Team Rocket (#13)

Technical Report

Julia Abboud - Project Manager
Erin Golden - Test Engineer
Hope Jackson - Test Engineer
Loric Seba - CAD Engineer
Tatumn Short - Manufacturing Engineer

Maneuverability Competition

December 5th, 2025

1 Introduction

To learn more about the execution and thought that goes into the Engineering Design Process of mechanical products, Team Rocket was tasked to create a drill-powered vehicle/bike from scratch. The team studied theory and application of mechanical components and worked to implement concepts including stress analysis, bearing calculations, factor of safety, material sourcing and selection, DFM, and design ideation into the product. Throughout the process, engineering project management, collaboration, and professional skills were also practiced. Requirements of this project included limitations on sourcing frames from existing bikes, mandatory use of 3 wheels each holding at least 15% of the rider's weight, power supplied by a cordless electric drill, a vehicle weight limit of 50lb, a budget of $200, and an 11-week timeline. Finally, Team Rocket set out to win the culminating Run Off held against other similar project teams, choosing to compete in the Maneuverability Competition.

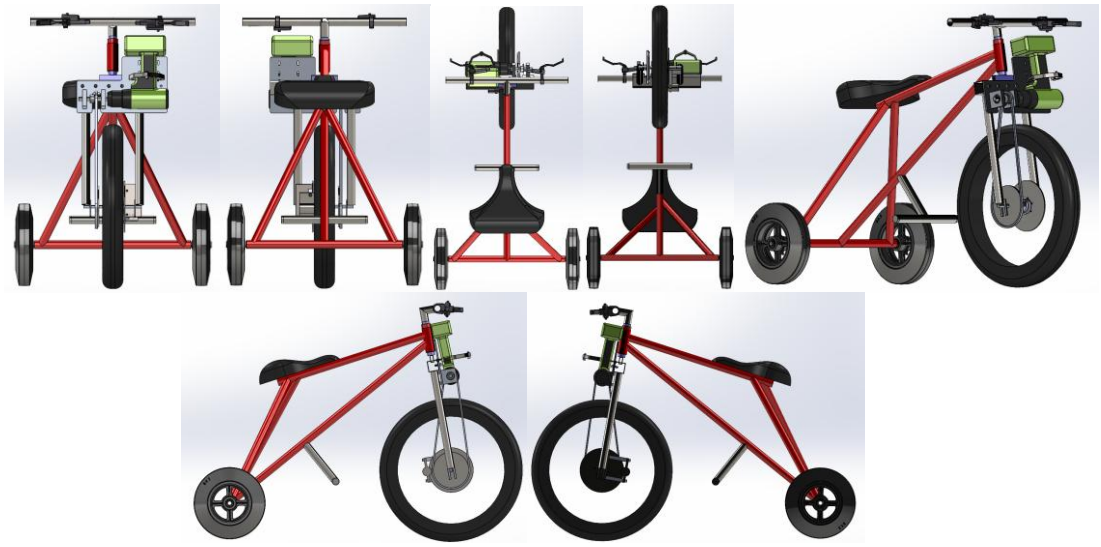


Figure 1. *CAD Views of Bike*

The maneuverability challenge includes a section where vehicles needed to snake through cones, a narrow, 3ft tall tunnel to pass through, and an area to complete 2 U-turns within a 5ft radius, ending in a complete stop. This knowledge shaped Team Rocket's design, which sought to prioritize the agility of the bike. As such, the final design powered an easily maneuverable front steering wheel with 2 rear wheels for stability. The bike was created to be small to fit in tight spaces and remain light. Team Rocket emphasized simplicity throughout this project and worked to make sure every component in the vehicle was necessary and utilized to its maximum potential. The result was a clean and stable design, ready for the team to manufacture, and win in the Run-Off.

2 Design

2.1 Conceptual Designs

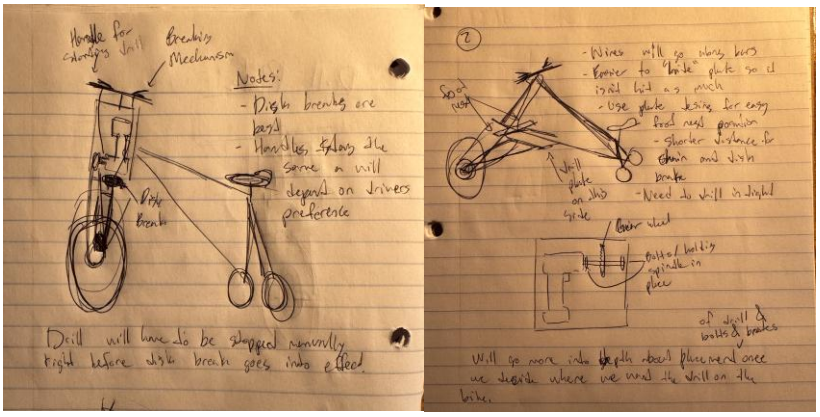


Figure 2. *Initial Hand Sketches*

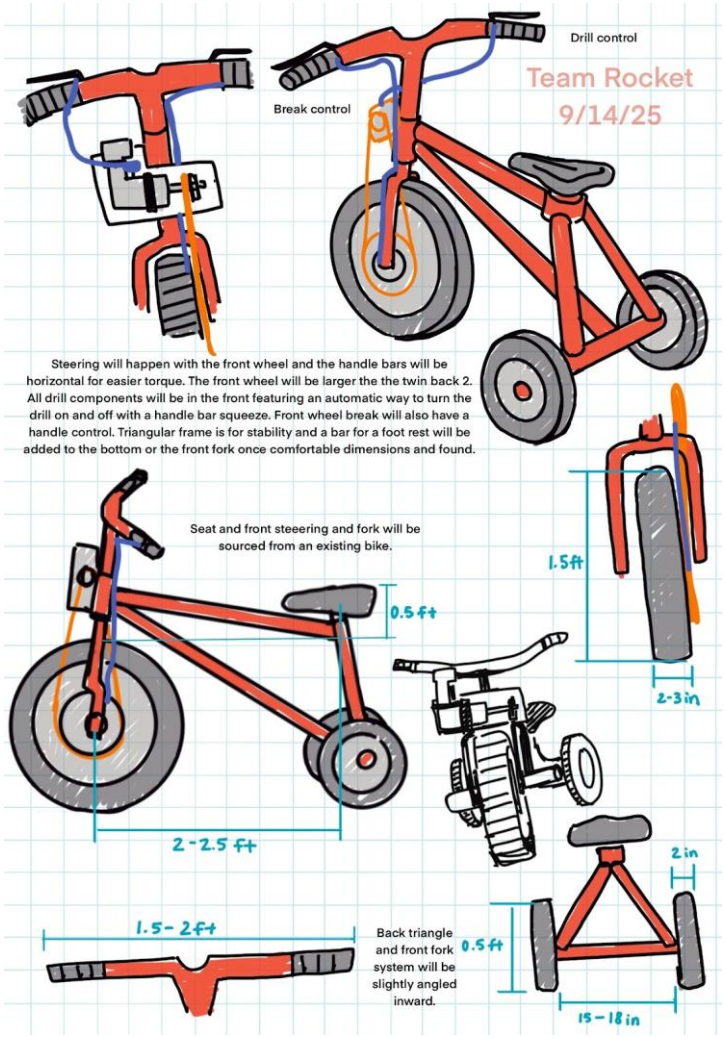


Figure 3. *Initial Digital Sketches*

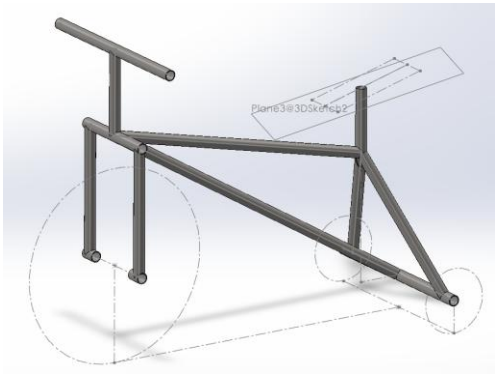


Figure 1. *Initial Frame CAD Model*

After numerous discussions and revisions, the team's initial design was based on the goal of stability, while still being maneuverable. Team Rocket settled on the idea of a small bike taking the shape of a tricycle with a triangular shape for strength. This would allow the driver to be well-balanced while moving slowly, as well as minimizing extraneous parts. The group decided on a triangular frame made of round steel tubing because of its durability and the initial belief it would be easier to manufacture. This design was within the 3ft height limit of the Maneuverability challenge and under the 50lb weight limit. Powering the front wheel was chosen to simplify the drive-train system and optimize torque. Originally, the team believed sourcing a front fork would be best for the design.

2.2 Selected Design

Team Rocket's final design is built around a large front-driven wheel for increased maneuverability with a compact frame to fit through tight spaces and make sharper turns. Most of the body is comprised of circular tubing to support the unique copes required of the frame and to withstand large stresses. A custom front fork was chosen to mount the drill plate more securely. Rectangular tubing is used solely in the front fork to attach the drill plate. The bike is operated through two breaks on the handles. The left which serves as a break on the front wheel and right that triggers the drill throttle through a repurposed rim break. The vehicle is capable of multiple speeds because of the trigger sensitivity. Aside from the frame, custom components included the drill plate, disk break holder, and break block.

The team stuck to the initial design with only a few modifications. One of the changes from the initial design was the offsetting of the back support pipes. This change followed design review recommendations to make the frame easier to manufacture, removing the need to create double copes. Post design review, the system for the back wheels was also modified to no longer use a long axle shaft held by spacers through the back tube and instead smaller inserts on either side to thread bolts into and hold the wheels. Another minor change was adding copes to all the framework for manufacturing. The rectangular tube in the front fork was changed from a 1" tube to a 1.5" tube to prevent the drill plate from colliding with the bike's headset. The final change made was adding a mount for the disk break that could be used as a braking system.

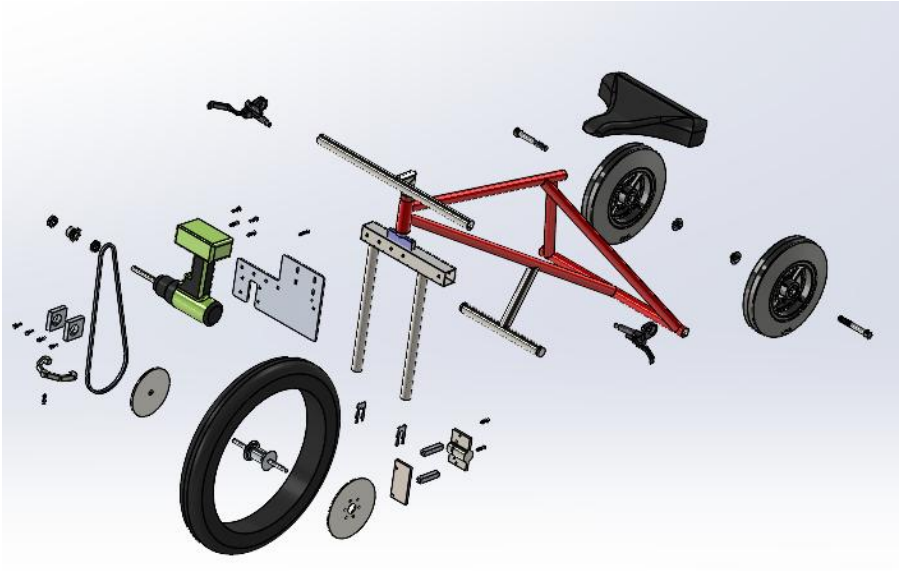


Figure 2. *Exploded View of CAD Model*

3 Component Analysis

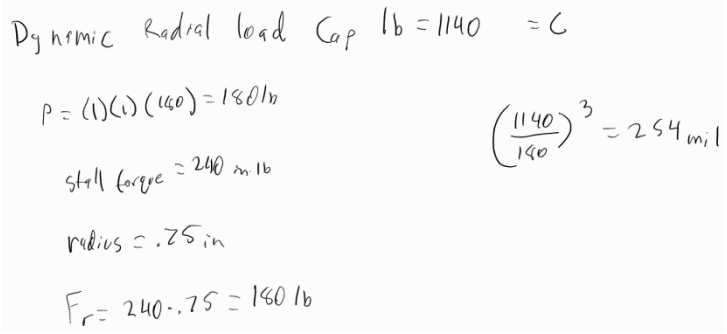
3.1 Critical components

3.1.1 Weldments

The weldments connecting the rest of the frame to the headset and weldments under the seat connecting the top beam to the left and right side beams were analyzed as critical points. These connections were deemed critical because weldments tend to be the weakest part of a frame and the headset and weldments beneath the seat will see the largest forces. The team designed these connections to withstand forces from the rider, forces caused by forward motion, and breaking by angling components. At both locations there are two points of connection to help counteract any moments and create secure weldments done by amateur welders.

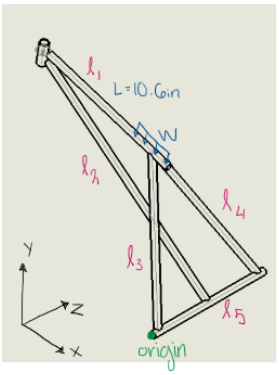
3.1.2 Headset Bearings

The headset is angled at about 10° to counteract moments that could be caused from forward motion and tip a rider over the front of the bike. Even though the wheel will produce only an upward reactionary force, this angle means the bottom bearing experiences both axial and normal forces and the top bearing experiences axial forces. Bearings were picked to withstand the calculated forces.



3.2 Failure Analysis

3.2.1 Schematic/Free Body

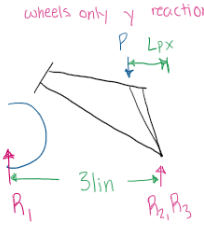


Material Properties:
$S_y = 32$ ksi
$S_{ult} = 58$ ksi
$E = 30.5$ Msi
$G = 11.5$ Msi

Weight Rider: 168.40lb

$D_o = 1$ in
$D_i = 1in - 2(0.083in) = 0.834in$

$I = \frac{\pi}{64}(D_o^4 - D_i^4) = 0.025\ in^4$
$A = \frac{\pi}{4}(D_o^2 - D_i^2) = 0.239\ in^2$
$J = \frac{\pi}{32}(D_o^4 - D_i^4) = 0.051\ in^4$



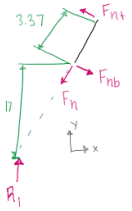
point load: $P = 168.41b$
location x: $L_{px} = 6.766_{in} + 5.3in\cos(18°)$
$L_{px} = 11.8\ in$

$\sum M_{rear} = 0 = R_1(31in) - P\,L_{px}$
$R_1 = 64\ lb$

$\sum M_{R_2} = 0 = R_1(9.51in) - P(9.51in) + R_3(19.02in)$
$R_3 = 52.18\ lb = R_2$

CHECK: $\sum F_y = 0 = 64\ lb + 2(52.18lb) - 168.41b$
$0 = 0$ ✓

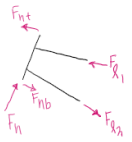
HEAD STOCK



$\sum M_b = 0 = R_1 \cdot 17in \cdot \sin(10°) - F_{nt} \cdot 3.37in$
$F_{nt} = 56.1\ lb$

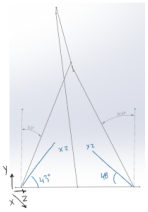
$\sum F_x = 0 = -F_n \sin(10°) + F_{nb}\sin(80°) - F_{nt}\sin(80°)$
$F_n = \frac{\sin(80°)}{\sin(10°)}(F_{nb} - F_{nt})$

$\sum F_y = 0 = R_1 - \left(\frac{\sin(80°)}{\sin(10°)}(F_{nb} - F_{nt})\right)\cos(10°) - F_{nb}\cos(80°) + F_{nt}\cos(80°)$
$0 = R_1 + F_{nt}\left(\frac{\cos(10°)}{\sin(10°)}\sin(80°) + \cos(80°)\right) - F_{nb}\left(\frac{\cos(10°)}{\sin(10°)}\sin(80°) + \cos(80°)\right)$
$F_{nb} = 67.22lb$
$F_n = 63.07lb$

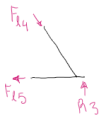


$\sum F_x = 0 = F_n\sin(10°) + F_{l2}\cos(39°) - F_{l1}\cos(18°) - F_{nt}\sin(80°) + F_{nb}\sin(80°)$
$F_{l2} = F_{l1}\frac{\cos(18°)}{\cos(39°)} - 21.91b$

$\sum F_y = 0 = F_n\cos(10°) - \left(F_{l1}\frac{\cos(18°)}{\cos(39°)} - 21.91b\right)\sin(39°) + F_{l1}\sin(18°) + F_{nt}\cos(80°) - F_{nb}\cos(80°)$
$0 = 73.971b - F_{l1}\frac{\cos(18°)}{\cos(39°)}\sin(39°) + F_{l1}\sin(18°)$
$F_{l1} = 160.41b$
$F_{l2} = 174.41b$

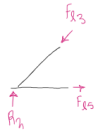


l_3: $\phi_{xz} = 43°$, $\theta_{xz-y} = 36.07°$ $\vec{u}_{l3} = (\cos(36.07°)\sin(43°), \sin(36.07°), \cos(36.07°)\cos(43°))$
l_4: $\phi_{xz} = 48°$, $\theta_{xz-y} = 34.54°$ $\vec{u}_{l4} = (\cos(34.54°)\sin(48°), \sin(34.54°), \cos(34.54°)\cos(48°))$



