

# FIRE RAY®

## Optical Beam Smoke Detectors



## Optical Beam Smoke Detection Guide

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## Introduction to this Guide

The aim of this guide is to offer information on the proper use of Infrared (IR) / Optical Beam Smoke Detectors to protect lives, equipment and property.

This guide summarises the design requirements, the principles of operations and practical applications for their incorporation as a component of an automatic fire detection and alarm system.

For specific applications, Optical Beam Smoke Detectors can be important links in a well-engineered automatic fire alarm system. Thanks to their own capabilities, Optical Beam Smoke Detectors can overcome the problems and limitations of point-type smoke detectors.

Fire Fighting Enterprises Limited has created this guide as an aid to fire protection engineers, mechanical and electrical engineers, fire service personnel, fire detection and alarm designers and installers to gain a full understanding of the Optical Beam Smoke Detector's capabilities, and how they differ from point-type smoke detectors.

Everyone who has responsibility for specifying, designing, installing, commissioning and maintaining systems with Optical Beam Smoke Detectors will find this guide both informative and educational; it is intended as a guide to good practice but does not aim to be an exhaustive guide to fire standards and codes.

### Disclaimer:

Compliance to National Codes of Practice or any other applicable design standards remain the responsibility of the FFE customer and their system designer. Although Fire Fighting Enterprises Ltd. Engineers may provide assistance to achieve a satisfactory beam installation during Technical Support, the customer will remain responsible for installing, commissioning and maintaining the system.

## Glossary of Terms

**Analogue Addressable Optical Beam Smoke Detector:** A device which, in addition to providing alarm and fault indications to a control unit, communicates a unique identification (address) in order to show which device has been activated.

**Automatic Fire Alarm System:** A system of controls, initiating devices and alarm signals in which some or all of the initiating circuits are activated by automatic devices such as Optical Beam Smoke Detectors.

**Automatic Gain Control (AGC):** The ability of an Optical Beam Smoke Detector to compensate for light signal degradation due to dust or dirt and/or building movement.

The rate of compensation is limited to ensure that the detector is still sensitive to slow, smouldering fires.

**False Alarms:** An unwanted alarm generated by a cause(s) other than fire.

**Fire:** A chemical reaction between oxygen and a combustible material where rapid oxidation results in the release of heat, light, flame and/or smoke.

**Listed / Approved:** The inclusion of a device in a list published by a recognised testing organisation, indicating that the device has been successfully tested to meet the applicable standards.

**Obscuration (Cumulative Obscuration):** The reduction of the ability of light to travel from one point to another due to the presence of solids, liquids, gases, or aerosols. CUMULATIVE OBSCURATION is a combination of the density of these light-blocking particles per metre and the linear distance, which these particles occupy, i.e., smoke density times the linear distance of the smoke field; it is usually expressed in % / m.

**Optical Beam Smoke Detector (OBSD):** A device that monitors the amount of light transmitted between a light source and a photosensitive receiver. When smoke particles enter the light beam path, some of the light is scattered and some absorbed, thereby reducing the light reaching the Receiver. If this obscuration exceeds a set value, the Optical Beam Smoke Detector responds and communicates its status to a Fire Panel.

**Optical Beam Smoke Detector Coverage:** The area that an Optical Beam Smoke Detector is considered to effectively sense smoke. This area is limited by applicable standards and national codes.

**Reflector (Prism):** The device that returns the light back to the Transceiver unit. A Reflector may utilise prism(s) so that the reflected beam path is along the transmitted path.

**Sensitivity:** The ability of an Optical Beam Smoke Detector to respond to a given level/threshold of smoke obscuration.

**Smoke:** The gaseous and solid airborne results of combustion.

**Smoke Colour:** The relative lightness or darkness of smoke, ranging from invisible to white to grey to black.

**Point-Type Smoke Detector:** A ceiling mounted device that senses smoke at a radius from its particular location. Point-type detectors have a defined range of coverage.

**Stratification:** An effect that occurs when the air containing smoke particles is heated by smouldering or burning material and, becoming less dense than the surrounding cooler air, rises until it reaches a level at which there is no longer a difference in temperature between it and the surrounding air. Stratification can also be caused by forced ventilation.

**Transmitter (Tx)/Receiver (Rx)/Control Unit:** The Transmitter projects a modulated infrared light beam over an area to a Receiver (directly or via a Reflector). The Receiver forwards the signal to a Control Unit for analysis (this can be a separate or integrated unit depending on the detector type). The Control Unit informs the Fire Panel on the status of the equipment.

**Transceiver (TR):** A unit combining the Transmitter and the Receiver is called a Transceiver.

**Transparencies (Filters):** A panel of plastic having a known level of Obscuration, which can be used to test the proper sensitivity of an Optical Beam Smoke Detector.

**Fault Condition:** The status of a device or system that impairs its proper operation, i.e. open circuit on an initiation loop. The notification of a fault condition indicated on a control panel or annunciator is a "FAULT" SIGNAL



## I. What is an Optical Beam Smoke Detector?

### I.1 Definition

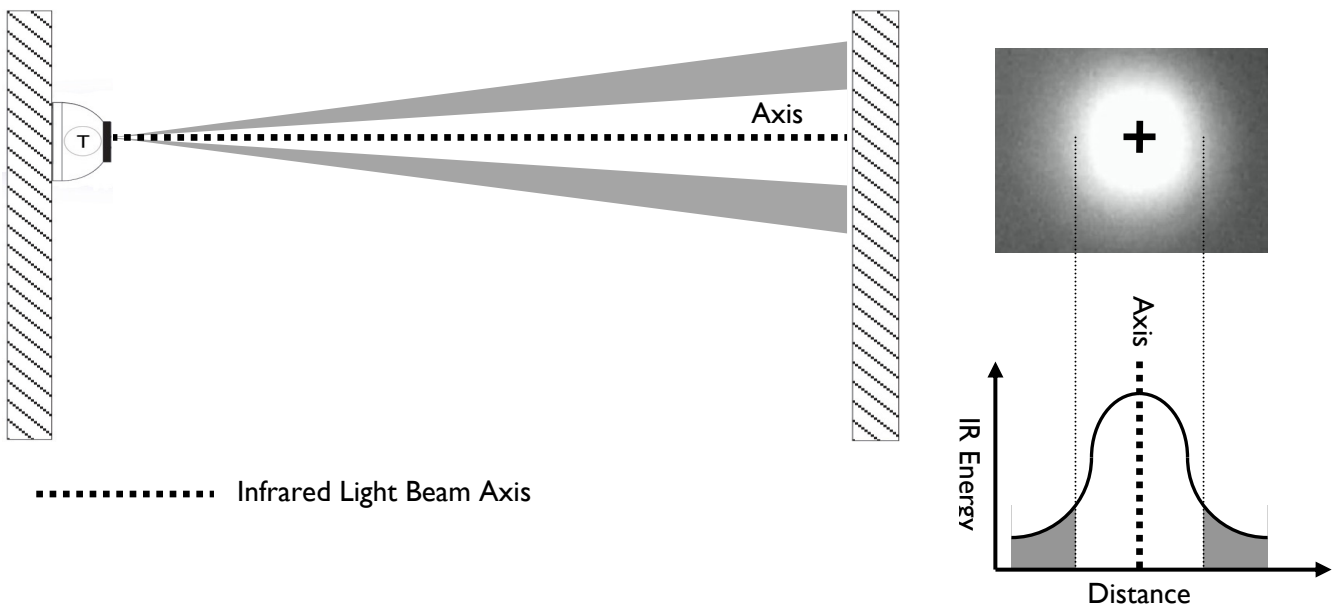
An Optical Beam Smoke Detector (OBSD) comprises a Transmitter (Tx), a Receiver (Rx) and a Control Unit:

The **Transmitter** is an infrared light source that generates and projects a modulated infrared (invisible) light beam over an area to the Receiver.

The **Receiver** is a photosensitive sensor that forwards the signal to a Control Unit;

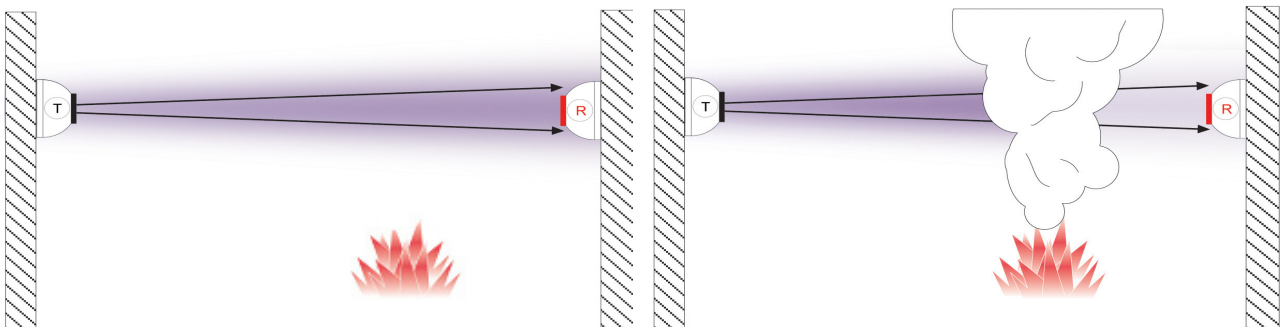
The **Control Unit**, which can be a separate or integrated unit (depending on the type of Optical Beam Smoke Detector) analyses the signal information and communicates with the Fire Panel on the status of the Optical Beam Smoke Detector.

