Coffee Grinder

Mechanical Engineering Design 1

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EML3005

EML3005 Design Report

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I. Introduction

COFFEE grinders use either blades or revolving abrasive surfaces to prepare roasted coffee beans into grinds. The first United States patent for a coffee grinder was filed in 1798 by Thomas Bruff [1]. Grinders like this were hand powered. These became obsolete with the introduction of electric coffee grinders to the market in the early 20th century. The first electric coffee grinder patent was granted in 1916 to Hobart Manufacturing Corporation [2]. Blades were chosen for the grinding mechanism of this machine, rather than rotating burrs, to reduce the cost of the assembly. As the blades are high-wear parts, their material was chosen to be T304 steel. The housing of the unit and its grinding chamber are made of high-density polyethylene (HDPE), as this material is food safe, rigid enough to hold its form under moderate loading, and is less costly to form than other options such as metal. To adjust the fineness of the grind, three buttons are placed on the front of the unit that allow a user to grind the beans for differing amounts of time. There is also a pulse button that the user can hold to pulse grind the beans. To reduce cost, the unit has holes in the back to dissipate heat from free convection, rather than using a fan for forced convection. The unit uses standard US AC wall voltage which is then converted to DC power. The overall dimensions of the unit are 9 x 9 x 8.2 in. The overall mass of the unit is 2.9 lbm.

II. Design Description

The primary design consists of 3 assembly components – the base, grinding chamber and auxiliary containers. The base houses the motor, drivetrain and circuitry. The grinding chamber encloses the blade and holds the coffee beans as they are being ground. The auxiliary containers serve as extra storage for beans or grounds. An exploded view of the design is appended to the end of this document.

Grinding Chamber Assembly

The grinding chamber is a cylindrical HDPE container designed to hold approximately 50 cubic inches. This is a large enough capacity for a half pound of beans with extra room in case some beans fall under the blade. The chamber has two slots cut through its base which allow it to be secured into the base by twisting it clockwise into locking pins. Beneath the chamber is a coupling shaft. This coupler is cross-shaped and accepts the male variant on the base. The shaft travels through a sealed bearing seated in the chamber. On the inside of the chamber, the blade threads onto the shaft secured by a flanged hex nut.

A. Grinding Chamber Dimensions

The more compact the design is, the cheaper it will be to store. The width and length of the grinder are determined by the base assembly; however, the total height is determined by the height of the base assembly as well as the grinding chamber. The lowest height that is generally comfortable to pour beans into is 44 in (3 2/3 ft) off the ground [3]. The standard counter height is 36 in and the distance from the bottom of the grinder base to the bottom of the grinding chamber is 4.5 in. Thus, the grinding chamber should be approximately 3.5 in (9 cm) tall. The chamber should have a volume of 50 cubic inches. Being cylindrical, the radius (r_c) of the chamber can be calculated using the volume of (V_c) and height (h_c) of the cylinder as follows:

$$r_c = \sqrt{\frac{V_c}{\pi h_c}}$$

Thus, the radius of the grinding chamber should be approximately 2 in (5 cm). The exact dimensions of the grinding chamber are summarized in its attached part drawing.

Auxiliary Containers Assembly

The auxiliary containers are designed to provide extra storage in addition to the grinding chamber. There are two removable containers, each of which holds 22 cubic inches. The combined storage is enough to carry an additional half pound of beans.

Base Assembly

The heart of the design is the base assembly. The front panel has four buttons. Three of these buttons will grind the beans for a preset amount of time when pressed: 7 seconds for coarse grounds, 12 seconds for medium, and 18 seconds for fine. This time correlates with the blade dimensions (Fig. 1-3). The fourth button will activate the grinder while it is pressed for a custom grind time. The buttons ride on a plastic guide with compression springs beneath them. When pressed the buttons are pressed, metal contacts complete a circuit to start the motor. The spring rebounds on the button when pressure is taken off to prevent the circuit from continuously running. A PCB supports the guides which the buttons slide on and facilitate the connection to the motor. The PCB is screwed into standoffs in the housing using socket head screws. The leads from the buttons lead to another PCB serving as the main junction for all electrical connections. The 3 leads in this junction PCB are the buttons, the motor, and the power source. The junction will regulate the input power and only activate the motor for the set times. The motor chosen is a 60-volt Nema 17 motor. It will run at 10,000 rpm and is connected to a drive shaft assembly via a steel hub secured with two set screws. The drive shaft assembly consists of the shaft with a flat and a 36-tooth gear. That gear drives a 12-tooth gear which is part of the main shaft assembly. Thus, a gear ratio of 1:3 is implemented, and the blade spins at 30,000 rpm. The main shaft assembly has the 12-tooth gear and a steel shaft leading up to the top of the assembly. The main shaft assembly is press fit through a sealed bearing which is seated at the top of the base. At the end of the main shaft, the male coupler is press fit on to transfer the rotary motion in the grinding chamber assembly. The HDPE base housing itself is a rectangular prism with an angled front face. This allows for a user to easily view and access the buttons and their labels. The base has holes in the back to allow for heat to dissipate by free convection. This method keeps the unit under a peak temperature of 83 degrees Fahrenheit, which is well below the melting point of HDPE. Heat transfer calculations are outlined in Appendix A. The base also has a mounting plate for the motor and standoffs for the PCBs. There are 3 guide pieces for running wires to keep them managed well. Lastly, there is a bottom lid which secures to the base with snap fits, holding the two pieces together while still allowing for the unit to be serviced.

Blade Dimensions

To choose the most appropriate blade for the coffee grinder many different parameters had to be considered. These characteristics include the blade radius from the axis of rotation, the thickness of the blade edge, the width of the blade, and the material of the blade. In order to determine the ideal blade radius and thickness an analysis was done on the blade to determine how varying these dimensions would affect the ability of the blade to cut a roasted coffee bean, the number of beans cut per revolution, and the time taken for the blade to cut a predetermined amount of coffee beans. Blade parameters were chosen based on the performance of the respective blade dimensions.

The analysis to determine these dimensions is as follows:

1. Find the force the blade imparts on the bean (F_a) using the angular velocity of the blade (ω), the tangential velocity of the blade (v_t), the blade radius (r), the mass of an individual bean (m_b), the average bean width (b_w), and the amount of time the blade acts on the bean (Δt). The time interval is found using the time it takes the blade to travel the one-tenth the width of the bean in radians. The following equations are used:

$$\Delta v_t = v_f - v_i$$

$$\Delta t = \frac{b_w}{r \cdot \omega}$$

$$F_a = m \cdot \frac{\Delta v_t}{\Delta t}$$

2. After the force the blade imparts on the bean is calculated, the number of beans the blade can cut per revolution and how long this takes needs to be calculated. This is calculated using the following equation where B_L is the number of beans per layer, A_C is the area of the container floor, b_L is the bean length, and A_B is the cross-sectional area of the bean, approximated as the width times the length of the bean:

$$B_L = \frac{A_C}{A_B} = \frac{\pi \cdot r^2}{b_w \cdot b_L}$$

This value doesn't consider the fact that there will be space between each bean that will cause this number to decrease significantly. Using the assumption that between 2 beans there were approximately 2 beans worth of area, the beans per layer was approximated using the following equation where AB_L is the approximate beans per layer:

$$AB_L = \frac{B_L}{2}$$

3. Now to determine the number of beans that are cut per revolution the following parameters are needed: stresses each bean experiences, number of sectors of beans in a given layer, number of beans per sector, the number of blades, and the probability of the blade not cutting the bean. The stresses each bean experiences (σ_b) at varying blade thickness and radii were calculated using the following equation where δ is the blade thickness, F_a is the impulse force on each bean, and b_L is the bean width.

$$\sigma_b = \frac{F_a}{b_L \cdot \delta}$$

4. The number of sectors was found by taking the area of the container divided by the sector area at a given bean radian value. The number of beans per sector was found by dividing the beans per layer by the number of sectors. Before the number of beans cut per revolution can be found, the number of beans experiencing higher stress than the UTS of the average coffee bean 1needs to be considered. This is found using the following equation where A_f is the area of the beans in the container that experience sufficient stress, A_0 is the area of the container where the beans do not experience sufficient stress, r is the radius of the blade, δ is the thickness of the blade, S is the number of sectors per layer, R_c is the number of beans cut per revolution, B_N is the number of blades, and B_s is the number of beans per sector.

$$R_c = B_N \cdot B_s \cdot \frac{S}{8} \cdot \left(1 - \frac{A_f}{A_0}\right)$$

The number of sectors is divided by 8 due to the beans pushing each other and the chance of the blade not cutting the bean (even if it is in A_f). The number of sectors each blade is assumed to cut is 1 out of every 8.

5. With this information, the number of revolutions taken to grind a cup of beans at a given setting can be found (R_T). Each bean grind type has a corresponding particle size. The number of revolutions needed to just cut a bean is determined by the following equation where R is the number of revolutions, X is the target particle size; a

coefficient of 0.8 is used, assuming that each blade interaction cuts 20% off the bean.

$$X = 0.8^R$$

This value is now used along with the number of layers (L), number of beans per layer B_L, and the number of beans cut per revolution R_c. The equation is as follows:

$$R_T = \frac{L \cdot B_L \cdot R}{R_c}$$

6. The time in seconds it takes for each grind type to be complete is found using the following equation where T_i is the time it takes for a specified grind type (i = 1,2,3,4), ω is the angular velocity of the blade, and C_T is the time for the coffee beans to transition to the bottom layer depending on the grind type. This is assumed to be 0.5 seconds, 1 second, and 2 seconds for a coarse grind, medium grind, and fine grind, respectively.

$$T_i = \frac{R_T}{\omega} + (L \cdot C_T)$$

Based on these calculations, the time taken to grind a cup of coffee at varying coffee ground particle size are shown in graphs below.

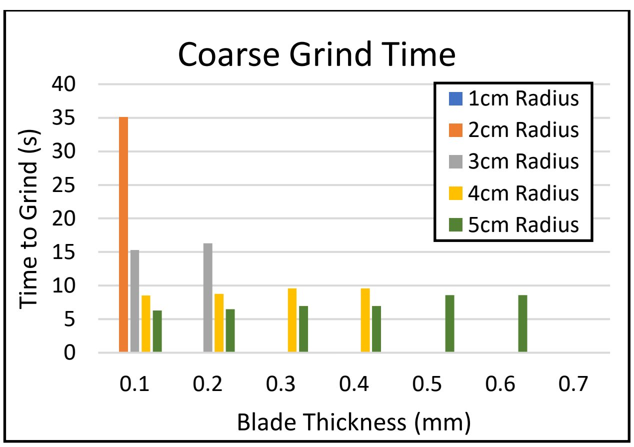

Figure 1: Time taken to for each blade thickness and blade radius to grind a cup of coarse coffee beans.

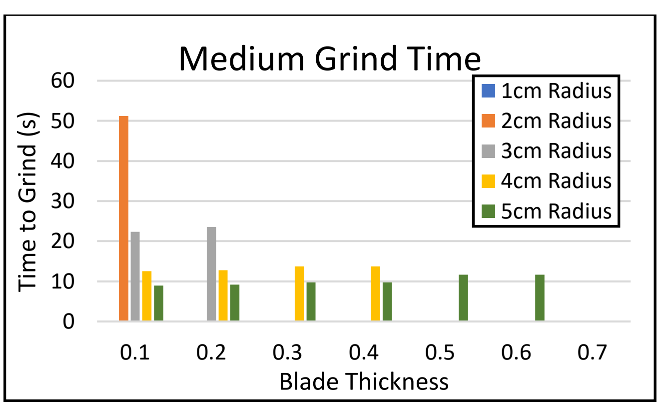

Figure 2: Time taken for each blade thickness and blade radius to perform a medium grind for a cup of coffee beans.

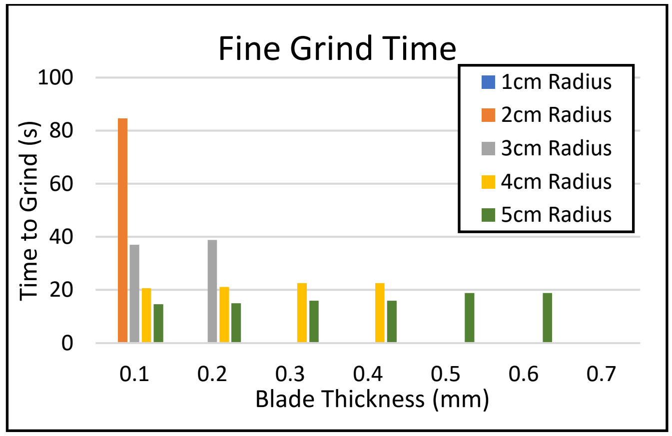

Figure 3: Time it taken for each blade thickness and blade radius to perform a fine grind on a cup of coffee beans.

The results illustrate that a 1cm blade could not produce the necessary stresses to grind the beans. The radius of the grinding chamber is approximately 5cm, so the blade radius chosen is 5cm. The thickness of the blade edge was determined by time it took to grind a cup of coffee and the industry standard thickness of a knife blade. The standard kitchen blade is 0.35mm to 0.5mm [4]. Given this range and the fact that we are using the 5cm radius blade the optimal blade thickness is 0.5mm. The blade thickness and radius that will result in all the beans being grinded in a short span time are 0.5mm and 5cm respectively.

The blade width is not a critical value for grind time, but it needs to be chosen to fit the dimensions of the container. The blade width chosen for the determined blade thickness and radius was 1cm.

Blade Material

The process for selecting the material of the blade is dependent on how fatigue resistant it can be, the cost, and the manufacturability. The material that was chosen was T304 Stainless Steel due to its resistance to high cyclic stresses and its cheap cost. Another material that was considered was T409. T304 Stainless Steel is a better option than T409 Stainless Steel due to its better finish, durability, and lower surface corrosion [5]. T304 Stainless Steel is the commonly used for products involving food contact which also contributes to the choice [6].

III. Mechanical & Kinematic Analysis

The RPM of our blade is calculated from the input RPM from the motor and the gear ratio used. The equation is as follows:

$$RPM_{Out} = \frac{RPM_{in}}{GR}$$

where RPM_{Out} is the resulting RPM of the blade, RPM_{in} is the input motor RPM, and GR is the gear ratio of the system.

The input rpm is 10,000 rev/min and the gear ratio is 1:3 so the rpm of the blade is 30,000 rpm. The tangential velocity of the blade at its radius can be found using the following relation where r is the radius of the blade and v_t is the tangential velocity of the blade.

$$v_t = RPM_{Out} \cdot r$$

To determine the torque of the motor, the manufacturer's speed and torque curves were used and can be seen below.

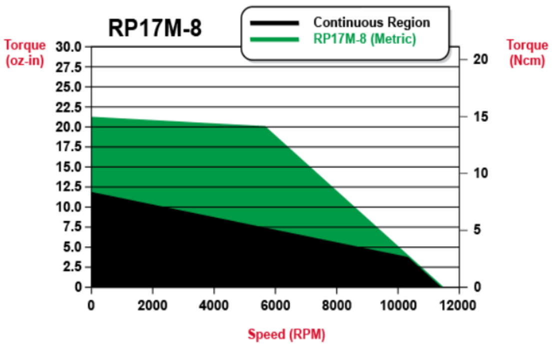

Figure 4: RP17M-8 Speed/Torque Curves [7]

Thus, the torque for a speed of 10,000 rpm is approximately 2.5 N·cm (Fig. 4). The transfer of torque from the motor to the blade can be found using the input torque of the motor and the gear ratio. The following equation describes the transfer of torque where T_O is the output torque, T_{in} is the input torque, and GR is the gear ratio.

$$GR = \frac{T_O}{T_{in}}$$

$$T_O = GR \cdot T_{in}$$

From this analysis, the resulting torque is calculated as approximately 0.83 $N \cdot cm$.

The operating power (P) of this blade grinder can then be determined using the flowing calculation:

$$P = T_O \cdot RPM_{out}$$

The resulting power of the blade grinder is approximately 26.2 W. The wattage is conserved no matter what torques or rpms are used to conservation of energy. The only factor not considered is that the wattage isn't linear due to the different operating efficiencies for rpm and torque at varying values.

IV. Static Failure Analysis

The static failure analysis of the coffee grinder is studying the structural integrity of our coffee grinder in the most extreme scenario. The top of the grinder base was analyzed to determine if the static stresses from the weight of the unit it would cause any yielding. As a worst-case scenario, the entire weight of the unit, plus 1/2 lb of coffee beans, minus the weight of the motor, was modeled on the top of the grinder. A FEA analysis was used to compute the max stress this part would endure as depicted in Fig. 5. Failure will be determined by using Tresca's Criterion because this failure theory is useful for ductile materials such as the HDPE we used in our coffee grinder design. Tresca predicts failure when the maximum shear stress recorded is greater than one-half the yield stress of the material so failure in our coffee grinder will follow the same analysis.

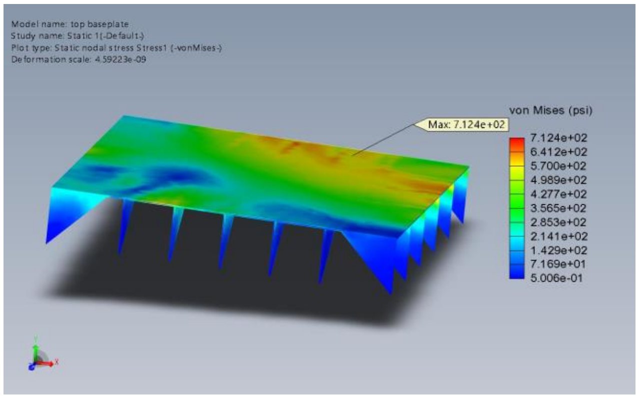

Figure 5: The stress concentrations on the top baseplate of the grinder computed in Solidworks® Simulations.

The grinder base is composed of HDPE and the maximum stress it was subjected to was 4.9 MPa. The yield strength of HDPE is 23MPa at room temperature. Thus, the grinder bade will not fail, with a factor of safety of 4.7.

The second critical component of the coffee grinder is the motor mount, which is part of the HDPE base. The motor base is constantly subjected to the weight of the motor. The motor base is connected to the motor body and acts as a cantilever beam with a fixed end. The FEA analysis is displayed below:

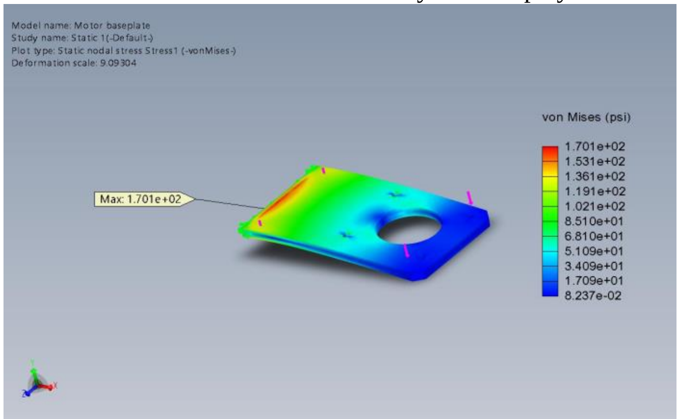

Figure 6: The stress concentrations on the motor mount. The maximum stress is a tensile stress acting at the interface of the motor mount and the motor body.

The maximum stress that the motor mount is subjected to is a tensile stress of 1.17 MPa. This illustrates that the part will not fail due to the mounting of the motor with a factor of safety of 20.

V. Fatigue Analysis

Fatigue analysis on the coffee grinder was conducted to determine the longevity of the coffee grinder for consistent use. The coffee grinder component that was analyzed was the blade of the grinder since it is exposed to the highest cyclic stress. The fatigue analysis was focused on two distinct parts of the blade: the blade-shaft interface, and the area where the bean contacts the blade.

The analysis on the shaft and blade interface determines whether the part will fail at this section. To determine the cycles to failure the Goodman Failure Equation is used:

$$\frac{\sigma_a}{\sigma_N} + \frac{\sigma_m}{\sigma_{UTS}} = 1$$

Where σ_a is the stress amplitude, σ_m is the mean stress, σ_{UTS} is the ultimate tensile stress, and σ_N is the fatigue stress.

The mean stress is the centripetal force acting on the blade interface and the stress amplitude is the max bending stress from impact with the coffee beans. The mean stress at the base of the blade can be determined by dividing the centripetal force by the interface cross-sectional area. The stress amplitude is taken as the bending stress (σ_b) using the following equation where I is the moment of inertia about the neutral axis, M is the maximum bending moment, and y is the distance from the neutral axis to the moment arm.

$$\sigma_b = \frac{M \cdot y}{I}$$

The moment is calculated by treating the blade as a cantilever beam that is being acted on by a uniformly increasing distributed load due to beans impacting the blade at various radii. The equation for the maximum moment is as follows where P is the applied load, and r is the radius at which the load was applied.

$$M_{MAX} = \frac{P \cdot r^2}{3}$$

The resulting fatigue stress for the 5cm radius blade was 0.174 MPa. The S-N curve for T304 steel is used to find the corresponding cycles to failure at this failure stress. The S-N curve for T304 stainless steel is shown below.

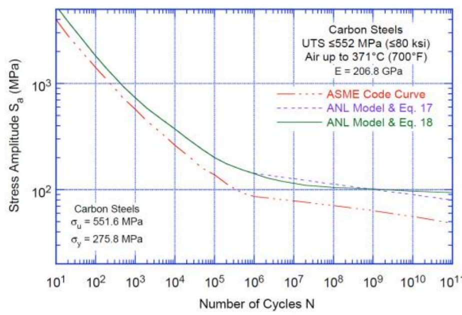

Figure 7: The SN curve of T304 Stainless Steel [8]

Using this S-N curve it can be seen that the failure stress is well below the endurance limit so in theory this part will never fail due to the cyclic stresses. In reality, this part will fail due to microplasticity, the analysis of which is outside of the scope of this project.

The fatigue due to the impacts of the beans on the blade can also be analyzed using essentially the same method. The only difference is that the mean stress acting at those points can be determined from the average stress that acts on the blade for one whole revolution. The stress that the blade experiences per bean is the force applied divided by the contact area which is the blade thickness times the bean width. The stress per revolution can be found then by multiplying the number of beans cut per revolution by the stress per revolution. This comes out to approximately 100MPa. This is the fatigue stress since the other stresses on the blade are negligible at this area, so the cycles to failure is approximately 10^9.

To find the life in units of years that the coffee grinder can run for different grind types, the cycles to failure is divided by the number cycles taken for each respective grind type, then, assuming different use cases, this is converted into years. Below is a table of different lifetimes for different usage scenarios:

Coffee Grind Type	Coarse Every Day	Medium Every Day	Fine Every Day	Each Grind Type Every Day
Time (Years)	12.81	9.01	5.50	1.94

It can be seen that using the specified blade radius and thickness of 5cm and 0.5mm respectively, the longevity this coffee grinder provides makes it suitable for several different usages. If a single cup of coarse grinds are produced every day, this coffee grinder provides about 13 years of service.

VI. Part List & Production Costs

The parts and assemblies used in the design are listed below. Parts are numbered P-XXX; assemblies are labeled A-XXX. Parts labeled OTS are off-the-shelf parts.

