

Flat Glass Inspection Criteria per ASTM C 1036 – 06 (abridged)¹

Terminology:

crush,—lightly pitted condition with a dull gray appearance.

dig,—deep, short scratch

dirt,—small particle of foreign matter embedded in the surface of flat glass.

gaseous inclusion,—round or elongated bubble in the glass.

linear blemish,—scratches, rubs, digs, and other similar imperfections.

point blemish,—crush, knots, dirt, stones, gaseous inclusions, and other similar imperfections.

rub,—abrasion of a glass surface producing a frosted appearance.

scratch,—damage on a glass surface in the form of a line caused by the movement of an object across and in contact with the glass surface.

Inspection:

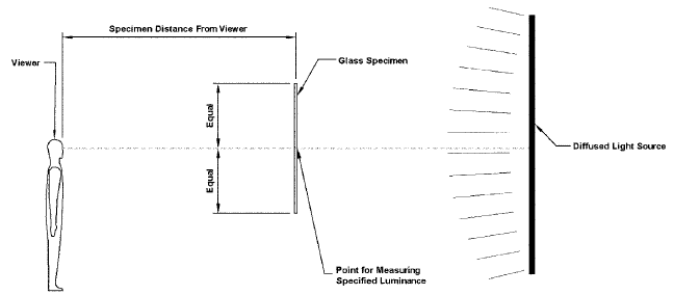
Visual inspection should be done with the naked eye.

The inspector shall place the glass in a vertical position

Inspector shall view through the glass at an angle of 90°

Lighting should be daylight level (**without direct sunlight**) or other uniform backlight that simulates daylight.

View at the distance specified by defect type.



Quality Criteria:

Allowable Point Blemish, (viewing distance 39")

Blemish size <1.2mm (0.05") allowed without restriction.

Blemish size >1.2mm (0.05") <2.0mm (0.10") allowed with a minimum separation of 600mm (24").

Blemish size >2.0mm (0.10") none allowed.

To determine point blemish size, measure height and width of blemish and average. Only the point blemish is to be measured, and not any distortion that may be present.

Allowable Linear Blemish, (viewing distance starting at 160")

Faint or light scratch <75mm (3") allowed.

Medium scratch ≤75 (3") allowed with a minimum separation of 600mm (24")

Medium or heavy scratch >75mm (3") are not allowed

To determine scratch intensity start at 160" and move closer until scratch becomes visible, (refer to table).

Detection Distance	Blemish Intensity
Over 3.3 m (132 in.)	Heavy
3.3 to 1.01 m (132 to 40 in.)	Medium
1 to 0.2 m (39 to 8 in.)	Light
Less than 0.2 m (8 in.)	Faint

All listed criteria are based on ASTM C 1036 – 06, Quality Level 3.

¹ Information Provided By: Northwestern Industries, Inc. / Document Q-1001-001

Coated Vision Glass Inspection Criteria per ASTM C 1376 – 03 (abridged)¹

Terminology:

coating rub—a surface abrasion of appreciable width that has partial, or complete, removal of the coating producing a hazy appearance.

coating scratch—partial, or complete, removal of the coating along a thin straight or curved line.

corrosion—change in the color or level of reflected or transmitted light over all or part of the glass surface as a result of degradation of the coating from external sources.

crazing—a random conglomeration of fine lines or cracks in the coating.

mark/contaminant—a deposit of foreign material on the glass surface.

pinhole—small area in which the coating is entirely or partially absent.

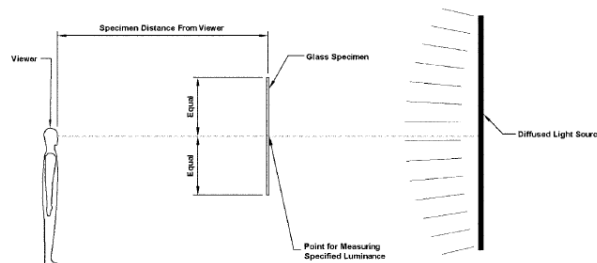
Inspection:

Visual inspection should be done with the naked eye.

