MFGE23P/C1
CAPSTONE 1

HYDRAULIC MAINTENANCE PLATFORM (B1 Type)

A Product Design

Presented to the

MAPUA

UNIVERSITY

SCHOOL OF MECHANICAL AND MANUFACTURING ENGINEERING

In Partial Fulfillment

Of the Requirements for the Degree of

Bachelor of Science in Manufacturing Engineering

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ACKNOWLEDGEMENT

Before we start, we would like to thank our professor, Dr. Seyed Hamed Hashemi Sohi from the School of Mechanical and Manufacturing Engineering – Mapua University for his thorough guidance and insights that served as our guide in making this research and product design.

We would also like to express our gratitude to our parents, guardians, and family who supported us and guided us through our journey as students. Without their motivation and wise words, we would not be the creative, passionate, and resourceful students that we are today.

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CHAPTER 1: PROJECT SCOPE

1.1. Problem Statement

The task of the researchers is to design and improve a Hydraulic Maintenance Platform for TRONAIR Inc. that provides efficiency and cost-effectiveness. The purpose of a hydraulic maintenance platform is to assist workers in doing maintenance and other external work such as inspection to aircrafts at an elevated level.

Hydraulic maintenance platforms provide assistance to workers for added accessibility to the aircraft at an elevated level for work efficiency and safety. Maintenance platforms have platform base that enables workers to do tasks such as repairs and maintenance safely at a flat and stable surface. The platforms also have caster mount for added mobility. These platforms are crucial and come in very handy in performing maintenance and inspection, or other operations to be done to the aircraft.

Figure 1. Actual Hydraulic Maintenance Platform

Our group decided to improve the design of the product which will enable workers to operate efficiently and easily. By this design, less effort and time will be exerted in performing such tasks. This product's purpose is to assist workers in operating maintenance and inspection to the aircraft.

1.2. Contemporary issues relevant to the project

1.2.1 Omissions

During maintenance, errors are prone to occur; one form of such is omissions. An omission happens when a technician forgets to include a component (bolts, screws, etc.) during the maintenance or reparation of an aircraft. Missing out on certain processes, especially during checks, is also an omission. Omissions occur because of human nature – we tend to take shortcuts to get the job done quickly.

To combat this, technicians are required to follow the aircraft manual, provided by the manufacturer. However, these manuals are lengthy and tedious to go through, hence, airlines come up with checklists (based on the aircraft manual) for technicians to follow.

1.2.2. Ramp and maintenance damage

An International Air Transport Association survey estimates that 36–40 percent of damage to aircraft is from ramp and maintenance damage, sometimes called friendly foreign object damage (IATA, 1991). These areas are especially prone to damage and require robust material performance in these locations.

Ramp and maintenance damage can represent significant costs to the airlines. The repair of a damaged component is only part of the cost. The airline also bears the cost of flight delay or cancellation and the effects on connections and aircraft rotation.

1.2.2 Factors affecting ease of maintenance

The rapidly evolving complexity of products has kept pace with evolving technology. Improvements in reliability techniques, however, have been unable to keep pace with the growing degree of product complexity (Crawford and Altman, 1972; Morgan et al., 1963; Oborne, 1981). New problems in equipment downtime have been proliferating, and the concept of maintenance as a tool to reduce downtime has assumed growing importance (Imrhan, 1991).

As far as designing equipment for maintenance is concerned, it has been practiced more as an art than as a science, to the extent that it has evolved more as a result of common sense than by means of scientific investigation (Oborne, 1981). It is worth noting in this context that maintenance is perhaps the most expensive of all human–machine system activities. This is because of the increasing need to perform maintenance activities and the high and ever

increasing cost of human labor. An estimation of the cost of human labor is extremely important, since maintenance may be the only field of operation that relies solely on human capital and human skill.

1.3. Client Identification and Recognition of Need

This project has been proposed by Tronair Inc. to provide them a new design of a hydraulic maintenance platform. One of the products provided by the company is hydraulic maintenance platform that needs redesigning and improvement; in our case, it needs to be cost-effective and lightweight for ease of mobility and accessibility.

Majority of the product's potential market will be the aviation companies for their maintenance and repair operations to an aircraft. Though it can also be used in other fields in doing maintenance and repairs alike at an elevated level. In aviation business, maintenance platforms are one of the most used equipment in doing repairs and inspection to an aircraft. It plays a crucial role in checking the aircrafts for damages and potential repairs. Without these maintenance platforms, performing maintenance and inspection to an aircraft would be inefficient and unsafe. Our product's design has specifications that are cost-effective and lightweight that aids the workers in doing their job efficiently and easily. This product is proudly designed by us, Mapua University students.

1.4. Potential Impact on the Society

We are students from one of the highly respected and highly reputable engineering schools in the Philippines. With our knowledge we were able to come up with a design that saves space and lightweight. The hydraulic maintenance platform that we have designed is cost-effective and is designed to last especially in the aviation field. Some features were also added for the crew's ease of use.

We take pride that our product can compete globally by applying the knowledge, principles, and creativity that we obtained from our school. We also took into consideration the school's vision that "Mapua shall be among the best universities in the world.", and we made sure to include the school's nature of competitiveness for our product to fit global standards.

1.5. Project Goals and Objectives

The main goal and objective of this project is to design an aircraft maintenance platform using Fusion360, then the actual product will be made on site by Tronair Inc. for better efficiency, cost-effectivity, and build quality. The product's structural integrity must also be considered as well as its reliability for the years to come to build a good relationship with the clients and potential buyers.

The first major milestone of this project is the design approval and meeting the standard needs of this product. Our professor first must approve the initial design that. We need to get feedback from him first regarding our design and which aspects need improvements. This will help guide us to reach our main goal that is to produce a quality hydraulic maintenance platform. The next milestone for this project is to have the company's approval to produce our desired product design. After the product has been approved, they will now fund this project and make the actual product possible.

1.6. Initial Project Constraints

The students must provide the company a new and improved design of "Hydraulic Maintenance Platform" that will aid the aviation company in providing outstanding products to their consumers and clients. Reducing the cost and efficiency while doing work is the main goal in doing this project. The product must be top notch, using the resources that the supplier provided. Taking into consideration that we aren't doing tasks face-to-face due to the pandemic; the budget is limited yet the product is high quality, and the structural integrity is not compromised, it can be concluded that the project is a success.

CHAPTER 2: PROJECT PLANNING AND TASK DEFINITION

2.1. Task Identification

2.1.1. ASSIGNING THE PROJECT

During our first class meeting, we made a proposal for bicycle helmet brakes and to redesign an automatic solar powered gate. Due to project and budget limitations, as well as the limit of doing practical work due to the pandemic, we ended up taking suggestions from our professor for possible project proposals. At the end, we up with the redesigning of hydraulic maintenance platform.

2.1.2. IMPROVING THE PRODUCT IDEA

Unfortunately, our team only had the chance to see the actual design of the product virtually. It would have been much better if we were able to see the product physically to better understand the actual hydraulic maintenance platform. Luckily, there are youtube videos that show what an actual maintenance platform is to give us a better idea on what it looks like in person, as well as a 360 view of it. After seeing samples of a maintenance platform, we started visualizing our own ideas and concepts. We then thought of better ideas and structural improvements for its design.

2.1.3. BUILDING A PRODUCT DESIGN CONCEPT

The process of building a design took our team some time. We used the software Autodesk Fusion 360. We need to do a complete analysis of the maintenance platform's each part and mechanism. After doing so, we selected the appropriate materials then tested its durability and workability.

2.1.4. GATHERING INFORMATION ABOUT THE PROPOSED PRODUCT DEIGN

By utilizing zoom and having weekly calls with our team and our professor, we had the chance to further improve our proposed design. Our professor graciously guided us with our design; he pointed out the parts that needed improvement, corrected our errors, commended us on the parts we did right, and provided us some insight. Also, with the aid of several websites and textbooks about maintenance platforms.

2.1.5. REVISING THE PRODUCT BASED ON THE GATHERED INFORMATION

All comments and recommendations that our team was able to gather through these processes were done with the utilization of Autodesk Fusion 360 software.

2.1.1. REVISING THE PRODUCT DESIGN

With the use of Autodesk Fusion 360, the design process was done by redesigning the actual proposed product and going through its concepts and actual design. Going through each component and studying its build quality to find out what material or which design principle can be altered for better results.

2.2. Gantt Chart

Task Name	Start Date	End Date	Duration
Assigning the project	May 24	May 31	8
Improving the product idea	May 31	June 3	4
Building a product design concept	June 3	June 7	5
Gathering information about the proposed product design	June 7	July 12	35
Revising the product based on the gathered information	June 7	Aug 1	55
Revising the product design	June 7	Aug 5	61

Table 1. List of Task Duration

Task Name	5/31/21	6/3/21	6/7/21	7/12/21	8/1/21	8/5/21
Assigning the project						
Improving the product idea						
Building a product design concept						
Gathering information about the proposed product design						
Revising the product based on the gathered information						
Revising the product design						

CHAPTER 3: LITERATURE REVIEW

3.1. Related Articles

3.1.1. 15F2918 Multi-Purpose Maintenance Platform

Figure 1. Multi-Purpose Maintenance Platform

The Multi-Purpose Maintenance Stands are compatible with several aircraft models and may be used for wing, engine, or fuselage maintenance. This maintenance platform has pullouts to conform to any aircraft shape with protective bumpers for aircraft protection.

TECHNICAL FEATURES:

- Platform Dimensions: 60"W x 145"L; with pullouts extended Platform Dimensions: 88¼"W x 145"L
- Adjustable 4.5' to 6', in 5" increments
- 1000 lbs. capacity

- All-steel, welded construction

- Morton tread grip decking
- Adjustable pullout planks
- Forklift pockets integrated in frame
- Adjustable pullout handrails
- Adjustable pullout stabilization jacks
- Overall dimensions: 68"W x 95"H x 159"L
- Epoxy powder coat

3.1.2. Aft Equipment Bay Stand

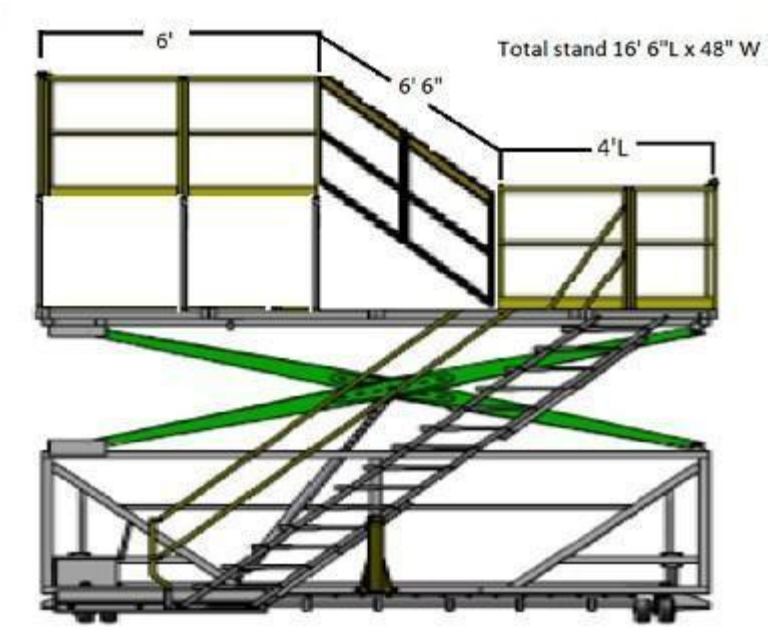


Figure 2. Aft Equipment Bay Stand

The custom Aft Equipment Bay maintenance platform provides a safe alternative to A-Frame style ladders by providing a stable, tip free and easily mobile platform for getting in and out of aircraft equipment

bays. This stand is compatible with the A300 Series (A318, A319, A320, A21, A330, A340) and Boeing 737, 757, and 767.

TECHNICAL FEATURES:

- Platform dimensions: 48”W x 16’6”L
- 24"W stairs stay parallel at any height
- Adjustable pull out handrails
- All steel, welded construction
- Morton tread grip decking
- 1,000 lbs capacity
- Towbar Included
- Epoxy powder coat paint
- 48"H of adjustability
- DC power hydraulics

3.1.3. Wide Body Nose Dock

Figure 3. Wide Body Nose Dock

The Wide Body Nose Dock facilitates nose maintenance and completion of windshield placement. The base footprint of the stand is constructed primarily of 6061-T6 aluminum. Top platform is 24' x 14' and is height-adjustable from 159" to 183" using proprietary jacks.

TECHNICAL SPECIFICATIONS:

- Leveling and stabilizing jacks
- OSHA and ANSI compliant design
- 42"H guardrails,21"H mid-rails and 4"toe-boards
- Top platform height is adjustable from 159" to 183"
- Articulating stairways self-adjust for height differentials
- Adjustable sliding deck sections with non-marking protective rubber bumper along slider edges
- Constructed from 6061-T6 aluminum
- Platform area of 24' x 14' area around the nose
- Designed-for-purpose non-slip decking on platforms
- HD 12” swivel casters with brakes and swivel locks
- Sliders allow for contouring to the profile of aircraft tail due to variations of stand placement.
- Pricing includes: Design, Engineering, Manufacturing/Fabrication

3.1.4. Adjustable Fall Protection Platform Cage

Figure 4. Adjustable Fall Protection Platform Cage

The Adjustable Fall Protection Platform Cage provides a safe, OSHA compliant work area while offering fall protection for your hard to access maintenance needs. This is an extremely versatile adjustable fall protection cage mounted to a 4' by 4" work platform. Adjustable height 5' to 23' with adjustable cage size up to 10' by 10'.

TECHNICAL FEATURES:

- Hand operated stabilizer jacks
- Grip strut steps prevent buildup.
- Basket has 10' square safety fence
- Adjustable platform height of 5' to 23'
- Certified to withstand 90 mph winds
- Safety fence can be adjusted to the slope of the wing

surface

3.1.5. B7 Aircraft Maintenance Platform

Figure 5. B7 Maintenance Platform

The B7 Aircraft Maintenance Platform is a practical and economic solution for high and overhead maintenance or production jobs that are 7' to 15' off the ground. It is also used as temporary access stairway for aircraft and construction work. The B7 Stand features a 4' x 7' work platform that may be positioned to any height in its range by means of its self-contained hydraulic system. Zero-emission 80V AC electric drive.

TECHNICAL FEATURES:

- Hydraulically elevates 7' to 15'
- Platform size: 48"W x 84"L
- Stairs stay parallel at any height
- HD 8" casters and 16" pneumatic
- Non-slip serrated treads and platfor

- Standard 500 lbs. capacity
- Fully contained hydraulic system
- OSHA and ANSI compliant design
- 42"H handrails with 21" mid-rails and 4" toe-boards
- Constructed from high grade carbon steel

3.1.6. B4 Aircraft Maintenance Stand

Figure 6. B4 Aircraft Maintenance Stand

The B4 Aircraft Maintenance Stand is a practical and economic solution for high and overhead maintenance or production jobs that are 3' to 7' 2" off the ground.

TECHNICAL FEATURES:

- Heavy duty carbon steel construction
- Hydraulically elevates 36" to 86"
- Platform size: 30"W x 76"L with bumper
- 42"H handrails with 21" mid-rails and 4" toe-boards
- Telescoping ladder to access platform
- OSHA and ANSI compliant design
- 500 lbs. capacity
- (4) 8" Swivel locking casters
- Tow bar included
- Foot actuated hydraulic pump

3.1.7. FRP Composite B5 Aviation Maintenance Platform

Figure 7. FRP Composite B5 Aviation Maintenance Platform

The FRP Composite B5 Aviation Maintenance Platform is a practical and economic solution for high and overhead maintenance or production jobs that are 88" to 130″H. The composite construction provides a solution that is environmentally responsible, more effective and more resourceful than traditional non-renewable material such as steel.

TECHNICAL FEATURES:

- Platform height: 88" -130″ (2.24m– 3.30m)
- FRP Composite main construction
- UV-resistant surface veil standard
- Removable 42"H FRP handrails with 21" mid-rails
- Onboard storage hooks for removable railings
- Non-conductive, non-sparking and corrosion-resistant design
- Platform size: 3′ x 7′ (.91m – 2.13m)
- 750 lbs. (340.19 kg) max capacity
- OSHA and ANSI compliant design
- FRP platform gritted non-slip surface
- Front side bumper for aircraft protection
- Easy to operate, high-capacity manual hydraulic hand pump

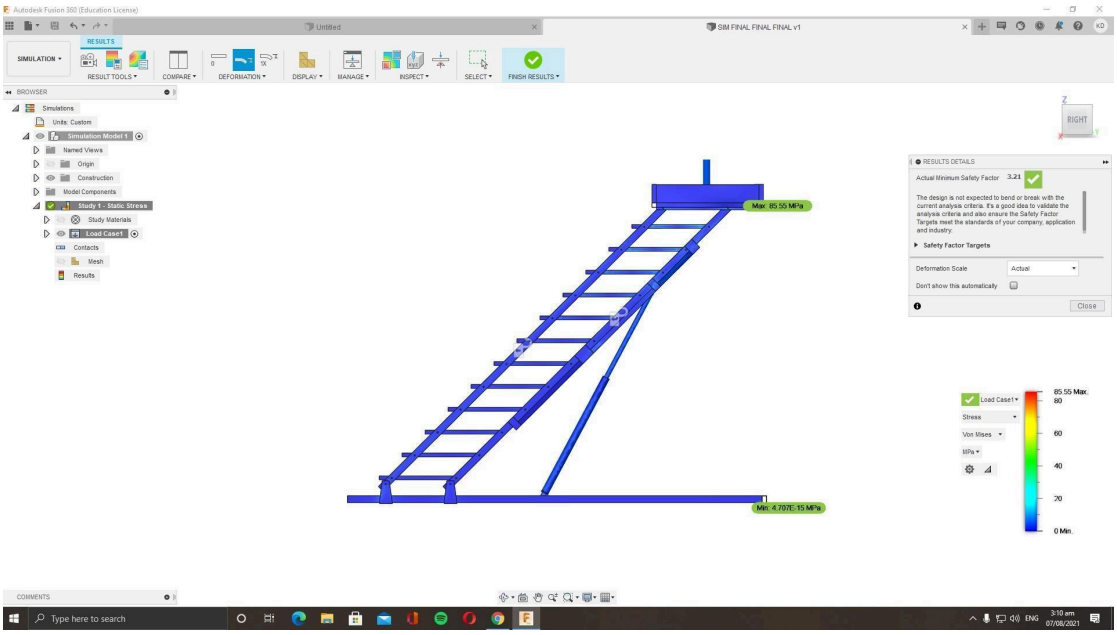
- Telescoping FRP composite ladder allows access at any height
- Lightweight construction and stronger, pound-for-pound, than steel
- Steel tow bar with pintle eye, locks in the upright position when not in use
- Platform locking pins for additional safety, spaced for 6” height adjustments
- Pump controls and locking pins are accessible from ground level to meet AFM
- Compact 62-3/4” x 88-3/8” (1.59m x 2.25m) Base size for low cost transportation
- (4) 6″ (15.24 cm) locking swivel casters with independent brakes and swivel locks
- Removable composite 42”H (1.07m) guardrails with 21" mid-rails and 4" toe-boards
- The stand base features a counterweight for stability and safe climbing at any height

3.2. Design Theories, Design Constraints, Applicable Codes and Standards Used in the Design

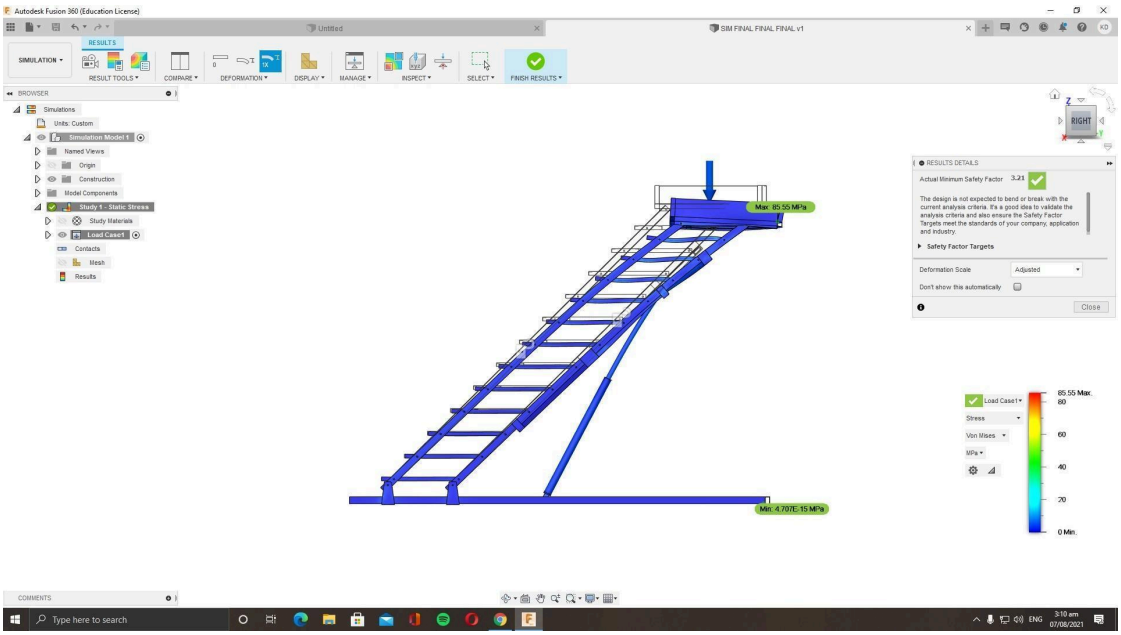
3.2.1. Design Constraints

Tronair Inc's. quality aircraft equipment is based on international standards and specifications where errors are kept to a bare minimum. Of course, we must also meet those standards. In doing so, we used Autodesk Fusion 360 software, the group designed and simulated the process on how it was done and operated. Component design has been labeled and drawn in scale to the exact specifications and dimensions for better visualization of the final output. Our group considered the parts where the maintenance platforms needed redesigning and improvement for the structure's overall weight and mobility.

3.2.2. Strength Test



Deformation Scale: Actual



Deformation Scale: Adjusted 1.0X

SOLUTION:

$$Mass = 180\ kg$$

$$Gravity = acceleration = 9.8\frac{m}{s^2}$$

$$F = m * a$$

$$F = 180\ kg * 9.8\frac{m}{s^2}$$

$$F = 1,764\ N$$

CHAPTER 4: DESIGN CONCEPTUALIZATION AND FINAL DESIGN SELECTION

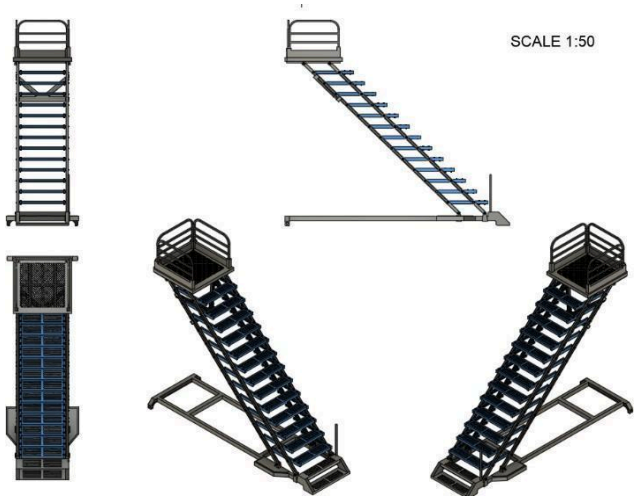
4.1. Design Considerations

In making the design output, we based all the parts through the actual product of Tronair, Hydraulic Maintenance Platform (B1 Type). The group decided to make the

maintenance platform as economical as possible while maintaining the quality and the safety standard. The group advised that when designing this maintenance platform, we must aim that this design can be manufactured in real events. Our team make sure that all the materials used in the design are available in the market and can easily assembled while manufacturing the product.

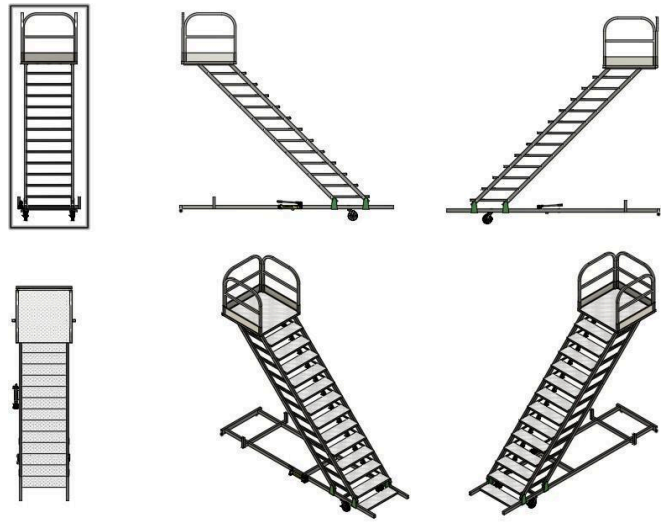
4.2. Concept Generation

4.2.1 First Design Draft

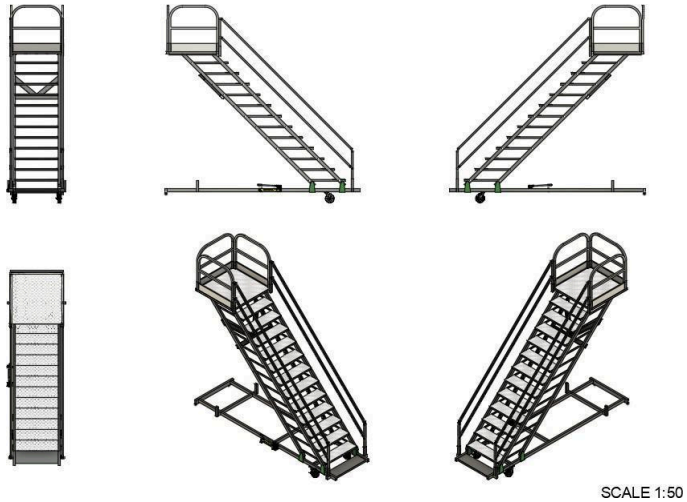


4.2.2. Second Design Draft

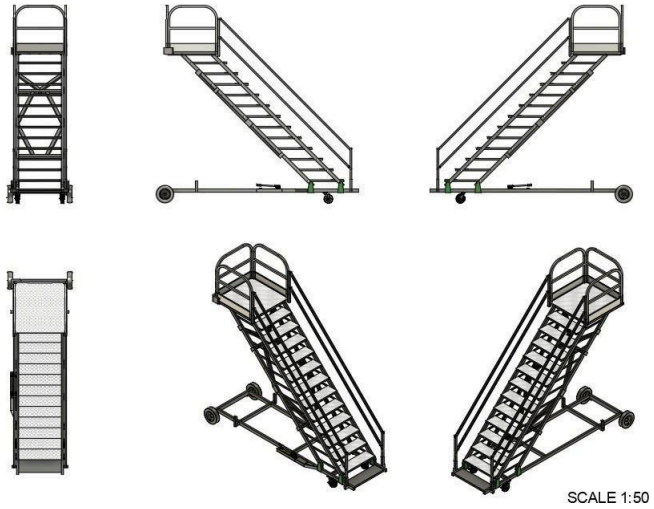
4.2.3. Third Design Draft



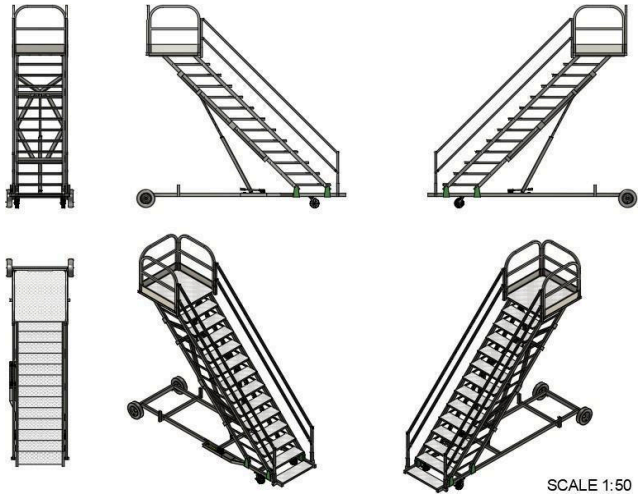
4.2.4. Fourth Design Draft



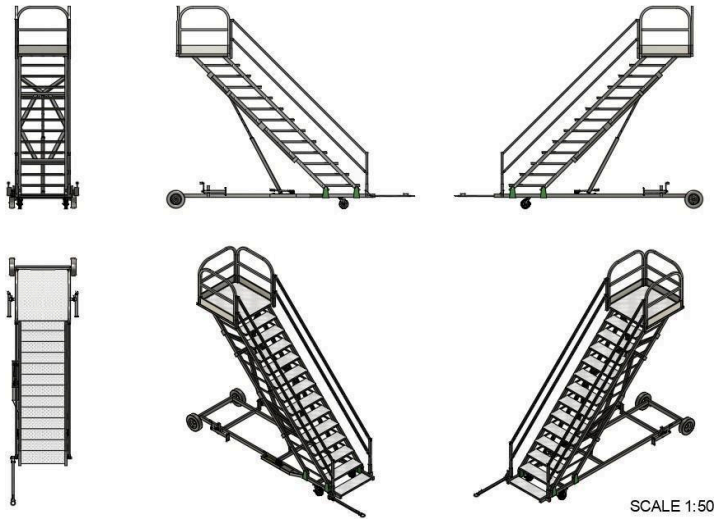
4.2.5. Fifth Design Draft



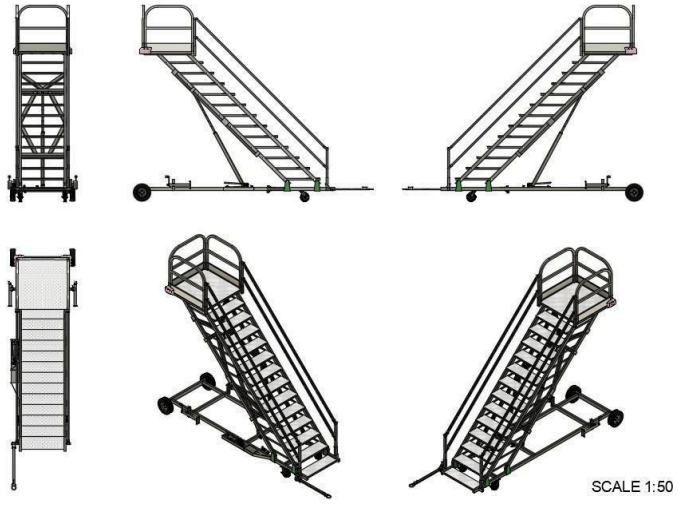
4.2.6. Sixth Design Draft



4.2.7. Seventh Design Draft



4.2.8. Eighth Design Draft



4.3. Concept Evaluation and Selection

Item	Description	Qty
1	Main Frame Weldment	1
2	Caster	2
3	Jack	2
4	4, Bolt Hub	2
5	Wheel Assembly	2
6	3/8 – 24 NF x 1 ¼ LG	8
7	3/8 – 24 UNF Nylok Nut	52
8	½ - 20 x 4 ½ LG CS	8
9	½ - 20 Nylok Nut	8
10	Lift Rail Spacer	8
11	1 Nylok Nut	3
12	1 – 14 x 5 ½ LG CS	1
13	3/8 Elbow	2
14	Bushing	3
15	Breather	1
16	3/8 x ¼ Right Angle Male Swivel	1
17	3/8 Male Tee	1
18	3/8 Gate Valve	1
19	3/8 Close Nipple	1
20	Oil Filter Bracket	1
21	Filter	1
22	Swivel Adapter	1
23	Street Elbow	2
24	Dual Acting Pump	1
25	3/8 x ¼ Reducing Bushing	1
26	Valve	1
27	3/8 Nipple	1
28	3/8 x ½ Reducing Bushing	1
29	½ x 3/8 Female Swivel	1
30	Hydraulic Cylinder	1
31	¼ x ¼ Female Swivel	1

32	¼ Needle Valve	1
33	¼ M Nipple	1
34	Service Tee	1
35	Hose Assembly	1
36	Hose Assembly	1
37	9/16 x ¼ Right Angle Swivel	1
38	Hose Assembly	1
39	Hose Assembly	1
40	Hose Assembly	1
41	¼ NF x 3 ¼ LG CS	2
42	¼ - 28 Nylok Nut	3
43	Handle Pump	1

4.3.1 Availability in the Market

Item	Description	Qty	YES	NO
1	Main Frame Weldment	1	*	
2	Caster	2	*	
3	Jack	2	*	
4	4, Bolt Hub	2	*	
5	Wheel Assembly	2	*	
6	3/8 – 24 NF x 1 ¼ LG	8	*	
7	3/8 – 24 UNF Nylok Nut	52	*	
8	½ - 20 x 4 ½ LG CS	8	*	
9	½ - 20 Nylok Nut	8	*	
10	Lift Rail Spacer	8	*	
11	1 Nylok Nut	3	*	
12	1 – 14 x 5 ½ LG CS	1	*	
13	3/8 Elbow	2	*	
14	Bushing	3	*	
15	Breather	1	*	
16	3/8 x ¼ Right Angle Male Swivel	1	*	
17	3/8 Male Tee	1	*	
18	3/8 Gate Valve	1	*	

19	3/8 Close Nipple	1	*	
20	Oil Filter Bracket	1	*	
21	Filter	1	*	
22	Swivel Adapter	1	*	
23	Street Elbow	2	*	
24	Dual Acting Pump	1	*	
25	3/8 x ¼ Reducing Bushing	1	*	
26	Valve	1	*	
27	3/8 Nipple	1	*	
28	3/8 x ½ Reducing Bushing	1	*	
29	½ x 3/8 Female Swivel	1	*	
30	Hydraulic Cylinder	1	*	
31	¼ x ¼ Female Swivel	1	*	
32	¼ Needle Valve	1	*	
33	¼ M Nipple	1	*	
34	Service Tee	1	*	
35	Hose Assembly	1	*	
36	Hose Assembly	1	*	
37	9/16 x ¼ Right Angle Swivel	1	*	
38	Hose Assembly	1	*	
39	Hose Assembly	1	*	
40	Hose Assembly	1	*	
41	¼ NF x 3 ¼ LG CS	2	*	
42	¼ - 28 Nylon Nut	3	*	
43	Handle Pump	1	*	

4.3.2. Directory for the Suppliers

Company Name: Seno Hardware Inc.

