DECEMBER 15, 2025

PORTFOLIO

PROJECTS

BENJAMIN SCHLICH
(470) 273-0516 | benschlich45@gmail.com | LinkedIn

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The NASA Human Exploration Rover Challenge is an annual competition that challenges university teams to design, build, and race functional human-powered rovers over simulated extraterrestrial terrain. The competition emphasizes engineering design, fabrication, testing, and performance under realistic mission constraints.

As part of the suspension design team, I contributed to the research, design, and analysis of the rover's suspension system to ensure durability, terrain adaptability, and optimal performance. My work included:

- Developing and evaluating multiple suspension alternatives using a decision matrix to select the optimal design
- Creating detailed CAD models of the suspension and full rover assembly
- Conducting FEA simulations and a Failure Modes and Effects Analysis (FMEA) for the suspension
- Planning and managing suspension fabrication, assembly, and testing
- Supporting project documentation, including suspension course management, timeline, budget tracking, and performance analysis

The attached portfolio pages are excerpts from the team's Design Review Report, highlighting the suspension design process, technical analyses, fabrication and assembly strategy, testing methodology, and overall integration into the rover for competition performance.

As part of an advanced Mechanical Engineering CAD course, I recreated complex mechanical components and assemblies in Autodesk Inventor using detailed engineering drawings as the sole reference. Across 11 structured part and assembly sets (42 total engineering drawings), I translated fully dimensioned 2D documentation into accurate 3D parametric models and then generated complete, standards-based technical drawings from my models.

This project required proficiency in:

- Advanced solid modeling and feature-based parametric design
- 3D sketching and complex geometry creation
- Freeform modeling techniques
- Sheet metal design and flat pattern development
- Mechanical assemblies with motion constraints
- Top-down assembly workflows
- Design Accelerator tools (gears, shafts, bearings, etc.)
- Frame Generator for structural assemblies

For each set, I ensured dimensional accuracy, proper constraint application, and manufacturing-ready drawing outputs including views, sections, tolerances, and annotations. The final deliverables

demonstrate my ability to interpret engineering documentation, model parts precisely, build functional assemblies, and produce professional-level technical drawings suitable for manufacturing.

During a mechanical engineering internship, I redesigned a section of industrial machine guarding that required frequent removal during weekly maintenance shutdowns. The original design was difficult to handle, prone to stress concentrations, and susceptible to impact damage from debris in a harsh operating environment.

The redesign focused on improving maintainability for maintenance crews while increasing structural robustness without increasing overall weight. Key changes included revised mounting locations, thicker and repositioned handles for safer handling, reinforced tubing to reduce stress concentrations, and a simplified clip-and-slot mounting system to speed installation and alignment.

The final design improved ease of removal and reinstallation, increased durability under repeated impact loading, and better accommodated real-world maintenance constraints.

As part of my involvement with the AIAA Rocketry Club, I designed, simulated, and flew a high-powered rocket from concept through launch. I was responsible for the aerodynamic design of the nose cone and fin set, which I modeled in Autodesk Inventor with the goal of achieving stable, efficient flight.

Using OpenRocket, I simulated the full flight profile to evaluate stability, predict apogee, and select appropriate motor delay timing. The final configuration achieved a 10.4% stability margin, with simulations predicting a peak altitude of approximately 721 meters and a maximum velocity of 186 m/s.

The project culminated in the fabrication, assembly, and successful launch of the rocket using an H195T-14A motor, earning my Level 1 High Power Rocketry (HPR) certification.

As a summer research assistant in a robotics lab, I designed and fabricated a custom mount to integrate an Intel RealSense D435i onto a UR5e for vision-based object detection.

I measured the camera and robot mounting interfaces, including threaded hole spacing and diameters, and used these measurements to dimension the design in SOLIDWORKS. The mount was optimized to be lightweight and rigid, with filleted edges for strength, and positioned the camera for reliable depth capture.

Certifications

UNIVERSITY OF GEORGIA
College of Engineering

NASA Human Exploration Rover Challenge 2026

Design Review Report

November 24, 2025

University of Georgia

College of Engineering

Paul D. Coverdell Center
500 D.W. Brooks Drive
Athens, GA 30602

Division: Human Powered - University

Social Media Links: Instagram: uga_herc, Linkedin: University of Georgia NASA HERC Club, Youtube: ugaherc

Faculty Advisor: [redacted]
Team Leader: [redacted]
Team Safety Officer: [redacted]

Engagement Lead*: [redacted]

Safety Team*: [redacted]

Senior Design Pool*: [redacted] Benjamin Schlich [redacted]

General Design Pool*: [redacted]

Engagement Team*: [redacted]

**The roles of these team members are not static and are subject to change on an as-needed basis.*

1.3 Suspension

Table #3: Suspension Design Matrix

Design Matrix: Suspension		Criteria 1	Criteria 2	Criteria 3	Criteria 4	Criteria 5	Criteria 6	Criteria 7	Criteria 8	Design Scores
		Terrain Adaptability	Durability	Weight	Maintenance / Complexity	Performance	Cost / Material Availability	Integration	Energy Efficiency	
*	Criteria Weight (1-5)	4	4	3	3	5	4	4	1	
** Idea 1:	**Drooped Double Wishbone**	9	6	6	4	9	5	7	7	190
	Weighted Ranking	36	24	18	12	45	20	28	7	
Idea 2:	**Drooped Double Wishbone (Front) + Trailing Arm (Rear)**	5	8	4	7	6	8	7	3	178
	Weighted Ranking	20	32	12	21	30	32	28	3	
Idea 3:	**Drooped Double Wishbone (Front) + Multilink (Rear)**	8	6	7	4	8	5	7	8	185
	Weighted Ranking	32	24	21	12	40	20	28	8	
Idea 4:	**Level Double Wishbone**	8	6	4	5	7	6	5	7	169
	Weighted Ranking	32	24	12	15	35	24	20	7	
Idea 5:	**Multilink**	7	5	3	5	8	8	4	5	165
	Weighted Ranking	28	20	9	15	40	32	16	5	

Idea 1 - Drooped Double Wishbone

This setup uses two parallel A-arms mounted at an angle instead of parallel to the ground. This helps maintain a better contact patch with the ground by optimizing the camber change (camber increases with compression) when going over obstacles. This design is relatively simple and allows us to adjust the stiffness. Having the same suspension all around makes it more predictable than using different suspension types in the front and rear.

Idea 2 - Drooped Double Wishbone (Front) + Multilink (Rear)

This setup uses two parallel A-arms mounted at an angle instead of parallel to the ground, plus a more complex multilink system in the rear. The front double wishbone suspension provides a good contact patch and ride, while the rear multilink suspension provides stability for the rover. This is because multilink suspension is heavily reinforced and over-engineered to prevent failure points and enhance stability for any vehicle it is attached to. Having it would improve the rover's cornering; however, it would increase the rover's design complexity and material requirements. It might also reduce ride quality by being stiff to provide stability in all directions.

Idea 3 - Drooped Double Wishbone (Front) + Trailing Arm (Rear)

This setup uses two parallel A arms mounted at an angle on the front of the rover, and a Trailing Arm suspension in the rear. While complex, a trailing-arm suspension would allow free movement of the rear axle and provide a much smoother ride, better able to absorb bumps and angles. The double wishbone setup has an upper and lower arm attached at an angle to the wheel, with the shock attached to the chassis and lower wishbone. The trailing arm connects to the chassis behind the wheel. After the arm is placed parallel to the wheel, and the shock absorbers are placed behind the wheel, the trailing arm is attached to the chassis through a simple upper and lower connection. Having the trailing arm in the rear only eliminates the inherent flaws of the solid axle setup, failing to control camber and having poor lateral stability.

Idea 4 - Level Double Wishbone

This setup is essentially the same as the angled double wishbone suspension system, with one significant difference: the shock and springs are laid horizontally across the system. This type of suspension is typically only seen in race cars and hypercars due to the fact that the few benefits it has, improved aerodynamics and lowered center of gravity, are generally only useful at high speeds. Additionally, the angled double wishbone system mimics this system at heavy loads, reducing the need to place the shocks and springs at a horizontal position.

Idea 5 - Multilink

This setup uses four metal arms that connect the solid rear axle to the vehicle's frame. The 4-link suspension divides the spring's job in two: the link holds the axle in place, and the spring supports the vehicle's weight. The use of 4 metal arms allows the axle to twist significantly, keeping the tires on the ground over rough terrain; however, due to the system's complexity and the many moving parts, they wear down quickly and were thus rejected for the final design.

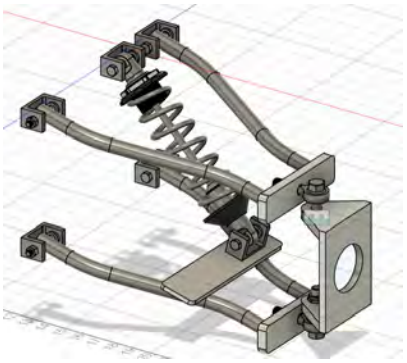


Fig #13: Chosen Suspension Design

Chosen Design - Drooped Double Wishbone (-15 Degree Angle)

The angled double wishbone design on both the front and back axles was selected as the optimal design for the rover. This approach provides a good balance between strength, adjustability, and performance while maintaining the vehicle's compact structure. The suspension system's angled geometry provides significant improvements in camber control and stability as the rover maneuvers across different terrains, ensuring the wheels maintain better contact with the ground. Additionally, an independent suspension layout for each wheel allows each wheel to react to bumps and obstacles independently, reducing energy loss. The dimensions of this suspension system are shown in Appendix A.

1.7 Assembled Vehicle

The rover construction and assembly process will be a phased approach, with construction starting with the subsystems that require welding. The welding process will take place in UGA's fabrication lab by members of our team who have completed the UGA-required welding training. After each subsystem is constructed, it will be bolted or welded together. The suspension system will be welded to the chassis, while the wheels will bolt into the wheel hubs. The steering system will bolt into the wheel knuckle, while the steering column will be welded to the chassis. The drivetrain pedals will fit through the pedal rod on the chassis, while the axle will be keyed into the wheel hubs. Then a chain will link the pedal gear to the gear attached to the axle.

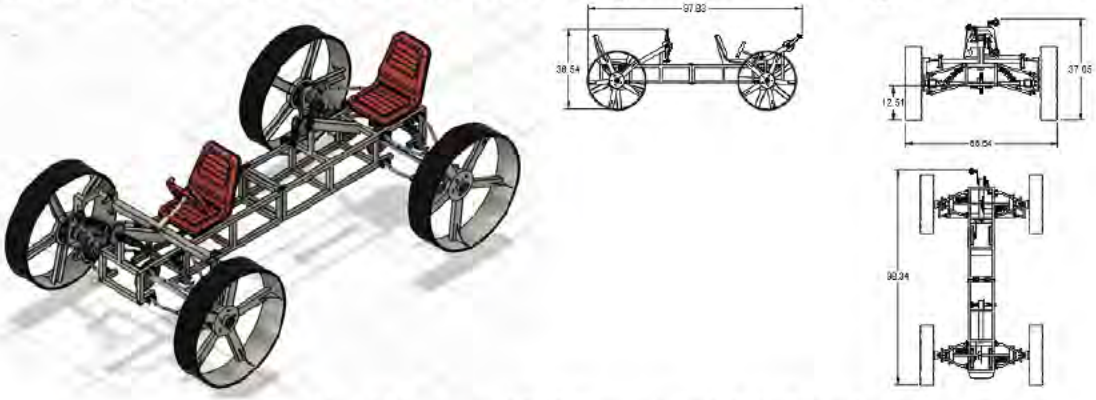


Fig. #31 Assembled Rover Model & Drawings

2.0 ANALYSIS OF DESIGN

2.1 Course Management Plan

[redacted]

Suspension

The drooped angle was chosen for High Butte and Crater with Ejecta because the added angle raises the chassis, providing extra ground clearance for steep climbs and mounds. The drooped wishbone arms also prevent the front suspension from bottoming out at the onset of tall obstacles.

The double wishbone geometry was chosen in anticipation of the Undulating Terrain and Bouldering Rocks obstacles. The double wishbones keep camber more consistent over uneven travel and improve tire contact on rocky terrain.

2.2 Requirements

The rover's chassis is 7'x12"x10', which, when folded at the center and split into two halves, will fit within the 5'x5'x5' box requirement. The non-pneumatic wheels, which will be the part of the rover sticking the furthest outside the chassis, are 6" wide each. Therefore, the widest the rover will be is 24", which is well under the 5' limit. The wheels also have a diameter of 26"; therefore, the folded rover will have a length of at most 4.6', which meets the requirement. The pedals, steering wheel, and where there are no parts that will cause injury. The turning radius is 4.49'. This will most likely vary greatly, but it allows for over 5' tolerance, fitting well into the 10' turning radius constraint. The rover has no energy storage devices. As for safety, the rover will be equipped with brakes and seat belts. Based on the material weights, the rover will weigh approximately 163.5 lbs.

3.0 SAFETY

3.1 Personnel Hazard Analysis (PHA)

The safety team observed, researched, and analyzed several potential hazards to produce Preliminary Hazard Analysis (PHA) charts. The PHA process is primarily used to identify hazardous events and the controls that can be put in place to prevent or mitigate their occurrence. Much of our criteria for determining these risk factors depends on the same standards used in the UGA HERC 2025 Design Report. Our final risk analysis charts examine hazards that may occur throughout the fabrication, testing, and competition phases. Hazards are scored on a 1-10 scale for probability and severity, with the product representing the total risk. The PHAs we created consider hazardous components, environmental constraints, safety-related equipment, safeguards, alternate approaches, and subsystem malfunctions. A discussion of each PHA can be found below.

3.1.1 Construction/ Fabrication PHA

The PHA reveals many areas of high and medium risk during the fabrication process. The highest risks are ocular damage and hearing impairment. These would most likely be due to

loose debris and noise from machinery and tools during fabrication. These risks can be mitigated by ensuring proper PPE use: eye protection, ear protection above 85 dB, long nonbaggy clothing, and enclosed shoes. Proper PPE use will also help reduce the likelihood and severity of burns, cuts, and chemical burns during fabrication. Cuts and strain injuries are common during the fabrication phase due to extensive use of machinery, metalworking, and heavy lifting. To reduce the likelihood of these incidents, all team members involved in fabrication will be required to receive proper training on tools and machinery.

Table #8: Construction/Fabrication PHA

Hazards	Probability	Severity	Total risk
Burns	4	3	12
Cuts	9	2	18
Blunt Force	2	6	12
Chemical Burns	1	5	5
Electric Shock	2	4	8
Ocular Damage	4	8	32
Hearing Impairments	4	8	32
Strain Injury	9	3	27

3.1.2 Testing PHA

The testing-phase PHA indicates no major hazard concerns, with the primary risks limited to strains, cuts, and blunt-force impacts. Strains may occur during driver testing, but are expected to remain minor with proper communication between the driver and team. During incline testing, a strict 30-ft buffer zone will be maintained behind the rover to minimize the risk of blunt force injuries. Blunt-force trauma is considered a risk only for personnel outside the rover, assuming no structural failure occurs, although all drivers will wear helmets. Due to the hands-on nature of our rover operation, cuts are the most likely hazard; however, severity is expected to remain low with proper PPE, including long sleeves, long pants, long socks, enclosed shoes, and fingered gloves.

Table #9: Testing PHA

Hazards	Probability	Severity	Total risk
Burns	1	4	4
Cuts	6	2	12
Blunt Force	2	5	10
Chemical Burns	1	5	5
Electric Shock	1	5	5
Ocular Damage	2	3	6
Hearing Imparements	1	3	3
Strain Injury	3	2	6

3.1.3 Performance/Competition PHA

The competition PHA shifts the focus from the fabrication and testing phases of the competition to the dynamic operational safety of vehicles and drivers on the course. There are two primary major hazard concerns: Strain Injury and Blunt Force, both with a score of 12. Strain injury to the driver is the most probable hazard identified, as it can result from the high physical effort required to

Table #10: Performance/Competition PHA

Hazards	Probability	Severity	Total risk
Burns	1	2	2
Cuts	3	2	6
Blunt Force	3	4	12
Chemical Burns	1	1	1
Electric Shock	1	3	3
Ocular Damage	3	2	6
Hearing Impairments	1	1	1
Strain Injury	4	3	12

navigate the diverse, challenging terrain drivers encounter in competition. This risk can be mitigated through intensive pilot training and optimization of the rover's drivetrain. Other likely hazards, such as ocular damage and cuts, are deemed lower risk and are sufficiently controlled with mandated personal protective equipment. Drivers will be wearing safety goggles and gloves, reducing the likelihood of these risks.

3.2 Failure Modes and Effects Analysis

The safety team collaborated with each subsystem group to develop a Failure Modes and Effects Analysis (FMEA) for each group's respective design. These analyses aim to identify the most critical failure modes that could affect rover performance or rider safety. To conduct these analyses properly, we have adopted the same criteria used in the UGA HERC 2025 Design Report. This criterion consists of a chart listing potential failure modes, their causes, and the detection methods identified by the subsystem and safety teams. Predicted failure modes are assigned scores from 1 to 10 on severity, occurrence, and detectability. A severity score of 1 represents a negligible effect, while a score of 10 indicates catastrophic failure or injury risk. An occurrence score of 1 suggests the event is highly unlikely, whereas a score of 10 indicates it occurs extremely often or every time. A detectability score of 1 indicates we will identify the failure before it becomes critical, while a score of 10 implies little to no warning before failure. The product of these scores produces a Risk Priority Number (RPN) for each failure mode. High RPNs (red) represent our primary concerns for structural integrity and safety, followed by orange and yellow as moderate risks, and green as lower-priority issues.

Table #14: Suspension FMEA

Process Step	Failure Mode	Potential Effect	Severity	Potential Cause	Occurance	Current Control	Detection	RPN
Ball Joints (Upper/Lower)	1.) Worn/Loose (play) 2.) Catastrophic separation 3.) Torn dust boot	1.) Clunking noise, wandering steering 2.) Total loss of control, wheel detachment 3.) Leads to premature wear (Mode 1)	10	1.) Normal wear 2.) Lack of lubrication (torn boot) 3.) Contamination (dirt/water)	5	1.) Sealed, greased-for-life design 2.) Regular inspection (check for play)	3	150
Control Arm Bushings	1.) Worn/Deteriorated 2.) Torn/Separated	1.) "Clunking" noise 2.) Vague steering 3.) Uneven tire wear 4.) Alignment issues	6	1.) Normal wear/Age 2.) Environmental exposure (oil, ozone) 3.) High stress loads	7	1.) Durable material choice (rubber, polyurethane) 2.) Periodic visual inspection	3	126
Upper Control Arm	1.) Crack/Fracture 2.) Bent/Deformed	1.) Sudden loss of wheel alignment, loss of control 2.) Poor handling, uneven tire wear	10	1.) Material fatigue 2.) Severe impact (pothole) 3.) Mfg. defect	3	1.) FEA simulation in design 2.) Material selection 3.) Visual inspection	4	120
Lower Control Arm	1.) Crack/Fracture 2.) Bent/Deformed	1.) Sudden loss of wheel alignment, loss of control 2.) Poor handling, uneven tire wear	10	1.) Material fatigue 2.) Severe impact (pothole) 3.) Corrosion	3	1.) FEA simulation in design 2.) Material selection 3.) Corrosion coating	4	120
Knuckle / Spindle	1.) Crack/Fracture 2.) Damaged bearing bore	1.) Total loss of control, wheel detachment 2.) Wheel wobble, premature bearing failure	10	1.) Severe impact 2.) Manufacturing defect 3.) Improper bearing installation	2	1.) Robust design (forging/casting) 2.) Manufacturing QA/QC (NDT)	4	80
Shock Absorber (Damper)	1.) Leaking fluid (seal fail) 2.) Internal valve failure	1.) "Bouncy" ride 2.) Poor handling 3.) Reduced braking effectiveness 4.) Wheel hop	6	1.) Normal wear/Age 2.) Debris damaging shaft/seal	6	1.) High-quality seals 2.) Shaft dust boot 3.) "Bounce test" / visual leak check	2	72
Coil Spring	1.) Fracture/Break 2.) Sagging (fatigue)	1.) Sudden drop in ride height, potential tire contact 2.) Incorrect alignment, poor handling	9	1.) Corrosion (road salt) 2.) Material fatigue 3.) Severe impact	3	1.) Corrosion-resistant coating 2.) Material selection 3.) Visual inspection	2	54

The suspension FMEA identified that the risks associated with the suspension center on component degradation. The highest-risk area is the ball joints, and the issue arises as components connecting the rover's frame to the suspension and wheel assemblies degrade, potentially leading to catastrophic failure and injury to drivers, which is why it has a high severity. This, along with all other listed failure points, is caused by overloading and simple wear over time. The cracking of the upper and lower control arms is also a severity of 10; however, the likelihood of this occurring is slim, as it would require a total material failure rather than a degradation failure. Nevertheless, these risks can be avoided by frequent inspections to ensure the system's components withstand the loads they are subjected to during the competition. Testing of each component will take place before it is installed on the final rover, ensuring driver safety.

[redacted]

Top 6 Highest RPN Failure Modes In Order Of Highest To Lowest

1. Drivetrain Chain Tension Failure (448)
2. Drivetrain Chain Derailment (252)
3. Task Tool Piloting Error (200)
4. Drivetrain Axle Key Out (192)
5. Wheel Material Failure (180)
6. Drivetrain Gear Key out (168)

4.0 PROJECT PLAN

4.1 Timeline

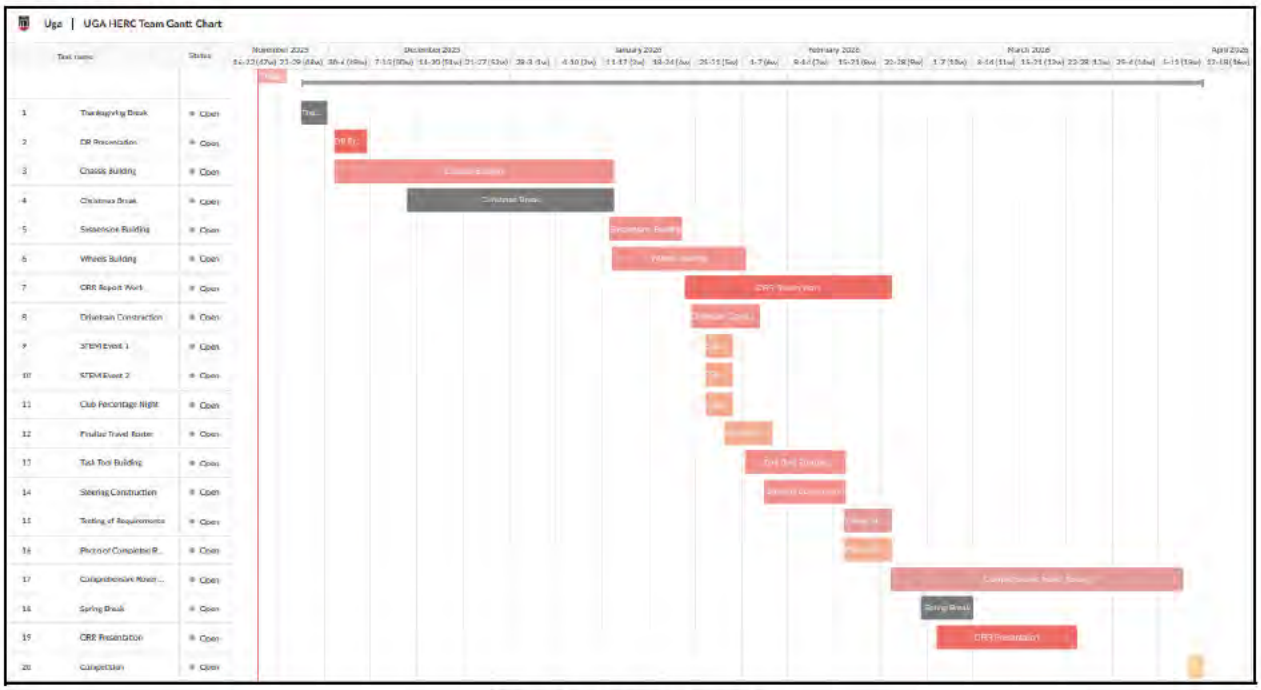


Fig #32: Gantt Chart

Following the submission of this report and the presentation, we will be on Thanksgiving break from November 26-30. Before the break, we will begin purchasing the necessary parts for chassis construction and continue as we move on to other subsystems in the spring semester. After we get back from Thanksgiving break, we will have our DR presentation, where we will present our rover design, gather input and feedback, and modify our designs accordingly. Construction will take place throughout December, and it will be completed after we get back from Christmas break. After this, construction of the subsequent subsystems will start simultaneously. We will start by constructing the wheels and suspension, as they will involve welding, and other subsystems rely on them for fabrication. After this, we will work on the drivetrain while some of our members host two STEM engagement events at Georgia schools and a percentage night at a local restaurant. This is also when work on the ORR report will begin and will be carried out accordingly throughout construction as changes to the rover design are documented. Meanwhile, we will decide which members will be attending the competition based on the budget and finalize the travel roster, which we will then use to begin reserving travel

accommodations. Finally, the task tool and steering construction will be the last pieces of fabrication done simultaneously. Then, final preparations for the competition will begin around UGA's spring break, which include taking the completed rover photo, testing the rover, and turning in the ORR report and presentation. With everything completed, we will pack the rover and transport it to Huntsville for the competition in April.

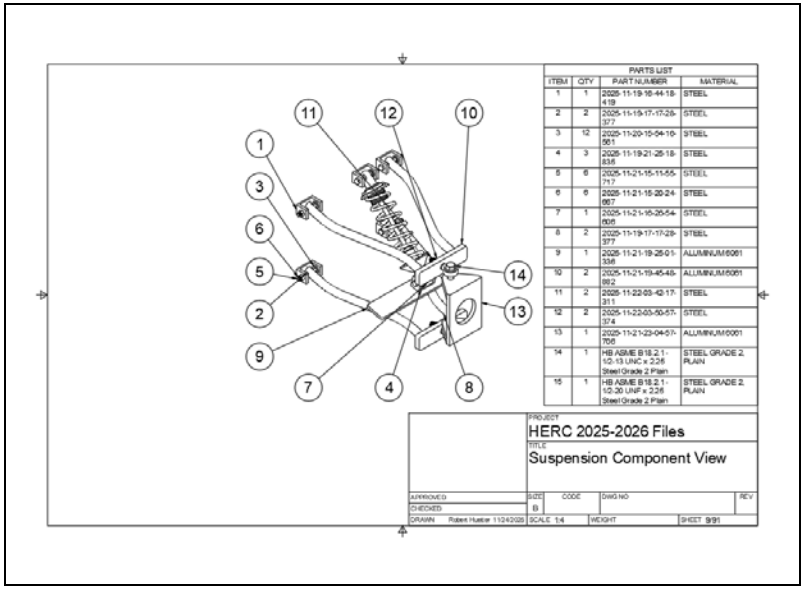
4.2 Updated Budget

Table #17: Updated Budget Chart

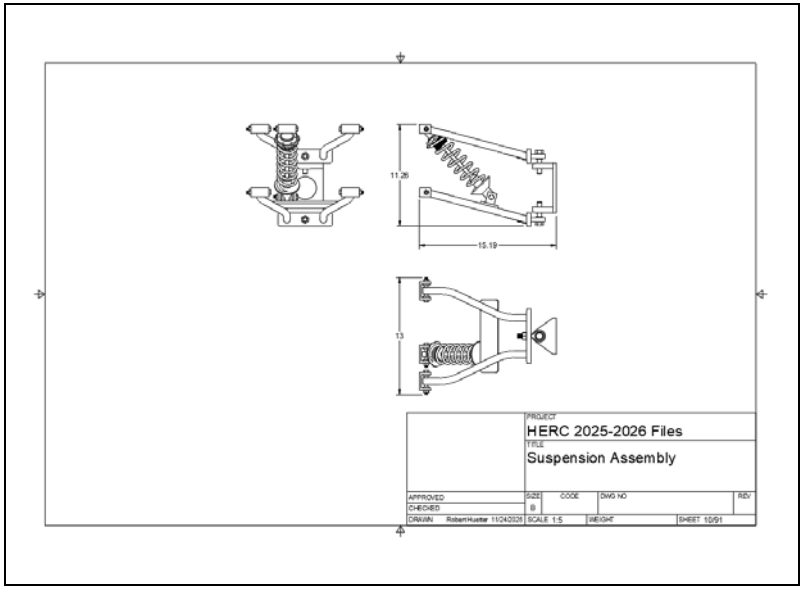
[redacted]

Suspension			
	Four 150 lb rated rear shocks	$400	
	Multipurpose 6061 Aluminum U-Channel 0.26" Leg x 0.17" Base Thickness, 1-1/4" High x 2" Wide Outside, 3 ft.	$41	
	8x Ball Joint Rod End, 1/2"-20 Thread	$62	
	Multipurpose 6061 Aluminum 1/4" Thick, 2" x 48" Sheet	$24	
	General Purpose Aluminum Tubing 3/4" OD, 0.083" Wall Thickness, 3x 6 ft.	$120	
	Multipurpose 6061 Aluminum Bar 1/2" Thick x 1-1/2" Wide, 8 ft.	$59	
	Multipurpose 6061 Aluminum Bar 3/8" Thick x 4" Wide, 3 ft.	$56	
	Multipurpose 6061 Aluminum Bar 1/2" Thick x 4" Wide, 3 ft.	$79	
Subtotal	**$841**		

[redacted]



Drawing 3: Suspension components



Drawing 4: Suspension assembly dimensions

NOTES UNLESS OTHERWISE SPECIFIED:
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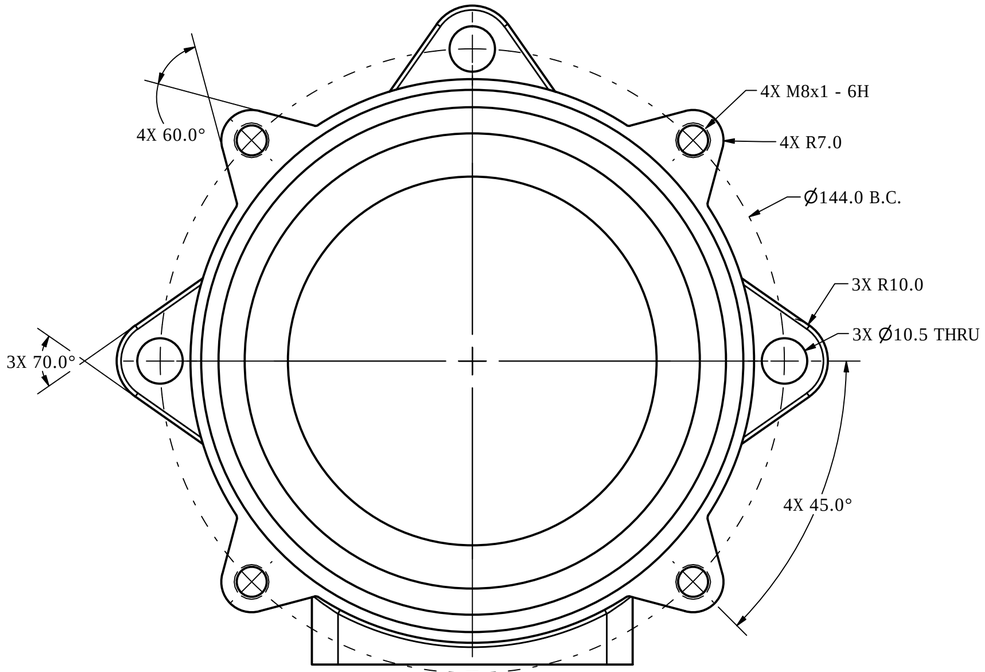

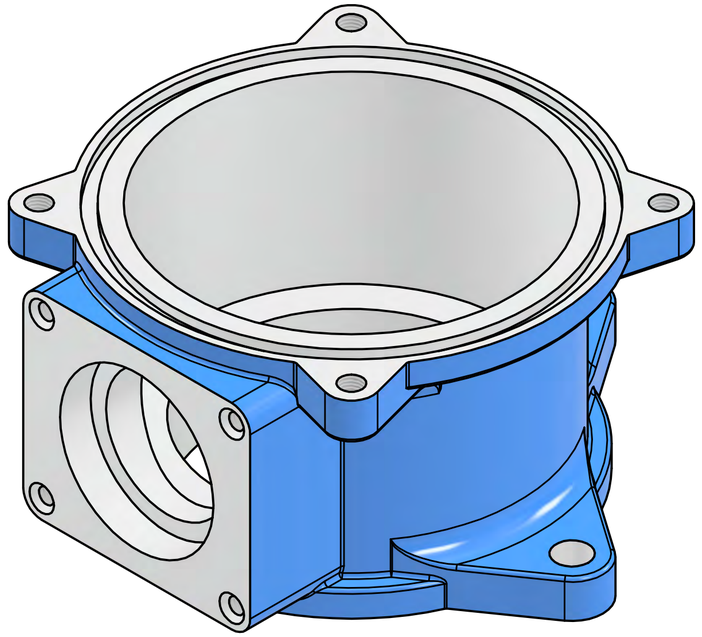

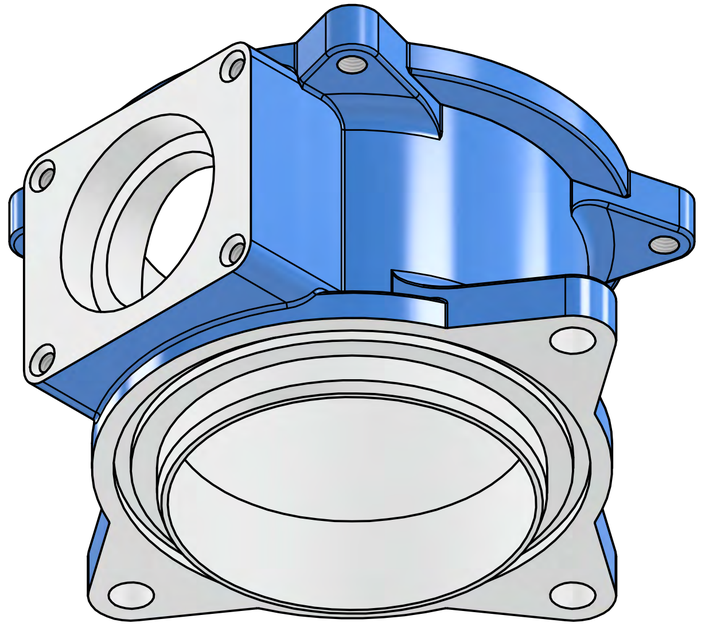

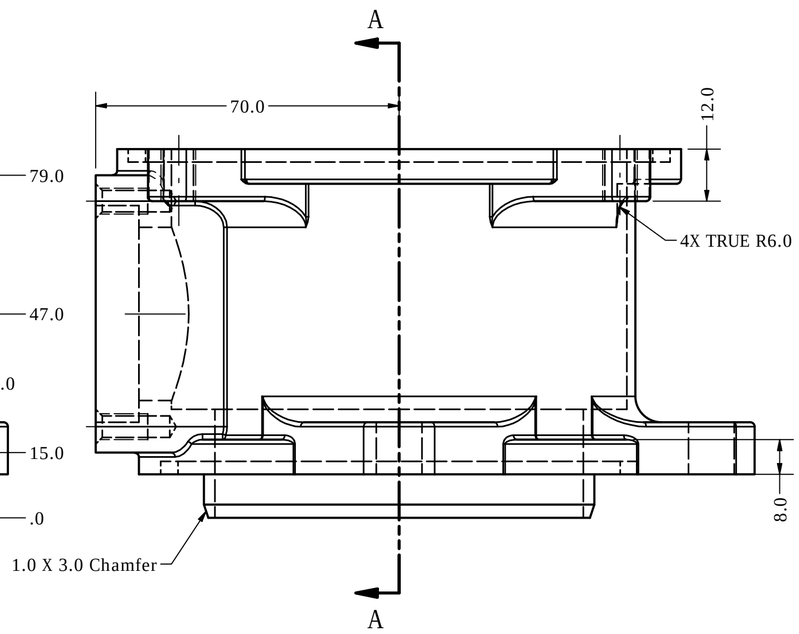

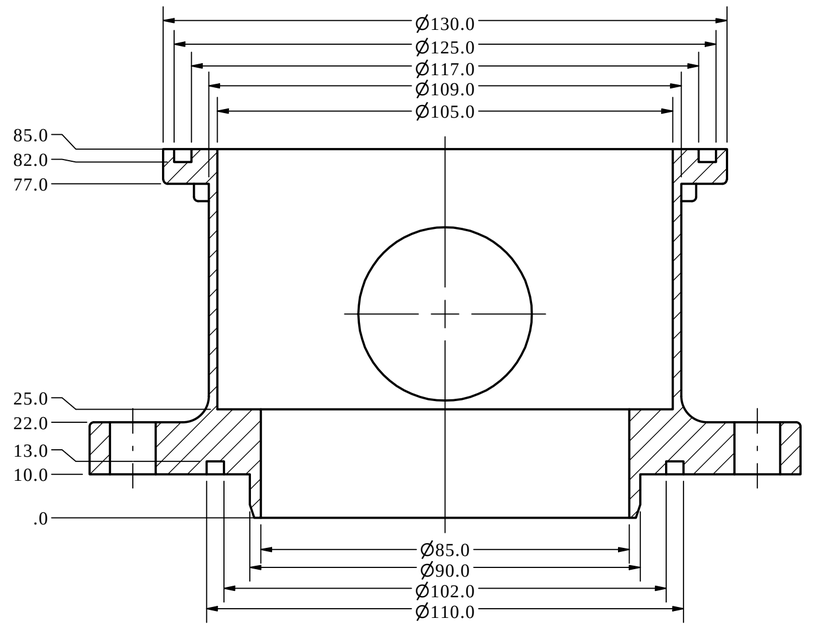

SECTION A-A
SCALE 1 : 1

THE UNIVERSITY OF GEORGIA, ATHENS, GA			
THIRD ANGLE PROJECTION	DRAWN BY: Ben Schlich		DATE: 8/23/2025
	TITLE: Shy Guy Flange		PART #: SLD1
ALL DIMENSIONS ARE IN MILLIMETERS TOLERANCES UNLESS OTHERWISE SPECIFIED: x.x ±0.5 x.xx ±0.25 x.xxx ±0.125 ANGULAR ±0.5	MATERIAL: Aluminum 6061		
	MASS: 0.647 kg	SCALE: 1 : 1	SIZE: A2	SHEET: 1 of 5

