

Evolution Fasteners (UK) Ltd
Department of Engineering and Laboratory Services

TECHNICAL GUIDE: FIRE RESISTANCE

FIRE RESISTANCE, RATING AND CLASSIFICATION OF
EVOLUTION® PRODUCTS

Introduction

Technical Guide: Fire Resistance *'fire resistance, rating and classification of Evolution® products'*, is a guidance document provided by Evolution Fasteners (UK) Ltd for educational purposes only.

The form of this document shall, for the purposes of recognition and familiarity, take the form of a British Standard as formatted in accordance with BS 0: 2016, *'A standard for standards'* as well as the rules for the structure and drafting of UK standards (The British Standards Institution, 2017). However, the reader should take note that this document is not published, nor intended to be published by the British Standards Institution (herein referred to as "BSI").

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Where citations and references are made, it is in the *'Harvard Style'* pursuant to the guidance laid out by Imperial College London (Imperial College London, 2017).

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1.0 Scope

This document sets out the principals by which the tests will be performed, test data captured, data analysis, data reporting and other activities required, as well as all other pertinent information surrounding the topic of fire resistance, rating and classification of Evolution® branded products.

As this document relates to empirical testing and regulatory requirements pertaining to the activities of Evolution Fasteners (UK) Ltd, the author has elected to include and maintain the principals of BS EN ISO/IEC 17025: 2017, '*General requirements for the competence of testing and calibration laboratories*', to maintain the integrity, accuracy and validity of test results as well as for familiarity and codification into our existing quality management system.

2.0 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of referenced document (including any amendments) applies.

BS 0, *A standard for standards – principals of standardisation*,

BS EN ISO/IEC 17025: 2017, *General requirements for the competence of testing and calibration laboratories*,

BS EN ISO 9001: 2015, *Quality management systems. Requirements*,

BS EN ISO 13943: 2017, *Fire safety. Vocabulary*

BS 476-6: 1989 & A1: 2009, *Fire tests on building materials and structures. Method of test for fire propagation for products*,

BS 476-7: 1997, *Fire tests on building materials and structures. Method of test to determine the classification of the surface spread of flame of products*,

BS EN 520: 2004 & A1: 2009, *Gypsum plasterboards. Definitions, requirements and test methods*,

BS EN 1364-1: 2015, *Fire resistance tests for non-loadbearing elements. Walls*,

BS EN 13501-1: 2018, *Fire classification of construction products and building elements. Classification using data from reaction to fire tests*,

BS EN 14195: 2014, *Metal framing components for gypsum board systems. Definitions, requirements and test methods*,

BS EN 14566: 2008 & A1: 2009, *Mechanical fasteners for gypsum plasterboard systems. Definitions, requirements and test methods*,

Statutory Instruments 2010 No. 2214, *Building and buildings, England and Wales*. The Building Regulations 2010,

Statutory Instruments 2015 No. 0051, *Health and safety*. The Construction (Design and Management) Regulations 2015,

Regulation (European Union) No. 305/2011, *Construction Products Regulations (the)*,

Approved Document B, Volume 1: Dwellings (2019 Edition), HM Government Ministry of Housing, Communities and Local Government,

Approved Document B, Volume 2: Buildings other than dwellings (2019 Edition), HM Government Ministry of Housing, Communities and Local Government,

Technical Report No. 021, *Reaction to fire requirements for small components*, European Organisation for Technical Assessments,

Rules for the structure and drafting of UK standards, British Standards Institution,

Citing & Referencing: Harvard Style, Imperial College London Library.

3.0 Terms and definitions

For the purposes of this technical procedure, the following terms and definitions apply:

3.1 amendment

alteration and/ or addition to previously agreed technical or editorial content of an existing document, standard, regulation, statutory instrument, law, etc,

3.2 black body radiation source^{1,2}

ideal thermal radiation source which completely absorbs all incident heat radiation, whatever wavelength and direction

3.2 combustible

capable of being ignited and burned (as adjective), or, item capable of combustion (as noun),