Contact Person: Mrs. Nene

Phone: 0932-9012-889

Address: Lot 2 ITC Compd., Valenzuela, Metro Manila

Company Name: Greson Industrial Sales Corporation

Contact Person: Mrs. Berna

Phone: 0930-6063-223

Address: 100 5th St, East Grace Park, Caloocan, Metro Manila

Company Name: Samco Bolts and Nuts Center

Contact Person: Mr. Guiller

Phone: 0922-8431-113

Address: 120 7th Ave, Grace Park West, Caloocan, 1405 Metro Manila

Company Name: J. Jesar General Merchandise

Contact Person: Mr. Tony

Phone: 0932-5633-975

Address: MacArthur Highway Malanday Valenzuela Metro Manila

Company Name: Rallyson Enterprises

Contact Person:

Phone: (02) 8364 2267

Address: 100 C-3 road Corner B. Serrano Grace Park, Barangay 116, Caloocan, Metro Manila

Company Name: Megawell Industrial Marketing Corporation

Contact Person:

Phone: +63 (2) 8 367 2870

Address: 80, Rizal Avenue, Caloocan City 1405 Metro Manila

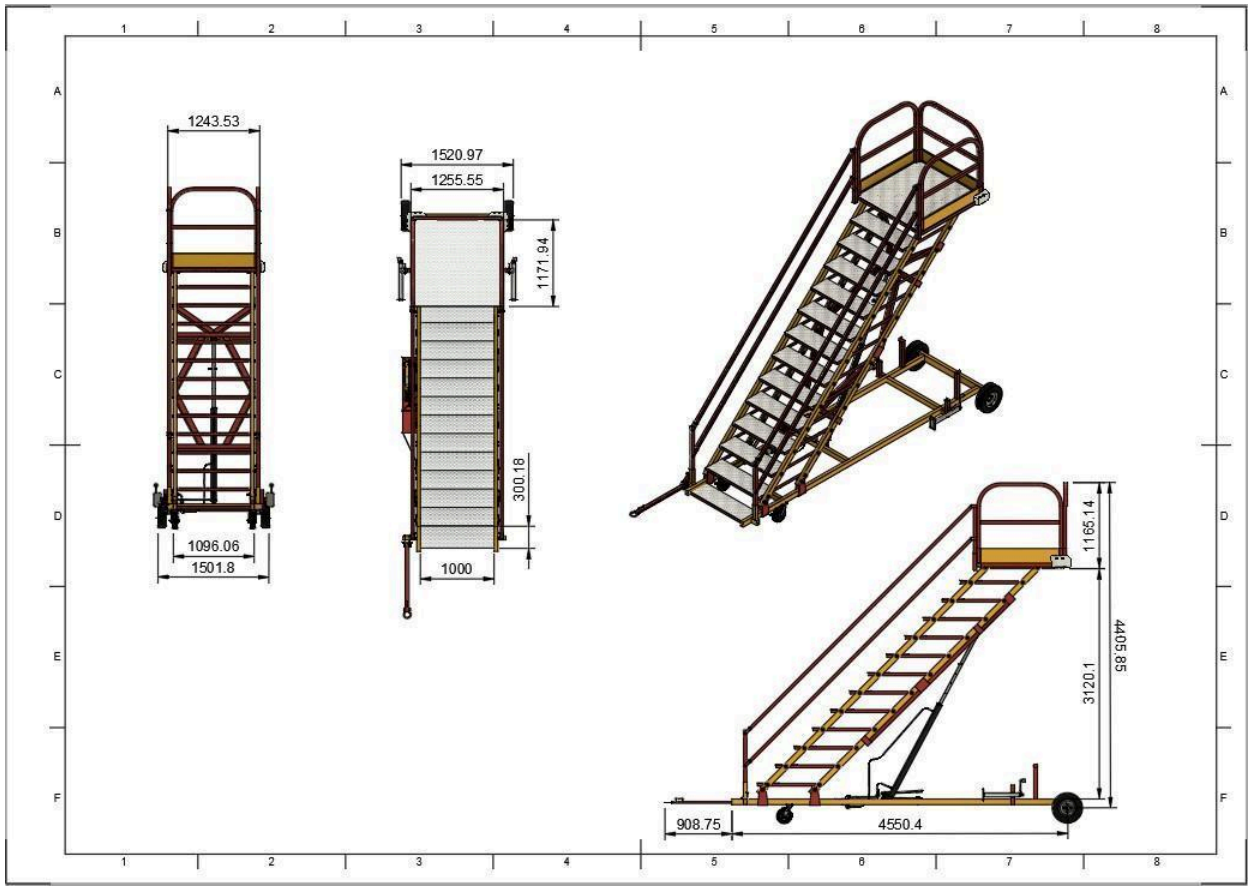
Company Name: Hi-Top Merchandising Inc.

Contact Person: Mrs. Lourdes

Phone: 09190845009

Address: 227 Biak Na Bato Street corner Sgt. Rivera Street, Brgy. Manresa, Quezon City

4.4. Final Design



CHAPTER 5: DETAILED PRODUCT DESIGN

5.1. Engineering Analysis and Simulation

5.1.1 Hydraulic Hand Pump

Figure 8. FRP ENERPAC P842

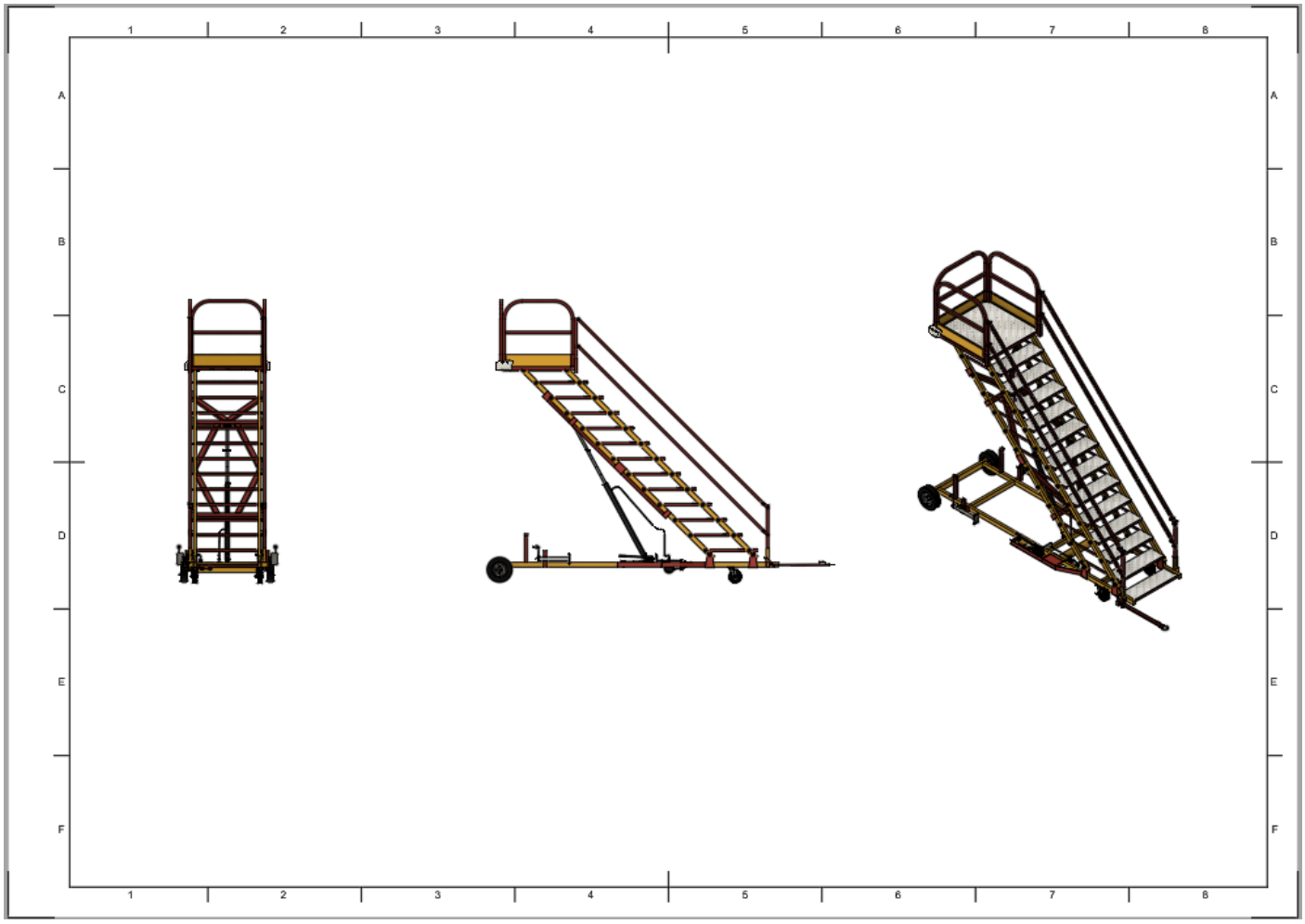
Model Number	Maximum Operating Pressure (psi)	Pressure Rating (psi) 1st Stage	Pressure Rating (psi) 2nd Stage	Cylinder Compatability	Pump Type	Reservoir Capacity (in^3)	Usable Oil Capacity (in^3)	Maximum Flow at Rated Pressure	Oil Displacement per Stroke (in^3)	Oil Displacement per Stroke (in^3) 1st Stage	Oil Displacement per Stroke (in^3) 2nd Stage	Maximum Handle Effort (lbs)	Piston Stroke (in)	Valve Operation	Power Source	Weight (lbs)
P141	10,000		10,000	Single-acting	Single Speed	20	20	.055 in3/stroke	0.055	-	-	72	0.5	Manual	Manual	4.5
P391	10,000		10,000	Single-acting	Single Speed	55	55	.151 in3/stroke	0.151	-	-	85	1	Manual	Manual	9
P142	10,000	200	10,000	Single-acting	Two Speed	20	20	.055 in3/stroke	-	0.221	0.055	78	0.5	Manual	Manual	5.3
P202	10,000	200	10,000	Single-acting	Two Speed	55	55	.151 in3/stroke	-	0.221	0.055	63	0.5	Manual	Manual	7.5
P392	10,000	200	10,000	Single-acting	Two Speed	55	55	.151 in3/stroke	-	0.687	0.151	93	1	Manual	Manual	9
P802	10,000	400	10,000	Single-acting	Two Speed	155	155	.151 in3/stroke	-	2.4	0.151	95	1	Manual	Manual	18
P842	10,000	400	10,000	Double-acting	Two Speed	155	155	.151 in3/stroke	-	2.4	0.151	95	1	Manual	Manual	22
P39	10,000		10,000	Single-acting	Single Speed	41	41	.15 in3/stroke	0.15	-	-	85	1	Manual	Manual	13.6
P77	10,000	500	10,000	Single-acting	Two Speed	41	41	.15 in3/stroke	-	1	0.15	88	1	Manual	Manual	15.6
P80	10,000	500	10,000	Single-acting	Two Speed	134	134	.15 in3/stroke	-	1	0.15	77	1	Manual	Manual	23.6
P801	10,000	500	10,000	Single-acting	Two Speed	250	250	.15 in3/stroke	-	1	0.15	77	1	Manual	Manual	31
P84	10,000	500	10,000	Double-acting	Two Speed	134	134	.15 in3/stroke	-	1	0.15	77	1	Manual	Manual	26
P462	10,000	200	10,000	Single-acting	Two Speed	453	453	.29 in3/stroke	-	7.69	0.29	110	1.5	Manual	Manual	61

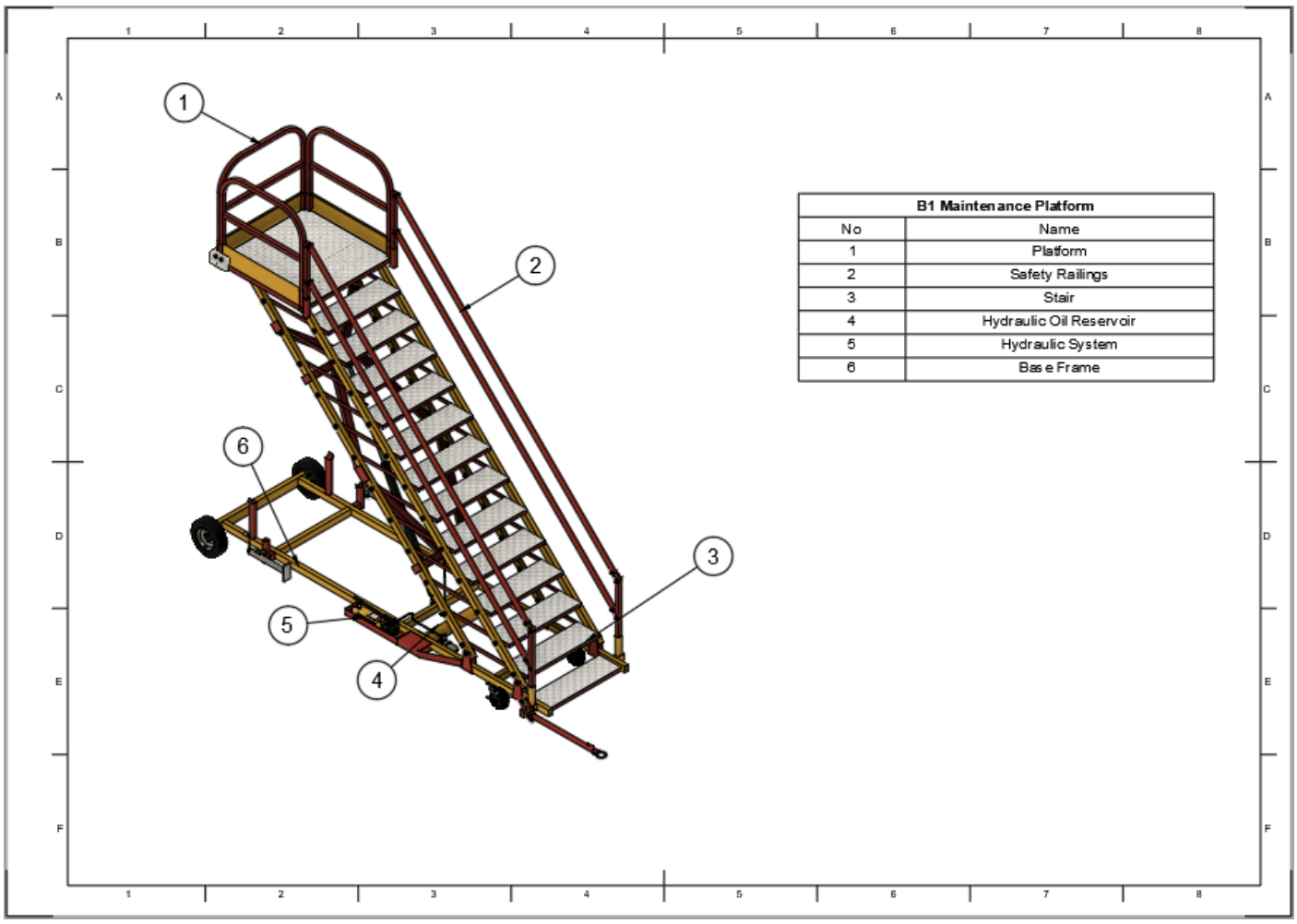
Product Lines: Industrial Tools

- Lightweight and compact design
- Durable glass-filled nylon reservoir and nylon encapsulated aluminum pump base for maximum corrosion resistance
- Two-speed operation on most models reduces handle strokes by as much as 78% over single speed pumps
- Lower handle effort to minimize operator fatigue

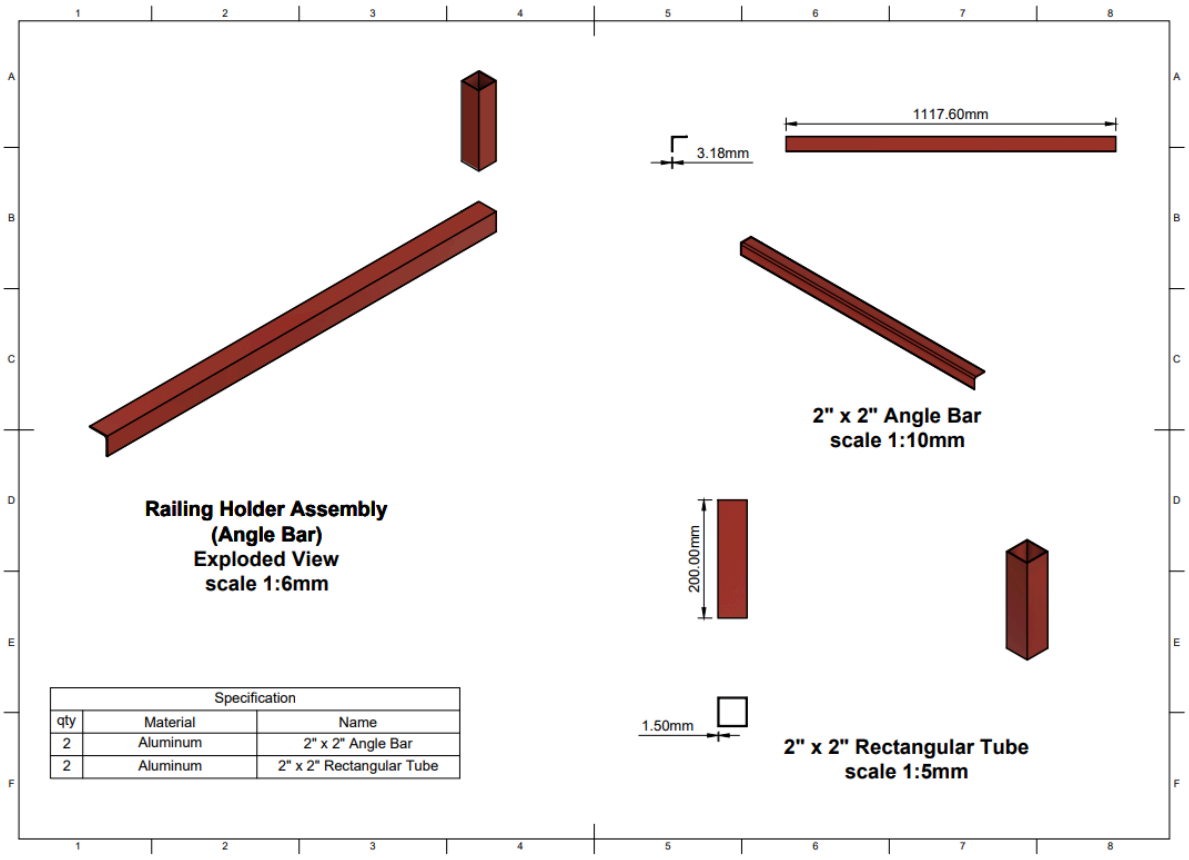
- Handle lock and lightweight construction for easy carrying
- Large oil capacities to power a wide range of cylinders or tools
- Non-conductive fiberglass handle for operator safety
- Internal pressure relief valve for overload protection

5.2. Layout / Detailed Drawings / Equipment Selection and Specifications

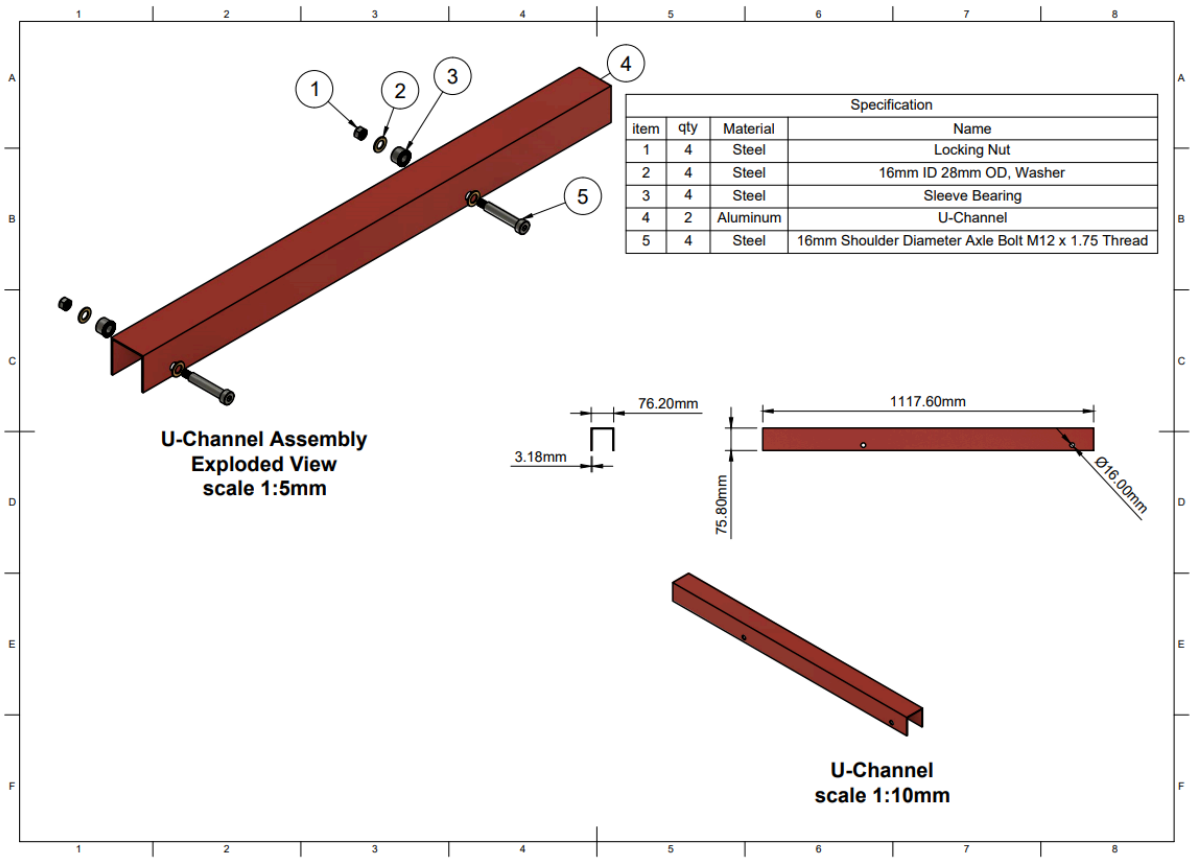




B1 Maintenance Platform	
No	Name
1	Platform
2	Safety Railings
3	Stair
4	Hydraulic Oil Reservoir
5	Hydraulic System
6	Base Frame

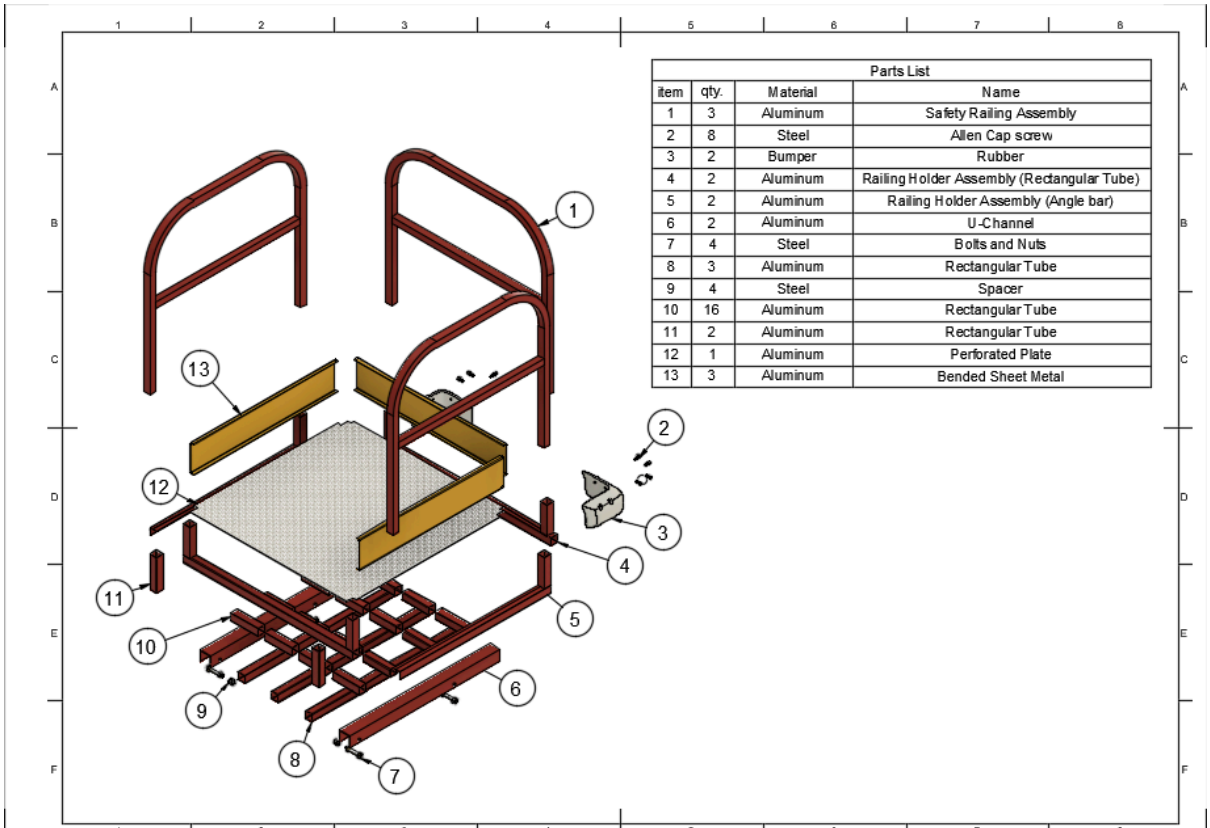


Specification		
qty	Material	Name
2	Aluminum	2" x 2" Angle Bar
2	Aluminum	2" x 2" Rectangular Tube

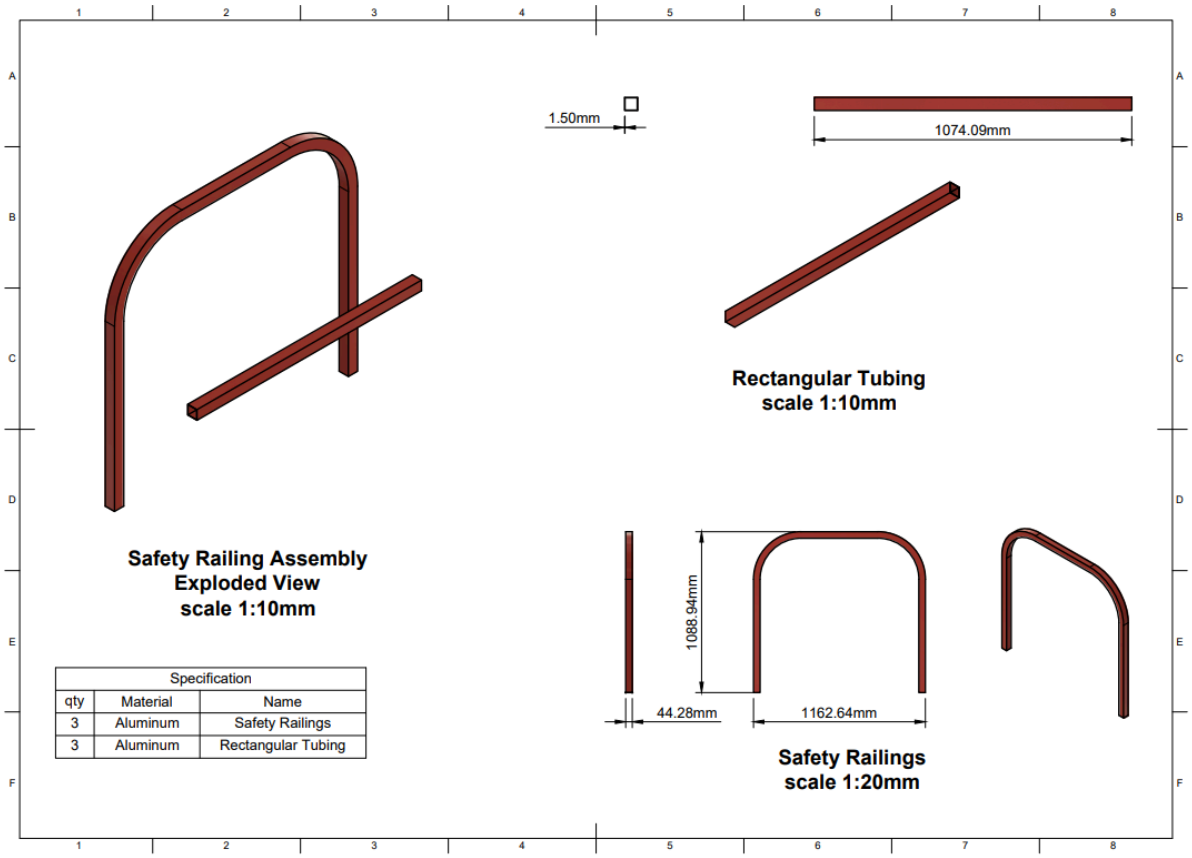


Specification			
item	qty	Material	Name
1	4	Steel	Locking Nut
2	4	Steel	16mm ID 28mm OD, Washer
3	4	Steel	Sleeve Bearing
4	2	Aluminum	U-Channel
5	4	Steel	16mm Shoulder Diameter Axle Bolt M12 x 1.75 Thread

