



ROTORCRAFT AND VTOL SYMPOSIUM

Tony Randall
December 2019

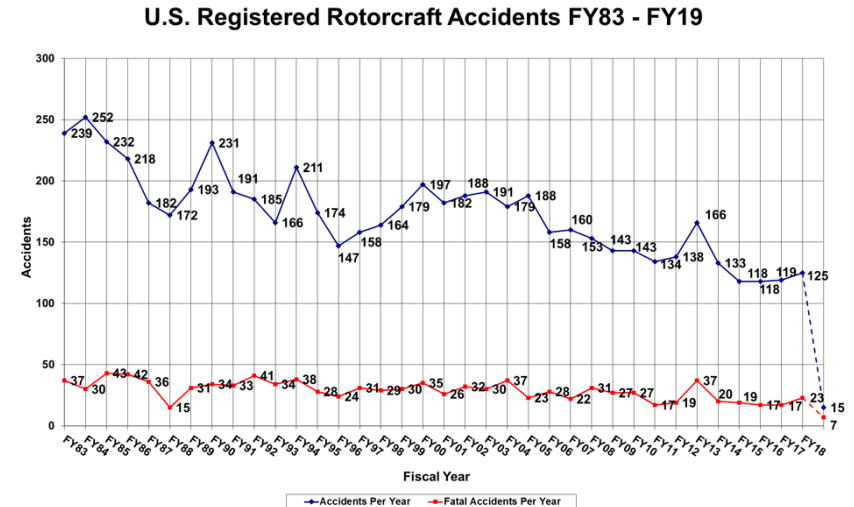
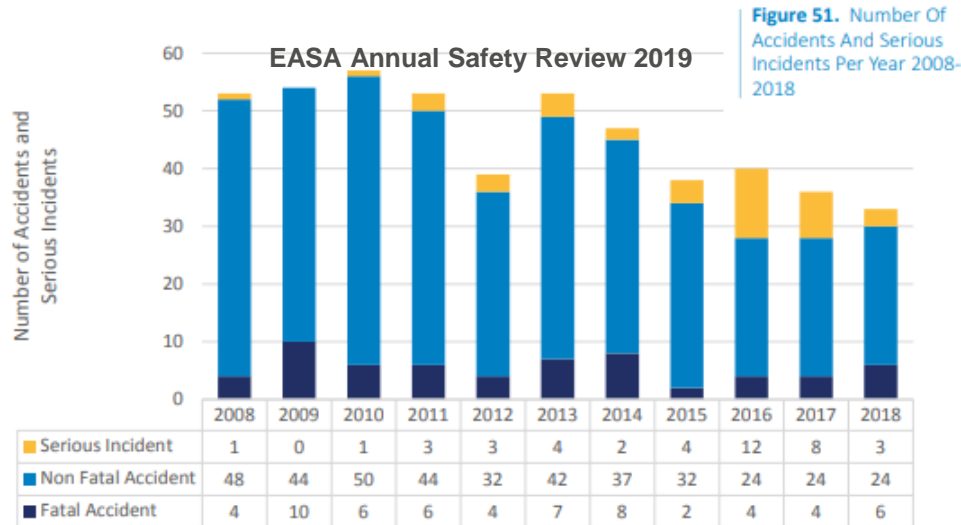
Current status of the industry and efforts to curb undesired outcomes

Bell fielded fleet efforts

Bell innovation for new design aircraft

Other Bell activities related to safety

Industrywide Current Commercial Fleet – in excess of 32,000 world wide
Bell: approximately 11,850 built / 8200 active (excludes the Bell-47)



What are the issues?

- CFIT
- Rotor strikes
- UIMC
- LOC
- ETC, ETC: Lots of human factors issues

What can or are we doing as an aircraft developer and manufacturer

- Design considerations for:
 - Pilots, maintainers, systems interaction and man-machine interface
- Collect and utilize data from all sources.

