Датчики горючих газов 2000

Руководство по эксплуатации

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Analox 2000 – Flammable Gas Sensors – User Manual

CONTENTS

ANALOX 2000 RANGE
FLAMMABLE GAS SENSORS

INTRODUCTION

The ANALOX 2000 Range of sensors are designed to detect Flammable gas, mainly Methane (CH4) in ambient air monitoring applications. There are two models in the range:

a. Model 2000 which is of the Explosion proof type and
b. Model 2001 which is a lower cost, uncertified type, suitable for use in areas which are not classified as being hazardous.

The Model 2000 consists of a stainless steel sensor unit certified Ex sd IIc T6, mounted on a cast iron junction box, which is certified EEx e II T6. This model also carries an Intrinsically Safe SYSTEM certificate Ex ias IIC. (details included later in this manual.)

The Model 2001 sensor unit is made from Acetal and contains a Ceramic sinter element. The sensor is mounted on a IP65, mineral filled thermoplastic junction box. Both junction boxes include screw type terminals for connection of signal cables.

The Model 2000 unit junction box includes 1 x 20mm threaded cable gland entry and 1 x 25mm threaded cable gland entry. Certified blanking plugs are supplied with the unit.

The Model 2001 has a single 20mm cable gland fitted to the junction box.

The Pellistors used in the 2000 and 2001 sensors are of the Poison resistant variety. Both types of sensor can be supplied with either VQ21 or VQ22 type Pellistors; Operating currents are 300 mA and 175 mA respectively. The VQ21 has a larger active element and is slightly more resistant to poisoning than the VQ22 but if the area to be monitored is unlikely to contain poisoning substances then other considerations may determine which Pellistors are chosen. (See - Intrinsic Safety applications)

PRINCIPLE OF OPERATION

Both sensors use the same devices to actually detect the presence of a flammable gas in the air surrounding the sensing surface. The elements used in these sensors are of the Catalytic Pellistor type and are sensitive to most common Combustible gases and vapors. A single sensor assembly may therefore be used to detect a wide range of these gases. The devices are made from two coils of very fine platinum wire which are embedded in separate beads of alumina. One device is the detector and the other is a temperature compensating element. The detecting element is treated with a catalyst which promotes oxidation of the gas and the compensating element is treated with an oxidation inhibiting agent. The two elements are connected to the Instrument in a Half Bridge configuration and the excitation current passing through them raises their temperature to about 550 Deg C. At this temperature, the gas oxidises on the Detector element and raises the temperature of the bead even further. This alters the resistance of the detector bead and this change in resistance is measured by the instrument and converted to produce a reading of the gas concentration, on the Instrument display. The output of the device is essentially linear for most gases up to high concentrations, typically 100% LEL and the response time to 25% LEL is about 2 or 3 seconds. Any pre-filtering of the gas before it reaches the sensor may lengthen the response time. If the sensors are required to operate in high gas concentrations for short periods, it has been found that for periods up to about 2 minutes, 10 second bursts of 8%, 10% and 80% methane in air, produce no ill effects. Prolonged exposure can result in zero drift which may be reversed by operating for a short period in clean air. Exposure to 40% concentration for longer periods, will begin to destroy the detector surface, altering the Zero point and reducing the sensitivity. Whenever a sensor is exposed to high concentrations of Combustible gas, the calibration should be rechecked as soon as possible.

The performance of the sensors may be temporarily impaired by operation in the presence of certain volatile substances containing halogens or sulphur. The sensors may recover after a short period of operation in clean air. Whenever the substance produces a permanent effect on the catalyst, resulting in a large reduction in sensitivity the sensor is said to be Poisoned. Typical substances which can cause poisoning are silicon oils and grease, anti-knock petrol additives and phosphate esters. Activated carbon filters will provide adequate protection from poisoning in most cases. Notwithstanding the above comments, the Combustible gas sensors have an inherently long life. Although the sensors respond to most Combustible gases, the signals produced vary in magnitude depending on the actual gas to which the sensor is exposed. The sensors should normally be calibrated using 50% LEL Methane, ie 2.5% Methane in air.

NOTE : When the sensors are used to detect a different gas than that used for calibration, then a correction factor should be applied to the readings obtained. A table showing conversion factors for various gases is shown in Appendix A of this manual. (See also Instrument Calibration below)

WARNING: When a pellistor type sensor is exposed to concentrations of flammable gas greater than 100% LEL (5% Methane in air) there eventually comes a point at which the signal output from the sensor DECREASES as a result of an INCREASING concentration of the gas.

