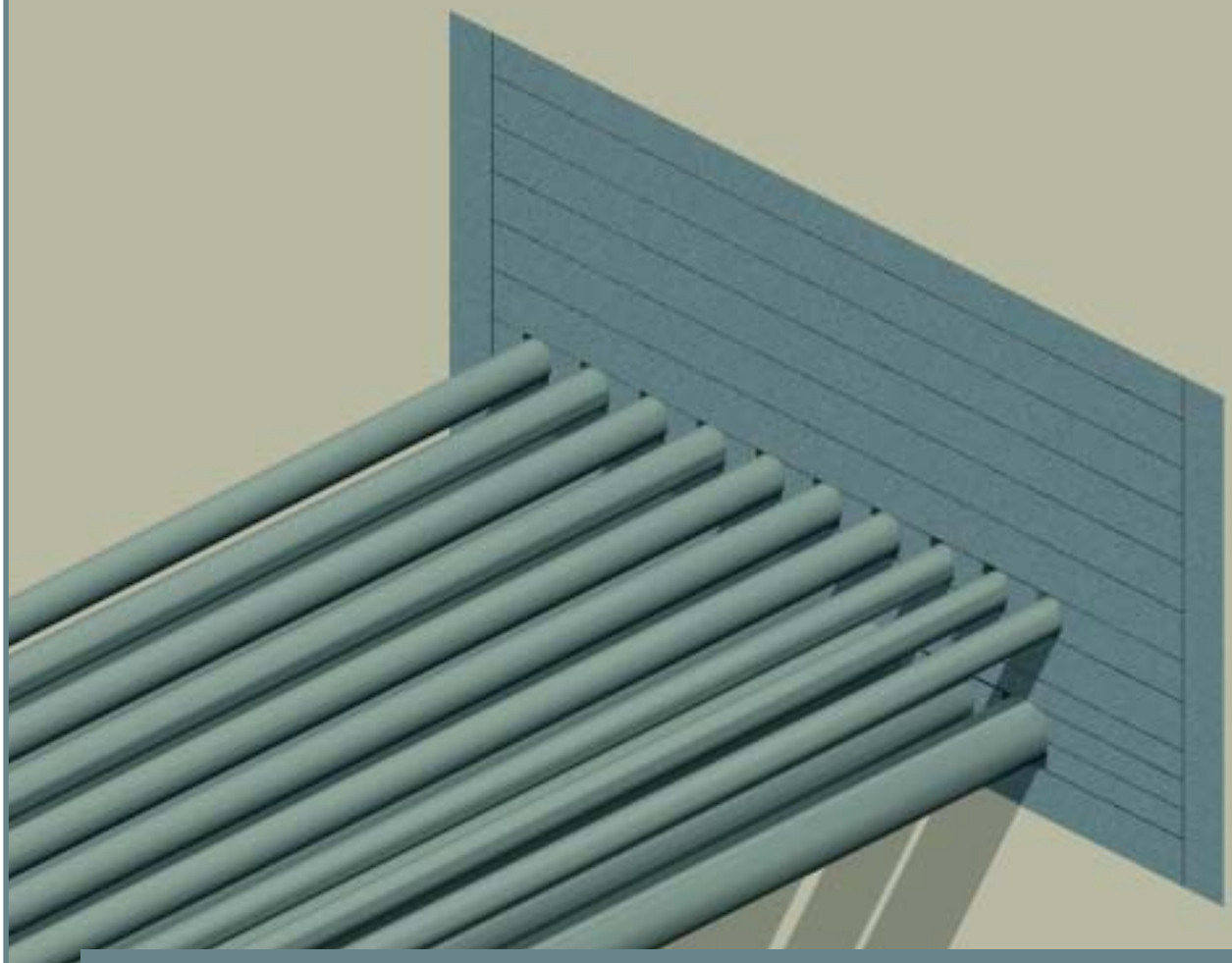
ACTIFOAM®

SEALING SYSTEM FOR FIRESAFE DUCTING OF CABLES IN BUILDING AND INDUSTRIAL APPLICATIONS



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INNOVATIVE TECHNOLOGY

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BEELE Engineering/CSD International: the inventors of the ACTIFIRE® technology

The ACTIFIRE® technology was developed specifically to allow mechanical loads on the construction caused by fire to be absorbed. This technology is designed to enable the sealant materials used to perform an active and fire-resistant function during a fire. This function is not achieved by volume-expanding (intumescent) materials, whose surface structure swells during fire and thereby provides thermal insulation for the materials behind, but materials that when exposed to high temperatures or fire will produce new fire retardant material (in large volume).

The purpose of ACTIFIRE® technology is to ensure that during a fire the rubbers, thermoplastics and compounds used for the seal will produce such an amount of fire retardant material that major deformations or displacements can easily be followed. As a result the penetration will remain fire-tight. The higher the temperature, the more fire retardant material will be produced. Because of this “active material production”, in the event of a fire an elevated pressure will be formed inside the penetration. The result is that a virtually solid rubber mass forms inside the penetration, with which its fire resistant and sealing capacity is effortlessly maintained.

In addition, “excess” new material produced is forced out of the penetration at the exposed side (together with all the softened plastic materials of the cable sheaths). The expansion caused in this way not only effectively lengthens the penetration but it also compensates for the displacements and substantially extends the withstand time in a fire.

This production of extra fire retardant material during fire is not only necessary in order to absorb the resultant deformations and displacements of the construction and conduits. This extra fire retardant material also fills up the openings which are left by the softening and combustion of cable sheathing and insulation.

The development of the ACTIFIRE® technology has the added benefit that the sealing systems which are manufactured on the basis of this technology are far less vulnerable for inadequate maintenance than existing systems.
Even if a cable is removed from the penetration without sealing the remaining opening, the ACTIFIRE® technology will ensure that this opening is immediately compressed in the event of subsequent fire or elevated temperature.

This means a significant reduction in the fire engineering risk of cable and pipe penetrations.

The ACTIFIRE® technology is based on a combination of only two components (additives), which are capable of giving virtually all base elastomers fire-retardant properties. The new technology also ensures that, when exposed to flames, fire-retardant ACTIFIRE® rubbers, thermoplastics and compounds will not shrink.

