oxygen measurement mode comprises an **Operating Page** and a **Calibration Page.** The **Operating Page** is a general use page in which parameters are viewed only and cannot be altered. To alter or program a parameter, refer to the programming pages in Section 7. The **Calibration Page** allows a calibration to be carried out. A 5-digit calibration code is used to prevent unauthorized access to the sensor calibration page. The value is preset at 00000 to allow access during commissioning, but should be altered to a unique value, known only to authorized operators, in the **Set Up Outputs page** – see Section 7.4

6.2.1 Operation Page



Measured Dissolved Oxygen
The measured dissolved oxygen is displayed in either ppm or ppb.

– press to advance to next parameter
or
– press to advance to **Calibration Page**, Section 6.2.2.

Sample Temperature
The sample temperature is displayed in either °C or °F – see Section 7.3

Alarm 1 Set Point
The set point value and relay/l.e.d. action are programmable – see Section 7.4, **Set Up Outputs Page**.

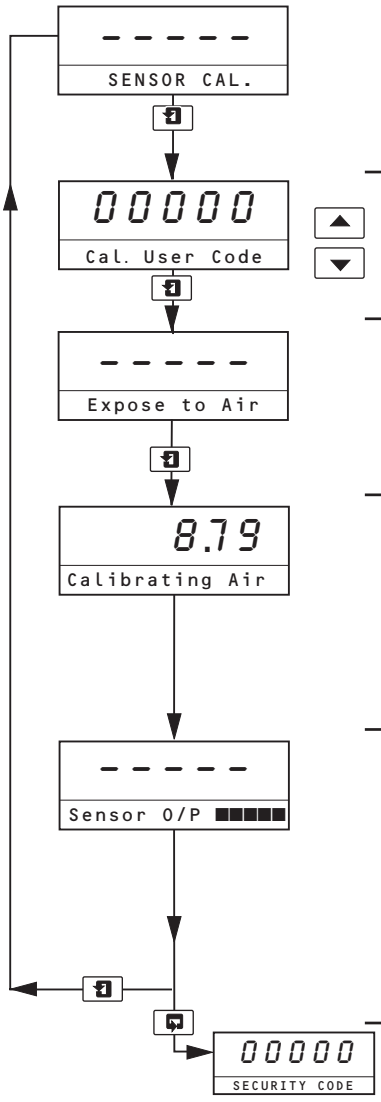
Alarm 2 Set Point
The set point value and relay/l.e.d. action are programmable – see Section 7.4, **Set Up Outputs Page**.

Advance to **Calibration Page** – see Section 6.2.2.

6.2.2 Calibration Page

Calibration involves standardizing the instrument and the sensor by exposing the sensor to air.

During a calibration, retransmission and alarm outputs are automatically held to prevent inadvertent operation of ancillary equipment.



– press to advance to next parameter

or

– press to Advance to **Access to Secure Parameters Page**, Section 7.1

Calibration Access

Enter the required calibration code number, between 00000 and 19999. If an incorrect value is entered, access to calibration is prevented and **Calibration Page** is displayed.

Before depressing the button, direct the sample flow, by opening the drain valve at the bottom of the flowcell assembly, to expose the sensor to air – see Fig. 4.3.

Calibrating Air

Displayed for three to five minutes, allowing the sensor response to become stable. During this period the oxygen value displayed is calculated using the data from the previous calibration.

Return the system to normal by closing the drain valve at the base of the flowcell asembly. The sample water will now pass across the D.O. sensor – see Fig. 4.3.

Sensor Output

Provides an indication of the sensor performance in the form of a 5 bar display.

When 5 bars are displayed, the sensor has maximum life remaining.

When 2 bars are displayed and flashing, the sensor is exhausted.

A replacement sensor should be ordered when three bars are displayed.

If a calibration is carried out when 2 bars are displayed, the calibration is ignored and the values obtained from the previous calibration are used.

Advance to **Access to Secure Parameters Page**, Section 7.1

Caution. Take care that the membrane at the end of the sensor does not come into contact with any hard or sharp objects.

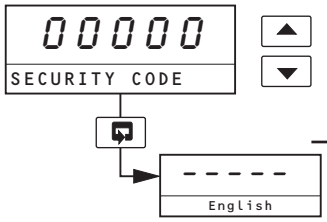
Note.