3.3 combustion

exothermic reaction of a substance with an oxidising agent,

3.4 compliance

action of a person or body in fulfilling provisions or requirements, etc,

¹ The emissivity (3.8) of a black body radiant source is unity,

² A black body can also be an ideal radiator of energy,

- 3.5 conformity**
Fulfilment of a provision,
- 3.6 deflagration**
combustion (3.3) wave propagating at subsonic velocity,
- 3.7 detonation**
reaction characterised by a shock wave propagating at a velocity greater than the local speed of sound in the unreacted material,
- 3.8 emissivity**
ratio of the radiation emitted by a radiant source to the radiation that would be emitted by a black body radiant source at the same temperature,
- 3.9 European standard (EN)**
standard adopted by CEN (European Committee for Standardisation), CENELEC (European Committee for Electrotechnical Standardisation or ETSI (European Telecommunications Standards Institute),
- 3.10 expanded uncertainty³**
quantity defining an interval for the result of a measurement that may be expected to encompass a large fraction of the distribution of values that could reasonably be attributed to the measurand,
- 3.11 explosion**
abrupt expansion of gas which may result from a rapid oxidation or decomposition reaction, with or without, an increase in temperature,
- 3.12 fire⁴**
process of combustion (3.3) characterised by the emission of heat and fire effluent and usually accompanied by smoke, flame, glowing, or a combination thereof,
- 3.13 fire behaviour^{5,6,7}**
change in, or maintenance of, the physical and/ or chemical properties of an item and/ or structure exposed to fire (3.12),
- 3.14 fire resistance^{8,9}**
ability of a test specimen or item to withstand fire or give protection from it for a period of time,

³ The fraction may be viewed as the coverage probability or level of confidence of the interval,

⁴ In the English language, the term “fire” is used to designate three concepts, two of which related to specific types of self-supporting combustion with different meanings. Of these three, two of them are designated using two different terms in both French and German,

⁵ Comparable with the term “fire performance”,

⁶ This concept covers both “reaction to fire” (3.17) and “fire resistance” (3.14),

⁷ In English, this term may also be used to describe the behaviour of a fire,

⁸ Typical criteria used to assess fire resistance in a standard fire test are fire integrity, fire stability and thermal insulation,

⁹ The term “fire resistance”, as an adjective, refers only to this ability.

3.15 International standard (ISO or IEC)

standard adopted by ISO (International Standards Organisation) or IEC (International Electrotechnical Commission),

3.15 normative

characteristic of material in a standard that is essential to the application of the standard in the manner intended, and against which it is possible to demonstrate and claim conformity to the standard,

3.16 normative reference

document to which reference is made in a standard or document in such a way as to make it indispensable for the application of the standard or document,

3.17 reaction to fire

response of a test specimen when exposed to fire (3.12) under specified conditions in a fire test,

3.18 regulation

document providing binding legislative rules, that is adopted by an authority or government,

3.19 standard

document, established by consensus and approved by a recognised body, that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context,

3.20 Technical Report (TR)

document published by ISO, IEC, CEN, CENELEC or EOTA (European Organisation for Technical Assessment) containing informative material not suitable to be published as a standard or Technical Specification,

3.21 Technical Standard (TS)

document published by ISO, IEC, CEN, CENELEC or EOTA about which there is the possibility of future approval as a standard, but for which at present there are reasons precluding immediate publication as a standard.

4.0 Symbols and abbreviations

For the purposes of this technical procedure, the following symbols and abbreviations apply:

e.g. Latin term '*exempli gratia*', which translates to "for example",

i.e. Latin term '*id est*', which translates to "to clarify".

5.0 Requirements pursuant to the laws of the United Kingdom

5.1 General

The prevailing legislation in the United Kingdom is the Building Regulations 2010 (as amended, herein referred to as “the 2010 Regulations”), specifically Part B (Fire Safety). The 2010 Regulations consider five aspects of fire safety in the construction of buildings:

- B1 Means of early warning of fire and adequate means of escape from the building (including, but not limited to, emergency lighting and fire exit signage), and,
- B2 Control of internally spread fire (linings), which includes the wall linings, i.e. plaster, plasterboard or timber-based boards on the walls and/ or ceilings and how they will resist the spread of flames and only radiate reasonable levels of heat in the event of a fire, and,
- B3 Control of internally spread fire (structures), where fire and smoke shall be controlled/ prevented from spreading to concealed spaces in the building’s structure by fire stopping and fire cavity barriers, and,
- B4 Control of externally spread fire, where the external walls and roof of the structure will resist spread of fire to the walls and/ or roof of other buildings in the vicinity of the structure on fire, and,
- B5 Access and facilities for the fire service.

