Easy Reach

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Description:

Easy Reach is an electromechanical system that will be retrofitted into cabinets. It is a system that uses linear actuators and a support system to lower shelves down and out of the cabinet, and then raise them back up and in. The objective of this product was to provide people with a safe and easy method of retrieving items from the shelves in an upper cabinet. This is specifically helpful for individuals that have limited mobility or dexterity, but this product can be used by anyone. The system uses a remote-control system to travel the actuators, as well as push buttons and proximity sensors as added safety features.

Justification:

The use of this product allows the safe and easy retrieval of items from the shelves in upper cabinets. When trying to grab an item down from an upper shelf that is out of reach, most people would need to either climb up on a chair, ladder, or countertop. Not only is this a hassle, but climbing up onto one of these items is dangerous. Easy Reach eliminates the potential risk of injury from falling when trying to access an upper shelf inside of a cabinet. The push of a button on an easy to use remote control allows the safe and easy retrieval of any item from the shelves. This is a necessity for those with limited mobility or dexterity, or anyone that wants a safe and easy method for retrieving items from upper cabinet shelves.

Requirement	Value/parameter	Reason
Run off of Plug Power	12 VDC input	Power requirement for linear actuators
Lift Minimum Weight	Min: 0 lbs Max: 100+lbs	AVG of at least 50 lbs per shelf from customer feedback
Safe Operation	Move with minimal material deflection or item shifting	Product aimed at elderly or disabled people
Easy Use	Simple control/operation	Customer feedback showed concern over ease of use
Height Control	Can be stopped at any point in the movement	Desire for keeping out of reach of children from customer feedback

