Honeywell
GENT

Fire System
Innovators

Enhanced Design and Installation Guide

Fire Detection Systems

This Design and Installation Guide provides a simple guide for the provision of a fire detection and alarm system in accordance with the recommendations detailed within the British Standard Code of Practice BS 5839-1:2017. It is designed to act as an aide-memoire and there is no substitute for reading the full standard, copies of which can be obtained from British Standards Institute 389 Chiswick High Road, Chiswick, London W4 4AL. Tel: 020 8996 9001. Web: www.bsi-global.com Email: orders@bsi-global.com

Contents

Introduction

This guide, due to its size, provides a basic overview to anyone involved in the design or action of a fire detection system. It will identify the current legislative requirements as well as clarify the responsibilities placed on the three key roles involved with the provision of a new system, namely the Designer, Installer and Commissioning Engineer, as well as remind the End User or Owner/Occupier what part they play in ensuring that the best possible system is supplied to protect life and property from fire.

It is important that everyone involved is conversant with the current British Standard Codes of Practice BS 5839-1:2017 for general buildings and should also be conversant with the British Standard relating to general wiring BS 7671. The guide, which has been prepared by Honeywell Gent, one of the UK's largest manufacturers of fire detection systems, is intended to offer practical advice and is not a substitute for any of the standards or legislation referred to.

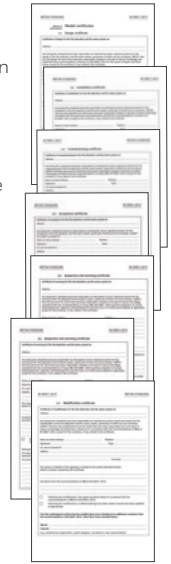
Legal elements

- Regulatory Reform Fire Safety Order 2005
- The Equality Act 2010 (formerly the Disability Discrimination Act 1995)
- Building Regulation Approved Document Part B
- Building Regulation Approved Document Part M

All these documents in some way affect what is included in the system. However the Owner/Occupier is ultimately responsible for the level of protection provided.

It is recommended that the Owner/Occupier carries out a Fire Risk Assessment to identify the level of protection required i.e. one of the categories detailed within BS 5839-1:2017 (L1, L2, L3, L4, L5, M, P1 or P2)

The full responsibilities of the Owner/Occupier are detailed within the new Regulatory Reform Fire Safety Order (RRO) that replaced the majority of existing laws within the UK from October 2006.



System Design

Any design should be prepared by a competent individual/organisation, who has consulted all interested parties and created a set of drawings, a specification, a cause & effect or fire plan, a list of Variations and completed a Design certificate, detailed within BS 5839-1:2017. If designs are undertaken without this research being carried out, the fire detection system is unlikely to comply with the legal requirements. This could result in prosecution of the parties involved, particularly those within the supply chain as well as the Owner/Occupier.

WARNING: Anyone who takes on the responsibility for design will do so at their own risk and design liability insurance is advisable.

The Designer's responsibilities:

- Agree the level of protection or category with Owner/Occupier
- Justify any Variations and document reasons
- Detail the detection & alarm zones
- Prepare specification and drawings including;
  - Siting of manual call points
  - Siting of point type heat and smoke detectors
  - Siting of beam detectors
  - Siting of any other forms of detection
- Specify type of cable for each circuit
- Specify type of system and equipment
- Specify links to other equipment
- Take into account the risk of false alarms – use the Gent 'pull out' application guide at the back of this booklet
- Allow for correct level of sounders and visual alarms
- Prepare a fire plan or cause and effect chart
- Sign a design certificate

Note: BS 5839-1:2017 recommends that a fire detection system is designed by a competent person, who takes responsibility for completing the design and signing off a 'Design certificate'. This should not be confused with other certificates relating to Installation and Commissioning, that are completed by the parties responsible for those parts.

Also if the contract allows, it is suggested that the Designer witness tests the completed system to ensure the original design is still appropriate – the Design certificate can then be completed after any amendments are included.

Design Stage 1

Talk to the interested parties to decide on the level of protection or category and agree variations.

The importance of pre-design planning cannot be overstated. Many parties are likely to have an interest in what the fire detection system is expected to do. Ultimately it is up to the Owner/Occupier, who is responsible by law, to make the final decision on the level of protection provided for a particular building.

In most circumstances the Owner/Occupier will appoint a competent Designer to carry out this work and take liability for the design as a whole.

The nominated Designer is expected to consult the following organisations:

- The User or Facilities Manager
- The Building Control Officer
- The Health and Safety Executive
- The Insurer
- The local Fire and Rescue Service
- A specialist fire alarm system supplier

Issues to be covered by the Designer should include:

- The Fire Risk Assessment demands
- The requirements necessary to comply with the Regulatory Reform (Fire Safety) Order (RRO) 2005, the Equality Act 2010 (formerly the Disability Discrimination Act 1995) and Building Regulations Approved Documents Part B and Part M
- The prime purpose of the system (Property or life protection or both)
- The level of protection suggested by the interested parties. (Category P1 or P2, M or L1 L2 L3 L4 or L5)
- The list of Variations identified by the interested parties

Design Stage 1

Determine the System Category or level of protection.

Systems designed for Protection of Property only, fall into two classifications P1 or P2.

The objective of a Category P1 is to provide the earliest possible warning of a fire to minimise the time between ignition and the arrival of the fire fighters.

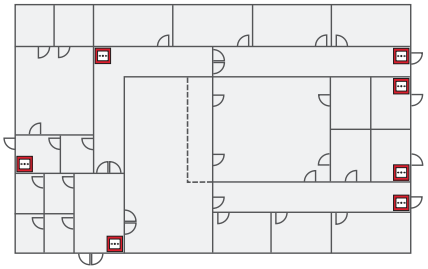
P1 is designed to protect the whole building whilst P2 is installed in defined parts of the building only, which may have an extraordinary high risk or hazard.

Life protection on the other hand will often depend on the number of people accessing a particular building and depending on the variations, the systems can range from simple Type M to L1 categories, these being detailed in the following diagrams.

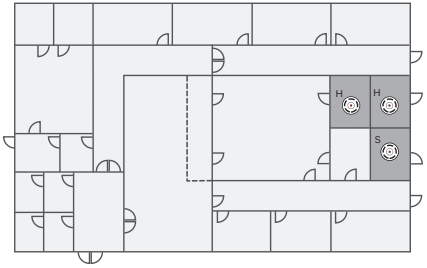
These diagrams show a typical building with a number of escape routes, side rooms and open plan areas used for escape.

A Category M system requires manual call points on all exits as well as corridors where persons are not expected to walk more than 30/45m (see Design Stage 3) to operate one.

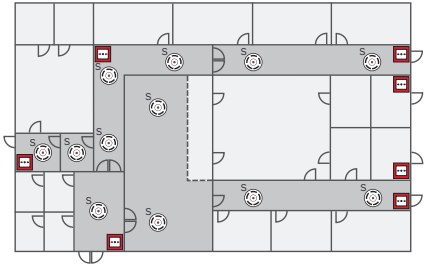
M



L5



L4



Design Stage 1

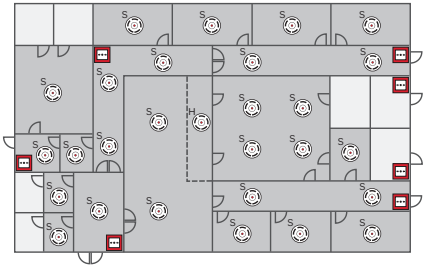
Category L5, designed for buildings that have a particular risk identified which warrants some special attention. For example if there is an area of high risk which is considered worthy of having some automatic detection but a manual system is also needed, then this will be termed as L5/M.

Category L4 provides detection within the escape routes only, whereas L3 not only covers these areas but all rooms leading onto the escape route. The reasoning behind this is to alert people of the danger prior to the corridor becoming "Smoke logged" so people can escape safely.

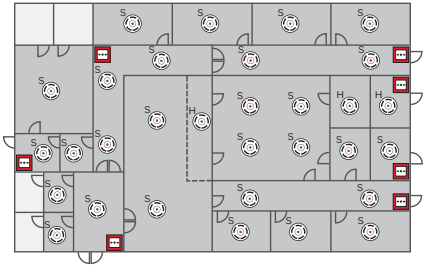
L2 is a further enhancement of protection with all the areas covered by an L3 category as well as all high risk areas such as boiler rooms etc.

