

PD CEN/TS 16459:2013



BSI Standards Publication

External fire exposure of roofs and roof coverings — Extended application of test results from CEN/TS 1187

bsi.

...making excellence a habit.
AVA Documents™
Document Sharing Hub

National foreword

This Published Document is the UK implementation of CEN/TS 16459:2013.

The UK participation in its preparation was entrusted to Technical Committee FSH/22/-/8, Fire resistance tests for external fire exposure for roofs.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

© The British Standards Institution 2013. Published by BSI Standards Limited 2013

ISBN 978 0 580 77465 2

ICS 13.220.50; 91.060.20

Compliance with a British Standard cannot confer immunity from legal obligations.

This Published Document was published under the authority of the Standards Policy and Strategy Committee on 31 December 2013.

Amendments issued since publication

Date	Text affected
------	---------------

TECHNICAL SPECIFICATION
SPÉCIFICATION TECHNIQUE
TECHNISCHE SPEZIFIKATION

CEN/TS 16459

December 2013

ICS 13.220.50; 91.060.20

English Version

**External fire exposure of roofs and roof coverings - Extended
application of test results from CEN/TS 1187**

Exposition des toitures et des couvertures à un feu
extérieur - Application étendue des résultats d'essai de la
CEN/TS 1187

Beanspruchung von Bedachungen durch Feuer von außen
- Erweiterter Anwendungsbereich der Prüfergebnisse aus
CEN/TS 1187

This Technical Specification (CEN/TS) was approved by CEN on 14 April 2013 for provisional application.

The period of validity of this CEN/TS is limited initially to three years. After two years the members of CEN will be requested to submit their comments, particularly on the question whether the CEN/TS can be converted into a European Standard.

CEN members are required to announce the existence of this CEN/TS in the same way as for an EN and to make the CEN/TS available promptly at national level in an appropriate form. It is permissible to keep conflicting national standards in force (in parallel to the CEN/TS) until the final decision about the possible conversion of the CEN/TS into an EN is reached.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

Contents

Page

Foreword.....	5
Introduction	6
1 Scope	8
2 Normative references	8
3 Terms and definitions	9
4 Product and end-use application parameters for roof coverings/roof systems.....	11
5 Extended application.....	12
5.1 General principles for extended application for roof coverings/roof systems	12
5.2 Extended application by additional tests	13
5.2.1 Additional tests on one product/end-use application parameter	13
5.2.2 Additional tests on several product/end-use application parameters	13
5.3 Extended application by calculation.....	14
5.4 Guidance on the use of historical test data	14
6 Influence of product parameters and end-use application parameters on external exposure to fire test performance.....	14
7 General guidance to the annexes for Application Rules	18
Annex A (normative) Application rules for test results from CEN/TS 1187 test 1, per product group and/or components	21
A.1 General.....	21
A.2 General rules, valid for every product within a product group and/or component	23
A.3 Product groups	24
A.3.1 Slates and tiles.....	24
A.3.1.1 slates and tiles, non-metallic.....	24
A.3.1.2 Metallic tiles.....	26
A.3.2 Small elements.....	27
A.3.2.1 General.....	27
A.3.2.2 Bitumen shingles	27
A.3.2.3 Miscellaneous small elements	29
A.3.3 Reinforced bitumen sheets.....	29
A.3.4 Plastic and rubber sheets	31
A.3.5 Roof-lights	33
A.3.6 Glazing systems.....	34
A.3.7 Profiled non-metallic sheets.....	34
A.3.7.1 Profiled fibre cement sheets.....	34
A.3.7.2 Profiled bitumen based sheets.....	34
A.3.7.3 Miscellaneous profiled non-metallic sheets	34
A.3.8 Composite metallic sandwich panels.....	34
A.3.9 Profiled metal sheets.....	34
A.3.10 Flat metal sheets.....	35
A.3.11 Liquid applied roof waterproofing kits	35
A.3.12 Miscellaneous	35
A.4 Components	35
A.4.1 Adhesive	35
A.4.2 Separating layer.....	36
A.4.3 Insulation layer.....	38
A.4.4 Vapour Barrier.....	41
A.4.5 Supporting deck.....	43
Annex B (normative) Application rules for test results from CEN/TS 1187 Test 2, per product group.....	45
B.1 General.....	45

B.2	General rules, valid for every product within a product group	46
B.3	Product groups	47
B.3.1	Slates and tiles	47
B.3.1.1	Non-metallic slates and tiles (reaction-to-fire-class A1 to A2-s3 d2 according to EN 13501-1)	47
B.3.1.2	Metallic tiles	49
B.3.2	Small elements (reaction-to-fire-class B-s1,d0 to F according to EN 13501-1)	49
B.3.2.1	General	49
B.3.2.2	Bitumen shingles.....	49
B.3.2.3	Miscellaneous small elements	50
B.3.3	Reinforced bitumen sheets	51
B.3.4	Plastic and rubber sheets.....	53
B.3.5	Roof-lights.....	54
B.3.6	Glazing systems	54
B.3.7	Profiled non-metallic sheets.....	54
B.3.7.1	Profiled fibre cement sheets	54
B.3.7.2	Profiled bitumen based sheets	55
B.3.7.3	Miscellaneous profiled non-metallic sheets	55
B.3.8	Composite metallic sandwich panels.....	55
B.3.9	Profiled metal sheets	55
B.3.10	Flat metal sheets	55
B.3.11	Liquid applied waterproofing kits.....	55
B.3.12	Miscellaneous	55
Annex C (normative)	Application rules for test results from CEN/TS 1187 test 3, per product group.....	56
C.1	General	56
C.2	General rules, valid for every product within a product group	58
C.3	Product groups.....	59
C.3.1	Slates and tiles	59
C.3.1.1	Non-metallic slates and tiles (reaction-to-fire-class A1 to A2 – s3 d2, according to EN 13501-1)	59
C.3.1.2	Metallic Tiles	61
C.3.2	Small elements (reaction-to-fire-class B – s1, d0 to F; according to EN 13501-1)	61
C.3.2.1	General	61
C.3.2.2	Bitumen Shingles	61
C.3.2.3	Miscellaneous small elements	63
C.3.3	Reinforced bitumen sheets	64
C.3.3.1	General	64
C.3.3.2	Typical roof waterproofing system.....	64
C.3.4	Plastic and rubber sheets.....	69
C.3.4.1	General	69
C.3.4.2	Typical roof waterproofing system.....	70
C.3.5	Roof-lights.....	75
C.3.6	Glazing systems	76
C.3.7	Profiled non-metallic sheets.....	76
C.3.7.1	Profiled fibre cement sheets	76
C.3.7.2	Profiled bitumen-based Sheets.....	76
C.3.7.3	Miscellaneous profiled non-metallic sheets	76
C.3.8	Composite metallic sandwich panels.....	76
C.3.9	Profiles metal sheets.....	76
C.3.10	Flat metal sheets	77
C.3.11	Liquid applied roof watering kits	77
C.3.12	Miscellaneous	77
Annex D (normative)	Application rules for test results from CEN/TS 1187 Test 4 for individual product groups	78
D.1	General	78

