
IGU Quality Standard Reference Document

Table of Contents

1. Purpose
2. Viewing Requirements
3. General Quality Requirements
4. Definitions and Terminology
5. References

1. Purpose

View Smart Glass is a new generation of intelligent windows that use electrochromic technology to predictively adjust tint levels in response to external conditions and user preference. The dynamic insulating glass unit (IGU) contains an electrochromic coating to switch between clear and tinted on demand. The IGU can be configured with a range of sizes, shapes, colors and inboard lite options.

This document defines View's Quality Standard that will serve as a single-point quality reference. Its intention is to provide suitable quality criteria and methods for inspection that View applies and carries out during production of the IGU.

Our goal is to ensure that View's products are fit for their purpose, meet customer needs and expectations, and ensure that the IGU conforms to internationally accepted industry standards.

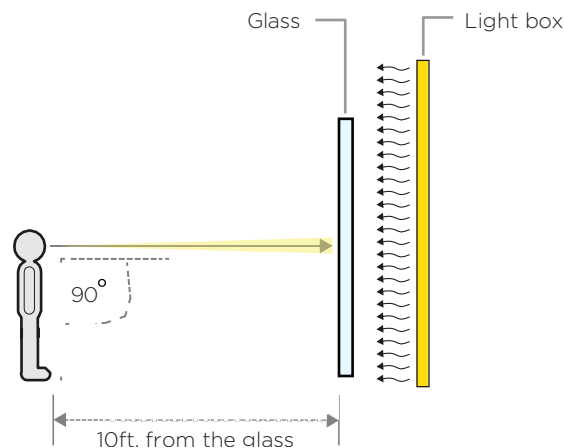
This document provides a summary and reference of applicable standards but does not replace the supporting industry standards.

2. Viewing Requirements

View follows the recommended ASTM Standard C1036 for viewing glass during the manufacturing and inspection process (see Figure 1 and 2). Visual inspection must be in accordance with glazing or installation requirements.

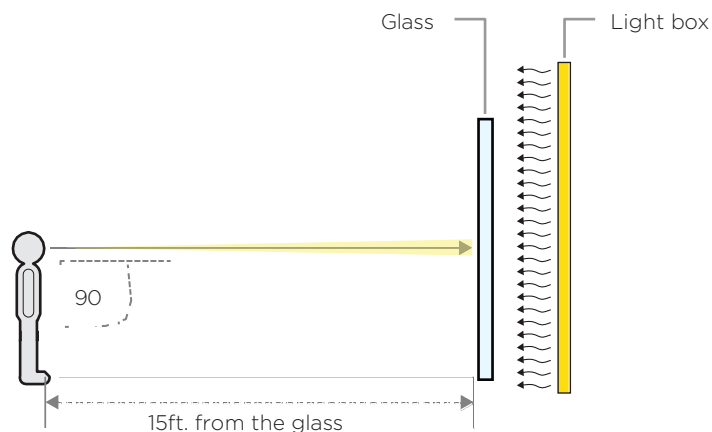
- 2.1.1 Glass for vision installation, either clear or coated, must be inspected at a viewing angle of 90 degrees. The glass shall be placed in a vertical position and viewed on the light box with uniform diffused background lighting that simulates daylight at a distance of approximately 10 ft. (3.0m) from the viewer to the glass.

Figure 1



- 2.1.2 Glass for overhead installation with a clear or laminated coat must be inspected at a viewing angle of 90 degrees. The glass shall be placed in a vertical position and viewed on the light box with uniform diffused background lighting that simulates daylight from a minimum distance of 15 ft. (4.6 m) from the viewer to the glass.

Figure 2



- 2.1.3 The person viewing the glass must look through the sample at a 90-degree angle (perpendicular) to the surface. Inspection viewing must not exceed 5 seconds for lites up to 6 ft², 10 seconds for

lites up to 35 ft2, and 20 seconds for lites larger than 35 ft2.

During inspection, the angle between the surface of the coated glass and the light beam proceeding to the eyes of the observer after transmission by the coated glass shall not exceed 30 degrees. If defects are visible within these viewing requirements, refer to applicable defect tolerances defined in section 3.

3. General Quality Requirements

View's IGUs comply with inspection level Q3 of ASTM Standard C1036. The requirements specified in this standard are derived from applicable ASTM standards in Q3 category.

3.1 General Glass

3.1.1 Thickness

The glass thickness must be measured with a micrometer or caliper which is graduated to 0.01 mm. Thickness must meet the specifications in accordance with Table 1.

3.1.2 Dimensions and Squareness

3.1.2.1 Dimensions (Length and Width)

Glass dimension must be measured with a steel scale tape with a graduated measurement of 1 mm. Length and width measurements must be made on adjacent sides (edge-to-edge, including any flares). Measurements taken at any point must meet the allowed tolerances on Table 1.

3.1.2.2 Squareness

Glass squareness must be determined by measuring both diagonals (corner-to-corner). The difference in the length between two diagonal measurements must not exceed the allowable tolerances in Table 1.

Dimensions and Squareness of Rectangular Glass

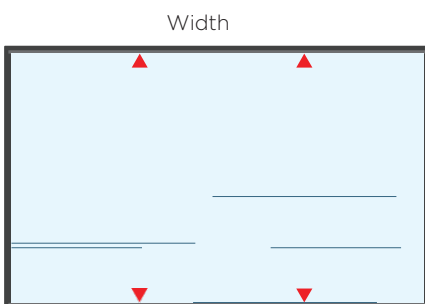


Figure 3

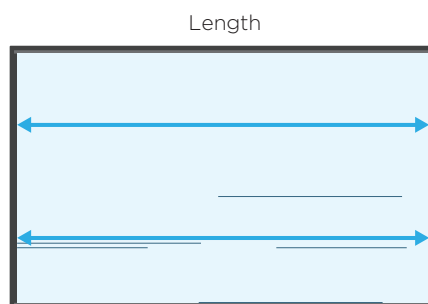


Figure 4

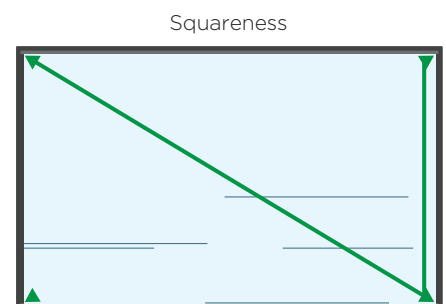


Figure 5

Table 1: Dimensional Tolerances (Ref: ASTM C1036-11)

GLASS THICKNESS	CUT-TO-SIZE GLASS			
	Min Thickness	Max Thickness	Length & Width	Squareness
3.0 mm (0.11 in)	2.92 mm (0.11 in)	3.40 mm (0.13 in)	+/- 1.6 mm (0.06 in)	+/- 2.0 mm (00. 78 in)
4.0 mm (0.15 in)	3.78 mm (0.14 in)	4.19 mm (0.16 in)	+/- 1.6 mm (0.06 in)	+/- 2.0 mm (00. 78 in)
5.0 mm (0.19 in)	4.57 mm (0.18 in)	5.05 mm (0.20 in)	+/- 1.6 mm (0.06 in)	+/- 2.0 mm (00. 78 in)
6.0 mm (0.23 in)	5.56 mm (0.22 in)	6.20 mm (0.24 in)	+/- 1.6 mm (0.06 in)	+/- 2.0 mm (00. 78 in)

3.1.3 Surface Defects

Surface defects include scratches and point defects. When inspecting for surface defects, the glass shall be viewed at a distance of 10 ft. for vision glass or 15 ft. for overhead glass. The inspection shall then progress sequentially to each of the shorter distances for other applicable blemish intensities. Any defects detected from the viewing distances shall be compared with the length and separation criteria for allowed surface defects.

3.1.3.1 Scratch

Scratches noted on the IGU surface that are not on the EC coating shall be classified into the following categories: light, medium and heavy. Refer to Table 2 for a guide in classifying the scratch intensity. Allowed tolerance for scratches must be in accordance with Table 3.

Table 2: Surface Defects Intensity Chart (Ref: ASTM C1036)

DETECTION DISTANCE (A)	SURFACE DEFECTS INTENSITY
Over 3.3 meters (10.82 ft.)	Heavy
1.01 meters (3.31 ft.) to 3 meters (9.84 ft.)	Medium
Less than 1 meter (3.2ft.)	Light

Note: Detection distance (A) is defined as the distance from the viewer to glass surface when the defect is first seen. The intensity is determined by comparing the detection distance to the intensity chart. Defect length is decided by measuring the perpendicular distance between the ends of the defect.

Table 3: Allowable Scratch and Distribution (Ref: ASTM C1036)

INTENSITY AND SIZE	ALLOWABLE FOR Q3 LEVEL (NUMBER)
Light scratch (any size)	Allowed - Any number
Medium \leq 75mm (3 in)	Allowed with a minimum separation of 600 mm (24 in)
Medium \geq 75mm (3 in)	None allowed

3.1.3.2 Point Defects

Point defects are bubbles, spots, stones, knots, dirt, gaseous stones, and crush defects that can be found, regardless of the glass being clear or coated. The size of defects must be determined by measuring the maximum length and maximum perpendicular width of the blemish, then calculating the average of the two dimensions. The allowed tolerances must be in accordance with Table 4.

Glass with point defects > 1.20 mm (0.04 in) and < 2.00 mm (0.08 in) must be rejected if there is less than 600 mm (24 inches) separation between defects. Point defects visible at viewing distance and > 2.00 mm (0.08 inches) must be rejected, regardless of lite size.

Table 4: Allowable Point Defects (Ref: ASTM C1036)

DEFECT SIZE (MM)	ALLOWABLE FOR Q3 QUALITY LEVEL
$d \leq 1.00$ mm (0.03 in)	Allowed
1.01 mm (0.04 in) < $d \leq 2.00$ mm (0.07 in)	Allowed with a minimum separation of 600 mm (24 in)
$d > 2.01$ mm (0.08 in)	None allowed

3.1.4 Edge Quality

The View electrochromic IGU glass edges will be fully seamed with either an arris edge or a pencil grind edge prior to the tempering process. For arris edge the arris shall be at approximately 45 degrees. Edge quality will follow ASTM Standard C1036 shown in Table 5.

Table 5: Allowable Shell Chip Size and Distribution (Ref: ASTM C1036)

DESCRIPTION	ALLOWABLE SHELL CHIP SIZE
Chip Depth	≤ 50 % of glass thickness
Chip Width	\leq Glass thickness or 6mm (1/4 inches), whichever is greater
Chip Length	≤ 2 times the chip width

3.2 Tempered Glass

3.2.1 Flatness (Ref: ASTM C1048)

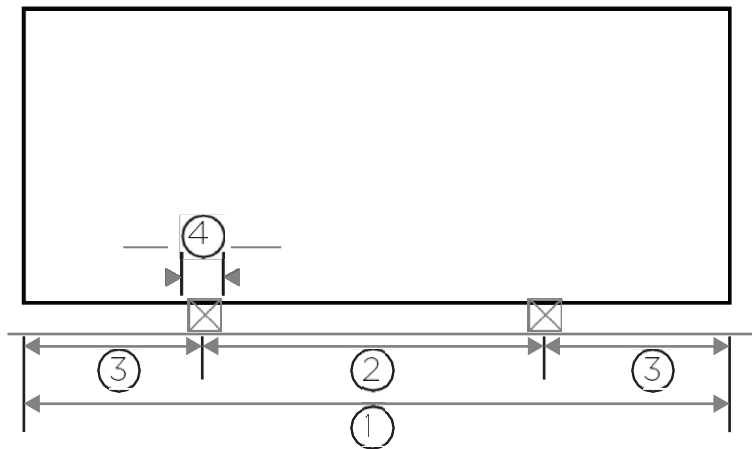
After passing through the tempering process, tempered glass will not be as flat as annealed glass because bowing, either local or overall, can occur. Bow will depend on the nominal thickness, the glass size dimension, and the ratio between the dimensions.

