

SEMI F69-1213^E

I TEST METHOD FOR TRANSPORT AND SHOCK TESTING OF GAS DELIVERY SYSTEMS

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^E This Standard was editorially modified in October 2017. A change was made to correct a nonconforming title per the *Procedure Manual*, Appendix 4.

1 Purpose

1.1 This Document provides test methods for qualifying the mechanical integrity of gas delivery systems through vibration and shock testing.

2 Scope

2.1 The test methods recommended herein provide for vibration (transport simulation) and shock testing of gas delivery systems (including conventional and surface-mount) for semiconductor processing.

2.2 The test methods recommended herein apply to gas delivery systems not crated or packaged for shipment. Specifically, the test methods are to be applied to the assembled and interconnected gas delivery components and their associated mounting panel (backplane), with or without a sheet metal enclosure.

2.3 For the purpose of this Guideline, transportation vibration, and its simulation, are expectedly more severe than in-use vibrational levels. Thus the transportation simulation test is considered acceptable to assess mechanical integrity adequate for both shipment and life-cycle vibrational stress of the gas delivery systems.

2.4 The intent of the shock test is to provide further assessment of equipment malfunction that may result from shocks experienced during unpacking, installation, or use in the field.

2.5 Successful completion of the tests recommended herein is a recommended metric of mechanical integrity for gas delivery systems architecture, design, and assembly techniques.

NOTICE: SEMI Standards and Safety Guidelines do not purport to address all safety issues associated with their use. It is the responsibility of the users of the Documents to establish appropriate safety and health practices, and determine the applicability of regulatory or other limitations prior to use.

3 Limitations

3.1 This Document, as a guide, does not provide detailed information sufficient for conducting the tests. It is the responsibility of the user and testing entity to procure a copy of the referenced test procedures from the issuing organization(s).

3.2 The test methods recommended herein are intended to evaluate gas delivery systems architectures, design principles, and assembly methodologies, not individual production gas delivery systems.

3.3 The functional components of gas delivery systems, for example mass flow controllers and pressure transducers, may be adversely affected by the forces seen during these tests. Such components may require recalibration after testing.

4 Referenced Standards and Documents

4.1 *SEMI Standards and Safety Guidelines*

SEMI F1 — Specification for Leak Integrity of High-Purity Gas Piping Systems and Components

4.2 United States Military Standard¹

MIL-STD-810G — Environmental Engineering Considerations and Laboratory Tests; § 514.6 (Vibration) and § 516.6 (Shock)

NOTICE: Unless otherwise indicated, all documents cited shall be the latest published versions.

5 Terminology

5.1 Definitions

5.1.1 *bag leak test* — a helium leak testing procedure in which the system undergoing leak test is placed in a helium-filled plastic bag while connected to a functional helium leak detector.

5.1.2 *g* — a unit of force equal to that exerted by gravity upon a mass in equilibrium on the earth's surface. Expressed in Newtons (kg-m/sec.²).

5.1.3 *leak tight* — having a helium leak rate no greater than that specified by the customer or end-user.

6 Vibration Testing

NOTE 1: Vibration testing should be performed in its entirety before continuing to the shock testing.

6.1 In general, conduct vibrational testing according to MIL-STD-810G, § 514.6, Procedure 1, Category 4- truck-restrained cargo, applying highest acceleration level for 3 hours in each axis (a total of 9 hours). This will subject the gas delivery systems to the equivalent physical stress of a 4828 kilometer (3000 mile) motor freight shipment over improved or paved highways. Because vibration tables are commonly single-axis devices, the gas delivery systems will be subjected to single-axis random vibrational frequencies in the range of 5–500 Hz, sequentially, in each of its three axes.

6.2 Prior to initiating the test, examine the gas delivery systems for physical defects and document the results.

6.3 Prior to initiating the test, thoroughly prepare the gas delivery systems for testing. This includes, but is not limited to, insuring all fasteners and sealing mechanisms are tightened to manufacturers' or design specifications.

6.4 Prior to initiating the test at the test site, make certain that the gas delivery system is leak tight using inboard test procedures per SEMI F1.

6.5 The MIL-STD-810G transportation test recommended herein provides for different acceleration levels for each of the 3 axes of the device under test. Because the majority of gas delivery systems are shipped in a vertical orientation, this convention is maintained for the purpose of the transportation simulation tests. Thus the vertical orientation would have the gas delivery system mounted vertically with respect to the vibration table top (see Figure 2), the longitudinal orientation would have the gas delivery system mounted flat to the vibration table top (see Figure 1), and the transverse orientation would have the gas delivery system mounted on its side, against the vibration table top (see Figure 3). Note that the terms 'vertical,' 'longitudinal,' and 'transverse,' are contextual to motor freight transport, and receive different acceleration levels, within MIL-STD-810G. A simplified and conservative approach to applying MIL-STD-810G involves applying the highest acceleration level, associated with the vertical axis, to all three orientations as illustrated in Figures 1 through 3.

6.6 Mount the gas delivery system, in any of its untested axes, securely to the vibration table. See Figures 1 through 3.

6.7 Initiate and run for 3 hours the vibration test corresponding to the orientation of the gas delivery system.

6.8 At the conclusion of the test, examine the gas panel for physical defects and document the results.

6.9 At the conclusion of the test, leak test the gas delivery system using inboard leak procedures per SEMI F1. Alternatively, by agreement with the customer, all leak testing may be withheld until completion of all shock and vibration testing. This presumes specific failure mode information is not required.

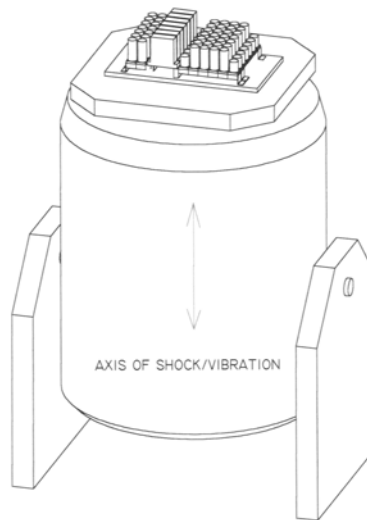
6.10 Repeat ¶¶ 6.6 through 6.9 until all 3 axes are tested.

¹ United States Military Standards, Available through the Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120-5099, USA; Telephone: +1.215.697.3321.

6.11 The post-test report should include, at minimum, the following:

1. Pre-test examination results.
2. Pre-test leak rates.
3. Summary and chronology of test events, test interruptions, and test failures.
4. All vibration measurement data.
5. Post-test examination results.
6. Post-test leak rates.

(See Tables A1-1 and A1-2 in Appendix 1 for a sample data format)



#1 Plane of gas sticks is parallel to shock/vibe table and transverse to test input.

Figure 1
Horizontal Orientation