ANALOX 1320 SURVEYOR

INSTRUCTION MANUAL

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IMPORTANT NOTES

Any adjustments or repairs to the ANALOX 1320 range of instruments should only be carried out by a competent electronic engineer, familiar with instrument technology.

SAEP Ltd. WILL NOT ACCEPT RESPONSIBILITY FOR ANY EVENTS OCCURRING AS A RESULT OF UNAUTHORISED ADJUSTMENTS OR REPAIRS TO THE INSTRUMENTS.

SAEP Ltd. operate a policy of continuous improvement to their products and reserve the right to change the design, components and specification of their equipment, without prior notice.

However, the company will endeavour to keep their customers informed of any changes, which they consider to be relevant to the continued satisfactory performance of their products.

The information in this document is given in good faith and believed to be correct, at the time of publication.

The purchaser's attention is drawn to the Appendix at the end of this manual, with regard to Warranty Conditions.

Further technical assistance may be obtained by contacting SAEP by one of the means indicated below.

SECTION 1 OPERATING INSTRUCTIONS

1.1 INTRODUCTION

The ANALOX 1320 Surveyor Instrument is designed to operate in conjunction with external sensors, provide indication of the concentration of oxygen, flammable or toxic gases and initiate alarms if the measure concentration falls outside pre-set limits.

The systems are available as Full 19" x 30" Rack containing up to 15 monitoring channels or as a Half Rack unit with up to 7 monitoring channels. The systems provide the following facilities:

a) Individual Indication for each channel
b) Audible and Visual alarm indication
c) Relays on all alarm circuits if required
d) Open collector drive on all alarms
e) 4-20mA Output on each channel
f) Easy calibration and alarm setpoint adjustment
g) Fault and Over range Indications

The systems are designed to operate primarily from a 24 volt DC power supply but may also be configured to run from a Mains supply of 220v, 240v or 110v AC, by means of an optional external Transformer unit. Optional Battery Back up power can be fitted to provide uninterrupted operation in the event of mains failure.

A typical system would consist of the following items:

a) A Rack tray assembly including Backplane
b) A single Facilities Card
c) One Channel card per monitoring point
d) One sensor unit per monitoring point
e) Relays fitted as required
f) Optional external power supply for operation from AC Mains

1.1.1 Weight and Dimensions (Overall)

	Height	Width		Depth	Weight
Instrument Tray Full Width	133mm	483mm	(84E)	268mm	2.2kg
Instrument Tray Half Width	133mm	241mm	(42E)	268mm	1.7kg
Channel Card	128mm	25mm	(5E)	246mm	245gms
Facilities Card Full Width	128mm	45mm	(9E)	246mm	255gms
Facilities Card Half Width	128mm	35mm	(7E)	246mm	255gms

1.2 GENERAL DESCRIPTION

The ANALOX 1320 Surveyor is a multi channel monitoring system designed primarily for the detection and display of concentration of Oxygen, Toxic and Flammable gases, together with user adjustable alarm circuits. Each Channel card can be configured to operate from a range of input signals:

a) 4-20mA Loop Powered sensor/transmitters
b) Pellistor Half-bridge Flammable sensors
c) Voltage level signals
d) Millivolt level signals
e) 4-20mA Live output sensors (Simrad etc.)

The Channel Cards provide excitation power for both Loop powered 4-20mA transmitters and Flammable sensors. Adjustment is provided in the power supply for the Flammable sensors and both supplies are protected against short circuit faults in the sensors or associated wiring.

Measured level indication is provided by an Edgewise Analogue meter on the front panel of each Channel card. Calibration is easily carried out using the Zero and Span adjustments on the front panel of each Channel card.

User adjustable HI and LO alarms are incorporated in each channel, together with fault and over-range indication. The HI, LO and fault alarms can be fitted with 3 optional plug-in relays, which can be configured, by jumper links, to operate in a normally energise or de-energised state. In the latter case, this provides a 'Fail-Safe' condition. The alarm Setpoints can be displayed on the Channel Card meter by operating a spring loaded switch on the front panel. The HI and LO alarms can be individually configured using jumper links, to operate on a High going or Low going signal and may be of the latching or non-latching type. Both alarm circuits incorporate Open Collector outputs in addition to relays.

The Fault alarm circuit operates when the measured input signal drops below the Zero point by about 6% of full range and is useful for indicating open circuit sensor connections or obscuration of the Optical system in an Infra red type sensor. The over-range alarm operates when the input signal exceed the full range by about 6%.

An 'Inhibit' function is built in to each Channel card to prevent alarm triggering during calibration or alarm setpoint adjustment. This function also operates during the first 30 seconds after initial application of power, to allow the sensors to settle.

Each Channel card also provides a 4-20mA analogue output which is proportional to 0-100% of full scale reading for the particular card.

Every system also requires a 'Facilities Card' which incorporates circuitry common to all Channel cards in the system. These include power supplies and 3 Global alarm circuits incorporating relays and 'Open Collector' outputs. Using jumper links, these Global alarm circuits may be configured in a voting or non-voting mode and can also provide 'Fail-Safe' operation.

A local Audible alarm is built in to the Facilities card together with an 'Alarm Accept' push button switch, which mutes the audible alarm.

Provision is made for connection of separate external Audible and Visual alarm devices together with a remote 'Mute' capability. The external audible alarm may be disabled by pressing either the local 'Alarm Accept' or closing the Remote 'Mute' switch. The external alarm outputs are of the open collector type, designed to operate relays.

The systems may be specified at ordering stage, to include or exclude any combination of relays, ie if only the Global relays are required, then the relays on the Channel cards, together with their associated driver components, can be omitted, resulting in a considerable cost saving on a full 15 channel system. The relays and their associated drivers are Plug-in devices thus enabling easy upgrading at a later stage if necessary.

