GNG 2101

Design Project User and Product Manual

Walker Loader

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List of Acronyms and Glossary

Provide a list of acronyms and associated literal translations used within the document. List the acronyms in alphabetical order using a tabular format as depicted below.

Table 1. Acronyms

|  |  |
| --- | --- |
| **Acronym** | **Definition** |
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Provide clear and concise definitions for terms used in this document that may be unfamiliar to readers of the document. Terms are to be listed in alphabetical order.

Table 2. Glossary

|  |  |  |
| --- | --- | --- |
| **Term** | **Acronym** | **Definition** |
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# Introduction

Explain the basic context for your work and any assumptions that you have made for your work. Give an overview of the structure of your document (i.e. explain how it is organized) and summarize the purpose of the document, the scope of activities and the intended audience for the document. Also describe any security/safety or privacy considerations associated with the use of the User and Product Manual.

This User and Product Manual (UPM) provides the information necessary for <types of users> to effectively use the <System Name (Acronym)> and for prototype documentation.

# Overview

Explain the problem and why it is important.

Explain the fundamental needs of the user.

Explain what differentiates your product from others or the key aspects that make your product better.

[add pictures of your final prototype]

Explain the key features or major functions of the product without going into much detail.

Explain the architecture/construction of the system in non-technical terms (metal frame, microcontroller, web-based, etc.), the user access mode (unfold frame, GUI, button, etc.) and any special conditions.

A block diagram is a useful thing to include here too.

## Cautions & Warnings

There are a few different cautions which should be take when using our product such as; when the walker loading platform is lowered to the desired height, the user must stop pushing the actuator button. Another caution which should be taken is keeping hands and feet free of moving parts and not under the platform.

# Getting started

## Configuration Considerations (& System Organization and Navigation)

See section 3.4 for the explanation as to why sections 3.1 & 3.4 were merged

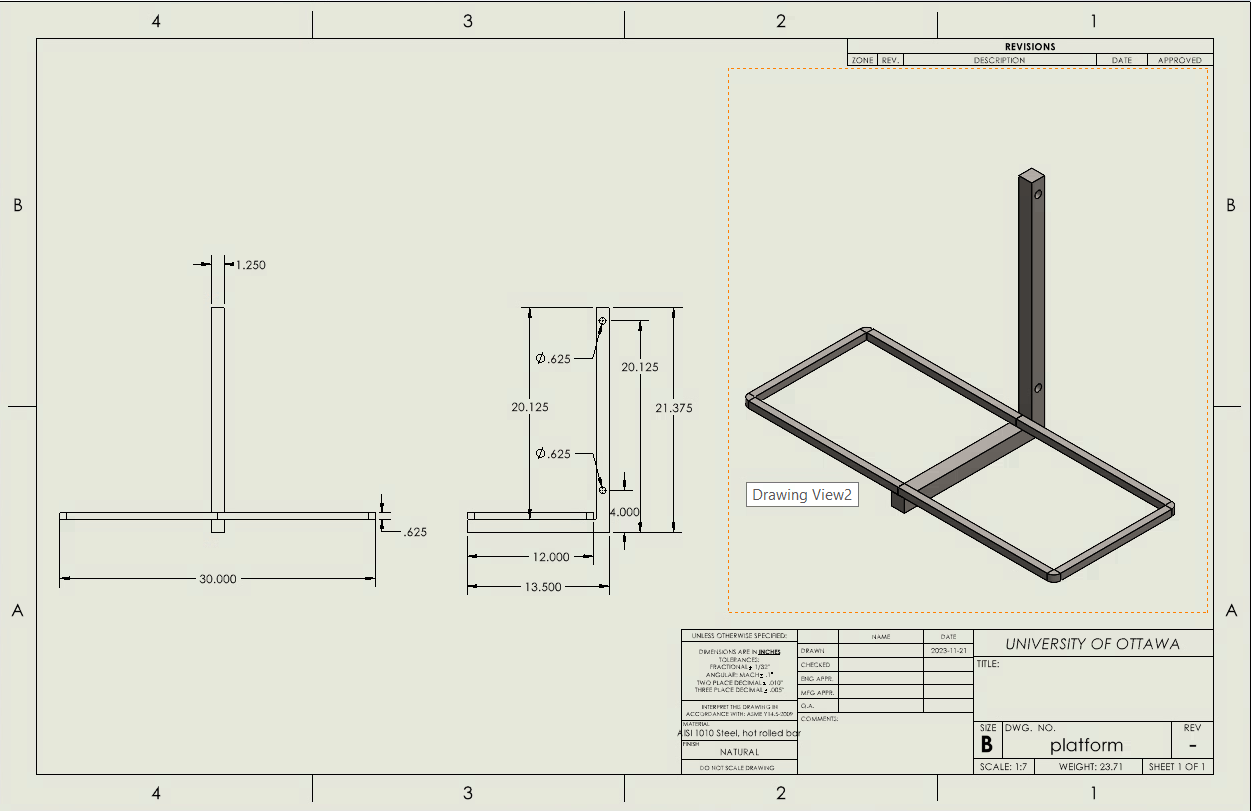
The walker loader prototype is comprised of several components:

* + a platform to hold the walker
  + a hitch attachment to affix the device to the car’s trailer hitch
  + the two sets of pivot arms that link these two parts together
  + the linear actuator that pushes on the upper arms to lift/lower the platform
  + the rocker switch that controls the extension of the actuator, along with its wires
  + the power supply adapter

Other components required for the practical use of the prototype:

* + a 1-¼” trailer hitch
  + an external power supply or an outlet connected to the car’s battery
  + a strap to secure the walker to the platform while driving

