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CONSTRUCTION DETAIL GUIDE 1

Openings

Windows, Doors, Skylights & Bushfire Shutters for WUI Homes

Adapted for Canadian WUI conditions from:

- AS 3959:2018 (Australian Standard — Construction of Buildings in Bushfire-Prone Areas)
- California Building Code Chapter 7A (Materials & Construction Methods for Exterior Wildfire Exposure)
- NRC National Guide for WUI Fires (National Research Council Canada, 2021)
- FireSmart Canada Construction Guidance & Best-Practice Checklist
- IBHS Wildfire Prepared Home Standard (Insurance Institute for Business & Home Safety)
- NFPA 1144 (Standard for Reducing Structure Ignition Hazards from Wildland Fire)

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1. Why Openings Are Critical in Wildfire

Windows, doors, skylights, and garage doors are among the most vulnerable components of a building during a wildfire. While vents provide the most common ember entry pathway, openings represent the largest potential breach points. When glazing fails under radiant heat exposure, the building's interior becomes directly exposed to embers, flames, and convective heat — and structure loss typically follows within minutes.

Post-fire damage surveys from the 2018 Camp Fire (Paradise, California), the 2017 Tubbs Fire (Santa Rosa, California), and the 2003 Okanagan Mountain Park Fire (Kelowna, BC) consistently show that window failure is a primary mechanism for structure ignition. Single-pane annealed glass can crack and fall out within 1–3 minutes of direct flame exposure, creating openings through which embers enter freely. Once inside, embers ignite curtains, furniture, and carpeting — and the structure burns from the inside out.

The vulnerability of openings is not limited to direct flame contact. During a WUI fire event, radiant heat from burning vegetation, neighbouring structures, or accumulated combustible debris near the building can cause glass failure even when flames do not reach the window. Research by Quarles et al. (2010, University of California) demonstrates that glass failure is driven by temperature differentials between the exposed glass surface and the portion protected by the frame. Larger windows are more vulnerable because they have proportionally more exposed glass relative to protected edge.

THE CRITICAL FINDING

Dual-pane windows with at least one tempered pane are more than four times more resistant to radiant heat failure than single-pane annealed glass. Tempered glass resists thermal stress fracture because the manufacturing process creates compressive surface stresses that must be overcome before cracks can propagate.

— Quarles et al., Home Survival in Wildfire-Prone Areas, UC ANR Publication 8393

This guide covers every type of opening in a residential building: windows (fixed and operable), exterior doors (entry, sliding, French), skylights, garage and vehicle access doors, and bushfire shutters. For each component, it provides specifications graded by WER level (the FireHard Canada Wildfire Exposure Rating system), product research, construction sequences for new builds and retrofits, and maintenance protocols.

The goal is practical: give your builder, designer, or yourself the specifications and product references needed to protect every opening in your home from ember intrusion, radiant heat, and direct flame contact — without having to cross-reference four different international standards.

1.1 How Openings Fail During Wildfire

Understanding the failure mechanisms is essential for specifying the right protection. Openings fail through four distinct pathways, each requiring a different response:

Radiant Heat Glass Failure

The most common failure mode. Radiant heat from burning vegetation, structures, or debris creates temperature differentials across the glass surface. The exposed centre heats and expands while the frame-protected edges remain cooler. Tensile stress develops at the edges, and when it exceeds the glass's strength, cracks initiate and propagate inward. Annealed glass

fails at relatively low radiant heat fluxes (approximately 15–20 kW/m² sustained exposure). Tempered glass resists approximately 40 kW/m² due to its pre-compressed surface. Dual-pane units provide additional protection because the inner pane is partially shielded by the outer pane and the insulating air gap.

Direct Flame Impingement

When flames contact the window directly — from burning vegetation within Priority Zone 1A, an ignited deck, accumulated debris, or a neighbouring structure fire — the thermal load is far higher than radiant heat alone. Single-pane annealed glass typically fails within 1–3 minutes. Even dual-pane tempered glass can fail under sustained flame contact, though it provides significantly more time (typically 10–15 minutes). This time matters: it may be the difference between a structure surviving the fire front passage and igniting.

Ember Intrusion Through Failed Glazing

Once glass has cracked and fallen away, the opening is fully exposed to the ember storm. Wind-driven embers enter the building, landing on carpets, curtains, furniture, and paper. In the oxygen-rich, sheltered interior, a single ember can produce a flame within minutes. If window screens are intact, they can significantly reduce the size and energy of embers passing through — IBHS research shows that fine-mesh screens (1/16″, approximately 1.6mm) reduce ember energy to the point where ignition of interior furnishings is unlikely, even if the glass has failed.