Item No.	Part No.	Name	Quantity
0	A-000	Coffee Grinder	1
1	A-001	Base Assembly	1
2	A-002	Grinding Chamber Assembly	1
3	A-003	Auxiliary Containers Assembly	1
4	A-004	Drive Shaft Assembly	1
5	A-005	Main Shaft Assembly	1
6	P-001	Grinding Chamber Lid	1
7	OTS-001	10-24 Hex Flange Nut	1
8	P-002	Blade	1
9	P-003	Grinding Chamber	1
10	OTS-002	3/16" Sealed Ball Bearing	2
11	P-004	Female Coupler	1
12	P-005	Base	1
13	P-006	Button	4
14	P-007	Buttons PCB	1

Item No.	Part No.	Name	Quantity
15	P-008	Junction PCB	1
16	P-009	Wire Guide	3
17	P-010	Bottom Lid	1
18	OTS-003	3/8" Compression Spring	4
19	P-011	Wall Cable	1
20	OTS-004	Nema 17 Motor	1
21	P-012	Male Coupler	1
22	P-013	Drive Shaft Hub	1
23	OTS-005	3-48 x 1/4" Socket Head Screw	6
24	OTS-006	5-40 x 1/4" Set Screw	2
25	OTS-007	M3x0.5mm x 4mm Socket Head Screw	4
26	P-014	Drive Shaft	1
27	P-015	Main Shaft	1
28	P-016	Auxiliary Container Lid	2
29	P-017	Auxiliary Container	2
30	OTS-008	24 Pitch 36 Tooth Gear	1
31	OTS-009	24 Pitch 12 Tooth Gear	1

Table 1: Bill of Materials

Item	Unit Cost	Quantity	Total
Shell Mold	$23,920	2	$47,839
Bean Storage Mold	$5,425	2	$10,849
Grounds Storage Mold	$13,549	1	$13,549
Stamping Service	$3,000	1	$3,000
Grind Chamber Lid Mold	$11,631	1	$11,631
Storage Lid Mold	$10,671	1	$10,671
Grand Total			$97,539

Table 2: Initial Cost Analysis

Injection molding will be used to fabricate the plastic parts used in the coffee grinder. These include the base, the auxiliary containers, and container lids. To ensure longevity for high-volume production, the molds will be made from steel. Steel molds are more difficult to form and more expensive than 3D printed plastic molds or aluminum molds, but fatigue slower than others. This allows them to keep consistent tolerances over time, ensuring higher-quality production. Since steel molds last longer than plastic or aluminum molds, they can be treated as one-time expenses, so overall manufacturing cost will decrease as more models are made. Manufacturing a mold for the housing would be considered medium difficulty due to its shape, which is why a mold for each half of the housing costs significantly more than either of the storage molds.

After costs for manufacturing molds are factored for, the next highest cost comes from manufacturing the grinder blade. T304 stainless sheet steel was chosen because it is food safe, fatigue resistant, and widely available. To refine the blades to be ready for manufacturing, they must be stamped and sanded to sharpen. Cost data from [9] shows that the average cost for a “simple” operation would cost approximately $2,500 initially. Since the blade requires additional forming after being cut from the sheet, an estimate of $3,000 per operation was used. After the blade is formed, it must be sharpened via wide belt sanding, which is commonly used to sharpen knives and blades.

In addition to manufacturing the blades using an external source, the shafts and hubs will be produced by a machine shop. Large-scale production metal parts are manufactured via CNC milling by this method. The shafts will be extruded then machined from round steel bar stock. The main shaft will not require additional machining beyond the standard cylindrical shape, but the drive shaft will require machining into a D shaft, which has one end partially or totally machined into a flat. This is used to provide a more secure base for set screws to be in contact with. The female coupler will need to be machined to add threads. Shafts will be manufactured rather than purchased OTS since this design requires specific shaft geometry, especially regarding the drive shaft.

Cost data for fasteners, shafts, the motor, and other OTS parts is not provided, as their individual costs would be negligible compared to initial costs for manufacturing the molds and stamping operations.

APPENDIX A: HEAT DISSIPATION CALCULATION

The motor chosen for this design is the RP17M, which operates at 60V and 26 Watts. The continuous rated current is 0.6 amps. The equivalent resistance is 4 ohms. Given the dimensions of the motor, the approximate surface area of convection is 6.9 * 10^{-3} m^2 [10]. The heat generated by the running motor in watts (q) can be calculated using the resistance in ohms (R) and the continuous current (I) as follows:

$$q = I^2R$$

By this formula, the heat generated by the running motor is 1.44 watts. If the motor is left running and heat is dissipated by free convection until a steady-state temperature is reached, the steady-state temperature of the motor in Celsius (T_s) can be calculated using the motor surface area in m^2 (A), the ambient temperature in Celsius (T_a), and the convection heat transfer coefficient in W/(m^2K) (h) as follows:

$$T_s = \frac{q}{hA} + T_a$$

The convection heat transfer coefficient between the steel body of the motor and the air can be assumed to be 25.32W/(m^2K) [10]. Room temperature can be assumed to be 20 degrees Celsius. Thus, the steady-state temperature of the motor can be calculated to be 28 degrees Celsius or 83 degrees Fahrenheit.

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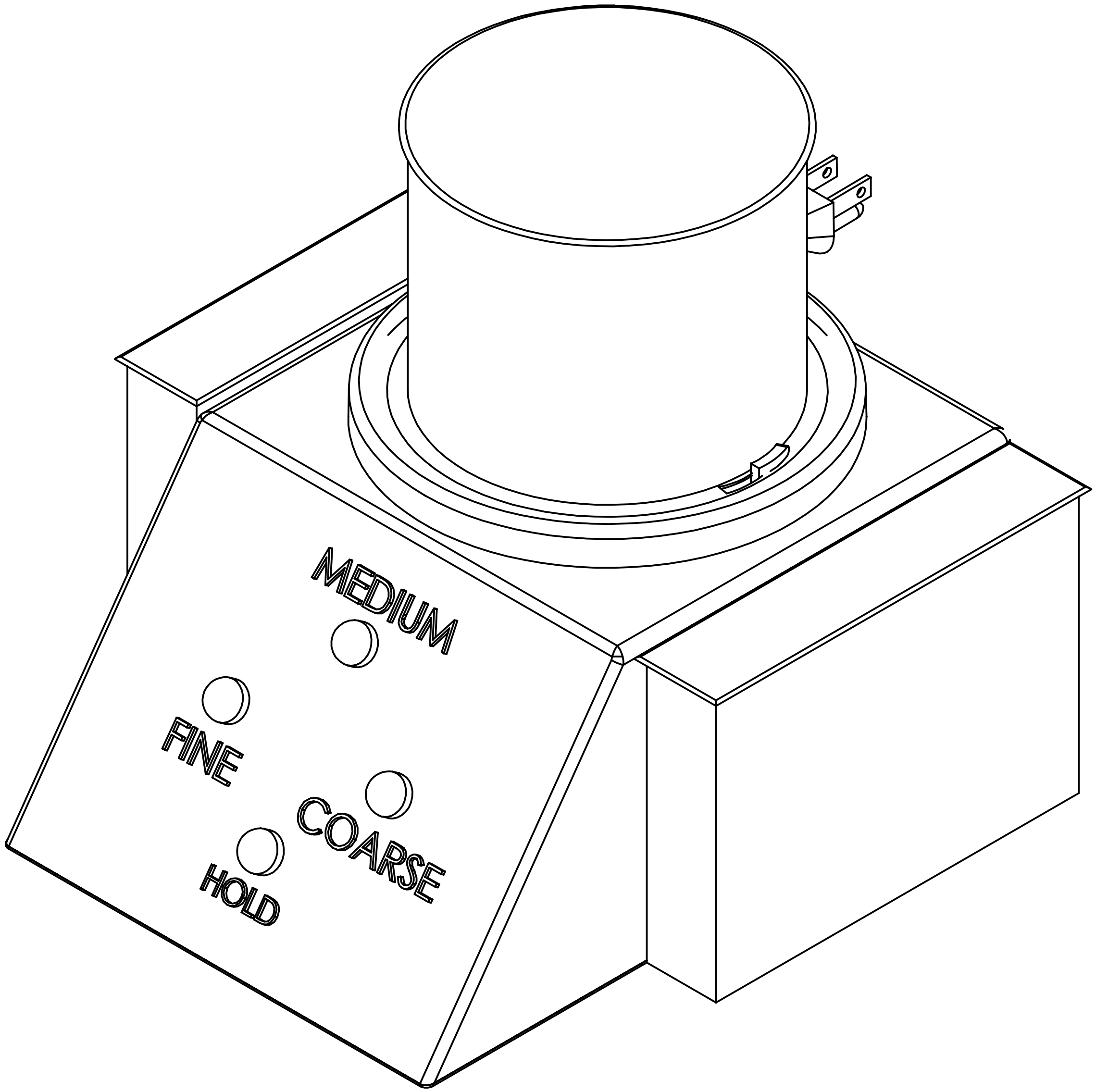


NOTES:
1. DIMS IN INCHES
2. QTY: 1

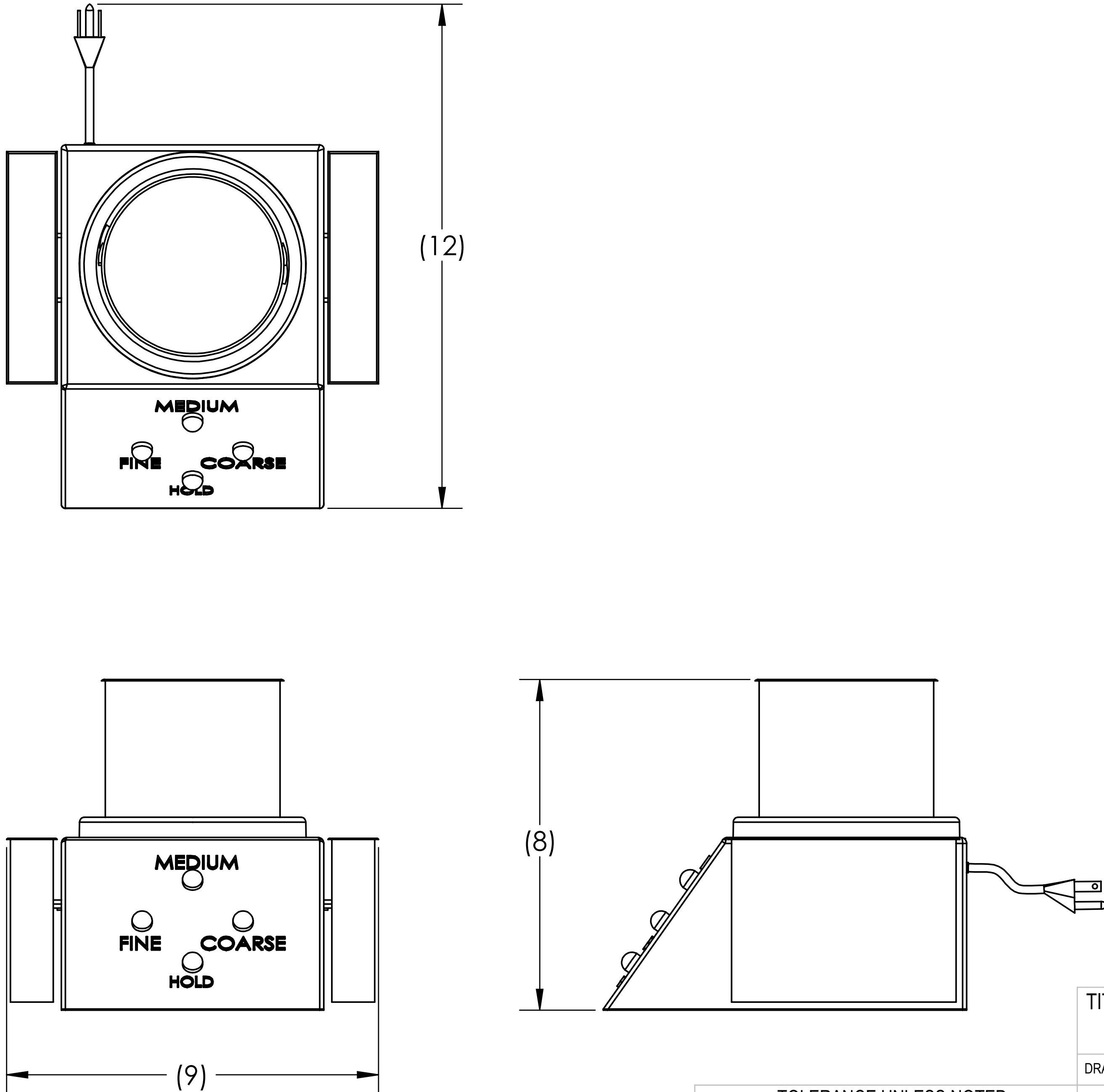
TITLE: COFFEE GRINDER ASSEMBLY

DRAWN	JOHN FAIELLA
DESIGNED	JOHN FAIELLA

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	A-000	A
SCALE: 1:2		SHEET 1 OF 3

5 4 3 2 1



NOTES:
1. DIMS IN INCHES
2. QTY: 1

TITLE:
COFFEE GRINDER ASSEMBLY

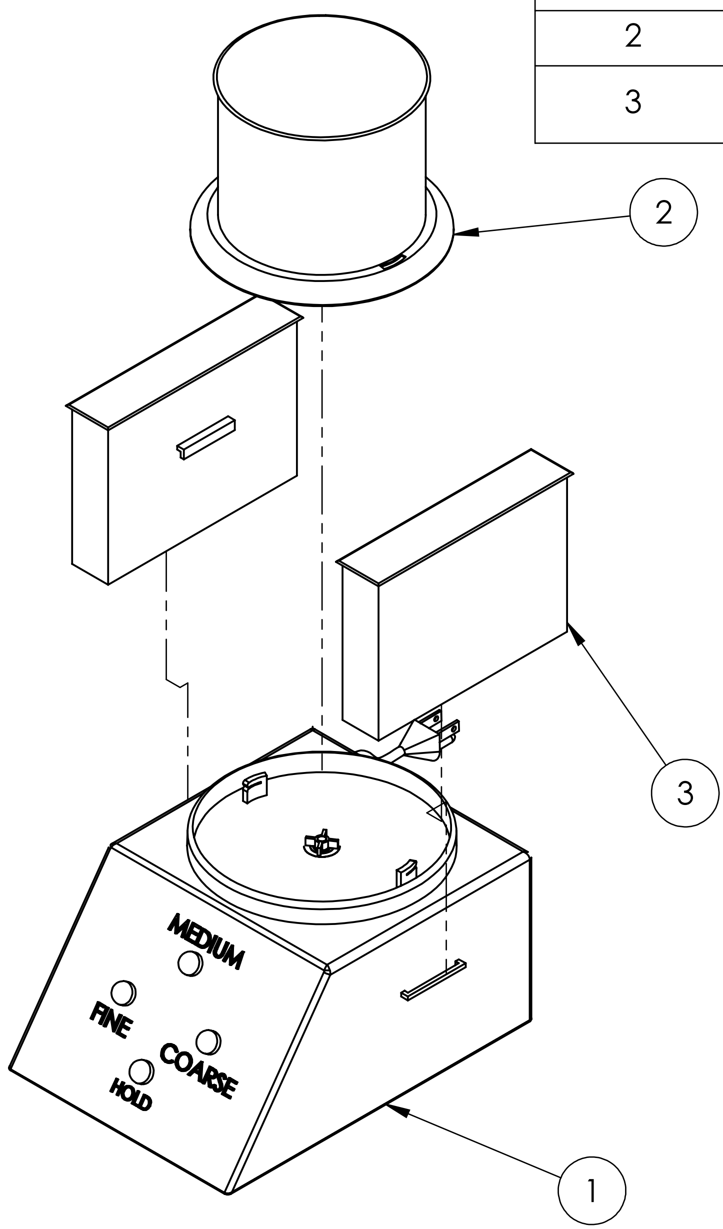
DRAWN	JOHN FAIELLA
DESIGNED	JOHN FAIELLA

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	A-000	A
SCALE: 1:4		SHEET 2 OF 3

5 4 3 2 1

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	A-001	Base Assembly	1
2	A-002	Grinding Chamber Assembly	1
3	A-003	Auxiliary Containers Assembly	1

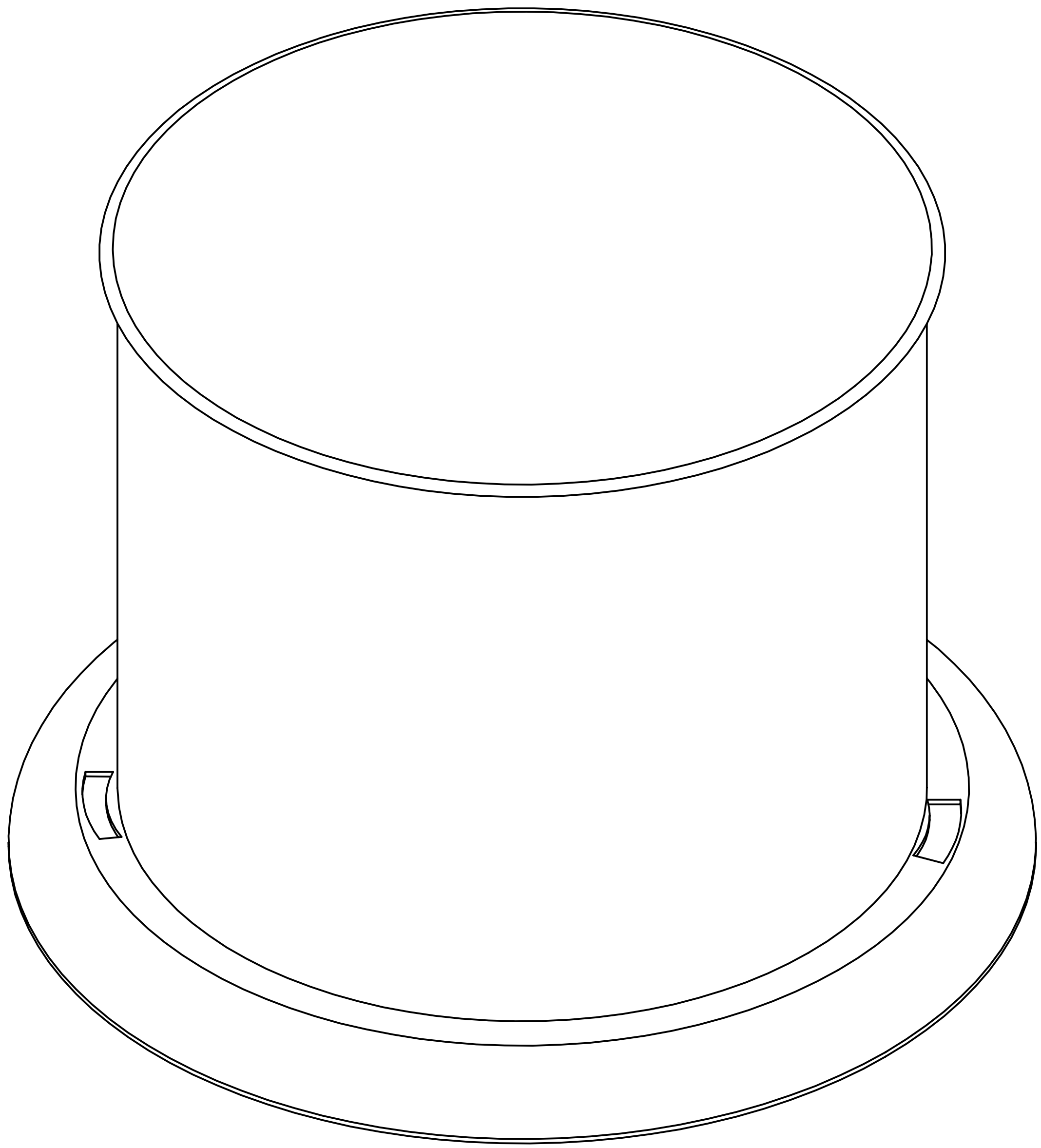


NOTES:
1. DIMS IN INCHES
2. QTY: 1

TITLE:	COFFEE GRINDER ASSEMBLY
DRAWN	JOHN FAIELLA
DESIGNED	JOHN FAIELLA
SIZE A	DWG. NO. A-000
REV	A
SCALE: 1:4	SHEET 3 OF 3

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

5 4 3 2 1



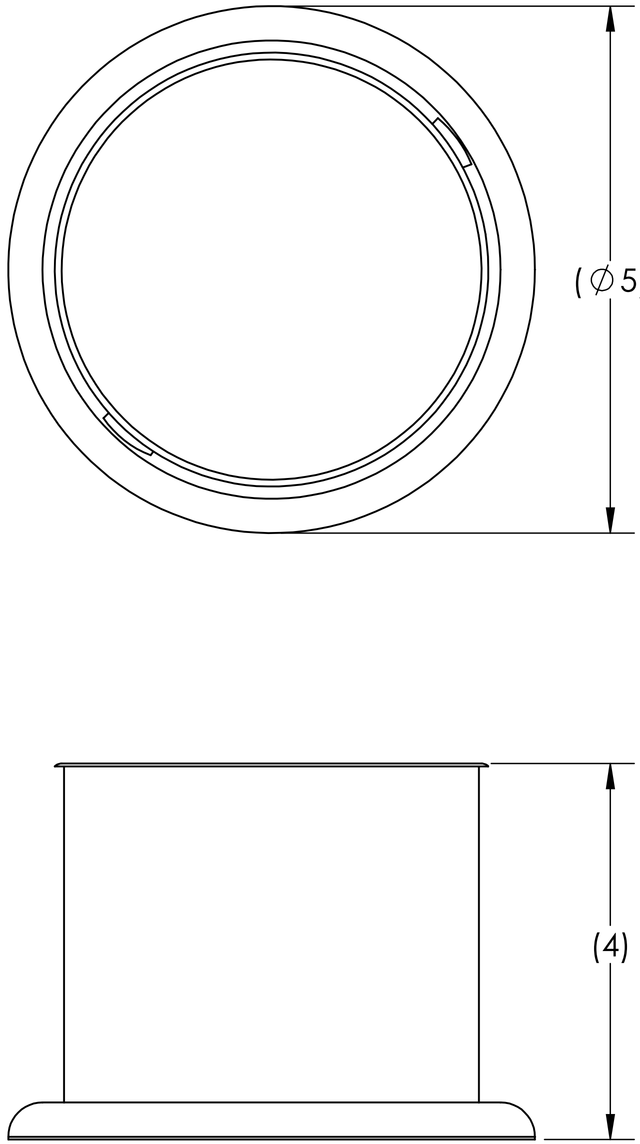
NOTES:
1. DIMS IN INCHES
2. QTY: 1

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:
GRINDING CHAMBER ASSEMBLY

DRAWN	JOHN FAIELLA	
DESIGNED	JOHN FAIELLA	
SIZE A	DWG. NO. A-002	REV A
SCALE: 1:1		SHEET 1 OF 3

5 4 3 2 1

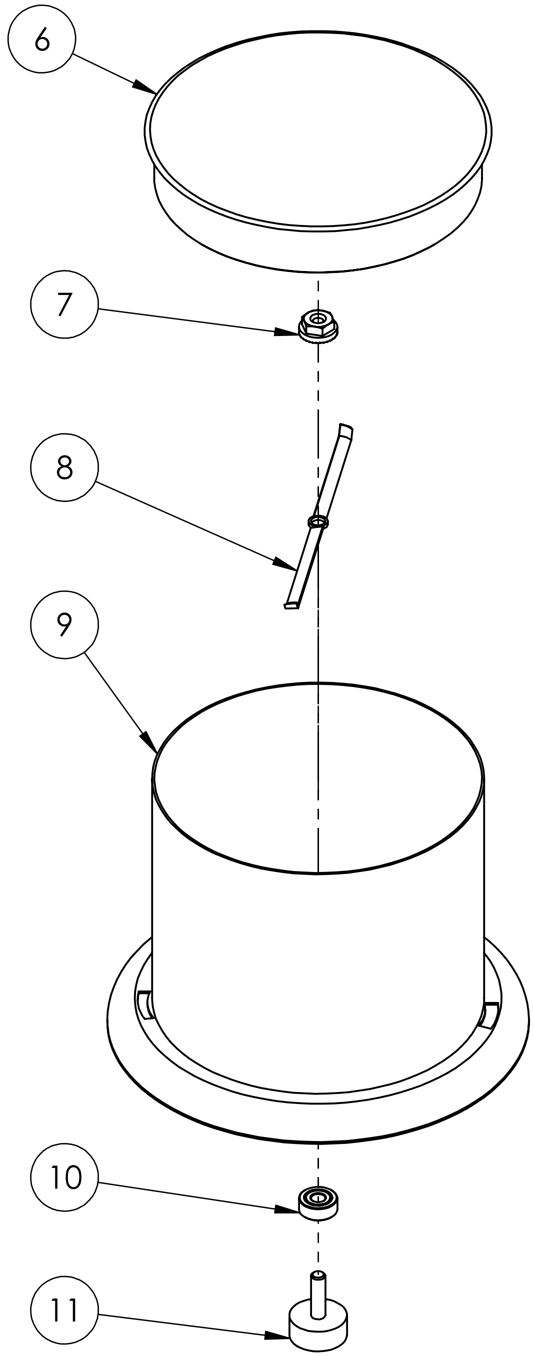


NOTES:
1. DIMS IN INCHES
2. QTY: 1

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: GRINDING CHAMBER ASSEMBLY			
DRAWN	JOHN FAIELLA		
DESIGNED	JOHN FAIELLA		
SIZE A	DWG. NO. A-002		REV A
SCALE: 1:2		SHEET 2 OF 3	

