Application Note	Fixed Systems Guide	Date	1-1-2000
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		By	Lars Boettern

Fixed Monitoring Electronics, Environments, and Terminology

Part 1: Electronics

A. Number Prefixes

Number	Description	Prefix	Abbreviation	Example
1,000,000,000	Billion	Giga	G	Gigabyte
1,000,000	Million	Mega	M	Megabucks
1,000	Thousand	Kilo	K	Kilogram
1	one			
0.001	One Thousandth	milli	m	milliamp
0.000001	One Millionth	micro	mu	microinch
0.000000001	One Billionth	nano	n	nanosecond

B. Relays

B1. Theory of Operation

Definition of "relay": an electrically controlled switch

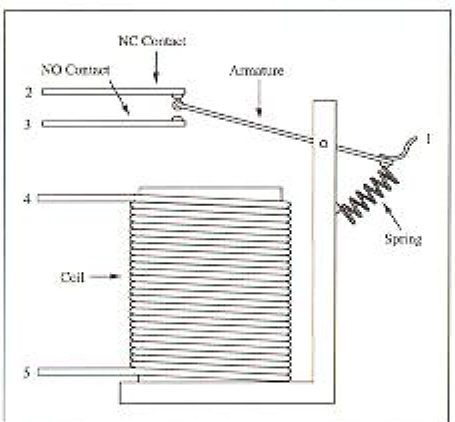

Diagram 1: Basic Structure of a single-pole-double-throw relay

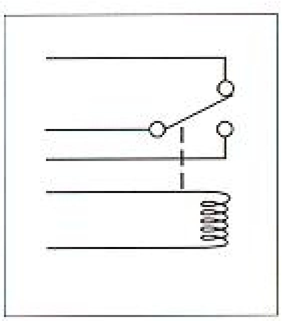

Diagram 2: Symbol for Relay

B2: Relay Specifications

Voltage and Current Rating: Relays have Voltage and Current ratings. The GasChek family has Voltage and Current ratings of 5 Amps and 250 VAC or about a one horsepower motor. Since alternating current tends to reduce theOften times the DC Current and Voltage is less than the AC ratings. The GasChek relays are rated for 5 Amps and 30 VDC (100 watt DC horn or strobe light).

C. Contact Types

C1. Mercury Wetted

Some relays have mercury on the contacts to reduce contact resistance and "pitting". Pitting can occur on relay contacts if high current loads are interrupted. Mercury-wetted contacts are often used for low-level analog signal switching.

C2. Dry

Dry contacts are named as such because they are not "wetted with Mercury". The GasChek has "Dry" contact relays and are adequate for the loads that will be switched in typical gas detection applications.

C3. Poles/Throws: Forms A, B and C

Form A - Denotes a Normally Open Single Pole, Single Throw Contact Form B - Denotes a Normally Closed Single Pole, Single Throw Contact Form C - Denotes a Single Pole, Double Throw set of contacts

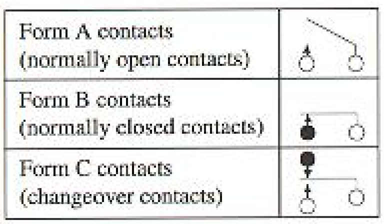

Diagram 3: Form A, B, and C Relays

C4. Double Pole - Double Throw

Double Pole - Double Throw relay is nothing more than two single pole, single throw contacts that switch together. The two sets of contacts are electrically isolated from each other (as well as the Gas Chek!)

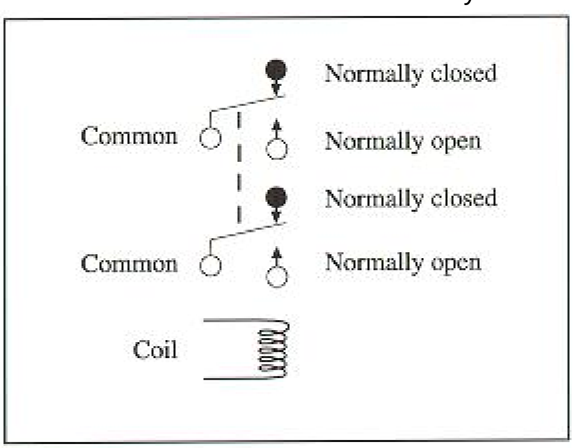

Diagram 4: Double Pole-Double Throw relay

C5. Energized / De-energized

Some applications require that an alarm signal be sent to an output device if power is interrupted to the gas detection system. If the output is wired to the "Normally Open" contacts of the relay (typical installation), there is no way for the output device to receive a command to operate since the relay is in the same state with the power off and with the power on.