### I.2 Beam Profile



The transmitted beam of Infrared is a cone of light where the intensity or energy of IR light reduces as a function of distance from the axis, as shown on the graph.

### 1.3 Operation Principles



The Optical Beam Smoke Detector (OBSD) works on the principle of light obscuration. The photosensitive element of the OBSD detects IR light produced by the Transmitter in a normal condition. The Receiver is calibrated to a preset sensitivity level based on a percentage of total obscuration.

Unlike point-type optical smoke detectors, OBSDs are generally less sensitive to the colour of smoke. Therefore, an Optical Beam Smoke Detector may be well suited to applications that are unsuitable for point-type optical detectors, such as applications where the anticipated fire would produce black smoke. OBSDs do require visible smoke and therefore may not be as sensitive as ionisation detectors in some applications.

When the IR beam is obscured by smoke the received signal drops accordingly. This obscuration could be in a concentrated plume of smoke or in a more diluted yet wider plume, both being within the protected space and presenting the same level of obscuration.

Note: condensation can be considered as an obscuration phenomenon.

Since the sudden and total obscuration of the light beam is not a typical smoke signature, the OBSD will see this as a fault condition, not an alarm. This threshold is typically set by the manufacturer. This minimizes the possibility of an unwanted alarm due to the blockage of the beam by a solid object, such as a display sign or a ladder, being inadvertently placed in the beam path.

Very small, slow changes in the obscuration of the light source are also not typical of a smoke signature. These changes may occur because of environmental conditions such as dust or dirt accumulation on the OBSD's optical assemblies or on the reflector surface. Small, slow changes may also occur due to building movement.

Changes caused by environmental conditions are typically compensated for by an automatic gain control (AGC). When the OBSD is first turned on and put through its set-up program, it assumes the light signal level at that time as a reference point for a normal condition.

As the quality of the light signal degrades over time, the AGC can compensate for this change. The rate of compensation is limited to ensure that the OBSD will maintain its set sensitivity and



will also still be sensitive to smouldering or slow burning fires.

When the AGC can no longer compensate for the loss of signal (as with an excessive accumulation of dust or dirt or building movement) the Optical Beam Smoke Detector

will signal a fault condition, so that maintenance can take place.

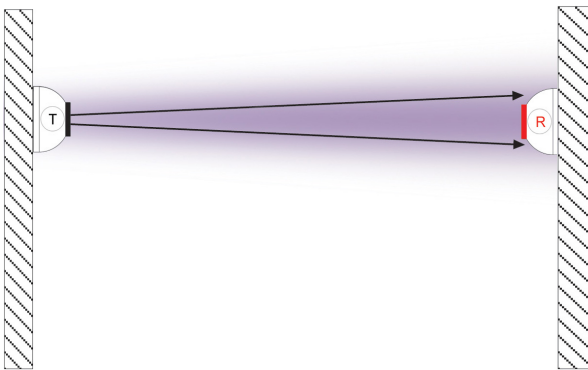
With a motorised Optical Beam Smoke Detector, it will automatically realign itself to ensure optimum alignment following building movement.

## 1.4 Optical Beam Smoke Detector Types

There are two main types of Optical Beam Smoke Detectors:

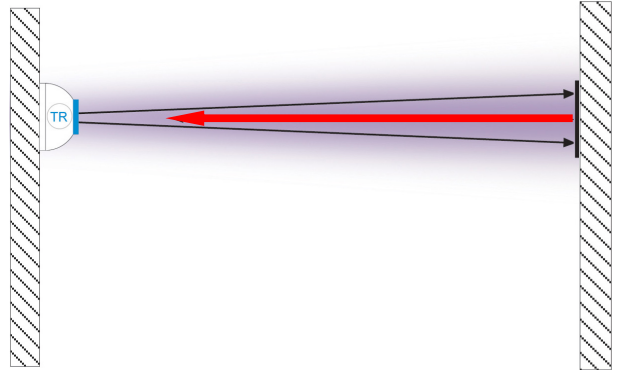
### 1.4.1 End to End

The Transmitter (Tx) and the Receiver (Rx) are installed at each end of the area to be protected, up to 120 metres apart. The Receiver is electrically connected to a Control Unit, the latter being installed at the ground level.



### 1.4.2 Reflected

The Transmitter (Tx) and the Receiver (Rx) are contained within one unit: the Transceiver (TR). The transmitted infrared light beam is reflected back by a reflector (prism) mounted directly opposite this unit, up to 100 metres away. The Receiver is connected to a Control Unit that can be either integrated into the Transceiver or installed at low level.



### 1.4.3 Application of End to End and Reflected Optical Beam Smoke Detectors

The type of Optical Beam Smoke Detector used will be dictated by the installation and environment conditions and constraints.

**End to End Optical Beam Smoke Detectors** are less susceptible to stray reflections as reflections go back to the Transmitter. As a result, End to End Optical Beam Smoke Detectors can operate within narrower gaps in the line of sight.

In addition, End to End Optical Beam Smoke Detector Transmitter and Receiver units are generally compact and easily adopted into “aesthetic” architectural designs.

**Reflected Optical Beam Smoke Detectors** use less wiring for reduced installation costs (power and wiring are only required at the Transceiver end) and only requires the Transceiver to be aligned. However the Reflected Optical Beam Smoke Detector can be vulnerable to stray reflections close to the IR beam path.

As the Reflector has a wide acceptance angle, it does not need to be aligned as accurately as both ends of an End to End Optical Beam Smoke Detector.

### 1.4.4 Motorised Optical Beam Smoke Detector Technology

The latest technology in Optical Beam Smoke Detectors has incorporated a motor which allows for automated alignment.

In conjunction with a System Controller installed at low level, the user can control and steer the motorised detector heads from the keypad without the need to perform the commissioning and maintenance at height.

Software algorithms assist with this auto-alignment as well as building movement compensation.



## 2 Where is an Optical Beam Smoke Detector Used?

### 2.1. Traditional Applications

Optical Beam Smoke Detectors are used to provide “open area” smoke detection. They are typically used in situations where it is either impractical, inappropriate or not cost effective (installation, wiring and maintenance) to use traditional point-type detectors or aspirating smoke detection. They also enable coverage of a large area, at minimal cost.

OBSDs are also suited for situations that include high ceilings, with dusty and dirty environments.

OBSDs are not suitable for outdoor applications primarily due to environmental conditions eg rain, fog, mist, nor indoor applications where a risk of condensation exists, as these are seen as obscuration phenomena.

Some examples of common applications:

- Warehouses
- Atriums
- Conference / Exhibition Centres
- Shopping Malls
- Historic Buildings
- Churches / Mosques
- Museums
- Manufacturing Plants
- Airports
- Hangars
- Stables
- Sport / Leisure Centres

### 2.2. Special Applications

An Optical Beam Smoke Detector that is enclosed in a flameproof housing and is ATEX certified is suitable for use in potentially Hazardous Areas:

- Zone I Environments
- Refineries
- Mills
- Munitions Factories and Stores
- Flammable Liquid Stores
- Flammable Gas Stores
- Flammable Powder Stores
- Industrial Plants and Warehouses
- Power Stations

### 3 Specify an Optical Beam Smoke Detector

#### 3.1. Standards

The following guidelines are provided to give a general summary of common situations where Optical Beam Smoke Detectors are used.

There are many recognised National and International standards and Codes of Practice. Please refer to your local authority for further guidance. For the purposes of this Guide we have used BS5839-1.