5 4 3 2 1



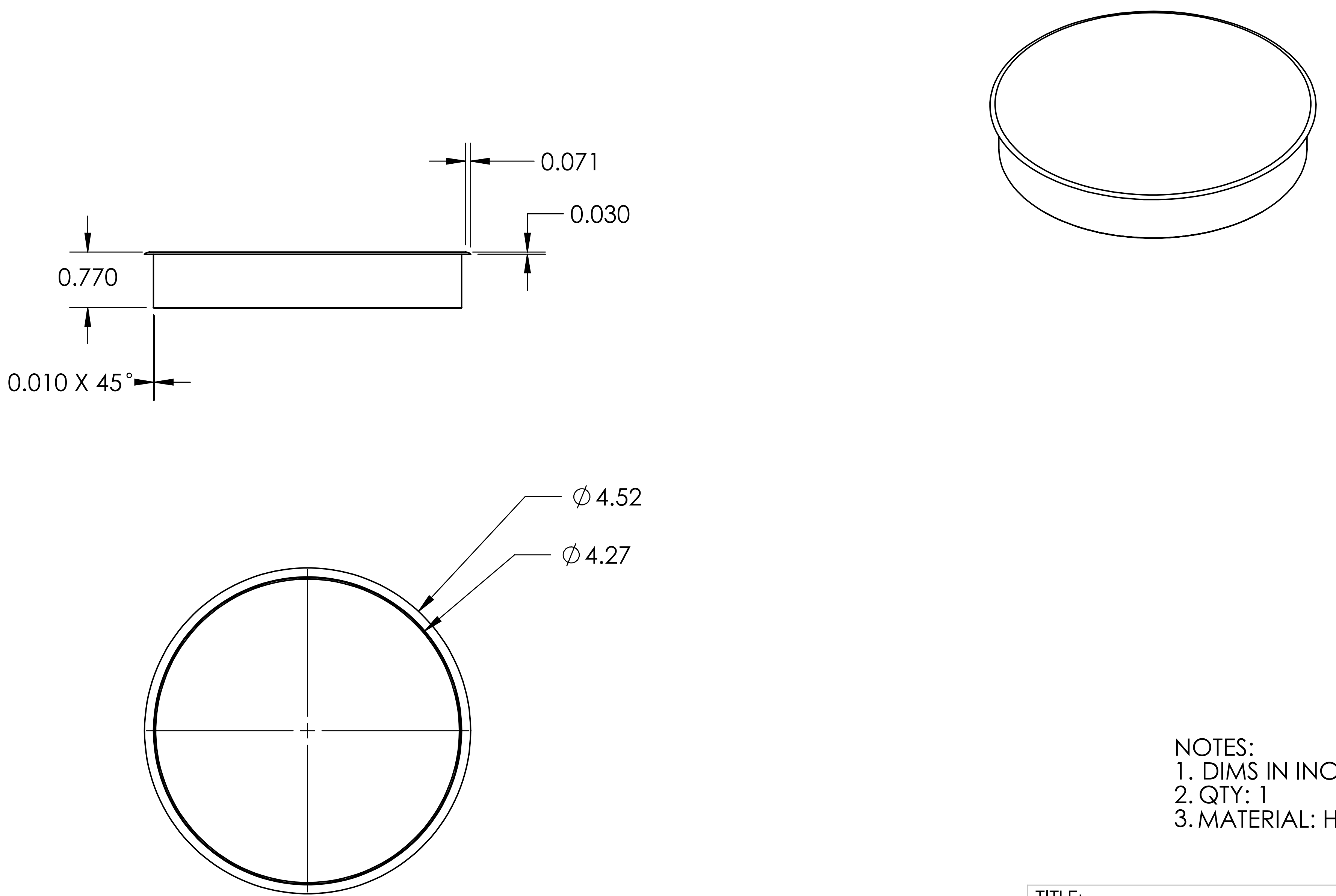
ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
6	P-001	Grinding Chamber Lid	1
7	OTS-001	10-32 Flanged Hex Nut	1
8	P-002	Grinding Blade	1
9	P-003	Grinding Chamber	1
10	OTS-002	3/16" Ball Bearing	1
11	P-004	Female Coupler	1

NOTES:
1. DIMS IN INCHES
2. QTY: 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:	GRINDING CHAMBER ASSEMBLY
DRAWN	JOHN FAIELLA
DESIGNED	JOHN FAIELLA
SIZE	A
DWG. NO.	A-002
REV	A
SCALE: 1:2.5	SHEET 3 OF 3

5 4 3 2 1

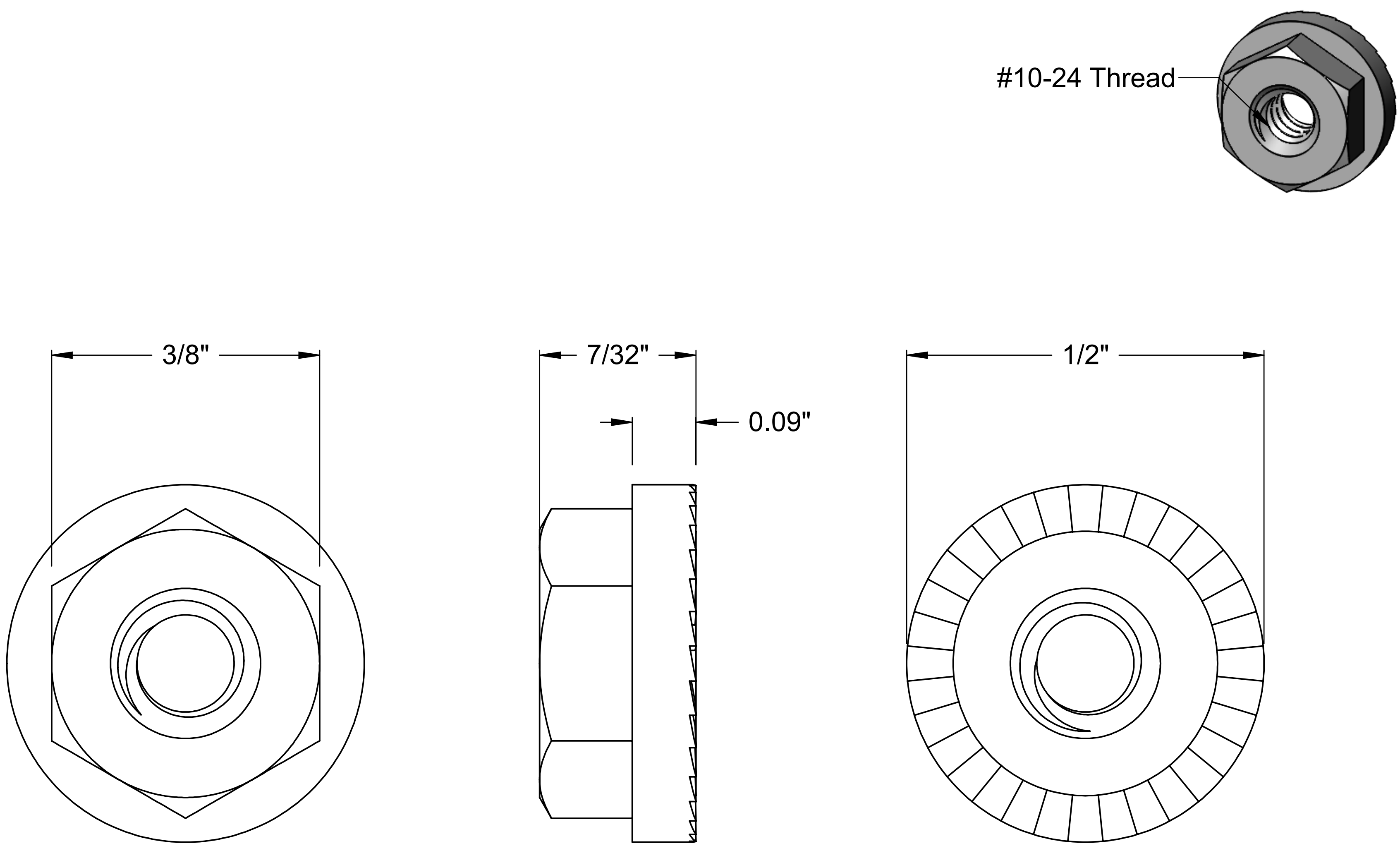


NOTES:
1. DIMS IN INCHES
2. QTY: 1
3. MATERIAL: HDPE

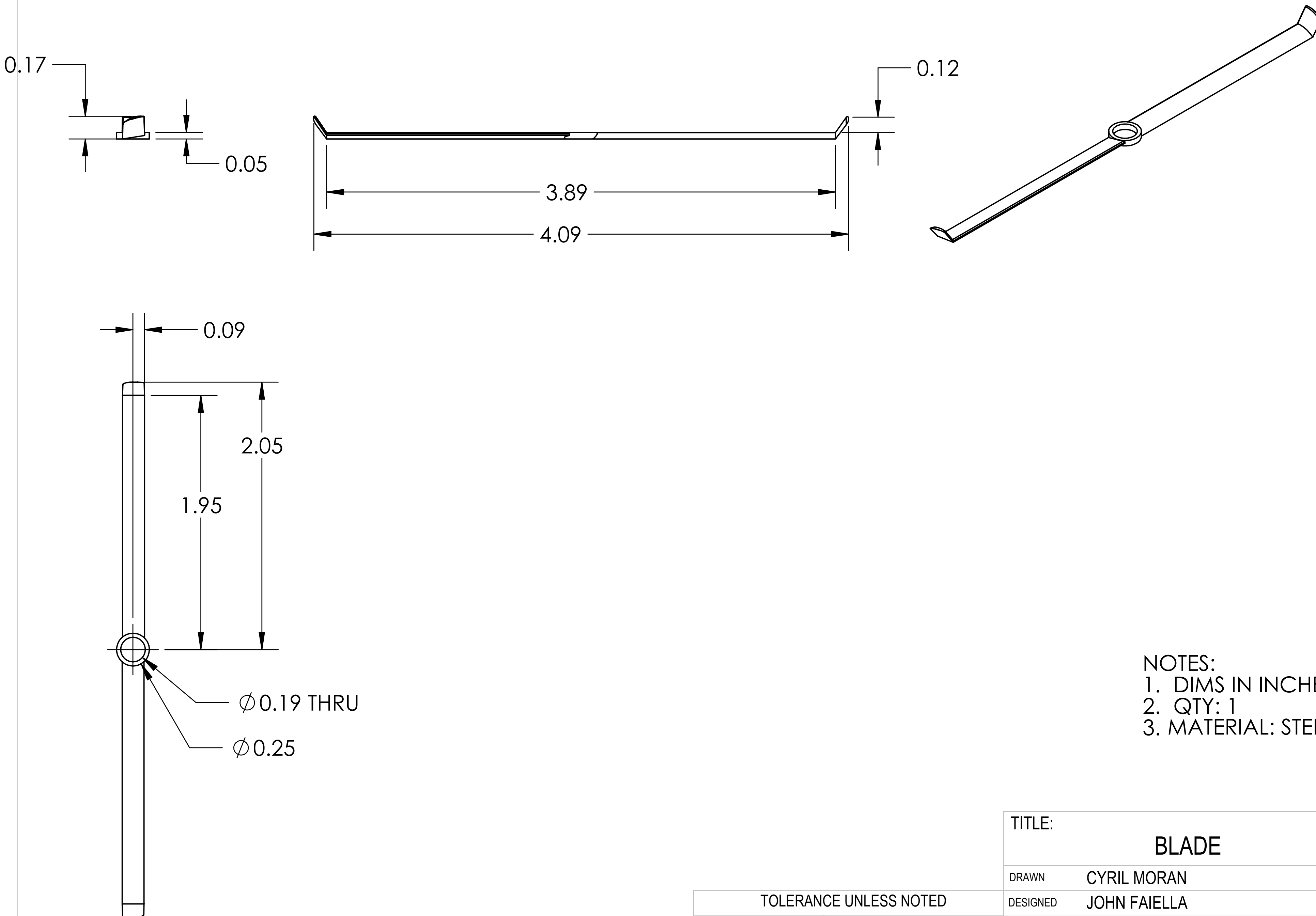
TOLERANCE UNLESS NOTED			
DIMENSION TYPE	PLACES IN DIMENSION		
	0.0	0.00	0.000
LOCATIONAL	±0.050	±0.020	±0.005
ANGULAR	±5	±2	±0.5

TITLE:	GRINDING CHAMBER LID
DRAWN	CYRIL MORAN
DESIGNED	JOHN FAIELLA
SIZE	A
DWG. NO.	P-001
REV	A
SCALE:	1:2
SHEET 1 OF 1	

5 4 3 2 1



PART NUMBER	**OTS-001**
10-24 Hex Flange Nut	

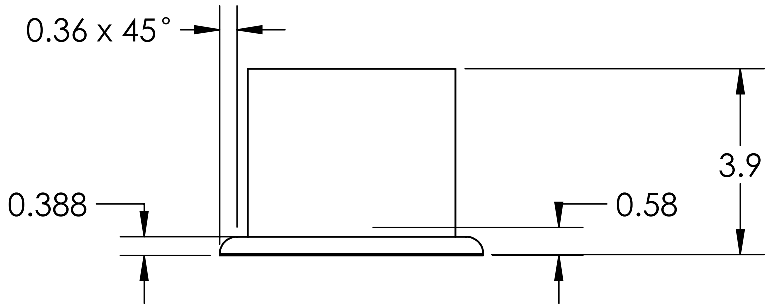


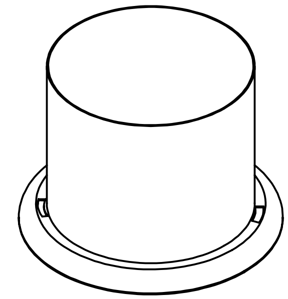
NOTES:
1. DIMS IN INCHES
2. QTY: 1
3. MATERIAL: STEEL

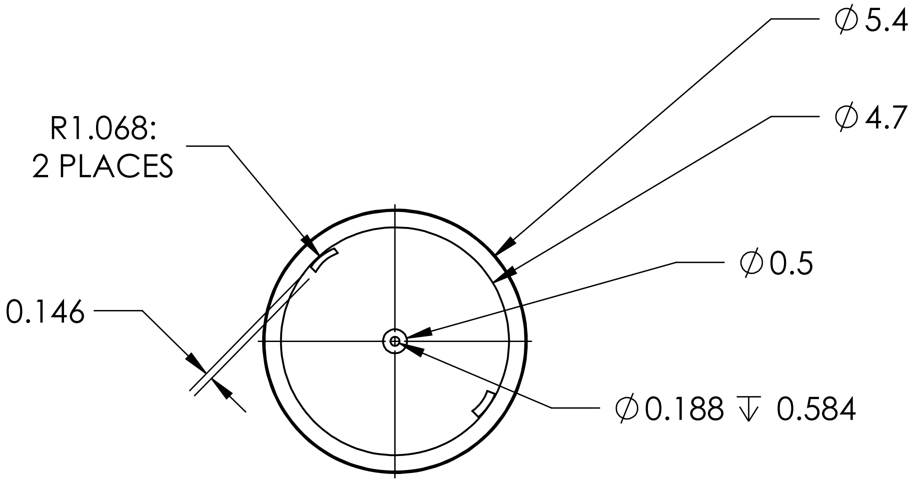
TOLERANCE UNLESS NOTED			
DIMENSION TYPE	PLACES IN DIMENSION		
	0.0	0.00	0.000
LOCATIONAL	±0.050	±0.020	±0.005
ANGULAR	±5	±2	±0.5

TITLE:	BLADE
DRAWN	CYRIL MORAN
DESIGNED	JOHN FAIELLA
SIZE	A
DWG. NO.	P-002
REV	A
SCALE:	1:1
SHEET 1 OF 1	

5 4 3 2 1





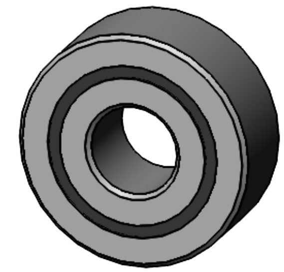


NOTES:
1. DIMS IN INCHES
2. QTY: 1
3. MATERIAL: HDPE

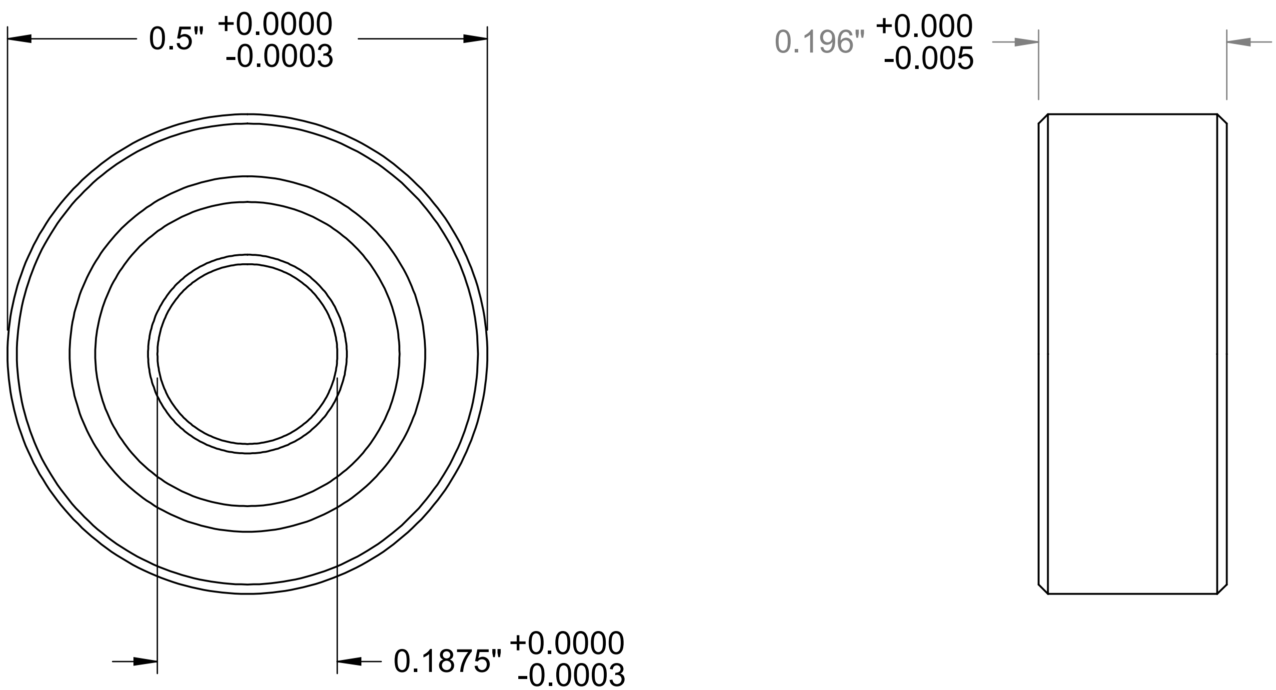
TOLERANCE UNLESS NOTED			
DIMENSION TYPE	PLACES IN DIMENSION		
	0.0	0.00	0.000
LOCATIONAL	±0.050	±0.020	±0.005
ANGULAR	±5	±2	±0.5

TITLE:	GRINDING CHAMBER
DRAWN	CYRIL MORAN
DESIGNED	JOHN FAIELLA
SIZE	A
DWG. NO.	P-003
REV	A
SCALE:	1:4
SHEET 1 OF 1	

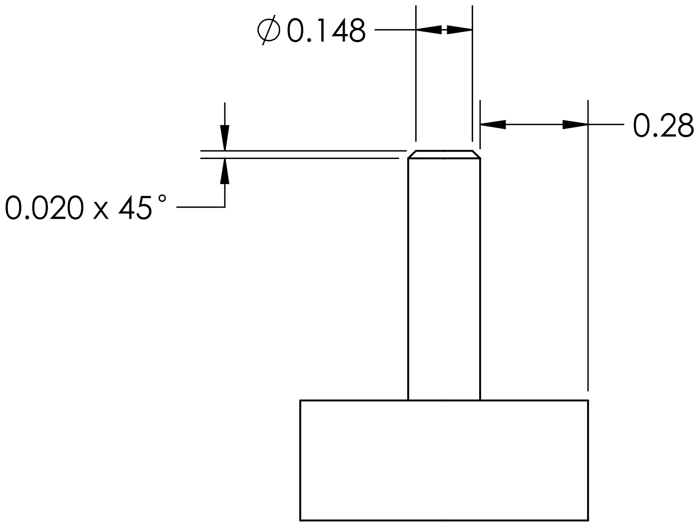
5 4 3 2 1

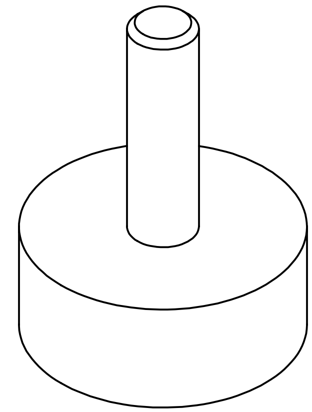


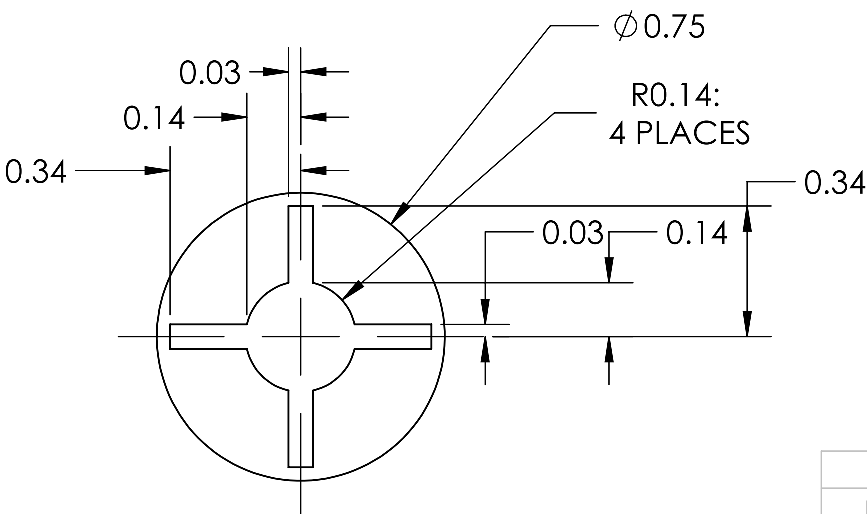
Trade Number: R3-2RS



PART NUMBER	OTS-002
3/16" Sealed Ball Bearing	





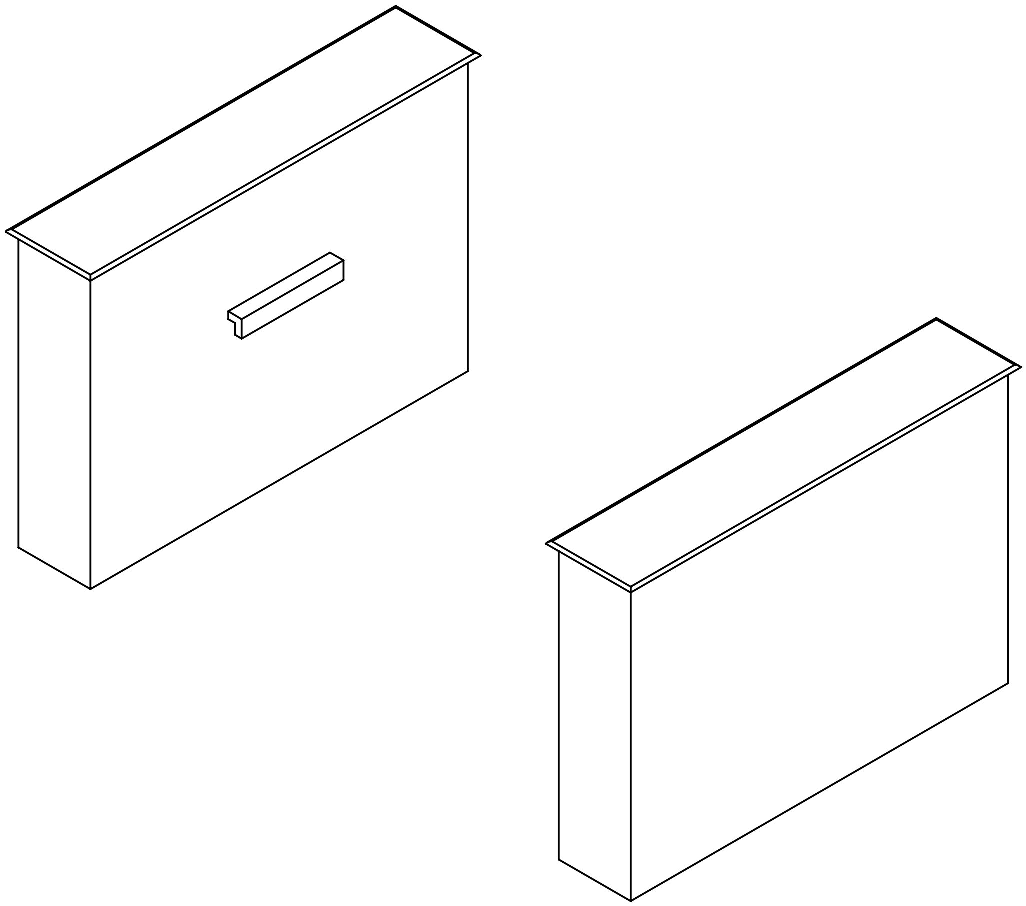


NOTES:
1. ALL DIMS IN INCHES
2. QTY: 1
3. MATERIAL: STEEL

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: FEMALE COUPLER			
DRAWN	CYRIL MORAN		
DESIGNED	JOHN FAIELLA		
SIZE A	DWG. NO. P-004		REV A
SCALE: 2:1		SHEET 1 OF 1	

