

Secondary Airline Mobility Device

Design Team: Eric Arndt, Hannah Fjellman, James Tang, Noah Trapp

Advisor: Dr. Aaron Suminski

Client: Dan Dorszynski

Abstract

Today, many wheelchair-bound airplane passengers are injured or embarrassed during transfers between their electric wheelchairs and airplane aisle chairs. To solve this problem, our team designed an aisle chair that limits the number of transfers for passengers, thereby lowering the chances of being injured while traveling. Our aisle chair consists of two pieces that come together to form one cohesive chair. The passenger sits on the seat of the chair while on their electric wheelchair. When the passenger boards the plane, then are slid onto the base of the device and then wheeled onto the airplane. This eliminates 50% of transfers (per leg of trip) where the passenger is physically picked up and moved while traveling. After fabrication and testing, we have concluded that our design is ideal for conveniently eliminating transfers, but still has the potential for future improvements.

Problem Definition

Motivation:

- Airplane travel is currently a very uncomfortable and unsafe process for disabled passengers
- 32,000 disability-related airline complaints in 2016 [1]
- Our client uses a wheelchair and travels via airplane multiple times every year. He has personally been dropped on numerous occasions
- A device which limits assisted-transfers will make travel safer and more enjoyable for our client

Background:

- Plane boarding and exiting process currently includes 4 transfers per flight (See Fig. 3): passenger must be lifted into aisle chair, lifted into airplane chair, and then vice versa when exiting
- Electric wheelchairs are not allowed on airplanes

Competing Designs:

- Products currently on the market are expensive and do not limit transfers
- Previous BME designs eliminated some transfers, but could be improved by streamlining the design and adding functional height adjustability



Figure 1: Columbia Medical Aislemaster TransportMate [2]



Figure 2: The BME 301 Spring 2018 Design

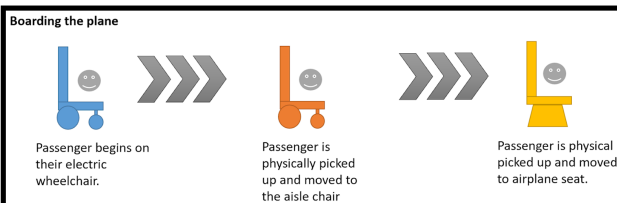


Figure 3: The normal boarding process for disabled passengers

Design Criteria

- Seat of the device must be height adjustable
- Device must support 300 lbs.
- Device must weigh less than 40 lbs. to comply with carry-on weight requirements.
- The device must fit through airplane aisle (Max width: 20")
- Device must be stowable under airplane seat when compact
 - (8" height x 14" width x 18" length)[3]
- Total cost must not exceed \$500

Final Design

The final design consists of:

- Two separable pieces (the seat and the base) to allow for height adjustment
- One seatbelt to ensure user safety
- Flexible back for comfort
- Collapsible design to a height of 8"
- See Figure 4 for the boarding process

The Seat:

- The seat is made of a sturdy, lightweight piece of plastic for the bottom of the seat
- The back of the seat is made of flexible mesh for comfort. The mesh is fastened between two metal bars for stability.
- The back and bottom of the seat are held together with bolts and screws
- The rollers allow the seat to slide from the electric wheelchair to the base and back again

The Base:

- The motorcycle jack allows for height adjustment
- The caddy on the bottom allows for 360° movement
- The jack can separate from the movement if necessary to allow for easy storage

Dimensions: The final dimensions of our device are:

- 20" x 17.5" (length and width) with dolly
- 14" x 17" (length and width) without dolly
- 8.07" height after folding

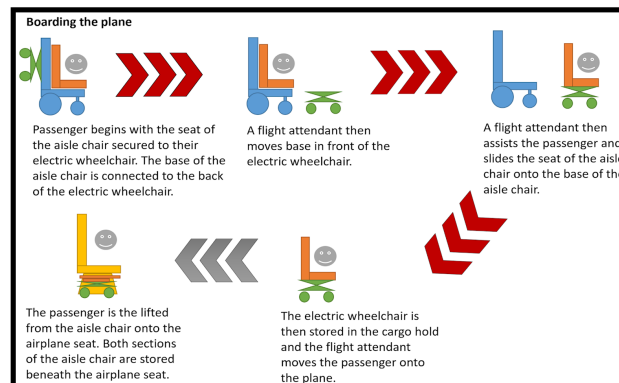


Figure 4: The boarding process with our mobility device. Red arrows designate transfers eliminated by the device

Testing and Results

This testing was conducted to determine if the requirements stated in the design criteria were met. These tests included:

- The aisle chair could adjust between a seat height of 8" and 18.75"
- The seat held 350 lbs.
- At its widest point, the aisle chair measured 17.5"
- Time from minimum to maximum height: 1 minute

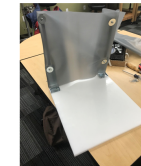


Figure 5: Seat of aisle chair



Figure 6: Motorcycle jack used in testing

After testing was completed, the design met most of the design criteria. The aisle chair is easy to use and compactable. It met the requirement of fitting under an airplane seat, which was a number one priority for our client. The seat is also adjustable enough to alternate between needed heights for maximum usability. Due to limited resources, materials that were too heavy were used. This led to the device exceeding its 40 lb. weight requirement. As a result, the design meets the most important design criteria, but needs some improvements (discussed in the Future Work section) before it can be put on the market.

Future Work

- Construction of a lighter-weight jack in place of the motorcycle jack we purchased. This could make the final product a lot lighter and easier to carry.
- Construction of lighter weight rollers on the bottom of the seat.
- An addition to the device that would allow it to slide directly over the airplane seat to also eliminate the final transfer.
- An automatic or foot-powered jack could make it easier for flight attendants to operate the device without any confusion.
- Further research into materials that are lighter weight.

Acknowledgments

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References

[1] Transportation.gov. (2017) 2016 Report on Disability-Related Air Travel Complaints Received in 2015. [online] Available at: <https://www.transportation.gov/airconsumer/2016-report-disability-related-air-travel-complaints-received-2015>.

[2] (2017) AisleMaster TransportMate Compact Wheelchair. [online] Available at: <https://www.1800wheelchair.com/product/aislemaster-transportmate-compact-wheelchair/>

[3] (2017). Here's How Much Space You Get Under the Seat in Front of You on Every Airline [Online]. Available: <https://www.travelandleisure.com/airlines-airports/airplane-under-seat-storage-space>