D.2	General EXAP rules for CEN/TS 1187 test 4, valid for every product within a product group	80
D.3	Product groups	81
D.3.1	Slates and tiles	81
D.3.1.1	Non-metallic slates and tiles	81
D.3.1.2	Metallic slates and tiles	84
D.3.2	Small elements	84
D.3.2.1	General	84
D.3.2.2	Bitumen shingles	84
D.3.2.3	Miscellaneous small elements, e.g. plastic tiles	87
D.3.3	Reinforced bitumen sheets (same as bitumen shingles)	88
D.3.4	Plastic and rubber sheets	91
D.3.5	Roof-lights	94
D.3.6	Glazing systems	94
D.3.7	Profiled non-metallic sheets	94
D.3.7.1	Profiled fibre cement sheets	94
D.3.7.2	Profiled bitumen based sheets	94
D.3.7.3	Miscellaneous profiled non-metallic sheets	94
D.3.8	Composite (including metal faced) sandwich panels	95
D.3.9	Profiled metal sheets	95
D.3.10	Flat metal sheets	95
D.3.11	Liquid applied roof water-proofing kits	95
D.3.12	Miscellaneous	95
	Bibliography	96

Foreword

This document (CEN/TS 16459:2013) has been prepared by Technical Committee CEN/TC 127 “Fire safety in buildings”, the secretariat of which is held by BSI.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to announce this Technical Specification: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

Fire tests on individual roofs/roof coverings are carried out in accordance with CEN/TS 1187. The results from these tests can then be classified in accordance with EN 13501-5.

In order to derive classifications for similar roofs/roof coverings based on the data determined from CEN/TS 1187, additional rules are needed.

These rules are direct application rules or extended application rules. Rules within the direct field of application of test results are given in EN 13501-5 (these rules correspond to CEN/TS 1187).

This document outlines a procedure to develop rules for extended application and lists application rules which have already been developed in Annexes A to D for test methods 1 to 4 from CEN/TS 1187, where Annex A is related to test method 1, Annex B relates to test method 2, and so forth.

Annexes A to D have been developed based upon the available information and the roof systems in the market. The objective of this document is to provide a methodology for optimising the number of tests required to cover the maximum field of application.

Whilst special attention has been focused on roofs typically comprising a support deck/substrate, vapour barrier, insulation layer(s), membranes/roof coverings, there will be occasions when other separating layers or intermediate layers will be needed to satisfy other roof characteristics. These layers should be included in the consideration of the roof/the roof covering being classified.

NOTE Tests 1, 3 and 4 are carried out on a roof construction, whereas test 2 is done on a roof covering with its substrate below.

The decision route from the diagram below shows ways to determine which procedure to follow.

The solid line is compulsory, whereas the dotted line is optional.

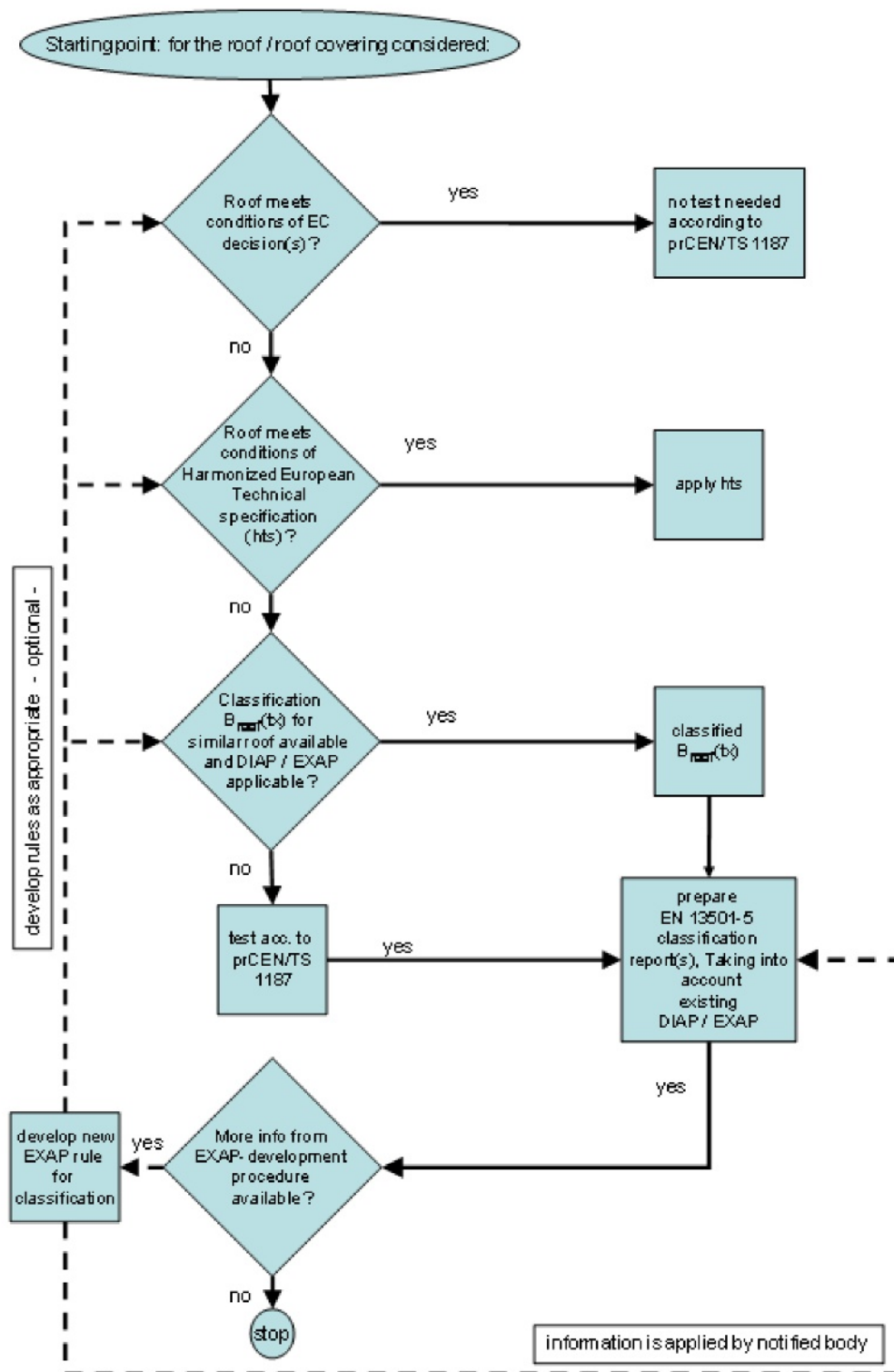


Figure 1 – Decision process on classification of roofs/roof coverings

1 Scope

This Technical Specification gives guidance on the process and development of extended fields of application using test results obtained from CEN/TS 1187 test 1 to 4, and included in test reports, and other relevant information in order to evaluate and classify the performance of roofs/roof coverings. This Technical Specification provides a methodology to consider the possible effect(s) on classification to EN 13501-5 from single or multiple changes to the individual product and end-use application parameters of the roof/roof covering.

