Intumescent Fire Seals Association

The Fire Risk Assessors Good Practice Guide No.3

Guidance in respect of the use of intumescent glazing seals in timber doors and screens

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CONTENTS

Purpose of this Document

Compartmentation and the provision of protected corridors and stairways are fundamental concepts in the fire safety provisions embodied in regulations. These objectives are achieved by incorporating fire resisting barriers, walls and floors within a building either to reduce the size of the enclosure in which fire may break out, or to construct safe egress routes when the route to a place of safety cannot include an alternative route or where the distance to travel is excessive. These protected routes provide the persons within the building an area of relative safety through which they can egress. Such barriers play an even greater role in buildings where horizontal evacuation is practiced, e.g. hospitals.

Modern buildings frequently incorporate large areas of glass as it provides an 'airy' open plan environment, but even in older properties fire resistant glazing has been incorporated in the doors and walls forming protected routes for health and safety purposes. Fire resisting glass is, however, one of the least robust materials used in buildings, with a 'melting' point approximately 200^{o}C below the temperature of the test furnace, (even for 30 minute applications), being highly conductive, relatively transparent to radiation and often extremely edge sensitive. Factory glazed metal doors and partitions/screens are less likely to compromise the conditions in a protected route to the same degree as timber glazed doors and screens. Traditionally these have been glazed on site, probably by the joiner/carpenter, rather than by glazing specialists, and therefore, they are more likely to be glazed incorrectly. This Guide is therefore primarily aimed at glazed timber doors and screens. The fire resistance of any glazing is only as good as the method of glazing and the glass, glazing system and the beads all have to work in harmony if the use of the protected space by egressing people is not to be compromised. This Guide is designed to assist any Fire Risk Assessor to make an intelligent appraisal of any fire resistant glazing installed in the facility that they are assessing and to give them basic guidance as to the likely performance and the best form of any recommended upgrading.

Background to Risk Assessments

Since 1999, buildings that are used for the employment of persons had to be subject to a Fire Risk Assessment Audit performed under the legal duties imposed by The Fire Precautions (Workplace) Regulations (Amended 1999). This included buildings that were already the subject of a Fire Certificate issued under the Fire Precautions Act 1971.

In England & Wales*[(1)], 1st October 2006 saw the introduction of the Regulatory Reform Order (RRO) which repealed the Fire Precautions Act and replaced it with the need for the 'responsible person' to carry out, or have carried out, an ongoing Fire Risk Assessment of the premises for which he/she is responsible. This Risk Assessment automatically embodies the requirements of the 'Workplace' Regulations as employees are also persons 'in and around' the building, and so fire safety moves away from a prescriptive base to a totally risk base system. The Fire Services' role in this process is no longer that of the inspecting authority and changes to that of being the auditor of the Risk Assessment process. The responsible person, normally the premises owner (possibly the Chairman of the Board) does, from this date, take total legal responsibility for the safety of all building occupants in the event of a fire breaking out.

The objective of this Risk Assessment is to demonstrate that, in the event of fire, the health & safety of persons in and around the building is not at risk. This process extends much further than the audits that were performed to ensure that the Fire Certificate conditions were being satisfied, as were previously undertaken by the Fire Service under the Fire Precautions Act.

Intumescent materials and smoke seals play a major role in restricting fire spread, and hence reducing death and injury, and this Good Practice Guide is designed to provide Risk Assessment auditors with information that will assist them in their Fire Safety Audit.

*[(1)], *In Scotland, the 'RRO' is known as the 'Fire (Scotland) Act 2005.*

Performance of Glass in Fire

Glass has been incorporated in fire walls and fire doors since such fire barriers were required. This glass has the potential to severely compromise the fire resistance of the construction into which it has been installed. Up until the start of the 1980's only one form of fire resisting glass was available, known as Georgian Wired Plate (GWP) which was available in either an 'as-cast' state (with a 'bobbly' surface or ground and polished on both faces (GWPP). The cast glass was translucent, rather than transparent and was not suited to many architectural applications.