L1 provides protection throughout the building to offer the earliest possible warning of fire, so as to achieve the longest available time for escape.

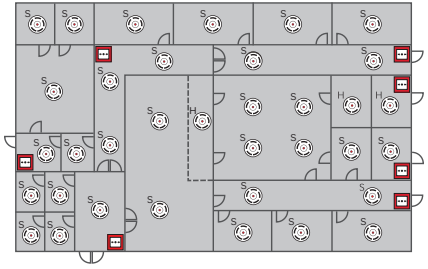
L3



L2



L1



Design Stage 2

Detection and alarm zones

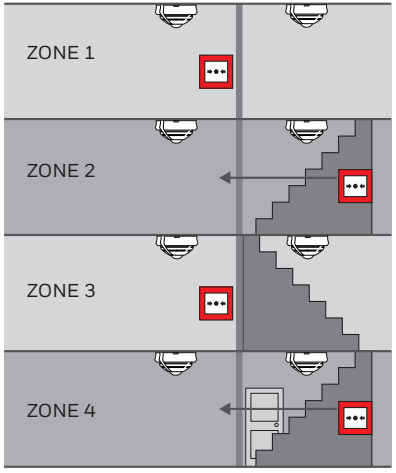
Generally a building is broken down into smaller compartments to enable the fire fighters to locate the fire as quickly as possible.

Even if the system is addressable it is still considered beneficial to have a separate 'at a glance' indication of the location of the fire.

These compartments of a building are called detection zones, which need to comply with the following criteria.

Detection zones

- A detection zone should cover no more than 1 storey, unless total floor area is less than 300m^2. Voids in the same fire compartment should be included in the same floor zone.
  The maximum floor area of a zone should not be greater than 2,000m^2, except for some large open plan areas that incorporate manual call points only, which can be extended to 10,000m^2. The maximum search distance for the fire fighters to see the seat of the fire within a zone should not exceed 60m assuming the route taken is the worst possible option. Vertical structures like stairwells, liftwells etc. should be considered as separate zones.
- A manual call point within a staircase should be connected to the zone associated with that floor and ideally be mounted on the accommodation side of the corridor exit. Automatic sensors on the stairwell remain as part of the stairwell detection zone.



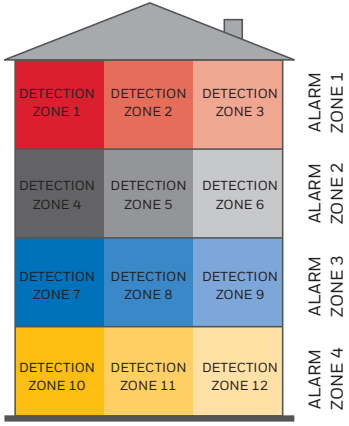
Design Stage 2

Alarm zones

An alarm zone is clearly defined within the standard but generally is an area of the building coinciding with the fire compartment boundaries. There must be a clear break between these alarm zones to ensure alert and evacuation messages are not overheard from adjacent areas.

The only other criteria is that an alarm zone may consist of a number of detection zones but not visa versa.

Alarm zones are only required when phased or staged evacuation is required. It is therefore important that care should be taken to ensure only one message is heard at any one time particularly where two alarm zones are attached.



Design Stage 3

Siting of manual call points

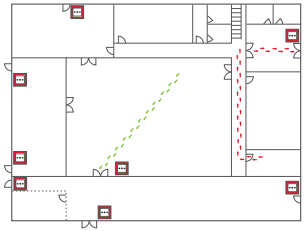
All manual call points, whatever the system, should comply to BS EN 54-11 Type A version only and should be located as follows:

- On all storey exits and all exits to open air irrespective of whether they are designated fire exits. Manual Call Points should only be installed on exits leading to the ultimate place of safety.
- Nobody should travel more than 45 metres to reach one, except if the exit routes are undefined in which case the direct line distance should not exceed 30 metres
- The above distances to be reduced to 25 and 16 metres respectively, if there are persons with limited mobility or there is a likelihood of rapid fire development
- In all areas with potential high fire risk such as kitchens etc.
- Where phased evacuation is planned, call points will need to be sited on all exits from a particular zone
- To be mounted at 1.4 metres above finished floor level
- All call points to be fitted with a protective cover

Manual call points should be fixed at a height of 1.4m above finished floor level, at easily accessible, well-illuminated and conspicuous positions free from potential obstruction. They should be sited against a contrasting background to assist in easy recognition. A lower mounting height is acceptable in circumstances where there is a high likelihood that the first person to raise an alarm of fire will be a wheelchair user.

Note: The measurement ought to be made between the finished floor level and the centre point of the frangible element.

Note: The figure of 1.4 m is arbitrary, but reflects long established custom and practice. A minor difference (e.g. less than 300 mm) in mounting height (e.g. to align with the mounting height of light switches) need not be regarded as significant, nor need it be recorded as a variation.



Manual Call Point

Route of travel 45m max (defined)

Route of travel 30m max (undefined)

Design Stage 4

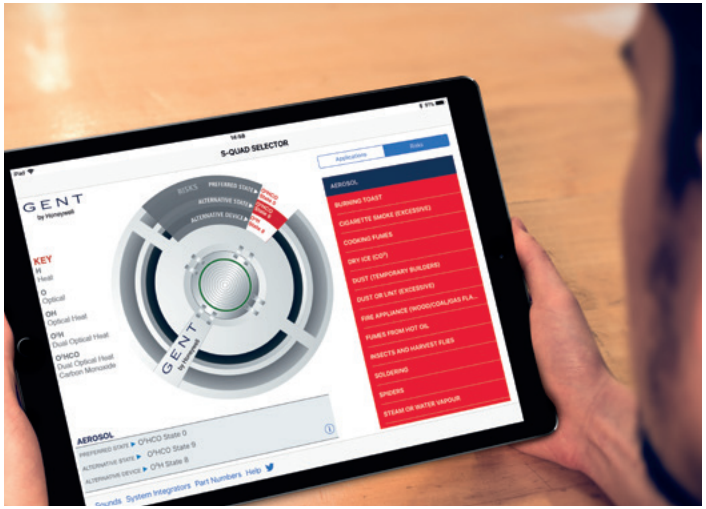
Selection and siting of sensors

For further advice please refer to clauses 21 & 22 of BS 5839-1:2017.

The objective is to select the correct sensor for the appropriate application, to provide the earliest warning of fire without the risk of a false alarm.

It is therefore worth trying to visualise the type of fire that is likely to occur in a particular room or area and also to familiarise oneself with the application and the risks that could give rise to a false alarm.

It should also be remembered that a Vigilon system can incorporate a whole range of different sensors using S-Quad multi-sensors. These can be set up for different applications and can be switched from 'state to state' should particular risks be present for short periods of time. This is achieved by an internal programmable timer, key switch or external input source. At the end of this booklet, a pull out section is attached showing a full application guide for all sensors including the latest S-Quad multi-sensor with a range of selectable 'states' for every application and risk.



Design Stage 4

Heat sensors complying to BS EN 54-5

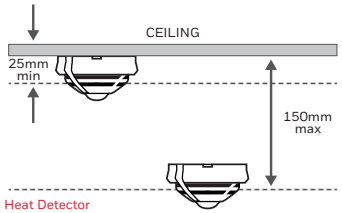
Vigilon with the S-Quad heat sensor has a number of pre-programmed 'states' that are detailed within BS EN 54-5.

Each state has its preferred use as described in the Application guide and incorporates two types of heat sensing element. One can be described as fixed temperature whilst the other is known as a rate of rise element. These elements have a broad range of application specific operating states that will respond quickly in the event of fire without risking a false alarm. See guide attached for specific advice on which state is recommended for a particular application.