3.2.1.1 Overall bow must be measured by placing the glass in a vertical position and supported on its longer side by two load bearing blocks at quarter-points (see Figure 6). The deformation shall be measured along the edges of the glass and along the diagonals, as the maximum distance between a straight metal ruler, or a stretched wire, and the concave surface of the glass (see Figure 7). Refer to Table 6 for allowable overall bow tolerance per glass thickness and dimension.

Note: Alternate method - For glass with 3 mm (0.11 in) thickness place the glass on a flat surface, concave side down, to determine the overall bow.

3.2.1.2 Localized bow must be measured over a limited length of 300 mm (11.81 in) by using a straight ruler or a stretched wire, parallel to the edge at a distance of 25 mm (0.98 in) from the edge of the glass (see Figure 7). The bow must not exceed 1.6 mm (0.06 in) over 300 mm (11.81 in) span.

Figure 6: Support Condition for Measurement of Overall Bow



Note:

1. Base (B) or Height (H)
2. $(B \text{ or } H)/2$
3. $(B \text{ or } H)/4$
4. Maximum 100mm (3.93 in)

Figure 7: Representation of Overall and Local Bow

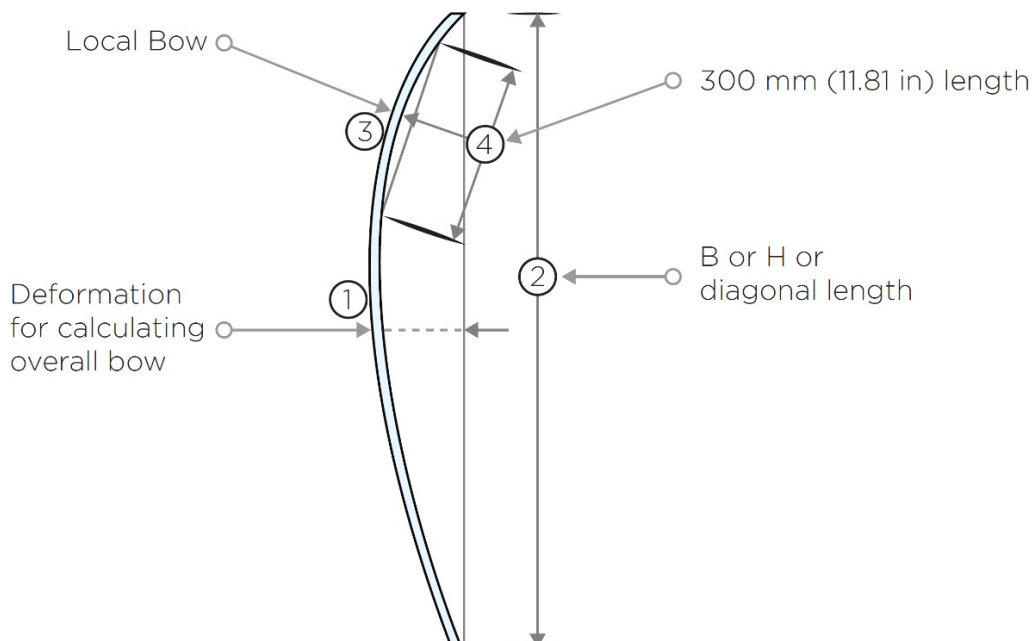


Table 6: Allowable Overall Bow Tolerance

(Ref: ASTM C1048)

GLASS THICKNESS	EDGE DIMENSION							
	0-35 IN	> 35-47 IN	> 47-59 IN	> 59-71 IN	>71- 83 IN	> 83- 94 IN	> 94 -106 IN	> 106- 118 IN
3 mm	0.16 in (4 mm)	0.2 in (5 mm)	0.28 in (7 mm)	0.35 in (9 mm)	0.47 in (12 mm)	0.55 in (14 mm)	0.67 in (17 mm)	0.75 in (19 mm)
3 mm (alternate)	0.79 in (2 mm)	0.79 in (2 mm)	0.12 in (3 mm)	0.2 in (5 mm)	0.24 in (6 mm)	0.28 in (7 mm)	0.31 in (8 mm)	0.4 in (10 mm)
4 mm	0.16 in (4 mm)	0.2 in (5 mm)	0.28 in (7 mm)	0.35 in (9 mm)	0.47 in (12 mm)	0.55 in (14 mm)	0.67 in (17 mm)	0.75 in (19 mm)
5 mm	0.16 in (4 mm)	0.2 in (5 mm)	0.28 in (7 mm)	0.35 in (9 mm)	0.47 in (12 mm)	0.55 in (14 mm)	0.67 in (17 mm)	0.75 in (19 mm)
6mm	0.12 in (3 mm)	0.16 in (4 mm)	0.2 in (5 mm)	0.28 in (7 mm)	0.35 in (9 mm)	0.47 in (12 mm)	0.55 in (14 mm)	0.67 in (17 mm)

3.2.2 Distortion

The glass must be viewed at a distance of 4.5 meters (14.76 ft.) from a zebra board using daylight or other uniform diffused illuminated light. Start viewing with the glass parallel with the zebra board (zero-degree position), then rotate the glass clockwise from zero degrees until it reaches the angle at which the distortion appears. This angle is called the vision interference angle and must be > 35 degrees. (See Figure 8)

The process of heating glass and rapidly cooling for added strength and safety features is a common industry practice. The glass, when at its hottest point, will become slightly soft and tends to conform to the shape of the rollers supporting it. This results in a visible pattern of distorted reflections and images known as Roll Wave Distortion and Edge Kink. Lead and Trail (L/T) is defined by the area of glass within 150 mm (5.90 in) of the leading or trailing edge of a lite in the direction in which it travels through the furnace.

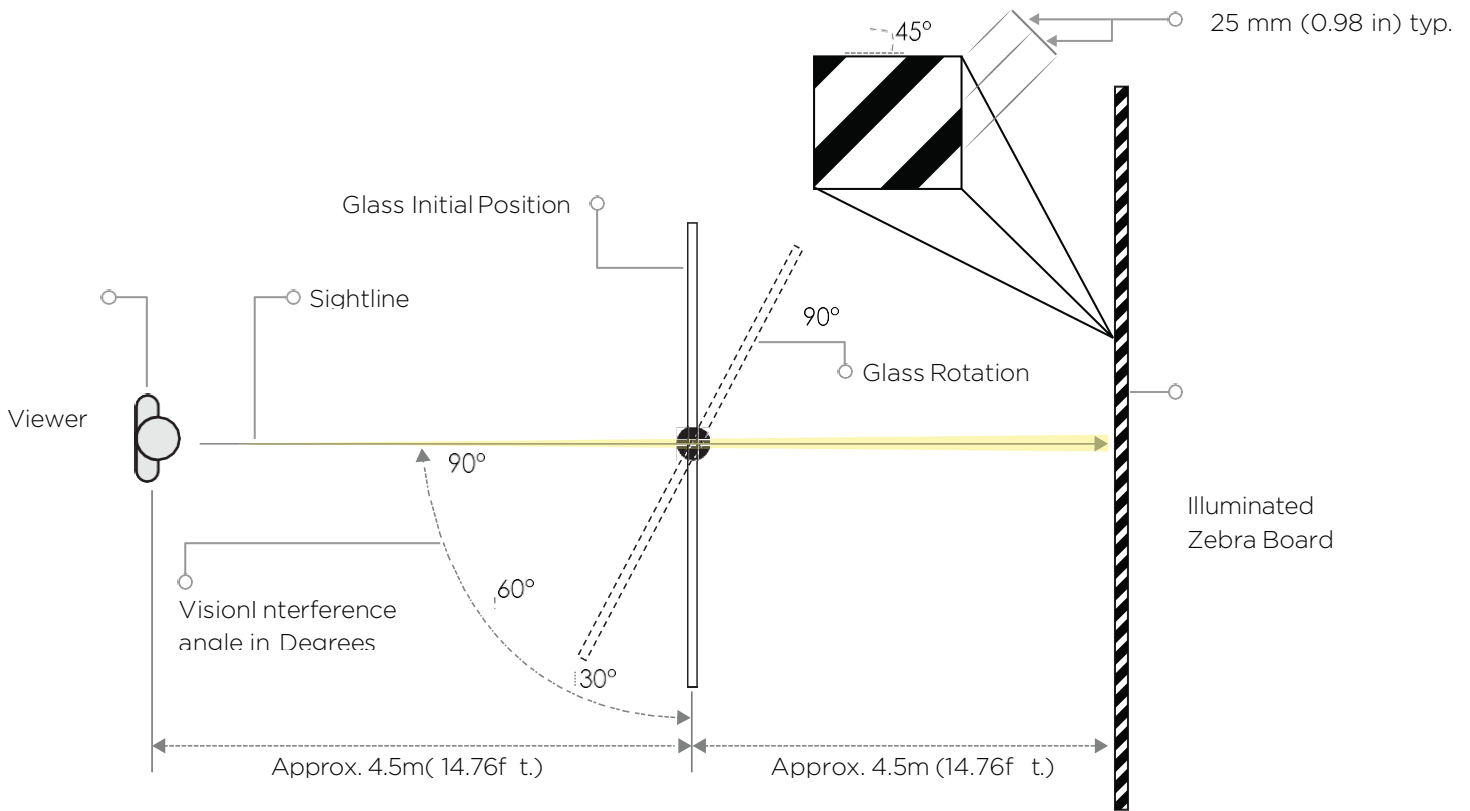
The unit of measurement for distortion in modern glass manufacturing is a millidiopter. The millidiopters of curvature of a surface are defined as $1000 / [\text{focal length of the curved surface in meters}]$. Larger millidiopter readings correspond to more surface distortion. All heat-strengthened or tempered glass must comply to the following:

3.2.2.1 When using the Osprey system, glass must not exceed 150 millidiopters in non-L/T region.

3.2.2.2 When using the Osprey system, glass must not exceed 250 millidiopters for the L/T region.

3.2.2.3 For heat treated glass, Peak to Valley (PV) max allowed delta must not exceed 0.005 inches.

Figure 8: Vision Interference Angle Procedure



3.2.3 Fragmentation Test

A fragmentation test is done to determine whether the glass breaks in the manner prescribed for a thermally-toughened safety glass. A fragmentation test shall be conducted at a minimum of once per hour if the same type of glass is run throughout the shift and every time the tempering machine is setup for another glass type. Maximum dimension of glass that can be tested is 80 inches x 40 inches.

