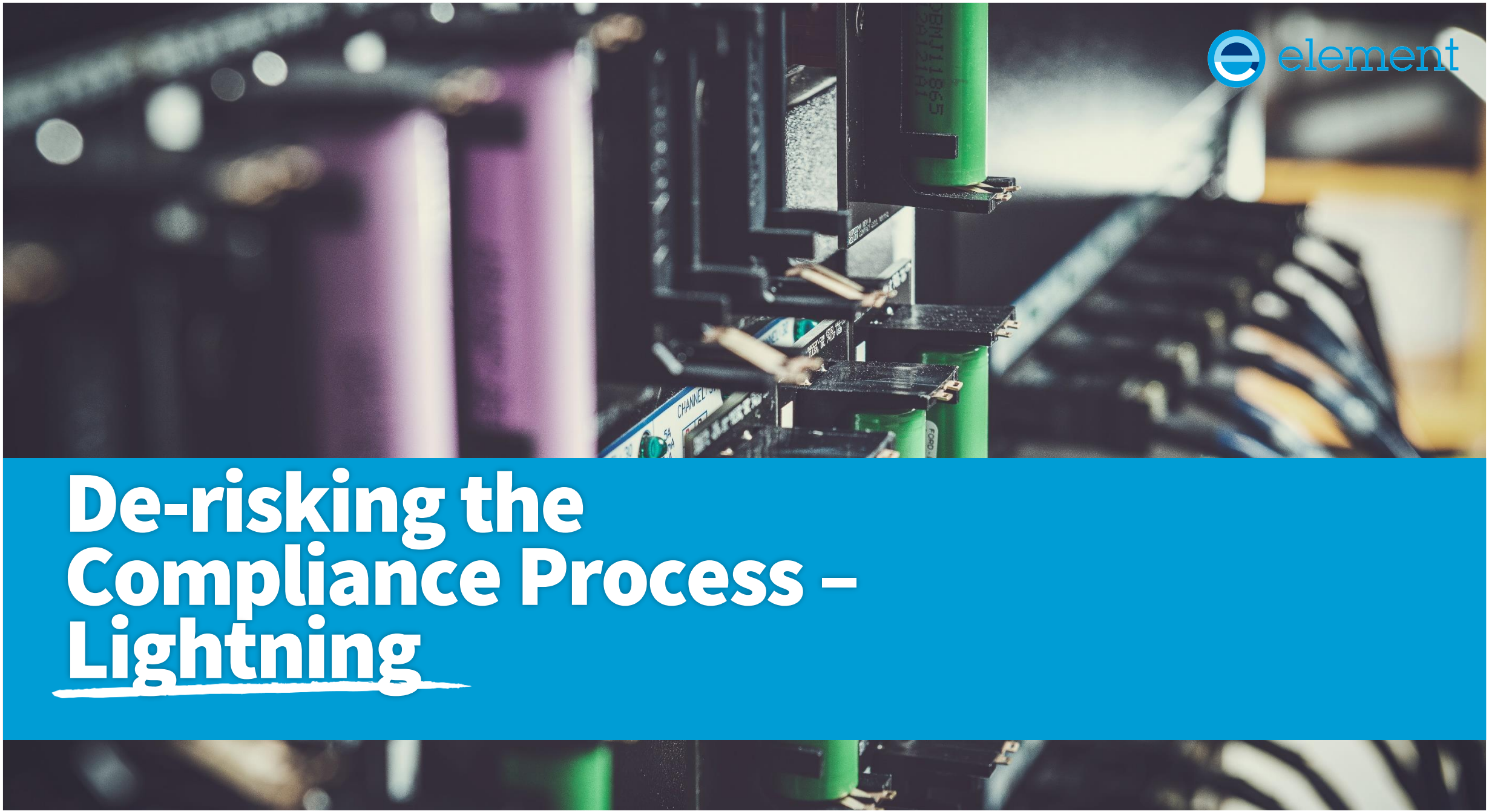


element

De-risking the Compliance Process – Lightning

Introduction

- Working with standards
  - European (Current)
  - US (Current)
  - How/why standards have changed

- Concept to certification
  - Structures (Worked example)
  - Fuels (Worked example)

Working with standards

EASA

- European Aviation Safety Agency
  - http://www.easa.europa.eu/

- The agency's responsibilities include:
  - expert advice to the EU for drafting new legislation;
  - implementing and monitoring safety rules, including inspections in the Member States;
  - type-certification of aircraft and components, as well as the approval of organisations involved in the design, manufacture and maintenance of aeronautical products;
  - authorization of third-country (non EU) operators;
  - safety analysis and research.

- You can access all the Certification Specifications through the website

Regulations

- Certification Specification CS
  - Give legally binding regulations
  - Split into various parts:
    - Part 25 – Large transport aircraft
    - Part 29 – Large Helicopters
  - In each part are sub paragraphs, some covering Lightning

Regulations give the requirements, but not guidance on how to satisfy them

LIGHTNING PROTECTION

CS 25.581 Lightning protection

(a) The aeroplane must be protected against catastrophic effects from lightning. (See CS 25.899 and AMC 25.581.)

(b) For metallic components, compliance with sub-paragraph (a) of this paragraph may be shown by –

(1) Bonding the components properly to the airframe; or

(2) Designing the components so that a strike will not endanger the aeroplane.

