

Loss Prevention Standard

LPS 1158: Issue 2.2

Requirements and tests for fire resistant glazing systems

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REVISION OF LOSS PREVENTION STANDARDS

Loss Prevention Standards will be revised by issue of revised editions or amendments. Details will be posted on our website at www.redbooklive.com

Technical or other changes which affect the requirements for the approval or certification of the product or service will result in a new issue. Minor or administrative changes (e.g. corrections of spelling and typographical errors, changes to address and copyright details, the addition of notes for clarification etc.) may be made as amendments. (See amendments table on page 18)

The issue number will be given in decimal format with the integer part giving the issue number and the fractional part giving the number of amendments (e.g. Issue 3.2 indicates that the document is at Issue 3 with 2 amendments).

USERS OF LOSS PREVENTION STANDARDS SHOULD ENSURE THAT THEY POSSESS THE LATEST ISSUE AND ALL AMENDMENTS.

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1. FOREWORD

1.1 Loss Prevention Council Approval Schemes are supported by the Association of British Insurers (ABI) and Lloyd's.

This Loss Prevention Standard (LPS) identifies the means of evaluation of fire resistant glazing systems.

Certification is based on:

- a) Satisfactory product test performance in accordance with the requirements of the Loss Prevention Certification Board (LPCB).
- b) Verification of the establishment and maintenance of the manufacturer's and/or installer's quality management system in general accordance with ISO 9001.
- c) Satisfactory product service experience.

1.2 This document has been prepared and agreed in accordance with the requirements of BS 7511. It has been adopted by the organisations listed in Appendix 3.

NOTES

Compliance with this LPS does not of itself confer immunity from legal obligations. Users of LPSs should ensure that they possess the latest issue and all amendments.

LPCB welcomes comments of a technical or editorial nature and these should be addressed to "the Technical Director" at enquiries@breglobal.co.uk.

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2. SCOPE

2.1 This Standard details the technical requirements for the certification of fire resisting glazing. It is applicable to the certification of:-

- specific glasses for use in a range of described proprietary and/or generic framing systems;
- specific framing systems for use with a described range of glasses; and
- specific glazing materials for use with described framing systems and glasses.

It is applicable to both insulating and non-insulating glass/glazing systems having fire resistances of 30, 60, 90 and 120 minutes as defined in BS 476 : Part 20 in either horizontal and/or vertical orientations.

This Standard covers the use of glass in fire resisting door assemblies but is not applicable to the door assemblies themselves, which are the subject of other schedules

3. DEFINITIONS

<i>Aspect ratio :</i>	The ratio of the longer side of a pane to its shorter side.
<i>Edge cover :</i>	The distance between the edge of the glass and the sight line.
<i>Edge sensitive glass :</i>	Glasses where edge cover requirements can significantly affect the fire performance of the glass.
<i>Framing system :</i>	Perimeter and intermediate components responsible for providing mechanical support within constructional requirements.
<i>Glazed wall :</i>	Fabricated glazed separating element.
<i>Glazing bead :</i>	A strip of wood, metal or other suitable rigid material attached to the surround to retain the glass.
<i>Glazing material :</i>	A material that provides a bedding for the glass and produces a joint between it and the surround.
<i>Glazing system :</i>	The complete system of components required to retain the glass in the frame.
<i>Insulating glass :</i>	A glass which, when subjected to test in accordance with BS 476 : Part 22 satisfies the insulation criteria for the duration specified in the application, but not less than 30 minutes. The integrity criterion may be satisfied for a time period in excess of the insulation requirement.
<i>Mullion :</i>	Vertical intermediate framing member.
<i>Non-insulating glass :</i>	A glass which, when subjected to test in accordance with BS 476 : Part 22 satisfies the insulation criteria for less than 30 minutes and satisfies the integrity criterion for the duration specified for the application.

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Pane : A single thickness of monolithic or laminated transparent or translucent material (glass or flat ceramic) installed in an element of construction for the purpose of allowing vision or the passage of light.

Pane size : The overall dimensions of the pane.

Supporting construction : The construction around the opening within which the framing system is fitted.

Transom : Horizontal intermediate framing member.

