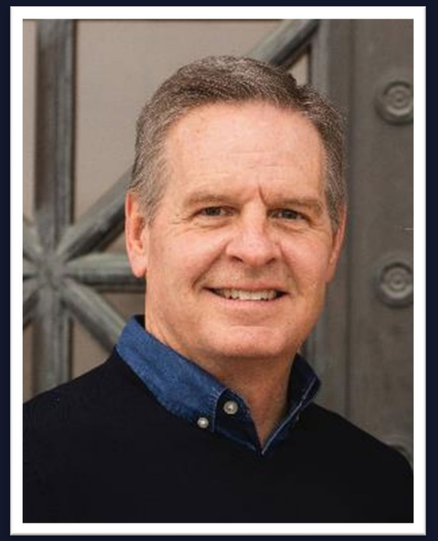
TRACER GAS LEAK TESTING TECHNOLOGY

Meeting Growing Technology and Production Demands



Paul Chamberlain
President/CEO

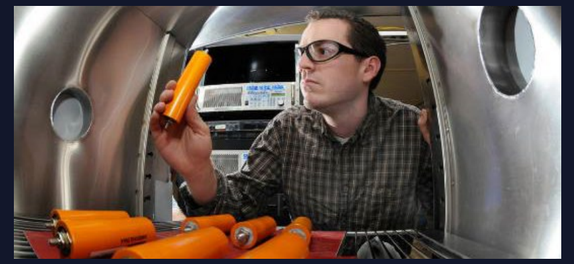
LACO TECHNOLOGIES

OVERVIEW

01

INTRODUCTION TO LACO TECHNOLOGIES

Founded:	1975
Headquarters:	Salt Lake City, Utah USA
Employees:	90+ direct employees
Support Network:	15+ global reps, distributors and ASFs
Customer Reach:	Over 900 customers in 40 countries
Quality System:	ISO 9001:2015 & ISO 17025:2017



LACO IS A LEADING MANUFACTURER & SUPPLIER OF LEAK TESTING SYSTEMS, INSTRUMENTS & ACCESSORIES.

In-house core competencies include

- Engineering, Manufacturing, Calibration Laboratory, and Service & Repair

Leak Testing Technology (LTS Division)

- Turnkey Production Systems
- Instruments (Leak Detectors)
- Accessories (Calibrated Leaks, etc.)
- Services (Repair, PM, Calibration)

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THE LEADER IN TRACER GAS LEAK TESTING

High-Performance Helium Leak Detectors

Standard Platform Leak Test Systems

FLEXSTATION Production Leak Test Systems

FLEXSTATION Production Leak Test Systems

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02

TRENDS IMPACTING LEAK TESTING

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MANUFACTURING TRENDS

- Higher Speed
- Lower Down Time
- Lower Costs of Testing
- Better Test Reliability
- Traceability
- Equipment Flexibility
- Automation

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PRODUCT TRENDS

- Lower Cost
- Higher Reliability
- Longer Life
- Higher Product Safety
- New Product Designs
- Environmental Considerations
- Government Regulations

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TECHNOLOGY TRENDS DRIVE LEAK TESTING

Leak Testing Requirements:

- Find smaller leaks
- Test faster
- Have more confidence in your test results

03

TWO GENERAL METHODS FOR LEAK TESTING

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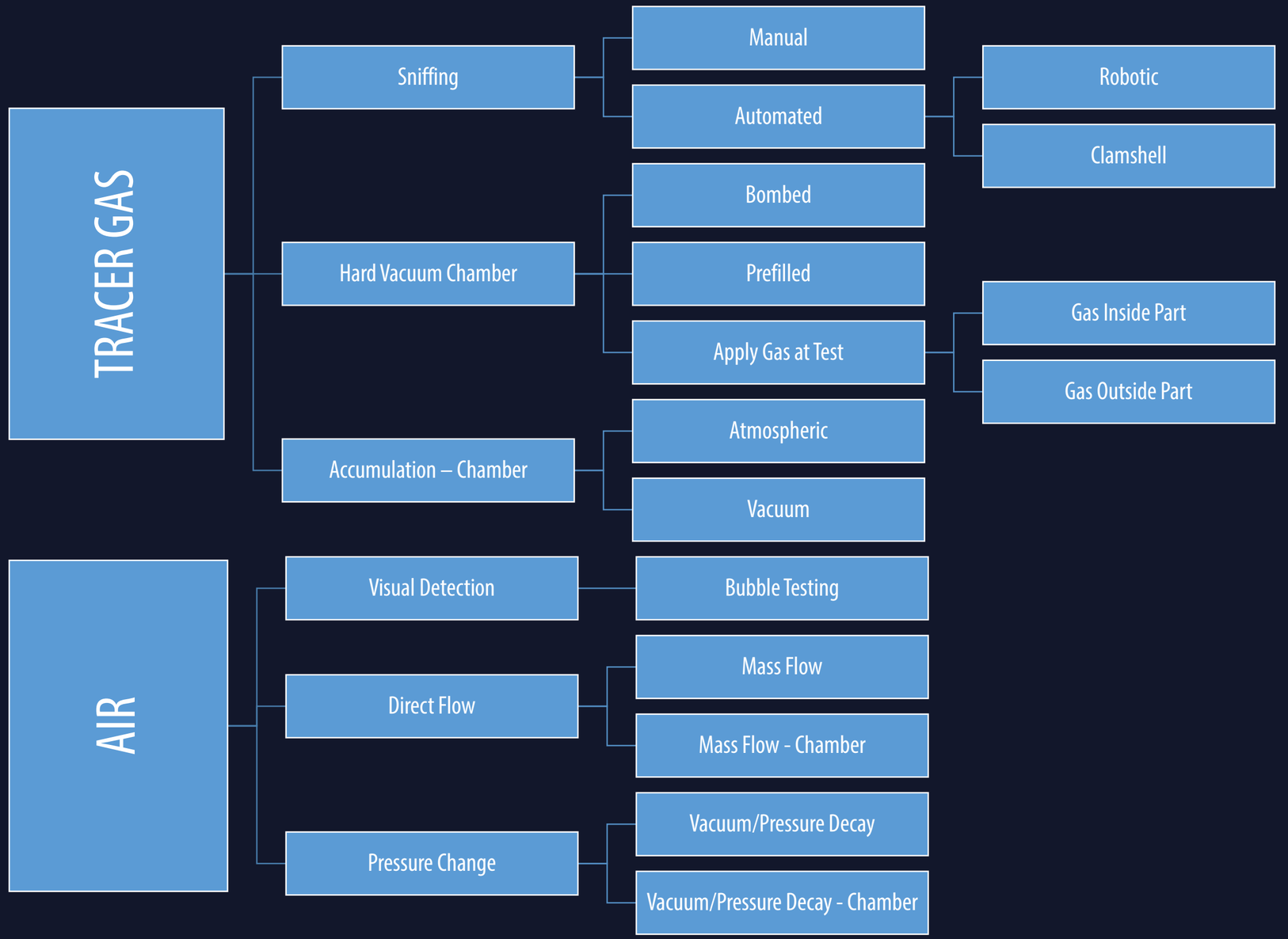
TRACER GAS AND AIR LEAK TESTING



