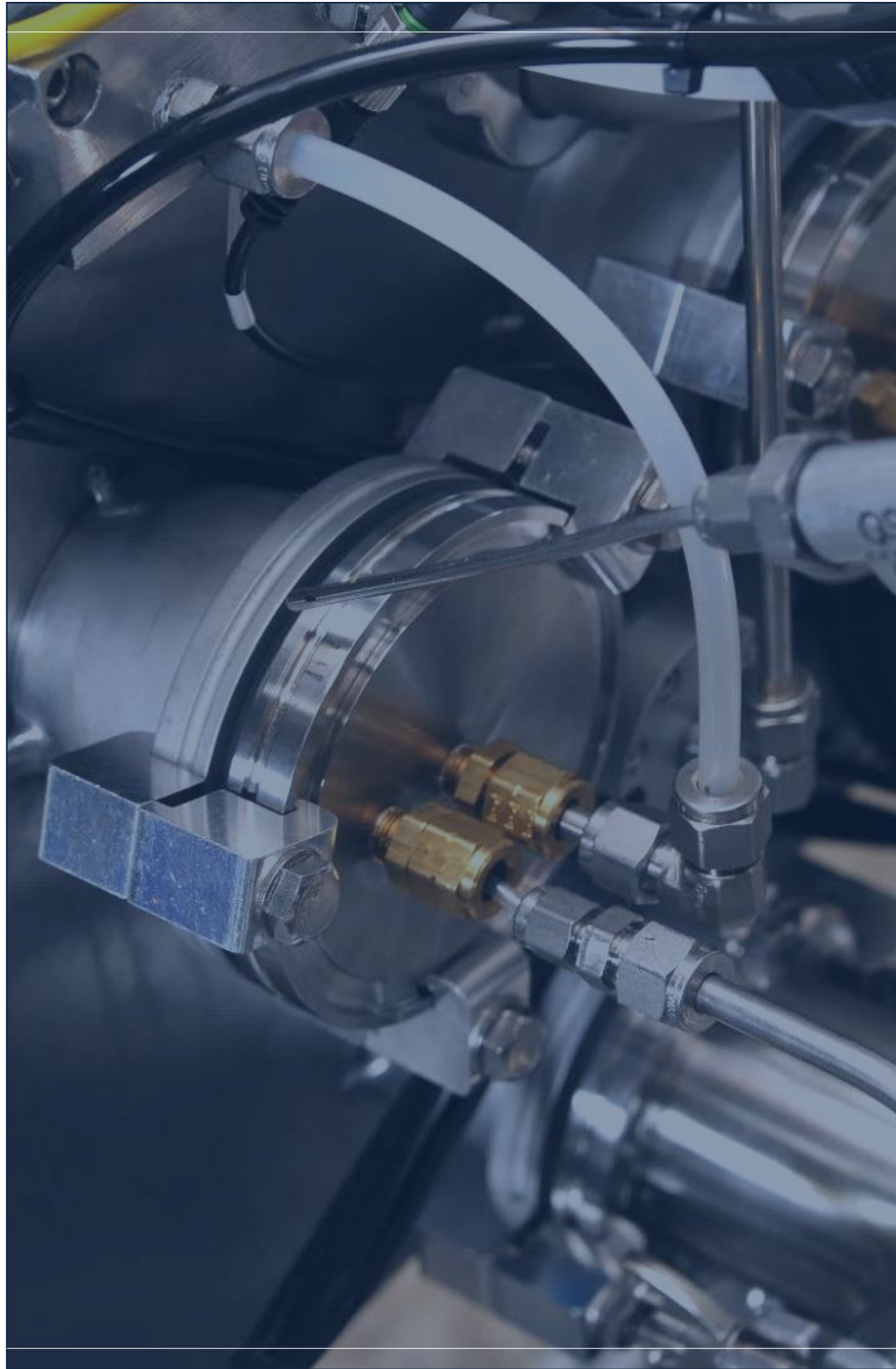




Finding Leak Testing Success Through Calibration and Validation

Paul Chamberlain
President, CEO





Overview

- Confidence in Your Leak Test Results
- Sources of Uncertainty
 - Pressure decay leak testing
 - Helium leak testing
- Addressing Uncertainty
- Calibrated Leak Standards
 - Types
 - What to look for
- Calibrating Your Process
- Validating Your Process
- Conclusion

A grayscale photograph of an industrial leak testing facility. The scene shows a long line of testing stations, each with a large cylindrical chamber and various sensors and cables. The equipment is arranged in a row, receding into the background. The lighting is even, highlighting the metallic surfaces and the complexity of the machinery.

Confidence in Leak Testing

Peace of Mind Your Measurement System is
Working Properly

How Fast Am I Driving?



I Am Driving Faster Than I Think!

Car speedometer calibrated with a 21.4" diameter factory-installed tire



Change stock tires to new 24.6" diameter tire

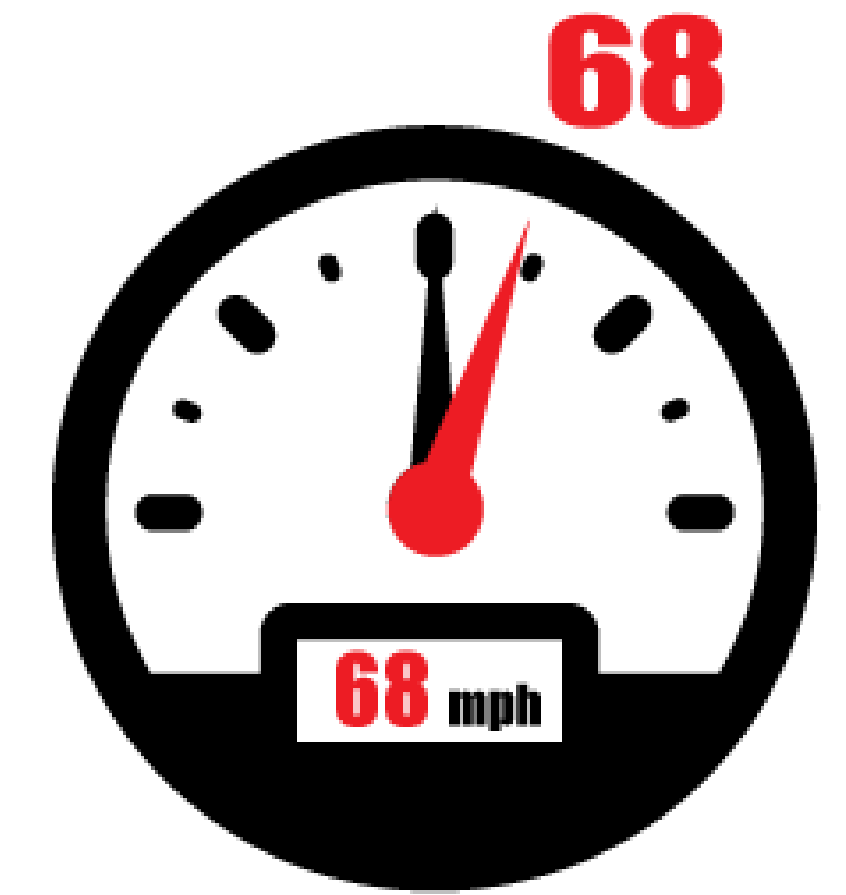


SPEEDING TICKET

Speedometer:
60 mph = 60 mph



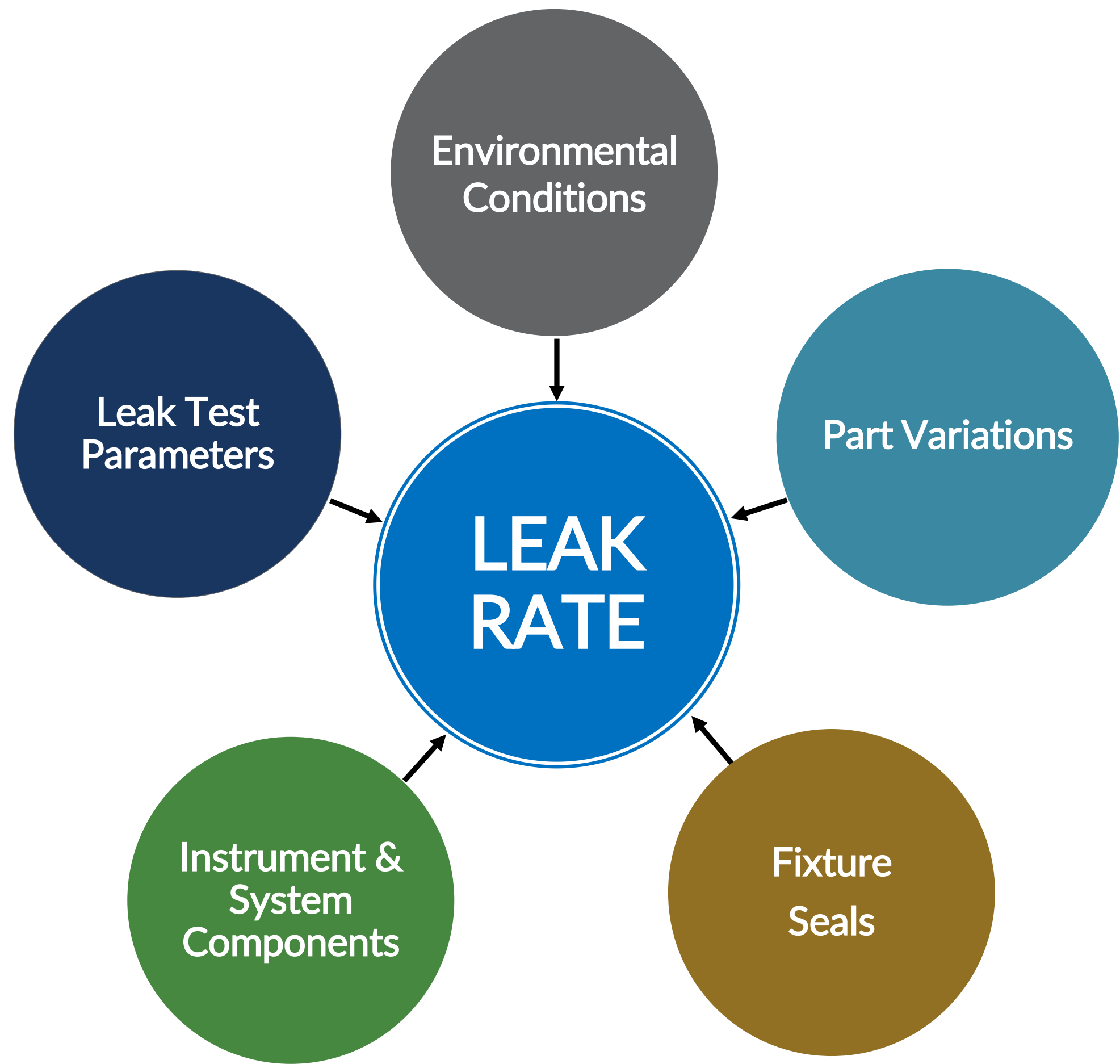
Speedometer:
60 mph = 68 mph



Without Confidence in My Leak Testing Process, Am I...