3.2.3.1 The selected particles of glass must be weighed on the mass scale. The total mass (in grams) must be in accordance to the specification of the thickness of glass being tested. Refer to Table 7 for allowable weight for each glass thickness.

Table 7: Maximum Allowable Mass Per Glass Thickness

GLASS THICKNESS	MAXIMUM ALLOWABLE MASS OF 10 LARGEST PARTICLES
4 mm (0.15 in)	63 g
5 mm (0.19 in)	76 g
6 mm (0.23 in)	92 g

3.2.4 Strain Pattern

Tempered glass can have an optical phenomenon called strain pattern or quench pattern. This can appear as faint spots, blotches, or lines and is the result of the air quenching

(cooling) of the glass when it is heat- treated. This is not considered a glass defect. The tempering process results in a higher surface compression directly opposite the air quench, air nozzles or slots. The higher compression areas in the glass are denser and can exhibit a darker appearance under some viewing conditions - especially when light is polarized, such as with skylight or other forms of reflected light. The strain pattern can be seen under certain lighting conditions; intensity is influenced by the viewing angle and by the perceptiveness of the viewer. Visibility of the strain pattern may be accentuated with thicker glass, tinted glass substrates, coated glass and multiple lites of heat-treated glass in laminated or insulating glass products.

3.2.5 Tempered and Heat Strengthened (HS) Glass Marking

The identification marking will include View’s name or official trademark and a designation of “Tempered” or “HS” Logo position from the edge of the glass to the edge of the logo must be 25 mm (0.98 in) +/- 5 mm (0.19 in).

3.3 Laminated Glass Requirements

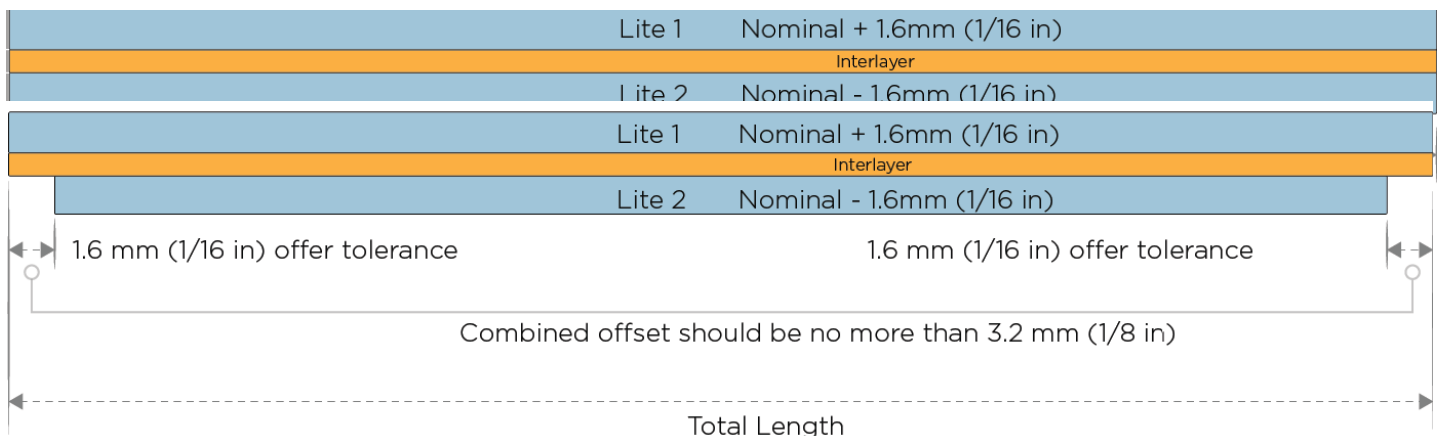
Laminated glass is constructed using two or more lites and joining the lites by using an interlayer between them. When laminated glass is required, the following quality specifications will apply:

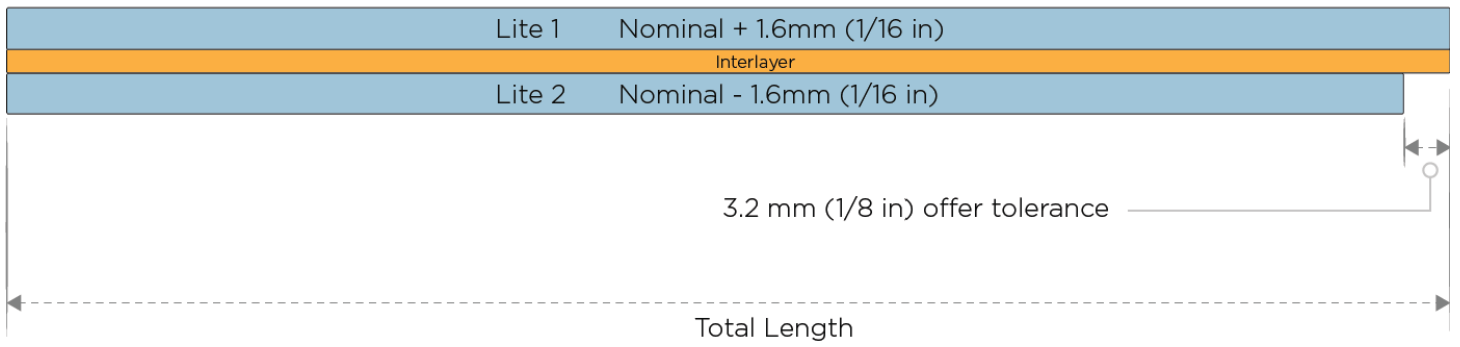
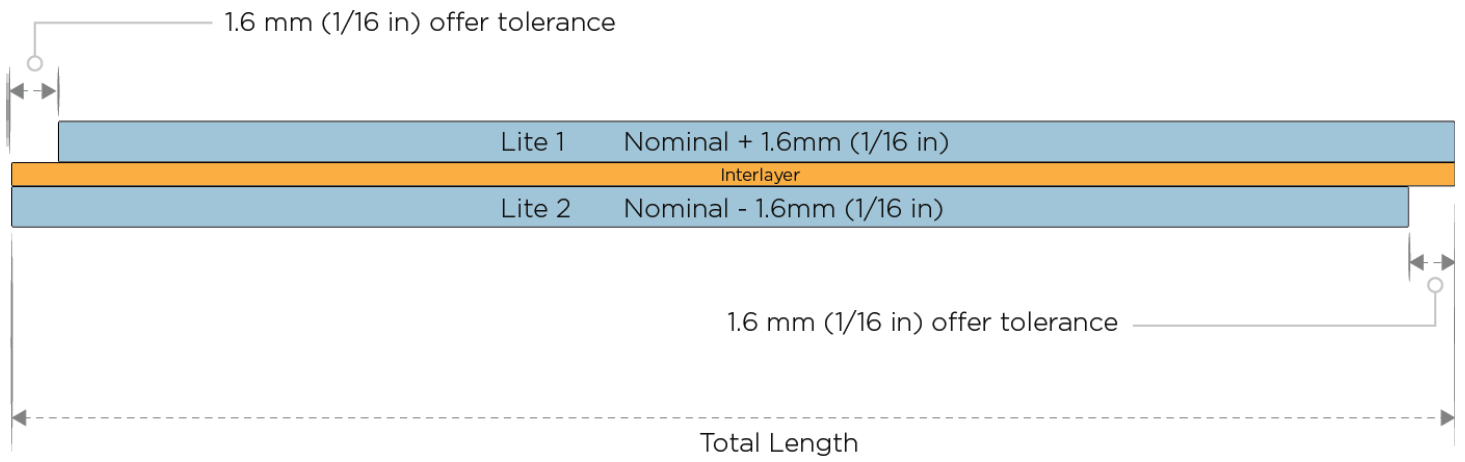
3.3.1 Dimensional Tolerances - Including Offsets

Length and width of the laminated glass must be measured from edge- to edge, including flares and offsets. Tolerance limits for dimensions on symmetrically laminated glass, including offset, must be within 3.0 mm (1/8 in) from nominal as specified by the order entry. See diagram examples below for allowable dimension discrepancies of a laminated mate lite.

- Lami lites 1 & 2 sizes are the same at nominal +/- 1.6mm (1/16 in)
- Length and width tolerances for 12.7mm (1/2 in) thick lami = 3.2mm (1/8 in) total offset

Note: ASTM C1172 sec 7.9 States: Measure length and width from edge to edge, including flares, mismatch, or offset. ASTM C1172 sec 8.5.1 States: The listed tolerances of overall laminate size include the cutting tolerance of the individual lites as well as the mismatch of the lites after the laminating process.





3.3.2 Flatness (Refer to ASTM C1172 Table 4)

Place sample glass in a freestanding vertical position, with the longest edge resting on blocks at the quarter points. With the laminate in this position, place a straightedge across the concave surface, parallel to and within 1 inches (25.4 mm) of the edge, and measure the maximum deviation with a taper or feeler gage. A dial indicator or caliper may also be used. For laminated glass using annealed transparent glass, the overall bow and warp shall not exceed 1/16 of an inch (1.6 mm) per 12 inches (300 mm) of length when measured in accordance with ASTM C1172 Section 6.8.

Table 8: Maximum Allowable Overall Bow and Warp for Laminated Other Than Annealed Transparent Glass

EDGE DIMENSION INCHES, (mm)		!	LAMINATE MAKE-UP OF TWO LITES INCHES, (mm)		
			1/4 inch (6mm)	4/16 inch (8mm)	3/8 inch (10mm)
0in - 18 in (0mm - 460mm)	1/8 in (3.2 mm)	1/16 in (1.6 mm)	1/16in (1.6 mm)	1/16 in (1.6 mm)	1/16 in (1.6 mm)
Over 18in - 36in (Over 460mm - 910mm)	3/16 in (4.8mm)	1/8 in (3.2 mm)	3/32 in (2.4 mm)	3/32 in (2.4 mm)	1/16 in (1.6 mm)
Over 36in - 48in (Over 910mm - 1220mm)	9/32 in (7.1 mm)	3/16 in (4.8 mm)	5/32 in (4.0 mm)	1/8 in (3.2 mm)	3/32 in (2.4 mm)
Over 48in - 60in (Over 1220mm - 1520mm)	3/8 in (9.5 mm)	9/32 in (7.1 mm)	7/32 in (5.6 mm)	3/16 in (4.8 mm)	1/8 in (3.2 mm)
Over 60in - 72in (Over 1520mm - 1830mm)	1/2 in (12.5 mm)	3/8 in (9.5 mm)	9/32 in (7.1 mm)	1/4 in (6.4 mm)	3/16 in (4.8 mm)
Over 72in - 84in (Over 1830mm - 2130mm)	5/8 in (15.9 mm)	1/2 in (12.7 mm)	11/32 in (8.7 mm)	5/16 in (7.9 mm)	1/4 in (6.4 mm)
Over 84in - 96in (Over 2130mm - 2440mm)	3/4 in (19.0 mm)	5/8 in (15.9 mm)	7/16 in (11.1 mm)	3/8 in (9.5 mm)	9/32 in (7.1 mm)
Over 96in - 108in (Over 2440mm - 2740mm)	7/8 in (22.2 mm)	3/4 in (19.0 mm)	9/16 in (14.3 mm)	1/2 in (12.7 mm)	3/8 in (9.5 mm)
Over 108in - 120in (Over 2740mm - 3050mm)	1.0 in (25.4 mm)	7/8 in (22.2 mm)	11/16 in (17.5 mm)	5/8 in (15.9 mm)	1/2 in (12.7 mm)

3.3.3 Blemishes and Surface Defects

When examining for surface defects on laminated glass, it shall be viewed and examined according to viewing requirements defined in Section 2. If a blemish is readily apparent under these viewing conditions, the allowable tolerances in Tables 9 and 10 will apply; however, the allowable defect tolerances are in accordance to the location of the defect, i.e., in the central area or outer area. All defects noted must be separated by a minimum of 300 mm (12 inches).