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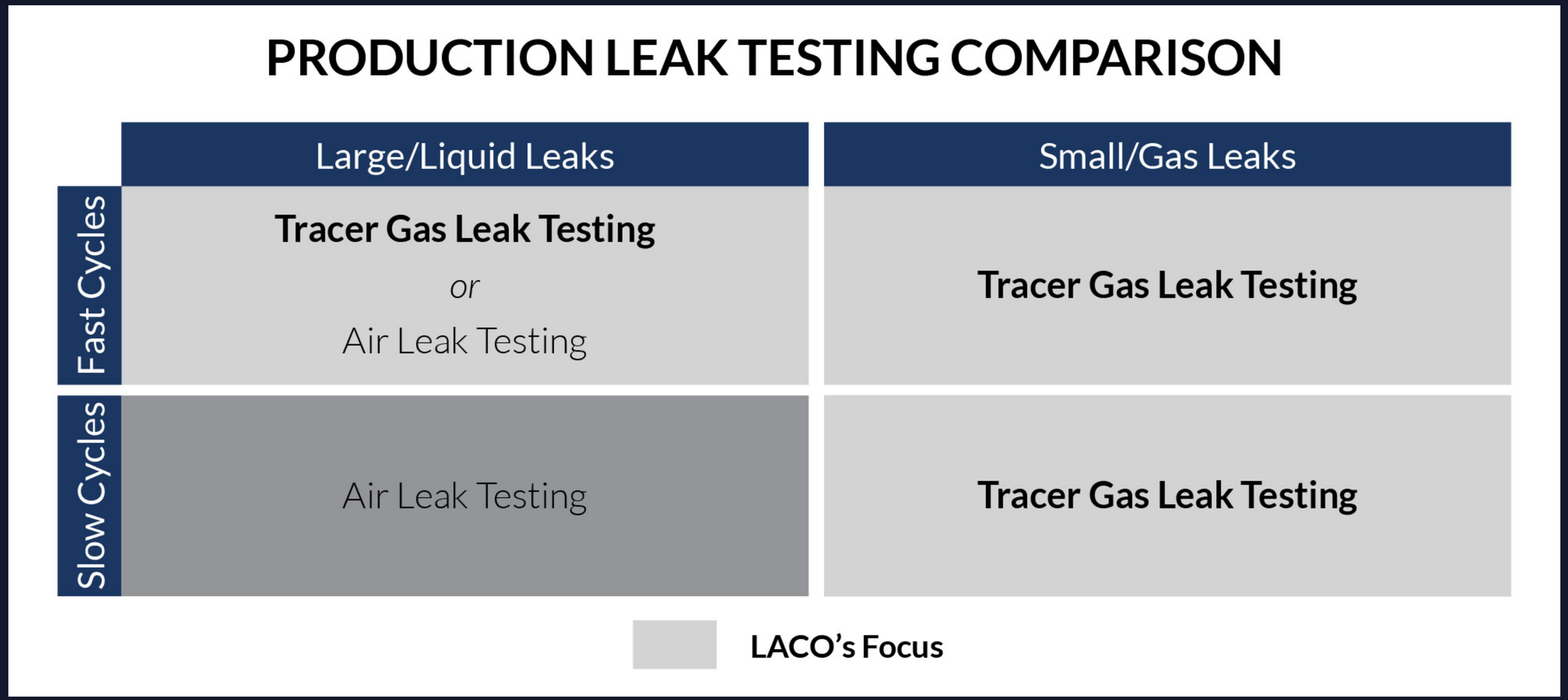
PRODUCTION LEAK TESTING COMPARISON



