Memorandum

To: Dr. Kosaraju

From: Team 04

Date: 1/28/20142013

Re: Progress Report

Dr. Kosaraju,

This is the first progress report for the up scaling of the U13A remote controlled helicopter.

In this document you will find, a summary of our teams' problem, as well as our need and goal statements, a list of parts orders, and discussion of what will be 3D printed on the upscale helicopter.

Also in this document, is the schedule that our team has laid out for the upcoming semester. This schedule is devoted to construction and testing.

Remote Control Helicopter

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Team 04

Progress Report

Document

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Mechanical Engineering Design II – Spring 2014

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Abstract

In this document, we will be discussing the scaling U13A remote controlled helicopter. To begin with, we will be giving a brief description of our client and an overview of the problem description from our client. Next we will be identifying the need, project goal, objectives, operating environment and the constraints of our project.

Next, we will introduce the concepts generated by our team. We will look at all the different areas in which we plan to improve upon, as well as the ideas proposed for these

improvements. Decision matrices will be introduced in this section to show how our group decided on the chosen ideas.Lastly, in this section we will be including visuals for the chosen concepts.

After concept generation was completed, our team went through the engineering analysis phase. Here we will be discussing the analysis which was done on the chosen areas for improvement from the concept selection stage. We will present analysis for the blades and landing gear.

Once engineering analysis was completed, the cost analysis began. Here we will present the bill of materials, along with the total cost of production. This section includes all final parts necessary to be made and ordered for the up scaling of the U13A helicopter.

Lastly, we will be summing up the whole proposal document. We will be restating all decisions made as well as where we are and where we are headed.

Chapter 1. Introduction

1.1 Introduction

We are team four, and our capstone project is the remote controlled helicopter. In this report we will be discussing, who our client is, what our project is, as well as, needs, goals, objectives, constraints, quality function deployment chart, the concept generation, engineering analysis, and cost analysis for our project.We will also give a brief look at what is in the near future for team four through a Gantt chart. To begin with we will introduce our client Dr. SrinivasKosaraju.

1.2 Client Information

Our client is the capstone instructor Dr. SrinivasKosaraju. He is a current mechanical engineering professor at Northern Arizona University. He has his doctorate in mechanical engineering. He had an idea that it would be a great all around engineering project to have students buy and research a remote controlled helicopter that was roughly ten inches and then upscale it for various applied applications. This project includes many different engineering subjects such as machine design and aerodynamics. It will prove to be a challenging project, but our team is very enthusiastic and ready to do what is necessary for a successful project.

1.3 U13A Remote Control Helicopter

For this project we will be up scaling a U13A Remote Controlled Helicopter made by UDIR/CFigure 1. The helicopters body is 11 inches long and 2 1/4 inches wide. One of the blades of the center rotor is 4 3/4 inches long and the rear rotor is 1 7/8 inches. It has four blades on

Figure 1: U13A Helicopter

the center rotor two blades are spinning clock wise while the other two are spinning counter clock wise. The helicopter has several led lights on it one in the front and five along the tail. This helicopter has a 3.7 V battery it lasts for 5 to 8 minutes per 90 minutes of charge. This helicopter is already equipped with a camera so it has the capability to take photos and video which can be viewed through a micro S.D. card. This helicopter does not have live feed. There is a gyroscope inside of the helicopter it also has a balance beam along the top of the center rotors both of there are to help keep the helicopter stable during flight.

The controller for the helicopter, as seen in Figure 2, controls the functions such as up and down and right and left. It also has a screen on the controller to display the throttle percent and the trim of the helicopter. The screen also displays how well the frequency is reaching the helicopter. The remote sends out a 2.4 GHz signal and has a controlling radius of 40 m. the controller is powered by four AA batteries and displays how much power is left in the batteries on the display. The controller has buttons on it to use the video and the camera fetchers and the display shows which fetcher is being used at a given time. The controller also has a button to turn on or off the lights and a button to accelerate the helicopter.

Figure 2. U13A remote control

1.4 Needs

The main need,created by our group for this project, through discussion with Dr. Kosaraju, is that the U13A helicopter is too small. Through this statement, we have broken it up in to several smaller needs to make the process of working on it more fluent. One of the first needs we have to work on is studying this helicopter and determining any problems with it that we may need to fix or any aspects of the helicopter that we can improve upon. We will need to upscale the model by 1.5 per the client’s request. Lastly, one of the client’s requests was to have capability for attachments so we need to determine what attachments may be useful and how to attach them.

1.5 Goals

From studying all the clients requests and all the needs we have determined a goal for this project. Our goal is to “successfully improve and upscale a remote controlled helicopter by 1.5 with the ability to add mission specific accessories.” We believe at this point this goal covers all the aspects of this project. As we work on this project we may have to alter our goal but this will happen as we go.

1.6 Objectives

The objective for this project is to design and build a remote controlled helicopter that has interchangeable attachments. A live feed camera will be attached to the final design that can provide live video to the users. The helicopter weight will be minimize in order to have the ability to add many attachments if needed.

The design should be able to accept batteries from different manufacturers. This includes using the ability to switch adaptors that can connect the battery to the helicopter. There will be two sets of batteries, one set in the helicopter, and one set in the remote control. The helicopter will contain a chargeable battery that can lasts for one-third the charging time. The remote control will consist of four AA batteries that provide a power to send/receive signal to the helicopter.

Carrying capability will be maximized in the prototype design. The materials that will be used in our design should be light and stiff, to maintain a high level of performance. The carried weight will be used to achieve stability in our design. Also the weight will be placed in the center of mass in the helicopter to increase the stability and resist wind flow.

We also are playing with the idea of using waterproof materials in building the helicopter, so it can be used in different weather conditions. There is still no specification of what materials that will be used, and how much would it cost. Upon further investigation and cost analysis we will be able to decide whether this is a task worth pursuing.

The altitude that the helicopter will achieve is forty meters in all directions. Currently we are considering stiff plastic propellers will be used in building the design to minimize the overall weight of the helicopter and create a maximum lift for the prototype. The range will be determined more specially based on the attachments and the weight lifted for each different run. The table of objectives can be seen in the following table, Table 1.

Table 1. Objectives

Objectives	Measurement Basis	Units
Design and build a RC helicopter	Amount of materials	Dollars
Attachments	Camera parts	Dollars
Batteries	Two sets of batteries	Dolars
Carrying Capabilities	Weight	lbs
Waterproof Materials	Cost for materials	Dollars
Lift Capabilities	Height range	Meters

1.7 Constraints

For the final design of the upscale remote control helicopter, the preliminary constraints are the following:

The helicopter must be at least 1.5 times the size of the model helicopter. In order to successfully upscale the helicopter 1.5 times, the dimensions of all of the components of the design, ranging from the tail length to the frame width must be at least 1.5 times larger than the original remote control helicopter.

The helicopter must be made out of a durable material that is also lightweight. In order for the helicopter to succeed at flight and survive all of the stresses associated with flying, landing, and even crashing the helicopter, it must be made of a lightweight and durable material with a high strength to density ratio.

Additionally, the operator must be able to control the helicopter at a long range. The range at which the helicopter can be controlled will be measured by the longest distance at which the remote control can still communicate with the helicopter.

The helicopter must have a satisfactory battery life. The duration of time that the helicopter can stay in the air for a single flight is determined by the battery life; it must be maximized to allow for the longest flight possible.

In addition to the battery life, the battery power must be capable of creating a lift force great enough to carry the weight of the helicopter and any accessory that may be mounted to the helicopter.

In order to demonstrate that accessories can be added to the helicopter, an onboard video camera will be mounted to the design. The data gathered aboard the helicopter must be communicated to the operator at real time and the helicopter must transmit a live video feed from the onboard camera to the remote operator.

Lastly, all costs associated with designing and building the upscale helicopter must be thoroughly justified with the customer, Dr. Raju, before funding will be received.

Chapter 2. 3D Printing

We have been discussing the option of 3D printing for this project with Dr. Tester. Our team has come to the conclusion that twenty four parts will be 3D printed. The material used will be Ultem 9085 in the Forester 3D printing machine.

2.1 3D Printing Modifications

We met with Dr. Tester this past week and were able to figure out what we need to do before we can begin printing. First he requests that our team have SolidWorks drawings for all parts, which we currently do have, for the parts we would like to print. After looking at a few parts he was able to show us how we can strengthen the parts for printing. He suggested filleting or chamfering all corners and filling some areas in completely. These ideas are to hopefully help strengthen the parts. Also looked at was the propeller for the helicopter. He pointed out that the propeller was made the way it was not for aerodynamics but for ease of molding. In noting this it was decided that we should go back to the drawing board and do some research to completely overhaul the blades so that maximum aerodynamic potential is reached. Once we have modified all parts, as well as designed new blades, we just need to figure out how each part shall be oriented within the printer to achieve maximum strength. Once these steps are completed, we should be ready to start 3D printing. We estimate around two weeks time to meet these needs. Lastly, we will probably not begin 3D printing until we are sure the ordered parts fit well within the printed parts to ensure that everything will fit together well. Thus, printing is not likely to occur until parts are received.

2.2 Modeled U13A

Our current model of the up scaled helicopter can be seen in Figure 3. This model will be changing due to strengthening modifications which must be made for the use of Ultem in the 3D printing process. While many modifications will occur, they will likely not be visible on the outside of the helicopter. Figure 4, shows the exploded up scaled helicopter.