This is caused by the flammable gas displacing Oxygen in the sample and gradually inhibiting the normal oxidation process, at the detecting element. Most monitoring instruments provide an OVER-RANGE indication to inform the user of this condition.(See also L.E.L. and U.E.L.)

L.E.L. and U.E.L.

The above principle of operation is only valid where the gas mixture to be sensed contains Oxygen. It is therefore suitable for detection of leakage's of gasest in atmospheric surroundings, where it is important to know the level of concentration, well before a hazardous situation arises. Flammable gas mixtures are only ignitable between certain fairly clear, but experimentally defined limits. These levels are known as the 'Lower Explosive Limit' (L.E.L.) and the 'Upper Explosive Limit' (U.E.L.). Typical L.E.L. figures for some common explosive gases are as follows :

Methane (Natural Gas) 5% + 95% Air
Hydrogen 4% + 96% Air
Ammonia 16% + 84% Air
Ethylene 3% + 97% Air
Butane 1.9%+ 98.1% Air
Propane 2.1%+ 97.9% Air

If the gas concentration is below the L.E.L. then combustion cannot take place due to insufficient gas, and if above U.E.L. level, there will be insufficient Oxygen present to sustain combustion.

SENSOR SIGNAL CABLES

All the S.A.E.P. Flammable gas sensors require a Three Core cable between the sensor and the measuring instrument. Because of the relatively heavy current demands of the Pellistor type of sensors, the connecting cables must be chosen with care. Pellistors of the VQ21 type, which are normally fitted in the Model 2000 and Model 2001, require an operating potential (at the Sensor) of 2.00 volts DC at a current of 300 milliamps. When a current of this magnitude is passed along signal cables, any significant resistance in the cables will result in a drop in voltage along the cables. As an example : Assume a cable run of 100 metres is required between the monitoring instrument and the sensor and the cross sectional area of the cable chosen is 1.00mm2. Most manufacturers quote the resistance of this cable to be 19.1 Ohms per kilometre, therefore in this case, a 100 metre length will have a resistance of 19.1 / 10 = 1.91 Ohms. Bearing in mind that as far as the loop current is concerned, the actual conductor length is 200 metres, (100m to the sensor and 100m back again) the total cable resistance in this case is 3.82 Ohms. Using Ohm's law to calculate the voltage drop across the entire cable:

Voltage Drop = Current x Resistance

Where Voltage is in Volts : Current is in Amps & Resistance is in Ohms

Voltage Drop = 0.3 x 3.82 = 1.15 Volts

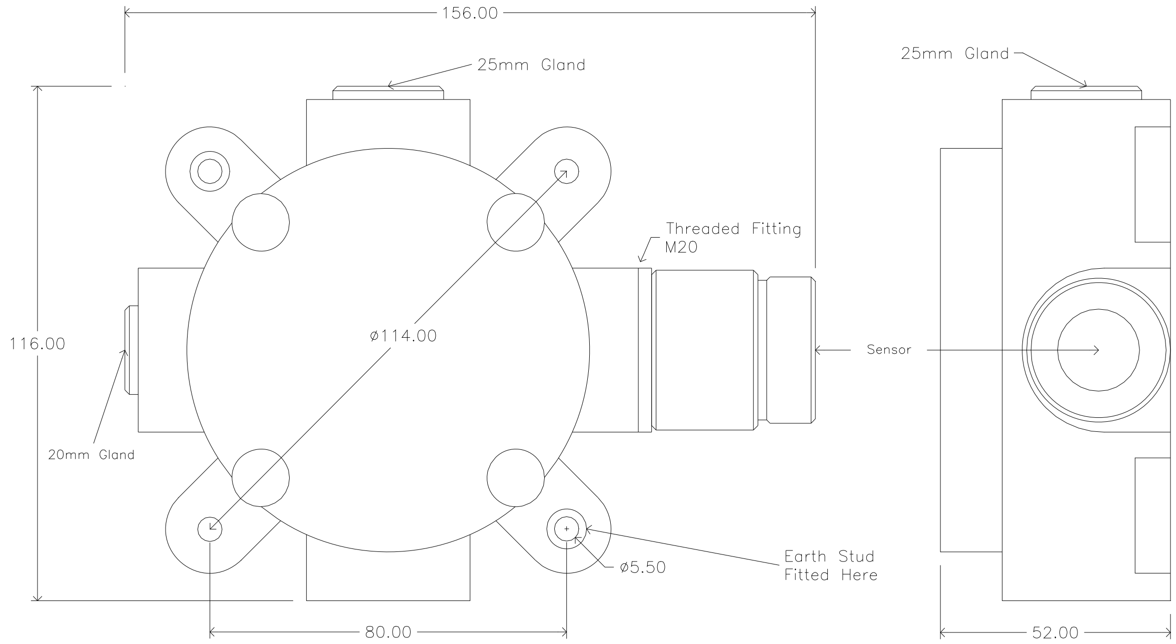
This means that if the monitoring instrument supplies a drive voltage of 2.00 volts then the sensor will only have 0.85 Volts applied to it. (2.00v-1.15v=0.85v). The pellistor sensor will NOT operate correctly in this condition.