Specific application guidance is given in Annexe A, Annex B, Annex C and Annex D for CEN/TS 1187 tests 1 to 4 respectively.

2 Normative references

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

CEN/TS 1187:2012, *Test methods for external fire exposure to roofs*

EN 490, *Concrete roofing tiles and fittings for roof covering and wall cladding - Product specifications*

EN 492, *Fibre-cement slates and fittings - Product specification and test methods*

EN 494, *Fibre-cement profiled sheets and fittings - Product specification and test methods*

EN 506, *Roofing products of metal sheet - Specification for self-supporting products of copper or zinc sheet*

EN 508-1, *Roofing products from metal sheet - Specification for self-supporting products of steel, aluminium or stainless steel sheet - Part 1: Steel*

EN 508-2, *Roofing products from metal sheet - Specification for self-supporting products of steel, aluminium or stainless steel sheet - Part 2: Aluminium*

EN 508-3, *Roofing products from metal sheet - Specification for self-supporting products of steel, aluminium or stainless steel sheet - Part 3: Stainless steel*

EN 534, *Corrugated bitumen sheets - Product specification and test methods*

EN 544, *Bitumen shingles with mineral and/or synthetic reinforcements - Product specification and test methods*

EN 1013 (all parts), *Light transmitting profiled plastic sheeting for single skin roofing*

EN 1304, *Clay roofing tiles and fittings - Product definitions and specifications*

EN 1849-2, *Flexible sheets for waterproofing - Determination of thickness and mass per unit area - Part 2: Plastic and rubber sheets*

EN 1873, *Prefabricated accessories for roofing - Individual roof lights of plastics - Product specification and test methods*

EN 12326-1, *Slate and stone products for discontinuous roofing and cladding - Part 1: Product specification*

EN 13162, *Thermal insulation products for buildings - Factory made mineral wool (MW) products - Specification*

EN 13163, *Thermal insulation products for buildings - Factory made expanded polystyrene (EPS) products - Specification*

EN 13164, *Thermal insulation products for buildings - Factory made extruded polystyrene foam (XPS) products - Specification*

EN 13165, *Thermal insulation products for buildings - Factory made rigid polyurethane foam (PU) products - Specification*

EN 13166, *Thermal insulation products for buildings - Factory made phenolic foam (PF) products - Specification*

EN 13167, *Thermal insulation products for buildings - Factory made cellular glass (CG) products - Specification*

EN 13169, *Thermal insulation products for buildings - Factory made expanded perlite board (EPB) products - Specification*

EN 13501-5:2005+A1:2009, *Fire classification of construction products and building elements - Part 5: Classification using data from external fire exposure to roofs tests*

EN 13707, *Flexible sheets for waterproofing - Reinforced bitumen sheets for roof waterproofing - Definitions and characteristics*

EN 13956, *Flexible sheets for waterproofing - Plastic and rubber sheets for roof waterproofing - Definitions and characteristics*

EN 14351-1, *Windows and doors - Product standard, performance characteristics - Part 1: Windows and external pedestrian doorsets without resistance to fire and/or smoke leakage characteristics*

EN 14509, *Self-supporting double skin metal faced insulating panels - Factory made products - Specifications*

EN 14782, *Self-supporting metal sheet for roofing, external cladding and internal lining - Product specification and requirements*

EN 14783, *Fully supported metal sheet and strip for roofing, external cladding and internal lining - Product specification and requirements*

EN 14963, *Roof coverings - Continuous rooflights of plastics with or without upstands - Classification, requirements and test methods*

3 Terms and definitions

For the purposes of this document, the relevant terms and definitions given in CEN/TS 1187:2012 and EN 13501-5:2005+A1:2009, together with the following apply.

3.1

adhesive

organic or inorganic material e.g. polyurethane-based, bitumen-based, dispersion adhesive, glue which is used to attach the surfaces of two or more products/components

Note 1 to entry: Adhesives or glues of the kind mentioned above could be applied separately and will thus form a separate layer within the roof built-up, while factory pre-applied adhesives or glues are part of the specific product/component forming a layer.

3.2

'as tested'

this term is used when an application rule does not exist for a specific parameter

3.3

binder content

binder content is the amount of binding material (by % weight or % volume) within the product. The binder could be inorganic or organic in nature. In the case of the latter, it will add a fire load to the product containing the binder, and will be considered within the classification of products or product groups. Within the substructure of products like mineral wool insulation products, particular felt layers, some tiling products, and some multi layer weather-proofing surface products the binder will typically be cured

Note 1 to entry: The definition of this term does not apply to compound waterproofing sheets

3.4

direct field of application of test results

outcome of a process (involving the application of defined rules) whereby a test result is deemed to be equally valid for variations in one or more of the product properties and/or intended end use applications

3.5

end-use application parameter

aspect of the mounting and fixing arrangement of a product reflecting/simulating its end-use application (e.g. type of substrate, fixing method, type and position of joints) which can affect the fire performance

3.6

extended field of application of test results

outcome of a process (involving the application of defined rules that can incorporate calculation procedures) that predicts, for a variation of a product property and/or its intended end use application(s), a test result on the basis of one or more test results to the same test standard

3.7

product group

range of roof products within defined limits of variability (defined by the manufacturer or a Technical Specification) of the product parameters and, if relevant, end-use parameters, for which the reaction of the roof in end use application to external fire exposure remains unchanged (does not get worse)

Note 1 to entry: As Clause 7 is concerned, product groups also include components for Annex A.

3.8

product parameter

aspect of a product (for example thickness, composition, density) which may vary and which can have an influence on the product's fire performance

3.9

roof pitch

inclination of the roof surface to the horizontal

Note 1 to entry: In the case of a tiled roof, the roof pitch is the rafter pitch since the tile pitch will be a few degrees lower due to the overlaps.