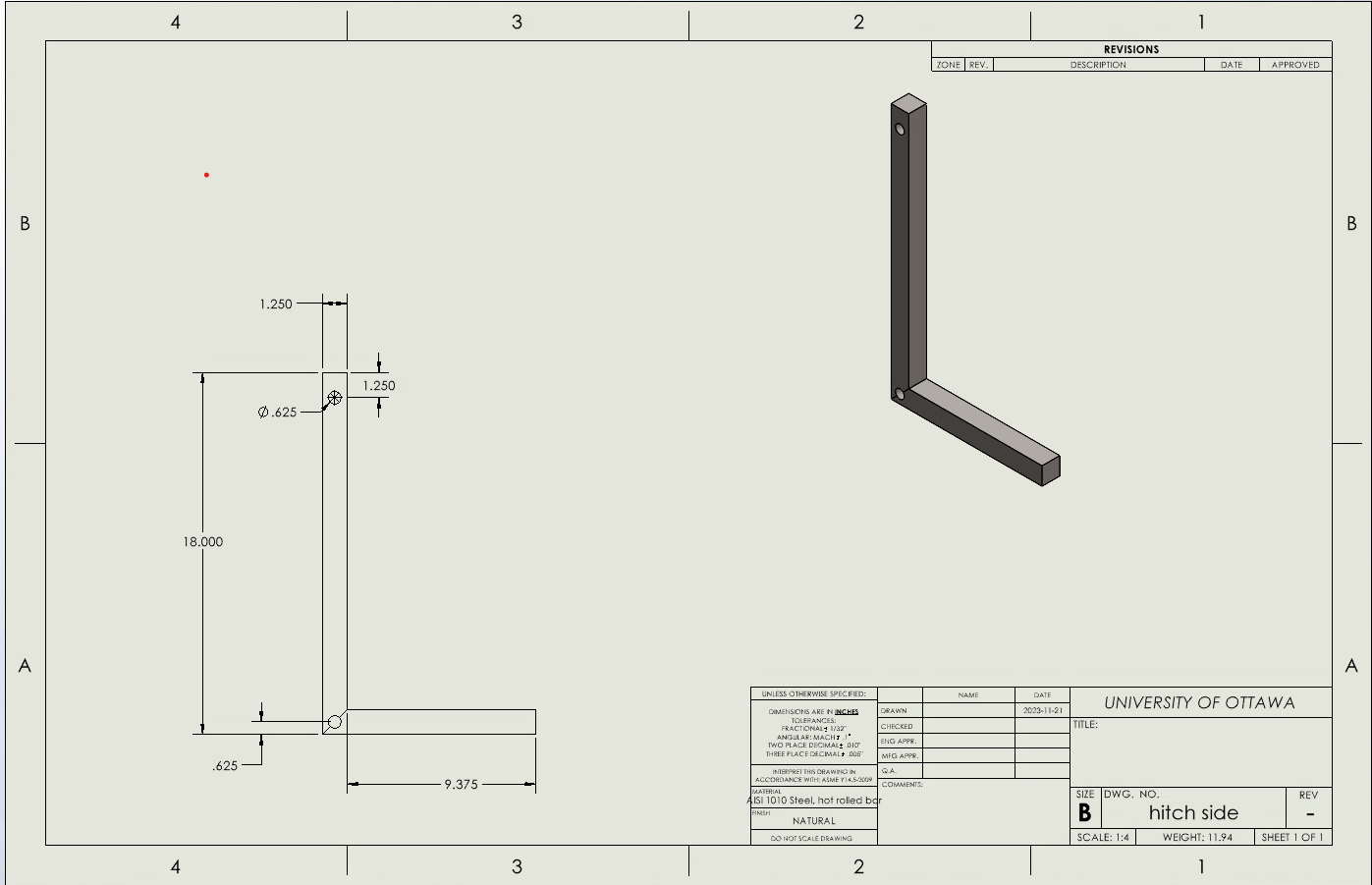
**Platform Design**



Platform: Figure 3.1-A

The platform is the component on which the folded walker will be placed upright, with its wheels in the open space on each side. The walker would lean forward, against the upright metal support, and strapped onto said support. The two holes are where the platform component is attached to the two sets of arms. This connection is made using 1-¼" bolts and nuts.

