NorCom SYSTEMS, INC.

Optical Leak Testing (OLT) Technology

January 5, 2026

Optical Leak Test Features

- Simultaneous gross and fine leak inspection in 1 test.
- Shorter test cycles. Sometimes only 6 minutes.
  - Eliminates helium bombing.
- Test with CDA, nitrogen, or helium.
  - Helium shortage temporary shut down an OLT Customer.
  - Until they switched to nitrogen.
- High volume testing. Up to 500 devices at a time.
- Usually < 10 minutes to setup a new p/n.
- Test packages mounted to a circuit board.
- Results can be networked for serial number tracking.
- Outputs results in L_{air} or L_{He} cc-atm/sec.
  - Simple or no conversion to reject limits in 883.

Hermetic Leak Test Methods

- Helium Mass Spectrometry, HMS (Fine)
- Bubble Leak testing (Gross)
- Dye Penetrant (Gross) (Destructive)
- Residual Gas Analysis (Destructive)
- Krypton 85 Fine and Red Dye for Gross
- Optical Leak Testing, OLT (Fine and Gross)

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Technical Issues with HMS and Bubble Leak Testing

- Long helium bomb cycle times, usually 8 hours.
  - Two helium bomb cycles.
  - One for HMS, another for bubble leak testing.

- Problems with bubble leak test.
  - High cost of fluorinert liquids for bubble test.
  - 3M to stop producing these fluids YE 2025.
  - Due to environmental concerns, there may be no supply.
  - Very operator dependent. Miss seeing bubbles.
  - Product contamination by fluids during bubble testing.

- Helium absorption by package causes false failures.
  - Typical problem with fiber optic cables attached.
- Gap in test coverage in the $1x10^{-5}$ cc-atm/sec range.

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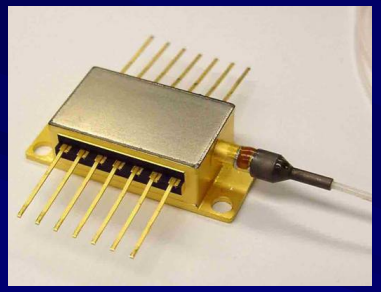
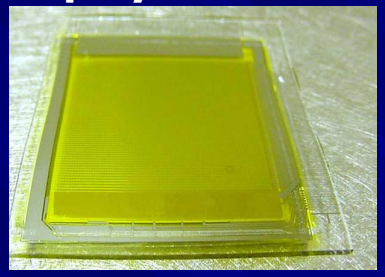
Typical Package Types for OLT