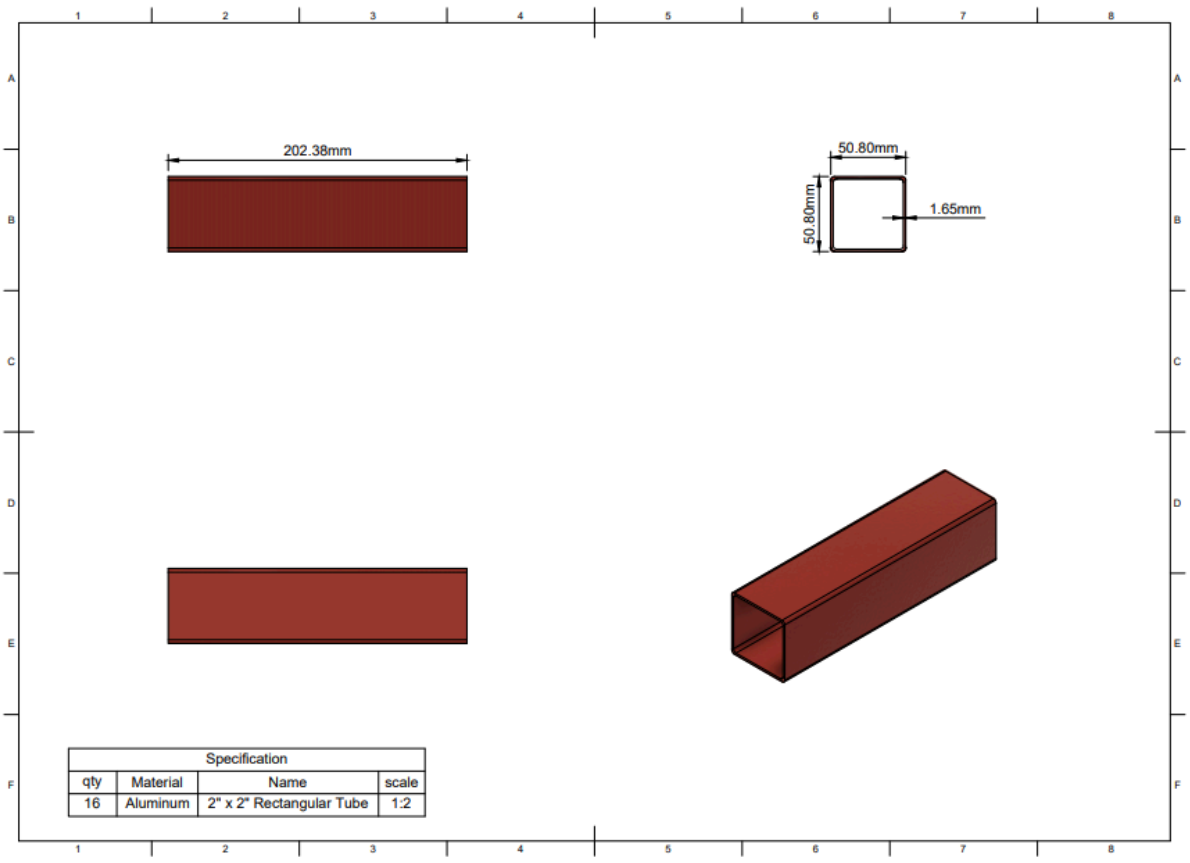
Platform Assembly



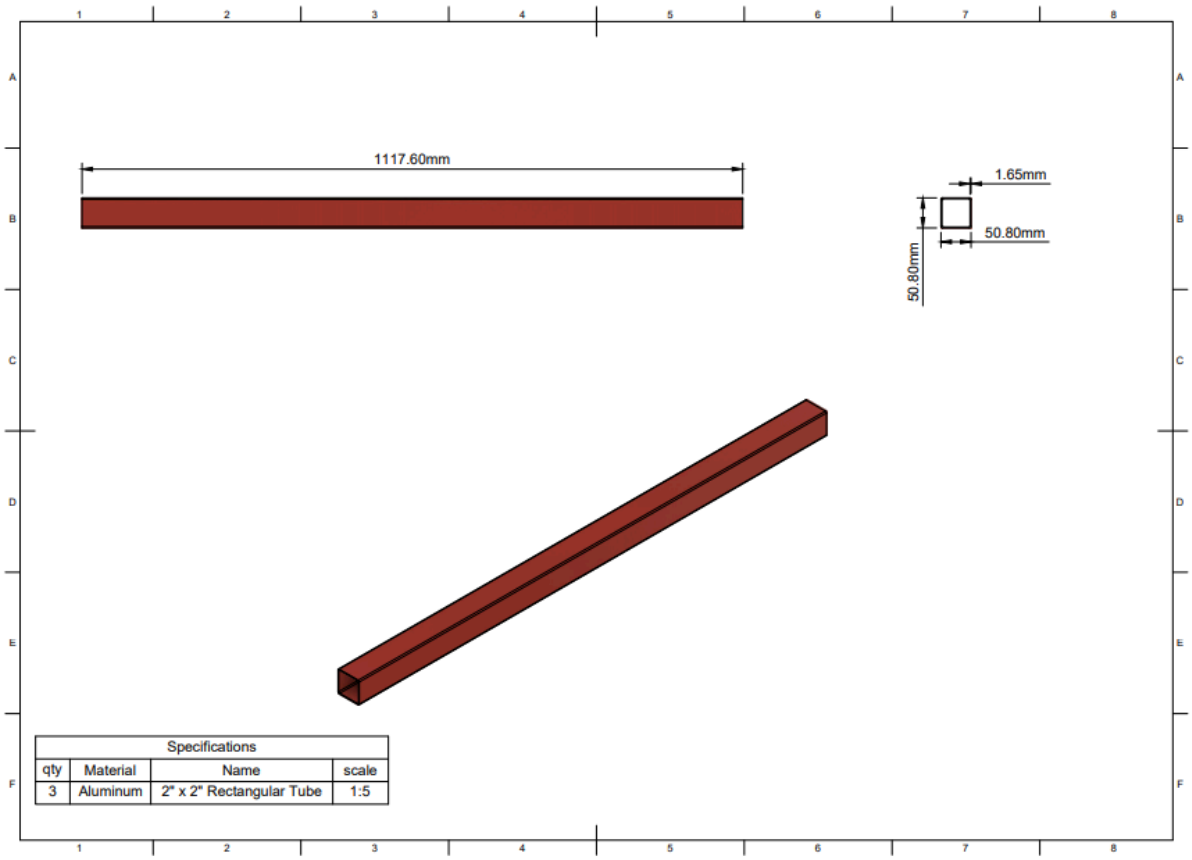
Parts List			
item	qty.	Material	Name
1	3	Aluminum	Safety Railing Assembly
2	8	Steel	Allen Cap screw
3	2	Bumper	Rubber
4	2	Aluminum	Railing Holder Assembly (Rectangular Tube)
5	2	Aluminum	Railing Holder Assembly (Angle bar)
6	2	Aluminum	U-Channel
7	4	Steel	Bolts and Nuts
8	3	Aluminum	Rectangular Tube
9	4	Steel	Spacer
10	16	Aluminum	Rectangular Tube
11	2	Aluminum	Rectangular Tube
12	1	Aluminum	Perforated Plate
13	3	Aluminum	Bended Sheet Metal



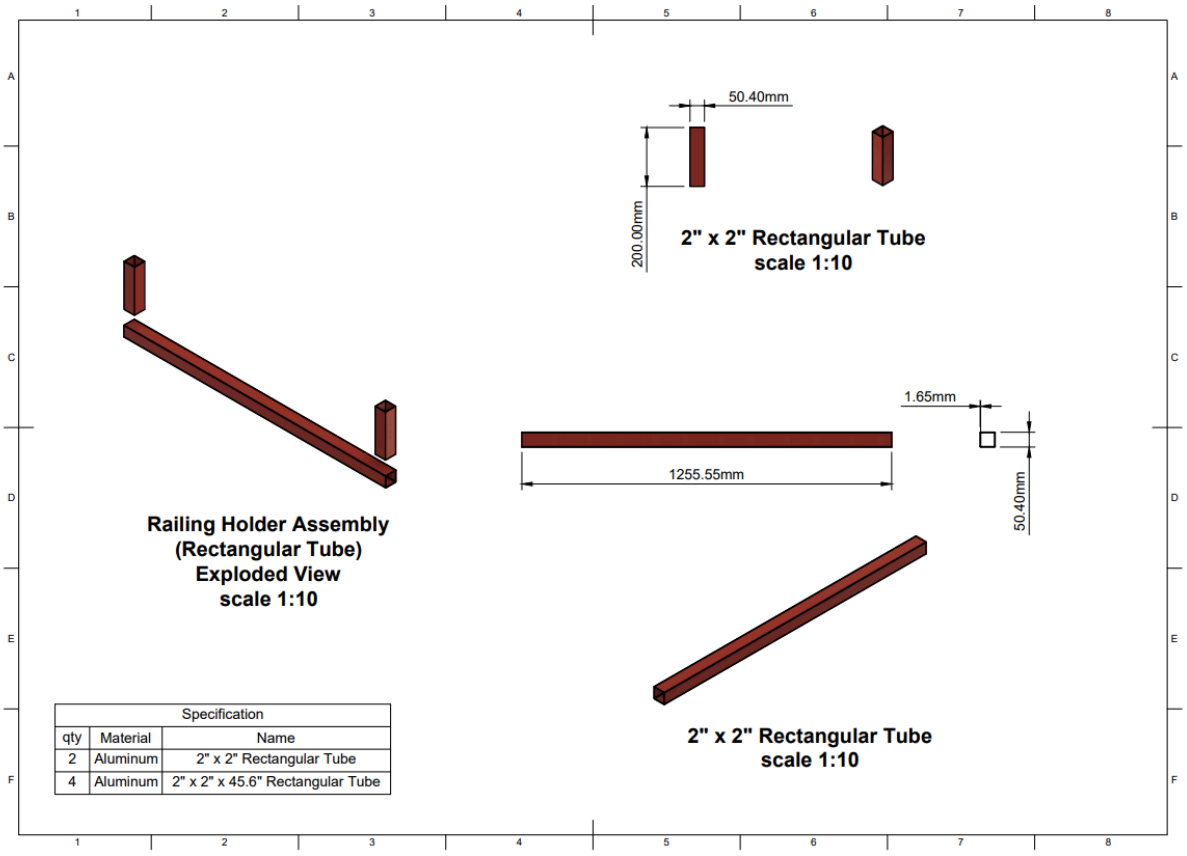
Specification		
qty	Material	Name
3	Aluminum	Safety Railings
3	Aluminum	Rectangular Tubing



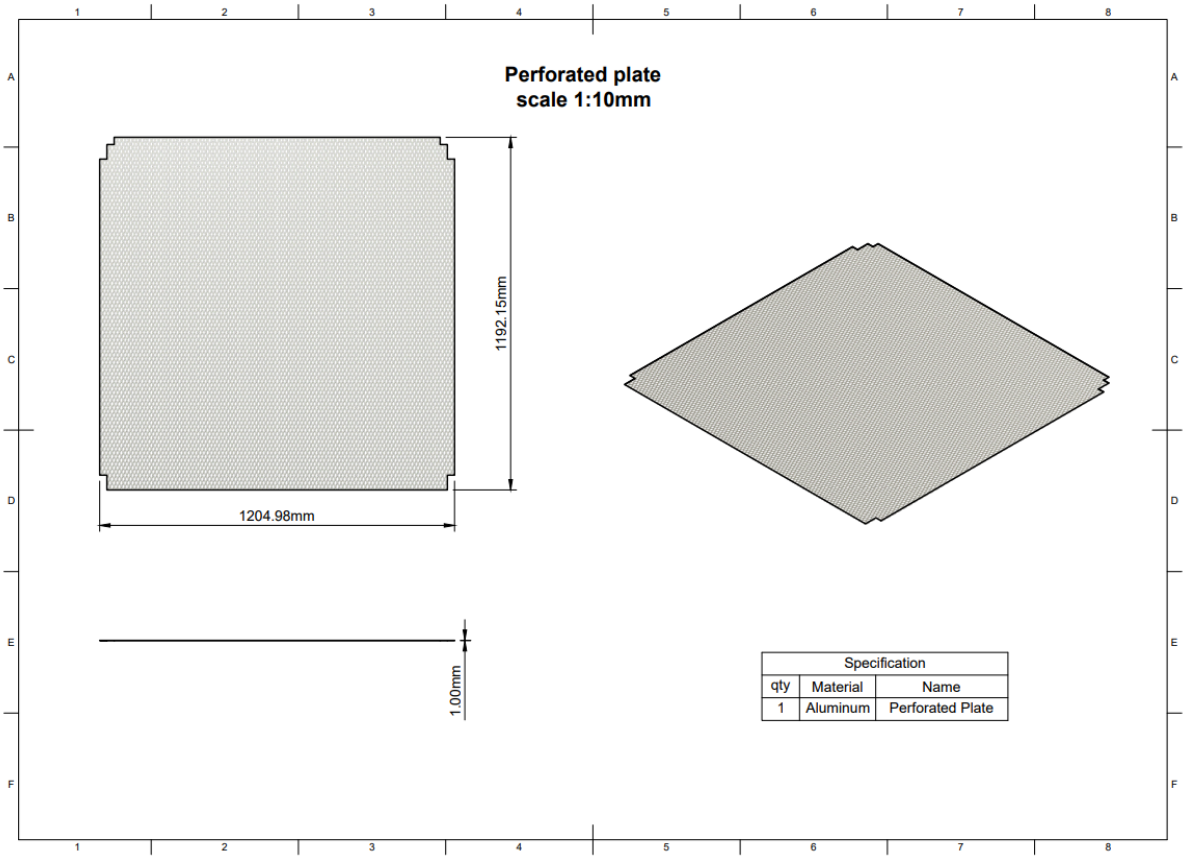
Specification			
qty	Material	Name	scale
16	Aluminum	2" x 2" Rectangular Tube	1:2



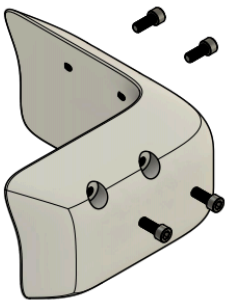
Specifications			
qty	Material	Name	scale
3	Aluminum	2" x 2" Rectangular Tube	1:5

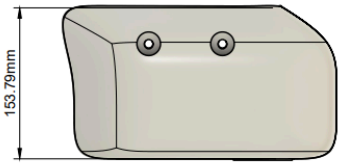


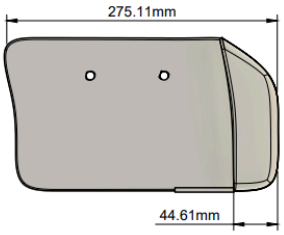
Specification		
qty	Material	Name
2	Aluminum	2" x 2" Rectangular Tube
4	Aluminum	2" x 2" x 45.6" Rectangular Tube

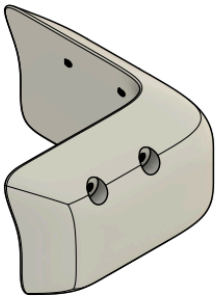

Perforated plate
scale 1:10mm
1192.15mm
1204.98mm
1.00mm
Specification
qty
Material
Name
1
Aluminum
Perforated Plate

Rubber Bumper Assembly
Exploded View
scale 1:3mm



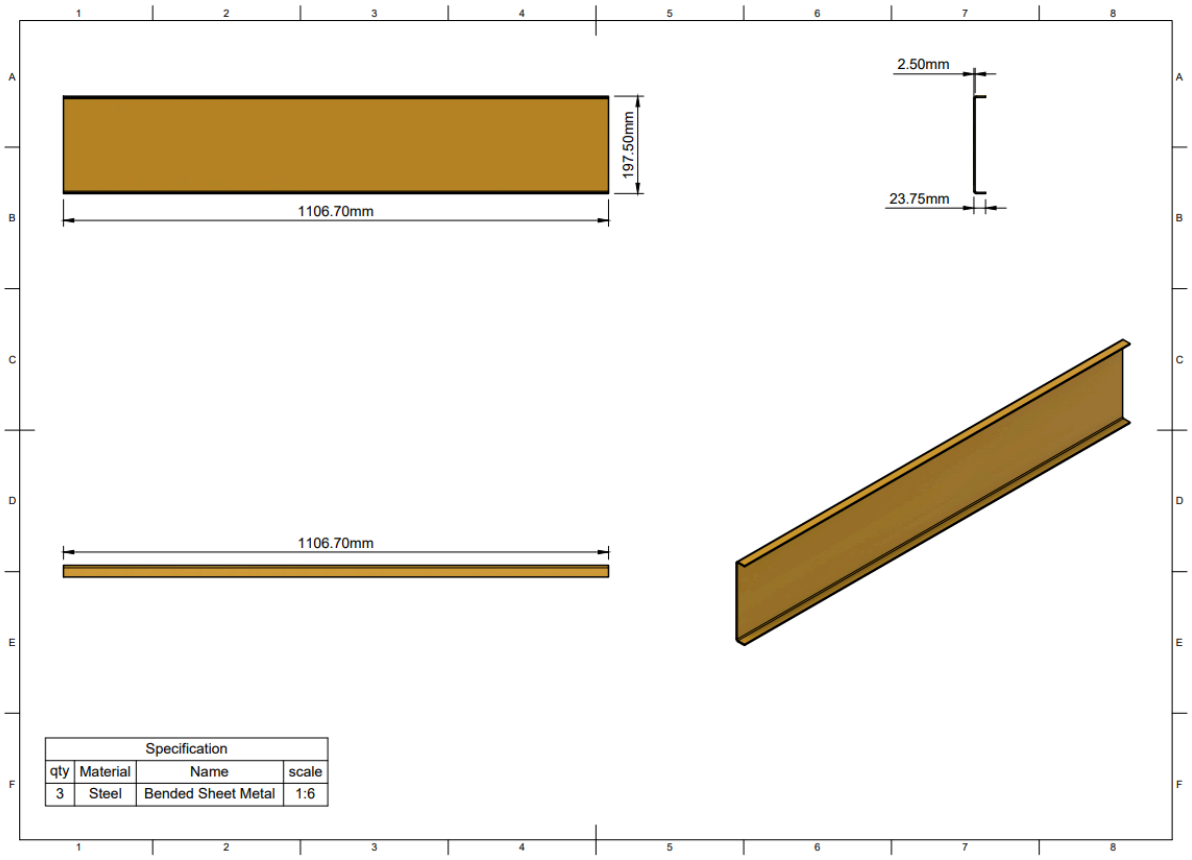






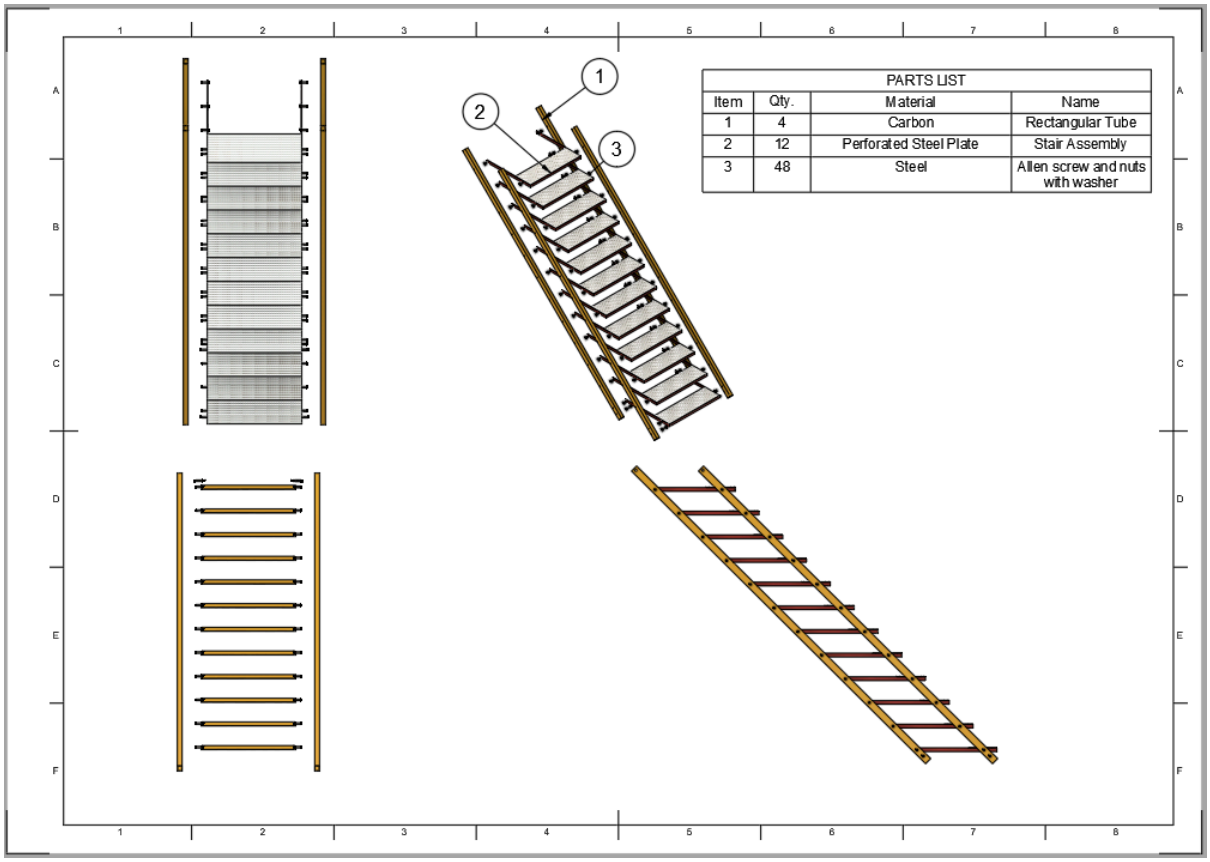
Specification		
qty	Material	Name
2	Steel	Allen Wrench Screws no.5
8	Rubber	Rubber Bumper

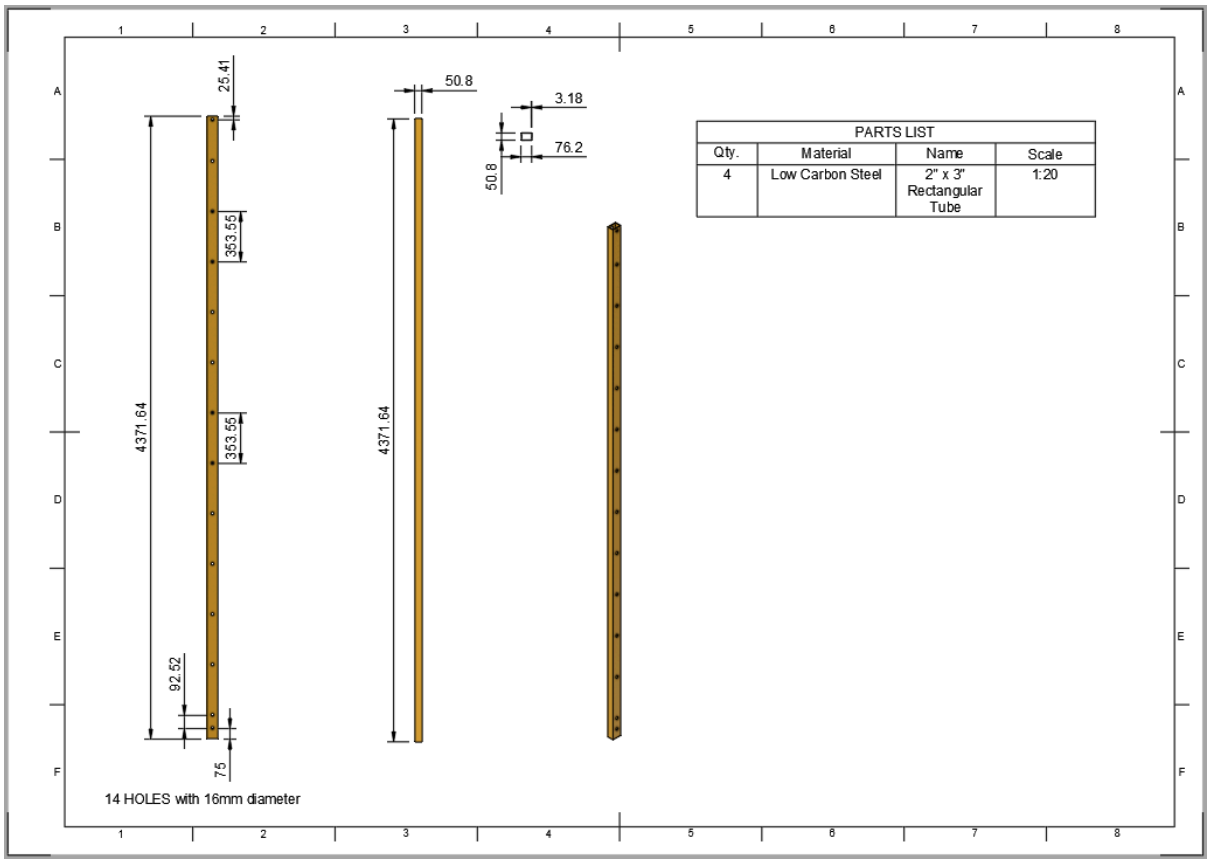
Rubber Bumper
scale 1:3mm



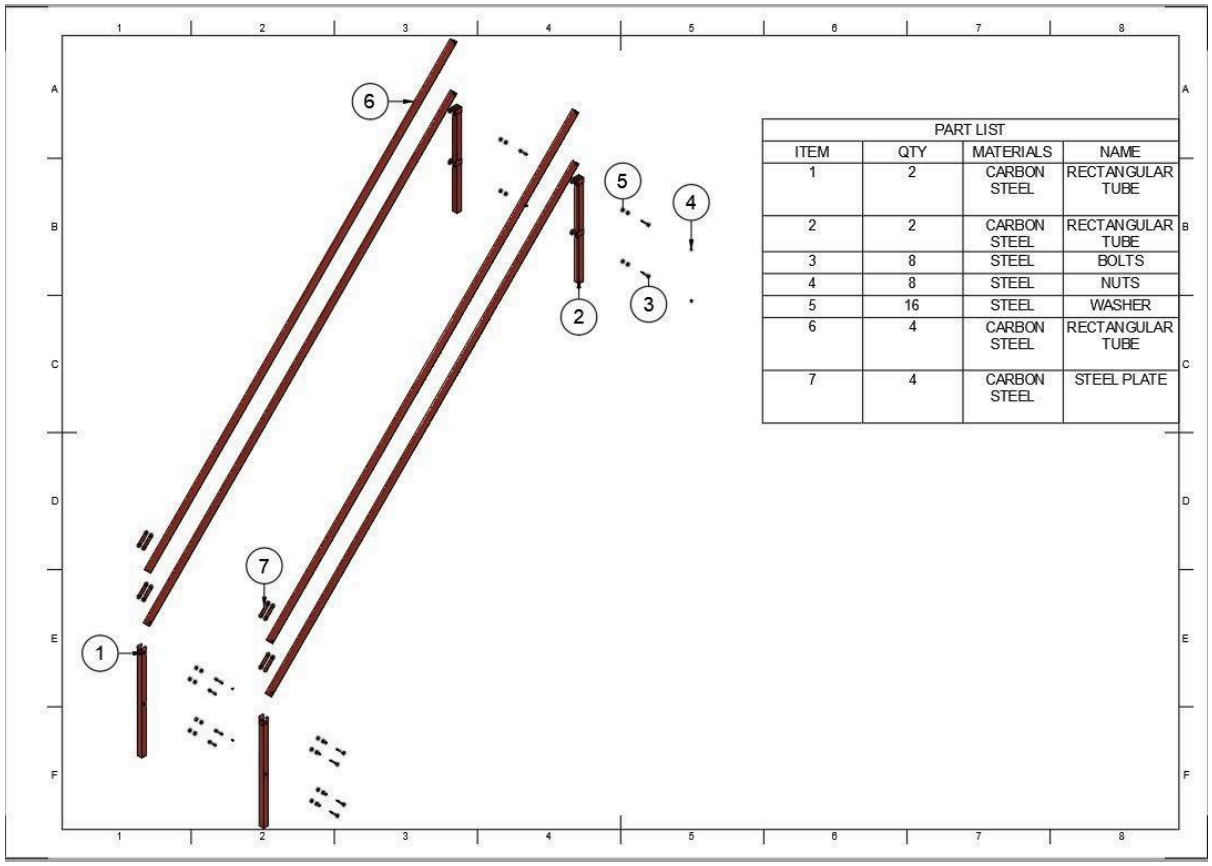
Specification			
qty	Material	Name	scale
3	Steel	Bended Sheet Metal	1:6

Members:

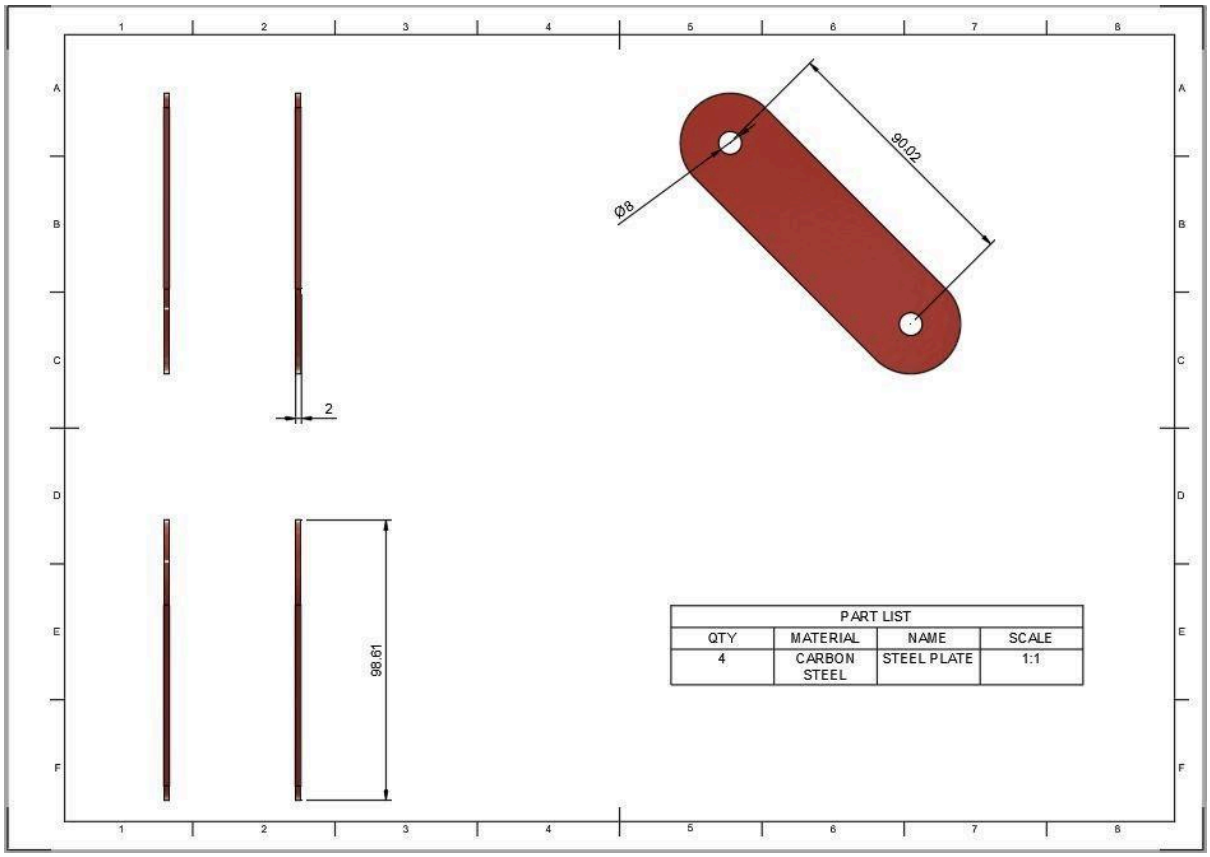

1
2
3
PARTS LIST
Item | Qty. | Material | Name
1 | 4 | Carbon | Rectangular Tube
2 | 12 | Perforated Steel Plate | Stair Assembly
3 | 48 | Steel | Allen screw and nuts with washer



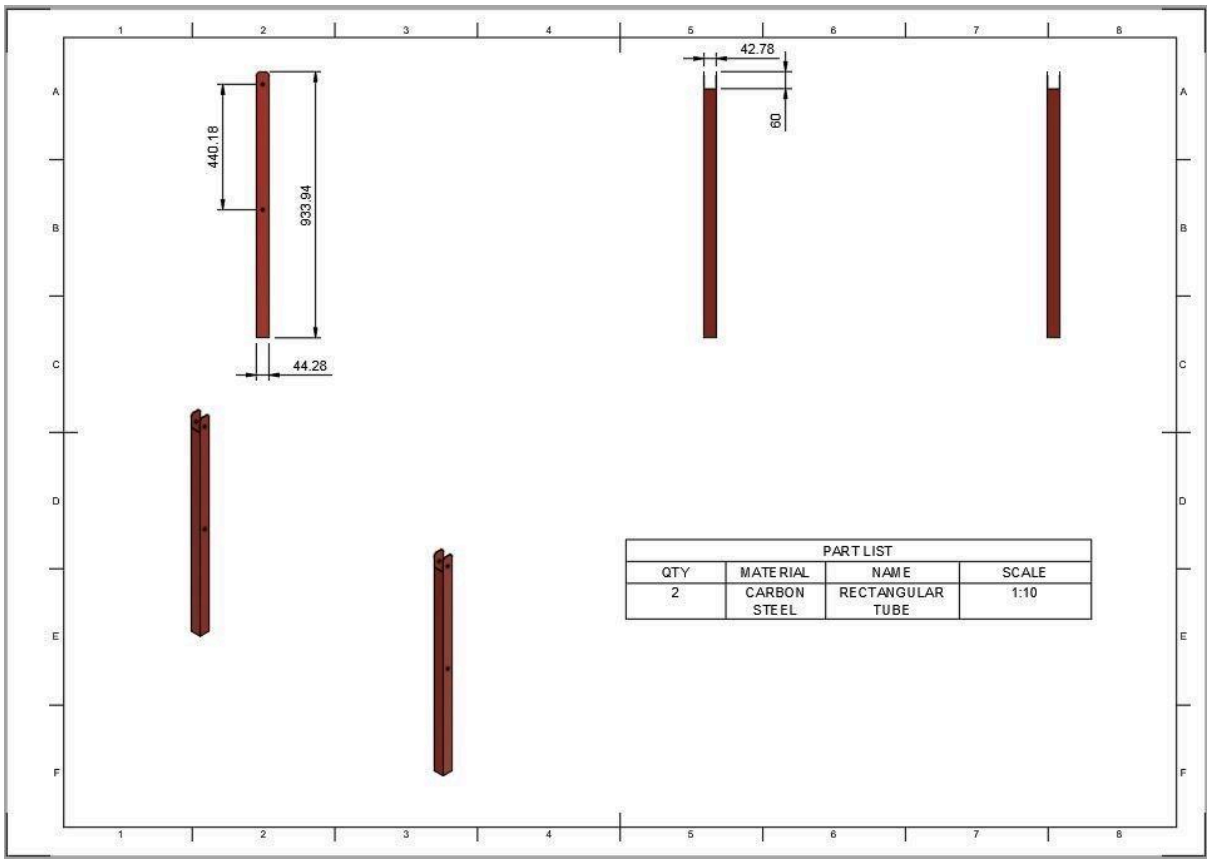
PARTS LIST			
Qty.	Material	Name	Scale
4	Low Carbon Steel	2" x 3" Rectangular Tube	1:20

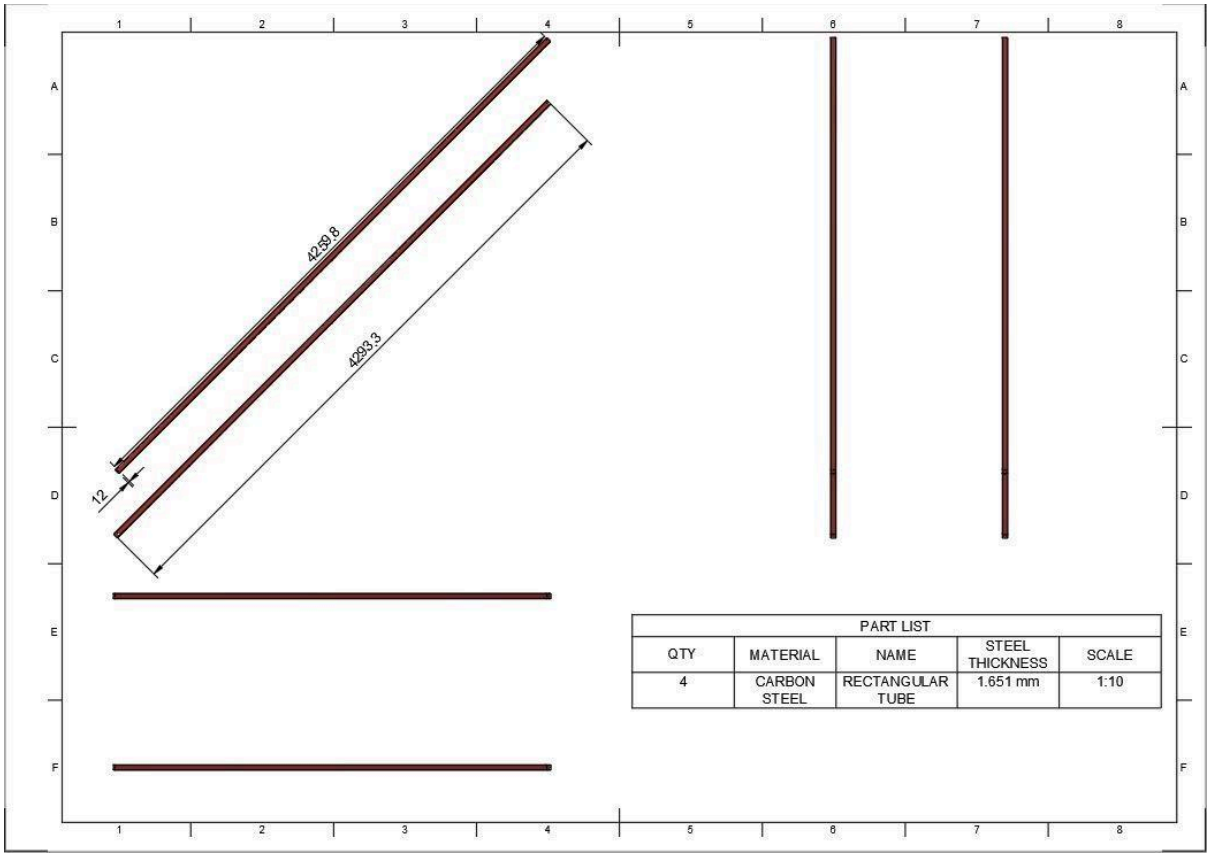


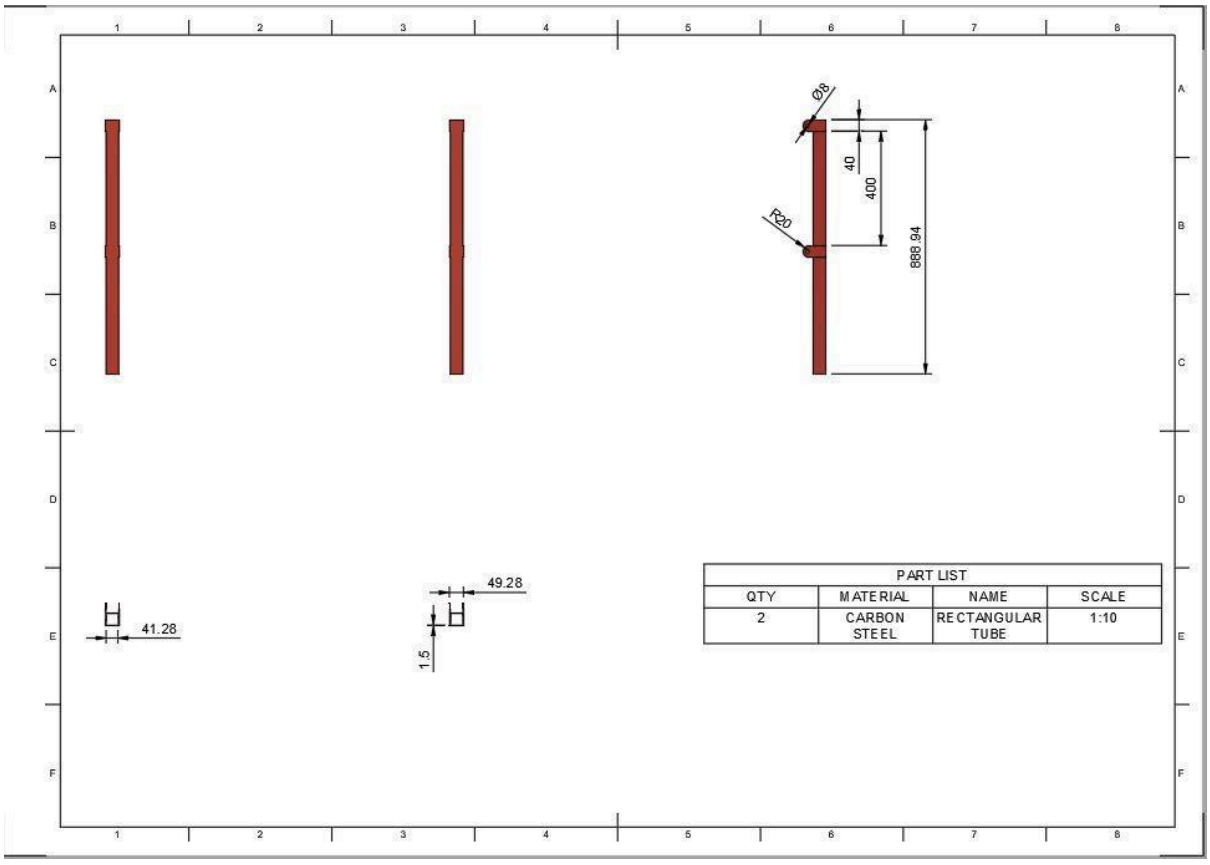
PART LIST			
ITEM	QTY	MATERIALS	NAME
1	2	CARBON STEEL	RECTANGULAR TUBE
2	2	CARBON STEEL	RECTANGULAR TUBE
3	8	STEEL	BOLTS
4	8	STEEL	NUTS
5	16	STEEL	WASHER
6	4	CARBON STEEL	RECTANGULAR TUBE
7	4	CARBON STEEL	STEEL PLATE



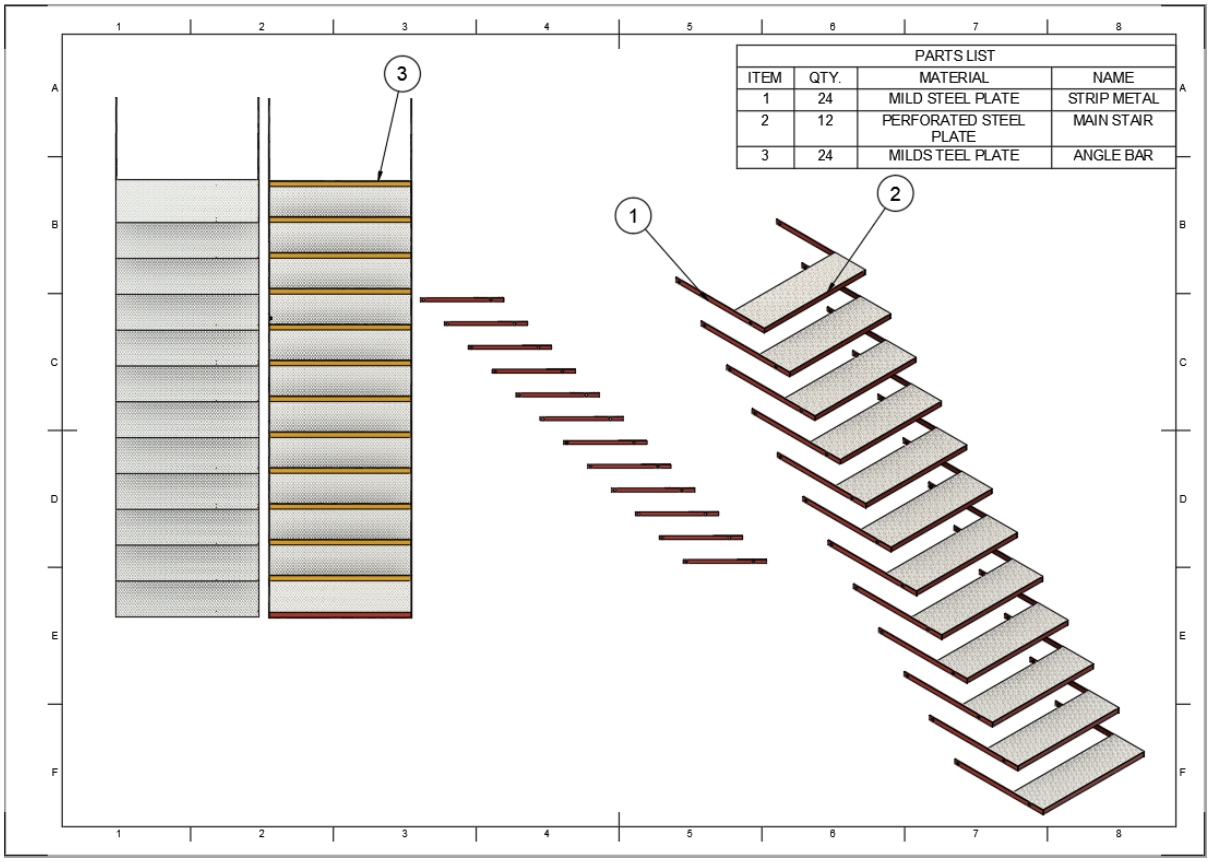
PART LIST			
QTY	MATERIAL	NAME	SCALE
4	CARBON STEEL	STEEL PLATE	1:1

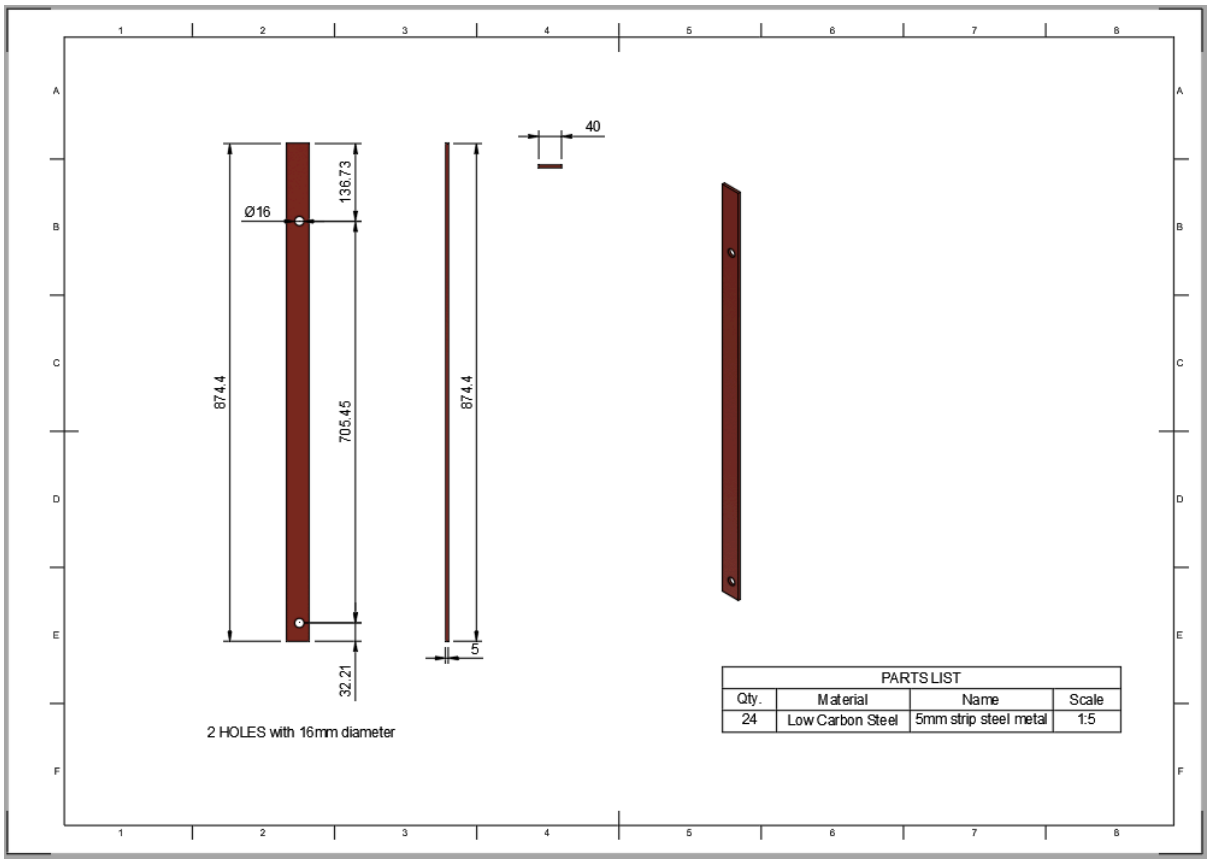

42.78
60
440.18
933.94
44.28
PART LIST
QTY
MATERIAL
NAME
SCALE
2
CARBON STEEL
RECTANGULAR TUBE
1:10

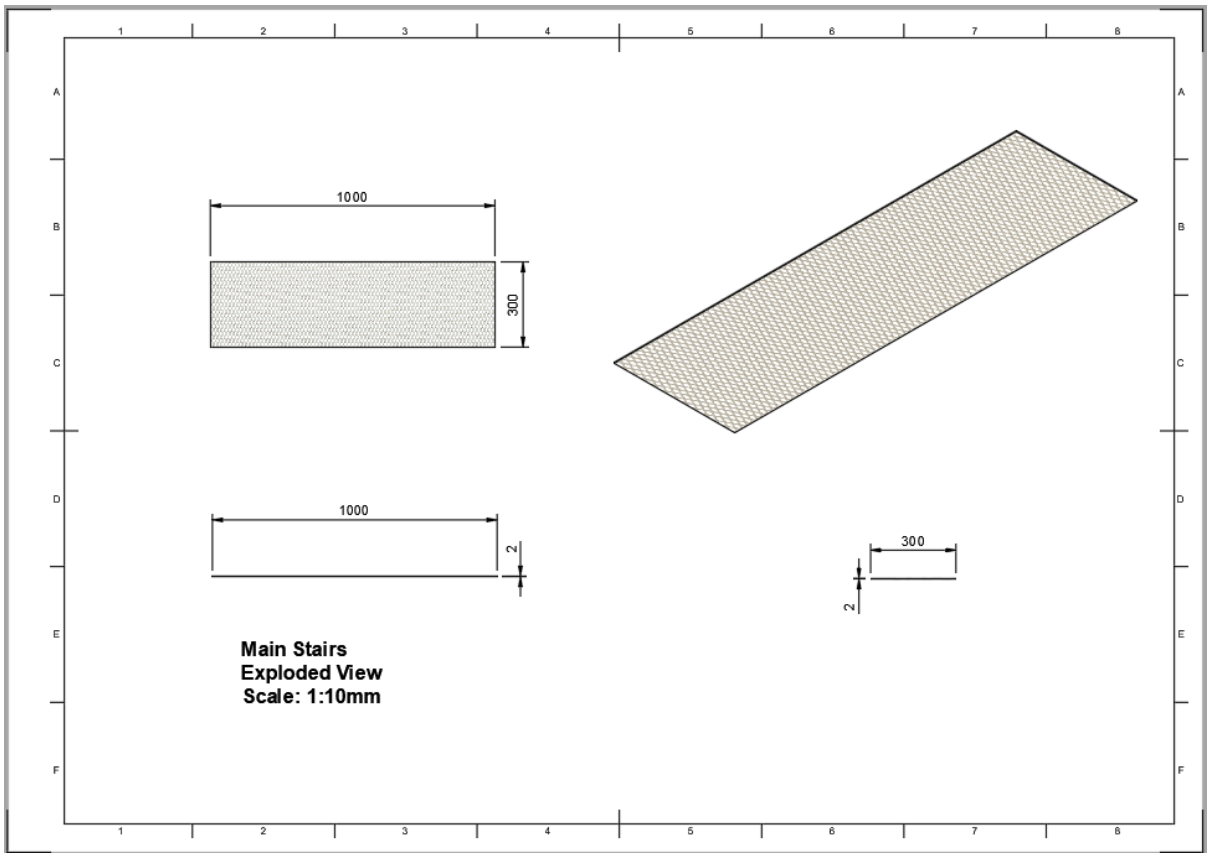

4259.8
4293.3
12
PART LIST
QTY
MATERIAL
NAME
STEEL THICKNESS
SCALE
4
CARBON STEEL
RECTANGULAR TUBE
1.651 mm
1:10

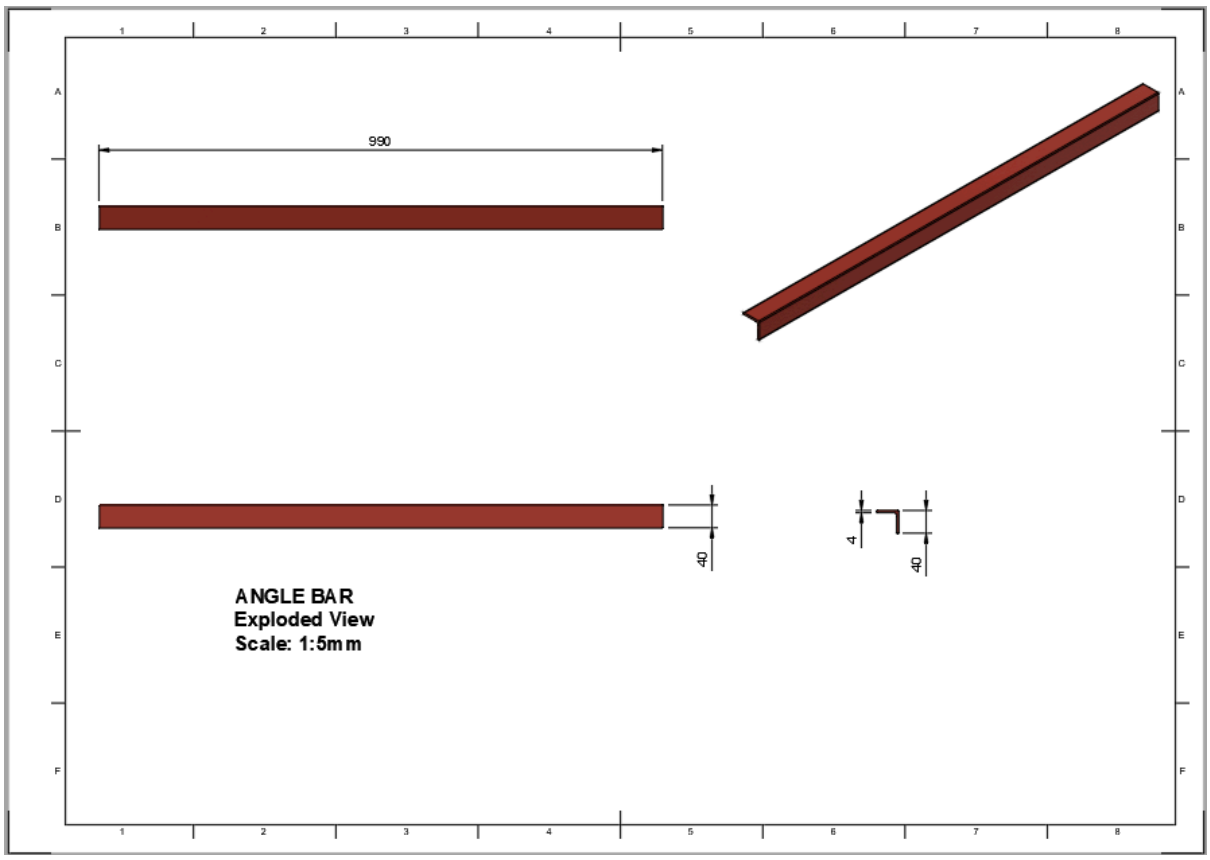

Ø8
40
400
R30
888.94
49.28
1.5
41.28
PART LIST
QTY
MATERIAL
NAME
SCALE
2
CARBON STEEL
RECTANGULAR TUBE
1:10

Main stairs

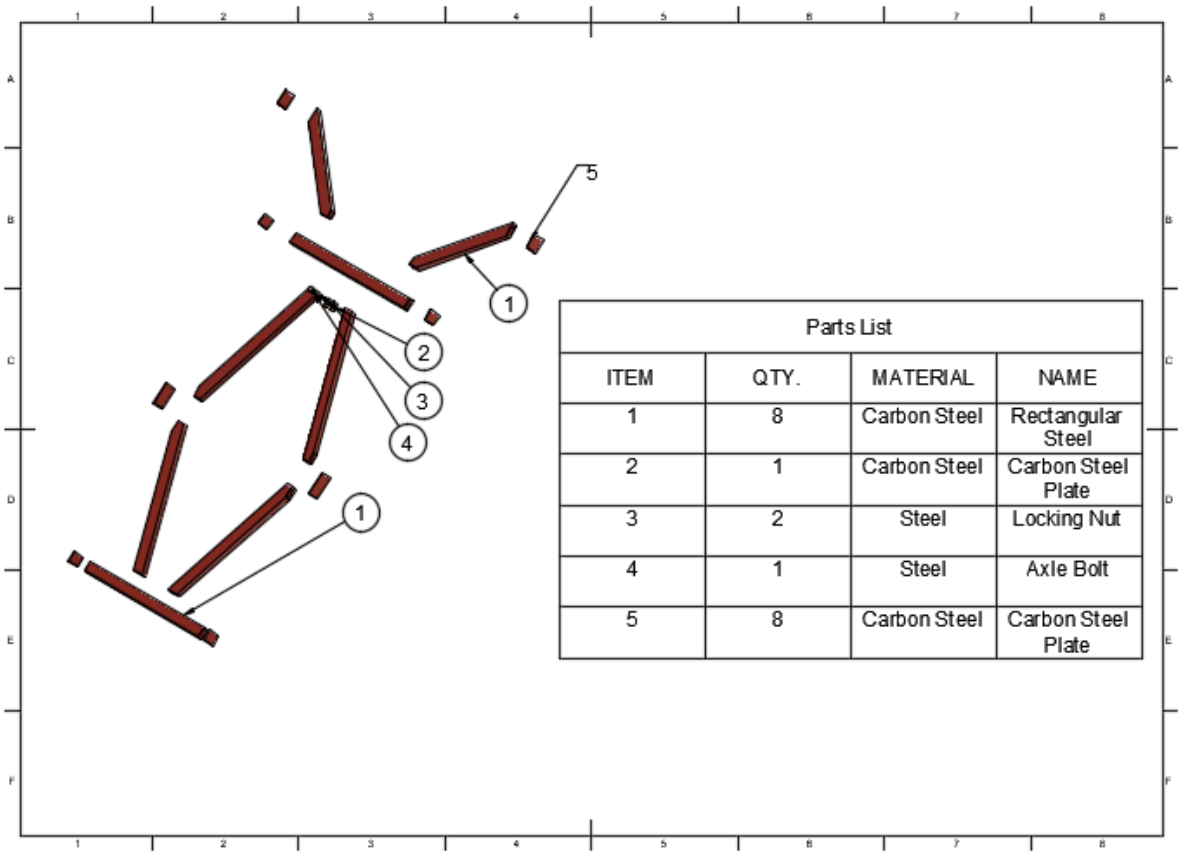

PARTS LIST
ITEM | QTY. | MATERIAL | NAME
1 | 24 | MILD STEEL PLATE | STRIP METAL
2 | 12 | PERFORATED STEEL PLATE | MAIN STAIR
3 | 24 | MILDS TEEL PLATE | ANGLE BAR
1
2
3