Note: Since all the relay contacts connect via the Instrument Backplane, they are NOT suitable for switching AC mains.

1.3 CHANNEL CARD CONTROLS AND INDICATIONS

1.3.1 The Channel Card

Controls and indicators on the Channel Card front panel are shown in Fig 1. and have the following functions:

1.3.2 The Analogue Display

This meter is used in conjunction with the 'LO/HI' switch immediately below it to provide, in its normal condition, an indication of the measured concentration of the gas detected by the sensor connected to that channel. It may be fitted with a number of scales, depending on the application – typical scales are: Oxygen 0-15%: Flammable Gas 0-100% LEL: Toxic Gas 0-100ppm etc. It is also used to display the Alarm Setpoints.

1.3.3 The HI/LO Switch

This switch is a three position device which is normally spring biassed to its central position. In this position, the Display meter indicates the measured gas concentration. If the switch is pushed to the Left, then the LO alarm Setpoint will be displayed and if pushed to the Right then the HI alarm Setpoint will be displayed. This allows easy adjustment of the alarm Setpoints.

1.3.4 The Power Indicator (P)

Indicates the presence of the main power supply from the Facilities Card to the Channel Card.

1.3.5 The Alarm Trip LEDs (HI and LO)

These Red LEDs will initially flash On and Off if the alarms are configured in the Latching mode and the appropriate alarm circuit trips. If the 'Alarm Accept' push button switch on the Facilities Card is operated, the LED will then remain illuminated in a steady condition, until the alarm state clears. If the alarms are configured in the Non-latching mode then if an alarm condition occurs, the appropriate LED will illuminate in a steady condition for as long as the alarm state exists, and then turn off.

1.3.6 The Fault LED (FLT)

If the input signal level falls below the normal Zero level, eg 4mA on a Loop powered sensor, by approximately 6% of full range, then the Fault alarm circuit will trip and the 'FLT' LED will illuminate. It will remain in that condition until the input signal is greater than the alarm trip point at which time it will turn off. This is a non-latching alarm.

1.3.7 The Over-range LED (OVR)

If the input signal level rises to a value of approximately 106% of full scale, then the Over-range alarm will trip and 'OVR' LED will illuminate. It will remain in that condition until the input signal falls below the alarm trip point at which time it will turn off. This is a non-latching alarm.

1.3.8 The Inhibit LED (INH)

This LED operates in conjunction with the Alarm Inhibit function and will be illuminated when the Inhibit switch is in its Left hand position and also for 30 seconds after initial power application. (See 1.3.11 Inhibit Switch).

1.3.9 The Alarm Setpoint adjustments (H & L)

These controls allow the user to adjust the HI and LO alarm Setpoints, in conjunction with the HI/LO switch, describe in 1.3.3 above. The procedure for adjusting these Setpoints is described in 2.4.9 below.

1.3.10 The Calibration Adjustments (C & Z)

These controls are used to adjust the zero offset (Z) and the Calibration span © during the calibration and alarm setting procedures to be carried out, without causing any internal or external alarms. **It should only be used during calibration and alarm setpoint adjustment procedures, and should never be left in this position during normal operation.** (See 1.3.8 Inhibit LED.)

1.3.11 The Inhibit Switch(INH)

When this switch is moved to its Left hand position, it causes the User alarms (High and Low) to be disabled. This allows the calibration and alarm setting procedures to be carried out, without causing any internal or external alarms. It should only be used during calibration and alarm setpoint adjustment procedures, and should never be left in this position during normal operation. (See 1.3.8 Inhibit LED).

1.3.12 The Internal Controls

There are three internal controls on each Channel Card which are only accessible when either the entire rack tray is withdrawn from its cabinet, or an Extender Card is fitted in place of the Channel Card and the Channel Card then connected to the Extender Card. These controls allow adjustment of the following levels.

a) VR9 which is located at the top of the card, immediately next to a Ferrite Coil. This is used to set the drive power for a flammable sensor. See 2.4.7 for adjustment procedure.

b) VR8 which is located near the lower edge of the card, directly below VR9. This is used to set the 4mA point on the 4-20mA output. It is factory set and should not normally require any adjustment.

c) VR5 which is the front most in a group of three potentiometers located at the top of the card, just behind the Display meter. This is used for adjusting the scaling of the display meter, is factory set and should not require further adjustment.

d) VR6 and VR7, the other two controls in the group of three, should **NOT be adjusted under any circumstances.** They are factory set and require a detailed knowledge of the full setting-up procedure to enable them to be correctly set.

1.4 FACILITIES CARD CONTROLS AND INDICATIONS

1.4.1 The Facilities Card

Controls and indicators on the Facilities Card are shown in Fig 1. and have the following functions:

1.4.2 Power Indicators LEDs

The three green LEDs indicate the presence of the main power supplies, generated on the Facilities card and passed via the backplane, to the Channel Cards.

1.4.3 The Alarm Accept Push Button

This switch is used to silence the internal and external Audible alarms and also enables the alarm circuits to reset, when the measured level on the channel which caused the alarm, returns to the safe side of the trip point. It is only used in conjunction with Latching alarms.

1.4.4 The Global Alarm LEDs

The operation of these LEDs depends on the configuration of the associated Jumper Links on the Facilities card. If the Facilities Card relays are configured in a non-voting mode, then if any one LO alarm on a Channel Card operates, then the Global LO alarm LED will illuminate. If any one Hi alarm on a Channel Card operates, then the Global HI alarm LED will illuminate. The same principle applies to the Global Fault LED. If the relay circuits are configured in a voting mode, then the Global LEDs will only operate if more than one type of alarm is present. Refer to 2.4.10 for a full description of the voting alarm mode.

