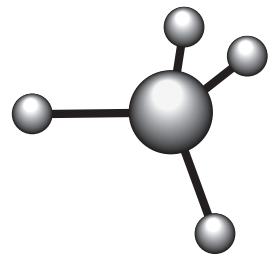
Data Sheet

Portable Gas Monitors

What is Gas?

Figure 1



The name gas comes from the word chaos which neatly summarises the main feature of the simplest state of matter. A gas is a swarm of particles moving randomly and chaotically; constantly colliding with each other and the walls of any container. The real volume of the particles is minute compared to the total space which they occupy and this is why gases fill any available volume and are readily compressed. The average speeds of gas molecules are of the order of 100s of metres per second and they are colliding with each other billions of times per second. This is why gases mix rapidly and why they exert pressure.

This constant motion is easily demonstrated by releasing a small amount of odorous gas in a room. Within seconds the gas can be smelt in all parts of the room. These properties apply to substances which are normally gaseous and to vapours from evaporated liquids.

A volume of any gas at the same temperature and pressure contains the same number of molecules irrespective of what the gas is. This means that measuring gas by volume is very convenient. Gas measurements at higher levels are in % (volume) and at lower levels parts per million, ppm (volume).

Whilst different gases have different densities, they do not totally separate into layers according to their density. Heavy gases tend to sink and light gases tend to rise, but their constant motion means that there is continuous mixing (i.e they do not behave like liquids).

So in a room where there is a natural gas (methane) leak, the gas will tend to rise because it is lighter than air but the constant motion means that there will be a considerable concentration at floor level. This will happen in perfectly still conditions but if there are any air currents, the mixing will be increased.

Air is a mixture of gases, typically:

Nitrogen	77.2%
Oxygen	20.9%
Water Vapour	0.9%
Argon	0.9%
Carbon Dioxide	0.03%
Other Gases	0.07%

Because its composition is reasonably constant, air is usually considered as a single gas which simplifies the measurement of toxic and flammable gases for safety and health applications.

Background to Gas Detection

Exposure to gas is a threat faced by many in their working environment. The hazards fall into three basic types, although the causes are many:

- **risk of fire or explosion** - combustible gases and vapours can build up to flammable concentrations and permeate wide areas. An ignition from a naked flame, hot surface or spark can then trigger an explosion. Concentrations of gas in air which are flammable vary depending on the gas. The commonly used measure is the LEL or Lower Explosive Limit of the gas. For methane, this figure is 5% by volume, in a balance of air. Crowcon gas detectors are set up to measure from 0 to 100% LEL with alarms typically set at 20% LEL. If the concentration exceeds the UEL (Upper Explosive Limit), there is not sufficient oxygen to support combustion. The UEL for methane is 15% by volume.

  Enriched oxygen levels enhance flammability of most materials.

- **risk of poisoning** - the toxic effects of many naturally occurring and industrial process gases are threatening to health and life. Hydrogen sulphide is often found underground in tunnels and sewers. Its bad egg odour can be smelt at low levels but higher levels will numb the nose and go on to cause paralysis and death. Instruments are set up to measure in the range 0 to 50ppm (parts per million). In the UK, the CONTROL OF SUBSTANCES HAZARDOUS TO HEALTH REGULATIONS (COSHH), require employers to assess risks and introduce controls to limit exposure. The EH40 guidance notes list the long term exposure limit for H_2S as 10ppm. For safety, Crowcon typically sets an instantaneous alarm at this level, even though continuous exposure for up to eight hours is considered safe. The EH40 booklet is available from **RS** stock no. 159-1311.

  Carbon Monoxide is an odourless gas produced by incomplete combustion of carbon fuels. Readily absorbed into the blood, it causes drowsiness and headaches at persistent low levels. At higher levels, asphyxiation occurs as carbon monoxide reduces the ability of the red blood cells to carry oxygen. EH40 puts the 15 minute cumulative exposure limit at 300ppm. Sulphur Dioxide has a choking smell and is acidic. It is produced by burning sulphur containing materials, and may be used as a process gas. Respiratory problems may occur at levels as low as 2ppm. A fuller list of toxic gases, and the industries in which they occur is printed at the end of this data sheet. If you are not sure what hazards you may be facing in your workplace, advice may be obtained from the Health and Safety Executive.

- **risk of asphyxiation** - depleted atmospheric oxygen concentration may cause impaired performance, unconsciousness and death. The normal atmospheric concentration of oxygen is 20.9%. Most people will be physically affected by levels below 17%. Atmospheres containing less than 15% oxygen are very dangerous. Personnel will be immediately overcome by exposure to atmospheres containing less than 13%. Crowcon oxygen detectors will typically alarm at levels below 19.5%. An enrichment alarm typically occurs at 23% to warn of the hazard of increased flammability.