C6. Normally Energized Relays

Some gas detection systems can be configured so that the relays are in the "energized" state under no-alarm condition. In this case, the output device is connected to the "Normally Closed" set of contacts. If the power goes out, the relay becomes "de-energized" and the output device is activated since it is connected to the "Normally Closed" set of contacts.

C7. Cascading Relays

When the load to be switched exceeds the ratings of the relay in the GasChek, a larger relay can be cascaded with the GasChek relay. The contacts in the GasChek relay apply line voltage to the coil of the larger relay. Large relays that are specifically designed to switch motors are often called "motor contactors" or sometimes just "contactors".

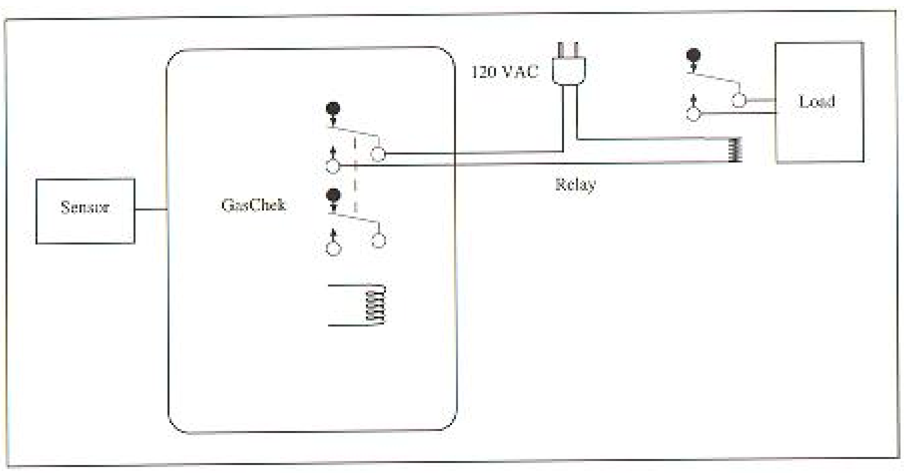

Diagram 5: Cascading relays for high Load

D. Relationship Between Voltage and Current

D1. Water Pressure Analogy

Q = P/K = Pressure/Resistance

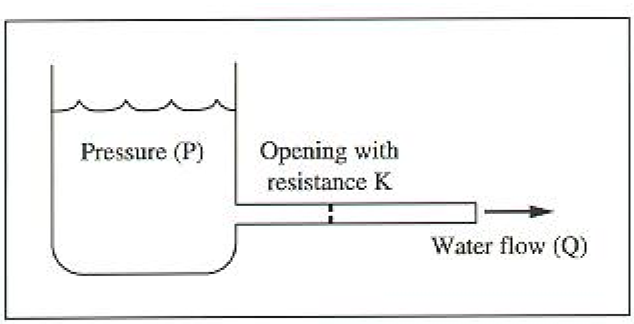

Diagram 6:

D2. Ohms Law The following expressions are all the same equation rewritten:

I= V/R

R=V/I

V=IR

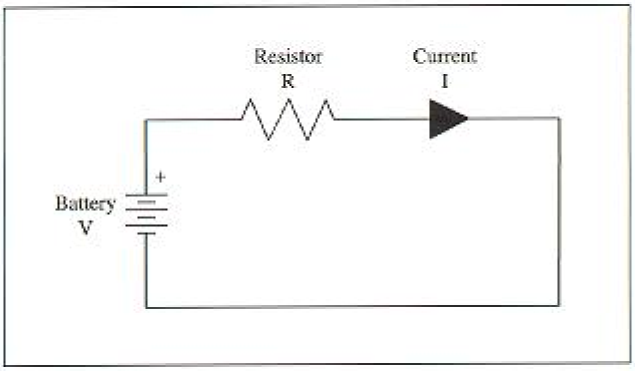

Diagram 7:

E. 4-20 mA Current Loop

E1. Manually Controlled Current Loop example:

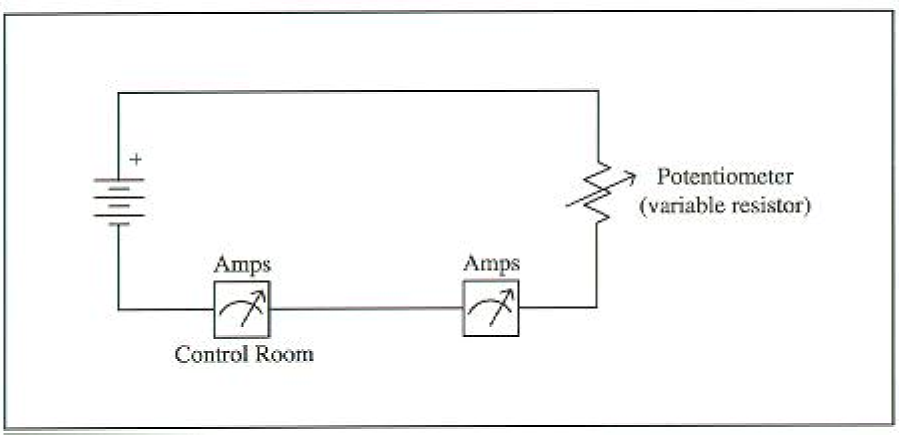

Diagram 8:

E2: Automatically Controlled Current Loop Example (GasChek/GasLink):

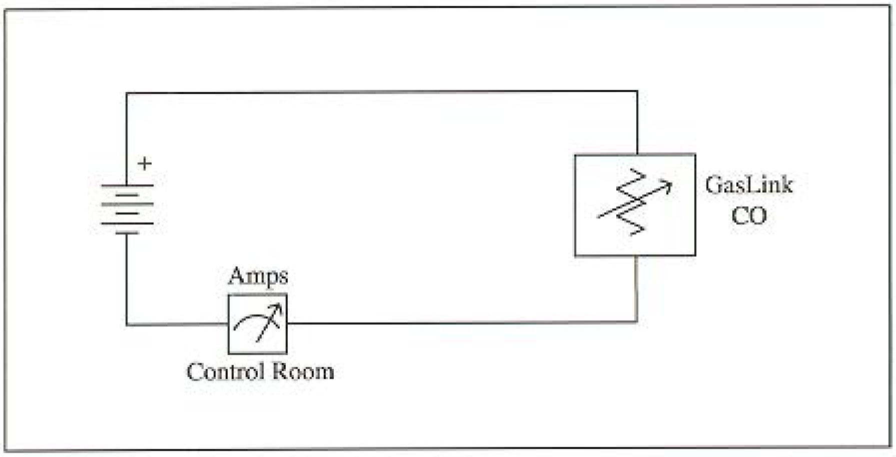

Diagram 9:

E3: 4-20 mA Current Loop Advantages:

- *Automatic Broken-wire Detection:* If the wire breaks, the controller will signal a fault condition. With a voltage loop, a broken wire can look like a healthy sensor indicating zero gas.
- *Only two wires:* The two wires carry both the power for the device to operate as well as the signal
- *More immunity to noise than a Voltage signal:* Voltage Protocol requires a high resistance measuring device which will respond more vigorously to noise currents induced by EMI.
- You can have more than one Indicating device in the loop and it won't affect the reading.

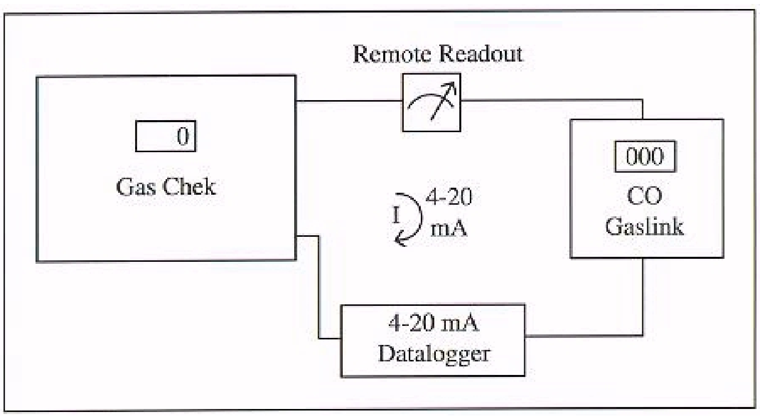

Diagram 10: 4-20 mA Current Loop

F. Wiring Recommendations

F1. Solid or Stranded: Wire can come either solid copper or stranded copper. Either type is fine as long as it has a shield and appropriate jacket for the application as discussed below.

F2. Shielding: Some cable (several wires together with a covering) can have a metal shield layer just under the jacket that reduces the susceptibility of the circuits to electrical interference. A shielded cable is mandatory for use with the GasChek continuous monitoring equipment.

F3. Jacket: The wires must be encased in a jacket that is appropriate for the application. The most typical jacket material is PVC.

Part 2: Hazardous (Classified) Location Terminology Class I Group Classifications

Group A: Atmospheres containing acetylene.

Group B: Atmospheres containing hydrogen, fuel and combustible process gases containing more than 30 percent hydrogen by volume, or gases or vapors of equivalent hazard such as butadiene, ethylene oxide, propylene oxide, and acrolein.

