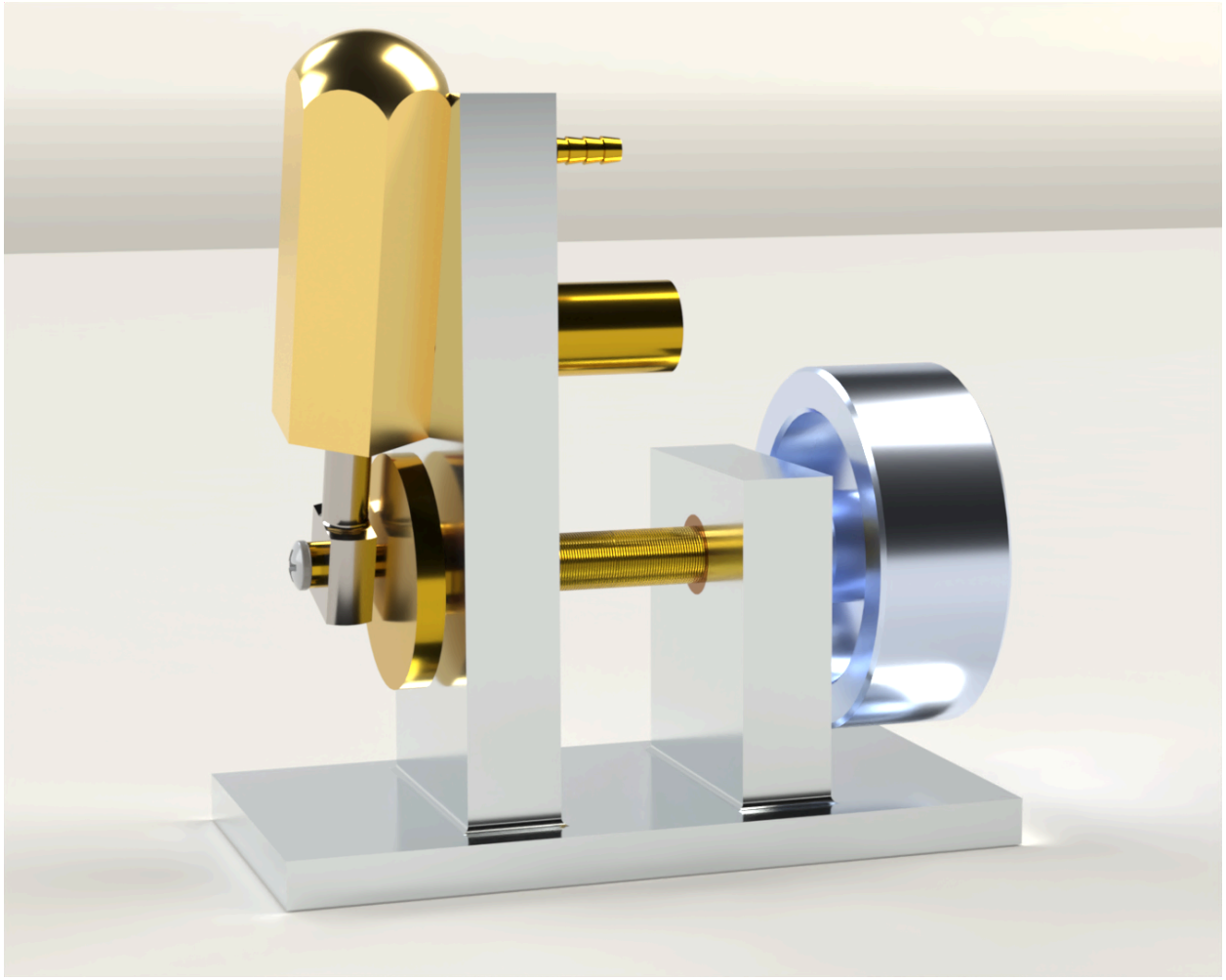
Pipsqueak Engine Design Report



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Executive Summary

At the request of STEAM Power, Inc., we have redesigned and revamped the pipsqeak engine design to improve manufacturability and fit within the constraints given to us. Suggested alterations include process changes and part changes, as only processes involving sheet metal, expendable mold casting, and CNC milling / turning are available to the company at this time. These changes will help us to meet the required production rate of 100 to 1000 engines manufactured per year. With such a low production rate, manufacturers can focus on the quality of the engines.

The main process we recommend including in the new design is expendable mold casting, specifically investment casting. This will lend to an excellent surface finish and impressive part accuracy. Because none of the parts are too large, and we are aiming for a low production rate, we suggest the use of investment casting to produce the cylinder, the baseplate/upright combination, and the crankwheel/shaft combination. This will decrease time machining and mitigate some material waste as well.

We also recommend combining several parts, again to decrease production time and simplify the assembly. Our final assembly recommendation has only eight parts instead of the eleven that the engine initially possessed. The combination of the baseplates and the uprights into one part rather than three also ensures alignment of the critical features, namely the holes, allowing the engine to run more smoothly.

Other, less important changes between the original assembly and the final recommended assembly include adding a radius to the top of the cylinder, cutting an additional groove out of the piston, and removing draft angles from the cylinder. These changes will reduce weight in the moving pieces of the engine, allowing it to run more efficiently. The changes also carry an aesthetic value.