Flammable Risk

Safety of people and plant in areas with potential flammable risk

Combustion of Gases and Vapours

Most organic chemical compounds will burn. Burning is a simple chemical reaction in which oxygen from the atmosphere combines rapidly with a substance, producing heat. The simplest organic compounds are those known as hydrocarbons and these are the main constituents of crude oil/gas. They are composed of carbon and hydrogen, the simplest hydrocarbon being methane, each molecule of which consists of one carbon atom and four hydrogen atoms. It is the first compound in the family known as alkanes. The physical properties of alkanes change with increasing number of carbon atoms in the molecule, those with one to four being gases, those with five to ten being volatile liquids, those with 11 to 18 being fuel oils and those with 19 to 40 being lubricating oils. Longer carbon chain hydrocarbons are tars and waxes. The first ten alkanes are:

CH_4	methane (gas)
C_2H_6	ethane (gas)
C_3H_8	propane (gas)
C_4H_{10}	butane (gas)
C_5H_{12}	pentane (liquid)
C_6H_{14}	hexane (liquid)
C_7H_{16}	heptane (liquid)
C_8H_{18}	octane (liquid)
C_9H_{20}	nonane (liquid)
$C_{10}H_{22}$	decane (liquid)

The above compounds are all known as aliphatics.

Alkenes are similar but their molecular structure includes double bonds. (Examples are ethylene and propylene.) Alkynes contain triple bonds. (Example is acetylene) Aromatic hydrocarbons such as benzene have a ring molecular structure and burn with a smoky flame).

When hydrocarbons burn they react with oxygen from the atmosphere to produce carbon dioxide and water (although if the combustion is incomplete because there is insufficient oxygen, carbon monoxide will result as well).

More complex organic compounds contain elements such as oxygen, nitrogen, sulphur, chlorine, bromine or fluorine and if these burn, the products of combustion will include other compounds as well. For example substances containing sulphur such as oil or coal will result in sulphur dioxide whilst those containing chlorine such as methyl chloride or polyvinyl chloride (PVC) will result in hydrogen chloride.

In most industrial environments where there is the risk of explosion or fire because of the presence of flammable gases or vapours, a mixture of compounds is likely to be encountered. In the petrochemical industry, the raw materials are a mixture of chemicals many of which are decomposing naturally or are being altered, by the processes. For example crude oil is 'cracked' to produce many simpler materials.

Explosions

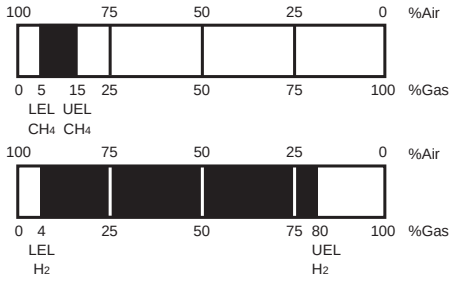
In order for gas to ignite there must be an ignition source typically a spark, or flame or hot surface. For ignition to take place there must be explosive mixture. This means the concentration of gas or vapour in air must be at a level such that the ''fuel'' and oxygen can react chemically.

The power of the explosion depends on the 'fuel' and its concentration in the atmosphere. Not all concentrations of flammable gas or vapour in air will burn or explode. The LOWER EXPLOSIVE LIMIT (LEL) is the lowest concentration of 'fuel' in air which will burn and for most flammable gases and vapours it is less than 5% by volume. So there is a high risk of explosion even when relatively small concentrations of gas or vapour escape into the atmosphere.

The UPPER EXPLOSIVE LIMIT (UEL) is the maximum concentration of 'fuel' in air which will burn. Concentrations above the UEL will not burn because there is insufficient atmospheric oxygen available. Hydrogen has a very wide explosion band, 4% to 80%.

Flammable liquids generally have a low FLASH POINT. This is the lowest temperature at which vapour is given off at sufficient rate to form an explosive mixture with air. Liquids with flash points below normal ambient temperatures automatically release vapour in sufficient volume to provide an explosive mixture, so leakage of such liquids is potentially as dangerous as a flammable gas leak.

Figure 2



Equipment Safety

Areas where there is the possibility of the presence of an explosive mixture of flammable gas or vapour and air are known as 'hazardous' and other areas as 'safe' or 'non-hazardous'. Any electrical equipment used in hazardous areas, including gas detection equipment, must be specially tested and approved to ensure that, in use even under fault condition, it cannot initiate an explosion.

Crowcon equipment meets European, American and other international standards. Testing is carried out in the U.K. by BASEEFA and SIRA Certification Service (both of whom have been approved by the British Government and the EEC Commission); UL in the USA, CSA in Canada. Gas detection equipment, when certified for use in hazardous areas in Europe, normally falls into one of the following categories.

In Europe, hazardous areas are generally defined as follows:

Zone 0	An area where an explosive mixture is likely to be present at all times, under normal operating conditions.
Zone 1	An area where an explosive mixture is likely to occur in normal operation.
Zone 2	An area where an explosive mixture is not likely to occur in normal operation, and if it does it is only for short periods.