Butterflies

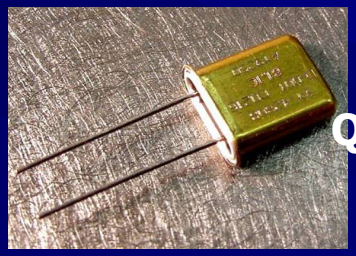


Pacemakers

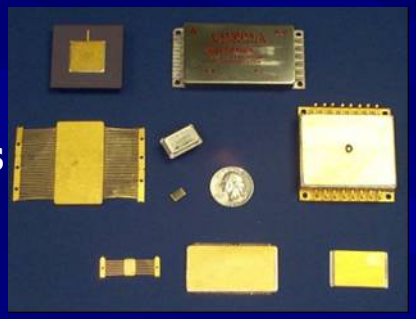
Display Devices



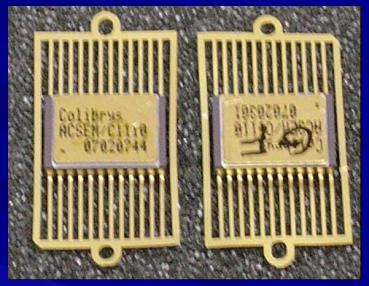
Frequency Control



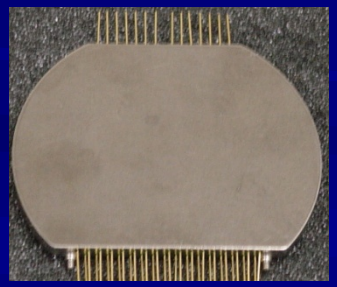
Quartz Crystals



Hybrids

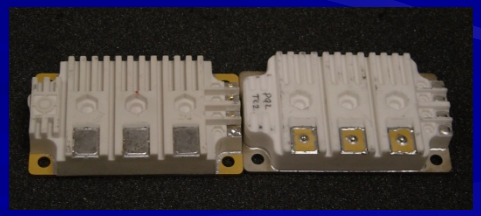


Fiber Optics



Custom

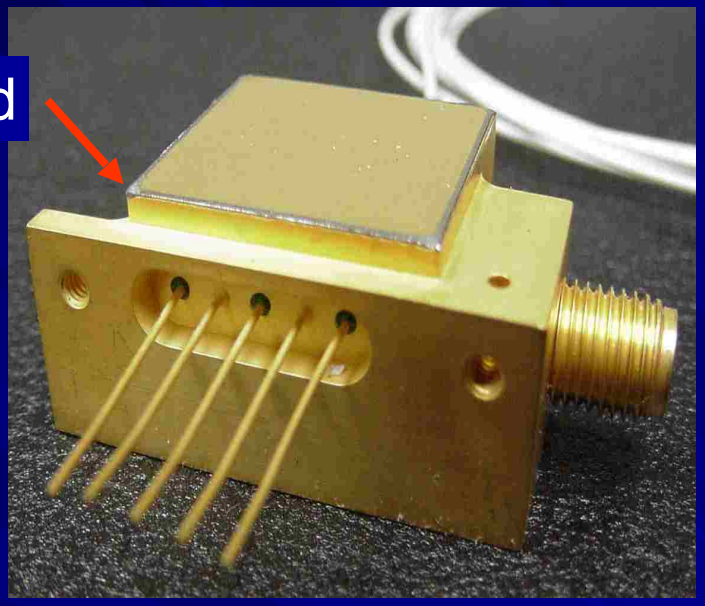
TO Styles

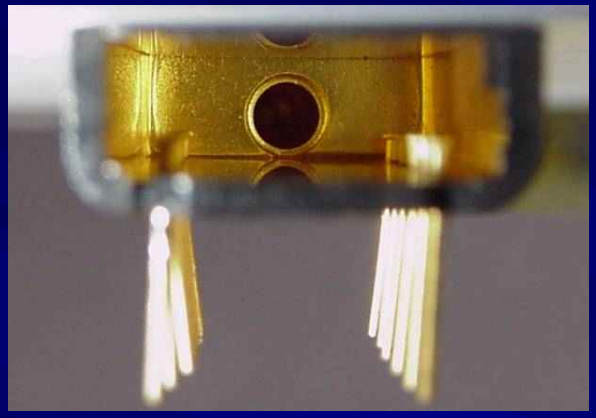


Power Devices

