Introduction to Fuel Tank Safety and Ignition Prevention: Design, Certification and Compliance (AERO0361)

Instructor: Darren L. Stout, C. Bruce Stephens (This course may be taught by either instructor).

Course Description
This course provides details on all elements of fuel tank design needed for compliance with the regulation, with specific emphasis on electrical design aspects. Some review of regulatory history, 14 CFR 25.981 [25-102] and 25.954 are included for reference as well as TCA, STC work. Specific design implementations are examined and evaluated. The course will also include a high-level overview of electromagnetic effects and compatibility (EME/EMC), lightning effects (direct and indirect), high intensity radiated fields (HIRF), precipitation static (P-static), electrical bonding requirements, and requirements for electrical wiring interconnection system (EWIS).

Who Should Attend?
This course is designed for all design engineering disciplines, project managers, project engineers and laboratory personnel whose aircraft system may require protection of the airplane's fuel system from ignition/explosion.

Course Highlights
- The electromagnetic environment: considerations for 25.981 and 25.954
- Metallic and composite aircraft structures: considerations for 25.981 and 25.954
- The history of fuel tank protection requirements for aircraft certification
- Direct and indirect effects of lightning and HIRF testing for 25.981, 25.954 compliance
- Requirements for in-tank mounted equipment (including FQIS)
- Requirements for out-of-tank mounted FQIS
- Requirements for fuel control equipment mounted out-of-tank
- Fuel tank bonding and continued safety
- 25.981 ICA; critical design configuration control limitations

Learning Objectives
- FAA certification process and requirements
- Direct effects of lightning zoning and criticalities
- RTCA/DO-160 levels for direct effects testing
- Indirect effects of lightning
- RTCA/DO-160 levels for indirect bench testing
Course Outline

Day One
Purpose and overview
• General/definitions
• Regulatory environment

Background and regulatory actions
• TWA 800/SFAR 88
• 24 CFR26/Lessons learned

Electromagnetic Effects and Electromagnetic Compatibility (EME/EMC)
The HIRF environment
Electrical bonding
Electrostatic Discharge (ESD)
Prescription Static (P-STATIC)
FAA certification process and requirements
25.981 team workshop

Day Two
Compliance considerations
• FQIS
• EWIS
• COS / ICA / CDCCL
• AC25-981
• AC120-97A

Design implementations
• Establish design requirements with the following considerations
• Temperature threat and design mitigations – heat sources
• Auto ignition temperature and margin
• Consideration of latent failure(s)
• Temperature of fuel tank wall
• Temperature of components within the fuel tank
• Temperature of components adjacent to the fuel tank

25.981 team workshop

Day Three
Fuel Tank Construction
• Fuel and Sealing
• Bonding

Electrical (Spark) threat
• Consideration of Latent Failure
• Ground Return Fault
• Connections Fault
• Wire harness runs internal and external

Lightning Threat and Design Mitigations
• Consideration of latent failure
• Lightning flashover
• Lightning transients
• E-field streamers and vents
• 25.981 team workshop

Day Four
Compliance implementation
• 14 CFR 25.981, Amendment 102/125
• Aircraft wiring and shielding
• Bonding
• Electrical Wiring Interconnect System (EWIS)

Verification and validation
• V&V methods
• Validate requirements as established in compliance plan are correct
• Verify design requirements established in implementation have been met
• 25.981 team workshop

Day Five
• Teams will prepare final 14 CFR 25.981 report-out
• Teams will report on their simulated compliance models and provide examples of appropriate compliance statements for FAA/EASA including design review, testing, analysis, and compliance inspections of the fuels system’s type design
• ICA/COS (keeping the initial design compliant)
• EWIS and product changes
• Final Q&A/test

Classroom hours / CEUs
31.50 classroom hours
3.15 CEUs

Certificate Track
Aerospace Compliance
Aircraft Maintenance and Safety
Electromagnetic Effects
Electrical Wiring Interconnection System (EWIS)

Course Fees
Early registration course fee: $2,595 if you register and pay by the early registration deadline (45 days out).

Regular registration course fee: $2,795 if you register and pay after the early registration deadline.

**U.S. Federal Employee Discount**
This course is available to U.S. federal employees at 10% off the registration fee. To receive the federal employee discount, you must enter the code **FGVT116** during the checkout process. Please note that you must validate your eligibility to receive this discount by entering your U.S. government email address (ending in .gov or .mil) when creating your online registration profile. This discount is available for both the early registration and regular registration fees.

**Netherlands Defence Academy Discount**
This course is available to Netherlands Defence Academy employees at a discounted registration fee. Please contact the NDA Procurement and Contracting department for details. Please note that you cannot register using our online system when requesting this discount.

**Instructor Bios**

**Darren Stout** is an EME/HIRF/Lightning ODA UM/AR at the Boeing Company. Darren has a wealth of experience in Electromagnetic Effects (EME), High Intensity Radiated Fields (HIRF), lightning effects, p-static effects, and transmitting personal electronic devices, RTCA/DO-160, MIL-STD-461, along with extensive experience in laboratory and aircraft testing. His experience is a result of over 30 combined years as an Electrical and EME engineer with Boeing, Lucent Technologies (Bell Labs), FAA, and BancTec. He also served six years in the United States Air Force as a B-52 navigator, instructor navigator, and radar navigator (bombardier), directing and performing higher headquarters missions including aircraft, systems, and munitions testing, and is a Desert Storm veteran. He has a BSEE degree in electrical engineering (lasers, fiber optics, and antenna arrays) from the University of Michigan - Ann Arbor, is an iNARTE certified EMC Engineer, and is a Level 2 Certified TEMPEST Professional.

**C. Bruce Stephens** is an HIRF/Lightning/EWIS ODA UM/AR at the Boeing Company and a consultant DER at his company, Stephens Aviation, with a wealth of experience in High Intensity Radiated Fields (HIRF) and Lightning protection of Aircraft. Stephens retired from Hawker Beechcraft after 28 years of service. He has HIRF/Lightning experience on both Part 23 and Part 25 including composite aircraft. Stephens is working with the Boeing Team to develop EWIS requirements and means of compliance on several aircraft projects. Stephens is a Six-Sigma/Lean Master Black Belt consultant, developing implementation and training materials, and teaches at a number of universities, including Webster University and Southwestern College. He has an executive M.B.A. and M.S. in Management from Friends University and a B.S. in Industrial Technology from Wichita State University.
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