In the United States, hazardous areas are classified by two Divisions:

Division 1	Equates to Zone 0 and Zone 1
Division 2	Equates to Zone 2

in Europe gas detection equipment, certified for use in hazardous areas in Europe, normally falls into one of the following categories.

Intrinsically Safe	denotes as EEx ia or EEx ib	For use in Zones 0,1, or 2 Zones 1 or 2
Flameproof	denotes as EEx d	For use in Zones 1 or 2
Increased Safety	denotes as EEx e	For use in Zones 1 or 2

Intrinsic safety differs from other forms of protection because it is based on the principle that the equipment is electrically safe. The definition of an intrinsically safe circuit is generally one that does not contain sufficient electrical energy, even under fault conditions, to cause a spark or generate sufficient heat to ignite a combustible gas mixture. Under the current standards, Ex ia equipment is tested with two coincident faults applied to the system. Ex ib equipment is tested with one fault.

Intrinsic safety requirements are covered by European Standards BS EN50014, EN50020 and EN50039, and the Codes of Practice BS5345: Part 4: 1977 and BS6959: 1989. In the United States the relevant Standard is UL 913 "Intrinsically Safe and Associated Apparatus (for use in Class 1, ll and lll Division 1, Hazardous (Classified) Locations)."

Other forms of protection are based on mechanical safety and for flameproof equipment the equipment enclosure should be capable of containing an explosion within it, thereby avoiding the possibility of the system becoming an external ignition source.

Flameproof requirements are covered by European Standard EN50018, BS4683: Part 2: 1971, BS5001: Part 5: 1977 and the Codes of Practice BS5345: Part 3: 1979 (Revised 1990). In the United States the relevant Standard is UL 1203 "Explosion Protected and Associated Apparatus (for use in Class 1, ll and lll Division 1, Hazardous (Classified) Locations)."

When selecting intrinsically safe equipment for a particular application it is necessary to know what the IGNITION TEMPERATURE of the gas or vapour is and in what GAS GROUP it is. The following tables provide the classifications to be found in BS5345 and BS5501 and also provide information on equivalent Standards.

Gas Groupings

Representative Gas	Cenelec EN50018 BS5501 Pt 5 IEC 79-1	Non-harmonised EEC Standards			
		UK BS4683 Pt 2	France C12-320	Germany VDE0171	USA UL698
	Group	Group	Group	Class	Group
Methane (Mining use)	1	1	1A or 1B	1	D
Propane	11A	11A	11A or 11B	1	D
Ethylene	11B	11B	111A	2	C
Hydrogen	11C	11C	-	3a	B
Carbon disulphide	11C	-	-	3b	-
Acetylene	11C	-	-	3c	A

Temperature Classifications		
Maximum Surface Temperature °C	EN50014, BS5501 Pt 1 BS4683 Pt 1, IEC79-1	USA UL 698
450	T1	-
300	T2	-
280	-	T2A
260	-	T2B
230	-	T2C
215	-	T2D
200	T3	T3
180	-	T3A
165	-	T3B
160	-	T3C
135	T4	T4
120	-	T4A
100	T5	T5
85	T6	T6

Approval Codes

To check whether an instrument is suitable for a particular gas or vapour, reference to its APPROVAL CODE is necessary, e.g.: EEx ia IIC T4.

E - Approved to European Norm.

Ex - Explosion Proof.

ia - Intrinsically safe, suitable for Zones 0, 1, and 2.

llC - Suitable for gases or vapours in Groups IIA, IIB and IIC.

T4 - Suitable for gases or vapours with ignition temperatures greater than 135°C.

Toxic Risk

Monitoring for Toxic Gases in areas where people work in the General Environment

The most important factor in the demand for toxic gas monitoring in the UK is the legislation known as the CONTROL OF SUBSTANCES HAZARDOUS TO HEALTH REGULATIONS 1988 (COSHH). Similar legislation exists elsewhere or is being introduced and COSHH takes into account the European Commission Directive 80/ 1107/EEC.

COSHH covers all toxic substances except those which have their own legislation (asbestos, lead, radioactive materials and materials present in mines).

The regulations spell out what employers and in a few cases employees have to do. (Failure to comply is subject to the penalties of the HEALTH AND SAFETY AT WORK ACT 1974).

The requirements are:

- Assess the risks to health and what precautions are needed
- Introduce measures to prevent or control the risk
- Maintain equipment and observe procedures
- Monitor exposure of workers and carry out health surveillance
- Train employees about the risks and precautions

The assessment is done by the employer with help from the Health and Safety Executive (HSE) if needed.

The best way of controlling a risk is to prevent exposure but if this is not possible, a process may have to be enclosed or ventilation and extraction equipment used or special handling procedures employed. It should be possible for most people to work in a safe environment day after day and HSE publishes Guidance Note EH40 (**RS** stock no. 159-1311) each year to help employers to control their processes adequately so that workers are not exposed to levels of toxic materials above the recognised safe levels.

