Fire or Ignition Resistant? Building Materials & Vegetation

Steve Quarles, IBHS

&

Pat Durland, Stone Creek Fire, LLC

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Reducing the vulnerability of buildings to wildfires –

- new construction
- retrofit to existing
Terms describing the combustibility of materials -

• Noncombustible
• Nonflammable
• Combustible

Are we able to distinguish performance between different combustible materials?

✓ Ignition-resistant material
   (IR material versus IR construction?)
✓ Fire-resistant (assembly, typically with some combustible materials)
✓ Heat release rate (HRR)
✓ Time to ignition / penetration / other observation
Building Materials and Components

- Roof & Edge
- Eave & Vents
- Windows
- Decks & Other Attachments
- Siding
Fire Testing Equipment

Big things, sort of big things, and small things
Setchkin Furnace – specified in standard procedure used to determine if a material can be considered noncombustible.

750 C (1380 F) inside the furnace

Sample
Combustible Materials

- Flame Spread Rating (Class A, B, C)
- Heat Release Rate
Steiner Tunnel, used in horizontal flame spread tests

Test material above the flame

Photo courtesy of Bill Hendricks (photo taken at Southwest Research, San Antonio, TX)
Inside of tunnel

Photo courtesy of Bill Hendricks (photo taken at Southwest Research, San Antonio, TX)
Steiner Tunnel – horizontal flame spread tests

- Class A, B, C flame spread ratings
- “ignition resistant material” rating
  (California Building Code, NFPA, ICC)
- “ignition resistant construction”
  (California Building Code, Chapter 7A)
Exhaust hood – measure amount of oxygen consumed during combustion. Calculate Heat Release Rate (HHR).

(Photo taken at Western Fire Center, Kelso, WA)
Peak Heat Release Rate (HRR) cannot exceed 25 kW / ft². The HRR during this test exceeded this amount, so this deck material would not comply with Chapter 7A requirements.

Deck testing at the University of California Fire Test Laboratory, 2001. Development of criteria used in CA SFM Std. 12-7A-4. This test was conducted under a collection system and the HRR was evaluated.
Nominal ‘One-hour’ construction through use of Type X gypsum board in the wall assembly.

Photo courtesy of Richard Avelar & Associates, Oakland, CA
Vertical burner – largely “radiant” exposure

One of 27 natural gas burners...

Time-temperature curve used during an ASTM E-119 fire test.

Photo taken at Western Fire Center, Kelso, WA
Vertical (or horizontal) Furnace

- “X” minute / hour (nominal) ratings
  - 20 minute rating [door, window]
  - 1-hour, 2-hour [wall, floor]

Photo taken at Western Fire Center, Kelso, WA
Test apparatus for roof tests

1) flame penetration 2) flame spread 3) ember generation

Air flow specified at 12 mph
“Brands” used in standard roof tests. One of three components in determining Class A, B, or C fire rating for a roof covering. Untreated wood shake roof is unrated.

Class A – 12” by 12”

B - 6” by 6”

C
Igniting Class A brand
Fire rating for roof coverings – Class A, B, & C

Burning [12”x 12”] Class A brand placed on roof covering.

Flame penetrated through to the underside of the roof sheathing, into what would be the attic.
Roofing

- Stand-alone
- By assembly
Roll roofing can be sold “generically”, but if intended for use in a fire rated assembly, look for rating.
With ‘assembly’ ratings, it is important to install the way it was tested. Read the directions & follow them. Consequences can be more critical than a parking ticket.
Complex roof designs

Intersection of roof-to-wall. Collection point for debris & embers. If debris is ignited by embers, flame contact exposure to shingle siding – more vulnerable than Class A roof.
Openings at edge of roof and ridge must be plugged where necessary. Open areas allow entry of debris and embers – the Class A roof covering can be by-passed.
The same basic apparatus is used for Wall, Window and Eave Tests [California SFM Standards 12-7A-1, 2, and 3]. These tests evaluate the “fire resistance” of a material & assembly.
CA SFM 12-7A-1. Testing at UC Fire Research Laboratory

Exposed side

150 kW burner output, 10 minute exposure, plus 60 min observation

Unexposed side

Burn through at lap joints. As constructed, this wall doesn’t pass
Plain bevel lap joints are vulnerable to flame penetration at the joint. Joint penetration - 1:15 min.

More complicated lap joints, such as this shiplap joint, are more difficult to penetrate. Joint penetration - 21:20 min

Source for figure: Dost and Botsai, 1990, *Wood: Detailing for Performance*
CA SFM 12-7A-1 (siding test) doesn’t evaluate vertical flame spread that could result in flame impingement on windows and at eave.

Flame spread up the wall

Penetration into stud cavity

Fire demonstration, Southern California
CA SFM 12-7A-2, window test. Testing has shown that the glass is more vulnerable than the frame.

