

# ABB KENT-TAYLOR

## The Company

ABB Kent-Taylor 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(B) is just one of the ten flow calibration plants operated by the Company, and is indicative of ABB Kent-Taylor's dedication to quality and accuracy.

BS EN ISO 9001



St Neots, U.K. – Cert. No. Q5907  
Stonehouse, U.K. – Cert. No. FM 21106

EN 29001 (ISO 9001)



Lenno, Italy – Cert. No. 9/90A



Stonehouse, U.K. – Cert. No. 0255

## Use of Instructions



### Warning.

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



### Caution.

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



### Note.

Clarification of an instruction or additional information.



### 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.

Information in this manual is intended only to assist our customers in the efficient operation of our equipment. Use of this manual for any other purpose is specifically prohibited and its contents are not to be reproduced in full or part without prior approval of Technical Communications Department, ABB Kent-Taylor.

### 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.

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# 1 INTRODUCTION

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## 1.1 General

The Model EIL8036 is a microprocessor based on-line monitor for measuring sodium in steam raising plant. Sample points include mixed bed outlets in water treatment plants, extraction pump discharge, boiler feed, boiler drum and steam.

Two range groups of 0.01µgk/g to 1mgk/g and 0.1µgk/g to 10mgk/g are available with current output automatically switched to cover two decades within one group at any one time. Alternatively, a fixed range of 0.1µgk/g to 1mgk/g can be selected.

## 1.2 Description

### 1.2.1 Sensor Unit

The Sensor Unit consists of a metal case which houses the liquid handling equipment. This equipment is mounted on a panel which is secured to the back of the case with four M6 captive bolts.

The Liquid Handling Section contains a clear acrylic flow cell where the sodium ion responsive electrode and the calomel reference electrode are presented to the flow sample. The flowcell also houses a temperature sensor for temperature correction of electrode output by the electronics. The pre-amplifier and the container for the reagent are mounted on the Sensor Unit door. The junction box, convenient for the electrical connection of the electrode pair, is also mounted on the door.

The sample is pre-treated to achieve the correct pH value by the introduction of an alkaline vapour.

For acid samples a pump, mounted on the door, is incorporated to supplement vapour addition.

Calibration is carried out by the use of standard solutions of known value under the control of the Transmitter Unit.

### 1.2.2 Transmitter Unit

The Transmitter Unit consists of a metal case of similar construction to that of the Sensor Unit with a chassis unit supporting circuit boards and other electrical sub-assemblies.

The microprocessor electronics is in the form of a Transmitter Unit which performs four main functions:

- it interprets and displays a reading of sodium received from the Sensor Unit,
- controls the calibration sequence,
- displays sample temperature, and
- provides the various outputs to remote equipment.

The display is a three digit, seven segment L.E.D. type indicating the level of sodium and also providing information on the operating mode. It informs the operator when the instrument is in the calibration mode, and when the calibration has not been successful.

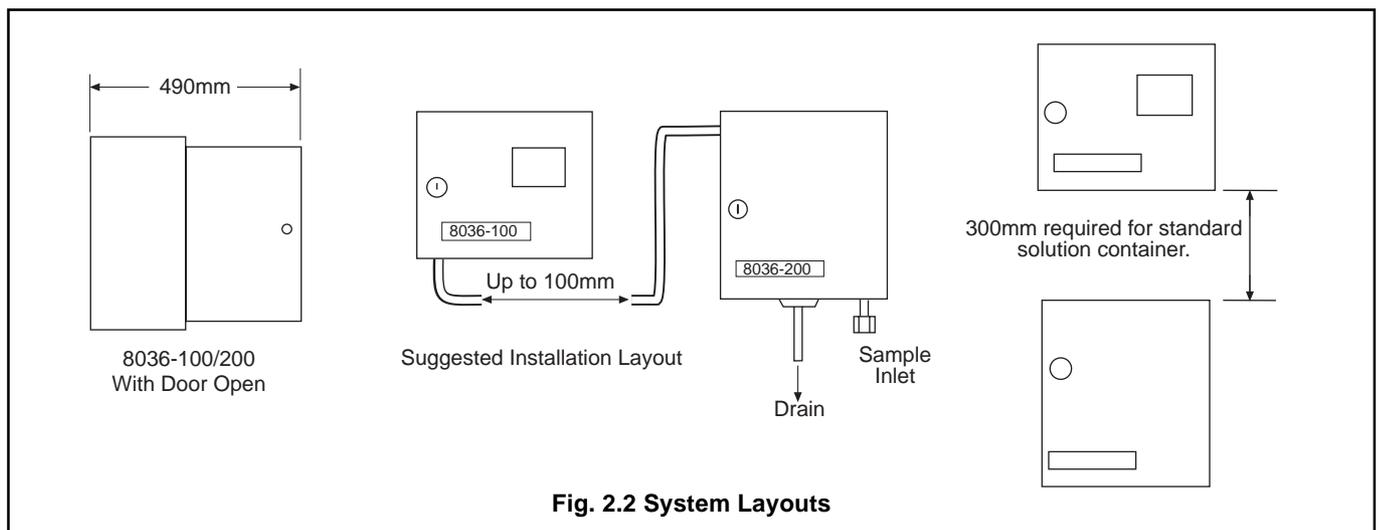
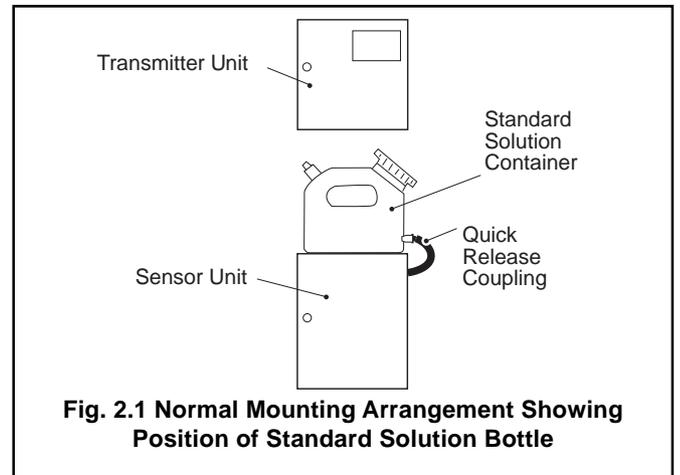
The case of the Transmitter Unit is suppressed against radio-frequency interference. A cable gland is provided on the bottom of the case for the cable to the liquid handling section. On the left-hand side is a gland plate drilled with six holes which may be enlarged to accept cable glands (not supplied with the equipment) suitable for the cables carrying the alarm signals, the outputs to the recorder, etc. The maximum gland size permissible is PG21.

2.1 Fixing of Units (Figs. 2.1, 2.2, 2.3 and 2.4)

2.1.1 Location and Layout (Figs. 2.1 and 2.2)

Both units should be mounted in a clean, vibration-free situation, avoiding direct radiant heat, sunlight and draughts. Areas containing chlorination equipment should also be avoided.

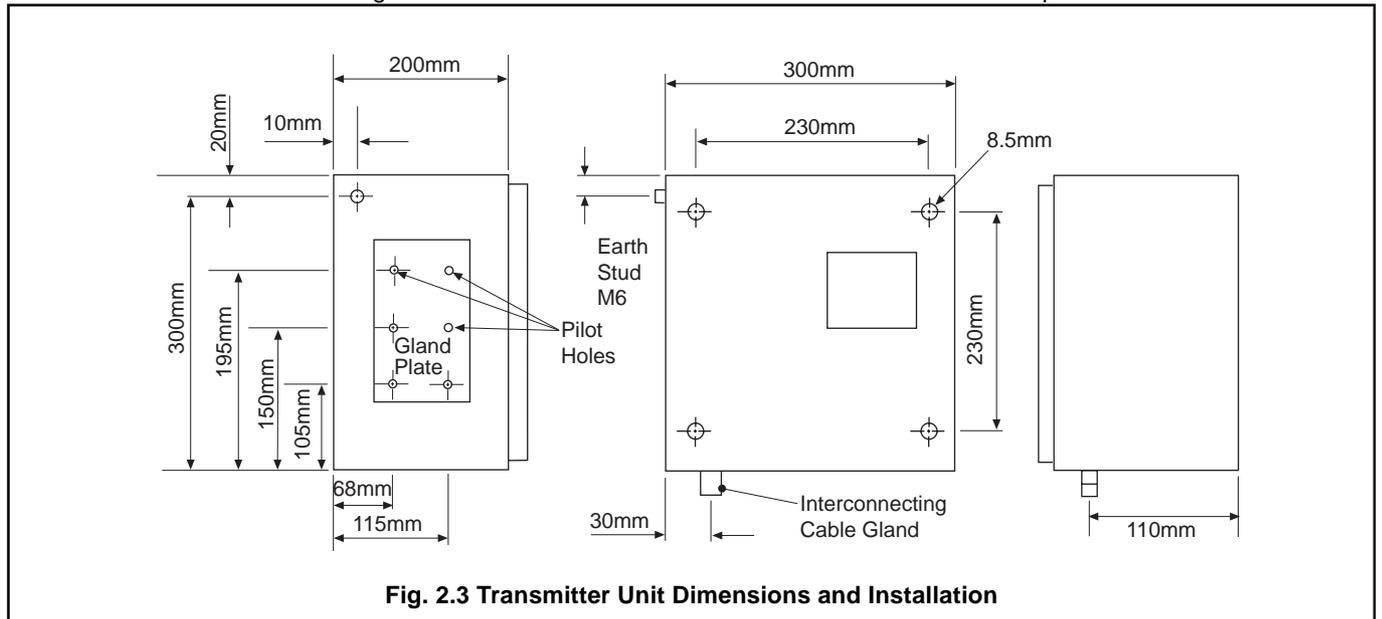
The Sensor Unit should be mounted not more than 10m from its associated sample cooler (see below). The Transmitter Unit may be mounted alongside or up to 100m away from the Sensor Unit. If the Transmitter Unit is to be mounted directly above the Sensor Unit, allow at least 300mm separation



between the units for access to the standard solution containers.

2.1.2 Sensor Unit (Fig. 2.3)

Holes in the case for wall-mounting the unit are suitable for 8mm diameter fasteners. Sufficient space must be left in front of the





### 2.3 External Pipe Connections

#### 2.3.1 Inlet

The sample should be connected to the Sensor Unit by means of 6.3mm (1/4in) o.d. tubing (stainless steel or rigid plastic). Connect this to the sample inlet coupling on the right-hand side of the panel via the grommet in the floor of the case.

The inlet tubing should be of sufficient wall thickness to withstand the highest sample pressure and the pipe lengths should be kept short. The inlet pipe should be bent to a right angle outside the case to allow future removal of the liquid handling panel when required.

Where particulate matter is present (e.g. magnetite in boiler samples) it is recommended that a 60 micron sample filter is fitted to the sample line.

A shut-off valve (not supplied with the equipment) is necessary in the sample inlet.

#### 2.3.2 Drain

The drain from the tundish at the bottom of the Sensor Unit case consists of two stub pipe connections suitable for 10mm (3/8 in) bore plastic or rubber tubing. Alkaline effluent from the monitor flow cell appears at one connection and waste sample from the other.

The two connections can either be linked by a 'Y' piece and taken to a contaminated drain, or they can be kept separate and led to appropriate drains.

### 2.4 Electrical Interconnections



**Warning.**

- Before making any connections, ensure that the power supply and high voltage power-operated control circuits are switched off.
- This equipment operates on a.c. mains supply voltage electricity. ~~Suitable safety precautions must always be taken to avoid the possibility of electric shock.~~

#### 2.4.1 Sensor Unit

The 8-way cable to connect the Sensor Unit to the Transmitter Unit is preformed and is supplied already connected to the Sensor Unit. This is to avoid the need to open the pre-amplifier box which could admit moisture, and because of the very high source impedance of the sodium electrode (up to 5000Mohm, at sample temperature of 5°C), would affect the instrument performance. For distances between the Sensor Unit and Transmitter Unit greater than 2m, the cable is extended using a junction box mounted adjacent to the Sensor Unit, and the required length of 8-way cable.