Traditional wired glass has a soda/lime composition and it is a material with a very high coefficient of expansion and is highly conductive. Unless the method of retaining glass in an aperture is kept to a minimum, the temperature difference between the glass exposed to the fire, and the glass edge protected by the glazing system will cause differential expansion and because of the lack of ductility in glass, inevitable breakage. The built-in wires prevent it from falling out. When there are no wires as is the case with many of the modern clear soda/lime composition toughened glasses, the temperature differential generated by the glazing system is CRITICAL to the performance and should form a major component in any Risk Assessment. With these monolithic unwired glasses the wrong glazing system (bead size/bead material/glazing medium) will reduce the **fire resistance of the glass from both 30 and 60 minutes to less than 5 minutes**. This represents a major compromise of any fire safety objectives and the Risk Assessor should establish the critical factors from the glass supplier before approving it as being safe, especially if it is glazed into a timber construction.

The need for and function of an Intumescent Glazing Medium

As stated earlier monolithic, or conventionally laminated glasses, wired and unwired have a relatively high conductivity. This means that any heat applied to the exposed face of glass is transmitted quickly to the unexposed face by conduction. Also glass readily transmits heat to the unexposed face beads by radiation. As a consequence any bead on the unexposed face which is installed directly in contact with the hot glass, or at best is only separated from it by an organic glazing tape, is exposed to rapid heating by this mixture of conduction and radiation. When the bead is of a combustible material, such as timber this heating will fairly quickly induce smouldering and almost inevitably ignition on the protected side of the barrier before 30 minutes has elapsed. This smouldering produces plentiful quantities of smoke which both reduces the tenability of this space; jeopardising the safety of people within it and providing a visual deterrent to persons entering the space. This is critical if the space is a protected route or stair enclosure. The eventual ignition of this bead will obviously create a more serious risk to those persons using the route. Therefore if the tenability of this space is to be guaranteed it is critical that a sealant is used to significantly reduce this flow of heat and to prevent the smoke production. An intumescent based seal is superior to all other sealants for this purpose.

The bead finish is also important. Without such seals undecorated timber beads have been shown to smoke copiously after the first 10 minutes of exposure. Unfortunately painted or varnished beads are known to smoke just as copiously after only a few minutes of exposure, which could be during in the period of evacuation, especially if it is a staged or phased evacuation. This smoke could jeopardise life safety due to both the physiological and psychological effects of smoke being produced on the protected side of the fire barrier. For these decorated beads it has been demonstrated that some intumescent sealants are able to mask these beads and reduce the risk of the coating smouldering or igniting.

With timber glazed elements a major function of a glazing seal is therefore to reduce the heat flow through the glass and onto the unexposed face retaining bead in order to prolong the time at which either smoke production or flaming could occur. The primary function of the glazing medium is to insulate the bead on the unexposed face from the heat being conducted through the glass and also, if possible to 'mask' the bead profile from the radiant heat. Intumescent based sealants, strips or gaskets have been shown to

have the capability of both insulating and 'masking' such beads.

Of more concern is the fact that should a non-intumescent sealant be use this could be the cause of an even earlier ignition or excessive smoke production, especially if it is more combustible than the beads to which it has been applied. Oil based mastics, (or putties), for example, could make conditions significantly more onerous on the unexposed face if they are to used in error. Re-glazing with an intumescent sealant is a preferred, if not vital requirement.
Insulated, or partially insulated glasses, which turn opaque and expand in thickness when heated, are not very edge sensitive and the beads require much less protection. However, the glazing pockets for these glasses must accommodate the expansion of the glass, otherwise the fracturing glass may crack coincidentally in a line just above the glazing beads seriously weakening the glass which may cause it to fall out prematurely. It is preferred that the glazing medium does not apply pressure to the edge of the glass.

