Implementation of the fire test method
BS EN 81-58 required by the Lifts Directive

BD 2628
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Executive summary

The purpose of the project on ‘Implementation of the Fire Test Method EN81-58 required by the Lifts Directive’ was to develop guidance on the classification of lift landing doors tested in accordance with BS EN 81-58: Safety rules for the construction and installation of lifts. Examination and tests. Part 58 – Landing doors fire resistance test,¹ to enable them to be used more easily within the UK market and ensure that the current levels of safety are maintained.

Approved Document B (AD B) gives guidance on the implementation of the Building Regulations 2000 (as amended) with respect to Part B (Fire safety). For many years AD B has specified the appropriate fire resistance of fire doors for use in certain situations within buildings by reference to classifications based on the BS 476 Part 22 – Fire tests on building materials and structures: Methods for determination of the fire resistance of non-loadbearing elements of construction.²

In order to satisfy the relevant mandate under the Construction Products Directive (89/106/EEC) as amended by the CE marking Directive (93/68/EEC), classifications based on the new European test methods, such as BS EN 1634-1: Fire resistance tests for door and shutter assemblies. Part 1 – Fire doors and shutters,³ were introduced into AD B within Appendix B in 2002.

As part of this process, a series of comparisons between the existing British Standard tests and the new European tests were carried out to ensure that the performance in the new test method was comparable and therefore that there was no lowering of safety standards. In order for AD B to include classifications based on the fire test method BS EN 81-58: Safety rules for the construction and installation of lifts. Examination and tests. Part 58 – Landing doors fire resistance test, a similar programme of comparative testing was considered essential to ensure technical consistency and safety levels.

The overall aim of this project was to develop a proposal for fire resistance times for lift landing doors when tested to BS EN 81-58 based upon comparison of relevant test data and/or assessment for specific lift doors, in accordance with BS 476 Part 22 and BS EN 81-58.

This report presents the results from a series of tests, examining the detailed BS EN 81-58 test results for a range of lift landing doors (focussing on those types of door most commonly sold in the UK market) and then comparing with the identical lift landing door test results to BS 476 Part 22.

The results of the work have shown the following:

- The primary mode integrity failure observed in 10 of the 16 fire tests carried out was sustained flaming. This was independent of the specific test method.
- Sustained flaming was generally associated with the components in the header and top track assembly.

- The test results are sensitive to the quality of installation of the lift landing doorsets. Problems attributed to possible installation problems in this project resulted in failures related to either leakage (BS EN 81-58 test method) or occurrence of gaps (BS 476 Part 22 test method).

- Based on the sustained flaming test results, there is an indication that lift landing doorsets will achieve a higher value of integrity when tested in BS EN 81-58. However, based upon the available data obtained from this project and the indication of variability in repeatability of the test methods, it is suggested that BS EN 81-58 test results can be accepted as equivalent to BS 476 Part 22 test results up to 120 minutes integrity.
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1 Introduction and objectives

Communities and Local Government contracted the Buildings Research Establishment (BRE) to carry out a project on ‘Implementation of the Fire Test Method EN81-58 required by the Lifts Directive’.

The purpose of the project was to develop guidance on the classification of lift landing doors tested in accordance with *BS EN 81-58: Safety rules for the construction and installation of lifts. Examination and tests. Part 58 – Landing doors fire resistance test*, to enable them to be used more easily within the UK market and ensure that the current levels of safety are maintained.

Approved Document B (AD B) gives guidance on the implementation of the Building Regulations 2000 (as amended) with respect to Part B (Fire safety). For many years AD B has specified the appropriate fire resistance of fire doors for use in certain situations within buildings by reference to classifications based on the *BS 476 Part 22: Fire tests on building materials and structures: Methods for determination of the fire resistance of non-loadbearing elements of construction*.

In order to satisfy the relevant mandate under the Construction Products Directive (89/106/EEC) as amended by the CE marking Directive (93/68/EEC), classifications based on the new European test methods, such as *BS EN 1634-1: Fire resistance tests for door and shutter assemblies. Part 1 – Fire doors and shutters*, were introduced into AD B within Appendix B in 2002.

