INTRODUCTION

"Fire-retardant-treated wood" (FRTW), as defined by the *National Building Code of Canada (NBCC),*[1] is wood which has been impregnated with fire-retardant chemicals in solution under high pressure in accordance with the CAN/CSA-O80 Series of Standards, *Wood Preservation*.

This means that any wood product that has been only coated on the surface (or has been impregnated using some method other than pressure-impregnation in accordance with the CAN/CSA-O80 Series of Standards) does not meet the NBCC definition of "fire-retardant-treated wood". As a result, in Canada, a more appropriate term for wood products using fire-retardant surface coatings is "fire-retardant-coated wood".

The treatment used in FRTW (as defined by the NBCC) reduces surface burning characteristics, such as flame spread, rate of fuel contribution and smoke contribution.

FRTW contains different chemicals than products known as preservative treated wood. However, the same manufacturing process is used to apply the chemicals. The products are not interchangeable. FRTW products are harder to ignite than untreated wood products.

Fire-retardant chemical treatments applied to FRTW retard the spread of flame and limit smoke production from wood in fire situations.

Fire-retardant treatments applied to FRTW enhance the fire performance of the products by reducing the amount of heat released during the initial stages of fire. The treatments also reduced the amount of flammable volatiles released during fire exposure. This results in a reduction in the rate of flame spread over the surface. When the flame source is removed, treated wood ceases to char.

During a fire, fire-retardant chemicals begin to react when temperatures reach a point slightly below the point where wood will ignite. Non-flammable gases and water vapour are formed and released at a slow steady rate thereby insulating the wood fibres from temperatures that would cause them to burn.

The fire-retardant treatments used in FRTW do not generally interfere with the adhesion of decorative paint coatings unless the treated wood has an increased moisture content. The finish characteristics of particular products should be discussed with the manufacturers of the treated wood.

FLAME-SPREAD RATING

FRTW as defined and specified in the NBCC must have a flame-spread rating of not more than 25. It therefore qualifies as an interior finish for any application since the most restrictive flame-spread rating is 25. FRTW must be identified by a label (Figure 1) from an independent testing laboratory or certification organization which indicates that the necessary tests were performed and production controls maintained.

For many wood species, and particularly plywood and lumber in sizes common to frame construction, FRTW treatment results in chemical retentions high enough to obtain a flame-spread rating of 25 or less. It should be noted that the chemicals will not usually penetrate the entire wood member, as refusal will usually occur when the chemicals have penetrated approximately 13 mm from the outer surface of the product.

The actual flame-spread rating of treated lumber or plywood depends on the fire-retardant chemicals used and the amount of chemicals retained in the wood, which depends on several factors, including wood species.

Commonly used chemicals are proprietary mixtures which are free of halogens, sulphates, ammonium phosphate and formaldehyde. These provide superior performance characteristics over previous formulations

and lower corrosivity to metal fasteners. These water-soluble chemicals are effective in reducing flame spread, and through careful proportioning succeed in reducing smoke development and afterglow.

To dispel any myths that may still exist, it should be understood that the fire-retardant treatment does not make the wood noncombustible. This idea stems from certain earlier versions of building codes which equated a 25 surface flame-spread rating to noncombustibility. The 2010 NBCC uses a different method to determine "noncombustibility" (CAN/ULC-S135, *Standard Method of Test for Determination of Degrees of Combustibility of Building Materials Using an Oxygen Consumption Calorimeter (Cone Calorimeter)*), and FRTW does not meet the noncombustibility criteria under that method.

The use of a fire-retardant treatment does not prevent ignition or charring. The rate of burn through fire-retardant-treated wood is approximately the same as that for untreated wood, even though ignition is more difficult and the rate at which flame travels across its surface (FSR) has been reduced.

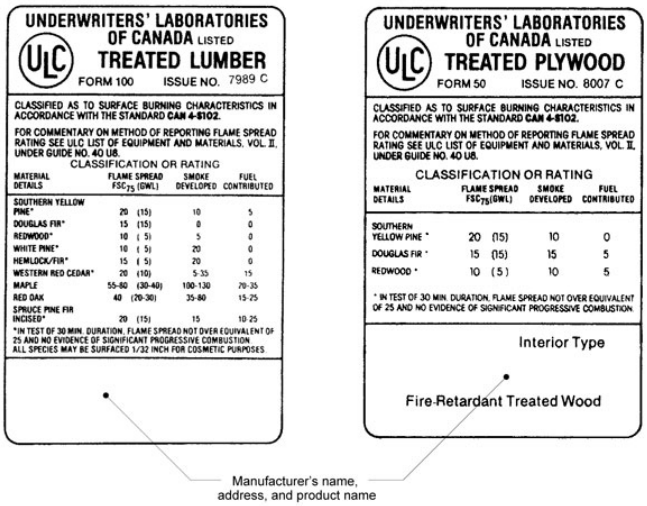

Figure 1. Sample labels/markings from one independent certification organization for fire-retardant-treated lumber and plywood.