$\sum F_y = 0 = -F_{l4}\sin(34.54°) + R_3$
$F_{l4} = 91.95\ lb$

$\sum F_z = 0 = F_{l4}\cos(34.54°)\cos(48°) - F_{l5}$
$F_{l5} = 50.68lb$

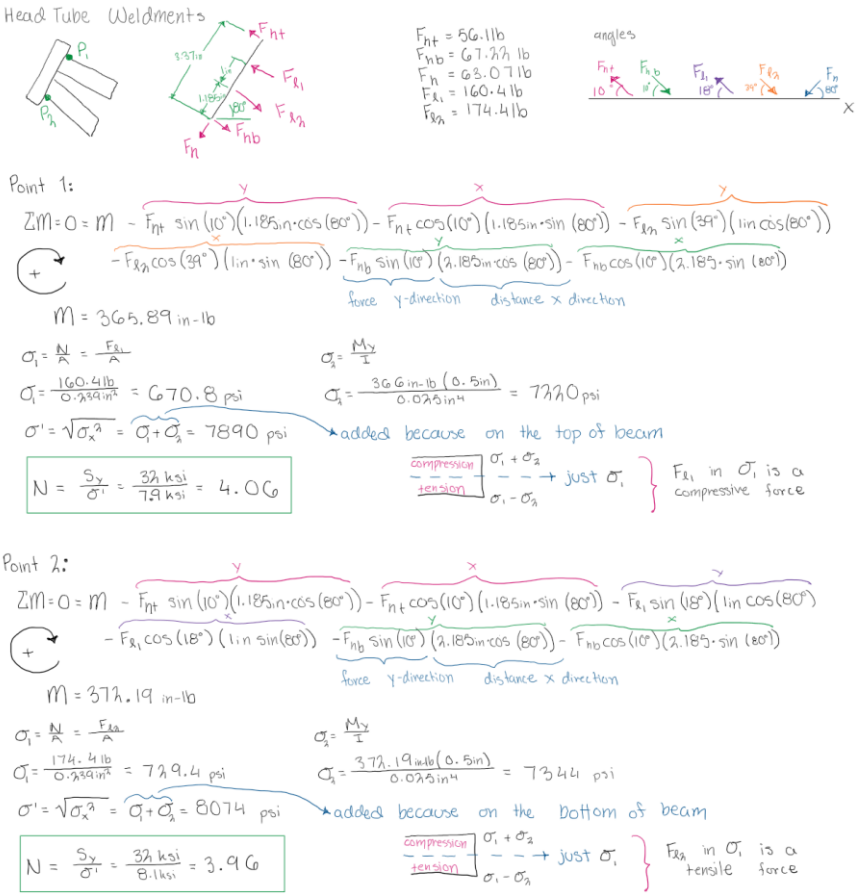


$\sum F_y = 0 = -F_{l3}\sin(36.07°) + R_2$
$F_{l3} = 88.54lb$

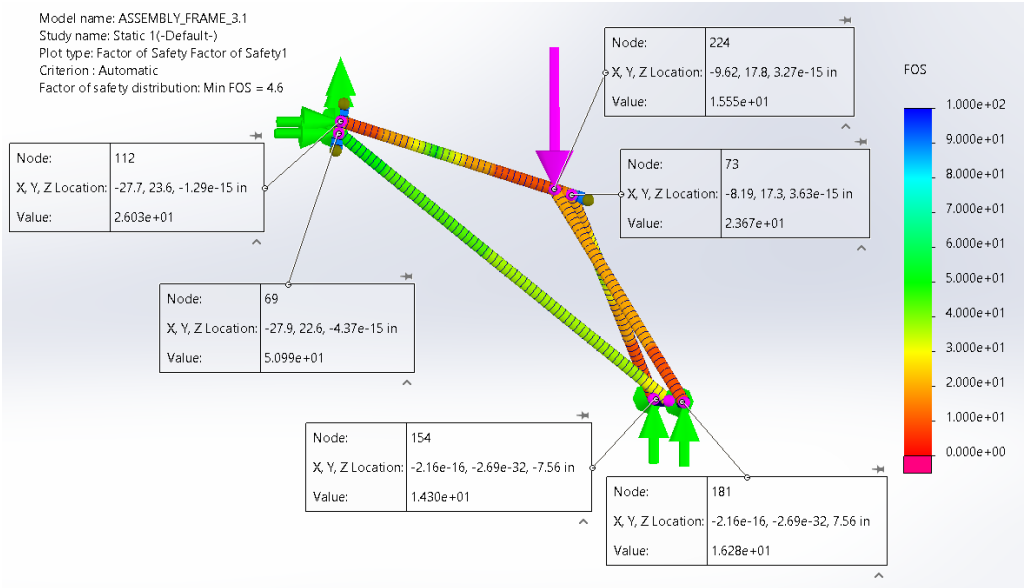
$\sum F_z = 0 = F_{l5} - F_{l3}\cos(36.07°)\cos(43°)$
$F_{l5} = 51.34lb$

3.2.2 Fundamental Equations (stress analysis)

$$\sigma = \frac{N}{A}, \qquad \sigma = \frac{My}{I}, \qquad \tau = \frac{VQ}{It} \; for \; tubing = \frac{2V}{A}, \qquad \tau = \frac{Tr}{J}$$



3.2.3 FEA



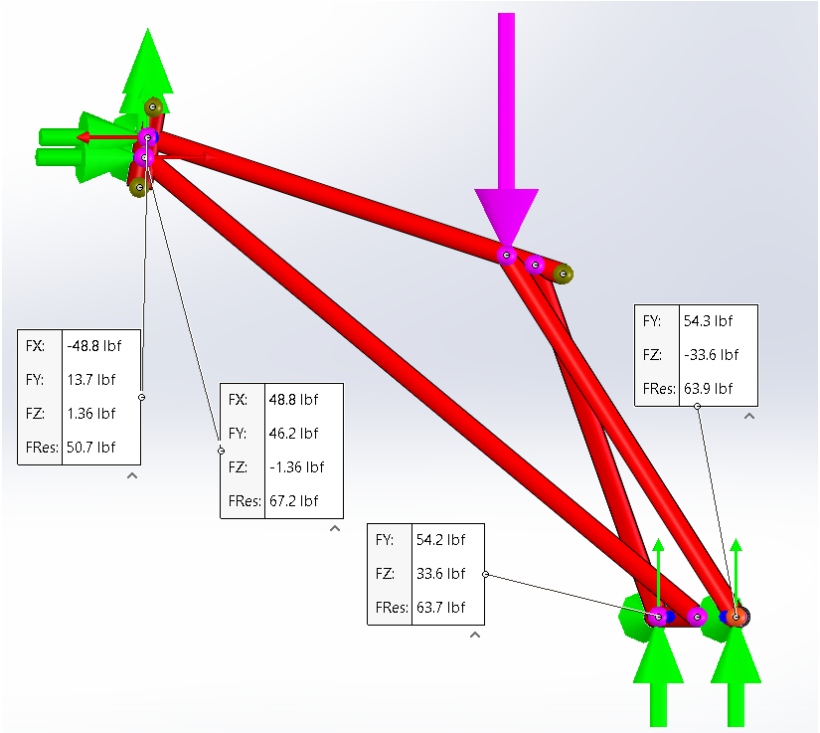


Figure 6. *CAD FEA*

3.3 Weight

The weight of the vehicle was estimated to be 31lb in SolidWorks. After building and weighing, the actual mass is about 37lb, which is under the 50lb requirement.

Mass properties of BIKE_ASSEMBLY_2.1.5
Configuration: Default
Coordinate system: -- default --

Mass = 31.07 pounds

Volume = 739.03 cubic inches

Surface area = 3055.58 square inches

Center of mass: (inches)
X = -19.07
Y = 11.68
Z = 0.56

File Name	Quantity	Total Weight
2319T96_High-Strength Rubber Whee...	2	5.16
2737T93_Roller Chain Sprocket	1	0.02
60355K291_Ball Bearing	2	0.01
90044A423_Black-Oxide Alloy Steel So...	5	0.01
90044A423_Black-Oxide Alloy Steel So...	9	0.02
AXLE_INSERT-1.0	2	0.01
Bike chain^BIKE_ASSEMBLY_2.1.5	1	0.08
DISK	1	1.52
DRILL-1.2	1	4.00
DRILL_PLATE-1.2	1	1.06
EDITABLE_GEAR	1	1.10
END-CAP	2	0.10
FOOT_REST-1.3(Default<As Machined...	1	0.67
FOOT_REST_CONNECTION-1.3(Defaul...	1	0.42
FRAME_3.0^BIKE_ASSEMBLY_2.1.5(Def...	1	6.28
FRONT_FORK-1.1(Default<As Machin...	1	3.75
FRONT_WHEEL	1	3.00
HEADSET_BEARING	1	0.03
HEAD_STOCK-1.0(Default<As Machine...	1	0.93
HEAD_TUBE-1.0(Default<As Machined...	1	0.44
PILLOW_BLOCK-1.2	2	0.29
RIM_BREAK_TRIGGER	1	0.32
SEAT	1	1.50
SHIMANO BT-MT200	2	0.22
TRIGGER_HOLDER	1	0.05
WHEEL_HOLDER_1.0	2	0.09

Figure 7. CAD mass properties and physical weight.

4 Fabrication

4.1 Overview

Fabrication started on 10/22/25 and was completed on 11/20/25. All parts were successfully manufactured to drawing specifications and were fully fitted together on 11/18/25. All team members were active contributors to this process.

4.2 Custom Parts

A variety of techniques and machines were used during manufacturing. Manufacturing began with cutting the tubing to size. The team bought 20ft of A513 Steel 1" OD, 14-gauge (0.083 Thickness) Round Tubing, using about 16ft of material and saving extra which was not needed. Major cuts began as 6ft x3, and 2ft. Team Rocket mapped out how to make the cuts and used the bandsaw to do so.

Tubing	inch	6ft = 72in
Bottom beam	35.33	69.33
Handlebar	20	
Front right fork	14	
Front left fork	14	43.02
Footrest	10	
Back beam	19.02	
Left side beam	21.61	70.89
Right side beam	20.65	
Top beam	21.63	
Footrest connection	7	
total (in)	183.24	3 x 6ft rods + 2ft
total (ft)	15.27	

4.2.1 Pillow Blocks

To begin manufacturing the pillow blocks, stock material was cut on the bandsaw slightly longer than the desired height so that there was surface to cut and face. On the first block, 0.001 inch of material was removed in the x-axis direction on one side before flipping to the other. On this side a fast pass was completed to take off material until close to Team Rocket's desired length. Another slower pass was completed to surface and reach the final length. The final position was set to zero so that the other pillow block could be cut to height using the same process. The block was then tuned so the bottom was facing up, and the front left corner was set as the zero position for x and y to align with the drawing dimensions for the screw holes. The process was identical for the other block. The holes were gradually drilled down in both blocks and then threads for 1/4-20 screws. [Appendix: Pillow Blocks]

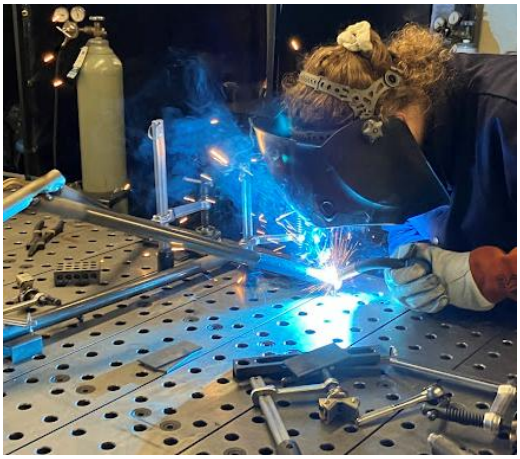
4.2.2 Drill Plate

The group outsourced manufacturing of the drill plate to the CU Boulder Idea Forge staff. The design was cut from 3/16 aluminum via waterjet. A manual deburring tool was used to fully remove any sharp edges. After discovering the chain intersected, a corner of the plate was rounded out using the mill. [Appendix: Drill Plate]

4.2.3 Tubes

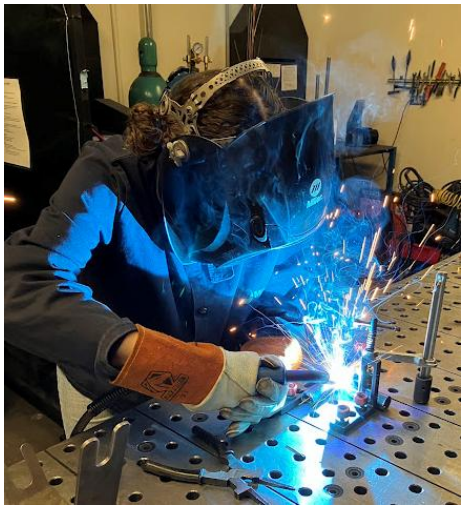
The frame, footrest, and front fork required a few steps. Team Rocket first made all the necessary copes at the appropriate angles and depths. This was necessary for welding to go smoothly. Labeling near the end of the bars helped align the parts and identify specific bars so manufacturing could be completed incrementally by different members.

4.2.4 Frame



The frame was put together over multiple days. Once all tubes were coped, it took about 3 hours to tack and weld the frame together. Welding the frame took a variety of techniques to make sure it was done correctly. The group started out making the main T, tacking the bottom frame bar and wheel bar together. Then, rotating the frame on side, tacked the frame front hub to the bottom bar. Measuring the angle between the bottom frame bar and the top frame bar, Team Rocket tacked on the top to the front hub. After that, the welder rotated the frame onto another side, so the two side bars would be lying flat. Tacking the frame together was easier than knowing how to rotate the. Each component of the frame was clamped down before being connected, so the frame was held up in awkward positions. This ensured that the bar was flat, and exactly where it needed to be. Double checking and dry assembling the frame were necessary so the copes connected to each end of the bar in the right position and orientation. [Appendix: Frame Components]

4.2.5 Footrest



Footrest construction also began with coping the tubes as labeled in the CAD design. The two pieces making this part were then welded together and later attached to the frame once the correct height was known. [Appendix: Footrest Components]

4.2.6 Front Fork

The front fork was easier to put together than the frame due to the simpler design and experience from the frame. The team clamped down the parts using rectangular blocks to space the circular side fork bars in the center of the top square fork bar. These were tacked together and welded. After, the top fork part that goes inside the hub was tacked and welded on using the same technique to make sure it was even with the table and square block.

Later, the dropouts were welded on the bottom of each fork bar. This was far harder to do as it was welding a flat surface onto a rounded surface. Team Rocket put one dropout flat on the table and clamped the fork on top so that the other side of the fork was under the table, then tacked. For the other side, the group locked the wheel in both dropouts and welded the other dropout to get an accurate distance between them. This helped make sure the weld fit the wheel. [Appendix: Front Fork Components]

4.2.7 Brake Block

The brake block is made from aluminum and could not be welded. The team used an end mill to cut the part to proper dimensions, then used the drill and tap method for a hole on the bottom. A hole was drilled through the front through to fit the break properly for activating the drill. [Appendix: Break Block]

4.2.8 Drill Shaft/Sprocket

Manufacturing the drill shaft took a couple techniques. Material was acquired from the Idea Forge shop and faced on the lathe to get the planned length. After that, Team Rocket used a hexagonal block to mill the sides of the shaft leaving a perfect hexagon shaped end. The sprocket was faced on the lathe to 0.1” to fit the bike chain. Additionally, setscrews were applied to clamp onto the drill shaft. After assembly success was confirmed, the drill shaft was dimpled. [Appendix: Drive Chain]

4.2.9 Disk Break Holder

The disk break holder was the final manufactured piece. Two aluminum supports were cut using on the bandsaw, then drilled and tapped with a M6-1 hole on the end connecting to the break, and a ¼-20 hole on the end leading to the support. The components were screwed together after manufacturing then tacked and welded to the front fork of the bike by two team members. Steel was used for the base that attached to the bike so it could be welded. This method successfully helped control the placement of the disk break. [Appendix: Disk Break Holder]

4.3 Materials/Parts

Team Rocket used A513 Steel 1” OD, 14-gauge (0.083 Thickness) Round Tubing for the frame. Aluminum was used for the drill plate and brake block. Standard parts used were chosen based on usability and affordability. These items were minimal, including the wheels, seat, chain, disk and rim breaks, handlebars, and headset.

5 Iterations of Design and Fabrication

5.1 Concepts to Reality

Team Rocket’s original conceptual design for the drill-powered bike was simple. The design was comprised of a hand drill mounted to a front-wheel drive, with a throttle and brake trigger attached to the handlebars. In the concept sketches, it seemed straightforward. It only took

a few days of CAD modeling to realize the shortcomings of the first design. The first problem the team ran into was the torque. The hand drill provided would not produce enough torque to allow the bike to move forward with the combined weight of the bike and rider. The team solved this with more thorough calculations on the gear ratio which ended up being 10:33. A main component missing from the original design was a mount for the disk break, so that was added.

