GENERAL STANDARD

FOR

INSTRUMENTS OF FIRE-FIGHTING

AND

DETECTION EQUIPMENT

CONTENTS :

PAGE No.

1. SCOPE

The purpose of an automatic fire detection system is to detect fire at the earliest practicable moment and to give an alarm so that appropriate action can be taken.

This Standard covers the minimum requirements for selection and installation of components in an automatic fire detection system to be used in Iranian Petroleum Industry.

2. REFERENCES

Throughout this Standard the following standards and codes are referred to :

IPS (IRANIAN PETROLEUM STANDARDS)

IPS-E-IN-260 "Indicating Lights, Alarms and Protective Systems"

BSI (BRITISH STANDARDS INSTITUTION)

BS 5445 : "Components of Automatic Fire Detection System"

Part 1 : "Introduction"

Part 2 : "Control and Indicating Equipment"

Part 3 : "Fire Alarm Devices"

Part 4 : "Heat Sensitive Detectors-Point Detectors Containing a Static Element"

Part 5 : "Heat Sensitive Detectors-Rate of Rise Point Detectors Without a Static Element"

Part 6 : "Specification for Point-Type Smoke Detectors using Scattered Light, Transmitted Light or Ionization"

Part 7 : "Specification for High Temperature Heat Detectors"

Part 8 : "Methods of Test of Sensitivity to Fire"

BS 5446 : "Components of Automatic Fire Alarm Systems for Residential Premises"

Part 1 : "Specification for Self-Contained Smoke Alarms and Point-Type Smoke Detectors"

BS 5839 : "Fire Detection and Alarm System for Buildings"

Part 1 : "Code of Practice for System Design, Installation and Servicing"

Part 2 : "Specification for Manual Call Points"

Part 3 : "Specification for Automatic Release Mechanisms for Certain Fire Protection Equipment"

Part 4 : "Specification for Control and Indicating Equipment"

Part 5 : "Specification for Optical Beam Smoke Detectors"

NFPA (NATIONAL FIRE PROTECTION ASSOCIATION)

72 D : "Proprietary Protection Signaling System"
72 E : "Automatic Fire Detection"

UL (UNDER-WATER LABORATORIES)

300 A "Outline of Investigation for Testing of Extinguishers"

3. UNITS

This Standard is based on International System of Units (SI), except where otherwise specified.

4. DEFINITIONS AND TERMINOLOGY

4.1 Fire Detectors

Fire detectors are those parts of an automatic fire detection system which continuously monitors suitable physical and/or chemical phenomena for detection of fires in the area under surveillance. (Fig. 1 Item A).

4.1.1 Heat detector

A detector which responds to an increase in temperature.

4.1.2 Smoke detector

A detector sensitive to particulate products of combustion and/or pyrolysis suspended in the atmosphere (aerosols).

4.1.2.1 Ionization smoke detector

A detector sensitive to combustion products capable of affecting ionization currents within the detector.

4.1.2.2 Optical smoke detector

A detector sensitive to combustion products capable of affecting the absorption or scattering of radiation in the infrared, visible and/or ultraviolet region of the electromagnetic spectrum.

4.1.3 Flame detector

A detector which responds to the radiation emitted by the flames from a fire.

4.1.4 Static detector

A detector which initiates an alarm when the magnitude of the measured phenomena exceed a certain value, for a sufficient time.

4.1.5 Differential detector

A detector which initiates an alarm when the differences (normally small) in the magnitudes of the measured phenomenon at two or more places exceeds a certain value, for a sufficient time.

4.1.6 Rate of rise detector

A detector which initiates an alarm when the rate of change of the measured phenomenon with time exceeds a certain value, for a sufficient time.

4.1.7 Point detector

A detector which responds to the phenomenon detected in the vicinity of a fixed point sensor.

4.1.8 Multi-Point detector

A detector which responds to the phenomenon detected in the vicinity of a number of fixed point sensors.

4.1.9 Line detector

A detector which responds to the phenomenon detected in the vicinity of a continuous line.

4.1.10 Resettable detector

A detector which after response may be restored from its alarm state to its normal state on cessation of the conditions which caused the response, without the renewal of any component. Various types are self-resetting detector, remotely resettable detector and locally resettable detector.

4.1.11 Non-Resettable detector

A detector which, after response, requires the renewal of a component or components to restore to its normal state.

4.1.12 Detachable detector

A detector which is so designed as to permit it to be easily removed from its normal operating position for maintenance and servicing purposes.

