Grenfell Tower – fire safety investigation: The fire protection measures in place on the night of the fire, and conclusions as to:

the extent to which they failed to control the spread of fire and smoke; the extent to which they contributed to the speed at which the fire spread.

Phase 1 Report – Appendix O

Review of the BBA certification for Reynobond Architecture Wall Cladding Panels

REPORT OF

Dr Barbara Lane FREng FRSE CEng

Fire Safety Engineering

24th October 2018

Specialist Field: Fire Safety Engineering

Assisted by : Dr Susan Deeny, Dr Peter Woodburn, Dr Graeme Flint,

Mr Tom Parker, Mrs Danielle Antonellis, Mr Alfie Chapman

On behalf of : Grenfell Tower Inquiry

On instructions of : Cathy Kennedy, Solicitor, Grenfell Tower Inquiry

Subject Matter To examine the circumstances surrounding the fire at

Grenfell Tower on 14th June 2017

Inspection Date(s): 6th October, 1st November, 7-9th November 2017

Dr Barbara Lane Ove Arup & Partners Limited 13 Fitzroy Street London W1T 4BQ

Appendix O- Review of the BBA certification for Reynobond Architecture Wall Cladding Panels

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O1 Purpose of Appendix O

- O1.1.1 The purpose of this Section of my Phase 1 report is to review the Agrément Certification documents for Reynobond ACM panels produced by the British Board of Agrément (BBA) in 2008 and 2017.
- O1.1.2 The 2008 Certificate was a Class 0 [national class] certificate.
- O1.1.3 The 2017 certificate is no longer a Class 0 certificate and is a Class B [European class] certificate.
- O1.1.4 The 2008 Certificate is the certificate that was available at the time of construction and completion of Grenfell Tower.
- O1.1.5 In this Appendix O I provide an explanation of what services the BBA provide, how these services are accredited and what companies can undertake this accreditation process.
- O1.1.6 I then explain the standing of product conformity certifications schemes as a means of demonstrating compliance with the Building Regulations.
- O1.1.7 I explain all the fire test evidence provided to me both the European and the National class Reaction to fire test data.
- O1.1.8 I have then identified which tests are relevant to the BBA certificate. I do this for the European test data and the National test data.
- O1.1.9 I explain the full content of the Agrément Certificate as I understand it. To do this I have marked up 34 parts of the Agrément Certificate as not every section of the Agrément Certificate is numbered.
- O1.1.10 As a result of this work I have concluded the following.
- O1.1.11 The front page of the 2008 1st issue of BBA Agrément certificate 08/4510 states it is for "*Reynobond Architecture Wall Cladding Panels*" and that "the panels may be regarded as having a Class 0 surface in England and Wales". In my opinion, the statement on the front page of the 2008 issue of BBA Agrément Certificate is factually incorrect, as follows.
- O1.1.12 Section 6.1 to Section 6.6 of the BBA Agrément Certificate specifically references the fire performance of three panels only. These are:
 - a) Standard sample with a Grey/Green Duragloss 5000 coating- B-s2, d0 to EN 13501-1: 2002
 - b) Fire retardant sample with a Gold Duragloss finish- B-s1, d0 to EN 13501-1: 2002
 - c) 90Fire retardant sample with a metallic grey PVDF finish- I=0 to BS 476-6 and Class 1 to BS 476-7

- O1.1.13 In my opinion, the statement on the front page of the 2008 issue of BBA Agrément Certificate 08/4510 is factually incorrect, as I have explained in Section O17. In summary:
 - a) Only one of the three panels referenced in the 2008 issue of BBA Agrément Certificate 08/4510 has been demonstrated to achieve National class 0
 - b) The available test evidence shows that a cassette system has never achieved national class 0 despite the cassette fixing system being specifically referenced on the 2008 certificate as a suitable method of fixing.
- O1.1.14 It is on this basis I consider this 2008 BBA certificate does not certify compliance with the requirements of the Building Regulations reaction to fire [Class 0] for "Reynobond Architecture Cladding Panels" and further it cannot be relied upon to indicate "Reynobond Architecture Cladding Panels" are suitable for the intended purpose and use [Class 0].
- O1.1.15 In any event, while I have seen the BBA certificate in disclosure provided to the Inquiry by various core participants, I have not seen any evidence that it was provided in the context of any Building Control approval or compliance, regarding fire safety in accordance with Part B of the Building Regulations at the relevant time.
- O1.1.16 Additionally, I have explained in Appendix F that I have serious concerns with the classification of ACP panels using BS 476-6 and BS 476-7 as during those tests the heat source is applied on the surface of the aluminium only and not to the significantly more combustible polyethylene core.
- O1.1.17 The surface spread of flame test is not representative of the end use condition where the polyethylene is exposed at the edges of the panels. The relevant test evidence, which I explain in detail in this Appendix O, substantially supports this view.
- O1.1.18 BBA certificates are not accompanied by the test data or classification reports upon which they rely. In light of my review below and in the light of the catastrophic events at Grenfell Tower it is my opinion that certificates such as those issued by the BBA should include relevant fire test data and classification reports so that parties can understand what has been tested and any limitations in the certificate.
- O1.1.19 Further, it is my opinion that the 2017 2nd issue amended BBA certificate 08/4510, which is the currently available version for Reynobond architecture wall panels, should be amended as a matter of urgency to state that the certificate is only valid for Reynobond 55 FR panels with a fire retardant core, in a riveted form, on an A2 minimum insulating substrate, and installed fully within the field of application stated in the BS EN 13501-1 classification report RA06-0372 (BBA00000054).

- O1.1.20 However, it is important to note that it remains to be properly proven if such a system can adequately resist the spread of fire, when typical building parameters such as windows, doors, vents, and other necessary construction details, are included in a polymeric rainscreen cladding system, in a realistic full scale fire test.
- O1.1.21 I have shown in Appendix E the concerns I have with the test construction detailing relative to typical construction forms in buildings. I will address this issue in the next Phase of my work.

O2 Disclosure of documents – additional information since 16th April 2018

- O2.1.1 As part of the disclosure, I have received three BBA Agrément certificates for "Reynobond Architecture Wall Cladding panels". These are:
 - a) Agrément Certificate 08/4510 Product Sheet 1 REYNOBOND ARCHITECTURE WALL CLADDING PANELS 1st issue 14/01/2008 (BBA00000047)
 - b) Agrément Certificate 08/4510 Product Sheet 1 ARCONIC CLADDING PANELS REYNOBOND ARCHITECTURE WALL CLADDING PANELS 2nd issue 04/08/2017(BBA00000046)
 - c) Agrément Certificate 08/4510 Product Sheet 1 ARCONIC CLADDING PANELS REYNOBOND ARCHITECTURE WALL CLADDING PANELS 2nd issue amended 22/09/2017 (BBA00000049)
- O2.1.2 On 19/07/2018, the BBA issued a letter to the public inquiry (BBA00000001) confirming the test reports used to produce the three certificates stated above were:

In the First Issue, the following fire performance was quoted, based on the associated test reports given below:

Grey/green 55 (also known as PE), B-S2, d0, via CSTB Report RA-0005A Gold FR, B-s1, d0, via CSTB Report RA06-0372 Metallic Grey FR, BS 476-6: 1989, Warrington Fire Research Report 132317 Metallic Grey FR, BS 476-7: 1997, Warrington Fire Research Report 132316

These data were carried over into the Second Issue. For the Amendment, only the data relating to the FR version were included.

O2.1.3 Note the General section of the 2008 1st issue of Agrément certificate 08/4510 states:

"This certificate is a conformation of the French Agréments 2/04-1081 and 2/01-845 issued by Centre Scientifique et Technique du Batiment (CSTB)".

O2.1.4 These documents are:

Avis Technique 2/04-1081 Reynobond System Rivete published 2004 and

- Avis Technique 2/01-845 Reynobond systeme cassettes published 2002.
- O2.1.5 These reports have not been disclosed to me to date. However, I have been able to obtain them from the CSTB website¹.
- O2.1.6 Both these reports were superseded prior to the issue of the 2008 Agrément certificate.
- O2.1.7 Avis Technique 2/04-1081 Reynobond System Rivete was superseded by Avis Technique 2/07-1244 Reynobond System Rivete in 2007.
- O2.1.8 Avis Technique 2/01-845 Reynobond System cassettes was superseded by Avis Technique 2/04-1083 Reynobond System cassettes in 2004.
- O2.1.9 It is unclear why BBA used out of date *French Agréments* as the basis of the 2008 1st issue of Agrément certificate 08/4510.
- O2.1.10 Avis Technique 2/04-1081, and Avis Technique 2/01-845 contain reaction to fire performance test evidence under the French classification system, however this performance is not referenced in the BBA certificate. The BBA do not state why this information was omitted as part of their confirmation.
- **O2.1.11** Neither Avis Technique 2/04-1081, or Avis Technique 2/01-845 refer to the reaction to fire test reports listed in the BBA letter issued a letter to the public inquiry (BBA00000001).
- O2.1.12 The later Avis Technique 2/07-1244 Reynobond System Rivete, dated 2007 does reference the classification report RA05-0005A which is referenced in the 2008 1st issue of Agrément certificate 08/4510.
- O2.1.13 It should be noted that reference to Avis Technique 2/04-1081 Reynobond System Rivete published 2004 and Avis Technique 2/01-845 Reynobond systeme cassettes published 2002 was removed from the 2017 2nd issue and 2017 2nd issue amendment of Agrément certificate 08/4510.
- O3 Evidence of provision of BBA Certificate in Primary Refurbishment
- O3.1.1 The BBA certificate is relevant to the construction at Grenfell Tower, because it is the only certificate available in the UK that refers to the fire performance of Reynobond Architecture Wall Cladding Panels.
- O3.1.2 Clause 0.15 of ADB states:
- O3.1.3 Third party accredited product conformity certification schemes not only provide a means of identifying materials and designs of systems, products or

¹ CSTB, Produits evalues, [online] available at: http://evaluation.cstb.fr/fr/avis-technique/detail/2-04-1081/ & http://evaluation.cstb.fr/fr/avis-technique/detail/2-01-845/ [accessed 17/10/2018]

- structures which have demonstrated that they have the requisite performance in fire, but additionally provide confidence that the systems, materials, products or structures actually supplied are provided to the same specification or design as that tested/assessed.
- O3.1.4 I discuss the Status of accredited product conformity schemes in the Building Regulations and approved documents further in Section O8.
- O3.1.5 It is not clear from the evidence whether the parties involved in the Grenfell Tower refurbishment relied on the 2008 BBA certificate at the time. I have seen e-mail correspondence (HAR00000933), disclosed by Harley, that Alcoa (now Arconic Inc.) provided a series of documents on 23rd April 2014, as a result of a project team exchanges regarding panel colour and costs for Grenfell Tower.
- O3.1.6 Agrément Certificate 08/4510 (HAR00000934) was attached to this email but is not specifically referred to in the correspondence. The other attachments were COSHH data, colour data, cleaning data and a sample Warranty Specimen document.
- O3.1.7 Harley forwarded this email and its attachments to Rydon 23rd April 2014 (HAR00000933).
- O3.1.8 Rydon forwarded the e-mail and attachments including BBA Agrément Certificate 08/4510 to Studio E on 23/04/2014 (SEA00002686). The e-mail contained no instructions or otherwise for Studio E.
- O3.1.9 The BBA certificate was a national class, Class 0 Agrément Certificate.
- O3.1.10 I have not seen any evidence in the documents provided to me to date, including correspondence, design documentation, or handover information, that the parties above ever discussed or relied on the BBA Agrément Certificate 08/4510. Further, the certificate does not form part of the Rydon O&M manual and I have not seen any evidence that RBKC Building Control; Studio E; Exova Warrington Fire or any other party either discussed or considered the BBA certificate in the context of the statutory approvals process under Part B of the Building Regulations.
- **O3.1.11** This will be the subject of further consideration at Phase 2.
- O3.1.12 Regardless of the factual position as to what was or was not considered in the context of the Grenfell Tower refurbishment, I present my review of the BBA certificate herein, for completeness.

O4 Timeline of test data and certificates

O4.1.1 As I have explained above, there are three versions of BBA Agrément Certificate 08/4510. These are dated 20018; August 2017 and September 2017. In Table O.1 below I have listed all National class and European class fire test data reports and classification reports I have been provided with by Arconic Inc. I have already reviewed these and this work is presented in my Appendix E.

Table O.1 National and European test/ classification reports I reviewed as part of my Phase 1 preliminary report (17th April 2018)

Product description	Report title	Date of issue of report/ letter	Product Manufacturer	Relativity reference
Reynobond RB 160 PE	Test report WARRES NO. 70708 BS 476-6 1989 Method of test for fire propagation for products	14/03/1997	Arconic	ARC00000355
Reynobond RB 160 PE	Test report WARRES NO. 70707 BS 476-7 1997 Method of classification of the surface spread of flame of products	14/03/1997	Arconic	ARC00000356
Reynobond RB 160 PE	Summary of WARRES NO. 70707 & WARRES NO. 70708 including opinion of compliance with the requirements for a class 0 surface as defined in paragraph A12(b) of Approved Document B, fire safety to the building regulations 1991	14/03/1997	Arconic	ARC00000357
REYNOBOND ® 55 PE Riveted system grey/green Duragloss 5000 coating	REACTION TO FIRE CLASSIFICATION REPORT No. RA05-0005A ACCORDING TO THE EUROPEAN STANDARD NF EN 13501-1+A1:2013	07/01/2005	Arconic	ARC00000358
REYNOBOND ® 55 PE system rivete gris/vert Duragloss 5000 coating	RAPPORT D'ESSAIS DE REACTION AU FEU NO RA05-0005A SELON LES NORMES EUROPEENNES NF EN 13823 ET NF EN ISO 11925-5	07/01/2005	Arconic	ARC00000359
REYNOBOND ® 55 PE system a cassette (chants fermes) gris/vert Duragloss 5000 coating	RAPPORT D'ESSAIS DE REACTION AU FEU NO RA05-0005B SELON LES NORMES EUROPEENNES NF EN 13823 ET NF EN ISO 11925-5	07/01/2005	Arconic	ARC00000360
REYNOBOND 33 (Overall thickness 3mm)	Summary of WFs No's 157530 & 157537 including opinion of compliance with the requirements for a class 0 surface as defined in paragraph A13(b) of Approved Document B, (2000 edition incorporating 2002 amendments) 'Fire Safety', To the Building Regulations 2000	14/09/2006	Arconic	ARC00000361

Product description	Report title	Date of issue of report/ letter	Product Manufacturer	Relativity reference
REYNOBOND 33 (Overall thickness 4mm)	Summary of WFs No's 157532 & 157535 including opinion of compliance with the requirements for a class 0 surface as defined in paragraph A13(b) of Approved Document B, (2000 edition incorporating 2002 amendments) 'Fire Safety', To the Building Regulations 2000	14/09/2006	Arconic	ARC00000363
REYNOBOND 33 (Overall thickness 2mm)	Warringtonfire test report No. 157537 BS 476: Part 6:1989 Method of Test for fire propagation of products	14/09/2006	Arconic	ARC00000364
REYNOBOND 33 (Overall thickness 2mm)	Warringtonfire test report No. 157530 BS 476: Part 7:1997 Method for classification of the surface spread of flame of products	14/09/2006	Arconic	ARC00000366
REYNOBOND 33 (Overall thickness 4mm)	Warringtonfire test report No. 157532 BS 476: Part 7:1997 Method for classification of the surface spread of flame of products	14/09/2006	Arconic	ARC00000367
REYNOBOND 33 (Overall thickness 4mm)	Warringtonfire test report No. 157535 BS 476: Part 6:1989 Method of Test for fire propagation of products	15/09/2006	Arconic	ARC00000365
REYNOBOND ® 55 PE Riveted system	REACTION TO FIRE CLASSIFICATION REPORT No. RA11-0032 ACCORDING TO THE EUROPEAN STANDARD NF EN 13501-1+A1:2013	09/02/2011	Arconic	ARC00000383
REYNOBOND Architecture PE Cassette system	REACTION TO FIRE CLASSIFICATION REPORT No. RA11-0244 ACCORDING TO THE EUROPEAN STANDARD NF EN 13501-1+A1:2013	12/10/2011	Arconic	ARC00000386
REYNOBOND ® 55 PE	REACTION TO FIRE CLASSIFICATION REPORT No. RA13-0333 ACCORDING TO THE EUROPEAN STANDARD NF EN 13501-1+A1:2013	31/01/2014	Arconic	ARC00000393
REYNOBOND ® 55 PE (cassette system)	REACTION TO FIRE CLASSIFICATION REPORT No. RA13-0333 ACCORDING TO THE EUROPEAN STANDARD NF EN 13501-1+A1:2013	04/12/2014	Arconic	ARC00000395
REYNOBOND® 55 PE Riveted system Duragloss ® 5000 35 µm finish	REACTION TO FIRE CLASSIFICATION REPORT No. RA14-0339 ACCORDING TO THE EUROPEAN STANDARD NF EN 13501-1+A1:2013	04/12/2014	Arconic	ARC00000397

Product description	Report title	Date of issue of report/ letter	Product Manufacturer	Relativity reference
REYNOBOND® 55 PE Riveted system Duragloss ® 5000 35 µm finish (translucent core)	REACTION TO FIRE CLASSIFICATION REPORT No. RA15-0200 ACCORDING TO THE EUROPEAN STANDARD NF EN 13501-1+A1:2013	22/09/2015	Arconic	ARC00000402
REYNOBOND® 55 PE Riveted system Duragloss ® 5000 35 µm finish (black core)	REACTION TO FIRE CLASSIFICATION REPORT No. RA15-0200 ACCORDING TO THE EUROPEAN STANDARD NF EN 13501-1+A1:2013	22/09/2015	Arconic	ARC00000402
REYNOBOND® 55 PE (cassette system) (translucent core)	REACTION TO FIRE CLASSIFICATION REPORT No. RA15-0201 ACCORDING TO THE EUROPEAN STANDARD NF EN 13501-1+A1:2013	22/09/2015	Arconic	ARC00000405
REYNOBOND® 55 PE (cassette system) (black core)	REACTION TO FIRE CLASSIFICATION REPORT No. RA15-0201 ACCORDING TO THE EUROPEAN STANDARD NF EN 13501-1+A1:2013	22/09/2015	Arconic	ARC00000405

- O4.1.2 I have taken the disclosed BBA fire test evidence and the disclosed Arconic Inc. fire test evidence listed in Table O.1, and over laid them on the time line in Figure O.1.
- O4.1.3 The purpose of this time line is to illustrate the relative status of the fire test evidence for cassette and riveted systems. It also illustrates the relative status of the fire test evidence under the national and European testing regime.

Timeline of documents disclosed to the Public Inquiry for Reynobond 55PE vs Grenfell Tower Timeline

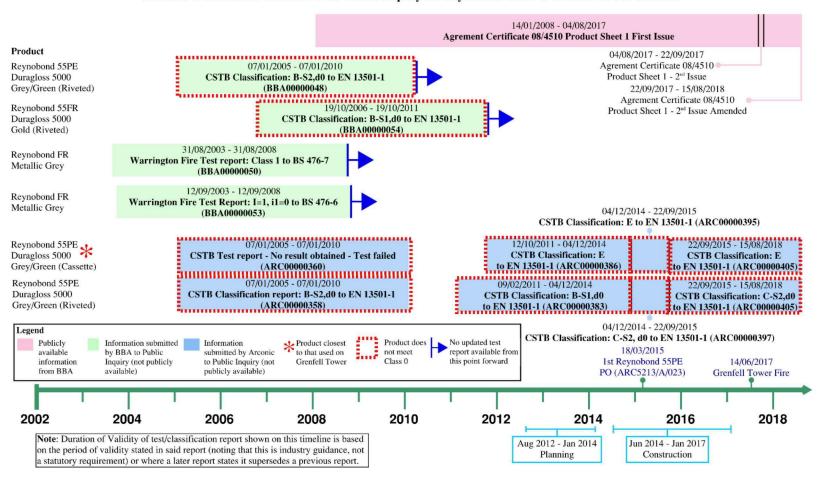


Figure O.1 Time line of disclosed documents relevant to Reynobond 55PE Standard core and FR core

O-9 Ove Arup & Partners Ltd

O5 Methodology for this review

- O5.1.1 In this Appendix O I examine the fire test evidence provided to me from the BBA upon which they based their BBA Agrément Certificate No. 08/4510 first published on 14/01/2008. This certificate remained in circulation as the Agrément Certificate for *Reynobond Architectural Wall Cladding Panels* until August 2017.
- O5.1.2 The 2008 BBA Agrément Certificate No. 08/4510 is a certificate of national Class 0 performance for *Reynobond Architectural Wall Cladding Panels*.
- O5.1.3 After the Grenfell Fire, the BBA issued a revised version of this Agrément Certificate, removing its Class 0 status, and providing a European Class B Agrément Certificate instead.
- O5.1.4 In this section, I examine the reaction to fire test evidence disclosed by the BBA for its relevance to national Class 0 performance as forms the basis of their certificate up to August 2017.
- O5.1.5 I will then explain the relevance of all the reaction to fire test evidence which Arconic the manufacturer of *Reynobond Architectural Wall Cladding Panels* have disclosed to the Inquiry.
- O5.1.6 I repeat this exercise for the 2017 revisions of the certificate (04/08/2017 and 22/09/2017) which are for the European classification "Class B" only.
- O5.1.7 To categorise all the test evidence I have received, I have relied on my analysis in Appendix F of my Expert Report in which I explained the different routes, through test evidence, to comply with Diagram 40 for external surfaces, as set out in the statutory guidance Approved Document B 2013.
 - a) Class 0: when composed throughout of materials of limited combustibility defined by testing to British Standards BS 476-11:1982 or BS 476-4:1970 (by reference to Section 13.a of Appendix A ADB 2013); or
 - b) Class 0: a Class 1 material which has a fire propagation index (I) of not more than 12 and sub-index (i1) less than 6, defined by testing to British Standards BS 476-7:1997 & BS 476-6:1989 respectively (by reference to Section 13.b of Appendix A of ADB 2013); or
 - c) Class 0: composed throughout of materials of limited combustibility (Class A2 or better) defined by testing to European Standards BS EN ISO 1182 & BS EN ISO 1716, BS EN ISO 1182 only or BS EN ISO 1716 & BS EN 13823 (by reference to Section 13.a of Appendix A ADB 2013).

Or:

d) BS EN 13501-1 Class B or better - defined by testing using European Standards BS EN ISO 1182 & BS EN ISO 1716, BS EN ISO 1182 only, BS EN ISO 1716 & BS EN 13823 and BS EN 13823 & BS EN 11925-2.

[As relevant to buildings with a storey more than 18m above ground level].

- O5.1.8 Therefore, for the 2008 publication of BBA Agrément Certificate 08/4510 I have examined any fire test data relevant to the three Class 0 routes a) to c) above.
- O5.1.9 For the 2017 publications of BBA Agrément Certificate 08/4510 I have examined all fire data relevant to the European Classification Class B as set out in d) above.
- O5.1.10 Having categorised all the test evidence and therefore products which achieve either national Class 0 or European Class B, I then provide my review of the relevant BBA Agrément Certificate No. 08/4510.
- O5.1.11 I explain what each part of it means and what it specifically relates to. I explain the relevant information it provides or importantly does not provide, in the context of the fire test data available
- O5.1.12 This investigation forms the basis of my conclusion that there is no relevant fire test evidence for the Reynobond 55 PE system installed at Grenfell Tower.
- O5.1.13 I will also explain why I have rejected the BBA Agrément Certificate 08/4510 Product Sheet 1 REYNOBOND ARCHITECTURE WALL CLADDING PANELS 1st issue 14/01/2008 (BBA00000047), as being sufficient to meet the definition of "Third party accredited product conformity certification schemes" in Clause 0.15 of ADB:
 - "a means of identifying materials and designs of systems, products or structures which have demonstrated that they have the requisite performance in fire, but additionally provide confidence that the systems, materials, products or structures actually supplied are provided to the same specification or design as that tested/assessed."
- O5.1.14 Finally, I set out my serious technical concerns with the Agrément Certificate 08/4510 Product Sheet 1 ARCONIC CLADDING PANELS REYNOBOND ARCHITECTURE WALL CLADDING PANELS 2nd issue 04/08/2017(BBA00000046) and Agrément Certificate 08/4510 Product Sheet 1 ARCONIC CLADDING PANELS REYNOBOND ARCHITECTURE WALL CLADDING PANELS 2nd issue amended 22/09/2017 (BBA00000049).

