Tolerance Standards

ASTM Applied Standards

a) Acceptability

Brick Glass's annealed laminated or flat tempered laminated glass products offer extraordinary optical qualities that meet or exceed the following industry-recognized standards as guidelines for acceptability.

The tolerances and specifications are strongly considered as general guidelines for acceptability/approval. In some instances, the specified tolerances may appear more or less exaggerated when viewing from a certain angle. It may be possible to reduce these tolerance levels but not all the time. Unusual shapes may cause various tolerance levels to be increased.

A lite of glass manufactured by Brick Glass that falls within the tolerance levels explained in the following pages are acceptable and will not be considered to be objected by any customer or the customer's customer.

Glass Dimensional Tolerances

a) Dimensions

Based on glass thickness according to ASTM C1036 – Standard Specification for Flat Glass, Table 2 (Dimensional Tolerance for Rectangular Shapes of Type 1 Transparent, Flat Glass):

Size Tolerance Single Lite

Clean cut glass			Polished Glass	
Length and width tolerance			Length and width tolerance	
Glass Thickness inches	Finished size tolerance inches		Glass Thickness inches	Finished size tolerance inches
1/8	1/8		3/16	1/8
3/16	1/8		1/4	1/8
1/4	1/8		5/16	1/8
5/16	1/8		3/8	1/8
3/8	1/8		1/2	1/8
1/2	1/8		5/8	1/8
5/8	1/8		3/4	3/16
3/4	5/32			

b) Twisting / Squareness

± 1/16" per 39" (2mm per 1m) (Figure 2)

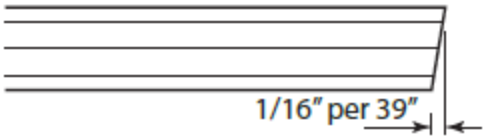


Figure 2

c) Edge types

When the glass is scored and broken out from the stock sheet:

i. The edges are extremely sharp
ii. They are not aesthetically pleasing to the eye and can be irregular
iii. The finish may hide micro fissures that when heated inside the oven may cause breakage.

The following processes are used to fix the previous issues from above (Figure 3):

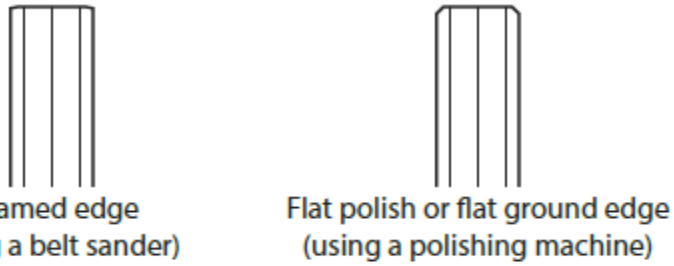


Figure 3

d) Edge straightness/bow on heat treated glass

Based on size and thickness of glass, according to ASTM C1048 - Standard Specification for heat treated flat glass, Figure 5 (overall bow and warp, maximum).

Overall Bow and Warp Maximum Single Lite

1.Place glass in a vertical position with glass resting on blocks.

2.Place a straight edge across the concave surface.

3.Measure widest gap with a fine scale ruler.

4.Refer to table to determine maximum allowable bow\warp.