4.2 Control and Indicating Equipment

The power required by detectors shall be supplied through control and indicating equipment. This item is used to accept the fire alarm signal of the connected detectors, to indicate these alarms audibly and visibly and to indicate the location of the danger (Fig. 1 Item B). If required, it should be able to pass on the fire alarm signal through fire alarm routing equipment (E) to the fire fighting organization or, through the control for automatic fire protection equipment (G), to an automatic CO_2 extinguishing equipment. It can be used to monitor the correct functioning of the system and give audible and visible warning of any faults e.g. short circuit, line breakage or fault in power supply.

4.3 Fire Alarm Devices

Equipment which is used to give a warning of fire e.g. sounder or visual indicator. (Fig. 1, Item C).

4.4 Auxiliary Equipment

In an automatic fire detection system there are equipment and connection elements which may sometimes be used as part of the system as follows:

4.4.1 Manual call point

A device for manual initiation of an alarm (Fig. 1, Item D).

4.4.2 Fire alarm routing equipment

Intermediate equipment which routes an alarm signal from (B) to a fire alarm receiving station (F), (Fig. 1, Item E).

4.4.3 Automatic fire protection equipment

Fire control of fire fighting equipment, e.g. extinguishing installation (Fig. 1, Item H).

4.4.4 Control for automatic fire protection equipment

An automatic device used to actuate the fire fighting system (H) after receiving a signal from (B) (Fig. 1, Item G).

4.4.5 Event logger

A suitable logger or recorder to record all necessary events occurred in an automatic fire detection system.

4.4.6 Power supply

The power for B and all auxiliary equipment shall be supplied from this unit (Fig. 1, Item L). This unit may include multiple power supplies (e.g. electricity from mains and standby power sources).

5. ZONES

A zone is a subdivision of protected premises such that the occurrence of a fire within it will be indicated by a fire alarm system separately from an indication of fire in any other subdivision. A zone will usually consist of an area protected by several manual call points and/or detectors, and is separately indicated to assist in location of the fire, evacuation of the building and fire fighting.

5.1 General Consideration

5.1.1 When a signal of fire is given it shall be necessary that there should be no confusion about the zone from which it is received.

5.1.2 The floor area of a single zone shall not exceed 2000 m² unless otherwise specified.

5.1.3 In general the signals used in different zones in the same premises should be the same.

5.1.4 Each zone should be readily accessible from the point(s) where the indication of the location of fire is provided. In general, access to any zone should be by normal circulation routes.

5.2 Recommendation for Size and Number of Zones

5.2.1 The floor area of a single zone shall not exceed 2000 m², unless otherwise specified.

5.2.2 The search distance, i.e. the distance that has to be traveled by a searcher inside the zone in order to determine visually the position of the fire, shall not exceed 30 m.

5.2.3 If the total floor area is 300 m² or less, then it may be considered as a single zone even though there may be more than one storey.

5.2.4 If the total floor area is greater than 300 m², then all zones should be restricted to a single storey, except that:

a) If the total floor area of a fire compartment is 300 m² or less, and any communication with other fire compartments is only at the lowest level of the building, then the fire compartment may be considered as a single zone even though there may be more than one storey within it;

b) if detectors or call points are fitted in stairwells, lift wells and etc., extending beyond the one floor but within one fire compartment, then the volume of the well should be considered as one or more separate zone.

6. FIRE DETECTORS PROJECT ENGINEERING GUIDES

Fire detectors shall be designed to detect one or more of three characteristics of a fire: smoke, heat and radiation (flame). No one type of detector is the most suitable for all applications and the final choice should be depend on individual circumstances. It should often be useful to employ a mixture of different types of detectors.

6.1 Recommended Types and Design Considerations

6.1.1 Heat detectors

They shall be selected from two types of heat-sensitive detector one is the point type of detector responding to the temperature of the gases in the immediate vicinity of a single point. The other is the 'line' type of detector which responds to the temperature of the gases in the vicinity of a line (not necessarily straight). Line detectors can be integrating or non-integrating: in the integrating type the response to temperature at one point on the line is modified by the temperature of the remainder of the line, while in the non integrating type the response to temperature at one point is independent of temperature at other points on the line. In both main types there shall be two main subdivisions:

a) Fixed temperature (static) elements:

They shall be disigned to operate when they reach a pre-selected threshold temperature.

b) Rate-of-rise of temperature element:

They shall be designed to operate when their temperature rises abnormally quickly.

