

DJI Inspire Gimbal Design

Team: Lambda

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**Mechanical & Aerospace
ENGINEERING**

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- B. Drawing Package

1 PROBLEM DEFINITION

1.1 OVERVIEW

The purpose of this project is to create a gimbal design that will be used to attach the DJI inspire drone to a GoPro Hero 4 Session. The gimbal design will need to have at least 2 axes of rotation and also feature a form of dampening to maintain stability while the drone is in flight. The gimbal also needs to have the functionality to mechanically press the button located on top of the GoPro camera; which will start and stop the recording of the GoPro camera.

1.2 ENGINEERING REQUIREMENTS

The following requirements need to be satisfied for the gimbal to be considered functional and commercially acceptable.

1.2.1 The gimbal shall have at least two axes of rotation (roll and pitch)

Source: This requirement is necessary in ensuring that the GoPro Hero 4 Session is able to capture multiple angles while the DJI Inspire is in flight. The gimbal needs to provide a roll axis that keeps the camera stable whenever the drone rolls or turns while also providing a pitch axis that allows the operator to change the angle at which the camera captures video.

Fulfillment Strategy: In order to fulfill this requirement, the gimbal will need to have the ability to rotate through two different rotational axes with ease. Roll and pitch will be accomplished by creating separate parts in the gimbal assembly that feature their own rotational motor. The roll axis will be achieved using a brushless motor featuring gyroscope that rotates the camera in such a way that it will counter any roll from the drone, maintaining a smooth and stable video capture.

1.2.2 The mass of the gimbal shall not affect flight times significantly

Source: This requirement is necessary in ensuring the DJI Inspire drone is not hindered during flight due to the presence of the gimbal. This requirement allows for the drone to function normally without any significant deficit to flight speed or take off speed as a result of the gimbal. The gimbal must not provide a significant amount of drag on the drone that may hinder its flight.

Fulfillment Strategy: In order to fulfill this requirement, the gimbal will need to be made out of lightweight materials that can function efficiently under the forces on the gimbal while the drone is in flight and taking off. The "Solidworks Simulation Add-In" will be used to analyze different materials under the forces of gravity, lift, and air resistance for when the drone is taking off and in flight. The weight of the gimbal will also be a factor in material choice.

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1.2.3 One end of the gimbal shall attach to the end of the DJI Inspire's "Gimbal Frame"

Source: This requirement is necessary in ensuring the gimbal is designed to exclusively fit the DJI Inspire's gimbal frame rather than being attachable to other drones. The gimbal will need to remain mounted to the gimbal frame throughout all of the Inspire's motion. The customer of the gimbal will also expect this gimbal to be designed with the DJI Inspire's flight patterns and build in mind.

Fulfillment Strategy: In order to fulfill this requirement, the gimbal will need to have a part or feature that is designed to quickly snap onto the gimbal frame the DJI Inspire provides. The gimbal will therefore feature a mounting option that will be attachable to this gimbal frame and can provide a stable mounting for the gimbal to operate during flight.

1.2.4 The other end shall attach to the GoPro Hero 4 Session

Source: This requirement is necessary in ensuring that the gimbal will be able to hold the GoPro Hero 4 Session and will maintain a constant hold on the camera during all of the Inspire's motion. The attachment needs to also hold the GoPro tightly to reduce the effect of air turbulence on the camera that can cause instability.

Fulfillment Strategy: The gimbal will need to have a case or holding method that will be connected to the gimbal and will allow for the GoPro camera to be secure and stable during flight and landing. This case will feature an attachable portion that makes removing the camera from the case easy.

1.2.5 The drone shall not block the camera's point of view facing forward during flight

Source: This requirement is necessary in ensuring that the GoPro camera gets a clean video capture that will not be interrupted by the Inspire's legs. The consumer will expect the gimbal to provide clearance from the Inspire's body that allows the camera to record uninterrupted.

Fulfillment Strategy: The gimbal will need to extend in order to remove the Inspire's legs from video capture during all motion. If the camera is too far back, the legs will enter the drone's point of view and will interfere with the capture. Since the legs of the drone during flight will be raised above the drone, the gimbal will also need to hold the camera beneath the drone to remove any obstructions.

1.2.6 The gimbal shall have a mechanical function that will press the recording button on the camera

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Source: This requirement ensures that the recording of the camera via the GoPro's on switch can still be accessed while attached to the gimbal. If the camera is in a case blocking the on switch, then the gimbal will need to provide a way to push the button mechanically.

Fulfillment Strategy: In order to fulfill this requirement, the gimbal will feature its own attachable button that can provide for easy operation while the GoPro is mounted to the gimbal. The gimbal's button will utilize the GoPro's switch by adding pressure to the switch using a peg attached to the button.

1.2.7 While the drone is on a flat surface, the gimbal shall be at least 15mm above the ground

Source: This requirement is necessary in ensuring the gimbal and the Go Pro camera will not be damaged when the Inspire is either landing or taking off. The 15mm provides enough clearance for the gimbal to avoid contact with the ground while the Inspire is taking off.

Fulfillment Strategy: The distance between the gimbal and the ground will need to be measured by comparing the gimbal to the legs of the Inspire when it is in landing orientation. The leg is around 76mm so to ensure the gimbal lies 15mm above the ground the gimbal design will not drop lower than half the leg's height, which will provide a clearance of around 38mm.

1.2.8 The gimbal shall have actuators common to remote controlled vehicles

Source: Actuators are used in remote control vehicles to control and move various mechanical systems. The gimbal will need to feature actuators like gyroscopes and brushless motors to rotate each of the gimbals arms over at least 2 axes. The actuators will provide the customer with a way to control the gimbal's movement and orientation.

Fulfillment Strategy: The gimbal will feature a separate brushless motor at each of the rotational arms, with a gyroscopic actuator featured on the arm that provides roll. The brushless motors will need to be connected to a driving mechanism that can rotate the arms and allows for the gimbal to be controlled remotely by the user.

1.2.9 The gimbal shall have a form of dampening that maintains stability of the camera during flight

Source: While in flight, the Inspire will create vibrations throughout both the drone and the gimbal. Too much vibration will lead to instability in the GoPro's video capture. A form of dampening will be required to reduce the vibration between the gimbal and the drone.

Fulfillment Strategy: The gimbal will use "rubber dampeners" common to other gimbals. The rubber dampeners will absorb vibration from the Inspire and allow for the camera stability to be

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more controlled during flight. The size and quantity of these dampeners will need to be considered as to provide enough dampening while not greatly increasing the mass of the gimbal.

1.2.10 The gimbal shall have equal weight distribution vertically

Source: While the drone is in flight, an unequal weight distribution in the gimbal can lead to an unbalance in the flight of the Inspire and has the possibility of veering the drone in a certain direction due to wind pushing along the gimbal's frame.

Fulfillment Strategy: The gimbal will need to have arms that have a certain amount of symmetry in order to maintain a center of balance directly beneath the gimbal frame on the Inspire. The design of the gimbal should have the GoPro positioned near the center of the gimbal's design.

1.3 GOALS

The following goals will be worked towards to help improve the gimbal's functionality

1.3.1 The gimbal should have 3 axes of rotation (roll, pitch, and yaw)

Source: While the gimbal only requires two axes to be functional, the gimbal should provide rotation for all 3 axes. The customer will want a gimbal that provides all possible forms of rotation, allowing for easier video capture at a vast quantity of orientations.

Fulfillment Strategy: The gimbal will need to feature three arms or parts that are capable of turning around an axis when acted upon by an actuator. The arm providing rotation over the yaw axis will need to be designed in a way that will not impede the flight pattern of the Inspire, similar to the design of the roll and pitch arms.

1.3.2 The gimbal should be easily attachable to both the DJI Inspire and the GoPro Hero 4 Session

Source: While not required, easily attachable features of the gimbal will allow for the gimbal to be removed without much hassle or time. The customer will want to remove the gimbal swiftly rather than removing it in a time consuming manner.

Fulfillment Strategy: The gimbal will need to feature detachable segments that can be easily removed and attached. These attachments also need to withstand forces of lift, air resistance, and gravity during flight to prevent the gimbal from breaking off the Inspire's gimbal frame.

1.3.3 The Gimbal should provide smooth and quick rotation on all three axes, providing a smooth video capture.

Source: The gimbal needs to move along each axis with smooth and quick rotations to ensure that video quality is upheld while also reducing the strain on the rotating arms. The customer will also expect the gimbal to function smoothly without visible defects occurring due to friction between contact points on the gimbal arms.

Fulfillment Strategy: Lightweight arms will require less torque to rotate and will allow for easier movement over these axes. Each contact point on the rotating arms will also need to be smooth enough to reduce friction between parts and allow for easier movement over these axes.

1.3.4 The gimbal should be cheap and made with inexpensive material

Source: Since the gimbal being designed has not been tested, a prototype should be made to ensure the gimbal operates as expected. A prototype should use inexpensive materials and mechanisms in order to avoid huge losses of money if the prototype does not work as planned.

Fulfillment Strategy: Cheap materials and actuators should be researched and tested using various testing software to determine cheap materials that still allow for the gimbal to function as expected.

2 CONCEPTUAL ANALYSIS

2.1 BACKGROUND RESEARCH

Most Gimbal use brushless motors as a way to rotate arms over various axes. Brushless motors create electromagnetic chambers using copper wires which rotate when a pulse is added, allowing for a constant spin cycle that can spin other mechanisms such as gears. [1]

2.2 CONCEPTS CONSIDERED

2.2.1 The Sphere

The first concept considered was a gimbal that relied upon a spherical shell for which the GoPro can securely rest in during flight. This sphere would have a tight fit compartment for the GoPro to attach and would feature a snap to close back similar to snap closures found on television remotes. Figure 1 depicts an image of this spherical holding. The Sphere would also include cylindrical light weight arms capable of rotating the spherical holding when acted upon by an actuator. The sphere features a series of rubber dampeners and has the ability to rotate across the pitch and roll axes. The Sphere is also very short and weighs very little. Figure 2 provides a full depiction of The Sphere. The sphere will have an integrated spring action piston that will push the button on the GoPro.

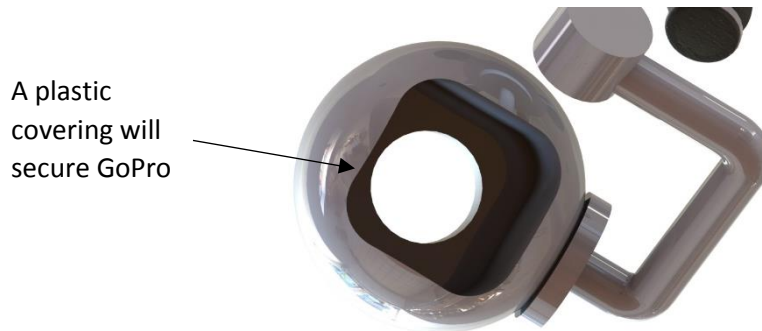


Figure 1. A spherical holding for the GoPro camera with an easy to close back.

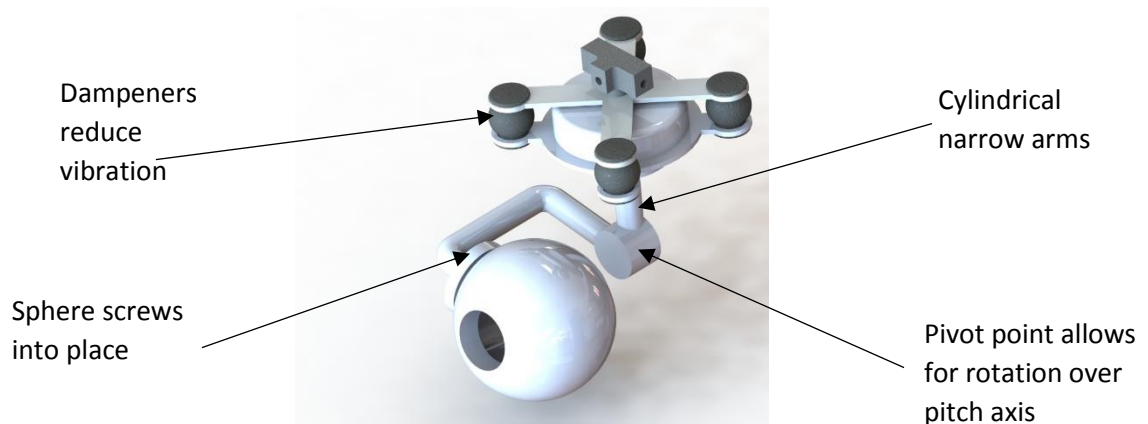


Figure 2. A depiction of The Sphere.

2.2.2 The Cube

The second concept considered was a gimbal that focus on a cubic housing that is similar in shape to the GoPro camera. The Cube will feature two separate coverings for the GoPro. These two coverings will easily attach together through precise extrusions. The Cube also focuses on maintain a center of mass central to the Inspire's gimbal frame by providing symmetry in its design and functionality. The Cube will also feature many dampeners to reduce the vibration that occurs along it's body. The arms of The Cube range from cylindrical to rectangular in nature. The Cube also features snap hooks that easily attach to Inspire's gimbal frame. The Cube will have a cover above the GoPro case that will house a mechanical button that is used to activate the GoPro's switch. Figure 3 depicts The Cube below.

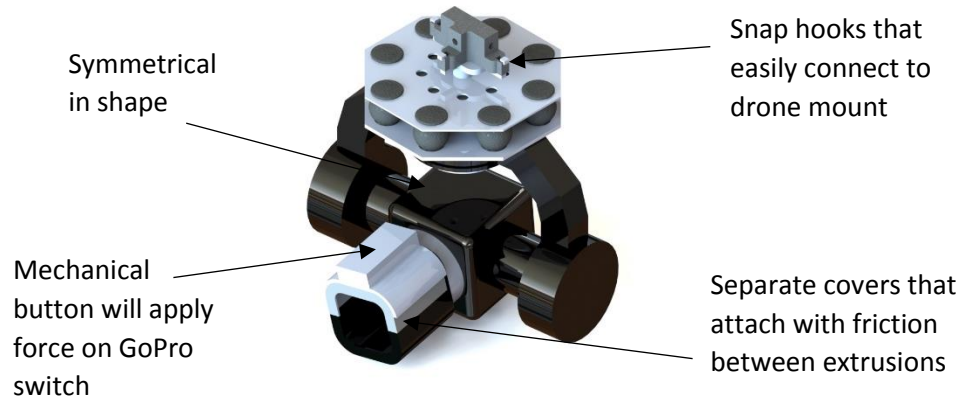


Figure 3. Depiction of The Cube gimbal

2.2.3 The Stick

The final concept considered was The Stick. The stick is a long gimbal that resembles a straight pole, but has various arms that allow for rotation in pitch and roll. The Stick is made of cylindrical parts that connect directly to the Inspire's gimbal frame. The Stick also holds one large dampener of equal diameter to the arm's cross sections as opposed to multiple dampeners. The end of The Stick has a "cage" that creates a tight grasp on the GoPro camera. The Stick also possess the same mechanical button as the Cube. The Stick is the lightest and thinnest of the concepts, with a high emphasis on center of mass. Figure 4 shows a depiction of The Stick

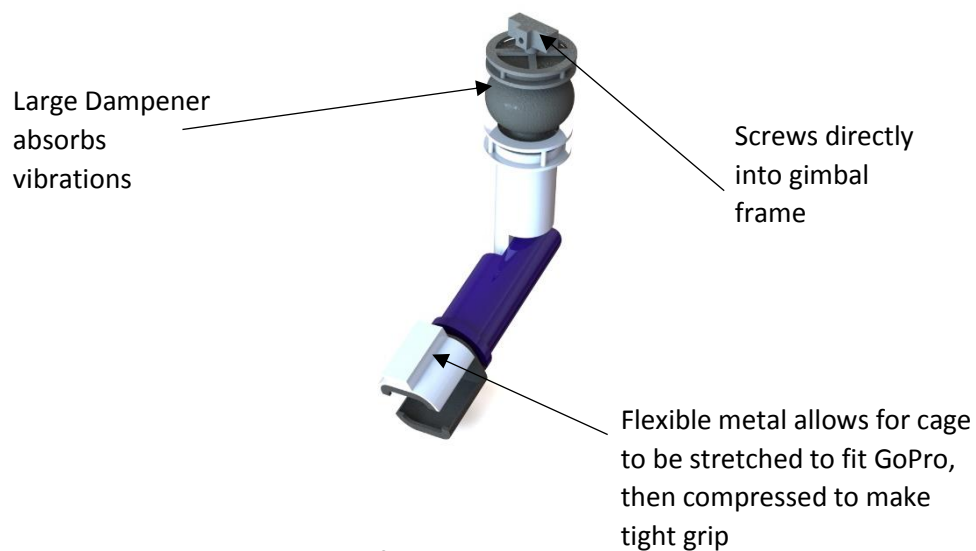


Figure 4. A representation of The Stick.

