Moving Beyond the Moveable Armrest – Evaluating Design Features for Passenger Accessibility

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October 18, 2022

Demographics of Passenger Accessibility Needs

4.8M
people 5 and older in the U.S. use a wheelchair or scooter.[2]

25.5M
(1 out of 12) people 5 and older in the U.S. had a disability that makes traveling outside the home difficult.[2]

85.3M
(1 out of 4) people living in the U.S. had a disability in 2014.[1]

Accessibility Features Required by Regulation (1990 ACAA Rules)

Moveable armrests on half the aisle seats if the airplane has 30 or more seats.
14 CFR 382.61

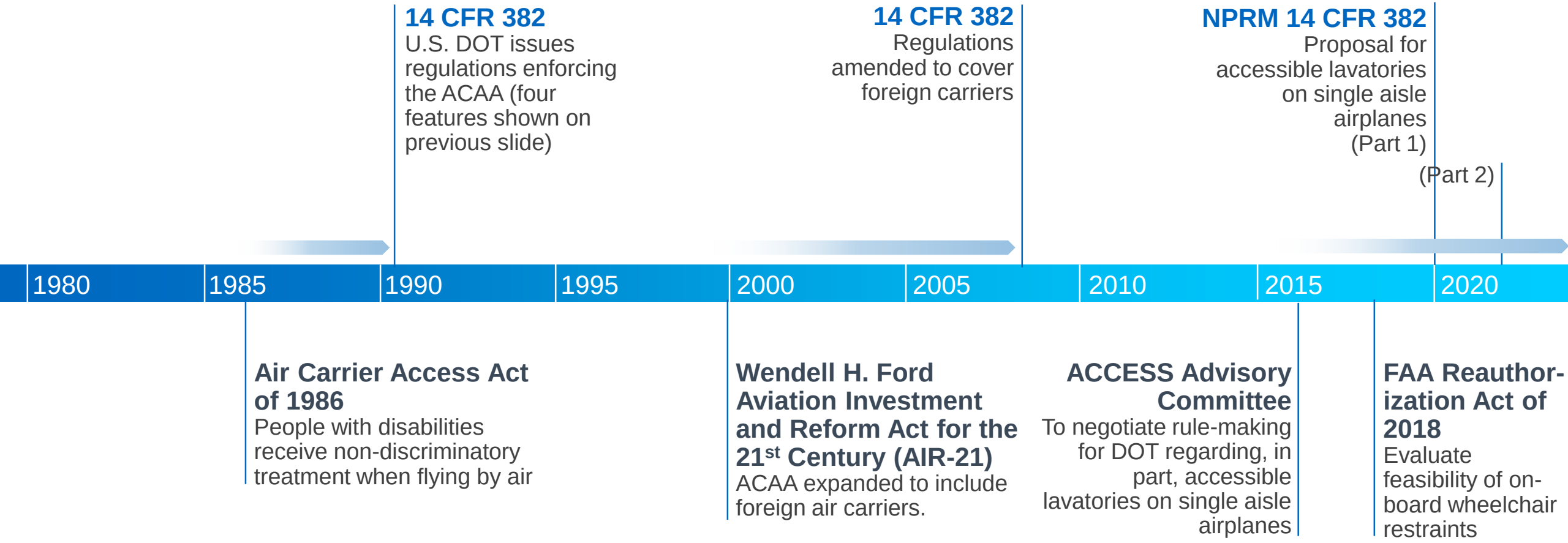
Priority stowage for wheelchairs in the cabin if the airplane has 100 or more seats.
14 CFR 382.67

At least one accessible lavatory if the airplane has more than one aisle.
14 CFR 382.63

Image: Innovint Aircraft Interior

On-board wheelchair (OBW) for passengers to reach a lavatory if the airplane has 60 or more seats.
14 CFR 382.65

History of Accessibility Features on Airplanes
(U.S. Regulatory Activity Only)