> *Exception No. 1*: Group D equipment shall be permitted to be used for atmospheres containing butadiene if such equipment is isolated in accordance with Section 501-5(a) by sealing all conduit 1/2-in. size or larger.
>
> *Exception No. 2*: Group C equipment shall be permitted to be used for atmospheres containing ethylene oxide, propylene oxide, and acrolein if such equipment is isolated in accordance with Section 501-5(a) by sealing all conduit 1/2-in. size or larger.

Group C: Atmospheres such as ethyl ether, ethylene, or gases or vapors of equivalent hazard.

Group D: Atmospheres such as acetone, ammonia, benzene, butane, cyclopropane, ethanol, gasoline, hexane, methanol, methane, natural gas, naphtha, propane, or gases or vapors of equivalent hazard.

> *Exception: For atmospheres containing ammonia, the authority having jurisdiction for enforcement of this Code shall be permitted to reclassify the location to a less hazardous location or a nonhazardous location.*

Class II Group Classifications

Group E: Atmospheres containing combustible metal dusts, including aluminum, magnesium, and their commercial alloys, or other combustible dusts whose particle size, abrasiveness, and conductivity present similar hazards in the use of electrical equipment.

(FPN): Certain metal dusts may have characteristics that require safeguards beyond those required for atmospheres containing the dusts of aluminum, magnesium, and their commercial alloys. For example, zirconium, thorium, and uranium dusts have extremely low ignition temperatures [as low as 20C (68F)] and minimum ignition energies lower than any material classified in any of the Class I or Class II Groups.

Group F: Atmospheres containing combustible carbonaceous dusts, including carbon black, charcoal, coal, or dusts that have been sensitized by other materials so that they present an explosion hazard.

(FPN): *See Standard Test Method for Volatile Material in the Analysis Sample for Coal and Coke,* ASTM D 3175-1989.

Group G: Atmospheres containing combustible dusts not included in Group E or F, including flour, grain, wood, plastic, and chemicals.

(FPN No. 1): For additional information on group classification of Class II materials, see *Manual for Classification of Gases, Vapors, and Dusts for Electrical Equipment in Hazardous (Classified) Locations,* NFPA 497M-1991.

(FPN No. 2): The explosion characteristics of air mixtures of dust vary with the materials involved. For Class II locations, Groups E, F, and G, the classification involves the tightness of the joints of assembly and shaft openings to prevent the entrance of dust in the dust-ignitionproof enclosure, the blanketing effect of layers of dust on the equipment that may cause overheating, and the ignition temperature of the dust. It is necessary, therefore, that equipment be approved not only for the class, but also for the specific group of dust that will be present.

(FPN No. 3): Certain dusts may require additional precautions due to chemical phenomena that can result in the generation of ignitable gases. See *National Electrical Safety Code,* ANSI C2-1993, Section 127A-Coal Handling Areas.

500-5. Class I Locations

Class I locations are those in which flammable gases or vapors are or may be present in the air in quantities sufficient to produce explosive or ignitable mixtures. Class I locations shall include those specified in (a) or (b) below.

(a) Class I, Division 1. A Class I, Division 1 location is a location (1) in which ignitable concentrations of flammable gases or vapors can exit under normal operating conditions; or (2) in which ignitable concentrations of such gases or vapors may exist frequently because of repair of maintenance operations or because of leakage; or (3) in which breakdown or faulty operation of equipment or processes might release ignitable concentrations of flammable gases or vapors, and might also cause simultaneous failure of electric equipment.

(FPN No. 1): This classification usually includes locations where volatile flammable liquids or liquefied gases are transferred from one container to another; interiors of spray booths and areas in the vicinity of spraying and painting operations where volatile flammable solvents are used; locations containing open tanks or vats of volatile flammable liquids; drying rooms or compartments for the evaporation of flammable solvents; locations containing fat and oil extraction equipment using volatile flammable solvents; portions of cleaning and dyeing plants where flammable liquids are used; gas generator rooms and other portions of gas manufacturing plants where flammable gas may escape; inadequately ventilated pump rooms for flammable gas or for volatile flammable liquids; the interiors of refrigerators and freezers in which volatile flammable materials are stored in open, lightly stoppered, or easily ruptured containers; and all other locations where ignitable concentrations of flammable vapors or gases are likely to occur in

the course of normal operations.

(FPN No. 2): In some Division I locations, ignitable concentrations of flammable gases or vapors may be present continuously or for long periods of time. Examples include the inside of inadequately vented enclosures containing instruments normally venting flammable gases or vapors to the interior of the enclosure, the inside of vented tanks containing volatile flammable liquids, the area between the inner and outer roof sections of a floating roof tank containing volatile flammable fluids, inadequately ventilated areas within spraying or coating operations using volatile flammable fluids, and the interior of an exhaust duct that is used to vent ignitable concentrations of gases or vapors. Experience has demonstrated the prudence of (a) avoiding the installation of instrumentation or other electric equipment in these particular areas altogether or, (b) where it cannot be avoided because it is essential to the process and other locations are not feasible (see Section 500-2, first FPN), using electric equipment or instrumentation approved for the specific application or consisting of intrinsically safe systems as described in Article 504.