Table 9: Maximum Allowable Laminating Process Blemishes for Vertical Glazing Reference: ASTM C1172

Note: All imperfections noted must be separated by a minimum of 12 inches (300 mm)

GLASS AREA	UP TO 25FT ² (2.5M ²)		25FT ² TO 75FT ² (2.5M ² -7M ²)	
	BLEMISH	CENTRAL AREA	OUTER AREA	CENTRAL AREA
Boil (Bubble)	1/16 in (1.6 mm)	3/32 in (2.4 mm)	1/8 in (3.2 mm)	3/16 in (4.8 mm)
Blow-in	N/A	CE 1/4 in (CE 6.4 mm) EE 1/16 in (EE 1.6 mm)	N/A	CE 1/4 in (CE 6.4 mm) EE 1/16 in (EE 1.6 mm)
Fuse	1/32 in (0.8 mm)	1/16 in (1.6 mm)	1/16 in (1.6 mm)	3/32 in (2.4 mm)
Hair, lint (singlestrand)	light intensity	medium intensity	light intensity	medium intensity
Dirt spot	1/16 in (1.6 mm)	3/32 in (2.4 mm)	3/32 in (2.4 mm)	5/32 in (4.0 mm)
Lint-areas of concentrated lint	light intensity	medium intensity	light intensity	medium intensity
Separation & Discoloration	None	None	None	None
Short interlayer un-laminated area	N/A	CE 1/4 in (CE 6.4 mm) EE 1/6 in (EE 1.6 mm)	N/A	CE 1/4 in (CE 6.4 mm) EE 3/32 in (EE 2.4 mm)
Scuff, streak	light intensity	medium intensity	medium intensity	medium intensity

The central area is an area formed by an oval or circle whose axes or diameters, when centered, do not exceed 80% of the overall dimension. The outer area is the area outside of the central area.

N/A - Not applicable

CE - Covered edge of glass edge bite

EE - Exposed edge (If CE or EE is unknown, use CE tolerance) Light intensity - Barely noticeable at 39 inches (1.0 m)

Medium intensity - Noticeable at 39 inches (1.0 m) but not at 10 ft. (3 m).

Table 10: Maximum Allowable Laminating Process Blemishes for Overhead Glazing Reference: ASTM C1172

Note: All imperfections noted must be separated by a minimum of 12 inches (300 mm)

GLASS AREA	UP TO 25FT ² (2.5M ²)		> 25FT ² (2.5M ²)	
	BLEMISH	CENTRAL AREA	OUTER AREA	CENTRAL AREA
Boil (Bubble)	3/32 in (2.4 mm)	1/8 in (3.2 mm)	3/16 in (4.8 mm)	1/4 in (6.4 mm)
Blow-in	N/A	CE 1/4 in (CE 6.4 mm) EE 3/32 in (EE 2.4 mm)	N/A	CE 1/4 in (CE 6.4 mm) EE 3/32 in (EE 3.2 mm)
Fuse	1/16 in (1.6 mm)	1/16 in (1.6 mm)	3/32 in (2.4 mm)	5/32 in (4.0 mm)
Hair, lint (single strand)	medium intensity	medium intensity	medium intensity	medium intensity
Dirt spot	3/32 in (2.4 mm)	3/32 in (2.4 mm)	5/32 in (4.0 mm)	3/16 in (4.8 mm)
Lint-areas of concentrated lint	medium intensity	medium intensity	medium intensity	medium intensity
Separation & Discoloration	None	None	None	None
Short interlayer un-laminated area	N/A	CE 1/4 in (CE 6.4 mm) EE 3/32 in (EE 2.4 mm)	N/A	CE 1/4 in (CE 6.4 mm) EE 1/8 in (EE 3.2mm)
Scuff, streak	medium intensity	medium intensity	medium intensity	medium intensity

The central area is an area formed by an oval or circle whose axes or diameters, when centered, do not exceed 80% of the overall dimension. The outer area is the area outside of the central area.

N/A - Not applicable

CE - Covered edge of glass edge bite

EE - Exposed edge (If CE or EE is unknown, use CE tolerance) Light intensity - Barely noticeable at 39 inches (1.0 m)

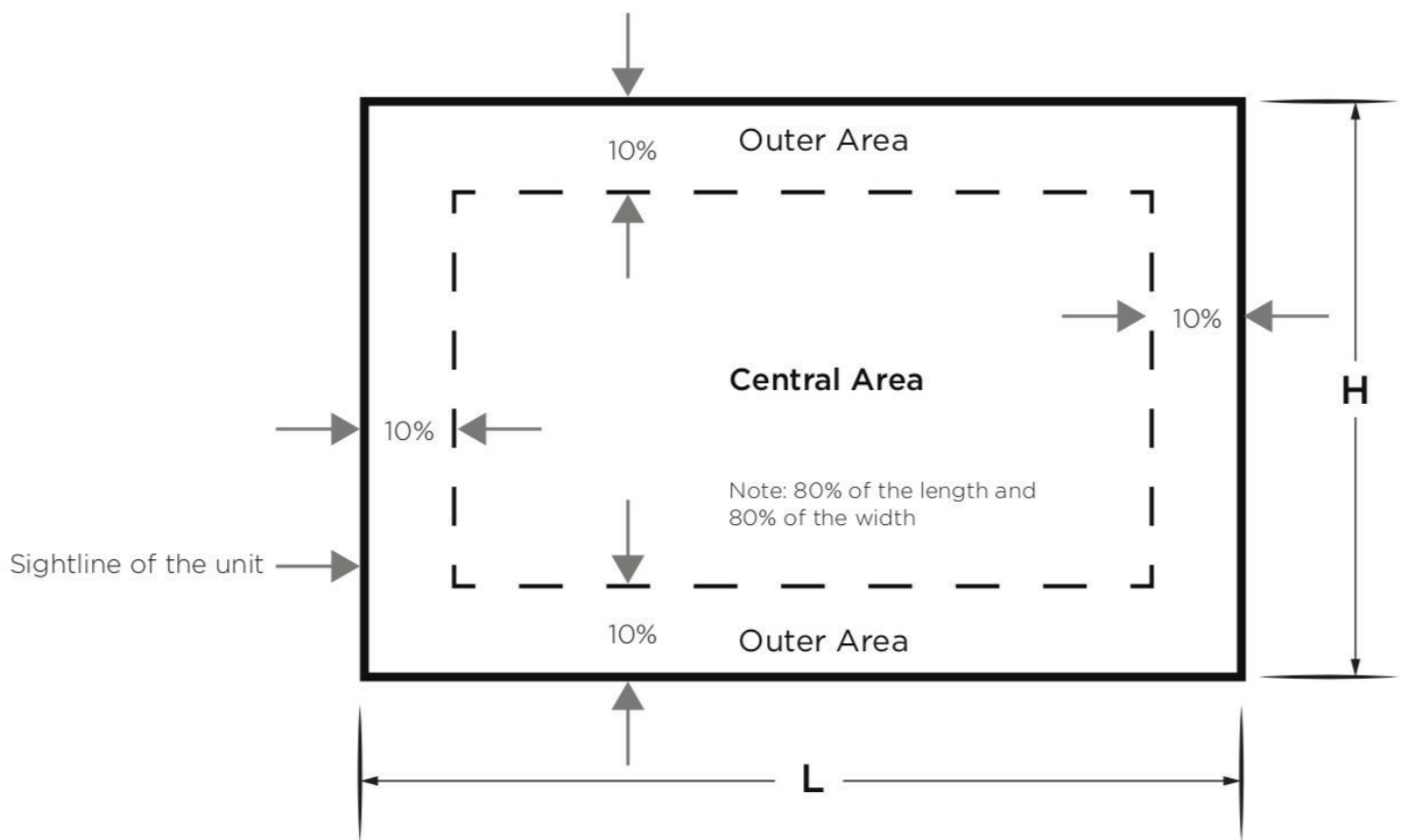
Medium intensity - Noticeable at 39 inches (1.0 m) but not at 10 ft. (3 m)

3.4 Coated Glass Requirements

Laminated glass is constructed using two or more lites and joining the lites by using an interlayer between them. When laminated glass is required, the following quality specifications will apply:

- 3.4.1** The electrochromic IGU shall be viewed and inspected according to requirements in Section 2. If a blemish is readily apparent under these viewing conditions, the tolerances in tables 11-13 apply. However, the allowable defect tolerance is in accordance to the location of the defect, i.e., in central area or outer area (see Figure 9 below).

Figure 9: Central and Outer Area of the Glass



Note: The central area is considered to form a square or rectangle defined by the center 80% of the length and center 80% of the width dimensions, centered on the glass. The remaining area is considered the outer area.

Table 11: Allowable Tolerances for Coated Mate Lite - Vision Glass Installation Ref: ASTM C1376

DEFECTS	CENTRAL AREA (MM)	OUTER AREA (MM)
Spot	1.6mm (0.06 in) Max	2.4mm (0.09 in) Max
Coating Scratch	50mm (1.96 in) Max Length	75mm (2.95 in) Max Length
Mark Containment	50mm (1.96 in) Max Length	75mm (2.95 in) Max Length
Coating Rub	None Allowed	Length plus width not to exceed 19mm (0.74 in)
Crazing (Arcing)	None Allowed	None Allowed
Corrosion	None Allowed	None Allowed

Note: No more than two (2) readily apparent defects are allowed in 75mm (3 in) diameter circle, and no more than five (5) ap parent defects are allowed in 300mm (12 in) diameter circle. Coated mate lite with a soft coat must have edge deletion of 12mm (0.47 in) to 16 mm(0.62 in).

Table 12: Allowable Tolerances for Coated Mate Lite - Overhead Glass Installation Ref: ASTM C1376

DEFECTS	CENTRAL AREA (MM)	OUTER AREA (MM)
Spot	2.4mm (0.09 in)	3.2mm (0.12 in) Max
Coating Scratch	75mm (2.95 in) Max	100mm (3.93 in) Max
Mark Containment	75mm (2.95 in) Max	100mm (3.93) Max
Coating Rub	Length plus width not to exceed 19mm (0.74 in)	
Crazing (Arcing)	None Allowed	None Allowed
Corrosion	None Allowed	None Allowed

Note: No more than two (2) readily apparent defects are allowed in 75mm (3in) diameter circle, and no more than five (5) apparent defects are allowed in 300mm (12in) diameter circle. Coated mate lite with a soft coat must have edge deletion of 12mm (0.47 in) to 16 mm (0.62 in).

3.5 Electrochromic Coated Glass Requirements

3.5.1 Coated glass, including electrochromic glass, may have defects inherent to the deposition process. Due to deposition process, some defects are more unique than clear glass, such as the following:

- Banding
- Coating scratch
- Mitigation mark (pinhole/void)
- Non-uniformity

Note: Refer to glossary in Section 4 for detailed description of above items.

