

Safety in Numbers
Marine-Inspired Kinetic Sculpture



Olin College

ENGR2330: Introduction to Mechanical Prototyping

Sculpture by:

Rowan Sharman, Henry Rachootin, Ava Lakmazaheri, Diego Alvarez, Alisha Pegan, Caz Nichols

Report by Rowan Sharman

03/26/2017

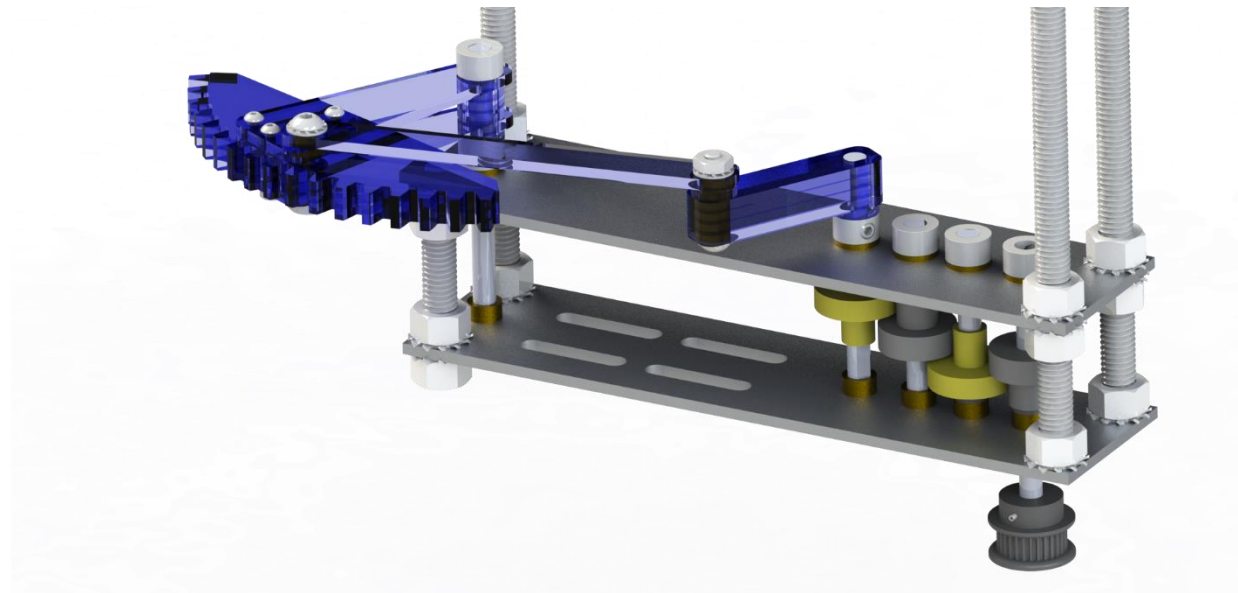
Summary:

In this sculpture, we attempted to capture the schooling motion that many species of small fish use to confuse predators. When fish move in this way, they give the illusion of being one larger, faster-moving, and less predictable thing. We decided to attempt a similar effect by using the rotational motion of thin sheet metal fish to give the illusion of translational motion.

The basic idea is that our brass fish are nearly invisible when pointed directly at or away from the viewer, yet appear again when they are “swimming across” in front of the viewer. There is also a relatively high density of fish in the sculpture, and they are somewhat shiny so they glint in the light. This provides for a smoother transition. The fish rotate through 180 degrees, and then back, so the effect is that they “swim” from left to right and then back.

Design:

The most complicated part of the sculpture is the gearbox and four-bar linkage combination. This component gears down the motor output, and changes the rotational motion of the motor into the oscillating 180 degree motion of the fish.