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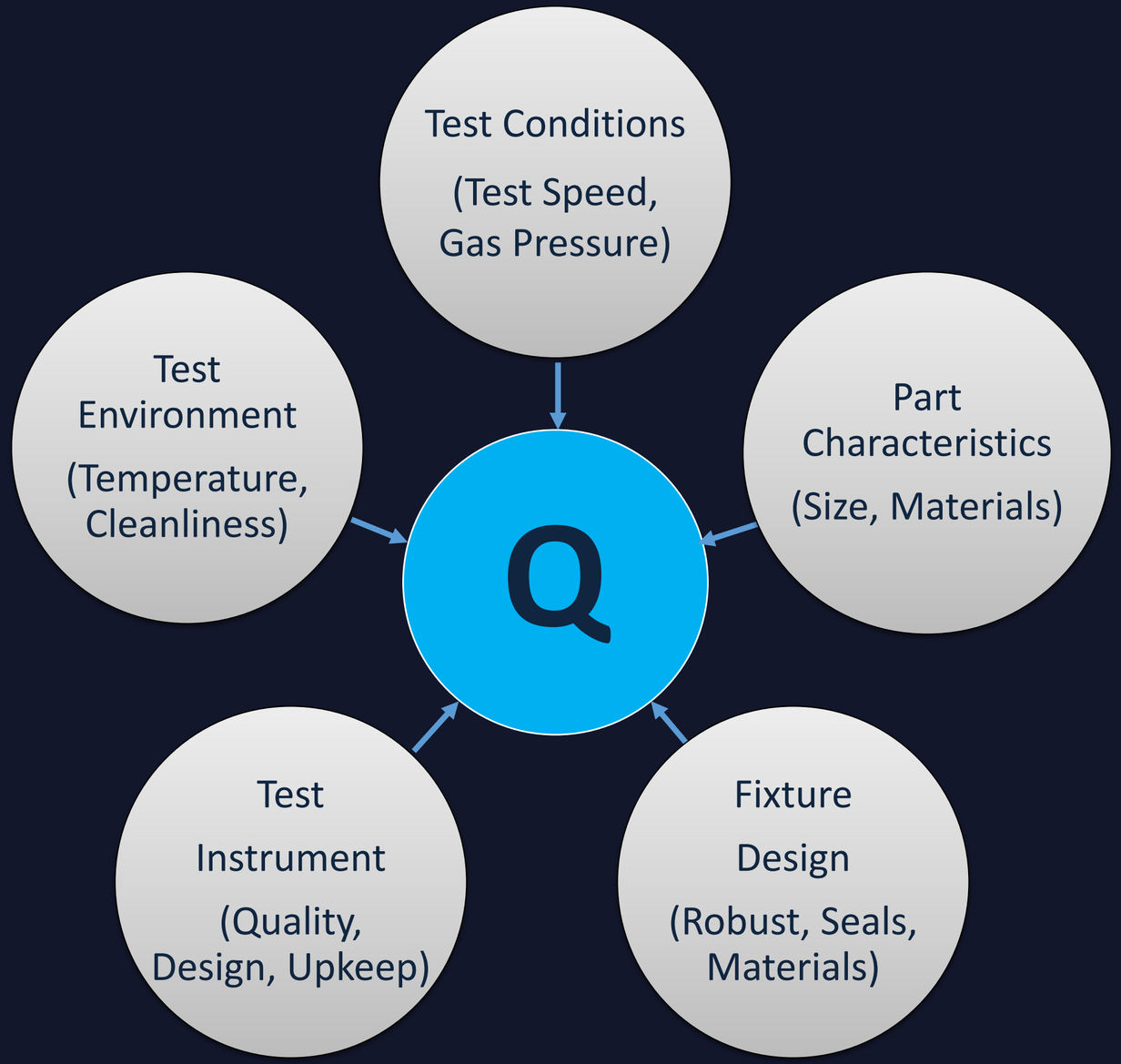
What Can Impact The Measured Leak Rate (Q) – Causing Measurement Uncertainty?



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AIR LEAK TESTING – THREE APPROACHES

Bubble Immersion

- Visually look for bubbles emitting from leak defect
- Not easily quantitative

Pressure Decay

(Indirect Method)

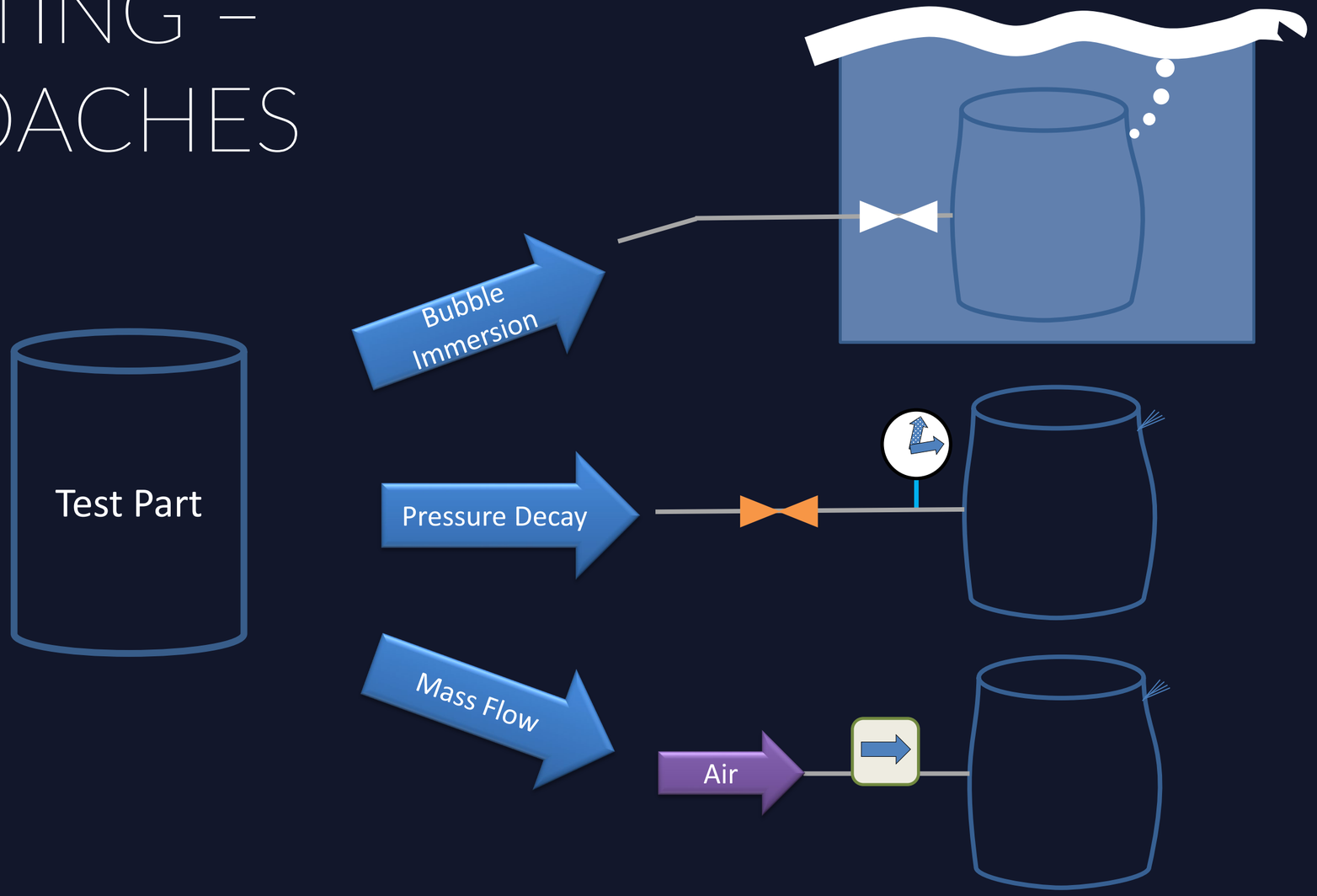
- Electronically measure air pressure drop in a pressurized test part due to a leak defect
- Correlate pressure change to leak rate