NOTES UNLESS OTHERWISE SPECIFIED:
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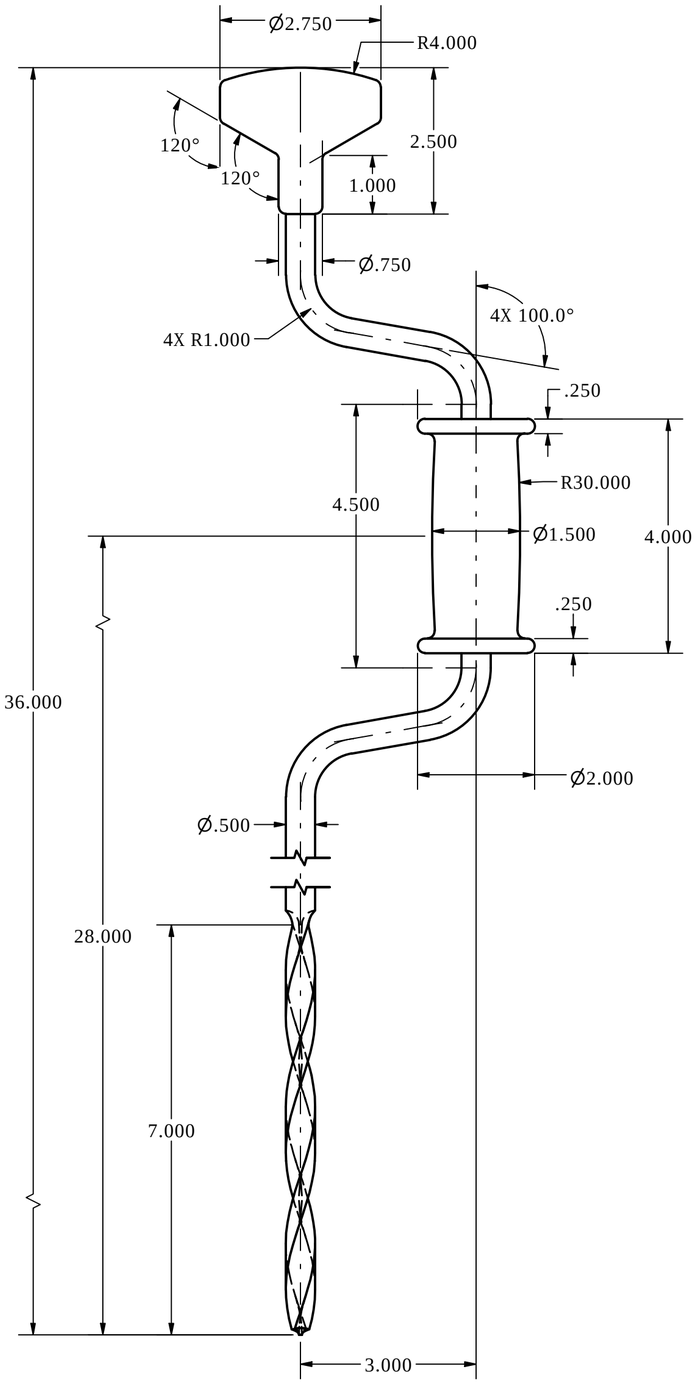
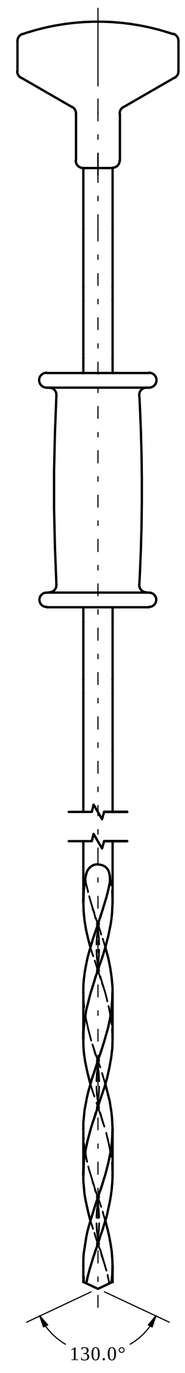
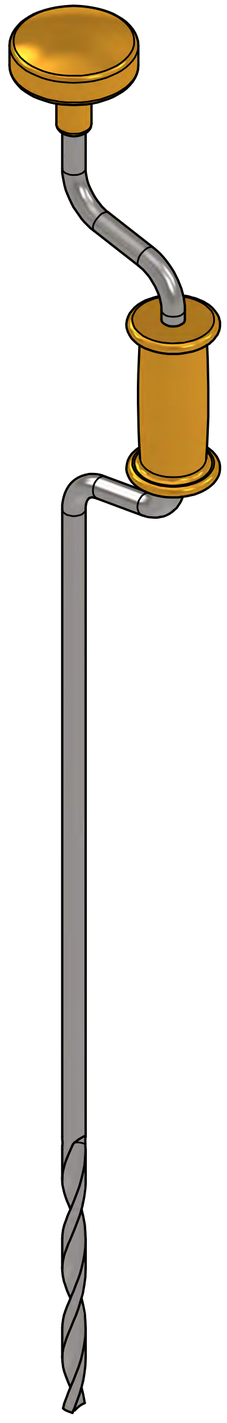
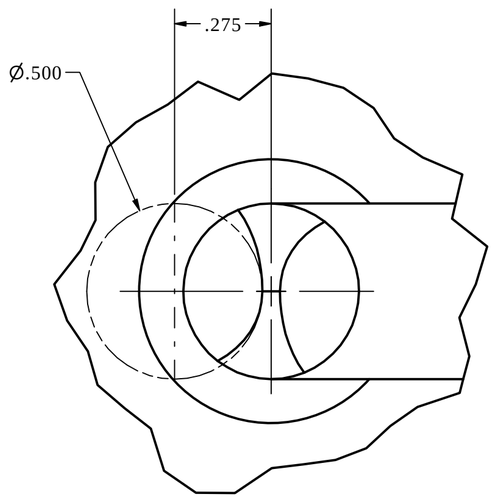
2. FLUTES TWIST 540.0°

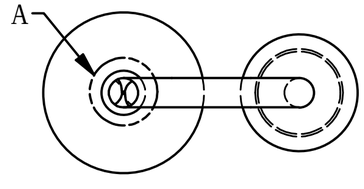






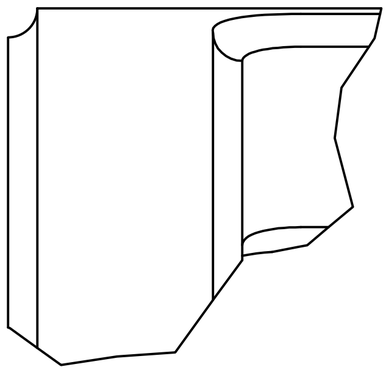


DETAIL A
SCALE 3 : 1

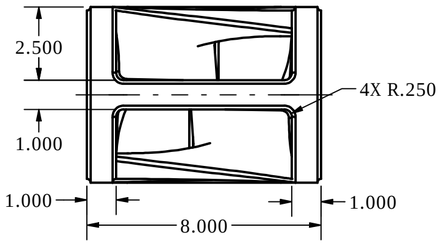


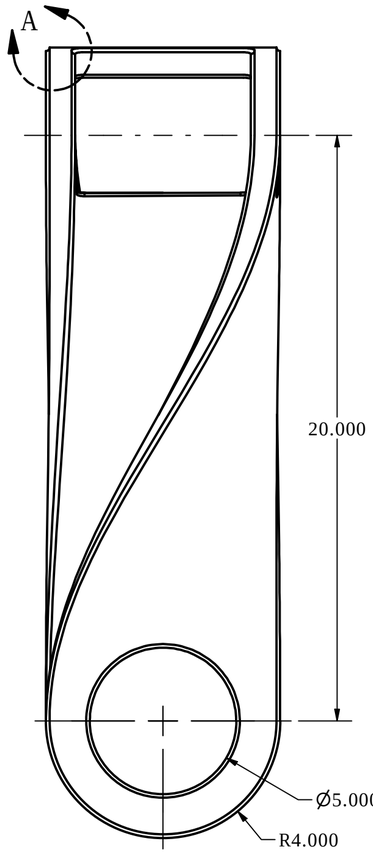
THE UNIVERSITY OF GEORGIA, ATHENS, GA				
THIRD ANGLE PROJECTION	DRAWN BY Ben Schlich		DATE 9/4/2025	
	TITLE Hand Drill		PART # SLD2	
ALL DIMENSIONS ARE IN INCHES	MATERIAL Steel, Alloy			
TOLERANCES UNLESS OTHERWISE SPECIFIED: x.x ±0.02, x.xx ±0.01, x.xxx ±0.005, x.xxxx ±0.0025; FRACTIONAL ±1/32; ANGULAR ±0.5°	MASS 5.510 lbmass	SCALE 1 / 2	SIZE C	SHEET 2 of 5

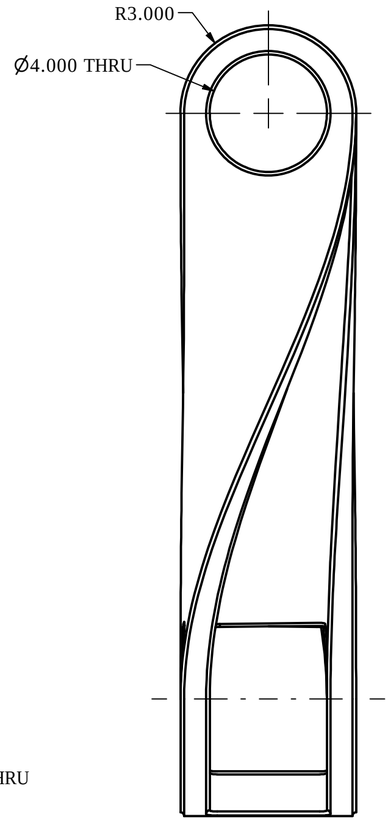
NOTES UNLESS OTHERWISE SPECIFIED:
1. INVERTED ROUNDS R0.125

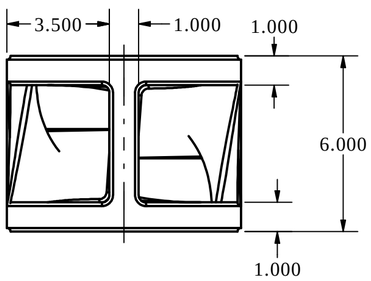


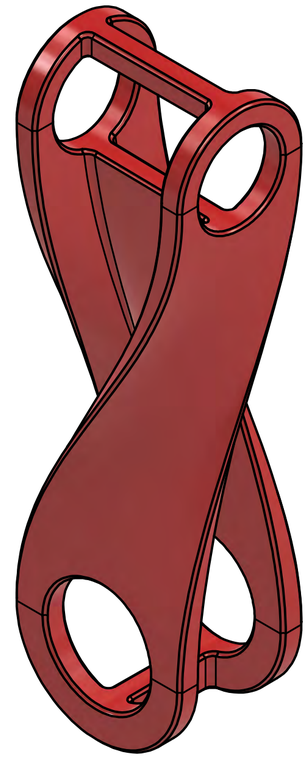
DETAIL A
SCALE 2 : 1

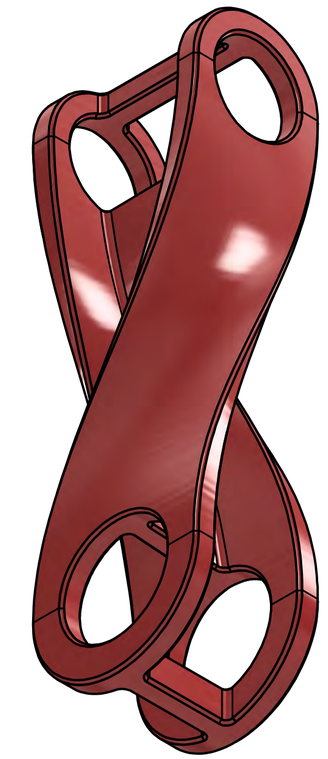






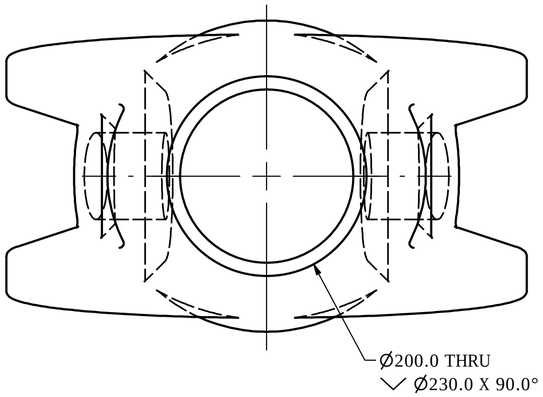


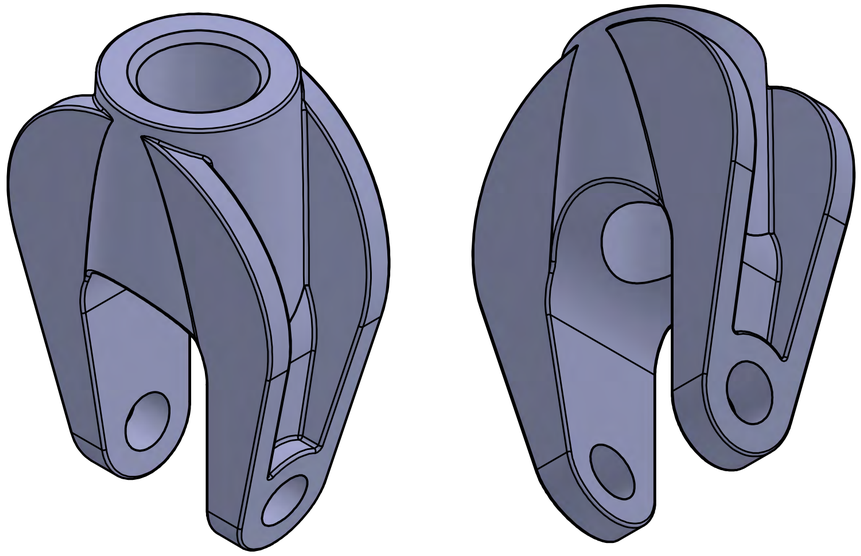


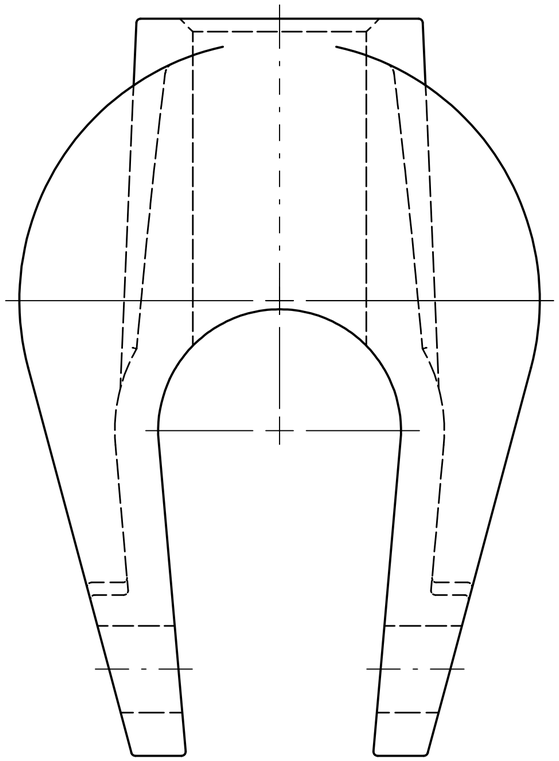


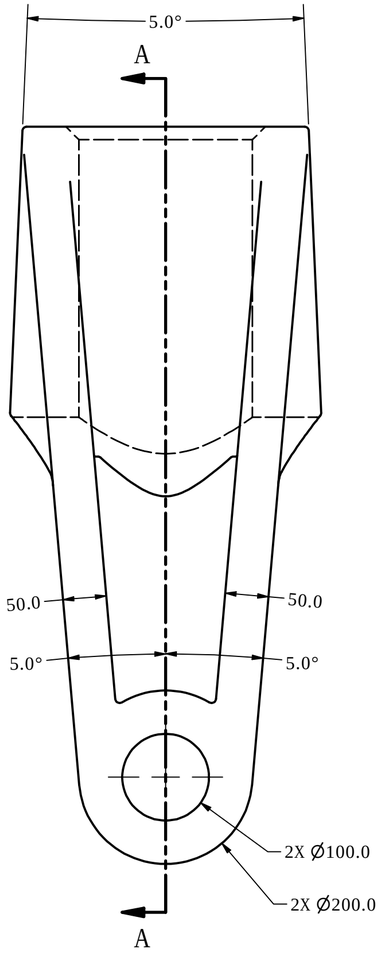
THE UNIVERSITY OF GEORGIA, ATHENS, GA			
THIRD ANGLE PROJECTION	DRAWN BY: Ben Schlich		DATE: 9/11/2025
	TITLE: Modern Art		PART #: SLD3
ALL DIMENSIONS ARE IN INCHES	MATERIAL: ABS Plastic		
TOLERANCES UNLESS OTHERWISE SPECIFIED: x.x ±0.02, x.xx ±0.01, x.xxx ±0.005, x.xxxx ±0.0025; FRACTIONAL ±1/32; ANGULAR ±0.5°	MASS: 10.935 lbmass	SCALE: 1 / 4	SIZE: C / SHEET: 3 of 5

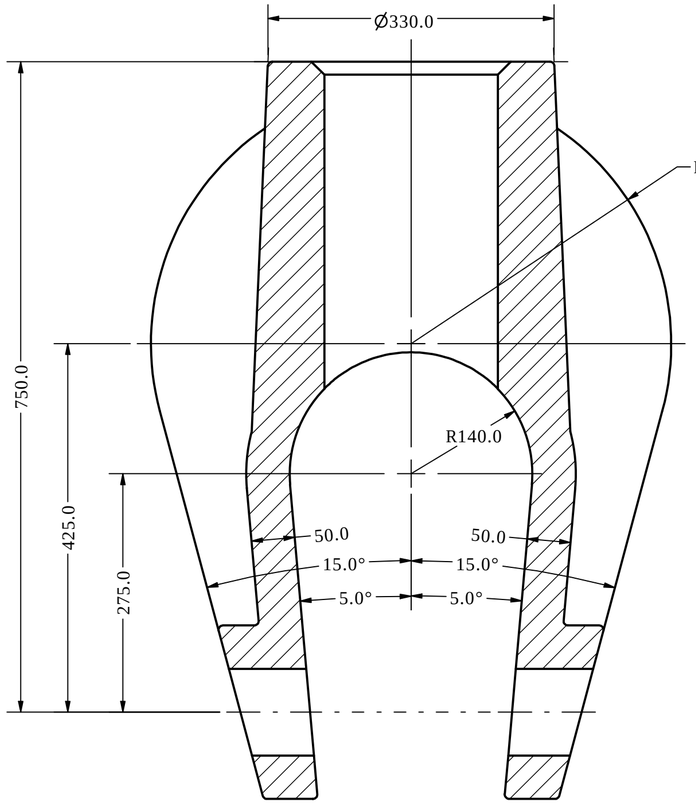
NOTES UNLESS OTHERWISE SPECIFIED:
1. FILLETS AND ROUNDS R5.0







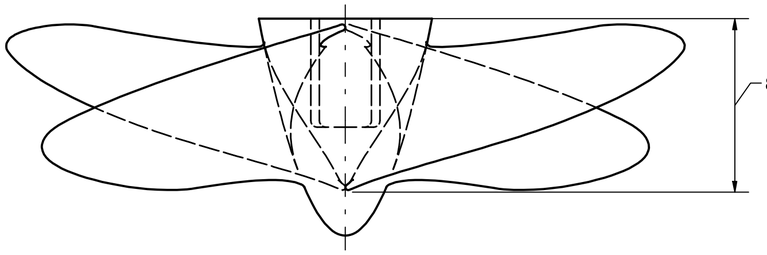


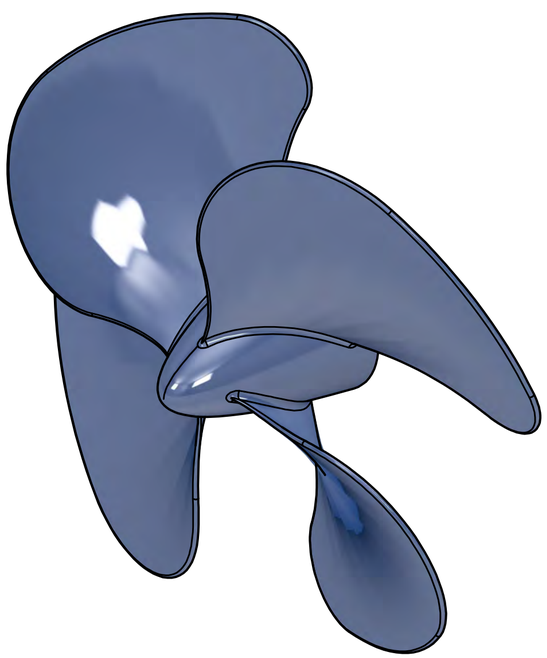


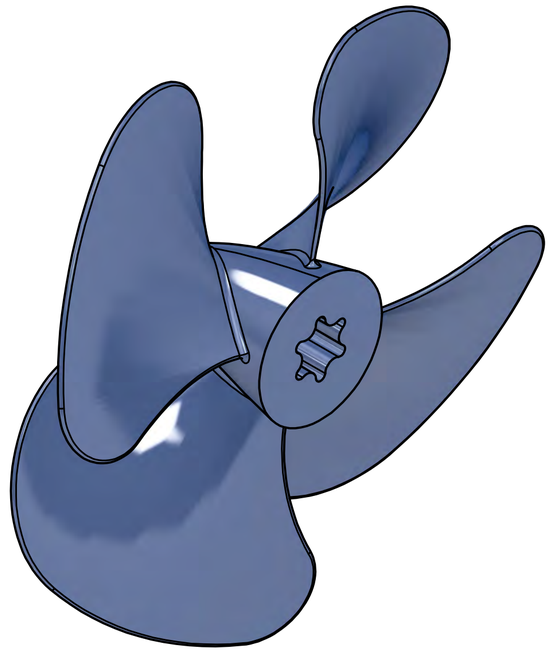
SECTION A-A
SCALE 1 / 5

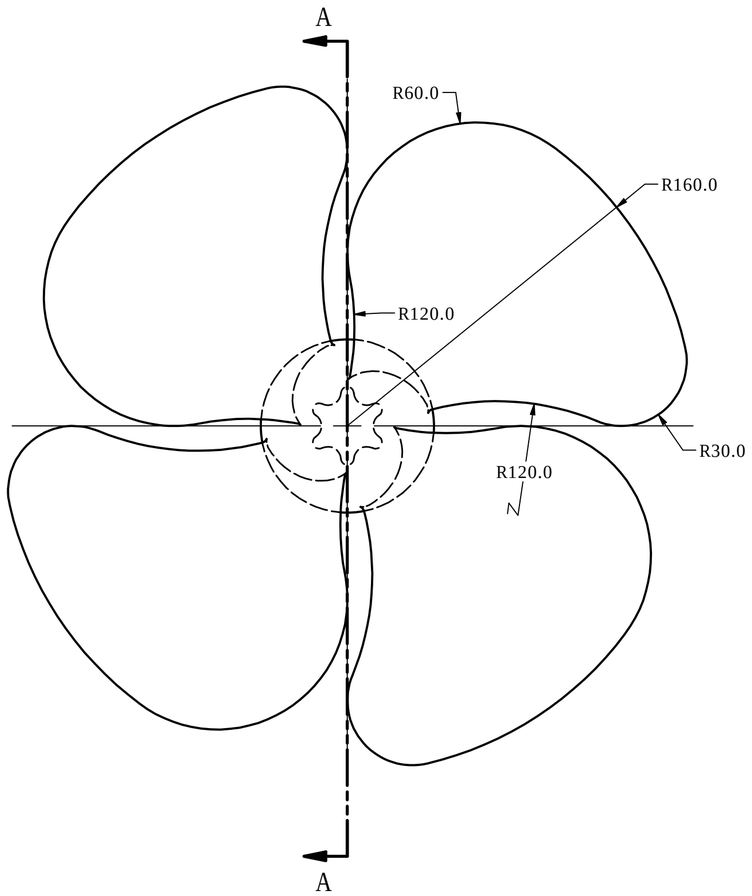
THE UNIVERSITY OF GEORGIA, ATHENS, GA			
THIRD ANGLE PROJECTION	DRAWN BY: Ben Schlich		DATE: 9/18/2025
	TITLE: Shackle		PART #: SLD4
ALL DIMENSIONS ARE IN MILLIMETERS TOLERANCES UNLESS OTHERWISE SPECIFIED: x.x ±0.5 x.xx ±0.25 x.xxx ±0.125 ANGULAR ±0.5	MATERIAL: Steel, Alloy		
	MASS: 366.788 kg	SCALE: 1 / 5	SIZE: A2 / SHEET: 4 of 5

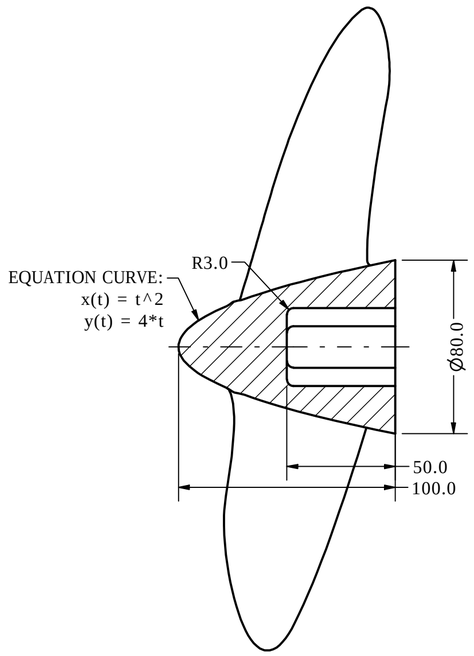
NOTES UNLESS OTHERWISE SPECIFIED:
1. BLADE THICKNESS: 3.0
2. BLADE PITCH 300.0
3. BLADE REVOLUTION: 0.25
4. BLADE EDGE HAS FULL ROUNDOVER
5. FILLETS AND ROUNDS: 3.0



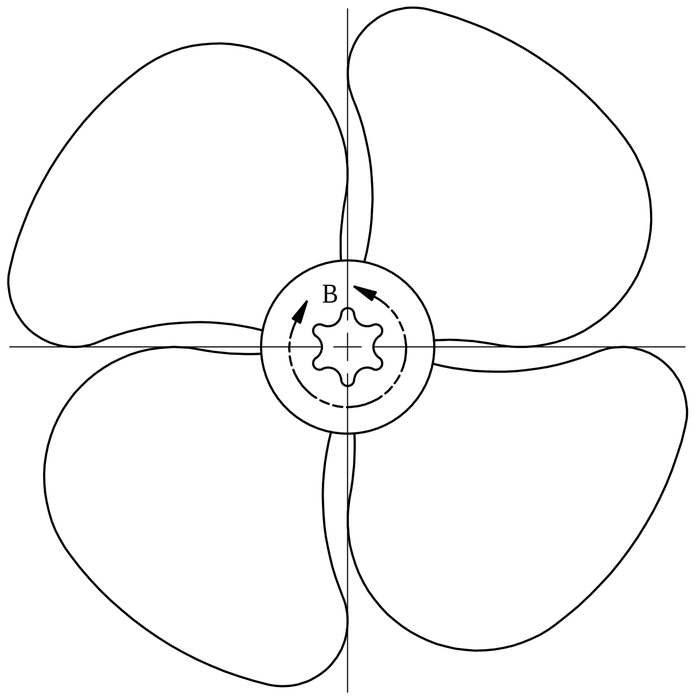


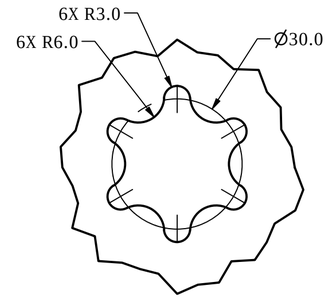






SECTION A-A
SCALE 1 / 2

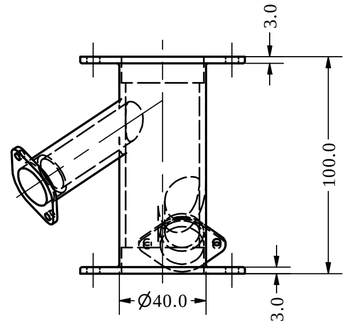


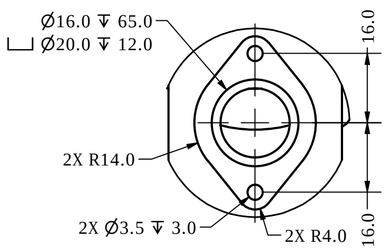


DETAIL B
SCALE 1 : 1

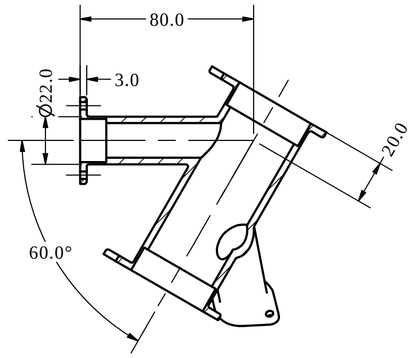
THE UNIVERSITY OF GEORGIA, ATHENS, GA			
THIRD ANGLE PROJECTION	DRAWN BY: Ben Schlich	DATE: 10/10/2025	
	TITLE: Propeller	PART #: SLD5	
ALL DIMENSIONS ARE IN MILLIMETERS TOLERANCES UNLESS OTHERWISE SPECIFIED: x.x ±0.5 x.xx ±0.25 x.xxx ±0.125 ANGULAR ±0.5	MATERIAL: ABS Plastic		
	MASS: 0.439 kg	SCALE: 1 / 2	SIZE: A2 / SHEET: 5 of 5

NOTES UNLESS OTHERWISE SPECIFIED:
1. FILLETS AND ROUNDS R1.0

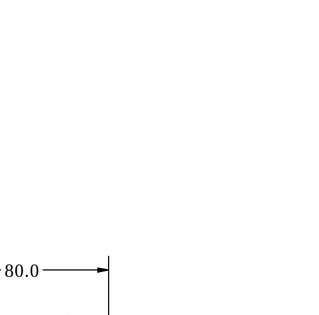




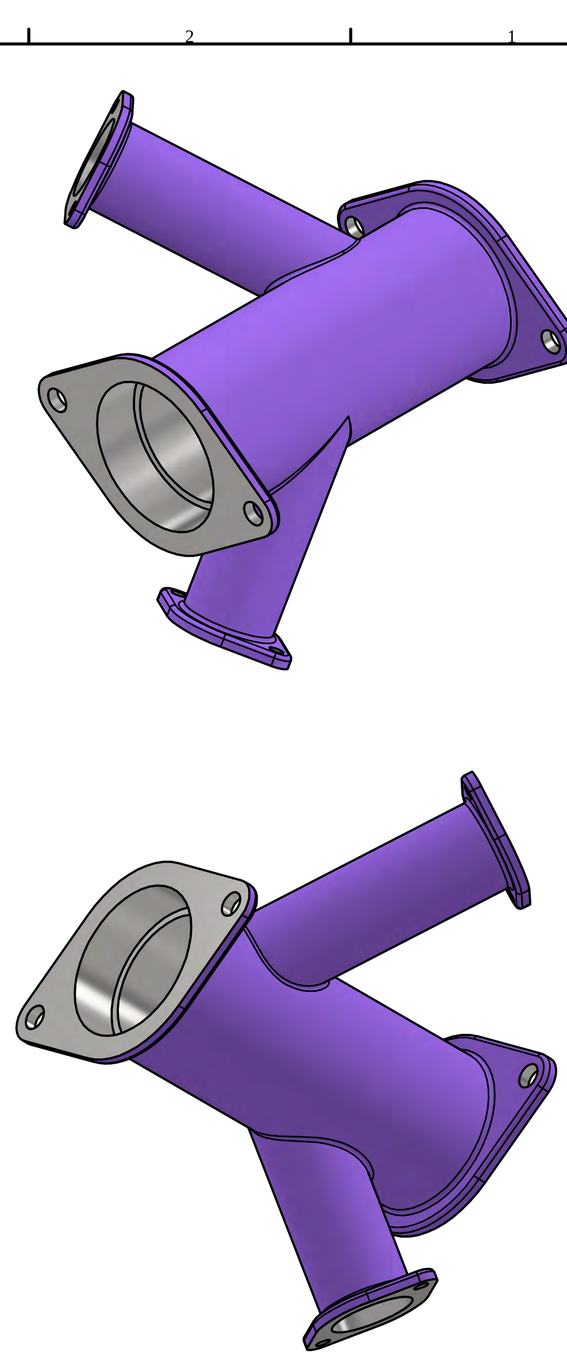
SCALE 1 : 1

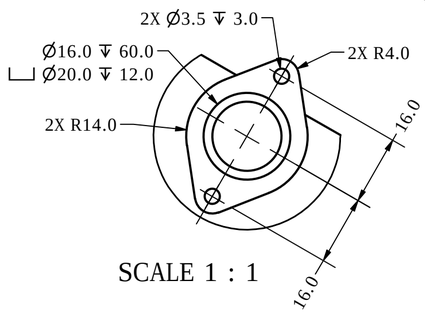


SECTION A-A
SCALE 1 / 2



SECTION B-B
SCALE 1 / 2

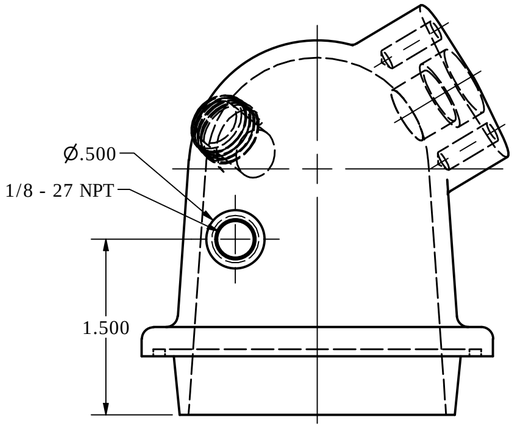




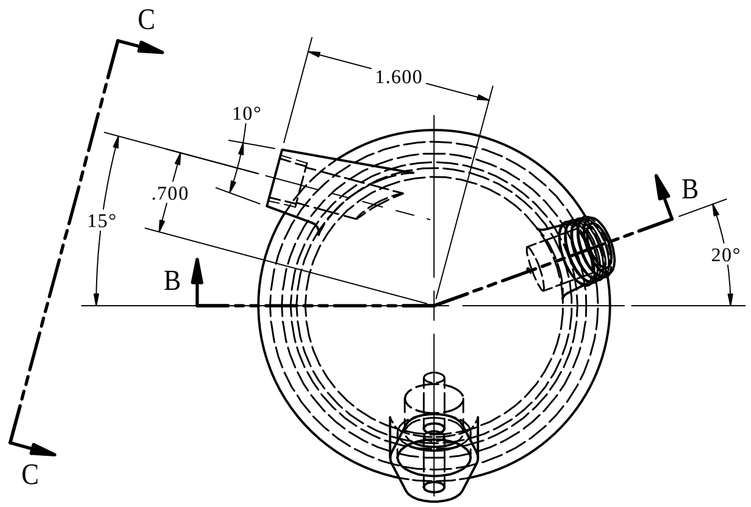
SCALE 1 : 1

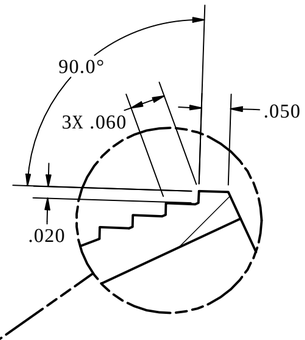
THE UNIVERSITY OF GEORGIA, ATHENS, GA			
THIRD ANGLE PROJECTION	DRAWN BY: Ben Schlich		DATE: 9/19/2025
	TITLE: Pipe Junction		PART #: SLD6
ALL DIMENSIONS ARE IN MILLIMETERS TOLERANCES UNLESS OTHERWISE SPECIFIED: x.x ±0.5 x.xx ±0.25 x.xxx ±0.125 ANGULAR ±0.5	MATERIAL: Stainless Steel		
	MASS: 0.416 kg	SCALE: 1 / 2	SIZE: A2	SHEET: 1 of 5

NOTES UNLESS OTHERWISE SPECIFIED:
1. FILLETS AND ROUNDS R0.100

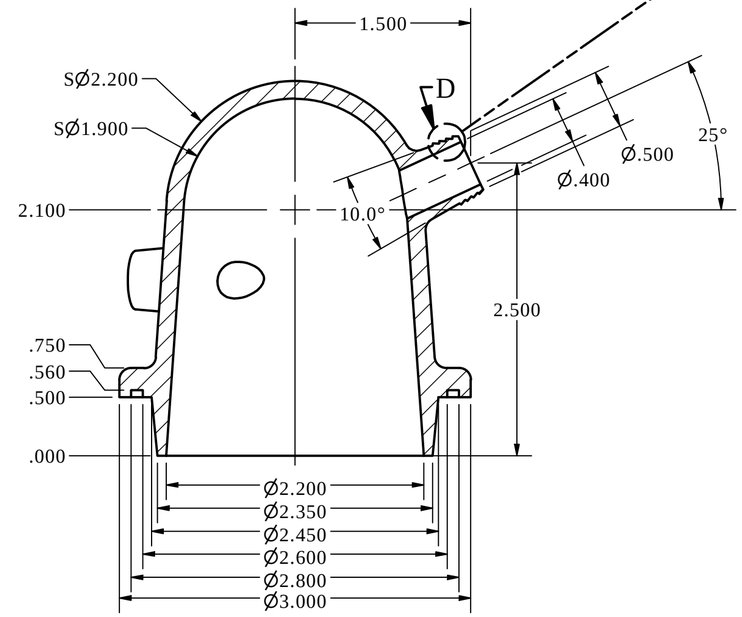


VIEW C-C
SCALE 1 : 1

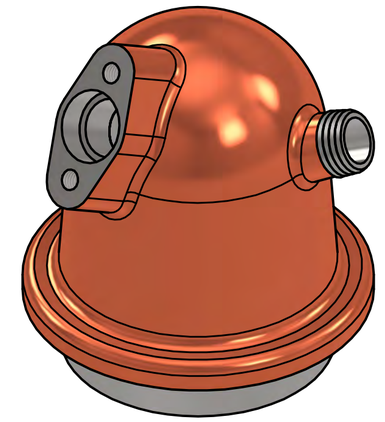


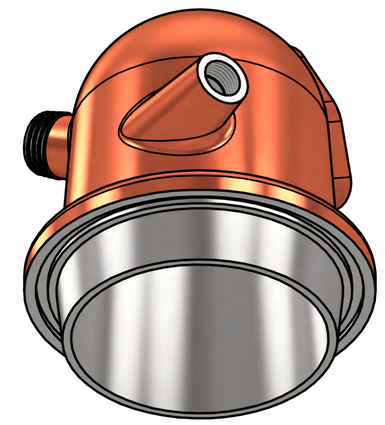


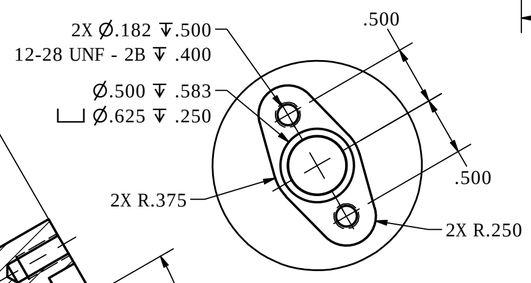
DETAIL D
SCALE 5 : 1

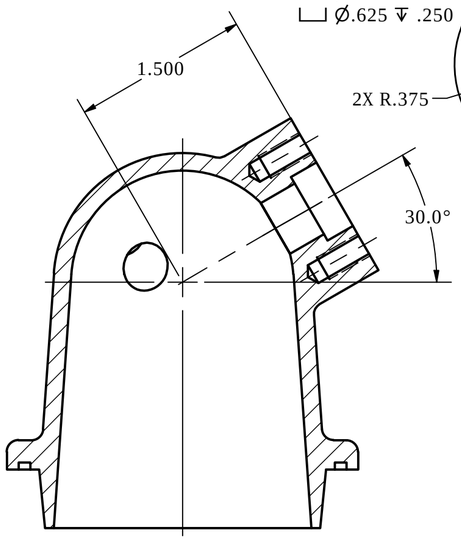


SECTION B-B
SCALE 1 : 1

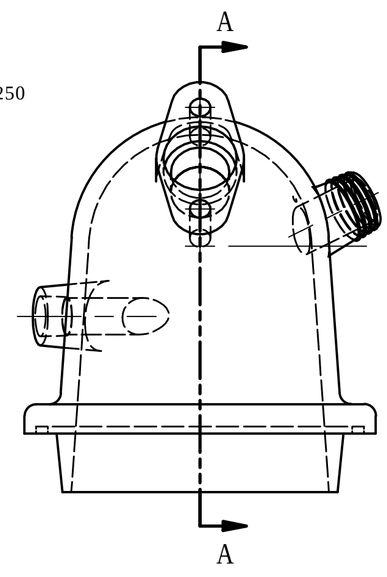






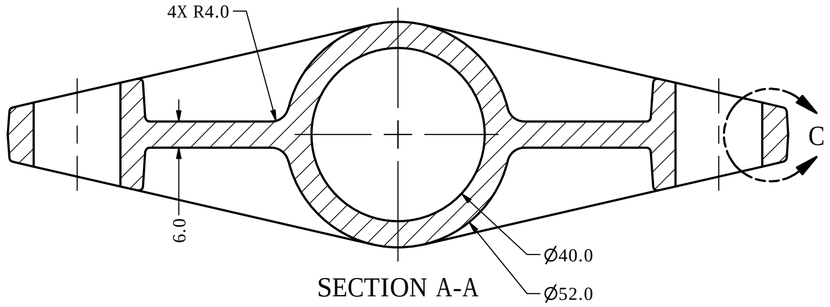


SECTION A-A
SCALE 1 : 1

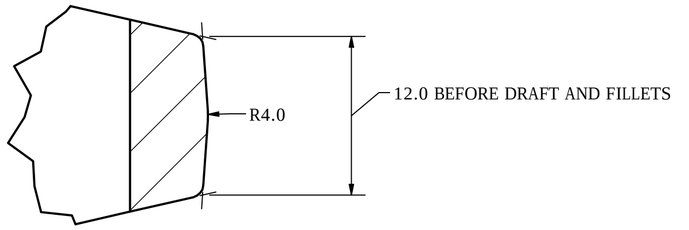


THE UNIVERSITY OF GEORGIA, ATHENS, GA			
THIRD ANGLE PROJECTION	DRAWN BY: Ben Schlich		DATE: 9/20/2025
	TITLE: Dome Manifold		PART #: SLD7
ALL DIMENSIONS ARE IN INCHES	MATERIAL: Stainless Steel, 440C		
TOLERANCES UNLESS OTHERWISE SPECIFIED: x.x ±0.02, x.xx ±0.01, x.xxx ±0.005, x.xxxx ±0.0025; FRACTIONAL ±1/32; ANGULAR ±0.5°	MASS: 1.125 lbmass	SCALE: 1 : 1	SIZE: C / SHEET: 2 of 5