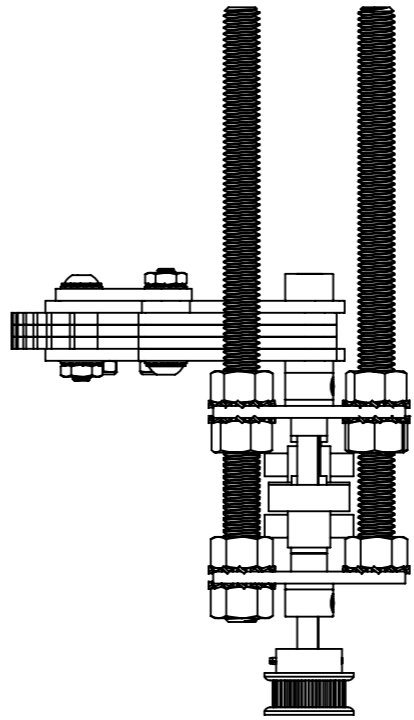
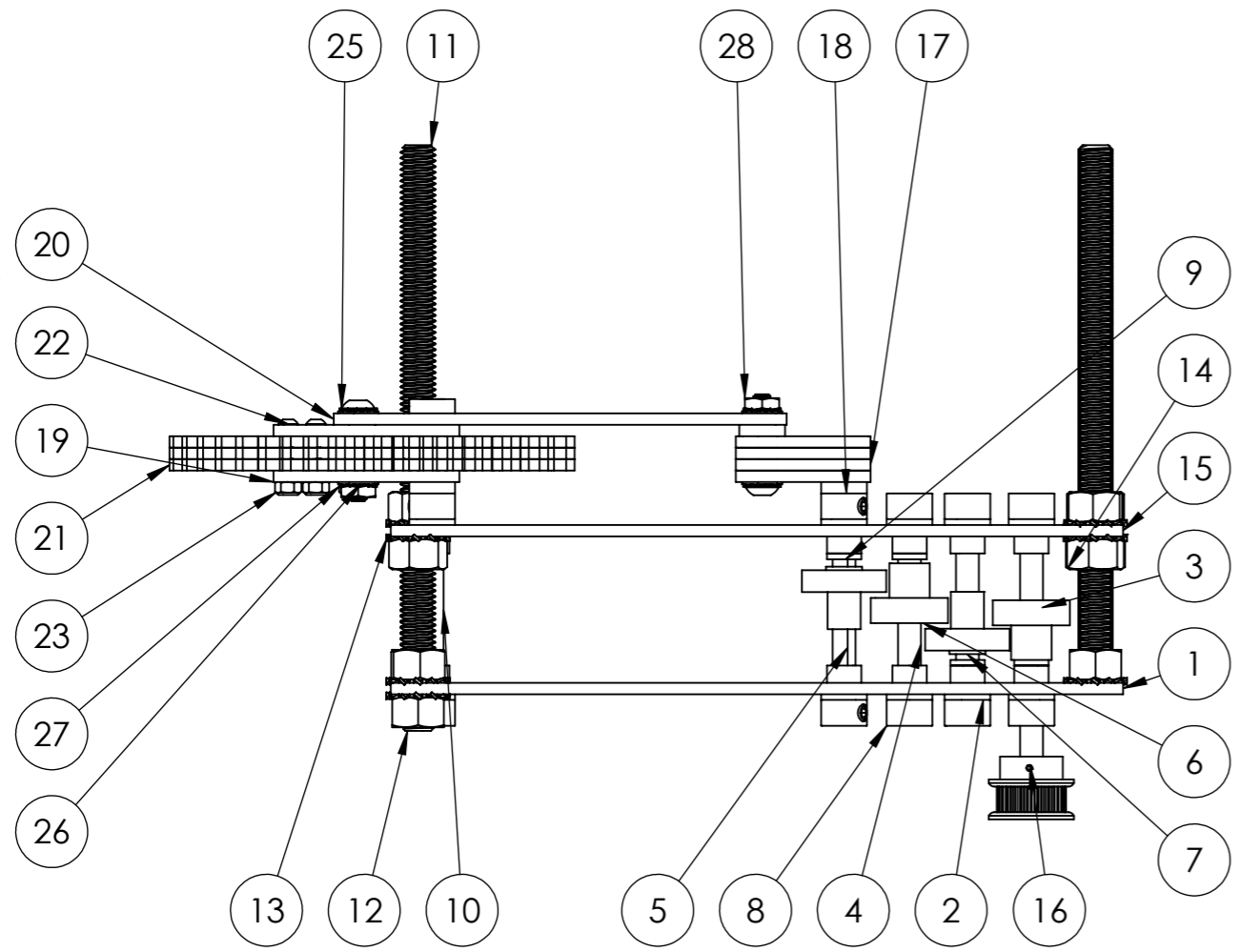
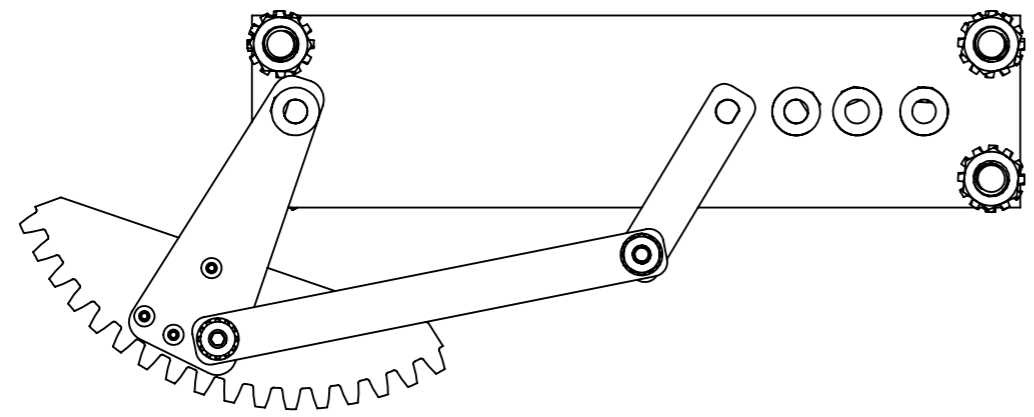
First, the motor is geared up by a factor of two by a set of pulleys. We designed the belt and pulley system in this way to allow for flexibility in the output speed without too much trouble. This output then is geared down by four gears whose net ratio is 10:1. The output of this gearbox turns the crank of a four-bar linkage with a section gear on it. The section gear travels continuously back and forth over a 180 degree region of the input gear which turns the fish.

This input gear turns a tray with a total of 17 gears, 11 of which are attached to the shafts carrying the fish. These gears can barely be seen in the upper left side of the photo below.



