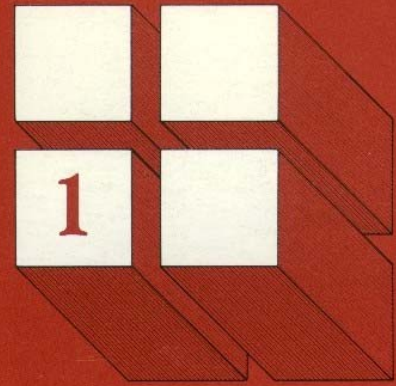


Design for Code Acceptance



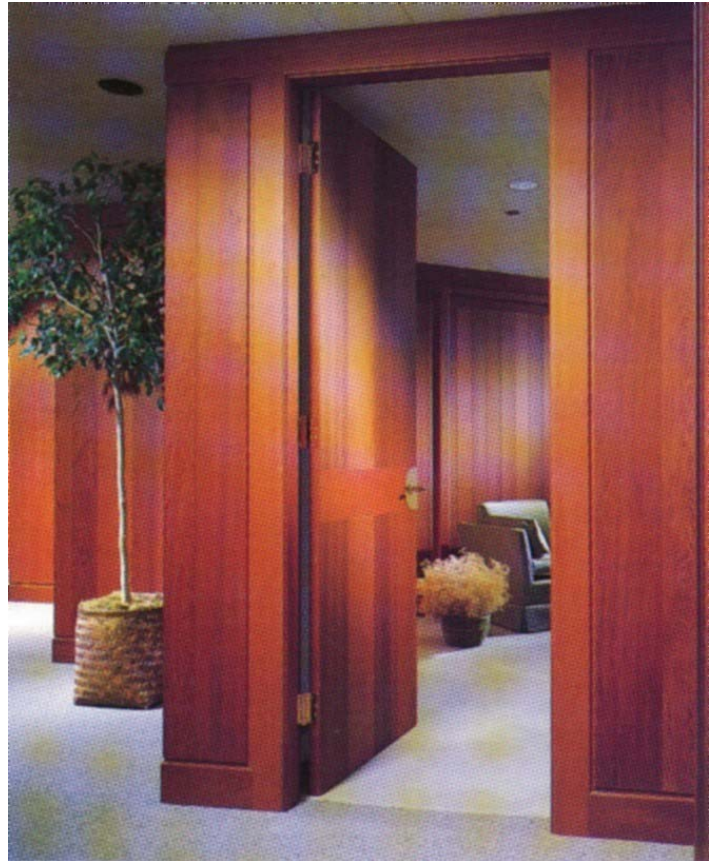
Flame Spread Performance of Wood Products

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.

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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, summauma, 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.

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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. | |
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