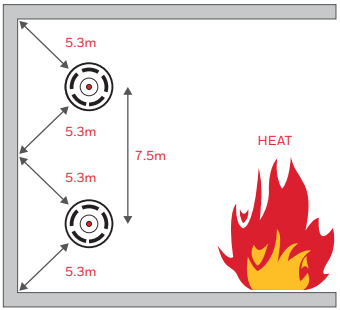
For example, the default state for the S-Quad heat sensor is Grade A1 (state 0) which has a fixed temperature operating point of 59.5°C + or – 5.5°C with a 'normal' rate of rise element, the current 'full list' of states provided by S-Quad and Vigilon are:

S-QUAD HEAT SENSOR	GRADE	FIXED TEMP RANGE	RATE OF RISE
State 0	A1	59.5 +/– 5.5°C	Normal sensitivity
State 13	A2	62 +/– 8°C	Less sensitivity
State 7	A2S	62+/- 8°C	None
State 5	B	77 +/– 8°C	Less sensitivity
State 6	BS	77 +/– 8°C	Disabled
State 15	OFF	-	-

Siting of HEAT detectors
(distance from ceiling)



HEAT detector spacing
(Under flat horizontal ceiling)



Design Stage 4

Smoke sensors complying to BS EN 54-7

Traditionally, 'point' type smoke sensors have fallen into two main categories, optical or ionisation.

Due to new European Directives for the storage and transport of radioactive sources, ionisation sensors are becoming less favourable and are being replaced by multi-sensors that utilise single or dual optical chambers that are also combined with heat and/or carbon monoxide sensing elements. This creates a whole range of sensors that are suitable for detecting different types of fires and yet ignore signals that previously have led to false alarms such as white dust or steam.

The tables below shows the various 'states' of these smoke sensor options. This should be read in conjunction with the attached application/risk charts to ensure the correct sensor is used for a particular location.

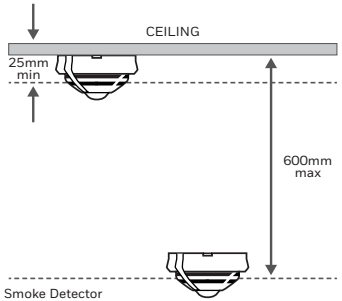
S-QUAD DUAL OPTICAL HEAT MULTI-SENSOR RANGE			APPROVALS	
Sensor	**State**	**Description of state set up**	**BS EN 54-5**	**BS EN 54-7**
OHeat & O²Heat	0	Medium Optical + A1 Heat	✓	✓
OHeat & O²Heat	2	Low Optical + A1 Heat	✓	
OHeat & O²Heat	3	High Optical + A1 Heat	✓	✓
OHeat & O²Heat	4	Medium Optical + A1 Heat + (no spike rejection on smoke)	✓	✓
OHeat & O²Heat	5	Medium Optical + B Heat	✓	✓
OHeat & O²Heat	6	Low Optical + BS Heat	✓	
OHeat & O²Heat	8	Delayed Medium Optical + A1 Heat	✓	✓
OHeat & O²Heat	11	Low Optical + B Heat	✓	
OHeat & O²Heat	12	A1 Heat Only	✓	✓
OHeat & O²Heat	15	All channels set to OFF	-	-

Smoke sensors complying to BS EN 54-7

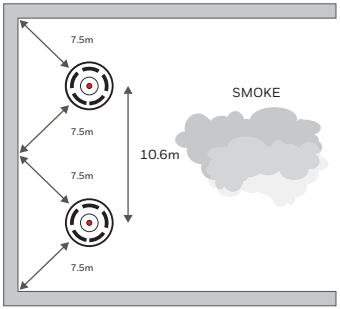
S-QUAD DUAL OPTICAL HEAT CARBON MONOXIDE MULTI-SENSOR RANGE			STANDARDS	
Sensor	**State**	**Description of state set up**	**BS EN 54-5**	**BS EN 54-7**
O²Heat & CO	0	Medium Optical + A1 Heat + Medium CO	✓	✓
O²Heat & CO	1	High Optical + A1 Heat + High CO	✓	✓
O²Heat & CO	2	Medium Optical + A1 Heat + Low sensitivity CO	✓	✓
O²Heat & CO	4	Medium Optical + A1 Heat + (no spike rejection on smoke)	✓	✓
O²Heat & CO	9	A1 Heat + Medium CO	✓	
O²Heat & CO	11	B Heat + Medium Optical	✓	✓
O²Heat & CO	12	A1 Heat Only	✓	
O²Heat & CO	15	All channels set to OFF	-	-

Design Stage 4

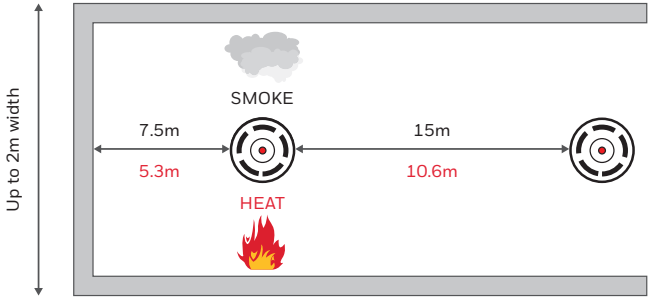
Siting of SMOKE detectors
(distance from ceiling)



SMOKE detector spacing
(Under flat horizontal ceiling)

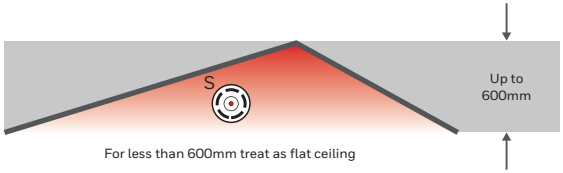


HEAT detector spacing in corridors (category P only)
SMOKE detector spacing in corridors (category L & P)

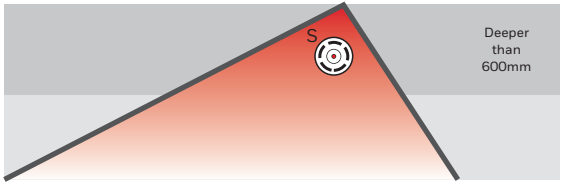


Design Stage 4

SMOKE detector under pitched roofs



For less than 600mm treat as flat ceiling

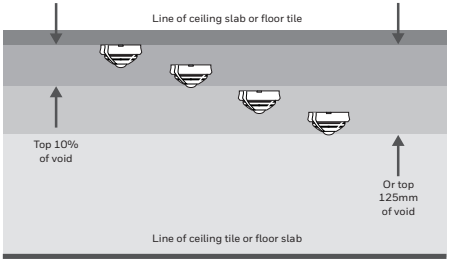


For greater than 600mm at least one row of detectors should be in the top 600mm. For apex ceilings extend coverage by 1% for each degree of angle up to a maximum of 25%

Mounting detectors in voids

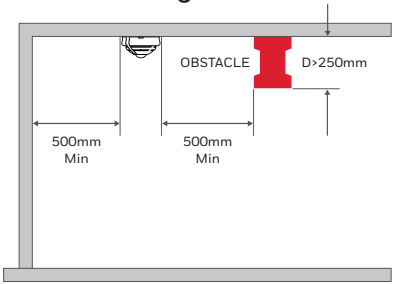
Applies to floor and ceiling void. Any of the below detector positions are acceptable.

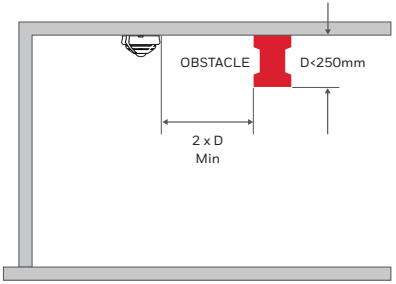
- Voids less than 800mm need not be protected
- Voids Over 800mm require protection
- Protection can be omitted through risk assessment but would require a variation

