

RAPPORT

Lazaros Tsantaridis, Birgit Östman

European Classes for the Reaction to Fire Performance of Wood Floorings

Träteknik

INSTITUTET FÖR TRATEKNISK FORSKNING

Lazaros Tsantaridis, Birgit Östman,

EUROPEAN CLASSES FOR THE REACTION TO FIRE PERFORMANCE OF WOOD FLOORINGS

Trätekt Rapport I 0411026

ISSN 1102 – 1071

ISRN TRÄTEK – R – – 04/026 – – SE

Keywords

classification
fire tests
multilayer floorings
reaction to fire
solid flooring
wood flooring

Stockholm November 2004

Contents

Summary	2
Svensk sammanfattning – Swedish summary	3
1. Introduction	4
1.1 New European classes for the reaction to fire of building products	4
1.2 CWFT – Classification without further testing	4
1.3 European classification system for the reaction to fire performance	7
1.4 Test methods	9
1.4.1 Small flame test	9
1.4.2 Radiant panel test	9
2. Applications for wood floorings	10
3. Test results for wood floorings	10
4. Discussion	15
4.1 Surface coatings	15
4.2 Solid floorings	16
4.3 Multilayer floorings	17
4.4 Other influencing parameters	17
5. Conclusion on Classification without further testing for wood floorings	18
6. References	20

Summary

The European system for CWFT, Classification without further testing, has been applied to wood floorings as being 'products with known and stable fire performance'. Both solid and multilayer wood floorings are included.

In addition, the same procedure has been applied also to four other types of wood products: Wood-based panels, Structural timber, Glulam and Solid wood panelling and cladding. These products have a separate classification system and are tested according to different methods. The results for these four types of wood products are reported separately.

The results presented clearly demonstrate the stable reaction to fire performance of different wood floorings. The main parameters influencing the reaction to fire characteristics of all wood floorings are product thickness, density, surface coating and end use conditions such as substrates, glued or not to substrate, interlayers or air gaps behind the product.

The work will result in a Commission decision for wood floorings published in the Official Journal of the European Communities. The classes will also be included in the harmonised product specification as soon as it becomes available from the product standard committee and used for CE-marking.

All wood floorings with coatings included obtain the European class D_{fl-s1} or C_{fl-s1} .

Wood floorings and end use applications not included in the CWFT classification table have to be tested and classified in the ordinary way. Better classification may then be reached, since no safety margins have to be fulfilled.

Svensk sammanfattning – Swedish summary

Nya möjligheter till förenklad europeisk brandklassificering finns för produkter med sk 'känt och stabilt beteende vid brand'. Träprodukter är ett utmärkt exempel på sådana produkter. Brandklassningen avser det nya europeiska systemet med sk Euroklasser, som för golvprodukter kallas klass A1_{fl}-F_{fl}. Klassningen ingår i de harmoniserade produktstandarderna som behövs för att byggprodukter ska kunna CE-märkas.

Förenklad brandklassning för produkter med 'känt och stabilt brandbeteende' innebär att brandegenskaperna dokumenteras genom inledande provningar, som ligger till grund för generell brandklassning och godkänns av europeiska organ, först av en grupp med nationella myndighetspersoner *Fire Regulators' Group (FRG)/ European Commission Expert Group on Fire Issues (EGF)* och sedan av ständiga byggkommittén *Standing Committee on Construction (SCC)*. Till sist publiceras brandklassningen i EUs officiella tidning *Official Journal*. Systemet kallas Klassificering utan ytterligare provning, eller på engelska CWFT som står för *Classification without further testing*. Alternativet är att varje enskild tillverkare provar sina produkter eller att produkten hamnar i den sämsta brandklassen F_{fl}, som betyder att inga brandegenskaper är dokumenterade.

Både massiva trägolv och flerskiktade trägolv av typ parkett ingår.

Kraven på dokumentation är hårda. Allt måste verifieras med provningar. Både massiva trägolv och olika flerskiktade golv av typ parkett har provats med avseende på olika slutanvändning, vilket lett till att många olika fall har provats och redovisats. Ytbehandling ingår också. För samtliga trägolv gäller dessutom att brandklassen beror av golvens minimitjocklek och minimidensitet.

Massiva trägolv med minst 8 mm tjocklek och flerskiktade golv minst 10 mm uppnår klass D_{fl}-s1 om de används utan luftspalt under. Med högre tjocklek kan de även användas med luftspalt under och uppnå samma brandklass. Luftspalten representerar bl a användning som trappsteg i öppna trappor. Furugolv ingår i denna grupp.

Vissa trägolv med högre densitet eller limmade mot obrännbart underlag kan uppnå klass C_{fl}-s1.

I samtliga fall måste golven vara ytbehandlade. Industriellt använda ytbehandlingar ingår.

De trägolv och slutanvändningar som inte finns med i tabellerna för europeisk klassificering måste brandprovas för att få en brandklass. Annars hamnar de automatiskt i den lägsta klassen F_{fl}, som betyder att inga brandegenskaper har dokumenterats. Trägolv med annan slutanvändning eller annan ytbehandling t ex brandskyddslack kan få högre brandklass om de brandprovas.

Resultaten sammanfattas på svenska i en Träteknik Kontenta /11/.

1. Introduction

1.1 New European classes for the reaction to fire for building products

A new classification system for the reaction to fire properties of building construction products has recently been introduced in Europe /1/. It is often called the Euroclass system and consists of two sub systems, one for construction products excluding floorings, i.e. mainly wall and ceiling surface linings and one for floorings. Both sub systems have classes A to F of which classes A1 and A2 are non combustible products. Flooring classes are called A1_f-F_f (f for flooring). The new system will replace the present national classification systems, which have formed obstacles to trade /7/.

The new classification system for reaction to fire performance was published in Official Journal in February, 2000 /1/ and is based on a set of EN standards for different test methods /2, 3, 4/ and for classification systems /5/.

The new European system has to be used for all construction products in order to get the CE-mark. Products with known and stable performance may be classified as groups according to an initiative from EC /6/. This is a possibility for wood products that have a fairly predictive fire performance. Properties like density, thickness, joints and type of end use application may influence the classification. If no common rules are available each producer has to test their products in order to fulfil requirements in product standards and to get the CE-mark. A common European classification without need for further testing of main wood products on the market are then beneficial to many producers in Europe.

1.2 CWFT – Classification without further testing

The procedure for CWFT is described in a document from DG Enterprise /6/. Main points are given below.

“Classified without further testing” (CWFT) corresponds to the definition “Products which have been proven to be stable in a given European class (on the basis of testing to the appropriate EN test method(s)) within the scope of their variability in manufacture allowed by the product specification (harmonised standard or ETA), and when evaluated for the influence of other possible variations, that may occur outside the scope of the specification, which may have an impact on their fire performance.” CWFT is a list of generic products, not a list of proprietary products.

CWFT lists are established by Commission Decision(s) in consultation with the Standing Committee on Construction (SCC). The Fire Regulators Group (FRG)/ European Commission Expert Group on Fire Issues (EGF), advised by its CWFT Working Group made up of representatives of regulators and experts on fire performance of building products, CEPMC (Council of European Products of Materials for Construction), Notified Bodies Group, CEN TC127 WG4, and CEN/EOTA TC (invited for specific cases, as applicants), will consider all requests made and forward recommendations onto the SCC for final opinion.