Heat detectors shall always have fixed temperature elements, and may additionally contain rate-of-rise element.

Heat detectors not containing fixed temperature elements shall not be used because they are unlikely to respond to slow growing fires.

6.1.2 Smoke detectors

6.1.2.1 They shall be selected from two main types of smoke detectors which are commonly used.

a) Ionization chamber smoke detectors

These are based on the fact that the electric current flowing between electrodes in an ionization chamber is reduced when smoke particles enter the chamber.

b) Optical smoke detectors

These detectors operate by detecting scattering or absorption of light by smoke particles.

6.1.2.2 Beam type smoke detectors operate on the optical obscuration principle. If line detection is the requirement beam type smoke detectors shall be used.

6.1.3 Flame detectors

Flame detectors detect ultraviolet and/or infra-red radiation. Both types use radiation-sensitive cells that 'see' the fire either directly or through built-in lenses or reflectors.

Infra-red flame detectors are intended to respond to the flickering radiation emitted by the diffusion type of flame normally found in fires. Because of the presence of other infra-red sources, such as the sunlightning, infra-red flame detectors shall have some method of discriminating between fire and non fire radiation.

Ultraviolet flame detectors detect the ultraviolet radiation emitted from flames, and normally operate in the range of wavelengths from 200 nm to 270 nm. Solar radiation in this range is absorbed by the high altitude ozone layer, and hence ultraviolet detectors do not normally respond to sunlight.

6.2 Selection Guides of Fire Detectors

6.2.1 General

In any automatic fire detection system a detector has to discriminate between a fire and the normal environment existing within the building. The system chosen should have detectors that are suited to the conditions and that provide the earliest reliable warning. Each type of detector responds at a different rate to different kinds of fire. With slowly smoldering fire such as the initial stages of a fire involving cardboard, a smoke detector would probably operate first. A fire that evolves heat rapidly and with very little smoke could operate a heat detector before a smoke detector. With a flammable liquid fire a flame detector could operate first. In general, smoke detectors give appreciably faster responses than heat detectors, but may be more vulnerable in giving false alarm.

A combination of various types of detectors may be necessary. The likely fire behavior of the contents of each part of the buildings or plants, the process taking place or planned and the design of the plant should be considered. The susceptibility of the contents to heat, smoke and water damage should also be considered. Heat and smoke detectors rely on transport of the products from the fire to the detector by convection. In general, these detectors relay on the presence of a ceiling (or other similar facility near-horizontal surface) to direct the products outwards from the fire to the detector. Heat and smoke detectors which are therefore suitable for use in most buildings, are generally unsuitable for open-air applications.

Flame detectors are particularly suited to outside applications, where there is no ceiling to direct the products outwards, they are especially suited to applications in which smoldering is unlikely (such as in liquid fuels). Flame detectors in buildings should mainly be used to supplement heat and smoke detectors, particularly under high ceilings and provided that an unobstructed view is possible.

6.2.2 Choice of heat detectors

Heat detectors are, in general, less sensitive than smoke detectors. They are unlikely to respond to smoldering fires, and will require the flames from the fire to reach about one-third of the distance to the ceiling before they will operate. They are therefore not suitable for the protection of places where unacceptable losses could be caused by small fires, e.g. in computer rooms. Before final selection of detectors type, an estimate should be made of the extent of the damage likely to occure before operation of a heat detector. Heat detector with rate-of-rise elements should be used where ambient temperature are low or vary only slowly. Fixed temperature detectors should be used where the ambient temperature is likely to fluctuate rapidly over short periods.

6.2.3 Choice of smoke detectors

6.2.3.1 Ionization chamber smoke detectors should be used to detect smoke containing small particles such as those produced in rapidly burning flaming fires. They are less sensitive to the larger particles found in optically dense smoke which may be produced by smoldering materials.

6.2.3.2 Optical smoke detectors should be used to detect smoke with larger, optically active, particles found in optically dense smoke. They are less sensitive to the small particles found in clean-burning fires.

6.2.3.3 Both types of smoke detectors have a sufficiently wide range of applications for the general fire detection purposes.

6.2.3.4 Certain materials when overheated (e.g. PVC) or when smoldering (e.g. polyurethane foam) produce smokes having mainly large particles to which ionization chamber smoke detectors should not be applied.