The 2-way cable is for the pump supply



**Note.** A stud terminal is fitted to the bottom of the Sensor Unit case and must be connected to a good known earth (ground).

#### 2.4.2 Transmitter Unit (Fig. 2.5)

Access to make the necessary connections is gained by removing the chassis unit as described in Section 2.1.2.

- Cut the cable from the Sensor Unit to a length to reach the Transmitter Unit easily to terminate on terminal block TB2 on the analogue board.
- Push the end of the cable through the gland in the base of the Transmitter Unit.
- Open the Transmitter Unit door, remove the front panel and pull the cable through the gland.
- Noting that the screening braid terminates at the cable gland and is prepared as shown in Fig. 2.5, prepare the cable end and attach it to the terminal block TB2. The terminal block may be pulled off the pins on the board if required.



**Caution.** The terminal block for Sensor Unit connection has eight terminals, whereas there are 12 pins on the board. Ensure that the correct eight pins are chosen for connection; these are marked with a separate 'box' – see the following text and Fig 2.5.

Pass the cables through the glands, and noting that Pin 1 of each block is nearest the top of the case, prepare the ends and attach them to the terminal blocks as follows – see also Fig.

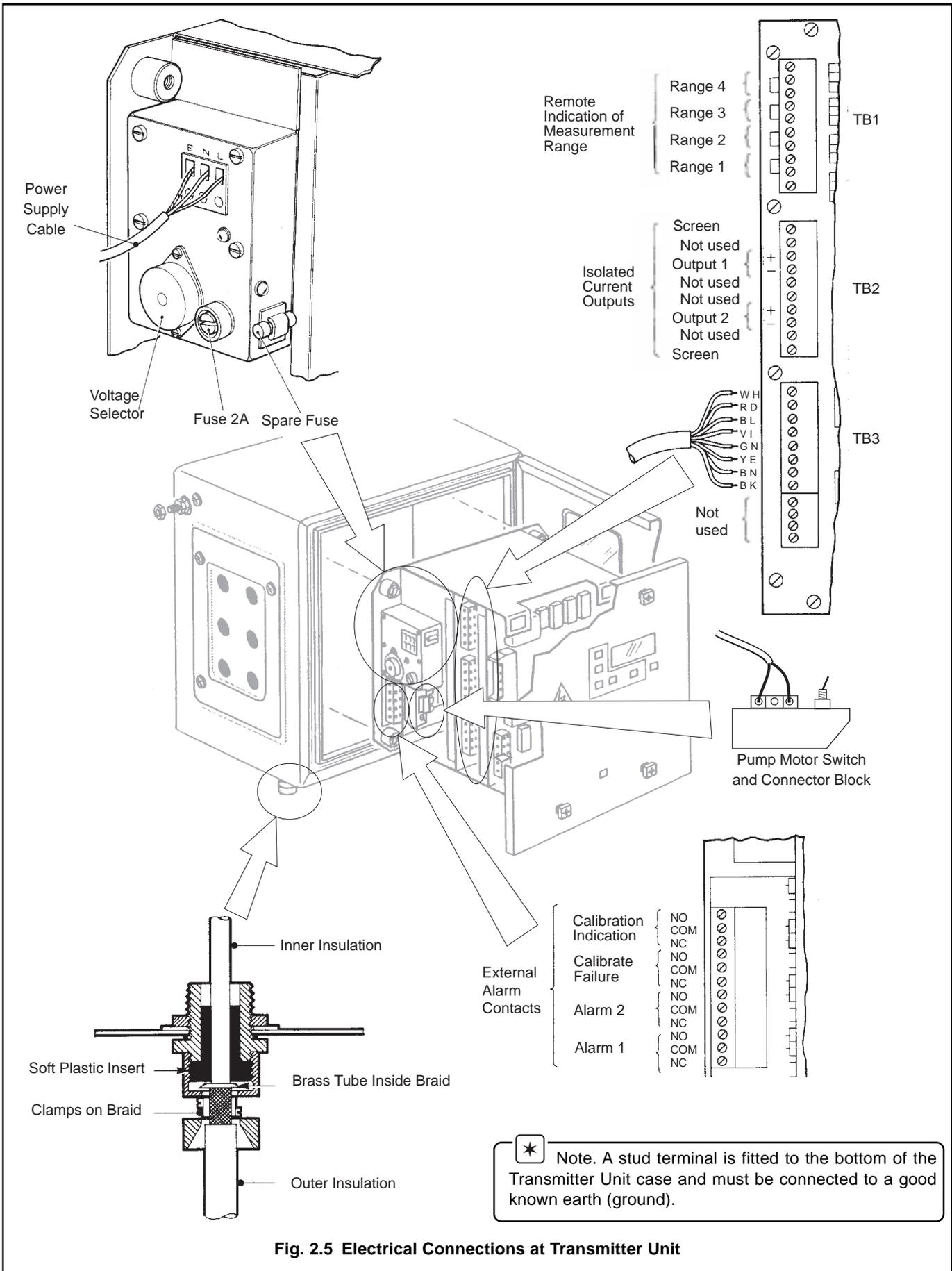
#### Analogue board TB1 (top edge):

PIN	1	0V		
	2	NO	} R4	Four sets of normally open contacts, one of which closes to show range of measurement remotely.
	3	COM		
	4	NO	} R3	
	5	COM		
	6	NO	} R2	
	7	COM		
	8	NO	} R1	
	9	COM		
	10	0V		

#### Analogue board TB2 (middle):

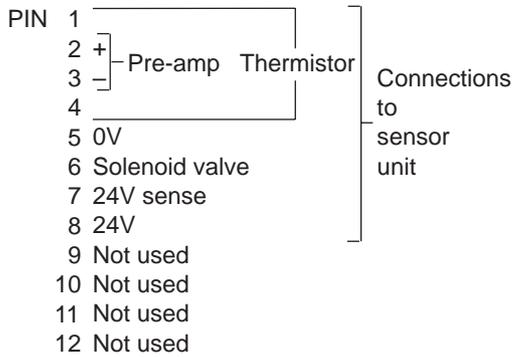
PIN	1	0V	} Isolated current outputs
	2	Not used	
	3	+	
	4	-	
	5	Not used	
	6	Not used	
	7	+	
	8	-	
	9	Not used	
	10	0V	

## ..2 INSTALLATION

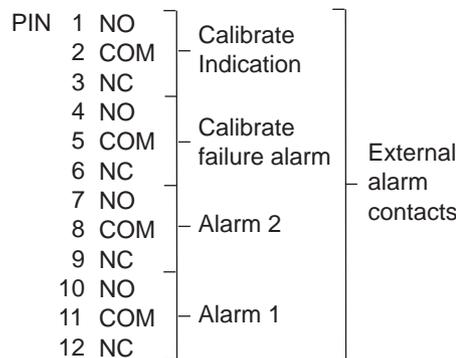


**Fig. 2.5 Electrical Connections at Transmitter Unit**

**Analogue board TB3 (bottom edge):**



**PSU board TB3:**



2.5.

**Digital board (nearest front panel - no terminations).  
Pump Motor Connector Block**

Connect the pump supply to the terminal block as shown in Fig. 2.5.

**Chassis**

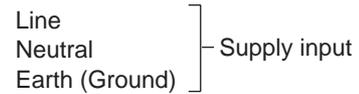


**Warning.** The power supply earth (ground) must be connected to ensure safety to personnel, reduction of the effects of RFI interference and correct operation of the power supply interference filter.

A voltage selector is located next to the supply terminals and

this must be set to the correct value before connecting the instrument to the supply – see Fig. 2.5.

Connect the power supply input as follows:



**2.5 Ancillary Equipment**

**2.5.1 Recorders**

The choice of two different isolated recorder output signals enables the instrument to be used with a wide variety of recording and data processing equipment. The load requirements are set out in Section 7, and the positions of the circuit board switches are given in Section 3.2.3

**2.5.2 Range Indication (Fig. 2.6)**

The remote range indication relays (TBI connections on the Analogue Board) can be used in several different arrangements to suit the requirements of the installation. The relays can, for example, be wired directly into the PLC or data logger, but if a recorder is used, a method of indicating the set range is required. A 2-pen recorder is necessary; pen 1 indicating the sodium concentration as above, and pen 2 recording the instrument range.

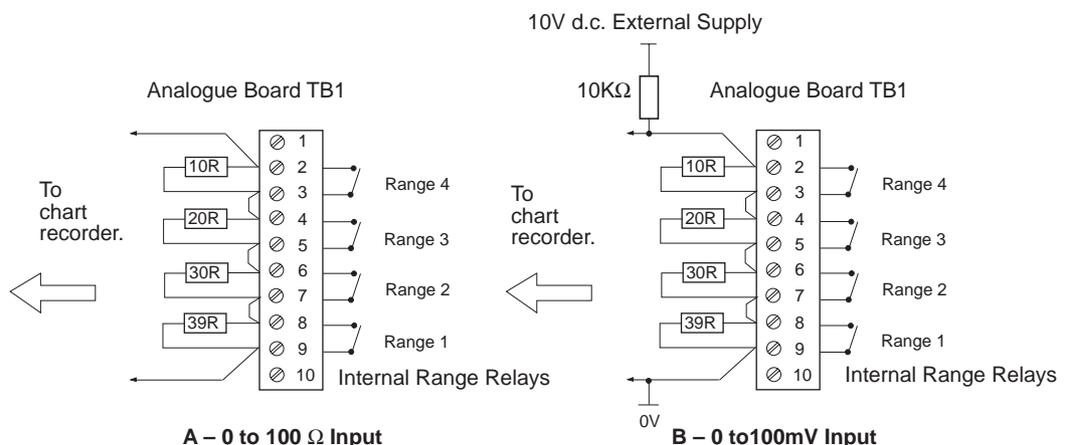
Suitable range indication recorder input can be achieved using a resistor network, connected as shown in the two examples in Fig. 2.6. and consists of four 1/4 watt resistors. A suitable resistor network kit as given in Section 6. A recorder with suitable voltage and resistance inputs can be provided by the Company. The recorder gives 60, 70, 80 and 90% scale deflection for ranges 1 to 4 respectively.

Other arrangements should be designed to suit the requirements of the system.

Ensure that all external equipment is set up and working according to the relevant instructions supplied with it.



**Note.** The remote range indication only applies



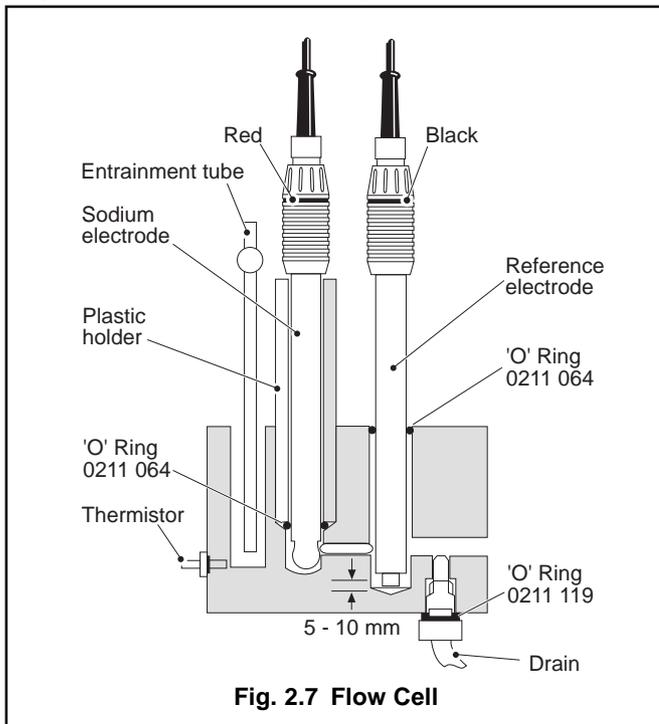
**Fig. 2.6 Resistor Network for 'Auto' Remote Range Indication Recorder**

## ...2 INSTALLATION

when the front panel switch is set to 'auto'.