NOTE: Although the ANALOX 2000 & 2001 sensors use a 3 wire connecting cable, only two of the wires carry the sensor excitation current. The third wire is connected to the centre tap of the 'Half Bridge' configuration. It only carries a signal voltage at very low current and may therefore be ignored as far as resistance effects are concerned. Most monitoring instruments designed to operate with Flammable gas detectors of the Pellistor type, have the facility for compensating, within limits, for this voltage drop. The ANALOX range of monitors, 1300 and 1320, allow the drive voltage to be adjusted up to about 3.8 volts. So, in the case of the above installation, the 1.15 volt drop across the cable could be compensated by adjusting the monitoring instrument drive voltage to 3.15 volts. It is not necessary to carry out all of these calculations every time an installation is done - correct operation of the sensor can be achieved by measuring the voltage AT THE SENSOR JUNCTION BOX TERMINALS, as per the installation instructions in the relevant monitoring instrument handbook. Data regarding maximum possible lengths for a selection of commonly used cables with 3 different Pellistor sensors, is included in Appendix B, at the end of this manual. A further point, which is often overlooked is that the resistance of copper cable has a temperature co-efficient. The effect of this variation in resistance due to temperature changes, can be significant on very long cable runs, particularly if the cable has a small cross sectional area and is subject to large variations in temperature. The measuring instrument is unable to distinguish between a change in cable resistance and a genuine gas signal. Copper cable resistance is normally quoted at 20□C and will vary by approximately □ 0.4% per degree C, as the temperature changes above and below this value. Using the above cable installation as an example, the total loop resistance was calculated to be 3.82 Ohms at 20□C. If the temperature of the cable drops to 0□C then the resistance will change to 3.80 Ohms. At first sight, this may not seem significant but could result in drift of the ZERO reading on the monitoring instrument.