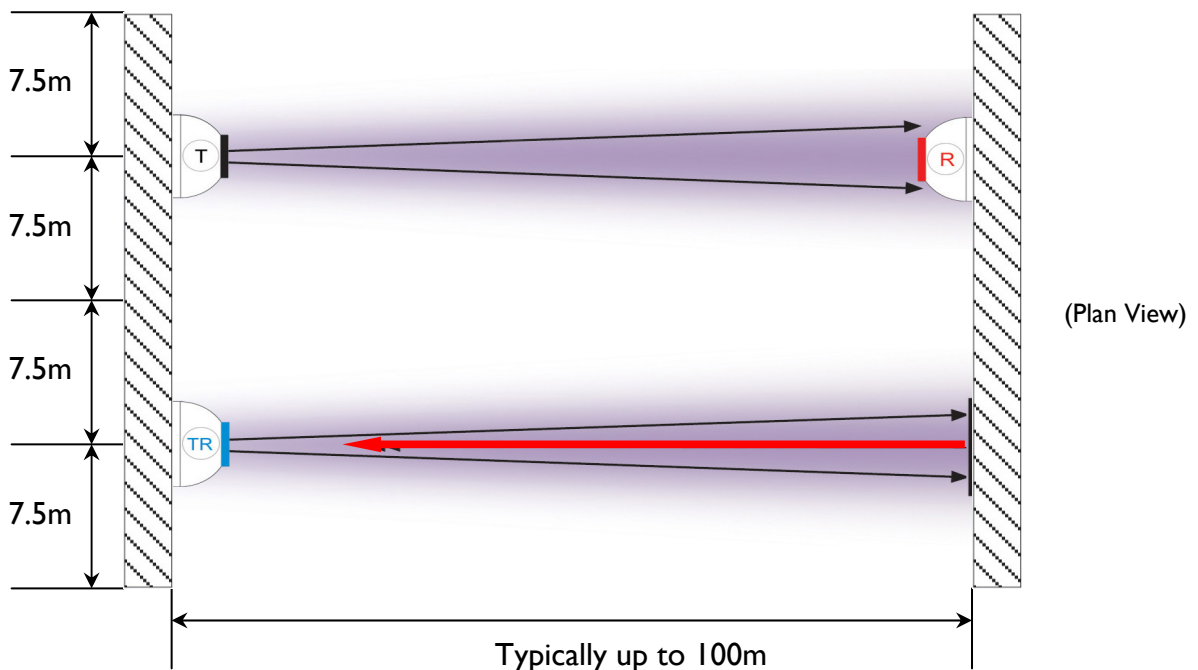
#### 3.2. Coverage / Ceiling Height

Optical Beam Smoke Detectors generally have an operating range of up to 100 metres.

*Note:* End to End Optical Beam Smoke Detectors can be offered with an extended range up to 120 metres

However, the optical concept means that the infrared light beam doesn't suddenly drop at 100 metres, but carries on, fading away progressively. With the Reflected OBSD, the infrared light beam actually travels up to 100 metres and back the same distance.

The recommended width of detection either side of the infrared light beam axis is 7.5 metres for satisfactory detection under flat ceilings (see section 3.3 Location, Spacing and Positioning for distances to be considered in some general applications).



**Hence an Optical Beam Smoke Detector can protect a wide area up to: 1,500 m<sup>2</sup>**

Optical Beam Smoke Detectors are ideally suited for high ceiling applications, where their infrared light beam path is less likely to be obstructed.

### **3.3. Location, Spacing and Positioning**

It is important that the Optical Beam Smoke Detector is positioned correctly. The time to signal a fire condition depends on the location of the OBSD within the premises, the volume and density of smoke produced, construction of the roof, ventilation arrangements and airflow within the detection area.

Experiments have shown that smoke from a fire does not rise directly upwards, but fans out as a plume due to dilution with cool air and heat layering effects.

High ceiling applications such as atria, lobbies, gymnasiums, sports arenas, museums, factories and warehouses are areas where OBSDs are not only acceptable, but are the detector of choice.

As OBSDs are mounted between 0.3 and 0.6m under the ceiling they are more likely to be below the stratification layer.

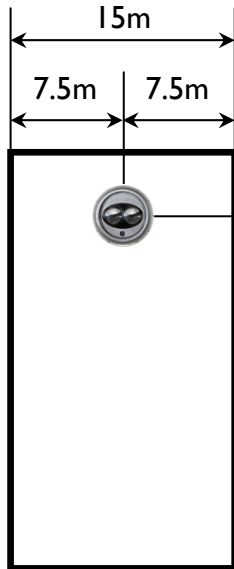
However, if there are objects below the ceiling that could obscure the beam path, the Detector Heads / Reflector positioning may need to be adjusted (this can be determined by smoke tests).

The effects of stratification are discussed in further detail in section 3.4.3. Stratification.

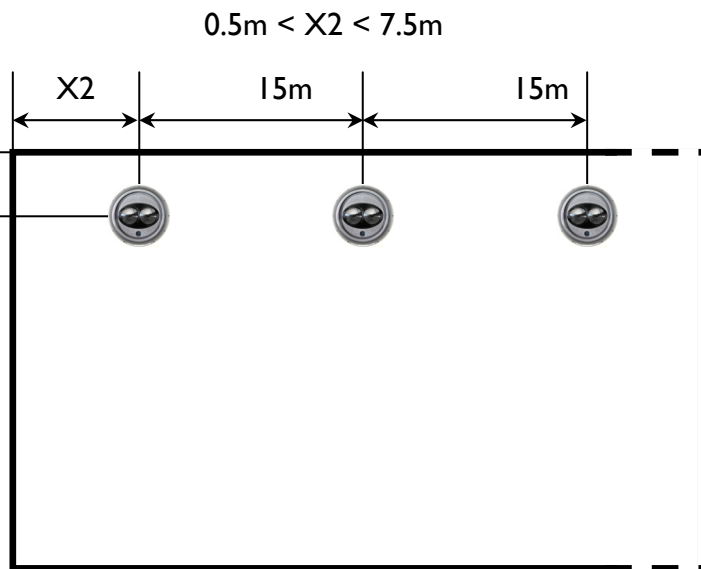
There are several models for positioning Optical Beam Smoke Detectors. The most common ones are described in subsequent pages.

### 3.3.1. Flat Ceiling

Single Optical Beam Smoke Detector:



Multiple Optical Beam Smoke Detectors:



### 3.3.2. Apex Ceiling – Pitched Type

A ceiling or roof with a slope in excess of 4.5 degrees should be regarded as an apex ceiling / roof.

When Optical Beam Smoke Detectors are mounted in an apex, the lateral coverage either side of the apex Beam can be increased in relation to the angle ( $\phi$ ) of the pitch of the roof up to 25 deg, using the following formula:

$$X = 15 + (15 \times \phi / 100) \text{ metres}$$

For example:

If the pitch angle ( $\phi$ ) is 20°, the lateral coverage can be increased from 15m either side of the infrared light beam axis to 18m, as follows:

$$X = 15 + (15 \times 20/100)$$

$$X = 15 + (3)$$

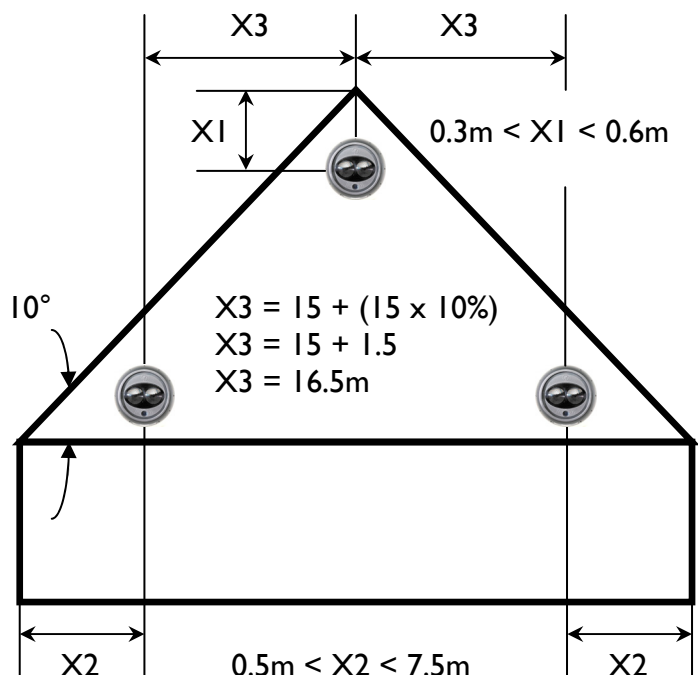
$$X = 18 \text{ metres}$$

This increase in lateral coverage only applies for OBSDs positioned at the apex. For all other OBSDs, the standard 15m spacing rule applies.