2.3 OPTIONS ANALYSIS

The most important requirement is that the gimbal attach to both the GoPro and the Drone. This is due to the fact the gimbals main purpose is to be medium between the GoPro and the Inspire, allowing for the recording of the camera from the drone's perspective. All three of the gimbal concepts connect to both the GoPro and the Inspire and pass this requirement. The next important requirement is that the gimbal is able to rotate at least 2 axes. This is important because the gimbal's purpose is to provide video capture of a camera attached to a moving drone. The motion of the drone requires that the gimbal rotate in order to maintain constant footage. Both The Cube and The Stick are capable of rotating on three axes, while The Sphere is only capable of rotating around 2 axes. The next requirement to be considered is the need for actuators common to remote controlled vehicles. Without actuators, the gimbal cannot be controlled manually and would not be able to rotate under controlled circumstances. All three gimbals have the ability to use actuators like brushless motors to rotate; however, The Cube is the only design that has adequate space to house these actuators. The next important requirement is the need for the gimbal to not drastically impact flight times. The Cube is considerably more massive than the other 2 concepts, with the Stick ranging in the middle, and The Sphere being the lightest of the three. This would indicate that the Sphere is the best choice for this requirement. The next important requirement to consider is the need for the gimbal to have a form of absorption that reduces the effects of the drone's vibrations. All three concepts feature dampening, however The Stick has a very heavy dampener that may not work as well due to its weight, The Cube has many dampeners that exceed this requirement. The next requirement to consider is the need for the gimbal to be above the ground by 15mm while the drone is landed. The Stick is very long and probably will not meet this requirement because of its length, the cube and the sphere are about the same length and will both meet this requirement. Another semi important requirement is the need for the camera's pov to be unobstructed during flight. Both The Cube and The Stick lie far below the drone and will not capture the legs in footage. The sphere is not protruded forward and may capture the bottom of the drone. The spherical holding of The Sphere also obstructs the vision of the GoPro. A semi-important requirement to consider would be the need for equal weight distribution. The stick is very symmetrical with its weight distribution. The Cube is also fairly symmetrical while The Sphere may not pass this requirement due to the weight of its pitch arm. Another requirement is that the gimbal have a mechanical way of pressing the button located on top of the GoPro. All three concepts have a way of managing this requirement, although the Sphere might not have enough space within the spherical holding to function successfully. None of the goals are vital to the gimbal's success, however they do improve the quality of the gimbal. The first goal is for the gimbal to have three rotational axes for extended movement. The Cube and the Stick both meet this, but the Sphere does not. The next goal is for both the GoPro and Inspire to be easily attachable. The GoPro is easily attachable for all three concepts, but The Stick and The Sphere do not have easy methods for attachment to the drone. The last goal is for the gimbal to be cheap and all of the concepts have the ability to be cheap. Based off this options analysis, the overall best concept of the three gimbals is The Cube. Table 1 below summarizes this options analysis.

Table 1. Decision Matrix

	Weight	Concept 1	Concept 2	Concept 3
Requirement 1.2.1	5	2	3	2
Requirement 1.2.2	4	3	1	2
Requirement 1.2.3	5	2	2	2
Requirement 1.2.4	5	2	2	2
Requirement 1.2.5	3	1	3	3
Requirement 1.2.6	3	1	2	2
Requirement 1.2.7	3	2	2	1
Requirement 1.2.8	4	1	3	2
Requirement 1.2.9	4	2	3	1
Requirement 1.2.10	3	1	2	3
Goal 1.3.1	2	0	2	2
Goal 1.3.2	2	1	3	1
Goal 1.3.3	2	2	2	2
Goal 1.3.4	1	2	2	2
Total (optional)				

Exceeds = 3 Points

Meets = 2 Points

Questionable = 1 Point

Does Not Meet = 0 Points

3 SYSTEM OVERVIEW

3.1 PHYSICAL DESCRIPTION

The final version of The Cube looks similar to its conceptual picture. It is more compact than the concept and can be seen below in Figure 5. A drone mount fits into the Inspire's gimbal frame. The Cube features three snap hooks that hook onto the drone mount and securely hold the gimbal while the drone is moving. 8 dampeners connect the clip frame to a separate frame that houses the yaw arm connector as seen in figure 6. Two yaw arms drop down 40mm and are securely screwed to the pitch arm. The pitch arm includes two cylindrical extrusions from a cube shaped center. The cube is attached to a small arm that rotates with roll and is connected to the cover for the GoPro. The Button housing is attached to the top GoPro cover with an adhesive and holds the button for which the GoPro switch is activated, as seen in Figure 7. The mass of the gimbal is 567g and has a resting length of 144mm.

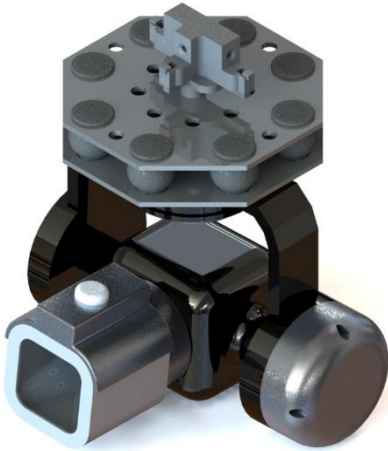


Figure 5. Completed Cube gimbal model.

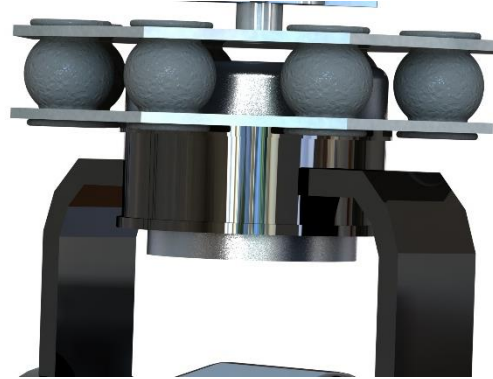


Figure 6. Yaw arm is secured between a frame and a cap via screws.

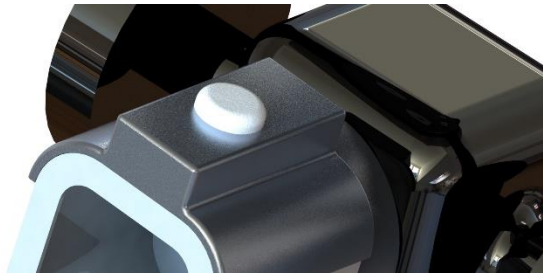


Figure 7. The button housing sticks to top cover and holds button.

3.2 FUNCTIONAL DESCRIPTION

The gimbal is connected to the drone by first attaching the “drone mount” to the Inspire’s gimbal frame via 3 flat head screws. The drone mount features easy clip on cuts that allow for snap hooks to easily be attached to the mount. Figures 8 and 9 demonstrate this clip on feature.

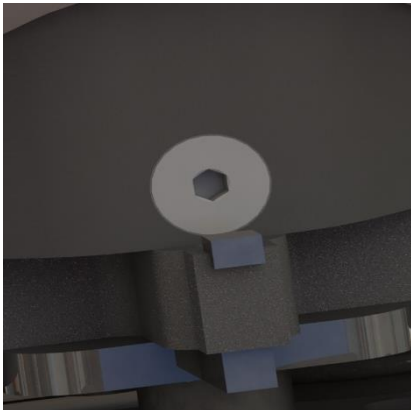


Figure 8. Drone mount screws into the gimbal frame.

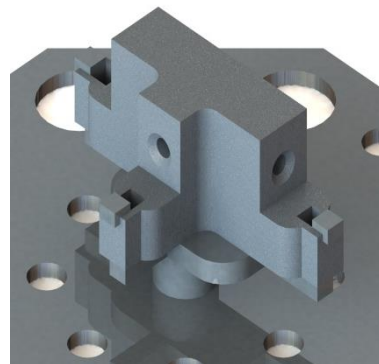


Figure 9. Snap hooks clip on to mount.

Each of the rotating arms is controlled using a brushless motor and a gear system that turns the arms. As the controller puts an input into the brushless motor, it will begin to turn the gears which will rotate the arm that the motor is acting upon. A picture of the gear set up is shown in figure 8 below.

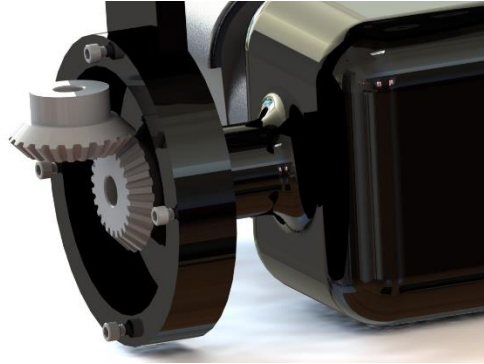


Figure 8. Gear Setup for rotation. Note that housing for gears was removed to show gears. The provided drawings found in Appendix B further highlight how the gears are set up.

Dampeners absorb the vibrations from the drone and increase the stability of camera footage as a result. The GoPro mount also reduces vibrations by creating a tight fit for the GoPro to lie in during flight. The GoPro mount features two parts, a base and a cover. The cover of the mount has grooves along the edge that fit and snap into place with the base. The GoPro mount is shown in the figures below.

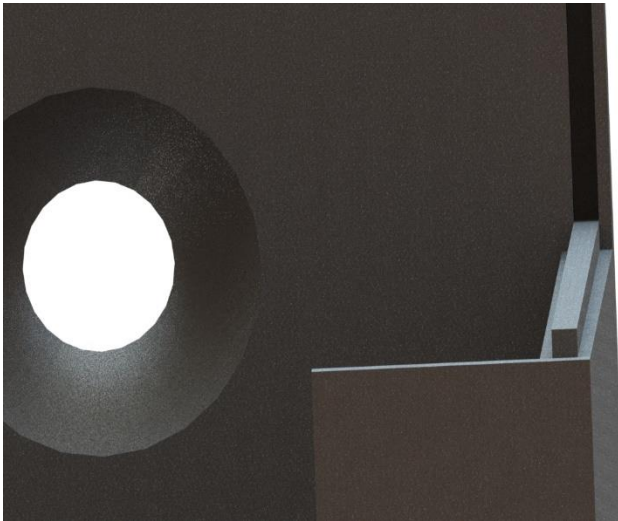


Figure 11 & 12. The base has an extrusion along the sides while the cover has a slot of equal dimensions. The base also features a slot in the back while the cover has an extrusion along the back of equal dimension. Since the case is made of ABS Plastic, the cover will slide onto the base with force and will remain during the Inspire's flight.

The button found on top of the GoPro cover utilizes the GoPro's switch mechanics and when pressed down will apply pressure to the switch activating it. Once the button is let go, the spring in the GoPro's switch will also spring the button back into place. The button has extrusions along the side that prevent it from flying out of its housing. The button pressed down can be seen in Figure 13.

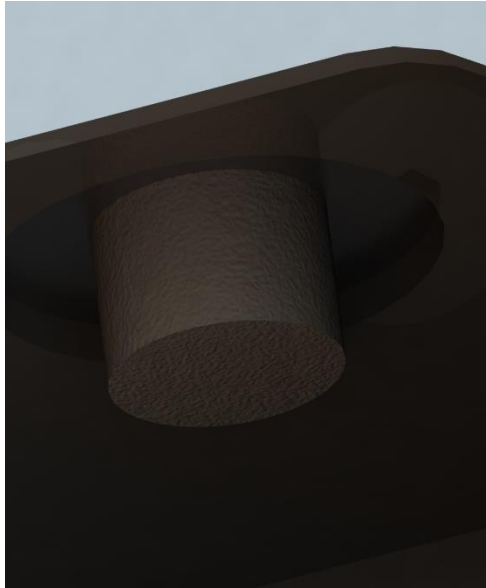


Figure 13. The button is pushed down and applies pressure to GoPro switch.

Additional images of the gimbal are shown below.



Figure 14. Gimbal attached to the DJI Inspire.

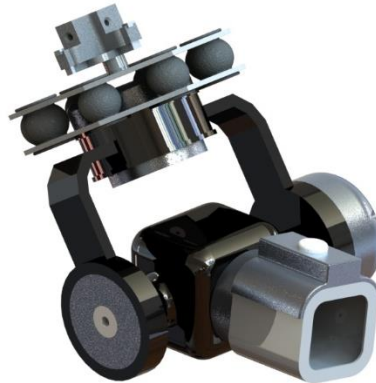


Figure 15. The Cube in motion.



Figure 16. Exploded view of Gimbal.