What is the industry doing about the issues:

Identifying the leading issues

- IHSF (IHST) / USHST / ESPN-R (EHEST) / Heli-Offshore / Industry groups
- Participation
 - OEMs / Operators / Regulators / Suppliers / Specialists / Industry

Actions

- EASA Rotorcraft Safety Roadmap
- EASA Safety Promotion Tasks (SPT)
- USHST Helicopter Safety Enhancements
- Actions by Individual OEMs / Suppliers / Regulators
- Proposed Safety Rating Methodology (multiple efforts)

Where can the OEMs contribute:

- Fleet statistics
- Crew Training
- Implement ARAC Recommendations:
 - Crash Resistant Fuel Systems
 - Crash Resistant Seats and Structure
 - Bird strike
- Safety Rating Concept
- Safety Continuum / Net Safety Benefit
- Part 27 & 29 Modernization

Fielded Fleet Efforts - Bell

© 2018 Bell Helicopter Textron Inc.

7

Bell 206



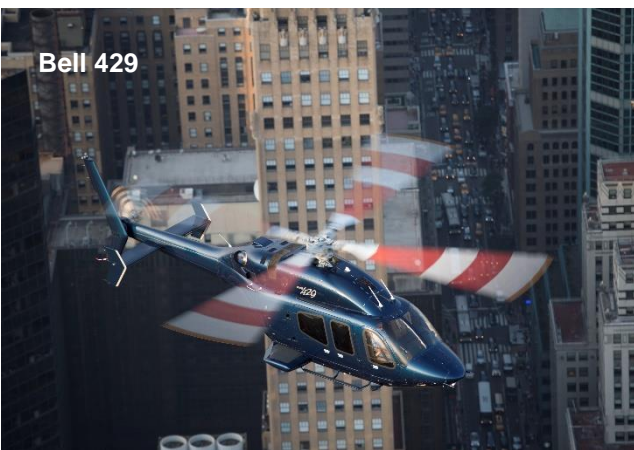
Bell 407



Bell 412



Bell 429



Bell 505



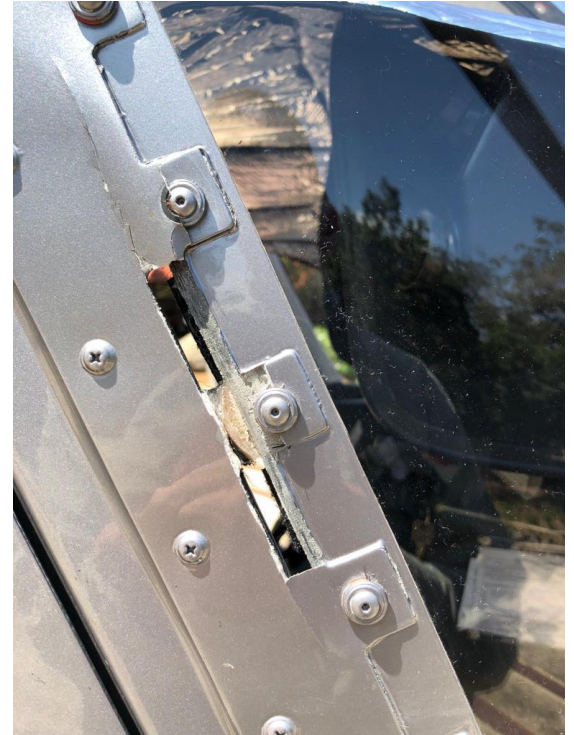
Bell Huey



Crash Resistant Fuel Systems

- 412 – Compliant to older standard (upgrade discussed in a later slide)
- 206 – CRFS kits available for A/B/L/L1 (same or similar hardware as L3/L4)
 - Weight penalty between 18-28 lbs, model dependent
- 407 – Compliant to current requirements with ELOS for 27.952(b)1
- 505 – Fully compliant
- 429 – Fully compliant

Optional polycarbonate windscreens available for 407, 206 and 429



407 Polycarbonate Windscreen Test

Bell Confidential and Proprietary
10



407 Safety Items of Interest:

- Garmin G1000H
- HUMS – 1st OEM supported single engine helicopter HUMS (STC)
- 407 Pulse Light System
 - Lightweight electric system controller that alternately pulses the landing and aux lights
 - Midair and Bird Strike mitigator
- Dual channel FADEC
- FAA Single Engine IFR Certification (August 2019)

CRFS Phase 1:

- Compliance to be shown to the fuel system requirements of “Perlmutter Amendment” 49 U.S.C. § 44737(2018) by the deadline of April 5, 2020
- Compliance primarily through substantiation of the existing design along with addition of attitude sensitive roll over valves in the fuel tank vents

CRFS Phase 2:

- Compliance to be shown to the latest CRFS standards
 - Anticipated to be completed by EOY 2020
- Compliance through substantiation of the existing design, modifications to the fuel system and fuel system drop test in representative aircraft structure

Seats:

- Bell 412EP has energy attenuating crew seats
 - Compliant with current 29.561(b) and 29.562
- Examining options for EA passenger seats

Bell 505: Advanced Certification Basis

- Dual FADEC
- Integrated Avionics
- FAA Amendment 27-47
- EASA CS-27 Amendment 3

Bell 429: Advanced Certification Basis

- FAA Amendment 27-44
- EASA CS-27 Amendment 2

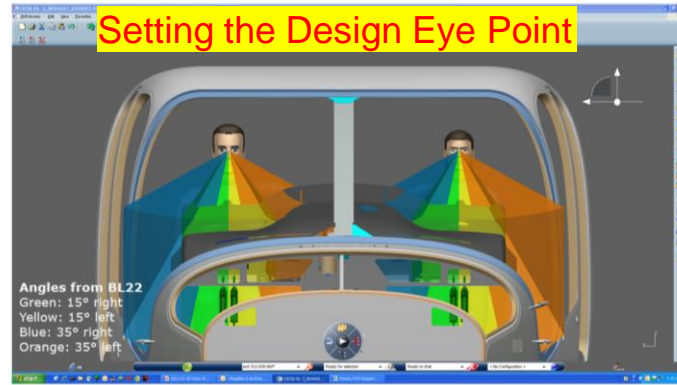


NEW AIRCRAFT INNOVATION

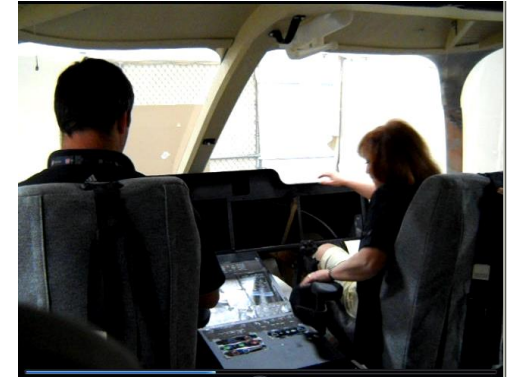
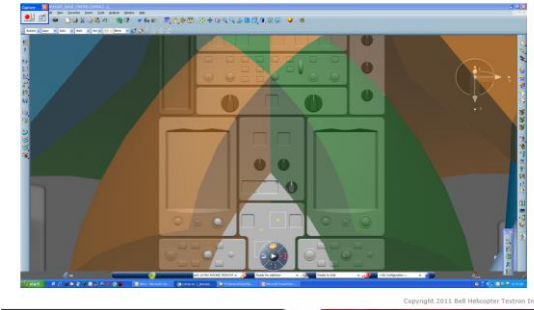
Crew Station Design and Development

Bell Confidential and Proprietary

16



Reach Study: Zone 1



Man Machine Interface & Situational Awareness

OEI/AEO Power Limit and Speed Cueing

- Aural, visual and stick feedback

Single Engine / Cat A Operations

- Hands off automatic re-trim

Flight Director Cueing

- Exact visual indication of flight control and flight director moding

Design through Crew Error Management Process

- Application of Part 25.1302
- Independent pilot review welcome!

ADS-B In/Out, HTAWS, Synthetic Vision, TCAS I/II

Main Rotor, Tail Rotor, Baggage Bay cameras (kits)

Pilot SA and Cueing is Essential!