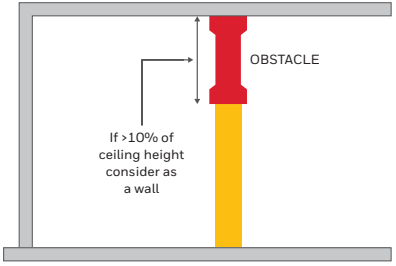


Design Stage 4

Limits of siting sensors near obstacles or walls

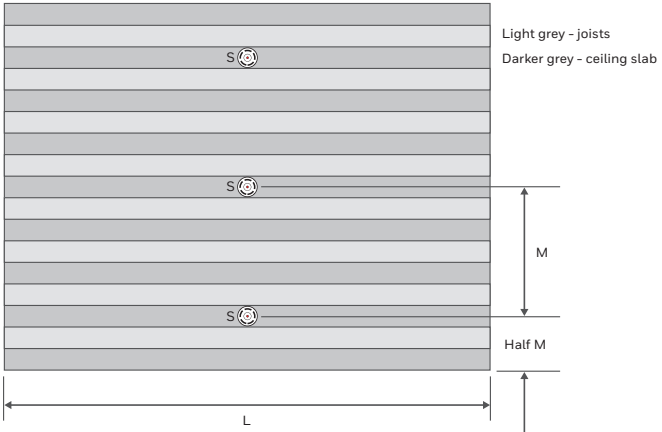






Design Stage 4

Ceilings with multiple joists

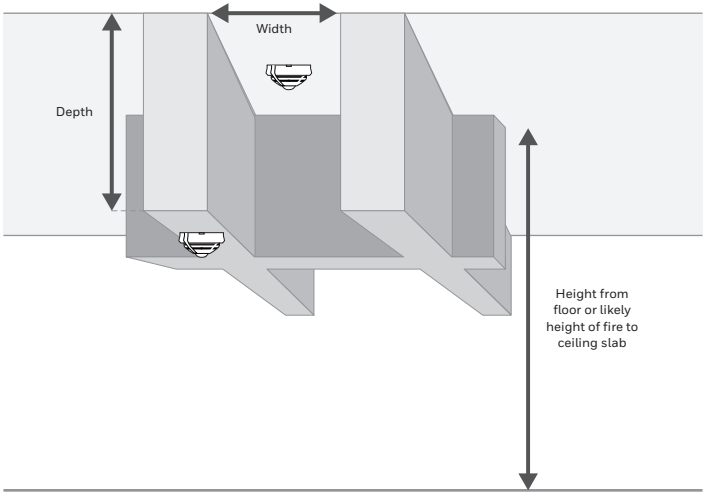


Permitted spacing is detailed in the table below: ratio between ceiling heights vs beam depth and maximum spacing 'M'.

CEILINGS WITH MULTIPLE JOISTS			
Ceiling height (H)	Beam depth (D)	Smoke sensor spacing (M)	Heat sensor spacing (M)
N/A	Less than 10% H	5m	3.8m
3m or less	More than 10% H	2.3m	1.5m
4m	More than 10% H	2.8m	2.0m
5m	More than 10% H	3.0m	2.3m
6m or more	More than 10% H	3.3m	2.5m

Design Stage 4

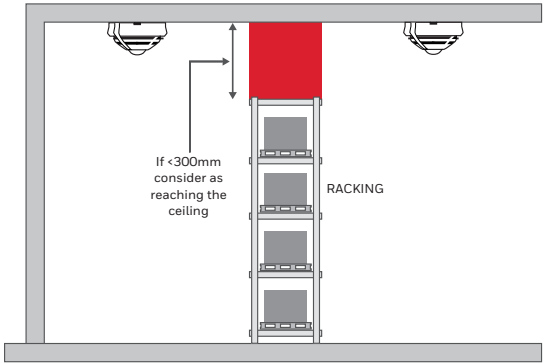
Lattice / Honeycomb Structures



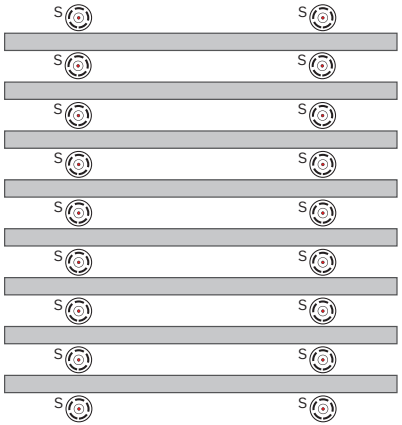
SPACING AND SITING OF DETECTORS ON HONEYCOMB AND SIMILAR CEILINGS				
Overall ceiling height from floor into cell H (to nearest whole metre)	Beam depth, D	Maximum distance between any point and the nearest smoke (heat) detector	Detector location if W is 4D or less	Detector location if W is more than 4D
6m or less	Less than 10% H	As per flat ceilings	Underside of beams	On structural slab in the cell
More than 6m	Less than 10% H and 600mm or less	As per flat ceilings	Underside of beams	On structural slab in the cell
More than 6m	Less than 10% H and more than 600mm	As per flat ceilings	Underside of beams	On structural slab in the cell
3m or less	More than 10% H	4.5m (3m)	Underside of beams	On structural slab in the cell
4m	More than 10% H	5.5 (4m)	Underside of beams	On structural slab in the cell
5m	More than 10% H	6m (4.5m)	Underside of beams	On structural slab in the cell
≥ 6m	More than 10% H	6.5m (5m)	Underside of beams	On structural slab in the cell

Design Stage 4

Obstructions from floor to ceiling



Ceilings above racking

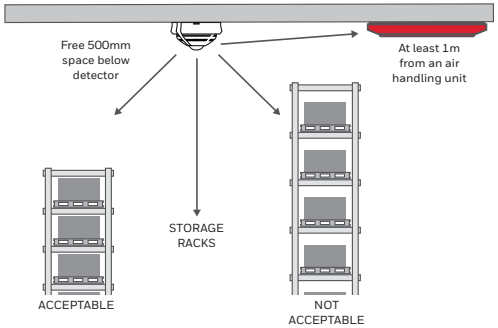


If gap between top of rack and ceiling is less than 300mm then treat as wall and provide detection in each aisle.

Design Stage 4

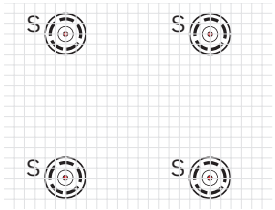
Ceilings with other obstructions or Air Handling units etc.

One of the most common mistakes is to mount a smoke sensor adjacent to the air conditioning intake or outlet grill. The minimum distance between the two should be at least 1 metre and further if possible. This is due to the fact that smoke may have difficulty penetrating the sensor when the air conditioning is switched on. Also there is a greater risk of the sensor becoming contaminated and giving rise to false alarms.

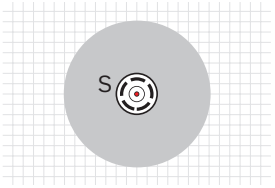


Ceilings with perforations

Detectors above ceilings with perforations can protect the area below subject to the following conditions:



- The perforations are uniform
- The minimum perforation is greater than 10mm
- The thickness of the perforation is less than three times the minimum dimension of the perforation

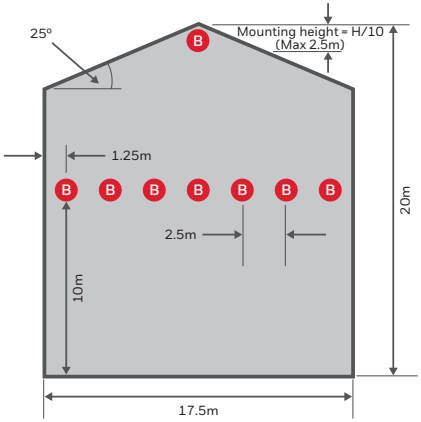


Where air is forced through a perforated ceiling, the detector should be mounted on a solid baffle with a minimum diameter of 1200mm

Design Stage 4

Siting of BEAM detectors

- General rules apply as for point detectors
- For apex ceilings extend coverage by 1% for each degree of angle up to a maximum of 25%
- Maximum distance from the highest point should not exceed 600mm. Where this is not possible (due to physical obstructions in roof space), the maximum distance from the ceiling should be 10% of the ceiling height or 2.5m, whichever is the lowest figure
- Avoid beams close to walls (500mm) or where temporary obstructions may occur
- Mount transmitter & receivers on a solid surface not affected by wind or natural temperature changes
- Additional units may be included in atria to detect at lower levels, to counter stratification effect. The width of the area protected on each side of these beam should be 12.5% of the mounted height



One beam detector covers 18.75m using extra % allowed due to angle of roof.

The gap either side of the detector should be 12.5% of the mounting height = 1.25m.

Due to regular obstructions to the Apex this section has changed to allow detectors to be mounted beyond 600mm. Please note that new conditions now apply please refer to the 2017 revision of the BS 5839 (22.5d 4).