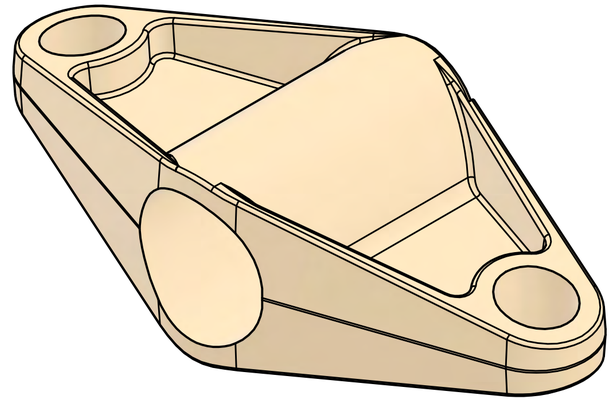
NOTES UNLESS OTHERWISE SPECIFIED:
1. FILLETS AND ROUNDS R1.0
2. DRAFT ANGLES 4.0°

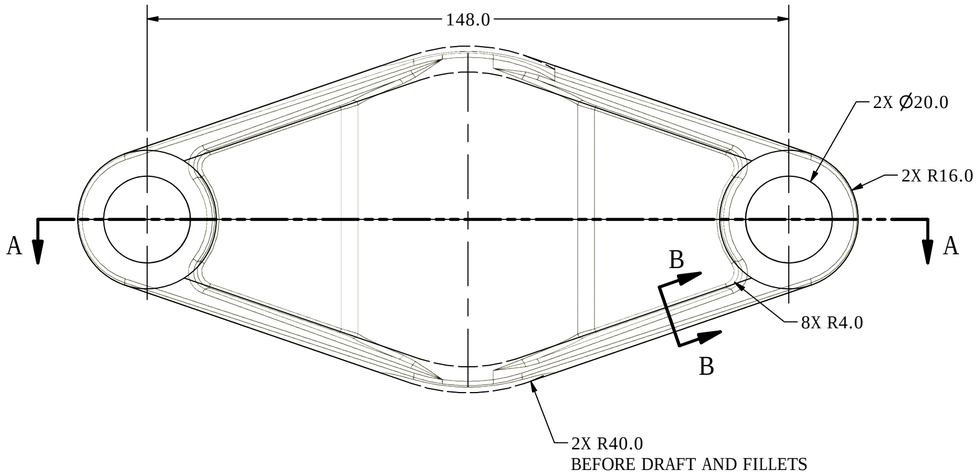


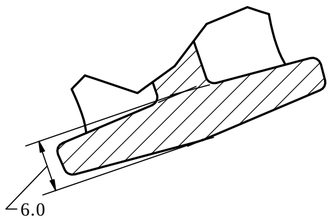
SECTION A-A
SCALE 1 : 1



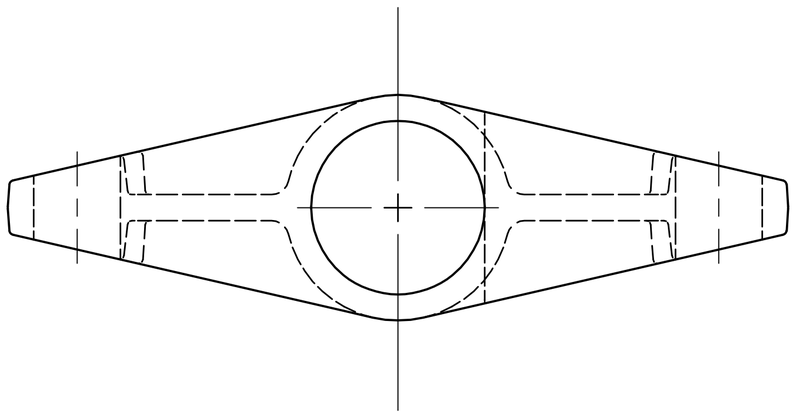
DETAIL C
SCALE 3 : 1

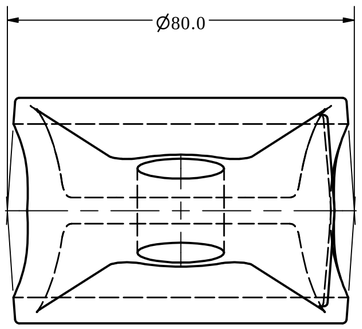






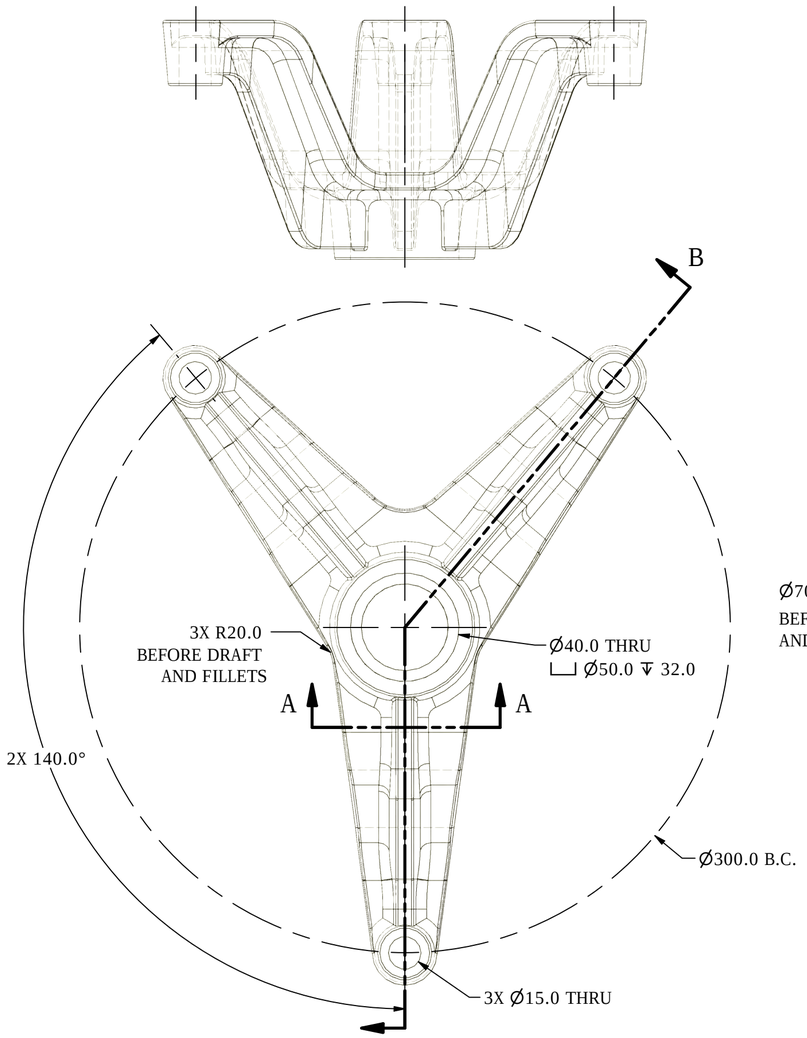
SECTION B-B
SCALE 2 : 1

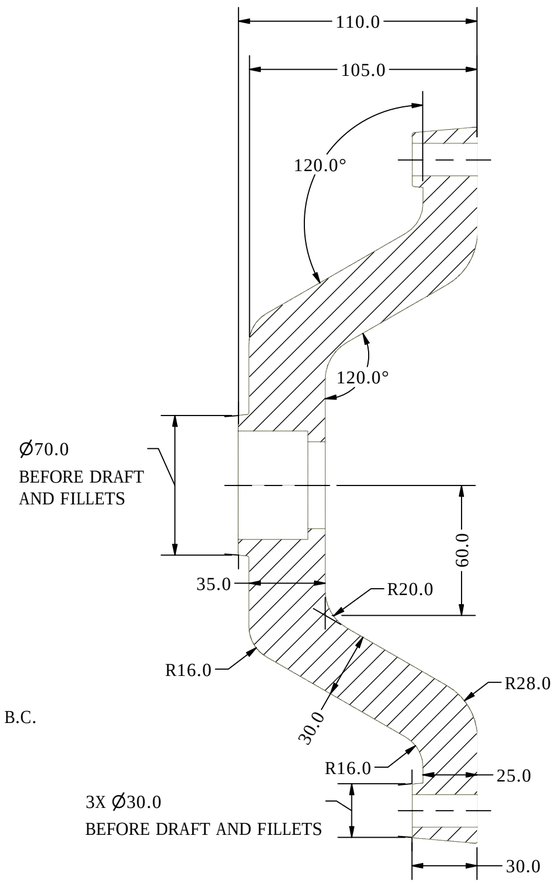




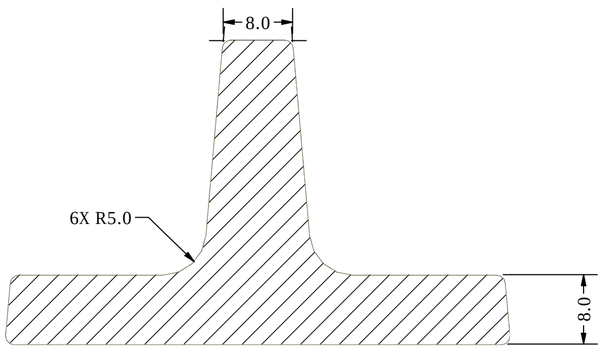
THE UNIVERSITY OF GEORGIA, ATHENS, GA			
THIRD ANGLE PROJECTION	DRAWN BY: Ben Schlich		DATE: 9/20/2025
	TITLE: Flying Purple People Eater		PART #: SLD8
ALL DIMENSIONS ARE IN INCHES TOLERANCES UNLESS OTHERWISE SPECIFIED: x.x ±0.02 x.xx ±0.01 FRACTIONAL ±1/32 x.xxx ±0.005 ANGULAR ±0.5° x.xxxx ±0.0025	MATERIAL: ABS Plastic		
	MASS: N/A	SCALE: 1 : 1	SIZE: A2	SHEET: 3 of 5

NOTES UNLESS OTHERWISE SPECIFIED:
1. FILLETS AND ROUNDS R1.0
2. DRAFT ANGLES 5.0°

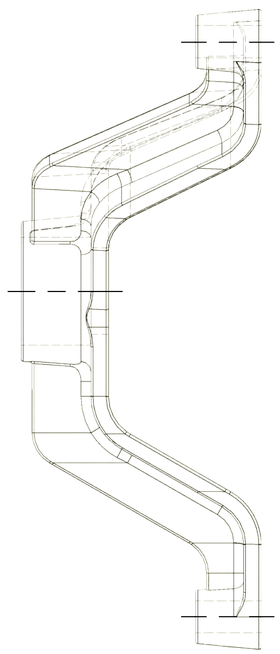


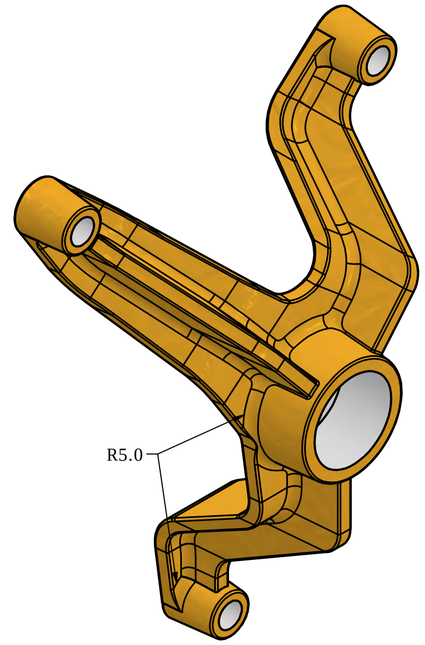


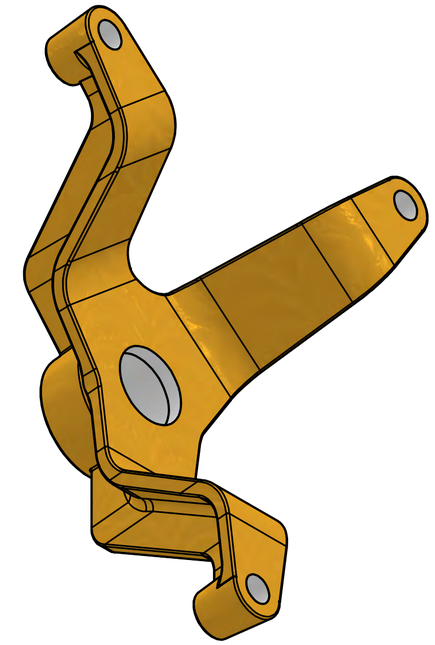
SECTION B-B
SCALE 1 / 2



SECTION A-A
SCALE 2 : 1

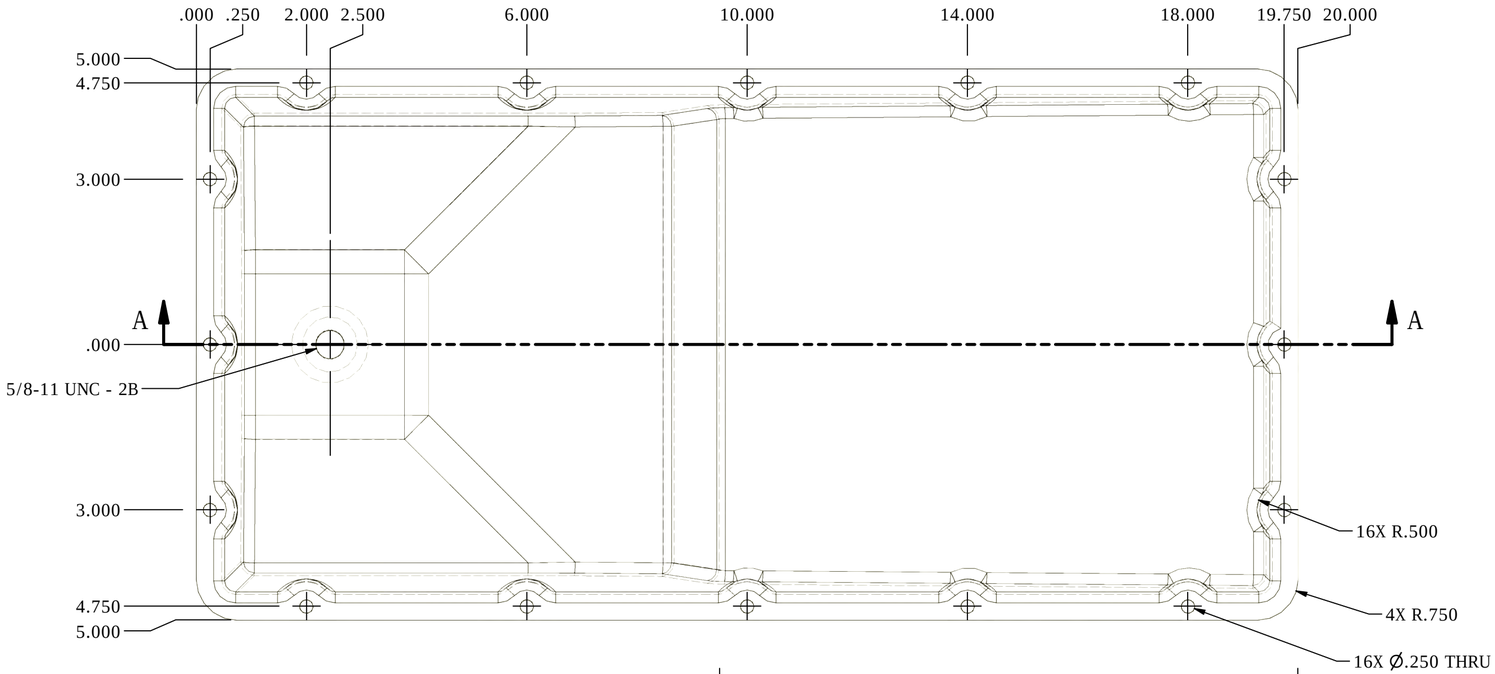


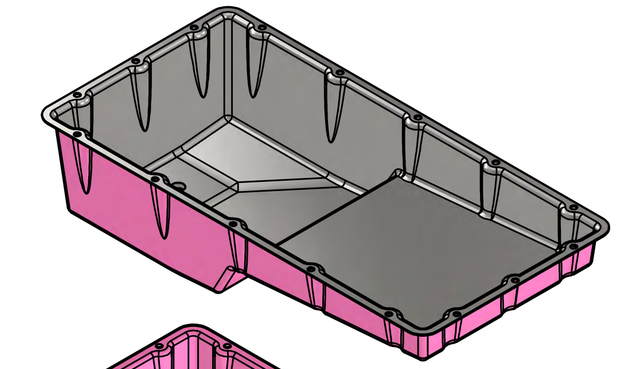


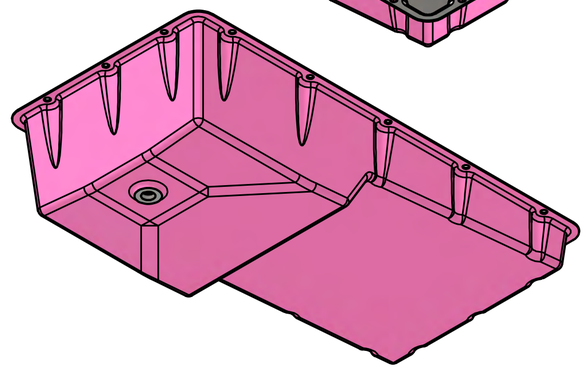


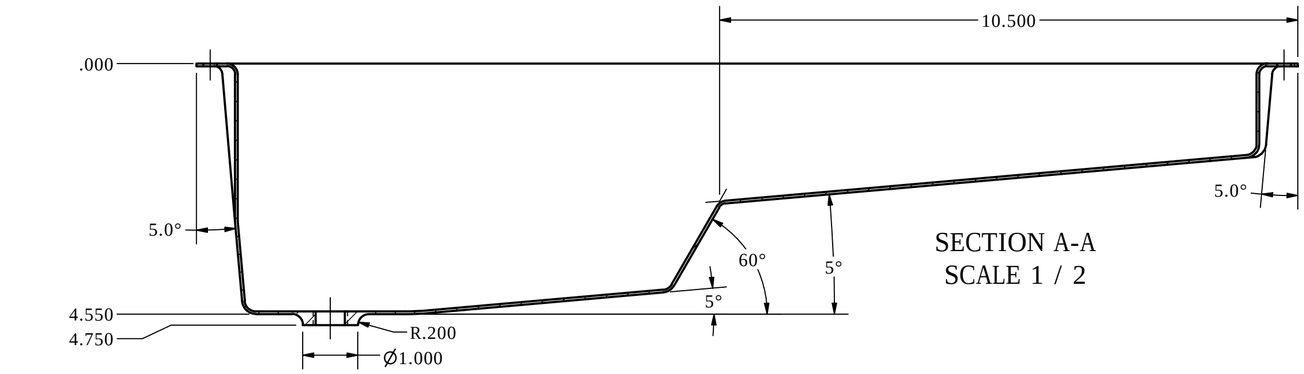
THE UNIVERSITY OF GEORGIA, ATHENS, GA			
THIRD ANGLE PROJECTION	DRAWN BY: Steering Knuckle		DATE: 9/21/2025
	TITLE: Ben Schlich		PART #: SLD9
ALL DIMENSIONS ARE IN MILLIMETERS	MATERIAL: Steel, Cast		
TOLERANCES UNLESS OTHERWISE SPECIFIED: x.x ±0.5, x.xx ±0.25, x.xxx ±0.125, ANGULAR ±0.5	MASS: 3.021 kg	SCALE: 1 / 2	SIZE: A2 / SHEET: 4 of 5

NOTES UNLESS OTHERWISE SPECIFIED:
1. THICKNESS 0.050
2. INTERIOR FILLETS AND ROUNDS R0.200

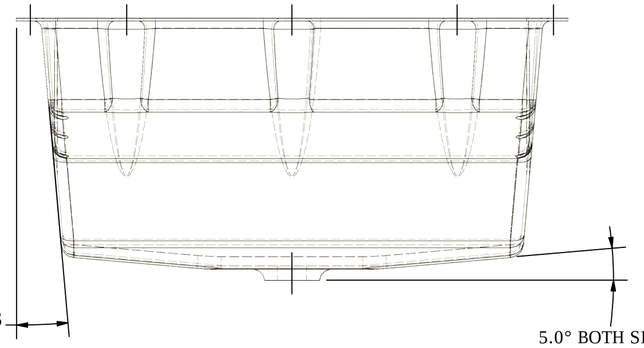


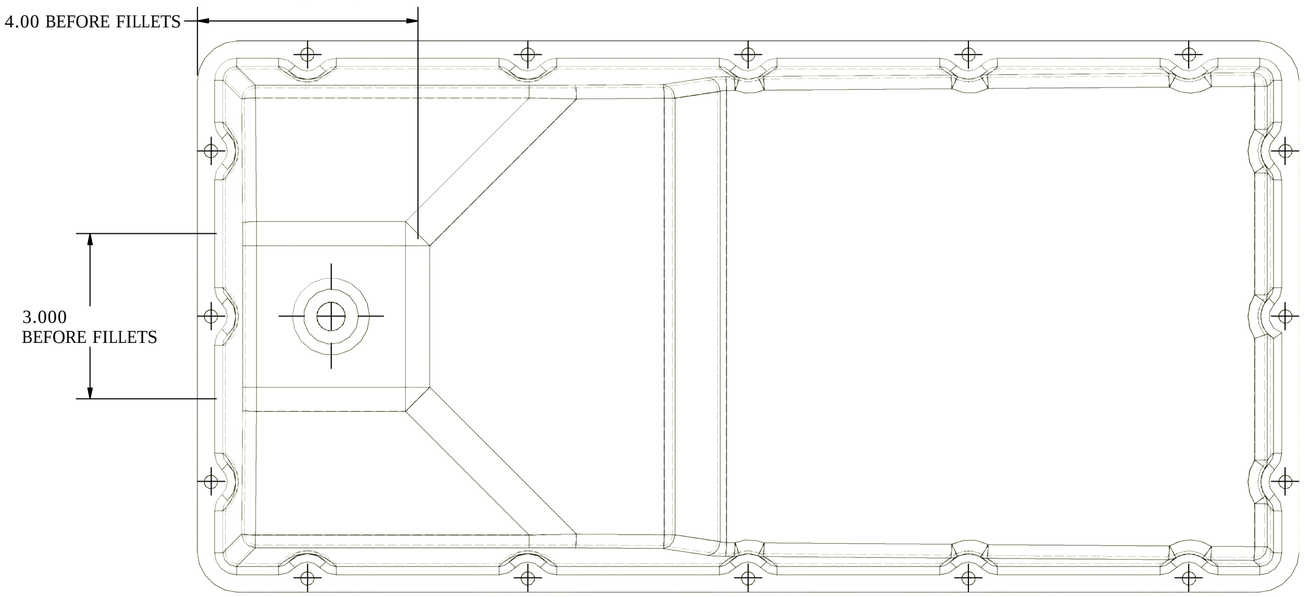






SECTION A-A
SCALE 1 / 2





THE UNIVERSITY OF GEORGIA, ATHENS, GA

THIRD ANGLE PROJECTION

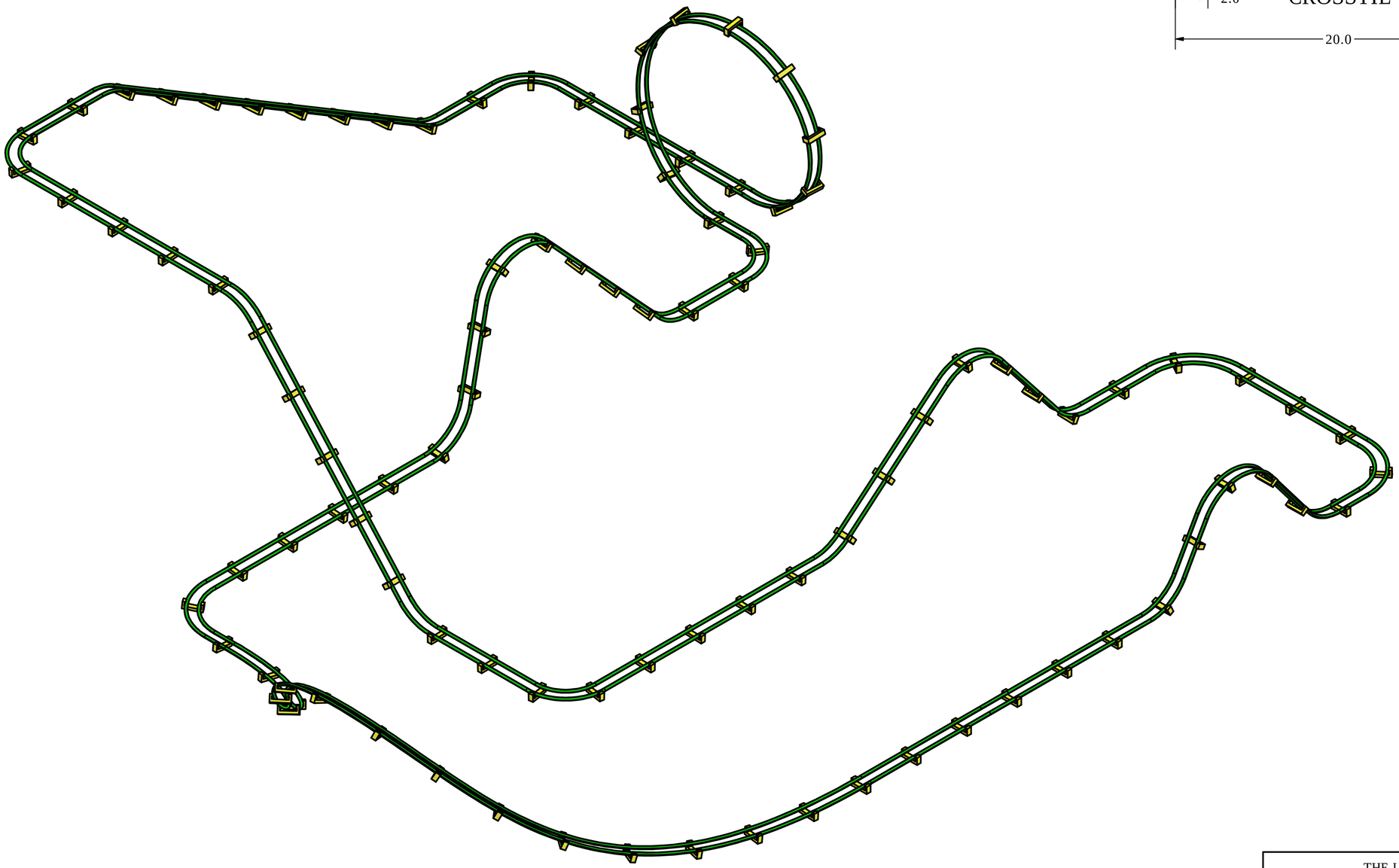
ALL DIMENSIONS ARE IN INCHES

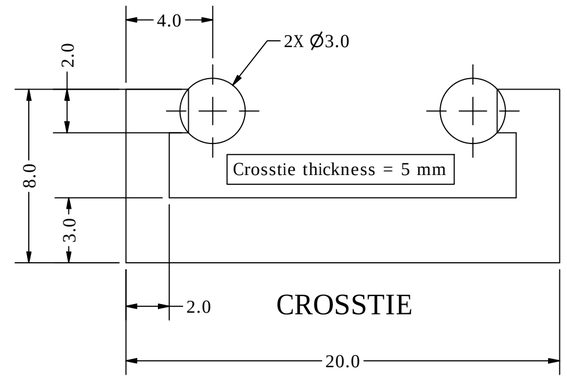
TOLERANCES UNLESS OTHERWISE SPECIFIED:

x.x	±0.02		
x.xx	±0.01	FRACTIONAL	±1/32
x.xxx	±0.005	ANGULAR	±0.5°
x.xxxx	±0.0025		

DRAWN BY: Ben Schlich			DATE: 10/11/2025	
TITLE: Oil Pan			PART #: SLD10	
MATERIAL: Stainless Steel				
MASS: 5.177 lbmass	SCALE: 1 / 2	SIZE: A2	SHEET: 5 of 5	

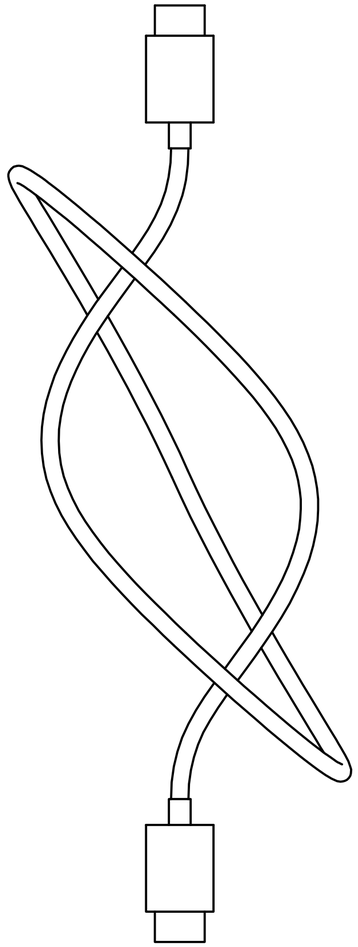
NOTES UNLESS OTHERWISE SPECIFIED:
1. BEND RADIUS: R50.0
2. NUMBER OF CROSSTIES: 100

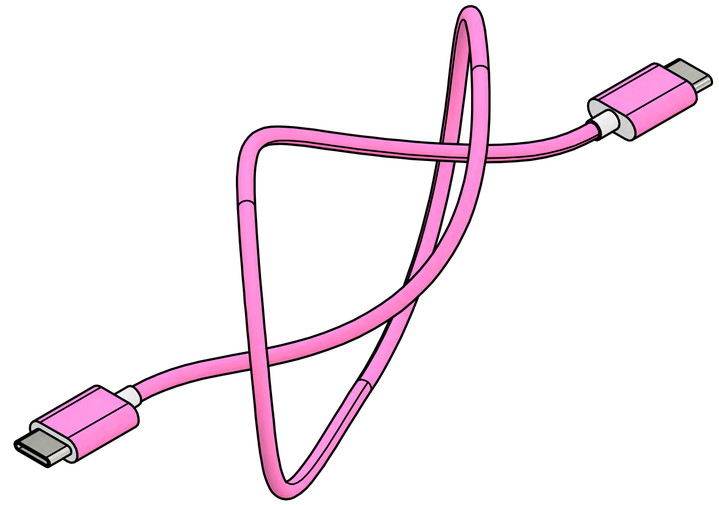


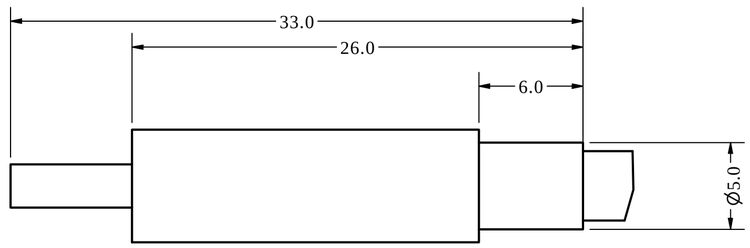


THE UNIVERSITY OF GEORGIA, ATHENS, GA			
THIRD ANGLE PROJECTION	DRAWN BY: Ben Schlich		DATE: 10/1/2025
	TITLE: Roller Coaster Track for Ants		PART #: 3DS1
ALL DIMENSIONS ARE IN MILLIMETERS	MATERIAL: Steel, Alloy		
TOLERANCES UNLESS OTHERWISE SPECIFIED: x.x ±0.5, x.xx ±0.25, x.xxx ±0.125, ANGULAR ±0.5	MASS: 1.032 kg	SCALE: 1 / 3	SIZE: A2 / SHEET: 1 of 5

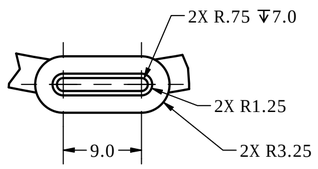
NOTES UNLESS OTHERWISE SPECIFIED:
1. CABLE DIAMETER: 4.0



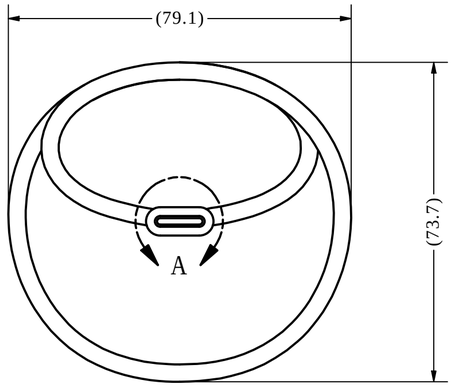


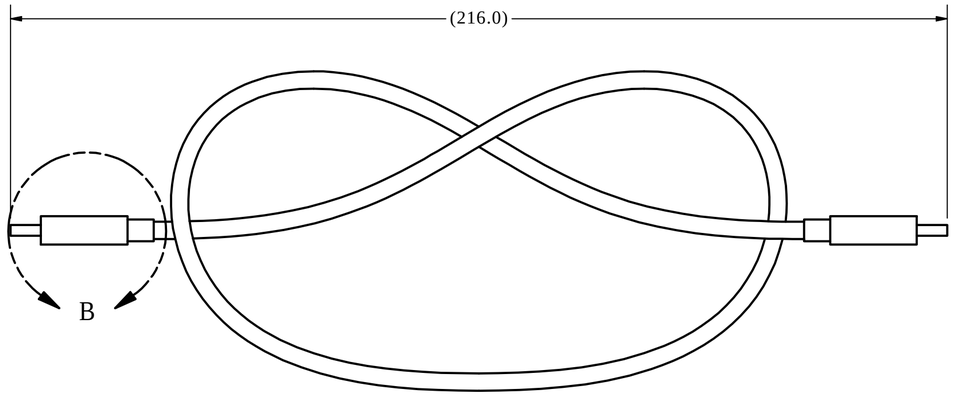


DETAIL B
SCALE 4 : 1



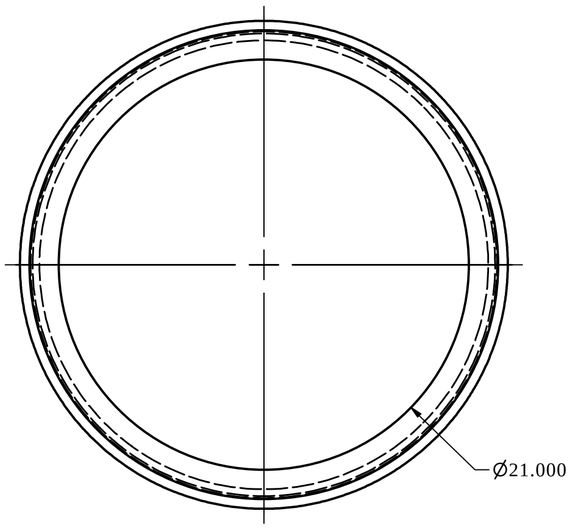
DETAIL A
SCALE 2 : 1

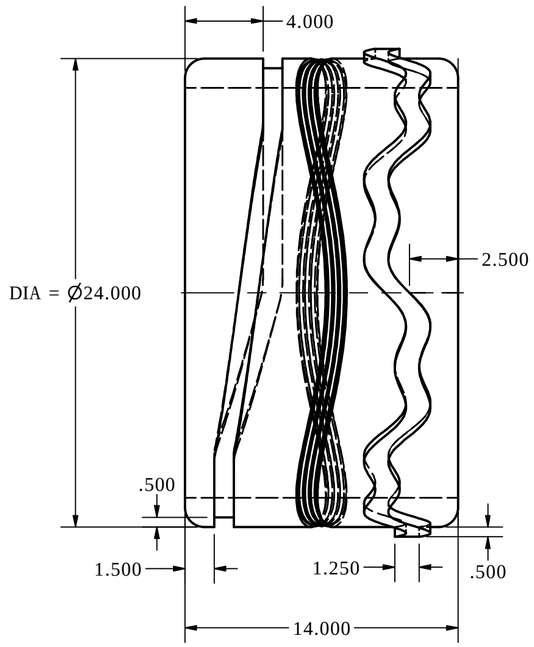


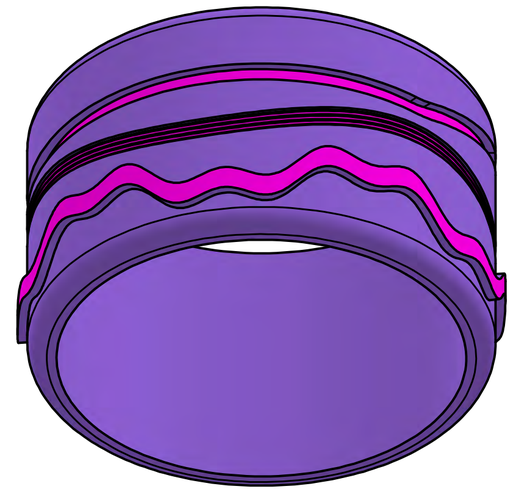


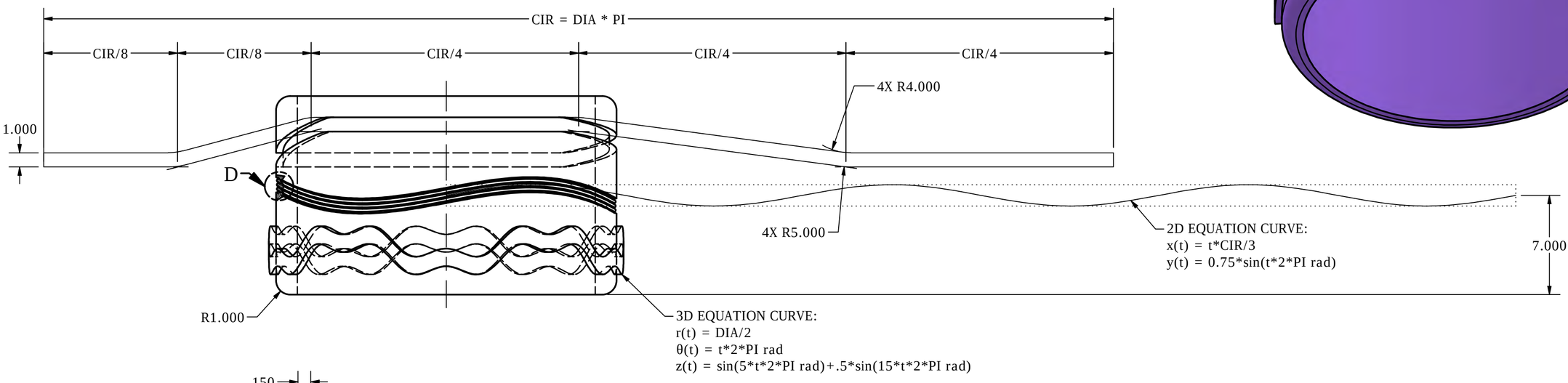
THE UNIVERSITY OF GEORGIA, ATHENS, GA			
THIRD ANGLE PROJECTION	DRAWN BY: Ben Schlich		DATE: 9/23/2025
	TITLE: USB Cable		PART #: 3DS2
ALL DIMENSIONS ARE IN MILLIMETERS TOLERANCES UNLESS OTHERWISE SPECIFIED: x.x ±0.5 x.xx ±0.25 x.xxx ±0.125 ANGULAR ±0.5	MATERIAL: Rubber, Silicone		
	MASS: 0.014 kg	SCALE: 1 : 1	SIZE: A2	SHEET: 2 of 5

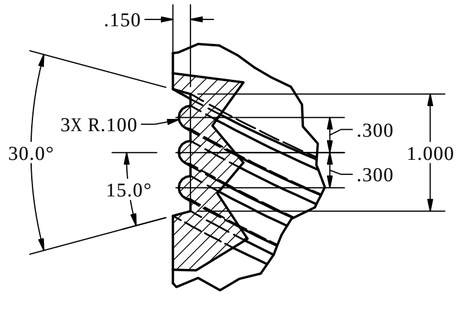
NOTES UNLESS OTHERWISE SPECIFIED:
1. NOTE RECOMMENDED FOR OFF-ROAD USE (OR ON-ROAD)