CWFT lists will refer to products of known and stable performance for defined end use applications with respect to their reaction to fire performance, their external fire performance and/or their resistance to fire (the latter to be developed in due course). “Products” are product families, product sub-families and generic products as defined Guidance Paper G and

specified by European Standards or European Technical Approvals. It may also be possible to extend the concept to kits and systems, if it is possible to define them with sufficient precision.

Products for which a clearly identifiable stage in the production process results in an improvement of the reaction to fire classification (e.g. a limiting of organic material) cannot normally be considered for CWFT status.

Products will only be considered for inclusion onto the lists where:

- their fire performance is demonstrated by test to be stable;
- they have been shown in tests to satisfy a given class;
- they have been defined with sufficient precision.

Requests to set up a new list, or to add products to existing lists, may come from any interested party, i.e. Member State, Technical Committee, CEN, CENELEC, EOTA, industry directly or European industry federations.

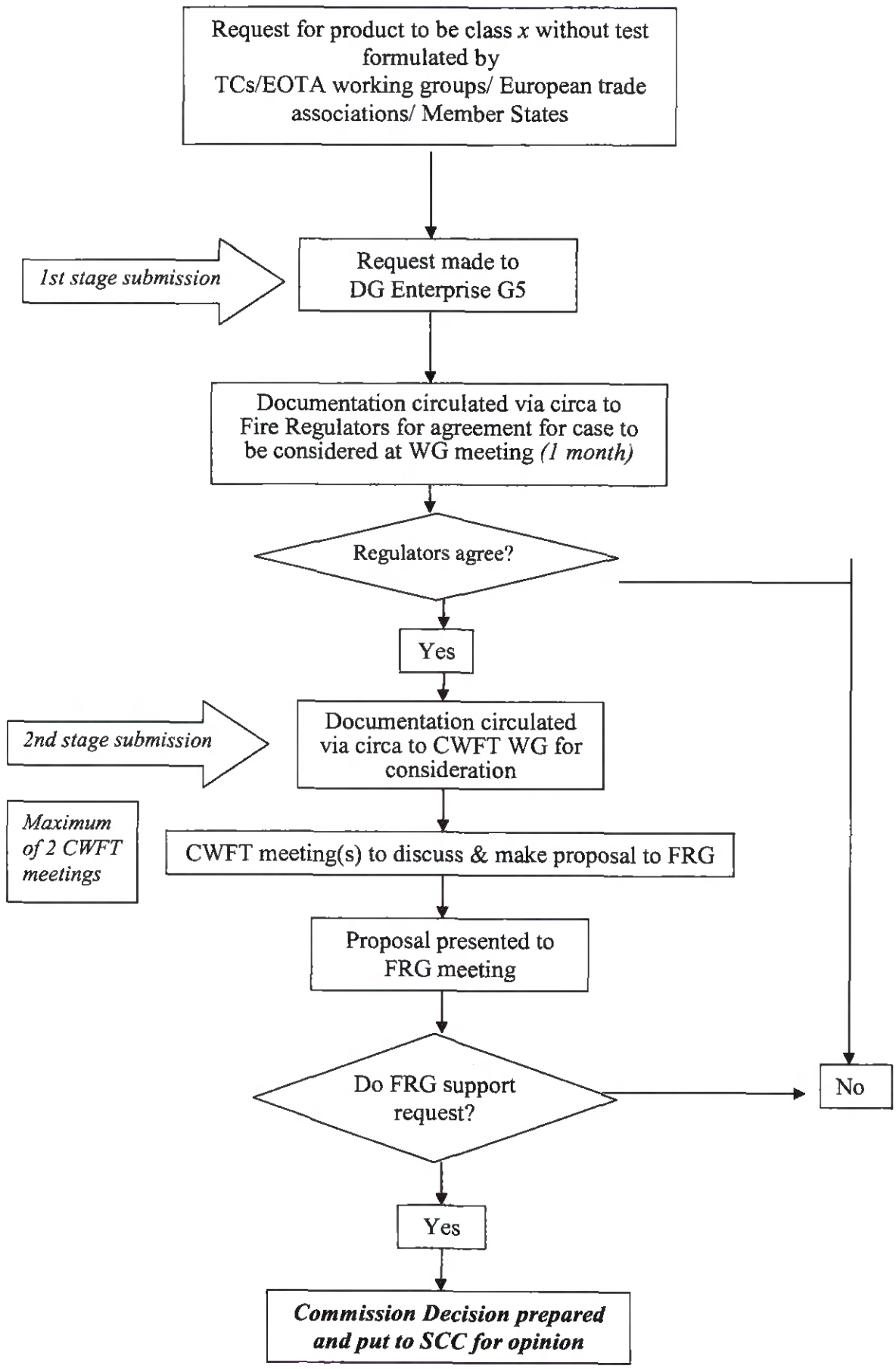
Requests should, however, wherever possible, come via CEN, CENELEC or EOTA. It is recommended that applications should not come from individual manufacturers, even though the results might apply to only one or a few manufacturers. Requests will be formally made to the European Commission, DG Enterprise G5 Construction unit.

The stages of the application procedure are shown diagrammatically on next page. To avoid unnecessary work and expense for applicants, this is a two stage procedure.

- The first stage is to get approval from the FRG/EGF that the products in question are suitable to be on the CWFT list. It is recommended that, at this stage, the application does not give the intended class(es); this will be assessed in detail in the Working Group on the basis of data and test results supplied. If the approval of the FRG/EGF is obtained, the applicant then supplies all the necessary details (in electronic format) and the request is considered by the Working Group; otherwise the procedure stops at this point.
- The second stage is a detailed analysis of the case and follows once the FRG/EGF has approved the application in principle. The CWFT Working Group will examine all the documents submitted, will request further information if necessary, and when the case is considered to be complete, will make a recommendation to the FRG/EGF. It should take no more than two CWFT WG meetings for this recommendation to be agreed.

Products claiming CWFT must be clearly above the lower class limits, to provide a safety margin. This should be determined on a statistical basis in relation to the scattering of results. In general terms, each classification parameter (as defined in the relevant classification standard in the EN 13501 series) should be either 20 % above the class limit (although some relaxation of this may be possible), or shown by statistical means to have a satisfactory safety level, for a request to be accepted. Due account will be taken of the likely variability in the production process of products.

The SCC will make the final decision based upon the recommendations from the FRG/EGF. All requests and related data will be submitted to the FRG/EGF for discussion (using written as well as oral procedures). The advice of the FRG/EGF will largely determine whether the request is forwarded to the SCC for opinion.



1.3 European classification system for the reaction to fire performance

The new European system for the reaction to fire performance classes consists of two sub-systems, one for construction products, i.e. mainly wall and ceiling surface linings and one for floorings, see [Tables 1.1 and 1.3](#). Three test methods are used for determining the classes of all combustible (classes B-E) building products (including floorings), see [Table 1.2](#). For non combustible products also additional test methods are used, see [Table 1.3](#).

This report deals only with wood floorings. A separate report on Euroclasses for other wood products is available /8/.

Table 1.1. Overview of the European classes for the reaction to fire for floorings /1/.

Euro class	Smoke class	Requirements according to			Critical heat flux kW/m ²	Typical products
		Non comb	Radiant panel	Small flame		
A1 _f	–	x	–	–	–	Stone
A2 _f	s1 or s2	x	x	–	≥ 8	Gypsum boards
B _f	s1 or s2	–	x	x	≥ 8	PVC- and some textile floorings
C _f	s1 or s2	–	x	x	≥ 4,5	Some wooden floors
D _f	s1 or s2	–	x	x	≥ 3	Most wooden floors
E _f	–	–	–	x	–	Some synthetic polymers
F _f	–	–	–	–	–	No performance determined

Table 1.2. Test methods used for determining the European classes for the reaction to fire of combustible building products.

