Operating Instructions

Zirconia-based Humidity Measuring System

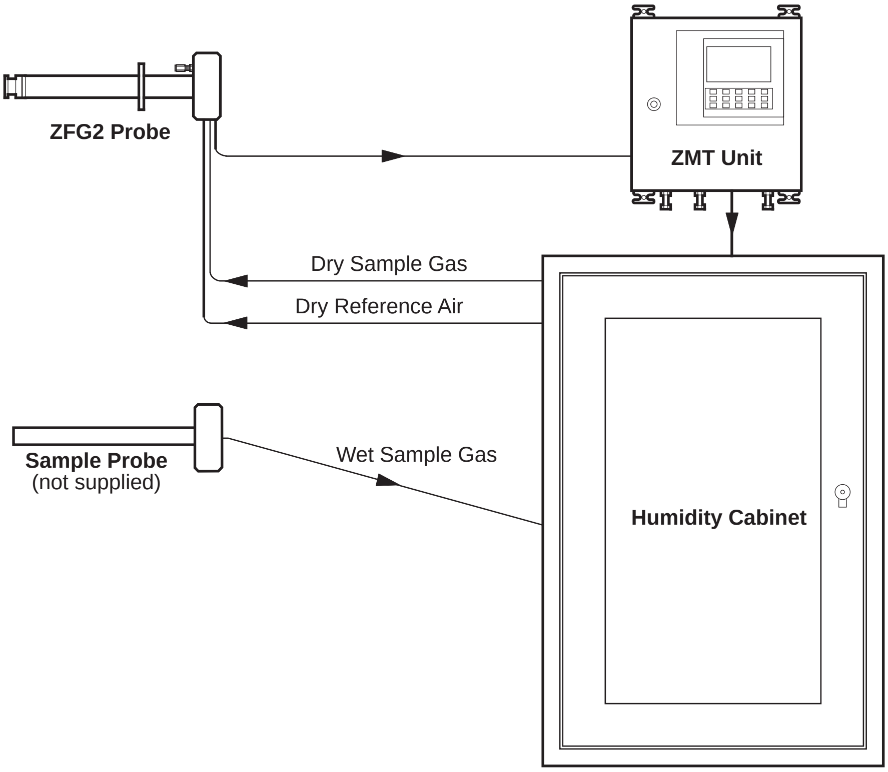

ABB Kent-Taylor

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1 INTRODUCTION

The Zirconia Based Humidity Measuring System (System 1) has been designed for continuous, alternate monitoring of 'wet' and 'dry' oxygen readings to give a calculated water vapour content. This measurement of water vapour content can be used in the tight control of air flow rates, temperature and humidity, resulting in considerable savings in energy and fuel, with increased productivity and improved quality of the end product.

These instructions must be read in conjunction with the ZFG2 Series Oxygen Probes Operating Instructions (ZFG2/0011), Issue 2 onwards.

1.1 Principle of Operation – Fig 1.1

The method of measurement is based on the fact that dry, clean air has an oxygen concentration of 20.95%. As the humidity of air increases, the oxygen concentration decreases proportionately. However, in processes which involve combustion the oxygen concentration will not only be affected by humidity changes but also by the process of combustion itself.

The ABB Kent-Taylor solution to humidity where products of combustion are present, is a system utilizing a Zirconia Probe and a constant dry air reference gas. As the reference gas will have a fixed Oxygen concentration of 20.95% any variation in Oxygen content, due to combustion, can be detected and eliminated.

A sample of the process gas is extracted and dried, with the thermoelectric dehumidifier, to a dew point of 1°C. The 'dried' sample gas is blown into the zirconia probe as a 'test gas' giving a new increased O_2 reading due entirely to the removal of the water vapour from the original 'wet' sample.

By taking alternate 'wet' and 'dry' O_2 readings at pre-selected intervals, and comparing them against the constant dry air reference, the water vapour content is calculated from the difference in the O_2 readings as dictated by the formula in Appendix A1. This can be set up to measure 0 to 1 kg/kg or lb/lb, or 0 to 60% absolute humidity.

Full details of the operation of the ZFG2 zirconia probe can be found in the ZFG2 Series Oxygen Probes Operating Instructions (ZFG2/0011), Issue 2 onwards.

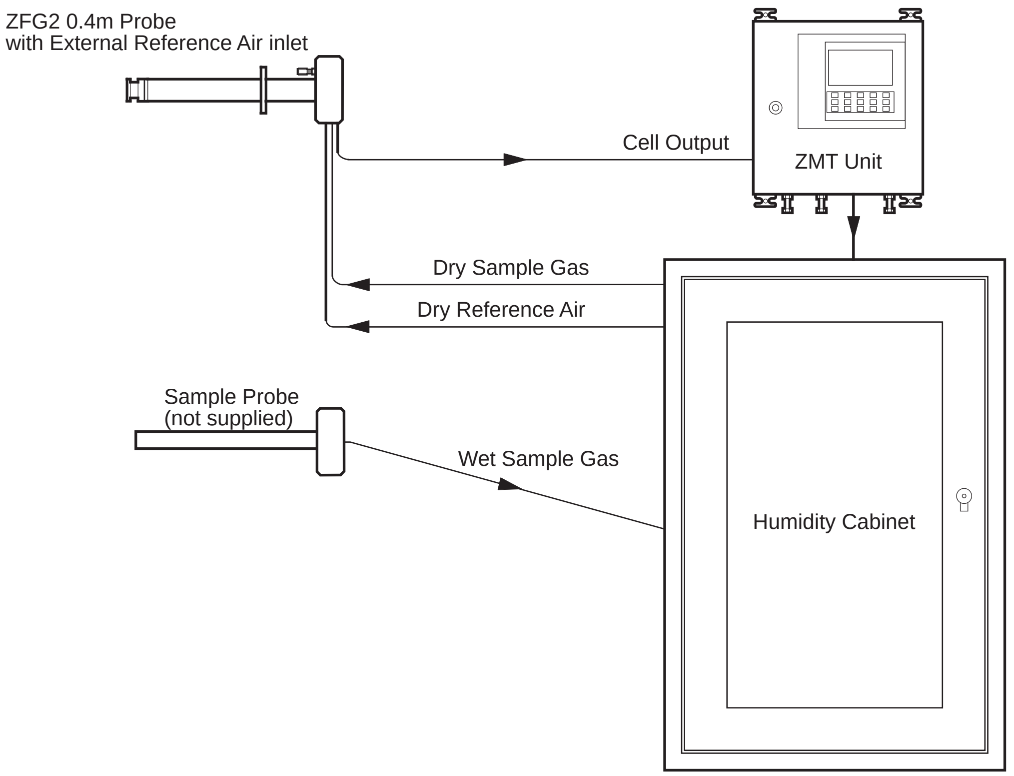


Fig 1.1 Ziroconia-based Humidity Measuring System, Schematic Diagram

2 PREPARATION

2.1 ZMT Zirconia Oxygen Analyser

2.1.1 Accessories

The following accessories are supplied with the instrument:

- Programme card
- Door key
- Cable entry bungs

2.1.2 Checking the Instrument Code Number - Fig. 2.1

1. Unlock and open the door, hinged at the right hand edge (turn key clockwise to open).

2. Check the instrument code number against the **IDENTIFICATION** table, table 1, shown below.

2.1.3 Checking the Programme Card Details

The programmed functions are defined on the programme card which should be mounted at a convenient location close to the unit for future reference.

The standard settings on the card are that of a standard instrument programme, i.e. as supplied if the user has not specified a particular dedicated programme.

If the functions detailed on the card are unsuitable for the application, they can be reprogrammed - see Sections 10 to 12. Write any changed parameter details onto the card.
Select a location:

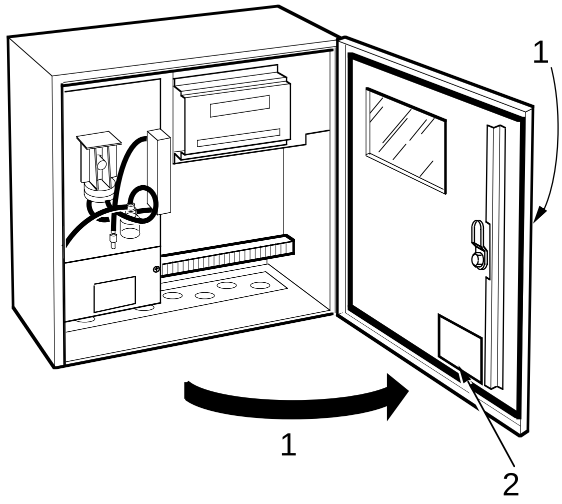


Fig. 2.1 Checking the Instrument Code Number

Basic Type Number	Probe Type	Reference Air Supply	Probe Temerature Control	N/A	Humidity Versions	Trim Control	Output Module 1	Output Module 2	Output Module 3	Mains Voltage
Digits 1,2,3/	**4**	**5**	**6/**	**7,8,9,10**	**11**	**12**	**13/**	**14**	**15**	**16**
ZMT Micro-processor based Oxygen analyser	2 ZFG2	0 None	1 Temp. Control	0000	2 Humidity System 1	0 None	0 None 4 Analogue + Relay	0 None 1 One Relay 4 Analogue + Relay	6 One Relay + One Solid State\ Relay	1 110V 50/60 Hz

Notes

1. The table is for identification purposes only. Only those code combinations applicable to the Humidity Measuring System 1 are shown.

Table 1 Identification, ZMT Unit

Code Number Example

ZMT / 2 0 1 / 00 00 2 0 / 4 0 2 2

- ZMT Oxygen analyser
- For use with Z-FG probe
- None
- Probe temperature control
- Not applicable
- Not Applicable
- Humidity System 1
- No trim control
- Module position 1 – analogue + relay
- Module position 0 – none
- Module position 6 – one relay + one solid state relay
- 110V 50/60Hz power supply

3 MECHANICAL INSTALLATION

For general installation details refer to Fig. 3.4.

3.1 Siting

Select a location for both the Humidity Cabinet and the ZMT Unit:

a) Ideally the Humidity Cabinet and ZMT unit should be mounted next to each other.

b) Within temperature and humidity limits of 0 to 30°C and 0 to 60% RH.

c) Where the IP55 protection rating is not exceeded.

d) Away from harmful vapours and/or dripping fluids.

e) Free from excessive vibration.

f) At a distance from the probe not exceeding the limitations specified in the ZFG2 Series Oxygen Probes Operating Instructions (ZFG2/0011), Issue 2 onwards:

   Note. If the 6 metres of flexible conduit supplied with Z-FG probes is insufficient, it can be extended using a suitable junction box (part no. 003000060).

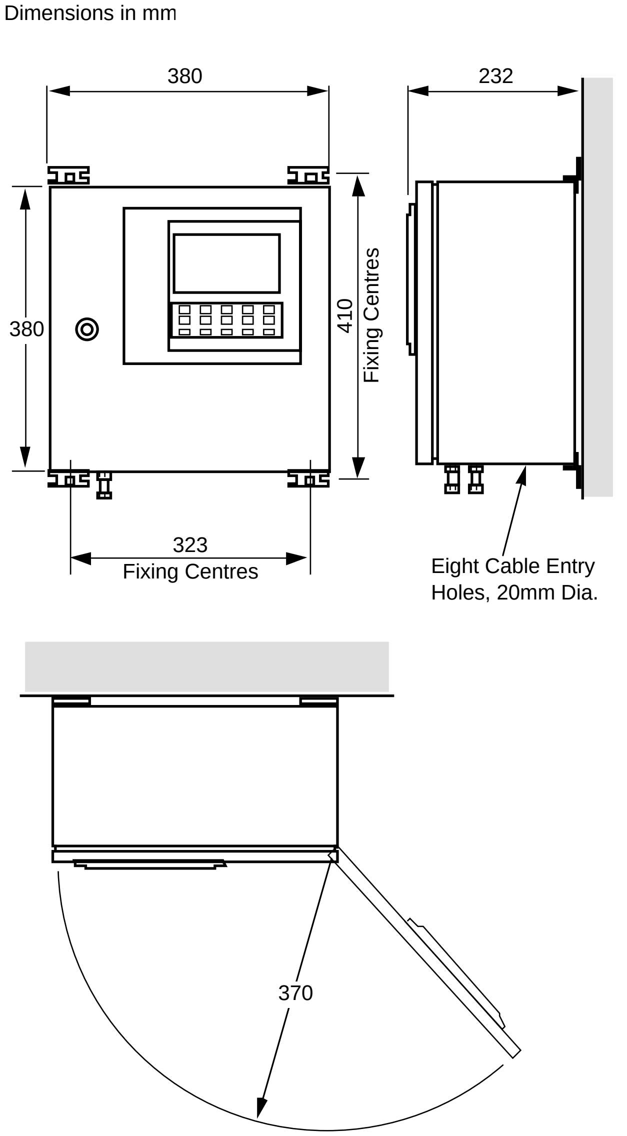


Fig. 3.1 Overall Dimensions, ZMT Unit

3.2 Installing the ZMT Unit

The unit is designed for wall mounting and weighs approximately 16.5kg.

3.2.1 Overall Dimensions – Fig. 3.1

Overall dimensions, including fixing centres and door arc clearance are shown in Fig. 3.1.

3.2.2 Mounting Details – Fig. 3.2

1. Carefully mark-out the fixing centres for the four mounting brackets.

2. Drill suitable holes for the type of fixings to be used.

3. Securely fix the instrument to the wall.

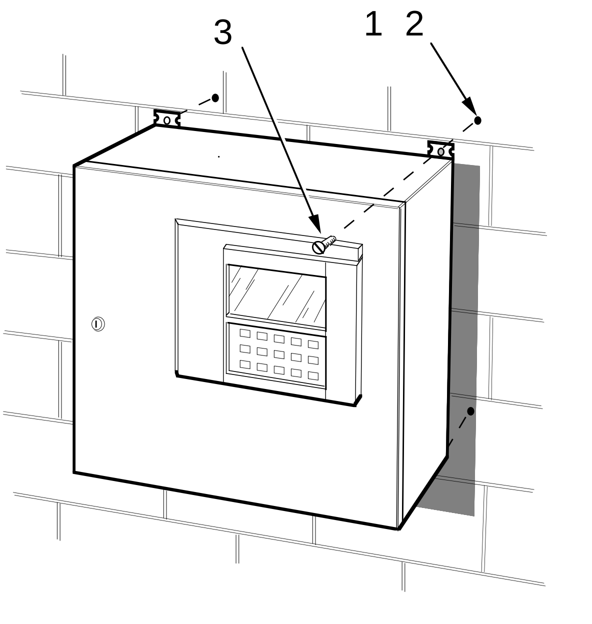


Fig 3.2 Mounting Details, ZMT Unit

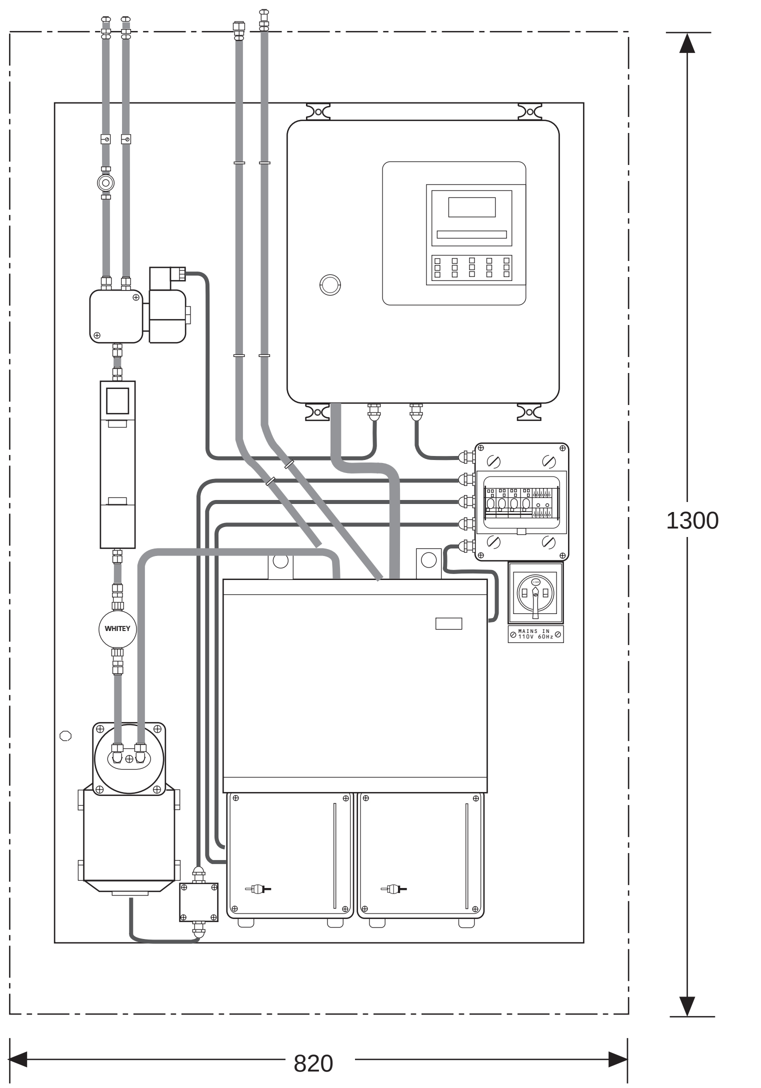


Fig. 3.3 Overall Dimensions, Humidity Cabinet

3.3 Installing The Humidity Cabinet

The unit is designed for wall mounting and weighs approximately 40kg. For general installation details refer to Fig. 3.4.

3.3.1 Overall Dimensions – Fig 3.3

Overall dimensions, including the wall mounting straps, are shown in Fig. 3.3.

3.3.2 Mounting Details

Using the method detailed for mounting the ZMT unit, and the dimensions in Fig. 3.3, fix the Humidity Cabinet to the wall.

3.4 Installing the ZFG2 Probe

a) Refer to the ZFG2 Series Oxygen Probes Operating Instructions (ZFG2/0011), Issue 2 onwards and install the ZFG2 probe.

   Note. In mounting the ZFG2 probe it is essential that the probe is mounted at a minimum of 10º downwards from the horizontal. This ensures that, under unusual plant conditions when condensation may occur, water cannot enter the cell and cause thermal shock of the sensor.

b) Connect a pipeline, of 316 stainless steel and 10mm minimum bore size, from the Probe Outlet of the Humidity Cabinet to the Test Gas Inlet of the probe.

c) Connect a pipeline, of 316 stainless steel and 10mm minimum bore size, from the Air Outlet of the Humidity Cabinet to the Reference Air Inlet of the probe.

3.5 Installing the Sample Probe

a) Install a suitable sample probe into the flue.

b) Connect a pipeline, of 316 stainless steel and 10mm minimum bore size, from the sample probe to the Sample Inlet of the Humidity Cabinet. Do not fully tighten the connection at the Humidity Cabinet at this stage.

   Note. The sample line, from the sample probe to the sample conditioning panel, must have a continuous downwards gradient to prevent water traps occurring in the sample line.

   The length of the sample line should be such that the temperature of the gas sample entering the thermo-electric dehumidifier never exceeds 30°C. Where applications involve high levels of humidity and high sample temperatures it may be necessary to insert a cooling coil in the sample line to meet this requirement. e.g. 1kg/kg at 600°C requires approximately 500 Watts of heat dissipation to cool it to 30°C.

   The condensate traps fitted in the sample condition panel are for maximum sample pressures of ±2000 Pascals (±200mm WG). The sample line bore should be such that –2000 Pascals suction is not exceeded. At inlet pressures exceeding +2000 Pascals sample gas will be vented from the condensate trap. At inlet pressures lower than –2000 Pascals air will be sucked into the system causing errors in the readings.