5 4 3 2 1



NOTES:
1. DIMS IN INCHES
2. QTY: 1

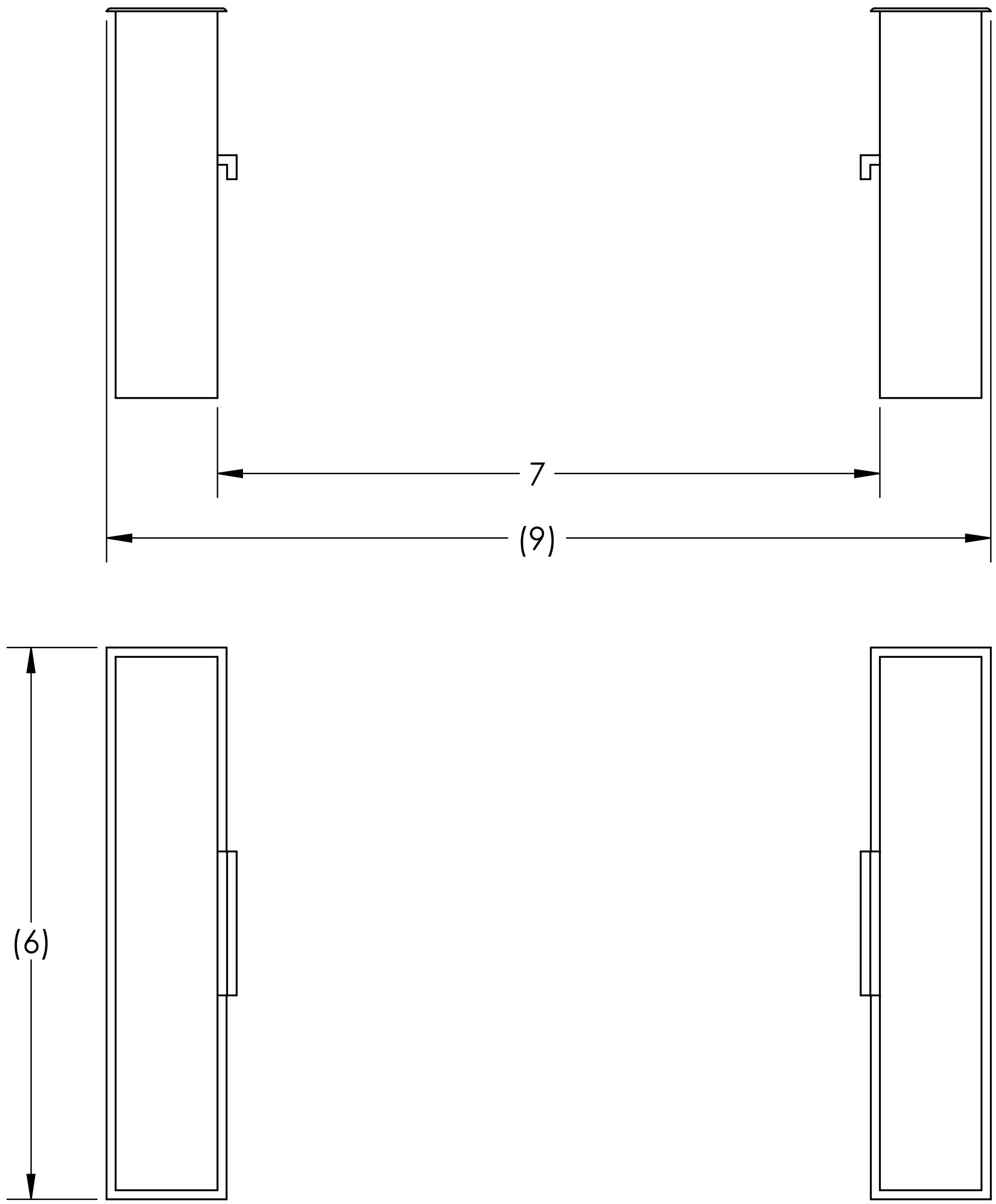
TOLERANCE UNLESS NOTED			
DIMENSION TYPE	PLACES IN DIMENSION		
	0.0	0.00	0.000
LOCATIONAL	±0.050	±0.020	±0.005
ANGULAR	±5	±2	±0.5

TITLE:
AUXILIARY CONTAINERS ASSEMBLY

DRAWN	JOHN FAIELLA
DESIGNED	JOHN FAIELLA

SIZE	DWG. NO.	REV
A	A-003	A
SCALE: 1:2		SHEET 1 OF 3

5 4 3 2 1



NOTES:
1. DIMS IN INCHES
2. QTY: 1

TITLE:
AUXILIARY CONTAINERS ASSEMBLY

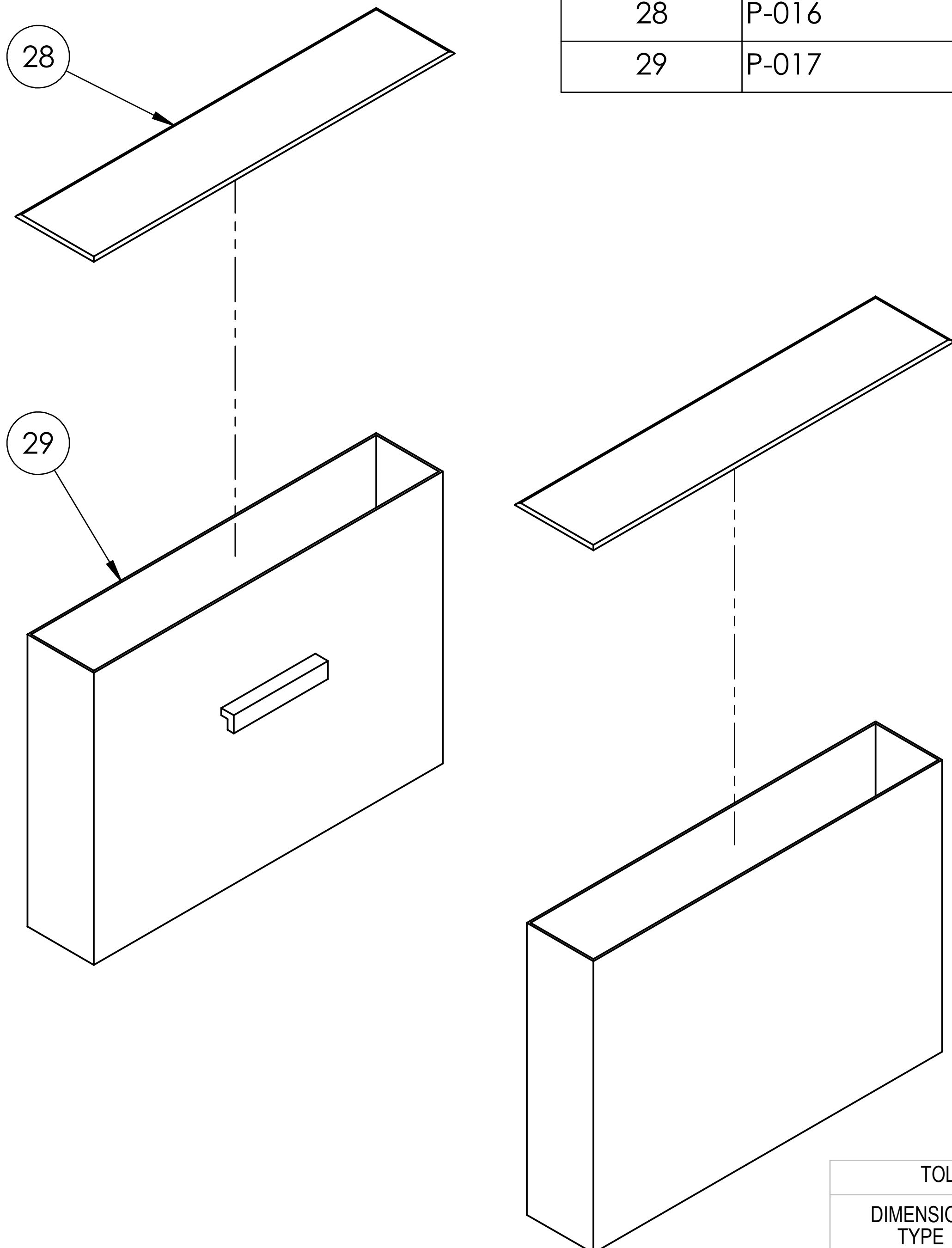
DRAWN	JOHN FAIELLA
DESIGNED	JOHN FAIELLA

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	A-003	A
SCALE: 1:2		SHEET 2 OF 3

5 4 3 2 1

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
28	P-016	Auxiliary Container Lid	2
29	P-017	Auxiliary Container	2



NOTES:
1. DIMS IN INCHES
2. QTY: 1

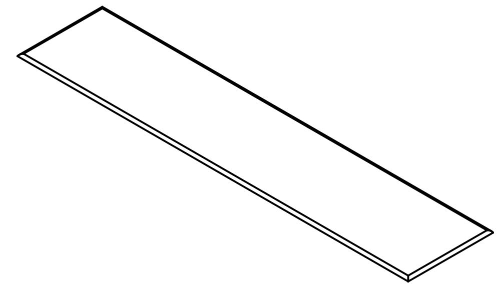
TOLERANCE UNLESS NOTED			
DIMENSION TYPE	PLACES IN DIMENSION		
	0.0	0.00	0.000
LOCATIONAL	±0.050	±0.020	±0.005
ANGULAR	±5	±2	±0.5

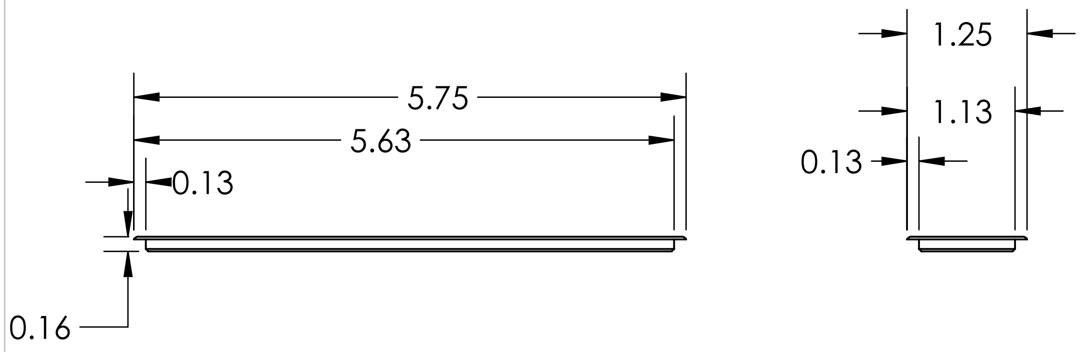
TITLE: AUXILIARY CONTAINERS ASSEMBLY

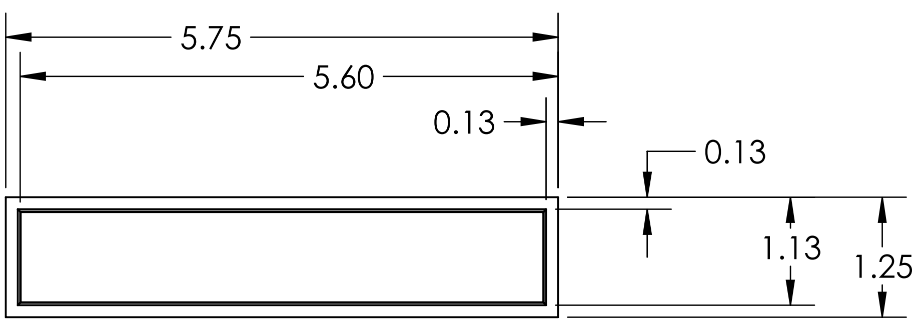
DRAWN	JOHN FAIELLA
DESIGNED	JOHN FAIELLA

SIZE	DWG. NO.	REV
A	A-003	A
SCALE: 1:2		SHEET 3 OF 3

5 4 3 2 1







NOTES:
1. DIMS IN INCHES
2. QTY: 1
3. MATERIAL: HDPE

TITLE: AUXILARY CONTAINER LID

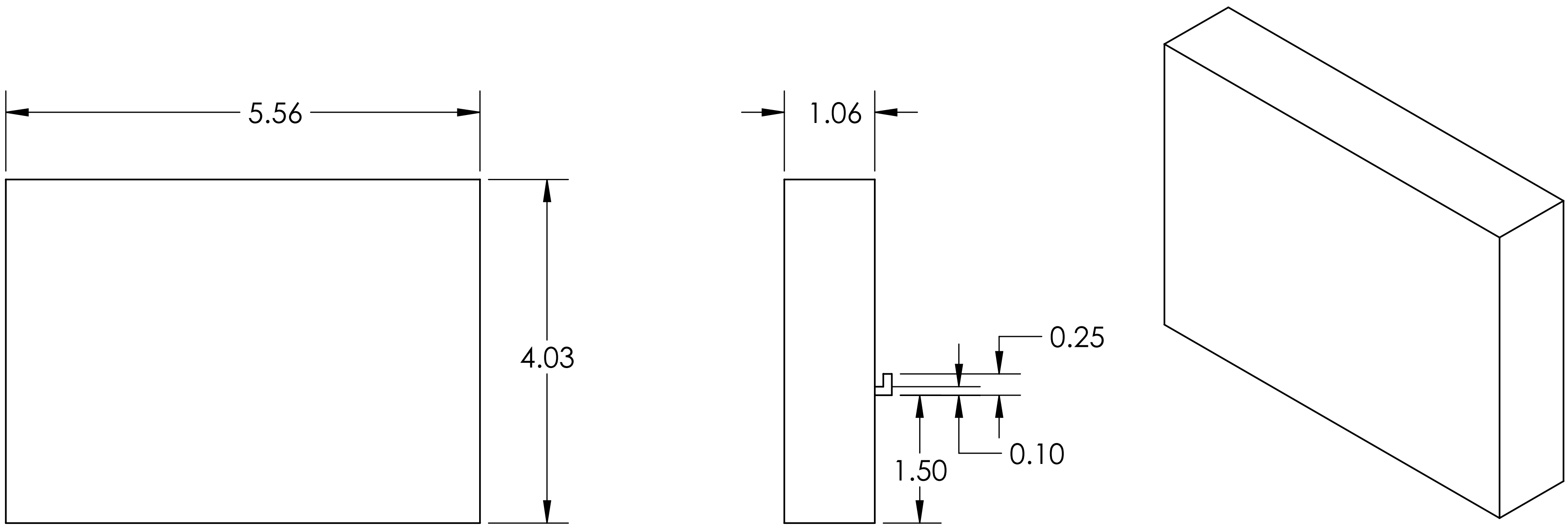
DRAWN CYRIL MORAN

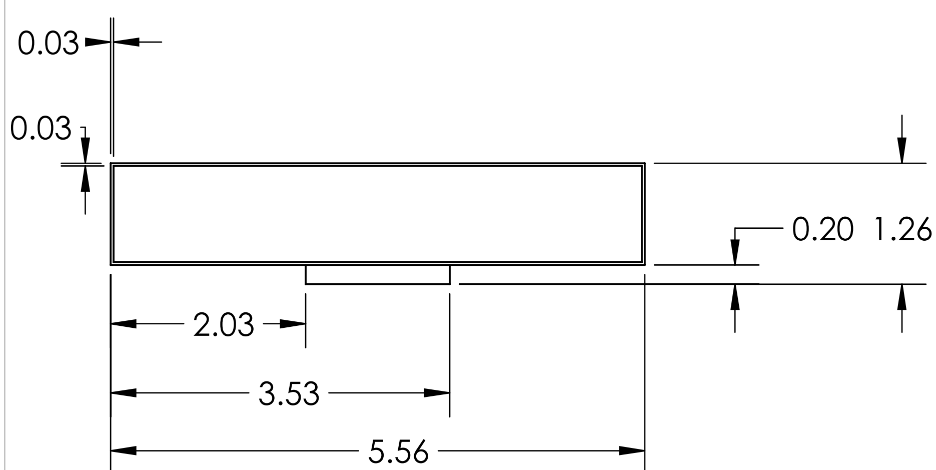
DESIGNED JOHN FAIELLA

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	P-016	A
SCALE: 1:2		SHEET 1 OF 1

5 4 3 2 1



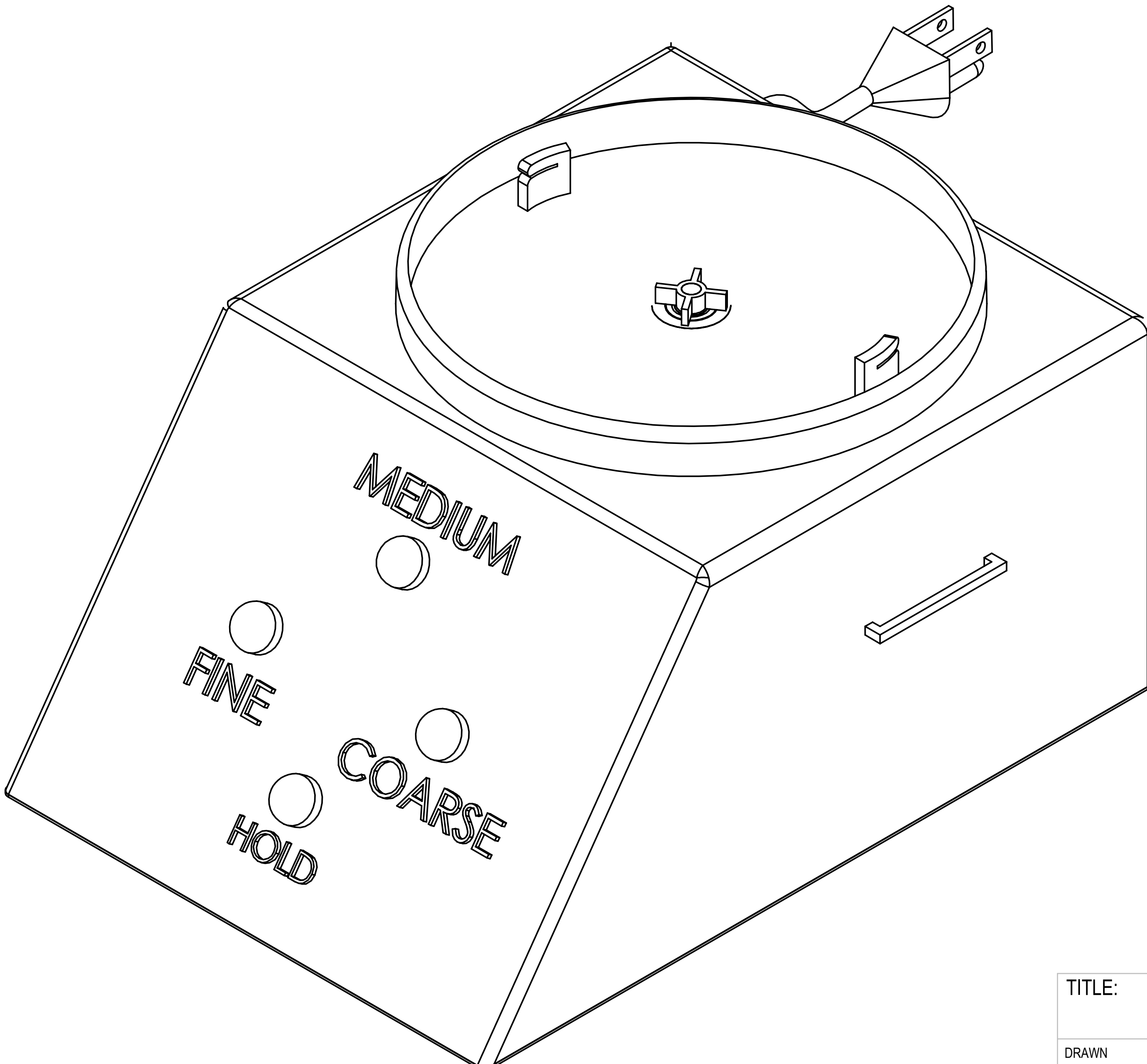


NOTES:
1. DIMS IN INCHES
2. QTY: 1
3. MATERIAL: HDPE

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: AUXILIARY CONTAINER		
DRAWN	CYRIL MORAN	
DESIGNED	JOHN FAIELLA	
SIZE: A	DWG. NO.: P-017	REV: A
SCALE: 1:2		SHEET 1 OF 1