- Shipping bad parts?
- Scrapping good parts?
- Not taking enough time to measure the leak?
- Taking too much time leak testing?

What Can Destroy My Confidence in My Leak Test Process?



What Can Destroy My Confidence in My Leak Test Process?

Environmental
Conditions

**WHEN THESE CHANGE
THE LEAK RATE CAN
CHANGE!**

Instrument &
System
Components

Fixture
Seals

The background of the slide is a grayscale photograph of industrial machinery, likely a robotic assembly line. It features various mechanical components, including metal frames, cables, and what appears to be a robotic arm or gripper. The lighting is somewhat dim, creating a technical and industrial atmosphere. A semi-transparent blue overlay is positioned in the center, containing the text.

Sources of Uncertainty

What can cause your leak test process to produce bad results?

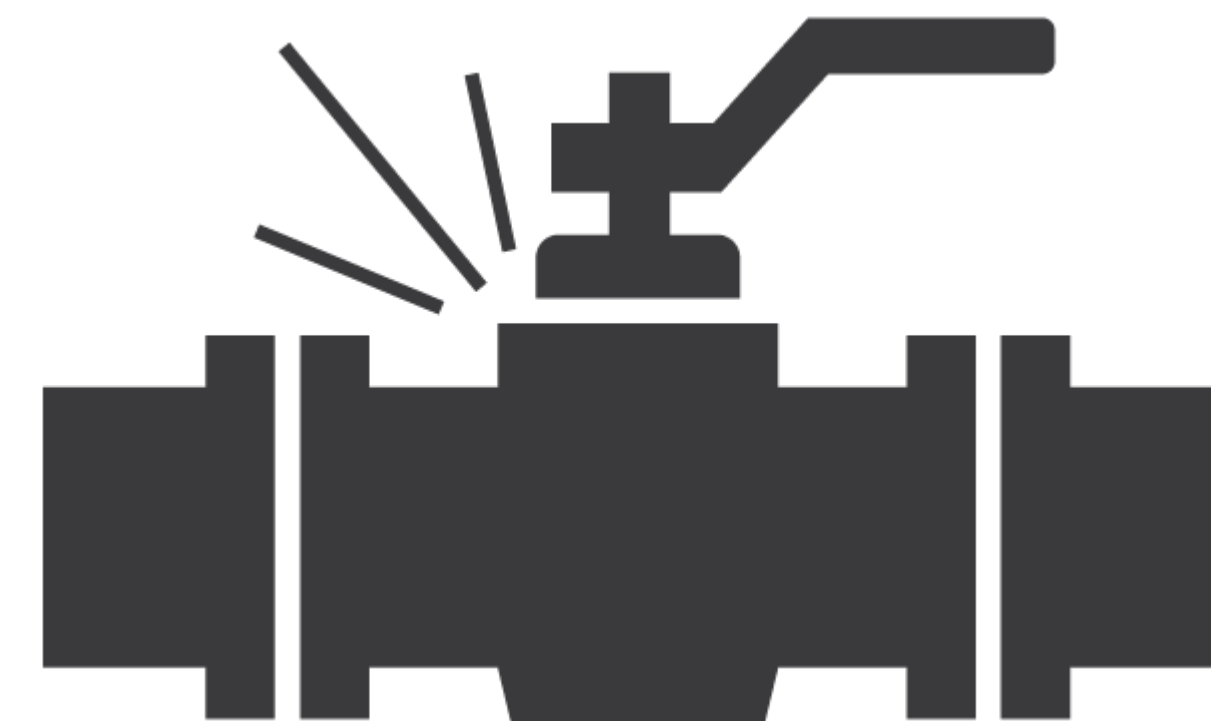
What Can Destroy My Confidence in My Leak Test Process?



Air (Pressure Decay) Leak Testing

What can affect my results?

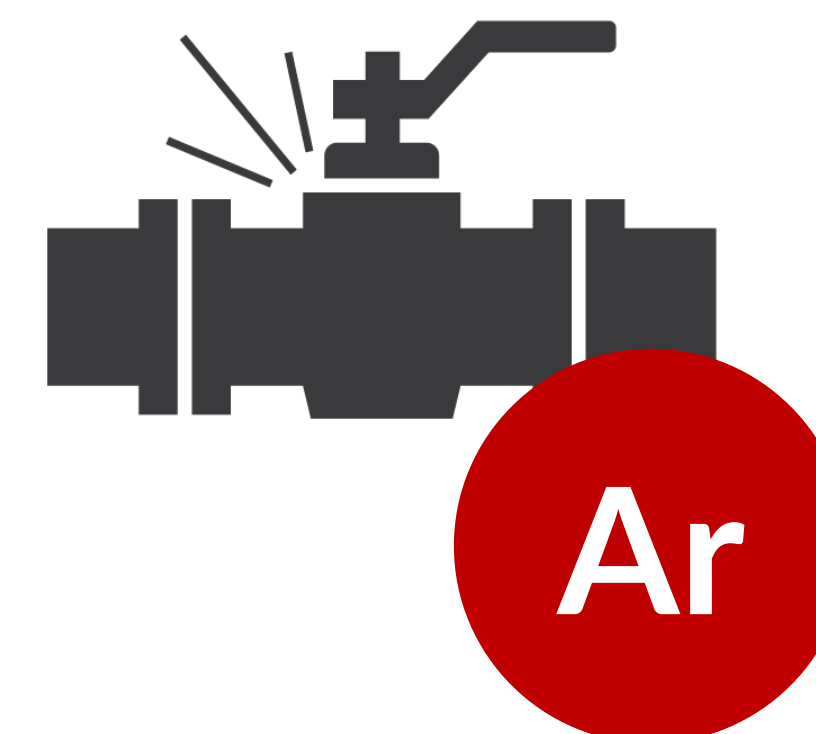
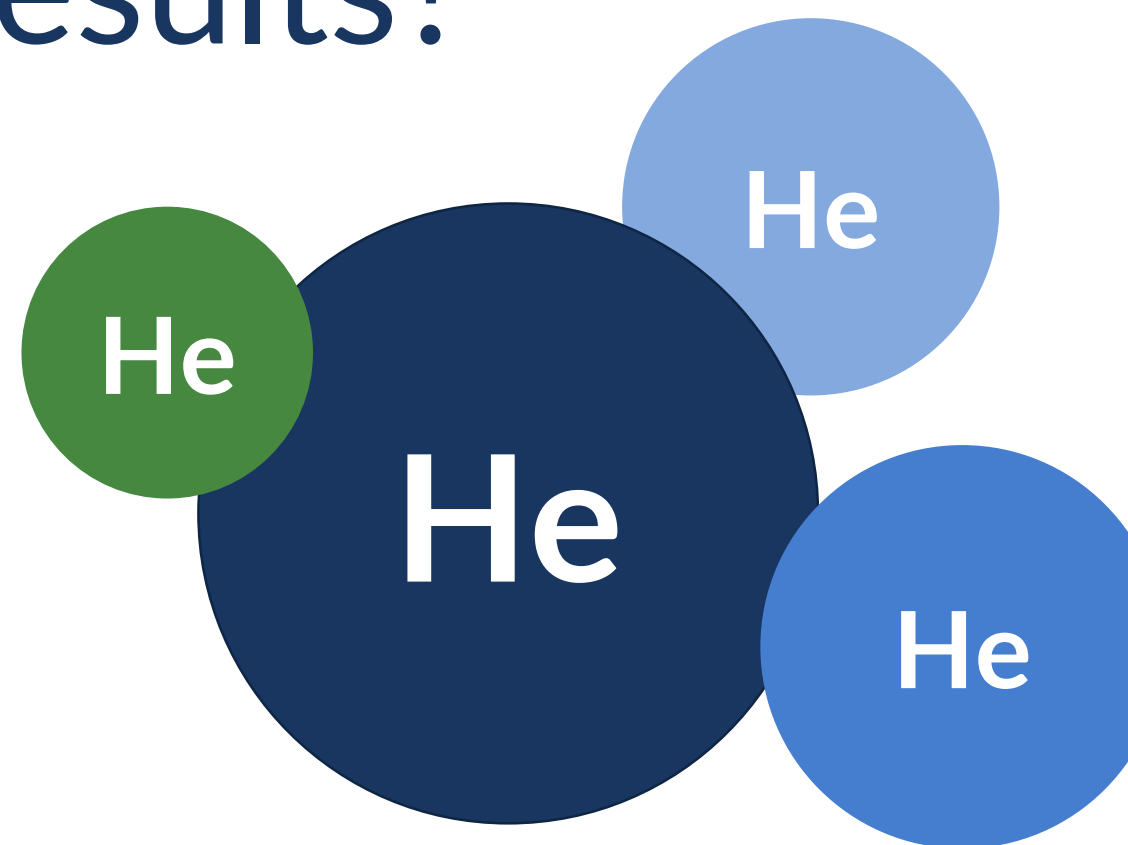
- Environmental Conditions
 - Room temperature **CHANGE**
- Part Variations
 - Incoming part temperature **CHANGE**
 - Part test volume **CHANGE**
 - Different part configurations
 - Part contamination
- Fixture Seals
 - Seal wear or damage
- Instrument/System
 - Leaky valve
- Leak Test Parameters
 - Change in settle timer
 - Change in leak test timer



Helium Leak Testing

What can affect my results?

- Environmental Conditions
 - Helium background in the test area
- Part Variations
 - Part contamination
- Fixture Seals
 - Seal wear or damage
 - Helium permeation of seals (causing high helium background)
- Instrument/System
 - Leaking valve
 - Helium background in the instrument/system
 - Someone changed the tracer gas and accidentally connected argon
- Leak Test Parameters
 - Change in leak test timer
 - Change in helium fill pressure



A large industrial leak testing chamber, likely a vacuum chamber, is shown in a factory setting. The chamber is cylindrical and has a large circular door on the left side. On the right side, there is a control panel with four buttons labeled "CLAMP UNCLAMP 1", "START", "ABORT / RESET", and "E-STOP". The chamber is mounted on a metal frame. In the background, a sign for "Service Team" and "TECHNOLOGIES" is visible. The image is overlaid with a semi-transparent blue banner containing text.

Addressing Uncertainty

How to gain confidence in my leak testing
process results

Addressing Uncertainty – System Design

What can be done in System Design?

- Potentially monitor environmental conditions
- Monitor incoming part temperature
- Design software that detects changes in critical recipe parameters – requiring re-calibration
- Build in performance checks into each test cycle such as background signal levels
- Provide software features that allow for user-defined calibration expiration intervals



What Else?

System Design alone can't do it all.

- How can we challenge the system?
- What protocol will ensure ongoing confidence?
- What can be used on existing systems, that may not be optimally designed, to gain confidence?



System Calibration and Validation

Even with the best System Design and Process Monitoring, **calibration and validation** with a **Calibrated Leak Standard** is required to instill ultimate confidence in your system.