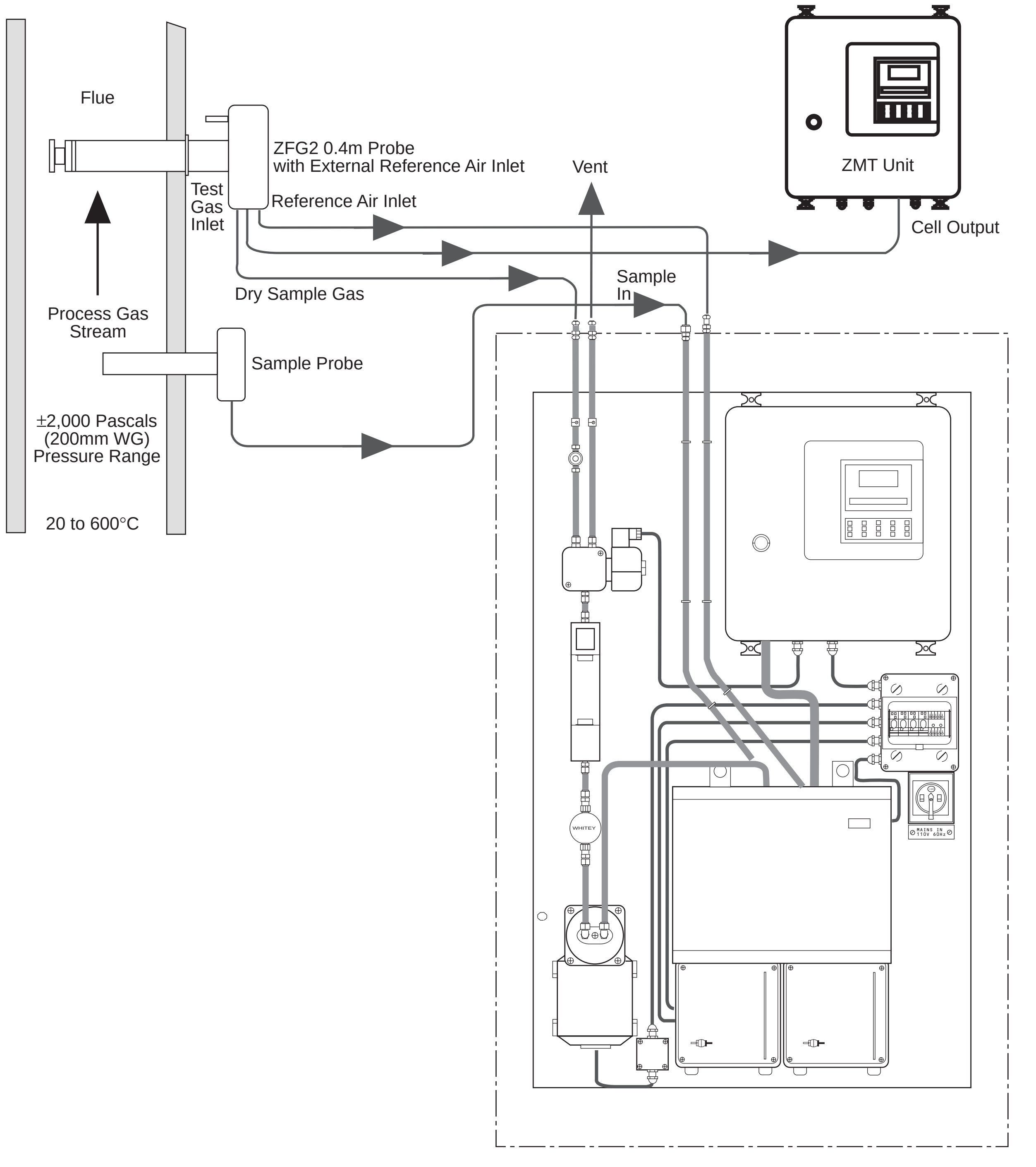


Fig. 3.4 Installation Schematic

4 ELECTRICAL INSTALLATION

WARNING. Before making any connections ensure that the power supply and any high voltage or power-operated control circuits are switched off.

A schematic interconnection diagram for the Humidity System 1 is shown in Fig. 4.3.

4.1 Access to Terminals – Fig. 4.1 and Fig. 4.2

4.1.1 ZMT Unit – Fig. 4.1

① Unlock and open the door, hinged at the right hand edge (turn key clockwise to open).

② Identify the signal connections terminal block.

To gain access to the mains connections terminal block:

③ Remove the two screws retaining the mains protection plate and remove the plate.

④ Identify the mains connections terminal block.

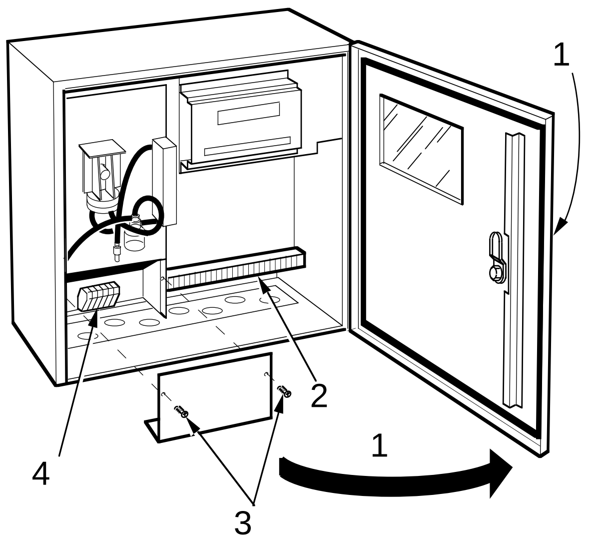


Fig. 4.1 Access to Terminals, ZMT Unit

4.3 Preparation

When making connections note the following:

a) Use only the cables and air tubing specified in Table 1.

b) Ensure that all cables enter the instrument via the glands nearest to the appropriate screw terminals and are short and direct.

Note. Figs. 4.4 and 4.5 overleaf show the recommended routing of cables for the most advanced instrument versions, i.e. those requiring the most cable entries. Alternative entries, nearer the appropriate screw terminals, may be used if some instrument facilities are not used.

c) For details of the ZFG2 probe details refer to the ZFG2 Series Oxygen probes Operating Instructions (ZFG2/0011), Issue 2 onwards.

Cable/Tubing Reference	Description
Cell output cable	16/0.2mm laid up red and blue twin copper braid with overall p.v.c. sheath
Thermocouple cable	Ni-Cr/Ni-Al BS4937 type K and DIN IEC 584 (BS part no. 4)
	Pt/Pt-Rh BS4937 types R and S and DIN IEC 584 (BS part nos. 1 and 2)
Heater cable (Z-FG probes only)	3-core 1mm^2 copper (20 metres max.)* 3-core 1.5mm^2 copper (32 metres max.)* 3-core 2mm^2 copper (69 metres max.)*
Air Tubing	$^1/_4$in. o.d. x $^1/_8$in. i.d. stainless steel, nylon or p.v.c. tube (100°C ambient max.)

* Total run length including flexible conduit.

Table 2 Cable References and Air Tubing Specification

4.3 Summary of Electrical Connections

Refer to Fig. 4.3 for overall schematic diagram.

Summary Of Electrical Connections, ZMT Unit

Terminal Reference	Connection		
Heater			
H			Probe Heater Supply
H			
E			
Mains Supply (From Humidity Cabinet) 110V 50/60Hz Only			
L			Line
N			Neutral
E			Earth
Probe Cell Output			
PROBE	–		From Probe Thermocouple
CELL	+		
Thermocouple			
PROBE	–		From Probe Thermocouple
T/C	+		
Output 3	**(O/P MODULE 3) solid state relay + relay**		
1	AC 1		Solid State Relay 1
2	AC 2		
3	—		
4	normally closed		Relay 2
5	common		
6	normally open		
Output 2	**(O/P MODULE 2) single relay**		
1	—		
2	—		
3	normally closed		Relay 2
4	common		
5	normally open		
Output 2	**(O/P MODULE 2) analogue retransmission + relay**		
1	positive		Analogue Retransmission 2
2	negative		
3	normally closed		Relay 2
4	common		
5	normally open		
Output 1	**(O/P MODULE 1) analogue retransmission + relay**		
1	positive		Analogue Retransmission 1
2	negative		
3	normally closed		Relay 1
4	common		
5	normally open		

Summary Of Electrical Connections, Humidity Unit

Terminal Reference	Connection
Mains Supply – 110V 50/60Hz Only	
1	Line
2	Neutral
3	Earth
Solenoid Control Connections	
4	Control neutral
5	Control live

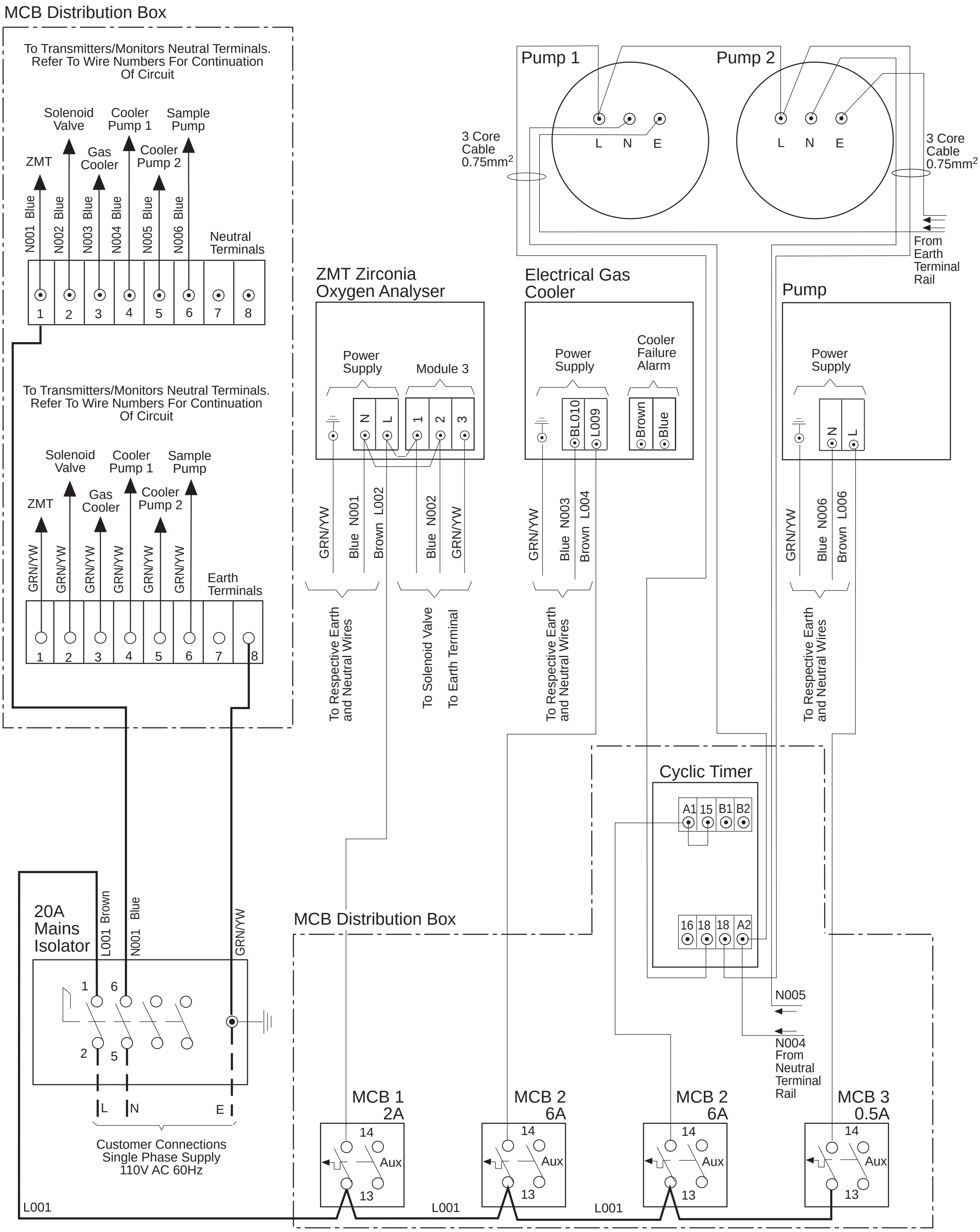


Fig. 4.3 Interconnections Schematic

4.4 Connection Details – Figs. 4.4 and 4.5

Connection details for the ZMT unit and Humidity Cabinet are shown in Figs. 4.4 and 4.5 respectively and are summarised on page 9.

4.4.1 ZMT Unit Connections – Fig. 4.4

Make connections 1 to 5, as applicable.

1. Mains:
   Brown to 'L'
   Blue to 'N'
   Green/Yellow 'E'

2. Output 3 (refer to Section 10 for clarification):

   'O/P MODULE 3'
   '1' – AC1
   '2' – AC2
   '3'
   } Solid state relay 1

   '4' – normally closed
   '5' – common
   '6' – normally open
   } Relay 3

3. Output 2 (refer to Section 2.2 for clarification):

   Single relay - 'O/P MODULE 2'
   '1' and '2' not connected

   '3' – normally closed
   '4' – common
   '5' – normally open
   } Relay 2

   Single relay + analogue output – 'O/P MODULE 2'
   '1' – positive
   '2' – negative
   } Analogue retransmission 2

   '3' – normally closed
   '4' – common
   '5' – normally open
   } Relay 2

4. Output 1 (refer to section 10 for clarification):

   Single relay + analogue output – 'O/P MODULE 1'
   '1' – positive
   '2' – negative
   } Analogue retransmission 1

   '3' – normally closed
   '4' – common
   '5' – normally open
   } Relay 1

5. Secure the Z-FG or ZFG2 conduit fitting into the gland plate and make the following connections:

Cell output	–	red to 'PROBE CELL +' blue to 'PROBE CELL –' screen to 'PROBE CELL E'
Probe thermocouple	–	white to 'PROBE T/C +' blue to 'PROBE T/C –'
Heater	–	brown to 'H' } polarity blue to 'H' } unimportant green/yellow to 'E'

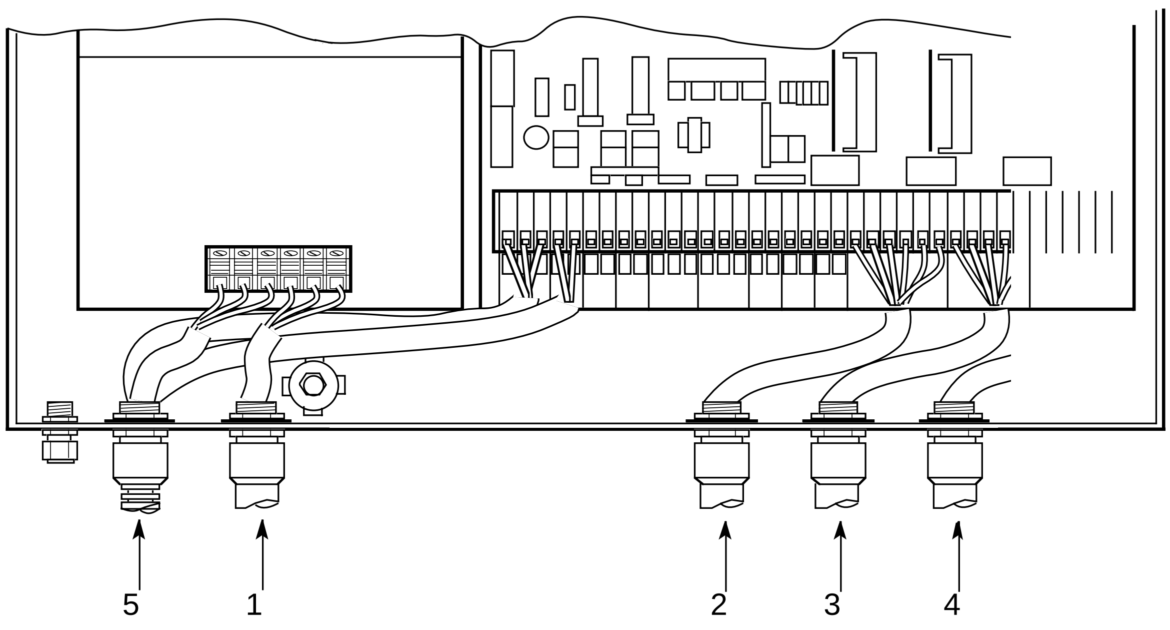


Fig. 4.4 Connection Details, ZMT Unit

5 SETTING UP

5.1 Setting the Mains Input Voltage – Fig. 5.1

The mains input voltage (230V or 110V) is selected by repositioning three plug-in 'handbag' links on the power p.c.b. The 110V position must be selected.

With reference to Fig. 5.1:

1. Unlock and open the door of the ZMT unit.

2. Remove the four screws retaining the pump or flow gauge mounting plate and carefully lift off the plate.

CAUTION. If a pump is fitted take care not to stress the connections between the pump and the power board.

3. Identify the three 'handbag' links.

4. Position all three links for a mains input voltage of 110V.

Refit the mounting plate.

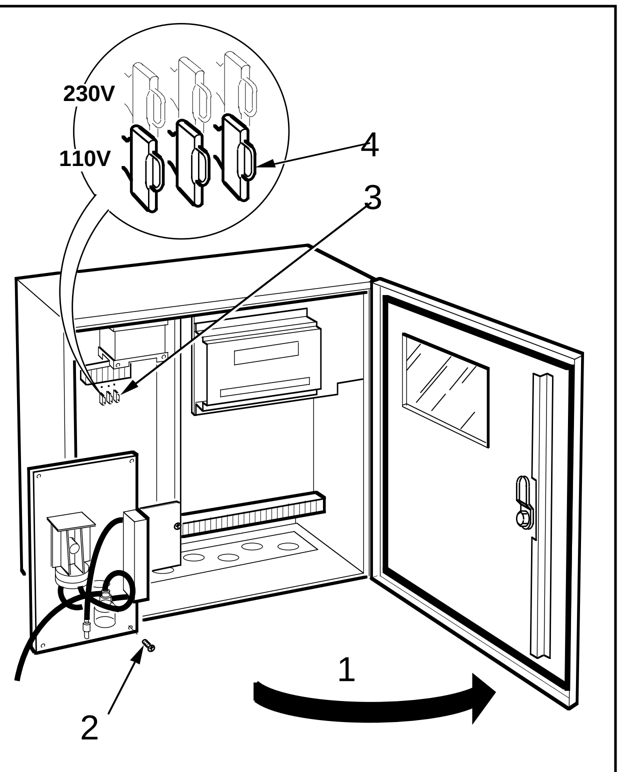


Fig. 5.1 Selecting the Mains Input Voltage

5.2 Selecting the Retransmission Output Range(s) – Fig. 5.2

The retransmission output range(s) is selected by repositioning a plug-in link on the relevant output module – see **Checking the Instrument Code Number** on page 2.

① Identify the relevant output module(s).

② Identify the retransmission selector link (PL3).

③ Set the link position for the retransmission output(s) required.

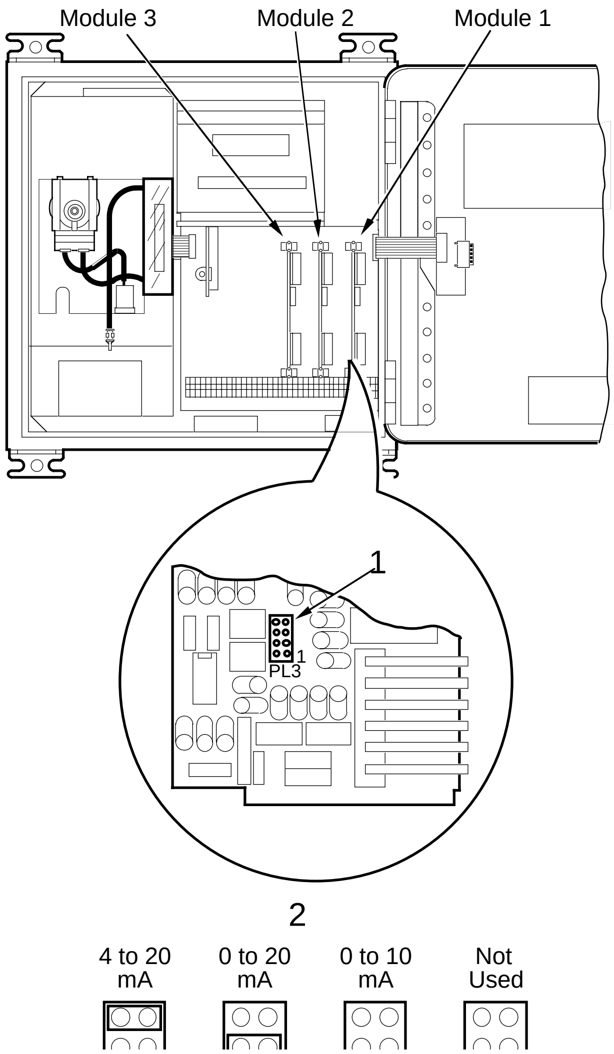


Fig. 5.2 Selecting the Current Output Range

5.3 Mechanical Setup

5.3.1 Fitting the Condensate Trap

a) Suspend the condensate trap from the bottom of the Humidity Cabinet and connect it to the Vacuum Safety Trap with a suitable piece of tubing.

b) Disconnect the sample probe line from the Sample Inlet fitting on the Humidity Cabinet.

c) Fill the 'U' tube and condensate trap with water, via the Sample Inlet fitting, until water can be seen to drip from the drain at the bottom of the condensate trap.

d) Re-connect the sample probe line to the Sample Inlet fitting and tighten.