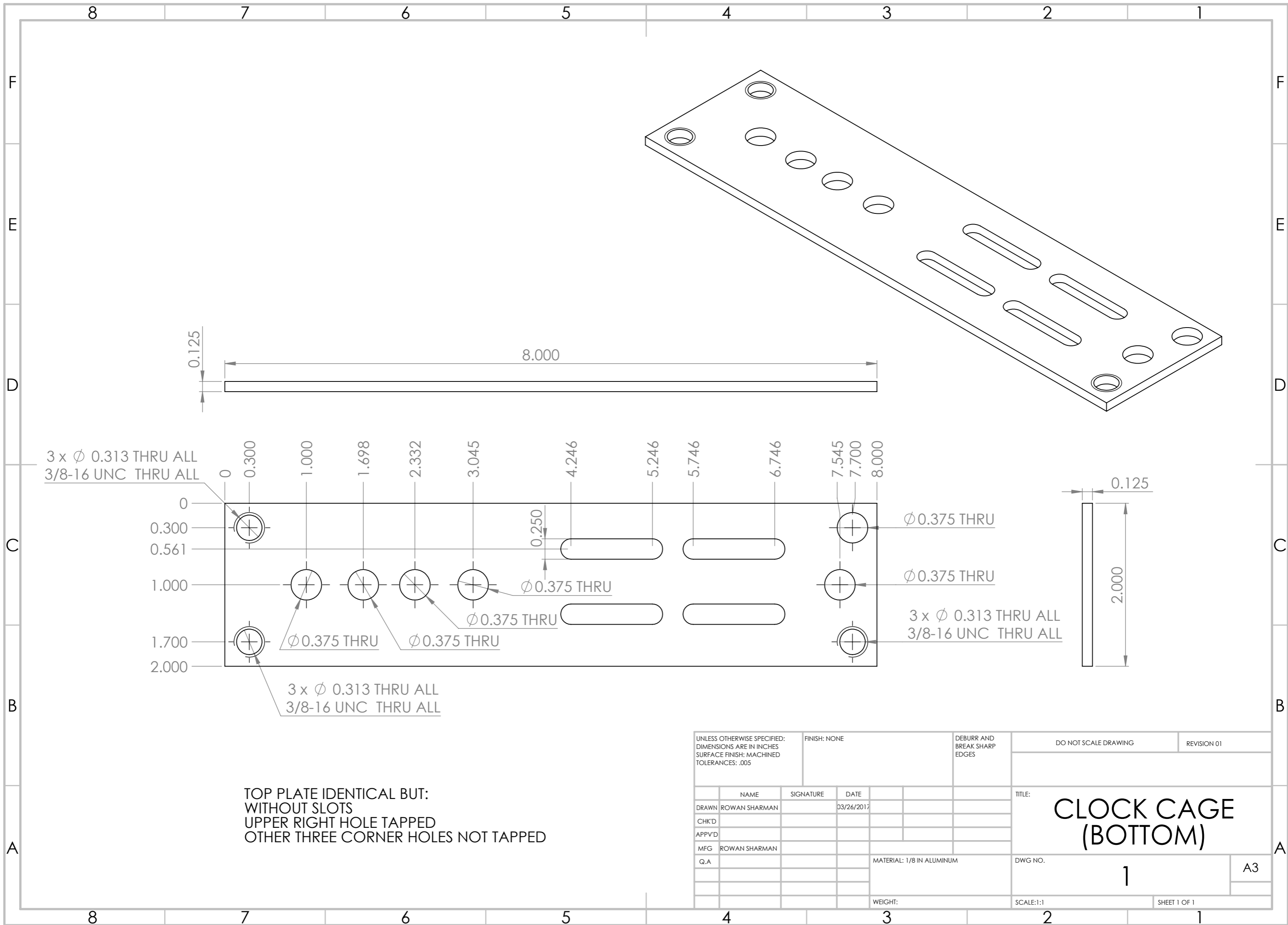
The gearbox is constructed, as shown, of two machined clock cages held apart and mounted by threaded rods. Parts are held onto the jack shafts where possible by spring pins, however some of the gears are simply press-fit onto the shafts, and some are allowed to rotate freely on their shafts.

The base of the sculpture is constructed of painted plywood, and includes many interesting joints which are glued together, including butt joints, housing joints, and mortise and tenon joints. The sculpture is bolted onto the base and much of the sheet metal is riveted together.