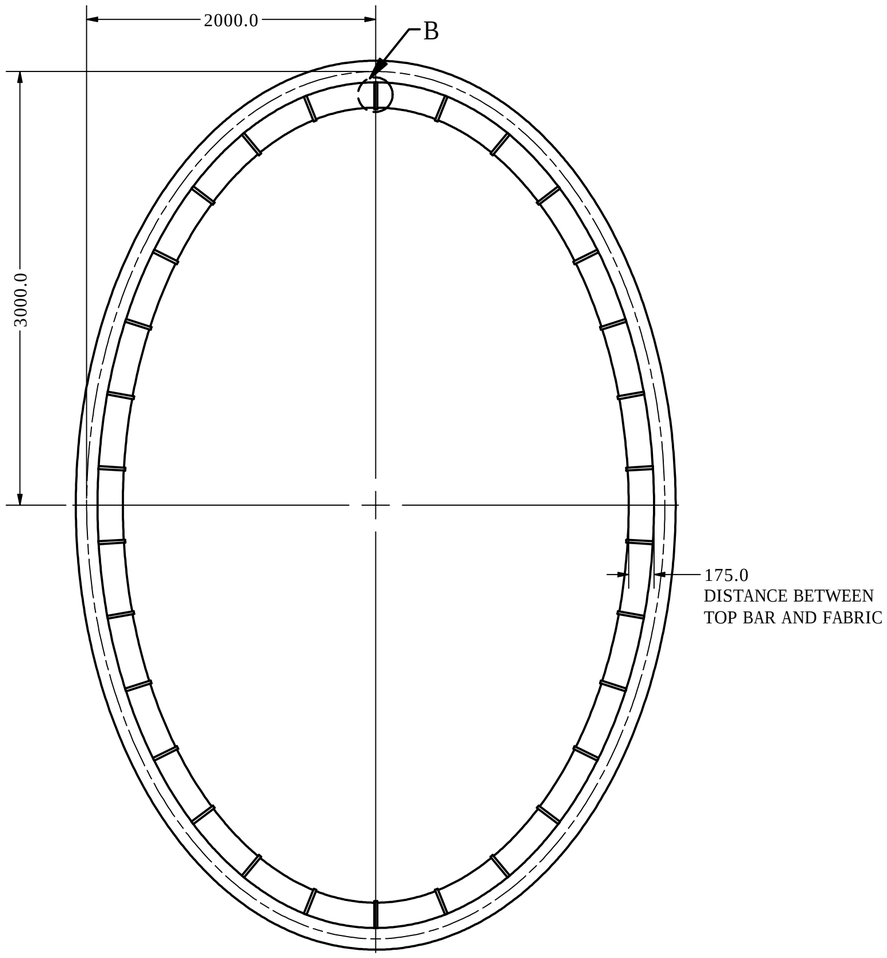


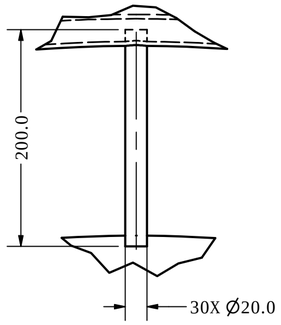


DETAIL D
SCALE 1 : 1

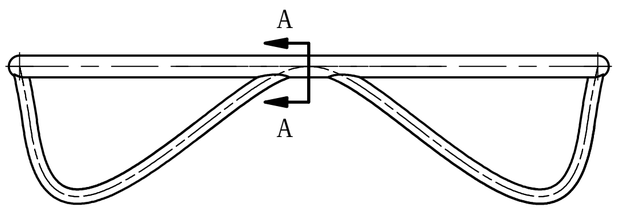
THE UNIVERSITY OF GEORGIA, ATHENS, GA			
THIRD ANGLE PROJECTION	DRAWN BY: Ben Schlich		DATE: 9/25/2025
	TITLE: Terrible Tire		PART #: 3DS3
ALL DIMENSIONS ARE IN INCHES	MATERIAL: Rubber		
TOLERANCES UNLESS OTHERWISE SPECIFIED: x.x ±0.02, x.xx ±0.01, x.xxx ±0.005, x.xxxx ±0.0025; FRACTIONAL ±1/32; ANGULAR ±0.5°	MASS: 48.900 lbmass	SCALE: 1 / 6	SIZE: C / SHEET: 3 of 5

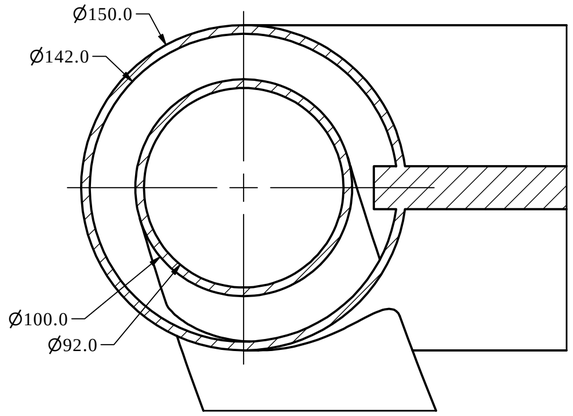
NOTES UNLESS OTHERWISE SPECIFIED:
1. FABRIC THICKNESS: 1.0



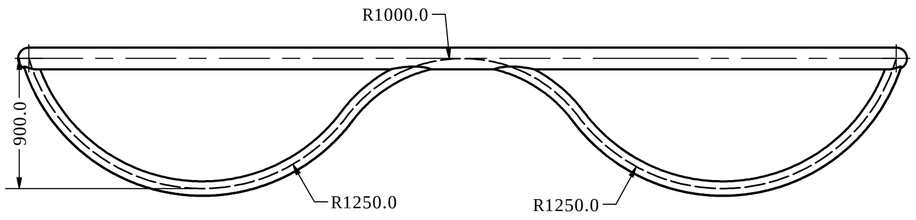


DETAIL B
SCALE 1 / 4



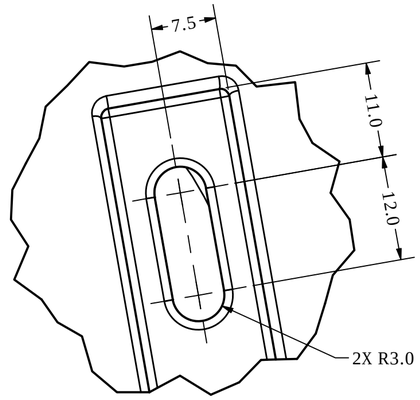


SECTION A-A
SCALE 1 / 2

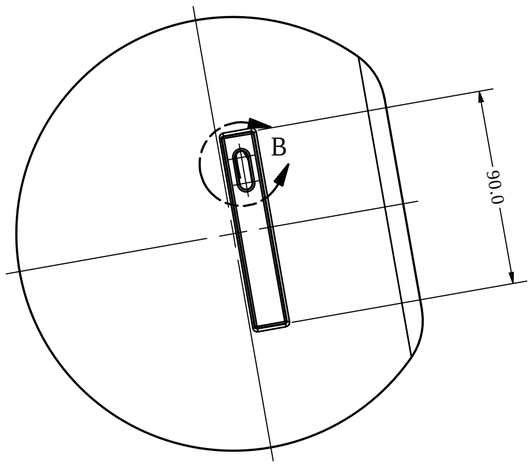


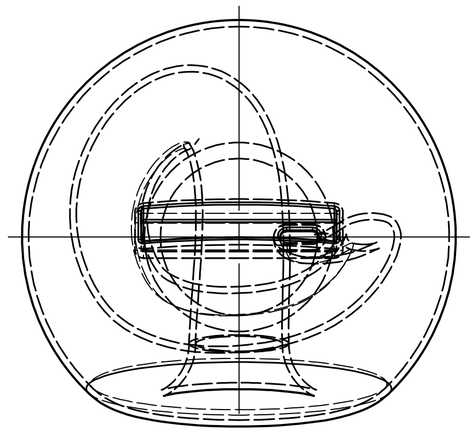
THE UNIVERSITY OF GEORGIA, ATHENS, GA				
THIRD ANGLE PROJECTION	DRAWN BY: Ben Schlich		DATE: 10/1/2025	
	TITLE: Anti-gravity Platform		PART #: 3DS4	
ALL DIMENSIONS ARE IN MILLIMETERS TOLERANCES UNLESS OTHERWISE SPECIFIED: x.x ±0.5 x.xx ±0.25 x.xxx ±0.125 ANGULAR ±0.5	MATERIAL: Steel, Alloy			
	MASS: 521.564 kg	SCALE: 1 / 30	SIZE: A2	SHEET: 4 of 5

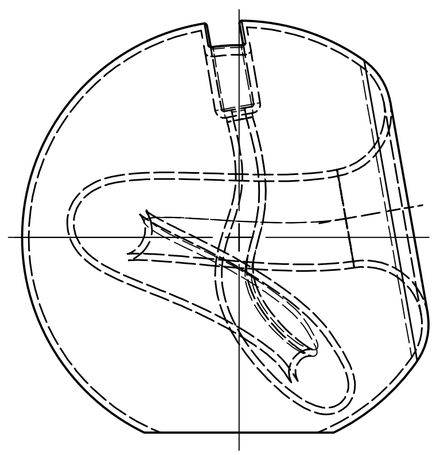
NOTES UNLESS OTHERWISE SPECIFIED:
1. SHELL THICKNESS: 3.0
2. FILLETS AND ROUNDS R1.0

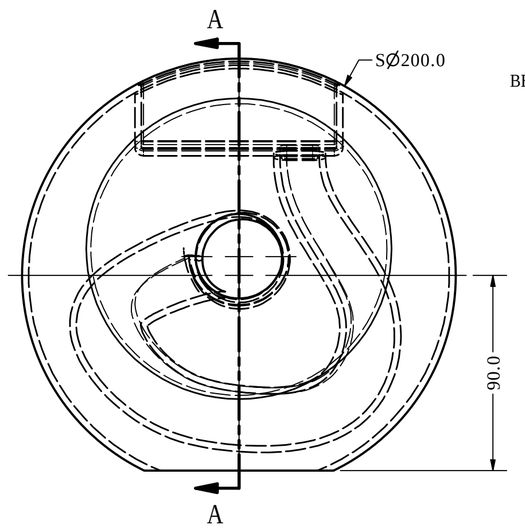


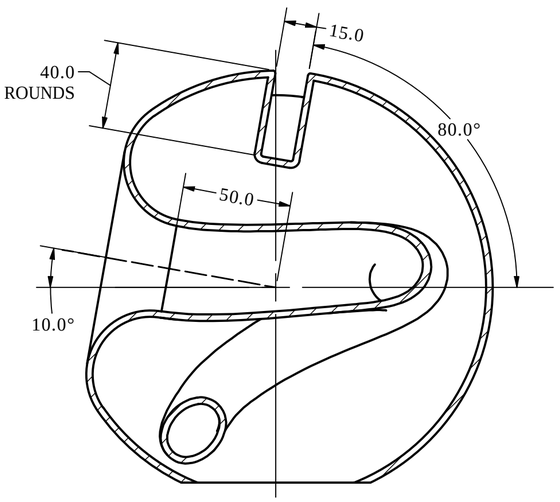
DETAIL B
SCALE 2 : 1







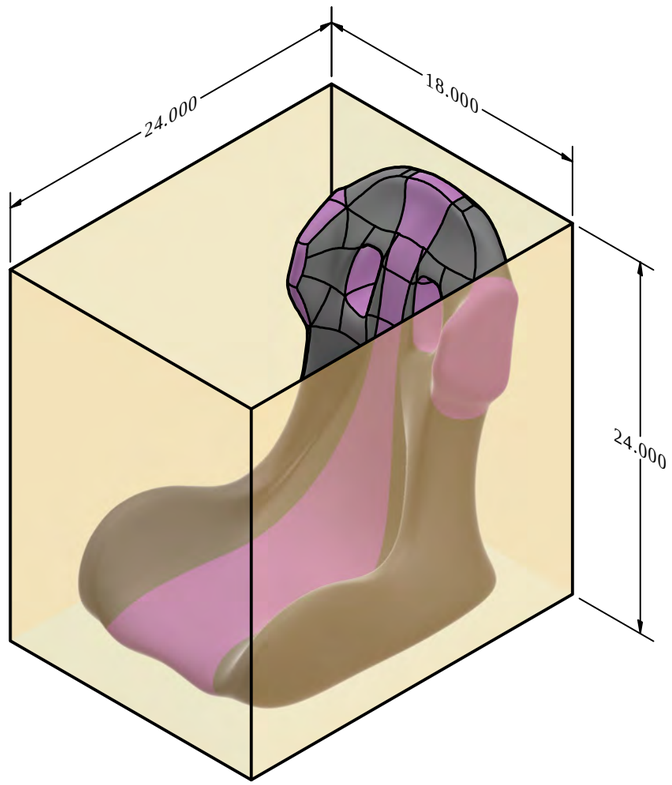


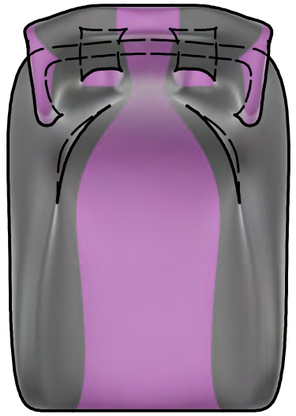


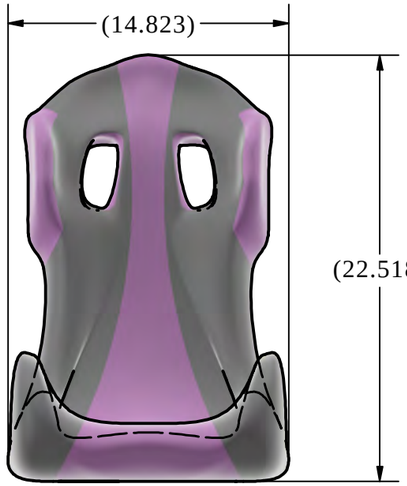
SECTION A-A
SCALE 1 / 2

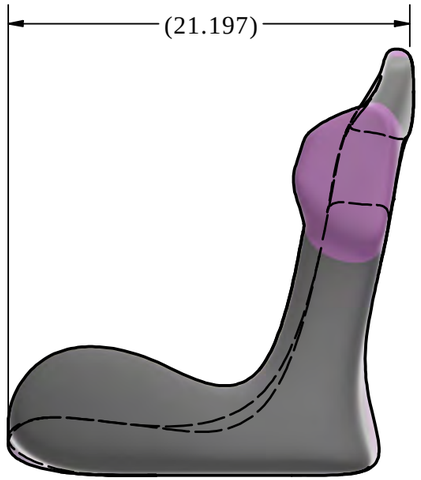
THE UNIVERSITY OF GEORGIA, ATHENS, GA			
THIRD ANGLE PROJECTION	DRAWN BY: Ben Schlich		DATE: 10/19/2025
	TITLE: Passive Speaker		PART #: 3DS5
ALL DIMENSIONS ARE IN MILLIMETERS TOLERANCES UNLESS OTHERWISE SPECIFIED: x.x ±0.5 x.xx ±0.25 x.xxx ±0.125 ANGULAR ±0.5	MATERIAL: ABS Plastic		
	MASS: 0.533 kg	SCALE: 1 / 2	SIZE: A2	SHEET: 5 of 5

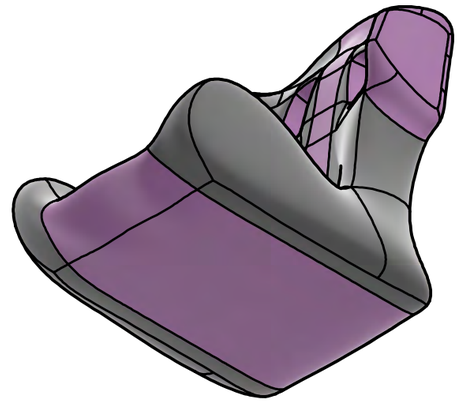
NOTES UNLESS OTHERWISE SPECIFIED:
1.





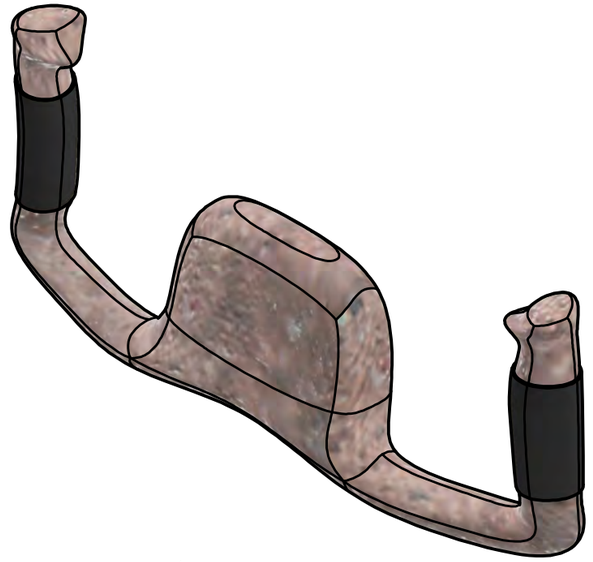


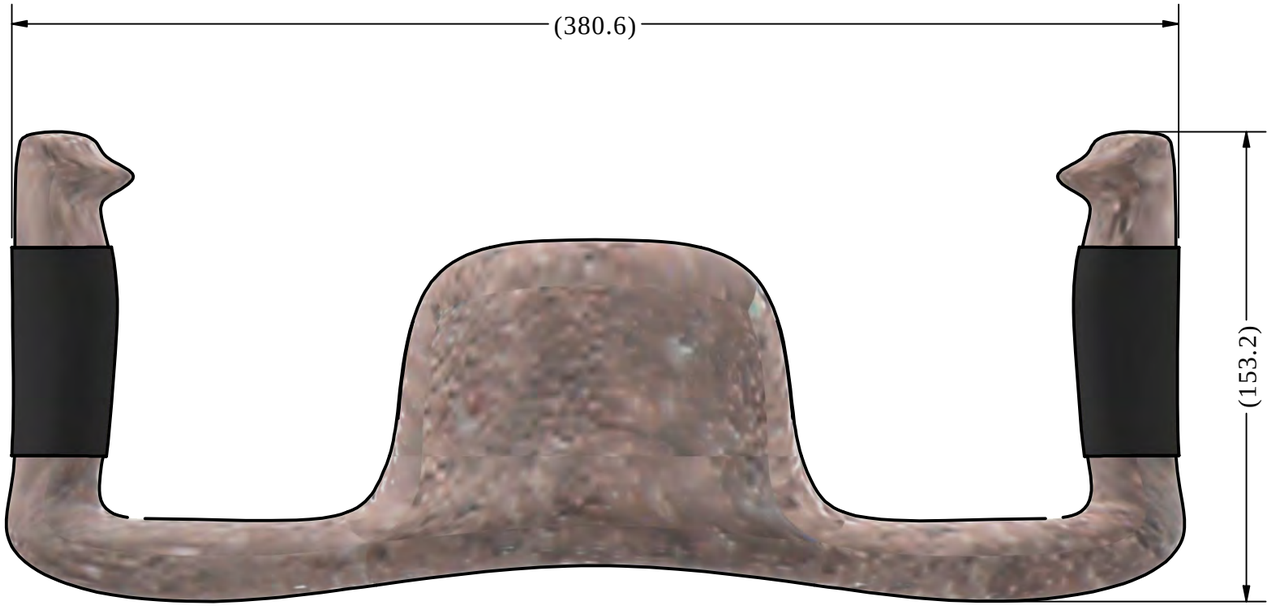


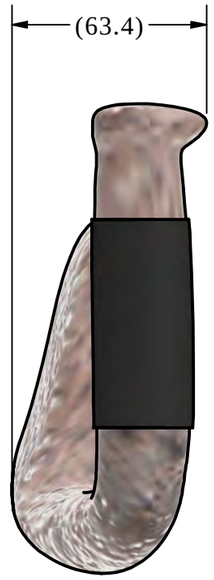


THE UNIVERSITY OF GEORGIA, ATHENS, GA			
THIRD ANGLE PROJECTION	DRAWN BY: Ben Schlich		DATE: 9/27/2025
	TITLE: Racing Seat		PART #: FF1
ALL DIMENSIONS ARE IN INCHES TOLERANCES UNLESS OTHERWISE SPECIFIED: x.x ±0.02 x.xx ±0.01 x.xxx ±0.005 x.xxxx ±0.0025 FRACTIONAL ±1/32 ANGULAR ±0.5°	MATERIAL: ABS Plastic		
	MASS: 63.559 lbmass	SCALE: 1 / 8	SIZE: B / SHEET: 1 of 5

NOTES UNLESS OTHERWISE SPECIFIED:
1.

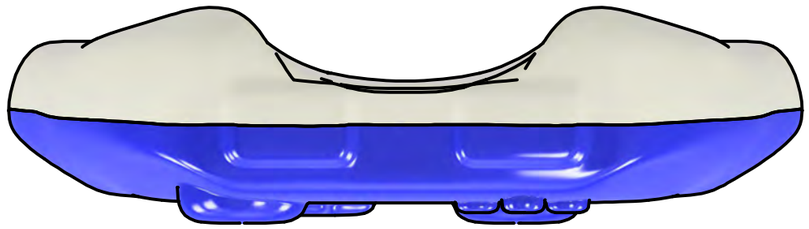


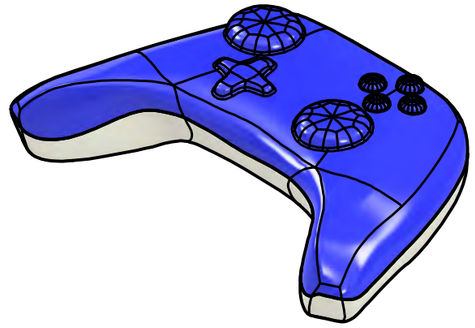


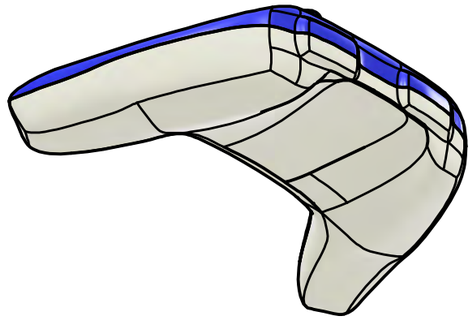


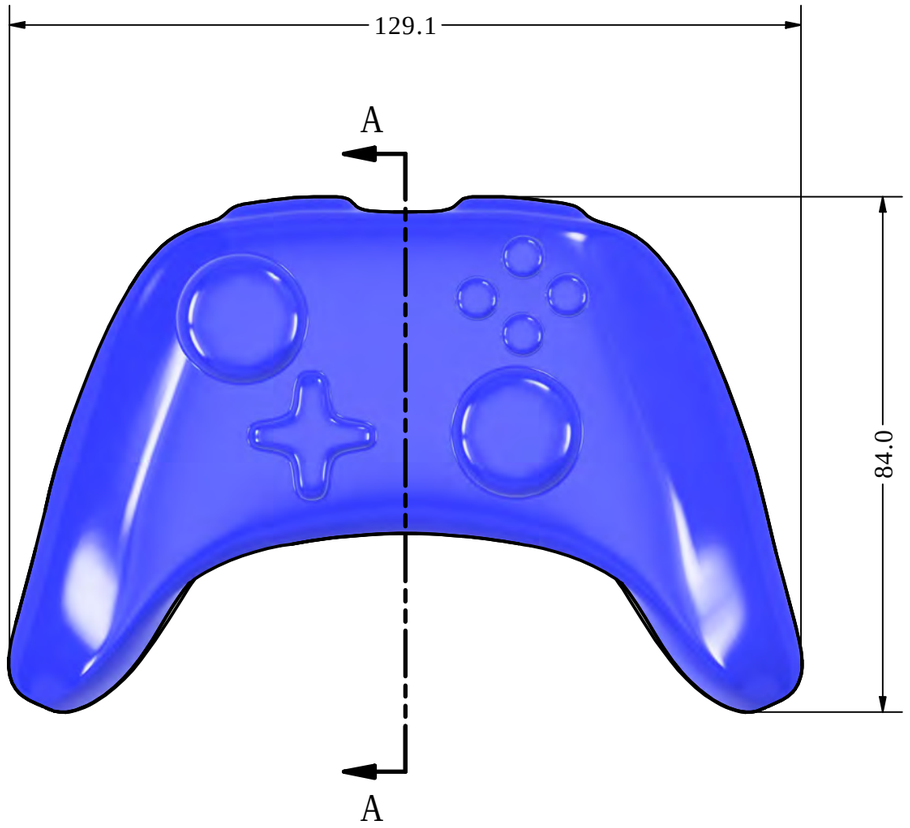
THE UNIVERSITY OF GEORGIA, ATHENS, GA			
THIRD ANGLE PROJECTION	DRAWN BY: Ben Schlich		DATE: 9/28/2025
	TITLE: Primitive Flight Yoke		PART #: FF2
ALL DIMENSIONS ARE IN MILLIMETERS	MATERIAL: Stone		
TOLERANCES UNLESS OTHERWISE SPECIFIED: x.x ±0.5, x.xx ±0.25, x.xxx ±0.125, ANGULAR ±0.5	MASS: 2.205 kg	SCALE: 1 / 2	SIZE: A3 / SHEET: 2 of 5

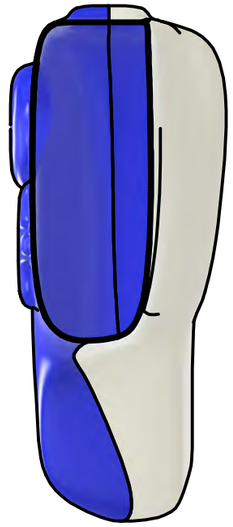
NOTES UNLESS OTHERWISE SPECIFIED:
1. SHELL THICKNESS: 0.5



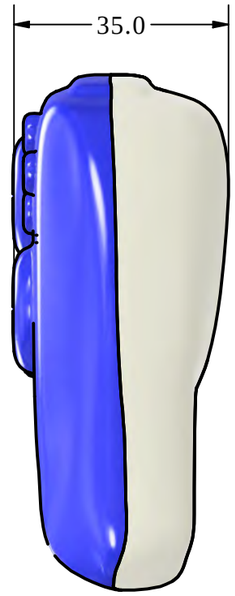






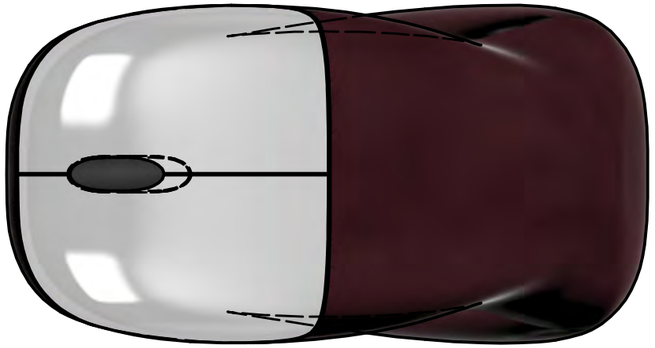


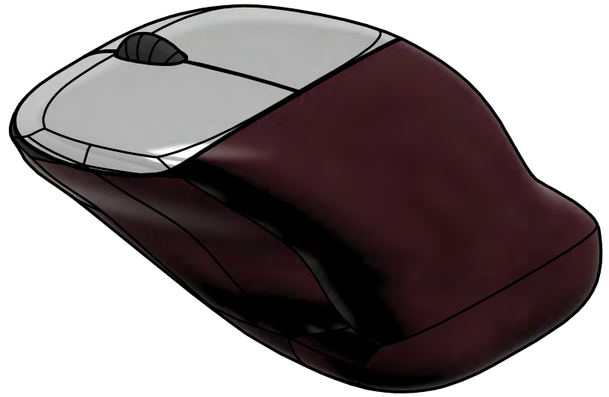
SECTION A-A
SCALE 1 : 1

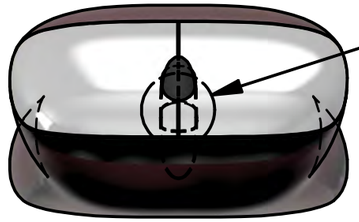


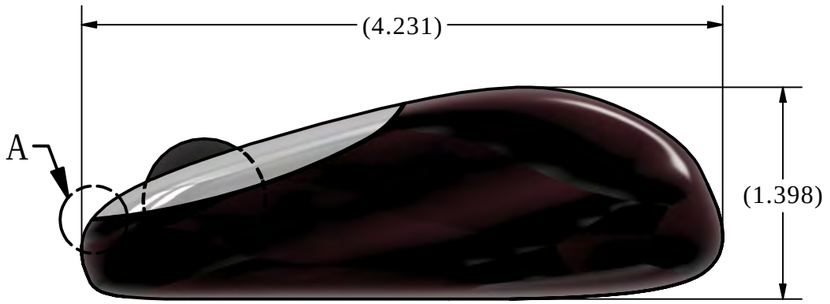
THE UNIVERSITY OF GEORGIA, ATHENS, GA			
THIRD ANGLE PROJECTION	DRAWN BY: Ben Schlich		DATE: 10/1/2025
	TITLE: Exbox Controller		PART #: FF3
ALL DIMENSIONS ARE IN MILLIMETERS TOLERANCES UNLESS OTHERWISE SPECIFIED: x.x ±0.5 x.xx ±0.25 x.xxx ±0.125 ANGULAR ±0.5	MATERIAL: ABS Plastic		
	MASS: 0.011 kg	SCALE: 1 : 1	SIZE: A3 / SHEET: 3 of 5

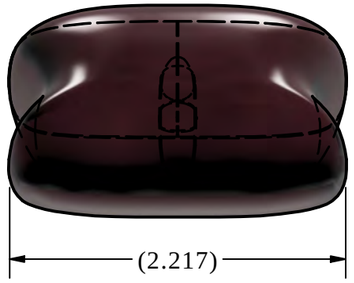
NOTES UNLESS OTHERWISE SPECIFIED:
1.

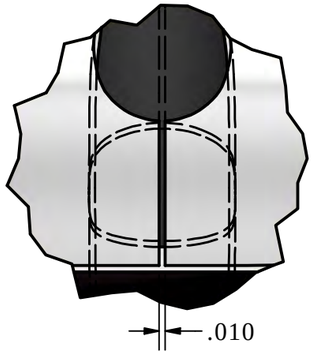










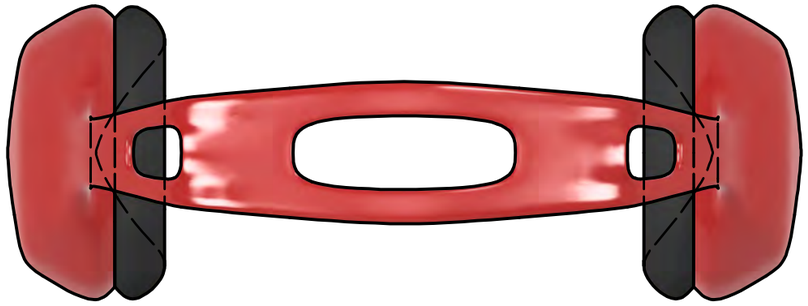


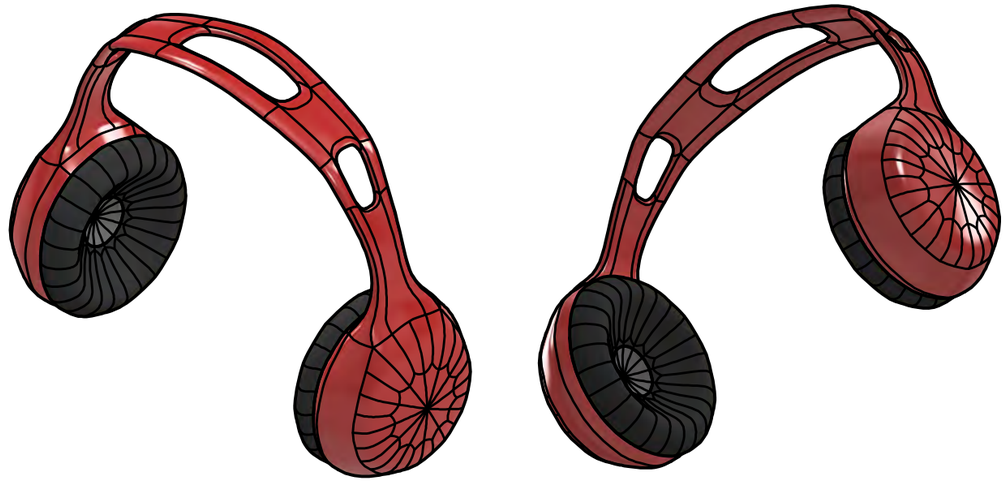
DETAIL B
SCALE 4 : 1

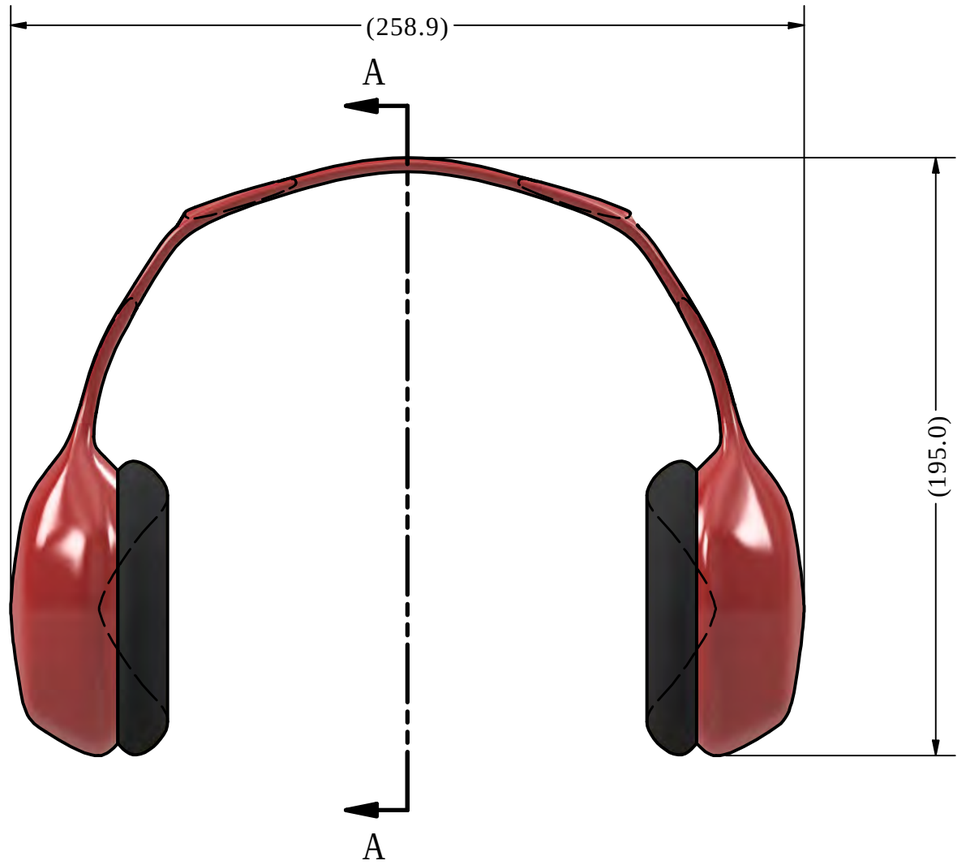
DETAIL A
SCALE 4 : 1

THE UNIVERSITY OF GEORGIA, ATHENS, GA			
THIRD ANGLE PROJECTION	DRAWN BY: Ben Schlich		DATE: 10/8/2025
	TITLE: Mouse		PART #: FF4
ALL DIMENSIONS ARE IN INCHES	MATERIAL: ABS Plastic		
TOLERANCES UNLESS OTHERWISE SPECIFIED: x.x ±0.02; x.xx ±0.01; x.xxx ±0.005; x.xxxx ±0.0025; FRACTIONAL ±1/32; ANGULAR ±0.5°	MASS: 0.317 lbmass	SCALE: 1 : 1	SIZE: B	SHEET: 4 of 5

NOTES UNLESS OTHERWISE SPECIFIED:
1.