This document shall seek to discuss the individual requirements under the laws of the United Kingdom in subsequent sections and clauses.

5.2 Standardisation

The 2010 Regulations lay down the rules and the degree of fire resistance of the elements of the structure. These are codified in British Standards, most notably in the BS 476 family, specifically parts 6 and 7 (respectively), where the empirical tests carried out to these standards yields an index of performance of specimens and then a fire propagation index, which would be detailed in the test report.

The standards, ultimately, produce fire ratings for the product that is being tested and these are defined in Approved Document B (now revised).

5.3 Requirements of Approved Document B

Approved Document B (herein referred to as “APB”) provides guidance on the requirements for fire safety pursuant to Part B of the 2010 Regulations.

At the time of writing this document it is important to note that the consequences of the various investigations and inquiries surrounding the tragedy of the fire at Grenfell Tower are still being carried out and that information presented in this document is subject to change without notice. However, this document will seek to provide the reader with all pertinent information up to the date of writing. To that end, it is important to note that HM Government undertook a study into the use-ability of APB in 2017 (HM Government: Department for Communities and Local Government, 2017), which revealed that a significant proportion of the construction industry relies on the guidance set out in ADB to help them comply with the 2010 Regulations and that APB itself is the most used document.

Until 2019, the ADB made references to the old “National class” classification system, which was:

- Class 0:** A material composed or is composed throughout of materials of limited combustibility (including non-combustible materials), or,
- A Class 1 material that has a fire propagation index of not more than 12 and a sub-index of not more than 6 when tested pursuant to BS 476-6 or BS 476-7.
- It is important to note that Class 0 is the **only** national class that is defined in ADB, the other classifications are defined in BS 476-7.

Table 02: National Class pursuant to BS 476-7				
Classification	Spread of flame at 1.5 mins		Final spread of flame	
	Limit (mm)	Sample Limit (mm)	Limit (mm)	Sample Limit (mm)
Class 1	165	165 + 25	165	165 + 25
Class 2	215	215 + 25	455	455 + 45
Class 3	265	265 + 25	710	710 + 75
Class 4	Exceeding the limits for class 3			

As noted above, Class 0 is not a fire classification identified by a test, but a creature born from the statute itself. As such, it was found that this reference was antiquated and not appropriate for the modern construction industry (despite its’ status as the “go-to” classification). This resulted in the 2019 edition of ADB which aligns itself with the European system.

5.4 Problems with Class 0 Materials and Ban on Combustible Cladding Materials

When considering the reasons why the 2010 Regulations were updated to follow European standards, it is important to acknowledge both the shortcomings of the National Classification system, in particular Class 0 as well as the subsequent ban on combustible cladding materials.

Class 0 is an out-of-date national product classification, which is based on two equally old and small-scale tests on individual production or materials (carried out pursuant to BS 476-6 and BS 476-7), which in and of themselves: only deal with the spread of flames over the surface of the tested material (or materials in the case of a composite) (Carrington, 2019).

Thus, Class 0 (and the tests required to ascertain such classification) do not measure the combustibility of a material or, in the case of a composite (such as the aluminium composite material (ACM) cladding panels used at Grenfell Tower) the core of such material. Due to this oversight in the statutes' methodology: combustible materials can achieve Class 0 classification – which ultimately leads to instances where materials are used in high-rise buildings.

The Government banned combustible material through Regulation 7 of the 2010 Regulations and revised ADB to the 2019 revision, which uses the modern classification system for determination of the combustibility of a product pursuant to that which is set out in BS EN 13501.

It is important to note that the 2010 Regulations are subject to imminent change and a new Authoritative Body is to be established pursuant to the recommendations of Dame Judith Hackett in her Independent Review of Building Regulations and Fire Safety (Hackitt, 2018)

6.0 Requirements pursuant to the laws of the European Union

6.1 General

Unlike the approach under UK law (5.0), the European approach is from two main parameters:

- a) Reaction to fire, and,
- b) Fire resistance.