- The air should be saturated with water vapour. This can be conveniently achieved by suspending the sensor inside a bottle containing a few drops of water.
- Errors in the calibration procedure, e.g. water droplets on the sensor membrane, can cause `Calibration Fail` to be displayed.

7 PROGRAMMING AND ELECTRICAL CALIBRATION

7.1 Access to Secure Parameters

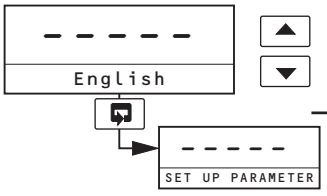
A 5-digit security code is used to access to the secure parameters.



Security Code
Enter the required code number, between 00000 and19999, to gain access to the secure parameters. If an incorrect value is entered, access to subsequent programming pages is prevented and **Operating Page** is displayed**.**

Advance to **Select Language Page**, Section 7.2**.**

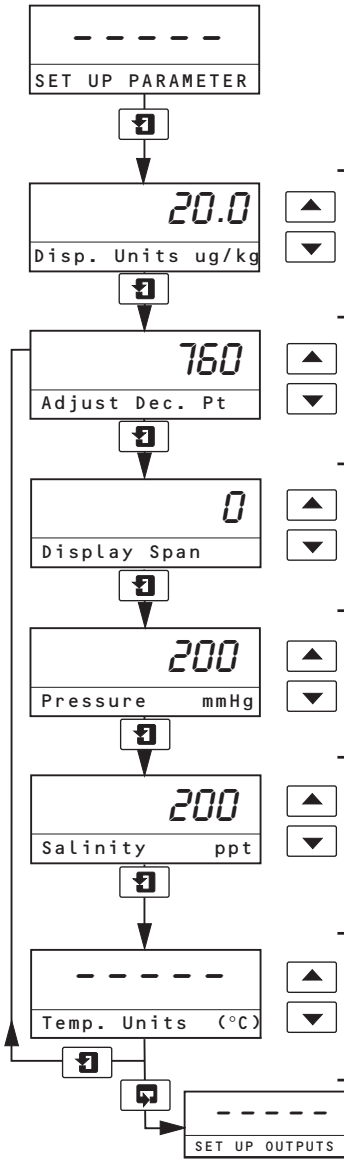
7.2 Select Language Page



Use the buttons to select the required language (English, French, German or Spanish).

Advance to **Set Up Parameters Page**, Section 7.3**.**

7.3 Set Up Parameters Page



– press to advance to next parameter
or
– press to advance to **Set Up Outputs Page**, Section 7.4.
These two switches are used to advance to all subsequent parameters and pages. If a parameter is changed it is automatically stored on operation of either switch.

Display Units
Select the required display units:
µg/kg, mg/kg, ppm or ppb.

Adjust Decimal Point
Select the decimal point position:
either no decimal places or one decimal place.

Display Span
Set the full scale span required.
i.e. for an operating span of 100.0 ppb, set the units to ppb, the decimal point to 1 position, and the display span to 100.0.

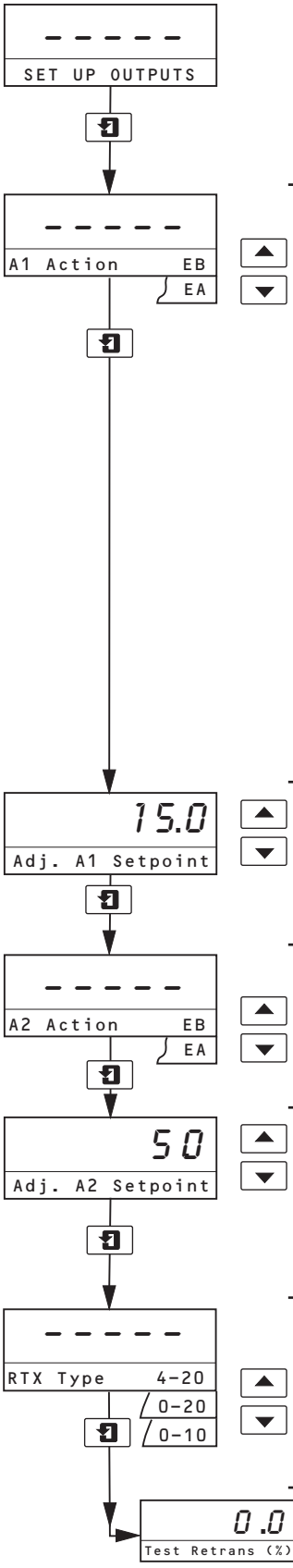
Barometric Pressure Correction
Set the local barometric pressure in mm Hg (between 500 and 800).
If the local barometric pressure is unknown the default value, which is the standard sea-level value of 760mmHg, should not be changed.