	Edge Dimension, cm (in.)											
	0–50 (0–20)	>50–90 (>20–35)	>90–120 (>35–47)	>120–150 (>47–59)	>150–180 (>59–71)	>180–210 (>71–83)	>210–240 (>83–94)	>240–270 (>94–106)	>270–300 (>106–118)	>300–330 (>118–130)	>330–370 (>130–146)	>370–400 (>146–158)
Glass Thickness, mm (in.)	Maximum Bow and Warp, mm (in.)											
3 (⅛)	3.0 (0.12)	4.0 (0.16)	5.0 (0.20)	7.0 (0.28)	9.0 (0.35)	12.0 (0.47)	14.0 (0.55)	17.0 (0.67)	19.0 (0.75)	...	...	...
3 (⅛) Alternate Method[A]	2.0 (0.08)	2.0 (0.08)	2.0 (0.08)	3.0 (0.12)	5.0 (0.20)	6.0 (0.24)	7.0 (0.28)	8.0 (0.31)	10.0 (0.39)	...	...	...
4 (5⁄32)	3.0 (0.12)	4.0 (0.16)	5.0 (0.20)	7.0 (0.28)	9.0 (0.35)	12.0 (0.47)	14.0 (0.55)	17.0 (0.67)	19.0 (0.75)	...	...	...
5 (3⁄16)	3.0 (0.12)	4.0 (0.16)	5.0 (0.20)	7.0 (0.28)	9.0 (0.35)	12.0 (0.47)	14.0 (0.55)	17.0 (0.67)	19.0 (0.75)	...	...	...
6 (¼)	2.0 (0.08)	3.0 (0.12)	4.0 (0.16)	5.0 (0.20)	7.0 (0.28)	9.0 (0.35)	12.0 (0.47)	14.0 (0.55)	17.0 (0.67)	19.0 (0.75)	21.0 (0.83)	24.0 (0.94)
8 (5⁄16)	2.0 (0.08)	2.0(0.08)	3.0 (0.12)	4.0 (0.16)	5.0 (0.20)	6.0 (0.24)	8.0 (0.31)	10.0 (0.39)	13.0 (0.51)	15.0 (0.59)	18.0 (0.71)	20.0 (0.79)
10 (⅜)	2.0 (0.08)	2.0 (0.08)	2.0 (0.08)	4.0 (0.16)	5.0 (0.20)	6.0 (0.24)	7.0 (0.28)	9.0 (0.35)	12.0 (0.47)	14.0 (0.55)	17.0 (0.67)	19.0 (0.75)
12–22 (1⁄12 –7⁄8)	1.0 (0.04)	2.0 (0.08)	2.0 (0.08)	2.0 (0.08)	4.0 (0.16)	5.0 (0.20)	5.0 (0.20)	7.0 (0.28)	10.0 (0.39)	12.0 (0.47)	14.0 (0.55)	17.0 (0.67)

e) Edge alignment

Alignment for edges on laminated or insulated units is ±1/8" (Figure 6)

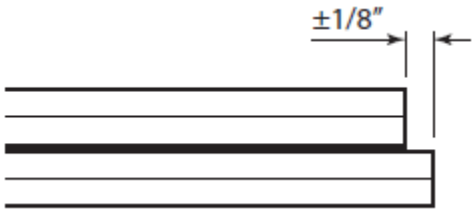


Figure 6

f) Hole alignment and distance tolerances

Hole placement: ± 1/16"

Hole alignment: (laminated units) (Figure 7) ± 1/8"

Hole dimensions: according to ASTM C1048 ± 1/16"

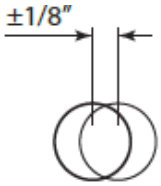


Figure 7

g) Overall thickness tolerance

In monolithic products per ASTM 1036, for laminated or insulated glass units, the final overall thickness of the insulated unit is not something that can be controlled precisely. All units have a 1/16 +/- thickness tolerance that is generated by the primary glass manufacturer and accepted by ASTM 1036.

h) Edge color

The edges of the glass may exhibit different colors depending on many factors, including the thickness, the size of the glass, the lighting conditions, the edge of finish type, and even materials within the glass composition. As the glass gets thicker and larger in dimensions, the green cast of the glass will become darker. Low iron glass will have the same effect.

Heat Treated Lites: Tempered, Heat Strengthened

a) Distortion in flat glass lites

There will be some roll distortion that exists in all heat strengthened and tempered glass lites, and the viewing angle will exaggerate these effects.

b) Iridescence

According to ASTM C1048 “A strain pattern also known as iridescence is inherent in all heat strengthened and fully tempered glass. This strain pattern may become visible under certain lighting conditions. It is a characteristic of heat-treated glass and should not be mistaken as discoloration or non-uniform tint or color, or a defect on the glass. The strain pattern does not affect any physical properties or performance values of the glass.”