4 REFERENCES

- [1] http://www.shapeways.com/tutorials/designing_mechanical_parts_3d_printing_the_whoosh

Appendix A

Bill of Materials

DJI INSPIRE GIMBAL DESIGN

Revision:1

Effective Date: 11/12/2016

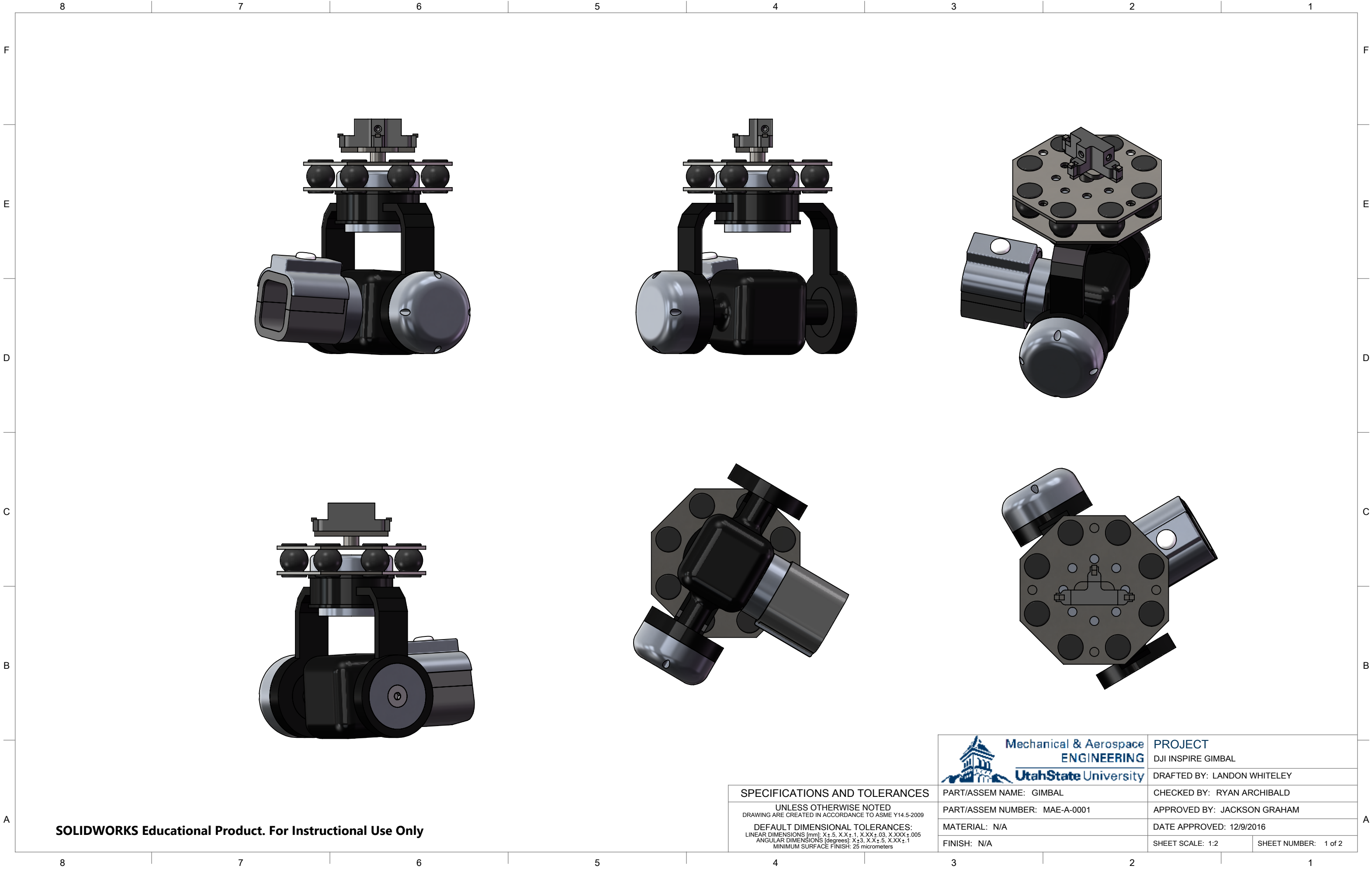
Page B1 of B1

Item No.	Part Name/Description	Part Number	Vendor/Manufacturer	Cost Ea.	QTY.	Total
1	Plastic Gear for 90° Motion Transfer	7297K140	McMASTER-CARR	\$5.30	6	\$31.80
2	Black-Oxide Alloy Steel Socket Head Screw	90044A282	McMASTER-CARR	\$8.72 (for 10)	4	\$8.72
3	Black-Oxide Alloy Steel Hex Drive Flat Head Screw	91253A107	McMASTER-CARR	\$8.49 (for 100)	4	\$8.49
4	Black-Oxide Alloy Steel Hex Drive Flat Head Screw	91253A109	McMASTER-CARR	\$6.21 (for 50)	8	\$6.21
5	Black-Oxide Alloy Steel Hex Drive Flat Head Screw	91253A537	McMASTER-CARR	\$10.87 (for 50)	3	\$10.87
6	Black-Oxide Alloy Steel Hex Drive Flat Head Screw	91253A540	McMASTER-CARR	\$7.86 (for 50)	1	\$7.86
7	Vibration Absorbing Rubber Ball	MAE-P-0017	Amazon	\$5.50 (for 3)	8	\$16.50
8	TMotor UAV Brushless Motor	MS2216	Robotstop	\$29.90	3	\$89.70

TOTAL \$180.15

Appendix B

Drawing Package

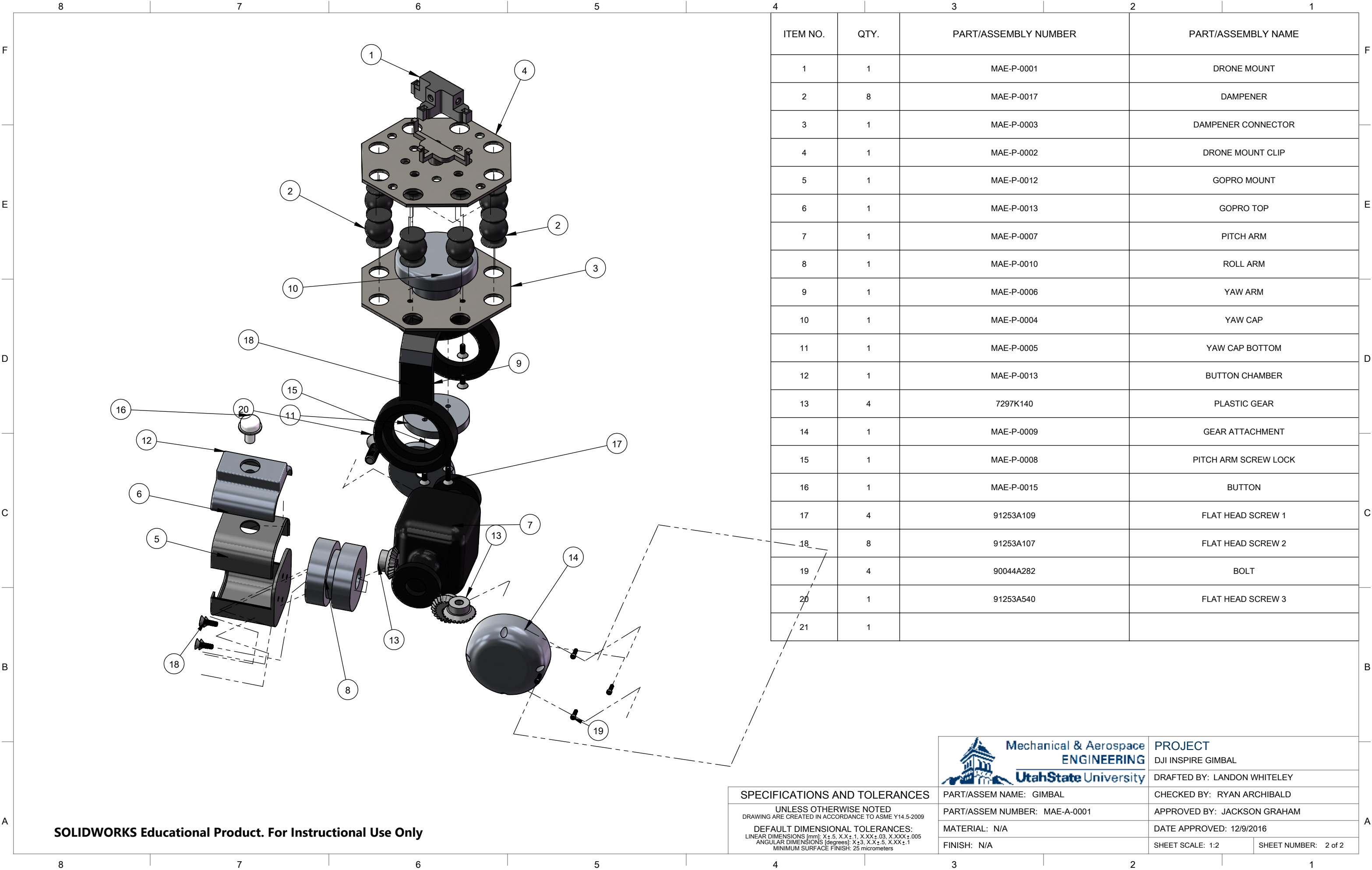


SPECIFICATIONS AND TOLERANCES

UNLESS OTHERWISE NOTED
DRAWING ARE CREATED IN ACCORDANCE TO ASME Y14.5-2009

DEFAULT DIMENSIONAL TOLERANCES:
LINEAR DIMENSIONS [mm]: X $\pm$ 5, XX $\pm$ 1, XXX $\pm$ 0.5, XXXX $\pm$ 0.005
ANGULAR DIMENSIONS [degrees]: X $\pm$ 3, XX $\pm$ 5, XXX $\pm$ 1
MINIMUM SURFACE FINISH: 25 micrometers

 Mechanical & Aerospace ENGINEERING UtahState University	PROJECT DJI INSPIRE GIMBAL	
	DRAFTED BY: LANDON WHITELEY	
	CHECKED BY: RYAN ARCHIBALD	
	APPROVED BY: JACKSON GRAHAM	
	DATE APPROVED: 12/9/2016	
PART/ASSEM NAME: GIMBAL	SHEET SCALE: 1:2	
PART/ASSEM NUMBER: MAE-A-0001	SHEET NUMBER: 1 of 2	
MATERIAL: N/A		
FINISH: N/A		

