Design Report 3

Group 1D
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Om Patel

EML2322L – Design & Manufacturing Lab
Summer 2026
7/26/2026

1. Concept Description

Concept Description

I. Overall Function

The primary function of this design is to safely and effectively mix the contents of a standard wide-mouth mason jar using the rotational output of an air-powered, single piston air engine. The design transmits power through a two-speed belt-driven system that allows the operator to select either a high- or low-speed mixing configuration while maintaining reliable belt engagement. The overall assembly was designed with considerations of functionality, manufacturability, ease of use, and safe containment of the mixed contents.

Power is transferred from the air engine piston through the modified flywheel, which drives a Buna-N belt connected to a stepped shaft. The shaft rotates the Oster drive pin, which engages the internal drive of the Oster blade assembly to rotate the blades while the mason jar remains stationary. The lid assembly securely seals the mason jar before it is flipped and attached, preventing leakage while allowing the blades to rotate freely in the sealed container.

II. Component Functions

The modified aluminum base serves as the structural foundation for the entire assembly. It supports the flywheel, shaft, platform supports, and tensioner system while maintaining the calculated center distances required for proper belt tension using the selected 14-inch belt. The base was dimensionally modified to accommodate the redesigned belt drive and tensioner assembly to maintain accurate shaft positioning relative to the flywheel.

The modified steel flywheel receives rotational power directly from the air engine. A shallow groove was machined into its circumference using a lathe. This manufacturing method is stronger, simpler, and less expensive than adding a retaining lip. The groove provides increased belt retention and does not allow the belt to slip off upward. The flywheel also incorporates a lower retaining lip that prevents the belt from contacting the stationary base, reducing unnecessary friction and improving operating efficiency.

Power is transmitted through a 14-inch Buna-N belt, selected for its resistance to abrasion, tearing, water, and oil while remaining inexpensive and readily available. The belt transfers rotational motion from the flywheel to the shaft with minimal slip.

Maintaining proper belt tension is accomplished by the tensioner assembly, consisting of a machined aluminum tensioner arm, a spacer, bearings, a bolt, and a nut. The original design utilized a single bearing, but the final design incorporates two vertically stacked bearings to ensure continuous belt contact regardless of belt position when switching between shaft speeds. The tension can be adjusted by loosening or tightening the assembly from underneath the base, allowing the operator to properly tension the belt after manually changing speed ratios.

The stepped shaft serves two primary functions: transmitting rotational power upward through the assembly and providing two selectable operating speeds. The shaft contains two belt engagement diameters separated by retaining lips that prevent the belt from walking during operation. Bearings located at both the lower and upper ends of the shaft minimize friction and allow smooth rotation while maintaining shaft alignment.

Two aluminum platform supports elevate the lid platform above the base while providing structural rigidity. Their placement was designed to support the platform without interfering with belt motion or shaft rotation.

The lid platform is manufactured using 3D printed PETG rather than machining. Due to its complex geometry and relatively low structural loading, additive manufacturing significantly reduces manufacturing time, cost, and complexity while maintaining sufficient strength for the application. The platform incorporates internal L-shaped locking slots that receive the mating features on the lid adapter, allowing the entire lid assembly to be inserted and rotated into a secure locked position in preparation of mixing jar contents.

The machined aluminum lid adapter acts as the interface between the mixer and the mason jar lid assembly. It contains the locking tabs that engage the lid platform and houses the modified lid and off-the-shelf Oster cutting blades while allowing the Oster blades to remain properly aligned with the rotating drive pin from underneath the lid assembly and at the top end of the shaft.

The modified over-the-shelf (OTS) metal mason jar lid, lid adapter, Oster blade assembly, and rubber gasket form a single detachable lid assembly. Unlike the original concept, these three primary components are permanently sealed together using food-safe sealant and adhesive, creating an independent assembly that can be removed from the mixer, threaded directly onto a mason jar, cleaned separately, and interchanged with compatible blade assemblies. The Oster blade assembly contains an internal bearing that allows the blades to rotate independently while the surrounding sealing components remain stationary. This design ensures reliable sealing when flipping the capped mason jar and attaching it to the mixer while transmitting rotational power only to the blades.

III. Component Materials

Material selection prioritized manufacturability, durability, corrosion resistance, and cost. Most custom structural components, including the base, platform supports, tensioner arm, and lid adapter, are machined from aluminum stock due to aluminum's favorable machinability, low weight, corrosion resistance, and availability.

The flywheel remains steel because it is an existing air engine component that is modified but keeps its original function of preserving rotational momentum from its high rotational inertia. Only the belt groove is machined into the original part to prevent slipping and friction.

The belt is manufactured from Buna-N rubber, providing sufficient friction for power transmission while resisting wear and exposure from indoor environments during operation.

The lid platform is 3D printed using PETG filament because its geometry would be significantly more difficult, expensive, and time-consuming to machine conventionally. Since the component experiences relatively low mechanical loading, additive manufacturing is the most practical manufacturing solution for this part.

Several commercial OTS parts were included to reduce manufacturing time and overall cost. These include bearings, bolts, washers, nuts, spacers, the Oster drive pin, Oster blades and rubber gasket, modified metal mason jar lid, and the Buna-N belt. Purchasing these components instead of manufacturing them improves design for manufacturability (DFM) while increasing repeatability and production simplicity.

IV. Attachment Method to the Air Engine

The mixer attaches to the air engine through the existing flywheel, eliminating the need for additional drive mechanisms. As compressed air powers the engine, the flywheel rotates and transfers motion through the belt to the stepped shaft. The operator may stop the engine, manually reposition the belt between shaft diameters, adjust belt tension using the tensioner assembly, and restart the engine to operate at a different mixing speed.

The completed lid assembly is first threaded onto a mason jar containing the desired contents. After the jar is inverted and inserted into the lid platform, the drive pin properly engages the blade assembly from below, and the locking tabs on the lid adapter engage the platform's L-lock slots. Rotating the lid assembly with the mason jar attached locks the jar securely in place while maintaining alignment with the rotating shaft.

This attachment method creates a rigid, detachable interface between the mixer and the mason jar while preventing accidental disengagement during operation. The sealed lid assembly confines the contents within the jar, preventing leakage onto the mechanical components and protecting both the user and the mixer during operation.

V. Design for Manufacturability Considerations

DFM was a major consideration throughout the development of this concept. Existing commercial OTS components were used instead of manufacturing new parts. Components requiring custom geometry were simplified for conventional machining or delegated to additive manufacturing. For example, machining a groove into the existing flywheel replaced a more complex welded design, while 3D printing the lid platform significantly reduced manufacturing difficulty without compromising functionality. Similarly, the redesigned detachable lid assembly also improves usability by allowing the mason jar, blades, and sealing components to be assembled, cleaned, and replaced independently of the mixer itself. This modular approach improves maintenance, repeatability, and overall practicality while satisfying the functional requirements of the project.

VI. Calculations

The calculations to determine the center distance from the flywheel to the shaft as well as the calculations to determine whether the height of the tensioner arm bearings is appropriate to properly engage the belt. The calculations were done using geometric formulas and dimensioning in MATLAB. Attached below are an image of the MATLAB script and a diagram, not drawn to scale, for the tensioner height configuration. The output of the script is:

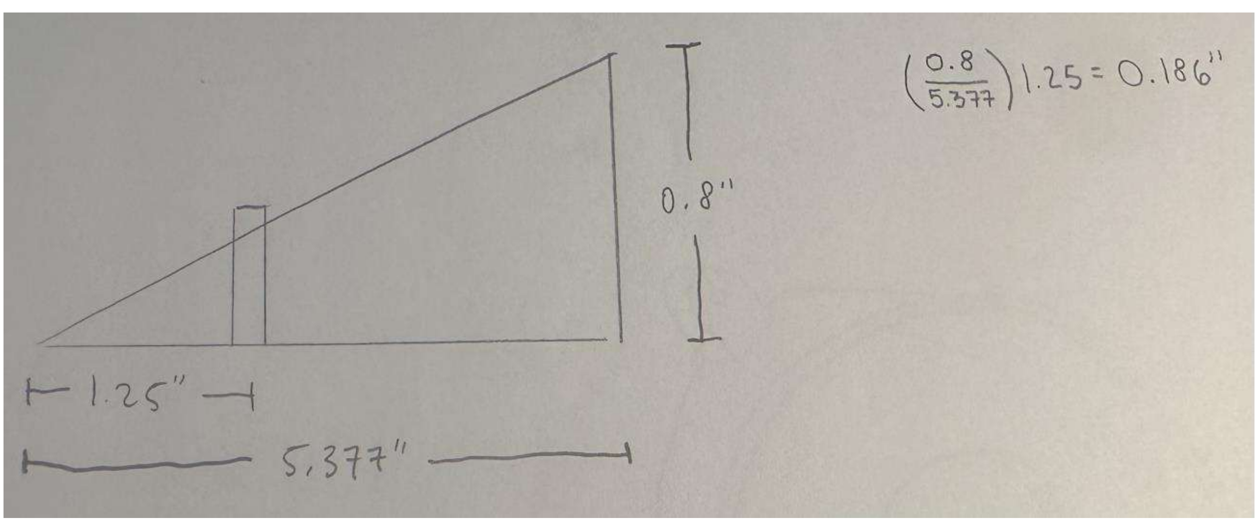
“The center distance from flywheel to shaft is 5.377 inches.

The belt does engage the tensioner properly:

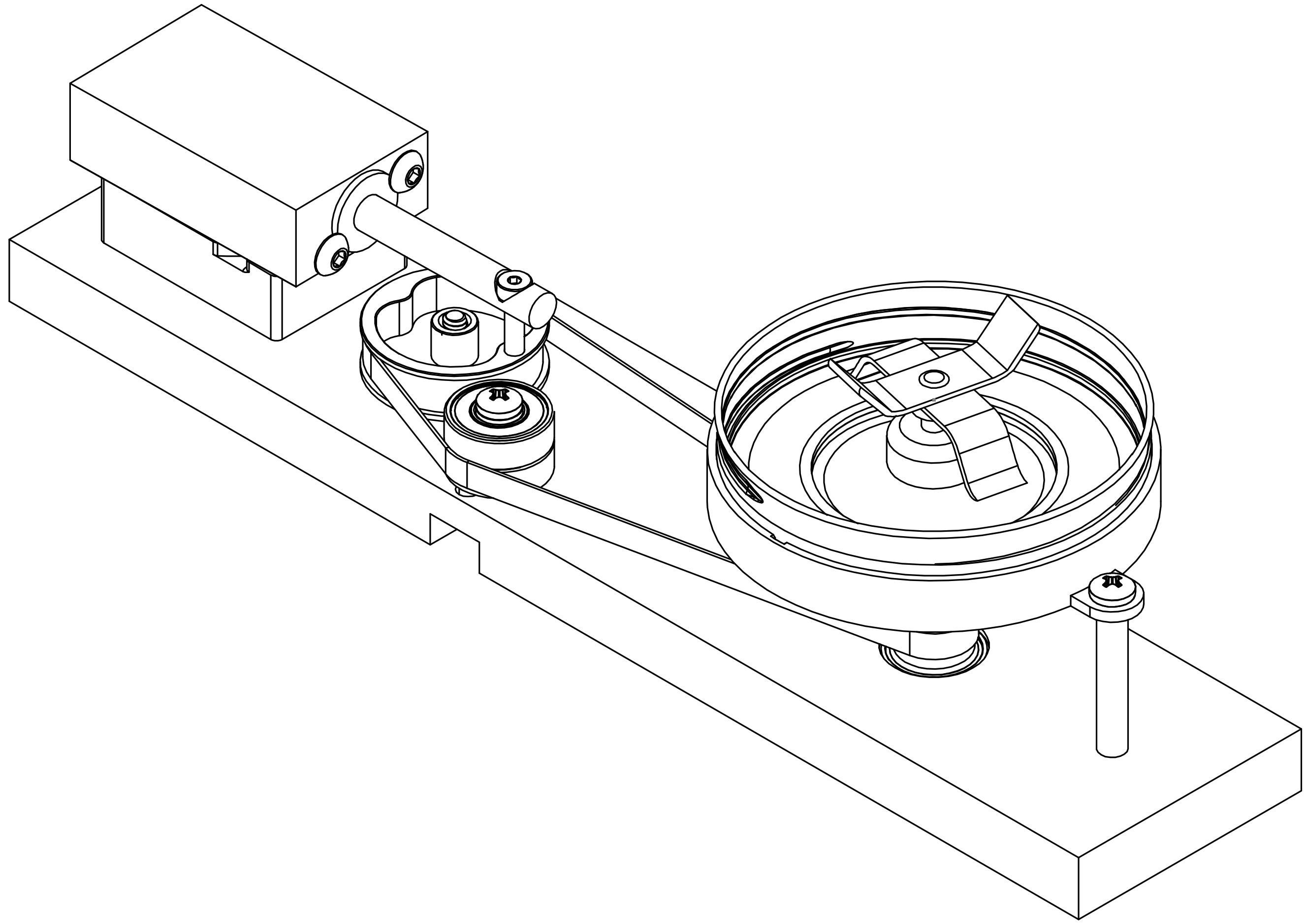
The belt is 0.186 inches tall at the tensioner.

The tensioner is 0.594 inches tall.”

```
clear; clc; close all;
% Belt Length Calculation -----------------------------------------------
% Knowns
D = 1.4;          % flywheel
d1 = 0.650;       % larger shaft diam
d2 = 0.375;       % smaller shaft diam
total = 14;       % belt length
% Equations applied
% Circumference = 2*pi*radius = pi*diameter
% l^2 = x^2 + y^2
% Length contribution from flywheel diameter
% Half circumference
fwd = pi*D/2; %flywheel diameter contribution
% Length contribution from shaft diameter
% Half circumference
sd = pi*d1/2; %shaft diameter d1 contribution (worst case)
% x is what we're solving for, its the distance from flywheel center
% to shaft center. constraints are respective diameters and 14 in. belt
% Calculation
y = (D - d1)/2; % difference of vertical diameter distance
l = (14 - pi*(D + d1)/2)/2; % diagonal distance from tops of diameters
x = round(sqrt(l^2 - y^2), 3); % find x, distance between centers

% Tensioner Height Calculation -------------------------------------------
% Knowns
x; % center distance
a = 1.25; % center distance of tensioner to flywheel
spacer = 0.031; % spacer height
bearing = 9/32; % bearing height
h_d = 0.8; % belt height on shaft, range: 0.85 - 0.45 (0.8 ~ worst case)
% Equations applied
% tan(theta) = opp/adj
% Similar triangles theory
% Total height of tensioner
% Spacer and both bearings only
h_t = round(spacer + (2*bearing), 3);
% we want to verify that the belt will not exceed the height of the
% tensioner bearings assembly to ensure contact throughout operation
% Calculation
h_b = round((h_d/x)*a, 3); % height of belt

% Results ---------------------------------------------------------------

% Center distance
fprintf('The center distance from flywheel to shaft is %g inches.\n\n', x)

% Belt/tensioner heights
if h_b > h_t
    fprintf('The belt does not engage the tensioner properly.\n')
else
    fprintf('The belt does engage the tensioner properly:\n')
    fprintf('The belt is %g inches tall at the tensioner.\n', h_b)
    fprintf('The tensioner is %g inches tall.\n', h_t)
end
```

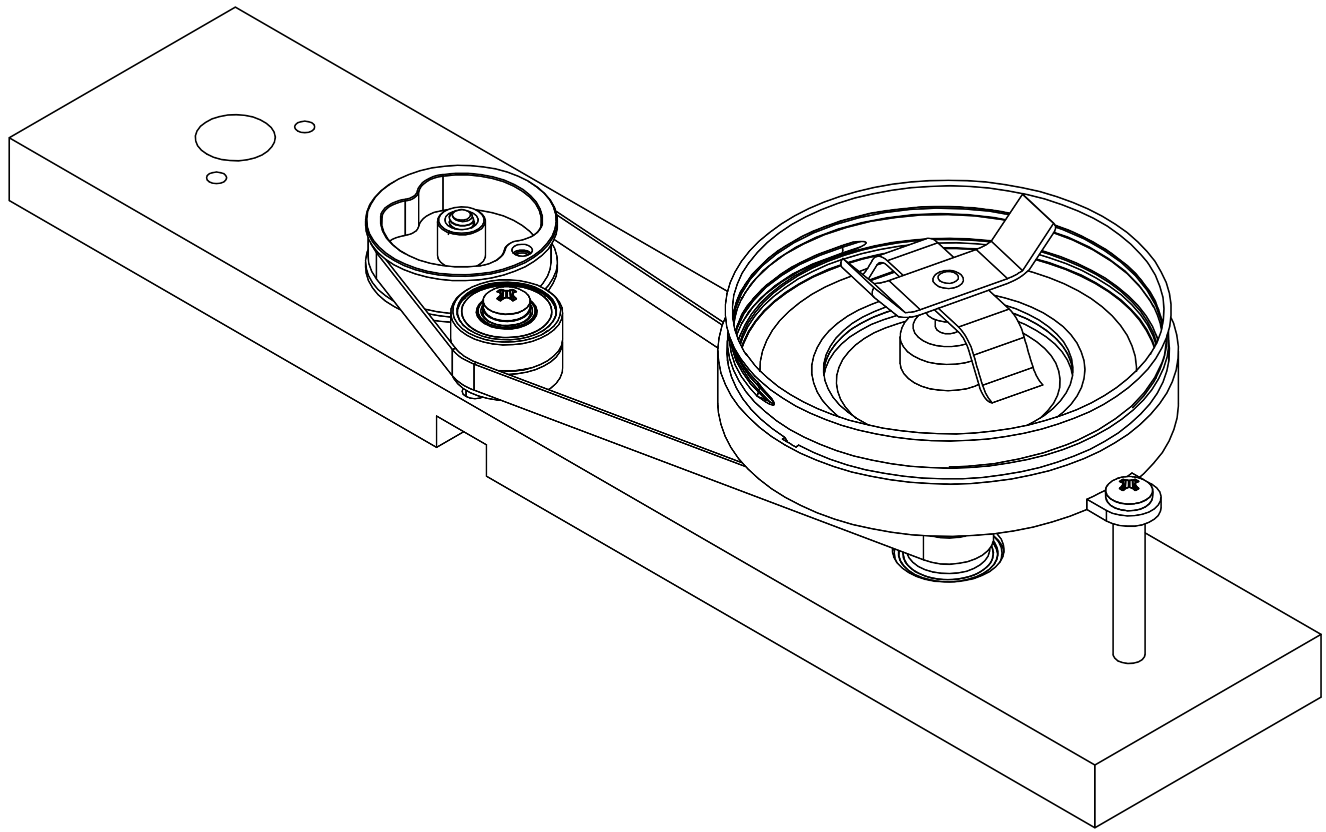


2. Assembly Drawings & B.O.M



				TITLE: MIXER ASSEMBLY			
				DRAWN	JACOB KAERCHER		
TOLERANCE UNLESS NOTED				CHECKED	OM PATEL		
DIMENSION TYPE	PLACES IN DIMENSION			SIZE	DWG. NO.		REV
	0.0	0.00	0.000	A	EML2322L-A1		A
LOCATIONAL	±0.050	±0.020	±0.005				
ANGULAR	±5	±2	±0.5	SCALE: 2:3		SHEET 1 OF 1	

5 4 3 2 1



TOLERANCE UNLESS NOTED			
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LOCATIONAL	±0.050	±0.020	±0.005
ANGULAR	±5	±2	±0.5