c) Birefringence

A rainbow type strain, or pattern known as birefringence, might be visible on heat treated glass or on any laminated product when annealed, under certain types of indirect lighting or when viewing the glass at an angle approximately 45° or more. This phenomenon occurs very rarely but all heat-treated glass will show it under specific lighting conditions. It is not considered a defect, discoloration or a non-uniform tint or color, but is characteristic of this type of glass.

d) Spontaneous breakage

Tempered glass may suffer spontaneous breakage due to nickel sulfide inclusions. Such a defect originates at the float glass manufacturing process and cannot be controlled or detected by the primary glass producers.

e) Tempered glass breakage pattern

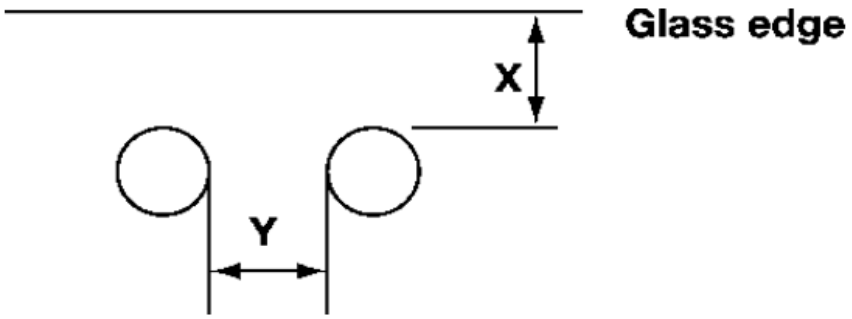
Tempered glass may break for various reasons, including damage to the glass during installation into a framing system, installation of the framing system in a way which places undue stress on the glass, damage from an impact of some kind, and other various reasons. These circumstances can sometimes cause glass to break after a period of time, not immediately. In addition, while tempered glass typically into small pieces, when following the breaking procedure described in 16 CFR 1201, it is possible that some longer, thinner pieces will be present, as the procedure indicates the following: “When breakage occurs, what appear to be the largest particles shall be selected within 5

minutes subsequent to the test and shall weigh no more than the equivalent weight of 10 square inches of the original specimen."

A breakage pattern with some longer, thinner pieces does not necessarily indicate a problem with the glass itself or the tempering process. This is particularly accentuated when the glass is laminated.

Fabrication Tolerance for Tempered Glass

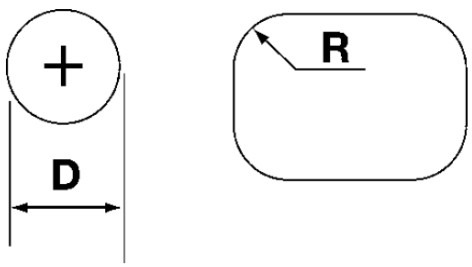
Glass Thickness (in) ⅛ 3/16 ¼ 5/16 ⅜ **Glass Thickness (in)** ½ ⅝ ¾



X	≥	1x the thickness of the glass	X	≥	2x the thickness of the glass
Y	≥	1.5x the thickness of the glass	Y	≥	2x the thickness of the glass

Any fabrication not meeting this criterion will require a relief slot for tempering NO EXCEPTIONS

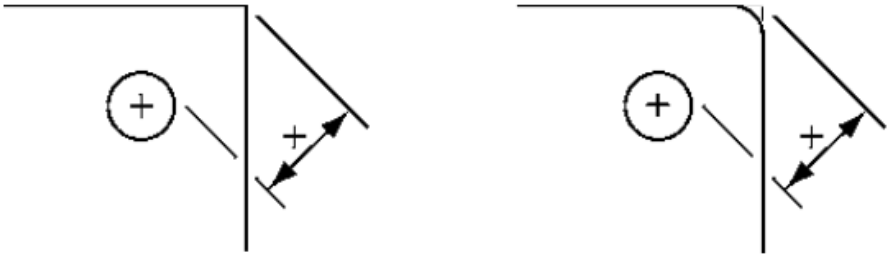
Glass Thickness	1/8	3/16	1/4	5/16	3/8	1/2	5/8	3/4



