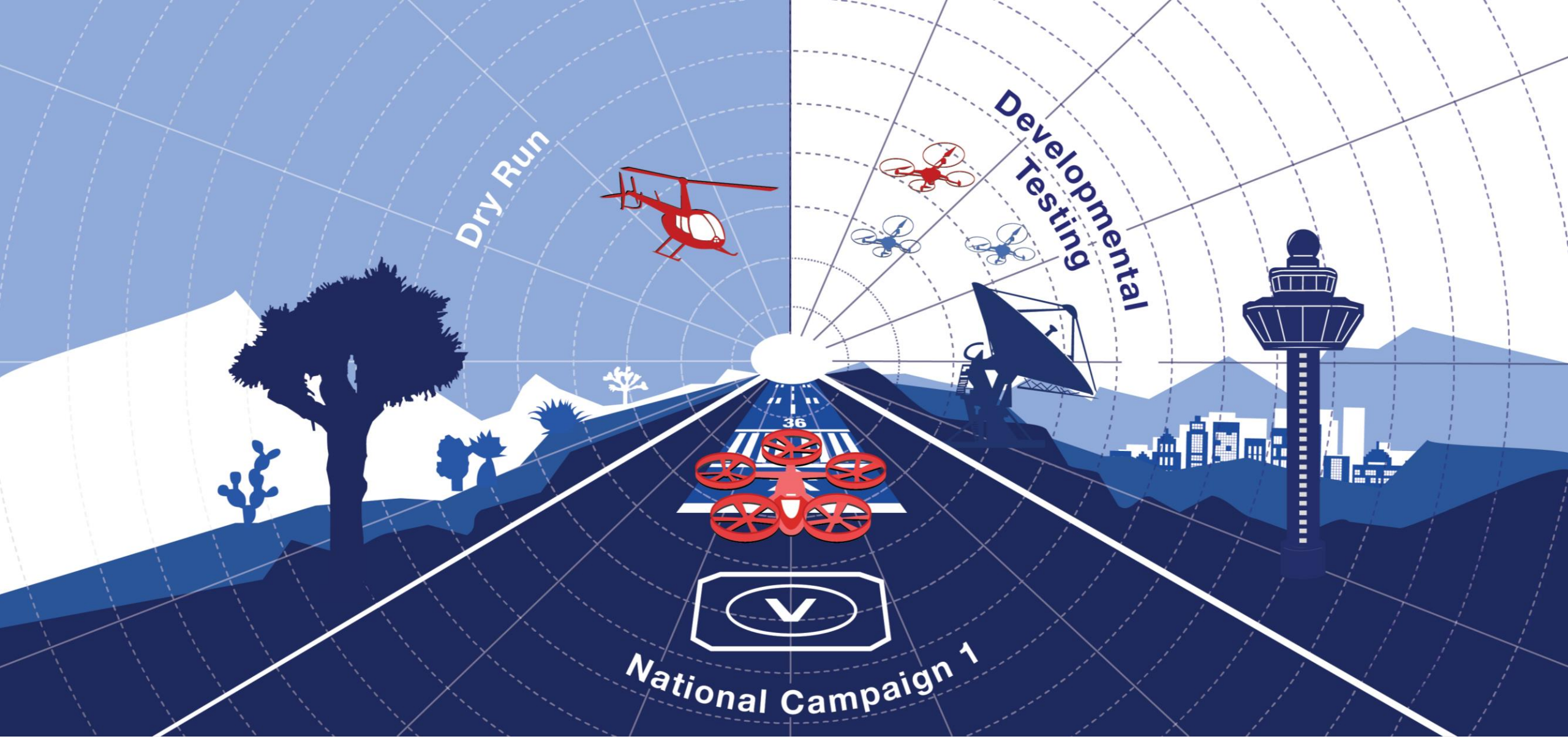
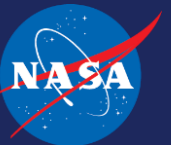