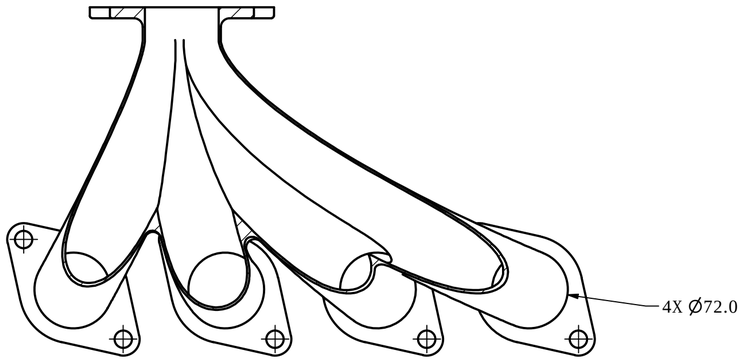




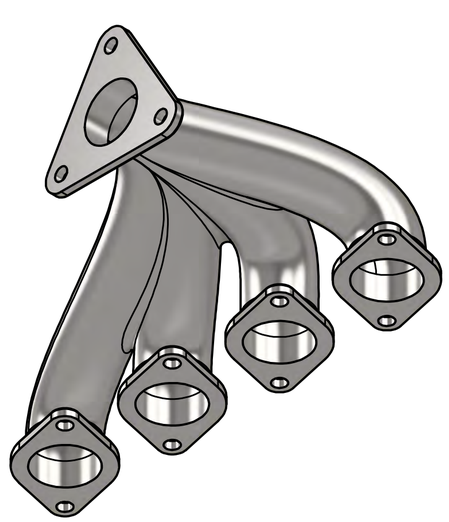
SECTION A-A
SCALE 1 / 2

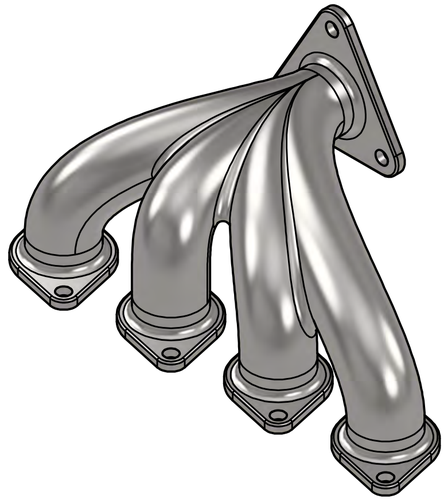
THE UNIVERSITY OF GEORGIA, ATHENS, GA			
THIRD ANGLE PROJECTION	DRAWN BY: Ben Schlich		DATE: 10/21/2025
	TITLE: Headphones		PART #: FF5
ALL DIMENSIONS ARE IN MILLIMETERS TOLERANCES UNLESS OTHERWISE SPECIFIED: x.x ±0.5 x.xx ±0.25 x.xxx ±0.125 ANGULAR ±0.5	MATERIAL: ABS Plastic		
	MASS: 0.606 kg	SCALE: 1 / 2	SIZE: A3	SHEET: 5 of 5

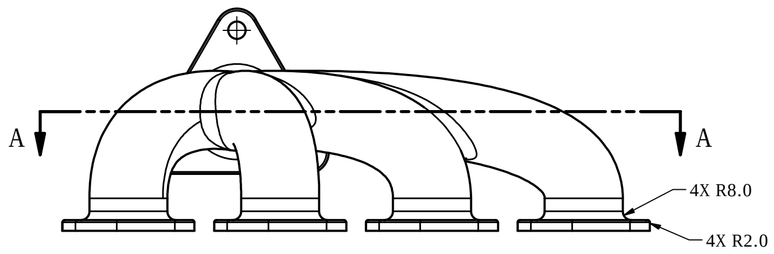
NOTES UNLESS OTHERWISE SPECIFIED:
1. PIPE MATERIAL THICKNESS: 2.0
2. FILLETS AND ROUNDS BETWEEN PIPES: 8.0

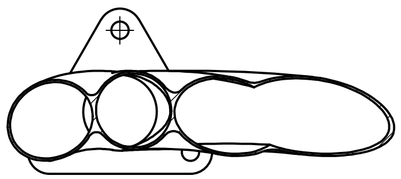


SECTION A-A
SCALE 1 / 4

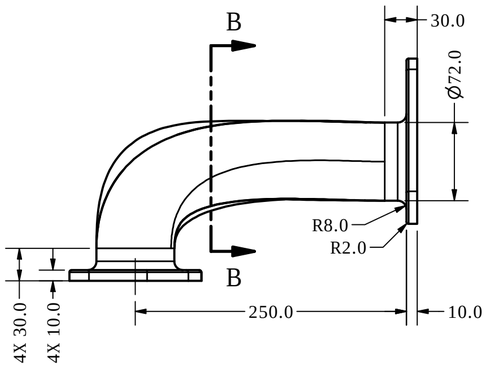


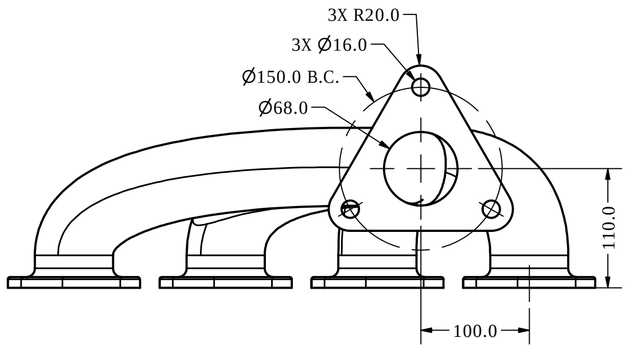


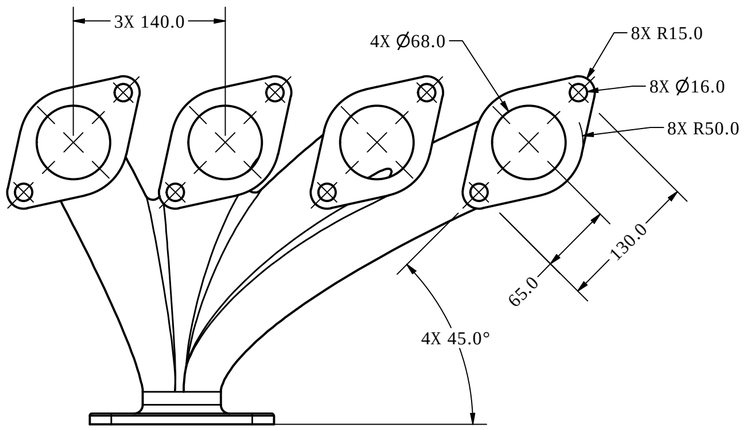




SECTION B-B
SCALE 1 / 4

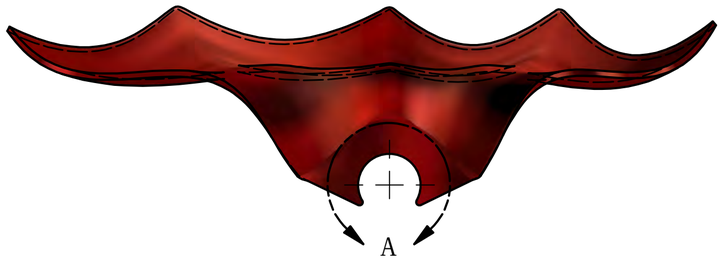


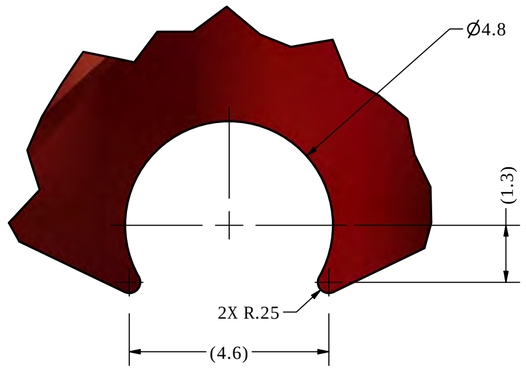




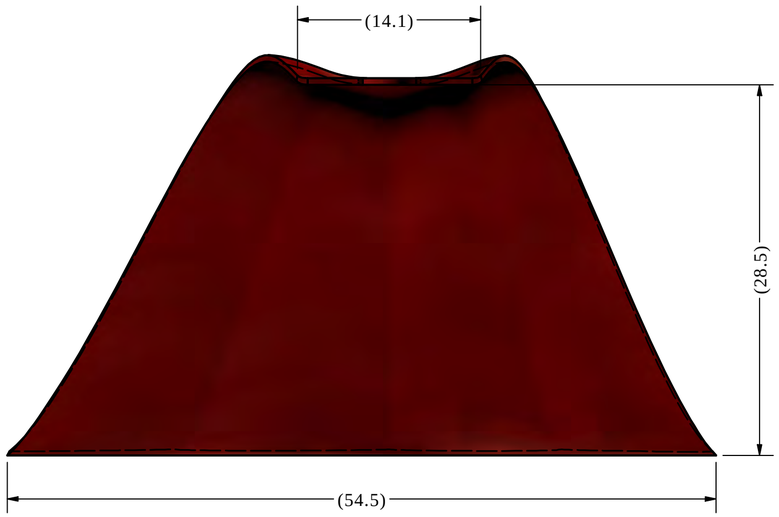
THE UNIVERSITY OF GEORGIA, ATHENS, GA			
THIRD ANGLE PROJECTION	DRAWN BY: Ben Schlich		DATE: 9/29/2025
	TITLE: Exhaust Manifold		PART #: SRF1
ALL DIMENSIONS ARE IN MILLIMETERS	MATERIAL: Stainless Steel, Austenitic		
TOLERANCES UNLESS OTHERWISE SPECIFIED: x.x ±0.5, x.xx ±0.25, x.xxx ±0.125, ANGULAR ±0.5	MASS: 6.819 kg	SCALE: 1 / 4	SIZE: A2 / SHEET: 1 of 5

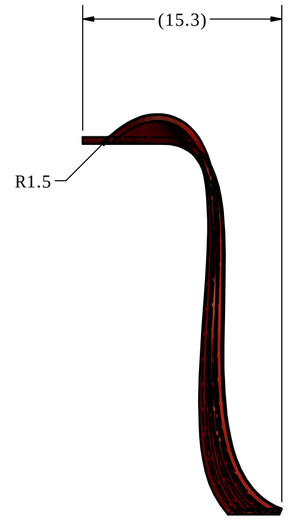
NOTES UNLESS OTHERWISE SPECIFIED:
1. MATERIAL THICKNESS: 0.5





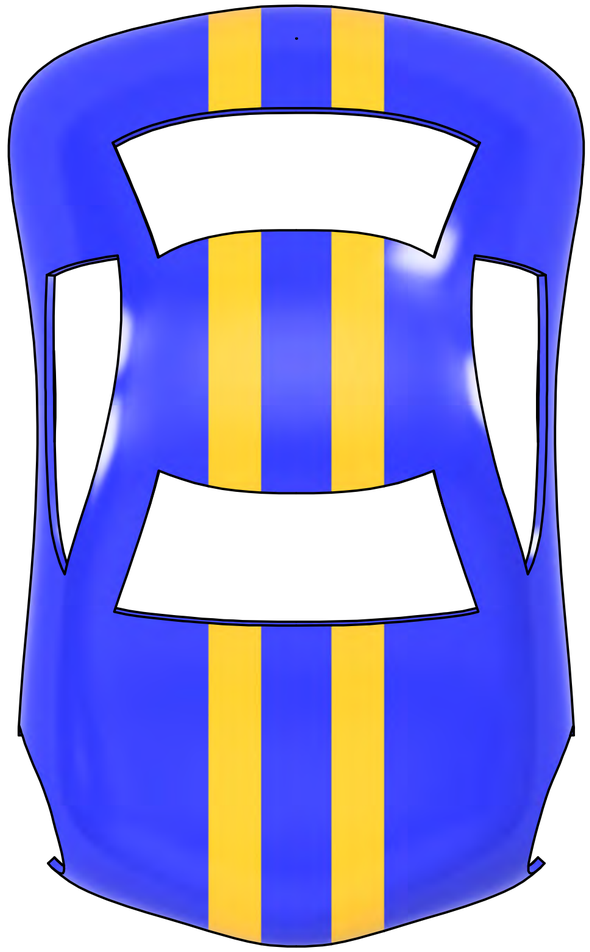
DETAIL A
SCALE 10 : 1

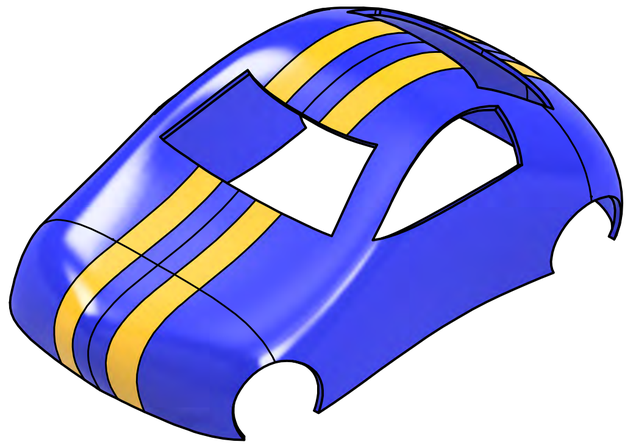


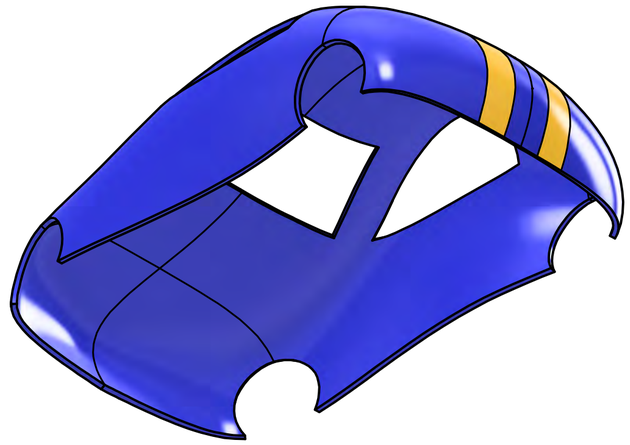


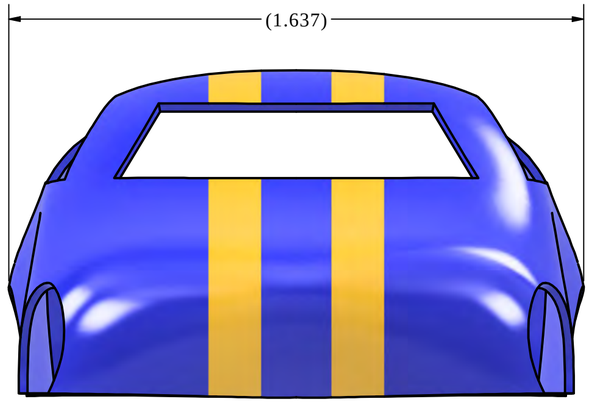
THE UNIVERSITY OF GEORGIA, ATHENS, GA			
THIRD ANGLE PROJECTION	DRAWN BY: Ben Schlich		DATE: 9/30/2025
	TITLE: Cape		PART #: SRF2
ALL DIMENSIONS ARE IN MILLIMETERS TOLERANCES UNLESS OTHERWISE SPECIFIED: x.x ±0.5 x.xx ±0.25 x.xxx ±0.125 ANGULAR ±0.5	MATERIAL: ABS Plastic		
	MASS: 0.675 g	SCALE: 3 : 1	SIZE: A2 / SHEET: 2 of 5

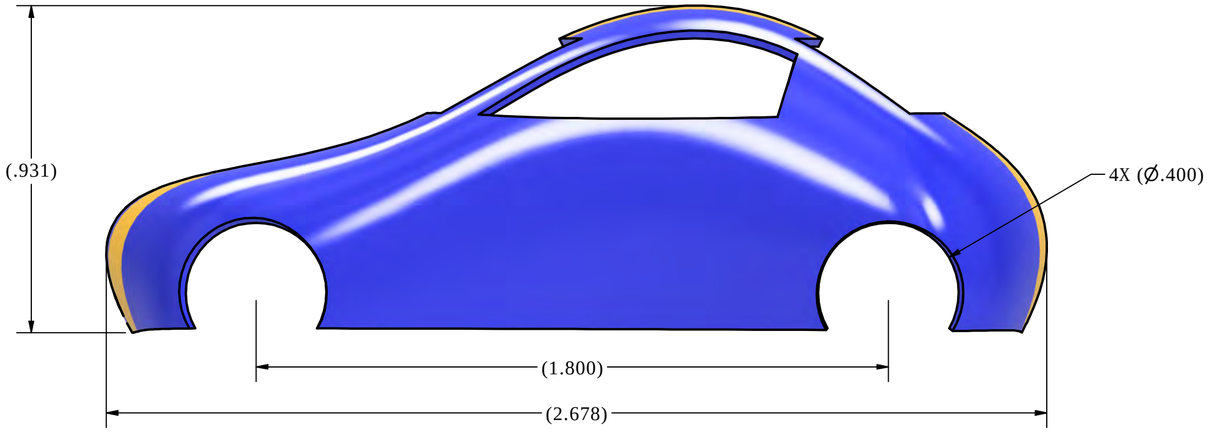
NOTES UNLESS OTHERWISE SPECIFIED:
1. MATERIAL THICKNESS: 0.025





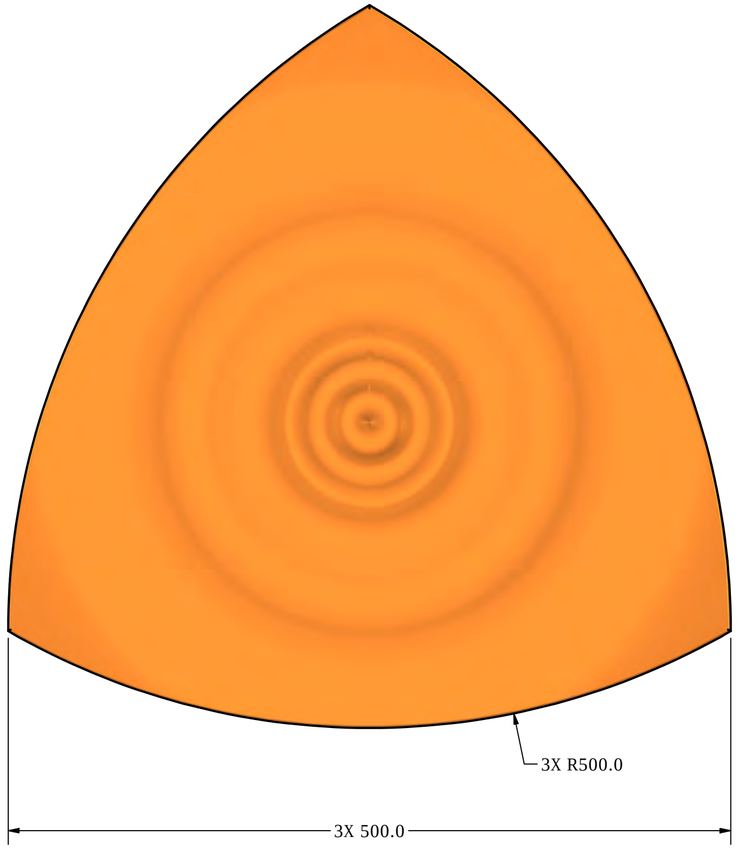


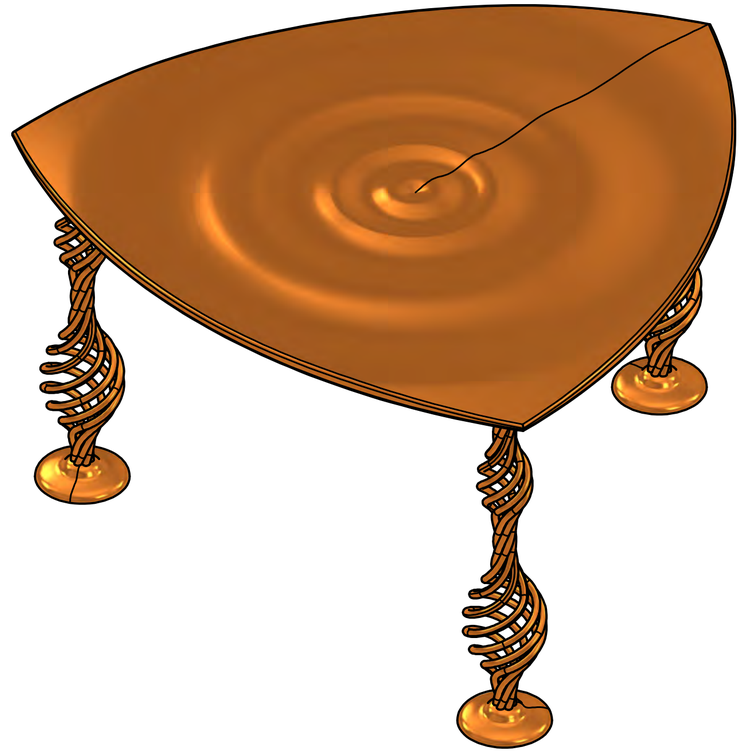


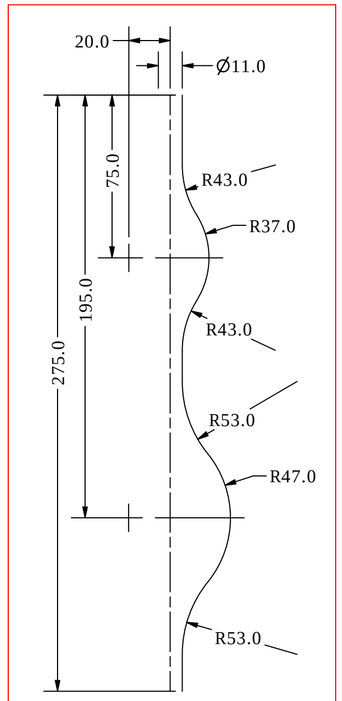


THE UNIVERSITY OF GEORGIA, ATHENS, GA			
THIRD ANGLE PROJECTION	DRAWN BY: Ben Schlich		DATE: 9/30/2025
	TITLE: Hot Wheels Body		PART #: SRF3
ALL DIMENSIONS ARE IN INCHES	MATERIAL: Zinc		
TOLERANCES UNLESS OTHERWISE SPECIFIED: x.x ±0.02, x.xx ±0.01, x.xxx ±0.005, x.xxxx ±0.0025; FRACTIONAL ±1/32; ANGULAR ±0.5°	MASS: 0.036 lbmass	SCALE: 3 : 1	SIZE: C / SHEET: 3 of 5

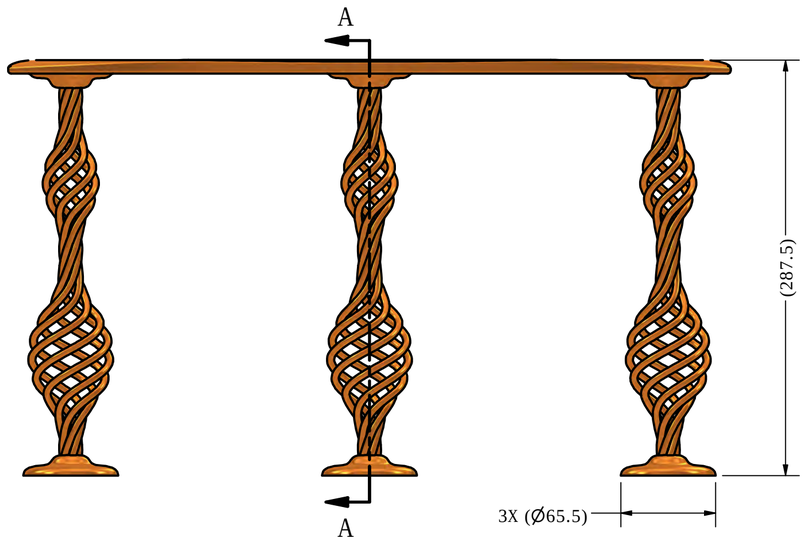
NOTES UNLESS OTHERWISE SPECIFIED:
1. FILLETS AND ROUNDS: R2.0

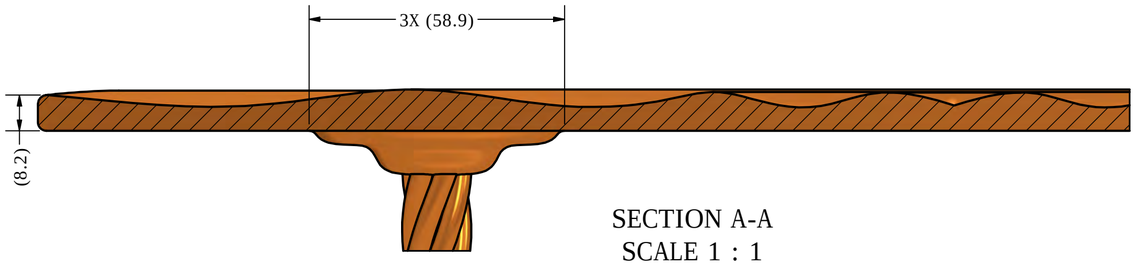






DIMENSIONS FOR REVOLVED SURFACE OF LEG

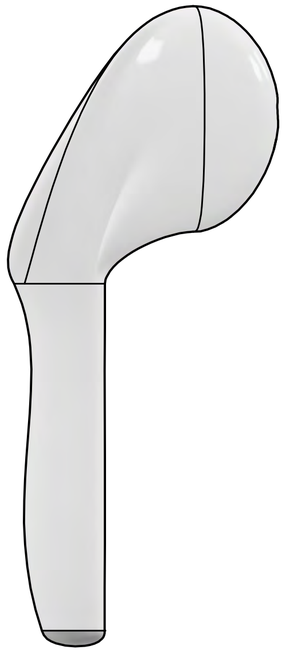


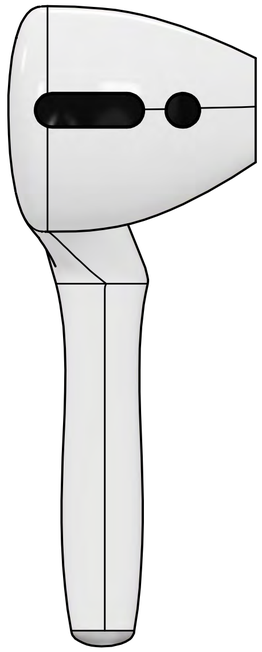


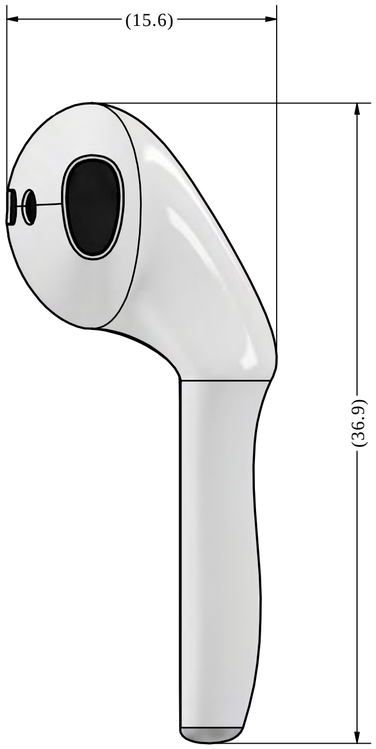
SECTION A-A
SCALE 1 : 1

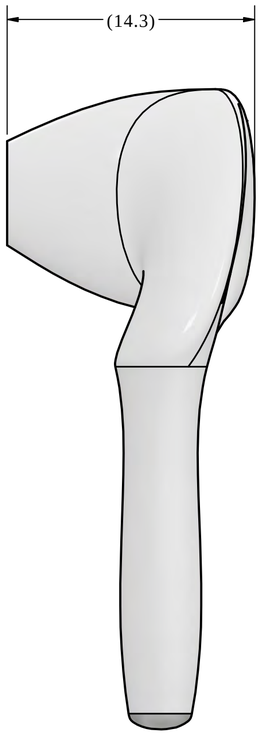
THE UNIVERSITY OF GEORGIA, ATHENS, GA				
THIRD ANGLE PROJECTION	DRAWN BY: Ben Schlich		DATE: 10/10/2025	
	TITLE: Coffee Spilling Table		PART #: SRF4	
ALL DIMENSIONS ARE IN MILLIMETERS	MATERIAL: Gold			
TOLERANCES UNLESS OTHERWISE SPECIFIED: x.x ±0.5, x.xx ±0.25, x.xxx ±0.125, ANGULAR ±0.5	MASS: 29.704 kg	SCALE: 1 / 3	SIZE: A2	SHEET: 4 of 5

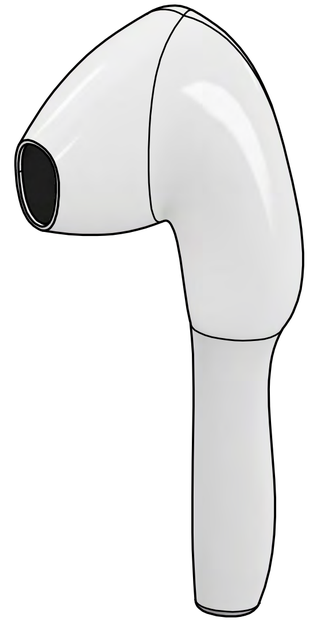
NOTES UNLESS OTHERWISE SPECIFIED:
1.

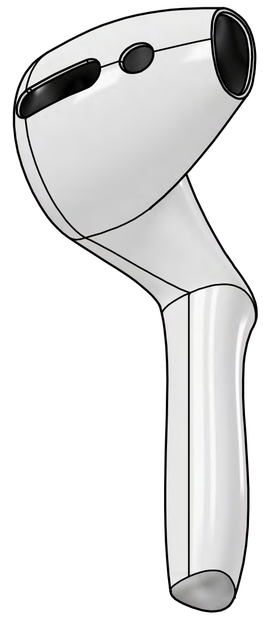


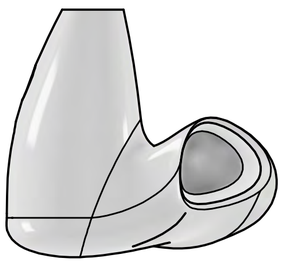






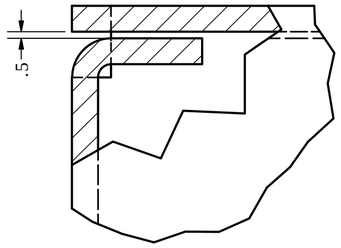




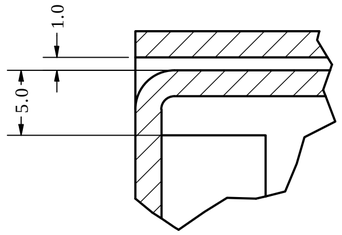


THE UNIVERSITY OF GEORGIA, ATHENS, GA			
THIRD ANGLE PROJECTION	DRAWN BY: Ben Schlich		DATE: 10/27/2025
	TITLE: O2 POD		PART #: SRF5
ALL DIMENSIONS ARE IN MILLIMETERS	MATERIAL: ABS Plastic		
TOLERANCES UNLESS OTHERWISE SPECIFIED: x.x ±0.5, x.xx ±0.25, x.xxx ±0.125, ANGULAR ±0.5	MASS: 1.548 g	SCALE: 4 : 1	SIZE: A2 / SHEET: 5 of 5

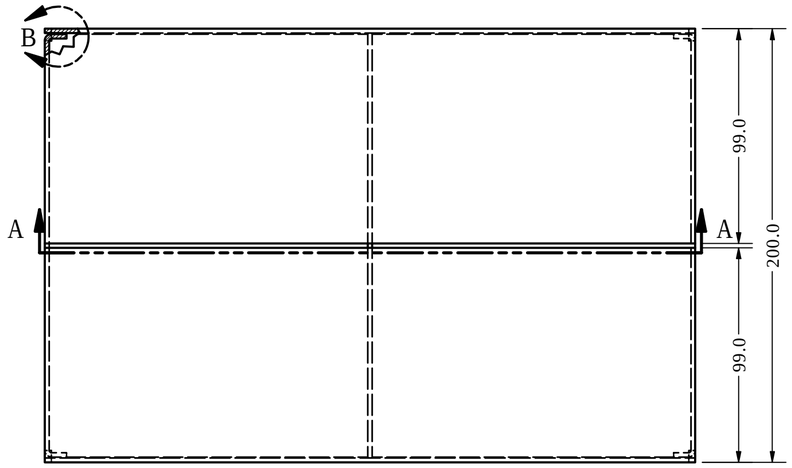
NOTES UNLESS OTHERWISE SPECIFIED:
1. MATERIAL THICKNESS: 2.0
2. BEND RADIUS: 1.0 (THICKNESS/2)

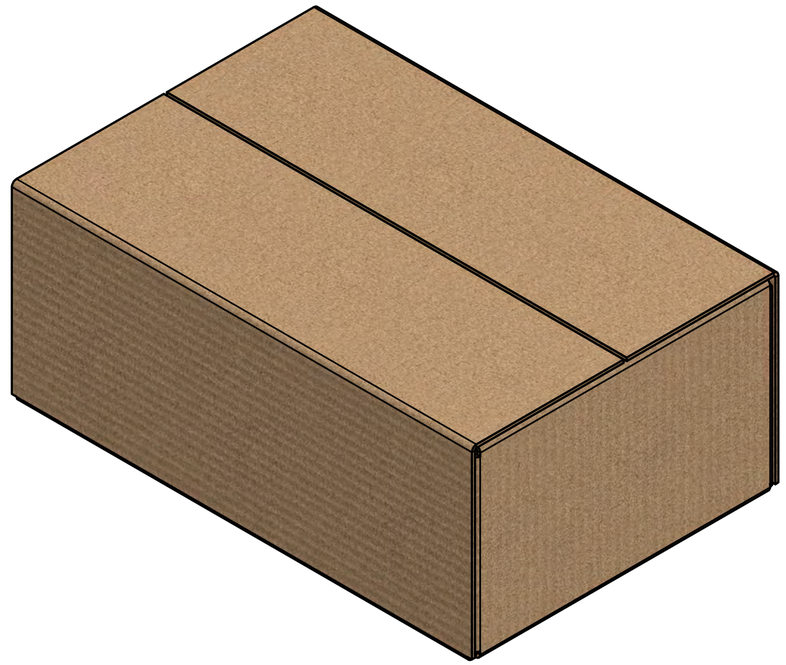


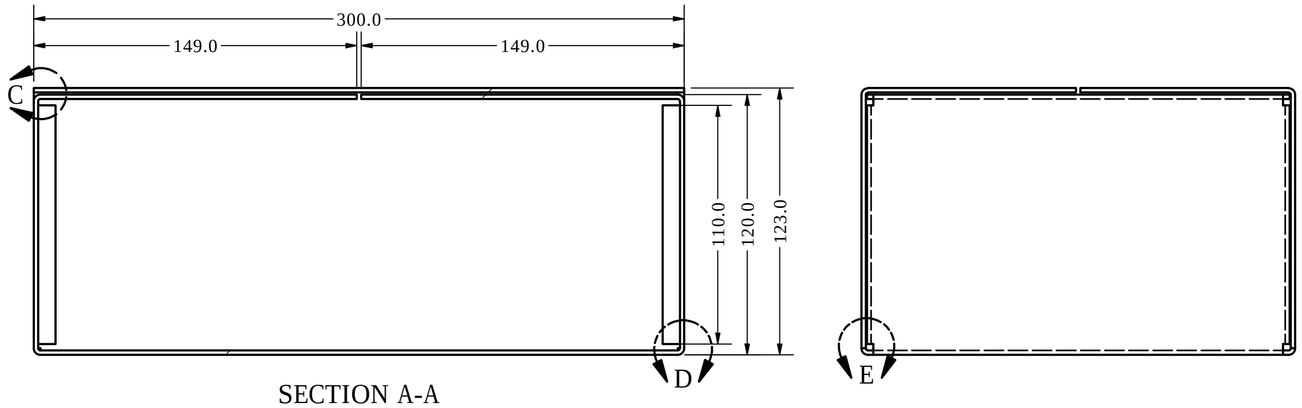
DETAIL B
SCALE 3 : 1



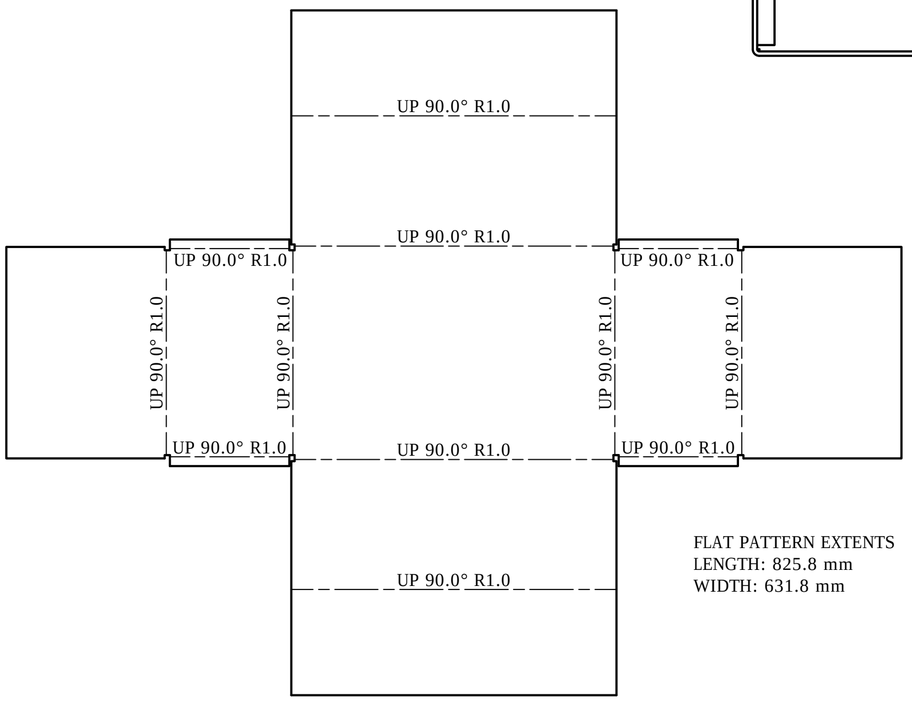
DETAIL C
SCALE 3 : 1



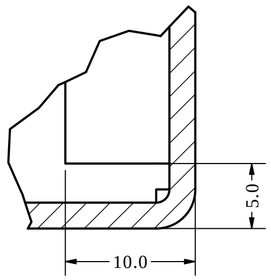




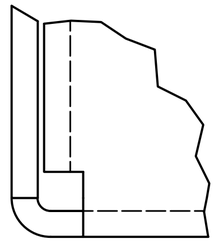
SECTION A-A
SCALE 1 / 2



FLAT PATTERN EXTENTS
LENGTH: 825.8 mm
WIDTH: 631.8 mm



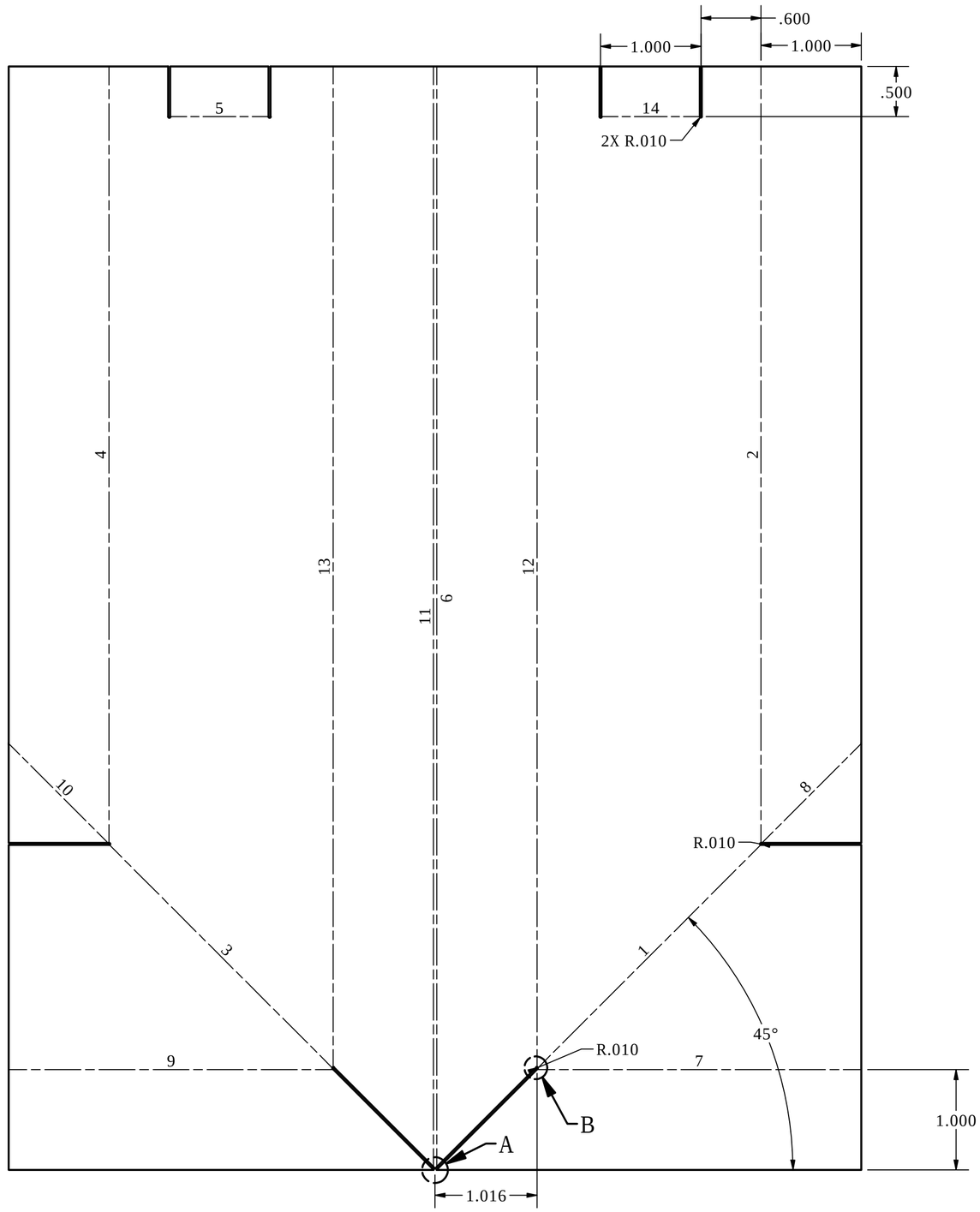
DETAIL D
SCALE 3 : 1

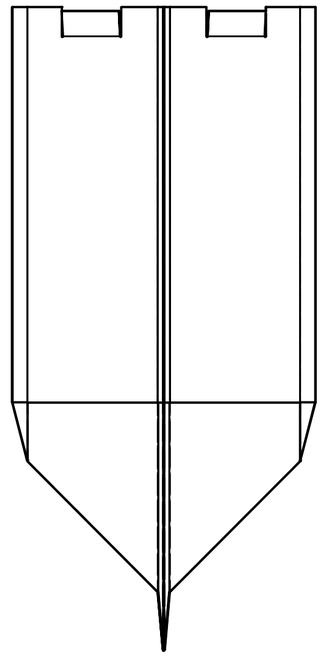


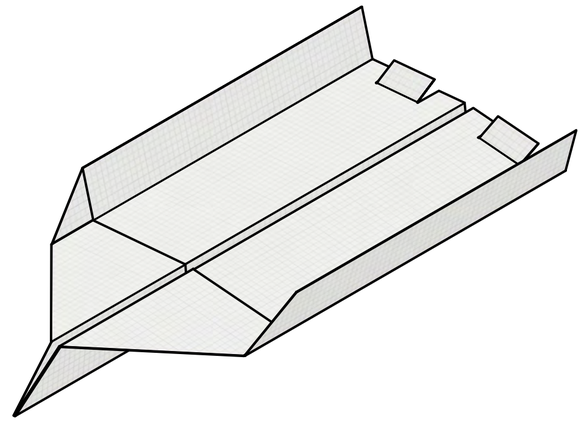
DETAIL E
SCALE 3 : 1

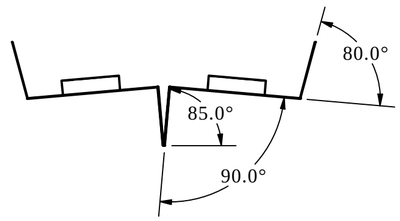
THE UNIVERSITY OF GEORGIA, ATHENS, GA			
THIRD ANGLE PROJECTION	DRAWN BY: Ben Schlich		DATE: 9/25/2025
	TITLE: Tactical Delivery Module		PART #: SM1
ALL DIMENSIONS ARE IN MILLIMETERS	MATERIAL: Paper		
TOLERANCES UNLESS OTHERWISE SPECIFIED: x.x ±0.5, x.xx ±0.25, x.xxx ±0.125, ANGULAR ±0.5	MASS: 0.550 kg	SCALE: 1 / 2	SIZE: A2 / SHEET: 1 of 5

NOTES UNLESS OTHERWISE SPECIFIED:
1. MATERIAL THICKNESS: 0.004
2. BEND RADIUS: 0.001 (THICKNESS/4)









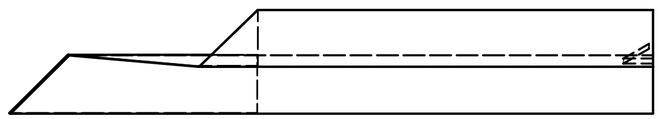
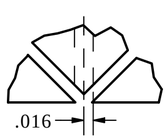
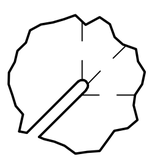


TABLE		
BEND ID	BEND DIRECTION	BEND ANGLE
1	DOWN	180
2	DOWN	80
3	DOWN	180
4	DOWN	80
5	DOWN	30
6	DOWN	85
7	DOWN	90
8	DOWN	180
9	DOWN	90
10	DOWN	180
11	DOWN	85
12	UP	90
13	UP	90
14	DOWN	30

