

Design Report 1

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EML2322L – Fall 2025

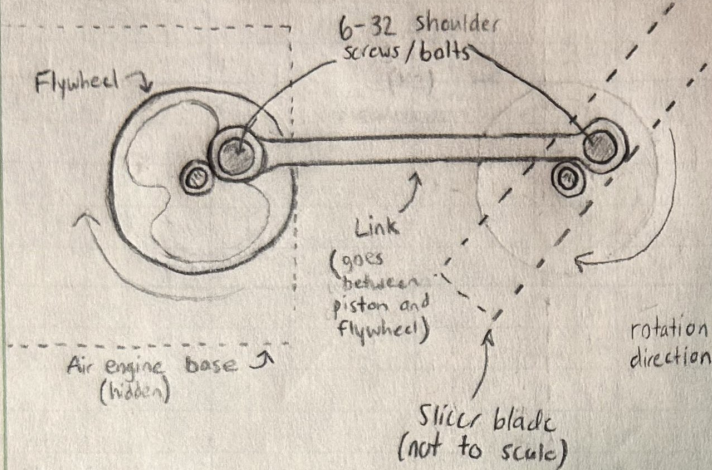
Submitted 10/5/2025

Design Description

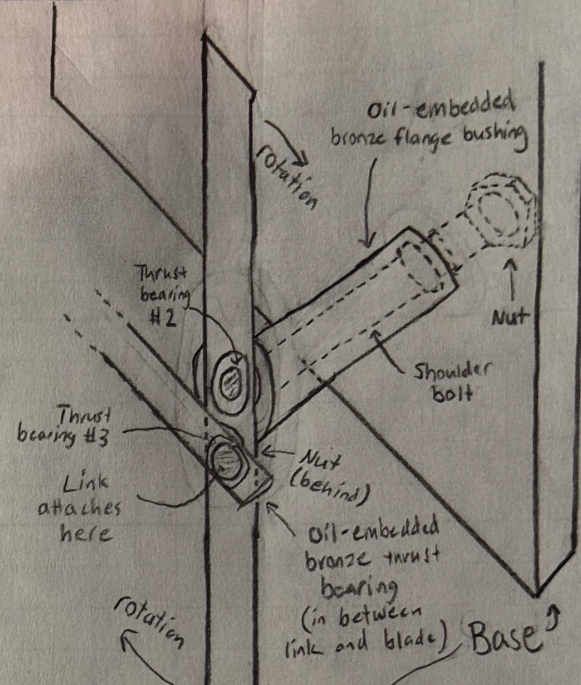
The following design is for a food slicer that is powered by a dual-action two-stroke compressed air powered piston engine. Rotational inertia stored in the rotating flywheel is used to facilitate the rotation of a blade (P5) spinning in the same direction, connected by an HDPE link (P6). The 5/32" alloy steel shoulder screw (already included in air engine assembly) connecting the piston to the flywheel is used to constrain the motion of the linkage, with the use of an oil-embedded bronze thrust bearing (OTS03) on both sides of the link (6A & 6B) to reduce friction. This linkage connects to the blade with another 5/32" alloy steel shoulder bolt (OTS01), allowing the blade to rotate at the same speed as the flywheel. More oil-embedded bronze thrust bearings are used on both sides of the linkage to reduce friction between the link and the blade (5A, 5B, 6A, 6B). An alloy steel shoulder bolt supports the blade, which is constrained between another oil-embedded bronze thrust bearing under the head of the shoulder bolt (5A) and an oil-embedded bronze flanged sleeve bearing (OTS04) (5B), which sits flush against the vertical wall of the HDPE base (P1). The shoulder bolts that pass through the blade are each fastened by a zinc-plated hex nut (OTS05). The vertical component of the base supports the air engine base with two stainless steel 10-24 screws (OTS02, which requires two 0.157" diameter, 10-24 UNC holes to be drilled into the bottom of the air engine base, on either side of the flywheel, 3" apart). This entire structure is then supported by a flat horizontal base component manufactured from HDPE (P2) and connected to the vertical portion by two 6-32 stainless steel screws (OTS06). As the blade rotates, it fits through a slot in the food grade PLA slicer compartment (P8). The compartment contains a 4" x 6" opening on the side through which food can be placed into (8A) and manually pushed into the blade with an HDPE food pusher (P3, 3A) and handle (P4). The food pusher components are connected with a stainless steel 6-32 screw. After being pushed past the slot in which the blade passes through, the food reaches the food stopper (P7, 7A), which determines the slice thickness with the slot in the compartment that it is placed in by the user. The food stopper stops the food before it gets sliced, and the food then falls through an opening. The blade cover (P9, P10, P11) is assembled with 4 x 6-32 stainless steel screws and keeps the blade out of reach to improve the safety of operation. The blade cover is attached to the top of the vertical base component with two more stainless steel 6-32 screws. All OTS components and stock materials are conveniently found on McMaster Carr, with the exception being the food grade PLA from Amazon.

EML2322L Design Specification Table							
Component (Name and/or Part Number)	Description / Size	Critical Surfaces (surface IDs and brief description)	Material	Vendor (if applicable)	Cost	Qty.	Justification / Notes
P1 Vertical Base Component	11.05" x 6.25" x 0.50"	N/A	Moisture-Resistant HDPE	McMaster Carr	\$ 5.21	1	\$333.79 for 48" x 96" x 0.5" HDPE = \$0.14/in ³ --> \$0.14/in ³ x 34.53 in ³ = \$5.21 . HDPE used for the cheap cost and manufacturability.
P2 Horizontal Base Component	15.25" x 9.00" x 0.25"	N/A	Moisture-Resistant HDPE	McMaster Carr	\$ 5.38	1	\$181.26 for 48" x 96" x 0.25" HDPE = \$0.16 / in ³ x 34.21 in ³ = \$5.38 . HDPE used for cheap cost, manufacturability, and rigidity.
P3 Food pusher surface	6.00" x 4.00" x 0.25"	3A - Food contact surface	Moisture-Resistant HDPE	McMaster Carr	\$ 0.94	1	\$181.26 for 48" x 96" x 0.25" HDPE = \$0.16 / in ³ x 6.00 in ³ = \$0.94 . Moisture-Resistant HDPE chosen for being safe for food contact as well as cheap and easily machinable.
P4 Food pusher handle	5.00" x 0.25" x 0.25"	N/A	Moisture-Resistant HDPE	McMaster Carr	\$ 0.05	1	\$333.79 for 48" x 96" x 0.5" HDPE = \$0.14/in ³ --> \$0.14/in ³ x 0.31 in ³ = \$0.05.
P5 Blade	9.75" x 0.5" x 0.063"	5A - Blade side surface - sliding on thrust bearing (OTS02) 5B - Blade side surface - sliding on flanged sleeve bearing (OTS04)	303 Easy-to-machine Stainless Steel (food safe)	McMaster Carr	\$ 5.37	1	\$13.23 for 12" x 0.5" x 0.125" bar = \$5.37 for 9.75" x 0.5" x 0.063" bar. 303 stainless steel chosen for high strength and manufacturability, and for smooth surface finish for sliding rotation.
P6 Link	6.375" x 0.25" x 0.25"	6A - Link top surface - sliding on thrust bearings (OTS02) 6B - Link bottom surface - sliding on thrust bearings (OTS02)	Moisture-Resistant HDPE	McMaster Carr	\$ 0.06	1	\$333.79 for 48" x 96" x 0.5" HDPE = \$0.14/in ³ --> \$0.14/in ³ x 0.40 in ³ = \$0.06 . HDPE used to facilitate movement with lightweight material, and to rotate easily about shoulder screws.
P7 Food stopper	6.00" x 4.25" x 0.25"	7A - Food contact surface	Moisture-Resistant HDPE	McMaster Carr	\$ 1.00	1	\$181.26 for 48" x 96" x 0.25" HDPE = \$0.16 / in ³ x 6.38 in ³ = \$1.00 . Moisture-Resistant HDPE chosen for being safe for food contact as well as cheap and easily machinable.
P8 Slicer Compartment	*Volume calculated on Solidworks due to complicated part geometry* ~ Overall size: 12.5" x 4.5" x 9" with 0.25" thickness	8A - Food contact surface	Food grade PLA	Amazon (YXPOLYER)	\$ 23.98	1	Filament weight 1000g, PLA density ~1.24 g/cm ³ , total volume ~49.2 in ³ , \$21.59/49.2in ³ ~\$0.44/in ³ --> \$0.44/in ³ x 54.5in ³ = \$23.98 . Complicated part geometry makes additive manufacturing ideal.
P9 Blade cover (top)	6.75" x 4.75" x 0.25"	N/A	Moisture-Resistant HDPE	McMaster Carr	\$ 1.26	1	\$181.26 for 48" x 96" x 0.25" HDPE = \$0.16 / in ³ x 8.01 in ³ = \$1.26 . HDPE used for cheapness and for manufacturability / ease of assembly.
P10 Blade cover (side 1)	11.30" x 6.75" x 0.25"	N/A	Moisture-Resistant HDPE	McMaster Carr	\$ 2.99	1	\$181.26 for 48" x 96" x 0.25" HDPE = \$0.16 / in ³ x 19.07 in ³ = \$2.99 . HDPE used for cheapness and for manufacturability / ease of assembly.
P11 Blade cover (side 2)	11.30" x 2.50" x 0.25"	N/A	Moisture-Resistant HDPE	McMaster Carr	\$ 1.11	1	\$181.26 for 48" x 96" x 0.25" HDPE = \$0.16 / in ³ x 7.06 in ³ = \$1.11 . HDPE used for cheapness and for manufacturability / ease of assembly.
OTS01 Shoulder bolts (91259A606)	6-32 thread, 5/32" Shoulder Diameter x 5/8" Shoulder Length		Alloy steel	McMaster Carr	\$ 10.62	2	(Assuming mass production) \$5.31 / screw for 5+ screws, \$10.62 for 2 screws *Does not include the shoulder screw already used for the air engine*
OTS02 10-24 screw (92949A247)	10-24 thread, 1" long, button head		18-8 Stainless steel	McMaster Carr	\$ 0.31	2	\$7.86 per pack of 50 = \$0.16 per screw, \$0.31 for 2 screws
OTS03 Thrust bearing (5906K561)	For 1/4" Shaft Diameter, 7/16" OD, 1/16" Thickness		841 bearing bronze	McMaster Carr	\$ 4.35	5	\$0.87 each, \$4.35 for 5 bearings
OTS04 Flanged sleeve bearing (6338K563)	For 3/16" Shaft Diameter and 5/16" Housing ID, 1/4" Long		841 bearing bronze	McMaster Carr	\$ 0.86	1	\$0.86 each
OTS05 Hex Nut (90480A007)	6-32 thread, 7/16" width		Zinc-plated steel	McMaster Carr	\$ 0.04	2	\$1.57 per pack of 100 = \$0.02 per hex nut, \$0.04 for 2 hex nuts
OTS06 6-32 screw (92949A148)	6-32 thread, 0.5" long, button head		18-8 Stainless steel	McMaster Carr	\$ 0.46	9	\$5.12 per pack of 100 = \$0.46 for 9 screws
				TOTAL	\$ 63.53		