5.2 Design Review and Key Revisions

5.2.1 Pre-Design Review TA Feedback

The TAs provided feedback before and during Team Rocket's design review, which fundamentally improved drawings and their dimensional consistency. Their comments included:

- Reorganize dimensions so related features are grouped logically
- Measure cope angles from the horizontal instead of arbitrary references
- The dimensions of all tube cuts and lengths, even if some values are initially estimated
- Round all corners on the drill plate

This feedback was valuable because it forced the group to think critically about how drawings would be interpreted by someone else, specifically the machinists who would be helping to create these parts. It also made the team realize how inconsistent some of the early dimensioning methods were. After making these changes, the drawings were far more professional and machinist friendly.

5.2.2 Design Review Feedback

Feedback from the machinists during the design review focused primarily on manufacturability, specifically drawing tolerances and copes, and practical details that would directly impact the success of the fabrication process. Their comments included:

- Use correct tolerances for pillow blocks and drawings
- Dimensions of hole patterns should be relative to each other for accuracy
- Avoid designs where three tubes intersect at one point
- Fix copes and provide explicit dimensioning for each
- Extend the drill shaft to improve chain alignment
- Include stock size information for all components
- Increase tube thickness to 14 gauges for better structural rigidity

This feedback directly improved the durability and precision of the final project. For example, increasing the tube wall thickness to 14-gauge would eliminate the frame from flexing and snapping, which would appear in early tests, and make it easier to weld. Adding extra mounting points for the drill plate would make the system significantly more stable.

5.3 Success & Unexpected Problems

5.3.1 Successes

The most successful parts of fabrication for the team included cutting and eventually coping tubes. Despite having extra material to account for mistakes, none was used for this process. Dividing the manufacturing of the pillow block among three members was also effective. The frame welded beautifully, as well. Consistent progress on this project was made every week, and the team's organization made it possible to complete the bike 2 weeks prior to the

deadline with minimal meetings outside of the course. Upon assembly, there were no major issues, and it was very rewarding to see the final product perform successfully.

5.3.2 Unexpected Problems

Team Rocket had a handful of unexpected problems throughout the manufacturing process, but the majority were simple to remedy. There were a few instances of manufacturing parts out of non-weldable materials as well as an issue of buying the ideal sprocket gear but being unable to customize it because the team overlooked the type of material it was. These issues were fixed using appropriate parts. The most time-consuming issue the group encountered was that the intended dive gear was completely irremovable from the scrap bike sourced from the Golden Optimist Bike Shop in Golden, CO. The scrap bike was such an old model that the Idea Forge shop did not have the correct tools to safely take the gear off. Thankfully, Team Rocket was able to find replacement gear from another bike. The chain slightly touched the drill plate and this was resolved by removing material from the drill plate.

5.4 Lessons Learned

Team Rocket learned more about precision and preparation. Following the machinists, Tas, and Professors' feedback and revising drawings with proper hole callouts, stock sizes, and reference datums, the parts came together quite well and without major rework. This taught the group how beneficial it was to think like a fabricator rather than just a designer—understanding how a part would be cut, welded, or assembled made the designs more realistic and machinist-friendly. Other lessons included having CAD fully accurate and complete in the beginning to avoid design ambiguity later in the process. This would help make sure the chain is aligned and not hitting anything. Using a custom fork made it easy to attach the drill plate and the team saw that fabrication takes a lot of time and so finding ways to divide it is optimal. Learning when to use in-set, button, or standard screws was critical, as was how to properly dimension odd, angled copes in drawings.

5.5 Future Improvements

If the course was two semesters long, the group would have repeated the 11-week timeline. Team Rocket would focus on designing the bike to be as torque-efficient and budget-friendly as possible while applying what was learned in lectures. Ending the first semester with a working protype would set the team up for success in making improvements and changes. During a second semester, Team Rocket would focus on testing the vehicle and making repairs when issues or mistakes are shown. The final design is functional and stable, but there is room to make it more efficient, maneuverable, durable, and fun. Incorporating lights, sounds, and a place to catch Pokémon are a few examples.

6 Timeline

	PLANNED TIMELINE		REAL TIMELINE
Week 9/15	• Team Charter • Organize Trello, Budget, & CAD • Install Design Center Templates • Preliminary Design and Sketches	**Week 9/15**	• Team Charter • Organize Trello, Budget, & CAD • Install Design Center Templates • Preliminary Design and Sketches
Week 9/22	• **Project Planning Doc (Sep 18th)** • Preliminary Budget • Preliminary CAD	**Week 9/22**	• **Project Planning Doc (Sep 18th)** • Preliminary Budget • Preliminary CAD
Week 9/29	• Finalize Pre-Design Review CAD • Stress calculations and FEA • Calculate Torque and Gear Ratio • Create Design Review Slides • **Design Review (Oct 6th)**	**Week 9/29**	• Finalize Pre-Design Review CAD • Stress calculations and FEA • Calculate Torque and Gear Ratio • Create Design Review Slides • **Design Review (Oct 6th)**
Week 10/6	• Refine Design based on Review Feedback • Buy Materials • Get Final Drawings Approved	**Week 10/6**	• Refine Design based on Review Feedback • Start buying Materials
Week 10/13	• Water Jet Drill Plate • Manufacture Blocks • Manufacture Drill Shaft • Manufacture Frame Parts	**Week 10/13**	• Refine Design based on Review Feedback • Finish buying Materials • Get Final Drawings Approved • Post Design Review Assignment
Week 10/20	• Start Design Report • Manufacture Frame Parts Continued • Manufacture Front Fork Parts	**Week 10/20**	• Start Design Report • Cut Tubing • Manufacture Pillow Blocks • Finalize Design Changes
Week 10/27	• Weld Frame • Weld Front Fork • **Report Draft (Oct 30th)**	**Week 10/27**	• Water Jet Drill Plate • Manufacture Drill Shaft • Cope Tubes • Manufacture Back Wheel Assembly • **Report Draft (Oct 30th)**
Week 11/3	• Manufacture Trigger System • Install Breaks • Test Breaks	**Week 11/3**	• Weld Main Frame • Source Drop Outs • Refine Report • Sandblast Parts
Week 11/10	• **Hardware Demonstration (Nov 10th)** • Assemble Fully • Extra Time for Delayed Tasks	**Week 11/10**	• Weld Front Fork • Manufacture Trigger • Back Wheel Assembly
Week 11/17	• Refine Design Report • Extra Time for Delayed Tasks • **Final Vehicle Testing Demonstration (Nov 21st)**	**Week 11/17**	• Weld Footrest & Seat • Build Drive Train • Install Breaks • Refine Design Report • **Final Vehicle Testing Demonstration (Nov 21st)**
Week 12/1	• **Run Off (Dec 4th)** • **Final Design Report (Dec 5th)** • Team Celebration	**Week 12/1**	• **Run Off (Dec 4th)** • **Final Design Report (Dec 5th)** • Team Celebration

Discrepancies in the Planned versus Actual Timeline are a result of team delays and changes to the manufacturing schedule as the group grew their understanding of what would be required to successfully execute this project. It took more time than expected to finalize the drawings and models after the Design Review and this offset manufacturing. Initial weeks were very similar between planned and reality as there were more upcoming deliverables that guided tasks. To correct becoming behind schedule, the team met once outside of class during week 11/17 to have more worktime.

7 Bill of Materials and Costs

Table 1. *Team Itemized Spending*

TOTAL BUDGET				**$ 200**		
Expenses	Source	Quantity	Predicted Cost ($)	Actual Cost ($)	Variance ($)	Description
Drill		1	PROVIDED		-	
Batteries		2	PROVIDED		-	
Bearings	Amazon	8	12.49	13.00	-0.51	6203, 1/2" ID
Front Tire	Community Cycle	1	10.00	10.00	0	20" OD
Rim Break	Community Cycle	1	0.00	0.00	0	
Seat	Community Cycle	1	7.00	10.00	-3	
Front Wheel	Golden Optimist	1	20.00	0.00	20	1/2" Pitch
Disk Breaks	Golden Optimist	1	5.00	0.00	5	20" OD
Chain	Golden Optimist	1	15.00	0.00	15	
Bike Headset Kit	Golden Optimist	1	9.99	0.00	9.99	
Pitch gear	Golden Optimist	1	15.02	0.00	15.02	1/2" Pitch
Back Wheels	Harbor Freight	2	8.99	19.43	-10.44	
Bolts	Machine Shop	2	0.00	0.00	0	5/8" OD, 3.5” Long
Screws	Machine Shop	2	0.00	0.00	0	M6-1
Screws	Machine Shop	25	13.72	0.00	13.72	1/4-20 11/16" Long
Zip Ties	Machine Shop	2	0.00	0.00	0	
Weld Nuts	McGuckin Hardware	2	3.00	5.38	-2.38	1/2-13 UNC
Fasteners	McGuckin Hardware	2	3.00	7.58	-4.58	1/2-13, 3" Long
Sprocket	McMaster-Carr	1	31.55	31.55	0	1/2" Pitch, 10 Teeth
Steel Frame Material	Metal Distributors	4	80.00	32.96	47.04	1" OD, .083" Thick
Steel Square Tubing	Metal Distributors	22in	4.00	2.70	1.3	1.25" OD, 1.12" ID
		Total:	238.76	**$132.60**		
		Remaining:	-38.76	67.4		

7.1 Cost Differences

The largest difference between the predicted cost and the actual cost was the price of the frame material. The predicted cost was based on a quick online search about 1” OD and 0.065”

thick tubing, for the actual frame the team switched to 1” OD and 0.083” thick tubing. Team Rocket also called several local locations to find out if they had this stock material or could order the tubing and their pricing. Because the group made a rough overestimate initially, it cost $47 less. Other components cost more based on taxes, as was the case for the Amazon order, and variances in products online, as was the case for the back wheels from Harbor Freight. The group stayed below $200 requirement at $132.60.

8 Advice

For Team Rockets of the past and future:

Read the advice given in class. It is very helpful and can set you up to avoid failure. Try to have a team bonding event during the first week to set the tone for the semester. Learn the work styles of your teammates early on so that you can appropriately assign tasks and achieve goals on time. Make sure that everyone is on the same page, and that you have scheduled meetings or find a way to appropriately communicate. Each team member should be involved so make sure you are aware of who is or is not being productive. Aim for most deadlines to be completed as early as (realistically) possible as it helps with adjusting for future conflicts. This helped our group getting things done and was a lot less stressful when figuring out individual tasks.

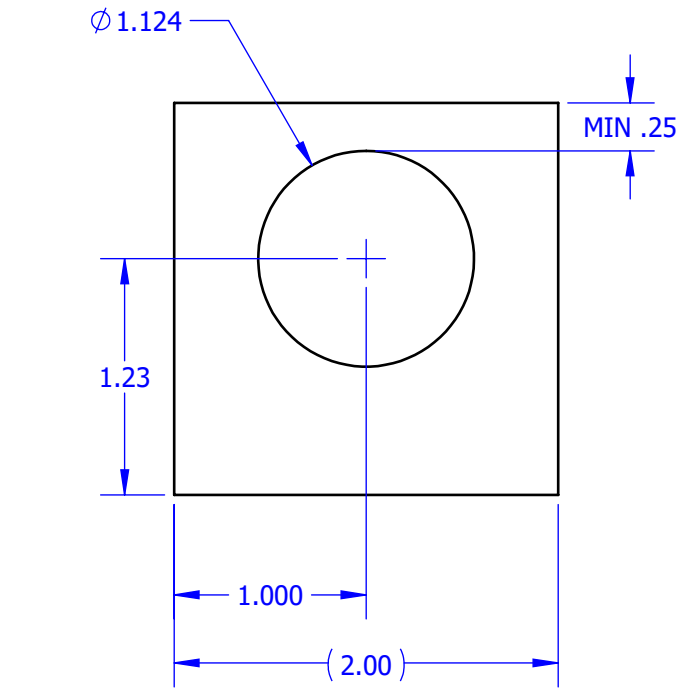
Find an effective method for iterating your designs that makes it obvious which design is the most up to date. Make sure to accurately model all your known parts when using CAD for the creation of custom parts. Coping round tubing is difficult at first but not that hard to figure out so do not let people dissuade you from round tubing if that is what you want to use. Do not use a disk break without using custom wheel dropouts. Make sure to ask appropriate questions when in the shop, it will make manufacturing faster in the end as you continue to learn. Check if your initial concept sketches are feasible and if not how they can be modified. Make sure all welds are using markings and are properly measured before tacking. Double check after tacking, then officially weld to get the best result. The design review should not be the first time people outside your team are seeing the bike design. Finding the simplest solution is usually the best, and only implement something complicated that one or multiple teammates are familiar with. Be “into” your bike, do not slack off, and have fun! Don’t stress out and document the process thoroughly for professional portfolios.

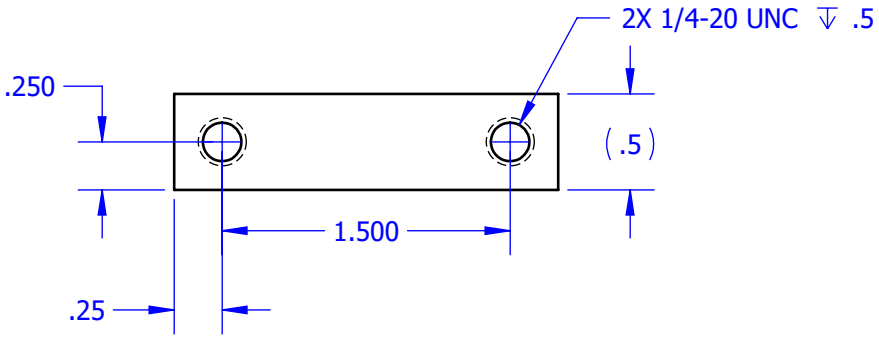
9 Appendix

9.1 Appendix: CAD Drawings

9.2 Appendix: Marked CAD Drawings

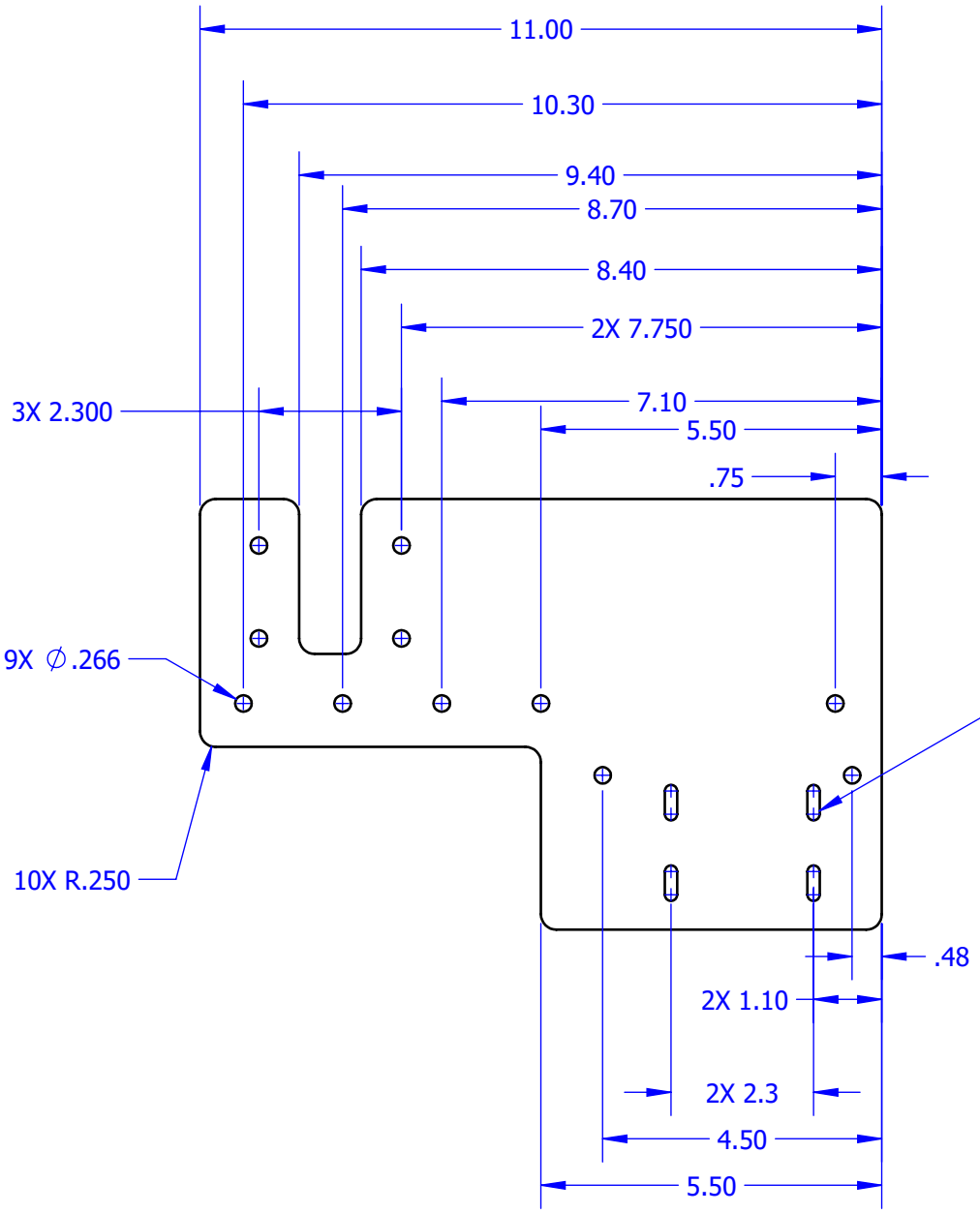
REV.	DESCRIPTION	DATE
A	INITIAL RELEASE	9/27/2025
B	UPDATE PER PRE DESIGN REVIEW FEEDBACK	10/2/2025