(c) For non-metallic components, compliance with sub-paragraph (a) of this paragraph may be shown by –

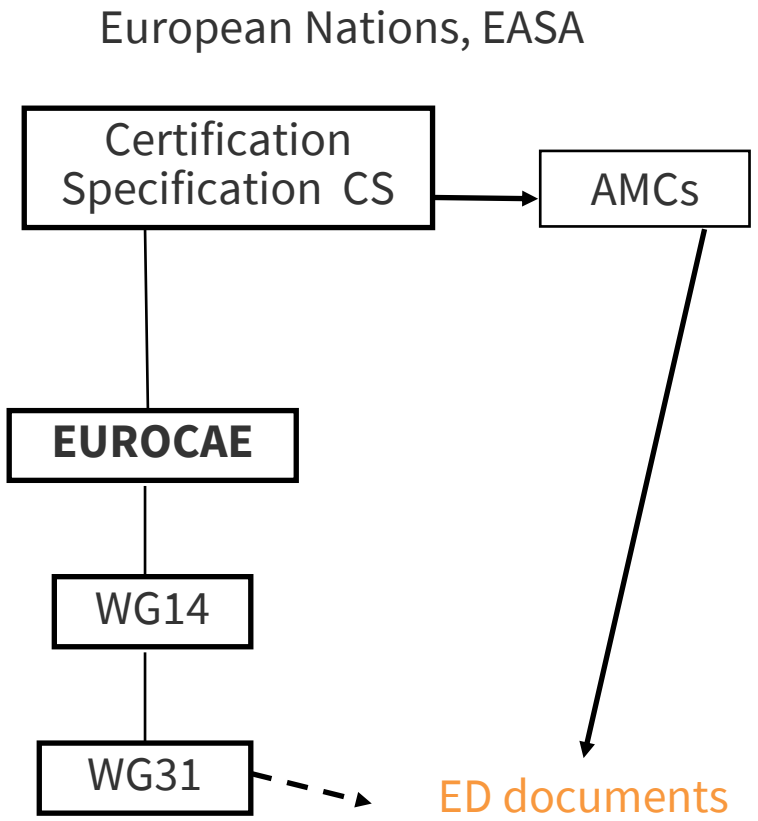
(1) Designing the components to minimise the effect of a strike; or

(2) Incorporating acceptable means of diverting the resulting electrical current so as not to endanger the aeroplane.

