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AMERICAN SOCIETY FOR TESTING AND MATERIALS
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Standard Specification for Flat Glass[1]

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This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 This specification covers the quality requirements for cut sizes of flat, transparent, clear glass having glossy, apparently plane and smooth surfaces for glazing, mirrors, and general architectural or similar uses.

1.2 This specification covers the quality requirements for cut sizes of flat transparent tinted heat-absorbing or light-reducing glass, or both, having glossy, apparently plane and smooth surfaces. The glass is intended to be used primarily for building construction to control the transmission of light, heat, or solar radiation, or combination thereof.

1.3 This specification covers the quality requirements for cut sizes of patterned and wired glasses for decorative and general glazing applications.

1.4 The dimensional values stated in inch-pound units, except for thickness designations, are to be regarded as the standard.

1.5 The following safety hazards caveat pertains only to the test method portion, Section 7, of this specification. *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*[2]

2. Referenced Documents

2.1 *ASTM Standards:*

C 162 Terminology of Glass and Glass Products[3]

E 308 Test Method for Computing the Colors of Objects by Using the CIE System[4]

E 903 Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres[5]

3. Terminology

3.1 *Definitions*—For additional definitions of terms, refer to Terminology C 162.

3.1.1 *blemishes in flat glass*:

NOTE 1—These definitions do not apply to in-service damage.

3.1.1.1 *crush*—a lightly pitted area resulting in a dull gray or white appearance over the region.

3.1.1.2 *digs*—deep, short scratches.

3.1.1.3 *dirt*—a small particle of foreign matter imbedded in the glass surface.

3.1.1.4 *gaseous inclusions*—round or elongated bubbles in the glass.

3.1.1.5 *knot*—a transparent area of incompletely assimilated glass.

3.1.1.6 *lines*—fine cords or strings, usually on the surface of sheet glass.

3.1.1.7 *open gaseous inclusions*—bubbles at the surface of glass that are open, leaving a cavity in the surface.

3.1.1.8 *process surface blemishes*—slight surface blemishes that originated in the process that can be small particles of foreign materials on either surface or surface irregularities.

3.1.1.9 *ream*—inclusions within the glass or layers or strings of glass that are not homogeneous with the main body of the glass.

3.1.1.10 *rub*—abrasion of the glass surfaces producing a frosted appearance. A rub differs from a scratch in having appreciable width.

3.1.1.11 *scratch*—any marking or tearing of the surface produced in manufacturing or handling, appearing as though it were done by a sharp or rough instrument.

3.1.1.12 *smoke*—streaked areas appearing as slight discoloration.

3.1.1.13 *stone*—any crystalline inclusion imbedded in the glass.

3.1.1.14 *string*—transparent line appearing as though a thread of glass had been incorporated into the sheet.

3.1.1.15 *wave*—blemishes resulting from irregularities of the surfaces of glass, making objects viewed at varying angles appear wavy or bent.

3.1.2 *vision interference angle*—the acute angle included

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[2] Latest issue, unless otherwise specified by the agency applying Specification C 1036.

[3] *Annual Book of ASTM Standards*, Vol 15.02.

[4] *Annual Book of ASTM Standards*, Vol 06.01.

[5] *Annual Book of ASTM Standards*, Vol 12.02.

between the plane of the glass and the vertical plane perpendicular to the wall, such plane including the observer when the glass is examined in accordance with 7.1.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *heat-absorbing glass*—glass for absorbing appreciable portions of radiant energy, especially solar energy.

3.2.2 *illuminant C*—as defined in Test Method E 308, an approximate representation of average daylight. Standard illuminant C (CIE 1931) (Commission Internationale de l'Éclairage) is a gas-filled lamp of color temperature 2848 K used in conjunction with a liquid filter (Davis-Gibson filter) for converting color temperature 2856 to 6670 K.

3.2.3 *light-reducing glass*—glass which is formulated to reduce the transmission of light.

3.2.4 *light transmittance*—that fraction of the incident light of a given wavelength which is not reflected or absorbed but passes through a substance.

3.2.5 *patterned glass*—rolled flat glass having a pattern on one or both surfaces.

3.2.6 *shading coefficient*—for any fenestration, the ratio of the rate of total solar heat gain through that type of fenestration to the total solar heat gain that would be admitted through a standard single pane of 3-mm (0.12-in.) thick clear glass in the same situation, the standard pane having a total solar transmittance value of 0.87.

3.2.7 *wired glass*—rolled glass having a layer of meshed or standard wire completely imbedded in the sheet.

