



Highly Accelerated Test Implemented at Avionics Supplier

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Case Study

- ◆ A leading avionics supplier has implemented Highly Accelerated Tests
- ◆ Objective: Mature products at initial customer delivery
- ◆ Method: Apply Highly Accelerated Life Test (HALT) during product development
- ◆ Initial pilot test successful
- ◆ HALT/HASS deployed throughout company
- ◆ Multiple test systems in use on 2 continents
- ◆ Test systems deployed at contract manufacturing sites



Definitions



- ◆ Highly Accelerated Test :
Monitor product performance while subjected to multiple combined environmental and/or operating stresses that are increased stepwise to values exceeding specified limits, up to the operating and/or destruction limits of the product.
- ◆ Applied to Design: HALT
- ◆ Applied to Production: HASS



Motivation

- ◆ By the end of the 90's, HAT tests had been implemented on a limited basis
- ◆ In 2001, AIRBUS announced a “Maturity at the entry into service” request for all A380's partners





Response

- ◆ " Product Maturity " Study Initiated:
 - Determine best practices to reach the operational reliability target from initial product delivery

- ◆ Measurement Parameter:
 - Rejection rate level at EIS

- ◆ 2 Aspects of "Product Maturity" Methodology:
 - "**Maturity Building**" during product development
 - "**Maturity Confirmation**" during product manufacturing



Outcome

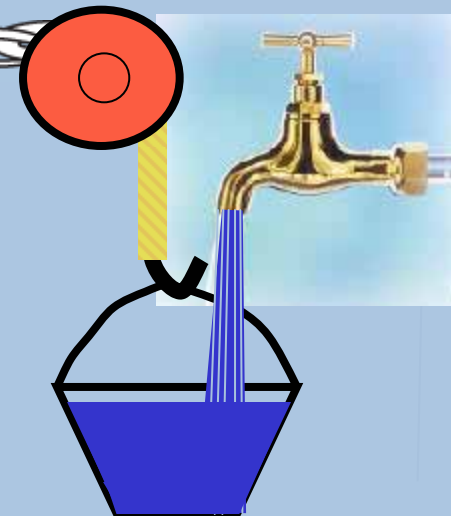
- ◆ **Highly Accelerated Testing fits naturally into both areas of the Product Maturity Project -**
 - **Product Development:** reveal and eliminate product weaknesses (thus increase maturity)
 - **Production Screening:** Highly Accelerated Stress Screening to identify additional defects introduced in the production process