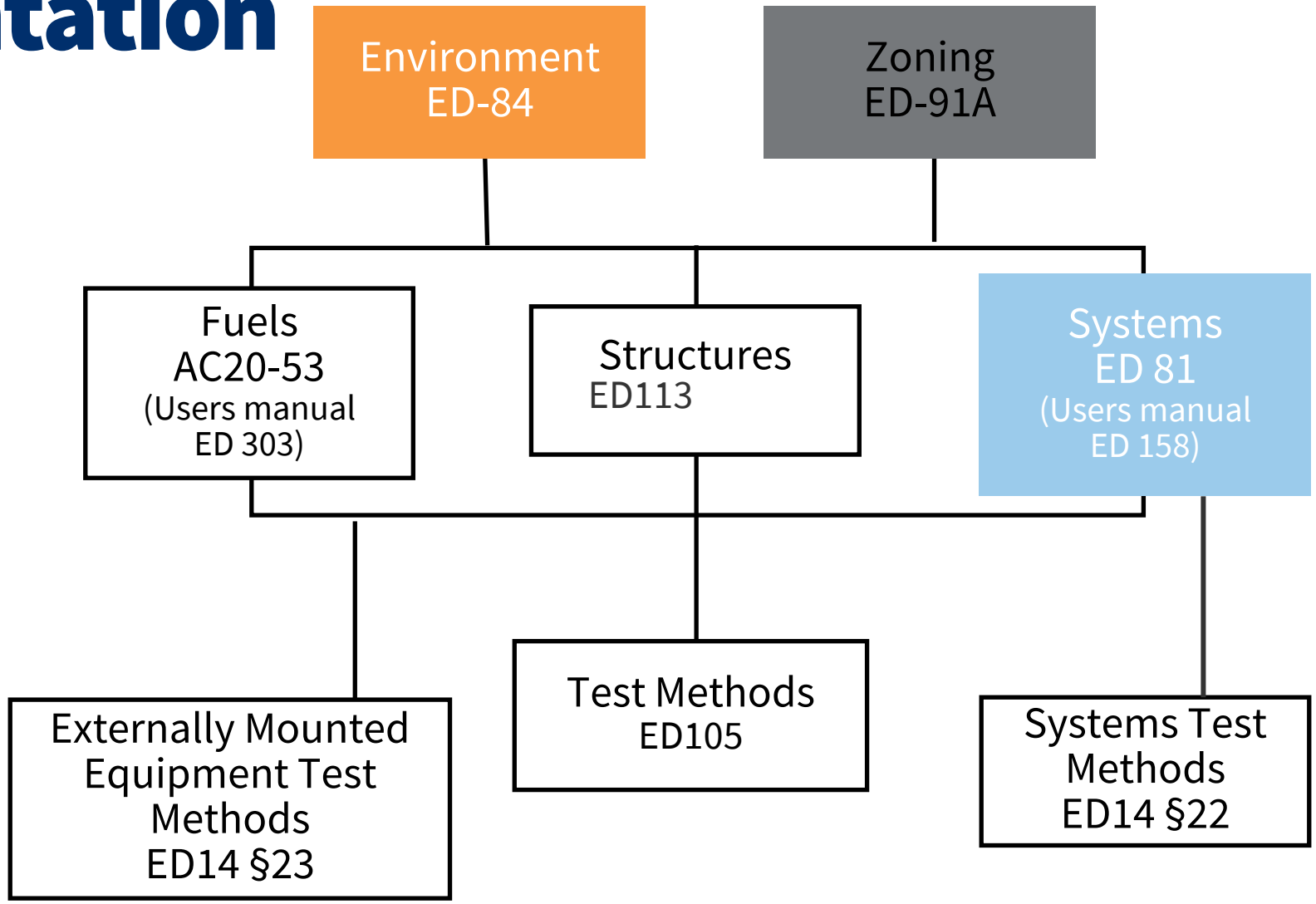
Eurocae

- European Organisation for Civil Aviation Equipment
  - http://www.eurocae.net/
- Comprises of several working Groups:
  - WG14 – Environment group
  - WG31 – Lightning group produces ED documents such as:
    - ED-84
    - ED-91
    - ED-105 etc

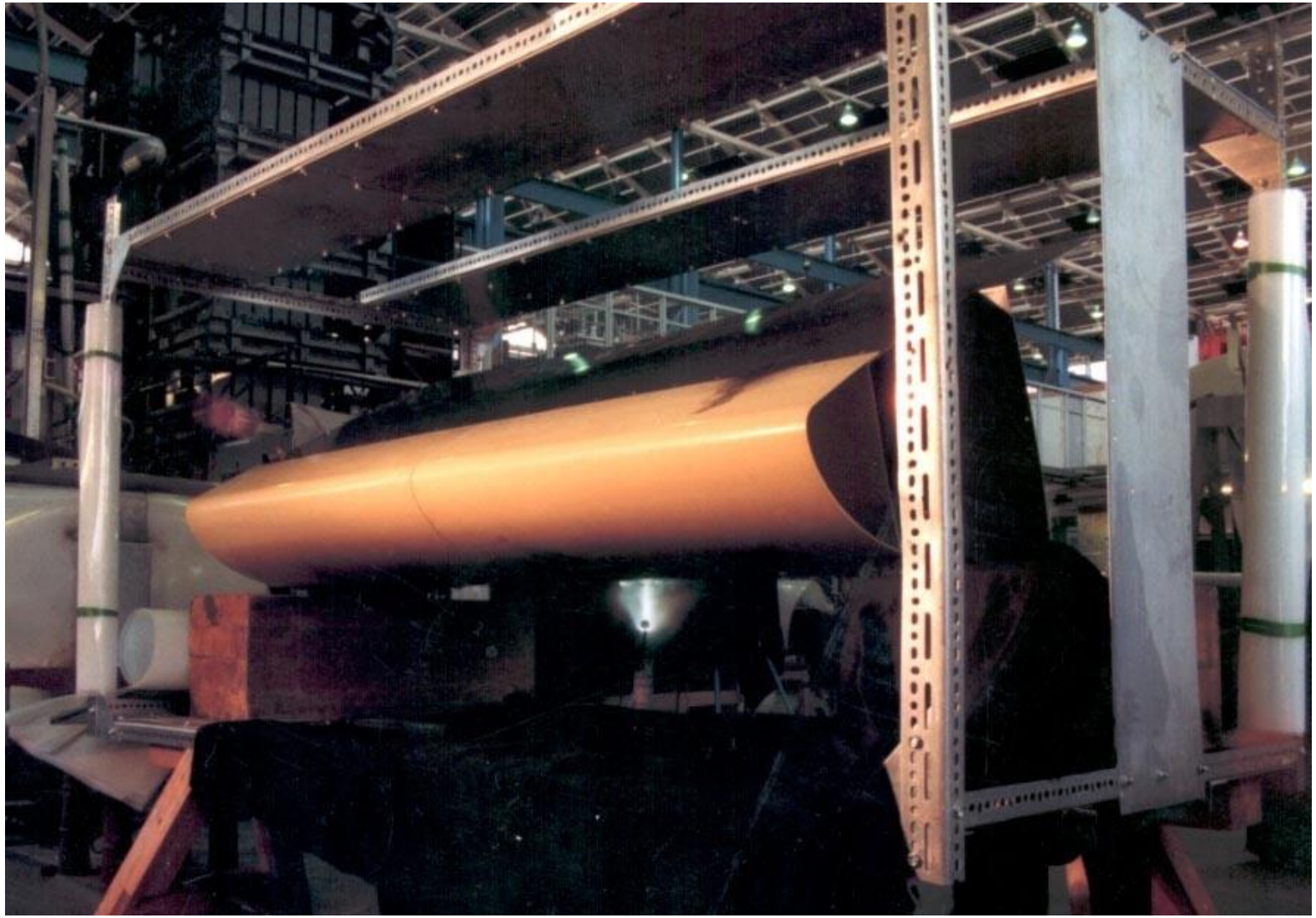
Relationship between Standards Committees and Authorities