Salinity Correction
Required when monitoring sea water or other waters containing high concentrations of dissolved salts.
Enter the appropriate value between 0 an 80 parts per thousand (ppt).
Leave at the default value of 0 ppt if correction is not required.

Temperature Units
Select either °C or °F.

Advance to **Set Up Outputs Page**, Section 7.4.

7.4 Set Up Outputs Page



– press to advance to next parameter

or

– press to advance to **Electrical Calibration Page**, Section 7.7.

These two switches are used to advance to all subsequent parameters and pages. If a parameter is changed it is automatically stored on operation of either switch.

Alarm 1 Action

For '**Fail-safe**' alarm operation the relay's alarm state must be the same as the power-down state, i.e. the relay is de-energised.

For **high alarm** operation the relay must be **E**nergised **B**elow the alarm set point (EB).
For **low alarm** operation the relay must be **E**nergised **A**bove the alarm set point (EA).

The alarm l.e.d.s are illuminated in the alarm condition.

Select the required alarm 1 action from the following table:

Alarm Action	L.E.D. Action for Input Above Set Point	L.E.D. Action for Input Below Set Point	Relay Action for Input Above Set Point	Relay Action for Input Below Set Point
EB	ON	OFF	De-energized	Energized
EA	OFF	ON	Energized	De-energized

The set point band is defined as the actual value of the set point plus or minus the hysteresis value. The hysteresis value is ± 1% of the full span value displayed in the **Set Up Parameter Page** – see Section 7.3. Alarm action occurs if the input value is above or below the set point band. If the input moves within the set point band the last alarm action is maintained.

Alarm 1 Set Point

The alarm 1 set point can be set to any value within the input range being displayed. The set point value is subject to hysteresis as detailed above.

Set the alarm set point to the required value.

Alarm 2 Action

Repeat as for **Alarm 1 Action** above.

Alarm 2 Set Point

Repeat as for **Alarm 1 Set Point** above.

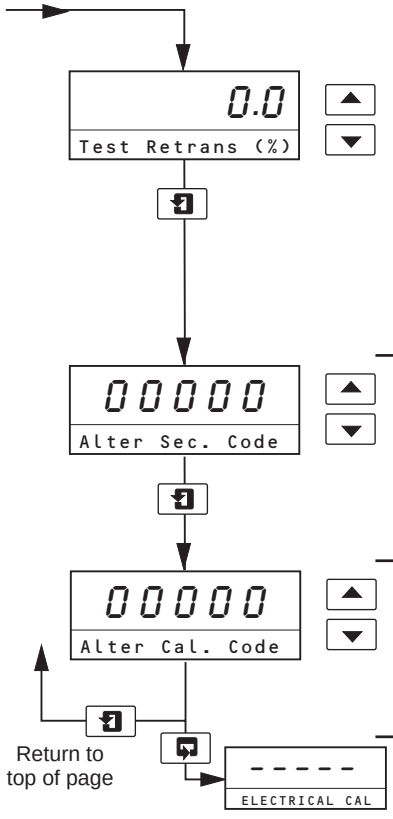
Retransmission Output Assignment

Select current output (mA).

Continued on next page.

…7.4 Set Up Outputs Page

Continued from previous page.



Test Retransmission Output
The instrument automatically transmits a test signal of 0, 25, 50, 75 or 100% of the retransmission range selected above. The % test signal selected is shown on the upper display.

Example – for a selected range of 0 to 20 mA and 50% retransmission test signal, 10 mA is transmitted.

Select the required retransmission test signal.

Alter Security Code
Set the security code to a value between 00000 and 19999.

IMPORTANT – **YOU MUST MEMORIZE THE NEWLY SET SECURITY CODE.** If it is forgotten contact the Company for advice.

Alter D.O. Calibration Code
Set the security code to a value between 00000 and 19999.

IMPORTANT – YOU MUST MEMORIZE THE NEWLY SET SECURITY CODE. If it is forgotten contact the Company for advice.

Advance to **Electrical Calibration Page**, Section 7.7.

7.5 Electrical Calibration

Note. The instrument is calibrated by the company prior to despatch and an electrical calibration should only be carried out if the accuracy of the instrument is suspect.