Mass Flow

(Direct Method)

- Electronically measure air flowing into a test part that replaces the air leaking out of the part due to a leak defect

AIR LEAK TESTING – THREE APPROACHES



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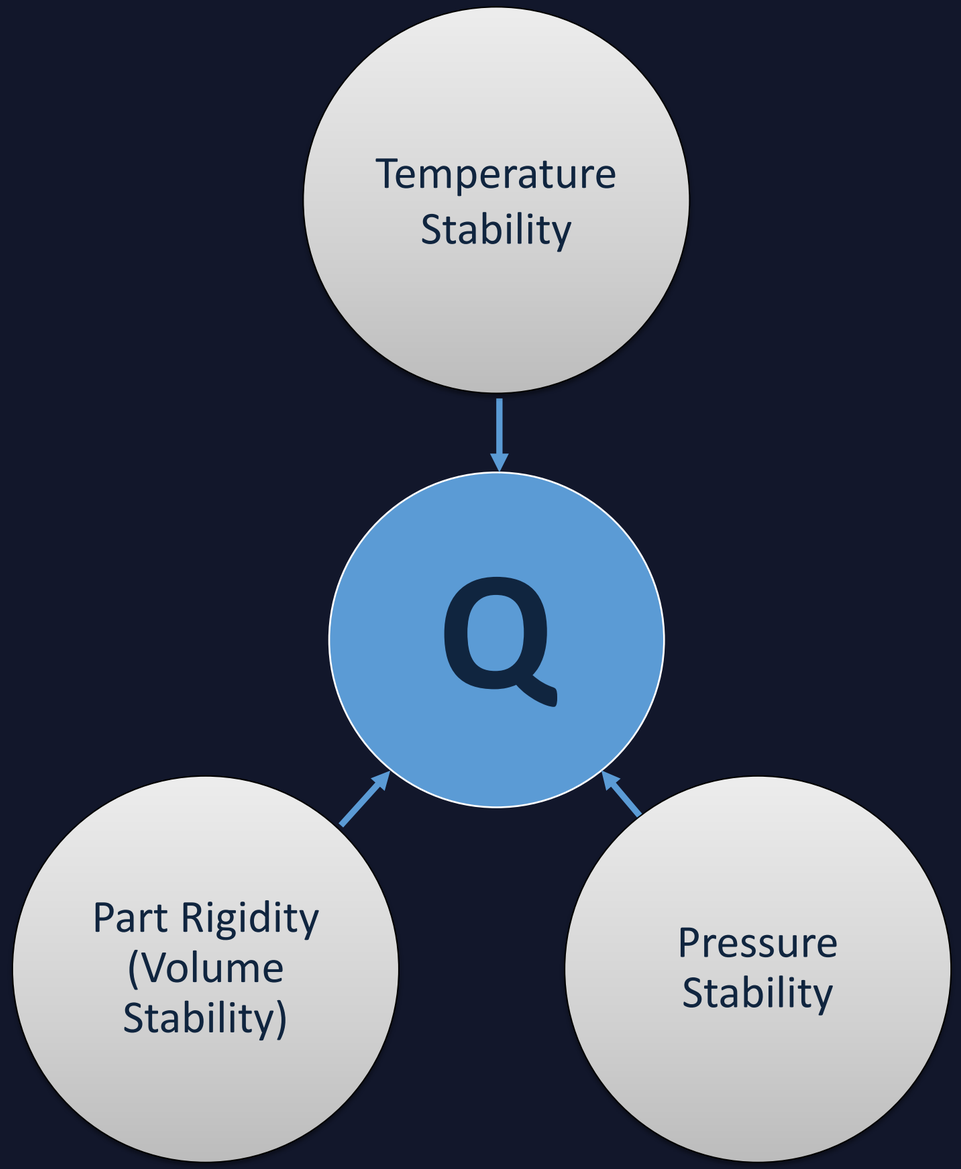
MEASUREMENT UNCERTAINTY IN AIR LEAK TESTING



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AIR LEAK TESTING – Improve Performance

Improve Temperature Stability

- Lower test pressures (less adiabatic heating)
- Slower test times (more time to stabilize temp. before measurement)
- Differential method can cancel out some temperature effects

Improve Pressure Stability

(more critical for Mass Flow method)

- Precision regulators
- Reference volumes
- Differential flow method

Improve Volume Stability

- Ensure part is rigid or restrained
- Slower test times (more time to stabilize volume before measurement)

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AIR LEAK TESTING – Improve Performance

All efforts to speed up test cycle time or improve sensitivity of the test - will result in more measurement uncertainty and erode confidence in the test results.