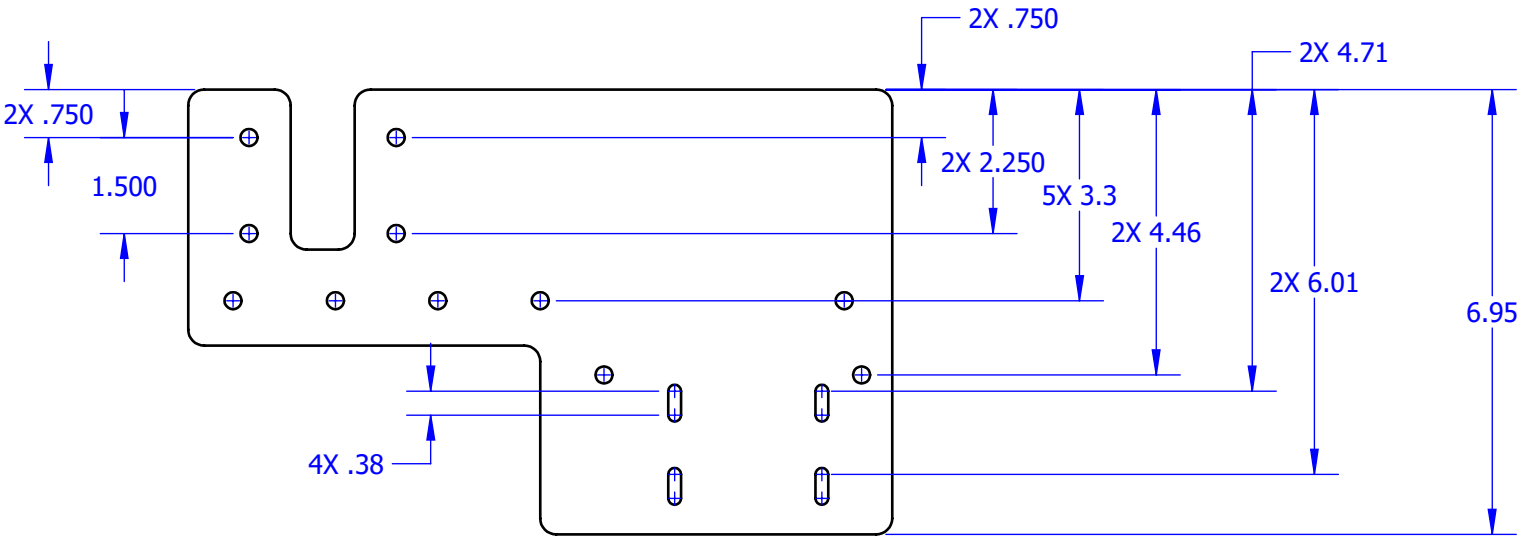
SPONSOR PROJECT TEAM NUMBER	MCEN 3025 TEAM ROCKET		DESIGN CENTER COLORADO
TOLERANCES UNLESS NOTED: UNITS: INCHES	X.X ±0.050 X.XX ±0.010 X.XXX ±0.005 X.X° ±0.5°		FILE NAME: PILLOW_BLOCK-1.2 APPROVAL
DRAWN BY: JA	DRAWN DATE: 10/2/25		MFD BY
MATERIAL: ALUMINUM			DESCRIPTION: PILLOW BLOCK
STOCK SIZE: 1/2" x 2" x 4"	PN	REV: B	SHEET: 1 of 1

REV.	DESCRIPTION	DATE
A	INITIAL RELEASE	9/27/2025
B	UPDATED WITH DRILL DIMENSIONS	9/29/2025
C	UPDATE WITH PREDESIGN REVIEW FEEDBACK	10/2/2025

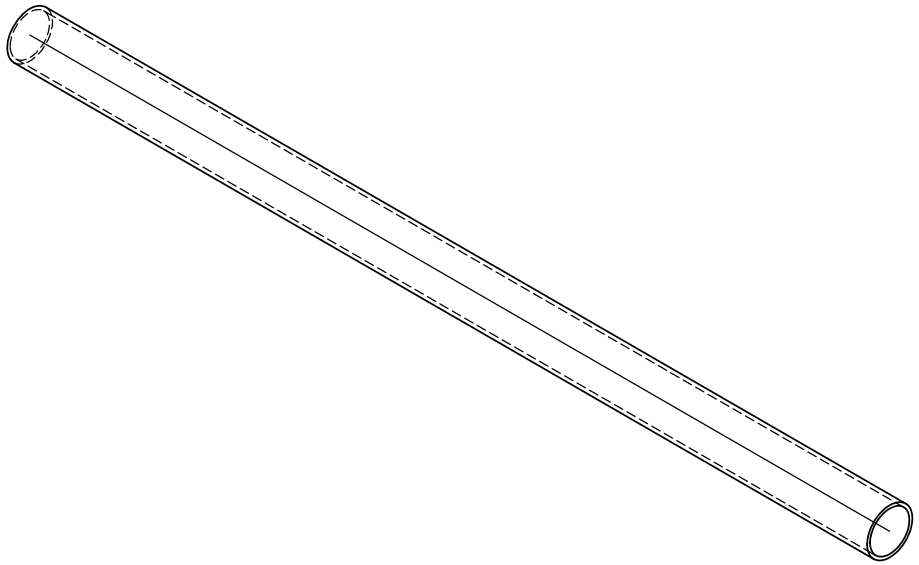


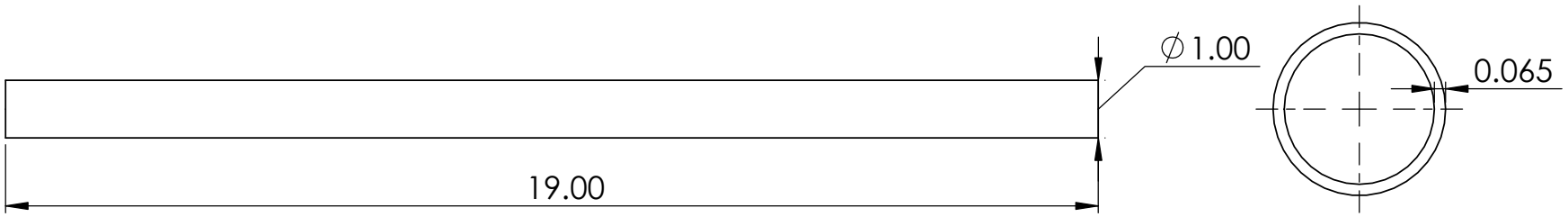
SPONSOR / PROJECT / TEAM NUMBER	MCEN 3025 TEAM ROCKET	DESIGN CENTER COLORADO	
TOLERANCES UNLESS NOTED: X.X ±0.05, X.XX ±0.010, X.XXX ±0.005, X.X° ±0.5°; UNITS: INCHES		FILE NAME: DRILL_PLATE-1.2	
		APPROVAL	
DRAWN BY: JA	DRAWN DATE: 10/2/25	MFD BY	
MATERIAL: ALUMINUM		DESCRIPTION: DRILL PLATE	
STOCK SIZE: 11" x 11" x 3/16"	PN	REV: C	SHEET: 1 of 2

REV.	DESCRIPTION	DATE
A	INITIAL RELEASE	9/27/2025
B	UPDATED WITH DRILL DIMENSIONS	9/29/2025
C	UPDATE WITH PREDESIGN REVIEW FEEDBACK	10/2/2025

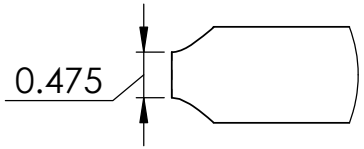


SPONSOR / PROJECT / TEAM NUMBER	MCEN 3025 TEAM ROCKET	DESIGN CENTER COLORADO	
TOLERANCES UNLESS NOTED: X.X ±0.05, X.XX ±0.010, X.XXX ±0.005, X.X° ±0.5°; UNITS: INCHES		FILE NAME: DRILL_PLATE-1.2	
		APPROVAL	
DRAWN BY: JA	DRAWN DATE: 10/2/25	MFD BY	
MATERIAL: ALUMINUM		DESCRIPTION: DRILL PLATE	
STOCK SIZE: 11" x 11" x 3/16"	PN	REV: C	SHEET: 2 of 2

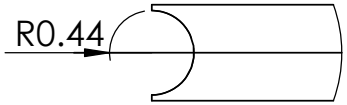




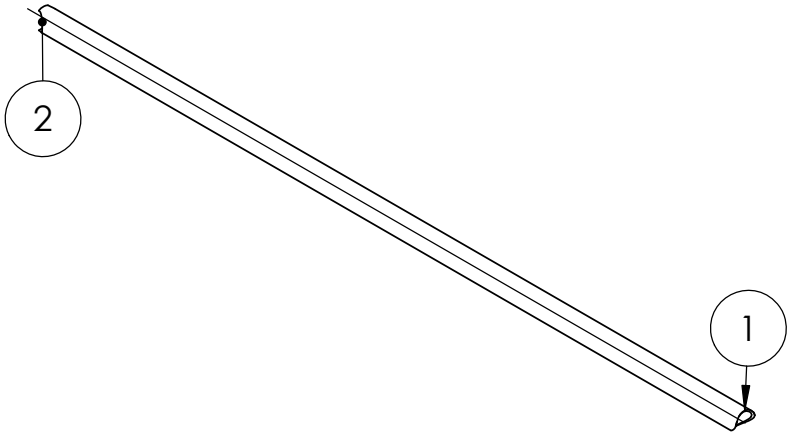
SPONSOR PROJECT TEAM NUMBER		dc DESIGN CENTER COLORADO DESIGN • BUILD • INVENT	
TOLERANCES UNLESS NOTED: UNITS:	X.X ± X.XX ± X.XXX ± X.X° ±°	FILE NAME ConnectorTube-1.0	
		APPROVAL	
DRAWN BY Hope Jackson	DRAWN DATE 10/2/2025	MFD BY	
MATERIAL Plain Carbon Steel		DESCRIPTION	
STOCK SIZE		PN / REV	SHEET 1 of 1

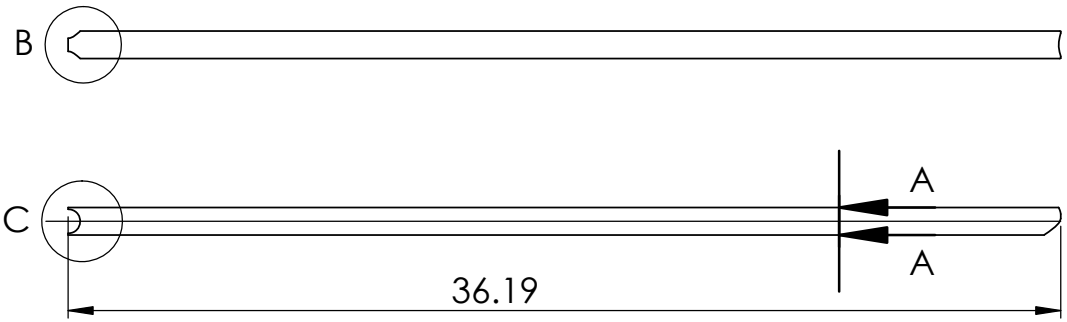


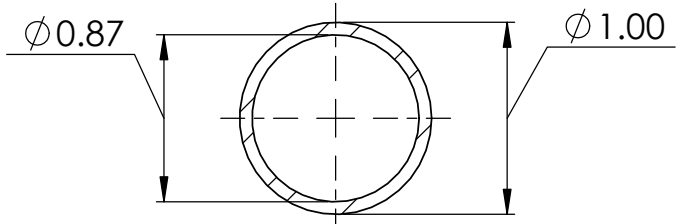
DETAIL B
SCALE 1 : 2



DETAIL C
SCALE 1 : 2



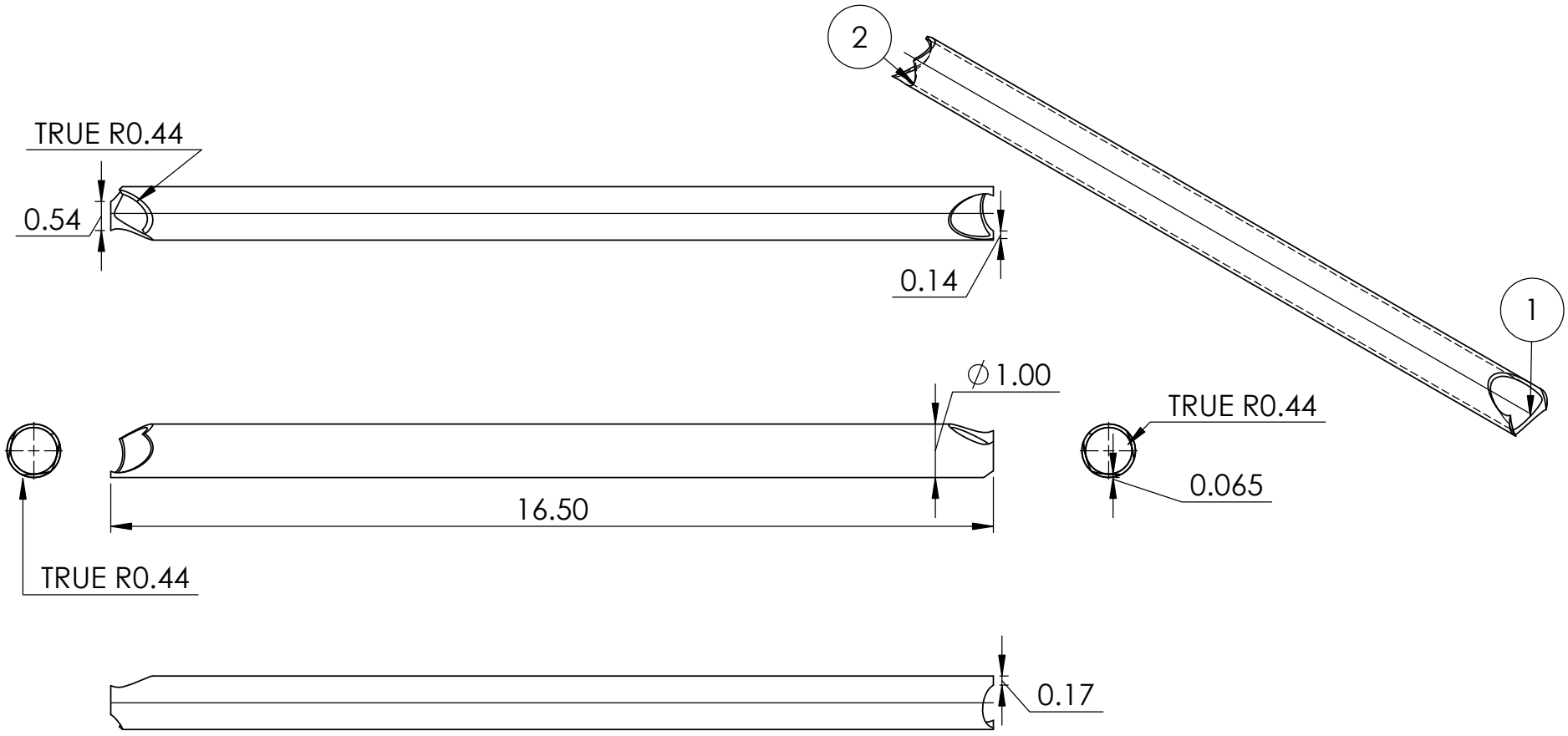




SECTION A-A
SCALE 1 : 1

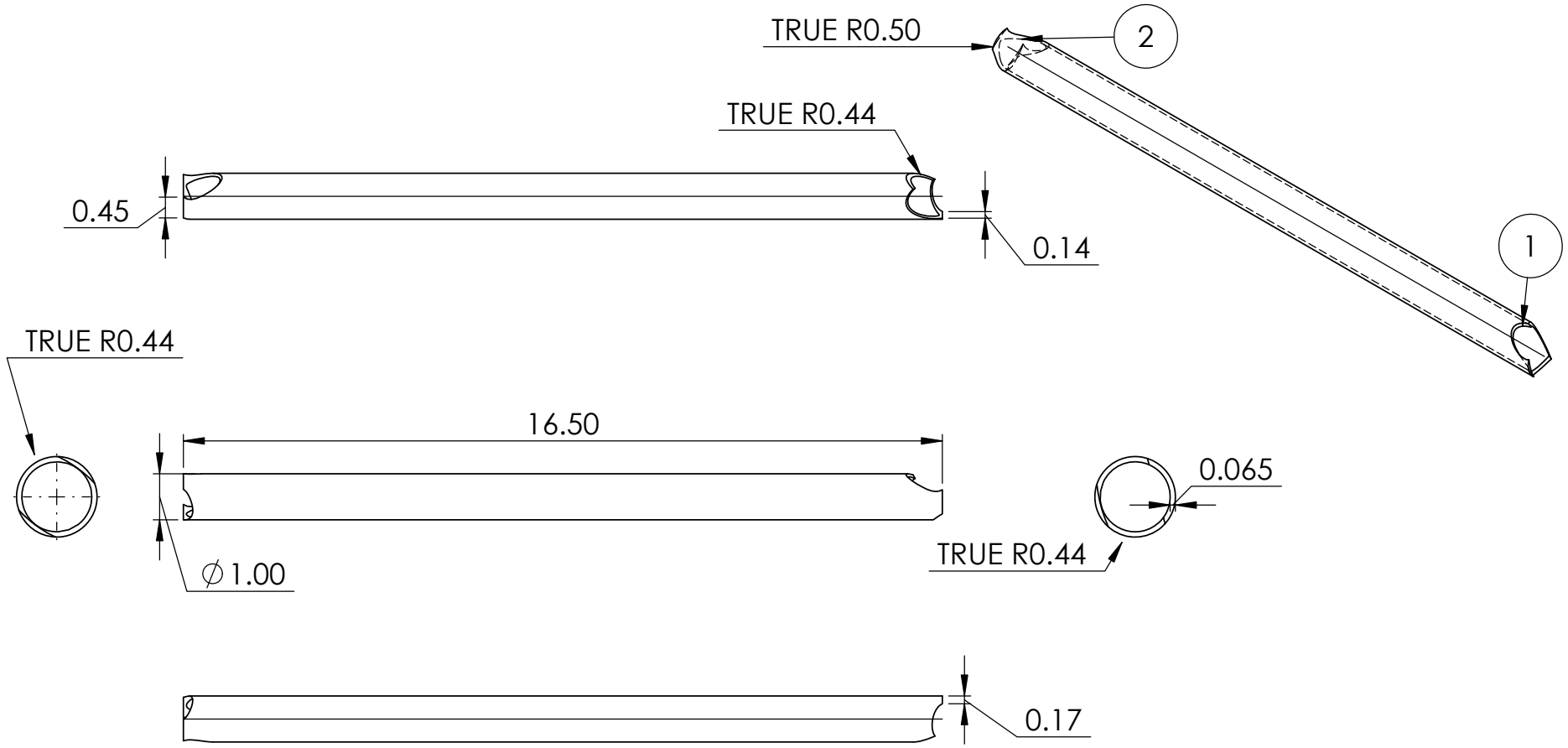
1. The tube end is cut at a 18 degree angle to fit with the base connector.
2. The tube end is cut for fit on top of the main connector beam.