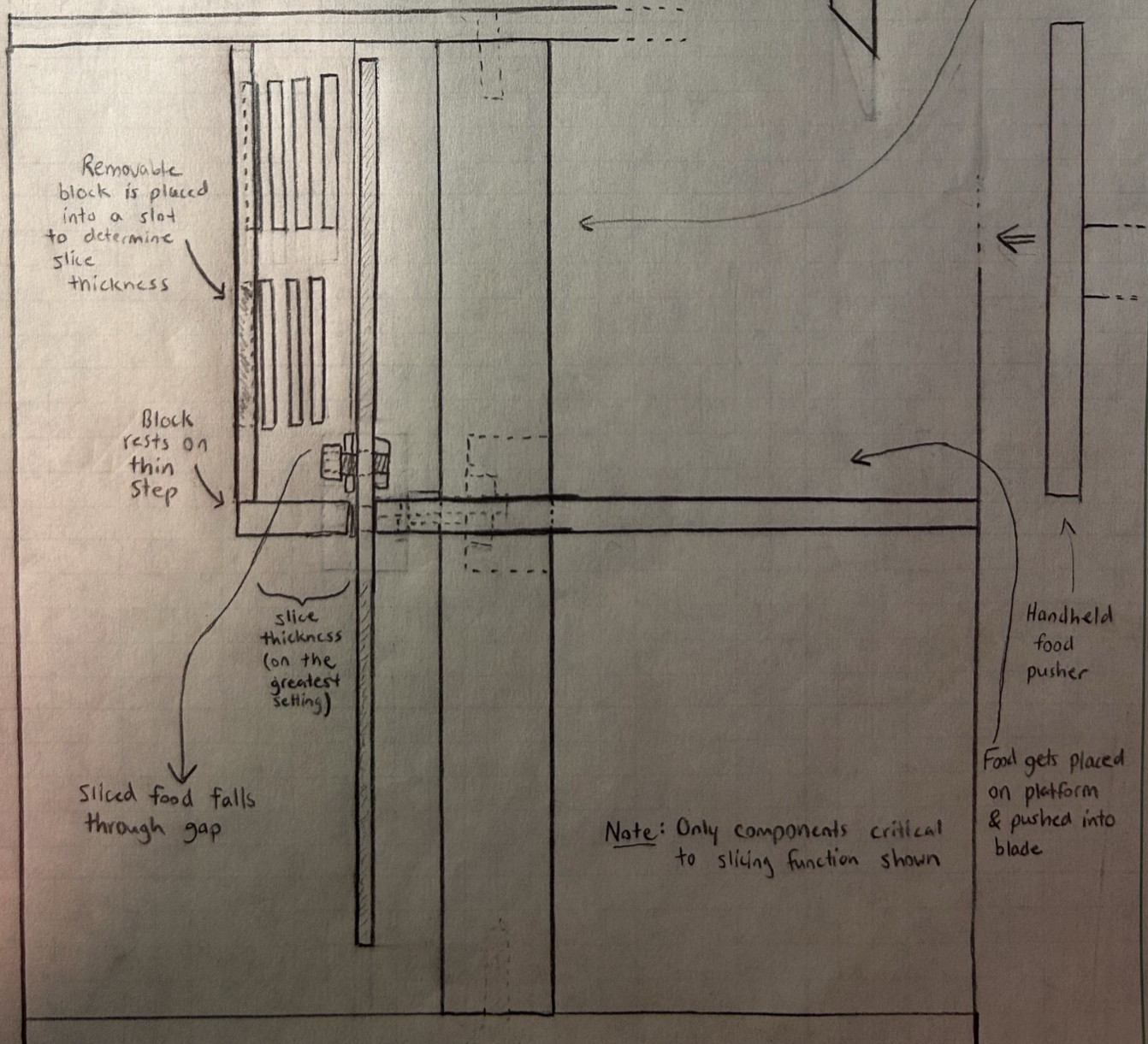
Link Mechanism



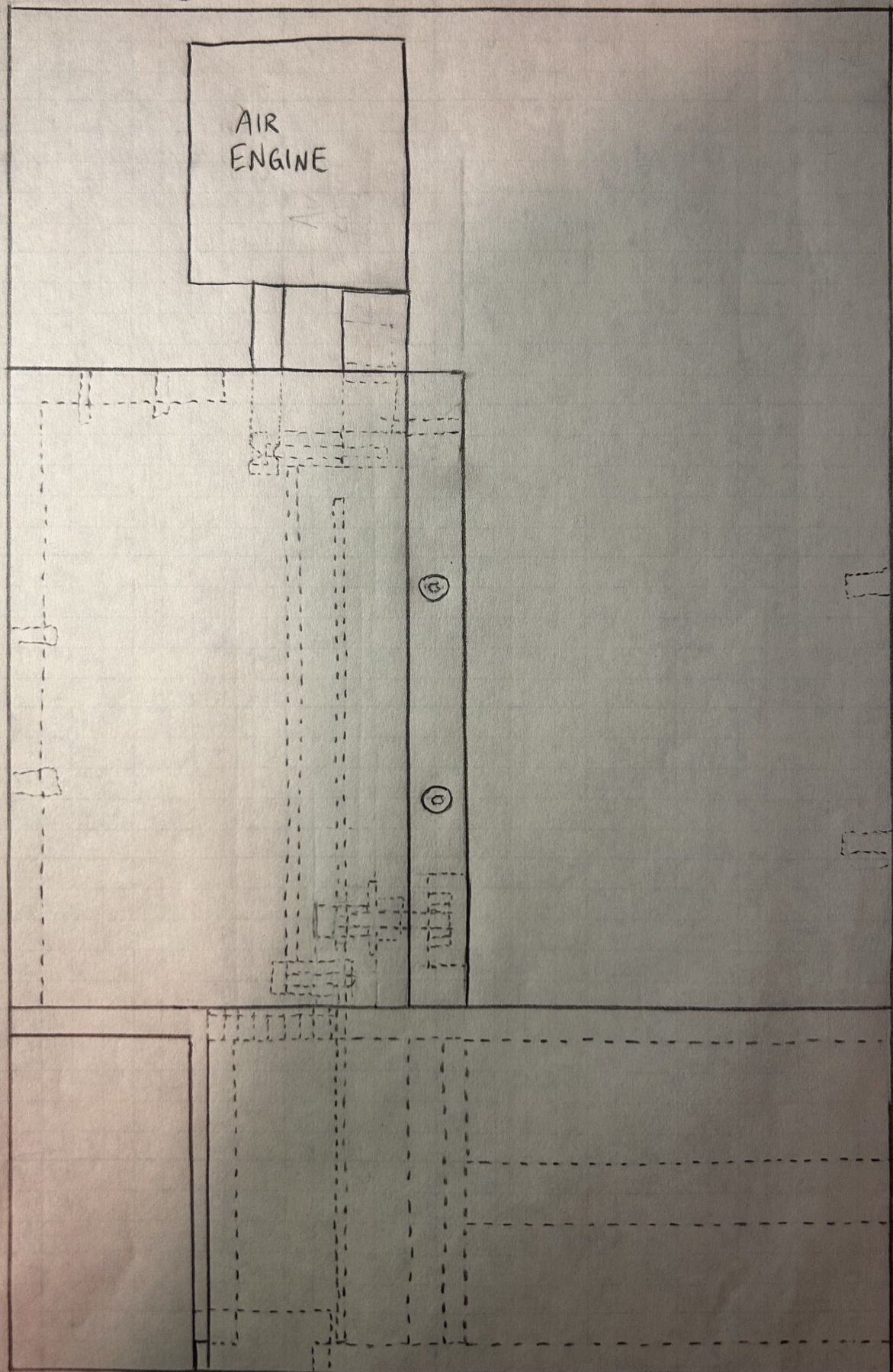