This is because one is constrained by basic laws of physics. It is very challenging to overcome instabilities when making very small total pressure or total flow air measurements at high speeds.

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TRACER GAS LEAK TESTING

Test part is filled with tracer gas which flows through a leak defect and is detected by a gas detector (usually a Helium Leak Detector) on the opposite side of the boundary.

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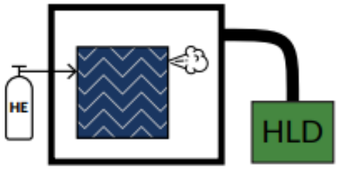
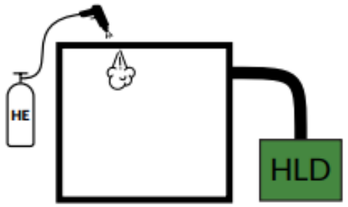
TRACER GAS LEAK TEST METHODS

Hard Vacuum

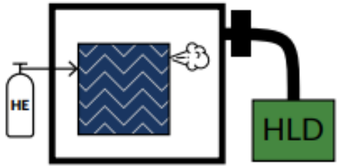


Inside-Out

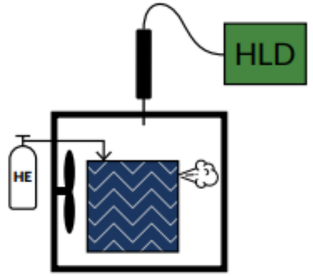


Outside-In

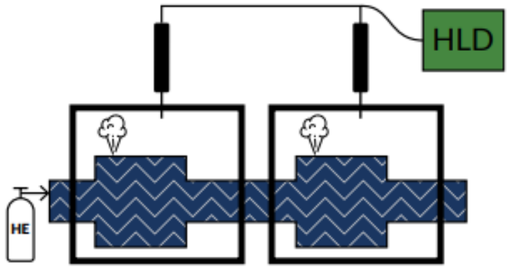
Accumulation



Vacuum

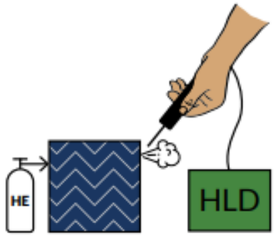


Atmospheric

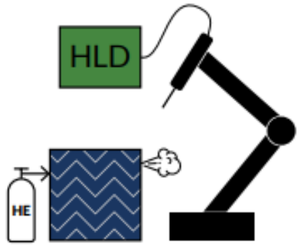


Multi-Chamber

Sniffing



Manual



Robotic

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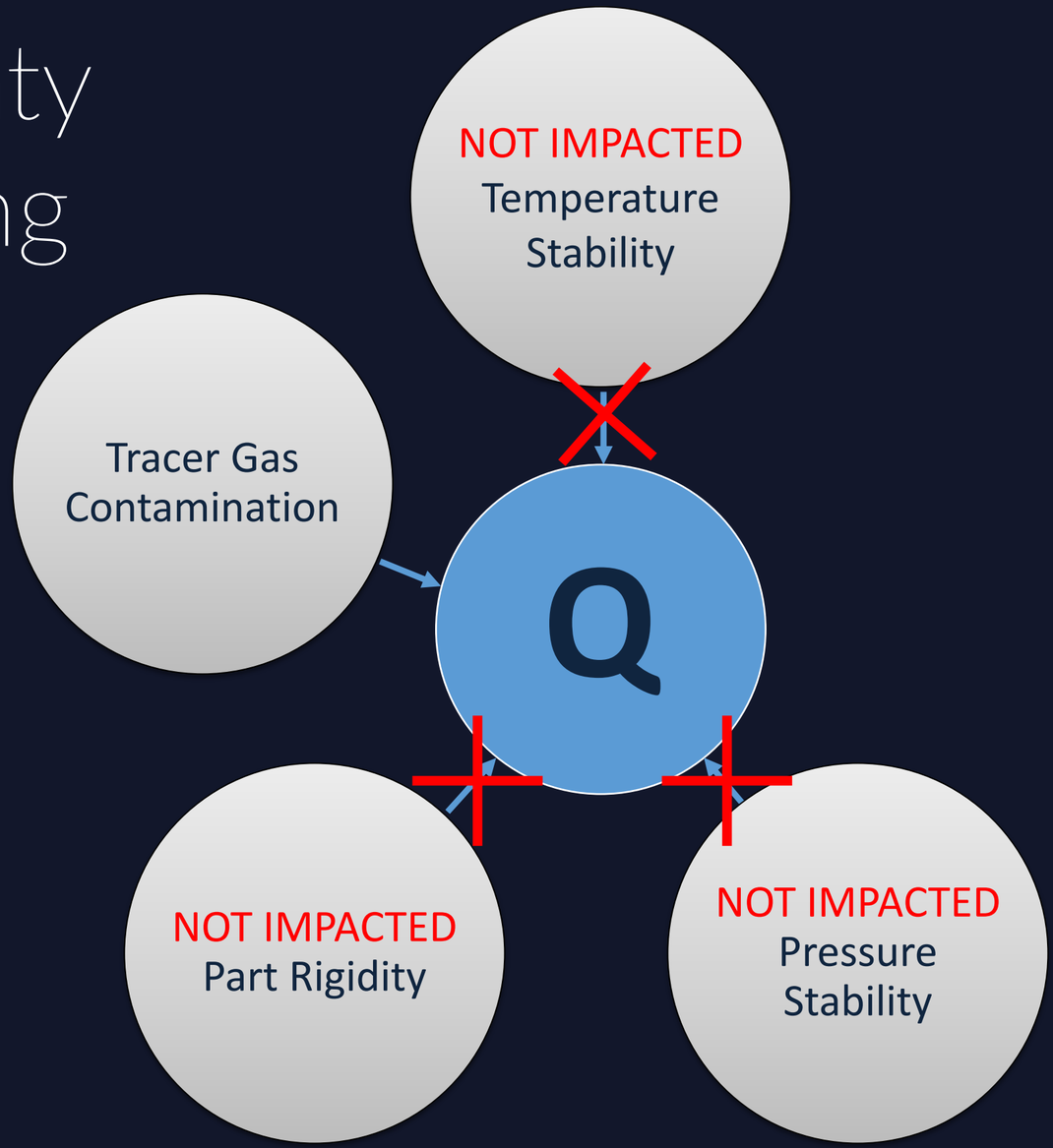
Measurement Uncertainty in Tracer Gas Leak Testing