5.3.2 Filling the Drying Chambers

a) Locate and fill both of the drying chambers with Calcium Chlorate.

b) Isolate one drying chamber, from the reference air, by closing both the top and bottom valves.

c) Open both the top and bottom valves on the other drying chamber to put it into the 'in use' condition.

Note. At any given time only one drying chamber should be in the 'in use' condition.

5.3.3 Connecting the Reference Air Supply

a) Connect a supply of clean, dry instrument air to the Air Inlet Connection of the Humidity Cabinet.

6 CONTROLS, DISPLAYS AND L.E.D.s

The programme controls, digital (upper) display and dot-matrix (lower) display are located on the front of the instrument – see Fig. 6.1.

6.1 Programme Controls, ZMT Unit – Fig. 6.1
The programme controls comprise of fifteen tactile membrane switches of which nine are required to operate the analyser. The six switches which are not required on these versions have been omitted from Fig. 6.1.

The switches are used to gain access to, or sequence through, a series of **programme pages** to view and/or change the **parameters** contained within the pages. Some pages contain two sets of parameters:

USER PARAMETERS – accessible at any time
SECURE PARAMETERS – accessible using a security sequence

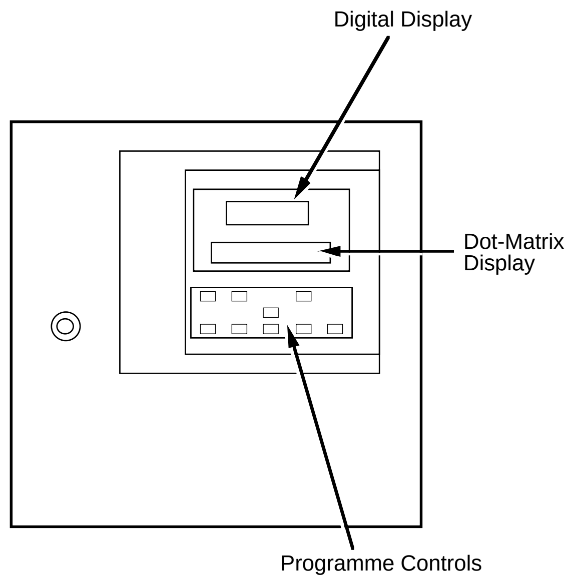


Fig. 6.1 familiarisation with Displays and Controls

Refer to Section 10.1 for the security sequence.

In normal operation the switches are used to view **User Pages** i.e. the measured humidity, cell temperature, alarms, and calibration (as applicable) – see Fig. 10.1. They can also be used to access a further series of **Utility Pages** to set-up relay/analogue retransmission outputs and assess system performance (Diagnostics Page) – see Fig. 10.1.

Individual switch functions are as follows:

%O2 'Humidity' switch – used for accessing the **Humidity Page** (see Fig. 10.3 on page 18).

Temp 'Temperature' switch – used for accessing the **Display Temperature Page** (see Fig.10.4 on page 21).

Alarm 'Alarm' switch – used for accessing the **Alarms and Indication Page** (see Fig. 10.5 on page 24).

Cal 'Calibration' switch – used for accessing the probe **Calibration Page** (see Fig. 11.1 on page 43).

'Page Advance' switch – used for advancing to the next programme page (see Fig. 10.1 on page 16).

'Parameter Advance' switch – used for advancing to the next parameter within a programme page and when calibrating, for rejecting unsatisfactory calibration values.

▲ 'Raise' switch – used for increasing a parameter value or stepping-up through a selection of parameters. Also used as a security switch for access to **SECURE PARAMETERS** within individual pages – refer to Section 10.1.1 on page 16.

▼ 'Lower' switch – used for decreasing a parameter value or stepping-down through a selection of parameters.

Note. Continuous pressure on the 'Raise' or 'Lower' switches causes the rate of change of displayed value to increase. To make small adjustments press the switches momentarily.

Enter 'Enter' switch – used for storing the programmed parameters and values into the instrument's non-volatile memory and, when calibrating, for accepting new calibration values.

Note. The instrument responds instantly to any programme change but the change is lost in the event of a power interruption, or during power-down, if it has not been 'Entered'.

6.2 Displays – Fig. 6.1

There are two displays: 5-digit, seven segment digital display (upper) and a 20-character, 9 x 7 dot-matrix display (lower).

The digital display shows any values relating to the parameter shown on the lower display at any one time.

The dot-matrix display is utilised for displaying all instrument parameters within the programme pages.

6.3 Mechanical Controls, Humidity Cabinet

The Humidity Cabinet houses three flow indicators, each having a manual control valve for the adjusting of flow rates. The control valve is situated at the bottom of each flow indicator.

7 START UP

7.1 Initial start-Up

Note. During start-up, it may be necessary to set the reference air flow to the probe. Refer to section 7.2 for clarification.

When the instrument is first switched on, the upper and lower displays are illuminated for approximately three seconds as a check for failed segments/dots.

The start-up procedure is then implemented in two stages:

Cell warm-up
Cell stabilising

7.1.1 Cell Warm-up

The upper display is blank and the following message is shown on the lower display at all page headers:

x x x Cell warming up

Note. x x x is a short-code page header identifying the current page – refer to Section 11.4 on page 29 for full details.

The instrument automatically monitors the probe temperature until it exceeds the **Probe Under Temperature Alarm Point** for the probe being used; 600°C for Kent probes. During the cell warm-up period all humidity-related parameters are inaccessible or disabled to prevent erroneous readings and/or inadvertent alarm/retransmission operation.

7.1.2 Cell Stabilization

After successful completion of **Cell Warm-up** the page header displays automatically revert to the following:

x x x Cell stabilising

Notes.

a) x x x is a short-code page header identifying the current page – refer to Section 11.4 on page 29 for full details.

b) The measured humidity concentration is now displayed in the upper display as an indication of system operation. This value is for observation only and **must not be taken as the true humidity concentration** until the start-up procedure is completed.

The cell output is monitored until a stable level is detected (15 minutes typ.) If the output has not stabilised after a period of approximately 30 minutes has elapsed, it is assumed that the measured humidity concentration is fluctuating (rather than the cell output) and the instrument reverts to normal operation, i.e. all instrument features available.

During the cell Stabilization period all humidity-related parameters are inaccessible/disabled to prevent erroneous readings and/or inadvertent alarm/retransmission operation.

7.2 Setting the Flow Rates

Unlock and open the door of the humidity Cabinet and the set the flow rates, using the manual control valves, as follows:

Dry Reference Air – 300cc/min.
Vent – 2 to 3 litre/min.
Dry Sample Gas – 2 to 3 litre/min.

7.3 Calibration of the ZFG2 Probe
Carry out a calibration of the ZFG2 probe as detailed in Section 11 on page 42.

7.4 Company Standard Settings and Options – Appendix A2.
For details of Company standard settings and options, for the ZMT unit, refer to Appendix A2.

8 OPERATION

8.1 Routine Maintenance Operations
The following routine maintenance operations should be carried on the Humidity System:

a) A weekly examination of the condensate trap and 'U' tube should be carried out to ensure they are free from debris, and the water replaced if necessary. Refer to Section 5.3.1 if it is necessary to replace the water.

b) A weekly examination of the Calcium Chlorate, in the drying chambers, should be carried out. If the Calcium Chlorate is of a sticky, semi-liquid consistency it should be replaced. Refer to Section 8.2 for replacing the Calcium Chlorate.

c) A monthly calibration of the ZFG2 probe should be carried out. Refer to Section 11 for details on calibrating the ZFG2 probe.

8.2 Replacing the Calcium Chlorate

a) Open both the top and bottom valves of the drying chamber which is isolated from the reference air to bring it into the 'in use' condition.

b) Isolate the drying chamber, which requires the Calcium Chlorate changing, by closing both the top and bottom valves.

c) Remove the drying chamber from the Humidity Cabinet and replace the Calcium Chlorate. Replace the drying chamber ensuring that both top and bottom valve remain closed.

9 FAULT FINDING

9.1 Simple Fault Finding
Carry out the checks detailed in the following table before contacting the Service Organisation.

Are all connections correctly made/?– refer to Section 3 and 4. Is there power to the instrument? Are the mains input selectors set to 110V? – see page 13. Check the **Diagnostics Page** parameters to assess system performance – see page 40. Is the reference air supply tubing blocked and or trapped and is the flow rate correct?

10 PROGRAMMING

10.1 PROGRAMMING – GENERAL
The overall programme chart is shown in Fig. 10.1. Refer to Figs. 10.2 (opposite) and 10.7 (on page 30) for summaries of the **User Pages** and the **Utility Pages**, respectively. The **Commissioning Page** parameters are programmed prior to despatch and cannot be accessed. For full commissioning procedures refer to the Commissioning and Calibration Manual, part no. ZMT/0012, Issue 4 onwards.

10.1.1 Access to Secure Parameters - Figs. 10.2 and 10.7
Secure parameters in individual pages can be accessed by operating and holding the 'Raise' switch for approximately 3 seconds, at any parameter in the page prior to security access being required.

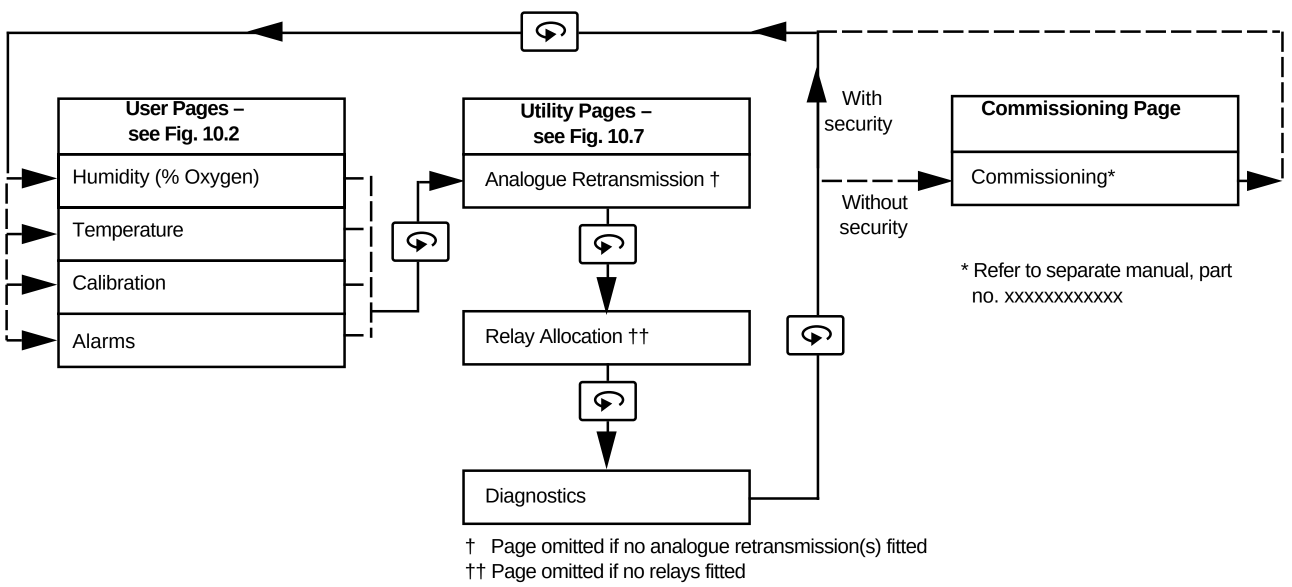


Fig. 10.1 Overall Programme Chart

Switch Panel Controls

%O2 → **Temp** → **Cal** → **Alarm**

%O2: % Water Vapour – see page 19

- Displays the measured humidity as % water vapour

Security

- Displays the residual water constant
- Displays the wet or dry Oxygen sample
- Set the time the system is to sample wet Oxygen
- Set the time the system is to sample dry Oxygen
- Select the Humidity Units (% water vapour, kg/kg or lb/lb)

Temp: Display Temperatures – see page 22

- Cell temperature

Security

- Cell temperature
  a) Units selection (°C or °F)
  b) T/C type selection (K, R or S) or preset temp.

Cal: Calibration – see page 42

- Hold retransmission levels (yes or no)
- Calibrate zero (single point calibration) using air, a test gas or by pre-setting
- Calibrate span (two-point calibration) using test gas

Alarm: Alarms and Indications – see page 25

- Humidity alarms (view only):
  a) Activated high or low
  b) Switched on or off
- Cell temperature alarms (view only):
  a) Activated high or low
  b) Switched on or off

Security

- Humidity alarms (view or change):
  a) Setpoint levels
  b) Activated high or low
  c) Switched on or off
- Cell temperature alarms view or change):
  a) Setpoint levels
  b) Activated high or low
  c) Switched on or off

Fig. 10.2 Summary of User Pages

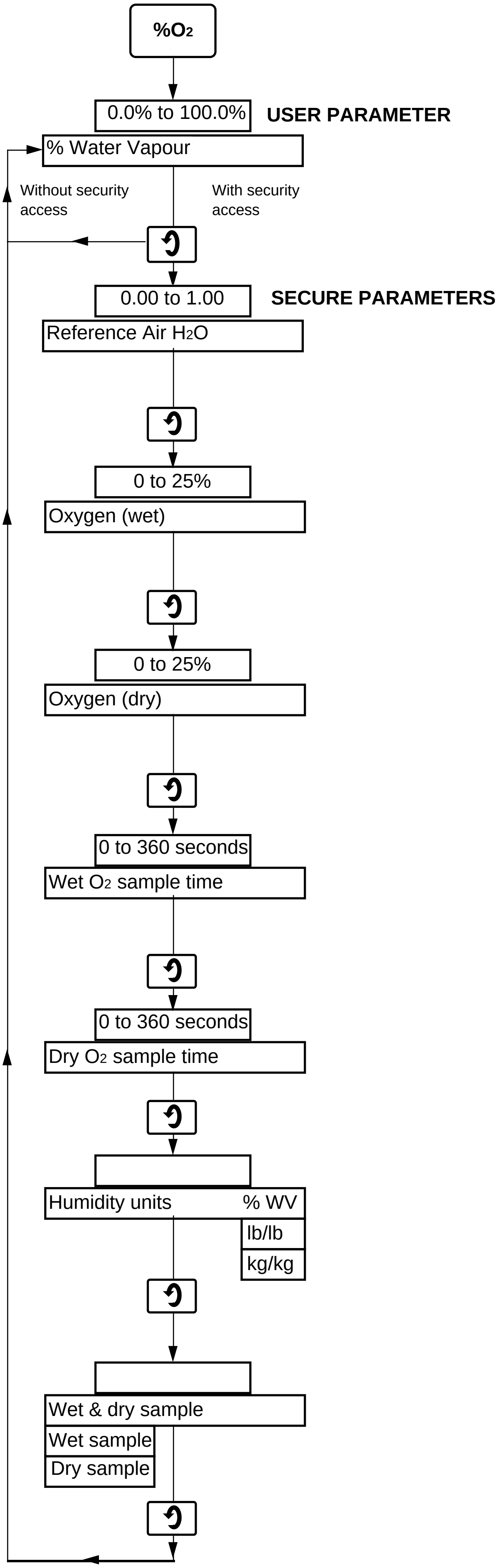


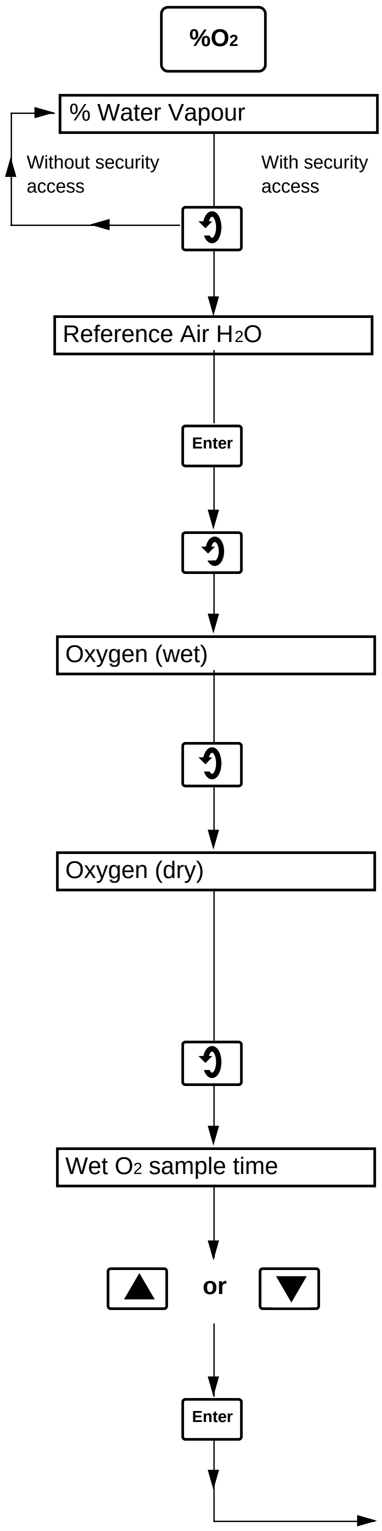
Fig. 10.3 Humidity Page Programme Chart

10.2 Programming – User Pages

10.2.1 Humidity Page – Fig. 10.3

The humidity content, % water vapour, is calculated from the equation in Appendix A1.

Note. The **USER PARAMETER** in this page can only be viewed. To change any parameter, the **SECURI PARAMETERS** at the bottom of the page must be accessed – see page 16.



Select the **% Water Vapour Page**.

USER PARAMETER

% Water Vapour (0 to 100%)
The calculated water vapour content (%) is shown on the upper display. It can also be displayed as lb/lb or kg/kg.

Advance to secure parameters, with security access.

SECURE PARAMETERS

Reference Air H_2O (0 to 1.0)
The residual water constant of the reference air is shown on the upper display.

Wet Oxygen Sample (0 to 25%)
The wet Oxygen sample, measured in situ iin the process gas stream, is shown on the upper display.

Advance to next parameter.

Dry Oxygen Sample (0 to 25%)
The dry Oxygen sample, is shown on the upper display. This sample starts as a wet oxygen sample which is extracted from the process gas stream. It is then de-humidified to a fixed dew point of 1°C and then fed to the Zirconia probe at the test gas inlet.

Advance to next parameter.

Wet Oxygen Sample Time (0 to 360s)
The amount of time in seconds that the system is sampling the wet oxygen is shown on the upper display.

Set the time that the system is to sample the wet Oxygen.

Store.

Continued overleaf

Continued from previous page.

Dry O_2 sample time

Dry Oxygen Sample Time (0 to 360s)
The amount of time in seconds that the system is sampling the dry oxygen is shown on the upper display.

▲ **or** ▼

Set the time that the system is to sample the dry Oxygen.

Enter

Store.

Humidity units %WV
lb/lb
kg/kg

Water Vapour, Display Units
Select the water vapour display units.

