Flat Glass Inspection Criteria per ASTM C 1036 – 11/ASTM C 1048-12

Terminology:

- **crush**.—lightly pitted condition with a dull gray appearance.
- **dig**.—deep, short scratch
- **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).
***View specimen from a distance of 6’***

Quality Criteria:

Allowable Point Blemish, (viewing distance 39") – within oval viewing area

- Blemish size <1.2mm (0.05") allowed without restriction on all areas of glass
- Blemish size >1.2mm (0.05") <2.0mm (0.10") allowed with a minimum separation of 600mm (24") inside viewing area
- Blemish size >2.0mm (0.10") none allowed inside viewing area

*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 6’) - within oval viewing area

- Faint or light scratch <75mm (3") allowed on all areas of the glass
- Medium scratch ≤75 (3") allowed with a minimum separation of 600mm (24") inside viewing area
- Medium or heavy scratch >75mm (3") are not allowed inside viewing area

To determine scratch intensity start at 6’ and move closer until scratch becomes visible, (refer to table)

***Strain pattern is considered a normal part of the heat treating process and is not considered a defect***

***Surface particles invisible to the naked eye are inherent in the heat treating process and are not a cause for rejection***

<table>
<thead>
<tr>
<th>Detection Distance</th>
<th>Blemish Intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Over 3.3 m (132 in.)</td>
<td>Heavy</td>
</tr>
<tr>
<td>3.3 to 1.01 m (132 to 40 in.)</td>
<td>Medium</td>
</tr>
<tr>
<td>1 to 0.2 m (39 to 8 in.)</td>
<td>Light</td>
</tr>
<tr>
<td>Less than 0.2 m (8 in.)</td>
<td>Paint</td>
</tr>
</tbody>
</table>
Laminated Glass Inspection Criteria per ASTM C 1172 – 11

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 parametric 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 parametric 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.
- **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).
- **streak** — a noticeably visible deviation on or in the laminating unit.

Inspection:
For inspection of individual glass lites refer to ASTM C 1036-11.

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 90º.

Lighting should be daylight level (without direct sunlight).

***View specimen from a distance of 6’***

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

<table>
<thead>
<tr>
<th>Blemish</th>
<th>Up to 25 ft² (2.5 m²)</th>
<th>25 to 75 ft² (2.5 to 7.0 m²)</th>
<th>Over 75 ft² (7.0 m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Central A</td>
<td>Outer A</td>
<td>Central A</td>
</tr>
<tr>
<td>Blow-in, edge boil</td>
<td>½ (2.1)</td>
<td>½ (2.1)</td>
<td>½ (2.2)</td>
</tr>
<tr>
<td>Boil (Bubbles)</td>
<td>½ (2.4)</td>
<td>½ (2.4)</td>
<td>½ (2.4)</td>
</tr>
<tr>
<td>Fuse</td>
<td>½ (2.4)</td>
<td>½ (2.4)</td>
<td>½ (2.4)</td>
</tr>
<tr>
<td>Hair, lint</td>
<td>½ (2.4)</td>
<td>½ (2.4)</td>
<td>½ (2.4)</td>
</tr>
<tr>
<td>Inside dirt</td>
<td>½ (2.4)</td>
<td>½ (2.4)</td>
<td>½ (2.4)</td>
</tr>
<tr>
<td>Lint-areas of concentrated lint</td>
<td>½ (2.4)</td>
<td>½ (2.4)</td>
<td>½ (2.4)</td>
</tr>
<tr>
<td>Separation, discoloration</td>
<td>½ (2.4)</td>
<td>½ (2.4)</td>
<td>½ (2.4)</td>
</tr>
<tr>
<td>Short interlayer, unlaminated area chip</td>
<td>½ (2.4)</td>
<td>½ (2.4)</td>
<td>½ (2.4)</td>
</tr>
<tr>
<td>Scuff, streak</td>
<td>light intensity</td>
<td>light intensity</td>
<td>light intensity</td>
</tr>
</tbody>
</table>

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.
Heat treated Glass Inspection Criteria per ASTM C 1048 – 11

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 – 11.

Coating related defects should be evaluated per ASTM C 1376 – 11.

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.