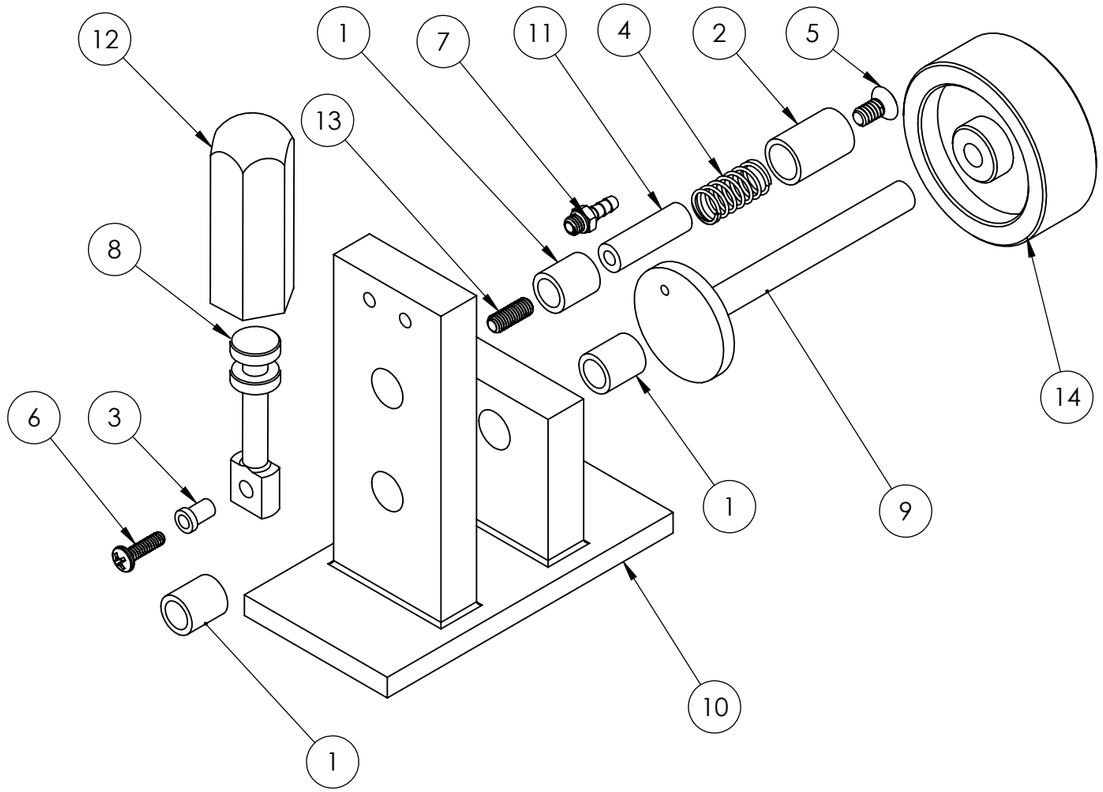
Overall, we are confident that the redesigned engine will reduce production time and better utilize the processes that we have available to us, while effectively reaching the target capacity. The new engine will also perform better than the original design and carry a higher quality surface finish.

Design & Manufacturing Report Body

Part: Baseplate
Primary Function: Structural foundation and base for the engine
Critical Features: Four holes to hold uprights in line
Selected Process: Investment Casting
Design Changes: Combine the uprights and baseplates into a single part
Justification: This will simplify the engine, reducing the number of parts and therefore the production time and cost. It will also increase the accuracy and the quality of the surface finish of the part.

Part: Piston
Primary Function: Translates force (pressure) into linear motion to drive the crankshaft
Critical Features: Cylindrical body diameter and pin hole diameter
Selected Process: CNC Mill/Lathe
Design Changes: Cut an additional notch into the thick cylinder at the top
Justification: Cutting a notch into the thick cylinder at the top will reduce the weight of the piston and allow it to move up and down more easily, reducing energy waste.

Part	Selected Process	Design Changes
Uprights/Baseplate	Investment Casting	Combine the uprights and the baseplate into a single part.
Flywheel	CNC Mill/Lathe	Get rid of draft angles, square the walls.
Crankwheel/shaft	Investment Casting & CNC Machining	Combine the crankwheel and shaft into one piece, machine critical dimensions. Leave a raised knob on the crankwheel face to reduce friction. Make it out of brass.
Piston Rod Bushing	CNC Mill/Lathe	No changes needed.
Cylinder	Investment Casting & CNC Mill/Lathe	Add radius to the top.
Rocker Pin	CNC Mill/Lathe	Make the outer diameter uniform, same threads on either side.
Spring Cover	CNC Mill/Lathe	No changes needed.



ITEM NO.	PART NO.	PART NAME	MATERIAL	QTY.
1	6391K163	Oil-Embedded Bronze Sleeve Bearing	841 Bearing Bronze	3
2	6	SPRING COVER	Brass	1
3	8	PISTON ROD BUSHING	Brass	1
4	9657K289	Compression Spring	Music-Wire Steel	1
5	91802A240	Passivated 18-8 Stainless Steel Phillips Oval Head Screws	18-8 Stainless Steel	1
6	91772A148	Passivated 18-8 Stainless Steel Pan Head Phillips Screw	18-8 Stainless Steel	1
7	5454K62	10-32 Brass Barbed Fitting	Brass	1
8	7	PISTON	AISI 1018 Steel	1
9	2	CRANKSHAFT/WHEEL	Brass	1
10	1	BASEPLATE/UPRIGHT	Aluminum 6061-T6	1
11	3	ROCKER PIN	AISI 1018 Steel	1
12	4	CYLINDER	Brass	1
13	91375A442	Alloy Steel Cup-Point Set Screw	Alloy Steel	1
14	5	FLYWHEEL	Aluminum	1

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
DEFAULT TOLERANCES:
ANGULAR: x.x = ±1
x.x = ±.02
x.xx = ±.01
x.xxx = ±.005

INTERPRET GEOMETRIC TOLERANCING PER:

DO NOT SCALE DRAWING

	NAME	DATE
DRAWN	B. W. COON	8 AUG 2025
CHECKED	J. PATTEN	8 AUG 2025
ENG APPR.	B. W. COON	8 AUG 2025
MATERIAL		
FINISH		
COMMENTS:		

