RTCA/DO 160
Section 26, Fire, Flammability
Working Group

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Agenda

- RTCA Who?
- Goal of Working Group for Section 26
- Why the confusion? A case study
- The new “approved” section 26
- Proposal for alternate method: test the box “whole”

Commercial Aircraft Electronics (Avionics)

- RTCA, Inc.
  - Not-for-Profit corporation that functions as a Federal Advisory Committee
  - Dozens of “Special Committees” working with oversight from a Program Management Committee, and input from the FAA

Environmental testing RTCA/DO-160

	RTCA/DO-160 (Section)	Test
	4, 5	Temperature and Altitude
	6	Humidity
	7, 8	Shock and Vibration
	9	Explosion Proofness
	10	Waterproofness
	11	Fluid Susceptibility
	12	Sand and Dust
	13	Fungus
	14	Salt Fog
	24	Icing
	26	Fire, Flammability

Electrical Testing RTCA/DO-160

- EMC Tests include:
  - Power Input
  - RF Emissions
  - RF Susceptibility
  - Lightning
  - ESD
  - And more..

Background

- Advisory circular (AC21-16F) identifies RTCA Doc. No. (RTCA/DO)-160F as an acceptable means of environmental qualifications for showing compliance with airworthiness requirements.
- This AC excludes Section 26, “Fire and Flammability” as it is not as stringent as FAA accepted methods.

Why it was not accepted

- Section 26 was added to RTCA/DO-160 Rev. E (2004)
- Category C, Flammability Method was written verbatim from UL94
- Some of the tests were not as stringent as FAR Part 25, Appendix F

Working Group Goal:

- Ultimately, draft new section 26 that will be accepted by the FAA
- Give clear guidance on how to meet compliance for the various configurations of components that house electronics
- Eliminate the current confusion within the industry with regards to aircraft electronic enclosure flammability testing

Case Study

- As an exercise, the task group was asked to perform a flammability analysis on two electronic units manufactured by Thrane and Thrane Company.
- Thrane and Thrane provided the drawings and description of these units. These were sent to each task group member.
- The two units are …

Case Study: Typical Box

– The **SBU (Swift Broadband Unit)** which is used to send and receive RF signals to the HLD Diplexer:

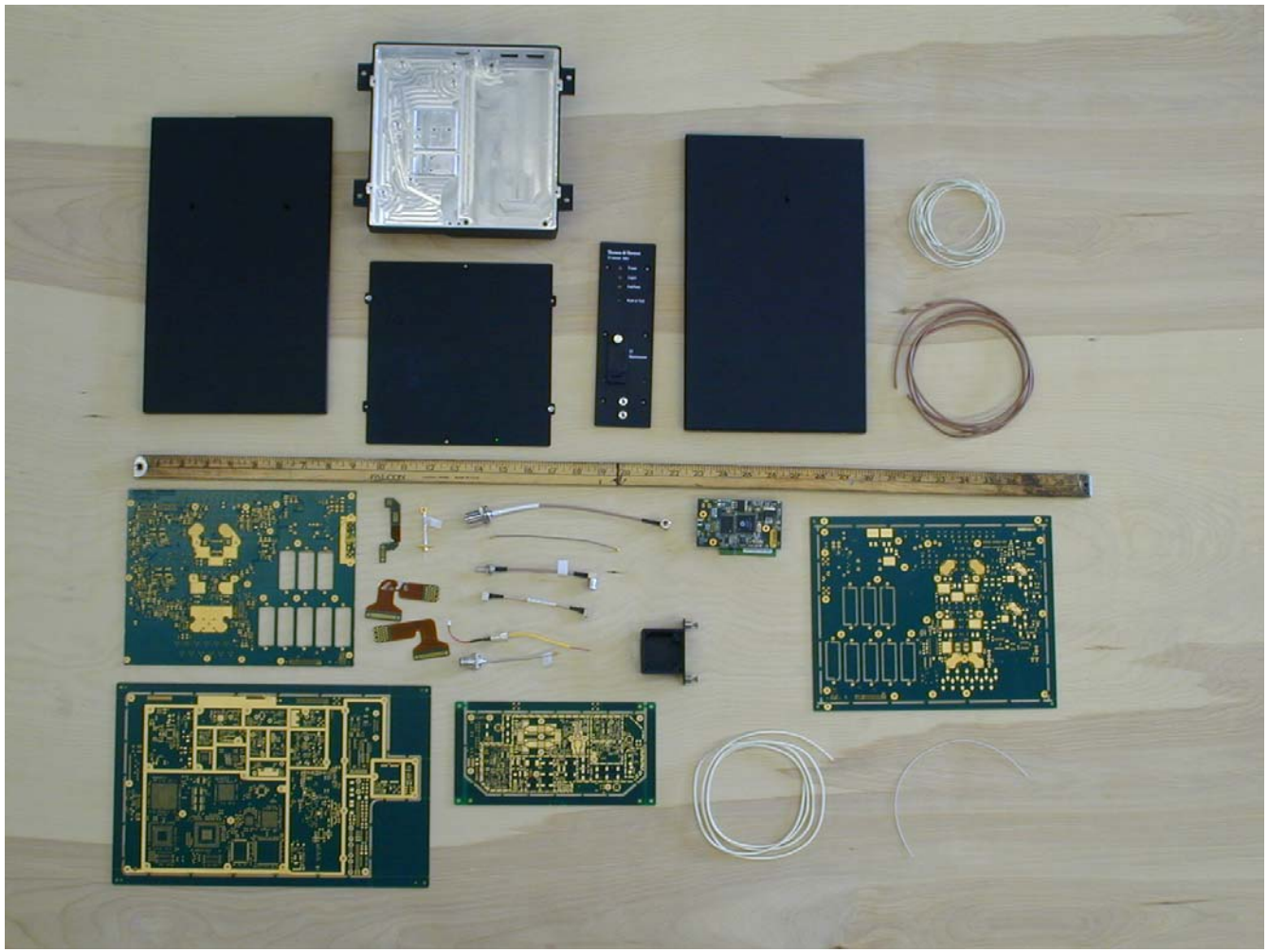
SBU, Metal unit with cooling/vent holes

Case Study: Typical Box

– The **HLD** (HPA/LNA/Diplexer which is a high power, **low noise amplifier**

HLD, metal construction with no cooling/vent holes

Breakdown of Individual Components SBU



Instructions:

- HLD - placed somewhere nearby the antenna and this can vary from behind the ceiling to inside the tail for use with tail mounted antennas.
- SBU - located inside a temperature controlled area of the aircraft, typically in the avionics bay.

Results – HLD

- no testing required as it is located in a non-pressurized area
- no testing required as it is an all metal box with no venting
- test all components using either 12 second vertical or 60 degree for cable and wire

Results – SBU

- test all parts (except metallic) and cable/wire to 12 second vertical or 60 degree.
- Because of its location they would not normally perform 12 second vertical tests on anything. All wire and cable inside the box would be subject to the 60 degree test.
- test all parts (except metallic) and cable/wire to 12 second vertical and 60 degree. They also used a criteria of “dimensions shorter than 50mm” for both non-metallic components and cables/wire to satisfy “small part exclusion”

Conclusions

- The information gathered confirmed that considerable variations to flammability testing of electronic enclosures can and does happen
- We used this information to offer specific guidance in Section 26 to reduce the variability in approach to testing

Section 26 changed:

- Focus on current industry accepted method, FAR Part 25 (Fire test Handbook)
- Define configurations that should be exempt from testing and which configurations should be tested
- Clearly define what meets “small electrical components” in the small parts exemption criteria
- Define how to approach sample size (raw material is often not available, use actual hardware?)

Section 26, Categories A & B

- Category A, Fireproof
- Category B, Fire Resistant

Category C, Applicability

- Category C: Flammability (bunsen burner)
- Applies to enclosures housing electronics and non-metallic material, component parts, sub-assemblies installed in pressurized or non-pressurized zones and non-fire zones.
- Test to be performed on equipment in a non-operating mode.
- The purpose of this test is to check the non-propagation of the flame in the case where ignition would appear inside or outside of the equipment.
- Tests will be performed on specimens of material.

Category C, Configurations Exempt

Testing is not necessary on enclosures housing electronic or non-metallic material if the following apply:

1. The enclosures is constructed of metal (metal finish that is non flammable), on all sides, and has no vent holes

2. The enclosures is constructed of metal (metal finish that is non flammable) on five sides and one side is constructed of glass polycarbonate(display) that has met the 12 second vertical test, and has no vent holes.

