Flight Test Hazard Planning
Near the Speed of Light

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Concept

- Hazard Centric database targeted at flight test hazards
- Appends related data and experience
- Hosted by NASA
  - Funded as research effort for a “Handbook”
  - Enabled/Expanded by web portal technology
  - Provides a government agency foundation
Concept

- Based on “higher ethical ground”
- Vision is to look to knowledge management
- Considered a “Professional’s” database
- Test community orientation
- Disclaimer protected
- Public accessible data (no sign in required)
- Meaningful/tailored results
Portal Content

- Essentially 4 Data Sections
  - Hazard Info
  - Application Data (Test Reports, videos, etc.)
  - Reference Data (Definitions, acronyms, processes, ...)
  - Test Community Partners & Expert
  - Contact Info
  - Gov’t, Industry, Consultants, ...  
  - Self-declared capability – no gov’t
Activity to Date

- NASA funding development of web portal (~$900K to date)
  - April 07: Initial core capability on existing NASA web structure
    - 132 records for FAR Part 25
    - Ability to search across hazard records

- NASA facilitating generation of FAA, FAR Part flight test certification hazard data
  - FAA Providing Funding ($165K per year)
  - Continuing effort; National TPS sub-contractor
OUTLINE

• Risk Management Initiatives
• Part 21 Changes
• Concept for use of Database
FAA Flight Test Risk Management

- As a safety organization we **promote best safety practices during certification flight tests**
  - We published FAA Order *4040.26A* in 2001
  - However, FAA Order 4040.26A is incomplete as a **tool** for Flight Test Risk Management
  - We are taking a **corporate approach** to further improve flight test safety by:
    - Modernizing our CFR 14 Part 21 Requirements for flight test safety
    - Providing the **tools** to implement risk assessments
PART 21 CHANGES
CFR 14 Part 21.35 Current

- Para (d) only requires *parachutes and emergency egress provisions* for certification flight tests
- Para (e) *excludes* gliders and manned free balloons in pilot decision to discontinue flight test due to hazards
- These rules are severely outdated
CFR 14 Part 21.35 Proposed Changes

- Para (d) will require a Risk Assessment (may include parachutes and/or emergency egress)
- Broader in scope and in line with industry standard
- Para (e) will include gliders and manned free balloons in pilot decision to discontinue flight test due to hazards
- Unknown why these were excluded
- Immediately Adopted Rule (IAR) expected in 2007
Database

- FAA needs a database to complete the process
- We joined forces with NASA’s lessons learned Handbook process
- We established an MOU with NASA
- NASA contracted with NTPS for populating the data
- We provided funding for initial data development for civil certification CFR Parts 23, 25, 27, 29, 31
- Part 25 THA’s “complete”
- Part 23/27/29/31 under construction
An Online Resource for Flight Test Safety Planning

Greg Lewis
National Test Pilot School
## Test Hazard Analysis Worksheet

<table>
<thead>
<tr>
<th>Test Title:</th>
<th>Hazard Category</th>
<th>Subjective Probability of Occurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>high</td>
</tr>
<tr>
<td>Aircraft/System:</td>
<td>catastrophic</td>
<td>critical</td>
</tr>
<tr>
<td>Hazard:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cause:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Effect:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimizing Procedures:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emergency Procedures:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risk Level: (after minimizing procedures taken into account):</td>
<td>High</td>
<td>Medium</td>
</tr>
</tbody>
</table>

### Hazard

- **Residual Risk**
- **EP’s**
- **Minimizing Procedures**
- **Effect**
- **Cause**
Data Gathering

• NTPS THA’s
  – Demonstration of classic Flight Test Techniques
  – Conservative limits

• Added inputs from the FAA
  – Aircraft Certification Offices in New York and Atlanta

• Next collected data from manufacturer’s
  – Boeing Long Beach, Gulfstream, Lockheed, Bombardier, Cessna, Raytheon, Boeing Seattle, Schweizer, Tiger, Boeing Rotary Systems, New Piper and Sikorsky
  – data still coming in

• All existing safety planning info, freely shared
NTPS Role

• After gathering data
  – We put the data into a common format
  – Not asking industry to change their process
    • just share what they have
NTPS Role (cont’d)

• Too many ways of saying nearly the same thing
• “Mature” the data
  – To make the database useful to a user, there must be some integration of inputs
  – Mitigations consolidated by
    • Hazard (e.g. Loss of Control) and by
      • Maneuver (e.g. Stalls)
  – Mine the data to:
    • Extract the unique safety suggestions in each area
    • Remove duplication
    • Make the database easier to use
Example Maturation

