Fire protection Advice for timber stairs

This report provides technical guidance on providing satisfactory fire performance of timber stairs to be acceptable within the context of the devolved building regulations.

These regulations particularly recommend that, where an escape stair is the only stair in the building and the building is not a dwelling, apartment or office of two or three stories, the stair should be constructed of materials of limited combustibility. This part is intended to give guidance of achieving compatibility with this recommendation using fire retardant treated timber.

2. Performance Requirements

2.1 General

Stairs are often required to have a proven fire performance particularly when they may be required to provide for escape or access during a fire. The specific requirements and level of performance depend upon the intended use of building into which they are installed, the number of occupants, the availability of other alternative escape routes and the height or number of storeys of the building. The requirements, as in technical guidance given to support the building regulations, for fire performance are in terms of Reaction to Fire and/or Fire Resistance performance and would normally preclude the use of timber stairways due to the combustible nature of the timber.

The basic objective of the technical guidance given to support the building regulations is for a staircase to provide for initial evacuation of the building occupants immediately at risk, to remain usable for fire-fighting and rescue by the fire services and to possibly provide for the subsequent evacuation by the other occupants of the building who may have initially been advised to remain where they were within the building at the time of the fire. Therefore, during occupant evacuation and fire-fighting operations, the stairs must remain serviceable by not supporting a spreading fire and continuing to provide adequate loadbearing capacity.

2.2 Reaction to Fire Performance

In order to comply with UK regulations escape stairs are required to be manufactured using materials that are non-combustible when tested to BS 476: Part 4\(^9\) or Class A1 in accordance with BS EN 13501\(^10\) or are of limited combustibility when tested to BS 476: Part 11\(^11\) or Class A2-s3,d2 in accordance with BS EN 13501-\(^10\), which limits their constructional materials to concrete or steel. Currently, timber products, due to their combustible nature, are not able to meet this requirement.

However, timber products can be upgraded using surface or impregnation treatments to have little or no surface spread of flame as measured by BS 476: Part 7\(^12\) and a very low rate of heat release as measured by BS 476: Part 6\(^13\) (or BS EN 13823\(^14\)). Class 0, or Class B-s3,d2 as defined in BS EN 13501-\(^10\), the highest product performance classification for lining materials, is readily achievable. Class 0 is achieved if a material is either composed throughout of a material of limited combustibility or a class 1 material that has a fire propagation index of not more than 12 and a sub-index \(i_1\) of less than 6. Similarly, Class B-s3,d2 is achievable if products have a low heat release rate particularly in the early part of the fire tests and a low total heat release.

The configuration of stairs is such that fire spread phenomenon, known as ‘the trench effect’ can occur, resulting in a much more rapid flame spread upwards on stairs than would be the case with floors or sloping surfaces. The geometry of the stairs is such that it can cause flames to bend forwards thus preheating the stair tread above that burning raising its temperature until its fire point is reached. The result is flame spread to that tread often before piloted ignition would occur, thus dramatically increasing the speed of flame spread. This mechanism of flame spread can be studied using the test method defined in ISO/TS 22269\(^15\).

2.3 Fire Resistance Performance

Fire resistance properties are normally associated with a separating element such as a wall or a floor rather than an ‘open’ type construction such as a stairway. However, the building regulations do call for fire resistance characteristics and this is normally provided by protecting the underside of the staircase with
plasterboard securely fixed to the stairs or by separating off the stairway with a fire resisting partition, thus preventing the fire attacking the timber components of the tread and risers. Protection in this way is normally adequate to satisfy the requirement for fire resistance from below the stairs for a sufficient time to enable occupants to escape and the fire service to ensure the building is evacuated.

If a fire resistance test is necessary this should follow the recommendations of BS EN 1365-6

2.4 TF2000 project

During 2000, the UK Government funded a research project, TF2000, which looked at the fire performance of multi-storey timber framed buildings incorporating timber staircases. One objective of this work was to investigate the adequacy of timber stairs in providing functional fire performance in terms of providing for safe escape and evacuation of occupants of the buildings and adequate access for the fire services to effect fire fighting and rescue. One experiment investigated the fire performance of a timber staircase when subjected directly to a fire exposure condition, being the most onerous condition for fire spread and involvement of the staircase. The TF2000 experiment used a typical timber staircase specification that included whitewood timber scissor stairs to provide a worse case scenario.