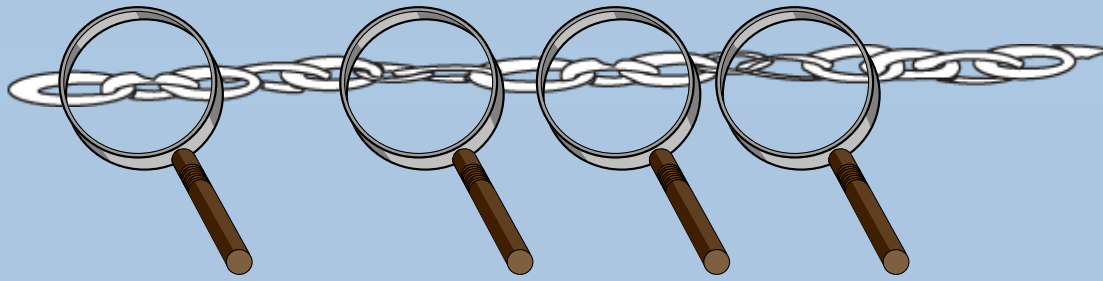


- ◆ *A Product can be symbolized as a chain...*

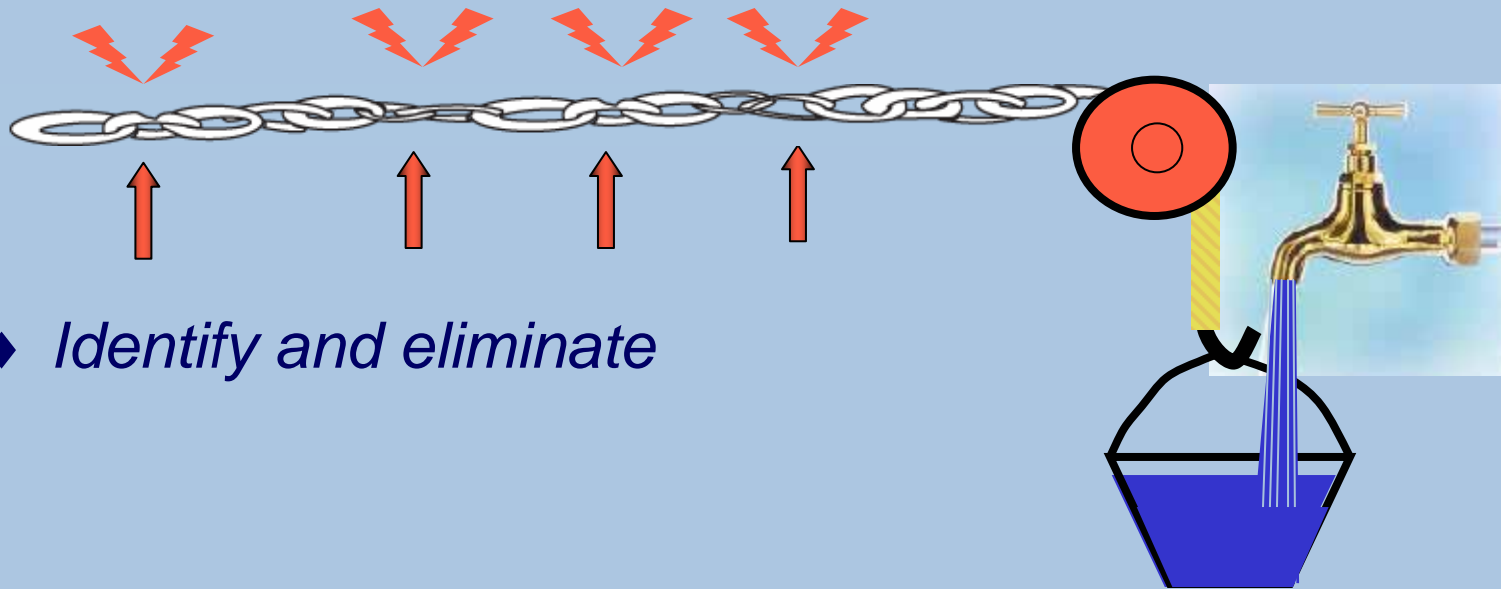


- ◆ *... functionality must be operational when overstresses are applied*





◆ *Weak links are latent failures*



◆ *Identify and eliminate*



- ◆ 2 types of weaknesses are found



- ◆ **Assembly maturity**

- component
- process

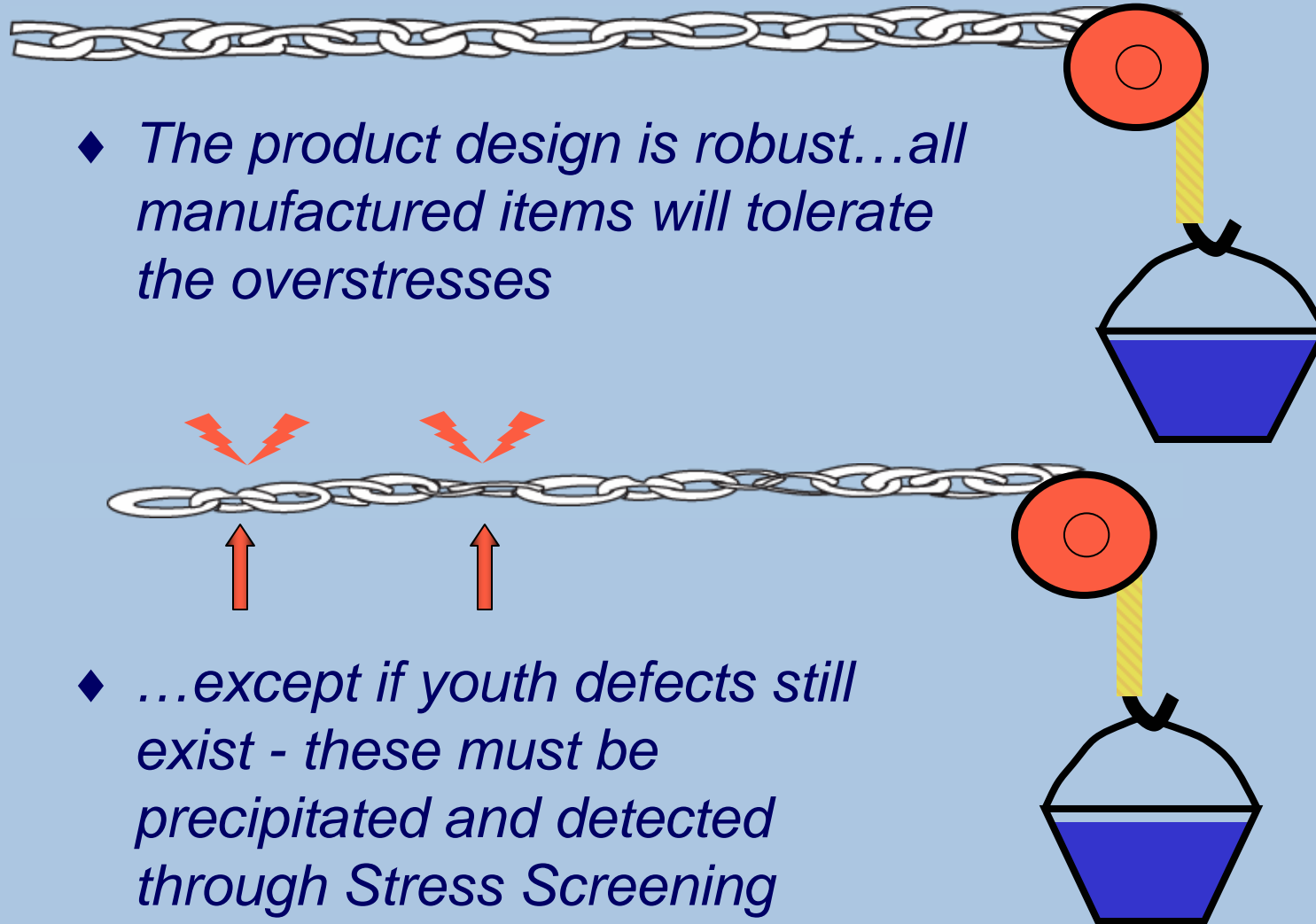


- ◆ **Design maturity:**

- Value, size mismatch
- technology



◆ To be fixed as part of design.



◆ *The product design is robust...all manufactured items will tolerate the overstresses*

