U.S. Rotorcraft Accident Data and Statistics

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Date: Jan 2012
U.S. Registered Rotorcraft Accidents
30 Year History: 1982-2011

Calendar Year | Accidents Per Year | Fatal Accidents Per Year
--- | --- | ---
1982 | 273 | 221
1983 | 252 | 184
1984 | 259 | 199
1985 | 221 | 186
1986 | 213 | 186
1987 | 171 | 177
1988 | 184 | 167
1989 | 199 | 168
1990 | 205 | 187
1991 | 157 | 194
1992 | 167 | 190
1993 | 149 | 205
1994 | 170 | 185
1995 | 170 | 170
1996 | 154 | 141
1997 | 149 | 134
1998 | 127 | 127
1999 | 127 |
2000 | 127 |
2001 | 127 |
2002 | 127 |
2003 | 127 |
2004 | 127 |
2005 | 127 |
2006 | 127 |
2007 | 127 |
2008 | 127 |
2009 | 127 |
2010 | 127 |
2011 | 127 |

Accidents Per Year | Fatal Accidents Per Year
--- | ---
42 | 31
41 | 39
41 | 30
41 | 29
34 | 29
35 | 26
37 | 31
41 | 33
41 | 28
25 | 38
26 | 32
25 | 24
24 | 24
35 | 19
28 | 18
U.S. Registered Rotorcraft Accidents
Focus on 10 Year History: 2001-2010

Accidents Per Year
Fatal Accidents Per Year

Calendar Year

Accidents

Federal Aviation Administration
Progressing from accident totals to accident rates requires flight hours.

The FAA’s General Aviation and Part 135 Activity Survey is the source for U.S. rotorcraft flight hour estimates used in this presentation.
U.S. Registered Rotorcraft Accidents
Estimated Accident Rates: 2001-2010

Calendar Year
Accidents
Accidents Rate per 100,000 Hours
Fatal Accident Rate Per 100,000 Hours

Accidents Rate per 100,000 Hours
Fatal Accident Rate Per 100,000 Hours
U.S. Registered Rotorcraft Accidents
Estimated Accident Rates: 2001-2010

Start of IHST initiative and goal to reduce accident rate 80% in 10 years

2006 – 2010: IHST was analysis centered
2011 – 2015: IHST is implementation centered

IHST’s goal is a rate of 1.8 by 2016.
What are the usual environmental conditions for rotorcraft accidents?

• Based on NTSB data for U.S. rotorcraft accidents from 2001-2010:
  
  Over 88% occur in daylight conditions

  Over 95% occur in VMC
What industry sectors result in the most rotorcraft accidents?

Helicopter EMS?
What industry sectors result in the most rotorcraft accidents?

Helicopter EMS?

Air Tour?
What industry sectors result in the most rotorcraft accidents?

Helicopter EMS?

Air Tour?

Offshore?
What industry sectors result in the most rotorcraft accidents?

Helicopter EMS?

Air Tour?

Offshore?
Rotorcraft Accidents by NTSB Classification
10 Years from CY01 to CY10 – 1,672 Accidents

- Instruction/Training 21.7%
- Personal/Private 20.0%
- Not Categorized 9.3%
- Aerial Application 8.2%
- EMS 7.8%
- Public Use 7.8%
- Other Work 7.4%
- Positioning 4.9%
- Business 4.7%
- Aerial Observation 3.3%
- Flight Test 1.4%
- External Load 1.9%
- 6 Other Categories 1.5%
- Flight Test 1.4%
IHST’s Analysis of U.S. Accidents

- Personal/Private: 18.5%
- Instruction/Training: 17.6%
- Aerial Application: 10.3%
- Emergency Medical Services: 7.6%
- Commercial: 7.5%
- Law Enforcement: 6.5%
- Air Tour / Sightseeing: 5.9%
- Business: 4.8%
- Aerial Observation: 4.2%
- Offshore: 4.2%
- Firefighting: 3.6%
- External Load: 2.7%
- Logging: 2.7%
- Patrol/Construction: 2.1%
- Utilities: 1.7%
Hopefully the last few slides left you with a better impression than this…

…but percentage of accidents within each industry sector is only half of the story.
Personal/Private Accidents Compared to Flight Hours

U.S. Personal/Private Helicopter Accidents and Flight Hours

% of Rotorcraft Hours

% of Rotorcraft Accidents
Aerial Application Accidents Compared to Flight Hours

U.S. Aerial Application Helicopter Accidents and Flight Hours

% of Rotorcraft Hours vs. % of Rotorcraft Accidents from 2001 to 2010.

