

# Aircraft Fire Hazards, Protection & Investigation

26 to 28 May 2020  
Woburn MA, USA



Instructor:  
Dr. N. Albert Moussa, P.E.

**BlazeTech**  
*Bringing Science to Safety*  
Offering Aircraft Safety Courses since 1998

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*Ubi fumus, ibi ignis*



## BlazeTech Corporation

Our services to the aircraft industry include R&D, testing, modeling and simulation, safety audits, consulting, accident investigation/reconstruction and expert witness, and product/technology assessment. Our products include a flash/fire discriminator; a variety of fire, explosion and structural damage software such as BlazeTank™ for fuel tank explosion analysis; FuelShield™ to protect fuel tanks against ullage explosion and hydrodynamic ram; and unique instrumentation to characterize aerosols and ash in flows (particles size, shape, temperature and mass flux). We provide customized training at client facility expanding on any subject matter in this course.

## Course Developer and Main Lecturer

**Dr. N. Albert Moussa**, Technical Director of BlazeTech, has over 40 years of experience in fire and explosion in civilian and military aircraft. He authored one book on flammability and over 150 publications, presentations and reports. He has worked on small- and full-scale testing of aircraft materials, components and entire systems, fire and explosion modeling and the design fire detection and suppression systems. Since 1996, he has consulted on major aircraft fire/explosion accidents in the US and overseas. His forewarnings about aircraft fuel system vulnerabilities before the TWA800 and Concorde disasters have gained him prominence in the US and European media. His credentials include: William Lockwood Memorial Lecture Award, Engineer of the Year by the NE- AIAA Section, AIAA Distinguished Lecturer, Best Papers by SAE and ASEI, and several ASME citations. He served on national committees and was Associate Editor of an ASME Journal. He received his Bachelors degree (with Honors) from Stanford University and Masters/Doctoral degrees from MIT, with both dissertations focusing on fire.

## Course Would Benefit:

Engineers, Managers, Accident Investigators and Transport Specialists who are responsible for commercial/military aircraft, helicopters, or Unmanned Aerial Vehicles including design, operation, specifications, certifications, flight safety, field inspection, maintenance, materials, fluids, fire detection/suppression, protection equipment, bomb threats and security, survivability, vulnerability, Safety Management System, emergency response at airport, accident investigation, risk analysis and mitigation.

## Course Schedule and Location

8:00 to 17:00 Tuesday-Thursday, 26 to 28 May 2020  
BlazeTech Corporation  
29 B Montvale Ave., Woburn, MA 01801 USA

## Fee and Registration

Fee: \$3,300. To register, fill out form below. Payments:  
-Credit cards: fax to BlazeTech 781-759-0703  
-Wire payments: contact us for details.  
-Checks: mail to BlazeTech; discount \$200. if check is received 1 month before course.  
Registration is incomplete until payment is received.

No walk-ins. We will confirm course no later than 2 weeks before course starts. We reserve the right to cancel the course.

## Registration Form

Name: \_\_\_\_\_

Title/Position: \_\_\_\_\_

Company: \_\_\_\_\_

Address: \_\_\_\_\_

City, State, Zip: \_\_\_\_\_

Country: \_\_\_\_\_

Phone/Fax: \_\_\_\_\_

E-mail: \_\_\_\_\_

Specific Interest: \_\_\_\_\_

**Payment:**  Check  Credit Card  Wire

Card #: \_\_\_\_\_

Expiration Date: \_\_\_\_\_ Amount: \_\_\_\_\_

3- or 4-Digits Security Code on card: \_\_\_\_\_

Name on Card: \_\_\_\_\_

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Billing Address for Card: \_\_\_\_\_

How did you hear about the course?

Colleague

Website

Email

Other: \_\_\_\_\_

## Course Objectives & Organization

While commercial air transport is very safe, the advent of new technologies poses new fire safety challenges, thus the motivation for this course. Expect a comprehensive and unique treatment of practical fire and explosion hazards onboard aircraft. Using case studies, we discuss initiating events, their evolution, systems survivability, design issues, protection methods and forensic implications, with the fundamentals introduced as needed. This approach is tailored to professionals who want to broaden and deepen their knowledge so as to handle new situations. We present a unified treatment of diverse situations that is pertinent to accidents, combat and terrorist attacks for both commercial and military aircraft. The course is illustrated by videotapes and photographs of real events and well controlled and instrumented bench- and full-scale tests by FAA, NTSB, DOD, NASA and BlazeTech. Attendees will benefit from a grasp of:

- Discussion of numerous real accident case studies
- Presentation of related fundamentals
- Available simplified analyses for quick answers
- When to use such analyses vs. computer models?
- What to ask from Subject Matter Experts?
- Discussion of testing and accident reconstruction
- How to assess hazards from new technologies?
- Dynamic class exchange of current issues

Attendees receive class notes containing a wealth of key data and a certificate of completion. Course is equivalent to three Continuing Education Credit Units.

