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**ASSESSMENT REPORT IFCA/04231**

**Field of Application of Astroflame Astro Pillow  
Intumescent Pillows, when used to protect  
Penetrations in fire resisting walls and floors**

Prepared on behalf of:

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## 1. INTRODUCTION

This report has been prepared by International Fire Consultants Ltd, on the instruction of Astroflame (Fire Seals) Ltd, hereafter referred to as Astroflame, for our assessment of the fire resistance contribution provided by Astroflame Astro Pillow Intumescent Pillows.

Products contributing to fire resistance are rarely supplied in an identical form to that which was tested. The specification will invariably require the components to be supplied to fill an aperture of a different size, orientation or with services, which are different from that tested. The result of a fire resistance test can apply to variations in service configurations/constructions as long as they do not reduce the performance to one which is below that specified. The influence of those variations is covered by a judgement, sometimes made by the approving authority.

Where the approving authority does not feel able to make such judgements, an expert opinion is often sought. Such an opinion is often expressed in the form of an assessment of the performance, which may be supported by numerical/quantifiable methods or may be purely an expert judgement.

When establishing the variations in the construction that can achieve the required fire resistance performance, International Fire Consultants Ltd follow the guidance given in BS.ISO/TR12470: 1998, *"Fire resistance tests - Guidance on the application and extension of results"*.

The assessment is based upon the constructional information supplied to us (detailed in Section 3 and upon the fire resistance test evidence for parts of the constructions (detailed in Section 4. A full analysis of the fire resistance performance of these assemblies is presented in Section 5.

## 2. PROPOSAL

It is proposed that this assessment will establish the performance of Astroflame Astro Pillow Intumescent Pillows in the following applications;

- a) Sealing of apertures of up to 600mm x 600mm (240 minutes) or 850mm x 850mm (120 minutes).
- b) Sealing of apertures in vertical wall or horizontal elements.
- c) Sealing apertures in concrete, blockwork, brickwork or plasterboard clad wall constructions, or concrete floor slabs.
- d) Maintaining the performance rating with respect to integrity and insulation for period up to 4 hours and 2 hours, respectively, subject to limitations defined in Section 5 herein.

In the absence of a bespoke test for establishing the fire resistance of penetration seals, the performance is to be adjudged against the integrity and insulation criteria of BS476: Part 22: 1987.

### 3. DESCRIPTION OF PRODUCT

Astroflame Astro Pillow Intumescent Pillows consist of a high quality high temperature resisting fabric pillow which contains a combination of components, the construction and formulation of which are lodged with International Fire Consultants Ltd, in confidence.

The pillows are available in the following sizes:

300mm x 200mm	(Large)
300mm x 150mm	(Medium)
300mm x 100mm	(Small)
300mm x 50mm	(Trunking)

The Astroflame Astro Pillow Intumescent Pillows can be used as a temporary or permanent fire stop in trunking and cable trays. They can also be used to fill gaps around services where access is required for maintenance or additional services. The pillows are located centrally within the thickness of the wall, (with the 300mm dimension of the pillows passing "through" the wall thickness), and are retained in place by their own weight and by induced friction. Alternatively, they can be used for stopping-off apertures within floor slabs, in which case a supporting grid must be placed within the aperture being fire stopped in order to support the weight of the pillows. The pillows are placed so that they are flush with the upper face of the floor slab, and positioned to provide a 300mm depth of firestopping to the horizontal construction element.

### 4. TEST EVIDENCE

The following test evidence has been considered in producing this assessment.

#### 4.1 WARRES R13046

This test was undertaken on the 8th August, 1996 at Warrington Fire Research Centre using the general methodologies of BS476: Part 20: 1987.

In this test a floor specimen 200mm thick constructed from lightweight reinforced concrete containing an aperture 600mm x 600mm was evaluated.

Within the opening of the concrete slab was secured a 153mm x 15mm galvanised steel cable tray, nominally 1475mm long. The tray was mechanically fixed to the floor slab by a Dexion triangular framework. Tied to the tray via plastic cable ties and steel wire, were 3 No. cables; 1 No. 22.5mm overall diameter, sheathed and armoured, with 4-core sheathed strands containing 7 No. copper wires each; 1 No. 17.5mm overall diameter, sheathed and armoured, with 4-core sheathed strands containing 7 No. copper wires each; and 1 No. 12.5mm overall diameter, sheathed and armoured, 3-core sheathed strands. The overall length of each cable was a maximum 1130mm.