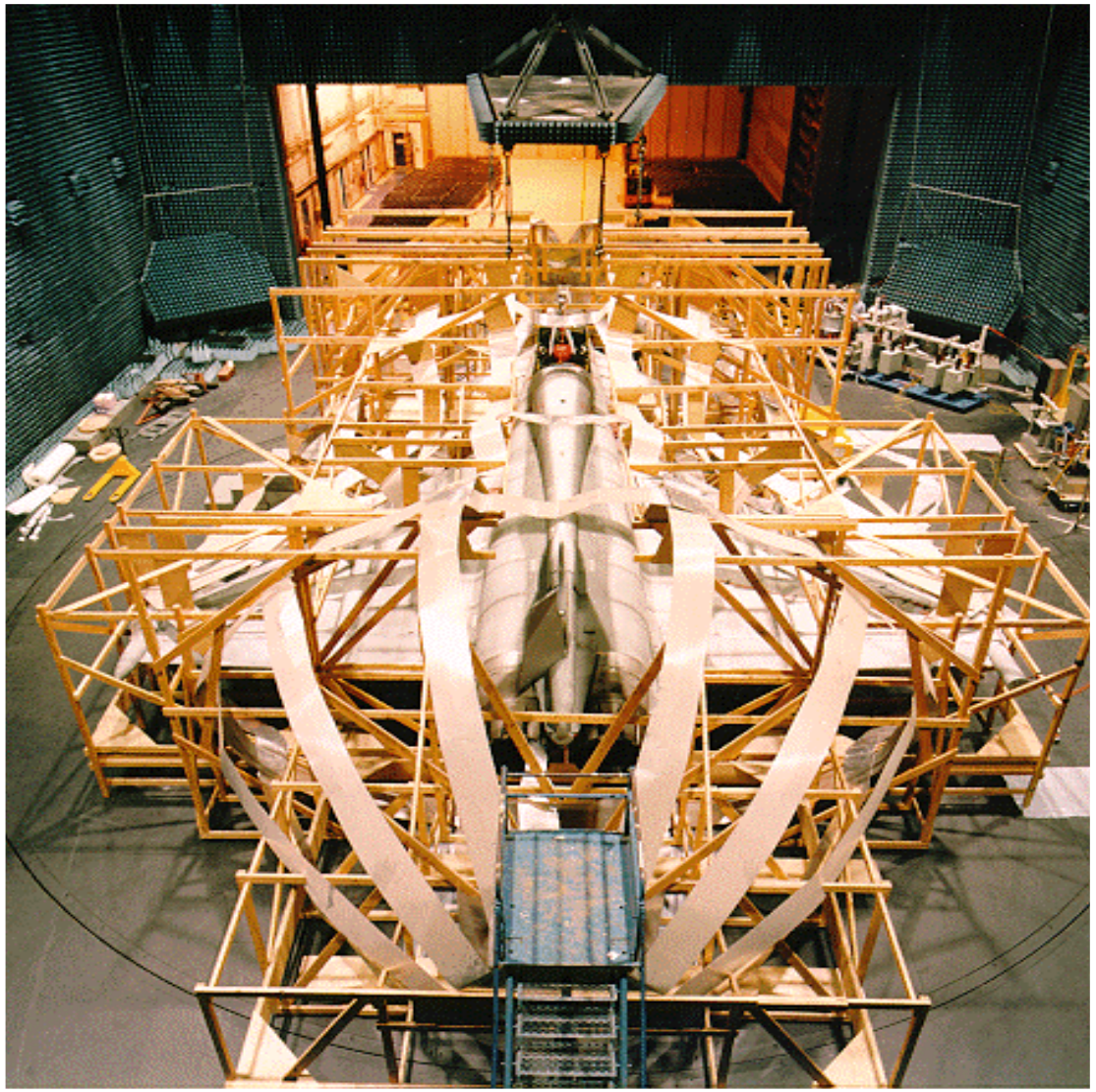
Structure of EUROCAE documentation



ED105 Direct Effects Example



ED105 Whole Aircraft Test Example

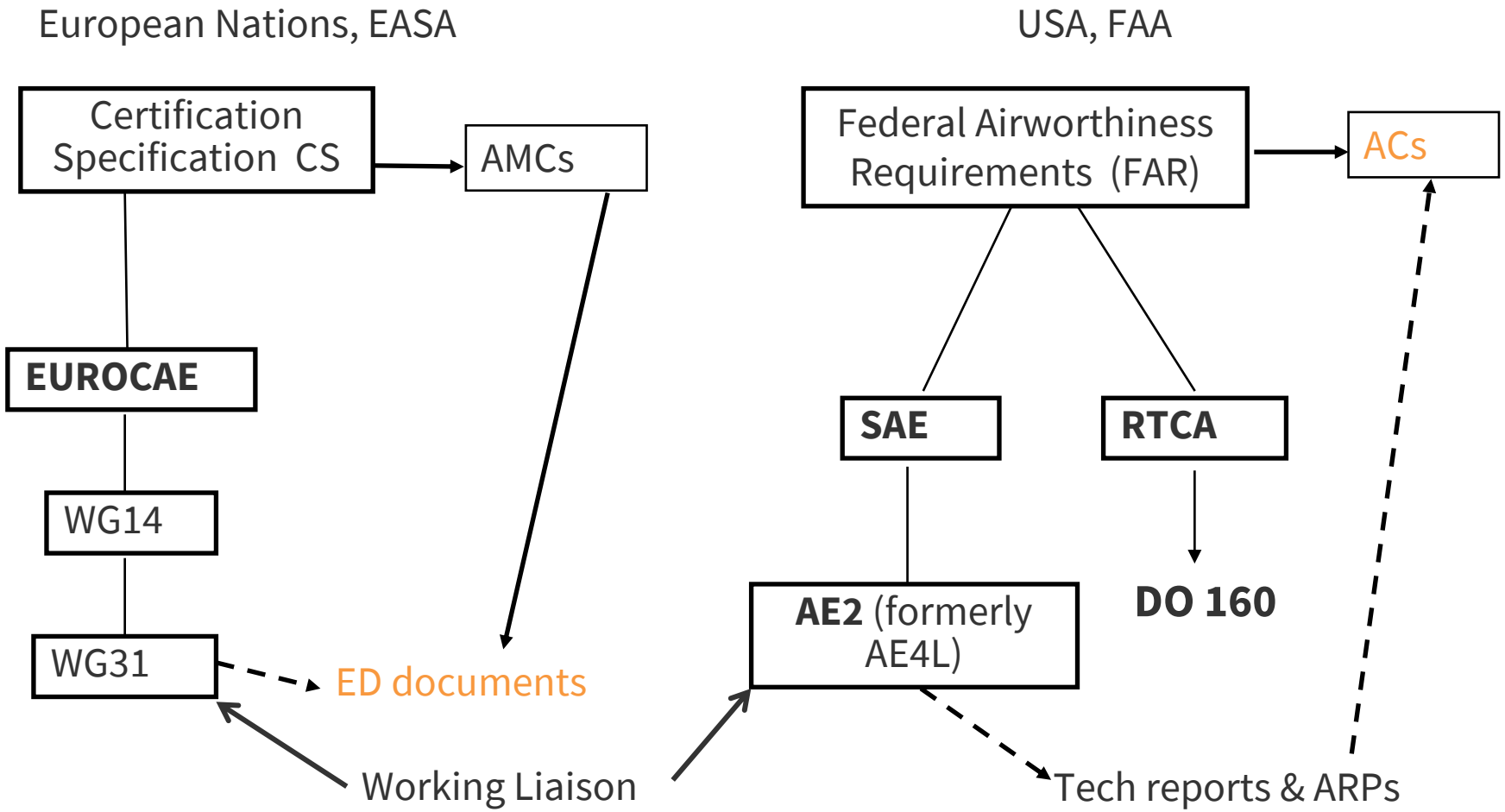


ED-14 Section 22&23 Examples

E.g. Section 22 Box test (Induced effect)

E.g. Section 23 direct effects test to antenna

Relationship between Standards Committees



Evolution of standards – Example

Showing G-TIGK drifting in heavy seas after ditching and evacuation of occupants, with tail rotor/gearbox missing and damaged main rotor blade.

TSS (*Transport supersonique standards*) 8.6 ~1975

200kA, 0.6 MJ/Ω

Super Puma TRB by similarity to Ecureuil TRB, tested to TSS8.6 but change from GRP to CFC

