FAA – Part 27 Rotorcraft Safety Continuum for Systems & Equipment

Federal Aviation Administration

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Overview

- **FAA Safety Continuum Background**
- **Considerations for the Rotorcraft Safety Continuum**
- **Rotorcraft Safety Continuum Policy**

FAA Safety Continuum 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 the recent policy statement **PS-ASW-27-15** released by the Rotorcraft Standards Branch as developed for CAR 6/Part 27 certificated rotorcraft (normal-category helicopters).

FAA 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 resources in a manner consistent with the public's safety expectations

FAA Safety Continuum (SC)

- 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, occupant count & 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” Appendix B Rotorcraft Regulatory Distinctions 27 vs. 29
(not exhaustive)

Weight

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

Note 3 small differences:
1 Stand-by Battery vs Start battery
2 Copilots Instruments for Pilot back-up
3 Dynamic Stability & Aperiodic response rate 6 sec. vs. 9 Sec.

Transport Category 7,000 - 20,000 lbs.

Transport Category
Over 20,000 lbs.





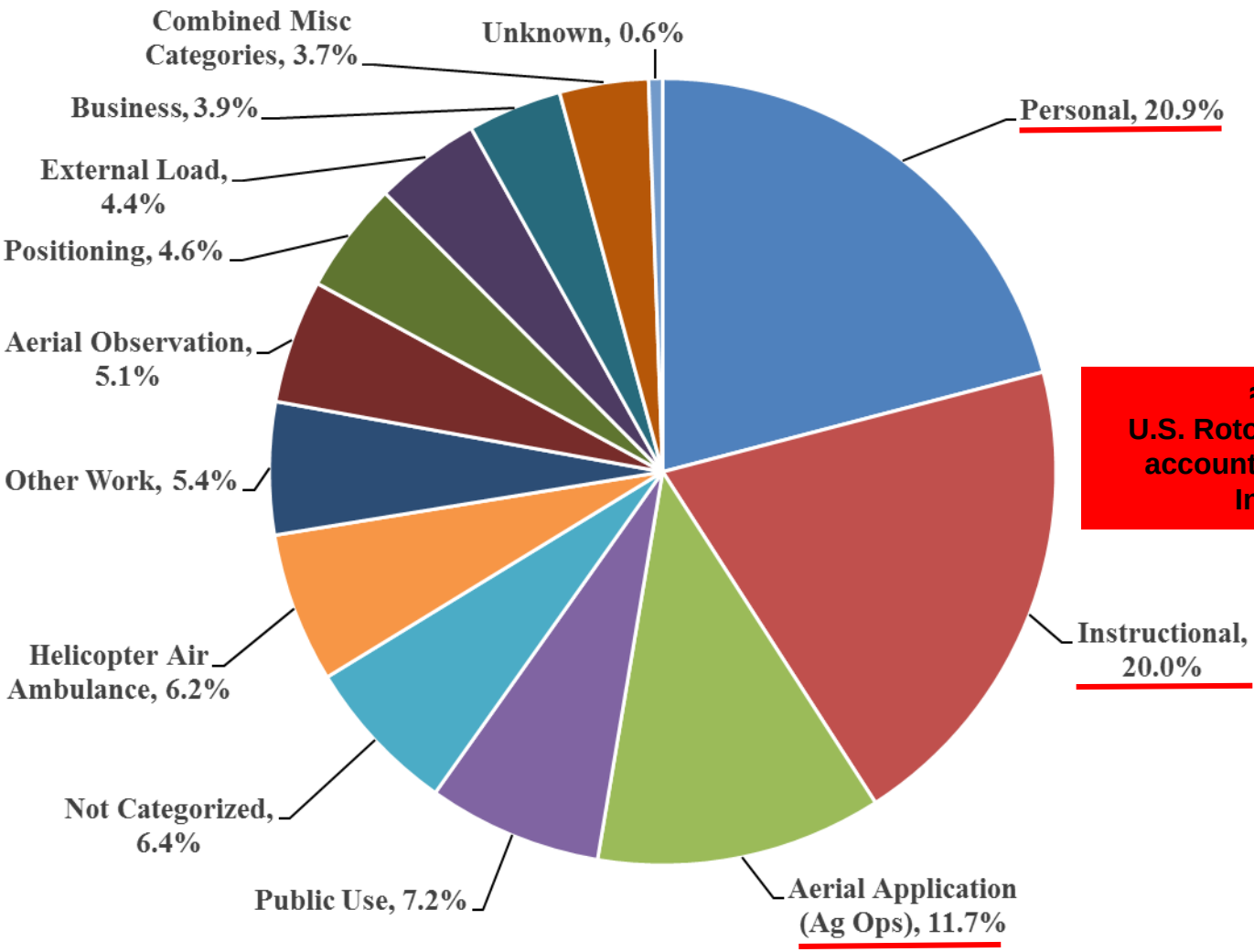





Considerations for the Rotorcraft Safety Continuum

U.S. Rotorcraft Accidents, NTSB Classification

1,396 accidents, 10 Years (CYs 2007-16)