O6 The British Board of Agrément

- **O6.1.1** The British Board of Agrément (BBA) were formed in 1966, then called the Board of Agrément.
- O6.1.2 The BBA website states that it offers "approval, certification and test services to manufacturers of products and systems supplying the construction industry".
- O6.1.3 Figure O.2 below was taken from their website which shows the eight "product approval" schemes that BBA operate:

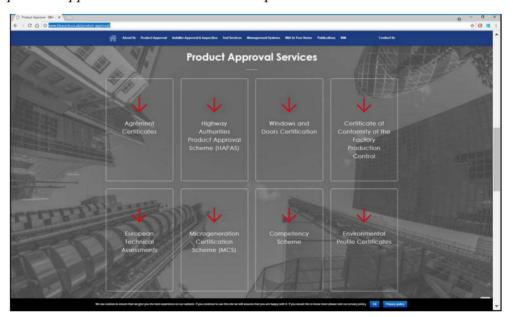


Figure O.2 Product Approval services offered by BBA (from http://www.bbacerts.co.uk/product-approval/ [accessed 20/07/2018]

- O6.1.4 As shown in Figure O.2, Agrément Certificates are one of the "product approval" schemes that BBA operate.
- O6.1.5 BBA Agrément Certificate 08/4510 Product Sheet 1 REYNOBOND ARCHITECTURE WALL CLADDING PANELS 1st issue 14/01/2008 (BBA00000047) contains the Statement that BBA is a United Kingdom Accreditation Service (UKAS) accredited certification body- Number 113 as shown in Figure O.3 below.

The BBA has awarded this Agrément Certificate for Reynobond Architecture Wall Cladding Panels to Alcoa Architectural Products as fit for their intended use provided they are installed, used and maintained as set out in this Agrément Certificate. In Coper

On behalf of the British Board of Agrément

Date of First issue: 14 January 2008

Greg Cooper: Chief Executive

The BBA is a UKAS accredited certification body — Number 113. The schedule of the current scope of accreditation for product certification is available in pdf format via the UKAS link on the BBA website at www.bbacerts.co.uk

Figure O.3 Reference to Accreditation status of UKAS on BBA Agrément certificate 08/4510 1st issue 2008

- 06.1.6 It is stated on the Schedule of Accreditation issued by United Kingdom Accreditation Service that UKAS have accredited BBA to "ISO/IEC 17065:2012 to provide product conformity certification".
- 06.1.7The BBA schedule of accreditation document 113 is the document by which BBA are accredited by UKAS under the guidance of ISO/IEC 17065:2012.
- 06.1.8 I next examine the role of UKAS.

UKAS 07

- O7.1.1 The purpose of UKAS as an organisation is defined in Approved Document 7 as:
- 07.1.2"The United Kingdom Accreditation Service is the sole national accreditation body recognised by the UK government to assess, against internationally agreed standards, organisations that provide certification, testing, inspection and calibration services. Accreditation by UKAS demonstrates the competence, impartially and performance capability of these organisations."
- **O7.1.3** UKAS themselves describe their role as:
- 07.1.4"The United Kingdom Accreditation Service (UKAS) is the sole national accreditation body for the United Kingdom. UKAS is recognised by government, to assess against internationally agreed standards, organisations that provide certification, testing, inspection and calibration services.
- 07.1.5 Accreditation by UKAS demonstrates the competence, impartiality and performance capability of these evaluators. In short, UKAS 'checks the checkers'. UKAS is a non-profit-distributing private company, limited by guarantee. UKAS is independent of Government.
- **O7.1.6** *UKAS* is appointed as the national accreditation body by Accreditation Regulations 2009 (SI No 3155/2009) and the EU Regulation (EC) 765/2008. UKAS operates under a Memorandum of Understanding with the Government, through the Secretary of State for Department for Business, Energy & Industrial Strategy.

- O7.1.7 UKAS is licensed by BEIS to use and confer the national accreditation symbols (formerly national accreditation marks) which symbolise Government recognition of the accreditation process.
- O7.1.8 UKAS accreditation provides an assurance of the competence, impartiality and integrity of conformity assessment bodies. UKAS accredited certification, testing, inspection and calibration reduces the need for suppliers to be assessed by each of their customers.
- O7.1.9 UKAS' involvement in international groups such as EA, IAF and ILAC, provides for mutual recognition. This reduces the need for multiple assessments of suppliers, and as a consequence helps to reduce barriers to trade for organisations who have UKAS accreditation.
- **O7.1.10** It is therefore BEIS policy to recommend the use of UKAS accredited conformity assessment services whenever this is an option.

UKAS is a non-profit-distributing private company, limited by guarantee. UKAS is self-financing and charges fees to conformity assessment bodies to cover operational costs and other expenditure. BEIS sponsors UKAS and provides funding to undertake public interest activities (i.e. non-fee earning activities) in representing the UK's interests in the global accreditation system."²

O7.1.11 Accreditation is explained by UKAS on their website as:

"Accreditation is the formal recognition that an organisation is competent to perform specific processes, activities, or tasks (which are detailed in a scope of accreditation) in a reliable credible and accurate manner. The provision of accreditation must be undertaken impartially; be objective, transparent and effective; use highly professional competent assessors and technical experts in all relevant fields; use assessors (and subcontractors) that are reliable, ethical and competent in both accreditation processes and the relevant technical fields. Accreditation delivers confidence in certificates and conformity statements. It underpins the quality of results by ensuring their traceability, comparability, validity and commutability"

O7.1.12 The international standards that UKAS use to accredit an organisation as competent to perform specific processes, activities or tasks is stated on their website as:

"UKAS is appointed by Government as the sole national accreditation body under the terms of SI 2009/3155, to deliver accreditation against the following harmonised international standards: ISO/IEC 17025:2017- General requirements for the competence of testing and calibration laboratories; ISO 15189:2012- Medical Laboratories - Requirements for quality and

² https://www.ukas.com/about/our-role/

³ https://www.ukas.com/about/about-accreditation/

competence; ISO/IEC 17020:2012-Conformity assessment - Requirements for the operation of various types of bodies performing inspection; ISO/IEC 17065:2012- General requirements for bodies operating product certification systems; ISO 14065:2013-Greenhouse gases -- Requirements for greenhouse gas validation and verification bodies for use in accreditation or other forms of recognition; ISO/IEC 17024:2012- General requirements for bodies operating certification of persons; ISO/IEC 17043:2010- Conformity Assessment - General requirements for proficiency testing; ISO/IEC 17021-1:2015- Conformity assessment - Requirements for bodies providing audit and certification of management systems; ISO 17034:2016- (replacing ISO Guide 34:2009 - Deadline November 2019) General requirements for competence of reference material producers; ISO 15195: 2003 Laboratory medicine - Requirements for reference measurement laboratories; ISO 22870:2016 Point-of-care testing (POCT) - Requirements for quality and competence⁴"

O8 Status of accredited product conformity schemes in the Building Regulations

O8.1 Approved guidance recommendations on independent certification schemes

O8.1.1 Regulation 7 of the Building Regulations 2010 requires that building work should be carried out with adequate and proper materials. Approved Document 7 provides guidance on how to comply with Regulation 7. In terms of demonstrating that a material is compliant with Regulation 7 Section 1 of Approved Document 7 states:

O8.1.2 Section 1: Materials

"1.1 Building work must meet the functional requirements of Schedule 1 of the Building Regulations. Approved Documents refer to materials covered by harmonised European product standards, British Standards, and other technical specifications. However, there is no obligation to adopt any particular solution contained in an approved document in order to meet functional requirements; the references are not exclusive and other materials may be suitable in the particular circumstances."

O8.1.3 Ways of establishing fitness of materials

"1.2 You can assess the suitability of a material for use for a specific purpose in a number of ways, as described in paragraphs 1.3 to 1.21."

⁴ https://www.ukas.com/about/about-accreditation/the-accreditation-process/accreditation-standards

O8.1.4 Independent certification Schemes

"1.15 There are many independent product certification schemes in the UK and elsewhere that may provide information on the performance of a product. Such schemes certify that a material complies with the requirements of a recognized document and indicates that it is suitable for its intended purpose and use. These may be in addition to, but not conflict with CE marking.

Note: materials which are not certified by an independent scheme might still conform to a relevant standard"

- O8.1.5 Approved Document 7 lists eight methods of demonstrating the suitability of a material for *use for a specific purpose* as defined in for compliance with Regulation 7 of the Building Regulations 2010:
 - 1. CE marking under the Construction Products Regulation
 - 2. CE marking under other EU directives and Regulations
 - 3. British Standards
 - 4. Other national and international technical specifications
 - 5. Independent certification Schemes
 - 6. Tests and calculations
 - 7. Past experience
 - 8. Sampling

O8.1.6 The use of guidance section of ADB 2013 states:

MATERIALS AND WORKMANSHIP

Any building work which is subject to the requirements imposed by schedule 1 to the Building Regulations shall be carried out in accordance with regulation 7. Guidance on meeting these requirements on materials and workmanship is contained in the Approved Document to support regulation 7.

Building Regulations are made for specific purposes, primarily the health and safety, welfare and convenience of people and for energy conservation. Standards and other technical specifications may provide relevant guidance to the extent that they relate to these considerations. However, they may also address other aspects of performance or matters which, although they relate to health and safety etc., are not covered by the Building Regulations.

When an Approved Document makes reference to a named standard, the relevant version of the standard to which it refers is the one listed at the end of the publication. However, if this version has been revised or updated by the issuing standards body, the new version may be used as a source of guidance provided it continues to address the relevant requirements of the Regulations.

Independent certification schemes

There are many UK product certification schemes.

Such schemes certify compliance with the requirements of a recognised document which is appropriate to the purpose for which the product is to be used. Products which are not so certified may still conform to a relevant standard.

Many certification bodies which approve such schemes are accredited by the United Kingdom Accreditation Service (UKAS).

Since the fire performance of a product, component or structure is dependent upon satisfactory site installation and maintenance, independent schemes of certification and accreditation of installers and maintenance firms of such will provide confidence in the appropriate standard of workmanship being provided.

Building Control Bodies may accept the certification of products, components, materials or structures under such schemes as evidence of compliance with the relevant standard. Similarly, Building Control Bodies may accept the certification of the installation or maintenance of products, components, materials or structures under such schemes as evidence of compliance with the relevant standard. Nonetheless, a Building Control Body will wish to establish, in advance of the work, that any such scheme is adequate for the purposes of the Building Regulations.

Technical specifications

Building Regulations are made for specific purposes including: health and safety, energy conservation and the welfare and convenience of people. Standards and technical approvals are relevant guidance to the extent that they relate to these considerations. However, they may also address other aspects of performance such as serviceability, or aspects which, although they relate to health and safety, are not covered by the Regulations.

When an Approved Document makes reference to a named standard, the relevant version of the standard is the one listed at the end of the publication. However, if this version of the standard has been revised or updated by the issuing standards body, the new version may be used as a source of guidance provided it continues to address the relevant requirements of the Regulations.

The appropriate use of a product which complies with a European Technical Approval as defined in the Construction Products Directive should meet the relevant requirements.

The Department intends to issue periodic amendments to its Approved Documents to reflect emerging harmonized European Standards. Where a national standard is to be replaced by a European harmonized standard, there will be a co-existence period during which either standard may be

referred to. At the end of the co-existence period the national standard will be withdrawn.

- O8.1.7 From the text quoted above, there are two recommended methods of demonstrating a material complies with the recommendations of ADB 2013: Independent certification scheme or a Technical Specification.
- **O8.1.8** Technical specification in ADB 2013
- **O8.1.9** In terms of Technical Specification Clause 0.7 of ADB states:

Fire performance of materials, products and structures

0.7 Much of the guidance throughout this document is given in terms of performance in relation to standard fire test methods. Details are drawn together in Appendix A to which reference is made where appropriate. In the case of fire protection systems, reference is made to standards for systems design and installation. Standards referred to are listed in Appendix H.

O8.1.10 The full list of appropriate technical specifications (discussed in the use of guidance section of ADB 2013) is listed in Appendix A of ADB 2013 (as stated in Clause 0.7 of ADB 2013).

O8.1.11 Independent certification and accreditation in ADB 2013

O8.1.12 Further guidance on *Independent schemes of certification and accreditation* is provided in Section 0.15 of ADB 2013:

0.15 Since the performance of a system, product, component or structure is dependent upon satisfactory site installation, testing and maintenance, independent schemes of certification and accreditation of installers and maintenance firms of such will provide confidence in the appropriate standard of workmanship being provided.

Confidence that the required level of performance can be achieved will be demonstrated by the use of a system, material, product or structure which is provided under the arrangements of a product conformity certification scheme and an accreditation of installers scheme.

Third party accredited product conformity certification schemes not only provide a means of identifying materials and designs of systems, products or structures which have demonstrated that they have the requisite performance in fire, but additionally provide confidence that the systems, materials, products or structures actually supplied are provided to the same specification or design as that tested/assessed.

Third party accreditation of installers of systems, materials, products or structures provides a means of ensuring that installations have been conducted by knowledgeable contractors to appropriate standards, thereby increasing the reliability of the anticipated performance in fire.

Building Control Bodies may accept the certification of products, components, materials or structures under such schemes as evidence of compliance with the relevant standard. Similarly, Building Control Bodies may accept the certification of the installation or maintenance of products, components, materials or structures under such schemes as evidence of compliance with the relevant standard. Nonetheless, a Building Control Body will wish to establish, in advance of the work, that any such scheme is adequate for the purposes of the Building Regulations. Many certification bodies which approve such schemes are accredited by UKAS.

O8.1.13 Figure O.4 summarises my findings of the relevant methods of demonstrating compliance with Regulation 7 and Regulation B4 of Schedule 1 of the Building Regulations 2010 using the appropriate approved guidance.

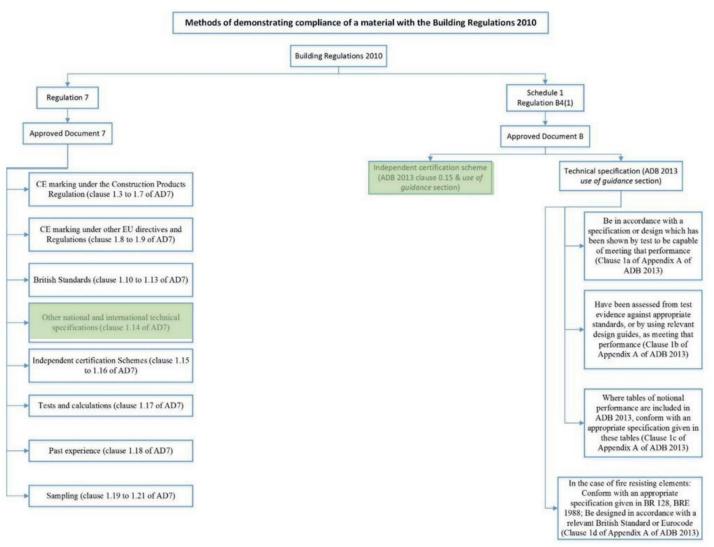


Figure O.4 Summary of methods for demonstrating compliance of a material with the Building Regulations 2010 (independent certification schemes highlighted in green).

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O8.2 The role of UKAS in the accreditation of independent certification schemes

- O8.2.1 ADB 2013 states that independent certification schemes are an appropriate method to "certify compliance with the requirements of a recognized document" (ADB 2013, p5). AD7 states: "Such schemes certify that a material complies with the requirements of a recognized document and indicates it is suitable for its intended purpose and use".
- O8.2.2 In both Approved Documents, the certification body operating the independent certification scheme is the *United Kingdom Accreditation Service* (UKAS).
- O8.2.3 To demonstrate compliance with the Building Regulations, ADB and AD7 recommend that certification bodies undertaking independent certification schemes are accredited by UKAS to undertake the tasks. Based on the standards I have listed directly above, UKAS uses the international standard ISO/IEC 17065:2012- General requirements for bodies operating product certification systems to accredit organisations to undertake certification schemes.
- **O8.2.4** It should be noted that Approved Document 7 states:

"It is important to check the scope of the accreditation of a certification body, as accreditation might cover only part of the certification bodies testing or certification business."

O8.2.5 Therefore, when an organisation is accredited by UKAS it is only for a specific set of test standards or the certification of a specific set of products.

O8.3 Organisations accredited by UKAS

- **O8.3.1** UKAS provide a list on their website⁵ of the organisations they have accredited to undertake specific testing or certification of products. It should be noted that the testing and certification listed is not limited to the fire testing/certification of construction materials.
- O8.3.2 It is stated on the Schedule of Accreditation issued by United Kingdom Accreditation Service that UKAS have accredited BBA to "ISO/IEC 17065:2012 to provide product conformity certification".
- O8.3.3 The front page of the 1st issue of BBA Agrément certificate 08/4510 in 2008 states:

"The BBA is a UKAS accredited certification body - Number 113."

⁵ https://www.ukas.com/browse-accredited-organisations/?org_cat=861&parent=Certification%20Bodies&type_id=11

- O8.3.4 The BBA schedule of accreditation document 113 is the document by which BBA are accredited by UKAS under the guidance of ISO/IEC 17065:2012.
- O8.3.5 This schedule is 24 pages long and lists the specific product conformity certification schemes which BBA are accredited by UKAS to undertake.
- O8.3.6 The schedule of accreditation document does not explicitly state that BBA Agrément Certificates are an accredited certification scheme under ISO/IEC 17065;2012.
- O8.3.7 It is therefore unclear whether an Agrément Certificate is a UKAS accredited "Independent certification scheme" as Agrément Certificates are not specifically referenced on BBAs UKAS accreditation sheet 113.
- O9 The reaction to fire test evidence received from the BBA to support their 2008 Class 0 Agrément Certificate
- O9.1.1 Section 6.1 to Section 6.6 of the 2008 BBA Agrément Certificate references the fire performance of three Reynobond panels only. These are:
 - a) Standard sample with a Grey/Green Duragloss 5000 coating- B-s2, d0 to EN 13501-1: 2002
 - b) Fire retardant sample with a Gold Duragloss finish- B-s1, d0 to EN 13501-1: 2002
 - c) Fire retardant sample with a metallic grey PVDF finish- I=0 to BS 476-6 and Class 1 to BS 476-7
- O9.1.2 The BBA letter issued to the Inquiry on 19/07/2018 (BBA00000001) provides additional information on the three samples quoted in the Agrément Certificate.

'First issue' refers to the 01/14/2008 publication.

In the First Issue [of certificate 08/4510], the following fire performance was quoted, based on the associated test reports given below:

Grey/green 55 (also known as PE), B-S2, d0, via CSTB Report RA-0005A

Gold FR, B-s1, d0, via CSTB Report RA06-0372

Metallic Grey FR, BS 476-6: 1989, Warrington Fire Research Report 132317

Metallic Grey FR, BS 476-7: 1997, Warrington Fire Research Report 132316

- **O9.1.3** I have reviewed these test reports.
- O9.1.4 The **first report**s are the two Warrington Fire Research Reports i.e. 132316 and 132317 for the *Metallic Grey FR*.

- O9.1.5 This fire test evidence for the *Fire retardant sample with a metallic grey PVDF finish* demonstrates a tested performance of Class 0 to BS 476-6 and BS 476-7.
- **O9.1.6** The test report states:

"The product was 'Reynobond 55 FR (colour reference 'RAL 9006 Metallic grey')', a composite coated aluminium panel having an overall thickness of 4mm and an overall weight of 73 kg/m2, comprising of a 3mm thick Fire retardant core (product reference RFA595/01-F) faced with a 0.5mm thick coil coated aluminium sheet (alloy reference '3005' ore equivalent, hardness reference 'H 46' or equivalent), bonded to both faces during the manufacturing process utilising a tie layer.

The decorative (test face) aluminium sheet was coated on the exposed face with a 5 micron thick epoxy primer and a 20 micron thick PVDF coating.

The reverse (non test face) aluminium sheet was coated on the exposed face with a 6 micron thick epoxy primer."

- O9.1.7 The **second report** is the CSTB Report RA-0005A (BBA00000048) for Grey/green 55 (also known as PE)
- O9.1.8 The reaction to fire classification report for *Standard sample with a Grey/Green Duragloss 5000 coating;* demonstrates a performance of **Class B** when classified to BS EN 13501-1.
- O9.1.9 The product description in the test report states that the sample was:

"Composite panel consisting of a low density polyethylene core thermally bonded (using a 70µm thick polyethylene film) between two precoated aluminium sheets. Tested system: riveted on metallic substructure.

Nominal thickness: 4mm

Nominal thickness of aluminium sheets: 0.5mm

Nominal mass per unit area: 5.5 kg/m²

Finishing coat: Duragloss 5000

Colour: grey/ green"

O9.1.10 Section 4.3 *field of application* of the test report states;

The classification is valid for the following product parameters:

For a thickness of 4mm

Only for the system riveted on any metallic substructure

The classification is valid for the following end uses:

On any A1 or A2 substrate with a density $\geq 700 \text{ kg/m}^3$

With a minimum air gap of 50mm

- **O9.1.11** The **third report** is the CSTB Report RA06-0372 (BBA00000054) for *Fire retardant sample with a Gold Duragloss finish*
- O9.1.12 The reaction to fire classification report for *Fire retardant sample with a Gold Duragloss finish* demonstrates a performance of **Class B** when classified to BS EN 13501-1.
- O9.1.13 The product description in the classification report states the sample was:

"Composite panel consisting of two precoated aluminium sheets thermally bonded on either side of a polyethylene core

Tested system: riveted on metallic substructure.

Nominal thickness: 4mm

Nominal thickness of aluminium sheets: 0.5mm

Nominal mass per unit area: 7.7 kg/m²

Finishing coat: Duragloss 5000 35 µm

Colour: gold-coloured"

O9.1.14 Section 4.3 *field of application* of the classification report states;

The classification is valid for the following product parameters:

a thickness of 4mm

A mass per unit area of 7.7 kg/m²

A 35 µm Duragloss finishing coat

The classification is valid for the following end uses:

Riveted on metal substructure

On any A1 or A2 substrate with a density $\geq 700 \text{ kg/m}^3$

With a minimum air gap of 50mm

- O9.1.15 National Class 0 is achieved where the product is either (a) composed throughout of materials of limited combustibility or (b) a Class 1 material which has a fire propagation index (I) of not more than 12 and a sub-index (i1) of not more than 6 (see paragraph 13 of Appendix A of ADB).
- O9.1.16 The European classification for materials of "limited combustibility" is defined in Table A7 of ADB as Class A2 or better. A material with a European Class B rating is not "limited combustibility" i.e. it is not A2 or better.

