

# Where there's smoke, there may be wildfire

**W**hether the blame goes to global warming, climate change, El Nino, urban expansion, careless smokers and campers, or some combination of this gang of usual suspects, it is clear that wildfires can take a devastating toll on residential and commercial structures, destroying many thousands of buildings each year. The use of specialty protective coatings, however, can significantly reduce the likelihood or severity of the effects of fire on vulnerable buildings.

In addition, these coating materials could gain additional prominence in protecting buildings and properties in the line of wildfires that annually destroy thousands or millions of acres of parched woodlands and brushlands in California, other western states, and Florida. The threat of such damage continues to mount, as development extends further into remote, formerly sparsely-populated areas.

A launch into any discussion of flame-protection coatings requires clarification of the terms used. ASTM E176, *Standard Terminology of Fire Standards*, makes several important and relevant distinctions, as follows.

**Flame resistance:** The ability to withstand flame impingement or give protection from it

**Fire retardancy:** The ability of a paint to retard the spread of flame over a coated substrate, usually at the sacrifice of the paint film

**Flame-retardant coating:** A fluid-applied surface covering on a combustible material which delays ignition and reduces flame spread when the covering is exposed to flame impingement

**Specialized coatings technologies can boost protection of buildings and properties in the line of forest, brush fires**

## Passing the test

**Allen Zielnik  
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**Fire-retardant coating:** A fluid-applied surface covering on a combustible material which delays ignition and combustion of the material when exposed to a fire

Based on these definitions, it can be concluded that fire-protective coatings possess at least two important properties: First, prevention or delay of ignition and combustion of the substrate, and second, limitation of the amount or rate of flame spread.

These separate functionalities are reputed to be provided by the various commercial coatings on the market. When applied to non-combustible materials such as steel beams, the objective, obviously, is not to prevent combustion, but rather to limit thermal weakening of the structural member and heat transfer to combustible materials. Fire-retardant products are typically applied to com-

combustible materials, and are applied like paints by brush, roller, or spray. Fire-resistant coatings are applied in much greater thicknesses and are generally sprayed or troweled to delay heat penetration through a substrate.

Most light-commercial and residential buildings, and some industrial structures, are of the "wood-stick" framing type of construction, and additionally involve the use of potentially combustible cladding and insulation materials such as foam. In addition, the widespread use of engineered-wood products such as glue-lam beams and trusses, sandwich panels, plywood, and OSB (oriented strand board) provide good sources of combustible fuel.

So how does the fire retardant work? Although some specialized technologies exist, the majority of fire-protective coatings work by reducing the flammability of materials by either blocking the fire physically or by initiating a chemical reaction that stops it.

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### Physical retardancy

- Chemical reactions that cool the materials
- Formation of a protective layer
- Dilution and release of water vapor or gas to restrict or extinguish the fire

### Chemical retardancy

- Gas-phase reactions such as the release of halogens like bromine or chlorine
- Char formation to create a carbon layer
- Intumescence, or expansion and formation of an insulating layer under the surface char

### Testing and evaluating fire-resistive coatings

So how are fire-preventative or fire-resistive coatings tested and evaluated? The primary specified test is ASTM E84, *Standard Test Method for Surface Burning Characteristics of Building Materials*. This test is frequently referred to as the "Steiner tunnel" test for surface flame spread and smoke generation. Developed by Al Steiner for testing building materials such as wood or gypsum board at Underwriters Laboratories in 1944,

the Steiner tunnel test has been standardized by the major North American standards-writing organizations (ASTM E-84, NFPA 255, UL 723, ULC S102) and widely incorporated into every North American building and fire code.

The test procedure makes use of a 25-foot-long, vented tunnel, lined with firebrick, with the test material mounted to the top of the chamber. At one end of the chamber, the sample is subjected to a high-energy flame for ten minutes. Flame spread is determined visually through windows built into the tunnel, and a light meter measures smoke density. These tests have also been adopted by the International Code Council in AC308, *Acceptance Criteria of Surface-Applied Fire-Retardant Coatings*.

### Test class ratings

ASTM E84/UL-723 class ratings are determined from burn tests of the coating on two reference material substrates, red-oak lumber and asbestos cement board, which are assigned values of 100 and 0, respectively. The test material is assigned a burn rating relative to these numbers. For example, a material that burns twice as fast as red oak would be given a flame spread rating of 200.

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Class	Flame spread
"A" or I	0-25
"B" or II	26-75
"C" or III	76-200

Remember, this rating applies only to a specific, single component such as a paint film. Most properly applied fire-retardant coatings typically reduce the flame spread to 25 or less, and fall into the Class A category, with top-performing products in the 5-10 range.

