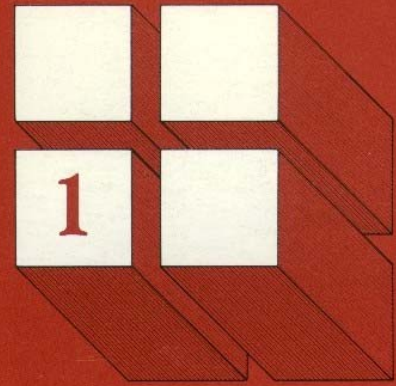


Design for Code Acceptance



Flame Spread Performance of Wood Products

Wood and wood-based products are widely used in interior wall, ceiling, and floor surfaces in all types of buildings.

Appearance, acoustical qualities, and interior design versatility have made wood surfaces highly desired by architects, designers, and building occupants. This publication briefly describes building code flame spread regulations on products used in interior finish and presents performance data on a range of wood products.

Flame Spread Requirements

Most code requirements for wood interior finish materials are expressed in terms of flame spread index numbers. These values are determined in a standard fire test which evaluates the surface burning characteristics of a material. Different maximum flame spread indices are permitted depending upon building occupancy, location of the material in the building, and the presence of sprinklers. Flame spread indices in this publication are provided for wood materials that qualify for various building design requirements.

Test Method

The standard fire test used to evaluate flame spread characteristics of wood building materials in the United States is ASTM E-84, *Standard Test Method for Surface Burning Characteristics of Building Materials*.



Classification in Codes are:

Class	Flame Spread Range	Example Locations
I or A	0-25	Enclosed vertical exits
II or B	26-75	Exit access corridors
III or C	76-200	Other rooms and areas

The test procedure exposes candidate materials in a horizontal, rectangular tunnel 17 3/4" wide by 12" in height and 25 feet long. The tunnel is equipped with two gas burners at one end that direct a flame onto the surface of the test material under a controlled air flow. Flame spreads along the surface of the material as the test progresses. Distance of the flame travel and the rate at which the flame front advances during a 10 minute exposure determine the calculated flame spread index.

To provide standard conditions for each test, the tunnel is calibrated to an index of 0 for noncombustible materials and 100 for 23/32" red oak flooring. Indices for tested materials can range from 0 to over 1000.



Wood Products

Lumber, plywood, and other wood-based materials exhibit a relatively narrow range of flame spread. Differences result from factors such as density, thickness, surface characteristics and chemical constituents. If the material is homogeneous, flame spread may be considered nearly independent of material thickness at thicknesses greater than 1/4".

Flame spread indices for a number of species of lumber, plywood, particleboard, shakes and shingles are listed in [Table 1](#). In products such as softwood and hardwood plywood, the arrangement and type of components may also influence surface flame spread. Some such products are described by face species and core composition in [Table 1](#). All ratings are based on the ASTM E-84 test method.

Flame spread indices for a number of commercially available wood products with factory applied overlay finishes are listed in [Table 2](#). Factory finished wall panels are typically tested and labeled to identify the flame spread classification of the finished product. Finish composition, adhesive, and finish thickness may, however, affect flame spread.

As can be seen from the listed indices, *most tested wood products have a flame spread index less than 200*, making them acceptable under current building codes for a wide range of interior finish uses. Flame spread indices for a range of proprietary wood-based interior finish materials are also available from their manufacturers. Commercially available fire retardant treatments for wood and panel products can reduce flame spread performance to an index of 25 or less. Check with the manufacturer for flame spread index.

A smoke-developed index was also measured for some of the wood products listed in [Table 1](#) and [Table 2](#). This index also has a value of 100 for red oak. None of the products tested exceeded 450, a limiting value commonly used in building code regulations.

While effort has been made to ensure the accuracy of the information in this publication, the American Forest & Paper Association, and the Companies and Associations identified, do not assume responsibility for the accuracy of the indices reported, the applicability or extension of the reported flame spread values to specific products, or their acceptance for use in particular applications.