SPONSOR PROJECT TEAM NUMBER		DESIGN CENTER COLORADO DESIGN • BUILD • INVENT	
TOLERANCES UNLESS NOTED: UNITS:	X.X ± X.XX ± X.XXX ± X.X° ±°	FILE NAME BaseTube-1.0	
		APPROVAL	
DRAWN BY Hope Jackson	DRAWN DATE 10/2/2025	MFD BY	
MATERIAL Plain Carbon Steel		DESCRIPTION	
STOCK SIZE		PN / REV	SHEET 1 of 1



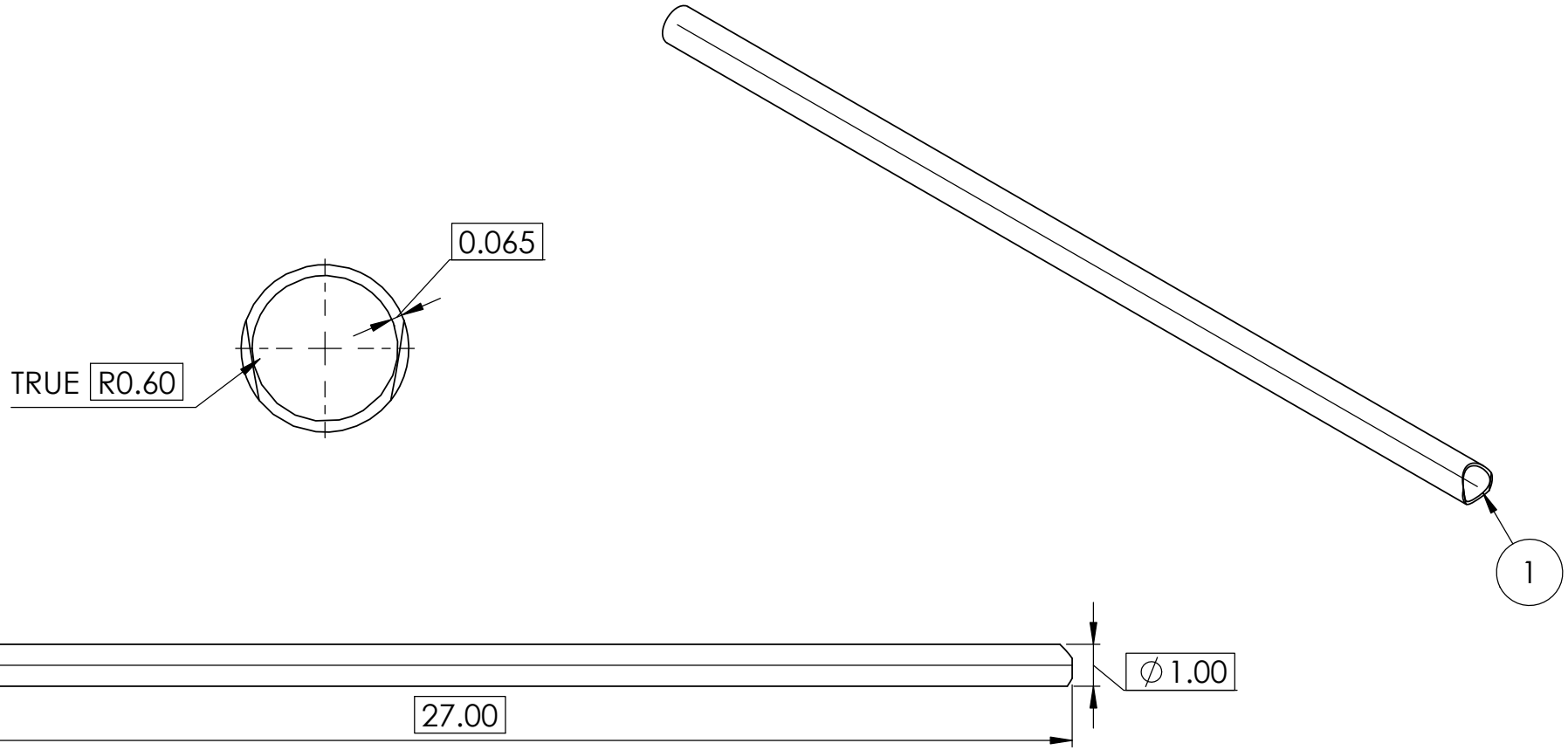
1. This end of the tube is cut to be able to attach and be welded to the connector tube
2. This end of the tube is cut to be able to connect to both the Left Support Beam and the Main Tube.

SPONSOR PROJECT TEAM NUMBER			DESIGN CENTER COLORADO DESIGN • BUILD • INVENT
TOLERANCES UNLESS NOTED: UNITS:	X.X ± X.XX ± X.XXX ± X.X° ±°		FILE NAME SupportBeams-Left-2.0
			APPROVAL
DRAWN BY Hope Jackson	DRAWN DATE 10/3/2025		MFD BY
MATERIAL Plain Carbon Steel			DESCRIPTION
STOCK SIZE		PN / REV	SHEET 1 of 1



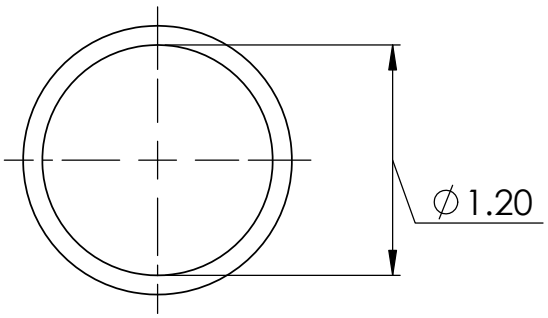
1. This end of the tube is cut to be able to attach and be welded to the connector tube
2. This end of the tube is cut to be able to connect to both the Left Support Beam and the Main Tube.

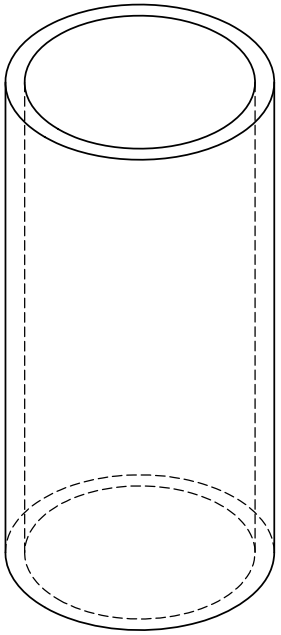
SPONSOR PROJECT TEAM NUMBER		dc DESIGN CENTER COLORADO DESIGN • BUILD • INVENT	
TOLERANCES UNLESS NOTED: UNITS:	X.X ± X.XX ± X.XXX ± X.X° ±°	FILE NAME SupportBeams-Right-1.0	
		APPROVAL	
DRAWN BY Hope Jackson	DRAWN DATE 10/3/2025	MFD BY	
MATERIAL Plain Carbon Steel		DESCRIPTION	
STOCK SIZE		PN / REV	SHEET 1 of 1

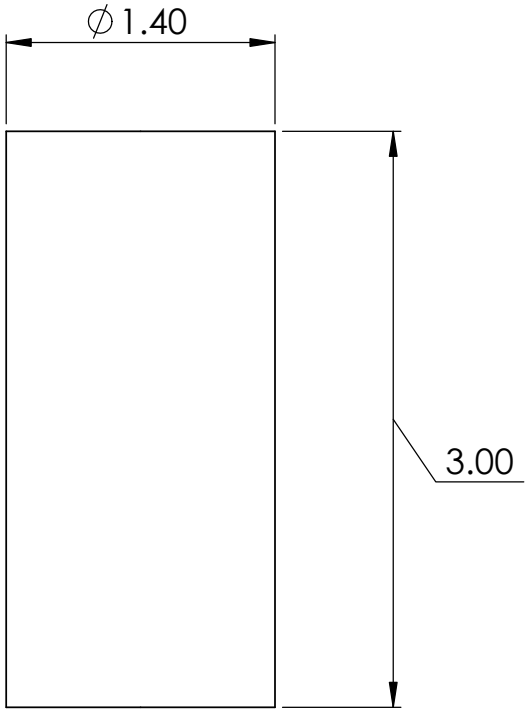


1. Tube's end is cut at an angle of 18 degrees to fit with the base connector.

SPONSOR PROJECT TEAM NUMBER		DESIGN CENTER COLORADO DESIGN • BUILD • INVENT	
TOLERANCES UNLESS NOTED: UNITS:	X.X ± X.XX ± X.XXX ± X.X° ±°	FILE NAME MainTube-1.0	APPROVAL
DRAWN BY Hope Jackson	DRAWN DATE 10/2/2025	MFD BY	
MATERIAL Plain Carbon Steel		DESCRIPTION	
STOCK SIZE		PN / REV	SHEET 1 of 1

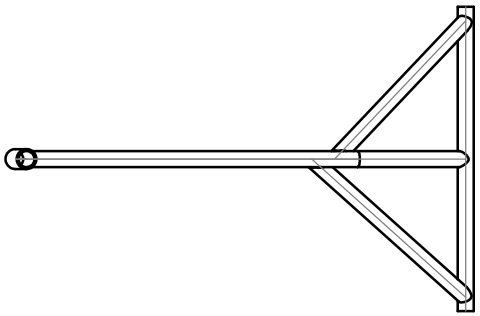


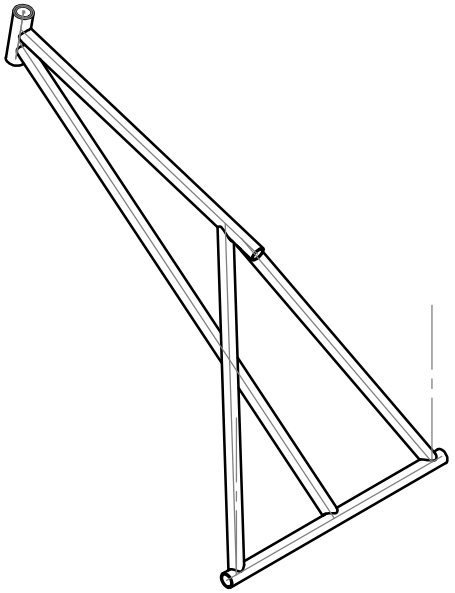


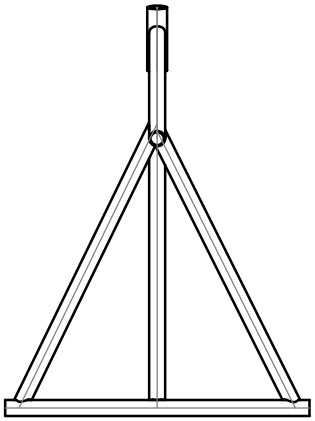


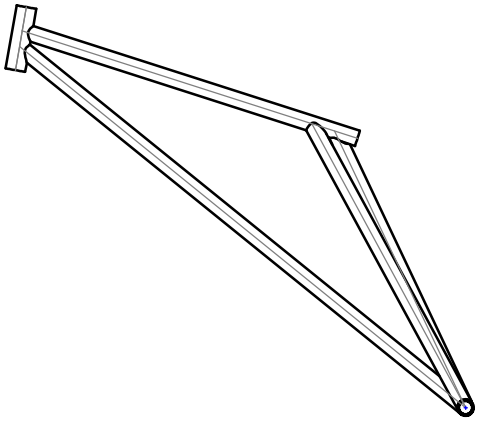
SPONSOR PROJECT TEAM NUMBER			DESIGN CENTER COLORADO DESIGN • BUILD • INVENT
TOLERANCES UNLESS NOTED: UNITS:	X.X ± X.XX ± X.XXX ± X.X° ±°		FILE NAME BaseConnector-1.0
			APPROVAL
DRAWN BY Hope Jackson	DRAWN DATE 10/2/2025		MFD BY
MATERIAL Plain Carbon Steel			DESCRIPTION
STOCK SIZE		PN / REV	SHEET 1 of 1

REV.	DESCRIPTION	DATE





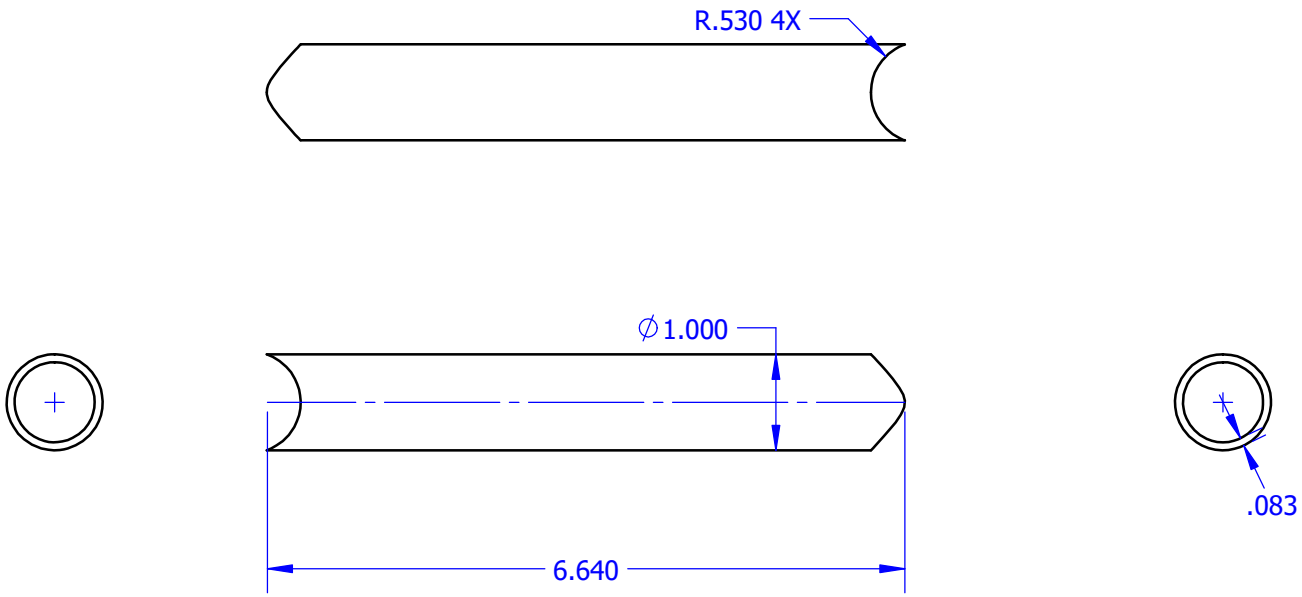




SPONSOR PROJECT TEAM NUMBER		dc DESIGN CENTER COLORADO DESIGN • BUILD • INVENT	
TOLERANCES UNLESS NOTED: UNITS: INCHES	X.X ± X.XX ±0.010 X.XXX ±0.005 X.X° ±0.5°	FILE NAME FRAME_3.1	
		APPROVAL	
DRAWN BY	DRAWN DATE	MFD BY	
MATERIAL		DESCRIPTION	
STOCK SIZE		PN / REV	SHEET 1 of 1