3.10

separating layer

functional layer within a roof construction that is typically used to separate layers that do not match for reason of chemical incompatibility, or it is needed as underlay, where applicable

Note 1 to entry: Separating layers are products such as fire protective layers (e.g. glass fleece); under-slating (e.g. polymeric sheet; polymeric sheet reinforced by polymeric fibres; bituminised reinforced sheets); and others such as bituminous kraft paper; aluminium sheet with covering (organic); and similar.

3.11

surfacing

surface finish applied either during construction or prefabricated as part of the surfacing layer

Note 1 to entry: Surfacing may include materials such as lacquer, UV-protective coating, slate chips, ceramic-based granules, products for factory-made lamination with glass-fleece or bituminous roofing felt, or similar.

3.12

test result

outcome of a testing process and its associated procedures detailed within a specific test standard (which can include some processing of the results from the testing of a number of specimens)

Note 1 to entry: A test result is expressed in terms of one or more fire performance parameter(s).

3.13

type of product

products belonging to a subset of a product family (as defined in Guidance Paper G), grouping together products having a similar nature (e.g. polymer modified bituminous roofing felts, single-ply PVC membranes, cement based fibre boards, profiled metal roof sheets) and behaviour (e.g. products that melt or shrink under flame attack, or decompose)

3.14

factory (pre-) applied adhesive

layer of organic or inorganic material e.g. polyurethane-based, bitumen-based, that is factory-applied to products, such as to assist the installation, e.g. self-adhesion

4 Product and end-use application parameters for roof coverings/roof systems

Table 1 is the list of product parameters and end-use application parameters that shall be taken into account in Annexes A to D in making application rules. If other parameters are found to be relevant for a given product, then these too should be considered in accordance with the principles of Clauses 5 and 6.

Relevant information may be contained in other documents, such as harmonized Technical Specifications. This information may be needed to define the end-use application parameters for the particular product (or product group) that could influence the classification results in the external fire exposure tests to CEN/TS 1187 Methods 1 to 4.

Table 1 — List of product parameters and end-use applications parameters

PRODUCT PARAMETERS FOR ROOF COVERINGS/ROOF SYSTEMS
Type of product
Product composition
Reaction-to-fire classification according to EN 13501-1
Colour (consider also pigments)
Binder content
Thickness
Mass per unit area
Density

Geometry (structure, shape and constitutive layers of multi-layer product)
Air gaps (perpendicular to surface)
Joints
Surfacing on lower side (backing)
Surfacing on upper side (facing)
Factory (pre-)applied adhesive
Reinforcement: mass per unit area, type of material; position within layer etc.

END-USE APPLICATION PARAMETERS FOR ROOF COVERINGS/ROOF SYSTEMS
<i>End-use parameters-general</i>
Number of layers (details see for each product)
Order of layer in the roofing system
Orientation of each layer
<i>End-use parameters-support</i>
Roof pitch
Substrate or under-laying construction details
Application on existing roofs ("renovation")
Spacing of frame elements (non-standard-support)
<i>End-use parameters-mounting and fixing</i>
Mounting method
Fixing method (e.g. adhesive)
Distribution, Spacing and type of mechanical fixing (fasteners)
Joints
Air gaps

5 Extended application

5.1 General principles for extended application for roof coverings/roof systems

There are three options to establish rules for extended application. These are:

- by use of additional test results which, together with the initial test result, enables consideration of a larger range of one or several product parameters and end-use application parameters;
- by use of tests results in combination with application of calculations methods (compare with 5.3) relating the product and end-use application parameters to the fire performance;
- by use of historical data, see 5.4, and other relevant information e.g. data from previous tests.

NOTE Extended application rules are used to develop worst case 'build ups'. Standard 'build ups' are identified in the relevant product standards taking into account worst case 'build ups', e.g. where no specific test information is available, indicative testing is used to establish the worst case scenario.

5.2 Extended application by additional tests

5.2.1 Additional tests on one product/end-use application parameter

It is assumed that only one product/end-use application parameter changes and the other parameters remain constant and that there is an initial test result on one value of the product/end-use application parameter.

If the relationship between the fire performance and the product/end-use application parameter is unknown, the tests will be carried out on several variants of the parameter to assess the complete range of the product/end-use application parameter on which the extended application is required and to know this relationship.

From this relationship it will be possible to predict the different levels of fire performance as a function of the levels of the product/end-use application parameter and therefore the level of classification.

If there is an established rule about the relationship between the product/end-use parameter and the fire performance (direct application) of a product or product group, it will be possible to optimize the additional tests, as a function of the classification result which is expected, as follows:

- If the fire performance of the roof is known to be affected by the change of a product/end-use application parameter(s) in a known direction, the test can be carried out on the parameter, the variation of which is known to give the lowest (worst) performance in this instance for this product and/or its end use-application, without changing the classification level.
- If it is known that the fire performance changes with a change of the product/end-use application parameter but the relationship is not known, the number of additional tests shall be sufficient to define the relationship (sufficient means that the relationship is adequately defined over the intended range of parameter variation). For most relationships, this will require at least two additional test results.

When a relationship has been established between the fire performance and a product/end-use parameter, it shall be used to determine the classification of any product or product group covered by this relationship.

5.2.2 Additional tests on several product/end-use application parameters

When more than one roof covering product parameter or end-use application parameter is to change at the same time, and if the types of relationship are not known, it will be necessary to assess the tests needed according to an experimental plan or an empirical approach. Then a more detailed series of tests shall be performed to determine the relationship between these parameters, the external fire exposure performance, and the resultant classification.

The study of this relationship shall be carried out from direct tests according to CEN/TS 1187 Methods 1, 2, 3 or 4 and Classification to EN 13501-5.

If the types of relationship between the fire performance and the product/end use application parameter are not known, a series of tests will be necessary. The test series can be split into parts to get firstly a result on the type of the relationship (qualitative result) and secondly information on the quantitative relationship, if required.

In all cases the limits of field of application shall be complied with. When a limited approach is used, it has to be kept in mind that the resulting relationships are only valid for the particular limits of the other parameters that were kept constant in the test.

NOTE Results from other test methods can be used to determine which product parameter needs to be tested in European Standard methods. Reports on extended application are given in accordance with prEN EXAPRPT – Extended application reports on the fire performance of construction products and building elements.

5.3 Extended application by calculation

For extended application by calculation, it is necessary to have (an) established calculation method(s) shown to be valid for the intended range of parameter(s). This requires the calculation method to be validated in accordance with 5.2.1 or 5.2.2.

NOTE So far, there are no verified and validated published calculation methods that have been established and agreed for use.

5.4 Guidance on the use of historical test data

When undertaking extended application (EXAP) a good understanding of the product performance in fire is required. Some of this information will be known from the EN tests according to CEN/TS 1187, however for some products there shall exist a record of test results against previous standards.