Following a series of trial tests, a full-scale test was conducted. This involved igniting the staircase using alcohol soaked fibre strips and also having a burning mattress in the stairwell to add impressed irradiance to the piloted fire source. In summary, this study showed that the functional fire safety of the staircase was maintained i.e. the stairs were still usable to effect escape and for the fire service to evacuate the building and fight the fire. The full details are contained in the TF2000 report.

The results of the TF2000 study, supported by additional supporting tests conducted by members of industry, have demonstrated that timber staircases can provide for acceptable means of escape and access for fire fighters during a fire situation.

2.5 BD 2569 Fire performance of escape stairs

An experimental programme consisting of 13 fire tests conducted in 2009. The parameters investigated were stair geometry, timber used for treads and risers, the nature and level of reaction to fire treatment and the influence of floor coverings. A test methodology was developed which has proved to be repeatable and well defined in terms of fire loading, location of the seat of the fire, ventilation conditions and ignition procedure.

The geometry, materials and fire treatment of five stairs successfully tested using the methodology determined by BD 2569 are given in appendix A.

3 Functional Fire Safety

3.1 General

Staircases may be required to provide functional fire safety requirements in terms of the following:

- safe means of escape and evacuation of occupants of a building during or after a fire
- safe access for fire services for fire-fighting and rescue operations

To ensure that these requirements can be fulfilled stairs shall not contribute to the initiation and spread of fire and they shall have the ability to retain adequate loadbearing capacity.

3.2 Stair requirements

Timber staircases that satisfy the following requirements may be considered as providing adequate performance:

- be constructed of whitewood timber throughout, allowing a combination of softwood and heartwood
• can be constructed throughout of timber components that have been vacuum pressure impregnated to achieve a Class 0 or Class B-s3,d2 reaction to fire performance.

• shall satisfy the performance requirements given in Appendix b when evaluated in accordance with ISO TS 22269\textsuperscript{15}.

• durable coverings may be provided to the stair tread, but not to the riser, provided the combination of the covering with the timber staircase satisfies all the performance requirements of this guidance.

• the staircase shall be capable of providing the relevant fire resistance performance when subjected to fire from below, as evaluated by EN 1365-6\textsuperscript{16}

• the completed staircase, manufactured from the impregnated components, shall be capable of providing the loadbearing capacity and other functional non-fire related performances required by the design codes

Third party certification of stairs satisfying the requirements of this guidance can provide added confidence in the achievement of the necessary performance with reliability in manufacture. Such certification shall be provided by a UKAS accredited Certification Body

The above specification should be considered to be Best Practice for timber stairways even accepting that the technical guidance to building regulations disallow the use of a timber material due to its combustible nature.

3.3 Location design recommendations

Notwithstanding the fire performance requirements of the technical guidance to building regulations, staircases satisfying the requirements in 4.2 above may be considered to offer adequate provision for their use as escape stairs to buildings.

The fire resistance requirement for stairs in these locations is intended to provide protection in the event of a fire. Fire sources can be created by flammable waste and rubbish left in stairwells. Building design considerations can reduce the potential for this occurring. If the building design can reduce the locations for depositing flammable waste it will reduce the potential for an ignition source.

4 References


2. Building Regulations Scotland 2005 - Technical Standards Regulation 2.5 Part 2.5.1

3. Building Regulations Northern Ireland - Technical Booklet E

4. ETAG 008 Prefabricated Stair Kits, 2002

5. BS5395-1 :2000 Stairs, ladders and walkways. Part 1 Code of Practice for the design, construction and maintenance of straight stairs and winders

6. BS6100: 1992 Glossary of Building Terms

7. BS EN ISO 13943:2000 Fire Safety – Vocabulary

8. BS EN 14076:2004 Timber stairs - Terminology

9. BS 476 Part 4:1984 Non Combustibility Test for Materials

10. BS EN 13501-1: 2002 Fire classification of construction products and building elements, Part 1 – Classification using data from reaction to fire tests

12. BS 476 Part 7: 1997 Method of test to determine the classification of the surface spread of flame of products

13. BS 476 Part 6: 1989 Fire tests on building materials and structures – Method of test for fire propagation for products

14. BS EN 13823: 2002 Reaction to fire tests for building products – Building products excluding floorings exposed to the thermal attack by a single burning item

15. ISO TS 22269:2005 Reaction to fire tests – Fire growth – Full scale test for stairs and stair coverings


**Author:**

Report prepared by Kevin Underwood, Technical Director British Woodworking Federation for the British Woodworking Federation Stair Scheme and tabled at the winter meeting 2017.