Test method	Construction products excl. floorings, i. e. wall and ceiling linings	Floorings	Main fire properties measured and used for the classification
Small flame test EN ISO 11925-2	x	x	Flame spread within 60 or 20 s.
Single Burning Item test, SBI EN 13823	x	–	- FIGRA, Fire Growth Rate; - SMOGRA, Smoke Growth Rate; - Flaming droplets or particles
Radiant panel test EN ISO 9239-1	–	x	- Critical radiant flux; - Smoke production

Table 1.3. European classes of reaction to fire performance for floorings /1, 5/.

Class	Test method(s)	Classification criteria	Additional classification
A1_{FL}	EN ISO 1182 (1); <i>and</i>	$\Delta T \leq 30 \text{ }^\circ\text{C}$; <i>and</i> $\Delta m \leq 50 \%$; <i>and</i> $t_f = 0$ (i.e. no sustained flaming)	-
	EN ISO 1716	$\text{PCS} \leq 2.0 \text{ MJ.kg}^{-1}$ (1); <i>and</i> $\text{PCS} \leq 2.0 \text{ MJ.kg}^{-1}$ (2); <i>and</i> $\text{PCS} \leq 1.4 \text{ MJ.m}^{-2}$ (3); <i>and</i> $\text{PCS} \leq 2.0 \text{ MJ.kg}^{-1}$ (4)	
A2_{FL}	EN ISO 1182 (1); <i>or</i>	$\Delta T \leq 50 \text{ }^\circ\text{C}$; <i>and</i> $\Delta m \leq 50 \%$; <i>and</i> $t_f \leq 20\text{s}$	Smoke production (7)
	EN ISO 1716; <i>and</i>	$\text{PCS} \leq 3.0 \text{ MJ.kg}^{-1}$ (1); <i>and</i> $\text{PCS} \leq 4.0 \text{ MJ.m}^{-2}$ (2); <i>and</i> $\text{PCS} \leq 4.0 \text{ MJ.m}^{-2}$ (3); <i>and</i> $\text{PCS} \leq 3.0 \text{ MJ.kg}^{-1}$ (4)	
	EN ISO 9239-1 (5)	Critical flux (6) $\geq 8.0 \text{ kW.m}^{-2}$	
B_{FL}	EN ISO 9239-1 (5) <i>and</i>	Critical flux (6) $\geq 8.0 \text{ kW.m}^{-2}$	Smoke production (7)
	EN ISO 11925-2 (8): <i>Exposure = 15 s</i>	$F_s \leq 150 \text{ mm}$ within 20 s	
C_{FL}	EN ISO 9239-1 (5) <i>and</i>	Critical flux (6) $\geq 4.5 \text{ kW.m}^{-2}$	Smoke production (7)
	EN ISO 11925-2 (8): <i>Exposure = 15 s</i>	$F_s \leq 150 \text{ mm}$ within 20 s	
D_{FL}	EN ISO 9239-1 (5) <i>and</i>	Critical flux (6) $\geq 3.0 \text{ kW.m}^{-2}$	Smoke production (7)
	EN ISO 11925-2 (8): <i>Exposure = 15 s</i>	$F_s \leq 150 \text{ mm}$ within 20 s	
E_{FL}	EN ISO 11925-2 (8): <i>Exposure = 15 s</i>	$F_s \leq 150 \text{ mm}$ within 20 s	-
F_{FL}	No performance determined		

(1) For homogeneous products and substantial components of non-homogeneous products.

(2) For any external non-substantial component of non-homogeneous products.

(3) For any internal non-substantial component of non-homogeneous products.

(4) For the product as a whole.

(5) Test duration = 30 minutes.

(6) Critical flux is defined as the radiant flux at which the flame extinguishes or the radiant flux after a test period of 30 minutes, whichever is the lower (i.e. the flux corresponding with the furthest extent of spread of flame).

(7) **s1** = Smoke $\leq 750 \text{ } \%. \text{min}$; **s2** = not **s1**.

(8) Under conditions of surface flame attack and, if appropriate to the end-use application of the product, edge flame attack.

1.4 Test methods

1.4.1 Small flame test, EN ISO 11925-2

Fire tests have been performed in the single-flame source test. Measurements of ignitability parameters were made according to EN ISO 11925-2, see [Figure 1.1](#). The flame was applied for 15 s, and was exposed to the surface 40 mm above the bottom edge. The dimensions of the specimens were 250 mm x 90 mm. Six tests were performed for each product.

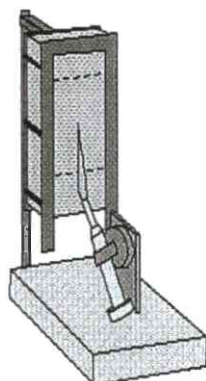


Figure 1.1. Small flame test, EN ISO 11925-2 for fire tests for floorings using a single-flame source test.

1.4.2 Radiant panel test, EN ISO 9239-1

Fire tests have been performed in the radiant heat source test. Measurements of burning behaviour were made according to EN ISO 9239-1, see [Figure 1.2](#). The tests were performed by using a standard substrate of 19 mm Particle board or standard substrate of 6 mm Fibre cement board according to EN 13238 or with an air gap underneath the wood flooring. An interlayer of paper 0,7 mm or foam 2,5 -3,0 mm or softboard 6 mm was applied, in some cases, between the flooring and the substrate for multilayer wood floorings. The dimensions of the specimens were 1050 mm x 230 mm. Triple tests, and for some cases two or five tests, were performed.

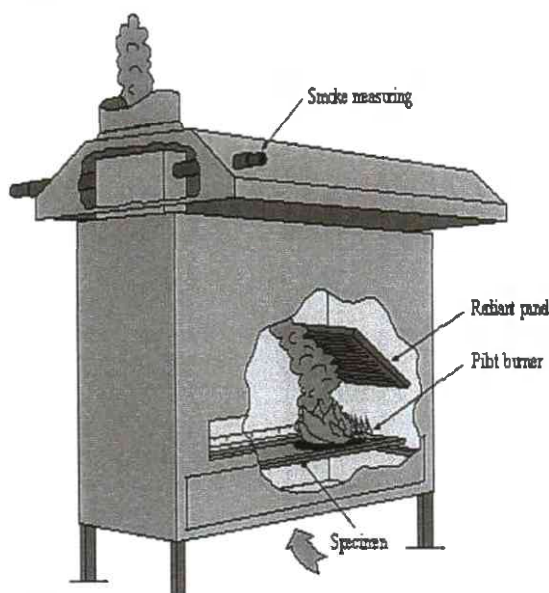


Figure 1.2. EN ISO 9239-1 for fire tests for floorings using a radiant heat source.

The following parameters are calculated from the Radiant panel test data:

CHF Critical Heat Flux, kW/m².
IoS Integral of the Smoke Obscuration, %min.

2. Applications for wood floorings

2.1 Harmonised standards

The reaction-to-fire classification for wood floorings will be included in the following harmonised product specifications:

- EN 14 342 Wood flooring – Characteristics, evaluation of conformity and marking,
- prEN 175.098 Prefabricated timber stairs – Specifications and requirements (under development).