A similar smoke-density rating system is applied for smoke generation. A smaller laboratory version of the Steiner test is defined in ASTM D3806, *Standard Test Method of Small-Scale Evaluation of Fire-Retardant Paints (2-Foot Tunnel Method)*. The E84 method, however, has become the *de facto* specification requirement. Interior large-scale room corner burn test methods also exist, but only a few manufacturers have this type of test data available for comparison.

Architects and construction specifiers may be familiar with hourly ratings for the fire endurance of products and materials; these, however, apply to the ability of an assembly to prevent the spread of fire between spaces while maintaining structural integrity. Therefore, these ratings apply to assemblies such as doors, walls, ceilings, etc., but not to single components such as coatings. It should also be noted that some flame-retardant paint additives are sold that can be added to coatings; the effectiveness of these products may vary, however.

It should be kept in mind that standard tests such as the Steiner tunnel test represent artificial conditions that may not be precisely representative of actual conditions in the field. To empirically illustrate the performance of their products, several of the major manufacturers of fire-protective coating systems also provide anecdotal information, often in the form of informative video demonstrations, of actual structural burn tests. While qualitative in nature, these demonstrations can often provide the architect or builder with supporting information about the effectiveness of products under consideration.

Fire-protective coatings are most effectively used in a whole-building approach. This

involves the application of protective coatings on all combustible surfaces during the construction phase, including structural framing, joists, and the back side of interior surfaces, such as paneling, flooring, and wallboard, as well as the building exterior. The use of a total-building approach can

reduce the amount of fire damage or delay fire spread to allow time for primary fire-fighting activities, an important attribute in less-developed, more-remote areas.

Fire-protective coatings are currently available in a variety of forms, from latex paint to stains and clear varnishes. When properly

#### ADVERTISEMENT

continued from page 142

Albert leaned toward him and asked, "But what about a roof that is all rusted over? You know, like a metal roof. What then?" Without missing a beat Todd answered, "Mule-Hide A-300." They both sat in silence for what seemed like an eternity and an hour until Albert drew in a breath and started to speak, only to be cut short by Todd who again said, "Mule-Hide A-300."

"So you're trying to tell me," said Albert incredulously, "that I can cover up my existing metal roof and improve its appearance without reroofing?" He began to stand up as if he couldn't control himself any longer. "You're telling me that this coating can extend the life of my existing roof?"

"Yup," said Todd, "in fact, it's truly elastomeric nature allows it to expand and contract as temperatures shift and rose slowly to encourage Albert to relax his cool. "It maintains its remaining flexible and staying at temperatures ranging from degrees below zero all the way up to sweltering 200 degrees. It's the only in this part of the country that can make much difference."

"Wrong again, my friend," replied Todd. "In fact, it'll save you money. The bright white finish reduces energy consumption. It's CRRC® and ENERGY STAR® listed; and you can lower cash outlays and minimize tax expense allowances by expensing roofing systems versus capital depreciation."

"Hold it! Now you've let me in once again," said Albert.

Todd turned to Albert and said, "The eyes and nose of the cash outlay, tax expense allowance systems, simple and easy."



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*Room-corner burn demonstration for fire-resistive coatings: In the left structure, the chair and drapes were treated with a fire-retardant material and the walls were treated with an intumescent fire-resistive latex paint. The structure on the right was untreated. Photo courtesy of NoBurn Inc.*

applied by factory-certified applicators, the use of these coatings may qualify the owner for insurance-rate discounts. In some cases, a similar level of protection, but at reduced cost, can be achieved with these materials in comparison to dry sprinkler systems. Of course, even where economic incentives do not apply, the opportunity for minimizing potential risks to occupants should be an important consideration, especially for schools, clinics, nursing homes, public buildings, etc.

Not all fire-protective coatings are suitable for weatherable exterior use, however. As with any coating, the potential for UV- and moisture-induced degradation can reduce fire-resistance properties or cause coating failure such as delamination. Not all manufacturers provide field data to support product claims, so the architect or specifier should require some proof of weatherability. Those manufacturers that do supply performance documentation typically offer a five-year product warranty.

In addition to the primary fire-protective properties, some coatings systems also incorporate biocides for mold and mildew prevention. At least one manufacturer of such dual-purpose coatings has teamed with a mortgage lender to offer a discount on loans for new construction.

### The marketplace

Several dozen manufacturers offer various fire-protective coatings, and a number of manufacturers specialize in this type of technology with a product line. Specialized manufacturers of note include FireFree Coatings, Flame Control Coatings, HyTech Thermal Solutions, NoBurn Inc., and Universal Fire Shield. Some of the major national and regional paint and coatings companies also offer products of this type.

As with all coatings, these products are subject to environmental and regulatory issues involving VOC content, so the prospective coating should be evaluated to ensure it is suitable and authorized for the given application and location. Qualifications for points under the LEED (Leadership in Energy and Environmental Design) rating system or otherwise "green" certified coatings should taken into account.

