

## CAN/CGSB 12.1 Safety Glazing

2017 version summary update



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GANA Thirsty Thursday January 18, 2018

## Definition of Safety Glazing

- Glazing material so constructed, treated, or combined with other materials that, if broken by **human contact**, the likelihood of **cutting or piercing injuries** that might result from such contact is **reduced**.
- NOT fire, fall-out, or an assessment of strength
- CAN/CGSB 12.1 (and ANSI Z97.1) are the inspiration of “Safety Glazing” standards for the world.

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## Background

- Injuries from glass doors
- ANSI Z97.1 – 1966 (voluntary)
- 1970's (Canada and USA)
  - safety glazing regulations
  - mandating use
  - primarily doors

<https://www.youtube.com/watch?v=IzHZDfp9DI0>



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## Previous CGSB 12.1 Updates

- Original publication CAN-2-M2-12.1-76
  - Published 10.01.1975
- Several revisions yield CAN/CGSB – 12.1-M90
  - Reasonably harmonized with ANSI Z97.1-1984
    - Glass Types (laminated & tempered)
    - Categories (457 mm & 1219 mm impact)
    - Boil test for laminated
    - Centre punch test for tempered
- Updates halted 1990 - 2014

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## PROMPTING CHANGE

- Several law suits involving monolithic wired glass
- Interests felt standards updates were needed (Canadian Code Center @ NRC)
- Notice sent by Standards Council of Canada (SCC) to Canadian Glass Committee indicating need to review standards periodically
- Canadian Glass Committee re-established

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## Glass Committee Objectives

- Clearly **define** safety glass and its product categories
  - **Update** to address technology and new products
  - **Harmonize** as much as possible with ANSI Z97.1
  - Develop under **SCC** rules
  - Ensure **applicable** to Canadian building practices and codes
- 
- First meeting Spring of 2014
  - Publication in Feb 2017
  - Acknowledged assistance from ASC Z97



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## CGSB Committee on Glass

- **Chair**
- Webb, M. Insulating Glass Manufacturers Alliance (Producer)
- **General interest category**
- Flack, J. Consultant
- Steel, K. Steel Consulting Services
- Zaremba, T. Roetzel & Andress, LPA
- **Producer category**
- Botman, R. Glassopolis Specialty Glass
- Fraser, E. PPG Flat Glass Canada Inc.
- Harder, B. Ferguson Corporation
- Liversidge, M. Precision Glass Services Inc.
- Schimmelpenningh, J. Eastman Chemical Company
- Wakefield, R. Trulite Canada
- **Regulator category**
- Chowhan, P. Health Canada
- Fortin, M. National Research Council of Canada
- **User category**
- Brook, M. BVDA Facade Engineering Inc.
- Panziera, S. Thinkform Architecture & Interiors
- Redmond, T. Ontario Building Official Association
- Sharp, G. Canadian Home Builders' Association
- Shelbourn, K. Canadian Building Envelope Science & Technology
- **Secretary (non-voting)**
- Jimenez, J. Canadian General Standards Board

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## Standard Adoption Process

- CGSB (Canadian General Standards Board) establishes the standard
- CGSB follows SCC (Standards Council of Canada) requirements for standards development.
- After the building code development process, NRC (National Research Council of Canada) publishes NBC (National Building Code of Canada)
- Provinces then consider adoption

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# Updated Standard

Title	
CAN/CGSB12.1-2017	CAN/CGSB12.1-M90
■ Safety Glazing	■ Tempered or Laminated Safety Glass

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## General

- Format and order of sections
- Section titles
- Limits and tolerances - small differences (1-3mm)
- Not published as dual language (English/French)
- References predominately CGSB Glass & ASTM International Standards
- Product definitions enhanced
- Specifications removed
- Test methodologies detailed
- Nominal thickness difference requires test
- Number of specimens stays the same (4)
- Weathering requirements (Laminated, OCG, Plastics, Mirror)

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## Scope

### CGSB 12.1 -2017

- Broadens to **glazing materials**
- **Defines injury** (cutting and piercing)
- Results from **breaking by human impact**
- **Building** and architectural uses
- **Does not address** the strength, durability, fire rated characteristics, appearance or methods of installation
- Defines products **not considered safety-glazing materials** (monolithic)
  - annealed glass
  - heat-strengthened glass
  - chemically-strengthened glass
  - glass-ceramic
  - wired glass
- **Harmonization** with ANSI Z97.1-2015

