



### Strategic Approach to Fire Safety December 2013

Al Carlo Pressurized Compartment Fire Marshal Boeing Commercial Airplanes

## Agenda

- Fire Safety Regulatory History
- Commercial Aviation Safety Team (CAST)/International Civil Aviation Organization (ICAO) Data
- In-flight Hidden Fires
- Fire Safety at Boeing
- Pressurized Compartment Fire Marshal
- Fire Safety Strategy
- Conclusions and Recommendations

# **Fire Safety Regulatory History**

### Amendment 25-15 (1967)

**1960's** 

Introduction of Appendix F as a MOC for flammability testing

#### Amendment 25-32 (1972)

No smoking/fasten seat belt signs Cargo liner flammability requirement

**1970's** 

Wiring flam requirement in 25.1359 and Appendix F

### AD 74-08-09 (1974) Lav Fire Protection

- No smoking placards
- Ashtrays
- Waste compartment inspection
- Smoking prohibited announcement

#### Amendment 25-58 (1984)

 Floor Prox light with separate power supply

**1980's** 

Additional emergency exit markings

#### Amendment 25-59 (1984)

- Seat cushion flammability
- Fully enclosed waste bins

#### Amendment 121-185 (1985)

- Lavatory smoke detectors
- Lavatory waste fire extinguishers
- Req. minimum of 2 Halon fire extinguishers
- Increase quantity of hand held fire extinguishers

#### Amendment 25-60 (1986)

- Class D limited to 1000 ft<sup>3</sup>
- Oil burner test required for cargo liners

#### Amendment 25-61 (1986)

Heat release and smoke requirements

# **Fire Safety Regulatory History**

### **1990's**

#### Amendment 25-72 (1990)

• Wiring flam requirement in 25.869

#### AD 93-07-15 (1993)

 Required increased fire protection for cargo portion of Combi airplanes

#### Amendment 25-93 (1998)

Elimination of Class D cargo compartment

## 2000's

### Amendment 25-111, 121-301 (2003)

Upgraded flammability standards for insulation materials installed behind interior panels (propagation and burn-through)

#### Amendment 25-113 (2004)

Wiring flam requirement in 25.869 referenced Appendix F

### U.S. and Canadian Operators Accident Rates by Year Fatal Accidents – Worldwide Commercial Jet Fleet – 1959 Through 2012



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# **In-Flight Hidden Fires**

Boeing Smoke/Fire/Fume/Burning Events Affecting the Pressurized Compartment for 2010-2012



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# **In-Flight Hidden Fires**

- Significant progress has been made in reducing major fire events
- Small scale smoke and fire events continue to occur
  - Smaller events could be 'pre-cursors' to a very rare significant smoke/fire event
  - Industry currently addresses events based on single event diagnosis
  - Small scale events can have significant economic impact due to air turn backs, diversions, and subsequent maintenance

# **Fire Safety at Boeing**

- Pressurized Compartment Fire Marshals (PCFM)
  - Overall Fire Safety within the Fuselage (Boeing Requirements)
- Propulsion Engineering
  - Unpressurized Area Fire Marshals
    - Unpressurized Areas and Flammable Fluids

### Payloads Engineering

- Fire Protection Lavatory and Crew Rest Fire Protection
- Flammability Engineering
  - Materials Flammability

### Systems Engineering

- Electrical Systems
  - Wiring and Equipment Fire Safety (EWIS)
- Environmental Control Systems (ECS)
  - Cargo Fire Protection, Smoke Penetration, Crew Rest Fire Protection, Thermal analysis, ECS Fire Protection Tech Council
- Boeing Research and Technologies
  - Material Expertise and Testing
- Enterprise Fire Protection

Aircraft Rescue and Firefighting (ARFF) – Field Equipment Standards and Procedures

# **Fire Safety at Boeing**

Cabin Smoke and Fire Safety Committee Mission Statement :

To monitor and evaluate potential safety and other issues relevant to fire and smoke within the pressurized volume of the airplane, and to make recommendations to Payloads, Systems, Structures, continued Airworthiness, and airplane programs.

- The committee is led by the Pressurized Compartment Fire Marshal Office
- The committee has responsibility for the content and the maintenance of Boeing document, "Airplane Fire-worthiness Design Criteria -Pressurized Compartments."
- The committee invites representatives from other organizations for specific projects/issues.

# **Pressurized Compartment Fire Marshal**

Boeing Requirements - Airplane Fireworthiness Design Criteria-Pressurized Compartments

- Material properties (flammability, smoke and toxicity)
- Systems and equipment requirements (contain failures, do not propagate)
- Installation requirements (fire barriers, separation requirements)
- Boeing Test Procedures to show compliance

## **Pressurized Compartment Fire Marshal**

### Role, Responsibilities and Authority

- Fire Safety requirements
  - Monitor and communicate Boeing Pressurized Compartment Fire Safety requirements across Boeing Commercial Airplanes
- Lead cross model fire safety projects
- Engineering Safety Reviews and airplane fire safety reviews
  - Perform initial Engineering Safety Reviews and airplane fire safety reviews on production lines to validate design/build complies with our requirements
- Boeing Safety Reviews
  - Provide input/recommendations at Boeing Safety Reviews on fire safety related in service events
- Boeing Accident Investigations
  - Participate in Boeing Accident Investigations related to Airplane Pressurized Compartment Fire Safety (Ground, In-flight and Post Crash

# **Pressurized Compartment Fire Marshal**

Current Participation in Regulatory Agency and Industry Activities:

#### FAA

- ARAC Revisions to new fireworthiness regulations
- CAST SE126 Carriage of Hazardous Goods
- ARC on Halon Replacement
- International Aircraft Systems Fire Protection Working Group
  - \*Smoke detection, fire suppression, Halon replacement, li-ion batteries
- International Aircraft Materials Fire Test Working Group
  - \*Insulation, Interiors materials, Flammability certification test methods, magnesium alloys in seats
- Technical Center Support for Test Planning and Witnessing
- EASA
  - CS 26 for Halon Replacement
- SAE
  - SAE S-9 Develop Fire Protection and Fire Safety industry standards for Portable Handheld Fire Extinguishers
- IATA
  - Carriage of Hazardous Goods
- ISO
  - Development of standards for Cargo: Fire Containment Cover (FCC) and Fire Resistant Container (FRC)
- NTSB
  - Support Active investigations involving Boeing Commercial Airplanes

# **Conclusions and Recommendations**

Post-Crash Fuel-Fed Fires

Evaluate information from events to potentially improve systems and materials to provide additional time for evacuation

### In-Flight Hidden Fires

- Boeing will continue to focus on preventions by utilizing requirement driven designs that minimize fire hazards based on lessons learned
- Boeing advocates continued development of industry team(s) based on PREVENTION
- Next steps: Regulatory and industry agreement in developing the industry working group