Blade Assembly



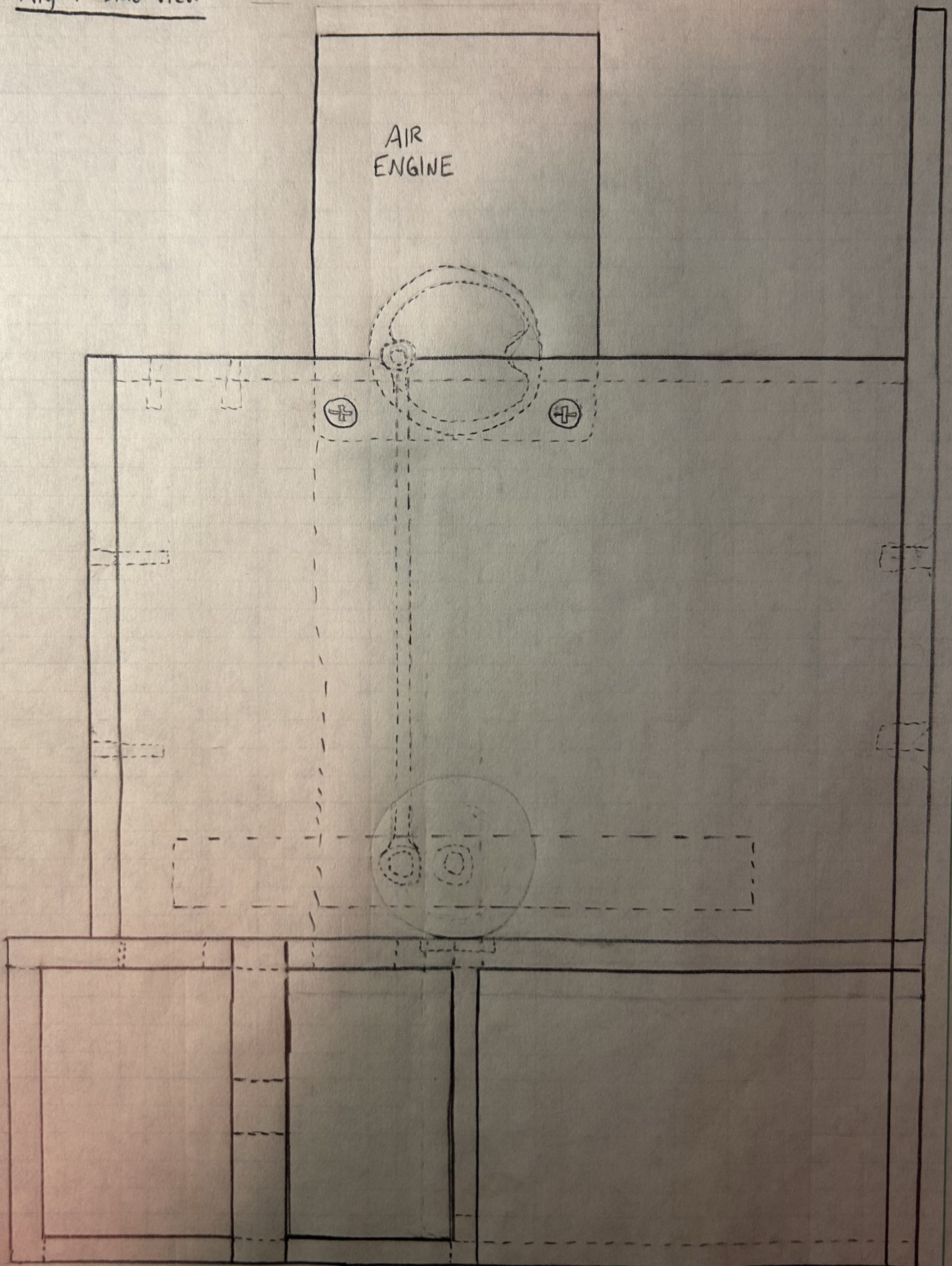
Slicing Mechanism (front view)