As part of this process, a series of comparisons between the existing British Standard tests and the new European tests were carried out to ensure that the performance in the new test method was comparable and therefore that there was no lowering of safety standards. In order for AD B to include classifications based on the fire test method *BS EN 81-58: Safety rules for the construction and installation of lifts. Examination and tests. Part 58 – Landing doors fire resistance test*, a similar programme of comparative testing was considered essential to ensure technical consistency and safety levels.

This presents the results from a series of tests, examining the detailed BS EN 81-58 test results for a range of lift landing doors (focussing on those types of door most commonly sold in the UK market) and then comparing with the identical lift landing door test results to BS 476 Part 22. The test results have been compared to benchmark their fire performance against BS 476 Part 22 for inclusion in the guidance.

Inclusion in the guidance will improve the ease of acceptance of BS EN 81-58 test data by Building Control Bodies, specifiers and regulators by giving it explicit visibility alongside BS 476 Part 22 and BS EN 1634-1.
It is important to note that only generic information with reference to broad product types has been included in this report. It does not refer to specific products or manufacturers. Also the concept of pass/fail is not relevant to this work and therefore will not be reported.

The overall aim of this project was to develop a proposal for fire resistance times for lift landing doors when tested to BS EN 81-58 based upon comparison of relevant test data and/or assessment for specific lift doors, in accordance with BS 476 Part 22 and BS EN 81-58.
2 Programme of work

Stakeholder group

The first phase of this project was primarily desk-based and involved the creation of a stakeholder group of representatives of the lift industry and other key stakeholders. Stakeholders contributed to the project through the provision of information on the scoping of the commonly used product types and ranges and also made representative specimens available for the comparative testing programme. A list of the stakeholder group members is provided in Appendix B.

Review of test methods

A short review of the fire test methods, BS 476 Part 22 and BS EN 81-58, was undertaken to summarise the basis of each test and highlight the primary differences. This review provided background information for consideration when designing the test programme and highlighted those factors that could influence the results from the tests. A summary of the review of the test methods is presented in Table 1.

<table>
<thead>
<tr>
<th>Table 1: Comparison of fire test methods</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Parameter</strong></td>
</tr>
<tr>
<td>Orientation of specimen</td>
</tr>
<tr>
<td>Furnace heating curve</td>
</tr>
<tr>
<td>Furnace pressure</td>
</tr>
</tbody>
</table>
## Table 1: Comparison of fire test methods

<table>
<thead>
<tr>
<th>Parameter</th>
<th>BS 476: Part 22</th>
<th>BS EN 81-58</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Integrity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sustained flaming</td>
<td>Not less than 10s</td>
<td>More than 10s</td>
<td></td>
</tr>
<tr>
<td>Cotton pad</td>
<td>Applied for 10s – 15s (Not used for uninsulated doorset)</td>
<td>Not used</td>
<td></td>
</tr>
<tr>
<td>Gap gauges</td>
<td>Employed after 5min: 6mm x 150mm (other than at sill level), 25mm dia. for any gap</td>
<td>Not used</td>
<td></td>
</tr>
<tr>
<td>Leakage rate</td>
<td>Not used</td>
<td>Employed after 14 min.: Limit = 3m³/(min.m)</td>
<td></td>
</tr>
<tr>
<td><strong>Insulation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean and maximum temperature measurements on insulated, partially insulated and uninsulated doorsets.</td>
<td>Mean and maximum temperature measurements on insulated and partially insulated doorsets. Not required for uninsulated doors.</td>
<td>Different rules for siting of thermocouples.</td>
<td></td>
</tr>
<tr>
<td>For insulated or partially insulated doorsets, no thermocouples closer than 50mm from joints/edges/through component or stiffener.</td>
<td>No thermocouples closer than 100mm from joints/edges/through component or stiffener.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Deflection measurement</strong></td>
<td>Monitor lateral deflection.</td>
<td>Deformation measurements to be made at specified locations.</td>
<td></td>
</tr>
<tr>
<td><strong>Radiation flux measurements</strong></td>
<td>For information, monitor radiation from unexposed face of uninsulated or partially insulated doorsets.</td>
<td>If required, monitor radiation from unexposed face.</td>
<td></td>
</tr>
<tr>
<td><strong>Direct field of application</strong></td>
<td>Not included.</td>
<td>Included.</td>
<td></td>
</tr>
</tbody>
</table>

