ONEIDA RESEARCH SERVICES, INC.
INSPECTION • ANALYSIS • TESTING

Ultra-High Advanced Leak Detection with the HSHLD® Model 310

Executive Summary


HSHLD® Model-310

The **HSHLD® Model 310** by Oneida Research Services (ORS) represents a breakthrough in high-sensitivity helium leak detection. Designed to meet and exceed the stringent requirements of **Mil-Std-883, Method 1014**, this Quadrupole Mass Spectrometer system offers unmatched precision, automation, and flexibility for both fine and gross leak testing. With its dual-point calibration and modular design, the Model 310 sets a new benchmark for reliability, affordability, and ease of use in leak rate qualification.

1. Introduction

Leak detection is critical in ensuring the integrity and longevity of hermetically sealed devices across industries such as aerospace, medical, automotive, and electronics. Traditional helium leak detectors often fall short in sensitivity, calibration accuracy, and adaptability. The **HSHLD® Model 310** addresses these limitations with a robust, user-friendly system that delivers consistent, traceable results.

Technical Overview

Key Features

- **Dual-Point Calibration**: Automatically calibrates using two leak rate standards (as low as 1×10^{-11} atm-cc/sec), ensuring accurate R1 measurements within the instrument's linear range.
- **Full Mass Range Spectrometer**: Covers 1–100 amu (expandable to 300 amu), enabling detection of helium and other gases including oxygen, argon, nitrogen, DME, and SF_6.
- **Automated Testing**: Fast cycle times (2–5 minutes) and intuitive software interface reduce operator error and increase throughput.
- **Dry Gross Leak Capability**: Eliminates the need for FC-72 fluids, reducing operational costs and environmental impact.

- **Fine & Gross leak**: HSHLD® Model 310 can perform both the fine and gross leak test in a single test sequence.

2. Fine & Gross leak tests in single test sequence

The HSHLD® Model 310 performs both fine and gross leak detection in a single test sequence by continuously monitoring chamber pressure over time.

To begin, a reference pressure-time curve is established using a solid object with external dimensions similar to the test package. Once placed in the HSHLD® chamber, pumping starts, and the resulting pressure-time profile serves as the baseline for comparison.

Next, the actual test package is inserted into the chamber. Under identical conditions, a new pressure-time curve is generated and overlaid on the reference. Comparing the two curves reveals any deviations indicative of gross leaks.

As illustrated in the figure below, the test sequence consists of four distinct phases. The first three are used to identify gross leaks based on how the sample's pressure behavior diverges from the reference.

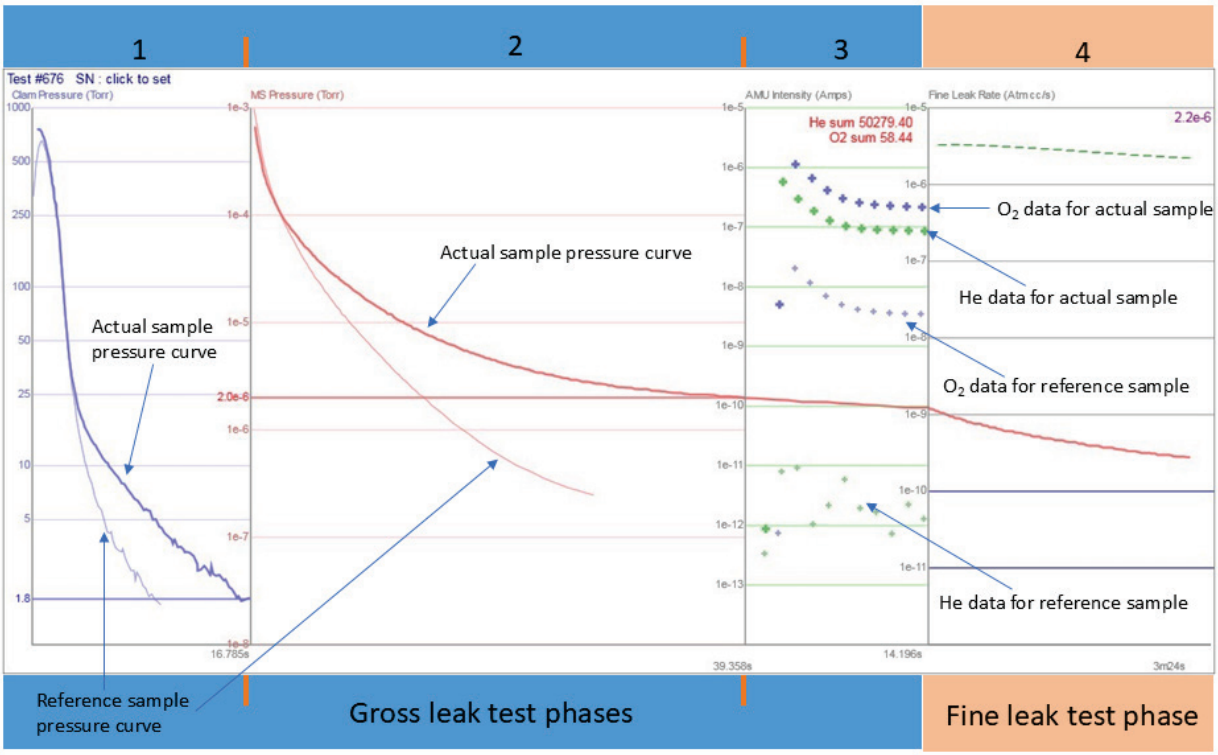

Fig. 1: Gross Leak Detection. In phases 1, 2, and 3 of the test sequence, the pressure curve of the actual sample consistently shows higher values than the reference curve. *Phase 2:* The extended duration along the X-axis for the actual sample suggests significant gas release, confirming the presence of a gross leak. *Phase 3:* Elevated levels of helium and oxygen in the sample further support the conclusion that it is a gross leaker.