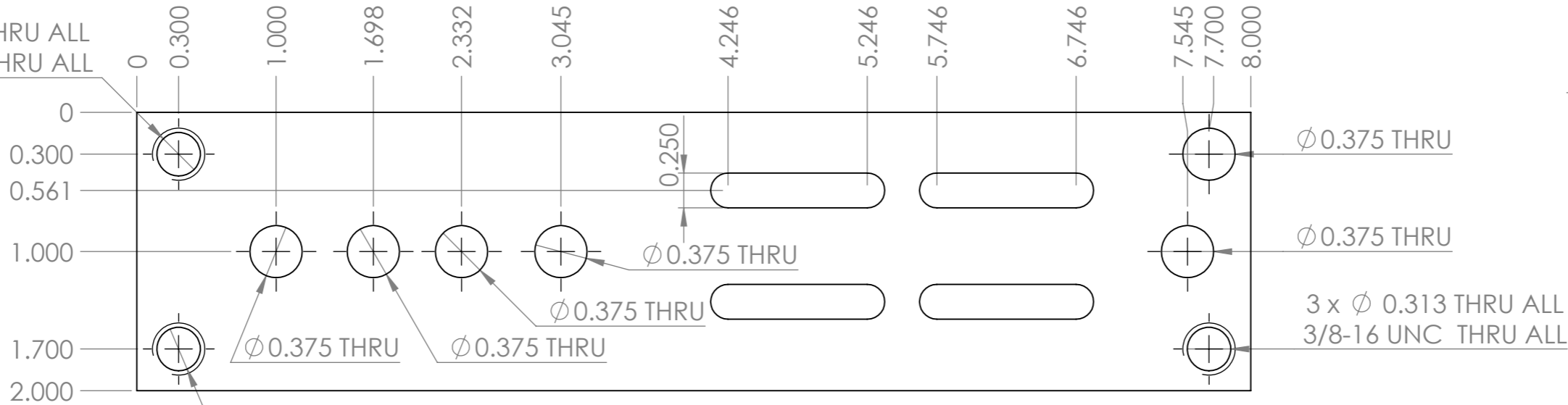


ITEM NO.	PART DESCRIPTION	QTY.
1	Clock Cage Bottom	1
2	Bushing 1/4"	10
3	D-Shaft 1/4"	1
4	D-Shaft 1/4"	2
5	D-Shaft 1/4"	1
6	Helical Gear 11t x 21t	2
7	Helical Gear 9t x 23t	2
8	Shaft Collar 1/4"	11
9	Plastic Spacer/Washer 1/4"	4
10	D-Shaft 1/4"	1
11	Threaded Rod 3/8"-16 x 6"	3
12	Threaded Rod 3/8"-16 x 3"	1
13	External-Tooth Lock Washer 3/8"	12
14	Hex Nut 3/8"-16	12
15	Clock Cage Plate Top	1
16	Spring Pin 1/16" x 3/4"	1
17	Laser Cut Acrylic Linkage (Crank)	4
18	Laser Cut Acrylic 1/4" Spacer	6
19	Laser Cut Acrylic Linkage (Rocker)	2
20	Laser Cut Acrylic Linkage (Bar)	1
21	Laser Cut Acrylic Section Gear	3
22	Button Head Screw #4 x 3/4"	3
23	Nylon Insert Locknut #4	3
24	Brass Tubing Bushing	2
25	Button Head Screw #10 x 1"	2
26	Flat Washer #10	4
27	External-Tooth Lock Washer #10	4
28	Hex Nut #10	2
29	1254N23	1

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES		FINISH: NONE		DEBURR AND BREAK SHARP EDGES		DO NOT SCALE DRAWING		REVISION 01	
NAME		SIGNATURE		DATE		TITLE:			
DRAWN ROWAN SHARMAN				03/26/2017		<h1>GEARBOX AND LINKAGE ASSY</h1>			
CHK'D									
APPV'D									
MFG									
Q.A									
				MATERIAL:		DWG NO.		A3	
				WEIGHT:		SCALE:1:2		SHEET 1 OF 1	



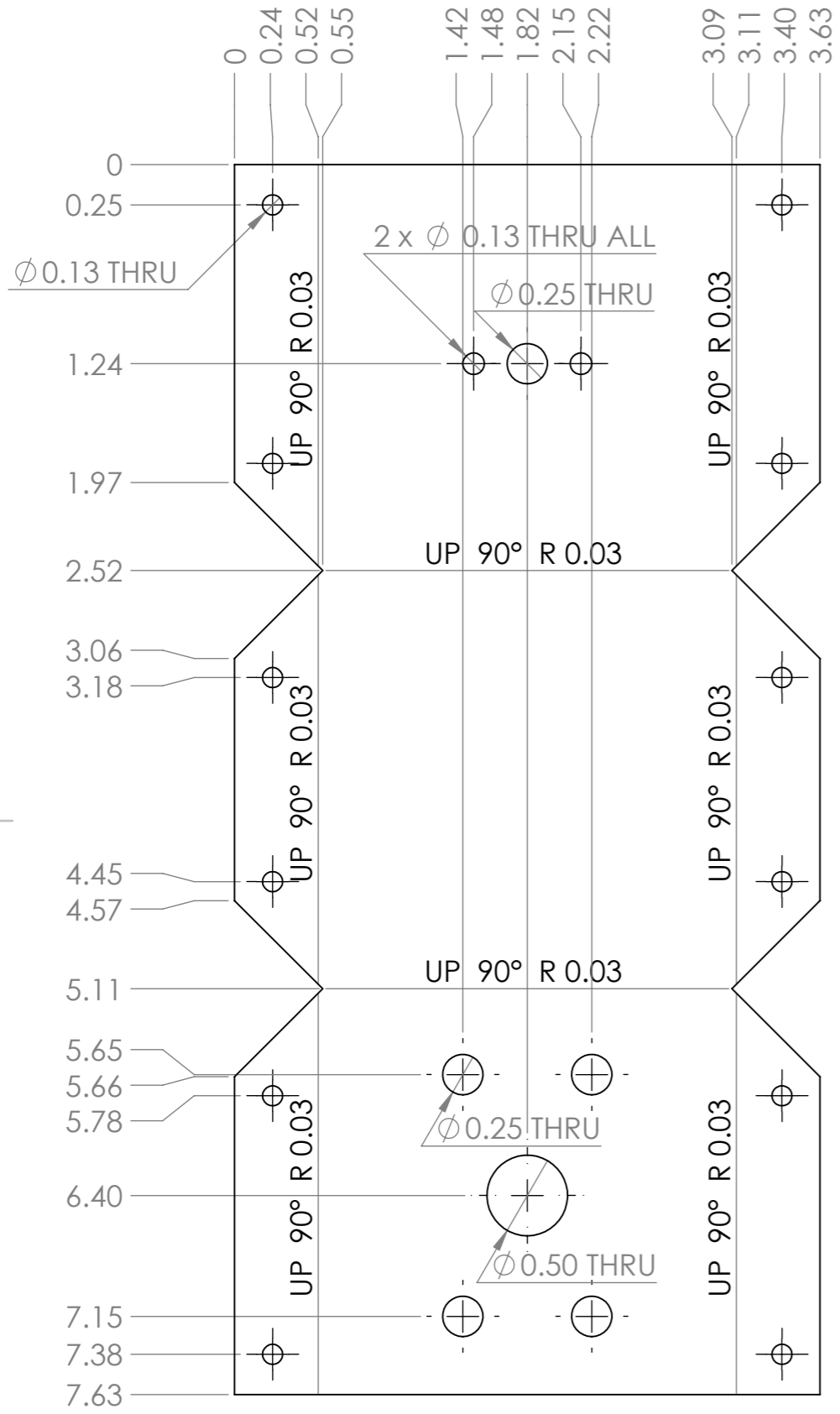
3 x ϕ 0.313 THRU ALL
3/8-16 UNC THRU ALL



