

Understanding Leak Testing and Leak Rate: Why They Matter for Product Quality

Leak testing is essential for verifying the airtightness of industrial products and ensuring safety, reliability, and compliance.

MODENA, EMILIA ROMAGNA, ITALY, April 18, 2025 /EINPresswire.com/ -- In the world of industrial manufacturing, [leak testing](#) plays a critical role in ensuring that products meet the strictest standards of performance, safety, and durability. Whether it's a medical device, an automotive component, or a home appliance, any product that is meant to contain or isolate gases or liquids must undergo rigorous testing to verify that it does not leak.

Leak testing is the process of checking a component or system for unintended passages of air, gas, or fluid. The goal is to ensure the product is hermetically sealed or within acceptable limits of leakage. Various industries rely on this testing to detect defects that could compromise performance or safety.

Several methods are available for leak testing, each with its own pros and cons:

- Helium leak testing: The most accurate and sensitive method. It uses helium as a tracer gas and is ideal for



Die Casting Industry



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detecting extremely small leaks, but it's expensive due to the cost of helium and the required equipment.

- Bubble test (water immersion): A simple and low-cost method where the part is submerged in water, and air bubbles indicate the location of a leak. However, it's subjective, cannot quantify the leak, and is not automatable.

- Pressure decay test: Involves monitoring pressure changes over time using sensors. It is cost-effective and avoids water contact but lacks accuracy and traceability.

- Differential pressure test: This method improves accuracy by comparing the pressure between a reference volume and the test part, allowing for better detection of minor pressure changes.

ForTest designs its products based on air leak and flow testing systems using compressed air, overcoming the limitations of traditional methods by providing objective, repeatable, and traceable results. These systems can be seamlessly integrated into automated production lines and deliver real-time PASS/FAIL evaluations based on predefined thresholds.

The [leak rate](#) is a measurable value that defines how much gas or fluid passes through a defect (e.g., a crack or pinhole) per unit of time under a certain pressure differential (ΔP). It is typically expressed in cc/min, cc/s, or mbar·L/s.

Even in seemingly sealed systems, small amounts of gas can migrate due to molecular interactions with the system's walls or through microscopic defects. Thus, the leak rate gives us a quantifiable way to assess how airtight a component truly is.

Factors Influencing Leak Rate:

Gas type: Smaller molecules like helium escape more easily through micro-openings than larger molecules.

Material and wall structure: Porosity or micro-cracks can increase leak rate.

Pressure differential: Higher ΔP usually increases the leakage flow.

For example, a 20 cm cube pressurized to 1.5 bar and emptied after 30 days shows a calculated leak rate of about $1.54 \cdot 10^{-3}$ cc·bar/s, demonstrating how even small losses can be quantified.

Why Leak Testing and Leak Rate Matter?

Safety: In applications like airbags, brake systems, or medical devices, leaks can pose serious hazards.

Regulatory Compliance: Standards such as UNI 10903 set guidelines for leak testing, especially in the automotive and foundry sectors.

Product Reliability: Undetected leaks can lead to product failure, customer dissatisfaction, and costly recalls.

Process Optimization: By defining acceptable leak thresholds, manufacturers can ensure consistent quality without over-engineering parts.

Traceability and Quality Control: Modern testing instruments provide digital records, allowing manufacturers to trace and verify every test.

In some cases, legislation or standards (like UNI 10903) provide specific leak rate limits. In others, the customer defines the leak acceptance criteria based on the part's function. However, many scenarios require a combination of experience, test data, and technical evaluation to define the correct leak rate. Critical parameters include:

Test pressure

Part volume

Cycle time

When no clear standard exists, it's the expertise of the testing engineer that ensures the chosen method meets both technical and commercial expectations.

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