◆ *...except if youth defects still exist - these must be precipitated and detected through Stress Screening*



Product Development HALT

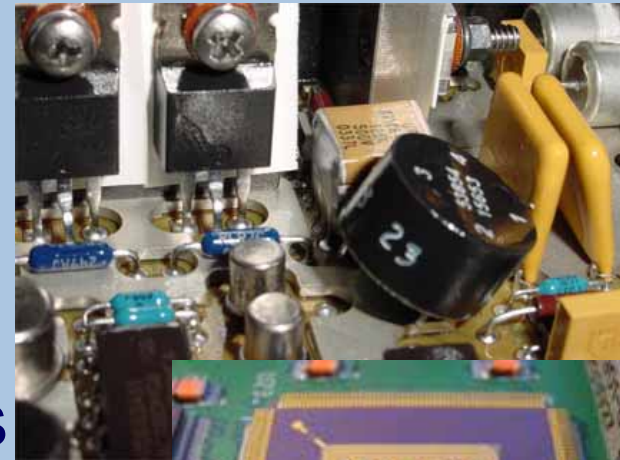
- ◆ HALT Applied to Design:
 - Application of overstress to precipitate failures (weak links)
 - Analysis of the failures – find root cause
 - Corrective action – design changes
 - Continue until functional and destruct limits far exceed specification

- ◆ Results on "Pilot Products" – Positive
 - HALT methodology is deployed to all new products in development.
 - All divisions use Highly Accelerated Tests in development.