5 4 3 2 1

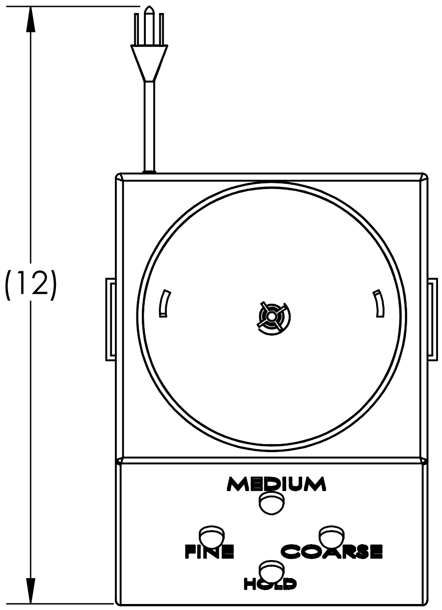


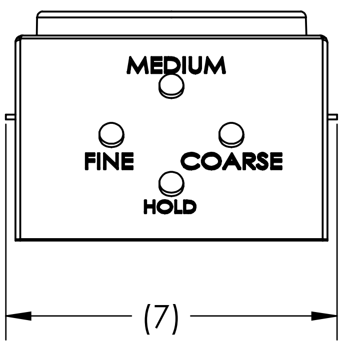
NOTES:
1. DIMS IN INCHES
2. QTY: 1

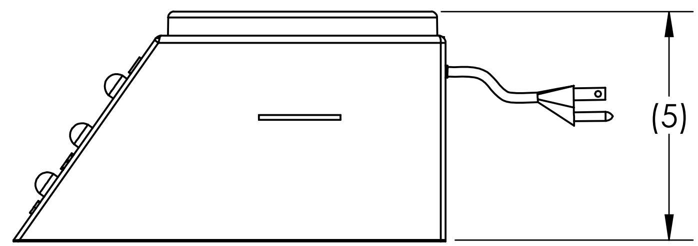
TOLERANCE UNLESS NOTED			
DIMENSION TYPE	PLACES IN DIMENSION		
	0.0	0.00	0.000
LOCATIONAL	±0.050	±0.020	±0.005
ANGULAR	±5	±2	±0.5

TITLE: BASE ASSEMBLY		
DRAWN	JOHN FAIELLA	
DESIGNED	JOHN FAIELLA	
SIZE A	DWG. NO. A-001	REV A
SCALE: 1:1.5		SHEET 1 OF 4

5 4 3 2 1





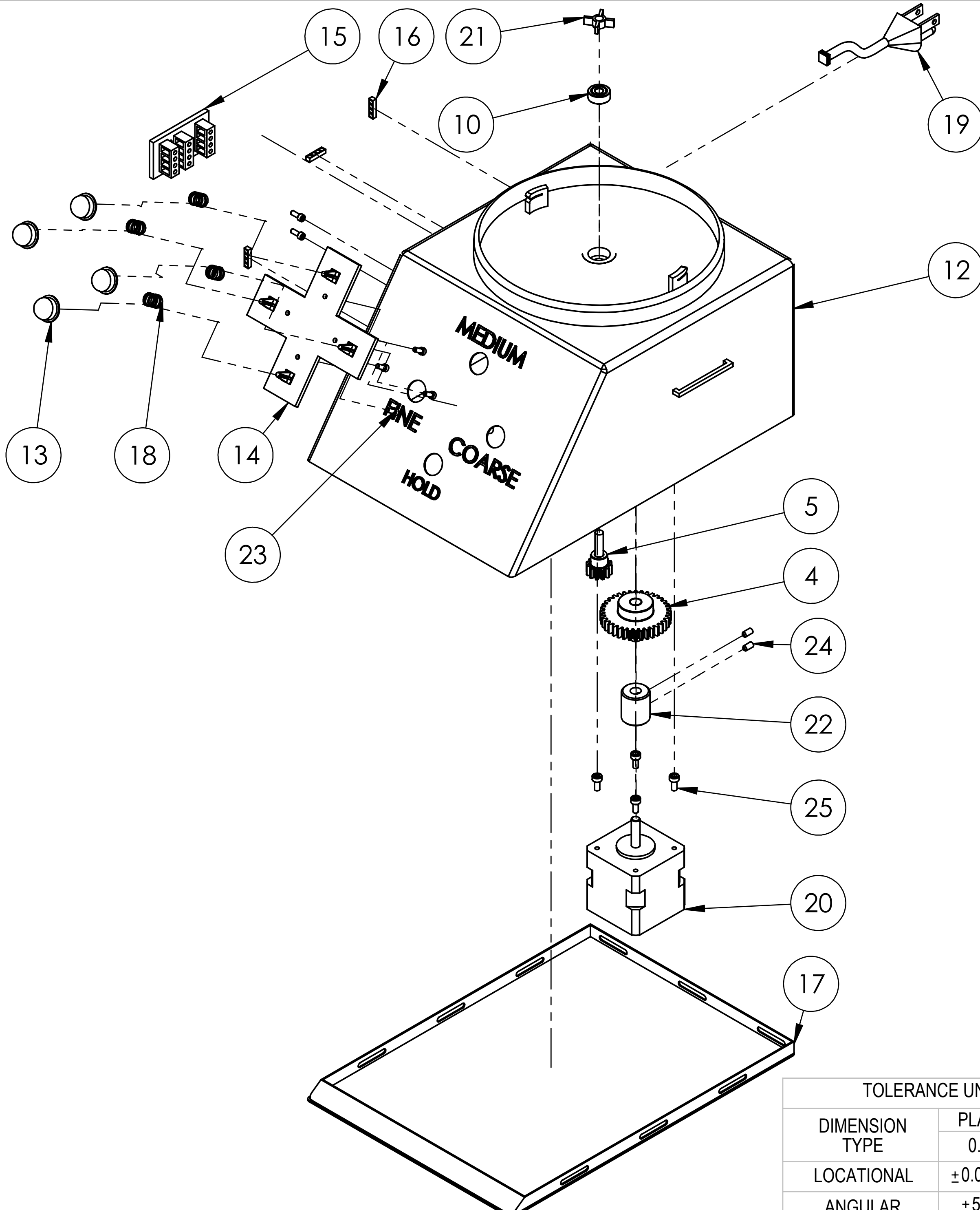


NOTES:
1. DIMS IN INCHES
2. QTY: 1

TITLE:	BASE ASSEMBLY	
DRAWN	JOHN FAIELLA	
DESIGNED	JOHN FAIELLA	
SIZE A	DWG. NO. A-001	REV A
SCALE: 1:4		SHEET 2 OF 4

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

5 4 3 2 1



NOTES:
1. DIMS IN INCHES
2. QTY: 1
3. WIRES HIDDEN FOR CLARITY

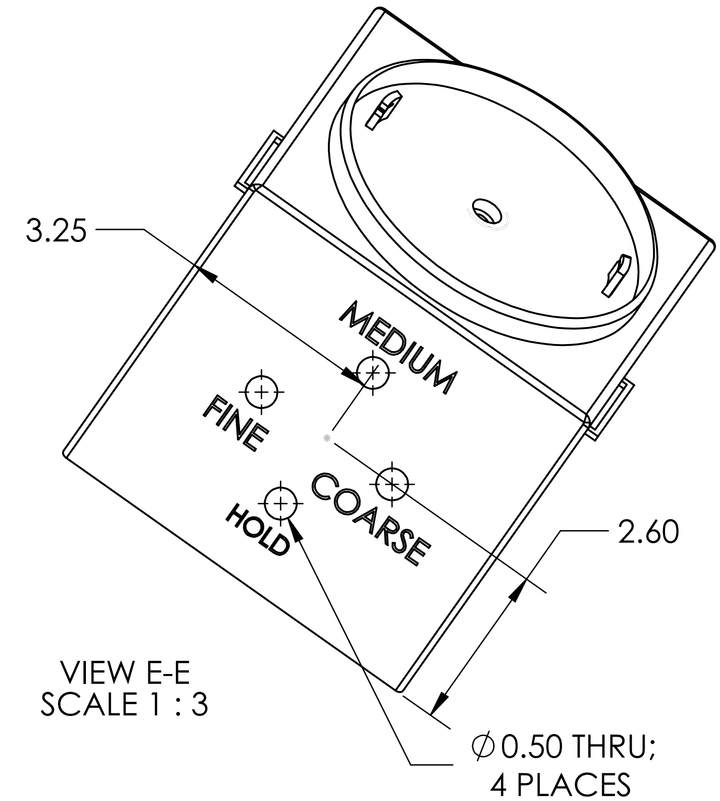
TOLERANCE UNLESS NOTED			
DIMENSION TYPE	PLACES IN DIMENSION		
	0.0	0.00	0.000
LOCATIONAL	±0.050	±0.020	±0.005
ANGULAR	±5	±2	±0.5

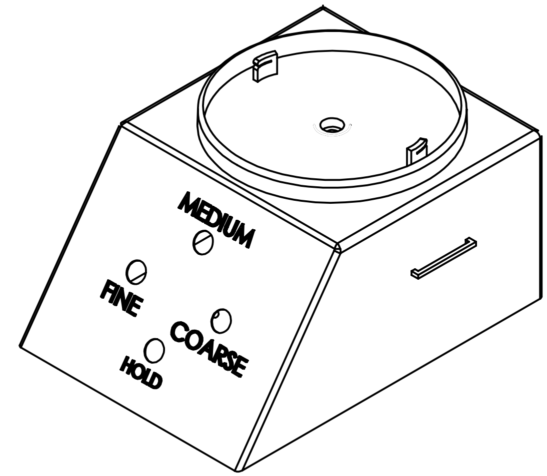
TITLE:	BASE ASSEMBLY
DRAWN	JOHN FAIELLA
DESIGNED	JOHN FAIELLA
SIZE	A
DWG. NO.	A-001
REV	A
SCALE: 1:3.5	SHEET 3 OF 4

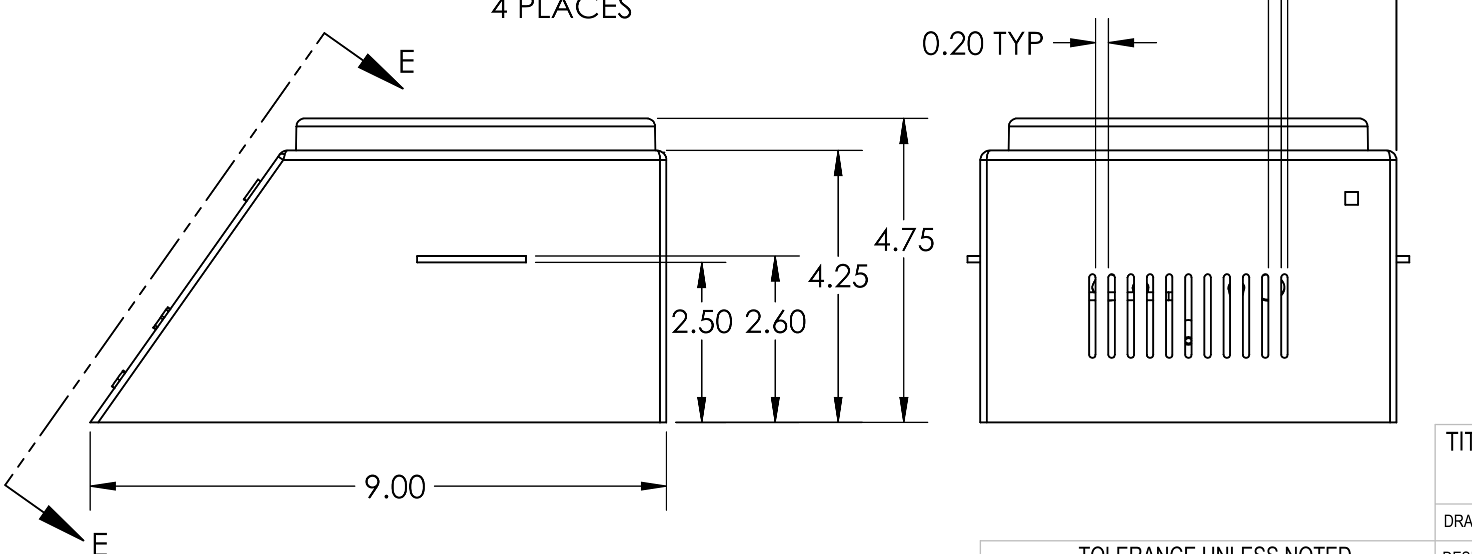
5 4 3 2 1

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
4	A-004	Drive Shaft Assembly	1
5	A-005	Main Shaft Assembly	1
10	OTS-002	3/16" Ball Bearing	1
12	P-005	Base	1
13	P-006	Button	4
14	P-007	Buttons PCB	1
15	P-008	Junction PCB	1
16	P-009	Wire Guide	3
17	P-010	Bottom Lid	1
18	OTS-003	3/8" Compression Spring	4
19	P-011	Wall Cable	1
20	OTS-004	Nema 17 Motor	1
21	P-012	Male Coupler	1
22	P-013	Drive Shaft Hub	1
23	OTS-005	3-48 x 1/4" Socket Head Screw	6
24	OTS-006	5-40 x 1/4" Set Screw	2
25	OTS-007	M3x0.5mm x 4mm Socket Head Screw	4

5 4 3 2 1





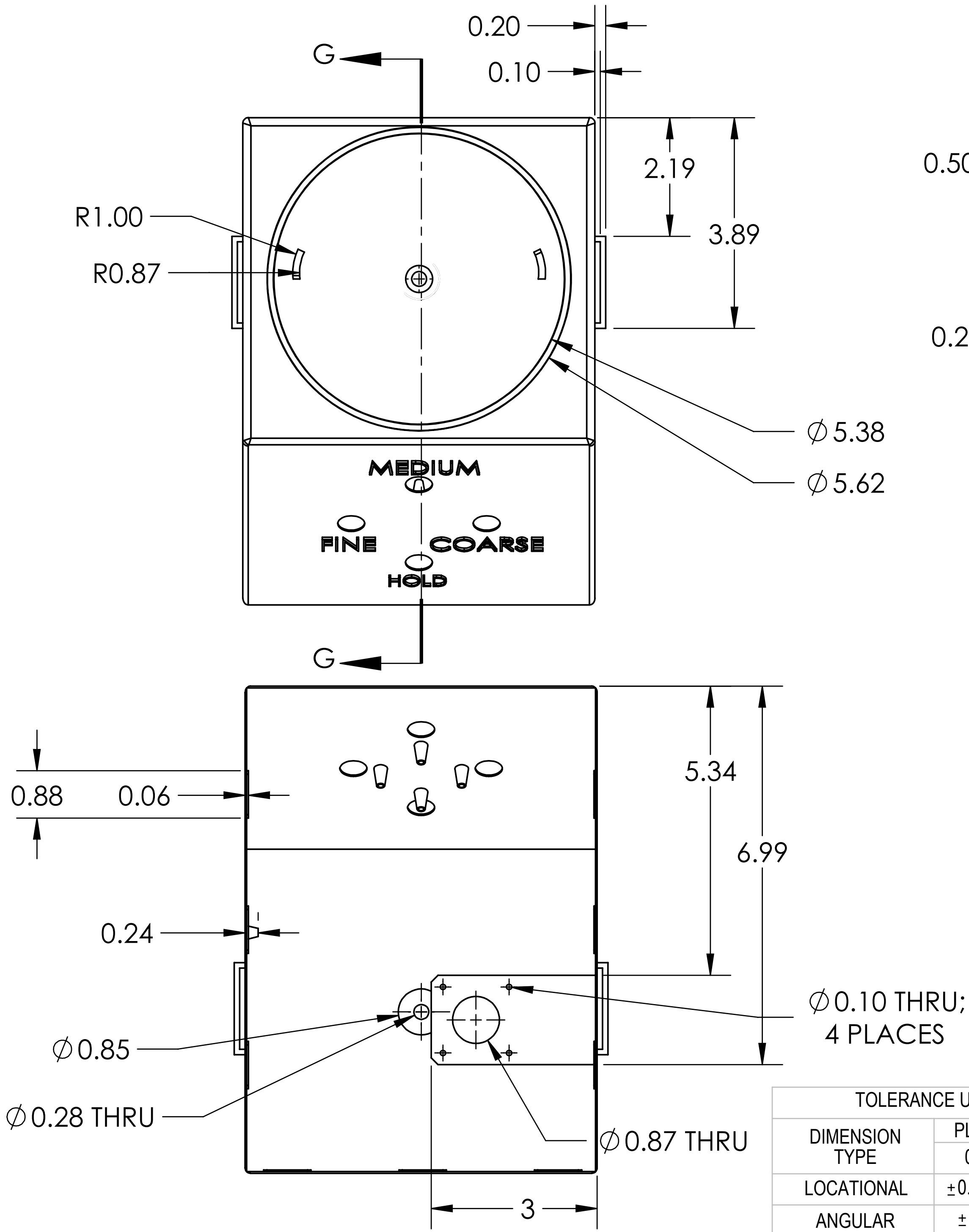


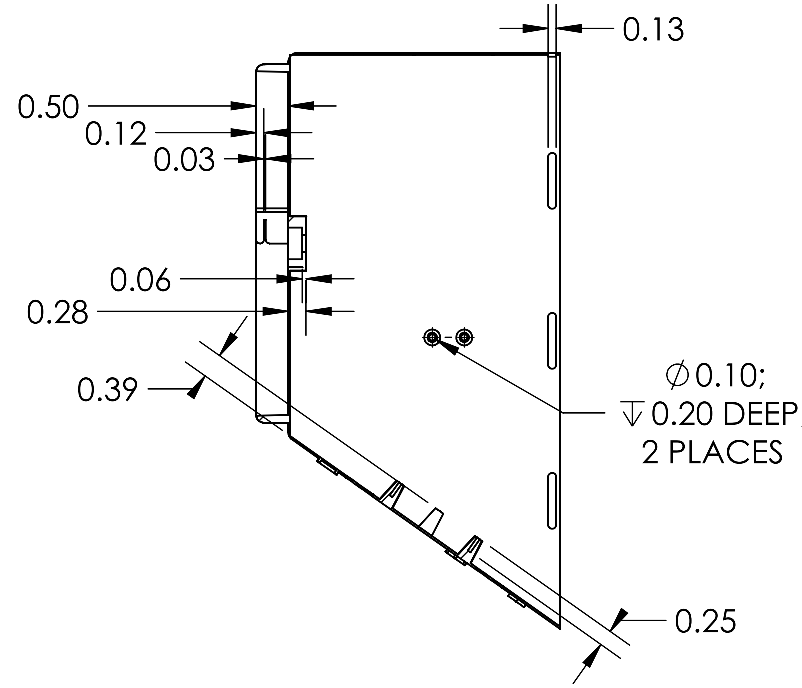
NOTES:
1. DIMS IN INCHES
2. QTY: 1
3. MATERIAL: HDPE
4. SHELL THICKNESS: 0.03

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:	BASE	
DRAWN	JOHN FAIELLA	
DESIGNED	JOHN FAIELLA	
SIZE A	DWG. NO. P-005	REV A
SCALE: 1:3		SHEET 1 OF 2

5 4 3 2 1





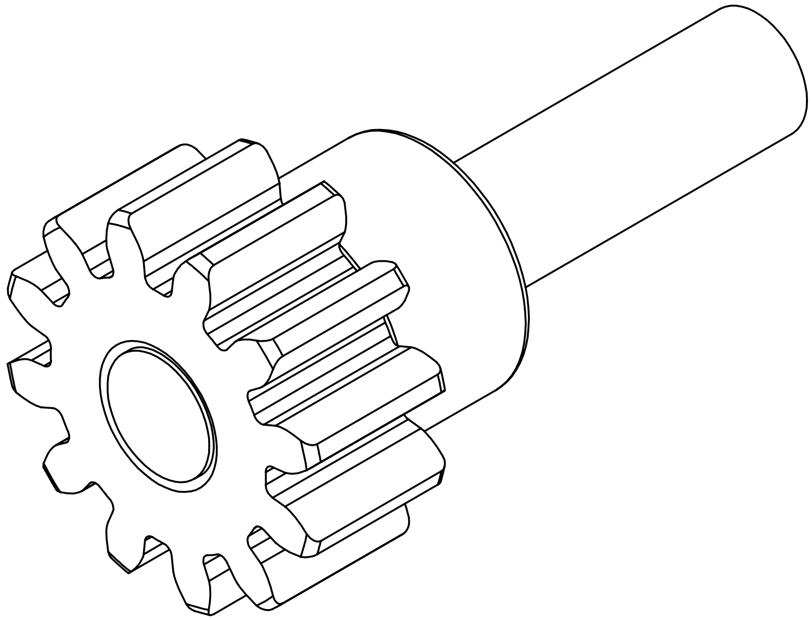
SECTION G-G
SCALE 1 : 3

NOTES:
1. DIMS IN INCHES
2. QTY: 1
3. MATERIAL: HDPE
4. SHELL THICKNESS: 0.03

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:	BASE	
DRAWN	JOHN FAIELLA	
DESIGNED	JOHN FAIELLA	
SIZE: A	DWG. NO. P-005	REV: A
SCALE: 1:3		SHEET 2 OF 2

5 4 3 2 1

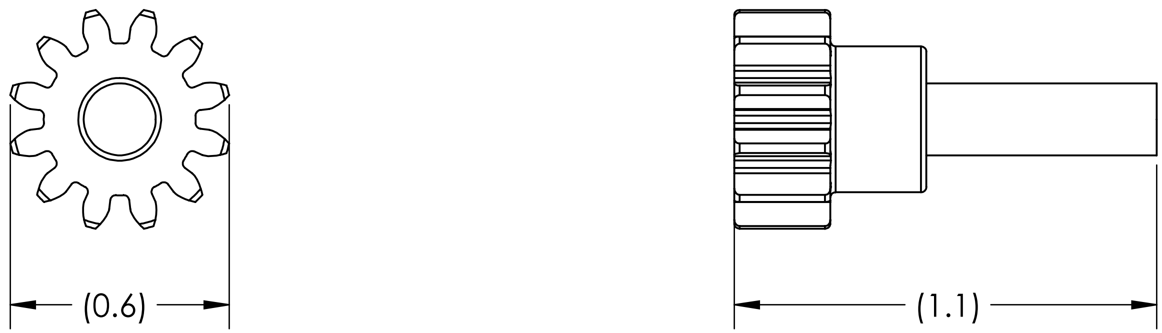


NOTES:
1. DIMS IN INCHES
2. QTY: 1

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: MAIN SHAFT ASSEMBLY		
DRAWN	JOHN FAIELLA	
DESIGNED	JOHN FAIELLA	
SIZE A	DWG. NO. A-005	REV A
SCALE: 4:1		SHEET 1 OF 3