EH40 sets out OCCUPATIONAL EXPOSURE LEVELS in two categories.

MAXIMUM EXPOSURE LEVELS, MELs are for the more dangerous substances and exposure to materials with MELs should be as low as possible and certainly not above their MEL.

OCCUPATIONAL EXPOSURE STANDARDS, OESs for the less dangerous materials are the exposures which can be viewed as safe and employees can work in them day after day.

EH40 lists OCCUPATIONAL EXPOSURE LIMITS (OELs) showing substances with MELs separately from those with OESs. The list gives LONG TERM (8 hour) EXPOSURE LIMITS (LTELs) applicable to exposure during a normal working day and SHORT TERM (15 minute) EXPOSURE LIMITS (STELs) applicable to occasional exposure to higher levels. (Where no 15 minute limit is given a level of three times the 8 hour limit is used).

When mixtures of toxic gases are encountered the effects on health are often additive and this needs to be taken into account (exposure to two gases with similar effects, each at 50% of their OELs may be equivalent to working at an OEL or the two gases together may have an enhanced effect.

Exposure to toxic substances has to be calculated on a TIME WEIGHTED AVERAGE (TWA) basis, so for example a person working at an OEL for 7 hours with a 1 hour lunch break will have had an exposure of 7/8 of the LTEL.

The following data has been extracted from EH40/96:

		LTEL (8 HR TWA)	STEL (15 MIN TWA)
Gases with MELs			
Ethylene oxide	C_2H_4O	5	15
Fommaldehyde	HCHO	2	2
Hydrogen Cyanide	HCN	-	10
Gases with OESs			
Ammonia	NH_3	25	35
Carbon dioxide	CO_2	5000	15000
Carbon monoxide	CO	50	300
Chlorine	CL_2	0.5	1
Chlorine dioxide	ClO_2	0.1	0.3
Fluorine	F_2	-	1
Hydrogen bromide	HBr	-	3
Hydrogen chloride	HCI	-	5
Hydrogen fluoride	HF	-	3
Hydrogen sulphide	H_2S	10	15
Nitric acid	HNO_3	2	4
Nitrogen dioxide	NO_2	3	5
Nitric oxide	NO	25	35
Ozone	O3	-	0.2
Phosphine	PH_3	-	0.3
Sulphur dioxide	SO_2	2	5
Sulphur hexafluoride	SF_6	1000	1250

The monitoring aspect of COSHH is particularly relevant because monitoring is required:

- If the failure of control measures would lead to serious health risks
- If it is not certain that exposure limits are not being exceeded
- If it is not clear that control measures are working properly

When monitoring of exposure is called for records of the monitoring must be kept and employees must be told about their risks, the precautions and the results of any monitoring and health surveillance.

Gaseous toxic substances are especially dangerous because they are usually invisible and often odourless. Also their physical behaviour is not always predictable since their temperature and pressure affect their properties dramatically as do the effects of draughts. The need for continuous monitoring has led to the development of data logging facilities.

Hydrogen Sulphide (H_2S)

Hydrogen sulphide is well known because of its bad egg odour which can be smelt down to less than 0.1 ppm. A maximum safe exposure limit is 10 ppm but high concentrations cannot be smelt and can lead to instant paralysis. It has almost the same density as air so detectors are mounted at head height or near potential sources of leaks.

It is produced during the decay of organic materials, extracted with oil (when the oil is said to be sour) and is often found underground during tunnelling and in sewers. It is a constituent of biogas. It has some industrial uses and is produced as a by-product in others (e.g. fibre manufacture).

Sulphur Dioxide (SO_2)

(For Sulphur Trioxide, see Acid Gases)

This gas is colourless and has a characteristic choking smell. It is formed on burning sulphur and materials containing sulphur such as oil and coal and it is highly acidic, forming sulphurous acid when dissolved in water. With the oxides of nitrogen it is a cause of acid rain and in the atmosphere, especially when it is foggy, it affects many people's respiratory systems.

In industry its maximum safe level is 2 ppm. It is found in industrial areas and near power stations and it is a raw material for many processes. It has a use in the treatment of water to displace excess chlorine and because of its sterilising properties it is used in food processing. It is twice as heavy as air and it tends to fall to ground level.

Carbon Monoxide (CO)

Carbon monoxide, which is odourless and colourless is the most abundant toxic gas. Different authorities put maximum safe exposure limits at 30 to 50 ppm and even lower levels have the effect of causing drowsiness. Having a similar density to air, it is readily inhaled and detectors need to be mounted at head height.

Any process where there is incomplete combustion of carbon fuel leads to the production of carbon monoxide, e.g. petrol and diesel engines, coal, gas and oil boilers, even smoking. Its presence in mines is due to the slow combustion of coal.