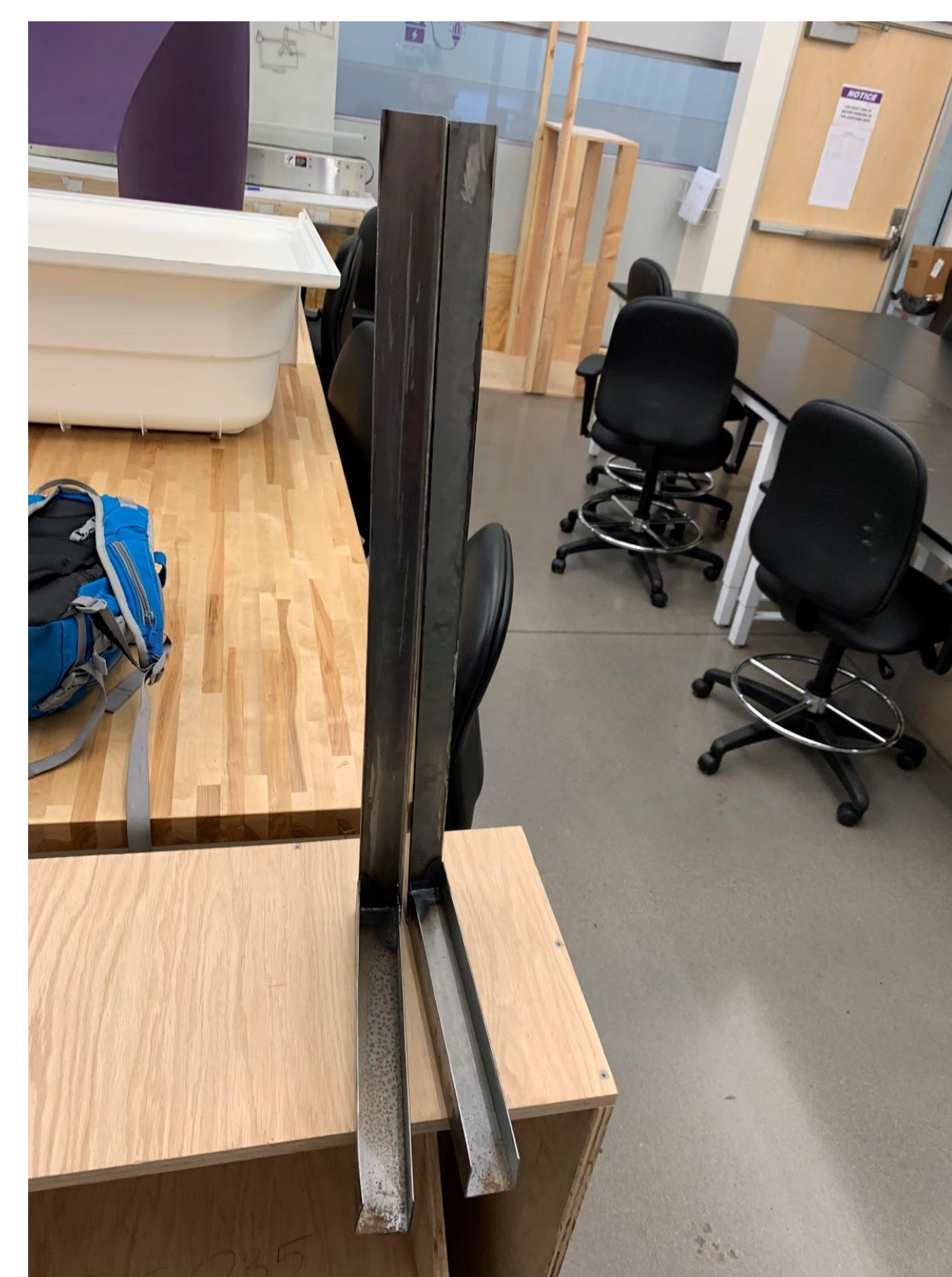| Engineering Standards	Description	How/Why does it apply?	How will it be implemented?
ADA-308.2 Forward Reach (Unobstructed)	If there are no obstacles, then the high forward reach is 48 inches maximum and the low forward reach is 15 inches minimum from the ground.	This regulation applies to the easy reach mechanism since a person needs to reach to grab items from a shelf.	Standard kitchen cabinets place the bottom edge 54 in. above the ground. The easy reach mechanism will bring the shelf platforms 6 in. below the bottom shelf level
ADA-308.2 Forward Reach (Obstructed High Reach)	When there are obstacles the high forward reach's maximum is 48 inches from the ground and the reach depth is 20 inches. If the reach depth is greater than 20 inches then maximum high forward reach is 44 inches from the ground and the maximum reach depth is 25 inches.	The obstacle portion of this regulation applies to the easy reach mechanism because a person needs to reach to grab items from a shelf and at times need to reach in the back of the shelves to grab items.	Standard kitchen cabinets place the bottom edge 54 in. above the ground. The easy reach mechanism will bring the shelf platforms 6 in. below the bottom shelf level
ADA-308.3 Side Reach (Unobstructed)	Without obstacles, the maximum high side reach is 48 inches and the minimum low side reach is 15 inches from the ground.	The side reach regulation applies to the easy reach mechanism since a person at times needs to perform a side reach to grab items from a shelf.	