TWENTY-SEVENTH ANNUAL

TestConX™

Archive

DoubleTree by Hilton
Mesa, Arizona
March 1-4, 2026

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Enhanced Test Socket Reliability:

Through Multi-Modal Failure Analysis and Design Optimization for High-Volume Semiconductor Manufacturing

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Tektronix Component Solutions

Mesa, Arizona ● March 1–4, 2026

Background
Ramped Production

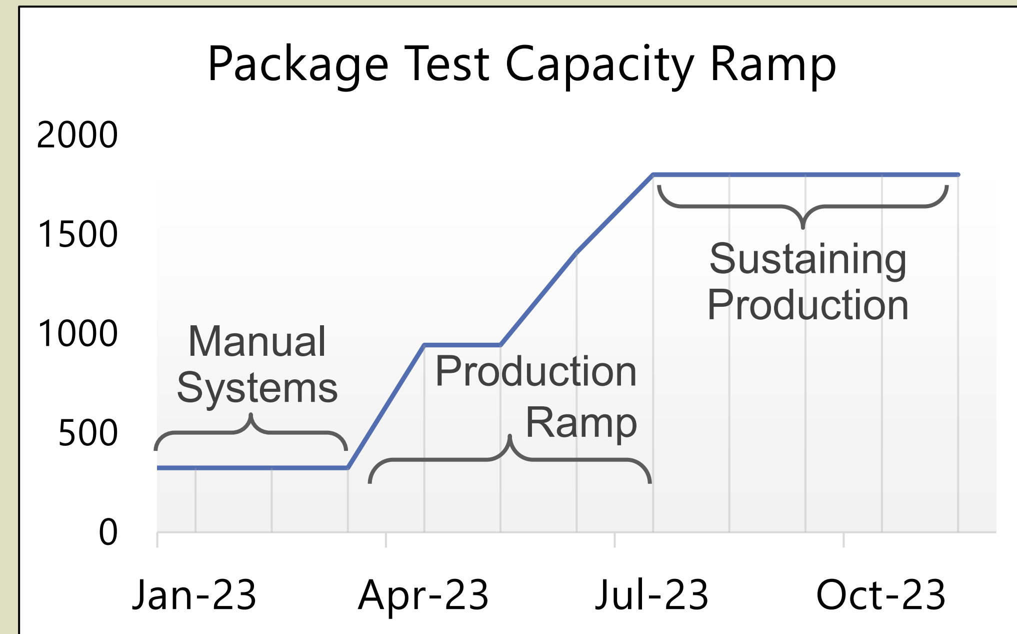
New Program Demand:

Execute **fivefold** increase in BGA package test output within a compressed timeline to meet critical program deliveries

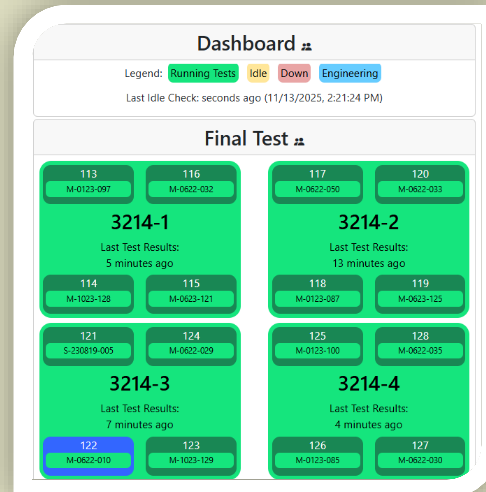
Our Solution:

- ✓ Introduce automated handling test equipment
- ✓ Workforce expansion
- ✓ Factory visibility and data capture

Qty. 6 Manual Single Site Test Systems



Real Time Dashboard



Additional Qty. 4 Quad-Site Robot Handler Test Systems

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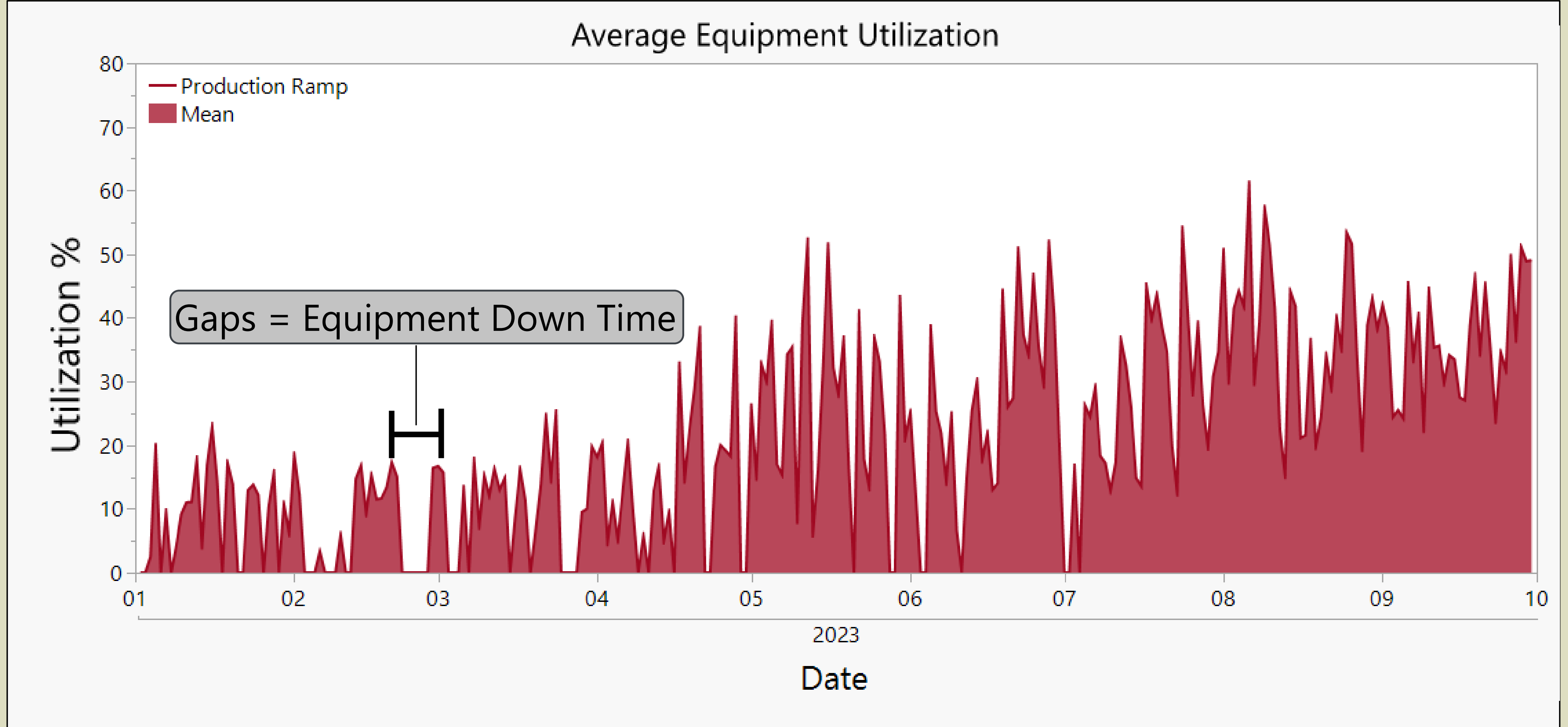
Background
Test Application

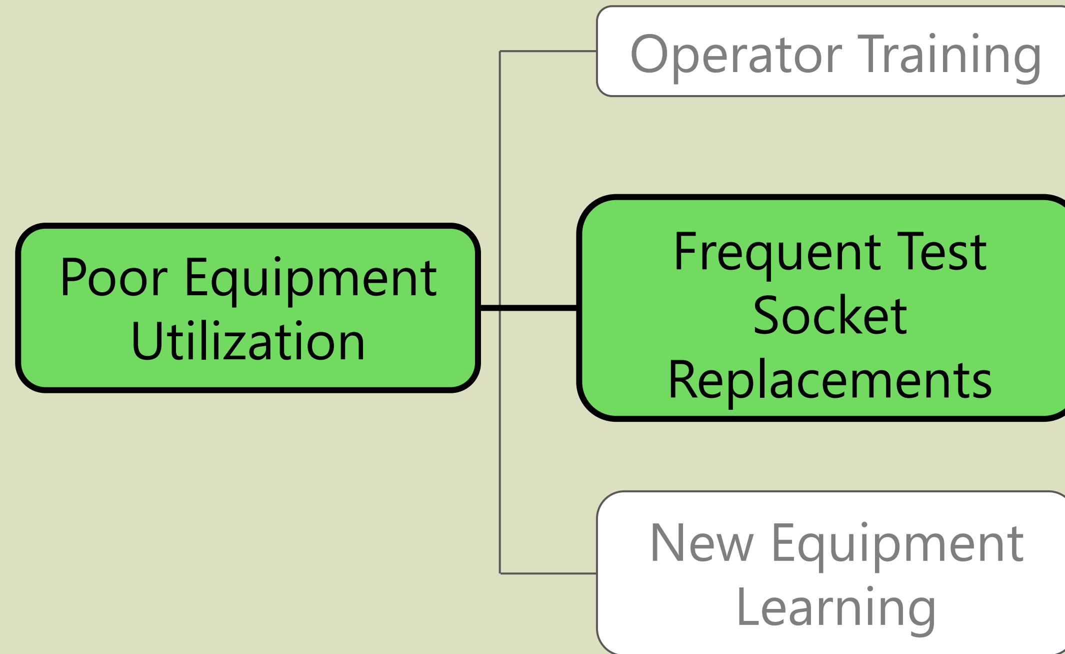
★ **Test Highly Sensitive to CRES**

	Tri-Temp	**3x 30min test**	Performance must be ensured at hot, cold and ambient temperatures
	At-Speed		Part is tested at speed conditions as it would be used in its end application
	System Level Test (SLT)		On Board peripherals to test transmission and control of external resources
	IO Characterization		Instead of a simple IO check, Inputs and Outputs are characterized
	Multiple Communication Methods		Subtests are executed to check different forms and different lines of communication between on board peripherals
	State Performance		There is extra complexity added as the chip is tested in its different operating states