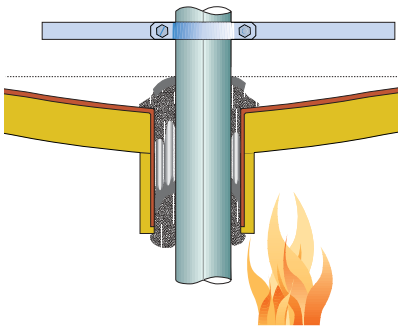
Based on the ACTIFIRE® technology it has proved possible to produce mixtures of rubbers and thermoplastics having an oxygen index far in excess of the minimum value of 30 LOI (Limiting Oxygen Index) which is specified for flame-suppressant materials. Rubber mixtures have even been formulated which exhibit an oxygen index of 85 (an oxygen-rich environment of 85% is required for the rubber to ignite!).

To obtain the flame-suppressant properties, the ACTIFIRE® technology does not make use of halogens, such as chlorine, bromine and fluorine. As a result, a number of rubber formulations (depending on the base elastomer) have been found to comply effortlessly with the values relating to the smoke index and the toxicity of fumes generated by rubber products as set by the Naval Engineering Standard.

The additives to be used for the ACTIFIRE® technology were chosen crucially on the basis of extreme length of lifetime. It is not specified anywhere in the specifications or regulations that fire-resistant sealing systems shall be artificially aged before the systems are tested. And nevertheless, it is known in advance that this kind of systems are characterized by long service lifetimes.

In spite of this omission in the requirements, the new ACTIFIRE® technology is ‘future-proof’. After artificial ageing the flame-suppressant and shrink-resistant properties of various ACTIFIRE® rubbers and compounds, when used at normal temperature, exhibit hardly any difference from those of new material.

The newly developed ACTIEFIRE® technology not only makes a fundamental contribution towards optimizing passive fire prevention systems. The technology also makes it possible to extend the application scope of passive fire prevention to many other sectors. Fire safety in general can therefore be raised to a significantly higher level on board ships and in buildings and installations.



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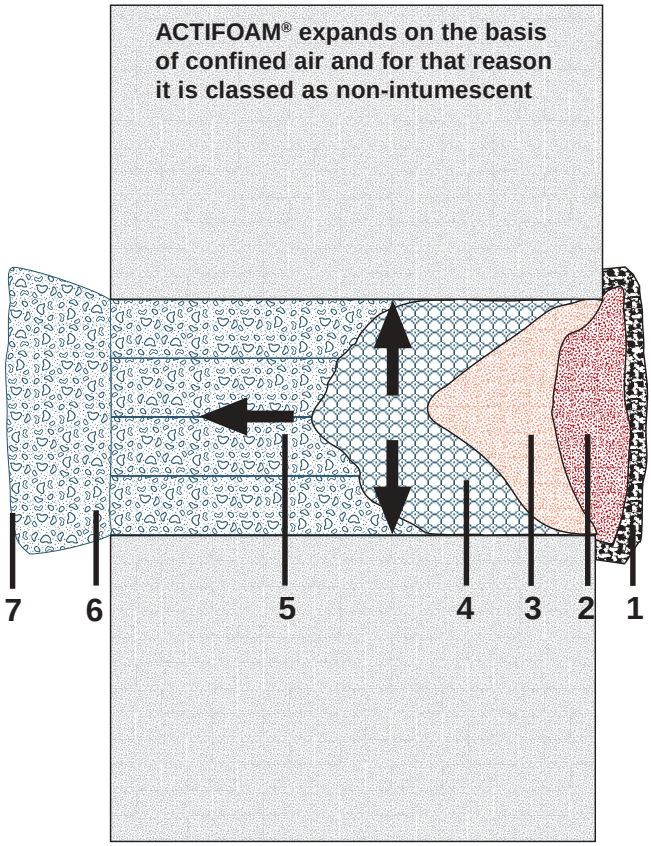
BEELE Engineering/CSD International: the inventors of the ACTIFOAM® technology

Based on the experience gained with the ACTIFIRE® technology in the applications of the RISE ® sealing system, a development has been started up with the goal of further optimizing the technology. In particular for the installations in the construction sector, the RISE® system – although recognized as superior in terms of fire performance – is perceived as being technologically rather too advanced.
For that reason the ACTIFOAM® system has been developed as a derivative of the ACTIFIRE® technology.

Installation of the ACTIFOAM® penetrations is extremely simple. These penetrations also possess outstanding fire performance properties. The functionality of the expansion in the ACTIFOAM® penetrations is exactly opposite to that of the ACTIFIRE® technology. Instead of the length of the penetration being extended by the massive formation of new material at the exposed side, with ACTIFOAM® the expansion is achieved by means of volume expansion of confined air in the cell structure. As a result, the extension takes place at the non-exposed side.

The functionality of the ACTIFOAM® technology



1) at the exposed side some expansion of the foam first occurs at first, and a crust forms under the effect of the fire. This crust encloses the foam and at the same time acts as a shield against the effect of the fire.
This is the protective fire barrier.

2) the foam behind the crust gradually loses its original structure and changes into a fine granular substance consisting of carbon held together by the softened polymer. In this way a second fire barrier is formed whilst some thermal insulation is maintained.
This is the thermal fire barrier.

3) the layer of foam behind is thermally protected, and only those cells coming into contact with high temperatures will burst open. The remaining foam continues to provide insulation on the basis of its closed cell structure. As a result the process of change in the foam structure will steadily diminish.
This is the retardant barrier.
Depending on the length of time it is exposed to fire, this barrier will move further and further into the penetration.

4) the temperature is now such that no more structural change takes place, and the air in the closed cells can expand without the cells bursting. This results in volume expansion of the foam, and in this way all the openings in the penetration are closed off.
This is the sealant barrier.

5) because the foam is enclosed inside the penetration, due to the volume enlargement of the closed cells the foam will expand towards the non-exposed side.
In effect this means that the length of the penetration is extended and therefore the foam rubber mass is given long-term protection against the continuing effects of fire and heat.

6) the foam is held tightly in the penetration. Because of the pressure exerted by the foam mass expanding inside the penetration, some foam will be forced out of the opening. As a result, the foam emerging from the penetration will swell to a larger size than when it was inside the penetration.

7) outside the penetration, the foam is heated only by the cables and pipes that it carries. The surface temperature will remain low and easily comply with the maximum temperature increase of 180°C as required in the standards.
Furthermore, the original cell structure is maintained at the non-exposed side. Therefore the foam remains mechanically intact as well.