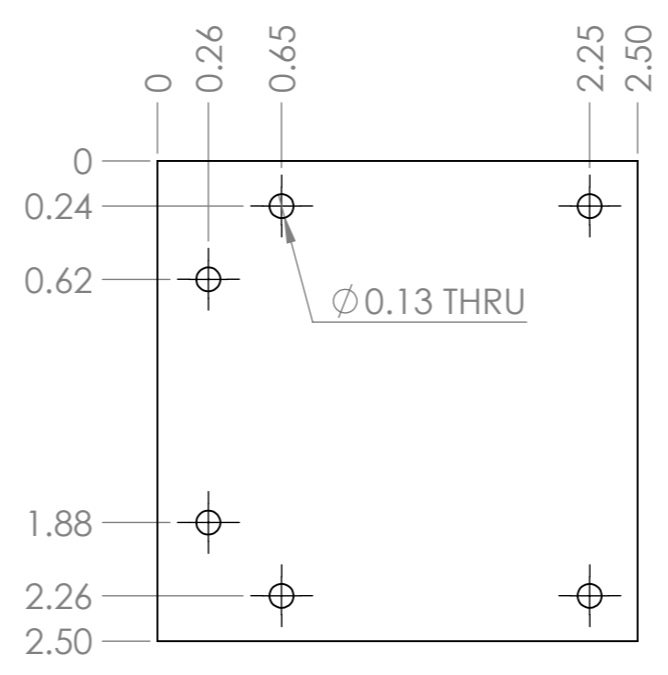
3 x ϕ 0.313 THRU ALL
3/8-16 UNC THRU ALL

TOP PLATE IDENTICAL BUT:
WITHOUT SLOTS
UPPER RIGHT HOLE TAPPED
OTHER THREE CORNER HOLES NOT TAPPED

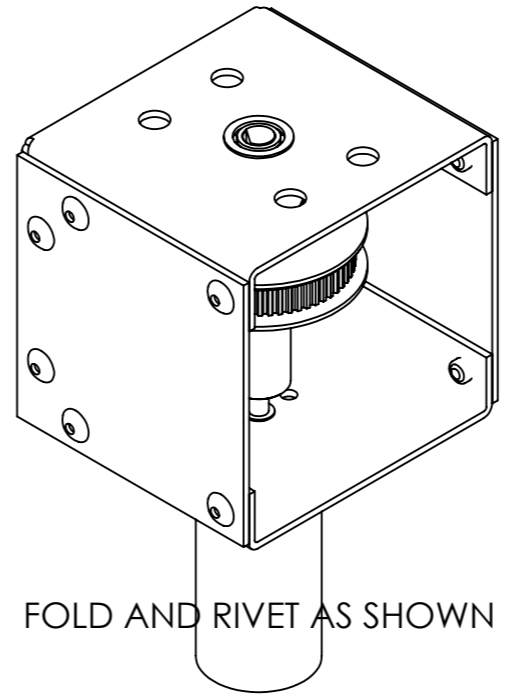
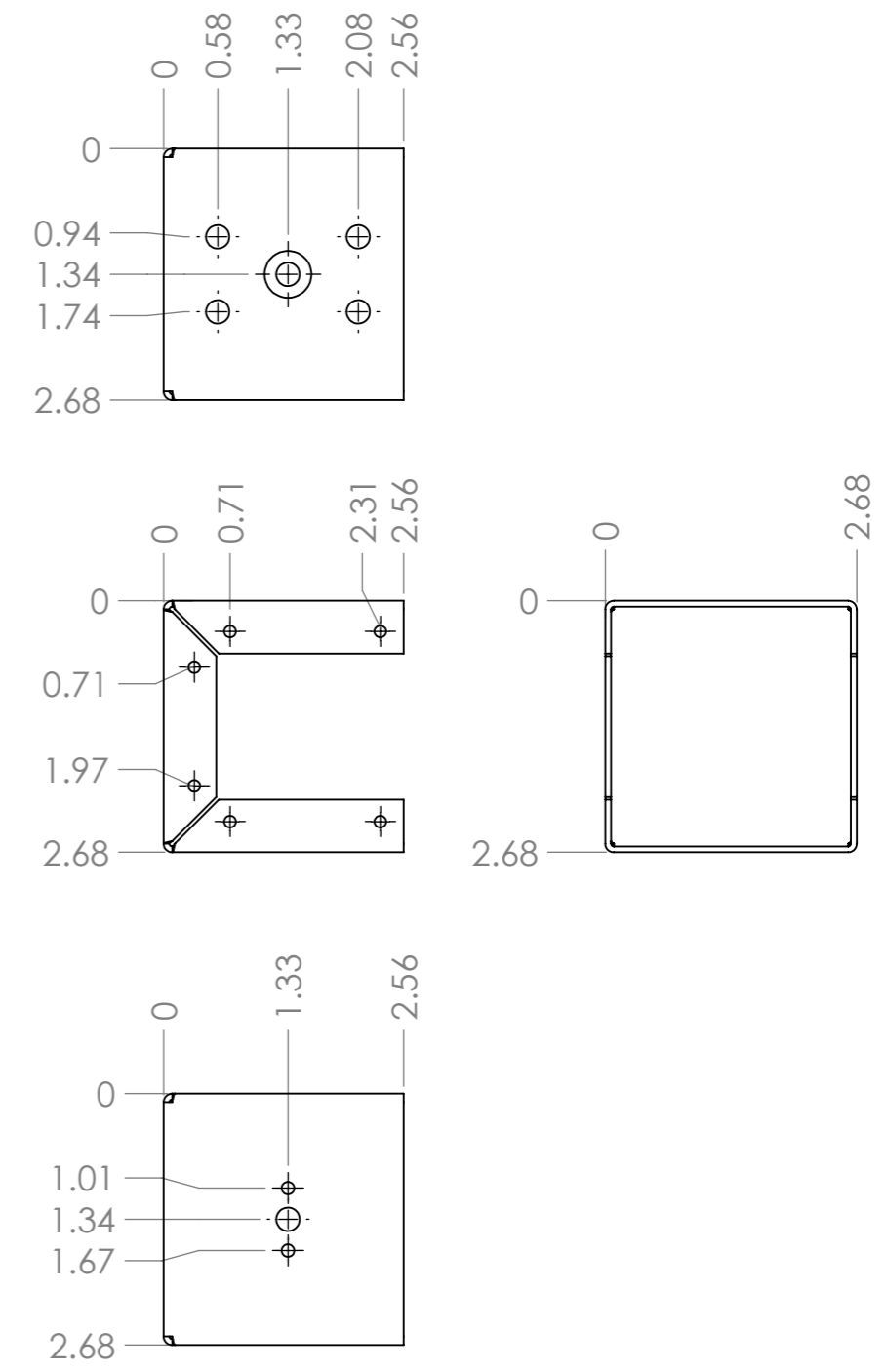
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES SURFACE FINISH: MACHINED TOLERANCES: .005			FINISH: NONE			DEBURR AND BREAK SHARP EDGES			DO NOT SCALE DRAWING			REVISION 01		
DRAWN ROWAN SHARMAN			SIGNATURE			DATE 03/26/2017			TITLE: CLOCK CAGE (BOTTOM)					
CHK'D			MFG ROWAN SHARMAN			MATERIAL: 1/8 IN ALUMINUM			DWG NO. 1			A3		
APPV'D			Q.A.			WEIGHT:			SCALE: 1:1			SHEET 1 OF 1		