- O9.1.17 Only one product referenced on the 2008 BBA Agrément Certificate has the relevant test evidence to demonstrate that it achieves Class 0: 'Reynobond 55 FR (colour reference 'RAL 9006 Metallic grey')'.
- O9.1.18 The other two products referenced in the 2008 BBA Agrément Certificate *Grey/green 55 (also known as PE)* and *Gold FR*, do not have the relevant test evidence to demonstrate Class 0. I therefore reject these products as a suitable basis for the BBA Class 0 Agrément Certificate.
- O9.1.19 It should be noted that although Section 6.4 of the 2008 1st issue of the BBA Agrément certificate states:
 - "6.4 These performances may not be achieved by other colours of the product and the designations of a particular colour should be confirmed by: England and Wales— Test or assessment in accordance with Approved Document B, Appendix A, Clause 1"
- O9.1.20 This does not apply to the *Gold FR* panel as classification report *RA06-0372* states the field of application of the panel is "A 35µm Duragloss finishing coat" therefore only the thickness of the Duragloss paint not the colour is relevant to the fire performance of the FR panel.
- O9.1.21 It should also be noted that the classification report RA-0005A (BBA0000048) states that the field of application for the Reynobond 55PE riveted system is only for:

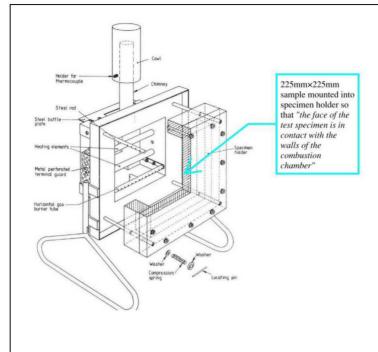
"Finishing coat: Duragloss 5000

Colour: grey/ green"

O9.1.22 Any other colour of Reynobond 55PE riveted system would therefore not be covered by the classification report RA-0005A (BBA00000048).

O10 Additional National Class evidence submitted to the Inquiry

- O10.1.1 As I explained in Appendix F, there are three methods by which Class 0 is defined by means of Section 13 in the Approved Document B:
 - a) Limited Combustibility by National Standard testing (BS 476-4, BS 476-11)
 - b) Class 0 Limited Combustibility by European Standard testing (Class A2 or better to BS EN 13501-1)
 - c) Class 0 Class 1 to BS 476-7 and I<12 i1<6 to BS 476-6
- **O10.1.2** No BS 476-4 or BS 476-11 test or classification reports have been disclosed to me by any party, to date, for any *Reynobond Architecture Wall Cladding Panels*.
- O10.1.3 However, Arconic Inc., have provided the relevant fire test data in the form of four BS476-6 test reports, the associated BS476-7 reports and letters of confirmation for Class 0 for: Reynobond RB 160 PE; Reynobond 55 FR (Colour reference 'RAL 9006 metallic grey') 4mm overall thickness; and REYNOBOND 33 in either 2mm, 3mm or 4mm overall thickness.
- O10.1.4 In Table O.2 I have listed the national test/ classification reports disclosed to me for Reynobond Architectural Wall Cladding Panels set out above.
- O10.1.5 For reference, in Figure O.5 below I provide images of the test set up and a short description of the test procedure for BS 476-6 and BS 476-7. Please refer to Appendix F for my full description of all of the reaction to fire tests referenced in ADB.



- a) BS 476-6 test apparatus
- 225mm×225mm sample exposed to heat only on outermost surface from two electric heaters and a gas burner.

Measurement of temperature rise of flue gases in furnace chimney above that of a standard calibration curve used to determine material classification.



- b) BS 476-7 test apparatus
- 885mm×270mm sample exposed to heat from a radiant panel. Small gas flame impinged on bottom corner of sample on outermost surface to ignite material.

Material classified by horizontal distance travelled by flame in a given time.

Figure O.5 BS 476-6 and BS 476-7 test apparatus

O10.1.6 From review of these test reports it can be seen that the Reynobond 55 FR (Colour reference 'RAL 9006 metallic grey') tested had a polyethylene core containing fire retardants. The core of Reynobond RB 160 PE; and REYNOBOND 33 (all thicknesses) did not contain fire retardants.

- O10.1.7 From Table O.2, it can be seen that all BS 476-6 and BS 476-7 test reports for the Reynobond Architecture Wall Cladding Panels demonstrate Class 1 to BS 476-7 and I<12 i1<6 to BS 476-6.
- O10.1.8 All of these *Reynobond Architecture Wall Cladding panels* therefore achieve Class 0.
- O10.1.9 This is confirmed in letters from the BRE for the Reynobond RB 160 PE and REYNOBOND 33 in either 2mm, 3mm or 4mm overall thickness.
- O10.1.10 I have no test data relating to any Reynobond panels that failed to achieve Class 0 (by means of Class 1 to BS 476-7 and I<12 i1<6 to BS 476-6). I cannot state therefore if any *Reynobond Architecture Wall Cladding panels* have ever failed to achieve Class 0.
- O10.1.11 I have a number of observations to make about the test data.
- O10.1.12 The BS 476-6; and BS 476-7 test reports are dated between 1997 and 2006 only. After 2006 all reaction to fire tests or classification reports disclosed to me to date were undertaken under European test/ classification standards. These additional tests/classification reports are discussed later in my Section O11. However, I note here that none of the panels tested to the European Classification system achieved Class A2 or better to BS EN 13501-1. None of this test data, and so none of those panels, can therefore be considered as fulfilling the criteria relating to Class 0 under clause 13a of ADB.
- O10.1.13 It is unclear why apparently no *Reynobond Architecture Wall Cladding panels* have been tested to BS 476-6; and BS 476-7 after 2006 as the National classification system is still referenced as a suitable method for demonstrating compliance in all versions of ADB published after 2006.
- O10.1.14 The Agrément Certificate 08/4510 Product Sheet 1 REYNOBOND ARCHITECTURE WALL CLADDING PANELS 1st issue 14/01/2008 (BBA00000047) was the only Agrément certificate for Reynobond products in the UK between 2008 and 2017. Therefore, at the time of the issue of the 2017 2nd issue of Agrément certificate 08/4510, eleven years had passed since the last relevant Class 0 test.
- O10.1.15 Of the three panels with supporting Class 0 test evidence, only Reynobond 55 FR (Colour reference 'RAL 9006 metallic grey') was referred to directly in the 2008 BBA Agrément certificate (as stated by BBA in their letter to the inquiry (BBA00000001).
- **O10.1.16** I do not know whether Arconic did not provide the BBA with all of the test evidence that I have seen for Reynobond RB 160 PE and REYNOBOND 33 in either 2mm, 3mm or 4mm overall thickness, or if the BBA simply chose not to refer to it or disclose it. I note the following points in relation to this.
- O10.1.17 The test report/ classification reports for the Reynobond RB 160 PE and REYNOBOND 33 in either 2mm, 3mm or 4mm overall thickness all state:

"The specification and interpretation of fire test methods are the subject of ongoing development and refinement. Changes in associated legislation may also occur. For these reasons it is recommended that the relevance of test reports over five years old should be considered by the user. The laboratory that issued the report will be able to offer, on behalf of the legal owner, a review of the procedures adopted for a particular test to ensure that they are consistent with current practices, and if required may endorse the test report"

- **O10.1.18** It should be noted that this five-year period of validity is industry guidance and not statutory guidance.
- O10.1.19 The test/classification reports for the Reynobond RB160 PE are dated 1997. The test/classification reports were therefore out with their stated period of validity in 2002. This may explain why it was not referenced on the 2008 certificate.
- O10.1.20 The test/classification reports for the Reynobond 33 are dated 2006. The test/classification reports for the Reynobond 33 would therefore be within their stated period of validity at the time of issue of the 2008 issue of BBA Agrément Certificate 08/4510. However, none of the Reynobond 33 test/classification reports were used by the BBA to create the 2008 issue of BBA Agrément Certificate 08/4510 (as confirmed by the BBA letter (BBA00000001).
- O10.1.21 Finally, all of the test/classification reports referenced in Table O.2 state:

"The test results relate only to the behaviour of the test specimens of the product under the particular conditions of test; they are not intended to be the sole criterion for assessing the potential fire hazard of the product in use"

O10.1.22 All of the test/classification reports referenced in Table O.2 also state:

"The test results relate only to the specimens of the product in the form in which they were tested. Small differences in the composition or thickness of the product may significantly affect the performance during the test and may therefore invalidate the test results. Care should be taken to ensure that any product which is supplied or used is fully represented by the specimens which were tested"

- O10.1.23 I have explained in detail in Appendix F, my serious concerns about the use of the national testing standards BS 476-6 and BS 476-7 to classify composite materials where the inner layers have a significantly higher contribution to the fire load than the outermost layer. The reason for this is that testing to BS 476-6 and BS 476-7 does not expose the combustible core material to direct heating, where as in the end use condition on buildings the core materials can be exposed to direct flaming at the edges of the product.
- **O10.1.24** I know from my professional experience before the Grenfell Tower fire that none of this test evidence would have been available in the public domain, so

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the analysis I have presented here could not have been done by others relying on the BBA certificate.

Table O.2 List of all national standard test/classification reports for Reynobond Architecture wall cladding panels disclosed to me to date

100						-	•			O I								
	Report title	Report sponsor	Report produced by	Date of test	Date of issue of report/	Product Manufacturer	Product description	Test Standard referenced		Core Type	Test face	Test substrate	Non test face	Sample size (mm)	Classification/ test result stated in Report	Classification report/ Test report/ BBA certificate number	Disclosed by	Relativity reference
	Test report WARRES NO. 70708 BS 476- 6 1989 Method of test for fire propagation for products	Reynolds Aluminium France SA	Warrington Fire	28/01/1997	14/03/1997	Arconic	Reynobond RB 160 PE	BS 476-6	3	Low density polyethylene (920 kg/m^3)	0.5mm thick, chromate pretreated aluminium sheet coated on the exposed face with one coat of a PVF 2 (70% 'Kynar 500') coating (colour reference 'Silver Anodic 906'), coil coated to a dry film thickness of 25 microns.	Calcium silicate board specimen holder (as specified in clause 5.3 of BS 476-6)	Coated aluminium sheet comprised 0.5mm thick, chromate pretreated aluminium sheet coated on the exposed face with one coat of an epoxy washcoat, coil coated to a dry film thickness of 5 microns	885mm×270mm×4mm	I=0.3 i1=0.0	WARRES NO. 70708	Arconic	ARC00000355

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Report title	Report sponsor	Report produced by	Date of test	Date of issue of report/ letter	Product Manufacturer	Product description	Test Standard referenced	Core Thickness (mm)	Core Type	Test face	Test substrate	Non test face	Sample size (mm)	Classification/ test result stated in Report	Classification report/ Test report/ BBA certificate number	Disclosed by	Relativity reference
Test report WARRES NO. 70707 BS 476- 7 1997 Method of classification of the surface spread of flame of products	Reynolds Aluminium France SA	Warrington Fire	28/01/1997	14/03/1997	Arconic	Reynobond RB 160 PE	BS 476-7	3	Low density polyethylene (920 kg/m^3)	0.5mm thick, chromate pretreated aluminium sheet coated on the exposed face with one coat of a PVF 2 (70% 'Kynar 500') coating (colour reference 'Silver Anodic 906'), coil coated to a dry film thickness of 25 microns.	Each specimen was placed over 25mm thick by 20mm wide calcium silicate based spacers positioned around its perimeter and mounted onto a backing board so that a 25mm enclosed air gap was provided between the unexposed face and the backing board	Coated aluminium sheet comprised 0.5mm thick, chromate pretreated aluminium sheet coated on the exposed face with one coat of an epoxy washcoat, coil coated to a dry film thickness of 5 microns	225mm×225mm×4mm	Class 1	WARRES NO. 70707	Arconie	ARC00000356
Summary of WARRES NO. 70707 & WARRES NO. 70708 including opinion of compliance with the requirements for a class 0 surface as defined in paragraph A12(b) of Approved Document B, fire safety to the building regulations 1991	Reynolds Aluminium France SA	Warrington Fire		14/03/1997	Arconic	Reynobond RB 160 PE	BS 476-6 & BS 476-7	3	Low density polyethylene (920 kg/m^3)	0.5mm thick, chromate pretreated aluminium sheet coated on the exposed face with one coat of a PVF 2 (70% 'Kynar 500') coating (colour reference 'Silver Anodic 906'), coil coated to a dry film thickness of 25 microns.	N/A classification letter	Coated aluminium sheet comprised 0.5mm thick, chromate pretreated aluminium sheet coated on the exposed face with one coat of an epoxy washcoat, coil coated to a dry film thickness of 5 microns	4mm	Class 0	WARRES NO. 70708 & WARRES NO. 70707	Arconic	ARC00000357

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Report title	Report sponsor	Report produced by	Date of test	Date of issue of report/ letter	Product Manufacturer	Product description	Test Standard referenced	Core Thickness (mm)	Core Type	Test face	Test substrate	Non test	Sample size (mm)	Classification/ test result stated in Report	Classification report/ Test report/ BBA certificate number	Disclosed by	Relativity reference
Warrington Fire Research Report 132316	ALCOA ARCHITECTURAL PRODUCTS	Warrington Fire	03/06/2003	12/09/2003	Arconic	Reynobond 55 FR (Colour reference 'RAL 9006 metallic grey')	BS 476-7	3	Fire retardant core (Product reference RFA594/01- F)	0.5mm thick coil coated aluminium sheet (Alloy reference '3005' or equivalent, hardness reference ' H46' ore equivalent), bonded during the manufacturing process utilising a tie layer. 5 micron thick epoxy primer and a 20 micron thick PVDF coating	25mm enclosed air gap positioned between the unexposed face of the product and the backing board.	6 micron thick epoxy primer	885mm×270mm×4mm	Class 1	WF 132316	BBA	BBA00000050
Warrington Fire Research Report 132317	ALCOA ARCHITECTURAL PRODUCTS	Warrington Fire	12/06/2003	12/09/2003	Arconic	Reynobond 55 FR (Colour reference 'RAL 9006 metallic grey')	BS 476-6	3	Fire retardant core (Product reference RFA594/01- F)	0.5mm thick coil coated aluminium sheet (Alloy reference '3005' or equivalent, hardness reference ' H46' ore equivalent), bonded during the manufacturing process utilising a tie layer. 5 micron thick epoxy primer and a 20 micron thick PVDF coating	12.5mm airspace at the back of the product by testing over non- combustible perimeter battens 20mm wide and 12.5mm thick.	6 micron thick epoxy primer	225mm×225mm×4mm	I = 1 i1 =0.0	WF 132317	BBA	BBA00000053

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Report title	Report sponsor	Report produced by	Date of test	Date of issue of report/	Product Manufacturer	Product description	Test Standard referenced	Core Thickness (mm)	Core Type	Test face	Test substrate	Non test face	Sample size (mm)	Classification/ test result stated in Report	Classification report/ Test report/ BBA certificate number	Disclosed by	Relativity reference
Summary of WFs No's 157531 & 157536 including opinion of compliance with the requirements for a class 0 surface as defined in paragraph A13(b) of Approved Document B, (2000 edition incorporating 2002 amendments) 'Fire Safety', To the Building Regulations 2000	ALCOA ARCHITECTURAL PRODUCTS	Warrington Fire		14/09/2006	Arconic	REYNOBOND 33 (Overall thickness 3mm)	BS 476-6 & BS 476-7	2.4	Low density polyethylene (924 g/cm^3)	0.3mm thick 3004 H46 aluminium with Beckers Industrie 'B19 9034 35N' polyester paint coating	N/A classification letter	0.3mm thick 3004 H46 aluminium with Beckers Industrie 'B19 9034 35N' polyester paint coating	3mm	Class 0	WF157531 & WF157356	Arconic	ARC00000362

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Report title	Report sponsor	Report produced by	Date of test	Date of issue of report/	Product Manufacturer	Product description	Test Standard referenced	Core Thickness (mm)	Core Type	Test face	Test substrate	Non test	Sample size (mm)	Classification/ test result stated in Report	Classification report/ Test report/ BBA certificate number	Disclosed by	Relativity reference
Summary of WFs No's 157532 & 157535 including opinion of compliance with the requirements for a class 0 surface as defined in paragraph A13(b) of Approved Document B, (2000 edition incorporating 2002 amendments) 'Fire Safety', To the Building Regulations 2000	ALCOA ARCHITECTURAL PRODUCTS	Warrington Fire		14/09/2006	Arconic	REYNOBOND 33 (Overall thickness 4mm)	BS 476-6 & BS 476-7	3.4	Low density polyethylene (924 g/cm^3)	0.3mm thick 3004 H46 aluminium with Beckers Industrie 'B19 9034 35N' polyester paint coating	N/A classification letter	0.3mm thick 3004 H46 aluminium with Beckers Industrie 'B19 9034 35N' polyester paint coating	4mm	Class 0	WF157532 & WF157355	Arconic	ARC00000363

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Report title	Report sponsor	Report produced by	Date of test	Date of issue of report/	Product Manufacturer	Product description	Test Standard referenced	Core Thickness (mm)	Core Type	Test face	Test substrate	Non test face	Sample size (mm)	Classification/ test result stated in Report	Classification report/ Test report/ BBA certificate number	Disclosed by	Relativity reference
Warringtonfire test report No. 157537 BS 476: Part 6:1989 Method of Test for fire propagation of products	ALCOA ARCHITECTURAL PRODUCTS	Warrington Fire	17/08/2006	14/09/2006	Arconic	REYNOBOND 33 (Overall thickness 2mm)	BS 476-6	1.4	Low density polyethylene (924 g/cm^3)	0.3mm thick 3004 H46 aluminium with Beckers Industrie 'B19 9034 35N' polyester paint coating	Each specimen was placed over 12.5mm thick by 20mm wide calcium silicate based spacers positioned around its perimeter and mounted onto a backing board so that a 12.5mm enclosed air gap was provided between the unexposed face of the specimen and the backing board	0.3mm thick 3004 H46 aluminium with Beckers Industrie 'B19 9034 35N' polyester paint coating	225mm×225mm×2mm	I = 0.9 i1 =0.2	WF 157537	Arconic	ARC00000364

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Report title	Report sponsor	Report produced by	Date of test	Date of issue of report/	Product Manufacturer	Product description	Test Standard referenced	Core Thickness (mm)	Core Type	Test face	Test substrate	Non test	Sample size (mm)	Classification/ test result stated in Report	Classification report/ Test report/ BBA certificate number	Disclosed by	Relativity reference
Warringtonfire test report No. 157530 BS 476: Part 7:1997 Method for classification of the surface spread of flame of products	ALCOA ARCHITECTURAL PRODUCTS	Warrington Fire	14/08/2006	14/09/2006	Arconic	REYNOBOND 33 (Overall thickness 2mm)	BS 476-7	1.4	Low density polyethylene (924 g/cm^3)	0.3mm thick 3004 H46 aluminium with Beckers Industrie 'B19 9034 35N' polyester paint coating	Each specimen was placed over 25mm thick by 20mm wide calcium silicate based spacers positioned around its perimeter and mounted onto a backing board so that a 25mm enclosed air gap was provided between the unexposed face and the backing board	0.3mm thick 3004 H46 aluminium with Beckers Industrie 'B19 9034 35N' polyester paint coating	885mm×270mm×2mm	Class 1	WF 157530	Arconic	ARC00000366

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Report title	Report sponsor	Report produced by	Date of test	Date of issue of report/	Product Manufacturer	Product description	Test Standard referenced	Core Thickness (mm)	Core Type	Test face	Test substrate	Non test face	Sample size (mm)	Classification/ test result stated in Report	Classification report/ Test report/ BBA certificate number	Disclosed by	Relativity reference
Warringtonfire test report No. 157532 BS 476: Part 7:1997 Method for classification of the surface spread of flame of products	ALCOA ARCHITECTURAL PRODUCTS	Warrington Fire	14/08/2006	14/09/2006	Arconic	REYNOBOND 33 (Overall thickness 4mm)	BS 476-7	3.4	Low density polyethylene (924 g/cm^3)	0.3mm thick 3004 H46 aluminium with Beckers Industrie 'B19 9034 35N' polyester paint coating	Each specimen was placed over 25mm thick by 20mm wide calcium silicate based spacers positioned around its perimeter and mounted onto a backing board so that a 25mm enclosed air gap was provided between the unexposed face and the backing board	0.3mm thick 3004 H46 aluminium with Beckers Industrie 'B19 9034 35N' polyester paint coating	885mm×270mm×4mm	Class 1	WF 157532	Arconic	ARC00000367

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Report title	Report sponsor	Report produced by	Date of test	Date of issue of report/	Product Manufacturer	Product description	Test Standard referenced	Core Thickness (mm)	Core Type	Test face	Test substrate	Non test	Sample size (mm)	Classification/ test result stated in Report	Classification report/ Test report/ BBA certificate number	Disclosed by	Relativity reference
Warringtonfire test report No. 157535 BS 476: Part 6:1989 Method of Test for fire propagation of products	ALCOA ARCHITECTURAL PRODUCTS	Warrington Fire	17/08/2006	15/09/2006	Arconic	REYNOBOND 33 (Overall thickness 4mm)	BS 476-6	3.4	Low density polyethylene (924 g/cm^3)	0.3mm thick 3004 H46 aluminium with Beckers Industrie 'B19 9034 35N' polyester paint coating	Each specimen was placed over 12.5mm thick by 20mm wide calcium silicate based spacers positioned around its perimeter and mounted onto a backing board so that a 12.5mm enclosed air gap was provided between the unexposed face of the specimen and the backing board	0.3mm thick 3004 H46 aluminium with Beckers Industrie 'B19 9034 35N' polyester paint coating	4mm	I = 0.9 i1 =0	WF 157535	Arconic	ARC00000365

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Report title	Report sponsor	Report produced by	Date of test	Date of issue of report/	Product Manufacturer	Product description	Test Standard referenced	Core Thickness (mm)	Core Type	Test face	Test substrate	Non test	Sample size (mm)	Classification/ test result stated in Report	Classification report/ Test report/ BBA certificate number	Disclosed by	Relativity reference
Summary of WFs No's 157530 & 157537 including opinion of compliance with the requirements for a class 0 surface as defined in paragraph A13(b) of Approved Document B, (2000 edition incorporating 2002 amendments) 'Fire Safety', To the Building Regulations 2000	ALCOA ARCHITECTURAL PRODUCTS	Warrington Fire		14/09/2006	Arconic	REYNOBOND 33 (Overall thickness 2mm)	BS 476-6 & BS 476-7	1.4	Low density polyethylene (924 g/cm^3)	0.3mm thick 3004 H46 aluminium with Beckers Industrie 'B19 9034 35N' polyester paint coating	N/A classification letter	0.3mm thick 3004 H46 aluminium with Beckers Industrie 'B19 9034 35N' polyester paint coating	2mm	Class 0	WF157530 & WF157357	Arconic	ARC00000361

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O11 All European Class evidence submitted to the Inquiry for Reynobond Architecture Wall Cladding Panels

- O11.1.1 The BBA letter issued to the Inquiry on 19/07/2018 (BBA00000001) provides additional information on the fire test evidence relevant to the European reaction to fire test:
- O11.1.2 Grey/green 55 (also known as PE), B-S2, d0, via CSTB Report RA-0005A
- O11.1.3 Gold FR, B-s1, d0, via CSTB Report RA06-0372
- O11.1.4 The BBA therefore relied on two European classification reports (RA-0005A, and RA06-0372) when they created the 2008 BBA Agrément certificate 08/4510.
- O11.1.5 This test evidence is not referred to on the Agrément Certificate itself.
- O11.1.6 As part of the disclosure process from BBA and Arconic I have received these two test reports. I have also received European test data or classification reports for a further seven *Reynobond Architecture Wall Cladding Panels*.
- O11.1.7 The European Classification reports for those the seven additional *Reynobond Architecture Wall Cladding Panels* are dated after the first issue of BBA Agrément Certificate 08/4510 in 2008. Note these seven panels are all described as Reynobond 55PE panels but tested in different years; with different surface coating; different core materials and different fixings.
- O11.1.8 All seven sets of evidence are dated before the 2nd issue of BBA Agrément Certificate 08/4510 in 2017.
- O11.1.9 However, none of these seven test reports are referenced on the 2nd issue of BBA Agrément Certificate 08/4510 in 2017.
- O11.1.10 I do not know whether Arconic did not provide the BBA with all the additional European test evidence I have seen for Reynobond 55PE or if the BBA simply chose not to refer to it or disclose it.
- O11.1.11 In Table O.3, I have provided the full reference list of all the European test data I have
- **O11.1.12** I have indicated in Table O.3 which of the test/ classification evidence for the *Reynobond Architecture Wall Cladding panels* were referenced on the 2008 first issue and then referenced in the 2017 second issue of BBA Agrément certificate 08/4510.
- O11.1.13 I have then compared the stated classification/ test result for all of the *Reynobond Architecture Wall Cladding panels* with the European relevant