2.2 End use applications

The end-use applications are as floorings and as steps in stairs with or without an air gap behind, see [Figure 2.1](#).

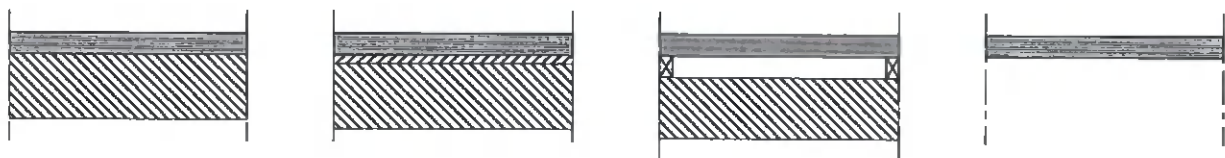


Figure 2.1. Examples of end uses for wood flooring. From the left: Flooring directly on a substrate; with an interlayer between the flooring and the substrate; with a closed air gap in between and to the right with an open air gap without anything underneath (e.g. as in an open staircase).

3. Test results for wood floorings

The test results for wood floorings are summarised in [Table 3.1 to 3.5](#).

Test results from Small flame test EN ISO 11925-2 are summarised in [Table 3.1](#).

Test results from Radiant panel test EN ISO 9239-1 are summarised in [Table 3.2 and 3.3](#).

National Radiant Panel test results are summarised in [Table 3.4](#).

Test results for wood-based panels as floorings from Radiant panel test EN ISO 9239-1 are summarised in [Table 3.5](#).

Table 3.1. Solid and Multilayer wood flooring results from Ignitability test, EN ISO 11925-2 (at 15 or 30 s exposure of flame).

Product	Thick-ness mm	Dens-ity kg/m ³	Flame spread within 60 s ¹⁾		Flame spread within 20 s ²⁾	Ignition of filter paper ¹⁾	Class EN 13501-1	Ref. no (below table)
			Surface	Edge				
Spruce, planed	12	463	< 150	< 150	< 150	No	*	1
Spruce, planed, knot	12	430	< 150	< 150	< 150	No	*	1
Spruce, planed, joint	12	482	< 150	< 150	< 150	No	*	1
Spruce, planed, joint, knot	12	423	< 150	< 150	< 150	No	*	1
Spruce, unplanned	12	500	< 150	< 150	< 150	No	*	1
Spruce, unplanned, knot	12	488	< 150	< 150	< 150	No	*	1
Spruce, unplanned, joint	12	474	< 150	< 150	< 150	No	*	1
Spruce, unplanned, joint, knot	12	471	< 150	< 150	< 150	No	*	1
Pine	20	515	< 150	< 150	< 150	No	*	1
Oak	22	700	< 150	< 150	< 150	No	*	2
Poplar	22	400	< 150	< 150	< 150	No	*	2
Sitka spruce	22	300	< 150	< 150	< 150	No	*	3
Oak	10	690	-	-	< 150	No	*	4
Chestnut	14	547	-	-	< 150	No	*	5
Chestnut with coat	14	570	-	-	< 150	No	*	6
Pine with soap	25	508	-	-	< 150	No	*	7
Pine oiled	25	499	-	-	< 150	No	*	7
Pine oiled twice	25	481	-	-	< 150	No	*	7
Sitka spruce with UV acrylate	18	411	-	-	< 150	No	*	7
Sitka spruce with UV PU	18	420	-	-	< 150	No	*	7
Sitka spruce with UV oil	18	398	-	-	< 150	No	*	7
Veneered floor covering	7	901	-	-	< 150	No	*	7
Multilayer parquet	10	577	-	-	< 150	No	*	7
Multilayer parquet with UV oil	10	533	-	-	< 150	No	*	7
Paper interlayer	0,7	450	-	-	> 150	No	F _{fl}	8
Foam interlayer	2,5	30	-	-	> 150	No	F _{fl}	8
Softboard interlayer	6	280	-	-	< 150	No	E _{fl}	8

1) at 30 s impignement of flame, 2) at 15 s impignement.

* Satisfies the small flame requirements for class D_{fl} - B_{fl} (only 15 s exposure of flame required for floorings)

References

1. Tsantaridis L: CEN Ignitability test results for wood building products, Trätek report L 9702010, 1997.
2. Gaillard J-M: Reaction to fire test EN ISO 11925-2, CTBA Test Report N° 02/PC/PHY/277/3, 2002.
3. Tsantaridis L and Mollek V: Fire testing of Sitka spruce according to EN ISO 11925-2, Trätek Test Report A12323/2002-12-17, 2002.
4. Gaillard J-M and Georges V: Reaction to fire test EN 9239-1 and EN 11925-2, CTBA Test Report N° 03/PC/PHY/130-1, 2003.
5. Gaillard J-M and Georges V: Reaction to fire test EN 9239-1 and EN 11925-2, CTBA Test Report N° 03/PC/PHY/130-2, 2003.
6. Gaillard J-M and Georges V: Reaction to fire test EN 9239-1 and EN 11925-2, CTBA Test Report N° 03/PC/PHY/130-3, 2003.
7. Tsantaridis L and Mollek V: Fire testing of wood floorings according to EN ISO 11925-2, Trätek Test Report A12411/2003-09-04, 2003.
8. Tsantaridis L and Mollek V: Fire testing of flooring interlayers according to EN ISO 11925-2, Trätek Test Report A12412/2003-09-04, 2003.

Table 3.2. Solid wood flooring results from Radiant panel test, EN ISO 9239-1.

Product	Total thickness mm	Total density kg/m ³	Substrate	Surface coating type, g/m ²	CHF kW/m ²	Smoke % min	Class EN 13501-1	Ref. no (below table)
Sitka spruce ³⁾	20	383	Part. b.	-	4,6	6	C _{fl} -s1	9
-"- (transv.)	20	383	Part. b.	-	4,9	8	C _{fl} -s1	9
Sitka spruce ³⁾	20	404	Air gap ¹⁾	-	4,7	3	C _{fl} -s1	9
-"- (transv.)	20	404	Air gap ¹⁾	-	7,0	3	C _{fl} -s1	9
Sitka spruce ⁴⁾	8	400	Part. b.	-	4,3	15	D _{fl} -s1	9
-"-	20	413	Air gap ¹⁾	-	5,2	13	C _{fl} -s1	9
Spruce (new)	32	454	Air gap ¹⁾	-	5,4	7	C _{fl} -s1	9
Pine	25	527	Air gap ¹⁾	-	3,9	31	D _{fl} -s1	9
- "-	25	511	Air gap ¹⁾	Soap, 100	6,7	25	C _{fl} -s1	9
- "-	25	516	Air gap ¹⁾	Oil, 100	4,3	24	D _{fl} -s1	9
Beech (old)	21	672	Part. b.	-	4,0	12	D _{fl} -s1	9
Beech (new)	21	663	Air gap ¹⁾	-	6,7	30	C _{fl} -s1	9
Chestnut ⁵⁾	14	547	Part. b.	-	2,6	13	E _{fl}	9, 11
Chestnut	14	570	Part. b.	Acryl, 85	3,6	-	D _{fl}	12
Oak (old)	21	618	Air gap ¹⁾	-	4,3	8	D _{fl} -s1	9
-"- (new)	21	835	Air gap ¹⁾	-	4,5	9	D _{fl} -s1	9
Oak	10	690	Part. b.	-	4,6	25	C _{fl} -s1	10
Sitka spruce	18	433	Air gap ¹⁾	UV acr, 60	4,4	12	D _{fl} -s1	9
- "-	18	430	Air gap ¹⁾	UV PU, 60	5,1	5	C _{fl} -s1	9
- "-	18	436	Air gap ¹⁾	UV oil, 20	5,5	22	C _{fl} -s1	9
Parquet, solid, 1 layer (Beech, PVAc)	6	716	Part. b. ²⁾	-	3,7	26	D _{fl} -s1	9
Oak (new)	21	791	Air gap ¹⁾	UV acr, 60	5,5	12	C _{fl} -s1	9
-"-	20	798	Air gap ¹⁾	UV acr, 120	5,4	31	C _{fl} -s1	9
-"-	20	820	Air gap ¹⁾	UV PU, 60	5,8	7	C _{fl} -s1	9
-"-	20	741	Air gap ¹⁾	UV PU, 120	4,3	16	D _{fl} -s1	9
-"-	20	791	Air gap ¹⁾	UV oil, 20	5,2	10	C _{fl} -s1	9
-"-	20	771	Air gap ¹⁾	UV oil, 60	5,4	6	C _{fl} -s1	9
Spruce	32	450	Air gap ¹⁾	Oil, 60	5,8	10	C _{fl} -s1	13
Beech	20	650	Air gap ¹⁾	-"	4,6	9	C _{fl} -s1	13
Beech	20	665	Air gap ¹⁾	-	4,5	16	C _{fl} -s1	13
Oak	21	790	Air gap ¹⁾	Oil, 60	5,7	2	C _{fl} -s1	13
Oak	21	720	Air gap ¹⁾	-"	5,7	1	C _{fl} -s1	13

