



Designation: ~~C1376–21~~ C1376 – 21a

Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass¹

This standard is issued under the fixed designation C1376; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers the optical and aesthetic quality requirements for pyrolytic and vacuum deposition coatings applied ~~to~~ on flat glass for use in building glazing.

1.2 The coatings ~~covered~~ are applied ~~to~~ on the glass using either pyrolytic or vacuum (~~sputtering~~) sputtering deposition methods and ~~are typically applied to~~ control solar heat gain, energy performance, comfort level, and condensation and to enhance the aesthetic of the building.

1.3 This specification addresses blemishes related to the coating only. It does not address glass blemishes, applied ceramic frits to spandrel glass, and organic film opacifiers.

1.4 The *Nonuniformity for Coated Glass* requirements, given in 6.10, pertain to ~~as installed in the building exterior glazing units of vertical and sloped orientations~~ orientations as installed in the building exterior.

1.5 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 Reference to these documents shall be the latest issue unless otherwise specified by the authority applying this specification.

2.2 *ASTM Standards:*²

C162 Terminology of Glass and Glass Products

C1036 Specification for Flat Glass

C1048 Specification for Heat-Strengthened and Fully Tempered Flat Glass

D2244 Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates

3. Terminology

3.1 *Definitions:*

¹ This specification is under the jurisdiction of ASTM Committee C14 on Glass and Glass Products and is the direct responsibility of Subcommittee C14.08 on Flat Glass. Current edition approved Feb. 1, 2021; Sept. 1, 2021. Published March 2021; November 2021. Originally approved in 1997. Last previous edition approved in 2015; 2021 as C1376 – 15; C1376 – 21. DOI: 10.1520/C1376-21-10.1520/C1376-21A.

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

3.1.1 Refer to Terminology **C162** or Specification **C1036** or **C1048**, as appropriate.

3.1.2 *blemishes in flat glass*—refer to Specification **C1036** or **C1048**, as appropriate.

3.1.3 These definitions do not apply to in-service damage.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *coated overhead glass*—glass used in an installation in which the lower edge of the glass is more than 6 ft (1.8 m) above (the viewer’s) floor level or cannot be approached within 10 ft (3.0 m); the glass can usually but not always be viewed in both transmission and reflection; the glass is usually sloping in from the vertical plane, however, may also be vertical or sloping out from the vertical plane.

3.2.2 *coated spandrel/non-vision glass*—glass used in an installation in which the glass is only viewed in reflection from the building’s exterior. ~~The exterior;~~ the glass is usually installed vertically, however, may be at a slope to the vertical ~~plane~~plane.

3.2.3 *coated vision glass*—glass used in an installation in which the lower edge of the glass is a maximum of 6 ft (1.8 m) above (the viewer’s) floor level; the glass can be viewed in transmission or reflection; the glass is usually vertical, however, may also be sloping in or out from the vertical plane; and the glass can be approached within 10 ft (3.0 m) or less. If the distance is greater than 10 ft (3.0 m), see *coated overhead glass*. ~~glass,~~ which would apply.

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

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

3.2.6 *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.

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

3.2.8 *cut size*—flat glass sheets cut to specific ~~dimensions,~~dimensions for end use, [55-a840f842f787/astm-c1376-21a](https://standards.iteh.ai/55-a840f842f787/astm-c1376-21a)

3.2.9 *edge deletion*—the process of removing a portion of the vacuum deposition coating from the glass surface typically within 1 ~~min.~~ (25 mm) or less of all edges before insulating or laminating the glass.

3.2.10 *mark/contaminant*—a deposit of foreign material on the ~~glass surface,~~surface of the glass or coating.

3.2.11 *nonuniformity*—obvious variation in ~~reflected color of the coating~~ color within a lite of coated glass, or between two or more lites of coated glass ~~of glass,~~ or both, with like construction that have been installed in the same plane and elevation in the same building, or both buildings.

3.2.11.1 *banding*—wide or narrow area(s) of nonuniformity with demarcation that appears as a linear feature and may occur anywhere on a ~~lite.~~lite of coated glass.

3.2.11.2 *edge to edge*—gradient nonuniformity within a lite of coated glass.

3.2.11.3 *lite to lite*—nonuniformity between individual ~~lites.~~lites of coated glass.

3.2.11.4 *mottling*—splotchy or patchy nonuniformity (not to be confused with strain pattern; see **X1.1.5**).

3.2.11.5 *picture framing*—perimeter nonuniformity within a lite of coated glass.

3.2.12 *pinhole*—small ~~are~~blemish in which the coating is entirely or partially absent.

3.2.13 *pyrolytic*—~~term used to describe a method of manufacture of a coating;~~ process type of coating that applies the coating to hot glass, usually at the time of flat glass manufacturing.

3.2.14 *spot*—~~a small,~~small opaque blemish ~~in-on or in or under the~~ coating.

3.2.15 *stock size*—flat glass ~~sheets~~ cut to standard dimensions that will be cut to smaller sizes in a subsequent process.

3.2.16 *vacuum deposition*—~~term used to describe a method of manufacture of a coating;~~ the process type of coating that applies the coating in a vacuum chamber to *stock size* or *cut size* flat glass.

3.2.17 *vacuum sputtering*—see *vacuum deposition*.

4. Significance and Use

4.1 This specification groups coated glass according to application. These groups are: vision, spandrel/non-vision, and overhead. Similar but unique quality tolerances and inspection guidelines/criteria have been outlined for each application. The glass to be coated shall comply with the applicable provisions of Specifications **C1036** and **C1048**.