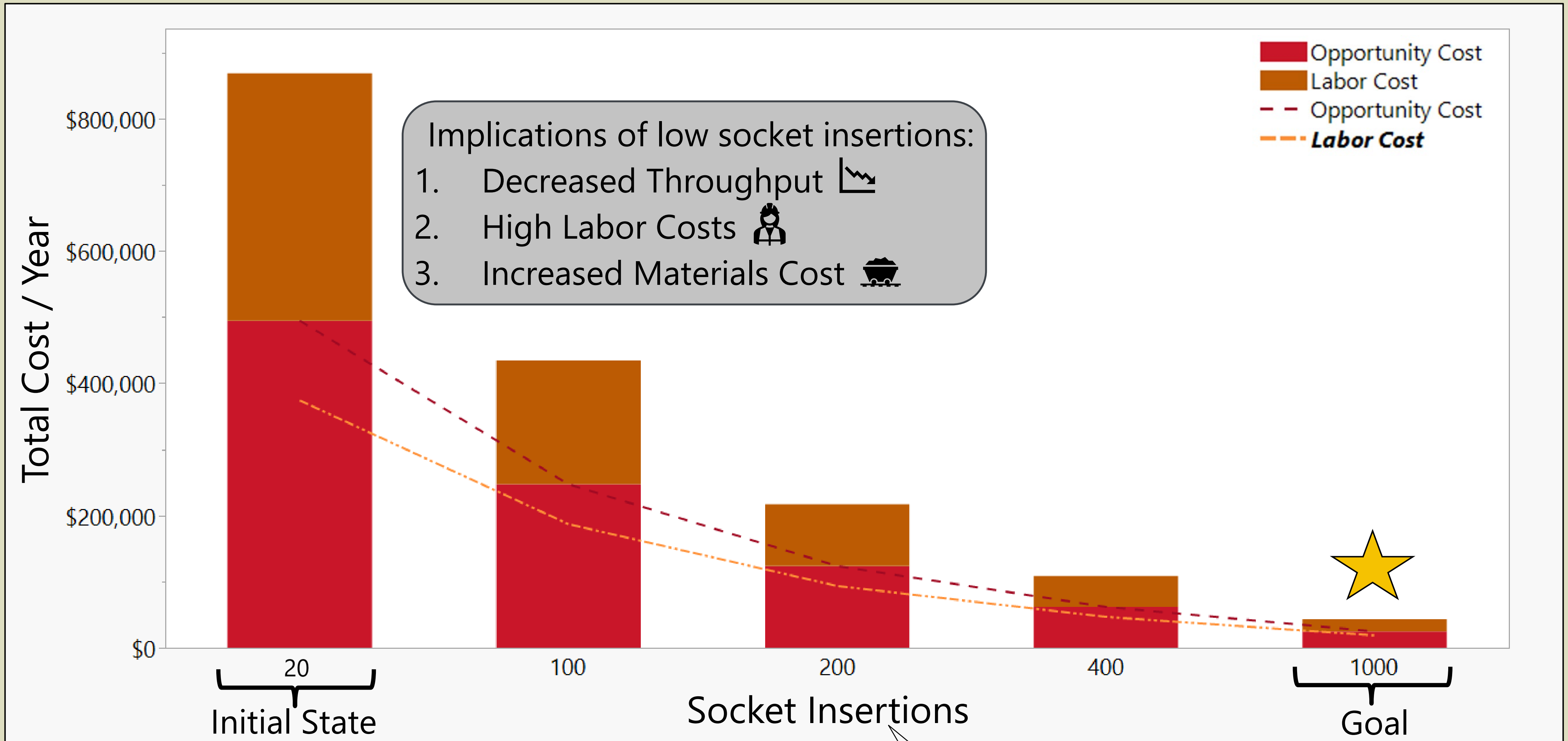
The Problem



Problem Solving Process



Motivation



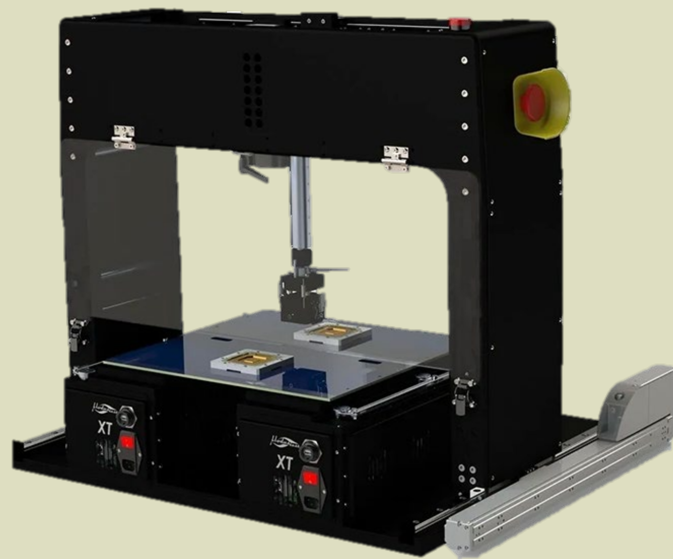
Insertions = Tested Parts Between Maintenance Events

The Tools

Real-Time Dashboard

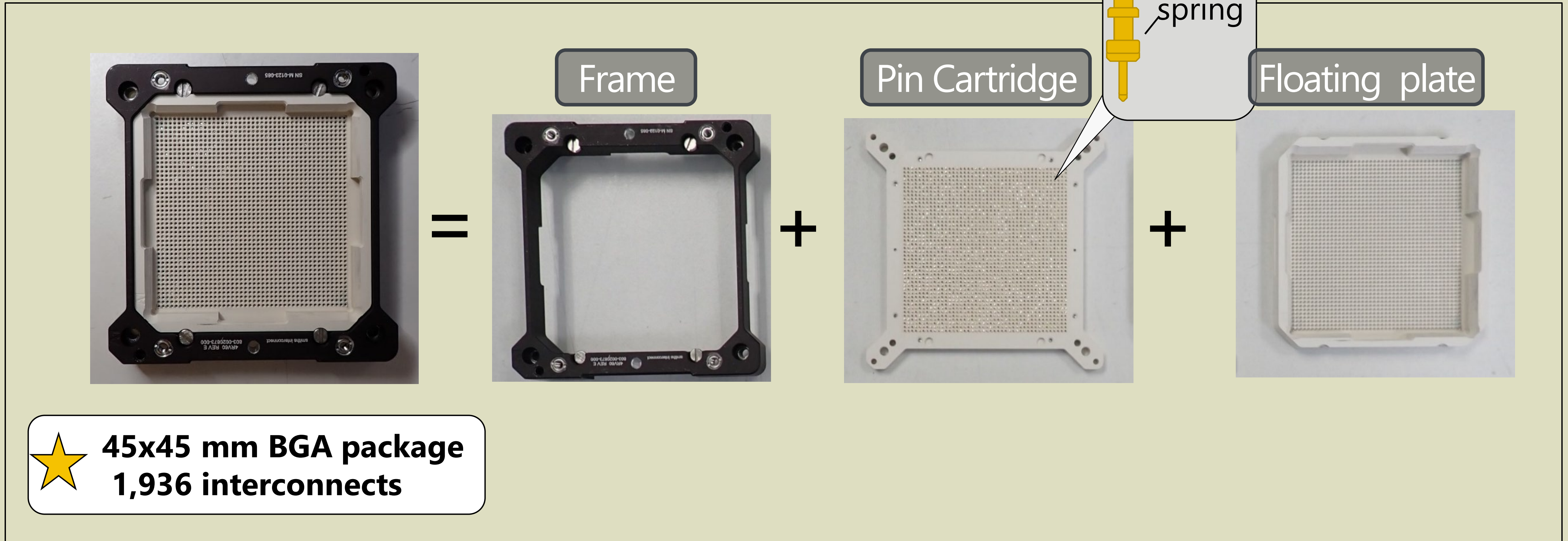
Keyence VR-5000 Profilometer

ModusTest Contact Resistance (CRES) Tester



Hitachi TM4000 SEM

BGA Socket Introduction



CRES Testing

Example Scatter Plot

Fail | Run Test

	Short	0.005	System Menu
	Bin1	0.05	Test List
	Bin2	0.1	Test Map
	Bin3	0.25	Test Results
	Bin4	0.5	Test Analysis
	Bin5	1	MTC
	Fail	Apply	Save Screen

Eng Notation: MILI

MPT IDLE

Sites 1 1 Results 12 18

Test Date: 10/26/2023
Test Time: 2:09:13 PM
Serial #: m-0622-053

Mean: 49.042E+03 Std: 17.878E+03
Min: 42.084E-03 Max: 55.557E+03
Cph: -914.361E-03 Cpk: -914.361E-03

Count: 0 500 1000 1500 2000 2500

Bin Number	
BIN1	10-0%
BIN2	103-5%
BIN3	75-3%
BIN4	24-1%
BIN5	13-0%
FAIL	1711-88%
TOTAL	1936
NOTEST	0-0%

Analysis

Live Scatter | Save Chart | Add To Report | Show Report | Save Report | Clear Report

Apply Scatter Chart Axis Limits

	Y-Axis	X-Axis
Max	1.000	10.000
Min	0.000	0.000

1 CRES Test = 1,936 Data Points

Ohms: 2.000E+0, 1.800E+0, 1.600E+0, 1.400E+0, 1.200E+0, 1.000E+0, 8.000E-1, 6.000E-1, 4.000E-1, 2.000E-1, 0.000E+0