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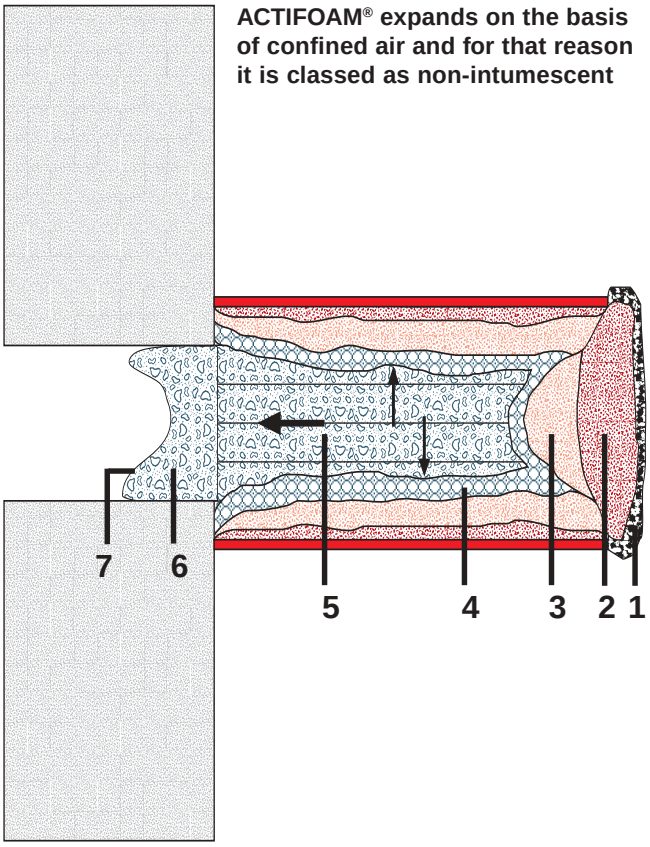
BEELE Engineering/CSD International: the inventors of the ACTIFOAM® technology

Based on the new technology, a number of fire tests have been carried out with FIRSTO® firestops, in which the steel casing was filled with a fire resistant packing of ACTIFOAM® sheets instead of yellow sponges and blue inserts. It was found that even where a firestop was positioned entirely at the exposed side it effortlessly complied with an F-90 fire rating.
The advantage of the ACTIFOAM® technology is that, unlike the FIRSTO® firestops, it is no longer necessary to apply any material in the opening or to install a firestop at each side of the wall.

A debate is currently taking place about so-called intumescent materials, which are used so that in the event of a fire a layered carbon structure will be formed with the objective of providing thermal protection for the materials behind. In the longer term, intumescent materials are thought to be capable of losing their foaming capability as a result of sensitivity to moisture and ageing. For that reason these materials are required under the new regulations to be subjected to a large number of additional tests to demonstrate that their functionality is retained in the long term. Furthermore there is some concern as to smoke emission.

The functionality of the ACTIFOAM® technology



ACTIFOAM® expands on the basis of confined air and for that reason it is classed as non-intumescent

1) at the exposed side some expansion of the foam first occurs, and a crust forms under the effect of the fire. This crust encloses the foam and at the same time acts as a shield against the effect of the fire.
This is the protective fire barrier.

2) the foam behind the crust and under the steel casing gradually loses its original structure and changes into a fine granular substance consisting of carbon held together by the softened polymer. In this way a second fire barrier is formed whilst some thermal insulation is maintained.
This is the thermal fire barrier.

3) the layer of foam behind is thermally protected, and only those cells coming into contact with high temperatures will burst open. The remaining foam continues to provide insulation on the basis of its closed cell structure. As a result the process of change in the foam structure will steadily diminish.
This is the retardant barrier.
Depending on the length of time it is exposed to fire, this barrier will move further and further into the penetration.

4) the temperature is now such that no more structural change takes place, and the air in the closed cells can expand without the cells bursting. This results in volume expansion of the foam, and in this way all the openings in the penetration are closed off while at the same time the protective granular substance is compressed.
This is the sealant barrier.

5) because the foam is confined in the casing, due to the volume enlargement of the closed cells the foam will expand towards the non-exposed side.
In effect this means that the length of the penetration is extended and therefore the foam rubber mass is given long-term protection against the continuing effects of fire and heat.

6) the foam is held tightly in the casing. Because of the pressure exerted by the foam mass expanding inside the casing, only some foam applied in the front part of the opening will be forced out of the casing. As a result, the foam emerging from the penetration will swell to a larger size than when it was inside the penetration and provide renewed sealant protection.

7) The surface temperature will remain low and easily comply with the maximum temperature increase of 180°C as required in the standards. Furthermore, the original cell structure is maintained. Therefore the foam remains mechanically intact as well.

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ACTIFOAM® is used to fill any cavities or gaps in constructions. In case of fire the cavity will be totally filled with the expanding rubber, offering a perfect fire seal for a very long duration. ACTIFOAM® can also be used for other sealing purposes.
An advantage is that ACTIFOAM® does not absorb water.

Tested with 2.5 bar water pressure during 24 hours.
Due to the closed cell structure, the rubber has good thermal insulation properties. The K value at 10 °C according to NEN-EN 12667 is 12.3 mk/W.
The density of the foam rubber is at 23 °C according to ISO 2781 between 0.35 and 0.4 g/cm³.

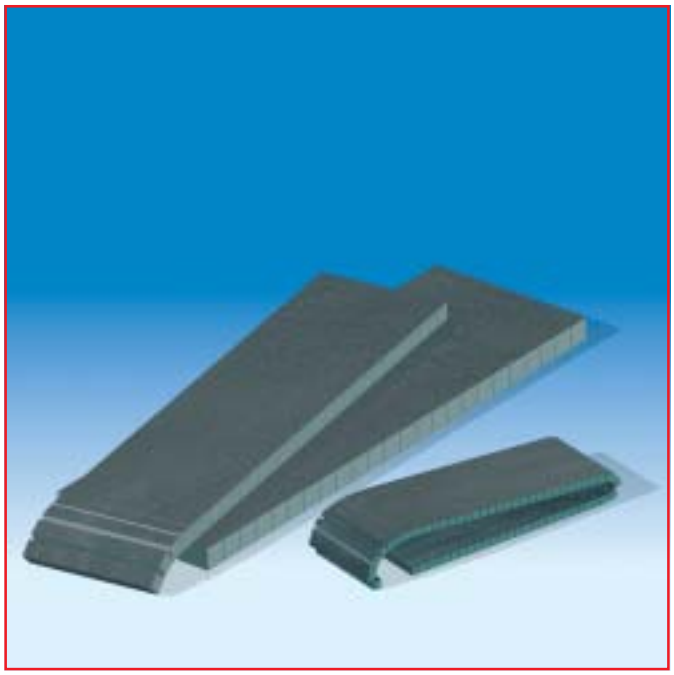
ACTIFOAM® foam rubber is supplied in sheets with a thickness ranging from 10 up to 25 mm and in round profiles up to 50 mm diameter.

