Fire Protection Association

RISCAuthority

ACTIVE FIRE PROTECTION GUIDE
Detection Systems: Optical Beam Detection

This document has been produced by the RISCAuthority Active Suppression & Detection working group to provide information and outline guidance on the application of Optical Beam Detection (OBD) Systems.

Summary

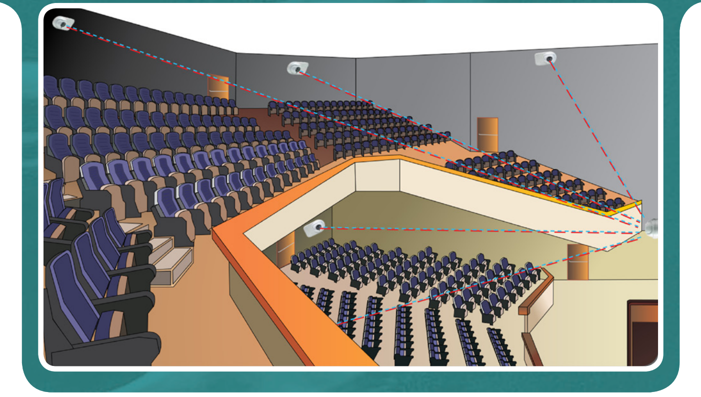
Refer to AFPG-30 Detection Series Overview.

Optical Beam Detection Systems:

- are essentially uncased versions of point detectors with a supersized infrared source and receiver.
- use a source of infrared light, projected across an area to a receiver, to monitor for smoke from a fire. The presence of smoke reduces the received signal and this is used to determine the presence of fire. They come in two basic forms: End to End, where the source and receiver are mounted at either ends of the protected space, and Reflective,where the light source and receiver is mounted in the same housing and the light path is returned from a reflector opposite.
- require the smoke to be visible but some versions may also be capable of detecting fires from clean burning (low smoke) fuels, by the detection of 'shimmer' as the refractive index of air is changed by temperature. This function is called 'thermal turbulence detection'.
- (newer forms of the technology) can overcome many of the limitations of traditional OBD systems in respect of sunlight, reflections, vibration, and 3D space coverage – Open-area Smoke Imaging Detection (OSID).
- can prove economical in the protection of large, open-plan spaces with relatively high ceilings where access for maintenance of point detectors can be problematic. They are particularly economical when sited in the apex of a roof.
- have shortcomings in high compartments where the smoke may stratify (stop rising) before reaching the ceiling. This situation may require the deployment of OBDs at multiple levels; used at an angle to the horizontal to cover the height of the protected space in addition to its area; or adoption of OSID.
- are able to span up to 100m and as such typical applications include aircraft hangars, warehouses, leisure facilities, cultural centres, shopping centres, cinemas, museums, and in muti-storey atria. They are not suitable in applications where the beam will be regularly broken by the passage of people or equipment.

Optical beam detectors are essentially uncased versions of point detectors with a supersized infrared light source and receiver that may be placed 10 to 100m apart to span a compartment or be housed in the same unit with the beam bounced off a distant reflector. Optical beam detectors are specifically designed for use in large indoor areas such as warehouses, manufacturing workshops and aircraft hangars, where the installation and maintenance of point detectors would be difficult. They have also found application in large historic buildings like cathedrals where interference with ornate ceilings must be avoided.

More recently, the technology has been updated in the guise of OSID that gives improved performance in complex situations where vibration, structural movement, bright sunlight and reflections may be problematic. Performance requirements for optical beam detectors are laid out in BS EN 54-12.

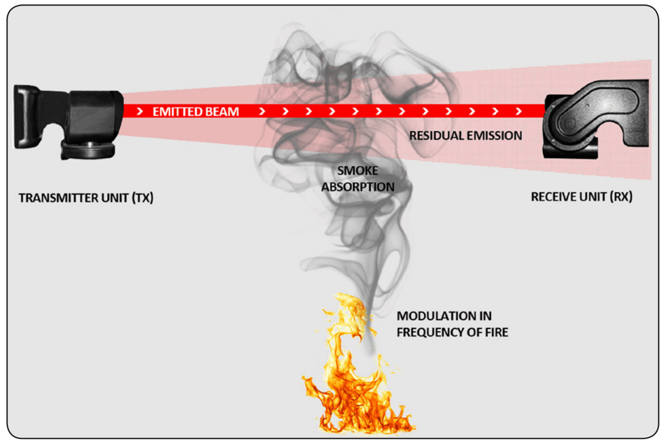


How Optical Beam Detection works

During operation, the modulated infrared light beam is projected at the receiver and the signal is continuously monitored for change. Any smoke entering the beam will act to scatter the light, reducing the signal received, and will cause the system to go into alarm at a predetermined level for a period of time. Some systems are also capable of measuring the change in light transmission resulting from the varying refractive index of air with temperature – this approach may provide benefit in the detection of clean burning fuels that generate heat, but less visible smoke.