Case Studies of New Design Features for Accessibility

Accessible Lavatory on Single-Aisle Airplanes

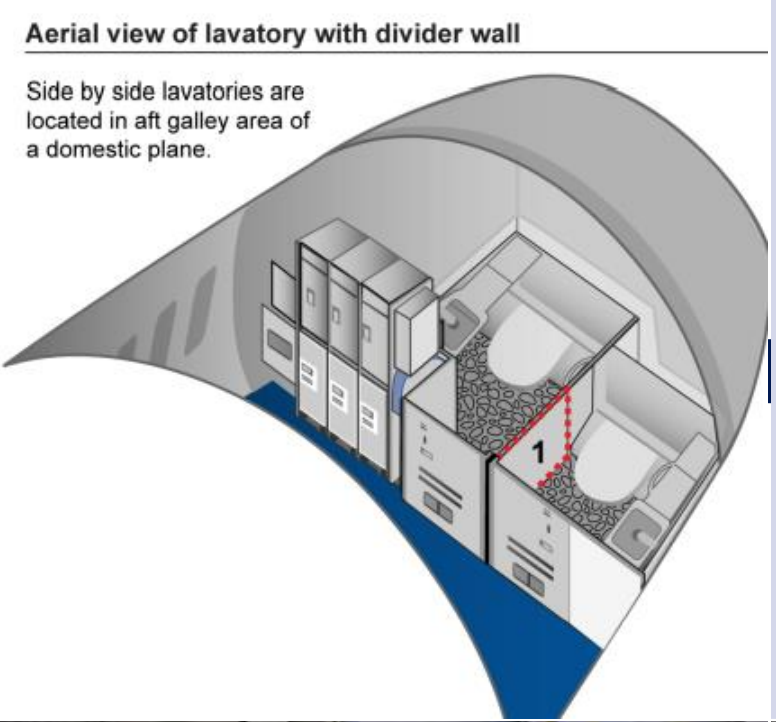
Overview of FAA Notice of Proposed Rulemaking (NPRM)

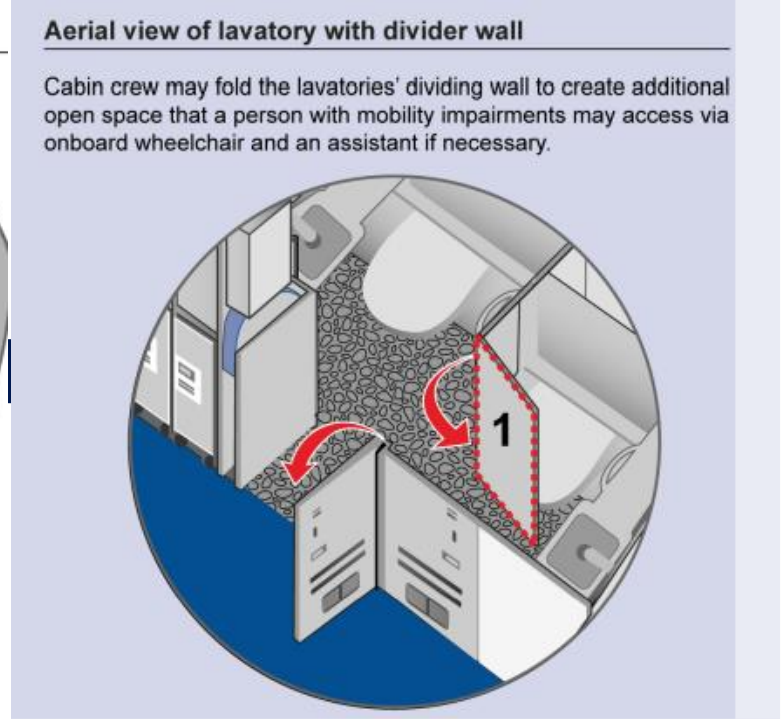
In-Cabin Wheelchair Securement Systems

Overview of National Academy of Sciences, Engineering & Medicine Study

Market-Driven Concepts

Feature Requests Seen at Boeing





Accessible Lavatory on Single-Aisle Airplanes

Overview of FAA NPRM

Concept: Require single-aisle airplanes to include an accessible lavatory. (>125 pax aircraft)

NOTE: The range on single aisle airplanes is greater than when the rule came out for dual aisle airplanes.

NPRM Summary of requirements:

(a)(1) Accessibility for up to 95th %-tile male using OBW

(a)(2) Space for up to 95th %-tile male to assist

(b)(1) Grab bars appropriately placed

(b)(2) Faucet water temp control for accessibility

(b)(3) Call buttons and locks for accessibility

(b)(4) Lav controls and sensors for accessibility

(b)(5) Lav door sill for OBW access

(b)(6) Toe clearance not reduced

(c) Retrofit not required for paragraph (a)

(d) Effective 18 years after order or 20 years after delivery or 3 years after new Type Cert from effective date of rule.