Design Stage 5

LIMITS OF CEILING HEIGHTS (GENERAL)		
Detector type	Maximum (m)	Up to 10% (m)
Heat detector – Class A	9.0	10.5
Heat detector – Other Classes	7.5	10.5
Point smoke detectors	10.5	12.5
Carbon monoxide detectors	10.5	12.5
Optical beam smoke detectors – Normal sensitivity	25.0	28.0
Optical beam smoke detectors – Enhanced sensitivity (alarm at 35% attenuation or less)	40.0 (see Note 1)	43.0 (see Note 1)
Aspirating smoke detection – General limit	10.5	12.5
Aspirating smoke detection – Class C with at least 5 holes	15.0	18.0
Aspirating smoke detection – Class C with at least 15 holes	25.0	28.0
Class B with at least 15 holes	40.0 (see Note 2)	43.0 (see Note 2)

NOTE 1 The use of supplemental detection is recommended [see 22.5d)] unless the risk (i.e. probability × consequence) of stratification is minimal.

NOTE 2 The use of multilevel sampling is recommended [see 22.7c)] unless the risk (i.e. probability × consequence) of stratification is minimal.

Choice and siting of alarm sounders and visual alarms

Sounders and strobes are generally provided for systems designed to protect life. However, on the rare occasion when only the property is being protected it is still essential to mount a sounder adjacent to the fire control panel as well as immediately outside the main entrance for the fire fighters.

Before deciding on the number and location of sounder/visual alarms, it is important to establish what the 'Fire Plan' or cause and effect will be.

If the building is not going to have a 'one out – all out' arrangement, the evacuation procedures must be established. Once this is known, you can then establish the alarm zone areas where different alarm messages may be given, for example an alert or an evacuation tone.

Design Stage 5

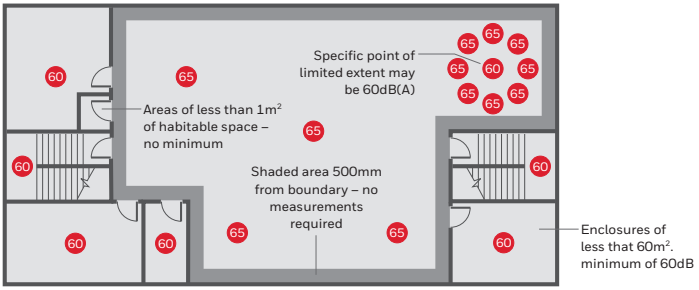
Design Tip 1

Research* over the last twenty years has proven that a voice enhanced sounder is preferred to a bell or electronic sounder as people pay more attention to a spoken message. The Gent S-Cubed and S-Quad offer sounders that include recorded speech messages delivered in a synchronised manner to create a clear instruction to persons at risk within a building.

* Sources: Brian Piggott (The Fire Research Station) and David Canter (Surrey University)

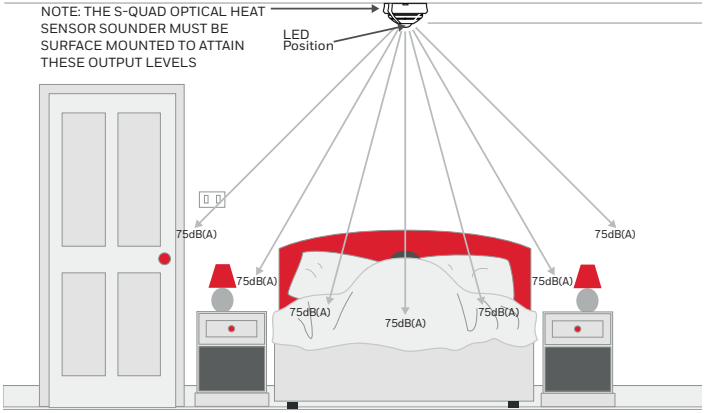
Audible alarm levels within buildings are generally accepted as 65dB(A) throughout. However, the new standard does accept that in certain locations this can be as low as 60dB(A). This allows some degree of flexibility, although in general the majority of a site must achieve 65dB(A) or greater to be compliant.

The drawing below illustrates the areas where 60dB(A) is permitted:



Design Stage 5

It is maintained that to rouse sleeping persons you need to achieve a minimum of 75dB(A) at the bedhead.



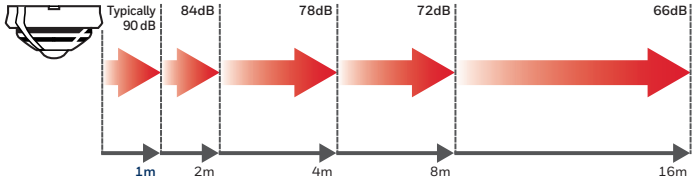
For areas with high ambient background noise levels, the Standard recommends a sound level of 5dB(A) above the norm although it now goes on to say the maximum sound levels should not exceed 120dB(A) for health & safety reasons. Finally it is essential that at least one sounder is placed within each fire compartment and the sounder choice should be common throughout the building. You should not mix bells and electronic sounders within the same building although the Gent S-Cubed and S-Quad both offer bell and electronic sounders, allowing a system upgrade or switch over from a bell tone to an electronic tone when required.

Sound attenuation is affected by numerous physical structures within a room, including the door, furniture, people and materials used for floor, walls etc.

General internal doors will attenuate at least 20dB(A), whilst heavier fire doors may well attenuate by up 30dB(A). To ensure 75dB(A) is achieved within a bedroom it is accepted that the sounder is mounted within the room rather than the corridor outside. Use of sensor sounders ensures an even spread of sound throughout the building without the need for separate louder sounders. Visual Alarms are a common method for providing alarm in areas of high background noise. Where these are the primary means of alarm they must comply to

Design Stage 5

BS EN 54-23. They may also be used in areas where there is a requirement for slience even in an emergency such as TV studios, operating theatres or where a staff alarm is employed ahead of a general evacuation. The exception could be where sound of any description is undesirable, for example operating theatres, TV studios and places of entertainment where a discreet staff alarm system is the best option to avoid panic.



Visual alarms are also included as a requirement of the Equality Act 2010 (formerly the Disability Discrimination Act 1995) and Approved Document Part M of the Building Regulations and should be included in all sleeping accommodation where people with a hearing disability may be present. **For more information on how to design systems with Visual Alarms please refer to the Honeywell Gent VAD Guide.**

Design Tip 2

S-Quad combines a sounder and strobe within a sensor which not only reduces the number of individual devices you have to install, but also provides an even cover of sound and light throughout a building.

Design Stage 6

Control equipment and power supplies

The Control panel itself should comply to BS EN 54-2 and any power supply used should comply to BS EN 54-4. Today all of the Gent fire control panels incorporate their own battery and charger and as long as the guidelines for loading these systems are complied with, the batteries should be sufficient to maintain the system for a period of at least 24 hours with half an hour alarm load thereafter.

Design Stage 6

It is however recommended that a battery load calculation is carried out to verify the standby period provided by the capacity of the battery supplied.

Irrespective of the size or type of system the control panel should be sited with the following points in mind;

- In an area of relatively low fire risk
- On the ground floor entrance which the fire fighters will use
- In buildings of multiple occupancy, the panel should be sited within a communal area or if this does not exist, a location which is accessible at all times
- Where ambient light levels, ensure visibility at all times
- Fire zonal indication should be clearly displayed by an Light Emitting Indicator or an illuminated mimic diagram – it is not acceptable to simply accept the information from an LCD or VDU display

If there are several entrances to the building, consideration should be given to the provision of repeat indicators.

The Installer's responsibilities:

To install all equipment in accordance with the standards

- To use the correct types of cable
- To test the cables, continuity and earth, and provide certificates
- To flag up any Variations that affect the Design
- To produce a set of 'as fitted' drawings
- To sign off the Installation certificate

Types of cable and where to use them

There are two basic grades of cable permitted for use on fire alarm systems. These are known as Standard grade and Enhanced grade designed to meet the new standard BS EN 50200.

The choice of cable needed is dependent on how long the cable is expected to continue to operate whilst a fire is occurring.

The integrity of the system is paramount and all interconnections between devices must be considered especially those that affect the signals critical path.

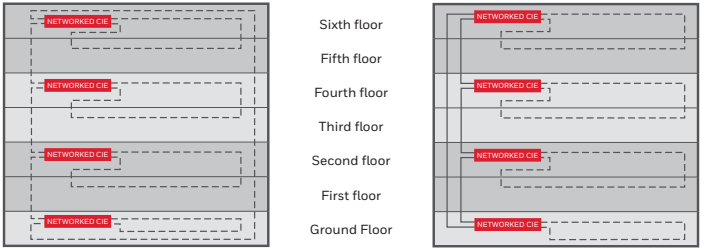
Firstly the Standard insists that the mains supplies to the system, the manual call points, the sounders and the automatic sensor circuits are wired in fire resistant cables.