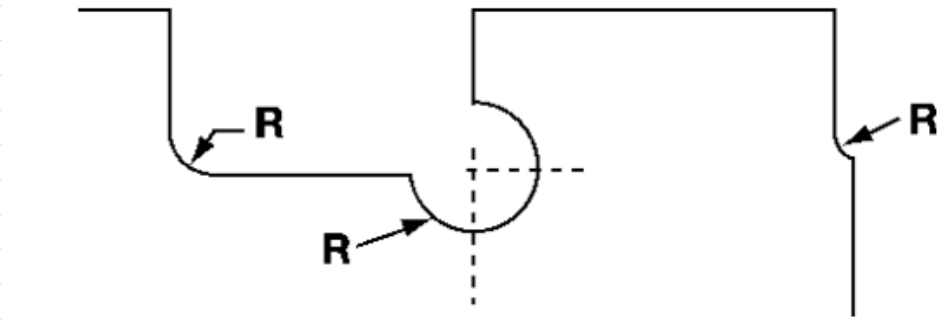
D ≥ 1x the thickness of the glass

R ≥ 1x the thickness of the glass

Glass Thickness	1/8	3/16	1/4	5/16	3/8	1/2	5/8



X ≥ 4.5x the thickness of the glass



R ≥ 1x the thickness of the glass

Insulated Glass Units

a) Distortion, surface bow

The air sealed within an insulated glass unit will respond to the gas laws of physics the moment the unit is sealed. These laws govern the volume of gas as it relates to changes in temperature and pressure. As the sealed-in air is heated or cooled, it expands or contracts in volume. As the barometric pressure falls and rises, it likewise expands and contracts. This causes the two lites to bow away from and toward each other. As a result, objects viewed in reflection will be distorted. The amount of distortion depends upon the amount of deviation from flatness and the pattern of movement of the objects viewed. There is no known method by which the identical internal volume,

air temperature and pressure can be achieved in each and every insulated unit for a specific project and still have the advantages of a sealed unit. Distortion will also be evident in the units with heat treated glass and from unequal glazing pressures around the perimeter (reference GANA glazing manual-11 design considerations).

An insulated glass unit that is composed of heat treated laminated lites will, in most cases, enhance the glass surface to accentuate levels of bow or warp and roller distortion that in non-laminated insulated glass units may not be considered objectionable.

b) Primary sealant creep in

Maximum primary sealant “creep in” 3/32”. The “creep in” may not necessarily follow a continuous or even line or pattern, it may show up in spots.

c) Edge finish aesthetics

The sealant prevents the insulated glass unit from condensation and structural failure; it is not intended to be an aesthetically pleasing product. We do not recommend the use of insulated glass units with the edges exposed or in a special visual edge application. The primary and secondary sealant may show small spots or stains along its surface, particularly noticeable when using gray sealants. Silicone may also exhibit areas with slightly different hues due to the application process, it could be noticeable when the depth of the sealant is above a quarter of an inch. Both conditions do not compromise the structural performance of the silicone.

In addition, the aesthetic qualities of the edge finish of insulated glass units will be those that are consistently manufactured by our equipment and may vary in uniformity of edge finish and appearance. None of the above-described aesthetic conditions are considered defects and therefore will not be a cause for rejection.

d) Space splices

The spacer in an insulated glass unit will not be a continuous bar; the metal spacer in an insulated glass unit will be spliced at different positions. The number of joints or splices will differ from unit to unit and cannot be predetermined. The splices are a part of the process of making an insulated glass unit and therefore are not a reason to reject any unit.

Soft Coated Low E Products

a) Edge deletion

The coating will be removed from all edges of the glass to properly insulate it. This is not a feature that can be ignored.

I) Appearance

It will be uneven in appearance, showing scratched areas and different uneven patterns.

ii) Dimensions

It will have an estimated standard depth of 3/8”–1/2”. The edge deletion is allowed to infringe the sight line up to 1/8”. It is visible at close inspection.

b) Color uniformity

Glass and film products that are coated may unexpectedly yield slight differences as reflected in color, intensity of light transmittance, reflectance or both. These almost unperceivable differences are no cause for rejection.

c) Color shift when laminating

When using a Low-E or reflective coating embedded within a laminate and placed in contact with the interlayer, the refractive index of the coating is changed and will result in a perceived color shift that is generally red/purple.

d) Heat

Soft coated Low-E products will considerably lower the amount of incoming solar heat into a building while allowing a great amount of visible light in. This does not mean that all of the incoming heat will be completely eliminated.