(b) Class I, Division 2. A Class I, Division 2 location is a location (1) in which volatile flammable liquids or flammable gases are handled, processed, or used, but in which the liquids, vapors, or gases will normally be confined within closed containers or closed systems from which they can escape only in case of accidental rupture or breakdown of such containers or systems, or in case of abnormal operation of equipment; or (2) in which ignitable concentrations of gases or vapors are normally prevented by positive mechanical ventilation, and which might become hazardous through failure or abnormal operation of the ventilating equipment; or (3) that is adjacent to a Class I, Division 1 location, and to which ignitable concentrations of gases or vapors might occasionally be communicated unless such communication is prevented by adequate positive-pressure ventilation from a source of clean air, and effective safeguards against ventilation failure are provided.

(FPN No. 1): This classification usually includes locations where volatile flammable liquids or flammable gases or vapors are used but that, in the judgment of the authority having jurisdiction, would become hazardous only in case of an accident or of some unusual operating condition. The quantity of flammable material that might escape in case of accident, the adequacy of ventilating equipment, the total area involved, and the record of the industry or business with respect to explosions or fires are all factors that merit consideration in determining the classification and extent of each location. (FPN No. 2): Piping without valves, checks, meters, and similar devices would not ordinarily introduce a hazardous condition even though used for flammable liquids or gases. Locations used for the storage of flammable liquids or of liquefied or compressed gases in sealed containers would not normally be considered hazardous unless also subject to other hazardous conditions.

500-6 Class II Locations

Class II locations are those that are hazardous because of the presence of combustible dust. Class II locations shall include those specified in (a) and (b) below.

(a) Class II, Division 1: A Class II, Division 1 location is a location (1) in which combustible dust is in the air under normal operating conditions in quantities sufficient to produce explosive or ignitable mixtures; or (2) where mechanical failure or abnormal operation of machinery or equipment might cause such explosive or ignitable mixtures to be produced, and might also provide a source of ignition through simultaneous failure of electric equipment, operation of protection devices, or from other causes; or (3) in which combustible dusts of an electrically conducive nature may be present in hazardous quantities.

(FPN): Combustible dusts that are electrically nonconducive include dusts produced in handling and processing of grain and grain products, pulverized sugar and cocoa, dried egg and milk powders, pulverized spices, starch and pastes, potato and woodflour, oil meal from beans and seed, dried hay, and other organic materials that may produce combustible dusts when processed or handled. Only Group E dusts are considered to be electrically conducive for classification purposes. Dusts containing magnesium or aluminum are particularly hazardous, and the use of extreme precaution will be necessary to avoid ignition and explosion.

(b) Class II, Division 2. A Class II, Division 2 location is a location where combustible dust is not normally in the air in quantities sufficient to produce explosive or ignitable mixtures, and dust accumulations are normally insufficient to interfere with the normal operation of electrical equipment or other apparatus, but combustible dust may be in suspension in the air as a result of infrequent malfunctioning of handling or processing equipment and where combustible dust accumulations on, in, or in the vicinity of the electrical equipment may be sufficient to interfere with the safe dissipation of heat from electrical equipment or may be ignitable by abnormal operation or failure of electrical equipment.

(FPN No. 1): The quantity of combustible dust that may be present and the adequacy of dust removal systems are factors that merit consideration in determining the classification and may result in an unclassified area. (FPN No. 2): Where products such as seed are handled in a manner that produces low quantities of dust, the amount of dust deposited may not warrant classification.

500-7 Class III Locations

Class III locations are those that are hazardous because of the presence of easily ignitable fibers or flyings, but in which such fibers or flyings are not likely to be in suspension in the air in quantities sufficient to produce ignitable mixtures. Class III locations shall include those specified in (a) and (b) below.

(a) Class III, Division 1. A Class III, Division 1 location is a location in which easily ignitable fibers or materials producing combustible flyings are handled, manufactured, or used.

(FPN No. 1): Such locations usually include some parts of rayon, cotton, and other textile mills; combustible fiber manufacturing and processing plants; cotton gin and cotton-seed mills; flax-processing plants; clothing manufacturing plants; woodworking plants; and establishments and industries involving similar hazardous processes or conditions.

