



Designation: F 14 – 80 (Reapproved 1995)^{ε1}

AMERICAN SOCIETY FOR TESTING AND MATERIALS
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Standard Practice for Making and Testing Reference Glass-Metal Bead-Seal¹

This standard is issued under the fixed designation F 14; 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.

^{ε1} NOTE—Editorial changes were made throughout in November 1995.

1. Scope

1.1 This practice covers procedures for preparing and testing reference glass-to-metal bead-seals for determining the magnitude of thermal expansion (or contraction) mismatch between the glass and metal. Tests are in accordance with method F218 (2).

1.2 This practice applies to all glass-metal combinations, established or experimental, particularly those intended for electronic components.

1.3 The practical limit of the test in devising mismatch is approximately 300 ppm, above which the glass is likely to fracture.

1.4 *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. Referenced Documents

2.1 ASTM Standards:

C 770 Test Method for Measurement of Glass Stress-Optical Coefficient²

F 15 Specification for Iron-Nickel-Cobalt Sealing Alloy³

F 30 Specification for Iron-Nickel Sealing Alloys³

F 31 Specification for 42 % Nickel-6 % Chromium-Iron Sealing Alloy³

F 79 Specification for Type 101 Sealing Glass²

F 105 Specifications for Type 58 Borosilicate Sealing Glass²

F 218 Test Method for Analyzing Stress in Glass³

F 256 Specification for Chromium-Iron Sealing Alloys with 18 or 28 % Chromium³

F 257 Specifications for 28 % Chromium-Iron Alloy for Sealing to Glass⁴

3. Summary of Practice

3.1 Seals of a standard configuration are prepared from a representative sample of each metal and glass to be tested. Each material is prepared by an approved method and sized as specified. The seal is formed, annealed, and measured for optical retardation from which the axial stress and expansion mismatch are calculated. At least two specimens are required from which average values are obtained.

4. Significance and Use

4.1 The term reference as employed in this practice implies that both the glass and the metal of the reference glass-metal seal will be a standard reference material such as those supplied for other physical tests by the National Institute of Standards and Technology, or a secondary reference material whose sealing characteristics have been determined by seals to a standard reference material (see NIST Special Publication 260).⁵ Until standard reference materials for seals are established by the NIST, secondary reference materials may be agreed upon between producer and user.⁶

5. Apparatus

5.1 *Polarimeter*, as specified in Method F 218 for measuring optical retardation and analyzing stress in glass.

5.2 *Heat-Treating and Oxidizing Furnaces*, with suitable controls and with provisions for appropriate atmospheres (Annex A1) for preconditioning metal, if required.

5.3 *Glassworking Lamp or Sealing Furnace*, radiant tube, muffle, or r-f induction with suitable controls and provision for use with inert atmosphere.

5.4 *Annealing Furnace*, with capability of controlled cooling.

5.5 *Ultrasonic Cleaner*, optional.

5.6 *Micrometer Caliper*, with index permitting direct reading of 0.02 cm.

6. Materials

6.1 *Metal*—Representative rod stock with out-of-round not exceeding 1 % shall be selected, preferably with a diameter in

¹ This practice is under the jurisdiction of ASTM Committee C-14 on Glass and Glass Products and is the direct responsibility of Subcommittee C14.04 on Physical and Mechanical Properties.

Current edition approved Nov. 10, 1995. Published January 1996. Originally published as F14 – 61 T. Last previous edition F 14 – 80 (1991)^{ε1}.

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

³ *Annual Book of ASTM Standards*, Vol 10.04.

⁴ Discontinued, see 1973 *Annual Book of ASTM Standards*, Part 6.

⁵ Available from NIST Standard Reference Materials, Gaithersburg, MD 20899.

⁶ Gulati, S. T., and Hagy, H. E., "Expansion Measurement Using Short Cylindrical Seal: Theory and Measurement," *Thermal Expansion 6*, edited by Ian D. Peggs, Plenum, New York, N. Y., 1978, pp. 113–130.