Designation: E1603/E1603M – 11 (Reapproved 2022)

Standard Practice for Leakage Measurement Using the Mass Spectrometer Leak Detector or Residual Gas Analyzer in the Hood Mode[1]

This standard is issued under the fixed designation E1603/E1603M; 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 practice covers procedures for testing the sources of gas leaking at the rate of 1×10^{-8} Pa m^3/s (1×10^{-9} standard-cm^3/s at 0 °C) or greater. These test methods may be conducted on any object that can be evacuated and to the other side of which helium or other tracer gas may be applied. The object must be structurally capable of being evacuated to pressures of 0.1 Pa (approximately 10^{-3} torr).

1.2 Three test methods are described;

1.2.1 *Test Method A*—For the object under test capable of being evacuated, but having no inherent pumping capability.

1.2.2 *Test Method B*—For the object under test with integral pumping capability.

1.2.3 *Test Method C*—For the object under test as in Test Method B, in which the vacuum pumps of the object under test replace those normally used in the leak detector (LD).

1.3 *Units*—The values stated in either SI or std-cc/sec units are to be regarded separately as standard. The values stated in each system may not be exact equivalents: therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *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. Referenced Documents

2.1 *ASTM Standards:*[2]

E1316 Terminology for Nondestructive Examinations

2.2 *ASNT Standards:*[3]

SNT-TC-1A Recommended Practice for Personnel Qualification and Certification in Nondestructive Testing

ANSI/ASNT-CP-189 Standard for Qualification and Certification of Nondestructive Testing Personnel

2.3 *Military Standard:*[4]

MIL-STD-410 Nondestructive Testing Personnel Qualification and Certification

2.4 *AIA Standard:*[5]

NAS-410 Certification and Qualification of Nondestructive Test Personnel

3. Terminology

3.1 *Definitions*—For definitions of terms used in this practice, see Terminology E1316.

4. Summary of Practice

4.1 These test methods covered in this practice require a helium LD that can provide a system sensitivity of 10 % or less of the intended leakage rate to be measured.

4.2 *Test Method A*—This test method is used to helium leak test objects that are capable of being evacuated to a reasonable test pressure by the LD pumps during an acceptable length of time (see Fig. 1). This requires that the object be clean and dry. Auxiliary vacuum pumps having greater capacity than those in the LD may be used in conjunction with them. The leak test sensitivity will be reduced under these conditions.

[1] This practice is under the jurisdiction of ASTM Committee E07 on Nondestructive Testing and is the direct responsibility of Subcommittee E07.08 on Leak Testing Method.

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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] Available from American Society for Nondestructive Testing (ASNT), P.O. Box 28518, 1711 Arlingate Ln., Columbus, OH 43228-0518, http://www.asnt.org.

[4] Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, http://dodssp.daps.dla.mil.

[5] Available from Aerospace Industries Association of America, Inc. (AIA), 1000 Wilson Blvd., Suite 1700, Arlington, VA 22209-3928, http://www.aia-aerospace.org.

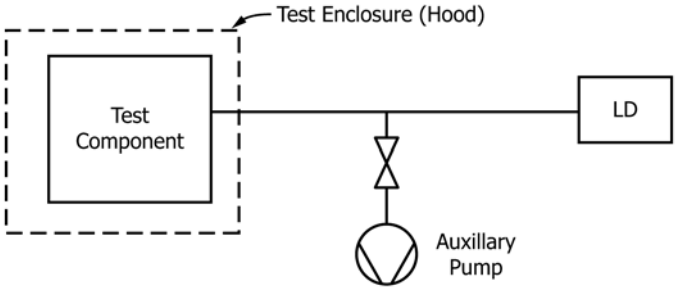

FIG. 1 Test Method A

4.3 *Test Method B*—This test method is used to leak test equipment that can provide its own vacuum (that is, equipment that has a built-in pumping system) at least to a level of a few hundred pascals (a few torr) or lower. Refer to Fig. 2.

4.4 *Test Method C*—When a vacuum system is capable of producing internal pressures of less than 2×10^{-2} Pa (2×10^{-4} torr) in the presence of leaks, these leaks may be located and evaluated by the use of either a residual gas analyzer (RGA) or by using the spectrometer tube and controls from a conventional MSLD, provided that the leakage is within the sensitivity range of the RGA or MSLD under the conditions existing in the vacuum system. Refer to Fig. 3.