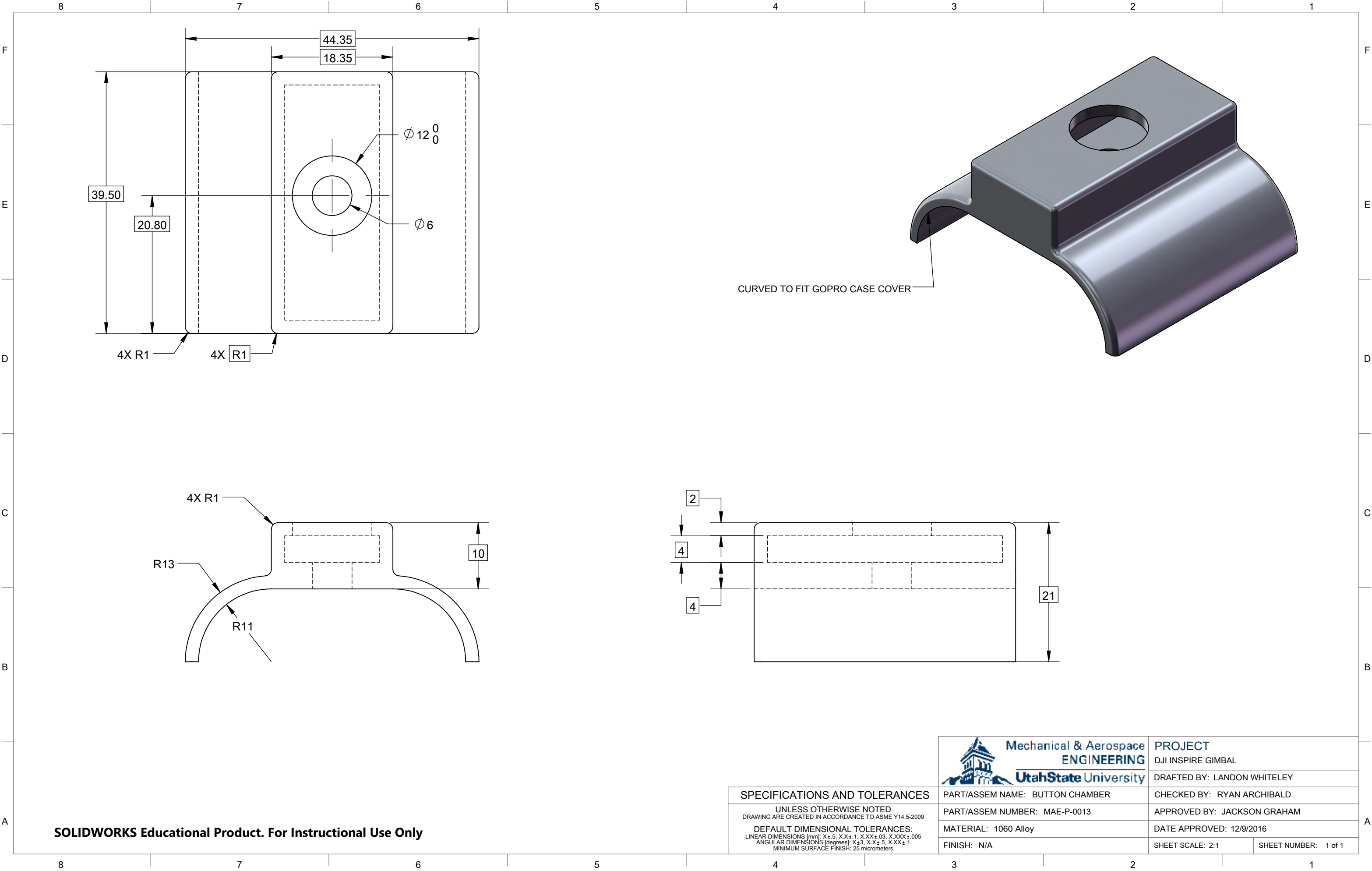


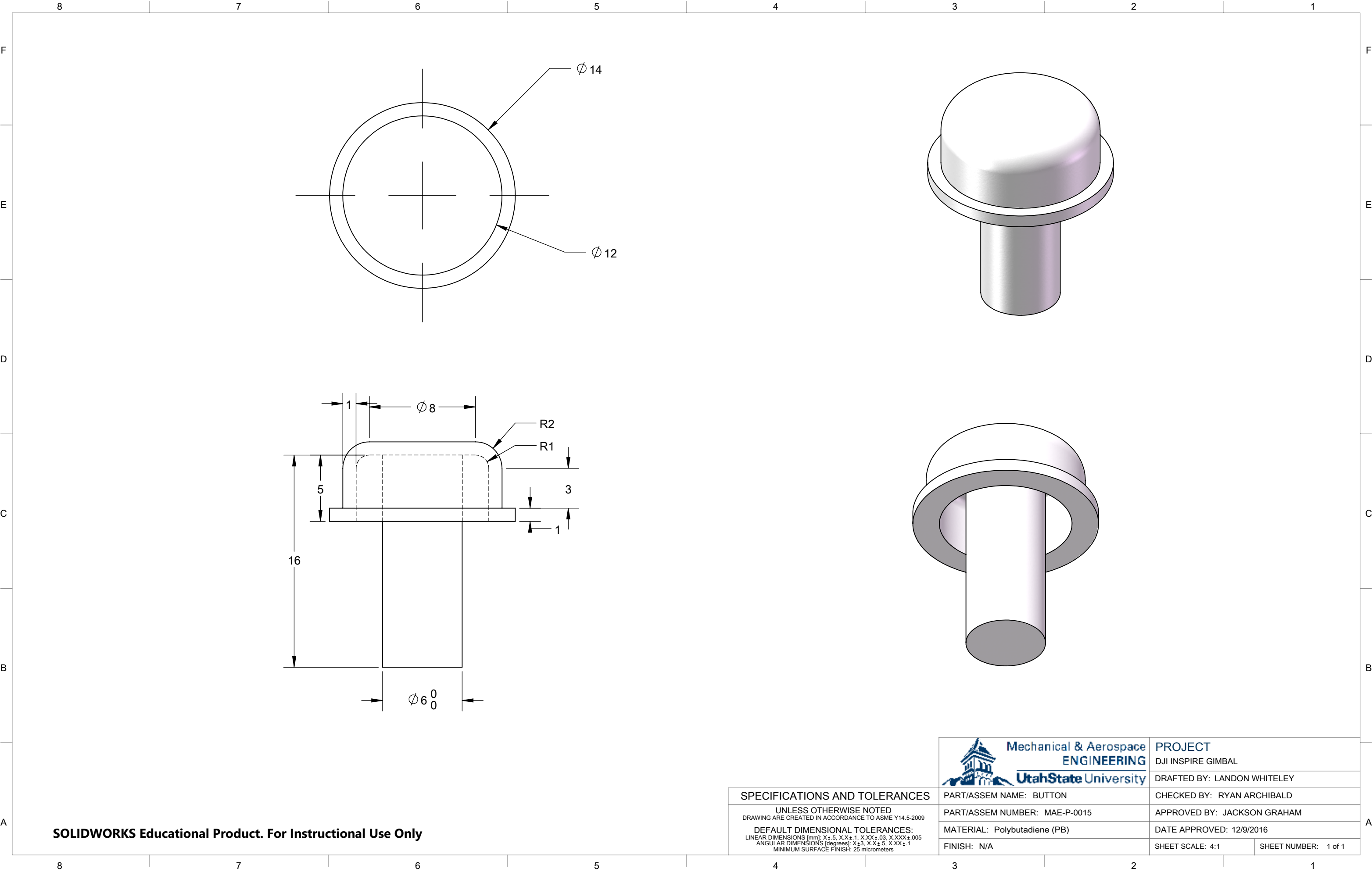
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2	8	MAE-P-0017	DAMPENER
3	1	MAE-P-0003	DAMPENER CONNECTOR
4	1	MAE-P-0002	DRONE MOUNT CLIP
5	1	MAE-P-0012	GOPRO MOUNT
6	1	MAE-P-0013	GOPRO TOP
7	1	MAE-P-0007	PITCH ARM
8	1	MAE-P-0010	ROLL ARM
9	1	MAE-P-0006	YAW ARM
10	1	MAE-P-0004	YAW CAP
11	1	MAE-P-0005	YAW CAP BOTTOM
12	1	MAE-P-0013	BUTTON CHAMBER
13	4	7297K140	PLASTIC GEAR
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15	1	MAE-P-0008	PITCH ARM SCREW LOCK
16	1	MAE-P-0015	BUTTON
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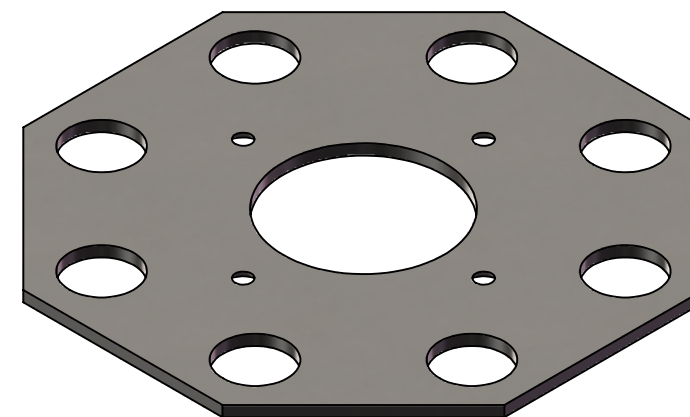
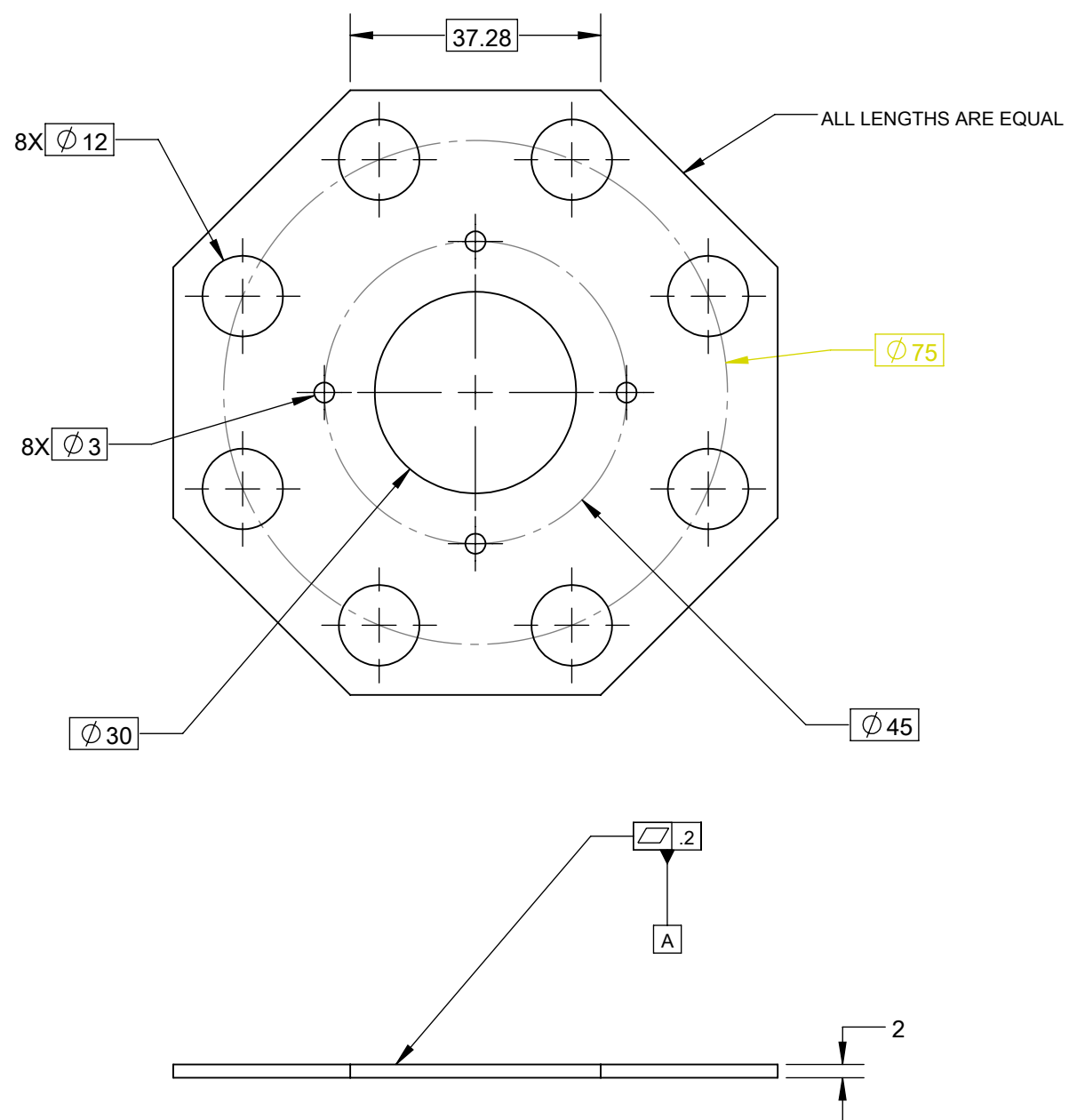
SPECIFICATIONS AND TOLERANCES
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DEFAULT DIMENSIONAL TOLERANCES:
LINEAR DIMENSIONS [mm]: X±.5, XX±.1, XXX±.03, XXXX±.005
ANGULAR DIMENSIONS [degrees]: X±3, XX±.5, XXX±.1
MINIMUM SURFACE FINISH: 25 micrometers



PROJECT DJI INSPIRE GIMBAL	
DRAFTED BY: LANDON WHITELEY	
CHECKED BY: RYAN ARCHIBALD	
APPROVED BY: JACKSON GRAHAM	
DATE APPROVED: 12/9/2016	
SHEET SCALE: 1:2	SHEET NUMBER: 2 of 2

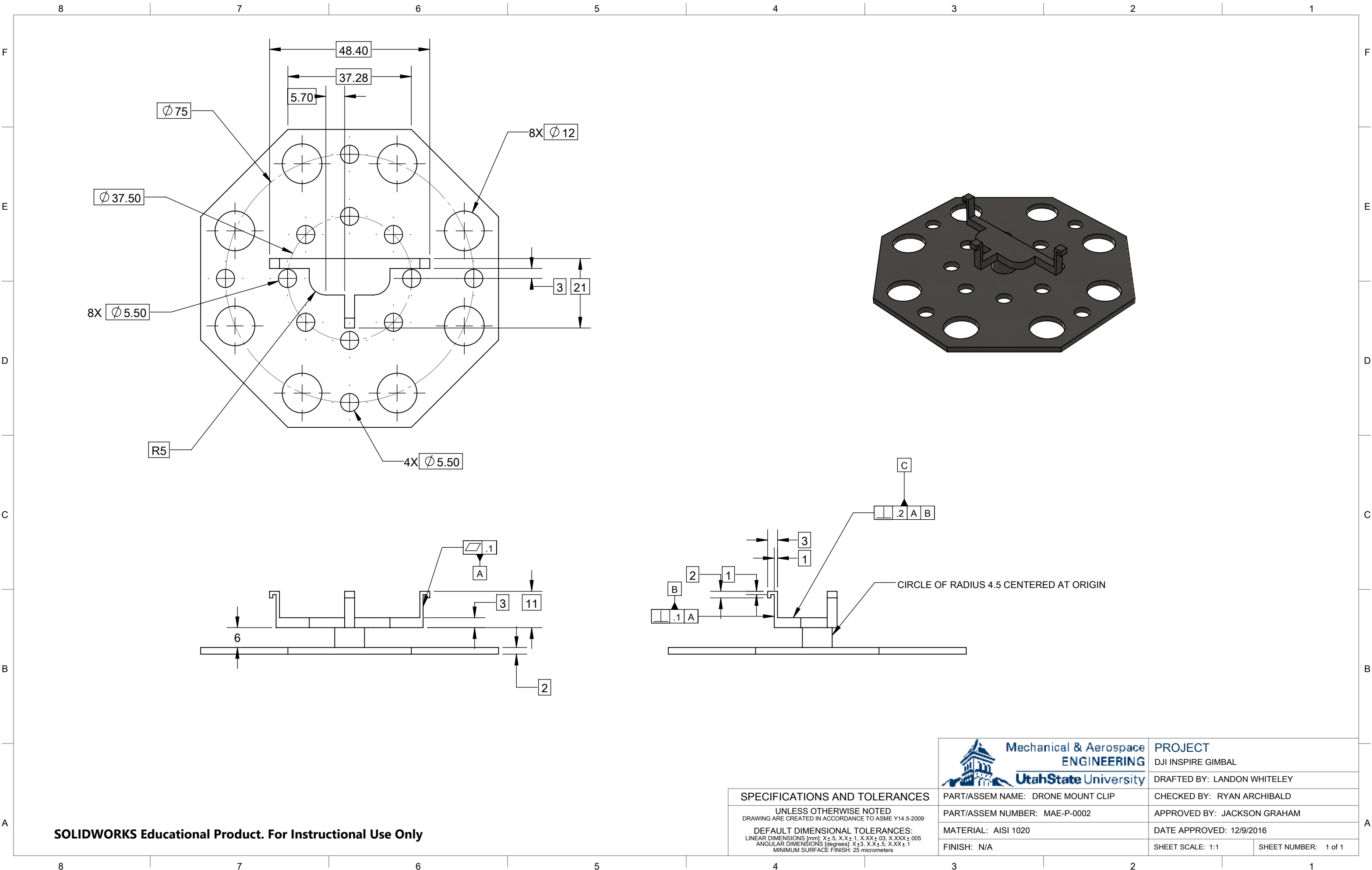






SPECIFICATIONS AND TOLERANCES
UNLESS OTHERWISE NOTED DRAWING ARE CREATED IN ACCORDANCE TO ASME Y14.5-2009
DEFAULT DIMENSIONAL TOLERANCES: LINEAR DIMENSIONS [mm]: X $\pm$ 5, XX $\pm$ 1, XXX $\pm$ 0.3, XXXX $\pm$ 0.05 ANGULAR DIMENSIONS [degrees]: X $\pm$ 3, XX $\pm$ 5, XXX $\pm$ 1 MINIMUM SURFACE FINISH: 25 micrometers

 Mechanical & Aerospace ENGINEERING UtahState University	PROJECT DJI INSPIRE GIMBAL	
	DRAFTED BY: LONDON WHITELEY	
	CHECKED BY: RYAN ARCHIBALD	
	APPROVED BY: JACKSON GRAHAM	
	DATE APPROVED: 12/9/2016	
PART/ASSEM NAME: DAMPENER CONNECTOR	PART/ASSEM NUMBER: MAE-P-0003	MATERIAL: AISI 1020
FINISH: N/A	SHEET SCALE: 1:1	SHEET NUMBER: 1 of 1



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SPECIFICATIONS AND TOLERANCES

UNLESS OTHERWISE NOTED
DRAWING ARE CREATED IN ACCORDANCE TO ASME Y14.5-2009
DEFAULT DIMENSIONAL TOLERANCES:
LINEAR DIMENSIONS (mm): X $\pm$ 5, XX $\pm$ 1, XXX $\pm$ 0.3, XXXX $\pm$ 0.05
ANGULAR DIMENSIONS (degrees): X $\pm$ 3, XX $\pm$ 5, XXX $\pm$ 1
MINIMUM SURFACE FINISH: 25 micrometers



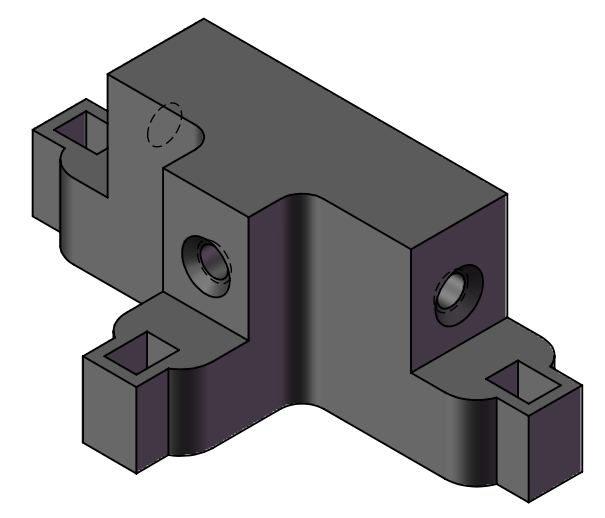
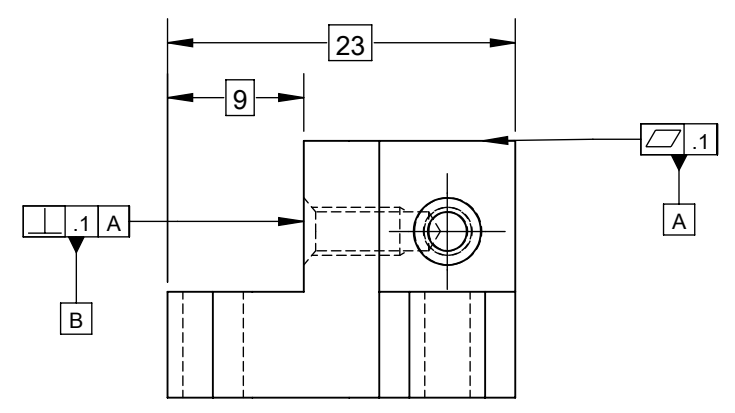
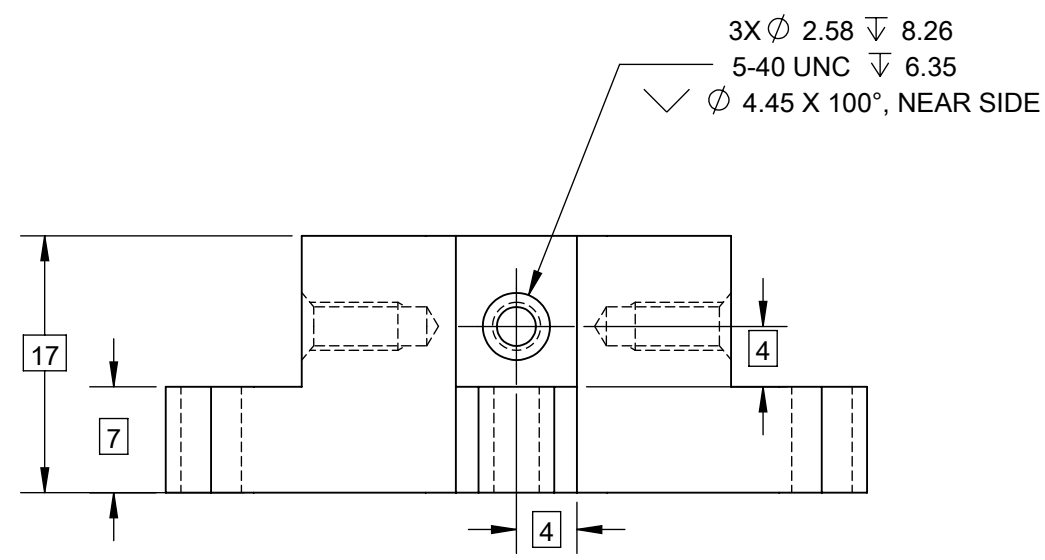
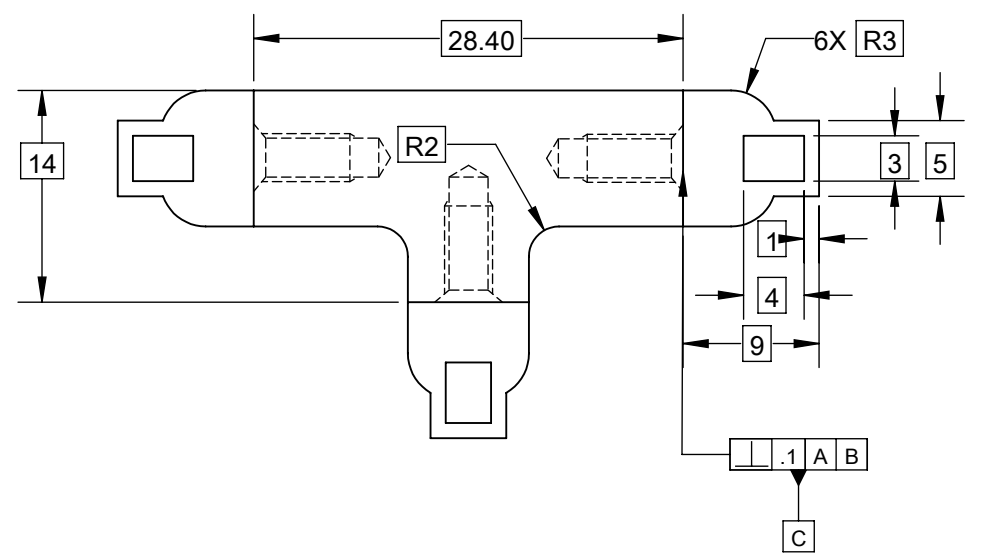
PROJECT	
DJI INSPIRE GIMBAL	
DRAFTED BY: LONDON WHITELEY	
CHECKED BY: RYAN ARCHIBALD	
APPROVED BY: JACKSON GRAHAM	
DATE APPROVED: 12/9/2016	
SHEET SCALE: 1:1	SHEET NUMBER: 1 of 1