(FPN No. 2): Easily ignitable fibers and flyings include rayon, cotton (including cotton linters and cotton waste), sisal or henequen, istle, jute, hemp, tow, cocoa fiber, oakum, baled waste kapok, Spanish moss, excelsior, and other materials of similar nature.

(b) Class III, Division 2. A Class III, Division 2 location is a location in which easily ignitable fibers are stored or handled.

Exception: In process of manufacture.

Explosion Proof vs. Intrinsically Safe

Explosion Proof: Devices that are UL Classified as "Explosion-Proof" prevent explosions in hazardous locations by containing an explosion (should it occur) within the classified device, and thus preventing its propagation into the atmosphere which surrounds the explosion-proof enclosure. GasChek explosion-proof detector housings have been Classified by UL as Explosion-Proof for use in Class I, Division 1, Groups B, C, and D hazardous locations. ZoneGuard explosion-proof detector housings have been classified by UL as Explosion-Proof for use in Class I, Division 1, Groups A, B, C, D, E, F, and G hazardous locations. Wires leading to Explosion-proof classified devices must be run in conduit. Note: The conduit must also carry an explosionproof classification. GasChek and ZoneGuard controller housings are not explosion-proof, and must always be located in a non-hazardous location.

Intrinsically Safe: Devices that are classified "Intrinsically Safe" prevent explosions in hazardous locations by employing electrical designs that eliminate the possibility of ignition. This generally involves adding protective components in series with energy storage devices. The purpose of the protective components is to reduce the risk of ignition due to spark or increased surface temperature of components. Biosystems' PhD Plus and PhD Ultra multi-sensor gas detectors, and Toxi Series single sensor gas detectors are classified by UL and the Canadian Standards Association as Intrinsically Safe for use in Class I, Division 1, Groups A, B, C, and D Hazardous Locations.

Part 3: Glossary

Aerobic decomposition: Bacterial decomposition via biochemical pathways which require (and consume) oxygen.

Aerosol: Suspension of fine solid or liquid particles in air.

Alumina: Common name for any one of several forms of aluminum oxide (Al2O3) used in aluminum production, abrasives, ceramics, and electrical insulation.

Anaerobic decomposition Bacterial decomposition via biochemical pathways which do not require oxygen.

Atmosphere: The total gases, vapors, mists and fumes present in a specific location.

Broad-range sensor: A sensor or type of detector which detects a class or category of contaminant rather than a single molecular species.

Calibration: Procedure by which the performance of a detector is verified by comparison with a known standard and adjusted to provide maximum accuracy.

Capillary attraction: The force that allows a porous material to soak up a liquid. Capillary attraction results when the adhesion of a liquid to a solid surface is greater than the internal cohesion of the liquid. It is this force that causes the liquid to be raised against a vertical surface, as water is in a clean glass tube.

Capillary: Tubule or pore with a very small internal diameter.

Catalyst: A substance which facillitates or allows a chemical reaction to occur but which is not consumed in the reaction.

Ceiling limit: The maximum concentration to which an unprotected worker may be exposed for even a brief period of time. OSHA has assigned some, but not all, toxic substances with a ceiling limit. Unprotected workers may not enter an environment even momentarily when concentrations of toxic substances exceed the ceiling level.

Colorimetric: Detection technique which hinges on a measurable color change in the reactants.

Combustion: Oxidation of a substance by burning.

Confined space: A confined space is characterized by three conditions (a) limited access; (b) not designed for continuous worker occupancy; and (c) large enough for entry. A confined space which contains any additional serious safety hazards (i.e. known or potential atmospheric hazards, material with the potential for engulfment, steeply sloping floors or other recognized hazards) must be treated as a "permit required confined space" with entry made only in accordance with a written program centered on the issuance and use of an entry permit. (OSHA 29 CFR 1910.146.)

Cross sensitivity: Predictable sensitivity of a detector to contaminants other than the one used for calibration.

Desorbtion: Process by which a previously absorbed material is given off or released by another (i.e., when the walls of a hydrocarbon storage vessel which have absorbed some of the product releasing dangerous vapors when the vessel is heated during welding).

Diffusion: Process by which particles of liquids, gases or solids spread from regions of higher concentration to regions of lesser concentration as a result of random molecular movement.

Dilution fitting: An adaptor designed to mix the gas sample being drawn into an instrument with a known volume (or ratio) of fresh air. Used with "hot bead" type combustible gas sensors to allow readings to be obtained in oxygen deficient atmosphere.

Displacement: A process by which the atmosphere originally present in a confined space is shifted or replaced by another. A typical example is the accidental introduction of a heavier than air "displacing" gas such as argon into a confined space. The argon tends to form a density dependent layer near the bottom of the confined space which displaces the atmosphere previously present, frequently resulting in a hazardous oxygen deficiency.

