FAA – Rotorcraft Safety Continuum for Systems & Equipment

Federal Aviation Administration

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Background

- The Federal Aviation Administration's (FAA) Aircraft Certification Service (AIR) continues to pursue the vision of AIR: 2018
  - one part of this goal is to implement a Safety Continuum for each aircraft type.

- This presentation will highlight in part the recent policy initiative the Rotorcraft Directorate has developed for CAR 6/Part 27 certificated rotorcraft (normal-category helicopters).

Safety Continuum (SC)

- Is reflected in Title 49 USC
- Is integral to FAA standards & oversight
- Recognizes differences in acceptable levels of safety and certitude
- Helps FAA:
  - balance risk and safety requirements
  - determine appropriate level of rigor in standards, policies, and processes
  - focus safety resources in a manner consistent with the public's expectations

PHOTO: Airbus

PHOTO: Cessna Aircraft Co.

PHOTO: Robinson Helicopter Company.


PHOTO: Associated Press


PHOTO: Air Tractor, Inc.

Safety Continuum (SC)

- As an integral part of the Safety continuum is the development of a risk-based decision making process for use in design, and airworthiness certification.
  - The result is the applicable design requirements and means of compliance are scalable, based on classes of CAR 6/Part 27 Rotorcraft.

- The FAA primarily uses aircraft weight, passengers & propulsion type to distinguish airworthiness requirements across products

U.S. “Basic” Rotorcraft Regulatory Distinctions
(not exhaustive)

Weight

Transport Category
Over 20,000 lbs.

Transport Category 7,000 - 20,000 lbs.

Normal Category up to 9 pass . & 7,000 lbs.

U.S. “IFR” Rotorcraft Regulatory Distinctions
(not exhaustive)

Weight

Normal Category up to 9 pass . & 7,000 lbs.

Transport Category 7,000 - 20,000 lbs.

Transport Category
Over 20,000 lbs.



