BCA Aviation Safety

The Role of the Manufacturer in an Airplane Accident Investigation

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Agenda
Boeing Accident Investigation

- Boeing Information
- Accident Statistics
- Accident Investigation Preparation
- Assistance Provided by Boeing to an Investigation
- Boeing Safety Process
The Boeing Company

- Established in 1916
- First 707 delivered in 1958: 20,300+ total airplanes delivered since,
- ~12500 Active airplanes
- 165,000+ employees world-wide
- 311 Field Reps
- 149 bases
The Boeing Company
Air Safety Investigation

Incidents are majority of work

- In last 3 years
  - ~300 Incidents
  - 26 Accidents
  - 17 Launches (these include both incident and accident)
- Incident sometimes more work than accidents
  - Result in a launch
  - Involve lab and analysis work
  - Result in a final report
Agenda
Boeing Accident Investigation

- Boeing Information
- **Accident Statistics**
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We Must Continuously Improve Safety to Keep the Number of Accidents in Decline as Departures Increase

Note: Data reflects years 1959 through 2014 for Western-built Commercial Jet Transports with Maximum Take-off Weight at or above 60,000 Pounds
Agenda

Boeing Accident Investigation

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Launch Preparation
Boeing Accident Investigation

- 24/7/365 communications +1-206-544-7500 (BCA Operations Center)
- Maintain call list
- Team member training, Go-Team Conference, Bloodborne Pathogens, HR
- Medical Requirements
- Pre-selected expert team members
  - Investigator
  - Flight Operations
  - Human Factors
  - Survival Factors
  - Propulsion
  - Structures
  - Landing Gear
  - Flight Controls
  - Airplane Systems
  - Pinger Training- (Investigators only)
  - (Employee Assistance Program (upon return from site))
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Boeing Assistance During an Investigation

Boeing Accident Investigation

- **What Boeing Brings to the Accident Investigation Process**
  - Field Phase Support
    - Trained Personnel
    - Access to SME’s at Boeing
  - Post Field Phase (examples)
    - Lab Capabilities
    - Analysis
    - Additional Expertise
Boeing has a large well-trained technical workforce with detailed knowledge of the design, certification, manufacture, maintenance, and in-service operation of these airplanes.
Boeing Support | Post Field Phase

Boeing Accident Investigation

Boeing Capabilities

- **Lab and Test Facilities:**
  - EQA laboratory (teardown/documentation)
  - BMT laboratory (metallurgical)
  - Noise laboratory (CVR sound analysis)
  - Simulators (Pilot-in-the-loop, motion based)
  - Airplane ground or flight test

- **Analysis:**
  - FDR data analysis
  - Runway track analysis
  - Data visualization
Boeing Tools and Capabilities: EQA Lab

Boeing Accident Investigation

- EQA: Equipment Quality Analysis Laboratory
- Complete photographic examination, electrical testing, hydraulic testing, and environmental chamber testing of individual components
- X-ray; Computed Tomography / Digital Radiography scan equipment available
- No charge for this service. All activities done under direction of investigation.
- Quarantine room; NTSB access only. Investigation personnel always invited to participate.
Boeing Tools and Capabilities: M&PT

Boeing Accident Investigation

- **M&PT: Material and Process Technology**

  - Complete metallurgical examination including Scanning Electronic Microscopy
    - Material verification; hardness scan, surface preparation & finish, etc.
    - Fracture face analysis
    - Corrosion detection
Boeing Tools and Capabilities: FDR
Boeing Accident Investigation

- From Foil to Solid State
  - Most recorders record anywhere from 18 parameters to well over 1000; generally 25 hours worth
  - Many are still tape based, digital recorders
  - 787: ‘Dual Combi’ recorders; two individual units

![Image of Forward Enhance Airborne Flight Recorder (EAFR) and Recorder Independent Power Supply (RIPS)]
Boeing Tools and Capabilities: FDR
Boeing Accident Investigation

- Boeing typically receives data from investigation authority
  - We convert raw data into engineering units (for plotting & analysis)

- FDR Data Analysis
  - Direct plotting
  - Desktop Simulation using certified aerodynamic models developed for each model type
  - Kin Con Analysis (Kinematic Consistency; independent way of performance verification)
  - Runway Track Analysis
Boeing Multi-Model Full Flight Simulator

M-Cab Overview – Hardware Overview

- **Engineering Cab**
  - Multi-model (707, 727, 737, 747, 767, 777 & 787)

- **Cab based on 767 Shell**
  - Generic interior
  - 2 Pilot, 3 Observer Seats

- **Uses same aerodynamic model as training simulators**
  - Open loop (normal mode)
  - Backdrive (used to re-create accident scenarios)
  - Software models of airplane systems
M-Cab Overview

- Replaceable Control Stand / Aisle Stand
  - 737 and 777 styles

- Programmable Instrument Displays

- Replaceable Mode Control Panel
  - 737 and 767 styles

- Replaceable Control Column/Wheel
  - 737 and 777 styles

- Generic Overhead Panel
Simulation Scenarios

National Airlines Flt 102
Bagram Afghanistan
Simulation Scenarios

Simulation Scenario Results (Max Thrust, MRAP Shift to Jackscrew)

Note: Elevators move to their float position when hydraulics are failed.

Thrust = 108% Engine N1
Flight Vis Simulation

Time = 3368.16

ATC: Indonesia 200, wind calm, check gear down and lock clear to land runway
GPWS: TOO LOW TERRAIN (2x)
Capt: Clear to land Indonesia 200
Sounds similar to altitude alert
Capt: Check speed, Flaps fifteen
Investigation Process | Summary
Boeing Accident Investigation

- Our responsibilities include:
  - Be prepared to launch
  - Assist and advise
  - Make changes as necessary

- Our goal: Prevention