1.5 ROUTINE CHECKS

1.5.1 General

The following routine checks should be carried out at regular intervals:

a) Check that the Green Power LEDs are illuminated on all Channel Cards and the Facilities Card.

b) Check that there are no Amber warning LEDs illuminated and that all Inhibit switches are in their Right hand position.

c) Check that there are no Red Alarm LEDs illuminated, unless a channel is in an alarm state.

d) Observe the meter readings on all channels - Toxic and Flammable channels should normally read 0 and Oxygen channels 21%

e) Check the alarm setpoints by operating the HI/LO switch on each Channel Card and reading them on the meter. Compare the setpoints with the recommended values.

Note: It is NOT necessary to operate the Inhibit switch when CHECKING the alarm setpoints.

1.5.2 Reporting

If any of the checks outlined in 1.5.1 fail to comply with the expected results then this should be reported to an authorised engineer.

1.6 CALIBRATION

1.6.1 General Information

Before any calibration is carried out, the sensors should have been operating for at least 15 minutes or in the case of Toxic sensors, at least three hours. Before any adjustments are carried out, the Inhibit switch on the Channel Card to be calibrated should be moved to the Left hand position, thus disabling the alarm circuits, on that card.

WARNING: The code of practice regarding selection, installation and maintenance of electrical apparatus for use in potentially explosive atmospheres must be complied with at all times. The user is referred to BS5345 Part 1 1976 and any subsequent amendments.

1.6.2 Flammable Sensor

a) Setting Zero: Either ensure that the sensor is located in an atmosphere free of flammable gas or fit a gassing cap to the sensor and apply a slow flow of Inert gas such as Nitrogen, having a flow rate of between 100 and 300 millilitres per minute. Allow the indication on the Channel Card meter to stabilise and if it does not read Zero, then adjust the 'Z' control for a reading of Zero. (Note: Anti-clockwise rotation decreases the reading). Remove the Inert gas source.

b) Setting Gain: Fit a gassing cap tot he sensor and apply a 50% LEL gas mixture having a flow rate of between 100 and 300 millilitres per minute. Allow the indication on the Channel Card meter to stabilise, approximately 3 minutes, and adjust the 'C' control for a reading of 50 on the meter. Remove the flammable gas mixture and the gassing cap and check that the reading returns to its normal Zero reading. This may take a few minutes. During this time, the alarm setpoints could be checked and if necessary, adjusted. (See 2.4.9).

1.6.3 Toxic Sensor

a) Setting Zero: Either ensure that the sensor is located in an atmosphere free of the gas to which the sensor is sensitive, or fit a gassing cap to the sensor and apply a slow flow of Inert gas such as Nitrogen. Adjust the flow rate to between 100 and 300 millilitres per minute and allow the indication on the Channel Card meter to stabilise. If it does not read Zero, then adjust the 'Z' control for a reading of Zero. (Note: Anti-clockwise rotation decreases the reading). Remove the Inert gas source. Note: If a Zero reading cannot be obtained within the range of the 'Z' control then the Toxic Sensor/Transmitter output current should be checked by an authorised engineer. (See 1.6.4)

b) Setting Gain: Fit a gassing cap to the sensor and apply a gas mixture applicable to the sensor, having a flow rate of between 100 and 300 millilitres per minute. Allow the indication on the Channel Card meter to stabilise, approximately 5 minutes, and adjust the 'C' control until the Channel Card meter indicates the concentration of the applied gas mixture. Remove the Toxic gas mixture and the gassing cap and check that the reading returns to its normal Zero reading. This may take a few minutes. During this time, the alarm setpoints could be checked and if necessary, adjusted. (See 2.4.9).

Note: If a satisfactory reading cannot be obtained within the range of the 'C' control then the Toxic Sensor/Transmitter output current should be checked by an authorised engineer. It is also possible that the sensor cell has reached the end of its life and should be replaced.

1.6.4 Oxygen Sensor

a) Setting Zero: Fit a gassing cap to the sensor and apply a slow flow of Inert gas such as Nitrogen. Adjust the flow rate to between 100 and 300 millilitres per minute and allow the indication on the Channel Card meter to stabilise. This may take several minutes. If the meter does not read Zero, then adjust the 'Z' control for a reading of Zero.
(**Note:** Anti-clockwise rotation decreases the reading). Remove the Inert gas source.

b) Setting Gain: Either remove the gassing cap and expose the sensor to clean gas free air or fit a gassing cap to the sensor and apply a known mixture of Oxygen and Nitrogen, having a flow rate of between 100 and 300 millilitres per minute. Allow the indication on the Channel Card meter to stabilise, approximately 5 minutes. In the case of air calibration, adjust the 'C' control until the Channel card meter indicates 21%, or if using an Oxygen/Nitrogen mixture, adjust the 'C' control for a reading corresponding to the applied gas mixture. Remove the gas mixture and the gassing cap if fitted. The alarm setpoints could now be checked and if necessary, adjusted. (See 2.4.9).

Note: If a satisfactory reading cannot be obtained within the range of the 'C' control then the Oxygen Sensor/Transmitter output current should be checked by an authorised engineer. It is also possible that the sensor cell has reached the end of its life and should be replaced.

1.6.5 Engineering Notes

The Flammable sensors supplied with the ANALOX 1320 systems normally operate with 2.0 volts DC across the pair of Pellistor. Under normal conditions, ie no Flammable gas present, the Centre tap voltage should at half the excitation voltage ie. 1.0 volt. DC.