ED84 1998

200kA, 2.0 MJ/Ω

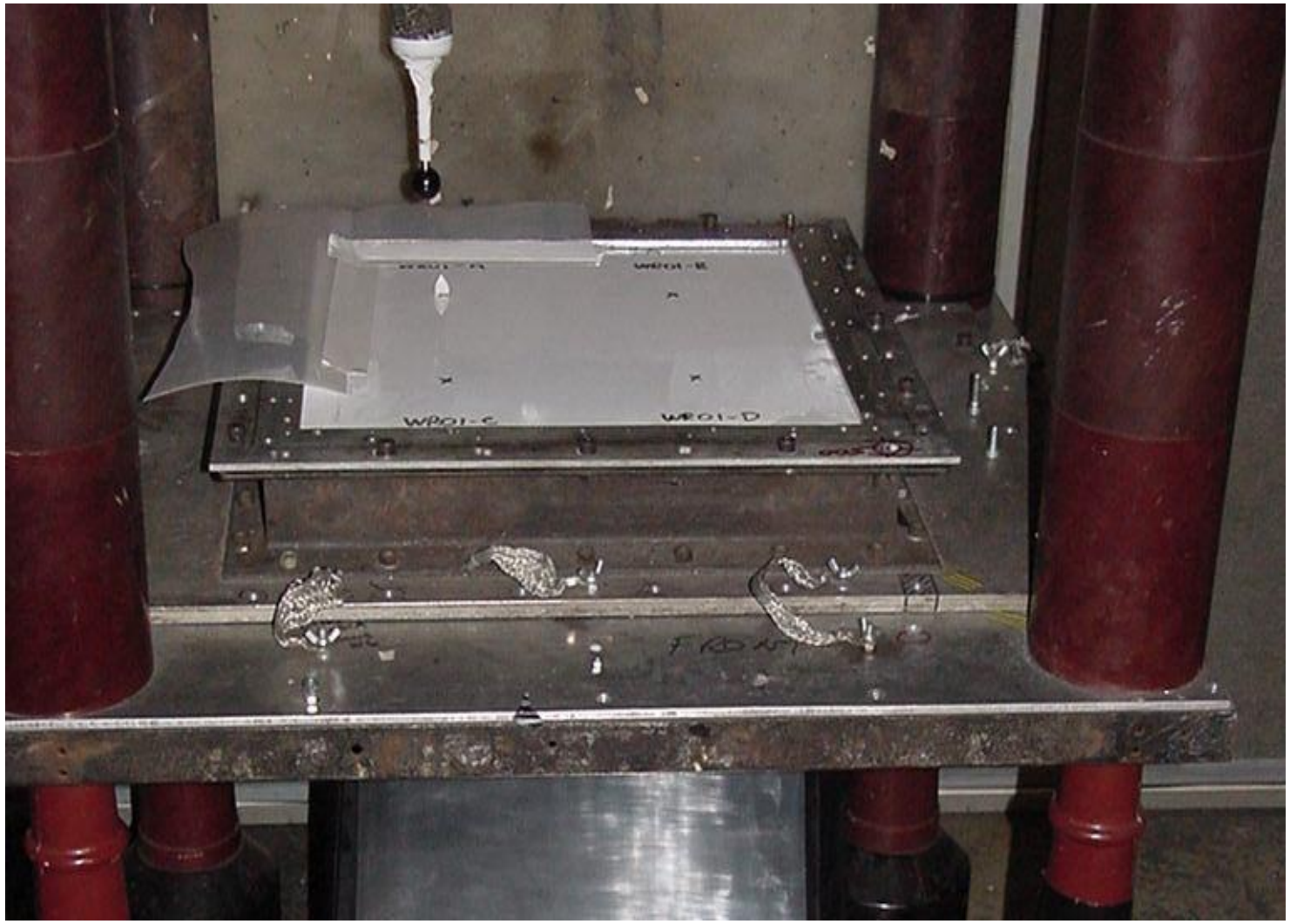
Concept to Certification

element

Structures

- **General Approach given in Guidance Material (ARP5577 / ED113)**
- Determine Lightning Zones
- Establish External Environment
- Identify possible ignition sources or areas subject to detrimental damage
- Design Protection (& pass/fail criteria)
- Devise a certification plan
- Review with Airworthiness Authorities
- Verify Compliance

Structures – Example Tests



Structures – Example Tests

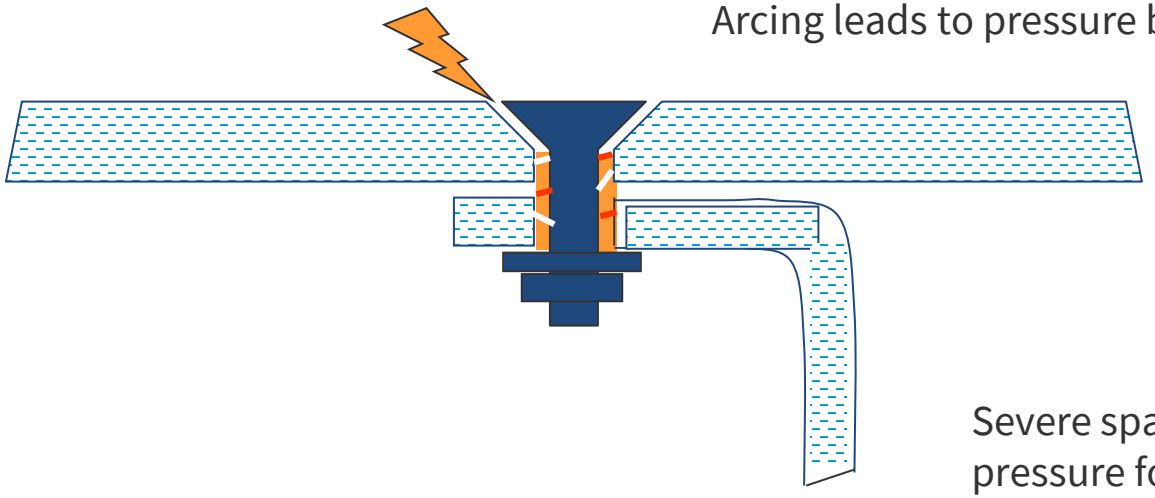
Fuels 25.954-1 (Guidance in ED-303)

element

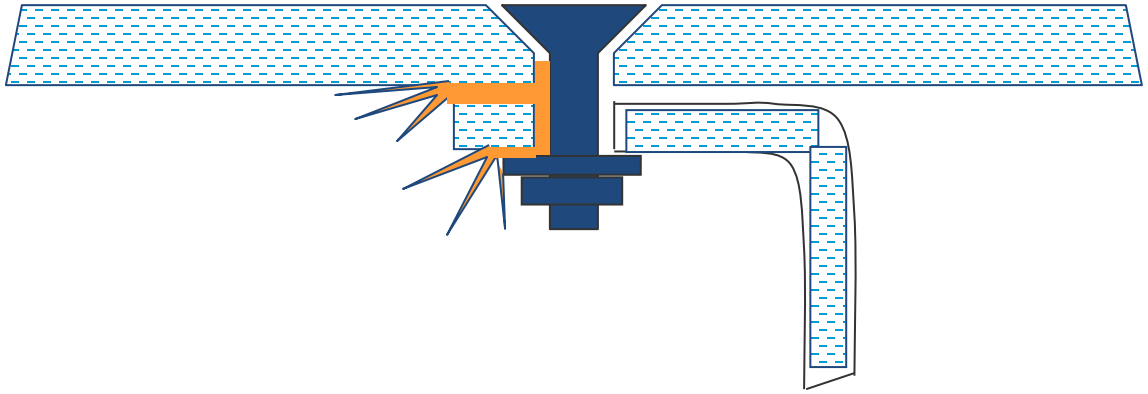
- **Perform safety assessment to determine fault tolerance and non-fault tolerance**
  - Intrinsically safe
    - E.g. plastic fuel filler cap
  - Fault-tolerant
    - Design isn’t intrinsically safe and requires protecting
    - Protection needs to fault tolerant e.g. multiple layers of protection
  - Non-fault-tolerant
    - Required detailed and thorough safety assessment to show that a catastrophic event is extremely improbable
    - I.e. avoid if at all possible!