The electrochromic IGU shall be viewed and inspected according to requirements in Section 2. If a blemish is readily apparent under these viewing conditions, the tolerances in tables 14-15 apply.

3.5.1 The following coating related defects and criteria are unique to View's electrochromic glass.

3.5.2.1 Non-Uniformity

Coating non-uniformity is visible variation in color or tint level that may occur from lite to lite and may also occur within a lite in the form of edge-to-edge gradation, banding or mottling. Visual observation of color differences, especially on the exterior of the building, are subjective and vary from person-to-person. Perceivable differences are not an immediate cause for rejection. Variations in color can be affected by lighting conditions, distance and angle of observation.

The transmitted color uniformity of the device is measured using the Radiant Imaging Colorimeter. The color map of the IGU is divided into a 5x5 grid of boxes, and the average color coordinates (L^* , a^* , b^*) are determined for each box. These color coordinates are then used to calculate the color difference (ΔE) between all pairs of boxes, and the results must meet the specifications below.

- A. Tint 1 Visible Transmission (T_{vis}) must be 45% - 75% for a clear mate lite and ΔE must be ≤ 8 .
- B. Tint 3 ΔE must be ≤ 14 .
- C. Tint 3 T_{vis} must be between 3% and 10% for a clear mate lite.

The reflected color uniformity of the device is measured using inline spectrometers angled at 10 degree and 45 degree incidence angles on surface 1 (exterior facing surface) of monolithic lites. Color coordinates L^* , a^* , b^* are measured at each point on a 3x5 grid of points (3x points along the shorter dimension, 5x along the longer). Lite-to-Reference ΔE (LtR ΔE) is determined for the measurement in the middle of each unit (within 2 inches of the geometrical center), as compared to the center point color coordinate of a chosen reference lite.

- A. For Generation 4 (Gen 4) units, LtR ΔE for 10 degree and 45 degree measurements should be ≤ 4.5 .
- B. For Generation 3 (Gen 3) units, a^* measurements should be < 0 , for both 10 degree and 45 degree.

3.5.2.2 Coloration Edge Glow

Glow that extends into the unit ≤ 2.0 inches from glass edge is allowed and must be

a gradual fading of color.

3.5.2.3 Pinhole and/or Mitigation Mark

Pinhole or a mitigation mark is a small area in which the coating is entirely or partially absent. Refer to Table 14 for allowed tolerances.

Table 14: Allowable Pinhole Tolerances for EC Coated IGU

GLAZING TYPE	WITHIN 10 MM		WITHIN 75 MM		WITHIN 300 MM	
	CENTRAL AREA	OUTER AREA	CENTRAL AREA	OUTER AREA	CENTRAL AREA	OUTER AREA
Vertical	(1) ≤ 0.4 mm	(1) < 0.6 mm	(1) < 0.4 mm	(1) < 0.6 mm	(2) < 0.4 mm	(2) < 0.4 mm
	(2) ≤ 0.25 mm	(2) ≤ 0.3 mm	(3) ≤ 0.25 mm	(3) ≤ 0.30 mm	(7) ≤ 0.25 mm	(7) ≤ 0.3 mm
			(1) ≤ 0.6 mm-allowed in central area for the whole lite			
Overhead/Skylight	(1) < 0.6 mm		(2) < 0.6 mm		(3) < 0.6 mm	
	(2) < 0.35 mm		(4) < 0.35 mm		(7) < 0.3 mm	

Note: Number in parenthesis represents allowable defect quantity. Total number of pinhole density should not exceed 0.8/square foot

3.5.2.4 Surface 2 (S2) Scratch

Surface 2 (S2) scratch is for EC coating surface. Refer to Table 15 for allowed tolerances.

Table 15: Allowable Tolerances for EC Coating S2 Scratch

Tier	SCRATCH DIMENSION		WITHIN 300 MM (11.81 in) DIAMETER	PER 20 SQ.FT
	LENGTH	WIDTH		
1	None allowed			
2	≤ 10mm (0.39 in)	≤ 0.25mm	2	2
3	≤ 15mm (0.59 in)	≤ 0.35mm	2	4

3.5.2.5 Segmented S2 scratch is allowed if end-to- end length is ≤ 25 mm (0.98 in) and width is ≤ 0.25 mm.

3.5.2.6 Sliver of light is a gap between EC coating and spacer.

- A. For rectangular units, it is allowed at one edge only with a maximum width of ≤ 2 mm (0.07 in).
- B. For non-rectangular units, it is allowed on any edge with a maximum width of ≤ 2 mm (0.07 in).

3.5.2.7 Blue spot is allowed if size is ≤ 1.4 mm (0.05 in) regardless of tier or location. Maximum of 2 blue spots within 75 mm (2.95 in) diameter and 5 blue spots within 300 mm (11.81 in) diameter are allowed.

- 3.5.2.8 Banding is acceptable if not readily apparent within the viewing distance.
- 3.5.2.9 Smudges or fingerprints are allowed if not readily apparent within the viewing distance and Delta E transmission spec is met.
- 3.5.2.10 Reflected color of the IGU must have an a* value of ≤ 4 as measured from a 45-degree angle from surface 1 while the IGU is in tint 1 with no voltage applied.

3.6 Spacer

View uses a foam spacer to structurally hold the glass lites apart. Spacer must be clean, dry, and free of grease, fingerprints, etc.

The foam spacer must be viewed through the lites along the perimeter of the unit and must comply with the following requirements:

- 3.6.1 Sliver of light should follow the specifications as mentioned in section 3.5.2.6.
- 3.6.2 Uniform sightline or rate of change with minimum 0.118 inches (3mm) in width is acceptable per 39 inches (1 meter) of wave in spacer.
- 3.6.3 Twisted spacer is not allowed.
- 3.6.4 Any contamination on the glass bonding area and spacer bonding surface is not allowed.

3.7 Primary Seal Application (Butyl)

Butyl or Polyisobutylene (PIB) is used as primary sealant to prevent moisture from entering the sealed airspace in the IGU to ensure that the IGU will not exhibit fogging or other signs of premature failure during the IGU's lifetime.

Butyl or PIB must be applied to the spacers in the required minimum amount to effectively provide a primary seal from glass-to-spacer. The PIB must be positioned correctly on the spacer to minimize the risk of the butyl flowing into the interior of the unit. The amount applied along the perimeter of the unit, both the front and back must be inspected and comply with the following requirements:

- 3.7.1 PIB must be applied in a continuous and uninterrupted manner. Application must not extend > 2 mm (0.08 inches) beyond the spacer Day Light Opening (DLO) inside the unit.
- 3.7.2 Any PIB thin-outs must be \leq 5.0 mm (0.19 in).
- 3.7.3 PIB gaps are not allowed.
- 3.7.4 PIB must be uniformly and sufficiently pressed to give an even thickness and good adhesion to the glass or bus bar tab and the spacer surface. The butyl must appear darker after properly wetted to the glass for maximum gas retention and to prevent secondary sealant blow-by. PIB wetted width must be 3.0 mm (0.11 in) to 5.0 mm (0.19 in) on all sides of the unit, except in manually applied PIB areas where PIB width can be > 5.0 mm (0.19 in).

3.8 Gas Filling (Argon)

Gas filling is the process of filling argon into air spaces to improve the insulating value of the sealed IGU.

Argon content percentage must be measured in representative units during production process right after the press for gas fill concentration. Units shall have an initial argon concentration of 90% minimum at the time of sealing. (Ref: ASTM E2190-10)

3.9 Overall IGU Offset

(Ref: IGMA TB-1200-83) Refer to the illustrations on the next page.

After receiving a spacer, the EC lite is mated with one or two mate lites and pressed into an IGU. The IGU must be within the following dimensional offset tolerances:

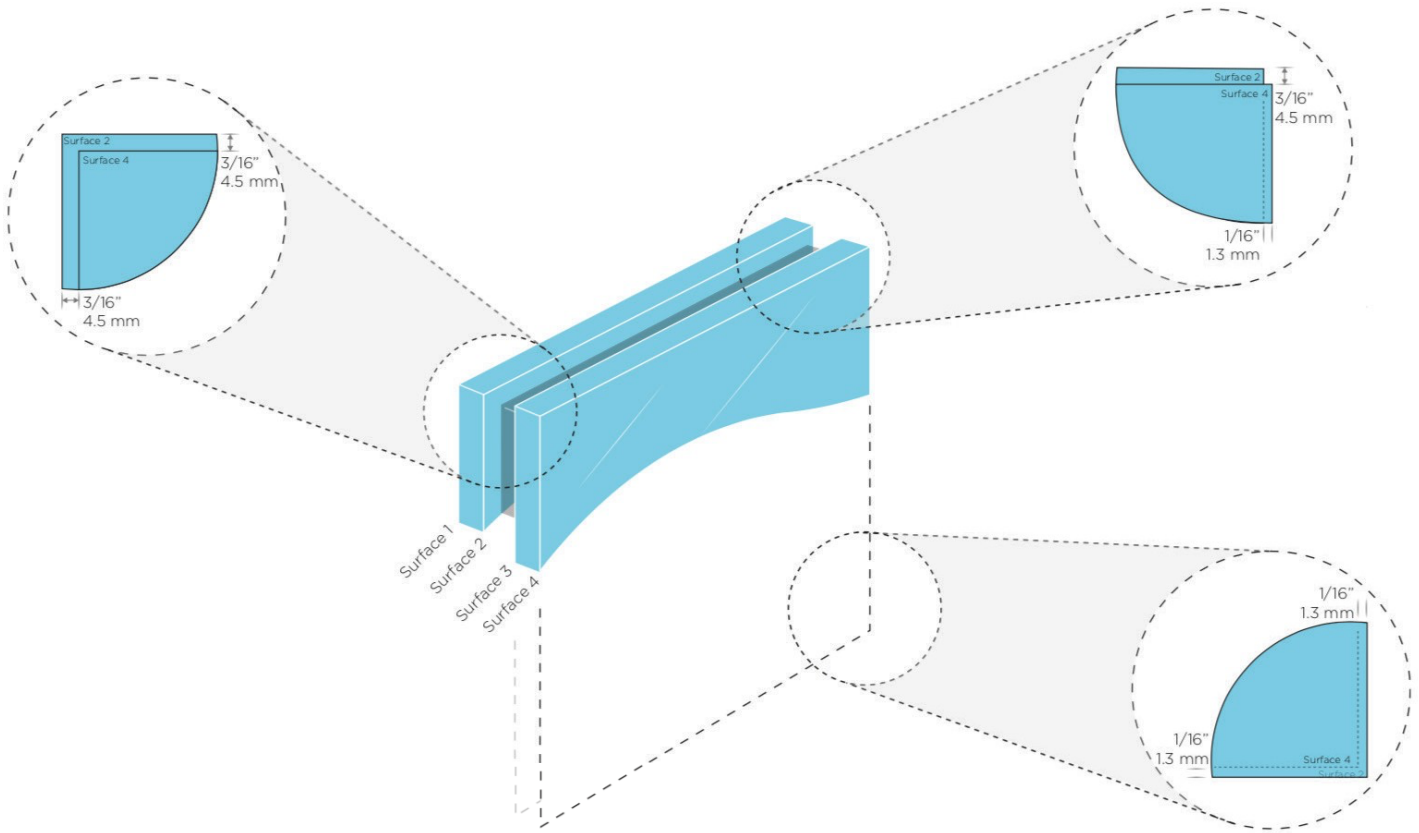
- 3.9.1 Lites 1 and 2 and in the case of a triple pane, lite 3, must all be flush and aligned at each

IGU Quality Standard

edge with a max deviation on one side of 3/16 inches if the opposite side is offset by 1/16 inches.