The comments above relate to single glazing for internal use. The need for reduced sound transmission has resulted in a growth in 'twin-glazed' partitions. Twin-glazing is very direction sensitive and if there is a fire glass and a non-fire glass adjacent to each other, it is critical that the non-fire glass is sacrificial and installed on the most likely side for fire exposure. If it is on the wrong side, then the performance of the fire glass can be seriously reduced due to overheating. If there is any doubt when twin glazing is installed, then specialist help should be sought.

It is important, therefore, that the Risk Assessment of premises where fire resisting glass is installed does review the presence or absence of, and the nature of, any glazing media used in such installations.

This Guide assumes that all metal glazing systems will have been factory made and installed by the manufacturer, or at least under their instructions, and so this invariably concentrates on timber glazing which is very likely to have been glazed on site. Metal glazed systems are still very sensitive to the selection of the glazing system.

Conclusion

Fire resisting glazing plays an important function in the design and construction of protected routes in buildings; corridors and stairways, but this critical function can be seriously compromised by the method of glazing and selection of the glazing medium:

- Unwired soda/lime toughened glasses can have their fire resistance reduced to less than 5 minutes if the wrong glazing system is used (beads and medium)
- Monolithic wired glass and borosilicate glass (Pyran) can cause the generation of significant volumes of smoke in the escape route if the glazing system is of the wrong type, or if it fails to control the flow of conducted heat to the bead on the unexposed face of the glazing. This will frequently manifest itself in flaming, within 15 to 25 minutes.
- Insulated glass may be seriously weakened, and fail to achieve its potential if a pressure forming glazing system is used around the perimeter of the glass, which, if used, is not installed in accordance with the manufacturers evidence of performance.

Checklist of possible actions as a result of an audit

TIMBER GLAZED ELEMENTS (TIMBER BEADS ON TIMBER SUBSTRATES); GENERAL

Is the glass integral wired glass (Pyroshield), borosilicate clear glass (Pyran), ceramic glass (Firelite - only in small panes unless laminated)?

Yes - The glass is installed in a compatible frame and it is only the selection of the glazing system and the method of fixing that needs to be analysed.

No - The glass may be installed in a totally incompatible framing system that could result in rapid failure, see next question.

Is the clear glass an insulating glass; such glasses carry the name for example, Pyrodur, Pyrobelite, Pyrobel, Pyrostop, Contraflam, Pyranova (and others *)?

Yes - The glass must be installed in a glazing medium that allows the glass to expand in thickness. Check manufacturers recommendations, but the glazing medium should be compressible, e.g. a thick bead of acrylic intumescent mastic, an open cell foam and capping sealant.

No - The glass may be a monolithic clear soda/lime toughened glass which is fundamentally incompatible with timber beads and must be installed absolutely in accordance with the manufacturers recommended actions to prevent catastrophic failure.

If the glass contains wires, is it integral wired glass i.e. Pyroshield, which is very robust, or is it marked Pyroguard (or a name other than Pyroshield)?

Yes - Pyroshield is wholly compatible with a timber glazing system and the glazing medium only needs to address the heat conduction problem.

No - The glass must be installed strictly in accordance with the manufacturer's recommendations.

TIMBER GLAZED ELEMENTS; ROBUST NON-INSULATING GLASSES (E.G. PYROSHIELD, PYRAN, FIRELITE) IN TIMBER BEADS

Is there a discernable thickness of sealant, glazing strip or gasket between the glass and the beads?

No - Heat conduction through the glass is likely to result in early smouldering of the timber bead and any non-intumescent glazing medium, resulting in the production of acrid smoke and an increasing loss of visibility creating a deterrent to people wishing to use the route. Ignition of the bead will eventually occur. Recommended action - re-glaze with a suitable intumescent sealant (see IFSA Information Sheet No. 2).