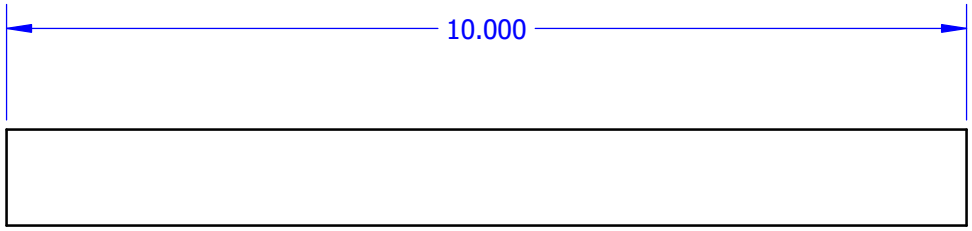
REV.	DESCRIPTION	DATE
B	CORRECTED DIMENSIONS AND MATERIAL	10/2/2025
C	PRE DEISIGN REVIEW UPDATES (JA)	10/5/2025
D	CHANGED THICKNES TO 0.834 AND ADDED COPE	10/18/2025

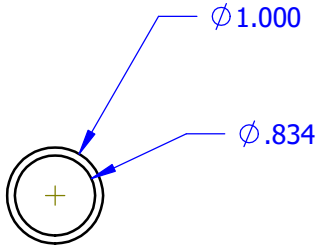
NOTE: MACHINE AS 130 DEG COPE



SPONSOR PROJECT TEAM NUMBER	MCEN 3025 TEAM ROCEKT		DESIGN CENTER COLORADO DESIGN • BUILD • INVENT
TOLERANCES UNLESS NOTED: UNITS: INCHES	X.X ± X.XX ±0.010 X.XXX ±0.005 X.X° ±0.5°		FILE NAME FOOT-REST_CONNECTION_1.3 APPROVAL
DRAWN BY EG	DRAWN DATE 10/18/2025		MFD BY
MATERIAL PLAIN CARBON STEEL			DESCRIPTION FOOT REST CONNECTION
STOCK SIZE 1" OD X 0.083" WALL TUBE		PN	REV D SHEET 1 of 1

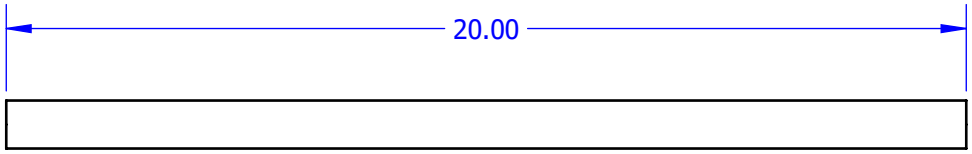
REV.	DESCRIPTION	DATE
A	INITIAL RELEASE	10/1/2025
B	CORRECTED DEMINTIONS AND CHANGED MATERIAL	10/2/2025

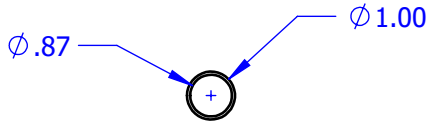




SPONSOR PROJECT TEAM NUMBER	MCEN 3025 TEAM ROCKET		DESIGN CENTER COLORADO DESIGN • BUILD • INVENT
TOLERANCES UNLESS NOTED: UNITS: INCHES	X.X ±0.05 X.XX ±0.010 X.XXX ±0.005 X.X° ±0.5°		FILE NAME FOOT-REST_1.3 APPROVAL
DRAWN BY EG	DRAWN DATE 10/1/2025		MFD BY
MATERIAL PLAIN CARBON STEEL			DESCRIPTION FOOT-REST
STOCK SIZE 1" OD X 0.083" ID		PN	REV B SHEET 1 of 1

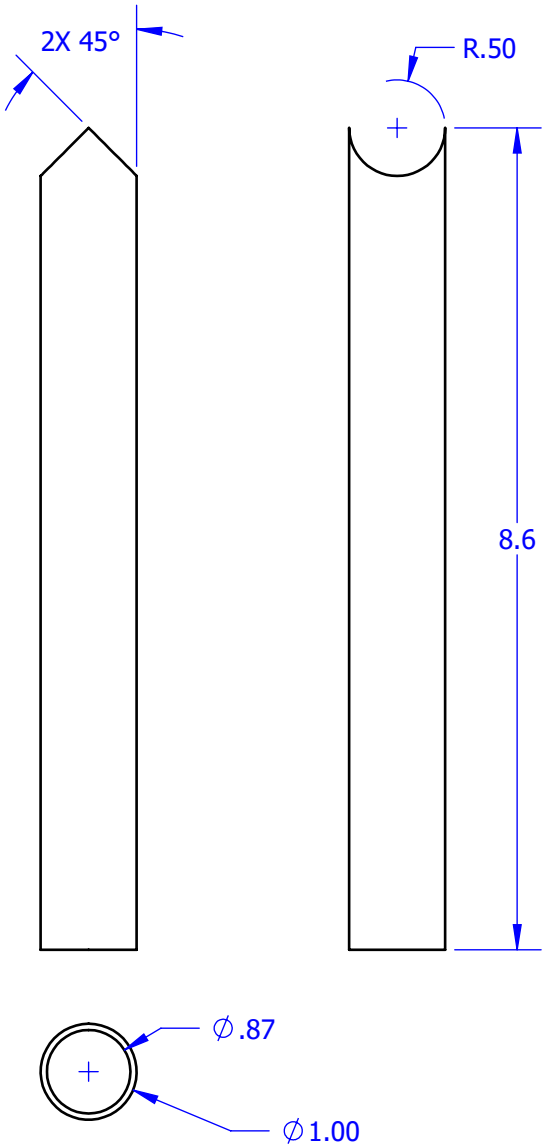
REV.	DESCRIPTION	DATE
A	INITIAL RELEASE	10/5/2025





SPONSOR PROJECT TEAM NUMBER	MCEN 3025 TEAM ROCKET		DESIGN CENTER COLORADO
TOLERANCES UNLESS NOTED: UNITS: INCHES	X.X ± X.XX ±0.010 X.XXX ±0.005 X.X° ±0.5°		FILE NAME FRONT_FORK_2.0
			APPROVAL
DRAWN BY JA	DRAWN DATE 10/5/25		MFD BY
MATERIAL PLAIN CARBON STEEL			DESCRIPTION FRONT FORK HANDEL
STOCK SIZE		PN	REV A SHEET 1 of 1

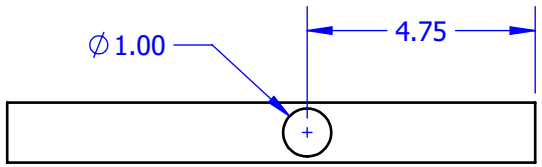
REV.	DESCRIPTION	DATE
A	INITIAL RELEASE	10/5/2025

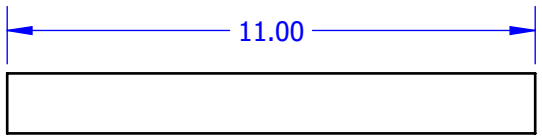


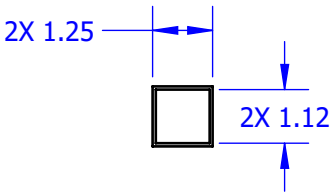
NOTE:
HEIGHT SUBJECT TO CHANGE, NOT IMPORTANT FOR ASSEMBLY TO FUNCTION

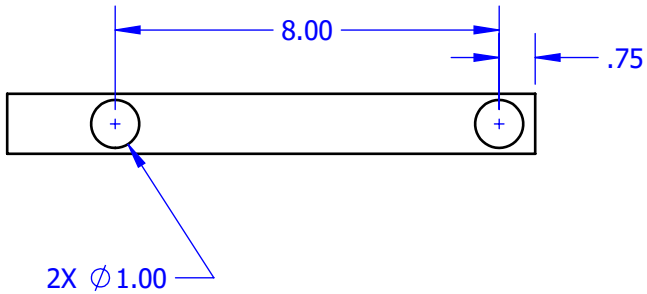
SPONSOR PROJECT TEAM NUMBER	MCEN 3025 TEAM ROCKET		DESIGN CENTER COLORADO
TOLERANCES UNLESS NOTED: UNITS: INCHES	X.X ± X.XX ±0.010 X.XXX ±0.005 X.X° ±0.5°		FILE NAME FRONT_FORK_2.0 APPROVAL
DRAWN BY JA	DRAWN DATE 10/5/25		MFD BY
MATERIAL PLAIN CARBON STEEL			DESCRIPTION FRONT FORK CENTER BAR
STOCK SIZE		PN REV A	SHEET 1 of 1

REV.	DESCRIPTION	DATE
A	INITIAL RELEASE	10/5/2025



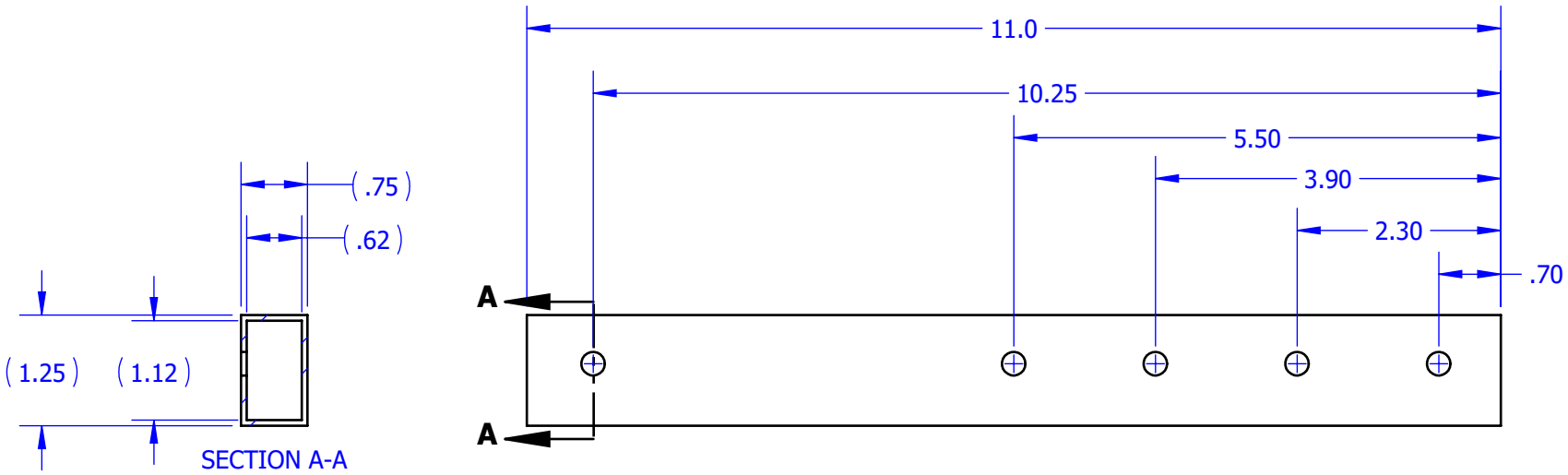






SPONSOR PROJECT TEAM NUMBER	MCEN 3025 TEAM ROCKET		
TOLERANCES UNLESS NOTED: UNITS: INCHES	X.X ± X.XX ±0.010 X.XXX ±0.005 X.X° ±0.5°	FILE NAME	FRONT_FORK_2.0
		APPROVAL	
DRAWN BY: JA	DRAWN DATE: 10/5/25	MFD BY	
MATERIAL: PLAIN CARBON STEEL		DESCRIPTION	FRONT FORK CROSSBAR
STOCK SIZE		PN / REV: A	SHEET: 1 of 1

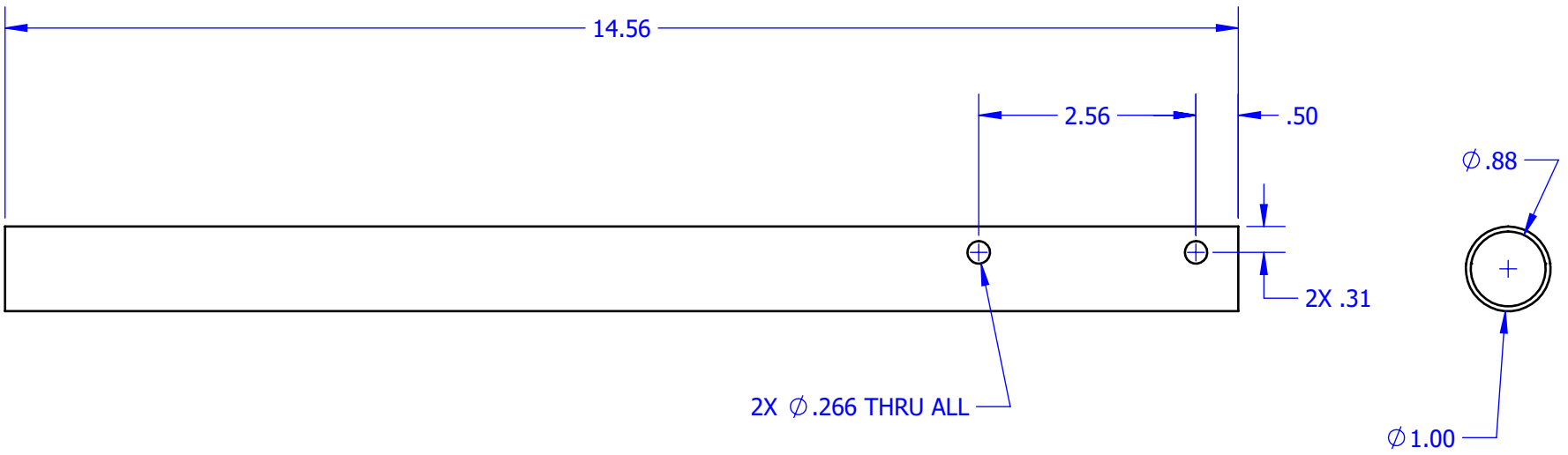
REV.	DESCRIPTION	DATE
A	INITIAL RELEASE	10/5/2025



ALL HOLES THROUGH ONE WALL ONLY

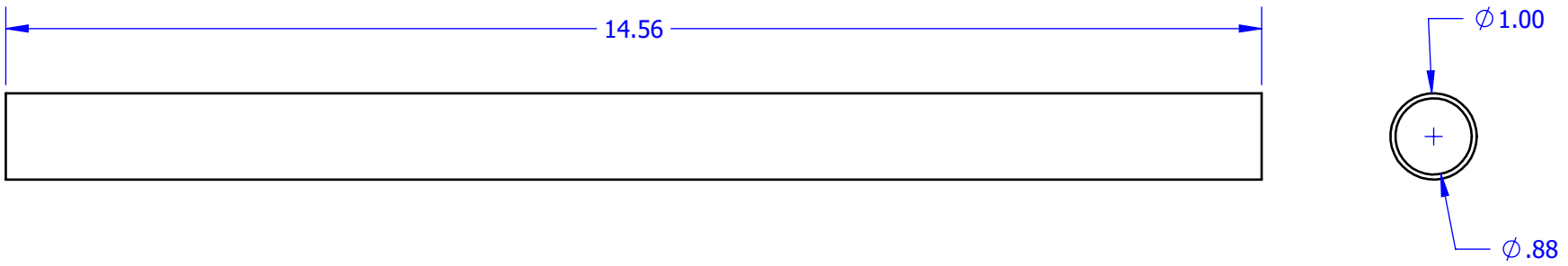
SPONSOR / PROJECT / TEAM NUMBER	MCEN 3025 TEAM ROCKET	DESIGN CENTER COLORADO
TOLERANCES UNLESS NOTED: X.X ±, X.XX ±0.010, X.XXX ±0.005, UNITS: INCHES X.X° ±0.5°		FILE NAME: HEAD_STOCK_1.0
		APPROVAL
DRAWN BY: JA	DRAWN DATE: 10/5/25	MFD BY
MATERIAL: PLAIN CARBON STEEL		DESCRIPTION: HEAD STOCK
STOCK SIZE	PN / REV: A	SHEET: 1 of 1

REV.	DESCRIPTION	DATE
A	INITIAL RELEASE	10/5/2025



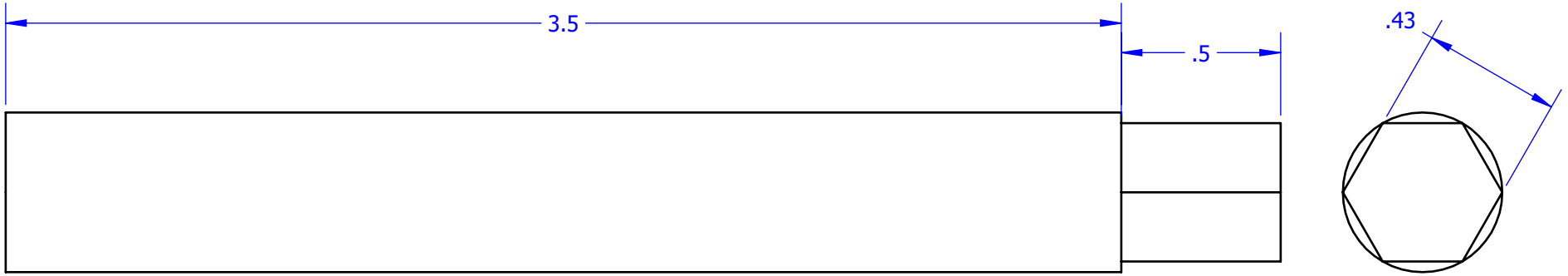
SPONSOR PROJECT TEAM NUMBER	MCEN 3025 TEAM ROCKET	DESIGN CENTER COLORADO	
TOLERANCES UNLESS NOTED: UNITS: INCHES	X.X ± X.XX ±0.010 X.XXX ±0.005 X.X° ±0.5°	FILE NAME FRONT_FORK_2.0	
		APPROVAL	
DRAWN BY JA	DRAWN DATE 10/5/25	MFD BY	
MATERIAL PLAIN CARBON STEEL		DESCRIPTION FRONT FORK LEFT	
STOCK SIZE		PN	REV A
			SHEET 1 of 1