6.2.3.5 Smoke detectors can not detect the products from clean burning liquids (such as alcohol) which do not produce smoke particles. This is not usually a serious disadvantage because a fire will normally involve other combustible materials at an early stage. Clean burning fires can be detected by their resulting thermal turbulence, so optical beam smoke detectors incorporating thermal turbulence detection are particularly suitable for such risks. Smoke detectors incorporating thermal turbulence detectors may be unsuitable for installation immediately above blower heaters or industrial processes that produce appreciable waste heat.

6.2.4 Choice of flame detectors

6.2.4.1 Because of their inability to detect smoldering fires, flame detectors should be used in specialized applications or as a supplement to heat or smoke detectors, and not be considered as general purpose detectors. Because flame detectors do not depend on the convective transport of fire products to the detectors, but on the virtually instantaneous and straight-line transmission of flame radiation, flame detectors can respond to a flaming fire more quickly than can heat or smoke detectors, and do not need to be mounted on a ceiling.

6.2.4.2 They are particularly suitable for use in applications such as the general surveillance of large open areas in warehouses or timber yards, or the local surveillance of critical areas where flaming fire may spread very rapidly, e.g. at pumps, valves or pipework containing flammable liquids, or areas of thin vertical combustibles such as paneling or oil paintings.

6.2.4.3 For flame detectors to work with maximum efficiency, they should have a clear line-of-sight to the area being protected.

6.2.4.4 If there is a chance that the fire may have an initial smoldering phase, then infra-red detectors should be used, since may ultraviolet radiation could be absorbed by the smoke before it reaches the detector.

7. CONTROL EQUIPMENT DESIGN CRITERIA

7.1 General

Control and indicating equipment should comprise equipment for the reception, indication, control and relaying of signals originating from detectors or call points connected to it, and for the activation of alarm sounders and alarm signaling devices.

7.2 Functional Requirement

7.2.1 Alarm condition

7.2.1.1 When a fire state is detected, the control unit shall activate the following:

a) Outputs to external circuits for the energization of fire alarm devices (e.g. sounders) external to the control and indicating equipment, so arranged that a single open circuit or short circuit at any point on the external wiring will not prevent the fire alarm devices from operating.

b) A visible indication of the fire alarm.

c) A separate and continuous visible indication for each zone in which a detector or manual has operated.

d) Operation of other functions specified by the user, such as initiation of signals to fire protection equipment.

7.2.1.2 Switches shall be provided to silence the alarm condition responses in (a). The alarm condition responses specified in (a) shall continue until silenced by the manual operation of either the appropriate silencing switch or the reset switch. They shall not be automatically silenced. It is recommended that the reset switch is not operated until the source of the alarm is identified. While the alarm devices are silenced an audible signal shall be given at the control and indicating equipment, until the fire alarm system is reset. This audible signal, which may be the same as the fault warning, shall give a sound different and distinctive from any fire alarm sounder. This signal shall sound for a minimum of 0.5 Sec. at least once every 15 Sec.

7.2.1.3 The fire alarm responses specified in items (b), (c), (d) of 7.2.1.1, once given, and the audible signal indicating that the alarms have been silenced, shall all persist until the system is manually reset.

7.2.2 Fault warning condition

7.2.2.1 Fault warnings shall be given by at least the following:

a) An audible warning from a sounder situated at the control and indicating equipment and preferably within it. The sound level shall not be less than 50 dB(A) at every point less than 1m from the control equipment enclosure.

b) A visible indication on the indicating equipment.

c) A visible indication of the zone or location concerned in the event of faults such as short circuit or disconnection of the leads to one or more detectors and/or call points, and removal of any detector.

d) A signal for transmission to a remote manned centre where provision for such a link is made.

7.2.2.2 The fault warning condition responses shall be given within 100 Sec. of the occurrence of any one of the following:

a) Short-circuit or disconnection of the connection to any normal power supply, standby power supply and battery charging equipment associated with the giving of an alarm of fire.

b) Short-circuit or disconnection of the leads to one or more detectors and/or call points if the fault would disable one or more detectors and/or call points.

c) Removal of any detector or call point of the plug-in type or disconnection from its transmitter or power supply.

d) Short-circuit or disconnection of any leads to fire alarm devices (sounders) external to control and indicating equipment.

e) Cessation of any scanning or interrogating process within the control equipment.

f) Rupture of any fuse or operation of any protective device such as to prevent a fire alarm being given.

g) Failure of a processor to correctly excute its software.

h) Detection of any error in memory checking procedure.