The Toxic and Oxygen Sensor/Transmitter combination devices operate on the Loop powered principle. The output current should be 4.0mA when the sensor is NOT exposed to the appropriate gas and 20.0mA when exposed to the full scale concentration indicated on the Sensor/Transmitter housing. Intermediate values of output current may be calculated as follows:

$$\text{Output Current} = \frac{\text{Test Gas Concentration} \times 16}{\text{(Sensor Full Scale Range)}} + 4\text{mA}$$

eg. For an Oxygen Sensor/Transmitter with a range of 25% in air:

$$\text{Output Current at } 20.90\% = \frac{20.90 \times 16}{25} + 4 = 17.38 \text{ mA}$$

ANALOX Sensor/Transmitters are fitted with internal 'ZERO' and 'SPAN' adjustments. These controls may be adjusted, if necessary, within limits, to compensate for ageing of the Sensor cell. If it is not possible to achieve the desired 'SPAN' adjustment then it is probable that the Sensor cell is exhausted and should be replaced. Refer to device handbooks for further information.

SECTION 2 INSTALLATION AND COMMISSIONING

2.1 NOTES ON INSTALLATION

2.1.1 Classification of Hazardous Areas

The risk of an explosive atmosphere being formed is a variable factor dependent upon the conditions in the environment under consideration. Consequently, in order that consistency may prevail, hazardous areas are classified into three zones. The publication BS5345 Part 1 1976 refers.

Zone 0 – An area containing an explosive gas/air mixture continuously or for long periods.

Zone 1 – An area possibly containing an explosive gas/air mixture during normal operation.

Zone 2 – An area in which an explosive gas/air mixture is likely to occur for short periods only during normal operation.

2.1.2 Certification

An apparatus designed for installation and use in hazardous areas is certified in accordance with BS229 or BS4683 or BS5501 and conforms to one of the following types of protection.

Intrinsic Safety	Exi	BS5501 Part 7
Flameproof	FLP	BS229
Flameproof	Exd	BS4683 Part 2
Increased Safety	Exe	BS4683 Part 4
Combined Protection	Exed	BS4683 Part 2 & 4
Non Sparking	ExN	BS4683 Part 3
Special Protection	Exs	SFA 3009 1972

2.1.3 Apparatus Gas Groups

Apparatus for use in hazardous areas are, where appropriate, grouped into one of four sub-groups. These are described as I, IIA, IIB and IIC. Sub-grouping is normally applied to Flameproof and Intrinsic safety types of protection. Other types of protection apply equally to all gases subject only to temperature classification.

The former applies to apparatus designed to BS4683 and the following table shows the relationship between the gas group and the former gas groups related to BS229.

BS4683 Part 2 Group	Representative Gas	BS229 Group
I (Mining)	Methane	I
IIA	Propane and Industrial Methane	II
IIB	Ethylene	III
IIC	Hydrogen	IV

2.1.4 Temperature Classification

When selecting apparatus according to temperature classification, the maximum surfaced temperature of the apparatus should not exceed the ignition temperature of the gases or vapours involved. Information regarding ignition temperatures is published in BS5345 Part 1.

The following table shows the temperature classification codes. The ambient temperature is assumed to be 40 ^{o} C unless otherwise state and marked on the device.

Classification Code	Maximum Surface Temperature
T1	450oC
T2	300oC
T3	200oC
T4	135oC
T5	100oC
T6	85oC

2.1.5. Classification Code

Apparatus marking requirements normally include a certification code which includes the following:

a) Symbol for type of protection
b) Apparatus group
c) Temperature classification

Example Exd Iib T5
A unit with flameproof type protection (d) suitable for apparatus groups IIA and IIB with a maximum surface temperature of 100^{o}C (T5).

2.1.6 Certifying Authority

The certifying authority for most of the ANALOX range of Apparatus is The British Approvals Service for Electrical Equipment in Flammable Atmospheres, otherwise known as BASEEFA, which is a part of the Health and Safety Executive. Certificates are prefixed Ex. There are also recent European standards referred to as CENELEC standards which are prefixed EEx.

2.1.7 Threaded Cable Entries

All threaded cable entries in junction boxes etc should only be fitted with APPROVED types of cable glands, stopper boxes or blanking glands, according to the type of wiring system used. Guidance on appropriate types of wiring is contained in BS5345 Part 1 and are summarised as follows:

a) Cables drawn in steel
b) Cables that are otherwise protected against mechanical damage.

1. Armoured Cable
2. Thermo plastic or elastomer, in screened or armoured cable with OVC, PCP or similar sheath overall
3. Cables enclosed in seamless aluminium sheath with or without armour, with an outer protection sheath.
4. Mineral Insulated metal sheathed cable
5. Thermo plastic or elastomer insulated flexible cable or cord with flexible metallic screen or armour and PVC, PCP or armour similar sheath overall.

2.2 INSTALLATION

2.2.1 General

The ANALOX SURVEYOR 1320 system may be a seven point (Half Tray) or fifteen point (Full Tray) installation. Several different type of sensor may be connected to the Instrument depending on the types of gas to be monitored. The types of sensor required are usually specified by the supplier, in consultation with the customer.

2.2.2 Half Tray Unit (See Fig 2)

A Half tray unit houses up to seven Channel cards and one Facilities card. THE FACILITIES CARD MUST ONLY BE FITTED IN THE LEFT HAND CARD SLOT. If the unit is specified with less than seven Channel cards, then blank panels are fitted to the unused positions. An installation may contain more than one tray thus providing a system with a large number of monitoring points.

All installation wiring is connected to screw terminal blocks on the rear of the tray assembly.

2.2.3 Full Tray Unit (See Fig 3)

A Full Tray assembly is functionally identical to the Half Tray unit except that it provides space for up to fifteen Channel Cards and the Facilities Card. Again, the Facilities Card must only be fitted in the Left Hand card slot. This assembly fits directly into a standard 19" instrument console or cabinet. Blank front panels are fitted to any unused Channel Card positions.