7.5.1 Equipment Required

a) Current source: 0 to +100 μA.
b) Decade resistance box (temperature input simulator): 0 to 1k5 Ω.
c) Digital milliammeter (current output measurement): 0 to 20 mA.

Note. Resistance boxes have an inherent residual resistance which may range from a few milliohms up to 1 ohm. This value must be taken into account when simulating input levels, as should the overall tolerance of the resistors within the boxes.

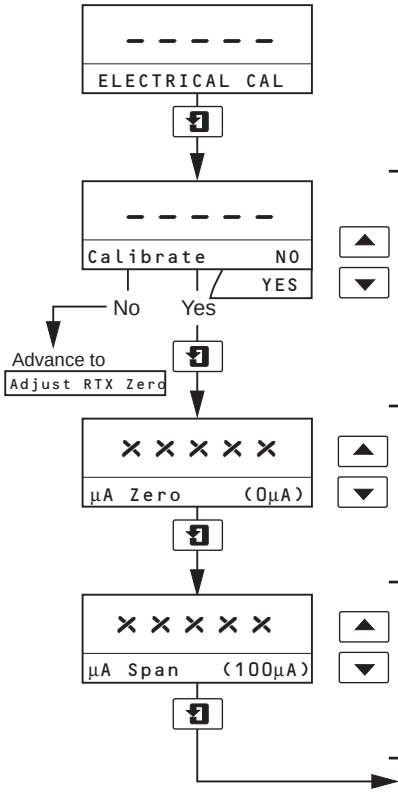
7.6 Preparation

a) Switch off the supply and disconnect the sensor, temperature compensator and current output from the electronics unit terminal block – see Fig. 3.4 or Fig. 3.5.
b) Wall-mounted Instruments
   1) Connect the microamp source '+' and '-' to terminals 1 and 3 respectively.
   2) Connect the decade box between terminals 5 and 6, with terminals 6 and 7 linked.
   3) Connect the milliameter to the retransmission output terminals.
   4) Ensure that the earth of the current source and decade box are connected to the instrument earth stud.

   Panel-mounted Instruments
   1) Connect the microamp source '+' and '-' to terminals 12 and 10 respectively.
   2) Connect the decade box between terminals 7 and 8, with terminals 6 and 7 linked.
   3) Connect the milliameter to the retransmission output terminals.
   4) Ensure that the earth of the current source and decade box are connected to the instrument earth stud.
c) After either of the sections in b) above, switch on the supply and allow ten minutes for the circuits to stabilize.
d) Select the **Electrical Calibration Page** and proceed as in Section 7.7, following.

7.7 Electrical Calibration Page

In this section the actual values denoted by '✕ ✕ ✕ ✕ ✕ ' are unimportant and are used to determine display reading stability when carrying out the electrical calibration procedure.



– press to advance to next parameter
or
– press to advance to **Operating Page**, Section 6.2.1.

Electrical Calibration
Select `YES` to access the electrical calibration sequence. Select `NO` to advance to **Adjust Retransmission Zero** – see following page.

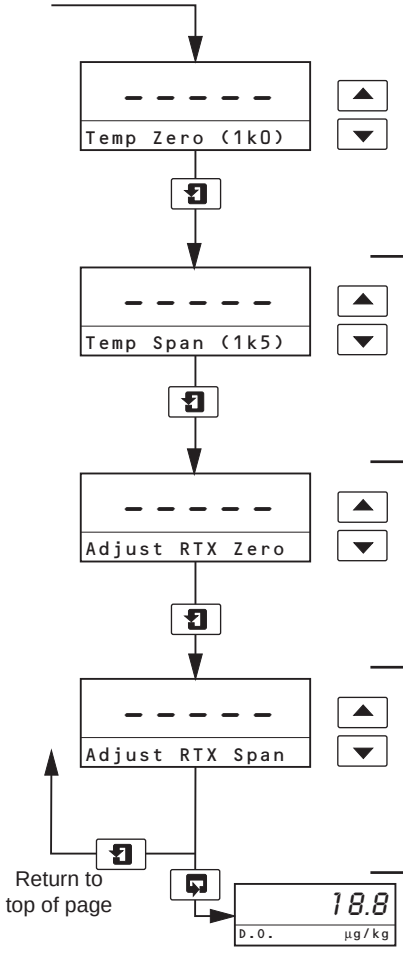
Microamp Zero
Set the current source to 0 μA and allow the instrument display to stabilize.