4.2 Coating blemishes are an inherent part of the ~~glass-coating~~ glass coating process. In addition, coatings can be damaged as a result of improper transportation, storage, handling, fabrication, or installation.

4.3 Individual manufacturers should be contacted for recommended storage, handling, fabrication, installation, and application guidelines.

5. Classification

5.1 *Kinds*—~~Coated Pyrolytic or vacuum deposition coated~~ flat glass furnished under this specification shall be of the following kinds, as specified:

5.1.1 *Kind CV*—Flat transparent glass conforming to the applicable requirements of Specification **C1036** or **C1048**, or both, and having a coating applied to one or more of the glass surfaces which further conforms with the requirements hereinafter specified for coated vision glass.

5.1.2 *Kind CO*—Flat transparent glass conforming to the applicable requirements of Specification **C1036** or **C1048**, or both, and having a coating applied to one or more of the glass surfaces which further conforms with requirements hereinafter specified for coated overhead glass.

5.1.3 *Kind CS*—Flat glass conforming to the applicable requirements of Specification **C1036** or **C1048**, or both, and having a coating applied to one or more of the glass surfaces that further conforms with the requirements hereinafter specified for coated spandrel/non-vision glass.

6. Requirements

6.1 These specifications apply to cut size glass only. For specifications of stock size glass and blemishes not listed, contact the manufacturer.

6.2 All glass is to be inspected in transmission (unless otherwise noted) at a viewing angle of 90° to the specimen, using a bright uniform background with diffused daylight conditions, without direct sunlight. For factory inspection, the specimen shall be placed a minimum of 12 in. from the light source using uniform diffused background lighting with a minimum luminance of 1700 lux (160 ~~foot-candles~~)fc) and maximum of 2500 lux (230 ~~foot-candles~~)fc) measured at the center of the glass surface closest to the light source. If a blemish is readily apparent under these viewing conditions and detection distance as stated in **6.3**, the criteria in **Table 1**, **Table 2**, or **Table 3** applies for each kind of coated glass.

6.3 Defect detection distance for coated vision glass (*Kind CV*) is 10 ~~ft.~~ft. (3.0 m) and for coated overhead glass (*Kind CO*) and coated spandrel/non-vision glass (*Kind CS*) is 15 ~~ft (4.6 m);~~(4.6 m) for both Range Nos. 1 and 2 (see **Table 3**).

6.4 No more than two readily apparent blemishes are allowed in a 3-in. (75 mm) diameter circle, and no more than five readily apparent blemishes are allowed in a 12-in. (300 mm) diameter circle.

TABLE 1 Quality Specifications for Cut Size Coated Vision Glass (Kind CV)

Blemish	Central Area, in. (mm)	Outer Area, in. (mm)
<u>Blemish (maximum)</u>	<u>Central Area</u> in. (mm)	<u>Outer Area</u> in. (mm)
Pinhole	$\frac{1}{16}$ (1.6) max	$\frac{3}{32}$ (2.4) max
Pinhole (size)	$\frac{1}{16}$ (1.6)	$\frac{3}{32}$ (2.4)
Spot	$\frac{1}{16}$ (1.6) max	$\frac{3}{32}$ (2.4) max
Spot (size)	$\frac{1}{16}$ (1.6)	$\frac{3}{32}$ (2.4)
Coating Scratch	2 (50) max length	3 (75) max length
Coating Scratch (length)	2 (50)	3 (75)
Mark/Contaminant	2 (50) max length	3 (75) max length
Mark/Contaminant (length)	2 (50)	3 (75)
Coating Rub	none allowed	length plus width not to exceed $\frac{3}{4}$ (19)
Coating Rub (length plus width)	none allowed	$\frac{3}{4}$ (19)
Grazing	length plus width not to exceed 2 in. (50) max	length plus width not to exceed 3 in. (75) max
Crazing (length plus width)	2 (50)	3 (75)
Corrosion	none allowed	none allowed

TABLE 2 Quality Specifications for Cut Size Coated Overhead Glass (Kind CO)

Blemish	Central Area, in. (mm)	Outer Area, in. (mm)
<u>Blemish (maximum)</u>	<u>Central Area</u> in. (mm)	<u>Outer Area</u> in. (mm)
Pinhole	$\frac{3}{32}$ (2.4) max	$\frac{1}{8}$ (3.2) max
Pinhole (size)	$\frac{3}{32}$ (2.4)	$\frac{1}{8}$ (3.2)
Spot	$\frac{3}{32}$ (2.4) max	$\frac{1}{8}$ (3.2) max
Spot (size)	$\frac{3}{32}$ (2.4)	$\frac{1}{8}$ (3.2)
Coating Scratch	3 (75) max length	4 (100) max length
Coating Scratch (length)	3 (75)	4 (100)
Mark/Contaminant	3 (75) max length	4 (100) max length
Mark/Contaminant (length)	3 (75)	4 (100)
Coating Rub	length plus width not to exceed $\frac{3}{4}$ (19)	length plus width not to exceed 1 (25)
Coating Rub (length plus width)	$\frac{3}{4}$ (19)	1 (25)
Grazing	length plus width not to exceed 2 in. (50) max	length plus width not to exceed 3 in. (75) max
Crazing (length plus width)	2 (50)	3 (75)
Corrosion	none allowed	none allowed

6.5 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.

6.6 For coating edge deletion, the demarcation between where the coating was removed and where it still remains may be visible in the finished glazing unit and is not considered a defect. Any discoloration in the edge deleted area is also not considered a defect.