



Designation: F18 – 12 (Reapproved 2017)

Standard Specification and Test Method for Evaluation of Glass-to-Metal Headers Used in Electron Devices¹

This standard is issued under the fixed designation F18; 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 and test method cover acceptance requirements for headers used in electron devices and describes procedures for determining conformance to these requirements.

1.2 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.3 The following safety hazard caveat pertains only to the test method (Sections 7 – 13) described in 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.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Terminology

2.1 Definitions of Terms Specific to This Standard:

2.1.1 The header may be described as an external metal member of cylindrical, oval, or other shape into which is sealed one or more wire leads or metal tubulations through a glass medium. The metal parts may be plated or unplated and the glass may be clear or opaque.

3. Significance and Use

3.1 This standard covers procedures for conducting mechanical and vacuum leak tests on glass-to-metal headers and is suitable for quality control and research and development use.

¹ This specification and test method are under the jurisdiction of ASTM Committee F01 on Electronics and are the direct responsibility of Subcommittee F01.03 on Metallic Materials, Wire Bonding, and Flip Chip.

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3.2 This standard is suitable for assessing both the quality of materials as well as the manufacturing techniques used.

4. Acceptance Requirements

4.1 The headers shall conform to the requirements as specified in 4.1.1 and 4.1.2 when tested in accordance with the prescribed methods of test (Sections 5 – 13).

4.1.1 Visual:

4.1.1.1 Cracks around the lead shall be restricted axially and radially to one lead diameter. Specimens showing any other type of crack shall be rejected.

4.1.1.2 The glass shall be free of inclusions exceeding one half of the smallest lead diameter. Gas bubbles entirely enclosed by glass are permissible up to a diameter not exceeding that of the smallest lead.

4.1.1.3 Metallic parts shall be as free of draw lines or grooves longer (by visual estimate) than one half of the seal length as best commercial practice will permit.

4.1.1.4 In the case of clear glass seals, reference is made to the seal area only.

4.1.1.5 In the case of opaque glass seals, reference is made to any portion of the exposed metal parts.

4.1.2 Leak:

4.1.2.1 With the header sealed to the mass spectrometer leak detector, the number of detectable leaks in a sample lot shall be less than the limit agreed upon between the purchaser and the seller.

TEST METHODS

5. Apparatus

5.1 *Microscope*, of 10 power magnification, unless otherwise specified, in combination with suitable incandescent white light source.

5.2 *Mass Spectrometer Leak Detector*, adjusted to respond to a tracer gas such as helium and capable of detecting leaks of 10^{-9} mL/s at standard temperature and pressure.

5.3 *Hood*, having a volume of approximately 250 cm^3 ($2.5 \times 10^{-4} \text{ m}^3$), to cover the test specimen completely with the tracer gas. (The hood should be flushed with the tracer gas for at least 10 s).

5.4 *Fixture*, suitable for making a seal between the header under test and the leak detector. A suggested jig is shown in Fig. 1.

5.5 *Bath*, two constant temperature water baths, and an immersion bath maintained at a temperature of -80°C to -70°C .

5.6 *Torque Fixture*, capable of holding the header in a fixed position and capable of rotating a lead about its axis.

5.7 *Bending Fixture*, capable of rotating the header through an arc of $90, +0 - 5^{\circ}$, about an axis of the lead under test and through the exit point of the lead from the glass. A weight is attached to the lead at a point close to the extremity.

5.8 *Megohmmeter*, for testing electric insulation.

5.9 *Furnace*, capable of heating parts to a temperature of 450°C maximum.

5.10 *Lead Pull Tester*, capable of holding the header in a fixed position while applying a load along the axis of the lead in a direction perpendicular to the plane containing the rim of the header. The displacement of one constraining member of the tester shall increase at a constant rate with respect to the second constraining member of the tester.

6. Conditions of Test

6.1 Tests shall be made in the order indicated in Sections 7 – 13, and on individual specimens unless otherwise specified. Each test shall be performed with the apparatus described in the corresponding paragraph of Section 5. Tests on leads shall be made on portion of the lead external to the finished device

unless otherwise specified. Lead dimensions referred to are nominal dimensions agreed upon between the purchaser and the seller.

7. Thermal Shock

7.1 With the header at room temperature immerse it in water held at 98°C , minimum, for 1 min; and quench in water at 1°C , maximum, for 1 min. The volume of the water bath shall be large enough to prevent appreciable change in temperature upon immersion of the header. Repeat this cycle 6 times. Then bake the header in the furnace at $100 \pm 5^{\circ}\text{C}$ and under a vacuum of less than 10^{-3} torr (1.33×10^{-4} kPa) for a minimum of 12 h. The headers shall conform to the requirements specified in 4.1.