### CGSB 12.1 M-90

- Applicable to **tempered glass** or glass combined with materials to reduce the likelihood of injury
- By **objects projected from an exterior source** or by glass fragments when the glass is cracked or broken.
- Intended primarily for use in **doors** and adjacent glazed panels

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## Terms & Definitions

- Asymmetrical material
- Bent glass
- Bubble
- Cracking
- Crack-free particle
- Crazeing
- Delamination
- Discoloration
- Fully tempered glass
- Laminated glazing
  - 2-ply glass laminates
  - Multi-ply glass laminates
- Glass/Plastic laminates
- Mirror glazing
- Organic Coated glass
- Plastic Glazing material
- Safety Glazing Materials

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## Product Types

### CGSB 12.1-2017

- Laminated
- Fully Tempered
- Organic-coated
- Plastic
- Mirror

### CGSB 12.1-M-90

- Laminated
- Fully Tempered

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## Sizes

- CGSB 12.1-2017
  - Unlimited
    - 863mm x 1930mm
    - Designated: "U"
  - Limited
    - min 406mm x 762mm up to "U"
    - Designed: "L"
    - Dimensional limits as tested
- CGSB 12.1-M-90
  - ≤0.8m (Cat I)
  - >0.8m (Cat II)

Note:  
M-90 Sizes linked to categories I and II

## Classes & Categories

### CGSB 12.1-2017

- Impact Classification
  - A = Drop height of 1219mm – 1232mm
  - B = Drop height of 452mm - 470mm

### CGSB 12.1 M-90

- Product Classification
  - A = Sheet Glass
  - B = Float Glass
- Impact Category
  - Category I
  - Category II





## Marking

### CGSB 12.1-2017

- Supplier name, designation or mark (Logo)
- Standard: CAN/CGSB-12.1-2017
- Size: L or U
- Class: A or B
- Place of Fabrication (if more than 1 location)
- Other info permitted
- Sample Label:

ABC Lam – Kelowna  
CAN/CGSB-12.1-2017 UA

### CGSB 12.1 M-90

- Manufacturer's name/ Trademark
- CAN|CGSB-12.1-M
- CAN|CGSB-12.1-M-1 for Cat 1 only

#### NOTES

- Shall be legibly and permanently marked
- Same nominal thickness
- Same production manner
- No mark = No compliance

## Application of the mark (2017)

- Laminated glass stock sheets
  - Marked by the manufacturer of the stock sheet
- Cut size laminates, FT, OCG
  - Marked by company producing the finished cut size panel
- Fabricator to mark plastic glazing
- Indoor only application = “Indoor Use Only”
- Installer shall mark field applied OCG (films) also mark: “Glaze this side in”

# Test Methods

## Test Overview

- **Impact Test** is essentially the same but with added clarification
- **Fragmentation test** – Tempered glass
- **Mirrors** – impact on “non-reinforced” side
- **Bent Glass** – direction how to test
- **Indoor (only) Applications** – aging, weathering and testing
  - Exterior qualifies interior
- **Thermal test** – Laminated and Organic Coated
- **Weathering** – exposure and testing

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# Tests

Test	Glazing materials <sup>a</sup>			
	Laminated glazings	Fully tempered glass	Organic coated glazings	Plastic glazing
Impact (see 10.1)	X	X	X	X
Centre punch fragmentation (see 10.2)		X <sup>b</sup>		
Thermal (see 10.3)	X		X <sup>c</sup>	
Weathering <sup>d</sup> (see 10.4)	X		X <sup>e</sup>	X
Indoor aging (see 10.4.3)	X		X	X
Hardness (see 6.5 and 10.1.4 c)				X <sup>f</sup>
Modulus (see 6.5 and 10.1.4 c)				X <sup>f</sup>

<sup>a</sup> Bent and mirror glazing shall be tested in accordance with requirements of the base-glazing product (see 6.2).  
<sup>b</sup> Centre Punch Fragmentation test is used to evaluate the fracture pattern of fully tempered glass specimens that do not break during impact test of 10.1.  
<sup>c</sup> Thermal test only applies to organic coated glazings when organic coated glazings are used in the building envelope.  
<sup>d</sup> Weathering tests on laminated and organic coated glasses shall be performed on the thinnest construction of all components with clear glass, clear plastics and clear interlayers.  
<sup>e</sup> Mirror glazing shall be tested in accordance with 10.4.3.  
<sup>f</sup> Only required if breakage occurs under impact.