**Copyright © 1997, 1998, 2001, 2002
American Forest & Paper
Association, Inc.**

Table 1

Reported Flame Spread Indices

Material¹	ASTM E-84 Flame Spread²	Source³	Material¹	ASTM E-84 Flame Spread²	Source³
LUMBER			SOFTWOOD PLYWOOD (Exterior Glue⁶)		
Birch, Yellow	105-110	UL	Cedar 3/8"	70-95	APA
Cedar, Pacific Coast Yellow	78	CWC	Douglas Fir 1/4"	150	APA
Cedar, Western Red	70	HPVA	Douglas Fir 5/16"	115-155	APA
Cedar, Western Red	73	CWC	Douglas Fir 3/8"	110-150	APA
Cherry 3/4"	76	HPVA	Douglas Fir 1/2"	130-150	APA
Cottonwood	115	UL	Douglas Fir 5/8"	95-130	APA
Cypress	145-150	UL	Hemlock 3/8"	75-160	APA
Elm 3/4"	76	HPVA	Southern Pine 1/4"	95-110	APA
Fir, Douglas	70-100	UL	Southern Pine 3/8"	100-105	APA
Fir, Douglas 3/4" flooring	83-98	WEY	Southern Pine 5/8"	90	APA
Fir, Amabilis (Pacific Silver)	69	CWC	Redwood 3/8"	95	UL
Fir, White	65	HPVA2	Redwood 5/8"	75	UL
Gum, Red	140-155	UL			
Hem-Fir Species Group ⁵	60	HPVA2			
Hemlock, West Coast	60-75	WEY, UL	HARDWOOD PLYWOOD⁷		
Larch, Western	45	HPVA2	Ash 3/4" - Particleboard Core	134	HPVA
Maple (flooring)	104	CWC	Birch 1/4" - Douglas Fir Veneer Core	135-173	HPVA
Oak, Red or White	100	UL	Birch 1/4" - Fuma Veneer Core	127	HPVA
Oak, Red 3/4"	84	HPVA	Birch 3/4" - Douglas Fir Veneer Core	114	HPVA
Oak, White 3/4"	77	HPVA	Birch 3/4" - High Density Veneer Core	114	HPVA
Pecan 3/4"	84	HPVA	Birch 3/4" - Particleboard Core	124	HPVA
Pine, Eastern White	85	CWC	Birch 3/4" - MDF Core	134	HPVA
Pine, Idaho White	72	HPVA	Honduras Mahogany 3/4" - Particleboard Core	105	HPVA
Pine, Idaho White	82	WEY	Lauan 11/64"	167	NIST
Pine, Lodgepole	98	WEY	Lauan 1/4"	150	HPVA
Pine, Northern White	120-215	UL	Oak 1/4" - Douglas Fir Veneer Core	153	HPVA
Pine, Ponderosa ⁴	105-230	UL	Oak 3/4" - MDF Core	123	HPVA
Pine, Ponderosa	115	HPVA2			
Pine, Red	142	CWC	PARTICLEBOARD		
Pine, Southern Yellow	130-195	UL	3/16" (Aromatic Cedar Flakeboard)	156	HPVA
Pine, Sugar	95	HPVA2	3/8"	200	UL
Pine, Western White	75	UL	1/2"	135	HPVA
Poplar, Yellow	170-185	UL	1/2"	156	NIST
Redwood	70	UL	5/8"	153	NIST
Redwood 3/8"	102	UL	11/16"	168	UL
Spruce, Engelmann	55	HPVA2	3/4"	145	UL
Spruce, Northern	65	UL	3/4"(Exterior Glue ⁵)	88-98	APA2
Spruce, Sitka	74	CWC	MEDIUM DENSITY FIBERBOARD - MDF		
Spruce, Western	100	UL	3/8"	140	UL
Walnut	130-140	UL	7/16"	125	HPVA
Walnut 3/4"	101	HPVA	5/8"	120	HPVA
ORIENTED STRAND BOARD, WAFERBOARD (Exterior Glue⁶)			11/16"	140	UL
5/16"	127-138	APA2	3/4"	140	HPVA
7/16"	86-150	APA2	3/4"	140	HPVA
1/2"	74-172	APA2	3/4"	130	HPVA
3/4"	147-158	APA2	1"	90	UL
Copyright © 1997, 1998, 2001, 2002 American Forest & Paper Association, Inc.			SHAKES and SHINGLES		
			Western Red Cedar Shakes 1/2"	69	HPVA
			Western Red Cedar Shingles 1/2"	49	HPVA

TABLE 1 FOOTNOTES

¹ Thickness of material tested is one-inch nominal except where indicated.

² The ASTM E-84 test method has been revised a number of times during the years referenced by the source reports. However, the E-84 test apparatus has changed little over this period. Slightly different flame spread indices, usually lower, result when recent E-84 flame spread calculation techniques are applied to older wood product data. These changes in flame spread indices are not sufficient to change the flame spread class for the wood products described in this report.