8. Torque

8.1 *Leads Less than 0.021 in. (0.53 mm) in Diameter*—Clamp the lead to be tested between 2 and 4 diameters away from the glass. With the header fixed, rotate the lead through $1080 \pm 30^{\circ}$ (3 complete revolutions) about its own axis at a uniform rate of 10 to 20 r/min. After completion of the test, the header shall conform to the requirements specified in 4.1.

8.2 *Leads or Terminals Greater than 0.021 in. (0.53 mm) in Diameter*—To the outer portion of the terminal at a point between 2 and 4 terminal diameters away from the glass, slowly apply a torque of at least 250 lbf-in./($\text{in. of lead diameter}$)² or $(0.0438 \text{ N}\cdot\text{m}/(\text{mm of lead diameter})^2)$ as calculated using the nomograph shown in Fig. 2. The header shall conform to the requirement specified in 4.1.

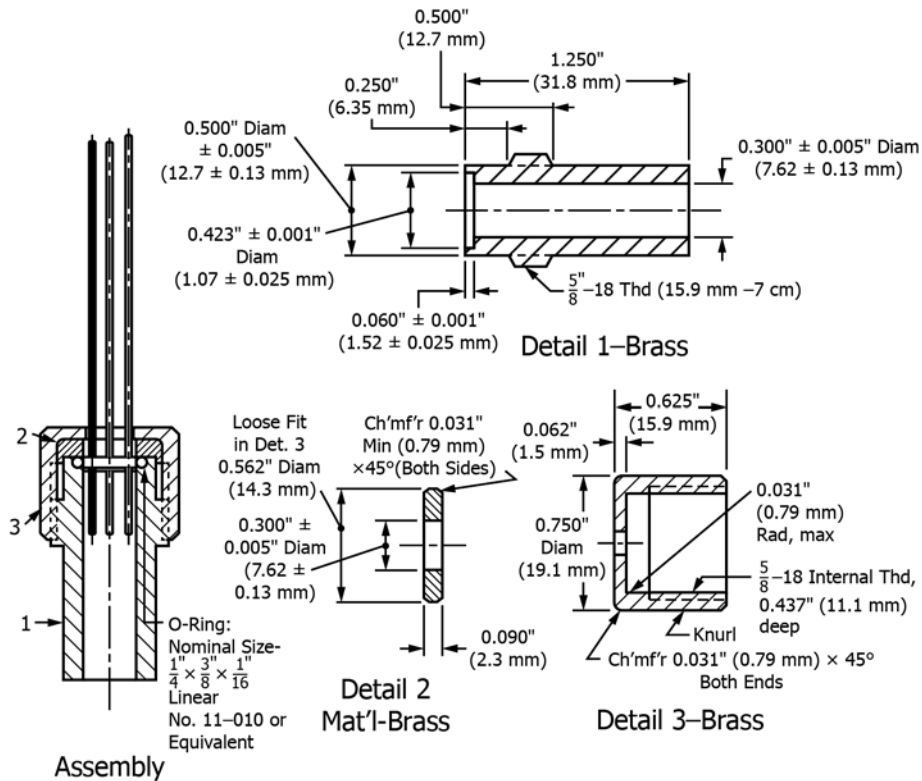
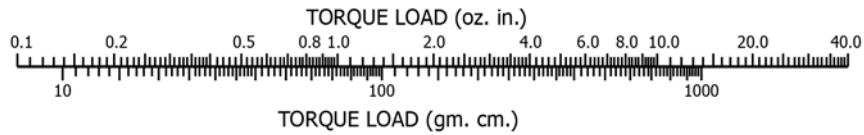


FIG. 1 Fixture for Making a Seal Between the Header Under Test and the Leak Detector



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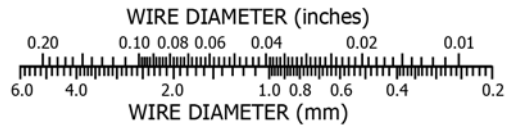


