Report

Full-scale test of fire detection in a facade using heat detection cable and flame detector

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SUMMARY:
This report presents a full-scale test carried out 31 January 2017 in which the objective was to find out how much the fire progresses before it is detected by a heat detection cable mounted in a steel pipe, and a flame detector.

In the setup being tested the flame detector detected the fire almost immediately after ignition. The heat detection cables mounted in steel pipes did not detect the fire until it had spread all the way to the pipes.

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1	2017-12-14	First version. English version of report A17 20188

Contents

1 Introduction

The objective was to carry out a full-scale test in order to find out how much the fire progresses before it is detected by two heat detection cables in a steel pipe mounted under the rafter in two different hights, and a flame detector.

2 Experimental setup

2.1 RISE Fire Research's large test hall

The tests were carried out inside a large test hall at RISE Fire Research, Trondheim. The hall is equipped with a ventilation system to which air is supplied through ducts in the floor, and which is vented by ceiling fans. The tests were carried out with the ventilation system shut off. A schematic overview of the hall is presented in Figure 2-1.

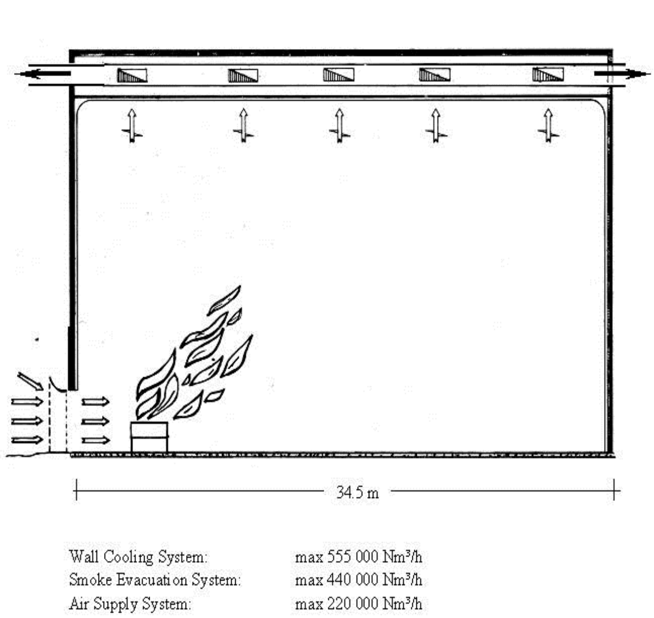


Figure 2-1 Overview of dimensions and ventilation for SP Fire Research's large test hall.

2.2 Test facade

The experimental setup consisted of a wall constructed by OSB boards. The wall was 4.8 m wide and 2.5 m high, with a 0.5 m roof overhang held up by rafters with a 0.6 m centre distance. Figure 2-2 shows a drawing of the wall, and photos of the wall are shown in Figure 2-3 and Figure 2-4. The middle part of the wall was covered with 3 mm thick plywood with ignition time measured to be below 35 seconds and spreading to 350 mm mark was less than 100 seconds when tested according to IMO Res. A.653(16). This is equivalent to the plywood used in IMO Res. 265(84) [1,2].

