

High-Performance Window Technologies: Inspection and Performance Considerations

Window inspection singapore — practical guidance for building owners and managers

Facade Inspection Singapore — BCA-Approved Competent Person

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Window inspection in Singapore — what BCA Competent Persons check on high-performance glazing: low-E coatings, IGUs, gaskets, sealants, and performance metrics.

A modern Singapore office tower can have hundreds of square metres of high-performance glazing on a single elevation, and every one of those panels is a quiet engineering compromise between visible light, solar heat gain, glare, U-factor and energy cost. When a panel fails — a desiccated low-E coating, a fogged insulating glass unit (IGU), a hardened EPDM gasket — it doesn't fall off the building dramatically; it just costs the owner running cost and tenant comfort, and gets quietly worse. A serious window inspection in Singapore is what catches these defects while they are still cheap to remedy.

This post sets out what high-performance window technologies actually do, how their performance metrics behave with age and exposure, and what a BCA Competent Person inspects to verify they are still doing their job.

The performance language of glazing

Every high-performance window can be described against a small set of metrics:

- Visible Transmittance (VT) — fraction of visible light transmitted
- Solar Heat Gain Coefficient (SHGC) — fraction of solar radiation transmitted as heat
- U-factor — heat transmission rate; lower is better insulating
- Reflectance — fraction reflected (specular at glass-air interfaces)
- Absorptance — fraction absorbed and converted to heat in the glass

Most float glass manufactured today reflects about 4% of visible light at each glass-air interface (8% total for a single uncoated pane). Beyond about 80° angle of incidence, even clear glass reflects more than 50% of incident sunlight. Clear quarter-inch glass absorbs only about 7% at

normal incidence — but tinted, heat-absorbing glasses absorb significantly more, which is why they feel hot to the touch in direct sun.

For inspection, the takeaway is that a panel's behaviour depends heavily on what's on, in and between the glass — and most of those layers degrade in different ways.

What's actually in a high-performance window

A modern glazed unit blends multiple technologies:

Glass treatments

- Low-E coatings — engineered to preferentially reflect far-infrared and near-infrared while transmitting visible light. These coatings underpin most modern high-performance glazing.
- Reflective coatings — broader-spectrum mirroring used where solar control is paramount.
- Tints — bronze, grey or blue-green additives that increase absorptance to lower SHGC and control glare.
- Laminates — interlayer films for safety, acoustic and security performance.
- Surface treatments and applied films — anti-reflective, low-E retrofit films, anti-glare.

Assembly

- Multiple panes — double or triple glazing.
- Gas fills — argon or krypton between panes to reduce U-factor.
- Spacers — warm-edge or stainless-steel spacers separating the panes; the spacer is also where edge-seal failure typically initiates.
- Frames — aluminium (often thermally broken), steel, uPVC or composite.
- Air leakage — measured at the perimeter seal of the operable unit and the frame-to-wall interface.

Advanced technologies

- Dynamic windows — electrochromic or thermochromic glass.
- BIPV — building-integrated photovoltaics within the glazing, now governed under the SCDF Fire Code 2023 for wall-integrated PV.
- Automated shading — internal or interpane blinds responding to solar angle.

For inspection, each of these adds a failure mode the inspector must understand.

What a window inspection actually checks

A periodic window inspection blends visual and instrumented techniques:

Visual and tactile

- Glass condition — chips, scratches, scoring, edge damage at corners, signs of impact
- Visible coating degradation — patchy reflectance, "ghosting", or visible halos suggesting low-E delamination

- IGU fogging or condensation between panes — desiccant exhaustion or breach of the edge seal
- Frame condition — corrosion, paint failure, deformation, dropped sashes
- Gasket compression — EPDM, silicone or neoprene gaskets that have lost compression and sit proud
- Sealant integrity — cohesive failure, adhesion failure, hardening or chalking; typical T/D ratio of 2 with minimum depth around 6 mm

Operational

- For openable units: hinge corrosion, friction stay condition, restrictor function (especially residential units where fall-from-height is a recognised hazard), latch and lock function

Instrumented

- Infrared thermography — to map cold spots indicating insulation displacement, gas-fill leakage, or thermal bridges at frames
- Moisture meter and damp surveys — at sill heads and inside reveals to confirm whether visible staining is condensation or external water ingress
- Air leakage check — smoke pencil or anemometer at the perimeter and operable seals on tested elevations

Common defects and red flags during glazing inspection

- IGU edge-seal failure showing as condensation between the panes
- Spacer tarnishing visible at the edge of the glass — early warning of seal compromise
- Patchy reflectance or rainbow patterning suggesting low-E coating delamination or applied-film failure
- Hardened, chalking or cracked perimeter sealant on multiple panels of the same elevation
- EPDM or silicone gaskets that no longer compress evenly, leaving micro-gaps for air and water
- Cracked or loose window panels
- Dangling sashes or broken hinges on openable units
- Condensation patterns inside that move with weather rather than internal RH — a sign of air leakage past the gasket, not just internal humidity
- Restrictor missing or removed on residential openable windows above a fall height

The Singapore context — why glazing performance matters

Singapore's climate hits glazing hard: high solar radiation, sustained humidity, intense UV, cyclic thermal stress and salt aerosol on coastal-facing elevations. A high-performance specification chosen at design intent — say, a low-E IGU with argon fill and warm-edge spacers — will progressively drift from spec as gaskets age, edge seals breach and coatings degrade. Periodic inspection is the discipline that catches the drift before it shows up as a tenant complaint or a safety incident.

For residential towers, falling-glass risk is a separate concern. Cracked or loose vision panels, dangling windows, missing capping and corroded fixings on the operable hardware are all defects that fall squarely within the BCA periodic facade inspection scope.

Singapore regulatory context

Window inspection sits within three frames. The Building Control (Periodic Inspection of Buildings and Building Facades) Regulations 2021 (BCA) explicitly include the curtain wall, glass facade and glass parapet in the definition of "facade", so periodic inspection of glazing is part of the PFI obligation. The SCDF Fire Code 2023 governs fire-rated glazing, fire shutters at facade interfaces, and (under the new Clause 10.2.3) wall-integrated PV in glazed assemblies. The Workplace Safety and Health Act governs inspection access — particularly relevant for high-rise glazing inspections that need rope access, gondola or BMU under the WSH (Work at Heights) Regulations and the Approved Code of Practice CP 20 for suspended scaffolds.

What to do next

If your building has glazing more than 10 years old, three pre-inspection items will materially improve the value of the survey: pull the original glazing specification (low-E type, gas fill, spacer system, sealant grade), pull the maintenance records for any sealant or gasket replacement programme, and identify the worst-exposure elevations (typically west and south) for prioritised close-range inspection. From there, a Competent Person can size the inspection scope to where the risk and the remediation cost actually concentrate.

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- Service overview: facadeinspection.com.sg
- Periodic facade & structural inspection: [Periodic Structural Inspection](#)
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Sources & references

- Source training material: Window Technologies: Properties Primer (Facade Design Tool, University of Minnesota & LBNL).
- Building and Construction Authority (BCA) — Periodic Facade Inspection (PFI), Building Control Act and Building Control (Periodic Inspection of Buildings and Building Facades) Regulations 2021. www1.bca.gov.sg
- Ministry of Manpower (MOM) — Workplace Safety and Health Act 2006 and subsidiary regulations including WSH (Risk Management), WSH (Work at Heights), and WSH (Scaffolds) Regulations. www.mom.gov.sg
- Singapore Civil Defence Force (SCDF) — Code of Practice for Fire Precautions in Buildings 2023 Edition (effective 1 March 2024). www.scdf.gov.sg