4. GENERAL REQUIREMENTS

- 4.1 Certification of products will be issued on the basis of initial type tests followed by regular audit tests. It is also required that products be manufactured under a quality management system in accordance with ISO 9001. Details of these requirements and the general rules governing the certification are published separately.
- 4.2 Products will be certificated for specified end use conditions including size and configuration. The scope of certification will be determined by assessment of the fire test information in accordance with the methodology given herein.

5. NON-FIRE REQUIREMENTS

- 5.1 Glasses shall be classified in accordance with the requirements of BS 6206. This shall be reported in the certification issued. Although not directly affecting fire performance such information may be useful in establishing compliance with the requirements of Part N of Schedule 1 to the Building Regulations regarding glazing - materials and protection.

6. FIRE REQUIREMENTS

- 6.1 Fire testing shall be conducted in accordance with the relevant requirements of BS 476 : Parts 20 and 22 at a NAMAS accredited laboratory. Independently validated test data from other sources may be accepted at the discretion of the certification body as supplementary information but will not be used as the main basis of the assessment. Fire Test Study Group (UK) resolutions and procedures should be followed.
- 6.2 There is no fixed programme of tests owing to the wide range of sizes, configurations and constructional variables. The testing programme shall, therefore, be designed in conjunction with the certification body to ensure that the scope of certification adequately covers the manufacturer's requirements. The Assessment Principles, (Section 7), and the Field of Application, (Appendix 1) will provide guidance to enable a suitable test programme to be devised. Typical test configurations are detailed in Appendix 2.
- 6.3 For the evaluation of one particular type of glass for use in one or more proprietary framing system, the system tested should be of a generic design selected to evaluate those parameters critical to the particular glass type. Alternatively, if a proprietary system is selected, it should be done on the basis that features which are critical to the glass type provide the most onerous conditions, if they can be identified, thus providing scope for wider assessment of other systems.

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- 6.4 For the evaluation of a particular framing systems it may be possible to select a glass type or types which represent the most onerous situation from which other glass types may be assessed, otherwise the test information may only be applied to glasses with similar properties.
- 6.5 For timber framed systems, which will generally be non-proprietary, a generic, minimal construction may be selected which will form the basis of the assessment of other timber framed constructions. The precise details of the tested construction(s) may vary dependent on the parameters of construction which are critical for the particular glass type under construction, e.g. edge cover.

7. ASSESSMENT PRINCIPLES

- 7.1 In order to define the scope of certification an assessment will be conducted based upon available test data. It will examine the following aspects:
- (a) The ability of a particular framing system to support the glass(es) for the required fire resistant period.
 - (b) The ability of the glass to remain in position for a given fire resistance period when suitably glazed.
 - (c) Compatibility between the glass and frame combination.
 - (c) The ability of a given pane size to achieve a specific fire resistance period and the ability of the transom to support it.
 - (e) An indication of the effects of aspect ratio.
 - (f) The ability of the assembly to accommodate shared transom and mullions.
 - (g) The effect incorporating a door assembly within an associated structure (glazed wall), if required.
 - (h) The method of fixing the assembly to a given restraint frame must be appropriate to the nature of the supporting structure. Consideration must be given to the likelihood of the same framing being fixed to different supporting structures in reality.
 - (i) The possibility of alternative ancillary items such as glazing gaskets, pointing mastics, decorative trims etc.
- 7.2 The failure of a glazed wall under test conditions may be clearly attributed to either performance of the glass, e.g. slumping from the frame, or performance of the framing system, e.g. ignition on the unexposed face or some form of mechanical or structural failure. The assessment will consider the mode of failure in order to identify the factors which may limit possible design variations. The mode of failure will be critical in determining the extent to which the tested system can be modified or assessed in to a wider field of application.
- 7.3 Assessment of variations from the tested specimens will be on the basis of interpolation except where there is clear indication from the test evidence that extrapolation will not prejudice the required fire resistance performance. For example, a large margin of performance may provide sufficient confidence to permit an increase in size.

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- 7.4 Assessments shall be based on information derived from the appropriate test or tests as specified in Sections 5 and 6 and in accordance with the field of application information given in Appendix 1.
- 7.5 Deviation from the field of application rules (Appendix 1) is permitted provided technical justification is given.

