

## **Requirements and Specifications**

As a senior design team representing the Meyerson Foundation, our goal is to provide a wheel chair trainer for a child within the Flagstaff School district. This wheel chair trainer will potentially enable a child who is not a candidate for a motorized wheel chair to have the freedoms to move about without assistance. The requirements for this project are broken into six categories: Mechanical, Electrical, Environmental, Documentation, Testing, and General. The specifications for each of these six categories are shown below.

The first requirement deals with the mechanical aspect of this project. At this time these requirements are comprised of the platform that the chair will sit on as well as the motors used to drive the platform. These two requirements are broken into specifications handling the size, weight, organization, interconnect, package, and protection. The specifications for the mechanical system are listed below:

- Must fit in the elevator and through a standard door
  - Doors at the school are 36” wide; ADA says a doorway should be a minimum of 32” wide. Design will aim for 32” wide to give breathing room for elevator entrance which is 36” wide.
  - The student's wheelchair is about 22” wide. A standard wheelchair according to another standard's website, is 24.5” wide.
  - The length of the student wheelchair is about 30” where the base will fit it, a standard wheelchair is 31”.
  - The elevator is 60” deep so we shouldn't have a problem designing for 32” long.
- Wheelchair shouldn't be more than 2 inches above floor level
- Ramp up to the platform
  - ADA compliant ramps have a max slope of 1” rise to 12” run. We want to comply with this even for our trainer ramp for easy access.
- Sides on the platform
- Wheelchair needs to be anchored to the platform for safety purposes
- Attachment needs to be quick and easy to engage
- Can't damage the wheelchair
- Can use available holes on wheelchair frame
- Platform needs to hold 250 pounds
- Control system can not weigh more than 5 lbs.
- Wheelchair needs to travel up a standard ADA-compliant ramp
  - ADA compliance says maximum slope of 1” rise to 12” run. For a factor of safety, we might go with 1/10.
- The Wheelchair Trainer needs to be able to be moved for storage when wheelchair is not on it
  - Possibly a handle to pull or push the platform
  - Control system can rest on the platform when not in use

The second requirement deals with the electrical aspects of this project. At this time these requirements are comprised of the batteries, controls, and motor to drive this system. These three requirements are broken into specifications handling the power, accuracy, values and ranges, interfacing and aging aspects. The specifications for the electrical system are listed below:

- Battery
  - Needs to be rechargeable for use within 45 minutes.
  - Needs to run 20 minutes of continual operation.
  - Should be able to be disconnected for extended periods of time (summer).
  - Use standard 110 outlet
- Controls
  - Needs to go forward/backward
  - Needs to turn right/left
  - Must be controlled by two switches (can use the switches already mounted on the wheelchair that are used for communication device)
    - Leg switch: controls stop/go
    - Head switch: controls forward/backward and turns to left/right
      - Must scan through 4 directions
      - Automatic and step scanning available
  - Variable speed
    - Slow for getting on elevator and turning corners
    - Speed should be the speed of a slow walking pace when cruising
  - Have an alternative control: joystick
  - Have a cut-off switch that can be activated by the person with the student
    - Cutoff switch should have dynamic breaking to ensure quick stopping and does not allow student to roll backwards if stopped on ramp.
  - Control system can't interfere with the communication device mount
  - A prefab mount is acceptable
- Motors
  - Must be able to move a minimum of 250 lbs.
  - Must be able to move up a standard ADA ramp.

The third requirement deals with the environmental aspects of this project. At this time these requirements are comprised temperature, humidity, vibration, and shock of the system. The specifications for the environmental system are listed below:

- System must operate in a temperature range of 45-100 degrees Fahrenheit.
- System must withstand exposure to humidity from indoor air conditions.
- System can not come in direct contact with any moisture
- System must withstand low vibrations
  - The wheel chair must be able to go into an elevator without problems
  - The wheel chair must be able to go up a ramp without problems

The fourth requirement deals with the documentation of this project. After speaking with Jane Scott, we were able to determine that the requirements for the documentation must include a Maintenance Manual and User's guide with the final product. These two documents will include the specifications listed below:

- Maintenance Manual
  - Instructions on replacing batteries
    - Where to find them
    - How to remove them
    - How often to change them
    - How to put them back in
  - General care of chair
    - Checking connections from the control system
    - Locking and unlocking the electrical system
  - Place stickers showing proper handling on platform
- User's Guide
  - How to change to different controls
  - Battery charging
  - Storage conditions
  - How the cutoff switch operates
  - Locking the chair in securely
  - Extending and storing the ramp

The fifth requirement deals with the testing aspects of this project. At this time these requirements are comprised of testing the batteries, controls, motor, cutoff switch, charger, and entire system. These six requirements are broken into specifications handling the procedures and equipment used in testing. The specifications are listed below:

- Batteries
  - Test length of use
    - As the voltage decreases the resistance must decrease proportionally to give a constant current
    - Try multiple times to get an average battery life
- Controls
  - Test to ensure correct operation of the control system
  - Check to make sure the chair moves in all directions
  - Check to make sure they chair operates in variable speeds
  - Check to make sure chair can easily get on an elevator using slow speed
- Motor
  - Test to see that both motors run at the same speed
  - Ensure there is enough power to drive both motors at two different speeds
  - Check in various situations
- Cutoff switch
  - Try the cutoff switch in different situations

- Slope
- Flat ground
- Different speeds
- Different directions
- Battery Charger
  - Ensure that batteries can be charged for use in 45 minutes
  - Ensure that batteries can withstand continuous use of 20 minutes
  - Ensure that battery charger works in standard 110 outlet
- Complete System
  - Run the complete system in various situations
  - Ensure system runs for 20 minutes
  - Ensure batteries are easily removed
  - Try chair with joystick to ensure proper use

The sixth requirement deals with any general aspects of this project. At this time these requirements are comprised client preferences and reliability of the system. The specifications for the general system are listed below:

- Client preferences
  - The client would like to have removable batteries
  - Complete system should be as user friendly as possible
  - Wheel Chair trainer should give ease of use to student
- Reliability
  - Number one goal is safety and simplicity
  - Chair will be used for many years to come