Pitch angles over 25° must use the maximum lateral coverage figure of 18.75m either side of the beam, calculated as follows:

$$X = 15 + (15 \times 25/100)$$

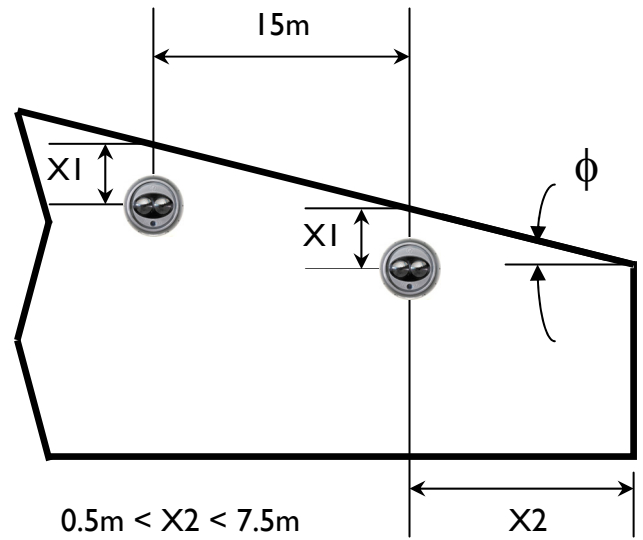
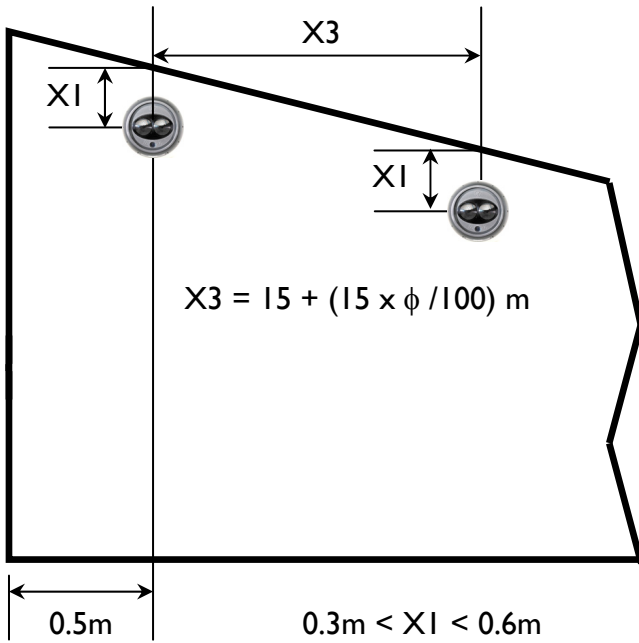
$$X = 18.75 \text{ metres}$$



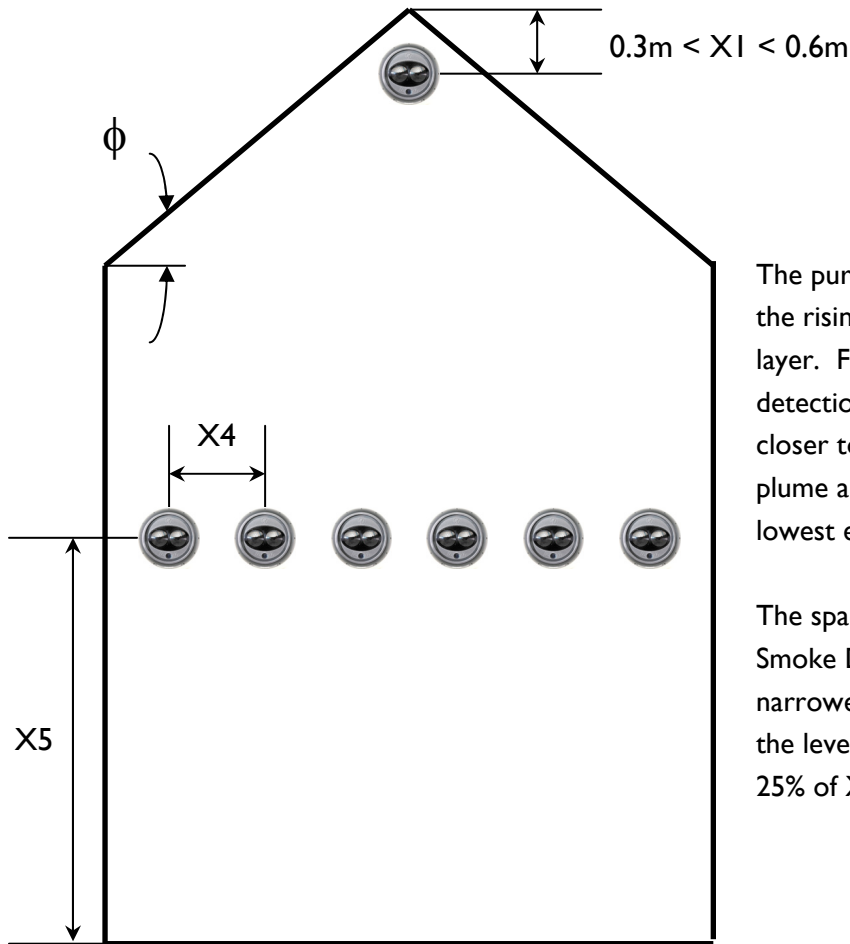


### 3.3.3. Apex Ceiling – Shed Type

A ceiling or roof with a slope in excess of 4.5 degrees ( $\phi$ ) should be regarded as an apex ceiling / roof.



### 3.3.4. Atrium



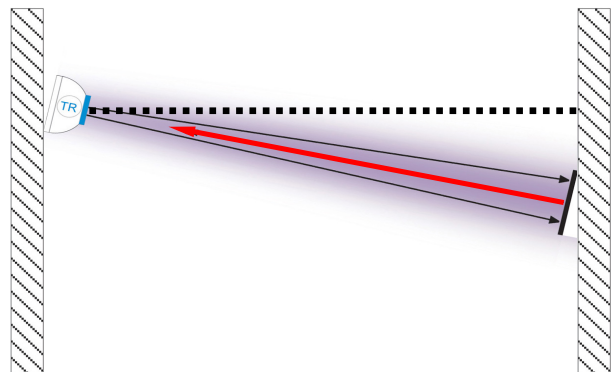
The purpose of this approach is to detect the rising plume rather than the smoke layer. For this approach, supplementary detection is used; OBSDs are mounted closer to ensure they intersect the rising plume and are installed at a level below the lowest expected stratification level.

The spacing (X4) between Optical Beam Smoke Detectors is based on the narrowest potential width of the plume at the level of detection (X5), typically X4 is 25% of X5.

If the Optical Beam Smoke Detector is to be placed in an Atrium, or near glass / polished surfaces, the Receiver / Reflector should be offset from the central line of sight, and angled back to the Transmitter.

This can be either on the vertical or on the horizontal axis, or a combination of both.

In the instance of a Reflected Optical Beam Smoke Detector, the reflected infrared light beam from the Reflector will be returned to the Receiver in the normal way.



### 3.4. Capability to Critical Environments

#### 3.4.1. High Air Velocity

High air movement does not have as great an effect on Optical Beam Smoke Detectors as other detector types. An Optical Beam Smoke Detector's sensing range can be as long as a football field (maximum beam range is typically 100m). It is therefore less likely that smoke will

be blown out of the Optical Beam Smoke Detector's sensing range. Although reduced spacing is not required in high airflow areas, attention should be given to the anticipated behaviour of smoke in these applications.

#### 3.4.2. Hostile Environment

Optical Beam Smoke Detectors are not as limited as point-type detectors to hostile environments.

In addition, flameproof Optical Beam Smoke Detectors have been designed for protection of large hazardous (with potentially explosive atmospheres) areas, such as:

- Zone I Environments
- Refineries
- Mills
- Munitions Factories and Stores
- Flammable Liquid Stores
- Flammable Gas Stores
- Flammable Powder Stores
- Industrial Plants and Warehouses
- Power Stations

This version provides an early warning of smouldering or strongly smoke-generative fires, which may not be picked up by flame detectors installed in these hazardous locations.

Flame / explosion proof Optical Beam Smoke Detectors are ATEX certified.

### 3.4.3. Stratification

Stratification occurs when smoke is heated by smouldering of burning materials and becomes less dense than surrounding cooler air.

The smoke rises until there is no longer a difference in temperature between the smoke and the surrounding air.