TITLE: MIXER ASSEMBLY

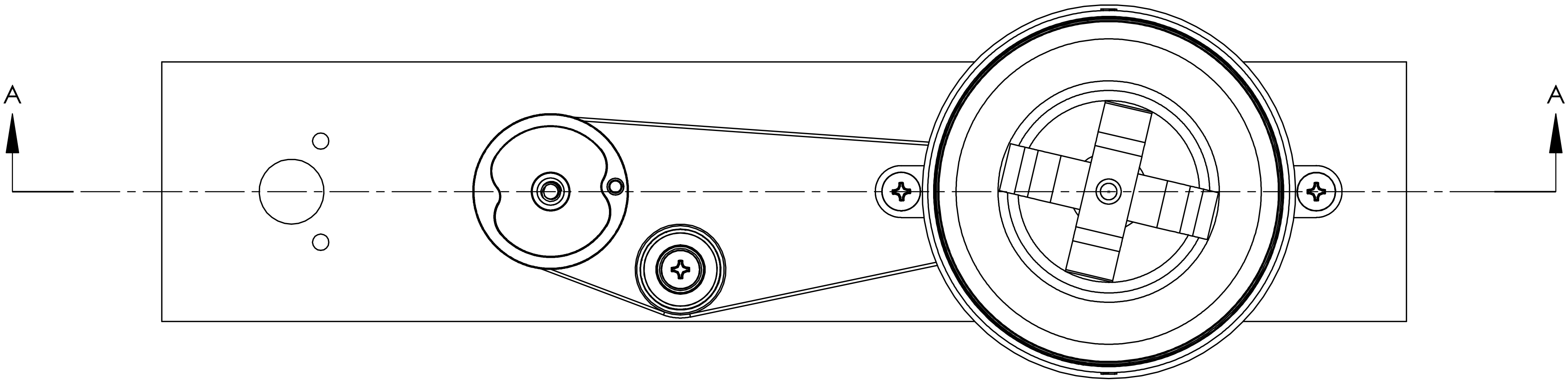
DRAWN JACOB KAERCHER

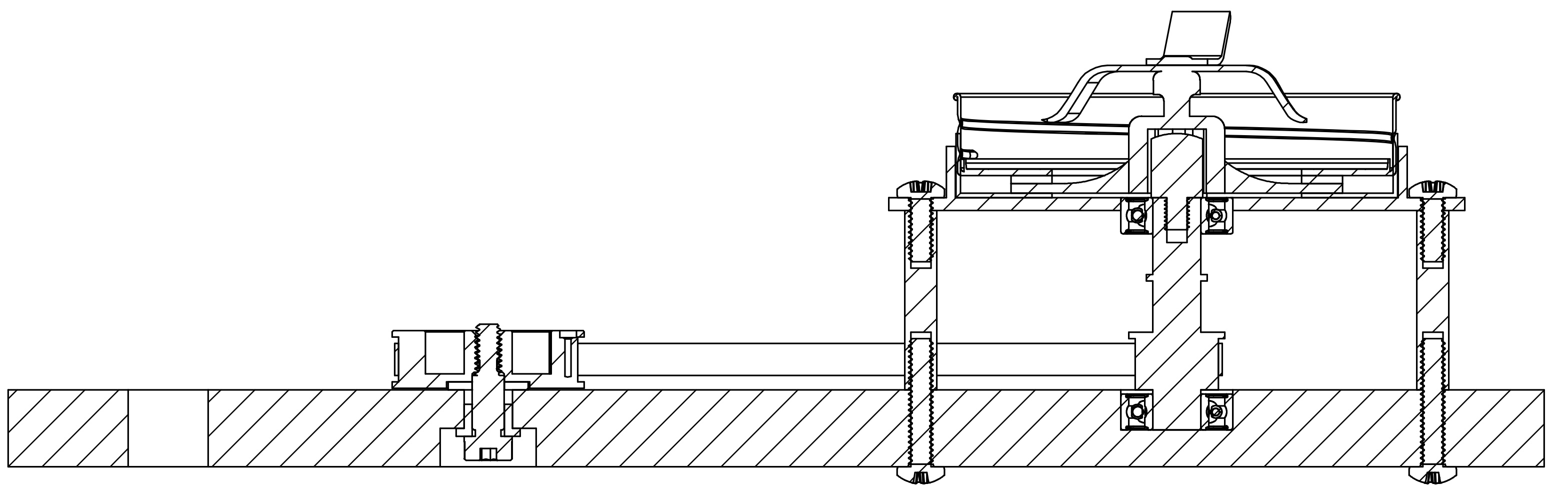
CHECKED OM PATEL

SIZE	DWG. NO.	REV
A	EML2322L-A2	A

SCALE: 2:3 | SHEET 1 OF 6

3 2 1





SECTION A-A

TOLERANCE UNLESS NOTED			
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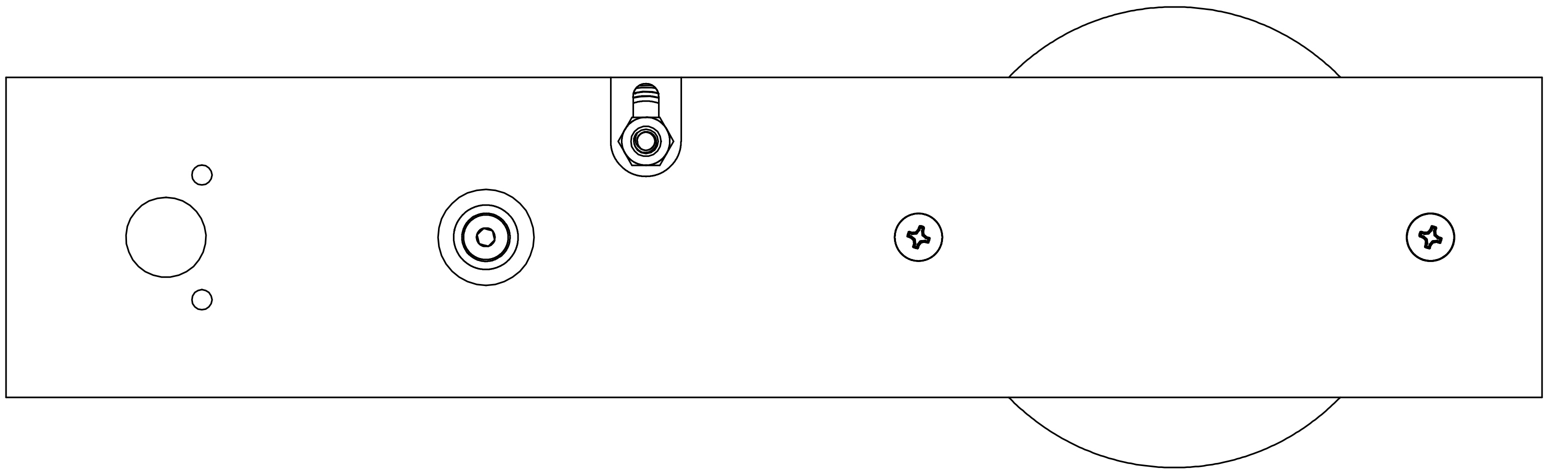
LOCATIONAL	±0.050	±0.020	±0.005
ANGULAR	±5	±2	±0.5

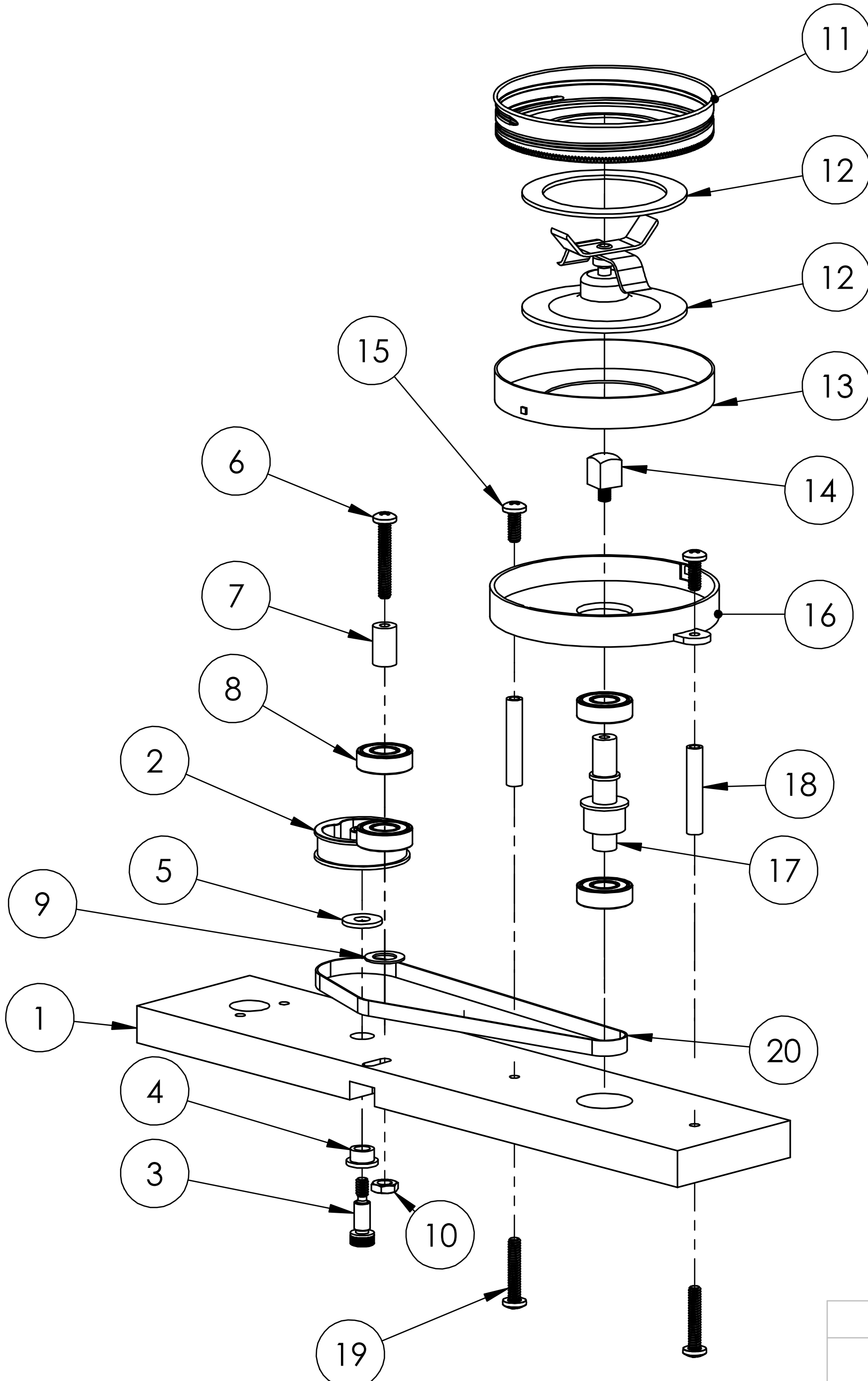
TITLE:	MIXER ASSEMBLY	
DRAWN	JACOB KAERCHER	
CHECKED	OM PATEL	
SIZE A	DWG. NO. EML2322L-A2	REV A
SCALE: 2:3		SHEET 2 OF 6

3 2 1



				TITLE: MIXER ASSEMBLY		
				DRAWN	JACOB KAERCHER	
TOLERANCE UNLESS NOTED				CHECKED	OM PATEL	
DIMENSION TYPE	PLACES IN DIMENSION			SIZE	DWG. NO.	REV
	0.0	0.00	0.000	A	EML2322L-A2	A
LOCATIONAL	±0.050	±0.020	±0.005			
ANGULAR	±5	±2	±0.5	SCALE: 2:3		SHEET 3 OF 6

5 4 3 2 1



TOLERANCE UNLESS NOTED			
DIMENSION TYPE	PLACES IN DIMENSION		
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LOCATIONAL	±0.050	±0.020	±0.005
ANGULAR	±5	±2	±0.5

TITLE: MIXER ASSEMBLY		
DRAWN	JACOB KAERCHER	
CHECKED	OM PATEL	
SIZE A	DWG. NO. EML2322L-A2	REV A
SCALE: 1:3		SHEET 4 OF 6

3 2 1

ITEM NO.	PART NUMBER	VENDOR PART NUMBER	DESCRIPTION	QTY.
1	EML2322L-P1	-	Base	1
2	EML2322L-P2	-	Modified Flywheel	1
3	EML2322L - OTS03 (AIR ENGINE)	91259A172	10-24 x 1/2 inch Left-Hand Threaded Shoulder Screw	1
4	EML2322L - OTS07 (AIR ENGINE)	1677K100	1/4 inch ID x 3/8 inch OD x 1/4 inch Long Sleeve Bearing	1
5	EML2322L - OTS11 (AIR ENGINE)	7421K100	1/4 inch ID x 5/8 inch OD x 1/16 inch Thick Thrust Bearing	1
6	EML2322L - OTS03	6-FMPP-10C125	Machine Screw Phillips Drive Pan Head 10-24 x 1-1/4" Type 316 Stainless	1
7	EML2322L-P3	-	Tensioner Arm	1
8	EML2322L - OTS06	BB-R6-ZZ/1	R6-ZZ Ball Bearing - 3/8"x7/8"x9/32"	4
9	EML2322L - OTS07	WBB511839	3/8" I.D. x 5/8" O.D. x 0.031" Steel Arbor Shim	1
10	EML2322L - OTS08	0000-103719	#10-24 Coarse Thread Hex Machine Screw Nut Stainless Steel 18-8	1
11	EML2322L-P4	RC-086	Modified Lid	1
12	EML2322L - OTS10	OS-010	Blender Cutter Blade and Rubber O-Ring Seal	1
13	EML2322L-P5	-	Lid Adapter	1
14	EML2322L - OTS09	OS-070	Univen Blender Square Drive Pin Stud	1
15	EML2322L - OTS05	6-FMPP-10C050	Machine Screw Phillips Drive Pan Head 10-24 x 1/2" Type 316 Stainless	2

TOLERANCE UNLESS NOTED			
DIMENSION TYPE	PLACES IN DIMENSION		
	0.0	0.00	0.000
LOCATIONAL	±0.050	±0.020	±0.005
ANGULAR	±5	±2	±0.5

TITLE: MIXER ASSEMBLY

DRAWN JACOB KAERCHER

CHECKED OM PATEL

SIZE A | DWG. NO. EML2322L-A2 | REV A

SCALE: 1:1 | SHEET 5 OF 6

3 2 1

ITEM NO.	PART NUMBER	VENDOR PART NUMBER	DESCRIPTION	QTY.
16	EML2322L-P6	-	Lid Platform	1
17	EML2322L-P7	-	1/4 inch Tube OD x 1/8 NPT Male Straight Adapter	1
18	EML2322-P8	-	Platform Support	2
19	EML2322L-OTS04	6-FMPP-10C100	Machine Screw Phillips Drive Pan Head 10-24 x 1" Type 316 Stainless	2
20	EML2322L - OTS02	6082K51	1/4" Wide Flat Belt, 14" Outer Circumference	1

TOLERANCE UNLESS NOTED			
DIMENSION TYPE	PLACES IN DIMENSION		
	0.0	0.00	0.000
LOCATIONAL	±0.050	±0.020	±0.005
ANGULAR	±5	±2	±0.5

TITLE: MIXER ASSEMBLY

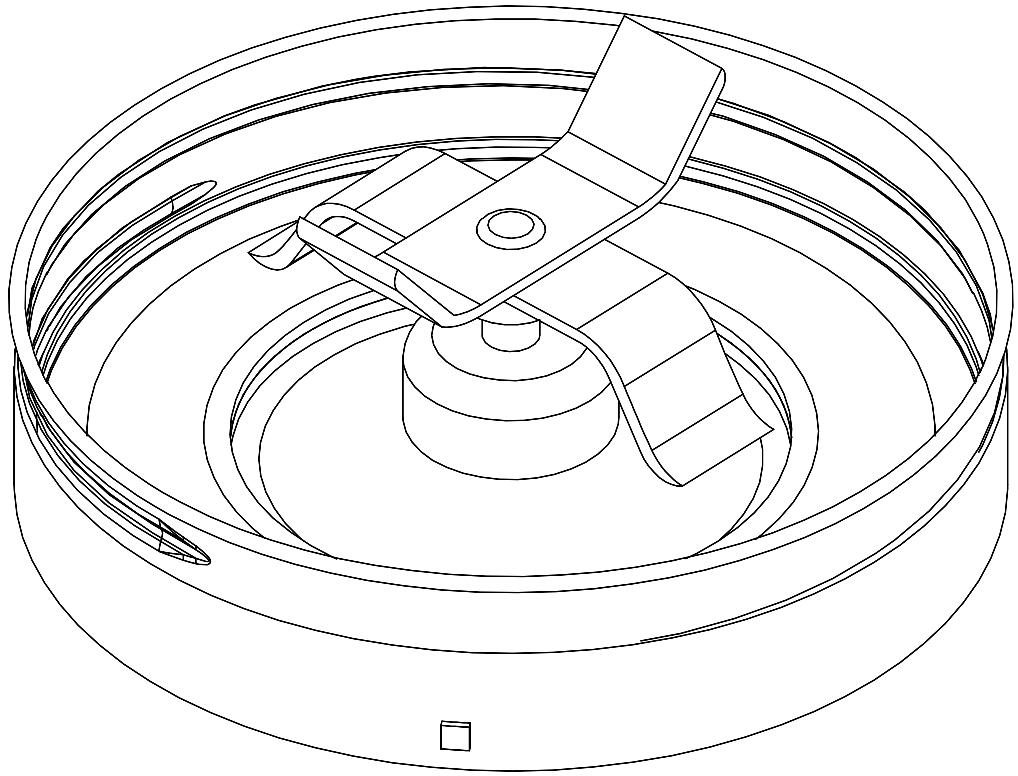
DRAWN JACOB KAERCHER

CHECKED OM PATEL

SIZE A DWG. NO. EML2322L-A2 REV A

SCALE: 1:1 SHEET 6 OF 6

3 2 1



TITLE:	LID CONSTRUCTION		
DRAWN	JACOB KAERCHER		
CHECKED	MATTHEW SABAG		
SIZE A	DWG. NO. EML2322L-A3		REV A
SCALE: 3:2		SHEET 1 OF 5	

TOLERANCE UNLESS NOTED			
DIMENSION TYPE	PLACES IN DIMENSION		
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LOCATIONAL	±0.050	±0.020	±0.005
ANGULAR	±5	±2	±0.5

3 2 1

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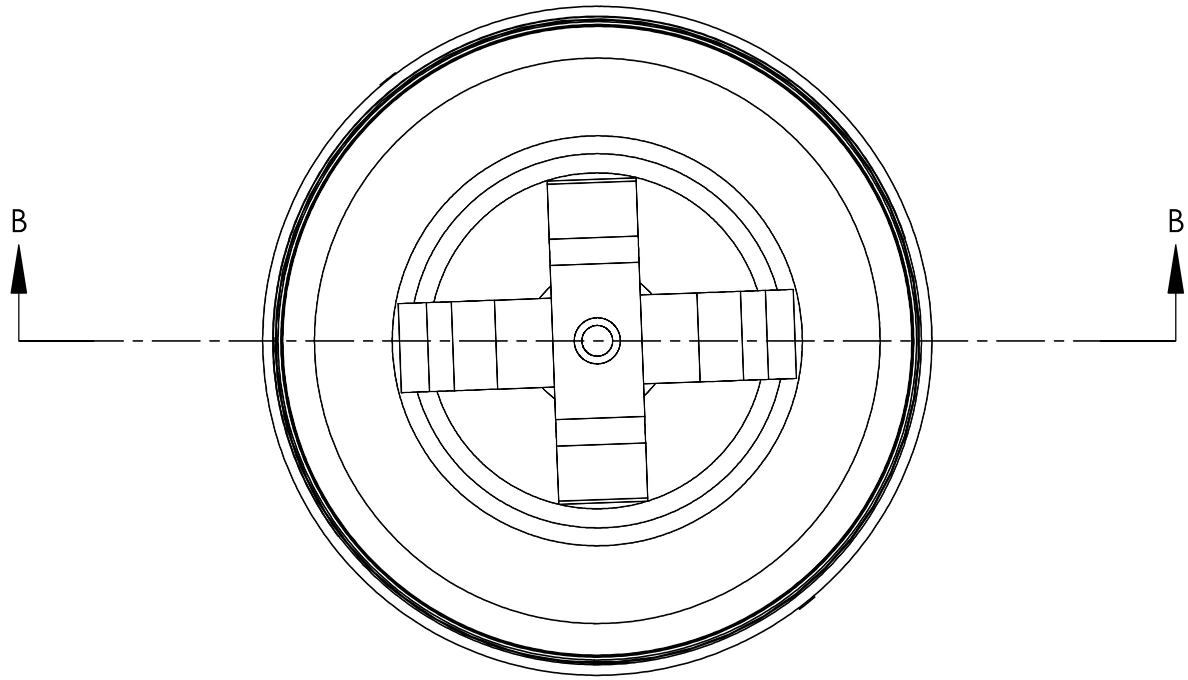

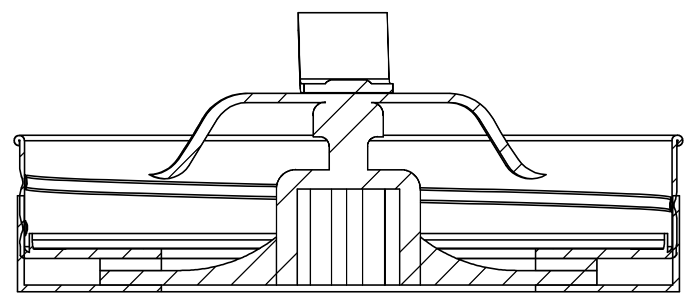

SECTION B-B

TOLERANCE UNLESS NOTED				
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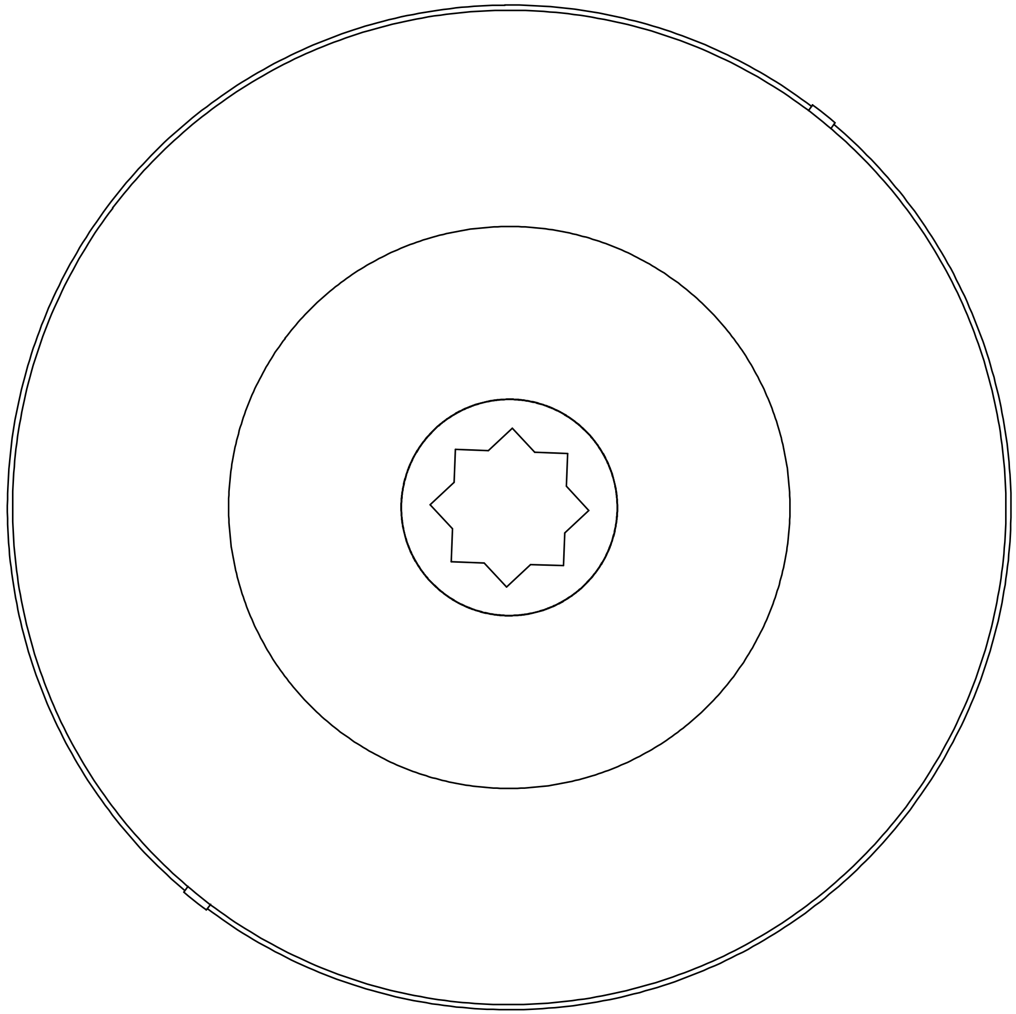
LOCATIONAL	±0.050	±0.020	±0.005	
ANGULAR	±5	±2	±0.5	