BRACKET: MAKE 1

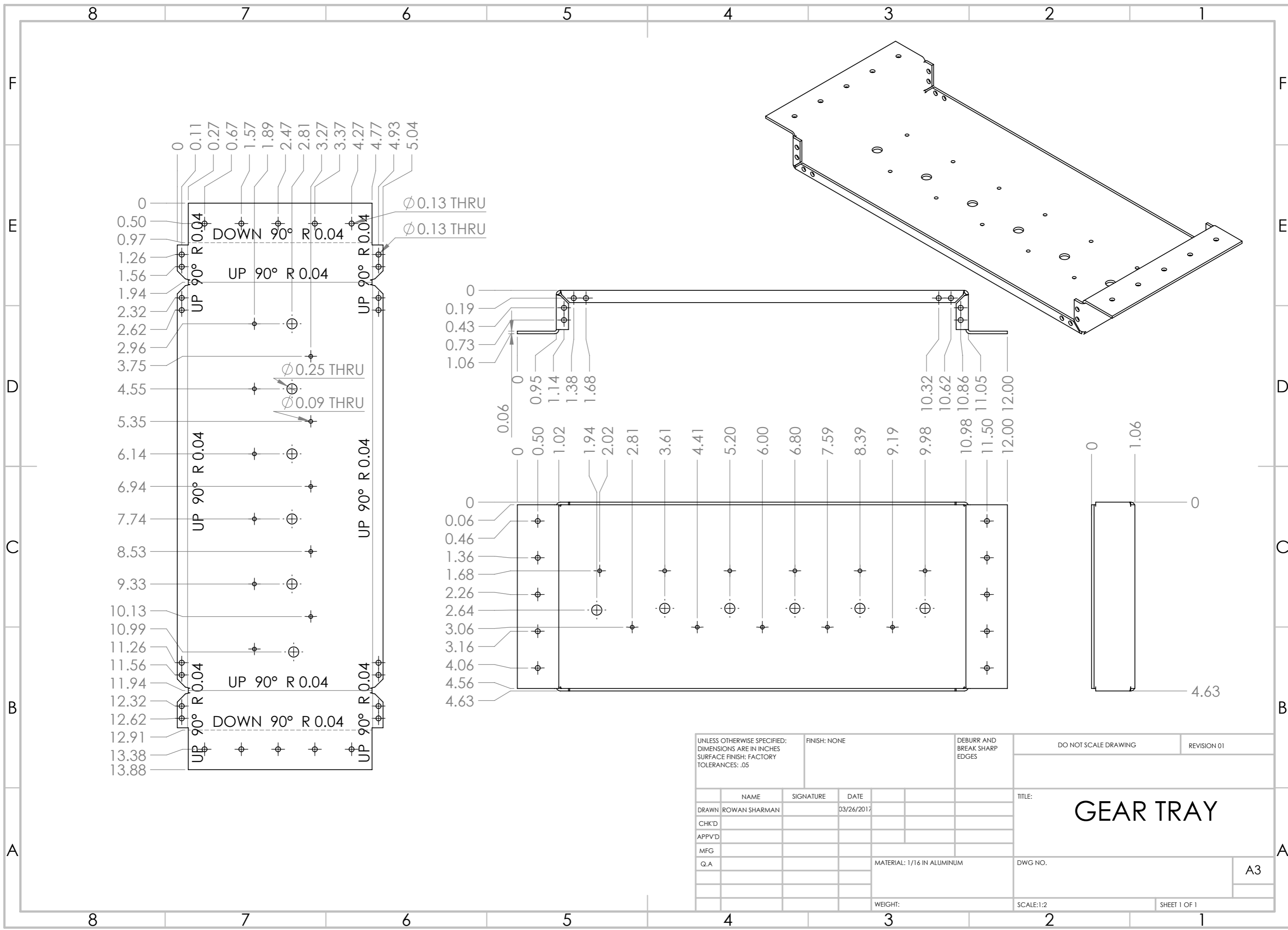


GUSSET: MAKE 2



FOLD AND RIVET AS SHOWN

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES SURFACE FINISH: FACTORY TOLERANCES: .05			FINISH: NONE		DEBURR AND BREAK SHARP EDGES		DO NOT SCALE DRAWING		REVISION 03		
	NAME	SIGNATURE	DATE				TITLE: MOTOR MOUNT BRACKET				
	DRAWN	ROWAN SHARMAN	03/26/2017				DWG NO. 1				
	CHK'D						A3				
	APPV'D						SCALE: 1:1				
	MFG				MATERIAL: 1/16 IN ALUMINUM		SHEET 1 OF 1				
	Q.A				WEIGHT:						