5 4 3 2 1



NOTES:
1. DIMS IN INCHES
2. QTY: 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: MAIN SHAFT ASSEMBLY

DRAWN JOHN FAIELLA

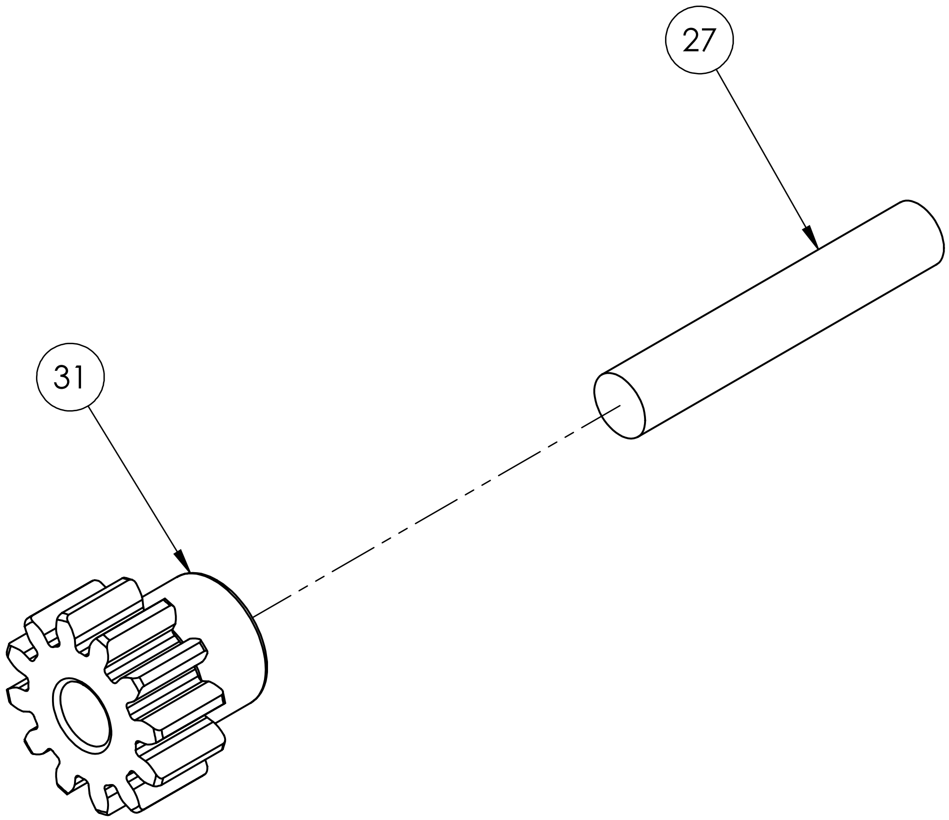
DESIGNED JOHN FAIELLA

SIZE	DWG. NO.	REV
A	A-005	A

SCALE: 2:1 SHEET 2 OF 3

5 4 3 2 1

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
27	P-015	Main Shaft	1
31	OTS-009	24 Pitch 12 Tooth Gear	1



NOTES:
1. DIMS IN INCHES
2. QTY: 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: MAIN SHAFT ASSEMBLY

DRAWN JOHN FAIELLA

DESIGNED JOHN FAIELLA

SIZE A

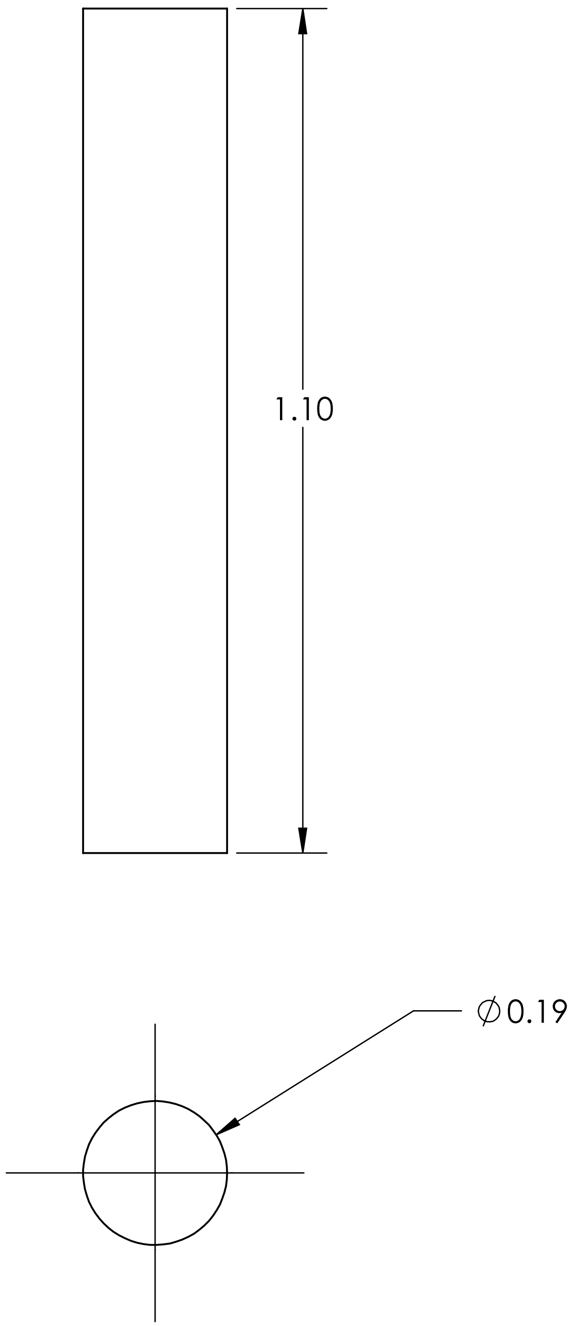
DWG. NO. A-005

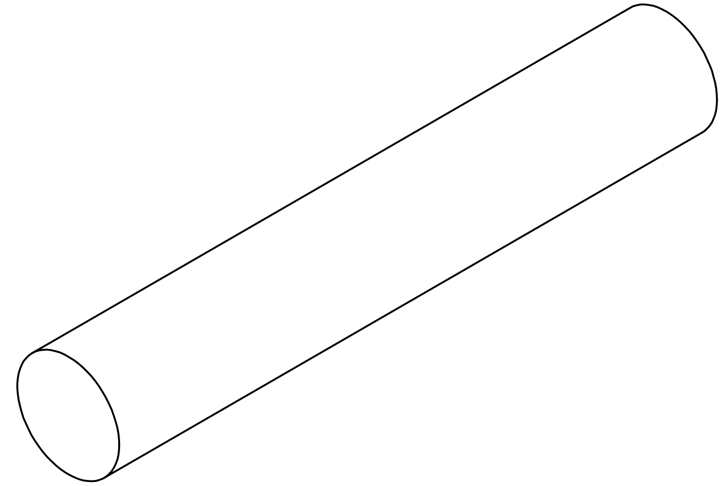
REV A

SCALE: 2:1

SHEET 3 OF 3

5 4 3 2 1



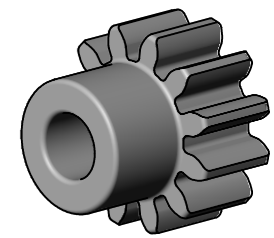


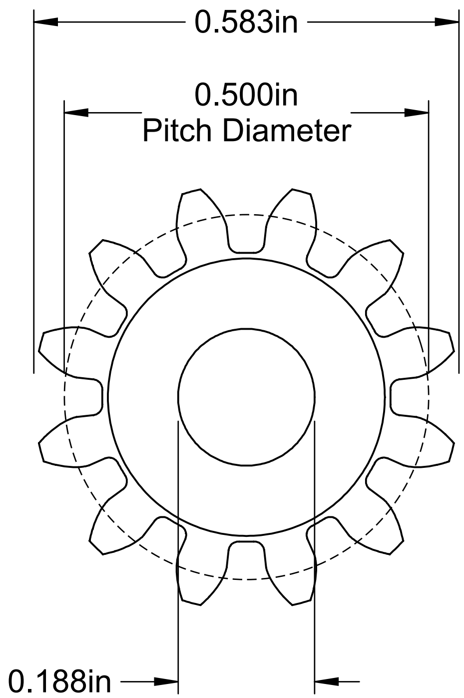
NOTES:
1. DIMS IN INCHES
2. QTY: 1
3. MATERIAL: STEEL

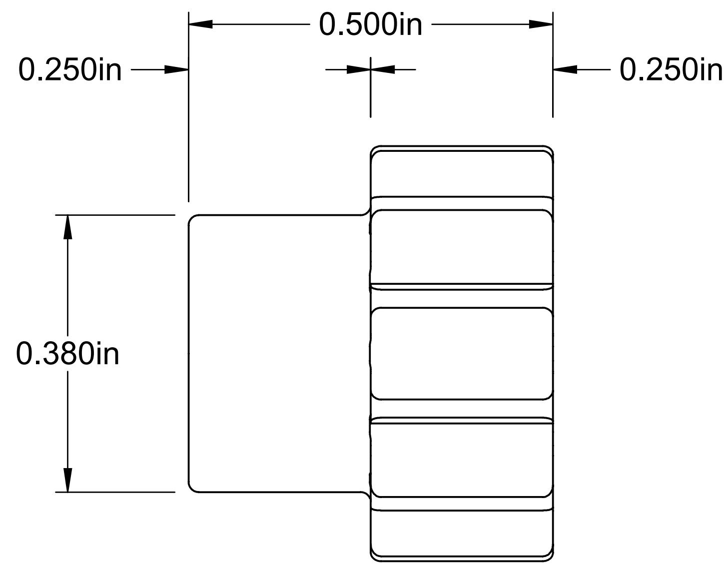
TITLE:	MAIN SHAFT
DRAWN	JOHN FAIELLA
DESIGNED	JOHN FAIELLA
SIZE	A
DWG. NO.	P-015
REV	A
SCALE: 4:1	SHEET 1 OF 1

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

5 4 3 2 1

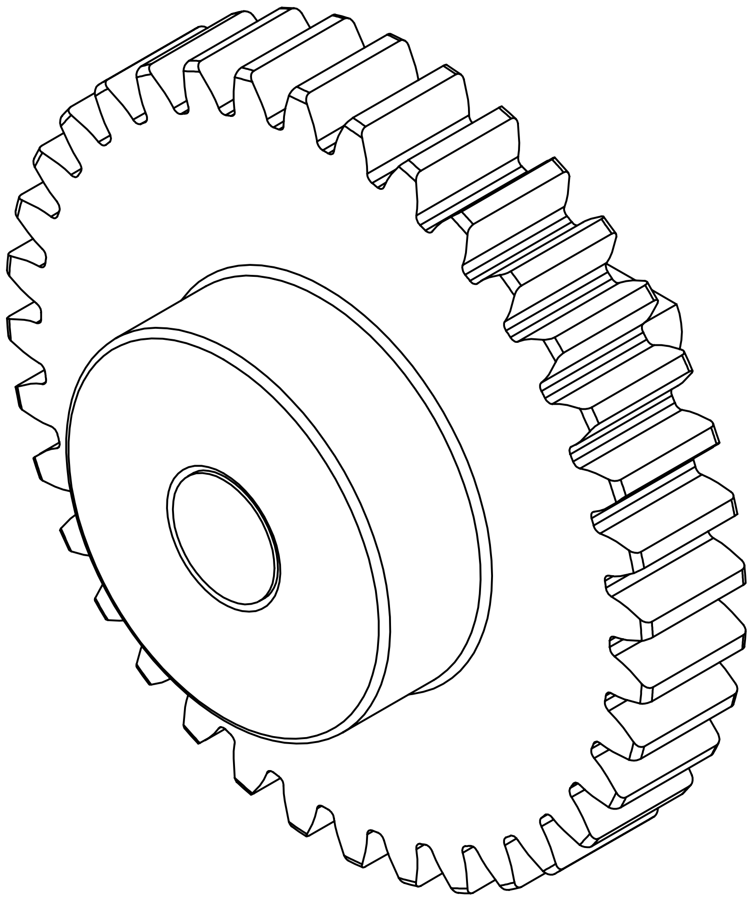






Pressure Angle: 20°
Gear Pitch: 24
Number of Teeth: 12

PART NUMBER	**OTS-009**
24 Pitch 12 Tooth Gear	

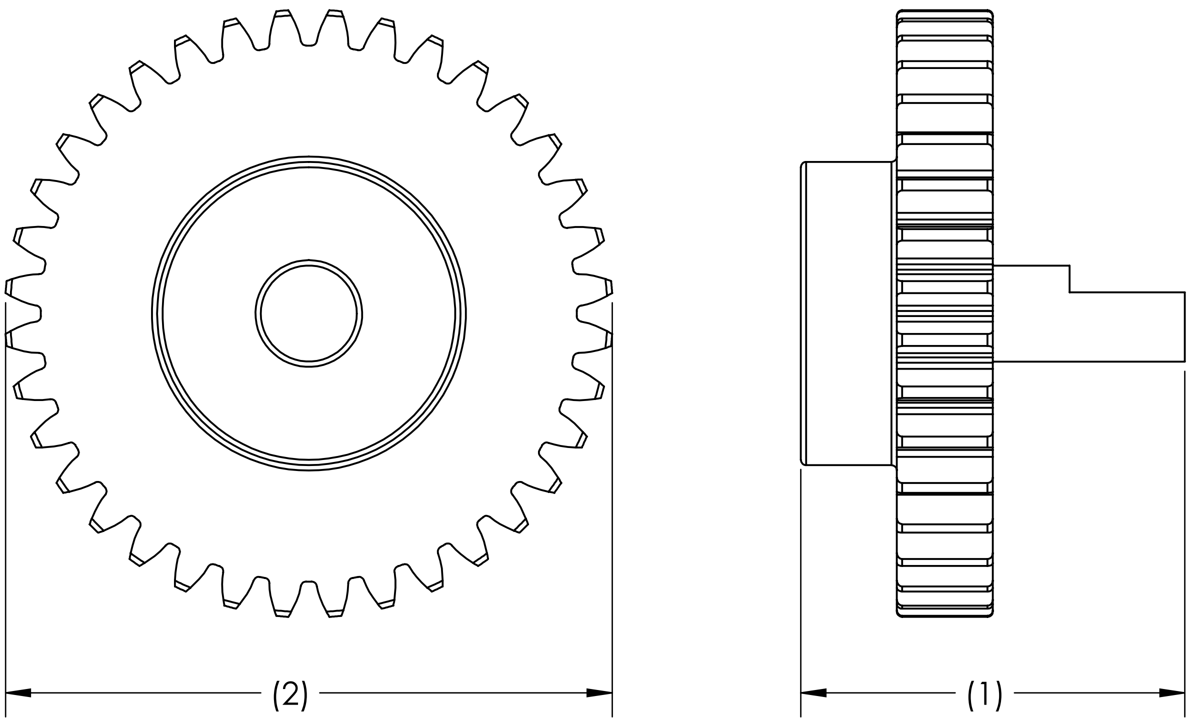


NOTES:
1. DIMS IN INCHES
2. QTY: 1

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: DRIVE SHAFT ASSEMBLY		
DRAWN	JOHN FAIELLA	
DESIGNED	JOHN FAIELLA	
SIZE A	DWG. NO. A-004	REV A
SCALE: 3:1		SHEET 1 OF 3

5 4 3 2 1



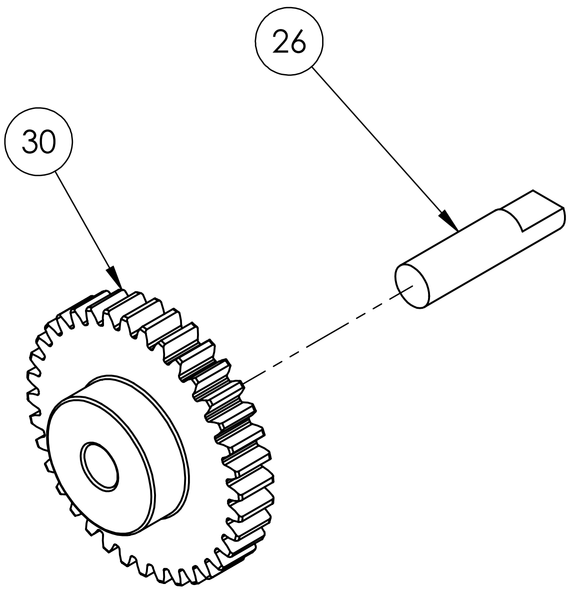
NOTES:
1. DIMS IN INCHES
2. QTY: 1

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: DRIVE SHAFT ASSEMBLY			
DRAWN	JOHN FAIELLA		
DESIGNED	JOHN FAIELLA		
SIZE A	DWG. NO. A-004		REV A
SCALE: 2:1		SHEET 2 OF 3	

5 4 3 2 1

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
26	P-014	Drive Shaft	1
30	OTS-008	24 Pitch 36 Tooth Gear	1

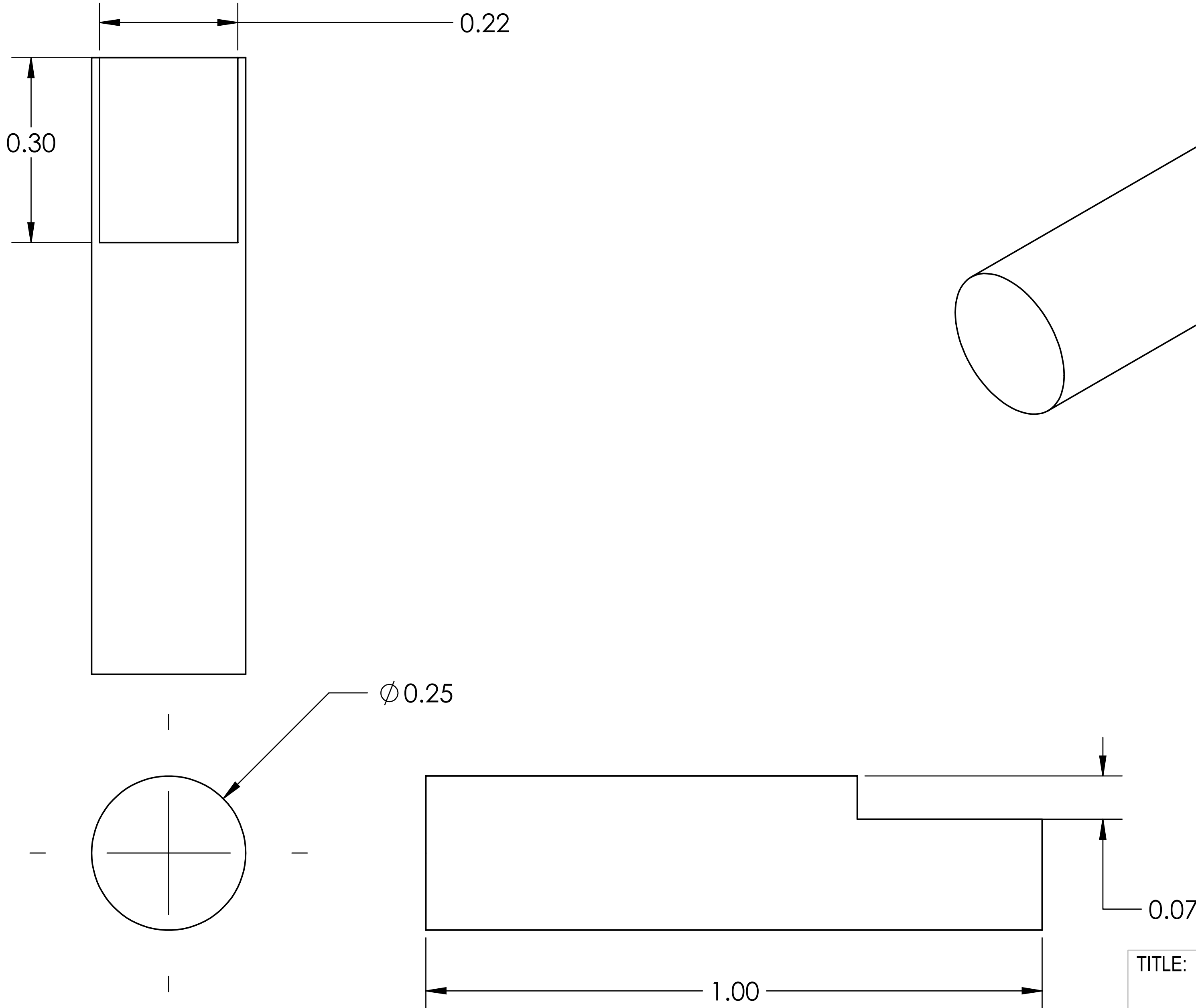


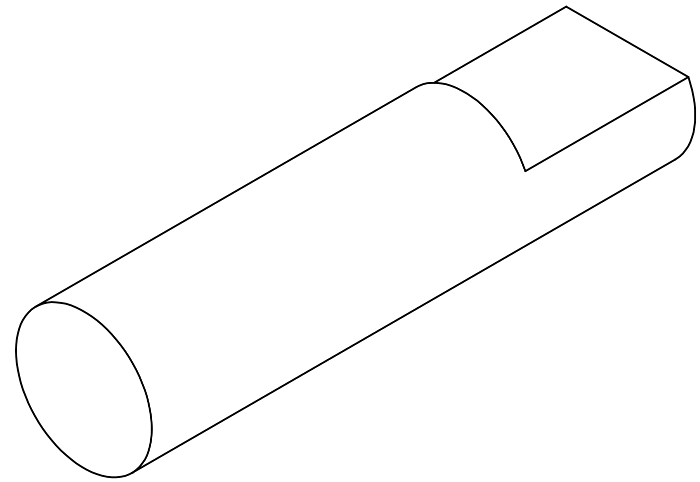
NOTES:
1. DIMS IN INCHES
2. QTY: 1

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: DRIVE SHAFT ASSEMBLY			
DRAWN	JOHN FAIELLA		
DESIGNED	JOHN FAIELLA		
SIZE A	DWG. NO. A-004		REV A
SCALE: 1:1		SHEET 3 OF 3	

5 4 3 2 1



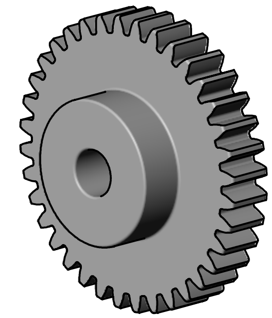


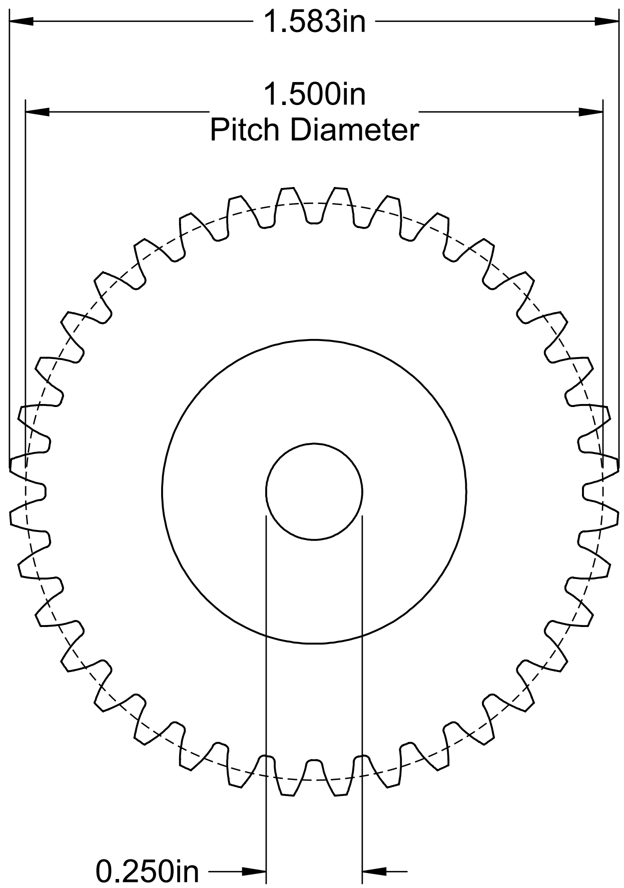
NOTES:
1. DIMS IN INCHES
2. QTY: 1
3. MATERIAL: STEEL

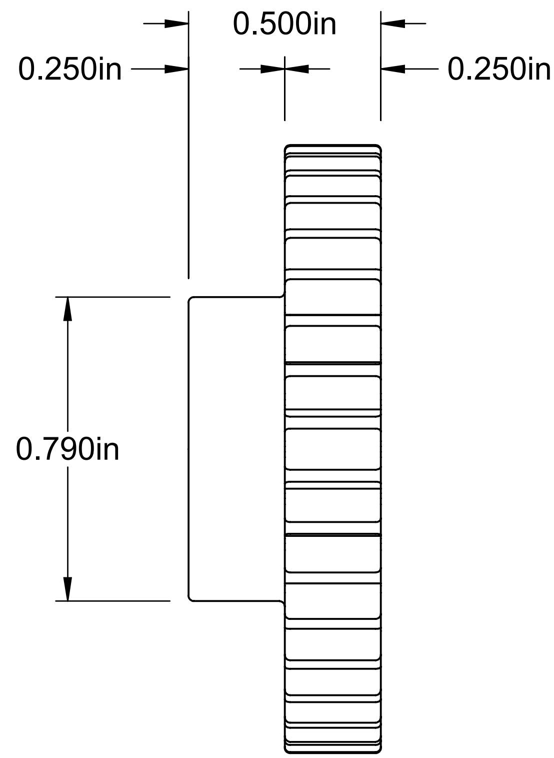
TOLERANCE UNLESS NOTED			
DIMENSION TYPE	PLACES IN DIMENSION		
	0.0	0.00	0.000
LOCATIONAL	±0.050	±0.020	±0.005
ANGULAR	±5	±2	±0.5