Carbon Fibre Bolted Joints

Arcing leads to pressure build up

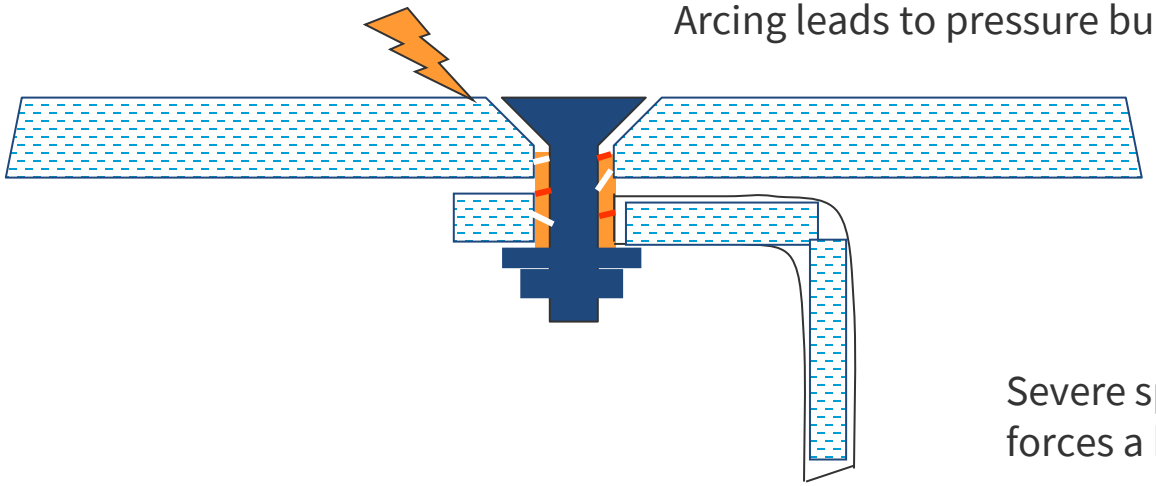


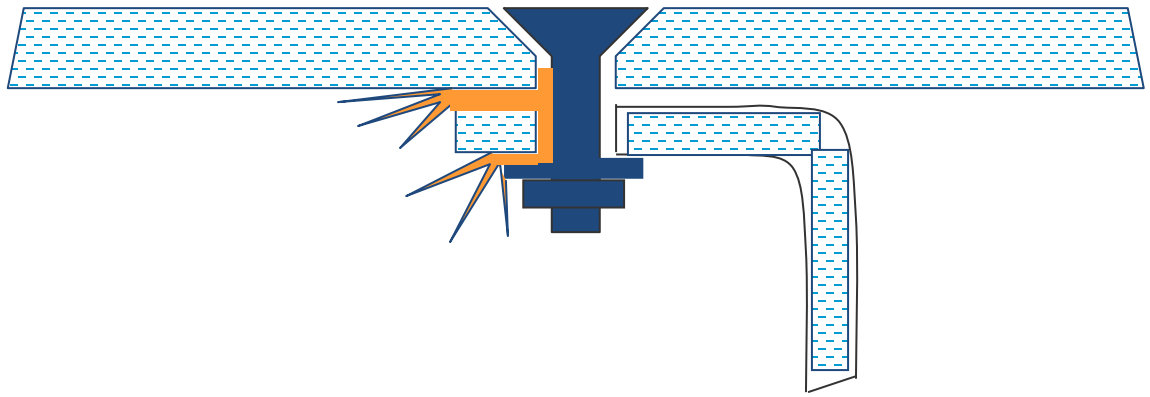
Severe sparking occurs if the pressure forces a hole



Carbon Fibre Bolted Joints

Arcing leads to pressure build up





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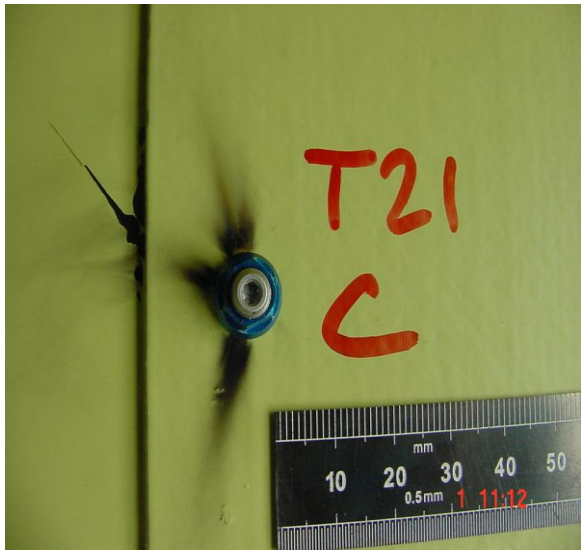