TITLE:	LID CONSTRUCTION	
DRAWN	JACOB KAERCHER	
CHECKED	MATTHEW SABAG	
SIZE A	DWG. NO. EML2322L-A3	REV A
SCALE: 1:1		SHEET 2 OF 5

3 2 1



TITLE: LID CONSTRUCTION		
DRAWN	JACOB KAERCHER	
CHECKED	MATTHEW SABAG	
SIZE A	DWG. NO. EML2322L-A3	REV A
SCALE: 3:2		SHEET 3 OF 5

TOLERANCE UNLESS NOTED			
DIMENSION TYPE	PLACES IN DIMENSION		
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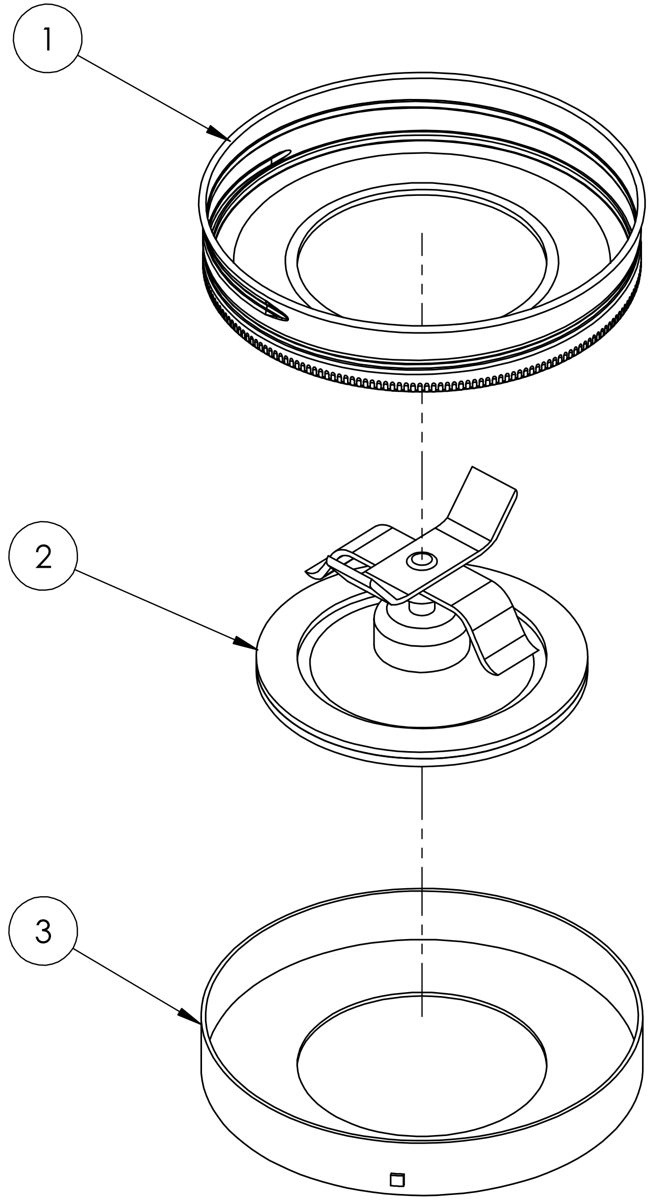
LOCATIONAL	±0.050	±0.020	±0.005
ANGULAR	±5	±2	±0.5

3 2 1



TITLE: LID CONSTRUCTION

TOLERANCE UNLESS NOTED				
DIMENSION TYPE	PLACES IN DIMENSION			
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LOCATIONAL	±0.050	±0.020	±0.005	
ANGULAR	±5	±2	±0.5	

DRAWN	JACOB KAERCHER
CHECKED	MATTHEW SABAG

SIZE	DWG. NO.	REV
A	EML2322L-A3	A
SCALE: 2:3		SHEET 4 OF 5

3 2 1

ITEM NO.	PART NUMBER	VENDOR PART NUMBER	DESCRIPTION	QTY.
1	EML2322L-P4	RC-086	Modified Lid	1
2	EML2322L - OTS10	OS-010	Blender cutter blade and rubber O-ring seal	1
3	EML2322L-P5	-	Lid Adapter	1

TOLERANCE UNLESS NOTED			
DIMENSION TYPE	PLACES IN DIMENSION		
	0.0	0.00	0.000
LOCATIONAL	±0.050	±0.020	±0.005
ANGULAR	±5	±2	±0.5

TITLE: LID CONSTRUCTION

DRAWN JACOB KAERCHER

CHECKED MATTHEW SABAG

SIZE A

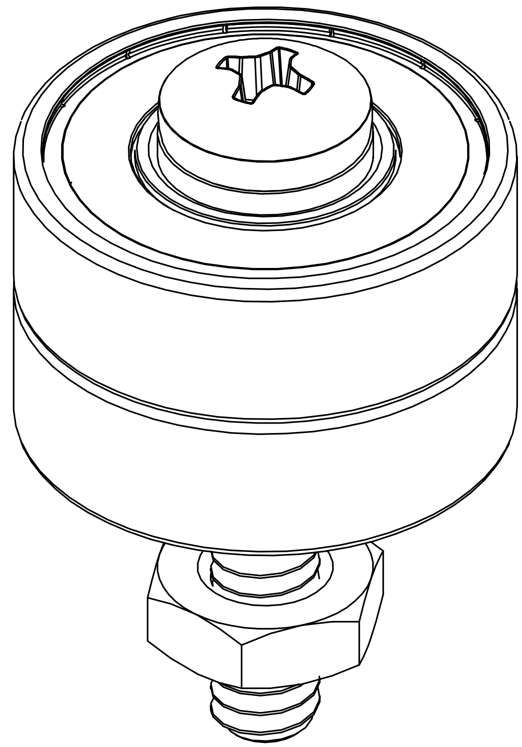
DWG. NO. EML2322L-A3

REV A

SCALE: 2:3

SHEET 5 OF 5

3 2 1



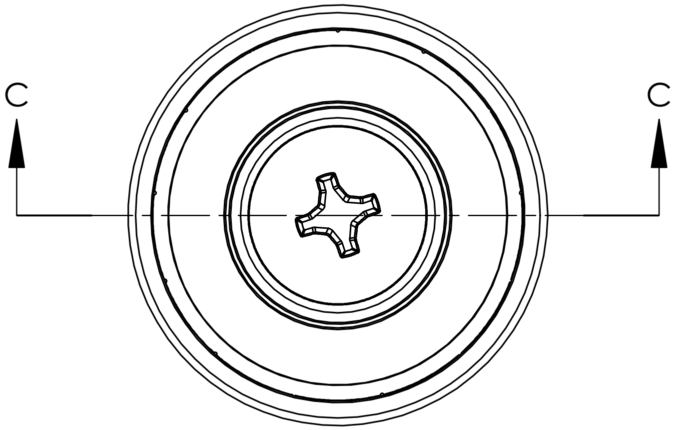
TITLE:
TENSIONER CONSTRUCTION

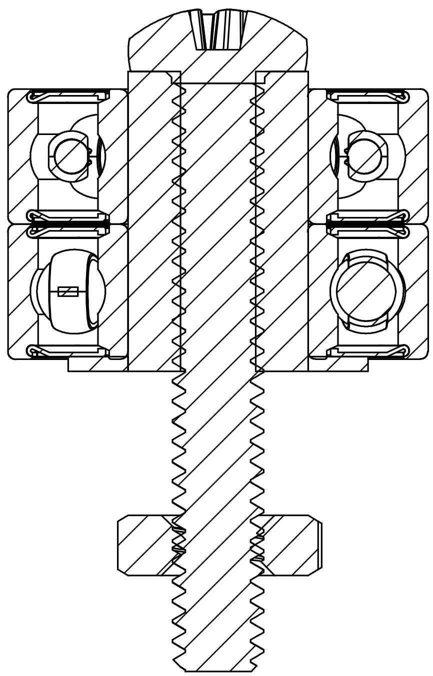
DRAWN	OM PATEL
CHECKED	JACOB KAERCHER

TOLERANCE UNLESS NOTED			
DIMENSION TYPE	PLACES IN DIMENSION		
	0.0	0.00	0.000
LOCATIONAL	±0.050	±0.020	±0.005
ANGULAR	±5	±2	±0.5

SIZE	DWG. NO.	REV
A	EML2322L-A4	A
SCALE: 3:1		SHEET 1 OF 4

5 4 3 2 1





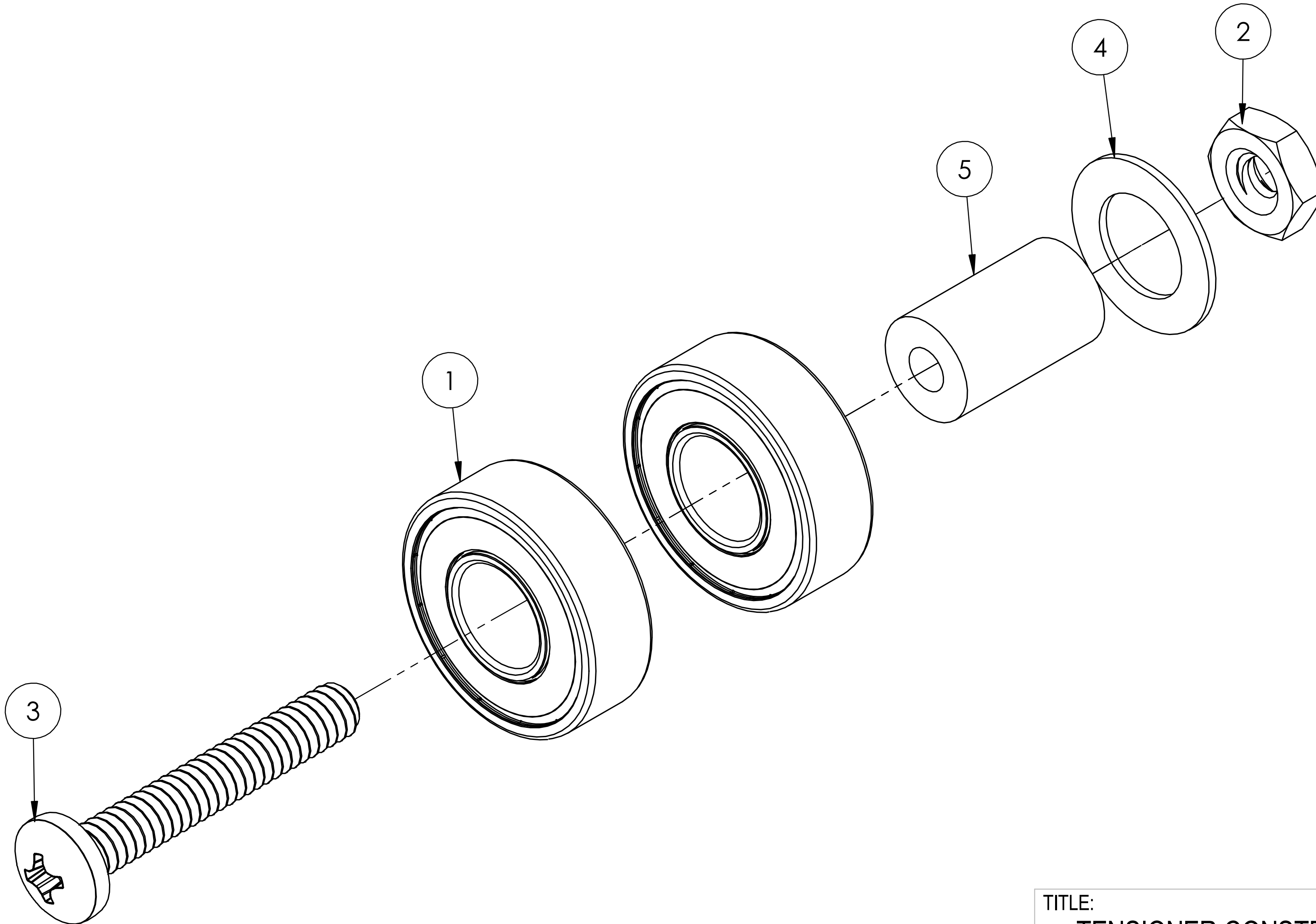
SECTION C-C

TITLE:	
	TENSIONER CONSTRUCTION
DRAWN	OM PATEL
CHECKED	JACOB KAERCHER

TOLERANCE UNLESS NOTED			
DIMENSION TYPE	PLACES IN DIMENSION		
	0.0	0.00	0.000
LOCATIONAL	±0.050	±0.020	±0.005
ANGULAR	±5	±2	±0.5

SIZE	DWG. NO.	REV
A	EML2322L-A4	A
SCALE: 5:2	SHEET 2 OF 4	

3 2 1



TOLERANCE UNLESS NOTED			
DIMENSION TYPE	PLACES IN DIMENSION		
	0.0	0.00	0.000
LOCATIONAL	±0.050	±0.020	±0.005
ANGULAR	±5	±2	±0.5

TITLE: TENSIONER CONSTRUCTION		
DRAWN	OM PATEL	
CHECKED	JACOB KAERCHER	
SIZE A	DWG. NO. EML2322L-A4	REV A
SCALE: 2:1		SHEET 3 OF 4

ITEM NO.	PART NUMBER	VENDOR PART NUMBER	DESCRIPTION	QTY.
1	EML2322L - OTS06	BB-R6-ZZ/1	R6-ZZ Ball Bearing	2
2	EML2322L - OTS08	0000-103719	#10-24 Coarse Thread Hex Machine Screw Nut Stainless Steel 18-8	1
3	EML2322L - OTS03	6-FMPP-10C125	Machine Screw Phillips Drive Pan Head 10-24 x 1-1/4" Type 316 Stainless	1
4	EML2322L - OTS07	WBB511839	3/8" I.D. x 5/8" O.D. x 0.031" Steel Arbor Shim	1
5	EML2322L-P3	-	Tensioner Arm	1

TOLERANCE UNLESS NOTED			
DIMENSION TYPE	PLACES IN DIMENSION		
	0.0	0.00	0.000
LOCATIONAL	±0.050	±0.020	±0.005
ANGULAR	±5	±2	±0.5

TITLE:
TENSIONER CONSTRUCTION

DRAWN OM PATEL

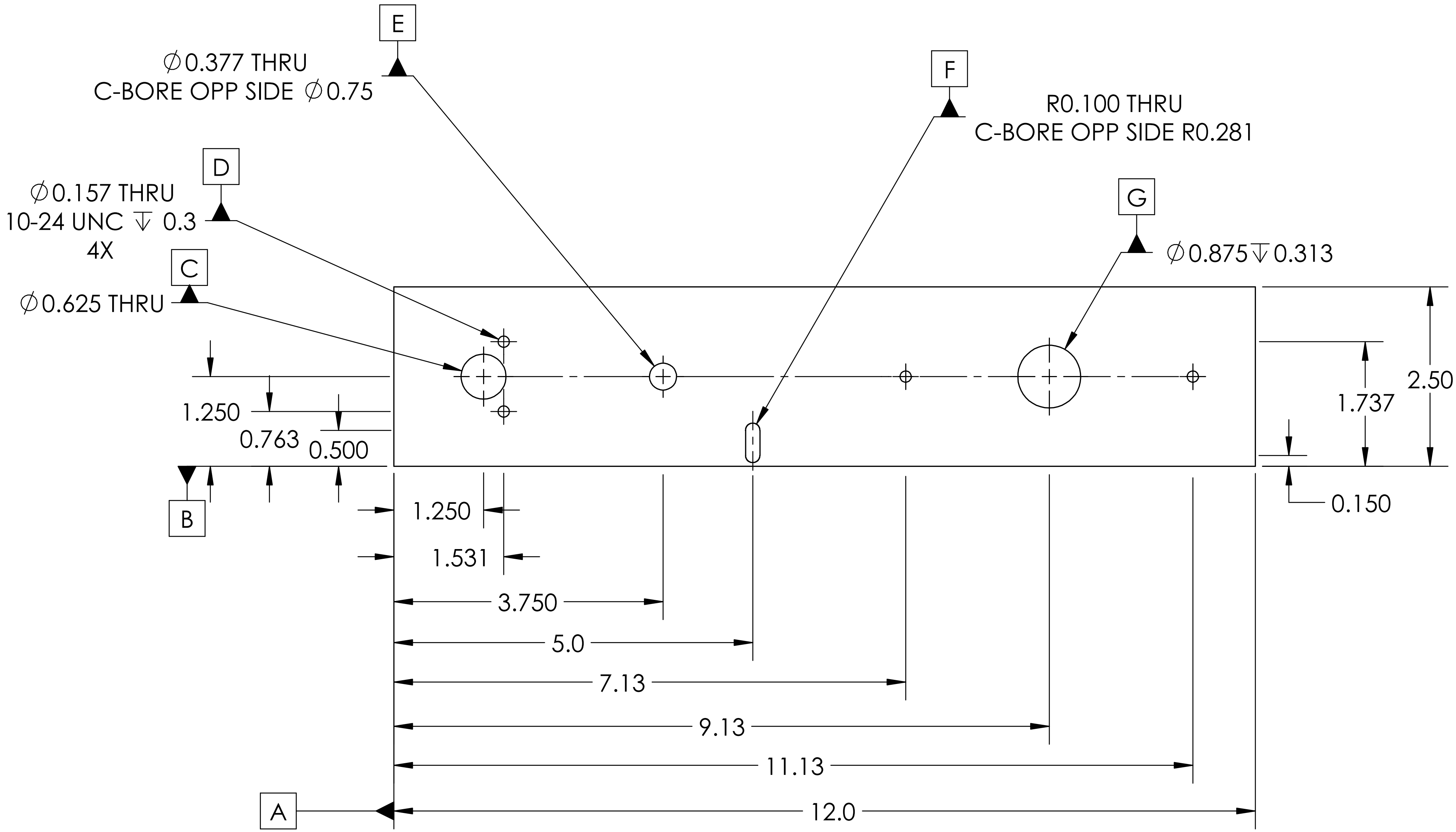
CHECKED JACOB KAERCHER

SIZE A DWG. NO. EML2322L-A4 REV A

SCALE: 2:1 SHEET 4 OF 4

5 4 3 2 1

3A. Appendix A: Detail Part Drawings

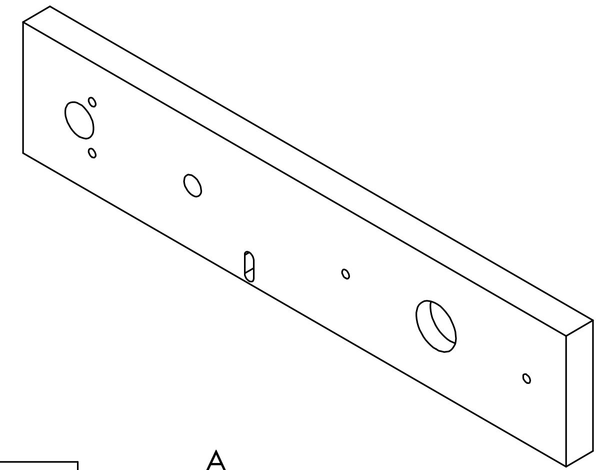


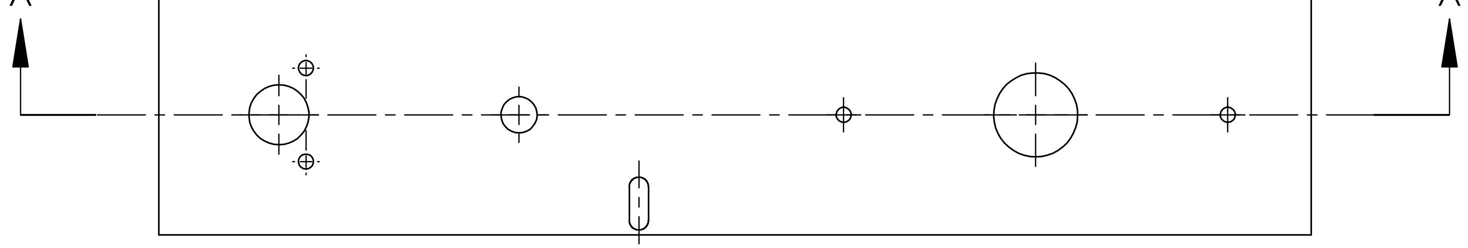
NOTES:
1. QTY: 1
2. MAT'L: ALUMINUM 6061-T6
3. FINISH NOTED SURFACES
4. BREAK SHARP EDGES
5. DIMS IN INCHES