Frame and Seal Failure

Vinyl (PVC) window frames can soften, deform, and collapse when exposed to radiant heat, even if the glass remains intact. This creates gaps between the frame and the rough opening through which embers and hot gases enter. Aluminium frames conduct heat but maintain structural integrity at higher temperatures. Wood frames can char and ignite if directly exposed to flame. Fiberglass frames offer the best combination of thermal stability and non-combustibility. Gap seals (weatherstripping, caulking) can also fail under heat, creating ember pathways around otherwise intact assemblies.

2. Specifications by WER Level

The following specifications are graded by FireHard Canada Wildfire Exposure Rating (WER) level. Each level builds on the previous — WER-2 includes all WER-1 requirements plus additional measures. For a full explanation of the WER system, see the FireHard Canada WER Technical Document (free download at firehard.ca).

AS 3959 to Canadian Adaptation: Key Differences

The FireHard Canada FireHard specifications are adapted from AS 3959:2018 (Australian Standard — Construction of Buildings in Bushfire-Prone Areas), which provides the most detailed element-by-element requirements of any international bushfire construction standard. However, direct adoption of AS 3959 is not appropriate for Canadian residential construction. The key differences and their rationale:

Frame materials. AS 3959 requires metal frames at BAL-40 and BAL-FZ, and permits metal-reinforced PVC-U at BAL-12.5 through BAL-29. In Canada, full metal window frames are commercial/institutional products unsuitable for residential use in cold climates due to thermal bridging, condensation, and ice formation. FireHard Canada specifies fiberglass as the preferred WER-2+ frame material (non-combustible, thermally broken, dimensionally stable at extreme temperatures, manufactured in Canada) and aluminium-clad wood as an acceptable alternative (aluminium exterior provides fire resistance while wood interior manages thermal performance). At WER-4, the fire performance objective of AS 3959's metal-frame requirement is met by fire-rated assemblies with fiberglass or steel-reinforced frames — this is a bespoke engineering specification, not a prescriptive product selection.

Glazing thickness. AS 3959 specifies toughened (tempered) glass minimum 5mm at BAL-29 and above. Canadian residential IGUs typically use 3mm or 4mm panes. FireHard Canada adopts the 5mm minimum for WER-3 and WER-4 — specify this explicitly when ordering replacement IGUs or new windows for high-exposure applications. Standard dual-pane tempered IGUs with 3–4mm panes remain acceptable at WER-1 and WER-2.

Screening of fixed portions. At BAL-40, AS 3959 requires both openable AND fixed portions of windows to be screened with ≤2mm mesh of steel or bronze. This reflects the reality that at high radiant heat fluxes, glass failure exposes the entire opening — not just the openable portion. FireHard Canada adopts this requirement at WER-3 and WER-4: all window surfaces, fixed and operable, should be screened.

The 400mm zone. AS 3959 imposes additional requirements on windows less than 400mm from ground level, or less than 400mm above decks, carport roofs, and awnings. In this zone, window frames must be of bushfire-resisting timber, listed timber species, metal, or metal-reinforced PVC-U (not standard unreinforced vinyl). This requirement reflects the higher ignition risk where debris accumulates and flames are closest. FireHard Canada recommends applying this principle in all WER levels: for any window with a sill height less than 400mm above grade or above an attached deck, specify non-combustible or metal-reinforced frames regardless of the overall WER level.

Seal flammability. At BAL-40, AS 3959 requires that seals to stiles, heads, and sills have a flammability index no greater than 5 (tested to AS 1530.2). For Canadian applications, this translates to specifying silicone-based or intumescent weatherstripping rather than standard EPDM rubber at WER-3 and above. Silicone seals maintain flexibility at Canadian winter temperatures while also resisting ignition under radiant heat exposure.

BAL-FZ fire resistance rating. At BAL-FZ (Flame Zone), AS 3959 requires window systems to achieve an FRL (Fire Resistance Level) of at least -/30/- (30 minutes integrity) or pass AS 1530.8.2 testing. For doors, the same -/30/- FRL applies. FireHard Canada adopts this at WER-4. In practice, WER-4 is a bespoke professional engineering scope — buildings in this exposure zone require a site-specific assessment and fire-rated assemblies selected by a qualified professional. The specifications in the WER-4 column of the tables below are minimum starting points, not complete prescriptions.