***Strain pattern is considered a normal part of the heat treating process and is not considered a defect***

***Surface particles invisible to the naked eye are inherent in the heat treating process and are not a cause for rejection***

Quality Criteria:

Maximum Allowed Bow and Warp

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

<table>
<thead>
<tr>
<th>Glass Thickness, mm</th>
<th>3 (hh)</th>
<th>5 (hh)</th>
<th>7 (hh)</th>
<th>9 (hh)</th>
<th>11 (hh)</th>
<th>13 (hh)</th>
<th>15 (hh)</th>
<th>17 (hh)</th>
<th>19 (hh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Edge Distance, cm</td>
<td>0-20</td>
<td>20-30</td>
<td>30-40</td>
<td>40-50</td>
<td>50-60</td>
<td>60-70</td>
<td>70-80</td>
<td>80-90</td>
<td>90-100</td>
</tr>
<tr>
<td>3 (hh)</td>
<td>5.0 (0.19)</td>
<td>4.0 (0.16)</td>
<td>5.0 (0.19)</td>
<td>7.0 (0.28)</td>
<td>9.0 (0.35)</td>
<td>12.0 (0.47)</td>
<td>14.0 (0.55)</td>
<td>17.0 (0.67)</td>
<td>16.0 (0.63)</td>
</tr>
<tr>
<td>5 (hh)</td>
<td>2.0 (0.08)</td>
<td>2.0 (0.08)</td>
<td>2.0 (0.08)</td>
<td>3.0 (0.12)</td>
<td>5.0 (0.20)</td>
<td>6.0 (0.24)</td>
<td>7.0 (0.28)</td>
<td>8.0 (0.31)</td>
<td>10.0 (0.38)</td>
</tr>
<tr>
<td>7 (hh)</td>
<td>3.0 (0.12)</td>
<td>4.0 (0.16)</td>
<td>5.0 (0.20)</td>
<td>7.0 (0.28)</td>
<td>9.0 (0.35)</td>
<td>12.0 (0.47)</td>
<td>14.0 (0.55)</td>
<td>17.0 (0.67)</td>
<td>16.0 (0.63)</td>
</tr>
<tr>
<td>9 (hh)</td>
<td>6.0 (0.24)</td>
<td>7.0 (0.28)</td>
<td>9.0 (0.35)</td>
<td>12.0 (0.47)</td>
<td>14.0 (0.55)</td>
<td>17.0 (0.67)</td>
<td>16.0 (0.63)</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>11 (hh)</td>
<td>10.0 (0.40)</td>
<td>11.0 (0.44)</td>
<td>13.0 (0.51)</td>
<td>15.0 (0.58)</td>
<td>18.0 (0.71)</td>
<td>20.0 (0.73)</td>
<td>22.0 (0.80)</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>13 (hh)</td>
<td>15.0 (0.60)</td>
<td>16.0 (0.63)</td>
<td>18.0 (0.71)</td>
<td>20.0 (0.73)</td>
<td>22.0 (0.80)</td>
<td>24.0 (0.84)</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>15 (hh)</td>
<td>20.0 (0.80)</td>
<td>21.0 (0.83)</td>
<td>23.0 (0.90)</td>
<td>25.0 (0.97)</td>
<td>27.0 (1.04)</td>
<td>29.0 (1.11)</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>17 (hh)</td>
<td>25.0 (1.04)</td>
<td>26.0 (1.08)</td>
<td>28.0 (1.15)</td>
<td>30.0 (1.22)</td>
<td>32.0 (1.29)</td>
<td>34.0 (1.36)</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>19 (hh)</td>
<td>30.0 (1.22)</td>
<td>31.0 (1.25)</td>
<td>33.0 (1.32)</td>
<td>35.0 (1.39)</td>
<td>37.0 (1.46)</td>
<td>39.0 (1.53)</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>22-24 (13-12 hh)</td>
<td>1.0 (0.04)</td>
<td>1.0 (0.04)</td>
<td>1.0 (0.04)</td>
<td>1.0 (0.04)</td>
<td>1.0 (0.04)</td>
<td>1.0 (0.04)</td>
<td>1.0 (0.04)</td>
<td>1.0 (0.04)</td>
<td>1.0 (0.04)</td>
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</tbody>
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