³ Sources:

APA -APA-The Engineered Wood Association, Research Reports 128, Revised, August 1979.

APA2 - APA-The Engineered Wood Association Test Results

CWC - *Fire Safety Design in Buildings*, Canadian Wood Council, 1996.

HPVA -Hardwood Plywood and Veneer Association, Test Reports, 202, 203, 335, 336, 337, 592, and 596; Special flame spread performance tests, Aug. 1974; T9234, T9237, T9317, T9344, T9354, May 1995; T9422, T9430, T9431, T9453, T9665, Feb/July 1997.

HPVA2 - Hardwood Plywood and Veneer Association, March/April 1995; October/December 2000.

NIST-National Institute of Standards and Technology (formerly National Bureau of Standards), Technical Notes 879 and 945.

UL -Underwriter's Laboratory, UL 527, May 1971; Subject 723, Assignment 71SC509, Mar 15 &16,1971; Assignment 84NK1898, File R10917, Mar 9, 1984.

WEY -Weyerhaeuser Fire Laboratory, 1973, 1987, January & February 1988.

⁴ Average of 18 tests was 154 with three values over 200.

⁵The Hem-Fir Species Group represents six species: Californian Red Fir, Grand Fir, Nobel Fir, Pacific Silver Fir, Western Hemlock, and White Fir. The reported flame spread index represents a product containing a mixture of these species. When lumber is from a single species refer to the specific species flame spread index.

⁶ Exposure 1 or exterior.

⁷ Flame spread of plywood is affected by the species of the face veneer but can also be influenced by the species of the underlying core veneer. Various panel constructions involving certain core species show a relatively high degree of variability and potential to yield flame spread values above 200. Panel constructions involving cores of aspen, sumauma, yellow poplar and white fir have exhibited this behavior with average flame spread indices ranging from 78 to 259. Other factors, in addition to species, including material and process variables related to specific manufacturers can also affect flame spread. Thus, for plywood panels with certain core species, test data from the actual manufacturer is particularly important in establishing the flame spread classification of the product.

Copyright © 1997, 1998, 2001,2002
American Forest & Paper Association, Inc.

Table 2

Reported Flame Spread Indices of Factory Finished Products

Material ¹	ASTM E-84 Flame Spread
PARTICLEBOARD	
5/32" Factory Finished Printed	116-178
5/32" Paper Overlay	159-176
5/32" Vinyl Overlay	180
1/4" Vinyl Overlay	127
3/8" Vinyl Overlay	130
1/2" Vinyl Overlay	175
5/8" Vinyl Overlay	100
MEDIUM DENSITY FIBREBOARD (MDF)	
3/16" Factory Finished Printed	167
1/4" Vinyl Overlay	121
HARDBOARD	
1/8" Paper Overlay	155-166
1/8" Vinyl Overlay	164
3/16" Vinyl Overlay	148
HARDWOOD PLYWOOD	
Cherry 1/4" Factory Finished	160
Elm 1/4" Factory Finished	130-145
Hickory 1/4" Factory Finished	140
Lauan 1/4" Factory Finished Printed	99-141
Lauan 1/4" Vinyl Overlay	120
Lauan 3.6mm Factory Finished Printed	123-191
Lauan 3.6mm Vinyl Overlay	108-158
Lauan 3.6mm Paper Overlay	132-190
Maple 1/4" Factory Finished	155
Oak 1/4" Factory Finished	125-185
Pecan 1/4" Factory Finished	145-150
Pine 1/4" Factory Finished	120-140
Walnut 1/4" Factory Finished	138-160
SOFTWOOD PLYWOOD	
1/4" Douglas Fir w/Medium Density Overlay ²	140
3/8" Douglas Fir w/Medium Density Overlay ³	110
3/8" Douglas Fir w/High Density Overlay ³	110
ORIENTED STRAND BOARD, WAFERBOARD (Exterior Glue⁴)	
7/16" Phenolic Paper Overlay ³	150-155
FOOTNOTES	
¹ Source: Hardwood Plywood and Veneer Association Test Records, except as noted.	
² Canadian Wood Council, <i>Fire Safety Design in Buildings</i> , 1996.	
³ APA - The Engineered Wood Association Test Results.	
⁴ Exposure 1 or exterior.	
Copyright © 1997, 1998, 2002 American Forest & Paper Association, Inc.	