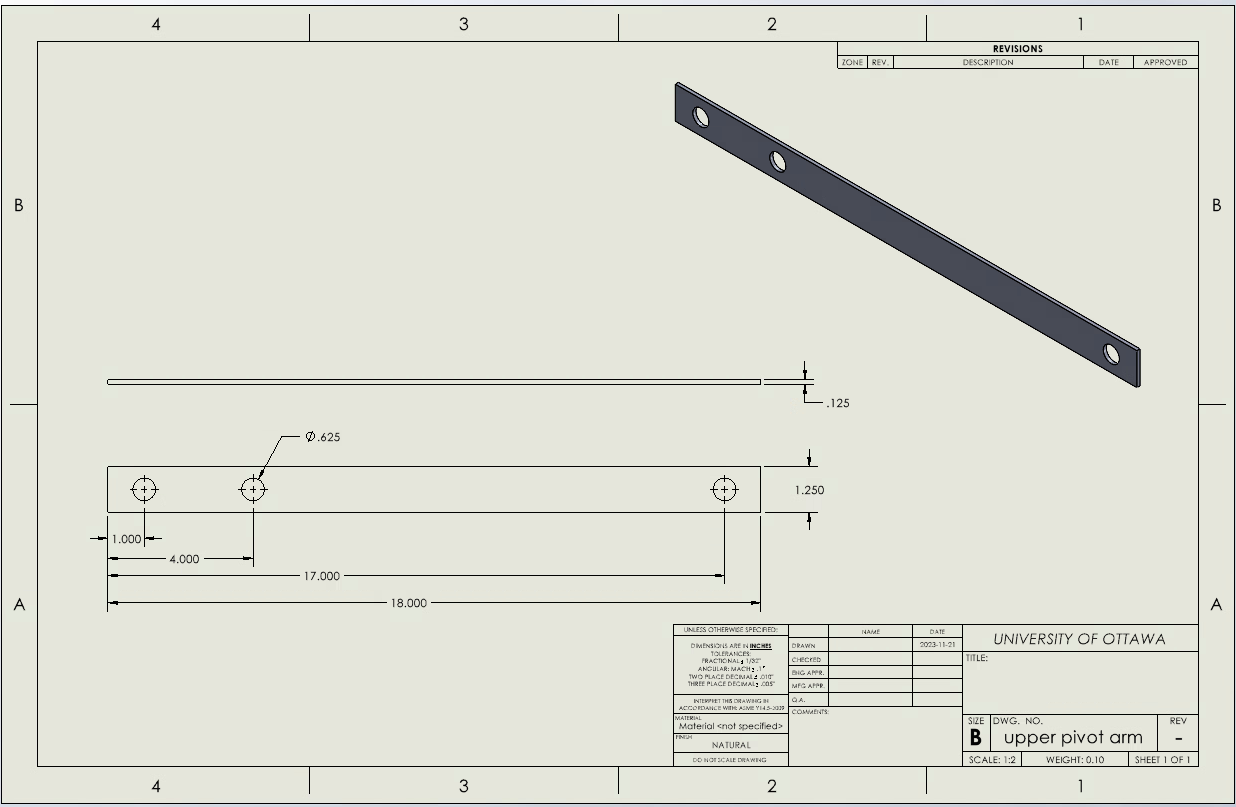
**Hitch Attachment Design**



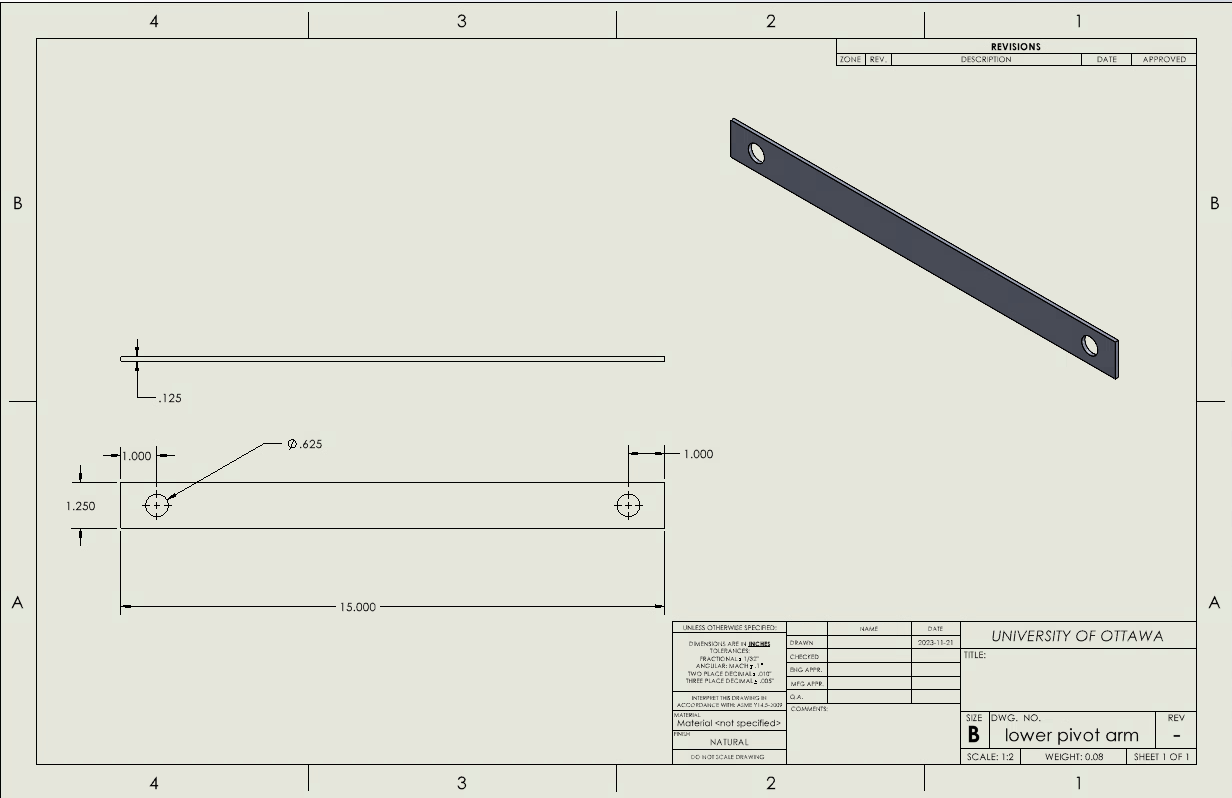
Hitch Attachment: Figure 3.1-B

The hitch attachment is the component that adjoins the vehicle’s trailer hitch and the walker loader. The two sets of holes on the vertical bar are again where the arms connect to this component. Not shown in this diagram are the holes of the same size (1-¼") on the horizontal bar, which will directly attach the hitch and the loader. This will be described in greater detail in section 3.3.

**Pivot Arm Designs**



Upper Arm: Figure 3.1-C-1



Lower Arm: Figure 3.1-C-2

The two sets of pivot arm join the platform to the hitch attachment. The two sets of arms will each have two of their holes (rightmost in the schematics shown) attached to these components with bolts and nuts. The remaining hole in the upper arms is where a smaller nut and bolt attach them to the top of the linear actuator, allowing the arms (and thus the platform) to be moved by it.

Note that the final prototype ended up using L-shaped metal arms of these dimensions instead of the flat metal pieces shown in these designs. This was done for greater strength and rigidity of the arms.

**Linear Actuator**



# “Mono-Gatari Linear Actuator 12V Stroke Heavy Duty with Mounting Bracket”: Figure 3.1-D

The linear actuator is what moves our device. One of the metal brackets and one of the pins shown on the left (both shown in diagram) connect the bottom of the actuator to the hitch attachment of the device. The top is connected to the upper arms through their smallest hole via bolt and nut, as mentioned previously. This connection allows the actuator to extend/retract, but also tilt slightly, allowing the arms to move.

**Rocker Switch**



“mankk Polarity Reverse Momentary Rocker Switch 12V DC 10A DPDT 6 Pin (ON)/Off/(ON)”: Figure 3.1-E

The rocker switch is switch with three states: up, off, and down. By pressing up or down, the walker loader’s platform can be moved in the desired direction. When not being pressed either way, the linear actuator will stay in place and keep the platform at a consistent height. The connection of the wires is depicted in section 6.1.3.

