Investigative Update of Battery Fire
Japan Airlines B-787 - Jan 7, 2013

Deborah A.P. Hersman
Chairman
January 24, 2013
Timeline – JAL Battery Incident

• 10:06am - aircraft arrived at gate in Boston from Narita, Japan
  • 183 passengers and 11 crew deplaned
• 10:32am - Cleaning and maintenance crew noticed smoke in cabin
• 10:35am - Mechanic noted flames coming from APU battery in aft electronics bay
Timeline, cont.

• 10:37am – Airport Rescue & Fire Fighting notified
• 10:40am – Fire and rescue personnel arrive on scene
• 12:19pm – Fire and rescue personnel report event was “controlled”
APU Battery

Exemplar Battery

JAL Event Battery
Damage to Aft Electronics Bay
Investigative Activities

• Battery exam and teardown at NTSB Materials Laboratory

• Component exam and teardown
  • Tucson, AZ – Battery Charger Unit and Start Power Unit (Securaplane Technologies)
  • Phoenix, AZ – APU Controller (United Technology Aerospace Systems)
  • Seattle, WA – Two General Purpose Modules (Boeing Commercial Airplanes)
  • Fujisawa, Japan – Battery Monitoring Unit (Kanto Aircraft Instrument)
JAL APU Battery Cells

Exemplar Battery  JAL Event Battery
### Cell and Battery Specifications

<table>
<thead>
<tr>
<th></th>
<th>Cell</th>
<th>Battery</th>
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<tbody>
<tr>
<td>Nominal capacity (Ah)</td>
<td><strong>75</strong></td>
<td><strong>75</strong></td>
</tr>
<tr>
<td>Nominal voltage</td>
<td><strong>3.7</strong></td>
<td><strong>29.6</strong></td>
</tr>
<tr>
<td>Operational voltage range (V)</td>
<td><strong>2.5 – 4.025</strong></td>
<td><strong>20 – 32.2</strong></td>
</tr>
<tr>
<td>Weight (lb.)</td>
<td><strong>6.0</strong></td>
<td><strong>63</strong></td>
</tr>
<tr>
<td>Dimensions (in.)</td>
<td><strong>W</strong> 5.2</td>
<td><strong>10.9</strong></td>
</tr>
<tr>
<td></td>
<td><strong>D</strong> 2.0</td>
<td><strong>14.2</strong></td>
</tr>
<tr>
<td></td>
<td><strong>H</strong> 7.7</td>
<td><strong>8.5</strong></td>
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</tbody>
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Cell Design

(including terminal)

(Unit: inch)
Electrodes

Cell construction

- Negative terminal
- Positive terminal
- Positive electrode
- Negative electrode
- Separators
- Rupture plate
- Case
Example of a Cell CT Scan
NTSB Lab Activities
## Cell Examinations To Date

<table>
<thead>
<tr>
<th>SEM – Scanning Electron Microscopy</th>
<th>EDS – Energy Dispersive Spectroscopy</th>
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<tbody>
<tr>
<td>8</td>
<td></td>
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<tr>
<td>• CT scan of entire assembly</td>
<td></td>
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<td>8</td>
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<tr>
<td>• CT scan</td>
<td>• CT scan</td>
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<td>• disassembled</td>
<td>1</td>
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<td>7</td>
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</tr>
<tr>
<td>• CT scan</td>
<td>• CT scan</td>
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<tr>
<td>• disassembled</td>
<td>2</td>
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<tr>
<td>• SEM</td>
<td>• disassembled</td>
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<td>• CT scan</td>
<td>• CT scan</td>
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<tr>
<td>• disassembled</td>
<td>3</td>
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<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td>• CT scan</td>
<td>• CT scan</td>
</tr>
<tr>
<td>• disassembled</td>
<td>4</td>
</tr>
<tr>
<td>• SEM</td>
<td>• CT scan</td>
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<tr>
<td>• EDS</td>
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</table>
We Are Looking For:

- Signs of thermal runaway
- Signs of electrical short circuiting
- Manufacturing defects
- “Anything unusual”
Damaged Electrode - Internal Short Circuit
CT Scan of Battery
Findings To Date

- Fire was present
- Signs of thermal runaway
- Signs of electrical short circuiting
Next Steps

• Complete the in-house laboratory examinations
• Conduct examinations and testing of exemplar batteries
• Synthesize lab examination findings with fire forensics and aviation systems investigation
Parties to Investigation

• Federal Aviation Administration
• Boeing Commercial Airplanes
• Accredited Representatives
  • Japan – JTSB
    • GS Yuasa
    • Japan Airlines
  • France – BEA
    • Thales Avionics Electrical Systems
• Technical assistance provided by Carderock Division, Naval Surface Warfare Center
JTSB Investigation
ANA Battery Event

Photo by Reuters/Kyodo/Landov
ANA – Smoke Vented During Flight
Battery Case “Anomaly”

Viewed From Outside (Post-clean)

Viewed From Inside (Post-clean)
• Finding: electrical arc between battery cell and inside of battery case
• Not believed to be initiating event