- Calibrated Leak Standards – known reference leak
- Calibrated Leak Standards are used in the leak test process along with a robust protocol to **CALIBRATE** and **VALIDATE** your system





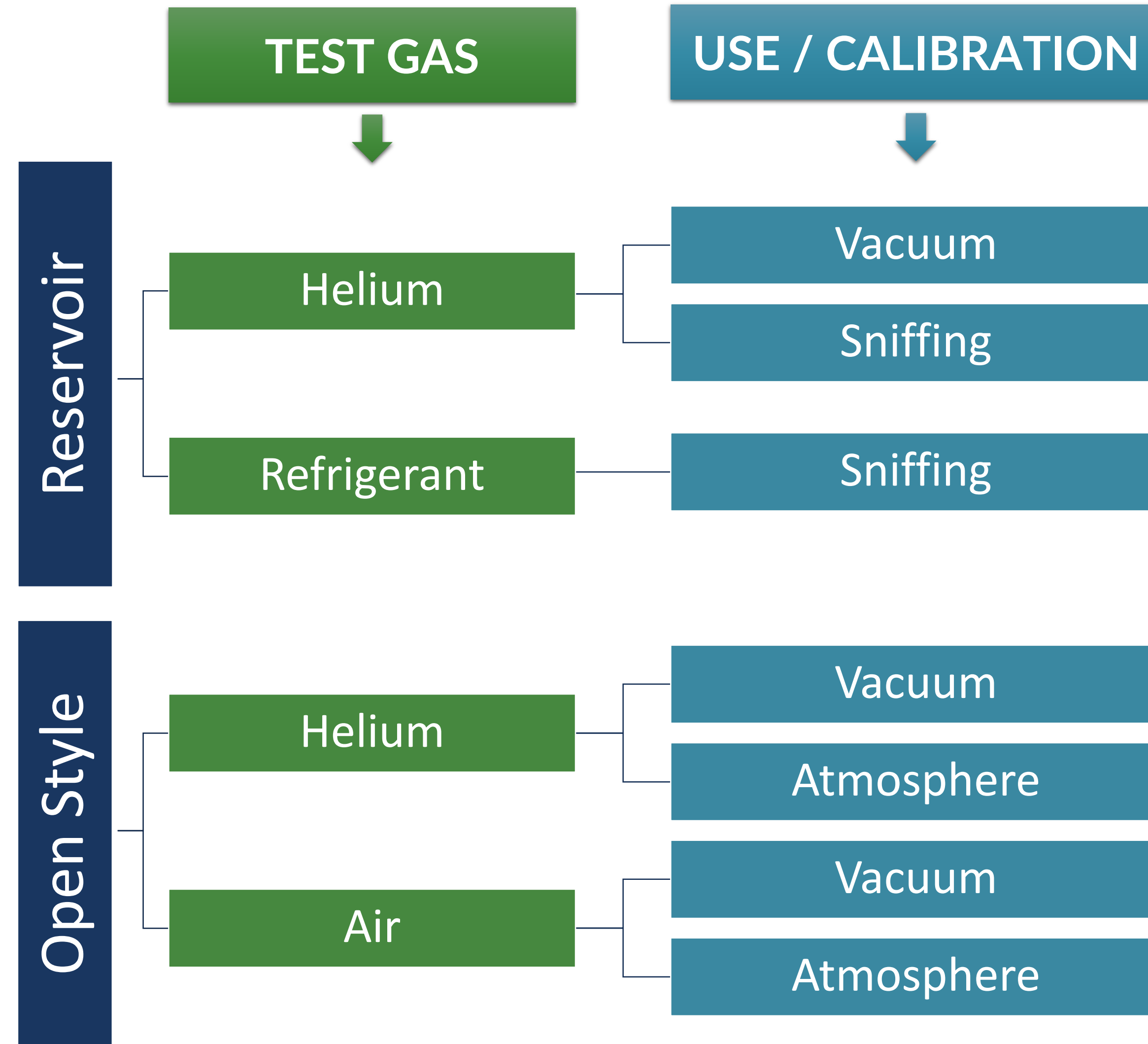
Calibrated Leak Standards

Types | Designs | What to look for...

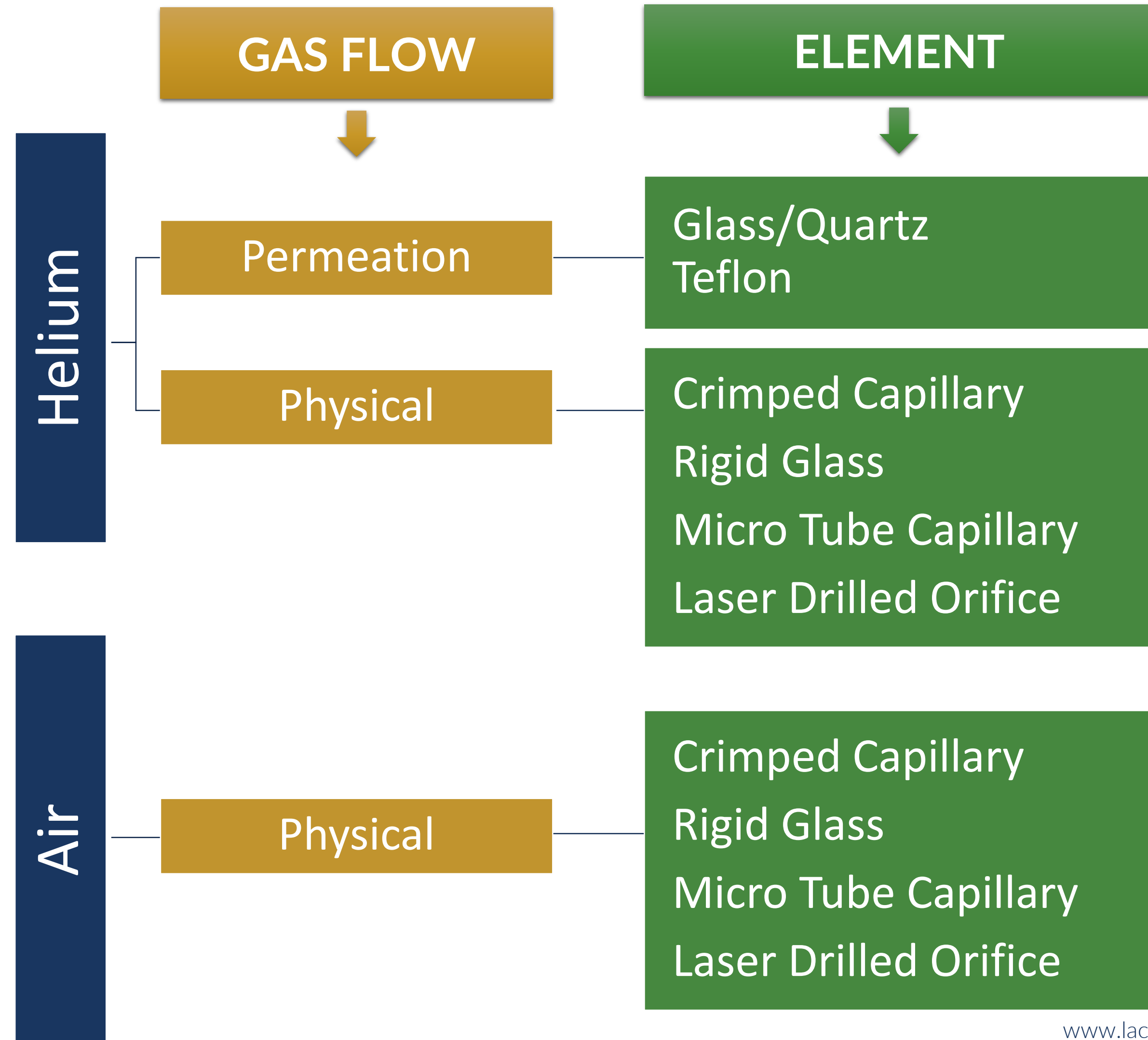
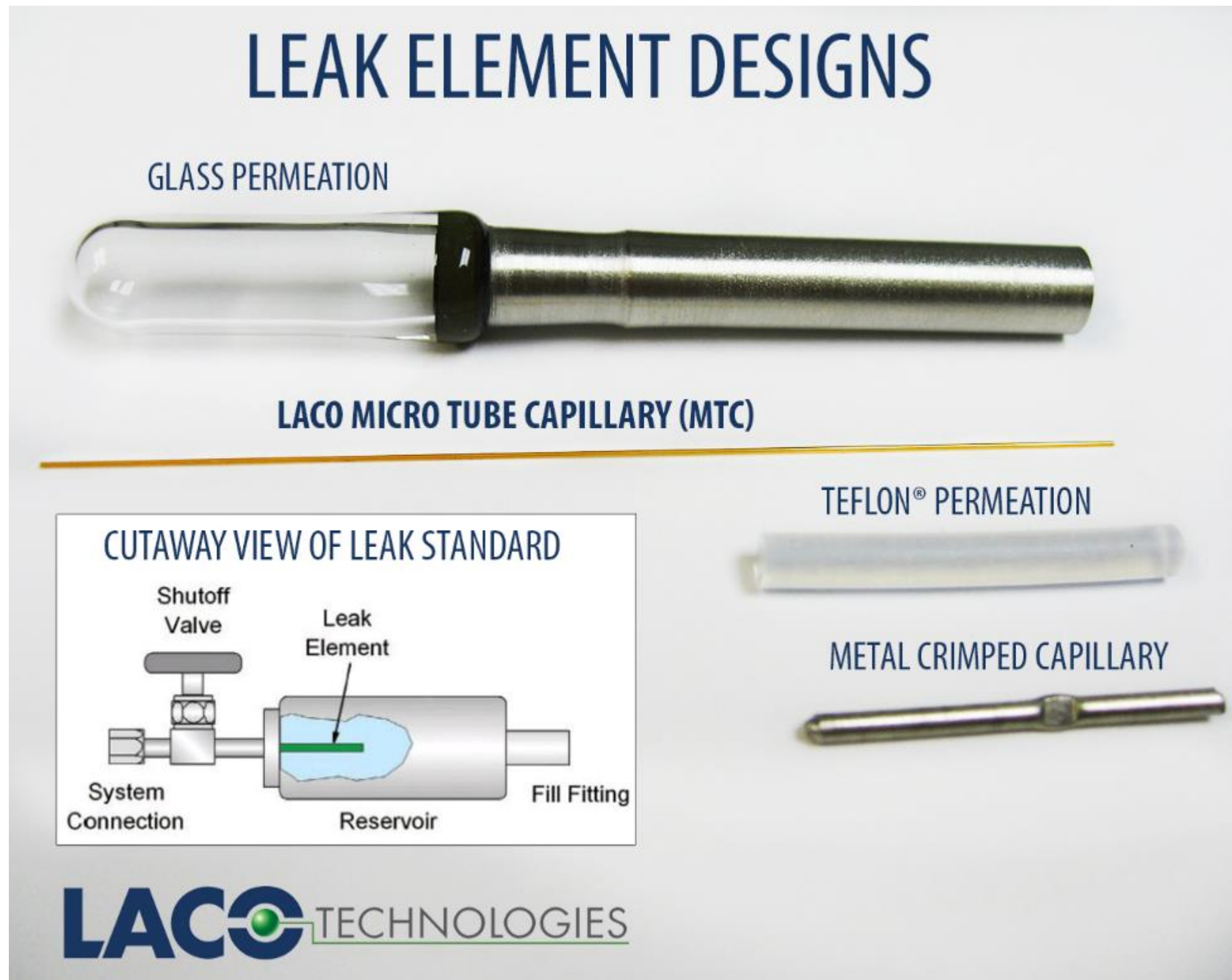
Types of Calibrated Leak Standards