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TRACER GAS LEAK TESTING
Improving Performance

- Tracer gas contamination is the primary challenge that can impact tracer gas leak testing.
- Noise or background levels of the tracer gas (such as helium) can interfere with the ability to measure the leak – particularly smaller leaks.
- This can be easily overcome by proper design and operation of the leak testing system.

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TRACER GAS LEAK TESTING
Alternative to Air Leak Testing

- Because tracer gas leak testing is much more sensitive compared to air leak testing, it can be considered as an alternative when faster test cycles or more sensitive leak testing is needed.
- Depending on certain factors, helium tracer gas leak testing can find leaks up to 100,000 times smaller than air leak testing methods in a production leak testing environment.
- Tracer gas leak testing is also NOT sensitive to variations in test gas pressure, temperature, or test volume – like air leak testing is.

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TRACER GAS LEAK TESTING PERFORMANCE

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TRACER GAS SELECTION

The Ideal Tracer Gas

- Rare in the natural environment (not interfere with measurement)
- Inert – will not chemically react
- Easy to detect separately from other gas species
- Environmentally friendly
- Low cost
- Readily available

TRACER GAS TESTING PERFORMANCE

Candidate Tracer Gases

Helium

- Most common and most sensitive
- Inert gas, low atmospheric concentrations, sensitive instrument
- Can be easily diluted and/or recovered

Hydrogen

- Used in limited applications in place of helium (less sensitive)
- Used as forming gas (5% H_2, 95% N_2) for safety
- Is highly reactive and present in environment in many forms

Other Inert Gases

- All other inert gases are either very expensive or have relatively high concentrations in the environment, causing background noise and limiting sensitivity (Argon, for example)

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TRACER GAS TESTING PERFORMANCE
Candidate Tracer Gases (con't)

Refrigerants

- Good candidates for tracer gas testing when the refrigerant is already part of the system to be tested (already charged in the device)
- Often used with the sniffing technique

Other Gases or Vapors

- Any other sealed device that has a gas or a volatile liquid inside can be tracer gas tested with the media sealed inside the device
- Sensitivities and test cycle times will vary greatly depending on the nature of the gas or vapor

TRACER GAS TESTING PERFORMANCE

Tracer Gas	Best Practical Sensitivity (atm.cc/sec)	Can Be Diluted	Can Be Recovered	Test Methods	Relative Tracer Gas Cost
Helium	1 x 10-9	Yes	Yes	Vac Chamber, Atm Chamber, Sniffing	High (at 100% Conc.)
Hydrogen	1 x 10-5	No	No	Sniffing	Low
Argon	1 x 10-6	Not Practical	Yes	Sniffing, Vac Chamber	Medium
Refrigerants	1 x 10-6	No	Yes	Sniffing, Vac Chamber	N/A
Electrolyte Vapor	1 x 10-5	N/A	N/A	Sniffing, Vac Chamber	N/A

Helium Leak Testing

When is it a good candidate to replace Air Leak Testing?

- Need to speed up test cycle time (not compromising measurement uncertainty or variability of test results)
- Need to tighten up leak rate sensitivity (reject limit)
- The product needs to be tested at high test pressures (higher the pressure, the better likelihood for improvement)
- The product contains large internal dead volume
- The product volume (part) cannot be kept stable when pressurized