Accessible Lavatory on Single Aisle Airplanes

Type Design (Part 25) Challenges:

- Perfecting the design; some manufacturers are close but do not meet all of NPRM requirements[6]
  - Boeing offers the Pax Plus lav design (cannot fit OBW **and** assistant)
  - Airbus offers the SpaceFlex V1 and V2 lav design (V2 cannot fit OBW **nor** assistant)
  - Bombardier C-Series (now Airbus A220) offers an accessible design (cannot fit OBW **and** assistant)

Operator Challenges:

- Potential displacement of revenue-generating seats (three seats) – cost estimated at $33.3 billion in loss revenue over 25 years (includes costs for retrofitting immediately) [4].
  - NPRM seeks to refine the economic impact

Needs of Passengers:

- Paralyzed Veterans of America ran a survey in 2016 which indicated two thirds of survey respondents would not fly if unable to use the lavatory.[5]
- Although 99% of domestic flights are on single-aisle airplanes, only 4.5% of the fleet have accessible lavatories today.[4]

Boeing Disclaimer: *The information in this section of the presentation is from the DOT NPRM and is NOT a product of Boeing Engineering.*

Accessible Lavatory on Single Aisle Airplanes

Advancements

- NPRMs to 14 CFR 382 released and comments being reviewed
  - Part 1: lav accessibility improvements without changing the lav footprint itself
  - Part 2: expand the size of the lav
- Accessible lavatory designs are available

Challenges

- Economic impact for incorporating an accessible lav needs refinement
- Timeline for incorporation based on NPRM… the expectation is full fleet would not contain accessible lavs until 45 years after rule-making takes effect. [4]
  - Are there ways to compromise on features (for example, not require space for an assistant in the lav) to implement other features sooner and would that be of any benefit to disabled passengers?

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In-Cabin Wheelchair Securement Systems

Overview of National Academies Study

Concept: Permit aircraft passengers in wheelchairs to remain in their wheelchair through the use of an installed wheelchair securement system in the cabin.

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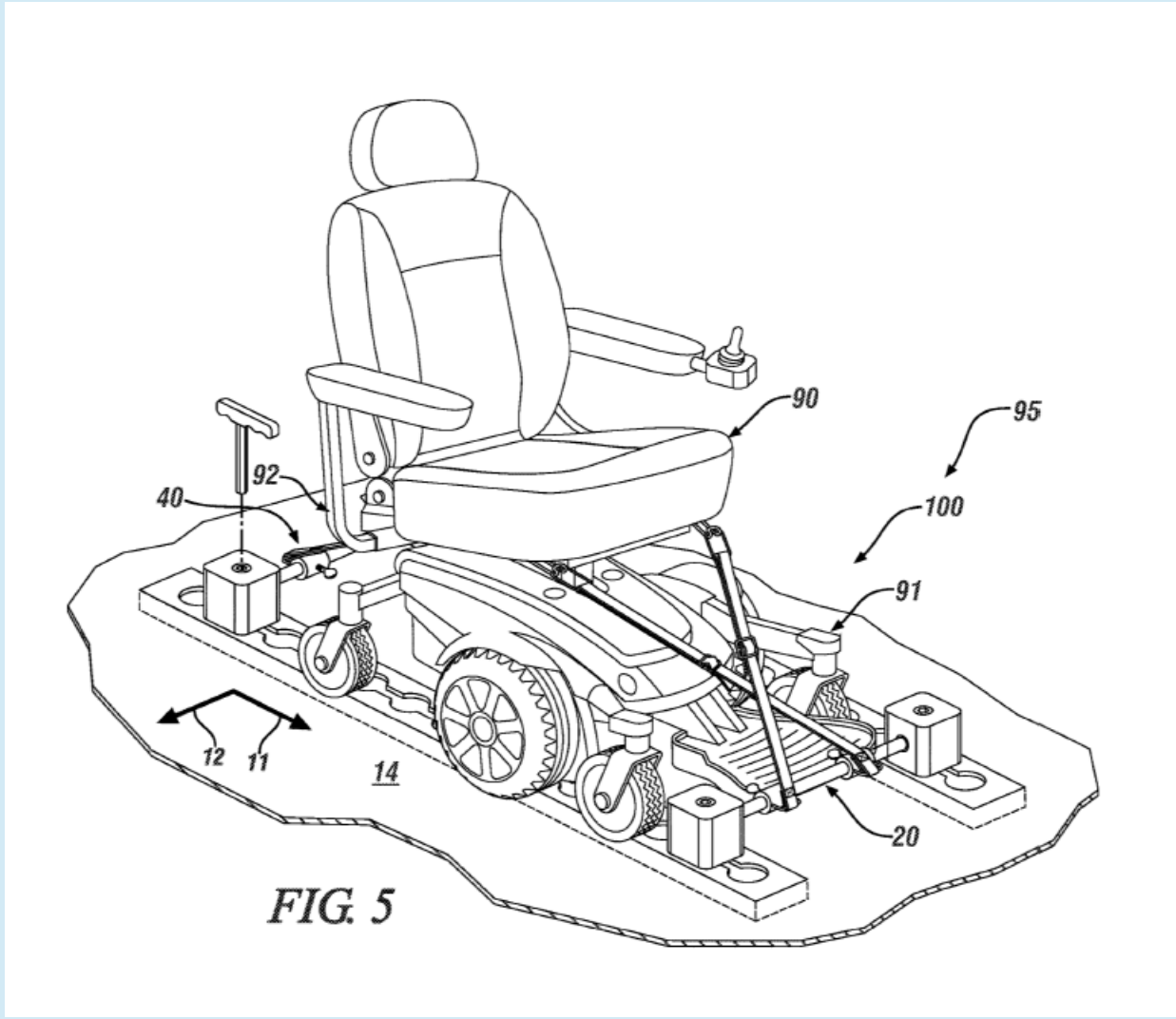