It is also used in enormous quantities as a cheap chemical reducing agent e.g. in steel production and other metal refining and heat treatment and in the production of methanol by reaction with hydrogen.

Oxides of Nitrogen - Nitric Oxide (NO) and Nitrogen Dioxide (NO_2)

There are three oxides of nitrogen. Nitrous oxide (N_2O) (modem name dinitrogen oxide) is not poisonous. It is used as an anaesthetic and as a propellant for whipped cream. Nitric oxide NO (modem name nitrogen monoxide) and nitrogen dioxide NO_2 are the constituents of so called NOx which with sulphur dioxide causes acid rain. The main cause of these gases in the atmosphere is petrol and diesel engines. At the point of exhaust, nitric oxide accounts for about 90% of NOx. However it reacts spontaneously with oxygen in the open atmosphere to give nitrogen dioxide. Nitric oxide is a colourless gas but nitrogen dioxide is an acid, pungent smelling, brown gas. The maximum safe level for nitric oxide is 25ppm and for nitrogen dioxide 3ppm. Both can be detected by electrochemical sensors. In the open environment it is best to monitor for nitrogen dioxide.

Carbon Dioxide (CO_2)

Despite the fact that we breathe out carbon dioxide and that it is present in the atmosphere to the extent of about 400ppm, its maximum safe level is 5000ppm (0.5%). It is produced during combustion and in brewing and other fermentation processes, and is one of the main constituents, with methane, of landfill gas and sewage treatment digester gas. There are hazards in the brewing industry, particularly as the gas is heavier than air and collects at low levels. There is some degree of risk in crowded, badly ventilated places, and this problem is often worsened by oxygen deficiency.

CO_2 is also used to increase plant growth by elevating normal levels in greenhouses etc.

It is odourless and colourless and difficult to measure in ppm levels. Infrared absorption is the usual detection technique

Oxygen Risk

Ensuring that there is a safe level of oxygen

The usual concentration of oxygen in the atmosphere is 20.9%. Unless there is adequate ventilation the level is reduced surprisingly quickly by breathing and combustion. Other ways of depleting the oxygen level include dilution by other gases such as carbon dioxide (but note that 0.5% is the maximum safe level) and nitrogen and chemical absorption by corrosion processes and similar reactions.

The table below shows the effect of a diluting gas on the level of oxygen.

Concentration of diluting gas	Resulting oxygen concentration
0.50%	20.80%
1%	20.70%
5%	19.90%
10%	19.00%
15%	18.20%
20%	17.40%
25%	16.70%

Instruments for monitoring oxygen normally provide alarms at 18 or 19% because most people begin to behave abnormally when the level reaches 17% and death comes very quickly if the level drops only 2 or 3% more. Exposure to atmospheres containing between 10% and 13% oxygen can bring about unconsciousness so quickly that the individual cannot help or protect himself. There are more deaths from oxygen deficiency than from any other gas hazard because the possibility of low oxygen levels is forgotten whereas flammable and toxic gases are more often considered.

Oxygen enrichment can dramatically increase the flammability of anything which will burn. If the level exceeds 24% even materials such as clothing, which might normally just smoulder, will burst into flame.

Gasman II Personal Gas Monitor

Gasman 11 is a personal gas detector capable of monitoring for the presence of a single gas hazard. Compact and lightweight, Gasman 11 is convenient to carry and simple to use.

The versions available from the RS catalogue are:

- Flammable (FL) **RS** Stock No. 303-3722
- Oxygen (OX) **RS** Stock No. 303-3744
- Hydrogen Sulphide (H_2S) **RS** Stock No. 303-3766
- Carbon Monoxide (CO) **RS** Stock No. 303-3750

Other gas ranges are available using Gasman 1, even though they are not listed. For a quotation, please call 01536 444101.

Compact Safety Monitor

Gasman II is designed to be carried in a shirt pocket or on a belt. An intermittent bleep and flash from the green 'power' LED confirms operation. When a gas hazard is detected, Gasman alerts the wearer to the danger by sounding an audible alarm and flashing twin red alarm LEDs. Factory set alarm levels give warning well in advance of danger levels.

Gasman II features:

- Pocket sized
- Rugged IP66 enclosure
- High intensity audible visual alarm
- Liquid crystal display
- Data logging
- Time weighted average

Simple to use

Two push button switches are provided. The large button switches the unit on and runs a self test. Both buttons are required to switch the unit off. Gas values are displayed on a clear LCD. A display backlight is also operated by push-button.

Practical

The top mounted sensor will not be obscured by clothing when the instrument is worn in a pocket, and is arranged to be close to the human breathing zone. A triax moulded case resists mechanical impact and chemical attack. Water and dust sealing is to IP66.

User adjustments are performed by removing a screw cover to gain access to the pot. This enables adjustment of zero, calibration and alarm levels by selecting function.