NOTE Under certain circumstances this information can be used as part of the EXAP procedure. This will help to reduce the number of new tests which are required.

In applying these principles, the following conditions shall be met:

- EXAP is only undertaken by a Notified Body;
- Primary data shall be obtained from the relevant CEN/TS 1187 Test 1 to 4.

6 Influence of product parameters and end-use application parameters on external exposure to fire test performance

In Clause 4 of this document, Table 1 shows the list of product and end-use application parameters that can influence the results from external fire exposure tests to roofs.

The following is an analysis of how each of these parameters can influence the test result for each of the four different CEN/TS 1187 test methods, assuming that all other parameters are kept unchanged.

The fire testing in different European countries has historically been based on different exposure to burning brands, to radiant exposure and to wind, as shown in Table 2.

Individual European countries will require fire test 1, 2, 3 or 4 depending on these national regulatory requirements. There is no ranking in the order of test methods.

Table 2 — Exposure conditions for CEN/TS 1187 tests 1 to 4

Use CEN/TS 1187 test 1, 2, 3 or 4			
Burning brands	Burning brands and wind	Burning brands and wind and radiant heat	Burning brands and wind and radiant heat, in two stages
Test 1	Test 2	Test 3	Test 4

One of the most important end-use application parameters for the fire performance is the roof pitch. Past traditions in different Member States have caused roofs to be tested at different angles of pitch, as illustrated in Table 3 below.

Table 3 — The standard tested angle of pitch for CEN/TS 1187 tests 1 to 4

Angle of roof to horizontal in the test [degrees]	CEN/TS 1187 Test 1	CEN/TS 1187 Test 2	CEN/TS 1187 Test 3	CEN/TS 1187 Test 4
0	-	-	-	For roofs angles up to 10 degrees
5	-	-	For roof angles below 10 degrees	-
15	For roof angle less than 20 degrees	-	-	-
30	-	Standard angle of test. The results apply for any roof angle	For roof angles from 10 to 70 degrees inclusive	-
45	For roof angles of 20 degrees or more	-	-	For roof angles greater than 10 degrees
Special angle of pitch?	Yes, for special roofs, but the data is limited to the roof system as tested	-	Yes, if required in special cases, but the data is limited to the roof systems as tested	-

Unless the following text says that a parameter has no effect on the performance, no general rules can be given. However, for some tests it is possible to interpolate between or extrapolate from data points from samples having a different value for a particular product and or end-use parameter. It is also possible to group roof coverings /roof systems of a similar nature in order to derive a direct application rule.

The influence of a combination of parameter changes on results from external fire exposure tests to roofs may be inter-related. The combination of parameters that give the lowest performance in the test shall be identified. If the combination giving the worst performance cannot be identified, tests shall be done on a series of combinations of the relevant parameters of the roof system.

Table 4 lists the potential impact on the external fire performance of a roof system from a variation of parameters (as from Table 1), when tested to CEN/TS 1187.

NOTE Specific effects, per product group, are provided in Annexes A to D for test methods 1 to 4 respectively.

Table 4 — Potential impact of parameters and particular characteristics when tested to CEN/TS 1187

PRODUCT PARAMETERS FOR ROOF COVERINGS/ROOF SYSTEMS	Potential impact of parameter and/or its change
Type of product	Organic content/fire load Organic content and/or fire load of the roof may be critical to the outcome of the external fire exposure test e.g. as relevant for fire spread and fire penetration. In some cases, the organic content of layers within the roof could be protected from the effects of the external exposure. The effect of organic content is therefore dependent on the available route for fire penetration into and/or through the roof.
Product composition	The composition of the product may influence the fire performance parameters (in all tests).
Reaction-to-fire classification acc. to EN 13501–1	Any change of product to another reaction-to-fire classification according to EN 13501–1 may have an effect on the external fire performance of the roof.
Colour (consider also pigments)	Colour can affect the surface emissivity and absorptivity of the specimen under test. Dark colours can heat up more quickly than light colours or shiny surfaces.
Binder content	See type of product.
Thickness	The thickness can have an influence on the fire performance.
Mass per unit area	The mass per unit area can have an influence on the fire performance.
Density	The density can have an influence on the fire performance.
Geometry (structure, shape and constitutive layers of multi-layer product)	Geometry may influence the fire performance. The effect could vary depending on the characteristics of parameters defining geometry (e.g. structure, profile, shape and position of layers within a multi-layer product).
Air gaps (perpendicular to surface)	Air gaps can influence the fire performance.
Joints	The type and position of joints can influence the fire performance.
Surfacing	The surfacing on the lower side (backing) and/or on the upper side (facing) can influence the fire performance. Different types of coating or facing can have very different behaviour in fire.
Factory (pre-)applied adhesive	Characteristics of adhesives such as type, position and mass per unit area of the adhesive can influence the fire performance e.g. by adding extra combustible material to the product.
Reinforcement: mass per unit area, type of material; position within layer etc.	Characteristics of reinforcements such as type, position and mass per unit area can influence the fire performance, e.g. a non-combustible intermediate layer may reduce the propensity for penetration.

END-USE PARAMETERS FOR ROOF COVERINGS/ROOF SYSTEMS	Potential impact of parameter and/or its change
<i>End-use parameters-general</i>	
Number of layers (see details for each product)	Number of layers can influence the fire performance.
Order of layers in the roofing system	The order of layers can influence the fire performance.
Orientation of each layer	The orientation of each layer can influence the fire performance. For example: — For non-symmetrical products the effect on fire performance of the top and bottom surfaces of a layer may be different. — A different performance in fire may also be due to a directional effect at one face (like a surface with linear trapezoid profiles). The flame spread may be blocked or guided by the directional effect (the profile direction).
<i>End-use parameters-support</i>	
Roof pitch	The roof pitch influences the fire performance. See Table 2.
Substrate or underlying construction details	Substrates/under-laying construction details (e.g. supporting deck) may influence the fire performance. Important parameters include thickness, density, heat capacity, heat conductivity, deformation and the contribution of the substrate/under-laying construction details to the fire penetration. Where the external layer is sufficiently inert to heat, the effect of the substrate may be minimal. <i>In some cases CEN/TS 1187 makes reference to different substrates or supporting decks for different end-use applications.</i>
Application on existing roofs ("renovation")	Application on existing roofs ("renovation") may influence the fire performance.
Spacing of frame elements (non-standard-support)	Spacing of frame elements (non-standard-support) may influence the fire performance.
<i>End-use parameters-mounting and fixing</i>	
Mounting method	The method used to install products can influence the fire performance. NOTE Some additional guidance on the influence of mounting methods is given in CEN/TS 15447.
Fixing method (e.g. adhesive)	The fixing method may influence the fire performance. NOTE Some additional guidance on the influence of mounting methods is given in CEN/TS 15447.
Distribution, spacing and type of mechanical fixing (fasteners)	Distribution, spacing and type of mechanical fixing (fasteners) may influence the fire performance.