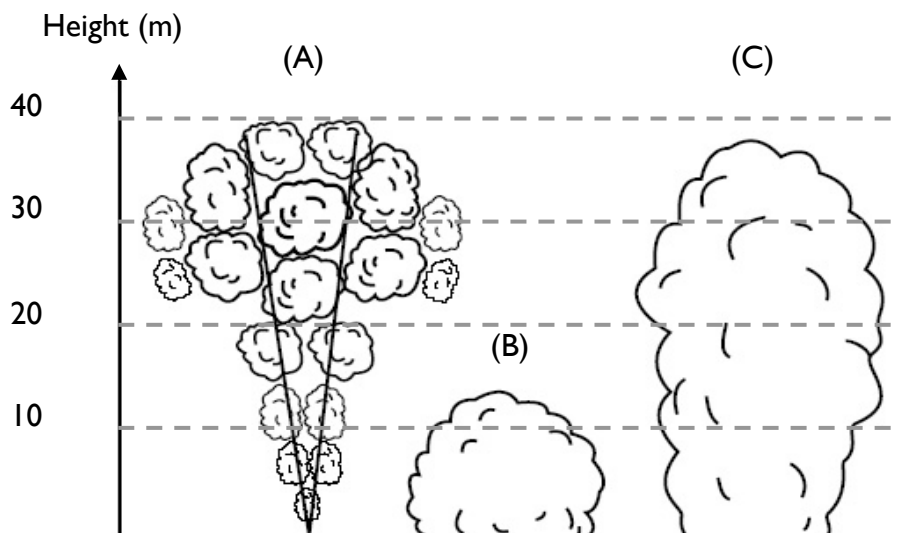
Therefore, stratification may occur in areas where the air temperature may be elevated at the ceiling level, but especially where there is a lack of ventilation.

On smooth ceilings, Optical Beam Smoke Detectors should generally be mounted between 0.3m to 0.6m from the ceiling.

In many cases, however, the location and sensitivity of the detectors shall be the result of an engineering evaluation that includes the following:

- structural features
- size and shape of the room and bays
- occupancy and uses of the area
- ceiling height and shape
- surface and obstructions
- ventilation
- ambient environment
- burning characteristics of the combustible materials present
- configuration of the contents in the area to be protected.

The results of an engineering evaluation may require an installation at a reduced height to overcome the effects of stratification or other obstructions.



(A) This plume is narrow at the ground level and expands at higher levels; it can be detected readily at these levels. (B) This fire is slow to develop; the temperature of the plume cools around 10m to 15m causing it to stratify at this level. (C) This plume develops at lower levels and doesn't cool until it reaches higher elevations. Due to the high temperature, its size is equal from floor to ceiling.

There is no sure way of identifying what condition will be present at the start of a fire. Any of the following detection schemes can provide for prompt detection regardless of the condition present at the time of fire initiation:

**Diagonal Optical Beam  
Smoke Detectors to  
Detect the Smoke Layer:**

The purpose of this approach is to quickly detect the development of a smoke layer at whatever temperature condition exists. One or more OBSDs are aimed at an upward angle to intersect the smoke layer regardless of the level of smoke stratification. When using this approach, more than one OBSD is recommended. (Under the current BS5839 this technique would require a variation)

**Horizontal Optical Beam  
Smoke Detectors to  
Detect the Smoke Layer  
at Various Levels:**

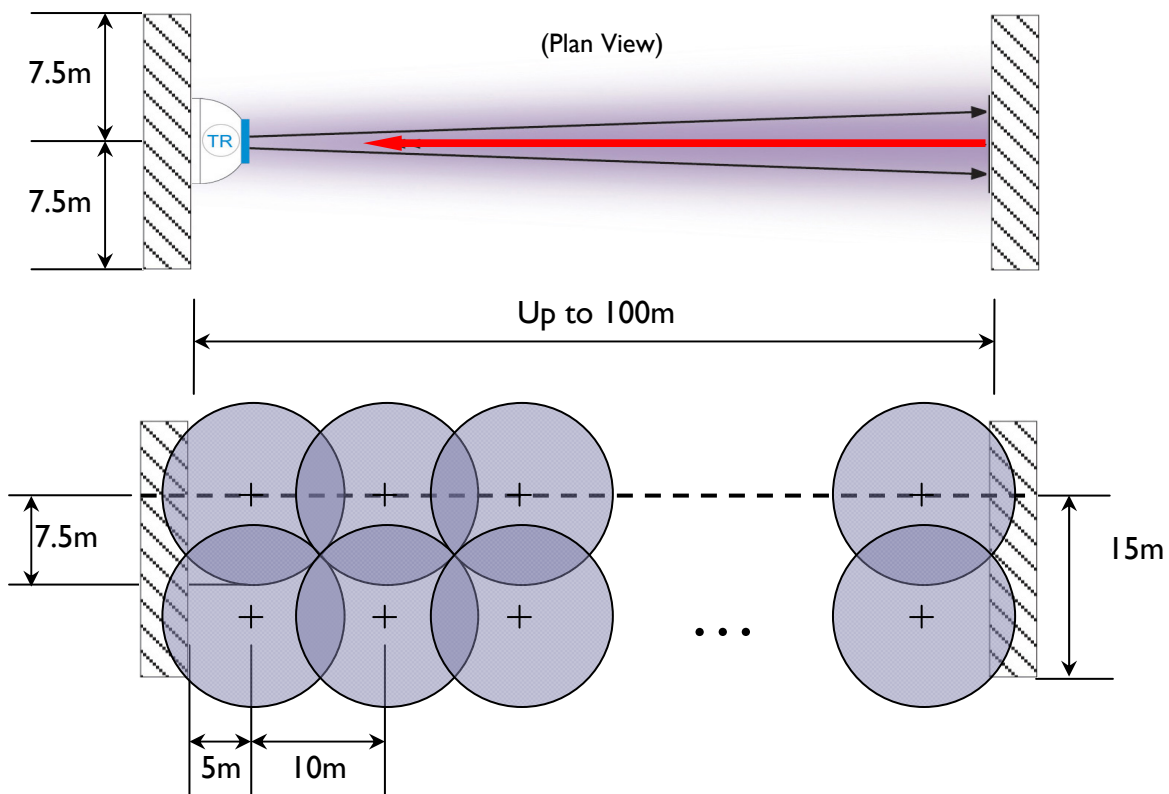
The purpose of this approach is to quickly detect the development of a smoke layer where a stratification layer exists. One or more OBSDs are located at the ceiling, in accordance with prevailing Codes of Practice. A supplementary layer of several OBSDs is located in a plane below the smoke layer. If the smoke layer level is not known, additional supplementary layers could be introduced.

**Horizontal Optical Beam  
Smoke Detectors to  
Detect the Smoke Plume:**

The purpose of this approach is to detect the rising plume rather than the smoke layer. A supplementary layer of several OBSDs is located in a plane between floor and ceiling. The spacing of the supplementary OBSDs is often dictated by prevailing Codes of Practice and is typically 25% of the height of the layer of supplementary OBSDs from the floor. One or more OBSDs must be included at ceiling level, in accordance with prevailing Codes of Practice.

### 3.5. Comparison with Point-Type Detectors

	<b>Point-Type Detector</b>	<b>Optical Beam Smoke Detector</b>
High Air Velocity:	High Air Velocity may blow smoke out of the sensing chamber, thus reducing the point-type detector's performance.	High air movement does not have as great an effect on an Optical Beam Smoke Detector. An OBSD's sensing range can be typically 120m, it is therefore less likely that smoke will be blown out of the OBSD's sensing range.
Coverage/Spacing:	Radius = 7.5m Distance between detectors = 10m Qty required to cover 1,500m <sup>2</sup> = 15 units minimum	Lateral coverage = 7.5m either side Distance between detectors = 15m Qty required to cover 1,500m <sup>2</sup> = 1 unit
Installation/Maintenance in Wide Areas:	Access to all detectors positioned across the ceiling, which require individual wiring, testing and maintenance.	Along the end walls only.



**Optical Beam and Point-Type Smoke Detectors have their own applications.  
Fewer Devices = Lower Installation and Maintenance Costs.**