Radiant exposure from neighboring house that was destroyed.
Tempered glass more resistant to heat exposures than annealed glass. Prescriptive compliance to California Building Code Chapter 7A is inclusion of tempered pane in dual pane window.
Burn through at a joint in a combustible (wood) soffit. This view is from the perspective of the attic.
Heat Release Rate greater than 25 kW / ft²

Expanded test for decking – CA SFM 12-7A-4A

Dropping flaming debris

CA SFM 12-7A-4A, HRR already discussed. Other criteria included in 12-7A-4A standard includes self-extinguish within 40 min. and restriction on dropping burning debris
CA SFM 12-7A-4A also has burning brand test, using ASTM E-108 apparatus.
Ignition Resistant Material and SFM 12-7A-4 A -

Part A. Under-deck flame impingement exposure.
- Acceptance criteria:
  1. HRR < 25 kW/ft2
  2. Self-extinguish after 40 minutes
  3. Cannot drop flaming debris
  4. Cannot break under own load

Part B. Brand test (top of deck)
- Acceptance criteria:
  1. Self-extinguish after 40 minutes
  2. Cannot drop flaming debris
  3. Cannot break under own load
Performance of decking

Part A. Under-deck flame impingement exposure.
- Acceptance criteria:
  1. HRR < 25 kW/ft²
  2. Self-extinguish after 40 minutes
  3. Cannot drop flaming debris
  4. Cannot break under own load

Part B. Brand test (top of deck)
- Acceptance criteria:
  1. Self-extinguish after 40 minutes
  2. Cannot drop flaming debris
  3. Cannot break under own load

Plus Flame Spread rating – 10 minute ASTM E-84
Performance of decking

Part A. Under-deck flame impingement exposure.

- Acceptance criteria:
  1. HRR < 25 kW/ft²
  2. Self-extinguish *Glowing allowed* after 40 minutes
  3. Cannot drop flaming debris
  4. Cannot break under own load

Part B. Brand test (top of deck)

*Use ‘B’ brand instead of ‘A’ brand.*

- Acceptance criteria:
  1. Self-extinguish *Glowing allowed* after 40 minutes
  2. Cannot drop flaming debris
  3. Cannot break under own load

Requirements for compliance in San Diego County
Performance related to decking
(Fire demonstration in northern California)

WPC, not 7A compliant

Chapter 7A compliant
(SFM 12-7A-4)

35 minutes after burning Class B brand placed on decks.

WPC
(wood plastic composite)

Redwood

Initial exposure to Class B brand placed on top surface.
Noncombustible siding (gypsum wall board).
Noncombustible:

✓ “yes” or “no”, by test

Combustible Materials:

✓ Heat Release Rate (HRR)
✓ Flame Spread Index
• Ignition Resistant Material
✓ “yes” or “no”, by test
• Fire resistance ratings
  ✓ Class A, B, C for roof
  ✓ “x” minute or hour rating for wall, floor, or other component

Summary: You can use standard test data to discriminate performance between combustible materials.
Internet search for “WUI Products Handbook”

http://osfm.fire.ca.gov/strucfireengineer/pdf/bml/wuiproducts.pdf
Where building safety research leads to real-world solutions.

Thanks for your attention!
Steve Quarles
s quarles@ibhs.org
Cell: (813) 404-4942
www.disastersafety.org
www.extension.org/surviving_wildfire
Vegetation – Presentation by Pat Durland
Vegetation

• Terms & Concepts
  – Ignition resistant
  – Fire resistant
  – Highly flammable
  – Volatile
  – Low flammability
  – Less flammable
  – Lean, Clean & Green
  – Firewise plants
Landscape Assemblies in the Ignition Zone

- Large Flames (radiant heat)  100’ away
- Surface Fire (flame contact)  30’ away
- Ember Ignitions  30’ away
Landscape Assemblies in the Ignition Zone

Zone 1  (30 feet)
Eliminate ignition hazards (available fuel)
Volatile Plants & Debris
The Undesired Results
Vegetation

- **Flammable Characteristics**
  - Pyrophytes (fire plants)
    - Active & Passive
  - Oils, resins, waxes
  - Excess litter

- **Flammable Condition**
  - Dry tissue
  - Low moisture content
  - Unhealthy: stressed, aged, etc.
  - Poorly maintained
Vegetation

• Flammable **Characteristics**
  – Pyrophytes (fire plants)
    • Active & Passive
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  – Excess litter

• Flammable **Condition**
  – Dry tissue
  – Low moisture content
  – Unhealthy: stressed, aged, etc.
  – Poorly maintained
It ain't what you don't know that gets you into trouble. It's what you know for sure that just ain't so.

Mark Twain
Conflicts

• Plants described as highly flammable survive severe fire conditions?

Lean?
Conflicts

• Plants described as highly flammable survive severe fire conditions?

• Plants described as low flammability, are volatile and burn intensely?
  – Plant Lists
    • Oleander
  – Deciduous plants and trees
Different Outcomes to the same event
WHY?
Observe what did NOT burn!
Pyrophyte
Rehab
Pyrophyte
Rehab
University Inn July 2006
Everything should be made as simple as possible, but not simpler.

Albert Einstein
Achieving a Firewise Landscape
(by combining physical & social sciences)

• Understanding of how vegetation responses to fire

• Attractive/functional plants

• Effective messaging/marketing
  – Explain ‘catch’ phases
  – Avoid generalizations

• A resident willing to ACT!

• Continued maintenance
Lean ?
Clean ?
Green ?
Lean ?
Clean ?
Green ?
Discussion
Thanks and Be Safe!

Pat Durland
www.stonecreekfire.com