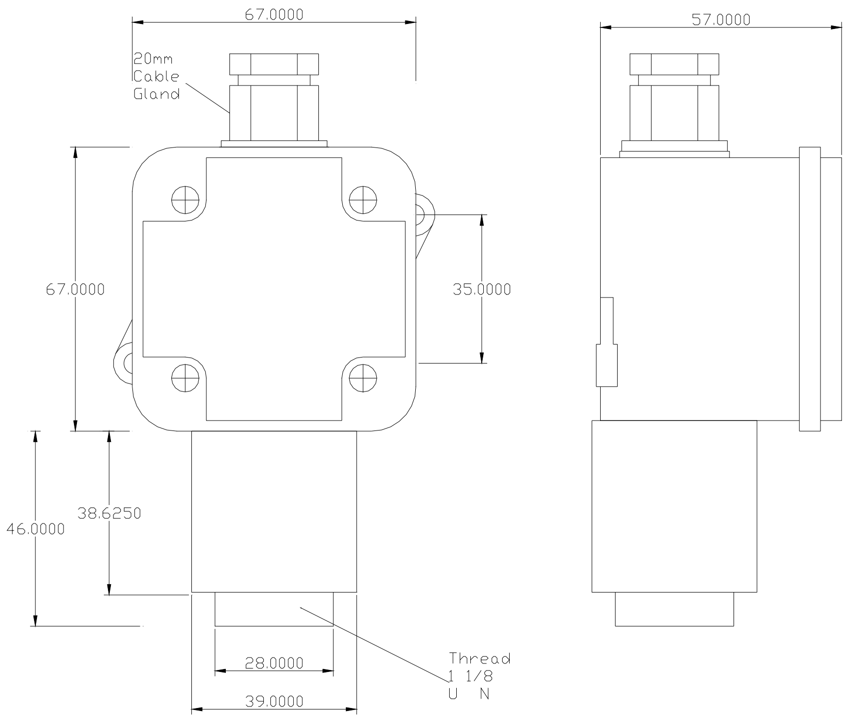
INSTRUMENT CALIBRATION

There is some confusion over what is meant by the Sensitivity of instruments used to measure the concentrations of combustible gas. Ideally, all units employing catalytic combustion as the measuring principle should be calibrated in terms of percentage of potential combustibility, where 100% scale reading represents an ignitable mixture, for a particular Gas/Air mixture. It is unfortunate that the sensing elements are not equally responsive to all combustible gas/air mixtures and although the sensitivity to a wide range of gases is similar to within a few percent of L.E.L. and for all practical purposes, the inaccuracies may be ignored, it may be desirable in certain cases to make allowances for these variations. It is therefore common practice to calibrate units of this type over the range 0 - 100% L.E.L. where 100% scale is equal to the actual percent concentration of the calibration gas, at the Lower Explosive Limit. e.g. An instrument calibrated 0-100% L.E.L. Methane would effectively read 5% v/v at 100% scale and one calibrated for Butane would indicate 100% scale at 1.9% gas concentration. Cross sensitivities between a number of gases may be derived from the selection of data and formulae given in Appendix A of this manual.

SENSOR PHYSICAL DETAILS

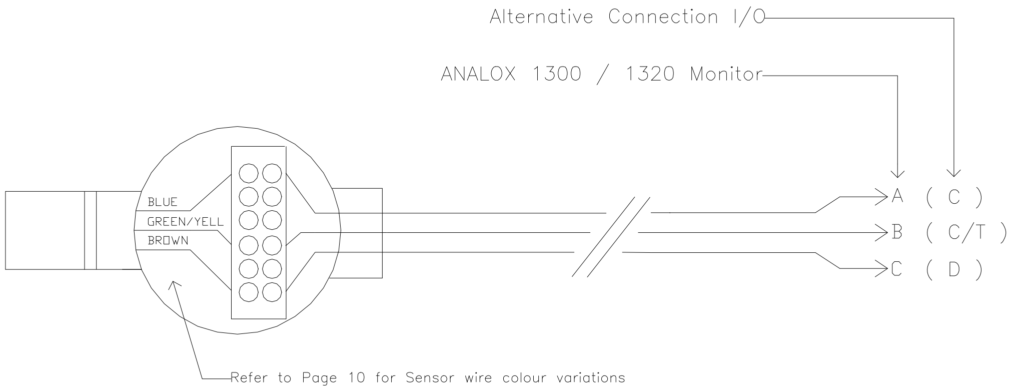


ANALOX 2000 Flammable Gas Sensor Assembly

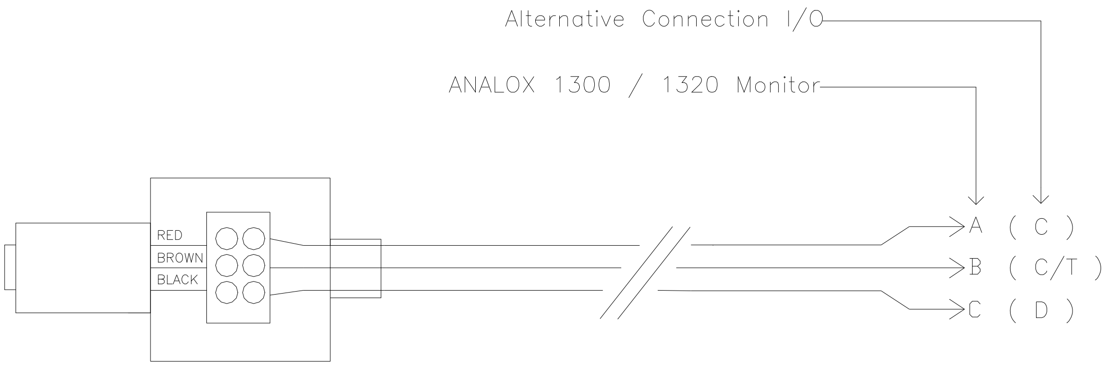


ELECTRICAL CONNECTIONS

ANALOX 2000 SENSOR



ANALOX 2001 SENSOR



FLAMMABLE SENSOR WIRING VARIATIONS

There are currently three different types of Sensor Head available from Analox and the Wiring colours differ on each sensor. Details of the wiring colours are given below

a. EEV Stainless Steel, VQ4250 Exds Sensor has wiring colours :