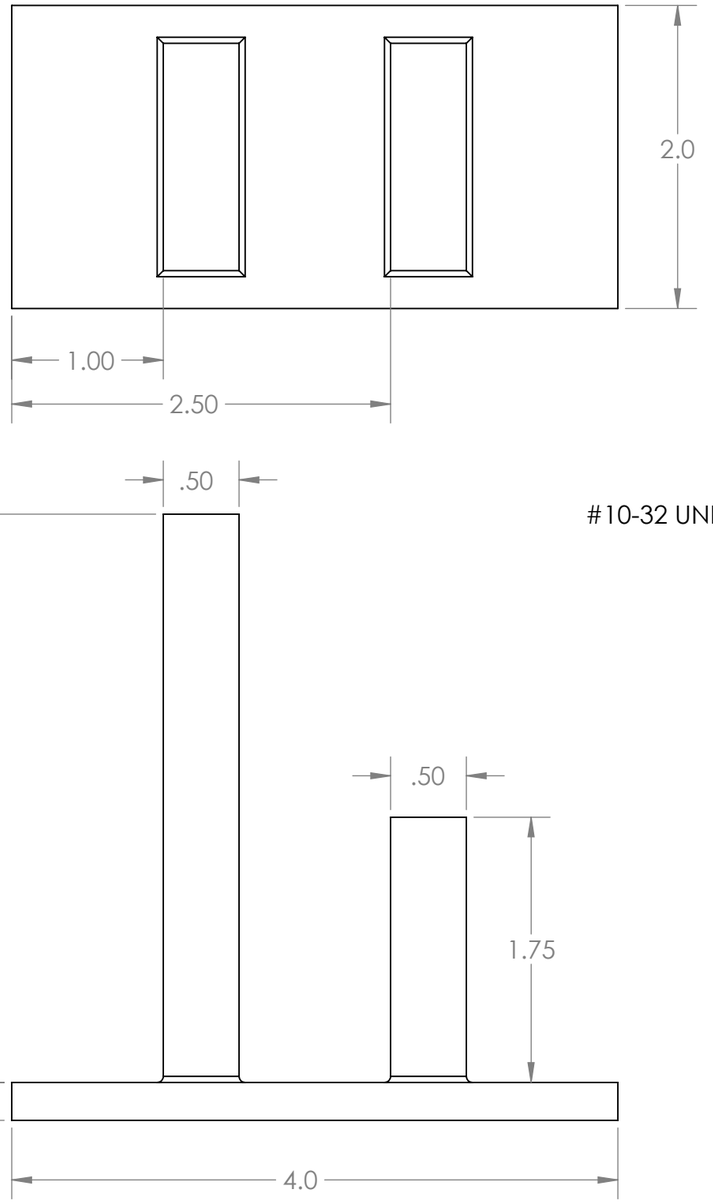
TEAM 5

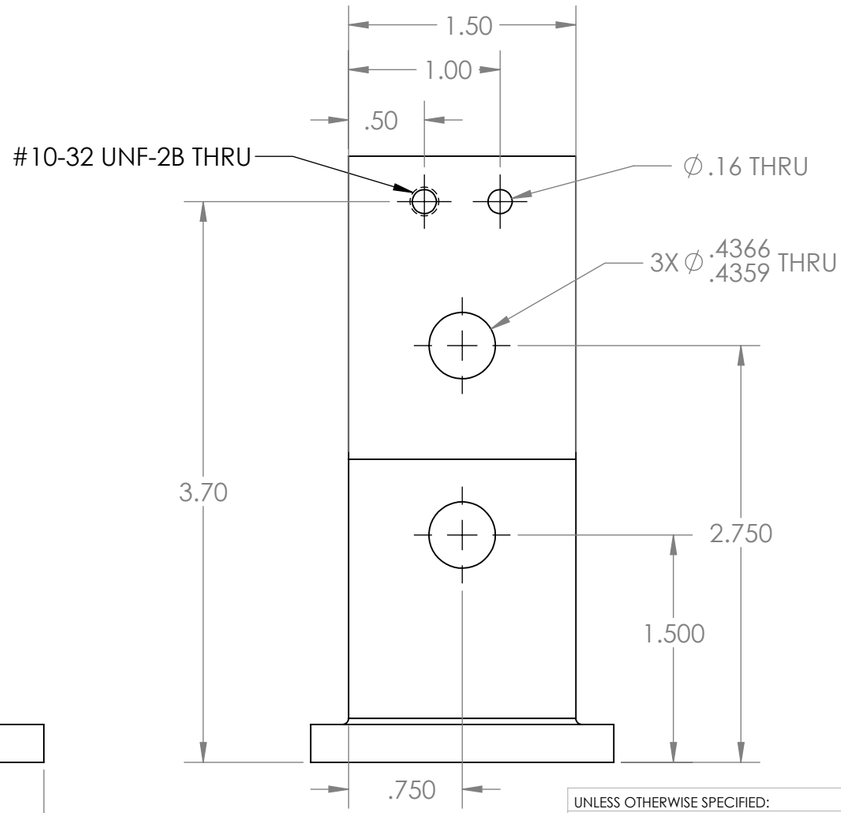
TITLE:

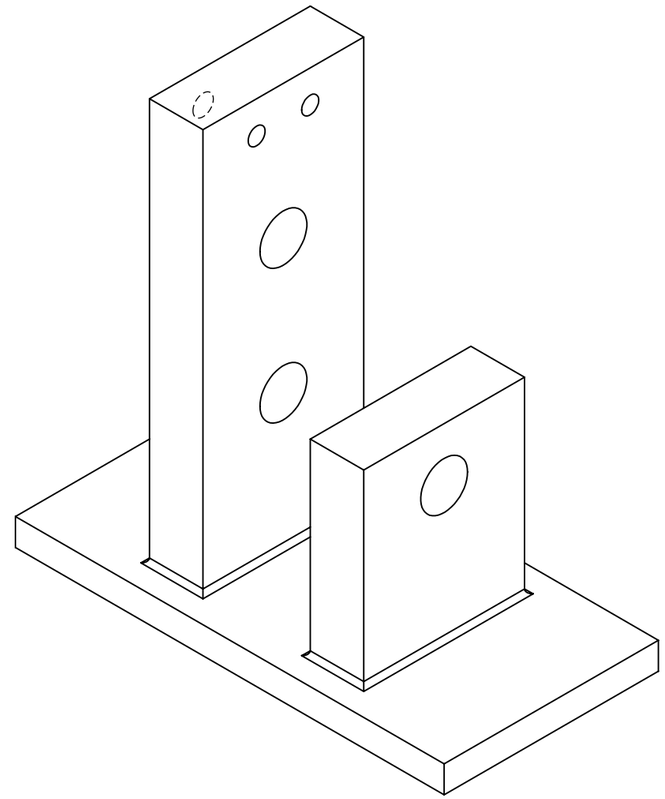
EXPLODED VIEW ENGINE

SIZE	DWG NO.	REV
B	1	1

SCALE: 1:1.5 | DWG. NO. 001 | SHEET 1 OF 1







BREAK ALL SHARP EDGES AND REMOVE ALL BURRS.