3. Compliance with Military Standards

- Meets **Mil-Std-750 Method 1071** and **Mil-Std-883 Method 1014** conditions A1, A2, and A5.
- Minimum fine leak detection: $<1.0\times10^{-12}$ atm-cc/sec helium.

The **HSHLD® Model 310** is engineered to meet and exceed the rigorous requirements of two cornerstone military standards for leak testing:

MIL-STD-883 test method 1014-describes the hermetic seal testing for hybrids/microelectronics. MIL-STD-750 Method 1071 – describes the Hermetic seal testing for discrete semiconductor devices. Both the test method includes measuring rate of helium escape from sealed packages. Following tables list the requirements for standard leak rates for the given package volume.

MIL-STD-750E, Test method 1071.9	
Equivalent Standard leak rates	
Volume (cc)	Leak rate (atm cc/s air)
≤ 0.002 cc	5×10^{-10}
> 0.002 cc & ≤ 0.05 cc	1×10^{-9}
> 0.02 cc & ≤ 0.5 cc	5×10^{-9}
>0.5 cc	1×10^{-8}

MIL-STD-883H, Test method 1014.13	
Equivalent Standard leak rates	
Volume (cc)	Leak rate (atm cc/s air)
≤ 0.01 cc	5×10^{-8}
> 0.01 cc & ≤ 0.5 cc	1×10^{-7}
> 0.5 cc	1×10^{-6}

Leak rate limits defined by MIL-STDs

MIL-STD-750 Method 1071 – Seal Testing for discrete semiconductor devices

- **Scope**: Defines procedures for evaluating the hermeticity of semiconductor packages, including transistors, diodes, and voltage regulators.
- **Test Conditions**:
  - **Fine Leak Detection**: Using helium or krypton tracer gases, with sensitivity down to **1×10^{-12} atm-cc/sec**.
  - **Gross Leak Detection**: Includes bubble tests, dye penetrant, and fluorocarbon immersion methods.

MIL-STD-883 Method 1014 – Seal Testing for Microelectronic Devices

- **Scope**: Ensures hermetic sealing of microcircuits used in military, aerospace, and Class III medical implants.

- **Test Methods**:
  - **Flexible Fine Leak**: Helium back-pressurization with conversion to air-equivalent leak rates.
- **Recent Revisions**:
  - **Tightened leak rate limits**: As low as **1×10^{-9} atm-cc/sec (air)** for hybrid Class K devices.
  - **Mandatory conversion to air-equivalent rates** using the **Howl-Mann equation**. Please visit Howl-Mann equation calculator on our website to set test parameters and determine pass/fail criteria for Helium fine leak testing.

4. Applications

Device Types

- Hybrid microelectronic packages
- Medical implants (e.g., pacemakers, cochlear devices)
- Automotive sensors
- Laser components
- Pressurized cylinders
- Xenon/Krypton-filled lamps

Industry Use Cases

- **Defense & Aerospace**: Qualification of mission-critical components under extreme conditions.
- **Medical Devices**: Ensuring biocompatibility and long-term reliability of implants.
- **Semiconductors**: Leak testing of ICs, crystals, and transistor packages.

5. Competitive Advantages

Feature	HSHLD® Model 310	Traditional Leak Detectors
Calibration Accuracy	Dual-point, linear	Single-point, often outside usable range
Sensitivity	$<1\times10^{-12}$ atm-cc/sec	Typically, 10^{-9} to 10^{-10} atm-cc/sec
Gas Flexibility	Helium + multiple gases	Primarily helium
Cost Efficiency	Lower purchase & operating cost	Higher cost, fluid-dependent
Usability	Automated, technician-friendly	Manual, training-intensive

- **Traceability**: Dual-point calibration and automated R1 calculations ensure compliance with the latest revisions.

- **Versatility**: Supports both **MIL-STD-750** and **MIL-STD-883**, making it ideal for hybrid, monolithic, and semiconductor devices.
- **Future-Proofing**: Designed to accommodate evolving standards, including ultra-low leak rate thresholds and dry gas methodologies.

6. Conclusion

The **HSHLD® Model 310** is a transformative solution for manufacturers seeking high-precision MIL-STD leak testing without the complexity or cost of legacy systems. Its modular architecture, automated calibration, and broad gas compatibility make it ideal for both R&D and production environments. Whether you're qualifying components to military standards or innovating in medical technology, the Model 310 delivers confidence, compliance, and clarity.

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