TITLE: DRIVE SHAFT		
DRAWN	JOHN FAIELLA	
DESIGNED	JOHN FAIELLA	
SIZE A	DWG. NO. P-014	REV A
SCALE: 4:1		SHEET 1 OF 1

5 4 3 2 1

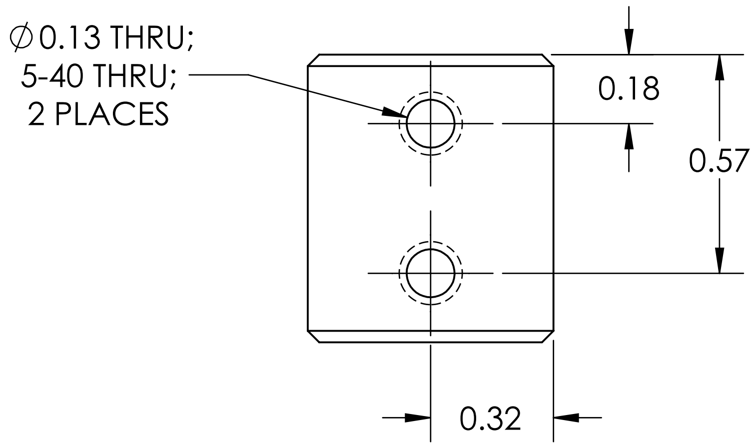


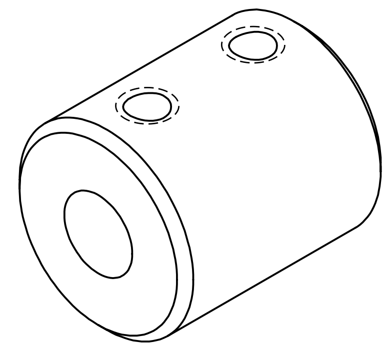


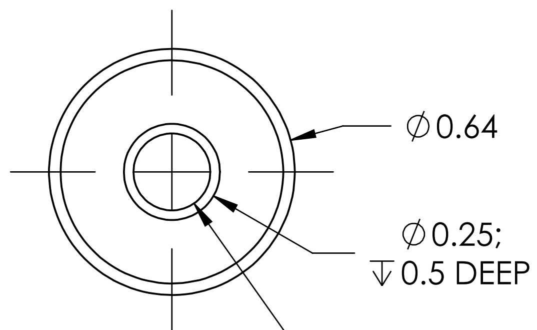


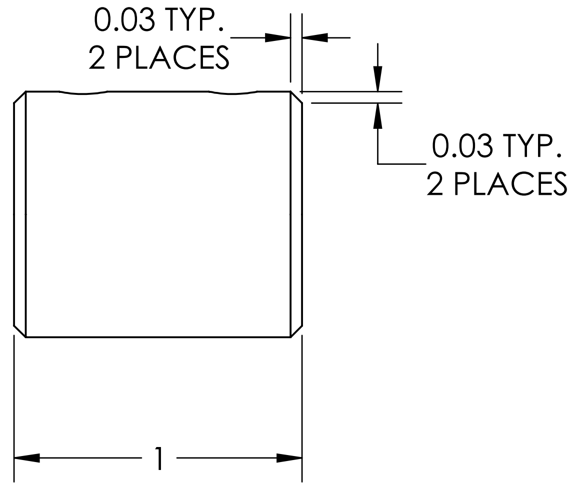
Pressure Angle: 20°
Gear Pitch: 24
Number of Teeth: 36

PART NUMBER	OTS-008
24 Pitch 36 Tooth Gear	







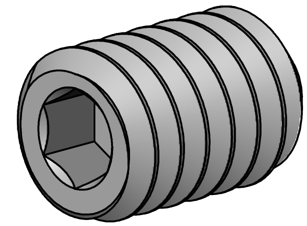


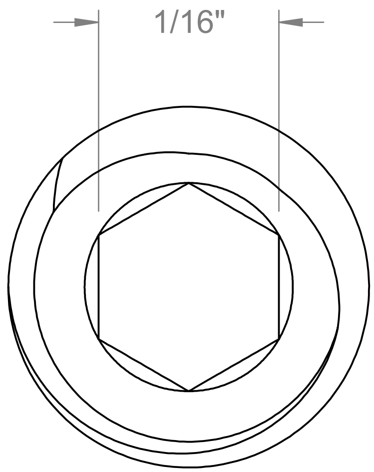
NOTES:
1. DIMS IN INCHES
2. QTY: 1
3. MATERIAL: STEEL

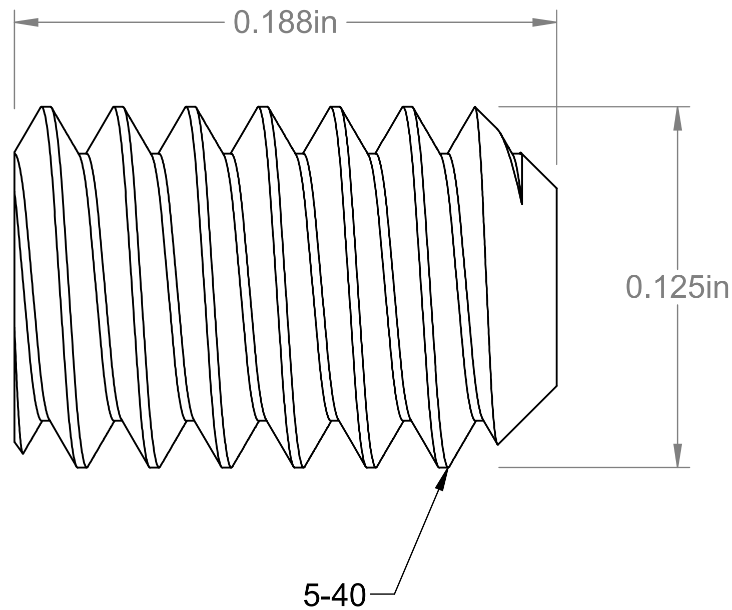
TOLERANCE UNLESS NOTED			
DIMENSION TYPE	PLACES IN DIMENSION		
	0.0	0.00	0.000
LOCATIONAL	±0.050	±0.020	±0.005
ANGULAR	±5	±2	±0.5

TITLE:	DRIVE SHAFT HUB	
DRAWN	JOHN FAIELLA	
DESIGNED	JOHN FAIELLA	
SIZE A	DWG. NO. P-013	REV A
SCALE: 2:1		SHEET 1 OF 1

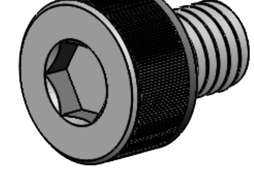
5 4 3 2 1

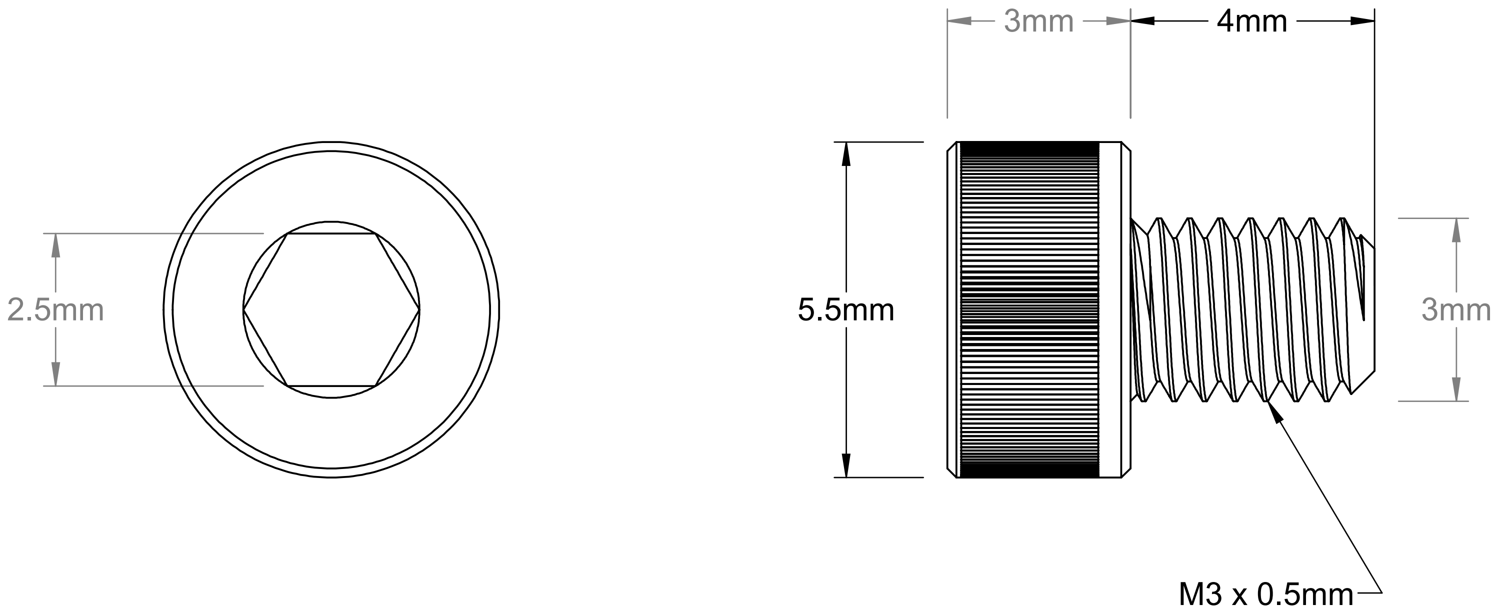




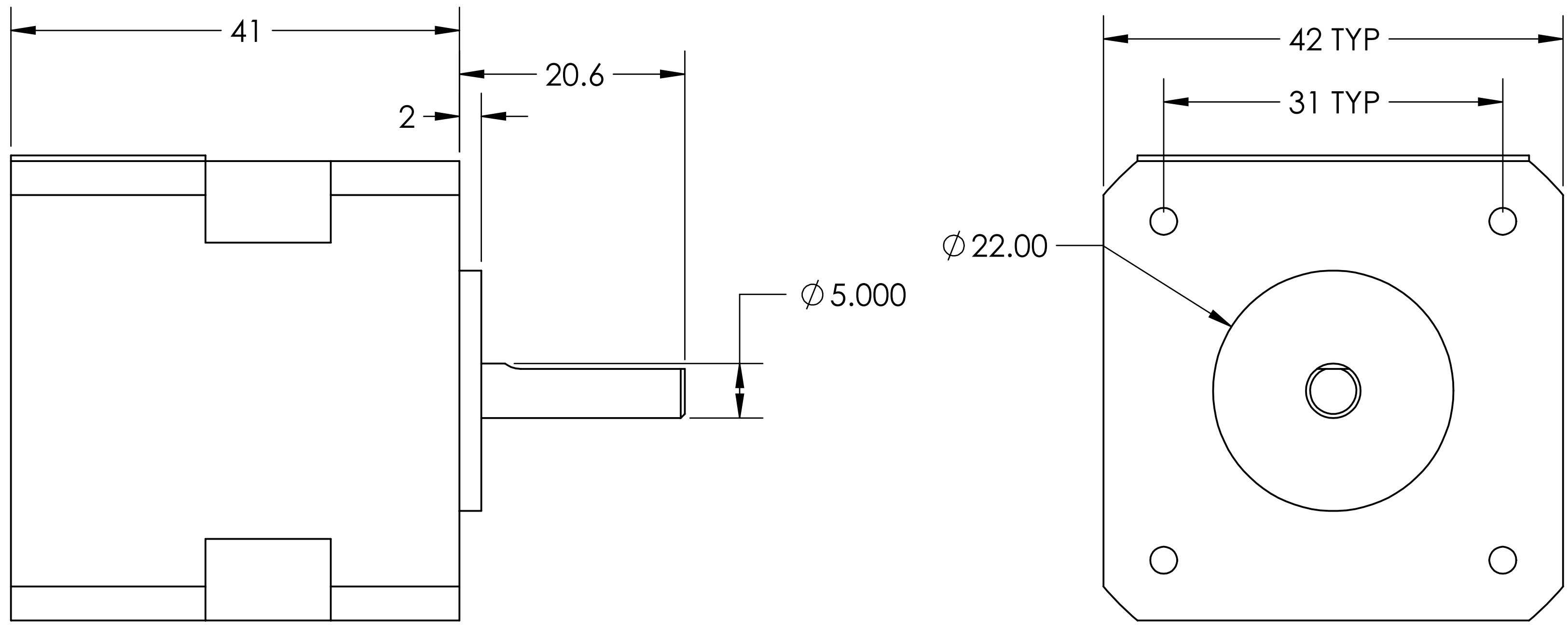


PART NUMBER	**OTS-006**
5-40 x 3/16" Set Screw	





PART NUMBER	OTS-007
M3x0.5mm x 4mm Socket Head Screw	

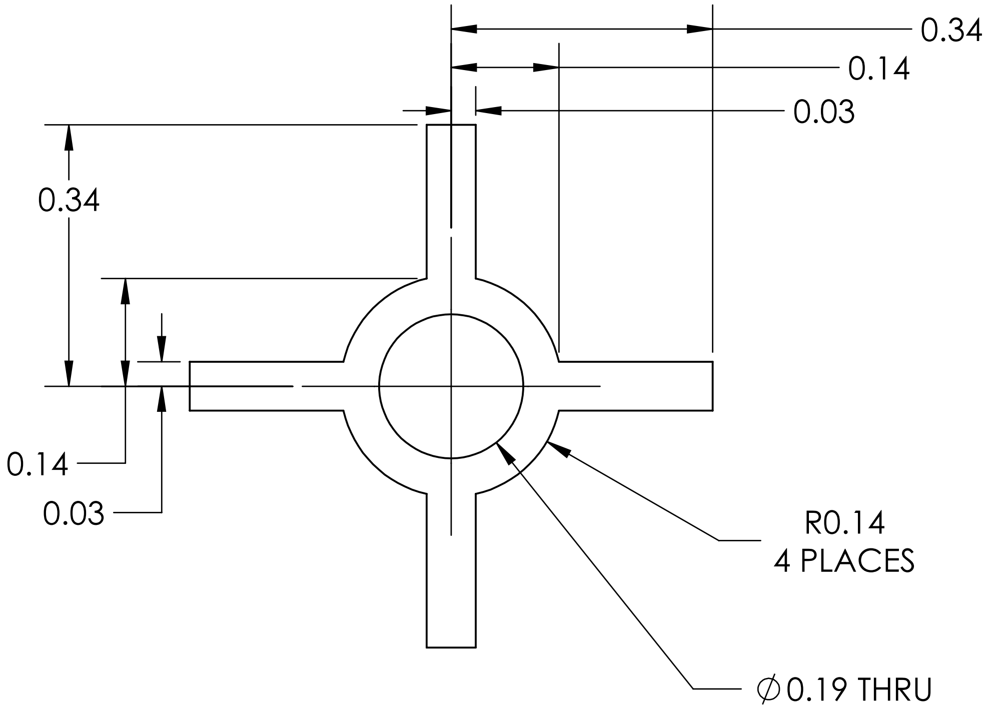


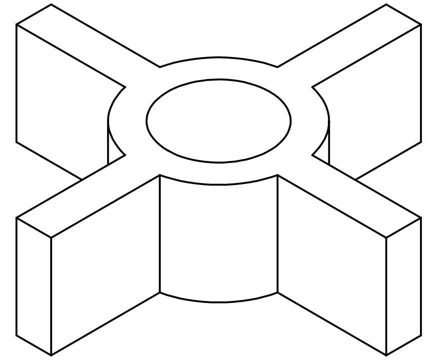
NOTES:
1. DIMS IN MM
2. DIMS SPECIFIED BY MANUFACTURER

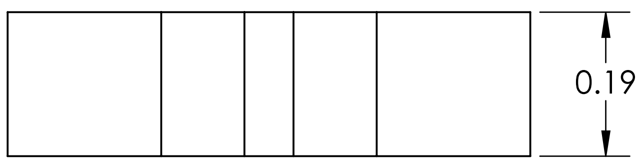
TOLERANCE UNLESS NOTED			
DIMENSION TYPE	PLACES IN DIMENSION		
	0.0	0.00	0.000
LOCATIONAL	±0.050	±0.020	±0.005
ANGULAR	±5	±2	±0.5

TITLE: NEMA 17 MOTOR		
DRAWN	AARON SOSSONG	
DESIGNED	ELECTROCRAFT	
SIZE A	DWG. NO. OTS-004	REV A
SCALE:1.5:1		SHEET 1 OF 1

5 4 3 2 1



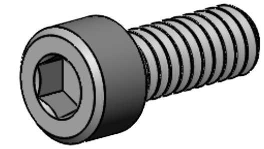


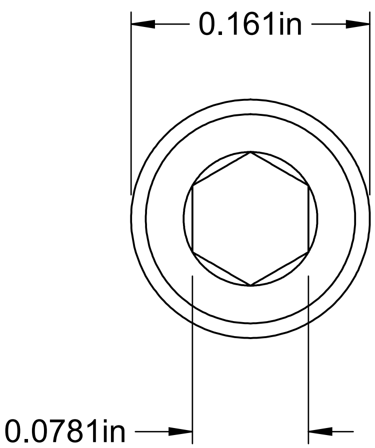


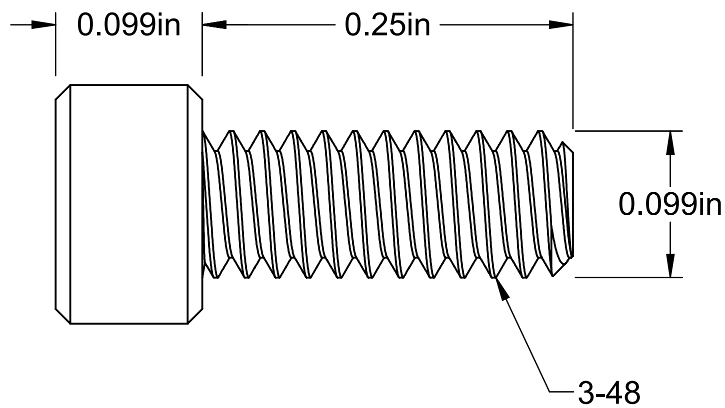
NOTES:
1. DIMS IN INCHES
2. QTY: 1
3. MATERIAL: STEEL

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

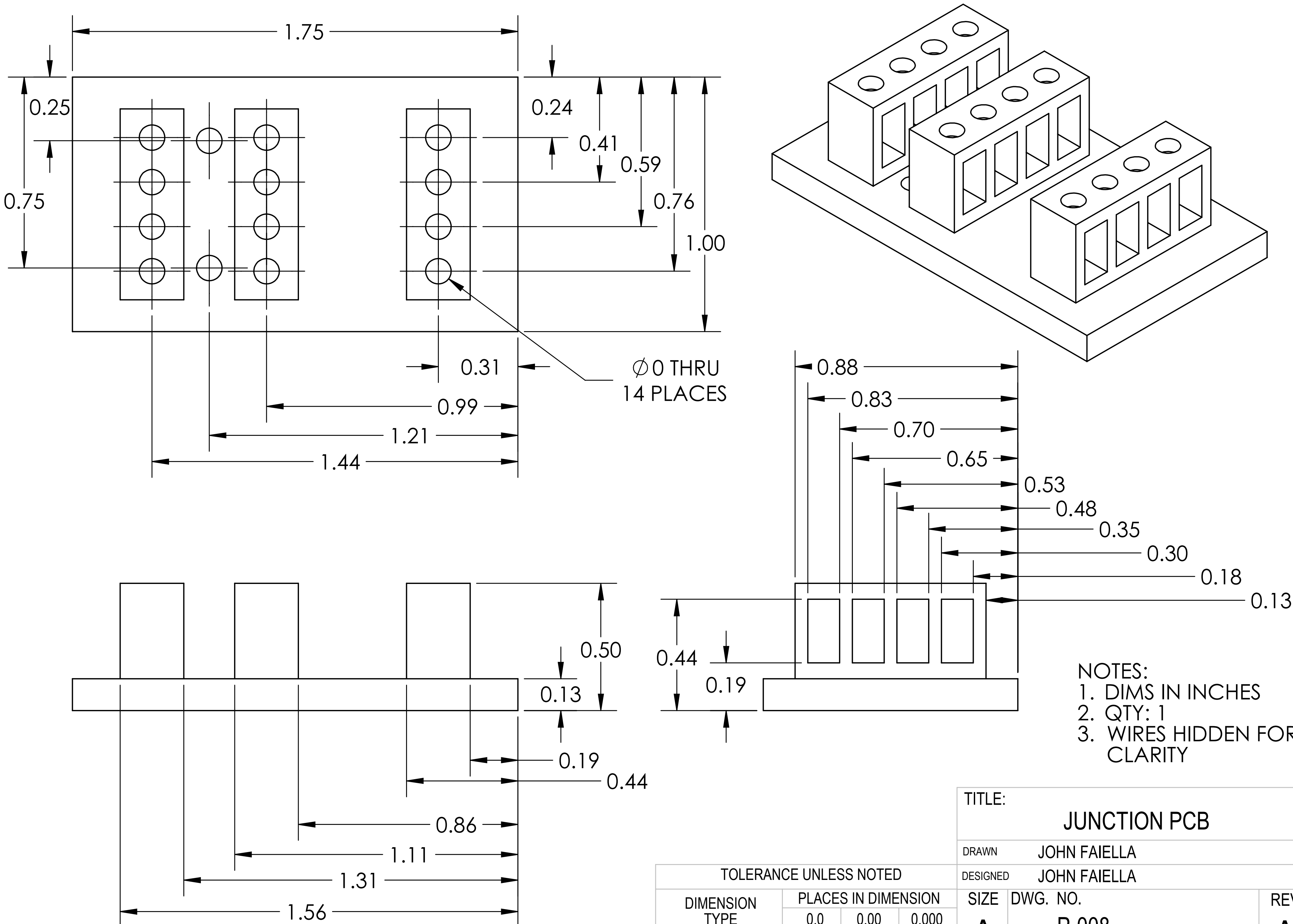
TITLE: MALE COUPLER		
DRAWN	JOHN FAIELLA	
DESIGNED	JOHN FAIELLA	
SIZE A	DWG. NO. P-012	REV A
SCALE: 4:1		SHEET 1 OF 1