A basket of galvanised wire mesh of 50mm x 50mm squares, with a wire diameter of 2.5mm was lowered into the opening and mechanically fixed to the floor slab and shaped around the cable tray. Within the basket were packed intumescent pillows – 30 No. of 300mm x 200mm; 6 No. of 300mm x 100mm and 5 No. of 300mm x 150mm. Above the pillows and the opening was laid another piece of galvanised steel mesh (approximately 910mm x 970mm) tied with wire to the exposed overlapped mesh of the basket.

The specimen was subjected to the furnace temperature and pressure conditions appropriate to BS476: Part 20: 1987 and the fire performance achieved are summarised as:

<b>Integrity</b>	:	<b>240 minutes</b>
<b>Insulation</b>	:	<b>113 minutes</b>

The fire test was terminated after 240 minutes with no loss of integrity. As the Intumescent Pillows reacted to the heating conditions of the fire test, they expanded and ruptured. The Intumescent pillows remained in place due to the restraint of the wire basket. The edges of the aperture in the concrete floor slabs were recorded as glowing at the end of the fire test, however this is not recorded as constituting an integrity failure. The insulation criteria was exceeded after 113 minutes when a thermocouple located on the largest cable positioned 25mm away from the Intumescent pillow recorded a temperature of 198°C (T/C 36).

## 5. ANALYSIS

The following analysis evaluates how the above test evidence relates to the use of the proposed Intumescent Pillows sealing system and addresses the following parameters.

- Fire resistance of Astroflame Astro Pillow Intumescent Pillows
- The orientation of the element
- The maximum size of aperture which may be sealed by the system
- The nature of the penetrating services
- The nature of the associated construction

## 5.1 Analysis – Floor Penetrations

Test WARRES R13046 demonstrated that a 200mm thick lightweight reinforced floor slab with an aperture 600mm x 600mm supporting a cable tray achieved 240 minutes integrity and 113 minutes insulation performance, when protected by intumescent pillows.

The insulation performance was measured on the penetrating cable tray and cables 25mm distance from the surface of the Intumescent Pillows. The maximum allowable criteria (180°C rise above ambient) was exceeded after 113 minutes as measured on the largest penetrating cable (22.5mm diameter).

After 120 minutes fire test duration the temperature on the largest cable and the cable tray were recorded as 185°C and 132°C above ambient respectively. It is unclear from the fire test report if there were any signs of localised heating of the large penetrating cable. The ability of the Intumescent Pillows to adapt to the shape of the penetration and to provide a closeness of fit thereby limiting the presence of voids along the length of the penetrating cables, is dependent on the assembly of the pillows within the aperture.

The fire test methodology is subject to operating tolerances. This, combined with variations in the installation of the Intumescent Pillows, indicate that the insulation performance may be limited to 120 minutes provided that the maximum cable penetration does not exceed 23mm in overall diameter.

## 5.2 Analysis – Wall Penetrations

In test WARRES R13046 a 200mm thick floor slab included an aperture 600mm x 600mm accommodating a 153mm wide galvanised steel cable tray. The aperture was fire stopped with Intumescent Pillows tightly packed into place. The Intumescent Pillows were supported by a wire basket which prevented any of the Intumescent Pillows from becoming dislodged. During the fire test the Intumescent Pillows remained in place and when exposed to the fire conditions during the fire test the Intumescent Pillows contents expanded resulting in some of the Intumescent Pillows becoming ruptured. The expanding Intumescent Pillows pushed the upper mesh layer upwards away from the upper concrete floor slab surface.

If the Intumescent Pillows had been arranged in an aperture of equal size in a vertical wall element it would be reasonable to expect the Intumescent Pillows to react in a similar manner. The wire mesh support would not be required when the Intumescent Pillows are placed within a wall penetration, provided that they are carefully and tightly packed into place. The pillows are supported by the lower edge of the wall aperture, and then by each other, once stacked.

A vertically arranged test sample of an aperture fire stopped using Intumescent Pillows tested under the methodologies of BS476: Part 20: 1987 would be subjected to a lower furnace pressure depending on its location in the vertical element and would not have gravity acting against the pillows. Therefore it is reasonable to expect at least an equal fire resisting performance to that demonstrated in WARRES R13046, as long as any penetrating services are independently supported on both sides of the opening.



### 5.3 Maximum size of Aperture

The maximum size of aperture tested was 600mm x 600mm as demonstrated in WARRES R13046. Because of limited fire test evidence the maximum approved aperture size is limited to this for 240 minute applications. Any aperture within a horizontal element is also limited to the fire tested specimen size provided that the Intumescent Pillows are fully supported in a wire mesh system as tested, if they are to provide 240 minutes integrity.