Sheets are delivered in sizes:

500x500x10 mm	1000x500x10 mm
500x500x15 mm	1000x500x15 mm
500x500x20 mm	1000x500x20 mm
500x500x25 mm	1000x500x25 mm

They can easily be cut to size with a sharp knife.

The colour is dark blue/grey.



ACTIFOAM® pre-slit sheets are delivered in sizes:

300x100x10 mm	600x100x10 mm
300x100x15 mm	600x100x15 mm
300x100x20 mm	600x100x20 mm
300x100x25 mm	600x100x25 mm
300x150x10 mm	600x150x10 mm
300x150x15 mm	600x150x15 mm
300x150x20 mm	600x150x20 mm
300x150x25 mm	600x150x25 mm
300x200x10 mm	600x200x10 mm
300x200x15 mm	600x200x15 mm
300x200x20 mm	600x200x20 mm
300x200x25 mm	600x200x25 mm

The 10 mm thick sheets have 30 (60) pre-cutted profiles 10x10 mm, the 15 mm thick sheets 20 (40) profiles 15x15 mm, the 20 mm thick sheets 15 (30) profiles 20x20 mm and the 25 mm thick sheets 12 (24) profiles 25x25 mm

The profiles can easily be torn off.

The colour is dark blue/grey.

If the walls inside the conduit opening exhibit large irregularities, they should be locally smoothed with FIWA® fire safe sealant. Otherwise insufficient smoke tightness will be obtained.

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The cables can be ducted through the conduit opening in random order.
It is most important that they are not pulled too tight in order not to hamper their separation at a later stage.

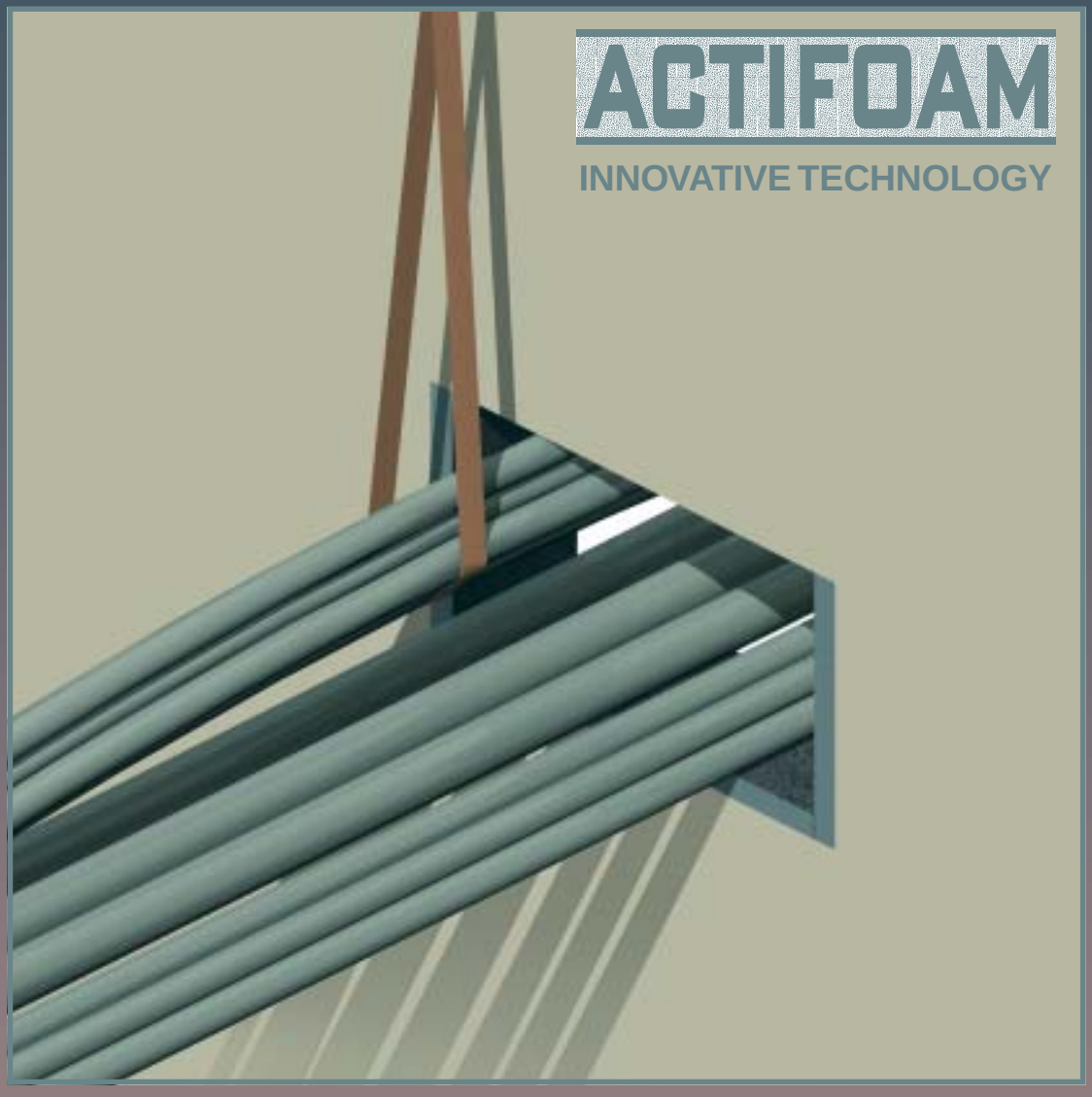
ACTIFOAM® rubber sheets are cut into strips fitting to the size of the walls inside the conduit opening. For this purpose ACTIFOAM® sheets with a thickness of 25 mm are used.

The ACTIFOAM® rubber sheets should fit snugly in the conduit opening to ensure a tight fit against the walls. This is important to avoid smoke penetrating between the sheets and the wall.

