Designation: F105 – 72 (Reapproved 2015

Standard Specification for Type 58 Borosilicate Sealing Glass[1]

This standard is issued under the fixed designation F105; 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 Type 58 borosilicate sealing glass for use in electronic applications.

NOTE 1—This specification is primarily intended to consider glass as most generally used, that is, glass in its transparent form as normally encountered in fabricating electronic devices. X1.3 refers to a sealing alloy that is compatible with this glass. Type 58 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:*[2]

C336 Test Method for Annealing Point and Strain Point of Glass by Fiber Elongation

C338 Test Method for Softening Point of Glass

C598 Test Method for Annealing Point and Strain Point of Glass by Beam Bending

D150 Test Methods for AC Loss Characteristics and Permittivity (Dielectric Constant) of Solid Electrical Insulation

D257 Test Methods for DC Resistance or Conductance of Insulating Materials

E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

E228 Test Method for Linear Thermal Expansion of Solid Materials With a Push-Rod Dilatometer

F14 Practice for Making and Testing Reference Glass-Metal Bead-Seal

F15 Specification for Iron-Nickel-Cobalt Sealing Alloy

F140 Practice for Making Reference Glass-Metal Butt Seals and Testing for Expansion Characteristics by Polarimetric Methods

F144 Practice for Making Reference Glass-Metal Sandwich Seal and Testing for Expansion Characteristics by Polarimetric Methods

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):

	Weight %
Major Constituents:	
Silica (SiO_2)	65.0
Alumina (Al_2O_3)	7.5
Boron oxide (B_2O_3)	18.0
Soda (Na_2O)	2.0
Potash (K_2O)	3.0
Barium oxide (BaO)	3.0
Minor Constituents:	
Lithium oxide (Li_2O)	0.6
Fluorine (F)	0.6, max
Reducible oxides (Note 3)	0.05, 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.

NOTE 3—Total of arsenic trioxide (As_2O_3), antimony trioxide (Sb_2O_3), and lead oxide (PbO).

5. Physical Requirements

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. Finish and Workmanship

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*—Test Method C338.

7.2 *Annealing Point*—Test Method C336 and Test Method C598.

[1] This specification is under the jurisdiction of ASTM Committee C14 on Glass and Glass Products and is the direct responsibility of Subcommittee C14.04 on Physical and Mechanical Properties.

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[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.

TABLE 1 Physical Requirements

Property	ASTM Test Method[A]	Condition	Value
Softening point	C338	see 7.1	715 ± 10°C
Annealing point	C336 or C598	see 7.2	480 ± 10°C
Thermal expansion coefficient	E228	see 7.3 0 to 300°C	4.65 ± 0.20 ppm/°C
Contraction coefficient	E228	see 7.4 (annealing point minus 15 to 30°C)	5.8 ± 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, °C	Typical Value
Volume resistivity (dc)	D257	25	log *R* (Ω·cm) 17.0
		250	log *R* (Ω·cm) 9.1
		350	log *R* (Ω·cm) 7.3
Dielectric constant (1 MHz)	D150	20	5.0
Dissipation factor (1 MHz)	D150	20	0.0027
Loss index (1 MHz)	D150	20	0.014

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

7.3 *Thermal Expansion Coefficient*— Pretreat the specimen 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 E228.

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 E228.

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 Practice F14, Practice F140, or Practice F144.

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 E29, to the nearest unit in the last right-hand place of figures used in expressing the specified limit.

9. Packaging and Marking

9.1 Packaging 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.

9.2 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.

10. Investigation of Claims

10.1 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.

APPENDIX

(Nonmandatory Information)

X1. ADDITIONAL INFORMATION

X1.1 *Physical Properties*—The physical properties 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.

X1.2 *Typical Values for the Mean Coefficient of Linear Thermal Contraction*—Typical values for the mean coefficient of linear thermal contraction of Type 58 borosilicate 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 7.4) from a point above the maximum temperature shown to 30°C at a rate not exceeding 1.5°C/min.

X1.3 *Compatible Metals and Sealing Alloys* —The thermal expansion characteristics of Type 58 sealing glass are generally satisfactory for sealing to the alloy covered by Specification F15, (nominal composition: 29 % nickel, 17 % cobalt, and 53 % iron).

TABLE X1.1 Physical Properties

Property	Condition	Unit	Value	Tolerance
Density	...	g/cm^3	2.27	±0.02
Refractive index	Sodium D Line	...	1.48	±0.02
Birefringence constant or stress-optical coefficient	...	10^{-12} Pa^{-1}	3.8	±0.2

TABLE X1.2 Typical Contraction Coefficients

Temperature Range, °C	Mean Contraction Coefficient, µm/m° C or ppm/°C
100 to 30	4.5
200 to 30	4.6
300 to 30	4.7
400 to 30	4.9
420 to 30	5.0
450 to 30	5.5
480 to 30	6.2