A comprehensive test programme was designed to identify the full scope of comparative data necessary to enable the development of a transposition from BS 476 Part 22 to BS EN 81-58 with a high degree of confidence and with a focus on maintaining current levels of safety. This involved testing identical doorsets in accordance with the fire test methods BS 476 Part 22 and BS EN 81-58. The fire test procedures are explained in more detail below.
BS EN 81-58 fire test procedure

General
The BS EN 81-58 test involves exposing the landing side of a lift landing door to the furnace heating conditions specified in BS EN 1363-1: Fire resistance tests. Part 1: General requirements. During the test a positive pressure exists over the full height of the door on the exposed side inducing the leakage of furnace gases to the unexposed side. The leaked gases were collected by a canopy fitted over the door on the unexposed face of the test construction, connected via an airflow measuring station, to an extract fan. The concentration of CO2, used as a tracer gas, is measured in the furnace and at the airflow measuring station where the gas flow and its temperature are measured. From these measurements it is possible to calculate the leakage rate of hot gases through the test door.

The canopy arrangement is shown in Figure 1. A schematic showing the arrangement of the test equipment is shown in Figure 2.

Verification procedure for leakage rate measurement
The verification procedure for leakage rate measurement is specified in Annex C of BS EN 81-58. The test requires verification of the proper functioning and accuracy of the airflow measuring system and the airflow CO2 sampling and analysis system. For the qualification test the front of the specimen was first protected with insulation and the propane-fuelled ISO 9705: Fire tests – Full scale room test for surface products5 burner installed beneath the canopy.

After setting the extract fan to produce an airflow of nominally 0.6Nm³/min, the burner was ignited and the propane gas supply adjusted to a normalised rate of 1.36l/s; at this flow, and assuming complete combustion, the burner will produce CO2 at a rate of 0.25Nm³/min. The burner was run for a total of 15 minutes, the first 10 minutes being a pre-heat period which was followed by a 5 minute measurement period.

Furnace control
The furnace temperature was measured by means of eight plate thermocouples positioned symmetrically in the furnace with their measuring junctions 100mm from the exposed face of the door or wall. The temperature was controlled so as to follow the temperature/time relationship specified in BS EN 1363-1.

Two pressure sensing heads were positioned in the furnace, set 0.30m and 2.17m above the level of the sill of the door, to monitor the pressure within the furnace. The pressure was maintained in accordance with section 6.2 of BS EN 81-58 with the pressure at the sill level controlled to be in the range 2 + or - 2 Pa, this was achieved by maintaining the furnace pressure at the lower pressure sensing head as closely as possible to 4.5 Pa.
Unexposed face temperature measurements

The temperature of the unexposed face of the lift landing door was measured using five chromel/alumel thermocouples each soldered to a copper disc and covered with a 30mm-square insulation pads. The temperature of the door was recorded for information only as a formal evaluation against the insulation criteria was not required. The thermocouples, labelled 1 to 5, were positioned as shown in Figure 3.

Irradiance measurements

The irradiance was measured during the course of the test by a radiometer, as specified in BS EN 1363-2: Fire resistance tests. Part 2 – Alternative and additional test procedures, positioned at a perpendicular distance of 1m from the centre of the test specimen to receive radiation from the full area of the doorset. The head of the heat flux meter monitoring the radiation was positioned through an aperture made in the curtain of the canopy arrangement.