PART/ASSEM NAME: DRONE MOUNT CLIP

PART/ASSEM NUMBER: MAE-P-0002

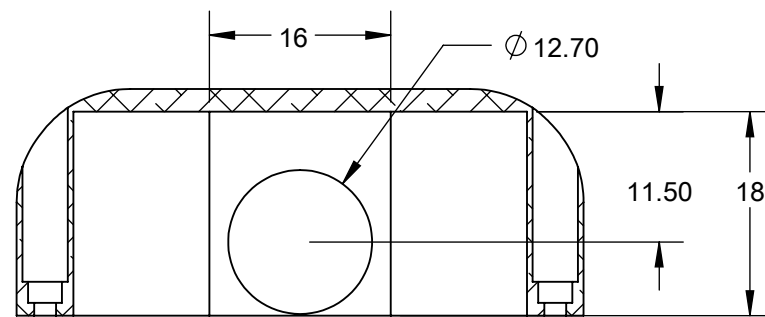
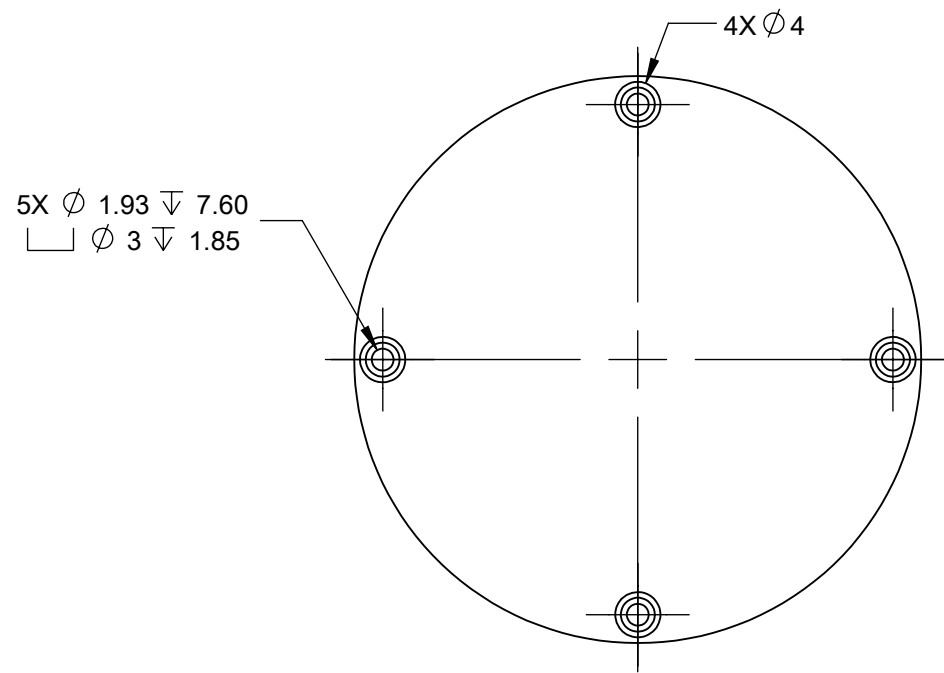
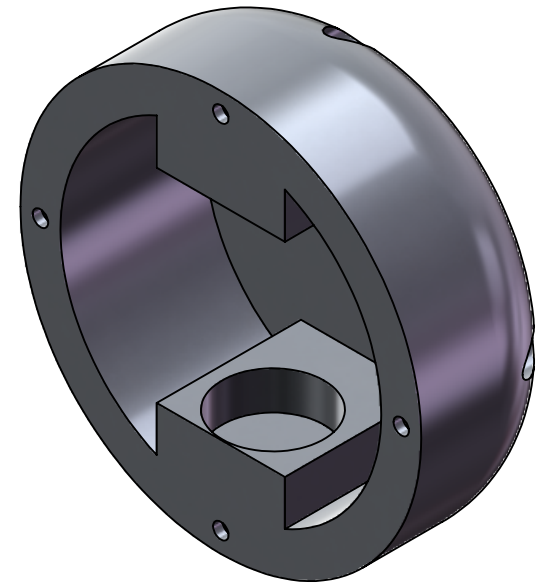
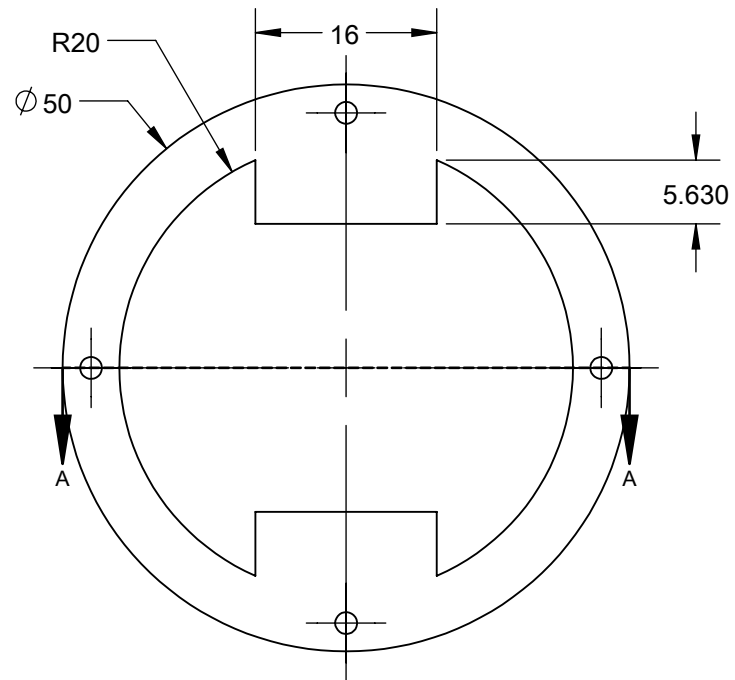
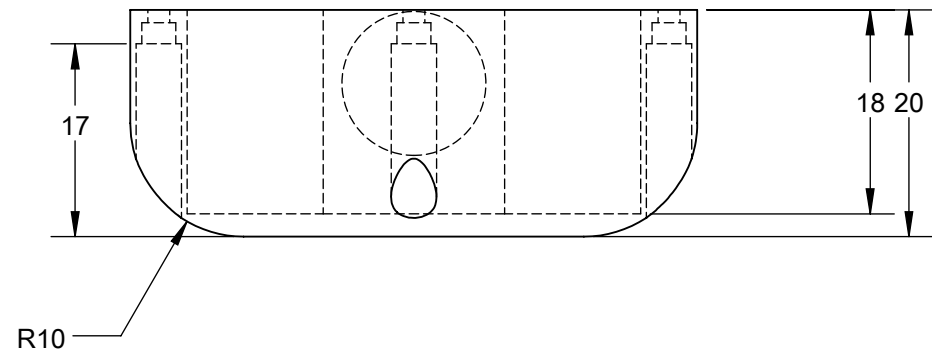
MATERIAL: AISI 1020

FINISH: N/A



SPECIFICATIONS AND TOLERANCES	
UNLESS OTHERWISE NOTED DRAWING ARE CREATED IN ACCORDANCE TO ASME Y14.5-2009	
DEFAULT DIMENSIONAL TOLERANCES: LINEAR DIMENSIONS (mm): X $\pm$.5, XX $\pm$.1, XXX $\pm$.03, XXXX $\pm$.005 ANGULAR DIMENSIONS (degrees): X $\pm$ 3, XX $\pm$.5, XXX $\pm$.1 MINIMUM SURFACE FINISH: 25 micrometers	

 Mechanical & Aerospace ENGINEERING UtahState University	PROJECT DJI INSPIRE GIMBAL	
	DRAFTED BY: LANDON WHTIELEY	
	CHECKED BY: RYAN ARCHIBALD	
	APPROVED BY: JACKSON GRAHAM	
	DATE APPROVED: 12/9/2016	
PART/ASSEM NAME: DRONE MOUNT		SHEET SCALE: 2:1
PART/ASSEM NUMBER: MAE-P-0001		
MATERIAL: ABS		
FINISH: N/A		
		SHEET NUMBER: 1 of 1