### 1. Flammability of Fuels, Oils and Hydraulics

- Current and alternate compositions (biofuels)
- Vapor pressure, flash/fire points
- Ignition and flame temperatures

### 2. Fuel Tank Fire and Explosion

- Ullage flammability and deflagration
- Predict fire/overpressure using BlazeTank
- N<sub>2</sub> Inerting: 9% vs. 12% O<sub>2</sub>
- Penetration/perforation by debris/bullet impacts
- SFAR 88: lessons learned (TWA 800, B747, NY)

### 3. Engine Fires

- When to use hot surface vs. auto ignition temp.
- Full-scale tests on AV8-B and simulated F-16
- Protection systems
- Oil fire (Trent 972, Airbus A380, Indonesia)
- Post-landing engine fires (CFM56, B737, Okinawa)
- Uncontained engine failures (CF6, DC-10, Sioux City, IA; Trent 972, A380, Singapore; GE90, B777, Las Vegas; CFM56-7B, 737, Southwest Airlines)

### 4. Post-Crash Fires

- Pool fire and anti-misting fuel (Air France 358, A340, Toronto, Canada)
- Impact (Asiana 214, B777, San Francisco, CA)
- Rejected takeoff (Continental 603, DC-10-10, LAX)

### 5. Li- Battery Fires

- Primary cells, rechargeable cells, battery essentials
- Battery fire hazards
- Battery safety standards and testing
- Fire in packing facility at airport, Los Angeles, CA
- Inadequate battery handling, Toluca, Mexico & LAX
- Li ion battery fires in APU (JAL, B787, Boston, MA)

### 6. Li- Battery Fires in Cabin

- Incidents involving PEDs and laptops
- Cell phone fire (Qantas 7, A380, SW of Dallas)
- Protection methods in cabin

### 7. Li- Battery Fires in Cargo

- UPS 6, B747, Dubai, United Arab Emirates
- Asiana Cargo 991, B747, Jeju Island, South Korea
- UPS 1307, DC-8, Philadelphia, PA
- South African 295, B747, Mauritius, Indian Ocean
- FedEx Express 0004, MD-11, Memphis, Tennessee
- FedEx protection system
- UPS protection system

### 8. Flammability of Polymeric Materials

- Thermal degradation, ignition, flaming, smoldering, smoke, toxicity, flame retardants
- FAR 25.853 test methods
- Effects of pressure and oxygen concentration
- Attendant uniforms

### 9. Cabin Fires

- Breached fuselage vs. burn-through
- Flammability of seats and panels
- Flashover (full scale FAA tests)
- Passenger evacuation (British Airtours 28M, B737, Manchester, UK)

### 10. Fires in Cargo and Hidden Areas

- Ventilation and smoke movement
- Federal Express, Boston
- Oxygen generator fire (ValuJet 592, DC-9 Everglades, Miami Dade Count, Florida)

### 11. Smoke and Fumes

- Smoke movement
- Air Canada 797, DC-8, Cincinnati, OH
- Cockpit protection equipment

### 12. Electrical Wiring Fires

- Wire types: Teflon, Tefzel, Kapton, TKT
- Wiring problems, causes, fixes and challenges
- Swiss Air 111, MD-11, Nova Scotia

### 13. Flammability of Composite Structures

- Unique properties of composites
- Fire test methods
- Thermal degradation model
- Composites v. Aluminum structures
- Unmanned Aerial Vehicles

### 14. External Hazards That Can Impact Aircraft

- Classification of energetic/hazardous materials
- Detonation of Improvised Explosive Devices
- Air blast from explosives
- Internal explosions (Pan Am 103, B747, Lockerbie)
- Structural response: local v. global deformation
- Shoulder mounted missile (DHL A300, Baghdad)

### 15. Fire Detection Systems

- Types: smoke, ionization, thermal and optical
- Pros and cons of various detector types
- Use in various hazard zone classifications
- Sources of false alarms

### 16. Fire Suppression Systems

- Passive and active fire suppression in fuel tanks
- Halon replacement agents, clutter effects
- Hand held systems
- Ground-based AFFF fire suppression strategies
- Environmental issues with AFFF

### 17. Aircraft Accident Investigation

- Investigative process (ICAO, NTSB, FAA)
- Anatomy of a fire accident; accident precursors
- Forensic tools, NFPA 921
- Timeline and pathline reconstruction
- Critical tests and modeling
- Contributory human factors

### 18. Summary of Fire/Explosion Pattern Recognition

- In-flight v. ground fires:
- Pre v. post crash fires (CRJ-100, Lexington, KY)
- Explosions: solid v. fuel vapor (TWA 800, B747, NY)
- Structural failures identification
- Impact from debris v. ballistic threat
- Casualties from smoke inhalation v. thermal injury
- Lessons learned

Discussions are encouraged throughout the course.