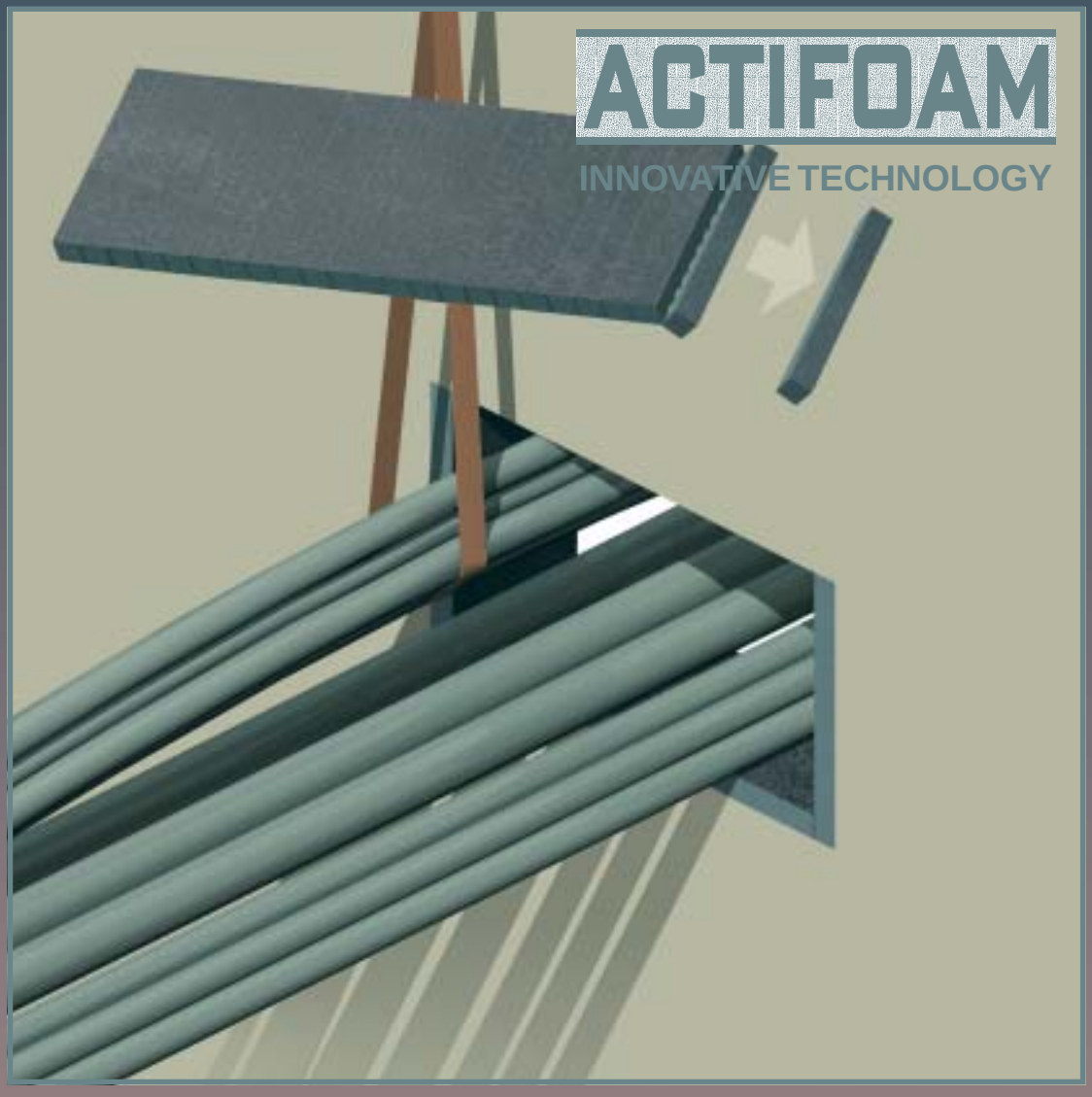
An ACTIFOAM® rubber sheet must also be placed in the conduit opening underneath the layer of cables.
A band is placed around the cable bundle to lift the bundle of cables.

A slightly oversized strip of ACTIFOAM® rubber with a thickness of 25 mm is placed inside the conduit opening underneath the cables. The sheet will be compressed by the weight of the cables.

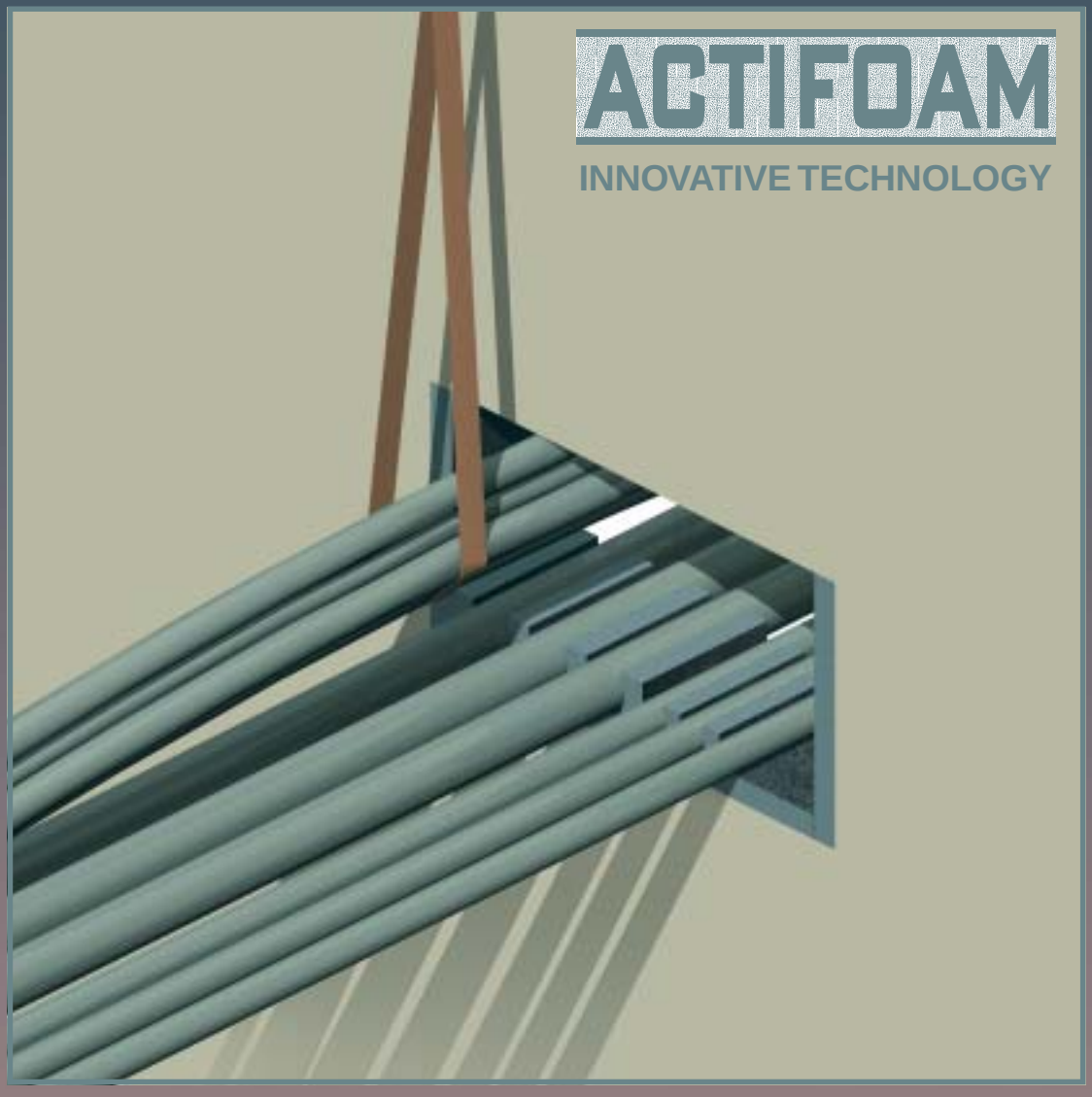
One layer of cables is spread out on the ACTIFOAM® rubber sheet at the bottom of the conduit opening.
The other cables are lifted to make room for further finishing the first layer.