Category C, Small Parts Exemption

Small Parts Exemption:

Parts/materials which are considered small may be exempt due to their small size and amount because they would not contribute significantly to the propagation of a fire. Examples of small parts could be: knobs, handles, rollers, fasteners, clips, grommets, rub strips, pulleys, etc. Further definition is offered below:

Size Relation (Typical Usage)
Fits inside a 76.2 mm x 76.2 mm x 12.7 mm (3” x 3” x .5”) or 50.8 mm x 50.8 mm x 50.8 mm (2” x 2” x 2”) Box without bending of the part
Smaller than 50.8 mm x 76.2 mm x 1.178 mm (label and / or its adhesive) (2” x 3” x .07”)
Smaller than 6.35 mm (0.25”) Dia. Sphere (drop of thread lock or Nycote)
Smaller than 101.6 mm x 2.286 mm (4” x .09”) dia (lacing tape)

Consideration must be given when more than one small part is located in the same proximity with other small parts (one part may ignite the other part) as the combined fuel load may contribute to propagation of a flame, in this case the above small parts exemption would not apply.
Small parts exemption does not apply to wire and cable.

Category C, Test Methods

Table 26-2 Type of Test Determination

Components	Method	Paragraph
All materials other than rubber or elastomer parts, wire and cable	Vertical 12 second bunsen burner test	26.7.2
Rubber or elastomer parts	Horizontal bunsen burner test	26.7.3
Wire and cable	60 degree bunsen burner test	26.7.4

- Methods verbatim from Fire Test Handbook

Other changes

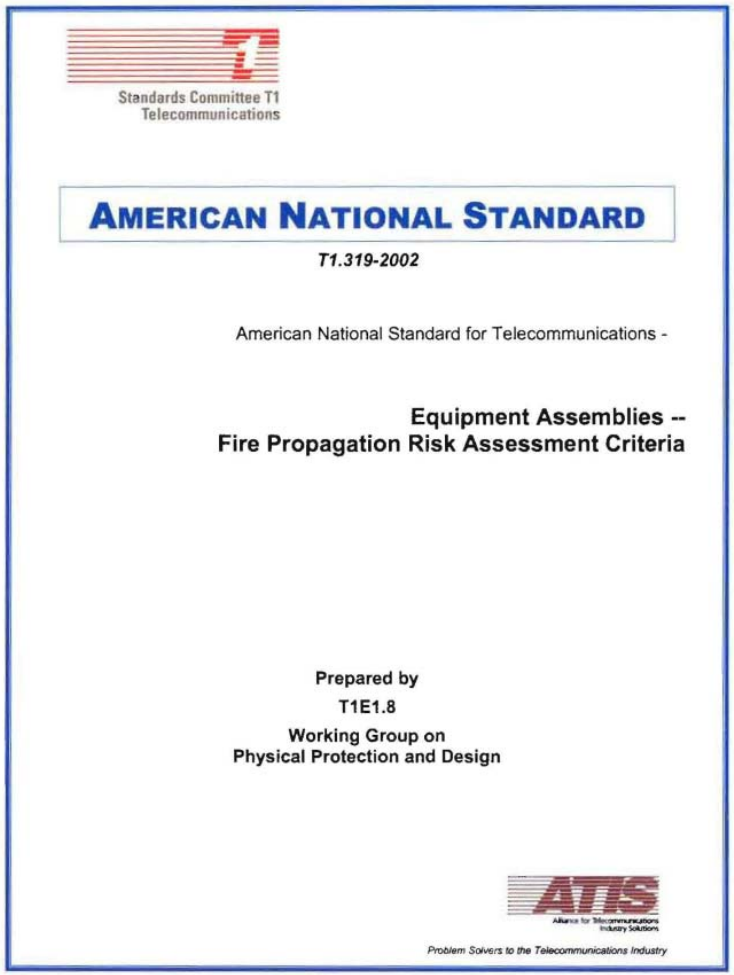
- Methane gas of 99 percent minimum purity shall be used.
- **Specimen Size**
- The specimen will be a rectangle at least 3 by 12 inches (75 by 305 mm), unless the actual size used in the aircraft is smaller and it is not possible to acquire a larger sample of the material. Since the allowable burn length is 8 inches a sample less than 8 inches would not meet the pass requirements if burned completely.
- Added a “User guide” which includes the information from the appendix in each pertinent section in the FAA Handbook
- Added guidance for the Cat. A and B testing

Assuming Rev G is accepted…where do we go from here?