- test data required to demonstrate the stated Class 0 performance on the BBA certificate
- O11.1.14 This is test data which relates to Limited Combustibility by European Standard testing and so by definition is Class A2 or better to BS EN 13501-1 as defined by clause 13a of Appendix of ADB.
- O11.1.15 The first page of Agrément Certificate 08/4510 Product Sheet 1 ARCONIC CLADDING PANELS REYNOBOND ARCHITECTURE WALL CLADDING PANELS 2nd issue 04/08/2017(BBA00000046) states:
 - "the panels have a B-s2, d0 or a B-s1, d0 reaction to fire classification to BS EN 13501-1: 2007, depending on the grade chosen"
- O11.1.16 In order to understand the basis of the Agrément Certificate 08/4510 Product Sheet 1 ARCONIC CLADDING PANELS REYNOBOND ARCHITECTURE WALL CLADDING PANELS 2nd issue 04/08/2017(BBA00000046), I have compared the stated classification/ test result for a given *Reynobond Architecture Wall Cladding panels* with the Class B classification stated on the 2017 Agrément certificate.
- **O11.1.17** In Table O.3 it can be seen that only three of the nine *Reynobond Architecture Wall Cladding Panels* that I have European test/ classification evidence for, achieve Class B between 2005 and 2015. These are REYNOBOND ® 55 PE Riveted system grey/green Duragloss 5000 coating; Reynobond FR ACM gold coloured; and REYNOBOND ® 55 PE (Riveted system) grey Duragloss 5000 coating.
- **O11.1.18** None of the other six *Reynobond Architecture Wall Cladding Panels* were classified between 2005 and 2015 as Class B.
- O11.1.19 I consider a few very significant themes to have emerged from my analysis of all the European reaction to fire test data made available to me.
- O11.1.20 The REYNOBOND ® 55 PE (cassette system) has been consistently classified as Class E since 2011. The REYNOBOND ® 55 PE (cassette system) has been classified as Class E four times and failed to achieve any classification in 2005. I provide a specific review of cassette systems in Section O12. I have discovered that the fixing of the panels appears to have a significant effect on the reaction to fire performance obtained by the panels.
- O11.1.21 The riveted panel therefore consistently achieves a higher performance than the cassette panels. There appears to be no material difference in the panels other than the fixing and the surface colour (in some instances). In Section O12, I provide a specific review of the test results for both the cassette and riveted system to understand how much worse the cassette system performs when compared to the riveted system.
- O11.1.22 Secondly, I have found that the REYNOBOND ® 55 PE (Riveted system) that is referenced on the 2017 2nd issue of BBA Agrément Certificate 08/4510 was in fact downgraded from Class B to Class C by virtue of the results stated

in REACTION TO FIRE CLASSIFICATION REPORT No. RA14-0339 ACCORDING TO THE EUROPEAN STANDARD NF EN 13501-1+A1:2013 (ARC00000397). The REYNOBOND ® 55 PE (riveted system) was classified as Class B twice then subsequently Class C twice.

- **O11.1.23** Therefore, Table 3 of the 2017 issue of BBA Agrément Certificate 08/4510 was factually incorrect on the date it was published.
- **O11.1.24** I provide a specific review of the worsening performance classification of the riveted system and the reasons for this in Section O13.
- O11.1.25 Finally, the classification reports for REYNOBOND ® 55 PE Riveted system grey/green Duragloss 5000 coating; Reynobond FR ACM gold coloured; and REYNOBOND ® 55 PE (Riveted system) grey Duragloss 5000 coating that actually achieve Class B state very specific limitations on how the panels are to be installed to achieve a Class B classification. This includes specific restrictions on the materials upon which the Reynobond panels are placed and that the classification is only for the panels when riveted.
- **O11.1.26** No reference is made in the 2017 BBA Agrément Certificate to the restrictions on the substrate required to achieve the Class B performance their certificates provide.
- **O11.1.27** I discuss the effect of the substrate on the classification of *Reynobond Architecture Wall Cladding Panels* in Section O14.

Table O.3 Review of the performance of all variants of Reynobond Architecture Wall Cladding Panels to European Classification

			-			•	10		_				
Arconic panel	Surface colour	Core Type	Thickness (mm)	Fixing required to achieve stated fire perform ance	Classification of panel	Substrate required to achieve stated fire performance (i.e. insulation performance requirement)	Date of issue of report/ letter	Classificati on report/ Test report/ BBA certificate number	Test report/ Classification report Relativity reference	Disclosed by	Referenced by BBA Agrément Certificate No 08/4510 (As confirmed by BBA)	Class A2 or better to BS EN 13501	Class B or better to BS EN 13501
REYNOBOND ® 55 PE Riveted system grey/green Duragloss 5000 coating	Grey/ green Duragloss 5000	PE	4	Riveted	В	Class A2 or better	07/01/2005	RA05- 0005A	ARC0000035 8, ARC0000035 9, BBA0000004	Arconic	Yes	No	Yes
REYNOBOND ® 55 PE cassette system grey/green Duragloss 5000 coating	Grey/ green Duragloss 5000	PE	4	Cassette	Unclassified (noting however results could be used to demonstrate Class E)	Class A2 or better	07/01/2005	RA05- 0005B	ARC0000053	Arconic	No	No	No
Reynobond FR ACM	Gold	FR PE	4	Riveted	В	Class A2 or better	19/10/2006	RA06-0372	BBA0000005	BBA	Yes	No	Yes
REYNOBOND ® 55 PE (Riveted system)	Grey	PE	4	Riveted	В	Class A2 or better	09/02/2011	RA11-0032	ARC0000038 3	Arconic	No	No	Yes
REYNOBOND Architecture PE (Cassette system)	Various	PE	4	Cassette	Е	Not stated	12/10/2011	RA11-0244	ARC0000038 6	Arconic	No	No	No
REYNOBOND ® 55 PE	White	PE	4	Riveted or Cassette	Е	Class A2 or better	31/01/2014	RA13-0333	ARC0000039 3	Arconic	No	No	No

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Arconic panel	Surface colour	Core Type	Thickness (mm)	Fixing required to achieve stated fire perform ance	Classification of panel	Substrate required to achieve stated fire performance (i.e. insulation performance requirement)	Date of issue of report/ letter	Classificati on report/ Test report/ BBA certificate number	Test report/ Classification report Relativity reference	Disclosed by	Referenced by BBA Agrément Certificate No 08/4510 (As confirmed by BBA)	Class A2 or better to BS EN 13501	Class B or better to BS EN 13501
REYNOBOND ® 55 PE (cassette system)	White	PE	4	Cassette	E	Class A2 or better	04/12/2014	RA13-0333	ARC0000039 5	Arconic	No	No	No
REYNOBOND ® 55 PE Duragloss ® 5000 35 µm finish (Riveted system)	Various	PE (black core or translu cent core)	4	Riveted	С	Class A2 or better	04/12/2014	RA14-0339	ARC0000039 7	Arconic	No	No	No
REYNOBOND ® 55 PE Duragloss ® 5000 35 µm finish (Riveted system)	Various	PE (black core or translu cent core)	4	Riveted	С	Class A2 or better	22/09/2015	RA15-0200	ARC0000040 2	Arconic	No	No	No
REYNOBOND ® 55 PE (Cassette system)	Various	PE (black core or translu cent core)	4	Cassette	Е	Class A2 or better	22/09/2015	RA15-0201	ARC0000040 5	Arconic	No	No	No

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O12 The variation in fire performance caused by Cladding fixings

- O12.1.1 Section 6.1 to Section 6.6 of the 2008 BBA Agrément Certificate 08/4510 (my marked up section 28) references the fire performance of three panels only. These are:
 - a) Standard sample with a Grey/Green Duragloss 5000 coating- B-s2, d0 to EN 13501-1: 2002
 - b) Fire retardant sample with a Gold Duragloss finish- B-s1, d0 to EN 13501-1: 2002
 - c) Fire retardant sample with a metallic grey PVDF finish- I=0 to BS 476-6 and Class 1 to BS 476-7
- O12.1.2 Section 4.3 of *Field of application* of the classification report *Reaction to fire Classification Report No. RA05-0005A According to the European Standard NF EN 13501-1*(BBA00000048), for the REYNOBOND ® 55 grey/green Duragloss 5000 coating states that this Class B classification is valid for the following product parameters and end use conditions only:
 - "a) Product parameters
 - a. For a thickness of 4mm
 - b. Only for the system riveted on any metallic substructure
 - b) End use conditions
 - a. On any A1 or A2 substrate with a density > 700 kg/m3
 - b. With a minimum airgap of 50mm"
- O12.1.3 The classification report is therefore very specific that the Class B classification for Reynobond 55PE only applies to the riveted system.
- O12.1.4 As part of Arconic's disclosure I have received the original test report that the classification report *Reaction to fire Classification Report No. RA05-0005A According to the European Standard NF EN 13501-1*(BBA00000048) this is REACTION TO FIRE TEST REPORT No. RA05-0005A ACCORDING TO THE EUROPEAN STANDARDS NF EN 13823 AND NF ISO 11925-2 dated 07/01/2005 was based upon (ARC00000535).
- O12.1.5 I have also received an additional test report as part of Arconic's disclosure where the exact same Reynobond 55PE panels were tested but as cassette fixed instead of riveted. This is *REACTION TO FIRE TEST REPORT No. RA05-0005B ACCORDING TO THE EUROPEAN STANDARDS NF EN 13823 AND NF ISO 11925-2* dated 07/01/2005 (ARC00000536).

- O12.1.6 From these two test reports I have therefore been able to directly compare the reaction to fire performance of cassette fixed vs riveted fixed Reynobond 55PE panels.
- O12.1.7 Section 11.6 of the European classification standard BS EN 13501-1 states for a product to be classified as Class B:

The product shall satisfy all of the following criteria:

a) EN ISO 11925-2

Under condition of surface flame attack and, where required, edge flame attack (see 6.3) with 30 s exposure time, there shall be no flame spread in excess of 150 mm vertically from the point of application of the test flame within 60 s from the time of application;

b) EN 13823

No lateral flame spread (LFS) to the edge of the specimen.

FIGRA (= FIGRA_{0,2 MJ}) \leq 120 W/s

 $THR_{600s} \le 7,5 \text{ MJ}$

- **O12.1.8** As a reminder from Appendix F
 - a) FIGRA- maximum of the quotient of heat release rate from the specimen and the time of its occurrence using a THR-threshold of 0,2 MJ
 - b) THR 600s- total heat release from the specimen in the first 600 s of exposure to the main (primary) burner flames
 - c) LFS-Lateral flame spread along the 1000mm long wing
- O12.1.9 FIGRA and THR 600s are measurements of the combustibility of the material
- O12.1.10 As the 2008 issue of Agrément certificate 08/4510 states that the standard sample with a Grey/Green Duragloss 5000 coating achieves B-s2, d0 to EN 13501-1: 2002 I have compared the BS EN ISO 11925-2 and BS EN 13823 test results for the 55PE riveted and cassette system to the Class B performance requirements.
- O12.2 Reynobond 55PE Riveted system 2005 test data
- O12.2.1 REACTION TO FIRE TEST REPORT No. RA05-0005A ACCORDING TO THE EUROPEAN STANDARDS NF EN 13823 AND NF ISO 11925-2 dated 07/01/2005 (ARC00000535) provides the results of the reaction to fire tests of six samples of Reynobond 55PE riveted system tested to NF EN ISO 11925-2 and NF EN 13823,
- O12.2.2 This test report lists the samples as consisting of a 3mm thick core of low density polyethylene (PE) with 0.5mm thick, pre-coated aluminium sheets bonded to both faces. It does not record the colour of the core. The system is referred to in the test report as a riveted system.

O12.2.3 The test set up description from the report is stated in Figure O.6

Specimens 1 to 3: REYNOBOND® 55 PE riveted system

Mounting: panels fixed with rivets on a framework in aluminium profiles then applicate on gypsum plasterboard. The riveted system means that the panel edges are free and that the low density polyethylene is apparent.

Assembly with horizontal join at 200mm and vertical joint at 500mm.

Figure O.6 Excerpt on sample specification from REACTION TO FIRE TEST REPORT No. RA05-0005A ACCORDING TO THE EUROPEAN STANDARDS NF EN 13823 AND NF ISO 11925-2 dated 07/01/2005 (ARC00000535).

- O12.2.4 The Reynobond 55 PE riveted system achieved the results listed in Table O.4 for FIGRA, THR600s and LFS to NF EN 13823 and flame spread to NF EN ISO 11925-2.
- O12.2.5 I have compared these results to the Class B limits, defined in BS EN 13501-1 Table 1 in Table O.4.

Table O.4 REACTION TO FIRE TEST REPORT No. RA05-0005A ACCORDING TO THE EUROPEAN STANDARDS NF EN 13823 AND NF ISO 11925-2 dated 07/01/2005 (ARC00000535) vs Class B defined limits of BS EN 13501-1

	Test measurements	required for class B	classification	
	BS EN 13823 test c	riteria		BS EN ISO 119252 test criteria
	FIGRA(W/S)	THS 600s (MJ)	LFS	Flame spread
Test results from 'REACTION TO FIRE TEST REPORT No. RA05-0005A ACCORDING TO THE EUROPEAN STANDARDS NF EN 13823 AND NF ISO 11925-2' (ARC00000535)	62.6	3.8	< edge of specimen	No
Class B defined limits	<120	<7.5	< edge of specimen	<150mm

- O12.2.6 As can be seen in Table O.4 the 4mm thick Reynobond 55 PE core riveted system achieved all of the Class B requirements to BS EN 13823.
- O12.2.7 The riveted system as described in REACTION TO FIRE TEST REPORT No. RA05-0005A ACCORDING TO THE EUROPEAN STANDARDS NF EN 13823 AND NF ISO 11925-2 dated 07/01/2005 (ARC00000535) therefore passed all four of the criteria for Class B classification to BS EN 13501-1 Table 1.
- O12.2.8 This is reflected in the supporting Classification report REACTION TO FIRE CLASSIFICATION REPORT No. RA05-0005A ACCORDING TO THE EUROPEAN STANDARD NF EN 13501-1+A1:2013 (ARC00000358) issued 07/01/2005 and excerpt of which is provided in Figure O.7:

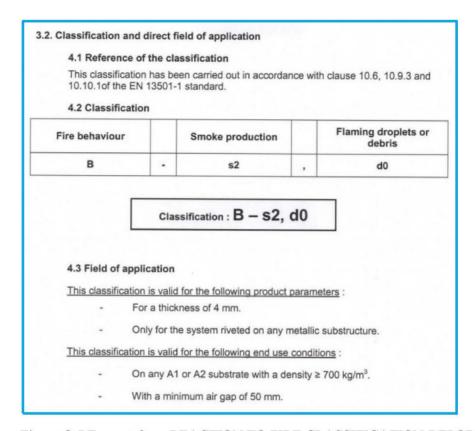


Figure O.7 Excerpt from REACTION TO FIRE CLASSIFICATION REPORT No. RA05-0005A ACCORDING TO THE EUROPEAN STANDARD NF EN 13501-1+A1:2013 (ARC00000358) dated 07/01/2005

O12.3 Reynobond 55PE Cassette system - 2005 test data

- O12.3.1 REACTION TO FIRE TEST REPORT No. RA05-0005B ACCORDING TO THE EUROPEAN STANDARDS NF EN 13823 AND NF ISO 11925-2 dated 07/01/2005 (ARC00000536) provides the results of the reaction to fire tests of six samples of Arconic Reynobond 55PE to NF EN ISO 11925-2 and NF EN 13823 undertaken using a sample of Arconic Reynobond 55PE cassette system.
- O12.3.2 This test report lists the samples as consisting of a 3mm thick core of polyethylene (PE) with 0.5mm thick, pre-coated aluminium sheets bonded to both faces. The system is referred to in the test report as a cassette (closed edges) system. This test report does not specify that the core is low density PE, however the recorded nominal weight per unit area of the material in this test is the same as that recorded in the test of the riveted system recorded in Section O9.
- O12.3.3 The test set up is described in the report as per Figure O.8:

Specimens 1: REYNOBOND® 55 PE cassette system

Mounting: panels shaped in cassettes, clung back on a framework in aluminium profiles, then applied on gypsum plaster boards. The cassette system means that there are metal returns on the panel edges and that, consequently, the low density polyethylene is not apparent.

Assembly with horizontal joint at 200mm and vertical joint at 500mm

Figure O.8 Excerpt of sample specification from REACTION TO FIRE TEST REPORT No. RA05-0005B ACCORDING TO THE EUROPEAN STANDARDS NF EN 13823 AND NF ISO 11925-2 dated 07/01/2005 (ARC00000536)

- O12.3.4 The Reynobond 55 PE cassette system achieved the results listed in Table O.5 below for FIGRA, THR600s and LFS to NS EN 13823 and flame spread to NF EN ISO 11925-2.
- O12.3.5 Again, I have compared these results to the Class B defined limits from BS EN 13501-1 Table 1, as well as to the results of the riveted panel I found in the previous section. See Table O.5 below.

Table O.5 REACTION TO FIRE TEST REPORT No. RA05-0005B ACCORDING TO THE EUROPEAN STANDARDS NF EN 13823 AND NF ISO 11925-2 dated 07/01/2005 (ARC00000536) for Reynobond 55 PE cassette vs Class B defined limits of BS EN 13501-1

	Test measurement	s required for cla	assification	
	BS EN 13823 test	criteria		BS EN ISO 119252 test criteria
	FIGRA(W/S)	Flame spread	LFS	Flame spread
Reynobond 55 PE cassette system results (ARC00000360)	1009.2	No	< edge of specimen	No
Reynobond 55 PE riveted system results (ARC00000359)	62.6	No	< edge of specimen	No
Class B limit	<120	<150mm	< edge of specimen	<150mm

O12.3.6 From Table O.5 it can be seen that a maximum FIGRA value of 1009.32 W/s was recorded for the cassette system, which is 8.4 times greater than the Class B classification limit, and sixteen times higher than the results for the riveted panel. I have graphed the FIGRA results for the Reynobond 55PE Cassette and riveted system in Figure O.9.

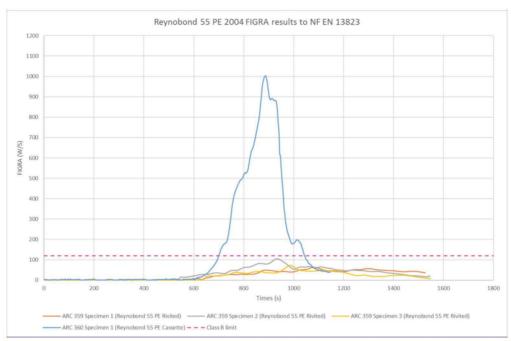


Figure O.9 comparison of Reynobond 55PE riveted and Cassette FIGRA results

- O12.3.7 A maximum THR600s value of 59MJ was recorded which is 7.9 times greater than the Class B classification limit and 15 times higher than that of the riveted panel.
- O12.3.8 On Page 7 of REACTION TO FIRE TEST REPORT No. RA05-0005B ACCORDING TO THE EUROPEAN STANDARDS NF EN 13823 AND NF ISO 11925-2 dated 07/01/2005 (ARC00000536) for the cassette system it states:

Comments :

630 sec : ignition inside the cassette in the angle.
About 700 sec : large ignition inside the cassettes

850 sec : stop of the main burner because HRR > 400 kW.

The tests were stopped after 850 seconds; the results are not usable but give an idea of the fire behaviour of the product.

- O12.3.9 It is therefore important to note that the cassette sample had failed to such an extent that the test had to be stopped. No evidence could therefore be used from the BS EN 13823 test therefore the only classification the Cassette system could obtain would be Class E using the BS EN ISO 119252 test criteria.
- **O12.3.10** In summary:
 - a) Table 1 of BS EN 13501-1 defines 4 performance criteria which together permit a product to be classified as Class B, three criteria from BS EN 13823 and one from BS EN ISO 11925-2. The Reynobond 55 PE cassette system does not perform within the combined limits defined for Class B.
 - b) The Reynobond 55PE cassette system therefore cannot not be classified as a Class B material based on the European classification system.

O13 Downgrading of Classification of Riveted Reynobond 55PE Architecture Wall cladding panels

- O13.1.1 It can be seen in my timeline of evidence in Figure O.1; that the BBA Agrément Certificate 08/4150 [Class B] for the Reynobond Architectural panels was not published until 4th August 2017. This is nine years after the publication of the 2008 BBA Agrément Certificate No 08/4510 [Class 0] Product Sheet 1 Reynobond Architecture Wall Cladding Panels (ARC00000368).
- O13.1.2 I have been provided with six reaction to fire classification reports to EN 13501-1, dated between 2008 and 2017, and produced for the Reynobond 55PE with a non-fire retardant core with either cassette or riveted fixing.
- O13.1.3 In Table O.6 I have provided the original 2005 European classification for the Arconic Reynobond 55PE cassette system followed by the later classifications obtained by the cassette system after 2008.

Table O.6 Classifications of Reynobond 55PE Cassette systems 2005-2018

Date	Sample details	Classification	Report title	Relativity reference
07/01/2005	3mm thick PE core 0.5mm Alu. sheets Grey/Green surface	Unclassified however test results would result in Class E as achieved BS EN ISO 11925-2 requirement	REYNOBOND ® 55 PE system a cassette (chants fermes) gris/vert Duragloss 5000 coating	ARC00000360
12/10/2011	3mm thick PE core 0.5mm Alu. sheets Surface colour: "Various"	Class E	REACTION TO FIRE CLASSIFICATION REPORT No. RA11-0244 ACCORDING TO THE EUROPEAN STANDARD NF EN 13501-1+A1:2013	ARC00000386
04/12/2014	3mm thick PE core 0.5mm Alu. sheets Surface colour: White	Class E	REACTION TO FIRE CLASSIFICATION REPORT No. RA13-0333 ACCORDING TO THE EUROPEAN STANDARD NF EN 13501-1+A1:2013	ARC00000395
22/09/2015	3mm thick PE core 0.5mm Alu. sheets Surface colour: "Various"	Class E	REACTION TO FIRE CLASSIFICATION REPORT No. RA15-0201 ACCORDING TO THE EUROPEAN STANDARD NF EN 13501-1+A1:2013	ARC00000405

- O13.1.4 It can be seen in Table O.6 that the Reynobond 55PE cassette system has at all times been classified as Class E between 2005 and 2018.
- O13.1.5 The 2008 BBA Agrément Certificate (ARC00000368) has therefore been factually incorrect from its publication in 2008. In Section 6.3 of the Agrément certificate it states that the "the products may be regarded as having Class 0". The certificate contains multiple references to the cassette system (Section 1.4, figure 1, Section 5.2, Section 11.4) notwithstanding that the available fire test evidence shows that this is not the case.
- O13.1.6 The classifications for the Reynobond 55PE riveted system from 2005 to 2018 are shown in Table O.7.