Weak Links Found in HALT

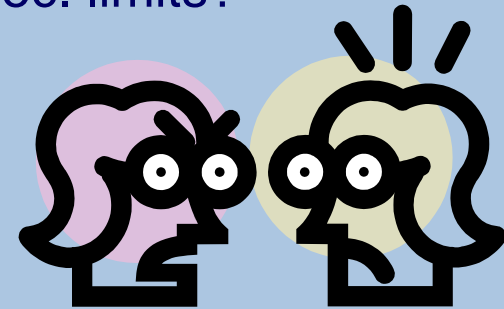
- ◆ Capacitor leakage current from thermal stress
- ◆ Shift of active component parameters in temperature
- ◆ Contacts on connectors
- ◆ Board fixturing, interconnects
- ◆ Component/print mismatch
- ◆ Lead detachment (broken wires) in transformer





Main Organizational Objections

- ◆ Philosophical
 - Why test beyond the specified limits?
 - Why correct failures that occurred beyond spec. limits?
- ◆ Lack of Accelerated Test knowledge
- ◆ Cost and time not budgeted in advance
- ◆ Seen as more work for the designers
- ◆ Working prototypes required for Highly Accelerated Tests
- ◆ Early requirement for diagnostic test to monitor product performance during HALT





Highly Accelerated Testing in Production: HASS

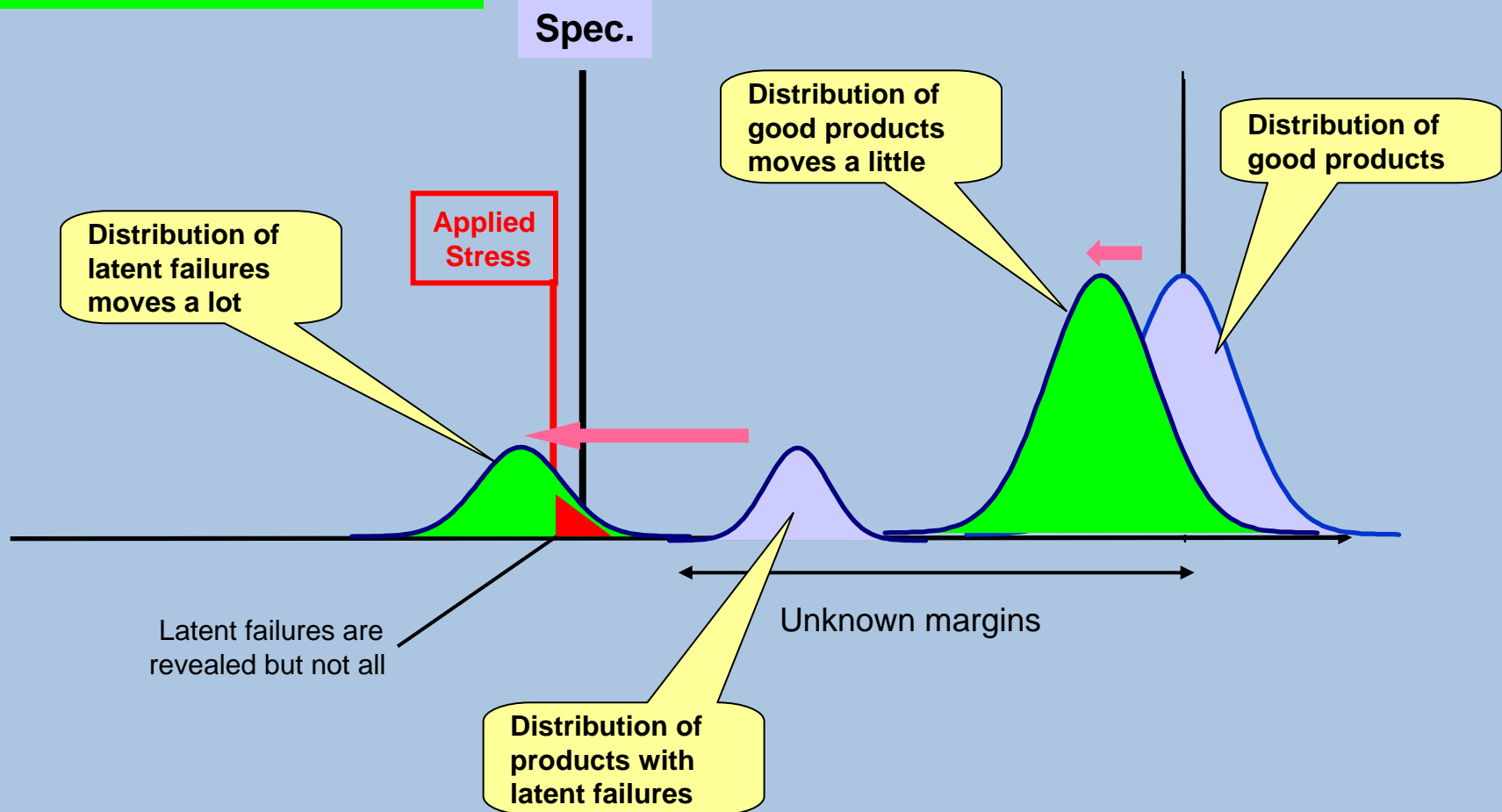
- ◆ During the production cycle, traditional “burn-in” is generally performed to eliminate infant failures
 - Example : thermal cycle within specification limits for 24 to 48 hours
- ◆ HASS, can more effectively eliminate infant failures
 - Stress beyond specs and operating limits: **Precipitate**
 - Reduce stress within limits: **Detect**