Test the box whole
Advantages:

- Does not require breakdown and analysis of individual components
- Only one test would be required (multiple burns may be required on same unit based on internal fuel load)
- If flame cannot stay lit (enclosure does not allow sufficient air for combustion) unit passes
- If combustion of internal components does occur, data can include observations for smoke and external flame (useful?)

ANSI T1.319



Standards Committee T1
Telecommunications

AMERICAN NATIONAL STANDARD

T1.319-2002

American National Standard for Telecommunications -

Equipment Assemblies --
Fire Propagation Risk Assessment Criteria

Prepared by
T1E1.8
Working Group on
Physical Protection and Design

ATIS
Alliance for Telecommunications Industry Solutions

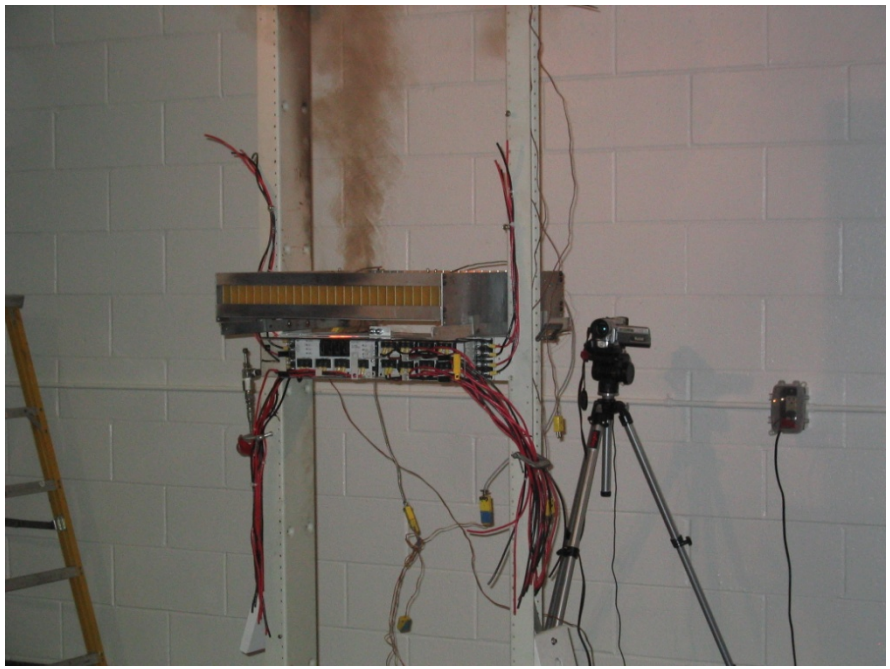
Problem Solvers to the Telecommunications Industry