8. AUDIT TEST REQUIREMENTS

- 8.1 To ensure continuing compliance for the certificated end use, audit testing shall be conducted.
- 8.2 For each certificate issued an audit test shall be conducted at not more than three-year intervals.
- 8.3 The audit test shall be to BS 476 : Part 22 on a full scale specimen. The precise design, size and configuration shall be as specified by the certification body but related to the original test programme. Fire resistance tests conducted for other purposes may be accepted in lieu of audit tests at the certification body's discretion.
- 8.4 If a test result indicates that a system does not meet the expected fire resistance the reason shall be immediately investigated by the certificated company and certification body and agreed corrective action taken. In such circumstances the certification body reserves the right to require a repeat test to be conducted and, if necessary, may terminate, suspend or reduce the scope of its certification.

9. IDENTIFICATION

- 9.1 The certificate will be issued individually to the manufacturer and included in the annual LPCB *List of Approved Fire and Security Products and Services*. It will include a description of the product and details of the scope of certification such as fire resistance and maximum pane sizes. Parameters critical to the maintenance of product performance will be specified. These may include edge cover, edge restraint, glazing material, glazing bead detail and allowable framing/glass variants.
- 9.2 Products shall be suitably marked with the relevant certification reference number.
- 9.3 Each product shall be despatched with a data sheet which clearly includes the following details:
- The reference number and scope of certification.
 - The storage and handling provisions.
 - The installation instructions.

10. INSTALLATION

LPCB certificated products shall be installed in accordance with the specification agreed by the LPCB. Where this is not the case the LPCB logo and reference number shall be omitted and the system shall not be considered as certificated.

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11. MAINTENANCE

This scheme does not cover maintenance of the installed products.

12. QUALITY

The manufacturer shall demonstrate to the satisfaction of the LPCB that the quality management system under which the products are manufactured and installed is in general accordance with ISO 9001.

The manufacturing base and installation procedure shall be initially inspected by the LPCB and thereafter shall be inspected twice a year for the duration of certification.

13. POST INSTALLATION INSPECTION

The LPCB reserves the right to make random inspections of installed certificated products. Any certificated products found not to comply with the specification agreed with the LPCB shall be investigated and may result in loss of certification.

14. COMPLAINTS

Complaints about LPCB certificated products shall be investigated by the LPCB. Where complaints are not resolved to the satisfaction of the LPCB, the LPCB may withdraw certification.

15. LISTING

Certificated products will be listed in the annual LPCB *List of Approved Fire and Security Products and Services*.

16. PUBLICATIONS REFERRED TO

ISO 9001	Quality management systems - Requirements
BS 476 :	Fire tests on building materials and structures
	Part 20 : 1987 Method for determination of the fire resistance of elements of construction (general principles).
	Part 22 : 1987 Methods for determination of the fire resistance of non-loadbearing elements of construction.
BS 6206 : 1981	Impact performance requirements for flat safety glass and safety plastics for use in buildings
BS 7511: 1989	General criteria for certification bodies operating product certification.

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APPENDIX 1: FIELD OF APPLICATION OF TEST EVIDENCE

The following rules detail the extent to which test data obtained from a particular specimen may be applied to other design variations. They are applicable where the mechanical performance of the framing system depends upon a single material. Where this is provided by a combination of materials acting in conjunction then the scope of certification will be established on an individual case basis.

The rules assume a single change from tested design. Where multiple changes are to be made the cumulative effects will require evaluation as part of the technical assessment.

Deviation from, or additions to, these rules are permitted provided technical justification is given.

A1.1 ORIENTATION

The approval will cover glass glazed walls oriented +/- 15° from the angle at which they were tested provided the integrity performance achieved exceeded that required by 10%. In the absence of a sufficient overrun, no change is permitted from the angle tested.

A1.2 ASYMMETRIC GLAZING SYSTEMS

Tests on asymmetrical glazed walls with the glazing beads on the fire side of the construction cover those with glazing beads on the non-fire side of the construction but not vice versa.

A1.3 HEIGHT

Overriding all increases in the number and/or size of panes is the restriction that approval of any glazed wall is limited to the maximum height tested. This may be increased, subject to these rules, to a maximum of 4 metres if the test was on a full (3m) height specimen.

A1.4 ASPECT RATIO

A1.4.1 30 minutes fire resistance (insulating and non-insulating glass)

The aspect ratio may be varied without restriction in conjunction with the size increases allowed under A.1.5.1.

A1.4.2 >30 minutes fire resistance (non-insulating glass)

The aspect ratio may be varied without restriction provided that the largest dimension of the pane and the area are not increased after those changes allowed under A.1.5.2.

