

Introduction

This information sheet provides guidance and test results to the fire hazard properties of common solid timber flooring or floor covering used in commercial Class 2 to 9 buildings under the Building Code of Australia (BCA). The guide is not applicable to domestic houses. The property that needs to be assessed for timber floors under BCA Specification C1.10a relates to the critical radiant flux (CRF) and the Smoke Development Rate (where appropriate). However, there are some instances where the criteria in BCA Specification C1.10, Early Fire Hazard Indices must also be met. This information sheet outlines these requirements and provides information on different flooring species and thickness.

Applications Required to Comply with Either Specification

Specification C1.10a stipulates “Deemed-to-Satisfy” (DTS) requirements for floor materials and floor coverings. This Specification places limits on values such as Critical Radiant Flux and smoke development rates for floor materials and coverings. Depending on the final application, the same products may be required to meet Specification C1.10a or C1.10. An example of this is plywood flooring. When it is used uncovered as exposed flooring, the plywood is required to comply with Specification C1.10a. When the plywood is used as a substrate with another floor covering over it, then the plywood is required to comply with Specification C1.10. In this second example the covering layer is required to comply with Specification C1.10a.

Specification C1.10a - Floor Materials and Coverings

DTS Provisions

This specification sets out the deemed-to-satisfy requirements for floor materials and floor coverings. A floor material or covering is required to have a Critical Radiant Flux (CRF) equal to or greater than specific values that are dependent on the building class, location in the building and whether a complying sprinkler system is installed or not. Where the building does not have a sprinkler system it must also have a Smoke Development Rate equal to or less than (\leq) 750 percent-minutes.



Pernod Ricard Corporate Office by architects Woodhead Pty Ltd. Winner of the Australian Timber Design Awards for Best Use of Timber Flooring in 2007. *Photographer:* Steve Back Interiors Architecture & Maritime Photography Australia

The lowest allowed CRF is 1.2 kW/m² for most buildings with sprinklers. For various locations and building types there is an increased CRF requirement of ≥ 2.2 or ≥ 4.5 kW/m². The different levels are related to whether a complying sprinkler system is installed, the mobility of the occupants or whether it is a fire-isolated exit. The highest requirement is for CRF ≥ 4.5 kW/m² for accommodation for the aged and patient care areas, not fitted with a complying sprinkler system and for some buildings with fire isolated exits.

The required CRF and smoke development rates are given in the BCA and are reproduced in Table 1 below.

Table 1: CRITICAL RADIANT FLUX (CRF) AND SMOKE DEVELOPMENT RATES OF FLOOR MATERIALS AND FLOOR COVERINGS

Class of Building	Fire-isolated exits	Other areas		
		Unsprinklered		Sprinklered ¹
	CRF	CRF	Smoke development rate	CRF
Class 2,3,5,6,7,8 or 9b <i>Excluding Class 3 Accommodation for the aged</i>	≥ 2.2	≥ 2.2	≤ 750	≥ 1.2
Class 3 <i>Accommodation for the aged</i>	≥ 4.5	≥ 4.5	≤ 750	≥ 2.2
Class 9a <i>Patient care areas</i>	≥ 4.5	≥ 4.5	≤ 750	≥ 2.2
Class 9a <i>Areas other than patient care areas</i>	≥ 4.5	≥ 2.2	≤ 750	≥ 1.2
Class 9c <i>Resident use areas</i>	≥ 4.5	*	*	≥ 2.2
Class 9c <i>Areas other than resident use areas</i>	≥ 4.5	*	*	≥ 1.2
Class 2,3,5,6,7,8 or 9b <i>Lift Cars</i>	≥ 2.2			
<p>* Unsprinklered Class 9c buildings are not permitted For the purposes of this table:</p> <p>1. "Sprinklered" means a building fitted with a sprinkler system complying with Specification E1.5 of the BCA</p> <p>≥ means equal to or greater than the value that follows this symbol</p> <p>≤ means equal to or less than the value that follows this symbol</p>				

How Timber Meets Specification C1.10a

There are many combinations of timber floors from solid timber, parquet, strip, floating, particleboard and plywood floors. Generic data is available for solid timber and wood products that are not specific to one manufacturer, for example tongue and groove (T&G) flooring or plywood products that are of one species. The composition of floating floors, bamboo, laminated and particleboard (and their respective CRF and smoke development rates) vary from manufacturer to manufacturer and the individual manufacturer should be consulted for this information.

The critical criteria for solid timber flooring (including parquet) are the species and the thickness of the timber. There will be a different CRF for different thicknesses within the one species.

A common mistake made by designers when specifying particleboard or plywood under a floor covering is to require the substrate of the floor to have a CRF. This is not necessary. Only the covering or floor material

has to comply with C1.10a. When particleboard or plywood is used as the substrate, the Early Fire Hazard Properties are those required in Specification C1.10 (Spread-of-Flame Index and Smoke-Developed Index). A CRF (and Smoke Development Rate if the building is unsprinklered) will be required for the floor covering. However, as the floor covering is part of an assembly (substrate and covering) a floor covering manufacturer should test the floor covering and substrate together to obtain a CRF value with the substrate underlay (e.g. plywood or particleboard) included. Often this is not done and therefore it is recommended that this be checked.



Dusk project by architect Campbell Drake (Diretribe Pty Ltd) Winner of the Australian Timber Design Award 2007, Highly commended 2007 for both New Buildings or Renovation – Students & Entrants Under 30 and Best Use of Plywood & LVL. *Photography: Tanja Kimme*

The Critical Radiant Flux and Smoke Development Rates for various timber species used for solid timber flooring is contained in the table below which is broken into two parts - 12 mm and greater and 19 mm and greater thickness for various solid timber species. For 12 mm solid timber flooring there is a requirement that it be backed by the appropriate plywood or particleboard, or placed onto a non-combustible substrate such as concrete.