REV.	DESCRIPTION	DATE
A	INITIAL RELEASE	10/5/2025



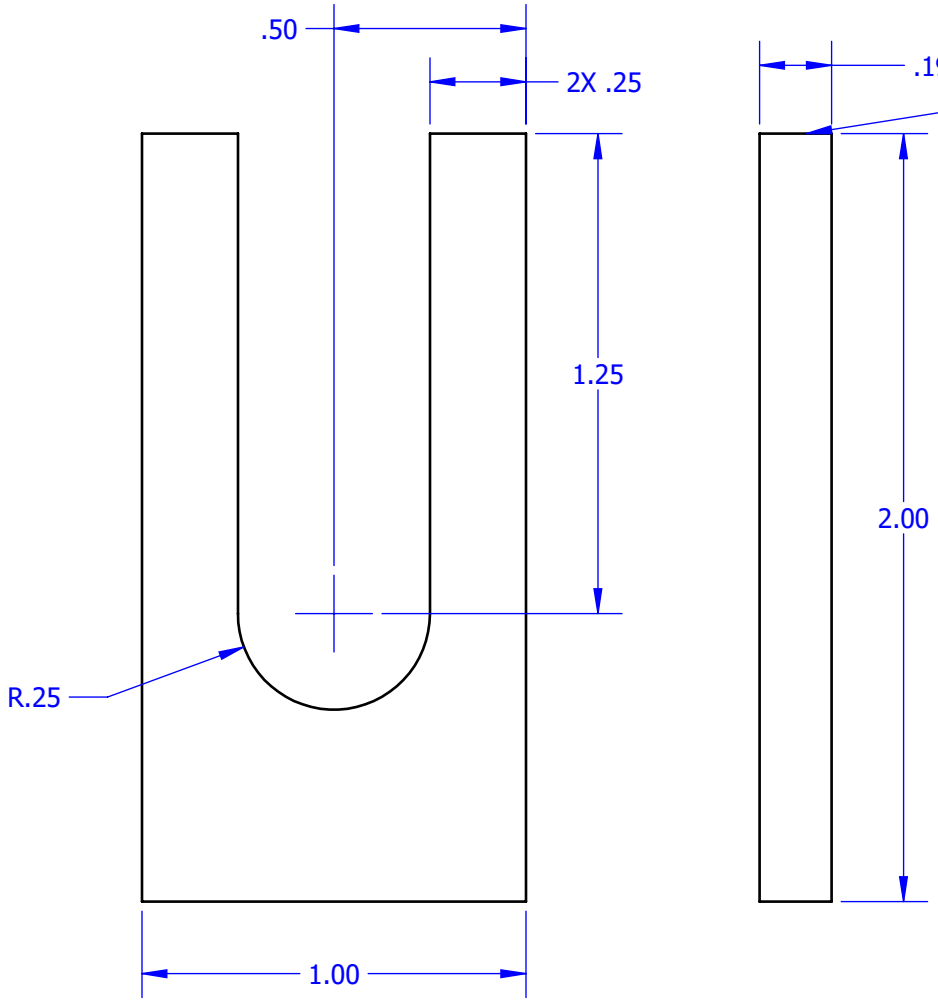
SPONSOR PROJECT TEAM NUMBER	MCEN 3025 TEAM ROCKET		DESIGN CENTER COLORADO
TOLERANCES UNLESS NOTED: UNITS: INCHES	X.X ± X.XX ±0.010 X.XXX ±0.005 X.X° ±0.5°		FILE NAME FRONT_FORK_2.0
			APPROVAL
DRAWN BY JA	DRAWN DATE 10/5/25		MFD BY
MATERIAL PLAIN CARBON STEEL			DESCRIPTION FRONT FORK RIGHT
STOCK SIZE		PN	REV A
			SHEET 1 of 1

REV.	DESCRIPTION	DATE
A	INITIAL RELEASE	10/4/2025

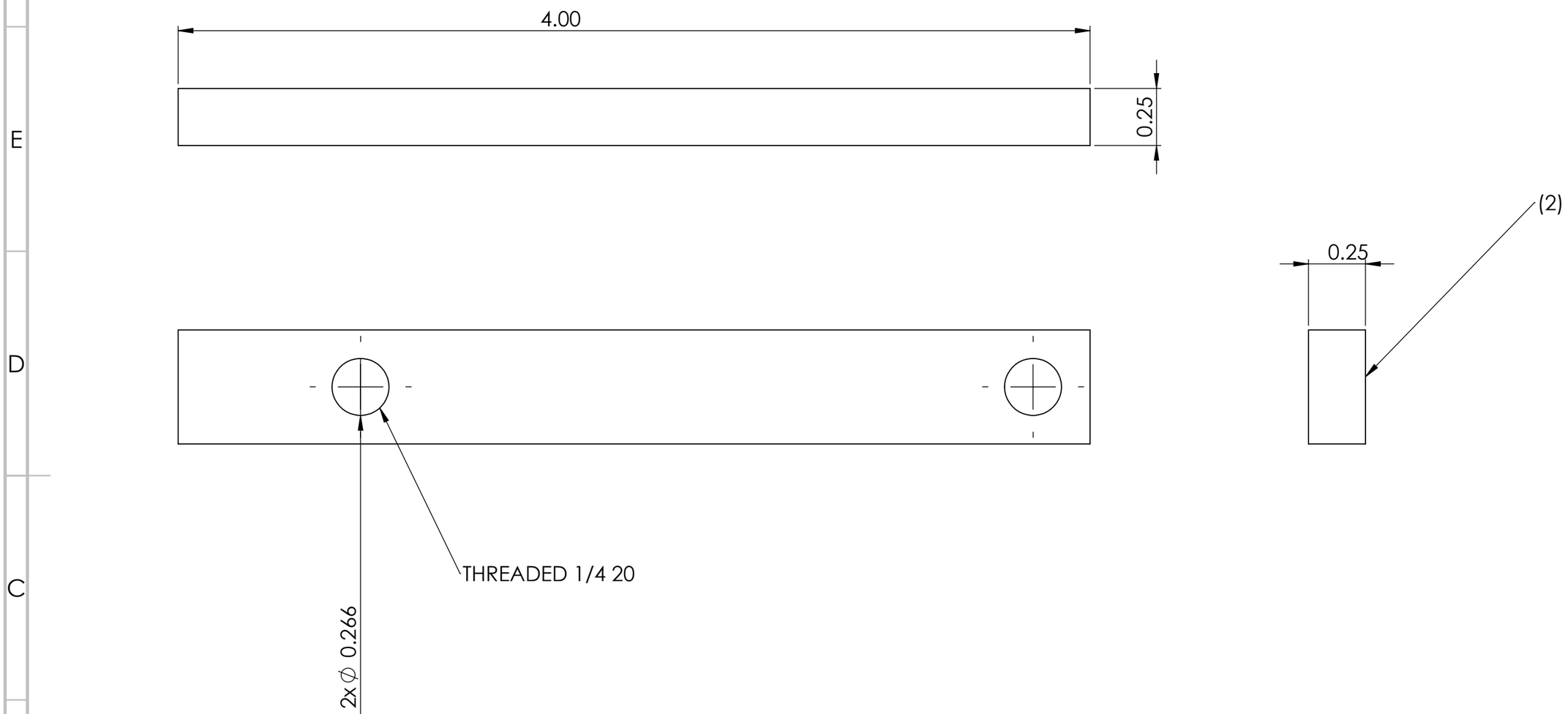


SPONSOR PROJECT TEAM NUMBER	MCEN 3025 TEAM ROCEKT		DESIGN CENTER COLORADO
TOLERANCES UNLESS NOTED: UNITS: INCHES	X.X ±0.05 X.XX ±0.010 X.XXX ±0.005 X.X° ±0.5°		FILE NAME DRILL-1.2
			APPROVAL
DRAWN BY JA	DRAWN DATE 10/4/25		MFD BY
MATERIAL 1566 CARBON STEEL			DESCRIPTION DRILL SHAFT
STOCK SIZE 1/2" X 5.5"		PN	REV A
			SHEET 1 of 1

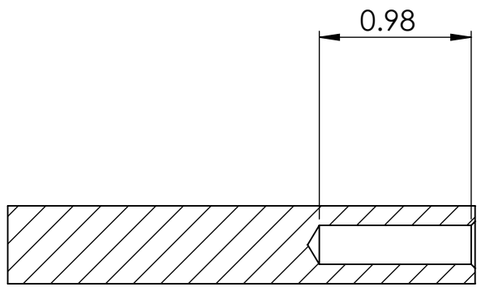
REV.	DESCRIPTION	DATE
A	INITIAL RELEASE	10/5/2025



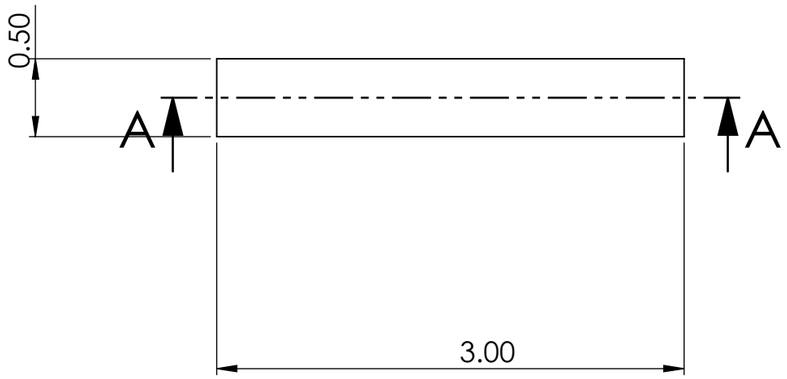
SPONSOR PROJECT TEAM NUMBER	MCEN 3025 TEAM ROCKET		DESIGN CENTER COLORADO
TOLERANCES UNLESS NOTED: UNITS: INCHES	X.X ± X.XX ±0.010 X.XXX ±0.005 X.X° ±0.5°		FILE NAME WHEEL_HOLDER_1.0
			APPROVAL
DRAWN BY JA	DRAWN DATE 10/5/25		MFD BY
MATERIAL ALUMINUM			DESCRIPTION WHEEL HOLDER
STOCK SIZE		PN	REV A / SHEET 1 of 1

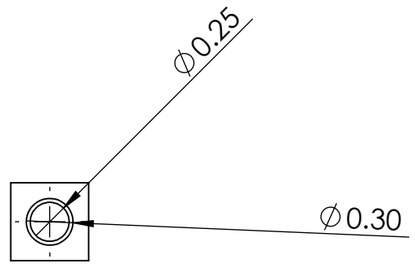


UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:	FINISH:				DEBURR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING	REVISION
	NAME	SIGNATURE	DATE			TITLE:	
DRAWN							
CHK'D							
APPV'D							
MFG							
Q.A				MATERIAL:		DWG NO.	A3
						disk holder part base	
				WEIGHT:		SCALE:2:1	SHEET 1 OF 1



SECTION A-A



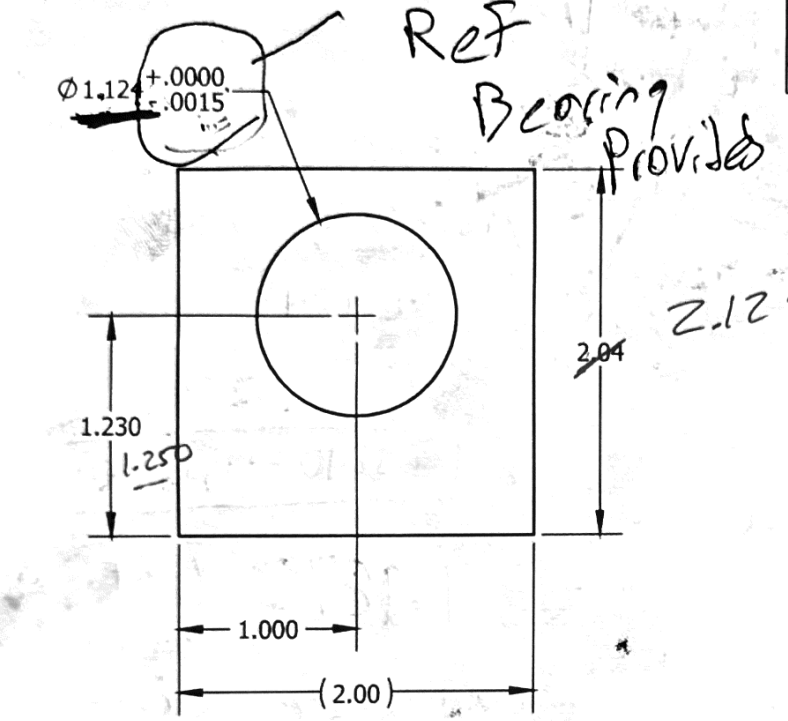


UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:		FINISH:			DEBURR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING	REVISION
	NAME	SIGNATURE	DATE			TITLE:	
DRAWN							
CHK'D							
APPV'D							
MFG							
Q.A				MATERIAL:		DWG NO.	A3
						disk holder part support	
				WEIGHT:		SCALE:1:1	SHEET 1 OF 1

1.125 -.0003 -.0013

1200 rpm

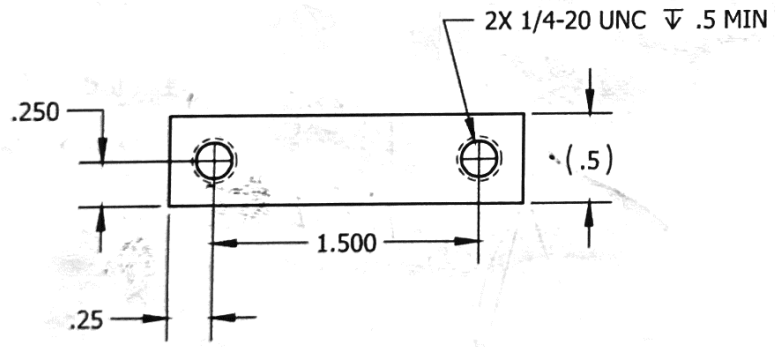
REV.	DESCRIPTION	DATE
A	INITIAL RELEASE	9/27/2025
B	UPDATE PER PRE DESIGN REVIEW FEEDBACK	10/2/2025
C	POST DESIGN REVIEW EDITS	10/12/2025



#7 drill - 1000 rpm - 0.75 ↧

2200 ish rpm

750 rpm

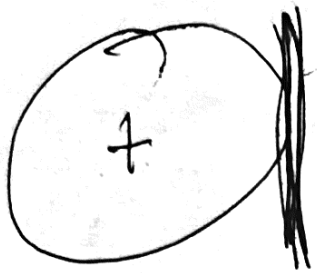


1.375

1.280

SPONSOR / PROJECT / TEAM NUMBER	MCEN 3025 TEAM ROCKET	dc DESIGN CENTER COLORADO	
TOLERANCES UNLESS NOTED: UNITS: INCHES	X.X ±0.030 X.XX ±0.010 X.XXX ±0.005 X.X° ±0.5°	FILE NAME	PILLOW_BLOCK_1.3
		APPROVAL	
DRAWN BY: JA	DRAWN DATE: 10/2/25	MFD BY	
MATERIAL: ALUMINUM		DESCRIPTION: PILLOW BLOCK	
STOCK SIZE: 1/2" x 2" x 4"		PN	REV: C / SHEET: 1 of 1

30 = 0



1.350 –
~~.10~~ ~~.09~~ +.08
~~1.3500~~
1.3582

Micrometer
1.2507in

1.1243

~~1.1240~~ - 1.1230

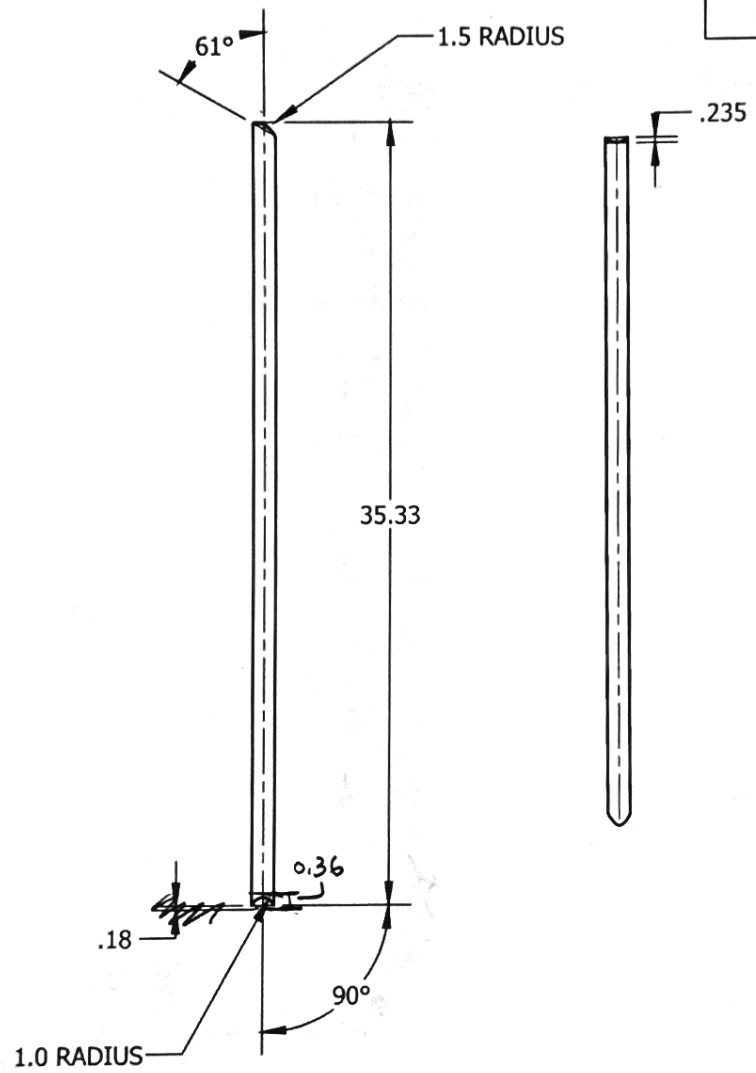
1.0873 left: .0357
take: .010
1.0958 left: .0272
left: .018
1.1050 take: .008
1.1128 left: .010
1.1188 take: .005
take: .004