Deflection measurements

The horizontal deflection at the mid-height of the doorset was continuously monitored using two displacement transducers. One transducer was connected to the leading edge of the left-hand door panel whilst the other was connected to the leading edge of the right-hand door panel. Additional measurements were taken at intervals during the early part of the test by reference to two taut datum wires set across the face of the doorset level with both the bottom and mid-height of the panels. The location of the additional measurement points is shown in Figure 4.

Furnace CO₂ measurement

A sample probe was introduced into the furnace near its centre. Furnace gases were drawn through the probe and passed through a series of cooling, filtering and drying arrangements prior to being presented to analyser where the CO₂ content of the gases was continuously monitored throughout the course of the test.

Gas flow measurement

The 200mm-diameter flexible ducting leading from the canopy was connected to an airflow measuring system comprising two lengths of 210mm-diameter steel tube with an orifice plate set in between. The airflow measuring system was sized to comply with the requirements of ISO 5221: Air distribution and air diffusion – Rules to methods of measuring airflow rate in an air handling duct.

The system was calibrated against a reference flow measuring device and the calculation of airflow found to be in accordance with that specified in the standard. The system had d and d/2 tappings to measure the pressure drop
across the orifice; the upstream tapping was also used to measure the underpressure at the orifice plate. A 1mm-diameter sheathed thermocouple was inserted into the flow measuring pipe to rest at the axis of the pipe 100mm downstream from the orifice plate. Readings from this thermocouple were used to apply temperature corrections to the measured airflow.

Further downstream from the sheathed thermocouple a perforated gas sampling probe was inserted into the steel tube; gases were drawn through the probe and passed through a series of cooling, filtering and drying arrangements prior to being presented to analyser where the CO₂ content of the gases was continuously monitored throughout the course of the test.

Performance criteria

BS EN 81-58 specifies three criteria of performance as follows:

**Integrity (E):** The integrity criterion is satisfied as long as the leakage rate per metre width of the door does not exceed 3m³/(min.m), not taking into account the first 14 min of the test.

Integrity shall also be considered to have been lost by the occurrence of sustained flaming. Sustained flaming is deemed to be flaming for more than 10s.

**Thermal insulation (I):** Evaluation against the insulation criteria was not required for the lift landing doors tested in this project.

**Radiation (W):** Evaluation against the radiation criterion was not required as part of this project. The radiation criterion is satisfied until the measured radiation exceeds the value of 15 kW/m², measured as specified in BS EN 1363-2.

BS 476 Part 22 fire test procedure

**Furnace control**

The furnace temperature was measured by means of 16 chromel/alumel thermocouples positioned symmetrically in the furnace, with their measuring junctions 100mm from the exposed face of the door or wall. The temperature was controlled so as to follow the temperature/time relationship specified in BS 476-20: Fire tests on building materials and structures. Part 20 – Method for the determination of the fire resistance of elements of construction (general principles). ¹

A pressure sensing head positioned 2.45m above the base of the furnace was used to monitor the pressure within the furnace. The pressure was maintained in accordance with section 3.2 of BS 476-20 taking the sill level (0.28m above the base of the furnace) to be the notional floor level.
Irradiance measurements

The irradiance throughout the test was measured by a radiometer positioned at a perpendicular distance of 1 m from the centre of the test specimen to receive radiation from the full area of the doorset.

Deflection measurements

The horizontal deflection at the mid-height of the doorset was continuously monitored using two displacement transducers. One transducer was connected to the leading edge of the left-hand door panel whilst the other was connected to the leading edge of the right-hand door panel. Additional measurements were taken at intervals during the early part of the test by reference to two taut datum wires set across the face of the doorset level with both the bottom and mid-height of the panels. The location of the additional measurement points is shown in Figure 4.

Unexposed face temperature measurements

The temperature of the unexposed face of the lift landing door was measured using five chromel/alumel thermocouples each soldered to a copper disc and covered with a 30 mm-square insulation pads. The temperature of the door was recorded for information only as a formal evaluation against the insulation criteria was not required. The thermocouples, labelled 1 to 5, were positioned as shown in Figure 3.