BLUE, GREEN/YELLOW, BROWN

Where Blue is the Compensator Lead, which connects to the 'A' Terminal of the 1300.
Green/Yellow is the Signal output Lead which connects to the 'B' Terminal of the 1300.
Brown is the Detector Lead, which connects to the 'C' Terminal of the 1300
Due to possible confusion with European mains wiring colours (Blue, Green/Yellow, Brown) and in the interests of safety, the manufacturer decided to change the colours of the wiring on all new issues of this sensor.
The wiring colours on the latest issue of the Stainless Steel VQ4250 sensor are as follows :

RED, YELLOW, BLUE

Where Red is the Compensator Lead, which connects to the 'A' Terminal of the 1300.
Yellow is the Signal output Lead, which connects to the 'B' Terminal of the 1300.
Blue is the Detector Lead, which connects to the 'C' Terminal of the 1300.

b. GROVELY 210 Mod FLAM Stainless Steel Exds Sensor has wiring colours :

RED, GREEN, BLUE

Where Red is the Compensator Lead, which connects to the 'A' Terminal of the 1300.
Green is the Signal output Lead, which connects to the 'B' Terminal of the 1300.
Blue is the Detector Lead, which connects to the 'C' Terminal of the 1300.

c. ANALOX Black Acetal Sensor has the following wiring colours :

RED, GREEN, BLACK

Where Red is the Compensator Lead, which connects to the 'A' Terminal of the 1300.
Green is the Signal output Lead, which connects to the 'B' Terminal of the 1300.
Black is the Detector Lead, which connects to the 'C' Terminal of the 1300.

Sensors a. and b. are normally supplied fitted to an EExe Cast Iron Junction Box and together, form the ANALOX 2000 Flammable gas sensor unit, suitable for use in Hazardous areas. Sensor c. , the ANALOX 2001, is a less expensive alternative which can be used in areas which are not classified as Hazardous.

IMPORTANT: IF THE SENSORS ARE INCORRECTLY CONNECTED, PERMANENT DAMAGE COULD BE SUSTAINED WHEN POWER IS APPLIED.

SENSOR INSTALLATION

INSTALLATION

Care should be exercised during installation, not to damage the sintered element on the front surface of the device. IT IS PARTICULARLY IMPORTANT THAT THEY ARE NOT EXPOSED TO SILICON BASED SUBSTANCES OR HALOGENS, either during installation or in their normal operating condition. This could lead to the sensors being Poisoned, as described above in the 'OPERATING PRINCIPLE' section.

SENSOR POSITION

The type of gas to be detected determines, in general, the physical 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 mounting 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, in roof spaces etc and similar consideration should be given to adequate ventilation.

Additionally, the effects of any ventilation must be 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. TABLE 1 on the next page, shows examples of molecular weights of some common flammable gases and groups them in categories according to their weight, relative to air.

Lighter than Air				Heavier than Air			
Hydrogen	2.0	Methane	16.0	Ethane	30.1	Hydrogen Sulphide	34.0
Ammonia	17.0	Carbon Monoxide	28.0	Butane	58.1	Propane	44.1
Ethylene	28.0	Acetylene	26.0	Pentane	72.2	Toluene	92.1
				Hexane	86.2	Heptane	100.2

TABLE 1. Relative Molecular weight of common gases NOTE: AIR = 29

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

ACCESSORIES

Calibration adaptors and collecting cones are available for both types of sensor. Identification and part Numbers are listed below.
Calibration adaptor for ANALOX 2000 when used WITHOUT Collecting cone : SA2 SO2 FLOW
Calibration adaptor for ANALOX 2000 when used WITH Collecting cone : SA2 FLOW1
Calibration adaptor for ANALOX 2001 when used With or WITHOUT Collecting cone :
SA2 FLOW1 Collecting Cone : SA2 PO2 CONEFLAM

Further details may be obtained from AST. Ltd., whose address, telephone and fax numbers are on the front page of this manual.

CERTIFICATION

Areas into which gas sensors may be installed, may be classified as being potentially or actually hazardous, in accordance with applicable legislation, or alternatively may be unclassified. Hazardous areas are split into zones as defined in BS 5345 and IEC79-10, as follows:

Zone 0: in which an explosive gas/air mixture is continuously present or present for long periods.
Zone 1: in which an explosive gas/air mixture is likely to occur during normal operation.
Zone 2: in which an explosive gas/air mixture is not likely to occur and if it does, will only exist for a short period.

Zone 0 areas normally only permit the installation or use of Intrinsically Safe equipment, classified Ex(ia) or in certain cases Ex(s) (Specially Certified for Zone 0).