Figure 3. SolidWorks model of the U13A helicopter

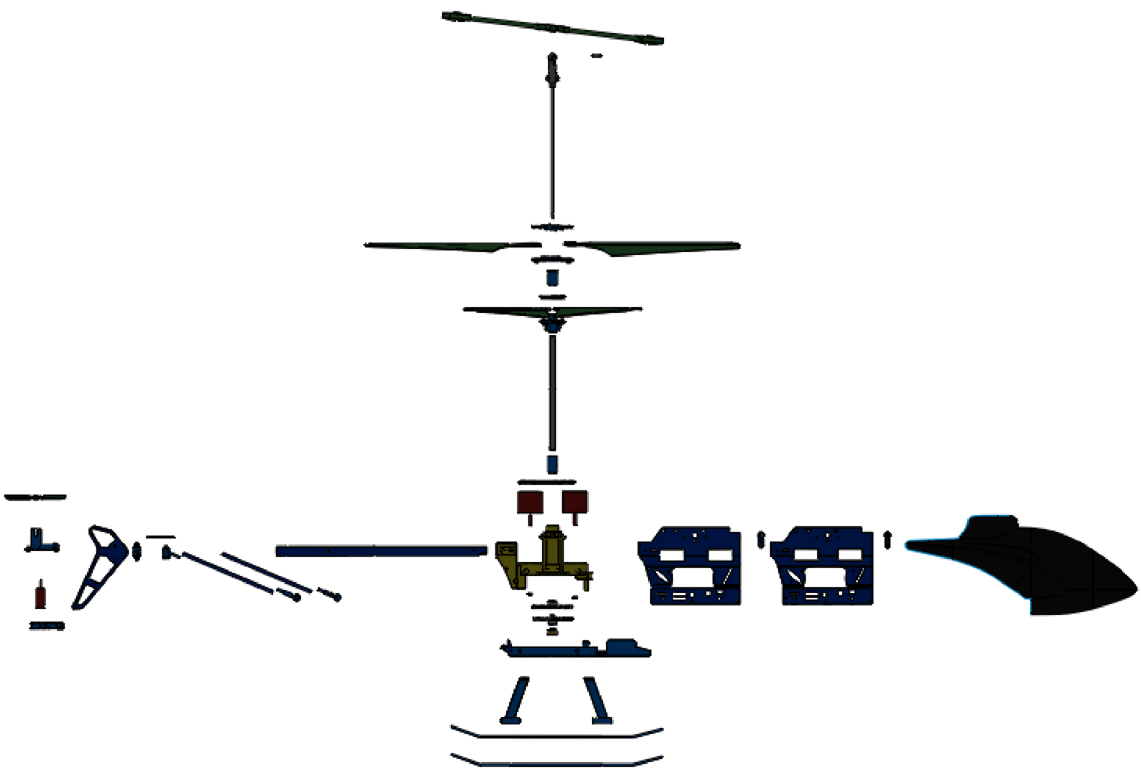

Figure 4. Exploded SolidWorks model of the U13A helicopter

Chapter 3. Parts

Last semester, our team created a list that was comprised of all parts that needed to be ordered to successfully up scale the U13A remote controlled helicopter. Last week, we ordered all parts except for the four gears. It seems that we need to find a new website to order these from since the one we had chosen is currently out of stock. While ordering all other parts last week we found there was a minor complication. Since we ordered parts from eight different sites and these parts are shipped from all over the world, this led the credit card company to believe that this was “peculiar” card activity. Thus the cards were temporarily declined and whether the parts were ordered was under question. However, after some investigating, it appears as though all but one transaction took place and our team was successfully able to help make the cards active again. So currently, our team is waiting for the arrival of all ordered parts and is reordering one part, as well as, finding a new site for gears.

Chapter 4. Conclusion

In chapter one, our team talked about our client and what tasks needs to be done in the next few weeks of the semester. We also discussed what our needs and goals are. The need is to create an upscale helicopter that has live action camera features. The goal is to successfully create an upscale helicopter 1.5 times the normal size that has removable attachments. Objectives were also discussed in order to meet specific engineering requirements and constraints. Our main objective is to have live camera feed that can record on flight. Constraints were also discussed based on its size, durability, range, battery life, and on board video. In our quality function deployment matrix, we discussed the engineering requirements and customer requirements. These were all based on the customer weights and constraints.

In chapter two, our team discussed the currents status of 3D printing various parts of the helicopter. We explained how modifications need to be made to all engineering drawings and that we need to redesign the blades. Also discussed, was that our team will be printing on the Forester printer using Ultem 9085. Lastly, we discussed that printing will not likely occur until all ordered parts are in to ensure the best fit for all parts.

In chapter three, we discussed were our team is at with the ordering of parts. While we have seen some minor complications, we are confident all parts will be correct and will arrive in a timely manner. We also talked about how our team still needs to order the gears and one part which was unable to be ordered at an earlier date.

Lastly, in the coming weeks, it is our teams' goal to make sure all ordered parts are correct. We also need to modify SolidWorks parts while creating a new propeller. Finally, we need to make sure that the parts we have designed will fit with the parts in which we have ordered.