Table O.7 Classifications of Reynobond 55PE Riveted systems 2005-2018

Date	Sample details	Core material	Classification	Report title	Relativity reference
07/01/2005	3mm thick PE core 0.5mm Alu. sheets Surface colour: Grey/Green	Not stated	Class B-S2, d0	REACTION TO FIRE CLASSIFICATION REPORT No. RA05-0005A ACCORDING TO THE EUROPEAN STANDARD NF EN 13501- 1+A1:2013	ARC00000358
09/02/2011	3mm thick PE core 0.5mm Alu. sheets Surface colour: Grey	Not stated	B- \$1, D0	REACTION TO FIRE CLASSIFICATION REPORT No. RA11-0032 ACCORDING TO THE EUROPEAN STANDARD NF EN 13501- 1+A1:2013	ARC00000383
04/12/2014	3mm thick PE core 0.5mm Alu. sheets Surface colour: "Various"	Not stated	C - s2, d0	REACTION TO FIRE CLASSIFICATION REPORT No. RA14-0339 ACCORDING TO THE EUROPEAN STANDARD NF EN 13501- 1+A1:2013	ARC00000397
22/09/2015	3mm thick PE core 0.5mm Alu. sheets Surface colour: "Various"	Translucent Core and Black core	C - s2, d0	REACTION TO FIRE CLASSIFICATION REPORT No. RA15-0200 ACCORDING TO THE EUROPEAN STANDARD NF EN 13501- 1+A1:2013	ARC00000402

- O13.1.7 It can be seen in Table O.7.that the Reynobond 55PE riveted system was classified in 07/01/2005 and 09/02/2011 as Class B to EN 13501-1 by CSTB.
- O13.1.8 On 04/12/2014 the riveted system was downgraded to the lower classification Class C to EN 13501-1. The riveted system was then classified again as Class C in 2015 both by CSTB.
- O13.1.9 I have undertaken a specific analysis of the BS EN 13823 test results for the test results from 09/02/2011(ARC00000383), 04/12/2014(ARC00000397), and 22/09/2015 (ARC00000402) to try and find out why the performance of

the riveted system changed from Class B to Class C after 2014. I present my results in Table O.8.

- O13.1.10 These test results show that:
 - (a) The riveted system tested with a translucent core exceeds the Class B FIGRA value of 120W/S; and
 - (b) The riveted system tested with a black core obtains a FIGRA value of less than the Class B limit of 120W/s.
- **O13.1.11** It therefore appears that the colour of the core of the Reynobond Architecture Wall cladding panels affects the reaction to fire performance obtained.
- O13.1.12 After 2015 it also appears that the black and translucent cores are classified together using the lower classification of Class C based on the translucent core.
- **O13.1.13** This Class C performance for the riveted panels is not referred to in the 2017 2nd issue BBA Agrément certificate 08/4510 for the standard panels. No mention is made that there are two different core types in the 2017 2nd issue of BBA Agrément certificate 08/4510.

Table O.8 BS EN 13823 FIGRA results for the Reynobond 55PE panels classified on 09/02/2011(ARC00000383), 04/12/2014(ARC00000397), and 22/09/2015 (ARC00000402)

Date of issue of classification report	Classification report Relativity reference	Product	Classification stated in report	Core	FIGRA (W/s)
09/02/2011	ARC00000383	09/02/2011 REYNOBOND ® 55 PE Riveted system - Core not stated (ARC00000383)	B- S1, D0	Not stated	96.2
04/12/2014	ARC00000397	04/12/2014 REYNOBOND® 55 PE Riveted system Duragloss ® 5000 35 μm finish- Core not stated (ARC00000397)	C - s2, d0	Not stated	154.8
22/09/2015	ARC00000402	22/09/2015 REYNOBOND® 55 PE Riveted system 35 μm finish Translucent core and Black core (ARC00000402)	C - s2, d0	Translucent core	154.8 (identical to result stated in ARC00000397)
				Black core	96.2 (identical to result stated in ARC00000383)

- **O13.1.14** It is stated on the BBA website that an Agrément Certificate is subject to a formal review every three years as well as intermediate 'variation reports' with associated 'corrective action plans'.
- O13.1.15 In Table O.9 I list all variation reports disclosed to me to date related to the review of the Reynobond Agrément Certificate undertaken over 2014-2017. BBA therefore conducted six reviews of the Agrément Certificate.

Table O.9 Arconic disclosure of BBA review reports

Relativity reference	Date	Author	Title
ARC00000394	10/09/2014	BBA	Variation report
ARC00000400	10/04/2015	BBA	BBA 3-yearly review report
ARC00000401	25/08/2015	BBA	Variation report
ARC00000409	23/02/2016	BBA	Variation report
ARC00000410	15/11/2016	BBA	Letter from BBA to Arconic regarding 3-yearly review
ARC00000414	14/02/2017	BBA	Variation report

- O13.1.16 I have reviewed the documents listed in Table O.9 and can find no reference to reaction to fire tests.
- O13.1.17 The BBA state in their document "Frequently asked questions relating to Grenfell Tower" that they were not aware of these further tests (Figure O.10)

Q21. Arconic say they provided the classification results to various customers and certification authorities. Did they get in touch with the BBA regarding the test data giving their product a lower reaction to fire rating to EN13501-1?

A. It is a contractual requirement on our clients that any changes to formulation and specification of their Certified products are notified to the BBA and that this disclosure takes place prior to the proposed change to the production process being implemented. Arconic did not do this.

Figure O.10 Response 21 of BBA FAQ document

O13.1.18 I do not know why the BBA appear to have been unaware of the additional test data that I have referred to above. It is concerning that the BBA have indicated that relevant test data was not provided. This will require further investigation in Phase 2.

O14 Effect of substrate on the classification of Reynobond Architecture Wall Cladding panels

- O14.1.1 In all of the European test/classification reports disclosed to me to date the Reynobond panels have been tested with a Class A2 or better substrate.
- O14.1.2 The field of application for the REYNOBOND ® 55 PE Riveted system grey/green Duragloss 5000 coating (BBA00000048) states explicitly that this Class B classification is valid for the following product parameters and end use conditions only:

http://www.bbacerts.co.uk/download/Grenfell%20FAQ%20Update%20 11042018.pdf

⁶ British Board of Agrement.). Frequently asked questions relating to Grenfell Tower. v0.4 9th April 2018. Retrieved from

- a) Product parameters
 - a. For a thickness of 4mm
 - b. Only for the system riveted on any metallic substructure
- b) End use conditions
 - a. On any A1 or A2 substrate with a density >700 kg/m3
 - b. With a minimum airgap of 50mm
- O14.1.3 The field of application for the REYNOBOND ® 55 PE (Riveted system) grey Duragloss 5000 coating (ARC00000383) states explicitly that this Class B classification is valid for the following product parameters and end use conditions only:

This classification is valid for the following product parameters:

- -An overall nominal thickness of 4mm
- An overall nominal weight per unit area of 5.5 kg/m²
- -A 35 µm thick Duragloss 5000 finish
- A grey colour

This classification is valid for the following end use conditions:

- System riveted on metal substructure
- -With a minimum airgap of 50mm

Without substrate or with any class A1 or A2-s1, d0 class substrate with a density $\geq 820 \text{kg/m}^3$

O14.1.4 The field of application for the REYNOBOND ® FR (Riveted system) Gold Duragloss 5000 coating (BBA00000054) states explicitly that this Class B classification is valid for the following product parameters and end use conditions only:

This classification is valid for the following product parameters:

- -A thickness of 4mm
- A mass per unit area of 7.7 kg/m²
- -A 35 µm thick Duragloss finishing coat

This classification is valid for the following end use conditions:

- Riveted on metal substructure
- -With a minimum airgap of 20mm
- -With or without class A1 or A2-s1, d0 mineral insulation

-With or without class A1 or A2-s1, d0 substrate with a density of $\geq 820 \text{kg/m}3$

- Note it is unclear where the substrate requirements for the REYNOBOND ® FR (Riveted system) Gold Duragloss 5000 coating is an incorrect translation as it appears to allow any substrate to be used. If this were the case it would say any substrate rather than make a specific reference to Class A1 and Class A2. My understanding is that the field of application was intended to be the same as the standard panel "Without substrate or with any class A1 or A2-s1, d0 class substrate with a density $\geq 820kg/m^3$ "
- O14.1.6 Substrate is defined in BS EN 13501-1 Section 3.1.11 as:

"Product which is used immediately beneath the product about which information is required."

O14.1.7 End use application is defined in BS EN 13501-1 Section 3.1.13 as:

"real application of a product, in relation to all aspects that influence the behaviour of that product under different fire situations. NOTE It covers aspects such as its quantity, orientation, position in relation to other adjacent products, and its method of fixing."

O14.1.8 Section 6.3 states "Specific requirements for the single burning item test, the ignitibility test and the test for the determination of the burning behaviour of floorings, using radiant heat source of BS EN 1350-1 states:

"The potential contribution of a product to fire does not only depend on its intrinsic properties and the thermal attack, but also to a large extent on its end use application in the construction. Therefore, it shall be tested so as to simulate its end use application.

Note: it should be noted that as a consequence of a product being used in different end use applications, the product can have different classifications relating to each application."

"Typical positions in relation to other products are for example:

-free standing: without any product immediately behind or in front of it. In this case the product shall be tested free standing with an appropriate support;

- -On a substrate: glued or mechanically fastened or simply in contact. In this case the product shall be tested with a substrate and fastening representing the end use application;
- -forming a cavity with a substrate. The product shall be tested as such.

Details of the test arrangements are given in the relevant test method

Taking into account the role of the substrates and the fixings on the potential contribution of a product to a fire, a single product may be classified in

- different classes as a function of its end use application. If only one end use is envisioned, only that end use shall be tested."
- O14.1.9 ACP panels in a rainscreen façade system are not *free standing* or *glued or mechanically fastened or simply in contact* with a substrate. They are installed forming a cavity with the thermal insulation. I therefore consider the thermal insulation in an ACP rainscreen façade system to be the *substrate*, as defined in accordance with Sections 6.3 of BS EN 13501-1.
- **O14.1.10** Using this definition of substrate and referring to the field of application for the three *Reynobond Architecture Wall Cladding Panels* that achieve Class B, the thermal insulation used with the ACP panels must therefore achieve Class A2 or better.
- **O14.1.11** If thermal insulation material, other than a class A2 material, is used, the classification of the *Reynobond Architecture Wall Cladding*, as stated by Clause 6.3 of BS EN13501-1 would not apply.
- **O14.1.12** The Celotex PIR insulation installed on Grenfell Tower is classified as Class D to BS EN 13501-1. The use of Celotex PIR insulation would therefore invalidate the tested performance of the only three *Reynobond Architecture Wall Cladding Panels* that achieve Class B.
- **O14.1.13** I am not aware of any polymeric foam insulation that achieves Class A2 or better reaction to fire performance.
- **O14.1.14** In my opinion, the failure of the BBA certificate to mention the limitations on the test data in the sections relating to *Behaviour in relation to fire* is a serious omission.
- O15 Effect of surface coating colour on the classification of Reynobond Architecture Wall Cladding panels
- **O15.1.1** Section 6.4 of the 2008 1st issue of the BBA Agrément certificate states:
 - "6.4 These performances may not be achieved by other colours of the product and the designations of a particular colour should be confirmed by: England and Wales— Test or assessment in accordance with Approved Document B, Appendix A, Clause 1"
- O15.1.2 This Gold FR panel as classification report RA06-0372 states the field of application of the panel is "A 35 μ m Duragloss finishing coat" with no reference to the colour.
- O15.1.3 Therefore, it appears only the thickness of the Duragloss paint not the colour is relevant to the fire performance of the FR panel. This is not however consistent in all classifications of Reynobond panels.

O15.1.4 It should also be noted that the classification report RA-0005A (BBA00000048) does state the field of application for the Reynobond 55PE riveted system is only for:

"Finishing coat: Duragloss 5000

Colour: grey/green"

- O15.1.5 Any other colour of Reynobond 55PE riveted system would therefore not be covered by the classification report RA-0005A (BBA00000048).
- O15.1.6 The September 2015 classification reports for both the cassette and riveted Reynobond 55PE systems (ARC00000405 and ARC00000402 respectively) state that the field of application is for "various colours of finishes" of "35µm thick Duragloss 5000 finish" therefore after 2015 the specific colour of the finish coating of the panel does not appear to affect the classification of the Reynobond 55PE panels as long as it is "35µm thick Duragloss 5000 finish".
- O15.1.7 It is therefore not consistent across all of the Reynobond classification reports whether the thickness of the Duragloss coating; the colour of the coating or both affect the classification obtained by the panel.
- O15.1.8 I suggest that independent testing should be carried out to prove either way whether the thickness or colour of the Duragloss coating has any material effect on the reaction to fire classification of the panel.
- O16 My assessment of the validity of BBA certificates
- O16.1 Validity of the 2008 1st issue of BBA Agrément certificate 08/4510
- **O16.1.1** The front page of the 2008 1st issue of BBA Agrément certificate 08/4510 states it is for "Reynobond Architecture Wall Cladding Panels" and that "the panels may be regarded as having a Class 0 surface in England and Wales".
- O16.1.2 In my opinion, the statement on the front page of the 2008 issue of BBA Agrément Certificate is factually incorrect, as follows.
- **O16.1.1** Section 6.1 to Section 6.6 of the BBA Agrément Certificate references the fire performance of three panels only. These are:
 - a) Standard sample with a Grey/Green Duragloss 5000 coating- B-s2, d0 to EN 13501-1: 2002
 - b) Fire retardant sample with a Gold Duragloss finish- B-s1, d0 to EN 13501-1: 2002
 - c)Fire retardant sample with a metallic grey PVDF finish- I=0 to BS 476-6 and Class 1 to BS 476-7

- O16.1.2 Two panels are therefore stated to have a European Class B rating (These are the Standard sample with a Grey/Green Duragloss 5000 coating; and Fire retardant sample with a Gold Duragloss finish).
- O16.1.3 This European classification level is not equivalent to the requirements of the National Class 0, which is cited in Section 13 of Appendix A of ADB as:
 - 13 The highest National product performance classification for lining materials is Class 0. This is achieved if a material or the surface of a composite product is either:
 - a. composed throughout of materials of limited combustibility; or
 - a Class 1 material which has a fire propagation index (I) of not more than 12 and sub-index (i1) of not more than 6.

Note: Class 0 is not a classification identified in any British Standard test.

- **O16.1.4** Limited combustibility is defined in Table A7 of ADB under the European Classification system as:
- O16.1.5 "Any material/product classified as Class A2-s3, d2 or better in accordance with BS EN 13501-1:2007 Fire classification of construction products and building elements, Part 1 – Classification using data from reaction to fire tests."
- O16.1.6 Clause 13b of Appendix A of ADB states Class 0 can be achieved by "a Class 1 material which has a fire propagation index (I) of not more than 12 and sub-index (i1) of not more than 6". These values cannot be demonstrated through European standard tests on by testing to BS 476-6 and BS 476-7.
- O16.1.7 A Class B reaction to fire classification cannot therefore be relied upon for a Class 0 certificate.
- O16.1.8 Only the Fire retardant sample with a metallic grey PVDF finish, has the relevant test evidence, to support its Class 0 performance. This is by means of achieving a Class 1 material which has a fire propagation index (I) of not more than 12 and sub-index (i1) of not more than 6".to the national test standards BS 476-6 and BS 476-7 therefore meeting the requirements of Clause 13b of Appendix A of ADB.
- O16.1.9 In my opinion, the test evidence for this single panel cannot provide sufficient evidence to certify all "*Reynobond architecture wall panels*" as Class 0. This is because of a substantial additional body of evidence that has been disclosed to the Inquiry. From my review of this evidence I have found:
- O16.1.10 I have received test or classification reports as part of the disclosure form both Arconic and the BBA. From review of this information
 - a) I have found test evidence relating to 14 forms of *Reynobond Architecture Wall Cladding Panels*.

- b) Five "Reynobond Architecture Wall cladding panels" have undergone the relevant testing and achieved a National Class 0 classification. These are Reynobond RB160; Reynobond 33 (2mm, 3mm and 4mm overall thicknesses); and Reynobond FR 'Metallic grey PVDF finish'.
- c) All five of these classifications are dated prior to 2008. However, neither the Reynobond RB160, or Reynobond 33 (2mm, 3mm and 4mm overall thicknesses), are referenced on the 2008 version of the Agrément certificate.
- d) The certificate is therefore not a complete record of the panels that achieve Class 0.
- e) All of the Class 0 classification and supporting test reports state "Small differences in the composition or thickness of the product may significantly affect the performance during the test and may therefore invalidate the test results. Care should be taken to ensure that any product which is supplied or used is fully represented by the specimens which were tested".
- f) None of the "Reynobond Architecture Wall Cladding panels" that achieved Class 0 were subsequently tested to European standards.
- g) However, a further nine Reynobond Architecture Wall Cladding panels were tested and classified under the European classification system. These include the two referenced in the 2008 1st issue of Agrément certificate 08/4510. All of those product forms failed to achieve the European reaction to fire test class A2, in order to be considered "limited combustibility" and hence Class 0 to Clause 13a of Appendix A of ADB 2013.
- h) There is no test evidence that any cassette form of Reynobond has ever achieved a European classification higher than Class E. I consider that cassette systems should have been omitted entirely from the 2008 1st issue of BBA Agrément certificate 08/4510 on that basis.
- i) Originally there was test evidence to support the Reynobond 55PE riveted system and Reynobond FR riveted systems at Class B, but, the Reynobond 55PE riveted system was downgraded to Class C in 2014.
- j) The CSTB fire tests upon which Arconic and the BBA rely, always consist of the ACP installed over a Class A1 or A2 substrate. I am aware of no polymeric insulation available on the market in the UK at this time, with an A1 or A2 reaction to fire classification. For comparison purposes the Celotex PIR insulation installed on Grenfell tower has a Class D classification.
- k) Since 2015 classification reports for both the cassette and riveted Reynobond 55PE systems (ARC00000405 and ARC00000402 respectively) state that the field of application is for "various colours of finishes" of "35μm thick Duragloss 5000 finish", therefore the specific colour of the finish coating of the panel does not appear to affect the

European classification of the Reynobond 55PE panels. It is the thickness of the finish. I don't have enough clear evidence from the tests provided to me, to understand and conclude properly on colour versus thickness of paint, nor how they may be related, properly.

- **O16.1.11** It is on this basis I consider this BBA certificate does not certify compliance with the requirements of the Building Regulations reaction to fire [Class 0] for "Reynobond Architecture Cladding Panels" and further it cannot be relied upon to indicate "Reynobond Architecture Cladding Panels" are suitable for the intended purpose and use [Class 0].
- O16.2 Validity of the 2017 2nd issue of BBA Agrément certificate 08/4510
- O16.2.1 A 2nd issue of Agrément certificate 08/4510 was issued on the 4th August 2017. The front page states it is for "Arconic Cladding Panels Reynobond Architecture Wall Cladding panels".
- O16.2.2 The first page of Agrément certificate states:
- O16.2.3 "The panels have a B-s2, d0 or a B-s1, d0 reaction to fire classification to BS EN 13501-1: 2007, depending on the grade chosen. The use of both panel grades is restricted to buildings up to 18 metres in height, unless specific conditions are met (see section 7)."
- O16.2.4 The footnote to Section 1.4 of the 2nd issue of Agrément certificate 08/4510 in 2017 states "The manufacturing and the use of the cassettes, the sub-frame and its attachment to the substrate wall are not covered by this Certificate.". This is exclusion is not stated on the front page of the Agrément certificate nor in the title of the Agrément certificate.
- O16.2.5 Additionally, the classification report used as the basis of the B-s2, d0 classification stated for the *ST with grey/green Duragloss 5000 coating* in Table 3 of the Agrément certificate had in fact been superseded three years prior to the 2017 2nd issue of Agrément certificate 08/4510. The riveted version of the standard panel had been downgraded to Class C.
- O16.2.1 It is on this basis I consider this BBA certificate does not certify compliance with the requirements of the Building Regulations reaction to fire [B-s1, d0 or B-s2, d0 reaction to fire classification to BS EN 13501-1: 2007] for "Reynobond Architecture Cladding Panels" and further it cannot be relied upon to indicate "Reynobond Architecture Cladding Panels" are suitable for the intended purpose and use [B-s1, d0 or B-s2, d0 reaction to fire classification to BS EN 13501-1: 2007].

- O16.1 Validity of the 2017 2nd issue amended version of BBA Agrément certificate 08/4510
- O16.1.1 An amended version of 2nd issue of Agrément certificate 08/4510 was issued on 22 September 2017.
- O16.1.2 This amendment removed ST (assumed to be an abbreviation of the *standard* panel as described in the 2008 certificate) panel from the *Behaviour in* relation to fire section.
- O16.1.3 Additionally, the statement on the front cover was amended to state:
- **O16.1.4** "Behaviour in relation to fire the panels have a B-s1, d0 reaction to fire classification to BS EN 13501-1: 2007 and are restricted for use on buildings up to 18 metres in height, unless specific conditions are met (see section 7)."
- O16.1.5 This is not reflected in the title of the Agrément certificate which still states "Reynobond Architecture Wall Cladding Panels" and the statement on the front page that "the panels have a B-s1, d0 reaction to fire classification to BS EN 13501-1: 2007".
- O16.1.6 The 2017 Agrément certificate is a Class B certificate. From my review of all available evidence, only three of the eleven "*Reynobond Architecture Wall Cladding panels*" classified under the European classification system achieve Class B to BS EN 13501-1.
- O16.1.7 The only "Reynobond Architecture Wall Cladding panel" that had relevant evidence to demonstrate it achieved Class B in 2017 was the Reynobond FR riveted system. Even then the 2017 2nd issue amended version of BBA Agrément Certificate 08/4510 made no reference to any restrictions on thickness of the panel; mass per unit area of the panel; finishing coat thickness; fixing method or substrate classification. All these parameters have specific requirements for the panels to achieve the Class B classification stated in the BS EN 13501-1 classification report upon which the BBA rely, RA06-0372 (BBA00000054).
- O16.1.8 It is on this basis I consider this BBA certificate does not certify compliance with the requirements of the Building Regulations reaction to fire [B-s1, d0 reaction to fire classification to BS EN 13501-1: 2007] for "Reynobond Architecture Cladding Panels" [with a FR core] and further it cannot be relied upon to indicate "Reynobond Architecture Cladding Panels" are suitable for the intended purpose and use [B-s1, d0 reaction to fire classification to BS EN 13501-1: 2007].
- O16.1.9 In light of the above, I recommend that the first page and title of the 2017 2nd issue amended BBA certificate 08/4510, which is the currently available version for Reynobond architecture wall panels, be immediately changed to state that the certificate is only valid for Reynobond 55 FR panels with a fire retardant core, in a riveted form, and when installed within the field of

application stated in the BS EN 13501-1 classification report RA06-0372 (BBA0000054).

O17 My reading of BBA Agrément Certificate 08/4510 Product Sheet 1 Reynobond Architecture Wall Cladding Panels

- O17.1.1 For transparency, I now provide my review of the BBA Agrément Certificate 08/4510 Product Sheet *1 Reynobond Architecture Wall Cladding Panels*. This was first issued in 14/01/2008 and was the relevant version of the Reynobond BBA Agrément Certificate at the time of the refurbishment of Grenfell Tower in 2012 to 2014.
- O17.1.2 This Section of my Expert Report therefore aims to:
 - a) Show the reader what can be found in the certificate.
 - **b)** Give a summary of my opinion on what the certificate advises in terms of fire safety performance.
 - c) Provide my specific commentary on BBA Agrément Certificate 08/4510 Product Sheet 1 *Reynobond Architecture Wall Cladding Panels* first issue 14/01/2008, based on the fire test evidence and classification reports provided to me.
 - d) Set out clearly therefore why I reject the BBA certificate as an appropriate method of demonstrating compliance of the rain screen ACM panel system installed on Grenfell Tower
- O17.1.3 Not all sections of the BBA Agrément Certificate are numbered therefore I have numbered the sections of the certificate myself. These have been boxed in red and numbered Section 1 to Section 34. Each section number is then discussed in the Table rows adjacent.
- O17.1.4 Note, in this section I make reference to the approved guidance for England, Scotland and Northern Ireland which are Approved Document B, the Nondomestic and Domestic Technical Handbook; and Technical Booklet E respectively. I will use the abbreviations: ADB, NDTH and DTH; and TB E for these guidance documents respectively.