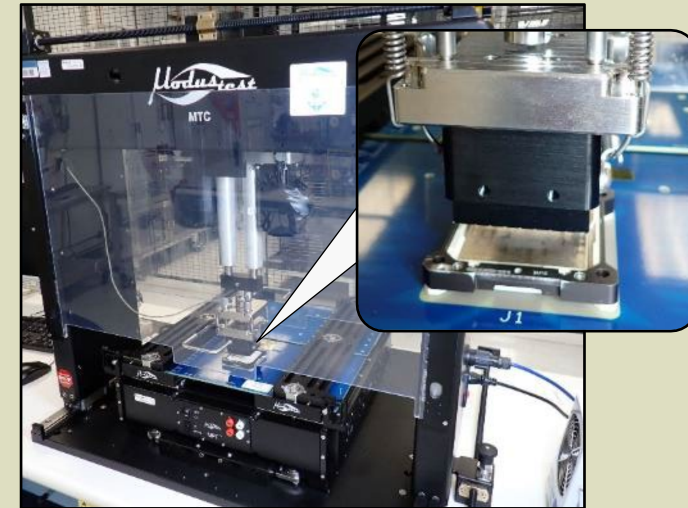
Test Count: 0, 5, 10, 15

Bin 5

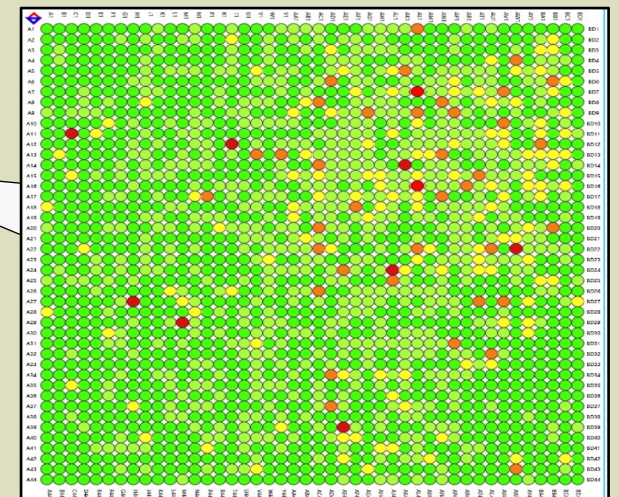
Bin 4

Bin 3

Bin 1,2



Mean Map/Measles Chart



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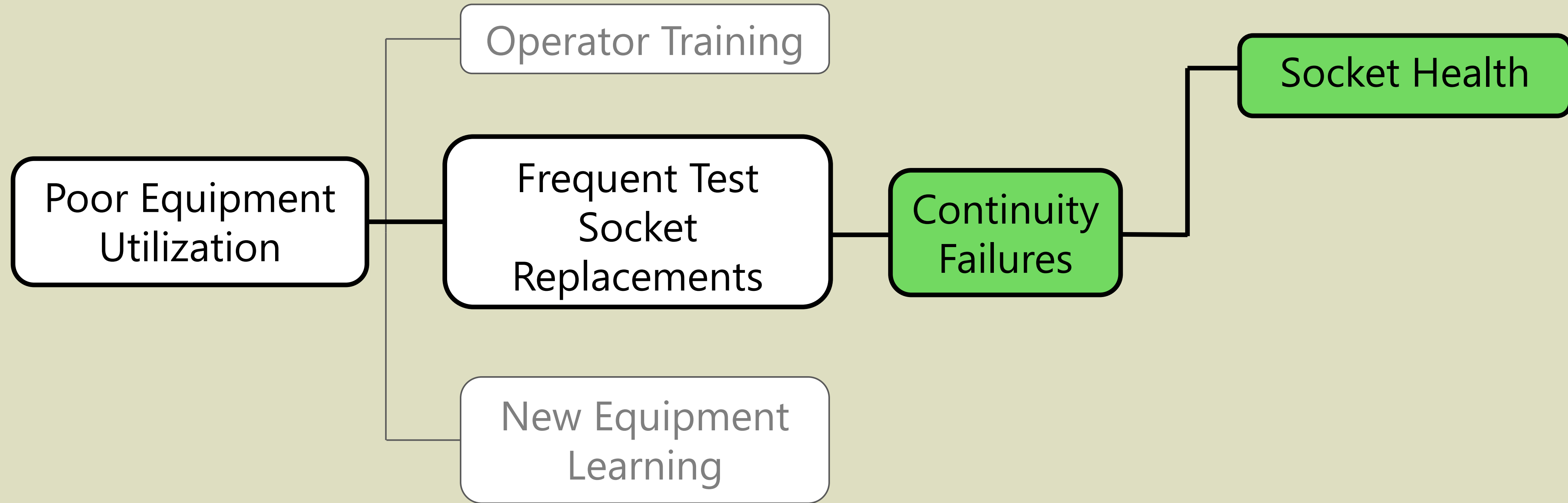
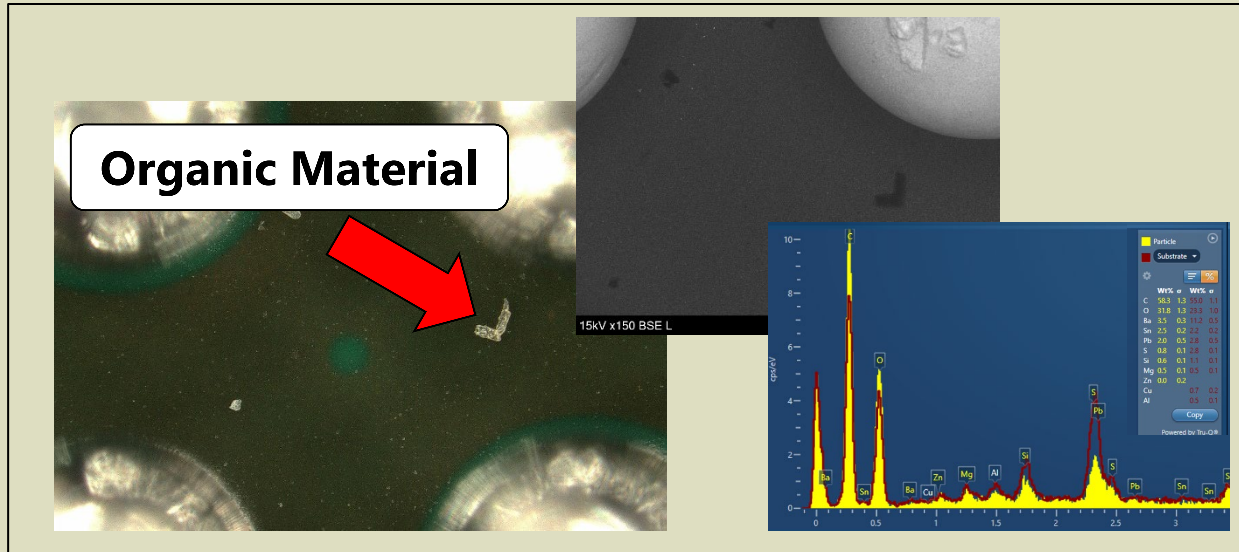
Enhanced Test Socket Reliability

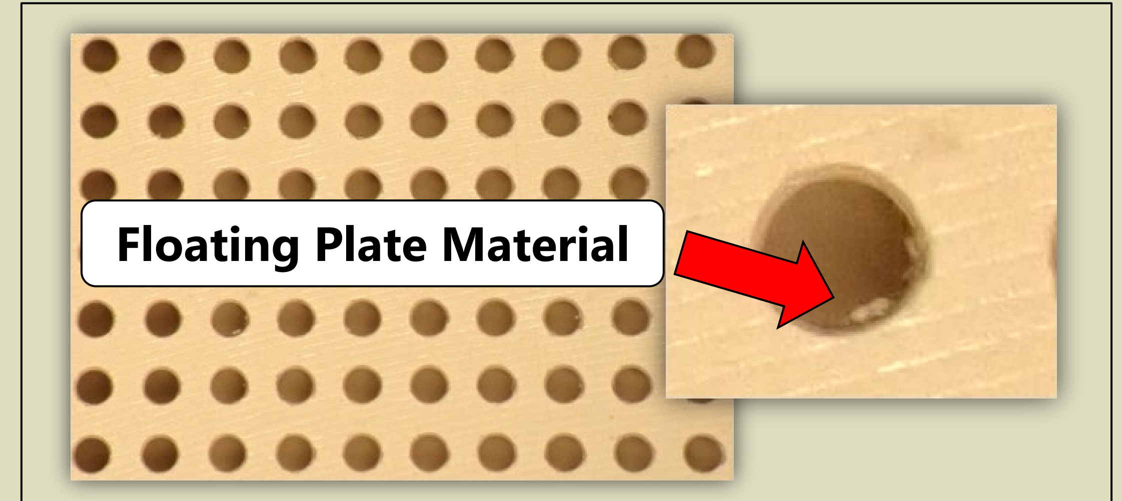
2026

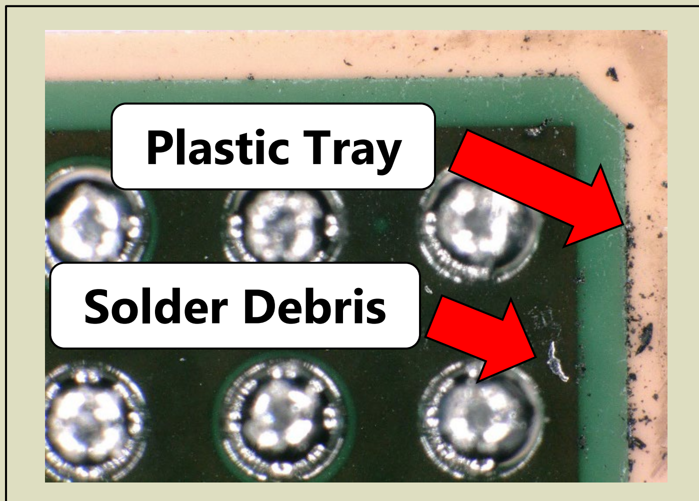
Problem Solving Process

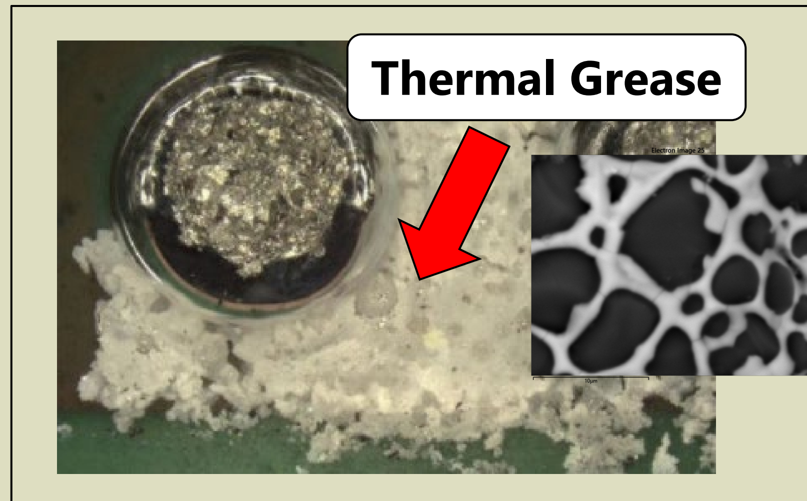


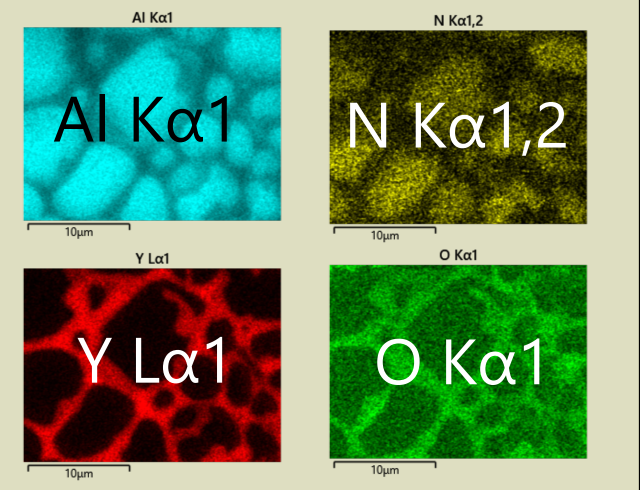
Multiple Sources of Foreign Object Debris