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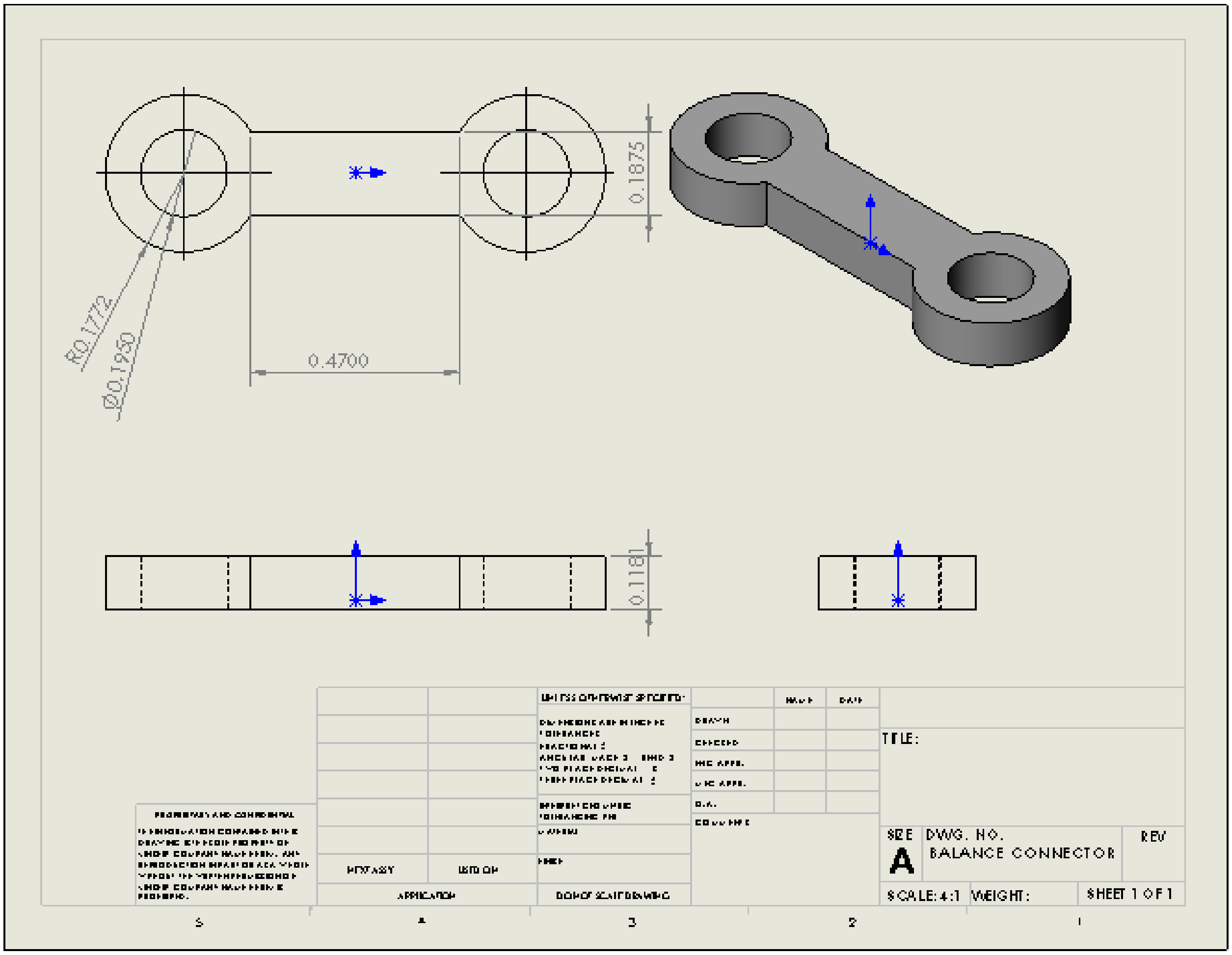
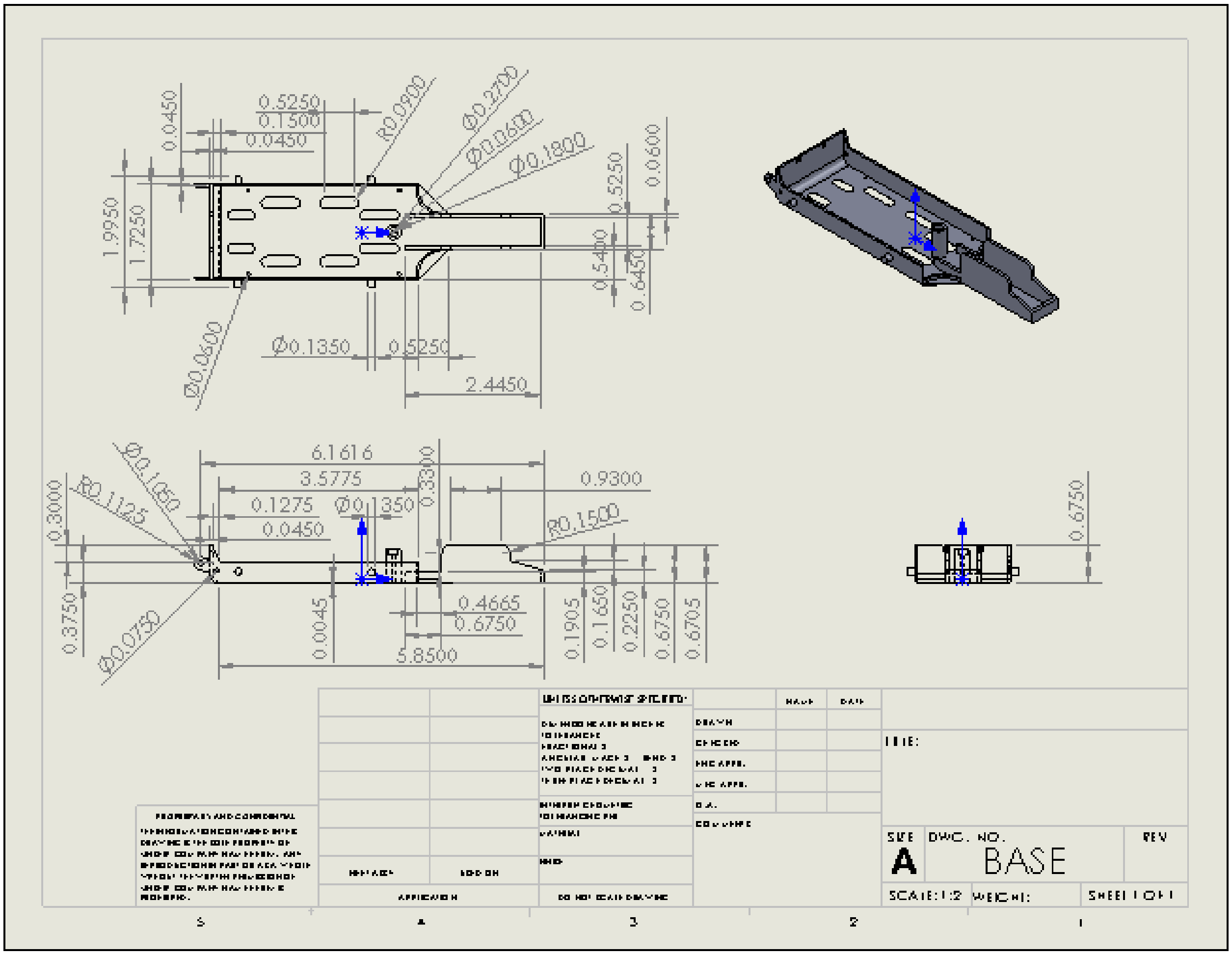
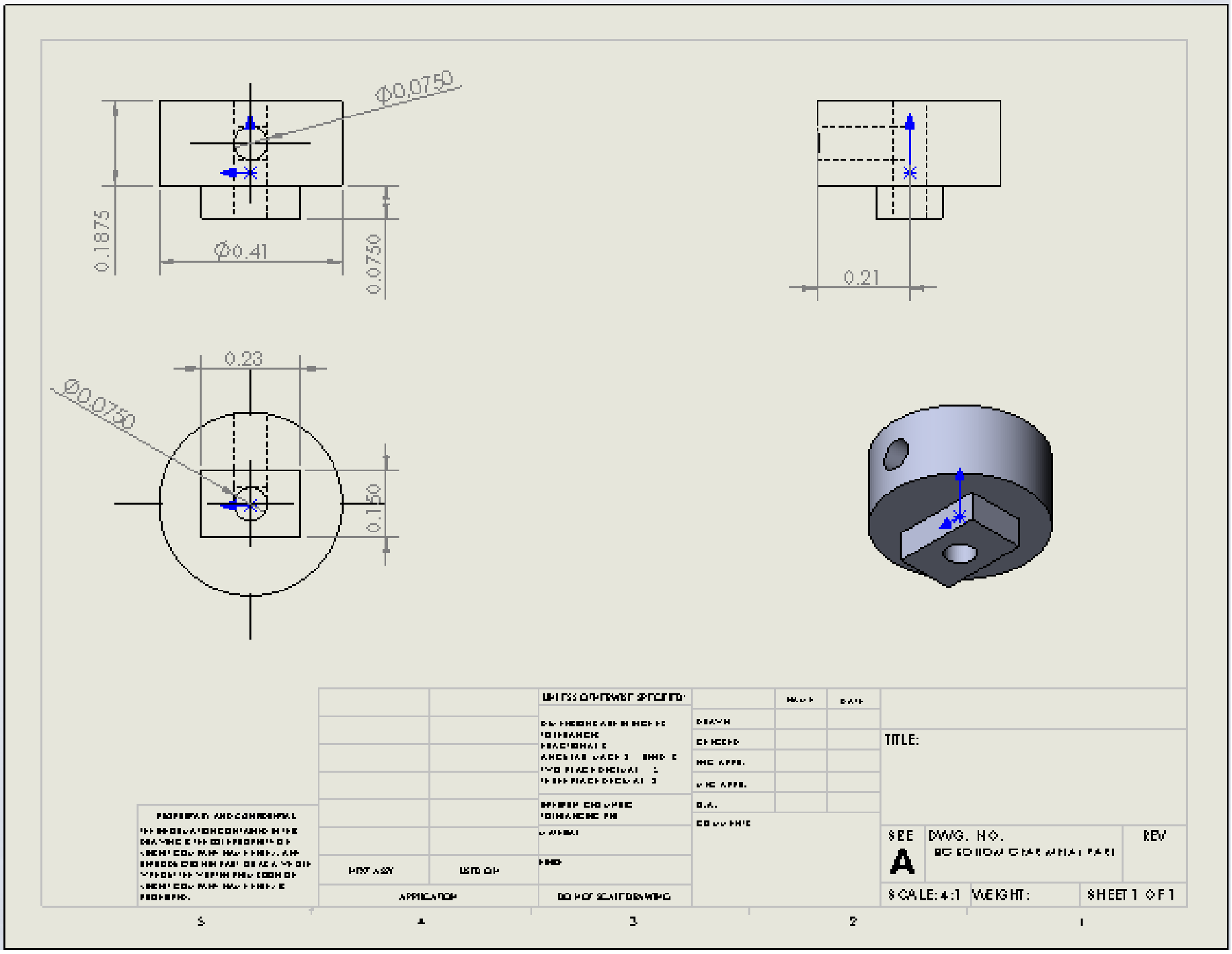
Appendix A