2.1 Windows

Component	WER-1 (Ember)	WER-2 (Radiant)	WER-3 (Flame)	WER-4 (Flame Zone)
Glazing type	Dual-pane, min. one pane tempered	Dual-pane, both panes tempered	Dual-pane, both tempered, min. 5mm each pane (per AS 3959 Cl. 7.5.2); or tested to SFM 12-7A-2	Fire-rated glazing assembly: FRL -/30/- min. or tested to AS 1530.8.2. Min. 5mm tempered panes.
Frame material	Any (wood, vinyl, aluminium, fiberglass). Metal-reinforced vinyl preferred over unreinforced. Per AS 3959: metal-reinforced PVC-U acceptable at BAL-12.5.	Fiberglass, aluminium-clad wood, or aluminium. Metal-reinforced vinyl acceptable. No unreinforced vinyl.	Fiberglass or aluminium-clad wood. No vinyl (reinforced or otherwise). AS 3959 requires metal; fiberglass is the Canadian equivalent.	Fire-rated assembly: fiberglass or steel-reinforced frame. FRL -/30/- or AS 1530.8.2. Bespoke engineering scope.
Screens	Non-combustible mesh, ≤2mm aperture recommended	Non-combustible mesh, ≤2mm aperture required on all operable windows	All surfaces (fixed AND operable) screened: ≤2mm aperture, corrosion-resistant steel or bronze. Per AS 3959 Cl. 8.5.2.	All surfaces (fixed AND operable) screened: steel or bronze mesh only, ≤2mm aperture; no aluminium. Per AS 3959 Cl. 9.5.2.
Gaps (frame to wall)	≤3mm; seal with non-combustible caulk	≤3mm; seal with non-combustible caulk or intumescent strip	≤3mm; intumescent seal required. Seal flammability index ≤5 (silicone or intumescent). Per AS 3959 Cl. 8.5.2.	≤3mm; intumescent or fire-rated seal required
Exterior trim	Non-combustible or ignition-resistant recommended	Non-combustible or fibre cement required	Non-combustible required (fibre cement, metal, masonry)	Non-combustible required; metal or masonry only
Bushfire shutters	Recommended for windows facing vegetation	Recommended for all windows; required if vegetation <30m	Required on all windows	Required on all windows; steel or bronze only

CANADIAN CONTEXT: VINYL WINDOWS

Vinyl (PVC) windows are the most common residential window type in Canada, representing over 60% of new installations. At WER-1, vinyl windows with dual-pane tempered glass provide adequate ember protection. At WER-2 and above, vinyl frames become a liability: PVC softens at approximately 80°C and can deform at the radiant heat fluxes expected in these exposure zones, creating gaps for ember entry even if the glass survives. For WER-2+, specify fiberglass or aluminium-clad wood frames, or protect vinyl windows with bushfire shutters. If your home has existing vinyl windows with single-pane glass, the most cost-effective first step is adding bushfire shutters rather than replacing all windows.

THE 400mm ZONE: AS 3959 imposes additional frame requirements on any window less than 400mm above grade or less than 400mm above an attached deck or awning. In this zone, even at the lowest BAL levels, unreinforced vinyl is not acceptable — frames must be bushfire-resisting timber, metal, or metal-reinforced PVC-U. FireHard Canada recommends applying this principle at all WER levels: if your window sill is close to the ground or close to a deck surface, upgrade that frame regardless of your overall WER level.

2.2 Exterior Doors

Exterior doors include entry doors, sliding glass doors (patio doors), French doors, and pet doors. Each type presents different vulnerabilities. Entry doors are generally more robust (solid-core construction, smaller glass area) while sliding glass doors represent the largest single glazed opening on most homes and are often the most vulnerable component.

Component	WER-1 (Ember)	WER-2 (Radiant)	WER-3 (Flame)	WER-4 (Flame Zone)
Entry doors	Solid-core wood min. 45mm (1-3/4″) or insulated steel/fiberglass	Solid-core wood, insulated steel, or fiberglass; 20-min fire rating recommended	20-min fire-rated door assembly required; steel or fiberglass preferred	Door system FRL -/30/- or tested to AS 1530.8.2. Steel or fiberglass. Bespoke engineering scope.
Door glazing	Dual-pane, min. one tempered	Dual-pane, both tempered	Dual-pane, both tempered; limit glazed area	Fire-rated glazing per wall assembly rating
Sliding glass doors	Dual-pane, one tempered pane	Dual-pane, both tempered; shutters recommended	Dual-pane both tempered + shutters required	Fire-rated assembly or steel shutters required
Weather seals	Weatherstrip all gaps >3mm	Weatherstrip all gaps; non-combustible or silicone seals	Intumescent weatherstrip; gaps ≤3mm	Intumescent seals; gaps ≤3mm
Door-to-sill gap	≤3mm with draught excluder	≤3mm with non-combustible draught excluder	≤3mm; intumescent seal at threshold	≤3mm; fire-rated threshold assembly
Pet doors	Self-closing flap; seal when not in use	Self-closing flap with non-combustible frame; seal during fire season	Remove or permanently seal; not recommended at WER-3	Not permitted

SLIDING GLASS DOORS: THE LARGEST VULNERABILITY

A standard 6-foot sliding glass door has approximately 4.5 m² of glazed area — more than any window in the home. If the glass fails, the opening is large enough to admit thousands of embers simultaneously. Post-fire surveys from the 2017 Tubbs Fire found that homes with unprotected sliding glass doors facing burning vegetation or neighbouring structures had significantly higher loss rates than homes where these doors were protected by shutters, had tempered glass, or faced away from the fire approach direction.