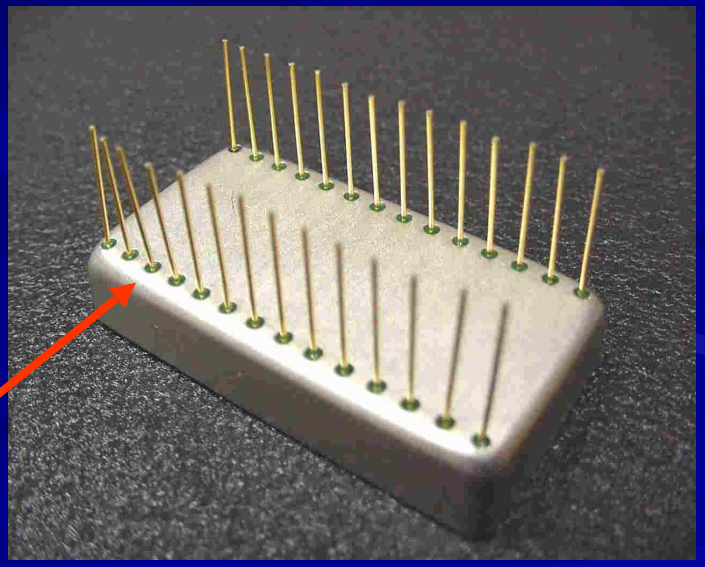
Sources of Leaks in Packages

Along the weld



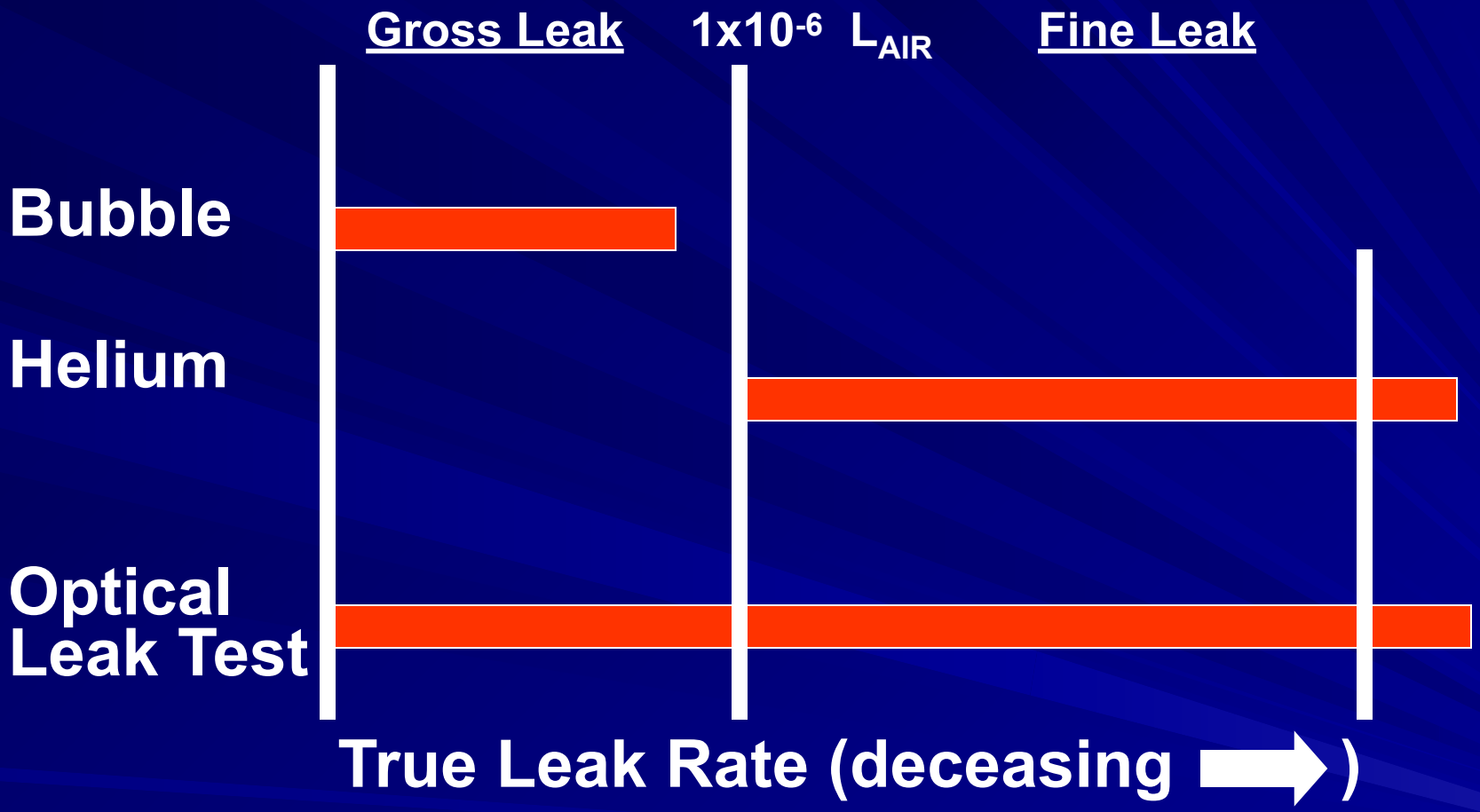


A defect in the lid or housing



At the glass to metal feed through

No Gap in Coverage with OLT



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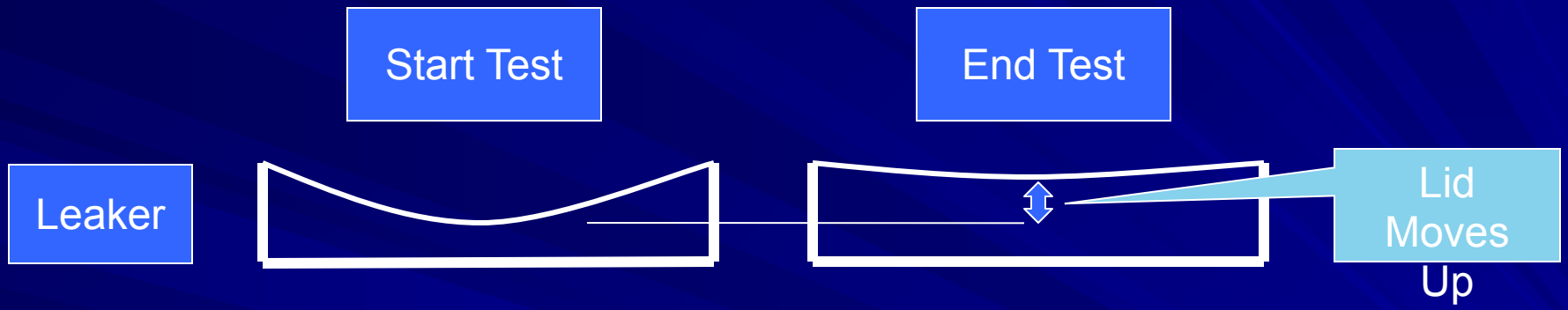
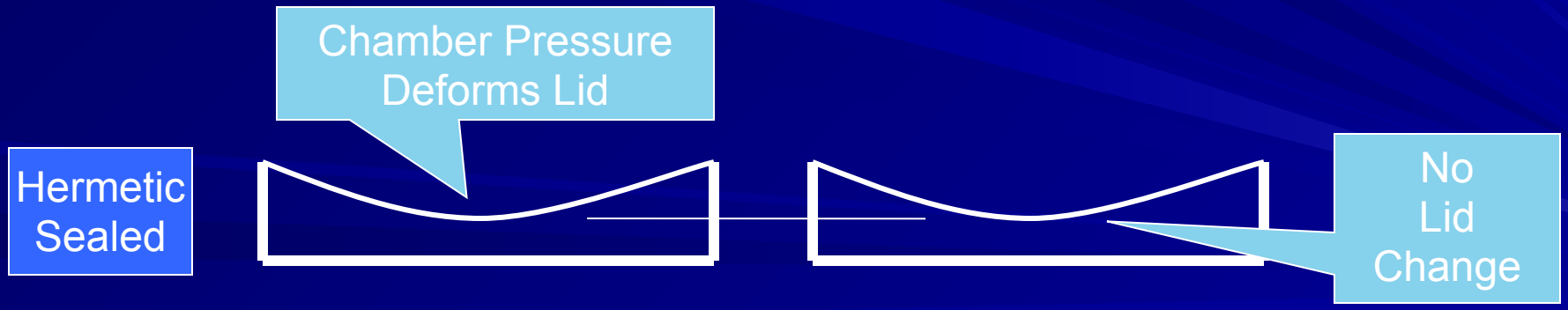
Theory Leaking vs Hermetic

- Side view of package.
- Chamber pressure causes lid to bow down “ ”.