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
DEFAULT TOLERANCES:
x.x = ± 0.02
x.xx = ± 0.01
x.xxx = ± 0.005
ANGULAR: x.x = ± 1

MATERIAL: ALUMINUM 6061-T6

FINISH: CAST AND MACHINED

	NAME	DATE
DRAWN	J. WINTERS	08 AUG 2025
CHECKED	J. PATTEN	08 AUG 2025

COMMENTS:

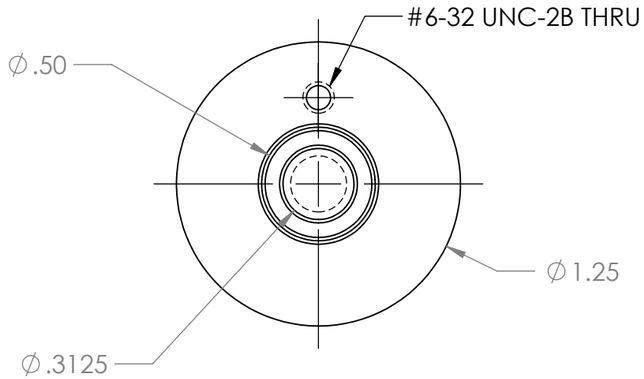
DO NOT SCALE DRAWING

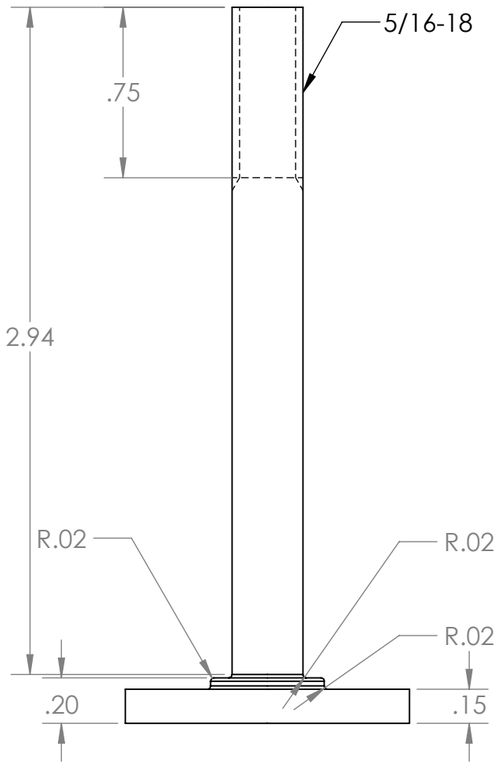
TEAM 5

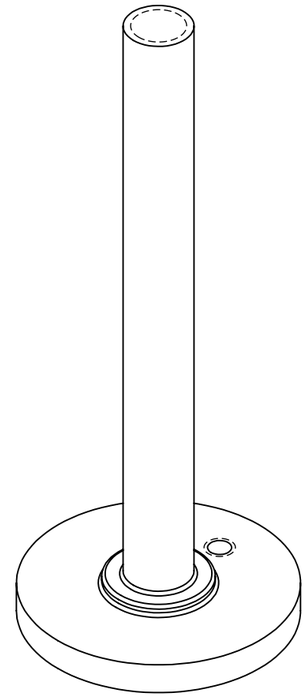
TITLE: BASEPLATE / UPRIGHTS

SIZE	PART NO.	REV
B	1	1

SCALE: 1:1 | WEIGHT: 0.25 | SHEET 1 OF 1







BREAK ALL SHARP EDGES AND REMOVE ALL BURRS.

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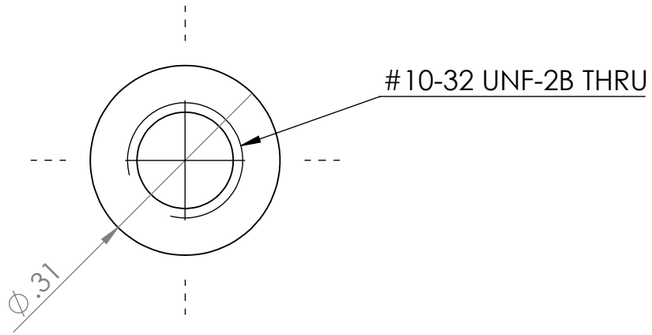
	CHECKED: J. PATTEN	7 AUG 2025
COMMENTS:		
MATERIAL: BRONZE UNS22000		
FINISH: MACHINED		
DO NOT SCALE DRAWING		

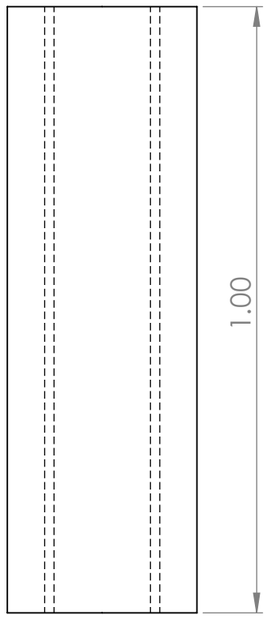
TEAM 5

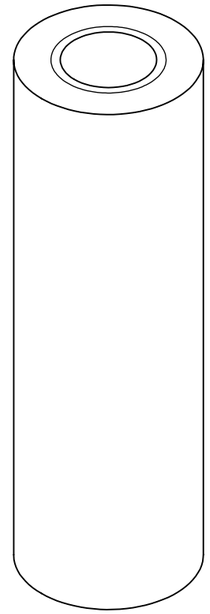
TITLE: Crankwheel

SIZE	PART NO.	REV
B	2	1

SCALE: 1:1 | WEIGHT: .002 | SHEET 1 OF 1







BREAK ALL SHARP EDGES AND REMOVE ALL BURRS.