▲ **or** ▼

%WV

%WV display units.

or

lb/lb

lb/lb display units.

or

kg/kg

kg/kg display units.

Enter

Store.

Advance to next parameter.

Wet & dry sample
Wet sample
Dry sample

Water Vapour, Display Units
Select either wet & dry, wet or dry sample.

Wet & dry sample

Wet and dry sample.

or

Wet sample

Wet sample.

▲ **or** ▼

or

Dry sample

Dry sample.

Enter

Store.

To

% Water vapour

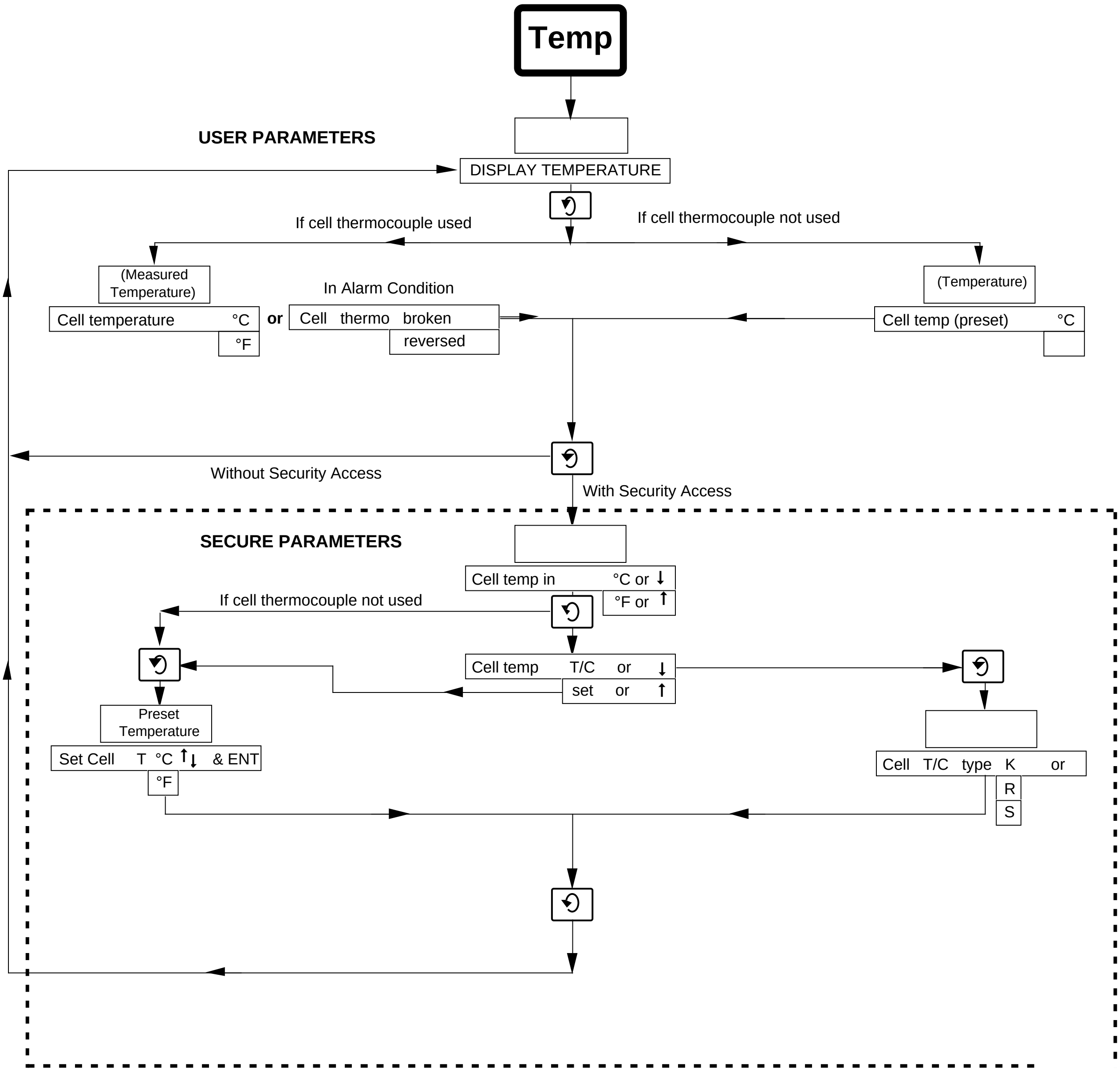
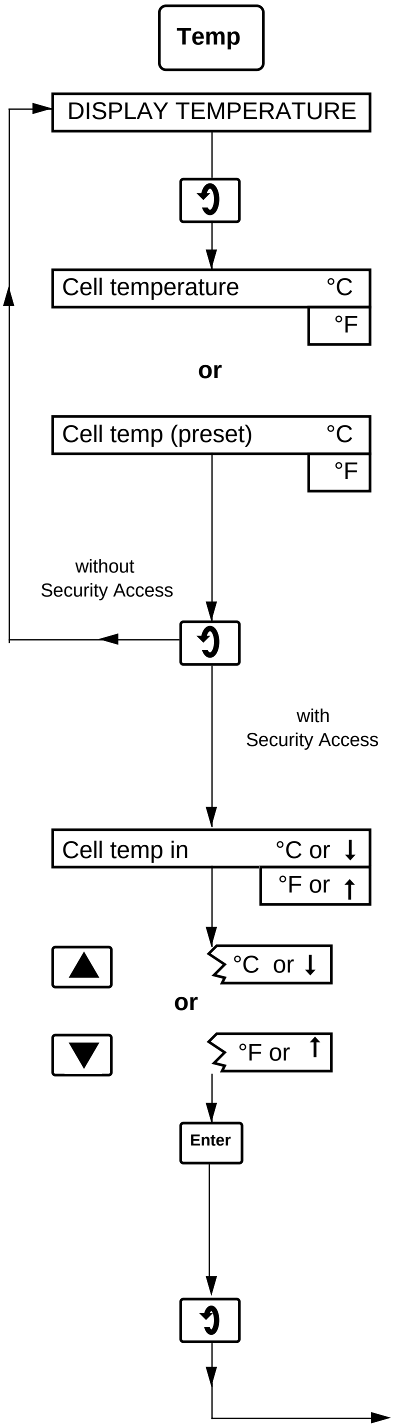


Fig. 10.4 Temperature Page Programme Chart

10.2.2 Display Temperature Page – Fig. 10.4

Refer to Fig. 10.4 when carrying out the following procedures.

Note. The **USER PARAMETERS** in this page can only be viewed. To change any parameter, the **SECURE PARAMETERS** at the bottom of the page must be accessed – see page 16.



Select the **Display Temperature Page**.

USER PARAMETERS

Advance to next parameter.

Measured Cell Temperature
The measured cell temperature is shown on the upper display.

or

Preset Cell Temperature
The preset cell temperature is shown on the upper display.

Note. A preset cell temperature disables the probe heater supply and subsequently can not be used with Z-FG probes.

Advance to next parameter (with security access).
or
Return to top of **Display Temperature Page** (without security access).

SECURE PARAMETERS

Cell Temperature, Display Units
Select the cell temperature display units.

°C display units.

or

°F display units.

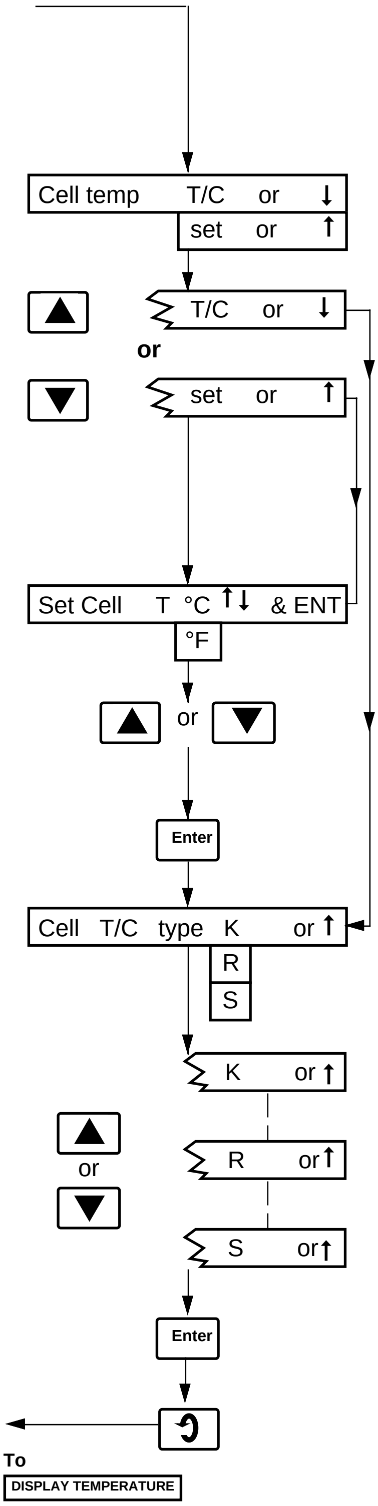
Store

Note. Any analogue retransmission outputs, relay outputs or diagnostic checks relating to the cell thermocouple input are automatically displayed in the units selected – see Figs. 17, 18 and 19 on pages 32, 38 and 44 respectively.

Advance to next parameter.

Continued opposite.

Continued from opposite page.



Cell Temperature, Thermocouple or Preset Temperature
Select whether the cell temperature is to be preset or measured using a thermocouple:

Use thermocouple to measure cell temperature.

or

Use preset cell temperature.

Note. The preset temperature is a reference value for calculation of Oxygen concentration using the Nernst equation and is not a temperature control setting for the probe.

Presetting the Cell Temperature
The preset temperature is shown on the upper display.

Set the temperature to that at which the probe is operated (must be greater than 600°C).

Store.

Cell Temperature Thermocouple Type
Select the thermocouple being used for cell temperature measurement:

Type K thermocouple.

Type R thermocouple.

Type S thermocouple.

Store

Return to top of **Display Temperature Pa**

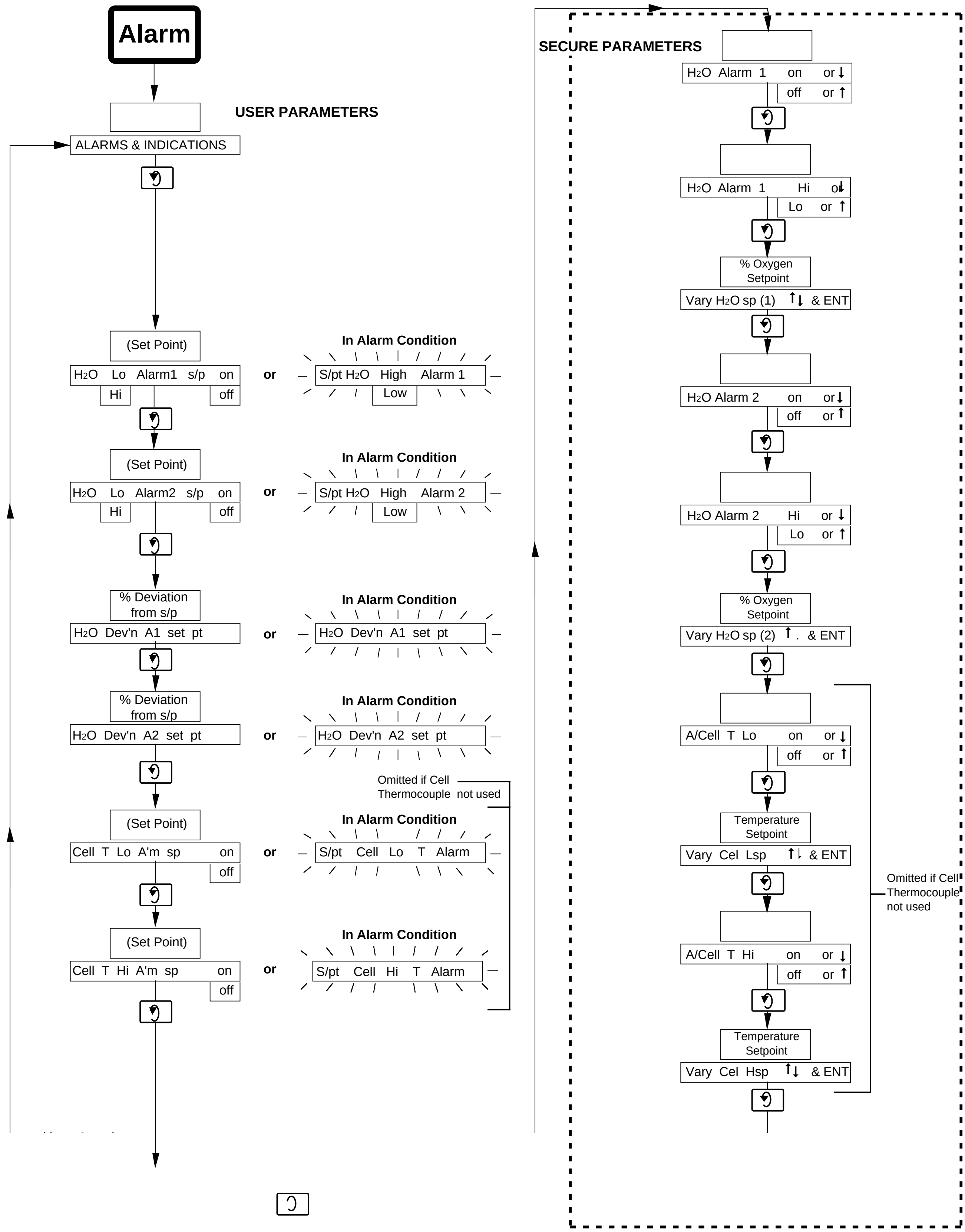


Fig. 10.5 Alarm Page Programme Chart

10.2.3 Alarms and Indications page – Fig. 10.5

Refer to Fig. 10.5 when carrying out the following procedures.

Note. The **USER PARAMETERS** on this page can only be viewed. To change any parameter, the **SECURE PARAMETERS** at the bottom of the page must be accessed – see page 16.

Alarm

Select **Alarms and Indications Page**.

ALARMS & INDICATIONS

USER PARAMETERS

Advance to next parameter.

H_2O Lo Alarm1 s/p on
Hi off

Humidity Alarm 1 Setpoint

The set point is shown on the upper display. The alarm may be either on or off and activated either high or low:

- High – alarm activated above set point.
- Low – alarm activated below set point.

or

S/pt H_2O High Alarm 1
Low

In alarm condition (display flashing).

Advance to next parameter.

H_2O Lo Alarm2 s/p on
Hi off

Humidity Alarm 2 Setpoint

As for **Humidity Alarm 1 Setpoint**, above.

or

S/pt H_2O High Alarm 2
Low

In alarm condition (display flashing).

Advance to next parameter.

%H_2O Dev'n A1 set pt

Humidity 1, Deviation from Setpoint

The deviation of the measured Humidity concentration from that of the **Humidity Alarm 1 Setpoint** is shown on the upper display.

Advance to next parameter.

%H_2O Dev'n A2 set pt

Humidity Alarm 2, Deviation from Setpoint

The deviation of the measured Humidity concentration from that of the **Humidity Alarm 2 Setpoint** is shown on the upper display.

Advance to next parameter.

Cell T Lo A'm sp on
off

Cell Temperature Low Alarm Setpoint

Note. This parameter is omitted if the cell temperature is preset in the **Display Temperature Page** – see page 22.

The setpoint is shown on the upper display and the alarm may be on or off.

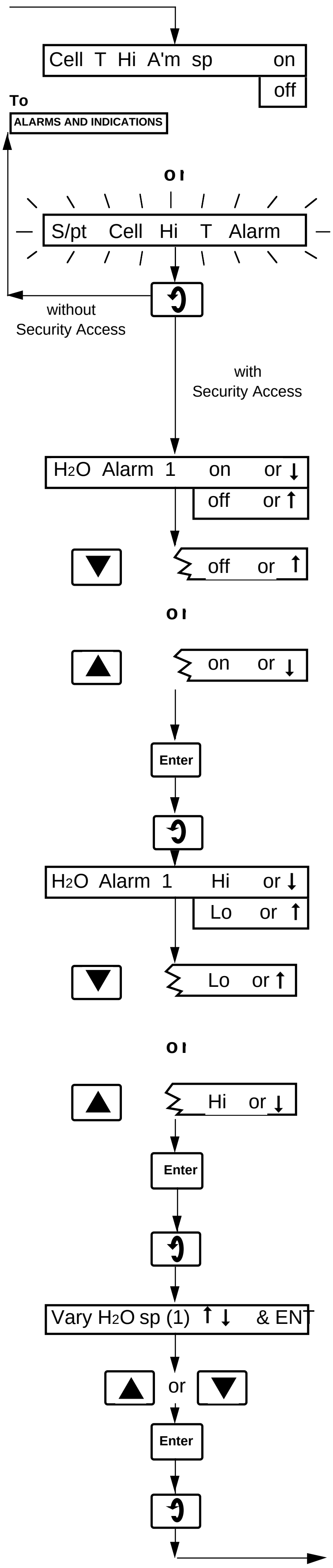
or

S/pt Cell Lo T Alarm

In alarm condition (display flashing).

Advance to next parameter.

Continued overleaf.



Continued from previous page.

Cell Temperature High Alarm Setpoint
As for **Cell Temperature Low Alarm Setpoint**, above.
Note. The high alarm setpoint may be set at a lower value than that of the low alarm setpoint, if required.

or

In alarm condition (display flashing).

Return to top of **Alarms and Indications Page** (without security access).
or
Advance to **SECURE PARAMETERS** section (with security access).

SECURE PARAMETE

Humidity Alarm 1, On or

Switch off.

or

Switch on.

Store.

Advance to next parameter.

Humidity Alarm 1, Activated High o

Activate low (below setpoint).

or

Activate high (above setpoint).

Store.

Advance to next parameter.

Adjust Humidity Alarm 1 Set

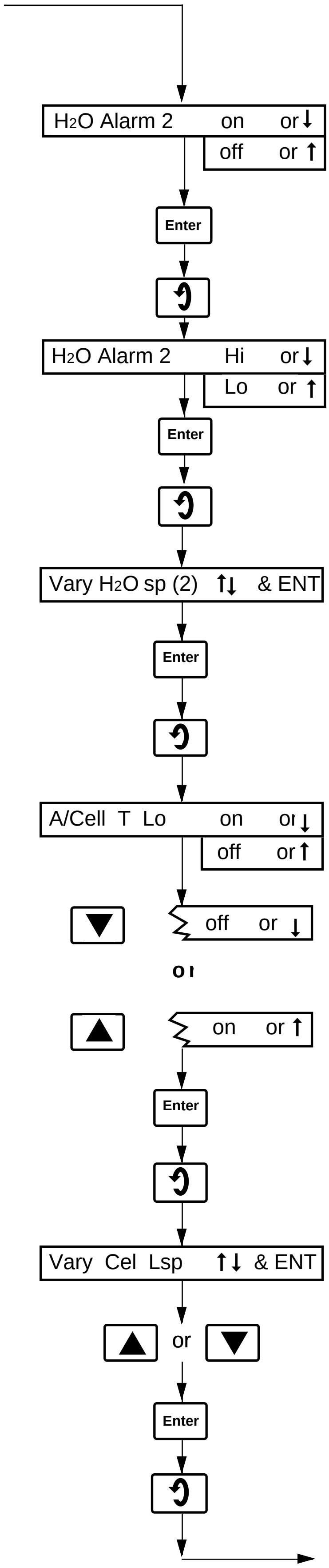
Set the value on the upper display to that of the setpoint required.

Store

Advance to next parameter.

Continued opposite.

Continued from opposite page.



Humidity Alarm 2, On or Off
Repeat as for **Humidity Alarm 1**, On or Off, above.

Store

Advance to next parameter.

Humidity Alarm 2, Activated High or Low
Repeat as for **humidity Alarm 1, Activated High or Low**, above.

Store

Adjust Humidity Alarm 2 Setpoint
Repeat as for **Adjust Humidity Alarm 1 Setpoint**, above.