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Helium Leak Testing

When considering replacing Air Leak Testing

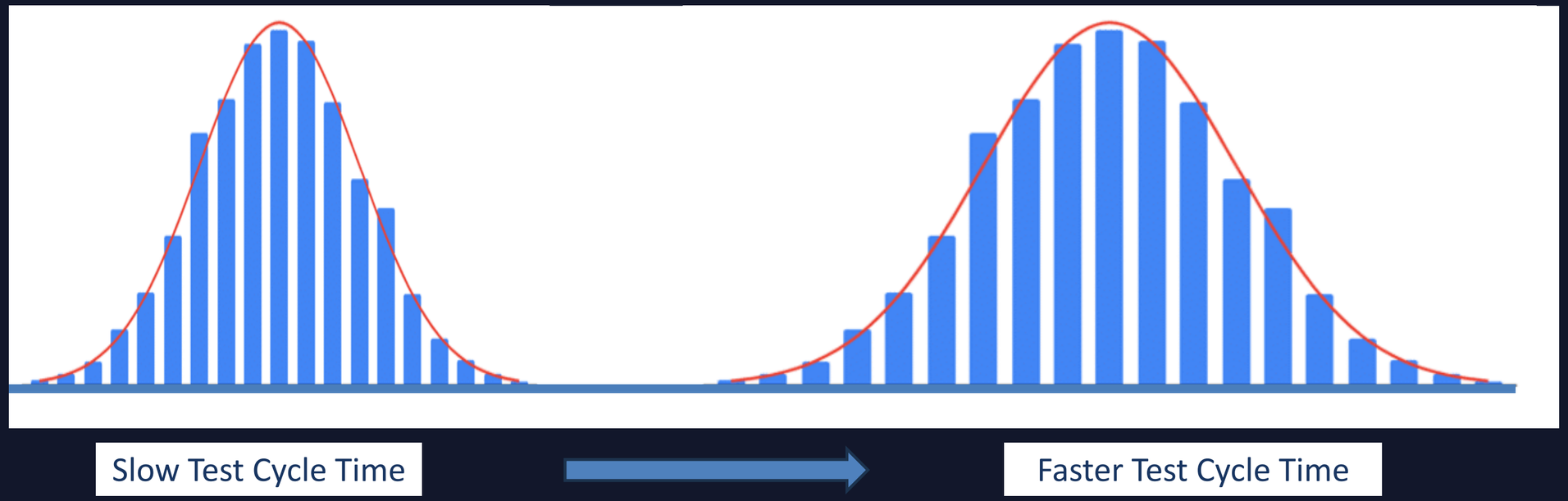
For Example:

- An air pressure decay application with a leak rate limit of 0.5 sccm (8.3 x 10-3 atm.cc/sec) can sometimes be successfully tested.
- But if there is a demand to speed up the cycle time the results may become less repeatable and the test become impossible to perform.

Helium Leak Testing

When considering replacing Air Leak Testing (con't)

Potential impact on test results by speeding up test cycle on air leak testing applications.



Result: More variability in test results.

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Helium Leak Testing

When considering replacing Air Leak Testing (con't)

Example:

- Air pressure decay application with a leak rate limit of 0.5 sccm (8.3 x 10-3 atm.cc/sec)
- Substitute helium hard vacuum chamber method using 5% helium, results in an equivalent helium leak rate of 4.2 x 10-4 atm.cc/sec.
- This leak rate is easily achievable with high repeatability using a helium leak detector
- Because the helium is highly diluted the helium cost is very minimal.
- Result: Faster cycle times without sacrificing repeatability
- NOTE: In this application, Hydrogen (forming gas) might also be a candidate

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CASE STUDIES

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AUTOMOTIVE BATTERY PACK (TRAY)

Purpose of leak testing is to prevent ingression and meet IP67 leak tightness requirements

- Leak rate limit would be in the range of 1 sccm.
- Under some conditions, 1 sccm is within the range of air pressure decay leak testing method.
- However, due to large part size (internal dead volume) and potential for volume expansion (creep) when internally pressurized to only a few psi, air pressure decay is not a good candidate.
- A tracer gas method is recommended.

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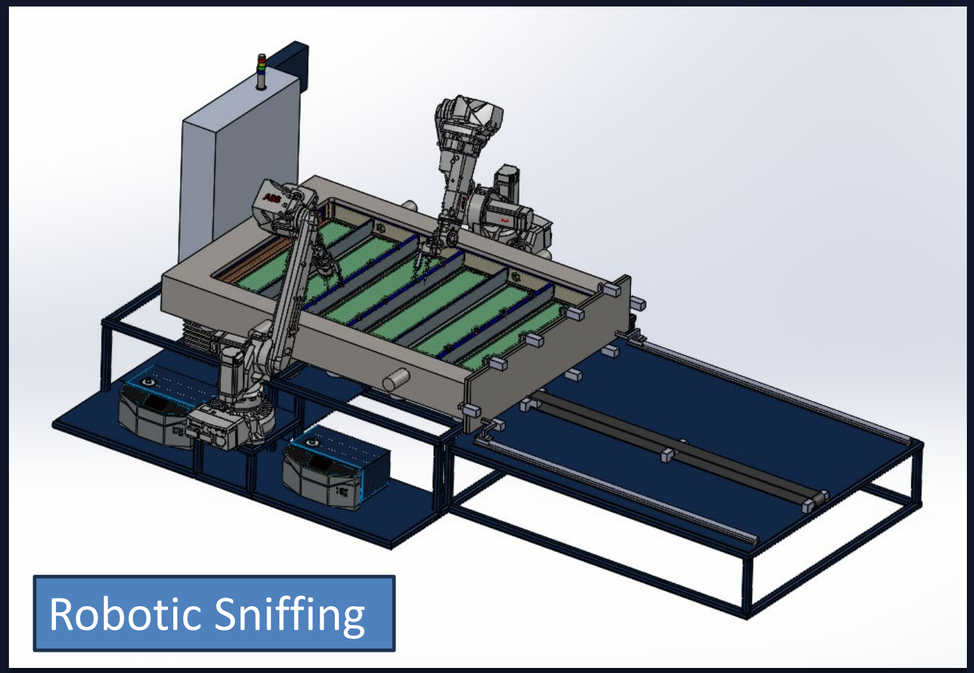
AUTOMOTIVE BATTERY PACK (TRAY)

Tracer Gas Methods Using Helium or Forming Gas H_2



Robotic Sniffing

Chamber Accumulation

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Fire Protection Sprinkler

Purpose of leak testing is to prevent leakage of water within the sprinkler manifold.