FRTW is generally restricted to interior use because of the possibility that the protective salts in the treatment chemicals will leach out of the materials if they are exposed to the weather.

FRTW products are used in many interior applications, such as millwork and panelling, where the code requirements for flame spread are most restrictive. The Canadian building codes also permit the use of fire-retardant treated lumber and plywood for roof and floor trusses, beams, interior roof decks, and for interior load-bearing and non-load bearing partitions.

FRTW is suitable for indoor applications where the humidity is not expected to exceed 60 percent for long periods of time. FRTW should be protected from excessive moisture and weather during transit, storage, and erection. While some wetting might be expected during installation, frequent wetting or ponding is unacceptable. In general, FRTW requires more care in installation than would normally be considered sufficient good practice for non-FRTW products.

Exterior Use

When FRTW products are used in areas where the material is exposed to weather or high humidity, it must be treated with special non-leaching chemicals similar to those used for fire-retardant treated cedar shakes and shingles.

An accelerated weathering test (ASTM D2898) exposes FRTW to regular wetting and drying cycles to represent actual long-term outdoor conditions. FRTW must still achieve a flame-spread rating of 25 after undergoing this accelerated weathering procedure in order to qualify for exterior use.

These requirements apply to products used, for example, as exterior grade fire-retardant treated plywood siding over wood studs in exterior walls of noncombustible buildings and FRTW decorative cladding on exterior marquee fascias of noncombustible buildings.

FIRE-RETARDANT COATINGS

As mentioned above, in addition to chemical impregnation by pressure-treating that produces FRTW, there are also fire-retardant coatings that can be applied to the surface of wood products (referred to as "fire-retardant-coated wood" (FRCW)) to reduce the surface flame-spread rating to less than 75 or 25. These coatings, are generally used for architectural woodwork applications where appearance is important.

These coated products can be used for interior finish in noncombustible buildings under the NBCC except where the flame-spread rating limits apply not only to exposed surfaces but also to surfaces that may be exposed by cutting through the product in any direction. FRTW products are excluded from these requirements, while products protected by fire-retardant coatings are not. This recognizes the permanency of the pressure-impregnated fire-retardant treatments.

The image shown here is a photo of the attic of a church. Trusses in the attic spaces were fire-stopped and coated with a fire-retardant paint. This avoided the cost of sprinklering the concealed spaces.

Fire-retardant coatings are available in clear and white finishes. Where a solid colour is required, one or two coats of alkyd paint can be applied over the clear or white fire-retardant coating with only a small increase in the flame-spread rating. Check with manufacturers of specific products for more information.

The reaction of these coatings to fire and the actual mechanism of protection varies according to the composition of the coating. Some of the basic mechanisms of protection are as follows:

- Insulation: thick coatings that insulate the treated material against high temperatures.
- Crust formation: the coating melts under the action of heat, covering the treated material with an impermeable insulating crust.
- Heat absorption: the coating absorbs the heat and maintains the temperature of the protected surface below its ignition temperature.
- Intumescent insulation: the coating swells when heated to form a thick insulating layer that delays the spread of flame and the transmission of heat to the protected surface.

Like FRTW products, wood products protected by fire-retardant coatings, because of their reduced flame-spread rating, canbe used in areas where untreated wood products cannot be used. However, many fire-retardant coatings are not suitable for use in high humidity or exterior applications.

Fire-retardant coatings are manufactured as proprietary products. For specifications on rate of coverage and tested properties, a manufacturer should be consulted.

These products can be applied by brush, roller, or sprayer. Because fire-retardant coatings are usually high viscosity (thick) liquids, they should be maintained at room temperature, especially when spray-applied, to ease application. Where appearance is important, two light coats, to reduce sagging, are superior to one heavy coat and usually provide the required flame-spread characteristics as long as total application thickness is achieved.