Zone 1 areas normally only permit the installation or use of equipment certified as Flameproof ie Ex(d) or any equipment suitable for Zone 0. In certain circumstances, Increased Safety equipment, classified Ex(e) may be allowed. In addition, equipment certified Ex(ib), Ex(p) and Ex(s) may be used in this Zone, but these classes are not generally related to Flammable sensors.

Zone 2 areas normally permit the use of all classifications quoted for Zones 0 and 1 and in addition, Ex(n), Ex(o) and Ex(q) - again, these latter classifications are not generally relevant to Flammable sensors, but are shown for completeness.

Unclassified areas permit the installation or use of any equipment, whether certified or not. From a certification point of view, sensors of the Catalytic type are considered as being a bit unusual in that they contain a heated filament. Introduction of a heated filament into what may be a potentially explosive atmosphere may seem to be inviting trouble! However, careful study of Flame Arresting devices and materials since the introduction of the gauze arrestor of 'Davy Lamp' fame, has led in the case of gas detection sensors, to the almost exclusive use of sintered metal with a carefully selected pore structure. S.A.E.P certified sensors incorporate a disc of sintered stainless steel between the pellistors and the surrounding atmosphere. Up to the time of writing this manual, certification classifies the filament chamber with the special protection class, Ex(s) combined with the appropriate terminal chamber, Ex(d) or Ex(e). Combination of the appropriate certification classes ie Exs(d) or Exs(e) implies that the certified equipment has been tested and is suitable for inclusion in areas which permit the use of (d) or (e) classification, as appropriate.

INTRINSICALLY SAFE SYSTEM

The ANALOX 2000 sensor may be used as a component within an Intrinsically Safe SYSTEM where the area to be monitored is classed as Zone 0 and therefore requires that any electrical equipment system used therein be classified Ex ia. The ANALOX 2000 SYSTEM comprises the following items:

a. The Sensor and its Junction box.
b. A combination of Zener Barriers.
c. Suitable connecting cable between the Zener barriers and the sensor junction box.

However, due to the relatively high currents which flow in the cables (up to 300mAmps), there are some constraints placed on the length and type of cable which may be used in the Hazardous area. The constraints are due to the amount of energy which can be stored within the inductance and capacitance of the cable. This energy could be released in the form of a spark, if the cable becomes damaged, thereby causing a potentially dangerous condition. Where relatively high currents are carried by a cable and the terminating impedance is low, as is the case with Pellistor sensors, the parameter of main concern is the inductance of the conductors. The Total Inductance of a conductor is directly proportional to its length so the longer the cable, the higher the Inductance value. The parameters of the cables must meet the specification laid down by the certifying authority (BASEEFA). The cable parameters are included on the System certificates, copies of which are shown at the end of this manual. As can be seen from the data, if a sensor with VQ21 type Pellistors is to be used in a Group IIC application, ie Hydrogen or Acetylene present, then the maximum permissible TOTAL cable inductance is 4.4uH (4.4 micro henries). This means that the cable run between the Zener barriers and the sensor junction box in this application, will be restricted to about 6 metres. The quoted length is based on a typical 3 core IS class cable (complying to DIN VDE 0165) which has a quoted Inductance of 0.7 millihenries/Km., ie 0.7 microhenries per metre. From the certificate schedule data, using a sensor fitted with VQ21 Pellistors for a Group IIC application, the maximum permissible Inductance is 4.4uH. So, if the cable has an Inductance of 0.7uH/metre then the maximum length can be calculated:

$$\text{Length} = \frac{4.4}{0.7} = 6.29 \text{ metres.}$$

This example illustrates the absolute worst case and for installations with less severe Gas Groups, longer cables can be used. Also, if the sensor is fitted with VQ22 Pellistors, which operate at a lower current (175 mAmps) the restrictions are again less severe.

Some calculated values for different applications using VQ21 and VQ22 Pellistors are shown below. These calculations are based on a 3 core cable supplied by LAPPKABEL, 'OLMASS - EB CY' part number 0045800.

2000 Sensor with VQ21 Pellistors.

Gas Group	Maximum cable length
IIC	6.29 mtr.
IIB	19.00 mtr.
IIA	63.43 mtr.

2000 Sensor with VQ22 Pellistors.

Gas Group	Maximum cable length
IIC	25.39 mtr.
IIB	76.14 mtr.
IIA	253.86 mtr.

SENSOR RESPONSE TIME

The time taken for the monitoring instrument to indicate the concentration of gas at the sensor is dependent on two factors.

a. The speed of response of the actual detecting elements.
b. The ease of access of the gas to the detecting elements.