Store

Advance to next parameter.

Cell Temperature Low Alarm Setpoint, On or Off

Switch off.

or

Switch on.

Store

Advance to next parameter.

Adjust Cell Temperature Low Alarm Setpoint

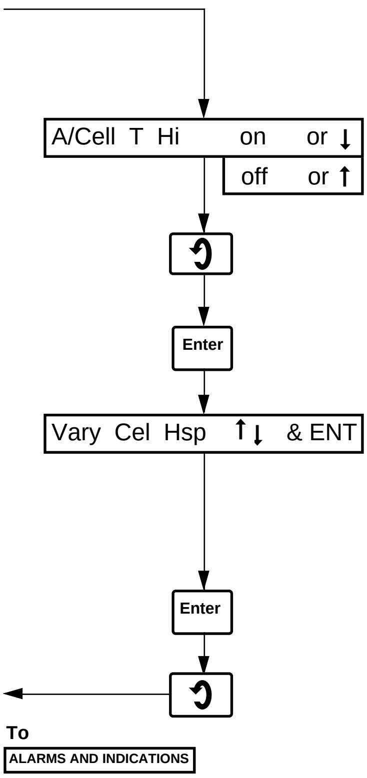
Set the value on the upper display to that of the setpoint required.

Store

Advance to next parameter.

Continued overleaf.

Continued from opposite page.



Cell Temperature High Alarm Setpoint, On or Off
Repeat as for **Cell Temperature Low Alarm Setpoint, On or Off,** above.

Advance to next parameter.

Store

Adjust Cell Temperature High Alarm Setpoint
Repeat as for **Adjust Cell Temperature Low Alarm Setpoint,** above.

Note. The low alarm setpoint may be set to a higher value than that of the high alarm setpoint, if required.

Store

Return to top of **Alarms and Indications Page.**

10.2.4 Alarm Indication - Fig. 10.6

In the event of an alarm, short-code page header description and abbreviated alarm description are shown on the lower display – see Fig. 10.6.

If an alarm(s) occurs whilst a parameter in any particular page is being viewed, the lower display automatically reverts to the top of that page to show the alarm description, i.e. to prevent an alarm being overlooked.

Note. If an alarm(s) occurs whilst a calibration procedure is being implemented any relays assigned to the alarm are activated but the alarm description is not displayed until the calibration is complete, in order to prevent interruption of a calibration procedure.

Once the alarm condition has been indicated, all user/ programming pages can be viewed to assess the action required to clear the alarm. In the **Alarm and Indications Page** any activated alarm parameter reverts to a flashing alarm message; non-activated alarm parameters are unchanged.

Lower Display

Short-code Page Header:

%H_2O	–	Humidity
T	–	Temperature
ALM	–	Alarms and Indications
CAL	–	Calibration
AN	–	Analogue Retransmission
RLY	–	Relay Allocation
DIA	–	Diagnostics

Abbreviated Alarm Description

cell T/C reversed	–	Cell thermocouple reversed
broken cell T/C	–	Broken cell thermocouple
cell warming up	–	Cell warming up*
cell stabilising	–	Cell stabilising*
cell under temp	–	Cell under temperature
cell Lo T alarm	–	Low cell temperature alarm
cell Hi T alarm	–	High cell temperature alarm
Hi H_2O alarm 1	–	High Oxygen alarm 1
Lo H_2O alarm 1	–	Low Oxygen alarm 1
Hi H_2O alarm 2	–	High Oxygen alarm 2
Lo H_2O alarm 2	–	Low Oxygen alarm 2

Multiple Alarm Indicator

* Applicable only on initial start-up – see page 15

Fig. 10.6 Alarm Indication

10.2.5 Multiple Alarm Indication

In the event of more than one alarm being activated the alarm of highest priority for accurate instrument operation is shown on the lower display i.e. fault alarms have priority over user alarms. An asterisk at the end of the display signifies that an additional alarm, or alarms, has occurred.

Alarm priorities, in descending order, are as follows:

- Cell thermocouple reversed
- Cell thermocouple broken
- Probe warming up
- Cell stabilising } see Section 7.1
- Cell under temperature
- High cell temperature
- Low cell temperature
- Humidity 1
- Humidity 2

Any additional alarm(s) can be located by viewing the **Alarms and Indications** and **Display Temperature** pages.

10.2.6 Instrument Response in Event of Fault Alarm(s)

If a fault alarm(s) occurs the instrument automatically controls specific parameters to prevent use of unreliable information and/or to prevent damage to the probe. Activation of user alarms have no effect on instrument operation.
Instrument response for each fault alarm is detailed in Tables 10.1 to 10.3 following:

10.3 Programming – Utility Pages

10.3.1 General Programming

A summary of Utility Pages is shown in Fig. 10.7 below. For a summary of the User Pages refer to Fig. 10.2 on page 17.

10.3.2 Analogue Retransmission Page – Fig. 10.8 (continued)

Refer to Fig. 10.8 when carrying out the following procedures.

Alarm Description	Pages Affected	Parameters Affected
'cell T/C reversed' (shown at all page headers)	Humidity page	% H O not available (top display blank)
	Temperature page	Measured cell temperature is replaced by 'Cell thermo reversed'
	Alarms and Indications page	Humidity alarms 1 and 2 are disabled Deviation alarms revert to flashing alarm description – 'S/pt H O High/Low Alarm 1/2'
	Relay Allocation page	Any relay with cell temperature alarm assigned is disabled Any relay with humidity alarm assigned is disabled
	Analogue Retransmission page	Any retransmission with % water vapour assigned is set to minimum output Any retransmission with cell temperature assigned is set to minimum output
	Calibration page	Not available

Table 10.1 Cell Thermocouple Reversed

Alarm Description	Pages Affected	Parameters Affected
'cell T/C broken' (shown at all page headers)	Humidity page	% H O not available (top display blank)
	Temperature page	Measured cell temperature is replaced by 'Cell thermo broken'
	Alarms and Indications page	Humidity alarms 1 and 2 are disabled Deviation alarms revert to flashing alarm description – 'S/pt H O High/Low Alarm 1/2'
	Relay Allocation page	Any relay with cell temperature alarm assigned is disabled Any relay with humidity alarm assigned is disabled
	Analogue Retransmission page	Any retransmission with cell temperature assigned is set to maximum output
	Calibration page	Not available

Table 10.2 Cell Thermocouple Broken

Alarm Description	Pages Affected	Parameters Affected
'cell under temp' (shown at all page headers)	Humidity page	% H O not available (top display blank)
	Temperature page	Measured cell temperature is replaced by 'Cell thermo broken'
	Alarms and Indications page	Humidity alarms 1 and 2 are disabled Deviation alarms revert to flashing alarm description – 'S/pt H O High/Low Alarm 1/2'
	Relay Allocation page	Any relay with humidity alarm(s) assigned is disabled
	Analogue Retransmission page	Any retransmission with % water vapour assigned is set to minimum output
	Calibration page	Not available

Table 10.3 Cell Under Temperature Alarm

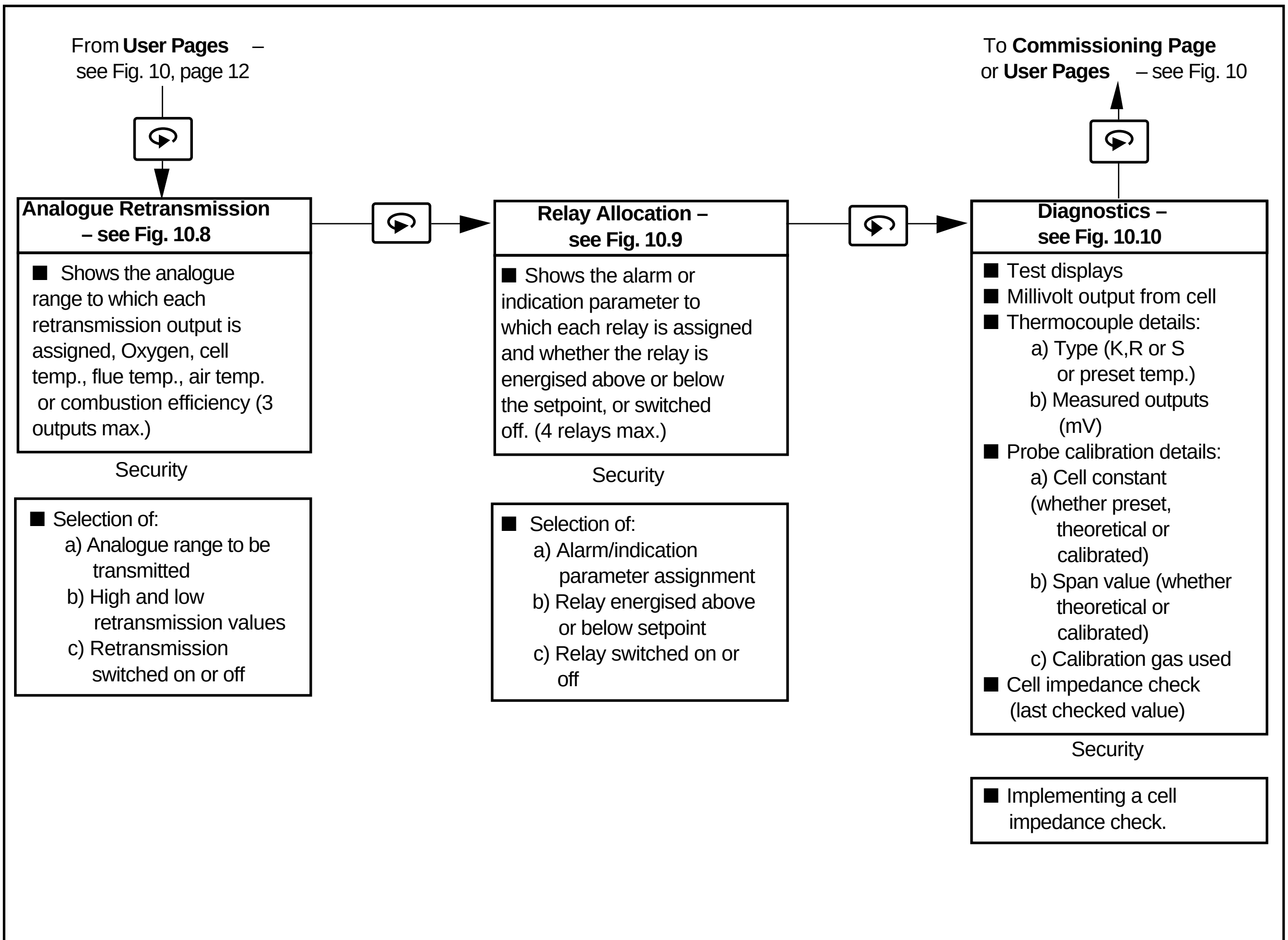


Fig. 12.1 Utility Pages

10.3..2 Analogue Retransmission Page – Fig. 10.8

N.B. This page is omitted if there are no retransmission outputs.

The number of retransmission outputs is selected on the **Commissioning Page** (see separate manual xxxxxxx):
1 or 2 – basic analysers

The following parameter ranges may be assigned to any of the retransmission outputs:
Measured % water vapour
Measured cell temperature *

* Cannot be retransmitted if utilising a preset temperature – refer to Section 10.2.2 on page 22.

Refer to Section 5.2 on page 13 to identify the retransmission current output range.

Note. The **USER PARAMETERS** in this page can only be viewed. To change any parameter the **SECURE PARAMETE** section must be accessed for **each individual retransmission output** – see page 16.

Contiinued on page 32

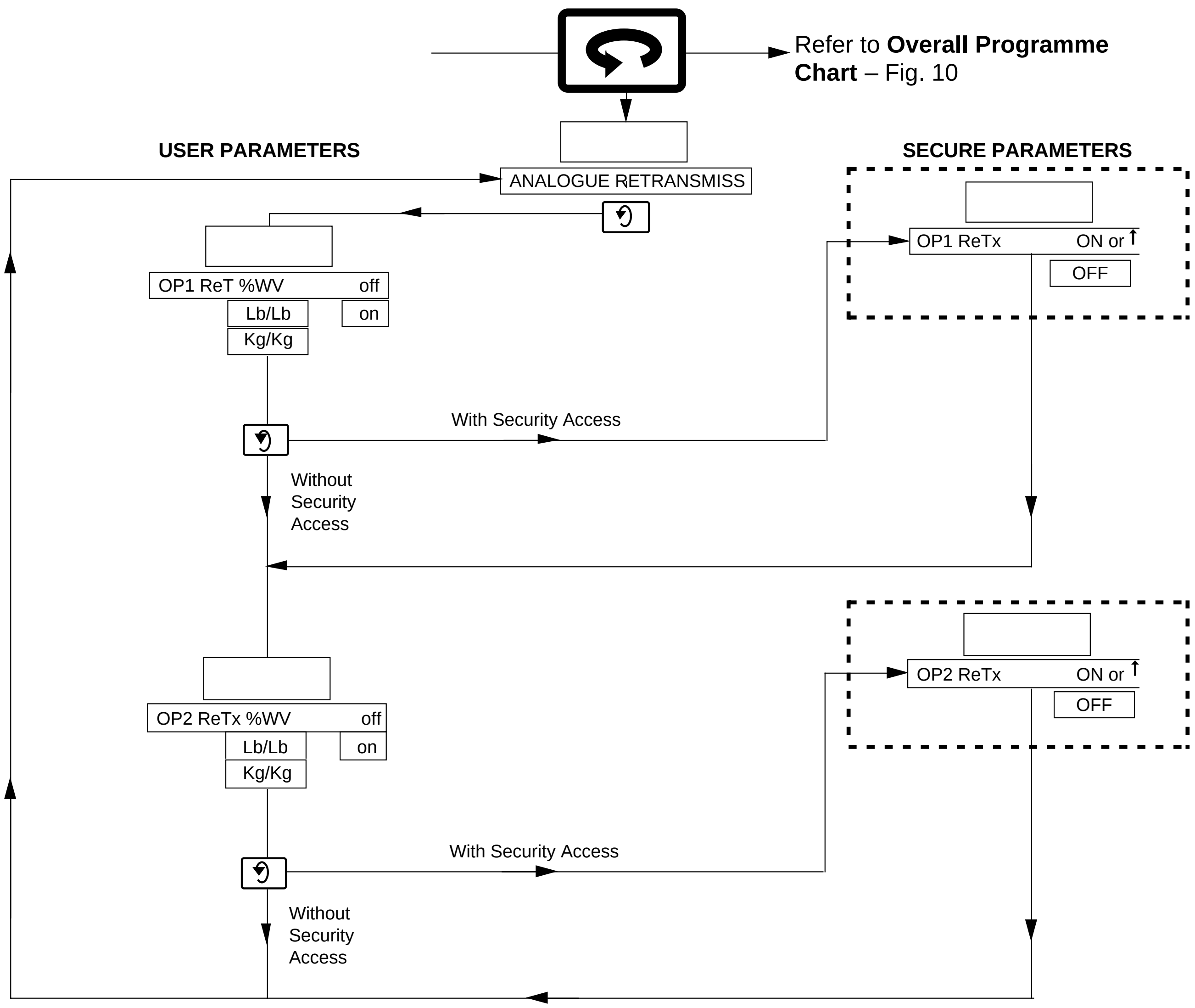
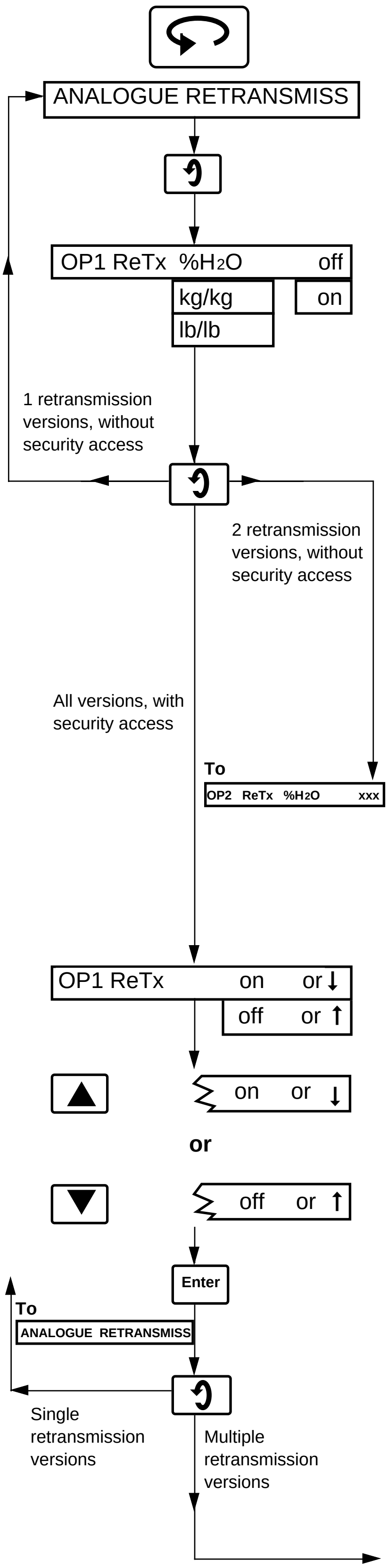


Fig. 10.8 Analogue Retransmission Page Programme Chart



Select **Analogue Retransmission Page.**

Advance to next parameter.

USER PARAMETER

Retransmission Output 1

The parameter range assigned to retransmission output 1 is displayed. The output may be either on or off, and the units are the same as those selected in the Humidity Page. Refer to pages 19 and 20 for full details of ranges.

Return to top of **Analogue Retransmission Page** (1 retransmission versions).

or

Advance to next parameter (2 retransmission versions without security access).

or

Advance to **SECURE PARAMETERS (Retransmission 1)** section (all versions, with security access).

SECURE PARAMETERS (Retransmission 1)

Retransmission Output 1, On or Off

Switch on.

or

Switch off.

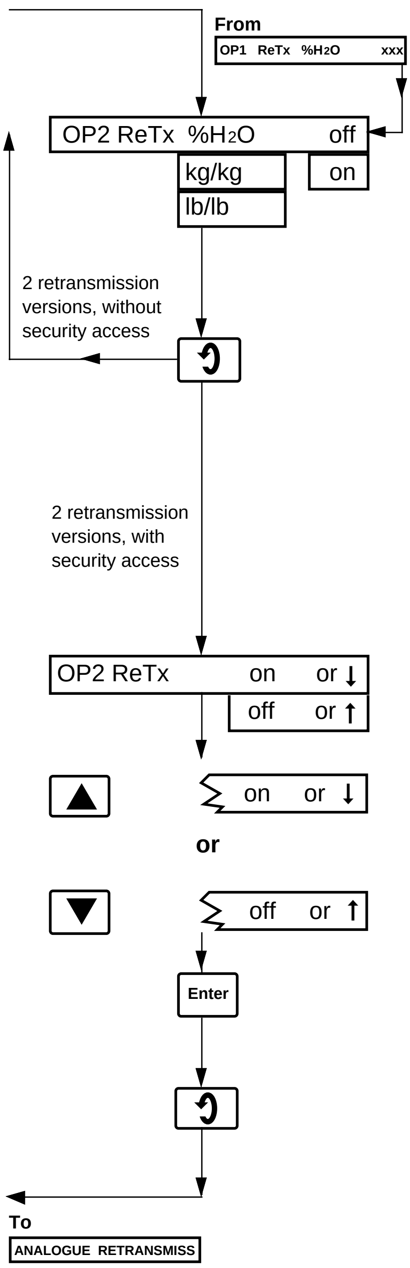
Store

Return to top of **Analogue Retransmission Page** (single retransmission versions).

or

Advance to next parameter (multiple retransmission versions).

Continued opposite.



Continued from opposite page.

USER PARAMETER

Retransmission Output 2

The parameter range assigned to retransmission output 2 is displayed. The output may be either on or off, and the units are the same as those selected in the Humidity page.

Return to top of **Analogue Retransmission Page** (2 retransmission versions).

or

Advance to **SECURE PARAMETERS (Retransmission 2)**

SECURE PARAMETERS (Retransmission

Retransmission Output 2, On or

Switch on.

or

Switch off.