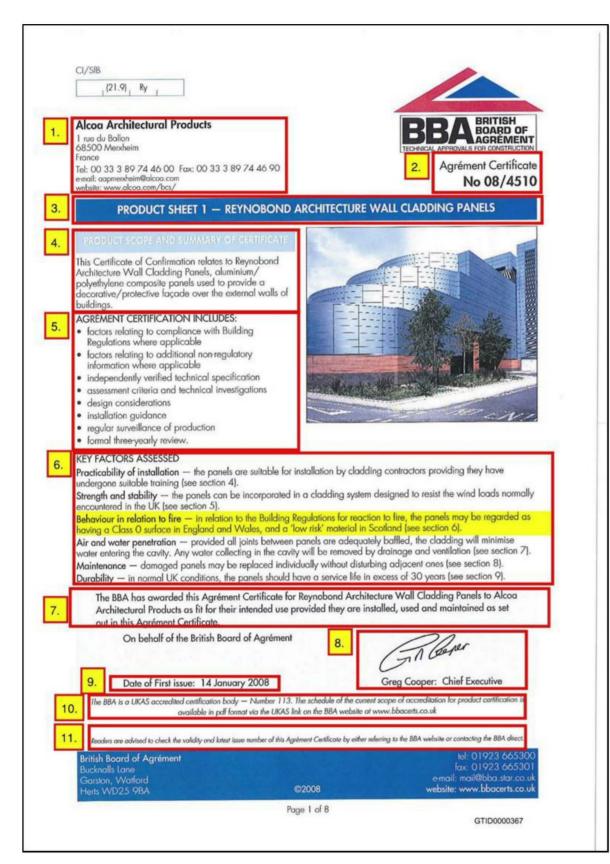


Figure O.11 Page 1 of Agrément Certificate 08/4150 Product Sheet 1 Reynobond Architecture Wall Cladding Panels (first issue 14/01/2008) – section numbering added by author

Table O.10 Description and review of content: Page 1 of Agrément Certificate No 08/4510 (14/01/2008)

My Section Number	Description of section				
1	This section states Name, address and contact of the Company that BBA has produced the Agrément Certificate on behalf of.				
2	The individual reference number for the Agrément Certificate. Note the number before the "/" refers to the year the certificate was first published i.e. 08 means the certificate was first published in 2008.				
3	This section states the product name as relates to the Agrément Certificate.				
4	Product scope and summary of certificate- the product referenced is "Reynobond Architecture Wall Cladding Panels"				
5	This section lists eight items the Agrément Certificate includes. These are stated as: • Factors relating to compliance with Building Regulations where applicable • Factors relating to additional non regulatory information where applicable • Independently verified technical specification • Assessment criteria and technical investigations • Design considerations • Installation guidance • Regular surveillance of production • Formal three yearly review				
6	This section, 'Key Factors Assessed', Sets out 6 key factors addressed, one of which is behavior in relation to fire. It specifically states "in relation to the Building Regulations for reaction to fire, the panels may be regarded as having a Class 0 surface in England and Wales, and a 'low risk' material in Scotland". The Agrément Certificate then cross-refers the reader to Section 6 of the Agrément Certificate. No reference is made to any limitations on (a) the thickness of the panels (b) the core material type (c) the fixing method of the panels (d) the surface coating of these panels or (e) substrate requirements. No reference is made to the performance of the panels in accordance with the Building (Northern Ireland) Regulations 2000, despite these being referenced on page 2 and Section 6.3 of the Agrément Certificate.				
7	Statement that "The BBA has awarded this Agrément Certificate for Reynobond Architecture Wall Cladding Panels to Alcoa Architectural products as fit for their intended use provided that they are installed, used and maintained as set out in this Agrément Certificate" No reference is provided to the specific Sections of the Agrément Certificate that state the installation, use and maintenance requirements for the panels. I consider these to be: Installation – Sections 10 and 11 of the BBA certificate Use – General section of the BBA certificate (my Section 15) and Section 2 of the BBA certificate Maintenance requirements – Section 8 of the BBA Certificate				
8	Signature of chief executive of BBA Greg Cooper				
9	The date of first issue of Agrément Certificate				
10	Statement that BBA is UKAS accredited certification body- Number 113. It is stated on the Schedule of Accreditation issued by United Kingdom Accreditation Service that UKAS have accredited BBA to "ISO/IEC 17065:2012 to provide product conformity certification". I am not clear if Agrément Certificates are in fact accredited by UKAS as a product conformity scheme. Please refer to Section O7.				
11	Statement that "Readers are advised to check the validity and latest issue number of this Agrément Certificate by either referring to the BBA website or contacting the BBA direct"				

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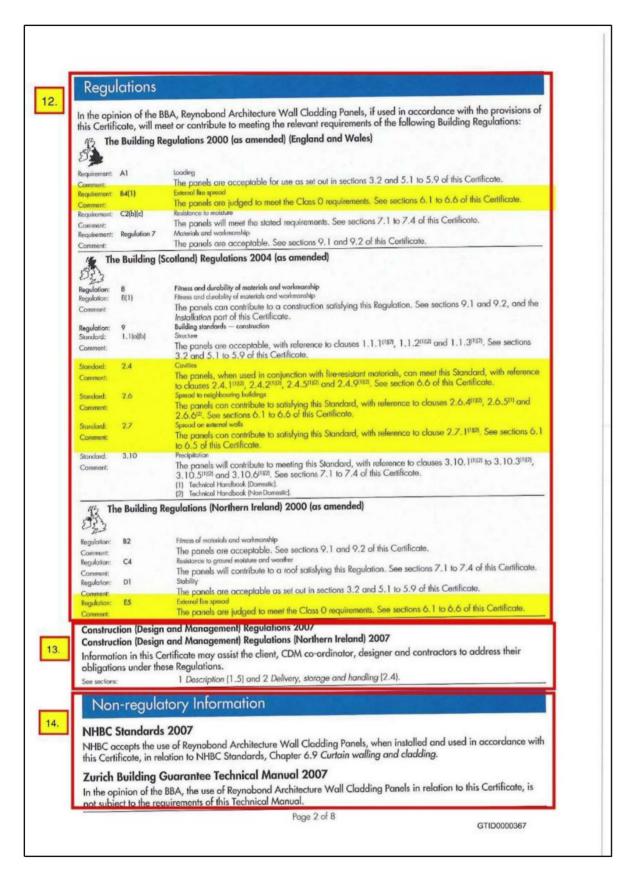


Figure O.12 Review of Page 2 of Agrément Certificate 08/4150 Product Sheet 1 Reynobond Architecture Wall Cladding Panels (first issue 14/01/2008) – Section numbers added by author

Table O.11 Description and review of content: Page 2 of Agrément Certificate No 08/4510 (14/01/2008)

My Section number	Description of section of BBA Agrément Certificate 08/4150
12	This section states
Regulations	"In the opinion of the BBA, Reynobond Architecture Wall Cladding Panels, if used in accordance with the provisions of this certificate, will meet or contribute to meeting the relevant requirements of the following Building Regulations". Three sets of Building Regulations are then referenced in the Agrément Certificate. These are: The Building Regulations 2000 (as amended) (England and Wales); The Building (Scotland)
12	Regulations 2004 (as amended); and the Building Regulations (Northern Ireland) 2000 (as amended). For Building Regulations 2000 (as amended) (England and Wales) the only fire regulation
Building Regulations 2000 (as amended) (England and Wales)	referenced is B4(1) External fire spread. The certificate states that "the panels are judged to meet the Class 0 requirements" and refers the reader to sections 6.1 to 6.6 of the certificate.
	Regulation B4(1) is the regulation for the control of external fire spread however the Regulation does not state a specific classification for reaction to fire performance requirement for the materials used in the external wall construction only that "The external walls of the building shall adequately resist the spread of fire over the walls, and from one building to another.
	The relevant version at the time the Agrément Certificate was published was ADB 2006 edition amended 2007 (ADB 2007). Diagram 40 of this document recommends that the external wall surface classification for any dimension over 18m of a building with a building height greater than 18m achieves either "Class 0 (national class) or Class B-s3, d2 or better (European class)".
	For any dimension up to 18m of a building with a building height greater than 18m "Index (I) not more than 20 (national class) or class C-s3, d2 or better (European class), Timber cladding at least 9mm thick is also acceptable, (the Index I relates to tests specified in BS 467-6)".
10	As I explained in Appendix F of my Expert Report, Class 0 can be demonstrated by 3 separate methods and I have considered this Agrément Certificate on that basis.
12 Building (Scotland) Regulations 2004	For the Building (Scotland) Regulations 2004 (as amended) three mandatory standards relevant to fire are referenced in the Agrément Certificate. These are 2.4 <i>Cavities</i> ; 2.6 <i>Spread to neighboring buildings</i> and 2.7 <i>Spread on external walls</i> .
	I will not discuss these requirements further as they are not relevant to Grenfell Tower.
12 Building Regulations	
(Northern Ireland) 2000 (as amended)	The BBA Agrément Certificate states that "the panels are judged to meet the Class 0 requirements" and refers the reader to sections 6.1 to 6.6 of the certificate.
	I will not discuss these requirements further as they are not relevant to Grenfell Tower.
[Cross references to Clause 6.1 and 6.2 of the certificate]	The guidance sections for Building Regulations 2000 (as amended) (England and Wales); The Building (Scotland) Regulations 2004 (as amended); and the Building Regulations (Northern Ireland) 2000 (as amended) all direct the reader to refer to Section 6.1 to 6.5 of the Agrément Certificate. Please refer to my review of Section 6.1 to 6.5 of the Agrément Certificate in the Section I
	have numbered 28.

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My Section number	Description of section of BBA Agrément Certificate 08/4150
13 CDM	This section states that "information in this Certificate may assist the client in, CDM coordinator, designer and contractors to address their obligations under these Regulations" where the Regulations referenced are the Construction (Design and management) Regulations 2007 & the Construction (Design and management) Regulations (Northern Ireland) 2007.
14 N D1-4	The reader is also referred to section 1.5 and section 2.4 of the certificate.
14 Non Regulatory Guidance	This section sets out the non-regulatory information relevant to the product. Two standards are referenced. These are the NHBC Standards 2007 (specifically chapter 6.9 Curtain walling and Cladding) and the Zurich Building Guarantee Technical Manual 2007.
	Section 1.1 Application of the NHBC standards states "The NHBC Standards give the Technical Requirements, Performance Standards and Guidance for the design and construction of dwellings acceptable to NHBC. In the Standards, a DWELLING means a HOME as defined in the NHBC Rules.". The introduction to Chapter 6.9 states: "This Chapter gives guidance on the forms of curtain walling and cladding acceptable to NHBC. Curtain walling and cladding systems that do not conform to the following descriptions will not normally be acceptable to NHBC.". Section 6.9 D7 and D8 of the NHBC standards are specific to rainscreen cladding.
	Section 6.9 D7 states: "Rainscreen cladding systems shall be designed and certificated in accordance with appropriate Standards. Rainscreen cladding systems, including panels, should have current certification confirming satisfactory assessment by an appropriate independent technical approvals authority accepted by NHBC, including: British Board of Agrément (BBA) or Building Research Establishment (BRE) Certification. Systems that are assessed and certificated by an appropriate independent technical approvals organization in accordance with the CWCT Standard for Walls with Ventilated Rainscreens will normally be acceptable to NHBC.
	Other certification bodies or test documentation, may be acceptable if they are considered by NHBC to be a suitable alternative. The certification, together with all test documentation should be made available to NHBC before work on the rainscreen begins on site.
	The use of the system should be within the scope of the certification and test documentation."
	In Section O19 I have given my opinion that the rain screen cladding system installed on Grenfell Tower was not within the scope of the certification and test documentation either referenced on the BBA Agrément certificate or any of the evidence disclosed by Arconic.
	Section 6.9-D8 provides guidance on the in-service performance of rainscreen panels. Guidance is provided on the loads, movement, and fixings; weather resistance; insulation; thermal bridging and condensation; air infiltration; compartmentation; acoustic performance; electrical continuity and earth bonding; durability; and tolerances.
	The only reference to provisions for fire safety is that in the insulation section it states: "Reference should be made to BRE document BR135 - 2003 'Fire performance of external thermal insulation for walls of multi-storey buildings' when specifying the type of insulation system to be installed."
	I am not providing any opinion on BR135 at this stage.
	Finally, I do not currently have a copy of the Zurich Building Guarantee Technical Manual 2007 disclosed to me, and therefore I cannot comment on the statement made in the BBA certificate.

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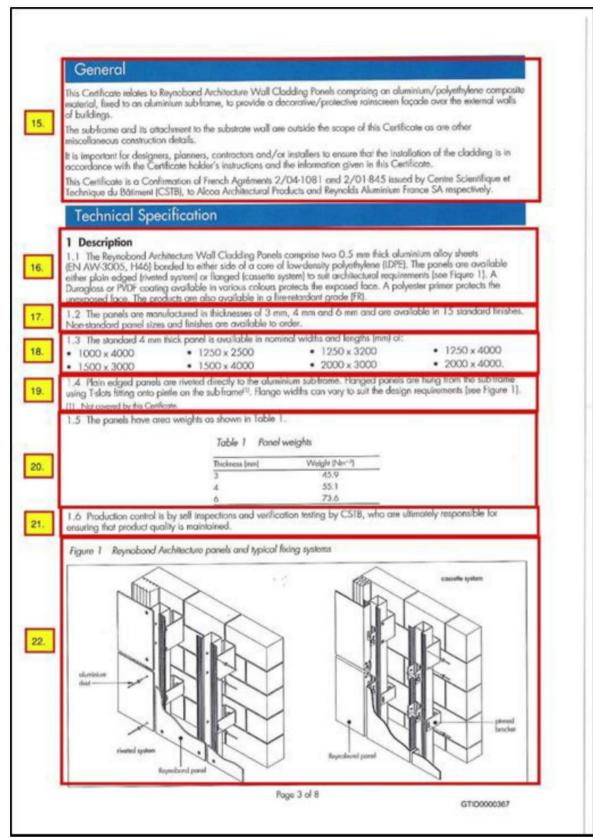


Figure O.13: Page 3 of Agrément Certificate 08/4150 Product Sheet 1 Reynobond Architecture Wall Cladding Panels (first issue 14/01/2008) – section numbering added by author

Table O.12 Description and review of content: Page 3 of Agrément Certificate No 08/4510 (14/01/2008)

My Section number	Description of section of BBA Agrément Certificate 08/4150
15	This 'General' section explains what the certificate "relates to". The product referenced is "Reynobond Architecture Wall Cladding panels". In this instance the Reynobond panels are described as "comprising of an aluminum/polythene composite material, fixed to an aluminum sub frame, to provide a decorative/protective rainscreen over the external walls of buildings". The sub frame and its attachment wall are stated to be outside the scope of the Certificate.
	I have identified the relevant test data available to me in this Appendix and explained why the majority of that test data does not support this general statement regarding wall cladding panels.
	The certificate then states "It is important for designers, planners, contractors and/ or installers to ensure that the installation of the cladding panels is in accordance with the certificate holders instruction and the information given in this certificate". However, no guidance is provided on how the reader may obtain the certificate holder's instructions.
	Importantly it states here in Section 15 "This certificate is a conformation of the French Agréments 2/04-1081 and 2/01-845 issued by Centre Scientifique et Technique du Batiment (CSTB)".
	These documents are Avis Technique 2/04-1081 Reynobond System Rivete published 2004 and Avis Technique 2/01-845 Reynobond systeme cassettes published 2002. I have obtained these reports form the CSTB website. Both of these reports were superseded prior to the issue of the 2008 Agrément certificate. It is unclear why BBA refer to them in the Certificate. Both of these documents contain reaction to fire performance test evidence under the French classification system however this performance is not referenced in the BBA certificate. BBA do not state why this information was omitted.
	The fire performance of the product has been determined by the BBA through a separate assessment process of specific test/classification reports. This is not evident from the Certificate itself, but has been confirmed by BBA in a letter to the inquiry indicating the test/classification reports upon which they based the fire performance of the 2008 issue of the Agrément certificate 08/4510 (BBA00000001).
16 Technical Specification 1 Description	In clause 1.1 of the BBA Agrément Certificate it states: "The Reynobond Architecture Wall Cladding Panels comprise of two 0.5mm thick aluminum alloy sheets (EN AW-3005, H46) bonded either side of a core of low density polyethylene (LDPE). These panels are available either plain edged (riveted system) or flanged (cassette system) to suit architectural requirements (See figure 1). A Duragloss or PVDF coating available in various colors protects the exposed face. A polyester primer protects the unexposed face. The products are also available in a fire-retardant grade (FR)."
	No reference is provided here to any restrictions on fixing method; core colour; or substrate that can be used in conjunction with the panels to achieve the stated fire performance on the front page of the Agrément Certificate despite these factors having a significant effect on the reaction to fire performance achieved by the panels as I have found in Section O12, O13 and O14.
17	In Section 1.2 of the BBA Agrément Certificate it states: "The panels are manufactured in thickness of 3mm, 4mm and 6mm and are available in 15 standard finishes. Non standard panel sizes are available to order".

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My Section number Description of section of BBA Agrément Certificate 08/4150				
	Arconic have only ever tested 2mm, 3mm, or 4mm thick panels for reaction to fire performance (See Section O12).			
	There is therefore no evidence supporting reaction to fire test performance for any 6mm panels. However, this is not stated on the Agrément Certificate.			
	Further to this, the actual panels referenced in Section 6 <i>Behavior in relation to fire</i> section of the Agrément certificate were all 4mm thick.			
18	Section 1.3 of the Agrément Certificate states that: "The standard 4mm thick panel is available in nominal widths and lengths (mm) of: 1000×4000; 1500×3000; 1250×2500; 1500×4000; 1250×3200; 2000×3000; 1250×4000; 2000×4000". No definition is provided for what a "Standard panel" is in terms of surface coating; core			
	material composition or fixing method, only that it is 4mm thick. I have found in Section O9, O10, O11, O12, O13, O14 that surface coating; core material composition and fixing of the panels has a significant effect on the fire performance obtained and only certain panels achieve the Class 0 performance stated on the front of the Agrément certificate.			
19	Section 1.4 of the Agrément Certificate states: "Plain edged panels are riveted directly to the aluminum sub frame. Flanged panels are hung from the sub frame using T slots fitting onto pintle on the sub frame [1]. Flange widths can vary to suit the design requirements (See figure 1)". Footnote [1] of the Agrément Certificate states: Not covered by this certificate.			
	The certificate therefore references both riveted and cassette fixing methods for the panels. I have found in Section O12 that the cassette fixed system has a significantly worse reaction to fire performance than the riveted system.			
	In the section I have numbered 15 on the Agrément Certificate, it is stated that "The sub frame and its attachment to the substrate wall are outside of the scope of this certificate as are other miscellaneous construction details". It is not at all clear from the wording used, but it appears that that footnote [1] ("not covered by this certificate") refers to the sub frame and not to the cassette method of fixing itself. This aligns with the exclusion of the sub-frame in "General" – refer to my marked No.15 above.			
20	Clause 1.5 of the Agrément Certificate lists the weight per m ² of the product for 3mm, 4mm and 6mm panel thicknesses. Note this table is incorrect as based on my review in Section O9 as the fire rated panel is in fact 2.2 kg/m ² heavier than the standard panel.			
21	Clause 1.6 of the Agrément Certificate states: "Production control is by self-inspection and verification testing by CSTB, who are ultimately responsible for ensuring that product quality is maintained".			
22	Figure 1 in the BBA certificate shows an isometric view of Reynobond Architecture panels and typical fixing systems. Both the riveted and cassette system are clearly shown.			
	When considering all the relevant test evidence disclosed by Arconic and the BBA (Section O9 and O10) no reference is made here in the diagrams to any of the required restrictions on substrate reaction to fire performance; air gap depth behind the panel; panel thickness; panel surface coating; or panel core material composition.			
	I have found in Section O12 that the cassette fixed system has a significantly worse reaction to fire performance than the riveted system; in Section O13 the core material (black or translucent) affects the classification; and that the substrate must achieve a specific reaction to fire classification in Section O14			

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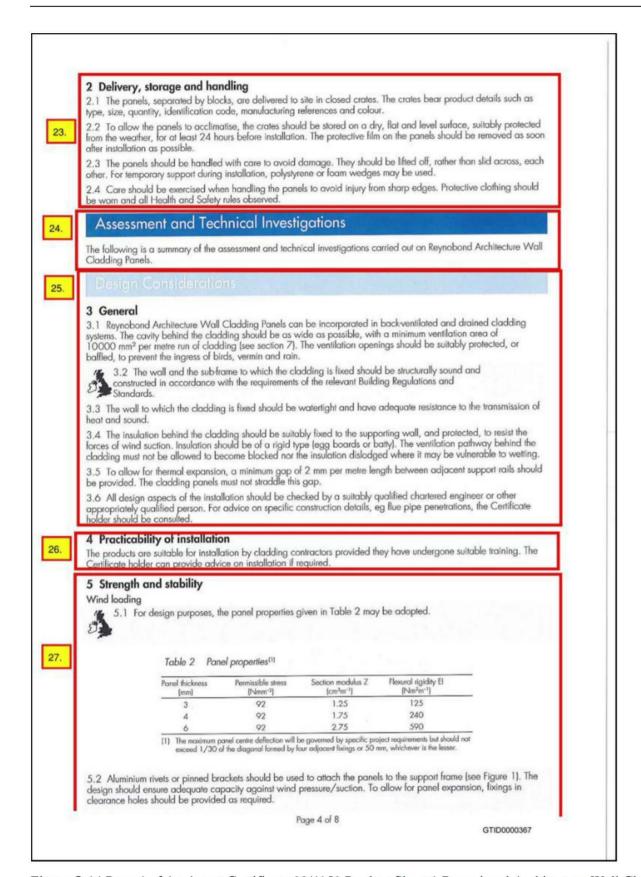


Figure O.14 Page 4 of Agrément Certificate 08/4150 Product Sheet 1 Reynobond Architecture Wall Cladding Panels (first issue 14/01/2008) – section numbering added by author

Table O.13 Description and review of content: Page 4 of Agrément Certificate No 08/4510 (14/01/2008)

My Section number	Description of section of BBA Agrément Certificate 08/4150			
23 2 Delivery, storage and handling	Clause 2 of the Agrément Certificate describes the form in which the product is delivered, i.e. in separate blocks. It also details the storage requirements of the products, as well as the handling procedures. Health and Safety rules are referred to here.			
24	This section of the BBA certificate states:			
Assessment and Technical investigations	"The following is a summary of the assessment and technical investigations carried out on Reynobond Architectural Wall Cladding Panels".			
25 3 General	Section 3 'General' of the Agrément Certificate states: 3.1 Reynobond Architecture Wall Cladding Panels can be incorporated in back ventilated and drained cladding systems. The cavity behind the cladding should be as wide as possible with a minim of ventilation area of 10000mm² per m run of cladding (See Section 7) The ventilation openings should be suitably protected, or baffled, to prevent the ingress of birds, vermin and rain. 3.2 The wall and the sub frame to which the cladding panel is fixed should be structurally sound and constructed in accordance with the requirements of the relevant Building Regulations and Standards. 3.3 The wall to which the cladding is fixed should be water tight and have adequate resistance to the transmission of heat and sound. 3.4 The insulation behind the cladding should be suitably fixed to the supporting wall, and protected, to resist the forces of wind suction. Insulation should be of a rigid type (egg boards or batty). The ventilation pathway behind the cladding must not be allowed to become blocked nor the insulation dislodged where it may be vulnerable to wetting. 3.5 To allow for thermal expansion, a minimum gap of 2mm per meter length between adjacent support rails should be provided. The cladding panels must not straddle this gap. 3.6 All design aspects of the installation should be checked by a suitably qualified chartered engineer or other appropriately qualified person. For advice on specific construction details e.g. flue pipe penetrations, the certificate holder should be consulted. No cross reference is made in this section to the fire safety requirements in Section 6 of the Agrément Certificate. Important design information is omitted here relating to limitations on fixing method, core type or substrate. As I have shown in Section 012, 013, and 014 all of these factors significantly affect the fire performance obtained by the panels.			
26 4 Practicality of installation	Clause 4 of the Agrément is titled "Practicality of installation". In this case the Agrément Certificate states the product must be installed "by cladding contractors provided than have undergone switchle training." No definition of switchle training is provided.			
27 5 Strength and stability	Provided they have undergone suitable training". No definition of suitable training is provided. This section states the maximum permissible wind loading of the panels and makes reference to the panels in 3, 4, or 6mm thicknesses. Arconic have only ever tested 2mm, 3mm, or 4mm thick panels for reaction to fire performance			
	(See Section O12). There is therefore no evidence supporting reaction to fire test performance for any 6mm panels. However, this is not stated on the Agrément Certificate.			