Fastener Sparking in Composites

element

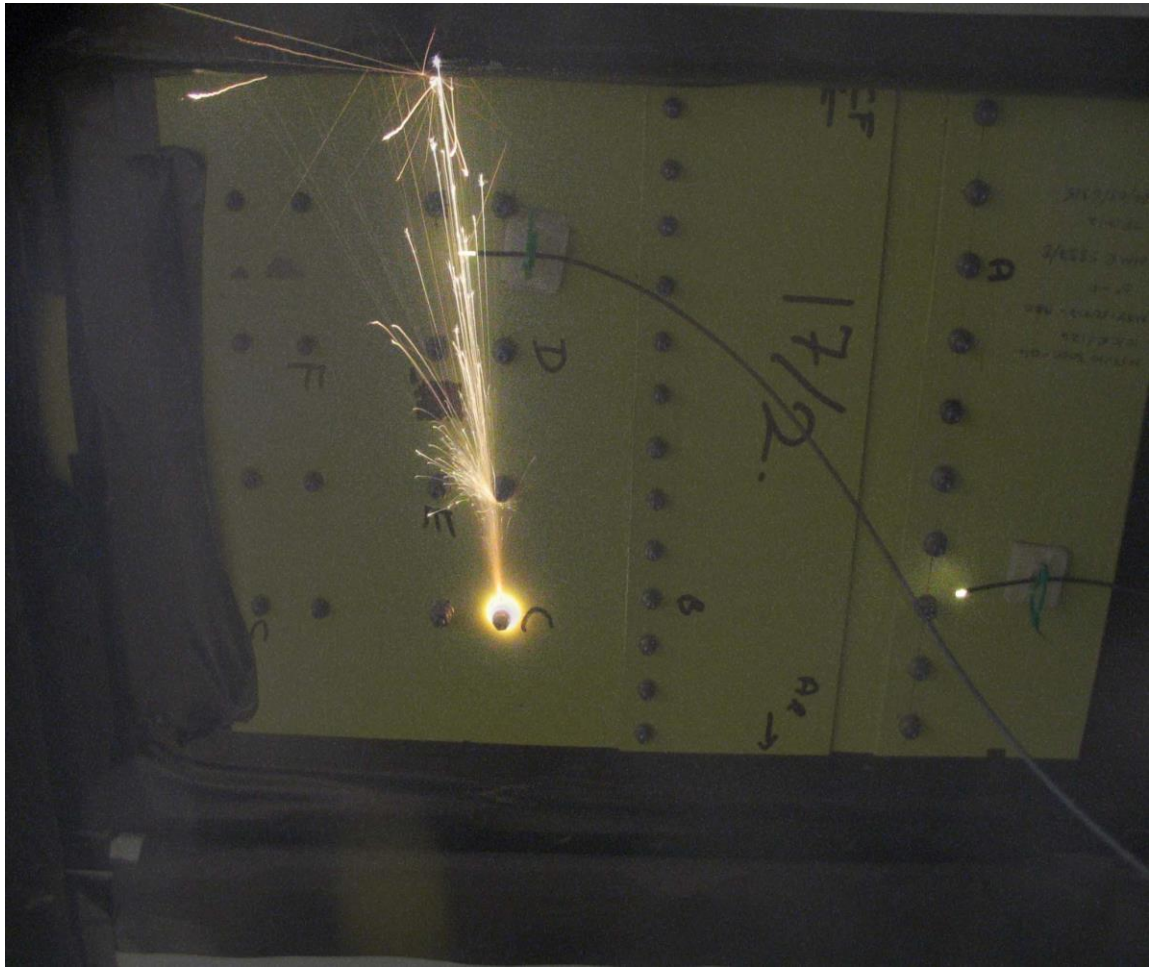
- Requires “Pressure containment” and bonding

- Very complex & depends on small details
  - scratches or creased internal surfaces (nut/washer seating)
  - tolerance of fasteners in holes
  - surface finish on fasteners
  - degree/depth of countersink?

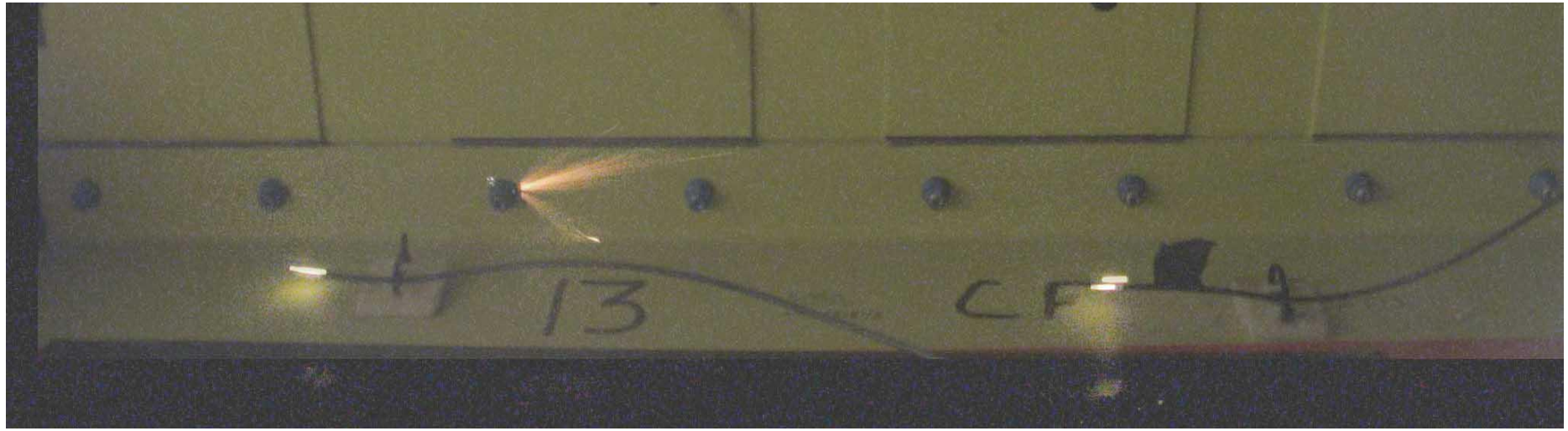
- Voltages are not very high
  - Struck fastener may be ~300V
  - Adequate clearance is needed

Example of Sparking Fastener

element



Example of Sparking Fasteners



Concept to certification

element


Q&A

THANK YOU