Store

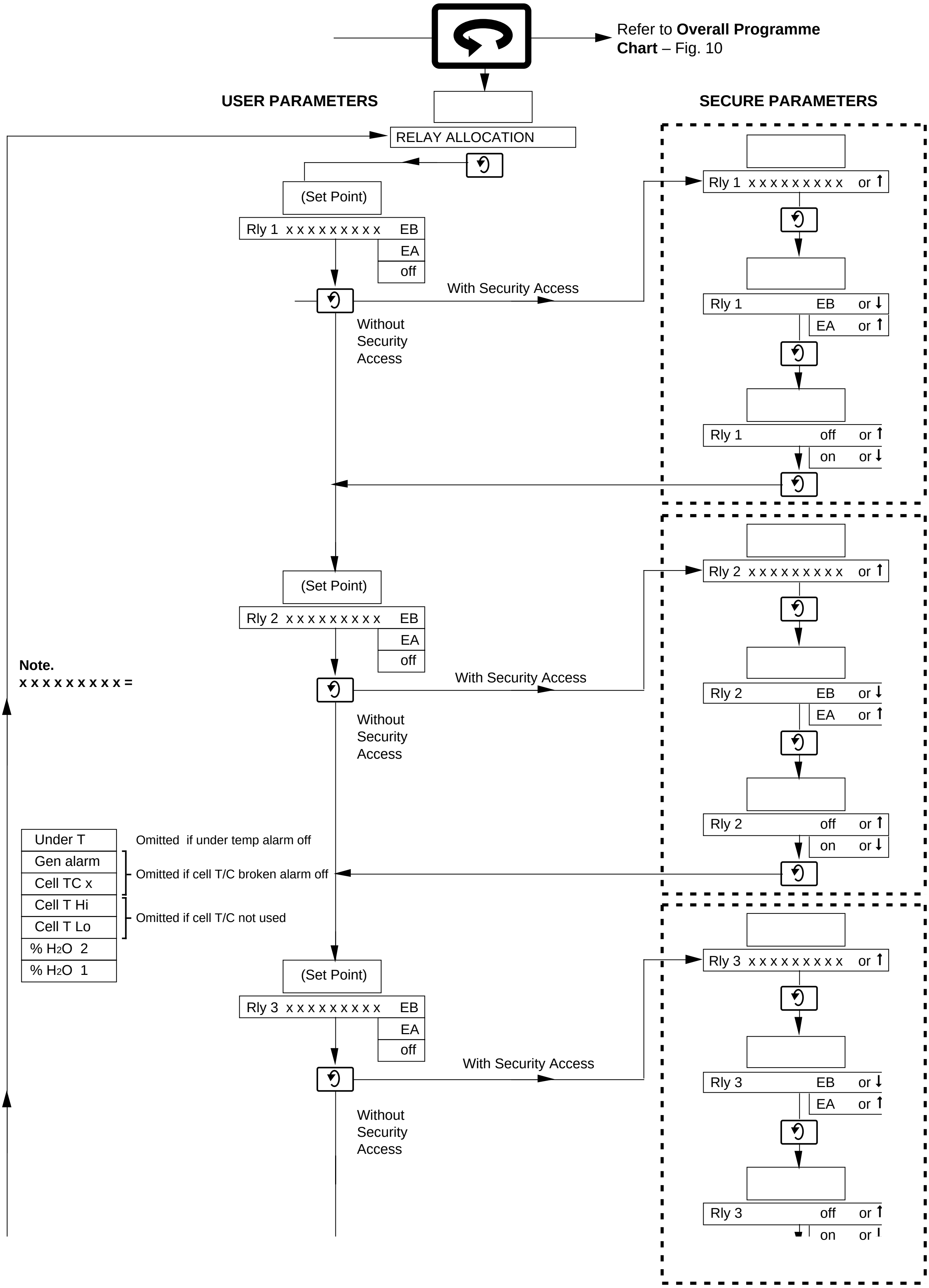


Fig. 10.9 Relay Allocation Page Programme Chart

10.3.3 Relay Allocation Page – Fig. – 10.9

Refer to Fig. 10.9 when carrying out the following procedures.

N.B. This page is omitted if there are no relay outputs. The number of relay outputs (0 to 3) is selected in the **Commissioning Page** – see separate manual xxxxxx.

The following parameters/parameter ranges may be assigned to any of the relay outputs:

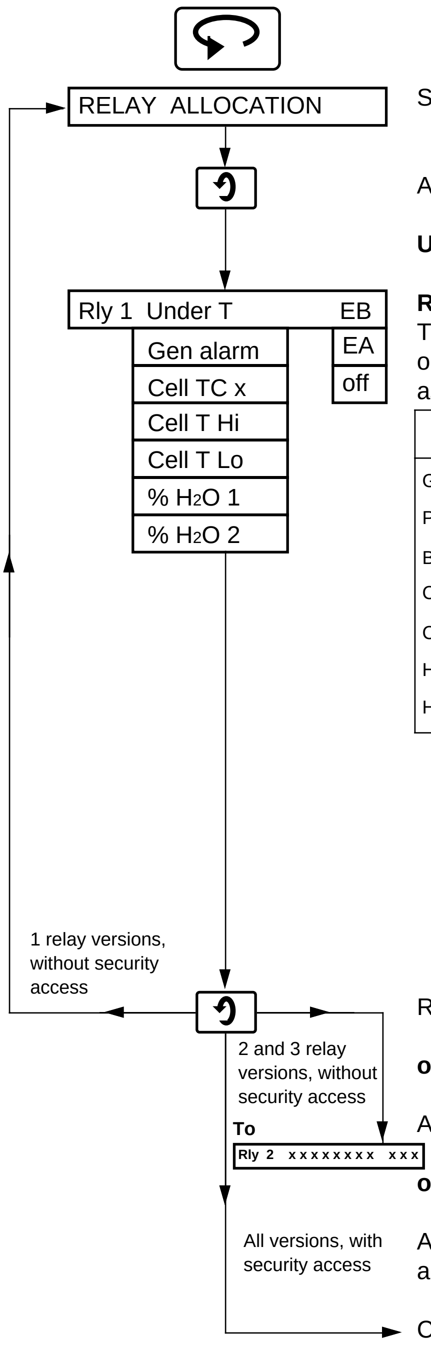
- General alarm (for any alarm)
- Probe under temperature alarm
- Broken cell thermocouple

Fault Alarms

- Cell temperature too high
- Cell temperature too low
- Humidity alarm 1
- Humidity alarm 2

User Alarms

Note. The **USER PARAMETERS** in this page can only be viewed. To change any parameter the **SECURE PARAMETE** section must be accessed for **each individual retransmission output** – see Section 10.1 on page 16.



Select **Relay Allocation Page**.

Advance to next parameter.

USER PARAMETER

Relay 1
The parameter assigned to relay 1 is displayed. The relay may be energised above or below the set point/changeover point depending on the parameter, or switched off, as follows:

Parameter	EA (Energised Above)	EB (Energised Below)	Off
General alarm	Energised in alarm condition	Energised in normal condition	Off
Probe under temperature	Energised in fault condition	Energised in normal condition	Off
Broken cell thermocouple	Energised in fault condition	Energised in normal condition	Off
Cell temperature high	Energised in alarm condition	Energised in normal condition	Off
Cell temperature low	Energised in alarm condition	Energised in normal condition	Off
Humidity alarm 1	Energised in alarm condition	Energised in normal condition	Off
Humidity alarm 2	Energised in alarm condition	Energised in normal condition	Off

Return to top of **Relay Allocation Page** (1 relay versions, without security access).

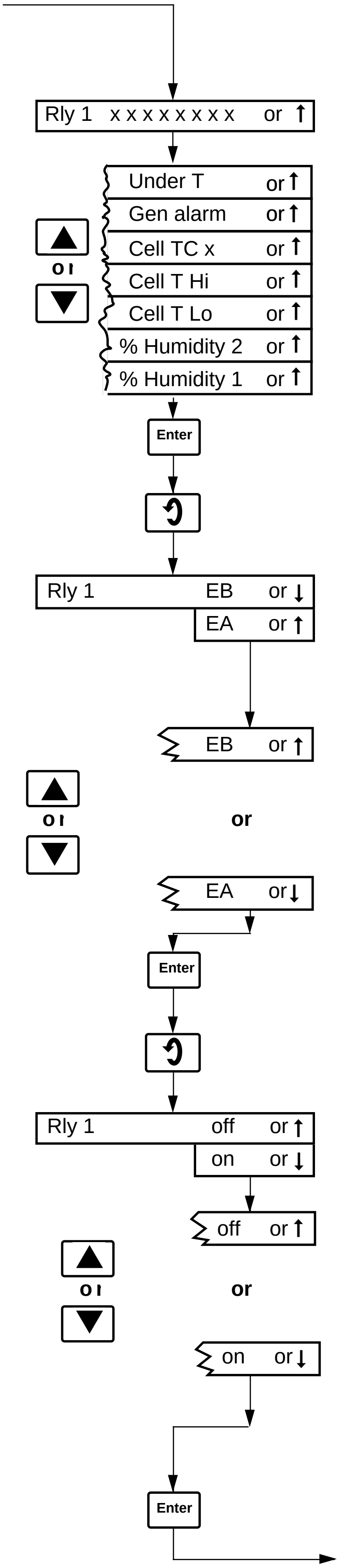
or

Advance to next parameter (2 and 3 relay versions, without security access).

or

Advance to **SECURE PARAMETERS (relay 1)** section (all versions, with security access).

Continued overleaf.



Continued from previous page.

SECURE PARAMETERS

Relay 1, Parameter

Select the parameter to be assigned to relay 1.

Store

Advance to next parameter.

Relay 1, Operation

The relay can be energised above or below the set point/changeover point (depending on the parameter) – see **Relay 1** above.

Select the relay operation required:

Energise below the set point/changeover point.

or

Energise above the set point/changeover point.

Store

Advance to next parameter.

Relay 1, On or Off

Switch on.

or

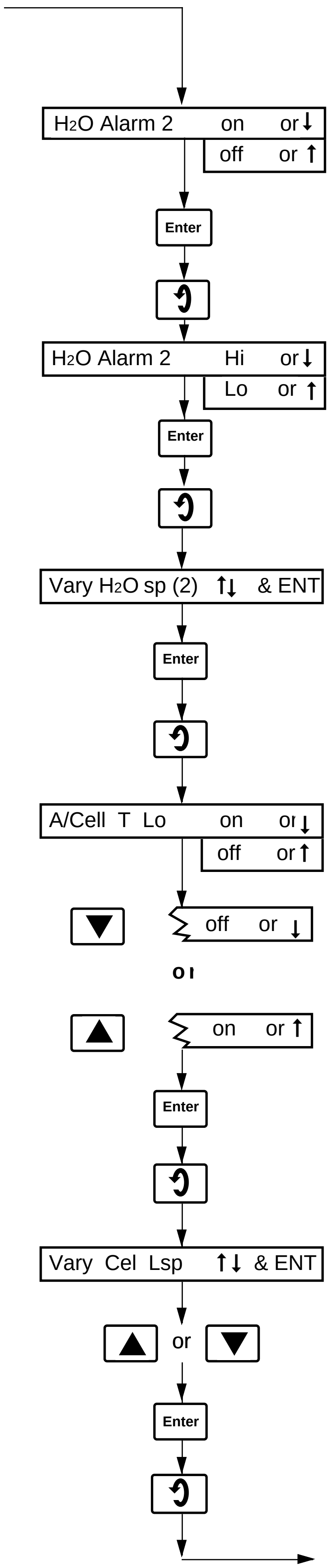
Switch off.

Note. Only the relay itself can be switched off in this page. The set point, where applicable, may be switched on or off in the **Alarms and Indications Page** – see page 25.

Store

Continued opposite.

Continued from opposite page.



Humidity Alarm 2, On or Off
Repeat as for **Humidity Alarm 1**, On or Off, above.

Store

Advance to next parameter.

Humidity Alarm 2, Activated High or Low
Repeat as for **humidity Alarm 1, Activated High or Low**, above.

Store

Adjust Humidity Alarm 2 Setpoint
Repeat as for **Adjust Humidity Alarm 1 Setpoint**, above.

Store

Advance to next parameter.

Cell Temperature Low Alarm Setpoint, On or Off

Switch off.

or

Switch on.

Store

Advance to next parameter.

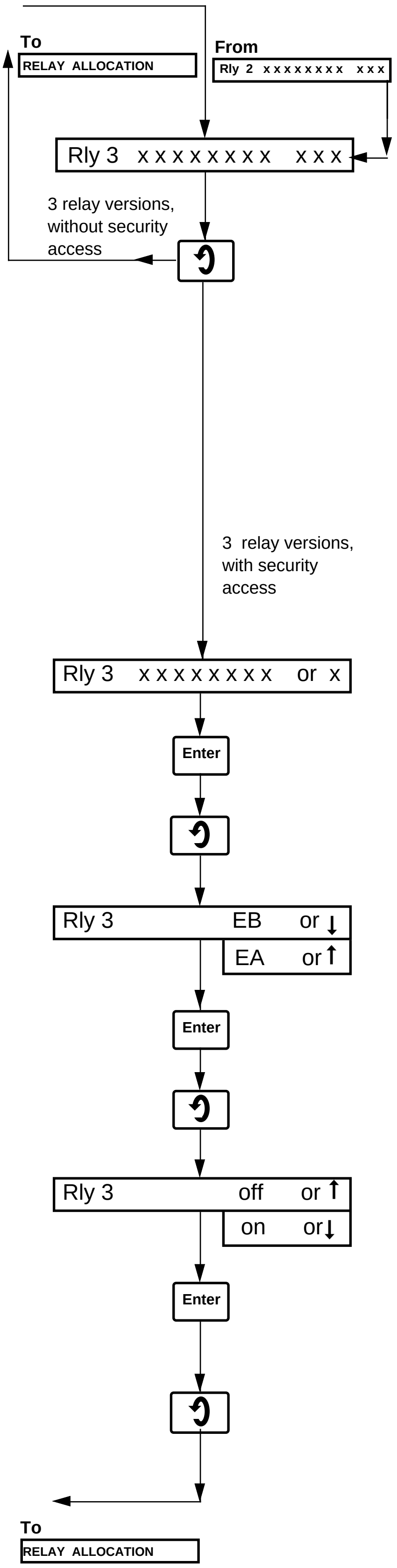
Adjust Cell Temperature Low Alarm Setpoint

Set the value on the upper display to that of the setpoint required.

Store

Advance to next parameter.

Continued overleaf.



Continued from previous page.

USER PARAMETER

Relay 3
The parameter assigned to relay 3 is displayed. Repeat as for **Relay 1** on page 36.

Return to top of **Relay Allocation Page** (3 relay versions, without security access).

or

Advance to **SECURE PARAMETERS (relay 3)** section (3 version, with security access).

SECURE PARAMETERS

Relay 3, Parameter
Repeat as for **Relay 1, Parameter** on page 36.

Store

Advance to next parameter.

Relay 3, Operation
Repeat as for **Relay 1, Operation** on page 36.

Store

Advance to next parameter.

Relay 3, On or Off
Repeat as for **Relay 1, On or Off** on page 36.

Store

Return to top of **Relay Allocation Page** (3 relay versions).

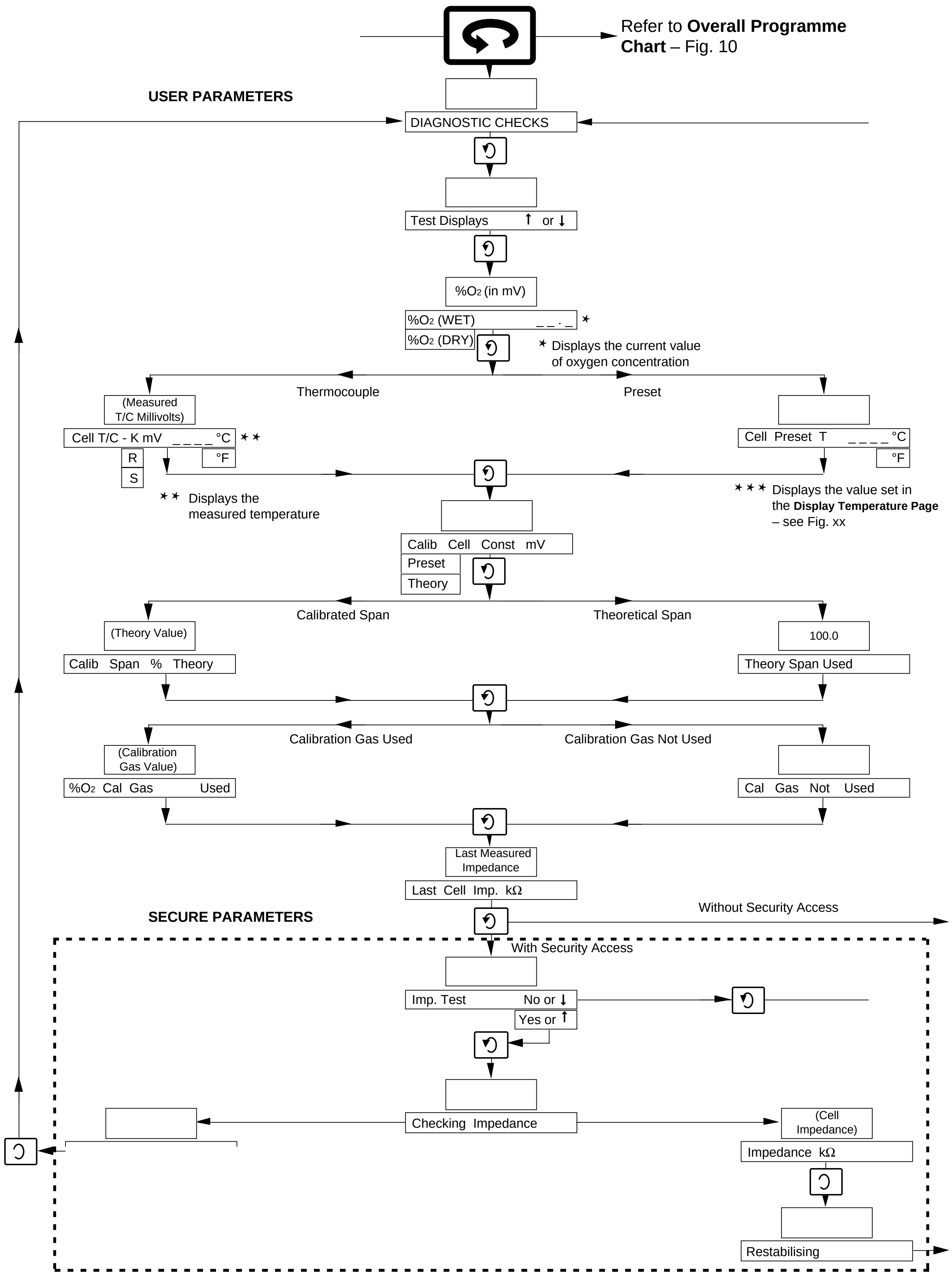


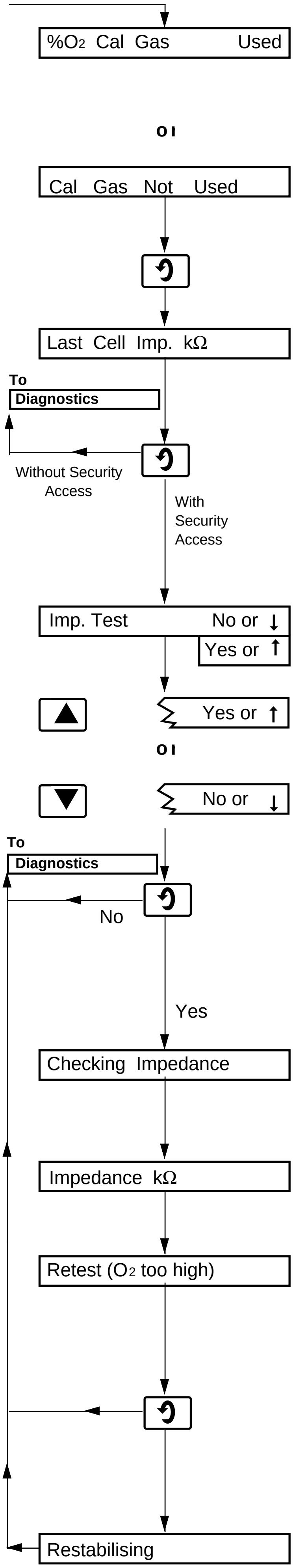
Fig. 10.10 Diagnostics Page programme Chart

10.3.4 Diagnostics Page – Fig. 10.10

This page is used for simple fault finding and monitoring the system performance.