Top View



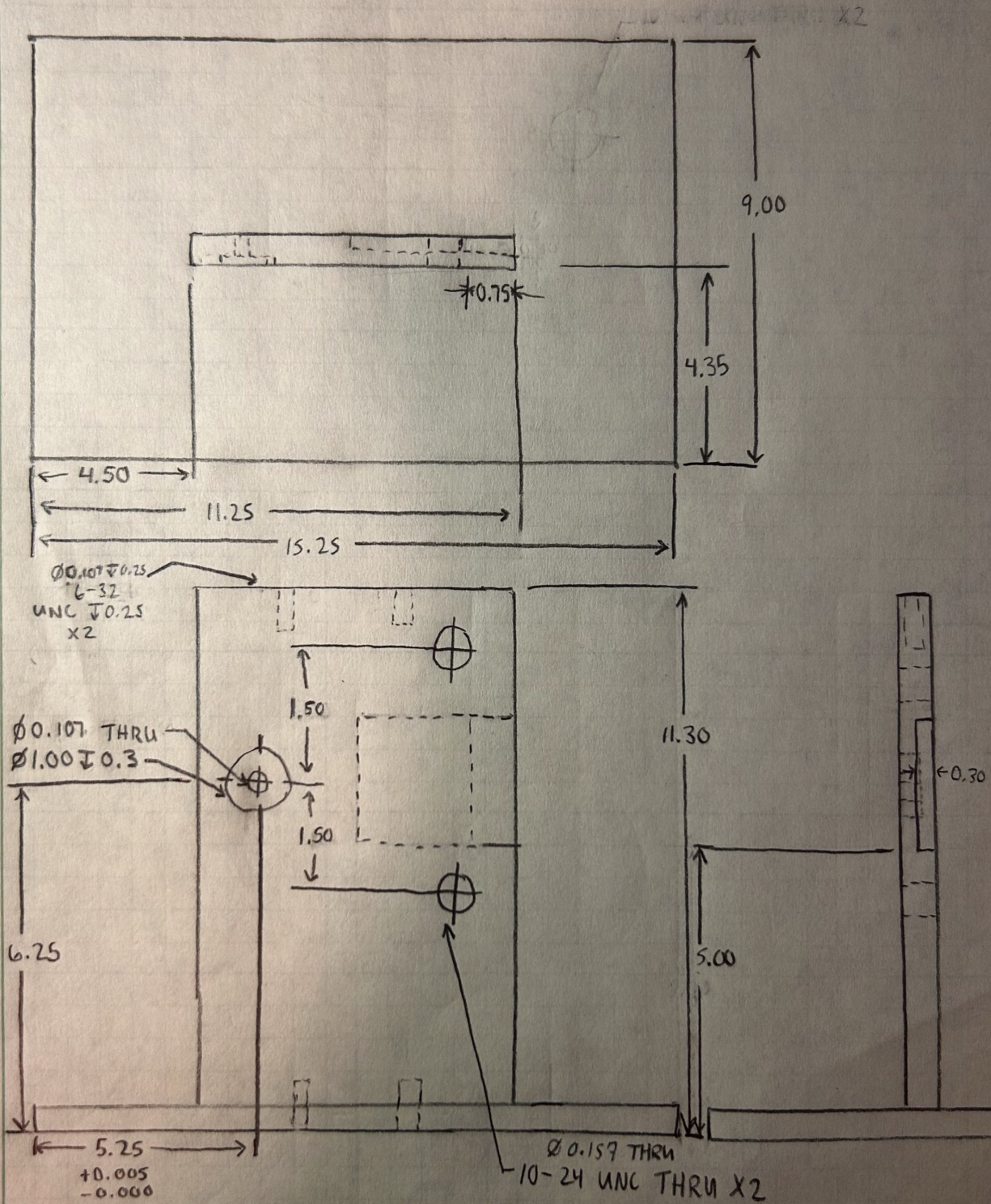
Right Side View



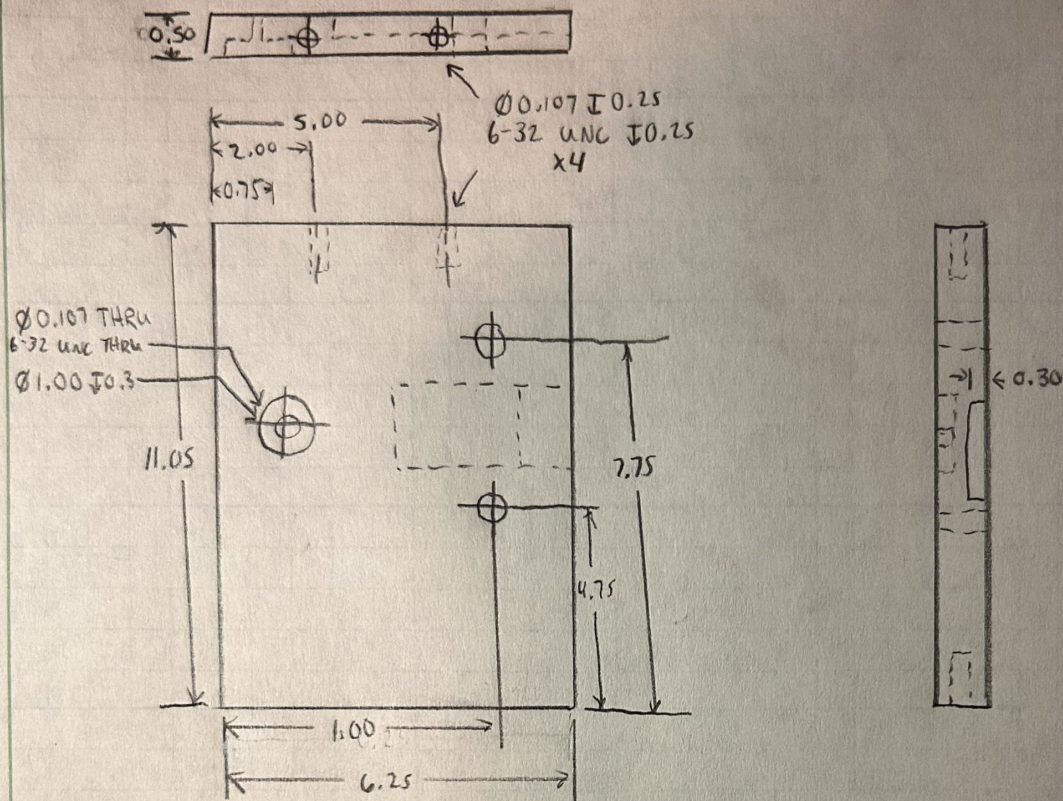
Base (Assembled)