FLAT PATTERN EXTENTS
LENGTH: 8.5 in
WIDTH: 11.0 in



DETAIL A
SCALE 5 : 1



DETAIL B
SCALE 5 : 1

THE UNIVERSITY OF GEORGIA, ATHENS, GA

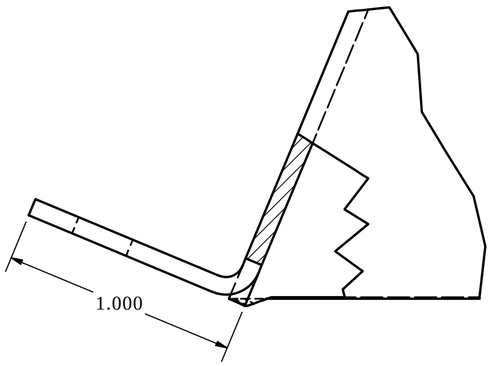
THIRD ANGLE PROJECTION

ALL DIMENSIONS ARE IN INCHES

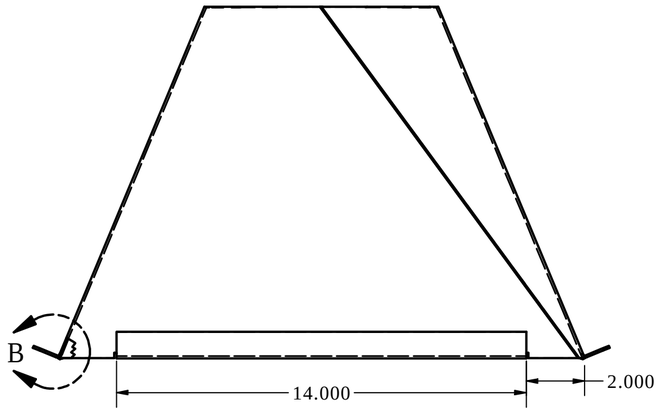
TOLERANCES UNLESS OTHERWISE SPECIFIED:
x.x ±0.02
x.xx ±0.01
x.xxx ±0.005
x.xxxx ±0.0025
FRACTIONAL ±1/32
ANGULAR ±0.5°

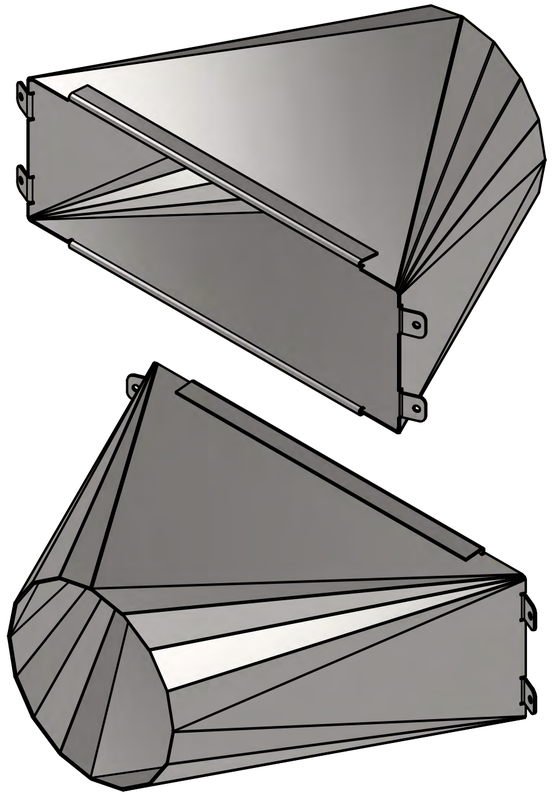
DRAWN BY: Ben Schlich			DATE: 9/26/2025
TITLE: Futuristic Stealth Bomber			PART #: SM2
MATERIAL: Paper			
MASS: 0.013 lbmass	SCALE: 1 : 1	SIZE: C	SHEET: 2 of 5

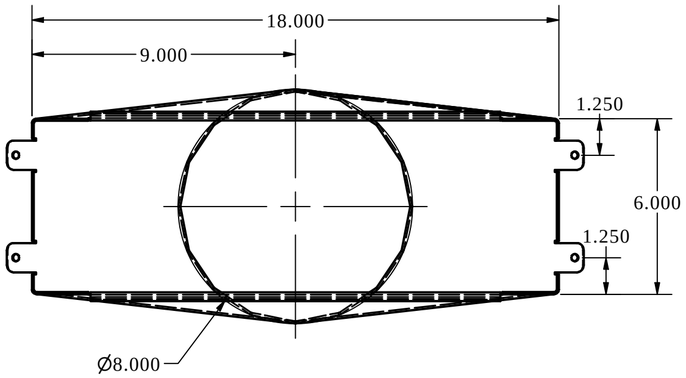
NOTES UNLESS OTHERWISE SPECIFIED:
1. MATERIAL THICKNESS: 14 ga



DETAIL B
SCALE 2 : 1







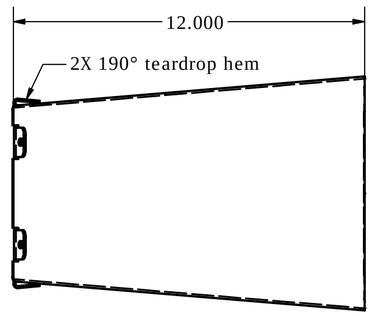
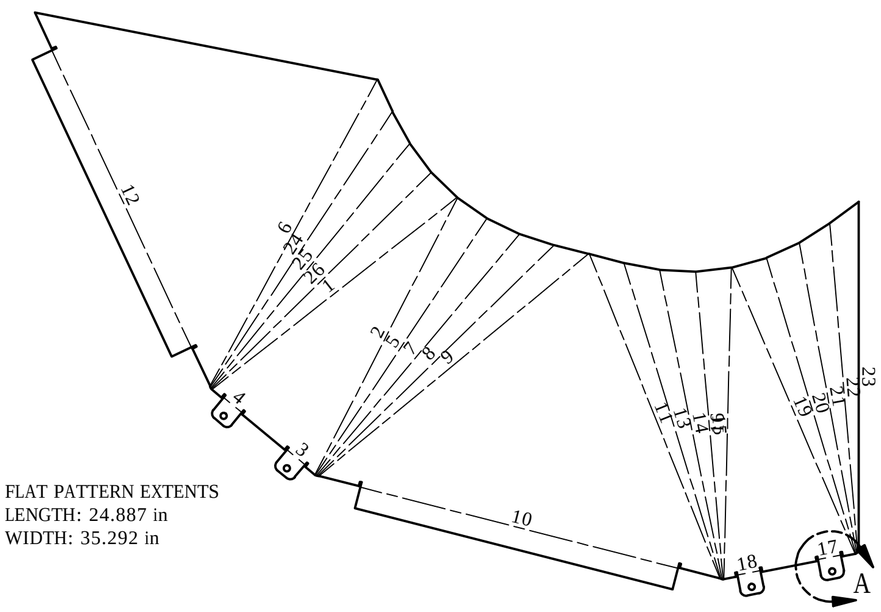
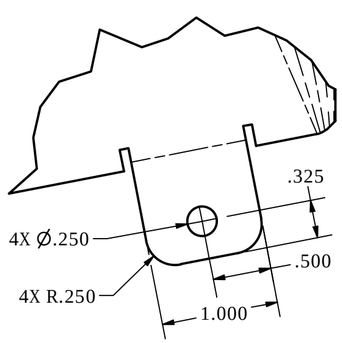


TABLE			
BEND ID	BEND DIRECTION	BEND ANGLE	BEND RADIUS
1	UP	10.473	.075
2	UP	10.473	.075
3	DOWN	90	.075
4	DOWN	90	.075
5	UP	20.585	.075
6	UP	13.966	.075
7	UP	22.266	.075
8	UP	25.518	.075
9	UP	13.966	.075
10	DOWN	190	.075
11	UP	13.966	.075
12	DOWN	190	.075
13	UP	25.518	.075
14	UP	22.266	.075
15	UP	20.585	.075
16	UP	10.473	.075
17	DOWN	90	.075
18	DOWN	90	.075
19	UP	10.473	.075
20	UP	20.585	.075
21	UP	22.266	.075
22	UP	25.518	.075
23	UP	13.966	.075
24	UP	25.518	.075
25	UP	22.266	.075
26	UP	20.585	.075



FLAT PATTERN EXTENTS
LENGTH: 24.887 in
WIDTH: 35.292 in



DETAIL A
SCALE 1 : 1

THE UNIVERSITY OF GEORGIA, ATHENS, GA

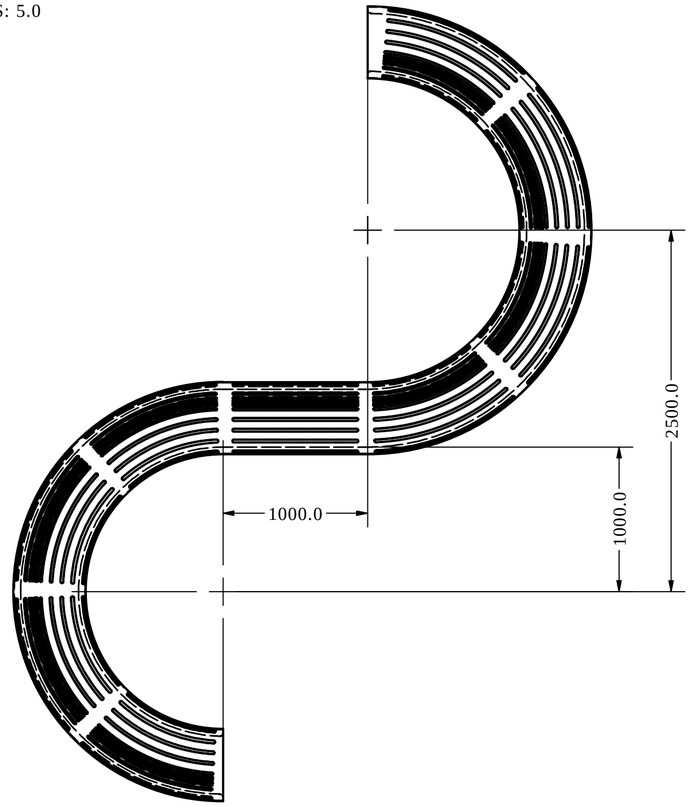
THIRD ANGLE PROJECTION

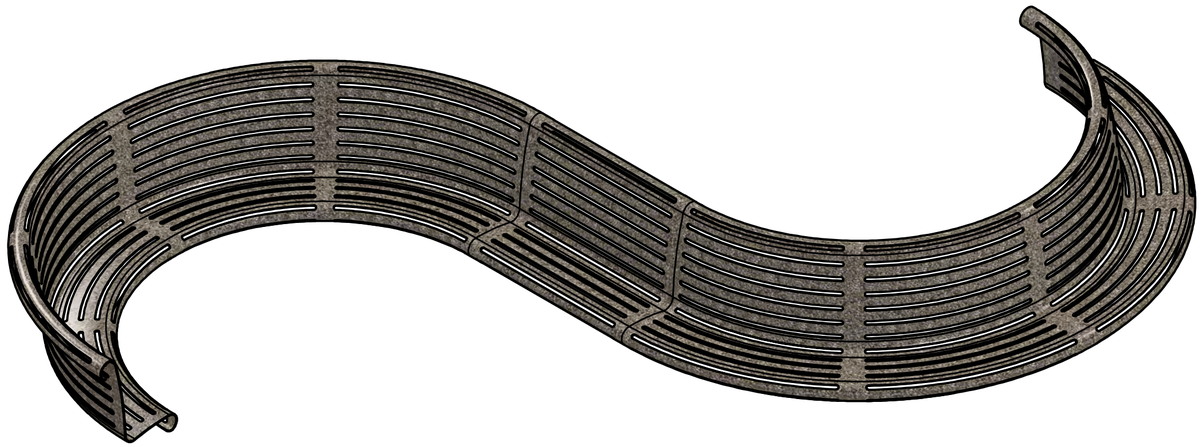
ALL DIMENSIONS ARE IN INCHES

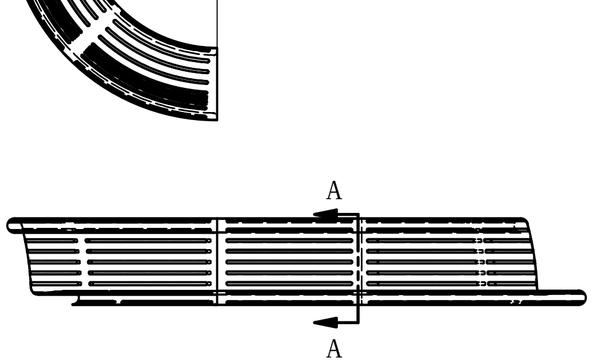
TOLERANCES UNLESS OTHERWISE SPECIFIED:
x.x ±0.02
x.xx ±0.01
x.xxx ±0.005
x.xxxx ±0.0025
FRACTIONAL ±1/32
ANGULAR ±0.5°

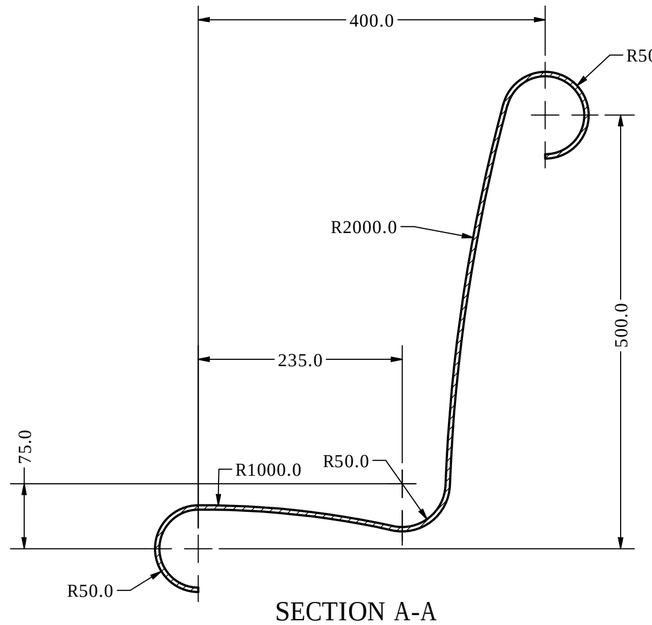
DRAWN BY: Ben Schlich			DATE: 9/30/2025
TITLE: Supply Duct			PART #: SM3
MATERIAL: Steel, Alloy			
MASS: 9.965 lbmass	SCALE: 1 / 4	SIZE: C	SHEET: 3 of 5

NOTES UNLESS OTHERWISE SPECIFIED:
1. MATERIAL THICKNESS: 5.0

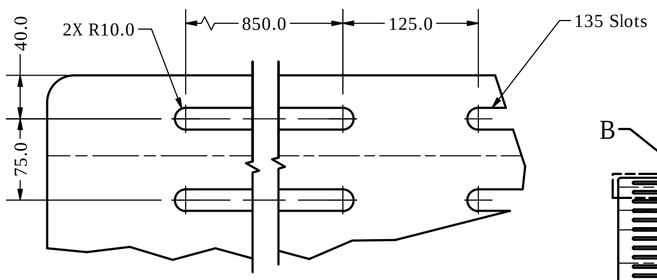








SECTION A-A
SCALE 1 / 5



DETAIL B
SCALE 1 / 4

FLAT PATTERN EXTENTS
LENGTH: 8854.0 mm
WIDTH: 1120.2 mm

TABLE			
BEND ID	BEND DIRECTION	BEND ANGLE	BEND RADIUS
1	DOWN	12.773	1995
2		180	1258.209
3		180	1241.791
4	DOWN	254.986	45
5	UP	100.294	50
6	DOWN	12.964	995
7	DOWN	179.571	45

THE UNIVERSITY OF GEORGIA, ATHENS, GA

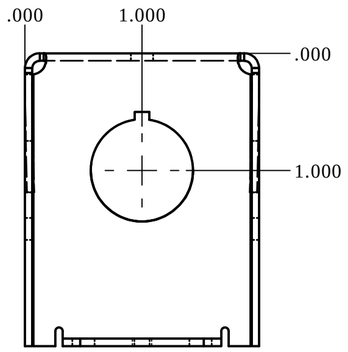
THIRD ANGLE PROJECTION

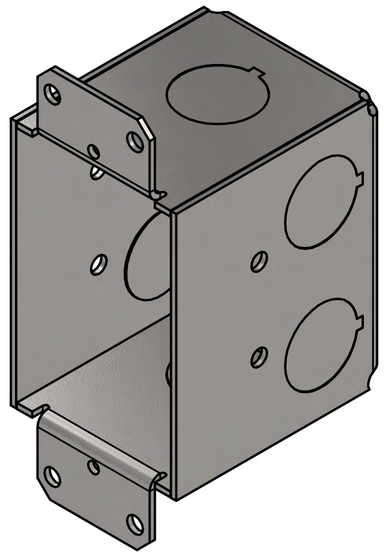
ALL DIMENSIONS ARE IN MILLIMETERS

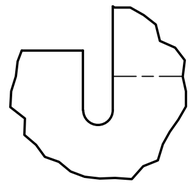
TOLERANCES UNLESS OTHERWISE SPECIFIED:
x.x ±0.5
x.xx ±0.25
x.xxx ±0.125
ANGULAR ±0.5

DRAWN BY: Ben Schlich
DATE: 10/23/2025
TITLE: Park Bench
PART #: SM4
MATERIAL: Stainless Steel
MASS: 304.016 kg
SCALE: 1 / 30
SIZE: A2
SHEET: 4 of 5

NOTES UNLESS OTHERWISE SPECIFIED:
1. MATERIAL THICKNESS: 16 ga

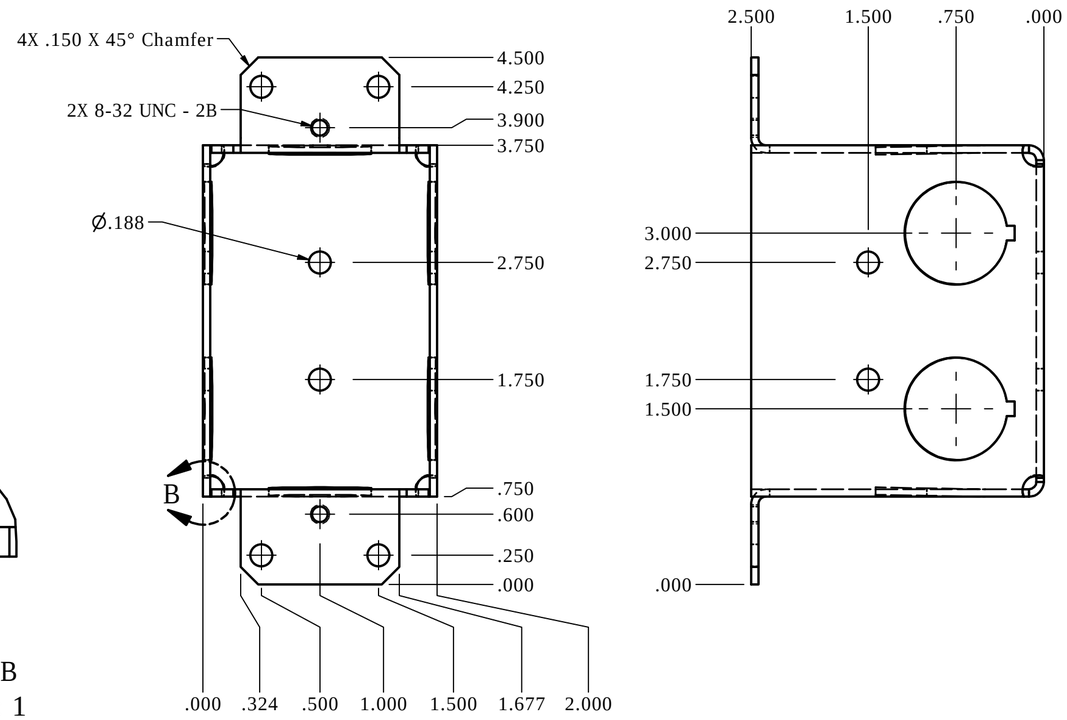


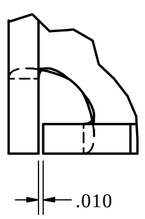




DETAIL A
SCALE 4 : 1

FLAT PATTERN EXTENTS
LENGTH: 6.779 in
WIDTH: 9.186 in





DETAIL B
SCALE 4 : 1

TABLE			
BEND ID	BEND DIRECTION	BEND ANGLE	BEND RADIUS
1	DOWN	90	.064
2	UP	90	.064
3	UP	90	.064
4	UP	90	.064
5	UP	90	.064
6	DOWN	90	.064

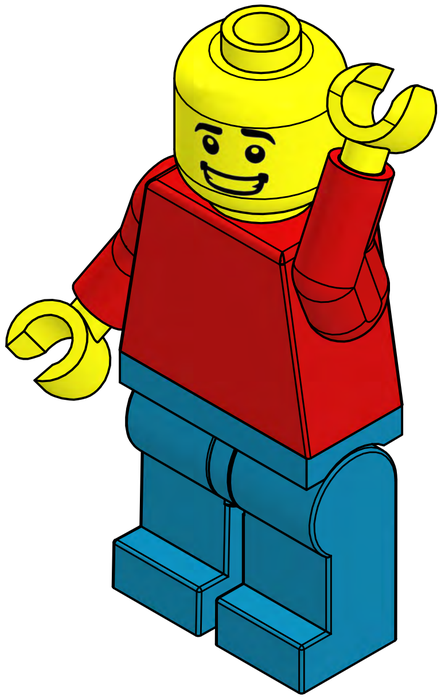
THE UNIVERSITY OF GEORGIA, ATHENS, GA

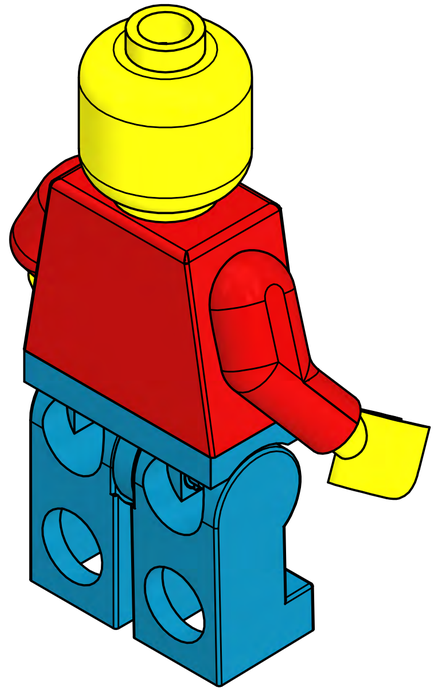
THIRD ANGLE PROJECTION

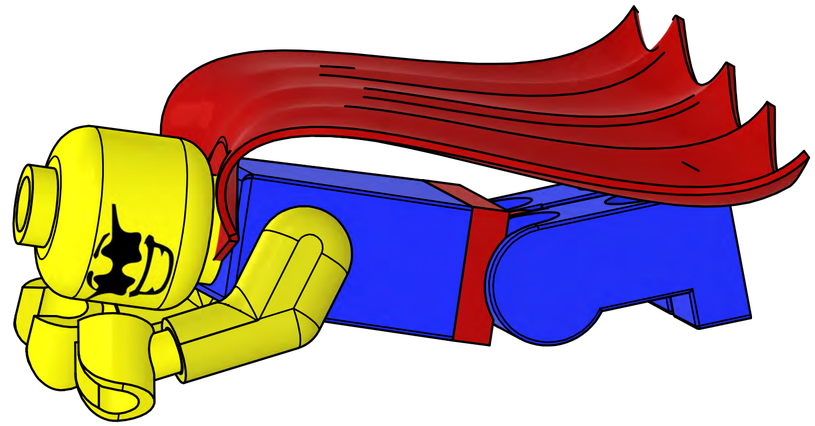
ALL DIMENSIONS ARE IN INCHES

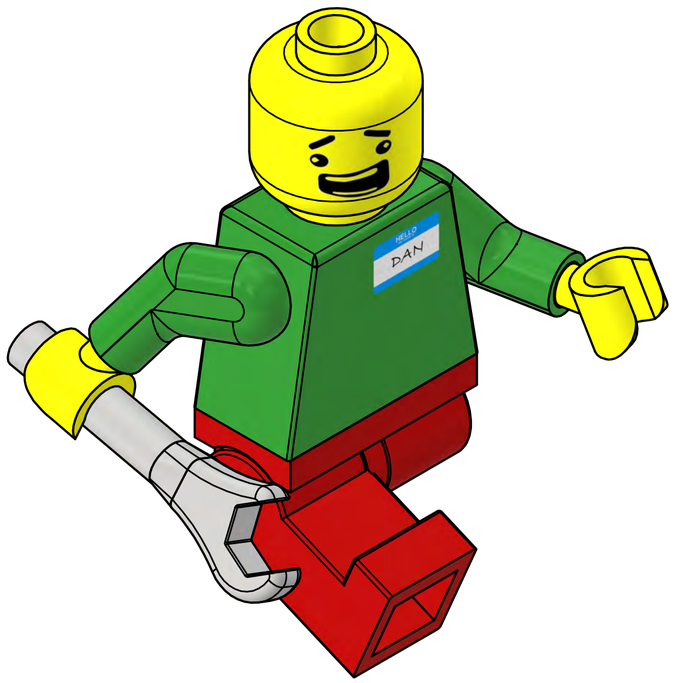
TOLERANCES UNLESS OTHERWISE SPECIFIED:
x.x ±0.02
x.xx ±0.01
x.xxx ±0.005
x.xxxx ±0.0025
FRACTIONAL ±1/32
ANGULAR ±0.5°

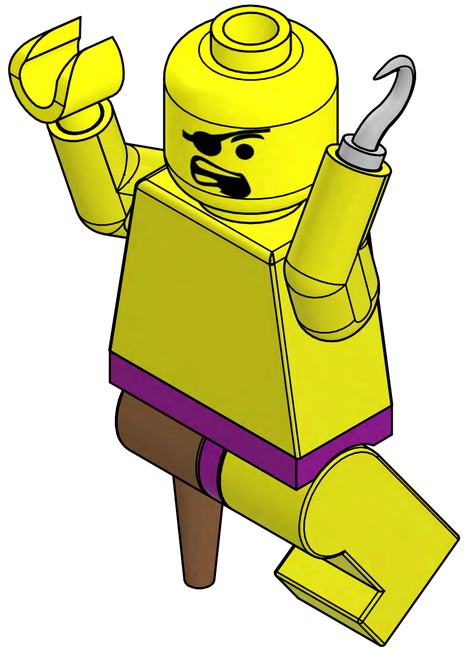
DRAWN BY: Ben Schlich
DATE: 11/17/2025
TITLE: Electrical Box
PART #: SM5
MATERIAL: Steel, Galvanized
MASS: 0.551 lbmass
SCALE: 1 : 1
SIZE: C
SHEET: 5 of 5









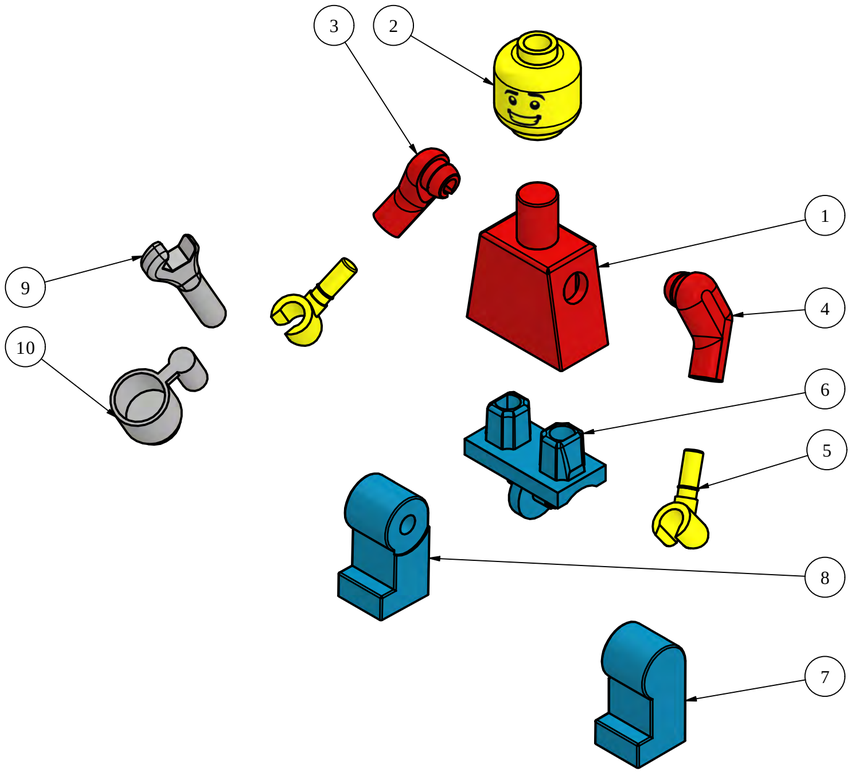


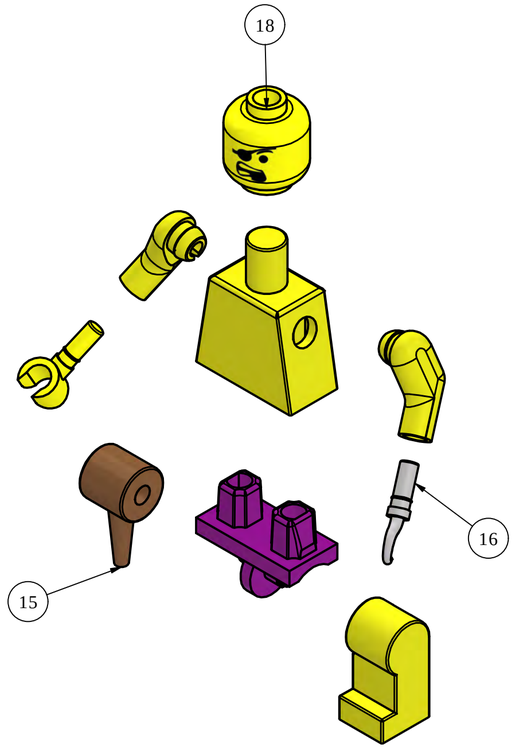
THE UNIVERSITY OF GEORGIA, ATHENS, GA			
THIRD ANGLE PROJECTION	DRAWN BY: Ben Schlich		DATE: 12/1/2025
	TITLE: Dan the Lego Man		PART #: DtLM
ALL DIMENSIONS ARE IN MILLIMETERS	MATERIAL		
TOLERANCES UNLESS OTHERWISE SPECIFIED: x.x ±0.5, x.xx ±0.25, x.xxx ±0.125, ANGULAR ±0.5	MASS: 4.067 g	SCALE: 4 : 1	SIZE: A2 / SHEET: 1 of 2

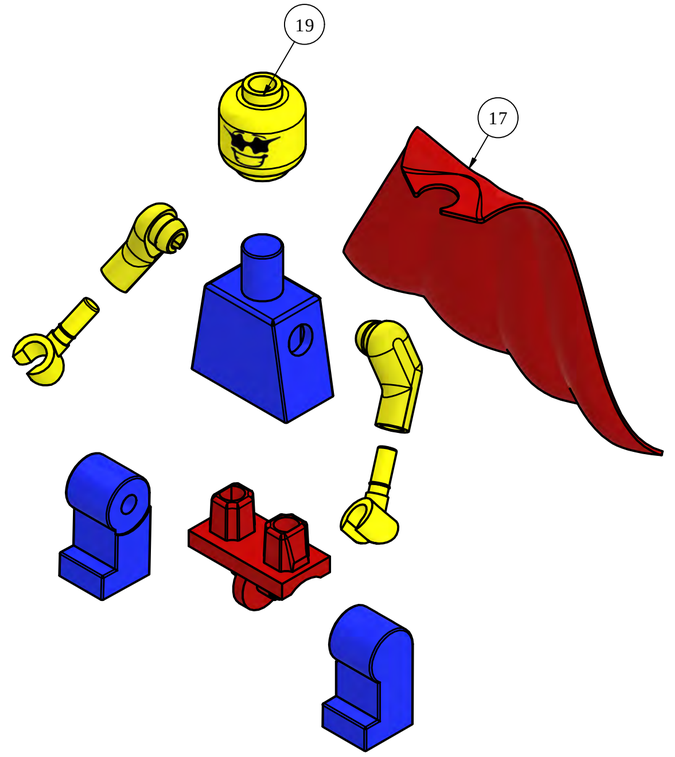
PARTS LIST			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	DtLM1	Torso
2	1	DtLM2	Head
3	1	DtLM3	Right Arm
4	1	DtLM4	Left Arm
5	2	DtLM5	Hand
6	1	DtLM6	Waist
7	1	DtLM7	Left Leg
8	1	DtLM8	Right Leg
9	1	DtLM9	Wrench
10	1	DtLM10	Mug

PARTS LIST			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	DtLM1	Torso
3	1	DtLM3	Right Arm
4	1	DtLM4	Left Arm
5	2	DtLM5	Hand
6	1	DtLM6	Waist
7	1	DtLM7	Left Leg
15	1	DtLM11	Peg Leg
16	1	DtLM12	Hook
18	1	DtLM2-4	Head (Pirate)

PARTS LIST			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	DtLM1	Torso
3	1	DtLM3	Right Arm
4	1	DtLM4	Left Arm
5	2	DtLM5	Hand
6	1	DtLM6	Waist
7	1	DtLM7	Left Leg
8	1	DtLM8	Right Leg
17	1	SRF2	
19	1	DtLM2-5	Head (Star Glasses)



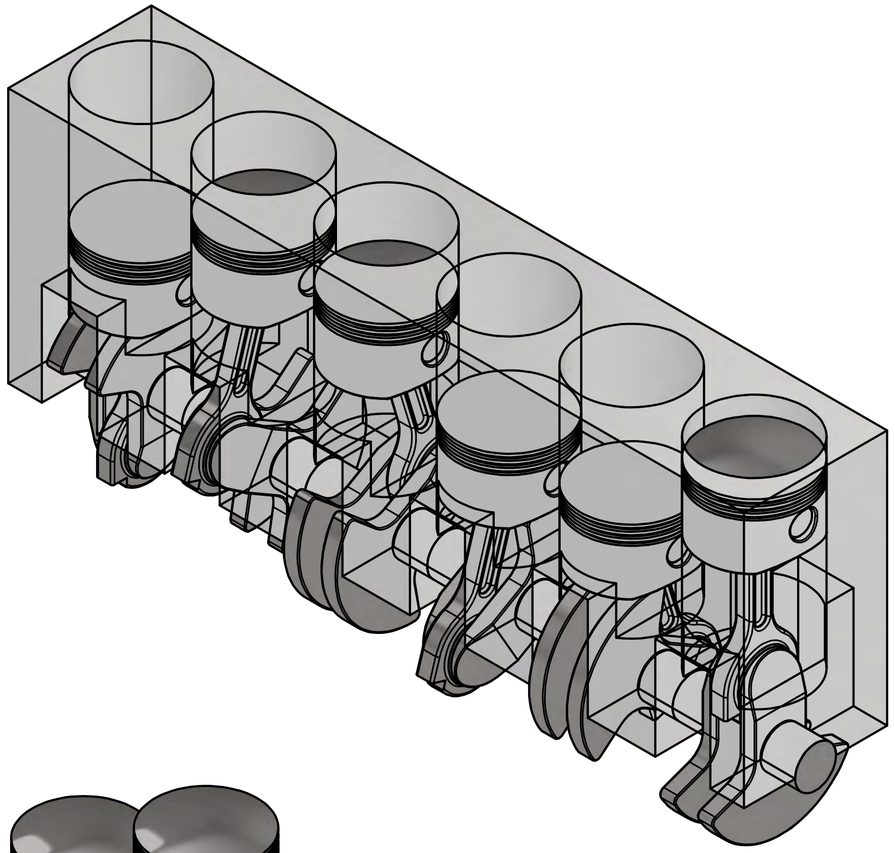


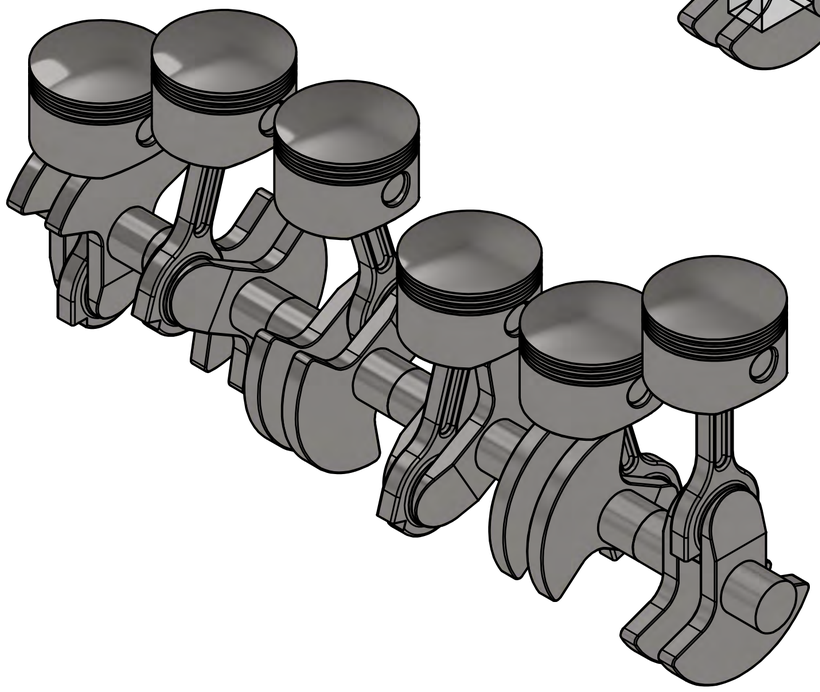


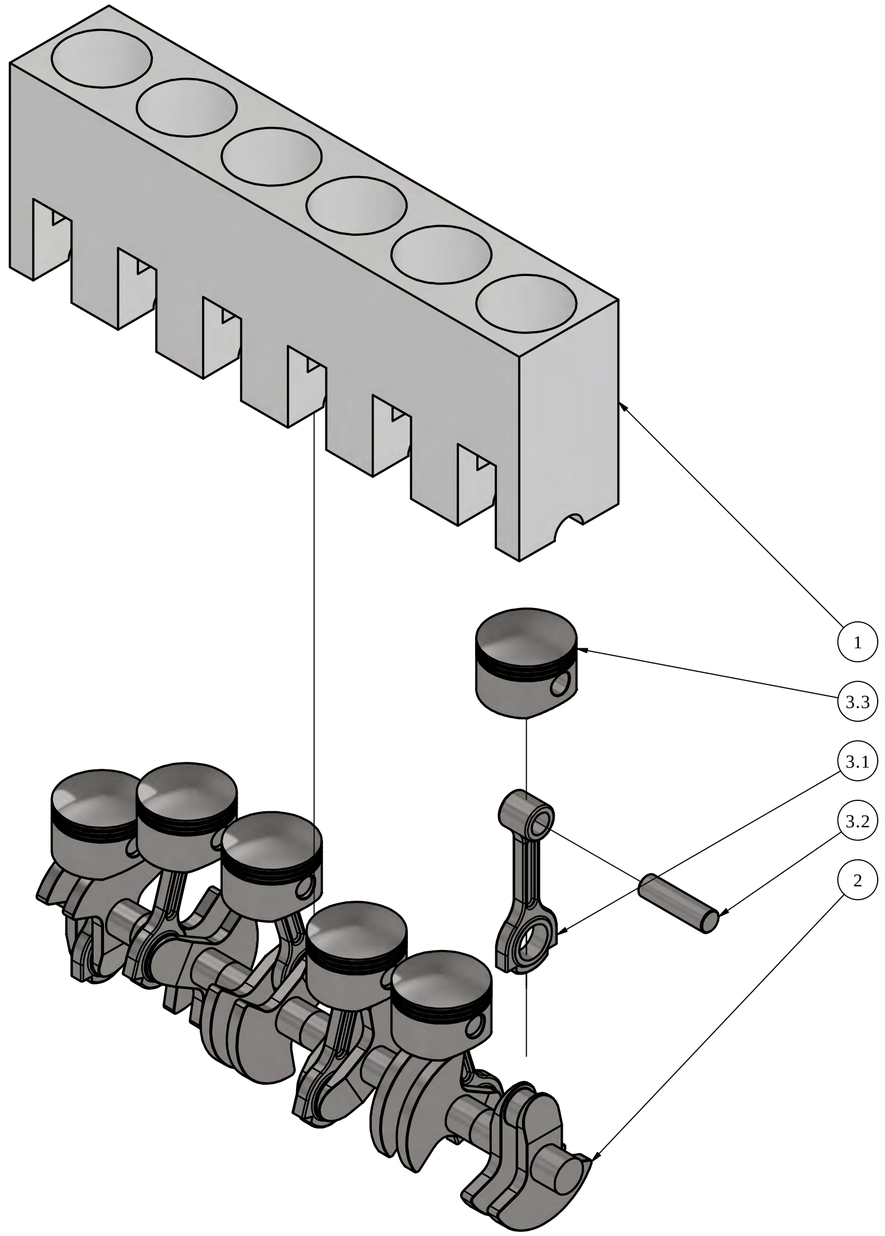
THE UNIVERSITY OF GEORGIA, ATHENS, GA				
THIRD ANGLE PROJECTION	DRAWN BY Ben Schlich		DATE 12/1/2025	
	TITLE Dan the Lego Man		PART # DtLM	
ALL DIMENSIONS ARE IN MILLIMETERS TOLERANCES UNLESS OTHERWISE SPECIFIED: x.x ±0.5 x.xx ±0.25 x.xxx ±0.125 ANGULAR ±0.5	MATERIAL			
	MASS 4.474 g	SCALE 2 : 1	SIZE A2	SHEET 2 of 2

NOTES UNLESS OTHERWISE SPECIFIED:
1.