Microamp Span
Set the current source to +100 μA and allow the instrument display to stabilize.

Continued on next page.

…7.7 Electrical Calibration Page

Continued from previous page.



Calibrate Temperature Zero
Set the temperature simulator resistance box to 1000Ω and allow the instrument display to stabilize.

Calibrate Temperature Span
Set the temperature simulator resistance box to 1500 Ω and allow the instrument display to stabilize.

Adjust Retransmission Zero
Set the milliammeter reading to 4.00 mA.

Note. Retransmission signal zero is calibrated using 4.00 mA. The correct value transmitted depends on the range selected in the **Set Up Outputs Page**.

Adjust Retransmission Span
Set the milliammeter reading to 20.00 mA.

Note. Retransmission signal span is calibrated using 20.00 mA. The correct value transmitted depends on the range selected in the **Set Up Outputs Page**.

Return to **Operating Page**, Section 6.2.1**.**

8 MAINTENANCE

8.1 Maintenance

No routine maintenance is required for this instrument other than periodic calibration – see Section 6.2.2.

8.1.1 Changing the Sensor

Caution.

- Only install the oxygen sensor immediately prior to use, otherwise leave it stored in its protective container.
- Take care not to damage the delicate membrane on the end of the oxygen sensor.
- Ensure that the mating surfaces (carrying the electrical connection) of the oxygen sensor and connector body are clean and **completely** dry.
- Take special care to line up the two pins in the oxygen sensor with their respective sockets before making the connection and tightening.

a) Isolate and drain the flowcell.

b) Unscrew the clamping screw and remove the sensor assembly from the flowcell.

c) Inspect the sensor. If the membrane is clean, replace the sensor – proceed to d) below.

If deposits are visible on the membrane, remove them by gently wiping the membrane with a moist paper tissue; for oily or greasy deposits, the tissue may be moistened with a mild detergent or, if necessary, with iso-propyl alcohol (propan - 2 - ol). After cleaning, dry the interior of the flowcell with a paper tissue or soft cloth, ensure that the O-ring is correctly positioned against the shoulder near the end of the cavity – proceed to 11) below to test the sensor.

d) Unscrew the connector nut; remove the sensor capsule and discard both capsule and O-ring.

e) Take out the O-ring from the flowcell; dry the interior of the flowcell with a tissue or soft cloth and insert the new O-ring supplied with the replacement capsule. Ensure that the O-ring is correctly located on the shoulder near the end of the cavity.

f) Remove the top from the container of the new sensor.

g) Unscrew the protective cap from the rear of the sensor

h) Place a new O-ring (supplied) as shown in Fig. 4.1 and locate the connector body on the sensor.

i) Slip the connector nut over the connector body and screw onto the sensor firmly.

j) Slide the thrust washer over the connector body.

k) Insert the complete assembly into the flowcell.

l) Use the clamping screw to secure the assembly. Screw in firmly using finger pressure only.

Caution. Do not overtighten the clamping screw.

m) Reinstate sample flow through the flowcell.

n) Carry out a calibration – see Section 6.2.2.

8.2 Error Messages

If erroneous or unexpected results are obtained the fault may be indicated by an error message – see Table 8.1.

Error Message	Possible Cause
FAULTY PT1000	Temperature compensator/ associated connections are either open/short circuit.
FAULTY MODULE	D.O. sensor input module is probably faulty.
LAST CAL. FAILED	Message only displayed on power-up. The last D.O. calibration, carried out before power-down, failed.*
NV MEMORY ERROR	The contents of the non-volatile memory have not been read correctly during power up.**

* This message applies to the last D.O. calibration carried out prior to power-down and is not an indication of incorrect electrical calibration.

** To rectify the fault, switch off, wait 10 seconds and switch on again. If the fault persists contact the Company.

Table 8.1 Error Messages

9 SIMPLE FAULT FINDING

9.1 Low Sensor Output or no Response to D.O. Changes

a) Check that the sample drains fully from flowcell. If the sample does NOT drain fully check:
   i) Operation of ball valve.
   ii) Sample inlet flow rate does not exceed 400 ml min^{-1} maximum.
   iii) Sample fluid paths are free flowing and clear of partial blockages.
   iv) Ball valve drain tube is not kinked, blocked, excessively long, does no rise along its length.
   v) Flow gauge is not blocked or dirty.

b) Replace the sensor (see Section 8.1.1) as an initial check. It is also important that all program parameters have been set correctly and have not been altered inadvertently – see Section 7.

