

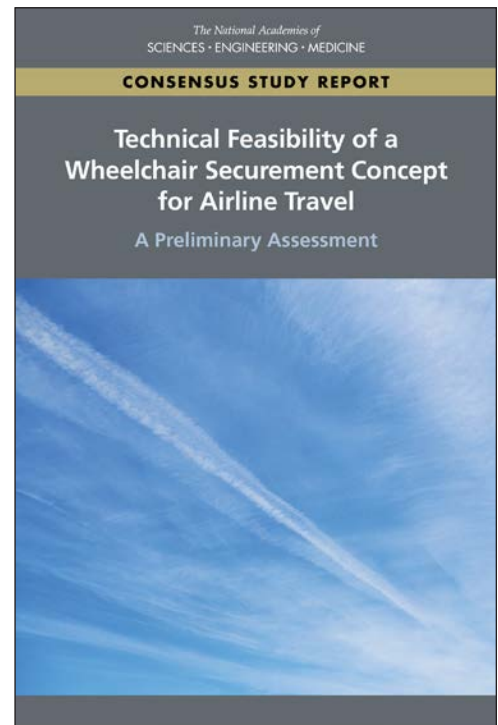


September 2021

# Technical Feasibility of a Wheelchair Securement Concept for Airline Travel: A Preliminary Assessment

Wheelchair securement systems for passenger use in airplane cabins are intuitively appealing as a solution to many of the hardships that people with disabilities and who are nonambulatory face when flying. Such systems are currently used and designed in accordance with widely accepted safety standards for public and private modes of surface transportation, including cars, vans, and transit buses. In using these systems, people who are nonambulatory can board the vehicle in their personal wheelchair, stay seated in the wheelchair for the duration of the trip, and wheel off the vehicle upon reaching the destination. Airline transportation, however, is an exception because it invariably requires people who are nonambulatory to fly in an airplane seat.

In the Federal Aviation Administration Reauthorization Act of 2018, Congress called for the U.S. Access Board to examine the feasibility of wheelchair securement systems for passenger use in airplane cabins and the ways in which people with significant disabilities who use wheelchairs can be accommodated by such systems if feasible. In response, the U.S. Access Board commissioned a National Academies of Sciences, Engineering, and Medicine study on the *Technical Feasibility of a Wheelchair Securement Concept for Airline Travel: A Preliminary Assessment*.



## FINDINGS AND CONCLUSIONS

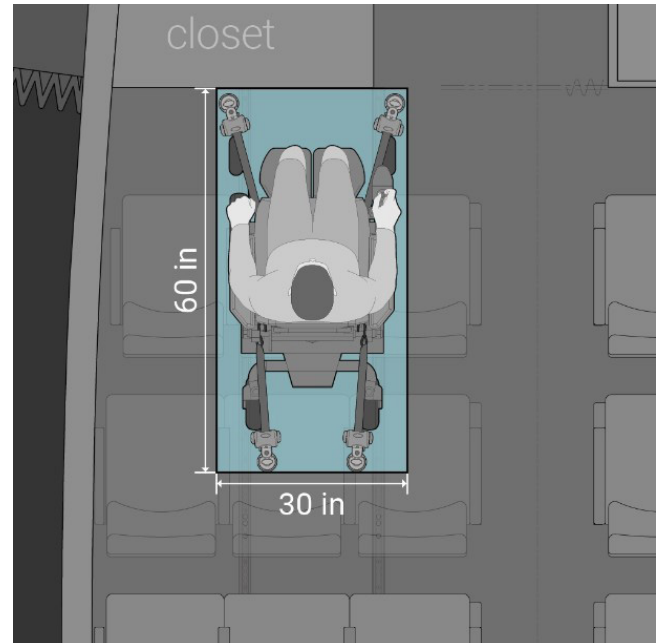
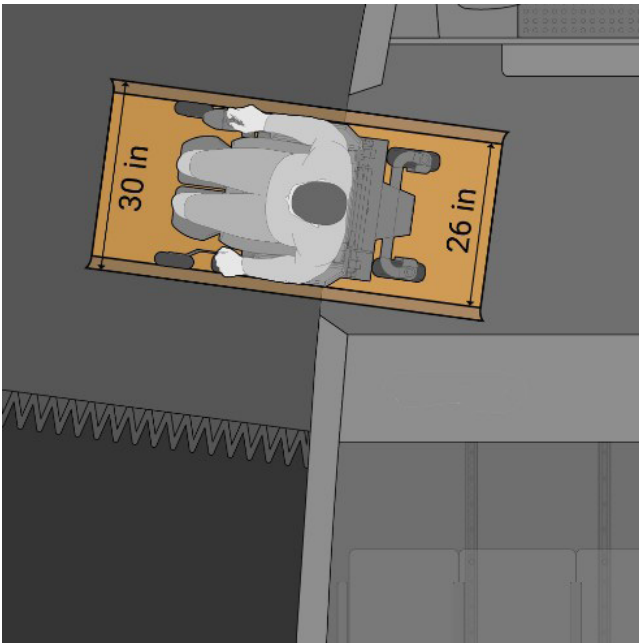
The following three major technical considerations were deemed most relevant to this technical assessment, conducted by an expert committee:

- Whether airplanes common to airline service have enough doorway and interior space to enable a power or manual wheelchair to enter and exit the passenger cabin and maneuver to and from a securement location that provides sufficient room for the functioning of the securement system and medically essential wheelchair position adjustments;

- Whether an airplane floor and its structure can accommodate the loadings imparted by an occupied power wheelchair; and
- Whether a secured personal wheelchair can meet the crashworthiness, occupant injury protection, and other relevant air transportation safety requirements of the Federal Aviation Administration (FAA).