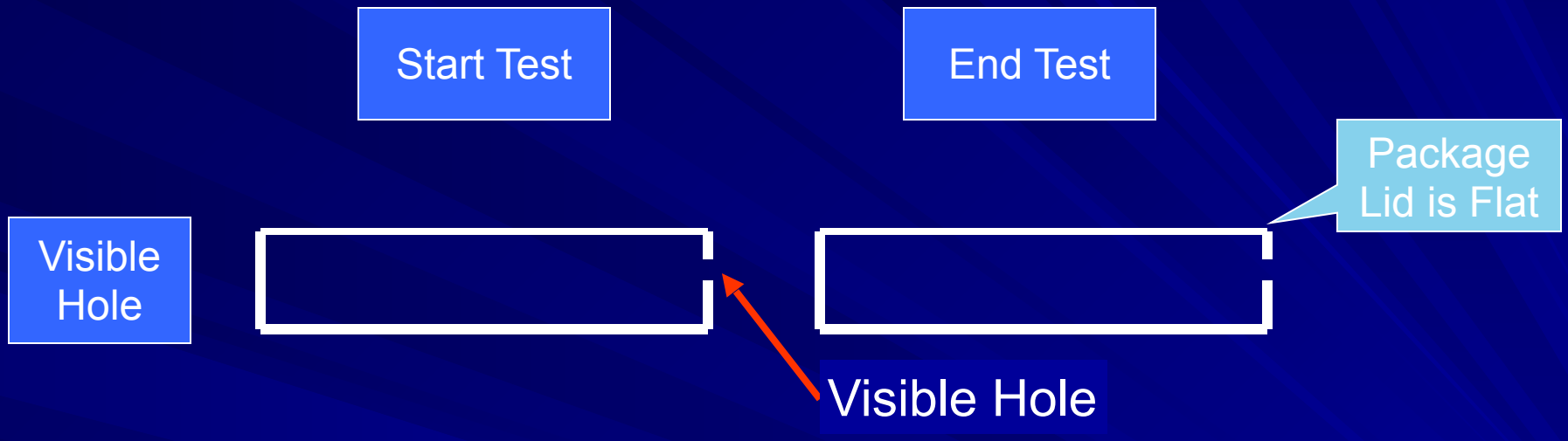


- Air rushes in on a leaking package to push lid up.

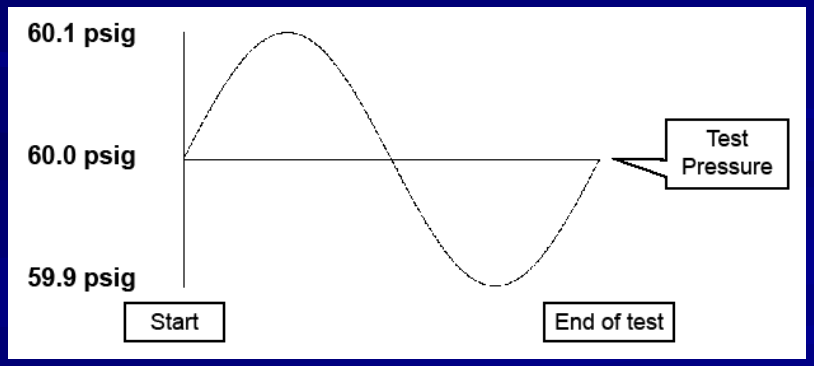


- Air can not get into sealed package to move lid.

Theory with Visible Hole



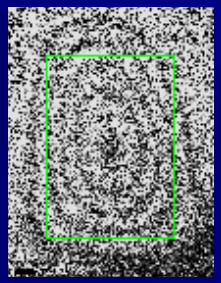
- Air rushes in through visible hole so lid stays flat.
- Add pressure modulation to measure spring rate of lid.
- Above lid stiffness is 0 um/psi. Hermetic > -0.02 um/psi.



- Typical pressure modulation for butterfly package with lid stiffness – 1um/psi.

Interference Fringes

- Fringe is short for Interference Fringe.
- Definition by britannica.com.
  - A bright or dark band caused by beams of light in phase or out of phase. Light waves will add their crests if they meet in the same phase (bright band). The troughs will cancel the crests if they are out of phase (dark band).
- Similar to dropping a pebble in water.



Live video fringe of package with changing pressure.

Convert with software

Phase map showing fringes on leaking device.

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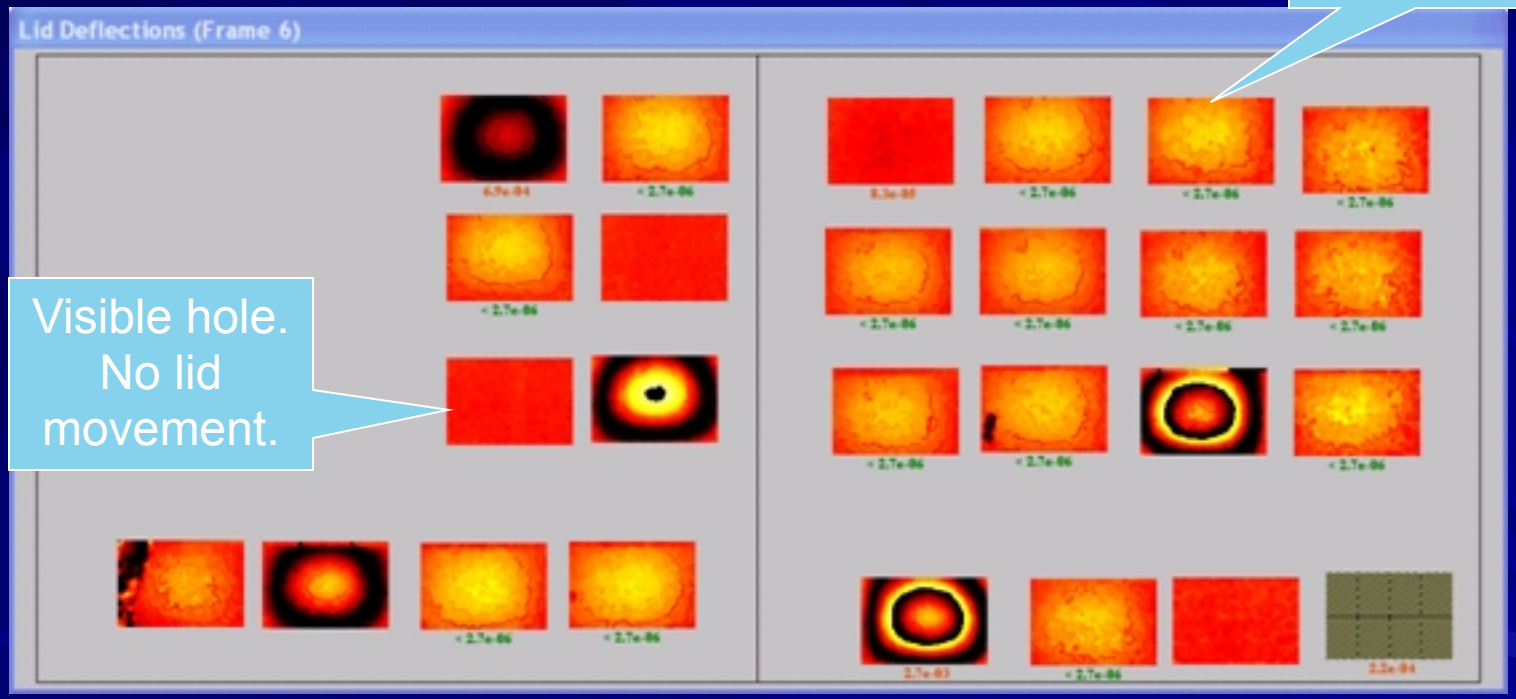
Laser Interferometer Phase Maps