UNLESS OTHERWISE SPECIFIED:		NAME	DATE
DIMENSIONS ARE IN INCHES DEFAULT TOLERANCES: x.x = ± .02 x.xx = ± .01 x.xxx = ± .005	DRAWN	M. S. KEYES	8 AUG 2025
	CHECKED	J. PATTEN	8 AUG 2025
	COMMENTS:		
MATERIAL AISI 1018 STEEL			
FINISH COLD ROLLED / MACHINED			

DO NOT SCALE DRAWING

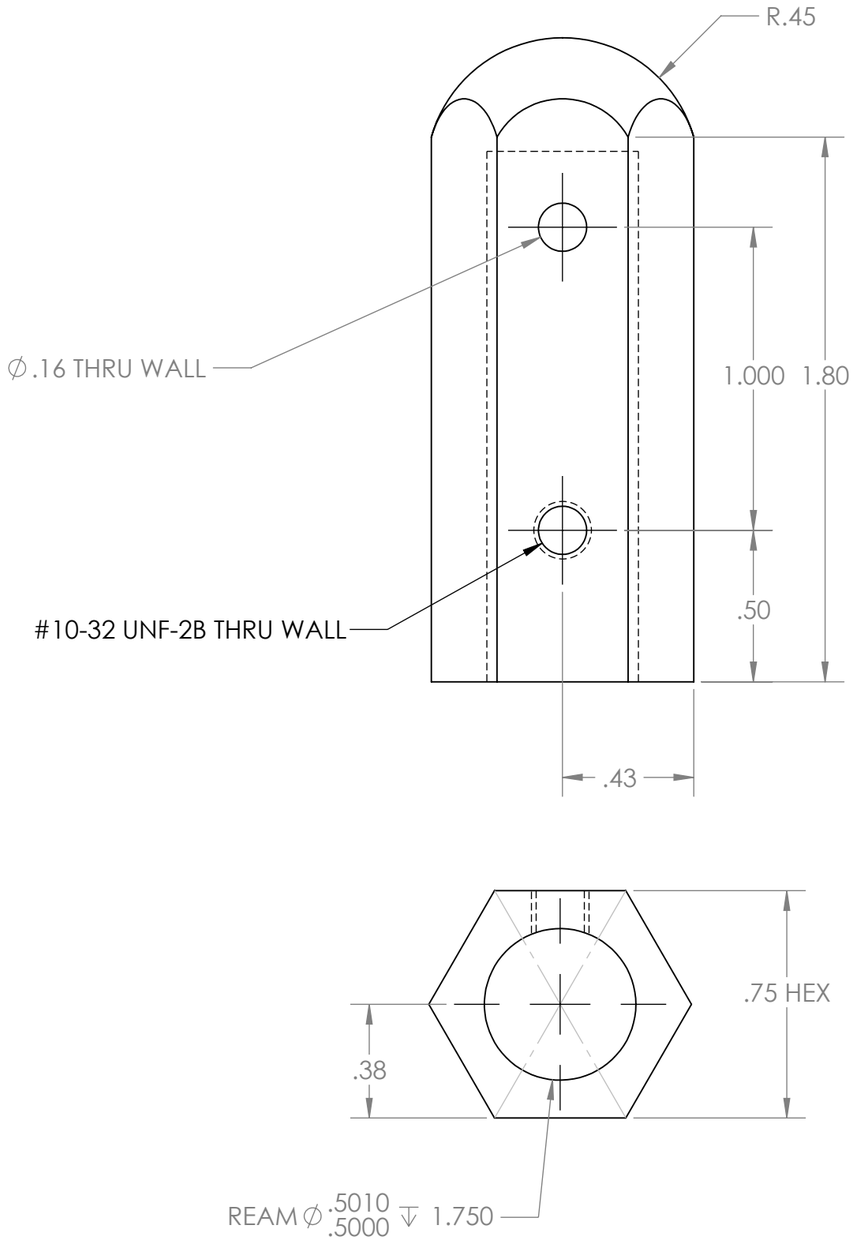
TEAM 5

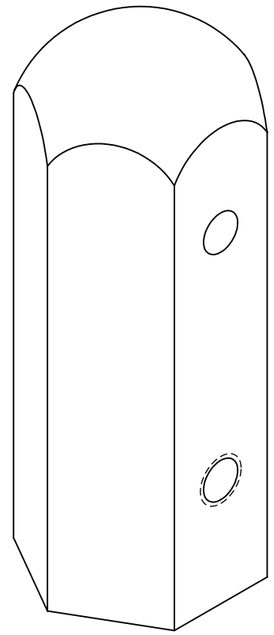
TITLE:

Rocker Pin

SIZE	PART NO.	REV
B	3	1

SCALE: 2:1 | WEIGHT: .01 | SHEET 1 OF 1





NOTES:
1. TOP RADIUS FORMED WITH THE RADIUS TOOL

BREAK ALL SHARP EDGES AND REMOVE ALL BURRS.

