FLAME SPREAD

INTRODUCTION

Flame spread is primarily a surface burning characteristic of materials, and a flame-spread rating is a way to compare how rapid flame spreads on the surface of one material compared to another.

Flame-spread rating requirements are applied in the *National Building Code of Canada (NBCC)* [1] primarily to regulate interior finishes.

Any material that forms part of the building interior and is directly exposed is considered to be an interior finish. This includes interior claddings, flooring, carpeting, doors, trim, windows, and lighting elements.

If no cladding is installed on the interior side of an exterior wall of a building, then the interior surfaces of the wall assembly are considered to be the interior finish, for example, unfinished post and beam construction. Similarly, if no ceiling is installed beneath a floor or roof assembly, the unfinished exposed deck and structural members are considered to be the interior ceiling finish.

TEST METHOD

The standard test method that the NBCC references for the determination of flame spread ratings is CAN/ULC-S102, *Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies*, published by ULC Standards.

AVAILABILITY OF TEST RESULTS

Appendix D-3 of the NBCC, Division B, provides information related to generic flame-spread ratings and smoke developed classifications of a variety of building materials.

Information is only provided for generic materials for which extensive fire test data is available (Table 1). For instance, lumber, regardless of species, and Douglas fir, poplar, and spruce plywood, of a thickness not less than those listed, are assigned a flame-spread rating of 150.

In general, for wood products up to 25 mm thick, the flame-spread rating decreases with increasing thickness. Values given in the Appendix D of the NBCC are conservative because they are intended to cover a wide range of materials. Specific species and thicknesses may have values much lower than those listed in Appendix D.

Specific ratings by species are given in Table 2 below. Information on proprietary and fire-retardant materials is available from third-party certification and listing organizations or from manufacturers. The values listed in Table 2 apply to finished lumber; however, there has been no significant difference in flame-spread rating noted in rough sawn lumber of the same species.

The American Wood Council has additional information in their Design for Code Acceptance publication, *DCA 1 Flame Spread Performance of Wood Products*[2] for the U.S.

PAINTS AND WALL COVERINGS

Normally, the surface finish and the material to which it is applied both contribute to the overall flame-spread performance. Most surface coatings such as paint and wallpaper are usually less than 1 mm thick and will not contribute significantly to the overall rating.

This is why the NBCC assigns the same flame-spread and smoke developed rating to common materials such as plywood, lumber and gypsum wallboard whether they are unfinished or covered with paint, varnish or cellulosic wallpaper as shown previously in Table 1.

There are also special fire-retardant paints and coatings that can substantially reduce the flame-spread rating of an interior surface. These coatings are particularly useful when rehabilitating an older building to reduce

the flame-spread rating of finish materials to acceptable levels, especially for those areas requiring a flame-spread rating no greater than 25.

In general, the NBCC sets the maximum flame-spread rating for interior wall and ceiling finishes at 150, which can be met by most wood products.

For example, 6 mm Douglas Fir plywood may be unfinished, painted, varnished or covered with conventional cellulosic wallpaper. This has been found to be acceptable on the basis of actual fire experience.

This means that in all areas where a flame-spread rating of 150 is permitted, the majority of wood products may be used as interior finishes without special requirements for fire-retardant treatments or coatings.

FLOORING

In a room fire, the flooring is usually the last item to be ignited, since the coolest layer of air is near the floor.

For this reason, the NBCC, like most other codes, does not regulate the flame-spread rating of flooring, with the exception of certain essential areas in high buildings:

- exits;
- corridors not within suites;
- elevator cars; and,
- service spaces.

Traditional flooring materials such as hardwood flooring and carpets can be used almost everywhere in buildings of any type of construction.

More detailed information on the flame-spread rating test, CAN/ULC-S102, and the NBCC provisions related to flame spread rating requirements of interior finishes can be found in Chapter 6 of CWC's *Fire Safety Design in Buildings*.[3]

Table 1. Assigned flame-spread ratings and smoke developed classifications

Materials	Applicable Standard	Minimum Thickness (mm)	Unfinished		Paint or Varnish not more than 1.3 mm Thick, Cellulosic Wallpaper not more than 1 Layer[1][2]	
			FSR	SDC	FSR	SDC
Brick, concrete, tile Steel, copper, aluminum Gypsum plaster	None None CSA A82.220M	None 0.33 None	0	0	25	50
Gypsum wallboard	CSA A82.27-M4 ASTM C 1396/C 1396M	9.5	25	50	25	50
Lumber	None	16	150	300	150	300
Douglas Fir plywood[3] Poplar plywood[3] Plywood with Spruce face veneer[3]	CSA O121 CSA O153-M CSA O151	11	150	100	150	300
Douglas Fir plywood[3]	CSA O151	6	150	100	150	100
Fiberboard low density	CAN/ULC-S706	11	X	100	150	100
Hardboard Type 1 Standard	CAN/CGSB-11.3M	 9 6	 150 150	 X 300	 [4] 150	 [4] 300
Particleboard	ANSI A208.1	12.7	150	300	[5]	[4]
Waferboard, OSB	CSA O437.0 CAN/CSA-O325	– –	[4] [4]	[4] [4]	[4] [4]	[4] [4]

Notes:
(1) Flame-spread ratings and smoke developed classifications for paints and varnish are not applicable to shellac and lacquer.
(2) Flame-spread ratings and smoke developed classifications for paints apply only to alkyd and latex paints.
(3) The flame-spread ratings and smoke developed classifications shown are for those plywoods without a cellulose resin overlay.
(4) Insufficient test information available.

Source: 2010 NBCC Division B, Appendix D, Section D-3.

Table 2. Typical flame-spread ratings and smoke developed classifications of wood products

Product Lumber, 19 mm thickness		Flame-Spread Ratings	Smoke Developed Classifications
Cedar	Western Red	73	98
	Pacific Coast Yellow	78	90
Fir	Amabilis (Pacific Silver)	69	58
Hemlock	Western	60 - 75	-
Maple	(Flooring)	104	-
Oak	Red or White	100	100
Pine	Eastern White	85	122
	Lodgepole	93	210
	Ponderosa	100 – 230	-
	Red	142	229
	Southern Yellow	130 - 195	-
	Western White	75	-
Poplar		170 – 185	-
Spruce	White	65	-
	Sitka	74	74
	Western	100	-
Shakes	Western Red Cedar	69	-
Shingles	Western Red Cedar	49	-

Source: Fire Safety Design in Buildings, 1995.

[1] National Building Code of Canada, National Research Council, Ottawa, ON, 2010.
[2] www.awc.org
[3] Available at www.cwc.ca as a free PDF for download.