7.2.2.3 The audible warning specified in item (a) of 7.2.2.1 shall be distinctive and of different character from any fire alarm sounder. This signal shall sound for a minimum of 0.5 S at least every 5 Sec.

7.2.2.4 If provision is made for manually silencing the fault sounder, the removal of the fault shall automatically reset the audible fault warning circuit or shall cause the audible fault warning to re-sound until this circuit is reset manually. The occurrence of a fault in a different zone, or a different fault in the same zone, while the sounder is silenced, shall cause the sounder to sound again.

7.3 Construction Requirement

7.3.1 The control and indicating equipment shall be housed in an enclosure providing a degree of protection of at least IP 31. To prevent dust deposition inside the equipment, the top of the enclosure shall be imperforated except for cable entries which shall be provided with dustproof seals.

7.3.2 All manual controls shall be robust, positive in operation and so designed and positioned as to restrict the likelihood of accidental operation. All manual controls shall be clearly labeled to indicate their function.

7.3.3 The colors of visual indicators shall be as follows:

a) Fire alarm indicators and other indicators shown only during a fire condition shall be red.
b) Indicators of fault shall be yellow.
c) The indicator of energization shall be green.
d) Indicators of other functions within the fire alarm system shall not be red or green.

7.3.4 Indications shall be given either by steady lights or by flashing lights. Where flashing lights are used, the 'on' and 'off' periods shall each be not less than 0.25 S.

The rates of flashing shall be as follows:

a) For indicators of fire, not less than 1.0 Hz;
b) For indicators of fault, not less than 0.2 Hz.

7.3.5 Components of good and acceptable quality shall be used and the Manufacturer of the equipment shall certify that all components are suitable for their purpose and are operated within their ratings.

7.4 Electrical Requirement

7.4.1 The control and indicating equipment shall derive its power from a normally continous and reliable source. A standby power supply consisting of a secondary battery with automatic charging unit shall also provided to be available in the event of failure of main power supply. The main and standby power supplies shall each be capable of supplying the maximum load under normal, fault and fire conditions.

7.4.2 An appropriate means of automatic charging shall be provided for any standby battery. The system for recharging the standby battery shall be capable of recharging the battery to 85% of its rated capacity in 24 hours.

7.4.3 Transitions between the main and standby supplies and vice versa shall not cause any change in any indications, warnings or outputs being given by the control and indicating equipment, other than those relating to the power supplies.

8. INSTALLATION OF FIRE DETECTORS

8.1 General

8.1.1 Where subject to mechanical damage, detectors shall be protected.

8.1.2 Detectors shall be supported independently of their attachment to the circuit conductors.

8.1.3 In the case of solid joist construction, detectors shall be mounted at the bottom of the joist.

8.2 Installation of Heat Detectors

8.2.1 Spot-type heat detectors shall be located upon the ceiling not less than 15 centimeters from the side wall, or on the side walls between 15 centimeters and 30 centimeters from the ceiling (Fig. 2).

8.2.2 Line type heat detectors shall be located upon the ceilings or on the side walls not more than 50 centimeter from the ceiling.

8.3 Installation of Smoke Detectors

8.3.1 Spot-type detectors shall be located on the ceiling not less than 150 mm from a sidewall, or if on the sidewall, between 150 to 300 mm from the ceiling.

8.3.2 Line-type smoke detectors shall be located on the ceiling or on the sidewalls not more than 500 mm from the ceiling.

8.3.3 On smooth ceilings, with no forced air flow, spacing of 9 meter may be used as a guide. In all cases the Manufacturer's recommendations shall be followed.

8.3.4 For slope ceilings, a row of detectors shall first be spaced and located within 90 cm of the peak measured horizontally. The number and spacing of additional detectors, if any, shall be based on the horizontal projection of the ceiling (Fig. 3).

8.3.5 For proper protection for buildings with high ceilings, detectors shall be installed alternately at two levels, one half at ceiling level, and the other half at least 1 meter bellow the ceiling (Fig. 4).

8.4 Installation of Flame Detectors

8.4.1 Flame detectors shall be so designed and installed that their field of vision will be sufficient to assure detection of specified area of fire.

8.4.2 Where conveyance of materials on chutes or belts, or in ducts or tubes, or otherwise, to or past a detector is involved, spacing considerations will not govern, but strategic placement of detectors is required to assure adequate detection.