UNLESS OTHERWISE SPECIFIED:		NAME	DATE
DIMENSIONS ARE IN INCHES DEFAULT TOLERANCES: x.x = ± 0.02 x.xx = ± 0.01 x.xxx = ± 0.005 ANGULAR: x.x = ± 1	DRAWN	J. PATTEN	25 JUN 2025
	CHECKED	B.W. COON	26 JUN 2025
MATERIAL: BRASS	COMMENTS:		
FINISH: EXTRUDED / MACHINED	DO NOT SCALE DRAWING		

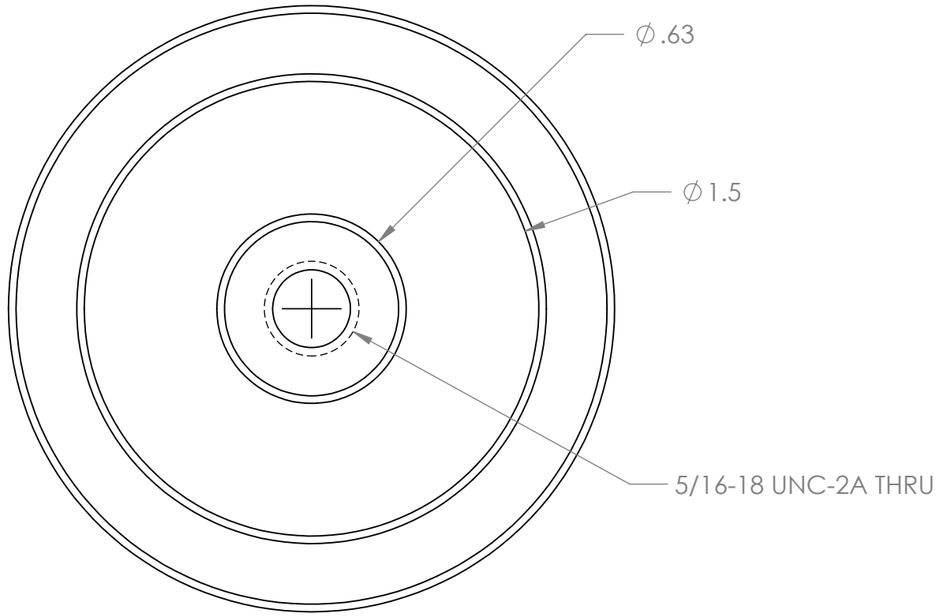
TEAM 5

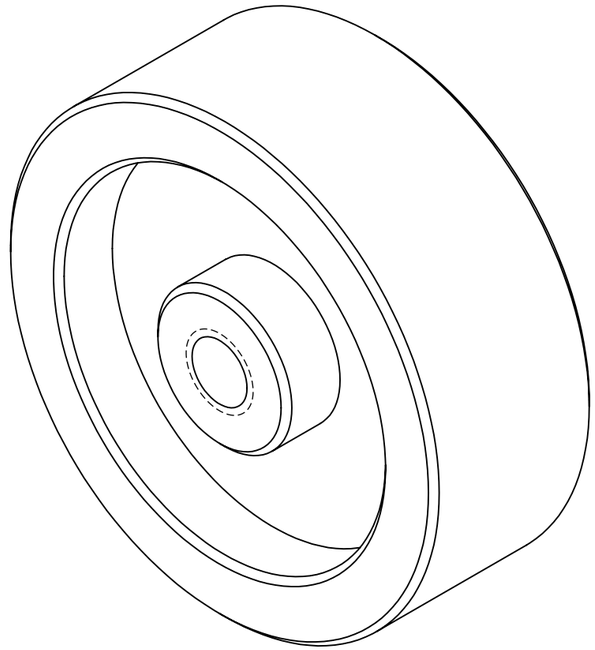
TITLE:

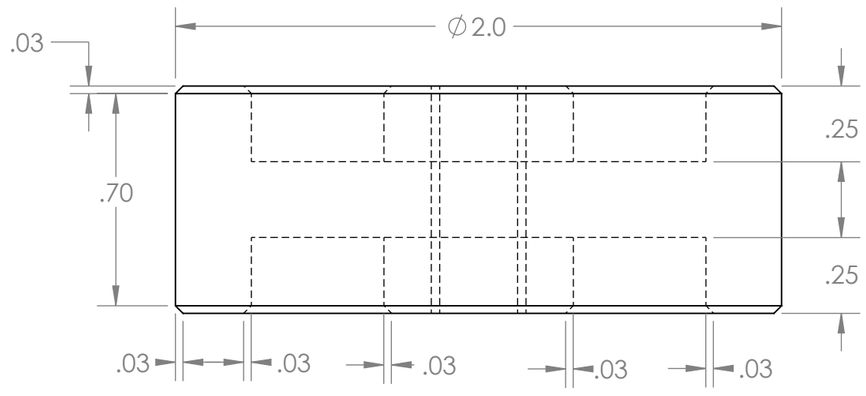
CYLINDER

SIZE	PART NO.	REV
B	4	1

SCALE: 2:1 | WEIGHT: 0.25 | SHEET 1 OF 1







BREAK ALL SHARP EDGES AND REMOVE ALL BURRS.

UNLESS OTHERWISE SPECIFIED:	NAME	DATE
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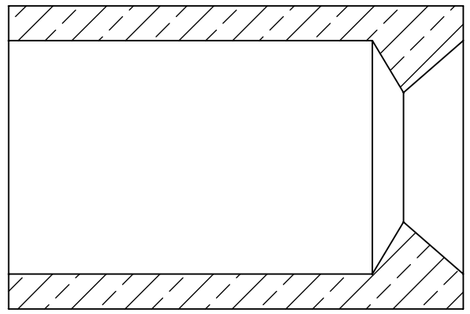
	CHECKED: J. PATTEN	7 AUG 2025
	COMMENTS:	
MATERIAL: ALUMINUM 6061 ALLOY BRASS		
FINISH: SAND BLASTED		
	DO NOT SCALE DRAWING	