~ See P1, P2

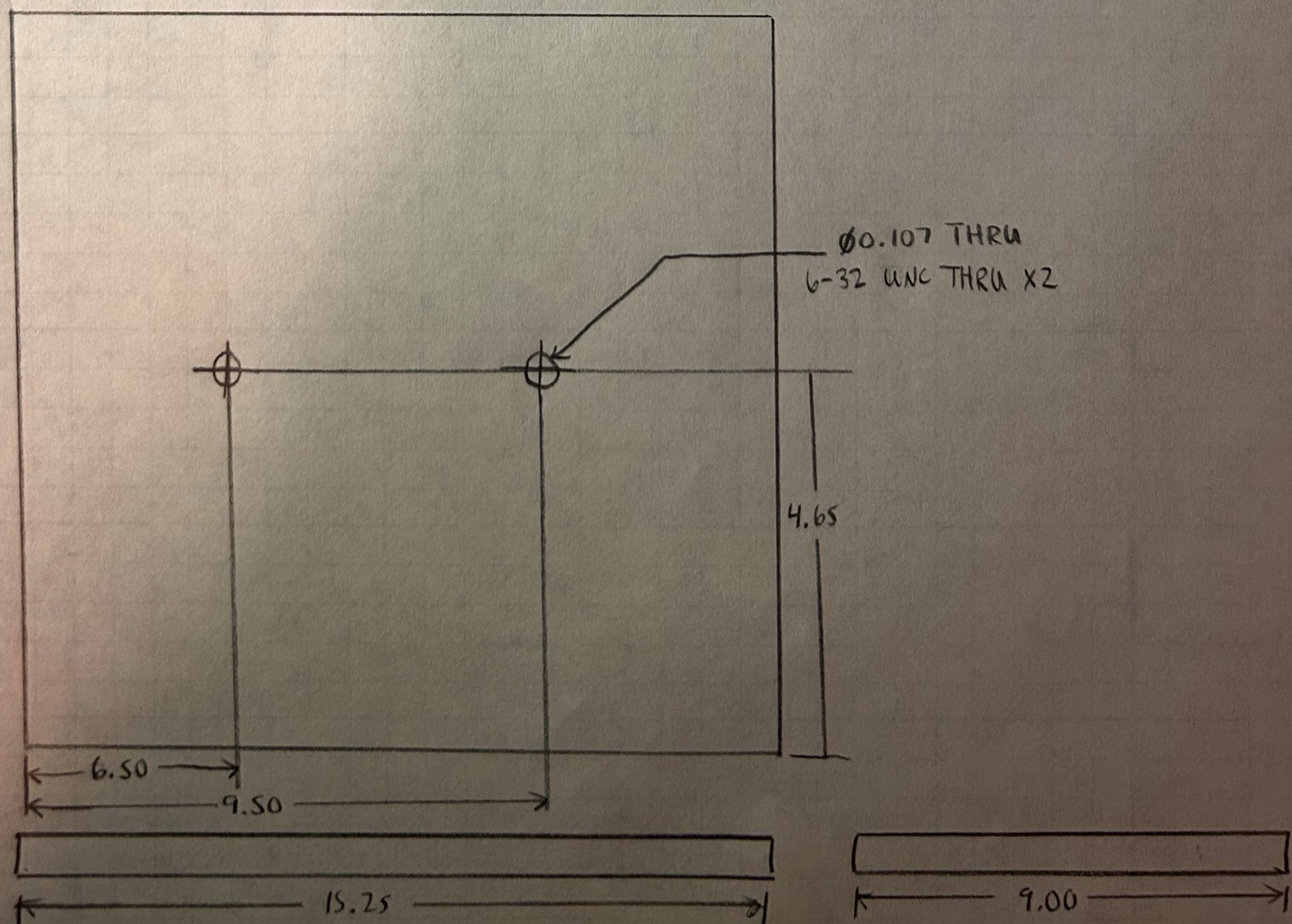
Units: Inches



(P1) Vertical Base Component Units: Inches
Material: HDPE

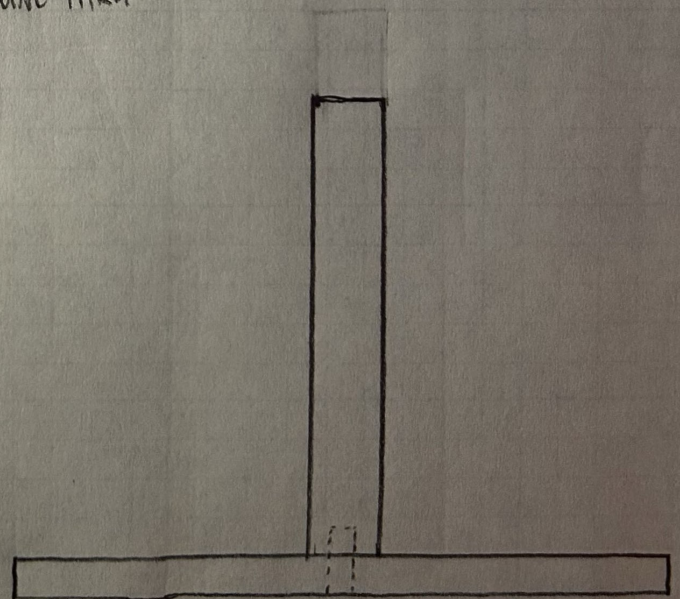
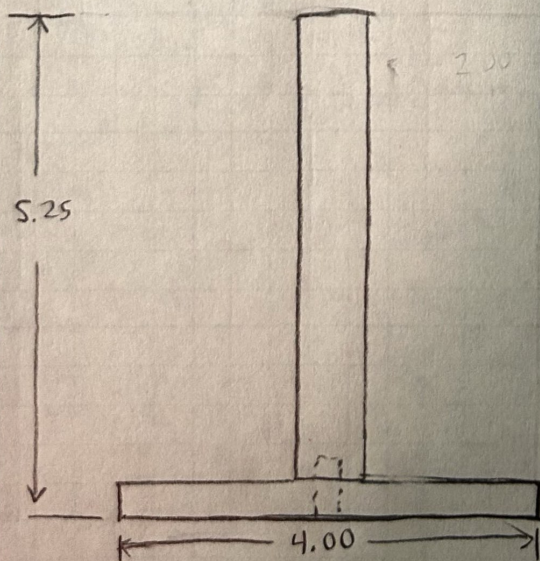
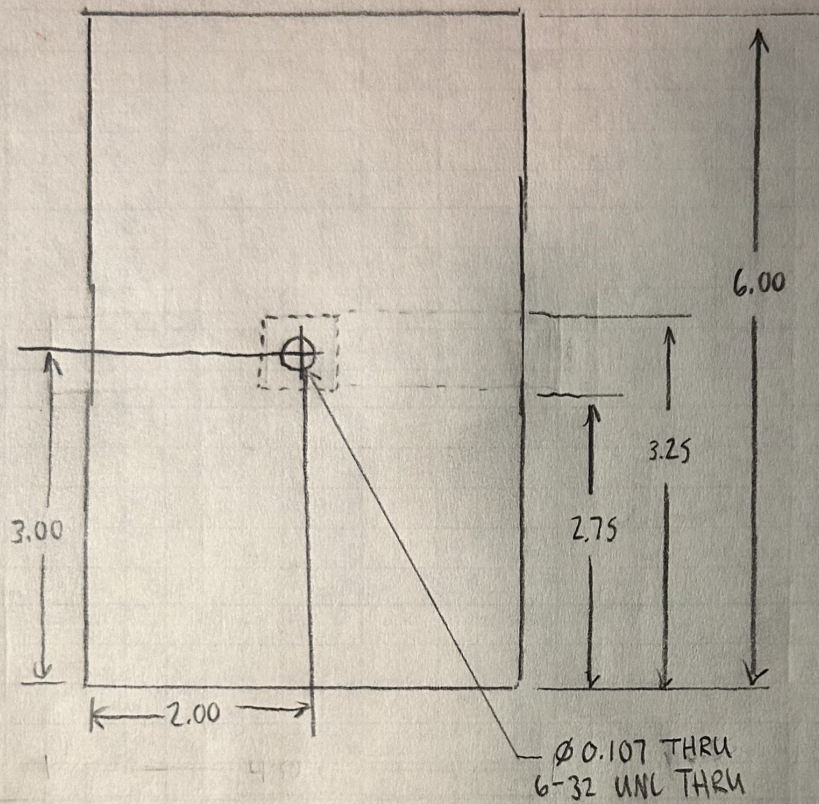


(P2) Horizontal Base Component Units: Inches
Material: HPPE

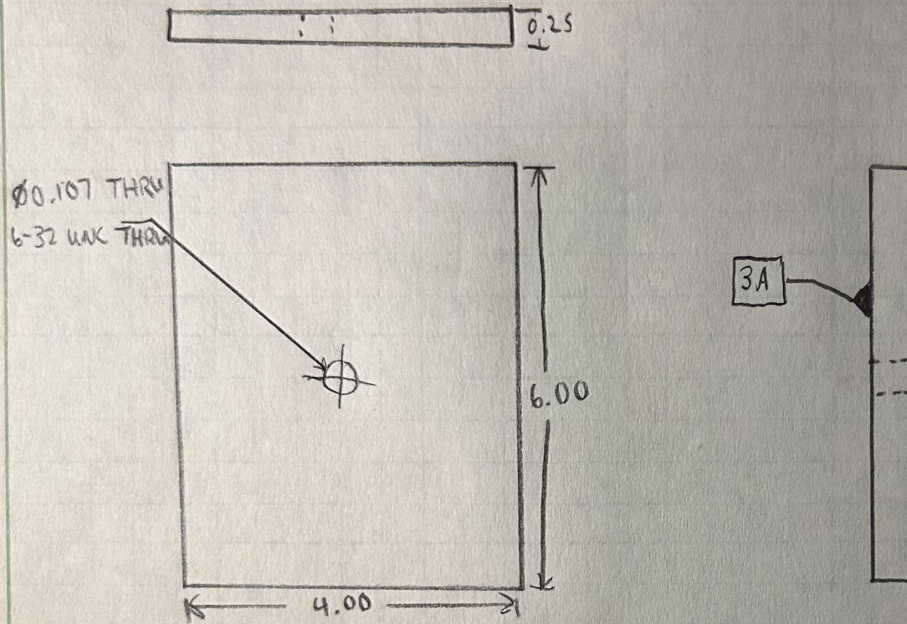


Food Pusher (Assembled)