Priority retrofit action: if you have a single-pane sliding glass door facing vegetation, this is your highest-priority opening upgrade.

2.3 Skylights

Skylights are vulnerable to falling embers and debris landing directly on the glazing surface, and to radiant heat from below if the roof structure ignites. Operable skylights are more vulnerable than fixed skylights because the opening mechanism creates potential gaps. California Chapter 7A requires that operable skylights be screened with non-combustible mesh not exceeding 1/8″ (3.2mm) openings.

WER-1	WER-2	WER-3	WER-4
Dual-pane, one tempered. Fixed preferred. If operable, non-combustible mesh screen ≤2mm.	Dual-pane, both tempered. Non-combustible frame. Mesh screen ≤2mm on all operable units. Seal frame-to-roof gaps with non-combustible flashing.	Dual-pane both tempered or wired glass. Non-combustible frame and flashing. Fixed only (no operable skylights). Consider elimination.	Eliminate skylights where possible. If required, fire-rated assembly with steel frame, wired or fire-rated glass, and non-combustible flashing. Fixed only.

2.4 Garage and Vehicle Access Doors

Garage doors are among the leakiest components of a residential building envelope. A standard sectional garage door has gaps at the bottom seal, between panels, and at the side and top tracks. IBHS research identifies garage doors as a significant ember entry point. The AS 3959:2018 Amendment 2 added specific requirements for vehicle access doors at BAL-29 and above: weatherstripping on all edges, and at BAL-40, a complete prohibition on ventilation slots.

For Canadian WUI conditions, the key measures are: bottom seal replacement (most garage door bottom seals deteriorate within 3–5 years and leave gaps exceeding 6mm), side and top weatherstripping, and — at higher WER levels — replacement with a door that has interlocking panel joints and certified gap control.

WER-1	WER-2	WER-3	WER-4
Replace bottom seal if gaps >3mm. Weatherstrip sides and top. Screen any ventilation openings with ≤2mm mesh.	All WER-1 measures. Install interlocking panel seals. Weatherstrip with non-combustible or silicone seals. All gaps ≤3mm.	All WER-2 measures. No ventilation slots unless screened with corrosion-resistant steel or bronze mesh. Consider insulated steel door with certified seal system.	Insulated steel door required. No ventilation slots permitted. All gaps ≤3mm with intumescent or fire-rated seals. Interlocking panel joints.

3. Bushfire Shutters

Bushfire shutters are the single most effective retrofit measure for protecting openings. A properly specified and installed shutter protects the glazing from radiant heat (preventing glass failure), blocks ember intrusion (even if glass has cracked), and reduces convective heat load on the opening. AS 3959 explicitly recognizes bushfire shutters as a compliant protection method at all BAL levels (Clause 3.7).

The strategic value of shutters is that they decouple the window's vulnerability from the building's wildfire performance. A home with single-pane vinyl windows that has properly installed bushfire shutters may outperform a home with dual-pane tempered glass that has no shutters — because the shutter prevents the thermal load from reaching the glass at all.

3.1 AS 3959 Clause 3.7: Bushfire Shutter Requirements

The Australian Standard provides the most detailed specification for bushfire shutters. These requirements apply at all BAL levels and should be adopted as the baseline for Canadian WUI applications:

AS 3959 CLAUSE 3.7 — BUSHFIRE SHUTTERS

1. Fixed to building, non-removable
2. When closed: no gap greater than 3mm between shutter and wall/sill/head
3. Readily manually operable from inside or outside the building
4. Must protect the entire window or door assembly
5. Materials per the relevant BAL clause (aluminium acceptable at BAL-12.5 to BAL-29; steel or bronze only at BAL-40 and BAL-FZ)
6. Where perforated: uniformly distributed perforations; max 3mm aperture for radiant heat protection only; max 2mm aperture when also providing ember protection; perforated area ≤20% of shutter
7. If shutters on all external doors: at least one operable from inside for safe egress

3.2 Fire Hard Shutters: Product Specifications

Fire Hard Shutters are exterior manual roller shutters purpose-built for wildfire hardening, designed and assembled in British Columbia. They are the FireHard Canada flagship product and are engineered to meet or exceed AS 3959 Clause 3.7 requirements at WER-1 through WER-3 (aluminium construction; for WER-4, steel shutters are required).

