Wheelchairs in the Cabin Aviation Structural Issues

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STEP // SENIOR TECHNICAL EXPERTS PROGRAM
ADVANCING SAFETY THROUGH SCIENCE

Acknowledgement/Disclaimer

- The views expressed in this presentation are those of the authors and do not necessarily reflect the view of the Agency
- FAA research may advise regulatory decisions, however, certification approvals are based on published federal regulations and policy

- No company proprietary data will be shown; pictures/data are from research tests with similar outcomes

FAA Mission Overview

- FAA's mission is safety and setting standards required in the interests of safety
- FAA research focuses on the safety mission. This includes:
  - Evacuation processes
  - Crashworthiness
  - Fire safety
  - In-flight safety, including weight and balance

Wheelchair Feasibility Research Overview

- The FAA initiated research on the feasibility for allowing personal wheelchairs on board transport category airplanes.
- The scope of this research includes:
  - Understanding the existing standards associated with wheelchair tie-down
  - Evaluating the compatibility of those standards with current FAA requirements
  - Determining the criteria necessary to ensure safety of occupants is not compromised when a wheelchair tie-down in the cabin is used, including:
    - Structural considerations
    - Ramifications on overall egress
    - Compatibility with interior arrangement

Occupant Safety Regulations - Structural

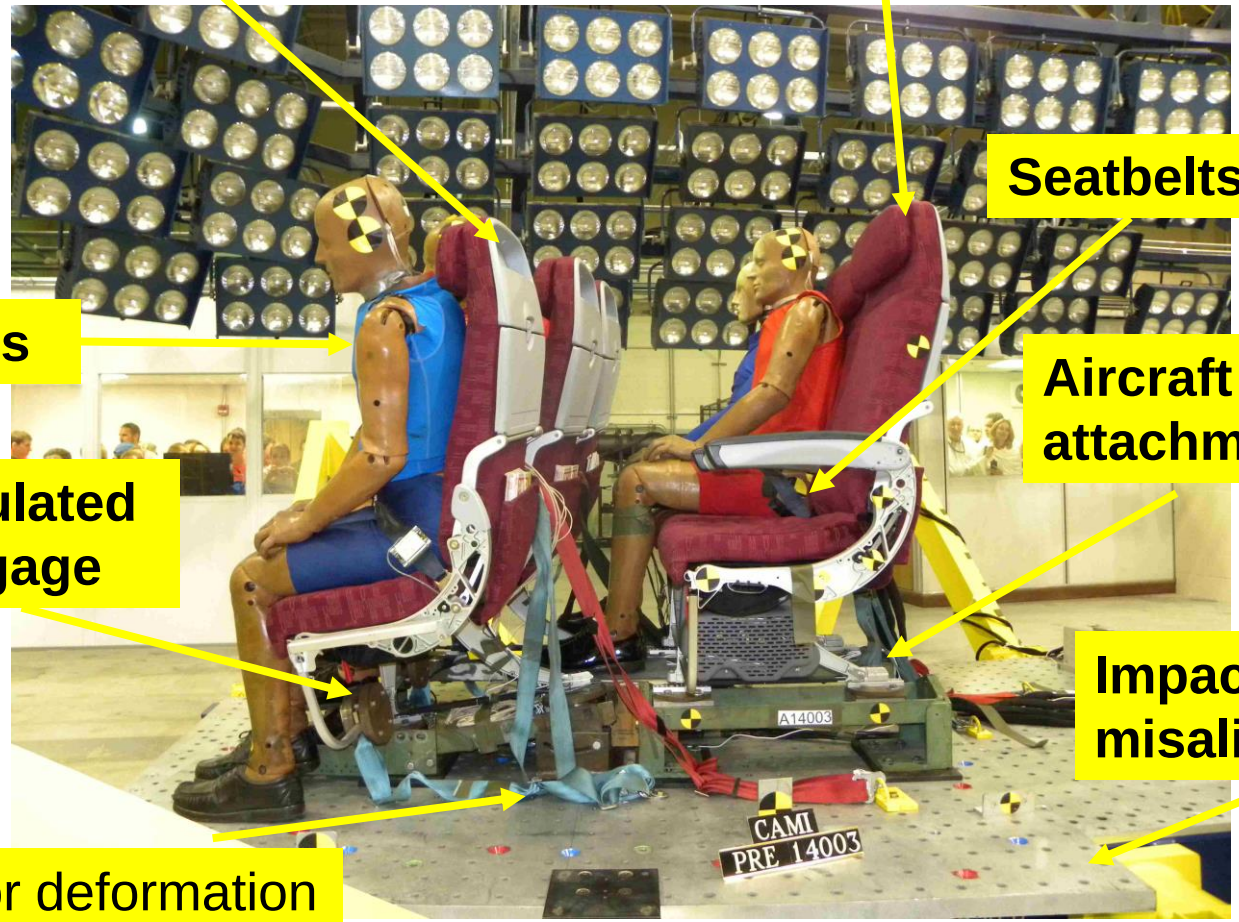
- Related to egress
  - Maintain aircraft attachment
  - Acceptable deformations
- 14 CFR 25.785 Overall requirement to prevent serious injury during emergency landing
- 14 CFR 25.561 defines static load factors
- 14 CFR 25.562 defines dynamic load factors

