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Ignition Potential of Decks Subjected to an Ember Exposure: Executive Summary

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Introduction

During a wildfire, attached decks can be a vulnerable component of a building. If ignited by flames or by wind-blown embers, a burning deck could then ignite the adjacent building. An underdeck flame impingement exposure is used to evaluate deck performance as part of the current California State Fire Marshal and American Society for Testing and Materials (ASTM) standard test methods, as well as the California Building Code that applies to construction in wildfire-prone areas. To pass the California standard, a deck can ignite, but the heat released while burning cannot exceed the specified maximum heat release rate. Although the California State standard test method acceptance criteria includes the ability for a decking product to self-extinguish, it is not one of the requirements for compliance based on language in Chapter 7A of the California Building Code. The vulnerability and performance of decking subjected to an ember exposure is not considered. Given both the possible distance that wind-blown embers can travel and the typical size of most residential and commercial properties, it would not be possible to reduce the ember exposure to a deck with even the most effective defensible space on an individual property. Therefore, understanding the threat of an ember exposure to a deck is critical to understanding its vulnerability to wildfire.

The objectives of this study were to (1) evaluate the ability of an ember exposure to directly ignite combustible wood and plastic composite decking, and (2) evaluate the effectiveness of the standard underdeck flame impingement exposure test to predict the performance of combustible decking subjected to an ember exposure.

Description of Testing

Eight different deck board products were evaluated by subjecting them to wind-blown ember exposures in the IBHS Research Center test chamber. Material types included wood, both fire-retardant treated (FRT) and non-fire-retardant treated, and plastic composite (PC) products composed specifically of wood fiber and either polyvinyl chloride (PVC) or polyethylene (PE) thermoplastics. Some of the decking products complied with the standard test method and acceptance criteria specified in Chapter 7A, and some did not. (Refer to Table 1.) The PC products used in testing were capped—including a thin co-extruded part of the deck board that constitutes the outer surface—and non-capped options. All test decks were 5 ft x 5 ft (1.5 m x 1.5 m). The between-deck-board gap was nominally 1/8-in. (3 mm) wide. The deck boards were attached to four joists that were spaced 16 in. (40 mm) on-center.

Table 1. Information for deck board products used in experiments.

Deck Name	Abbreviation	Type	7A Compliant	Capped
PVC Composite	PVC	PC	Yes	No
PE Composite 1	PE-1	PC	No	No
PE Composite 2	PE-2	PC	Yes	No
PE Composite 3	PE-3	PC	Yes	Yes
PE Composite 4	PE-4	PC	No	Yes
High-Density Tropical Hardwood	H	Wood	Yes	N/A
Medium-Density Softwood	S	Wood	Yes	N/A
FRT Wood	FRT	Wood	Yes	N/A

Summary

Wind-blown ember exposures resulted in smoldering and flaming ignitions at multiple locations on the deck. Where sustained and transitory flaming occurred, flame heights were low. Sustained flaming was defined as continuous flaming for more than five seconds. Transitory was defined as continuous flaming for less than five seconds.

Table 2 provides ignition results quantified by visual observations, with one exception: the PC decking products initially exhibited smoldering combustion, but did not transition to flaming. For one replication of the PE-1 decking product, sustained flaming occurred after an approximate 48-minute ember exposure. The transitory flaming observed in the high-density hardwood decking product began after an approximate 47-minute exposure. The medium-density softwood decking product developed sustained flaming after an approximate 12-minute ember exposure.

Table 2. Observations of smoldering and flaming ignition during ember exposure tests.

Deck Type	Performance	
	Replication 1	Replication 2
PVC	Smoldering	Smoldering
PE-1	Smoldering	Sustained Flaming[1]
PE-2	Smoldering	Smoldering
PE-3	Smoldering	Smoldering
PE-4	Smoldering	Smoldering
H	Smoldering	Transitory Flaming[2]
S	Sustained Flaming	Sustained Flaming
FRT	Smoldering	Smoldering

[1] Continuous flaming for more than five (5) seconds
[2] Continuous flaming for less than five (5) seconds

The current experiment evaluated the performance of the decking assembly without contribution of vegetation or other combustible materials that could be located under or on a deck. If ignited, nearby combustible materials would likely result in a more severe exposure to the deck and would also likely reduce the capability of an ignited material to self-extinguish. Additionally, the accumulation of vegetative debris at the deck-to-wall juncture and in the between-deck board gaps would have likely facilitated ignition and possibly facilitated the transition from smoldering or glowing to flaming. Results presented here are, therefore, not the worst-case condition or even the most typical condition. Instead, they represent a condition that provides for, in our opinion, the lowest likelihood of ignition by embers and the highest opportunity for self-extinguishment.

Conclusions

Results indicated that smoldering and flaming ignitions consistently occurred at deck board gaps above a joist location. The time-to-flaming ignition varied from between 12 minutes for the non-FRT softwood deck (S) and 47 minutes for one of the PC products. Although the ember flux was not measured, this variation in time-to-ignition provided relative information on the susceptibility of decking products to ignition from wind-blown embers.

Consideration of these experimental results and the compliance provisions provided in Chapter 7A point to a limitation in the way nominally combustible decking products are evaluated and accepted. As anecdotally acknowledged by firefighting professionals, ember ignitions of buildings that are ultimately destroyed during a wildfire typically start out as small fires. Left unattended, these small fires grow. A critical component in understanding the vulnerability of a deck attached to a building was whether flames from an ignited deck could spread to the building or whether they would eventually self-extinguish. It may be impractical for a test conducted in a commercial fire lab to evaluate flame spread under wildfire conditions and with the complexity of a deck attached to a building, but evaluating the ability to self-extinguish is reasonable.

A realistic measure of flame spread and a provision that provides information on the ability of a product to self-extinguish would improve the procedures by which nominally combustible decking products are accepted for use. Given the use of these combustible products, more stringent defensible space requirements (i.e., the selection, placement, and maintenance of vegetation and other combustible materials on the property), including adoption of an underdeck noncombustible zone, would reduce the vulnerability of these products.