§25.1302 Inspired

- Transport category rule - not required for rotorcraft
- Proactive safety enhancement
- Rotorcraft industry leading process

Overview

- Assess all cockpit equipment and crew tasks
- Anticipate user interface errors
- Evaluate design through simulation testing
- Improve design before aircraft delivery



Safety Margins:

- High-bandwidth Triplex Systems each fully capable of flying the aircraft
- Maximum system separation for zonal threats
- Elimination of mechanical linkages and associated maintenance issues
- Ergonomic cockpit controls

Simplification:

- Single axis inputs through complete control axis decoupling
- Automatic transition between flight regimes
- Collective tactile queuing

Pilot Assist:

- Seamless/transient-free reconfiguration following failures
- Collective tactile queuing and limit trimming
- Automatic airspeed trim to AEO, OEI or AEI V_{ne}
- Unusual attitude recovery
- Autorotation entry assist

Automation to autonomy:

- Auto-couple envelope protection
- Detect and avoid integration
- Optionally piloted
- Fully autonomous

525 Drive System Design

The Relentless Drive System incorporates an innovative arrangement and construction of components to collectively minimize the possibility of a loss of lubrication event and ensure that the maximum flight time is achieved if such an event does occur.

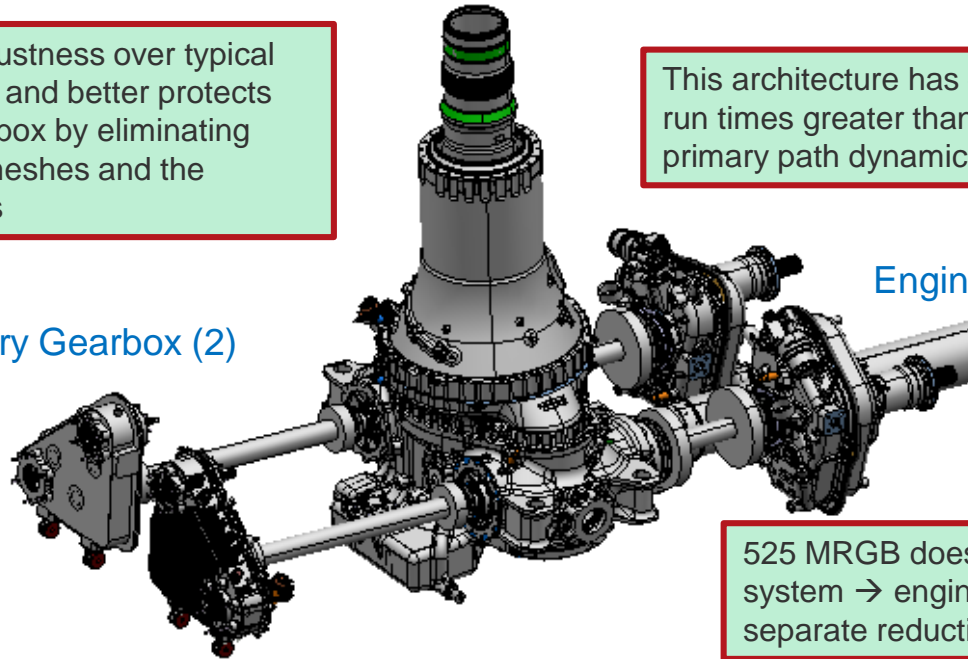
Main Rotor Gearbox

This architecture adds robustness over typical drive system architectures and better protects the critical main rotor gearbox by eliminating high speed bearing/gear meshes and the associated high heat loads

This architecture has demonstrated loss of lube run times greater than 60 minutes for all the primary path dynamics (MRGB, TRGB, IGB)

Accessory Gearbox (2)

Engine Reduction Gearbox (2)



525 MRGB does not use a high speed planetary system → engine speed reduction occurs in separate reduction gearboxes for each engine



OTHER SAFETY ACTIVITY

- **IETMS (Interactive Electronic Technical Manual)**
 - Eliminates the use of out of date publications
 - 505 first new platform to be completely digital
 - 429 first existing platform to transition: January 2019
 - 407 will be complete by end of 2019
 - 412 scheduled to be complete by 2nd quarter 2020
- **Safety Rating Scheme**
- **Robust System Safety Process**
- **Design and Manufacturing Safety Management System**
 - First aircraft OEM with FAA acceptance

Bell Training Academy

- Only structured transition courses offered today
 - Conducted on combination of aircraft and simulator
- Starting to talk about the need to develop training schemes for low time pilots and emerging markets
 - Cockpit Trainers (non-motion, non-visual)
 - Garmin has a G1000H desktop trainer available
 - VR and Augmented Reality based training
 - No substitute for real autorotation



THANK YOU