4. Classification and Intended Use

4.1 *Types, Classes, Styles, Forms, Qualities, and Finishes*—Glass shall be of the following types, classes, styles, forms, qualities, and finishes, as specified (see Section 5):

4.1.1 *Type I—Transparent Glass, Flat:*

4.1.1.1 *Class 1—Clear:*

Quality

q^1—Mirror select
q^2—Mirror
q^3—Glazing select
q^4—Glazing A
q^5—Glazing B
q^6—Greenhouse

4.1.1.2 *Class 2—Tinted, Heat-Absorbing and Light-Reducing*:

Quality

q^3—Glazing select
q^4—Glazing A
q^5—Glazing B
Style A—Higher light transmittance
Style B—Lower light transmittance

4.1.1.3 *Class 3—Tinted, Light-Reducing*:

Quality

q^3—Glazing select
q^4—Glazing A
q^5—Glazing B

4.1.2 *Type II—Patterned and Wired Glass, Flat*:

Class

1—Clear
2—Tinted, heat-absorbing and light-reducing (A and B applies to Class 2 only)
Style A—Higher light transmittance
Style B—Lower light transmittance
3—Tinted, light reducing

Form (Classes 1, 2, and 3)

1—Wired, polished both sides
2—Patterned and wired
3—Patterned

Quality

q^7—Decorative
q^8—Glazing

Finish

f^1—Patterned one side
f^2—Patterned both sides

Mesh (Forms 1 and 2)

m^1—Diamond
m^2—Square
m^3—Parallel strand
m^4—Special

Pattern (Forms 2 and 3)

p^1—Linear
p^2—Geometric
p^3—Random
p^4—Special

4.2 *Intended Use of Transparent Flat Glass*:

4.2.1 *Mirror Select Quality*, q^1—Intended to be coated for premium mirrors.

4.2.2 *Mirror Quality*, q^2—Intended to be coated for general use mirrors.

4.2.3 *Glazing Select Quality*, q^3—Intended for architectural fenestrations or other applications where distant objects are viewed through the glass by the observer.

4.2.4 *Glazing A Quality*, q^4—Intended for selected glazing applications such as appliances or show cases where the observer views near objects through the glass.

4.2.5 *Glazing B Quality*, q^5—Intended for general glazing applications that have lesser aesthetic demands than a q^3 or q^4 quality grade.

4.2.6 *Greenhouse Quality*, q^6—Intended for greenhouses or other applications where restrictions on aesthetic conditions are not required.

4.3 *Intended Use of Patterned and Wired Flat Glasses*:

4.3.1 *Decorative Quality*, q^7—Intended for use where design and aesthetic characteristics are major considerations.

4.3.2 *Glazing Quality*, q^8—Intended for general glazing where functional or aesthetic characteristics are a consideration and where surface blemishes are not a major concern.

4.3.3 *Wired Glass*—Intended for skylights and general glazing where fire retardation or glass retention in the frame are a consideration.

5. Ordering Information

5.1 Purchasers should select the preferred options permitted in this specification, and include the following information in procurement documents:

5.1.1 Title, number, and date of this specification,

5.1.2 Type, class, quality, style, and form, as requested (see 4.1),

5.1.3 Edges (see 6.1),

5.1.4 Length and width of cut size (see 6.3, 6.8.1.1, and 6.8.2.1), and

5.1.5 Glass thickness (see 6.3, 6.8.1.1, and 6.8.2.1).

5.1.6 *Samples*—If for any particular purpose samples with bids are necessary, they should be specifically asked for in the invitation for bids and the particular purpose to be served by the bid sample should be definitely stated.

5.2 Additional information to be specified for tinted, heat-absorbing or light-reducing flat glass, or both:

5.2.1 *Heat-Absorbing Glass*—Style and tint.

5.2.2 *Light-Reducing Glass*—Transmittance and tint.

5.2.3 *Availability*—Heat-absorbing glass is available in a variety of styles and tints, but within limitations. Combinations of all styles and tints are not possible. It is advisable that before referencing glass to this specification, the authority applying this specification should consult with suppliers.

5.3 Additional information to be specified for patterned or wired glass, or both.

5.3.1 For patterned glass, pattern description, whether one or both sides.

5.3.2 For wired glass, surface finish, wire mesh, and pattern description, if any.

5.3.3 *Samples*—If for any particular purpose samples with bids are necessary, such as wired glass that may contain numerous gaseous inclusions along the wire, they should be specifically asked for in the invitation for bids and the particular purpose to be served by the bid sample should be definitely stated.

6. Requirements

6.1 *Edge*—An edge shall be cut, ground, sanded to remove sharp edges only, seamed, ground and polished, beveled, or mitered, as specified.

6.2 *Marking*—Each package of glass shall bear a label, affixed by the manufacturer, giving the manufacturer's name or trademark, the quality of glass, nominal thickness, and place of manufacture.