- Phase maps taken every 6 seconds or so throughout leak test.



Hermetic: only one fringe

Visible hole. No lid movement.

Leaker: Many fringes indicate lid moving up.

1 fringe = 0.13 um
= ¼ wavelength of light

Only OLT Can Directly Measure L_{air}

- Table VII in MIL-STD-883 is proper table for reject limits, which are in L_{air} .
- HMS uses Howl Mann equation to convert R to L.
- Only OLT can directly measure L_{air} with air.

OLT Capability

- Recent test on wafer level device.
  - 24 hours, 64 psig, 0.01 cc,
  - stiffness -0.05 um/psi.

  - L_{he} = 1.04 x 10^{-10} cc-atm/sec (actual)
  - L_{air} = 3.87 x 10^{-11} cc-atm/sec (calculated)
  - R_1 = 3.93 x 10^{-14} cc-atm/sec (calculated)

- OLT matches Krypton 85 capability.
- OLT exceeds HMS capability.

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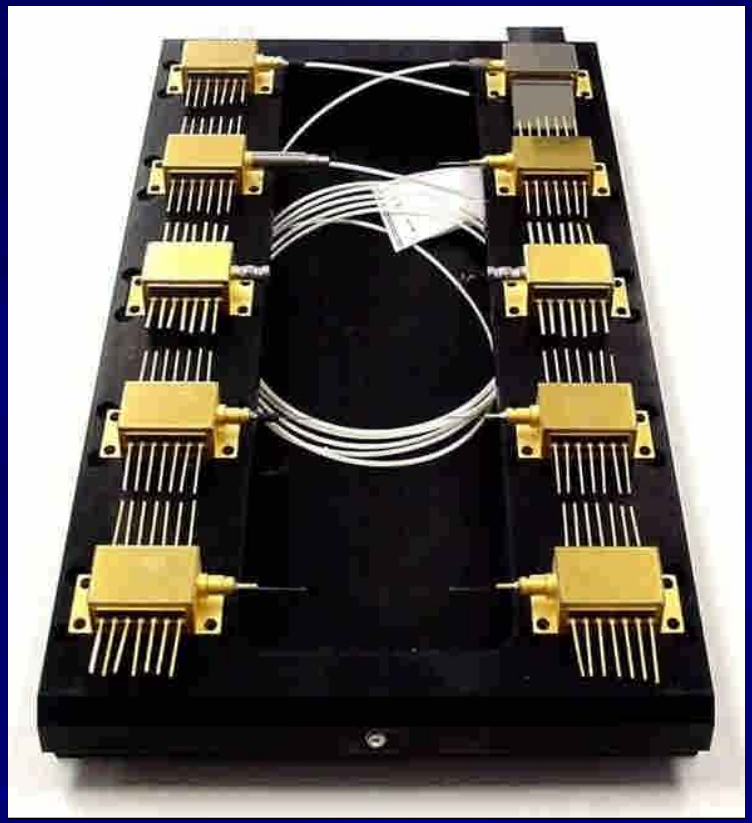
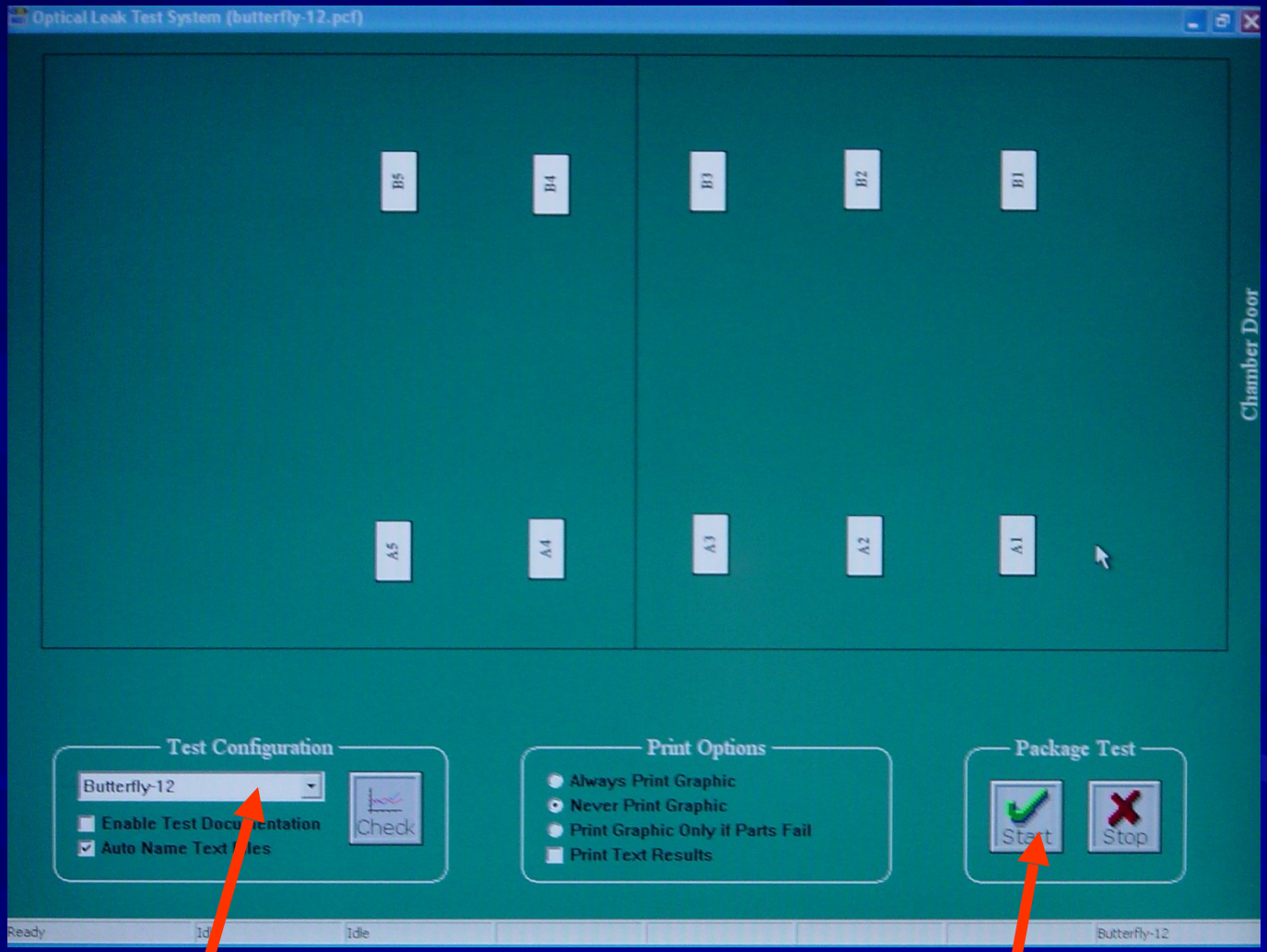
System Operation