2.2.4 Instrument Installation

The Units are installed as follows:

a) Insert the tray assembly into the console or cabinet and secure with the screws provided, using the four holes in the side flanges.
b) Connect up the installation wiring to the terminal blocks on the rear of the unit in accordance with Figure 4.
c) Insert and secure the Facilities card in the LEFT most slot.
d) Insert the Channel Cards in the slots associated with the installed wiring.
e) Fit blanking plates to any unused Channel Card slots.

CHANNEL CARD

O	+24	24v DC for use with Open Collector Outputs
O	OCL	LO Alarm Open Collector output
O	OCF	Fault Alarm Open Collector output
O	OCH	HI Alarm Open Collector output
O	NOH	HI Alarm Relay Normally Open Contact
O	COH	HI Alarm Relay Common Contact
O	NCH	HI Alarm Relay Normally Closed Contact
O	NOL	LO Alarm Relay Normally Open Contact
O	COL	LO Alarm Relay Common Contact
O	NCL	LO Alarm Relay Normally Closed Contact
O	NOF	Fault Alarm Relay Normally Open Contact
O	COF	Fault Alarm Relay Common Contact
O	NCF	Fault Alarm Relay Normally Closed Contact
O	4-20+	4-20mAmp Analogue Output Positive
O	4-20-	4-20mAmp Analogue Output Negative
O	A	Sensor Drive Power Positive Output
O	B	Sensor Signal Input
O	C	Sensor Common Connection
O	Ov	24v Supply Common

Note: The Terminals marked A, B and C are sometimes referred to as C, C/T and D respectively, when used with some Flammable sensors.

FACILITIES CARD

O	+24	24v DC for use with Open Collector Outputs
O	GOCL	Global LO Alarm Open Collector Output
O	GOCF	Global Fault Alarm Open Collector Output
O	GOCF	Global HI Alarm Open Collector Output
O	GNOH	Global HI Alarm Relay Normally Open Contact
O	GCOH	Global HI Alarm Relay Common Contact
O	GNCH	Global HI Alarm Relay Normally Closed Contact
O	GNOL	Global LO Alarm Relay Normally Open Contact
O	GCOL	Global LO Alarm Relay Common Contact
O	GNCL	Global LO Alarm Relay Normally Closed Contact
O	GNOL	Global Fault Alarm Relay Normally Open Contact
O	GCOF	Global Fault Alarm Relay Common Contact
O	GNCF	Global Fault Alarm Relay Normally Closed Contact
O	EXTA	External Audio Alarm Open Collector Output
O	EXTV	External Visual Alarm Open Collector Output
O	EMUT	External Alarm Mute Switch
O	EMUT	External Alarm Mute Switch
O	ac/dc+	24v AC supply input OR 24v DC Positive Input
O	ac/dc-	24v AC supply input OR 24v DC Negative Input
O	Ov	External Back-up Battery Negative and ????????????????
O	24vBTY	External Back-up Battery Positive input

Fig 4. Instrument Tray Rear Screw Terminals

2.2.5 Wiring Specification

It is important to realise when considering relative distances between the Instrument and sensors, that the cables used to carry the sensor signals can affect the operation of the system as a whole. All cables have resistance which causes voltage drop along their length. This resistance decreases as the cross sectional area of the conductors is increased. Ie. Basically, the thicker the conductor, the better (within reason). Also, long cable runs act as good aerials and can pick up interference from all sorts of sources, particularly in Industrial environments. Whilst precautions are taken in the Instrument to minimise the effect of interference, it is recommended that where possible, the minimum requirement of a twin twisted screened pair, having a conductor cross sectional area of 1.5mm^2 is used for Loop Powered sensors.

2.2.6 Cable for Loop Powered Sensors

If the above recommended cable, ie twin twisted screened pair, having a conductor cross sectional area of 1.5 mm^2, is used for a Loop Powered sensor, then cable runs of up to 1 kilometre can be used without any detrimental effects.

2.2.7 Cable for Flammable Sensors

Flammable sensors operate at much higher currents, typically 300 milliamps, so the effect of long cable runs is much more severe than that on a 4-20mA device. The voltage drop along a length of cable can be calculated by finding the resistance per unit length of the cable and simply applying Ohms Law. **Remember that a 100 metre run of cable actually consists of a loop length of 200 metres.** If a cable is quoted as having a resistance of say 12.5 Ohms per Kilometre, which is about average for a 1.5mm^2 cross sectional conductor, then a 100 metre cable run will have a total loop resistance of:

$$\frac{12.5}{10} \times 2 = 2.5 \text{ Ohms}$$

Using Ohms Law, the voltage drop on a cable of resistance 2.5 Ohms passing a current of 300 mAmps is:

V = I x R = 0.3 x 2.5 = 0.75 Volt

This means that to obtain 2.00 volts ACROSS THE SENSOR then the Channel Card must produce 2.00v + 0.75v = 2.75 Volts ACROSS THE INSTRUMENT TERMINALS.
The Channel card Flammable power supply maximum voltage is about 3.8 Volts, so, using a cable having a cross sectional area of 1??? 5mm2 would permit a maximum cable run of about 250 metres.

If the conductors have a cross sectional area of 2.0 mm^2, they would have a resistance of about 9.5 Ohms per Kilometre and would permit cable runs of up to 300 metres and if increased to 2.5mm^2. 7.6 Ohms per Kilometre, the permissible length would be increased to about 400 metres.

Cables for the Flammable sensors require THREE conductors, two of which carry the 300 mA current. ('A' and 'C') The third conductor carries the sensor output signal voltage.

2.3 SENSOR INSTALLATION

2.3.1 General

There are several different sensors available for detection of flammable, toxic and oxygen gases. Ensure that the correct type of sensor is used with the correctly configured Channel Card. Each Channel Card is clearly labelled on the front panel handle with the type of gas it is configured to detect, together with its full-scale range and the Unit of Measurement, and each sensor is also labelled with similar data.