The aspect ratio may be changed to a more adverse shape by a percentage equal to the period of overrun, provided there is no increase in area. For example, for a 60 minute integrity requirement a 66 minute result would enable a 10% increase in the largest dimension of the pane together with a corresponding reduction in the other dimension so that the area was unchanged.

The percentage overrun may be shared between increasing the pane size and adversely changing the aspect ratio. For example, for a 60 minute integrity requirement, a 72 minute result would enable a 10% increase in area as in above and a 10% adverse change in aspect ratio as specified.

A1.4.3 >30 minutes fire resistance (insulating glass)

The aspect ratio may be varied without restriction in conjunction with the size increases allowed under A.1.5.2.

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A1.5 PANE SIZE

A1.5.1 30 minutes fire resistance (insulating and non-insulating glass)

A1.5.1.1 Metal frames

The dimension of the glass may be increased by up to 25% in height and 25% width providing the framing system, in particular the transom, is able to support the glass.

A1.5.1.2 Timber frames

The dimensions may be increase in the same proportions as the metal frames (see above). In addition, in order to obtain approval for the maximum pane size there must be evidence that the framing system has previously been tested successfully in conjunction with a similar glass of that height and weight.

A1.5.2 >30 minutes fire resistance (insulating and non-insulating glass)

A1.5.2.1 Metal frames

The area may be increased by a percentage equal to the period of overrun with no adverse change in aspect ratio. For example, for a 60 minute integrity requirement, a 66 minute result would enable an increase in area of 10%. In no case shall the permitted pane area increase by more than 25%.

The percentage overrun may be shared between increasing the pane size and adversely changing the aspect ratio. For example, for a 60 minute integrity requirement, a 72 minute result would enable a 10% increase in area as in above and a 10% adverse change in aspect ratio as specified.

For insulated glass, since the insulation performance is independent of pane size, there is no limit on the increase of pane size with respect to insulation performance apart from those resulting from consideration of integrity performance.

A1.5.2.2 Timber frames

The dimensions may be increased in the same proportions as the metal frames (see above). In addition, in order to obtain certification of the maximum pane size there must be evidence that the framing system has previously been tested successfully in conjunction with a similar glass of that height and weight.

A1.6 NUMBER OF PANES

A number of panes in a glazed wall may be increased provided that there is supporting test evidence of shared mullions and/or transoms as appropriate.

The number of panes in a glazed wall may be decreased provided that the area of any pane does not exceed the maximum allowable under these rules.

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A1.7 **EDGE COVER**

A1.7.1 Non-insulating glasses

Within manufacturing tolerances edge cover may not be decreased.

Edge cover may be increased except for edge sensitive glasses.

A1.7.2 Insulating glasses

Within manufacturing tolerances edge cover may be increased but not decreased.

A1.8 **MATERIALS**

A1.8.1 General

Materials may not be substituted by those of a lower melting point or lesser strength than those tested.

A1.8.2 Timber

Timber densities of higher than that tested are covered.

Timber densities less than that tested are not covered unless validated by the assessor.

A1.8.3 Glazing Materials

Glazing materials may not be substituted without supporting test evidence unless the glazing materials are themselves certified for that use.

A1.9 **REBATE DETAIL**

Frequently variation will be required of the shape, size and appearance of framing components that make up the glazing rebate. The following rules are to ensure that the fire resistance performance of the resulting glazing method is not compromised. For ease of understanding reference will be made to glazing beads, but it is equally applicable to a rebate machined from solid timber frame or profiled steel upstand.

A1.9.1 Glazing bead details

A1.9.1.1 General

Glazing bead fixing centres may be decreased but not increased.

Tests carried out on lower melting point fixings cover higher melting point fixings, but not vice-versa.

A1.9.1.2 Timber frames

A test using pinned glazing beads covers screwed glazing beads provided the length, strength, angle and position of the fixings are unchanged. The converse is not acceptable.

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The angle of the fixings relative to the glazing bead and frame cannot vary by more than 10° from that tested.

The extent that any fixings 'crossover' the plane of the glass may not be varied.

A1.9.1.3 Metal frames

A test using stud located glazing beads covers screw fixed glazing beads. The converse is not acceptable.

The position of the glazing bead fixings may be varied to accommodate different glass/glazing system thicknesses provided compression details are unaffected.