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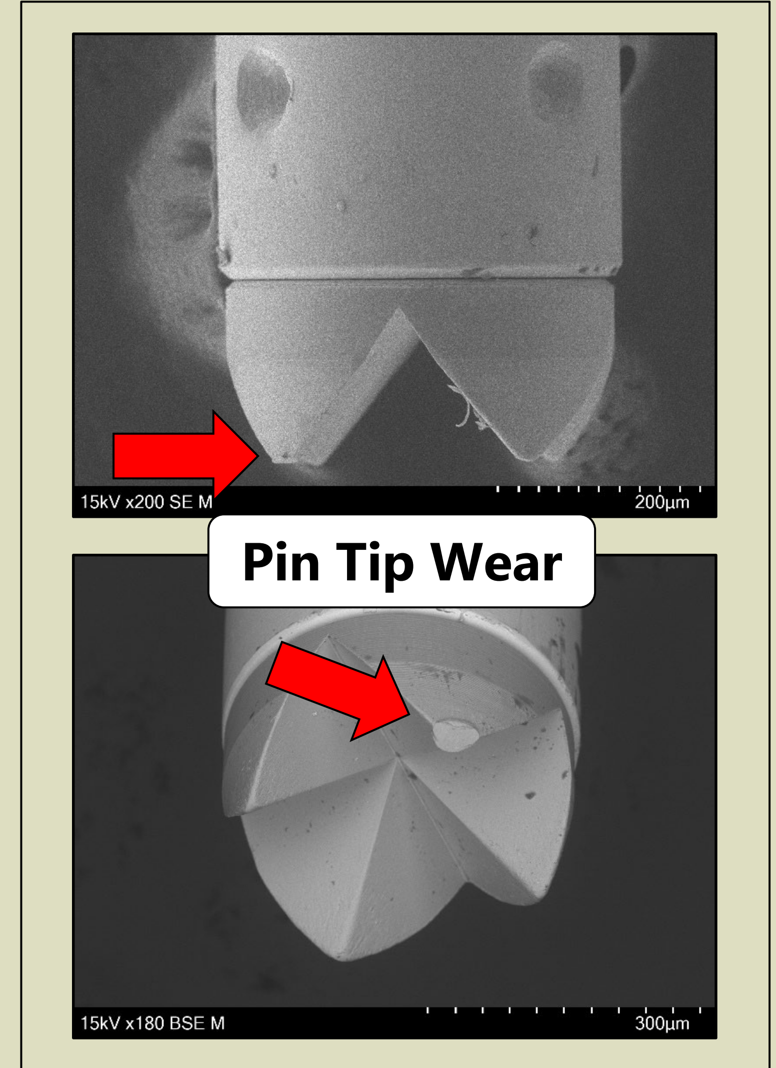
Pin Failure Modes