Spandrel or Painted Glass

a) Mock ups

It is advised to have a mock-up fabricated first in order to make a more informed decision concerning any known limitations, tolerances or standards stated in this document. Brick Glass also advises that the mock-up should be put at the job site in the same conditions as the future job.

Perceived color or lighting transmission differences when placing the glass in front of lights and using it as a lighting device will not be subject to reject the product.

b) Painted Glass inspections

Industry standards detail that the finished lite should be viewed from a distance of 15 feet and under natural daylight conditions.

i) Opaque and non-vision areas background

These lites are not intended for use in applications that are positioned against incoming light transmission, as the light and any pinholes, lack of paint uniformity, or other inherent qualities of the product will be noticeably visible.

ii) Pinholes

When viewing spandrel under the conditions described above, reflected pinholes and scratches are not considered defects if they are unobtrusive.

iii) Color variation

Color and reflectance may vary when viewed under a uniform, opaque background. This is not considered a defect unless the color variance is above Delta E 4.5.

General Inspection

Industry standards (ASTM) clearly specify that the finished monolithic, laminated, or insulated glass units are to be visually inspected from a distance of 10 feet and at a viewing angle of 90 degrees to the said glass product, which has been placed against a bright and uniformly colored opaque background and viewed in a natural daylight setting.

Once this criterion is in place, standards for acceptability to tempered/annealed laminated glass, insulated glass units are as follows:

a) Bubbles

Per ASTM C1172 Table 1, if there should appear an air bubble or other such impurity that is readily apparent, then the following criteria applies in determining acceptability: Air bubbles larger than 1/4" in diameter are not allowed in any part of the glass area. Blow in or short interlayer larger than 1/4" is not allowed, unless the glass is captured by more than 1/4".

b) Seeds

Per ASTM C1172 Table 1, seeds are a defect found on the glass surface between the laminate and the glass. Seeds up to 1/32" are allowed unless there are seeds accumulation. In 80 percent of the central glass area, up to three seeds no larger than 3/16" per 10 square feet are allowed, unless there is a seed accumulation. In the outer 20 percent, up to four seeds no larger than 3/16" per 10 square feet are allowed.

Per ASTM C1172 Table 1, areas of concentrated lint or interlayer scuff streak are allowed when they are barely noticeable at 3 feet. Hair is allowed if not noticeable at 11 feet.