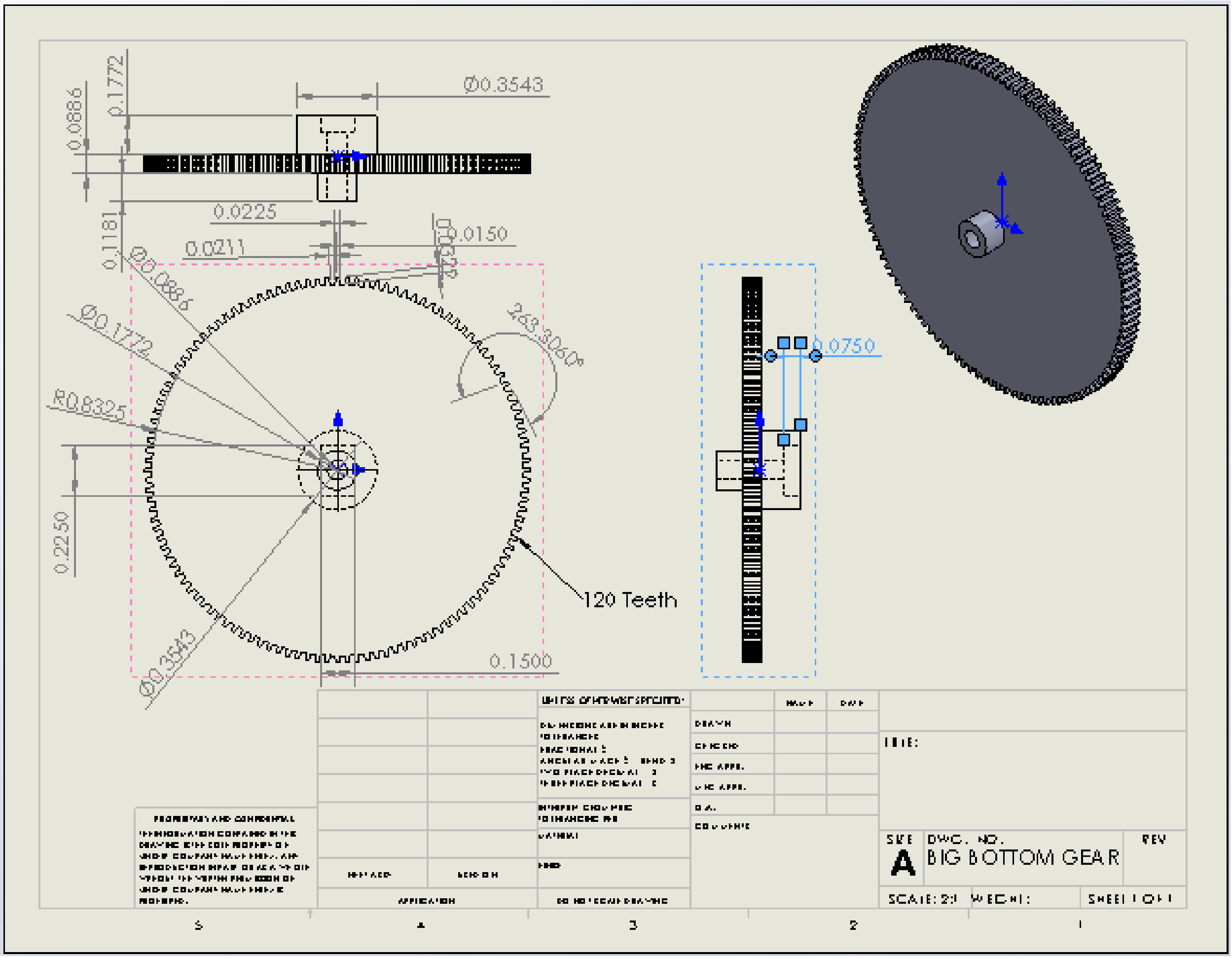
Drawing 1. Balance Connector



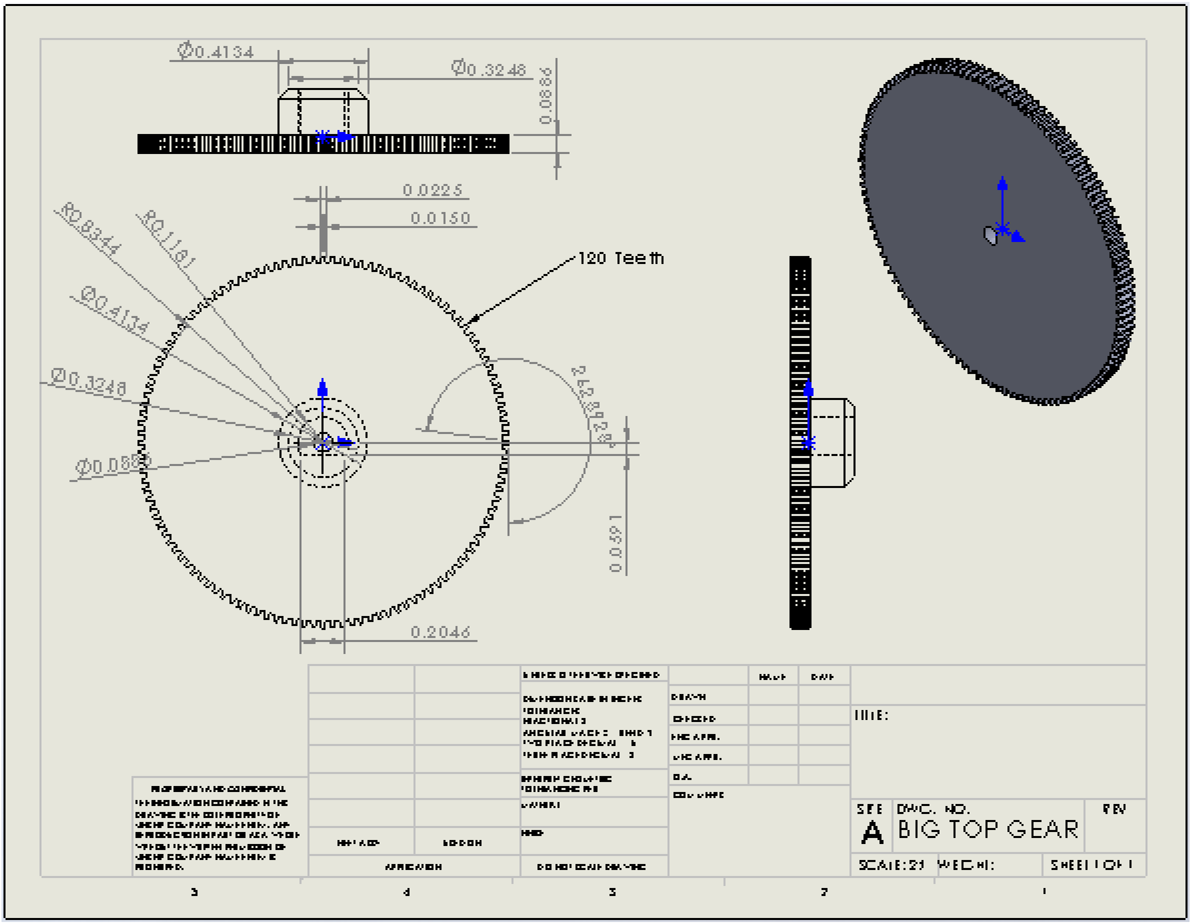
Drawing 2. Base



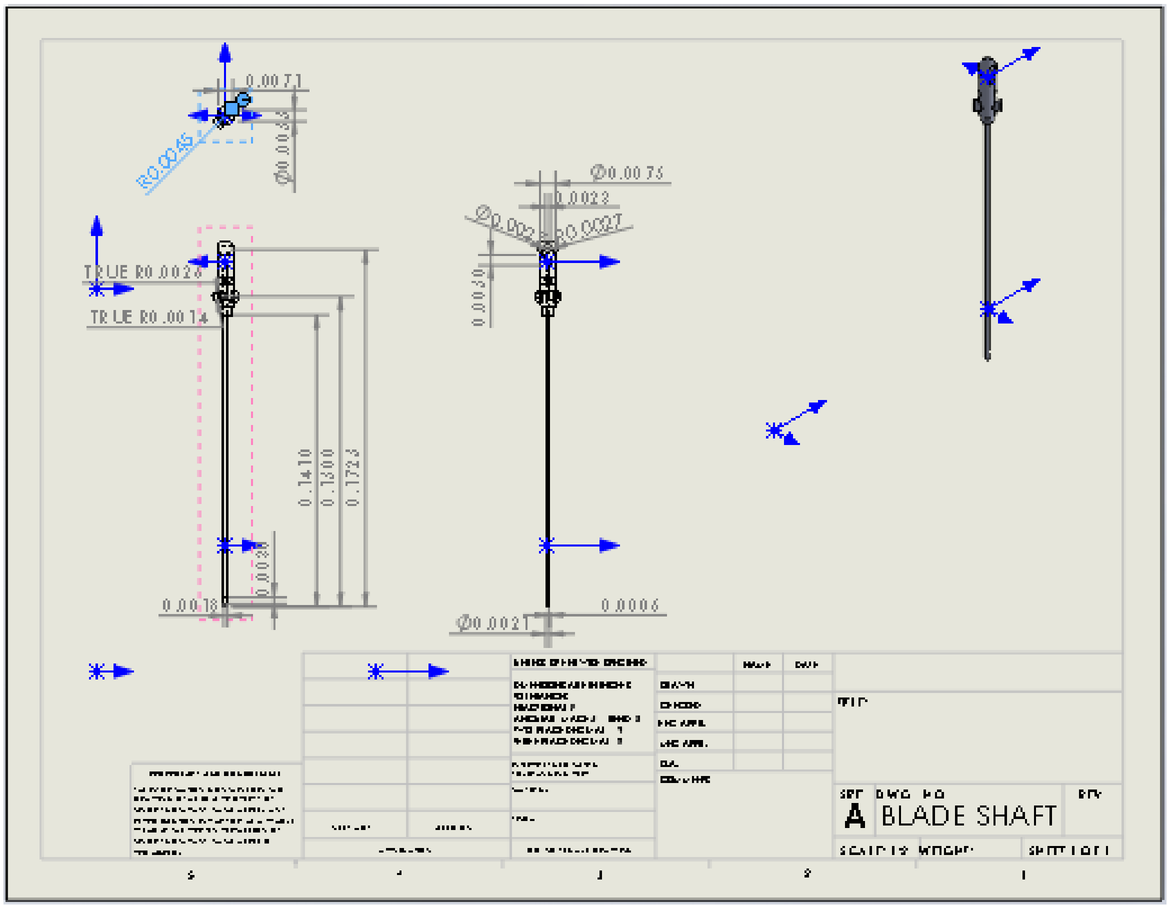