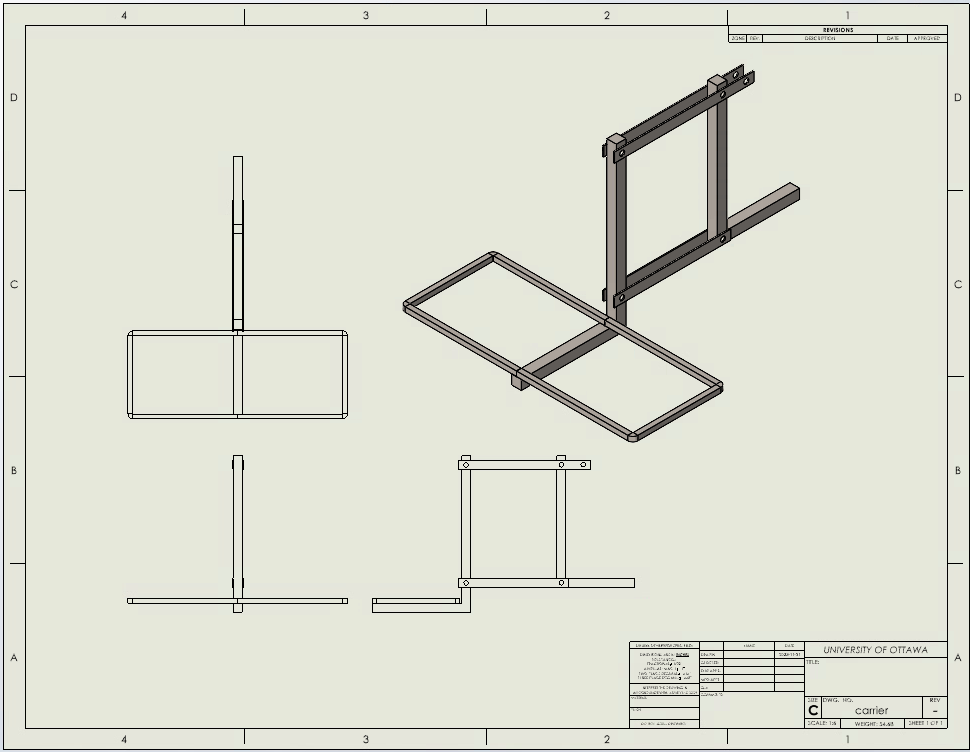
**Power Supply**



“Facmogu DC 12V 10A Power Adapter, 120W AC 100-240V to DC 12V with 2.5mm X 5.5mm US Plug”: Figure 3.1-F

The power supply is what gives the prototype its electricity, converting the. The US plug attaches to the blue wire that leads to the switch, and the other plug connects to the power source, whether that be an external power source or an outlet connecting to the car’s battery.

**Connected Mechanical Components:**



Connected Mechanical Components: Figure 3.1-G

The schematic above depicts the attachments of the mechanical parts of the device, save for the linear actuator which is attached to the bottom hitch attachment bar with its bracket (which is welded on), and attached to the top arms through the remaining holes. These connections were already discussed. Furthermore, the hitch attachment is not shown in connection with the vehicle’s hitch in this diagram.

## User Access Considerations

All users that could be using the prototype are people who require the assistance of a walker while out of the house. The two main groups of people who use walkers are the elderly and people with physical disabilities. Our prototype was designed such that the user needs to fold and push the walker onto a platform on the ground during loading, and they need to unfold it and pull it out when unloading. These motions should be possible with the use of one arm, allowing the other to hold onto the bumper of the car for balance.

Elderly people are usually able to make use of their arms, so this should be manageable for that user group. People with disabilities should also be able to make use of this device as long as they have enough range of motion and strength in their arm to perform the aforementioned motions.

## Accessing/setting up the System

Setting up the system can be done in just 3 easy steps:

* 1. Line up the holes of the bottom of the hitch attachment and the holes of the trailer hitch.

2. Put a 1-¼" bolt through all the holes

3. Fasten with a 1-¼" nut and wrench

Then you’re ready to use your walker loader!

* 1. **Line up the holes:**



Line up Holes: Figure 3.3-A

Line up the holes of the hitch attachment component (encircled in yellow above) with the holes of the same size (1-¼") in the hitch.

**2. Insert Bolt**

Put a bolt through all these holes.

**3. Fasten**

Place a nut onto the bolt. Tighten it with a wrench until completely secured and resistant to movement.

From this point forward, the walker loader can be loaded and unloaded.

## System Organization & Navigation

Section 3.4, the organization of the system, was merged into section 3.1 so that all connections are described immediately under the diagrams of each component. This was done to make the organization easier to understand.

## Exiting the System

To end use of the walker loader, first remove the walker from it by pressing down on the switch until the platform is on the ground, unstrapping and unfolding the walker, and pulling it off the platform. With the walker unloaded, press up on the switch to raise the walker loader back to its resting position. The device will automatically stop moving upwards once this maximum height has been reached.

To remove the walker loader from your vehicle entirely, the steps are opposite of those from the setup. First, disconnect the walker loader from its power source. Then, detach the loader from the hitch. Just like that, the product is removed from the vehicle.

# Using the System

## Transports Walker

The primary function of this product is to provide a way to easily transport a walker with you to your destination. This provides a way for people to be self-sufficient who would otherwise need assistance to load and unload the walker from the car.

## Easy Attachment

The carrier is designed to easily attach to the hitch receiver of your vehicle. It comes with a simple installation process, requiring minimal tools and installation time. This gives the users the ability to easily transfer the carrier between vehicles.

## Material and Durability

The product is made of stainless-steel ensuring safety and sturdiness while being resilient against weather elements.

## Accessibility

The carrier was designed with accessibility as a main concern, to this extent it provides easy loading and unloading of the walker controlled by a switch. This lets people who would not normally have the strength to lift the walker into the car a way to transport their walker without assistance.

## Compatibility

The product was created using the smaller size of hitch size in mind. This allows the possibility of mounting the carrier on any type of car or truck hitch due to the adapters being easily obtainable from other sources.

# Troubleshooting & Support

## Error Messages or Behaviors

* + The user might experience breakage or damage in the trailer hitch mount for the Walker Loading System, such that they will need to uninstall the system and perform the required fixation.
  + Corrosion could occur in the pivot points of the platform; therefore, any unusual sounds should be paid attention to, and cleaning should be required.
  + The platform will need to go down at different ranges depending on the type of car; therefore, when lowering the platform, it should not touch the ground, it should reach the ground. If the linear actuator is forced to touch the ground and it gets damaged, starts making sounds or does not work, then it needs to be replaced.

## Special Considerations

* + Please review the type of actuator used, if it needs to be replaced.
  + The platform should not touch the ground at any moment to avoid burning the Linear Actuator.

## Maintenance

* + Pines on the pivot points need to be replaced when corrosion starts.
  + The body of the platform with the actuator needs to be coated with anti-corrosion coating.
  + The actuator locking pines need to be checked occasionally to ensure safety during movement of the platform.

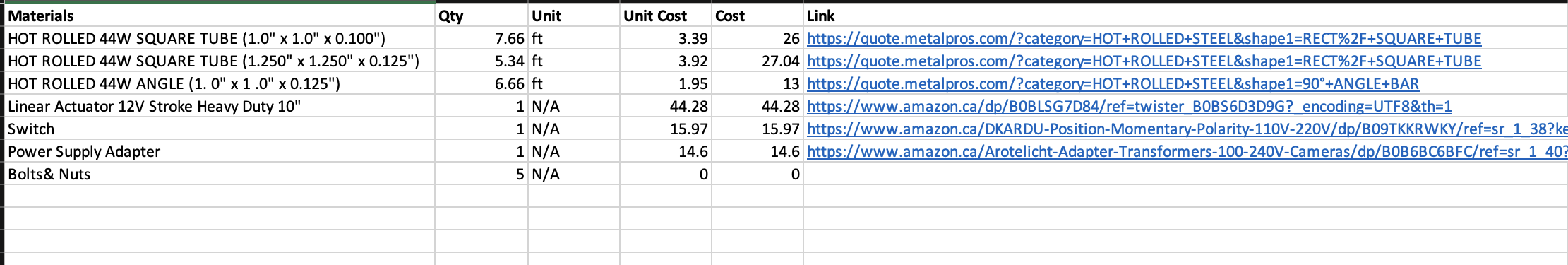
## Support

* The main contact if in case of emergency would be CEED personal that have their contact information. Maker [Lab-makerlab@uottawa.ca](mailto:Lab-makerlab@uottawa.ca).