- 3.9.2 If one edge of the unit is flush, then the lites on the opposite side of the unit must be $\leq 1/8$ inches offset from each other.

Figure 10: IGU Mate Lite Offset and Size Tolerance for IGUs



- Mate lite 1 & EC are different sizes. Aligned on one side on the IGU; Offset is affected on the opposite side
- Length and width “size” tolerances are set according to the ASTM C1036 Standard Table 2: (+/-) 1.3 mm (1/16in).
- Offset dimension is determined by single sheet cut size, cut size tolerance and mate lite alignment

Note: ASTM C1036 Table 2 for mate lite size indicates: Measure length and width from edge to edge of a single lite, including flares and bevels.

Figure 11:

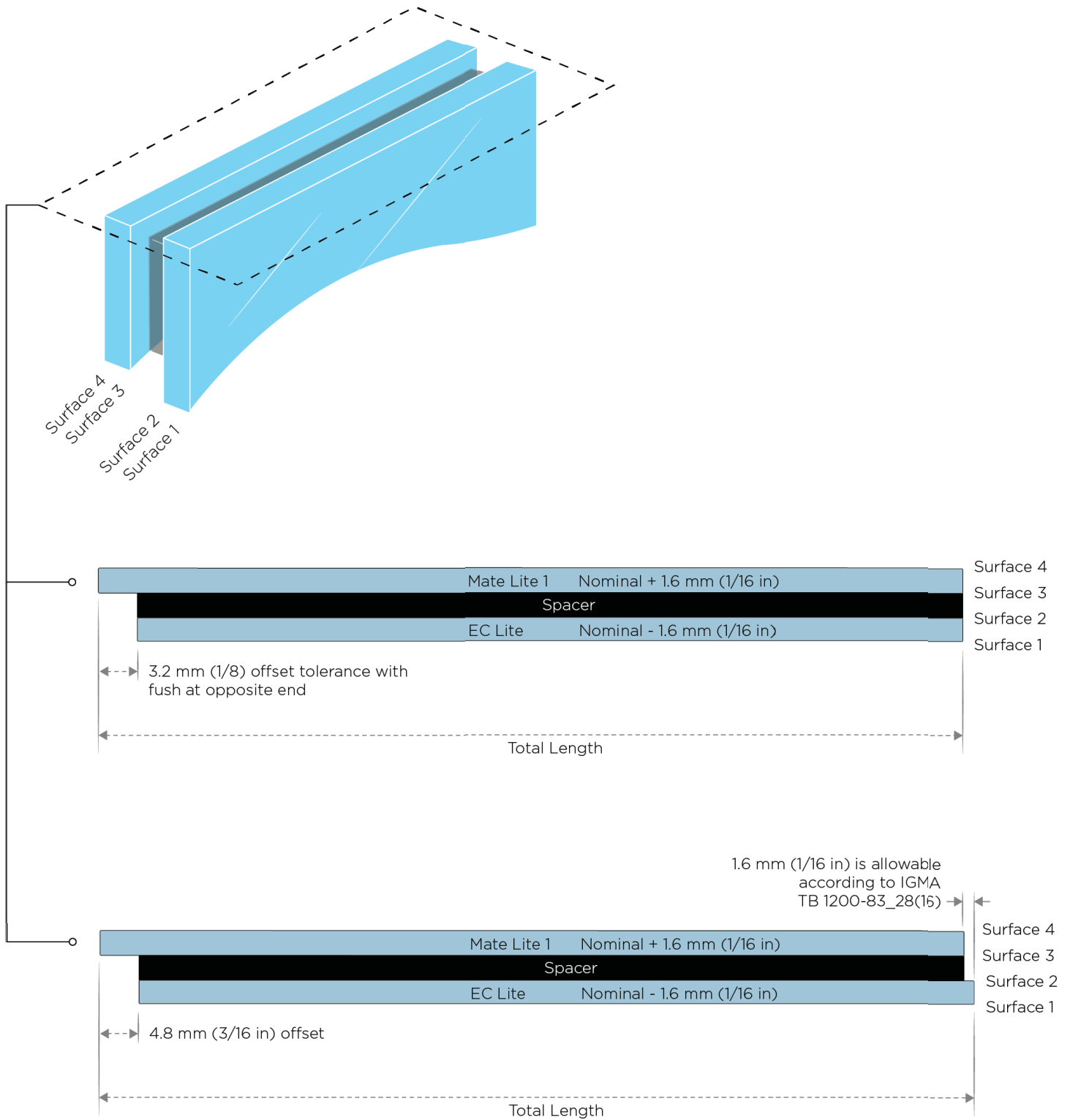
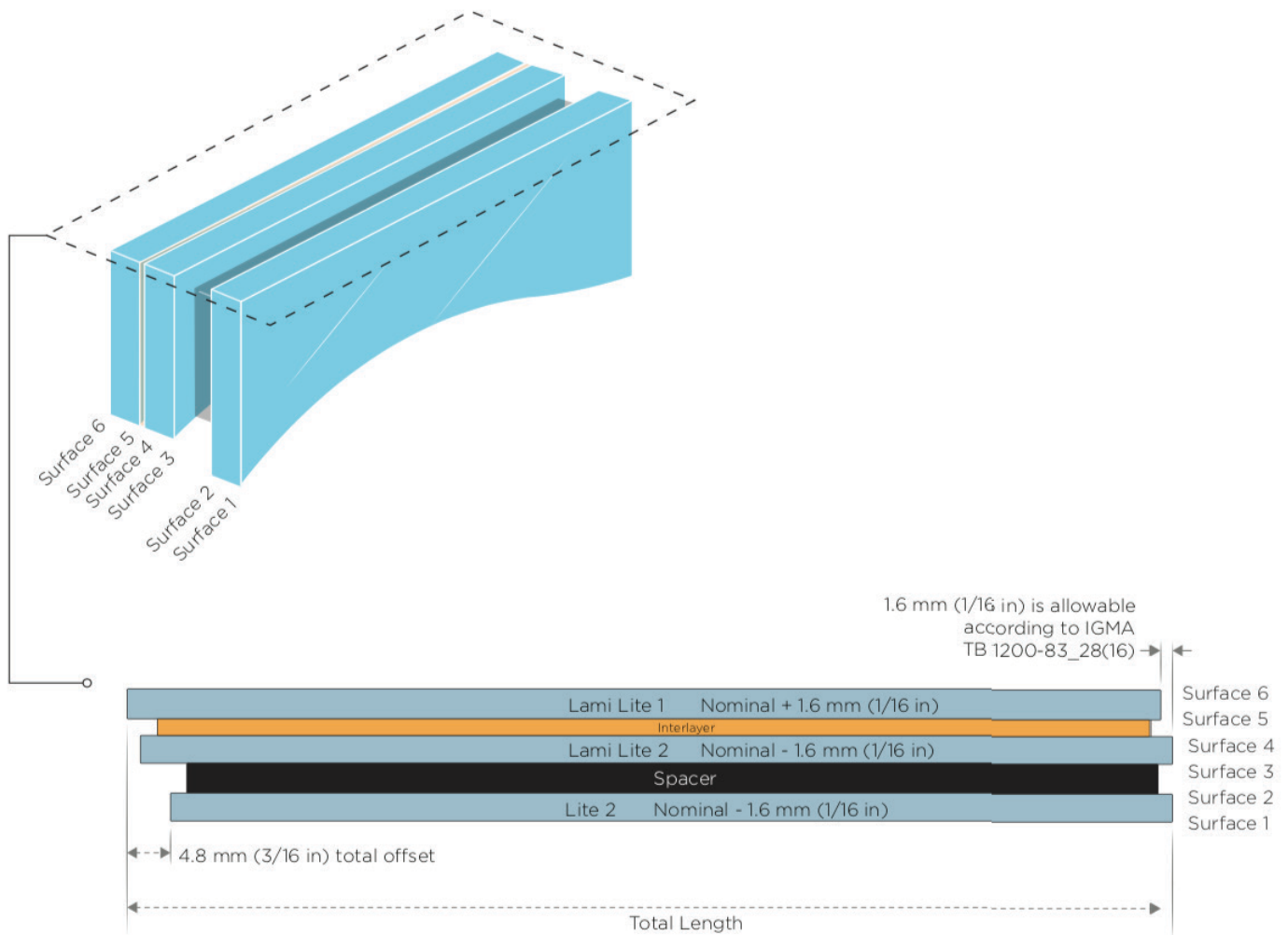


Figure 12: Mate Lite Offset and Size Tolerance for IGUs



- Mate lites 1 & 2 are different sizes. Mismatch on both sides of the lami mate lite; meets ASTM C1172 spec.
- Length and width “size” tolerances are set according to the ASTM C1172 spec
- The listed tolerances of overall laminate size include the cutting tolerances of the individual lites as well as the mismatch of the glass lites after the laminating process.

Note: ASTM C1036 Table 2 for mate lite size indicates: Measure length and width from edge to edge of a single lite, including flares and bevels.

3.10 Lead Attach

Lead wires must connect to the busbar tabs via solder to complete the electrical circuit of the electrochromic IGU. The lead attach consists of two wires: a red wire, which connects to the TEC busbar and a black wire, which connects to the ITO busbar. The lead wires connect to a solder pad which lies over the ink busbar tab ensuring a strong bond between the wire and glass surface. The lead attach must comply to the following requirements:

- 3.10.1 Solder pad length must be 50.8 mm (2 in) long +/- 12.7 mm (0.5 in)
- 3.10.2 Solder pads must be laid with busbar tab in center of solder pad +/- 6.35 mm (0.25 in).
- 3.10.3 Lead wires must join at location 76.2 mm (3 in) +/- 12.7 mm (0.5 in) from glass edge of IGU.
- 3.10.4 Lead wires must extend 139.7 mm (5.5 in) +/- 0.01 mm (0.5 in) beyond the edge of IGU to allow for Smart Window Connector attachment.
- 3.10.5 Lead wires must be taped to centerline of spacer using mylar and sealant compatible tape.

Figure 13: Lead Attachment Pad



3.11 Smart Window Connector

A Smart Window Connector (SWC) is the Keyed M8 one-wire chip plug which ultimately connects the IGU to the controller. SWCs must be thoroughly connected to the lead wires protruding from the IGU, bonded with solder and hermetically sealed. Insufficient connection or hermetic seal will lead to reliability failures and/or intermittent connection. The SWC must comply to the following requirements:

- 3.11.1 SWC must protrude from the IGU at a distance of 76.2 mm (3 in) +/- 12.7 mm (0.5 in) from corner of IGU.
- 3.11.2 After connecting to lead wires, a SWC must be a total length of 14-17 inches.