Drawing 3. Metal part of bottom gear



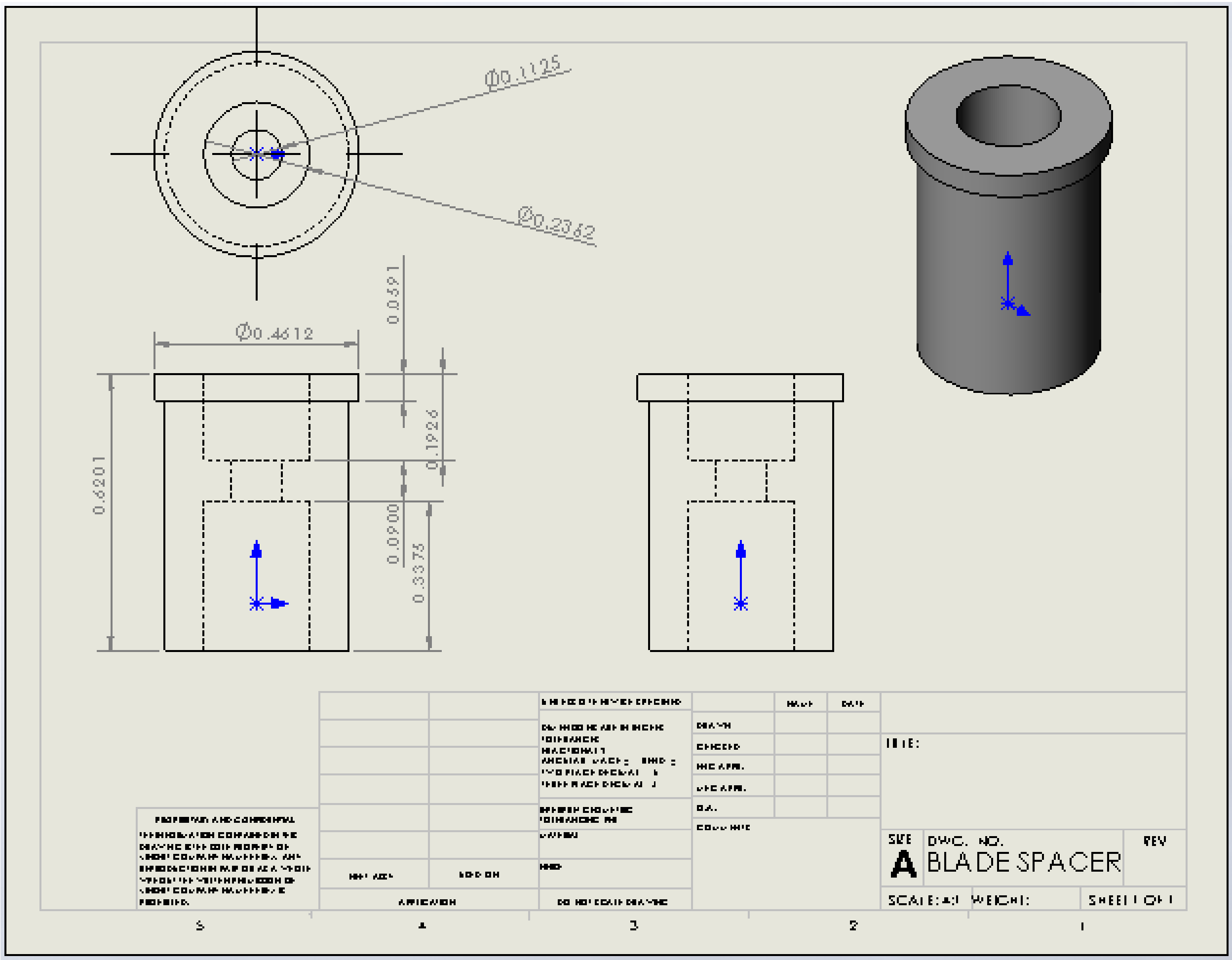
Drawing 4. Big bottom gear



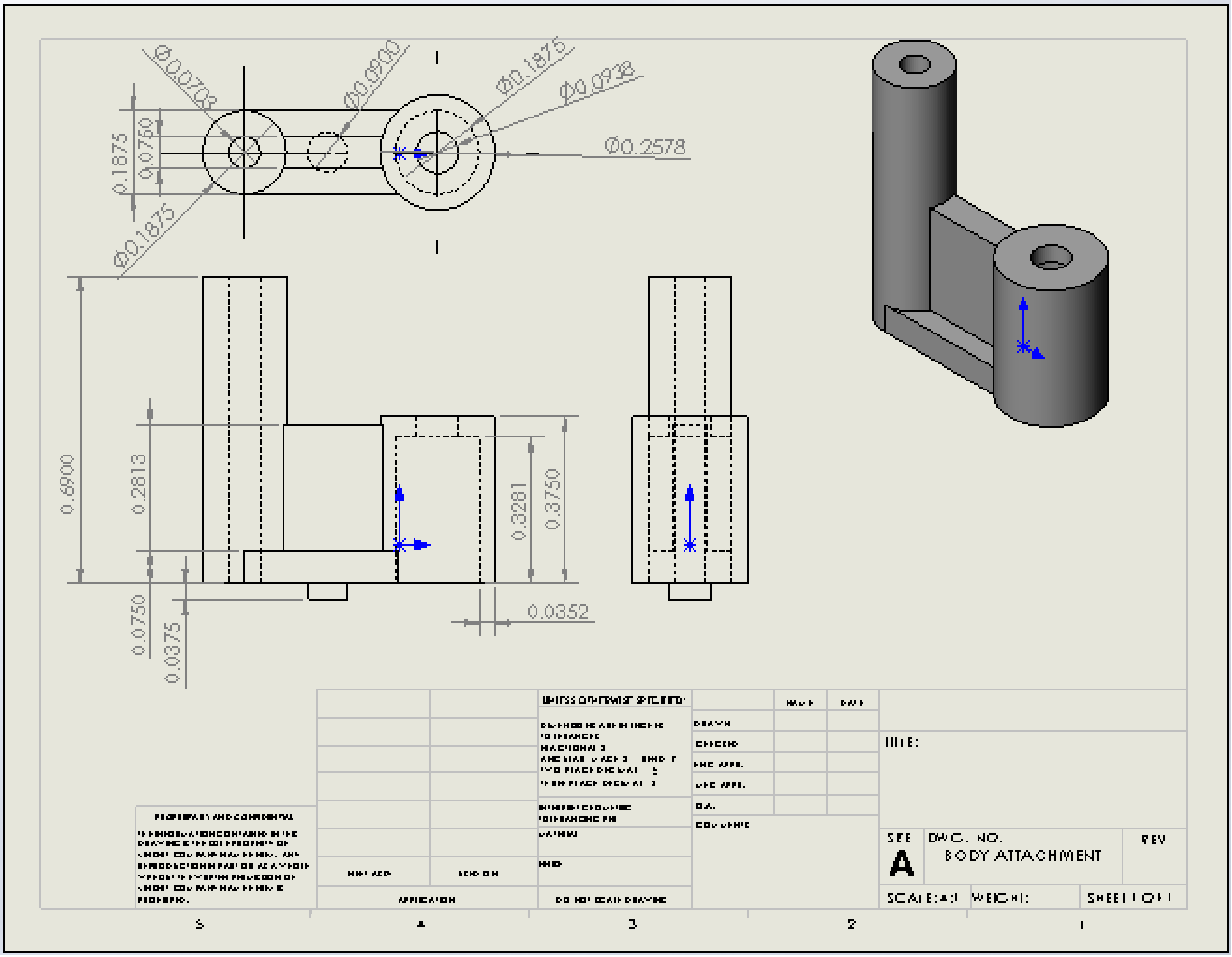
Drawing 5. Big top gear



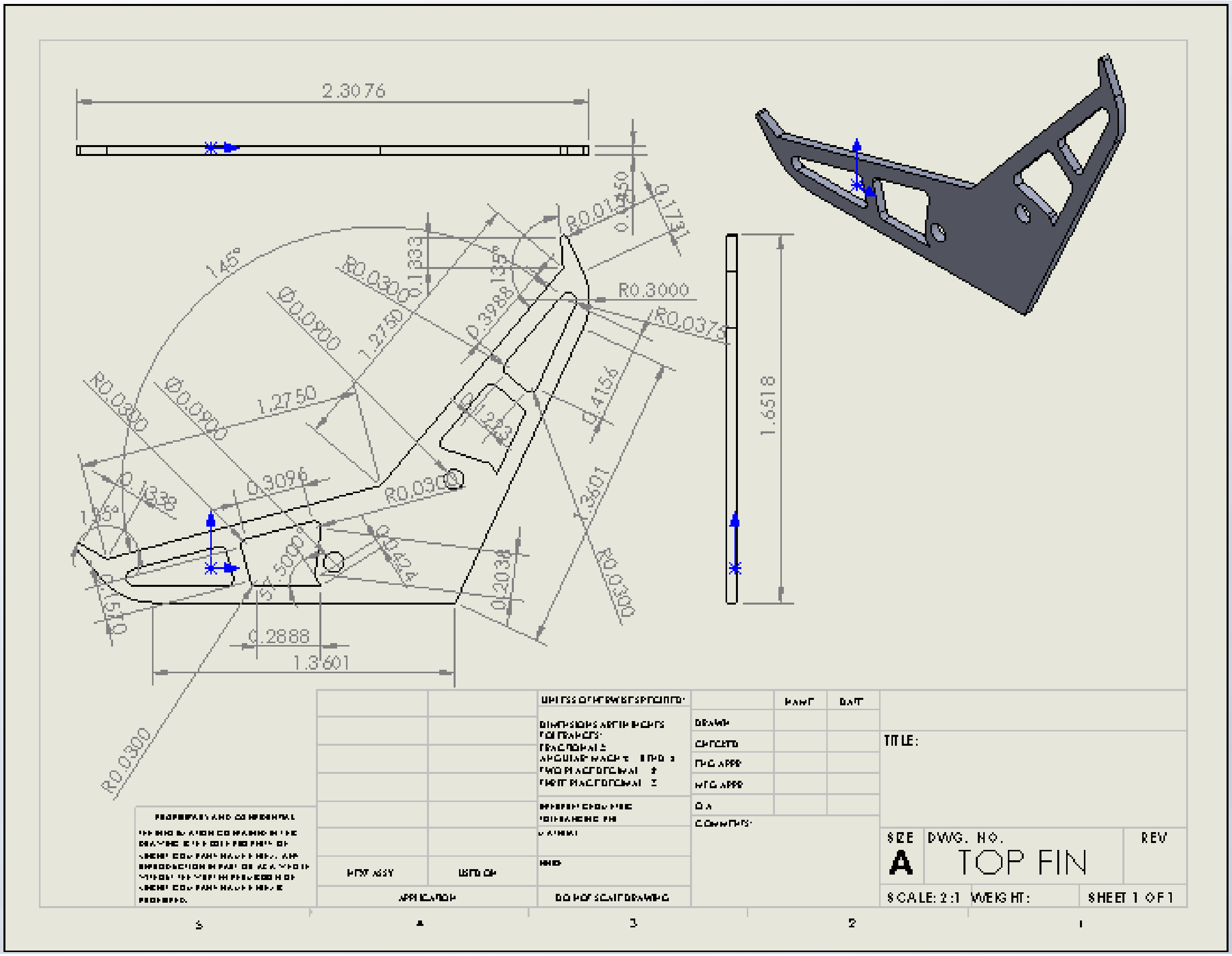