Care should be exercised during installation, not to damage the sensor sinters or membranes or allow them to become contaminated with grease, water or dirt. **IT IS PARTICULARLY IMPORTANT THAT FLAMMABLE SENSORS ARE NOT EXPOSED TO SILICON BASED SUBSTANCES OR HALOGENS.** For these reasons, it is recommended that the sensor is kept in its delivered wrapping until the system and wiring are ready for commissioning.

2.3.2 Sensor Location

The type of gas to be detected determines, in general, the location of the sensor. Whereas a gas that is heavier than air will require a low sensor mounting position, a lighter than air gas will necessitate an elevated counting point. Consideration should be given to those areas where it is anticipated that leakage may occur eg. In the vicinity of valves, pipe flanges, compressors etc. and also to the possibility of pockets of gas collecting in the event of a leak. In this respect, heavier than air gases eg. Propane or Butane may tend to accumulate in floor ducts, pits etc. and ventilation should be provided for these areas as a normal precaution. Lighter than air gases eg. Methane or Hydrogen will tend to accumulate between ceiling joists and similar consideration should be given to adequate ventilation.

Additionally, the effects of any ventilation must by considered in the siting of gas sensors and it may be prudent to mount sensors in air extraction ducts. However, excessive velocities can affect the sensors and it may be necessary to provide a degree of draught protection.

The table below shows examples of relative densities for common flammable gases.

Lighter than Air		**Heavier than Air**	
Hydrogen	0.07	Ethane	1.04
Methane	0.55	Hydrogen Sulphide	1.20
Ammonia	0.58	Propane	1.52
Carbon Monoxide	0.97	Butane	1.94
Ethylene	0.98	Pentane	2.40
Air	1.00	Hexane	2.97
		Toluene	3.14
		Heptane	3.45

The flammable sensors should be mounted with the sinter facing downward, whether it is mounted high or low.

2.3.3 Flammable Sensor Connections (See Fig 6a)

Flammable sensors use Terminals A, B, and C – 'A' being the Positive Drive voltage, 'B' is the Signal Input and 'C' is Signal common and Negative of the Drive voltage. (See also Fig 4)

IT IS VERY IMPORTANT THAT THE FLAMMABLE SENSORS ARE CORRECTLY WIRED OTHERWISE THE PELLISTORS COULD SUSTAIN PERMANENT DAMAGE.

2.3.4 Loop Powered 4-20mA Sensors (See Fig 6b)

Both the Toxic and Oxygen Sensors are of this type and should be connected to Terminals 'A' and 'B' Terminal A is the positive '24v' and should be connected to the Sensor/Transmitter positive lead. Terminal B should be connected to the Sensor Negative.

2.3.5 Live Output 4-20mA Sensors (See Fig 6c)

This type of device, examples of which are SIMRAD GD100 and other Infra Red sensors, usually provide a 'Live' 4-20mAmp output and do NOT require application of the Loop power, provided by the 1320 Channel cards. In this case, the sensor output should be connected to Terminals 'B' and 'C'. Terminal B is the Positive Input and Terminal C is Negative Input.

2.3.6 Dummy Loads

Dummy loads are used to simulate a typical sensor thus enabling the Instrument to be checked out without connecting the sensors. When the Instrument is despatched from the factory, the appropriate dummy loads are fitted for each Channel Card. These should only be removed when the sensor wiring is ready to be connected and they should be retained as an aid to fault diagnosis.

A dummy load for a Flammable Sensor consists of two 5.6 Ohm resistors connected as shown in Fig 5a.

A dummy load for a Toxic or Oxygen Sensor/Transmitter consists of a single 4700 Ohm resistor connected as shown in Fig 5b.

2.4 COMMISSIONING

2.4.1 General

Commissioning an ANALOX 1320 system entails checking the Jumper Link Configuration, calibrating each Channel Card in the system using appropriate gases and adjusting the alarm Setpoints. Calibration gas of known accuracy is required – the calibration procedure is outlined in section 1.6 above.

WARNING: IF THE SYSTEM OPERATES FROM AN AC MAINS SUPPLY, CHECK THAT THE POWER SUPPLY UNIT IS CONFIGURED FOR THE CORRECT MAINS SUPPLY, PRIOR TO CONNECTION OF THE MAINS SUPPLY. The Optional external power units are clearly marked on the outside of the case with the operating mains supply voltage.

2.4.2 Channel Card Jumper Link Settings

The locations of all Jumper Links are shown in Fig 7. The Jumper Link settings are pre-set, for the application specified by the customer, before the Channel Cards leave the factory. However, these settings should be checked during the commissioning procedure and verified against the settings below. Unless otherwise specified, any relays fitted to the Channel Cards will be configured to operate in the 'Energise in Alarm' Mode. If the relays are required to operate in the 'Fail-Safe' mode then the appropriate Jumper Links should be reset as described.

To ease the setting procedure, all directions apply to a Channel Card with the components toward the user and the Front Panel to the Left. The directions are then given as NORTH, SOUTH, EAST and WEST for the Jumper Link settings.

If a Link position is described as 'OFF', then the jumper link should be placed on ONE of the pins only, instead of linking the two pins.

2.4.3 Link Settings for Flammable Sensor

LO -	SOUTH	L1 -	OFF	L2 -	SOUTH	L3 -	OFF
L4 -	NORTH	L5 -	NORTH	L6 -	NORTH	L7 -	NORTH
L8 -	NORTH	L9 -	OMITTED	L10 -	(VQ21) SOUTH	L11 -	NORTH
				L10 -	(VQ27) NORTH		

Note: In some installations, if the sensor cable is quite long, it may not be possible to adjust the 'ZERO' control for a Zero reading due to the cable resistance. In this case, try changing the position of Link L10. However, this Link must always be fitted in either the NORTH or SOUTH positions and not omitted.