PART NUMBER	**OTS-005**
3-48 x 1/4" Socket Head Screw	

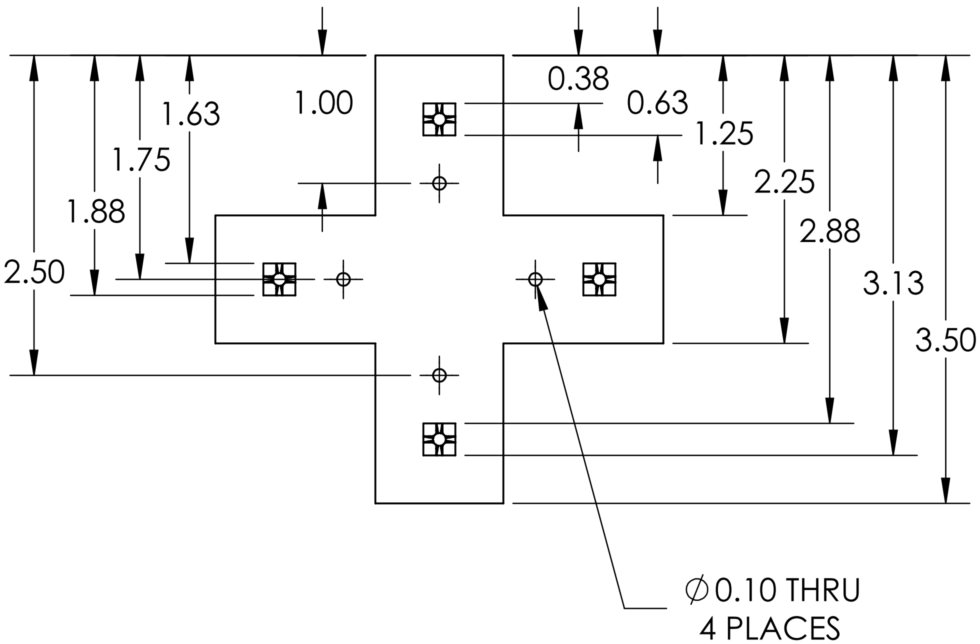


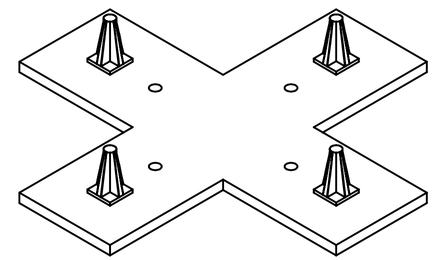
NOTES:
1. DIMS IN INCHES
2. QTY: 1
3. WIRES HIDDEN FOR CLARITY

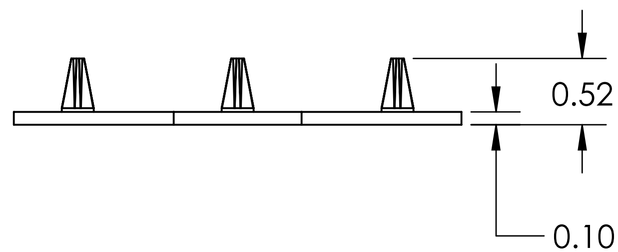
TOLERANCE UNLESS NOTED			
DIMENSION TYPE	PLACES IN DIMENSION		
	0.0	0.00	0.000
LOCATIONAL	±0.050	±0.020	±0.005
ANGULAR	±5	±2	±0.5

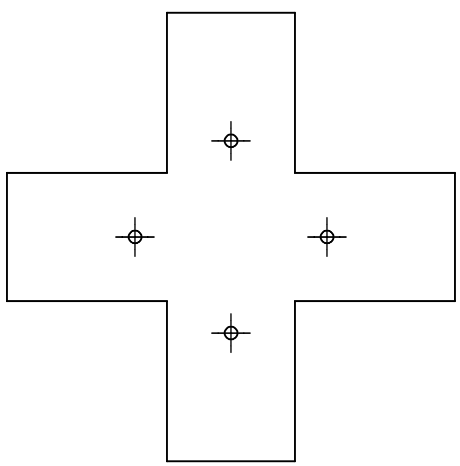
TITLE:	JUNCTION PCB
DRAWN	JOHN FAIELLA
DESIGNED	JOHN FAIELLA
SIZE	A
DWG. NO.	P-008
REV	A
SCALE: 2:1	SHEET 1 OF 1

5 4 3 2 1







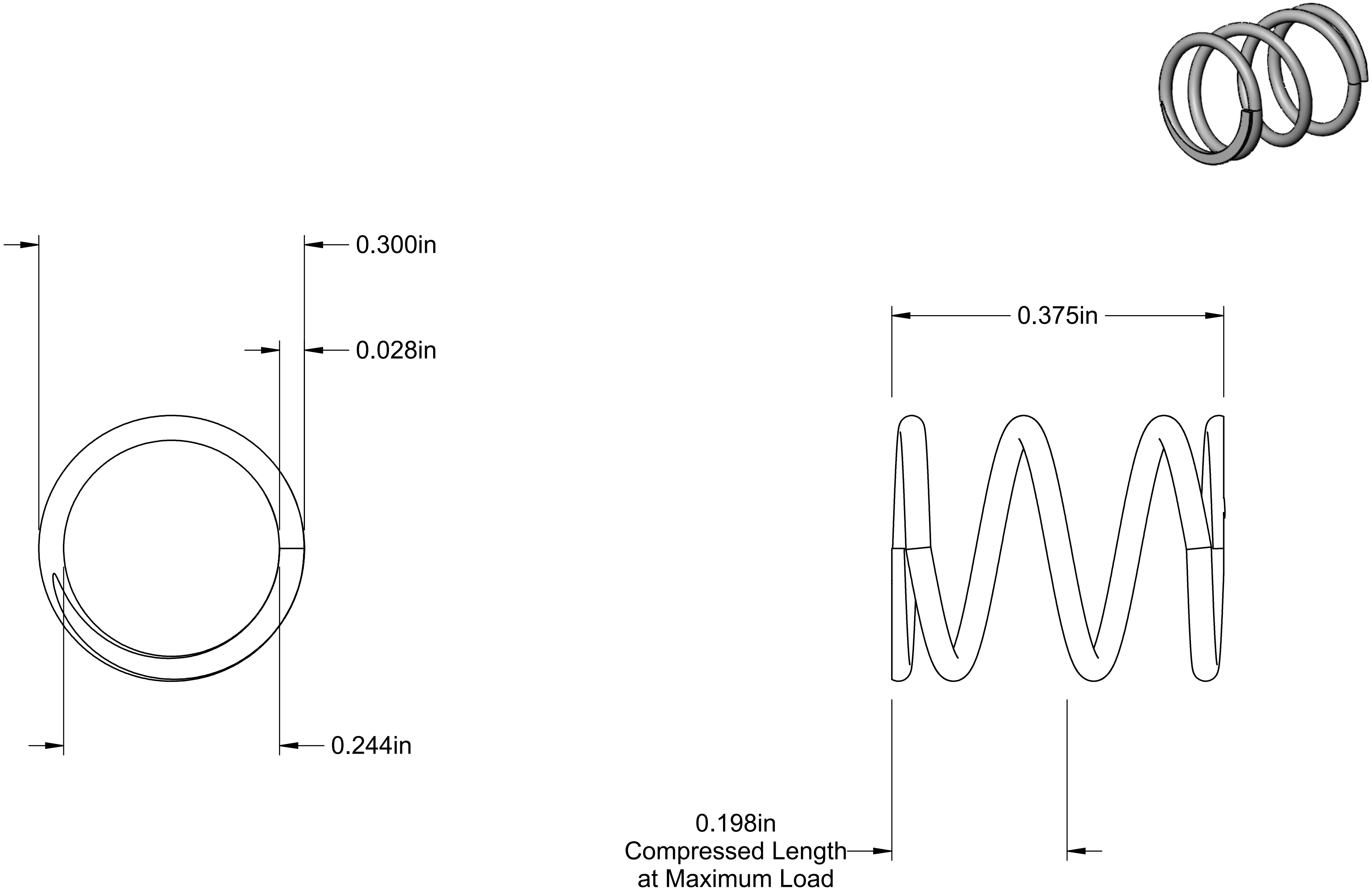


NOTES:
1. DIMS IN INCHES
2. QTY: 1
3. WIRES HIDDEN FOR CLARITY

TITLE: BUTTONS PCB				
DRAWN	JOHN FAIELLA			
DESIGNED	JOHN FAIELLA			
SIZE: A	DWG. NO. P-007			REV: A
SCALE: 1:1.5				SHEET 1 OF 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

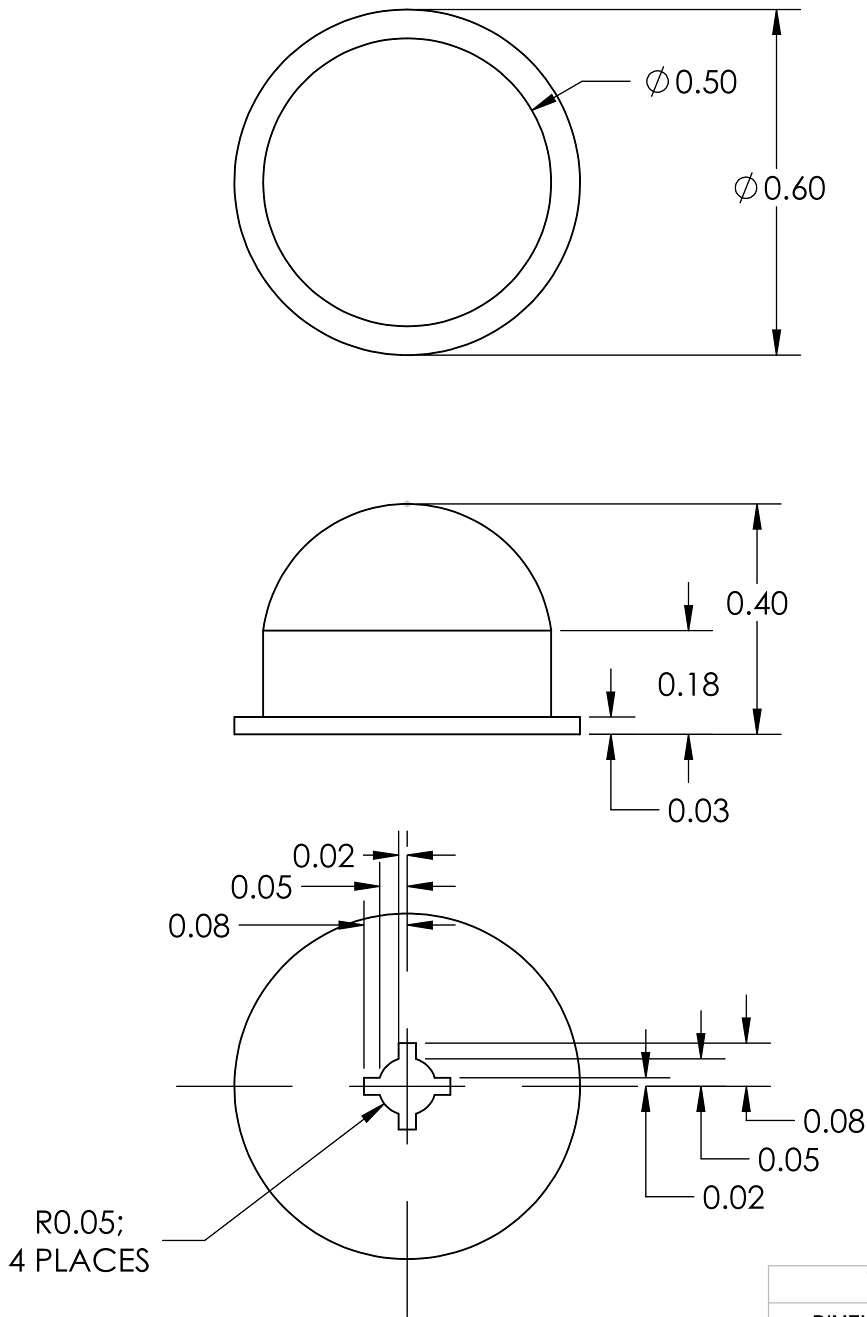
5 4 3 2 1

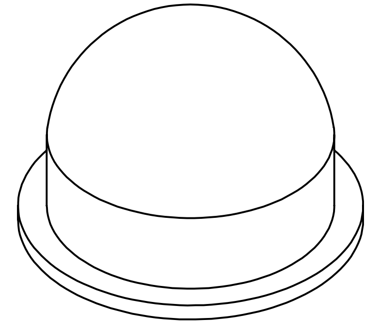


Maximum Load: 3.70 lbs.

Spring Rate: 20.900 lbs./in.

PART NUMBER	OTS-003
3/8" Compression Spring	



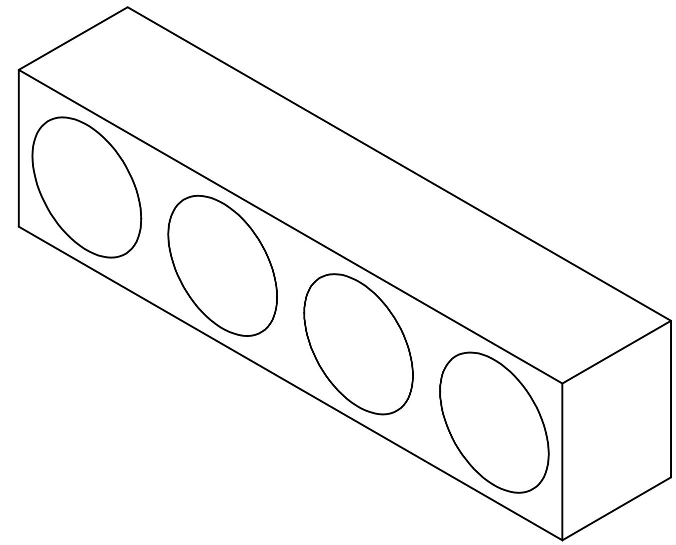


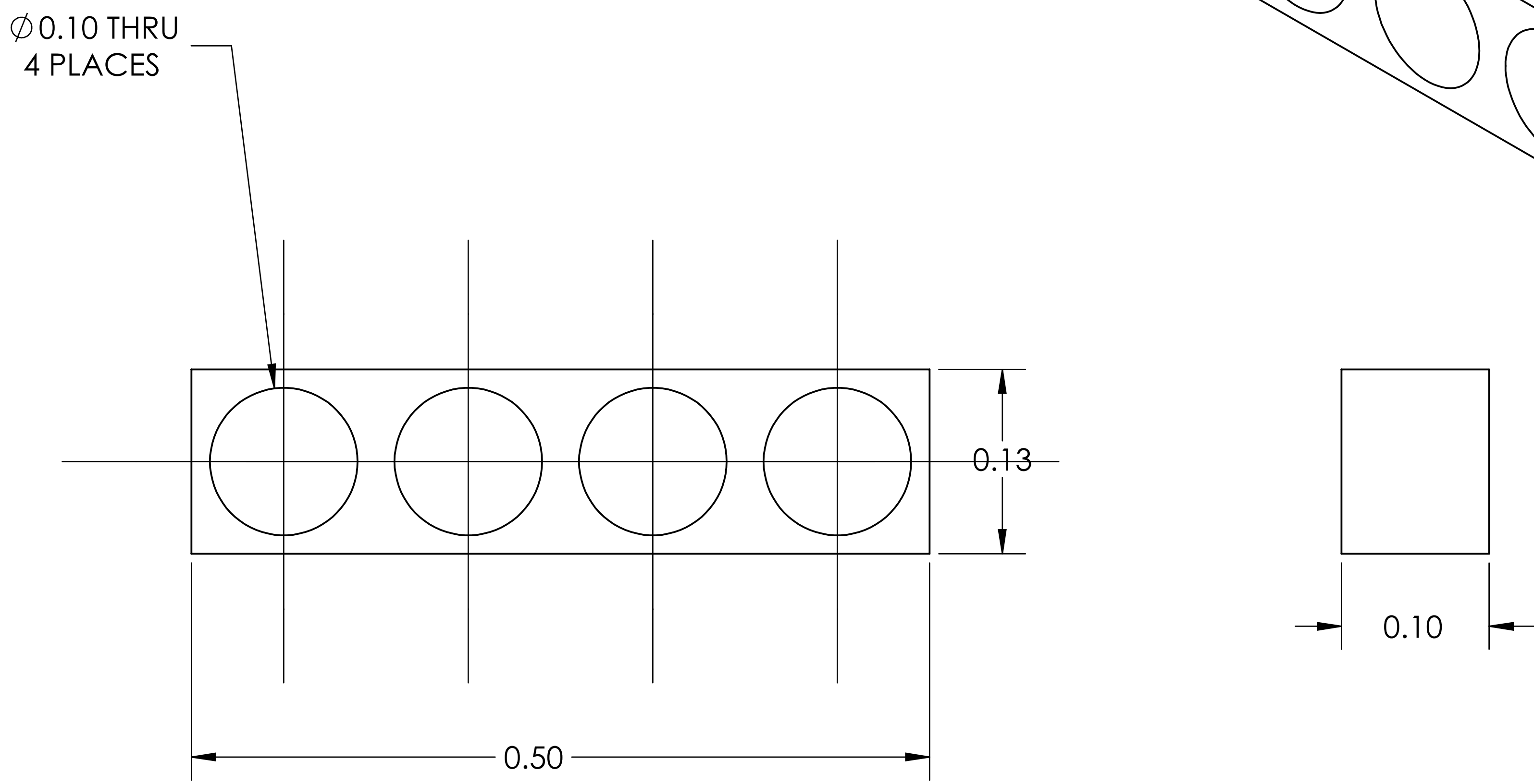
NOTES:
1. DIMS IN INCHES
2. QTY: 4
3. MATERIAL: HDPE

TITLE:	BUTTON
DRAWN	JOHN FAIELLA
DESIGNED	JOHN FAIELLA
SIZE	A
DWG. NO.	P-006
REV	A
SCALE:	3:1
	SHEET 1 OF 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

5 4 3 2 1





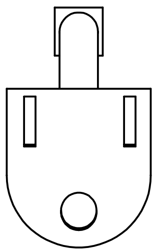
NOTES:
1. DIMS IN INCHES
2. QTY: 3
3. MATERIAL: HDPE

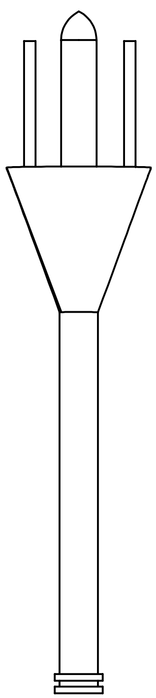
TITLE:	WIRE GUIDE
DRAWN	JOHN FAIELLA
DESIGNED	JOHN FAIELLA

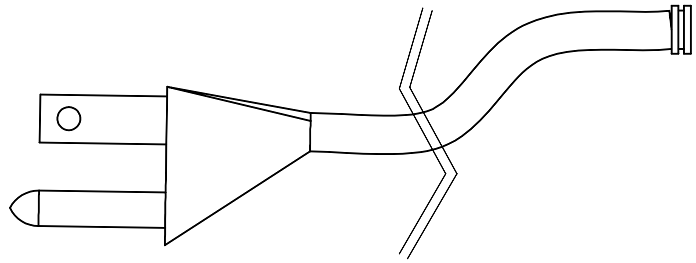
SIZE	DWG. NO.	REV
A	P-009	A
SCALE: 8:1		SHEET 1 OF 1

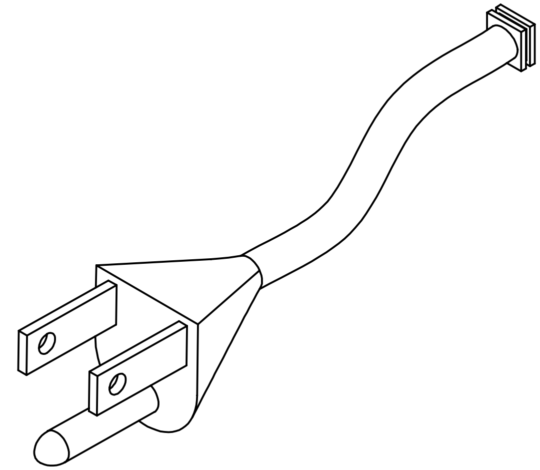
TOLERANCE UNLESS NOTED			
DIMENSION TYPE	PLACES IN DIMENSION		
	0.0	0.00	0.000
LOCATIONAL	±0.050	±0.020	±0.005
ANGULAR	±5	±2	±0.5

5 4 3 2 1









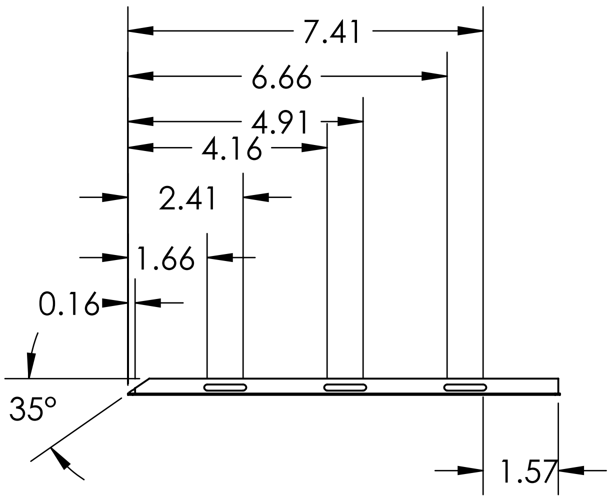
NOTE: CABLE LENGTH SHORTENED FOR MODELING

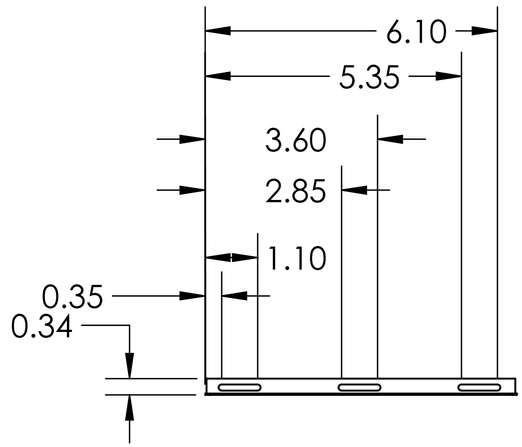
NOTES:
1. DIMS IN INCHES
2. QTY: 1
3. STANDARD US AC WALL PLUG
4. 3 FEET CABLE LENGTH

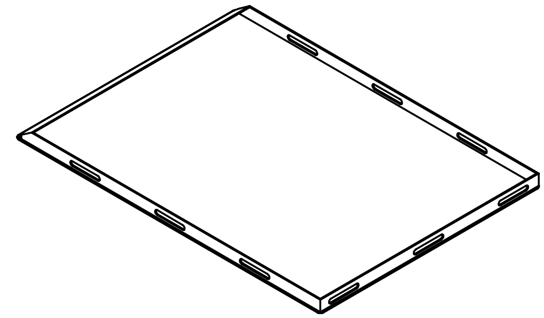
TITLE:		
WALL CABLE		
DRAWN	JOHN FAIELLA	
DESIGNED	JOHN FAIELLA	
SIZE A	DWG. NO. P-011	REV A
SCALE: 1:1		SHEET 1 OF 1

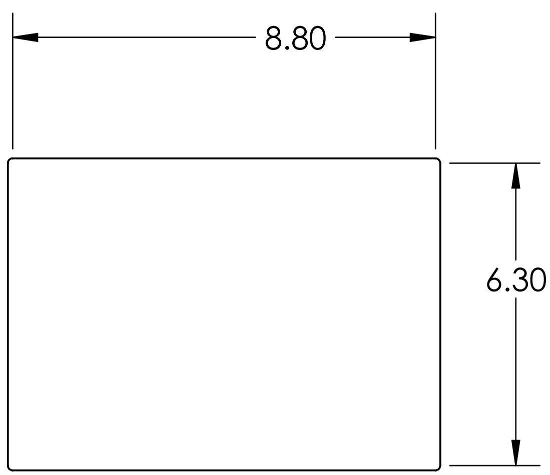
TOLERANCE UNLESS NOTED			
DIMENSION TYPE	PLACES IN DIMENSION		
	0.0	0.00	0.000
LOCATIONAL	±0.050	±0.020	±0.005
ANGULAR	±5	±2	±0.5

5 4 3 2 1









NOTES:
1. DIMS IN INCHES
2. QTY: 1
3. MATERIAL: HDPE

TITLE: GRINDER BOTTOM LID				
DRAWN	CYRIL MORAN			
DESIGNED	JOHN FAIELLA			
SIZE A	DWG. NO. P-010			REV A
SCALE: 1:4			SHEET 1 OF 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

5 4 3 2 1