Dosimeter: An instrument or device designed to measure contaminant exposure accumulated over a specified interval.

Dusts: Fine particles produced by the breakdown of solid materials. (Aerosol suspensions of asbestos fibers are a typical example of a fibrous dust.)

Electrochemical sensor: Sensor which makes use of an electrochemical reaction to provide an electrical output proportional to the concentration of contaminant the sensor is designed to measure.

Electrode: (1) A solid electric conductor through which an electric current enters or leaves an electrolytic cell (as in an electrochemical sensor); or (2) a collector or emitter of electric charge or of electric-charge carriers, (as in the charged collecting plates of a photo-ionization or flame-ionization detector).

Electron volt (eV): A unit of energy equal to the energy acquired by an electron falling through a potential difference of one volt, (1.602 ´ 10-19 joule or 3.829 ´ 10-20 calories).

Flame arrestor: Device designed to physically contain or prevent the propagation of a flame to the atmosphere which surrounds a sensor or instrument.

Flame ionization: Process by which a hydrogen flame is used to provide the energy necessary for ionization of an atom or molecule.

Flammability range: The range between the lower explosive limit (LEL) and upper explosive limit (UEL) concentrations for a particular combustible gas. Combustible gas concentrations within the flammability range will burn or explode if a source of ignition is present.

Flashpoint: Temperature at which a combustible liquid gives off enough vapor to form an ignitable (i.e. LEL) concentration.

Fumes: Extremely small particulates usually formed as a by-product of high heat.

Functional test: Procedure used to verify the performance of an instrument which does not include actual adjustment.

Halogen: Any member of the group of chemically related nonmetallic elements which include fluorine, chlorine, bromine, and iodine.

Halogenated hydrocarbon: Hydrocarbon molecule with a chemical structure that includes one or more halogen atoms. Typical examples include ethylene bromide (C2H4Br2) and trichloroethylene (C2HCl3).

Hazardous atmosphere: A hazardous atmosphere is any which (per OSHA 29 CFR 1910.146) exposes workers to risk of death, injury, incapacitation or illness.

Heat-of-combustion: The amount of energy (in calories) produced by the combustion of a specific quantity (one mole) of a particular substance.

Humidity: The amount of water vapor present in the atmosphere.

Hydrocarbon: Organic compounds which consist entirely and exclusively of carbon and hydrogen atoms.

Ignitable: Capable of combustion if a source of ignition is present.

IDLH: Immediately dangerous to life and health. Any condition that poses an immediate or delayed threat to life or that would cause irreversible adverse health effects or that would interfere with an individual's ability to escape from the dangerous condition (OSHA 29 CFR 1910.146).

Infrared (IR): The range of invisible electromagnetic radiation with wavelengths from about 750 nanometers (just longer than red in the visible spectrum), to 1 millimeter (on the border of the microwave region).

Ion: An atom or molecule that has acquired a net electric charge by gaining or losing one or more electrons.

Ionization potential (IP): The amount of energy (usually expressed in electron Volts) necessary to remove an electron from a neutrally charged atom or molecule.

Ionization: Process by which an atom or molecule acquires a net electric charge as a function of the gain or loss of one or more electrons.

Lower explosive limit (LEL): The minimum concentration of a combustible gas in air which will ignite if a source of ignition is present. Used interchangeably with the term "lower flammability limit" (LFL).

Lower flammability limit (LFL): The minimum concentration of a combustible gas in air which will ignite if a source of ignition is present. Used interchangeably with the term "lower explosive limit" (LEL).

Metal oxide semiconductor (MOS) sensor: Sensor which uses an MOS element designed to undergo a change in conductance proportional to the amount of contaminant present.

Metal oxide semiconductor: Any of a number solid metallic oxides such as tin dioxide (SnO2) which have electrical conductivity which is greater than insulators but less than good conductors. MOS electrical conductivity can be differentiably modified by environmental conditions.

Mists: Suspensions of fine liquid droplets present in the atmosphere.

Mole: The amount of a substance that contains 6.0225 × 10 23 (Avogadro's number) of atoms or molecules.

Nephelometer: Particulate detectors which use the principle of backscattering of light from a calibrated source by the particulates present within a sensing chamber to determine particulate concentrations.

Organic molecule: Any molecule which contains one or more carbon atoms.

Organic: Pertaining to the chemistry of carbon.

OSHA: United States Department of Labor Occupational Safety and Health Administration.

Oxidation: (1) The combination of a substance with oxygen or (2) a chemical reaction in which the atoms in an element lose electrons.

Oxygen deficiency: Hazardous atmospheric condition due to a low oxygen concentration. OSHA (29 CFR 1910.146) defines oxygen concentrations which are less than 19.5% as hazardous due to oxygen deficiency.