Types of Calibrated Leak Standards



Leak Element Types



What to Look for in a Calibrated Leak

- Correct style for the application
 - Open-style versus Reservoir
 - Sniffer versus vacuum
 - Capillary versus permeation element
- Robustness
 - Protection & sensitivity to particulate contamination
 - Sensitivity to shock, vibration, impact
- Stability
 - Potential for long term drift
 - Temperature sensitivity
 - Low depletion rate (for reservoir types)
- Representative of an Actual Leak
 - Response time
 - Response to pressure conditions (flow regime)
- Accurate
 - Accredited calibration
 - Measurement uncertainty



Calibrated Leak Label

LACO TECHNOLOGIES
3085 West Directors Row
Salt Lake City, UT 84104
801-486-1004 • lacotech.com

Calibrated Leak Standard

Mod No: CM51X-81012V0/1	Temp: 23.2°C
Ser No: 1506	Temp Coef: 0.1%/°C
ID No: O9030	Cal Gas: Helium
Cal No: 773862	Gas Press: 97.8 Psig
Cal Date: 10 Oct 2017	Depl Rate: 0.2%/year

Leak Rate
(atmcc/sec) **5.62 x 10⁻⁸ ±15%** into vac

Helium Leak Standard with Reservoir Attach to Vacuum Test Chamber



Open-Style Air Leak Standard Attach to Pressure Decay LT Manifold

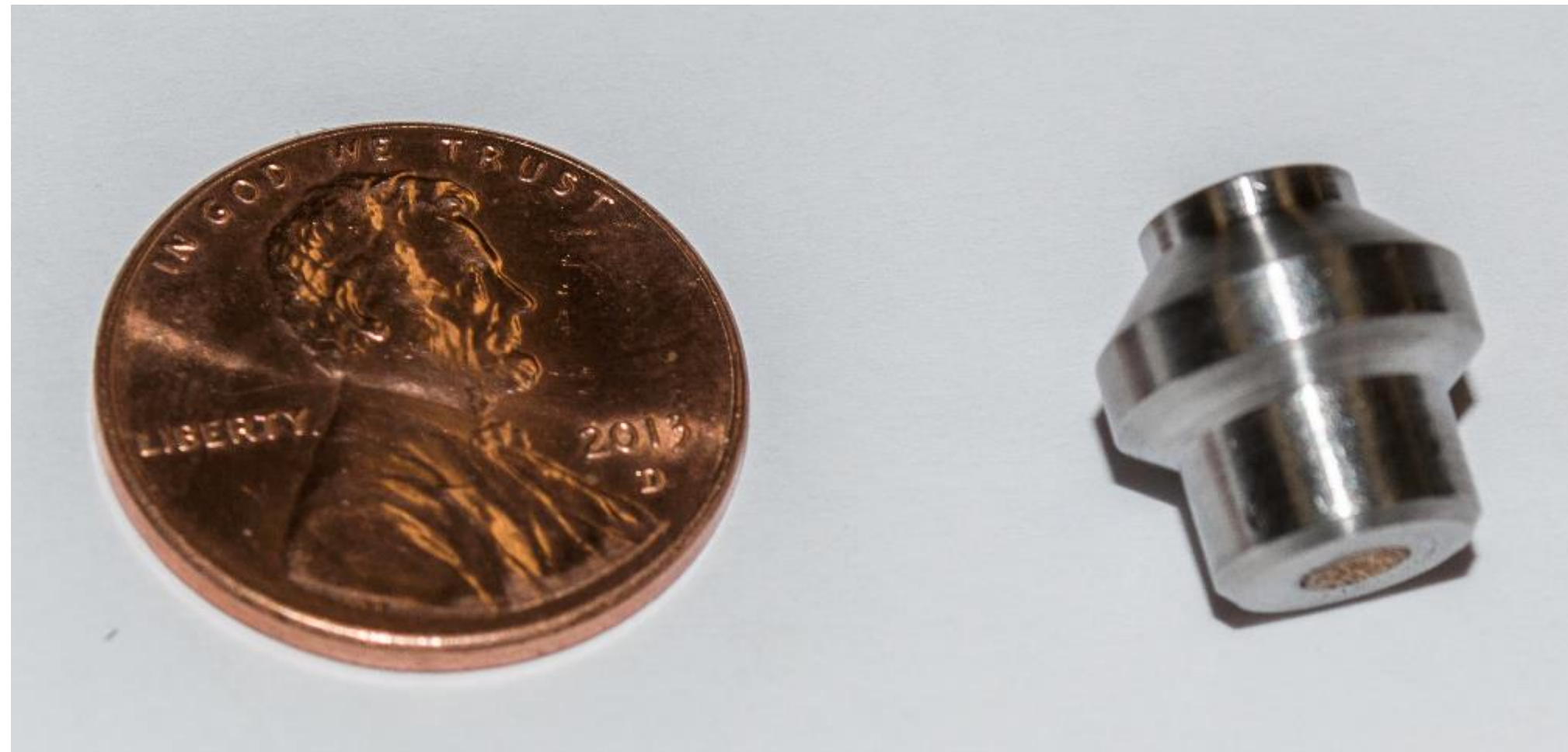


Open-Style Leaks For Installation Into Actual Parts



Leak Built Into a Dummy Part

Helium Bombing a Sealed Part



Pre-Filled and Sealed Part Leak Built Into an Actual Part





Calibrating

Using calibrated leak standards for leak test process calibration

Calibration Using a Calibrated Leak Standard

Instrument Versus System Calibration

Instrument Only	Instrument + Fixture	Instrument + Fixture + Test Part
Only verifies instrument measurement	Includes volume and other effects from fixture / test chamber	Includes potential impact of actual test part on the measurement



Calibration Using a Calibrated Leak Standard

For any type of leak test process, the best practice is to calibrate the system with:

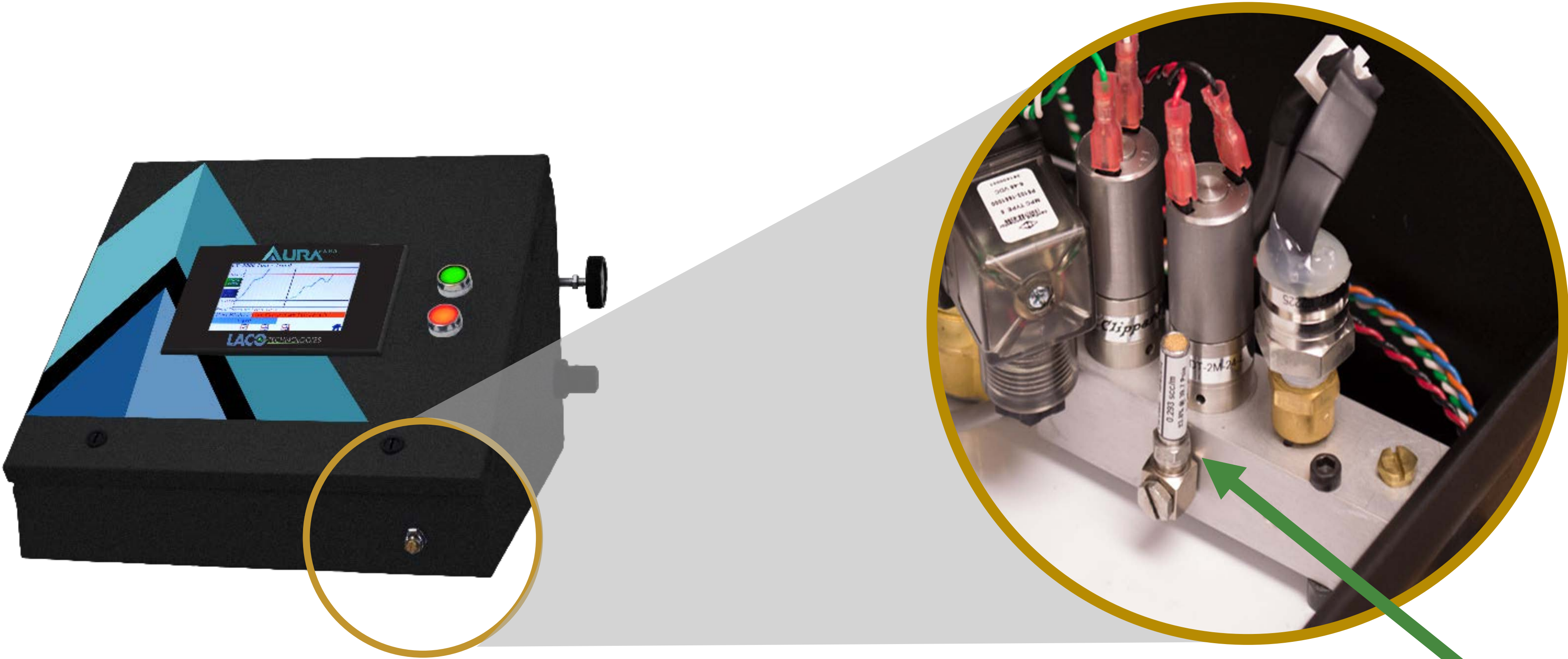
- the **INSTRUMENT** +
- the **TEST FIXTURE** +
- a **KNOWN GOOD PART**