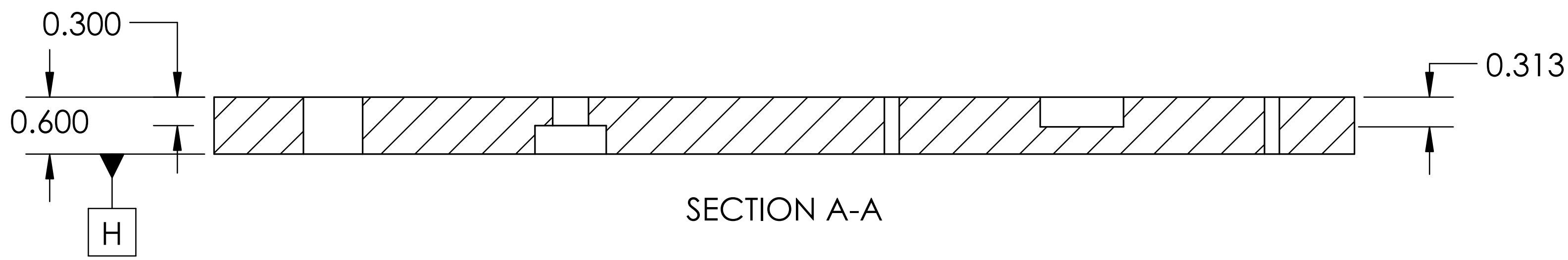
TOLERANCE UNLESS NOTED			
OPERATION	PLACES IN DIMENSION		
	0.0	0.00	0.000
MACHINING	±0.050	±0.020	±0.005
CUT OFF (SAW, BURN, SHEAR)	±0.1	±0.060	
WELDING	±0.1	±0.060	
ANGULAR DIMS	±5	±2	±0.5

TITLE:	MODIFIED BASE	
DRAWN	OM PATEL	
CHECKED	JACOB KAERCHER	
SIZE A	DWG. NO. EML2322L-P1	REV A
SCALE: 1:2		SHEET 1 OF 2

3 2 1







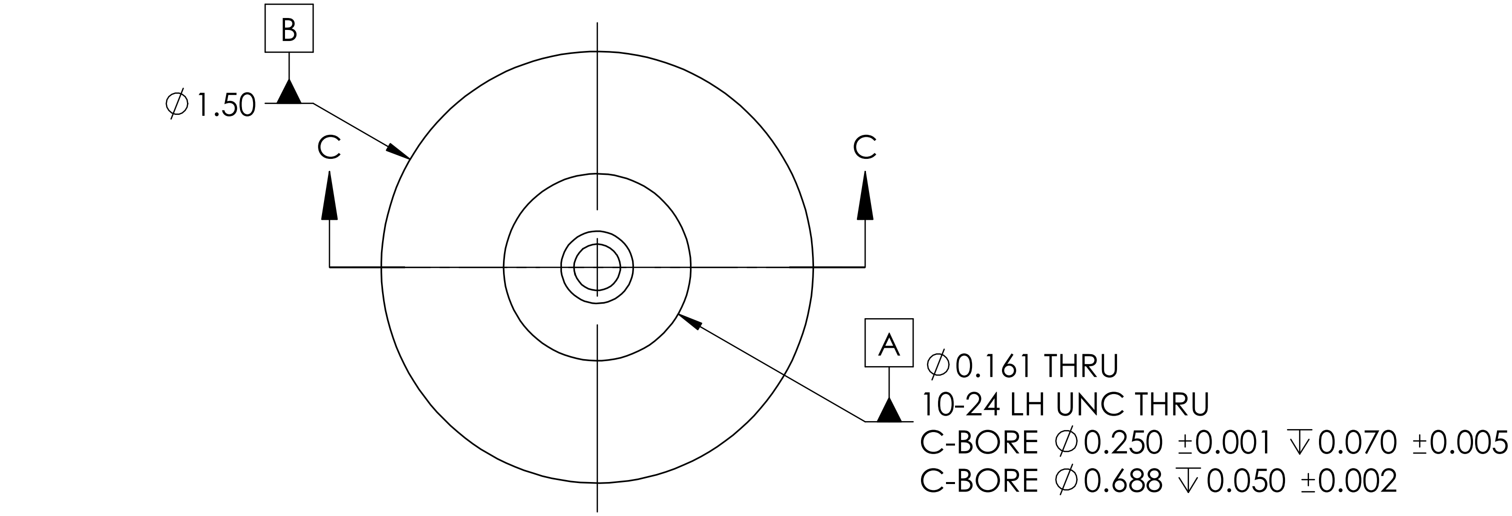
SECTION A-A

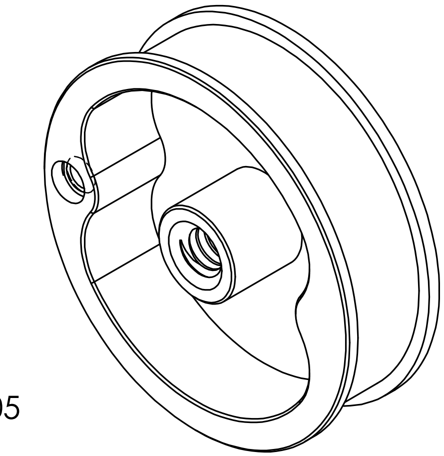
NOTES:
1. QTY: 1
2. MAT'L: ALUMINUM 6061-T6
3. FINISH NOTED SURFACES
4. BREAK SHARP EDGES
5. DIMS IN INCHES

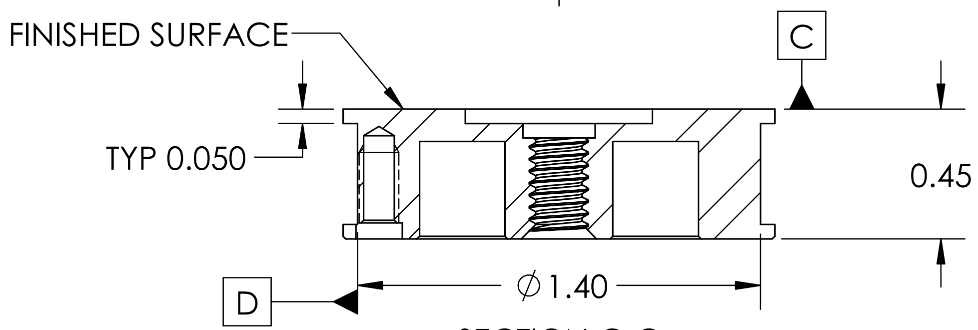
TOLERANCE UNLESS NOTED			
OPERATION	PLACES IN DIMENSION		
	0.0	0.00	0.000
MACHINING	±0.050	±0.020	±0.005
CUT OFF (SAW, BURN, SHEAR)	±0.1	±0.060	
WELDING	±0.1	±0.060	
ANGULAR DIMS	±5	±2	±0.5

TITLE: MODIFIED BASE		
DRAWN	OM PATEL	
CHECKED	JACOB KAERCHER	
SIZE A	DWG. NO. EML2322L-P1	REV A
SCALE: 1:2		SHEET 2 OF 2

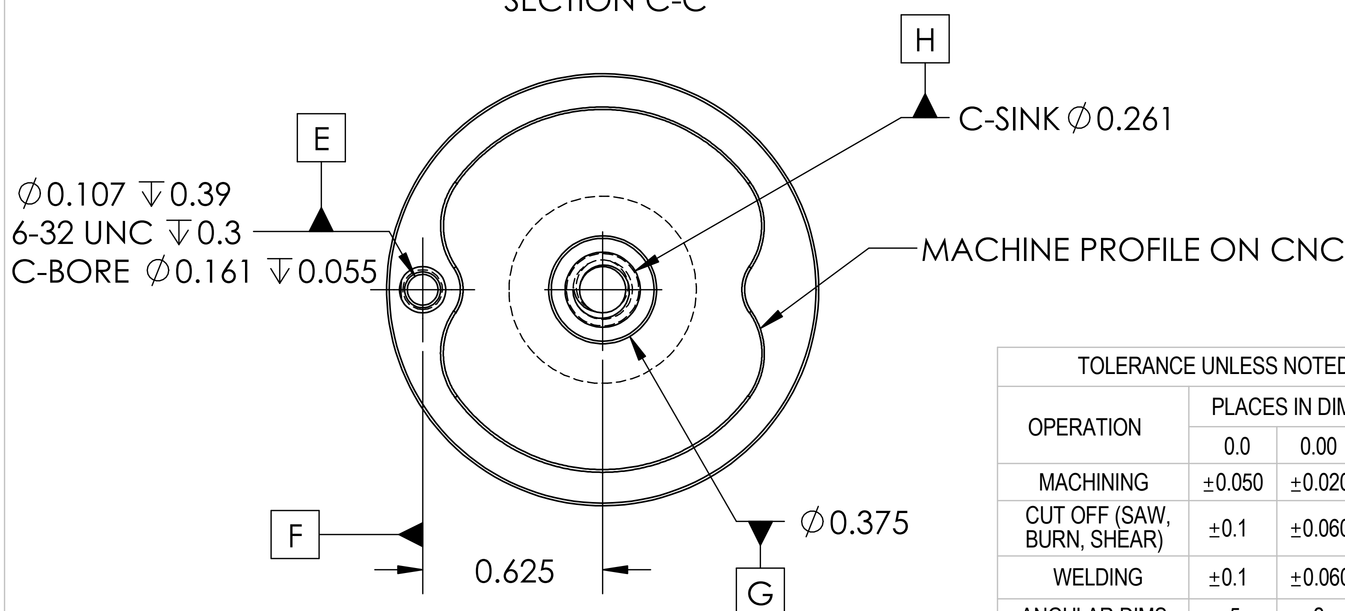
3 2 1







SECTION C-C



NOTES:
1. QTY: 1
2. MAT'L: PLAIN CARBON STEEL
3. FINISH NOTED SURFACES
4. BREAK SHARP EDGES
5. DIMS IN INCHES

TOLERANCE UNLESS NOTED			
OPERATION	PLACES IN DIMENSION		
	0.0	0.00	0.000
MACHINING	±0.050	±0.020	±0.005
CUT OFF (SAW, BURN, SHEAR)	±0.1	±0.060	
WELDING	±0.1	±0.060	
ANGULAR DIMS	±5	±2	±0.5

TITLE: MODIFIED FLYWHEEL

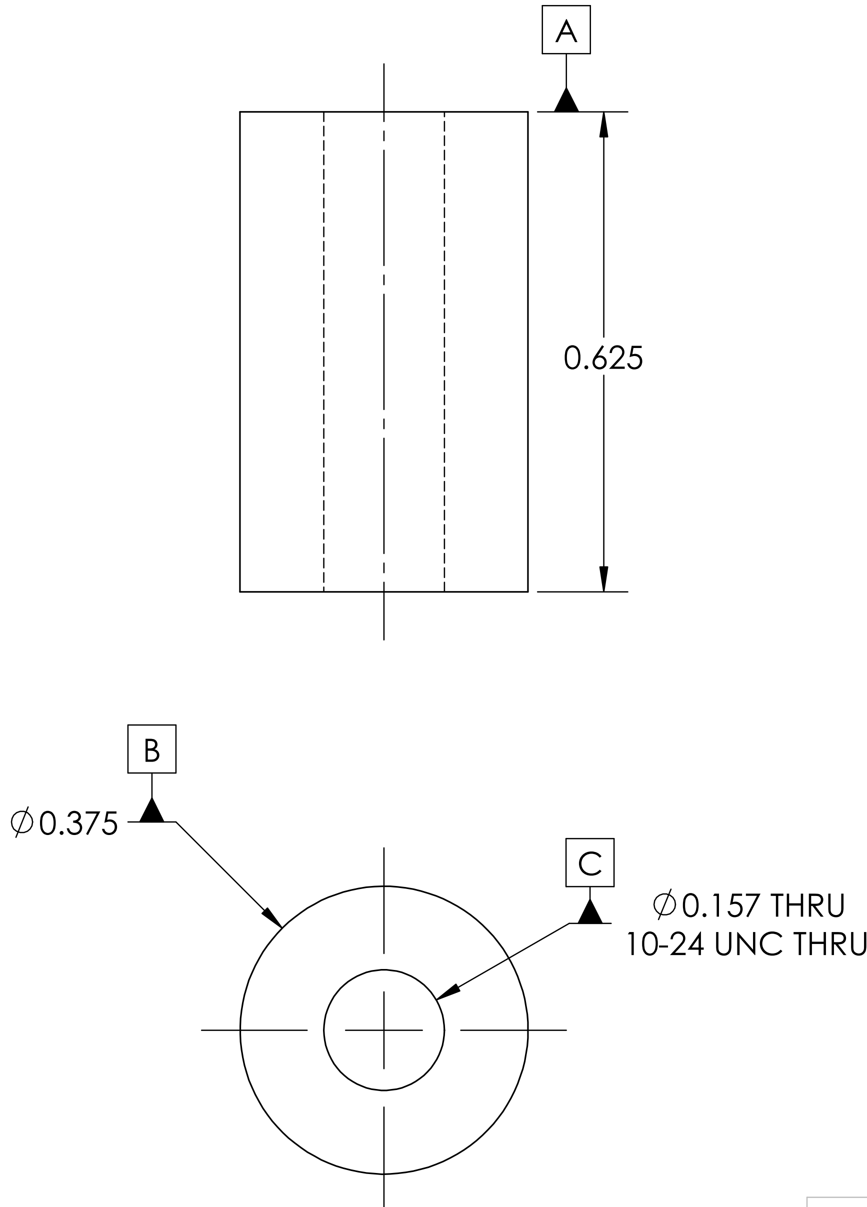
DRAWN JACOB KAERCHER

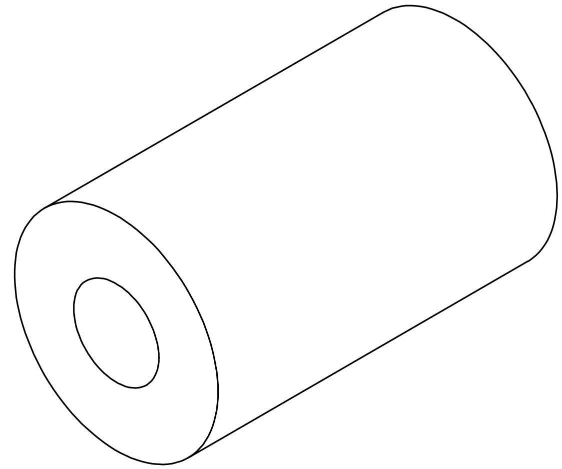
CHECKED OM PATEL

SIZE A | DWG. NO. EML2322L-P2 | REV A

SCALE: 3:2 | SHEET 1 OF 1

3 2 1



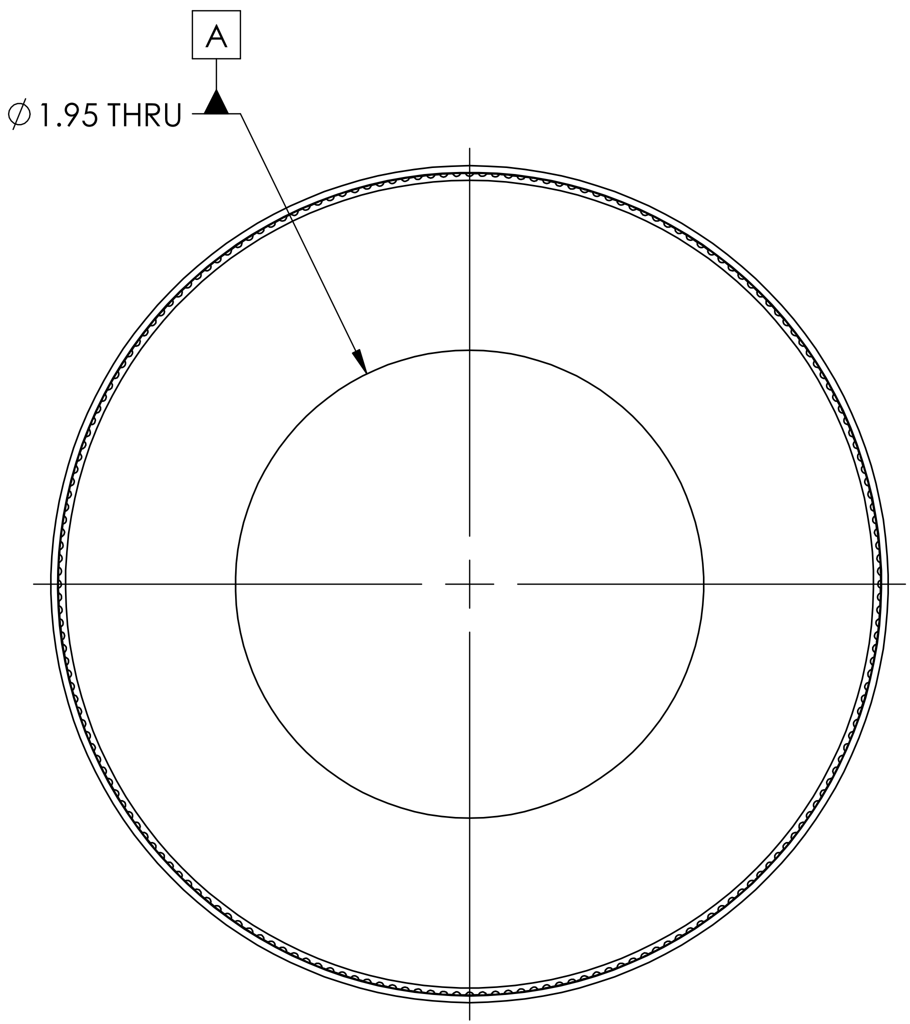


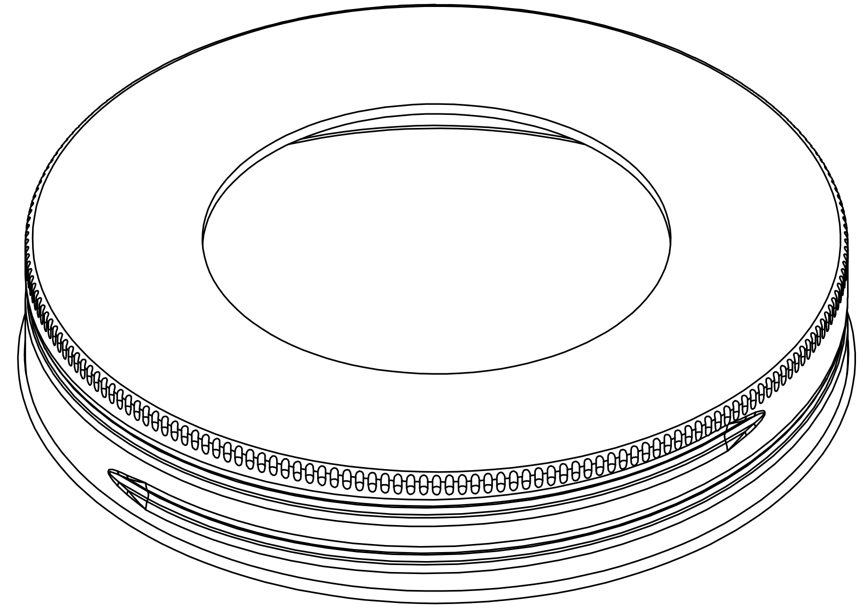
NOTES:
1. QTY: 1
2. MAT'L: ALUMINUM 6061-T6
3. FINISH NOTED SURFACES
4. BREAK SHARP EDGES
5. DIMS IN INCHES

TOLERANCE UNLESS NOTED			
OPERATION	PLACES IN DIMENSION		
	0.0	0.00	0.000
MACHINING	±0.050	±0.020	±0.005
CUT OFF (SAW, BURN, SHEAR)	±0.1	±0.060	
WELDING	±0.1	±0.060	
ANGULAR DIMS	±5	±2	±0.5

TITLE:	TENSIONER ARM	
DRAWN	JACOB KAERCHER	
CHECKED	OM PATEL	
SIZE A	DWG. NO. EML2322L-P3	REV A
SCALE: 4:1		SHEET 1 OF 1

3 2 1





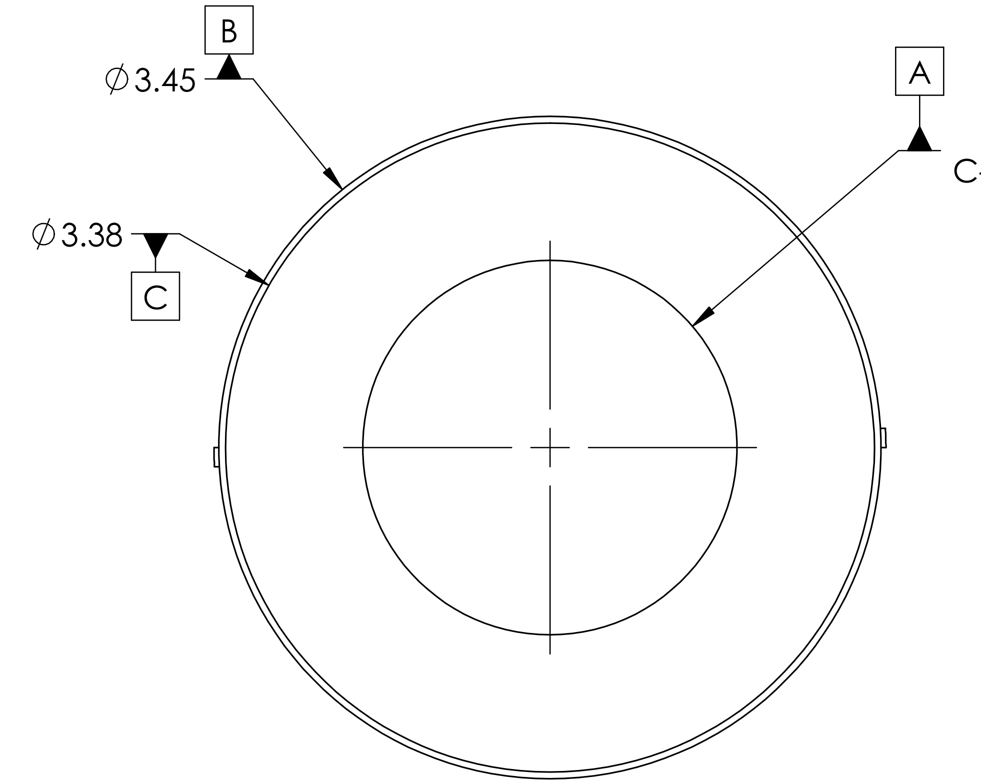
*OTS PART - ONLY MODIFIED FEATURES DIMENSIONED

