6th EUROPEAN FLIGHT TEST SAFETY WORKSHOP

Loss-of-Control - How do we tackle aviation’s number one killer?
Loss of Control In-flight
Accident Statistics and Some Personal Thoughts

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Chairman IATA Accident Classification Task Force
Loss of Control-Inflight (LOC-I)

- LOC-I is found in all segments of aviation:
  - General Aviation
  - Air Transport (multi pilot crew, usually considered very experienced!)
  - Military aviators
  - Display Flying (see Des Barker, European FTSW 2011 workshop)
  - FLIGHT TESTING

- LOC-I is not restricted to „novice pilots / beginners“
- LOC-I is a complex subject – involves many different disciplines
Loss of Control Workshop 2012

- Participation from many different countries:
  - Argentina
  - Brasil
  - Canada
  - China
  - Japan
  - Kasachstan
  - US
  - South Africa
  - Turkey
  - Many European Countries
Loss of Control Workshop 2012

- Flight Testers have their own set of challenges
  - Prototypes, highly modified aircraft
  - Some flights high risk
  - „Can do“-Attitude (try hard to make a test point)
  - Time Pressure
  - Fatigue

- First time that flight test safety workshop is opened up to airline pilots, researchers and other subject matter experts
Loss of Control Workshop 2012

- Flight testers need to also learn from operational pilots, how their product is being used (or rather mis-used!). Operational pilots have their own set of challenges (fatigue, boredom, shift work)
- LOC is a complicated subject – requires inputs from a diversity of fields
- So far no silver bullet
- We need to learn from each other!
Loss of Control-Inflight (LOC-I)

Definition:

„A loss of control accident is an accident in which an aircraft is unintentionally flown into a position from which the crew is unable to recover due to aircrew, aircraft, environmental, or a combination of these factors.“

(Jim Burin, FSF)
Introduction

Loss of Control-Inflight (LOC-I)

Can be

- An "Aircraft End State" (this is how IATA uses the term) – LOC-accident
- A temporary condition (when crew loses control temporarily) – LOC-incident

(Jim Burin, FSF)
Unusual Attitude

Late or inefficient recovery

Stall

Late or inefficient recovery

Enveloppe exceedance

UPSET
Dr. Dieter Reisinger 6th European Flight Test Safety Workshop
Salzburg, 19-21 Nov 2012
Loss of Control-Inflight – Categories

- Upset in Pitch
- Upset in Roll
- Airspeed
  - Airspeed Unreliable,
  - Airspeed not appropriate for the phase of flight / configuration
“Bank Angle” Events

1.85 / 1000 Flight Legs
0.84 / 1000 Flight Hours

(Don Bateman)
Incident: Roll-Upset in Cruise at 41,000 ft
Kenya Airways, Spiral Dive after departure on May 4, 2007
Loss of Control – General Aviation
General Aviation

1) ....other Types

2) ....Cirrus SR20/22
LOC – General Aviation Commonalities

- Often less experienced pilots
- Training usually less sophisticated (in particular training for non-normal situations)
- Capability of the aircraft vs Pilot Capability
  - Low performance overestimated by pilot
  - High Performance underestimated by pilot
Loss of Control – Air Transport
Introduction

- 13% Loss of Control - Inflight
- 2% Runway Collision
- 6% Undershoot
- 25% Runway Excursion
- 15% Inflight Damage
- 17% Ground Damage
- 6% Hard Landing
- 3% Tail Strike
- 7% Gear Up Landing / Gear Collapse
- 6% CFIT
- 0% Mid-air Collision

Source: IATA
LOC-I Accidents by Phase (2009-2011)
Loss of Control Accidents 2009-2011 – Air Transport

<table>
<thead>
<tr>
<th></th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
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<tbody>
<tr>
<td>Total Accidents</td>
<td>90</td>
<td>94</td>
<td>92</td>
</tr>
<tr>
<td>LOC Accidents</td>
<td>9</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>% LOC</td>
<td>10%</td>
<td>11%</td>
<td>9%</td>
</tr>
<tr>
<td>Total Fatal Accidents</td>
<td>18</td>
<td>23</td>
<td>22</td>
</tr>
<tr>
<td>Fatal LOC Accidents</td>
<td>8</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>% LOC</td>
<td>44%</td>
<td>43%</td>
<td>36%</td>
</tr>
</tbody>
</table>

Summary: 10% of accidents, 41% of fatal accidents

(IATA)
## Loss of Control Accidents 2009-2011

<table>
<thead>
<tr>
<th></th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
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</thead>
<tbody>
<tr>
<td>Total Fatalities</td>
<td>685</td>
<td>786</td>
<td>486</td>
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<tr>
<td>LOC Accident Fatalities</td>
<td>639</td>
<td>241</td>
<td>213</td>
</tr>
<tr>
<td>% LOC</td>
<td>93%</td>
<td>31%</td>
<td>44%</td>
</tr>
</tbody>
</table>

Summary: **56% of industry fatalities**
IATA Survey Approach to Stall

![Bar chart showing the number of events in different flight phases.

- IN. CLIMB
- CLIMB
- CRUISE
- DES
- HOLD
- APP/ LND

- Weather
- Wake turbulence
- Aircraft System
- ATC
- Flight Crew Error]
Air Transport

Colgan – Stall on Approach

Crash experts focus on sharp rise of plane’s nose

By Alan Levin
USA TODAY

Investigators trying to solve the week-old crash of Continental Connection Flight 3407 near Buffalo are hoping to find clues that will explain the mystery of why the plane’s nose inexplicably shot up during a seemingly normal landing.