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# Specimen Requirements

- Impact – 4 (same)
- Mirror with backing – 4
  - Impact non-reinforced side only
- Bent Glass – 4
  - Simple arc bend 1016 mm
- Thermal – 3 (same)
- Weathering – Various per product
- Indoor - various
- Flexural Modulus – ASTM D790
- Rockwell Hardness – 25 mm<sup>2</sup>; 6 mm thick

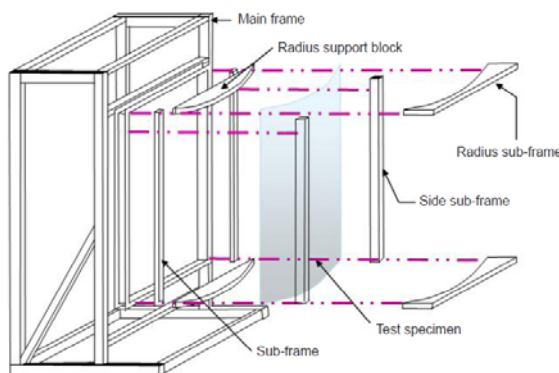


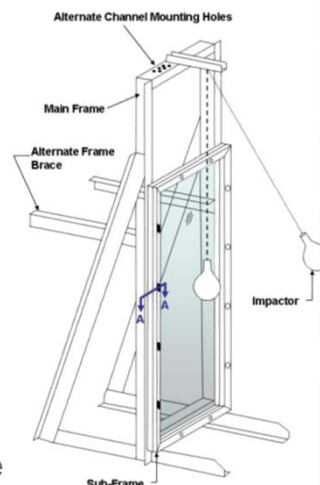
Figure 11 – Bent glass impact test frame (Exploded view)

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## Impact

- Specimen conditioning
  - Temperature 18°C – 29°C
  - Spaced for free air circulation
  - Minimum 4 hours
- Bag rotated around axis for each impact
- Pummel bag to original shape
- Free hanging impactor no more than 51mm from glazing surface (M-90:10 mm)
- Torque bolts 20Nm
- Sphere – vertical, 18N or less force
- Protective cloak suspended from frame no more than 10 mm from surface (M-90: bag drape)
- Curved glass impacted on convex surface



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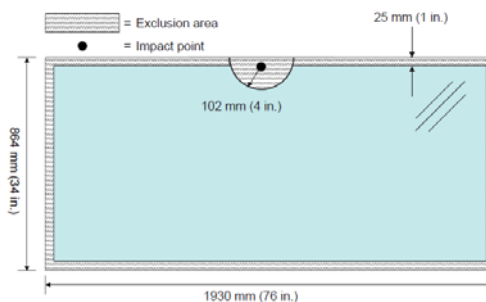
## Centre Punch Fragmentation

### CGSB 12.1-2017

- Required for tempered if no break after impact
- Flat and bent specimens
- Centre punch break 25mm in at midpoint of longest edge
- Temperature
  - 18.3°C - 29.4°C
- Exclusion area
- Within 5 min from fracture
- 10 largest particles, no more than mass of 6452mm<sup>2</sup> of unbroken specimen

### CGSB 12.1 M-90

- Centre punch break 15 mm in at midpoint of longest edge
- 10 largest particles, no more than mass of 6500mm<sup>2</sup> of unbroken specimen



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## Thermal

### CGSB 12.1-2017

- Boil (Wet)
  - 2 hours @ 100°C
- Bake (Dry)
  - 16 hours @ 100°C
- Re-conditioned prior to rating
  - 4 hrs. at 18°C – 29°C
  - separated with free flowing air;
- Evaluation
  - 12mm from edge
- Select either based on product
- OCG used in exterior glazing o

### CGSB 12.1 M-90

- Boil test only
- Remove & cool, no timing
- Evaluation
  - 10mm from edge



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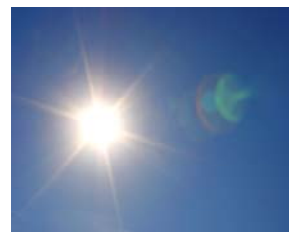
## Weathering – Exterior (2017)