6.3 *Dimensional Tolerances for Type I (Transparent Glass, Flat)*—Tolerances for length, width, and thickness shall be in accordance with Table 1.

6.4 *Blemishes for Type I (Transparent Glass, Flat)*—Blemishes shall be not greater than those listed in Table 2, Table 3, and Table 4.

6.5 *Quality* q^6 *(Greenhouse)*—Glass may contain visual blemishes that are suitable for greenhouse glazing.

6.6 *Additional Requirements for Type I, Class 2 (Tinted, Heat-Absorbing and Light-Reducing Flat Glass)*:

6.6.1 *Transmittance, Styles A and B*—The illuminant C (daylight) and solar transmittance shall be in accordance with Table 5.

6.6.2 *Blemishes for Type I, Class 2 (Tinted, Heat-Absorbing and Light-Reducing Flat Glass)*—The type and number of blemishes shall be not greater than those specified in Table 3 and Table 4.

6.6.3 *Tint*—The tint of each class, style, and quality shall be as specified. Note that the color of tinted heat-absorbing glass is a major consideration for either design and aesthetic reasons or for color matching requirements. Tinted heat-absorbing glass should be viewed as installed for color comparison. Colors may vary considerably among different manufacturers and from run to run.

6.7 *Additional Requirements for Type I, Class 3 (Tinted, Light-Reducing, Flat Glass)*:

6.7.1 *Luminous Transmittance*—Light-reducing glass may be produced in a wide range of luminous transmittance values. The transmittance shall be as specified.

6.7.2 *Blemishes for Type I, Class 3 (Tinted, Light-Reducing, Flat Glass)*—The type and number of blemishes shall be as specified in Table 3 and Table 4.

6.7.3 *Color*—The color of tinted glass is a major consideration for either design and aesthetic reasons or color matching requirements. Tinted glass should be viewed as installed for color comparison. Colors may vary considerably among different manufacturers and from run to run.

6.8 *Additional Requirements for Type II (Patterned and Wired Flat Glass)*:

6.8.1 *Wired (Forms 1 and 2)*:

TABLE 1 Dimensional Tolerance for Rectangular Shapes of Type 1 Transparent, Flat Glass

Thickness		Tolerance						Generally Available in the Following Qualities
Designation, mm	Traditional Designation	Nominal Decimal, in.	Thickness Range, mm min	Thickness Range, mm max	Thickness Range, in. min	Thickness Range, in. max	Length and Width for Cut Sizes, plus or minus, mm (in.)	
1.0	micro-slide	0.04	0.79	1.24	0.031	0.049	1.6 (1/16)	q^4, q^5
1.5	photo	0.06	1.27	1.78	0.050	0.070	1.6 (1/16)	q^4, q^5
2.0	picture	0.08	1.80	2.13	0.071	0.084	1.6 (1/16)	q^4, q^5
2.5	single	0.09	2.16	2.57	0.085	0.101	1.6 (1/16)	q^1, q^2, q^4, q^5
2.7	lami	0.11	2.59	2.90	0.102	0.114	1.6 (1/16)	q^4, q^5
3.0	double-⅛ in.	0.12	2.92	3.40	0.115	0.134	1.6 (1/16)	q^1, q^2, q^3, q^4, q^5, q^6
4.0	5⁄32in.	0.16	3.78	4.19	0.149	0.165	1.6 (1/16)	q^3, q^4, q^5
5.0	3⁄16in.	0.19	4.57	5.05	0.180	0.199	1.6 (1/16)	q^1, q^2, q^3, q^4, q^5
5.5	7⁄32in.	0.21	5.08	5.54	0.200	0.218	1.6 (1/16)	q^3, q^4, q^5
6.0	¼in.	0.23	5.56	6.20	0.219	0.244	1.6 (1/16)	q^1, q^2, q^3
8.0	5⁄16in.	0.32	7.42	8.43	0.292	0.332	2.0 (5/64)	q^3
10.0	⅜ in.	0.39	9.02	10.31	0.355	0.406	2.4 (3/32)	q^3
12.0	½ in.	0.49	11.91	13.49	0.469	0.531	3.2 (⅛)	q^3
16.0	⅝ in.	0.63	15.09	16.66	0.595	0.656	4.0 (5⁄32)	q^3
19.0	¾ in.	0.75	18.26	19.84	0.719	0.781	4.8 (3⁄16)	q^3
22.0	⅞ in.	0.87	21.44	23.01	0.844	0.906	5.6 (7⁄32)	q^3
25.0	1 in.	1.00	24.61	26.19	0.969	1.031	6.4 (¼)	q^3
32.0	1¼ in.	1.23	28.58	34.93	1.125	1.375	7.9 (5⁄16)	q^3