5. Significance and Use

5.1 *Test Method A*—This test method is the most frequently used in leak testing components. Testing of components is correlated to a standard leak, and the actual leak rate is measured. Acceptance is based on the maximum system allowable leakage. For most production needs, acceptance is based on acceptance of parts leaking less than an established leakage rate, which will ensure safe performance over the projected life of the component. Care must be exercised to ensure that large systems are calibrated with the standard leak located at a representative place on the test volume. As the volume tends to be large (>1 m^3) and there are often low conductance paths involved, a check of the response time as well as system sensitivity should be made.

5.2 *Test Method B*—This test method is used for testing vacuum systems either as a step in the final test of a new system or as a maintenance practice on equipment used for manufacturing, environmental test, or conditioning parts. As

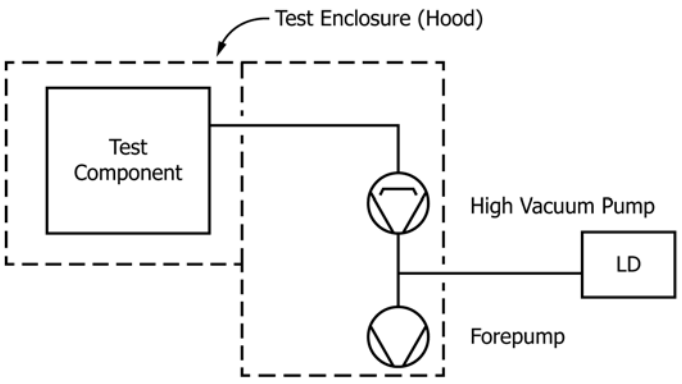

FIG. 2 Test Method B

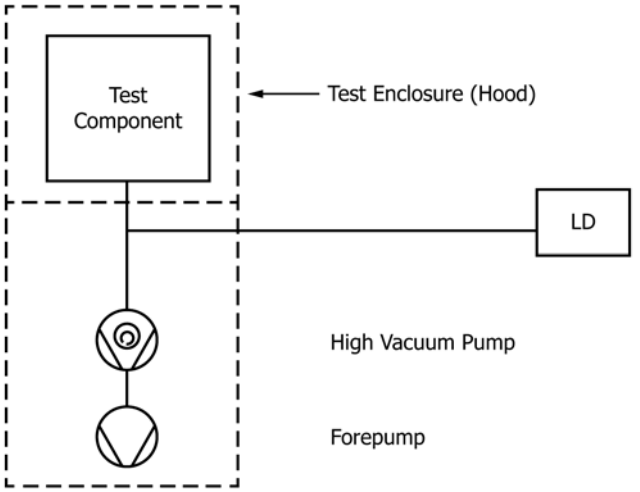

FIG. 3 Test Method C

with Test Method A, the response time and a system sensitivity check may be required for large volumes.

5.3 *Test Method C*—This test method is to be used only when there is no convenient method of connecting the LD to the outlet of the high-vacuum pump. If a helium LD is used and the high-vacuum pump is an ion pump or cryopump, leak testing is best accomplished during the roughing cycle, as these pumps leave a relatively high percentage of helium in the high-vacuum chamber. This will limit the maximum sensitivity that can be obtained.

6. Basis of Application

6.1 *Personnel Qualification*—If specified in the contractual agreement, personnel performing examinations to these test methods shall be qualified in accordance with a nationally recognized NDT personnel qualification practice or standard, such as ANSI/ASNT-CP-189, SNT-TC-1A, MIL-STD-410, NAS-410, or a similar document and certified by the employer or certifying agency, as applicable. The practice or standard used and its applicable revision shall be identified in the contractual agreement between the using parties.

7. Interferences

7.1 Series leaks with an unpumped volume between them present a difficult if not impossible problem in helium leak testing. Although the trace gas enters the first leak readily enough since the pressure difference of helium across the first leak is approximately one atmosphere, it may take many hours to build up the partial pressure of helium in the volume between the two leaks so that enough helium enters the vacuum system to be detected by the LD. This type of leak occurs frequently under the following conditions:

7.1.1 Double-welded joints and lap welds,
7.1.2 Double O-rings,
7.1.3 Threaded joints,
7.1.4 Ferrule and flange-type tubing fittings,
7.1.5 Casting with internal voids,
7.1.6 Flat polymer gaskets, and
7.1.7 Unvented O-ring grooves.