Yes - Establish the characteristics of this seal/sealant, possibly by removing a small piece and, in a safe place, testing its propensity to intumesce; or to smoke, smoulder and/or flame. If it does intumesce, then it may be retained, but if it displays undesirable characteristics it should be re-glazed (see IFSA Information Sheet No. 2).

Are the beads of a square profile and at right angles to the face of the glass?

Yes - Square beads are prone to early ignition and smoking due to the combined effect of conduction and radiation. Square beads are unlikely to provide 30 minutes fire resistance unless a copious quantity of multi-directional intumescent is used as a glazing medium between glass and bead. Re-glaze and/or consider a change in bead profile.

No - The bead is more likely to achieve the fire resistance, but the glazing medium should be selected as for the previous question.

Are the beads fixed with adequately long screws or pins set in at an angle?

No - Glazing beads will fall away once the substrate has been consumed to the line of the fixings (timber burns away to a depth of 20mm in 30 minutes). Put in additional angled pins and screws, nominally 38mm long and at approximately 45°.

Yes - Only the selection of the glazing medium is critical to prevent ignition on the unexposed face; check that the medium is suitable for use with timber beads and will not generate excessive smoke.

Is the glazing required to provide 60 minutes fire resistance?

Yes - If the timber is not hardwood and the beads at least 22mm deep and with an angled profile it is unlikely to provide 60 minutes fire resistance. Re-glaze with hardwood beads, nominally 25mm deep, fixed with angled pins and using a proprietary intumescent based glazing system from an IFSA member.

No - Softwood substrate, high density softwood or hardwood beads with angled beads, angled fixings and a suitable intumescent glazing system will suffice (see IFSA Information Sheet No.2).

TIMBER GLAZED ELEMENTS; NON-ROBUST EDGE SENSITIVE, NON-INSULATING CLEAR GLASSES (E.G. PYROSWISS, PYROCET, SWISS FLAM (AND OTHERS *)?

Is the glass installed in timber beads without any visible metal angle between the bead and the glass?

Yes - This glass may be installed in error as the glazing system may provide too much insulation to the glass edge. Check the acceptability of the details with the manufacturer/supplier, IFSA Secretariat or a fire glass expert. A special glazing system may be required or the glass be replaced with a type that is compatible with beads installed.

No - Check whether a metal angle is fixed which has been masked by a timber bead, protected by an intumescent sealant and check whether the system is acceptable to the glass supplier and is supported by adequate test evidence in this application. If not, then glass shall be replaced or glazed with a compatible system.

TIMBER GLAZED ELEMENTS; INSULATING CLEAR GLASSES (E.G. PYRODUR, PYROBELITE, PYROBEL, PYROSTOP, PYRANOVA, CONTRAFLAM (AND OTHERS *)?

Is the glazing system able to permit the glass to expand when heated?

No - This may inhibit the glass from achieving its full potential, especially when 'deep' timber beads are used. Re-glaze with a non-pressure forming intumescent material with a thickness of at least 3mm. The use of pressure forming seals are not recommended (e.g. seals based upon sodium silicate or intercalated graphite) unless supported by test evidence from the seal/ glass manufacturer.

Yes - The method of installation is acceptable, but the length and angle of fixings should be checked as some of these glasses are very heavy. Check fixing requirements with glass manufacturer.

** If the name is not one that is listed establish the exact nature of the glass from the manufacturer/supplier.*

Finally, reduce any further risks by recommending that any upgrading is undertaken using quality products supplied by a member of the Intumescent Fire Seals Association; companies that have always put evidence of performance at the top of their list. See the website (www.ifsa.org.uk) or contact the Secretariat for a list of companies.

The information in this document is based on the current knowledge and collective experience of the Association's membership. Whilst every effort has been made to ensure the accuracy of the guidance given, the Association cannot accept liability for loss or damage arising from the use of the information.