Performance criteria

BS EN 81-58 and BS 476-20 state that an uninsulated doorset is regarded as having a fire resistance (expressed in minutes) that is equal to the elapsed time (in completed minutes) between the commencement of heating and the termination of heating, or until failure to meet the integrity criteria occurs, whichever is the sooner.

Integrity

Failure is deemed to occur:

(a) when collapse or sustained flaming for not less than 10 s on the unexposed face occurs

(b) when a 6 mm-diameter gap gauge can penetrate through a gap into the furnace other than at sill level and be moved in the gap for a distance of at least 150 mm

(c) when a 25 mm gap gauge can penetrate through a gap into the furnace.
Test specimen product description

The generic descriptions of the products that were included in the test programme are summarised in Table 2 below. For each product reference, two identical door sets were obtained. One was tested in accordance with BS 476 Part 22 and the other in accordance with BS EN 81-58.

**Table 2: Summary of test specimens and dimensions**

<table>
<thead>
<tr>
<th>Product Reference</th>
<th>Description</th>
<th>Clear opening (W x H) mm</th>
<th>Door leaf (W x H) mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>2 panel centre opening</td>
<td>1100 x 2400</td>
<td>583 x 2423</td>
</tr>
<tr>
<td>B</td>
<td>4 panel centre opening</td>
<td>1800 x 2400</td>
<td>480 x 2439</td>
</tr>
<tr>
<td>C</td>
<td>Hinged doorset</td>
<td>800 x 2035</td>
<td>825 x 2051</td>
</tr>
<tr>
<td>D</td>
<td>2 panel side opening</td>
<td>800 x 2000</td>
<td>437 x 2045</td>
</tr>
<tr>
<td>E</td>
<td>2 panel side opening</td>
<td>1300 x 2000</td>
<td>670 x 2000</td>
</tr>
<tr>
<td>F</td>
<td>2 panel centre opening</td>
<td>1200 x 2000</td>
<td>620 x 2040</td>
</tr>
<tr>
<td>G</td>
<td>2 panel centre opening</td>
<td>800 x 2000</td>
<td>450 x 2045</td>
</tr>
<tr>
<td>H</td>
<td>2 panel centre opening</td>
<td>900 x 2000</td>
<td>490 x 2045</td>
</tr>
</tbody>
</table>

**Product A**

The specimen door assembly was a two-panel centre-opening lift landing door assembly, having a clear opening, 2400mm high x 1100mm wide. It was installed into brickwork 215mm-thick and tested with the landing side facing the furnace.

The door assembly comprised two door panels, two frame uprights and a top member (overbeam profile). The door panels ran on a steel track at the top and in a steel sill at the bottom.

**Product B**

The specimen door assembly was a four-panel centre-opening lift landing door assembly, having a clear opening, 2400mm high x 1800mm wide. It was installed into brickwork 215mm-thick and tested with the landing side facing the furnace.

The door assembly comprised four door panels, two frame uprights and a top member (overbeam profile). The door panels ran on a steel track at the top and in a steel sill at the bottom.
**Product C**

The specimen door assembly was a single leaf hinged steel door assembly, providing a clear opening, 2035mm high x 800mm wide. It was installed into a concrete block wall 190mm-thick having a nominal density of 1050 kg/m$^3$ and was tested with the leaf opening away from the furnace.

The door leaf was closed on its latch for the fire test.

During the fabrication of the door, a paper honeycomb core - normally installed within the leaf to stiffen the structure - was omitted. The core was omitted as the degradation or combustion of the core in the fire test would produce CO$_2$ which would affect the measure of the leakage around the door which is calculated using CO$_2$ as a tracer gas.

The doorset comprised a hollow steel leaf hung from a steel doorframe.