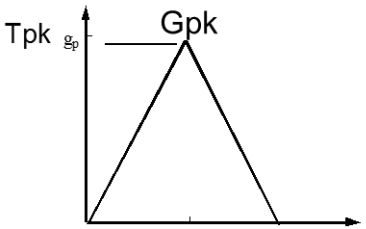
RESNA WC19 Wheelchairs…

In the absence of regulations, RESNA has developed voluntary standards for wheelchairs used as motor vehicle seats that can be used to evaluate wheelchairs in front and rear impacts.

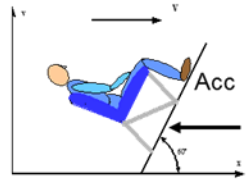
- Crash tested in 30 mph/20 g frontal impact
- Easy to secure to the vehicle
- Compatible with seatbelt use
- Keep occupants in a seated, upright position
- Have known level of lateral stability
- Limit forward and rearward excursions of the dummy
- Sustain impact with no complete fracture
- Do not create sharp edges in occupant space or projectiles
- Have well-secured batteries
- Have option for crashworthy wheelchair-mounted lap belt
- Can be evacuated without tools after crash
- Over 200 models already comply

Dynamic Test Description



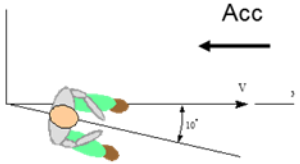


Test-1 Condition



From Right Side

Combined Vertical Horizontal Orientation	Transport (Part 25)
Gpk (gs)	14
Impact Velocity (f/s)	35
Onset Time (Tpk)	0.08