Design Stage 6

What cable? – Standard or Enhanced fire resistant cables?

The Standard fire resistant cable will satisfy most applications particularly with 'one out, all out' fire plans. Enhanced fire resistant cables are required for applications that need communications to continue during a fire incident when the building fabric may be destroyed. Examples of where Enhanced fire resistant cable should be used include:

- In un-sprinklered buildings where the 'Fire Plan' involves the evacuation of occupants in four or more phases
- In un-sprinklered buildings greater than 30 metres in height
- In un-sprinklered buildings or large networked sites where a fire could affect the cable's 'critical path', particularly where people will remain in occupation during a fire elsewhere on the site
- Where in part, a delayed evacuation may exist and the critical signal path may pass through an area of high risk
- Where a Risk Assessment has identified a particular need for Enhanced cable



Example of a networked fire alarm in a multi-storey building, showing standard cable grade throughout provided that there is diverse routing of the network cable loop.

Example of a networked fire alarm in a multi-storey building, showing standard cable grade for local wiring and enhanced grade for network cable.

Design Stage 6

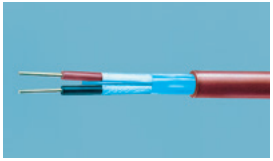
Other aspects in regard to Installation practice

The electrical characteristics of the cable such as impedance, capacitance etc should be capable of handling the data and power of the system.

For the Vigilon system, Gent regularly updates the list of approved standard and enhanced cables used for loops or networks. We would suggest you obtain the latest copy of our installation manuals or contact your local System Integrator to obtain the latest approved product.

Cable requirements

- Core size not less than 1mm (for Gent products 1.5mm loop cables are required)
- Where exposed cables are below 2m, additional mechanical protection should be considered
- The colour of the outer sheath should preferably be RED although other colours are permitted as long as it is common throughout the building and does not clash with any other electrical services



Fire cables should:

- be segregated from all other services
- not share the same conduit
- use a separate compartment if common trunking is used
- avoid running alongside high current power lines
- avoid running adjacent to lightning conductors
- avoid electro magnetic interference from other circuits

The Standard precludes the use of multicore cable where a single fault will cause more than one circuit to fail. This is particularly true with loop wired systems where communication from either end is required and the failure of a 4-core cable will mean that all communication is lost.

- Cable joints should be avoided, other than the components themselves
- Cable support should withstand the same temperature as the cable, which method the use of plastic cable clips, cable ties or trunking, where this is the main means of supporting the cable, should NOT be used
- Cables should not rely on suspended ceilings for their support
- Mains power supplies should also be wired back to the main circuit breaker in fire resistant cable

Design Stage 6

Recommendations for the mains power supplies

circuit breaker taken from the load side of the buildings main isolating device.

To facilitate local isolation during maintenance, suitable means should be provided for double pole isolation of the low voltage supply circuit that serves the power supply and control equipment.

This circuit breaker can incorporate a switch if necessary but in either event should be labelled 'FIRE ALARMS – DO NOT SWITCH OFF' – this supply should be used for the sole purpose of the fire alarm system.

In large multiple occupancy buildings it may be necessary to obtain a mains supply via a mains distribution board. However the same arrangements as above apply. The isolation of this local distribution board and the fire isolating device is a minimal requirement and should be inaccessible to unauthorised persons.

Ideally the supply should not be protected by a residual current device unless necessary to comply with requirements of BS 7671. If this is the case then it should not be capable of isolating the mains supply to the fire alarm system.

Inspection and testing of wiring

Prior to any equipment being connected, all installed cables should be subject to a 500V DC insulation test.

These tests should show an insulation value of at least 2M Ohms between conductors and between each conductor and screen or earth.

Earth continuity tests should be carried out on all mains supply circuits as well as an earth loop impedance in accordance with BS 7671. It is important with the Vigilon system that all earth leads or screen cables are terminated and connected through each device.

The maximum impedance of each loop or radial circuit should be recorded to ensure it meets the manufacturers recommendations. In the case of Vigilon this is determined by not exceeding the recommended maximum cable lengths. Loop circuits, should not be greater than 2Km and a maximum of 100 metres for any radial circuit connected on a loop powered interface.

System commissioning

Commissioning Engineer's responsibilities:

- Functional testing of all equipment
- Confirm fire plan or cause & effect is correct as per design
- Look for any incorrect positioning of sensors or other devices – snag them or list them as Variations
- Record sound level meter readings
- Provide a log book and product manuals
- Carry out staff training
- Collate all documents including
- Design Certificate
- Installation Certificate
- Commissioning Certificate (also sign it!)
- Cable test and wiring certificate
- Specification and drawings
- List of agreed Variations
- Fire Plan or 'Cause and Effect'
- Acceptance Certificate signed by clients representative

It is important that the system is commissioned by a competent person who has attended recognised training courses on the equipment as well as the British Standard.

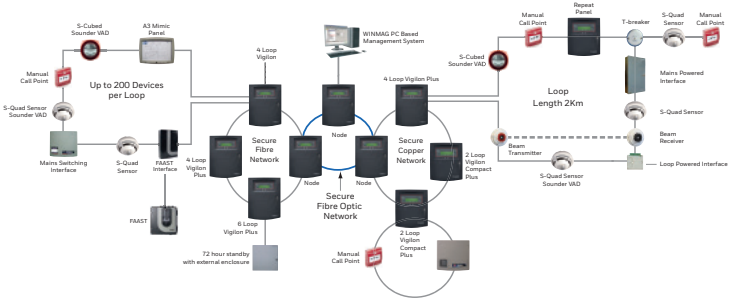
At this stage the entire system should be inspected and tested, in particular;

- Every manual call point, sensor, sounder, interface and indicator
- Check that all devices are correctly sited to cover the area they are intended to protect – see previous notes on siting of devices
- Check that all devices are correctly labelled and display the correct information on the control panels
- All sound pressure levels should be measured and recorded
- Any transmission of signals to remote centres or equipment should be proven
- The fire plan or cause and effect should be checked from every device
- All alarm panels and printers display the correct information and are sited correctly
- A suitable diagrammatic zone plan is mounted adjacent to the control panel
- No changes to the building have affected the siting of equipment or effectiveness of the system for example an additional partition requiring additional sensors
- Mains and standby power supplies are adequate and designed to support the system for a specified period, for example 24, 48 or 72 hours
- As far as reasonable, ascertain that the installation complies with the standard and certificates are provided by the installer
- If radio equipment is used, ensure all radio signals are of sufficient strength to ensure reliability
- Ensure there are no obvious shortcomings with the system as a whole and that all the documentation is correct

It is also recommended that the system is soak tested for up to a week, dependent on the system size, so that any teething problems are identified without giving rise to any false alarms.

Installation guide

The purpose of this section of the guide to fire detection and alarm systems is to look at the simple guidelines an installer should follow when installing a Honeywell Gent Vigilon Plus or Nano Analogue Addressable system.



Loop loadings

The Vigilon system supports up to 200 devices per loop and Nano up to 127 devices. In addition it is important to consider the mix of different loop devices and their respective loadings. The following table gives a guide to the maximum quantities permitted for each device type on a new Vigilon installation only.

The quoted maximum should not be exceeded (based on new vigilon plus installs only).