Joints	Joints (between products) may influence the fire performance. Observations during fire tests have shown that — Flames may reach the unexposed side of the product and the interior layer(s) via the joints. — Products may deform at the joints leading to small air gaps behind the product. — The presence of joint filler may also influence the test result. NOTE Some additional guidance on the influence of mounting methods is given in CEN/TS 15447.
Air gaps	Air gaps (e.g. cavities) may influence the fire performance. Observations during fire tests have shown that — One effect of air gaps may be that flames attack both sides of the product and reach lower layers. — This attack may be caused by open joints or openings formed at joints (vertical or horizontal) by whatever means under the exposure to fire in the test. — The heating of air in a partially enclosed space may lead to a chimney effect, substantially increasing the severity of the thermal attack. NOTE Some additional guidance on the influence of mounting methods is given in CEN/TS 15447.

7 General guidance to the annexes for Application Rules

The general structure used follows the tabulated contents list for the annexes, as given in Table 5 below.

Table 5 outlines general information/product groups/components, where the effect of product parameters and end-use application parameters has been evaluated.

NOTE In the tables developed in the annexes, the term 'as tested' is used when an application rule for a specific parameter does not yet exist. See also definition 3.2.

Table 5 — Contents of annexes, arranged according to product groups (A.3.1/D.3.1 to A.3.12/D.3.12), and information on the contribution of components (A.4.1 to A.4.5) to the fire performance

✓ = rules available from the annexes						
NOTE All cell entries under Annex A to D are subject to revision if test evidence is available.						
		ANNEX A	ANNEX B	ANNEX C	ANNEX D	Comments arising from enquiry stage
1	General Text	✓ (+ example sketch A)	✓	✓	✓	
2	General rules	✓	✓	✓	✓	rules common to each annex may

						be shifted to a new clause in this document at a later stage of document development
Product Groups and components:						
- Product Groups						
		ANNEX A	ANNEX B	ANNEX C	ANNEX D	Comments
3.1	slates and tiles					
3.1.1	Non-metallic slates and tiles, (Class A1 to A2 –s3,d2; according to EN 13501–1)	✓	✓	✓	✓	some products/materials are covered by EC Decision 2000/553/EC
3.1.2	metallic tiles	no EXAP rules available	no EXAP rules available	no EXAP rules available	no EXAP rules available	EC Decisions 2000/553/EC and 2005/403/EC cover particular products/materials
3.2	small elements (Class B-s1,d0 to F, according to EN 13501–1)					
3.2.2	Bitumen shingles	✓	✓	✓	✓	
3.2.3	Miscellaneous small elements	no EXAP rules available	no EXAP rules available	no EXAP rules available	no EXAP rules available	
3.3	Reinforced bitumen sheets	✓	✓	✓	✓	
3.4	Plastic and rubber sheets	✓	✓	✓	✓	
3.5	Roof-lights	no EXAP rules available	Not applicable	Not applicable	no EXAP rules available	
3.6	Glazing systems	no EXAP rules available	Not applicable	Not applicable	no EXAP rules available	
3.7	Profiled non-metallic sheets					
3.7.1	Profiled fibre cement sheets	no EXAP rules available	no EXAP rules available	no EXAP rules available	no EXAP rules available	some products/materials are covered by EC Decision 2000/553/EC
3.7.2	Profiled bitumen based	no EXAP rules	no EXAP rules	no EXAP rules	no EXAP rules	

	sheets	available	available	available	available	
3.7.3	Miscellaneous profiled non-metallic sheets	no EXAP rules available	no EXAP rules available	no EXAP rules available	no EXAP rules available	
3.8	Composite metallic sandwich panels	no EXAP rules available	no EXAP rules available	no EXAP rules available	no EXAP rules available	EC Decision 2006/600/EC covers particular products in specific tests
3.9	Profiled metal sheets	no EXAP rules available	no EXAP rules available	no EXAP rules available	no EXAP rules available	EC Decisions 2000/553/EC and 2005/403/EC cover particular products
3.10	Flat metal sheets	no EXAP rules available	no EXAP rules available	no EXAP rules available	no EXAP rules available	
3.11	Liquid applied roof waterproofing kits	no EXAP rules available	no EXAP rules available	no EXAP rules available	no EXAP rules available	
3.12	Miscellaneous	no EXAP rules available	no EXAP rules available	no EXAP rules available	no EXAP rules available	
- Components						
		ANNEX A	ANNEX B	ANNEX C	ANNEX D	Comments
4.1	Adhesive	✓	no EXAP rules available	no EXAP rules available	no EXAP rules available	
4.2	Separating layer	✓	no EXAP rules available	no EXAP rules available	no EXAP rules available	For Annexes B to D: rules are implemented in the particular product group description
4.3	Insulation layer	✓	not applicable	no EXAP rules available	no EXAP rules available	
4.4	Vapour barrier	✓	no EXAP rules available	no EXAP rules available	no EXAP rules available	
4.5	Supporting deck	✓	not applicable	no EXAP rules available	no EXAP rules available	

Annex A (normative)

Application rules for test results from CEN/TS 1187 test 1, per product group and/or components

A.1 General

This annex gives guidance on the application of external fire test results arising from CEN/TS 1187 Test 1. This is done to assist classification according to EN 13501-5.

Rules for roof systems are arranged in this annex following the general structure outlined in Clause 7 of the main document, for product groups and/or components.

NOTE The extent to which an individual component or layer is directly affected/damaged by the testing conditions will be influenced by those layers and components used around them.

In the tables developed, the term 'as tested' is used as an indicator that for a specific parameter an application rule does not yet exist. See 3.2.

If rules listed in this annex do not apply for a specific product /end-use application parameter, the rule "as tested" applies.

Rules on the influence of individual parameters shall be developed by application of the procedure(s) outlined in Clause 6 of the main document.

The product groups and/or components are as detailed below.

The rules for individual product groups and /or components are preceded by:

A.2 General rules, valid for every product within a product group and/or component, for Test 1.