Specification	Fire Hard Shutters
Construction	Double-wall extruded aluminium, ≥1.4mm wall thickness
Alloy	6063-T5 or 6063-T6
Operation	Manual crank (no electrical dependency)
Drive class	M1/M2 (manual)
Locking	Lockable in closed position
Gap control	Guide rail system with brush or rubber seal; ≤3mm gap when closed
Finish	Powder-coated; colour matched to building exterior

Specification	Fire Hard Shutters
WER suitability	WER-1 through WER-3 (aluminium). WER-4 requires steel alternative.
AS 3959 alignment	Clause 3.7 compliant: non-removable, manually operable, full-assembly coverage, ≤3mm gaps
Installation	Exterior face-mount to wall or reveal-mount within opening
Egress	Operable from inside; at least one shuttered door must allow interior egress per Clause 3.7(7)

WHY MANUAL OPERATION MATTERS

During a WUI fire event, power is often the first utility to fail. Electrical shutters that depend on grid power or battery backup become inoperable at precisely the moment they are needed. Manual crank operation ensures the shutters can always be closed, regardless of power status. AS 3959 requires that bushfire shutters be ‘readily manually operable’ — this is not just a convenience feature; it is a life-safety requirement.

Fire Hard Shutters use a mechanical crank system that operates independently of electrical supply. No batteries, no motors, no failure modes related to power.

3.3 Shutter Prioritization: Which Openings First?

For retrofit projects where budget requires phased installation, prioritize shutters in this order:

1. Sliding glass doors and large fixed windows facing vegetation or neighbouring structures. These represent the largest glazed area and the greatest potential breach. A failed 6-foot patio door admits more embers in 30 seconds than every vent in the house combined.

2. Windows on the side(s) of the building facing the most likely fire approach. In most BC WUI conditions, this is the upslope side or the side facing the closest continuous forest canopy.

3. Windows within 1.5m of a deck, porch, or attached combustible structure. If the deck ignites, these windows receive both radiant heat and direct flame exposure from below and beside.

4. Bedroom windows. If the home is occupied during a fire event, bedroom windows are life-safety critical. A shutter provides both ember protection and additional time for safe egress.

5. All remaining windows. Once priority openings are protected, complete the perimeter. A building is only as strong as its weakest opening.

4. Construction Sequences

4.1 New Construction: Window Installation for WER-2+

For new construction in WER-2 or higher exposure, specify the window assembly as a system: frame, glazing, flashing, sealing, trim, and screen must all be addressed together. The following sequence applies to all window types (casement, awning, slider, fixed) in wood-frame wall assemblies.

1. Rough opening preparation: Flash rough opening with self-adhering membrane (non-combustible substrate preferred). Extend membrane minimum 150mm onto face of wall sheathing. Sill pan with back dam and end dams. Ensure drainage path to exterior.

2. Frame installation: Set window frame in opening. Shim plumb and level. Secure with corrosion-resistant fasteners (stainless steel or hot-dip galvanized). Do not over-drive fasteners into frame.

3. Air and weather sealing: Apply continuous bead of non-combustible sealant (silicone or intumescent) between frame and rough opening. No gaps >3mm. Verify seal continuity at all four sides.

4. Flashing integration: Integrate window head flashing with weather-resistive barrier (WRB). Lap WRB over head flashing. Seal flashing-to-WRB joint. Ensure drainage plane continuity.

5. Non-combustible exterior trim: Install fibre cement or metal trim over frame-to-wall junction. Seal trim to wall and trim to frame with non-combustible caulk. No exposed wood trim at WER-2+.

6. Screen installation: Install corrosion-resistant steel, bronze, or aluminium mesh screen (≤2mm aperture) on all operable windows. Screen must cover full openable area. Secure with non-combustible fasteners.

7. Shutter provision: If shutters specified, install shutter guide rails and housing per manufacturer’s instructions. Verify ≤3mm gap between shutter slats and guide rails when closed. Test manual crank operation.

8. Interior finishing: Seal interior frame-to-wall gap with non-combustible backer rod and fire-rated sealant. Install interior trim.

4.2 Retrofit: Upgrading Existing Windows

For existing homes, full window replacement is often not feasible or economical as a first step. The following retrofit sequence provides progressive protection in order of cost-effectiveness:

Step 1: Seal all gaps (≤0.5 hr per window, <$5/window)

Inspect all window-to-wall junctions. Seal any gap >3mm with non-combustible silicone caulk. Replace deteriorated weatherstripping on operable windows. Check and seal glazing-to-frame joints.

Step 2: Install ember-resistant screens (≤1 hr per window, $30–$80/window)

Replace standard fibreglass insect screens with corrosion-resistant metal mesh, ≤2mm aperture. Stainless steel (316 grade) or bronze recommended for coastal or high-humidity locations. Aluminium mesh acceptable at WER-1 and WER-2.

Step 3: Install bushfire shutters (2–4 hrs per window, $400–$1,200/window)

Exterior roller shutters provide the most comprehensive protection. Face-mount or reveal-mount per site conditions. Verify ≤3mm gap when closed. Manual crank operation.

Step 4: Replace glazing ($300–$1,500/window)

When windows reach end of life, replace with dual-pane tempered glass in aluminium or fiberglass frames. This is typically the most expensive step and is best coordinated with planned window replacement cycles.