40
Ø16
136.73
87.44
705.45
87.44
5
32.21
2 HOLES with 16mm diameter
PARTS LIST
Qty. | Material | Name | Scale
24 | Low Carbon Steel | 5mm strip steel metal | 1:5

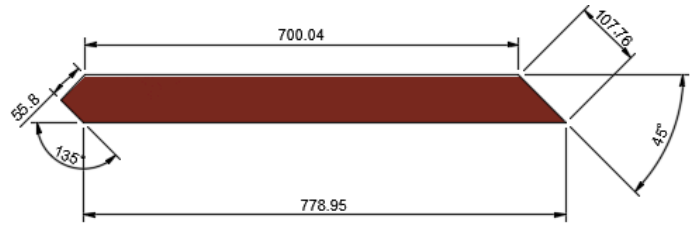

1000
300
1000
2
300
2
Main Stairs
Exploded View
Scale: 1:10mm

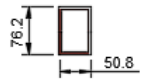

990
40
4
40
ANGLE BAR
Exploded View
Scale: 1:5mm

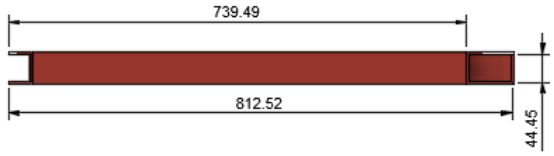
Staircase Brace

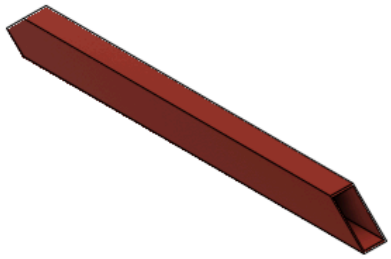


Parts List			
ITEM	QTY.	MATERIAL	NAME
1	8	Carbon Steel	Rectangular Steel
2	1	Carbon Steel	Carbon Steel Plate
3	2	Steel	Locking Nut
4	1	Steel	Axle Bolt
5	8	Carbon Steel	Carbon Steel Plate

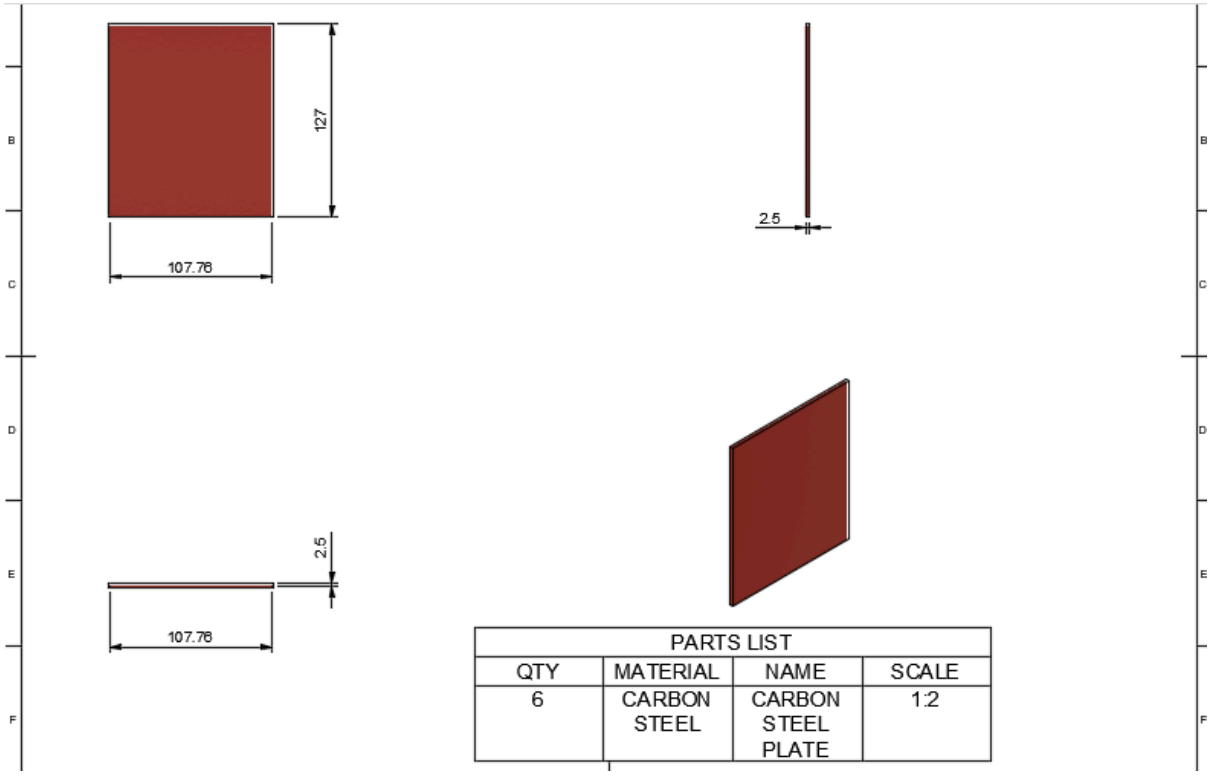




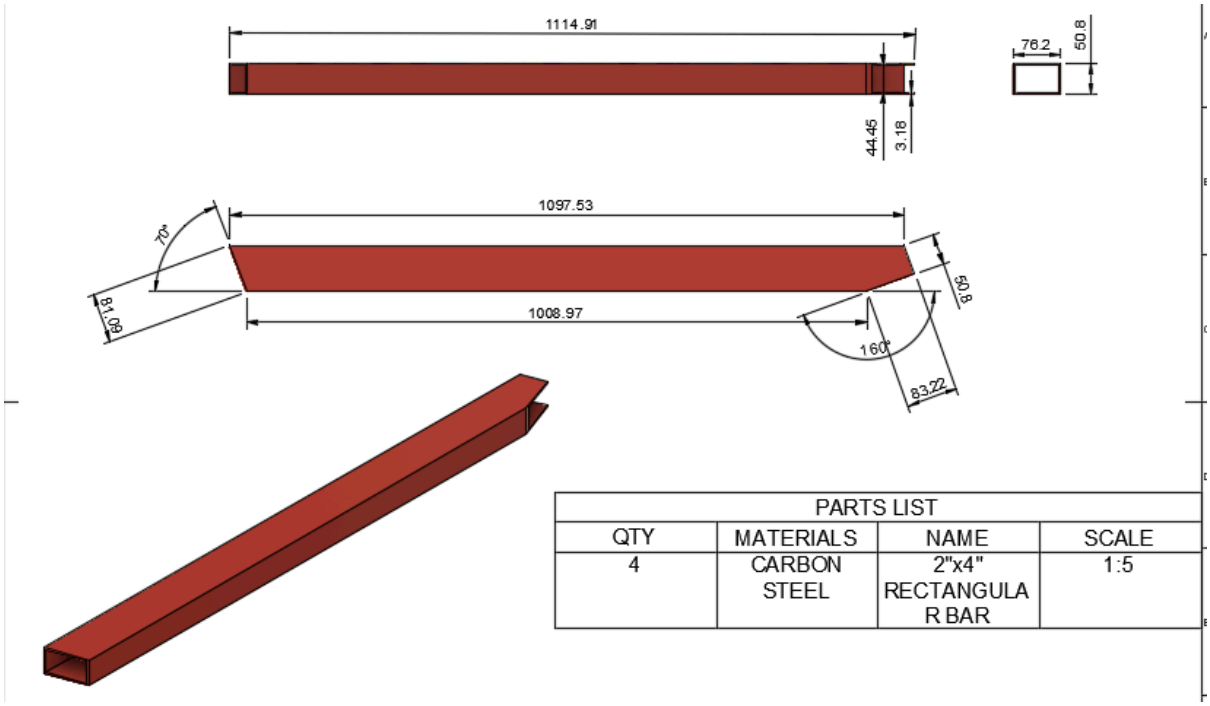




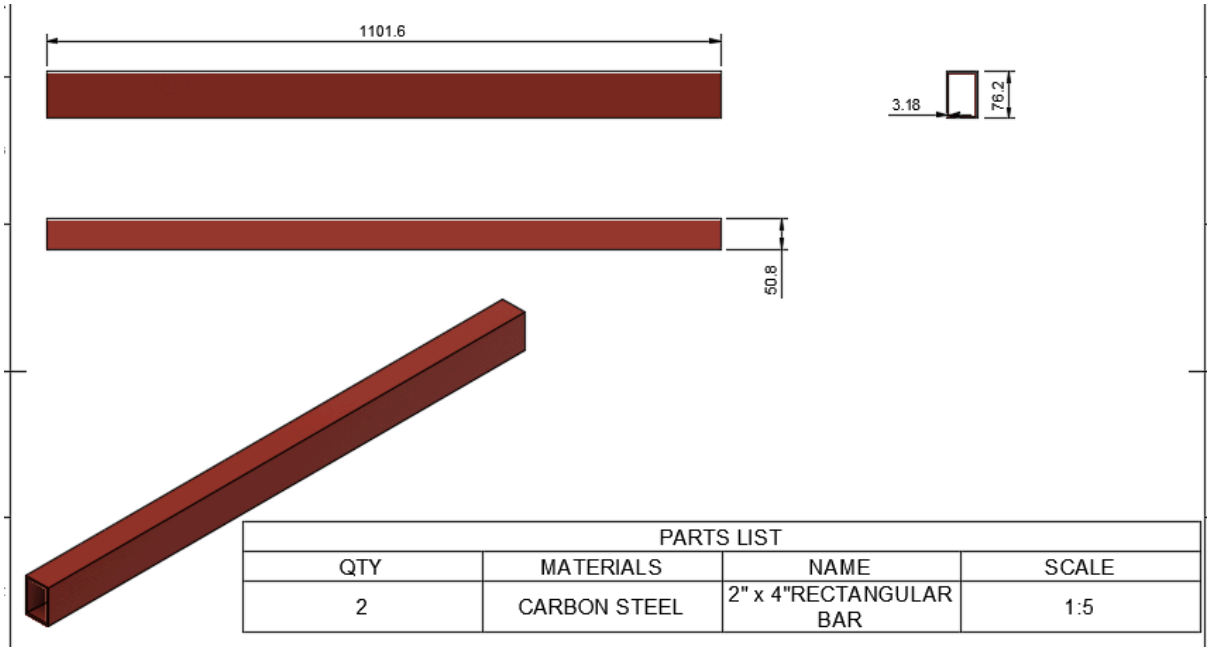
PARTS LIST			
QTY	MATERIAL	NAME	SCALE
2	CARBON STEEL	2" x 4" RECTANGULAR BAR	1:5



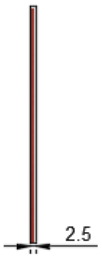
PARTS LIST			
QTY	MATERIAL	NAME	SCALE
6	CARBON STEEL	CARBON STEEL PLATE	1:2

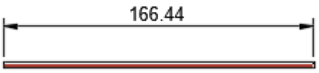


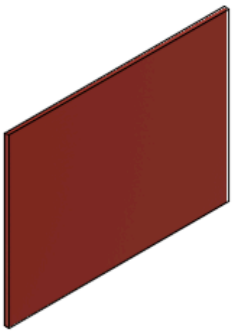
PARTS LIST			
QTY	MATERIALS	NAME	SCALE
4	CARBON STEEL	2"x4" RECTANGULAR BAR	1:5



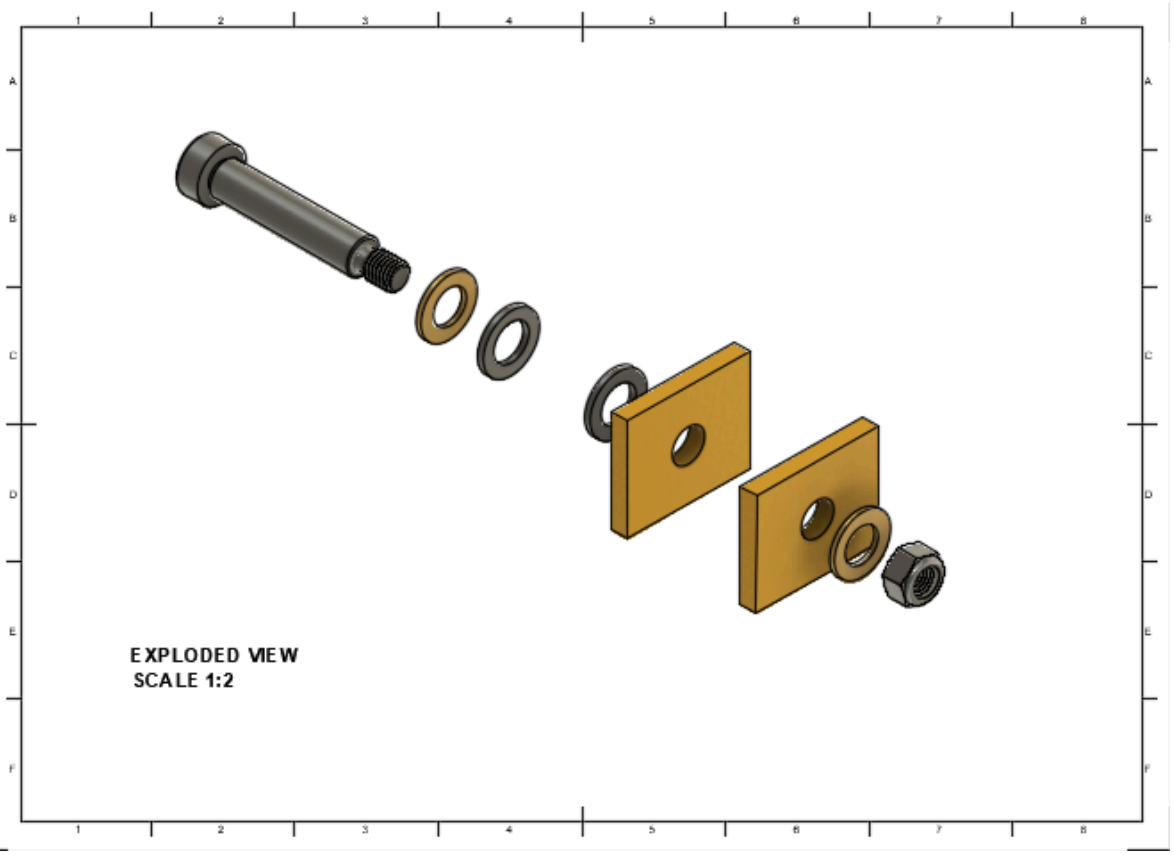
PARTS LIST			
QTY	MATERIALS	NAME	SCALE
2	CARBON STEEL	2" x 4"RECTANGULAR BAR	1:5

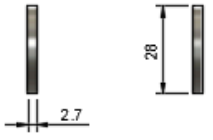


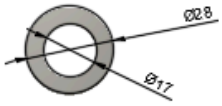


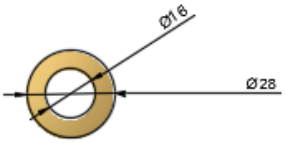


PARTS LIST			
QTY	MATERIAL	NAME	SCALE
2	CARBON STEEL	CARBON STEEL PLATE	1:2

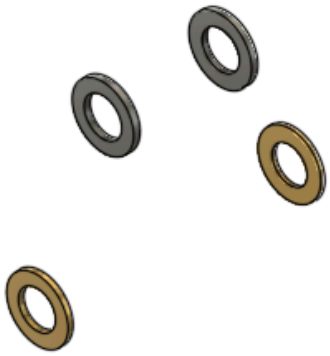


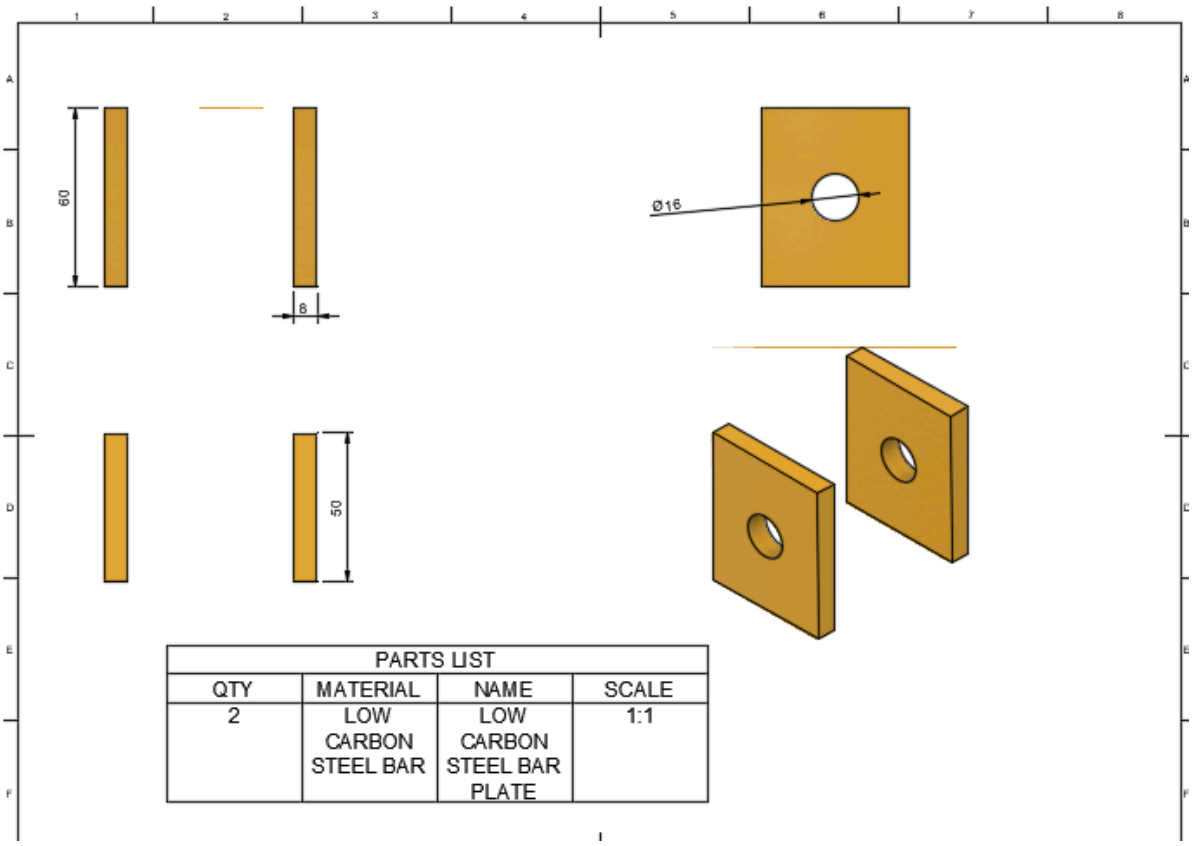




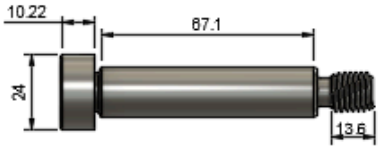


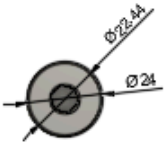
PARTS LIST			
QTY	MATERIAL	NAME	SCALE
2	STEEL	WASHER	1:1
2	STEEL	WASHER	1:1

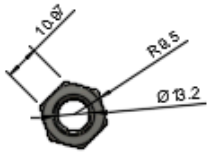




PARTS LIST			
QTY	MATERIAL	NAME	SCALE
2	LOW CARBON STEEL BAR	LOW CARBON STEEL BAR PLATE	1:1

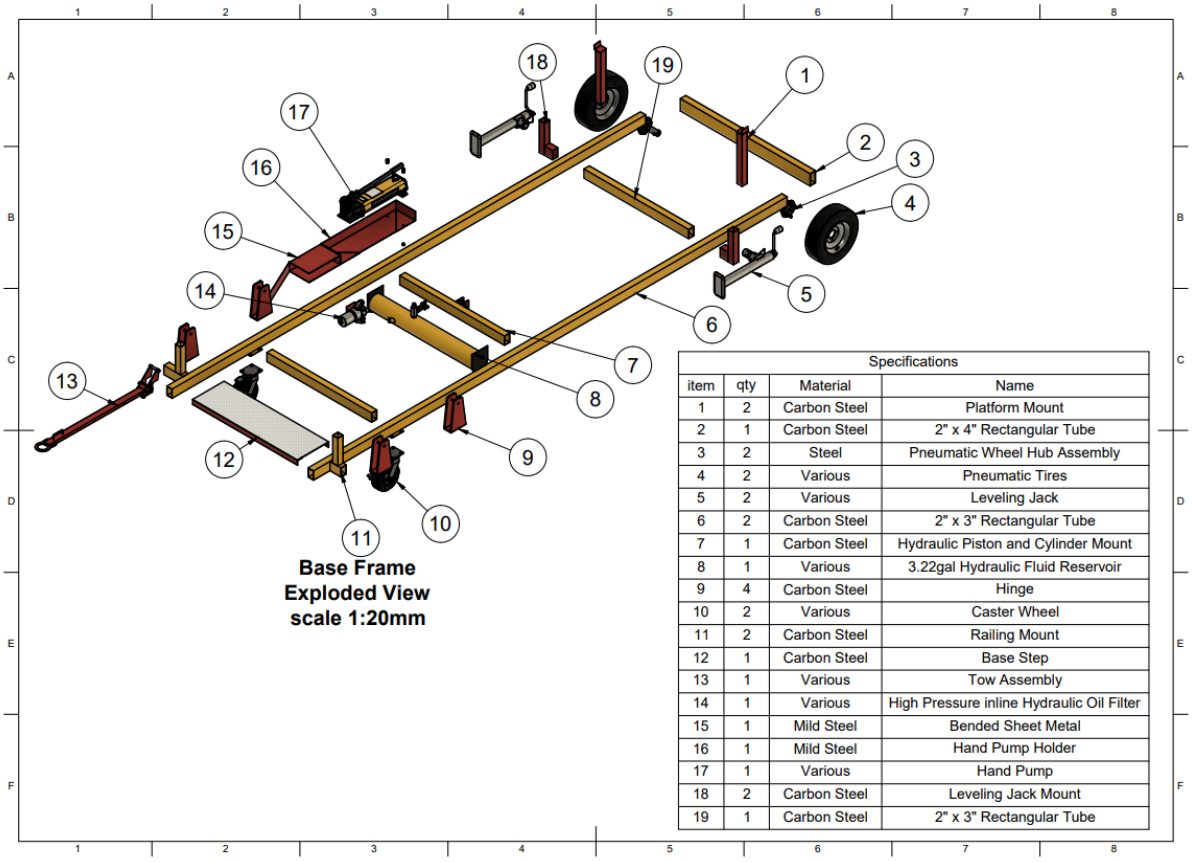




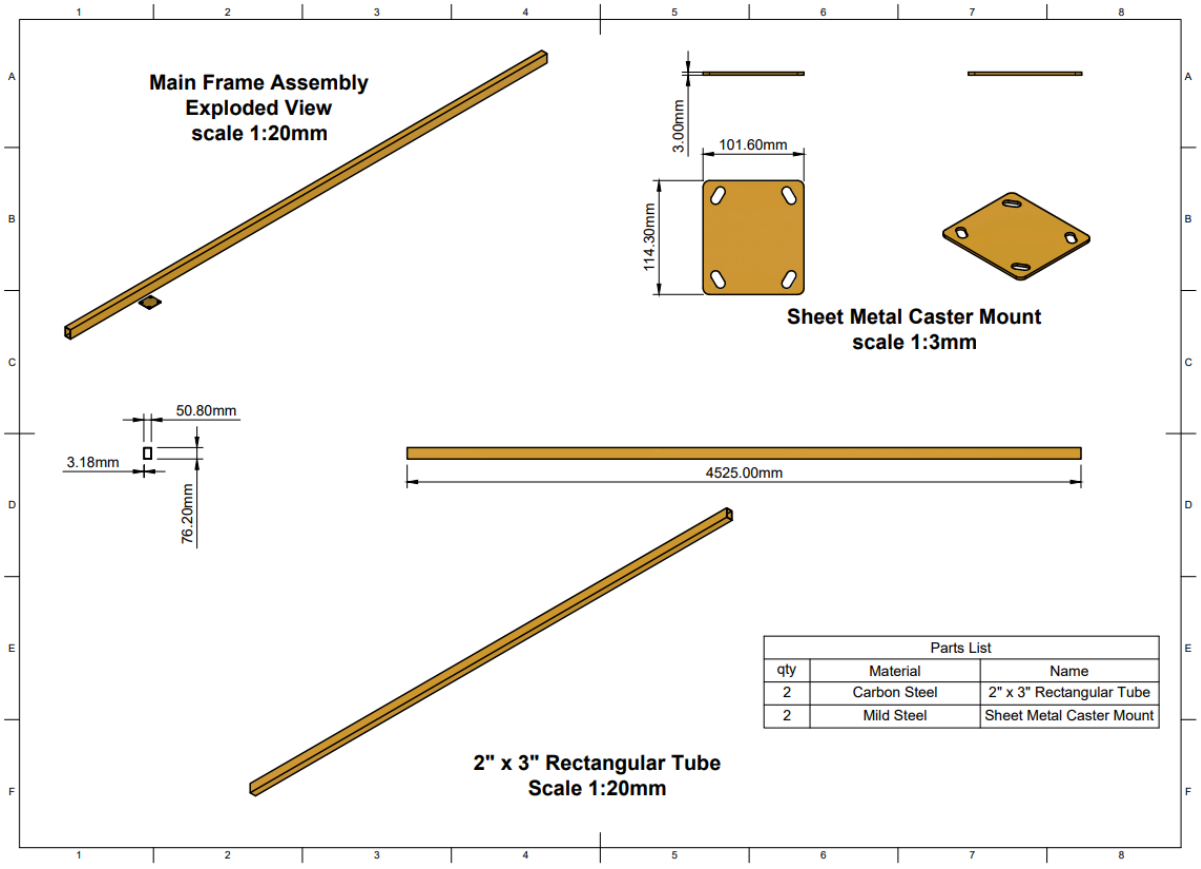


PARTS LIST			
QTY	MATERIAL	NAME	SCALE
1	STEEL	16mm SHOULDER DIAMETER AXLE BOLT M 12x1.75mm Thread	1:1
1	STEEL	LOCKING NUT	1:1

Base Frame

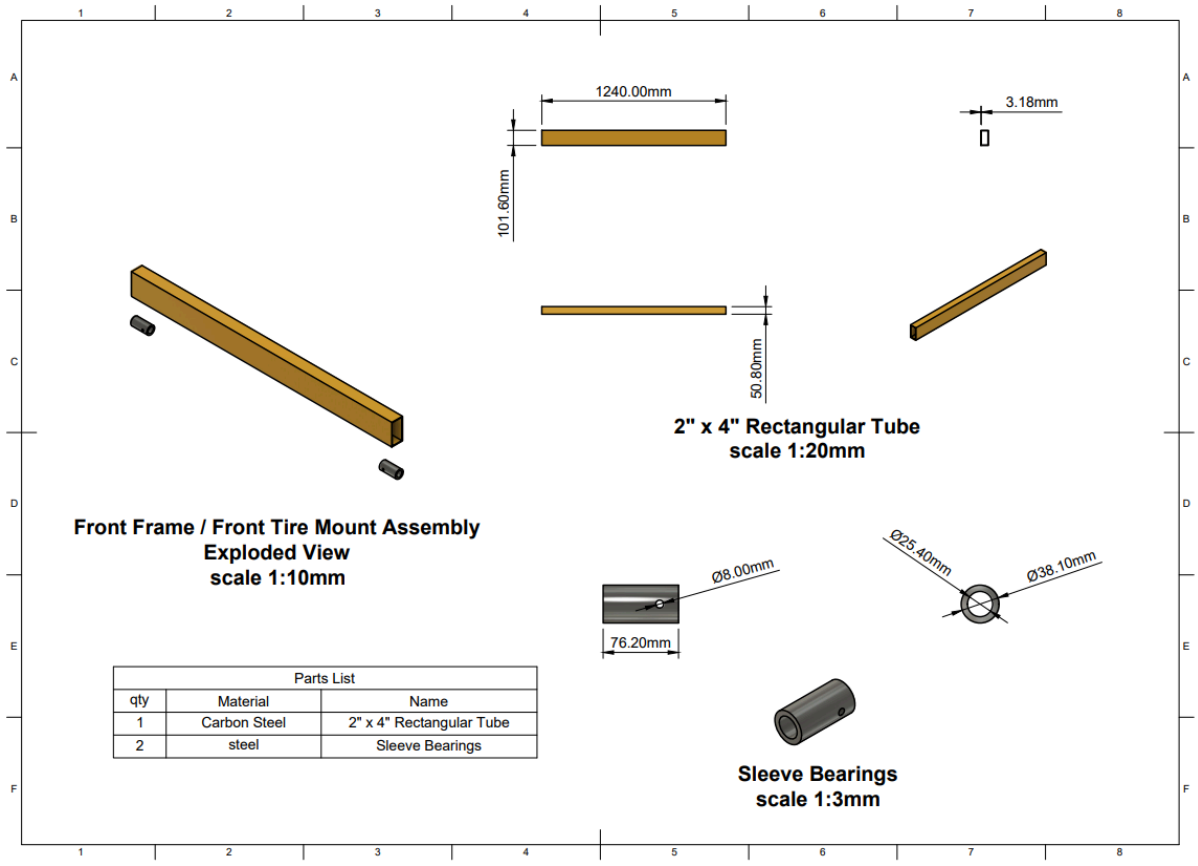


Specifications			
item	qty	Material	Name
1	2	Carbon Steel	Platform Mount
2	1	Carbon Steel	2" x 4" Rectangular Tube
3	2	Steel	Pneumatic Wheel Hub Assembly
4	2	Various	Pneumatic Tires
5	2	Various	Leveling Jack
6	2	Carbon Steel	2" x 3" Rectangular Tube
7	1	Carbon Steel	Hydraulic Piston and Cylinder Mount
8	1	Various	3.22gal Hydraulic Fluid Reservoir
9	4	Carbon Steel	Hinge
10	2	Various	Caster Wheel
11	2	Carbon Steel	Railing Mount
12	1	Carbon Steel	Base Step
13	1	Various	Tow Assembly
14	1	Various	High Pressure inline Hydraulic Oil Filter
15	1	Mild Steel	Bended Sheet Metal
16	1	Mild Steel	Hand Pump Holder
17	1	Various	Hand Pump
18	2	Carbon Steel	Leveling Jack Mount
19	1	Carbon Steel	2" x 3" Rectangular Tube