**Product D**

The specimen door assembly was a two-panel side-opening lift landing door assembly, having a clear opening, 2000mm high x 800mm wide. Excluding fixing brackets at the top of the door and a toe guard plate at the bottom, the overall size of the door was 2330mm high x 1480mm wide x 153mm deep. The door was installed into a concrete block (EN) or brick wall (BS) and was tested with the landing side facing the furnace.

The door assembly comprised a door frame assembly carrying two sliding door panels which ran on an aluminium track at the top of the assembly and in an aluminium sill at the bottom. The fast door panel closed against a slam panel; the door was closed by a counterweight suspended within the slam panel and both panels were retracted behind a side panel when the door was opened.

**Product E**

The specimen door assembly was a two-panel side-opening lift landing door assembly, having a clear opening, 2000mm high x 1300mm wide. The door was installed into a concrete block wall 190mm-thick having a nominal density of 1050 kg/m$^3$ (EN) or a brick wall (BS) and was tested with the landing side facing the furnace.

The door assembly comprised a door frame assembly carrying two sliding door panels which ran on aluminium tracks at the top of the assembly and in an aluminium sill at the bottom. The fast door panel closed against a slam panel; the door was closed by a counterweight suspended within the slam panel and both panels were retracted behind a side panel when the door was opened.


**Product F**

The specimen door assembly was a two-panel centre-opening lift landing door assembly, having a clear opening, 2000mm high x 1200mm. The door was installed into a concrete block wall 190mm-thick having a nominal density of 1050 kg/m³ (EN) or a 215mm-thick brickwork wall and was tested with the landing side facing the furnace.

The door assembly comprised a door frame assembly carrying two sliding door panels which ran on a steel rail at the top of the assembly and in an aluminium track at the bottom.

**Product G**

The specimen door assembly was a two-panel centre-opening lift landing door assembly, having a clear opening, 2000mm high x 800mm. The door was installed into a concrete block wall 190mm-thick having a nominal density of 1050 kg/m³ (EN) or a 215mm-thick brick wall and was tested with the landing side facing the furnace.

The finished architrave assembly, of overall dimensions 2250mm high x 1750mm wide x 110mm deep, comprised a header assembly, two vertical members (side panels) and a sill assembly.

The door assembly comprised two sliding door panels running on an aluminium rail at the top of the assembly and in an aluminium track at the bottom.

**Product H**

The specimen door assembly was a two-panel centre-opening lift landing door assembly, having a clear opening, 2000mm high x 900mm. The door was installed into a concrete block wall 190mm-thick having a nominal density of 1050 kg/m³ or a 215mm-thick brickwork wall and was tested with the landing side facing the furnace.

The finished architrave assembly, of overall dimensions 2250mm high x 1935mm wide x 110mm deep, comprised a header assembly, two vertical members (side panels) and a sill assembly.

The door assembly comprised two sliding door panels running on an aluminium rail at the top of the assembly and in an aluminium track at the bottom.
Test results

A summary of the test results is presented in Table 3.

