



**FPD.DEV**

THE FUTURE OF DISPLAY AND SYSTEMS DEVELOPMENT

# DO-160 Display Qualification

Integration and Qualification Practice

## CHAPTER 7

### In this chapter

Installed performance and product claims

Test plans, uncertainty and anomaly records

Capstone trade study and evidence review



## Diggy Breiling

Founder of FPD.DEV · Instructor

**ASQ · American Society for Quality**

**Current: CMDA**

Previously held: CSSBB, CMQ/OE

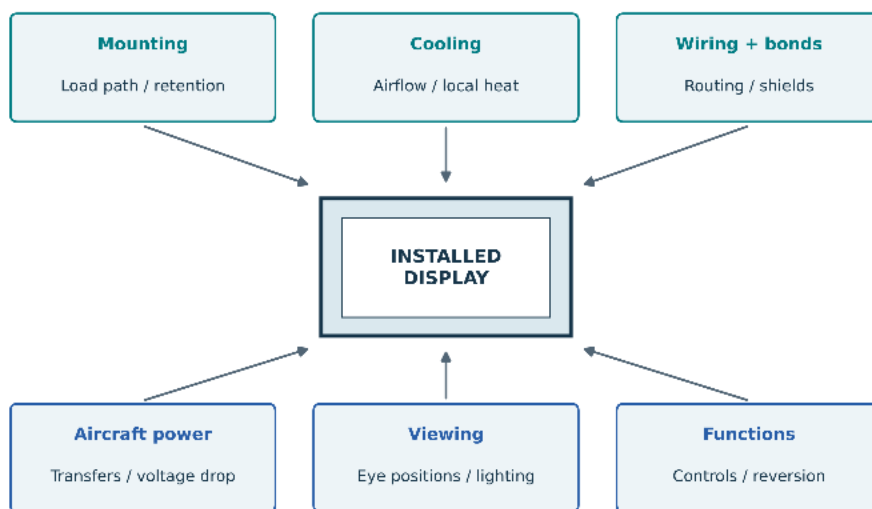
**ASCM / APICS: CPIM, CSCP**

Association for Supply Chain Management



# The installed display

Installation closes the remaining assumptions



Course engineering interpretation: FAA AC 25-118, AC 20-158B and AC 20-136C where applicable.  
Conceptual scope; not a physical installation drawing.

**Mounting and cooling  
match the assumptions**

Power, bonds and harness  
preserve the boundary

Viewing and controls work in  
the crew environment



# Display performance and crew use

- 01** AS8034: airborne display performance
- 02** MIL-STD-3009: NVIS display emission
- 03** MIL-STD-1472: military human engineering



# Development assurance and installation

- 01** DO-178C: software assurance
- 02** DO-254: electronic hardware assurance
- 03** ARP4754 / ARP4761: development and safety



# Qualification, production and service life

- 01** Environmental qualification supports the design
- 02** Production acceptance checks delivered units
- 03** Life and reliability claims need their own basis



# Readability and spectral performance

- 01** Use the intended viewing directions and ambient light
- 02** Check dimming, colour and information discrimination
- 03** Evaluate spectral requirements in each relevant mode
- 04** Treat the final optical stack as the measured product



# Operating envelope and product claims

- 01** State ambient, internal and functional limits
- 02** Identify permitted warm-up or degraded modes
- 03** Name the tested assembly and operating conditions
- 04** Keep enhanced capability tied to its evidence



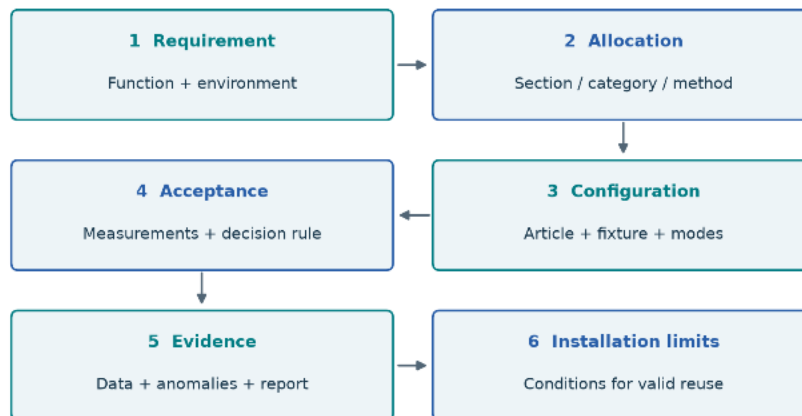
# The test contract buys evidence

- 01** Agreed matrix and acceptance criteria
- 02** Representative articles, fixtures and modes
- 03** Data, anomalies, retests and installation limits



# Closing a qualification matrix row

A qualification result needs an unbroken evidence chain



Design or installation change → assess affected requirements and evidence → justify credit or retest

Original planning diagram. Passing results remain tied to the tested configuration and supported installation assumptions.