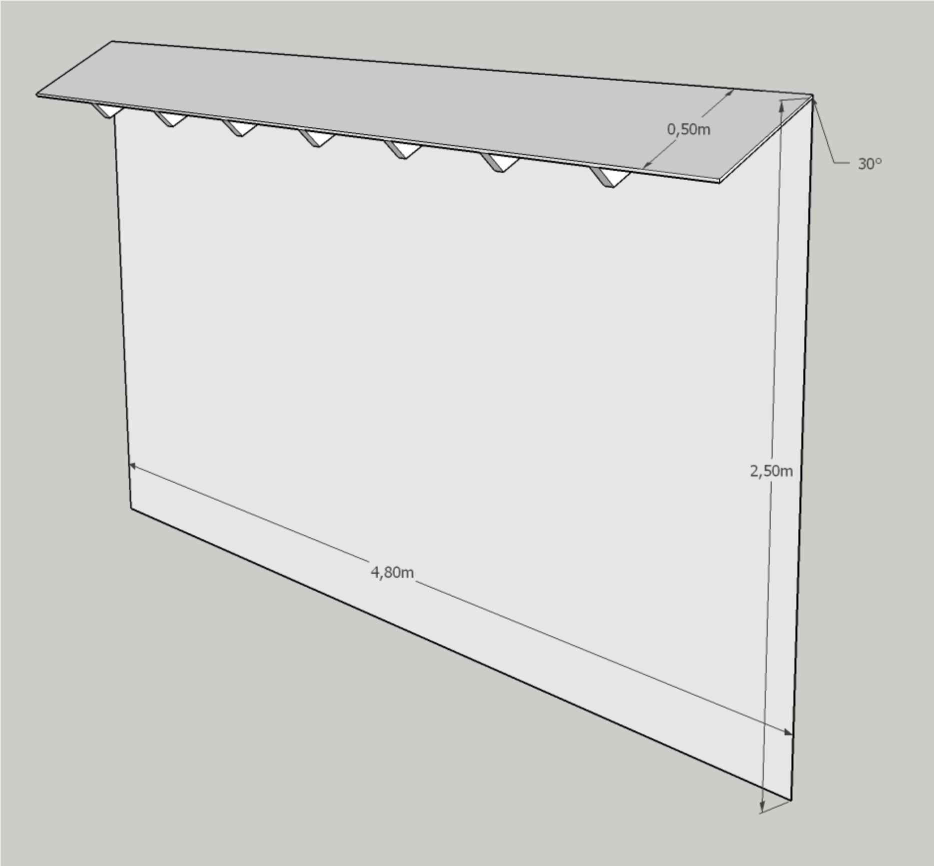


Figure 2-2 Drawing of the wall used during the test.

Figure 2-3 **The test wall seen from the front. The flame detector can be seen in the top right corner, with the lower heat detection cable being placed in a steel pipe. The second heat detection cable is mounted under the ceiling.**

Figure 2-4 Overview of the test wall seen from the side showing the flame detector and the position of the two steel pipes holding a heat detection cable.

2.3 Detectors

2.3.1 Heat detection cable

According to the product data sheet submitted from the client, Honeywell TH 88 is a heat detection cable that short circuits at 88 °C. See product data sheet in appendix A. The heat detecting cable was mounted in a steel pipe with an exterior diameter of 16 mm and 1.2 mm material thickness.

The detector system used was selected, delivered and installed by the customer. RISE Fire Research has no knowledge as to whether the properties of the tested product represent average product properties.

2.3.2 Flame detector

The flame detector used for the test was an Autronica Autroflame IR flame detector BG-201. See product data sheet in appendix B.

The detector system used was selected, delivered and installed by the client. RISE Fire Research has no knowledge as to whether the properties of the tested product represent average product properties.

2.4 Instrumentation

2.4.1 Temperature

All thermocouples were logged with RISE Fire Research's logging system with a frequency of 1 Hz.

To measure gas temperature encapsulated thermocouples type K with 1.5 mm diameter were used. Gas temperature was measured 5 cm above the fire source, and on the upper edge of the pipes holding the heat detection cables, 5 cm from the wall.

2.4.2 Photos and film

Photos and video were taken where relevant, to document the tests.

3 Test procedure

The heat detection cable was placed in a steel pipe as described in chapter 2.3.1 and attached to the wall using steel cable clips of two heights; 2.0 m and 2.4 m, above ground level. The flame detector was mounted in the top right corner of the wall so that the detection area covered the entire wall.

The fire was lit at the wall's centre by means of a FM Global standard igniter, which consists of a roll of cellulose wadding, diameter 7.6 cm, length 15.2 cm. The wadding was moistened by 23.5 cl heptane and put into a polyethylene bag.

4 Results

It took 6 seconds from the fire source was ignited until the flame detector detected the fire. Figure 4-1 gives an overview of the stage of fire at the point of detection.