Floating Floors

Recently, floating floors have been gaining in popularity particularly where a high level of amenity (for acoustic requirements for example) is needed. Floating floors can be made of a single timber species or combination of plywood, solid timber, timber veneer, bamboo, composite wood or a manufactured laminate. These are usually pre-finished and laid on a single or multiple underlay of foam, rubber or polyester sound reducing material. The flooring and underlay can have multiple shapes and properties, therefore it is recommended to refer to the manufacturer for the fire hazard properties in those instances.

Test Results for Solid Timber Flooring

Table 2 contains results for common solid timber. Where timber species are not listed refer to distributor of the product for further assistance.

Table 2: CRITICAL RADIANT FLUX (CRF) AND SMOKE DEVELOPMENT RATES OF SELECT SOLID TIMBER SPECIES**

THICKNESS	FIRE HAZARD PROPERTIES			
	12 mm and greater		19 mm and greater	
	Critical Radiant Flux [kW/m ²]	Smoke Development Rate [percent-minutes]	Critical Radiant Flux [kW/m ²]	Smoke Development Rate [percent-minutes]
Ash, alpine	>2.2 and < 4.5	<750	>2.2 and < 4.5	<750
Ash, mountain	>2.2 and < 4.5	<750	>2.2 and < 4.5	<750
Ash, silvertop	>2.2 and < 4.5*	<750	>2.2 and < 4.5	<750
Beech, myrtle	>2.2 and < 4.5*	<750	≥ 4.5	<750
Blackbutt	>2.2 and < 4.5*	<750	>2.2 and < 4.5	<750
Blackbutt, New England	>2.2 and < 4.5*	<750	≥ 4.5	<750
Blackwood	>2.2 and < 4.5*	<750	≥ 4.5	<750
Bloodwood, red	>2.2 and < 4.5*	<750	≥ 4.5	<750
Box, brush	>2.2 and < 4.5*	<750	≥ 4.5	<750

	FIRE HAZARD PROPERTIES			
THICKNESS	12 mm and greater		19 mm and greater	
NAME	Critical Radiant Flux [kW/m ²]	Smoke Development Rate [percent-minutes]	Critical Radiant Flux [kW/m ²]	Smoke Development Rate [percent-minutes]
Cypress	>2.2 and < 4.5*	<750	≥ 4.5	<750
Gum, blue, Sydney	>2.2 and < 4.5	<750	>2.2 and < 4.5	<750
Gum, blue, southern	>2.2 and < 4.5*	<750	≥ 4.5	<750
Gum, manna	>2.2 and < 4.5*	<750	>2.2 and < 4.5	<750
Gum, red, river	>2.2 and < 4.5*	<750	≥ 4.5	<750
Gum, rose	>2.2 and < 4.5	<750	>2.2 and < 4.5	<750
Gum, shining	>2.2 and < 4.5	<750	>2.2 and < 4.5	<750
Gum, spotted	>2.2 and < 4.5*	<750	≥ 4.5	<750
Gum, sugar	>2.2 and < 4.5*	<750	≥ 4.5	<750
Gum, yellow	>2.2 and < 4.5*	<750	≥ 4.5	<750
Ironbark, grey	>2.2 and < 4.5*	<750	≥ 4.5	<750
Ironbark, red	>2.2 and < 4.5*	<750	≥ 4.5	<750
Jarrah	>2.2 and < 4.5*	<750	≥ 4.5	<750
Karri	>2.2 and < 4.5*	<750	≥ 4.5	<750
Mahogany, red	>2.2 and < 4.5*	<750	≥ 4.5	<750
Merbau	>2.2 and < 4.5*	<750	≥ 4.5	<750
Messmate	>2.2 and < 4.5*	<750	>2.2 and < 4.5	<750
Pine, celery-top	>2.2 and < 4.5	<750	>2.2 and < 4.5	<750
Pine, radiata	>2.2 and < 4.5*	<750	>2.2 and < 4.5	<750
Stringybark, yellow	>2.2 and < 4.5	<750	>2.2 and < 4.5	<750
Tallowwood	>2.2 and < 4.5*	<750	≥ 4.5	<750
Turpentine	>2.2 and < 4.5*	<750	≥ 4.5	<750
Wattle, silver	>2.2 and < 4.5*	<750	≥ 4.5	<750

* Tested with substrate

** Warrington Fire Research Australia Report RIR 41117.2

*** TESTED SUBSTRATES FOR 12mm THICK TIMBER FLOORING**

SUBSTRATE SPECIFICATION	THICKNESS [mm]
Particleboard (density 716 kg/m ³)	≥ 19 mm
Fibre cement	≥ 15 mm
Normal weight concrete floor	≥ 75 mm
Light weight concrete floor	≥ 75 mm

Table 3 CRITICAL RADIANT FLUX (CRF) AND SMOKE DEVELOPMENT RATES OF SELECT PLYWOOD FLOORING

NAME	FIRE HAZARD PROPERTIES		REPORT NUMBER
	Critical Radiant Flux [kW/m ²]	Smoke Development Rate [percent-minutes]	
Pine, hoop ≥ 15 mm	>2.2 and < 4.5	<750	RIR 41117.2*
Pine, radiata ≥ 17 mm	>2.2 and < 4.5	<750	RIR 41117.2*
Pine, slash ≥ 17 mm	>2.2 and < 4.5	<750	RIR 41117.2*

*Warrington Fire Research Australia