DESCRIPTION	MAX DEVICES PER LOOP
S-Quad Sensor	200
S-Quad Sensor Sounder	200
S-Quad Sensor Sounder With Voice	200
S-Quad Sensor With BS EN 54-23 VAD High Power	50
S-Quad Sensor Sounder With Voice and BS EN 54-23 VAD High Power	45
S-Quad Sensor With BS EN 54-23 VAD Medium Power	60
S-Quad Sensor Sounder With Voice and BS EN 54-23 VAD Medium Power	70
S-Quad Sensor With BS EN 54-23 VAD Low Power	133
S-Quad Sensor Sounder With Voice and BS EN 54-23 VAD Low Power	100
S-Cubed Sounders	200
S-Cubed Sounders with Voice	200
S-Cubed Sounders with BS EN 54-23 VAD High Power	44
S-Cubed Sounders with BS EN 54-23 VAD Medium Power	57
S-Cubed Sounders with BS EN 54-23 VAD Low Power	100
S-Cubed Sounders with BS EN 54-23 VAD High Power	44
S-Cubed Sounders with BS EN 54-23 VAD Medium Power	57
S-Cubed Sounders with BS EN 54-23 VAD Low Power	100
Loop Powered Interfaces (LV switching relays)	100*
Loop Powered Interfaces (MV switching relays)	200*
Loop Powered Interfaces (conventional Zone)	32*
Keyswitch Interfaces	170*
Mains Powered Interfaces	32*
Manual Call Point	200
Beam Sensor (Pair)	16*
Loop Controlled Repeats	4***
Loop Controlled Mimics	4***
T-Breaker to wire Spurs	200

*Maximum number of beam sensors on a Nano loop is 8. **Maximum number of interface units on a Nano loop is 16. ***Repeat and mimic panels cannot be connected to a Nano Loop. Note: the Nano loop supports a maximum of 127 devices. Note: depending on interface usage these values can change.

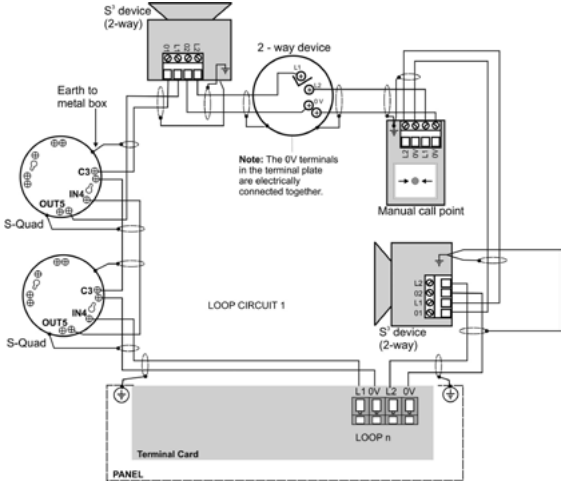
The above is for guidance only; when performing actual designs of systems the loop load calculator tool should be used to ensure design integrity.

If you have any concerns regarding loop loadings please contact the Honeywell Gent Sales Support Team.

Loop connections

All devices that connect to a Gent Analogue Addressable fire detection system follow the same loop connection methodology; please refer to the diagram below.

Each loop circuit can accept connection of up to a maximum of 200* addressable devices per loop. To maintain earth continuity on a loop it is important for the loop cable screen to be continued through each system device, whether the earth is connected to a device or not.



As every loop device has an isolator fitted, it is not necessary to apply special attention where there are more than 32 devices. However no more than a maximum of 512 input devices shall be installed on one control panel.

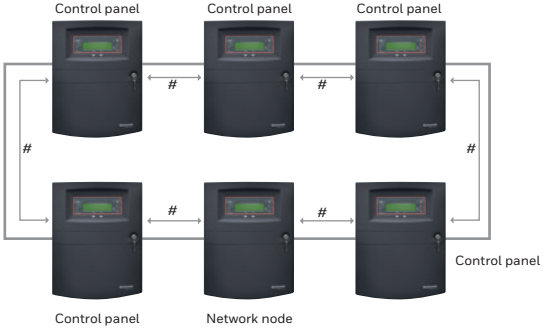
* Note: Nano single loop panel supports 127 devices only.

Loop Length

The permitted loop length for Vigilon with 1.5mm^2 cable is 2km and this may be extended to 2.5k with 2.5mm^2 cable. However this length is dependent on the quantity and distribution of powered alarm devices (sounders and VADs) It is therefore advisable that the loop load and standby calculator for Vigilon is used to ensure integrity of design.

Please note that Nano only supports loop length of up to 1km.

Vigilon network basic architecture



- 1.2Km Copper network cable distance
2Km Fibre network cable distance

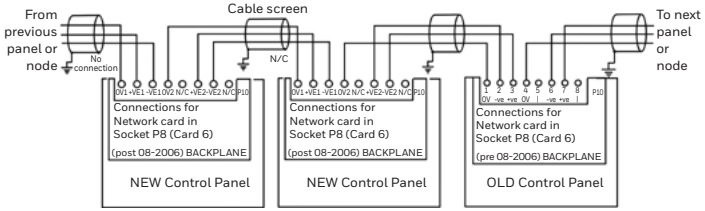
A standard Vigilon network comprises of up to 31 panels in a single secure loop. Larger networks up to 200 panels are possible with a multi-ring architecture. Contact Honeywell Gent for further support and details.

Please note that the Nano panel cannot be connected to a Vigilon network.

Network wire must be the same type i.e. copper or fibre per domain. The domain bridge can be fibre and local network can be copper or other way around.

Vigilon network connections

Mixing different types of cables on the same network is not supported, it will create impedance imbalance and disruption to data communication.



Information required prior to commissioning

The following information is required prior to commissioning being carried out to ensure that the system is set up and tested in accordance with the customers requirements and specification:

- As fitted drawings detailing all devices installed and the sequence they are connected on each loop
- Copy of design specification with variations
- Label schedule per loop detailing address details for each device that have been agreed with the building user and cross referenced to as fitted drawings
- Cause and effect schedule. The system will need to be set up to a predetermined cause and effect, this needs to be confirmed in writing or in the form of cause and effect matrix

DEVICE LABEL SCHEDULE - EXAMPLE

PROJECT	Anywhere	Page No	1
LOCATION	No Town	Panel No	1

DEVICE REFERENCE ON DRAWING	Type of device	Device label (Description to be displayed on panel) N.B MCP automatically display MCP using four characters	Panel No
		1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32	1
1/1	MCP	MAIN ENTRANCE	
1/2	SD	MAIN ENTRANCE LIFT LOBBY	
1/3	HD	GROUND FLOOR PLANT ROOM	
1/4	SND	GROUND FLOOR PLANT ROOM SND	
1/5	I/F	GROUND FLOOR PLANT ROOM I/F	
1/5	CH - 1	LIFT CONTROL	
1/5	CH - 2	ACCESS SS CONTROL	
1/5	CH - 3	GAS VALVE	
1/5	CH - 4	SPARE	
1/6	MCP	KITCHEN EXIT	
1/7	HD	KITCHEN	
1/8	HD	KITCHEN	
1/9	SD	KITCHEN STORE	

DEVICE LABEL SCHEDULE

PROJECT		Page	x or x
LOCATION		Panel No	

DEVICE REFERENCE ON DRAWING	Type of device	Device label (Description to be displayed on panel) N.B MCP automatically display MCP using four characters	Panel No
		1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32	

Labels can be up to 64 characters using token labels. A list of tokenaised labels can be found in the generic commissioning manual.

Cause and effect matrix example

Detection in zone \ Alarm in zone	1	2	3	4	5	6	7	8	9
1	●	○		○					
2	○	●	○		○				
3		○	●			○			
4	○			●	○		○		
5		○		○	●	○		○	
6			○		○	●			○
7				○			●	○	
8							○	●	○
9						○		○	●

● Evacuate ○ Alert

Zoning				
Second floor		1	2	3
First floor		4	5	6
Ground floor		7	8	9

Final documentation

On completion of commissioning and user training all documentation will have to be collected and handed to the client or their representative. This will include;

- Design, Installation and Commissioning certificates*
- Cable and insulation resistance test records
- "As fitted" drawings of the final installation, including cable run details
- Product manuals and user instructions
- System log book
- A copy of the fire plan documentation against which the commissioning engineer programmed the system
- The designer's specification and a written list of agreed Variations

* For existing systems the Verification Certificate could replace Design, Installation and commissioning

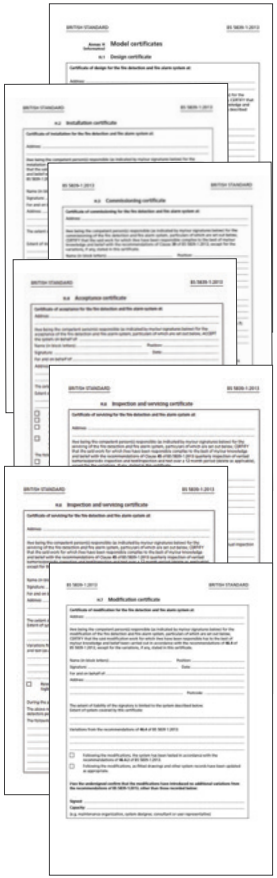


TABLE 1: SENSOR APPLICATION GUIDE This guide is aimed at providing advice on the most suitable type of sensor for specific applications. Obviously conditions may vary depending on the particular application and if there are any doubts we suggest you consult one of our field sales advisors.