Since a. is fixed, careful design of the housing and flame arrestor is essential to ensure that the gas diffuses as rapidly as possible on to the heated elements. The introduction of the sintered disc does however increase the overall response time and other protection devices such as splash guards, carbon filters etc. will inevitably degrade the speed even more. The design of such devices, combined with the essential flame arresting sintered disc, is a compromise between fast speed of response and other protection. The speed of response of a sensor/instrument combination can be expressed in a number of ways, and is currently done so by many manufacturers, in an attempt to show their instruments in a favourable light. S.A.E.P. have adopted what is believed to be the only accurate way of expressing this parameter. Since the response of a sensor is nominally exponential, irrespective of the gas concentration at the sensor, the time to reach a specific percentage of the actual concentration of the gas applied, is relevant. The most commonly chosen figure is 90% of final value and is usually quoted as the 'T90' time. S.A.E.P. quote the 'T90' time for the 2000 and 2001 sensors as less than 5 seconds, when using Methane (CH_4) as a test gas. Increased or decreased response times may be expected from those gases with a more or less complex molecular structure.

SENSOR ELEMENT LIFE

It is very difficult to honestly define the lifetime of a catalytic sensor, particularly when the conditions of use are outside the control of the manufacturer. There have been many cases where sensors have continued to operate satisfactorily for many years. In other cases, the life has been considerably less. The major causes of element failure, other than gradual degradation, have been due to open circuit filaments or chemical poisoning. Open circuit filaments can be caused by:

a. Incorrect connection to the power supply, resulting in one or both filaments burning out.
b. Passing excessive current through the filaments by applying too high an excitation voltage.
c. High concentrations of combustible gas/air mixture present at the sensor for excessive periods of time.
d. Physical shock causing mechanical damage.

CHEMICAL POISONING

This is an extremely complex problem on which, a considerable amount of research is currently being carried out. It is well known that some substances can cause a significant reduction on overall sensitivity of the system and in some cases, the effects are only temporary, in others a permanent degradation in response can take place. Materials to be particularly avoided are, Silicone, Lead and Sulphur compounds and Halogens. Whereas the importance of checking sensors for sensitivity at frequent and regular intervals cannot be over stressed, in the event of possible poisoning material being present, the procedure is doubly important. Preventative measures can also be taken to reduce the possibility of poisoning when certain gases are to be measured. These involve the introduction of an activated Carbon filter pack between the sensor and the surrounding ambient atmosphere.

APPENDIX TO ANALOX 2000 SERIES MANUAL

A feature of the Pellistor Combustible gas detectors is the almost universal response to LEL of hydrocarbons. Almost all detectable gases produce a similar output at LEL. This table lists the theoretical factors by which the signal with a Calibration gas should be multiplied to give the equivalent signal for other gases. For example:

For an instrument calibrated with Methane K Methane=112.0
To find equivalent for n-Nonane K n-Nontane = 35.2

Signal at 50% LEL = $50\% \times \frac{35.2}{112.0}$ = 15.7% (Methane Scale)

Gas	K	Gas	K	Gas	K
Acetaldehyde	67.3	Acetic Acid	60.8	Acetic Anhydride	51.5
Acetone	57.8	Acetylene	63.6	Alkyl Alcohol	57.1
Ammonia	141.7	n-Amyl Alcohol	36.6	Aniline	44.1
Benzine	45.6	Biphenyl	28.0	1,3 Butadiene	62.5
n-Butane	65.5	iso Butane	57.8	Butene-1	50.8
cis-Butene-2	54.2	trans-Butene-2	56.7	n-Butyl Alcohol	38.4
iso-Butyl Alchol	59.2	Tert-Butyl Alcohol	83.1	n-Butyl Benzine	35.8
n-Butyric Acid	42.5	Carbon Disulphide	19.8	Carbon Monoxide	84.4
Carbon Oxysulphide	104.6	Cyanogen	99.9	Cyclohexane	46.0
Cyclopropane	69.7	n-Decane	36.7	Diethelamine	64.7
Dimethylamine	64.7	2,3 Dimethylpentane	44.6	2,2 Dimethylpropane	44.4
Dimethylsulphide	48.6	1,4 Dioxane	50.0	Ethane	75.8
Ethyl Acetate	57.4	Ethyl Alcohol	81.5	Ethylamine	58.9
Ethyl Benzine	39.9	Ethylcyclopentane	44.4	Ethylene	79.1
Ethyleneoxide	57.9	Diethyl Ether	51.8	Ethyl Formate	49.5
Ethylmercaptan	62.8	n-Heptane	43.2	n-Hexane	41.2
Hydrazine	50.4	Hydrogencyanide	53.4	Hydrogen	85.8
Hydrogen Sulphide	45.6	Methane	112.0	Metyyl Acetate	55.6
Methyl Alcohol	96.2	Methylamine	86.5	Methylcyclohexane	49.4
Dimethyl Ether	70.0	Methylethylether	49.3	Methylethylketone	46.2
Methyl Formate	75.0	Methylmercaptan	67.9	Methylpropionate	57.2
Napthalene	38.1	Nitromethane	64.8	n-Nonane	35.2
n-Octane	41.9	n-Pentane	51.3	iso-Pentane	51.9
Propane	61.8	n-Propyl Alcohol	52.7	n-Propylamine	54.1
Propylene	57.7	Propyleneoxide	51.2	iso-Propylether	48.8
Propyne	46.5	Toluene	45.2	Triethylamine	44.6
Trimethylamine	54.3	Vinylethylether	46.9	o-Xylene	40.1
m-Xylene	43.8	p-Xylene	43.8		