To change the Alarm relays to operate in the 'Fail-Safe' mode set as follows:

L5	SOUTH	(HI Alarm)
L6	SOUTH	(LO Alarm)
L7	SOUTH	(FLT Alarm)

To operate HI and LO Alarms in the NON-LATCHING mode, then Jumper Link L3 should be placed in the 'ON' position.

Apart from L3, L5, L6 and Lt, the other Jumper Links should remain in the positions as shown.

2.4.4 Link Settings for Toxic Gas Sensor

LO -	NORTH	L1 -	ON	L2 -	SOUTH	L3 -	OFF
L4 -	NORTH	L5 -	NORTH	L6 -	NORTH	L7 -	NORTH
L8 -	SOUTH	L9 -	OMITTED	L10 -	OFF	L11 -	NORTH

To change the Alarm relays to operate in the 'Fail-Safe' mode set as follows:

L5 – SOUTH (HI Alarm) L6 – SOUTH (LO Alarm) L7 – SOUTH (FLT Alarm)

To operate HI and LO Alarms in the NON-LATCHING mode, then Jumper Link L3 should be placed in the 'ON' position.

Apart from L3, L5, L6 and L7, the other Jumper Links should remain in the positions as shown.

2.4.5 Link Settings for Oxygen Sensor

LO -	NORTH	L1 -	ON	L2 -	NORTH	L3 -	OFF
L4 -	NORTH	L5 -	NORTH	L6 -	NORTH	L7 -	NORTH
L8 -	SOUTH	L9 -	OMITTED	L10 -	NORTH	L11 -	NORTH

To change the Alarm relays to operate in the 'Fail-Safe' mode set as follows:

L5	SOUTH	(HI Alarm)
L6	SOUTH	(LO Alarm)
L7	SOUTH	(FLT Alarm)

To operate HI and LO Alarms in the NON-LATCHING mode, then Jumper Link L3 should be placed in the 'ON' position.

Apart form L3, L5, L6 and L7, the Jumper Links should remain in the positions as shown.

2.4.6 Initial Setting Up Procedure

Ensure that all sensors are connected to the Instrument. Switch on the system power and check that all power indicators are functioning. Switch off the power if all is in order. All adjustments should be carried out using the trimming tool provided or a miniature instrument screwdriver. Any damage to the adjustment controls caused by using unsatisfactory tools will invalidate the guarantee. Adjustment to the Flammable Sensor drive power can only be carried out using an Extender card or by carefully pulling the whole Instrument Tray a few inches out of the cabinet, to gain access to VR9. (For location of VR9 see 1.3.12 a)

2.4.7 Flammable Sensor Current

Before removing any Channel Cards from the Instrument Tray, the main power should be tuned OFF and only restored when the card has been refitted in the tray.

If an Extender Card is being used to gain access to VR9 then remove the Channel Card to be adjusted and fit the Channel Card to the Extender Card. Insert this combination into the Instrument Rack and switch on the power. Locate the terminals 'A', 'B' and 'C'IN THE SENSOR JUNCTION BOX. (If the sensors are not of SAEP source, these may be labelled 'C', ('C/T' and 'D'). Connect a DVM on a low DC volts range, across the terminations 'A' and 'C', or, in the alternative case, across the terminations 'A' and 'C', or, in the alternative case, across 'C; and 'D'. See Fig 8. Below.

Monitor the voltage across the terminals and adjust VR9 until the DVM reads 2.00 Volts. Remove the DVM, secure the junction box lid and repeat the above procedure for all Flammable Channels.

Fig 8. Flammable Sensor Voltage Test

IMPORTANT NOTES

a) There are occasions when a different type of Flammable sensor may be used, which operates with a different terminal voltage. Unless otherwise specified, always assume that the sensor requires 2.00 Volts.

b) Unless the cable run between the sensor and the Instrument Rack is very short ie less than about 10 metres, the sensor operating voltage MUST BE MEASURED AT THE SENSOR. Long cable runs will have significant resistance and will cause a voltage drop along the length. This drop will be subtracted from the voltage source at the Instrument Rack Terminals and could cause incorrect operation of the sensor. If the sensor Pellistors are not heated to the correct temperature, (approx 500^{O}C), then this will result in a reduction in sensitivity. (See also 2.2.5)

2.4.8 Loop Powered Sensor current

These devices are of the 4-20mA Transmitter type and are supplied form a current limited source on the Channel Card. There is no adjustment required for this current since it is controlled directly by the Sensor/Transmitter. However, the Loop current can be monitored by breaking the current loop circuit at any convenient point, eg in a Junction Box, and inserting a millimetre in series with the circuit. Alternatively, the sensor Loop current may be measured by fitting an extender card as described in 2.4.7 above and connecting a milliammeter across the RED and BLACK test points located at the top edge of each Channel Card. Refer to 1.6.4 above for an explanation of the expected current.

2.4.9 Alarm Setpoint Adjustment

When all the Channel Cards have been installed and calibrated the Alarm setpoints should now be checked and adjusted if necessary. When the Channel cards leave the factory, the LO and HI alarms are set to 25% and 50% of full scale respectively. To adjust these setpoints, proceed as follows.

a) Operate the 'INHIBIT' switch to its LEFT hand position, thus disabling the alarm circuits.

b) Push the 'LO/HI' switch to the 'LO' position – the meter will now indicate the LO Alarm setpoint. Using the trimming tool provided, or a miniature instrument screwdriver, adjust the 'L' control until the meter indicates the desired setpoint level.

c) Push the 'LO/HI' switch to the 'HI' position – the meter will now indicate the HI Alarm setpoint. Using the trimming tool provided, or a miniature instrument screwdriver, adjust the 'H' control until the meter indicates the desired setpoint level.

d) Release the 'LO/HI' switch and reset the 'INHIBIT' switch to its normal Right hand position.