Drawing 6. Blade shaft



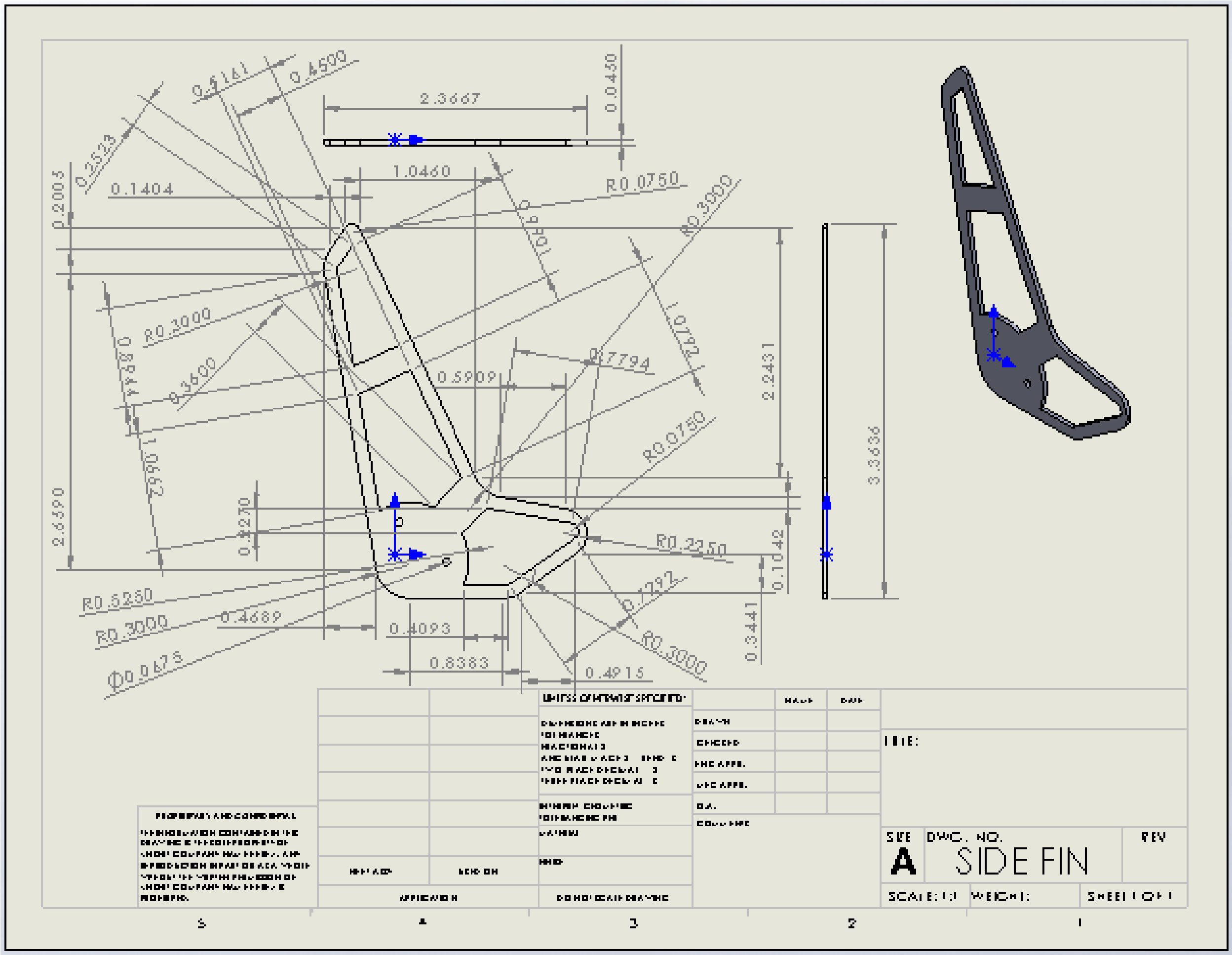
Drawing 7. Blade spacer



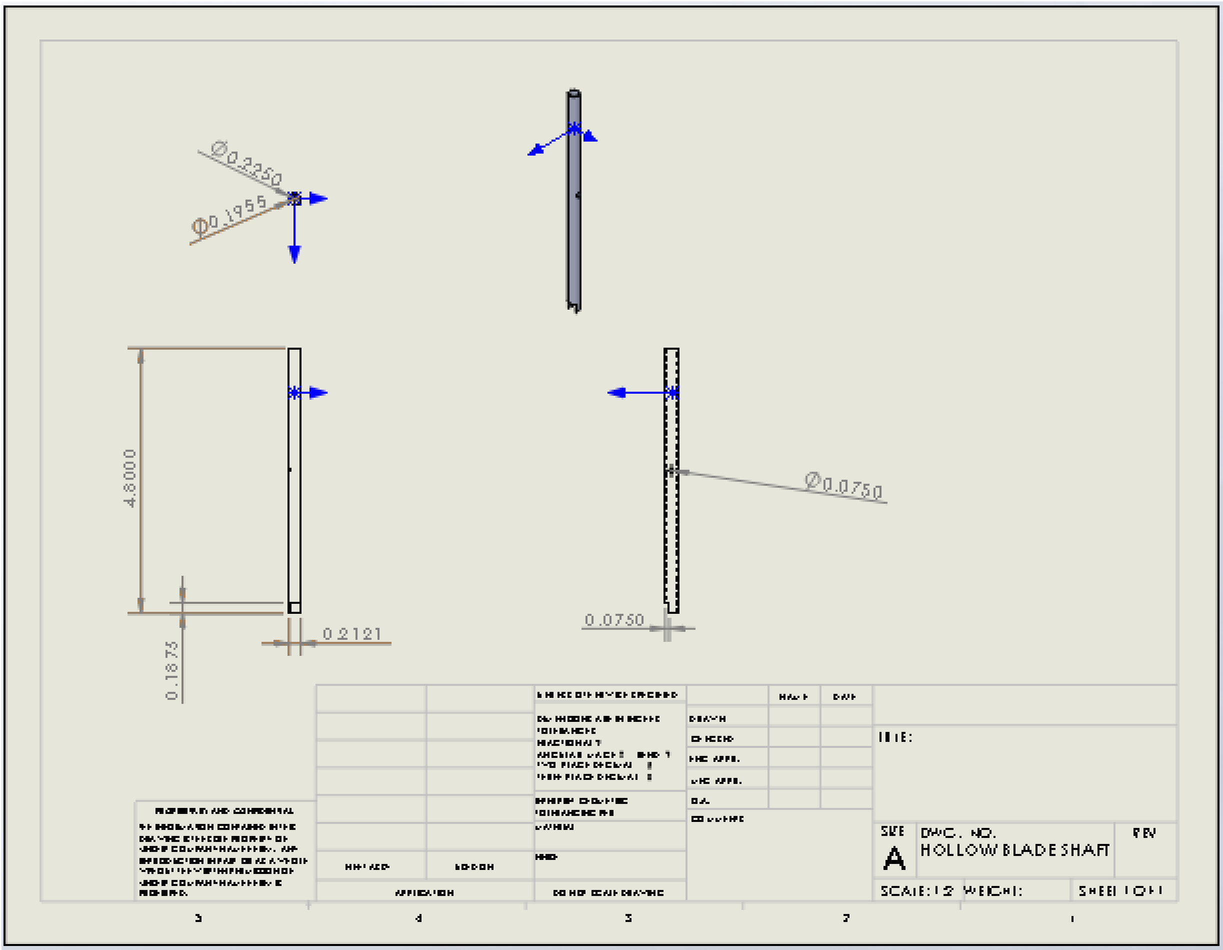
Drawing 8. Body attachment



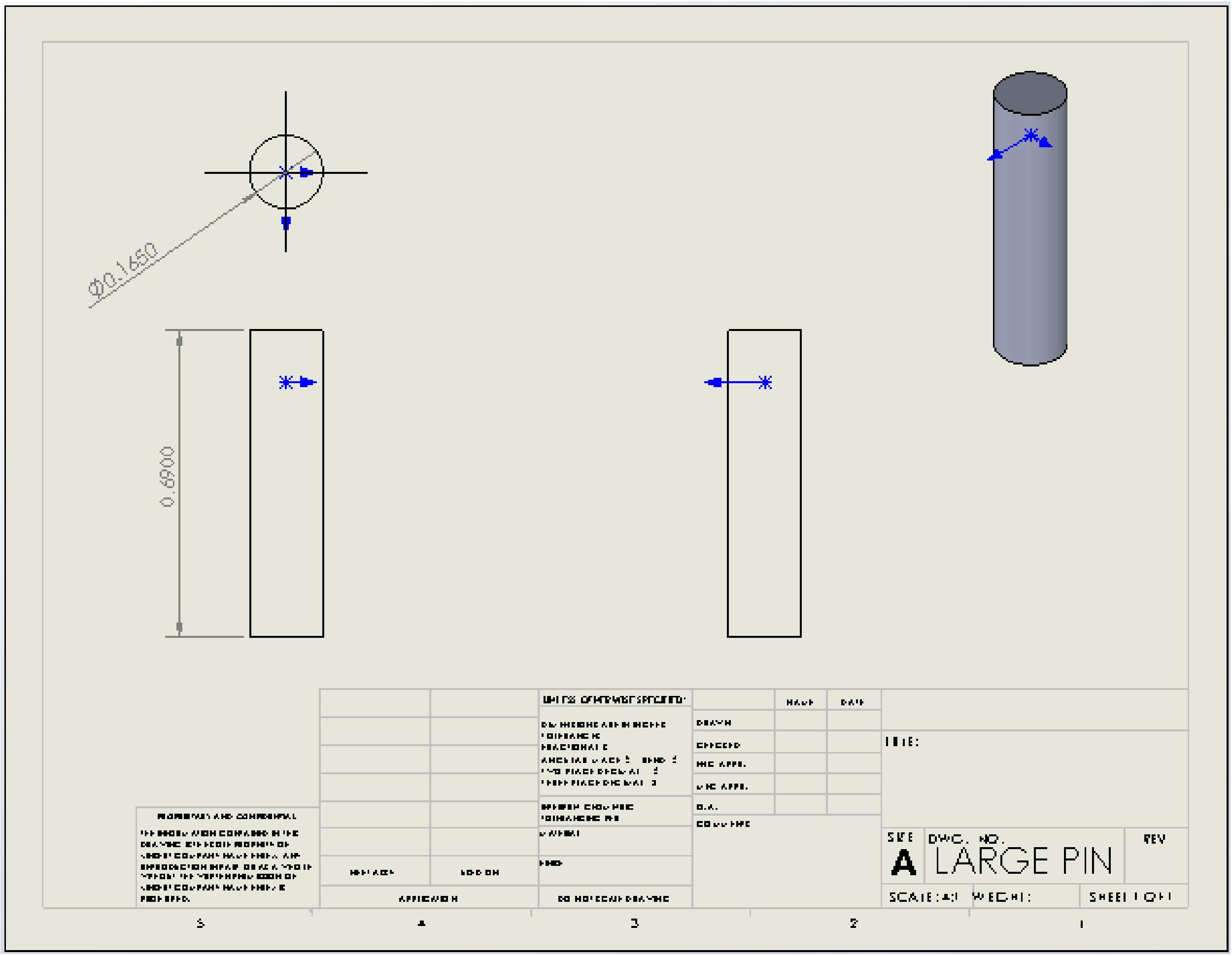