# Product Documentation

## Subsystem 1 of prototype

### BOM (Bill of Materials)



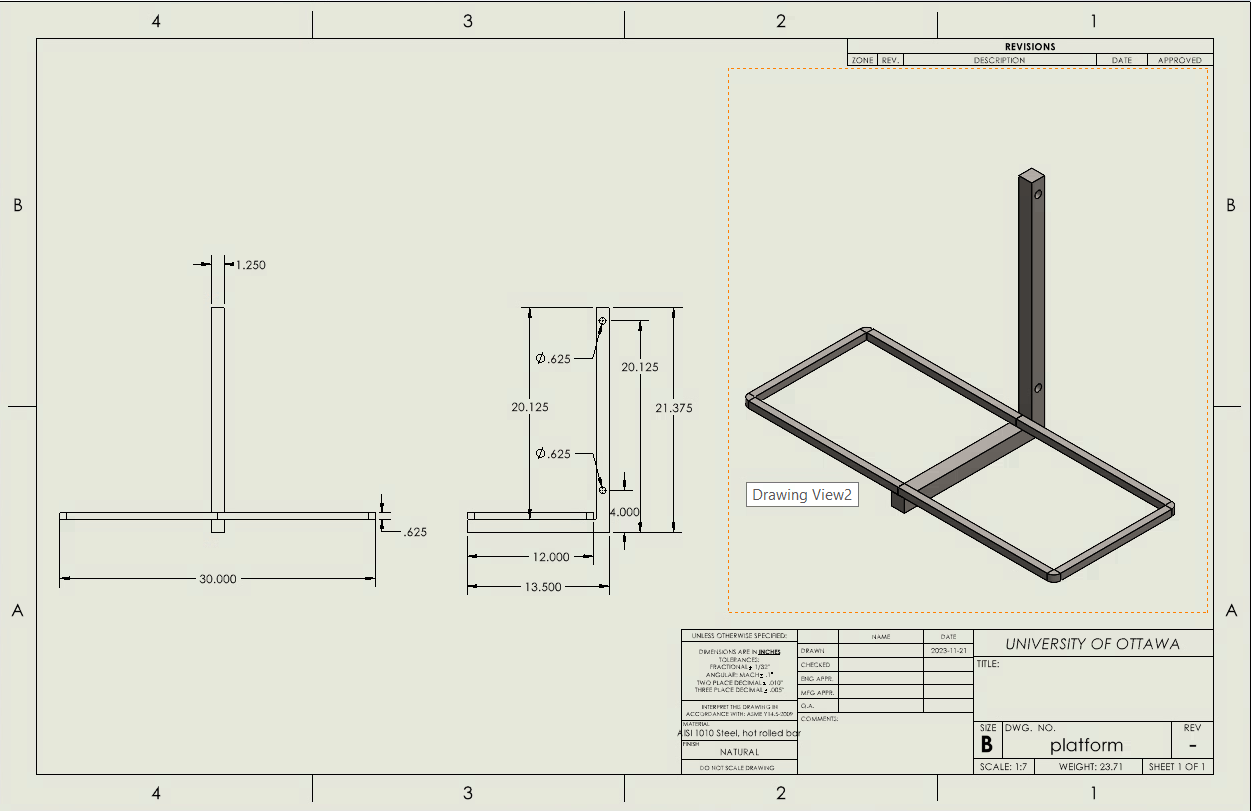
|  |  |
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| Materials | Link |
| HOT ROLLED 44W SQUARE TUBE (1.0"x 1.0"x 0.100") | <https://quote.metalpros.com/?category=HOT+ROLLED+STEEL&shape1=RECT%2F+SQUARE+TUBE> |
| HOT ROLLED 44W SQUARE TUBE (1.250"×1.250"× 0.125") | <https://quote.metalpros.com/?category=HOT+ROLLED+STEEL&shape1=RECT%2F+SQUARE+TUBE> |
| HOT ROLLED 44W ANGLE (1. 0"x1.0" x0.125") | <https://quote.metalpros.com/?category=HOT+ROLLED+STEEL&shape1=90°+ANGLE+BAR> |
| Linear Actuator 12V Stroke Heavy Duty 10' | Down below |
| Switch | <https://www.amazon.ca/dp/B09TKKRWKY/?coliid=I2XPKMEJ9OHMMN&colid=3VOPT8IIK3V3Q&ref_=cm_sw_r_apin_lstpd_S8M9WFXKDTAEP0PFSC7J&language=en_US&th=1> |
| Power Supply Adapter | <https://www.amazon.ca/dp/B0B6BC6BFC/?coliid=I3NVW5IV2CSLLV&colid=3VOPT8IIK3V3Q&ref_=cm_sw_r_apin_lstpd_S8M9WFXKDTAEP0PFSC7J&language=en_US&th=1> |
| Bots& Nuts | - |

<https://www.amazon.ca/Linear-Actuator-Stroke-Mounting-Bracket/dp/B0BLSGR6X6/ref=sr_1_6?crid=3815P8N9GGRR4&keywords=Linear%2BActuator%2B12V%2BStroke%2BHeavy%2BDuty%2B10%27&qid=1708124812&sprefix=linear%2Bactuator%2B12v%2Bstroke%2Bheavy%2Bduty%2B10%27%2Caps%2C93&sr=8-6&th=1>