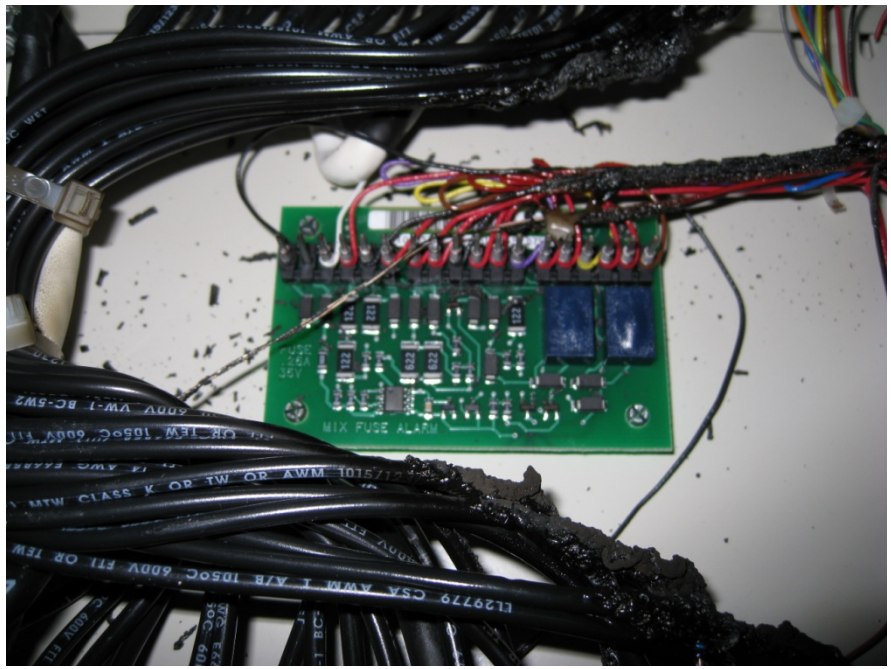
ANSI T1.319

- Title: Equipment Assemblies – Fire Propagation Risk Assessment Criteria
- Requires insertion of a programmable burner into the equipment chassis which simulates a circuit card igniting and burning through to completion
- Flame heat (amount of methane varies) based on the largest size circuit board
- Flame is placed to impinge area within chassis with most fuel load
- Heat released is measured along with observations of smoke
- Fire cannot escape the enclosure to ignite any surrounding equipment