The product groups include:

- A.3.1 Slates and Tiles;
 - A.3.1.1 non-metallic slates and tiles;
 - A.3.1.2 metallic tiles;
- A.3.2 Small elements;
 - A.3.2.2 Bitumen shingles;
 - A.3.2.3 Miscellaneous small elements;
- A.3.3 Reinforced bitumen sheets;
- A.3.4 Plastic and rubber sheets;
- A.3.5 Roof-lights;

- A.3.6 Glazing systems;
- A.3.7 Profiled non-metallic sheets;
 - A.3.7.1 Profiled fibre cement sheets;
 - A.3.7.2 Profiled bitumen based sheets;
 - A.3.7.3 Miscellaneous profiled non-metallic sheets;
- A.3.8 Composite metallic sandwich panels;
- A.3.9 Profiled metal sheets;
- A.3.10 Flat metal sheets;
- A.3.11 Liquid applied roof waterproofing kits;
- A.3.12 Miscellaneous.

The components include:

- A.4.1 Adhesive;
- A.4.2 Separating layer;
- A.4.3 Insulation layer;
- A.4.4 Vapour barrier;
- A.4.5 Supporting deck.

Clause 4, Table 1 lists the product and associated end use application parameters that may or may not influence the classification of external fire performance for each of the identified roofing systems. The following analysis indicates how each of these parameters may influence the classification from test results using CEN/TS 1187 test 1.

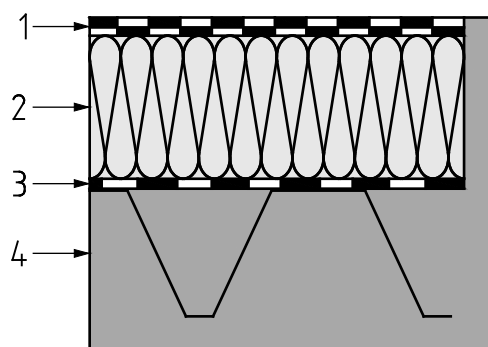
This annex considers the possible effect(s) of single or multiple changes to the individual product and end-use application parameters of the roof on the external fire performance. Since a variation of several parameters at the same time may lead to unexpected results, the rules that are given for a specific product group shall be applied, without exclusion of any one of these rules. In principle, the rules are only valid, if they are applied to one parameter in the roof system, and the others kept unchanged, unless otherwise stated.

For illustration purposes, the example sketch displayed below shows a possible combination of layers to form a roof system. In this example a roof is shown having flexible waterproofing sheets as uppermost layer (i.e. roof covering(s) as defined according to both CEN/TS 1187 and EN 13501-5). Within such a construction various combinations of layers are possible in practice.

The illustrated example combines products from roof sector(s) A3 (uppermost layer (i.e. roof covering(s) as defined according to both CEN/TS 1187 and EN 13501-5)(s)), and A.4.3 (insulation layer) and A.4.4 (vapour barrier) and A.4.5 (supporting deck).

As to the application rules given in this annex, together with direct application rules in EN 13501-5, the impact on the classification from each of those layers intended to be used in the roof system shall be considered.

Where the limit values are not stated, the assumption is made, that the product can be used as it is.



Key

- 1 reinforced bitumen sheets (according to A.3.3)
- 2 insulation layer (according to A.4.3)
- 3 vapour barrier (according to A.4.4)
- 4 supporting deck (according to A.4.5)

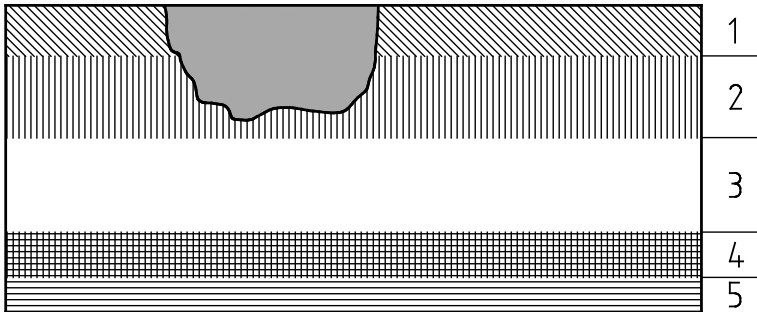
Figure A.1 – Example Sketch

A.2 General rules, valid for every product within a product group and/or component

General application rules cannot be given for each parameter in Table 1 of Clause 4. Based on experience with the external fire performance of widely used, but specific roof systems (e.g. roof systems built with flexible waterproofing layers, insulation boards, metal roof supporting deck (from top to bottom)), the following table lists rules for a restricted set of parameters.

Whenever rules are available for a product group or component (as given in A.3.1 to A.4.5) then these shall be used in addition to rules given here.

Parameter	Rules
Thickness	After testing of thinnest and thickest layer of product, respectively, the test result is valid for all thicknesses between these margins, if not specified otherwise.
Mass per unit area	After testing of heaviest and lightest layer of product, respectively, the test result is valid for all masses per unit area between these margins, if not specified otherwise.
Density	After testing of heaviest and lightest layer of product, respectively, the test result is valid for all densities per unit area between these margins, if not specified otherwise.
Order of layer in the roofing system	In regard to layer 3 (see sketch below) the layer positioned below the lowest layer affected by the fire (layer 2, influencing the test result) during the CEN/TS 1187 test, can be replaced by any other material with the same reaction to fire class or better. In regard to the uppermost layer that has not undergone a change relevant to the test result (i.e. layer 3, see sketch below) layer 4 and additional layers positioned below can be replaced by any other layer or layers.

	NOTE Additional national requirements on reaction to fire may apply.
1 uppermost layer (i.e. roof covering(s) as defined according to both CEN/TS 1187 and EN 13501–5) plus any layer between top and lowest affected layers, resp. 2 lowest affected layer 3 uppermost unaffected layer 4 any layer below 3 5 any layer below 4	
Surfacing on lower side (backing) of any layer in the roof system. and/or Surfacing on upper side (facing) of any layer in the roof system.	Note that this rule excludes the substitution of the external (top) layer. Test results are also valid for greater mass per unit area for surfacing with reaction to fire class A1 to A2 s3 d0. Test results are also valid for smaller mass per unit area for surfacing with reaction to fire class B s1 d0 to E, provided the surfacing does not belong to a group of products with built-in fire retardant (e.g. intumescent products). Furthermore, the % or organic content of the surfacing product, by mass, is not increased.
Reaction-to-fire classification (EN 13501–1) of any layer in the roofing system	Substitution is possible for a component or layer with the same or better reaction-to-fire classification when tested in the same end use application provided that the substitute component or layer is of the same generic product group. Note that this rule excludes the substitution of the external (top) layer.
Roof pitch	Covered by CEN/TS 1187 Test 1 or EN 13501–5

A.3 Product groups

A.3.1 Slates and tiles

A.3.1.1 slates and tiles, non-metallic

This subclause applies to discontinuously laid non-metallic roofing products (reaction-to-fire-class A1 to A2-s3,d2 EN 13501-1), that may be covered by European Standards (such as product standards, e.g. EN 490, *Concrete roofing tiles and fittings for roof covering and wall cladding – Product specifications*, EN 1304, *Clay roofing tiles and fittings – Product definitions and specifications*, EN 492, *Fibre-cement slates and fittings – Product specification and test methods*, EN 12326-1, *Slate and stone products for discontinuous roofing and cladding – Part 1: Product specification*).