¹⁾ Minimum height 40 mm; ²⁾ Glued to substrate; ³⁾ Large knots; ⁴⁾ Small knots; ⁵⁾ Resin content 1,9 %.

References

9. Tsantaridis L and Mollek V: Fire testing of homogenous wood floorings according to EN ISO 9239-1, Trätek Test Report A12413/2003-09-04, 2003.
10. Gaillard J-M and Georges V: Reaction to fire test EN 9239-1 and EN 11925-2, CTBA Test Report N° 03/PC/PHY/130-1, 2003.
11. Gaillard J-M and Georges V: Reaction to fire test EN 9239-1 and EN 11925-2, CTBA Test Report N° 03/PC/PHY/130-2, 2003.
12. Tsantaridis L and Mollek V: Fire testing of homogenous wood floorings according to ISO 5660-1, Trätek Test Report A12415/2003-09-04, 2003.
13. Gaillard J-M and Georges V: Reaction to fire test EN 9239-1 and EN 11925-2, CTBA Test Report N° 03/PC/PHY/130-3, 2003.

Table 3.3. Multilayer wood flooring results from Radiant panel test, EN ISO 9239-1.

Product	Total thickness mm	Total density kg/m ³	Top layer			Inter layer	Sub strate	Surface coating type, g/m ²	CHF kW/m ²	Smoke % min	Class EN 13501-1	Ref. no (below table)
			Wood species	Thickness mm	Glue type, g/m ²							
Parquet, multilayer	10	574	Beech	2,5	UF, 100	-	Part. b.	UV acr, 60	5,0	75	C _f -s1	14
-"	10	557	Beech	2,5	-"	-	Part. b.	-	3,2	48	D _f -s1	14
-"	10	541	Beech	2,5	UF, 300	-	Part. b.	-	4,1	55	D _f -s1	14
-"	12	585	Beech	3,5	UF	-	Part. b.	-	3,1	47	D _f -s1	14
-"	10	520	Beech	2,5	PVAc	-	Part. b.	-	2,7	38	E _f	14
-"	10	519	Beech	2,5	PVAc	-	Part. b.	UV oil, 20	5,0	91	C _f -s1	14
-"	12	556	Oak	3,5	UF	-	Part. b.	UV acr, 60	4,1	31	D _f -s1	14
-"	12	550	Oak	3,5	-"	-	Part. b.	-	3,4	25	D _f -s1	14
-"	10	557	Beech	2,5	-"	Paper	Part. b.	-	3,2	129	D _f -s1	14
-"	10	557	Beech	2,5	-"	Foam	Part. b.	-	2,9	85	E _f	14
-"	10	574	Beech	2,5	-"	Softb.	Part. b.	-	2,6	133	E _f	14
-"	12	557	Oak	3,5	-"	Softb.	Part. b.	-	3,0	40	D _f -s1	14
-"	15	541	Oak	3,5	-"	Softb.	Part. b.	-	3,4	43	D _f -s1	14
-"	15	540	Oak	3,5	-"	Foam	Part. b.	-	3,4	14	D _f -s1	14
-"	15	550	Oak	3,5	-"	-	Part. b.	-	3,7	27	D _f -s1	14
-"	14	480	Pine	3,6	UF	-	Part. b.	Acrylate	4,3	18	D _f -s1	14
-"	14	565	Oak	3,6	-"	-	Part. b.	-"	4,9	18	C _f -s1	14
-"	14	515	Birch	3,6	-"	-	Part. b.	-"	5,1	20	C _f -s1	14
-"	14	595	Alder	3,6	-"	-	Part. b.	-"	6,0	24	C _f -s1	14
-"	15	650	Merbau	4,0	-"	-	Part. b.	-"	7,4	8	C _f -s1	14
-"	10	590	Merbau	3,5	UF	-	Part. b. ²⁾	UV acr, 70	4,9	17	C _f -s1	15
-"	10	590	-"	3,5	-"	-	Fiber cement ²⁾	-"	6,7	11	C _f -s1	15
-"	14	540	Birch	3,5	-"	-	Air gap ¹⁾	UV acr, 98	3,7	111	D _f -s1	15
-"	14	590	Jarrah	3,5	-"	-	Air gap ¹⁾	-"	4,3	99	D _f -s1	15
-"	14	630	Paraju	3,5	-"	-	Air gap ¹⁾	-"	5,4	127	C _f -s1	15
-"	14	640	-"	3,5	-"	-	Part. b.	-"	5,5	77	C _f -s1	15
-"	14	630	-"	3,5	-"	Foam	Part. b.	-"	5,4	99	C _f -s1	15
Veneered floor covering	6	846	Ash	0,5	UF	-	Part. b.	UV oil, 20	7,6	24	C _f -s1	15
-"	6	867	Ash	0,5	-"	-	Part. b.	-	7,0	22	C _f -s1	15
-"	10	820	Oak	2,5	-"	-	Part. b.	UV acr, 50	4,2	14	D _f -s1	16
-"	10	820	-"	2,5	-"	-	Fiber cement	-"	3,9	20	D _f -s1	16

¹⁾ Minimum height 40 mm; ²⁾ Glued to substrate.

References

14. Tsantaridis L and Mollek V: Fire testing of multilayer wood floorings according to EN ISO 9239-1, Trätekt Test Report A12414/2003-09-04, 2003.
15. Tsantaridis L and Mollek V: Fire testing of multilayer wood floorings according to EN ISO 9239-1, Trätekt Test Report A12466/2004-02-24, 2004.
16. Tsantaridis L and Mollek V: Fire testing of veneered floor coverings according to EN ISO 9239-1, Trätekt Test Report A12468/2004-02-26, 2004.

Table 3.4. National Radiant panel test results for Wood floorings.