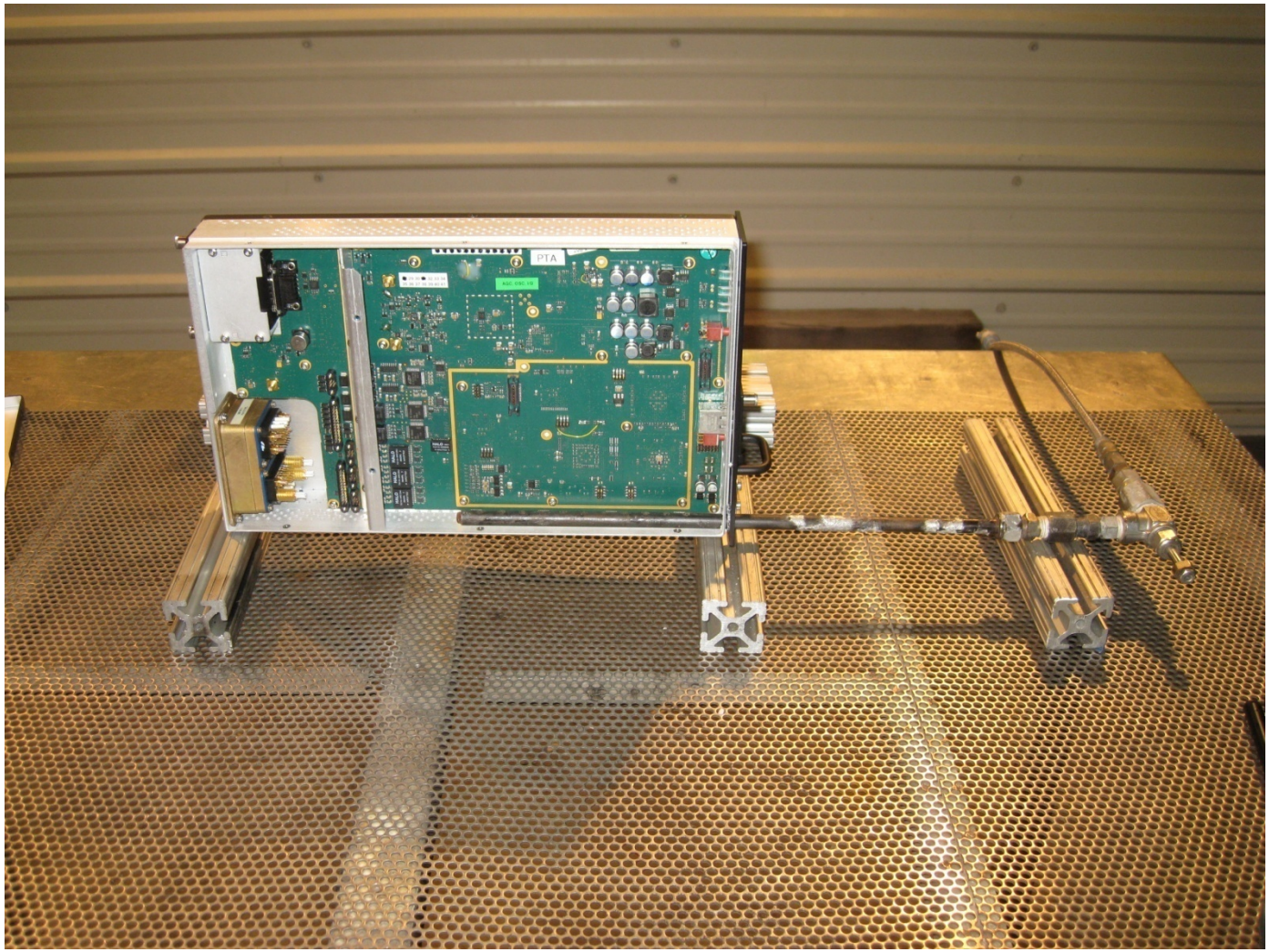
Typical Fire Test Set-up

Test in Progress





SBU, an experiment