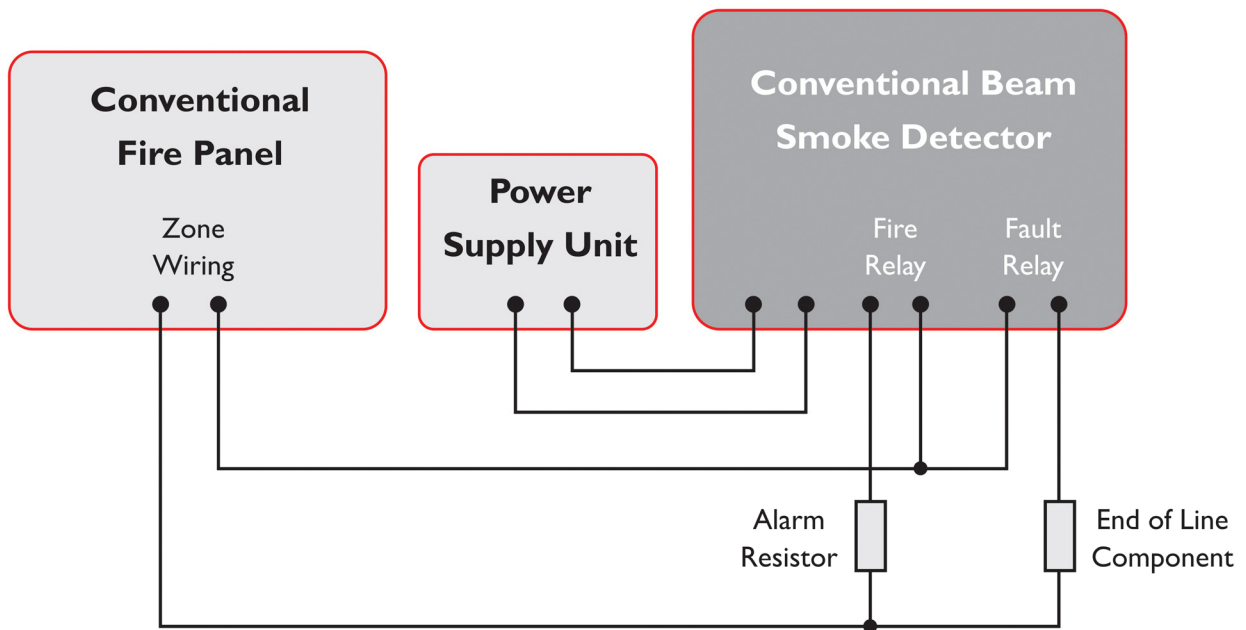


### 3.6. Interface to Fire Panels

#### 3.6.1. Conventional Optical Beam Smoke Detector

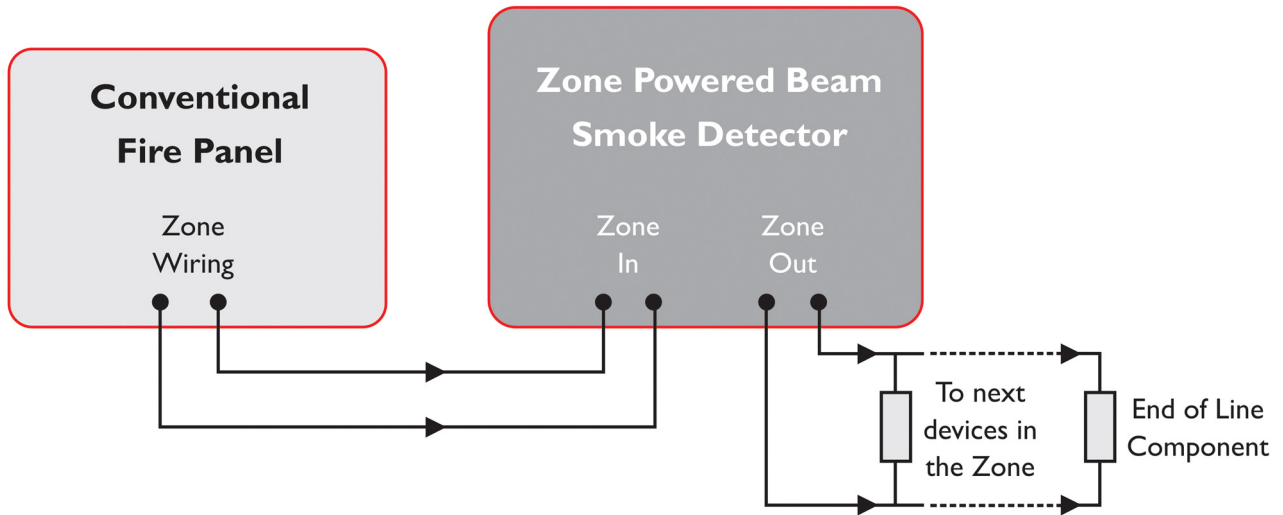
Conventional Optical Beam Smoke Detectors are very versatile; they are compatible with any conventional control panel and by using them in conjunction with a suitable interface module, they

can be added to any intelligent system irrespective of the communication protocol between the control panel and detectors.



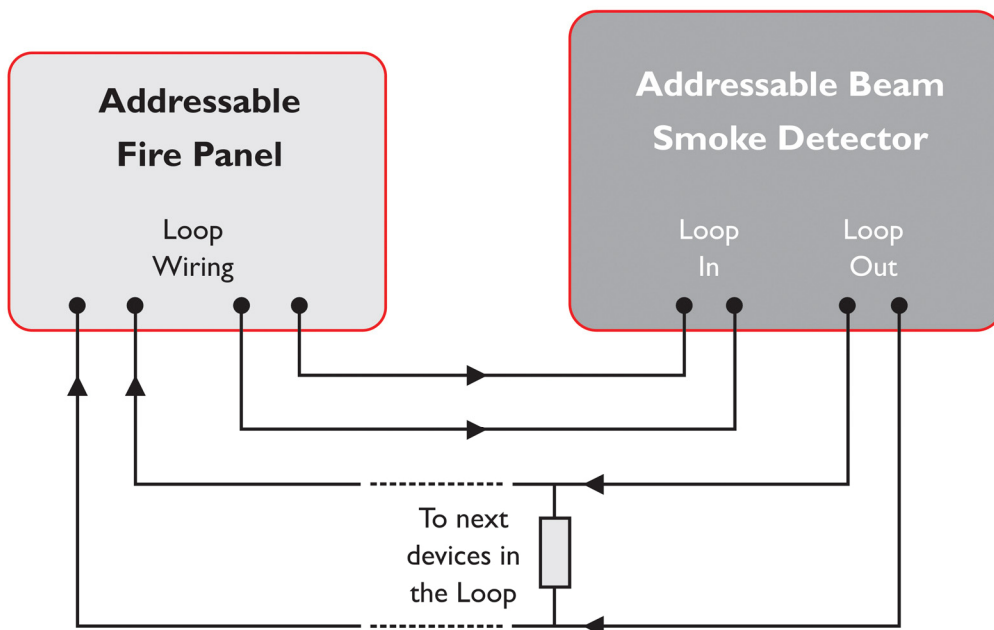
### 3.6.2. Zone Powered Optical Beam Smoke Detector

Zone Optical Beam Smoke Detectors are zone powered (lower current consumption) because they are designed to be interfaced directly onto the zone without the need for a separate power supply.



### 3.6.3. Addressable Optical Beam Smoke Detector

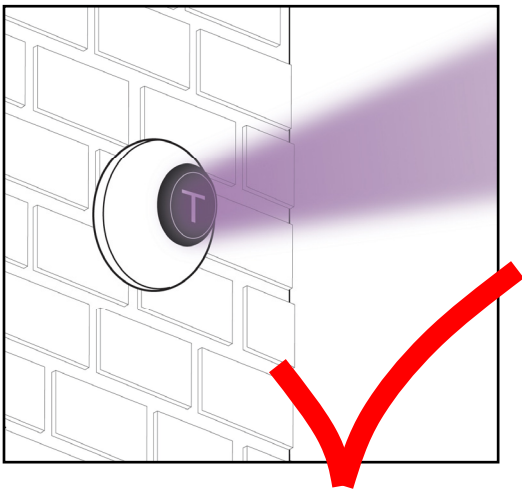
Addressable Optical Beam Smoke Detectors are loop powered and designed to be individually recognised within an intelligent system. This can be achieved either from the control panel (soft addressing) or from the device itself (hard addressing).



## 4 Install an Optical Beam Smoke Detector

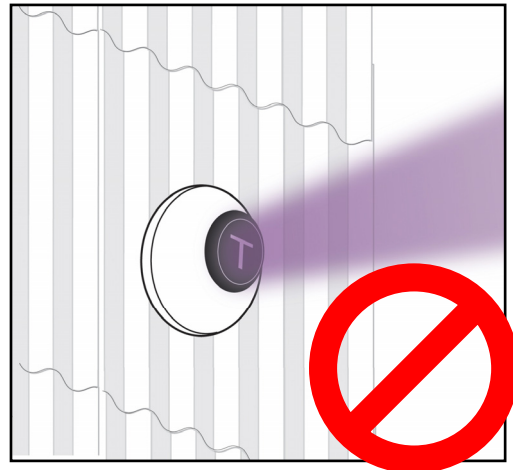
### 4.1. Structure

Optical Beam Smoke Detectors must be mounted on stable stationary surfaces for proper operation to prevent movement and subsequent misalignment. A surface that moves, shifts, vibrates, or warps over time will cause false alarm or fault conditions. Initial selection of a proper mounting surface will eliminate false alarms and nuisance fault signals.



Mount the OBSD on a stable mounting surface such as brick, concrete, a sturdy load-bearing wall, support column, structural beam or other surface that is not expected to experience vibration or movement over time.