Standard kitchen cabinets place the bottom edge 54 in. above the ground. The easy reach mechanism will bring the shelf platforms 6 in. below the bottom shelf level
NAAWS - Shelf Load Test	The maximum deflection does not exceed ¼ in when a 200 lb load is placed on each shelf.	Performing a test similar to this standard would ensure that the easy reach mechanism is safe for the customers.	The tests will be conducted to verify the construction
NAAWS - Structural Integrity Test	No permanent damage occurred to the cabinet when a 200 lb load is placed on each shelf.	Likewise, this test would strengthen the notion that the easy reach mechanism is safe for the customers.	The tests will be conducted to verify the construction
ASTM A1008/A1008M Steel for cabinets	The steel that can be used for cabinets is cold rolled, commercial quality carbon steel sheet	One of the materials needed for the easy reach mechanism is a steel sheet and steel rods.	Cold rolled, commercial quality carbon steel will be used
ANSI/KCMA-A161.1 Cabinet Standards	The following standard provides some requirements every American cabinet manufacture must follow. This includes being fully enclosed with backs, bottoms, sides and tops on wall cabinets, doors and drawers are properly aligned, frames must have rigid construction, and all materials must follow the proper performance standard.	A cabinet is built in order to test the easy reach mechanism. This means that the prototype cabinet must follow cabinet standards like the ones provided by ANSI/KCMA.	Before testing the mechanism, the cabinet will be tested to be sure it meets requirements.