8.4.3 Where necessary, detectors shall be shielded or otherwise arranged to prevent action from unwanted radiant energy.

9. COMBUSTIBLE GAS DETECTORS

9.1 General

Combustible gas detectors should be used whenever there is the possibility of a hazard to life or property caused by the accumulation of combustible gas-air mixture. The apparatus should be used to monitor a gas atmosphere bellow the lower explosive limit, in circumstances where accumulation of gas may concentrate the gas/air mixture to potentially explosive concentrations. The apparatus should be also used to monitor a gas atmosphere above the upper explosive limit, in circumstances where the ingress of air may dilute the gas/air mixture to potentially explosive concentrations.

9.2 Types of Combustible Gas Detectors

9.2.1 Catalytic sensors

The principle of operation depends upon the oxidation of flammable gas at the surface of an electrically heated catalytic element. The oxidation causes the temperature of the sensing element to change as a function of the concentration of gas so detected.

9.2.2 Thermal conductivity sensors

The principle of operation depends upon the heat losses by conduction of an electrically heated resistance element located in a gas sample stream of fixed velocity. The resulting change of electrical resistance is compared with that of a similar sensing element located in a reference cell, both electrical elements forming part of an electrical bridge or other measuring circuit.

This type of sensor shall be used for detection of specified single gases of relatively high thermal conductivity with respect to air, e.g., hydrogen, methane, etc. at concentration above the LEL.

9.2.3 Infra-red sensors

The principle of operation depends upon the absorption of a beam of infra-red radiation by the gas being detected. The absorption of infra-red radiation by gas is detected by photoelectric means and produces an electrical signal to provide indications of gas concentrations and alarms. Infra-red sensors may be used for the detection of specified combustible gases in a specified range of concentrations up to 100% gas.

9.2.4 Semiconductor sensors

The principle of operation depends upon changes of electrical conductance that occure by chemisorption when the heated semiconductor sensing element is exposed to gas. The changes of conduction are then determined in an appropriate electrical circuit and the apparatus is calibrated in any suitable range to provide indications of gas concentrations and alarms. This type of sensor is normally only used for the detection of a specified gas in a nominated range of concentrations.

9.3 Selection of Apparatus

9.3.1 The gas apparatus should be sensitive to each of the gases that it is required to detect and should also be suitable for the range of concentrations of the gases that will be encountered. Where a range of gases is likely to be present in an area to be monitored, it is recommended that a detector be selected that has been calibrated to the gas in that range to which it is least sensitive. However care should be taken to ensure that the sensors so calibrated will remain adequately sensitive to the other gases likely to be present. If this is not practicable, then an alternative approach is to select separate sensors, calibrated to the different gases likely to be present.

9.3.2 Fixed gas detection apparatus may be designed to produce any or all of the following:

a) indication of gas concentration;
b) audible and/or visual alarms;
c) electrical outputs to initiate actions such as process shutdown and automatic fire fighting procedures.

9.4 Installation

9.4.1 A fixed gas detection system should be so installed that it is capable of monitoring every part of a plant or other premises where combustible gases may accidentally accumulate. The system should be capable of giving an early warning of both the presence and the location of an accidental accumulation of combustible gases, in order to initiate one or more of the following actions, either automatically or under manual control:

a) safe evacuation of premises;
b) appropriate fire fighting procedure;
c) shutdown of process or plant;
d) ventilation control.

9.4.2 Sensors should be located in positions determined by those who have knowledge of gas dispersion, the process plant systems and equipment involved and safety engineering. A combination of following approaches to the location of remote sensors should be used:

a) source detection, in which the sensors are located immediately adjacent to the likely sources of hazard;

b) perimeter detection, in which the sensors are located to surround the whole area of plant from which the hazard may arise.

A combination of source and perimeter detection should be used for large outdoor sites (petrochemical plants) and source detection alone should be used for small enclosed sites.

9.4.3 The detection of lighter-than air gases or vapours, such as methane, and the detection of heavier-than air gases or vapours, such as octane, require that the detection apparatus should be located at appropriate levels relative to the potential sources of gas leakage. In the former case the detectors should be located above the potential source of gas leakage, while in the latter case they should be located bellow the source of gas leakage.

9.4.4 Few environmental problems occur in case of indoor installation of gas detectors. Care should be taken to protect sensors located immediately above ovens or boilers from drought and excessive ambient temperatures, in such environments detection errors, reduced life of detectors may result. The provision of correct ventilation and precautions for such plant should therefore not be neglected.