Refer to Fig. 10.10 when carrying out the following procedures

DIAGNOSTIC CHECKS	Select **Diagnostics Page**
↻	Advance to next parameter.
	USER PARAMETERS
Test Displays ↑ or ↓	**Display Tes**
▲ or ▼	Both the upper and lower displays are illuminated as a check for failec segments/dots.
↻	Advance to next parameter
%O_2 (Wet) / (Dry) – – . –	**Cell Output** The measured cell output (in millivolts) is shown on the upper display and the calculated Oxygen concentration, based on this value, is shown on the lower display. The displays alternate between 'wet' and 'dry' readings as the ZMT analyser cycles between 'wet' and 'dry' Oxygen samples.
↻	Advance to next parameter
Cell T/C - K / R / S mV _ _ _ _ °C / °F	**Cell Thermocouple Information** The measured cell thermocouple (in millivolts) output is shown on the upper display and the calculated temperature, based on this value, is shown on the lower display. The display units (°C or °F) and the thermocouple type are as programmed in the **Display Temperature Page** – see page 22.
or	or
Cell Preset T _ _ _ _ °C / °F	**Preset Cell Temperature Information** The lower display shows the preset cell temperature and the display units (°C or °F) which have been programmed in the **Display Temperature Page** – see page 22.
↻	Advance to next parameter.
Calib Cell Const mV / Preset / Theory	**Cell Constant (calibration zero) Information** The upper display shows the cell constant obtained from the last zero calibration procedure. The lower display indicates whether the constant was calibrated, preset or obtained theoretically.
↻	Advance to next parameter.
Calib Span % Theory	**Span Calibration Information** The upper display shows the calibrated span value as a percentage of theoretical response; 100% being the optimum value.
or	or
Theory Span Used	**Theoretical Span Information** The upper display shows the theoretical response value used for span calibration (100%).
↻	Advance to next parameter.
→	Continued opposite.



Continued from opposite page.

Gas Calibration Information (zero or span)
The upper display shows the Calibration Gas Value which was programmed when implementing either a zero or span calibration procedure – see Section 11.

or

Gas Calibration Not Used
The lower display shows that a gas calibration procedure has not been used; i.e. calibration was either preset or theoretical.

Advance to next parameter.

Last Cell Impedance Test
The last impedance test value (in kΩ) is shown on the upper display.

Return to top of **Diagnostics Page** (without security access).

or

Advance to next parameter (with security access).

SECURE PARAMETERS

Cell Impedance Test Requir

Yes.

or

No.

Return to top of **Diagnostics Page** (if 'No' selected).

or

Initiate impedance check (if 'Yes' selected). The display automatically reverts to the following:

Checking Impedance
Allow approximately three minutes for completion of cell impedance test.

The display automatically reverts to either of the following:

Measured Cell Impedance
The measured impedance (in kΩ) is shown on the upper display.

or

Retest (test not possible)
The cell output was insufficient for the impedance check to be implemented, i.e. measured oxygen concentration was too high.

Repeat the test after connecting a test gas of less than 3% O_2 to the probe.

Return to top of **Diagnostics Page** if 'Retest (O_2 too high) is displayed.

or

Advance to next parameter if 'Impedance in kΩ is displayed.

Cell Output Restabilising
Allow approximately three minutes for the cell output to stabilise.

The display automatically reverts to the top of the **Diagnostics Page**.

11 PROBE CALIBRATION

11.1 Calibration, General

It is not necessary to remove the probe from the flue to carry out the calibration procedures detailed in this section.

The analyser may be calibrated using single- or two-point procedures, as follows:

a) **Single-point** (zero) calibration
   Preset zero using known cell constant (limits of±30mV)
   Air calibration (20.95% O_2 nom.)
   Gas calibration using certified test gas (1 to 25% O_2)

b) **Two-point** (span) calibration
   Preset zero + certified test gas (1 to 10% O_2)
   Air calibration + certified test gas (1 to 10% O_2)

Notes.

a) Two-point calibration using air and a test gas is the most accurate procedure.

b) Single-point calibration using air is the most common and easily implemented procedure.

c) Two-point calibration using a preset zero value has a similar accuracy to single-point calibration.

d) For specialised technique of calibrating against a certified instrument contact the Company.

e) For a preset zero calibration the probe's cell constant must be known i.e. from certified information supplied by the Company or from a previous calibration procedure - see **Diagnostics Page** on page 45.

11.2 Equipment Required

Test gas connector kit, part no. 003000212 (Z-FG probes only)

Uncontaminated air supply
and/or
Certified test gas

see **11.1 Calibration, General** above

11.3 Preparation

a) Ensure that the probe is within its operating temperature limits:

   Z-FG probes – 20 to 600°C
   Z-GP2 probes – 600 to 900°C (type K THC)
   600 to 1200°C (type R THC)

b) Ensure that the **Start-up Procedure** has been carried out – see page 15.

N.B. Once the **Calibration Page** has been accessed, i.e. after operation of the 'Parameter Advance' switch when 'CALIBRATION SEQUENCE' is displayed, it cannot be exited until calibration is complete. A theoretical value may be manually accepted during calibration to facilitate an exit path from the Page or to provide a calibration reference for the probe, e.g. in the event of an unsuccessful calibration.

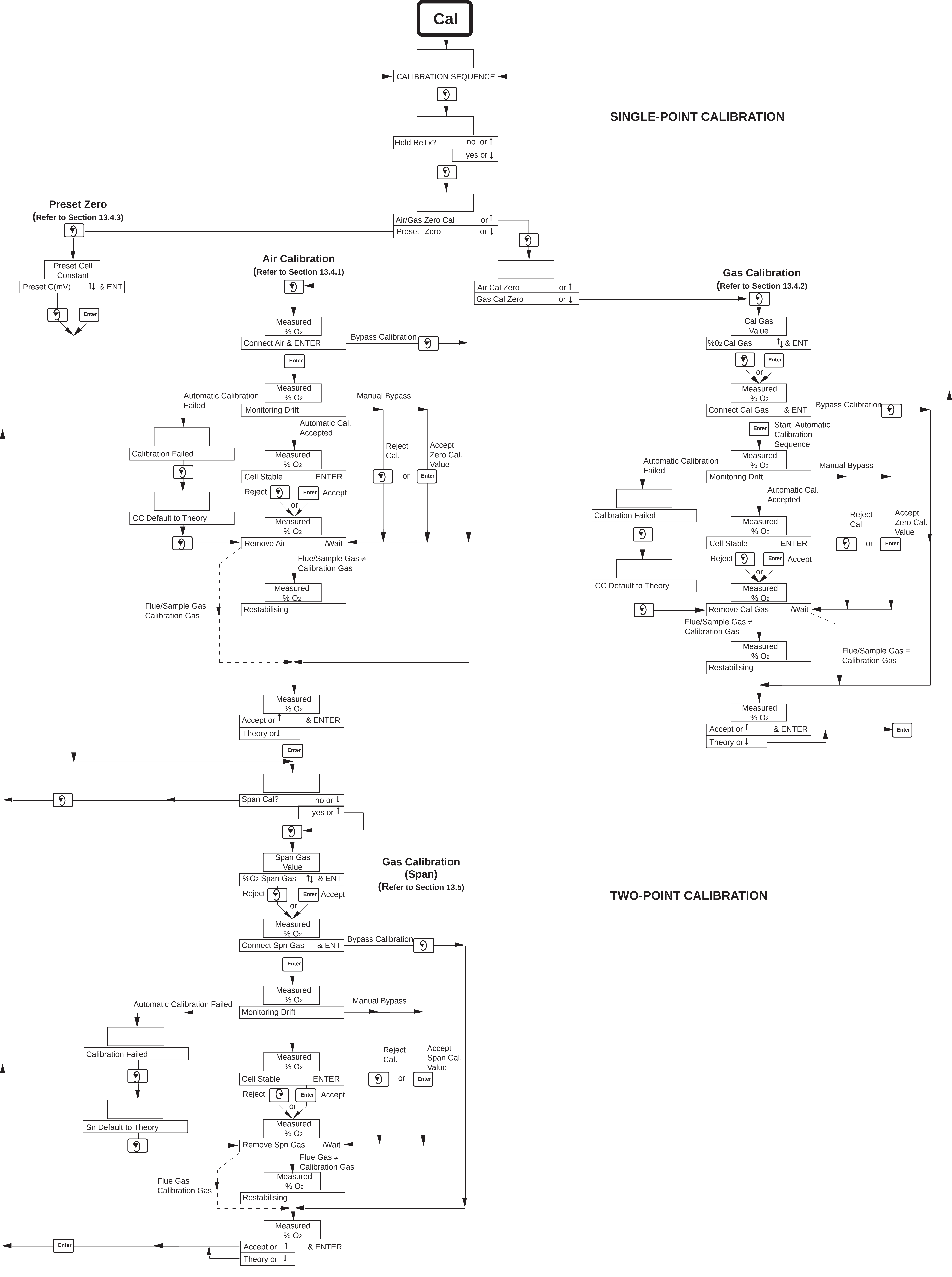
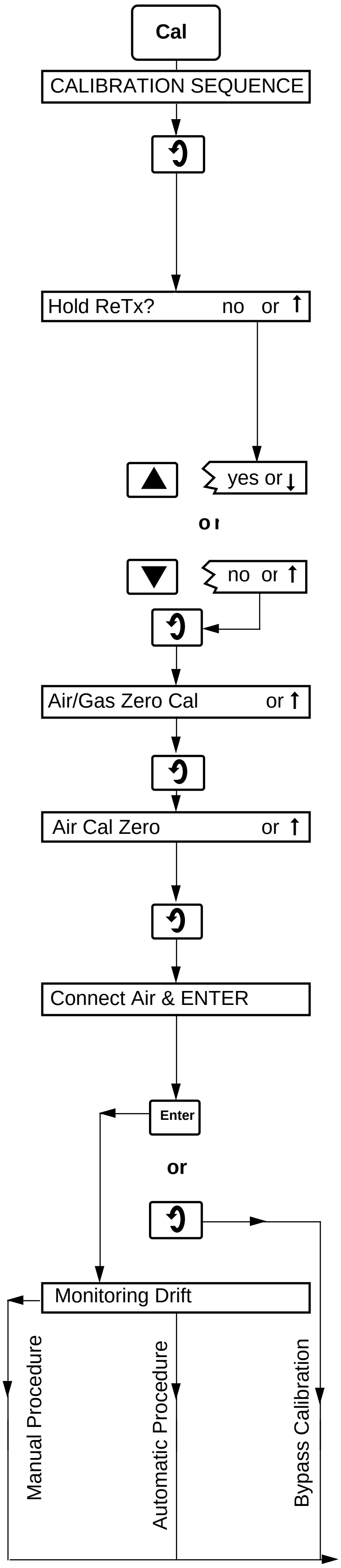


Fig. 20 Calibration Page Programme Chart

11.4 Single-Point (Zero) Calibration

11.4.1 Air Calibration – Fig. 11.1

Refer to Fig. 10.10 when carrying out the following procedure.



Select **Calibration Page**

Advance to next parameter.

Note. Any relays which are allocated to either Oxygen alarm 1 or alarm 2 are now disabled to prevent inadvertent alarms occurring during calibration – see Fig. 10.9 on page 34.

Hold Retransmission Level(s)
Any retransmission output which is assigned to the oxygen range can be held at its present level (e.g. if being used for control) or set to zero – see Fig. 10.8 on page 31.

Note. Any retransmission output which is assigned to the efficiency calculation is automatically set to zero.

Hold Oxygen retransmission output(s) at present level(s).

or

(If not already selected.) Set Oxygen retransmission output(s) to zero.

Advance to next parameter (the retransmission level is now held if 'yes' was selected).

Air or Gas Zero Calibration

Advance to next parameter (retransmission is now held if 'yes' was selected above).

Calibrate Zero Using Air
Note. The upper display shows the measured oxygen concentration value for the remainder of the zero calibration procedure.

Advance to next parameter

Air Connection
Remove the test gas blanking screw or plug from the test gas connector on the probe and connect an uncontaminated air supply to the connector – refer to the appropriate probe operating instructions.

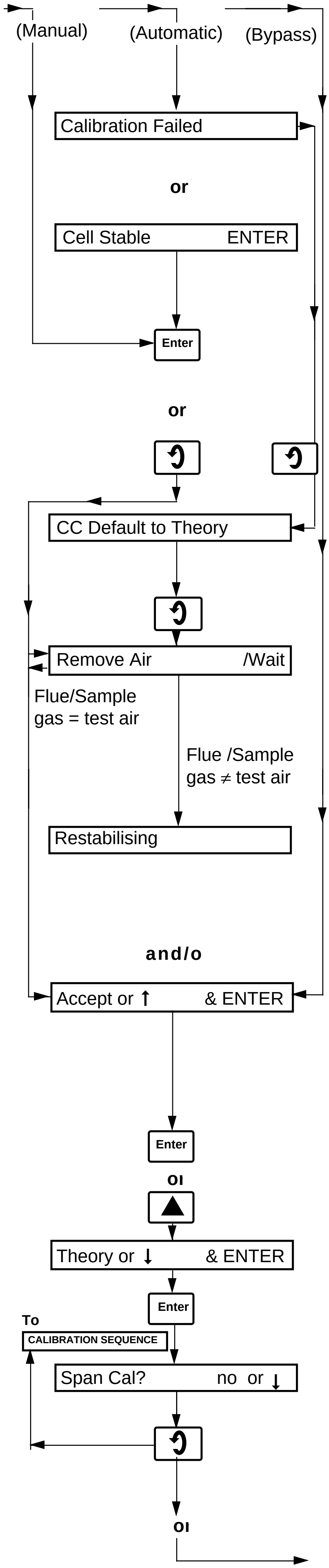
Initiate automatic zero calibration.

or

Bypass zero calibration procedure.

Monitor Cell Output
The cell output is monitored until a stable output is detected. The measured Oxygen concentration (calibration) value shown on the upper display may be manually accepted or rejected at any time prior to completion of automatic calibration (5mins. approx.), e.g. in the event of the cell stabilising rapidly (or its output fluctuating marginally) or if it is evident that the output will not stabilise.

Continued opposite



Continued from opposite page.

If a stable output is detected the display automatically reverts to either of the following:

Calibration Failed
Cell output has stabilised but is outside operational limits.

or

Cell Stable (Calibration Passed)
Cell output has stabilised at a value within acceptable limits. With the cell output in a stable state, the new zero calibration value can either be accepted or rejected, depending on the accuracy required.

Accept or Reject Zero Calibration Value
Accept new zero calibration value.

or

Reject new zero calibration value (previous calibration value is retained) or, if calibration has failed, advance to next parameter.

Set Cell Constant to Theoretical Value
The cell constant is automatically set to a theoretical (reference) value of 0mV to enable continued use of the probe in the event of a failed calibration.

Advance to next parameter

Air Removal
Disconnect the air supply from the probe and refit the blanking plug/ screw to the connector.

The cell output is monitored for approximately one minute to check for any change in Oxygen concentration due to the transition from air to flue gas measurement. The display automatically reverts to either of the following:

Cell Output Restabilising
Allow a suitable time for the cell output to stabilise.

Note. The display automatically reverts to the next parameter after approximately three minutes, irrespective of cell output stability.

and/or

Accept Zero Calibration or Default to Theoretical Cell Constant
The zero calibration value obtained can be either accepted or set to the theoretical (reference) value of 0mV, if unsatisfactory.

Note. If the calibration procedure was bypassed at **Air Connection** above, the 'Accepted' value is that of the previous calibration procedure.

Accept zero calibration value.

or

Select alternative option.

Set cell constant to 0mV i.e. if calibration was unsatisfactory and advance to next parameter.

Calibrate Span (Two-point Calibration)

Span (second point) calibration not required (return to top of **Calibration Page**

Note. All relay functions and/or retransmission outputs (as applicable) are now re-enabled.

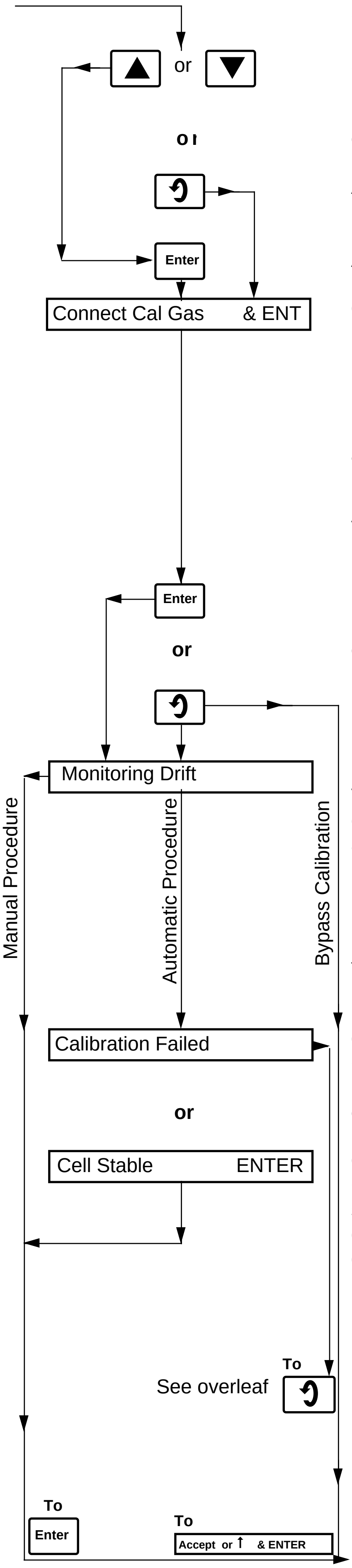
or

Continued overleaf.

	Continued from previous page.
▼	Select alternative option.
Span Cal? yes or ↑	Span (second point) calibration required.
↻	Advance to parameter.
%O_2 Span Gas ↑ ↓ & ENT	Refer to Section 11 on page 50.

11.4.2 Gas Calibration – Fig. 19

Cal	Select **Calibration Pa**
CALIBRATION SEQUENCE	
↻	Advance to next parameter. **Note.** Any relays which are allocated to either Oxygen alarm 1 or alarm 2 are now disabled to prevent inadvertent alarms occurring during calibration – see Fig. 10.9 on page 34.
Hold ReTx? no or ↑	**Hold Retransmission Level(s)** Any retransmission output which is assigned to the Oxygen range can be held at its present level (e.g. if being used for control) or set to zero – see Fig. 10.8 on page 31. **Note.** Any retransmission output which is assigned to the efficiency calculation is automatically set to zero.
▲ yes or ↓	Hold Oxygen retransmission output(s) at present level(s).
or	**or**
▼ no or ↑	(If not already selected.) Set Oxygen retransmission output(s) to zero.
↻	Advance to next parameter.
Air/Gas Zero Cal or ↑	**Air or Gas Zero Calibration**
↻	Advance to next parameter.
Air Cal Zero or ↑	
▲	Select alternative option.
Gas Cal Zero or ↓	**Calibrate Zero Using Gas**
↻	Advance to next parameter.
%0_2 Cal Gas ↑ ↓ & ENT	**Zero Calibration Gas Val**
	Continued opposite.



Continued from opposite page.

Set the value shown on the upper display to that of the zero calibration gas to be used (1 to 25% O_2).

or

Advance to next parameter if the displayed value is already correct.