Testing and designation are standardised through the use of BS EN 13501-1, which sets out the classification of construction products and building elements.

There are other tests that are pertinent to individual aspects of the classification, these are defined as:

Table 03: Fire Test Types (European Classification)	
Test	Test Standard
Single Burning Item	BS EN 13823
Non-Combustibility	BS EN ISO 1182
Heat of Combustion	BS EN ISO 1716
Direct Flame Impingement	BS EN ISO 11925-2

The actual Euro Class rating itself is determined pursuant to BS EN 13501-7, and is summarised as below (Peroni S.p.A., 2013):

Table 04: European Classification			
Definition	Grade	Smoke Propagation ¹⁰	Flaming Droplets ¹¹
Non-combustible material	A1	None	None
	A2	S1	D0
Combustible materials: very limited contribution to fire	B	S1	D0
Combustible materials: limited contribution to fire	C	S1	D0
Combustible materials: medium contribution to fire	D	S1	D0
Combustible materials: high contribution to fire	E	S2	D2
Combustible materials: easily flammable	F	S3	D2

¹⁰ S1 = little to no smoke, S2 = quite a lot of smoke and S3 = substantial smoke,

¹¹ D0 = no flaming droplets, D1 = some flaming droplets, D2 = quite a lot of flaming droplets.

6.2 Comparison with UK National Classification System

The approximated relationship between the old UK national classification system and the new European classification system can be defined as (Department of Housing, Planning and Local Government, 2020):

Table 05: Comparison between National Classification and European Classification	
National Classification	European Classification
-	A1
-	A2
Class 0	B
Class 1 and Class 2	C
Class 3	D
Class 4	E
-	F

6.3 Reaction to fire

Reaction to fire is the measurement of how a product or material will contribute to the development and propagation of a fire.

The European Classification System (sometimes referred to as “Euroclass”) was introduced in-line with the on-going harmonisation of European standards. Compared to the National Classification System, the European Classification System includes tests designed to better evaluate the reaction of building products and materials to fire.

Determination of reaction to fire, is generally determined by, or simply stated outright in the European standard or EAD (European Assessment Document) that covers that product.

6.4 Resistance to fire

The resistance to fire is the ability of the structure, or component thereof to resist, for a determined amount of time, to its’: stability, integrity and isolation capability and is expressed in minutes (the periods given can be 15, 20, 30, 40, 60, 90, 120, 180, 240 or 360 minutes) about the nominal fire curve.

The resistance itself can be identified by the products’ REI marking (Adriano, 2018), which is comprised of:

R	Load-bearing. The ability of the product to preserve its’ mechanical characteristics and the relevant load capacity during a normal fire, and,
E	Integrity. The ability of the product to not allow the passage or production of gases or vapours to the areas of the structure or system that are not exposed to the fire.

- I Thermal insulation. The ability of the product to reduce, within a temperature limit, the transfer of heat to the unexposed side.

7.0 Classification of Evolution® products

It is important to note that the reaction to fire and resistance to fire varies depending on the actual product being considered, as such to expediate the readers acquisition of a product's characteristic apropos fire, the reader should check the correct product grouping for the product they are considering using the table below:

Table 06: Classification based on Product Type Grouping (Part 01 of 04)			
Product Family	Product Type	Material	Grouping
EVDBZ, WH, AMN.	Anchors for Concrete	Carbon steel (hardened)	A
		ZAMAK®	E
CB, EVAB, GIA, A2GIA VFC, SPR, SPO, GIW GID SSSPR. A2PIW	Clips, bracketry, insulation anchors and Stress Plates	Sprung steel	B
WHL, WHX, CDWCP, CDWSDP, CDWFDZ, CDWFP, CDWFZ, CDWFCP, CWAS CWASD DWRT, EVUCD, DWSC, DWSP,	Drywall screws	Carbon steel (hardened)	A