### 2.6 Start-Up (Figs. 2.7, 2.8 and 3.5)

- a) Open the Transmitter Unit door and remove the front panel if this has not already been done.
- b) Remove the desiccator from its sealed bag and place it inside the Transmitter Unit.
- c) Switch the battery switch SW10 to 'ON' – see Fig. 3.5.
- d) Replace the front panel and secure by pressing in the four plastic fasteners.
- e) Power up the monitor at the external source and set the Range Switch to AUTO
- f) Open the Sensor Unit door and remove the cover from the junction box located on the door.
- g) Unpack the sodium electrode and carefully remove the rubber teat. Connect the electrode to the red connector (see Fig. 2.8) and then slide the electrode into the cylindrical plastic holder supplied – see Fig. 2.7. Locate the 'O' ring (which is packed in the central chamber of the flow cell) and carefully position it on the stem of the electrode just above the bulb. Carefully screw the holder into the



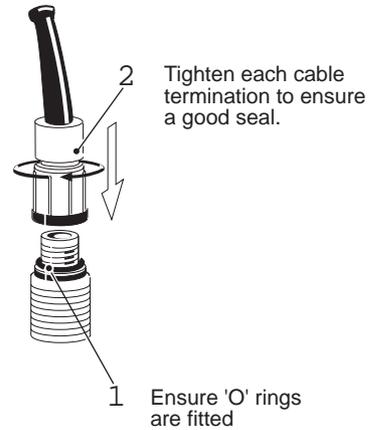
**Fig. 2.7 Flow Cell**

central chamber so the 'O' ring is compressed and the bulb of the electrode is just above the bottom of the chamber.

- h) Unpack the reference electrode and remove the rubber teat. Connect the electrode to the black connector (see Fig. 2.8) and release the black rubber filling hole plug. Fit the 'O' ring supplied over the electrode body and position the electrode centrally in the right-hand chamber of the flow-cell so that the ceramic plug is between 5 and 10mm from

the bottom of the chamber.

**Note.** It is extremely important that the 'O' rings are correctly fitted and that the inside of the electrode connections are dry and completely sealed. Moisture reduces the circuit impedance and affect the performance



**Fig. 2.8 Electrode Connections**

of the monitor.

- i) Fill reagent solution container with appropriate solution (see Section 5.1) .
- k) Open the shut-off valve upstream of the Sensor Unit and adjust until sample is overflowing from the constant head unit. (Note the max. and min. flow rates given in Section 7).
- l) Switch on the pump, if required (see Section 3.1).
- m) Leave for at least one hour and then check for leaks.
- n) Set up the transmitter as described in Section 3.2.3.
- o) Carry out a calibration as detailed in Section 4.
- p) The monitor now in operation, the lamp adjacent to the unit of measurement being illuminated.
- q) If desired, turn the range switch to one of the non-auto ranges.
- r) Press the ALARM 1 button and use the UP/DOWN buttons to set to the desired value. Repeat for ALARM 2.

#### 3.1 Sensor Unit (Fig. 3.1 and 3.2)

A flow schematic is shown in Fig. 3.1 and the physical layout of the unit is shown in Fig. 3.2.

The sample enters via a compression fitting at the bottom of the case and passes through one half of a heat exchanger which is used during the calibration sequence to bring the standard solution close to the temperature of the sample. This minimises the calibration time.

From the heat exchanger the sample passes through a solenoid valve to the constant head unit which removes the effect of changes in sample pressure and flow-rate. A small tube overflowing into the constant head on one side, ensures self starting when the sample is lost, and enables the monitor to function over a wide sample flow.

The sample is then delivered to the 'T' piece and stainless steel entrainment tube, where an alkaline vapour reagent is added to the sample to raise the pH value, before being presented to the sodium and reference electrodes mounted in a flow cell. The sample leaves the flow cell and is passed to drain at the bottom of the case.

The potential developed between the sodium ion-responsive electrode and calomel reference electrode is logarithmic with respect to changes in sodium ion concentration. The signal from the electrode pair is connected via a junction box to a voltage-to-current pre-amplifier whose output is connected to

the Transmitter Unit via the interconnection cable.

A temperature sensor fitted into the flow cell, detects the temperature of the sample. The sensor is connected to the Transmitter Unit which compensates for changes in output from the electrode pair over a range of 5 to 55°C.

Calibration of the monitor is carried out under the control of the microprocessor. After connection of the calibration tube to the standard solution container, the appropriate button on the Transmitter Unit is pressed. The solenoid valve on the liquid handling panel is energised changing over from sample to standard solution which first passes through the second half of the heat exchanger. The solution is presented to the electrode pair via the constant head unit and the vapour entrainment tube.

Although the solenoid valve is closed to the sample during a calibration sequence, under sample pressure the pressure relief valve opens, allowing sample to pass through the heat exchanger, bringing the standard solution to a similar value.

A pump supplements the quantity of reagent vapour delivered by the entrainment device. This pump is only required when an acid sample is to be monitored and satisfactory pH conditions cannot be achieved by normal entrainment. A satisfactory effluent pH depends on the degree of acidity of the sample together with the sodium concentration range which is to be monitored – see Section 5.4.2.

A separate drain from the flow cell is provided so that effluent pH can be measured.

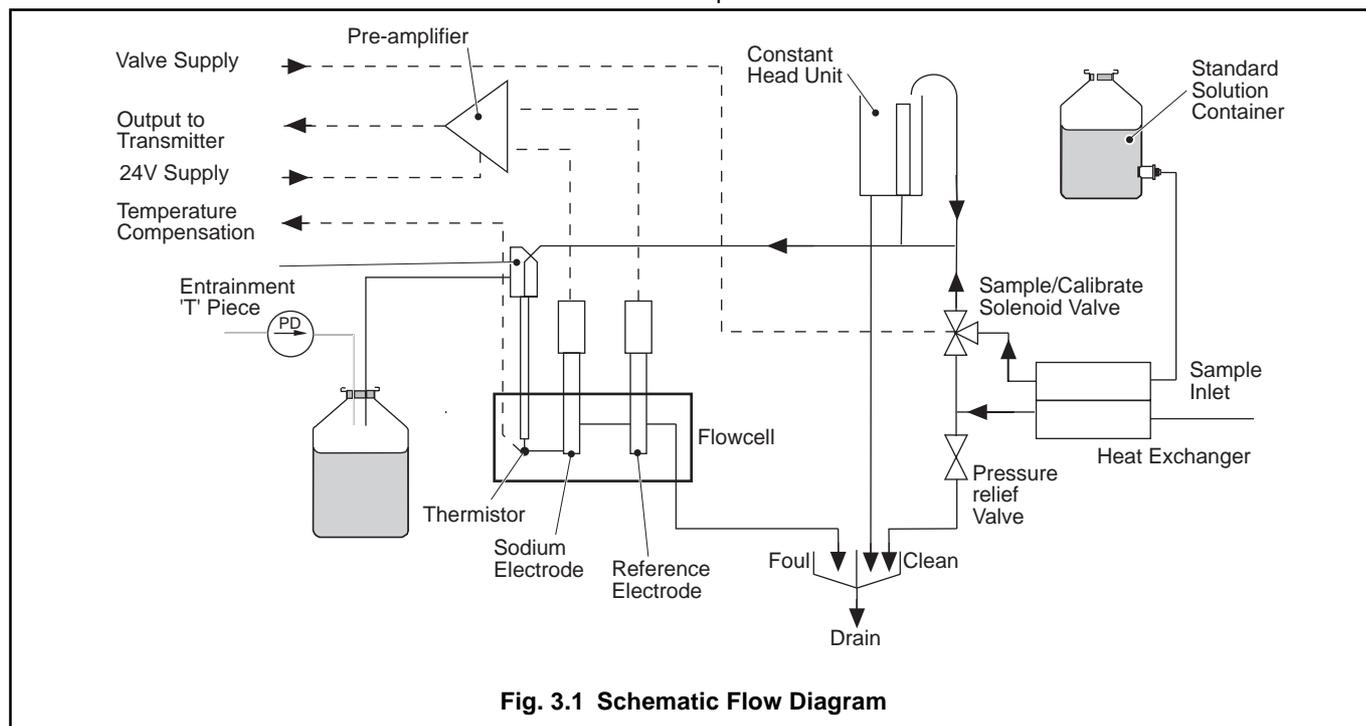
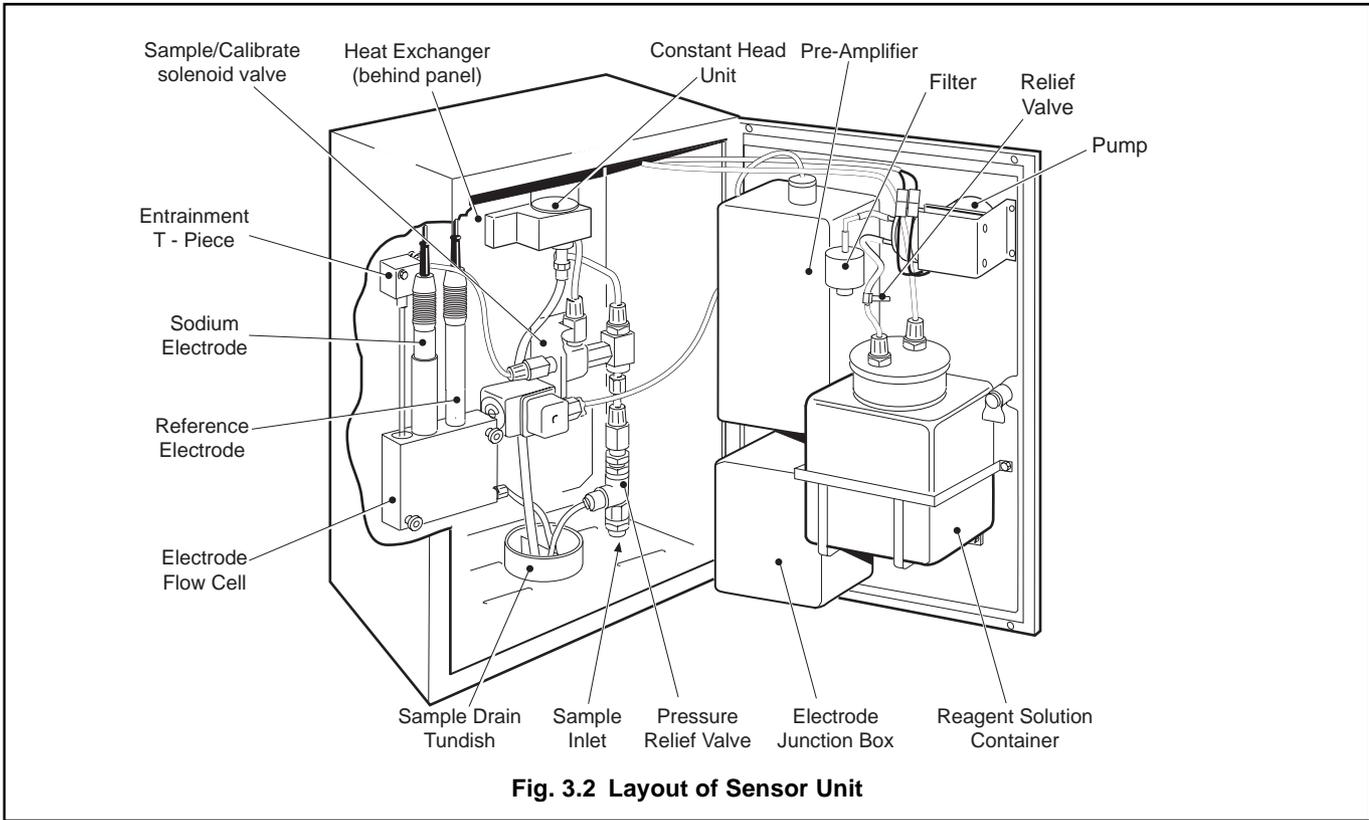


Fig. 3.1 Schematic Flow Diagram

## ...3 PRINCIPLE OF OPERATION



**Fig. 3.2 Layout of Sensor Unit**

The location of the pump on/off switch is shown in Fig. 2.5.