Batteries

Gasman II FL comes with rechargeable batteries and a charger is required. Disposable Alkaline batteries are fitted to toxic and oxygen versions of Gasman II to provide power for a year of standard shifts. Nimh battery packs fitted to flammable gas versions provide power for 10 hours and have a life expectancy of 1000 charge cycles. A six-way charger is available. Both single and six-way chargers have a selection switch for 110/240Va.c., or can be powered from a 12-24Vd.c. source.

Specification

Weight 210g including batteries.

Dimensions 130h x 160w x 30d (mm)

Typical measuring ranges and alarm settings:

Gasman II ranges:

- 0-100% LEL Methane _____20% LEL
- 0 to 50ppm Hydrogen Sulphide _____10ppm
- 0 to 500ppm Carbon Dioxide _____50ppm
- 0 to 25% Oxygen _____19% and 23%

Gasman I ranges:

- 0-10ppm Sulphur Dioxide _____2ppm
- 0 to 5ppm Chlorine _____0.5ppm
- 0 to 10ppm Nitrogen Dioxide _____2ppm
- 0 to 10ppm Hydrogen Chloride _____2ppm
- 0 to 25ppm Hydrogen Cyanide _____5ppm
- 0 to 50ppm Ammonia _____25ppm
- 0 to 1ppm Ozone _____19% and 23%

Response times T_{90}	Methane 20 seconds oxygen, 10 seconds, typical toxic gas 20 seconds
Expected service life of sensor:	Flammable 5 years, toxic 3 years, oxygen 1 year minimum
Alarms:	Audible sounder, 85dBA @ 1m twin flashing red LEDs indicates gas hazard continuous tone for discharge battery
Display:	7 segment high contrast custom LCD push-button backlight
Battery options:	Disposable battery life (3 x AA Alkaline cells) 1 year standard shifts (toxic gas/oxygen instruments). Rechargeable battery life (Nickel hydride) 10 hours between recharge (flammable gas instruments)
Operating temperature range:	-20 to 50C
Humidity:	-0 to 95% RH non-condensing
Accessories:	Rubber boot. Calibration adaptor/aspirator. Earpiece attachment. Charger unit. Six-way charger
Approval codes:	EEx ia (d) IIC T3/4 (Class 1, division 1, groups A, B, C, D)
Standards:	EN50018, EN50014, EN50020 UL913
Ingress protection:	IP66

Custodian

Portable Multi Gas Monitor

With its compact shape, clear alarms and rugged construction, Custodian is the ideal choice for the confined space worker. Its many features, however make it suitable for a host of applications requiring the monitoring of one to four gases. This instrument benefits from versatile configuration options and a highly intuitive Windows interface for set up and datalog access.

The versions available from the **RS** Catalogue are:

-Flammable (FL)	-	Flam/OX	**RS** Stock No. 242-4048
-Hydrogen Sulphide (H_2S)	-	Flam/HS/OX	**RS** Stock No. 285-8441
-Carbon Monoxide (CO)	-	Flam/CO/OX	**RS** Stock No. 285-8435
-Oxygen (O_2)	-	Flam/CO/HS/OX	**RS** Stock No. 285-8457

Other versions are available, even though they are not listed, for a quotation please call 01536 444101

Comprehensive Safety Monitor

For convenience, Custodian can be carried by the user in a variety of ways. There is a pocket clip, belt clip, chest harness and shoulder strap. With the optional carry case fitted, the instrument can be attached by a shoulder strap or waist belt. When a gas hazard is detected, Custodian's exceptional alarms make their presence felt. A penetrating 85dB siren and ultrabright Rash sequence from a pair of red LEDs alerts the wearer to the danger. Factory set alarm levels give warning well in advance of danger levels on toxic gas channels, time weighted average (TWA) exposure is monitored over 15 minute and 8 hour intervals. When thresholds are exceeded (levels prescribed by the Health and Safety Executive in the U K), a distinctive audible alarm is given, and a symbol on the display indicates the type of alarm. Continuous datalogging records historical exposure for subsequent analysis. Unlike many products on the market, these 'hygiene' features are standard on the Custodian.

Practical and Robust

Custodian is depended upon by thousands of workers worldwide in confined space, construction, manufacturing and many other industries. Its robust mechanical construction and advanced electronics ensure that it will function reliably in the most arduous conditions:

- Triax moulded case resists mechanical impact and chemical attack
- IP66 sealing keeps out water and dust
- Inherent immunity to interference from radio transmitters and mobile telephones
- International intrinsic safety approvals for use In hazardous areas

Simple to Use

Custodian is compact and lightweight and has simple pushbutton operation. One large tactile button is used for switching the instrument on and resetting alarms. Gas values and instrument status are displayed on a clear LCD with large digits and symbols. To prevent accidental switch-off, it is necessary to press both the main and '-' buttons together. Advanced user functions can be locked out with passwords. Basic go/no-go operation can be selected if an alarm-only detector is required. The unit can be fitted with:

- Pocket clip
- Belt clip
- Chest Harness
- Shoulder strap
- Carry case

User Adjustments

Adjustment is performed by stepping the instrument into adjust mode with a cursor key. This allows the user to scroll through zero, calibrate, alarm 1 and alarm 2 levels. These values can be adjusted by pressing the '+' or '-' buttons. Adjustments will only be stored in memory if a valid password is keyed in at the prompt.