Classic ESS

Before classic ESS

After classic ESS (48 Hrs)

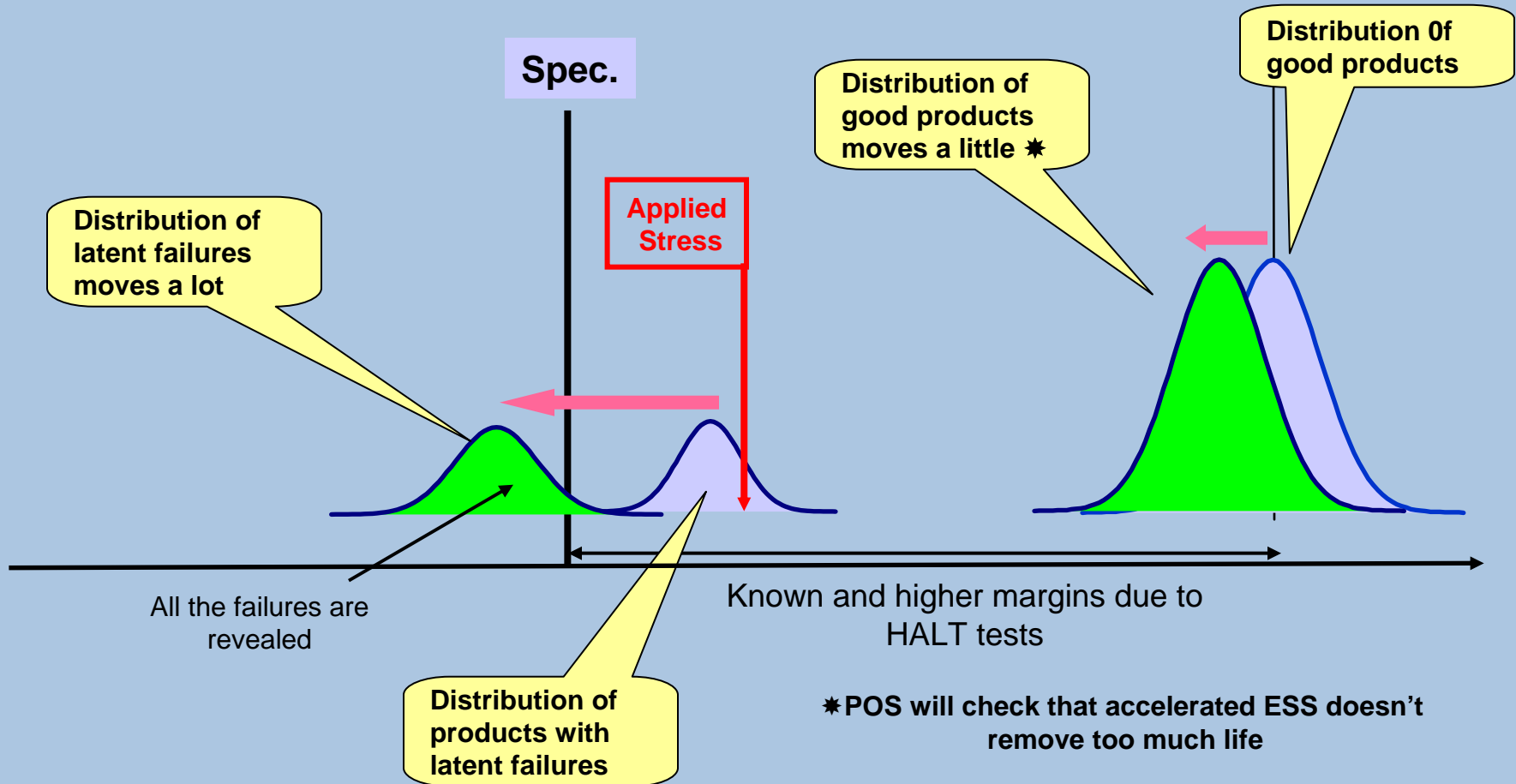




Before accelerated ESS

Accelerated ESS

After accelerated ESS (8 Hrs)