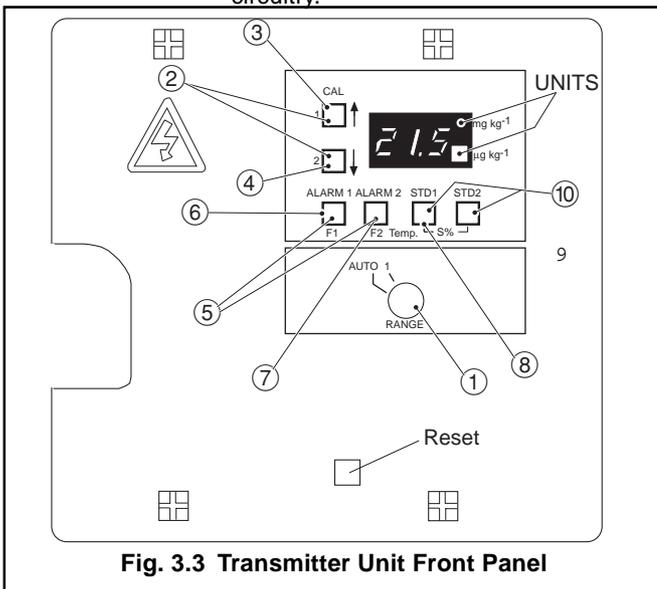
### 3.2 Transmitter Unit (Fig. 3.3)

#### 3.2.1 Electronics Chassis

The chassis contains three circuit boards:

**Digital board** – Nearest the front panel, containing the central processor unit, front panel controls and the display.

**Analogue board** – Middle board, containing the analogue input and current output circuitry.



**Fig. 3.3 Transmitter Unit Front Panel**

**PSU board** – Rear board, containing the power supply and output relays.

#### 3.2.2 Front Panel Controls (Fig. 3.4)

The controls are mounted on the front circuit board in the chassis. They protrude through holes in the front panel which is secured to the chassis by four plastic fasteners.

A 3-digit red LED display shows the sodium level in milligrams or micrograms per kilogram, the range being indicated by a lamp in the display adjacent to the relevant legend on the panel. The controls have the following functions:

##### **RANGE** switch

(2 Position) 1 AUTO, automatically switches to a range suitable for the sodium level being measured within the overall preset range. Remote range indication is provided.

Position 1 is a manual preset range which is selected in conjunction with SW 1 – see Section 3.3.3.

##### **SET VALUE: 2**

These buttons (UP/DOWN arrows) increase or decrease the value displayed on the digital indicator; used for setting the alarms and standard solution values.

##### **CAL 1: 3**

When the button is pressed a primary calibration sequence is initiated. Pressing CAL1 during a calibration for at least 5 seconds aborts the sequence.

### 3 PRINCIPLE OF OPERATION...

- CAL 2:** 4 When the button is pressed a secondary calibration sequence is initiated. Pressing CAL2 during a calibration for at least 5 seconds aborts the sequence.
- Alarm 1/Alarm 2:** 5 Used in conjunction with the UP/DOWN buttons to set the values at which the alarm relays operate.
- F1:** 6 Pressing this button during a calibration sequence, displays the output from the sodium electrode.
- F2:** 7 Holding this button while pressing and releasing RESET initiates a COLD START.
- Pressing F1 and F2 together gives the offset (in mV) generated by the electrode at the last calibration.
- STD1:** 8 Used in conjunction with the UP/DOWN buttons to set the values of the standard solutions into the instrument.
- STD2:** 9 Pressing STD1 and STD2 together gives an indication of the electrode % slope value, which was calculated during the last TWO POINT CALIBRATION.
- S%:** 0 Pressing STD1 and STD2 together gives an indication of the electrode % slope value, which was calculated during the last TWO POINT CALIBRATION.
- Temp.** Pressing F2 and STD1 together displays the temperature (in °C) of the solution in

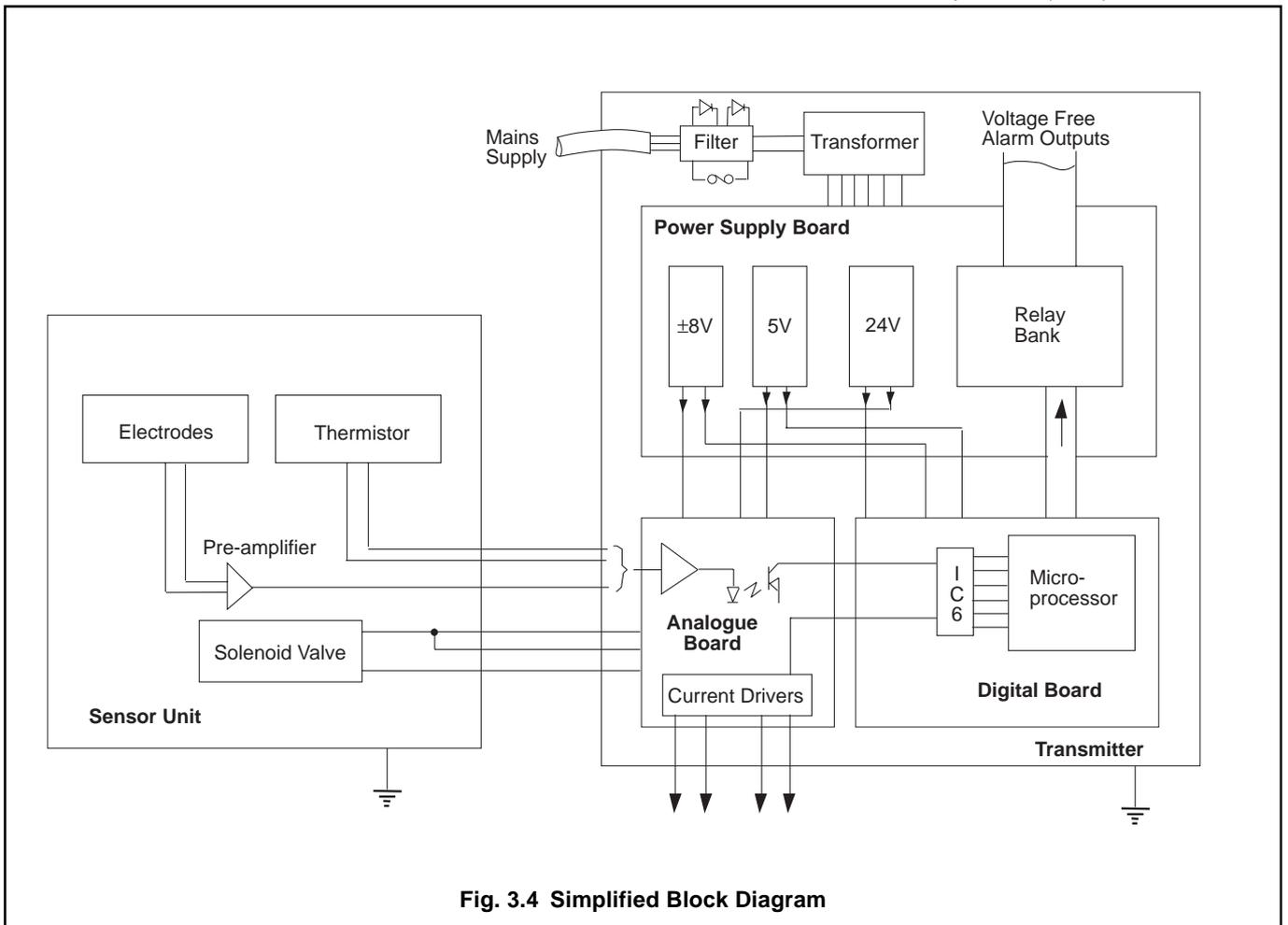


Fig. 3.4 Simplified Block Diagram

### ...3 PRINCIPLE OF OPERATION

the flowcell.

RESET:

Used to regain control of the instrument in the unlikely event of a malfunction due to high supply transient, etc (this button is not visible when the cabinet door is closed).

		SW1							
		1	2	3	4	5	6	7	8
Current Output (mA)	0-10 0-20 4-20	ON OFF OFF	ON OFF ON						
Output Law	Linear Log			OFF ON					
Low Cal. Solution	Standard Sample			OFF ON					
Range Group	1 2				OFF ON				
Auto Cal						OFF ON			
Alarm 2	Failsafe Normal							OFF ON	
Alarm 1	Failsafe Normal								OFF ON

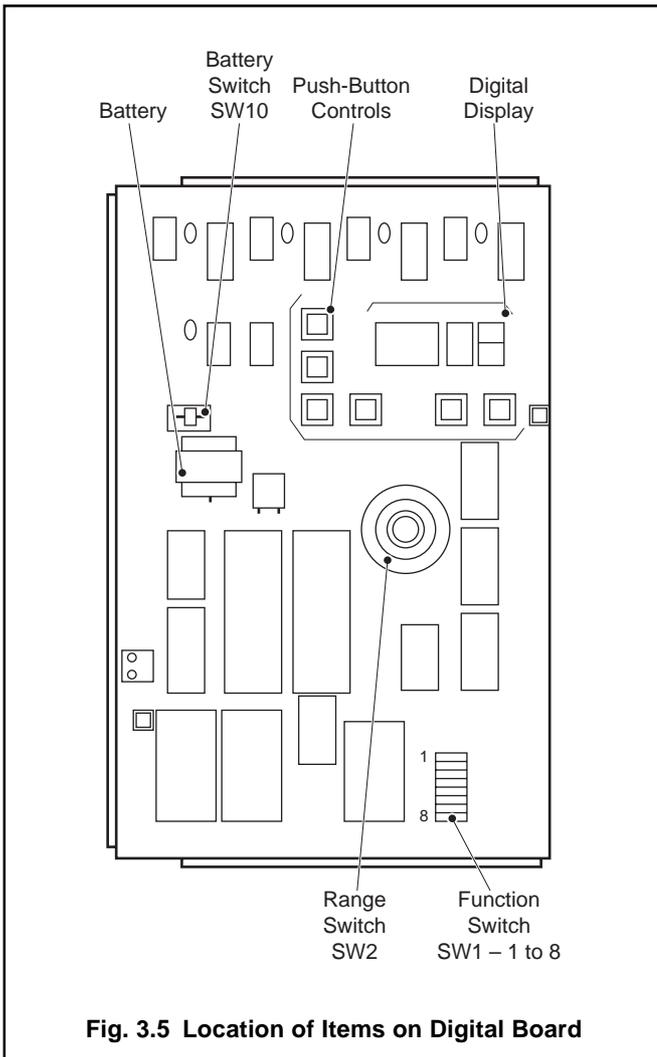


Fig. 3.5 Location of Items on Digital Board

#### 3.2.3 Circuit Board Function Switch SW1 (Fig. 3.5)

A range of eight ON/OFF switches in a dual in-line package is read by the microprocessor and provides controlling functions

	Group 1 (SW1.5 OFF) 0.1 µg/kg to 10 mg/kg	Group 2 (SW1.5 ON) 0.01 µg/kg to 1 mg/kg
AUTO	100 µg/kg to 10 mg/kg 10 µg/kg to 1 mg/kg 1 to 100 µg/kg 0.1 to 10 µg/kg	10 µg/kg to 1 mg/kg 1 to 100 µg/kg 0.1 to 10 µg/kg 0.01* to 1 µg/kg
1	Not Used	0.1 µg/kg to 1 mg/kg

for the alarms, output current and calibration – see Table 3.1.

