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AMERICAN SOCIETY FOR TESTING AND MATERIALS
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Standard Specification for Type 101 Sealing Glass[1]

This standard is issued under the fixed designation F 79; 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.

ε[1] NOTE—Section 11 was changed editorially in September 1995.

1. Scope

1.1 This specification covers Type 101 sealing glass for use in electronic applications.

NOTE 1—This specification is primarily intended to consider glass as most generally used, this is, glass in its transparent form as normally encountered in fabricating electronic devices. X1.3 lists sealing metals and alloys that are compatible with this glass. Type 101 glass in other forms such as powdered, crushed, sintered, fibrous, etc. are excluded. The requirements of this specification, as applied to these forms, must be established in the raw glass prior to its conversion.

2. Referenced Documents

2.1 *ASTM Standards:*

C 336 Test Method for Annealing Point and Strain Point of Glass by Fiber Elongation[2]

C 338 Test Method for Softening Point of Glass[2]

C 598 Test Method for Annealing Point and Strain Point of Glass by Beam Bending[2]

D 150 Test Methods for A-C Loss Characteristics and Permittivity (Dielectric Constant) of Solid Electrical Insulating Materials[3]

D 257 Test Methods for D-C Resistance or Conductance of Insulating Materials[3]

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specification[4]

E 228 Test Method for Linear Thermal Expansion of Solid Materials with a Vitreous Silica Dilatometer[4]

F 14 Practice for Making and Testing Reference Glass-Metal Bead-Seal[2]

F 140 Practice for Making Reference Glass-Metal Butt Seals and Testing for Expansion Characteristics by Polarimetric Methods[2]

F 144 Practice for Making Reference Glass-Metal Sandwich Seal and Testing for Expansion Characteristics by Polarimetric Methods[2]

3. Ordering Information

3.1 Orders for material under this specification shall include the following information:

3.1.1 Form,

3.1.2 Type of glass,

3.1.3 Dimensions,

3.1.4 Marking and packaging, and

3.1.5 Certification (if required).

4. Chemical Composition

4.1 The typical chemical composition of this glass is as follows (Note 2):

Major Constituents	Weight %
Silica (SiO_2)	56.0
Alumina (Al_2O_3)	1.5
Soda (Na_2O)	4.0
Potash (K_2O)	8.5
Lead oxide (PbO)	29.0
Antimony trioxide (Sb_2O_3)	1.0, max
Arsenic trioxide (As_2O_3)	1.0, max
Halogens	0.2, max

NOTE 2—Major constituents may be adjusted to give the desired electrical and physical properties to the glass. However, no change shall be made that alters any of these properties without due notification of, and approval by, the user.

5. Physical Properties

5.1 The material shall conform to the physical properties prescribed in Table 1. For electrical properties see Table 2 and its Footnote A.

6. Workmanship, Finish, and Appearance

6.1 The glass shall have a finish that ensures smooth, even surfaces and freedom from cracks, checks, bubbles, and other flaws of a character detrimental to the strength or life of the component or device for which its use is intended.

7. Test Methods

7.1 *Softening Point*—See Test Method C 338.

7.2 *Annealing Point*—See Test Method C 336 or Test Method C 598.

7.3 *Thermal Expansion Coefficient*—Pretreat the specimen

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

[3] *Annual Book of ASTM Standards*, Vol 10.01.

[4] *Annual Book of ASTM Standards*, Vol 14.02.

TABLE 1 Physical Requirements

Property	ASTM Test Method[A]	Condition[A]	Value
Softening point	C 338	sec 7.1	630 ± 10°C
Annealing point	C 336 or C 598	sec 7.2	435 ± 10°C
Thermal expansion coefficient	E 228	sec 7.3 0 to 300°C	8.95 ± 0.20 ppm/°C
Contraction coefficient	E 228	sec 7.4 (annealing point minus 15 to 30°C)	10.10 ± 0.20 ppm/°C

[A] Test methods and conditions are detailed in the appropriately referenced section of this specification.