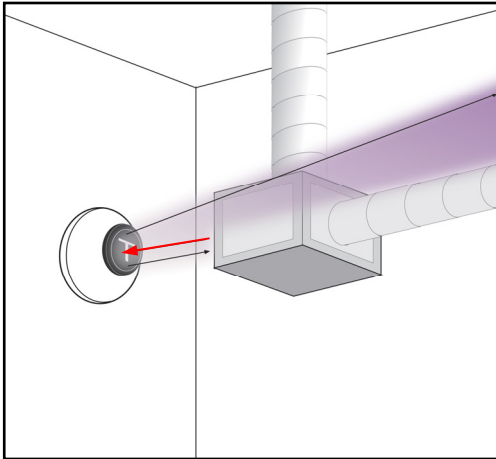
In cases where only one stable mounting surface, as defined earlier, can be used and a Reflected Optical Beam Smoke Detector has been chosen, the Transceiver should be mounted to the stable surface and the Reflector should be mounted to the less stable surface. The Reflector has a greater tolerance to unstable mounting locations as defined earlier.



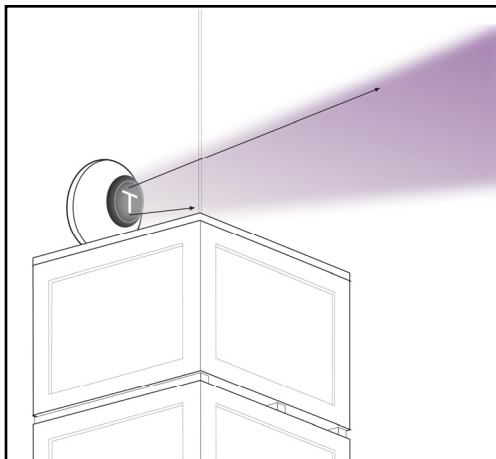
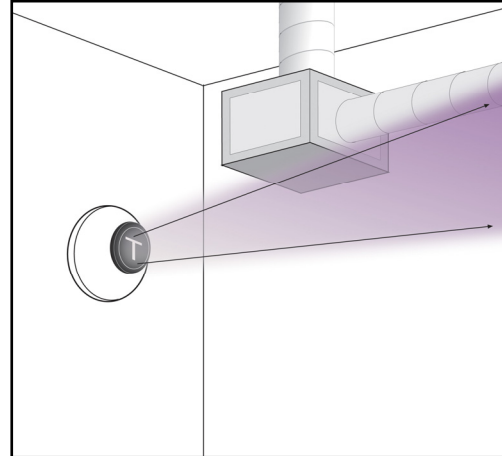
**DO NOT MOUNT** the Optical Beam Smoke Detector on corrugated metal walls, sheet metal walls, external building sheathing, external siding, suspended ceilings, steel web trusses, rafters, non-structural beam, joists or other such surfaces.

## 4.2. Reflections and Obscurations

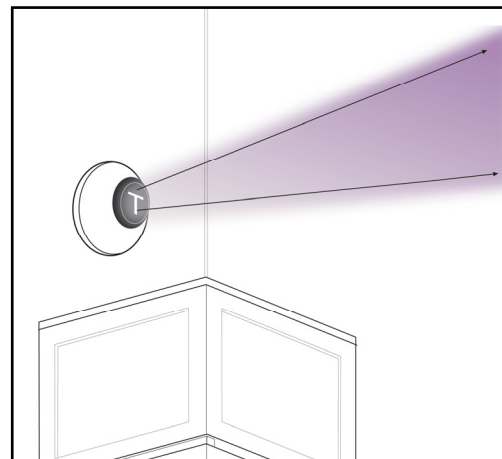
Reflective objects too near to the line of sight can reflect the infrared light beam from the Transmitter.



If this occurs, the whole area may not be protected or movement of these reflective objects can cause false alarms.



There must be a permanent clear line of sight between the Transmitter and the Receiver or Reflector.



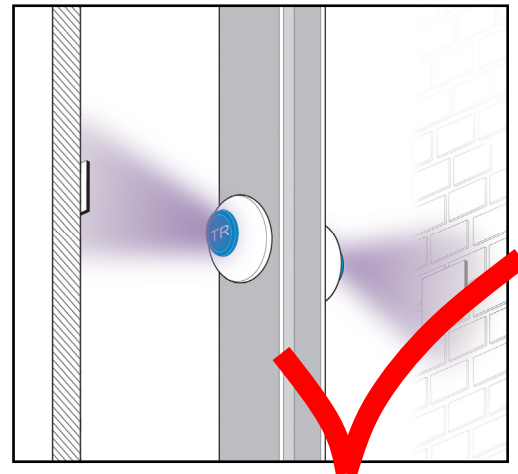
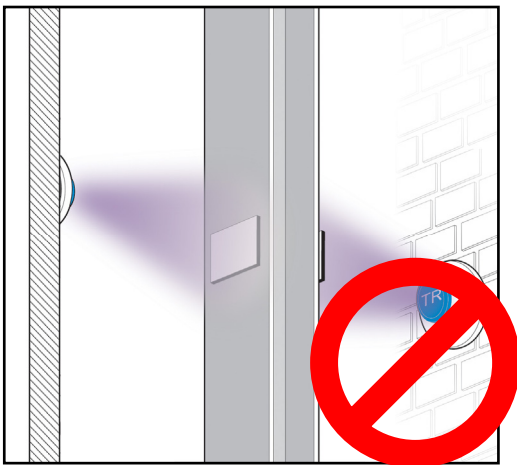
Any object in the infrared light beam path could cause a reduction in signal and ultimately may prevent the system from operating correctly.

### 4.3. Optical Cross Talk

Optical Beam Smoke Detectors should be positioned to avoid the infrared light beam from other OBSDs falling on the detector, either directly or indirectly.

If a pair of OBSDs is to be used to cover a distance greater than the manufacturer's recommendations or local regulations, then Transmitters should be positioned back to back.

Mounting Receivers or Reflectors back to back creates a high possibility for infrared light overspill.



### 4.4. Sunlight / Artificial Lights

Optical Beam Smoke Detectors are highly tolerant to ambient sunlight. They can discriminate between the IR signal from an OBSD and the IR that is naturally present in ambient sunlight, this is done by electronically filtering out the unwanted AC frequencies. However, just like the human eye, OBSDs cannot tolerate direct strong sunlight into the Receiver as that can saturate and cause fault or alarm signals.

Careful positioning of the Receiver, taking into account the direction of the sun as well as its diurnal and seasonal movements, is recommended. The Receiver could also be

mounted slightly higher than the Transmitter or Reflector, so that the Receiver is looking below the horizon. Alternatively, an End to End type OBSD is a good choice as the Transmitter can be pointed towards the sun as it will not be saturated.

Standard incandescent lamps, sodium lamps and camera photoflash sources may also contain IR, however normal fluorescent lamps may emit very little IR light.

#### 4.5. Heat Sources

Sources of high heat level can affect the line of sight between the Transmitter and the Receiver, and may have an adverse effect on the performance of the Optical Beam Smoke Detector.

#### 4.6. Sensitivity

The Optical Beam Smoke Detector's working environment (dust, humidity, etc.) as well as ceiling height are both elements to be considered

If possible, heat sources need to be placed as far as possible from the line of sight in order to avoid the potential of the heat haze distorting and attenuating the infrared light beam.

whilst selecting the sensitivity level. Sensitivity is the obscuration percentage at the moment an alarm is generated.

#### 4.7. Testing Procedures

After successful installation and alignment (see manufacturer's specific alignment procedure), the

Optical Beam Smoke Detectors will require testing for both Fire and Fault conditions.

##### 4.7.1. Fire Test

Taking into account the sensitivity threshold set during the installation, the OBSD can be smoke tested by progressively obscuring approximately half the Receiver optics (for the End to End type Optical Beam Smoke Detector) or half the Reflector (for the Reflected type) with non-reflective material.

The Transmitter optics must remain uncovered during the smoke test.

The OBSD will indicate a fire within a defined time (typically 10 seconds) by activating the fire indicator and closing the fire relay.

Once the environment is back to satisfactory levels and if the OBSD has not latched, the device will automatically return to the condition prior to the fire, within a defined time. If the OBSD is latched, the device will have to be reset manually.

##### 4.7.2. Fault Test

The Receiver optics (for the End to End type) and the Reflector (for the Reflected type) should be rapidly and completely covered. The Reflector should be covered with a non-reflective material.

The OBSD should indicate a fault condition after a defined time by activating the fault indicator.

Once the obstruction has been removed, the OBSD will automatically return to the condition prior to the fault, within a defined time.

*See manufacturer's product guide for all default, set up times and indicator characteristics on both fault and fire conditions.*



## 5 Commission an Optical Beam Smoke Detector

Once an OBSD is installed, as part of an automatic fire alarm system, it needs to be commissioned and set to normal operating mode before it can be formally handed over to the building owner.

Commissioning is a process that involves thorough testing of the system. Every OBSD (and all other devices on the system) must be activated in order to establish that the system operates correctly and is in accordance with the recommendations of the locally used standards and/or national codes.