Table 3.1 Circuit Board Function Switch

Table 3.2 Range Groups

\* Electronically, this is the lowest concentration which can be displayed; however, it is unlikely to be achieved in practice. Low concentration sodium measurements depend on sample and electrode conditions.

#### 3.2.4 Alarms



**Note.** The alarms cannot be set during a calibration sequence.

Two sodium concentration alarm control relays are provided, each having one pair of changeover contacts rated at 2A 250V a.c. (non-inductive). It is intended that both should operate as 'high' alarms i.e. when the sodium level increases beyond the set value.

For example, the lower setting may act as a warning that the sodium level has increased beyond a reasonable level, and the higher setting may be used in a shut down capacity. The alarm values are set by pressing the relevant ALARM button in conjunction with the SET VALUE buttons.

Terminal connections for alarms are shown in Section 2.4 and switches SW1.7 and SW1.8 determine contacts which are closed in non-alarm conditions – see Section 3.2.3.

Functions are as follows:

- In NORMAL the relays are de-energised i.e. NC contacts are closed.
- In FAILSAFE the relays are energised i.e. NO contacts are closed. Thus if the power source fails, both external alarms are flagged indicating a malfunction.

Two other sets of relay contacts are provided. One set changes over during a calibration sequence and the other set changes over to indicate failure to calibrate.

#### 3.2.5 Analogue Outputs (Table 3.2, Figs. 3.6 & 3.7)

Two identical isolated current outputs are available. Both outputs may be set to one of the three current ranges by means of switches SW1.1 and SW1.2. In each case the upper current limit corresponds to the full-scale reading of the range displayed on the front panel.



**Note.** If SW1.1 is set to ON and SW1.2 is set to OFF, no valid output is produced.

In AUTO two current outputs cover five decades of sodium concentration divided into four overlapping ranges. The overall range is determined by the RANGE GROUP selected by the position of SW1.5

Within the selected RANGE GROUP both the available current outputs represent two decades of sodium concentration at any one time. In AUTO the monitor switches automatically between these ranges as the sodium concentration varies. The following points regarding ranges should be noted:

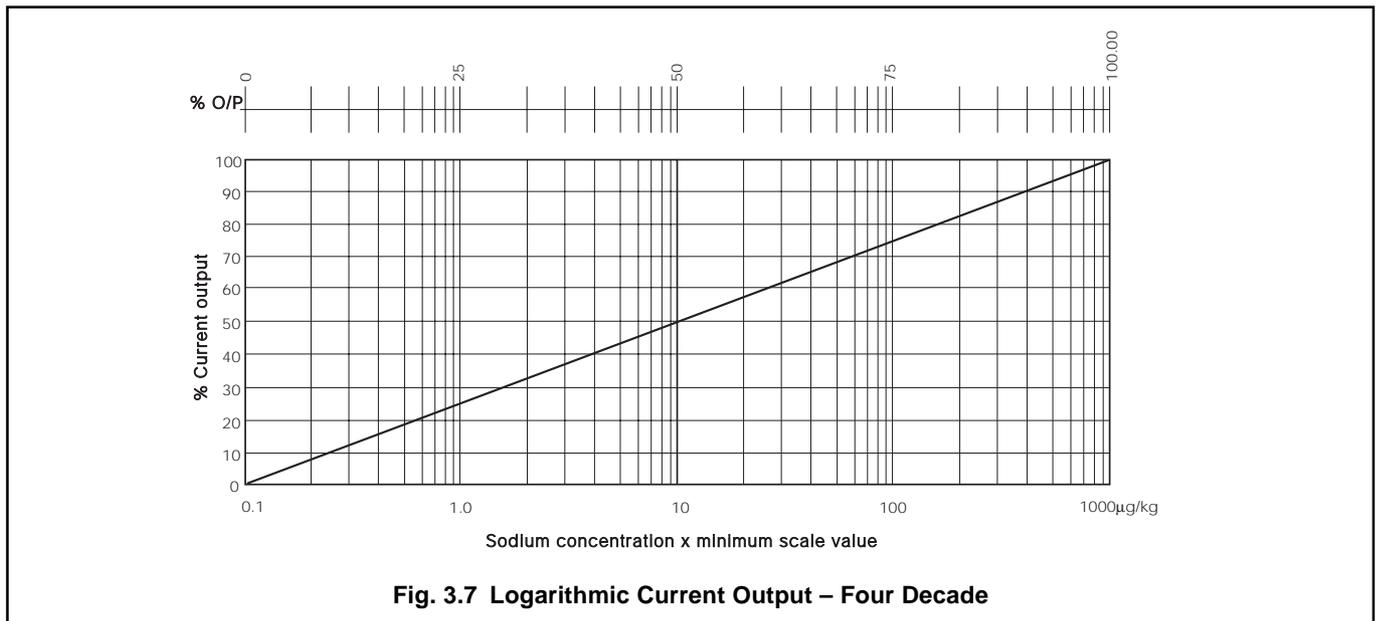
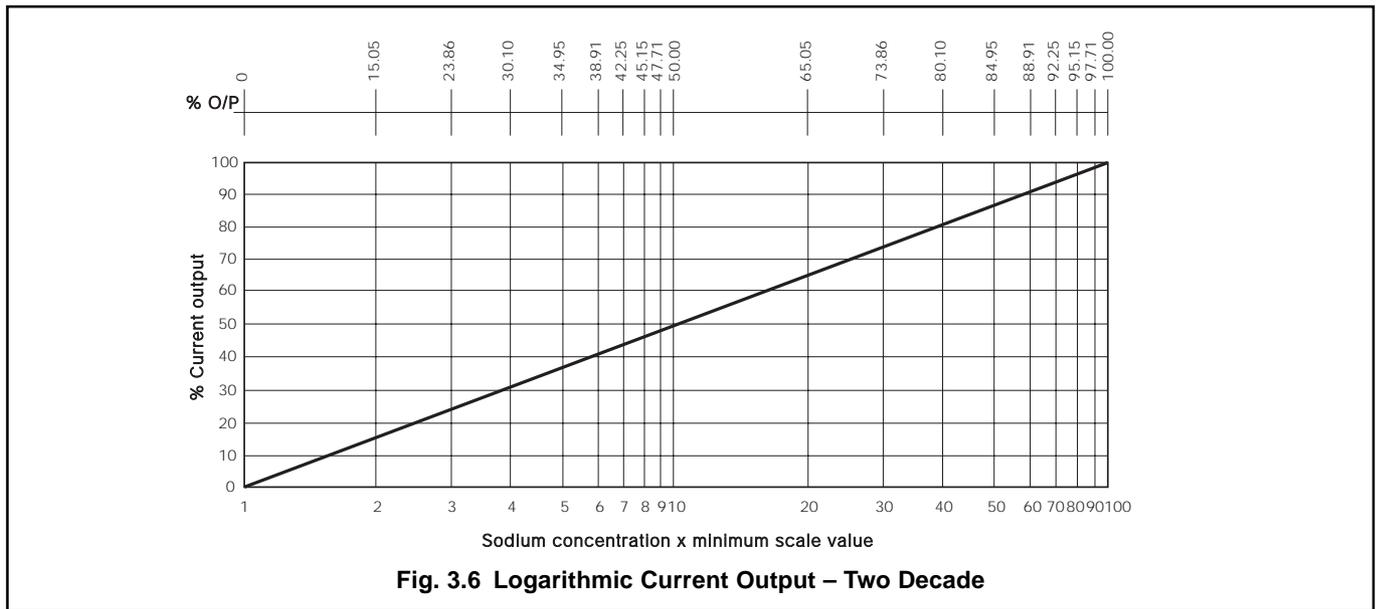
a) The range selection only refers to the current output, the digital display covers the full range capability of the

monitor.

b) If the concentration is outside the individual range or RANGE GROUP selected, the digital display flashes - (reading) - 'out' - (reading) - 'out' -, in every other way the monitor functions normally.

c) In AUTO, as the concentration increases, the switching to the next range takes place at 100% of the current output, giving a 50% output on the upper range (10% in linear output). When however the concentration decreases, the switching takes place at 0% of the current output, giving a 50% output on the lower range (10% in linear output). This provides a range switching hysteresis of one decade.

d) At all times in AUTO the current output range can be monitored or recorded remotely using the four remote RANGE INDICATION RELAY contacts.



## 4 CALIBRATION PROCEDURE

- e) In RANGE1 and SW1.5 set to ON a fixed range of 0.1µg/kg to 1mg/kg is selected.

The outputs can be configured to be LOGARITHMIC or LINEAR determined by the position of SW1.3. It should be noted that when the LOGARITHMIC output is selected, the output represents two decades of concentration (e.g. 0.1 to 10, 1 to 100µg/kg etc.). When the LINEAR output is selected however, the output represents zero to the full-scale reading (eg. 0 to 10, 0 to 100µg/kg etc.)

Calibrations can be carried out manually (single or two point) or automatically (single point only)

Before carrying out a calibration sequence, rinse the solution containers with high purity water and fill with fresh standard solution. A single point calibration only requires one solution (STD1). If a two point calibration is to be carried out, it is recommended that the lower value solution should be used first.

Pressing F1 during the calibration displays the indicated sodium concentration, but the zero or slope correction only takes place at the end of each calibration sequence.

**\*** **Note.** A calibration sequence can be aborted by pressing the CAL1 during the first or CAL2 buttons during the second calibration sequence until 'Abt' is displayed. Normal operation i.e. monitoring sample is resumed using the calibration constants from previous complete calibration sequences.

### 4.1 Manual Single Point Calibration

During this sequence the display on the front panel indicates 'CA1'. The full calibration sequence, performed as follows, takes approximately 45 minutes.

- The value of the standard solution is entered by first pressing the STD1 button and using the UP/DOWN buttons to set the concentration of the solution.
- Press CAL1 and the display counts '5, 4, 3, 2, 1' before the sequence is initiated to prevent a calibration being started by accidental pressing of the CAL1 button.
- The solenoid valve is energized which allows the sample to be replaced with the standard solution (STD1), from the external bottle.
- Both the concentration alarms are de-energised and the relay contacts for remote CAL indication change over.
- The current output follows the calibration sequence.
- After 15 minutes the microprocessor reads the output from

the electrode pair plus the temperature, then calculates the zero correction required to bring the reading to the preset standard solution concentration. The display now reverts to showing the sodium concentration value.

- The solenoid valve is de-energised to allow sample to flow through the electrode flow cell.
- The 'RUN' (sample) mode is resumed and 30 minutes are allowed for the system to recover before the alarms are made active and the remote CAL relay is de-energised.

Pressing F1 and F2 together, after a calibration, causes the display to show the mV offset. This is the difference between the voltage from the electrode and that expected from a typical electrode. The range is ±99mV. The magnitude of the offset is not important. However, large deviations from one calibration to the next indicates instability, and the cause should be investigated, e.g. a faulty sodium or reference electrode, poor connections etc.