Calibrating **ONLY** the instrument does not ensure the **SYSTEM** is calibrated

Calibration Using a Calibrated Leak Standard

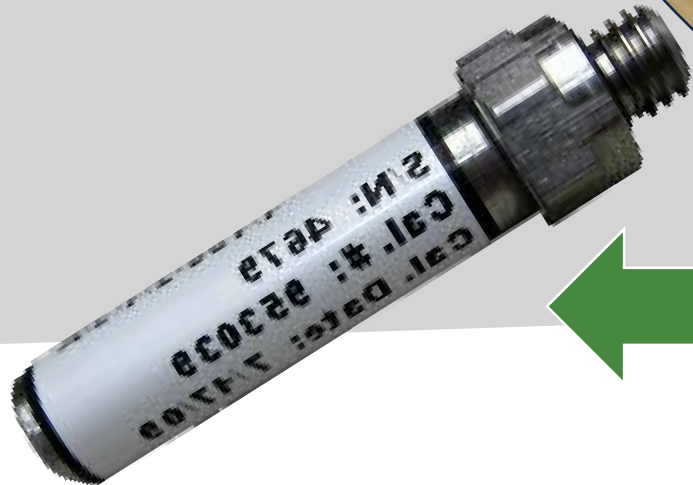
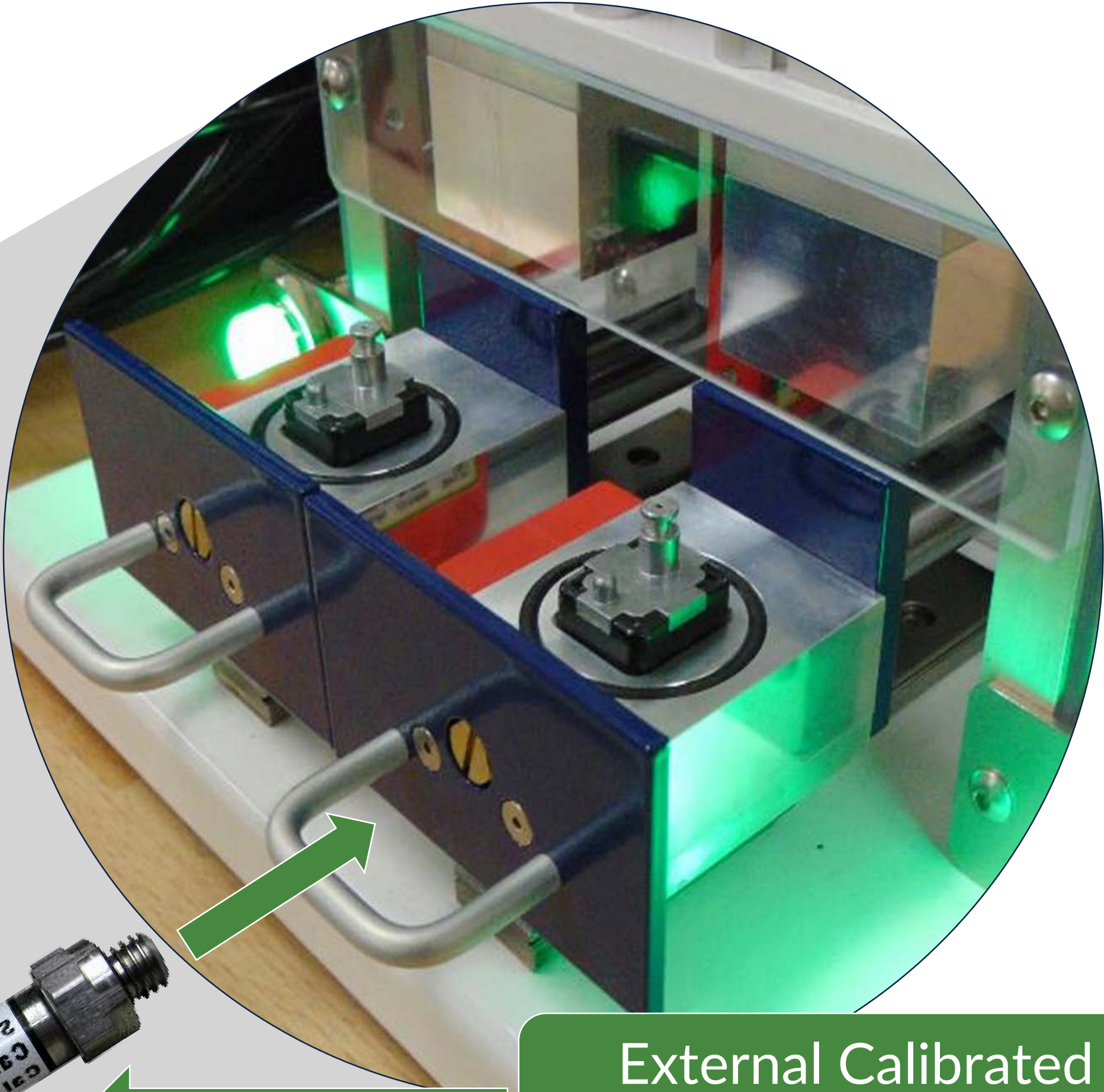
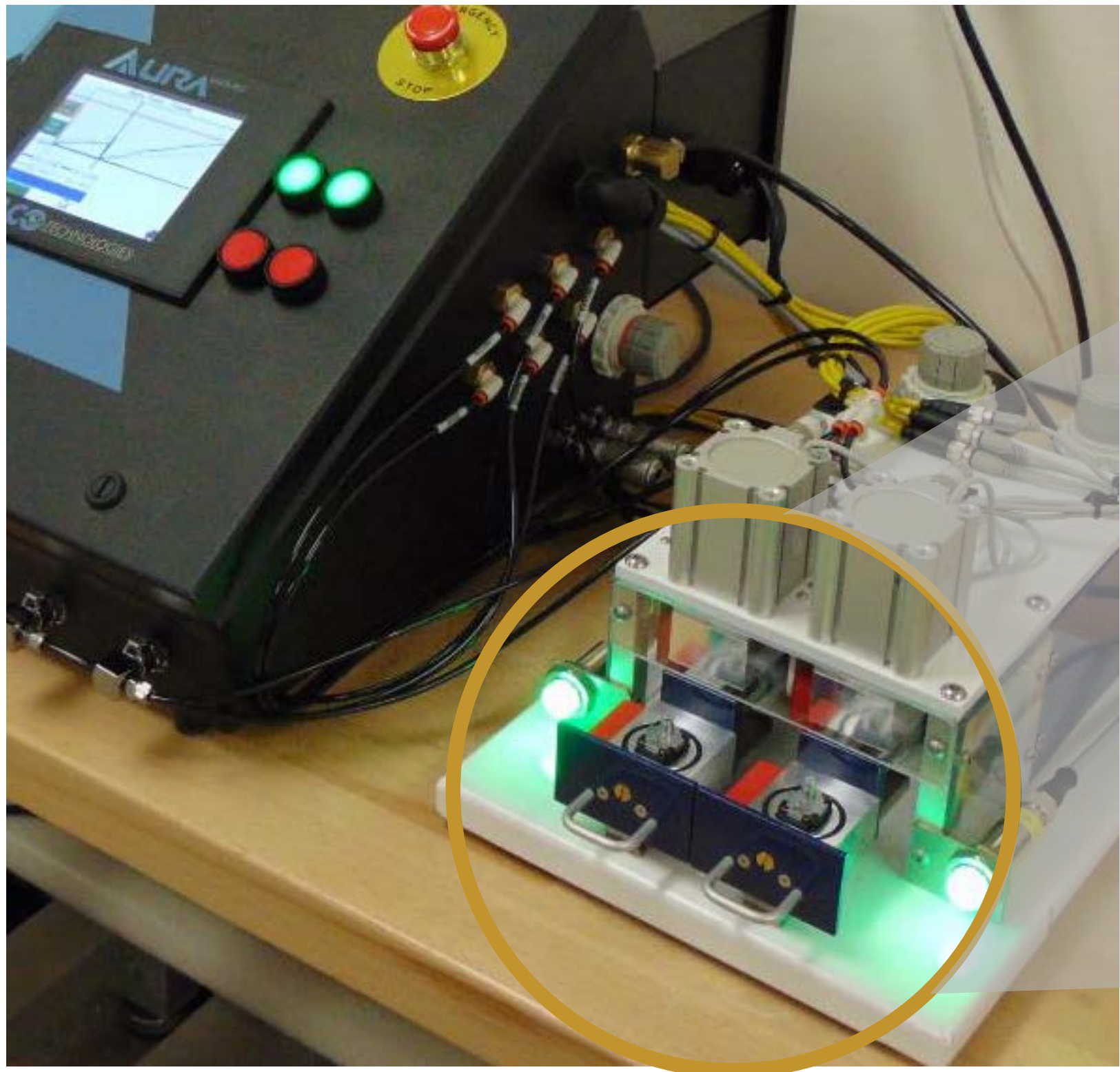
- Air Pressure Decay Application
 - Determine the relationship between pressure drop and leak rate
 - Normally the value of the leak standard = the reject limit of the test
- Implementation
 - Can be an internal leak standard that is automatically valved into the test circuit with the test fixture connected
 - Can be an external leak standard that is attached to the test manifold, a test part, or the test fixture
- Typical Protocol
 - Run test cycle with known good part (no leak)
 - Run test cycle adding the calibrated leak standard
 - Verify signal to noise ratio and calculate calibration factor (software)

Calibration Using a Calibrated Leak Standard



Internal Calibrated Leak Standard

Calibration Using a Calibrated Leak Standard



External Calibrated Leak Standard

Calibration Using a Calibrated Leak Standard

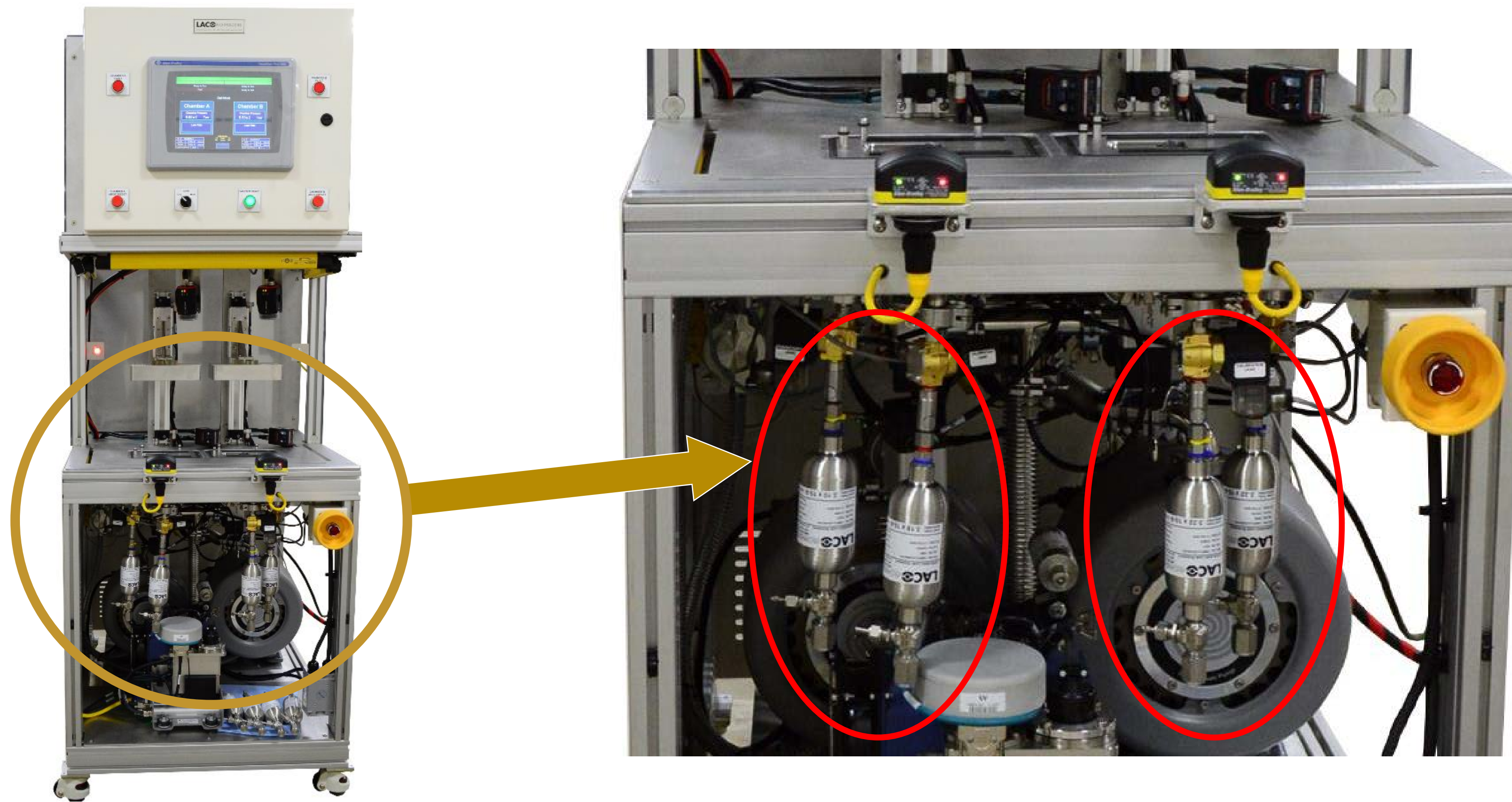
- **Helium Leak Test Application**
 - Determines a correction factor that may need to be applied that accounts for the impact of the setup on the helium signal.
 - Normally the value of the leak standard \approx the reject limit of the test
- **Implementation**
 - Should be an external leak standard that is either automatically valved into the test circuit or manually connected to the system, or connected to a master part
- **Typical Protocol**
 - Run test cycle with known good part (no leak)
 - Run test cycle adding the calibrated leak standard
 - Verify signal to noise ratio and calculate calibration factor (software)