Bearings

1	2
1.125 +24 1.1491in	1.125 +24 1.1490in
1.125 +22 1.1474in	1.125 +24 1.1492in
1.125 +23 1.1487in	1.125 +24 1.1492in
1.125 +24 1.1492in	1.125 +24 1.1493in

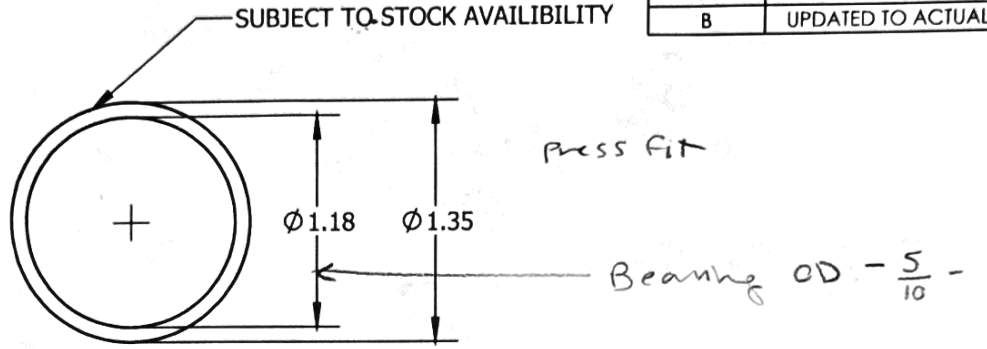
1	2
1.1251	1.1250
1.1254	1.1252
1.1257	1.1262
1.1252	1.1253
1.1255	1.1252
~~1.1253~~	1.1241
1.1243	1.1240

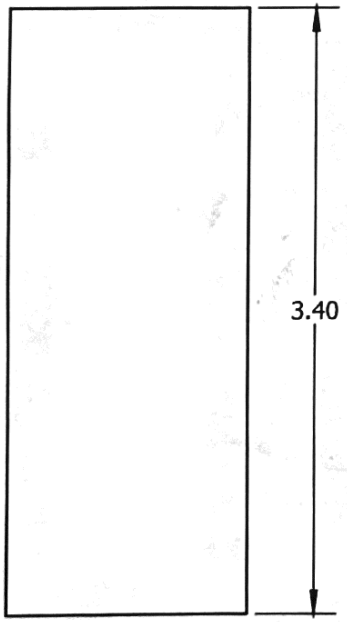
REV.	DESCRIPTION	DATE
A	INITIAL RELEASE	10/4/2025
B	CHANGE FROM 0.065" TO 0.083" THICKNESS TUBING AND ADD COPE	10/20/2025
C	COPE UPDATES	10/29/2025



SPONSOR / PROJECT / TEAM NUMBER	MCEN 3025 TEAM ROCKET	dc DESIGN CENTER COLORADO	
TOLERANCES UNLESS NOTED: UNITS: INCHES	X.X ± X.XX ±0.010 X.XXX ±0.005 X.X° ±0.5°	FILE NAME	BOTTOM_BEAM-4.0
		APPROVAL	
DRAWN BY: JA	DRAWN DATE: 10/20/25	MFD BY	
MATERIAL: PLAIN CARBON STEEL		DESCRIPTION: BOTTOM BEAM	
STOCK SIZE: 1" OD X 0.083" WALL TUBE		PN	REV: C / SHEET: 1 of 1

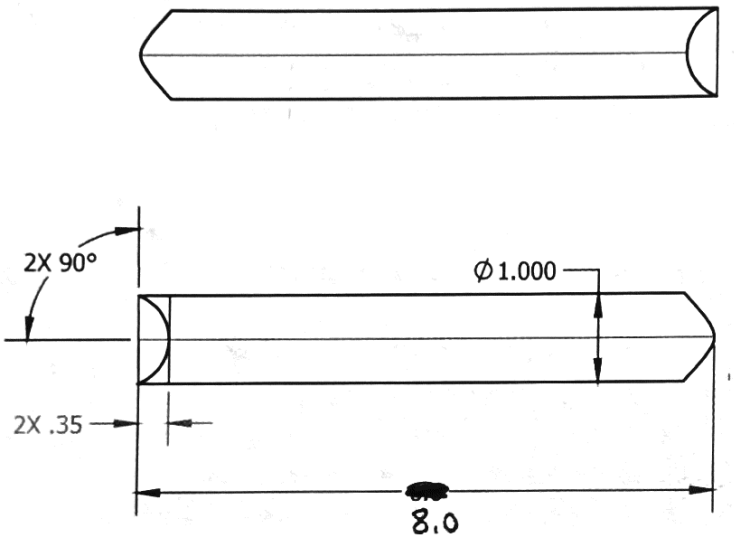
REV.	DESCRIPTION	DATE
A	INITIAL RELEASE	10/5/2025
B	UPDATED TO ACTUAL DIMENSIONS	10/30/2025



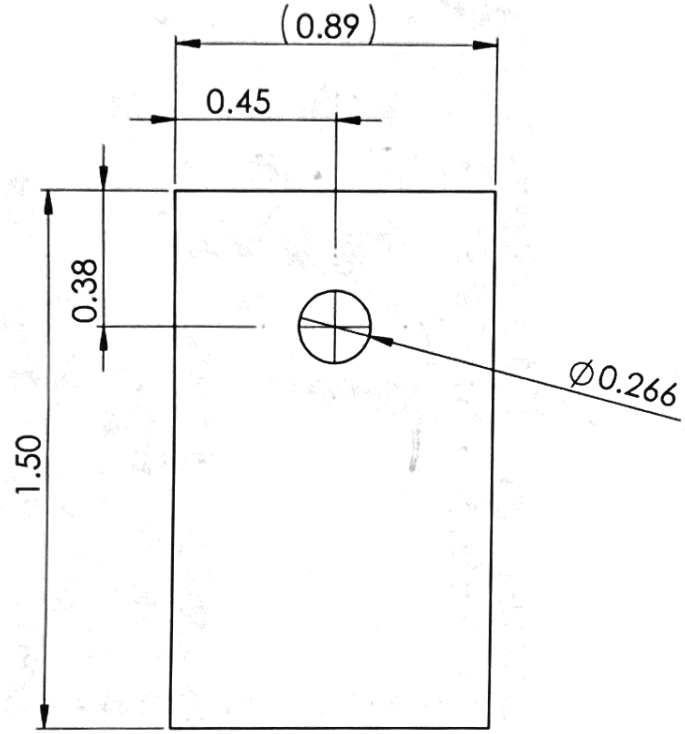


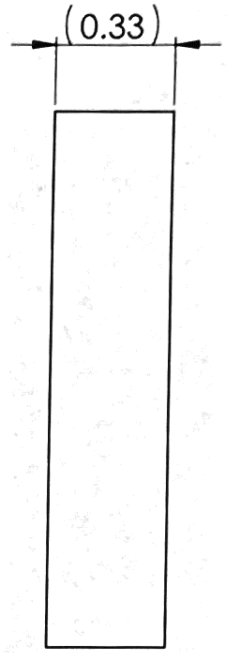
SPONSOR / PROJECT / TEAM NUMBER	MCEN 3025 TEAM ROCKET	dc DESIGN CENTER COLORADO	
TOLERANCES UNLESS NOTED: UNITS: INCHES	X.X ± X.XX ±0.010 X.XXX ±0.005 X.X° ±0.5°	FILE NAME	HEAD_TUBE-1.0
		APPROVAL	
DRAWN BY: JA	DRAWN DATE: 10/5/25	MFD BY	
MATERIAL	PLAIN CARBON STEEL	DESCRIPTION	HEAD TUBE
STOCK SIZE		PN / REV: B	SHEET: 1 of 1

REV.	DESCRIPTION	DATE
B	CORRECTED DIMENSIONS AND MATERIAL	10/2/2025
C	PRE DEISIGN REVIEW UPDATES (JA)	10/5/2025
D	CHANGED THICKNES TO 0.834 AND ADDED COPE	10/18/2025
E	UPDATE COPE	11/7/2025



SPONSOR PROJECT TEAM NUMBER	MCEN 3025 TEAM ROCEKT	dc DESIGN CENTER COLORADO	
TOLERANCES UNLESS NOTED: UNITS: INCHES	X.X ± X.XX ±0.010 X.XXX ±0.005 X.X° ±0.5°	FILE NAME FOOT-REST_CONNECTION_1.3	
		APPROVAL	
DRAWN BY EG	DRAWN DATE 10/18/2025	MFD BY	
MATERIAL PLAIN CARBON STEEL		DESCRIPTION FOOT REST CONNECTION	
STOCK SIZE 1" OD X 0.083" WALL TUBE		PN	REV E
			SHEET 1 of 1



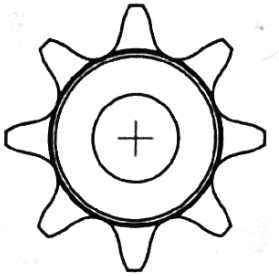


r = 0.1

1200 rpm edge
Hit 650 rpm

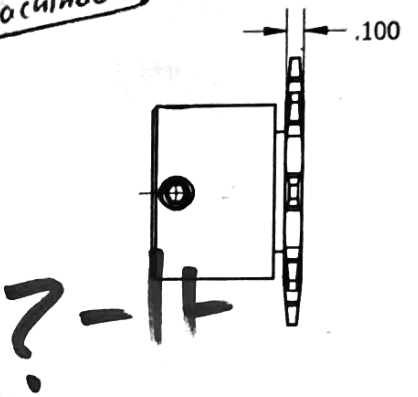
SPONSOR PROJECT TEAM NUMBER		dc DESIGN CENTER COLORADO	
TOLERANCES UNLESS NOTED: UNITS:	X.X ± X.XX ± X.XXX ± X.X° ±°	FILE NAME BRAKE_BLOCK-1.0	
		APPROVAL	
DRAWN BY EG	DRAWN DATE	MFD BY	
MATERIAL STEEL		DESCRIPTION BRAKE BLOCK	
STOCK SIZE		PN / REV	SHEET 1 of 1

REV.	DESCRIPTION	DATE
A	INITIAL RELEASE	11/11/2025



Plain bore + machinable

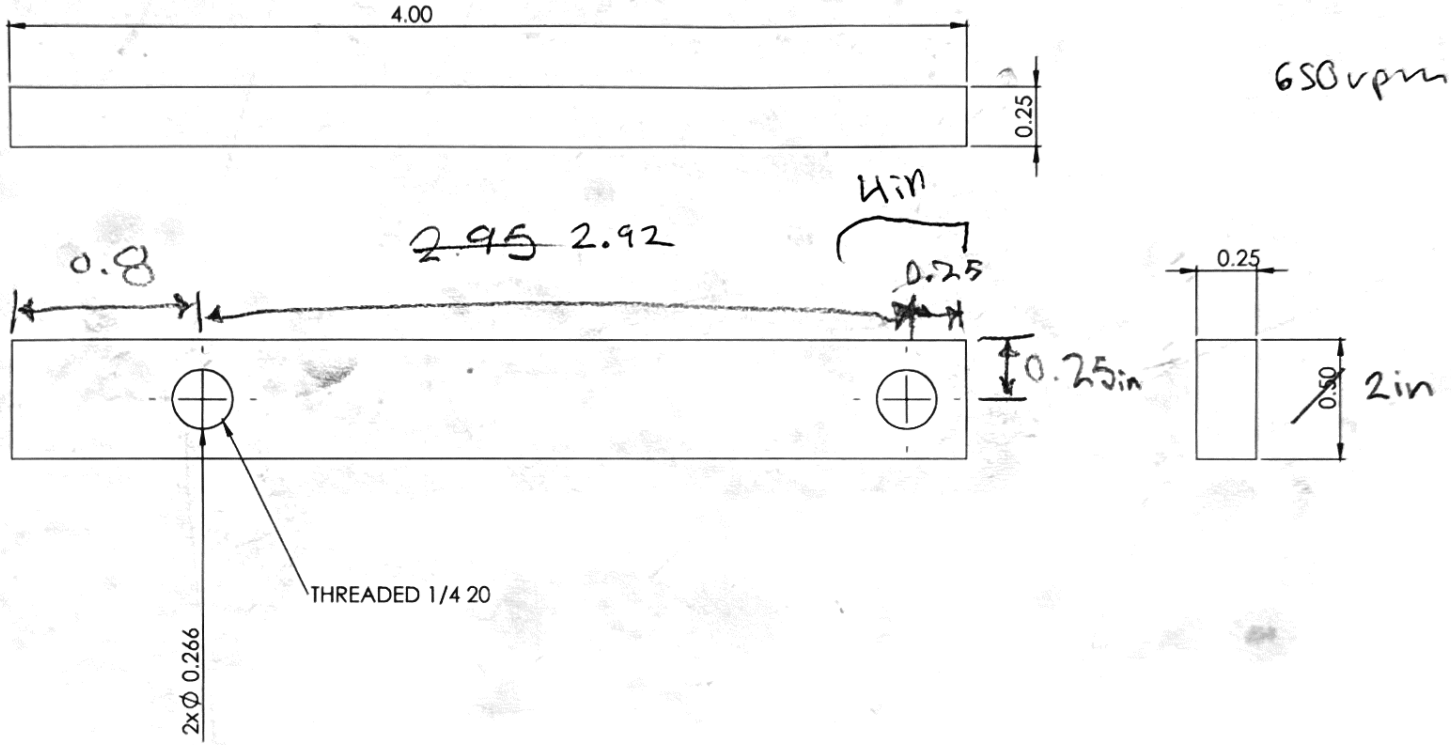
1/4-20 screws



SPONSOR / PROJECT / TEAM NUMBER	MCEN 3025 TEAM ROCKET		DESIGN CENTER COLORADO
TOLERANCES UNLESS NOTED:	X.X ±		FILE NAME: MODIFIED_ROLLER_CHAIN_SPROCKET
	X.XX ±0.010		APPROVAL
	X.XXX ±0.005		
UNITS: INCHES	X.X° ±0.5°		
DRAWN BY: EG	DRAWN DATE: 11/11/25		MFD BY
MATERIAL: STEEL			DESCRIPTION: Roller Chain Sprocket
STOCK SIZE		PN: 2737T93 / REV: A	SHEET: 1 of 1

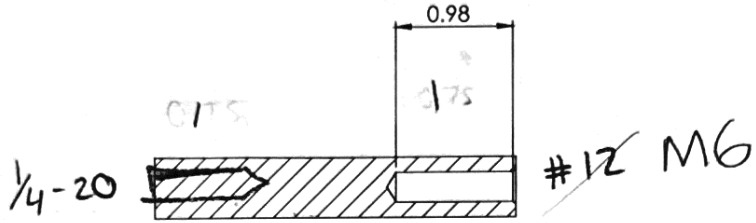
1200 edge (0.100 radius)

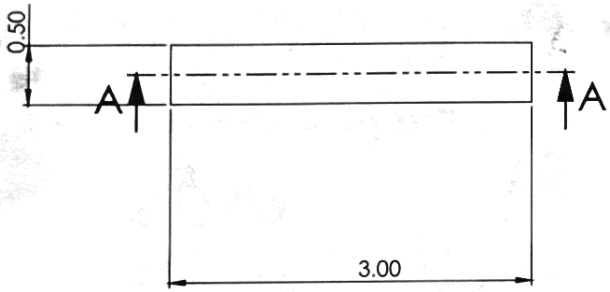
650 rpm

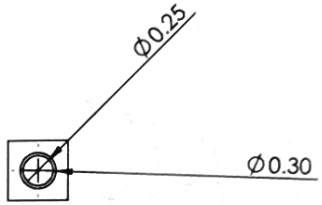


UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR ANGULAR:		FINISH:			DEBURR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING	REVISION
	NAME	SIGNATURE	DATE				
DRAWN						TITLE:	
CHK'D							
APPV'D							
MFG							
Q.A				MATERIAL		DWG NO.	A3
				WEIGHT:		SCALE:2:1	SHEET 1 OF 1

disk holder part base







UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:		FINISH:			DEBURR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING	REVISION
	NAME	SIGNATURE	DATE			TITLE:	
DRAWN							
CHK'D							
APPV'D							
MFG							
Q.A				MATERIAL:		DWG NO.	A3
				WEIGHT:		SCALE:1:1	SHEET 1 OF 1

disk holder part support