Drawing 9. Fin top



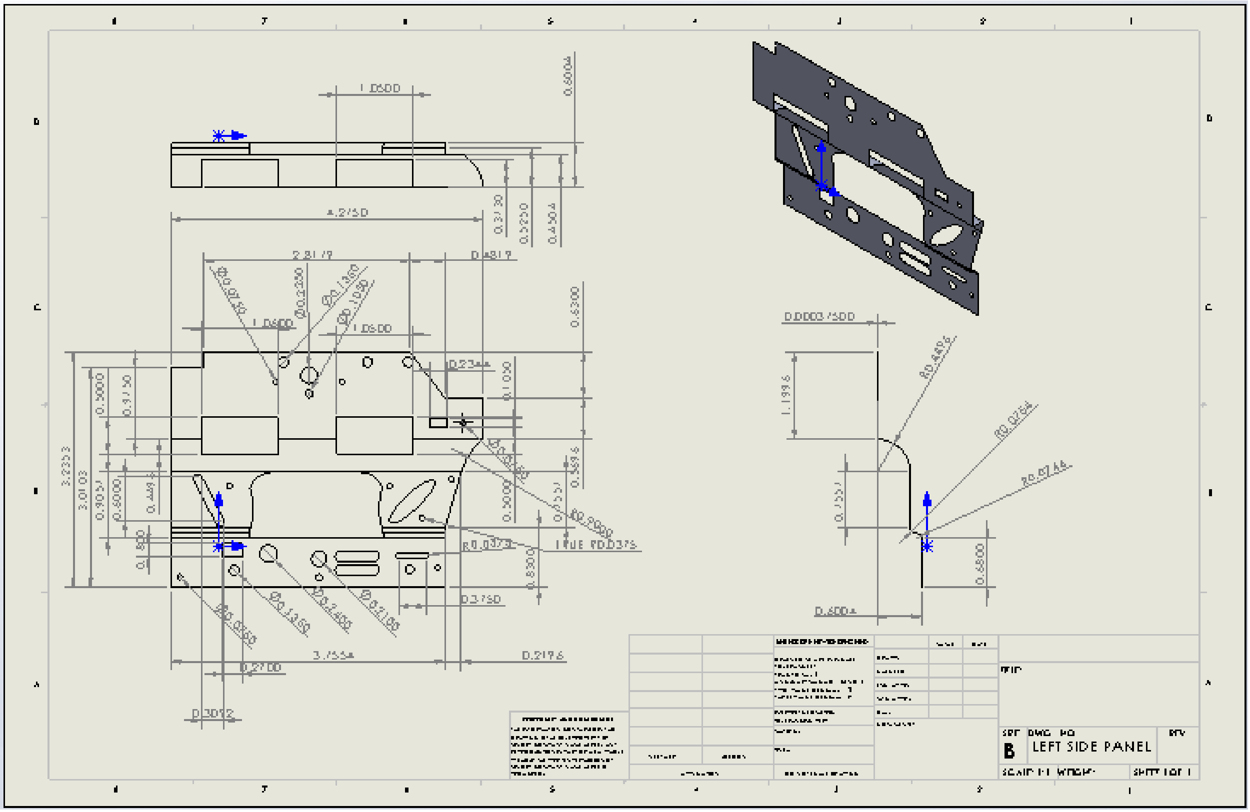
Drawing 10. Fin side



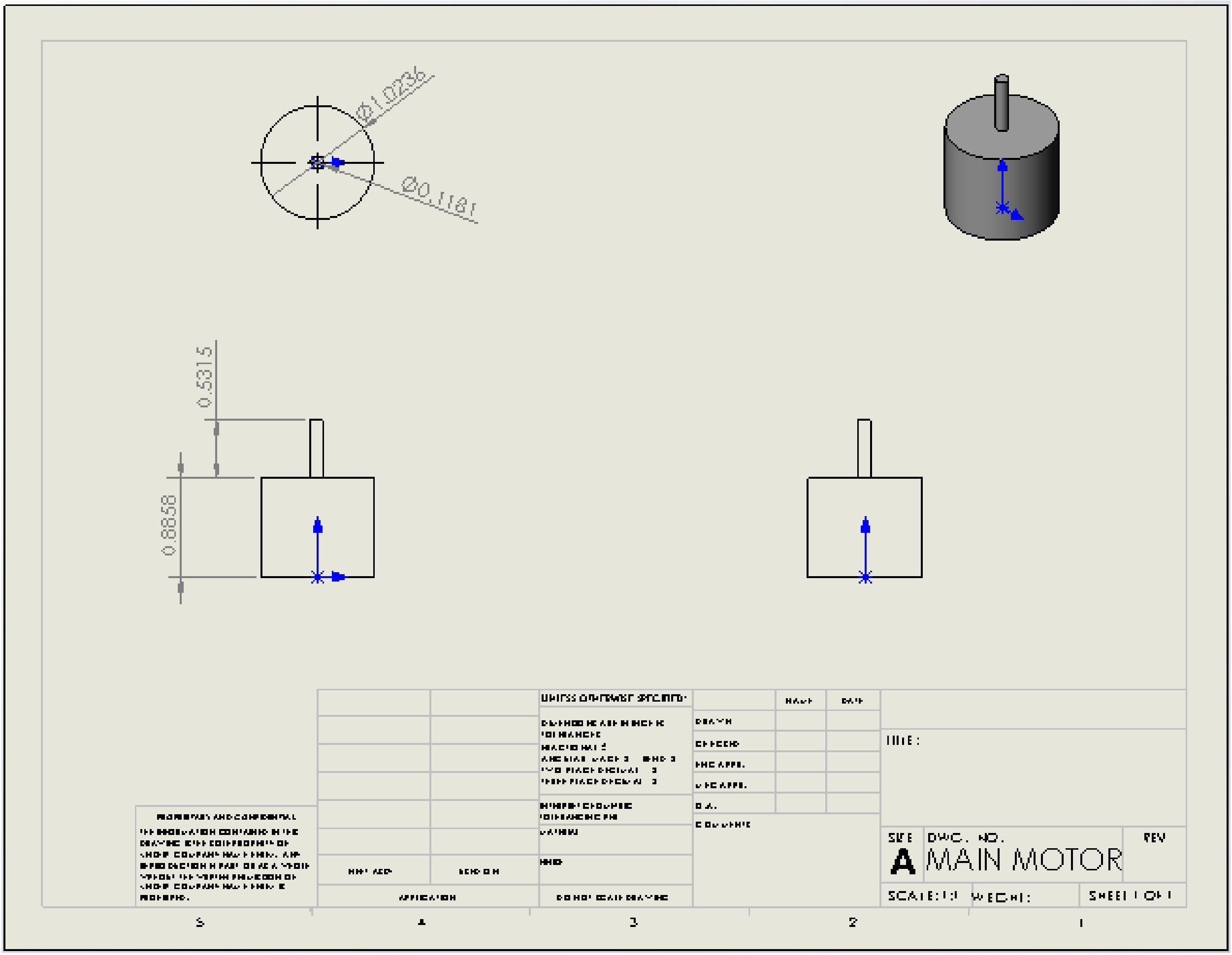
Drawing 11. Hollow blade shaft