<table>
<thead>
<tr>
<th>Product</th>
<th>Test</th>
<th>Description</th>
<th>Sustained flaming (mins)</th>
<th>Leakage (mins)</th>
<th>Gap (mins)</th>
<th>Integrity (mins)</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>EN</td>
<td>2 panel centre opening</td>
<td>135</td>
<td>135</td>
<td>n/a</td>
<td>135</td>
<td>No failure at test termination</td>
</tr>
<tr>
<td>A</td>
<td>BS</td>
<td>2 panel centre opening</td>
<td>125</td>
<td>n/a</td>
<td>125</td>
<td>125</td>
<td>No failure at test termination</td>
</tr>
<tr>
<td>B</td>
<td>EN</td>
<td>4 panel centre opening</td>
<td>39</td>
<td>135</td>
<td>n/a</td>
<td>39</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>BS</td>
<td>4 panel centre opening</td>
<td>125</td>
<td>n/a</td>
<td>15</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>EN</td>
<td>Hinged doorset</td>
<td>120</td>
<td>120</td>
<td>n/a</td>
<td>120</td>
<td>No failure at test termination</td>
</tr>
<tr>
<td>C</td>
<td>BS</td>
<td>Hinged doorset</td>
<td>91</td>
<td>n/a</td>
<td>120</td>
<td>91</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>EN</td>
<td>2 panel side opening</td>
<td>23</td>
<td>14</td>
<td>n/a</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>BS</td>
<td>2 panel side opening</td>
<td>120</td>
<td>n/a</td>
<td>120</td>
<td>120</td>
<td>No failure at test termination</td>
</tr>
<tr>
<td>E</td>
<td>EN</td>
<td>2 panel side opening</td>
<td>18</td>
<td>120</td>
<td>n/a</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>BS</td>
<td>2 panel side opening</td>
<td>22</td>
<td>n/a</td>
<td>120</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>EN</td>
<td>2 panel centre opening</td>
<td>29</td>
<td>120</td>
<td>n/a</td>
<td>29</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>BS</td>
<td>2 panel centre opening</td>
<td>23</td>
<td>n/a</td>
<td>40</td>
<td>23</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>EN</td>
<td>2 panel centre opening</td>
<td>40</td>
<td>120</td>
<td>n/a</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>BS</td>
<td>2 panel centre opening</td>
<td>61</td>
<td>n/a</td>
<td>120</td>
<td>61</td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>EN</td>
<td>2 panel centre opening</td>
<td>50</td>
<td>120</td>
<td>n/a</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>BS</td>
<td>2 panel centre opening</td>
<td>46</td>
<td>n/a</td>
<td>120</td>
<td>46</td>
<td></td>
</tr>
</tbody>
</table>

Note: In four of the tests above (Product A – BS, EN, Product C – EN and Product D – BS), the doorsets had not failed any of the performance criteria at the termination of the test, therefore the times reported relate to the test termination time.
Discussion

In total, 16 fire tests were carried out on eight different doorsets. One of these doorsets was a single leaf hinged steel door assembly (product C) which was included as a calibration-type element due to its simpler construction. This specific doorset achieved 91 minutes integrity in accordance with the BS 476 Part 22 fire test procedure and had not failed any of the integrity criteria in accordance with the BS EN 81-58 fire test procedure at the termination of the test at 120 minutes.

Doorsets G and H were very similar in terms of clear opening, door leaf dimension and configuration. As such, they can be compared to give an indication of the repeatability of the test methods. It can be seen by reference to Table 3 that the results vary from 40 minutes to 61 minutes integrity. This spread of data has been taken into account in reaching the conclusions to this project.

In one of the BS 476 Part 22 tests, there was an early failure due to the occurrence of a gap between the door leaves near the sill. In this case, it is considered that the doors were installed with insufficient gap in the ambient condition which would lead to additional stresses on the doorset in the early stages of the fire test. The only other failure due to a gap in the BS 476 Part 22 test resulted from a gap between the door frame and wall which may have been due to a failure in the fixing of the door frame. However, this specific failure was secondary to sustained flaming.

In one of the BS EN 81-58 tests, there was an early failure due to leakage which resulted when the side member forming the doorset slam post moved away from the wall due to a buckling of the fixing bracket. In all of these cases, there appears to have been an installation issue that was not repeated in the comparison test on the identical doorset, which means that the comparison of the performance in the two test methods is not valid.

Reference to Table 3 clearly shows that in 10 of the 16 tests, the first performance criteria that was exceeded was sustained flaming. In most instances, this occurred in the header and top track assembly. This contains the mechanism for opening and closing of the doors and typically includes a pulley, rollers, track, latching and door closing mechanisms. The sustained flaming was generally attributable to combustible components within the header and top track assembly.