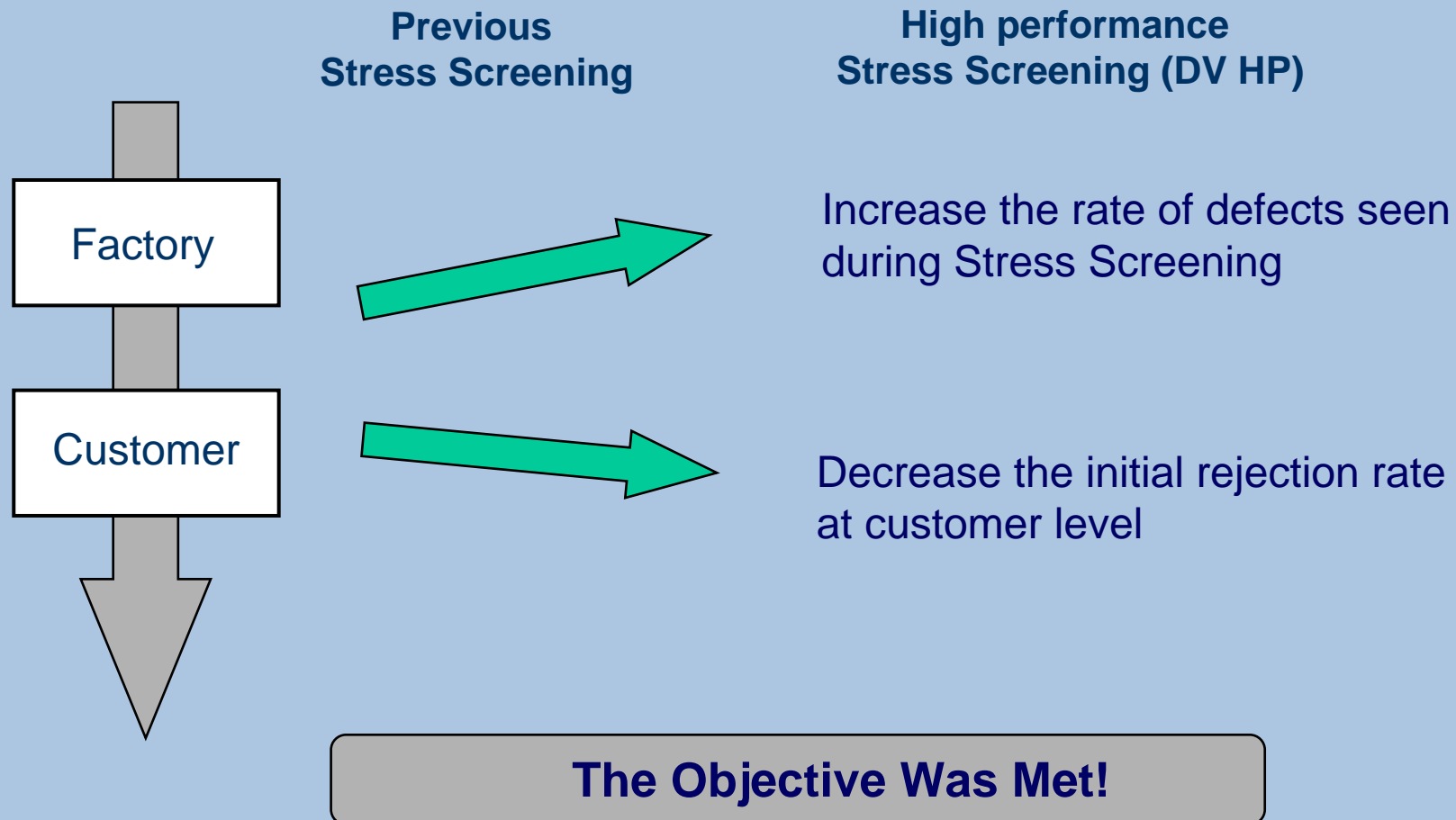
HASS Results

- ◆ Defects uncovered
 - Board interconnects
 - Board fixturing
 - Solder joint failures
- ◆ Highly Accelerated Testing initially implemented on A380 products
- ◆ After successful results on the A380, implemented on other A320-340 Airbus products for which traditional Stress Screening had reached its limits





◆ Impact on Failure Rate:





Before Using HASS

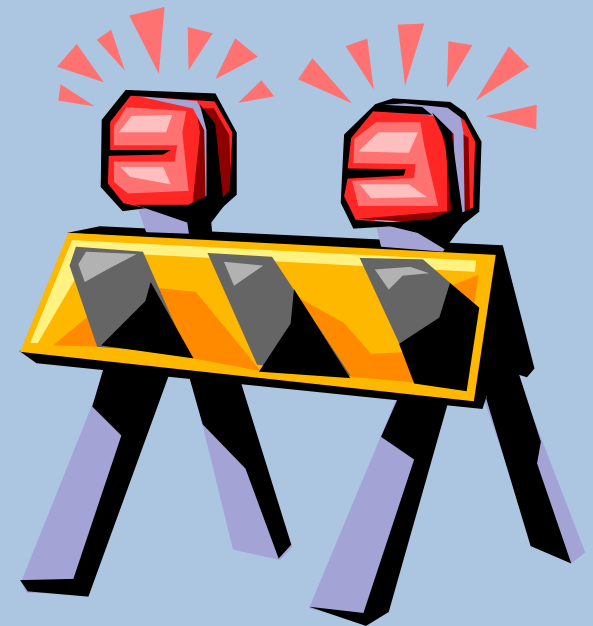
- ◆ HALT must be completed
 - Search for product weaknesses
 - Failure analysis and corrective action
 - Product limit determination
 - Initial Stress Screening profile determination

- ◆ Profile validation: POS
 - Non damaging (< 3 % of life reduction)
