Designation: E432 – 91 (Reapproved 2022)

Standard Guide for Selection of a Leak Testing Method[1]

This standard is issued under the fixed designation E432; 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 guide[2] is intended to assist in the selection of a leak testing method.[3] Fig. 1 is supplied as a simplified guide.

1.2 The type of item to be tested or the test system and the method considered for either leak measurement or location are related in the order of increasing sensitivity.

1.3 *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.*

1.4 *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. Referenced Documents

2.1 *ASTM Standards:*

E1316 Terminology for Nondestructive Examinations

3. Terminology

3.1 *Definitions*—The definitions of terms relating to leak testing which appear in Terminology E1316 shall apply to the terms in this guide.

4. Selection of System

4.1 The correct choice of a leak testing method optimizes sensitivity, cost, and reliability of the test. One approach is to rank the various methods according to test system sensitivity.

4.2 The various testing methods must be individually examined to determine their suitability for the particular system being tested. Only then can the appropriate method be chosen. For example, radioactive gases are not generally employed as a tracer for leak location because of the hazards associated with their use. However, such gases are employed in leakage detection equipment when they can be safely added to, and removed from, a test chamber on a periodic basis.

4.3 It is important to distinguish between the sensitivity associated with the instrument employed to measure leakage and the sensitivity of the test system followed using the instrument. The sensitivity of the instrument influences the sensitivity that can be attained in a specific test. The range of temperatures or pressures, and the types of fluids involved, influence both the choice of instrument and the test system.

4.4 The sensitivity of various test systems differ. For example, a test utilizing a mass spectrometer leak detector normally has an ultimate sensitivity of 4.4×10^{-15} mol/s when the procedure involves the measurement of a steady-state gas leakage rate. The sensitivity of the test may be increased under special conditions to 4.4×10^{-19} mol/s by allowing an accumulation of the leakage to occur in a known volume before a measurement of leakage is made. In the first case, the sensitivity of the test equals the sensitivity of the instrument; whereas in the second case, the sensitivity of the test is 10^4 times greater than that of the instrument. If the test system utilizes a mass spectrometer operating in the detector-probe mode, the sensitivity of the test can be 10^2 to 10^4 smaller than that of the mass spectrometer itself.

5. Leakage Measurement

5.1 In general, leakage measurement procedures involve covering the whole of the suspected region with tracer gas, while establishing a pressure differential across the system by either pressurizing with a tracer gas or by evacuating the opposite side. The presence and concentration of tracer gas on the lower pressure side of the system are determined and then measured.

5.2 A dynamic test method can be performed in the shortest time. While static techniques increase the test sensitivity, the time for testing is also increased.

5.3 Equipment or devices that are the object of leakage measurement fall into two categories: (*1*) open units, which are

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

Current edition approved June 1, 2022. Published July 2022. Originally approved in 1971. Last previous edition approved in 2017 as E432 – 91(2017)$^{\varepsilon 1}$. DOI: 10.1520/E0432-91R22.

[2] For ASME Boiler and Pressure Vessel Code applications, see related Recommended Guide SE-432 in the Code.

[3] Additional information may be obtained from Marr, J. W., *Leakage Testing Handbook*, Report No. CR-952, NASA, Scientific and Technical Information Facility, P. O. Box 33, College Park, MD 20740 (Organizations registered with NASA) or Clearing House for Federal, Scientific and Technical Information, Code 410.14, Port Royal Road, Springfield, VA 22151.