Butterfly devices with fiber optics in tray

Operator places tray into system and closes chamber door.

Simple to Start Test



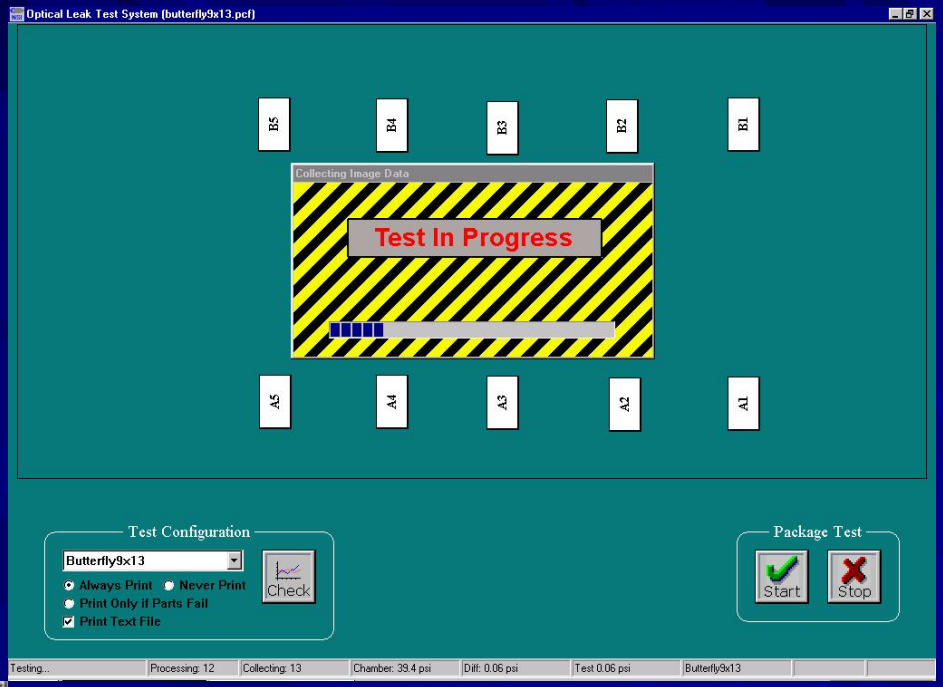
Choose from Menu

Press Start

Test Results

Shows 6 failing and 4 passing packages.