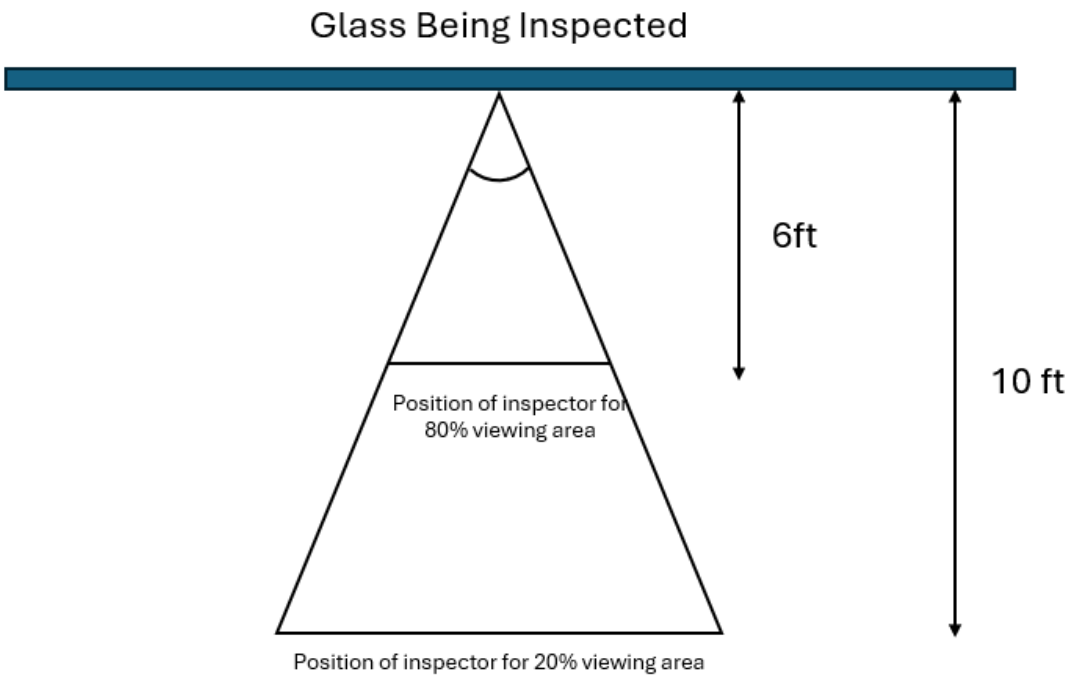
c) Edges and chips

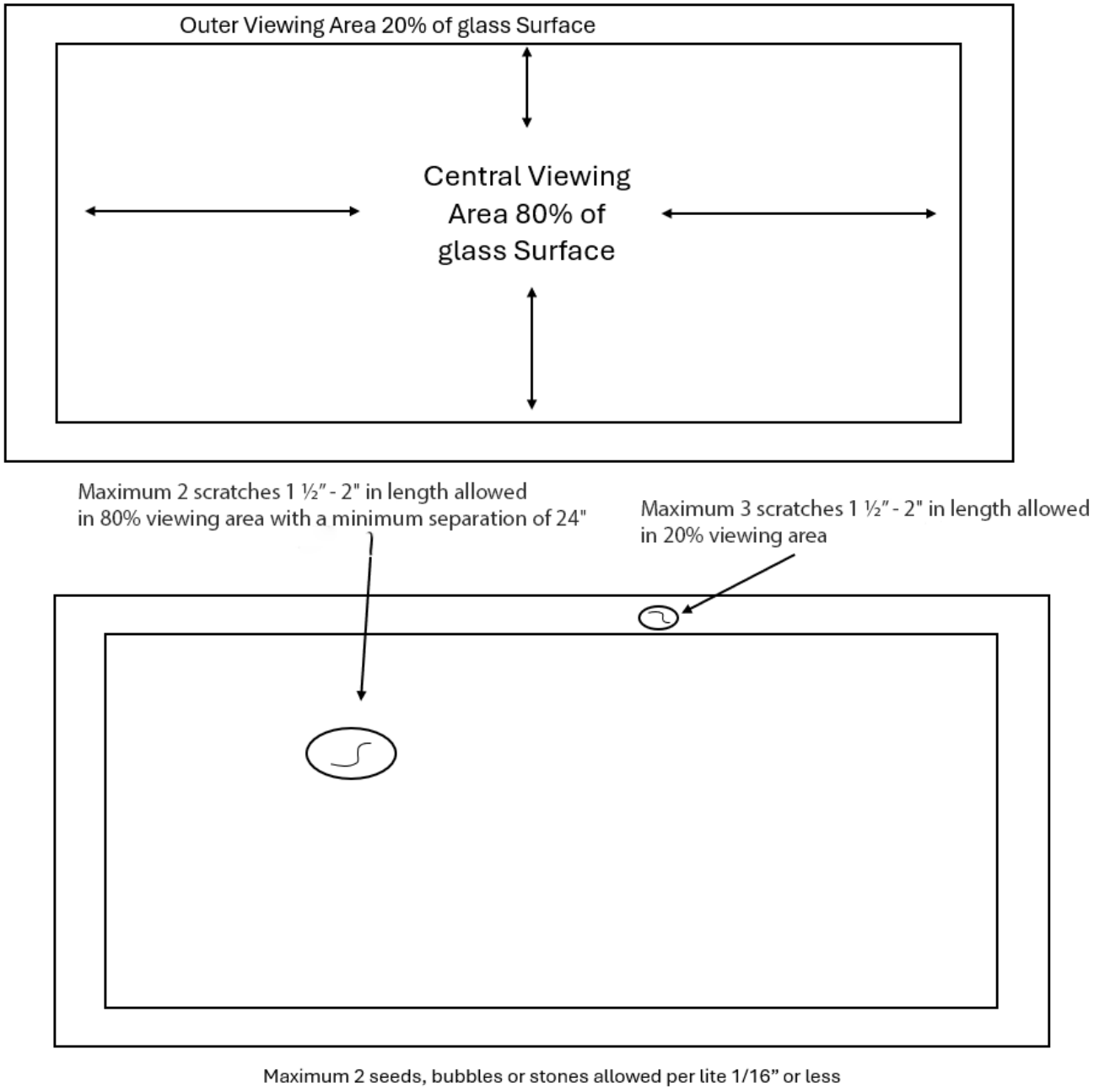
Chips on the edges are allowed when the edges are captured, and the chips are not visible through the glass surface once the glass is installed. When the edges are not captured, one chip per edge measuring less than 3/8" in length and 1/16" in width is allowed if it is not visible through the glass surface