Product	Total thickness mm	Total density kg/m ³	Top layer			Inter layer	Substrate	Surface coating type, g/m ²	CHF kW /m ²	Smoke max %	National Class	Ref no. (below table)	
			Wood specie	Thickness mm	Glue type, g/m ²								
50a	Parquet, solid	7	1)	Oak	7		-	Fiber cement 2)	Oil	9,7	2	B1	17
50b	“-	7	“-	Oak	7		-	“-	PU/Acr	9,2	2	B1	17
51a	“-	7	“-	Beech	7		-	“-	Oil	7,6	6	B1	18
51b	“-	7	“-	Beech	7		-	“-	PU/Acr	5,8	9	B1	18
52a	“-	7	“-	Maple	7		-	“-	Oil	7,8	9	B1	19
52b	“-	7	“-	Maple	7		-	“-	PU/Acr	6,1	5	B1	19
53a	“-	12	“-	Maple	12		-	“-	lacquer	5,4	11	B1	20
53b	“-	12	“-	APA	12		-	“-	“-	5,7	10	B1	20
53c	“-	12	“-	Esche	12		-	“-	“-	4,8	9	B1	20
53d	“-	12	“-	Oak	12		-	“-	“-	5,0	9	B1	20
53e	“-	12	“-	Beech	12		-	“-	Oil	5,6	15	B1	20
54	Parquet, multilayer	11	“-	Hardwood	2,5		-	“-	yes	7,8	43	B1	21
55	Parquet	11-12	“-	Many incl. oak and beech	not spec.		-	“-	lacquer			B1	22

¹⁾ Density not specified; Literature data (Kollmann and Coté: Principles of Wood Science and Technology, Springer-Verlag 1968) specify conditioned density (at about 12 % moisture content) 650-690 kg/m³ for oak and 680-720 kg/m³ for beech;

²⁾ Glued to substrate

References

- Bestimmung des Brennbarkeitsgrades im Radiant Panel-Apparat und des Qualmgrades gemäss Wegleitung für Feuerpolizeivorschriften, Prüfung von Baustoffen und Bauteilen, Teil B, Abschnitt 2.4 und 2.6, Ausgabe 1988; Prüfobjekt: Parkettbodenbelag Art. Eiche ca. 7 mm dick, geölt/versiegelt, Prüfbericht Nr. 413 652, EMPA, 2000.
- Bestimmung des Brennbarkeitsgrades im Radiant Panel-Apparat und des Qualmgrades gemäss Wegleitung für Feuerpolizeivorschriften, Prüfung von Baustoffen und Bauteilen, Teil B, Abschnitt 2.4 und 2.6, Ausgabe 1988; Prüfobjekt: Parkettbodenbelag Art. Buche ca. 7 mm dick, geölt/versiegelt, Prüfbericht Nr. 413 653, EMPA, 2000.
- Bestimmung des Brennbarkeitsgrades im Radiant Panel-Apparat und des Qualmgrades gemäss Wegleitung für Feuerpolizeivorschriften, Prüfung von Baustoffen und Bauteilen, Teil B, Abschnitt 2.4 und 2.6, Ausgabe 1988; Prüfobjekt: Parkettbodenbelag Art. Ahorn ca. 7 mm dick, geölt/versiegelt, Prüfbericht Nr. 413 652, EMPA, 2000.
- Prüfung des Brandverhaltens nach DIN 4102 Teil 1 und Teil 14, Klasse B1; Prüfmaterial: Verschiedene Parkettbodenbeläge aus der Kollektion "Duo-line" verlegt auf massiven mineralischen Untergrund, Prüfzeugnis 16-902 220 000, Otto-Graf-Institut, 2003.
- Prüfung des Brandverhaltens nach DIN 4102 Teil 1 und Teil 14, Klasse B1; Prüfmaterial: Hartholzparkett verlegt auf massiven mineralischen Untergrund, Prüfzeugnis 16-900 463 000b, Otto-Graf-Institut, 2001.
- Prüfung auf Schwerentflammbarkeit (Baustoffe B1) nach DIN 4102-1 (Mai 1998); Bezeichnung des Prüfgegenstandes: Parkett-Bodenbelag bezeichnet als "Royal-Parkett" in den Holzarten "Eiche", "Panga Panga", kanadisches Ahorn naturell", kanadisches Ahorn markant", Buche gedämpft natur", Buche gedämpft markant", Buche hell natur", Buche hell markant", "Jakoba", "Black Cherry", "amerikanischer Nussbaum", "Kambala", "Esche nature", "Sucupira", "Cumaro", "Doussi" und "Merbau"; MPA NRW Prüfzeugnis Nr. 23001967-2, 2003.

Table 3.5. Wood-based panel results from Radiant panel test, EN ISO 9239-1.

Product	Thick-ness mm	Density kg/m ³	Substrate	CHF kW/m ²	Smoke % min	Class EN 13501-1	Ref. no (below table)
Particleboard	10	680	Part. b.	3,8	20	D _f -s1	23
Particleboard	12	600	Part. b.	4,4	141	D _f -s1	26
MDF	9	765	Air gap ¹⁾	4,8	22	C _f -s1	24
Fibreboard, Medium board	9	840	Air gap ¹⁾	3,6	110	D _f -s1	24
Fibreboard, Hardboard	6	1050	Part. b	4,0	49	D _f -s1	24
Plywood, spruce	9	480	Air gap ¹⁾	3,9	54	D _f -s1	24
OSB	9	600	Air gap ¹⁾	4,2	35	D _f -s1	25

References

23. Radiant Panel test report, BASF Fire Safety Department, Report-Nr.: 21.1-3343/12260, 2001.
24. Summary of Radiant Heat Panel tests, VTT Building and Transport, 2001.
25. Radiant Panel test report, BASF Fire Safety Department, Report-Nr.: 21.1-3343/12257, 2001.
26. Results of the Round-Robin on the radiant panel test & on the methenamine tablet test. CEN TC 127 doc N 1289, February 1998.

4. Discussion

The test results were analysed for some main products parameters influencing the reaction to fire characteristics of wood floorings.

4.1 Surface coating

The influence of surface coatings have been determined in a systematic study with well defined uncoated products and coating systems including all mayor systems used by industry, i e UV cured acrylic, PU and oil coating systems used by parquet industry and in addition ordinary wood oil and soap mainly used for solid floorings. Both solid and multilayer floorings are included.

The results show that all coating systems improve or at least maintain the fire performance in the Radiant panel test for all uncoated flooring products, i e a higher critical heat flux is reached, see Figure 4.1.

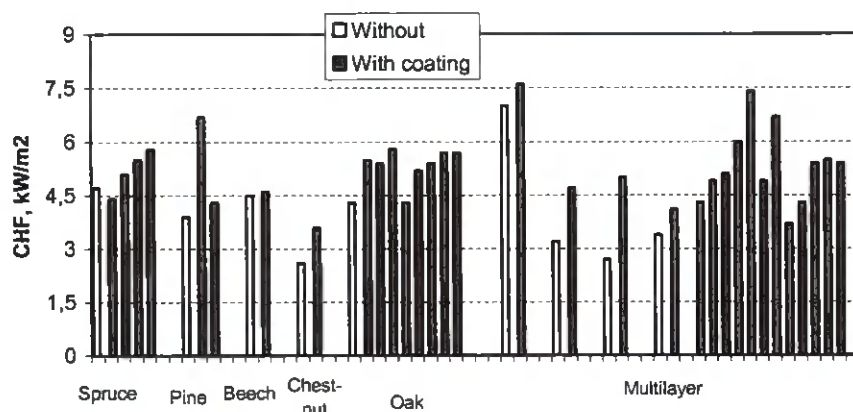


Figure 4.1. Critical Heat Flux, CHF, for all wood floorings without and with a surface coat.