Part 25 Stall Hazards
Many Varied Inputs

- Six different organizations submitted inputs for stalls
- Total of 66 different THA’s
  - Many redundant / nearly the same
- Used 19 different Hazard Titles
- Used 14 different Maneuver Names
- A plethora of verbose Hazards identified
- Hundreds of mitigations
  - Again many were redundant

“There is a risk of stall/departure from controlled flight when increasing angle-of-attack at low airspeeds.”
Matured Stall Hazards

- In the end, six stall hazards were identified
  1. Loss of control
  2. Loss of operating engine(s)
  3. Stall/spin chute fails to deploy
  4. Stall/spin chute fails to jettison when commanded
  5. Recovery chute uncommanded deployment
  6. Departing runway surface
     (During ground test of stall spin chute)
Loss of Control Mitigations

• “Loss of Control” mitigations matured into just twelve
• The matured mitigations include:

  1. Do stall testing in a **buildup approach**:  
     a. from least risk to highest risk  
        i. forward cg, mid cg, aft cg  
        ii. Power off before power on  
        iii. Wings level before turning  
        iv. 1 kt/sec before 3 kt/sec  
     b. **terminate buildup** if FAR limits on bank angle are exceeded at any point of the buildup
2. Establish minimum altitudes for:
   a. entry,
   b. recovery initiation,
   c. recovery chute deployment and
   d. manual bailout.
3. Perform pre-flight checks of stall warning and stick pusher, as applicable.
4. Anti-spin chute must be installed, functional and armed. Perform pre-flight and pre-maneuver checks of chute as applicable.
5. Minimum crew onboard.
6. Emergency Egress system must be installed and armed. Perform pre-flight and pre-maneuver checks of egress system as applicable.
Mitigations (continued)

7. Crew to wear helmets and parachutes.
8. Surface winds must be less than xx kts (parachute dependent).
9. No aggravated input stalls. All stalls will be ball centered.
10. No asymmetric power stalls.
11. If departing controlled flight retard throttles to idle and centralize controls.
12. Do not add power during recovery until airspeed is increasing above 1.2 Vs.
Look for “Test Hazard Database”
FAA Access

News & Updates

Get On Board for Commercial Human Space Flight

April 19 – Today, the Wall Street Journal Online published a conversation with FAA Associate Administrator for Commercial Space Transportation Patricia G. Smith and bikini-clad model Ronda Saxon. Smith was discussing the "Astro Baby" campaign.

- Airport Status and Delays
- Jobs at FAA
- Accident and Incident Data
- FAA Offices
FAA Access

- Safety Alerts for Operators (SAFO)
- CertAlerts for Certificated Airports
- Traffic Collision Avoidance System (TCAS) Safety Bulletin (PDF)

Data and Statistics
- Aviation Safety Information Analysis and Sharing (ASIAS)
  Note: This replaces National Aviation Safety Data Analysis Center (NASDAC)
- Accident and Incident Data
- Aviation Accident Reports and Statistics (NTSB)
- Runway Incursion Data and Statistics
- Weather
  More » Data & Statistics

Programs
- International Aviation Safety Assessments (ISA)
NASA PBMA Website Link

http://pbma.nasa.gov/ftsdb/home.aspx
http://pbma.nasa.gov/ftsdb/

For years the International Flight Test community has had a need for easy access to flight test maneuver descriptions, test hazards, and hazard mitigation techniques. This portal is a step in that direction, and builds on similar efforts by the Flight Test Safety Committee, the Society of Experimental Test Pilots, and the Society of Flight Test Engineers, and other professional organizations. Our objective is to identify and document hazards and mitigations associated with flight testing and provide a compilation of the flight test industry's corporate knowledge regarding flight test safety risk assessment. Where applicable, the database cross-references FAR guidance from Parts 23, 25 and other flight test-related sections. It also discusses typical industry risk levels assigned to specific types of tests. All data has been reviewed by at least two persons with extensive Flight Test and/or Aviation Safety Experience. We hope you find this tool helpful, and solicit your feedback and contributions as we work to keep it up to date.

Use of the FTSSB Portal does not require you to register and login. However, as this Portal evolves, registration will provide you with a number of benefits in relation to what you can access and view in the Portal, as well as customization and privileges.

Please enjoy the Portal as our guest and come back often to see what new features have been added.

Last Update of Test Hazard Analysis
4/20/2007
FAR Reference Search

Step 1: Select Flight Test Areas
Select at least one of the flight test area checkboxes below. The flight test area pull-down menus provide control over your search by narrowing the results of your Test Hazard Analysis search to data that includes the flight test areas you select.

- FAA Certification (FAR):
  - 25.201: Stall Demonstration

- Military Development:
  - 25.203
  - 25.207
  - 25.253(a)
  - (All)

- Research:
  - 25.831
  - 25.854
  - 25.855
  - 25.857
  - 25.858
  - 25.1301
  - 25.1329(f)

Step 2: Select Test Hazard Analysis Parameters
Optionally select the test hazard analysis parameters. The hazard analysis parameters provide control over your search by narrowing the results of your Test Hazard Analysis search to data that includes the test hazard parameters you select.