≈53% of U.S. Rotorcraft Accidents accounted for by Top 3 Industries

U.S. Rotorcraft Accident Rate Data

NTSB Classification	Accident Count*	Accident Rate*	Fatal Accident Count*	Fatal Accident Rate*
All Industries	1,266	4.96	218	0.85
Personal (4% of U.S. Heli Hrs)	264	26.24	44	4.37
Instructional (19% of U.S. Heli Hrs)	253	5.15	17	0.35
Aerial Application (5% of U.S. Heli Hrs)	144	11.71	13	1.06
Helicopter Air Ambulance (17% of U.S. Heli Hrs)	83	1.96	33	0.78

*Data is for 9 years of 2007-2010 and 2012-2016. 2011 was not included because flight hour data by industry was not available in 2011 due to problems with the FAA's General Aviation and Part 135 Activity Survey.

Summary of Accident Contributing Categories, 07-16

- **Personal/Private:**
  - Account for approximately 21% of helicopter accidents.
  - Based on estimated operating hours, contribute roughly **5 times** their "fair share."

- **Instruction/Training:**
  - Account for approximately 20% of helicopter accidents.
  - Contribute roughly **1.5 times** their fair share.

- **Aerial Application:**
  - Account for approximately 12% of helicopter accidents.
  - Contribute approximately **2 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.

Current Harmonized Guidance Material

- **AC 27.1B, 27.1309 provides guidance for compliance to FAR 27.1309**
- **AC recognizes SAE-ARP 4761/4754/A**
- **System Safety Assessment (SSA) process**
- **AC 20-174 for compliance to the new ARP 4754A.**

Safety Assessment Process

- **Functional Hazard Assessment (FHA)**
  - Aircraft Level & Systems Level FHAs
  - Used to Identify Effects (i.e. Failure Condition Categories) of System Failures on Aircraft
- **5 Failure Condition Categories**
  - Catastrophic
  - Hazardous/Severe-Major
  - Major
  - Minor
  - No-Effect

System Safety Assessment hardware, software & AEH requirements

- **Catastrophic** – DAL A ≤ 1 x 10 -9 = Triplex Redundant Systems
- **Hazardous** – DAL B ≤ 1 x 10 -7 = Dual Redundant Systems
- **Major** – DAL C ≤ 1 x 10 -5 = Dual Redundant Systems
- **Minor** – DAL D ≤ 1 x 10 -3 = Single System
- **No-Effect** – DAL E ≤ 1 x 10 ** = Non-Required Systems
  - ** no probability of occurrence requirements.
- As defined in AC27.1309 & SAE ARP4761 "Guidelines and Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment".

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

Rotorcraft SC for Part 27 Systems & Equipment

- **Single Engine IFR Concept Paper**
  - One input to the policy statement, among many other drivers
- **Policy vs. Rulemaking:**
  - 27.1309 is a performance based rule. No need for rule making to make adjustments.
  - 27.1316 (lightning), 27.1317 (HIRF), Appendix “B” (IFR) & 135 Ops. Rules requirements
    - Some of the suggested changes would drive rule making activity, this has very long timeline associated with it.
    - FAA Rotorcraft Branch is working to add more Rules to the Safety Continuum Policy, where adjustments in the guidance can further assist the lower classes of Part 27 helicopters certify systems and equipment.

Rotorcraft Safety Continuum Policy

Rotorcraft Safety Continuum Policy

- **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 rigor 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 Policy

- 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, 3 and 5
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. A qualitative analysis is allowed to justify minor and major failure conditions.
Note 3: At rotorcraft function level, no single failure will result in a Catastrophic Failure Condition.
Note 4. Secondary systems must meet the same criteria if they are installed to meet the probability requirements.
Note 5: This requirement can be met by a dual system of sufficient robustness, reliability, and independence.

Rotorcraft Safety Continuum Policy Status

- **Public comments reviewed & dispositioned:**
  - Most common comments:
    - Stated concerns with unintended consequences of lower classes of rotorcraft being utilized in critical operations
    - Wanted a more prescriptive policy, with technological specific solutions designated
    - Asked for Policy & Regulation changes in areas outside of 27.1309 i.e. 27.1316, 27.1317 and 27 Appendix “B” IFR
    - Sought greater DAL reductions for Class 3 Rotorcraft, concerned the policy would still require Triplex Systems for Catastrophic Failures

Rotorcraft Safety Continuum Policy Status

- **Policy Statement PS-ASW-27-15 released on June 30, 2017**
- **Continuing to coordinate with EASA, TCCA & ANAC as requested by industry**
- **FAA Rotorcraft Branch is working to add more Rules to the Safety Continuum Policy, where adjustments in the guidance can further assist the lower classes of Part 27 helicopters certify systems and equipment.**

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