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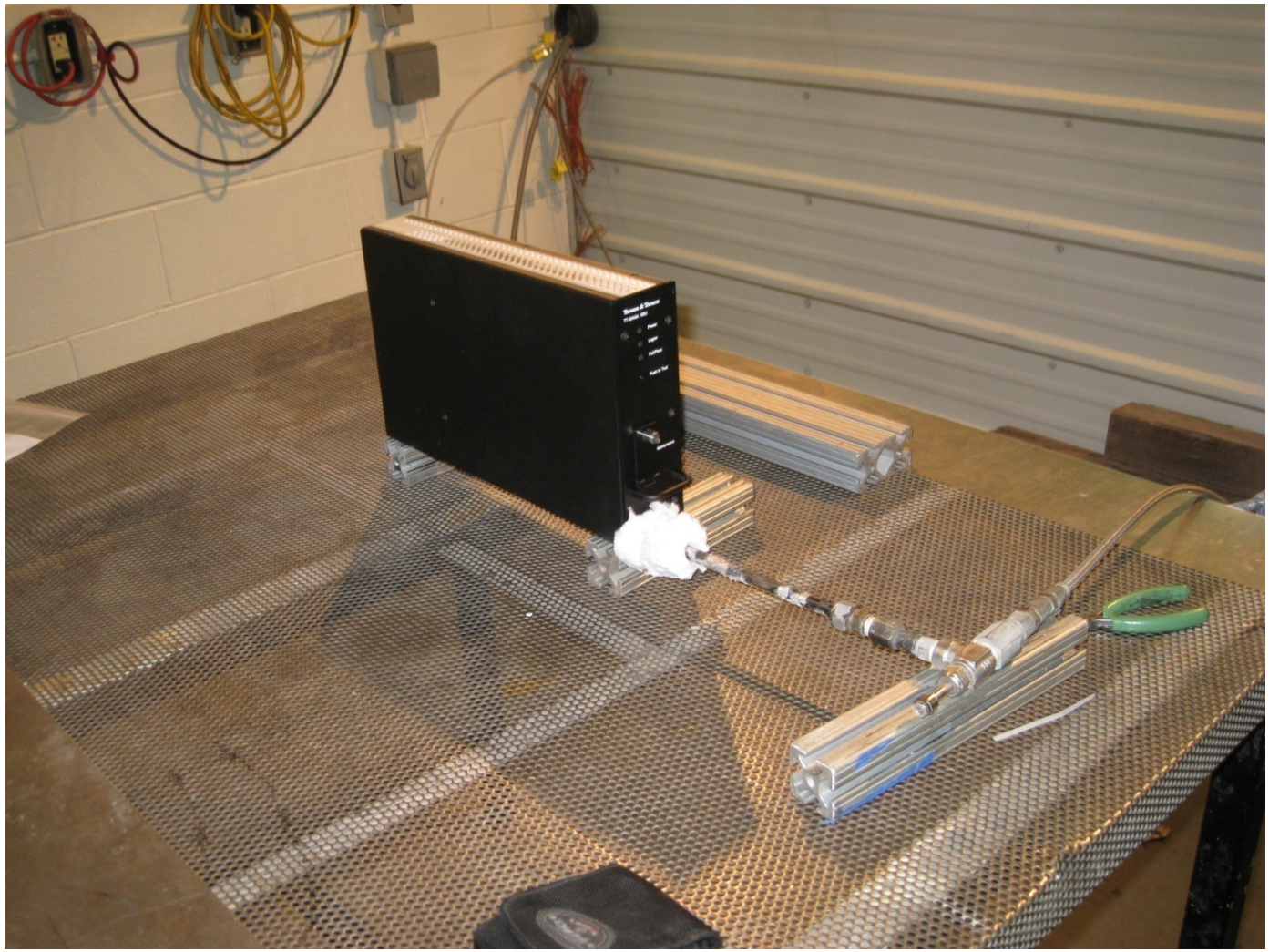
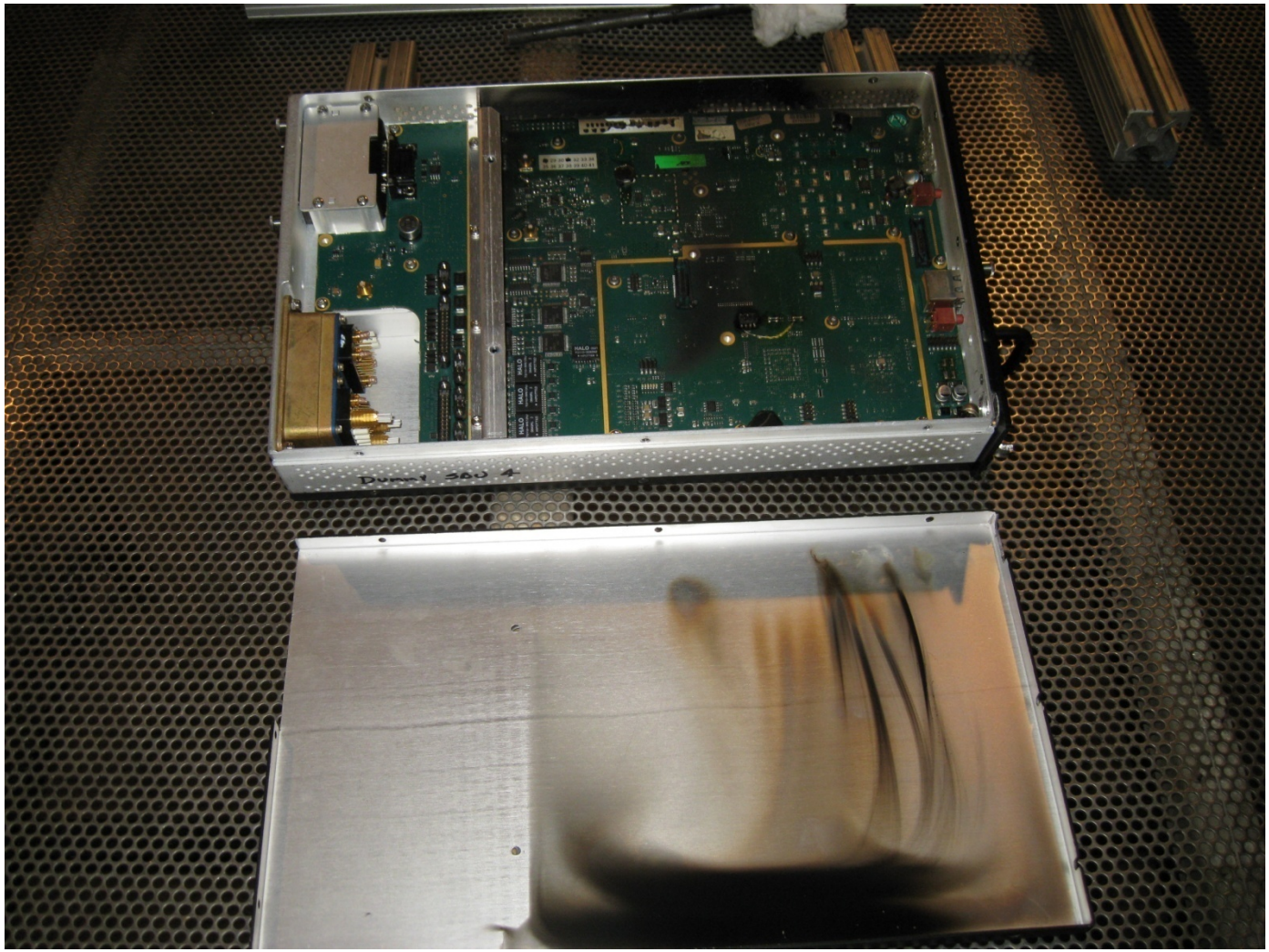