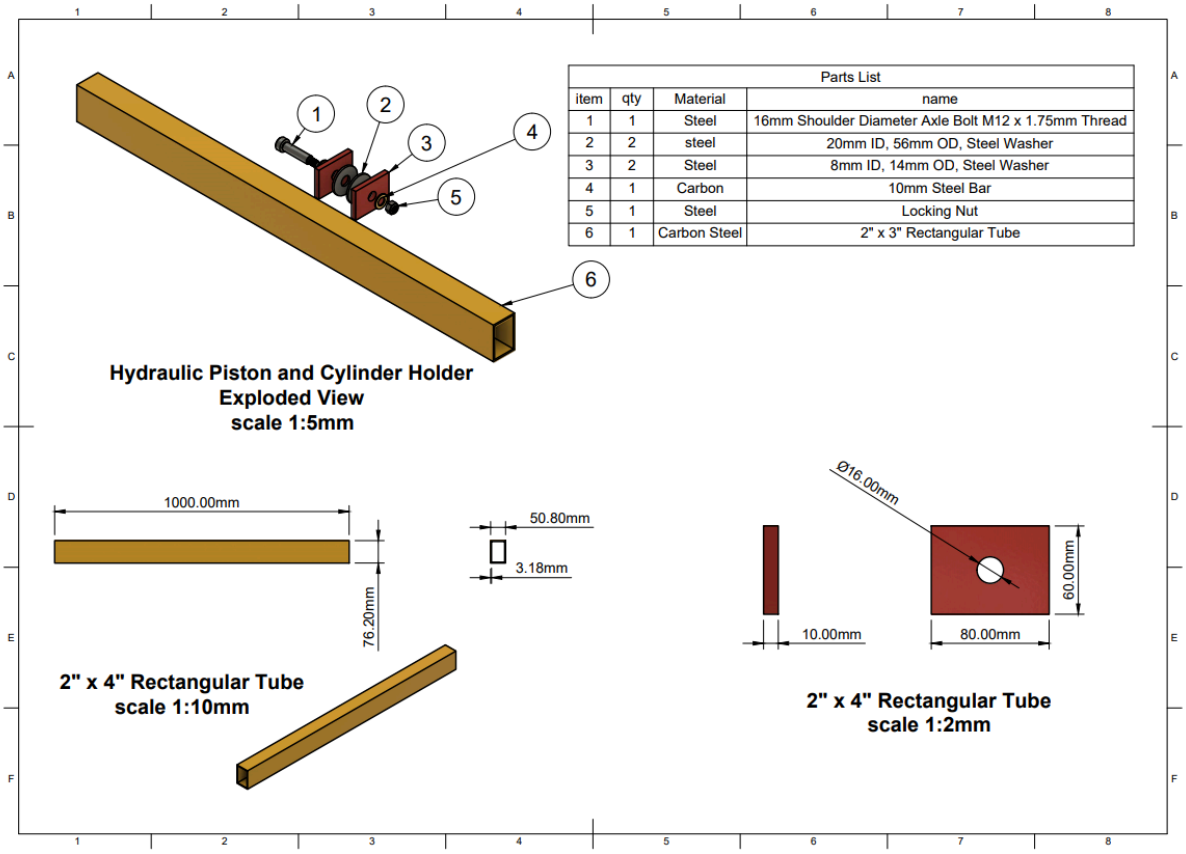


Parts List		
qty	Material	Name
2	Carbon Steel	2" x 3" Rectangular Tube
2	Mild Steel	Sheet Metal Caster Mount

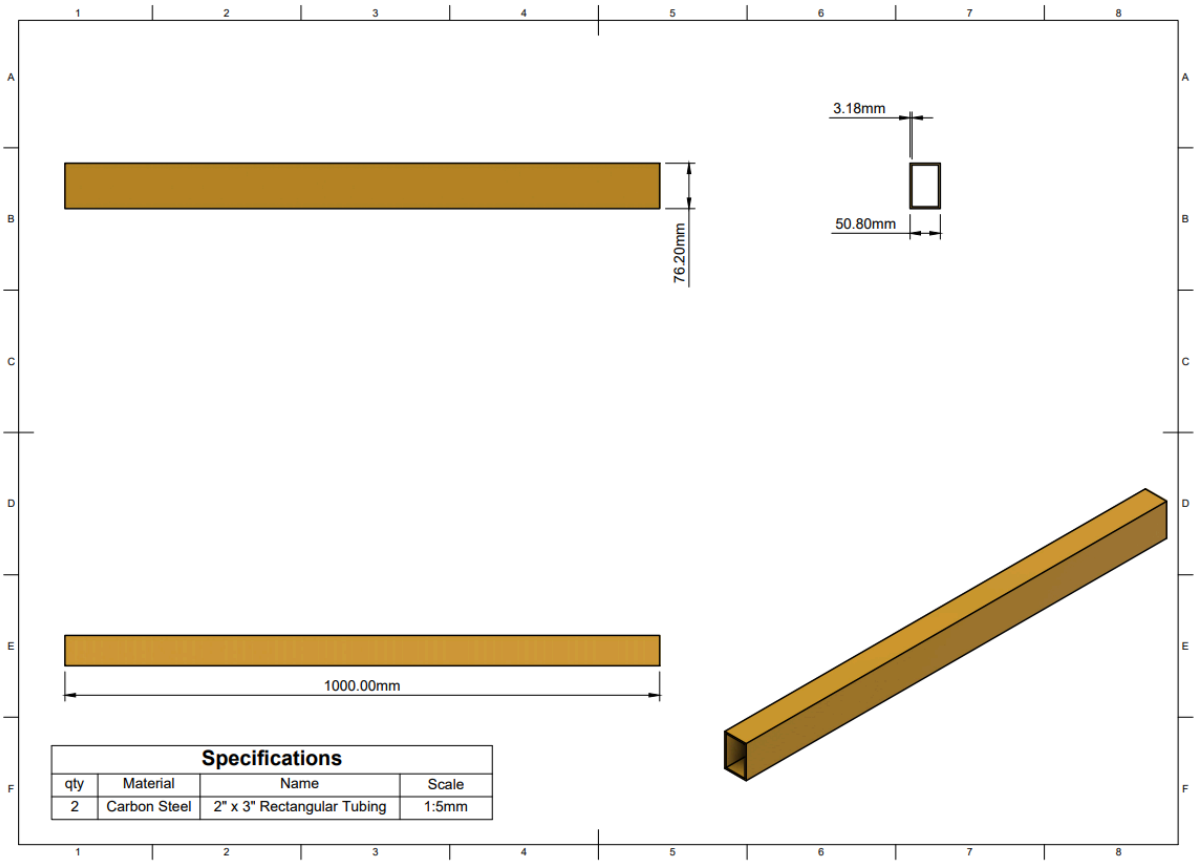
Front Frame



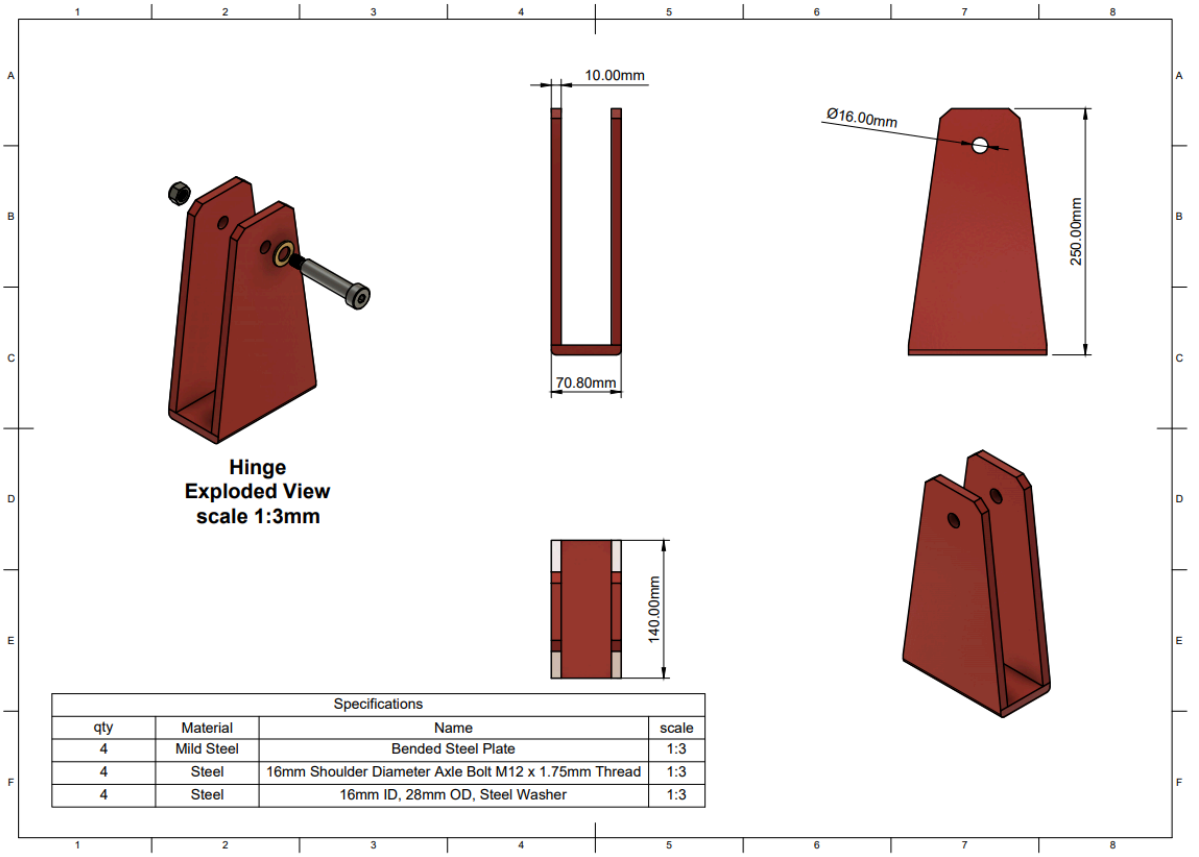
Parts List		
qty	Material	Name
1	Carbon Steel	2" x 4" Rectangular Tube
2	steel	Sleeve Bearings



Parts List			
item	qty	Material	name
1	1	Steel	16mm Shoulder Diameter Axle Bolt M12 x 1.75mm Thread
2	2	steel	20mm ID, 56mm OD, Steel Washer
3	2	Steel	8mm ID, 14mm OD, Steel Washer
4	1	Carbon	10mm Steel Bar
5	1	Steel	Locking Nut
6	1	Carbon Steel	2" x 3" Rectangular Tube

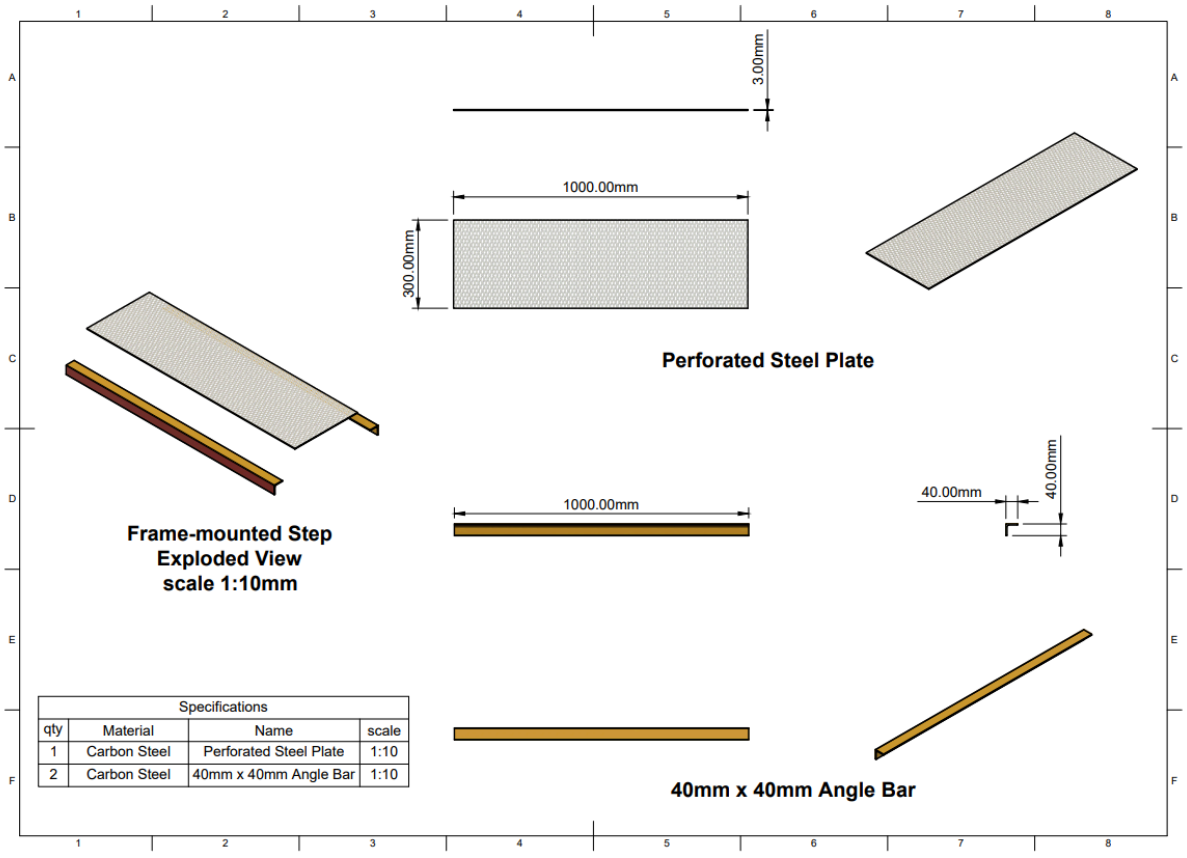


Specifications			
qty	Material	Name	Scale
2	Carbon Steel	2" x 3" Rectangular Tubing	1:5mm

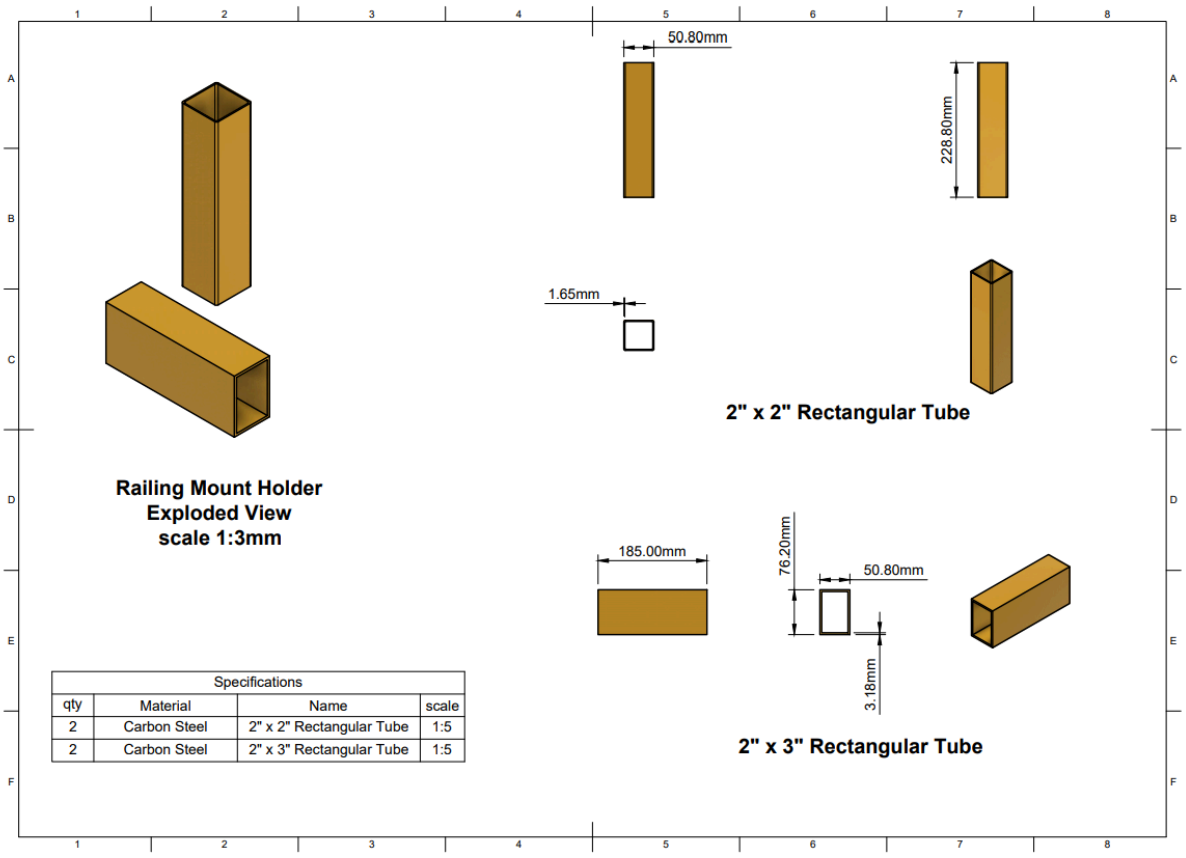


Hinge
Exploded View
scale 1:3mm

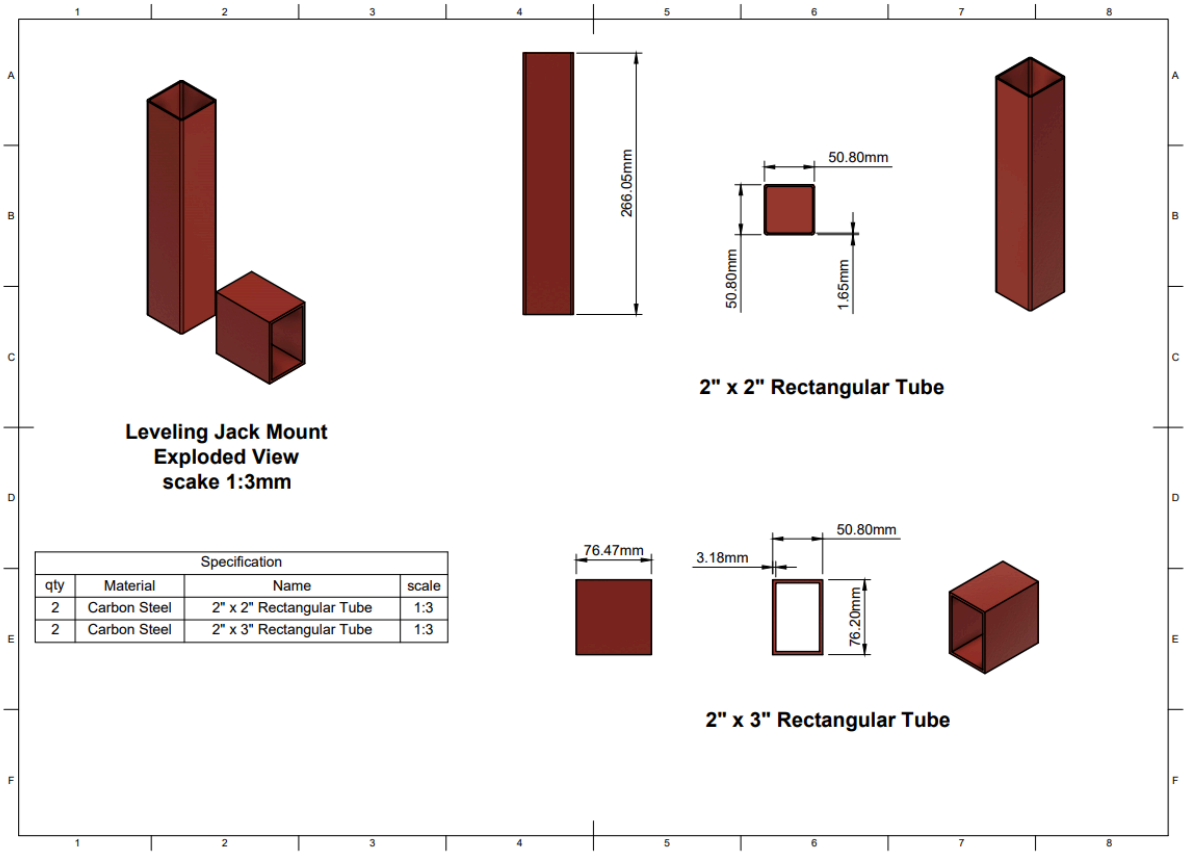
Specifications			
qty	Material	Name	scale
4	Mild Steel	Bended Steel Plate	1:3
4	Steel	16mm Shoulder Diameter Axle Bolt M12 x 1.75mm Thread	1:3
4	Steel	16mm ID, 28mm OD, Steel Washer	1:3



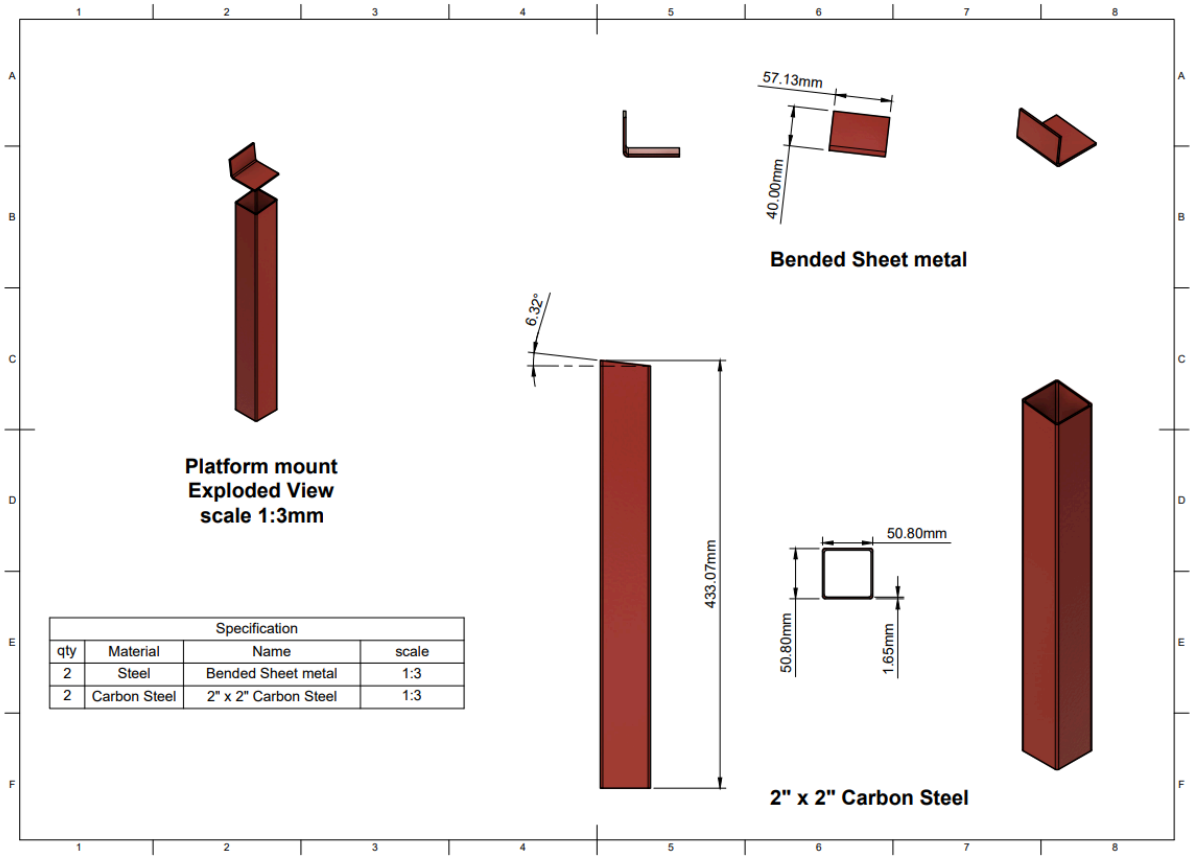
Specifications			
qty	Material	Name	scale
1	Carbon Steel	Perforated Steel Plate	1:10
2	Carbon Steel	40mm x 40mm Angle Bar	1:10



Specifications			
qty	Material	Name	scale
2	Carbon Steel	2" x 2" Rectangular Tube	1:5
2	Carbon Steel	2" x 3" Rectangular Tube	1:5



Specification			
qty	Material	Name	scale
2	Carbon Steel	2" x 2" Rectangular Tube	1:3
2	Carbon Steel	2" x 3" Rectangular Tube	1:3

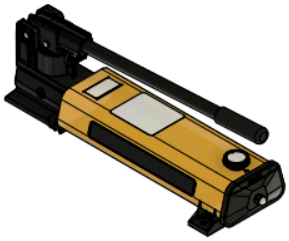


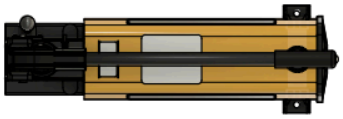
Specification			
qty	Material	Name	scale
2	Steel	Bended Sheet metal	1:3
2	Carbon Steel	2" x 2" Carbon Steel	1:3

Enerpac Double Acting Hydraulic Hand Pump P-842

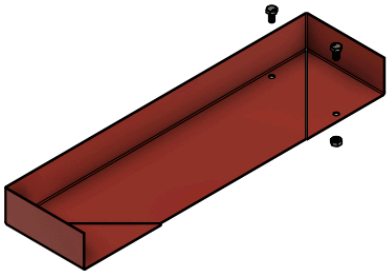
Axle Jack (12 ton/10.8 metric tons)
model no. 02-8126C0100

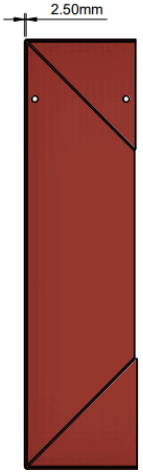
Specifications	
Capacity Tons	12
Closed Height in.	4" - 6.6"
Mechanical Extension in.	1.56" - 3.13"
Hydraulic Extension in.	5.44" - 8.31"
Fully Extended in.	11" - 18.44"
Length in.	19.75" - 25.375"
Width in.	5"
Weight lb	90lb

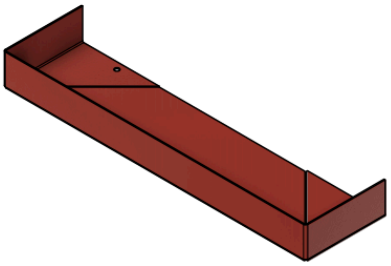




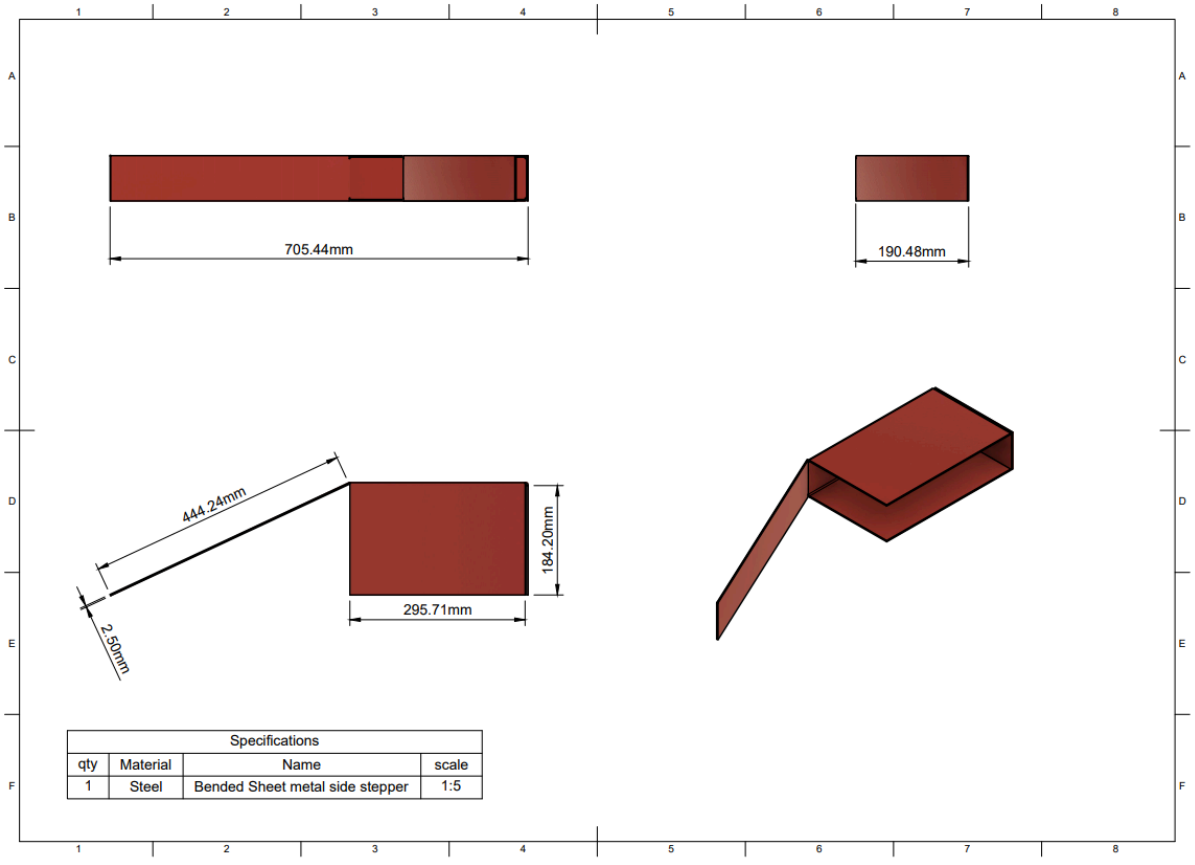
Hydraulic Holder
Exploded View
Scale 1:3mm





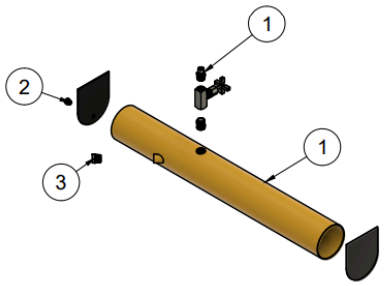


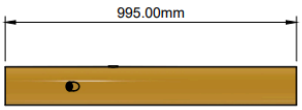
Specifications		
qty	Material	Name
1	Steel 2.5mm thick	Bended Sheet Metal
2	Steel	M10 x 5 Thread, 20mm long Bolt
2	Steel	Steel Hex nut

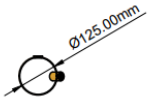


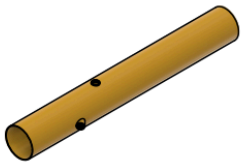
Specifications			
qty	Material	Name	scale
1	Steel	Bended Sheet metal side stepper	1:5

3.22gal Hydraulic Fluid Cylindrical Reservoir
Exploded View
scale 1:10mm



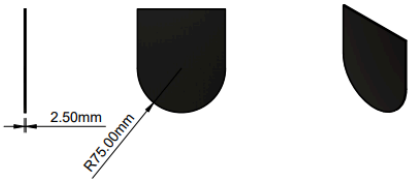


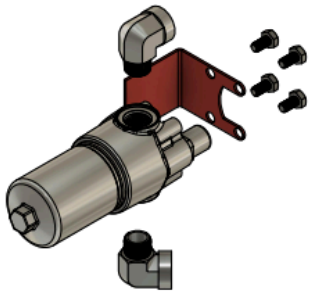




$$Capacity = \pi r^2(L) = \pi(62.5mm)^2(995mm) = 12210487.07mm^3 = converted\ to\ gal = 3.22gal$$