FIG. 5

In-Cabin Wheelchair Securement Systems

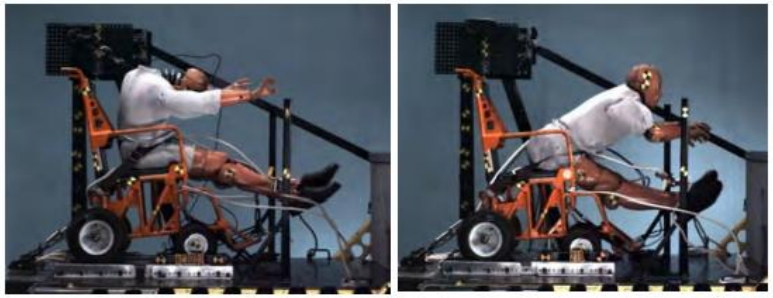

FIGURE 3-3 Peak-of-action photos for a 30-mph, 20-*g* frontal impact test of WTORS (WC18) using a 185-lb rigid surrogate wheelchair and a mid-size male ATD.
NOTE: Images show two different restraint configurations: lap/shoulder belt (left) and wheelchair-anchored lap belt (right).
SOURCE: University of Michigan Transportation Research Institute.

Type Design (Part 25) Challenges:

- FAA standards do not exist for wheelchair crashworthiness and there is uncertainty on what the FAA would require (25.561, 25.562, 25.785)
  - Occupant protection (both of occupant of wheelchair and nearby occupants) may not be a problem if two rows of seats are removed, but no equivalent standard for all of 25.785 requirements
  - Testing on wheelchairs done for ground vehicles (RESNA WC19 standard) similar to what may be necessary to address FAA required horizontal loads, but no similar test for vertical loads, nor all specific static and dynamic test conditions required for compliance to 25.561 and 25.562.
- Floor loads would need to be evaluated
- Flammability testing required for wheelchairs (RESNA WC16 not equivalent to FAA requirements for flammability testing)
- Many more regulations are applicable and would need to be evaluated

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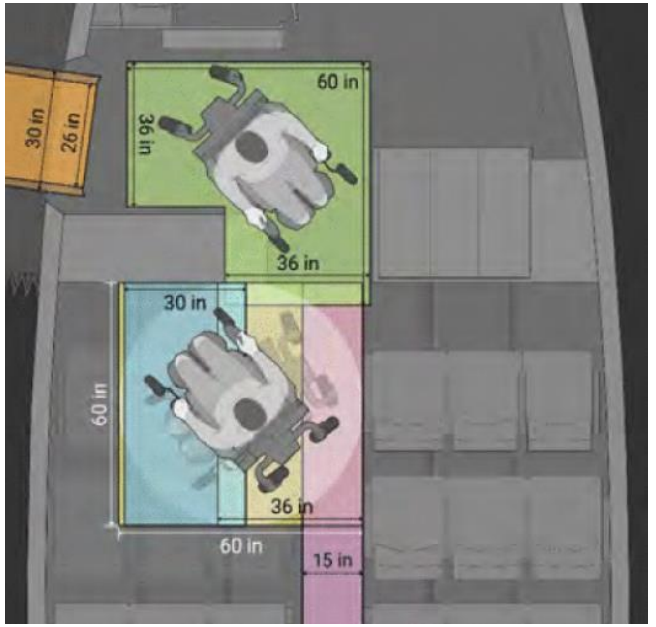
In-Cabin Wheelchair Securement Systems



Operator Considerations:

- Displacement of two rows of revenue-generating seats
- Aircraft configuration to allow maneuvering of the wheelchair into place
- Logistics in general… of ensuring sufficient number of airplanes in service to support, assistance to get wheelchairs secured, verification of wheelchair compatibility prior to ticketing and boarding, control of motorized wheelchairs during flight.