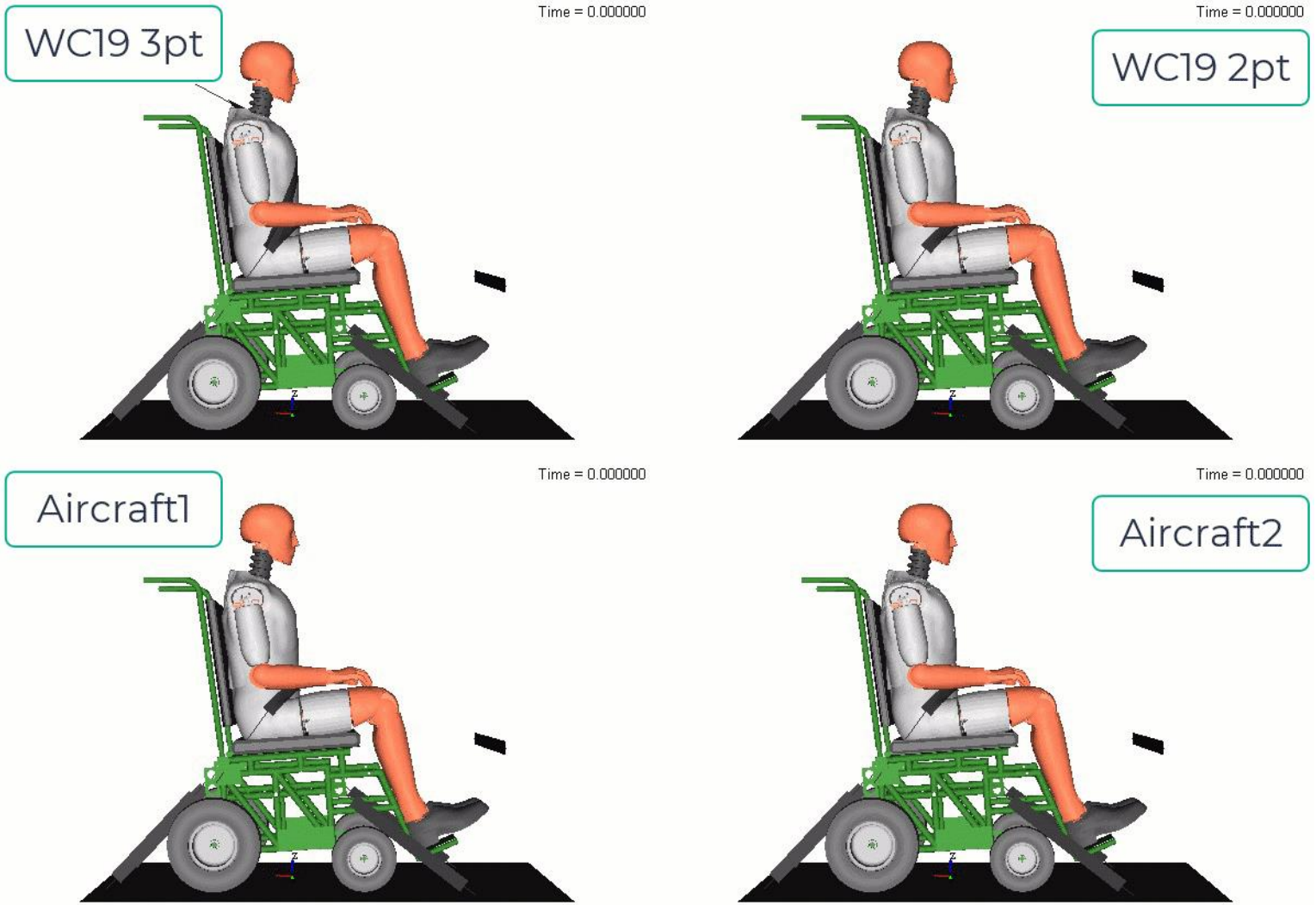


From Above

Test-2 Conditio

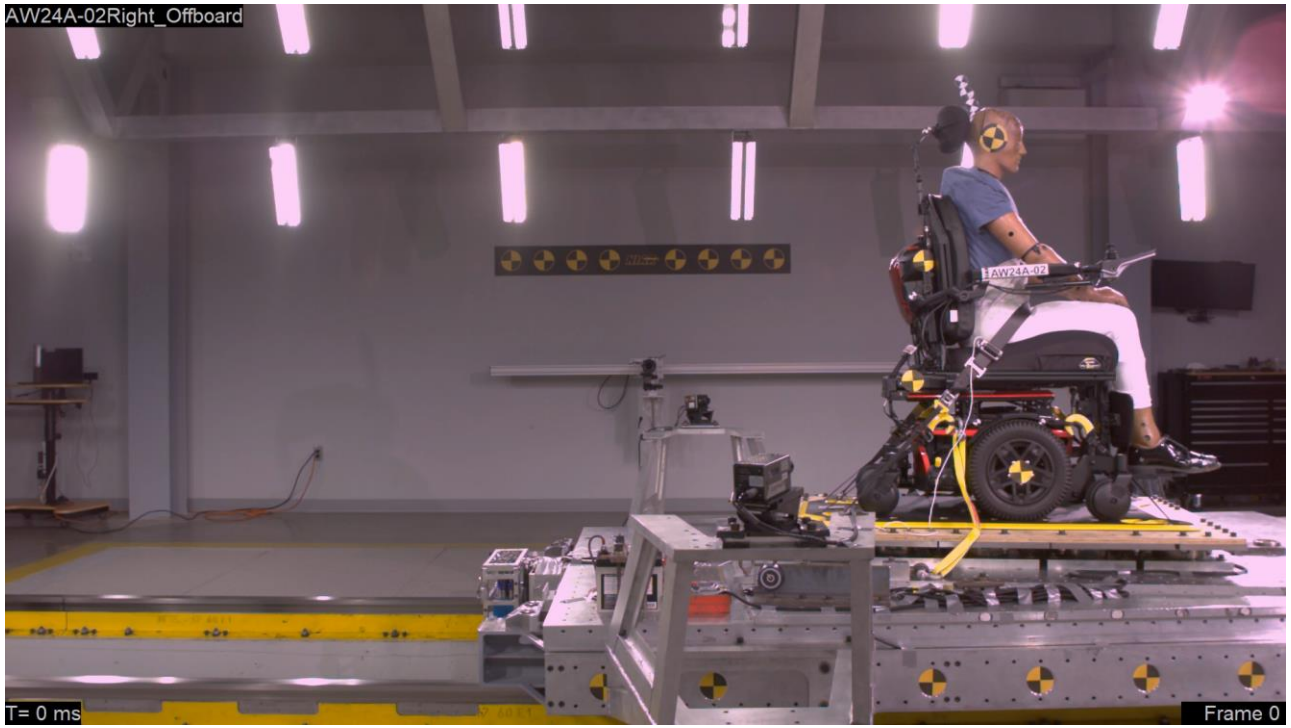
Horizontal 10° Yaw Orientation	Transport (Part 25)
Gpk (gs)	16
Impact Velocity (f/s)	44
Onset Time (Tpk)	0.09

