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FENESTRATION FOR WILDLAND–URBAN INTERFACE (WUI) DESIGN

Technical Bulletin | Wildfire-Resistant Windows and Building Envelope Considerations

WUI Design Requires a Whole-Building Approach

Buildings located in the Wildland–Urban Interface (WUI) may be exposed to wind-driven embers, radiant heat and direct flame contact during a wildfire. Reducing vulnerability requires a coordinated approach to the complete building enclosure including: roofs, exterior walls, vents, windows, doors, decks and interfaces between assemblies.

Windows are particularly important because failure of the glazing, frame or other components can create an opening through which heat, flames or embers can reach combustible materials inside the building. A high-performing wall or roof assembly therefore cannot compensate for fenestration that is poorly suited to wildfire exposure.

The critical consideration is not whether a window remains completely undamaged during wildfire exposure, but whether the glazing, frame and other components can maintain the integrity of the opening long enough to reduce the risk of flame, heat or embers reaching the building interior.

How Wildfire Exposure Affects Windows

Windows can be exposed to several mechanisms during a wildfire:

- Radiant heat can increase thermal stress in glazing and contribute to glass breakage.
- Direct flame exposure can affect glazing, frames, seals and other window components.
- Wind-driven embers can accumulate at openings and interfaces or enter the building following component failure.
- Combustible or melt-prone components may ignite, deform or otherwise compromise the integrity of the opening.

Glass selection is therefore only one consideration. Frame material, glazing configuration, screens and interfaces should also be considered as part of the WUI design strategy. Wildfire exposure adds another performance requirement to an opening that is already expected to meet structural, thermal, air, water, condensation and durability requirements.

Codes, Standards & Canadian Guidance

California Building Code — Chapter 7A

The 2025 California Wildland-Urban Interface Code (CWUIC), Title 24, Part 7, contains the exterior wildfire construction provisions. Section 504.8 addresses exterior glazing. Project teams should confirm the applicable code edition and local amendments with the authority having jurisdiction.

For exterior windows, skylights and glazed door assemblies, Section 708A.2.1 provides several compliance pathways, including:

- Multi-pane glazing with at least one tempered pane; glass block; or glazing with a fire-protection rating of at least 20 minutes; or
- Assemblies tested to SFM Standard 12-7A-2 – Exterior Windows.

SFM Standard 12-7A-2 provides an assembly-level test method for evaluating exterior windows under prescribed direct-flame exposure. The test uses a 150 kW direct-flame exposure for an eight-minute duration, providing a defined basis for evaluating how the window assembly performs during exterior wildfire exposure.

Meeting prescriptive glazing requirements does not necessarily ensure that a window assembly will provide effective wildfire protection. During a 2025 industry wildfire resistance testing program (that Cascadia participated in), the engineering team highlighted two potential failure mechanisms: glazing failure when the tempered pane is positioned on the exterior, leaving the interior annealed pane vulnerable to breakage, and heat-induced deformation and recession of vinyl window frames (from other manufacturers), which can create openings for flame intrusion.

These observations reinforce the importance of evaluating the performance of the complete window assembly rather than relying solely on prescriptive glazing requirements.

Natural Resources Canada

The National Research Council Canada (NRC) National Guide for Wildland-Urban Interface Fires (2021), Section 3.3.9, recommends testing window glazing and skylights to SFM Standard 12-7A-2. Its additional building recommendations address the enclosure as an interconnected system and include consideration of wildfire-resistant glazing, window assemblies and non-combustible screening.

FireSmart

FireSmart guidance provides practical best practices for construction and renovation in Canadian WUI areas. Fenestration-related recommendations include tempered glazing, non-combustible screening and reducing pathways through which embers can enter the building.

Together, these resources reinforce an important design principle: window selection should be coordinated with the overall wildfire-resilience strategy rather than evaluated independently.

Wildfire Testing and Fire Protection Ratings

SFM 12-7A-2 is a performance test for resistance to exterior flame penetration and structural failure under its prescribed exposure. Passing it does not confer a 20-minute, 45-minute or one-hour fire rating.

Fire-protection-rated window and glass-block assemblies are evaluated under standards such as CAN/ULC-S106 in Canada, or NFPA 257 and UL 9 in the United States. Fire-resistance ratings for walls and other building assemblies address a different set of performance requirements. Specify the required standard and classification rather than using “fire-rated” as a general synonym for wildfire-resistant. A rating under one standard does not establish compliance with another.

A product that complies with SFM 12-7A-2 should therefore not be described as fire-rated, just as a fire-rated assembly is not necessarily evaluated for exterior wildfire exposure.

Glazing Configuration and Assembly Performance

Glazing configuration plays an important role in how a window assembly performs during wildfire exposure. For conventional architectural glazing systems, specifying a tempered interior lite is an important starting point for improving resistance to heat-induced breakage.