Certain intrusions of the beam that are not related to smoke can be identified and filtered out or compensated for, such as complete blocking by the passage of people or vehicles, slow contamination of lenses and reflectors with dust (automatic drift compensation),and building movement. Good alignment of the transmitter and sensor is essential with some systems employing auto-alignment capability which also counters the impact of building movement from structural easing or temperature expansion/contraction. Since they are generally mounted high up in a building, many systems also incorporate motorised test filters for the purposes of remote calibration and maintenance.

OSID differs in that it replaces the single IR beam of OBD source with dual wavelength infrared (IR) and ultraviolet (UV) beams



and, in place of the single OBD detector, uses a digital camera type imaging sensor. This technology features high tolerance to vibration and structural movement and gives improved differentiation between smoke and environmental factors like dust and insects. One imaging device can support many emitters making it an efficient means of detection in complex 3-dimensional environments like building atria and theatres.

Key benefits

The key benefits of OSD systems include:

- The ability to protect very large areas and volumes giving significant cost savings in relation to point detectors for installation and through-life maintenance.
- The ability to detect when smoke is scattered over a wide area resulting in low detectable concentrations but made up for by the long beam path.
- The ability to be used at very high ceiling heights.
- The ability to cover large complex spaces with few sensors (OSID).
- Long wiring burden – reflective systems only require wiring for power and data transmission from one end.

General guidance

The installation requirements for OBD systems are given in BS 5839-1 Fire detection and fire alarm systems for buildings Part 1: Code of practice for design, installation, commissioning and maintenance of fire detection and fire alarm systems in non-domestic premises. Extracts are given below but the reader is directed to consult the full text.

- Detectors should be sited so that no point in the protected space is at a horizontal distance greater than 7.5m from an optical beam.
- OBD of normal sensitivity can be installed in buildings with a maximum ceiling height of 25m. Enhanced sensitivity devices may be installed up to 40m. 10% of the ceiling may be at slightly higher heights.
- If located in the apex of a ceiling, the separation distance may be increased by 1% for each degree of slope up to a maximum increase of 25% (maximum of 1.25 x (2 x 7.5) = 18.75m).
- The beam shall be located within 25 to 600mm of the ceiling or 600mm within an apex. These can be relaxed if the system is supplemental to other detection means.
- If mounted in voids less than 1.5m deep, the beam shall be in the top 10% of the void.
- A ceiling obstruction greater than 10% of the overall ceiling height should be treated as a wall.
- Partitions and storage racks within 300mm of the ceiling shall be treated as walls.
- Beams closer than 500mm to a wall, partition, or obstruction shall be discounted from providing detection.
- Beams shall be located at least 2.7m above the floor where the passage of people or equipment might break the beam.
- Solid mounting points for all components are required.
- The area protected by a device(s) will not exceed a system zone.

Challenges and considerations

Selection: Building stability, thermal expansion and contraction of the building, the levels of background air contamination (dust), potential fuel types, ceiling height, and the likelihood of smoke stratification all need to be considered when selecting the most appropriate technology.

Design: The design will need to appreciate system weaknesses in respect of contamination, the impact of reflections and sunlight, and factors that might contribute to stratification of smoke.

Testing and maintenance: Systems capable of self-alignment and calibration will reduce maintenance and upkeep. Systems not capable of self-alignment will need to ensure suitable means of access is provided to enable maintenance schedules to be met.

Management of false and unwanted alarms

Additional guidance is given in RISCAuthority document RC47: *Recommendations for the management of fire detection and alarm systems in the workplace.*

Applicable standards

BS 5839-1 Fire detection and fire alarm systems for buildings Part 1: Code of practice for design, installation, commissioning and maintenance of fire detection and fire alarm systems in non-domestic premises.

BSEN 54-12 Fire detection and alarm systems Part 12: Smoke detectors – Line detectors using optical beam.

Schemes

BAFE SP203-1 Design, Installation, Commissioning and Maintenance of Fire Detection and Fire Alarm Systems Scheme.

LPCB LPS 1014 Scheme requirements for certificated fire detection and alarm system firms.

Best practice

All providers of systems should be third party certificated to approved schemes.

Fire Services should be consulted on their requirements and necessary provisions for supporting the fire safety of the property.

Provision of Regulation 38 information is essential so that the role the detection and alarm system plays in the overall fire safety management plan of the building remains front and centre.