4.2 Solid wood floorings

Six wood species (spruce, sitka spruce, pine, beech, chestnut, oak) of different origin and thickness have been included, but no clear trend with density has been found as for SBI testing of wood products /8/. The absence of trend is true both for uncoated and surface coated solid wood floorings, see [Figure 4.2](#).

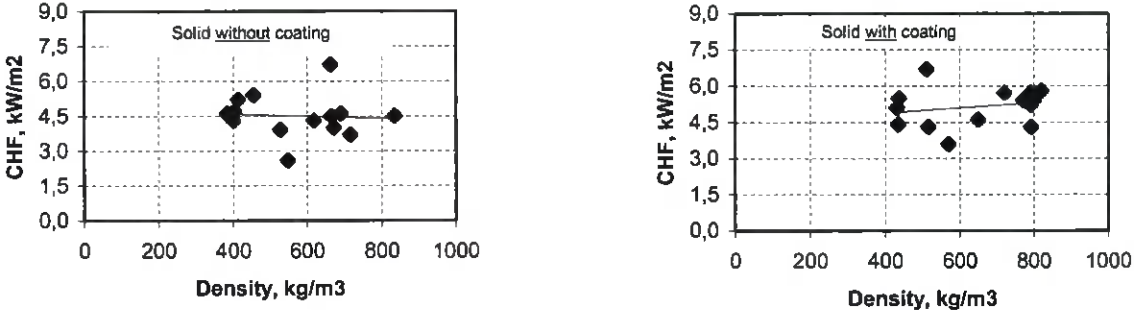


Figure 4.2. Critical Heat Flux, CHF, for solid wood floorings without and with a surface coat.

However, if the test data are analysed per wood specie, a certain pattern is obvious. Data for spruce without and with a surface coating are illustrated in [Figure 4.3](#) and data for oak without and with a surface coating in [Figure 4.4](#).

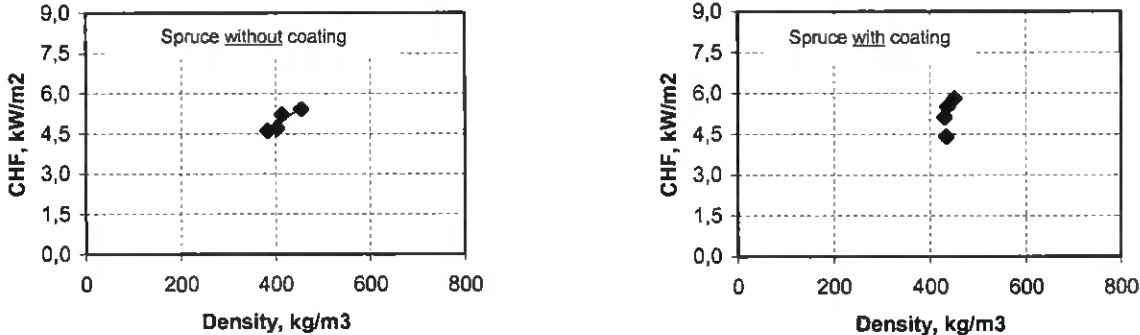


Figure 4.3. Critical Heat Flux, CHF, for solid spruce floorings without and with a surface coat.

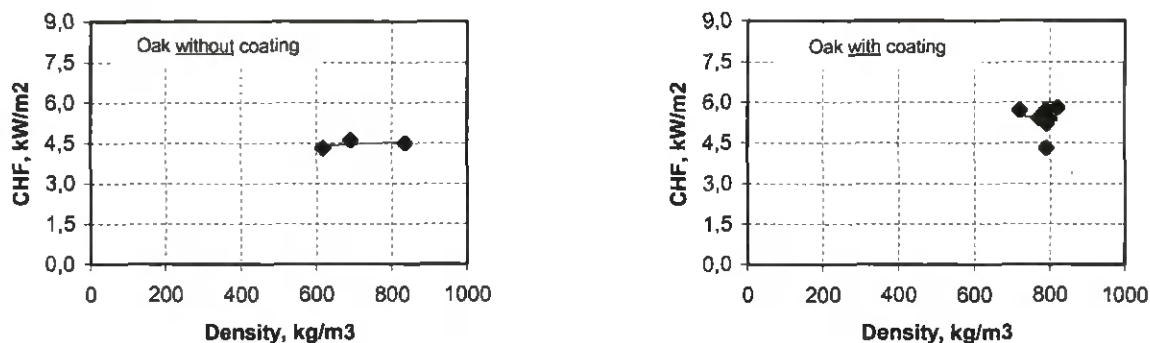


Figure 4.4. Critical Heat Flux, CHF, for solid oak floorings without and with a surface coat.

4.3 Multilayer wood floorings

More than ten different multilayer wood parquet products of different origin and thickness have been included. A trend with density is found mainly for surface coated multilayer wood floorings, see Figure 4.5.

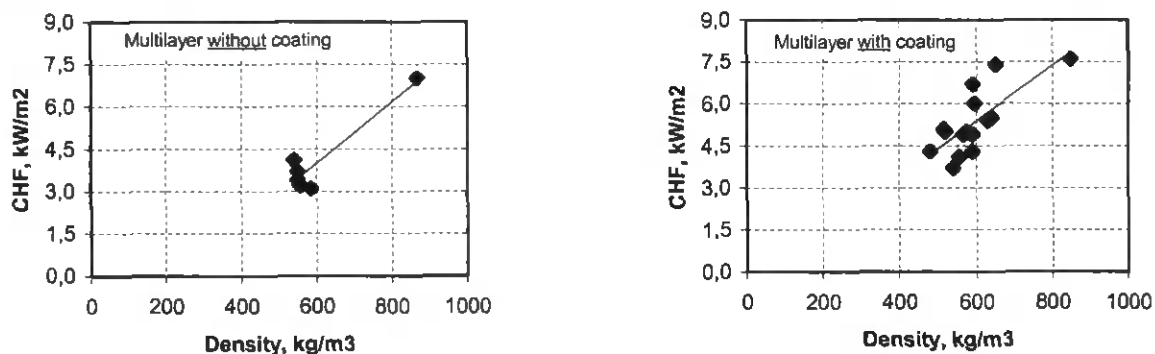


Figure 4.5. Critical Heat Flux, CHF, for multilayer wood floorings without and with a surface coat.

4.4 Other influencing parameters

Flame spread in the orientation along the wood grain is more rapid than transverse the grain, see data in Table 3.2 and Figure 4.6. The orientation along the grain has therefore been used in most of the testing as the worst case scenario.

Knots and other surface characteristics in solid wood floorings may improve the fire performance by stopping the flame spread along the surface, at least partly. Products with small or no knots have therefore been tested as the worst case scenario, see Table 3.2.

Different types and amounts of adhesives used for multilayer floorings have minor influence on the fire performance, see Table 3.3.

Interlayers behind the flooring and the substrate may degrade the fire performance for thin multilayer products, see Table 3.3. However, if the flooring thickness is at least 14 mm, the fire performance is maintained.