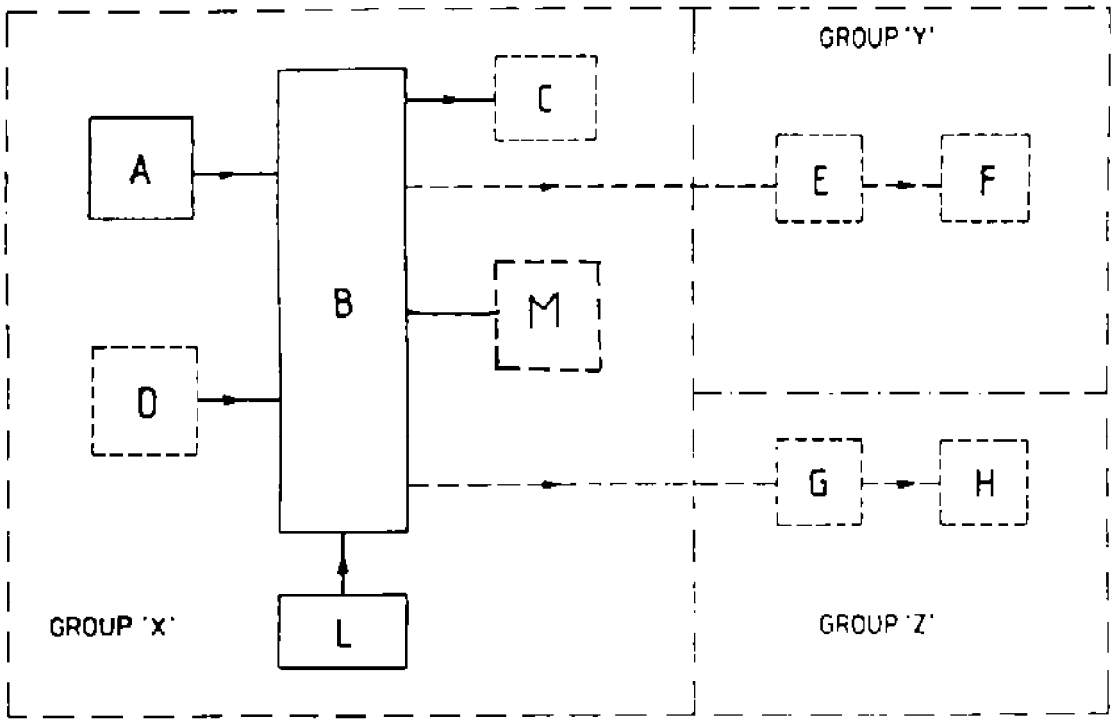
9.4.5 In outdoor installations, the environmental conditions may be very severe. For example, high winds may cause drift of the zero reading and even apparent transient loss of sensitivity during calibration due to dilution of the calibration gas being detected. Therefore adequate weather protection enclosures should be provided for the sensors. Steam, driving rain, snow, ice and dust may adversely affect the detection apparatus to an extent that either the gas cannot pass through the part of detector which is called the sintered flashback arrestor or the function of the sensor is degraded through moisture penetrating the sensor chamber.

9.4.6 In the case of machine mounted systems, care should be taken to ensure that the sensor has been designed to withstand vibration or that suitable vibration isolation is provided.

Key to Figure 1

Because of the various duties they are called upon to perform, it is convenient to divide the equipment shown in Fig. 1 into three functional groups. These groups, which have no relationship to the location of the component parts, are designated 'X', 'Y' and 'Z' in Fig. 1.