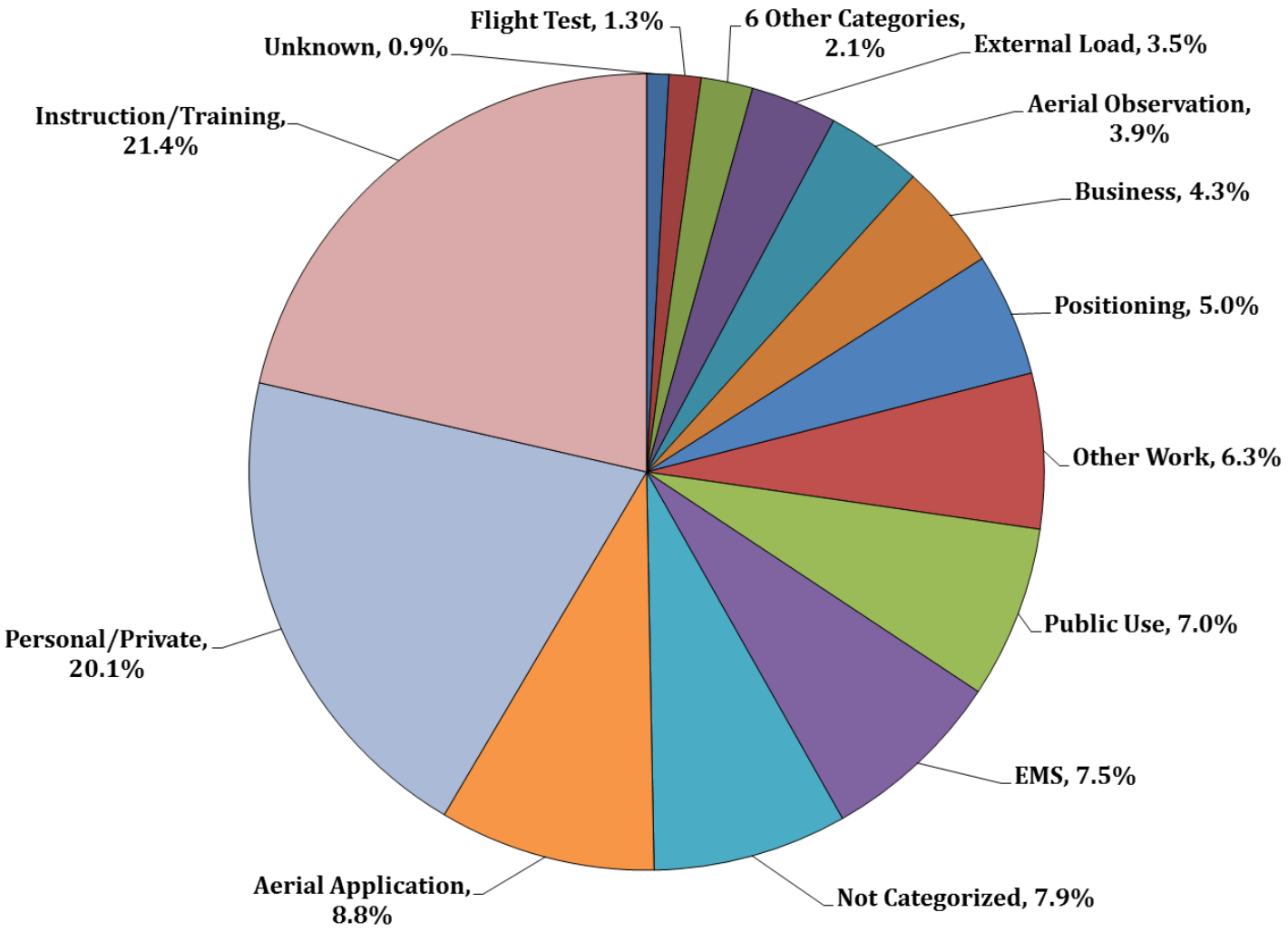







Rotorcraft Accidents by NTSB Classification

10 Years from FY04 to FY13 – 1,613 Accidents



Summary of Accident Contributing Categories

- **Personal/Private:**
  - Account for approximately 20 - 25% of helicopter accidents.
  - Based on estimated operating hours, contribute roughly **6 times** their "fair share."

- **Instruction/Training:**
  - Account for approximately 20% of helicopter accidents.
  - Contribute roughly **2 times** their fair share.

- **Aerial Application:**
  - Thru 2007, approximately 8% of helicopter accidents.
  - Thru 2007, contributed roughly their fair share.
  - Now contribute approximately **3 - 5 times** their fair share.

Evolving Landscape

- Technological advancements and business innovation are challenging our existing weight-based regulatory discriminators

- Need to determine how to use technology to improve rotorcraft safety, particularly in “high offender” operations.

- Find means to encourage practical and economical installations of safety enhancing systems – which may require that we broaden our concept of “safety” to include an evaluation of both risks and benefits.

Rotorcraft SC for Part 27 Systems & Equipment

- **Evaluated 27.1309 guidance to better address challenges with Part 27 (Normal category) rotorcraft:**
  - emerging technology,
  - legacy rotorcraft,
  - broad range of aircraft size, capability and complexity under Part 27
- **Developing Safety Continuum Policy Statement to address these challenges**
  - tiered approach for certification of Part 27 systems & equipment
  - Development Assurance Levels (DALs) tiered based on classes of Part 27 rotorcraft
- **Single Engine IFR Concept Paper was an input to the policy statement, among other drivers**

Rotorcraft Safety Continuum

- **First this policy establishes the following 4 classes of normal category rotorcraft as described in Table 1.**
- **The purpose of Table 1 is to highlight the defining elements of the risk vs rigger tailored approach and where dividing lines exist.**

Table 1. Normal Category Rotorcraft Classes

Class	Description
I	Reciprocating Engine Occupants 5 or less including crew
II	Single Turbine Engine Occupants 5 or less including crew Up to 4000lbs Max Gross Weight
III	Single Turbine Engine Occupants 6 or more including crew 4001-7000lbs Max Gross Weight
IV	Twin Turbine