NOTE Most products/materials in this sector are covered by EC Decisions such as 2000/553/EC.

	<i>Rules</i>
PRODUCT PARAMETERS FOR ROOF COVERINGS/ROOF SYSTEMS	
Type of product	As tested
Product composition	As tested
Reaction-to-fire classification acc. to EN 13501-1	As tested; not applicable for reaction-to-fire-class A1 products.
Colour (consider also pigments)	As tested; no influence for reaction-to-fire-class A1 products.
Binder content	As tested; no influence for reaction-to-fire-class A1 products.
Thickness	Test result is valid for all thicknesses greater than tested
Mass per unit area	Test result is valid for all masses per unit area greater than tested
Density	Test result is valid for all densities greater than tested
Geometry (structure, shape and constitutive layers of multi-layer product)	As tested
Air gaps (perpendicular to surface)	As tested
Joints	Test result is valid for overlapping joints larger than tested
Surfacing on lower side (backing)	See general rule.
Surfacing on upper side (facing)	See general rule.
Factory pre-applied adhesive	As tested
Reinforcement: mass per unit area, type of material; position within layer etc.	A higher mass per unit area of the same reinforcement material having a reaction-to-fire class A1 to A2-s3 d2 is acceptable. A smaller mass per unit area of the same material having reaction-to-fire class B-s1,d0 to F is acceptable. For both options, the specific material shall be kept in the same position within the product.
END-USE PARAMETERS FOR ROOF COVERINGS/ROOF SYSTEMS	
End-use parameters-general	
Number of layers (details see for each product)	As tested
order of layer in the roofing system	See general rules.
Orientation of each layer	As tested
End-use parameters - support	
Roof pitch	See general rule.
Application on existing roofs ("renovation")	As tested

Spacing of frame elements (non-standard-support)	As tested; compare with A.4.5 Supporting deck.
End-use parameters - mounting and fixing	
Mounting method	As tested
Fixing method (e.g. adhesive)	As tested
spacing and type of mechanical fixing (fasteners)	As tested, narrower spacing included; type of fastener not relevant.
Joints	Test result with butt joints includes step joints or similar.
Air gaps	As tested, smaller gaps included.

A.3.1.2 Metallic tiles

Products covered in this subclause are defined in the following harmonized European Standards such as EN 14783, *Fully supported metal sheet and strip for roofing, external cladding and internal lining - Product specification and requirements*, EN 506, *Roofing products of metal sheet - Specification for self-supporting products of copper or zinc sheet*, EN 508, *Roofing products from metal sheet - Specification for self-supporting products of steel, aluminium or stainless steel sheet* (Part 1 covering steel, Part 2 covering aluminium, Part 3 covering stainless steel).

PRODUCT FOR COVERINGS/ROOF SYSTEMS	PARAMETERS	Rules
Type of product		As tested
Product composition		As tested
Reaction-to-fire classification according to EN 13501-1		As tested
Colour (consider also pigments)		As tested, compare with surfacing.
Binder content		As tested
Thickness		Test results are valid for greater thicknesses of the same product.
Mass per unit area		Test results are valid for greater mass per unit areas of the same product.
Density		Test results are valid for greater densities of the same product.
Geometry (structure, shape and constitutive layers of multi-layer product)		As tested
Air gaps (perpendicular to surface)		Joints smaller than tested are acceptable.
Joints (overlapping)		Overlapping joints larger than tested are acceptable.
Factory pre-applied adhesive		As tested
Reinforcement: mass per unit area, type of material; position within layer etc.		As tested

END-USE PARAMETERS FOR ROOF COVERINGS/ROOF SYSTEMS	
End-use parameters-general	
Number of layers (details see for each product)	As tested
Order of layer in the roofing system	As tested
End-use parameters - support	
Application on existing roofs ("renovation")	As tested
Spacing of frame elements (non-standard-support)	As tested, compare with A.4.5.
End-use parameters - mounting and fixing	
Mounting method	As tested
Fixing method (e.g. adhesive)	As tested
spacing and type of mechanical fixing (fasteners)	As tested, smaller distances acceptable.
Joints	Test results with butt joints are applicable to step joints and similar.
Air gaps	As tested, smaller gaps acceptable.

NOTE Most products in this sector are covered by EC Decisions such as 2000/553/EC and 2005/403/EC.

A.3.2 Small elements

A.3.2.1 General

This subclause applies to discontinuously laid roofing products (reaction-to-fire-class B-s1,d0 to F according to EN 13501-1), that may be covered by European Standards.

A.3.2.2 Bitumen shingles

Products covered in this subclause are defined in Product Standards such as EN 544 Bitumen shingles with mineral and/or synthetic reinforcements

	Rules
PRODUCT PARAMETERS FOR ROOF COVERINGS/ROOF SYSTEMS	
Type of product	As tested
Product composition	As tested

Reaction-to-fire classification according to EN 13501-1	See general rules.
Colour (consider also pigments)	Colour of mineral finishing (e.g. slates, granules) not relevant
Binder content	Not relevant
Thickness	See general rules.
Mass per unit area	See general rules.
Density	See general rules.
Geometry (structure, shape and constitutive layers of multi-layer product)	As tested
Air gaps (perpendicular to surface)	Not relevant
Joints	Test result with overlapped joints allows for overlaps wider than tested.
Surfacing on lower side (backing)	See general rules.
Surfacing on upper side (facing)	See general rules. NOTE Including metal foil surfacing.
Factory pre-applied adhesive	smaller mass per unit area included; for the same material as long as the way of application is unchanged.
Reinforcement: mass per unit area, type of material; position within layer etc.	For filaments: (a) For lower mass of polyester per unit area the test result is valid. (b) For woven glass or glass fleece with a higher mass per unit area of the same type of product the test result is valid. (c) For polyester reinforcement the results are also valid for the same type of sheet with additional glass fleece (e.g. 2 reinforcements or combination).
END-USE PARAMETERS FOR ROOF COVERINGS/ROOF SYSTEMS	
End-use parameters-general	
Number of layers (details see for each product)	As tested
order of layer in the roofing system	As tested
Orientation of each layer	Not relevant
End-use parameters-support	
Roof pitch	See general rules.
Application on existing roofs ("renovation")	As tested NOTE It is necessary to develop rules for renovation purposes.
Spacing of frame elements (non-standard-support)	Non-standard supporting decks as tested can be replaced by decks belonging to the same type of material provided the supporting characteristics are not reduced.