d) Scratches

Per ASTM C1036 (Q3), all glass products are to be inspected from a distance of 6 feet. Visible scratches of up to 1 ½”– 2" inches in length, visible from this distance, are not allowed with a minimum separation of 24”. Concentrated scratches or abraded areas are not allowed. Any scratch that is not visible from 6 feet even if larger than the mentioned sizes will not be a cause for rejection.

Inspection Criteria





Logos

A non-removable, ceramic frit Brick Glass logo is stamped on all heat-treated glass that we fabricate in order to comply with ASTM and other international codes. We may be able to accommodate special logo requests, if required.

Receipt of Goods

Upon receiving the glass panels, each individual lite must be carefully inspected by the buyer. Any damages or defects found on the glass should be reported to our delivery driver and documented on the shipping paperwork. This process ensures that the pieces are fabricated according to the

specifications outlined in the approved costs or drawings. Brick Glass will handle any claims made after delivery with discretion. We guarantee remakes for glass that have defects outside of industry standards, as well as for measurements that fall outside of our acceptable tolerances.

Storage and Handling

All glass products must be stored in a secure, low moisture/dry location, preferably a climate-controlled environment. Care should also be taken to immediately clean off any foreign materials, liquids or gasses that may happen to spill, fall or otherwise come into contact with the glass. Liquids, even water or water vapor, will stain the glass if not cleaned quickly. This may even occur during transit, so it is very important to review your products carefully upon receipt.

At no time should metal, any sharp or hard objects be allowed near the glass as this may cause scratches or cause the glass to break.

Brick Glass will not be held liable for any damage resulting in negligence on the customer's behalf.

Will Call Liability & Storage Fees

Brick Glass encourages all material to be picked up promptly once they are ready. Orders that remain in our shop after two weeks will forfeit any warranties pertaining to chips, scratches, or other damages. Additionally, a fee of $50 will be applied for materials left in our shop beyond one month.

Installation

Glass installation, measurements (dimensions), shop drawings, and structural calculations are the sole responsibility of the customer. Brick Glass is solely responsible in manufacturing its products according to the Brick Glass order confirmation. Brick Glass is not responsible for any design, calculations, specifications, measurements, and installation details, knowledge of product final application and proper use, details, and effects of prior designs other than its own manufacturing processes.

Brick Glass will not perform any project revisions or glass calculations and will manufacture the order understanding that the customer comprehends that it is their sole responsibility to perform structural and load calculations and install the glass in a way that will serve its intended purpose safely and long lasting.

The frame where the glass is to be installed must be clean and free of liquids and debris, equipped with functioning weep holes, to allow for excess moisture drainage, and should be well-finished according to the manufacturer's original standards.

Any failure to comply with this will void the warranty.

Regular Care and Maintenance

Regular cleaning and maintenance will help conserve the brilliance of glass, maximize heat reflecting properties and provide greater long-term value. Brick Glass will not be held responsible for any negligence in the cleaning process.

Warranties

Standard warranties are available upon request. They are valid from the date the product is manufactured.