IEEE 2700-2019 Proximity Sensors	A typical distribution of digital depth is 2^n bits and the sensitivity applies to proximity sensors that leverage integrated LEDs	Proximity are essential in guaranteeing the safety of the customers	Make sure the proximity sensors met these requirements
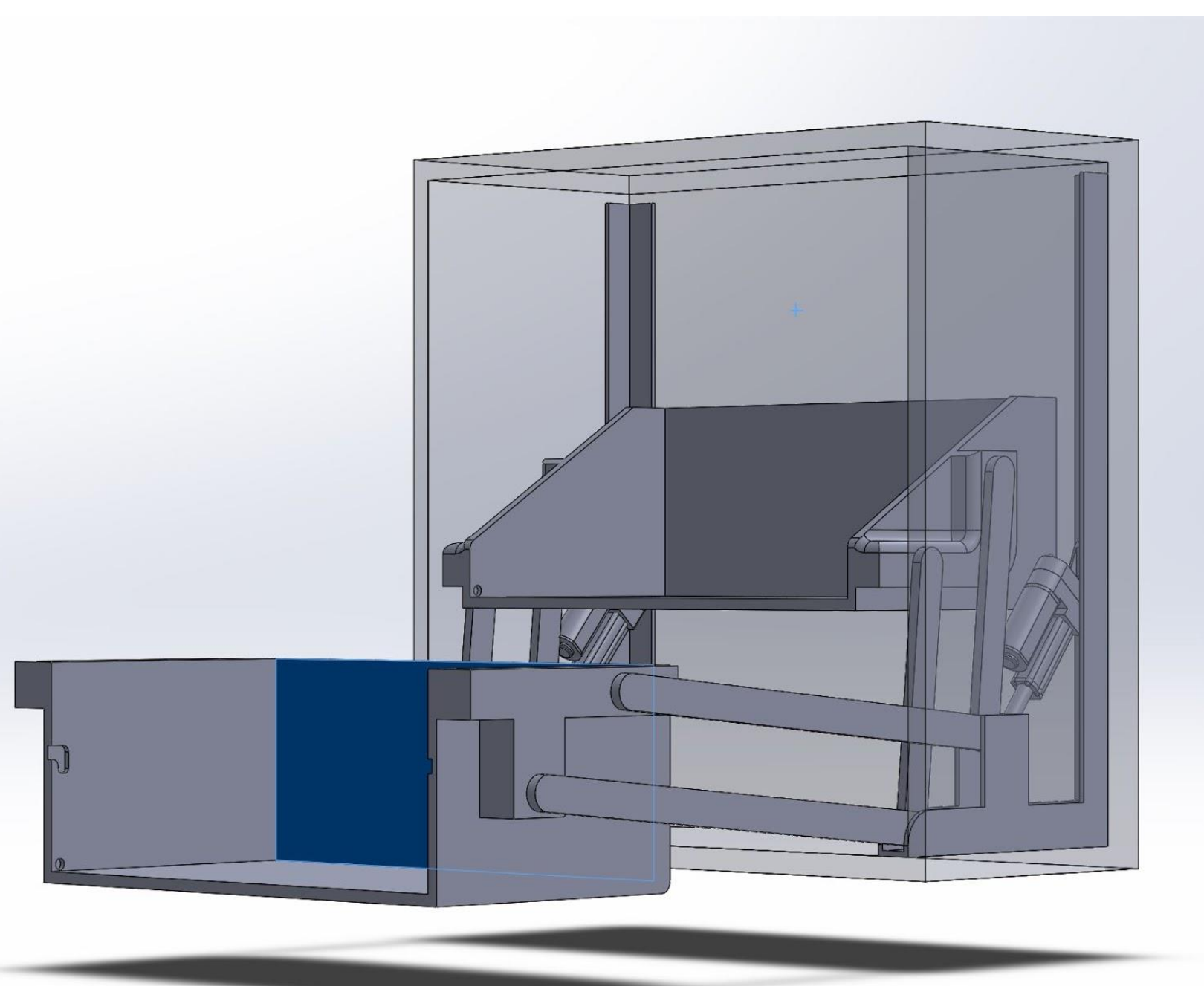
Mechanism with top shelf down
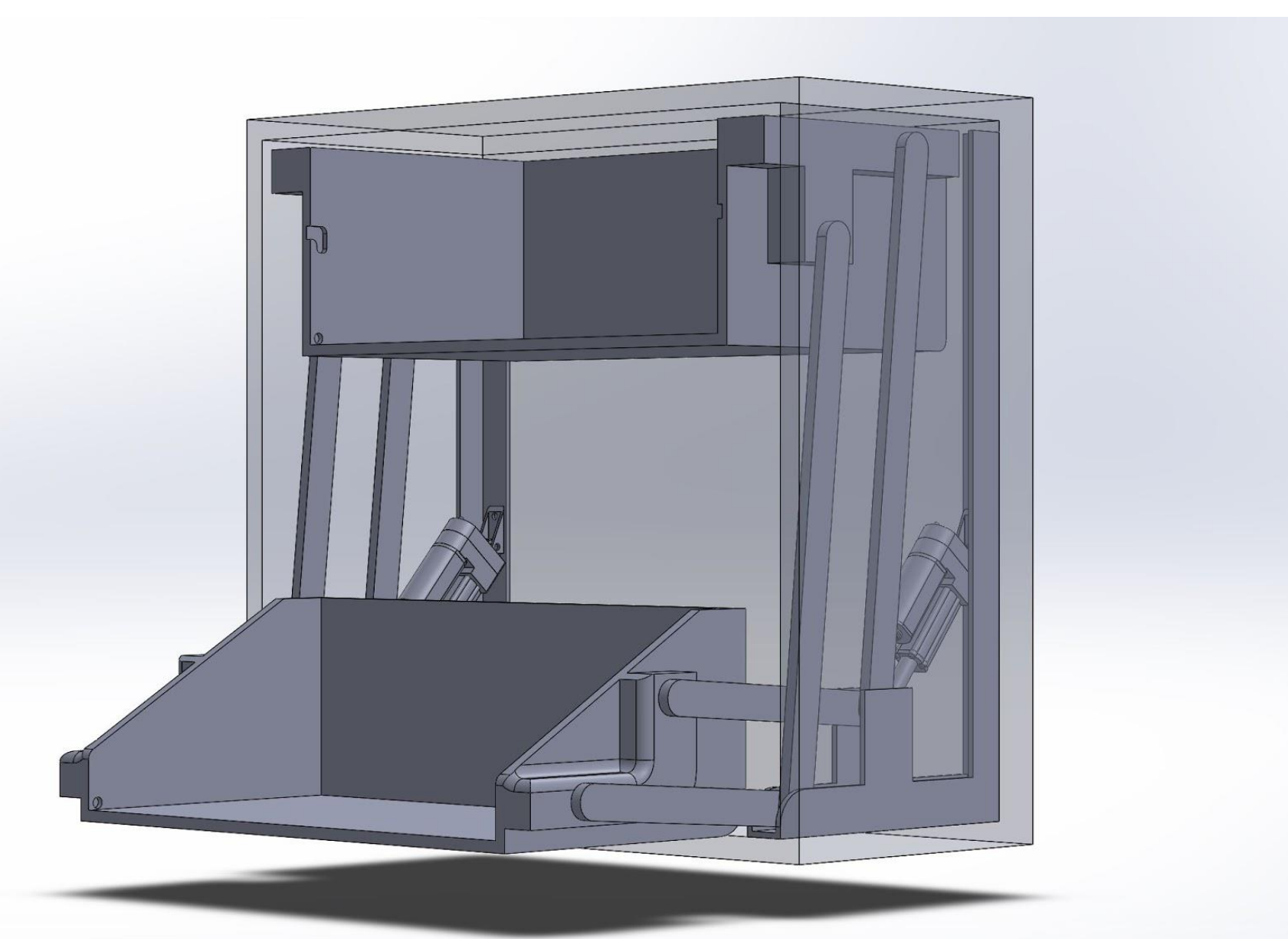
Mechanism with middle shelf down

Top shelf

Middle shelf

Arm Brackets

Mechanism arms

Testing Plan:

Requirement	Measurable Outcome	Pass/Fail
Run off Power Plug	The functionality of each component of the Easy Reach system will be tested with the system plugged into a standard outlet. These will be qualitative tests that verify that the actuators, control system, and proximity sensors work seamlessly when plugged into the power supply.	N/A
Lift Minimum Weight Test	The amount of weight the cabinet can hold	Pass
Safe Operations Test	Permanent Deformation in Shelf Arms or mounting brackets and Whether Items tip over or fall off shelf	N/A
Easy Use	Quantity of buttons the user has to push to control Easy Reach	N/A
Height control test/Proximity Sensor Test	Whether the motor stops when someone/something tries to interfere at a certain distance.	N/A

Results from test plan:

Grand Canyon University