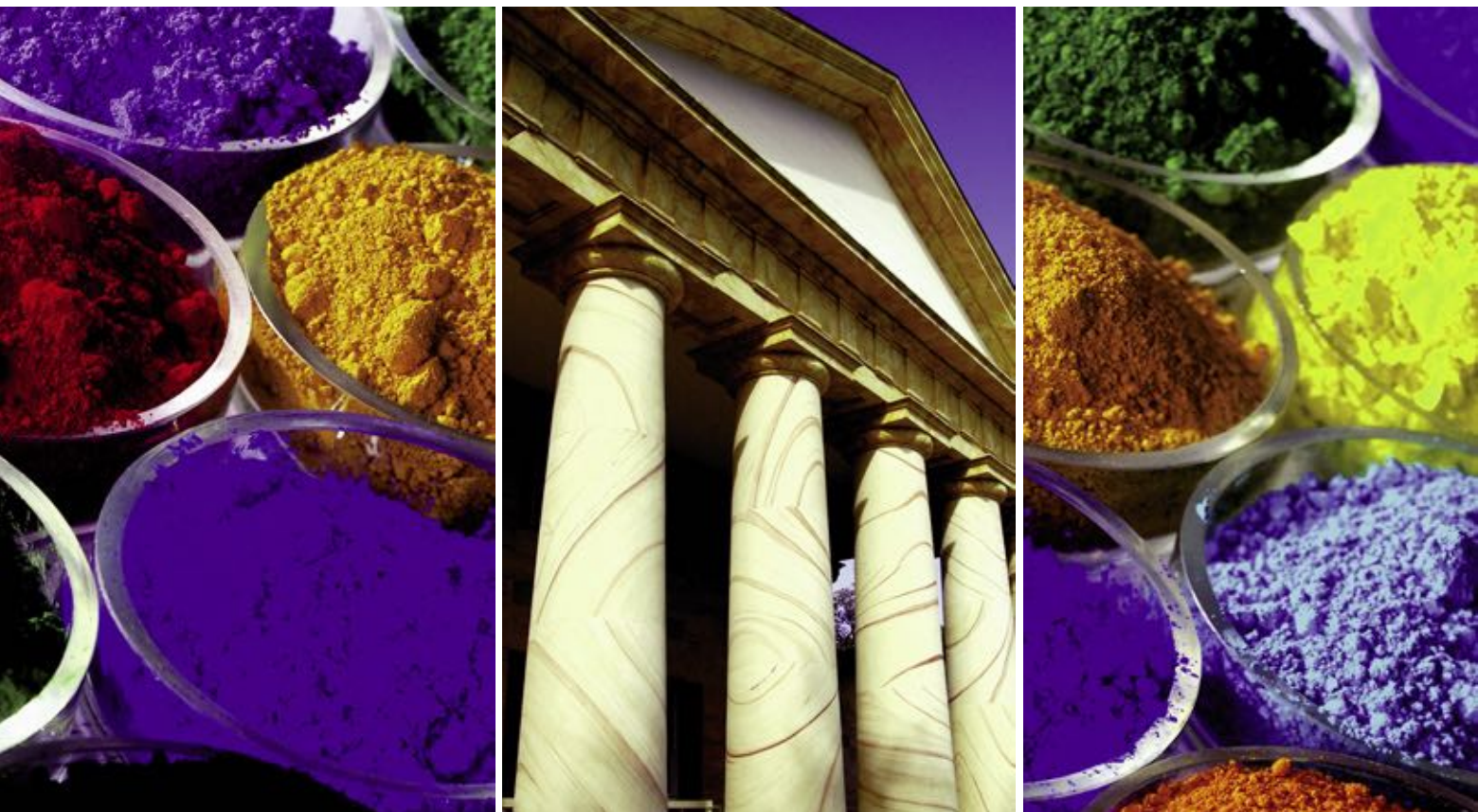
In considering fire-retarding or fire-resistive performance, the specifier or user should aim for "Class-A" rated fire protection and the lowest (best) flame-spread number. For interior applications, a corresponding smoke-density rating of 50 or less should be the objective. The manufacturer should state that the product is appropriate for specific substrates, as a variety of formulations are typically offered. The potential for insurance discounts should be investigated, as should a determination of whether the application must be done by certified contractors. Also meriting attention are the benefits of dual-purpose coatings that incorporate mold inhibitors.

In general, the greater the number of independent laboratory certifications, test data, and application case studies, the better the confidence the user will have in the protection capabilities of the product. Inquiry should also be made about service warranties, reapplication expectations, and insurance-premium discounts, as well as initial product cost. And remember, these products perform against fires started inside buildings, too, and not just against the wild-fire roaring through parched forests or brushlands.





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USA

Toll Free 866-906-5346  
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