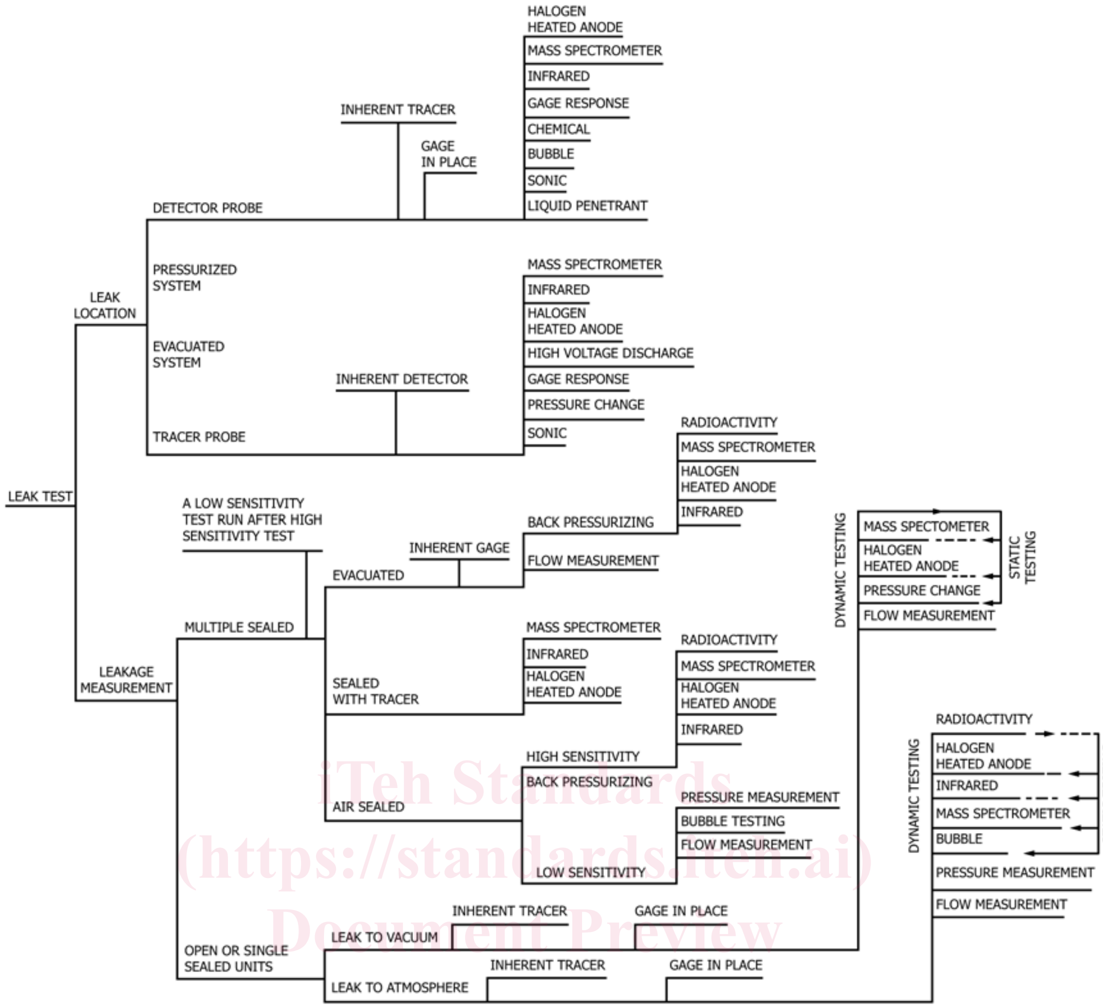

FIG. 1 Guide for Selection of Leakage Testing Method

accessible on both sides, and (*2*) units that are sealed. The second category is usually applied to mass-produced items including gas and vacuum tubes, transistors, integrated circuit modules, relays, ordnance units, and hermetically sealed instruments.

5.3.1 *Open or Single-Sealed Units*—Either evacuation or pressurization of one side of a unit that is accessible on both sides, may be employed to test for leakage across a unit.

5.3.1.1 *Systems Leaking to Vacuum*—In the order of increasing sensitivity for testing an evacuated system, the methods include: flow measurement, absolute pressure measurement, the alkaline-ion diode halogen detector, and the helium mass spectrometer leak detector.

(a) The first approach to the testing of units that may be evacuated is to determine if there is an inherent tracer in the system. This gas should be utilized if possible.

(b) When one side is evacuated, leakage of the tracer into the vacuum will reach the detector quickly if there is essentially no stratification. However, evacuation does not always allow the most sensitive and reliable measurement. If the evacuated region is extremely large, high pumping speeds will be required and the leakage gas will tend to follow streamlines to the pump port. The amount of tracer gas that reaches the detector may then be substantially reduced depending on the location of the detector in the evacuated region.

(c) When no inherent tracer is available, the next approach should be to determine if there is a gage in the system that might be used for leakage measurement. This gage might be an ionization gage or, in some fortunate circumstances, a mass spectrometer in the system as part of the analytical instrumentation. Consideration should be given not only to gages that are normally used for leak detection, but to any gas concentration detection equipment that may be used for leakage measurement if it happens to be available. Equipment not originally intended for pressure measurement may be used; for example, it is possible to detect the pressure rise in a leaking vacuum tube by operating the grid at a positive and an anode at a negative potential, and noting an increase in anode current with time.

(d) When there is no inherent tracer or gage within the system, a standard testing method must be chosen based on the sensitivity desired.

5.3.1.2 *Systems Leaking to Atmosphere*—The choice of a testing method for systems leaking to atmospheric pressure should be made in the same manner as suggested for evacuated