### 4.2 Manual Two Point Calibration

This sequence follows on from the single point calibration, but is selected by pressing CAL2 while the display indicates 'CA1'. The right hand decimal point is illuminated during the calibration sequence to indicate that two point calibration has been selected. When the second standard solution is being introduced the display indicates 'CA2'. The full calibration sequence takes approximately 1 hour and performs the following:

- The values of the standard solutions are entered by first pressing the STD1 button and using the UP/DOWN buttons to set the concentration of the first solution. Then press the STD2 button and set the concentration of the second solution using the UP/DOWN buttons.
- Follow the sequence for single point calibration from step b) to step e) in Section 4.1.
- During this period, while 'CA1' is displayed, press CAL2. The display counts '5, 4, 3, 2, 1' to avoid accidental initiation, and the right hand decimal point then illuminates.
- At the end of the first calibration sequence 'CA2' flashes on the display, indicating that the second standard solution should be connected to the monitor. Once this has been done the CAL2 button is pressed to continue the sequence.

**\*** **Note.** The microprocessor allows 15 minutes to elapse, between the end of the first calibration sequence (CA1) and pressing the CAL2 button to start the second calibration sequence (CA2). If this time is exceeded, the two point calibration is aborted.

- 15 minutes later, the microprocessor reads the output from the electrode pair plus the temperature, then, calculates the slope correction required to bring the reading to the second preset standard solution concentration. If the slope value falls below approximately 83% the external CAL FAIL alarm is activated and the display shows 'CF' indicating the sodium electrode is in need of attention.

## ...4 CALIBRATION PROCEDURE

- f) If the slope value is above this minimum value the instrument completes the sequence as in steps (g) and (h) of Section 4.1, and the display reverts to displaying the concentration value.

The slope value can be displayed at any time, including after a CAL FAIL, to indicate the condition of the sodium electrode. Keeping a note of the slope value gives an early warning of a CAL FAIL condition.

The voltage offset can also be displayed – see Section 4.1

### 4.3 Automatic Single Point Calibration



**Note.** It is recommended that a manual, two point calibration is first carried out before initiating the automatic calibration sequence.

The monitor can be set to perform automatic, single point calibrations at preset intervals (see Section 4.4) as follows:

- a) Enter the value of the standard solution by pressing the STD button and using the UP/DOWN buttons to set the concentrations of the solution.



**Information.** The recommended value for this standard is 100µg/kg.

- b) Place 5 litres of standard solution, in the bottle supplied, on top of the Sensor Unit and connect the delivery tube.

- c) Set switch SW1.6 to ON.

Period (hours)	Link 2
24	B1, B2
48	B1, A2
72	A1, B2
168 (weekly)	A1, A2

## 5 MAINTENANCE

An automatic, single point calibration then occurs at the preset intervals which have been selected via link 2 on the Digital board.

### 4.4 Auto Calibration Preset Intervals

Four preset auto calibration times can be set with link 2 on the digital board. Timings and corresponding link settings are shown in Table 4.1.

**Table 4.1 Preset Auto Calibration Timings/Link Settings**

### 5.1 Chemical Solutions

The reagents and calibration solutions detailed below are required to maintain the monitor in operation. Solutions should be stored in plastic bottles and where possible, should be freshly made.

#### 5.1.1 Reagent solutions

Two alternative reagent solutions may be used, depending on the lower limit of measurement desired. Concentrated ammonia solution, which provides adjustment of sample pH to 10.7 is suitable for measurements of sodium ion to approximately 0.5µg/kg. At concentrations below this, hydrogen ion interference becomes significant and an alternative reagent of 50% diethylamine solution should be used. This adjusts the sample pH to 11.2 - 11.5 and enables measurements to be made to concentrations below 0.1µg/kg.

Both reagents are mildly toxic and hazardous, and should be handled with care.

- a) Concentrated ammonia solution – 1 litre.



**Warning.** This reagent should only be handled under a fume hood. It causes burns and is irritating to the eyes, respiratory system and skin. Wear rubber gloves and eye protection. Note that in warm weather, pressure develops in the bulk container of ammonia, and the cap must be released with care.

A 35% w/v solution (s.g. 0.88) is recommended. However, lower concentrations, to a minimum of 30%w/v (s.g. 0.89), can be used. Reference should be made to section 5.4.2 which relates sodium concentration and pH.

- b) Diethylamine Solution – (50%)



**Warning.** Diethylamine is an extremely inflammable and irritating colourless liquid with a strong smell of ammonia. It should be handled with care at all times. The following points should also be noted:

- Avoid breathing vapour and avoid contact with skin and eyes.
- Work under a fume hood, wearing rubber gloves and eye protection.

- In the event of a fire, extinguish with water spray, foam,

## ...5 MAINTENANCE

dry powder or carbon dioxide.

- If a spillage occurs, shut off all possible sources of ignition, and instruct others to keep at a safe distance. Mop up spillage with plenty of water, diluting greatly. Ventilate the area well to evaporate any remaining liquid and dispel vapour.
- Effluent from the monitor contains diethylamine (if this reagent is used). Contact with it should also be avoided.

See Appendix B for di-isopropylamine.

Place 500ml of high purity water in the reagent container and carefully add 500ml of analytical reagent grade diethylamine ( $C_2H_5)_2NH$ . Swirl the solution and allow to cool to room temperature before applying the container cap.

### 5.1.2 Standard Solutions

The following instructions refer to the preparation of 100 $\mu$ g/kg and 1mg/kg sodium, (LOW and HIGH standard solutions respectively) but any concentrations can be prepared within the measuring range selected by appropriate dilution of the stock solution.

Two litres of each standard solution is required:

- a) Dissolve 2.543 ( $\pm 0.001$ )g of analytical reagent grade sodium chloride in approximately 100ml high purity water. Transfer to a 1 litre volumetric flask and make to the mark with more high purity water to give a stock solution of 1000mg/kg sodium ions. Store in a plastic container.
- b) Using a pipette, transfer 10ml of this solution to a 1 litre volumetric flask. Make to the mark with high purity water to give a solution of 10mg/kg sodium ions.
- c) Pipette 20ml of the 10mg/kg solution into a 2 litre volumetric flask and make to the mark with high purity water to give the LOW standard solution of 100 $\mu$ g/kg sodium ions. Transfer this solution to the bottle labelled STANDARD SOLUTION 1 (LOW).

- d) Transfer 200ml of the 10mg/kg solution to a 2 litre volumetric flask and make to the mark with high purity water to give the HIGH standard solution of 1mg/kg sodium ions. Transfer this solution to the bottle labelled STANDARD SOLUTION 2 (HIGH).

- i) It is not advisable to prepare static sodium solutions of less than 50 $\mu$ g/kg because low concentration solutions rapidly become contaminated and change in concentration.

- ii) Although the HIGH and LOW standard solutions are typically one-decade apart in sodium concentration, any concentration difference can be used within the constraints of i) above and the need to have a significant change in electrode output to achieve an accurate calibration.

 **Note.** High purity water = water containing less than

2 $\mu$ g/kg sodium ions and a specific conductivity of less than approximately 0.2 $\mu$ S/cm.

**5.1.3 Etch Solution** (for use on applications where the sample sodium concentration is below 1  $\mu$ g/kg – see also Section 5.2.2).



**Warning.** Sodium Fluoride is toxic. Avoid inhaling the dust and prevent contact with skin and eyes. Wear a dust mask, rubber gloves and eye protection. When prepared, the etch solution contains 0.1M Hydrofluoric acid (0.2% HF). Take care to prevent contact with skin and eyes.

Dissolve 5.0 ( $\pm 0.2$ )g analytical grade sodium fluoride, NaF, in approximately 400ml high purity water. Add to this solution 20 ( $\pm 0.2$ )ml 5M acetic acid \*,  $CH_3COOH$ , and dilute to 1 litre.

\* 5M acetic acid can be prepared from concentrated acid by adding 144 ( $\pm 1$ )ml analytical reagent grade glacial acetic acid (1.05s.g.) to 500ml of high purity water.



**Warning.** When preparing the acetic acid solution, carry out operation under a fume hood and observe the appropriate precautions when handling concentrated acids.

### 5.1.4 Salt Bridge Solution

This solution is required for refilling the calomel reference electrode at extended intervals. A stock solution of 3.0M potassium chloride may be prepared by dissolving 22.4g of analytical grade potassium chloride in approximately 90ml high purity water and then diluting to 100ml with more water. This solution should be stored in a tightly-stoppered plastic bottle. The electrode may be most conveniently refilled using a syringe.

## 5.2 Scheduled Servicing

The procedure outlined is a guide to the maintenance requirements of the monitor. Much depends on the particular installation and sample conditions.

### 5.2.1 Weekly

If continuously running at high concentrations (>100 $\mu$ g/kg) a weekly SINGLE POINT CALIBRATION is recommended.

### 5.2.2 Monthly

- a) Replace the bottle of reagent solution. The level of solution should not be allowed to fall below about three-quarters full. On low ambient temperature installations and for low sodium concentrations, the solution may require replacement more frequently.
- b) Check level of reference electrode filling solution; refill as required.
- c) The following procedures should be carried out:
  - i) When the sodium concentration is above 1  $\mu$ g/kg, carry out a TWO POINT CALIBRATION – see Section 4.2;

note slope value.

- ii) When the sodium concentration is below 1 µg/kg, apply the following reactivation/etch procedure before carrying out a TWO POINT CALIBRATION:

 **Note.** When used for prolonged periods at low concentrations, leeching of sodium ions from the electrode surface accelerates the ageing process of the electrode which is shown by poor response time, low slope value and a limitation to respond to low levels. Calibration may then be in error owing to slow response and poor reproducibility. The reactivation procedure minimises problems from these sources.

- 1) Remove the sodium electrode from the flowcell and slide off the sleeve and 'O' ring; it is not necessary to detach the electrode lead.
- 2) Prepare two plastic beakers, one containing approximately 50ml of etch solution and the other, about 200ml high purity water.
- 3) Dip the electrode in the etch solution for 60 (±5) seconds; then rinse in high purity water.

 **Note.** It is important not to exceed the etch time or the performance of the electrode may be permanently degraded.

- 4) Dispose of the etch solution by diluting to waste with plenty of water. Use fresh etch solution each time.
- 5) Fit the 'O' ring and sleeve and return the electrode to the flowcell. Run the monitor for 1 to 2 hours on low level sodium sample before attempting a calibration. No further calibration should be required until the next reactivation procedure.

It is important that this procedure is carried out at regular monthly intervals and that the process is started as soon as a new electrode is put into service.

 **Note.** It is extremely difficult to recover an 'old' electrode.

Since the reagent solution, in most circumstances, is replaced monthly, the following procedure should be carried out 24 hours after replenishment, in order to allow pH stability to be achieved.

This procedure is applicable for use with both ammonia and amine buffered systems.

### 5.2.3 3-Monthly

- a) Check condition of all plastic tubing; replace as required. Clean flow cell to remove any deposits.
- b) Regenerate desiccator by placing in oven at 130°C for two hours.

### 5.3 Shut-Down Procedures

- a) Close the sample valve up-stream of the monitor.
- b) Remove reagent container and safely dispose of the solution. Rinse the containers thoroughly.



**Warning.** Refer To 'REAGENT SOLUTION' for the safe handling of the reagent solutions.

- c) Fill the calibration solution container with high purity water and carry out a single point calibration to flush out the system.
- d) Remove the electrodes and follow procedure in Section 5.3.1.
- e) Flush all tubing with high purity water using a syringe, to remove any particulate deposits.
- f) Switch off the mains supply to the Transmitter Unit.
- g) SW10 should be set to 'OFF' if the instrument is to be out of commission for longer than, say, one week.

