



Standard Practice for

Making Reference Glass-Metal Butt Seals and Testing for Expansion Characteristics by Polarimetric Methods¹

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1. Scope

1.1 This practice covers the preparation and testing of reference glass-metal butt seals of two general configurations: one applicable to determining stress in the glass and the other to determining the degree of mismatch of thermal expansion (or contraction). Tests are in accordance with Test Method **F218** (Section 1.1).

1.2 This practice applies to all glass and metal (or alloy) combinations normally sealed together in the production of electronic components. It should not be attempted with glass-metal combinations having widely divergent thermal expansion (or contraction) properties.

2. Referenced Documents

2.1 ASTM Standards:²

F47 Test Method for Crystallographic Perfection of Silicon by Preferential Etch Techniques (Withdrawn 1998)³

F79 Specification for Type 101 Sealing Glass

F105 Specification for Type 58 Borosilicate Sealing Glass

F218 Test Method for Measuring Optical Retardation and Analyzing Stress in Glass

3. Summary of Practice

3.1 Five seals of a standard configuration are prepared from representative specimens of the glass and metal to be tested. The glass and metal are cleaned, treated, and sized to specified proportions. Plane-interfaced seals are formed, annealed, and measured for residual optical retardation. The stress parallel to the interface in each seal is calculated from the optical

retardation, and the average stress is computed for the sample. For disk-seals the thermal expansion mismatch is calculated.

4. Significance and Use

4.1 The term “reference” as employed in this practice implies that either the glass or 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 for Standards and Technology (NIST), or a secondary reference material whose sealing characteristics have been determined by seals to a standard reference material.⁴ Until standard reference materials for seals are established by the NIST, secondary reference materials may be agreed upon between manufacturer and purchaser.

5. Apparatus

5.1 *Polarimeter*, as specified in Test Method **F218** for measuring optical retardation and analyzing stress in glass.

5.2 *Cut-Off Saw*, with diamond-impregnated wheel and No. 180 grit abrasive blade under flowing coolant for cutting and fine-grinding glass rod.

5.3 *Glass Polisher*, buffing wheel with cerium oxide polishing powder or laboratory-type equipment with fine-grinding and polishing laps.

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

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

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

5.7 *Ultrasonic Cleaner*, optional.

5.8 *Fixture for Furnace Sealing*, designed as suggested in Annex A2.

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

¹ This practice 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.

³ The last approved version of this historical standard is referenced on www.astm.org.

⁴ See NIST SP 260.