Needs of Passengers:

- Required transfers between wheelchairs and aircraft seats are impossible for some, difficult for others, and can cause strain, discomfort, and injury.
- Sitting in an aircraft seat is impossible for some, difficult for others, and can cause significant pain, discomfort, and injury.
- Lost or damaged wheelchair put in stowage on the aircraft.
- The whole process of air travel for those in wheelchairs can be undignified (waiting for assistance, having to be handled by strangers) compared to other modes of transportation.

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In-Cabin Wheelchair Securement Systems

Advancements

- National Academies shows feasible, technically
- RESNA WC19 wheelchair standards for motor vehicles a good start to at least standardizing wheel chairs
- Seat suppliers / designers / new patents coming out, e.g., are all signs industry is working to design restraint systems and seats to address the issue

Challenges

- No FAA requirements/standards exist for this concept
- Expected that an industry standard for wheel chair design for aircraft (similar to WC19 for ground vehicles) would be needed
- Removing two rows of seats is going to impact operators (as seen by lav study for single aisle)

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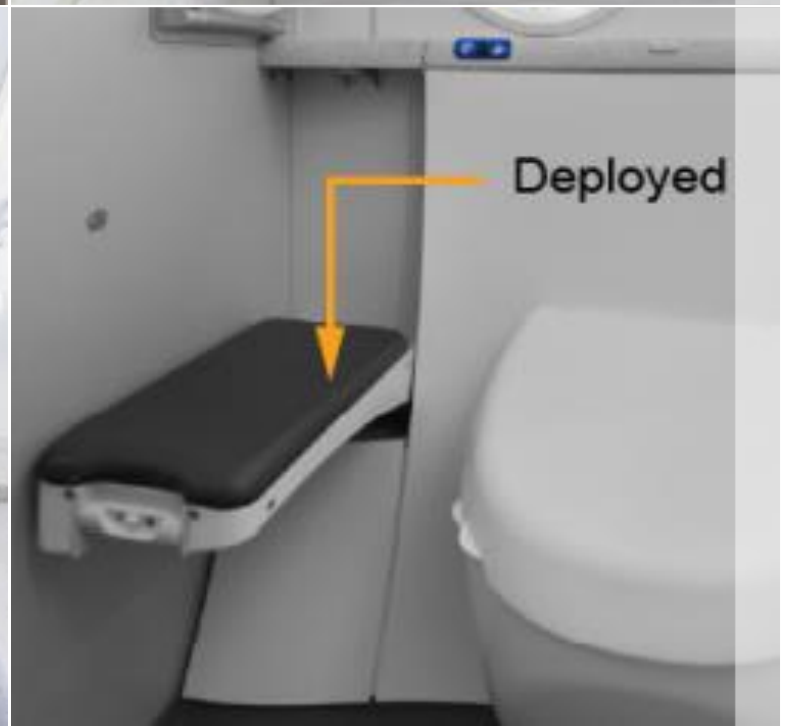

Market-Driven Concepts

Some concepts include:

- Moveable aisle walls on mini-suites
- Additional assist handles and handholds
- Fold-down lavatory benches
- Options for red/green color-blindness
- Use of braille
- Speech-to-Text for PA announcements

Market-Driven Concepts

Type Design (Part 25) Challenges:

- Simple features can be shown compliant using existing Part 25 regulations
- One-off rule-making required to address novel features (e.g. moveable mini-suite wall)

Operator Challenges:

- May increase crew workload in some designs

Needs of Passengers:

- Provides incremental improvements for accessibility within the cabin

Market-Driven Concepts

Advancements

- Demand is coming in from airlines for accessibility features

Challenges

- Negotiating rule-making activities for more complex designs takes time and the requirements are rarely known up front

How can industry get involved?

Continue to Research

Innovate

Develop Industry Standards


BOEING

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