- % of Rotorcraft Hours: % of Rotorcraft Hours from 0% to 20%
- % of Rotorcraft Accidents: % of Rotorcraft Accidents from 0% to 20%

Yearly statistics show a variation in the percentage of accidents compared to flight hours.
HEMS
Accidents Compared to Flight Hours

U.S. EMS Helicopter Accidents and Flight Hours

% of Rotorcraft Hours
% of Rotorcraft Accidents
Accident rate comparison

HEMS 2001 – 2010

3.9 accidents per 100,000 flight hours
Accident rate comparison

HEMS 2001 – 2010
3.9 accidents per 100,000 flight hours

Personal/Private 2001 – 2010
29.6 accidents per 100,000 flight hours

Over 7 Times Higher than Helicopter EMS
Another approach to examining rotorcraft accident trends:

Cro Amsaa
Cro Amsaa?

…is not this (Cro Magnon).
Cro Amsaa

...is not this (Cro Magnon).

...but is this!
Cro Amsaa Analysis

U.S. Rotorcraft Accidents CYs 2001 - 2010
1,672 Total Accidents

Legend
- Accidents CY 01 - 10
- Accidents CY 01 - 05
- Accidents CY 06 - 10
- FIT CY 01 -10
- FIT CY 01 - 05
- FIT CY 06 -10

Lambda Beta Fit-p0 MTBF(i)
0.75837 0.938 <10! 2.327398
0.417908 1.026 <10! 1.923547
1.58 0.849 <10! 2.572655

Cumulative Calendar Days (x)
The value of Beta tells a story about the safety of our system

If Beta = 1: safety of the system is not changing
If Beta > 1: failures occurring faster
If Beta < 1: failures occurring slower
Bottom line:

Overall, the safety of our system got slightly better from 2001 to 2010.

Comparatively,

2001 to 2005: system safety was stagnant to slightly deteriorating

2006 to 2010: system safety was improving
Cro Amsaa – All Rotorcraft Accidents

U.S. Rotorcraft Accidents CYs 2001 - 2010
1,672 Total Accidents

Our Mean Time Between Failure (MTBF) offers further confirmation of a system that is trending toward better safety the last 5 years:

Note the increase in the MTBF for 2006 to 2010 in comparison to 2001 to 2005.
Cro Amsaa - Only Personal/Private

U.S. Rotorcraft Accidents CYs 2001 - 2010
337 Personal/Private Accidents Only

Cumulative Calendar Days (x)

<table>
<thead>
<tr>
<th>Category</th>
<th>Lambda</th>
<th>Beta</th>
<th>Hit-p8</th>
<th>MTBF(i)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal/Private Accidents CY 01 - 10</td>
<td>0.11857</td>
<td>0.969</td>
<td>&lt;10!</td>
<td>11.15209</td>
</tr>
<tr>
<td>Personal/Private Accidents CY 01 - 05</td>
<td>0.06918</td>
<td>1.049</td>
<td>&gt;=10</td>
<td>9.573502</td>
</tr>
<tr>
<td>Personal/Private Accidents CY 06 - 10</td>
<td>0.215137</td>
<td>0.897</td>
<td>=10</td>
<td>12.0503</td>
</tr>
</tbody>
</table>

Legend:
- △ Accidents CY 01 - 10
- ▽ Accidents CY 01 - 05
- □ Accidents CY 06 - 10
- FIT Line CY 01 - 10
- FIT Line CY 01 - 05
- FIT Line CY 06 - 10

YR2012
M01D24
LDR
Although the Personal/Private sector improved from 2006 to 2010, the sector still lags behind the beta of the overall system for every block of years examined.
Using MTBF as a measurement, Personal/Private improved from 2006 to 2010 as compared to 2001 to 2005.
The Personal/Private MTBF did improve by 2.5 days from 2006 to 2010 as compared to 2001 to 2005.

But the MTBFs don’t compare favorably to other industry sectors, e.g. HEMS.
Gathering data on U.S. rotorcraft can be difficult, but we’re not so desperate that we’ve resorted to this technique yet.
What do we know about Personal/Private rotorcraft accidents?

• The IHST’s study of 523 U.S. accidents across 3 years provides the most complete analysis of:
  – What happened (Occurrence Categories)
  – Why it happened (Problem Statements)
  – How it could have been prevented (Intervention Recommendations)

• The next several slides will look specifically at these areas for the 97 Personal/Private accidents (18.5% of the 523 total accidents) in the IHST’s U.S. data set.
Personal/Private Accidents: Occurrence Categories tell “What happened?”