The Locate Entry boxes below assist you in finding the associated pull-down menu.
Record Field Search

Step 2: Select Test Hazard Analysis Parameters

Optionally select the test hazard analysis parameters below. The test hazard analysis parameters provide control over your search by narrowing the results of your Test Hazard Analysis search to data that includes the test hazard analysis parameters you select.

The Locate Entry boxes below assist you in finding the best matches in the associated pull-down menu.

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
<th>Locate Entry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Discipline</td>
<td>(All)</td>
<td></td>
</tr>
<tr>
<td>Test Maneuver</td>
<td>Stall</td>
<td></td>
</tr>
<tr>
<td>Hazard</td>
<td>(All)</td>
<td></td>
</tr>
<tr>
<td>Aircraft Type</td>
<td>(All)</td>
<td></td>
</tr>
<tr>
<td>Aircraft Power Plant</td>
<td>(All)</td>
<td></td>
</tr>
<tr>
<td>Uninhabited</td>
<td>Both, Yes, No</td>
<td></td>
</tr>
</tbody>
</table>
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- FAA Certification (FAR):
  Number: 25.201
  Title: Stall Demonstration

- Military Development:
  (All)

- Research:
  (All)

Step 2: Select Test Hazard Analysis Parameters

Vocationally select the test hazard analysis parameters below. The test hazard analysis parameters provide control over your search by narrowing the results of your Test Hazard Analysis search to data that includes the test hazard analysis parameters you select.

- Locate Entry boxes below assist you in finding the best matches in the associated pull-down menu.

  Test Discipline: (All)
  Test Maneuver: Stall
  Hazard: (All)
  Aircraft Type: (All)
  Aircraft Power Plant: (All)
  Inhabited: (Both)  Yes  No

Step 3: Enter Keyword Search

Vocationally enter one or more keywords into the text box below. If you enter a keyword, be sure to select at least one of the analysis fields (i.e., Maneuver, Hazard, Reference Number, or Reference Title). The results of this keyword search is limited to the records that also satisfy any criteria you selected above in Steps 1 and 2.

Select fields for your search: Select all | Deselect all

- Test Maneuver
- Hazard
- Reference Number
- Reference Title

Keyword(s): Stall

Submit  Clear
Keyword Search

Step 3: Enter Keyword Search

Select fields for your search: Select all | Deselect all

- Test Maneuver
- Hazard
- Reference Number
- Reference Title

Keyword(s): Stall

[Submit] [Clear]
Results of FAR Reference Search

<table>
<thead>
<tr>
<th>Maneuver</th>
<th>Hazard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recovery Chute Functional Test</td>
<td>Departing runway surface</td>
</tr>
<tr>
<td>Still</td>
<td>Stall</td>
</tr>
<tr>
<td>Stall</td>
<td>Stall</td>
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<td>Stall</td>
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Combine Selected Records
View Selected Records Sequentially

Check top box to select ALL records
Check individual box(e) for desired records
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Factor(s):

Corrective Action(s):
In Conclusion

- The matured THA database **IS** a wide array of test safety ideas and suggestions
  - But it is **NOT** an FAA-mandated solution
  - It is **NOT** a government-approved solution
  - And it is **NOT** an auto-safety planning device
    - The matured hazards, causes and mitigations are necessarily generic
    - Your test will have unique problems and will require unique solutions
    - The THA database can be an excellent starting point
In Conclusion

- **Military/Research Database Status**
  - Data under development at monthly Webex/telecon meetings

<table>
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<tr>
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<th>Date/Time</th>
<th>Lead</th>
</tr>
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<tbody>
<tr>
<td>Fixed Wing Icing</td>
<td>3rd Wednesday at 0900 PST</td>
<td>Kurt Blankenship (Glen Research Center)</td>
</tr>
<tr>
<td>Rotary Wing Icing</td>
<td>1st Thursday at 0900 PST</td>
<td>Kim Hanks (Army Test &amp; Training Center)</td>
</tr>
<tr>
<td>Propulsion</td>
<td>4th Thursday at 0900 PST</td>
<td>Brian Markowich (NAVAIR Pax River)</td>
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Contact Joe Orwat (x3866) or Bart Henwood (x5746)
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Next Year’s activity

- Initiate DDC for research/military flight test
- High AoA
- Continue portal development activity
- Input/Data Submission Module
- Create reference information
- Airworthiness and flight safety review process
- Hazard management process
Come Join Us!

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Flight Test Safety

Questions?

Suggestions?

Needs YOU To Speak Out!