*Whilst every effort has been made to ensure the accuracy of advice given, the federation cannot accept responsibility for any loss or damage arising from the use of the information supplied in this publication.*

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Appendix A – stair specifications determined through BD 2569 for use as fire protected escape stairs

<table>
<thead>
<tr>
<th>Type of Stair</th>
<th>Component</th>
<th>Treatment Process</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 straight</td>
<td>Strings</td>
<td>Dricon pressure impregnation to achieve a Class 1 surface spread of flame.</td>
<td>32x 360mm Kerto-S 25mm Euroclass C VR MDF by Premier Forest Products Ltd.</td>
</tr>
<tr>
<td></td>
<td>Treads</td>
<td>None</td>
<td>25mm Euroclass C VR MDF by Premier Forest Products Ltd.</td>
</tr>
<tr>
<td></td>
<td>Risers</td>
<td>None</td>
<td>25mm Euroclass C VR MDF by Premier Forest Products Ltd.</td>
</tr>
<tr>
<td></td>
<td>Newel Posts</td>
<td>Dricon pressure impregnation to achieve a Class 1 surface spread of flame.</td>
<td>90mm stop chamfered or square Hemlock</td>
</tr>
<tr>
<td></td>
<td>Handrail</td>
<td>Dricon pressure impregnation to achieve a Class 1 surface spread of flame.</td>
<td>63 x 44mm Hemlock</td>
</tr>
<tr>
<td></td>
<td>Balusters</td>
<td>Dricon pressure impregnation to achieve a Class 1 surface spread of flame.</td>
<td>41 mm stop chamfered or square Hemlock</td>
</tr>
<tr>
<td>2 dog-leg</td>
<td>Strings</td>
<td>Aquafire HP coating system comprising a primer, two part basecoat and two part topcoat</td>
<td>32x 360mm Kerto-S</td>
</tr>
<tr>
<td></td>
<td>Treads</td>
<td>Aquafire HP coating system comprising a primer, two part basecoat and two part topcoat</td>
<td>27mm Parana Pine</td>
</tr>
<tr>
<td></td>
<td>Risers</td>
<td>Aquafire HP coating system comprising a primer, two part basecoat and two part topcoat</td>
<td>15mm Plywood</td>
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<tr>
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<td>Newel Posts</td>
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</tr>
<tr>
<td></td>
<td>Handrail</td>
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<td>Balusters</td>
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<td>3 dog-leg</td>
<td>Strings</td>
<td>Dricon pressure impregnation achieve a Class 0 surface spread of flame.</td>
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<td>Treads</td>
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</tr>
<tr>
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<td>Risers</td>
<td>Dricon pressure impregnation to achieve a Class 0 surface spread of flame.</td>
<td>12mm MDF by Premier forest Products Ltd</td>
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<tr>
<td></td>
<td>Newel Posts</td>
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<td>90mm stop chamfered or square Hemlock</td>
</tr>
<tr>
<td></td>
<td>Handrail</td>
<td>Dricon pressure impregnation to achieve a Class 0 surface spread of flame.</td>
<td>63 x 44mm Hemlock</td>
</tr>
<tr>
<td></td>
<td>Balusters</td>
<td>Dricon pressure impregnation to achieve a Class 0 surface spread of flame.</td>
<td>41 mm stop chamfered or square Hemlock</td>
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<tr>
<td>Dog-leg</td>
<td>Strings</td>
<td>Treads</td>
<td>Risers</td>
</tr>
<tr>
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<td>12mm Euroclass B FR MDF by Premier Forest Products Ltd</td>
<td>90mm stop chamfered or square Hemlock</td>
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<td>Dricon pressure impregnation to achieve a Class 0 surface spread of flame.</td>
<td>Dricon pressure impregnation to achieve a Class 0 surface spread of flame.</td>
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<td>15mm Plywood</td>
<td>90mm stop chamfered or square Hemlock</td>
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