PARTS LIST			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	ENG1	Engine Block
2	6	ENG2	Crankshaft
3	1	ENG3	Piston Assembly
3.1	1	ENG4	Connecting Pin
3.2	1	ENG5	Wrist Pin
3.3	1	ENG6	Piston



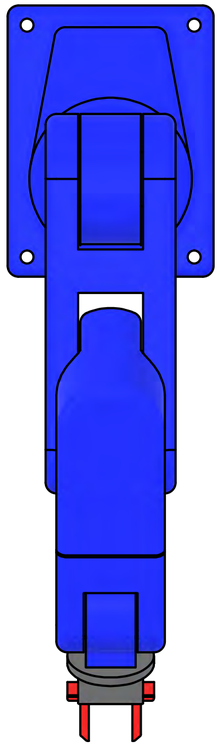


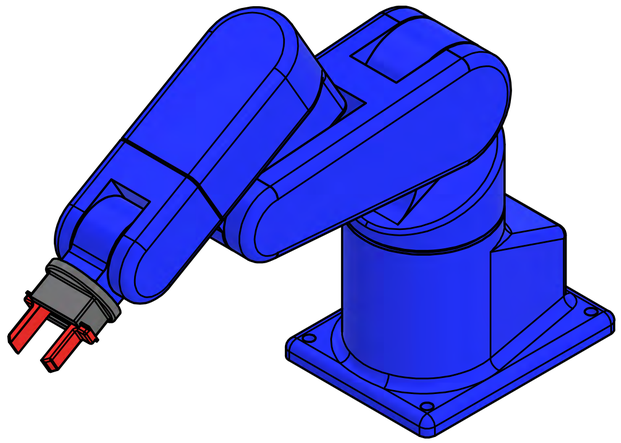


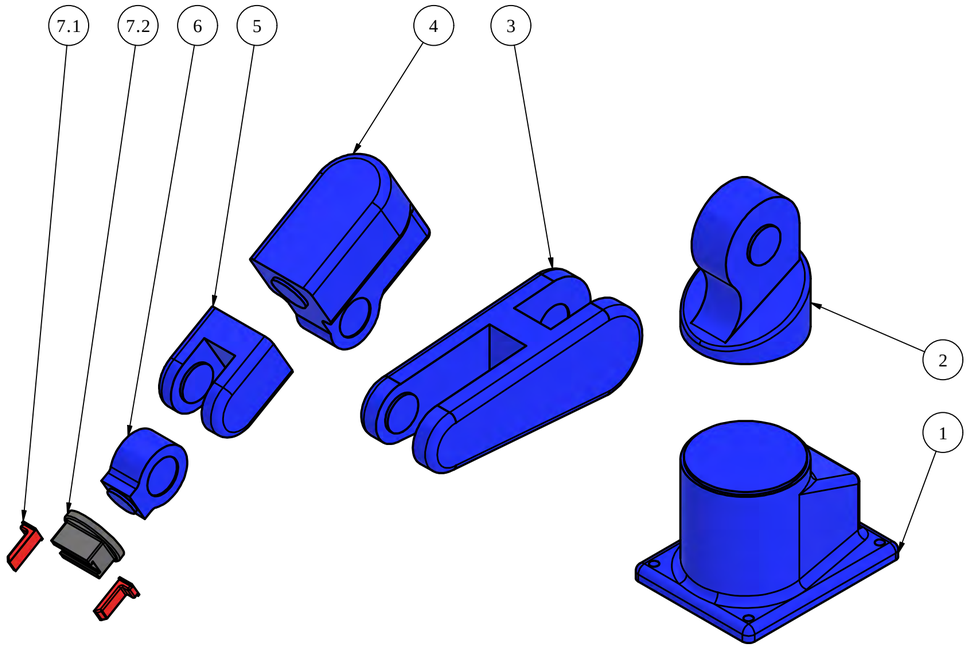
THE UNIVERSITY OF GEORGIA, ATHENS, GA				
THIRD ANGLE PROJECTION	DRAWN BY Ben Schlich		DATE 12/2/2025	
	TITLE 6-Cylinder Engine		PART # ENG9000	
ALL DIMENSIONS ARE IN MILLIMETERS	MATERIAL			
TOLERANCES UNLESS OTHERWISE SPECIFIED: x.x ±0.5, x.xx ±0.25, x.xxx ±0.125, ANGULAR ±0.5	MASS 68.815 kg	SCALE 1 / 3	SIZE A2	SHEET 1 of 1

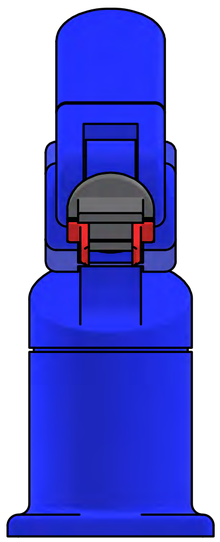
NOTES UNLESS OTHERWISE SPECIFIED:
1.

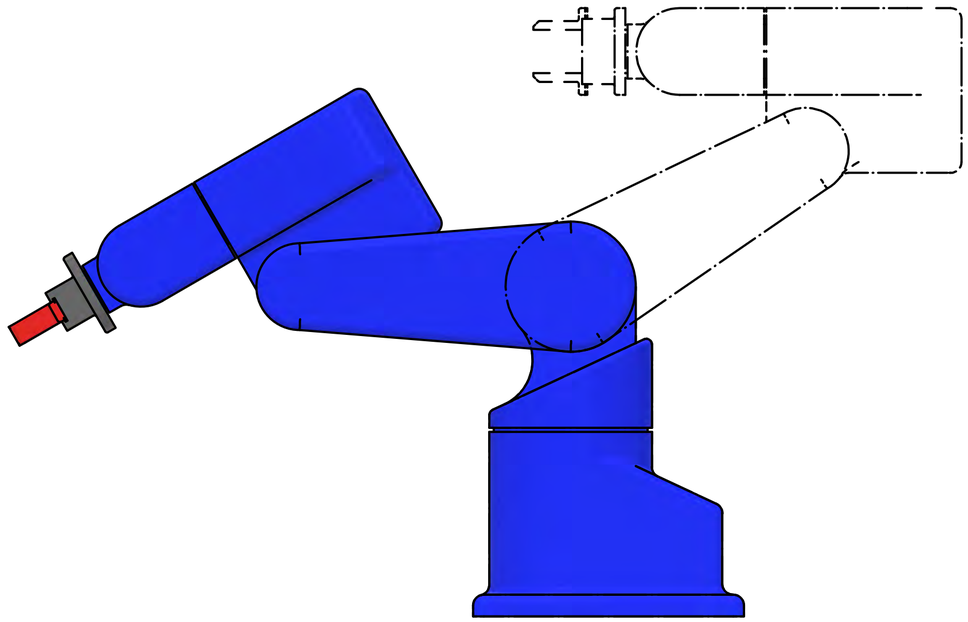
PARTS LIST			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	RA1	Base
2	1	RA2	Shoulder
3	1	RA3	Arm
4	1	RA4	Forearm
5	1	RA5	Wrist
6	1	RA6	Hand
7	1	RA7	Gripper Assembly
7.2	1	RA8	Clamp Mount
7.1	2	RA9	Clamp











THIRD ANGLE PROJECTION

ALL DIMENSIONS ARE IN MILLIMETERS

TOLERANCES UNLESS OTHERWISE SPECIFIED:
x.x ±0.5
x.xx ±0.25
x.xxx ±0.125
ANGULAR ±0.5

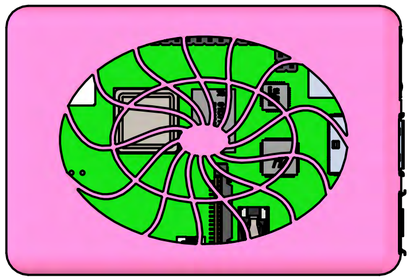
THE UNIVERSITY OF GEORGIA, ATHENS, GA

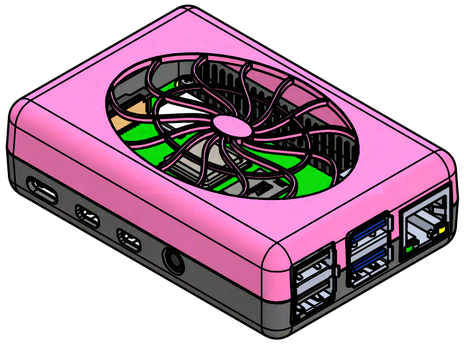
DRAWN BY: Ben Schlich	DATE: 12/3/2025	
TITLE: Robotic Arm	PART #: RA9000	
MATERIAL:		
MASS: 30.979 kg	SCALE: 1 / 4	SIZE: A2 / SHEET: 1 of 1

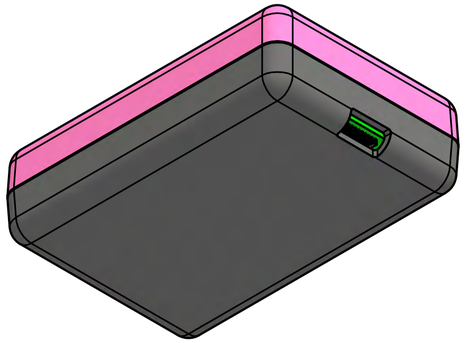
NOTES UNLESS OTHERWISE SPECIFIED:
1.

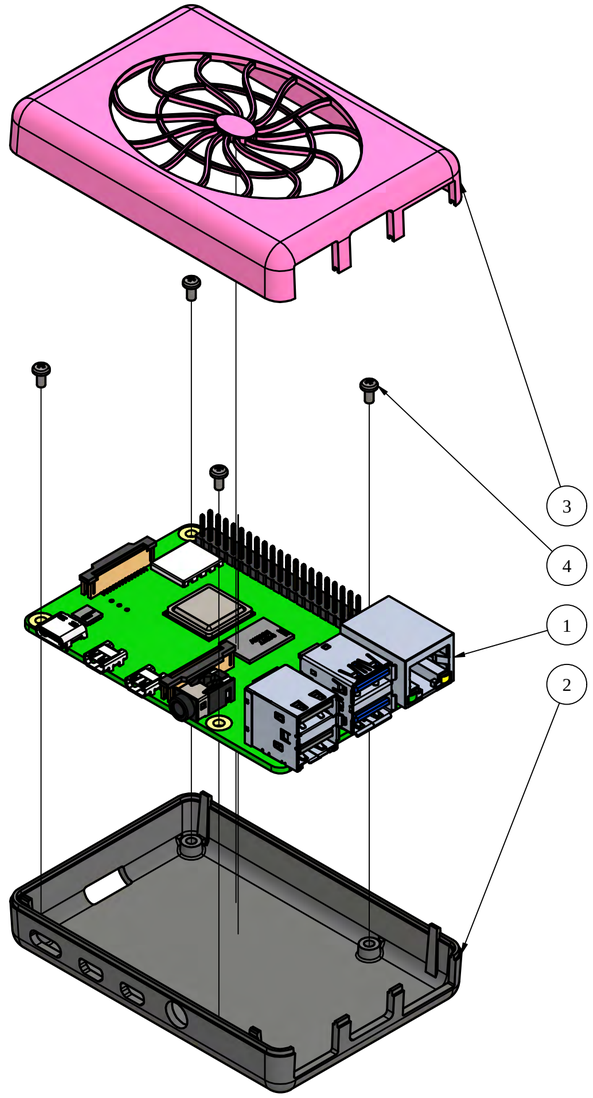
PARTS LIST

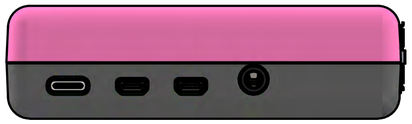
ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL
1	1	RPi4B	Raspberry Pi 4 Model B	Generic
2	1	RPi4B-B1	Case Bottom	ABS Plastic
3	1	RPi4B-T2	Case Top	ABS Plastic
4	4	ANSI B18.6.7M - M2x0.4 x 4, CRPHMSTIM(1)	Cross Recessed Pan Head Machine Screw - Type I - Metric	Steel, Mild

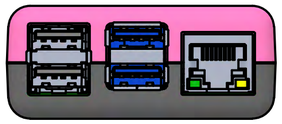












THIRD ANGLE PROJECTION

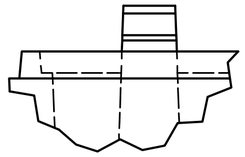
ALL DIMENSIONS ARE IN MILLIMETERS

TOLERANCES UNLESS OTHERWISE SPECIFIED:
x.x ±0.5
x.xx ±0.25
x.xxx ±0.125
ANGULAR ±0.5

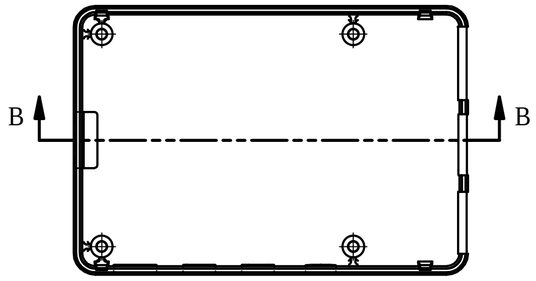
THE UNIVERSITY OF GEORGIA, ATHENS, GA

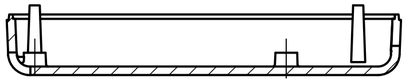
DRAWN BY: Ben Schlich		DATE: 12/3/2025	
TITLE: RPi 4 Model B Case Assembly		PART #: RPi4B-C2	
MATERIAL:			
MASS: 0.048 kg	SCALE: 1 : 1	SIZE: A2	SHEET: 1 of 3

NOTES UNLESS OTHERWISE SPECIFIED:
1. SHELL THICKNESS: 2.0
2. CASE INTERIOR FILLETS AND ROUNDS: R3.0
3. DRAFT ANGLES: 2.5

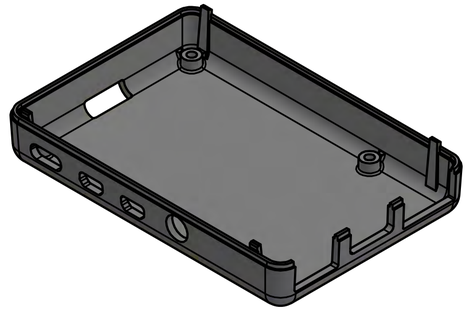


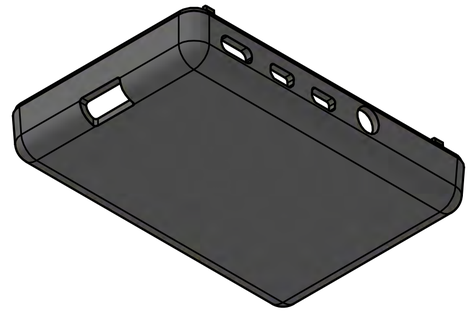
DETAIL C
SCALE 5 : 1
LIP AND SNAP DETAIL 1

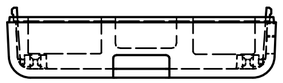


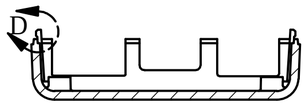


SECTION B-B
SCALE 1 : 1

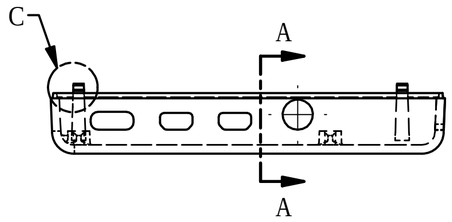


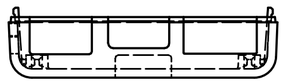


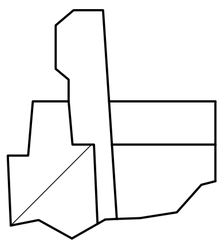




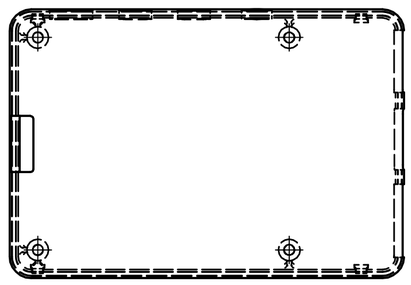
SECTION A-A
SCALE 1 : 1





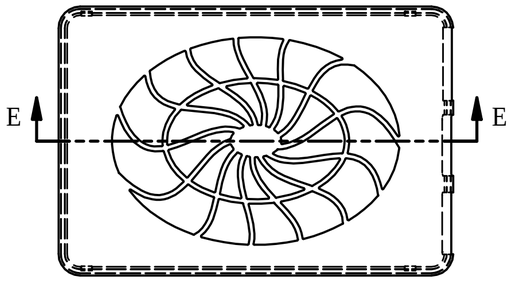


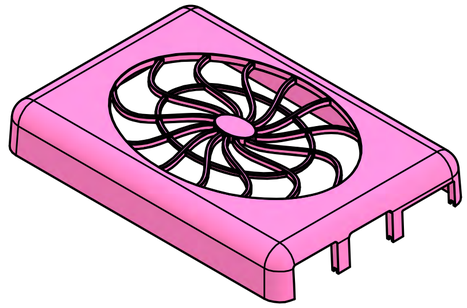
DETAIL D
SCALE 10 : 1
LIP AND SNAP DETAIL 2

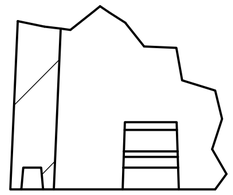


THE UNIVERSITY OF GEORGIA, ATHENS, GA			
THIRD ANGLE PROJECTION	DRAWN BY: Ben Schlich		DATE: 12/3/2025
	TITLE: Case Bottom		PART #: RPi4B-B1
ALL DIMENSIONS ARE IN MILLIMETERS TOLERANCES UNLESS OTHERWISE SPECIFIED: x.x ±0.5 x.xx ±0.25 x.xxx ±0.125 ANGULAR ±0.5	MATERIAL: ABS Plastic		
	MASS: 0.017 kg	SCALE: 1 : 1	SIZE: A2	SHEET: 2 of 3

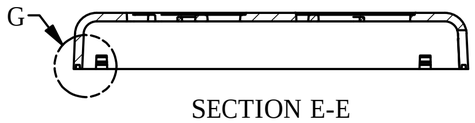
NOTES UNLESS OTHERWISE SPECIFIED:
1. SHELL THICKNESS: 2.0
2. CASE INTERIOR FILLETS AND ROUNDS: R3.0
3. GRILL FILLETS AND ROUNDS: R0.2
4. DRAFT ANGLES: 2.5



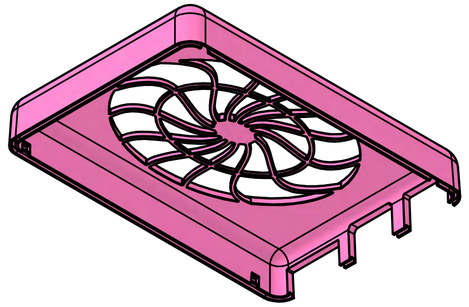


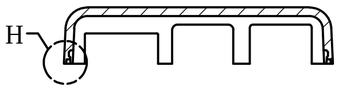


DETAIL G
SCALE 5 : 1

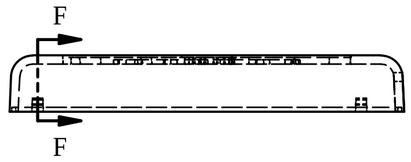


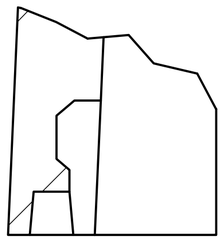
SECTION E-E
SCALE 1 : 1



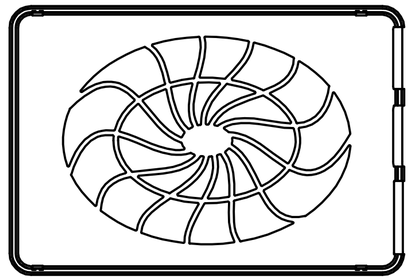


SECTION F-F
SCALE 1 : 1





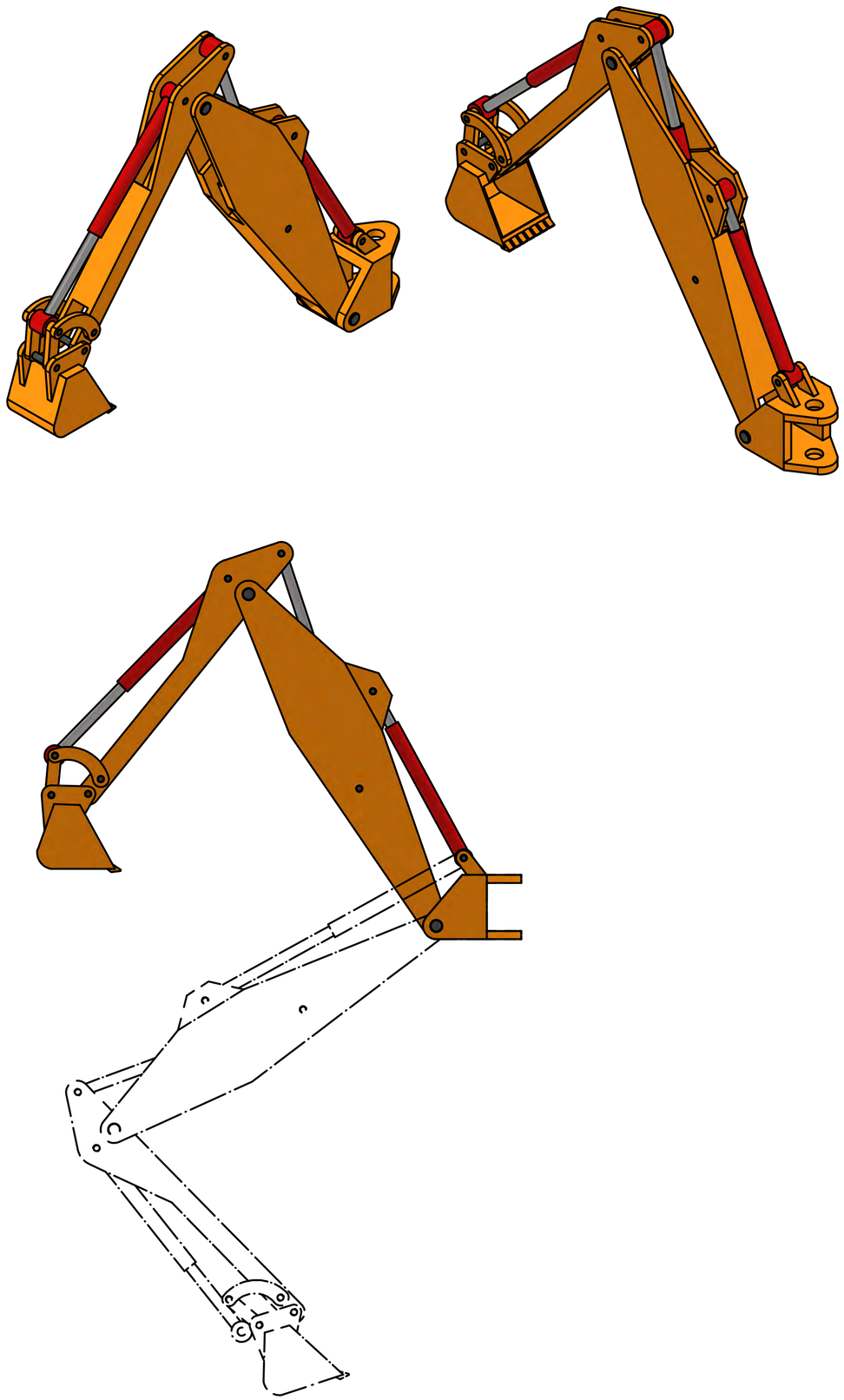
DETAIL H
SCALE 10 : 1
GROOVE AND SNAP RECESS DETAIL 2

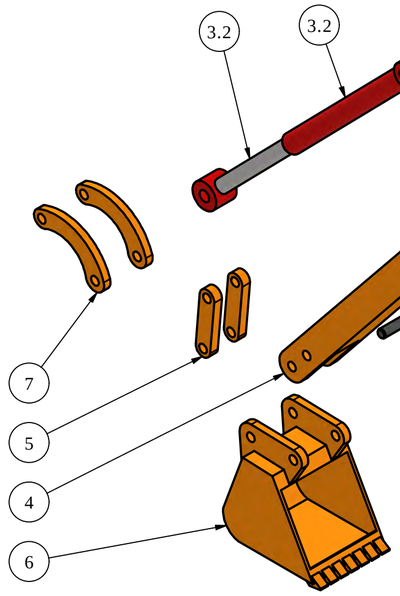


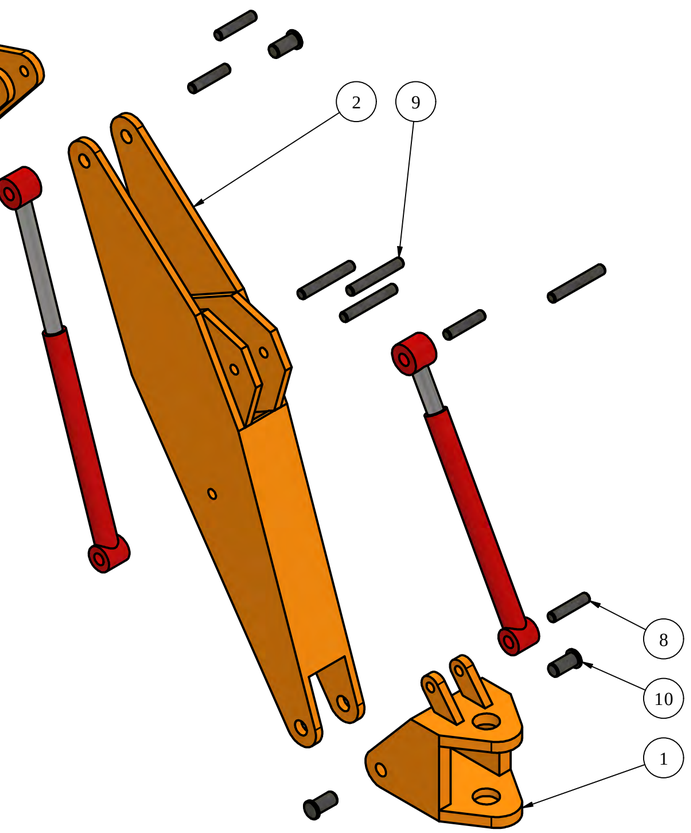
THE UNIVERSITY OF GEORGIA, ATHENS, GA			
THIRD ANGLE PROJECTION	DRAWN BY: Ben Schlich		DATE: 12/3/2025
	TITLE: Case Top		PART #: RPi4B-T2
ALL DIMENSIONS ARE IN MILLIMETERS TOLERANCES UNLESS OTHERWISE SPECIFIED: x.x ±0.5 x.xx ±0.25 x.xxx ±0.125 ANGULAR ±0.5	MATERIAL: ABS Plastic		
	MASS: 0.012 kg	SCALE: 1 : 1	SIZE: A2	SHEET: 3 of 3

NOTES UNLESS OTHERWISE SPECIFIED:
1.

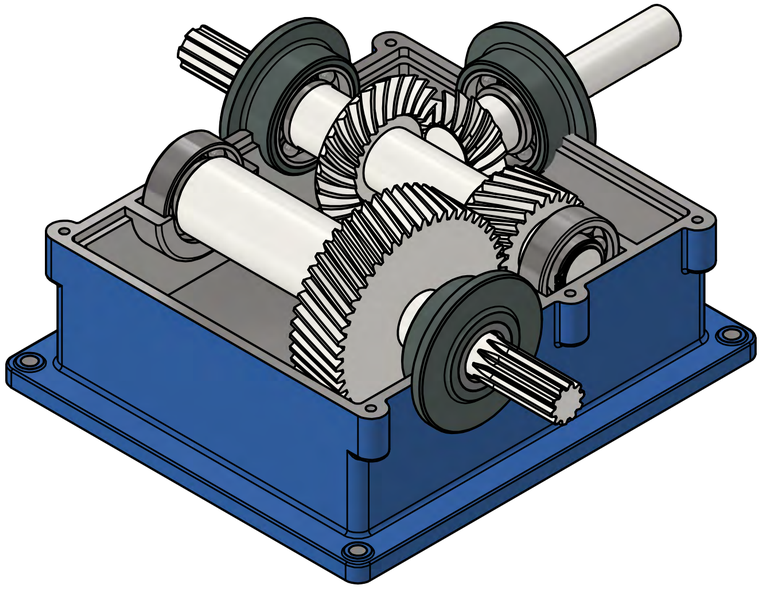
PARTS LIST				
ITEM	QTY	PART NUMBER	DESCRIPTION	MATERIAL
1	1	EB9001	Shoulder	Steel, High Strength, Low Alloy
2	1	EB9002	Boom	Steel, High Strength, Low Alloy
3	3	EB9003	Cylinder Assembly	
3.1	1	EB9003-1	Cylidner Piston Rod	
3.2	1	EB9003-2	Cylinder Barrel	
4	1	EB9004	Arm	Steel, High Strength, Low Alloy
5	1	EB9005	Straight Link	Steel, High Strength, Low Alloy
6	1	EB9006	Bucket	Steel, High Strength, Low Alloy
7	1	EB9007	Curved Link	Steel, High Strength, Low Alloy
8	4	ISO 2340 - A - 30 x 140	Clevis pins without head A	Steel
9	5	ISO 2340 - A - 30 x 200	Clevis pins without head A	Steel
10	4	ISO 2341 - A - 40 x 80	Clevis pins with head	Steel

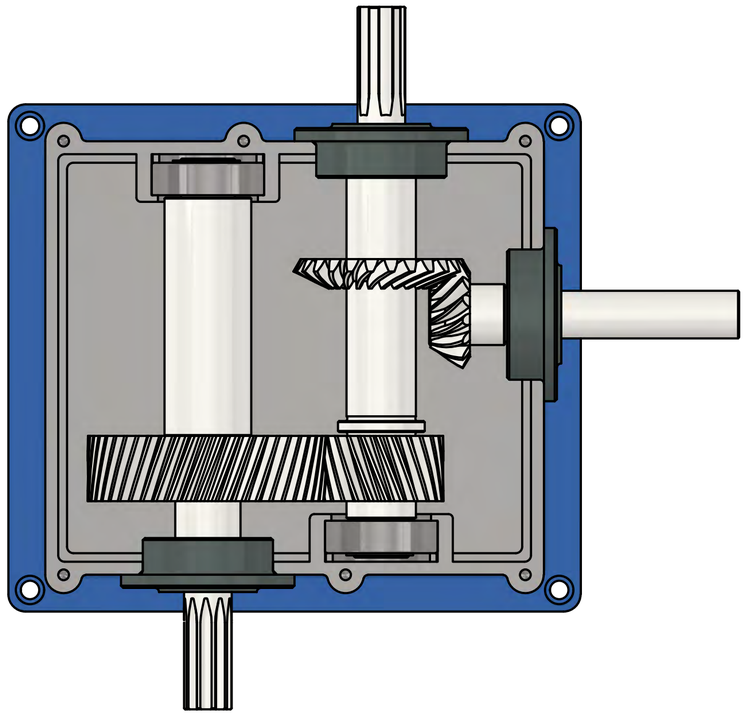


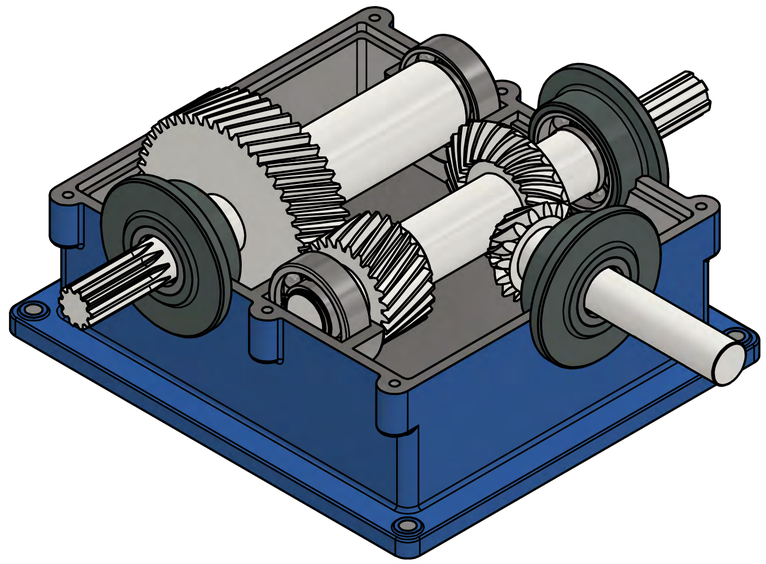


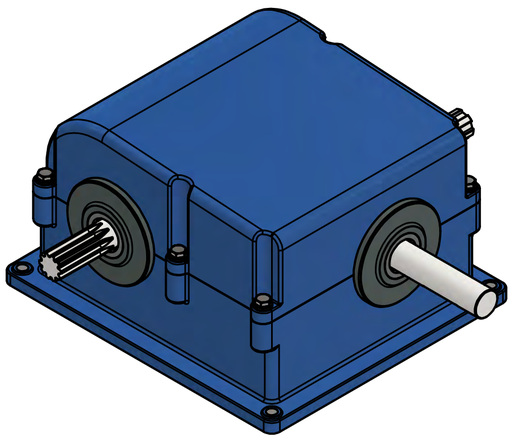


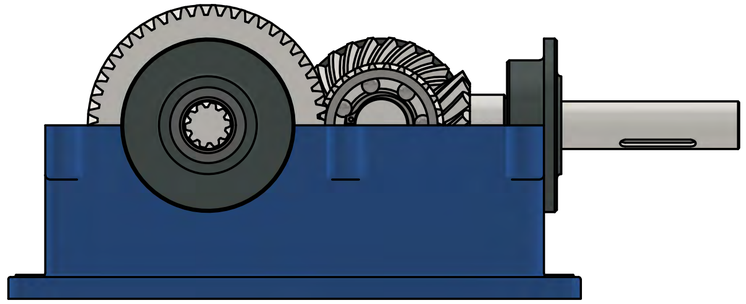
THE UNIVERSITY OF GEORGIA, ATHENS, GA				
THIRD ANGLE PROJECTION	DRAWN BY Ben Schlich		DATE 12/3/2025	
	TITLE Excavator Boom Assembly		PART # EB9000	
ALL DIMENSIONS ARE IN MILLIMETERS TOLERANCES UNLESS OTHERWISE SPECIFIED: x.x ±0.5 x.xx ±0.25 x.xxx ±0.125 ANGULAR ±0.5	MATERIAL			
	MASS 582.767 kg	SCALE 1 / 16	SIZE A2	SHEET 1 of 1

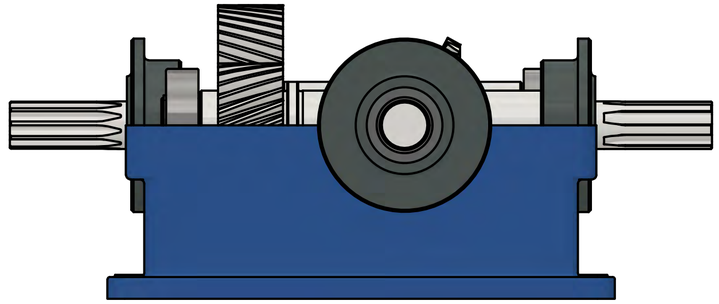






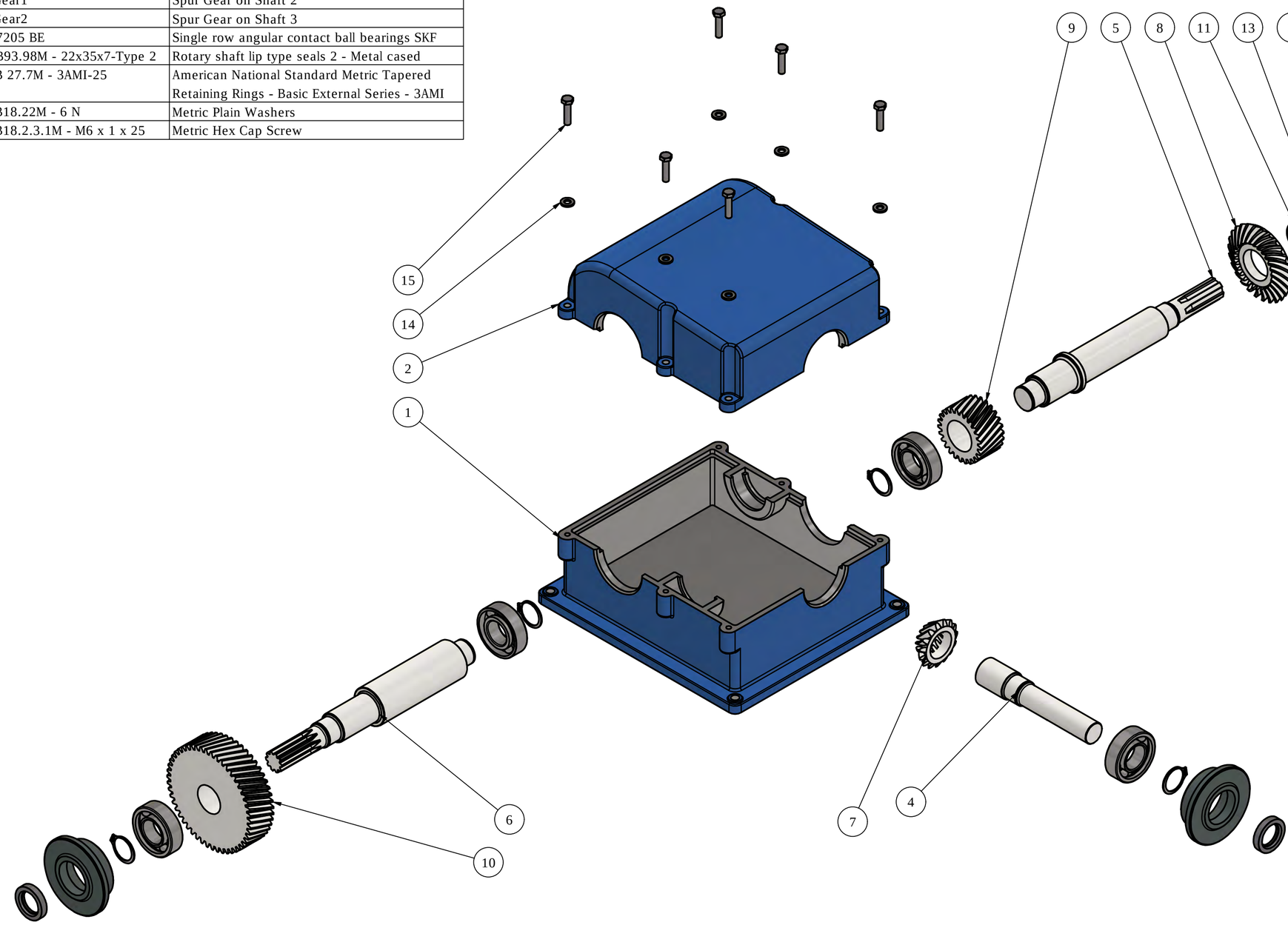




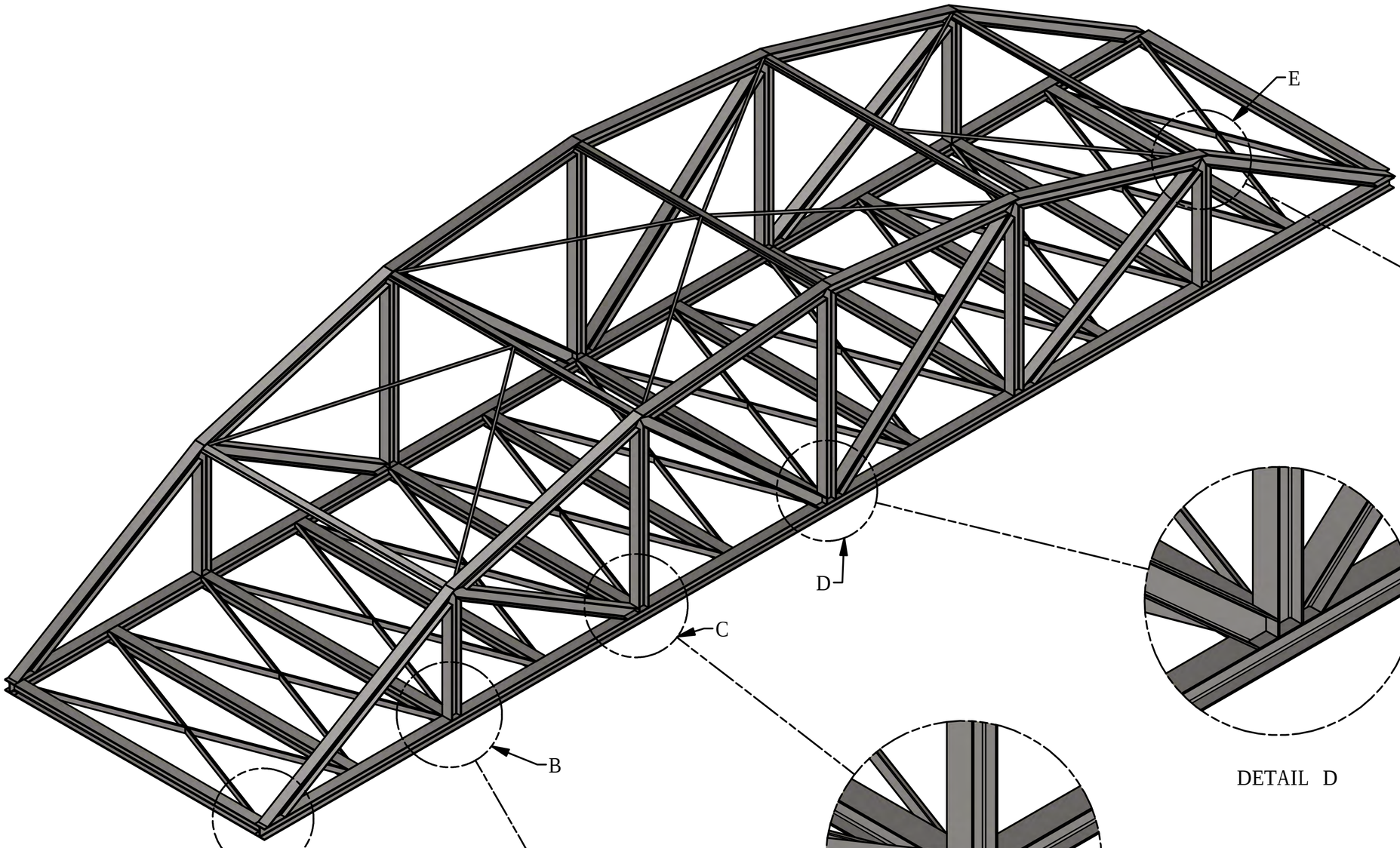


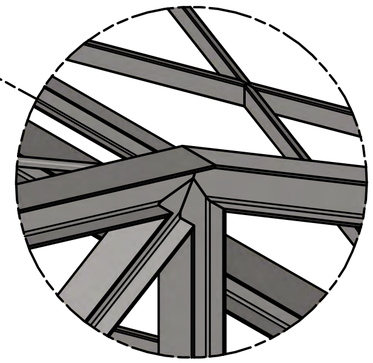
THE UNIVERSITY OF GEORGIA, ATHENS, GA				
THIRD ANGLE PROJECTION	DRAWN BY Ben Schlich		DATE 12/4/2025	
	TITLE GB Exploded View		PART # GB9000	
ALL DIMENSIONS ARE IN MILLIMETERS	MATERIAL			
TOLERANCES UNLESS OTHERWISE SPECIFIED: x.x ±0.5 x.xx ±0.25 x.xxx ±0.125 ANGULAR ±0.5	MASS 25.600 kg	SCALE 1 / 2	SIZE A2	SHEET 1 of 2