If the fault persists:

c) Carry out an electrical calibration as detailed in Section 7.5 and check that the instrument responds correctly to the current input.

   Failure to respond to the input usually indicates a fault with the transmitter, which must be returned to the Company for repair.

d) If the response in a) is correct, select the **Operating Page** and set the current source to a value which gives an on-scale D.O. reading on the transmitter. Make a note of the current source setting and the D.O. reading. Reconnect the sensor cable and connect the current source to the sensor end of the cable. Set the same current value on the source and check that the transmitter displays the noted reading in this configuration.

If check a) is correct but check b) fails, check the cable connections and condition. If the response for both checks is correct, fit a new sensor and calibrate it.

9.2 Checking the Temperature Input

Check that the instrument responds to a temperature input. Disconnect the PT1000 leads and connect a suitable resistance box directly to the transmitter inputs – see Section 7.5. Check that the transmitter displays the correct values as set on the resistance box – see Table 9.1.

Incorrect readings usually indicate an electrical calibration problem. Recalibrate the instrument – see Section 7.5.

9.3 High Sample Readings

If the sample reading is higher than expected, the most likely reason is air ingress into the main sample line.
Check and tighten ALL sample connections as it is possible to have an air leak into the sample without sample leaking.

Temperature (°C)	Input Resistance (Ω)
0	1000.0
10	1039.0
20	1079.3
30	1116.7
40	1155.4
50	1194.0
60	1232.4
70	1270.7
80	1308.9
90	1347.0
100	1385.0
130.5	1500.0

Table 9.1 Temperature Readings for Resistance Inputs

10 SPECIFICATION

Flowcell mounting: Vertically using the built-in fixing bracket.

Protection—
Flowcell Enclosure: IP54
Transmitter: Model 4641: IP66 NEMA 4X
Model 4646: IP66 NEMA 4X front

Sample temperature: 5 to 55 °C.

Sensor ambient temperature: 0 to 55 °C.

Transmitter operating temperature limits: –20 to 55 °C.

Transmitter operating humidity limits: up to 95% RH non-condensing.

Storage temperature limits—
Flowcell: –25 to 70 °C.
Sensor: 0 to 55 °C.
Transmitter: –25 to 70°C.

Sample flow: 100 to 500 ml/min.

Sample pressure: Maximum 2 bar.

Resolution: 0.1 µg/kg.

Accuracy: ±5% of reading or ±1 µg/kg, whichever is the greater.

Stability: ±5% of reading or ±1µg/kg per week, whichever is the greater.

Response time: 90% of a step change in 1 minute.

Temperature compensation: 5 to 55 °C automatic using Pt1000 resistance thermometer.

Salinity correction: preset within the range 0 to 80 ppt.

Barometric pressure correction: preset within the range 500 to 800 mm Hg.

Transmitter display—
Measured value: 5-digit x 7-segment back-lit l.c.d.

Information: 16-character, single line, dot matrix back-lit l.c.d.

Measuring ranges: 0 to 20.0, 0 to 200 µg/kg,
0 to 2.00, 0 to 20.0 mg/kg.

Set Points and Relays—
No. of set points: two.

Set point adjustment: programmable.

Set point hysteresis: ±1% of f.s.d. (fixed).

Local set point annunciation: red l.e.d.

No. of relays: two.

Relay contacts: single pole changeover.

Rating:	250 V a.c.	250 V d.c. maximum.
	3 A a.c.	3 A d.c. maximum.
Loading:		
(noninductive)	750 VA	30 W maximum.
(inductive)	75 VA	3 W maximum.

Insulation, contacts to earth: 2 kV r.m.s.

Retransmission—
No. of retransmission signals: one, fully isolated.

Output current: 0 to 10, 0 to 20 or 4 to 20 mA programmable.

Maximum load resistance: 750 Ω (20 mA maximum).

Serial communication: RS422/RS485 (optional).

Power Supply Voltage requirements:
100 to 130 V or
200 to 260 V 50/60 Hz.

Power Consumption: < 10 VA.

Error due to power supply variations: less than ±2% for +6% –20% variation from nominal supply voltage.

Insulation, mains to earth: 2 kV r.m.s.

Mechanical Data
Mounting:
Model 4641 wall mounting, Model 4646 panel mounting.