#### 5.3.1 Storage of Electrodes

Fill the rubber teat, supplied with the sodium electrode, with 1mg/kg sodium containing a few drops of concentrated ammonia solution – see Section 5.1.1 for safe handling of ammonia solutions. Push the teat over the end of the electrode. Fill the rubber teat supplied with the reference electrode with salt bridge solution and push the teat over the end of the electrode. Realign the silicon rubber sleeve to seal the refill aperture.

 **Note.** Neither electrode should ever be allowed to dry out.

### 5.4 Unscheduled Servicing

The monitor indicates an that abnormal operation is taking place by means of signals on the digital display as follows:

#### Fault

Display shows 'CAL1 or 'CAL2'

#### Possible cause

Normal reading when calibration sequence is taking place. Display reads flashing 'CAL2' when waiting for CAL2 button to be pressed to start calibration on second solution.

Display flashes (reading)-'out'-

Sample concentration exceeds the range group selected.

Display shows 'CF'

Calibration Fail – the monitor was unable to achieve a successful calibration.

Display shows 'hot'

Sample temperature has

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risen above 55°C – check cause.

### 5.4.1 Calibration Fail alarm

A Calibration Fail condition occurs after a TWO POINT CALIBRATION, when the calculated slope value is less than 83%. This could be caused by a number of factors which should be investigated. Some indication of the problem can be obtained by displaying "S%" (press STD1 and STD2 together) and noting the slope value.

- a) Slope values just below 83%
- Check that vapour bubbles are emerging from the bottom of the stainless steel entrainment tube.
  - Check condition of reagent solution.
  - Reactivate sodium electrode, – see Section 5.1.3. If slope value is not improved following a further calibration, the electrode should be replaced.
- b) Very low or zero % slope
- Check the operation of the solenoid valve.
  - Check flow of standard solution through flow cell.
  - Check level of salt bridge solution in the reference electrode.
  - Check for open circuit reference electrode by substituting with an electrode of known performance.
  - Check electrical connections in electrode junction box and inter-connection cable.

### 5.4.2 Malfunction of the Monitor

Malfunctions of the monitor may produce many effects following a calibration, some of which

- produce abnormal slope values, see Section 3.2.4,
- display alternates between (reading) and 'out'. A very large offset from the electrode pushes the reading beyond the range of the monitor.

It should always be remembered that any unpredictable problems may be due to the standard or reagent solutions. If any doubts exist regarding the integrity of these solutions, they should be replaced with freshly prepared solutions in the early stages of the fault finding investigations.

The accuracy of the monitor is governed by the condition of all the solutions involved which can be incorrectly made or contaminated.

Measuring the pH of the effluent from the flow cell indicates adequate buffering. The minimum pH depends on the minimum sodium concentration, but the pH value is calculated as:

pH must be greater than pNa + 3, so ideally at:

100µg/kg Na+, the pH must be greater than 8.4

10µg/kg Na+, the pH must be greater than 9.4

1µg/kg Na+, the pH must be greater than 10.4

0.1µg/kg Na+, the pH must be greater than 11.4

★ **Note.** If the reagent is allowed to become completely exhausted the reading may be very erratic due to the lack of ionic strength adjustment of the high purity sample.

Mechanical components involved with the liquid handling, should be systematically checked for leaks or blockages, because they change the chemical conditions around the electrode. By far the majority of all problems are found to be associated with the chemistry and the liquid handling section.

### 5.4.3 Replacement of Plastic Tubing (Fig. 5.2)

Periodically certain sections of plastic tubing require replacement due to leakage, blockages, or poor condition. It is good practice to remove the liquid handling panel every twelve months for a complete refurbishment which includes replacing all the plastic tubing. Only the correct size and type of tube should be used to fit the pipe connectors – see Section 6 for part numbers.

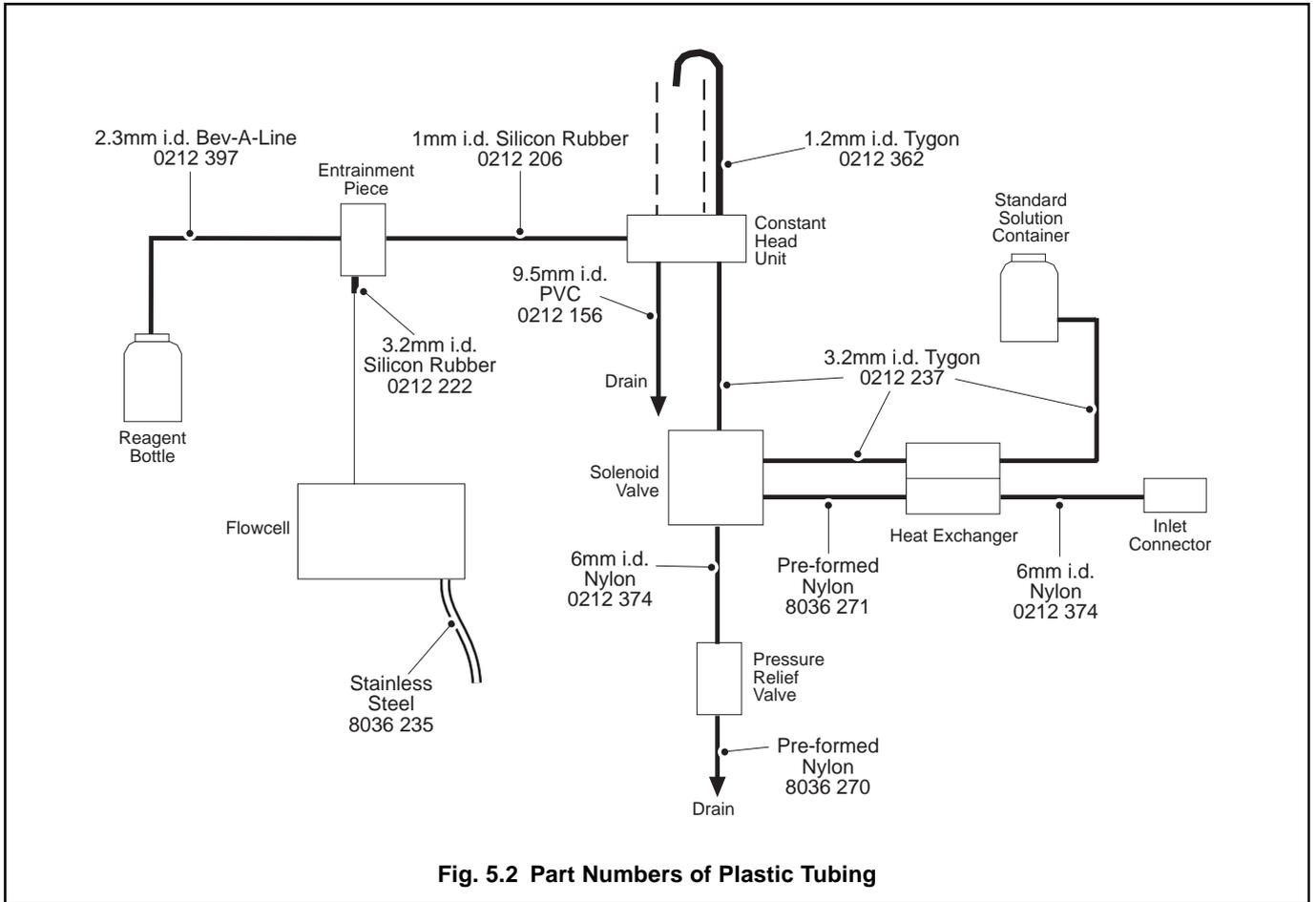
Two specific sections of tubing are critical:

- Between the constant head unit and the entrainment 'T' piece: Cut 100mm of the 1mm i.d. silicon rubber tube and fit onto the tube connectors. The tube should be taut, any change to this tube interferes with the flow and self starting characteristics.
- Between the reagent container and entrainment 'T' piece; this must be a polyethylene lined tube which has good chemical resistance to the reagent.

### 5.4.4 Simple Electronic Check

The ability of the Pre-amplifier and the Transmitter Unit to respond to an input, can be checked in the following way:

- Disconnect the electrode leads from the terminals in the junction box on the Sensor Unit door.
- Connect a milli-volt source to the electrode terminals:
  - negative to 'Na+'
  - positive to 'REF'
  - link 'REF' to 'SCR'.
- Connect a 10kohms resistor across terminals TH1 and TH2 in the Transmitter Unit to simulate 25°C.



**Fig. 5.2 Part Numbers of Plastic Tubing**

## 6 SPARES LIST

d) Initiate a COLD START (holding F2 and pressing RESET).	0212 156	Tubing 9.5mm id PVC	2m
	8036 270	Tube pre-formed Pressure relief valve drain	1
e) Inject 200mV and wait two minutes.	8036 271	Tube pre-formed Heat exchanger-solenoid valve	
f) Note the display reading.	1		
	8036 235	Tube stainless steel flowcell drain	1
g) Inject 259mV and wait two minutes.	0214 047	Tube connector 1.5mm	6
	0214 048	Tube connector 2.5mm	6
h) The reading should decrease by approximately one decade (eg. from 95 to 9.5µg/kg). The exact change in reading is not important because this test is simply to check that the electronics respond to changes in input voltage.	0214 526	Hose connector 9.5mm on constant head unit	1
	0216 452	Tube connector used on solenoid valve	2
	0216 451	Tube connector used on solenoid valve	2
j) A further 59mV decreases the reading by one decade.	0216 452	Tube connector inlet to pressure	

The same procedure can be carried out using a pH simulator, injecting mVs or equivalent pH values. Each pH unit change gives approximately one decade change on the display. A pH simulator also has the advantage of being able to check input insulation – see appropriate instruction manual for the simulator.

No consumable spares are required for this instrument.



**Note.** Part numbers to be allocated are indicated by three x's (xxx).

### Refurbishment Spares. One Years Requirement.

Part no.	Description	No. Required
1048 xxx	Low level sodium electrode	1
1370 xxx	Calomel reference electrode	
1		
8036 xxx	Sodium electrode retaining sleeve	1
0211 109	'O' ring 4mm id x 1.2mm used on thermistor	1
0211 119	'O' ring 6mm id x 1mm used on flowcell	1
0211 164	'O' ring 12.5mm id x 0.103mm used on flowcell	2
0211 034	'O' ring 9mm id x 1.5mm used on solenoid valve	
2		
0212 206	Tubing 1mm id Silicon Rubber	1m
0212 362	Tubing 1.2mm id Tygon	1m
0212 397	Tubing 2.3mm Bev-A-Line reagent container tube	
1m		
0212 362	Tubing 2.3mm id PVC	2m
0212 222	Tubing 3.2mm id sleeve silicon rubber used on entrainment tube	1m
0212 237	Tubing 3.2mm id Tygon	1m
0212 374	Tubing 6mm id Nylon	
1m		

0216 453	relief valve	1		Calibration Fail indication.
	Tube connector outlet on pressure relief valve	1		All voltage free 250V, 2A non-inductive.
8061 660	Knurled nut on flowcell	2	Battery Backup	Issue 6, 8036 180 digital boards: 10 years
8036 216	Entrainment 'T' piece	1		Prior to Issue 6: 4 weeks.
8035 677	Entrainment/earthing tube	1	<b>Installation Information</b>	
8036 247	Reagent container	1	Sample Temperature	5° to 55°C.
8063 xxx	Reagent container cap assembly	1	Sample Flow	50ml/min to 500ml/min.
0216 449	Female connector on standard solution containers	2	Sample Pressure	Minimum 0.14 bar (2 psi).
0216 447	Male connector used on calibration tube assembly	1	Ambient Temperature	0° to 55°C.
8036 227	Thermistor in flowcell	1	Dimensions of Sensor Unit	300mm wide x 400mm high x 200mm deep.
0231 550	Fuse, 2A ceramic	3	Mounting for Sensor Unit	Four Holes 8.5mm diameter 230mm horizontal 330mm vertical.
9435 040	Resistor kit of Remote Range Indication	1	Weight of Sensor Unit:	11kg.
0232 971	Illuminated push switch	2	Connections to Sensor Unit:	Sample inlet: 6.3mm o.d. compression fitting. Sample drain: 10mm flexible, atmospheric drain
0211 683	Thermistor retaining bush	1		Electrical: via gland, cable size 7mm to 10.5mm

**Strategic Spares Rarely Requiring Replacement**

Part no.	Description	No. Required
8036 180	Digital circuit board	1
7835 170	Analogue circuit board	1
9435 160	Power supply circuit board	1
8036 050	Pre-amplifier/box assembly	1
0216 023	Lock and two keys	1
8036 230	Flowcell complete assy. (less electrodes)	1
8036 222	Solenoid valve assembly	1
8036 210	Constant head unit assembly	1
0216 454	Pressure relief valve	1
8036 236	Heat exchanger	1
Ranges	0.01µg/kg to 1mg/kg or 0.1µg/kg to 10mg/kg internally selectable.	