Pin Cracks

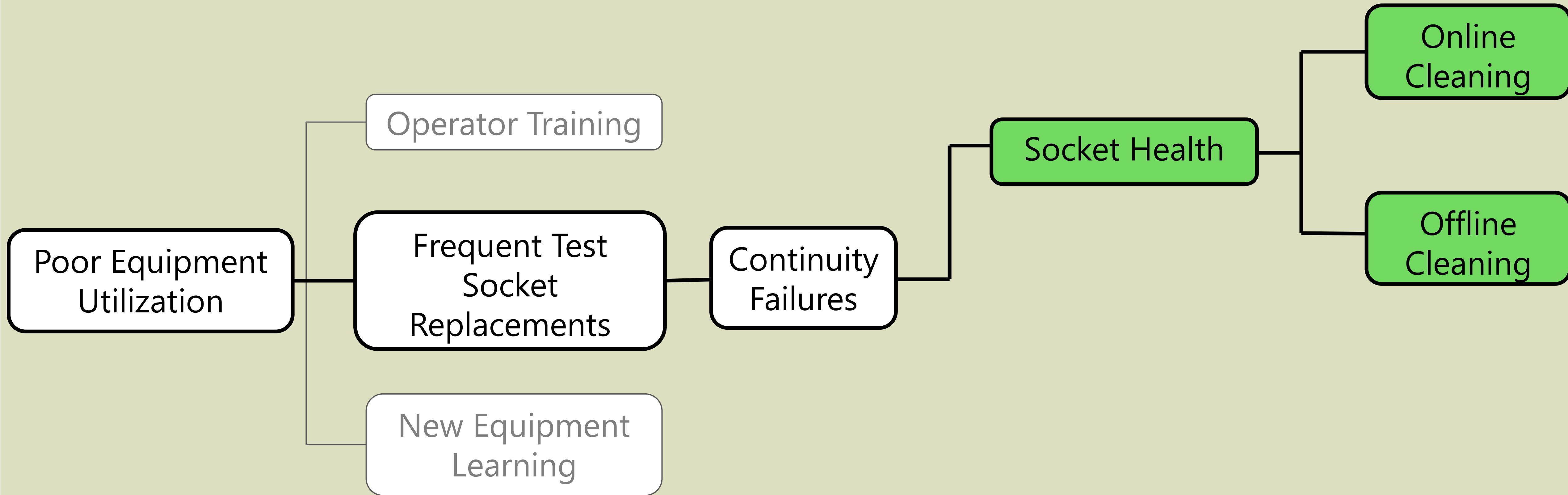
15kV x30 BSE M 1.00mm

15kV x200 SE M 200µm

15kV x150 BSE M 300µm



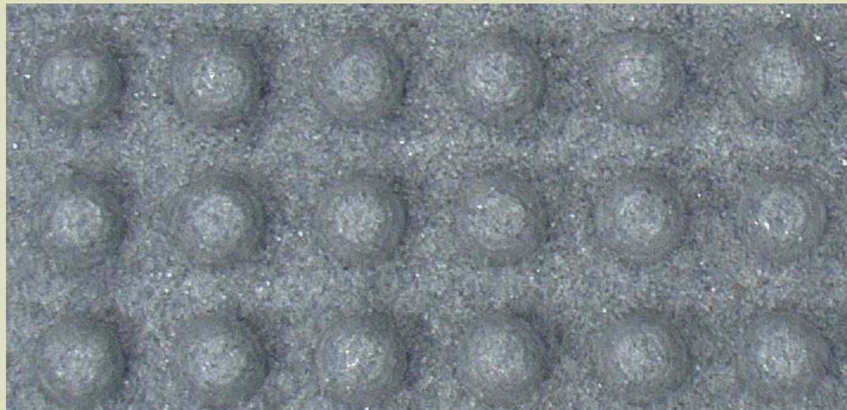
Problem Solving Process



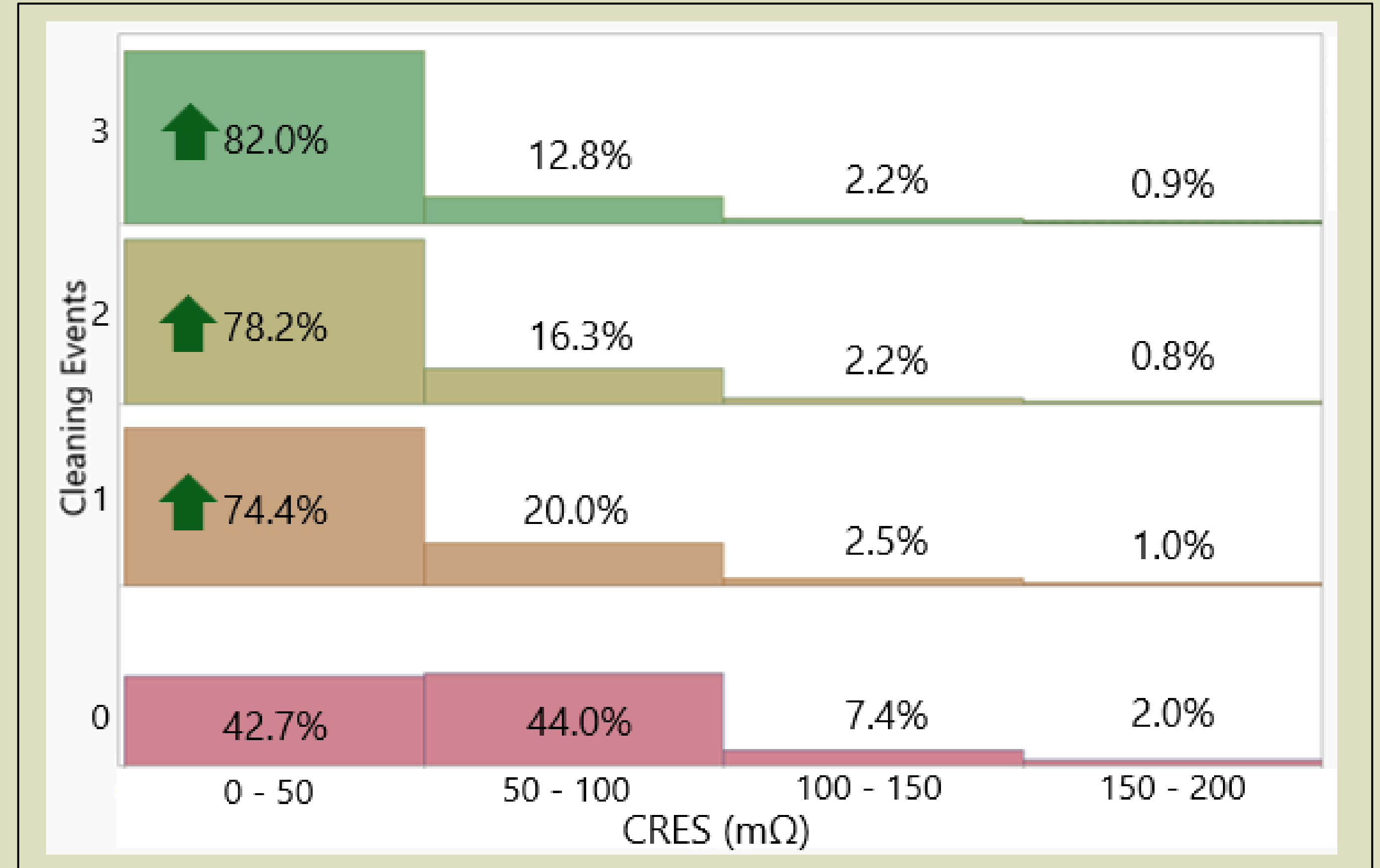
Online Cleaning

Used Cleaning Pad

New Cleaning Pad



Socket Cycled with Cleaning Pad Between CRES Testing



% High Conductivity Pins Increases with Iterative Cleaning Pad Usage

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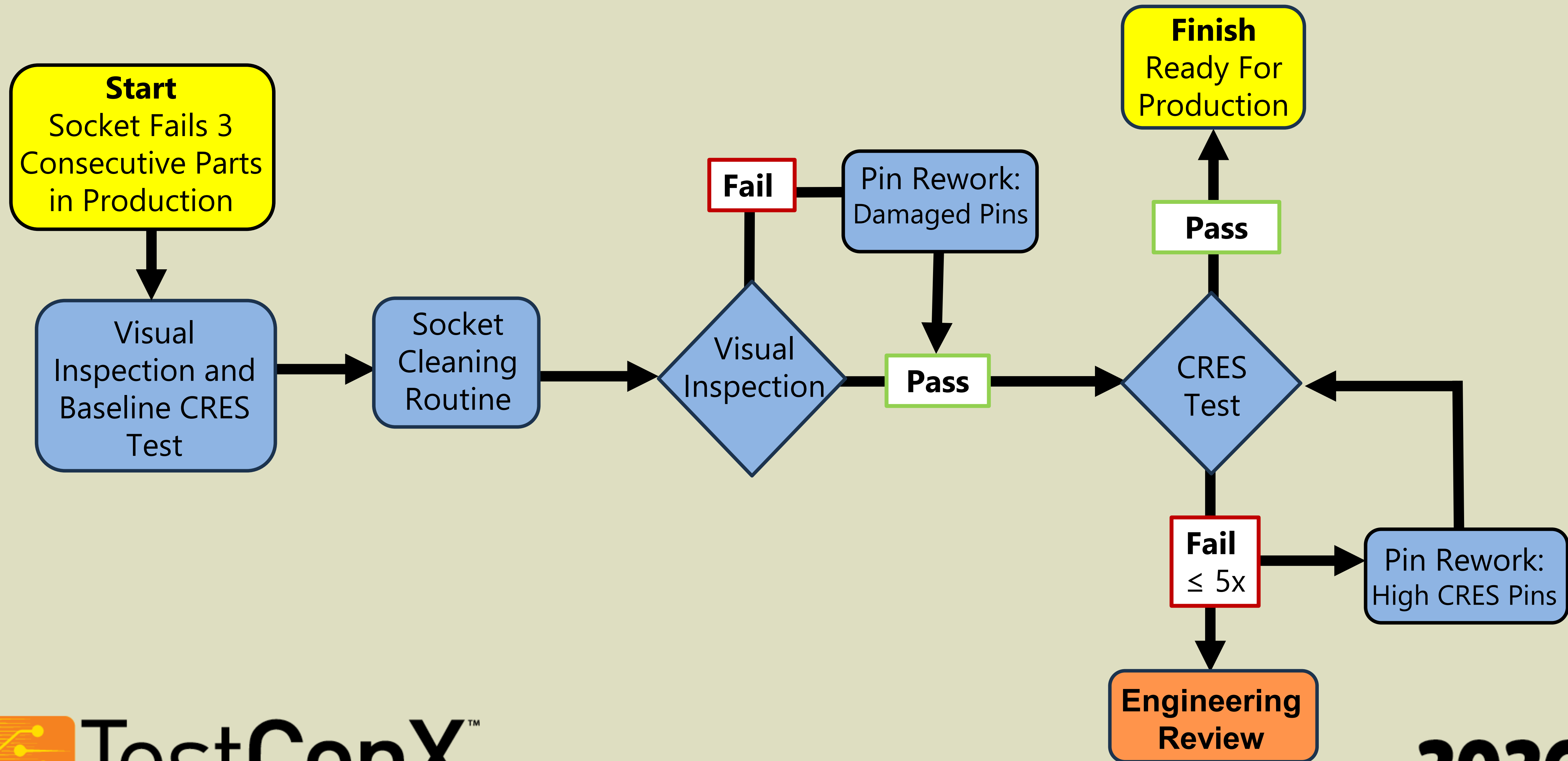
Offline Cleaning: Socket Maintenance Routine



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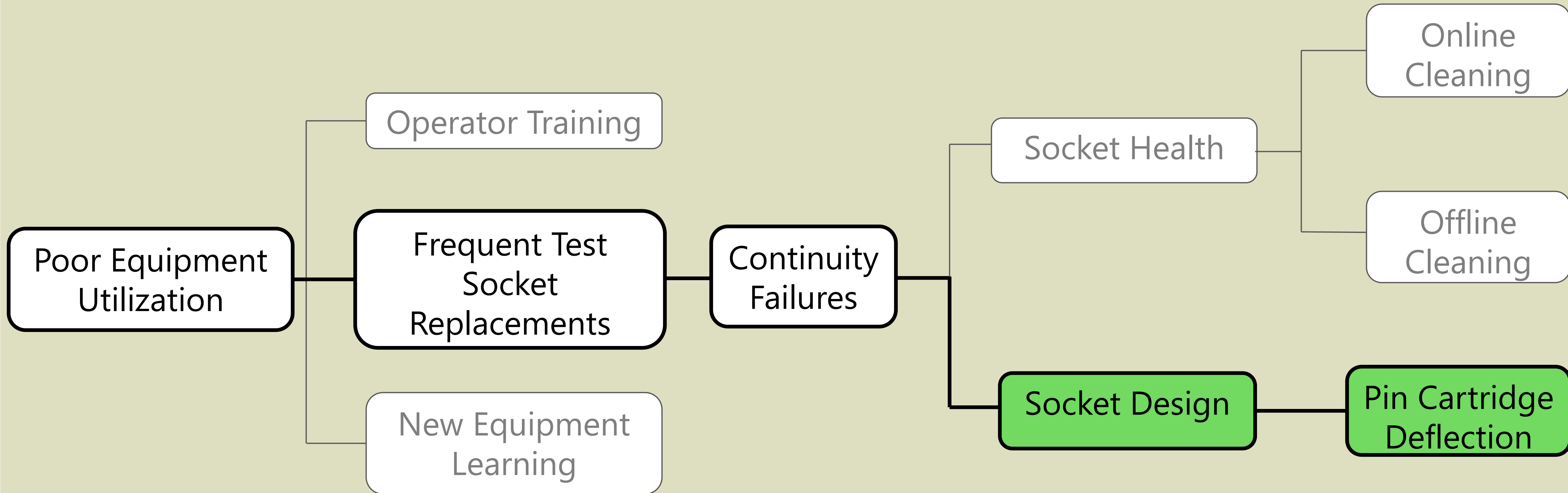
Problem Solving Process



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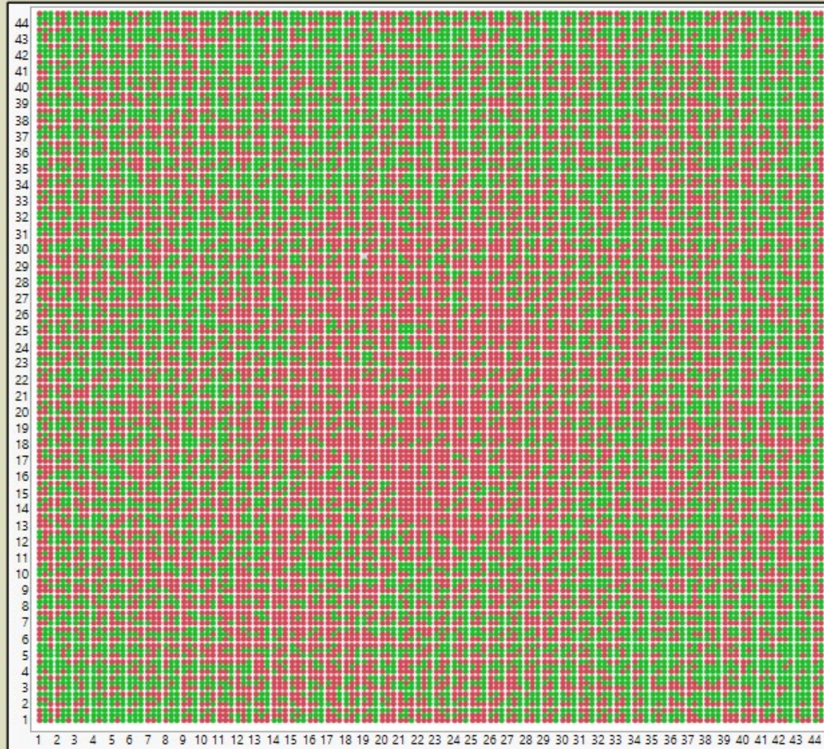
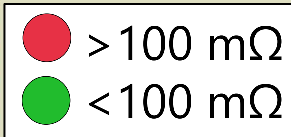
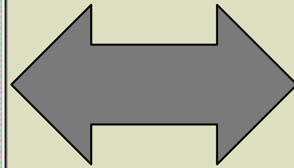
Cartridge Deflection