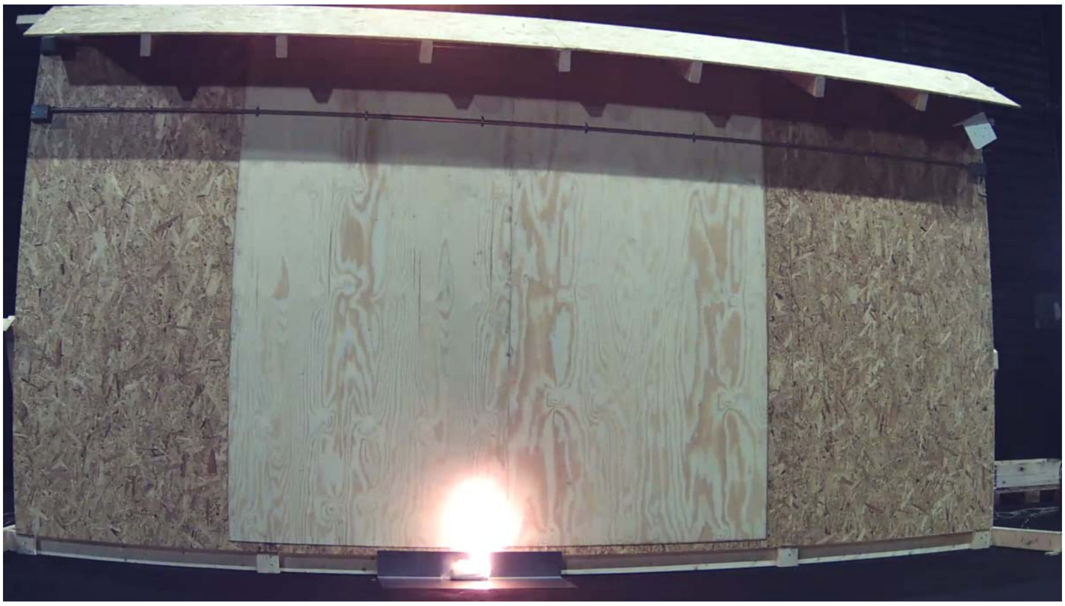


Figure 4-1 Stage of fire as the flame detector detected the fire, 6 seconds after ignition.

After around fire minutes the fire decreased. The temperature at both heat detection cables had then remained stable at around 100 °C. As the fire had decreased the plywood sheets were broken up in order for the fire to reach more materials and spread upwards. After 7 minutes and 55 seconds the heat detection cable installed at 2.0 m detected the fire, and 25 seconds later the heat detection cable installed at 2.4 m detected the fire. The stage of fire in each of the cases is shown in Figure 4-2 and Figure 4-3 respectively.

Figure 4-2 **Stage of fire as the lower heat detection cable detects the fire, 7 minutes and 55 seconds after ignition.**

Figure 4-3 **Stage of fire as the upper heat detection cable detects the fire, 8 minutes and 20 seconds after ignition.**

The fire was extinguished 25 seconds after the last heat detection cable detected the fire. Damage to the wall after the test is shown in Figure 4-4. An overview of temperatures measured on the top side of each pipe is shown in Figure 4-5.

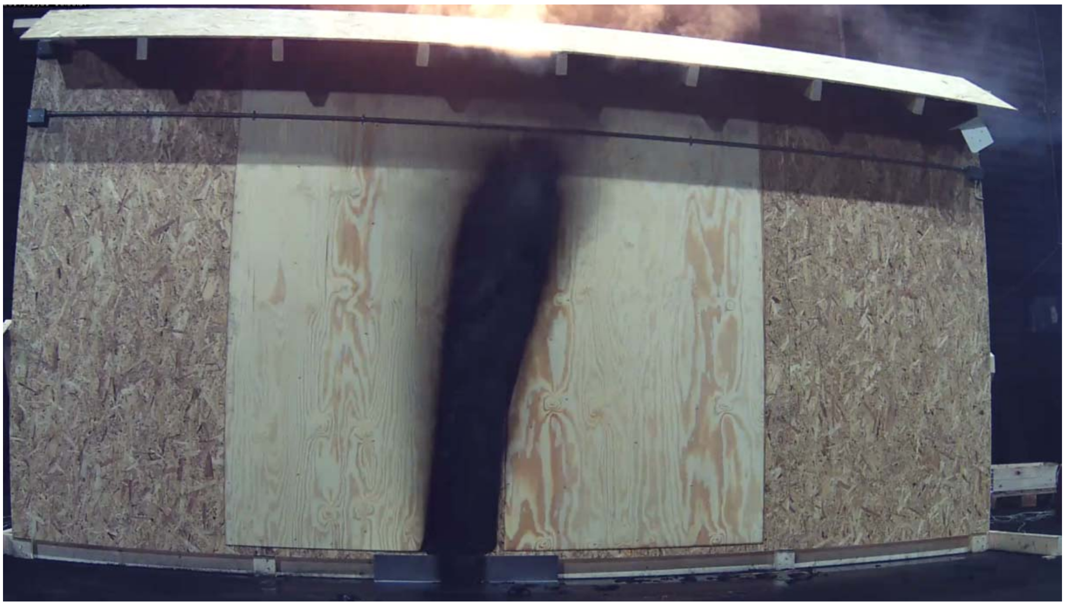


Figure 4-4 **Damage to the wall immediately after the fire had been extinguished, 8 minutes and 44 seconds after ignition.**