Accuracy ± 10% of concentration or ± 0.1µg/kg whichever is the greater (when sample temperature is within ±5°C of calibration temperature).

Reproducibility ±5% of concentration or ±0.1µg/kg (whichever is the greater) at constant temperature.

Response Time 1 to 100µg/kg – less than 4 minutes for 90% step change 100 to 1µg/kg – less than 6 minutes for 90% step change.

Outputs Two isolated current outputs in the range 0 to 10, 0 to 20 or 4 to 20mA. Maximum impedance 1kΩ. Logarithmic or linear.

Remote Range Four voltage-free contacts rated 125V a.c.,

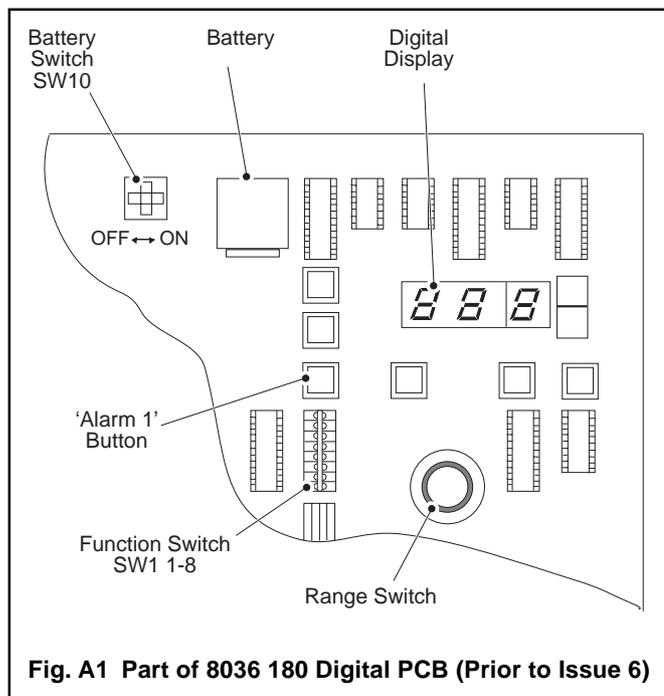
Indication 0.4A non-inductive.

External Alarms Two normal or fail-safe, high and low concentration alarms. Calibration Mode indication.

Max core sizeMains: 32/0.2mm

# APPENDIX A

	Signal: 24/0.2mm
Dimensions of Transmitter Unit	300mm wide x 300mm high x 200mm deep.
Mounting for Transmitter Unit	Four Holes: 8.5mm diameter 230mm horizontal 230mm vertical.
Weight of Transmitter Unit	11kg.



**Fig. A1 Part of 8036 180 Digital PCB (Prior to Issue 6)**

Electrical Connections	Via gland plate to fit glands as required.
Power supply Requirements	100/110/120/200/220/240V50/60Hz 100VA.
Power Supply Tolerances	Voltage +10% -20%. Frequency min. 47Hz, maximum 65Hz.
Case Protection of Transmitter Unit	IP55.
Maximum Distance Between Sensor & Transmitter Unit	100 metres.

## A.1 Transmitter Unit

### A.1.1 Previous Type Digital Circuit Board

(8036 180 - prior to Issue 6, as marked)

This digital board was fitted to earlier versions of the monitor

and is now superseded by the board described in the main text of this manual. The principle difference is the extension of the volatile memory on the later version. User programmable information on the earlier version is only retained for up to 4 weeks in power down conditions. Users of monitors with the earlier version board need to undertake additional tasks on a different board layout to the information given in the main text.

### Setting digital circuit board

#### Function switch (SW1)

This is situated just below the ALARM 1 push button, and is a series of eight dual-in-line switches – See Fig. A2. This switch is functionally similar and set as described in the main text.

#### Battery switch (SW10)

This is located at the top of the board – see Fig. A2. This switch is functionally similar and operated as described in the main text. However, SW10 must be switched to the 'OFF' position when the mains supply is switched off for periods greater than 4 weeks, to prevent damage to the Nickel-Cadmium battery.

#### Other switches and controls

These are located as shown in Fig. A2, and are functionally similar and operated as described in the main text.

#### Cold start

This event takes place on reinstatement of the mains supply when the mains supply has been lost for longer than 4 weeks,\* or when the battery switch SW10 has been switched off. Pressing RESET while holding F2 also initiates a COLD START.

After a COLD START the data in the volatile memory is lost, so the microprocessor:

- Sets Alarm 1 to minimum range value
- Sets Alarm 2 to full scale
- Reads the default standard solution values on SW1.6
- Sets the slope value to 100% and sets the zero offset to a default value.

Point d) enables the display to follow changes on the input to the Transmitter Unit, making electronics testing a simple operation.

The display permanently shows '888' after the mains supply has been reinstated. This indicates that the battery requires recharging. After approximately five minutes, normal operation can be resumed by pressing the RESET button. A TWO POINT CALIBRATION must now be carried out.

**Note.** Following a COLD START a full TWO POINT CALIBRATION is required for the instrument to produce valid sodium concentration values.

#### Warm start

This event takes place when the mains supply has only been lost for a period of less than 4 weeks\*, when data held in the volatile memory is maintained. The instrument returns to normal operation, maintaining calibration, standard solution and alarm values previously held.



**Note.** This refers to 8036-180 digital boards prior to Issue 6. Issue 6 boards retain the memory for 10 years.

### Sample temperature

The temperature of the sample water is continuously monitored by means of a thermistor housed in the flow cell.

If the temperature of the sample rises above 55°C, the display shows 'hot'. After 30 minutes the temperature is again measured. This procedure repeats until the sample temperature is less than 55°C; the monitor then returns to the 'RUN' mode.

## A.2 Shut - Down Procedure

### A.2.1 Transmitter unit

Undertake the procedure as follows:

- a) Open the unit and gain access to the digital board by releasing the 4 plastic fasteners securing the front panel.
- b) Set the battery switch (SW 10) to 'OFF'.

c) Replace the front panel and secure with the fasteners.

## A.3 Spares List

Substitute the new Digital Circuit Board complete ( Part Number 9435 180) as a replacement for the previous type.

## APPENDIX C

Check the new board against Section 3.2.3 and follow the procedures given in the main text in Section 2.4 and Section 2.6.

### Di-isopropylamine Reagent



**Warning.** Di-isopropylamine is an extremely inflammable, colourless liquid. It is irritating to the eyes, respiratory system and skin. It should be handled with care at all times. The following points should be noted:

- Avoid breathing vapour and avoid contact with skin and eyes.
- Work under a fume hood, wearing rubber gloves and eye protection.
- In the event of a fire, extinguish with water spray, foam, dry powder or carbon dioxide.
- If a spillage occurs, shut off all possible sources of ignition, and instruct others to keep at a safe distance. Mop up spillage with plenty of water, diluting greatly. Ventilate the area well to evaporate any remaining liquid and dispel vapour.
- Effluent from the monitor contains di-isopropylamine. Contact with the effluent should also be avoided.

Place approximately 500ml of concentrated reagent grade di-isopropylamine  $[(CH_3)_2CH]_2NH$  in the reagent container and apply the cap tightly.

### C1 Calibration for High Sodium Concentrations

In some applications it has been observed that good accuracy may not be obtained at high sodium concentrations if the monitor has been running for long periods at low concentration levels. The modifications detailed in this appendix explain how to overcome this.



**Warning.** Sodium fluoride is toxic. Avoid inhaling the dust and prevent contact with skin and eyes. Wear a dust mask, rubber gloves and eye protection.

The modifications comprise:

- a 3-port solenoid valve in the delivery tube from the reagent container;
- a change in standard solution composition;
- modified software in the transmitter unit.

### C2 The Calibration Procedure

For the first five minutes of the procedure the solenoid valve is energised, under the control of the software, such that the reagent vapour is blocked and air is introduced.

The standard solution, which is an acidified solution of sodium fluoride, passes through the flowcell and imparts a mild etch to the sodium electrode. The valve then closes and reagent vapour addition returns. (The alkaline reagent vapour is sufficient to overcome the weak acidity of the standard solution.)

The monitor then calibrates as normal for 15 minutes before returning to sample or secondary standard, as appropriate.

This procedure occurs during both normal and automatic calibration modes.

### C3 The solenoid Valve

This is connected via a 2-core cable to TB3 of the analogue board (see Figs. 2.5 and C1). A diode (part no. 0248 247) must be fitted across the terminals in the valve head.

### C4 Standard Solution Preparation (Acidified sodium fluoride solutions)

The following instructions refer to the preparation of 100µg/kg and 1mg/kg sodium, (LOW and HIGH standard solutions respectively) but any concentrations can be prepared within the measuring range selected by appropriate dilution of the stock solution.

Two litres of each standard solution is required:

a) Dissolve 1.826 ( $\pm 0.001$ )g of analytical reagent grade sodium fluoride in approximately 100ml high purity water. Transfer to a 1 litre volumetric flask and make to the mark with more high purity water to give a stock solution of 1000mg/kg sodium ions. Store in a plastic container.

b) Using a pipette, transfer 10ml of this solution to a 1 litre volumetric flask. Make to the mark with high purity water to give a solution of 10mg/kg sodium ions.

c) Pipette 20ml of the 10mg/kg solution into a 2 litre volumetric flask and add 2.0 ( $\pm 0.1$ )ml 0.05M acetic acid. Make to the mark with high purity water to give the LOW standard solution of 100µg/kg sodium ions. Transfer this solution to the bottle labelled STANDARD SOLUTION 2 (LOW).

d) Transfer 200ml of the 10mg/kg solution to a 2 litre volumetric flask and add 2.0 ( $\pm 0.1$ )ml 0.05M acetic acid. Make to the mark with high purity water to give the HIGH standard solution of 1mg/kg sodium ions. Transfer this solution to the bottle labelled STANDARD SOLUTION 2 (HIGH).

Valve Connection

i) It is not advisable to prepare static sodium solutions of less than 50µg/kg because low concentration solutions rapidly become contaminated and change in concentration.

ii) Although the HIGH and LOW standard solutions are typically one-decade apart in sodium concentration, any concentration difference can be used within the constraints of i) above and the need to have a significant change in electrode output to achieve an accurate calibration.



**Note.** High purity water = water containing less than 2µg/kg sodium ions and a specific conductivity of less than approximately 0.2µS/cm.

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#### Client Warranty

Prior to installation, the equipment referred to in this manual must be stored in a clean, dry, atmospherically controlled 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.



The Company's policy is one of continuous product improvement and the right is reserved to modify the information contained herein without notice.

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