10 Socket CRES Aggregate

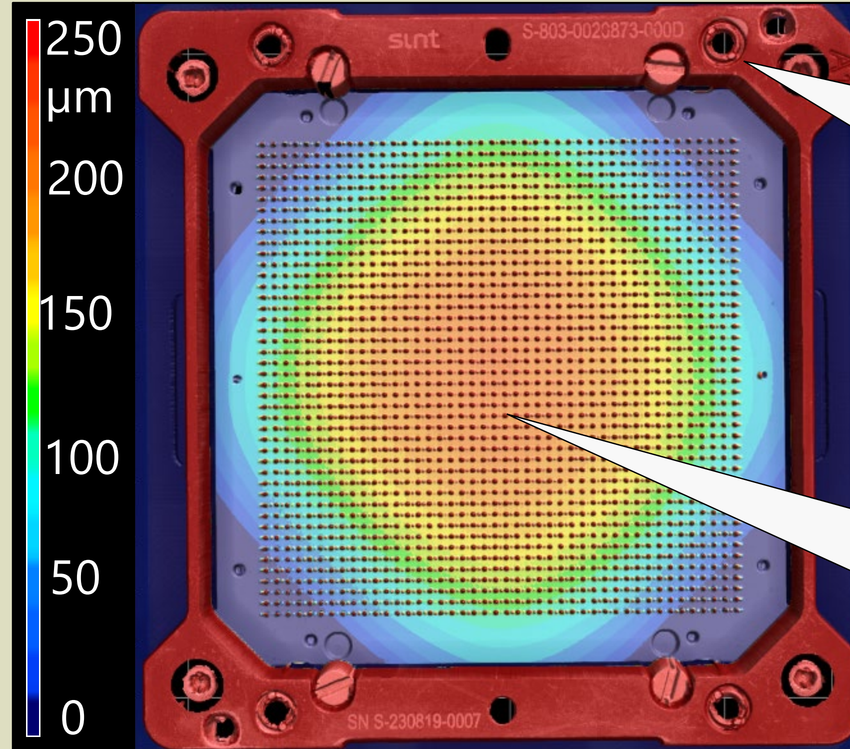






10 different socket CRES tests overlaid

Topographical Heat Map

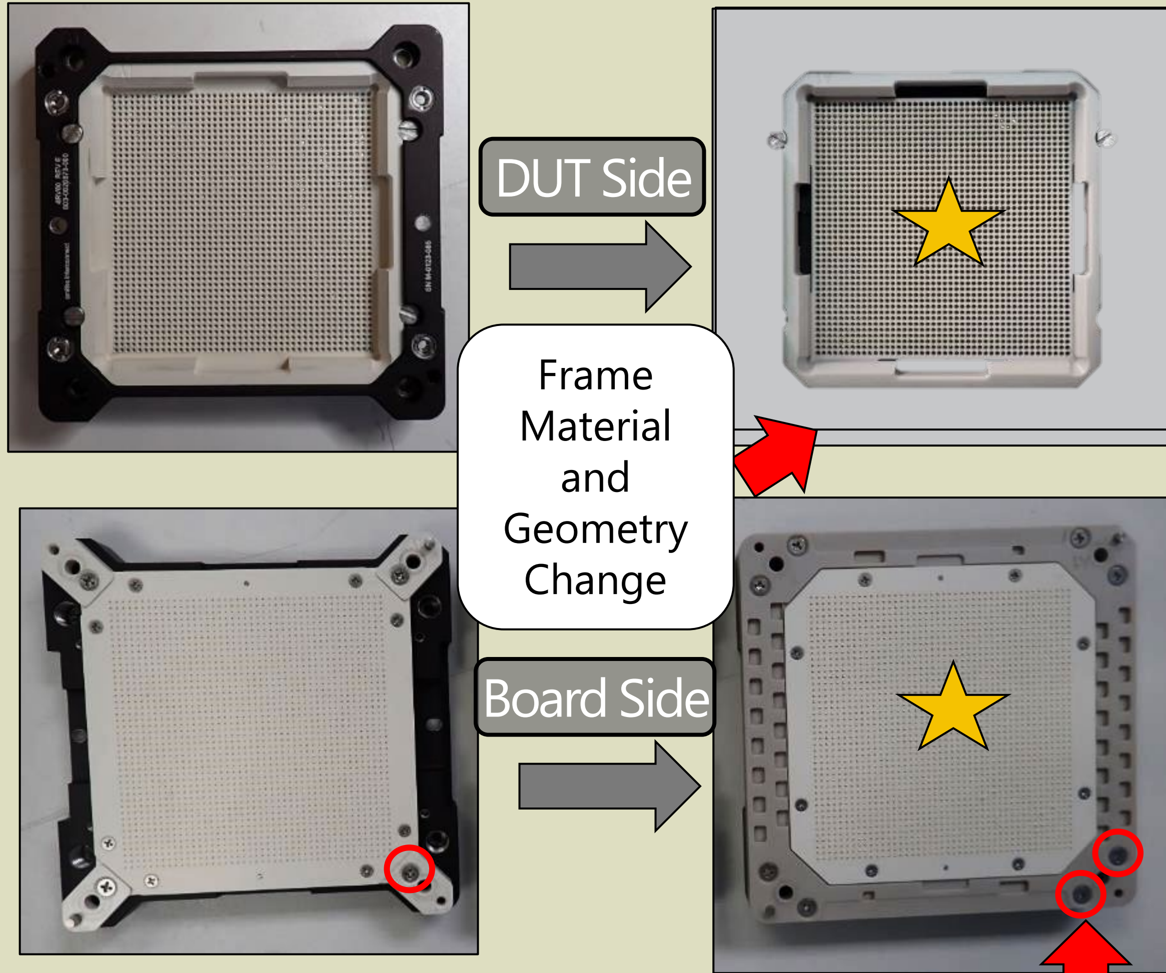


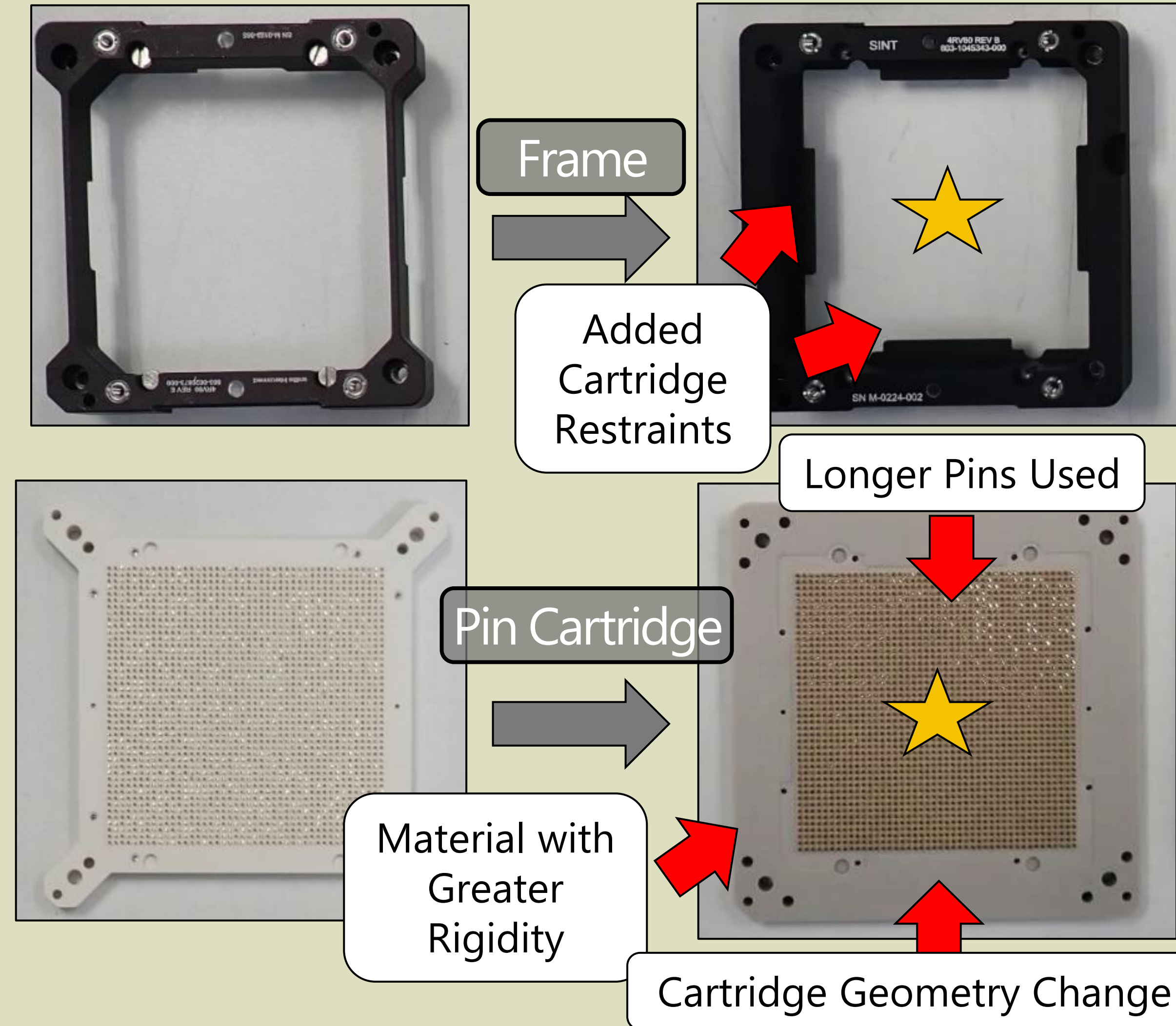
Frame Behavior

Arched Bridge Analogy

- ✓ Socket screwed to test board with 0.25 Nm torque wrench
- ✓ Floating plate removed for profilometry