 - Proven efficiency using real production items (appropriate defects precipitated and detected during the defined Stress Screening cycle)



Roadblocks to HASS

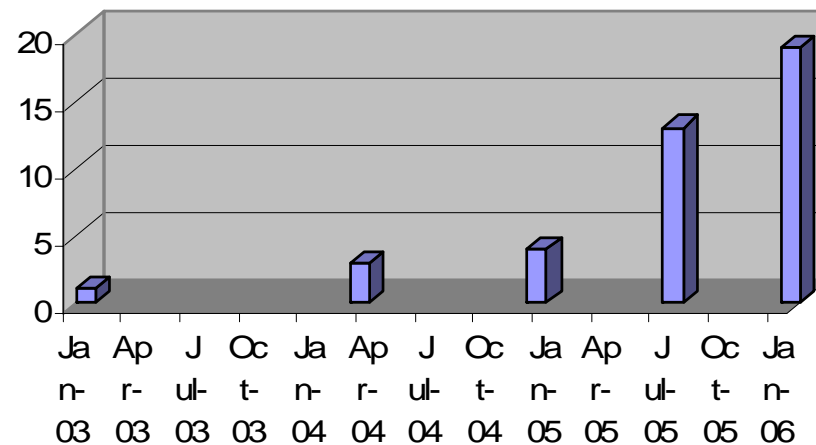
- ◆ Availability of equipment, fixturing, testing methodologies and resources
- ◆ Associated costs for facilities infrastructure (Piping, exhaust, LN2 tank, air compressor...)
- ◆ Test Efficiency (effectiveness at detecting “fugitive” defects)
- ◆ Fixturing for multiple units (design, qualification, and validation)





- ◆ Very rapid deployment
- ◆ Over 2004 and 2005
 - 13 systems used in 6 plants
 - Additional systems in 05'/ 06' →9 sites equipped

Installed Systems





Thank you!

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Knowledge Leader in Accelerated Testing

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