Tempered glass is heated and rapidly cooled to create surface compression, increasing its resistance to thermal stress compared with annealed glass. If it fails, however, it fragments into small pieces that can fall out. Annealed glass may crack relatively quickly but remain substantially in place, helping shield the interior lite from direct flame exposure. A interior tempered lite offers greater resistance to thermal stress, increasing

the likelihood that at least one layer of glass remains intact throughout the prescribed exposure. Tempering only the exterior lite, while leaving the interior lite annealed, can leave the assembly vulnerable to early glazing failure.

For Cascadia's wildfire-resistant window configurations, this product variant includes a tempered interior lite and increased glass thickness to 6 mm. Glazing performance must also be considered alongside the framing system, as both components contribute to the overall wildfire resistance of the window assembly.

Commercial Fiberglass as a WUI Fenestration Option

Commercial-grade pultruded fiberglass window systems provide one approach for combining wildfire resistance with the thermal, structural and durability requirements of high-performance building envelopes. Performance depends on the specific frame design and resin formulation; fiberglass framing is not inherently non-combustible.

Cascadia's Universal Series™ includes fiberglass window assemblies tested to SFM Standard 12-7A-2 – Exterior Windows.

Cascadia's testing and research reinforced the importance of glazing configuration in resisting wildfire exposure. These findings informed Cascadia's approach to wildfire-resistant glazing, including the use of a tempered interior lite and increased glass thickness to 6 mm to improve resistance to heat-induced breakage.

Cascadia offers two wildfire-resistant window configurations, Wildfire Resistant (WFR) and WFR Plus, incorporating design features informed by its research and testing into commercially available window systems.

These configurations incorporate measures including:

- 6 mm glazing with an interior tempered lite
- Mineral wool plugs within frame cavities
- Aluminum mesh screens where screens are required
- Commercial-grade pultruded multi-chambered fiberglass framing

The WFR Plus configuration incorporates these measures along with a fire-retardant resin within the fiberglass frame. This resin formulation is designed to slow ignition, reduce flame spread and promote faster self-extinguishing once the external flame source is removed. In internal testing that focused on frame performance, the WFR-plus frame maintained integrity beyond 30 minutes of exposure to the SFM-12-7a-2 test when paired with a fire-proof glass used for lab testing (more than 3x the required time to pass).

The fire-retardant additive is integrated into the resin system without changing the window's structural properties or air, water and thermal performance.

These systems demonstrate how wildfire resistance can be incorporated into commercial fenestration while maintaining the performance characteristics required for high-performance multifamily, institutional and commercial buildings.

Specification Considerations

Early in design, project teams should determine whether wildfire exposure should influence fenestration selection based on jurisdictional requirements, site conditions, owner objectives, insurer requirements or other project-specific resilience criteria.

When evaluating windows for WUI projects, design teams should consider:

- Applicable WUI codes and jurisdictional requirements
- Complete-assembly testing versus prescriptive compliance
- Glazing thickness and heat treatment
- Frame material and behaviour under heat and flame exposure
- Combustibility of screens and accessory components
- Ember pathways at operable elements and interfaces
- Air, water, structural and thermal requirements
- Integration of the window with adjacent enclosure assemblies

Wildfire exposure introduces another important consideration for fenestration design. By understanding the applicable jurisdictional requirements or best practice guidelines, test methods and performance objectives early in design, project teams can better align window selection with the broader wildfire-resilience strategy.

REFERENCES

- **California Building Code, Chapter 7A -** Materials and Construction Methods for Exterior Wildfire Exposure
  - https://codes.iccsafe.org/content/CACLAEBC2023P1/chapter-12-7a-materials-and-construction-methods-for-exterior-wildfire-exposure
- **National Research Council Canada -** National Guide for Wildland-Urban-Interface Fires: Guidance on Hazard and Exposure Assessment, Property Protection, Community Resilience and Emergency Planning to Minimize the Impact of Wildland-Urban Interface Fires
  - https://nrc-publications.canada.ca/eng/view/object/?id=3a0b337f-f980-418f-8ad8-6045d1abc3b3
- **FireSmart BC** - Wildfire Resilience Home Construction – Renovation and Landscaping Checklist
  - https://firesmartbc.ca/resource/wildfire-resilience-home-construction-renovation-and-landscaping-checklist/
- **California State Fire Marshal** - SFM Standard 12-7A-2 – Exterior Windows
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- **Willi, J.M., Gorham, D.J. & Horn, G.P.** – *Window Pane Failure During Exterior Fire Exposure*, Fire Technology, Vol. 61, pp. 1613–1645, 2025. DOI: 10.1007/s10694-024-01656-z.
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