Calibration Using a Calibrated Leak Standard



Internal Calibrated Leak Standard

Helium Hard Vacuum Leak Test Pre-Filled Part



Helium Hard Vacuum Leak Test Fill Part in Chamber



Actual Test Part



Dummy Part Used For Calibration



Calibrated Leak



The background image shows a complex industrial leak testing facility. On the left, a large piece of equipment with a circular viewing window is visible. In the center, there's a complex assembly of pipes and valves. To the right, a grey control cabinet with a warning label is present. The foreground shows a stainless steel workbench with various components and a vertical probe-like device. The overall scene is a professional industrial environment.

Validating

Using calibrated leak standards for leak test process validation

Validation Using a Calibrated Leak Standard

VALIDATION is simply verifying the calibration is accurate and has not drifted

AND...

Ensuring the leak test **process will properly reject parts** leaking above the reject limit

AND...

Parts leaking below the reject limit pass

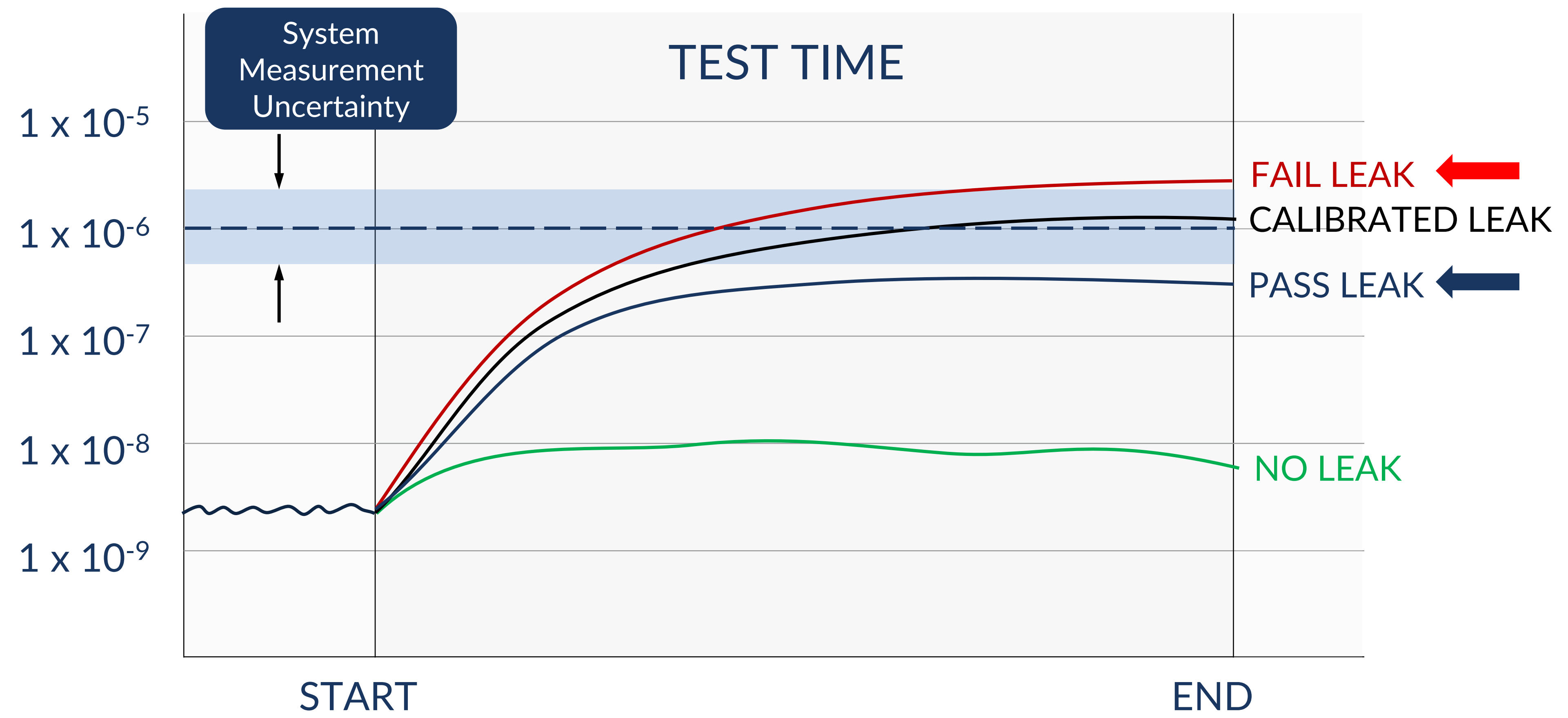
Validation Strategy Using a Calibrated Leak Standard

1. Perform appropriate system calibration with leak standard
2. Immediately validate the calibration by running test cycles with:
 - a. One leak standard above the reject limit
 - b. One leak standard below the reject limit
3. Verify no false positive or false negative
4. Repeat validation (steps 2 & 3) at prescribed times throughout the day