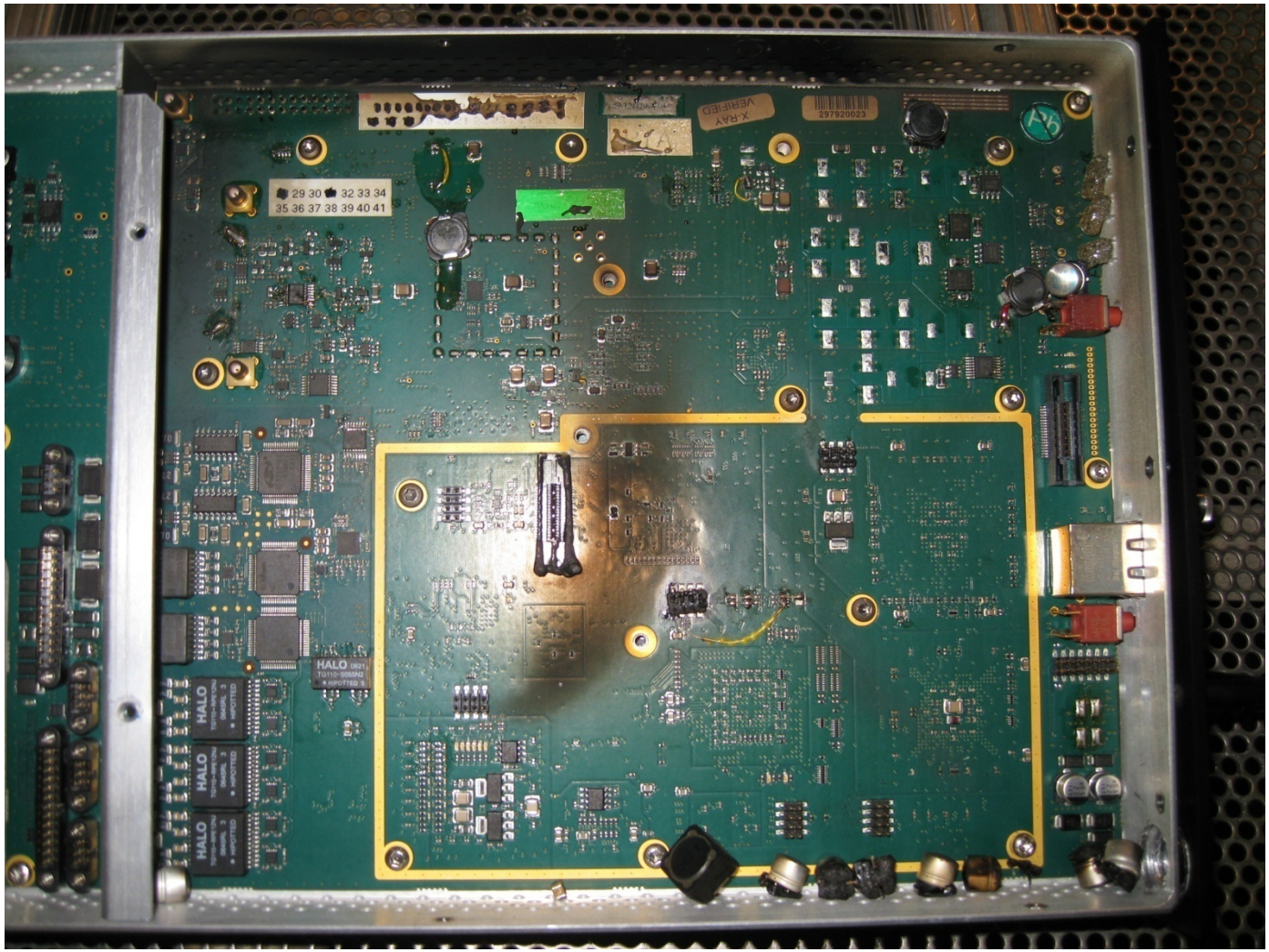
Line burner scaled for PCB of 7-inch height

Test in Progress

Results



Results



Disadvantages/Unanswered Questions

- How to rate pass/fail, or what is considered safe (plastic enclosures)
- Toxicity of burning small electronic components (usually left off for PCB testing)
- Does not address external fire source (plastic or non-metal enclosure)
- Correlation between individual component bunsen burner testing and complete unit (can you pass one test and not the other?)

Conclusion

- Although a fun exercise, it does not prove method is appropriate
- Any new methods, such as testing the “box” as installed in the aircraft rather than individual components will require:

  - Industry experts to concur on method
  - Test data to back-up new method
  - Round robin results used to refine method
  - Draft procedure circulated to SC135 committee, industry, and FAA for approval
  - Next Revision H in 2015

Thank You

Questions?

Contact agt@environlab.com if interested in participating in further development of specification