For proper cable separation, square profiles are torn off the pre-slit ACTIFOAM® rubber sheets. The sizes of the profiles should be equivalent to the cable diameters.

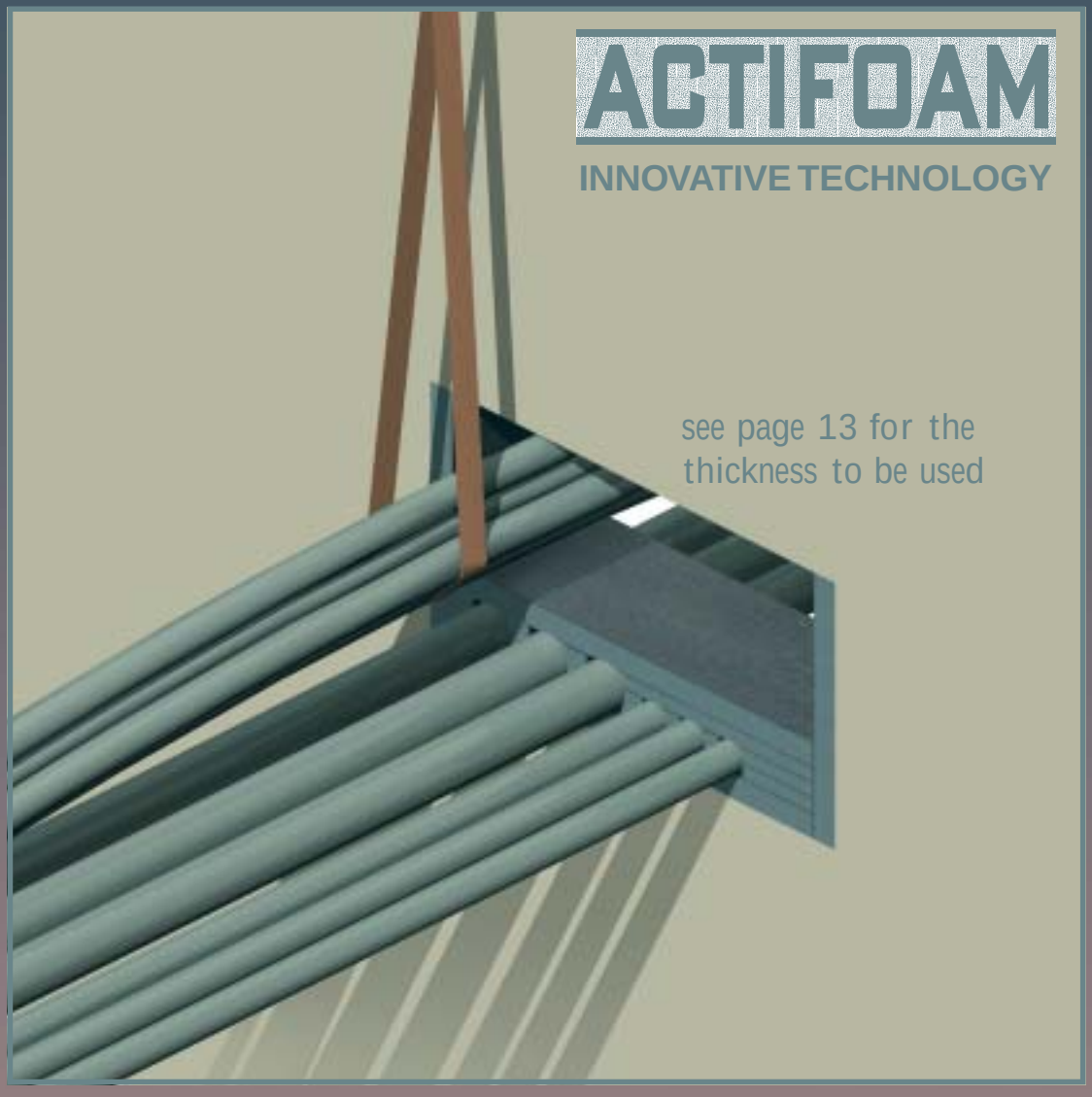


Profiles are slitted in sizes of 10x10, 15x15, 20x20 and 25x25 mm.
This enables an easy fit for corresponding cable sizes.
Cables larger than 25 mm should be separated by a minimum of 25 mm.



Adjacent to the first layer of cables and profiles, one or more extra sheets of ACTIFOAM® rubber is fitted to create a level layer for further filling the conduit opening.

An intermediate ACTIFOAM® rubber sheet is inserted in the conduit opening on top of the leveled first layer. The thickness of the intermediate layer is dependent on the maximum cable diameter.



see page 13 for the thickness to be used

The next layer of cables is spread out on the ACTIFOAM® intermediate rubber sheet. As indicated before, the cables should not be pulled too tight to enable this.

In the same way as with the first layer of cables, the cables are separated with the ACTIFOAM® pre-slit profiles and leveled with one or more ACTIFOAM® sheets. Take care for a tight fit.

The remaining space is filled with one or more ACTIFOAM® sheets. All sheets should fit tightly in the conduit opening to obtain a fair degree of smoke tightness.

Due to better sliding of greased rubber on rubber, for final finishing an ACTIFOAM® sheet must be inserted between the top layers of ACTIFOAM® sheets.

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Compression of the filling is necessary to obtain stability.
For this purpose it is easier to insert a couple of strips instead of sheets. The strips are greased all around with CSD® lubricant.

The first strip is inserted into the the opening between the layers by hand. For a wall thickness of 150 mm it is advisable to cut three strips 50 mm wide to enable easier insertion.

A piece of wood is used to push the strips tightly into the opening between the ACTIFOAM® rubber sheets.
The use of strips instead of sheets makes this much easier to do.