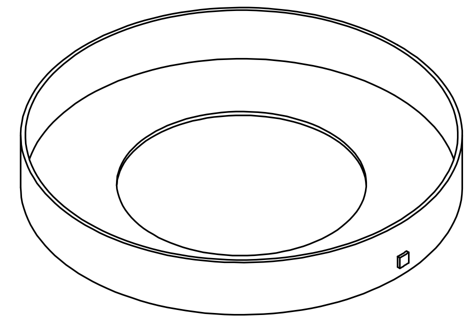
NOTES:
1. QTY: 1
2. MATL':
3. FINISH NOTED SURFACES
4. BREAK SHARP EDGES
5. DIMS IN INCHES

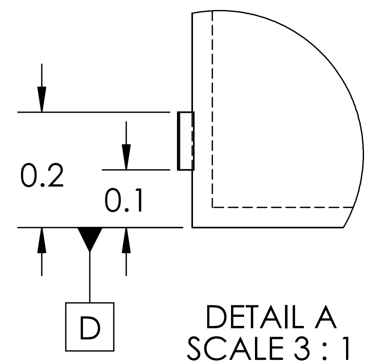
TOLERANCE UNLESS NOTED			
OPERATION	PLACES IN DIMENSION		
	0.0	0.00	0.000
MACHINING	±0.050	±0.020	±0.005
CUT OFF (SAW, BURN, SHEAR)	±0.1	±0.060	
WELDING	±0.1	±0.060	
ANGULAR DIMS	±5	±2	±0.5

TITLE: MODIFIED LID		
DRAWN	JACOB KAERCHER	
CHECKED	OM PATEL	
SIZE A	DWG. NO. EML2322L-P4	REV A
SCALE: 5:4		SHEET 1 OF 1

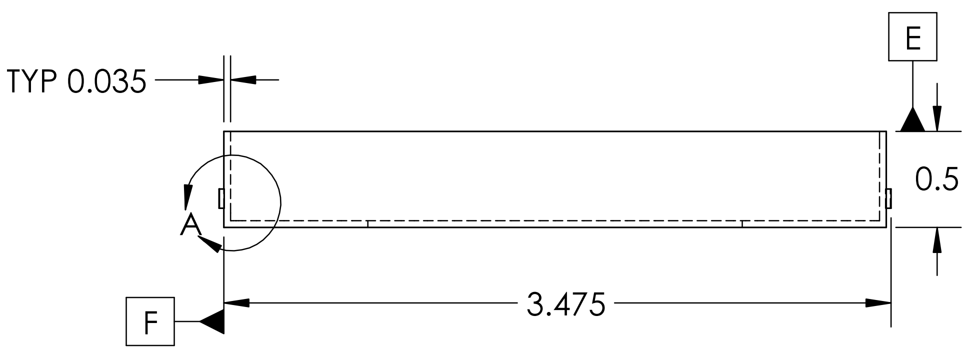
3 2 1







DETAIL A
SCALE 3 : 1

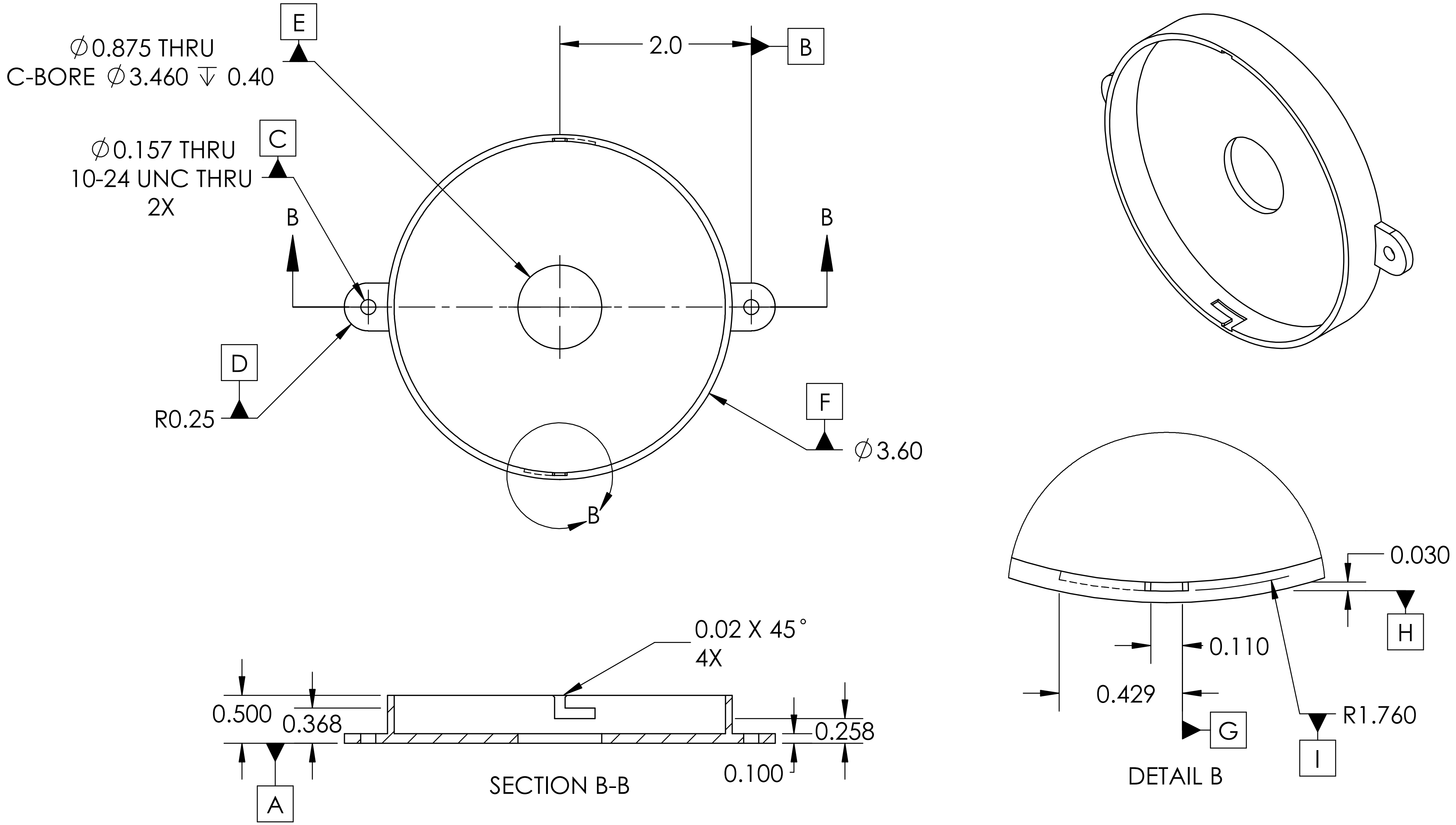


NOTES:
1. QTY: 1
2. MAT'L: ALUMINUM 6061-T6
3. FINISH NOTED SURFACES
4. BREAK SHARP EDGES
5. DIMS IN INCHES

TOLERANCE UNLESS NOTED			
OPERATION	PLACES IN DIMENSION		
	0.0	0.00	0.000
MACHINING	±0.050	±0.020	±0.005
CUT OFF (SAW, BURN, SHEAR)	±0.1	±0.060	
WELDING	±0.1	±0.060	
ANGULAR DIMS	±5	±2	±0.5

TITLE:	LID ADAPTER
DRAWN	OM PATEL
CHECKED	JACOB KAERCHER
SIZE	A
DWG. NO.	EML2322L-P5
REV	A
SCALE: 1:1	SHEET 1 OF 1

5 4 3 2 1



NOTES:
1. QTY: 1
2. MAT'L: PETG
3. FINISH NOTED SURFACES
4. BREAK SHARP EDGES
5. DIMS IN INCHES

TOLERANCE UNLESS NOTED			
OPERATION	PLACES IN DIMENSION		
	0.0	0.00	0.000
MACHINING	±0.050	±0.020	±0.005
CUT OFF (SAW, BURN, SHEAR)	±0.1	±0.060	
WELDING	±0.1	±0.060	
ANGULAR DIMS	±5	±2	±0.5

TITLE: LID PLATFORM

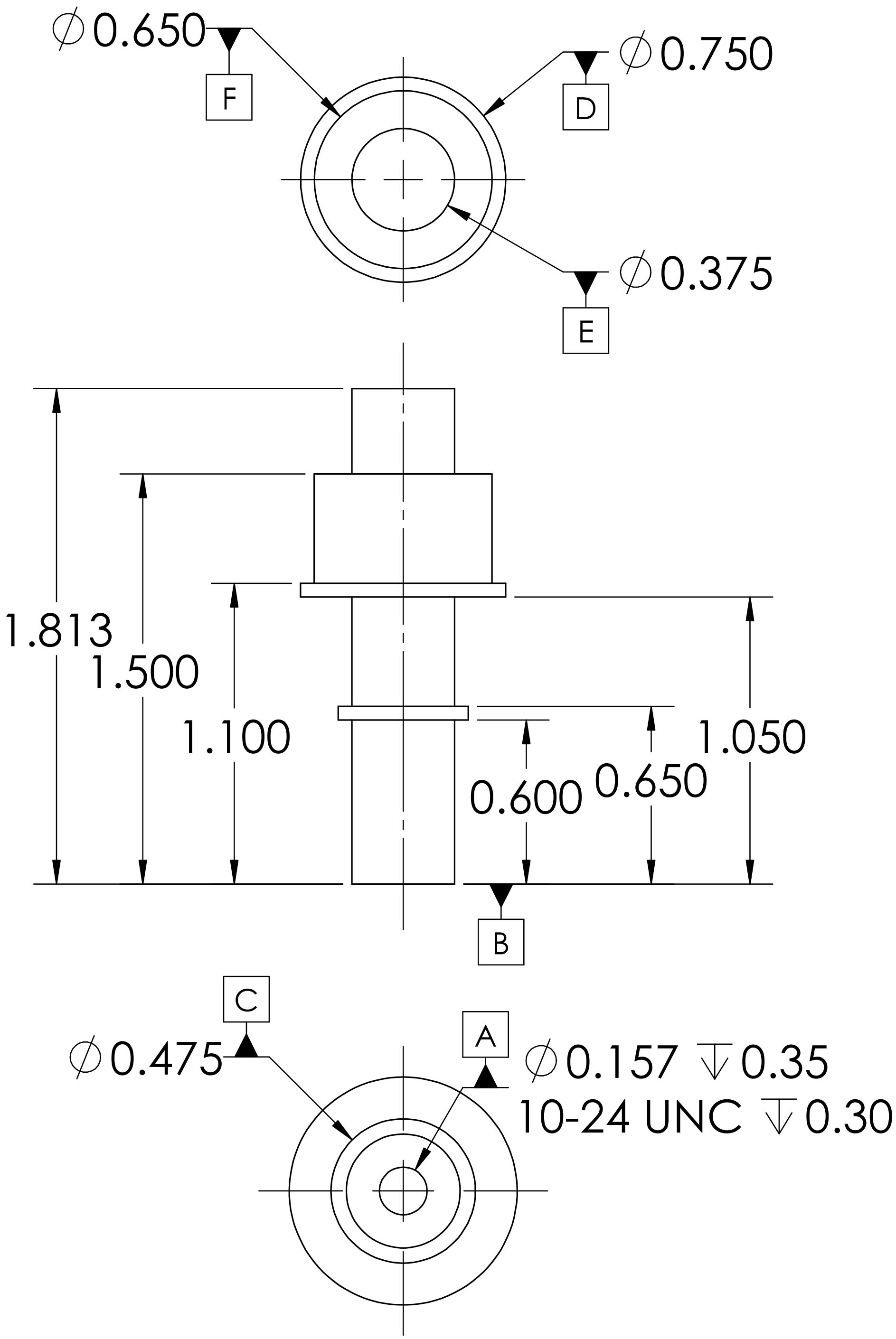
DRAWN: OM PATEL

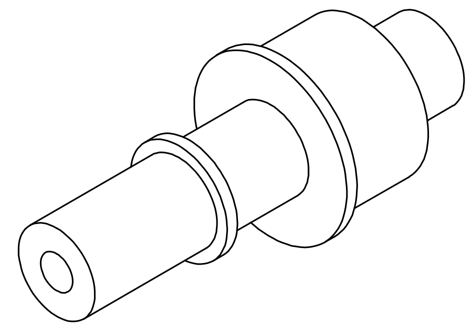
CHECKED: JACOB KAERCHER

SIZE: A | DWG. NO.: EML2322L-P6 | REV: A

SCALE: 2:3 | SHEET 1 OF 1

3 2 1



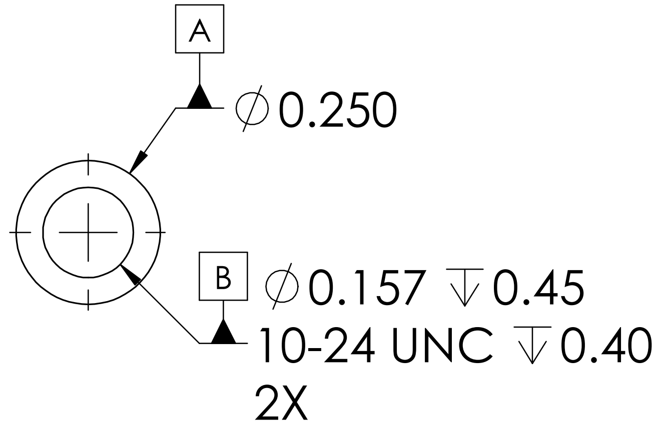


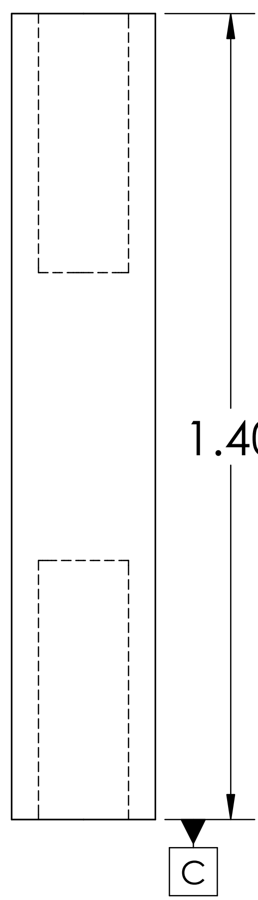
NOTES:
1. QTY: 1
2. MAT'L: ALUMINUM 6061-T6
3. FINISH NOTED SURFACES
4. BREAK SHARP EDGES
5. DIMS IN INCHES

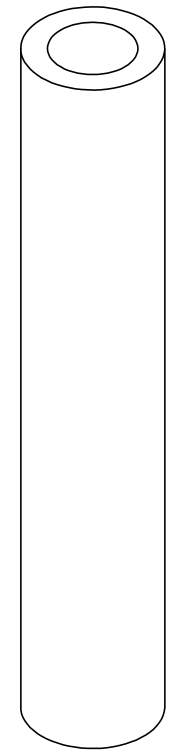
TOLERANCE UNLESS NOTED			
OPERATION	PLACES IN DIMENSION		
	0.0	0.00	0.000
MACHINING	±0.050	±0.020	±0.005
CUT OFF (SAW, BURN, SHEAR)	±0.1	±0.060	
WELDING	±0.1	±0.060	
ANGULAR DIMS	±5	±2	±0.5

TITLE: SHAFT			
DRAWN	JACOB KAERCHER		
CHECKED	OM PATEL		
SIZE A	DWG. NO. EML2322L-P7		REV A
SCALE: 5:3		SHEET 1 OF 1	

3 2 1







NOTES:
1. QTY: 1
2. MAT'L: ALUMINUM 6061-T6
3. FINISH NOTED SURFACES
4. BREAK SHARP EDGES
5. DIMS IN INCHES

TOLERANCE UNLESS NOTED			
OPERATION	PLACES IN DIMENSION		
	0.0	0.00	0.000
MACHINING	±0.050	±0.020	±0.005
CUT OFF (SAW, BURN, SHEAR)	±0.1	±0.060	
WELDING	±0.1	±0.060	
ANGULAR DIMS	±5	±2	±0.5

TITLE:	PLATFORM SUPPORT	
DRAWN	JACOB KAERCHER	
CHECKED	OM PATEL	
SIZE A	DWG. NO. EML2322L-P8	REV A
SCALE: 4:1		SHEET 1 OF 1

3 2 1

3B. Appendix B: Manufacturing Inspection Records

EML 2322L MANUFACTURING INSPECTION RECORD					
Part Number	*Revision*	*Part Name*	*Team Number*	*Machinist:*	
EML2322L-P1	A	MODIFIED BASE	1D	*Inspector:*	

No.	Ref. Location	Feature Type	Measurement Tool/Type	Requirement	Lower Bound	Upper Bound	Units	Results	Comments
1	A	Length	Caliper	1.250	1.245	1.255	Inches		
2	A	Length	Caliper	1.531	1.526	1.536	Inches		
3	A	Length	Caliper	3.750	3.745	3.755	Inches		
4	A	Length	Caliper	5.0	4.95	5.05	Inches		
5	A	Length	Caliper	7.13	7.11	7.15	Inches		
6	A	Length	Caliper	9.13	9.11	9.15	Inches		
7	A	Length	Caliper	11.13	11.11	11.15	Inches		
8	A	Length	Caliper	12.0	11.95	12.05	Inches		
9	B	Length	Caliper	0.150	0.145	0.155	Inches		
10	B	Length	Caliper	0.500	0.495	0.505	Inches		
11	B	Length	Caliper	0.763	0.758	0.768	Inches		
12	B	Length	Caliper	1.250	1.245	1.255	Inches		
13	B	Length	Caliper	1.737	1.732	1.742	Inches		
14	B	Length	Caliper	2.50	2.48	2.52	Inches		
15	C	Diameter	Caliper	0.625	0.620	0.630	Inches		
16	D	Thread	Fastener	10-24 UNC	N/A	N/A	N/A		
17	E	Diameter	Caliper	0.377	0.372	0.382	Inches		
18	E	Depth	Caliper	0.75	0.73	0.77	Inches		
19	F	Diameter	Caliper	0.200	0.195	0.205	Inches		
20	F	Diameter	Caliper	0.563	0.558	0.568	Inches		
21	G	Diameter	Caliper	0.875	0.870	0.880	Inches		
22	G	Depth	Caliper	0.313	0.308	0.318	Inches		
23	H	Length	Caliper	0.300	0.295	0.305	Inches		
24	H	Length	Caliper	0.313	0.308	0.318	Inches		
25	H	Length	Caliper	0.600	0.595	0.605	Inches		
26	Notes	Break Sharp Edges	Visual	Break Sharp Edges	N/A	N/A	N/A		
27	Notes	Finish Noted Surfaces	Visual	Finish Noted Surfaces	N/A	N/A	N/A		
							RESULT:	PASS	

Inspector Signature:			FAIL	☐ Remanufacture
Group Member 1:				☐ Rework
Group Member 2:				☐ Engineering Change
Group Member 3:		TA Signature		
Group Member 4:				

EML 2322L MANUFACTURING INSPECTION RECORD

Part Number	*Revision*	*Part Name*	*Team Number*	*Machinist:*
EML2322L-P2	A	MODIFIED FLYWHEEL	1D	
				Inspector:

No.	Ref. Location	Feature Type	Measurement Tool/Type	Requirement	Lower Bound	Upper Bound	Units	Results	Comments
1	A	Thread	Fastener	10-24 LH UNC THRU	N/A	N/A	N/A		
2	A	Diameter	Caliper	0.250	0.249	0.251	Inches		
3	A	Depth	Caliper	0.070	0.065	0.075	Inches		
4	A	Diameter	Caliper	0.688	0.683	0.693	Inches		
5	A	Depth	Caliper	0.050	0.048	0.052	Inches		
6	B	Diameter	Caliper	1.50	1.48	1.52	Inches		
7	C	Length	Caliper	0.45	0.43	0.47	Inches		
8	C	Length	Caliper	0.050	0.045	0.055	Inches		
9	D	Diameter	Caliper	1.40	1.38	1.42	Inches		
10	E	Thread	Fastener	6-32 UNC	N/A	N/A	N/A		
11	E	Diameter	Caliper	0.161	0.156	0.168	Inches		
12	E	Depth	Caliper	0.055	0.050	0.060	Inches		
13	F	Length	Caliper	0.625	0.620	0.630	Inches		
14	G	Diameter	Caliper	0.375	0.370	0.380	Inches		
15	H	Diameter	Caliper	0.261	0.256	0.266	Inches		
16	Notes	Break Sharp Edges	Visual	Break Sharp Edges	N/A	N/A	N/A		
17	Notes	Finish Noted Surfaces	Visual	Finish Noted Surfaces	N/A	N/A	N/A		
							RESULT:	PASS	