Overall dimensions—

in Environmental enclosure:
250 mm x 440 mm x 160 mm

Transmitter—
Model 4641: 160 mm x 214 mm x 68 mm.
Model 4646: 96 mm x 96 mm x 191 mm.

Panel cut-out: 92 mm x 92 mm.

Weights—

Environmental enclosure (with sensor fitted): 4.0 kg.

Model 4641: 2 kg.
Model 4646: 1.5 kg.

Sample connections –

Compression fitting to accept either 6 mm or 1/4 in. o.d. tubing – to be specified when ordering.

11 SPARES

11.1 Strategic Spares

Part No.	Description ..... Qty
0216 574	Flow Gauge assembly 1

PCB Assemblies,

Wall Mounted

9437 070	Complete main PCB assembly for single current output 1
9437 071	Complete main PCB assembly for single current output + Serial/Modbus 1
9437 072	Complete main PCB assembly for two current output version 1
4600 0295	Display PCB assembly 1
4600 0335	Low Level D.O. Module assembly 1
4600 0405	2nd Retransmission output module assembly 1

Panel Mounted

9437 075	Complete main PCB assembly (cropped) for single current output 1
9437 076	Complete main PCB assembly (cropped) for single current output + Serial/Modbus 1
9437 077	Complete main PCB assembly (cropped) for two current output version 1
4600 0246	Power supply PCB assembly (cropped) 1
4600 0335	Low Level D.O. Module assembly 1
4600 0405	2nd Retransmission output module assembly 1

Test Equipment

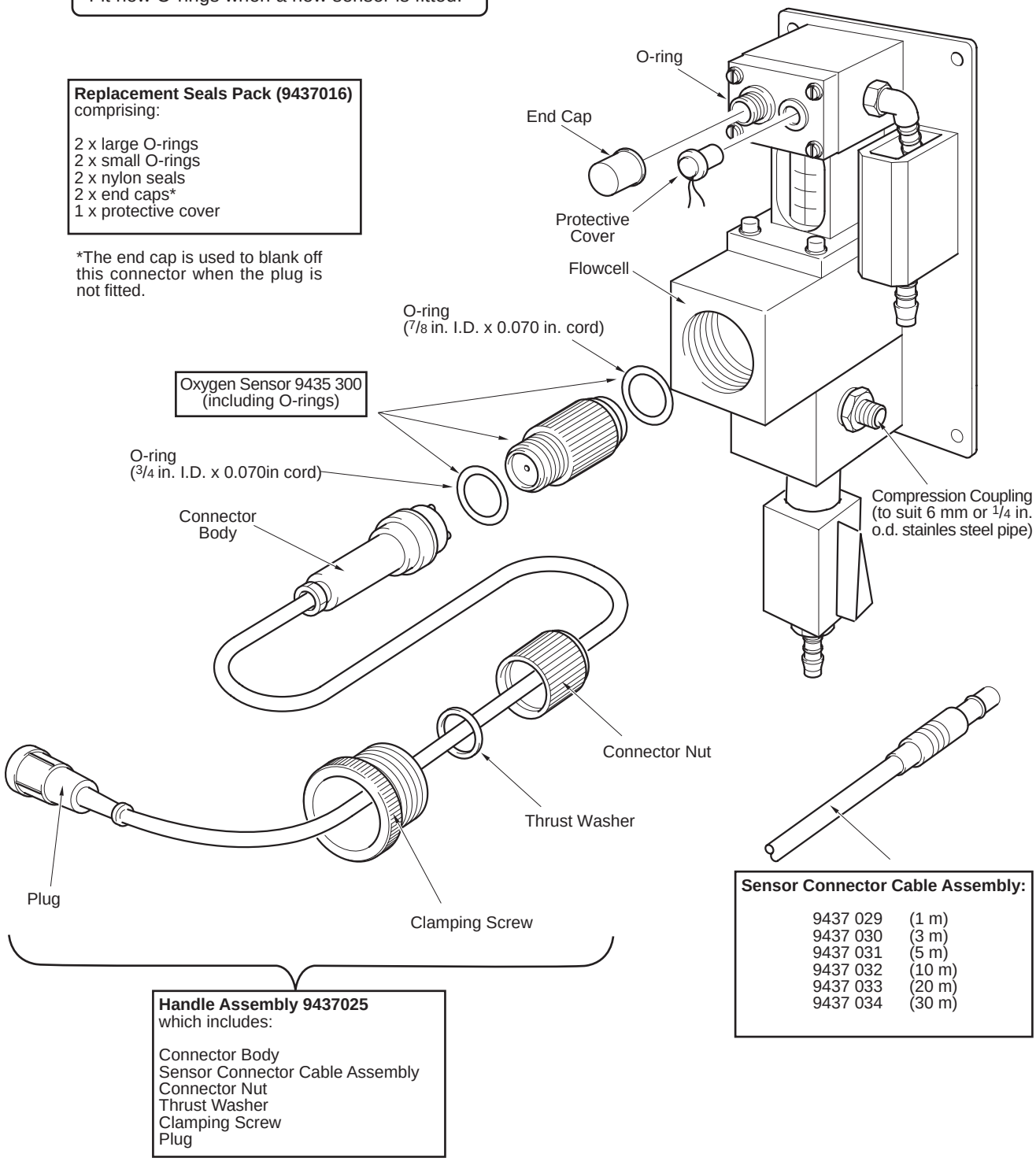
9439 950	Dissolved Oxygen Test Simulator 1
9439 035	Test Simulator lead 1