Step 5: Replace non-combustible trim (coordinate with Step 4)

When replacing windows, simultaneously replace wood exterior trim with fibre cement or metal. Seal all junctions.

COST-EFFECTIVENESS HIERARCHY

For an existing home with single-pane windows and no shutters, the return on investment follows this order: (1) seal gaps, (2) add screens, (3) add shutters, (4) replace glass. Steps 1–3 can protect a home for $2,000–$8,000 total. Full window replacement for a typical BC home costs $15,000–$40,000. Shutters on the highest-priority openings often provide better protection per dollar than wholesale window replacement.

Start with the cheapest measures and work up. A $5 tube of caulk on every window gap is the highest-ROI wildfire investment you can make.

5. Product Research & Recommendations

The following product categories are referenced in this guide. FireHard Canada curates partner products from verified manufacturers and offers them at negotiated pricing through firehard.ca. All products listed here meet the specifications described in Section 2.

5.1 Glazing

For Canadian WUI applications, specify dual-pane insulating glass units (IGUs) with at least one pane of tempered glass. For WER-2+, specify both panes tempered. Key Canadian and North American manufacturers offering WUI-suitable glazing include: Cardinal Glass Industries (IGU manufacturer supplying most major window brands), AGC Glass North America, and Vitro Architectural Glass. When ordering replacement IGUs, specify ‘both panes tempered’ explicitly — standard IGUs often have one annealed and one tempered pane.

5.2 Window Frames

For WER-2+, fiberglass frames offer the best combination of thermal performance, non-combustibility, and structural stability under heat exposure. Key manufacturers: Fibertec (Canadian manufacturer, Concord ON), Inline Fiberglass (Canadian manufacturer, Toronto ON), Marvin (fiberglass line), Pella (fiberglass line). Aluminium-clad wood frames (e.g., Loewen, Kolbe) provide fire resistance on the exterior while maintaining the interior aesthetic of wood. Verify that the aluminium cladding profile does not create gaps where embers could lodge.

5.3 Screens

Standard fibreglass insect screens provide no meaningful ember protection. Replace with corrosion-resistant metal mesh:

Material	Aperture	Best For	Notes
316 stainless steel	≤2mm	All WER levels; coastal/humid	Most durable. Corrosion resistant. Higher cost.
Bronze	≤2mm	All WER levels; heritage aesthetic	Excellent corrosion resistance. Develops patina. Expensive.
Aluminium	≤2mm	WER-1 and WER-2 only	Lower cost. Melts at ~660°C. Not suitable for WER-3/4 (direct flame).
Fibreglass/PVC	Any	Not recommended for WUI	Melts and burns. No ember protection. Replace.

5.4 Weatherstripping and Seals

Standard rubber weatherstripping can ignite or melt under radiant heat exposure. For WER-2+, specify silicone-based or intumescent weatherstripping. Intumescent seals expand when exposed to heat, closing gaps that develop as materials deform. Key products: Lorient (intumescent fire and smoke seals, widely available in Canada), Pemko (fire-rated door seals), Sealmaster (fire-rated brush seals for garage doors). For general-purpose gap sealing, high-temperature silicone caulk (rated ≥260°C) is appropriate for all WER levels.

5.5 Bushfire Shutters

Fire Hard Shutters (firehard.ca) are the FireHard Canada flagship product. For applications requiring steel shutters (WER-4), contact FireHard Canada for sourcing of steel roller shutter systems from European manufacturers with bushfire-rated products.

6. Maintenance Protocol

Openings require regular inspection and maintenance to remain effective. A window that was properly installed and sealed five years ago may have deteriorated weatherstripping, cracked caulk, torn screens, or accumulated debris in shutter guide rails. Annual inspection is essential.

6.1 Annual Inspection Checklist

1. Inspect all window-to-wall sealant joints. Re-caulk any cracked, separated, or missing sealant with non-combustible silicone.

2. Check weatherstripping on all operable windows and doors. Replace any strip that is compressed, torn, or hardened.

3. Inspect all screens for tears, holes, or loose mounting. Replace any damaged screen with ≤2mm non-combustible mesh.

4. Test all bushfire shutters: lower and raise each shutter using the manual crank. Verify smooth operation, ≤3mm gap when closed, and locking function.

5. Clean shutter guide rails of debris, dirt, and paint drips. Lubricate per manufacturer's instructions.

6. Inspect garage door bottom seal and side weatherstripping. Replace if gaps >3mm.

7. Remove combustible debris (leaves, pine needles, bark) from window sills, door thresholds, and shutter housings.

8. Inspect exterior trim for cracking, separation, or deterioration. Repair or replace as needed.

9. Verify that all windows and doors close and latch fully. Adjust hardware as needed.

6.2 Pre-Season Preparation

Before each fire season (typically May–October in BC), complete the annual inspection above plus: close and latch all shutters to verify they are functional before you need them in an emergency. Clear all combustible storage (firewood, lumber, cardboard) from within 1.5m of any window or door. Verify that sliding glass door tracks are clean and the door closes fully with no gap at the latch. If you have plywood window covers as a backup measure, verify they are labelled, accessible, and that mounting hardware is pre-installed.