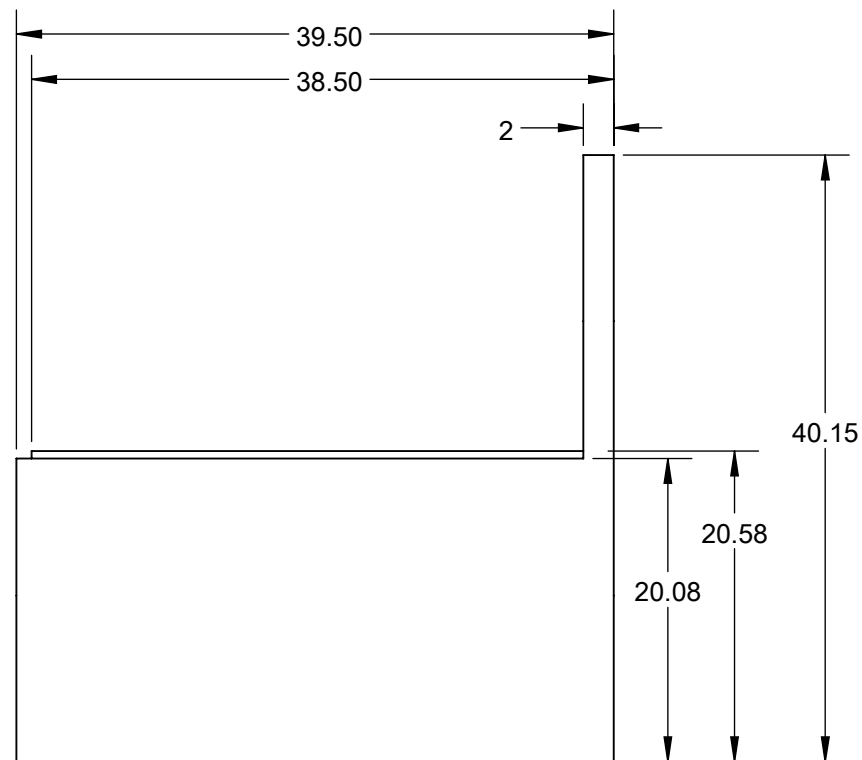
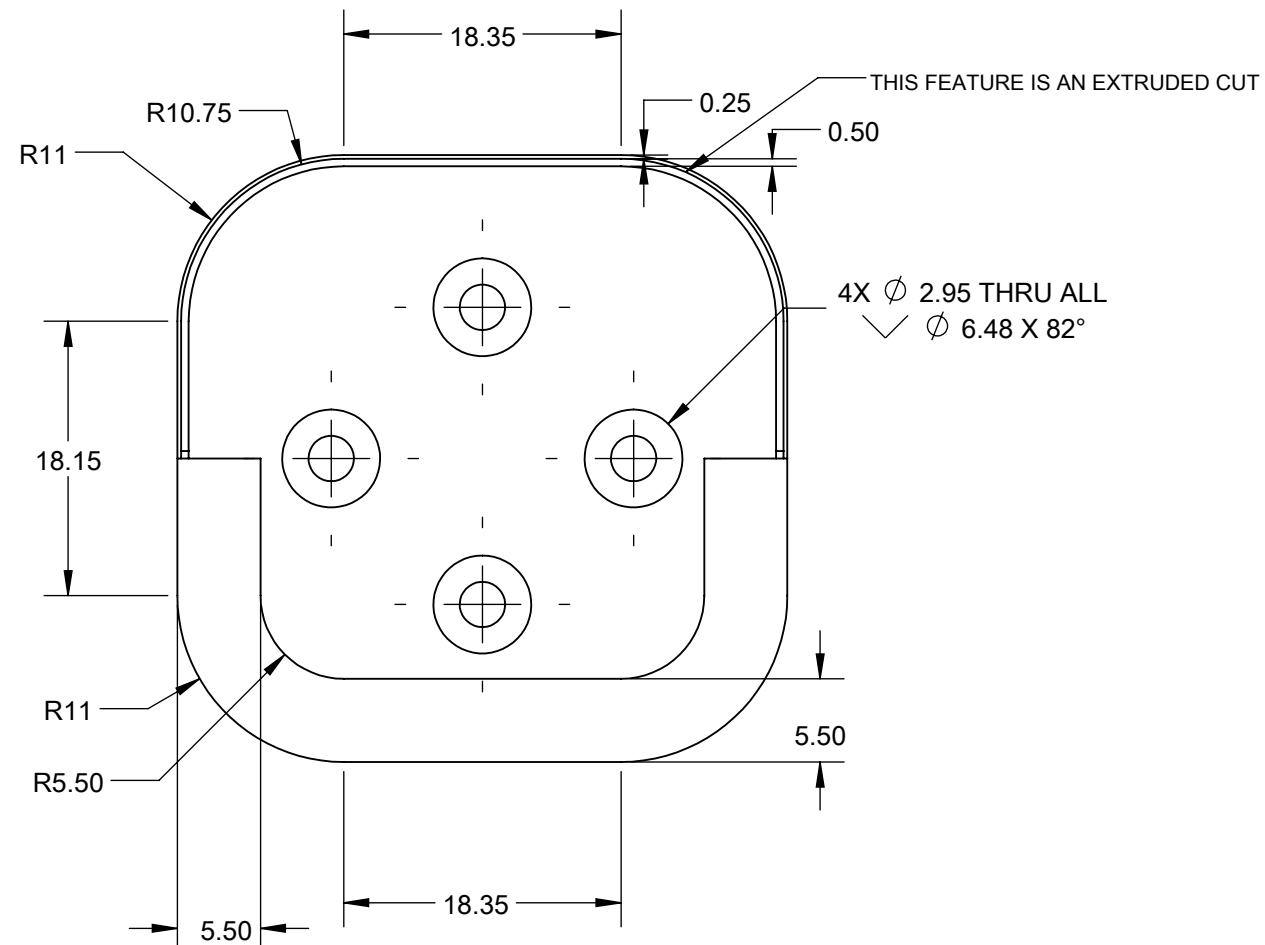
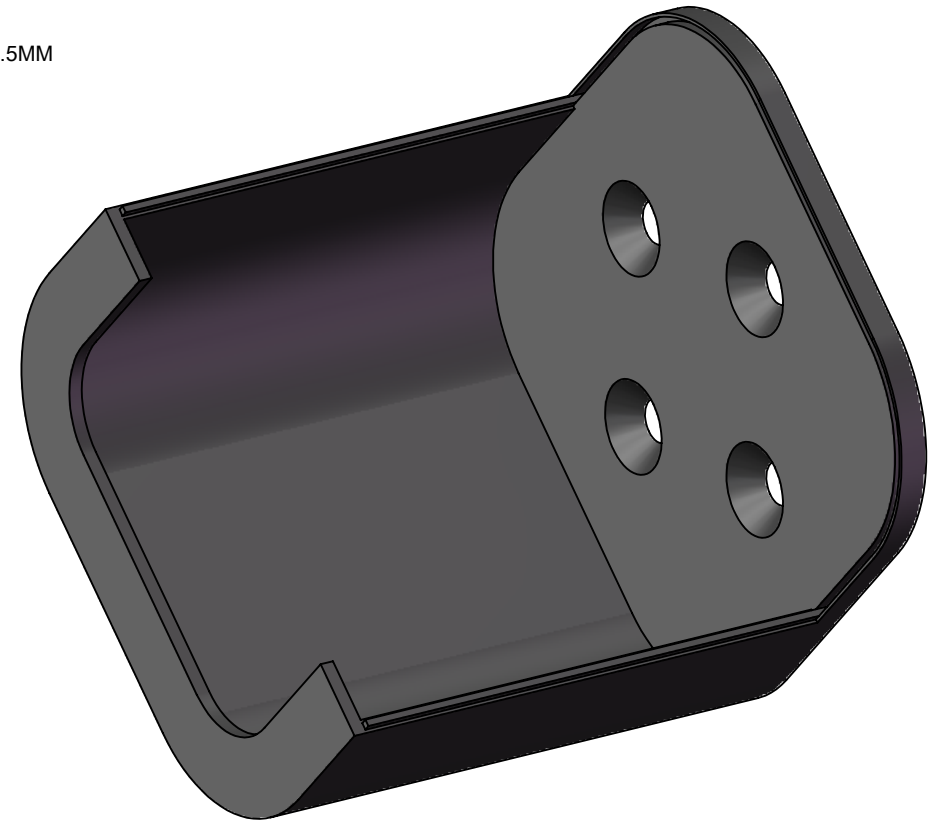
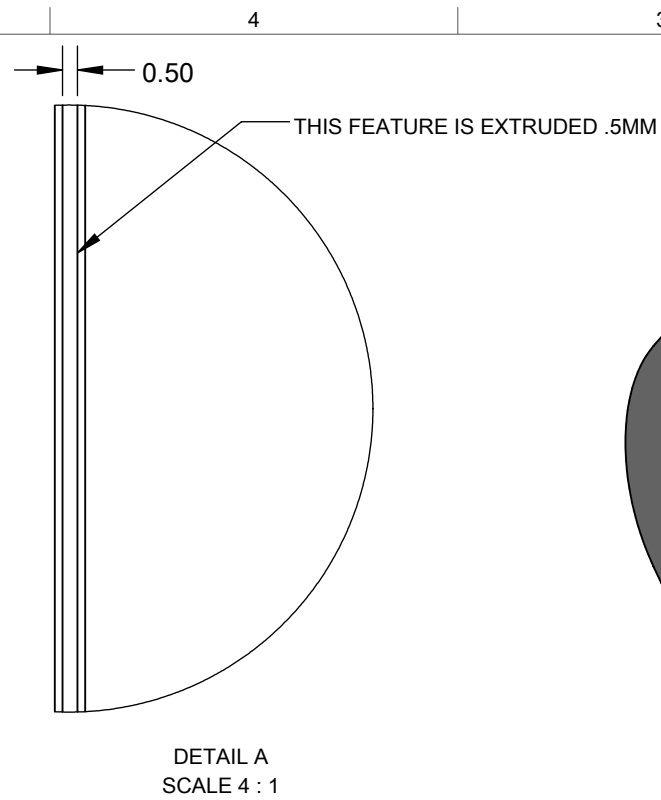
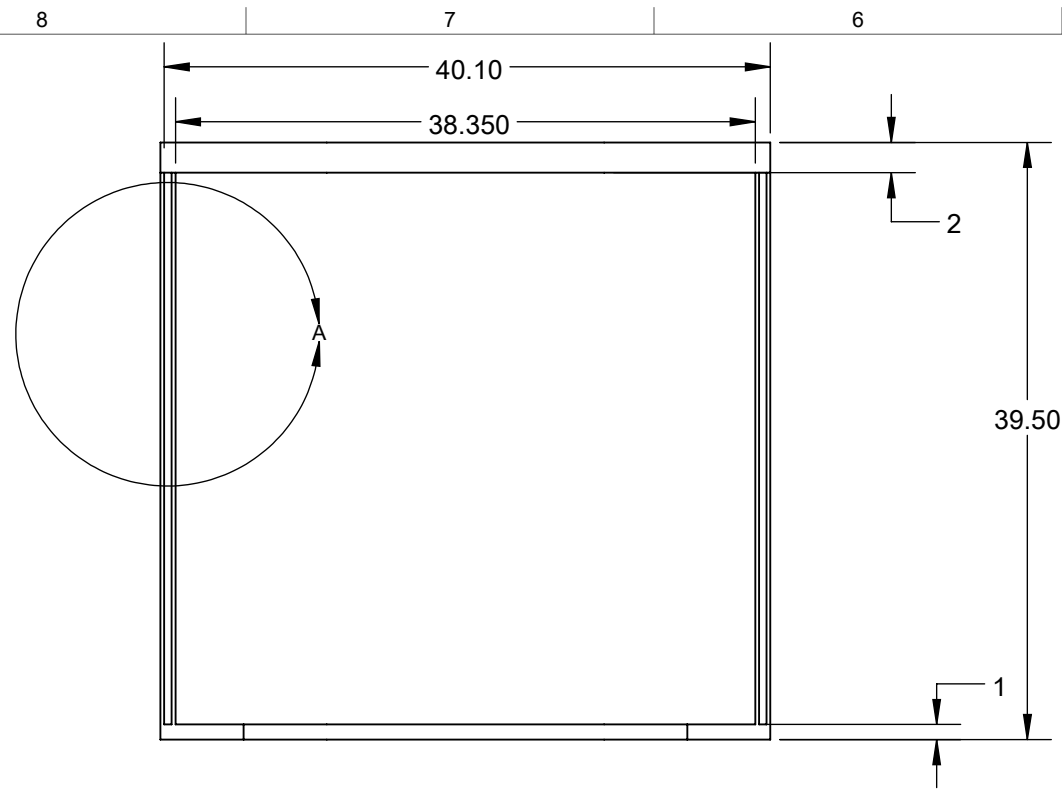
SECTION A-A

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SPECIFICATIONS AND TOLERANCES

UNLESS OTHERWISE NOTED
DRAWING ARE CREATED IN ACCORDANCE TO ASME Y14.5-2009
DEFAULT DIMENSIONAL TOLERANCES:
LINEAR DIMENSIONS (mm): X $\pm$ 5, XX $\pm$ 1, XXX $\pm$ 0.3, XXXX $\pm$ 0.005
ANGULAR DIMENSIONS (degrees): X $\pm$ 3, XX $\pm$ 5, XXX $\pm$ 1
MINIMUM SURFACE FINISH: 25 micrometers

	PROJECT	
	DJI INSPIRE GIMBAL	
	DRAFTED BY: LANDON WHITELEY	
	CHECKED BY: RYAN ARCHIBALD	
	APPROVED BY: JACKSON GRAHAM	
PART/ASSEM NAME: GEAR ATTACHMENT	DATE APPROVED: 12/9/2016	
PART/ASSEM NUMBER: MAE-P-0009	SHEET SCALE: 1.5:1	
MATERIAL: 1060 Alloy	SHEET NUMBER: 1 of 1	
FINISH: N/A		



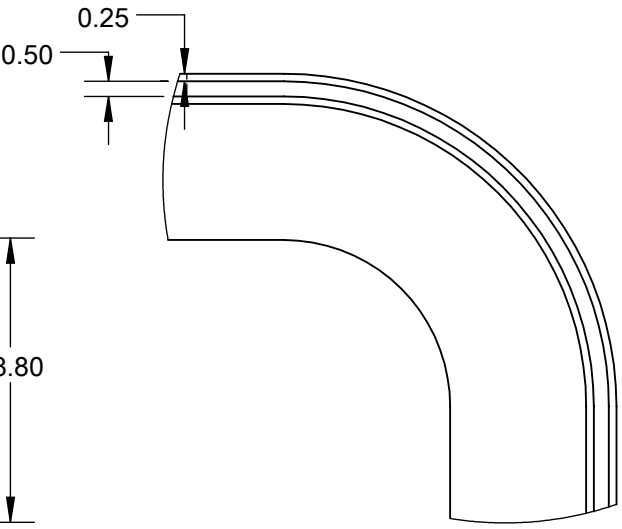
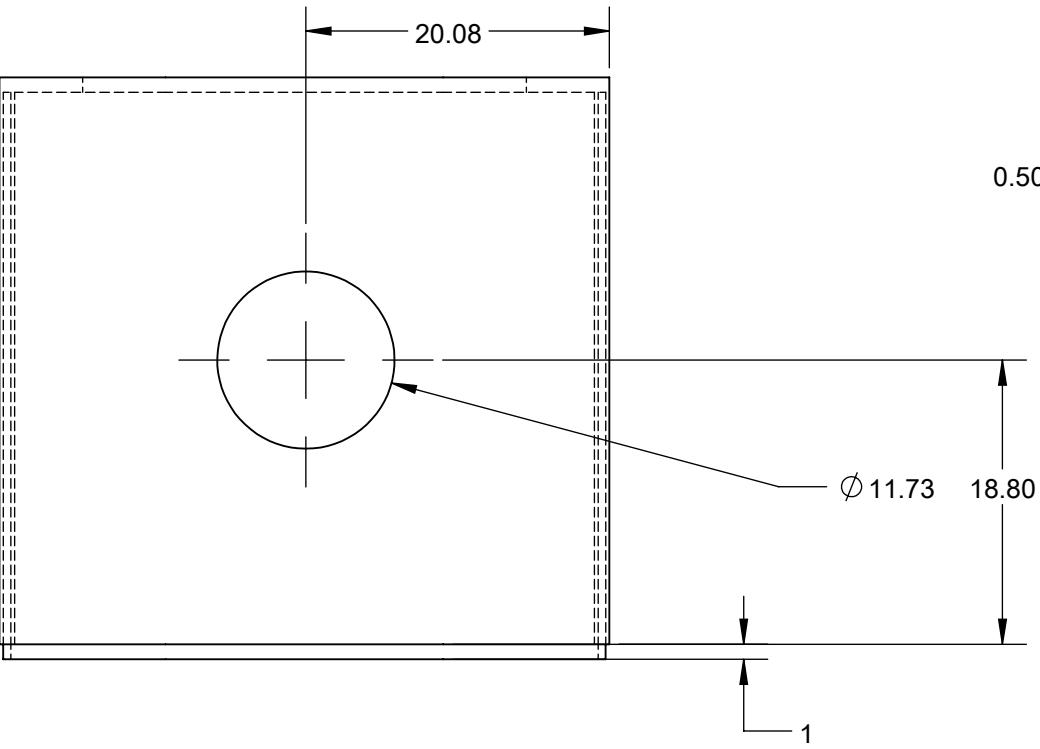
SOLIDWORKS Educational Product. For Instructional Use Only

SPECIFICATIONS AND TOLERANCES

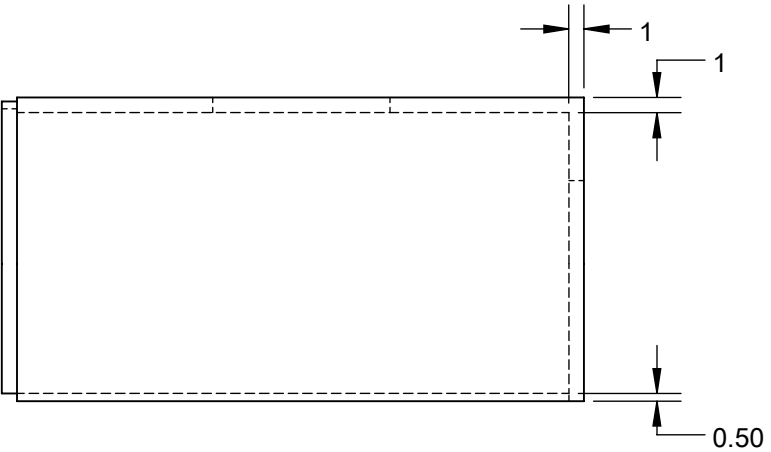
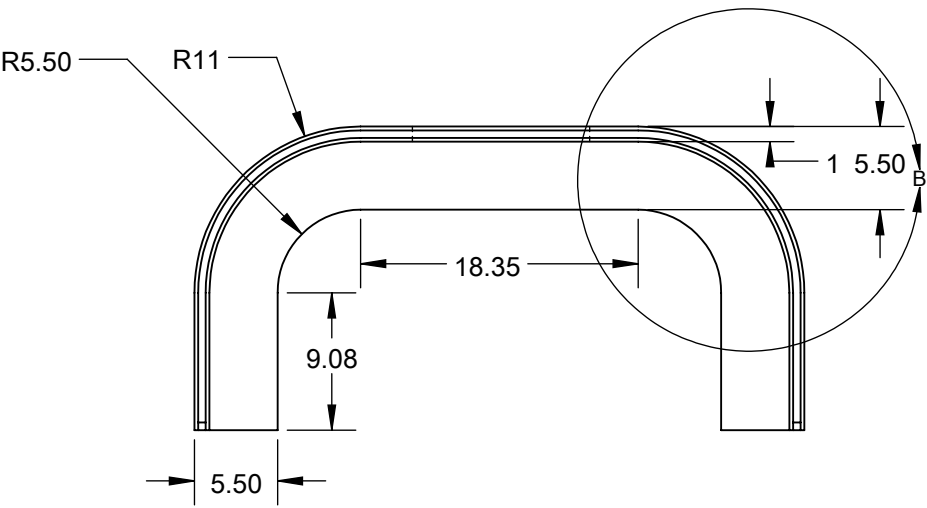
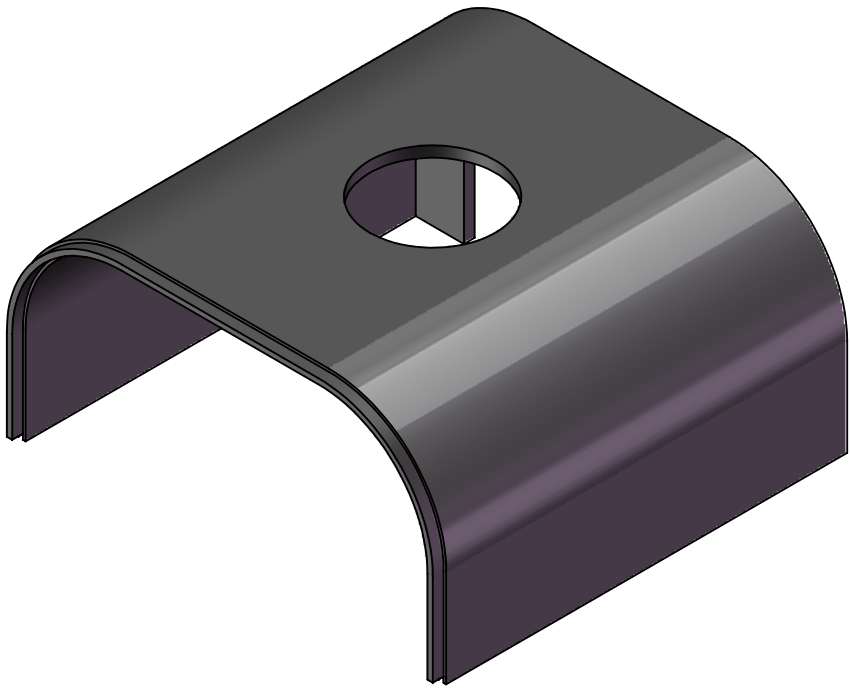
UNLESS OTHERWISE NOTED
DRAWING ARE CREATED IN ACCORDANCE TO ASME Y14.5-2009
DEFAULT DIMENSIONAL TOLERANCES:
LINEAR DIMENSIONS [mm]: X $\pm$ 5, XX $\pm$ 1, XXX $\pm$ 0.3, XXXX $\pm$ 0.005
ANGULAR DIMENSIONS [degrees]: X $\pm$ 3, XX $\pm$ 5, XXX $\pm$ 1
MINIMUM SURFACE FINISH: 25 micrometers