Inspector Signature:			FAIL	☐ Remanufacture
Group Member 1:				☐ Rework
Group Member 2:				☐ Engineering Change
Group Member 3:		TA Signature		
Group Member 4:				

EML 2322L MANUFACTURING INSPECTION RECORD

Part Number	*Revision*	*Part Name*	*Team Number*	*Machinist:*
EML2322L-P3	A	TENSIONER ARM	1D	
				Inspector:

No.	Ref. Location	Feature Type	Measurement Tool/Type	Requirement	Lower Bound	Upper Bound	Units	Results	Comments
1	A	Length	Caliper	0.625	0.620	0.630	Inches		
2	B	Diameter	Caliper	0.375	0.370	0.380	Inches		
3	C	Thread	Fastener	10-24 UNC THRU	N/A	N/A	N/A		
4	Notes	Break Sharp Edges	Visual	Break Sharp Edges	N/A	N/A	N/A		
5	Notes	Finish Noted Surfaces	Visual	Finish Noted Surfaces	N/A	N/A	N/A		
							RESULT:	PASS	

Inspector Signature:			FAIL	☐ Remanufacture
Group Member 1:				☐ Rework
Group Member 2:				☐ Engineering Change
Group Member 3:		TA Signature		
Group Member 4:				

EML 2322L MANUFACTURING INSPECTION RECORD

Part Number	*Revision*	*Part Name*	*Team Number*	*Machinist:*
EML2322L-P4	A	LID	1D	
				Inspector:

No.	Ref. Location	Feature Type	Measurement Tool/Type	Requirement	Lower Bound	Upper Bound	Units	Results	Comments
1	A	Diameter	Caliper	0.195	0.190	0.200	Inches		
2	Notes	Break Sharp Edges	Visual	Break Sharp Edges	N/A	N/A	N/A		
3	Notes	Finish Noted Surfaces	Visual	Finish Noted Surfaces	N/A	N/A	N/A		
							RESULT:	PASS	

Inspector Signature:			FAIL	☐ Remanufacture
Group Member 1:				☐ Rework
Group Member 2:				☐ Engineering Change
Group Member 3:		TA Signature		
Group Member 4:				

EML 2322L MANUFACTURING INSPECTION RECORD

Part Number	Revision	Part Name	Team Number	Machinist:
EML2322L-P5	A	LID ADAPTER	1D	
				Inspector:

No.	Ref. Location	Feature Type	Measurement Tool/Type	Requirement	Lower Bound	Upper Bound	Units	Results	Comments
1	A	Diameter	Caliper	1.95	1.93	1.97	Inches		
2	A	Diameter	Caliper	3.38	3.36	3.4	Inches		
3	A	Depth	Caliper	0.465	0.460	0.470	Inches		
4	B	Diameter	Caliper	3.45	3.25	3.65	Inches		
5	C	Diameter	Caliper	3.38	3.36	3.40	Inches		
6	D	Length	Caliper	0.1	0.08	0.12	Inches		
7	D	Length	Caliper	0.2	0.18	0.22	Inches		
8	E	Length	Caliper	0.5	0.48	0.52	Inches		
9	F	Length	Caliper	3.475	3.473	3.477	Inches		
10	Notes	Break Sharp Edges	Visual	Break Sharp Edges	N/A	N/A	N/A		
11	Notes	Finish Noted Surfaces	Visual	Finish Noted Surfaces	N/A	N/A	N/A		
							RESULT:	PASS	

Inspector Signature:			FAIL	☐ Remanufacture
Group Member 1:				☐ Rework
Group Member 2:				☐ Engineering Change
Group Member 3:		TA Signature		
Group Member 4:				

EML 2322L MANUFACTURING INSPECTION RECORD

Part Number	*Revision*	*Part Name*	*Team Number*	*Machinist:*
EML2322L-P6	A	LID PLATFORM	1D	*Inspector:*

No.	Ref. Location	Feature Type	Measurement Tool/Type	Requirement	Lower Bound	Upper Bound	Units	Results	Comments
1	A	Length	Caliper	0.100	0.095	0.105	Inches		
2	A	Length	Caliper	0.258	0.253	0.263	Inches		
3	A	Length	Caliper	0.368	0.363	0.373	Inches		
4	A	Length	Caliper	0.500	0.495	0.505	Inches		
5	B	Length	Caliper	2.0	1.95	2.05	Inches		
6	C	Thread	Fastener	10-24 UNC	N/A	N/A	N/A		
7	D	Diameter	Caliper	0.50	0.48	0.52	Inches		
8	E	Diameter	Caliper	0.875	0.870	0.880	Inches		
9	E	Diameter	Caliper	3.460	3.455	3.465	Inches		
10	E	Depth	Caliper	0.40	0.38	0.42	Inches		
11	F	Diameter	Caliper	3.60	3.58	3.62	Inches		
12	G	Length	Caliper	0.110	0.105	0.115	Inches		
13	G	Length	Caliper	0.429	0.424	0.434	Inches		
14	H	Length	Caliper	0.030	0.025	0.035	Inches		
15	I	Diameter	Caliper	3.520	3.515	3.525	Inches		
16	Notes	Break Sharp Edges	Visual	Break Sharp Edges	N/A	N/A	N/A		
17	Notes	Finish Noted Surfaces	Visual	Finish Noted Surfaces	N/A	N/A	N/A		

RESULT: PASS

Inspector Signature:			FAIL	☐ Remanufacture
Group Member 1:				☐ Rework
Group Member 2:				☐ Engineering Change
Group Member 3:		TA Signature		
Group Member 4:				

EML 2322L MANUFACTURING INSPECTION RECORD

Part Number	*Revision*	*Part Name*	*Team Number*	*Machinist:*
EML2322L-P7	A	SHAFT	1D	
				Inspector:

No.	Ref. Location	Feature Type	Measurement Tool/Type	Requirement	Lower Bound	Upper Bound	Units	Results	Comments
1	A	Thread	Fastener	10-24 UNC	N/A	N/A	N/A		
2	B	Length	Caliper	0.600	0.595	0.605	Inches		
3	B	Length	Caliper	0.650	0.645	0.655	Inches		
4	B	Length	Caliper	1.050	1.045	1.055	Inches		
5	B	Length	Caliper	1.100	1.095	1.105	Inches		
6	B	Length	Caliper	1.500	1.495	1.505	Inches		
7	B	Length	Caliper	1.813	1.807	1.818	Inches		
8	C	Diameter	Caliper	0.475	0.470	0.480	Inches		
9	D	Diameter	Caliper	0.750	0.745	0.755	Inches		
10	E	Diameter	Caliper	0.375	0.370	0.380	Inches		
11	F	Diameter	Caliper	0.650	0.645	0.655	Inches		
12	Notes	Break Sharp Edges	Visual	Break Sharp Edges	N/A	N/A	N/A		
13	Notes	Finish Noted Surfaces	Visual	Finish Noted Surfaces	N/A	N/A	N/A		
							RESULT:	PASS	

Inspector Signature:			FAIL	☐ Remanufacture
Group Member 1:				☐ Rework
Group Member 2:				☐ Engineering Change
Group Member 3:		TA Signature		
Group Member 4:				

EML 2322L MANUFACTURING INSPECTION RECORD

Part Number	Revision	Part Name	Team Number	Machinist:
EML2322L-P8	A	PLATFORM SUPPORT	1D	
				Inspector:

No.	Ref. Location	Feature Type	Measurement Tool/Type	Requirement	Lower Bound	Upper Bound	Units	Results	Comments
1	A	Diameter	Caliper	0.250	0.248	0.252	Inches		
2	B	Thread	Fastener	10-24 UNC	N/A	N/A	N/A		
3	C	Length	Caliper	1.40	1.38	1.42	Inches		
4	Notes	Break Sharp Edges	Visual	Break Sharp Edges	N/A	N/A	N/A		
5	Notes	Finish Noted Surfaces	Visual	Finish Noted Surfaces	N/A	N/A	N/A		
							RESULT:	PASS	

Inspector Signature:			FAIL	☐ Remanufacture
Group Member 1:				☐ Rework
Group Member 2:				☐ Engineering Change
Group Member 3:		TA Signature		
Group Member 4:				

3C. Appendix C: Manufacturing Process Outlines

Referenced Throughout the Manufacturing Processes:

5-Step Check

1. Make sure the power is off and the spindle has fully stopped rotating.
2. Position the plastic table covers below the spindle.
3. Release the quill clamp by using the palm of your right hand to rotate the 1.5” lever up (counterclockwise).
4. Raise the spindle to the uppermost position using the quill handle.
5. Raise the silver spindle lock to the highest position by pressing the round button, sliding the lock up, and then releasing the button once it is fully raised. Hand tighten the spindle lock so that it remains at the desired height.

4-Step Check

1. Check that the machine is in the correct range for the speed you will be using.
2. Check that there is clearance between the workpiece and the tool.
3. Put the shield down over the chuck/place the shield in front of the workpiece and tool.
4. Once the machine is on, check that the spindle is spinning in the correct direction following the Right Hand Rule.

Spindle Speed Calculation

Eq. 1: $\frac{12 \cdot V}{\pi \cdot D}$, where V = the recommended velocity [surface ft/min] for the tool being used, and D = tool diameter [in].

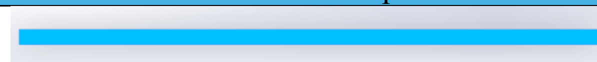
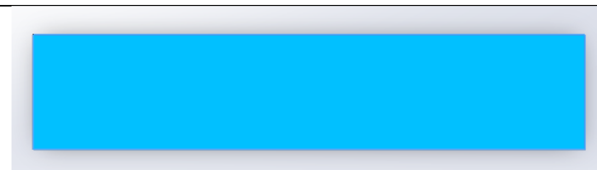
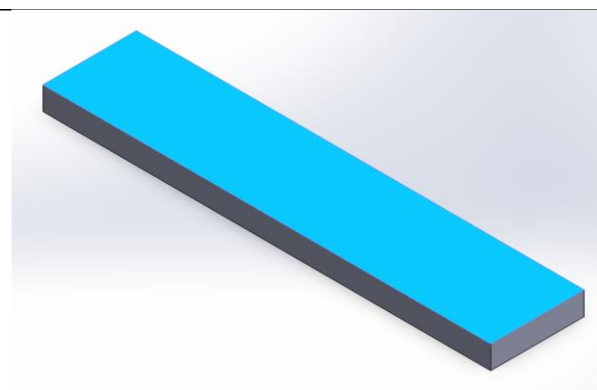
Note: All spindle speeds cited below are calculated using the recommend HSS speeds from Table 1 in [1]

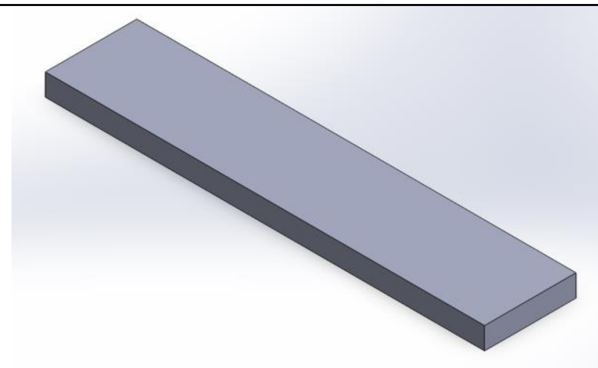
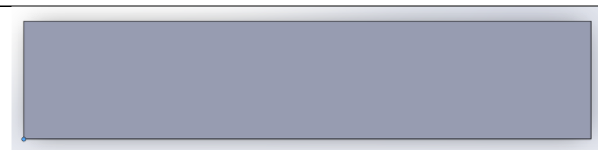
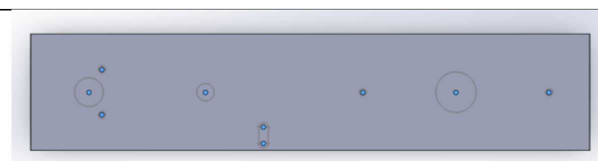
Material	Recommended HSS Speed, V [surface ft/min]
Acetal (Delrin)	250
Aluminum and its alloys	250
Brass (360 high machining)	250
Bronze (high tensile)	100
Cast Iron (soft)	100
Cast Iron (medium hard)	80
Cast Iron (hard chilled)	20
Hastelloy	20
Inconel	25
Magnesium and its alloys	300
Monel	25
High nickel steel	50
Mild steel (.2-.3 C)	100
Steel (.4-.5 C)	60
Tool steel	40
Forgings	40
Steel alloys (300-400 Brinell)	30
Heat Treated Steels	
35-40 Rockwell C	20
40-45 Rockwell C	20
45-50 Rockwell C	15
50-55 Rockwell C	15
stainless steel free machining	40
stainless work hardening	20
Titanium alloys	20
* multiply surface speeds in table by 2.5 for carbide cutting tools *	
* multiply surface speeds in table by 1.5 - 2.0 for HEM / HSM toolpaths *	

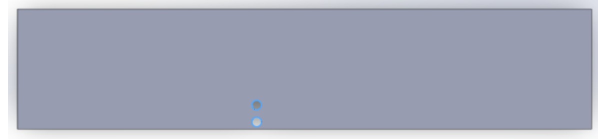
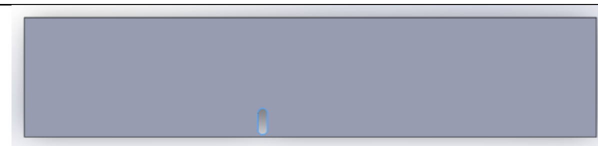
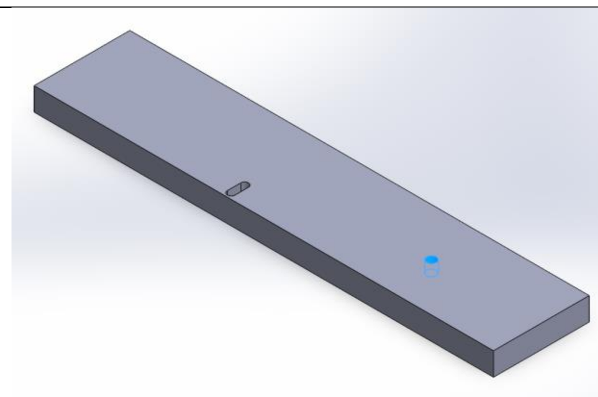
References:

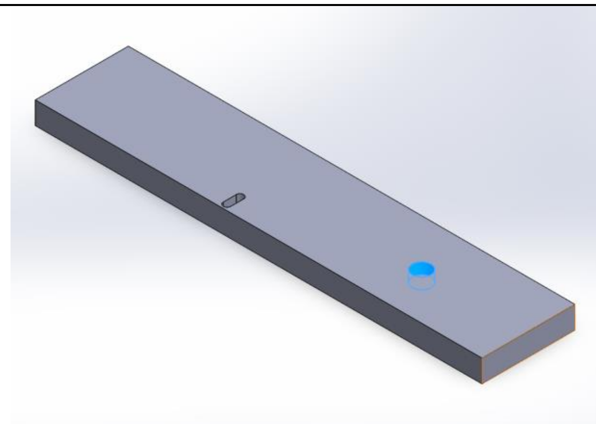
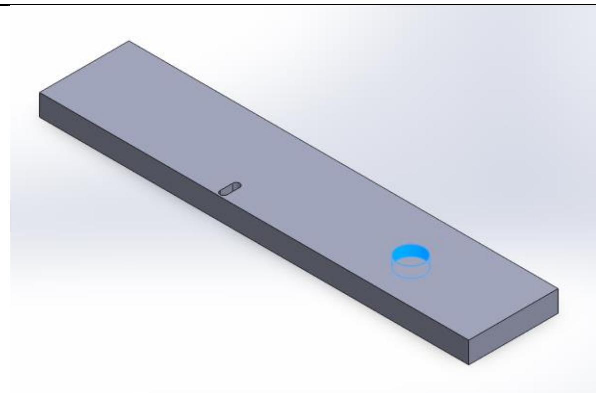
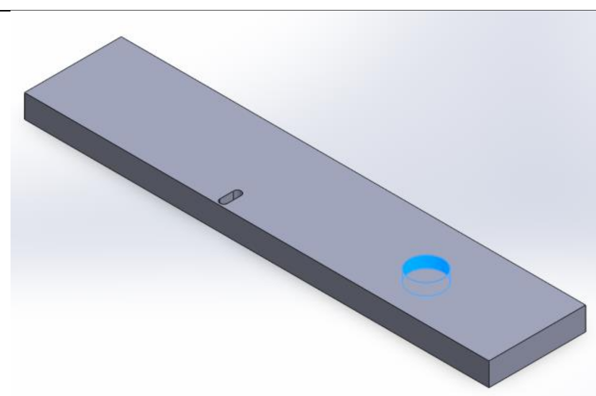
[1] “Speeds and Feeds,” *Ufl.edu*, 2025. https://web.mae.ufl.edu/designlab/Advanced%20Manufacturing/Speeds%20and%20Feeds/Speeds%20and%20Feeds.htm

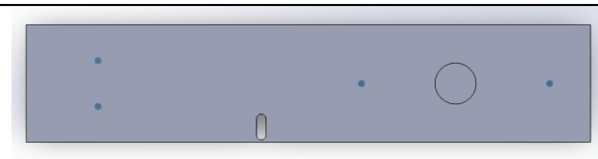
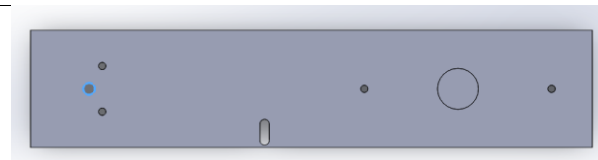
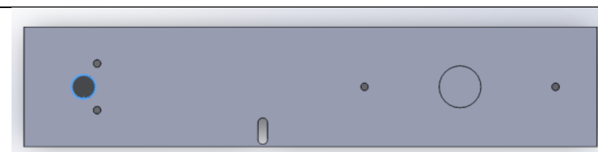
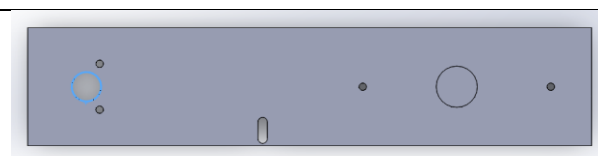
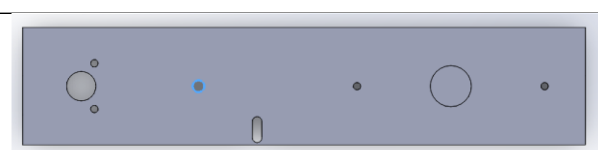
Modified Base (EML2322L-P1)

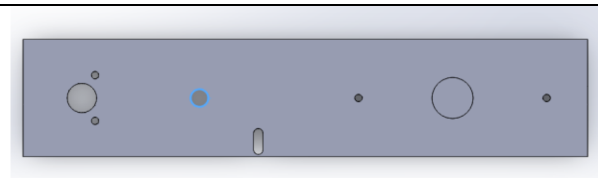
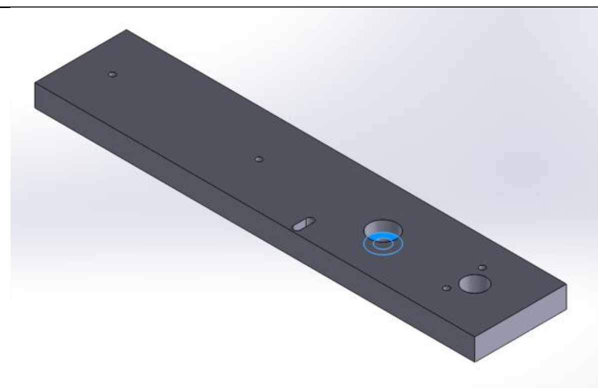
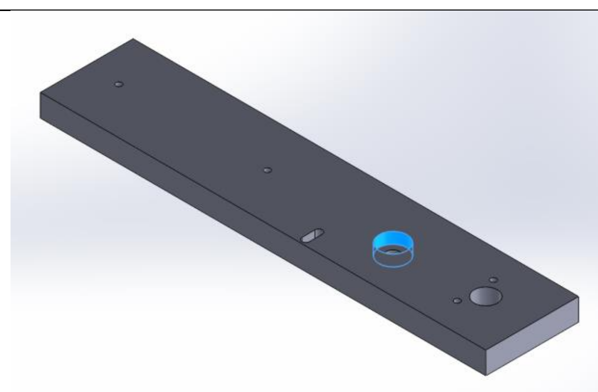
Manufacturing Processes	Process Setup
Select material and install the aluminum stock into the bandsaw vise, clamping against the tall side.	
Measure and mark the stock, apply oil, and cut to 12" long through 2.5" of material.	
Remove from bandsaw vise and deburr any sharp edges.	
Install the stock in the mill vise, with the face to be milled oriented up.	
Perform the 5-step check before installing the collet and 1" endmill into the spindle.	
Perform the 4-step check before turning the machine on and changing the spindle speed to 955 RPM.	
Take a destructive zero from the top face of the workpiece	

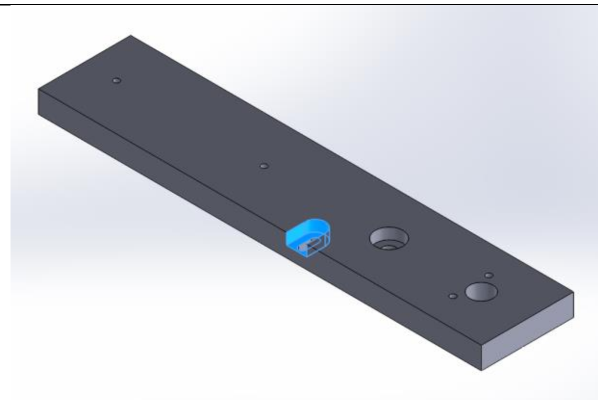
Mill the stock down to 12” x 2.5” x 0.6’’. Turn off the machine.	
Perform the 5-step check before uninstalling the collet and endmill and installing the drill chuck and cylindrical edge finder into the spindle.	
Perform the 4-step check before turning the machine on and changing the spindle speed to 950 RPM.	
Use the cylindrical edge finder to zero the x- and y-axis with respect to the datum in the bottom left corner. Offset the zeros by 0.100’’ on the DRO to account for the radius of the edge finder.	
Perform the 5-step check before uninstalling the cylindrical edge finder and installing the center drill into the drill chuck.	
Perform the 4-step check before turning the machine and changing the spindle speed to 1600 RPM.	
Locate the tensioner arm locations on the DRO, and center drill all holes shown.	
Turn the machine off. Perform the 5-step check before removing the center drill and installing a 0.200” drill bit into the drill chuck.	
Perform the 4-step check, turn the machine on, change the speed to 850 RPM, and apply oil to the hole locations.	