7. Referenced Standards

Standard	Relevance to Openings
AS 3959:2018	Section 3.7 (Bushfire Shutters), Sections 5.5–9.5 (Windows/Doors by BAL level), Section 3.6 (Gaps and screening)
California CBC Chapter 7A	Section 708A.2 (Exterior windows, skylights, glazed doors), Section 708A.3 (Exterior doors), Section 709A (Garage doors)
NRC WUI Guide (2021)	Section 6 (Building-scale construction measures), Table 6 (Windows, doors, and openings by exposure level)
NFPA 1144	Section 5.7 (Exterior windows and doors): tempered glass, solid-core doors, non-combustible screens
IBHS Wildfire Prepared Home	Section 4 (Openings): dual-pane tempered glass, non-combustible screens, weather seals, shutter guidance
SFM Standard 12-7A-2	California test standard for exterior windows: 150 kW direct flame, 8-minute duration
ASTM E2886	Test method for vent resistance to embers and direct flame (applicable to screened openings)
AS 1530.8	Australian fire test for building elements: Part 8.1 (radiant heat, BAL-12.5 to BAL-40), Part 8.2 (large flame, BAL-FZ)
NFPA 252	Fire test for door assemblies (20-minute rating referenced for entry doors)

8. Neighbouring Structure Exposure: Openings

During a wildland-urban interface fire, your windows and doors may face their most severe test not from vegetation but from a neighbouring structure on fire. A burning residential building at close range (3–6 metres) produces sustained radiant heat of 20–80 kW/m² for 30–90 minutes — far longer than a passing vegetation fire front. This section addresses how openings perform under this specific threat. For full details on the physics of building-to-building fire spread, see Module 6 (Exterior Walls, Cladding & Neighbouring Structure Exposure).

Windows are the weakest point

IBHS research found that at 35 kW/m² radiant heat exposure (approximately the flux from a burning structure at 5 metres), single-pane annealed glass fails within minutes. Dual-pane annealed glass lasts longer because the outer pane must fail before the inner pane is exposed. Dual-pane tempered glass survived a 25-minute exposure at 35 kW/m² without either pane breaking. This is why tempered glass in both panes is specified at WER-2 and above on exposed faces — a neighbouring structure fire is the exposure scenario where tempered glass matters most.

Wildfire shutters and neighbour exposure

Wildfire shutters are particularly valuable on faces that front close neighbouring structures. When your neighbour’s home is burning 4–6 metres away, closed shutters create a continuous aluminium barrier across every opening that reflects radiant heat away from the glass, blocks embers, and resists flying debris. Even if the glass behind the shutter eventually cracks from sustained heat, the shutter prevents embers and flames from entering the interior. For homes with unhardened neighbours within 10 metres, wildfire shutters on the affected face may be the single most cost-effective measure to prevent window-mediated interior ignition.

Design guidance for close neighbour faces

For new construction, minimise glazing area on faces within 10 metres of a neighbouring structure or property line zoned for residential construction. Relocate large windows and glazed doors to less exposed faces. Each opening is a weak point in the wall’s fire resistance. For retrofit, prioritise wildfire shutters on the face closest to unhardened neighbours, tempered glass verification on that face, and solid core or metal exterior doors. For separations under 3 metres, fire-rated shutters (tested to AS 1530.8.1 or equivalent) are recommended on all openings.

9. References

Standards and Codes

AS 3959:2018 + Amd 2:2020. *Construction of Buildings in Bushfire-Prone Areas.* Standards Australia. Sections 3.6, 3.7, 5.5–9.5.

AS 1530.8.1 / 8.2. *Methods for Fire Tests on Building Materials, Components and Structures — Part 8: Tests on Elements of Construction for Buildings Exposed to Simulated Bushfire Attack.* Standards Australia.

ASTM E2886/E2886M. *Standard Test Method for Evaluating the Ability of Exterior Vents to Resist the Entry of Embers and Direct Flame Impingement.* ASTM International.

California Building Code, Chapter 7A [SFM]. *Materials and Construction Methods for Exterior Wildfire Exposure.* 2022 Edition. Sections 708A, 709A.

SFM Standard 12-7A-2. *Exterior Windows — Fire Resistance Test Standard.* California Office of the State Fire Marshal. 150 kW direct flame, 8-minute duration.

NFPA 252. *Standard Methods of Fire Tests of Door Assemblies.* National Fire Protection Association.

NFPA 1144. *Standard for Reducing Structure Ignition Hazards from Wildland Fire.* National Fire Protection Association. Section 5.7.