Note. Ensure that the correct O-rings are fitted in the appropriate positions as shown.
Fit new O-rings when a new sensor is fitted.

Replacement Seals Pack (9437016)
comprising:

2 x large O-rings
2 x small O-rings
2 x nylon seals
2 x end caps*
1 x protective cover

*The end cap is used to blank off this connector when the plug is not fitted.



Handle Assembly 9437025
which includes:

Connector Body
Sensor Connector Cable Assembly
Connector Nut
Thrust Washer
Clamping Screw
Plug

Sensor Connector Cable Assembly:

9437 029	(1 m)
9437 030	(3 m)
9437 031	(5 m)
9437 032	(10 m)
9437 033	(20 m)
9437 034	(30 m)

Fig. 11.1 Replacement Spares

NOTES

PRODUCTS & CUSTOMER SUPPORT

Products

Automation Systems

- ***for the following industries:***
  - Chemical & Pharmaceutical
  - Food & Beverage
  - Manufacturing
  - Metals and Minerals
  - Oil, Gas & Petrochemical
  - Pulp and Paper

Drives and Motors

- ***AC and DC Drives, AC and DC Machines, AC motors to 1kV***
- ***Drive systems***
- ***Force Measurement***
- ***Servo Drives***

Controllers & Recorders

- ***Single and Multi-loop Controllers***
- ***Circular Chart , Strip Chart and Paperless Recorders***
- ***Paperless Recorders***
- ***Process Indicators***

Flexible Automation

- ***Industrial Robots and Robot Systems***

Flow Measurement

- ***Electromagnetic Magnetic Flowmeters***
- ***Mass Flow Meters***
- ***Turbine Flowmeters***
- ***Wedge Flow Elements***

Marine Systems & Turbochargers

- ***Electrical Systems***
- ***Marine Equipment***
- ***Offshore Retrofit and Referbishment***

Process Analytics

- ***Process Gas Analysis***
- ***Systems Integration***

Transmitters

- ***Pressure***
- ***Temperature***
- ***Level***
- ***Interface Modules***

Valves, Actuators and Positioners

- ***Control Valves***
- ***Actuators***
- ***Positioners***

Water, Gas & Industrial Analytics Instrumentation

- ***pH, conductivity, and dissolved oxygen transmitters and sensors***
- ***ammonia, nitrate, phosphate, silica, sodium, chloride, fluoride, dissolved oxygen and hydrazine analyzers.***
- ***Zirconia oxygen analyzers, katharometers, hydrogen purity and purge-gas monitors, thermal conductivity.***

Customer Support

ABB Automation provides a comprehensive after sales service via a Worldwide Service Organization. Contact one of the following offices for details on your nearest Service and Repair Centre.

United Kingdom

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Fax: +44 (0)1453 827 856

United States of America

ABB Automation Inc.
Tel: +1 (0) 755 883 4366
Fax: +1 (0) 755 883 4373

Client Warranty

Prior to installation, the equipment referred to in this manual must be stored in a clean, dry environment, in accordance with the Company's published specification. Periodic checks must be made on the equipment's condition.

In the event of a failure under warranty, the following documentation must be provided as substantiation:

1. A listing evidencing process operation and alarm logs at time of failure.
2. Copies of operating and maintenance records relating to the alleged faulty unit.

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