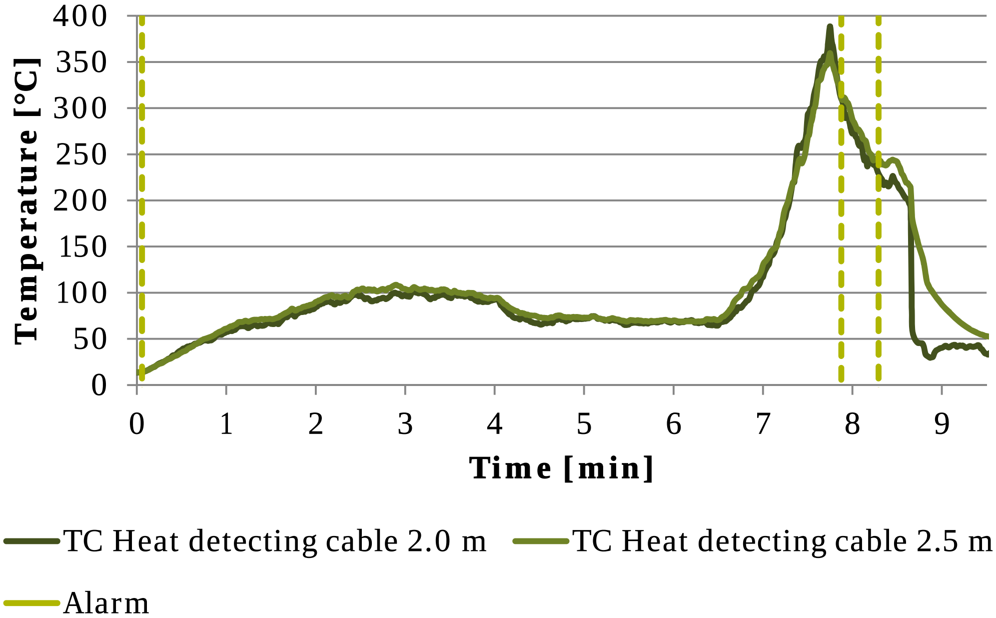


Figure 4-5 **The graph shows temperatures measured immediately above the pipes holding the heat detection cables. The detection times of the flame detector and the two heat detection cables are shown in vertical lines.**

5 Discussion

The flame detector detected the fire after 6 seconds. However, the distance between the detector and the fire was approximately 3.0 m, while the detector is approved for distances up to 25 m. The short distance may have impacted on the detection time, which means that the detection time may be longer in real fires.

A small igniter was selected, so that the flame detector would not detect the igniter, but the fire on the wall. A large start fire would have resulted in the fire spreading at a quicker pace, and it would not have decreased as observed in this case. The fact that boards instead of planks were used as surface, combined with the ventilation conditions, may have impacted on the growth of fire during the test. It is therefore important not to regard time until activation as a parameter, but rather compare the stages of fire at the points when the different detectors responded to the fire.

About three minutes into the test, stable temperatures around 100 °C were measured close to both pipes holding the heat detection cables, without these being able to detect the fire. A photo showing the stage of fire at this point is shown in Figure 5-1. The fact that the heat detection cable does not respond to the fire is in line with tests carried out in flame spread setup described in SPFR report F17 20188:01 [3], in which an equivalent heat detection cable mounted in steel pipe over a period of 30 minutes did not respond to temperatures around 100 °C. Figure 4-5 shows that a flame detection cable in steel pipe requires temperatures between 250 and 350 °C over half a minute period in order to detect a fire. The lower cable detects the fire first, however, the time difference between the two cables is marginal. This corresponds to tests carried out at Western Norway University of Applied Sciences in the spring of 2013 [4].