Rotorcraft Safety Continuum

- Second, this policy establishes how the tailored approach is applied when establishing the SAE ARP4754A Development Assurance Levels (DAL) in Table 2.
  - DAL levels as identified in Table 2 includes both, the top level Functional Development Assurance Level (FDAL) and the lower level Item Development Assurance Level (IDAL) as described in ARP4754A.
- Use the standard Functional Hazard Assessment (FHA) process as called out in ARP 4761 and assign the appropriate Hazard Classification i.e. Catastrophic, Hazardous, Major, Minor or No Effect.
- Then apply the systems and equipment DALs in Table 2 commensurate with the appropriate class of rotorcraft found in Table 1.

Table 2. Relationship Among Normal Category (CAR 6 & Part 27) Rotorcraft Classes, Probabilities, Severity of Failure Conditions, and System Development Assurance Level (FDAL/IDAL)

Classification of Failure Conditions	**No Safety Effect**	**<----Minor----->**	**<----Major---->**	**<--Hazardous--->**	**< Catastrophic>**
Allowable Qualitative Probability	**No Probability Requirement**	**Probable**	**Remote**	**Extremely Remote**	**Extremely Improbable**
Effect on Rotorcraft	No effect on operational capabilities or safety	Slight reduction in functional capabilities or safety margins	Significant reduction in functional capabilities or safety margins	Large reduction in functional capabilities or safety margins	Normally with hull loss
Effect on Occupants	Inconvenience for passengers	Physical discomfort for passengers	Physical distress to passengers, possibly including injuries	Serious or fatal injury to an occupant	Multiple fatalities
Effect on Flight Crew	No effect on flight crew	Slight increase in workload or use of emergency procedures	Physical discomfort or a significant increase in workload	Physical distress or excessive workload impairs ability to perform tasks	Fatal Injury or incapacitation
Classes of Rotorcraft	**Allowable Quantitative Probabilities and System Development Assurance Levels (FDAL/IDAL) (Note 1)**				
Class I Reciprocating Engine Occupants 5 or less including crew	No Probability or Development Assurance Levels Requirement	$<10^{-3}$ D Notes 1, 2	$<10^{-4}$ C Notes 1, 2 and 4	$<10^{-5}$ C Notes1, 2	$<10^{-6}$ C Notes 1, 2 and 3
Class II Single Turbine Engine Occupants 5 or less including crew Up to 4000lbs Max Gross Weight	No Probability or Development Assurance Levels Requirement	$<10^{-3}$ D Notes 1, 2	$<10^{-5}$ C Notes 1, 2	$<10^{-6}$ C Notes 1, 2	$<10^{-7}$ C Notes 1, 2 and 3
Class III Single Turbine Engine Occupants 6 or more including crew 4001-7000lbs Max Gross Weight	No Probability or Development Assurance Levels Requirement	$<10^{-3}$ D Notes 1, 2	$<10^{-5}$ C Notes 1, 2	$<10^{-7}$ C Notes 1, 2	$<10^{-8}$ B Notes 1, 2 and 3
Class IV Twin Turbine	No Probability or Development Assurance Levels Requirement	$<10^{-3}$ D Notes 1, 2	$<10^{-5}$ C Notes 1, 2	$<10^{-7}$ B Notes 1, 2	$<10^{-9}$ A Notes 1, 2 and 3

Note 1: The letters of the alphabet denote the typical FDAL/IDAL System Development Assurance.
Note 2: Numerical values indicate an order of probability of failure range and are provided here as a reference.
Note 3: At rotorcraft function level, no single failure will result in a Catastrophic Failure Condition.
Note 4. Secondary System may not be required to meet probability goals. If installed, it should meet stated criteria.

Rotorcraft Safety Continuum Status

- **Policy Statement Status**
  - FAA internal review (Dec. 2016)
  - Public review/comment (Feb. 2017)
- **Planning to coordinate with EASA, TCCA & ANAC**

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