The commissioning of an OBSD needs to encompass at least the following checks:

- Has the OBSD been installed correctly? (eg structurally and electrically)
- Is the OBSD aligned adequately? (eg no obstructions or reflections)
- Has the OBSD followed the Fault and Fire Alarm test procedure?
- Were the Fault and Fire Alarm tests logged at the Fire Panel? Have the OBSDs been properly connected to the Fire Panel?

## 6 Maintain an Optical Beam Smoke Detector

Before starting any maintenance on Optical Beam Smoke Detectors, the proper authorities need to be notified that the OBSDs will be temporarily out of service. The zone or whole system managing the OBSDs that are undergoing maintenance is disabled to prevent unwanted alarms and possible dispatch of fire services personnel.

Remember to advise these authorities when the maintenance activities have been completed and the whole system is operational again.

Optical Beam Smoke Detectors are designed to be as maintenance-free as possible. However, it is essential that routine checks (such as regular tests and scheduled service visits) and the special servicing are carried out in order for the OBSDs to remain fully operational and to function effectively in an alarm condition.

Routine checks should consist of:

- visual inspection of all devices for physical damage and any other condition that might impair proper operation
- ensuring that the installation remains mechanically (fixture) and electrically (wiring) sound
- no major changes to the environment: clear line of sight is maintained and reflections or obstructions have not been added
- Fault and Fire Alarm tests

If necessary, the lenses and / or the Reflector can be cleaned with a damp soft cloth. Washing liquid, alcohol or detergent must not be used.

Special servicing will be required under certain circumstances:

- after a fire
- if an unacceptable rate of false alarms is experienced
- when a new maintenance organisation is contracted
- following long period of disconnection

*In both circumstances, if any actions need to be undertaken, the installation and alignment criteria need to be fulfilled and the testing procedure must subsequently be carried out again.*

## 7 **FIRERAY®** Optical Beam Smoke Detectors

**FIRERAY®** range of Optical Beam Smoke Detectors is the widest in the world, offering a complete solution:

- End to End: **FIRERAY® 3000** and **FIRERAY® 2000 EExd**
- Reflected: **FIRERAY® 50R/100R**
- Reflected and Motorised: **FIRERAY® 5000**

### Approvals

**FIRERAY®** Optical Beam Smoke Detectors are being sold and installed across at least 80 countries on all continents, thus carrying an extensive range of approvals.



## **FIRERAY® Reflective Range**

### **FIRERAY® 50R/100R**



The **FIRERAY® 50R/100R** is a modern design providing economical and effective smoke detection in large open spaces. It also offers a reduction in the installation costs as the wiring is only required to the single Transceiver unit. It is available in conventional, zone powered and analogue addressable versions

The **FIRERAY® 50R/100R** combines an infrared transmitter and receiver in the same discrete unit and operates by projecting a well-defined beam to a reflective prism, which returns the beam to the receiver for analysis. Smoke in the beam path causes a drop in power, which, if below a pre-determined level, results in an alarm signal.

### **FIRERAY® 5000**



The **FIRERAY® 5000** motorised reflective, auto aligning infrared optical beam smoke detector can be installed with multiple detector heads per system, thus saving on installation time and costs. The commissioning procedure is simplified by a number of features, including laser assisted alignment, that combine to make the **FIRERAY® 5000** the quickest and easiest detector of its type to install; each detector takes under 4 minutes to auto align.

The **FIRERAY® 5000** combines an infrared transmitter and receiver in the same discrete unit and operates by projecting a well-defined beam to a reflective prism, which returns the beam to the receiver for analysis. Smoke in the beam path causes a drop in power, which, if below a pre-determined level, results in an alarm signal.

## FIRERAY® End to End Range

### FIRERAY® 3000



The **FIRERAY® 3000** is ideal for applications where line of sight for the IR (infra-red) detection path is narrow and where the building structure uses reflective surfaces. It has also been designed to be aesthetically pleasing and thus can equally suit modern architectural buildings as well as heritage sites, particularly where ornate ceilings exist.

The system comprises a modern looking Transmitter head, which emits a narrow beam of infra-red light to an associated Receiver head, with a compact Low Level Controller. Once smoke crosses through and thus obscures the IR beam path, the signal strength at the Receiver drops below a pre-set level which in turn results in an alarm condition.

### FIRERAY® Accessories

The **FIRERAY®** product range also includes an extensive range of accessories to aid the installation of the detectors to suit specific applications and the variation of standards/codes requirements.

### FIRERAY® 2000 EExd

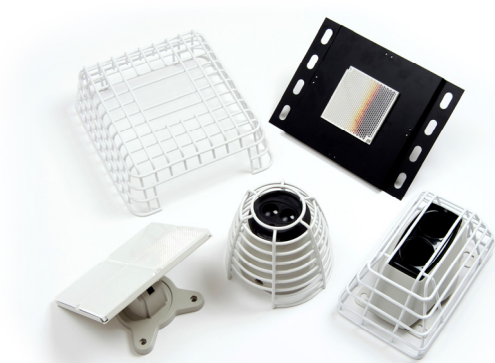


The **FIRERAY® 2000 EExd** is ideally suited for the protection of large areas, with potentially explosive atmospheres

The **FIRERAY® 2000 EExd** comprises an infrared transmitter and a separate receiver, both of which are housed in a flameproof enclosure and are ATEX certified for use in Group 2 hazardous areas. There is a separate, safe area, wall-mounted remote/low level control unit to allow adjustment and testing from a convenient non-hazardous location

This product carries the following Certification Code:

⊕ II 2 G D EEx d IIB T6  
(Tamb = -20°C to + 55°C)



## 8 **FIRERAY®** Reference List

Fire Fighting Enterprises Ltd (FFE) is the world leader in the manufacture of Optical Beam Smoke Detectors and has established an excellent reputation for the supply of fire detection products within the global fire industry.

In the past twenty-five years, more than 700,000 **FIRERAY®** Optical Beam Smoke Detectors have been produced from the manufacturing site in the UK, despatched and installed in applications across all continents and over 80 countries.

FFE offers the widest range of Optical Beam Smoke Detectors to protect lives, equipment and properties. The projects are numerous; a selection has been listed hereafter:

**UK:** Scottish Exhibition Centre, Glasgow  
West Ham Football Stadium  
London Heathrow Airport  
Gateshead Metro Centre  
Buckingham Palace  
New Tate Gallery  
Portcullis House  
Blenheim Palace  
British Museum  
The Sage

**USA:** US Capitol  
Jacksonville Arena  
MGM Grand Hotel  
Griffith Observatory  
Boston Opera House  
University of Texas, Austin  
Tropicana Resort & Casino  
Bryant St Pump - DCWASA  
White House Visitor Centre  
Chicago Bears Training Ground

**Europe:** Mercedes Benz, Rastatt factory  
2004 Athens Olympic Centres, Greece  
Westpoort Rotterdam, Netherlands  
Neuschwanstein Castle, Germany  
Sofia National Theatre, Bulgaria  
Bilbao Exhibition Centre, Spain  
Palace of Parliament, Romania  
Pushkino Warehouse, Russia  
Kaleom Salt Mine, Belarus  
Riga Airport, Latvia

### **Middle**

**East:** Dubai Airport, UAE  
Qatar Petroleum, Qatar  
Financial Centre, Bahrain  
Khafji Project, Saudi Arabia  
Saudi Aramco, Saudi Arabia  
World Trade Centre, Bahrain  
Amman Shopping Mall, Jordan  
New Doha International Airport, Qatar  
SAAD Health Science Centre, Saudi Arabia  
Abu Dhabi Pension & Retirement Fund HQ, UAE

**Asia:** Museum and Esplanade MRT Stations, Singapore  
LongTan Hydropower Station, China  
Bangkok King Power Mall, Thailand  
SPP Shipbuilding, South Korea  
FusionPolis, Singapore  
Dewan Majilis Parliament House, Brunei  
Mando - Iksan division, South Korea  
Chek Lap Kok Airport, Hong Kong  
KLIA Low Cost Terminal, Malaysia  
Festive Walk, Hong Kong

## Conclusion to this Guide

Recognising the capabilities and limitations of all types of smoke detectors is essential to the proper design of an automatic fire alarm system.

Optical Beam Smoke Detectors should be considered as the smoke detector of choice in high, open areas before selecting other types.

Optical Beam Smoke Detectors are an efficient and economical way of protecting lives, equipment and properties where:

- areas are wide
- ceilings are high
- architecture and aesthetics are important
- reduced cost of installation and servicing is important

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*All the information is given in good faith but Fire Fighting Enterprises Ltd cannot be held responsible for any errors or omissions. We are grateful to readers who notify us in the event of any need for corrections.*

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