PC Interfaces

Custodian can be connected to a PC running dedicated Windows applications.

- The Set Custodian program allows full access to instrument configuration and logged data files. Calibration is also simplified.
- LogManager software provides a clear graphical presentation of gas data recorded by the instrument. Gas data for all installed channels are displayed with a different coloured trace. Individual traces can be turned off and on to improve clarity. As the mouse pointer is moved around the trace, the gas value and event time are displayed on screen. Output files are spreadsheet compatible.
- Full versions of Set Custodian and LogManager are supplied on disk with each Comms Pod. They can be used to edit and inspect sample configuration and logged data files. In order to access real instrument data, a Comms Pod interface **RS** stock no. 242-4105 is required.

Range of Sensors

Standard single channel instruments are available for flammable, oxygen and toxic gas detection.

Multi-gas instruments are also available with one pellistor sensor for LEL flammable gas, up to two electro-chemical toxic gas sensors and one oxygen sensor Contact **RS** Purchase Support (01536 444066) for details of price and availability.

Clear Alarms and Display

Two ultra bright flashing red LEDs are highly visible over a wide field of view. A penetrating 85dB sounder reinforces the message with a selectable multi-tone. An earphone is available for very noisy environments. Gas readings, scanning between sensors, are displayed on a custom LCD with excellent contrast and wide viewing angle. Large digits are augmented by clear symbols for warnings such as low battery. Peak readings may be displayed. A backlight comes on when any button is pressed to enhance readability where the lighting is poor.

Programmable Alarms

For each gas channel, there are three levels of alarm plus two TWA (time weighted average) alarms for toxic gas channels. These operate on 15 minute and 8 hour exposure periods. All thresholds may be adjusted. Instantaneous alarms may also be:

- latching or self resetting
- rising or falling
- mutable (can be silenced while still in alarm condition)
- deactivated if not required

Instruments can be supplied with alarms configured to customer specification. A pass code protects the instrument against unauthorised changes.

Replaceable i.s. Battery Pack

Alkaline or rechargeable battery packs are available for Custodian. Battery packs are intrinsically safe (i.s.) and may be replaced in a hazardous area. Rechargeable packs feature nickel hydride batteries with a life expectancy of 1000 charge cycles. These batteries contain no hazardous cadmium, and do not suffer from the memory effect associated with NiCad batteries. Instruments can be left permanently on charge. A multi-charger is available. Both single and multi-way chargers are available for most standard DC and AC supply voltages.

Custodian Features

- Rugged IP66 enclosure
- Three instantaneous alarms
- 15 minute and 8hour TWA (time weighted average) alarms on toxic gas channels
- Programmable 85dB alarm siren
- Highly visible alarm lights
- Clear Liquid Crystal Display
- Datalogging
- Error checking

Specification - Custodian

Weight 500g including batteries
Dimensions 155h X 102w X 52d (mm)
Typical measuring ranges and alarm settings*:
- 0 to 100 %LEL methane _____20%LEL
- 0 to 50 ppm hydrogen sulphide _____10 ppm
- 0 to 500 ppm carbon monoxide _____50 ppm
- 0 to 10 ppm sulphur dioxide _____2 ppm
- 0 to 5 ppm chlorine _____0.5 ppm
- 0 to 10 ppm nitrogen dioxide_____2 ppm
- 0 to 5 ppm phosphine _____0.5 ppm
- 0 to 25 % oxygen _____19% & 23%

Response times T_{90} _____methane 20 seconds,
oxygen 10 seconds, typical toxic gas 20 seconds.
Expected service life of sensor _____flammable 5 years
toxic 3 years
oxygen 1 year minimum
Audible alarms_____85 dBA at 1m. Selectable tones
Confidence blip (selectable)
Continuous tone for discharged battery
Visual indications _____ Ultra bright flashing red
LED pair indicates gas hazard
Flashing cursor on display
indicates alarming channel
Clock symbol flashing on display
indicates TWA alarm
Display _____7 segment high contrast LCD,
8mm character height, with backlight
symbols for Peak Hold, Low Batt,
TWA alarm, Pump, Password prompt
Datalogging _____Sample rate adjustable
from 5 seconds to 1 hour
1300 to 3900 readings per channel
depending on gas concentration
Internal Pump (optional) _____Automatic on/off
Blocked flow detection with auto shut-off and alarm
0.5l/min flowrate
2 m non absorbent, hydrocarbon resistant hose
Rechargeable Battery Pack Life _____Toxic gas/oxygen
channels only; 50 hours
Flammable gas channel fitted;
12-15 hours between recharge
Alkaline Battery Pack Life (4 x AA cells) __Toxic gas/oxygen
channels only; 120 hours
Flammable gas channel fitted 26 hours
Operating temperature range _____-20 to 50C
Humidity _____0 to 95% RH non-condensing
Accessories _____Belt clip
Pocket clip
Chest Harness
Carry case
Shoulder strap
Calibration Adaptor/Aspirator
Earpiece attachment
Comms Pod interface unit
Multi-way charger
Manual bulb type aspirator with 2m hose
Internal sampling pump
Approval Codes _____EEx ia [dl IIC T3/4. Class1,
Division 1, Groups A, B, C, D.
Standards _____EN50014, EN50018, EN50020, UL913
Ingress Protection _____IP66
RF radiation _____EN50081-2
RF/ESD immunity _____ EN50082-2
Battery Charger _____6 hours full recharge from flat
accepts complete instrument or battery pack
automatic trickle charge feature
means batteries can be left on charge indefinitely
multiple unit charger available
DC input 12-30V; AC adaptors 110-250V