Accept new calibration gas value.

Gas Connection
Note. The upper display shows the measured oxygen concentration value for the remainder of the zero calibration procedure.

Remove the test gas blanking screw or plug from the test gas connector on the probe and connect the calibration gas (1 to 10% O_2) to the connector – refer to the appropriate probe operating instructions.

N.B. Ensure that the gas connected is equivalent to that setup at **Calibration Gas Value** above.

Initiate automatic zero calibration.

or

Bypass zero calibration procedure.

Monitor Cell Output
The cell output is monitored until a stable output is detected. The measured oxygen concentration (calibration) value shown on the upper display may be manually accepted or rejected at any time prior to completion of automatic calibration (five mins. approx.), e.g. in the event of the cell stabilising rapidly (or its output fluctuating marginally) or if it is evident that the output will not stabilise.

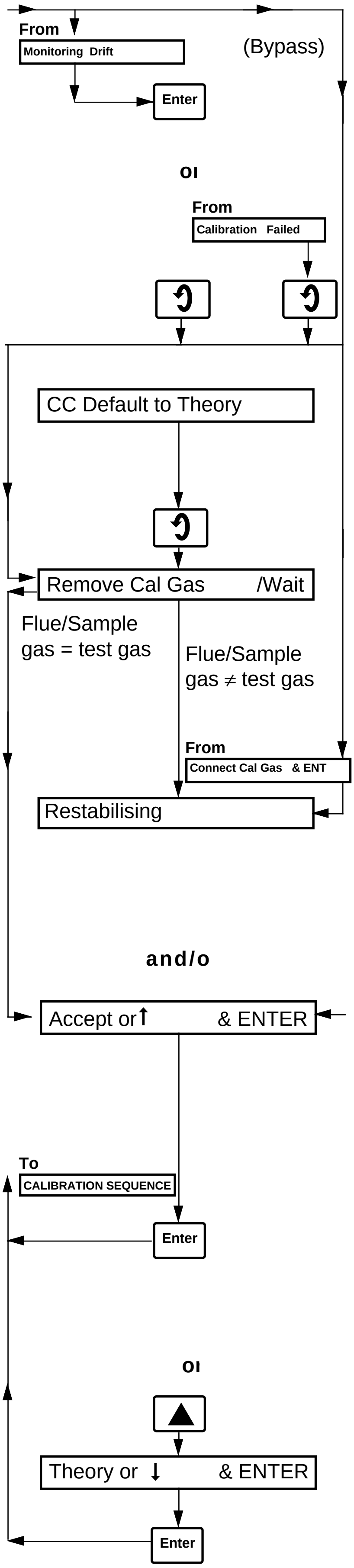
If a stable output is detected the display automatically reverts to either of the following:

Calibration Failed
Cell output has stabilised but is outside operational limits.

or

Cell Stable (Calibration Passed)
Cell output has stabilised at a value within acceptable limits. With the cell output in a stable state, the new zero calibration value can either be accepted or rejected, depending on the accuracy of the value on the upper display to that of the calibration gas.

Continued overleaf.



Continued from previous page.

Accept or Reject Zero Calibration Value
Accept new zero calibration value.

or

Reject new zero calibration value (previous calibration value is retained) or, i calibration has failed, advance to next parameter.

Set Cell Constant to Theoretical Value
The cell constant is automatically set to a theoretical (reference) value of 0mV to enable continued use of the probe in the event of a failed calibration.

Advance to next parameter

Gas Removal
Disconnect the calibration gas from the probe and refit the blanking plug/ screw to the connector.

The cell output is monitored for approximately one minute to check for any change in Oxygen concentration due to the transition from calibration gas to flue gas measurement. The display automatically reverts to either of the following:

Cell Output Restabilising
Allow a suitable time for the cell output to stabilise.

Note. The display automatically reverts to the next parameter after approximately three minutes, irrespective of cell output stability.

and/or

Accept Zero Calibration or Default to Theoretical Value
The zero calibration value obtained can be either accepted or set to the theoretica (reference) value of 0mV, if unsatisfactory.

Note. If the calibration procedure was bypassed at **Gas Connection**, above, the 'Accepted' value is that of the previous calibration procedure.

Accept zero calibration value and return to top of **Calibration Page**

Note. All relay functions and/or retransmission outputs (as applicable) are now re-enabled.

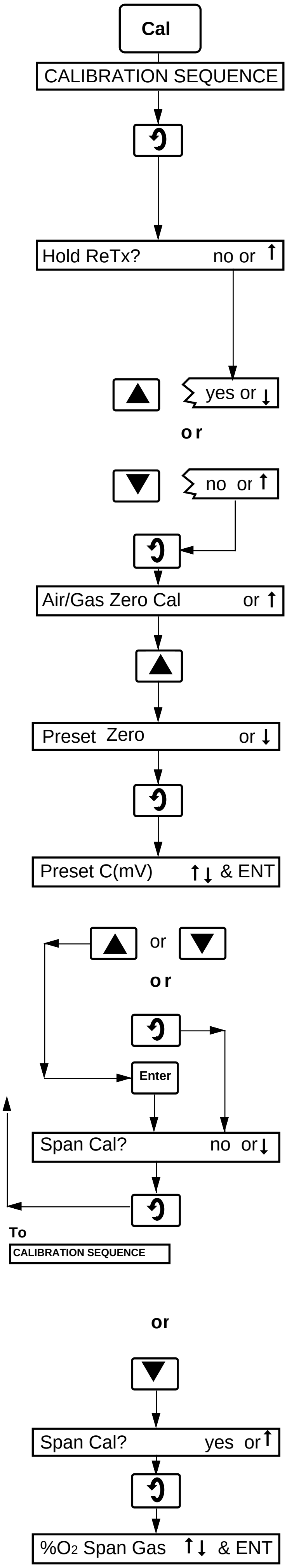
or

Select alternative option.

Set cell constant to 0mV, i.e. calibration unacceptable, and return to top o **Calibration Page**

Note. All relay functions and/or retransmission outputs (as applicable) are now re-enabled.

13.4.3 Preset Calibration



Select **Calibration Page**

Advance to next parameter.
Note. Any relays which are allocated to either Oxygen alarm 1 or alarm 2 are now disabled to prevent inadvertent alarms occurring during calibration – see Fig. 10.9 on page 34.

Hold Retransmission Level(s)
Any retransmission output which is assigned to the Oxygen range can be held at its present level (e.g. if being used for control) or set to zero – see Fig. 10.8 on page 31.
Note. Any retransmission output which is assigned to the efficiency calculation is automatically set to zero.

Hold Oxygen retransmission output(s) at present level(s).

or

(If not already selected.) Set Oxygen retransmission output(s) to zero.

Advance to next parameter

Air or Gas Zero Calibration

Select alternative option.

Use Preset Zero (Cell Constant) Value

Advance to next parameter

Preset Zero (Cell Constant) Value

Set the probe's cell constant on the upper display.

or

Advance to next parameter if the displayed value is already correct.

Accept new cell constant.

Calibrate Span (Two-point Calibration)

Span (second point) calibration not required (return to top of **Calibration Page).**

Note. All relay functions and/or retransmission outputs (as applicable) are now re-enabled.

or

Select alternative option.

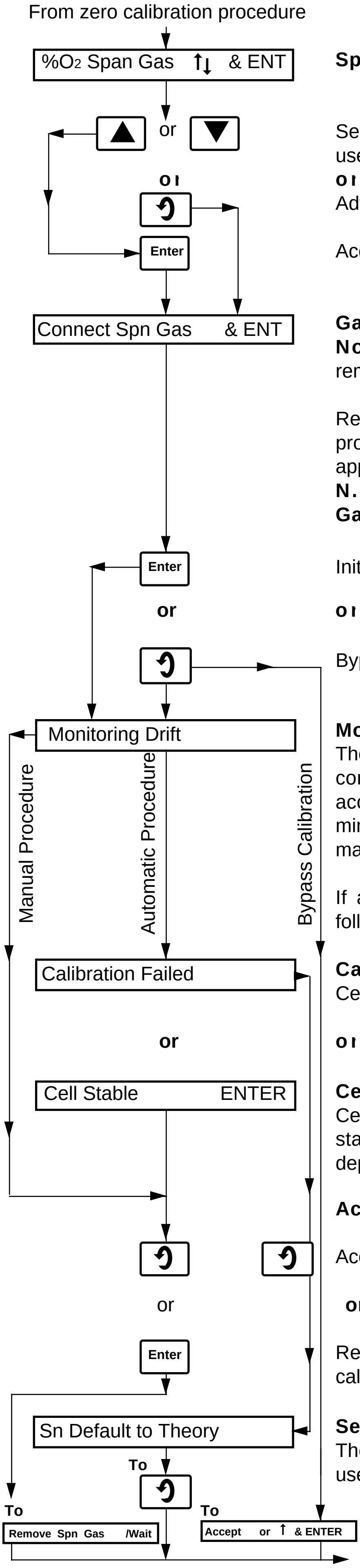
Span (second point) calibration required.

Advance to next parameter.

Refer to Section 11.5 overleaf.

11.5 Second-Point (Span) Calibration – Fig. 11.1, page 43

Carry out an air or gas zero calibration procedure – see Section 11.4.1 or 11.4.2.



Span Calibration Gas Value

Set the value shown on the upper display to that of the span calibration gas to be used (1 to 10%O_2).

or

Advance to next parameter if the displayed value is already correct.

Accept new calibration gas value.

Gas Connection

Note. The upper display shows the measured Oxygen concentration value for the remainder of the span calibration procedure.

Remove the test gas blanking screw or plug from the test gas connector on the probe and connect the calibration gas (1 to 10% O_2) to the connector – refer to the appropriate probe operating instructions.

N.B. Ensure that the gas connected is equivalent to that setup at **Span Calibratic Gas Value**, above.

Initiate automatic span calibration.

or

Bypass zero calibration procedure.

Monitor Cell Output

The cell output is monitored until a stable output is detected. The measured Oxygen concentration (calibration) value shown on the upper display may be manually accepted or rejected at any time prior to completion of automatic calibration (five mins. approx.), e.g. in the event of the cell stabilising rapidly (or its output fluctuating marginally) or if it is evident that the output will not stabilise.

If a stable output is detected the display automatically reverts to either of the following:

Calibration Failed

Cell output has stabilised but is outside operational limits.

or

Cell Stable (Calibration Passed)

Cell output has stabilised at a value within acceptable limits. With the cell output in a stable state, the new zero calibration value can either be accepted or rejected, depending on the accuracy required.

Accept or Reject Span Calibration Va

Accept new span calibration value.

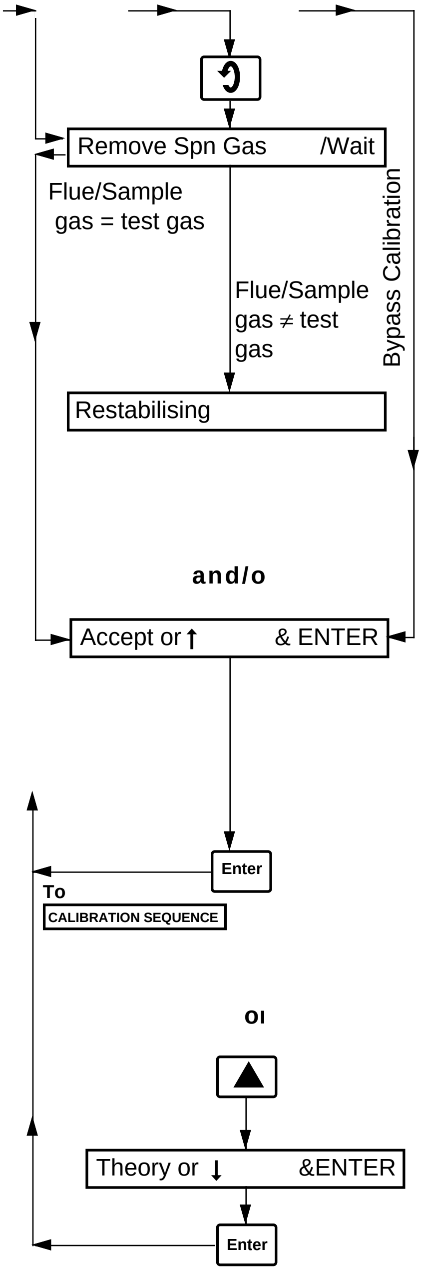
or

Reject new span calibration value (previous calibration value is retained) or, it calibration has failed, advance to next parameter.

Set Span to Theoretical Value

The span is automatically set to a theoretical (reference) value to allow continued use of the probe in the event of a failed calibration.

Continued opposite.



Continued from opposite page.

Advance to next parameter

Gas Removal
Disconnect the calibration gas from the probe and refit the blanking plug/ screw to the connector.

The cell output is monitored for approximately one minute to check for any change in Oxygen concentration due to the transition from calibration gas to flue gas measurement. The display automatically reverts to either of the following:

Cell Output Restabilising
Allow a suitable time for the cell output to stabilise.

Note. The display automatically reverts to the next parameter after approximately three minutes, irrespective of cell output stability.

and/or

Accept Span Calibration or Default to Theoretical Value
The span calibration value obtained can be either accepted or set to the theoretical (reference) value, if unsatisfactory.

Note. If the calibration procedure was bypassed at **Gas Connection**, above, the 'Accepted' value is that of the previous span calibration procedure.

Accept span calibration value and return to top of **Calibration Page**

Note. All relay functions and/or retransmission outputs (as applicable) are now re-enabled.

or

Select alternative option.

Set span calibration value to theoretical (reference) value, i.e. calibration unacceptable, and return to top of **Calibration Page**

Note. All relay functions and/or retransmission outputs (as applicable) are now re-enabled.

12 SPECIFICATION

O_2 Probe

ZFG2 zirconia flue gas oxygen probe

Insertion length	0.4m
Flue gas/operational temperature range	20 to 600°C
Reference air flow (dried)	300cc/min (external only)

ZFG Humidity System Sampling Cabinet

Inputs

Mains supply	110V 50/60Hz
Air supply in	2 to 8 bar clean dry instrument air
Solenoid operating line	110V 50/60Hz (from ZMT analyser)
Gas sample inlet	From sample probe 30°C max. at cabinet inlet (8mm o.d. compression fitting)
Allowable sampled gas pressure range	±2000 Pascals (300mm WG)
Test gas inlet (for in situ probe calibration)	Quick-connect inlet

Outputs

Dried sample gas to probe	2000 to 3000cc/min (6mm o.d. compression fitting)
Dried reference air supply to probe	300cc/Min (6mm o.d. compression fitting)
Gas sample vent (return to flue)	2000 - 3000cc/mIn (6mm o.d. compression fitting)
Condensate drain outlet	½in o.d. push fit for plastic pipe

ZMT Humidity Version Oxygen Analyser System 1

Mains supply	110V 50/60Hz
Measured range	0 to 1kg/kg water vapour & 0 to 60% absolute humidity selectable
Analogue output	0 to 10, 0 to 20 or 4 to 20mA d.c.
Indication accuracy	±3% of reading (when calibrated against O_2 probe using test gas)
System response time	60s to 90% of final value

APPENDICES

A1 Calculations for the Determination of % Water Vapour (Humidity) and Weight/Weight.

$$\% \ H_2O = (100 + k) - \left(\frac{100\ A}{B}\right)$$

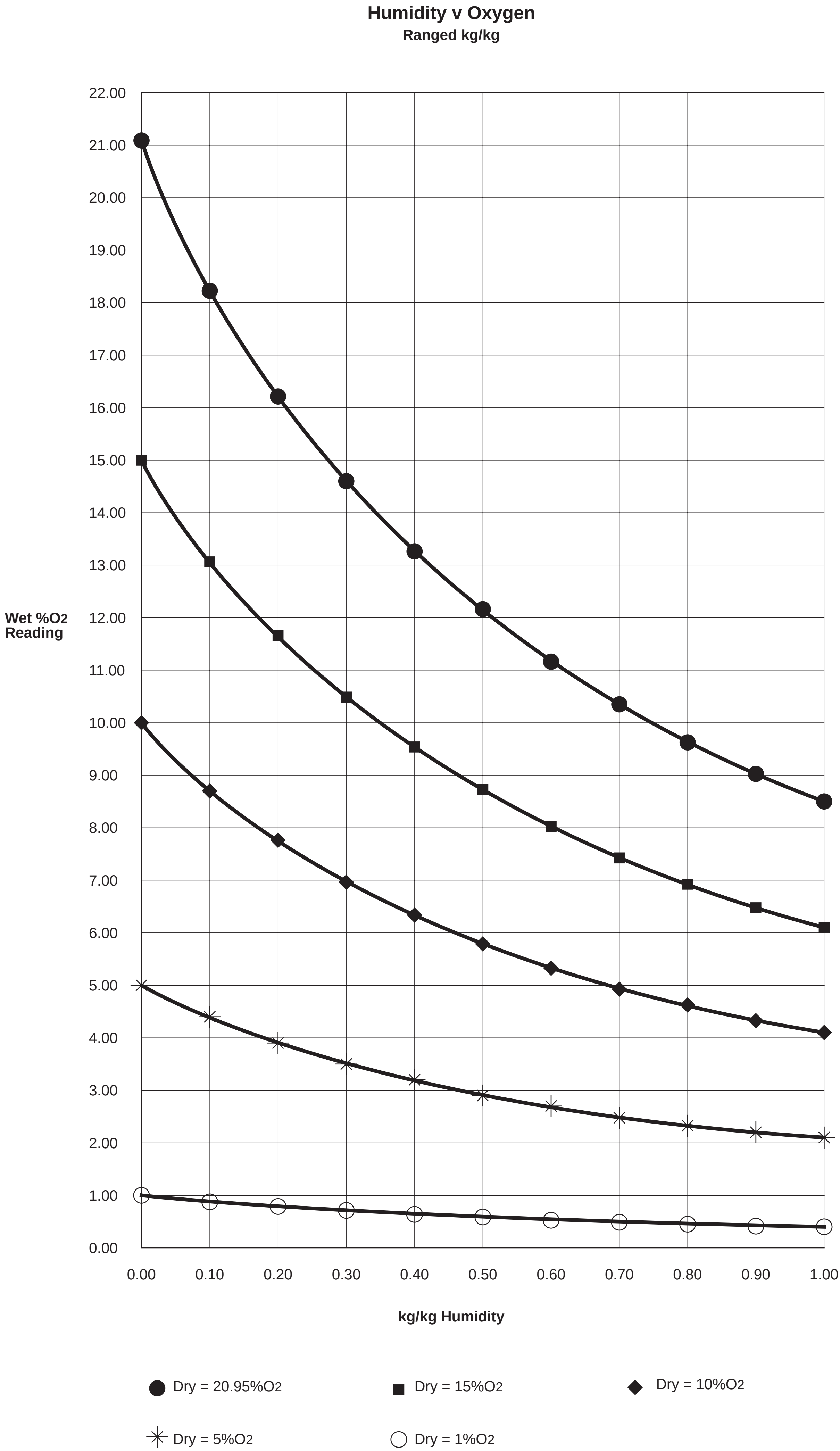
k – the residual water content in the dried sample gas (0.00 to 1.00)
O_2 Wet– 0.0% to 25.0% (A)
O_2 Dry – 0.0% to 25.0% (B)

Note. The % Water Vapour calculation assumes that O_2 Wet will always be less than O_2 Dry

A2 Company Standard Settings and Options

The Company standard settings and options for the Zirconia Based Humidity System are shown below:

Parameter	Standard Setting	Options	Page Number
% Water Vapour	kg/kg	lkg/kg, lb/lb or % Water Vapour	19
Temperature			
Alarms			
Analogue Retransmission			
Relay Allocation			


Humidity v Oxygen
Ranged kg/kg
Wet %O2 Reading
22.00
21.00
20.00
19.00
18.00
17.00
16.00
15.00
14.00
13.00
12.00
11.00
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
kg/kg Humidity
Dry = 20.95%O2
Dry = 15%O2
Dry = 10%O2
Dry = 5%O2
Dry = 1%O2

Notes.

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22.7.93

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