The integrity performance criterion for sustained flaming is sustained flaming on the unexposed face of the doorset for ≥10 seconds duration. This performance criterion is the same for both test methods and as already discussed, was the most common mode of failure. The data from both the BS 476 Part 22 and BS EN 81-58 test methods (with the data that was possibly affected by installation issues removed) are shown in Figure 5.
It can be seen that there is a reasonable correlation between the results from the two test methods. Analysis of this data does indicate a trend where the lift landing doorsets tested in the BS EN 81-58 test method are predicted to achieve higher values of integrity compared with BS 476 Part 22 test method as the fire resistance period increases. This analysis is based upon extrapolation but it does indicate that this difference in integrity from the two test methods is unlikely to exceed 15% based on the very limited data available and sustained flaming as the performance criteria.

The results in Table 3 show that if the header and top track assemblies of the lift landing doors were re-engineered to eliminate sustained flaming failures, then, with the exception of the installation variable, they could all achieve in excess of 120 minutes integrity in both the BS 476 Part 22 and EN 81-58 fire tests.

The primary difference that exists between the integrity criteria for the BS 476 Part 22 and BS EN 81-58 test methods relate to the measurement of leakage. Unfortunately, during this project, there was only one case in which the leakage criterion was exceeded. This was a very early failure that was attributed to a possible installation problem. In all of the other BS EN 81-58 tests, there was no recorded failure in the leakage criteria.
3 Conclusions

The primary mode integrity failure observed in 10 of the 16 fire tests carried out was sustained flaming. This was independent of the specific test method.

Sustained flaming was generally associated with the components in the header and top track assembly.

The test results are sensitive to the quality of installation of the lift landing doorsets. Problems attributed to possible installation problems in this project resulted in failures related to either leakage (BS EN 81-58 test method) or occurrence of gaps (BS 476 Part 22 test method).

Based on the sustained flaming test results, there is an indication that lift landing doorsets will achieve a higher value of integrity when tested in BS EN 81-58. In addition, there is no way to compare the failures due to leakage in the BS EN 81-58 fire test with those in the BS 476 Part 22 fire test since there were no failures of this type recorded (other than due to an installation problem). This therefore leaves the question of comparability between the measurement of integrity in the two test methods unanswered which could result in a potentially unsafe transposition for the fire resistance times for the BS EN 81-58 fire test.

Based upon the available data obtained from this project and the indication of variability in repeatability of the test methods, at this time, it is suggested that BS EN 81-58 test results be accepted as equivalent to BS 476 Part 22 test results up to 120 minutes integrity. However, it is strongly recommended that this position is kept under review as more relevant fire test data becomes available.
4 References


5 Figures

Figure 1: Schematic diagram of canopy arrangement for BS EN 81-58 test method
Figure 2: Schematic diagram showing arrangement of test equipment for BS EN 81-58 test method
Figure 3: Schematic showing location of thermocouples attached to unexposed face of the doorset

(Not to scale)
Figure 4: Schematic showing location of deflection measurement points
Figure 5: Comparison of BS 476 Part 22 and BS EN 81-58 test data with installation variable data removed
# Appendix: Stakeholder group membership

<table>
<thead>
<tr>
<th>Organization</th>
<th>Name</th>
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</thead>
<tbody>
<tr>
<td>Buildings Research Establishment</td>
<td>Debbie Smith</td>
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<tr>
<td>Buildings Research Establishment</td>
<td>Dick Jones</td>
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<tr>
<td>Buildings Research Establishment</td>
<td>Sue Green (Secretary)</td>
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<tr>
<td>Communities and Local Government (CLG)</td>
<td>Tracey Cull</td>
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<tr>
<td>AEA Technology (representing CLG)</td>
<td>Mike Payne</td>
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<td>Chief Fire Officers Association</td>
<td>John Llewellyn</td>
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<tr>
<td>DTI (now the Department for Business, Innovation and Skills)</td>
<td>Mike Dodds</td>
</tr>
<tr>
<td>Association of Building Engineers</td>
<td>Beryl Menzies</td>
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<td>Lift and Escalator Industry Association</td>
<td>Derek Smith</td>
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<td>Robert Lee</td>
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<td>Passive Fire Protection Federation</td>
<td>David Sugden</td>
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<td>Fire Brigades Union</td>
<td>Matt Wrack</td>
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