UNLESS OTHERWISE SPECIFIED:
 DIMENSIONS ARE IN INCHES
 SURFACE FINISH: FACTORY
 TOLERANCES: .05

FINISH: NONE

DEBURR AND
 BREAK SHARP
 EDGES

DO NOT SCALE DRAWING

REVISION 01

NAME	SIGNATURE	DATE
DRAWN ROWAN SHARMAN		03/26/2017
CHK'D		
APPV'D		
MFG		
Q.A		

TITLE:
GEAR TRAY

MATERIAL: 1/16 IN ALUMINUM

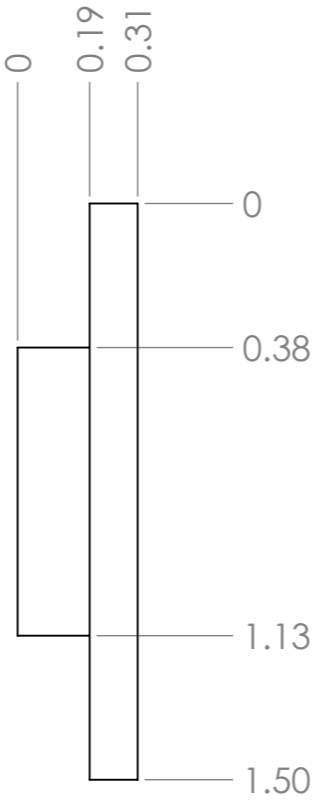
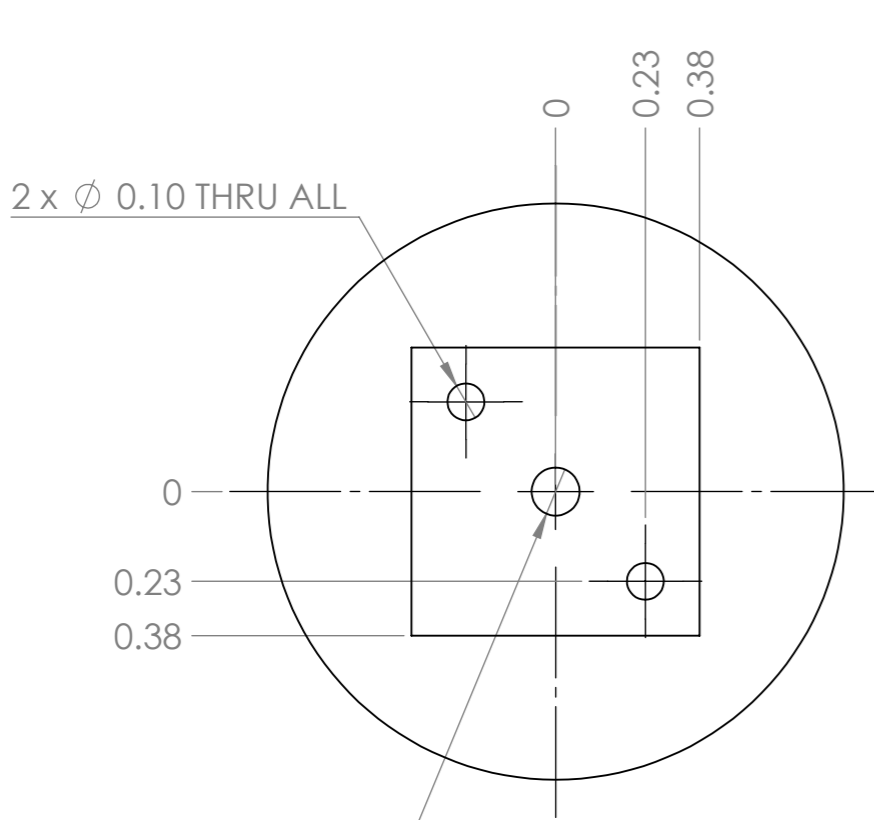
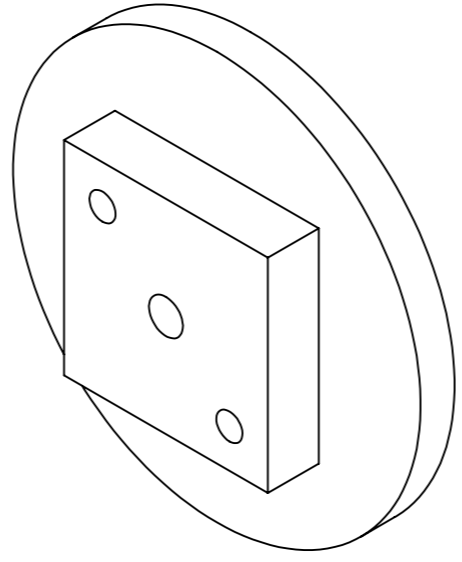
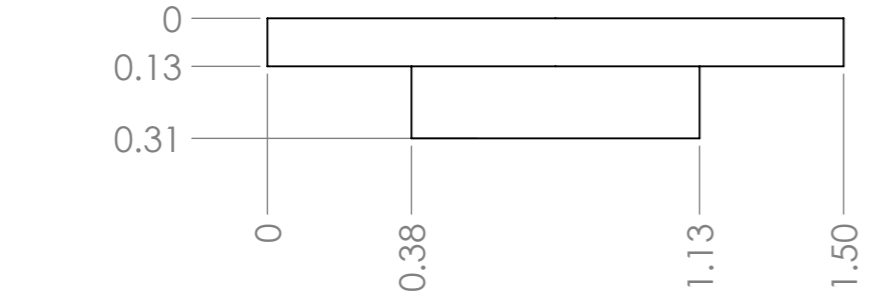
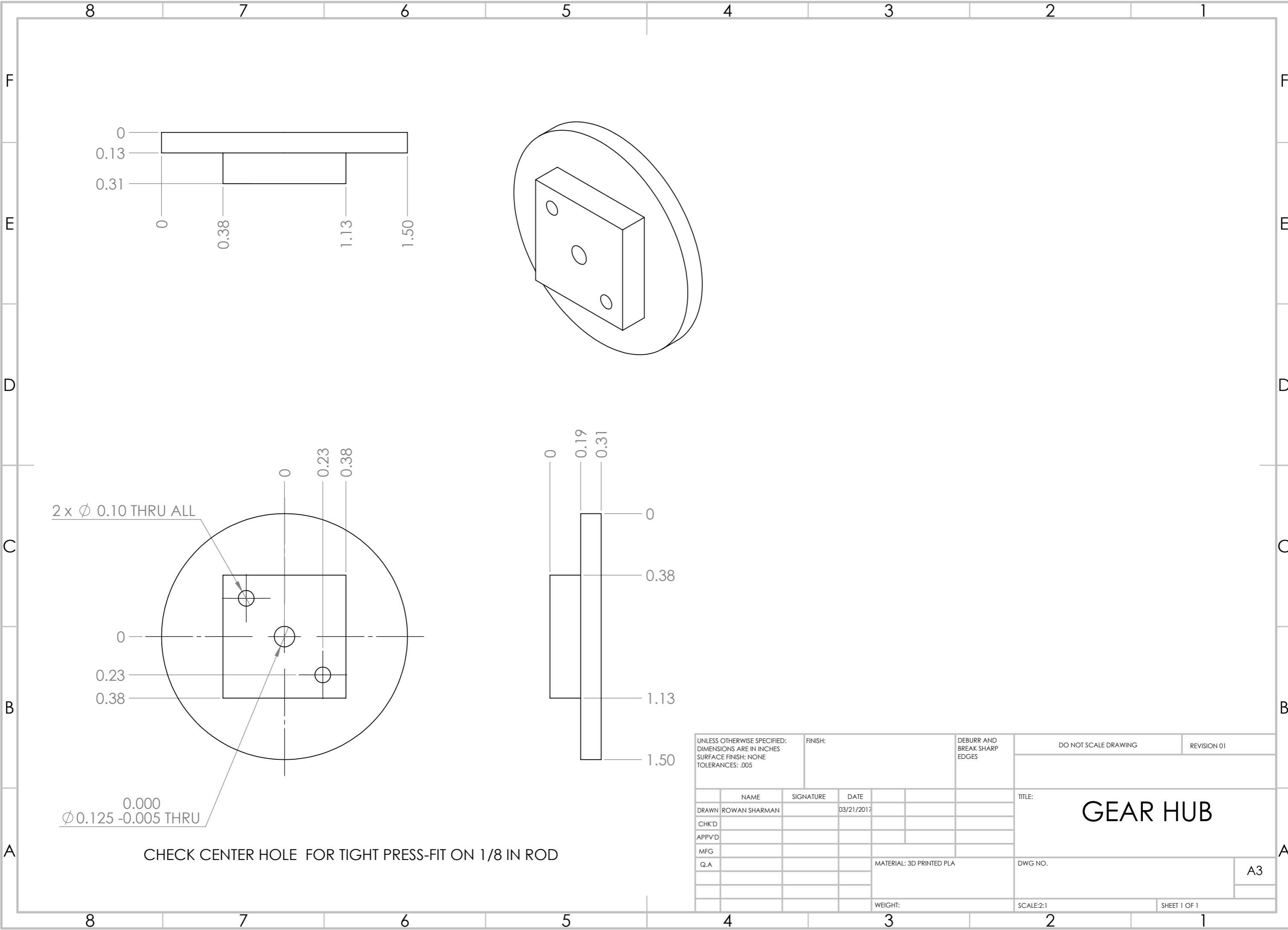
DWG NO.

A3

WEIGHT:

SCALE:1:2

SHEET 1 OF 1



2 x ϕ 0.10 THRU ALL

ϕ 0.125 -0.005 THRU

CHECK CENTER HOLE FOR TIGHT PRESS-FIT ON 1/8 IN ROD

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES SURFACE FINISH: NONE TOLERANCES: .005			FINISH:		DEBURR AND BREAK SHARP EDGES		DO NOT SCALE DRAWING		REVISION 01					
							TITLE: GEAR HUB							
DRAWN		ROWAN SHARMAN		SIGNATURE		DATE						03/21/2017		
CHK'D														
APPV'D														
MFG														
Q.A						MATERIAL: 3D PRINTED PLA		DWG NO.						
						WEIGHT:		SCALE:2:1		SHEET 1 OF 1				

A3