**Requirement and  
installation source**

Exact configuration and  
as-run evidence

Disposition and remaining  
installation limits



# A test-ready requirement record

| Record field        | Example content              | Purpose                 |
|---------------------|------------------------------|-------------------------|
| Requirement         | Hot ambient contrast         | Function to demonstrate |
| Method and state    | Temperature + light geometry | Reproducible conditions |
| Result and evidence | Ratio, uncertainty, trace    | Reviewable decision     |

## Illustrative row structure for the qualification matrix



# Measurement uncertainty at acceptance

- 01** Choose a decision rule before testing
- 02** Keep calibration and instrument range traceable
- 03** Account for geometry and repeatability
- 04** Report a borderline result with its uncertainty



# Test sequence and specimen history

- 01** Record previous exposure and any repairs
- 02** Select sequence from requirements and the test plan
- 03** Control changes between tests
- 04** Preserve evidence for cumulative effects



# Changes and anomalies

- 01** A changed part can alter several failure paths
- 02** Original failures remain in the record
- 03** Credit and retest follow the impact assessment



## Worked example: changing the cover glass

- 01 Record glass, adhesive, mass and geometry changes
- 02 Review optical, thermal and mechanical effects
- 03 Justify retained credit and targeted verification



# An anomaly record preserves the event

- 01** Capture time, stimulus, mode and configuration
- 02** Separate observed behaviour from suspected cause
- 03** Retain the failed run and investigation evidence
- 04** Approve correction and retest scope explicitly



## A change-impact review across disciplines

| Changed property     | Potential effect        | Evidence review             |
|----------------------|-------------------------|-----------------------------|
| Resistance / control | Power and warm-up       | Thermal and power tests     |
| Conductive layer     | Touch and EMC           | Functional / EMC checks     |
| Bonding / optics     | Stress and transmission | Mechanical / optical checks |

### Illustrative substitution: new transparent heater



## Capstone: the bonded touch display

- 01 10-inch display; nominal 28 VDC input
- 02 Pressurized flight deck; four structural mounts
- 03 Several environmental allocations remain open



# Capstone deliverables

- 01** Boundary and open-input list
- 02** All-section matrix and two procedure outlines
- 03** Monitoring, supplier evidence and installation checklist



## Capstone review points

- 01** A temperature request does not select a category
- 02** 22 minutes describes only the ideal ramp
- 03** 65,000 ft requires an aircraft or customer basis



## Second application: a helicopter

- 01 Unpressurized location and different harness
- 02 Isolators change mechanical and bonding assumptions
- 03 Common evidence needs a documented comparison



# Capstone: a military derivative

- 01** Allocate aircraft, mission and handling requirements
- 02** Map shared evidence and uncovered conditions
- 03** Reassess a military ground-vehicle installation



## Capstone: a constrained design choice

- 01** Bright cockpit display with cold-start requirement
- 02** Bonded heater, touch layer and EMI shield
- 03** Limited power budget and fixed mounting envelope
- 04** Propose evidence before selecting the final stack



# Capstone review: what earns acceptance

- 01** Every claim has a measurable criterion
- 02** Every selected method has a configuration
- 03** Interactions and failure recovery have evidence
- 04** Open items have owners and closure conditions



## Knowledge check

- 01 A panel report covers the complete display?
- 02 A survival result proves operation?
- 03 An emissions pass closes HIRF compliance?



## Knowledge check: the evidence gaps

- 01** Panel evidence has limited configuration coverage
- 02** Survival and operating criteria apply to different states
- 03** Emissions, susceptibility and aircraft HIRF differ



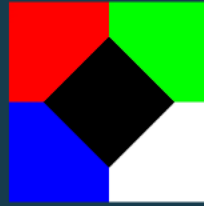
## Standards knowledge check

- 01 Storage pass versus powered operation?
- 02 Equipment EMI versus system E3?
- 03 Does a common chamber establish equivalence?



## Standards review: evidence and scope

- 01** Operating evidence must cover powered behavior
- 02** MIL-STD-461 equipment / MIL-STD-464 system
- 03** Procedure and acceptance determine coverage



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# **The Future of Display and Systems Development**

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**Next: [glossary](#)**

**DO-160 [glossary](#)**

I'm Diggy Breiling. Thank you for joining me.

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