Figure 3 **Gasman**

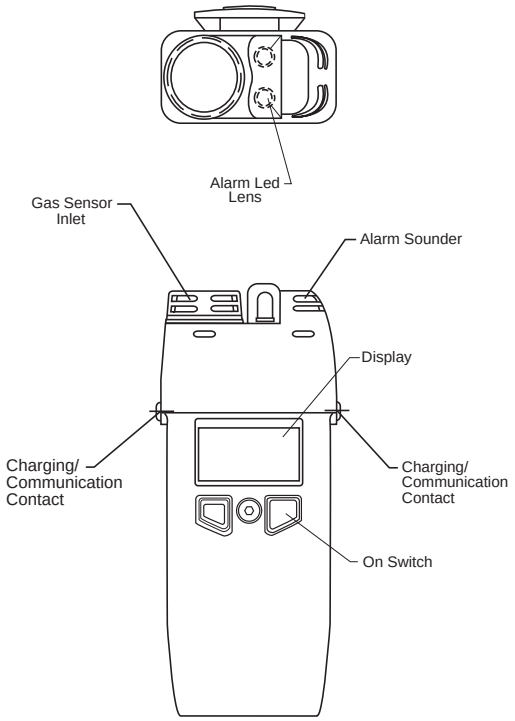
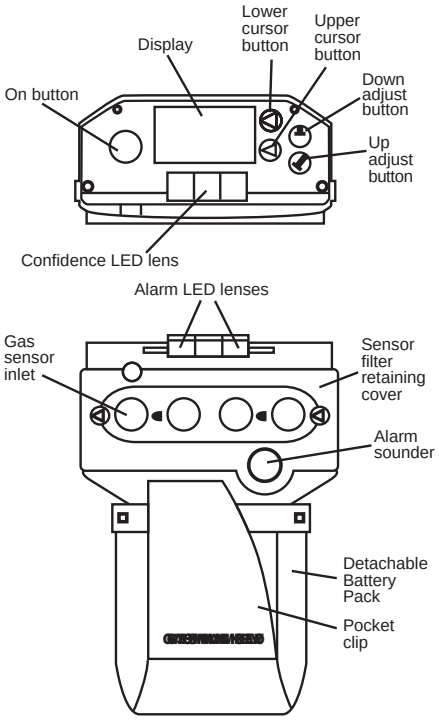


Figure 4 **Custodian**



Industries where toxic gases are found

CARBON MONOXIDE
Car Parks
Power Stations
Steel Works
Generating Plant
Mine Shafts
Chemical Companies
Garages
Metal Refinery & Heat Treatment
Underground Work
Nuclear Engineering
Laboratory
Car Manufacturing Plant
Tunnels

HYDROGEN SULPHIDE
Dirty Waste Water Sites
Petrochemical Companies
Offshore Companies
Tunnelling Contractors
Man Entry Applications
Chemical Companies
Laboratories
Dye Makers
Mines

SULPHUR DIOXIDE
Water Purification
Unclean Water Sites
Light Bulb Manufacturers
Power Stations
Paper Mills
Pet Food Manufacturers
Chemical Companies
Power Generating Plant
Steel Manufacturing

CHLORINE
Clean Water Plant
Paper Manufacturers
Chemicals & Plastic Manufacturers
Food Industry
Textiles

NITRIC OXIDE & NITROGEN DIOXIDE
All situations where there are combustible emissions therefore tunnels, car parks, loading bays etc.

HYDROGEN CYANIDE
Gold Refining
Acid Gases
Petrochemical Plant
Chemical Engineers
Laboratory
Pharmaceutical Manufacturers
Hospitals

AMMONIA
Refrigeration Plant
Clean Water Sites
Chemical Manufacturers
Fertiliser Manufacturers
Refrigerated Storage Depots
Food Processing Engineers
Plastics & Foams
Currency/Mint Manufacture