2.4.10 Global / Voting Alarms

The Facilities card included with all Instruments, incorporates three Global Alarm relays associated with the Channel Card HI, LO and Fault alarm circuits. Each of these relays may be configured to operate in two modes:

a. Non Voting mode b. Voting mode

In the Non-Voting mode, if any LO alarm on a Channel Card becomes active then the Global LO alarm relay on the Facilities Card will operate and the Front panel LED will illuminate. A similar action applies to the Hi and Fault alarms.

In the Voting mode, depending on the position of three individual Jumper Links on the Facilities card, a Global Alarm will only be operative if either two or three Channel Cards have the SAME alarm condition. The location of these Jumper Links can be seen in Fig 9.

Jumper 'LH' determines the Global HI alarm mode.
Jumper 'LL' determines the Global LO alarm mode.
Jumper 'LF' determines the Global Fault alarm mode.

If Jumper 'LH' is placed in the NORTH position, then the Global HI Alarm will operate in the NON-VOTING mode.

If Jumper 'LH' is placed in the middle position, then the Global Hi alarm will only operate when any TWO Channel Cards are in a HI Alarm condition.

Note: Each relay circuit may be Individually configured for operating mode. Eg LO relay in Three Alarm Voting Mode, HI relay in Two Alarm Voting mode and the Fault relay in a Non-voting mode.

In addition to the Voting modes, each of the relays may be configured to work in an 'Energise in Alarm' or 'Fail-Safe' mode, by Jumper Links L1, L2 and L3 on the Facilities card.

2.4.11 Facilities Card Jumper Link Settings

LH	NORTH	Global HI Alarm Non-Voting	Any 1 Alarm Activates
LH	MIDDLE	Global HI Alarm Voting	Any 2 Alarms Activate
LH	SOUTH	Global HI Alarm Voting	Any 3 Alarms Activate
LL	NORTH	Global LO Alarm Non-Voting	Any 1 Alarm Activates
LL	MIDDLE	Global LO Alarm Voting	Any 2 Alarms Activate
LL	SOUTH	Global LO Alarm Voting	Any 3 Alarms Activate
LF	NORTH	Global Fault Alarm Non-Voting	Any 1 Alarm Activates
LF	MIDDLE	Global Fault Alarm Voting	Any 2 Alarms Activate
LF	SOUTH	Global Fault Alarm Voting	Any 3 Alarms Activate
L1	NORTH	Global HI Relay only energised in Alarm condition	
L1	SOUTH	Global HI Relay normally energised ie Fail Safe	
L2	NORTH	Global LO Relay only energised in Alarm condition	
L2	SOUTH	Global LO Relay normally energised ie Fail Safe	
L3	NORTH	Global Fault Relay only energised in Alarm condition	
L3	SOUTH	Global Fault Relay normally energised ie Fail Safe	

2.4.12 Analogue Output 4-20mA

Each Channel Card is fitted with a 4-20mA Analogue output which represents 0 to 100% of the full-scale value, indicated by the label on the front panel of the Channel Card. The output is short circuit protected and will operate with loads in the range 50 Ohms to 250 Ohms.

Connections are made to Screw Terminals on the rear of the Instrument Tray. (See Fig 4)

There is a single adjustment for setting the 4.00 mAmp 'Zero' level. This is provided by VR8 whose location is described in 1.3.12 and can be seen on the Channel Card layout in Fig. 7. The control is factory set and should not normally require adjustment.

2.4.13 Battery Back-up

An input is provided on the Facilities Card Screw Terminal strip for connection of a 24 Volt battery to enable the Instrument to operate in the event of normal supply failure. The length of time for which the Instrument and its sensors will operate from the 24 Volt battery, depends on several factors:

a) The Ampere Hour Capacity of the battery
b) The Number of Channel Cards in the system
c) The Type of Sensors used in the system

It is difficult to give figures for any particular Set-up, but having specified a system, SAEP can give further advice with regard to Battery Back-up.

APPENDIX

WARRANTY INFORMATION

We provide the following Warranties for the Analox 1320:

A 1 year electronics warranty.

The Warranty period runs from the date of our Invoice.

We warrant that the equipment will be free from defects in workmanship and materials.

The Warranty does not extend to and we will not be liable for defects caused by the effects of normal wear and tear, erosion, corrosion, fire, explosion, misuse, use in any context or application for which the equipment is not designed or recommended, or unauthorised modification.

Following a valid Warranty claim in accordance with the above, the equipment, upon return to us, would be repaired or replaced without cost or charge but in our discretion we may elect instead to provide to you which ever is the lesser of the cost of replacement or a refund of net purchase price paid as per our Invoice on initial purchase from us. We shall have no liability for losses, damages, costs or delays whatsoever. We shall have no liability for any incidental or consequential losses or damages. All express or implied warranties as to satisfactory or merchantable quality, fitness for a particular or general purpose or otherwise are excluded and no such Warranties are made or provided, save as set out in this Clause 7.

In order to effectively notify a Warranty claim, the claim with all relevant information and documentation should be sent in writing to:

Analox Sensor Technology Limited
15 Ellerbeck Court
Stokesley Business Park
Stokesley
North Yorkshire
TS9 5PT

Or by e-mail to : info@analox.net
Or by Fax to : +44 1642 713900

We reserve the right to require from you proof of dispatch to us of the notification of Warranty claim by any of the above alternative means.

The equipment should not be sent to us without our prior written authority. All shipping and Insurance costs of returned equipment are to be born by you and at your risk. All returned items must be properly and sufficiently packed.