When the vertical or horizontal aperture is only required to maintain integrity for 120 minutes then it is reasonable to believe that the area of the aperture could be increased by a factor of 2, as the degradation in the pillows was considerably less after 2 hours, especially as the thermal exposure at 2 hours is less than half of that received over 4 hours. As a consequence it is International Fire Consultants opinion that Astro pillows in apertures of up to 850mm x 850mm can be approved if 120 minutes integrity and insulation is required.

### 5.4 Associated Construction

The associated construction supporting the Astroflame Astro Pillow Intumescent Pillows must be able to provide the required level of fire resistance performance. Therefore the thickness of the construction element shall be such that the fire resistance performance can be met. In any board lined construction the aperture needs to be fully lined-out on all edges with steel studs or similar. The pillows shall be arranged within the aperture to provide a depth of seal of 300mm. The pillows can only be arranged in this manner if the thickness of the vertical element can provide sufficient support for the Intumescent Pillows.

The horizontal construction elements are not subjected to the same thickness limits as additional support is provided by the wire basket arrangement. The horizontal element shall be able itself to provide the fire resistance performance.

### 5.5 Penetration Types

The insulation properties of any penetration through a sealed aperture may vary depending upon the individual thermal properties of the penetration service. However, test R13046 demonstrated that the proposed Intumescent Pillows achieved 240 minutes integrity performance when firestopping an aperture containing a 153mm wide galvanised steel cable tray. Alternative sized cable trays may be accommodated provided that a minimal edge cover of 100mm is provided. The number and configuration of the penetrations must be such that there is sufficient space to allow the Intumescent Pillows to be positioned around the penetrations forming a close contact seal around all sides of each penetrations. No penetration should be positioned against the edge face of the aperture.

*John G. Gough*

Non-combustible pipes (steel or copper) may be accommodated provided that their overall diameter does not exceed 23mm.

All service penetrations must be fully supported such that the service penetration does not impose any static load on to the Intumescent Pillows. The support to the penetration must also be able to provide a means of support for the required fire resistance period when subjected to BS476: Part 20: 1987 methodologies, such that there is no excessive thermal distortion or movement that would allow the penetration to cause premature integrity failure.

## 6. CONCLUSION

It is International Fire Consultants Ltd opinion that if apertures in horizontal or vertical construction elements (i.e. floor slab and walls) were to be fire-stopped with Astroflame Astro Pillow Intumescent Pillows, and evaluated with respect to the general methodologies of BS476: Part 20: 1987, then fire resistance periods of up to 240 minutes integrity and 120 minutes insulation performance would be achieved on apertures up to 600mm x 600mm. As the insulation failure was on the service penetration the insulation performance may be enhanced by the application of a proven insulated coating compatible with the service. Apertures of up to 850mm x 850mm are able to provide integrity and insulation ratings of up to 120 minutes when adjudged by the same standard.

This assumes that the Astroflame Astro Pillow Intumescent Pillows are correctly installed in compliance with any recommendations given in 5 above, and remain in full contact with the supporting construction and associated penetrations and that the services are independently supported.

## 7. LIMITATIONS

This assessment addresses itself solely to the ability of the Astroflame Astro Pillow Intumescent Pillows described to satisfy the criteria of the fire resistance test and does not imply any suitability for use with respect to other unspecified criteria.

The opinions regarding contribution of the Astroflame Astro Pillow Intumescent Pillows are subject to the construction of the elements complying with the specifications appropriate to the duration.

Where the constructional information in this report is taken from details provided to International Fire Consultants Ltd (IFC) and/or from fire resistance test reports referenced herein, it is, therefore, limited to the information given in those documents. It is necessarily dependent upon the accuracy and completeness of that information. Where constructional or manufacturing details are not specified, or discussed herein, it should not, therefore, be taken to infer approval of variation in such details from those tested or otherwise approved.



Where the assessed constructions have not been subject to an on-site audit by International Fire Consultants Ltd, it is the responsibility of anyone using this report to confirm that all aspects of the assemblies fully comply with the descriptions and limitations herein.

Any materials specified in this report have been selected and judged primarily on their fire performance. IFC do not claim expertise in areas other than fire safety. Whilst observing all possible care in the specification of solutions, we would draw the reader's attention to the fact that during the construction and procurement process, the materials used should be subjected to more general examination regarding the wider Health and Safety, and CoSHH Regulations.

## 8. VALIDITY

This assessment has been prepared based on International Fire Consultants Ltd's present knowledge of the products described, the stated testing regime and the submitted test evidence. For this reason anyone using this document after November 2007 should confirm its ongoing validity.

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