RESNA Aviation Comparison



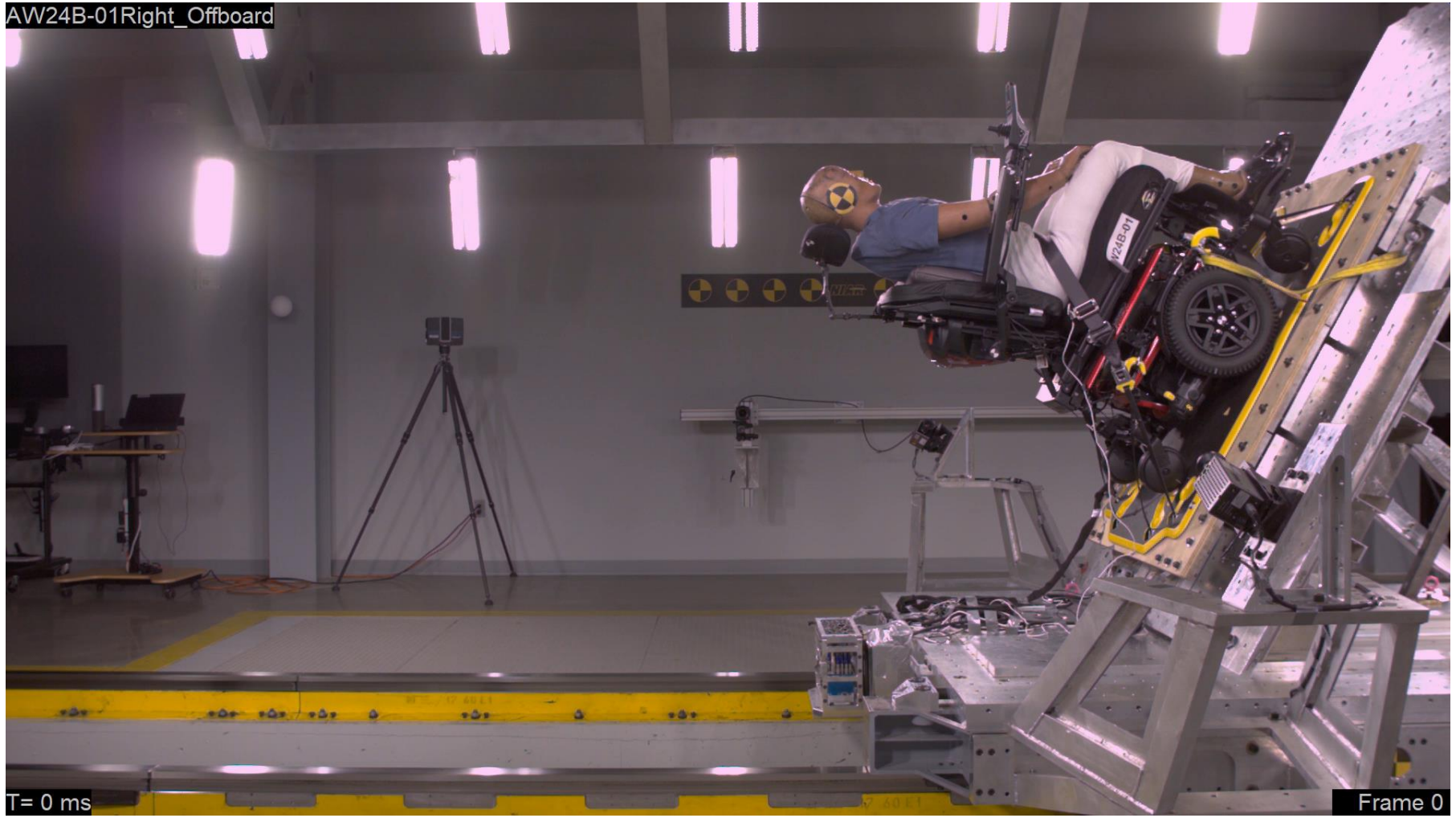
* Simulation courtesy of University of Michigan Transportation Research Institute[9]

Dynamic Test Example – Longitudinal Test



*Wheelchair test video courtesy of All Wheels Up

Dynamic Test Example – Vertical/Longitudinal Test



*Wheelchair test video courtesy of All Wheels Up

Wheelchair Feasibility Research

- The FAA is coordinating with University of Michigan Transportation Research Institute (UMTRI) via the National Institute on Disability, Independent Living, and Rehabilitation Research (NIDILRR)
  - FAA loaned a test dummy to UMTRI
  - FAA supporting UMTRI test protocol development
  - FAA providing feedback on test results
- The FAA is working with the National Institute of Aviation Research (NIAR)
  - Determining feasibility
  - Determining necessary safety criteria
  - Performing tests as necessary to support the above

Wheelchair Feasibility Research Milestones

- Determine suitability of ISO/RESNA wheelchair standards as a basis for aircraft structural compatibility
  - Based on initial testing, the ISO/RESNA standards can provide basis for substantiation of tiedown into an aircraft. However, it does appear that certain additional conditions or limitations will be needed to provide assurance that the required level of safety will be met. The work to define those conditions is ongoing.
- Evaluate and identify candidate tie-down systems
  - Underway based on industry activity and information from the Railroad Administration
  - Part of the NIAR work
- Report on aircraft considerations necessary to utilize suitable tie-down systems, and wheelchair standards necessary for aircraft compatibility
  - On schedule based upon initial results

Issues

- Current issues identified with ISO/RESNA
- Application of static load factors
  - Powered wheelchair designs have concentrated masses
  - Need to investigate application methods
- Lateral loading
- Secondary restraint
  - Is one required
  - No place on aircraft for secondary 3-point restraint
  - Need to determine if 2-point restraint is sufficient
- Weight of surrogate chair
  - Weight used to test restraint system is lower than most wheelchairs
  - Need to determine if can ballast and test at the higher load

Conclusions

- Research is progressing and gathering data to determine certification path
- Issues identified have possible mitigations
- Programs currently on schedule

Questions?