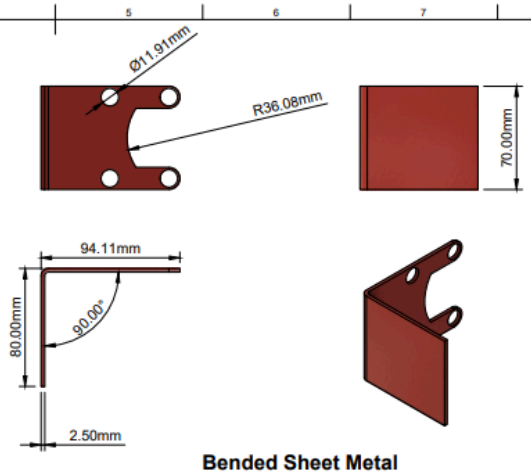
Specification				
item	qty	Material	Name	includes
1	1	Steel, Alloy Steel	3.22gal Cylindrical Reservoir	Fitting, Inline Hydraulic Valve, Fully Threaded Stainless Steel 304/304L
2	2	Alloy Steel	Sheet Metal	-
3	1	Steel	Hose Fittings	-



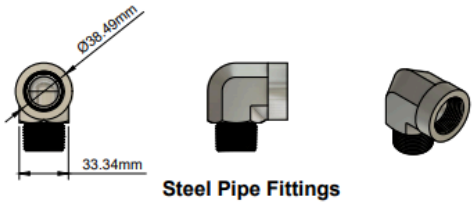


High Pressure Inline Hydraulic Oil Filter
Exploded View
scale 1:3mm

Specification		
qty	Material	Name
1	Steel	Bended Sheet Metal
1	Various	High Pressure Inline Hydraulic Oil Filter
2	Steel	Steel Pipe Fittings, Pipe Size 3/4
4	Steel	M10 x 1.5 Hex Head Screw



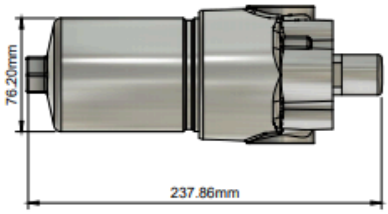
Bended Sheet Metal
scale 1:2mm

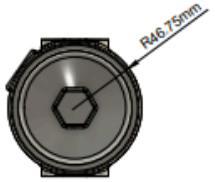


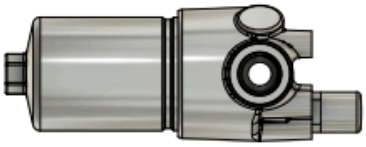
Steel Pipe Fittings
scale 1:2mm

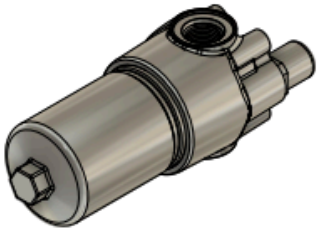
High Pressure Inline Hydraulic Oil Filter

Specifications	
Maximum Pressure	4000psi
Maximum Flow Rate	14.5 gpm
Relief Valve Opening Pressure	101 psid
Maximum Temperature	210°F
Material	Iron, Steel, Fiberglass, Buna-N Rubber
Overall Height	8 3/8"
Overall Width	3 9/16"

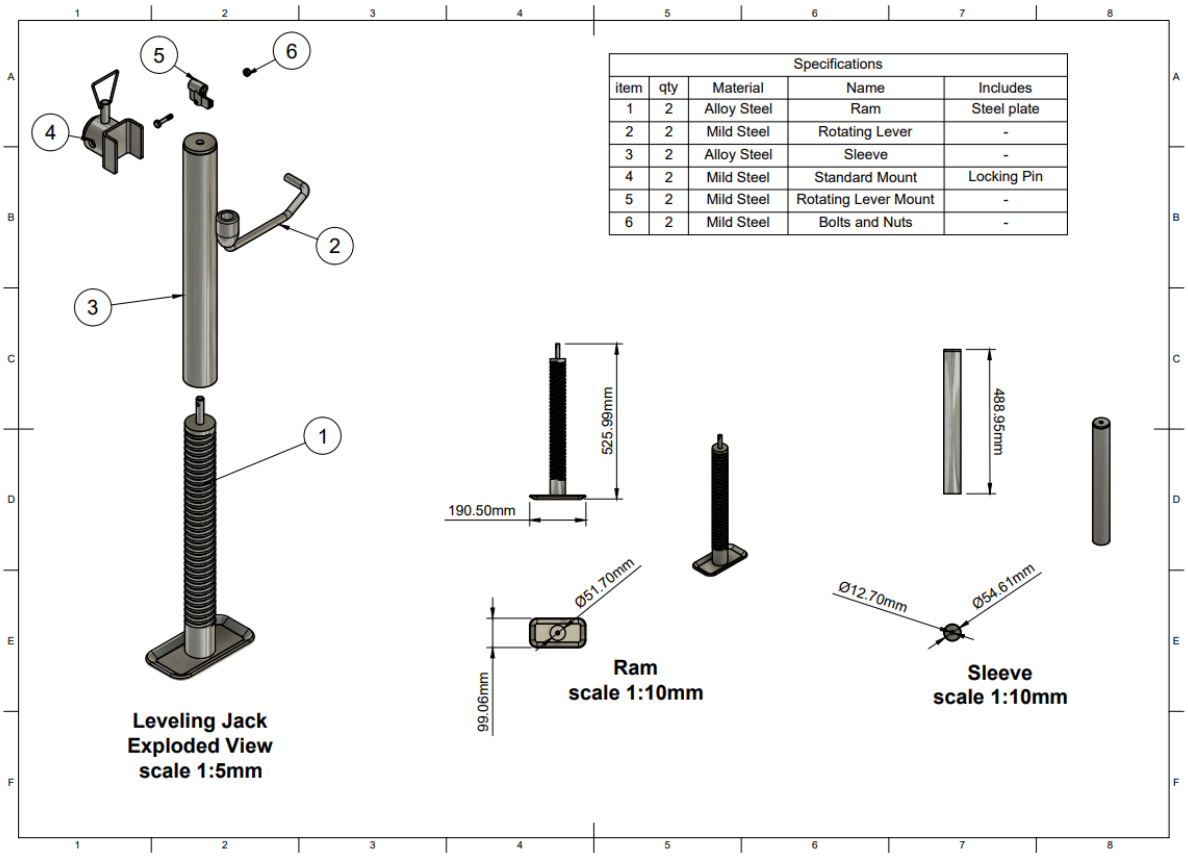




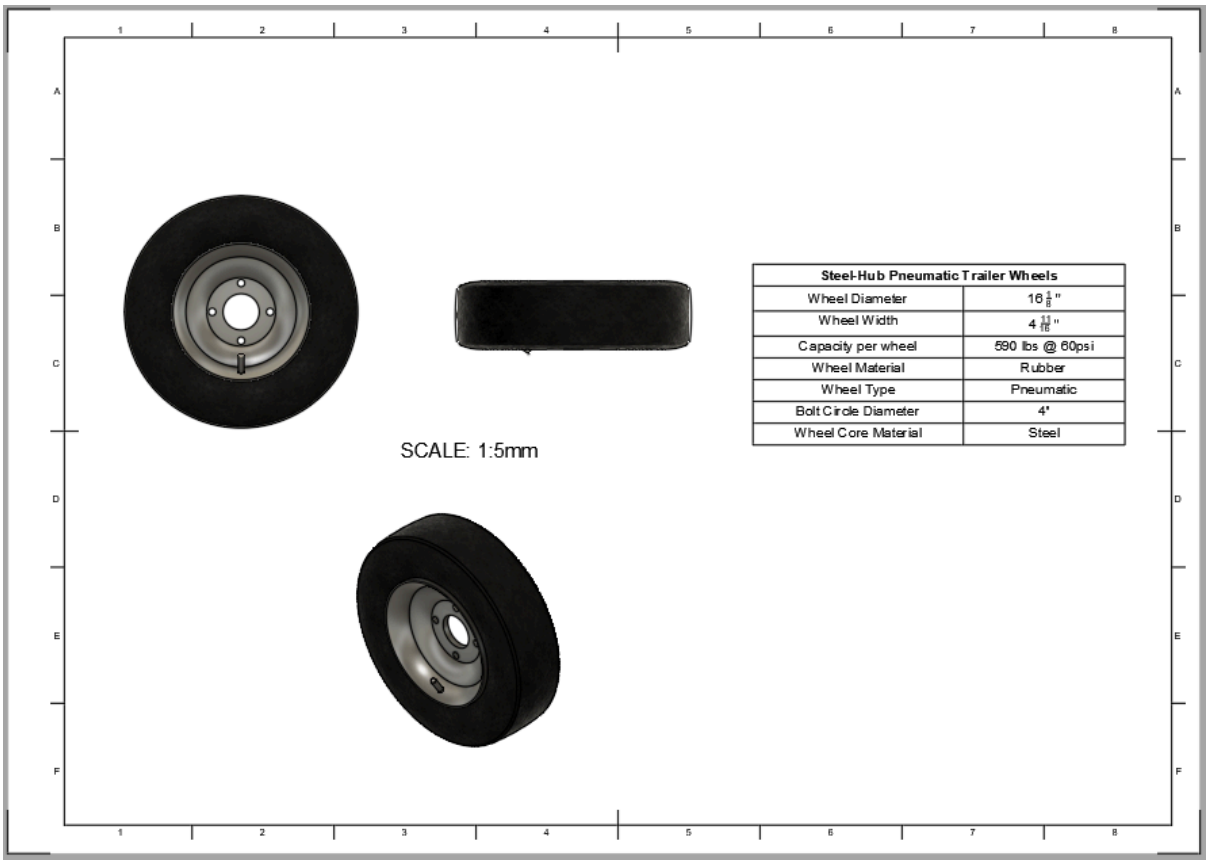




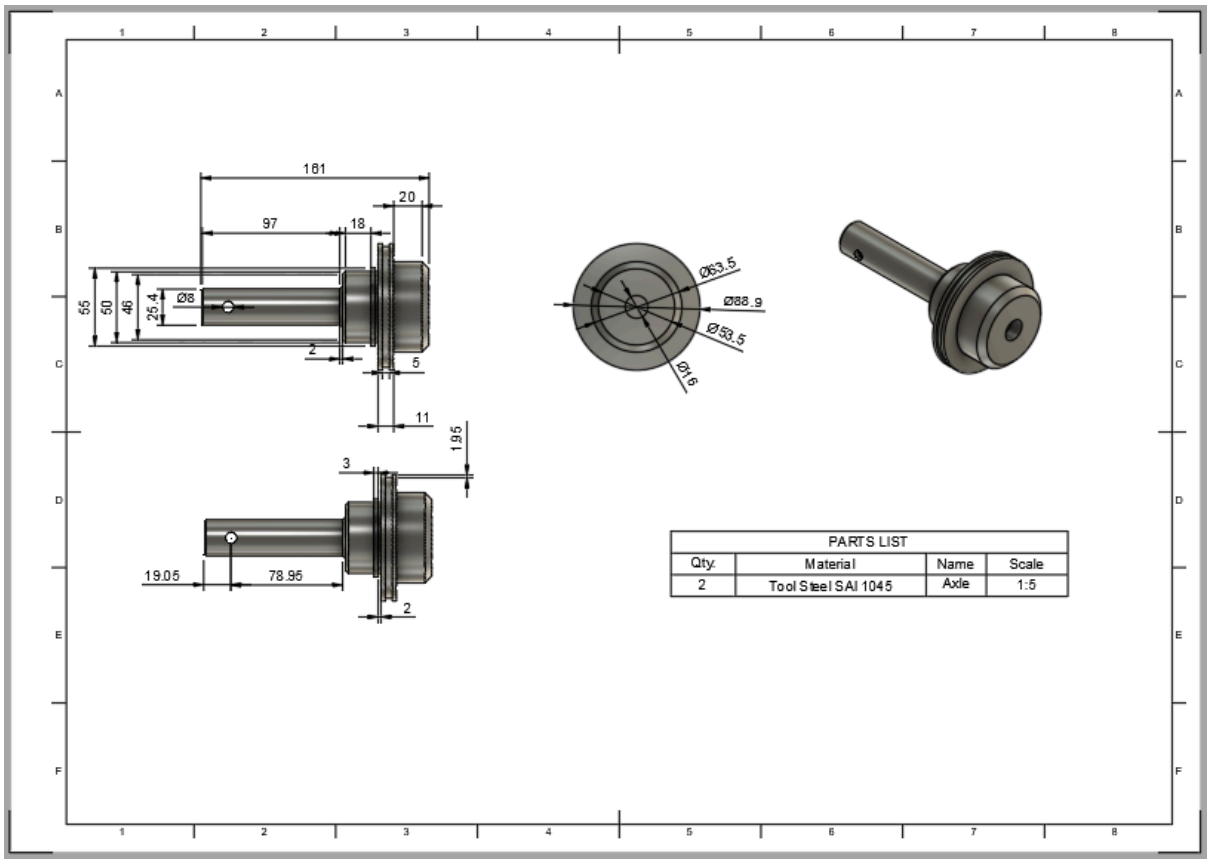
Leveling Jack



Pneumatic tire



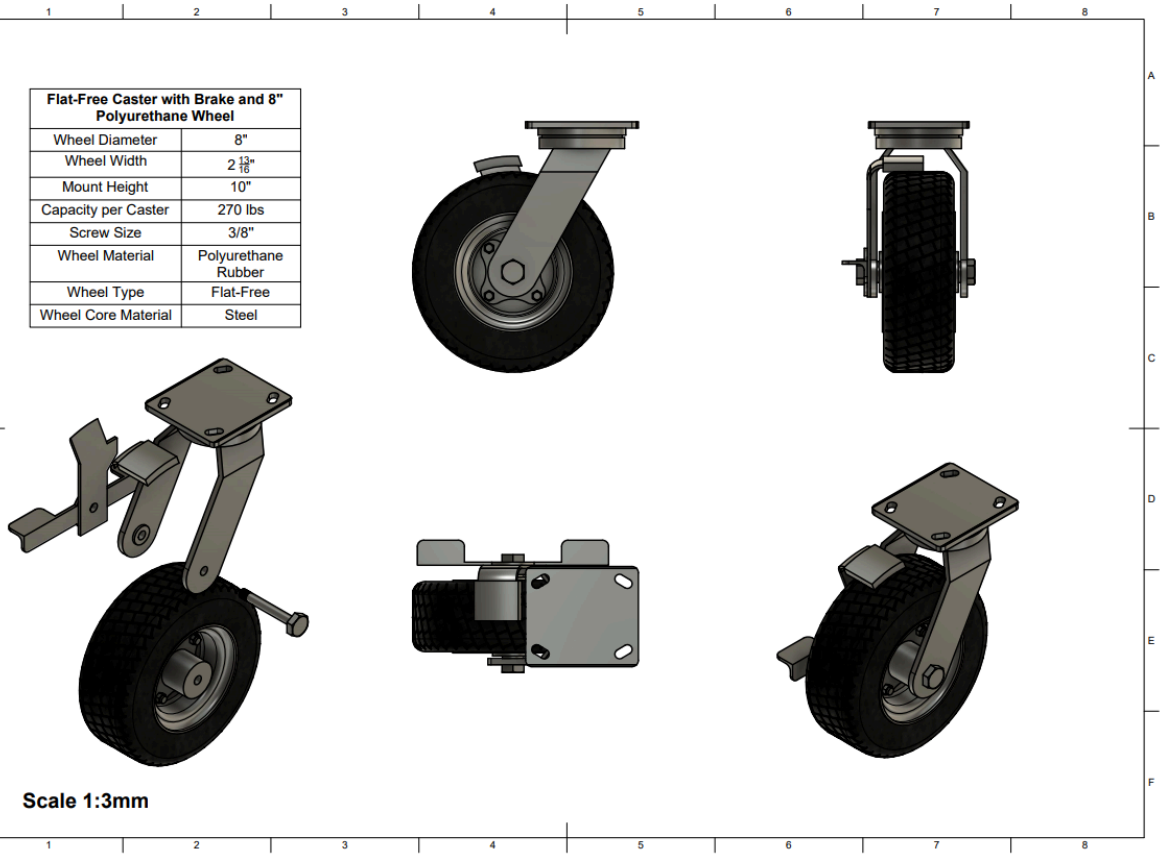
Steel-Hub Pneumatic Trailer Wheels	
Wheel Diameter	$16\frac{1}{8}$"
Wheel Width	$4\frac{13}{16}$"
Capacity per wheel	590 lbs @ 60psi
Wheel Material	Rubber
Wheel Type	Pneumatic
Bolt Circle Diameter	4"
Wheel Core Material	Steel



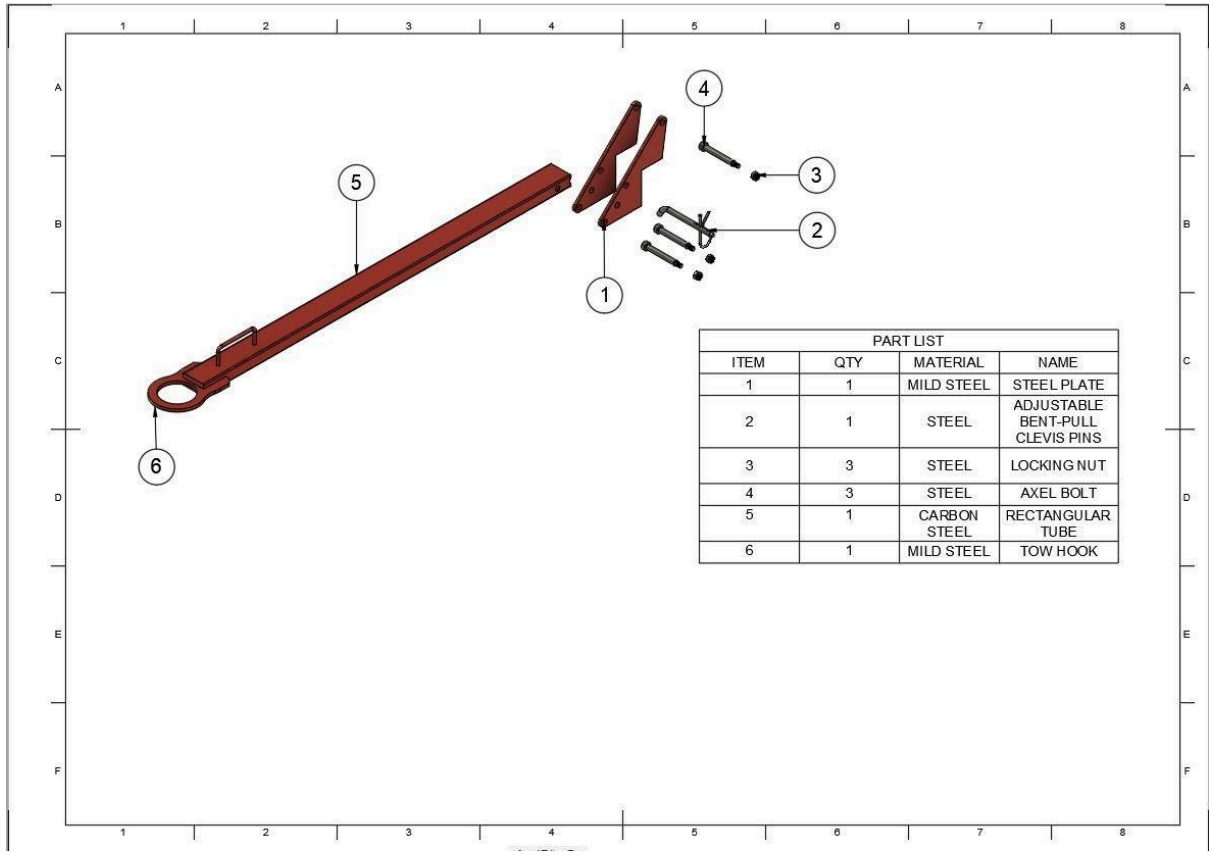
PARTS LIST			
Qty.	Material	Name	Scale
2	Tool Steel SAI 1045	Axle	1:5

Caster Wheel

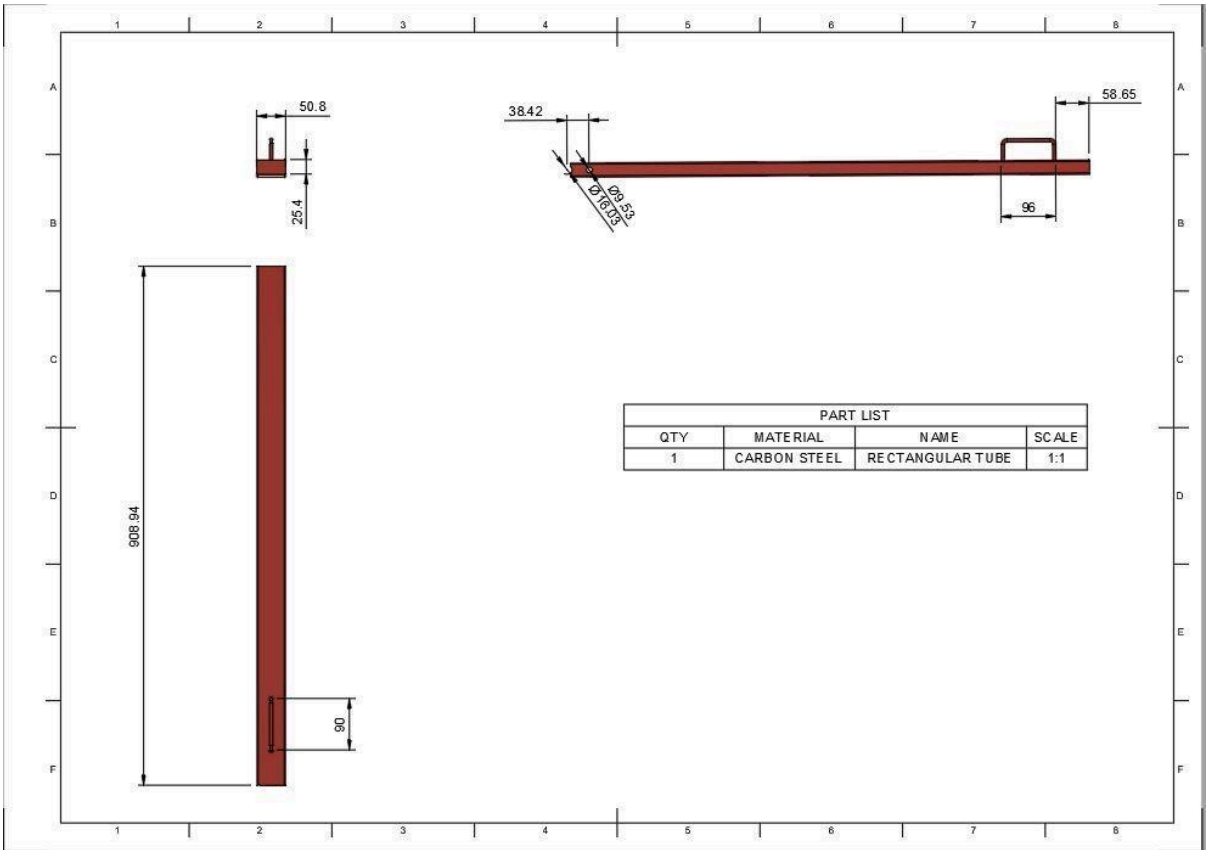
Flat-Free Caster with Brake and 8" Polyurethane Wheel	
Wheel Diameter	8"
Wheel Width	$2\frac{13}{16}$"
Mount Height	10"
Capacity per Caster	270 lbs
Screw Size	3/8"
Wheel Material	Polyurethane Rubber
Wheel Type	Flat-Free
Wheel Core Material	Steel



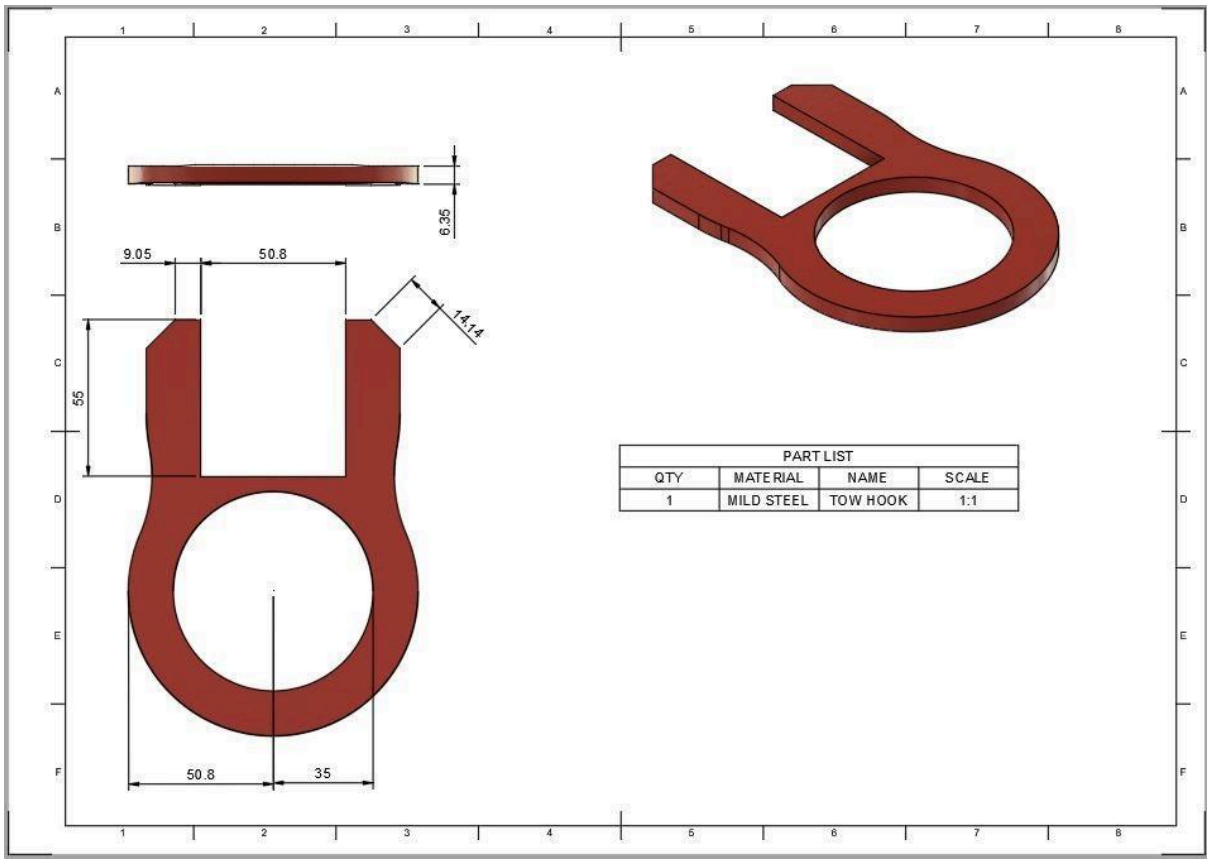
Tow Assembly

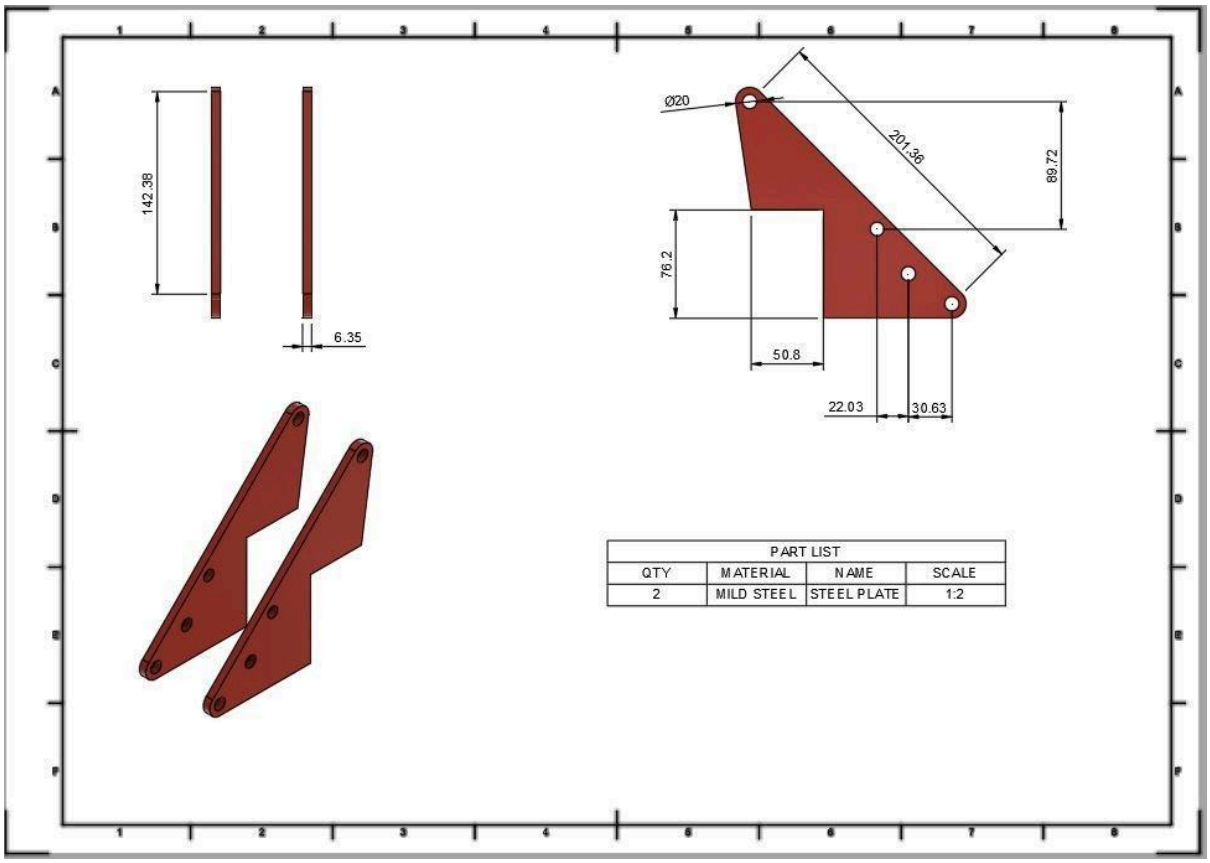


PART LIST			
ITEM	QTY	MATERIAL	NAME
1	1	MILD STEEL	STEEL PLATE
2	1	STEEL	ADJUSTABLE BENT-PULL CLEVIS PINS
3	3	STEEL	LOCKING NUT
4	3	STEEL	AXEL BOLT
5	1	CARBON STEEL	RECTANGULAR TUBE
6	1	MILD STEEL	TOW HOOK