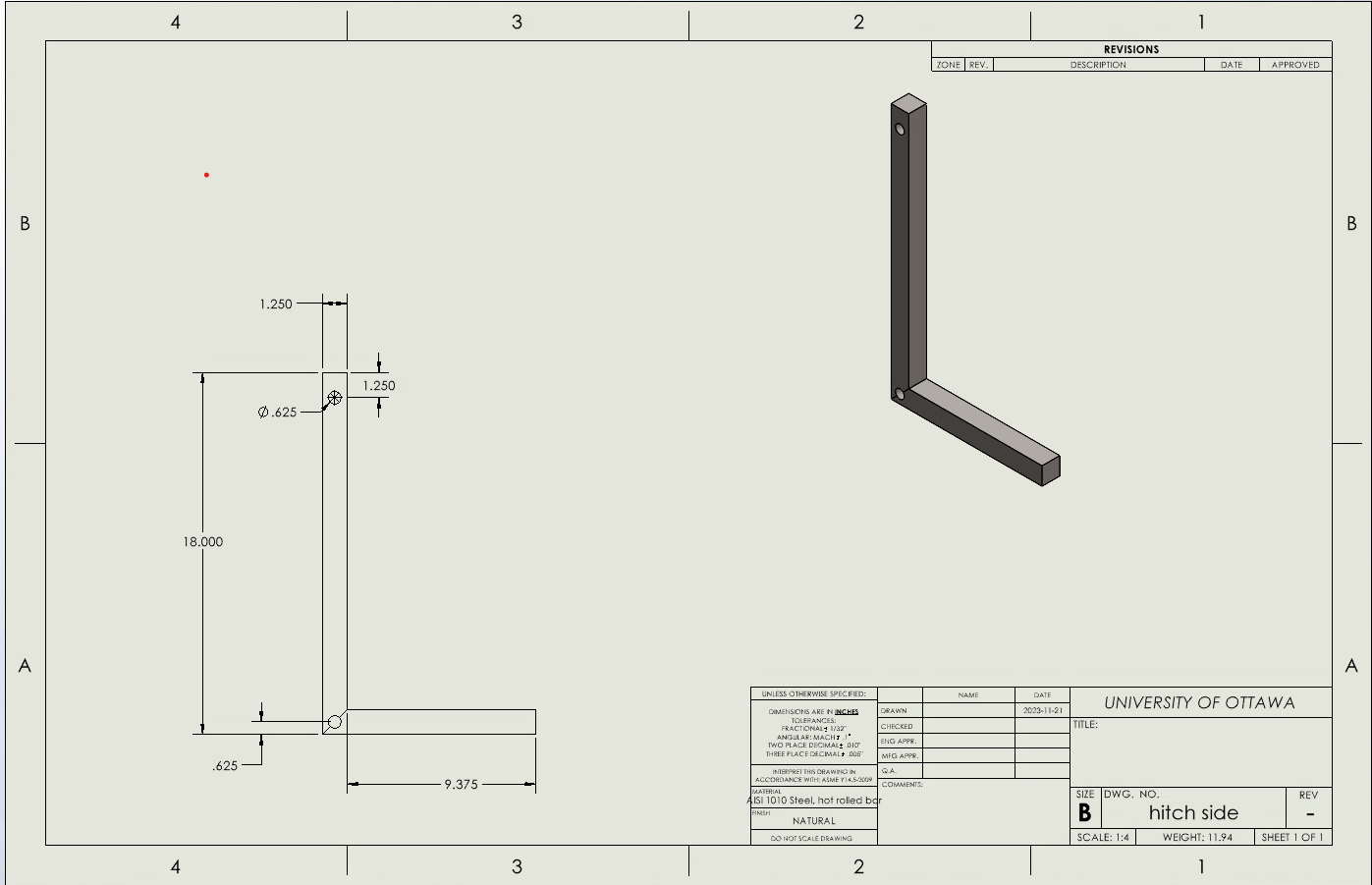
### Equipment list

* Drill Press
* MIG/TIG Welders
* Metal Cutting Bandsaw
* Solder Kit

### Instructions



Platform: Figure 6.1



Hitch Attachment: Figure 6.2

To assemble the platform and hitch attachment, the hot-rolled square tubes (1”x1”x0.1”) and (1.250”x1.250”x0.250”) listed in the BOM are necessary.

The metal must be cut using a Metal Cutting Bandsaw. Therefore, the different lengths indicated in the designs should be marked on the metal before cutting.

There are two sets of square tubes. The (1”x1”x0.1”) square tube will be used to create the long rectangular base (30’’x12’’) shown in Figure 6.1. The (1.250”x1.250”x0.125”) square tube will be used for both the “L” part of the platform design in Figure 6.1 and the Hitch Attachment in Figure 6.2.

All metal cutting for this project must be done at 90 degrees with the Metal Cutting Bandsaw, especially for the Hitch Attachment, as a hole will be drilled later at the bottom corner.

For the “L” part of the platform and hitch attachment, a total of four pieces of metal must be cut to form two separate “L”s. One single 'L' is made up of a long vertical metal piece and a small horizontal piece that will be welded together later. Therefore, the lengths for the horizontal and vertical pieces for the platform and hitch attachment should be 13.5”&20.125” and 10.625’’&16.75’’, respectively. In other words, once all the pieces of metal are cut, the vertical piece of the “L” should sit flush on the horizontal piece.

For the base of the platform, two pieces of 30’’ and two pieces of 12’’ will need to be cut.

After completing all the cutting for the platform and hitch attachment, the various holes indicated on both designs will need to be drilled using the drill press.

Once all the holes indicated in both designs are drilled, all the different pieces will need to be welded together.

We recommend starting with the two pieces of metal for the hitch attachment (H: 10.625’’, V: 16.75’’). As mentioned previously, the vertical piece should sit on top of the horizontal piece. Use proper tools such as a Welding Magnet for effective welding. We also suggest welding all four sides of the vertical square tube to the horizontal one to ensure solidity.

*Note*: Before welding the vertical and horizontal pieces together, we suggest leaving at least 0.5’’ of space from the edge of the horizontal piece to ensure proper welding.

Once the pieces for the hitch attachment are welded, the four pieces for the long rectangular base (2x30’’, 2x15’’) of the platform should be welded next.