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My Section number	Description of section of BBA Agrément Certificate 08/4150				
	Further, the actual panels referenced in Section 6 <i>Behavior in relation to fire</i> section of the Agrément certificate were all 4mm thick.				

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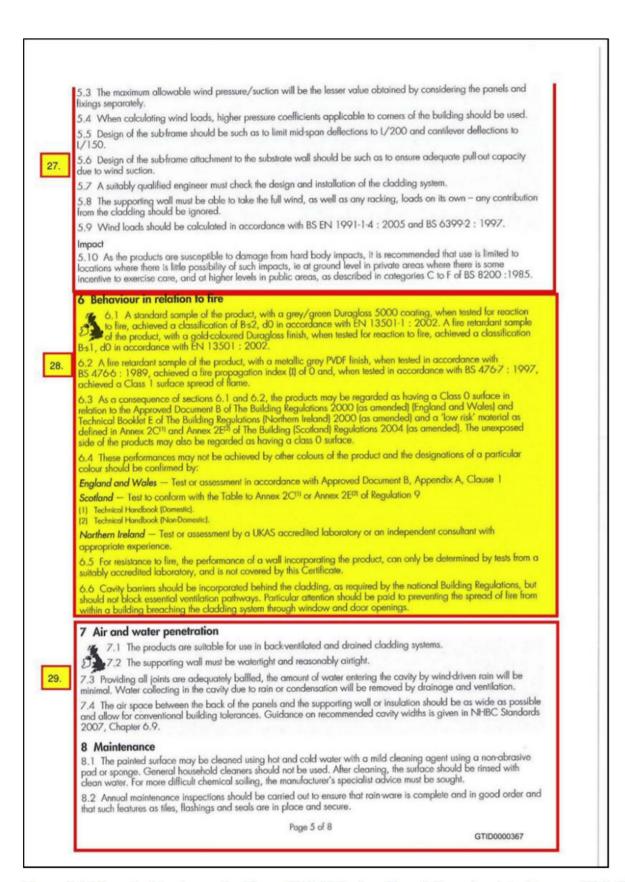


Figure O.15 Page 5 of Agrément Certificate 08/4150 Product Sheet 1 Reynobond Architecture Wall Cladding Panels (first issue 14/01/2008) – section numbering added by author

Table O.14 Description and review of content: Page 5 of Agrément Certificate No 08/4510 (14/01/2008)

14/01/2008)	
My Section number	Description of section of BBA Agrément Certificate 08/4150 Issue 1
27	Clause 5 of the Agrément Certificate is titled Strength and stability. Design information is given for maximum permissible wind loading, and impact. It should be noted that section 5.2 states: "Aluminum rivets or pinned brackets should be used to attach the panels to the support frame". The cassette system is therefore incorrectly referenced as a suitable method for fixing the panels, when it should in fact be entirely excluded from this Class 0 certificate as I found in my review in Section O12.
28 Behavior in relation to fire (Clause 6.1)	This section states the standard sample of the product, with a Grey/Green Duragloss 5000 coating, when tested for reaction to fire, achieved a classification of achieves B-s2, d0 in accordance with EN 13501-1: 2002 and the fire retardant sample of the product with gold coloured Duragloss finish achieved class B-s1, d0. As I explain in Section O9, a Class B rating is not equivalent to a class 0 rating. Therefore, this section is contradictory to the statement on the front page of the 2008 issue of BBA Agrément Certificate 08/4510 which states that " in relation to the Building Regulations for reaction to fire, the panels may be regarded as having a Class 0 surface in England and Wales". Further to this, important design information is omitted here relating to limitations on fixing method, core type or substrate. As I have shown in Section O12, O13, and O14 all of these factors significantly affect the fire performance obtained by the panels.
28 Behavior in relation to fire (Clause 6.2)	6.2 of the certificate states: A Fire retardant sample of the product with a metallic grey PVDF finish, when tested in accordance with BS 476-6: 1989 achieved a fire propagation index (I) of 0 and when tested in accordance with BS 476-7: 1997, achieved a Class 1 surface spread of flame. As I found in Section O9 this is the only Reynobond product referenced in the Behaviour in relation to fire section that achieves Class 0 and is therefore in accordance with the front page of the 2008 issue of BBA Agrément Certificate 08/4510 which states that "the panels are judged to meet the Class 0 requirements"
28 Behavior in relation to fire (Clause 6.3)	Section 6.3 of the Agrément Certificate states: 6.3 As a consequence of section 6.1 and 6.2, the products may be regarded as having a Class 0 surface in relation to the Approved Document B of the Building Regulations 2000 (as amended) (England and Wales) and Technical Booklet E of the Building Regulations (Northern Ireland) 2000(as amended) and a 'low risk' material as defined in Annex 2C and Annex 2E of the Building (Scotland) Regulations 2004 (as amended).
	No definition is provided in the Agrément Certificate as to what constitutes "the Products" despite the reaction to fire performance for the panels referenced in Sections 6.1 and 6.2 only being relevant for a specific thickness; fixing method; overall thickness; weight; core composition; fixing method and used in conjunction with specific substrate materials.
	From my review of the test evidence disclosed by BBA in Section O9 only one Reynobond product, Reynobond 55 FR ACM (Metallic Grey), had test evidence of Class 0 performance. Two products, Reynobond 55PE riveted (grey/green Duragloss 5000) and Reynobond FR ACM (Gold) had evidence for European Class B classification. The test evidence for these products is not one of the three test methods routes for demonstrating Class 0 performance (Section O9).

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REPORT OF
SPECIALIST FIELD
ON BEHALF OF:

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Even if one considers the product performance to be Class B (which the BBA certificate does not provide for), none of the limitations defined in the field of application section of each product classification report is included in the BBA certificate. The field of application provides specific limitations on thickness system of fixing, classification of substrate material and minimum air gap.

Reynobond 55PE riveted (grey/green Duragloss 5000) BS EN 13501-1 classification report is RA05-0005A (BBA00000048)

Reynobond FR ACM (Gold) BS EN 13501-1 classification report is RA06-0372 (BBA00000054)

Products out with these tested arrangements have no established reaction to fire performance, or in the case of the Reynobond 55 PE 4mm cassette system a substantially lower performance than the products referenced in Section 6.1 and 6.2 of the Agrément Certificate.

It should be noted that the only mention of a differing fire rating of the panels is in reference to differences in the colour of the panel surface coating. This is discussed in Section 6.4 of the Agrément Certificate quoted below:

28 Behavior in relation to fit (Clause 6.4)

6.4 These performances may not be achieved by other colours of the product and the designations of a particular colour should be confirmed by:

relation to fit England and Wales- Test or assessment in accordance with approved Document B, Appendix A, Clause 1 (Clause 6.4) Scotland- Test to conform with the Table to Annex 2C or Annex 2E of Regulation 9

Northern Ireland- Test or assessment by a UKAS accredited laboratory or independent consultant with

This does not apply to the Gold FR panel because classification report RA06-0372 states the field of application of the panel is "A $35\mu m$ Duragloss finishing coat". Therefore, only the thickness of the Duragloss paint, not the colour is relevant to the fire performance of the FR panel.

Section 6.4 of the BBA Agrément certificate would apply to the standard sample. The reason for this is classification report RA-0005A (BBA00000048) does state the field of application for the Reynobond 55PE riveted system is only for:

"Finishing coat: Duragloss 5000

Colour: grey/ green"

appropriate experience

Any other colour of Reynobond 55PE riveted system would therefore not be covered by the classification report RA-0005A (BBA00000048)

Any changes to the surface coating of the Metallic grey FR panel would also require that an additional test or assessment was made as there is no published allowance in BS 476-6 or BS476-7 that allows the results to be extended to other colours without a test or assessment.

29

Section 7 of the Agrément Certificate provides recommendations for 'Air and water penetration' Section 8 of the Agrément Certificate provides recommendations for the maintenance procedures for the panels.

Section 9 of the Agrément Certificate provides recommendations for the expected service life of the product in different conditions.

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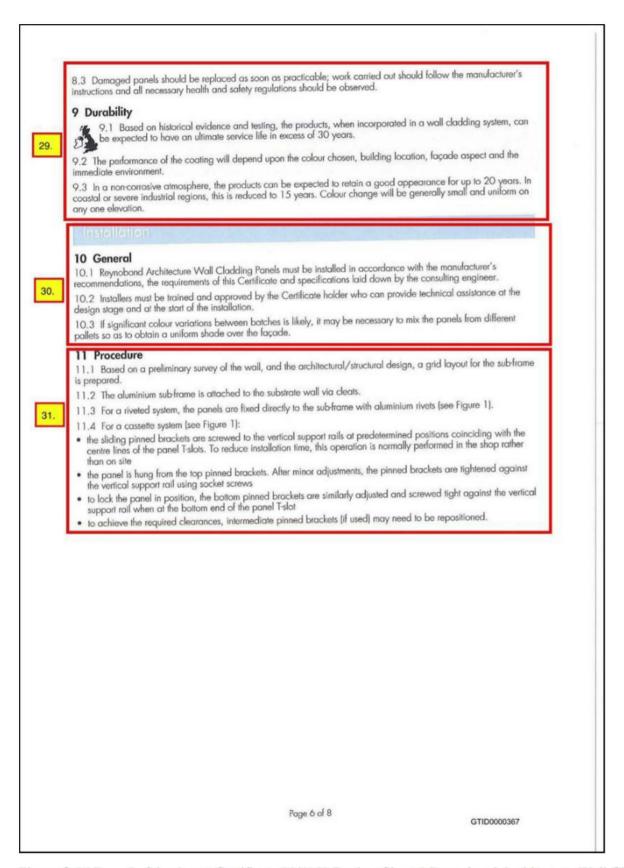


Figure O.16 Page 6 of Agrément Certificate 08/4150 Product Sheet 1 Reynobond Architecture Wall Cladding Panels (first issue 14/01/2008) – section numbering added by author

Table O.15: Description and review of content: Page 6 of Agrément Certificate No 08/4510 (14/01/2008)

My Section	Description of section of BBA Agrément Certificate 08/4150 Issue 1				
number					
30	Section 10 of the Agrément Certificate sets out the general requirements for installation.				
	Section 10.1 states:				
	"10.1 Reynobond Architecture Wall Cladding Panels must be installed in accordance with the				
	manufacturers recommendations, the requirements of this certificate and specifications laid down by				
	the consulting engineer"				
	No reference is provided to where the reader can obtain the manufacturers recommendations				
31	Section 11 of the Agrément Certificate sets out the installation procedure for the product.				
11 Procedure					
	Both the cassette fixing and riveted fixing are explained in detail.				
	Only the fire performance for the riveted system is referred to in the <i>Behavior in relation to fire</i>				
	section of the Agrément certificate.				
	I have found in Section O12 that the cassette system performs significantly worse in terms of reaction				
	to fire performance when compared to the riveted system. This is not stated on the Agrément				
	certificate.				

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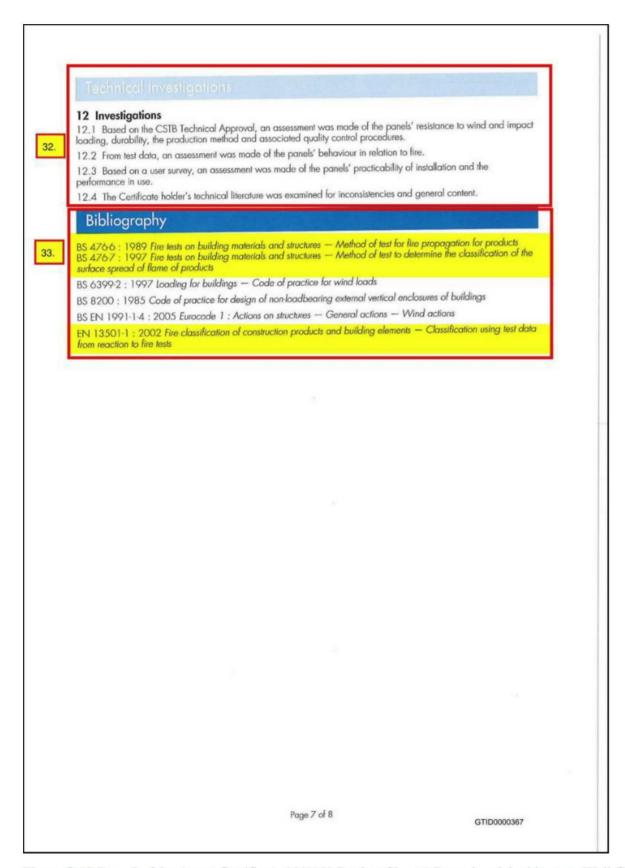


Figure O.17 Page 7 of Agrément Certificate 08/4150 Product Sheet 1 Reynobond Architecture Wall Cladding Panels (first issue 14/01/2008) – section numbering added by author

Table O.16 Description and review of content: Page 7 of Agrément Certificate No 08/4510 (14/01/2008)

My Section number	Description of section of BBA Agrément Certificate 08/4150 Issue 1				
32 12 Investigations	Section 12 of the Agrément Certificate states the technical investigations undertaken by BBA in the production of the certificate. These are quoted as:				
	12.1 Based on the CSTB Technical Approval, an assessment was made of the panels resistance to wind and impact loading, durability, the production method and associated quality control procedures.				
	12.2 From test data, an assessment was made of the panels reaction to fire. 12.3 Based on a user's survey, an assessment was made on the panels practicability of installation				
	and the performance in use. 12.4 The certificates holder's technical literature was examined for inconsistencies and general content.				
	No fire test reports are referred to anywhere on the BBA Certificate.				
	In Section 6.1 and 6.2 the classification of three specific products are provided. The BBA confirmed to the inquiry by letter (BBA00000001) that the fire performance on the BBA certificate was only based on assessment of the following products/test reports:				
	Grey/green 55 (also known as PE), B-S2, d0, via CSTB Report RA-0005A Gold FR, B-s1, d0, via CSTB Report RA06-0372				
	Metallic Grey FR, BS 476-6: 1989, Warrington Fire Research Report 132317 Metallic Grey FR, BS 476-7: 1997, Warrington Fire Research Report 132316				
	My review of these four tests and how they relate to "BBA certification for Reynobond Architecture Wall Cladding Panels" is provided in Section O10).				
33	The Bibliography Section of the Agrément Certificate states the British test standards BS 476-6 and BS 476-7 and European classification standard BS EN 13501-1 referenced in the certificate.				
	No reference is made to the actual test reports and actual classification reports that were used in the production of the Agrément Certificate.				
	Please refer to Section O9 of this Appendix where I have set out my investigations of the test reports used to create the BBA Agrément certificate.				

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GRENEELL TOWER INQUIRY

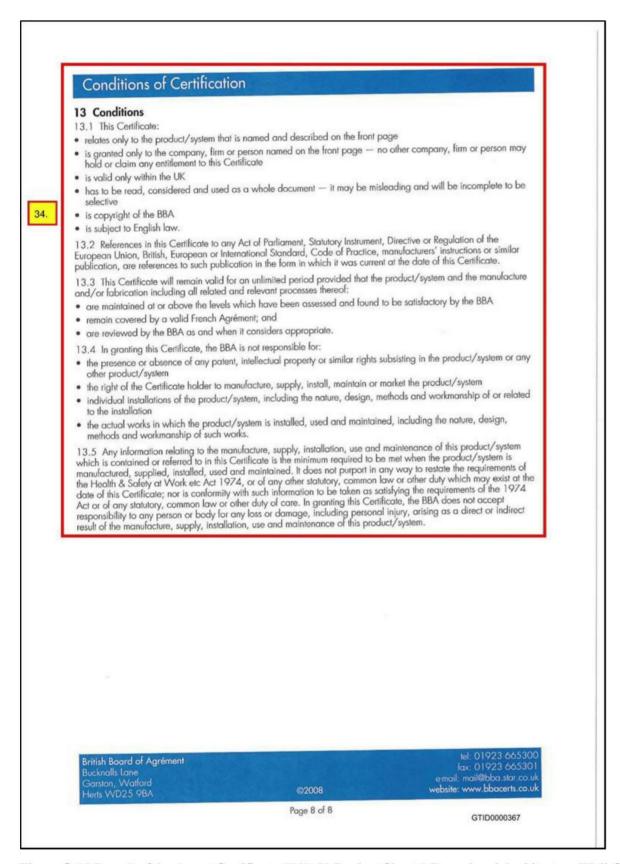


Figure O.18 Page 8 of Agrément Certificate 08/4150 Product Sheet 1 Reynobond Architecture Wall Cladding Panels (first issue 14/01/2008) – section numbering added by author

Table O.17 Description and review of content: Page 8 of Agrément Certificate No 08/4510 (14/01/2008)

My Section number	Description of section of BBA Agrément Certificate 08/4150 Issue 1				
34	Section 13 of the Agrément Certificate is titled Conditions of use of the certificate. Section 13.1 states: "13.1 This certificate Relates only to the product/ system named and described on the front page is granted only to the company, firm or person named on the front page-no other company, firm or person may hold or claim any entitlement to this certificate; is valid only in the UK; has to be read, considered and used as a whole document- it may be misleading and will be incomplete to be selective; is copyright of the BBA; is subject to English Law" The product named on the front page is Reynobond Architecture Wall Cladding Panels This implies that what is stated in the certificate is applicable to all Reynobond Architecture Wall Cladding Panels. The front page of the Agrément certificate states: "the panels are judged to meet the Class 0 requirements" In my summary in Section O15 I found that in fact that only three of the fourteen Reynobond Architecture Wall Cladding Panels that have been tested by Arconic can achieve Class 0. The company named on page one of the certificate (in the section I have numbered 1) is Alcoa Architectural Products. Arconic, as the company is called today, was created by Alcoa Inc.'s separation into two independent, publicly traded companies on 1 November 2016.				

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O18 Review of 2017 and 2017 amended BBA Agrément Certificate No 08/4510

- **O18.1.1** BBA issued a 2nd issue of BBA Agrément Certificate 08/4510 in 2017. The front page of this BBA Agrément Certificate states:
- **O18.1.2** "Behaviour in relation to fire- the panels have a B-s2, d0 or a B-s1, d0 reaction to fire classification to BS EN 13501-1, depending on the grade chosen"
- **O18.1.3** Table 3 of the 2017 issue of BBA Agrément Certificate 08/4510 refers to three panels:
 - a) ST with Grey/Green Duragloss 5000 coating
 - b) FR with a Gold Duragloss finish
 - c) FR with a metallic grey PVDF finish
- O18.1.4 These are the same three panels referenced in the 2008 issue of BBA Agrément Certificate 08/4510 as was confirmed in the BBA in a letter to the inquiry dated 19/07/2018 (BBA00000001) which states:

Fire

In the First Issue, the following fire performance was quoted, based on the associated test reports given below:

Grey/green 55 (also known as PE), B-S2, d0, via CSTB Report RA-0005A Gold FR, B-s1, d0, via CSTB Report RA06-0372 Metallic Grey FR, BS 476-6: 1989, Warrington Fire Research Report 132317 Metallic Grey FR, BS 476-7: 1997, Warrington Fire Research Report 132316

These data were carried over into the Second Issue. For the Amendment, only the data relating to the FR version were included.

- O18.1.5 The key differences noted from the 2008 1st issue of Agrément Certificate 08/4510(ARC00000368) and the 2017 2nd issue of Agrément Certificate 08/4510 (ARC00000415) are:
 - a) The original 2008 BBA Agrément Certificate 08/4510 is Class 0 whereas the 2017 2nd issue of BBA Agrément Certificate 08/4510 is for Class B only.
 - b) The 2008 version of the Agrément Certificate presented the riveted and cassette fixing systems in parallel. A detailed description and diagram of the cassette fixing system were previously included. The 2017 Agrément Certificate states: "The manufacturing and the use of the cassettes, the sub-frame and its attachment to the substrate wall are not covered by this Certificate"
- O18.1.6 The August 2017 Agrément Certificate (ARC00000415) was again reissued on 22 September 2017. I have compared this with the original 2017 certificate in Table O.19.

- O18.1.7 The key difference noted from the 2017 2nd issue of Agrément Certificate 08/4510 (ARC00000415) the 2017 2nd issue amendment of Agrément Certificate 08/4510 (ARC00000415) are that reference to the fire performance of the standard panel was removed.
- O18.1.8 In Table O.18, I have undertaken a full comparison of the 2008 (ARC0000368) and the August 2017 versions of Agrément Certificate 08/4150 (ARC00000415).
- O18.1.9 In Table O.19, I have undertaken a full comparison of the 2017 2nd issue of Agrément Certificate 08/4510 (ARC00000415) the 2017 2nd issue amendment of Agrément Certificate 08/4510 (ARC00000415).
- **O18.1.10** I have highlighted any significant changes which have occurred between the two versions of the certificate.
- **O18.1.11** Red text within the comparison tables represents the major differences between the two versions (2008 and 2017 or 2017 and 2017 amended version) of the Agrément Certificate.
- O18.1.12 Throughout I have focused on the text of the certificates that is relevant to fire performance, and so the recommendations of ADB Section 12 specifically. This is comprised of the general introductory and summary sections, as well as the more detailed sections of the certificate concerning the fire performance and mechanical fixings.
- O18.1.13 Other sections (e.g. durability, delivery and site handling, maintenance etc.) were not included in the table for conciseness.
- **O18.1.14** As I explained in Section O11, seven new reaction to fire classification reports were published for *Reynobond Architecture Wall Cladding panels* between the 2008 and 2017 issues of the Agrément certificates. None of these were referenced on the 2017 2nd issue of the BBA Agrément certificate.