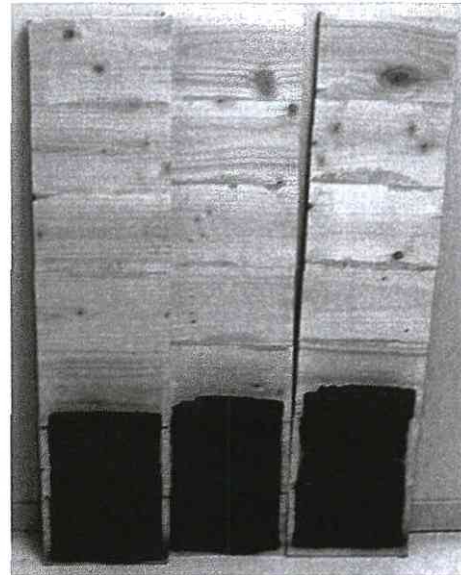
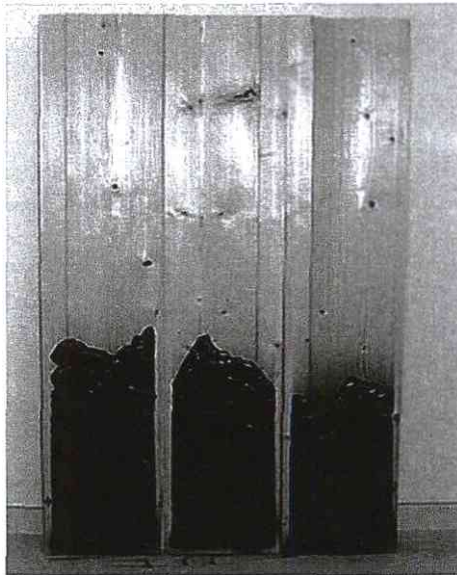


Figure 4.6. Solid wood floorings of spruce along the wood grain (left) and transverse the grain (right) tested in the Radiant panel test, EN ISO 9239-1.

5. Conclusion on Classification without further testing for wood floorings

5.1 Wood floorings - Classification

Some wood floorings with higher density or glued to non combustible substrate can be classified as class C_{fl-s1} .

Solid wood floorings with total thickness of at least 8 mm and multilayer wood parquet of at least 10 mm can, based on the evidence presented, be classified as class D_{fl-s1} , if mounted without air gap underneath. With higher thickness they can be used with air gap underneath and can be classified in the same class.

In all cases the wood floorings must have a surface coating. All industrial used coatings are included.

A draft proposed Commission Decision /10/ is given in [Table 5.1](#).

Table 5.1. Proposed Table For Inclusion In Commission Decision /10/.

CLASSES OF REACTION TO FIRE PERFORMANCE FOR WOOD FLOORING

Product ^{1,7)}	Product detail ⁴⁾	Minimum mean density ⁵⁾ (kg/m ³)	Minimum overall thickness (mm)	End use condition	Class ³⁾ for floorings
Wood flooring and parquet	Solid flooring of oak or beech with surface coating	Beech: 680 Oak: 650	8	Glued to substrate ⁶⁾	C _{fl} -s1
-"-	Solid flooring of oak, beech or spruce and with surface coating	Beech: 680 Oak: 650 Spruce: 450	20	With or without air gap underneath	C _{fl} -s1
-"-	Solid wood flooring with surface coating and not specified above	390	8	Without air gap underneath	D _{fl} -s1
-"-	-"-	390	20	With or without air gap underneath	D _{fl} -s1
Wood parquet	Multilayer parquet with a top layer of oak of at least 5 mm thickness and with surface coating	650 (top layer)	10	Glued to substrate ⁶⁾	C _{fl} -s1
-"-	-"-	650 (top layer)	14 ²⁾	With or without air gap underneath	C _{fl} -s1
-"-	Multilayer parquet with surface coating and not specified above	500	8	Glued to substrate	D _{fl} -s1
-"-	-"-	500	10	Without air gap underneath	D _{fl} -s1
-"-	-"-	500	14 ²⁾	With or without air gap underneath	D _{fl} -s1
Veneered floor covering	Veneered floor covering with surface coating	800	6 ²⁾	Without air gap underneath	D _{fl} -s1

- 1) Mounted in accordance with EN ISO 9239-1, on a substrate of at least Class D-s2,d0 and with minimum density of 400 kg/m³ or with an air gap underneath.
- 2) An interlayer of at least Class E and with maximum thickness 3 mm may be included in applications without an air gap, for parquet products with 14 mm thickness or more and for veneered floor coverings.
- 3) Class as provided for in Commission Decision 2000/147/EC Annex Table 2.
- 4) Type and quantity of surface coatings included are acrylic, polyurethane or soap, 50-100 g/m², and oil, 20-60 g/m².
- 5) Conditioned according to EN 13238 (50 % RH 23 °C)
- 6) Substrate at least Class A2-s1,d0.
- 7) Applies also to steps of stairs.

Acknowledgements

The work has been initiated by standard bodies within CENT C 175. It has been lead and sponsored by European industrial federations via CEI-Boi, mainly EOS European Organisation of the Sawmill Industry, FEP European Federation of the Parquet Industry and Swedish wood flooring producers via TMF Trä- och Möbelindustriförbundet.

6. References

1. COMMISSION DECISION of 8 February 2000 implementing Council Directive 89/106/EEC as regards the classification of the reaction to fire performance of construction products. Official Journal of the European Communities 23.2.2000.
2. SBI test, EN 13823, Reaction to fire tests for building products – Building products excluding floorings – exposed to the thermal attack by a single burning item, 2002.
3. Small flame test, EN ISO11925-2, Reaction to fire tests for building products – Ignitability of building products subjected to direct impingement of flame - Part 2: Single-flame source test, 2002.
4. Radiant panel test, EN ISO 9239-1, Reaction to fire tests for floor coverings – Part 1: Determination of the burning behaviour using a radiant heat source, 2002.
5. Classification system, EN 13501-1, Fire classification of construction products and building elements - Part 1: Classification using test data from reaction to fire tests, 2002.
6. Classification of products of known and stable performance - Procedural aspects. CONSTRUCT 01/491 rev 2, 2003.
7. Östman B, Nussbaum R: National standard fire tests in small-scale compared with the full-scale ISO room test, Trätek Report I 8702017, 1987.
8. Östman B, Mikkola E: European classes for the reaction to fire performance of wood products (except floorings), Trätek Report I 0411025, 2004.
9. Östman B: Euroclass for the reaction to fire of wood-based panels, Proc. 3rd European Wood-Based Panel Symposium, Hannover, September 2001. Trätek Rapport L 0111028, 2001.
10. CWFT case report for Wood floorings, CWFT doc 061 rev 8, December 2004.
11. Europeisk brandklassning av trägolv, (Short version of CWFT results for wood floorings in Swedish) Trätek Kontenta 0411024, 2004.

Detta digitala dokument
skapades med anslag från
**Stiftelsen Nils och Dorthi
Troëdssons forskningsfond**

Trätec

INSTITUTET FÖR TRÄTEKNISK FORSKNING

Box 5609, 114 86 STOCKHOLM
Besöksadress: Drottning Kristinas väg 67
Telefon: 08-762 18 00
Telefax: 08-762 18 01

Vidéum Science Park, 351 96 VÄXJÖ
Besöksadress: Lückligs plats 1
Telefon: 0470-599700
Telefax: 0470-599701

Skena 2, 931 77 SKELLEFTEÅ
Besöksadress: Laboratorgränd 2
Telefon: 0910-28 56 00
Telefax: 0910-28 56 01



Ingår i
SP-koncernen