PROJECT	
DJI INSPIRE GIMBAL	
DRAFTED BY: LANDON WHITELEY	
CHECKED BY: RYAN ARCHIBALD	
APPROVED BY: JACKSON GRAHAM	
DATE APPROVED: 12/9/2016	
SHEET SCALE: 2:1	SHEET NUMBER: 1 of 1

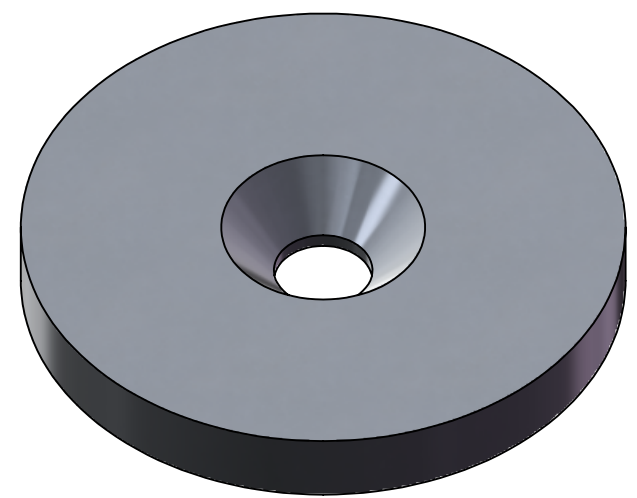
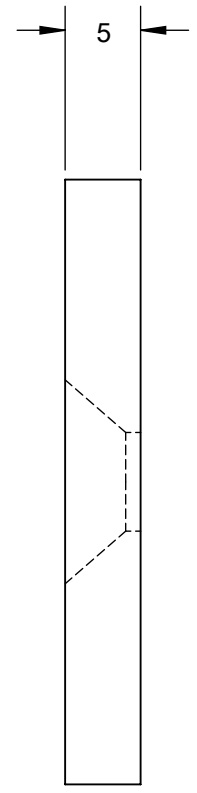
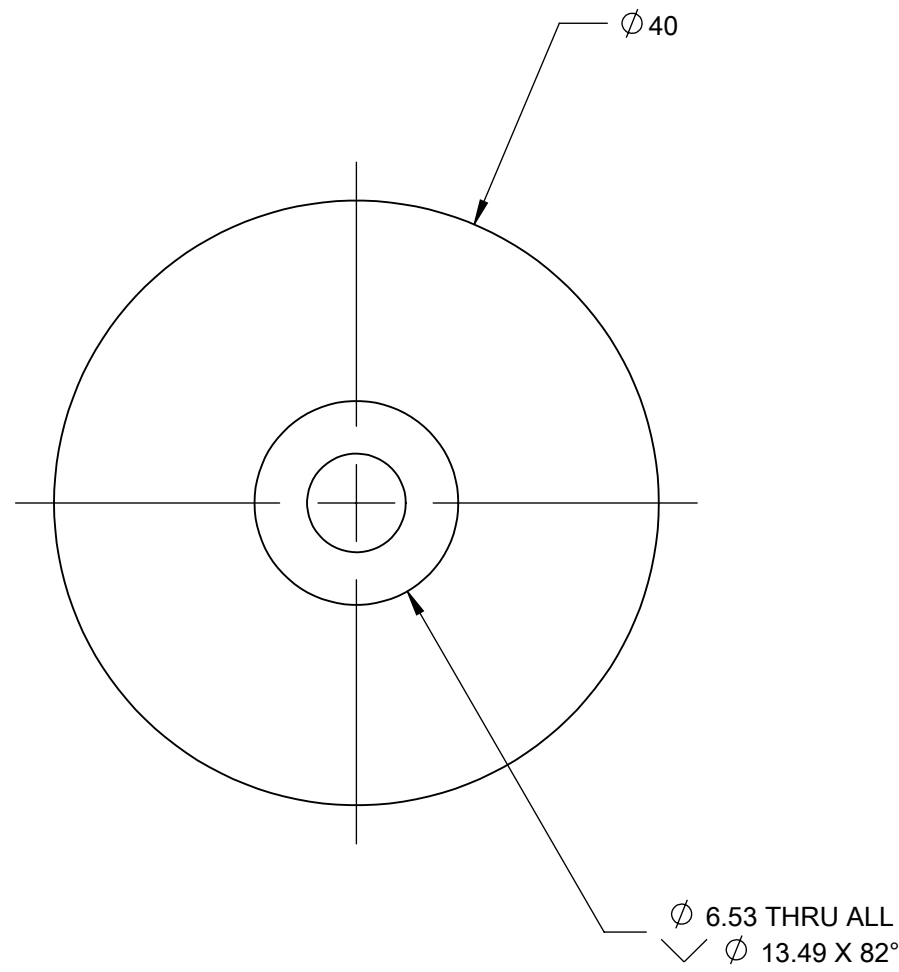


DETAIL B
SCALE 4 : 1



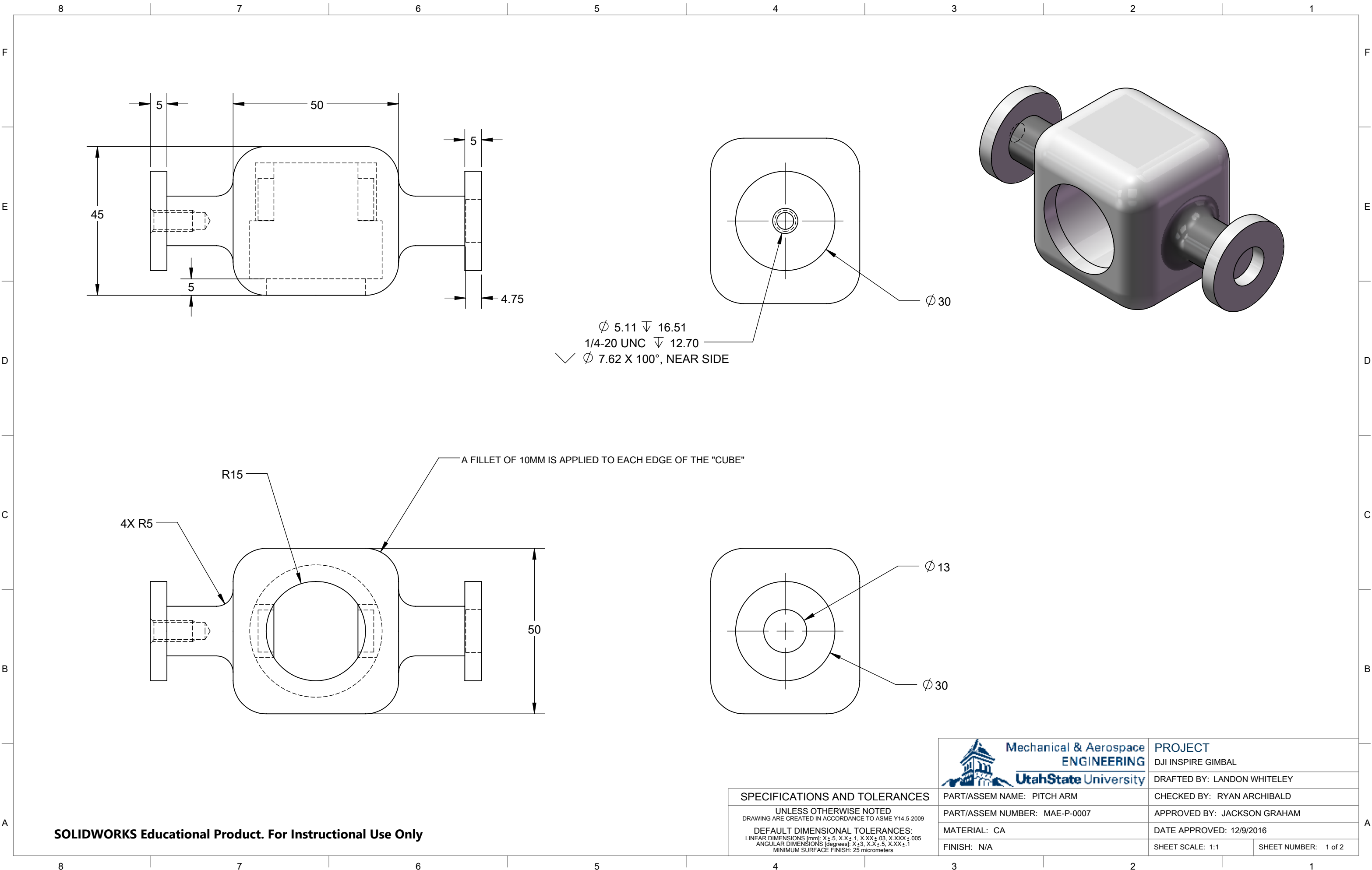
SPECIFICATIONS AND TOLERANCES
UNLESS OTHERWISE NOTED DRAWING ARE CREATED IN ACCORDANCE TO ASME Y14.5-2009
DEFAULT DIMENSIONAL TOLERANCES: LINEAR DIMENSIONS [mm]: X±.5, XX±.1, XXX±.03, XXXX±.005 ANGULAR DIMENSIONS [degrees]: X±3, XX±.5, XXX±.1 MINIMUM SURFACE FINISH: 25 micrometers

	PROJECT	
	DJI INSPIRE GIMBAL	
	DRAFTED BY: LANDON WHITELEY	
	CHECKED BY: RYAN ARCHIBALD	
	APPROVED BY: JACKSON GRAHAM	
PART/ASSEM NAME: GOPRO TOP	DATE APPROVED: 12/9/2016	
PART/ASSEM NUMBER: MAE-P-0013	SHEET SCALE: 2:1	
MATERIAL: ABS	SHEET NUMBER: 1 of 1	
FINISH: N/A		



SPECIFICATIONS AND TOLERANCES	
UNLESS OTHERWISE NOTED DRAWING ARE CREATED IN ACCORDANCE TO ASME Y14.5-2009	
DEFAULT DIMENSIONAL TOLERANCES: LINEAR DIMENSIONS [mm]: X $\pm$ 5, XX $\pm$ 1, XXX $\pm$ 0.3, XXXX $\pm$ 0.005 ANGULAR DIMENSIONS [degrees]: X $\pm$ 3, XX $\pm$ 5, XXX $\pm$ 1 MINIMUM SURFACE FINISH: 25 micrometers	

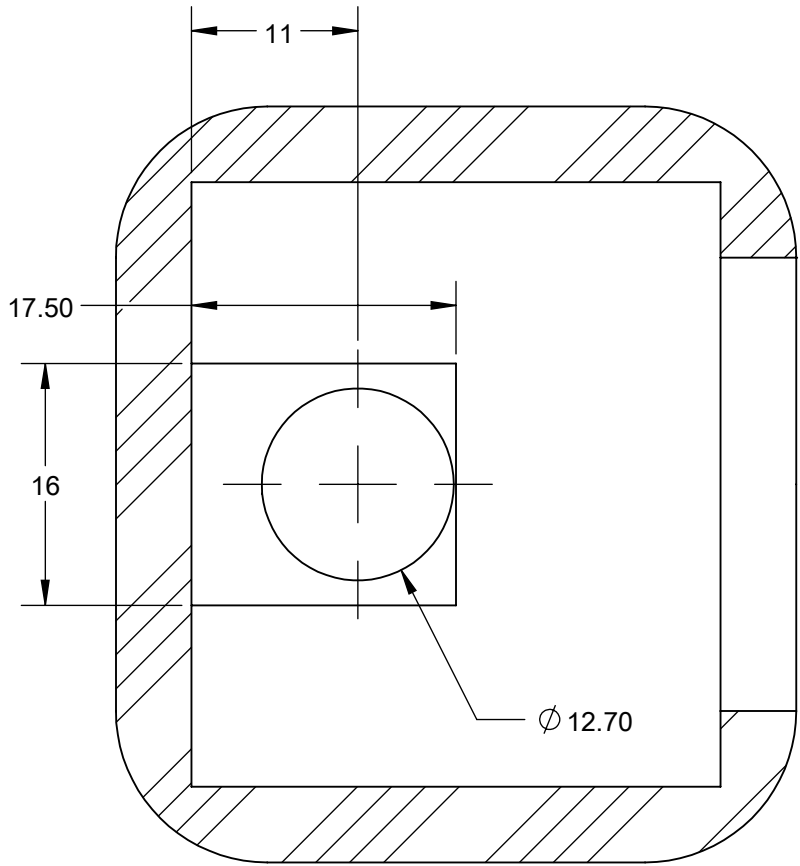
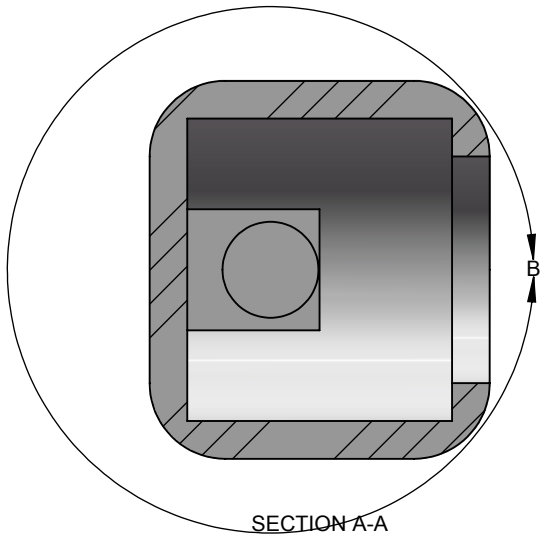
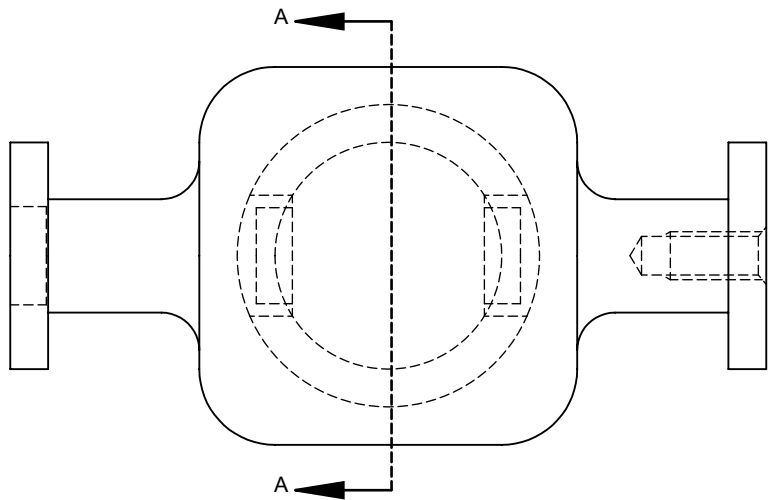
 Mechanical & Aerospace ENGINEERING UtahState University	PROJECT DJI INSPIRE GIMBAL	
	DRAFTED BY: LANDON WHITELEY	
	CHECKED BY: RYAN ARCHIBALD	
	APPROVED BY: JACKSON GRAHAM	
PART/ASSEM NAME: PITCH ARM SCREW LOCK		DATE APPROVED: 12/9/2016
PART/ASSEM NUMBER: MAE-P-0008		SHEET SCALE: 2:1
MATERIAL: 1060 Alloy		SHEET NUMBER: 1 of 1
FINISH: N/A		