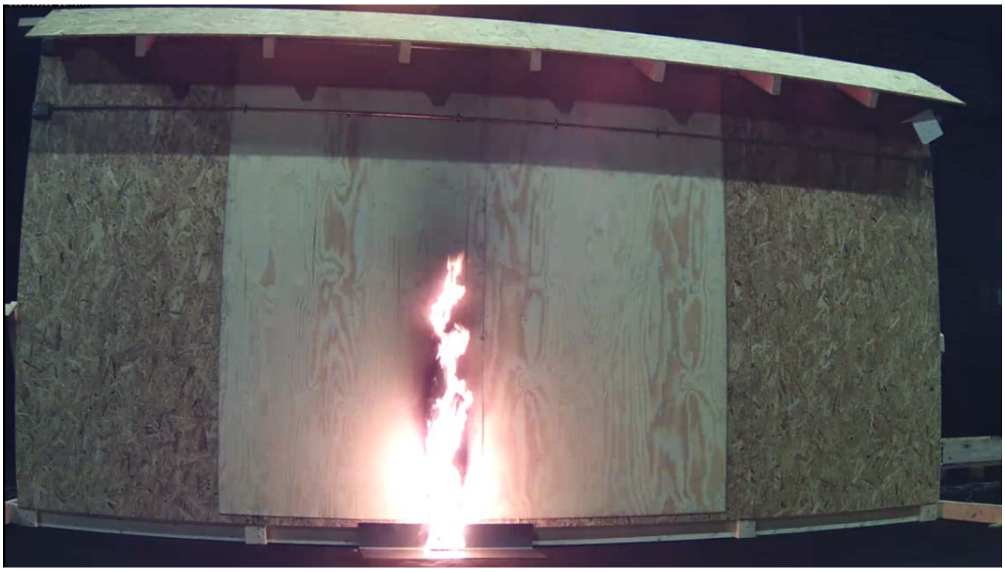


Figure 5-1 Stage of fire after 2 minutes and 53 seconds as temperatures surrounding the cable are stable at approx. 100 °C.

6 Conclusions

The flame detector detected the fire almost immediately after ignition. The heat detection cable mounted in steel pipe did not detect the fire until it had spread all the way to the cable.

Bibliography

1. IMO 2010 FTPC Part 5 - Test for surface flammability (test for surface materials and primary deck coverings). International Maritime Organization; 2012.

2. IMO Res. MSC.265(84) Annex 14 Amendments to the revised guidelines for approval of sprinkler systems equivalent to that referred to in SOLAS regulation II-2/12 (Resolution A.800(19)). International Maritime Organization; 2008.

3. Olofsson R. Test av stålrørs innvirkning på varmedetekterende kabels aktiveringstid ved ulike fluksnivåer. SP Fire Research AS; 2017. Report No.: F17 20188-01.

4. Rygnestad Helgesen V. Utvendig deteksjon ved verneverdige bygninger. [Haugesund]: Høgskolen Stord/Haugesund; 2013.

Varmedetekterende kabel

Honeywell

- **Kommer i 50 og 100 meters ruller**
- **UL-godkjenning S9029/S8976**
- **Enkel installasjon**
- **Kan skjøtes**

Artikkelnummer:

TH 68.	**50m**	**243024.4**
TH 68.	**100m**	**243024.5**
TH 88.	**50m**	**243024.6**
TH 88.	**100m**	**243024.7**
TH 105.	**50m**	**243024.8**
TH 105.	**100m**	**243024.9**
Festeklips for kabel		**243024.3**

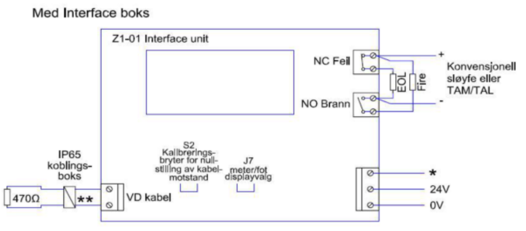
Elteks varmedetekterende kabel baserer seg på to-lederkabler som kortslutter ved en gitt temperatur: 68°C (lilla kabel), 88°C (hvit kabel) og 105°C (hvit kabel). Disse kablene kan kobles mot Eltek DA, via Tam/Tal moduler, eller via en interface enhet hvor man kan få lokal angivelse av antall meter ut på kabelen brann har oppstått.

Festeklips skal benyttes med 1 meters mellomrom. Festeklipsene sørger for anbefalt avstand fra underlag, ca 2 cm.