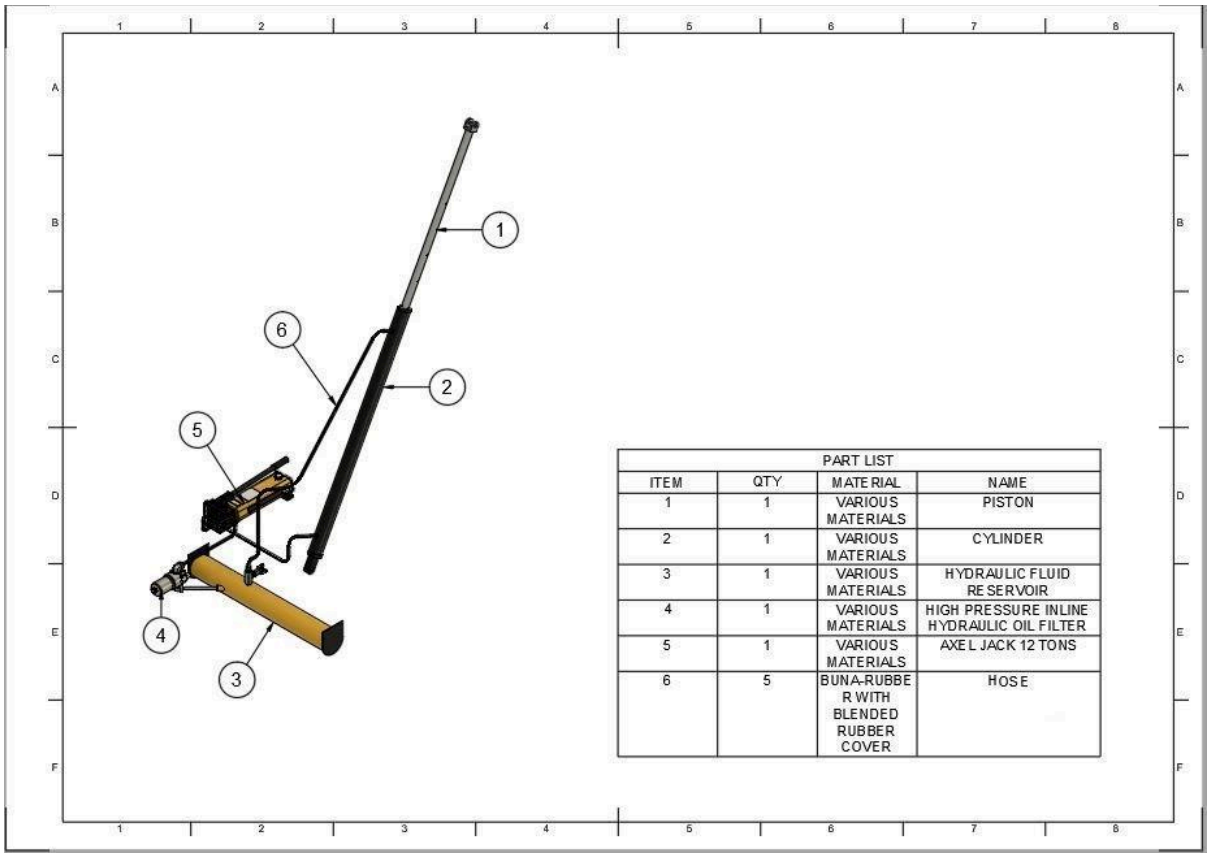
PART LIST			
QTY	MATERIAL	NAME	SCALE
1	CARBON STEEL	RECTANGULAR TUBE	1:1


6.35
9.05
50.8
14.14
55
50.8
35
PART LIST
QTY
MATERIAL
NAME
SCALE
1
MILD STEEL
TOW HOOK
1:1

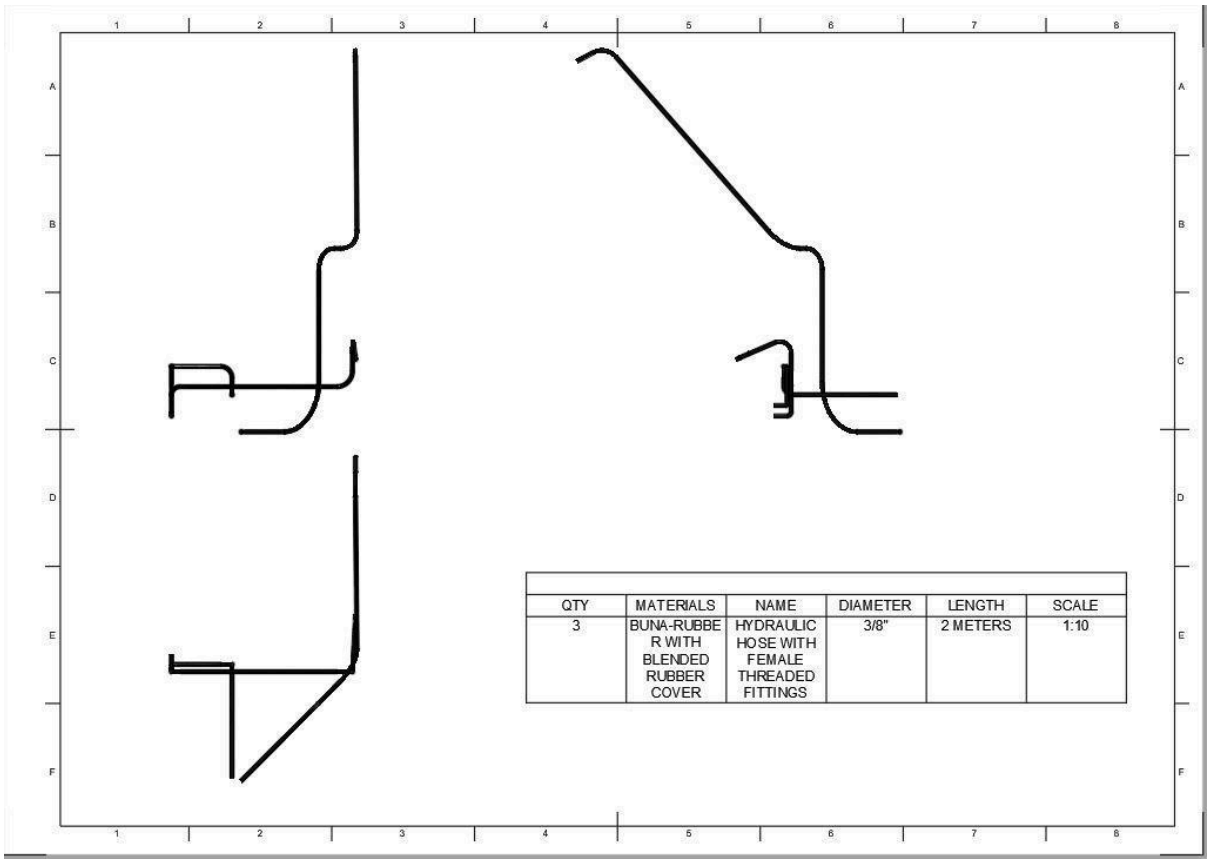


PART LIST			
QTY	MATERIAL	NAME	SCALE
2	MILD STEEL	STEEL PLATE	1:2

Hydraulic System

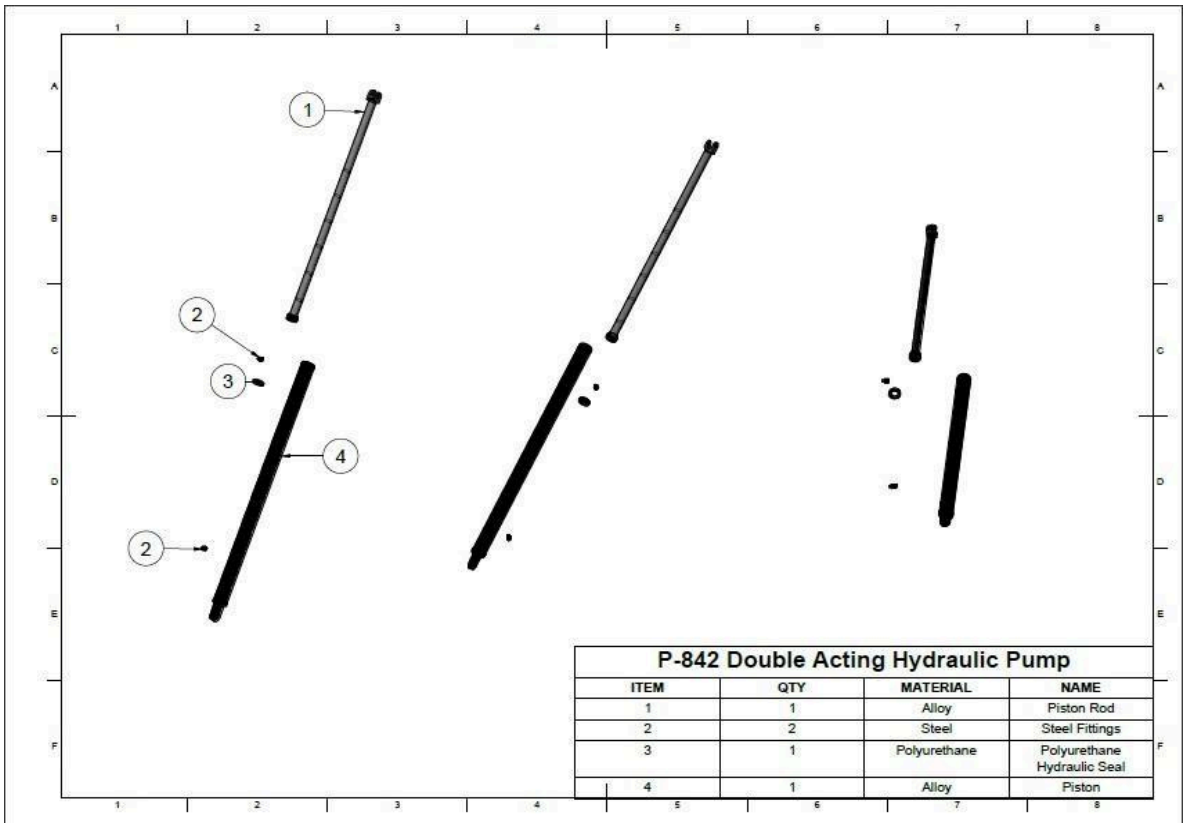


PART LIST			
ITEM	QTY	MATERIAL	NAME
1	1	VARIOUS MATERIALS	PISTON
2	1	VARIOUS MATERIALS	CYLINDER
3	1	VARIOUS MATERIALS	HYDRAULIC FLUID RESERVOIR
4	1	VARIOUS MATERIALS	HIGH PRESSURE INLINE HYDRAULIC OIL FILTER
5	1	VARIOUS MATERIALS	AXEL JACK 12 TONS
6	5	BUNA-RUBBER WITH BLENDED RUBBER COVER	HOSE



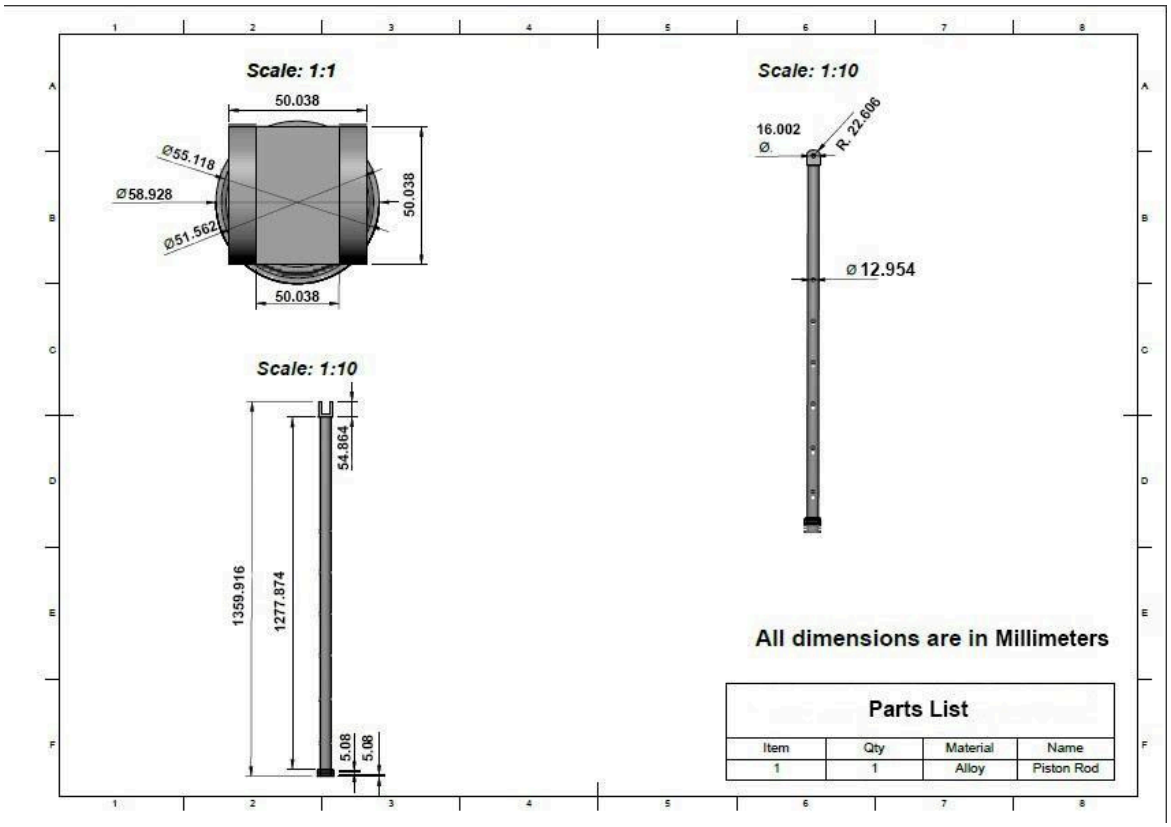
QTY	MATERIALS	NAME	DIAMETER	LENGTH	SCALE
3	BUNA-RUBBER WITH BLENDED RUBBER COVER	HYDRAULIC HOSE WITH FEMALE THREADED FITTINGS	3/8"	2 METERS	1:10

DOUBLE ACTING HYDRAULIC PUMP



P-842 Double Acting Hydraulic Pump

ITEM	QTY	MATERIAL	NAME
1	1	Alloy	Piston Rod
2	2	Steel	Steel Fittings
3	1	Polyurethane	Polyurethane Hydraulic Seal
4	1	Alloy	Piston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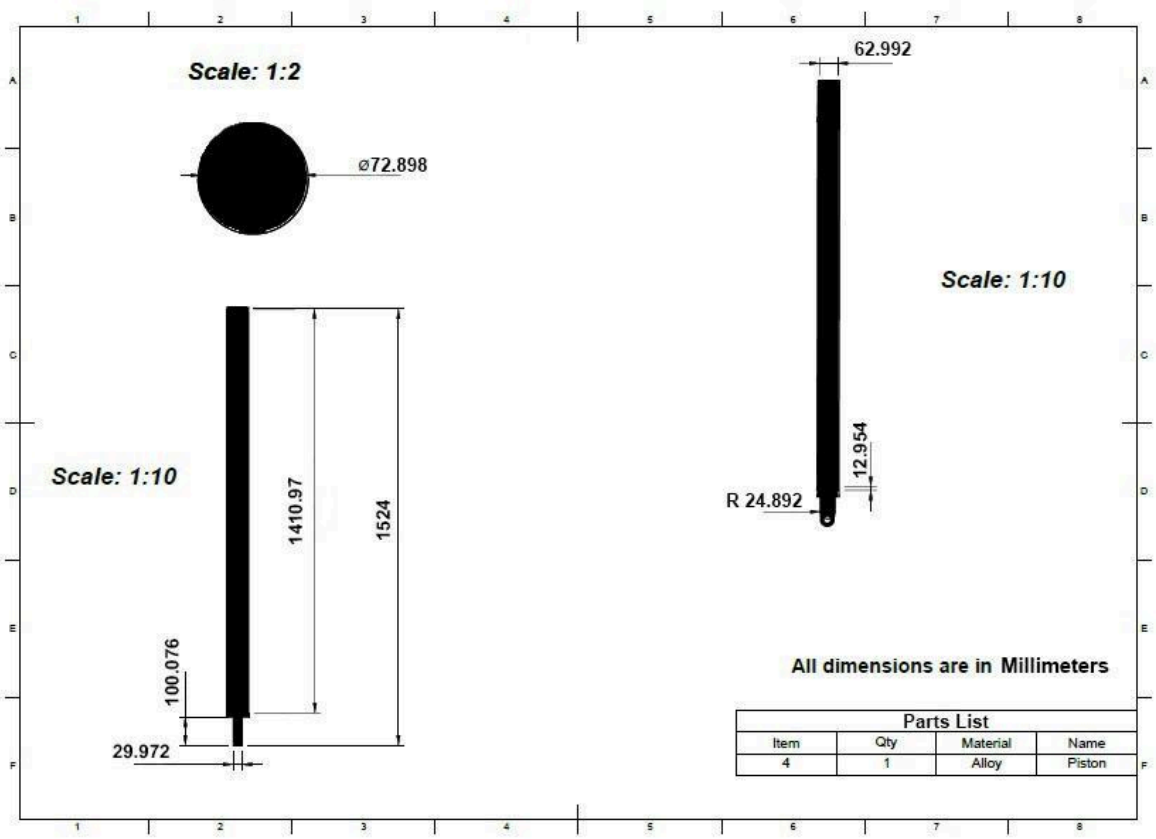
Ø55.118
Ø58.928
Ø51.562
50.038
50.038
Scale: 1:10
16.002
Ø
R 22.606
Ø 12.954
Scale: 1:10
54.864
1359.916
1277.874
5.08
5.08
All dimensions are in Millimeters
Parts List
Item
Qty
Material
Name
1
1
Alloy
Piston Rod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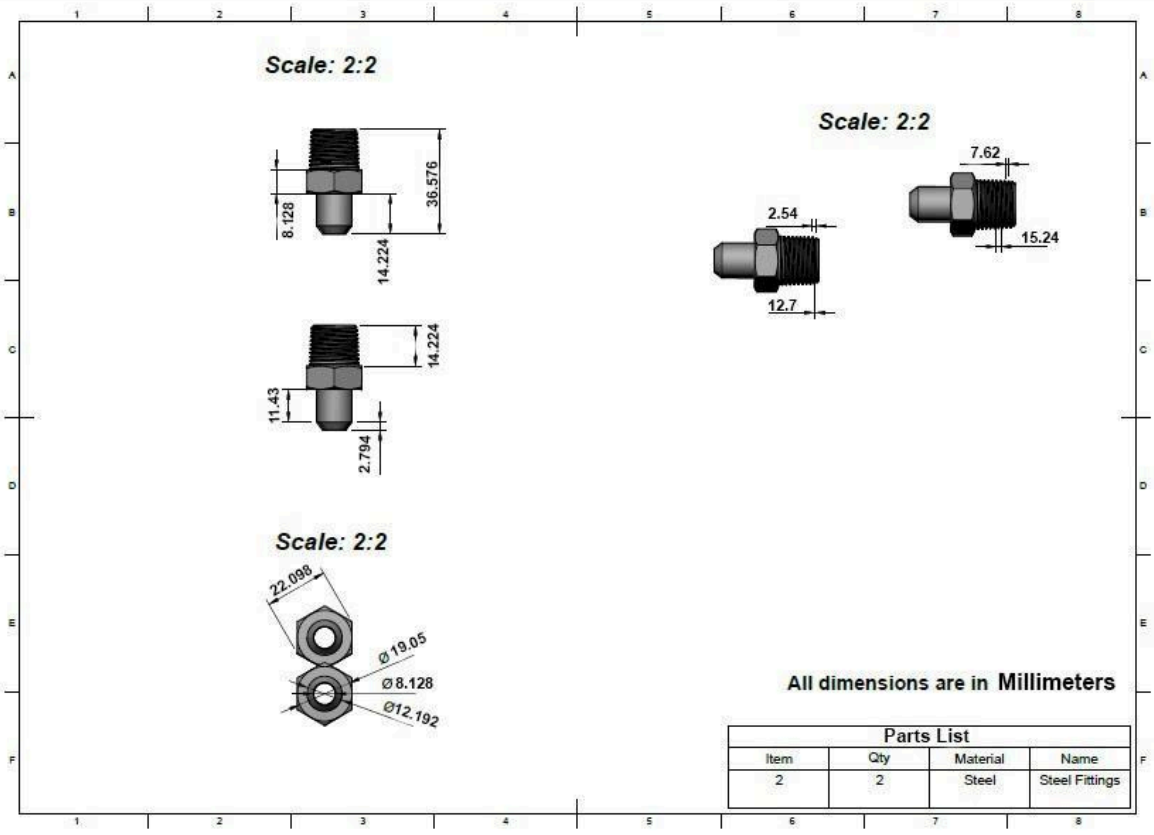
ø72.898
Scale: 1:10
1410.97
1524
100.076
29.972
62.992
Scale: 1:10
12.954
R 24.892
All dimensions are in Millimeters
Parts List
Item
Qty
Material
Name
4
1
Alloy
Piston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14.224
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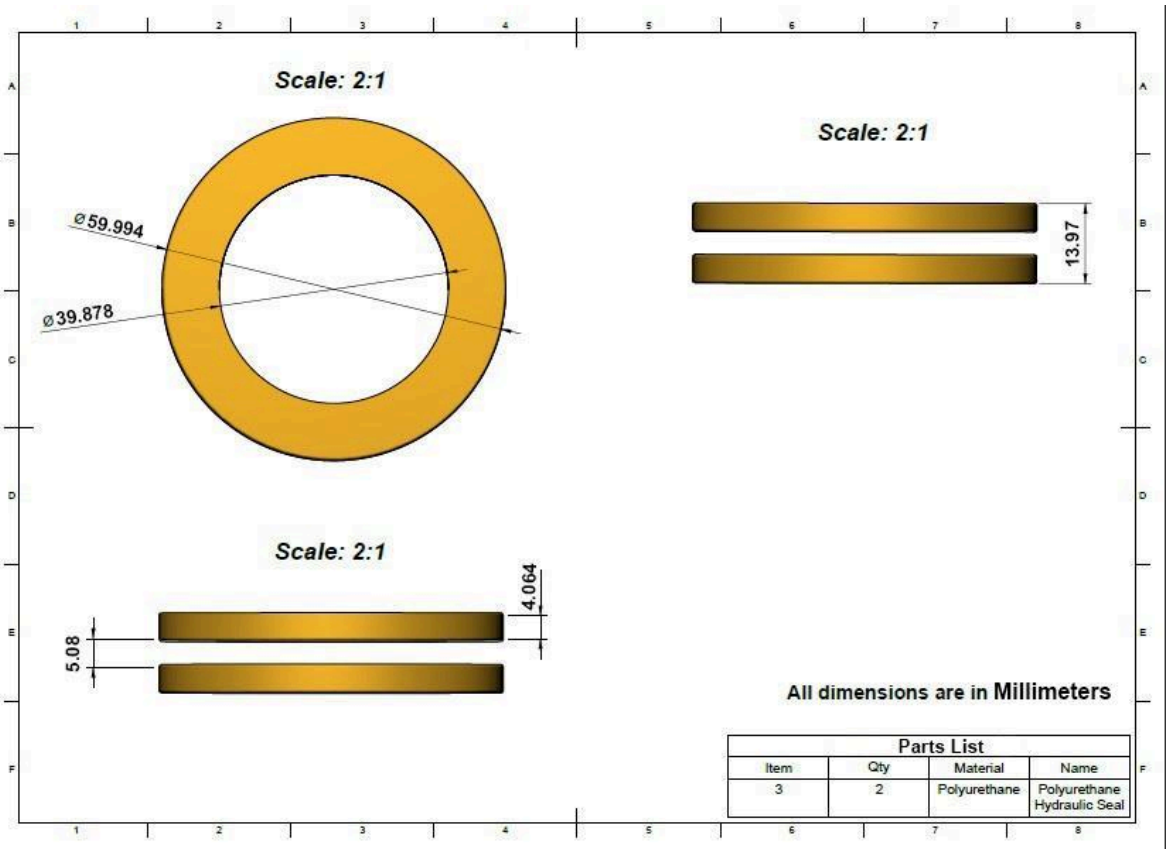
Ø19.05
Ø8.128
Ø12.192
22.098
Scale: 2:2
2.54
12.7
7.62
15.24
All dimensions are in Millimeters
Parts List
Item
Qty
Material
Name
2
2
Steel
Steel Fittings


Scale: 2:1
Ø59.994
Ø39.878
Scale: 2:1
13.97
Scale: 2:1
4.064
5.08
All dimensions are in Millimeters
Parts List
Item
Qty
Material
Name
3
2
Polyurethane
Polyurethane Hydraulic Seal

5.3. Application of Engineering Codes and Standards in Design

- **OSHA 1910 Subpart D — Walking Working Surfaces:** built in fall protection with guardrails. Removability of guardrails also adds to the ability to apply different fall protection techniques that may be more applicable given situation and work to be done
- **OSHA Act 1910 Section 5(a) (1) - General Duty Clause -** eliminates potential known hazard of mechanical/hydraulic failure by adding mechanical safety locking positions to help prevent the platform from falling.

5.4. Economic Analysis

For Assembling of the Maintenance Platform

Quantity	PARTS	UNIT PRICE	Amont
2	Mild Steel Plate (4ft x 8 ft x 5mm thk.)	7,896/sheet	15,792.00
1	Low Carbon Steel Rectangular Tube (1240mm x 2” x 4” x ⅛” thk.) *pre-cut order	625/unit	625.00
6	Low Carbon Steel Rectangular Tube (20ft x 2” x 3” x ⅛” thk.)	2,578/unit	15,468.00
4	Aluminum Rectangular Tube (20ft. x 2” x 2” x 0.065” thk.)	990/unit	4,950.00

3	Aluminum Steel Rectangular Tube (20ft. x 1.74” x 1.74” x 0.06” thk.)	800/unit	2,400.00
3	Aluminum Steel Rectangular Tube (20ft. x 1 ½ ” x 1 ½ ” x 0.065” thk.)	750/unit	2,250.00
20	Angle bar (MS PLATE) (4ft x 8ft x 4mm thk.)	6,324/unit	32,760.00
10	U-Channel (ALUMINUM PLATE) (4ft x 8ft x 3mm thk.)	4,460/unit	44,600.00
1	Perforated Steel Plate (4ft x 8ft x 1mm thk.)	2,000/sheet	2,000.00
2	Perforated Steel Plate (4ft. x 8ft x 2mm)	3,400/sheet	6,800.00
1	ENERPAC P842	84,000/unit	84,000.00
2	Pneumatic Wheel	900/unit	1,800.00
2	Caster wheel	1,230/unit	2,460.00
1	Full Hydraulic and Reservoir Assembly	45,000/unit	50,000.00
2	Lever Flat Jack Manufactured	4,800/unit	9,600.00
TOTAL COST OF MATERIALS = Php. 275,505.00			

CHAPTER 6: PROTOTYPE PROCESS, RESULT AND DISCUSSION

Making this HYDRAULIC MAINTENANCE PLATFORM (B1 Type) needs to be accurate in every dimension even in the smallest part of the product but having four brains in the group we are able to make this project in the right time of the deadline. We are not able to make this project due to the pandemic. This pandemic happening right now is caused by a virus called corona virus also known as Covid-19 enhanced community quarantine is implemented in every part of our country in Philippines it was a total lock down and no one should go outside unless it is needed with proper reason.

CHAPTER 7: CONCLUSIONS AND RECOMMENDATIONS

7.1. Summary of Goals and Objectives

"Student must design the HYDRAULIC MAINTENANCE PLATFORM (B1 Type) using the Fusion 360 application piece by piece and then make the actual product in the given website"

Considering the objectives specified and presented in every section, we as a group were able to satisfy every objective regarding the actual product called HYDRAULIC MAINTENANCE PLATFORM (B1 Type

7.2. Student Outcome Summary

“A” Ability to apply knowledge of mathematics, science, and engineering.

We were able to apply the knowledge of computing for the stress analysis of engineering through computing, power needed and its capacity.

“B” Ability to design and conduct experiments as well as analyze and interpret data.

We analyzed each part and the strengths needed in the product given to us using Autodesk Fusion360 software that is we know how to operate which helps us to meet desired materials needed.

“C” Ability to design a system to meet the desired needs.

We were able to build and design a HYDRAULIC MAINTENANCE PLATFORM (B1 Type) product that is needed for this project and to complete the course.

“D” Ability to function on multidisciplinary teams.

We were able to divide the tasks in each member of the groupmates that were within our grasps during this pandemic, the strengths of each member of the group shows each and every one ability and were highlighted in their parts.

“E” Ability to identify, formulate and solve engineering problems.

We were able to identify and solve each unexpected circumstance that may face during the gathering of proposed product design that led us to a better HYDRAULIC MAINTENANCE PLATFORM (B1 Type) product and able to finish it in time.

"F" Understanding of professional and ethical responsibility.

Having limited sources availability that are available, we were still able to gather needed information and still able to brainstorm using the online messenger, the ideas through our own understandings and needs are apply in the process.

"G" Ability to communicate effectively.

We make sure that our group top priority in working and finishing this product design is a to have a good communication that led us a success to able to present this project in right time.

"H" Broad education necessary to understand the impact of engineering solutions in a global/societal context.

We were able to research each part of the given product and the article about the HYDRAULIC MAINTENANCE PLATFORM (B1 Type) that helps us understand the use and purpose of this product in the field where it is used.

"I" Recognition of the needs for and ability to engage in lifelong learning.

The top needs of this HYDRAULIC MAINTENANCE PLATFORM (B1 Type) were newly redesigned and more useful than the product design given.

"J" Knowledge of contemporary issues.

We were able to apply the needs and replace the important parts of this product to the present time by considering its efficiency and multi-functional usage.

"K" Ability to use the techniques, skills, and modern engineering tools for engineering practice.

As a group effort and with proper communication, we as a group were able to practice engineering techniques that we learned for years and show our true ability while working on this project.

7.3. Concluding Remarks

The product that we design is a platform tool that plays a role in the aviation industry that acts to ensure safety for each in the maintenance department. We as a group are able to simplify the design that is given to us, also we are able to make the platform less heavy than the actual design but also with the materials that are more durable. We put a higher psi of hydraulic pump so that it can carry heavier people or equipment. It is more convenient to clean because we put a mesh grill as a stair in it. We improve the basic B1 type to a more reliable and durable one.

7.4. Recommendations

This project finished consuming more time and must be able to put effort in every part of doing it. Creating these kinds of projects requires communication in every group so that it can be finished in time. Coordination and patience are needed to create a flawless kind of project like this.

Visiting the Tronair website helps us in creating this project with the downloadable manual. We are able to see what the limitation of the basic product is and where we can improve it. Researching for what is the best part is a must. Watching videos, reading articles and asking other people for advice help

us to create this product that we are able to finish. All of these can help in accomplishing this kind of work.

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APPENDIX

QUOTE OF MATERIALS:

KIM'S MACHINE SHOP

FABRICATOR CONTRACTOR
8 Pasolo road Valenzuela City
C.P. # 0923-244-3192 / 0915-219-9161
kimberly_tech@yahoo.com

QUOTATION OF MATERIALS

August 5 2021

Quantity	PARTS	UNIT PRICE	Amont
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2	Lever Flat Jack Manufactured	4,800/unit	9,600.00
		TOTAL COST OF MATERIALS = Php. 275,505.00	

Sincerely yours,

Dante B. Bercasio
(General Manager)