Note: During the IHST analysis, each accident could be placed in multiple occurrence categories, so the percentages shown are not intended to sum to 100%.

- Loss of Control: 41%
- Autorotation: 27%
- System Component Failure: 23%
- Struck an Object: 21%
- Fuel Related: 12%
Personal/Private Accidents: More about “Loss of Control”

• Loss of control occurrences were further divided into more specific sub-areas.

• For Personal/Private, the Loss of Control sub-areas most frequently cited were (in descending order):
  – Performance Management
  – Exceeded Operating Limits
  – Lost Tail Rotor Authority
Personal/Private Accidents: Problem Statements tell “Why did it happen?”

Note: During the IHST analysis, each accident could be assigned multiple problem statements, so the percentages shown are not intended to sum to 100%.

- Pilot judgment & actions: 90%
- Safety Management: 43%
- Ground Duties: 41%
- Pilot Situational Awareness: 34%
- Part/system failure: 23%

Percentage of Personal/Private Accidents (97 accidents)
Personal/Private Accidents: Problem Statements tell “Why did it happen?”

Note: During the IHST analysis, each accident could be assigned multiple problem statements, so the percentages shown are not intended to sum to 100%.

For purposes of this presentation we will take a closer look at just a couple of the problem statements.
Personal/Private Accidents: Further details for selected problem statements

• “Pilot Judgment & Actions” problems most frequently occurred in the following sub-areas:
  – Decision Making, Landing Procedures, Procedure Implementation, Flight Profile

• “Pilot Situational Awareness” problems most frequently occurred in the following sub-areas:
  – Awareness of External Environment, Awareness of Visibility/Weather, Awareness of Internal Aircraft Issues
Personal/Private Accidents: Intervention Recommendations tell “How it could have been prevented”

Note: During the IHST analysis, each accident could be assigned multiple intervention recommendations, so percentages aren't intended to sum to 100%.

- **Training/Instructional**: 87%
- **Safety Management**: 62%
- **Systems and Equipment**: 35%
- **Regulatory**: 29%
- **Maintenance**: 20%
Personal/Private Accidents: Intervention Recommendations tell “How it could have been prevented”

Note: During the IHST analysis, each accident could be assigned multiple intervention recommendations, so percentages aren't intended to sum to 100%.

For purposes of this presentation we will take a closer look at only Systems and Equipment recommendations.
Personal/Private Accidents: A closer look at the top “Systems and Equipment” intervention recommendations

• **Post Incident Survivability**
  – Crash resistant fuel systems
  – Install Wire Strike Protection System
  – Improve helicopter specific ELT practices/standards

• **Situational Awareness Enhancers**
  – Install proximity detection system
  – Wire detection system for low altitude operations

• **Cockpit Indication/Warning**
  – Automate carburetor anti-ice function or early warning alert
  – Fuel system status
The first recorded incident of a pilot choosing to ignore statistical data at the risk of his crew and passengers happened a long time ago...
...in a galaxy far, far away.

But sir, the possibility of successfully navigating an asteroid field is approximately 3,720 to 1!!

Never tell me the odds!!
What do we know about Instructional/Training Accidents?

• Second highest number of accidents of any industry sector studied by the IHST’s review of U.S. helicopter accidents

• 92 accidents in Instructional Training
  – 17.6% of the 523 total accidents studied
Instructional/Training Accidents: Occurrence Categories tell “What happened?”

Note: During the IHST analysis, each accident could be placed in multiple occurrence categories, so the percentages shown are not intended to sum to 100%.

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loss of Control</td>
<td>61%</td>
</tr>
<tr>
<td>Autorotation</td>
<td>54%</td>
</tr>
<tr>
<td>Abnormal Runway Contact</td>
<td>17%</td>
</tr>
<tr>
<td>System Component Failure</td>
<td>15%</td>
</tr>
<tr>
<td>Landing Zone</td>
<td>9%</td>
</tr>
</tbody>
</table>
Instructional/Training Accidents: More about “Loss of Control”

• Loss of control occurrences were further divided into more specific sub-areas.

• For Instructional/Training, the Loss of Control sub-areas most frequently cited were (in descending order):
  – Performance Management
  – Interference with Controls
  – Dynamic Rollover
Instructional/Training Accidents: Problem Statements tell “Why did it happen?”