Side-by-Side: Socket Design Improvement





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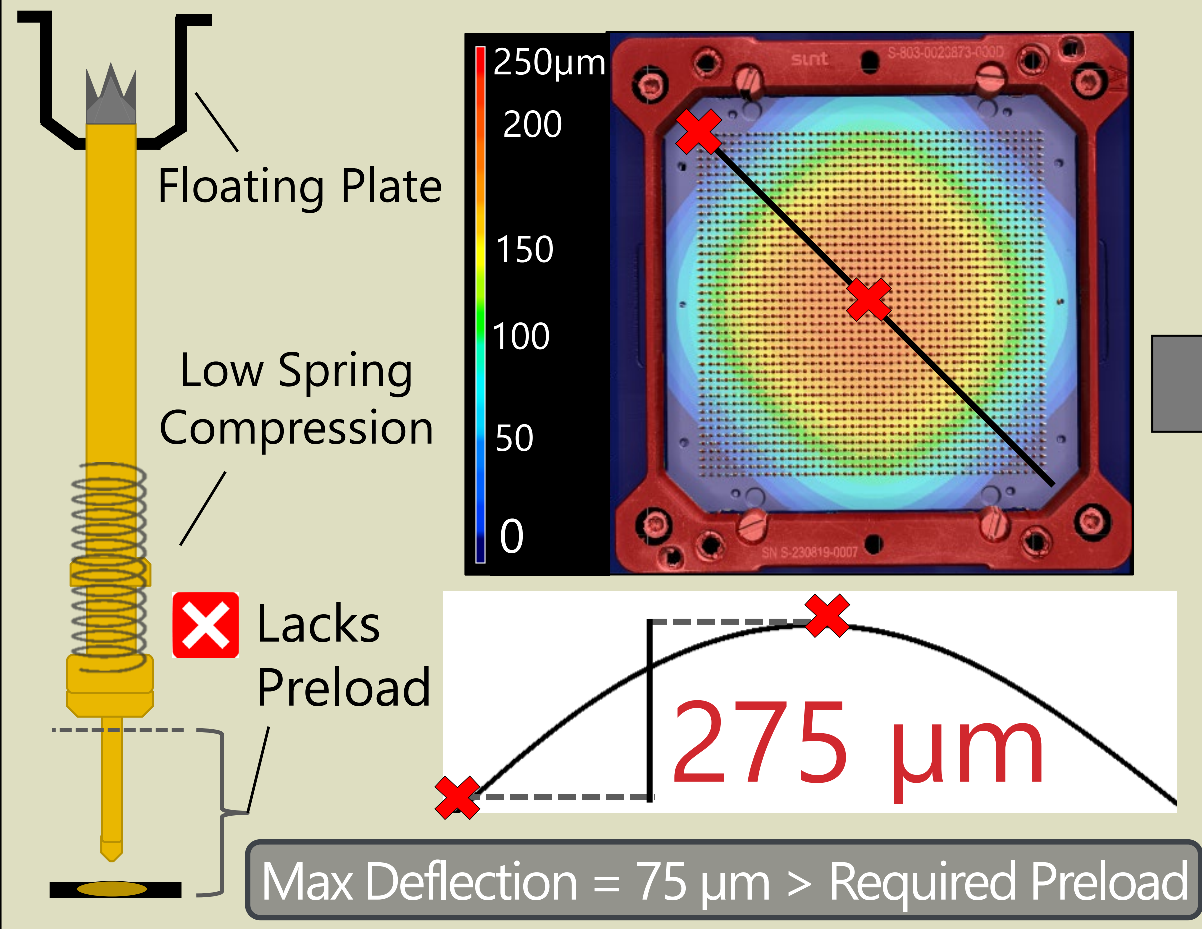
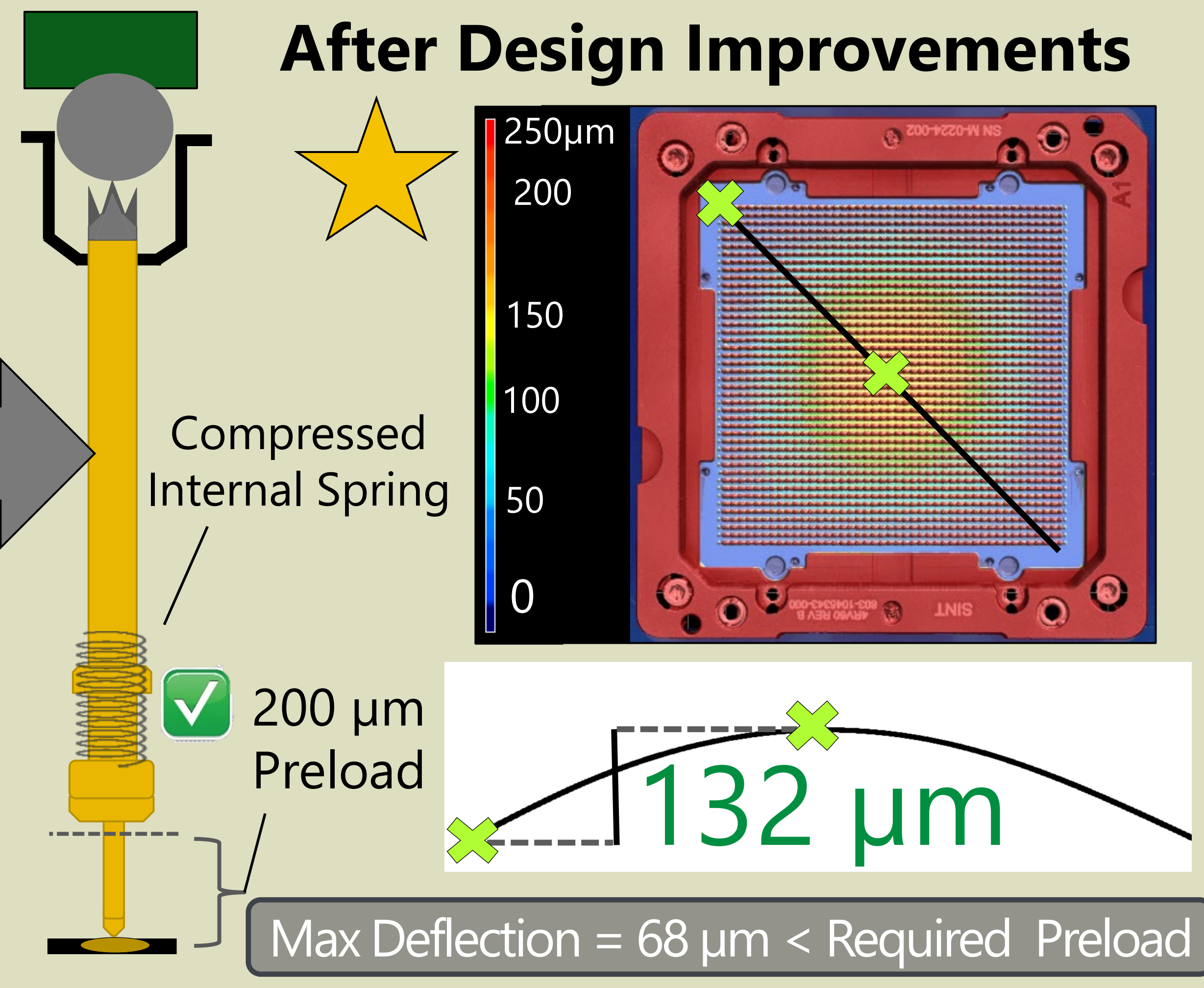
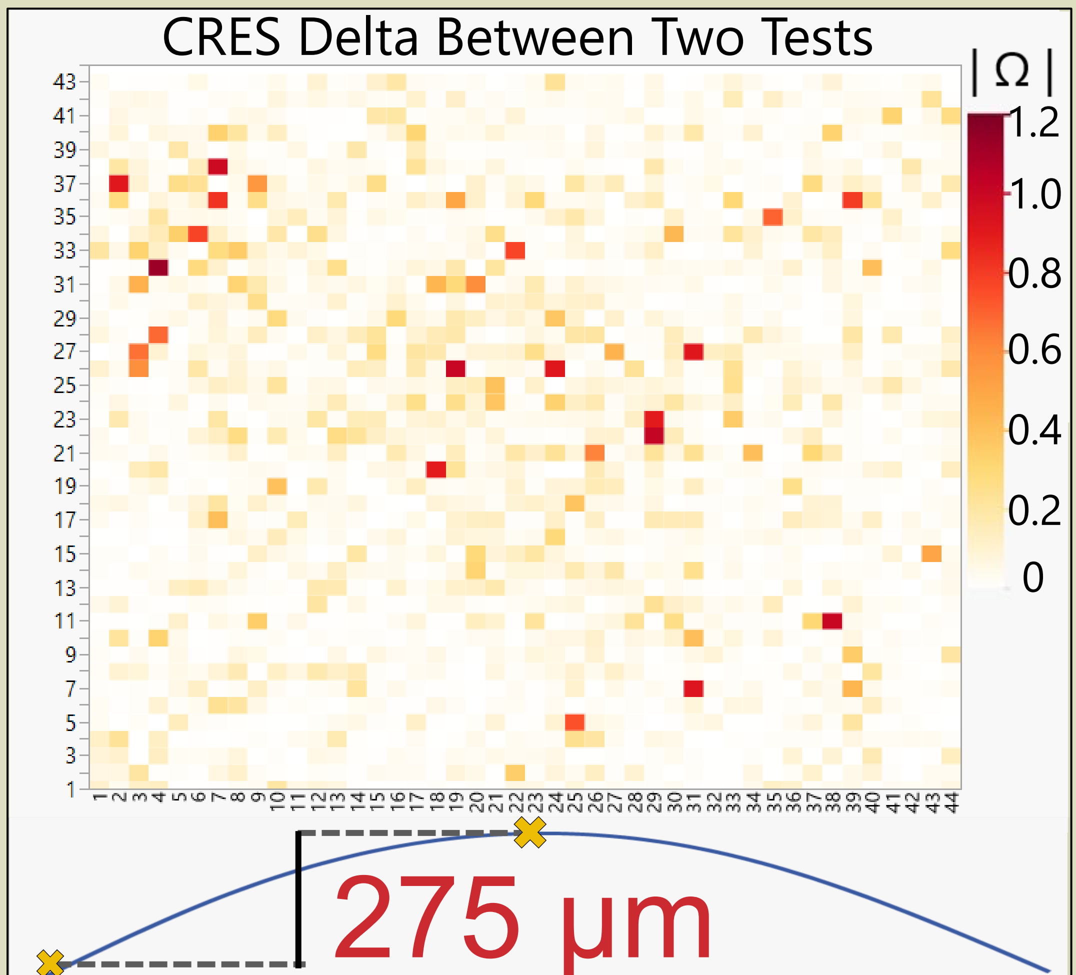
Socket Design Improvements