After Test



During Test

Test Report

System ID:	LEAKTEST40-702			
Software:	LeakTest (21.1.0.0)			
Config:	Butterfly2.pcf			
Run Mode:	2020-12			
File Name:	20210510_1129_Butterfly2.txt			
Test Date:	5/10/2021			
Test Time:	11:29:22			
Package:	Butterfly2			
Duration:	4	min		
Pressure:	30.004	psi		
Modulation:	0.13	psi		
Stiffness:	-0.9	um/psi	Allowable:	80%
Volume:	1	cc		
Cal Floor:	0.015	psi		
Sensitivity:	1.03E-06		atm-cc/sec	
Crit Leak:	2.60E-06		atm-cc/sec	

ID	Status	Leakage psi	Stiff um/psi	Codes	LHe Leak Rate atm-cc/sec	S/N
A01	Fail	2.345	-0.012	S	Gross	B8
A02	Fail	10.678	-0.794		4.51E-04	B9
A03	Fail	0.573	-0.868		5.331E-05	B10
A04	Pass	-0.011	-0.976		< 1.0e-06	B1
A05	Fail	-2.105	0.006	S	Gross	488
B01	Fail	0.855	-0.889		5.90E-05	B6
B02	Fail	13.329	-1.009		1.20E-03	902
B03	Pass	-0.001	-0.901		< 1.0e-06	B5
B04	Pass	0	-0.829		< 1.0e-06	4088
B05	Pass	0.003	-0.958		< 1.0e-06	816

Status

Leak Rate

Serial #

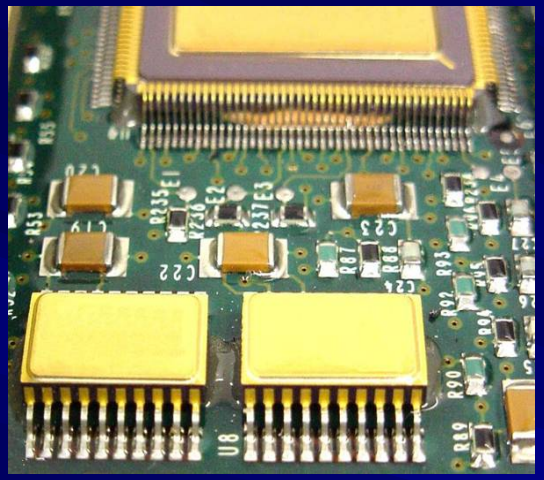
Test Report

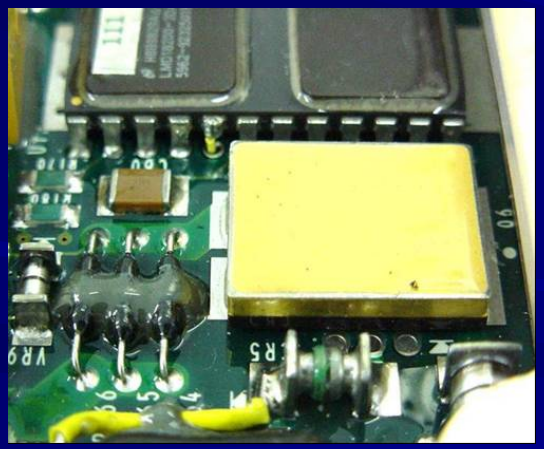
- Shows pass / fail status.
- Test result for each package.
- Serial numbers, s/n, can be entered with bar code reader prior to test.
- Text file can be uploaded to server for serial number and quality tracking.

Optical Leak Test System

Model 2020-12

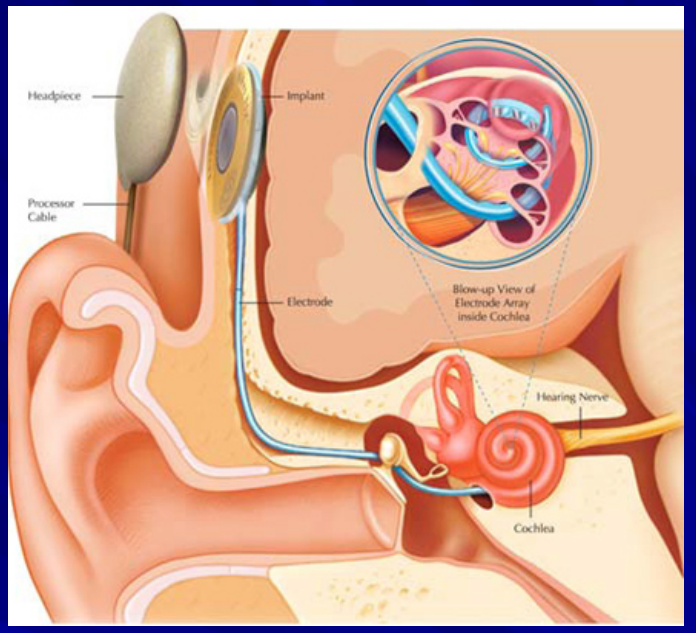
Testing Board Mounted Devices





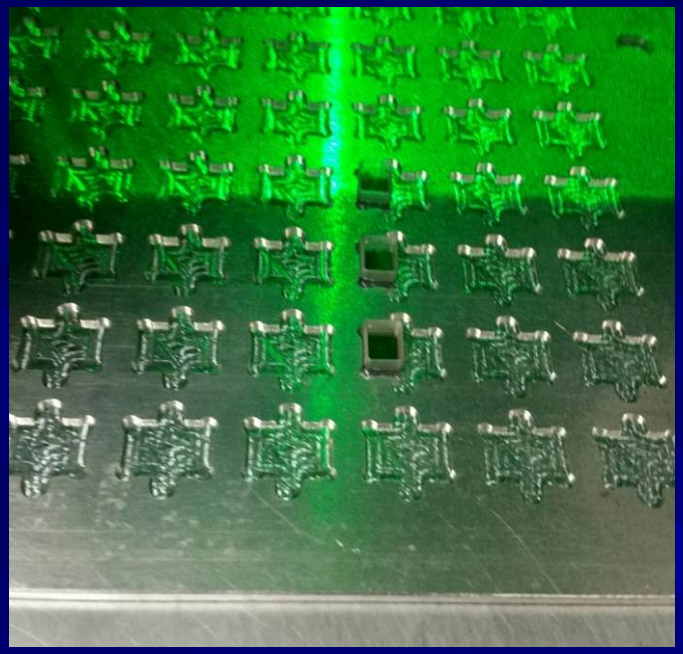
- Hermetic devices may fail during board assembly due to high temperature soldering process.
- Optical Leak Testing is not subject to gas absorption issues, so can test devices on assembled circuit boards.
- Since boards usually absorbs helium, HMS can not be used.

