Recommend Testing to Minimize Failures

Otto Bruegman

NOAA/JPSS

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With the help of
intern Kaden Loring

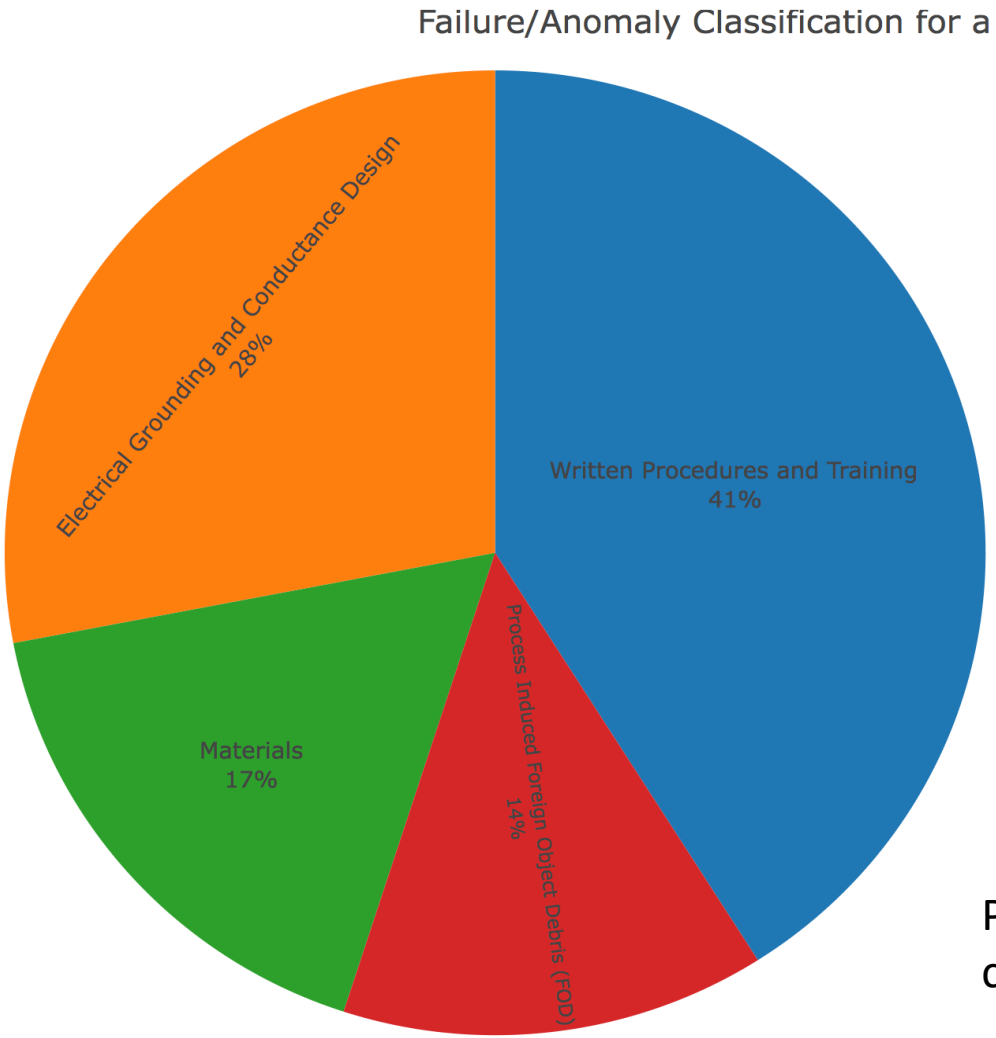
Contents

Introduction

- Experience: 6 years Instrument Systems Mgr., 5 years Instrument Mgr.
- Studying anomalies provides insight on issues that could impact new missions
- We reviewed anomalies* during mission phases C and D
- Root causes fell into four broad categories
- Discuss two mission options, both assume multiple identical satellite
- Discuss possible tests for the two mission options

* "Applications of Failure and Anomaly Analysis for Space Systems" K Loring, O Bruegman - 2020 IEEE Aerospace Conference, 2020

Common F/A Root Cause Attribution Results



Good enough the writer can use it successfully, not others.

Poor Grounding, Ground Loops, Crosstalk, ESD, etc.

- Written Procedures and Training
- Electrical Grounding and Conductance Design
- Materials
- Process Induced Foreign Object Debris (FOD)

Materials Incompatibility – unintended chemical reactions, bad bonds, reacts in vacuum, poor thermal properties, etc.

Poor machining, unintended material in coatings, weld spatter, poor cleaning, etc.

Fabrication, Sub-system Testing, and Integration (2005-2014)

Possible Missions And Test Concerns

- Assumed multiple identical small spacecraft in multiple orbits
- Assume 3-to-5-year design life
- Assume the two launch options
  - Launch Early - Launch all at once
  - Launch on Need - Launch one at a time storing the rest for launch based on need
- Possible concerns for the two launch options that may need testing
  - Supply chain issues – Often reliable with random off nominal parts
  - Full/limited testing – Test every unit or just the first unit
  - Process issues – Reliable until staff change
  - Life limited parts issues – May affect store and launch on need

Possible Tests For Mission

- Launch all copies early in the mission
  - Build a full-scale engineering development unit (EDU) designed for test
    - Full test on EDU
    - Limited testing on copies
  - Supply chain – Test incoming parts, verify required performance
  - Test new procedures using 2 or 3 different teams to validate consistent results are achievable
- Launch on need mission
  - Same EDU strategy
  - Plus, design and test for life limited parts, especially for long storage

Conclusion

- Suggest designing Test Program to fit new mission development
- Key take-aways are:
  - Suggestions base on assumption of launching multiple identical missions
  - Supply chain – Test incoming parts, verify required performance
  - Build and test a full-scale prototype, test the prototype, limited tests for the rest
  - Test new procedures using different teams to ensure consistent results
  - Design to minimize life limited parts and test, especially for long storage