FIRE-RETARDANT-TREATED WOOD ROOF SYSTEMS

In certain unsprinklered one-storey buildings, the NBCC permits the use of a roof deck construction system using FRTW that meets the flame-spread performance standard originally developed for noncombustible roof assemblies.

The required fire-resistance rating of the roof assembly can be waived if the deck is constructed of FRTW and the assembly passes the requirements of CAN/ULC S126

Standard Method of Test for Fire Spread Under Roof-Deck Assemblies.

A roof deck system of FRTW may be supported by:

- metal and reinforced concrete beams or joists;
- heavy timber supports; and/or,
- FRTW joists or trusses.

When supporting an FRTW roof system, unless the wood members are heavy timber, which has an inherent capacity to withstand fire exposure, they must be fire-retardant treated. Experience shows that both lumber and plywood decking must have a minimum actual thickness of 19 mm and both should be tongue and groove. Plywood decking, if not tongue and groove, must also have unsupported joints solidly backed with FRTW or plywood.

Figure 2 shows that the construction of roof assemblies using FRTW is similar to that of other types of roof assemblies, using a metallic vapor barrier membrane between the decking and the insulation. Usually 0.05 mm aluminum sheeting is attached with an approved adhesive, although steel foil is also acceptable. Galvanized roof nails may be used to fasten the insulation to the vapor barrier which is then stapled to the deck.

FRTW or noncombustible ceilings may be attached to the underside of the system, with the resulting concealed spaces appropriately fire stopped.

FRTW roof assemblies are permitted as an alternative to roof assemblies of noncombustible construction or ordinary wood-frame roof assemblies having a fire-resistance rating of 45 minutes. When used, however, the NBCC requires that, except for mercantile or light industrial occupancies, the area of the building be half that which would be permitted if either of the other two types of roof assembly were used.

As noted earlier, fire-retardant-coated wood is not the same as FRTW, and FRTW is specifically cited in the NBCC for this application; therefore, fire-retardant-coated wood is not permitted to be used under this requirement. However, its use may be accepted via approval of an alternative solution by the Authority-Having-Jurisdiction.

More detailed information about fire-retardant-treated wood and the NBCC provisions related to it can be found in Chapter 6 of CWC's *Fire Safety Design in Buildings.*[2]

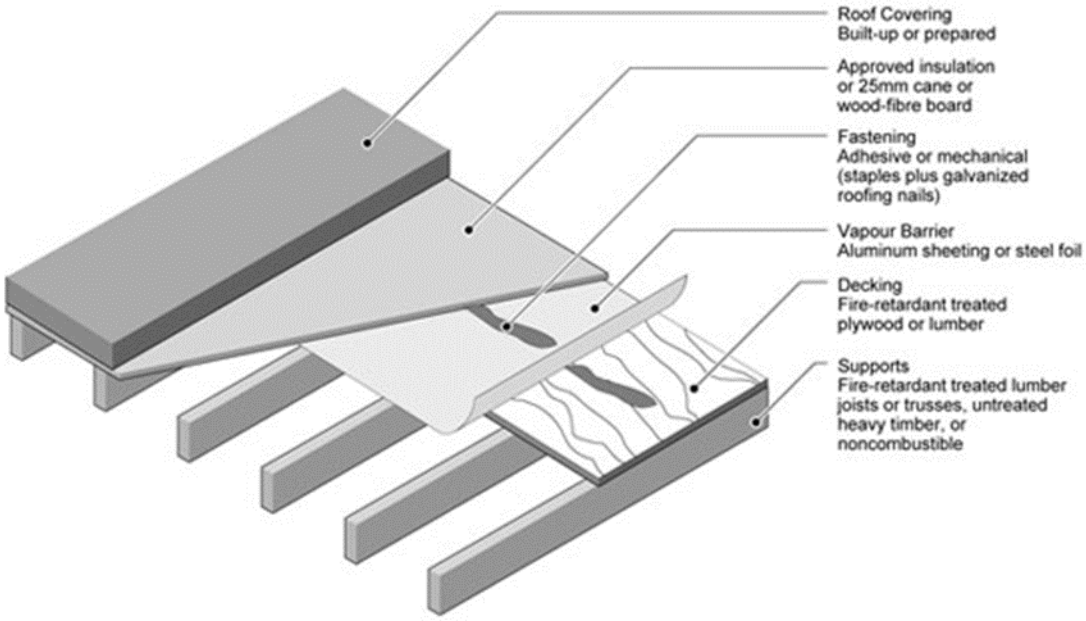

Figure 2. Fire-retardant-treated wood roof system.

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