TEAM 5

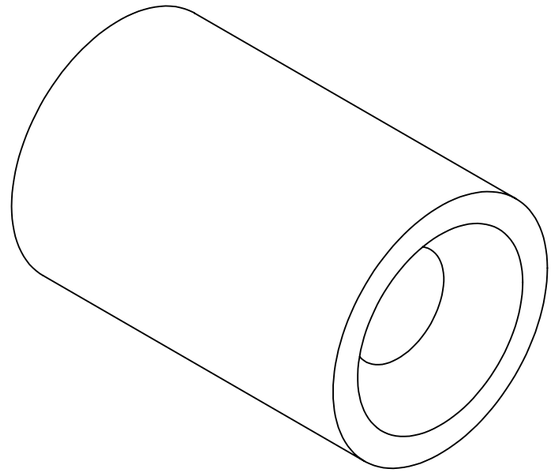
TITLE: FLYWHEEL

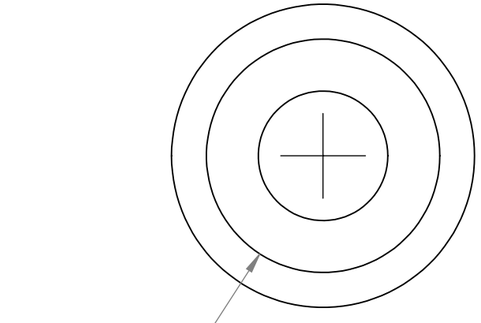
SIZE	PART NO.	REV
B	5	2

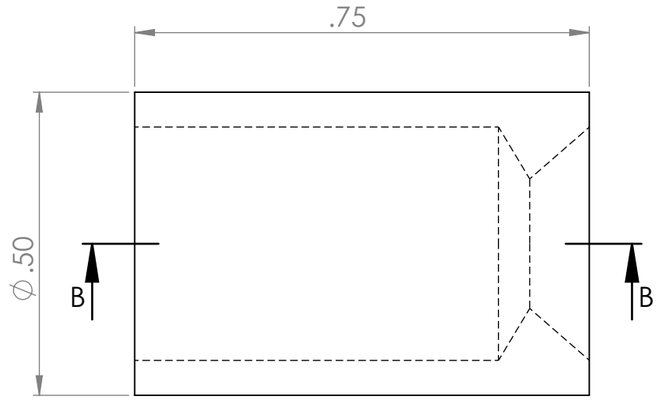
SCALE: 2:1 | WEIGHT: .23 | SHEET 1 OF 1

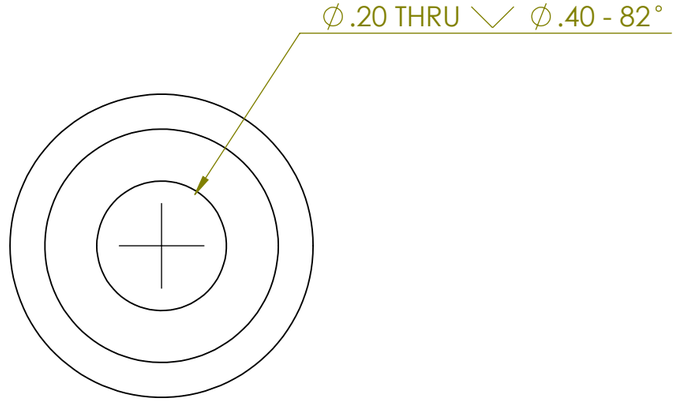


SECTION B-B









BREAK ALL SHARP EDGES AND REMOVE ALL BURRS.

UNLESS OTHERWISE SPECIFIED:		NAME	DATE
DIMENSIONS ARE IN INCHES DEFAULT TOLERANCES: x.x = ± .02 x.xx = ± .01 x.xxx = ± .005 ANGULAR: x.x = ±.005	DRAWN	J. PATTEN	01 AUG 2025
	CHECKED	M.S. KEYES	05 AUG 2025
	COMMENTS:		
MATERIAL BRASS			
FINISH MACHINED			
			DO NOT SCALE DRAWING

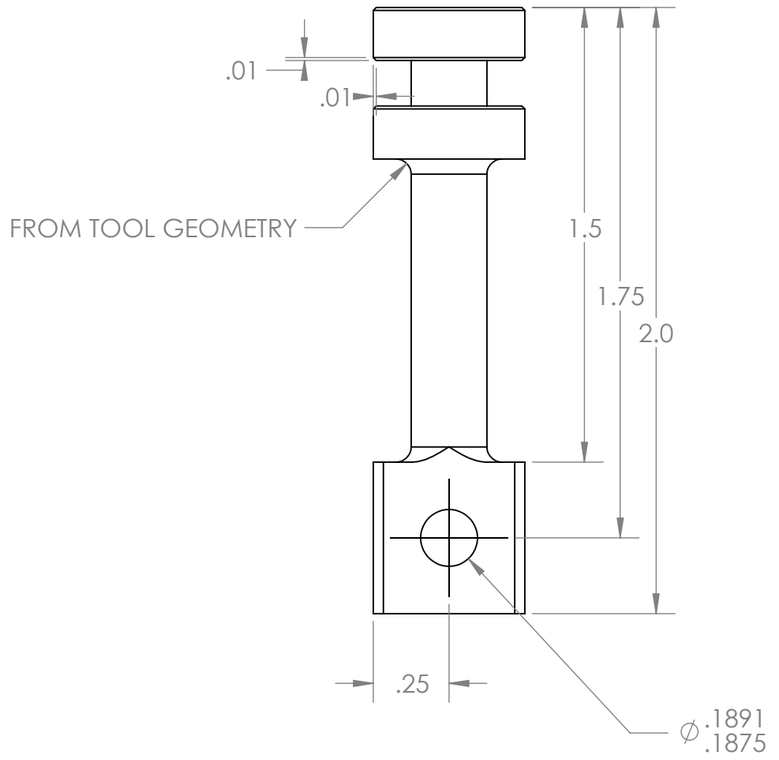
TEAM 5

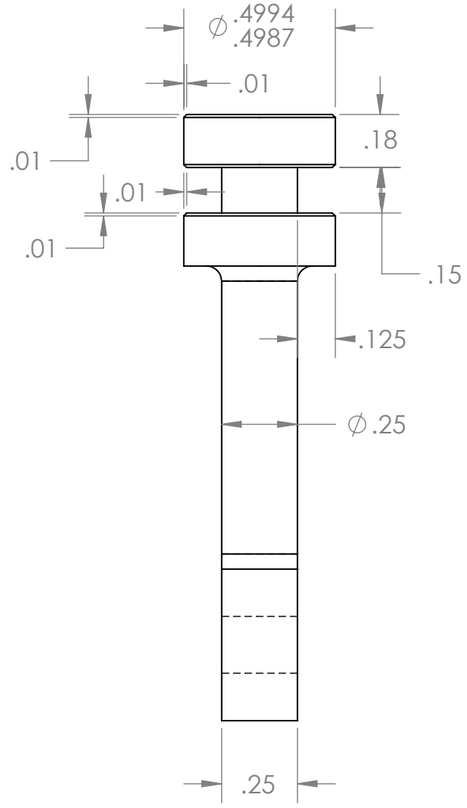
TITLE:

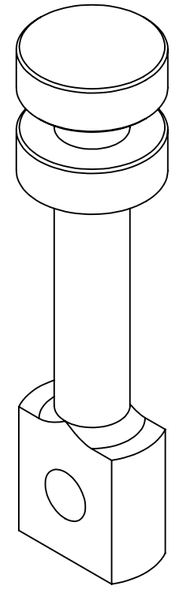
SPRING COVER

SIZE	PART NO.	REV
B	6	1

SCALE: 4:1 | WEIGHT: .02 | SHEET 1 OF 1







BREAK ALL SHARP EDGES AND REMOVE ALL BURRS.

UNLESS OTHERWISE SPECIFIED:		NAME	DATE
DIMENSIONS ARE IN INCHES DEFAULT TOLERANCES: x.x = ± .02 x.xx = ± .01 x.xxx = ± .005 ANGULAR: x.x = ± .5	DRAWN	M. S. KEYES	4 AUG 2024
	CHECKED	J. PATTEN	7 AUG 2025
	COMMENTS:		
MATERIAL AISI 1018 STEEL			
FINISH COLD ROLLED / MACHINED			
			DO NOT SCALE DRAWING

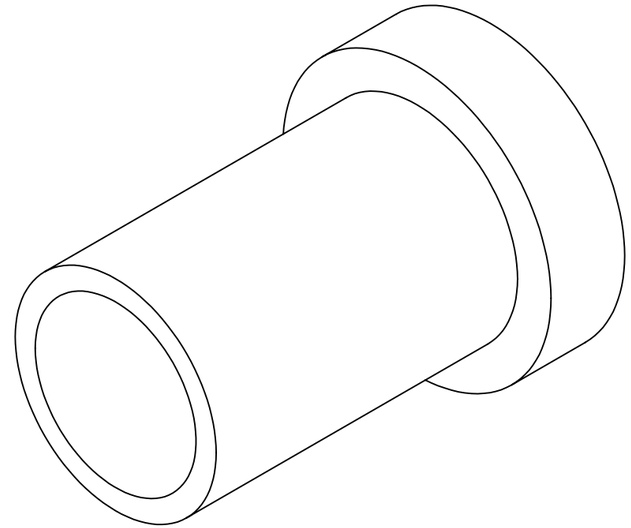
TEAM 5

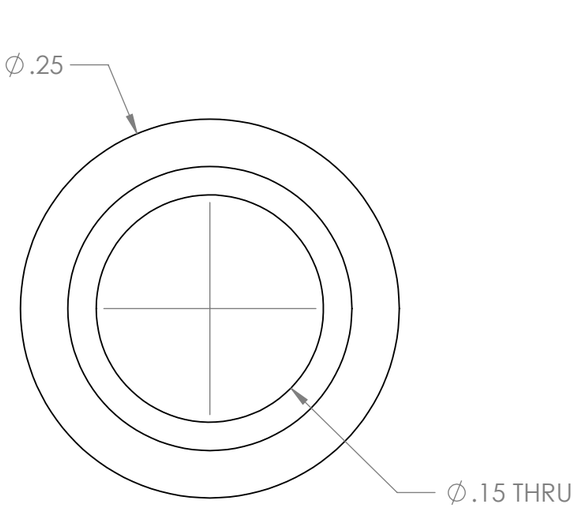
TITLE:

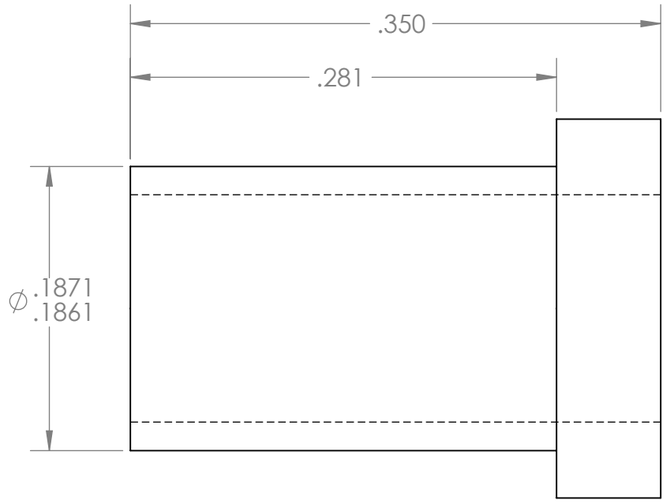
PISTON

SIZE	PART NO.	REV
B	7	1

SCALE: 2:1 | WEIGHT: .06 | SHEET 1 OF 1







BREAK ALL SHARP EDGES AND REMOVE ALL BURRS.

UNLESS OTHERWISE SPECIFIED:		NAME	DATE
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	CHECKED	J. PATTEN	06 AUG 2025
	COMMENTS:		
MATERIAL: BRASS			
FINISH: MACHINED			

DO NOT SCALE DRAWING

TEAM 5

TITLE:

PISTON ROD BUSHING

SIZE	PART NO.	REV
B	8	1

SCALE: 10:1 | WEIGHT: .002 | SHEET 1 OF 1