GENERAL APPLICATION FOR SENSOR	PREFERRED OPTION	OPTION 2	OPTION 3	OTHER SOLUTIONS
Air extraction ducts	Duct detectors	Aspiration		
Airport terminals	Beams** state 0	O^2H* state 0	Video	
Animal houses, stables, zoos etc.	EP heat state 0			
Areas of high risk like historic houses	Aspiration	O^2HCO* state 1	Radio detection	Suggest time out feature, used when reduced sensitivity is required
Atria	Beams** state 0	Aspiration Vertically		Note use 'snout' on receivers to protect against sunlight
Battery re-charge rooms	O^2H* state 0	Flame		
Bedroom	O^2H* state 0	O^2H* state 8		
Bedroom with adjacent bathroom	O^2H* state 8	O^2HCO* state 0	O^2HCO* state 9	Options dependent on severity of steam leakage into bedroom see table 2
Bedroom with bath and or kitchen attached	O^2H* state 8	O^2HCO* state 0	O^2HCO* state 9	Options dependent on severity of steam cooking fumes leakage into bedroom see table 2
Boiler room with coal or coke	H* state 5	O^2HCO* state 11		
Boiler room clean with gas / oil / electrical source	O^2H* state 5	O^2HCO* state 11		
Cable duct ways	Linear Heat	Beams** state 0		Watch out for obstructions for options 2
Car park (enclosed)	H* state 0	O^2H* state 2	O^2H* state 8	
Changing rooms alongside showers etc.	O^2HCO* state 9	H* state 0		
Clean data processing room	O^2HCO* state 1	O^2H* state 1	Aspiration	Watch for rapid air changes see table 2
Cold rooms	Aspiration	Use heat state 0 but avoid fitting near open doors		
Corridors, stairwells or internal passageways	O^2H* state 0			
Electrical switch or plant rooms	O^2HCO* state 0	O^2H* state 0		
Enclosures open to air	EP Heat	EP Flame		
Flour mills	O^2HCO* state 9	Flame detector		
Garage work areas	H* state 0	O^2HCO* state 9	O^2H* state 2	Suggest timeout feature to revert to O^2HCO* state 0
Kitchen, large commercial	H* state 6	O^2HCO* state 11		Suggest timeout feature revert to higher detection state 0 or 9 respectively
Kitchen, small domestic	O^2H* state 2	H* state 13		
Laundry room large, high ceiling	Beams** state 0	O^2HCO* state 9	Flame	Consider linear heat around machinery
Laundry room small, low ceiling	O^2HCO* state 9	H* state 13		
Laundry storage room	O^2HCO* state 9	H* state 0		
Libraries	O^2HCO* state 0	Aspiration	O^2H* state 0	
Normal office or working area	O^2H* state 0			
Open high ceilings in churches or cathedrals	Beams** state 0	Flames		Watch number of candles lit for option 2
Prison / secure accommodation	O^2HCO* state 2	O^2HCO* state 9		
Restaurant area	O^2H* state 0	H* state 0		Suggest timeout feature to switch between states
Retail shop, high ceilings (e.g. B&Q)	Beam** state 0			
Retail shop, normal ceiling height	O^2H* state 0	O^2HCO* state 0		
Room with gas fire	O^2H* state 0	O^2HCO* state 0		
Room with open wood / coal fire	O^2H* state 2	H* state 0		
Scientific laboratories	O^2HCO* state 0			Wide variation dependent on use contact engineer
Spray booths – spray shops	Flame	H* state 0	Linear Heat	Watch out for hazardous requirement
Steam rooms, sauna or shower areas	EP heat	O^2HCO* state 9		
Store rooms	O^2HCO* state 0			Subject to material in store
Tunnels	Flame	Linear Heat		
Warehouse	Beams** state 0	O^2H* state 0		Preferred option watch out for fork lift trucks and cranes
Warehouse loading bay	H* state 0	Flame	O^2H* state 0	
X-ray or other high EMC areas	Aspiration	O^2HCO* state 0		Ignore use of ionisation detectors

Note* Versions may include Speech, Sound and strobe or mixture of all features. ** Beams state dependent on path length.

TABLE 2: CHOICE AND SITING OF AUTOMATIC SENSORS This table provides guidelines on the type of sensor and programmable 'state' of those sensors, that should be used when specific risks are present. The solutions that are listed are chosen to provide optimum performance for detecting fire and minimising the risk of false alarms. In most cases the sensor 'states' can be preset at selected time frames and therefore revert back to a more sensitive 'state' for normal protection level shown on the application table.

SPECIFIC RISK	PREFERRED SOLUTION	OTHER OPTIONS OR ADVICE
Aerosol (excessive) / chemicals	Flame	HCO may be suitable depending on aerosol
Aerosol (general)	O^2H state 8 or O^2HCO state 0	If possible use Timezone disablement on O^2
Burning toast / food	H state 13 or O^2HCO state 9	This is a FIRE therefore manage with techniques such as Timezone disablement on O^2
Cigarette smoke (excessive)	O^2HCO state 2 or 9	If possible use Timezone disablement on O^2. Could give an alarm with high levels of CO (See note 1)
Cooking fumes	O^2HCO state 9	If possible use Timezone disablement on O^2
Direct sunlight	O^2HCO state 0	Fit snouts to beam detector receivers. Other sensors may be used including CO. May delay detection of fire with optical sensors because of thermal barrier effect. Avoid use of Flame detectors.
Dry Ice (CO_2)	O^2HCO state 9	All optical sensors are unsuitable
Dust (temporary eg. builders' clear up period)	Fit dust covers to sensors	Remove sensors altogether
Dust or lint (excessive)	O^2HCO state 9 or Flame	All optical sensors are unsuitable
Fork lift trucks and cranes	Aspiration and Beam **	Watch out when using beam detectors
Fire appliance – gas (clean burning)	O^2H state 0	See rapid temperature changes
Fire appliance – wood, coal, coke or flame effect gas	O^2H state 8	See rapid temperature and dust. Do not use Flame or CO
Fumes for hot oil based machines (suds etc.)	O^2HCO state 9	All optical sensors are unsuitable
Gas (battery charging, animal house)	O^2H state 0	CO sensors are unsuitable
High humidity (up to 95% RH)	O^2H state 0	Generally OK for all types, if humidity levels are constant. Continuous operation in high humidity environments may reduce the life expectancy of the sensor.
High powered electro-magnetic equipment	O^2H state 0	Avoid placing detectors or FDA cables near equipment (X-ray machines, scanners etc)
Insects and harvest flies	O^2HCO state 0 or 9	Excessive infestation of insects may cause a delayed response in O^2H as it can reduce the sensitivity of the optical chamber
Low humidity (less than 15% RH)	O^2H state 0	CO sensors should not be used in continuously dry environments
Rapid air changes	O^2H state 0	May delay detection dependent on location and direction / speed of air flow. Aspiration detection is an alternative
Soldering	O^2HCO state 9	If possible use Timezone disablement on O^2
Spiders (small)	O^2HCO state 9	All optical sensors including beams are unsuitable
Steam or water vapour (excessive / constant)	O^2HCO state 9	All optical sensors are unsuitable
Steam or water vapour (occasional / light)	O^2HCO state 0	O^2 will withstand quite high levels, O^2 may have delayed action
Temperature – high ambient	H state 5 or O^2H state 5	Suitable range 40°C to 65°C
Temperature – low (permanently below 0°)	Aspiration detectors	Use Heat state 0 but avoid fitting near open doors
Temperature – rapidly changing	H state 13	Fixed temperature operation only
Vehicle exhausts (occasional)	O^2HCO state 9 or O^2H state 8	Could give an alarm with high levels of CO (See note 1)
Welding or brazing	H state 13 or O^2H state 8	Type of welding must be known before selecting other sensor type

Note:

1) High levels of CO could cause physical damage to occupants therefore alarm is desirable but CO elements should not be relied on for sensing gas leaks.

2) Heat detectors configured to state 0 are suitable for all risks unless otherwise indicated.

3) An O^2H device should always be used in preference to an OH, where a specific unwanted alarm risk could occur.

The Vigilon System

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