Table O.18 Comparison of the 2008 (ARC00000368) and the August 2017 versions of Agrément Certificate 08/4150 (ARC00000415)

Agrément Certificate 08/4510 (2008)		Agrément Certificate 08/4510 (2017)		Significant changes
Section	Text	Section	Text	made in each section of the 2017 certificate
Product scope and summary of certificate – intro text	This Certificate of Confirmation relates to Reynobond Architecture Wall Cladding Panels, aluminium/polyethylene composite panels used to provide a decorative/protective façade over the external walls of buildings.	<no heading="" intro="" text="" –=""></no>	This Agrément Certificate Product Sheet relates to Reynobond Architecture Wall Cladding Panels, aluminium composite panels mechanically fastened to vertical aluminium rails, to provide an openjointed, back-ventilated and drained rainscreen cladding system for use over the external walls of new and existing buildings.	More detail included in description of system.
Key factors assessed	Practicability of installation – the panels are suitable for installation by cladding contractors providing they have undergone suitable training (see section 4)	Key factors assessed	<text removed=""></text>	Practicability of installation text removed

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Agrément Co	ertificate 08/4510 (2008)	Agrément Certi	Agrément Certificate 08/4510 (2017)	
Section	Text	Section	Text	made in each section of the 2017 certificate
Key factors assessed	Behaviour in relation to fire – in relation to the Building Regulations for reaction to fire, the panels may be regarded as having a Class O surface in England and Wales, and a 'low risk' material in Scotland (see section 6).	Key factors assessed	Behaviour in relation to fire – the panels have a B-s2, d0 or a B-s1, d0 reaction to fire classification to BS EN 13501-1:2007, depending on the grade chosen. The use of both panel grades is restricted to buildings up to 18 metres in height, unless specific conditions are met (see section 7).	 In this general statement, reaction to fire is as per the European classifications (Class B) only where previously British Standard classifications (Class O) were used. The specific test standard of classification (BS EN 13501-1:2007) is referenced in the 2017 version. A new statement on tall buildings is included (shown in red).
Key factors assessed	Air and water penetration – provided all joints between panels are adequately baffled, the cladding will minimise water entering the cavity. Any water collecting in the cavity will be removed by drainage and ventilation (see section 7)	Key factors assessed	Air and water penetration – the vertical and horizontal joints between the panels will minimise water entering the cavity. Any water collecting in the cavity will be removed by drainage and ventilation (see section 8).	Reference to the joints being baffled removed.
Regulations	[The Building Regulations 2000] Requirement: B4 (1) External fire spread Comment: The panels are judged to meet the Class O requirements.	Regulations	[The Building Regulations 2010] Requirement: B4 (1) External fire spread Comment: The products can contribute to satisfying this Requirement.	Less specific and change of language to 'contributes to' satisfying the regulation.

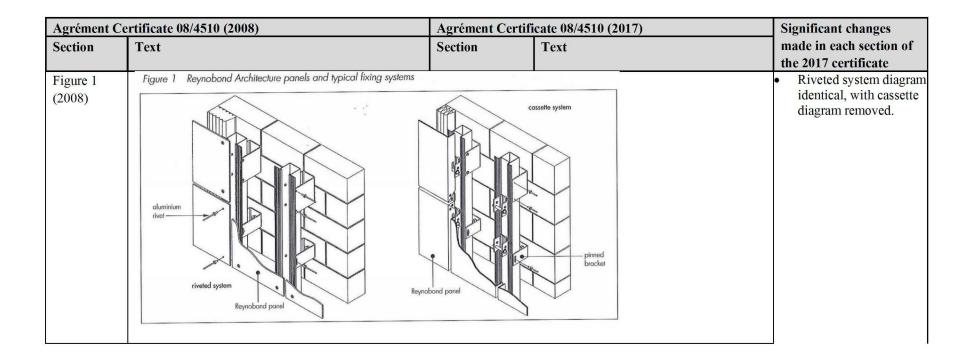
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Agrément	Certificate 08/4510 (2008)	Agrément Certif	icate 08/4510 (2017)	Significant changes
Section	Text	Section	Text	made in each section of the 2017 certificate
1.1	The Reynobond Architecture Wall cladding Panels comprise two 0.5mm thick aluminium alloy sheets (EN AW-3005, H46) bonded to either side of a core of low- density polyethylene (LDPE). The panels are available either plain edged (riveted system) or flanged (cassette system) to suit architectural requirements (see Figure 1). A Duragloss or PVDF coating available in various colours protects the exposed face. A polyester primer protects the unexposed face. The product is also available in a fire retardant grade (FR)	1.1	The Reynobond Architecture Wall cladding Panels are flat aluminium composite panels comprising two 0.5mm thick aluminium alloy sheets (EN AW-3005, H46 to BS EN 573-3:2013) bonded to either side of a low-density polyethylene (LDPE) core. The exposed face is coated with either a 28 µm layer of polyvinylidene difluoride paint (PVDF 70/30) or a 35 µm layer of polyester paint (Duragloss 5000), a polyester primer protects the unexposed face.	 Aluminium sheet European standard cited. Text on riveted & cassette fixing removed (shown in red). Specific paint products provided. Reference to fire retardant model moved to following section (red).
1.2	The panels are manufactured in thicknesses of 3mm, 4mm and 6mm and are available in 15 standard finishes.	1.2	The panels are available in two grades differentiated by the composition of the panel core, ST and FR with the nominal characteristics given in Table 1.	• Fire retardant model is included as one of the two grades available, rather than mentioned in 1.1 as 'also available'.

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Agrément	Certificate 08/4510 (2008)	Agrément Cer	rtificate 08/4510 (2017)	Significant changes
Section	Text	Section	Text	made in each section of the 2017 certificate
1.4	Plain edged panels are riveted directly to the aluminium sub-frame. Flanged panels are hung from the sub-frame using T-slots fitting onto pintle on the sub frame [1]. Flange widths can vary to suit design requirements (see Figure 1). [1] Not covered by this Certificate.	1.3 1.4	The panels are mechanically fastened to the aluminium sub-frame ⁽¹⁾ using aluminium rivets forming an open-jointed cladding system. Details of panel mountings are shown in figure 1. The flat panels can be formed into cassettes ⁽¹⁾ with different flange widths and fixed to the aluminium sub frame ⁽¹⁾ by means of T-slots fitting onto pins. (1) The manufacturing and the use of the cassettes, the sub-frame and its attachment to the substrate wall are not covered by this Certificate.	The 2017 version adds (shown red) an additional second reference to the footnote. and expands the footnote explaining cassette system is not covered by the certificate.
n/a	n/a	1.5	Items used with the system but outside the scope of this Certificate, include:	 New section with list of items not covered by the certificate. Insulation is specifically listed as non-combustible in this list.

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Agrément	Agrément Certificate 08/4510 (2008)		ertificate 08/4510 (2017)	Significant changes
Section	Text	Section	Text	made in each section of the 2017 certificate
Figure 1 (2017)	Figure 1 Typical fixing system for Reynobond Architecture Wall class	dding		

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Agrément (Certificate 08/4510 (2008)	Agrément Cer	rtificate 08/4510 (2017)	Significant changes
Section	Text	Section	Text	made in each section of the 2017 certificate
3.1	Reynobond Architecture Wall Cladding Panels can be incorporated in back ventilated and drained cladding systems. The cavity behind the cladding should be as wide as possible, with a minimum ventilation area of 10000mm² per metre run of cladding (see section 7). The ventilation openings should be suitably protected, or baffled, to prevent the ingress of birds, vermin and rain.	4.1 4.4	Reynobond Architecture Wall Cladding Panels are satisfactory for use in an open-jointed, back-ventilated and drained cladding system on the external walls of new and existing buildings of up to 18 metres in height (see section 7). Ventilation and drainage must be provided behind the panels. As the panels are open-jointed, the clear cavity between the back of the panel and the substrate wall (or insulation if installed on the substrate wall must be at least 50mm wide to ensure that a minimum ventilation area of 5000mm² per metre run of cladding is achieved. Joint gaps between the panels are between 10 and 20mm wide. All ventilation openings around the periphery of a cladding system incorporating the Reynobond Architecture Wall Cladding Panels should be suitably protected with mesh to prevent the ingress of birds, vermin and insects.	 New text introduced stating only satisfactory up to 18 metres in height (red). New text stating cavity depth must be at least 50mm (red). Minimum ventilation area reduced by half. New text stating joint gaps should be between 10 and 20mm (red). Closing ventilation openings changed from 'protection' or baffles, to mesh. Ventilation openings are clarified further i.e. stated to be around the edges of the system. Rain ingress no longer included.

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Agrément	Certificate 08/4510 (2008)	Agrément Certif	icate 08/4510 (2017)	Significant changes
Section	Text	Section	Text	made in each section of the 2017 certificate
3.4	The insulation behind the cladding should be suitably fixed to the supporting wall, and protected, to resist the forces of wind suction. Insulation should be of a rigid type (egg boards or batty). The ventilation pathway behind the cladding must not be allowed to become blocked nor the insulation dislodged where it may be vulnerable to wetting.	4.6	As the panels are open-jointed, any insulation installed behind the cladding must be suitably fixed to the supporting wall and protected to resist the forces of wind suction. Insulation should be of a rigid or semi-rigid type (e.g. boards) and where its performance could be diminished by moisture, a breather membrane should be provided over its outer face.	Text about moisture replaced with recommendation for a breather membrane to be provided.
3.6	All design aspects of the installation should be checked by a suitably qualified chartered engineer or other appropriately qualified person. For advice on specific construction details, e.g. flue pipe penetrations, the Certificate holder should be consulted.	4.2	It is important for designers, planner, contractors and/or installers to ensure that the installation of the panels is in accordance with the Certificate holder's instructions and the information given in this Certificate. All design aspects should be checked by a suitably qualified and experienced individual in accordance with the requirements of the relevant national Building Regulations and Standards. For advice on specific construction details, e.g. flue pipe penetrations, the Certificate holder should be consulted.	New text about importance of all stakeholders to ensure panels installed in accordance with instructions and certificate (shown red). Design check undertaken by a chartered engineer removed – only by 'suitably qualified' individual. Reference to the 'relevant national Building Regulations and Standards' added (red).

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Agrément C	Certificate 08/4510 (2008)	Agré	ément Certific	cate 08/4510 (2017)	Significant changes made in each section of	
Section	Text	Secti	ion	Text		
			***		the 2017 certificate	
6.1	6 Behaviour in relation to fire			-	The 2008 Agrément	
6.2 6.3 6.4 (2008)	6.1 A standard sample of the product, w to fire, achieved a classification of B-s2, of of the product, with a gold-coloured Dura B-s1, d0 in accordance with EN 13501: 2002				certificate stated the results obtained when the "fire retardant sample of	
	BS 4766: 1989, achieved a fire propagation achieved a Class 1 surface spread of flame.	6.2 A fire retardant sample of the product, with a metallic grey PVDF finish, when tested in accordance with BS 476-6: 1989, achieved a fire propagation index (I) of 0 and, when tested in accordance with BS 476-7: 1997, achieved a Class 1 surface spread of flame.				
	6.3 As a consequence of sections 6.1 and 6.2 relation to the Approved Document B of The Buil Technical Booklet E of The Building Regulations (defined in Annex 2C ⁽¹⁾ and Annex 2E ⁽²⁾ of The B side of the products may also be regarded as he	finish" was tested to BS 476-6 and BS476-7. A separate assessment was then made that these				
	6.4 These performances may not be achieved be colour should be confirmed by:	results demonstrate Class 0.				
	England and Wales — Test or assessment in acc	cordance with Approve	ed Document B, A	Appendix A, Clause 1	• In the 2017	
7.1 7.2 (2017)	7.1 Classifications for some colours of the Reynobond Architecture Wall Cladding Panels in accordance with BS EN 13501-1: 2007 or as defined in the national Building Regulations are shown in Table 3. These performances may not be achieved by all colours of the panels, and the classification of a particular colour should be confirmed by assessment or testing by a UKAS-accredited laboratory. Table 3 Fire classifications of panels				Agrément certificate the reaction to fire performance of the "FR with metallic grey PVDF coating" is just stated as Class 0 with no reference	
	Panels	Fire classification	Standard or	national Building Regulation	to the results to BS 476-6 and BS476-7.	
	ST with grey/green Duragloss 5000 coating	B-s2, d0		_	170 0 and BS 170 7.	
	FR with gold Duragloss 5000 coating	B-s1, d0		_		
	FR with metallic grey PVDF coating — Class 0 ⁽¹⁾ or 'low risk' ⁽²⁾					
	(1) As defined in Appendix A, paragraph 13(a) to the Appr section 3.4 of the Technical Booklet E to The Building Regu (2) As defined in section 2.E.3, table 2.20 of the Technical (Domestic) to The Building (Scotland) Regulations 2004 (as					
	7.2 The reverse side specification of the panel	7.2 The reverse side specification of the panels also has a Class 0 or 'low risk' classification.				

Agrément (Certificate 08/4510 (2008)	Agrément Co	ertificate 08/4510 (2017)	Significant changes
Section	Text	Section	Text	made in each section of the 2017 certificate
n/a		7.3	The products are not classified as being 'non-combustible' or of 'limited combustibility (non-combustible' in Scotland) and so their use is restricted to 18 metres in height unless a full scale fire test to either BS8414-1:2015 or BS8414-2:2015 has been conducted for the specific wall construction under consideration, and the other requirements of BRE Report BR135:2013 have been met.	 This is a new section that that states the panels are "restricted to 18 metres in height unless a full scale fire test to either BS8414-1:2015 or BS8414-2:2015 has been conducted for the specific wall construction under consideration, and the other requirements of BRE Report BR135:2013 have been met." No reference was made in the 2008 Agrément certificate to full scale fire testing or restricting the use of the panels to below 18m

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Agrément	Certificate 08/4510 (2008)	Agrément Certificate 08/4510 (2017)		Significant changes
Section	Text	Section	Text	made in each section of the 2017 certificate
6.5	For resistance to fire, the performance of a wall incorporating the product, can only be determined by tests from a suitably accredited laboratory, and is not covered by this certificate.	7.7	For resistance to fire, the performance of a wall incorporating the products can only be determined by tests from a suitably-accredited laboratory for the specific complete wall construction under consideration, and is not covered by this Certificate.	 This section references the resistance to fire of the panels. The 2017 Agrément certificate has added a phrase that phrase being specific about whole wall construction (shown red).
6.6	Cavity barriers should be incorporated behind the cladding, as required by the national Building Regulations, but should not block essential ventilation pathways. Particular attention should be paid to preventing the spread of fire from within a building breaching the cladding system through window and door openings.	7.8	To limit the risk of fire spread between floors in buildings subject to the national Building Regulations, fire barriers must be incorporated in the cavity behind the panels as required under these Regulations, but should not block essential ventilation pathways. Guidance on fire barriers can be found in BRE Report BR135:2013.	 'Cavity barriers' changed to 'fire barriers'. Specific reference to fire spread between floors. Barriers 'incorporated in the cavity', rather than 'behind the cladding'. New reference to BR135 and fire barriers
Procedure 11.3 11.4	For a riveted system, the panels are directly fixed to the sub-frame with aluminium rivets (see Figure 1). For a cassette system (see Figure 1): [hanging method described]	Procedure 13.3	For a riveted system, the panels are directly fixed to the sub-frame with aluminium rivets (see Figure 1).	Text in section unamended other than removing entirely the explanation of a cassette system.

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Agrément Certificate 08/4510 (2008)		Agrément C	ertificate 08/4510 (2017)	Significant changes	
Section	Text	Section	Text	made in each section of the 2017 certificate	
12.2	From test data, an assessment was made of the panels' behaviour in relation to fire.	14.2	An assessment was made of the panels' rigidity, durability and behaviour in relation to fire.	 'Test data' removed. General assessment only. 'Behaviour' replaced with 'rigidity, durability and behaviour'. 	

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O18.1.15 The August 2017 Agrément Certificate (ARC00000415) was again reissued on 22 September 2017, I explain the only changes made in Table O.19

Table O.19 Comparison of the 2017 2nd issue of Agrément Certificate 08/4510 (ARC00000415) the 2017 2nd issue amendment of Agrément Certificate 08/4510 (ARC00000415).

Agrément (Certificate 08/4510 (4 August 2017)	Agrément Certificate 08/4510 (22 September 2017)		Significant changes
Section	Text	Section	Text	from 2008 to 2017
Key factors assessed	Behaviour in relation to fire – the panels have a B-s2, d0 or a B-s1, d0 reaction to fire classification to BS EN 13501-1:2007, depending on the grade chosen. The use of both panel grades is restricted to buildings up to 18 metres in height, unless specific conditions are met (see section 7).	Key factors assessed	Behaviour in relation to fire — the panels have a B-s1, d0 reaction to fire classification to BS EN 13501-1: 2007 and are restricted for use on buildings up to 18 metres in height, unless specific conditions are met (see section 7).	• The B-s2, d0 result is removed (as this was the result achieved by the ST panel) Now only refers to B- s1, d0 classification for the FR panel.
Signatures	Date of Second issue: 4 August 2017 Originally certificated on 14 January 2008	Signatures	Date of Second issue: 4 August 2017 Originally certificated on 14 January 2008 Certificate amended on 22 September 2017 to remove ST panel.	Note associated with the removal of ST (standard core) panels from the certificate.
n/a	n/a	Additional Information	NHBC Standards 2017 In the opinion of the BBA, Reynobond Architecture Wall Cladding Panels, if installed, used and maintained in accordance with this Certificate, can satisfy or contribute to satisfying the relevant requirements in relation to NHBC Standards, Chapter 6.9 Curtain walling and cladding	New text added regarding the NHBC standards.

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Agrément	Agrément Certificate 08/4510 (4 August 2017)		Agrément Certi	ficate 08/4510 (22 September 2017)	Significant changes
Section	Text		Section	Text	from 2008 to 2017
1.2	The panels are available in two grades composition of the panel core, ST and characteristics given in Table 1.			The panels are available in the FR Grade with the nominal characteristics given in Table 1.	The fire retardant model is the only model stated as available in the amendment.
6.1 6.2 6.3 6.4 (2008)	7.1 Classifications for some colours BS EN 13501-1: 2007 or as defined in performances may not be achieved is should be confirmed by assessment Table 3 Fire classifications of panels	n the national Building Re by all colours of the pane	egulations are shown in Table Is, and the classification of a p	3. Inese	Test results of standard panels removed from amendment.
	Panels	Fire classification	Standard or national Build	ng Regulation	
	ST with grey/green Duragloss 5000 coating	B-s2, d0	_		
	FR with gold Duragloss 5000 coating	B-s1, d0	_		
	FR with metallic grey PVDF coating	-	Class O(1) or 'low r	sk' ⁽²⁾	
	(1) As defined in Appendix A, paragraph 13(a) to the Appr section 3.4 of the Technical Booklet E to The Building Regu (2) As defined in section 2.E.3, table 2.20 of the Technical (Domestic) to The Building (Scotland) Regulations 2004 (as 7.2 The reverse side specification of the panel	ulations (Northern Ireland) 201 Handbook (Non-domestic) and s amended).	2 (as amended). d in table 2.8, section 2.B.3 of the Tec		

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Agrément Certificate 08/4510 (4 August 2017)			Agrément Certificate 08/4510 (22 September 2017)		Significant changes
Section	Text		Section	Text	from 2008 to 2017
7.1 7.2 (2017)	7 Behaviour in relation to fire				
	7.1 Classifications for some colors BS EN 13501-1: 2007 or as define performances may not be achieved should be confirmed by assessment.				
	Table 3 Fire classifications of panels				
	Panels	Fire classification	Standard or natio	nal Building Regulation	
	FR with gold Duragloss 5000 coating	B-s1, d0	-1 -11		
	FR with metallic grey PVDF coating		Class 0 ⁽¹⁾	or 'low risk' ⁽²⁾	
	(1) As defined in Appendix A, paragraph 13(a) to the A section 3.4 of the Technical Booklet E to The Building F (2) As defined in section 2.E.3, table 2.20 of the Techn (Domestic) to The Building (Scotland) Regulations 2004				
	7.2 The reverse side specification of the pa				

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O19 Available fire test evidence for Reynobond wall panels and its application to Grenfell Tower

O19.1.1 Table O.20 below summarises the provisions made through Diagram 40 of ADB 2013 for the fire performance of the external surfaces of walls.

Table O.20 Performance of the external surface of a building required by Diagram 40 of ADB 2013

Diagram 40 [note boundary condition]	National material classification	European material classification
Any dimension over 18m; boundary more than 1000mm from relevant boundary	Class 0 (limited combustibility to BS 476-4 or BS 476-11 or Class A2 or better by virtue of Table A7 or I<12 i1<6 BS 476-6 and BS 476-7 class 1 together)	Class B-s3, d2 or better (tested to one or more of BS EN ISO 1182, BS EN ISO 1716; BS EN 13823; BS EN ISO 11925-2 as required by BS EN 13501-1)
Up to 18m above ground level	Index (I) not more than 20 (to BS 476-6 only)	Class C-s3, d2 or better (tested to one or more of BS EN ISO 1182, BS EN ISO 1716; BS EN 13823; BS EN ISO 11925-2 as required by BS EN 13501-1)

- O19.1.2 At the time of the Grenfell Tower refurbishment 2012 2016 the relevant BBA Agrément certificate for Reynobond Architecture Wall Cladding Panels was the 2008 1st issue.
- O19.1.3 As I explained in Section O8 Product conformity certification schemes are referenced in ADB as a method of demonstrating the performance of a product or material against the stated requirements for compliance.
- O19.1.4 The panels installed on Grenfell Tower were Reynobond 55PE; with smoke silver/ pure white Duragloss surface coating (depending on the location on the tower); hung on brackets as part of a bespoke cassette system; fitted in conjunction with a Class D substrate (Celotex RS 5000 and, in limited placed, Kingspan Kooltherm K15). This panel type is not any of the three panels referenced on the 2008 first issue Agrément certificate 08/4510. Please refer to Section O9 for more information on the evidence used to produce the 2008 Agrément Certificate.
- O19.1.5 As I have explained in Section O11, no Reynobond 55 PE cassette system has ever achieved better than Class E to BS EN 13501-1. A Class E material is noncompliant with Diagram 40 and clause 12.6 of ADB for use anywhere on any building with a height more than 18m above ground.
- O19.1.1 Between 2005 and 2014 the Reynobond 55PE riveted system was classified as Class B (when installed in conjunction with a Class A2 or better substrate).

This would therefore have been compliant for use above and below 18m in a building with a height greater than 18m.

- O19.1.2 As stated by Clause 6.3 of BS EN 13501-1 however:
 - "Taking into account the role of the substrates and the fixings on the potential contribution of a product to a fire, a single product may be classified in different classes as a function of its end use application. If only one end use is envisioned, only that end use shall be tested."
- O19.1.3 Therefore, the change in substrate and fixing method from the riveted system to the system as installed in Grenfell entirely invalidates the results of the tests.
- O19.1.4 After December 2014 the riveted system was downgraded to Class C (when installed in conjunction with a Class A2 or better substrate) this downgrade in performance occurred on 04/12/2014 three months prior to the first purchase order for Reynobond 55PE for use Grenfell tower on 18/03/2015 (ARC000000011).
- O19.1.5 I also explained in Section O10 only five Reynobond panels have achieved Class 0. These are Reynobond RB160; Reynobond 33 (2mm, 3mm and 4mm overall thicknesses); and Reynobond FR 'Metallic grey PVDF finish'. None of these are relevant for the compliance of the ACM rainscreen cladding system installed on Grenfell tower. Please refer to Section 11 where I discuss the differences between these panels and the panels used on Grenfell Tower further.
- O19.1.6 I therefore find that neither the 2008 1st issue of Agrément Certificate 08/4510 nor any other evidence disclosed by either BBA or Arconic demonstrates that the ACP rainscreen system installed on Grenfell Tower was compliant with the requirements of diagram 40 of ADB 2013.
- O19.1.7 I have explained in detail in Appendix E that the ACP rainscreen system installed as an assembly has no relevant test evidence to meet the performance criteria given in the BRE Report Fire performance of external thermal insulation for walls of multi storey buildings (BR 135) for cladding systems using full scale test data from BS 8414-1:2002 or BS 8414-2:2005.
- O19.1.8 I conclude therefore the Reynobond 55PE cassette system installed on Grenfell Tower was entirely non-compliant with the functional requirement of the Building Regulations B4(1).