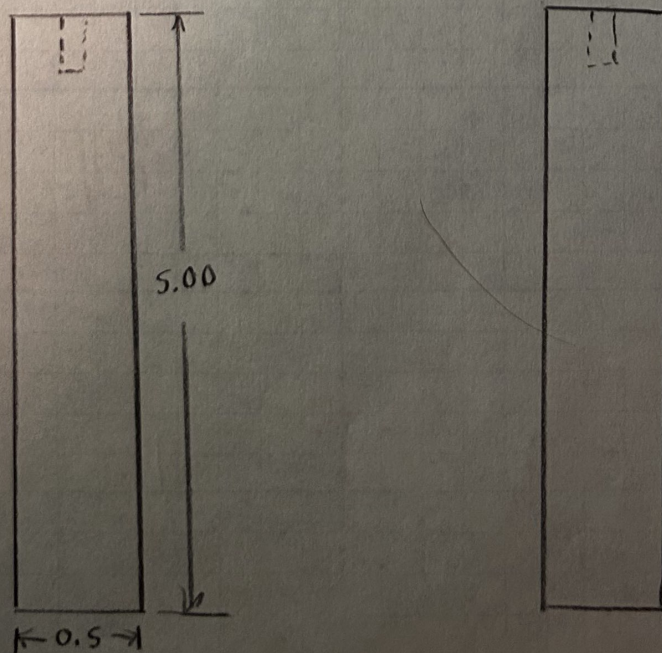
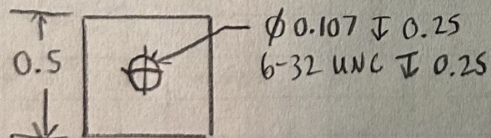
~ See P3, P4
Units: Inches



(P3) Food pusher surface Units: Inches
Material: HDPE



(P4) Food Pusher handle Units: Inches
Material: HDPE



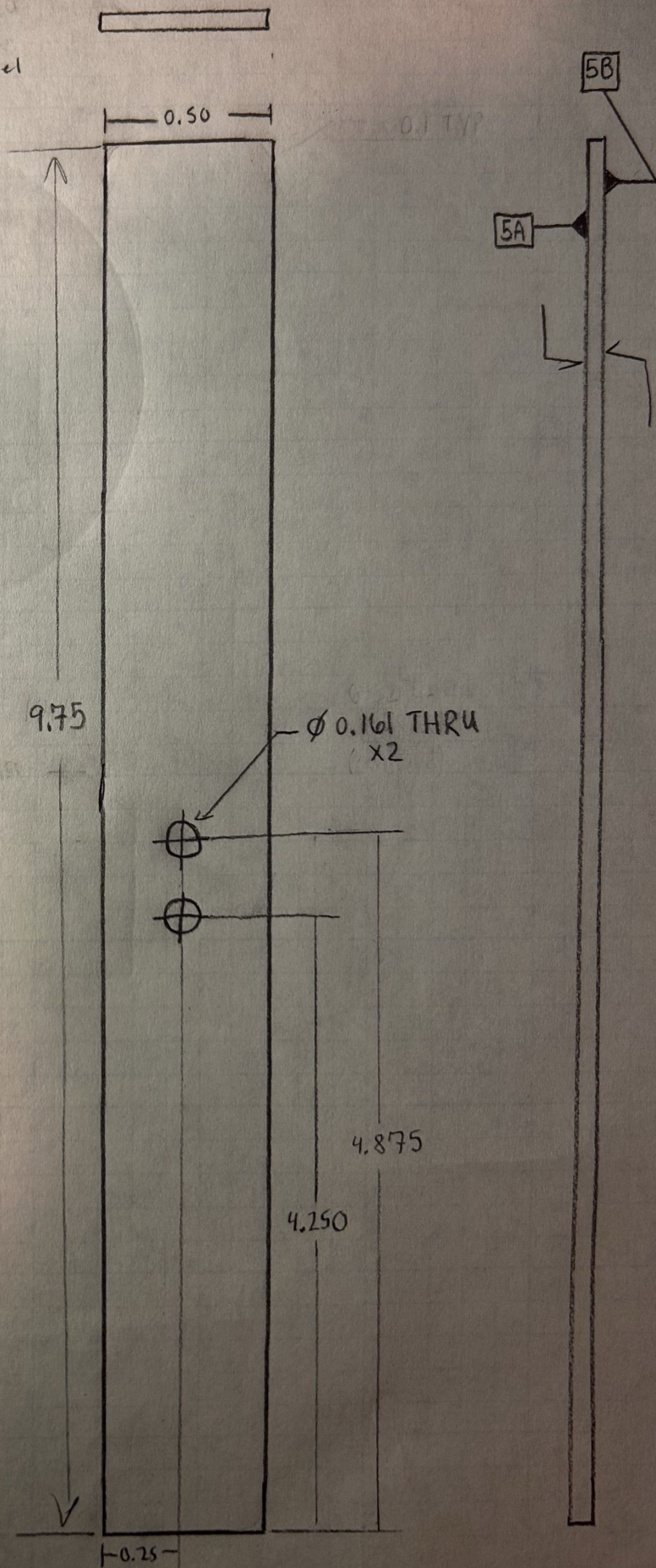
(P5)

Blade

Units: Inches

Material: 303 Stainless Steel

FINISH NOTED SURFACES

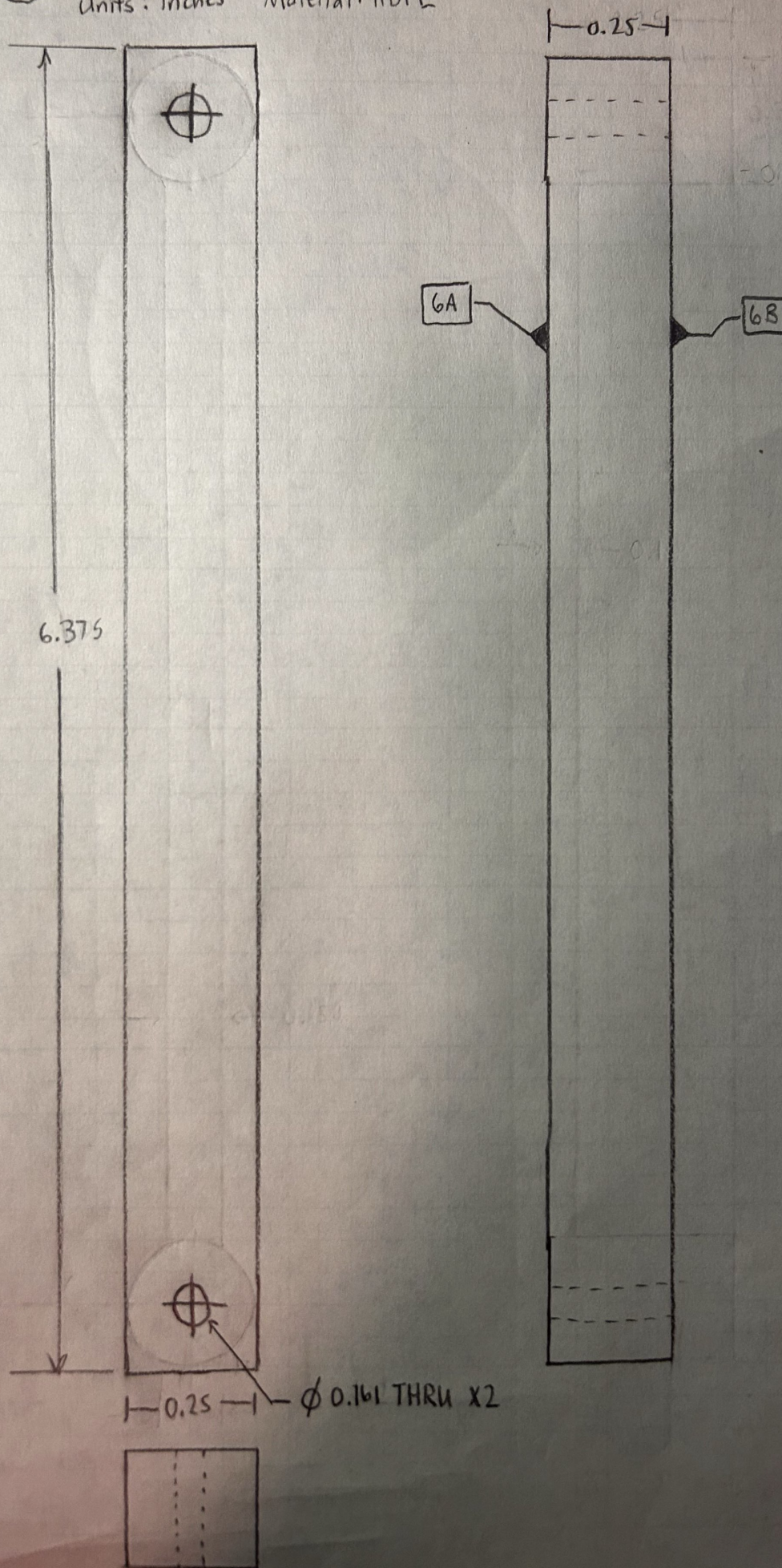
Thickness = $0.063 \begin{matrix} +0.000 \\ -0.005 \end{matrix}$ 

