NASA / FAA eVTOL Crashworthiness Workshop Series: Virtual Meeting #3:

DoD Considerations for Crashworthiness of eVTOL Vehicles – Purpose and Need

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Introduction

- Third in a series of workshops
  - The first provided the historical perspective and overall regulatory considerations
  - The second provided an in depth review of certification strategies from regulators and standards development organizations

- This installment will review the considerations for vehicle crashworthiness from the perspective of various agencies within the U.S. Department of Defense

Meeting Logistics

- Speakers and Moderators are on TEAMS meeting
- Participants will be using YouTube link available on website
- Participants can ask questions using ConferenceIO link available on website
- NASA or FAA will introduce each speaker and ask questions to that speaker at the end of their presentation
- Speakers will screen-share their presentation on the TEAMS meeting

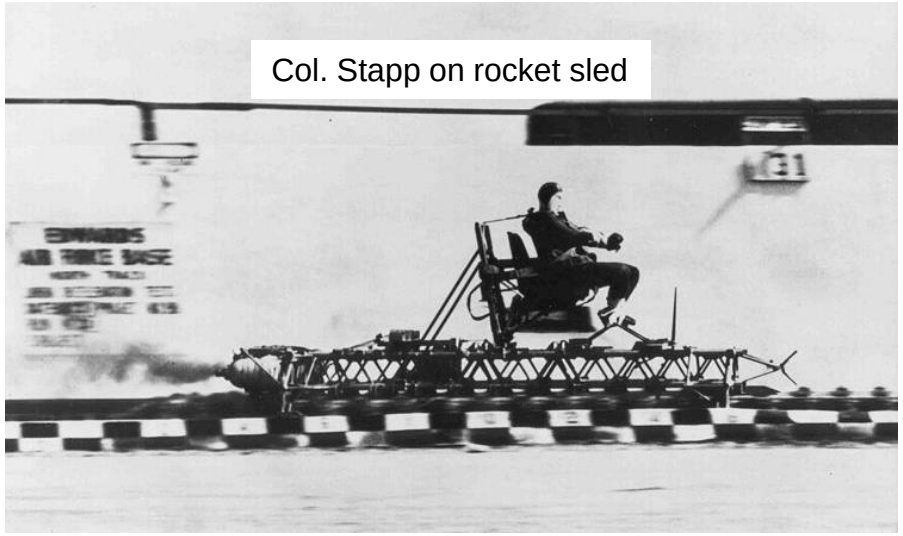
- Meeting website: https://nari.arc.nasa.gov/crashworthiness

NASA / FAA Workshop 3 Agenda – January 19, 2021

Speaker	Organization	Time (Eastern)	Presentation Title
Justin Littell / Joseph Pellettiere	NASA / FAA	12:00 – 12:15	Introduction and the DoD Crashworthiness background
Col. Nathan Diller	AFWERX	12:15 - 12:45	Agility Prime
Brandon Hall	NAVAIR	12:45 – 13:15	Research Topics Related to Naval Aviation Crashworthy Systems
Lindley Bark	NAVAIR	13:15 - 13:45	Crashworthiness and Qualification of Rotorcraft Seats by Modeling and Simulation
Casey Pirnstill / Nathan Wright	AFRL	13:45 - 14:15	USAF Needs/Difference, Current Research and Identified Knowledge Gaps with Future eVTOL Systems.

The Need for Crashworthiness in eVTOL Vehicles: Historical and Ongoing *DoD test campaigns*

- DoD first to consider crashworthiness in vehicles particularly for rotorcraft
- Hugh DeHaven – considered father of crashworthiness
- Col. Stapp – human g force limit testing
- AFRL sled testing
- 1970 first crashworthy fuel systems installed on Army helicopters
- UH-60 Blackhawk one of first helicopters designed with MIL-STD-1290 guidelines
- NASA LaRC – Full-scale rotorcraft testing
  - AH-1, UH-1, CH-46, CH-47, ACAP, F-111


Col. Stapp on rocket sled


ACAP

CH-46

The Need for Crashworthiness in eVTOL Vehicles:
Requirements / Regulations / Documents

- Long history of DoD crashworthiness requirements resultant from accident data and full-scale testing
- Aircraft Crash Survival Design Guide (ACSDG)
  - Five part document outlining crashworthiness technology resulting from accident surveys
- MIL-STD-1290A – came out of ACSDG
  - Light fixed and rotary wing aircraft crashworthiness
- MIL-S-58095A – Military helicopter crashworthy seat criteria
- MIL-S-85510-General specification for seats, helicopter cabin crashworthiness
- JSSG-2010-7 – Joint Services Specification Guide – Crashworthiness Handbook
- MIL-DTL-27244F – Tank, Fuel, Crash Resistant, Aircraft
- RDECOM TR 12-D-12 - Full Spectrum Crashworthiness

The Need for Crashworthiness in eVTOL Vehicles:
Market Demand – DoD

- IN 2020, the USAF initiated Agility Prime in order to jump start the eVTOL market implementation within the DoD
- The aim is to have 30 VTOL aircraft for various missions
- Aims for operational capability by 2023

- Nathan Diller will talk further on this Program and it’s details

The Need for Crashworthiness in eVTOL Vehicles: *Why Now?*

- Now is the time
  - Early in the vehicle development cycle
  - Will pay great dividends in the future
- Expect that accidents will happen
  - Protect the occupants to ensure continued growth and acceptance
- Current regulatory framework is based upon other designs
  - This may change in the future depending on performance
  - Attention to system level safety now, will prepare for the future

Continued Engagement

- Stay tuned for information on future workshops
  - eVTOL Crashworthiness application focused in the next few months
  - Possibly still on onsite working group meeting/discussion/tour in the spring