Oxygen enrichment: Hazardous atmospheric condition due to a high oxygen concentration. OSHA (29 CFR 1910.146) defines oxygen concentrations which are greater than 23.5% as hazardous due to oxygen enrichment.

Particulate: Aerosol particulate contaminants are suspensions of fine solid or liquid particles suspended in the atmosphere.

Parts-per-million (PPM): Unit of measurement used to express the ratio of the amount of a contaminant which is present to the total volume of atmosphere in which the contaminant is dispersed. One percent is equivalent to 10,000 PPM (likewise, 1 PPM is equivalent to 1/10,000 of one percent).

Passive diffusion: Sampling technique which utilizes unaugmented simple diffusion to measure contaminants or obtain readings.

PEL (Permissible exposure limit): OSHA specified limits for exposure by unprotected workers to toxic contaminants listed in 29 CFR 1910.1000.

Photoionization: Process by which ultraviolet light is used to provide the energy necessary for ionization of an atom or molecule.

Relative humidity: The ratio of the amount of water vapor in the air at a specific temperature to the maximum amount that the air could hold at that temperature, expressed as a percentage.

Relative response: The ratio of the response of a sensor to a contaminant other than the one used to calibrate the detector.

Short term exposure limit (STEL): Maximum concentration of a toxic substance to which an unprotected worker may be exposed calculated as a 15 minute time weighted average.

Silicone: Any of a group of semi-inorganic polymers based on the structural unit R2SiO, where R is an organic group. Silicones are characterized by thermal stability, extreme water repellence, physiological inertness, and have excellent lubricant properties. They are widely used in adhesives, lubricants, protective coatings, paints, electrical insulation, synthetic rubber, and medical products.

Sintered: Material manufactured or treated so as to be capable of admitting the passage of gas or liquid through pores or interstices.

Sorbent: Material which takes up or absorbs another.

Specificity: Degree to which a sensor is specific to the detection of a particular contaminant. The higher the specificity the less the sensor is likely to be responsive to hazards other than the one it is designed to measure.

Substance specific: Sensor in which the response is limited to a single or "narrow" range of contaminants.

Tetra-ethyl-lead (C2H5)4Pb: "Anti-knock" additive found in "leaded" gasoline.

Thermal conductivity sensor: Type of "Wheatstone Bridge" sensor in which the air conditioning effect of combustible gas on the active bead is used to detect combustible gas in the 0 - 100% by volume range.

Threshold limit value (TLV): Recommendation provided by the American Conference of Governmental Hygienists (ACGIH) and National Institute of Occupational Safety and Health (NIOSH) as a guideline for the control of potential health hazards in the workplace.

Time weighted average (TWA): The TWA limit is the maximum average concentration to which an unprotected worker may be exposed over an eight hour working day. The TWA is computed as a simple arithmetic average of worker exposure projected over an eight hour day. Time weighted averages permit excursions above the TWA limit only as long as they: (1) Do not exceed the STEL or ceiling limit and (2) Excursions above the TWA must be compensated by equivalent excursions below the limit.

Toxic atmosphere: Any atmosphere in which the concentration of gases, dusts, mists or vapors exceeds the permissible exposure limit (PEL).

Upper explosive limit (UEL): The maximum concentration of a combustible gas in air which will ignite if a source of ignition is present. Used interchangeably with the term "upper flammability limit" (UFL).

Upper flammability limit (UFL): The maximum concentration of a combustible gas in air which will ignite if a source of ignition is present. Used interchangeably with the term "upper explosive limit" (UEL).

Vapor density: Measure of a vapor's weight compared to air. (Gases and vapors which are lighter than air tend to rise while those that are heavier than air tend to sink.)

Vapor: The gaseous state of a substance which is a liquid or solid at room temperature.

Vaporization: Process by which a substance produces a vapor.

Volatile Organic Contaminants (VOC): Organic (carbon based) contaminants present in the atmosphere in the form of gases or vapors.

Volt: Unit of electrical measurement equal to the difference of electric potential between two points on a conducting wire carrying a constant current of one ampere when the power dissipated between the points is one watt.

Voltage: Electromotive force or potential difference, usually expressed in volts.

Wave-number: Frequency of light expressed as "reciprocal centimeters". (The wave-number is simply the number of waves per centimeter and is equal to the reciprocal of the wavelength of the light in centimeters.)

Wavelength: The distance between one peak or crest of a wave of light, heat, or other electromagnetic energy and the next corresponding peak or crest.

Wheatstone Bridge: Electrical circuit used in "hot bead" detectors to measure the presence of combustible gas as a change in resistance to electrical flow through the circuit.