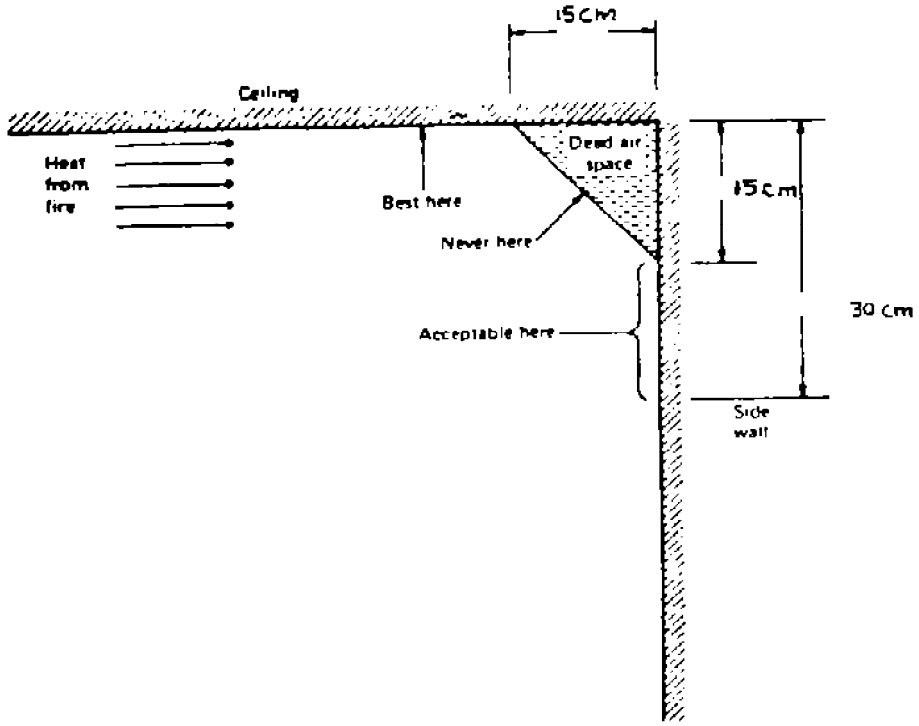
A) Fire detector
B) Detector control and indicating equipment
C) Fire alarm device
D) Manual call point
E) Fire alarm routing equipment
F) Fire alarm receiving station
G) Control for automatic fire protection equipment
H) Automatic fire protection equipment
L) Power supply
M) Event logger



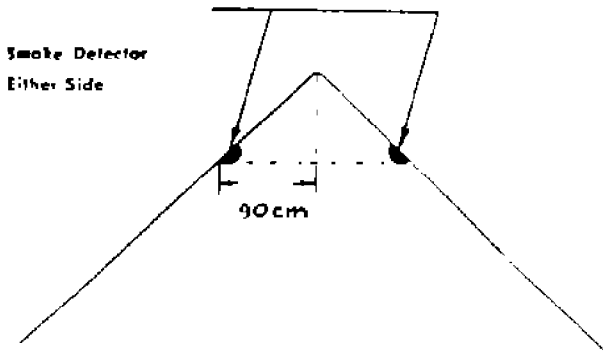
__ Equipment and connection elements which will always be present in an automatic fire detection system.

--- Equipment and connection elements which may sometimes be present in an automatic fire detection system.

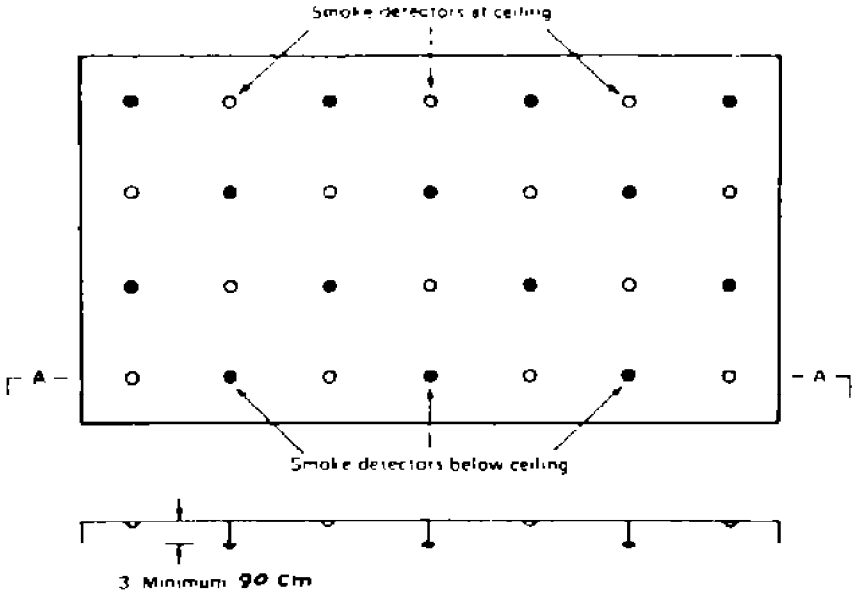
AUTOMATIC FIRE DETECTION SYSTEMS
Fig. 1



SPOT-TYPE HEAT DETECTORS-LOCATION IN CORNER AREAS
Fig. 2



SLOPE CEILING
Fig. 3



HIGH CEILING AREA SECTION A-A
Fig. 4