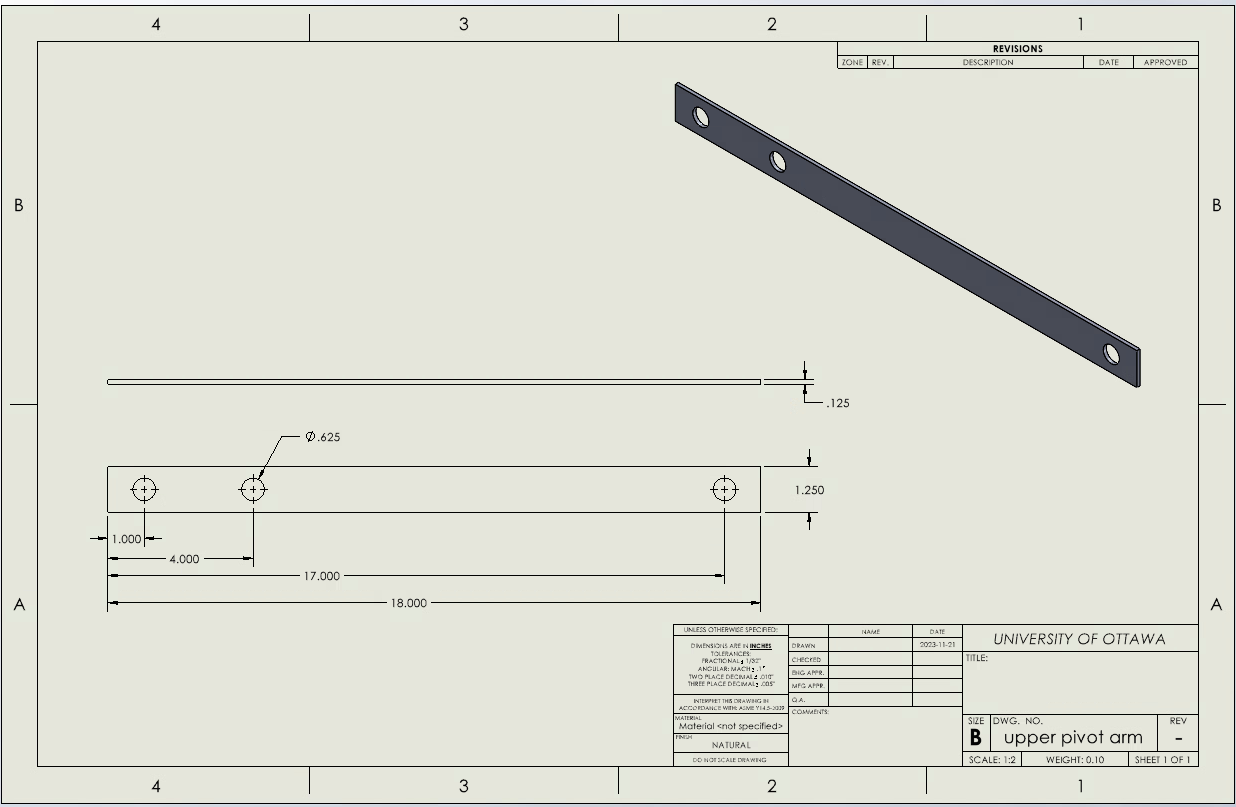
Next, the two pieces of metal for the “L” of the platform (H: 13.5’’, V: 20.125”) should be welded together, similar to the one done for the hitch attachment. However, not all sides of the vertical piece should be welded. To ensure that the long rectangular base sits flat on the “L”, we recommend avoiding welding the side of the vertical tube facing the longer end of the horizontal piece.

*Note*: The sequence of welding the different parts above does not have to be followed, as long as they are all done separately.

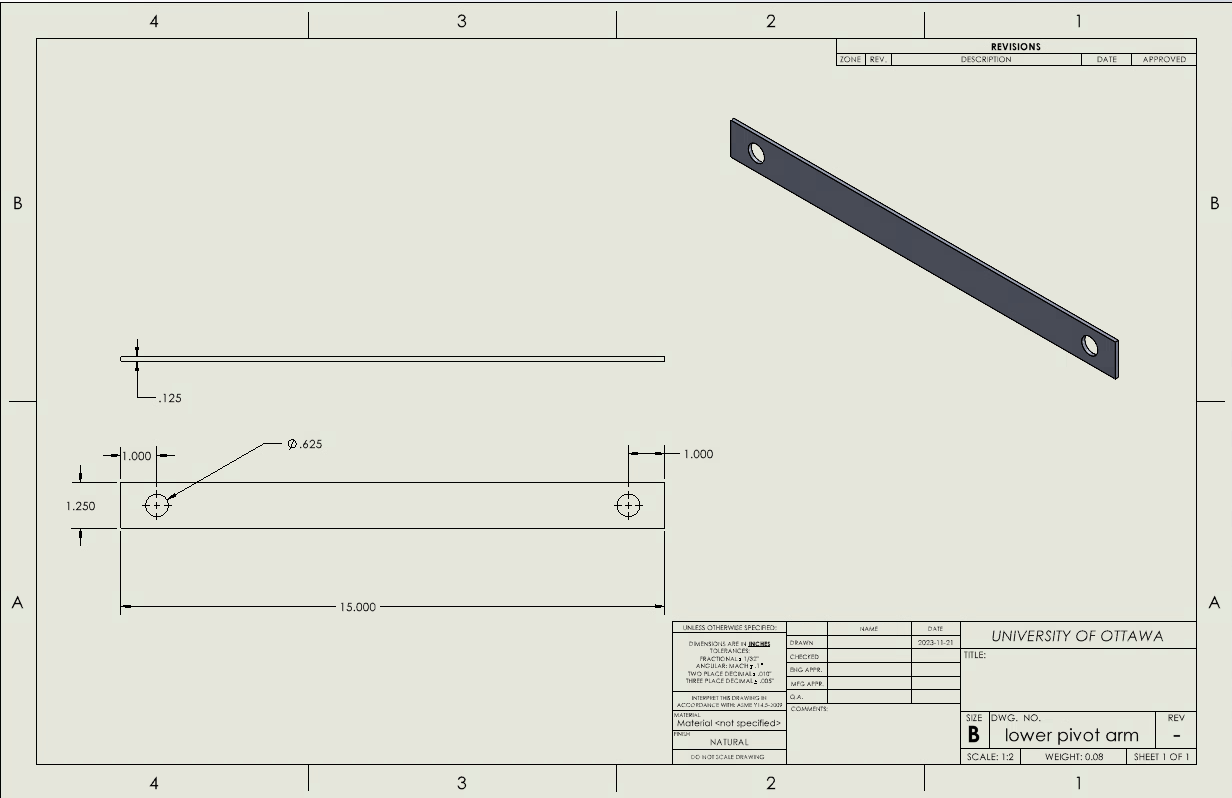
Once all the pieces for the rectangular base and the "L" for the platform are welded, all that remains is to weld the rectangular base to the “L”. Before welding them together, we recommend taking necessary precautions to ensure that the “L” is perfectly aligned at the middle of the rectangular base, as shown in figure 6.1. Finally, we also recommend flipping the platform upside down to weld all available spots on the rectangular base to the “L” to ensure solidity.