The inspector shall place the glass in a vertical position with light in transmission.

Inspector shall view through the glass at an angle of 90° from a distance of 10 ft.

Lighting should be daylight level (**without direct sunlight**) or other uniform backlight that simulates daylight.



If a defect is readily apparent under these conditions apply the following criteria.

Blemish ^{a,c}	Central Area, in. (mm) ^d	Outer Area, in. (mm) ^d
Pinhole	1/16(1.6) max	1/32(2.4) max
Spot	1/16(1.6) max	1/32(2.4) max
Coating scratch	2 (50) max length	3 (75) max length
Mark/contaminant	2 (50) max length	3 (75) max length
Coating rub	none allowed	length plus width not to exceed 3/4 (19)
Crazing	none allowed	none allowed
Corrosion	none allowed	none allowed

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

All listed criteria are based on ASTM C 1376 – 03, specifications for cut size vision glass.

¹ Information Provided by: Northwestern Industries, Inc. / Document Number: Q-1002-001

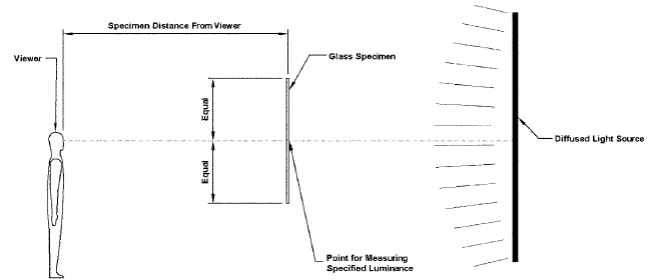
Laminated Glass Inspection Criteria per ASTM C 1172 – 03 (abridged)¹

Terminology:

- blow-in**—a separation of glass and interlayer at or close to the laminate edge caused by penetration of the autoclaving medium into the edge during manufacturing.
- boil (bubble)**—a gas pocket in the interlayer material or between the glass and interlayer.
- covered edge**—the perimetric area of the laminate covered by the channel or sash when installed.
- delamination**—a condition in which one or two of the lites of glass loses the bond between the glass lite and the interlayer.
- discoloration**—a visibly noticeable color change (from original) in the appearance of a material.
- edge boil**—See *boil (bubble)*.
- exposed edge**—the perimetric area of the laminate exposed to the environment after installation.
- fuse**—a glass particle or crystalline material that is permanently bonded to a surface of a lite.
- hair**—a slender, pigmented filament from human or animal epidermis or other thread-like filament.
- inside dirt**—foreign material trapped inside the laminate.
- lint**—short fibers of yarn or fabric trapped within the laminate.
- scuff**—See *streak*.
- separation**—an area of the laminate that has become delaminated (see *delamination*).
- short interlayer**—a condition of the laminate in which the interlayer does not extend to the edge.
- streak**—a noticeably visible deviation on or in the laminating unit.

Inspection:

- For inspection of individual glass lites refer to ASTM C 1036-06
- Coating related defects should be evaluated per ASTM C 1376 – 03.
- Visual inspection should be done with the naked eye.
- The inspector shall place the glass in a vertical position
- Inspector shall view through the glass at an angle of 90°



Lighting should be daylight level (**without direct sunlight**) or other uniform backlight that simulates daylight.

Quality Criteria:

1. Determine approximate lite surface area (ft²).
2. Determine defect location – central or outer viewing area. (The central area is considered to form a square or rectangle defined by the center 80 % of the length and 80 % of the width dimensions centered on a lite of glass. The remaining area is considered the outer area)
3. Evaluate defect according to the following table.

^cCE = covered edge of glass edge bite and EE = exposed edge. (If CE or EE is unknown use CE tolerance.)