Table 06: Classification based on Product Type Grouping (Part 02 of 04)			
Product Family	Product Type	Material	Grouping
DWSZ, F, DWSDZ, DWSDE, DWSDP, PHDZ, PHSDZ, WHDZ, WHSSDZ WHSDZ.	Drywall screws or cement board screws	Carbon steel (hardened)	A
CFSCY, DSFHC, SDSFHC, SDSCSK, WS, WST, BB, SSDH, ZGP, ERS.	Wood screws or for use in timber		
A2WS,			
A4WS,		Stainless Steel (A4)	D
DSP, SQD, DT, MB, MS, MES, SES, PH, R, T, SDS, SDSH.	Drive bits, setting tools and drill bits		A
CFT, TKG, CHGEU, CHGUK.	Power tools and electrical components	Various	G

Table 06: Classification based on Product Type Grouping (Part 03 of 04)			
Product Family	Product Type	Material	Grouping
EVPF, EVPP, EVNW, ECW, RW, PC, NW,	Various products made of, or containing combustible materials such as polymers, etc	Various	G
STCS, STCSC, MSCSK, MSHH, MSHHW.	Concrete and masonry screws	Carbon steel (hardened)	A
IS, T25IS. ICS,	Insulation screws		
A4IS	Insulation Screws	Stainless steel (A4)	D
A4HH. SSMSHH, A4CSK,	Concrete and masonry screws		
A4ST.	Self-tapping screws		
A4BM, A4BMHH, A4BMHT, A4LPHT, A4PH, A4WD, A4SS.	TEK® (self-drilling, self-tapping) screws		
TSBW, TSHW, TSBWHT, TSHWHT, TSFHR, TSN, TSLP, TSPH, TSTF, TSTFT, TSHF, BWZ / BWZP, HWZ / HWZP, ZWDP, ZWSP.		Carbon steel (hardened)	A
BW.	Washers		

Table 06: Classification based on Product Type Grouping (Part 04 of 04)			
Product Family	Product Type	Material	Grouping
BMDH, A2DH, A2LDH A2SSDH, BMTSHW, BMTSHF, BMHH, BMBW, BMHT, A2SSDH, BMTSFHR, BMTSLP, SSLP, SSHW, BMW.D. BMTSBWHT, BMTSPH, BMDW	TEK® (self-drilling, self tapping) screws	Stainless Steel (A2)	C
SS.	Washers		

The reaction to fire and resistance to fire have been determined by the relevant clauses in their corresponding and respective European standards (or European Assessment Document or Common Understanding of Assessment Procedure) for each product group.

It is worth noting that products with a classification of A1 by their nature, and pursuant to BS EN 13501-1 and EOTA Technical Report No. 021 that there is no requirement to determine a resistance to fire, however, for educational and guidance purposes, Evolution Fasteners has opted to calculate the equivalent resistance to fire using the calculation based approach outlined in EOTA Technical Report No. 020.

The reaction to fire and resistance to fire for Evolution® products is summarised and declared as below:

Table 07: Reaction to Fire and Resistance to Fire of Evolution® Products by Product Type Grouping¹²		
Product Type Grouping	Reaction to Fire¹³	Resistance to Fire¹⁴
A	A1	≥ R120
B	A1	≥ R120
C	A1	≥ R120
D	A1	≥ R120
E	Not declared ¹⁵	Not declared ¹⁵
F	Not declared ¹⁵	Not declared ¹⁵

For further information, it is advised that the reader consults the other supporting documentation that Evolution provide on our products, which are specifically relevant to that product, these come in the form of:

1. Technical Datasheets,
2. Engineering Specifications,
3. Declarations of Performance (where applicable pursuant to the 2011 Regulations).

¹² Refer to Table 06 to find the relevant Product Type Grouping for each individual product type/ family,

¹³ Determined pursuant to relevant European standard, European Assessment Document or Common Understanding of Assessment Procedure for that product,

¹⁴ Determined by calculations and assumptions pursuant to EOTA TR020 and EOTA TR021,

¹⁵ Assume no performance achievable by that product, or that the product should not be used or relied upon in a fire case scenario,

8.0 Bibliography and Citations

Please note that only references and citations given in the body of text of this document are included in the bibliography. Any references and citations given as footnotes on pages are not included. The documents referenced in Section 2.0 (Normative References) of this document are similarly: not referenced in this section.

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9.0 Document Revision History

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