Using the DRO, locate and drill through both tensioner arm thru-holes with the 0.200” drill bit.	
Turn off the machine and perform the 5-step check before uninstalling the drill bit and drill chuck.	
Perform the 5-step check before installing the collet and 0.200” endmill.	
Perform the 4-step check and turn on the machine. Using the DRO, locate the edge, apply oil, and mill between the two tensioner arm holes.	
Perform the 5-step check before uninstalling the endmill and installing the drill chuck and a 0.250” drill bit for the c-bore.	
Perform the 4-step check, turn on the machine, and change the speed to 800 RPM.	
Using the DRO, locate and drill the tensioner arm c-bore, 0.313” deep (for bearing and shaft). For the depth, use the DRO to locate the hole, release the quill lock, and lower the quill handle to touch off the surface. Raise the spindle lock up to the spindle’s location and lock it. Ensure the z-axis handle is set to zero, then raise the quill handle back to its original position where the spindle is all the way up. Rotate the z-axis handle to the specified depth (0.313’’). Apply oil and drill the c-bore with the 0.250’’ drill bit.	
Turn off the machine and perform the 5-step check before uninstalling the 0.250’’ drill bit and installing the 0.500’’ drill bit.	

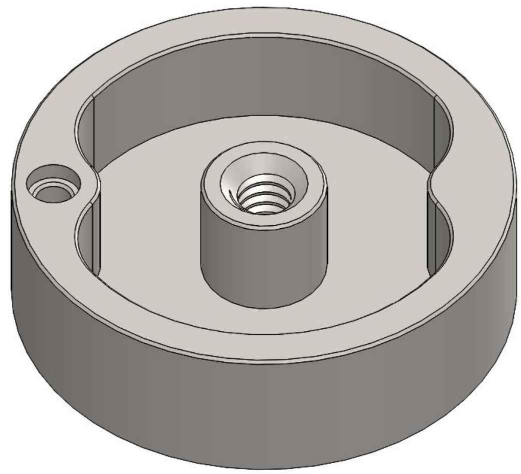
Perform the 4-step check, turn on the machine, and change the speed to 450 RPM. Then, apply oil and drill the c-bore with a 0.500'' drill bit.	
Turn off the machine and perform the 5-step check before uninstalling the 0.500'' drill bit and installing the 0.750'' drill bit.	
Perform the 4-step check, turn on the machine, and change the speed to 350 RPM. Then, apply oil and drill the c-bore with a 0.750'' drill bit.	
Turn off the machine and perform the 5-step check before uninstalling the 0.750'' drill bit and installing the 0.875'' drill bit.	
Perform the 4-step check, turn on the machine, and change the speed to 300 RPM, then drill the c-bore with a 0.875'' drill bit.	
Turn the machine off and perform the 5-step check before uninstalling the 0.875" drill bit and installing a 0.157" drill bit.	

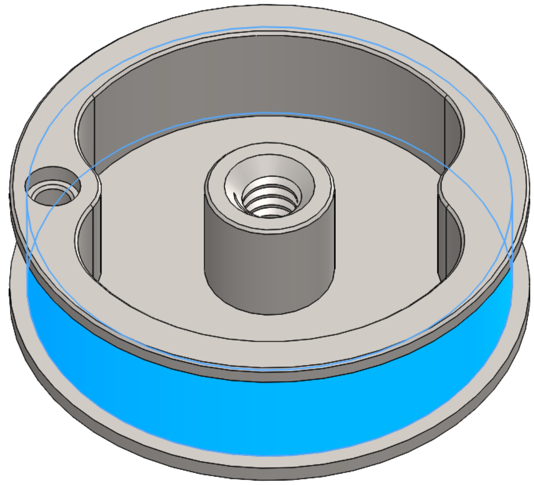
Perform the 4-step check, turn on the machine, apply oil, change the spindle speed to 1350 RPM and drill through the platform support thru-holes and screw holes for the manifold (4 places).	
Turn off the machine and perform the 5-step check before uninstalling the drill bit and installing a 0.250’’ drill bit for the manifold through hole.	
Perform the 4-step check, turn on the machine, and change the speed to 800 RPM.	
Using the DRO, locate the manifold through hole. First, apply oil and drill the through hole with the 0.250’’ drill bit.	
Turn off the machine and perform the 5-step check before uninstalling the 0.250’’ drill bit and installing the 0.500’’ drill bit.	
Perform the 4-step check, turn on the machine, and change the speed to 450 RPM. Then, apply oil and drill the through hole with the 0.500’’ drill bit.	
Turn the machine off and perform the 5-step check before uninstalling the 0.500’’ drill bit and installing the 0.625’’ drill bit.	
Perform the 4-step check, turn on the machine, and change the speed to 400 RPM. Apply oil and drill the through hole with the 0.625’’ drill bit.	
Perform the 4-step check, turn on the machine, and change the speed to 800 RPM.	
Using the DRO, locate the flywheel through hole. Apply oil and drill the through hole with the 0.250’’ drill bit.	
Turn off the machine and perform the 5-step check before uninstalling the 0.250’’ drill bit and installing the 0.377’’ drill bit.	

Perform the 4-step check, turn on the machine, and change the speed to 525 RPM. Apply oil and drill the through hole with the 0.377” drill bit.	
Turn off the machine and perform the 5-step check before uninstalling the 0.377” drill bit.	
Re-clamp the part in the mill vise, re-orienting to the opposite side to locate the flywheel c-bore	
Perform the 5-step check before installing the 0.750” drill bit for the c-bore	
Perform the 4-step check, turn on the machine, and change the speed to 350 RPM.	
Using the DRO, locate the flywheel c-bore. For the depth of 0.3”, use the DRO to locate the hole, release the quill lock, and lower the quill handle to touch off the surface. Raise the spindle lock up to the spindle’s location and lock it. Ensure the z-axis handle is set to zero, then raise the quill handle back to its original position where the spindle is all the way up. Rotate the z-axis handle to the specified depth (0.3’’). Apply oil and drill the c-bore with a 0.750’’ drill bit.	
Perform the 4-step check and turn on the machine. Using the spindle lock point, mill between the hole and the part edge.	

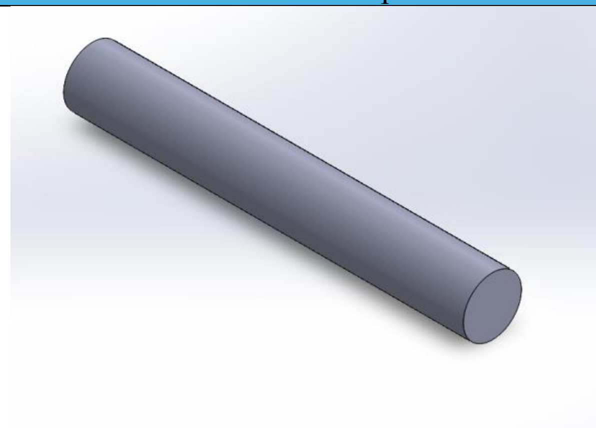
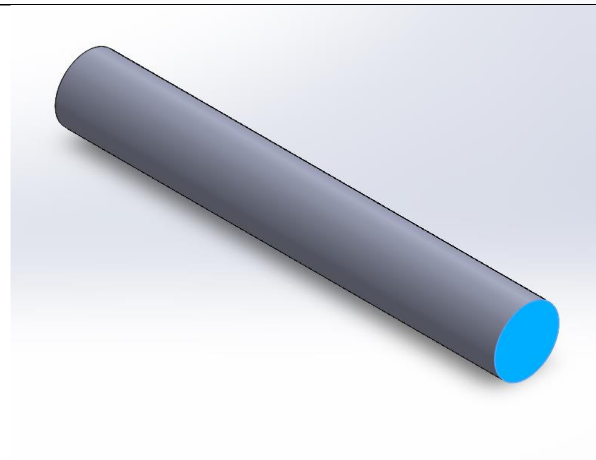
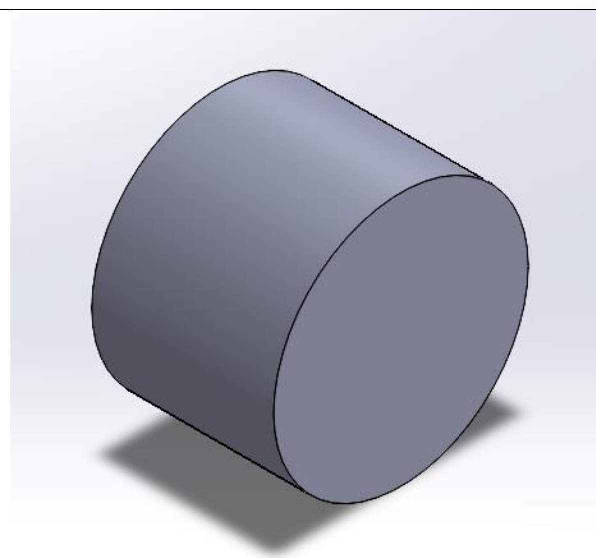
Turn off machine and perform the 5-step check before uninstalling the 0.750” drill bit and installing a 0.5625’’ endmill	
Perform the 4-step check, turn on the machine, and change the speed to 2000 RPM.	
Using the DRO and applying oil, mill the workpiece down to the desired distance of 0.83’’. Do three 0.100’’ passes to get desired depth of 0.300’’.	
Turn off the machine and perform the 5-step check before uninstalling the end mill and collet.	
Remove the workpiece from the vise. Hand-tap the platform support holes using a 10-24 UNC tap (4 places).	
Clean the machine.	

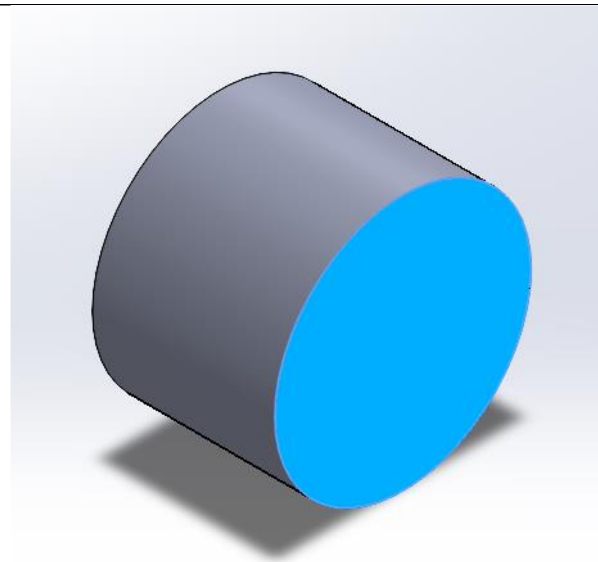
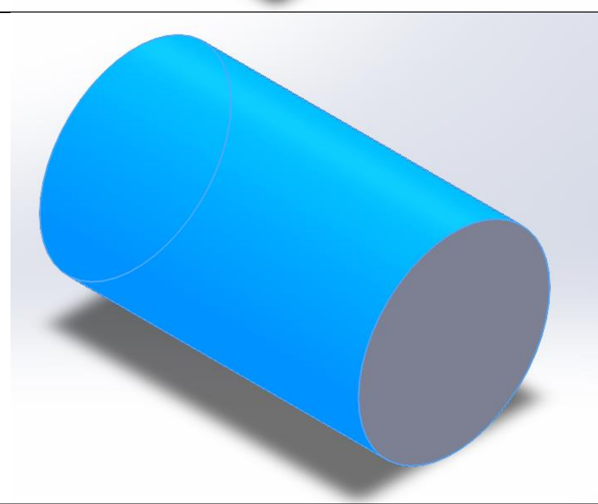
Modified Flywheel (EML2322L-P2)

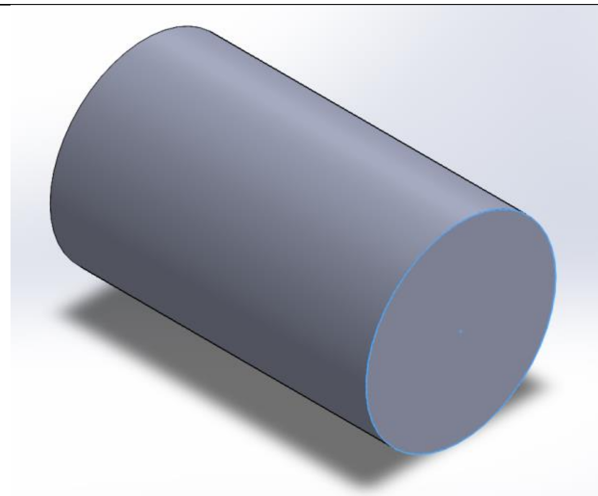
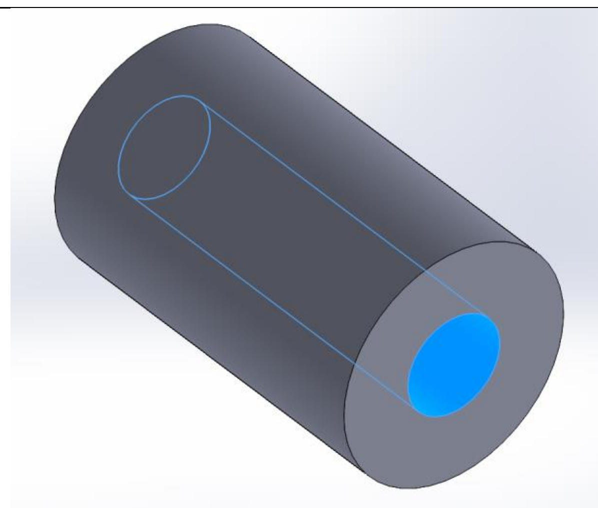
Manufacturing Processes	Process Setup
Select the existing 1.5” diameter x 0.45” tall flywheel.	
Install an internal chuck jaw attachment into the lathe chuck, sized to fit within the flywheel’s center bore.	
Insert the flywheel over the internal jaw attachment, aligning the c-bore relief with the jaws. Expand the jaws to grip the inside of the bore, securing the flywheel with its outer diameter and both faces fully exposed.	
Install the turning tool into the tool post and level the tool.	
Perform the 4-step check, turn on the machine, and change the speed to 325 RPM.	
Zero the tool at the outer diameter of the flywheel using the DRO to establish the X and Z reference points.	

Using the DRO and established reference points, turn down the middle section of the flywheel to 1.4” diameter, leaving the original 1.5” diameter lips 0.05” tall at each end for belt stability.	
Turn off the machine.	
Retract/collapse the internal chuck jaws and remove the flywheel. Deburr any sharp edges.	
Clean the machine.	

Tensioner Arm (EML2322L-P3)

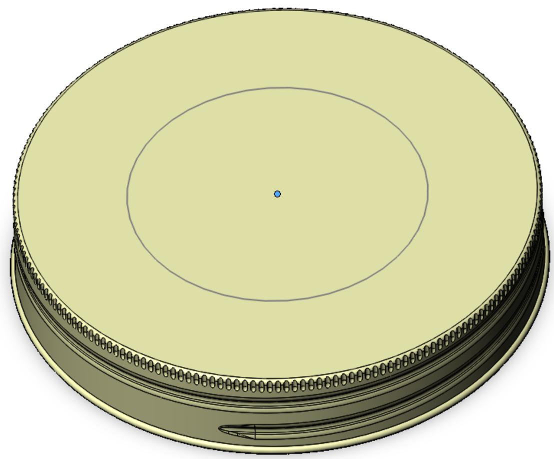
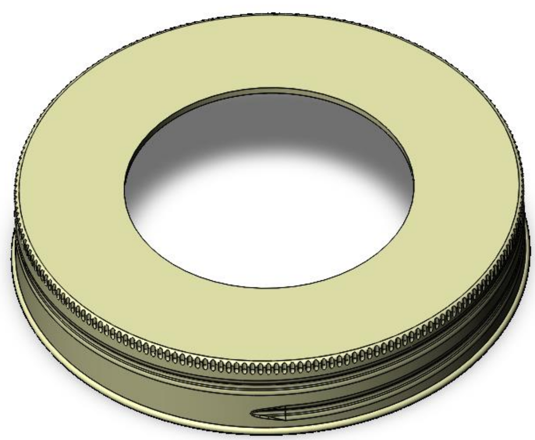
Manufacturing Processes	Process Setup
Select the 0.875” diameter round stock.	
Install the stock into the bandsaw vise.	
Measure and mark the stock, apply oil, and cut to 0.200” longer than 0.625”.	
Remove the part from the bandsaw vise and deburr any sharp edges.	

Install the stock into the lathe chuck, leaving sufficient length extending out for facing and turning.	
Install the turning tool into the tool post and level the tool.	
Perform the 4-step check, turn on the machine, and change the speed to 600 RPM.	
Zero the tool at the outer diameter of the stock using the DRO to establish the X and Z reference points.	
Face the end of the stock to achieve the proper length of 0.625”.	
Using the DRO, turn down the outer diameter to ensure a true 0.375” diameter along the length of the part.	
Turn off the machine and remove the turning tool.	

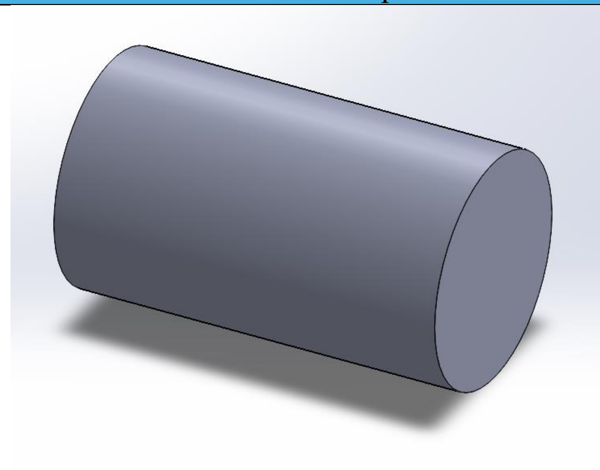
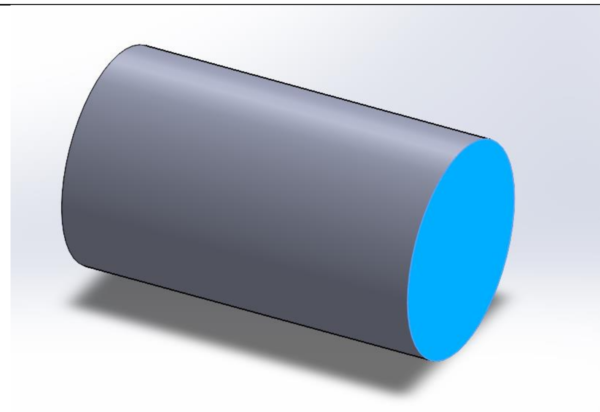
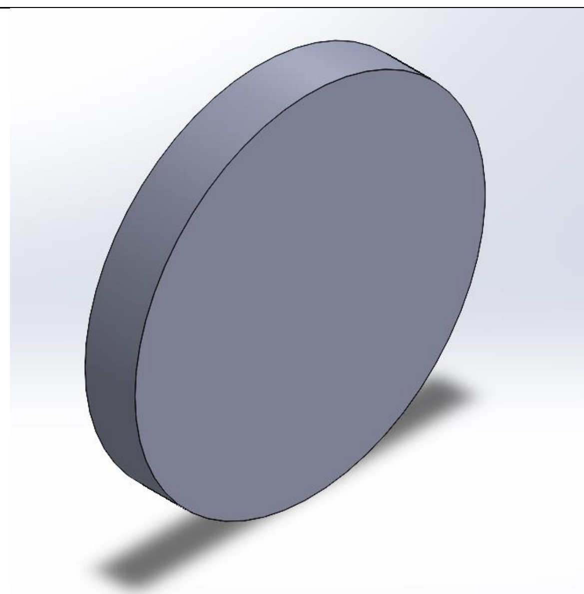
Install a center drill into the tailstock chuck.	
Perform the 4-step check, turn on the machine, and change the speed to 450 RPM.	
Using the tailstock, center drill the hole location in the center of the part.	
Turn off the machine, remove the center drill and install a 0.157" drill bit into the tailstock chuck.	
Perform the 4-step check, apply oil to the hole location, before turning the machine on and changing the speed to 600 RPM.	
Using the tailstock handwheel, drill the hole through the center of the part with the 0.157" drill bit.	
Turn off the machine and remove the drill bit and tailstock chuck.	
Remove the part from the lathe chuck.	

