SEMATECH Provisional Test Method for Leak Testing Tube Fitting Connections Used in UPW Distribution Systems
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Abstract: This test method provides an immersion leak test method applicable to tube fitting connections used in UPW distribution systems. It is intended for testing the integrity of the fitting connection with no externally applied load. It is applicable to tube fitting connections in which all parts in contact with the media are constructed of plastic materials. This document is in development as an industry standard by Semiconductor Equipment and Materials International (SEMI). When available, adherence to the SEMI standard is recommended.

Keywords:

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1. Introduction

1.1 Purpose—The purpose of this test method is to determine the sealing capability of off-the-shelf components containing tube fitting connections.

1.2 Scope

1.2.1 This method is applicable to tube fitting connections in which all parts in contact with the media are constructed of plastic materials. Nonwetted components, such as a nut or gripper, are not limited to a plastic material.

1.2.2 Only the seal between the tube and tube fitting connection is being evaluated within the scope of this document. All other seals are beyond the scope of this document.

1.2.3 When using this method for making comparisons between various tube and fitting manufacturers, the selected components must conform to the manufacturer's specifications for dimensional and material compatibility.

1.3 Limitations—This method is intended only for new components to be used in UPW without oxidants.

2. Referenced Documents

2.1 ASTM Standards

ASTM E479 Guide for Preparation of a Leak Testing Specification
ASTM E432 Guide for Selection of a Leak Testing Method
ASTM E515 Standard Test for Leaks Using Bubble Emission Techniques
ASTM D5127 Standard Guide for Electronic Grade Water

3. Definitions

3.1 excessive leakage—air leakage greater than 100 bubbles per minute from the fitting connection.

3.2 low surface tension liquid—liquid with a surface tension of less than 28 dynes per centimeter.

3.3 pressure-containing envelope—the internal area of a specimen that contains the media.

3.4 seal cap—an end closure or plug used to block the open end of a tube or fitting to allow a test specimen to be pressurized with air.

3.5 submersion tank—a transparent tank filled with a low surface tension fluid at 23 ± 3°C used for observing external leakage of air from the tube fitting connection.

3.6 *ultrapure water (UPW)—type E-1 electronic grade water as defined in ASTM D5127.*

4. **Summary of Test Method**

The specimen is submerged in a low surface tension liquid, and the pressure-containing envelope of the specimen is subjected to the manufacturer's maximum rated pressure. The fitting connection is observed for leakage while the specimen is submerged.

5. **Significance and Use**

5.1 This test method is designed to evaluate the sealing capability of the tube fitting connection when the pressure-containing envelope is subjected to pressure.

5.2 The results obtained by this method are applicable only to conditions that specifically duplicate the procedure used within this document.

5.3 This method can be used to evaluate tube fitting connections on the basis of test data obtained under the conditions described herein, but the results are not intended to imply a performance rating.

5.4 When using this method, it is assumed that the test specimens are truly representative of the material and manufacturing process specified for that product. Departure from this assumption could introduce discrepancies that are greater than those introduced by departure from the details of the procedure outlined in this method.

6. **Apparatus**

6.1 *Air Source.* Use an oil-free air source capable of achieving maximum rated pressure of the components to be tested.

6.2 *Pressure Monitor.* Provide an instrument to monitor pressure within ± 1% of full scale.

6.3 *Submersion Tank.* Provide a transparent submersion tank for observing leakage. The tank must be capable of holding enough fluid to allow the specimen to be submerged 25 ± 5 mm (1 ± 0.2 in.) at a minimum below the fluid surface at a 45 ± 5° angle. (See Figure 1 for the basic test setup.) A transparent cover or lid that does not create an airtight seal is recommended while the specimen is subjected to pressure.

7. **Materials**

7.1 *Air Source,* oil-free.

7.2 *Test Media,* a low surface tension liquid.

8. **Precautions**

8.1 *Safety Precautions*

8.1.1 This test method may involve hazardous materials, operations, and equipment. This test method does not purport to address the safety considerations associated with its use. It is the responsibility of the user to establish appropriate safety and health practices and to determine the applicability of regulatory limitations before using this method.

8.1.2 If a flammable immersion liquid is used, nitrogen or an inert gas must also be used.
8.1.3 Warning: This method may subject test specimens to the maximum performance rating of the products under evaluation. Adequate precautions must be taken to prevent injury to the person conducting the test.

8.1.4 The use of flammable and combustible liquids requires extreme caution. The addition of any energy source (e.g., sparks, flame, or compressed air) in or around open containers or vessels that contain flammable or combustible liquids is potentially dangerous. Conditions of use must fully mitigate the hazards. Consult local, state, and federal regulations for specific requirements.

9. Sampling and Test Specimens

9.1 Assembly—Specimens are to be assembled in accordance with the manufacturer's recommended assembly procedures.

9.2 Sample size—A minimum of three specimens shall be tested.

9.3 Specimen tubing length—A minimum of 150 mm (6 inches) is required.

9.4 Specimen surface—All surfaces of the specimens shall be free of visible flaws, scratches, or other imperfections, unless such imperfections are typically found on a representative sample of the product.

10. Conditioning

10.1 When conducting the test, maintain the ambient temperature at 23 ± 3°C (73 ± 5°F).

10.2 All specimens must be conditioned for a minimum of one hour in an air environment of 23 ± 3°C (73 ± 5°F) before being subjected to the test.

[Note: Unless the specimen undergoes a change in temperature during assembly (e.g., fusion or flaring), the condition may be satisfied by the length of the time the specimen has been stored at ambient conditions.]

11. Preparation of Apparatus

See Figure 1 for a schematic of the basic test system.

12. Procedure

12.1 Assemble the fitting and tube in accordance with the manufacturer's specifications. The tube length shall meet the specified value of Section 9.3 and be conditioned per Section 10.2. A seal cap shall also be attached to the test fitting. This will allow the specimen to be pressurized.

12.2 Submerge the specimen per Figure 1, and subject the specimen to the manufacturer's maximum rated pressure. Observe the fitting connection for leakage for a minimum of one minute. Record the leakage as bubbles per minute on the test data sheet.

12.2.1 If excessive leakage occurs (greater than 100 bubbles per minute), record the information as excessive leakage on the test data sheet.

12.2.2 Leakage from the seal cap is beyond the scope of this document and need not be measured or recorded.
12.3 Release the pressure in the specimen and disconnect the specimen from the test assembly.

12.4 Repeat 12.1 through 12.3 for the remaining two specimens.

13. **Data Presentation**

Include the following information on the test data sheet:

13.1 *Date Tested.*

13.2 *Operator and Test Facility.*

13.3 *Description of Items Tested,* including but not limited to:

- Tube—Manufacturer, O.D., wall thickness, part number, and material type
- Fitting—Manufacturer, type, size, part number, and material type

13.4 *Test Liquid.*

14. **Precision and Bias**

14.1 The precision of the procedure in SEMASPEC #92010947B–STD for determining the sealing capability of tube fitting connections from off-the-shelf components for UPW distribution systems is being determined.

14.2 Bias of the procedure in SEMASPEC #92010947B–STD for determining the sealing capability of tube fitting connections from off-the-shelf components for UPW distribution systems is being determined.

15. **Illustrations**

![Figure 1  Schematic of Basic Test System](image)
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