Validation

Using a Calibrated Leak Standard

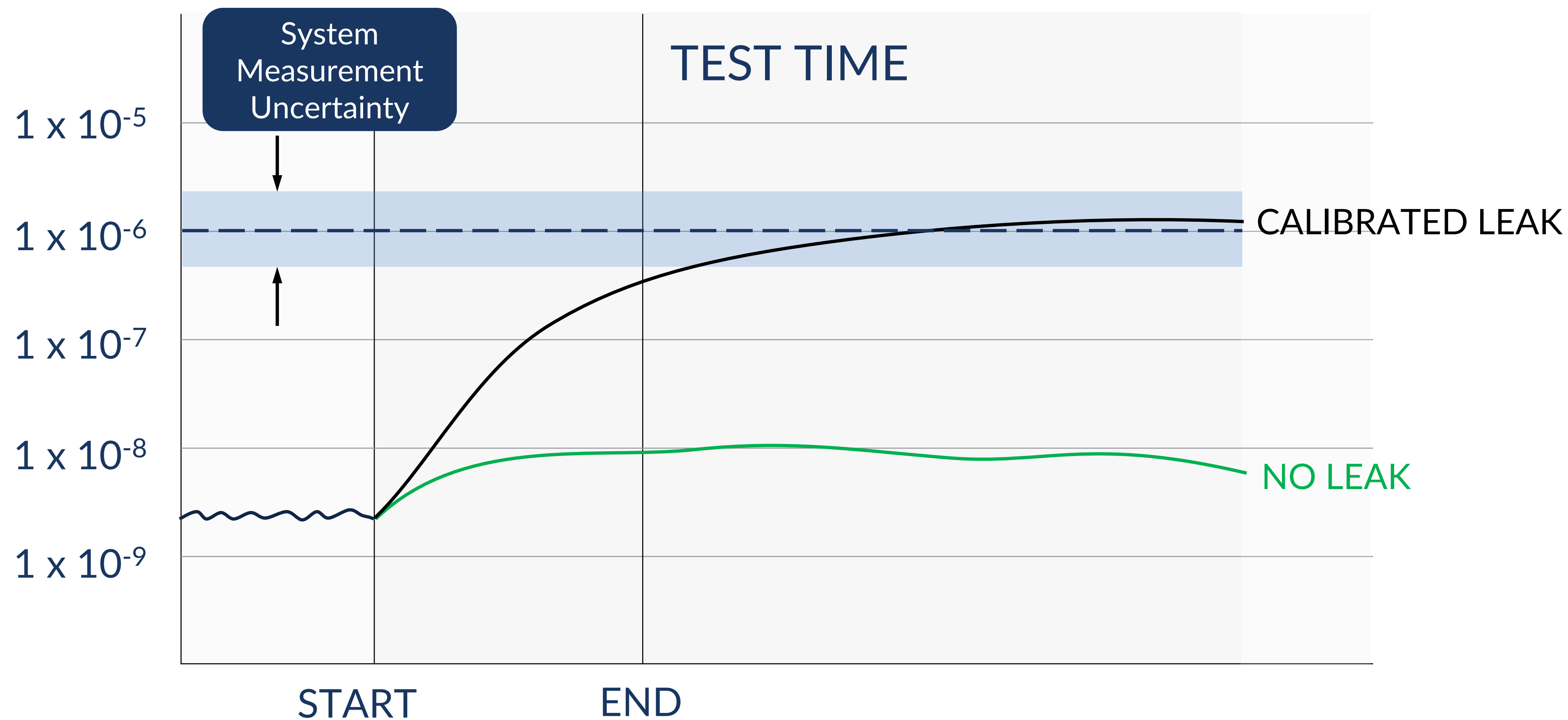
Typical Helium Hard Vacuum Leak Test



Validation

Test Time is Shortened

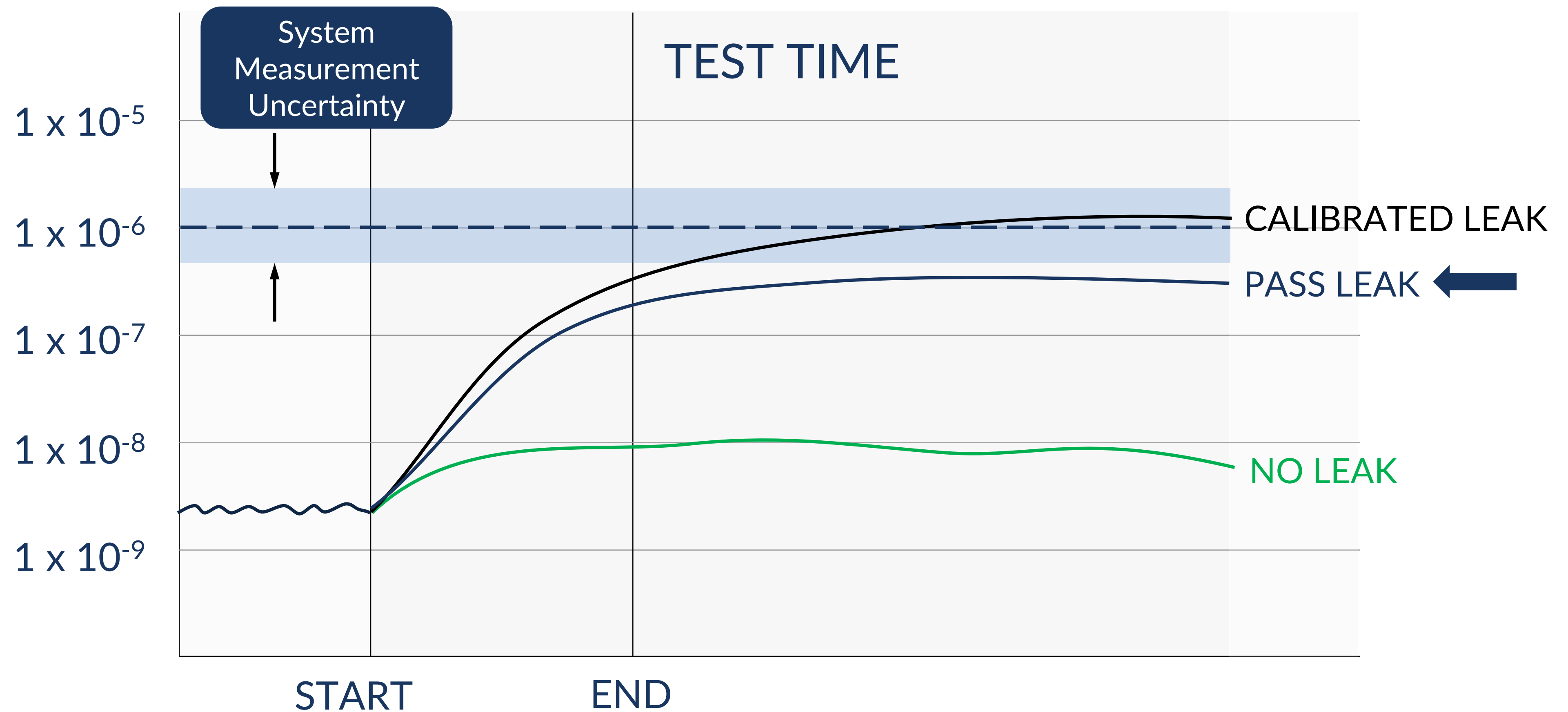
Typical Helium Hard Vacuum Leak Test



Validation

Test Time is Shortened

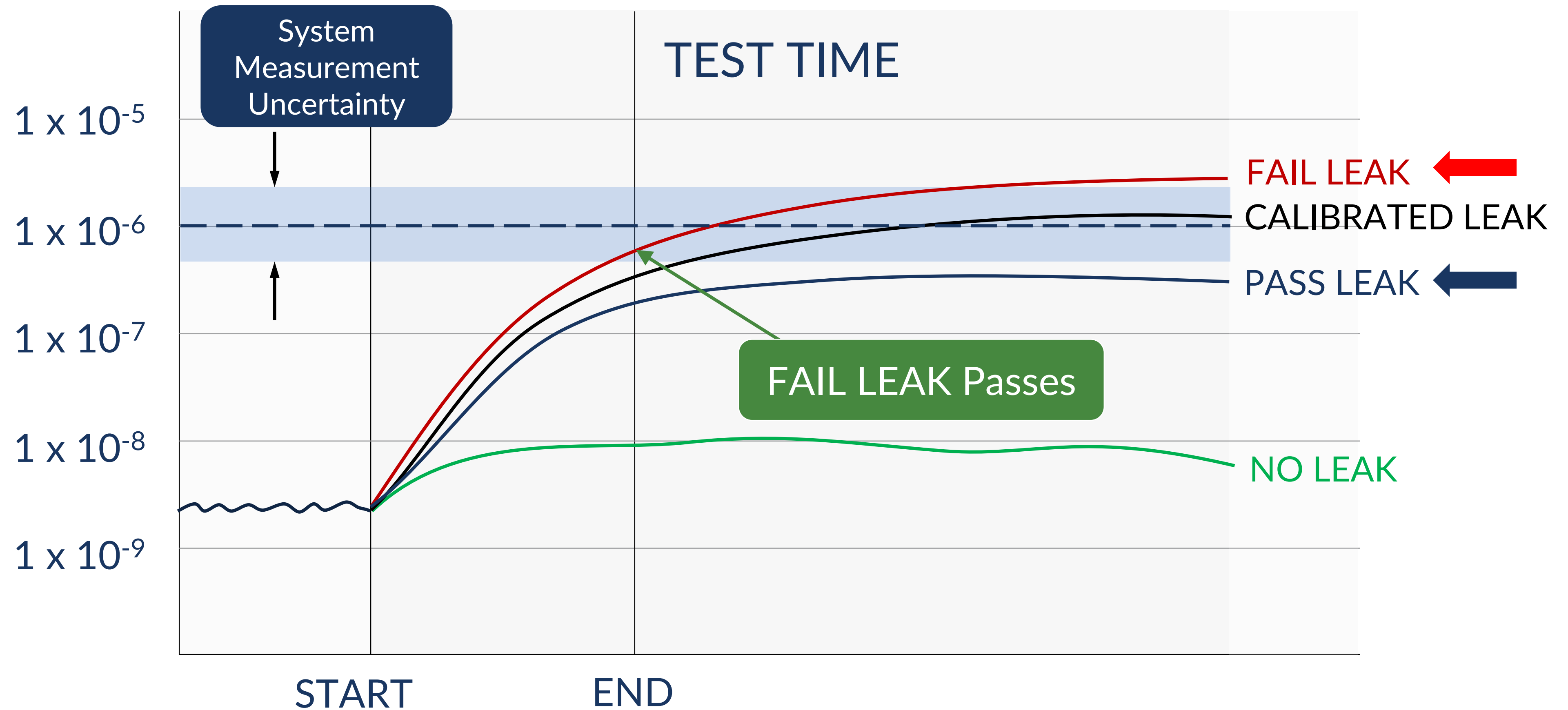
Typical Helium Hard Vacuum Leak Test



Validation

Test Time is Shortened

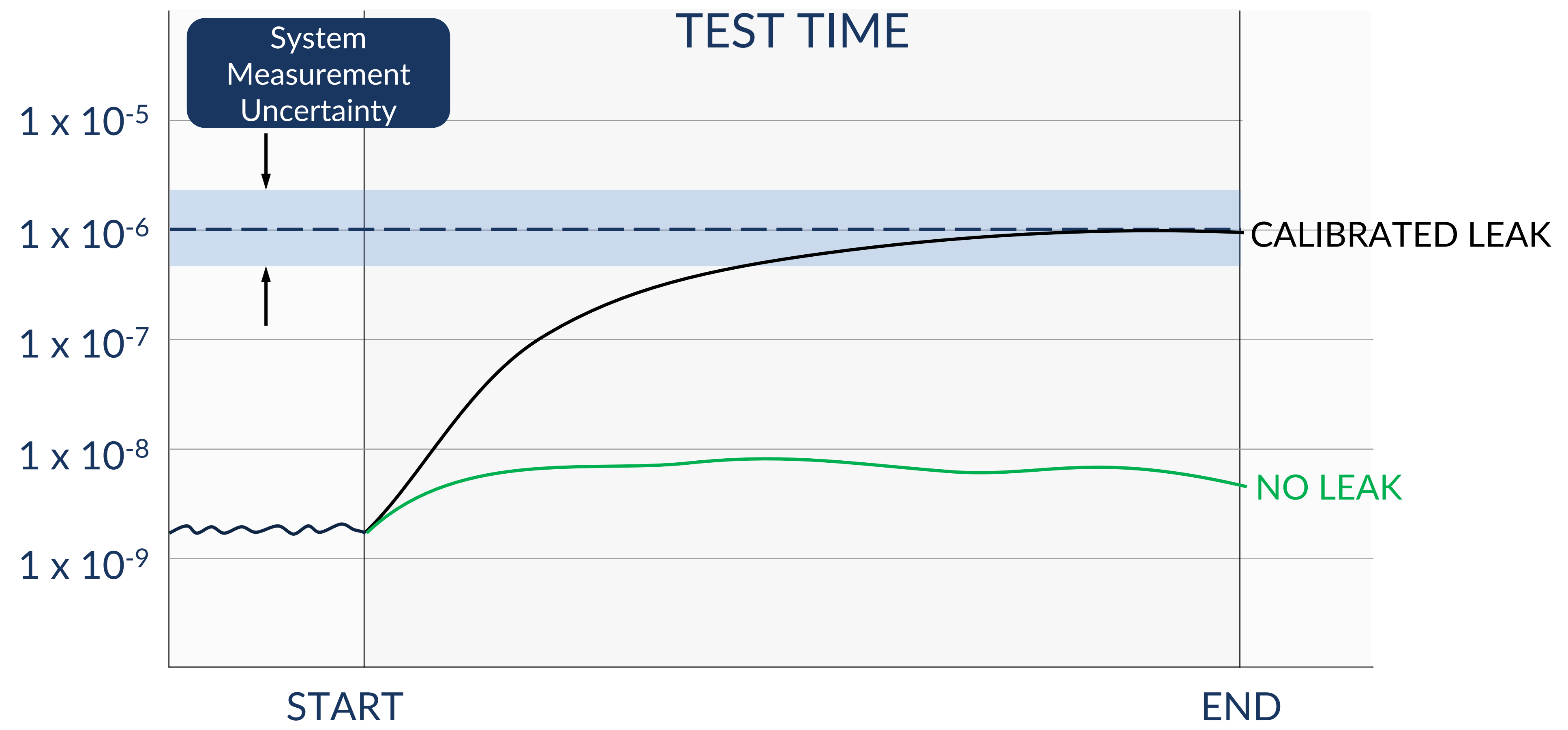
Typical Helium Hard Vacuum Leak Test



Validation

System Helium Background Rises

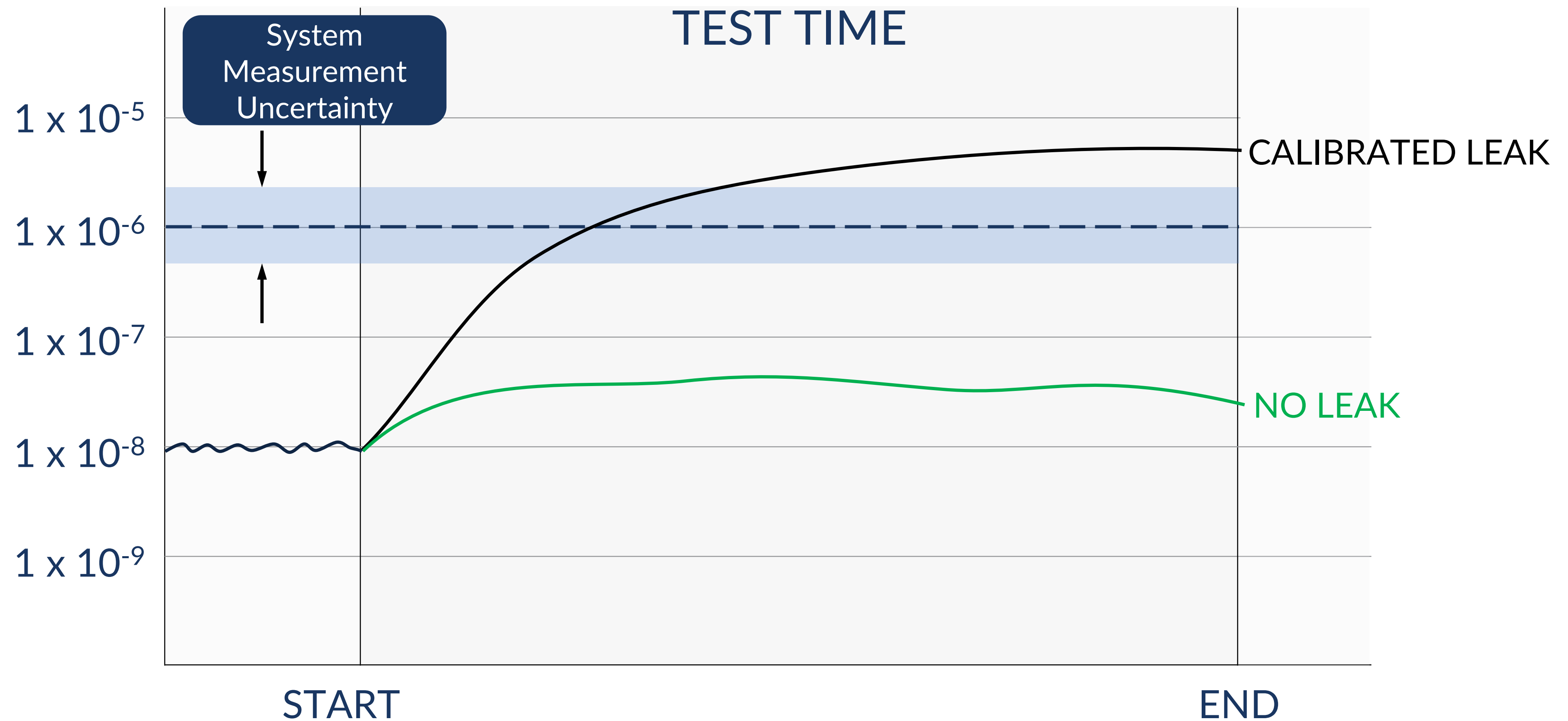
Typical Helium Hard Vacuum Leak Test



Validation

System Helium Background Rises

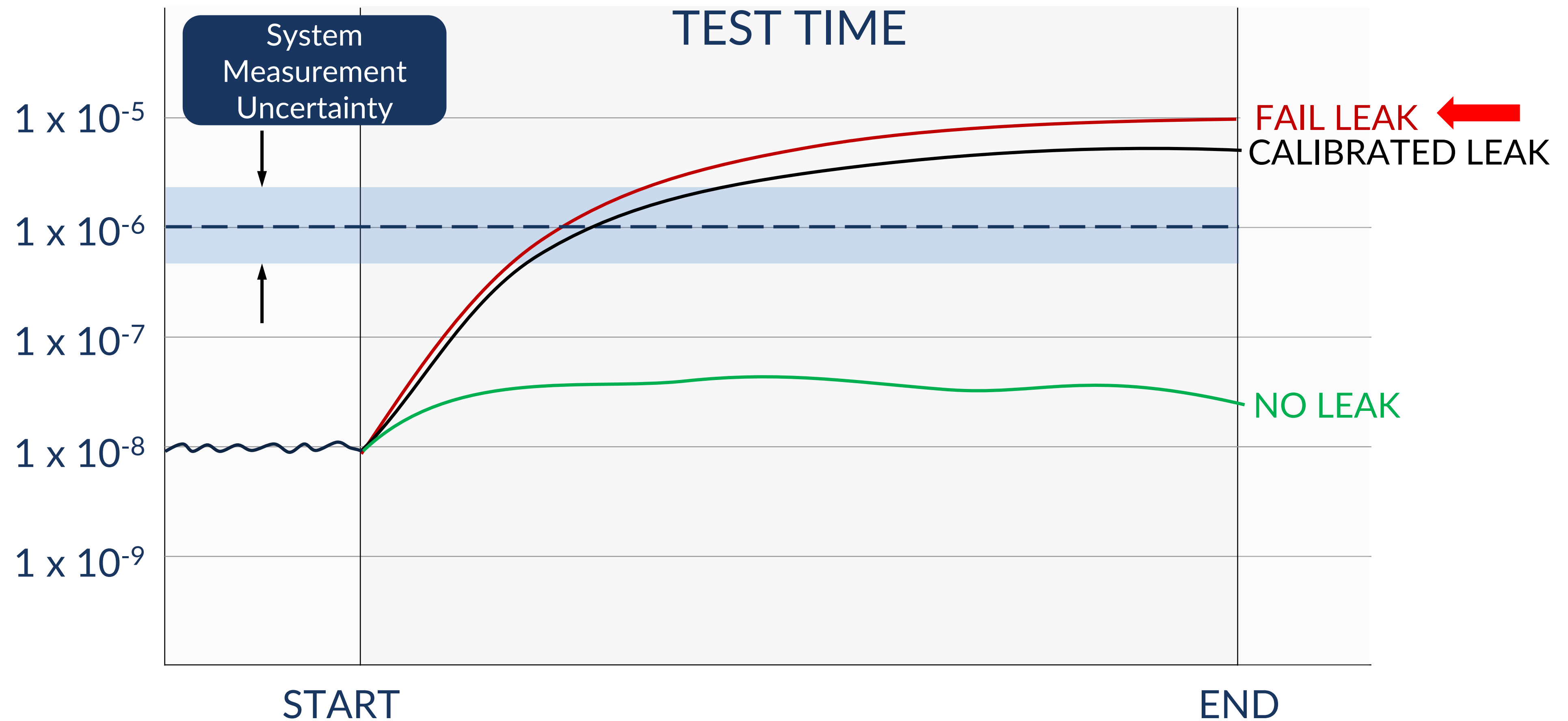
Typical Helium Hard Vacuum Leak Test



Validation