- Leak rate requirement of 3 sccm
- Test pressure of 500 psig
- Need to reduce test cycle time from 12 seconds to 8 seconds
- Due to high test pressure, reducing the cycle time will not allow for temperature stabilization, resulting more variability in test results – risking false positives and false negatives
- A helium tracer gas method is recommended using 1% helium
    - Equivalent leak rate: 1x10-3 atm.cc/sec (well within helium tracer gas leak testing capabilities)

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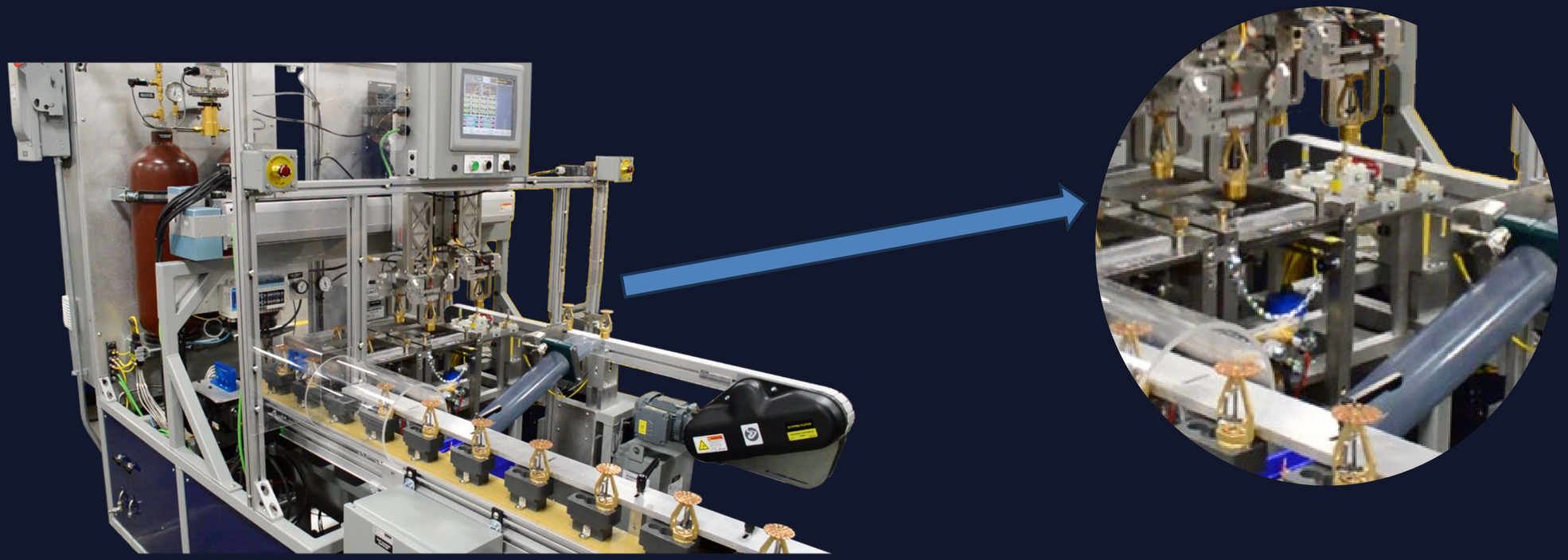
Fire Protection Sprinkler

Hard vacuum chamber or accumulation chamber method



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Battery Cell for Solar Panel Storage

Purpose of leak testing is to prevent electrolyte vapors from escaping and prevent humidity from entering the cell.

- Leak rate requirement of 0.01 sccm (1.7x10-4 atm.cc/sec)
- Too tight for air pressure decay leak testing.
- A helium tracer gas (5% helium) or hydrogen (forming gas) method is recommended

- Options:
  - Helium hard vacuum chamber leak test.
  - Hydrogen (forming gas) automated sniffer leak test.

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CONCLUSION

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TRACER GAS LEAK TESTING

- Much more sensitive compared to air leak testing methods. Able to meet increasingly stringent application demands.
- Not sensitive to factors such as temperature and test volume variations that can impact test results.
- Able to replace air leak testing methods in circumstances where measurement variability is unacceptable and/or faster cycles are required.
- In many of these applications diluted helium or forming gas (5% H_2) can be used, which significantly minimizes the cost impact.

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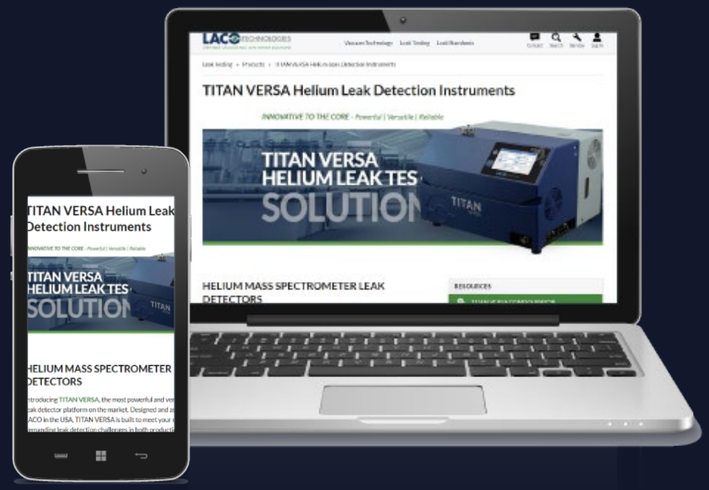
LACO Technologies

The industry-leading tracer gas leak test company, offering a complete range of solutions - from leak test instruments and accessories, to turn-key production systems.



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THANK YOU

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