Since these factors are theoretical, they will only give a guide to the response expected in other gases. For exact conversion factors, the Instrument should be calibrated using the relevant gases.

FLAMMABLE SENSOR CABLE REQUIREMENTS

When using the present ANALOX 2000 or 2001 Flammable sensors with the Analox 1300/1320 instruments, the following data gives guidance to the maximum permissible cable lengths, for wire having various cross sectional areas.

The usable cable length depends on several factors:

a Cross sectional Area in square millimetres (mm2) and hence the resistance of the wire.
b The operating current of the sensor
c The operating voltage of the sensor
d The maximum sensor excitation voltage available from the monitoring instrument

Cable resistance is normally quoted in Ohms per Kilometre and it should be bourne in mind that when used with a sensor that the actual wire length is TWICE the distance from instrument to sensor.

The Pellistors which can be used in the 2000/2001 have the following characteristics

Type	Operating Voltage	Operating Current
VQ21	2.0 volts	300 milliamps
VQ22	2.0 volts	175 milliamps
VQ23	2.0 volts	335 milliamps

The maximum sensor excitation voltage available from the 1300/1320 instruments is approx 3.8 Volts.

Assuming Maximum Sensor excitation voltage:
Maximum permissible voltage drop on the cable for the three types of sensor is as follows:

VQ21	3.8v – 2.0v = 1.8v
VQ22	3.8v – 2.0v = 1.8v
VQ23	3.8v – 2.5v = 1.3v

Therefore for the three different sensors the maximum wire resistance can be calculated

VQ21 max wire res. = $\frac{1.8}{0.3}$ = 6.0 Ohms

VQ22 max wire res. = $\frac{1.8}{0.175}$ = 10.28 Ohms

VQ23 max wire rex. = $\frac{1.3}{0.335}$ = 3.88 Ohms

Using: 1 0mm2 Cable with resistance 19.1 Ohms/Km (38.2 Ohms/loop)

VQ21 max. distance = $\frac{6}{38.2}$ = .157Km or 157mtr

VQ22 max. distance = $\frac{10.28}{38.2}$ = .269Km or 269mtr

VQ23 max. distance = $\frac{3.88}{38.2}$ = .102Km or 102mtr

Using 1.5mm^2 Cable with resistance 12.5 Ohms/Km (25.0 Ohms/loop)

VQ21 max. distance = $\frac{6}{25.0}$ = .240Km or 240mtr

VQ22 max. distance = $\frac{10.28}{25.0}$ = .411Km or 411 mtr

VQ23 max. distance = $\frac{3.88}{25.0}$ = .155Km or 155mtr

Using 2.0mm^2 Cable with resistance 9.7 Ohms/Km (19.4 Ohms/loop)

VQ21 max. distance = $\frac{6}{19.4}$ = .309Km or 309mtr

VQ22 max. distance = $\frac{10.28}{19.4}$ .529Km or 529mtr

VQ23 max. distance = $\frac{3.88}{19.4}$ = .200Km or 200mtr

Using 2.5mm^2 Cable with resistance 7.6 Ohms/Km (15.2 Ohms/loop)

VQ21 max. distance = $\frac{6}{15.2}$ = .394Km or 394mtr

VQ22 max. distance = $\frac{10.28}{15.2}$ = .676Km or 676mtr

VQ23 max. distance = $\frac{3.88}{15.2}$ = .255Km or 255mtr

DISPOSAL

According to WEEE regulation this electronic product can not be placed in household waste bins. Please check local regulations for information on the disposal of electronic products in your area.

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