In each case, the committee did not identify any issues that seem likely to present design and engineering challenges so formidable that they call into question the technical feasibility of an in-cabin wheelchair securement system and the value of exploring the concept further. In particular, the report documents that:

- A large majority of airplanes have a main boarding door with sufficient width to enable a large majority of personal wheelchairs to pass through.
- The most common cabin interior dimensions and layouts for the two most ubiquitous families of airplanes, the Boeing 737 and the Airbus A320, should require only modest interior modifications, which may include downsizing or relocating a forward closet, to create a wheelchair securement area located at the front of the cabin near the turn from the main boarding door.



- In particular, the removal of two successive rows of seats in a cabin location near the boarding door should:
  - provide sufficient room in most airplanes for a securement location spacious enough to allow the occupant of a wheelchair to maneuver into and out of the location and, once secured, to use physically and medically essential wheelchair position functions without impinging on the space of other passengers.
  - free up enough airplane floor structure to accommodate the load imparted by the heaviest of occupied power wheelchairs using load distribution systems that are commonly employed for seat assembly attachments, including pallet systems.
  - provide sufficient clear space to satisfy FAA criteria that the wheelchair occupant and nearby passengers do not risk serious head and leg injuries from striking objects or structure during a survivable crash or emergency event as long as the wheelchair remains secured and its occupant restrained.
- Furthermore, many personal wheelchairs, including power wheelchairs, comply with motor vehicle transportation safety and crash performance standards (WC19) for wheelchairs established by the Rehabilitation Engineering and Assistive Technology Society of North America (RESNA), providing a widely available and standardized interface for an in-cabin wheelchair tiedown and occupant restraint system.

However, more work is needed, the report explains, to understand how secured personal wheelchairs are likely to perform relative to certain FAA safety criteria in restraining and protecting occupants during a survivable airplane crash or emergency landing. In addition, the report identifies several important airline operational and passenger accommodation issues that would warrant careful consideration as part of any initiative to develop

and introduce an in-cabin wheelchair securement system intended to provide reliable and meaningful levels of flight service to people who are nonambulatory and have significant disabilities. These include providing needed passenger assistance and service, fare reservation system capabilities, procedures for validating wheelchair boarding eligibility, and protocols and power management for controlling wheelchair seating functions in flight.

## RECOMMENDATIONS

To fill these information gaps, the report recommends that:

**The U.S. Department of Transportation and the Federal Aviation Administration (FAA) establish a program of research, in collaboration with the Rehabilitation Engineering and Assistive Technology Society of North America and the assistive technology industry, to test and evaluate an appropriate selection of WC19-compliant wheelchairs in accordance with applicable FAA crashworthiness and safety performance criteria.**

**The U.S. Access Board sponsor studies that assess the likely demand for air travel by people who are nonambulatory if they could remain seated in their personal wheelchairs in flight. The studies could better define the space needed in the airplane cabin for wheelchair maneuvering and securement, provide insight into passenger support and service assistance requirements, and inform airline decisions about needed levels of fleet coverage and flight availability.**

The report concludes by observing that the next steps of research, testing, and evaluation would be planned and programmed in accordance with a high-level “roadmap” that defines and prioritizes decisions to be made and follow-on work. The U.S. Department of Transportation would be the logical lead for the development of such a roadmap in collaboration with the agencies and entities identified in the recommendations and with consultation and input from a wide range of interests and experts, including the airlines and their passenger service personnel, airframe manufacturers and interior component suppliers, people with disabilities and their advocates, and the assistive technology industry.

---

## COMMITTEE FOR A STUDY ON THE FEASIBILITY OF WHEELCHAIR RESTRAINT SYSTEMS IN PASSENGER AIRCRAFT

**ALAN M. JETTE (NAM)** (*Chair*), Boston University; **NAOMI ARMENTA**, Nelson\Nygaard; **PETER W. AXELSON**, Beneficial Designs, Inc.; **RORY A. COOPER**, University of Pittsburgh; **KAREN J. ERAZO**, Sun Country Airlines (retired); **FRANCIS S. HEMING, JR.**, Goodrich Interiors (retired); **KEVIN L. HIATT**, Safety Practitioner; **KATHARINE M. HUNTER-ZAWORSKI**, Oregon State University; **GEORGE A. LESIEUTRE**, The Pennsylvania State University; **MIRIAM A. MANARY**, University of Michigan Transportation Research Institute; **CLINTON V. OSTER, JR.**, Indiana University; **GARY M. WEISSEL**, Tronos Aviation Consulting; **MELISSA WELCH-ROSS** (*Study Director*)

For More Information ... This Consensus Study Report Highlights was prepared by the Transportation Research Board based on the Consensus Study Report *Technical Feasibility of a Wheelchair Securement Concept for Airline Travel: A Preliminary Assessment* (2021). The study was sponsored by the U.S. Access Board. Any opinions, findings, conclusions, or recommendations expressed in this publication do not necessarily reflect the views of any organization or agency that provided support for the project. Copies of the Consensus Study Report are available from the Transportation Research Board or <https://www.nap.edu/catalog/26323>.

Transportation Research Board

*The National Academies of*  
SCIENCES • ENGINEERING • MEDICINE

The nation turns to the National Academies of Sciences, Engineering, and Medicine for independent, objective advice on issues that affect people's lives worldwide.

[www.nationalacademies.org](http://www.nationalacademies.org)