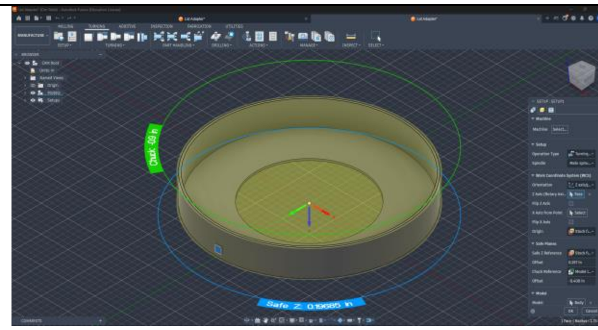
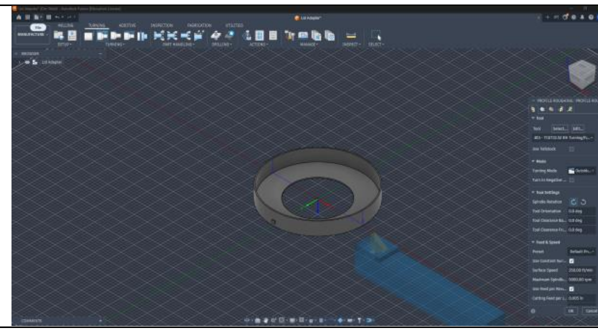
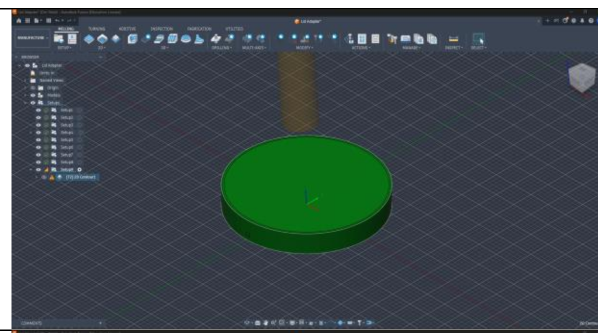
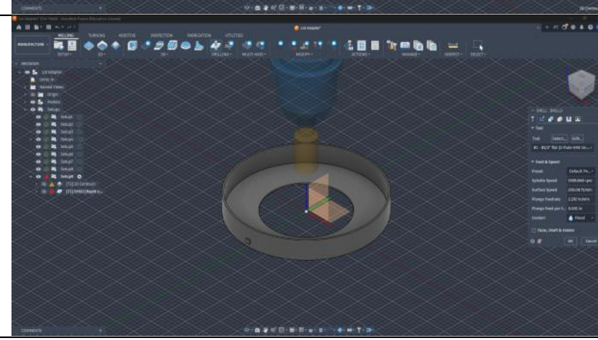
Hand-tap the center hole using a 10-24 UNC tap, thru.	
Deburr any sharp edges.	
Clean the machine.	

Modified Lid (EML2322L-P4)

Manufacturing Processes	Process Setup
Select the existing OTS lid to be modified.	
Mark the center of the lid for the 1.95” diameter thru-hole cutout.	
Use a punch and die to create the 1.95” diameter thru-hole in the lid.	
Deburr any sharp edges.	
Clean the machine.	

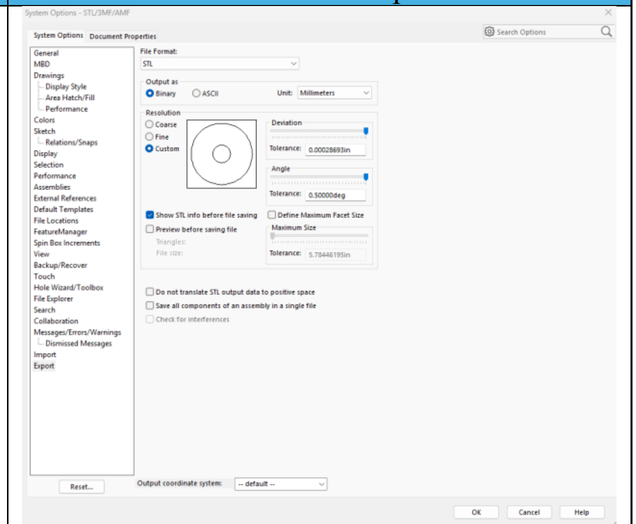
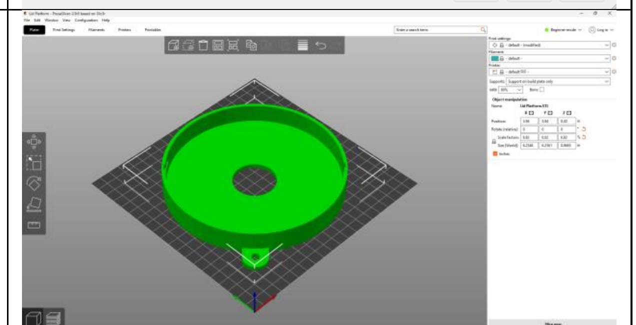
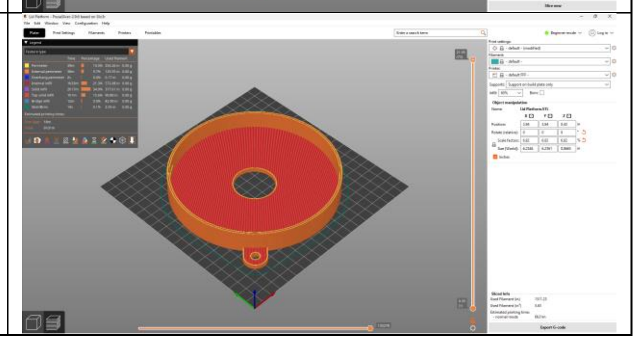
Lid Adapter (EML2322L-P5)

Manufacturing Processes	Process Setup
Select the 3.5” diameter round stock.	
Install the stock into the bandsaw vise.	
Measure and mark the stock, apply oil, and cut to 0.5” thick through the 3.5” diameter of material.	
Remove from the bandsaw vise and deburr any sharp edges.	

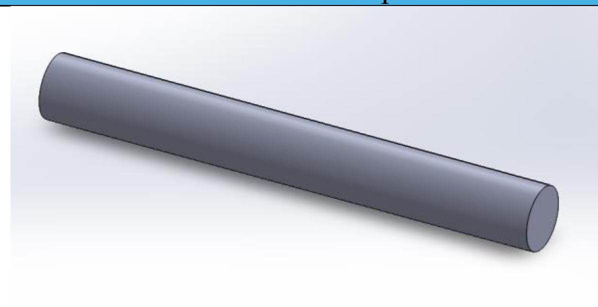
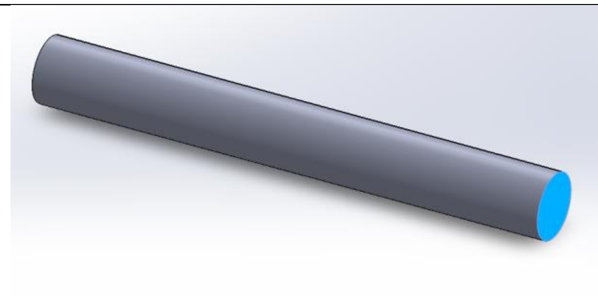
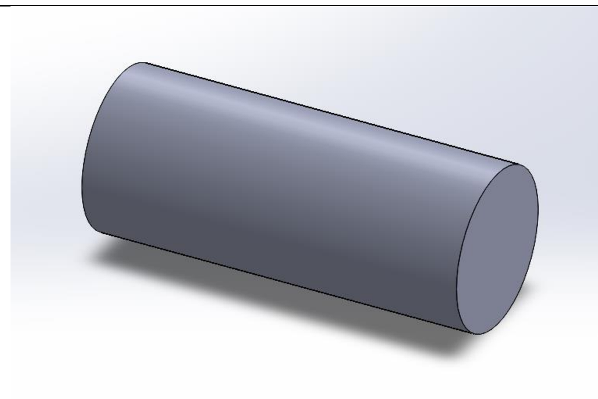
Open Solidworks file for the lid adapter in Autodesk Fusion. Select the “Manufacture” option, then the “Setup” option. Under “Operation Type”, select “Turning or mill/turn.” Configure the stock size to Ø 3.5’’ x 0.5’’.	
Under “Turning,” select “Turning Profile Roughing” for the outer diameter. Select tool and use spindle speed of 600 RPM to bring required section of the outer diameter from 3.50’’ to 3.47.’’	
Under “Turning,” select “Turning Profile Finishing” for the outer diameter. Select tool and use spindle speed of 600 RPM to bring required section of the outer diameter from 3.47’’ to 3.45.’’	
Under “Milling”, select “Drilling” for the center thru-hole. Select tool and use spindle speed of 250 RPM to drill/bore the 1.95” diameter thru-hole through the center of the part.	
Under “Milling”, select “Drilling” for the counterbore. Select tool and use spindle speed of 250 RPM to bore the 3.38” diameter c-bore to a depth of 0.465”.	
Insert required tools needed for the outer diameter and review G-code. Take the workpiece and insert part into the CNC machine.	

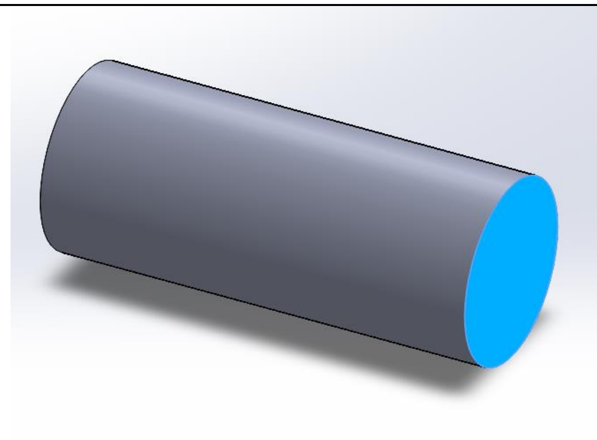
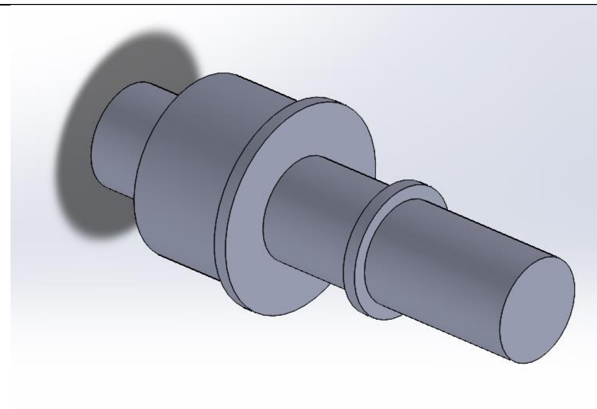
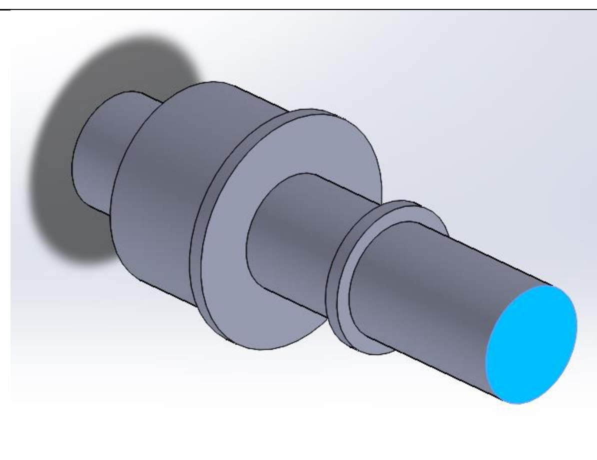
Run the CNC program.	
Remove the part from the chuck jaws once the program is finished running.	
Deburr any sharp edges.	

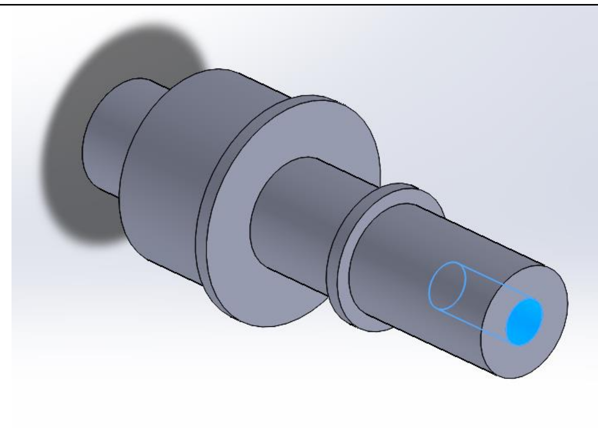
Lid Platform (EML2322L-P6)

Manufacturing Processes	Process Setup
Click “Options.” Drag the sliders for “Deviation” and “Angle” all the way to the right to maximize print accuracy. Save the CAD model as a .stl. File.	
Import the .stl file in the Prusa slicer. Rotate the model so that the toothpath is not outside the print area. In “Print Settings,” select “Support on build plate only” for “Supports” and 60% for “Infill.”	
Press “Slice now,” review the G-code, and upload it to the 3D-printer.	

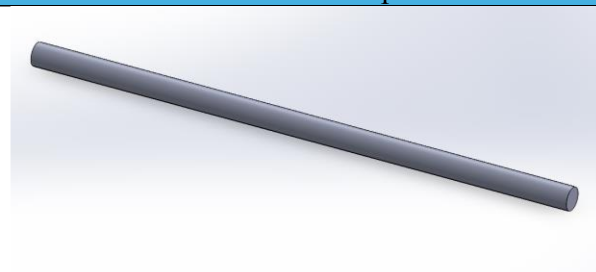
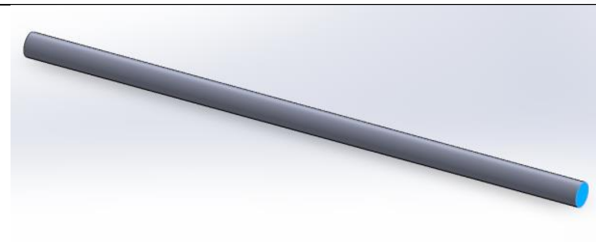
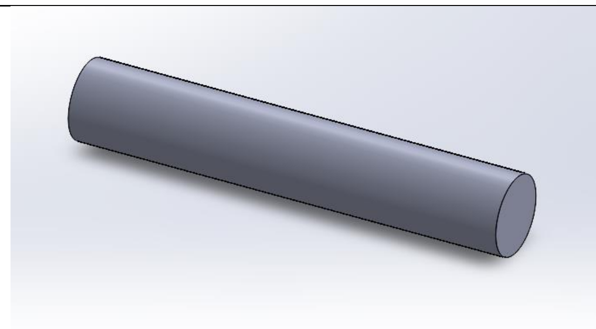
Shaft (EML2322L-P7)

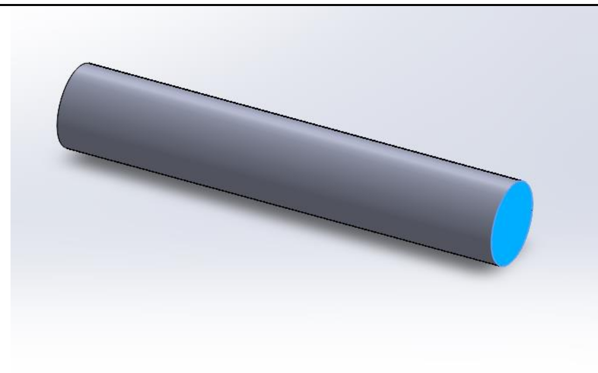
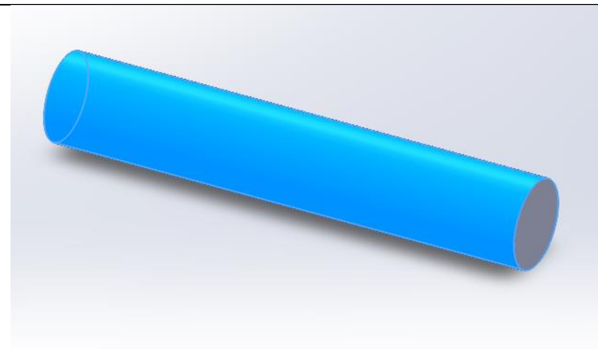
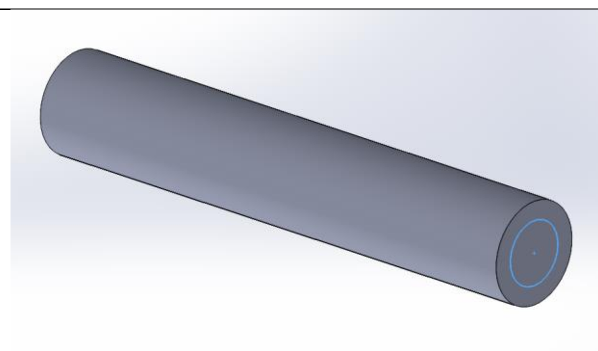
Manufacturing Processes	Process Setup
Select the 0.75” diameter round stock.	
Install the stock into the bandsaw vise.	
Measure and mark the stock, apply oil, and cut to 0.300” longer than 1.813” through the 0.75” diameter of material.	
Remove the part from the bandsaw vise and deburr any sharp edges.	
Install the stock into the lathe chuck, leaving sufficient length extending out for facing and turning.	
Install the turning tool into the tool post.	
Perform the 4-step check, turn on the machine, and change the speed to 600 RPM.	
Zero the tool at the outer diameter of the stock using the DRO to establish the X and Z reference points.	

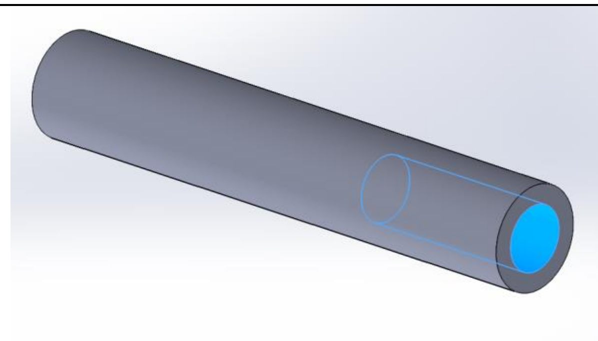
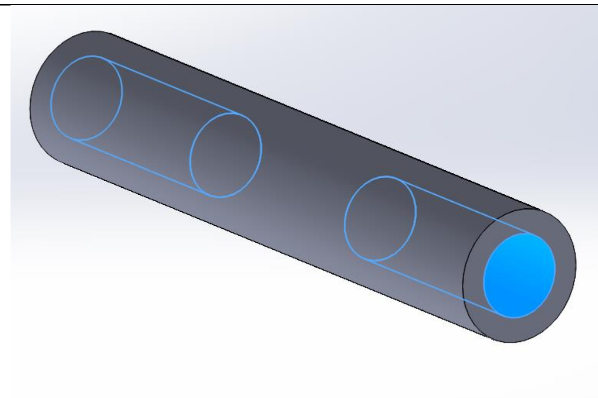
Face the end of the stock to achieve the proper length of 1.813” and flat reference surface.	
Using the DRO, turn each diameter along the shaft to the dimensions called out on the drawing, working from the largest diameter down to the smallest.	
Turn off the machine and remove the turning tool.	
Install a center drill into the tailstock chuck.	
Perform the 4-step check, apply oil to the hole location, before turning the machine on and setting the speed to 600 RPM.	
Using the tailstock, center drill the hole location for the drive pin.	

Turn the machine off, remove the center drill and install a 0.157” drill bit into the tailstock chuck.	
Perform the 4-step check, apply oil to the hole location, before turning the machine on and changing the speed to 600 RPM.	
Using the tailstock handwheel, drill the drive pin hole 0.35” deep.	
Turn off the machine and remove the drill bit and tailstock chuck.	
Remove the part from the lathe chuck jaws.	
Hand-tap the drive pin hole using a 10-24 UNC tap, 0.3” deep.	
Deburr any sharp edges.	
Clean the machine.	

Platform Support (EML2322L-P8)

Manufacturing Processes	Process Setup
Select the 0.25” diameter round stock, enough for 2 identical support rods.	
Install the stock into the bandsaw vise.	
Measure and mark the stock, apply oil, and cut to approximately 0.300” longer than 1.4”. Remove from the vise, deburr, and repeat to cut the second identical rod.	
Install one rod into the lathe chuck jaws, leaving sufficient length by extending out for facing and turning.	
Install the turning tool into the tool post.	
Perform the 4-step check, turn on the machine, and change the speed to 600 RPM.	
Zero the tool at the outer diameter using the DRO to establish the X and Z reference points.	

Face the end of the rod to achieve the proper length of 1.4”.	
Using the DRO, turn down the outer diameter to ensure a true 0.25” diameter along the length of the rod.	
Turn off the machine and remove the turning tool. Repeat this facing/turning sequence for the second identical rod.	
Install a center drill into the tailstock chuck.	
Perform the 4-step check, turn on the machine, and change the speed to 600 RPM.	
Using the tailstock, center drill the hole location in the top face of the rod.	
Turn the machine off, remove the center drill and install a 0.157” drill bit into the tailstock chuck.	
Perform the 4-step check, apply oil to the hole location, before turning the machine on and changing the speed to 600 RPM.	

Using the tailstock handwheel, drill the top-face hole 0.4” deep.	
Turn off the machine and remove the drill bit and tailstock chuck.	
Remove the rod, flip it end-for-end, and place it in the chuck jaws to expose the bottom face. Repeat the center drilling and drilling steps to drill the bottom-face hole 0.4” deep.	
Remove the rod from the lathe chuck.	
Hand-tap both the top and bottom holes using a 10-24 UNC tap, 0.4” deep each.	
Deburr any sharp edges. Repeat the drilling and tapping steps for the second identical rod.	
Clean the machine.	