(P6)

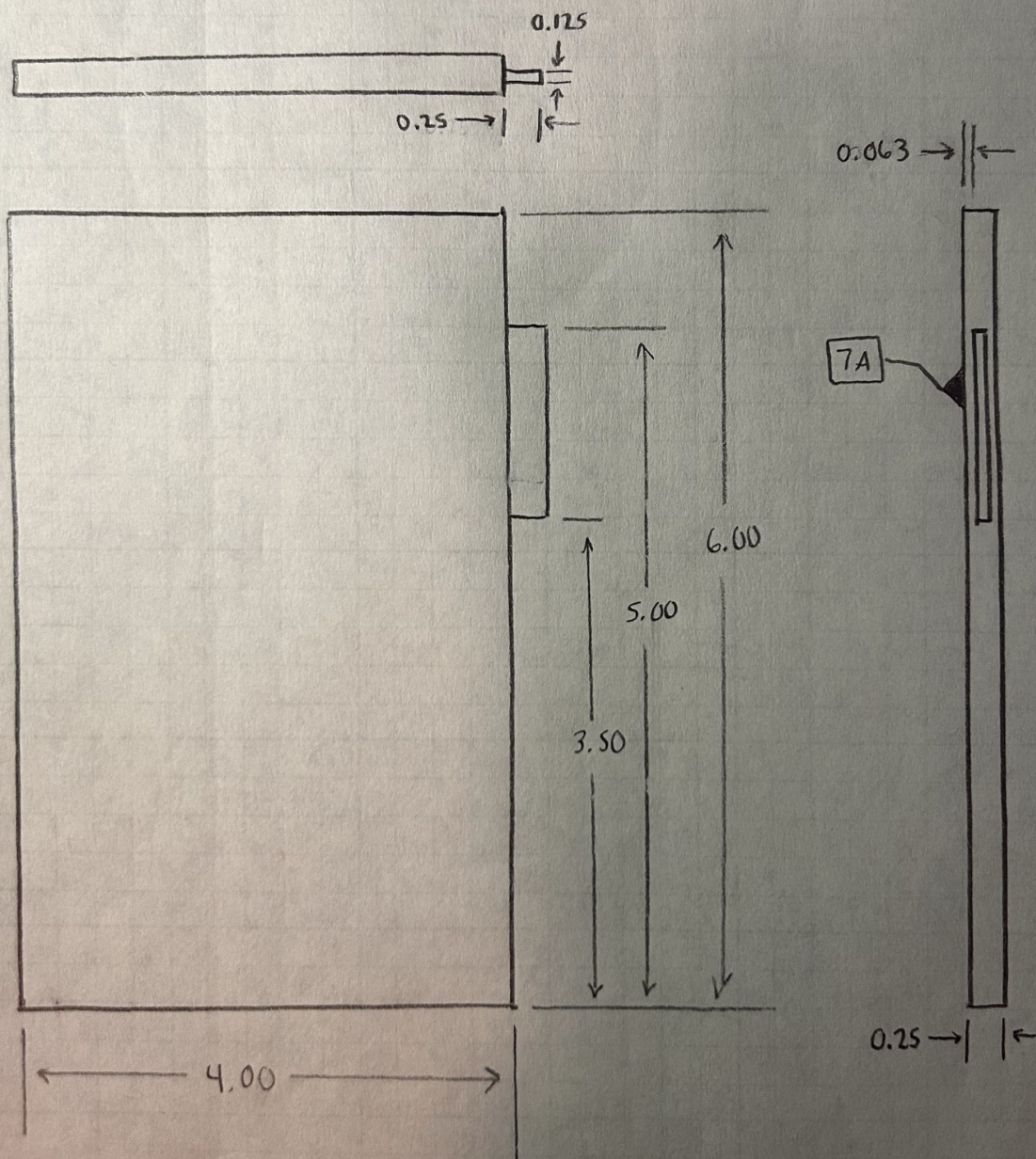
Link

Units: Inches

Material: HDPE



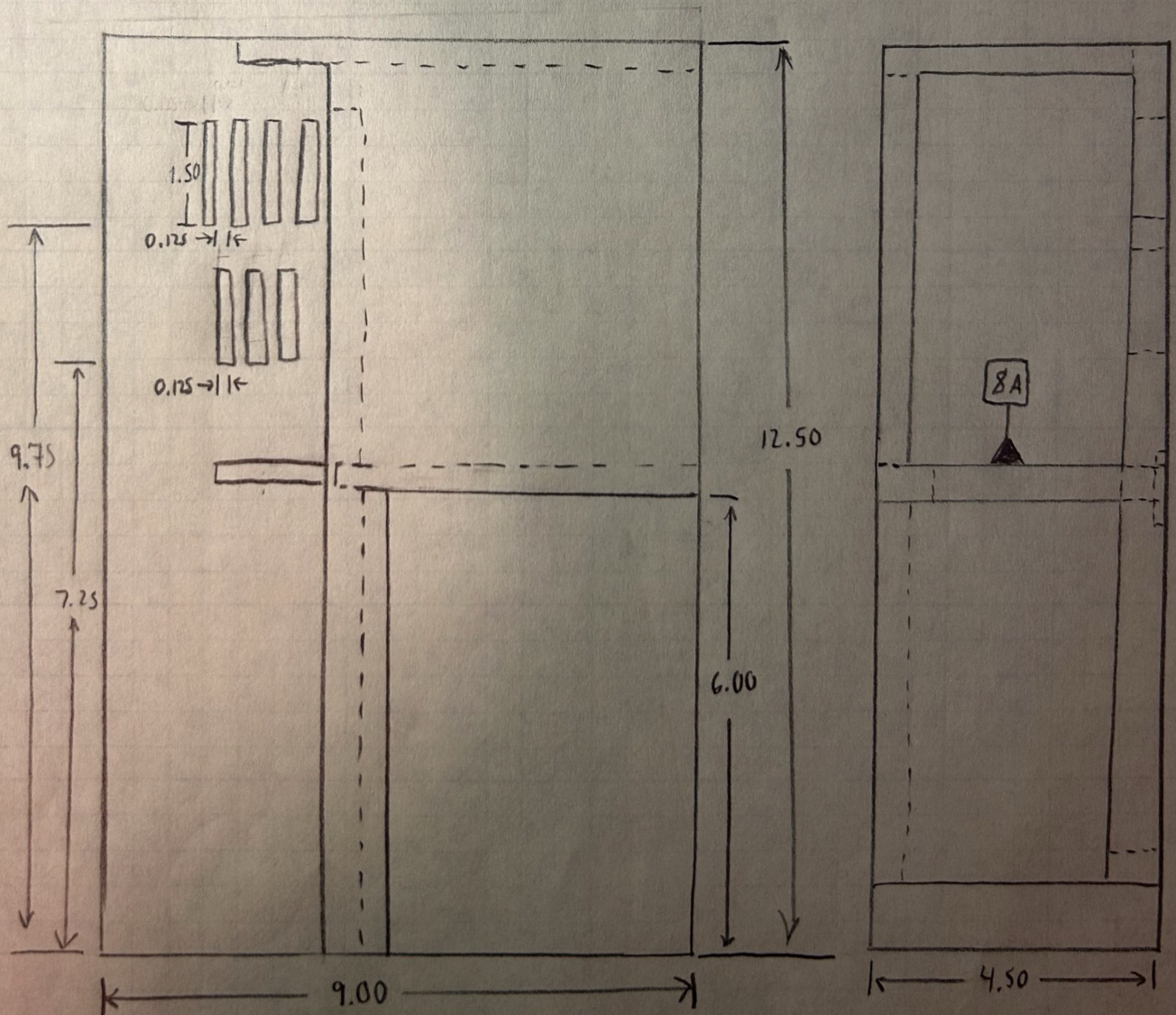
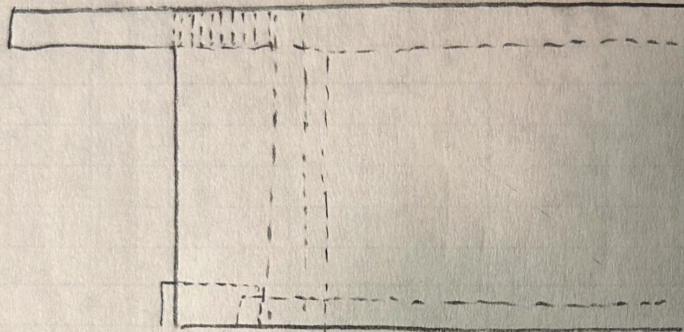
(P7) Food stopper