Guides and Resources

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FireSmart Canada (2018). *FireSmart Begins at Home Manual.* Partners in Protection Association / Canadian Interagency Forest Fire Centre. firesmartcanada.ca.

IBHS (2025). *Wildfire Prepared Home Standard.* Insurance Institute for Business and Home Safety. ibhs.org. Section 4 (Openings).

Queensland Reconstruction Authority and CSIRO (2024). *Bushfire Resilient Building Guidance for Queensland Homes.* Updated February 2024. qra.qld.gov.au.

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CSIRO (2020). *Bushfire Best Practice Guide.* Commonwealth Scientific and Industrial Research Organisation, Australia. research.csiro.au/bushfire. Building vulnerability framework, ignition pathways, ember attack mechanisms.

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Porter, K.A., Scawthorn, C.R., and Sandink, D. (2021). *An Impact Analysis for the National Guide for Wildland-Urban Interface Fires.* Institute for Catastrophic Loss Reduction, prepared for NRC Canada. doi:10.4224/40002649. Cost-benefit data for WUI construction measures.

UC ANR Fire Network (2025). “Windows.” University of California Agriculture and Natural Resources. ucanr.edu/sites/fire/Preparedness/Building/Windows. Chapter 7A verification pathways, glazing type performance comparison, screen recommendations.

Building America Solution Center (PNNL). “Windows Have Impact-Rated Glass, Fire-Resistant Glass, or Protective Coverings” and “Exterior Doors Are Insulated, Impact Rated, and Fire Rated.” Pacific Northwest National Laboratory / U.S. Department of Energy. basc.pnnl.gov. Glazing radiant heat performance, screen material comparison, door specifications.

Fire Safe Marin (2025). “Fire-Resistant Windows.” firesafemarin.org. Dual-pane performance, screen effectiveness after glass failure, shutter alternatives.

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Verification Pathways

The WER system recognizes three pathways to meet each specification. This mirrors how building codes work — a prescriptive path for straightforward compliance, and alternative solution paths for flexibility.

Deemed-to-Satisfy

Materials and assemblies explicitly named in the FireHard specification. If the design guide lists it, it meets the standard. Example: fibre cement panel, metal cladding, stucco, or masonry all satisfy “noncombustible cladding (or engineered equivalent)” without further testing.

Tested Equivalent

Products tested to the referenced standard by a recognized testing laboratory. The manufacturer’s test report is the evidence of compliance. Example: an ember-resistant vent not listed in this guide but tested to ASTM E2886 by an accredited lab meets the WER-2 vent specification.

Engineered Alternative

A P.Eng. assessment demonstrating equivalent performance through analysis. The engineer’s sealed report is the evidence. Example: a heavy-timber fence post (140×140mm minimum) may satisfy the WER-2 fencing specification through charring rate analysis, even though it is not noncombustible.

Fire-Rated Timber

Where a specification says “NC or fire-rated,” fire-rated timber is an acceptable alternative when it meets minimum section dimensions. Large-section timber chars at a predictable rate (approximately 0.65mm/min for softwood per Eurocode 5) and can maintain structural integrity for defined periods. For fencing, outbuilding framing, and deck substructure, timber sized to resist ignition for the design fire exposure period is acceptable at WER-1 through WER-3. Minimum section dimensions are specified in the relevant design guides. At WER-4, all exterior materials must be noncombustible — no timber alternatives.

Close Neighbour Exposure Level (CNEL)

Most Canadian subdivision homes are built 1.5–6 metres apart. If any face of your home is within 10 metres of a neighbouring structure, the CNEL system applies to that face. Measures scale with WER level. See the CNEL section in each FireHard design guide and Construction Detail Guide 6 for full technical details.

Disclaimer

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Not professional advice: This document does not constitute professional engineering, architectural, or construction advice. It is not a substitute for the services of a licensed engineer, architect, or other qualified professional.

No building is fireproof: Compliance with the recommendations in this document does not guarantee that a property will survive a wildfire event. Wildfire outcomes depend on fire intensity, duration, wind conditions, ember density, suppression response, terrain, vegetation, neighbouring property conditions, and other factors beyond building construction.

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FireHard Canada (firehard.ca) is a trade name of Wildernest Systems Inc. The Wildfire Exposure Rating (WER) system was developed by engineers at Wildernest Systems Inc. and Bulkley Valley Engineering Services Ltd., with landscape architecture expertise from Lazzarin Svisdahl Landscape Architects.

FireHard Canada publishes free wildfire hardening resources for Canadian homes. Six Construction Detail Guides, FireHard Self-Assessment Guides, four FireHard Design Guides, a New Construction Design Guide, and the FireHard Technical Reference are all available free at firehard.ca.

We are building FireHard Canada non-profit organization for stakeholder engagement, peer review, and ongoing refinement of the WER system. We are actively seeking engineers, architects, building scientists, insurers, building officials, researchers, and community advocates to participate.

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