Blemish	Up to 25 ft ² (2.5 m ²)		25 to 75 ft ² (2.5 to 7.0 m ²)		Over 75 ft ² (7.0 m ²)	
	Central ^A	Outer ^A	Central ^A	Outer ^A	Central ^A	Outer ^A
Boil (Bubbles)	1/16 (1.6)	3/32 (2.4)	1/8 (3.2)	3/16 (4.8)	1/4 (6.4)	1/4 (6.4)
Blow-in; edge boil	^B	CE 1/4 (6.4) EE 1/32 (0.8) ^C	^B	CE 1/4 (6.4) EE 1/16 (1.6) ^C	^B	CE 3/16 (8.0) EE 3/32 (2.3) ^C
Fuse	1/32 (0.8)	1/16 (1.6)	1/16 (1.6)	3/32 (2.4)	3/32 (2.4)	3/32 (4.0)
Hair, lint (single strand)	light intensity ^D	medium intensity ^E	light intensity ^D	medium intensity ^E	medium intensity ^E	medium intensity ^E
Inside dirt (dirt spot)	1/16 (1.6)	3/32 (2.4)	3/32 (2.4)	3/32 (4.0)	1/8 (3.2)	3/16 (4.8)
Lint-areas of concentrated lint	light intensity ^D	light intensity ^D	light intensity ^D	light intensity ^D	light intensity ^D	light intensity ^D
Separation, discoloration	none	none	none	none	none	none
Short interlayer; unlaminated area chip	^B	CE 1/4 (6.4) EE 1/16 (1.6) ^C	^B	CE 1/4 (6.4) EE 3/32 (2.4) ^C	^B	CE 1/4 (6.4) EE 1/8 (3.2) ^C
Scuff; streak	light intensity ^D	light intensity ^D	light intensity ^D	light intensity ^D	light intensity ^D	light intensity ^D

To establish light and medium intensity for a specific defect, view starting at 11 ft. moving forward down to 36”.

Light intensity – Barely noticeable at 36”

Medium Intensity – Noticeable at 36” but not 11 ft.

All listed criteria are based on ASTM C 1172 – 03

¹ Information Provided by: Northwestern Industries, Inc. / Document Number: Q-1004-001

Heat treated Glass Inspection Criteria per ASTM C 1048 – 04 (abridged)¹

Terminology:

bow/warp.—Curvature across the entire dimension(s) of the lite

crush.—lightly pitted condition with a dull gray appearance.

dig.—deep, short scratch

dirt.—small particle of foreign matter embedded in the surface of flat glass.

distortion.—Thermally tempered and heat-strengthened glass is made by heating glass in a furnace, the original flatness of the glass is slightly modified by the heat treatment, causing reflected images to be distorted.

gaseous inclusion.—round or elongated bubble in the glass.

linear blemish.—scratches, rubs, digs, and other similar imperfections.

point blemish.—crush, knots, dirt, stones, gaseous inclusions, and other similar imperfections.

rub.—abrasion of a glass surface producing a frosted appearance.

scratch.—damage on a glass surface in the form of a line caused by the movement of an object across and in contact with the glass surface.

strain pattern.—In heat-strengthened and fully tempered glass, a strain pattern, which is not normally visible, may become visible under certain light conditions.

Inspection:

Linear and point blemishes in glass should be evaluated per ASTM C 1036 – 06.

Coating related defects should be evaluated per ASTM C 1376 – 03.

Strain pattern, this is considered a normal part of the heat treating process and is not considered a defect.

Distortion, at this time no industry quality standards exist.

Bow and warp, see below.

Quality Criteria:

Maximum Allowed Bow and Warp

Vertical Method:

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

Place a straight edge across the concave surface.

Measure widest gap with a fine scale ruler.

Refer to table for to determine maximum allowable bow/warp.

Table: Maximum Allowed Bow and Warp

Glass Thickness, mm (in.)	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)
3 (1/8)	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 (1/8) 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 (5/16)	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)	...	...	...
5 (3/8)	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 (1/4)	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 (5/8)	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 (3/8)	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 (1/2 - 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)

All listed criteria are based on ASTM C 1048 – 04

¹ Information Provided By: Northwestern Industries, Inc. / Document Q-1003-001