Testing Implanted Medical Devices



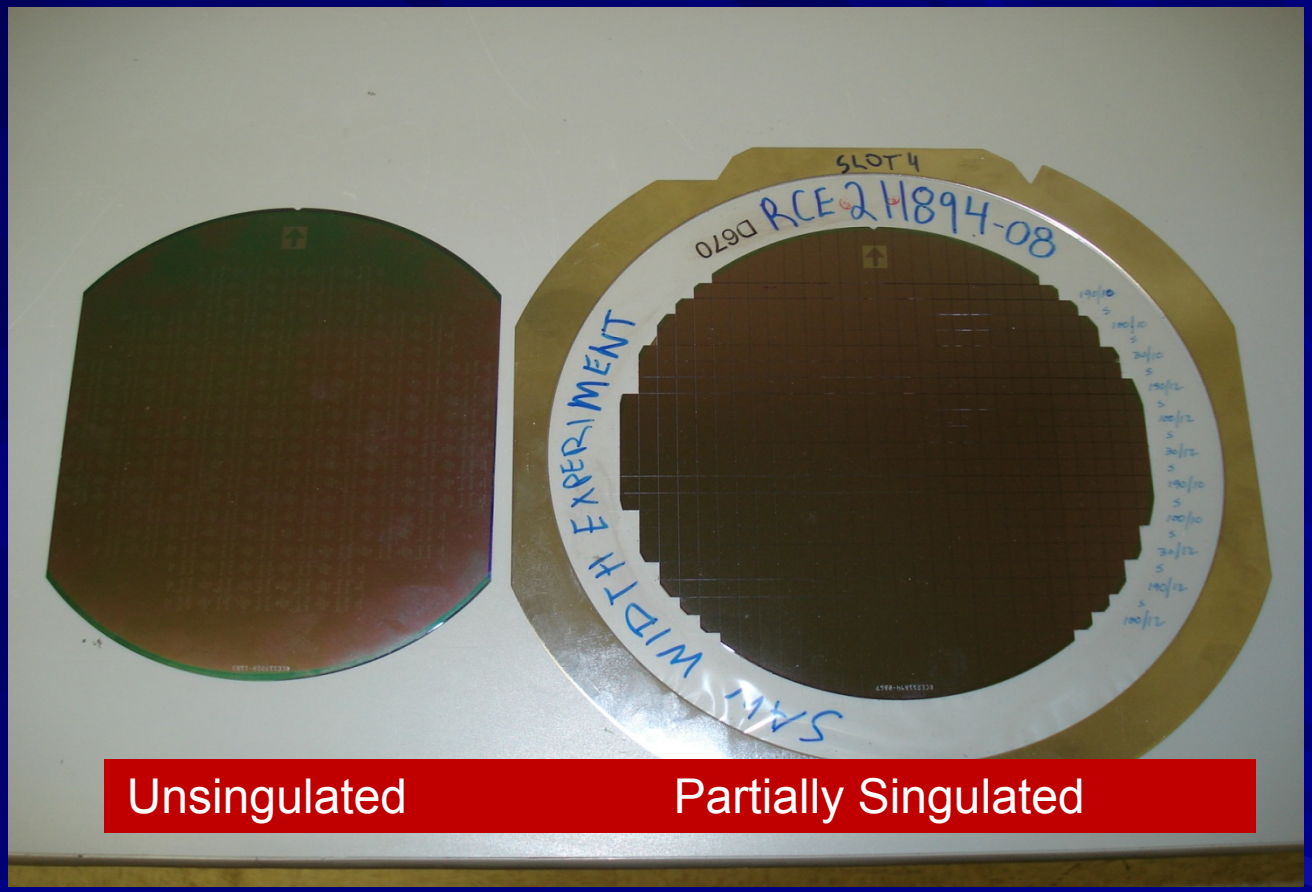
- **Hearing implant can be inserted in the skull of a toddler and may last 80+ years.**

OLT Leak Testing Retina Implant



- Module with clear window implanted on retina.
- Small: 3.5 x 5 x 2mm
- Applique or label to reflect laser light back to camera during OLT leak test (not shown).

Inspecting Wafer Level Devices



Because OLT is not susceptible to gas absorption, it's able to test wafer level parts that have cavities such as MEMS devices before or after they are diced.

Wafer Level Inspection

- Inspects up to 1000 devices per cycle
- Wafers can be tested while mounted to a saw frame

Optical Leak Technology Overview

- Tests for gross and fine leaks in one inspection
- Provides in-line, full matrix product testing
- No Helium bombing required
- No Helium absorption problems
- Inspects board mounted devices
- Eliminates bubble leak testing and use of Flourinert
- Easy to automate leak test operations and provide SPC

- Established in 1998 to support the Microelectronic, Medical, Automotive, Hybrid and Mems communities
- Over 300 installations in over 75 companies world wide
- The Optical Leak Testing method is listed in both Mil-Std 883 TM1014 and Mil-std 750 TM 1071
- Mature technology with a proven track record
- NorCom provides training, and installation support, and full warranty service

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