Figure 14: SWC exiting IGU



3.12 Secondary Sealant

The secondary sealant is critical to the structural integrity of the IGU. The secondary sealant used is a two-part sealant consisting of Base and Catalyst. Secondary Seal is defined as beginning at the furthestmost edge of PIB from daylight opening, including any manually added PIB strips to aid in ensuring proper wet out.

The secondary sealant must be checked and comply with the following requirements:

- Sealant must be continuous and completely fill the space between the spacer and edge of IGU.
- Sealant must be even with the edges of the glass with a tolerance of +/- 2.0 mm (0.07 in).
- Secondary Seal depth must be 8.5 mm (0.33 in) +/- 1.5 mm.
- Secondary sealant must be free of any moisture pathways from primary seal to atmosphere.
- There must be no sealant on the outer surface of the unit.
- SWC exits must be plugged. Hole and air gaps between SWC exit point and secondary seal is not allowed.

Figure 15: Secondary Sealant Between Lites of IGU



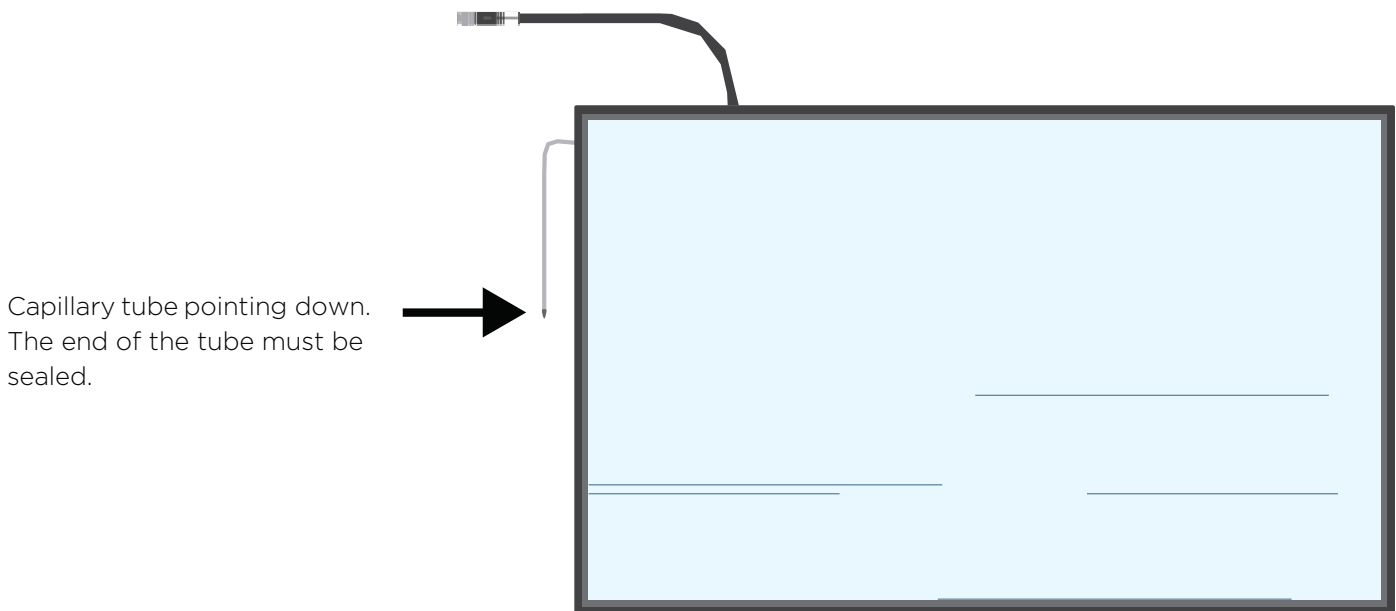
3.13 Capillary Tubes

3.13.1 The capillary tube is inserted into the IGU's spacer and must only be used for an IGU that will be installed at elevations 2,500 ft. or higher. It must be left open from the factory to its final installation site to allow IGU to equalize and maintain pressure. This tube has an inside diameter of 0.021 inches and is approximately 12 inches (300 mm) in length.

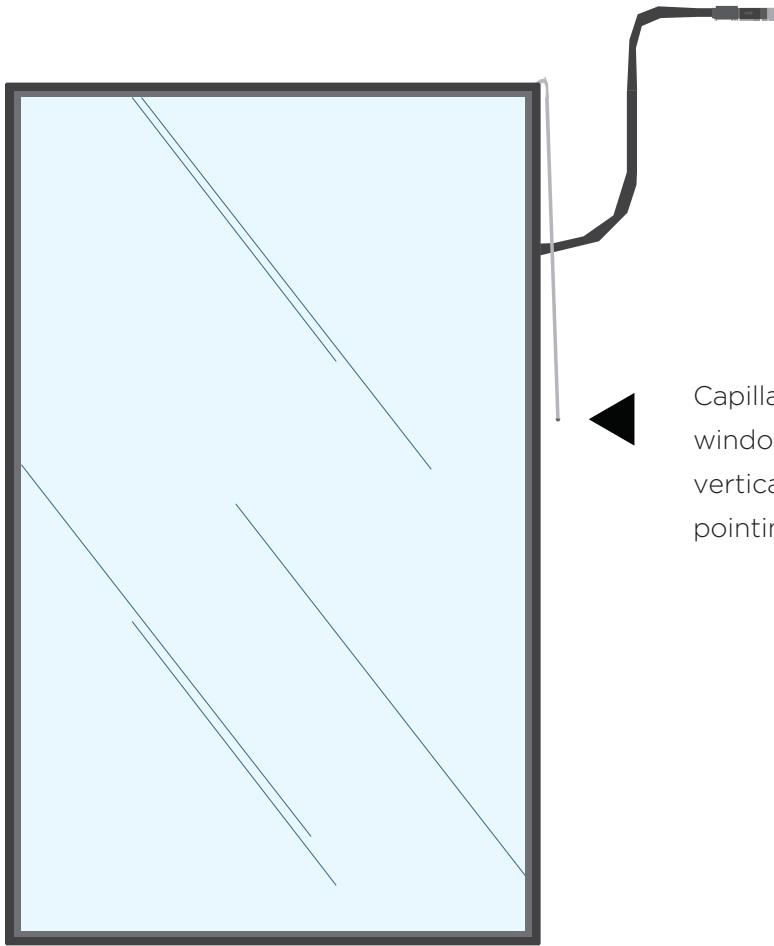
3.13.1.1 The capillary tubes, when required in the IGU, must be inserted into the final closing corner of the IGU.

- The capillary tube runs down 76.2 mm (3.0 in) +/- 25.4 mm (1.0 in) through the secondary seal.
- The tube protrusion inside the corner of the IGU is allowed up to a maximum of 0.25 inches (6 mm).
- Capillary tube label is required for IGU with capillary tube installed.
- Capillary tube exit point must be plugged by glazing team during installation.

Figure 16



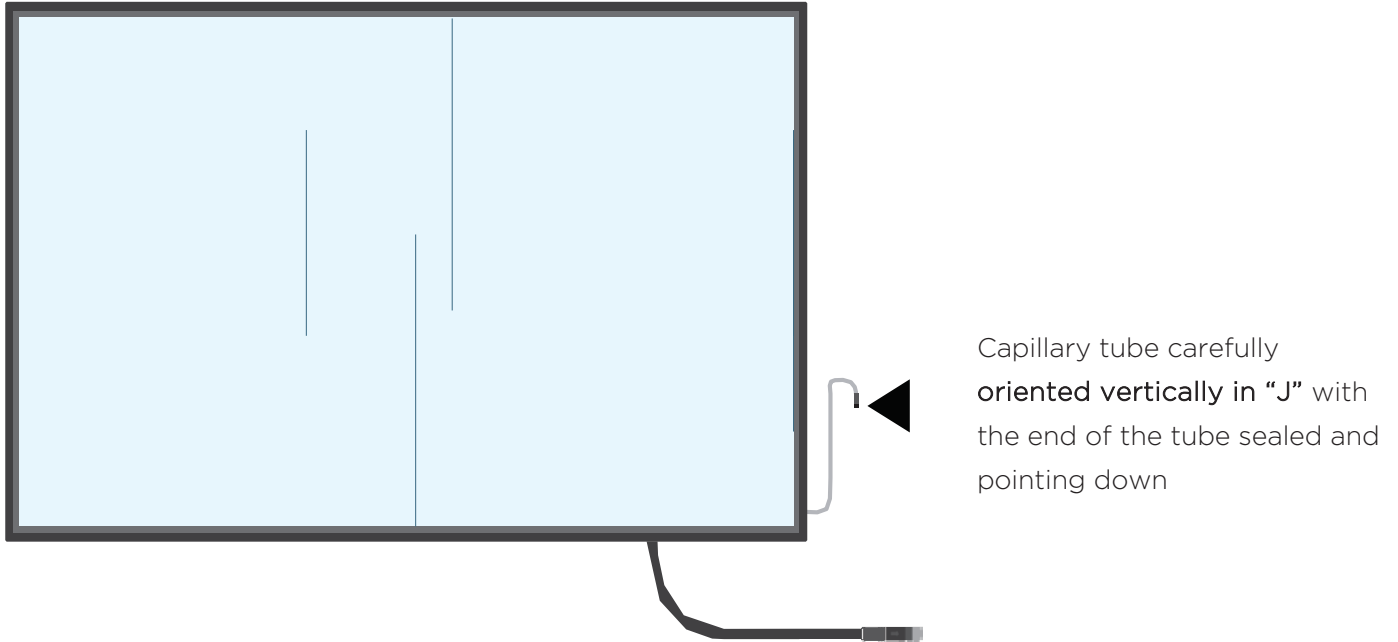
- If the IGU will be installed with the capillary tube located on the top corner of the window opening, the capillary tube must be out of horizontal position before installation. The tube must be carefully oriented vertically and pointing downward along the vertical dimension (figure 15).



Capillary tube located at the top corner of the window opening carefully oriented along the vertical dimension with the end of the tube pointing down.

- If the IGU will be installed with the capillary tube located at the bottom corner of the window opening, the capillary tube must be out of horizontal position before installation. The capillary tube must be oriented vertically by carefully curving the tube to make a “J” shape. Although the tube is pointing upward, the end of the tube must be pointing down and at least 1 inches from the bottom of the sash to prevent wicking of moisture into the tube (figure 16).

Figure 18

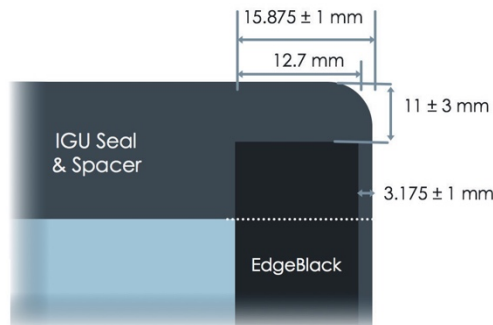


3.14 EdgeBlack

EdgeBlack is an external IGU feature which is applied to the unit at specified locations around the perimeter of the unit. EdgeBlack must be placed within specific tolerances to be most effective. The tolerances for placement are as follows:

- 3.14.1 EdgeBlack must be a width of 12.7 mm (0.5 in) applied on a clean surface free of any silicone or debris.
- 3.14.2 Inner edge of EdgeBlack near Day Light Opening (DLO) must be 15.875 mm (0.62 in) +/- 1 mm (0.03 in) from glass edge.
- 3.14.3 Outer edge of EdgeBlack must be 3.175 mm (0.12 in) +/- 1 mm (0.03 in) away from outer glass edge of IGU.
- 3.14.4 Ends of Edgeblack strips must be 11 mm (0.43 in) +/- 3 mm (0.12 in) from glass edge.