Tekniske data

- Ytre Diameter: 3.5mm
- Ledere: kobberbelagt Stål
- Merkespenning: 30VAC (42.2Vdc), 10A
- Resistans: 100 ohms/km maksimum pr. leder
- Minimum bøyeradius: 100mm

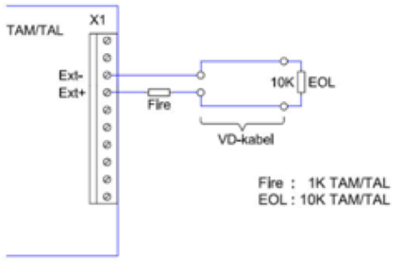
Kobling mot Interface



** Tilførselskabel med inntil 50Ω motstand kan tilkobles dersom Interface enheten plasseres på et annet sted enn der deteksjonsområdet starter. Interface modulen må kalibreres dersom tilførselskabel benyttes for å kunne gi korrekt lokasjon på varmedeteksjonen.

* 24V fra detektorsløyfe - gir lavt strømforbruk, men ikke bakgrunnsbelysning.
24V fra ekstern kilde m/bakgrunnsbelysning

Kobling mot Tam/Tal



Honeywell Life Safety AS er ISO 9001 sertifisert og produserer og håndterer alle produkter i henhold til RoHS (2002/95/EC) og WEEE (2002/96/EC).

Eltek Fire & Safety by Honeywell

Honeywell Life Safety AS

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B Product data sheet - flame detector

AUTROFLAME IR FLAME DETECTOR BG-201

Interactive fire detection systems
Product Datasheet

Features

- Interactive
- Different sensitivity settings possible
- Short circuit isolator in each detector
- Comprises a built-in alarm indicator (LED)
- Automatic addressing
- Solar resistant
- Very fast fire detection
- Not blinded by oil film on window
- High degree of immunity to false alarm sources
- EN54-10, EN54-17 approved
- Designed to meet the requirement of the major maritime classification societies

Description / Application

BG-201 is a point flame detector for detection of fires involving combustion of carbonaceous materials.

The detector has a high IP rating making it suitable for the harshest environments.

Performance class can be configured by the AutroSafe/Autroprime system according to table 1.

The advanced signal processing and DYFI+ intelligence ensure that the detector has a high immunity to any nuisance alarm source combined with fast detection of real fires. This makes the BG-201 detector the obvious choice for demanding applications such as a ship's engine room.

Note:
Accumulation of water, ice, snow or other pollution on the sensor window may affect the sensitivity of the detector. In order to maintain the detection range (table 1) the glass must be cleaned regularly.

Principle

Two infrared sensors detect the infrared spectrum from a fire. The sensors evaluate different parts of the infrared spectrum using this information to verify that the signals correspond to the characteristics of a real flame.

116-BG201/CGB, rev. A, 2017-01-18

Protecting life, environment and property

Technical specifications	
Weight	210 g
Materials	Polycarbonate, sapphire glass
Colour	Transparent / light grey
Sensitivity	Ref. Table 1
Field of view	Horizontal=+/-45°, Vertical=+30°/ -45° (see the Field of view diagram below for additional EN 54-10 information)
Voltage:	Supplied from detector loop
Current consumption: Stand by Current consumption: Alarm LED on	90 µA 2,1 mA
CPD certificate	0832-CPD-1999
Degree of protection	IP66 and 67
Working temperature	-40 to +70°C
Storage temperature	-50 to +70°C
Humidity	0-96 % rh, can withstand 100% condensing humidity for short periods of time
Maintenance	Cleaning of window
Service	Replace if faulty
Cable size	Maximum cable 2,5 mm2 / AWG14
Approvals	See website

Table 1 - Performance classes (EN 54/10)	
Performance class	**Range**
Class 1	Up to 25 m
Class 2*	Up to 17 m
Class 3	Up to 12 m