A1.9.2 Glazing bead configuration

Changes in the appearance, shape and size of glazing beads are permitted provided that there is no weakening of any retention or shielding effect nor any increased exposure to ignition from radiant heat. Edge cover rules must be followed.

A1.10 RESTRAINT

A1.10.1 Timber frames

A1.10.1.1 Expansion

Thermal expansion allowances need not be provided.

A1.10.1.2 Supporting constructions

Test results may be applied to use with any supporting construction of at least the same fire resistance period.

A1.10.1.3 Fixings

The type and location of fixings to the supporting construction may be varied without restriction provided the number of fixings is not less than that tested and the maximum tested fixing centres are not exceeded.

A1.10.2 Metal frames

A1.10.2.1 Expansion

Tests on glazing system components without expansion allowances may be applied to those with expansion allowances but not vice versa.

Tests on framing systems having one unrestrained, unfixed vertical edge and one restrained, fixed vertical edge will validate greater than tested widths. Otherwise certification will be restricted to the tested width.

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A1.10.2.2 Supporting constructions

Test results obtained using a masonry supporting construction may be applied to all other supporting constructions having at least the same fire resistance period. Otherwise certification will be limited to the tested supporting construction.

A1.10.2.3 Fixings

Test results obtained where the fixings to the supporting construction do not permit expansion may be applied to those that do. Otherwise the certification will be limited to that tested. In either event the number and configuration of fixings shall not exceed that tested.

A1.11 DOORS AND WINDOWS

A1.11.1 Timber doors

Glass may be certified for use in timber doorsets in accordance with the field of application rules for glass in timber frames provided it has been tested in a timber doorset for the appropriate fire resistance period. Subject to the restrictions of the field of application rules, the certification will apply to use in all timber doorsets that have been tested/certified for use with glazed apertures, for the fire resistance periods concerned in accordance with the provisions of recognised documentation for the certification of timber fire door assemblies. The certification will apply only up to the maximum pane sizes tested in a door including any extension allowable under these rules. In no case shall the glazed aperture be positioned or sized such as to interfere with any internal structural framing member of the door leaf nor be closer than 100mm from the edge.

A1.11.2 Metal doors

Glass may be certificated for use in metal doorsets in accordance with the field of application rules for glass in steel frames provided it has been tested in a steel doorset for the appropriate fire resistance period. Subject to the restrictions of the field of application rules, the certification will apply to use in all steel doorsets that have been tested/certified for use with glazed apertures.

In no case shall the glazed aperture be positioned or sized such as to interfere with any structural member of the door leaf unless validated by test or assessment.

The maximum door size permitted shall exceed that tested.

Aluminium doorsets are excluded.

A1.11.3 Windows

Proprietary metal framing systems including openable windows will only be certificated where the design of the system is such that they are either automatically self-closing or must be opened and closed by use of a specialist tool and cannot practically be left in an open condition. In such cases the maximum window size permitted shall not exceed that tested. Within this over-riding parameter, the field of application rules for glass in metal frames may be applied. The certification will only apply where the window incorporates tested hardware.

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A1.12 GLAZING MATERIALS

A1.12.1 Glazing materials may not be substituted without supporting test evidence unless the glazing materials are themselves certificated for that use.

A1.12.2 Glazing materials may be certificated in their own right for specified fire resistance periods in accordance with the undermentioned provisions. The foregoing field of application rules also apply:-

A1.12.2.1 Except as specified below, separate test results are necessary for each generic category of non-insulating glass to be covered. Such results apply irrespective of glass thickness.

Tests on monolithic wired glass validate use with toughened borosilicate and ceramic glasses but not vice versa.

Tests on modified toughened glasses validate use with toughened borosilicate and ceramic glasses but not vice versa.

With the exception of modified toughened glasses of more than half hour fire resistance, a test on any non-insulating glass validates use with all other glasses within the same generic category.

A1.12.2.2 Test results obtained using one insulating glass may be applied to use with all insulating glasses. Such results are not applicable to non-insulating glasses, nor vice versa.

For insulating glasses, the test results apply only to the thickness tested. Intermediate glass thicknesses may be covered by test results at the range extremes for both non-preformed and preformed series products.

A1.12.2.3 Separate test results will be necessary, as applicable, to cover use with timber framing systems, metal framing systems, timber doors and metal doors.