Note: During the IHST analysis, each accident could be assigned multiple problem statements, so the percentage shown are not intended to sum to 100%

- **Pilot judgment & actions**: 93%
- **Safety Management**: 54%
- **Ground Duties**: 20%
- **Pilot Situational Awareness**: 20%
- **Part/system failure**: 17%

Percentage of Instructional/Training Accidents (92 accidents)
Instructional/Training Accidents: Problem Statements tell “Why did it happen?”

Note: During the IHST analysis, each accident could be assigned multiple problem statements, so the percentage shown are not intended to sum to 100%

- Pilot judgment & actions: 93%
- Pilot Situational Awareness: 20%
- Part/system failure: 17%
- Safety Management: 10%
- Ground Duties: 0%

For purposes of this presentation we will take a closer look at just a couple of the problem statements.
Instructional/Training Accidents: Further details for selected problem statements

• “Pilot Judgment & Actions” problems most frequently occurred in the following sub-areas:
  – Procedure Implementation, Landing Procedures, Crew Resource Management, Decision Making

• “Pilot Situational Awareness” problems most frequently occurred in the following sub-areas:
  – Awareness of External Environment
Instructional/Training Accidents:
Intervention Recommendations tell “How it could have been prevented”

Note: During the IHST analysis, each accident could be assigned multiple intervention recommendations, so percentages aren't intended to sum to 100%
Instructional/Training Accidents: Intervention Recommendations tell “How it could have been prevented”

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For purposes of this presentation we will take a closer look at only Systems and Equipment recommendations.
Instructional/Training Accidents: A closer look at the top “Systems and Equipment” intervention recommendations

- **Post Incident Survivability**
  - Crash resistant fuel systems
  - Install Wire Strike Protection System

- **Cockpit Warning/Indication**
  - Install low rotor warning
  - Provide power available versus power required indicator
  - Low airspeed indicator warning

- **Situational Awareness Enhancers**
  - Wire detection system for low altitude operations
  - Automatic hover recovery system
  - Proximity detection system
The IHST study of U.S. rotorcraft accidents went quite a bit deeper than this.
What do we know about Aerial Application Accidents?

• Third highest number of accidents of any industry sector studied by the IHST’s review of U.S. helicopter accidents.

• 54 accidents in Aerial Application
  – 10.3% of the 523 total accidents studied

• Despite trailing Personal/Private and Instructional/Training in the IHST study’s percentage of total accidents, concerns in this industry sector are growing.
Percentage of Aerial Application Helicopter Accidents – Last 5 Years

- 5% in 2007
- 10% in 2008
- 7% in 2009
- 18% in 2010
- 19% in 2011
Percentage of Aerial Application Helicopter Accidents – Last 5 Years

Percentages the last 2 years are comparable to Personal/Private. Also, like Personal/Private, the flight hour exposure level is relatively low.
Knowing *when* U.S. Aerial Application rotorcraft accidents are more likely to occur does not require much guessing...
Aerial Application Accidents by Month: 10 years from 2001-2010
Aerial Application Accidents by Month: 10 years from 2001-2010

76% of accidents during 6 month peak U.S. growing season of May - Sep
Future challenges – what to do now?

• Personal/Private, Instructional/Training, and Aerial Application pose unique problems

• Difficult population of operators to reach
  – Not likely to attend major industry or government safety forums
  – Less awareness/exposure to industry-wide safety initiatives and best practices

• Small fleet sizes, often just 1 aircraft

• Have to convince them of the benefits to make any change
  – Must be low cost or no cost
  – Must make the case that it will show immediate results
The goals set by the rotorcraft community for reductions in U.S. rotorcraft accidents will require no higher than single digit annual accident totals in each industry sector of Personal/Private, Instructional/Training, and Aerial Application.
The goals set by the rotorcraft community for reductions in U.S. rotorcraft accidents will require no higher than *single digit* annual accident totals in each industry sector of Personal/Private, Instructional/Training, and Aerial Application.

This is where we stood at the end of 2011:

<table>
<thead>
<tr>
<th>Industry Sector</th>
<th>Accidents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal/Private</td>
<td>35</td>
</tr>
<tr>
<td>Instructional/Training</td>
<td>24</td>
</tr>
<tr>
<td>Aerial Application</td>
<td>24</td>
</tr>
</tbody>
</table>

So, there is some work to be done.
Difficult problems sometimes lead to a new level of cooperation and innovation to find a solution....
Difficult problems sometimes lead to a new level of cooperation and innovation to find a solution....

...the results may surprise everyone.
If you found the portions of this presentation that referenced the work by the IHST useful, please go to the following address for more information, including detailed analysis reports:

www.ihst.org
Questions?