The finished ACTIFOAM® multi-cable penetration.

Fire tested under LRS survey for two hours in an aerated concrete wall 150 mm thick.

Lloyd's Register

Project:	unknown	Certificate Number:	APE 0309043/1
Client:	Beele Engineering B.V. Beunkdijk 11, 7122 NZ Aalten, The Netherlands	Office: Sub-Office:	Amsterdam Apeldoorn
Client's Order Number:	0301-004	Date:	31 January, 2003
		Order Status:	Complete
Inspection Dates First:	and	Final:	31 January, 2003

This certificate is issued to the above mentioned client in order to certify that the undersigned Surveyor to this Society did, at their request, attend the works of CSD International B.V. at Aalten in order to witness a fire test on:

ACTIFOAM multi cable penetration in an aerated concrete wall for an F-120 fire rating

Procedure	: 0301-004 as per Fire Test Data Report
Test Duration	: 120 minutes
Thermocouples	: refer to the Fire Test Data Report
Insulation	: On Fireside: none; on Non-Fireside: none.

For the lay out of the penetrations see drawings T0183, TC001 and TC005 rev. 0

Findings:

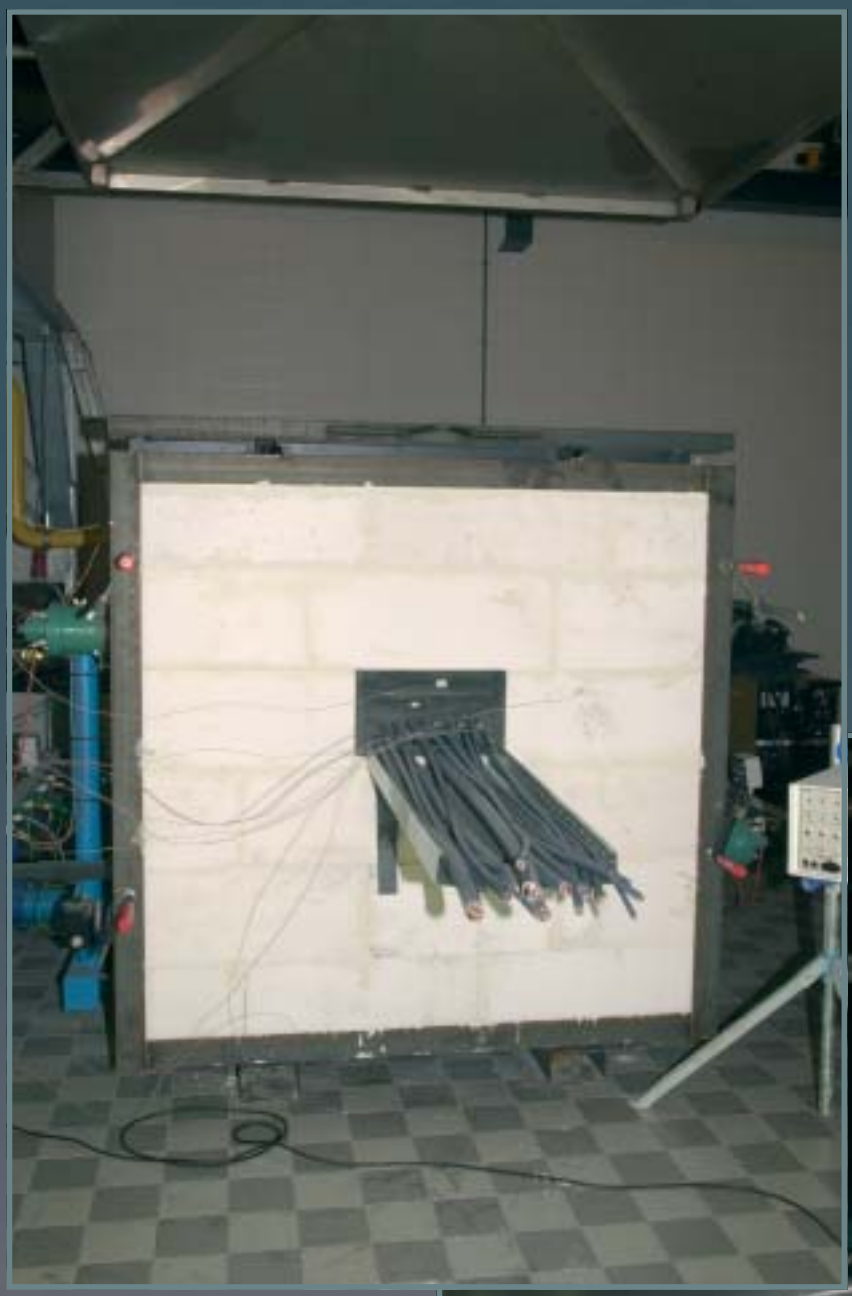
-Fire integrity : No flame and smoke breakthrough on the unexposed side.
-Mechanical stability : no openings or gaps occurred during testing.
-Thermal integrity : no temperature recordings exceeding 180 °C above initial temperature.
-Hose stream test : no leakage after a hose stream test of 2.1 bar for 16 sec/m².

Remarks:
The test was carried out in accordance with prEN 1366-3 : 1993 test procedure.

The test was completed with satisfactory results.

Lloyd's Register APELDOORN A.H. Zennipman

A.H. Zennipman
Surveyor to Lloyd's Register



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The expansion of the ACTIFOAM® rubber around the cables is substantial due to the high temperatures of the copper conductors.

The ACTIFOAM® foam rubber can also be used for the fire safe ducting of busbars. The installation is quick and simple and is similar to the system used for cable conduits.

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The air enclosed in the ACTIFOAM® cellular structure does the foam rubber expand outwards the penetration. On the exposed side a solid crust of carbon is formed.

Lloyd's Register

Project:	unknown	Certificate Number:	APE 0309100/1
Client:	Beele Engineering B.V. Vierde Broekdijk 12, 7122 NZ Aalten, The Netherlands	Office: Sub-Office:	Amsterdam Apeldoorn
Client's Order Number:	0303-008	Date:	6th March, 2003
		Order Status:	Complete
Inspection Dates First:	and	Final:	5th March, 2003

This certificate is issued to the above mentioned client in order to certify that the undersigned Surveyor to this Society did, at their request, attend the works of Beele Engineering B.V. at Aalten in order to witness a fire test on:

ACTIFOAM busbar penetration in an aerated concrete wall in accordance with a F-120 fire rating.