Certification for use with half-hour timber firedoors will only be granted where the test results were obtained using either an unblocked flaxboard cored leaf or a softwood joinery door.

Certification for use with one hour timber firedoors will only be granted where the test results were obtained using either an unblocked laminated softwood raft core with chipboard facings or a hardwood joinery door.

A1.12.2.4 Results apply to use with panes up to the size, height and aspect ratio tested/assessed in accordance with these field of application rules.

A1.12.2.5 Restrictions to use may apply where edge cover, rebate and glazing bead detail are likely to influence glazing material performance. Fixing and installation detail shall be specified in the certification in such circumstances.

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APPENDIX 2: TYPICAL TEST CONFIGURATIONS

In order to have the widest possible field of application it is recommended that test specimens include as many features as possible of the under-mentioned configurations. The certification body will be able to help design the test specimen(s) so that the widest possible field of application is achieved.

The relevant field of application rule is referenced in brackets:

A2.1 TEST CONFIGURATION - GENERAL

The specimen should:

- at least one through transom
- at least one cross member (transom and mullion)
- at least one 'T' section (transom and mullion)
- be tested in the most onerous direction (A1.2)
- have as large a variation in aspect ratio as possible - typically the maximum adverse ratio is considered at 5:1 or 1:3 (A1.4)
- have at least one pane of glass at the largest size to be certificated (A1.5)
- have at least four panes of glass (A1.6)
- have fixings of the lowest melting point possible (A1.9)
- have glazing bead fixing centres as far apart as possible (A1.9)
- have an unlatched double action leaf doorset in the centre of the specimen (at floor level) if the glazed wall is to contain a doorset (A1.11).

A2.2 SPECIMEN CONFIGURATION - TIMBER

The specimen should contain the following:

- have the largest pane should be mounted above the transom
- have the largest pane should be mounted within the positive pressure zone of the furnace
- have softwood frames should not exceed 570kg/m³ (A1.8)
- have hardwood frames should not exceed 650kg/m³ (A1.8)
- have frame fixing centres as far apart as possible (A1.10)
- have glazing beads should be located with pins in order to cover screws (A1.9)
- have the glazed wall to be fixed to the supporting construction with either all four edges fixed, or three edges fixed (one vertical edge free) (A1.10)
- include any veneer, coating or paints that could affect the fire resistance of the specimen

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A2.3 SPECIMEN CONFIGURATION - STEEL

The specimen should:

- include glazing beads should be located with studs in order to cover screws (A1.9)
- have maximum restraint to glazing system components as far as possible (A1.10)
- have the glazed wall to be fixed to the supporting construction with three edges fixed (one vertical 'free') (A1.10)
- have maximum possible restraint of glazed wall to thermal expansion as possible (A1.10)
- have the glazed wall to be mounted in a supporting construction of masonry (A1.10)
- have frame fixings to the supporting construction to be at least as frequent and as strong as those used in practice (A1.10).

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APPENDIX 3: ORGANISATIONS RATIFYING THIS LOSS PREVENTION STANDARD

Association of British Insurers	(ABI)
Association of County Councils	(ACC)
Certifire	
Chief and Assistant Chief Fire Officers' Association	(CACFOA)
Confederation of British Industry	(CBI)
Department of Environment	(DoE)
Fire Resistant Glass and Glazing Systems Association	(FRGGSA)
Glass and Glazing Federation	(GGF)
Institute of Building Control	(IBC)
Loss Prevention Council	(LPC)
Loss Prevention Certification Board	(LPCB)
Partition Industry Association	(PIA)
Warrington Fire Research Centre	(WFRC)

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Amendments Issued Since Publication

DOCUMENT NO.	AMENDMENT DETAILS	SIGNATURE	DATE
LPS 1158-2	Changes to copyright information	CJA	29/07/02
LPS 1158-2.1	Further changes to copyright information	CJA	16/09/05
LPS 1158-2.2	<ol style="list-style-type: none"> 1. New front cover 2. Title added to header 3. Contents page moved to Page 1. 4. Revision of Loss Prevention Standards added on Page 2 5. Notes added on Page 3. 6. Update of references to ISO 9001 standard (Clauses 1.1, 4.1, 12 and 16) 7. References to ISO 9002 deleted - this standard has been withdrawn and is replaced by ISO 9001 8. Repagination 9. Update to copyright information 	DC	Jan. 2014

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