The final result should look like the picture shown below





Upper Arm Figure 6.3



Lower Arm Figure 6.4

For the Upper and Lower arm, hot rolled angle bar (1.250”x1.250”x0.125”) listed in the BOM is necessary.

There will be 2 pieces of metal for the Upper Arm (Figure 6.3) and 2 pieces of metal for the Lower Arm (Figure 6.4). The different pieces will have to be cut using the Metal Cutting Bandsaw as well. Therefore, the different lengths indicated in the designs should be marked on the metal before cutting.

After completing all the cutting, the various holes indicated on both designs (Figure 6.3 & Figure 6.4) will need to be drilled using the drill press.

Using appropriate bolts and nuts the final assembly should look like Figure 6.5 below

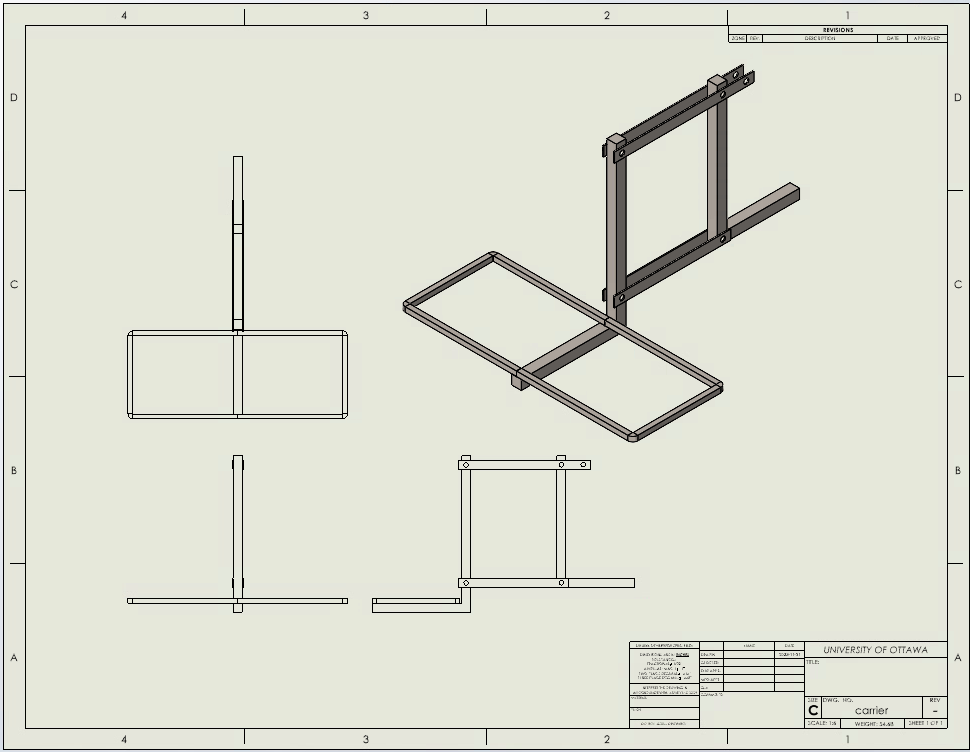


Figure 6.5

Finally, the mount provided with the actuator as shown in the picture below will have to be welded to the horizontal piece of the hitch attachment.



*Note*: the coating may need to be removed before welding.

Before welding, we recommend marking the necessary distance from the mount to the vertical piece of the hitch attachment so that the holes on top of the actuator align with the holes drilled on the upper arm.

*(Electrical part)*

To control and power the actuator, the rocker switch and power supply listed in the BOM above are required.

The wires provided with the rocker switch will need to be connected as shown in the picture below.



The other end of the black and red wires labeled 'motor' in the picture should be soldered to the corresponding black and red wires of the actuator.

The other ends of the wires labeled '+DVC' and 'Ground (-)' should be inserted into the DC transformer shown in the picture below, each in their respective entry ( '+' for '+DVC' and '–' for 'Ground'). Once inserted, the entries should be tightened with a screwdriver to ensure that the wires remain in place.



## Testing & Validation

Numerous tests were conducted on the final prototype to make sure that the walker loader was functional.

The first test conducted was a simple test of moving the walker up and down without any weight placed onto the frame of the loader. This was to test if the system would work, and it did it passed the test. From this test we concluded that the maximum height that the walker loader could lower was 13 inches.

The next test was testing to see if the walker loader could maintain the weight of a walker while in use. This was the reason the walker loader was made so this test was important to pass. The test was passed, the walker loader was able to handle the weight of this walker being put onto the frame and the linear actuator was able to support the whole weight of the system.



# Conclusions and Recommendations for Future Work

While developing our prototype we learned a lot. Something our group learned very quickly was that the materials needed to create this product were going the cost a lot and we needed to work with our budget in mind. The next thing we learned was that we needed to distribute the weight of the walker and platform since a linear actuator which fit our budget has a maximum load of approximatly 200 pounds. These were our main obstacles which we had to overcome. The most important avenue for future work is increasing the structural integrity of the product while it is on a moving vehicle. This is crucial for the safety of the user, and others on the road since relying on the linear actuator alone to support the weight, and impacts of the road will not be reliable.

If we had more time to work on this project, we would have continued with prototyping. With the knowledge we gained from the first three prototypes we would be able to create our next iteration which could serve as our final product. The changes we would be making would be adding a support to be used while driving, weatherproofing electrical components, shielding the walker from the elements, and streamlining our design. Streamlining our design and adding a safety support for our product would be beneficial and would cause little to no increase in our budget. We purposely avoided weatherproofing for the product and the walker due to budget restrictions, however these are parts of our product which should be added in the future to satisfy all of our clients needs.

# Bibliography

Insert your list of references here.

<https://m.media-amazon.com/images/I/61C1S4bPgwL._SX522_.jpg>

<https://m.media-amazon.com/images/I/614UkmZXI7L._SX522_.jpg>

<https://m.media-amazon.com/images/I/71Pcssmn0AL._SX522_.jpg>

APPENDICES

# APPENDIX I: Design Files

Summarize the relationship of this document to other relevant documents. Provide identifying information for all documents used to arrive at and/or referenced within this document (e.g., related and/or companion documents, prerequisite documents, relevant technical documentation, etc.).

Include all design files in MakerRepo.

Also provide the MakerRepo link to your project.

Table 3. Referenced Documents

|  |  |  |
| --- | --- | --- |
| **Document Name** | **Document Location and/or URL** | **Issuance Date** |
|  |  |  |
|  |  |  |
|  |  |  |
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# APPENDIX II: Other Appendices

You can include other critical and important work here. Maybe they are not important in the structure of this document but need to be included.