INFORMATION ABOUT IFSA

The Intumescent Fire Seals Association (IFSA) is a trade association established in 1982 with the following objectives:

- To promote the life safety benefit associated with the use of intumescent and smoke seals
- To promote research and development into extending the areas where these benefits can be utilised
- To participate in the development of test procedures for fire protection products in BSI, CEN and ISO which are fair, repeatable and reproducible.

IFSA maintains close links with the fire community. The Secretariat is based at International Fire Consultants and receives technical advice from its Principal Consultant, Peter Jackman.

At the time of its formation, IFSA recognised the need for a simple standard test to compare the performance of intumescent fire seals for use in fire doorsets, which was free from the influence of other materials and constructional variations and yet subjected the intumescent material to the conditions which prevail in a full scale test.
It, therefore, sponsored the development of such a test and this is now embodied in BS476: Part 23 (1987). Whilst the results of the test have a limited field of application, only being usable on single leaf, single action, latched doors of limited size and distortion characteristics, it does allow the sealing capability of intumescent seals to be compared without any influence from the leaf.

There is now an ISO equivalent test, i.e. BS ISO 12472: 2003.

Due to its repeatability the test method is being used successfully to evaluate the influence that real time ageing may have on the properties of intumescent fire seals produced by IFSA member companies. The programme is planned to investigate 25 years exposure to a variety of controlled and uncontrolled environments. Early findings showed no detectable visual decline and tests are being undertaken soon to confirm these findings.

A test programme undertaken in conjunction initially with DOE/BRE to produce standardise conditions for evaluating penetration seals formed the basis of the standard configuration incorporated in the CEN test procedure EN 1366-3 for evaluating seals for use with metal pipes. This configuration has been refined and now forms a draft technical report in ISO (DTR 10295-3) where a method of extrapolating the results of penetration sealing tests, using simple solid conductors, can be used to establish the field of application of intumescent sealants due to be published in 2010.

Fire stopping, service penetration sealing, fire doors and fire glass are all critical aspects of fire safe premises and under the new Regulatory Reform (Fire Safety) Order and the ongoing reliance on fire risk assessments, it is vital that risk assessors understand the role and function of these products. IFSA has produced a number of downloadable Good Practice Guides to help risk assessors know and understand when a particular intumescent application is right or wrong, or how a risk may be controlled by the use of the correctly specified sealing product. These guides were commended by the ABE in the 2006 Fire Safety Award competition.

The move away from brickwork, blockwork and cast concrete forms of construction, towards a greater use of studwork and joisted walls, floors and ceilings, has left many of our fire separating constructions compromised by the fitting of electrical services (switches, plug sockets, concealed lighting, extract fans). IFSA has co-operated with the Electrical Safety Council (ESC), in the preparation of their guide, 'Electrical installations and their impact on the fire performance of buildings; Part 1, Domestic Premises'. This did win the ABE's Fire Safety Award in 2009.

Intumescent materials can seriously reduce the impact that such installations may produce.

Correctly fitted sealing systems make a greater contribution to life safety in a fire than almost any other measure. If you do nothing else to enhance life safety – at least seal up the building with fire and smoke seals, preferably from an IFSA Member because they take fire safety seriously.

CURRENT IFSA MEMBERS AND CONTRIBUTORS TO THE INFORMATION SHEET

BASF The Chemical Company

Intumescent Seals

LORIENT

Sealmaster

MANN McGOWAN Advanced Intumescent Technology

PYROPLEX® UK Manufacturer of Passive Fire Protection Products

MINELCO

International

walraven BIS – Better Installation Systems

TECHNICAL CONSULTANTS TO IFSA

IFC Group

INTERNATIONAL FIRE CONSULTANTS LTD

Intumescent Fire Seals Association
20 Park Street
Princes Risborough
Buckinghamshire HP27 9AH
Tel: +44 (0)1844 276928
Fax: +44 (0)1844 274002
Web: www.ifsa.org.uk
Email: contactus@ifsa.org.uk