System Helium Background Rises

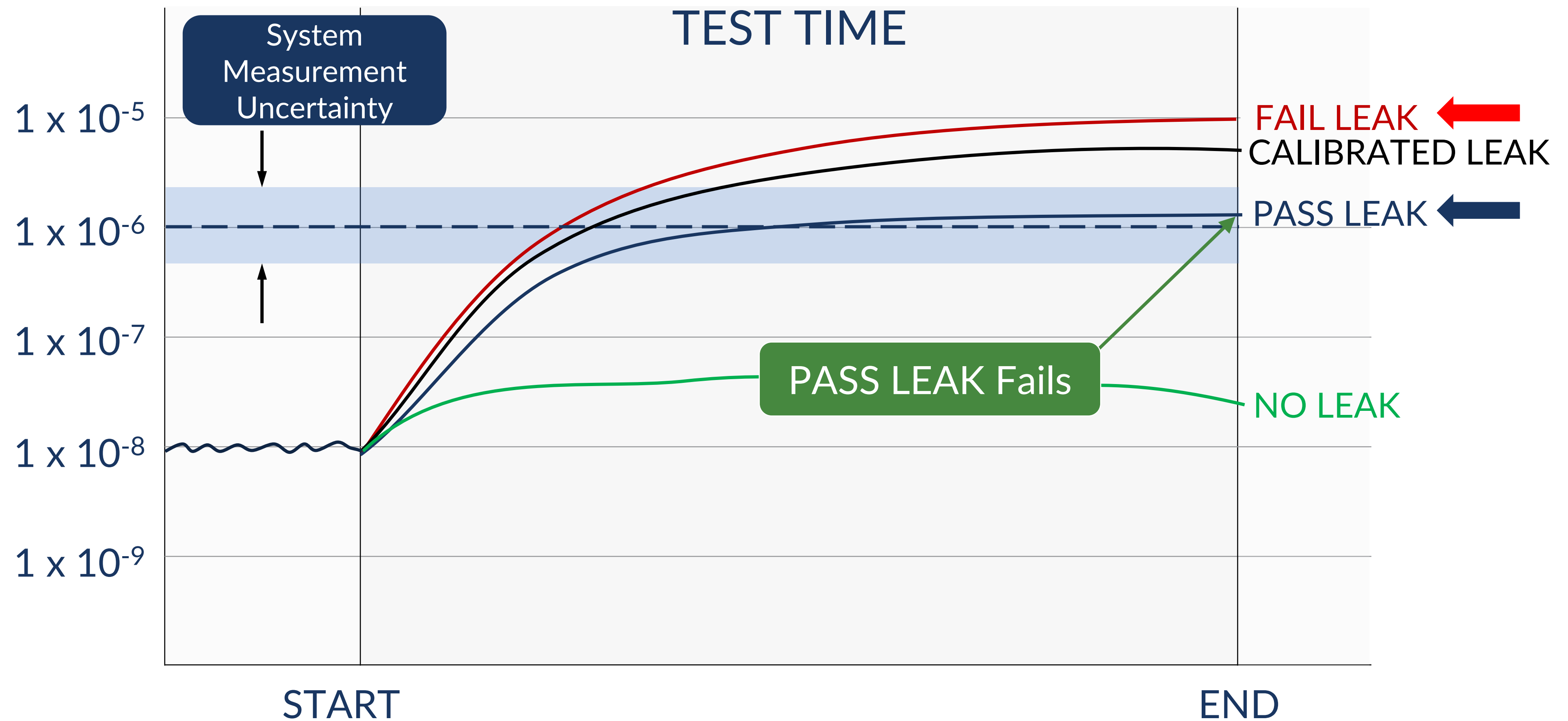
Typical Helium Hard Vacuum Leak Test



Validation

System Helium Background Rises

Typical Helium Hard Vacuum Leak Test





Conclusion

How Fast Am I Driving?



When I Have Confidence in My Leak Test Process...

- I am confident I am shipping good product
- I have satisfied customers with fewer warranties
- I have less waste/scrap
- I have peace of mind



THANK YOU!

- Stop By Our Booth (#1238) to Validate Your Coupon for a FREE Calibrated Leak Standard and Get Your Copy of This Presentation
- Contact Us to Review Your Current Calibration and Validation Strategy

- LinkedIn Group: *Production Leak Testing*
- Blog: www.lacotech.com/posts
- Website: www.lacotech.com