Units: Inches
Material: HDPE

(p8) Slicer compartment

Units: Inches

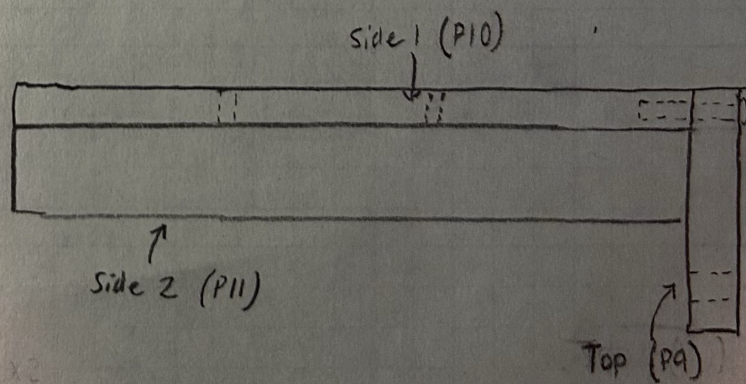
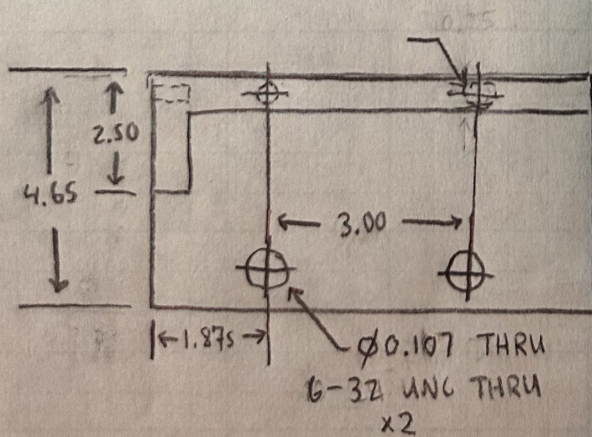
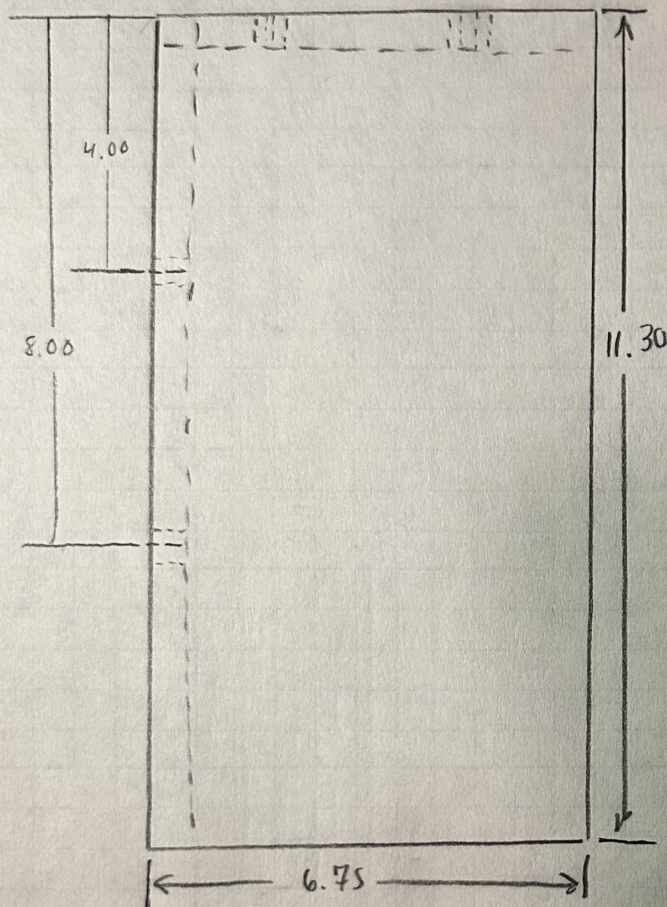
Material: Food Grade PLA



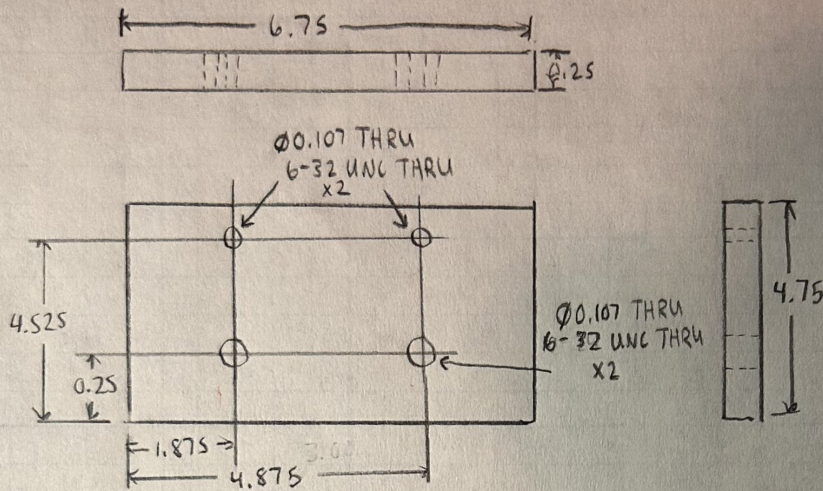
Blade cover (Assembled)

~ See P9, P10, P11

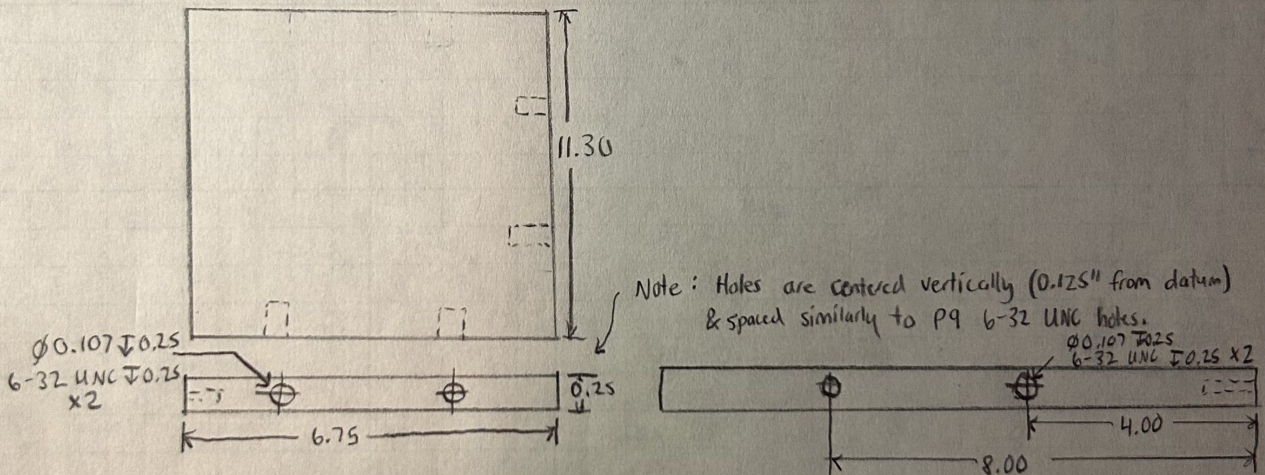
Units: Inches



(P9) Blade cover (top) Units: Inches
Material: HDPE



(P10) Blade cover (side 1) Units: Inches
Material: HDPE



(P11) Blade cover (side 2) Units: Inches
Material: HDPE