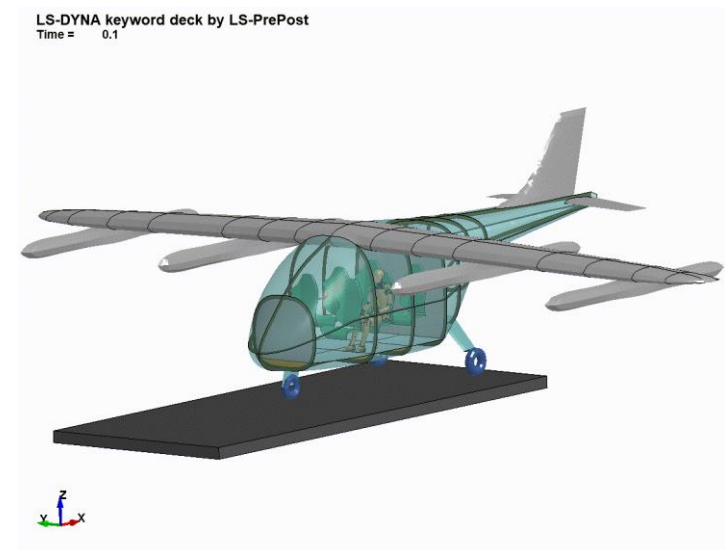


Breakout [3] – Crashworthiness Research and Testing Annex
Justin Littell, Research Aerospace Engineer, NASA Langley Research Center



Introduction

- NASA Langley Research Center has played a critical role in aircraft safety for the past 40+ years through the use of full-scale crash test research.
 - Rotorcraft, General Aviation, Transport in both Civilian and DoD sponsored research programs
- Full scale crash testing is critical in providing critical data used in regulatory requirements
 - Dynamic seat tests in 14 CFR § 23.562 and 27.562
- With new and novel eVTOL designs, performance under dynamic impact scenarios remains unknown
 - GA and rotorcraft has 50+ years of accident data and crash test to guide design and development
- Obtaining impact data on these aircraft (or representative construction) will provide regulatory bodies and standards organizations critical data to be able to create requirements necessary for eventual market adoption and maturation





NASA Langley Research Center Full-Scale Test Example





NASA Roles and Responsibilities

- Develop the Test Plan – which includes information about vehicle configuration, impact conditions, Anthropomorphic Test Device (ATD) usage and placement, and sensor placement/usage
- Provide all ATDs and seats (if not already present) – ATD sizes will range from 5th to 95th percentile, and type will be either from regulatory requirements – Hybrid II or FAA Hybrid III, or advanced – THOR, WIAMan
- Conduct 3D pre- and post-test point cloud scanning
- Conduct the crash test per the Test Plan
- Acquire all sensor and video data
- Provide test data to Partner. Test data includes airframe sensor and ground camera data. *Data will not include seat or ATD data*
- Perform post-test inspections which may include: vehicle disassembly, material removal, NDE methods and/or visual inspections of failed and partially failed components and document results
- Report out results (anonymized as much as possible) as NASA Technical Memorandum and/or technical reports to standards organizations for consideration of standards developments



Partner Roles and Responsibilities

- Provide an airframe test article(s) in good condition. Test articles do not need to be entire airframes, but at minimum be cabin sections with build characteristics close to final design.
- Provide data regarding airframe build to NASA as needed
- Provide data regarding flight characteristics including expected performance conditions (if known), weight, center of gravity and inertia properties necessary for test
- Provide guidance to NASA to identify hard points used for lifting and swing with appropriate margins of safety
- At partner discretion, be present for crash testing and post-test inspections
- Remove test article from NASA when post-test inspections are complete



Schedule and Milestones **Subject to change*

	Milestone	Date
1	Partner provide build details of test article(s)	Within 1 month of signing Annex
2	NASA to provide Test Plan to Partner	Within 1 month of completing Milestone 1
3	Partner to provide test article(s)	Within 4 months of completing Milestone 2
4	NASA begin buildup of test article(s)	Within 1 month of completing Milestone 3
5	NASA work with Partner to establish test date within test window	Within 1 month of completing Milestone 4
6	NASA to conduct crash test of Partner's test article(s)	Between Oct 2021 and September 2023
7	NASA to provide test data to Partner	Within 1 month of completing Milestone 6
8	NASA to conduct post-test inspection of test article(s)	Within 1 year of completing Milestone 6
9	Partner to remove test article(s) from NASA facility	Within 1 year of completing Milestone 7
10	NASA publish report	Within 1 year of completing Milestone 8