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SPECIFICATIONS AND TOLERANCES	
UNLESS OTHERWISE NOTED	
DRAWING ARE CREATED IN ACCORDANCE TO ASME Y14.5-2009	
DEFAULT DIMENSIONAL TOLERANCES:	
LINEAR DIMENSIONS (mm): X $\pm$ 5, XX $\pm$ 1, XXX $\pm$ 0.03, XXXX $\pm$ 0.005	
ANGULAR DIMENSIONS (degrees): X $\pm$ 3, XX $\pm$ 5, XXX $\pm$ 1	
MINIMUM SURFACE FINISH: 25 micrometers	

 Mechanical & Aerospace ENGINEERING UtahState University	PROJECT	
	DJI INSPIRE GIMBAL	
	DRAFTED BY: LONDON WHITELEY	
	CHECKED BY: RYAN ARCHIBALD	
	APPROVED BY: JACKSON GRAHAM	
PART/ASSEM NAME: PITCH ARM	DATE APPROVED: 12/9/2016	
PART/ASSEM NUMBER: MAE-P-0007	SHEET SCALE: 1:1	
MATERIAL: CA	SHEET NUMBER: 1 of 2	
FINISH: N/A		



THIS FEATURE IS MIRRORED ONTO THE OTHER SIDE OF THE CUBE AS WELL

DETAIL B
SCALE 2 : 1

SPECIFICATIONS AND TOLERANCES

UNLESS OTHERWISE NOTED
DRAWING ARE CREATED IN ACCORDANCE TO ASME Y14.5-2009
DEFAULT DIMENSIONAL TOLERANCES:
LINEAR DIMENSIONS [mm]: X $\pm$ 5, XX $\pm$ 1, XXX $\pm$ 0.3, XXXX $\pm$ 0.005
ANGULAR DIMENSIONS [degrees]: X $\pm$ 3, XX $\pm$ 5, XXX $\pm$ 1
MINIMUM SURFACE FINISH: 25 micrometers



PROJECT	
DJI INSPIRE GIMBAL	
DRAFTED BY: LONDON WHITELEY	
CHECKED BY: RYAN ARCHIBALD	
APPROVED BY: JACKSON GRAHAM	
DATE APPROVED: 12/9/2016	
SHEET SCALE: 1:1	SHEET NUMBER: 2 of 2

8 7 6 5 4 3 2 1

F

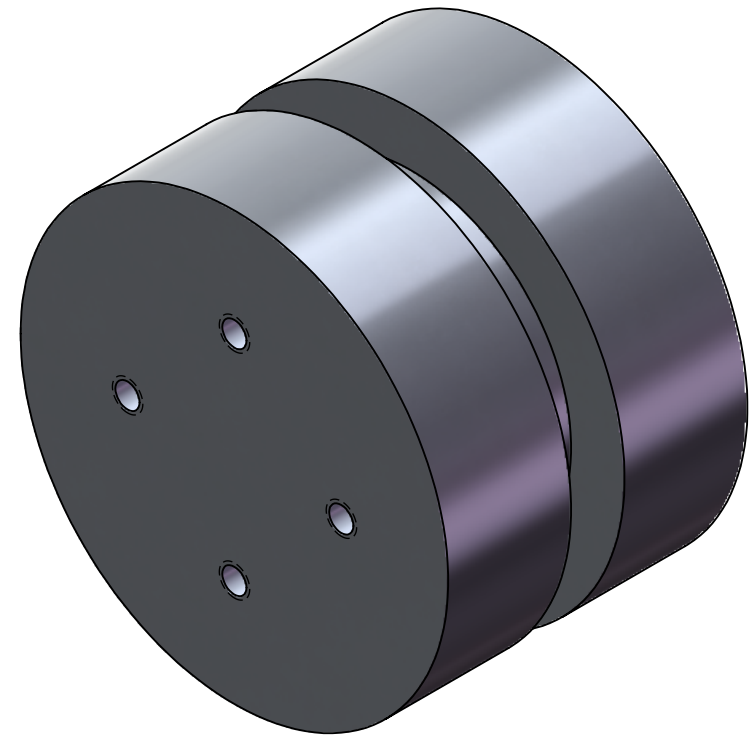
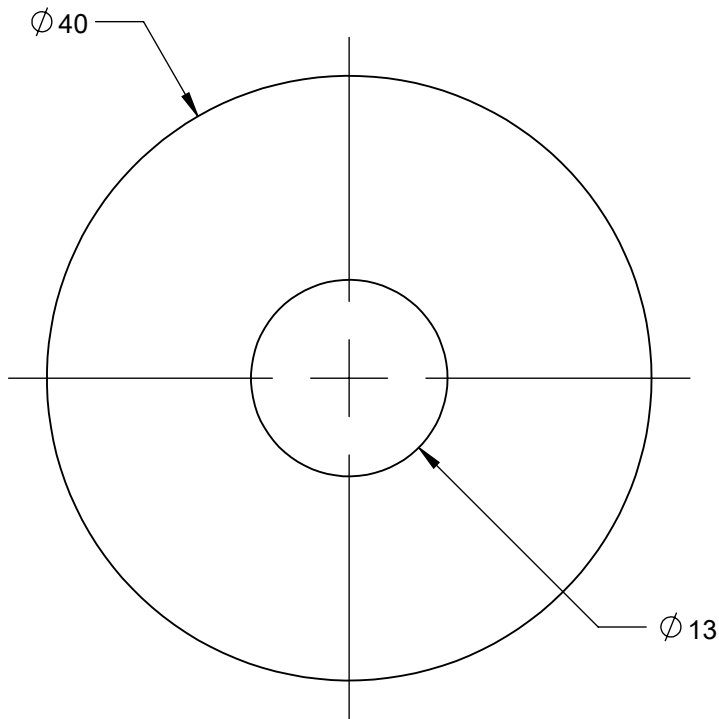
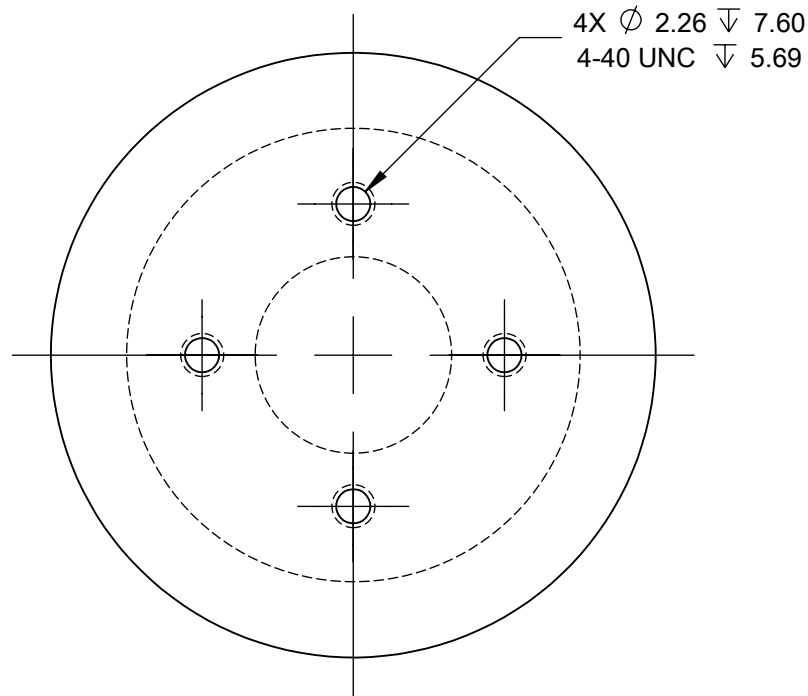
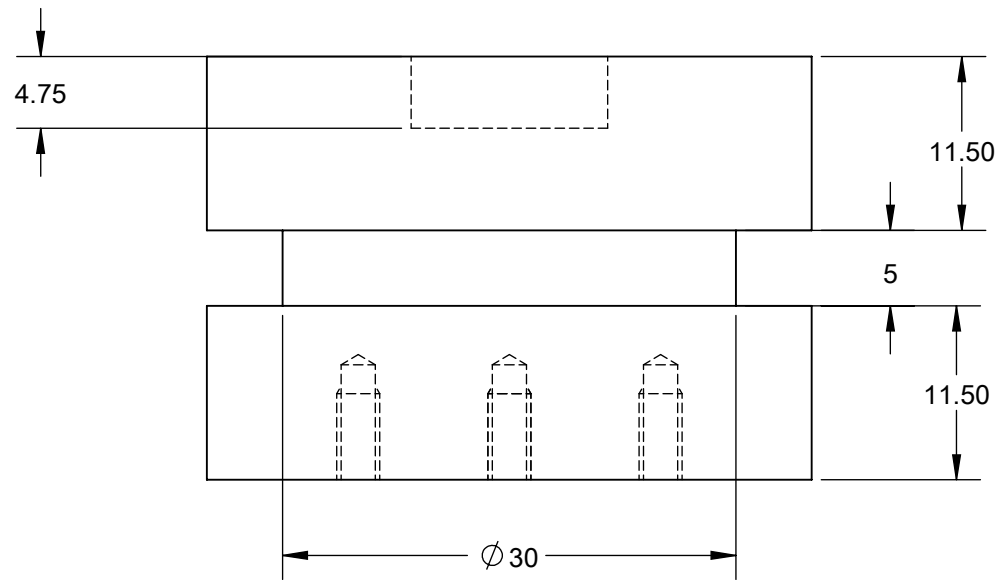
E

D

C

B

A



F

E

D

C

B

A

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SPECIFICATIONS AND TOLERANCES

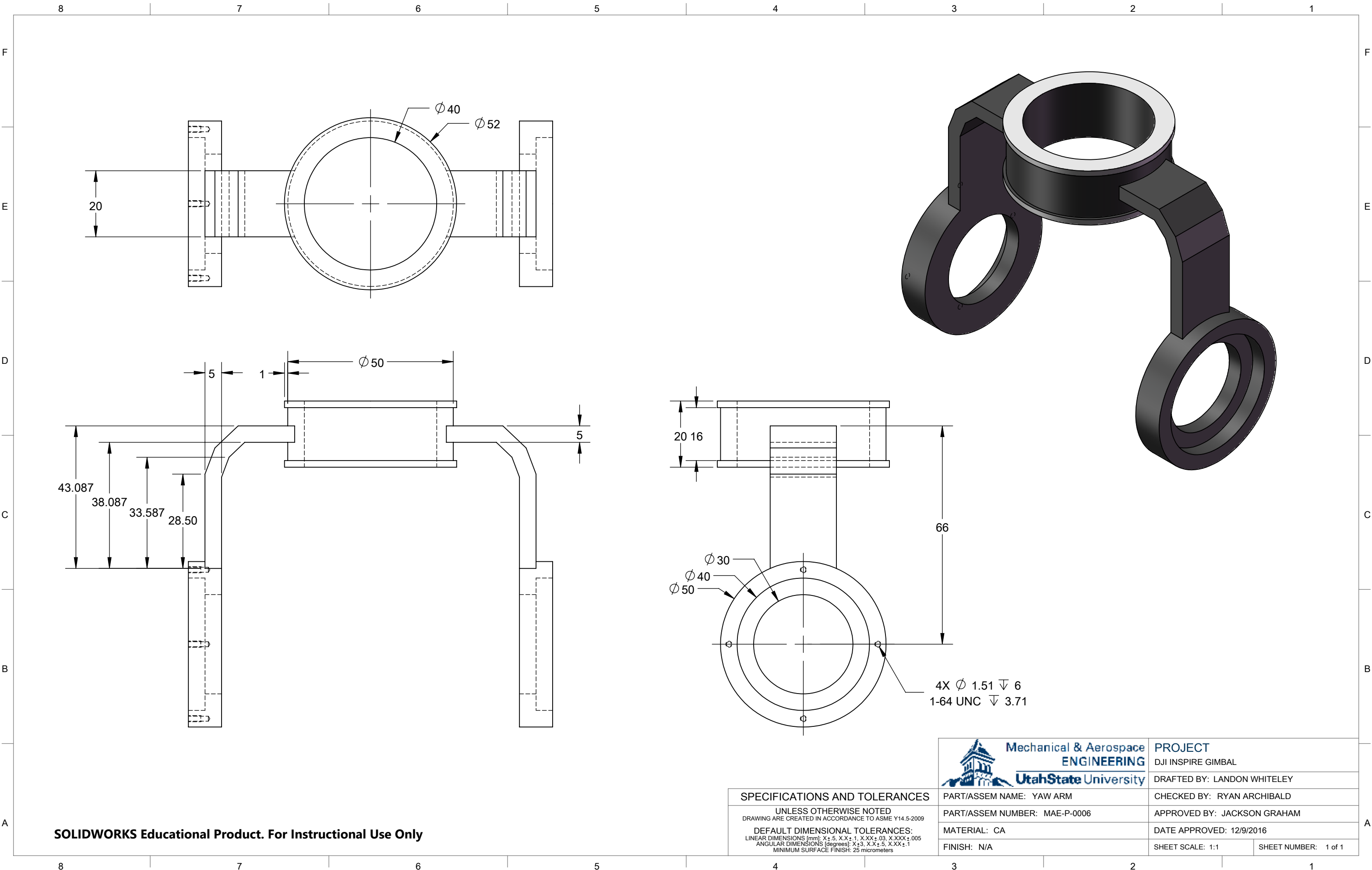
UNLESS OTHERWISE NOTED
DRAWING ARE CREATED IN ACCORDANCE TO ASME Y14.5-2009
DEFAULT DIMENSIONAL TOLERANCES:
LINEAR DIMENSIONS (mm): X ± 0.5 , XX ± 1 , XXX ± 0.03 , XXXX ± 0.005
ANGULAR DIMENSIONS (degrees): X ± 3 , XX ± 5 , XXX ± 1
MINIMUM SURFACE FINISH: 25 micrometers



PROJECT	
DJI INSPIRE GIMBAL	
DRAFTED BY: LANDON WHITELEY	
CHECKED BY: RYAN ARCHIBALD	
APPROVED BY: JACKSON GRAHAM	
DATE APPROVED: 12/9/2016	
SHEET SCALE: 2:1	SHEET NUMBER: 1 of 1

PART/ASSEM NAME: ROLL ARM
PART/ASSEM NUMBER: MAE-P-0010
MATERIAL: 1060 Alloy
FINISH: N/A

8 7 6 5 4 3 2 1



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SPECIFICATIONS AND TOLERANCES

UNLESS OTHERWISE NOTED
DRAWING ARE CREATED IN ACCORDANCE TO ASME Y14.5-2009

DEFAULT DIMENSIONAL TOLERANCES:
LINEAR DIMENSIONS (mm): X $\pm$ 5, XX $\pm$ 1, XXX $\pm$ 0.3, XXXX $\pm$ 0.05
ANGULAR DIMENSIONS (degrees): X $\pm$ 3, XX $\pm$ 5, XXX $\pm$ 1
MINIMUM SURFACE FINISH: 25 micrometers



PART/ASSEM NAME: YAW ARM

PART/ASSEM NUMBER: MAE-P-0006

MATERIAL: CA

FINISH: N/A

PROJECT

DJI INSPIRE GIMBAL

DRAFTED BY: LANDON WHITELEY

CHECKED BY: RYAN ARCHIBALD

APPROVED BY: JACKSON GRAHAM

DATE APPROVED: 12/9/2016

SHEET SCALE: 1:1

SHEET NUMBER: 1 of 1