### Laminated & OCG

- Exposure
  - South Florida – 1 year (Natural)
  - Xenon Arc – 3000 hrs.. (Accelerated)
- Assessment
  - Visible light stability
  - Yellowness
  - Haze
  - Color (Delta E)
  - Bubbles
  - Crazeing
  - Decomposition
- OCG only
  - Peel adhesion & tensile
- Qualifications
  - Thin qualifies thicker
  - Clear qualifies colored

### Plastics

- Natural Exposure
  - South Florida – 1 year
  - Xenon Arc – 3000 hrs..
- Assessment
  - Charpy impact
  - Bubbles
  - Degradation



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## Weathering – Indoor Applications (2017)

- Filtered Xenon Arc
    - Lower irradiance
    - 3000 hrs..
  - Assessment
    - Same as exterior
  - Qualifications
    - Passing exterior qualifies indoor
    - Thin qualifies thicker
    - Clear qualifies colored
- Mirror
    - Full size panels
    - Cyclic heat and humidity
    - Impact after exposure

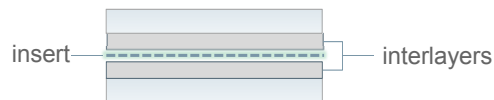


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## Weathering – Inserts

- Thinnest construction desired for qualification
- Inserts
  - Weathering
    - Encapsulated insert
    - Interlayer complies with weathering
    - Minimum thickness per ply as tested
  - Impact test required



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## Interpretation of Results

- Performance broken into Types
  - Type 1 – Fragments contained
  - Type 2 – Break safe
  - Type 3 – “Plastic” type break
  - Type 4 – No Break



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## Interpretation of Results

- Type 1
  - No passage of 76mm diameter sphere with horizontally applied force of 18 N
  - Detached particles up to 3 min after impact
    - In total weigh no more than a mass equivalent to 10,000mm<sup>2</sup> of the original test specimen
    - Single largest particle shall weigh less than a mass equivalent to 4,400 mm<sup>2</sup> of the original test specimen.
    - Detached individual particles less than the mass equivalent of 650 mm<sup>2</sup> shall be excluded from the fragment analysis.



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## Interpretation of Results

- Type 2
  - The 10 largest crack-free particles
  - Selected within 5 minutes after impact
  - Weigh no more than the equivalent weight of 6,452mm<sup>2</sup> of the original specimen.



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## Interpretation of Results

- Type 3
  - The stiffness and hardness of the specimen shall be determined.
  - A modulus of elasticity (see ASTM D790) less than 3.9 GPa
  - Rockwell hardness (see ASTM D785) less than M or R 140 shall indicate satisfactory compliance.

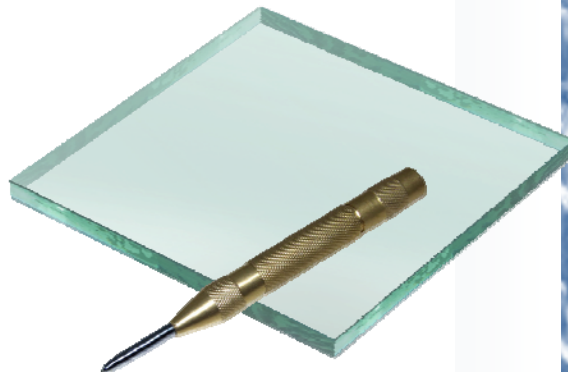
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## Interpretation of Results

- Type 4
  - Performed on tempered glass specimens
  - Specimens for testing shall previously have been tested via impact and, when impacted, no breakage has occurred.
  - Specimens temperature shall be between 18.3°C and 29.4°C prior to testing.



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## Removed content from M-90

- Discussion of dimensional tolerances except for impact and weathering specimen sizes.
- Glass thickness table
- No designation of clear or translucent (ASTM C1036, ASTM C1172)
- No flatness requirements (ASTM C1048)
- Wired Glass
- Preparation for Delivery
- Inspection
- Localized Warp and Overall Bow and Warpage
- Notes
- Dimensions and glass quality
- Sampling
- Tempered glass - description
- Strain Pattern - description



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## Summary

- Broader applicability or glazing types
- Impact test virtually unchanged
- Option in thermal tests based on product
- Glazing types for glass retention specification
- Impact classes changed from Cat to Class
- Weathering requirements included
- Specification details removed
- Reference standards and terminology added
- Harmonization with ANSI Z97.1-2015 achieved
- Safety Glazing standard significantly upgraded



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## Questions?



# Thank you!

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