TABLE 2 Electrical Properties[A]

Property	ASTM Test Method	Condition	Value (Typical)
Volume resistivity (dc)	D 257[B]	25°C	$\log_{10}R$ (Ω·cm) 17.0
		250°C	$\log_{10}R$ (Ω·cm) 9.9
		350°C	$\log_{10}R$ (Ω·cm) 7.8
Dielectric constant (1 MHz)	D 150[B]	20°C	6.7
Dissipation factor (1 MHz)	D 150	20°C	0.0014
Loss index (1 MHz)	D 150	20°C	0.009

[A] While having no influence on the sealing capability of the glass, electrical properties are included as information pertaining to the effect of the material on the performance of electronic devices in which it may be used.

[B] Test methods are cited in Section 2 of this specification.

by heating to 10°C above the annealing point and hold it at that temperature for 15 min; then cool it from that temperature to 100°C at a rate of 2 to 5°C/min. The cooling rate below 100°C is optional. Place the specimen in the dilatometer and determine the mean coefficient of linear thermal expansion for the 0 to 300°C range in accordance with Procedure A of Test Method E 228.

7.4 *Contraction Coefficient*—Heat the specimen in a vitreous silica dilatometer to 20°C above the annealing point and hold it at that temperature for 15 min; then cool at a rate of from 1.0 to 1.5°C/min to a temperature below 200°C. The rate of cooling from the point below 200 to 100°C shall not exceed 5°C/min. The rate of cooling from 100°C to room temperature is optional. During this cooling schedule, determine the thermal contraction curve and calculate the mean coefficient of linear thermal contraction between a point 15°C below the annealing point and 30°C in accordance with Procedure B of Test Method E 228.

7.5 *Bead Seal Test*—The thermal contraction match between the glass and a sealing alloy may be determined by preparing and testing an assembly in accordance with Practices F 14, F 140, or F 144.

8. Test Results

8.1 Observed or calculated values obtained from measurements, tests, or analysis shall be rounded in accordance with the rounding method of Practice E 29, to the nearest unit in the last right-hand place of figures used in expressing the specified limit.

9. Investigation of Claims

9.1 Where any material fails to meet the requirements of this specification, the material so designated shall be handled in accordance with the agreement mutually acceptable to the manufacturer and the purchaser.

10. Packaging and Package Marking

10.1 Packing shall be determined by the form in which this material shall be supplied and shall be subject to agreement between the manufacturer and the purchaser.

10.2 The material as furnished under this specification shall be identified by the name or symbol of the manufacturer. The lot size for determining compliance with the requirements of this specification shall be one day's production.

11. Keywords

11.1 glass; sealing

APPENDIX

(Nonmandatory Information)

X1. ADDITIONAL INFORMATION

X1.1 *Physical Properties*—The physical properties as listed in Table X1.1, in addition to those included as requirements of the specification, are presented for guidance in negotiating with a specific vendor for their imposition when particularly appropriate. These criteria are not included within the specification because their values are averages of results obtained by various methods, no one of which is presently agreed upon by the glass industry as a whole.

TABLE X1.1 Physical Properties

Property	Condition	Unit	Value	Tolerance
Density	...	g/cm^3	3.05	±0.02
Refractive index	sodium (D) line	...	1.56	±0.02
Birefringence, constant or stress-optical coefficient	...	10^{-12} Pa^{-1}	3.0	±0.2

X1.2 *Typical Values for the Mean Coefficient of Linear Thermal Contraction*—Typical values for the mean coefficient of linear thermal contraction of Type 101 glass are given in Table X1.2 for information only. These apply to a specimen of the glass when cooled during the thermal contraction test (see

TABLE X1.2 Typical Contraction Coefficients

Temperature Range, °C	Mean Contraction Coefficient, µm/m/°C or ppm/°C
100 to 30	8.6
200 to 30	8.9
300 to 30	9.2
400 to 30	9.7
420 to 30	10.1
450 to 30	10.8

7.4) from a point above the maximum temperature shown to 30°C at a rate not exceeding 1.5°C/min.

X1.3 *Type 101—Compatible Metals and Sealing Alloys*—The thermal expansion characteristics of Type 101 sealing glass are generally satisfactory for sealing to the metals and alloys in Table X1.3.

TABLE X1.3 Metals and Sealing Alloys Compatible with Type 101 Glass

Metal or Alloy	ASTM Specification
Platinum	...
Titanium	...
Dumet	F 29, Dumet Wire for Glass to Metal Seal Applications
52 Alloy	F 30, Iron-Nickel Sealing Alloys
41-6 Alloy	F 31, 42 % Nickel-6 % Chromium-Iron Sealing Alloy