



EVALUATING THE PERFORMANCE OF DECKS UNDER REALISTIC WILDFIRE CONDITIONS

Executive Summary

Key Takeaways

Research conducted by the Insurance Institute for Business & Home Safety (IBHS) has shown that during a wildfire, decks are a path for fire to reach a home. The best practices that resulted from the research described here are included in IBHS's [Suburban Wildfire Adaptation Roadmaps](#) and [Wildfire Ready Guide](#).

IBHS testing has revealed the following key insights:

- It is critical for the area beneath decks to be free of combustible materials.
- Fires that develop underneath a deck often spread to the wood joists and substructure. This leads to a more intense fire than those that begin on top of the deck. These intense fires under a deck are more likely to spread and ignite the home.
- Homes with decks overhanging sloping terrain should manage the down-slope landscaping and vegetation to minimize the potential for flames to extend under the deck.

If a deck ignites, the fire intensity is strongly linked to the joist material and wind conditions; the walking surface material is secondary.

For new construction, the following are critical:

- Metal joists are the best choice for new decks. They can cost approximately 30% more than wood joists but last significantly longer and have better performance. Because metal joists are noncombustible, they help reduce the risk from fire under a deck, fire from ember accumulation, and ignition in the gaps between the surface deck boards.
- IBHS also observed that higher-density deck boards (e.g., plastic composite and hardwood deck boards) were less vulnerable to ignition from embers. These high-density materials should be used with metal joists to maximize risk reduction.

For existing decks, mitigation actions must focus on keeping fire away from the area under the deck. A fire under the deck that spreads to wood joists can overwhelm any benefits of using higher-density deck boards above. The cost of changing the walking surface is too high relative to the gain in risk reduction if wood joists remain.

IBHS testing evaluated the standard test methods for deck materials and identified areas where test standards can be improved. IBHS recommends the following proposed changes to the current California building code test standards (SFM-7A-4A and ASTM E2632) for evaluating fire resistance of decks:

- Increase the size of the test specimen to be more representative of a real deck, at least 6 ft x 6 ft.
- Test specimens should be fully framed like an actual deck would be. The current methodology does not require all framing elements to be present.
- Include wind flow as part of the testing parameters.

- By making the test more realistic relative to real-world deck construction and wildfire conditions, our results showed that most common deck materials are more vulnerable to wildfire than indicated by standard testing methods.

Background

Depending on the frequency of maintenance around a building, a noticeable amount of fuel can accumulate underneath a deck. If this fuel is ignited by wind-blown embers, the flame might be tall enough (depending on fuel load, wind speed, and deck height) to reach the deck structure. People also store combustibles, such as firewood, under decks. Ignition of these materials intensifies the under-deck flame exposure. In this case, the under-deck flame exposure would be more intense and last longer than exposure from burning wind-blown debris.

Provisions in Chapter 7A of the California Building Code allow the use of many combustible deck board products. These materials include non-fire-retardant treated wood (e.g., redwood and western red cedar) and plastic composites. These decking products can be installed over combustible or noncombustible joists.

The current method for determining compliance with the California building code is State Fire Marshal (SFM) Standard 12-7A-4A and ASTM E2632. These test methods evaluate decking products by subjecting a test deck to a three-minute under-deck flame impingement and measuring the energy released by the burning deck. Non-compliance occurs when the peak heat release rate of the burning deck exceeds a specified threshold.

Research at IBHS began with the evaluation of the vulnerability of decks to wind-blown embers. This research provided evidence that the top surface of redwood decks was particularly vulnerable. Ignition typically occurred from ember accumulation in gaps between deck boards at joist crossings, which is an area where wind-blown vegetative fuel accumulates. This fuel can facilitate ignition by embers. After ignition, fire propagated both parallel and perpendicular to the building. When joists were perpendicular to the house, they provided a pathway for fire propagation to the building in the presence of wind.

Experimental testing at the IBHS Research Center also revealed the deck sub-structure often exacerbates the intensity of a fire that occurs when materials ignite under a deck. Fires on top of a deck caused by ember accumulation were typically less intense initially. However, fire could spread from the walking surface to the underlying joists and ultimately the home, especially if the joists are oriented perpendicular to the exterior wall.

Implications for Test Standards and Codes

IBHS testing has identified three areas in the standard test methods that do not accurately evaluate the true performance of decks:

- Use of a no-wind test condition

- Use of a test deck with a relatively small surface area
- Not considering the support joists as a variable in the test method

IBHS moved toward independently evaluating the effect of these parameters on deck performance by testing larger deck specimens (6.6 ft x 6.6 ft), adding wind (mean wind speed of 18 mph) to the test parameters, and examining different joist configurations and materials. The following summarizes the results:

- Fire intensity was markedly higher compared to the standard test method configuration of a small deck under no wind.
- Joists were the first part of the deck assembly to ignite and provided continuous flame exposure to the bottom side of the deck boards.
- Temperatures measured on the adjacent wall during these tests under the deck were enough to ignite most, if not all, combustible siding materials.
- In all configurations tested with metal joists:
 - The deck performed better at resisting full ignition.
 - Adjacent wall temperatures were significantly lower.

Recommendations

The current ASTM test method (ASTM E2632) used for Chapter 7A of the California Building Code to evaluate the response of a deck to an under-deck flame exposure fails to assess vulnerability in a real-world scenario. Test parameters such as deck size, wind and construction details are not addressed in the current standard test method.

Based on the observed deficiencies in the current test method, the following modifications are suggested.

Wind

- IBHS recommends the addition of wind to standardized testing methods. A no-wind condition leads to inaccurate modeling of the real-world wildfire scenario where wind has been an influential parameter in all recent destructive wildfires.

Size

- The 6.6 ft x 6.6 ft deck size used for our research was chosen after considering the size of the ASTM E108 tunnel (available in many commercial fire labs) and better represents an actual deck structure.

Construction Details

- The entire deck assembly should be considered in a test method to mimic real-world exposure.
- Modifying either the deck size and/or the presence of wind resulted in performance differences for decks made with Chapter 7A compliant combustible products.

- The results showed that combustible deck assemblies that ignited from an under-deck flame exposure present a higher risk to a home.

Noncombustible Joists

- Metal joists significantly reduced the vulnerability of the deck from both under-deck flame and top-of-deck ember exposures. Use of metal joists limits the fire growth toward the building by limiting the available fuel.
- Metal joists are about 30% more expensive than wood but last longer, are corrosion resistant (galvanized), lightweight, and perfectly straight.