Understanding what the crew was thinking in the final moments could help explain why the plane’s nose rose 31 degrees before quickly losing control and plummeting to the ground. All 49 people aboard died, along with a man on the ground.

Teams from the NTSB are also studying computer plots, running aerodynamic simulations and picking over charred wreckage in search of mechanical problems.

Determining why pilots act the way they do is among the most difficult tasks that the NTSB undertakes, safety experts and former investigators say.

The crash-proof cockpit voice recorders often leave few clues other than clipped comments and grunts. Even the most sophisticated data recorders do not say whether a pilot flicked a switch intentionally or accidentally.

“Marvin Henslowe. Was a pilot of plane.”

“Marvin Henslowe: Was a pilot of plane.”

“It’s an old, old issue in accident investigation,” said John Lauber, a former NTSB board member who studied pilot performance at NASA. “The technology does not exist that allows you to capture the intent. You always have to infer the intent.”

Investigators will interview the pilots’ co-workers, study their training and search for clues in their personality. They will also listen carefully to the cockpit recording.

“It’s extraordinarily difficult and it’s emotionally draining,” said Peter Goelz, who served as managing director of the NTSB.

“It means you have to listen very, very carefully to the sounds and activities of the last moments of an airplane. It’s terrible.”

The NTSB will spend months studying the pilots’ performance, spokesman Keith Holloway said.

In several major cases during the past 15 years, NTSB investigations have revolved as much on psychology as engineering:

➤ A co-pilot at the controls of an American Airlines Airbus A300 on Nov 12, 2001, tore the jet’s tail off by making several sharp movements of the rudder. The plane crashed in Queens, NY, killing 265 people. The NTSB found the airline’s training had improperly emphasized rudder use and that the design of the jet led to overuse of the rudder.

➤ When a US Airways jet crashed near Pittsburgh in 1994, killing 132 people, investigators concluded that a flaw in the jet’s rudder brought it down. Malcolm Brenner, an NTSB specialist in human performance, concluded that the pilots’ grunts were likely reactions to a rudder problem.

➤ The NTSB concluded that a flaw in the rudder brought a United Express flight down to earth in 2008, killing 50 people. **Colgan’s**
Turkish 1951 – Stall on Short Final
Air France 447 – Stall in Cruise
LOC – Air Transport Commonalities

- Very experienced pilots, multi-pilot crew
- One flight is like the other (with small variations)
- Boredom and Monotony
- Chronic Fatigue
- Expectation that the aircraft is fine
- Startle factor
- Potential that flying skills degrade over the years
Loss of Control-Inflight – Display Flying
Loss of Control

Co-Pilot Ejecting

Washington State
24 June 1994

= 20%
Loss of Control Elements

Sample Size = 158

(Source: Des Barker)
LOC – Root Causes

- Pilot Aircraft Handling
  - McDonnell Douglas C-17, Alaska, 28 July 2010
  - DH Mosquito, Barton, UK, 27 July 1996

- Engine Failure
  - Spitfire, Rouen Valley, 4 June 2001
  - Yakolev 52, Romania, 24 June 1995

- Passenger Interference
LOC – Display Flying Commonalities

- Very experienced pilots
- Usually single pilot
- Close to ground
- High closure rates
- Peer Pressure
- No margin for error

Details: See Des Barker, „Zero Error Margin“
Loss of Control-Inflight – Flight Test
Selected Accidents – Flight Test

- Airbus A330-300, speed below $v_{MCA}$, 30 June 1994
- Challenger 600 – deep stall, April 3, 1980
- Gulfstream G650, April 2011
- Many other, including „close calls“
LOC - Flight Test Commonalities

- Very experienced pilots, multi-pilot crew + engineer(s)
- High risk testpoints (but are those always really necessary)
  - $V_{MU}$-Testing?
- Time Pressure
- Expectation that the aircraft is NOT fine
LOC - Flight Test Commonalities

- Lack of or limited test point build-up
  - Time pressure
  - Not seeing a need for build up
- Pilot „trying to make a test point“
  - Using special technique which no regular pilot would use
  - Note: if test point can be made using a special technique, flag should be raised!
Loss of Control-Inflight – Personal Thoughts
Maintaining Situational Awareness is Key

- Startle Factor ("I do not know what it is doing")
- When under Spatial Disorientation
- When automation (partially) fails
- When pilots are fatigued

Source: Don Bateman
Do we need to revise the FARs / CS

- Usefulness of VMU Testing?
- Certain phenomena not fully addressed in aircraft certification (e.g. Crystal icing)
- Accident data shows that environmental conditions can exist, which are outside (or exceed) the coverage of Certification Design Regulations and Requirements
Pilots Skills and Knowledge

- This is not about knowing that the aircraft has three 90 kVA generators
- One accident is not like the other!

Source: Internet
Use Existing Training Aids

- Upset Recovery Training Aid, developed in 1996 and updated in 1998 is still a valid and excellent training tool
- Knowledge of instructor and the way he instructs is vital –
  - No shortcuts!
  - Build-Up Approach
Training in Aircraft

- For confidence building and peace of mind aerobatic instruction in a real aircraft is a **MUST**
  - Talk to spin-instructors!
- This is not about handling techniques
  - it is about
    - Rules of thumb
    - Self confidence (I have been there, I have seen it, I have survived this)
    - g-load experience
Training in Advanced Simulators

- Safe way to expose pilots to „critical“ situations
- Many initiatives to enhance aero model
- Specialised simulators for disorientation training
- Can never substitute a real flight (pilot psychology)

Source: TNO
WE NEED THE ABILITY OF THE HUMAN BRAIN TO ADAPT QUICKLY TO SITUATIONS WHICH WERE NOT FORESEEN BY OTHERS!

Source: Internet