PARTS LIST			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	GB9001	Bottom of gearbox housing
2	1	GB9002	Top of gearbox housing
3	3	GB9003	Shaft Cover
4	1	GB9004	Shaft 1
5	1	GB9005	Shaft 2
6	1	GB9006	Shaft 3
7	1	Bevel Gear1	Bevel Gear on Input Shaft
8	1	Bevel Gear2	Bevel gear on Shaft 2
9	1	Spur Gear1	Spur Gear on Shaft 2
10	1	Spur Gear2	Spur Gear on Shaft 3
11	5	SKF B7205 BE	Single row angular contact ball bearings SKF
12	3	ANSI/B93.98M - 22x35x7-Type 2	Rotary shaft lip type seals 2 - Metal cased
13	5	ANSI B 27.7M - 3AMI-25	American National Standard Metric Tapered Retaining Rings - Basic External Series - 3AMI
14	6	ANSI B18.22M - 6 N	Metric Plain Washers
15	6	ANSI B18.2.3.1M - M6 x 1 x 25	Metric Hex Cap Screw



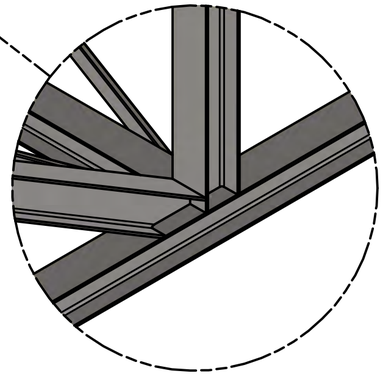
THE UNIVERSITY OF GEORGIA, ATHENS, GA			
THIRD ANGLE PROJECTION	DRAWN BY: Ben Schlich	DATE: 12/4/2025	
	TITLE: GB Exploded View	PART #: GB9000	
ALL DIMENSIONS ARE IN MILLIMETERS	MATERIAL:		
TOLERANCES UNLESS OTHERWISE SPECIFIED: x.x ±0.5, x.xx ±0.25, x.xxx ±0.125, ANGULAR ±0.5	MASS: 25.600 kg	SCALE: 1 / 3	SIZE: A2 / SHEET: 2 of 2



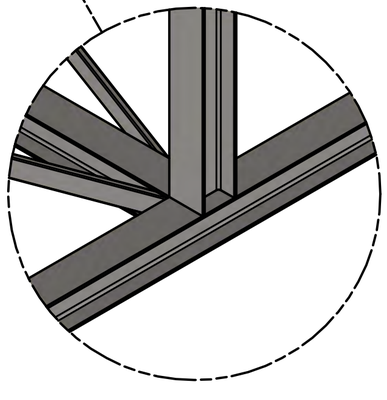


DETAIL E

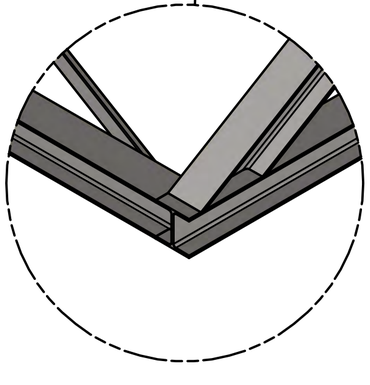
DETAIL D



DETAIL C

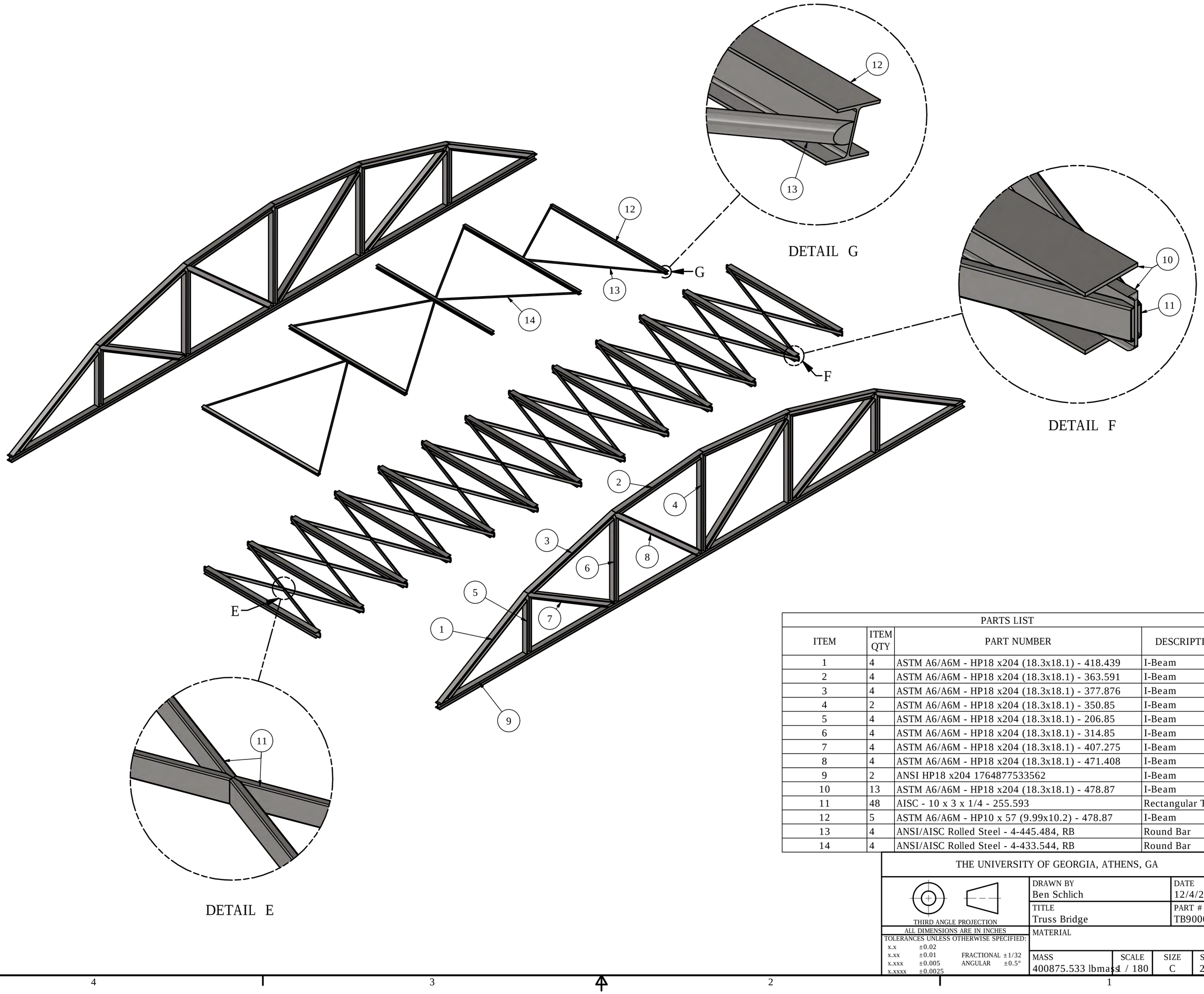


DETAIL B



DETAIL A

THE UNIVERSITY OF GEORGIA, ATHENS, GA			
THIRD ANGLE PROJECTION	DRAWN BY Ben Schlich		DATE 12/4/2025
	TITLE Truss Bridge		PART # TB9000
ALL DIMENSIONS ARE IN INCHES	MATERIAL		
TOLERANCES UNLESS OTHERWISE SPECIFIED: x.x ±0.02, x.xx ±0.01, x.xxx ±0.005, x.xxxx ±0.0025; FRACTIONAL ±1/32; ANGULAR ±0.5°	MASS 400875.533 lbmass	SCALE 1 / 120	SIZE C / SHEET 1 of 2



PARTS LIST			
ITEM	ITEM QTY	PART NUMBER	DESCRIPTION
1	4	ASTM A6/A6M - HP18 x204 (18.3x18.1) - 418.439	I-Beam
2	4	ASTM A6/A6M - HP18 x204 (18.3x18.1) - 363.591	I-Beam
3	4	ASTM A6/A6M - HP18 x204 (18.3x18.1) - 377.876	I-Beam
4	2	ASTM A6/A6M - HP18 x204 (18.3x18.1) - 350.85	I-Beam
5	4	ASTM A6/A6M - HP18 x204 (18.3x18.1) - 206.85	I-Beam
6	4	ASTM A6/A6M - HP18 x204 (18.3x18.1) - 314.85	I-Beam
7	4	ASTM A6/A6M - HP18 x204 (18.3x18.1) - 407.275	I-Beam
8	4	ASTM A6/A6M - HP18 x204 (18.3x18.1) - 471.408	I-Beam
9	2	ANSI HP18 x204 1764877533562	I-Beam
10	13	ASTM A6/A6M - HP18 x204 (18.3x18.1) - 478.87	I-Beam
11	48	AISC - 10 x 3 x 1/4 - 255.593	Rectangular Tube
12	5	ASTM A6/A6M - HP10 x 57 (9.99x10.2) - 478.87	I-Beam
13	4	ANSI/AISC Rolled Steel - 4-445.484, RB	Round Bar
14	4	ANSI/AISC Rolled Steel - 4-433.544, RB	Round Bar

THE UNIVERSITY OF GEORGIA, ATHENS, GA

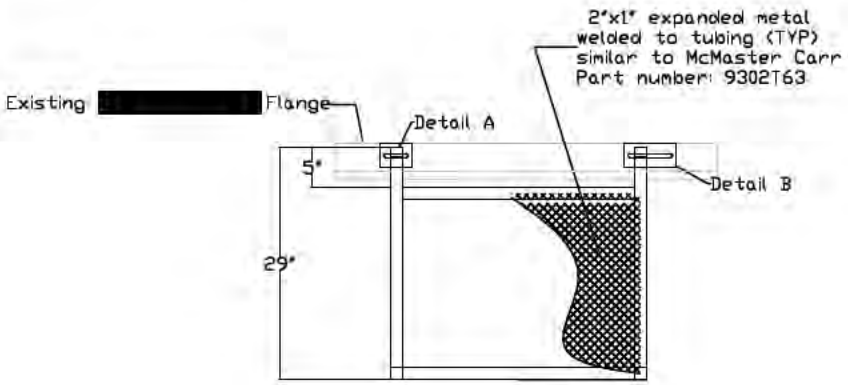
THIRD ANGLE PROJECTION

ALL DIMENSIONS ARE IN INCHES

TOLERANCES UNLESS OTHERWISE SPECIFIED:

x.x	±0.02		
x.xx	±0.01	FRACTIONAL	±1/32
x.xxx	±0.005	ANGULAR	±0.5°
x.xxxx	±0.0025		

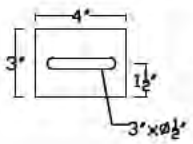
DRAWN BY: Ben Schlich			DATE: 12/4/2025
TITLE: Truss Bridge			PART #: TB9000
MATERIAL:			
MASS: 400875.533 lbmass	SCALE: 1 / 180	SIZE: C	SHEET: 2 of 2



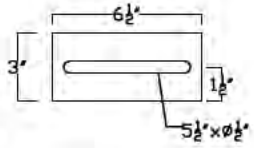
1 / SK-1 V1 [redacted] Guards–Top View
N.T.S.

Each section should not exceed 65 pounds

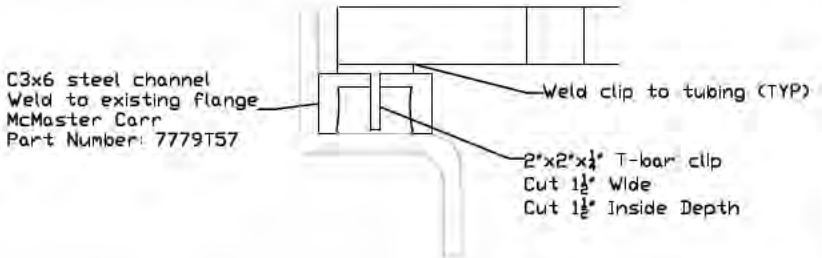
Detail A:
Single clip
channel bracket

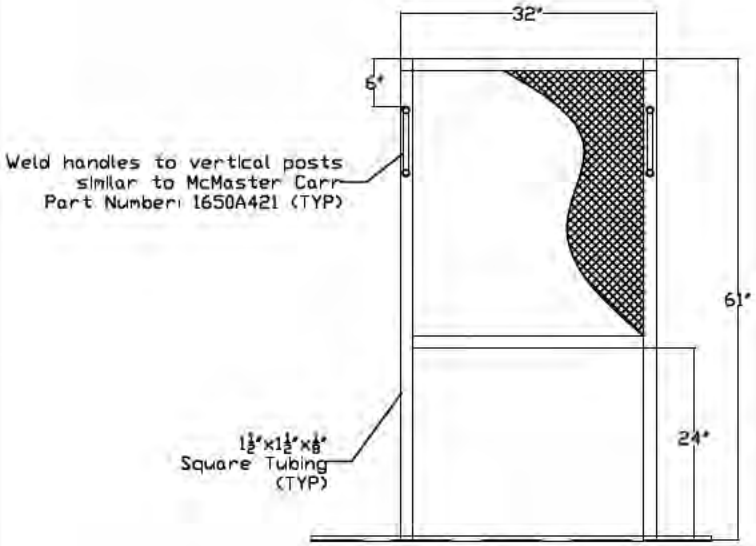


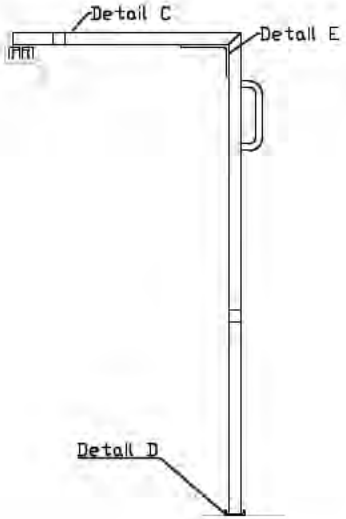
Detail B:
Double clip
channel bracket



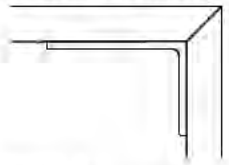
Detail C:
Clip and channel
connection point



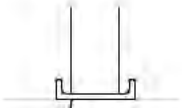




Detail E:
6"x4"x5/16" Angle Iron Support
Cut 1½" Wide
McMaster Carr
Part Number: 6983N29



Detail D:
Channel slot for
legs



2½"x⅝"x3/16" (Outside Dimensions)
U-channel McMaster Carr
Part Number: 7779T101

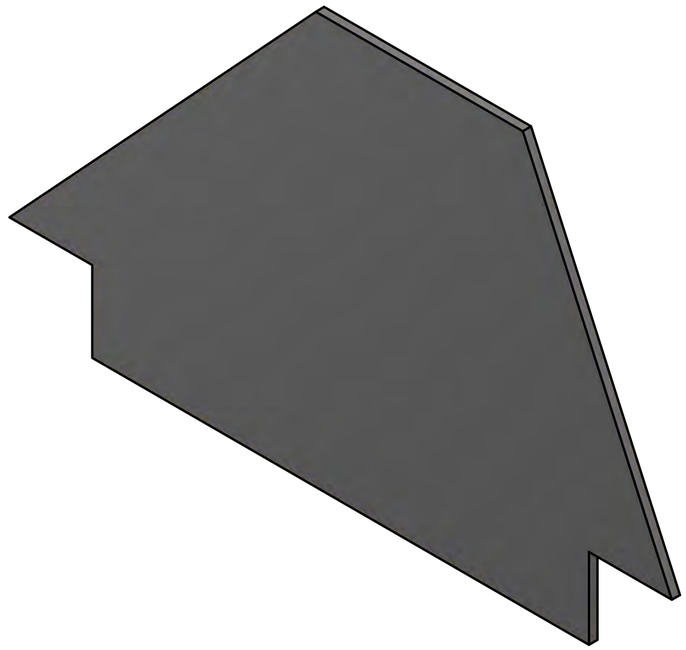
2 / SK-1 V1 [redacted] Guards–Front View
N.T.S.

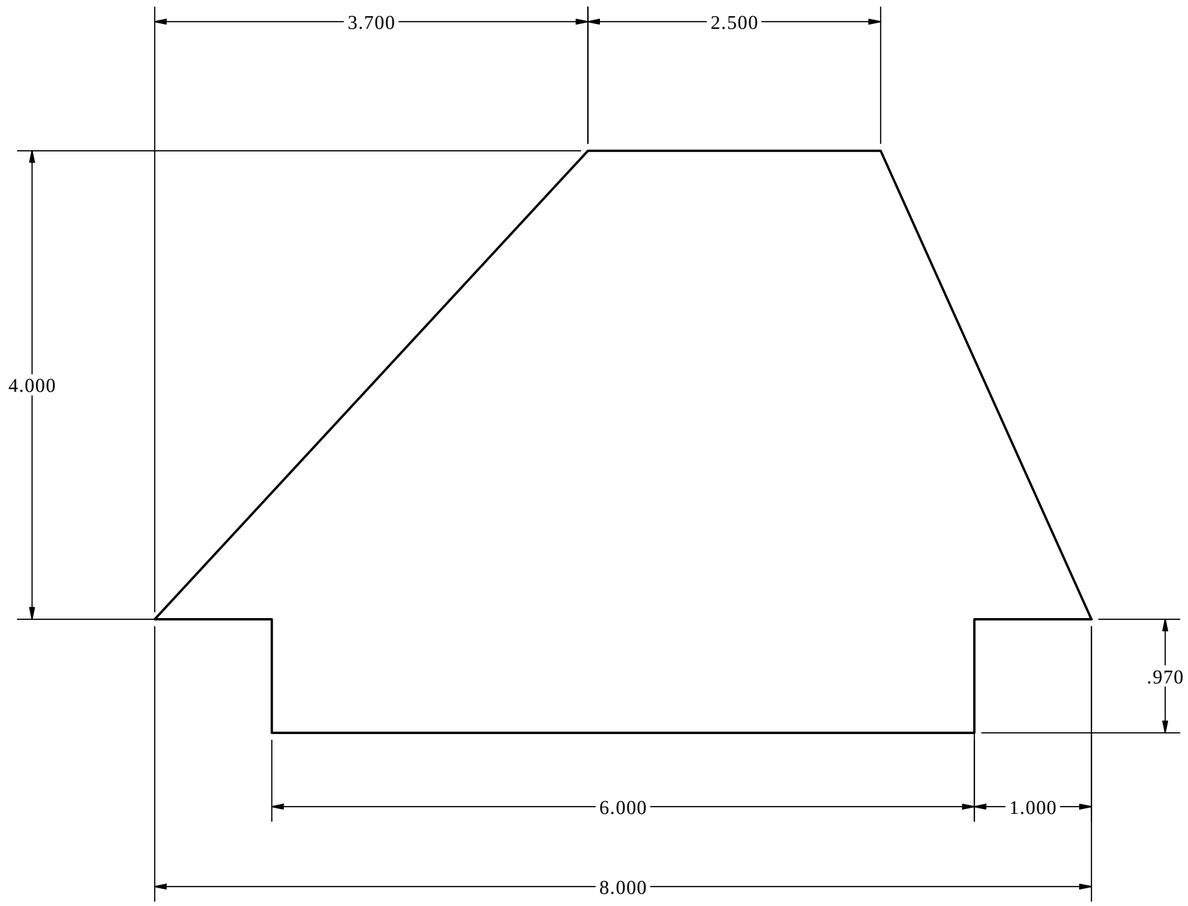
3 / SK-1 V1 [redacted] Guards–Side View
N.T.S.

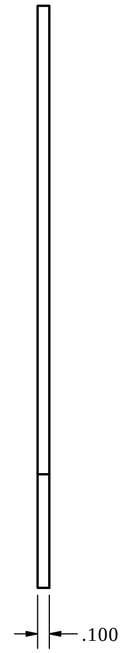
Guards
V1 [redacted]

NO. DESCRIPTION DATE
REVISIONS

DRAWN BY:
DESIGNED BY:
CHECKED BY:
JOB NO.
SCALE:
DATE:
SHEET TITLE:
[redacted] Guards
SHEET NO.
[redacted]







THE UNIVERSITY OF GEORGIA, ATHENS, GA

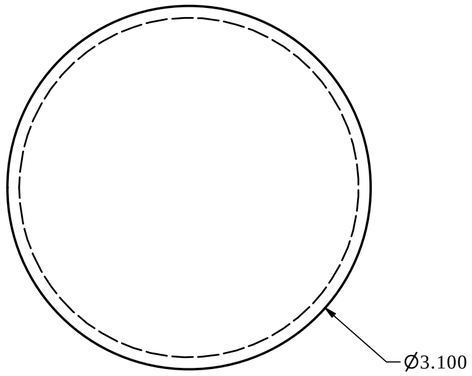
THIRD ANGLE PROJECTION

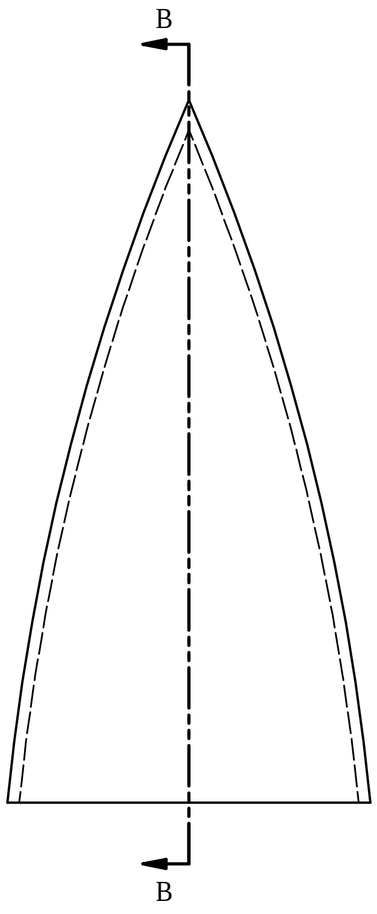
ALL DIMENSIONS ARE IN INCHES

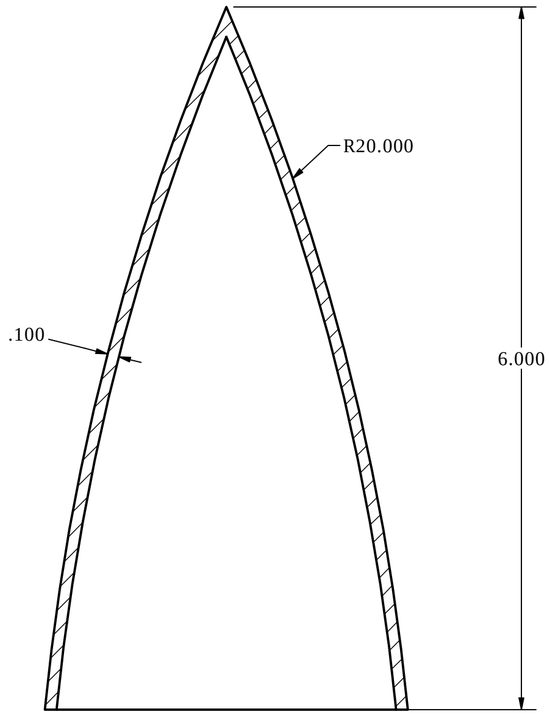
TOLERANCES UNLESS OTHERWISE SPECIFIED:

x.x	±0.02		
x.xx	±0.01	FRACTIONAL	±1/32
x.xxx	±0.005	ANGULAR	±0.5°
x.xxxx	±0.0025		

DRAWN BY: Benjamin Schlich			DATE: 9/9/2024
TITLE: Rocket Fin			PART #: F1
MATERIAL: ABS Plastic			
MASS: 0.103 lbmass	SCALE: 1 : 1	SIZE: C	SHEET: 1 of 2







SECTION B-B
SCALE 1 : 1

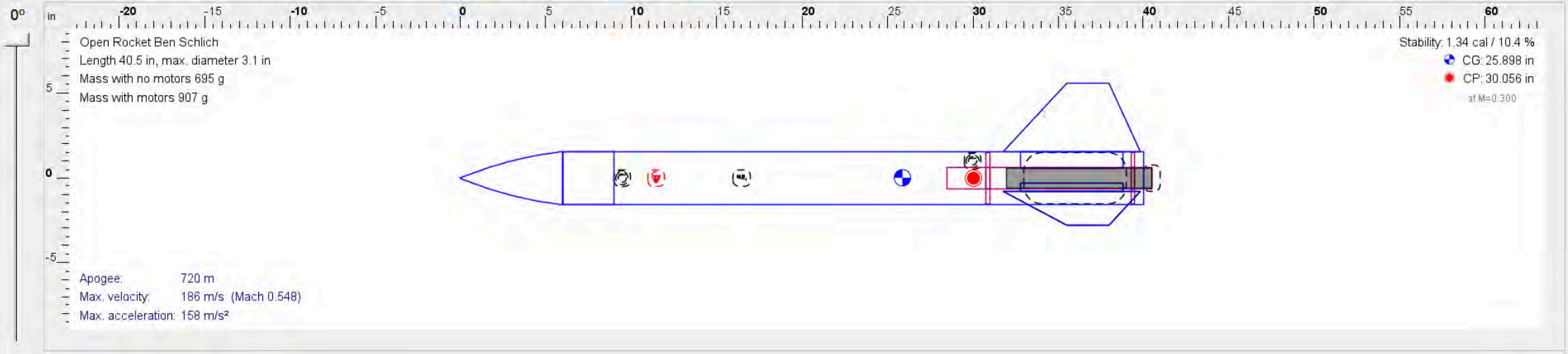
THE UNIVERSITY OF GEORGIA, ATHENS, GA			
THIRD ANGLE PROJECTION	DRAWN BY: Benjamin Schlich		DATE: 9/9/2024
	TITLE: Rocket Nose		PART #: N1
ALL DIMENSIONS ARE IN INCHES	MATERIAL: ABS Plastic		
TOLERANCES UNLESS OTHERWISE SPECIFIED: x.x ±0.02; x.xx ±0.01; x.xxx ±0.005; x.xxxx ±0.0025; FRACTIONAL ±1/32; ANGULAR ±0.5°	MASS: 0.132 lbmass	SCALE: 1 : 1	SIZE: C / SHEET: 2 of 2

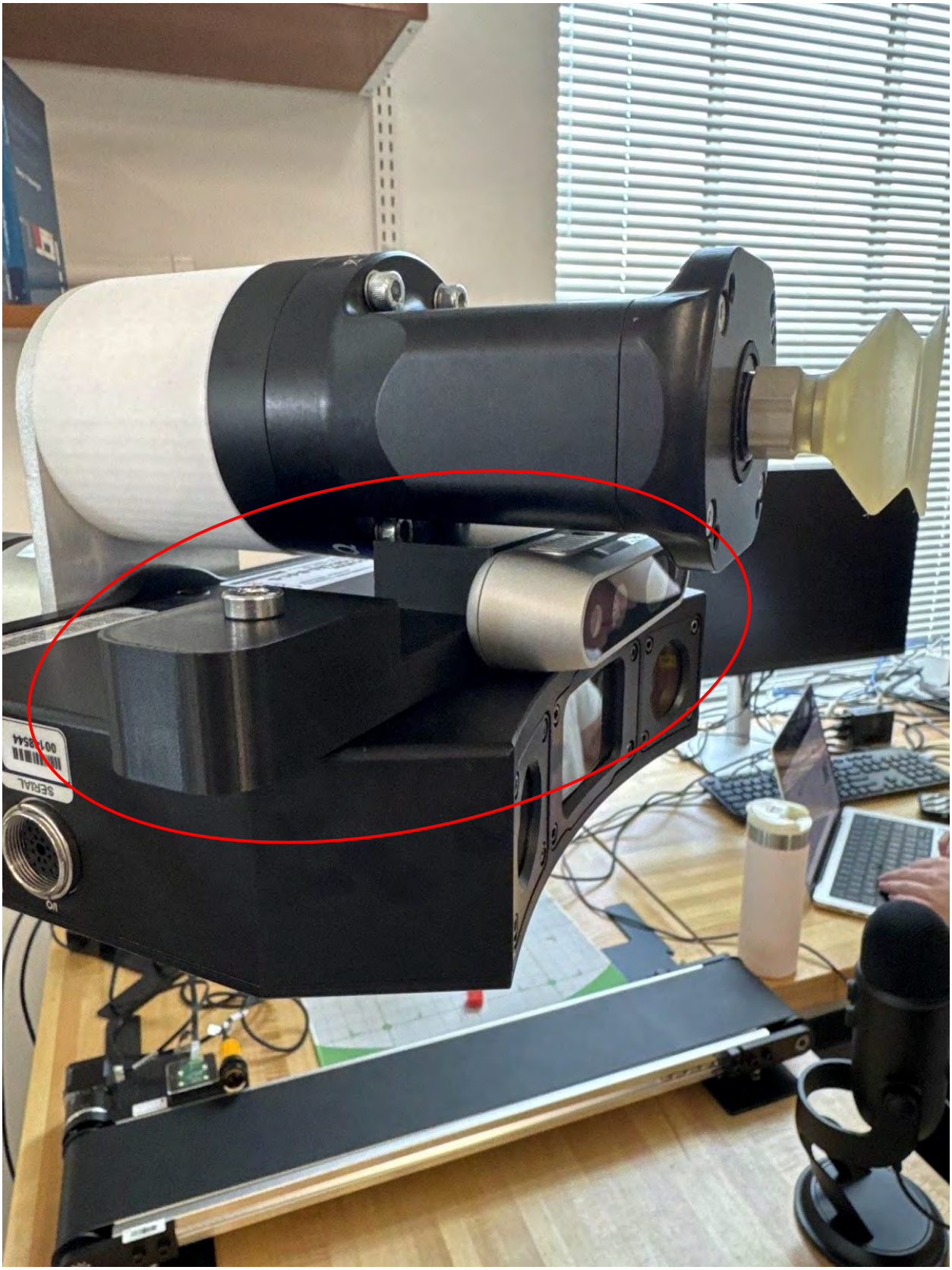
Rocket design | Motors & Configuration | Flight simulations

New simulation | Edit simulation | Run simulations | Delete simulations | Plot / Export

	Name	Configuration	Velocity off rod	Apogee	Velocity at deploym...	Optimum delay	Max. velocity	Max. acceleration	Time to apogee	Flight time	Ground hit velocity
!	Simulation 1	[HP-H135W-6]	17.4 m/s	720 m	26.7 m/s	8.62 s	186 m/s	158 m/s²	8.9 s	119 s	6.44 m/s

View Type: Side view | Zoom: Fit (9.6%) | Stability: Show CG/CP | Stages: Sustainer | Flight configuration: [HP-H135W-6]




SERIAL
00-19544

DASSAULT SYSTEMES

SOLIDWORKS

CERTIFICATE

Dassault Systèmes confers upon

BENJAMIN SCHLICH

the certificate for

SOLIDWORKS CAD Design Professional

March 9 2025

Academic exam at Dassault Systemes SOLIDWORKS Corp.

Manish KUMAR
SOLIDWORKS CEO
R&D Vice President

C-NKBQJRLV6D

NAR LEVEL 1 HIGH POWER CERTIFICATION APPLICATION

APPLICANT INFORMATION *(Completed by Applicant, **Print clearly**, failure to do so will delay certification.)*

Name Benjamin Schlich Email: benschlich45@gmail.com

[redacted]

NAR Number 121893 Expiration Date 1/20/26

I, Benjamin Schlich, certify that I am a member in good standing of the National Association of Rocketry. I am 18 years of age or older and I understand that I must comply with all applicable federal, state, and local laws or regulations during and after this certification attempt.

Signed Benjamin Schlich Date 02/06/25

HPR LEVEL 1 CHECKLIST *(Certification Team—Use this section for Level 1 Certification Attempts.)*

Preflight: Motor Used H195T *(At least one motor must be a H or I impulse motor.)*

☑ Motor is certified ☐ FAA COA activated (if required) ☑ Safety checklist completed (see back)

Flight: ☑ Flight was stable ☑ Recovery system deployed ☑ Safe recovery

Post Flight: ☑ Verify that no major damage is present. Minor impact damage or "zipper" is acceptable.

☑ Verify motor present **Successful Flight?** ☑ Yes ☐ No

CERTIFICATION AFFIDAVIT

*(Successful flights only, completed by the Certification Team. **Print clearly**, failure to do so will delay certification.)*

The undersigned, being members of the National Association of Rocketry have witnessed a flight by Benjamin Schlich, NAR Number 121893, of skills relative to the building and safe operation of High Power Rockets. We attest that the applicant is 18 years of age or older and a member in good standing of the NAR. We believe this member is qualified to build and operate High Power Rockets with a total installed impulse up to 640 N-sec. Level 1.

Name Armando Rodriguez Signature [signature] NAR # 89194

[redacted] Membership Expires 5/31/2025 HPR Cert. Level 2

Name _____ Signature _____ NAR # _____

Email _____ Membership Expires _____ HPR Cert. Level _____

Form MUST be signed by Certification Applicant and Certification Team.

NAR HPR LEVEL 1 TEMPORARY CERTIFICATION

has been completed by:

Benjamin Schlich
Name

121893
NAR Number

2/8/2025
Certification Date

Armando Rodriguez 89194 2
Witnessed By (Print Name) NAR # Cert. Level

This card is void 60 days after Certification Date.

Cut along dotted lines.

TO COMPLETE YOUR LEVEL 1 CERTIFICATION

*Go to NAR.org and log into your account. From the main Member Resources page, fill out the Level 1 Digital Certification Form. Pictures of **this** paper form must be attached to the digital form.*

NAR HIGH POWER CERTIFICATION CHECKLIST

Answer "YES", "NO" or "N/A" (not applicable).

Has the rocket model that is being used for the certification attempt been built by the applicant requesting certification?	Yes
Is the nosecone or payload shoulder sufficiently tight to prevent drag separation? The nosecone or payload should not wobble side to side or separate from its own weight. Is a vent hole needed to relieve pressure for high altitude flight? Do stage couplers fit snugly to prevent bending or separation during flight? Is the body tube thickness adequate to withstand high power flight (typically .050 inch walls or thicker)? Is there pre-existing damage which may weaken the model structure (e.g. tube crimps)? Are screws and fasteners tight, if used?	Yes
Are the rail buttons properly sized (for 1010 rail or larger), positioned and aligned correctly, and securely fastened to the airframe? For launch lugs, are they properly sized for the model (typically 1/4 inch dia. or larger), positioned and aligned correctly, and securely fastened to the airframe (taped on lugs are not permitted).	Yes
On cluster models, are the spaces between the motor tubes filled to prevent ejection pressure leakage? If mixing black powder and composite motors, does the modeler assure composite motor ignition before black powder motor ignition (composite motors ignite more slowly than black powder motors)? If the cluster model is not using all of its motors, are the unused motor tubes plugged to prevent ejection blow-by?	N/A
If a Level 1 Certification is being attempted, does the rocket model contain at least one H or I impulse motor?	Yes
Is (are) the motor(s) sufficient to safely fly the model? Use motor manufacturer's recommendations or recommended motor lists for similarly sized models as a starting point (Also consider, model weight, configuration, and finish when evaluating motor capabilities). Is (are) the motor(s) either NAR, Tripoli or CAR certified? Motors must be currently certified to be used. Low current igniter? ☐ Yes ☐ No	Yes
Is (are) the rocket motor(s) firmly restrained in the model? Check for engine mount integrity to prevent a "fly through" (Is a thrust ring used?). Check for a motor hook or similar motor restraint. Carefully check taped or friction fit motors for tightness. Ask the modeler what adhesives were used during assembly. Are clusters wired in parallel?	Yes
If electronics are used, is the battery secured against "g" loads? Will electrical connections fail or loosen from acceleration forces? Will igniters stay fully inserted in rocket motors during boost? Is the user protected against inadvertent operation, e.g. is the circuit remotely armed, are safety switches present, is an armed status indicator used (visual or audible)? Does the modeler have a checklist or reminder to arm or operate the system prior to flight?	N/A
If radio control is used for flight functions (e.g. recovery), is the operating frequency in the 27, 50, 53, or 72 megahertz bands? Use of 75 megahertz for flight functions is not permitted. Is the antenna protected from breakage (not flopping freely)? Did the operator range check their equipment?	N/A
Are the fins fully secured to the model? Check for looseness or cracking at the fin to body tube junction. "Thru the wall" construction is recommended for high power models. Is the fin material compatible with the motor thrust range (1/8 inch minimum plywood is recommended for high power models)? Ask the modeler how their fins are mounted, what adhesives were used (epoxy is preferred), and what fin material was used. Are the fins mounted parallel to the roll axis of the model? Are any warps present which may cause erratic flight?	Yes
Is the model stable? If stability is in doubt require proof of the CG and CP locations (remember CG should be forward of the CP by approximately 1.0 body tube diameters). Ask the modeler to show the CG and CP locations and how they were determined. Verify that the modeler shows the CG with the motor(s) intended for flight and not a smaller motor or fewer motors (clusters). Ask the modeler to show CG and CP for the complete model and less each stage for a staged model. Require evidence of CP calculations if further doubt exists.	Yes
Is the model in compliance with the FAA Certificate of Waiver or Authorization (COA)? Verify compliance by comparing model weight and power with charts/tables (if available) or by calculation. Ask the modeler what the expected performance is and how this determination was made (e.g. computer simulation, similar models).	Yes
Does the recovery system being used follow the requirements of an Active Recovery deployment system required for certifying? Inspect the recovery system. Verify that the shock cord is not cut or frayed and is free of burns. Are the shock cord mounts securely mounted to the model? Are sharp edges present which may cut shock cords, parachute risers, and suspension lines? Is hardware, e.g. swivels, screw eyes, sufficiently strong to withstand recovery loads. If required, perform a pull test on the recovery system. Is parachute protection (e.g. wadding) adequate? Check for parachute damage, e.g. tears, burns, which may spread during recovery.	Yes