FIG. 2 Nomograph of Torque Loads for Various Wire Diameters

9. Lead Fatigue

9.1 Attach to the flexible lead a weight computed from the following equations: For Fe-Ni-Co, Dumet, and Ni-Fe alloys (Fig. 3):

$$55,000 \times (\text{diameter of lead in in.})^2 = \text{oz}$$

or

$$2.4 \times (\text{diameter of lead in mm})^2 = \text{kg}$$

For Fe-Ni-Co clad copper (Fig. 4):

$$23,000 \times (\text{diameter of lead in in.})^2 = \text{oz}$$

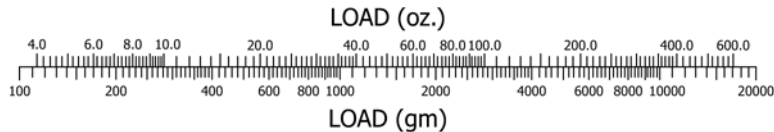
or

$$1.2 \times (\text{diameter of lead in mm})^2 = \text{kg}$$

The weighted lead shall be capable of being bent through 5 cycles at a rate of 15 to 20 cycles per minute without breaking. One cycle consists of a rotation of the header from $0 \pm 5^\circ$ (from the normal position) to $90 + 0 - 5^\circ$ and returning to $0 \pm 5^\circ$.

10. Electrical Leakage

10.1 The d-c resistance as measured between any two metal members shall be greater than 1000 MΩ. Perform this measurement at a temperature of $25 \pm 5^\circ\text{C}$ and a relative humidity of $45 \pm 10\%$. Apply a voltage of at least 500 V dc. The method of cleaning the headers prior to this test shall be as agreed upon by the purchaser and the seller.



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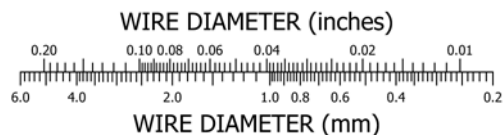


FIG. 3 Nomograph of Weights for Lead Fatigue Test of Fe-Ni-Co, Dumet, and Ni-Fe Alloys



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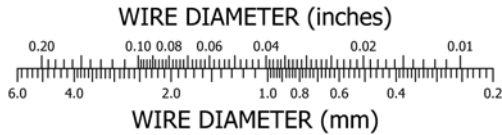


FIG. 4 Nomograph of Weights for Lead Fatigue Test of Fe-Ni-Co Clad Copper Wire

11. Simulated Thermal Welding Shock

11.1 Quench the header in water at + 2°C, maximum, from a temperature of 400 ± 10°C for matched seals and 285 ± 10°C for compression seals. Seals should reach thermal equilibrium at the elevated temperature before quenching. Then bake the header at 100 ± 5°C and under a vacuum less than 10⁻³ torr (1.33 × 10⁻⁴ kPa) for a minimum of 12 h. The header shall then conform to the requirement specified in 4.1.

12. Transformation

12.1 For matched seals, wrap two layers of tissue paper around the header to minimize thermal shock, and immerse the header into a low-temperature bath maintained between - 80°C and - 70°C for a minimum period of 1 h. Upon return to room temperature, the header shall show no evidence of transformation and shall conform to the requirements specified in 4.1.

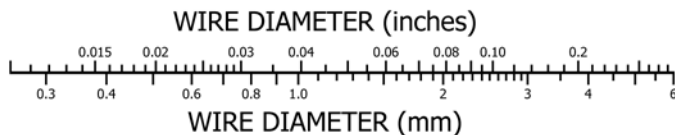
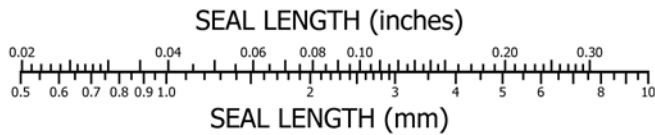


FIG. 5 Nomograph of Pull Test Loads for Various Wire Diameters and Seal Areas

13. Pull Test

13.1 Subject the leads to an axial pull (or push), with a force, as shown in Fig. 5, of at least 2800 psi (19.3 MPa) of sealed area on the pulled lead (Note 1). After the pull test the header shall show no evidence of leaks and shall conform to the requirements specified in 4.1.

NOTE 1—The sealed area of the pulled lead can be determined as follows:

$$A = \pi DL$$

where:

- A = sealed area of the pulled lead,
- D = diameter of the lead, and
- L = length of the glass-to-metal interface on the lead, excluding the menisci.

14. Report

14.1 The report shall include the results of all tests and their conformance with the specified requirements.

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15. Precision and Bias

15.1 *Precision*—It is not possible to specify the precision of the test methods contained in Standard F18 for Evaluation of Glass-to-Metal Headers Used in Electron Devices since inter-laboratory studies utilizing these methods have not been conducted.

15.2 *Bias*—No information can be presented on the bias of the procedures in Standard F18 for Evaluation of Glass-to-Metal Headers Used in Electron Devices because no specimens having an accepted reference value (traceable to a national standards laboratory) are available.

16. Keywords

16.1 electrical testing; glass to metal sealing; mechanical test methods