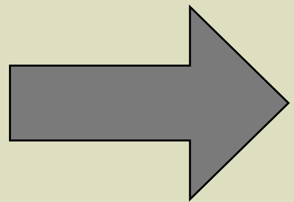


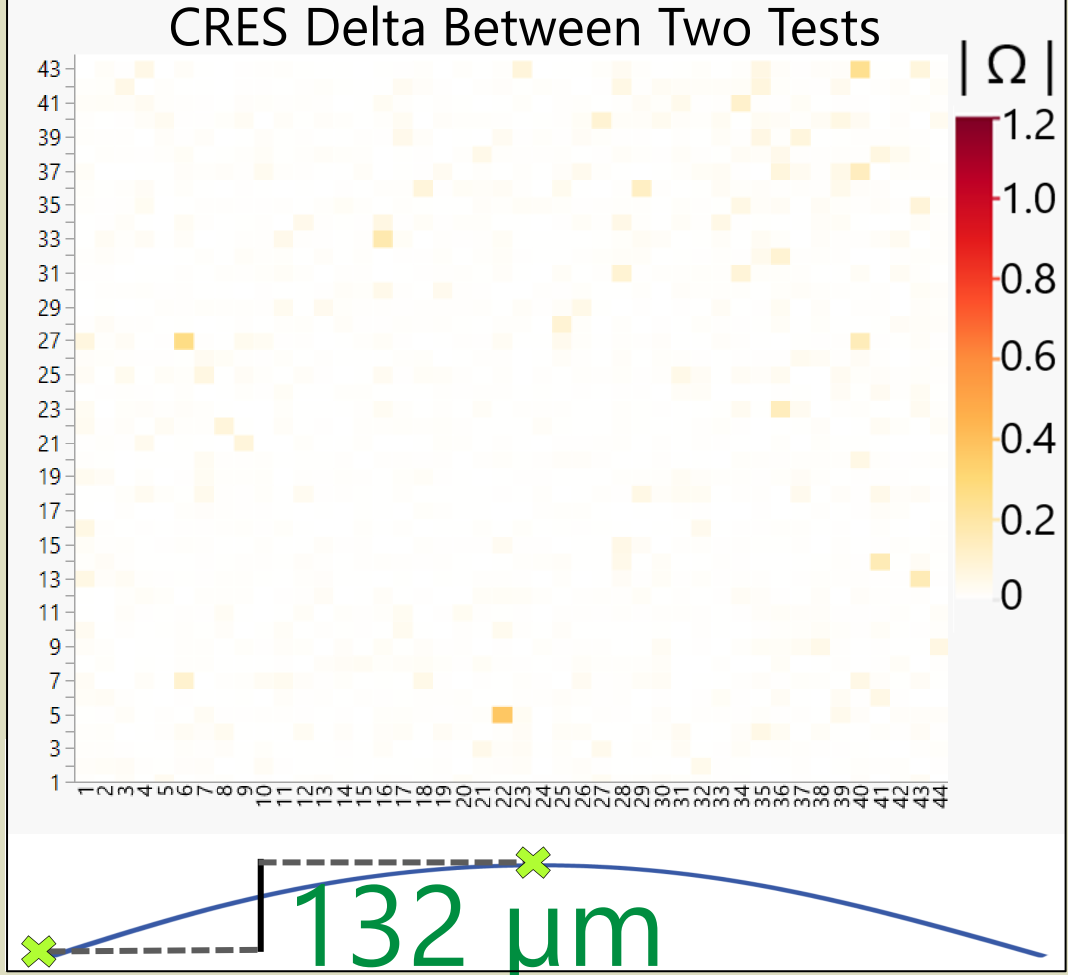
Socket Deflection and CRES Repeatability

Original Hardware



Final Socket Design





↓ Pin Cartridge Deflection = ↑ Repeatability

Yield Impact of Socket Reliability

Retest Recovery Rate and Final Yield – Production Ramp

- Retest Recovery Rate
- Final Pass Yield
- Number of Test

Number of Tests: 30000, 25000, 20000, 15000, 10000, 5000, 0

Final Pass Yield & Retest Recovery Rate: 100%, 80%, 60%, 40%, 20%, 0%

Q3, Q4 (2023) · Q1, Q2, Q3, Q4 (2024) · Q1, Q2, Q3 (2025)

Year - Quarter

$$Retest\ Recovery\ Rate = \frac{Parts\ Recovered}{Number\ of\ Retests}$$

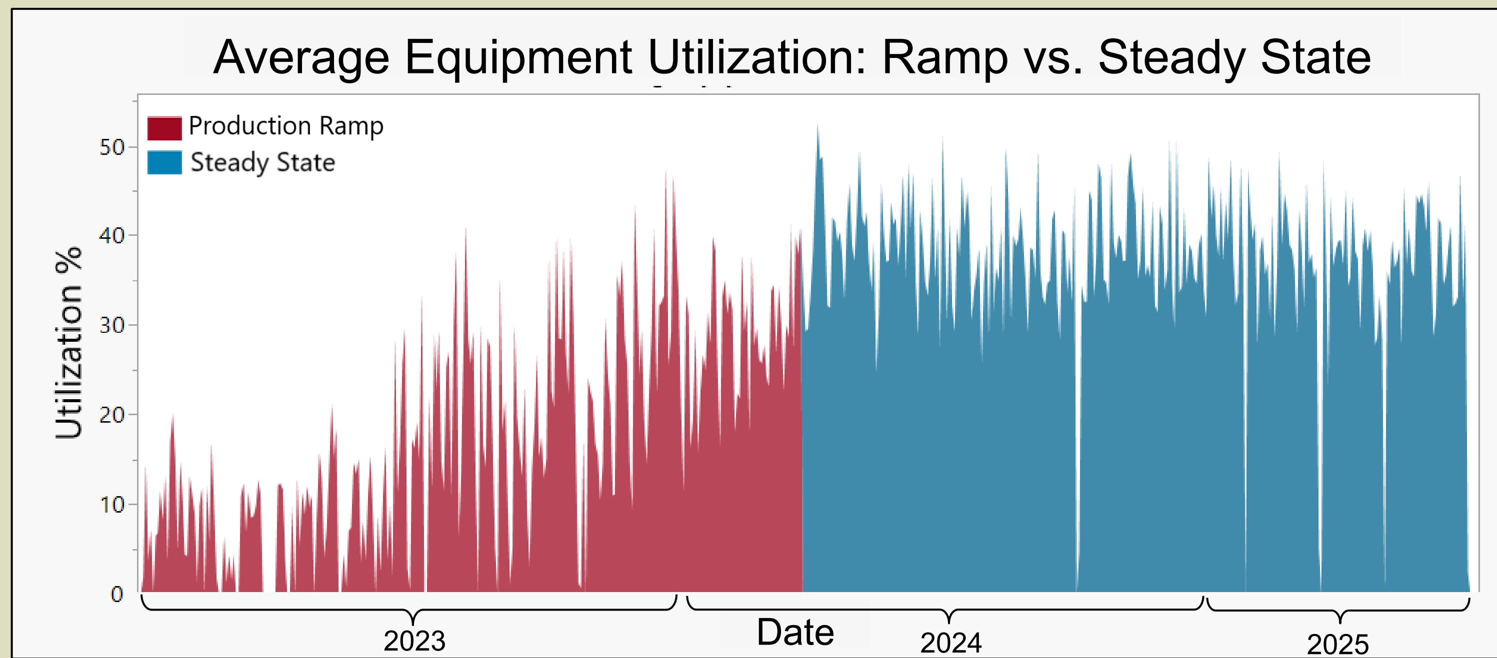
Results

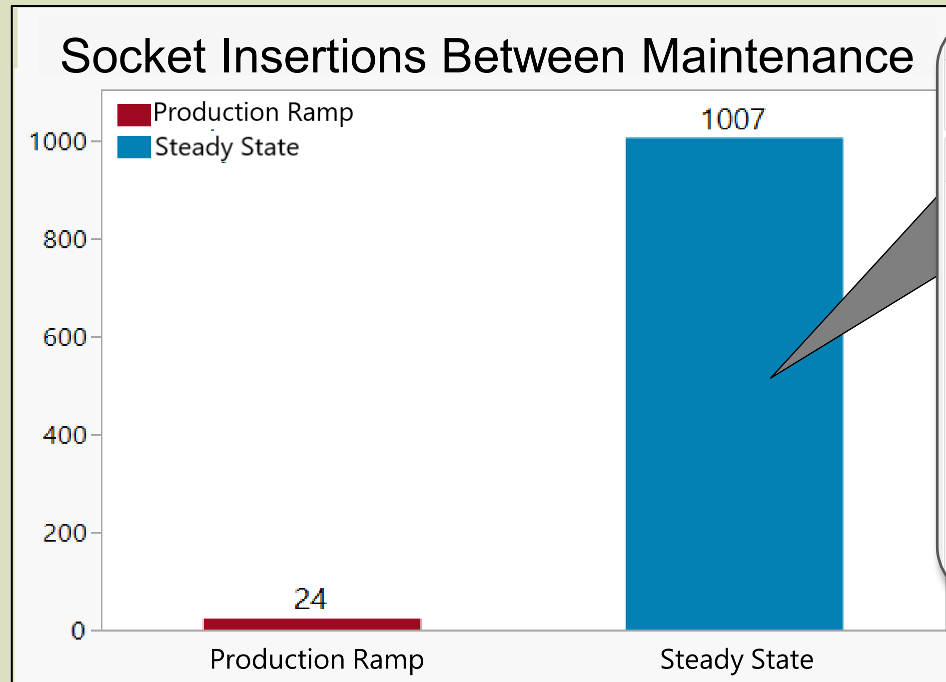
Our Goal:

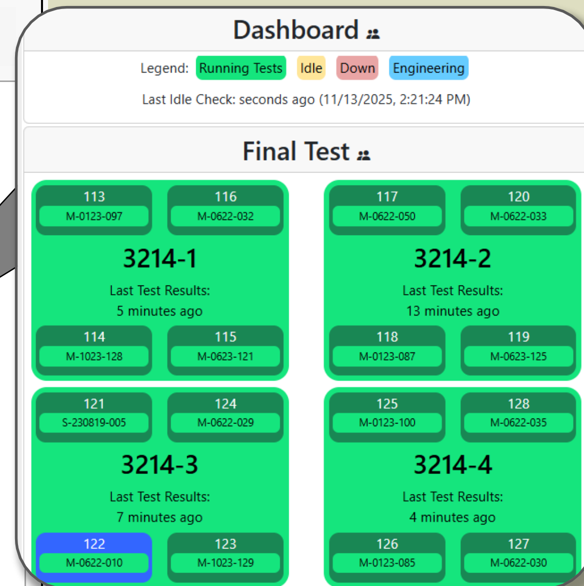
Support program ramp by increasing our average number of socket insertions 50x from ~20 to over 1000

Our Solution:

- ✓ Online Cleaning Pads
- ✓ Offline Socket Maintenance
- ✓ First Pass Yield Monitoring
- ✓ Socket Design BKM
- ✓ Equipment PM for FOD







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