Procedure	: 0303-008 as per Fire Test Data Report
Test Duration	: 120 minutes
Thermocouples	: refer to the Fire Test Data Report 0303-008
Insulation	: no additional fire insulation is provided

For the lay out of the penetrations see drawings R0139E rev.0, T0189 rev.0, TC001 rev.0 and TC009 rev.0

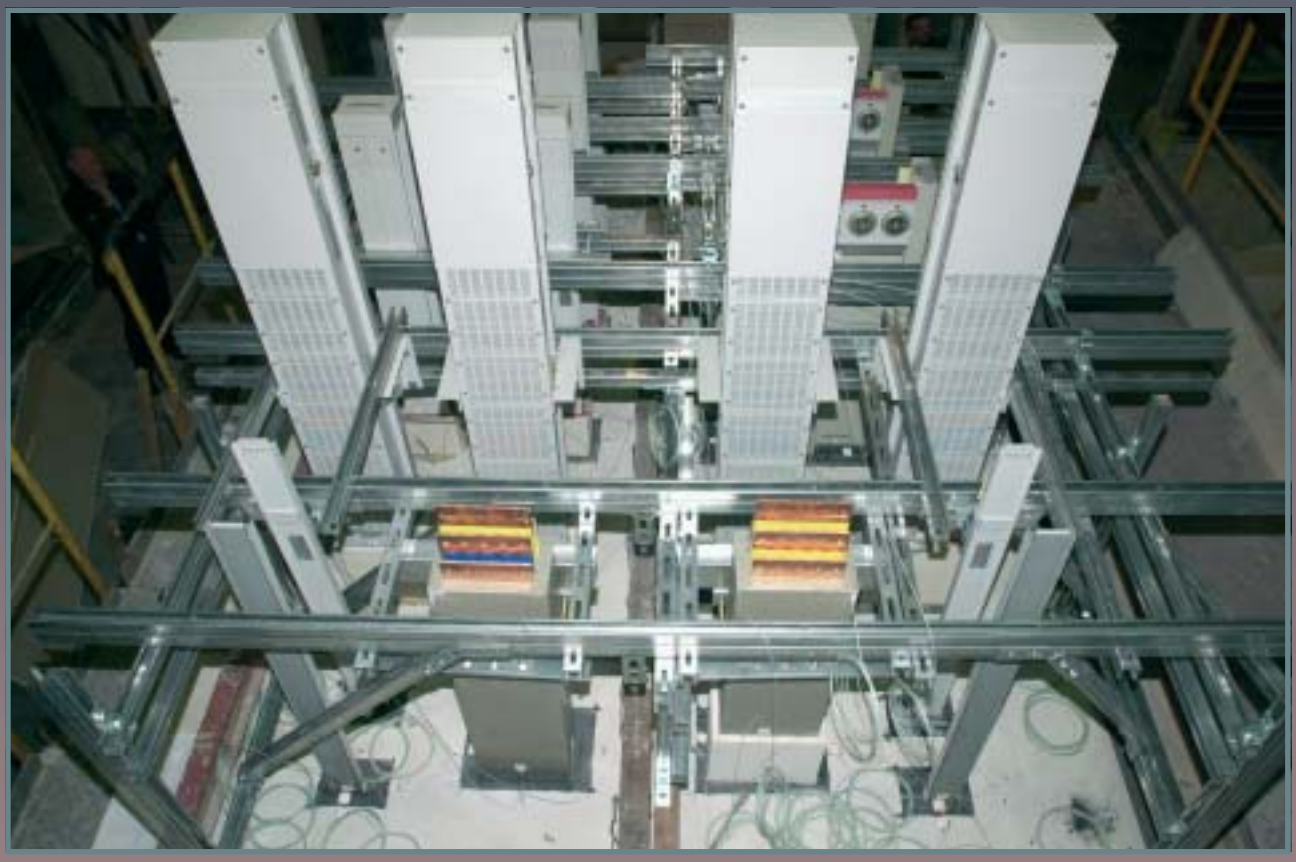
Findings:

Testresults have been recorded on the endorsed pages 5, 8, 9, 10, 11 and 12 of testreport no. 0303-008

Remarks:
The test was carried out in accordance with prEN 1366-3 time/temperature curve.

C.Evan Omnaas
Surveyor to Lloyd's Register

OFFICIAL FIRE TEST WITH A VARIETY OF DIFFERENT SIZES OF BUSBAR SYSTEMS IN A 150 MM THICK FLOOR SLAB



The ACTIFOAM® foam rubber showed its perfect thermal insulation and firestopping properties in an official two hours fire test.
The ACTIFOAM® foam rubber has been used also inside the busbar systems.

Despite of the fact that some busbars were equipped with heavy copper conductors, the measured temperature on the surface of the foam rubber did not reach more than ca. 75 °C at the end of the fire test.

A new version of the FIRSTO® firestops has been developed. The yellow sponges and blue rubber inserts are replaced by layers of ACTIFOAM® pads and profiles.

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Officially tested at Underwriters Laboratories with units with an opening up to 750x400 mm.

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Even when the ACTIFOAM® firestop is tested totally at the exposed side, no smoke is emitted at the unexposed side during the first hour of the fire test.

These pictures show the fire stopping quality of the ACTIFOAM® rubber.
Even with the firestop placed at the exposed side, a two hour fire exposure is possible.

ACTIFOAM

Successfully tested at Underwriters Laboratories for an F- and T-rating of 2 hours for units to be placed at the fire side and at the non-fire side.

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Deformation of the steel casing, deformation of the cable tray support, red hot metal parts and cable conductors, ACTIFOAM® can take it all.
This is a worse case fire test.

Due to the closed cell structure of the ACTIFOAM®, at the spot of exposure to heat expansion will take place by the volume enlargement of the air enclosed in the cells.

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On the exposed side a crust is formed to prevent the foam rubber to be consumed by the fire. ACTIFOAM® is therefore regarded as a non-intumescent material.

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Websites: http://www.beele.com, www.rise-systems.com and www.yfestos.com

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* BEESEAL® MULTI-PIPE AND CABLE PENETRATIONS
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* RISE® SEALING SYSTEM FOR MULTI-CABLE TRANSITS
* RISWAT® WATERTIGHT, FLEXIBLE PIPE PENETRATIONS
* YFESTOS® AFTERGLOW ESCAPE ROUTE MARKING

CONDUIT SEALING DEVICES OF AN AMAZING SIMPLICITY WITH AN OUTSTANDING PERFORMANCE

BEELE Engineering and CSD International have been involved with fire, water and gas tight sealing for more than 30 years. We have developed and tested products proven to provide the utmost in sealing protection around the world. To receive our complete civil construction and/or marine products catalogues, please contact your distributor or local representative.

distributed by:

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