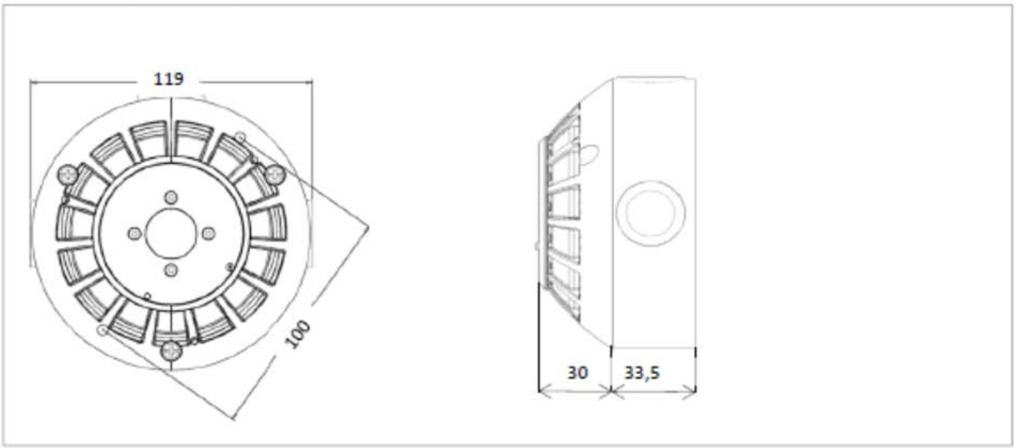
*In Legacy mode only class 2 is available

Table 2 – Mode selection	
Mode selection, cutting of jumper J4 on PCB	**J4**
STANDARD: AutroSafe / Autroprime mode	
LEGACY: FDI compatible mode	

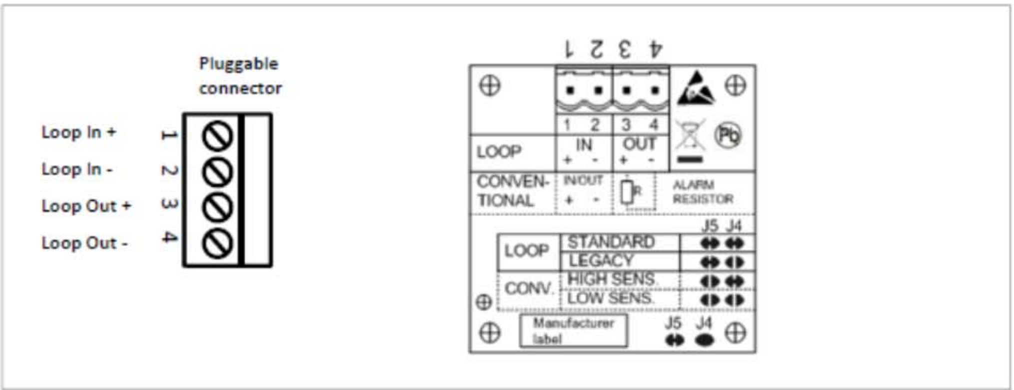
AutroFlame IR flame detector BG-201

Product Name	Part number	Description
BG-201	116-BG-201	AutroFlame IR flame detector
BG-201F	116-KITD-BG-201F	Facade security BG-201

Dimension Drawing (mm)



Connection Al_Com loop



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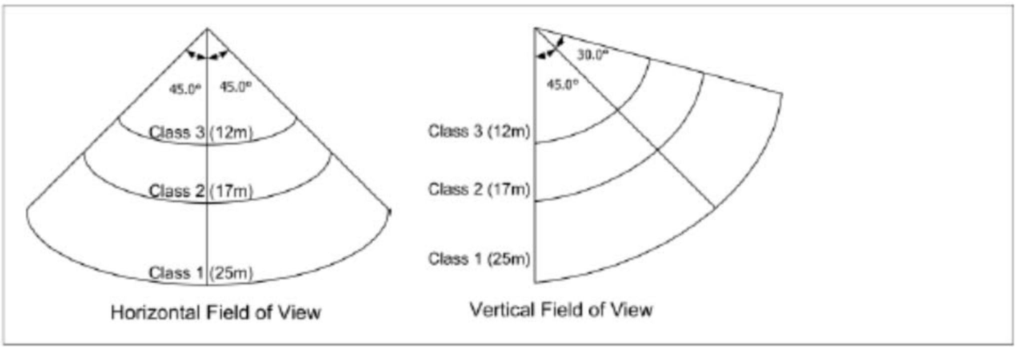
Field of view



To comply with the directional dependence requirements for EN 54-10:2002 an angle of ±30° from 0° (0° = Orientation of detector in same axes as flame source) should not be exceeded, based on lab testing at a distance of approximately 5.0 ft (1.5 m).

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