Figure 19: EdgeBlack Dimensions



3.15 Overall Thickness

The actual thickness of the IGU must be measured at each corner and near the midpoint of the edges between the outer glass surfaces. The measured value must be determined to an accuracy of 0.1 mm using digital calipers or a micrometer. The measured thickness values must not deviate from the minimum and maximum overall thickness of the IGU.

The allowable overall thickness (OAT) of the IGU is obtained by the following rules:

- 3.15.1 Define the thickness requirement of the IGU.
- 3.15.2 Determine the composition requirements to meet the defined thickness requirement of the IGU. Select the spacer type, mate glass, and when required, the interlayer.
- 3.15.3 Determine the tolerance of every individual component of the IGU, (i.e., minimum, nominal and maximum thickness) from Table 16 below.

3.15.3.1 EC Glass thickness - 6.00 mm (0.23 in): Min = 5.56 mm (0.22 in) (XA); Nominal = 6.00 mm (0.23 in) (XB); Max = 6.20 mm (0.24 in) (XC)

3.15.3.2 Spacer (Thickness specification: +/- 3%)

3.15.3.3 Mate lite see Table 17

3.15.3.4 Interlayer (Thickness specification: +/- 0.20 mm) (See Table 18)

Table 16: Spacer Tolerances
Ref: Manufacturer Specifications

SPACER TYPE	MINIMUM(X1)	NOMINAL(X2)	MAXIMUM(X3)
9.52 mm (3/8 in)	9.22 mm (0.36 in)	9.50 mm (0.37 in)	9.79 mm (0.38 in)
11.11 mm (7/16 in)	10.78 mm (0.42 in)	11.11 mm (0.43 in)	11.44 mm (0.45 in)
12.70 mm (1/2 in)	12.32 mm (0.48 in)	12.70 mm (0.50 in)	13.08 mm (0.51 in)
14.28 mm (9/16 in)	13.86 mm (0.54 in)	14.29 mm (0.56 in)	14.72 mm (0.57 in)
15.87 mm (5/8 in)	15.40 mm (0.60 in)	15.88 mm (0.62 in)	16.36 mm (0.64 in)
19.05 mm (3/4 in)	18.48 mm (0.72 in)	19.05 mm (0.75 in)	19.62 mm (0.77 in)
22.22 mm (7/8 in)	21.56 mm (0.84 in)	22.23 mm (0.87 in)	22.90 mm (0.90 in)

Table 17: Mate Glass Tolerances

Ref: ASTM C1036

GLASS TYPE	MINIMUM(X4)	NOMINAL(X5)	MAXIMUM(X6)
3 mm (0.11 in)	2.92 mm (0.11 in)	3.00 mm (0.11 in)	3.40 mm (0.13 in)
4 mm (0.15 in)	3.78 mm (0.14 in)	4.00 mm (0.15 in)	4.19 mm (0.16 in)
5 mm (0.19 in)	4.57 mm (0.17 in)	5.00 mm (0.19 in)	5.05 mm (0.19 in)
6 mm (0.23 in)	5.56 mm (0.21 in)	6.00 mm (0.23 in)	6.20 mm (0.24 in)

Table 18: Interlayer Tolerances

Ref: Manufacturer Specification

INTERLAYER TYPE	MINIMUM(X7)	NOMINAL(X8)	MAXIMUM(X9)
0.090	2.09 mm (0.08 in)	2.29 mm (0.09 in)	2.49 mm (0.09 in)
0.060	1.32 mm (0.05 in)	1.52 mm (0.05 in)	1.72 mm (0.06 in)
0.030	0.56 mm (0.02 in)	0.76 mm (0.02 in)	0.96 mm (0.03 in)

3.15.4 Sum values to determine the minimum to maximum overall thickness (OAT) of the IGU as follows:

3.15.4.1 For Double Glazed Unit (EC + Spacer + Mate Glass)

- Minimum OAT = $XA+X1+X4$
- Nominal OAT = $XB+X2+X5$
- Maximum OAT = $XC+X3+X6$

3.15.4.2 For Double Glazed Unit with laminated mate lite

- Minimum OAT = $XA+X1+X4+X7+X4$
- Nominal OAT = $XB+X2+X5+X8+X5$
- Maximum OAT = $XC+X3+X6+X9+X6$

3.15.4.3 For Triple Glazed Unit (EC + Spacer + Mate Glass + Spacer + Mate Glass)

- Minimum OAT = $XA+X1+X4+X1+X4$
- Nominal OAT = $XB+X2+X5+X2+X5$
- Maximum OAT = $XC+X3+X6$

3.15.4.4 For Triple Glazed with Laminated Glass (EC + Spacer + Mate Glass + Spacer + Mate Glass + Interlayer + Mate Glass)

IGU Quality Standard

- Minimum OAT = $XA+X1+X4+X1+X4+X7+X4$
- Nominal OAT = $XB+X2+X5+X2+X5+X8+X5$
- Maximum OAT = $XC+X3+X6+X3+X6+X9+X3$

3.15.5 The allowable overall thickness of the IGU must be within the calculated minimum to maximum overall thickness.

Note: Below is a sample calculation to determine the allowable minimum to maximum overall thickness of the IGU.

For OAT of double glazed IGU with required thickness of 25.40 mm (1.0 in):

3.15.5.1 Determine composition requirements:

- EC glass = 6.00 mm (0.23 in)
- Spacer = 12.7 mm (0.5 in)
- Mate Glass = 6.00 mm (0.23 in)

3.15.5.2 Determine the composition tolerances as shown in Table 19 below:

Table 19:

	EC GLASS 6 MM	AIR SPACE 1/2 IN	MATE GLASS 6 MM
Min	XA = 5.56	X1 = 12.32	X4 = 5.56
Median	XB = 6.00	X2 = 12.70	X5 = 6.00
Max	XC = 6.20	X3 = 13.08	X6 = 6.20

3.15.5.3 Sum all values:

- Minimum OAT = $5.50+12.32+5.56 = 23.44$ mm
- Nominal OAT = $6.00+12.70+6.00 = 24.70$ mm
- Maximum OAT = $6.20+13.08+6.20 = 25.48$ mm

3.15.5.4 The allowable OAT for 25.4 mm (1.0 in) is 23.44 mm (0.92 in) to 25.48 mm (1.00 in).

4. Definitions and Terminology

4.1 Defects

TERM	DEFINITION
Boil	A gas pocket between the glass and PVB interlayer of the laminated glass.
Blow-In	A separation of glass and interlayer close to the laminate edge. This is caused by permeation of the autoclaving medium into the edge during manufacturing.
Bow/Warp	Curvature across the entire dimension(s) of the lite.
Cluster	Accumulation of small defects.
Coating Scratch	Partial or complete removal of the coating along a thin line, straight or curved
Corrosion	Change in color or level of reflected or transmitted light over all, or part of, the glass surface. This occurs as a result of degradation of the coating from external sources.
Crazing	A random conglomeration of fine lines or cracks in the coating
Dirt Spot	Foreign material trapped inside the laminate.
Fuse	A glass particle that is permanently bonded to the surface of a lite.
Mark/contaminant	Foreign material deposited on the glass surface during the coating process.
Mismatch or Offset	Misalignment of the edges of two or three lites, either when sealed or laminated.
Mitigation Mark (Pinhole/Void)	Punctual void in the coating with partial or total absence of coating; it normally contrasts as clear, relative to the coating, when viewed in transmission.
Non-uniformity	Slight visible variation in color, either in reflection or transmission, within a lite or glass pane and/or between two lites of coated glass in the same building.
Scratches	A variety of linear score marks, whose visibility depends on their length, width, position, and arrangements.
Scuff/Streak	A noticeably visible directional blemish or discoloration on, or inside, the laminated unit.
Spot	A small, opaque blemish in the coating. Defect that commonly looks dark against the surrounding coating when viewed in transmission.
Separation	An area of the laminate that has become delaminated.
Short Layer	Accumulation of small defects.
Short Interlayer	A condition of the laminate in which the interlayer does not extend to the edge.

4.2 Process and Inspection

TERM	DEFINITION
Acceptable Defect	A readily apparent defect which does not detract from the overall aesthetics of the IGU. These defects are further defined by their size, density, and location relative to the viewing area.
Central Area	A square or rectangle defined by the center 80% of the length and 80% of the width dimensions centered on a lite of glass.
Clear	A neutral or unpowered state.
Coated Glass (Mate Lite)	Glass substrate that has low emissivity materials applied to the surface by deposition method.
Defects	Imperfections found in the manufacture of glass, such as halos, pinholes, spots, coating rub, scratches and marks.
Delta E (ΔE)	Defined as the total color difference between two locations, each given in terms of L^* , a^* and b^* , such that: $\Delta E = \sqrt{(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2}$ (Note: See ASTM C1376 for more details).
Distortion	The original flatness of the glass is modified by heat treatment causing reflected images to be distorted.
Dynamic Glass Unit	An insulating glass unit (IGU) that is composed of View electrochromic glass.
End State	States that an IGU can achieve either tinted or clear.
Insulating Glass Unit (IGU)	An assembly consisting of at least 2 panes of glass, separated by one or more spacers, hermetically sealed and structurally held together by a secondary sealant.
Outer Area	The remaining 20% area outside the central area.
Readily Apparent	Being seen within the viewing time, without prior knowledge or instructions.
Strain Pattern	Also called quench pattern is a result of a heat treatment process on the glass and is only visible under certain lighting conditions.
Spacer	A component, either foam, cork or aluminum, used to separate and control the width of the gap at the edge of the unit.
Spandrel Glass	Unit with S2 coated without busbar and wire connection. The Spandrel glass units will be installed in areas of the building to conceal structural building components such as columns, floors, plumbing, etc
Tint	The end state that an IGU achieves as transmission is reduced below neutral.
Viewing Time	Time allocated for visual assessment at 1 second per sq. ft. or up to 20 seconds.
Visual Assessment	Method used to view and assess the quality of the Dynamic Glass Unit.
Vision Interference Angle	The angle at which distortion in transmission first appears.

5. References

- ASTM Standard C162 Terminology of Glass and Glass Products
- ASTM Standard C1036 Specification for Flat Glass
- ASTM Standard C1048 Specification for Heat Strengthened and Fully Tempered Glass
- ASTM Standard C1376 Specification for Pyrolytic and Vacuum Deposition Coatings in Flat Glass
- ASTM Standard C1172 Specification for Laminated Architectural Flat Glass
- ANSI Z97.1 Safety Performance Specifications and Methods of Test for Safety Glazing Material Used in Buildings
- IGMA TB-1601-95(14) Guidelines for Capillary Tubes
- IGMA TM-3100-09 Visual Quality Guidelines
- IGMA TB-1200-83(16) Guidelines for Insulating Glass Dimensional Tolerances