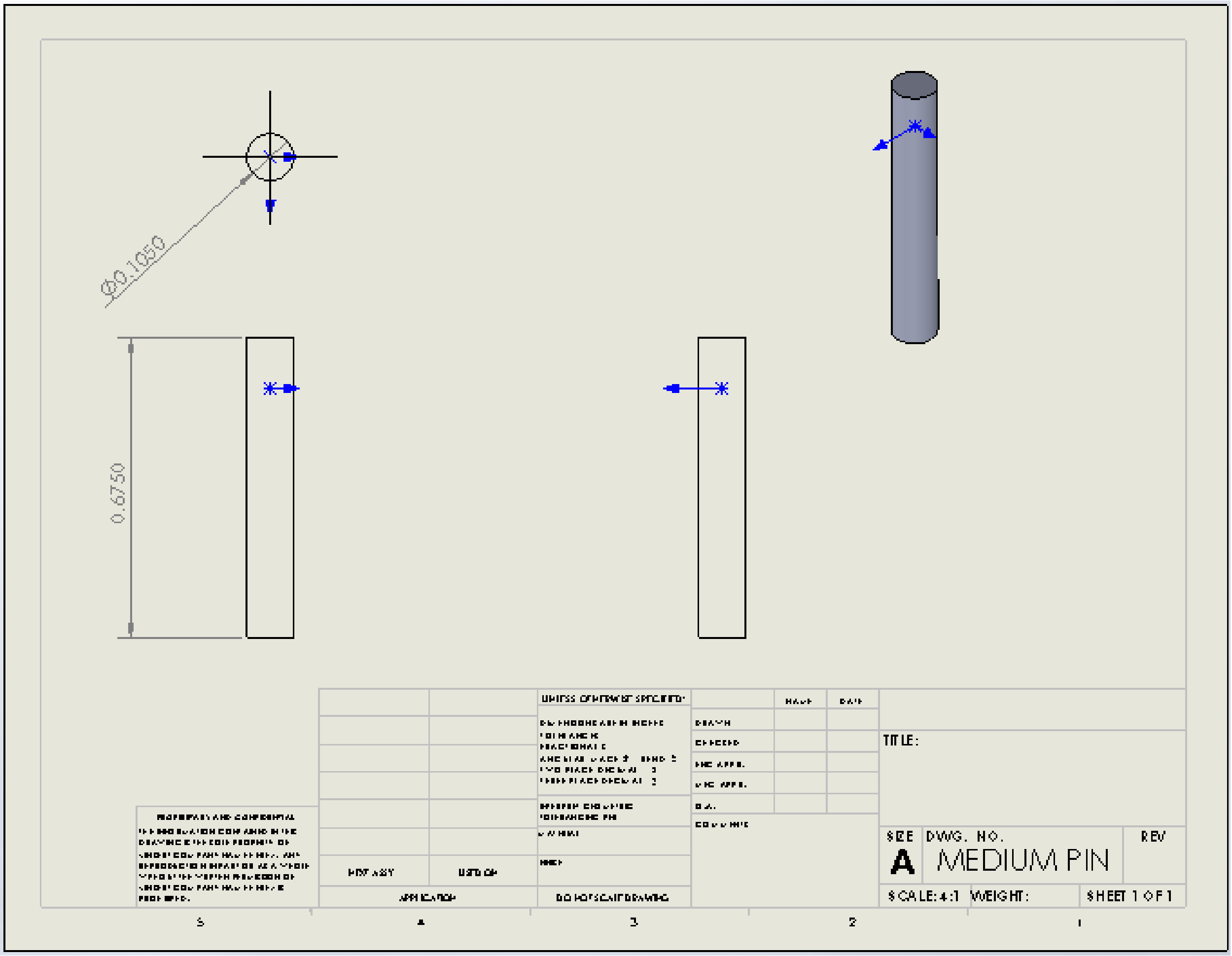
Drawing 12. Large pin



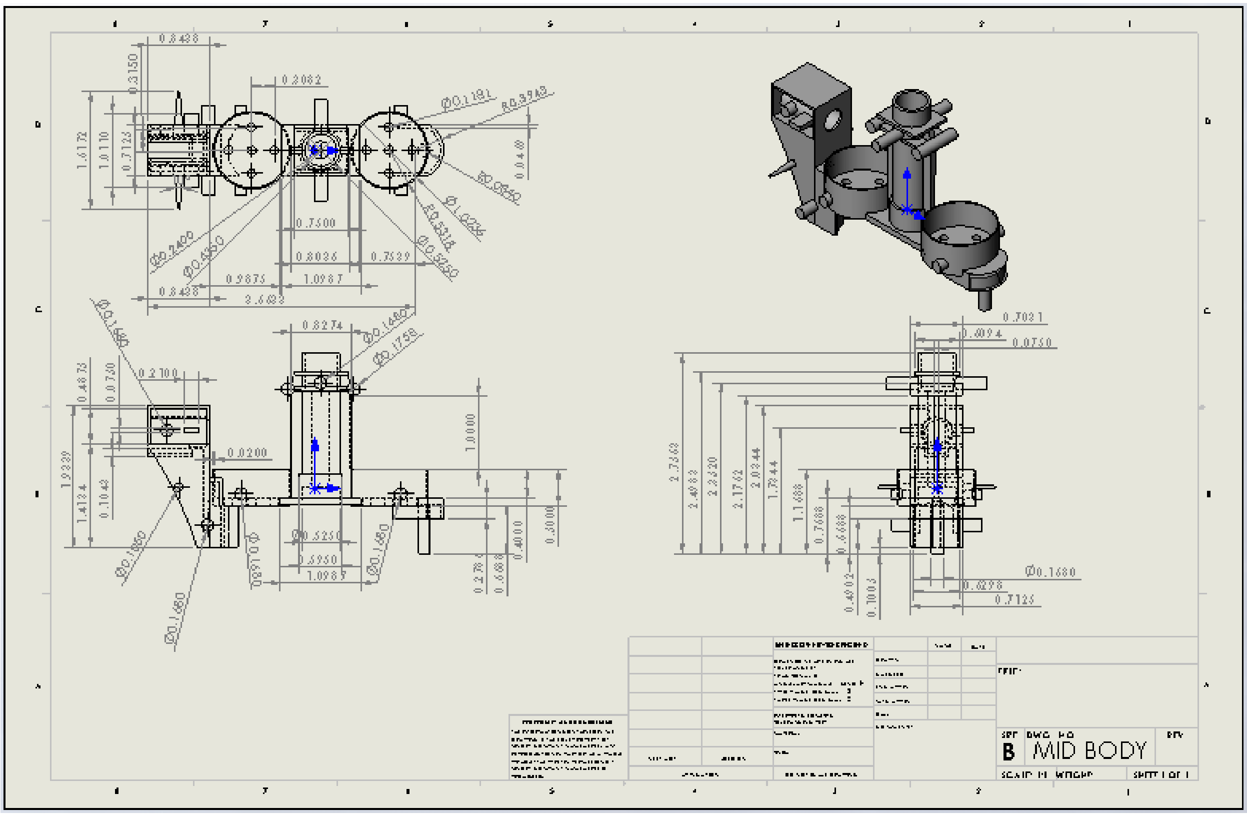
Drawing 13. Left side panel



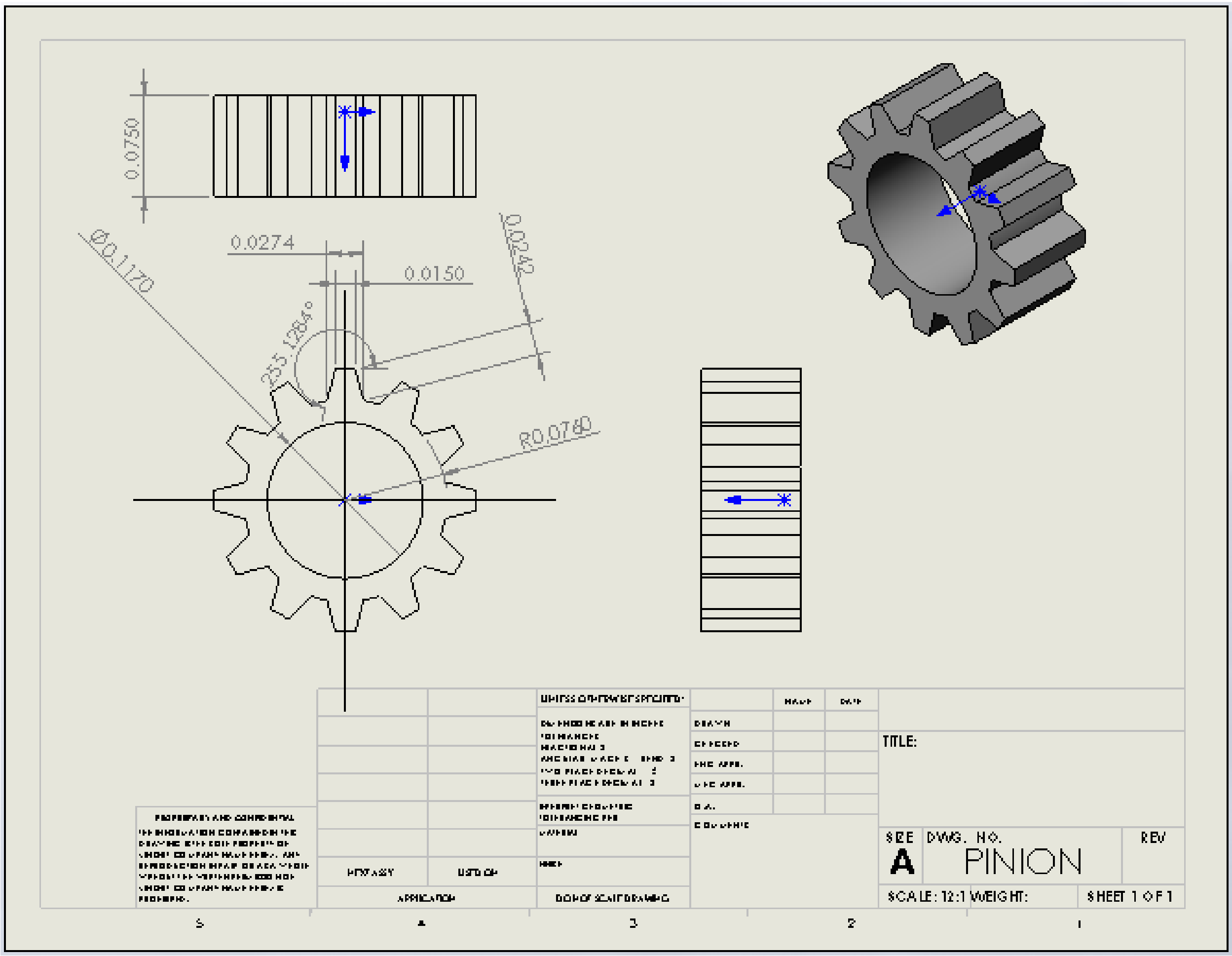
Drawing 14. Main motor



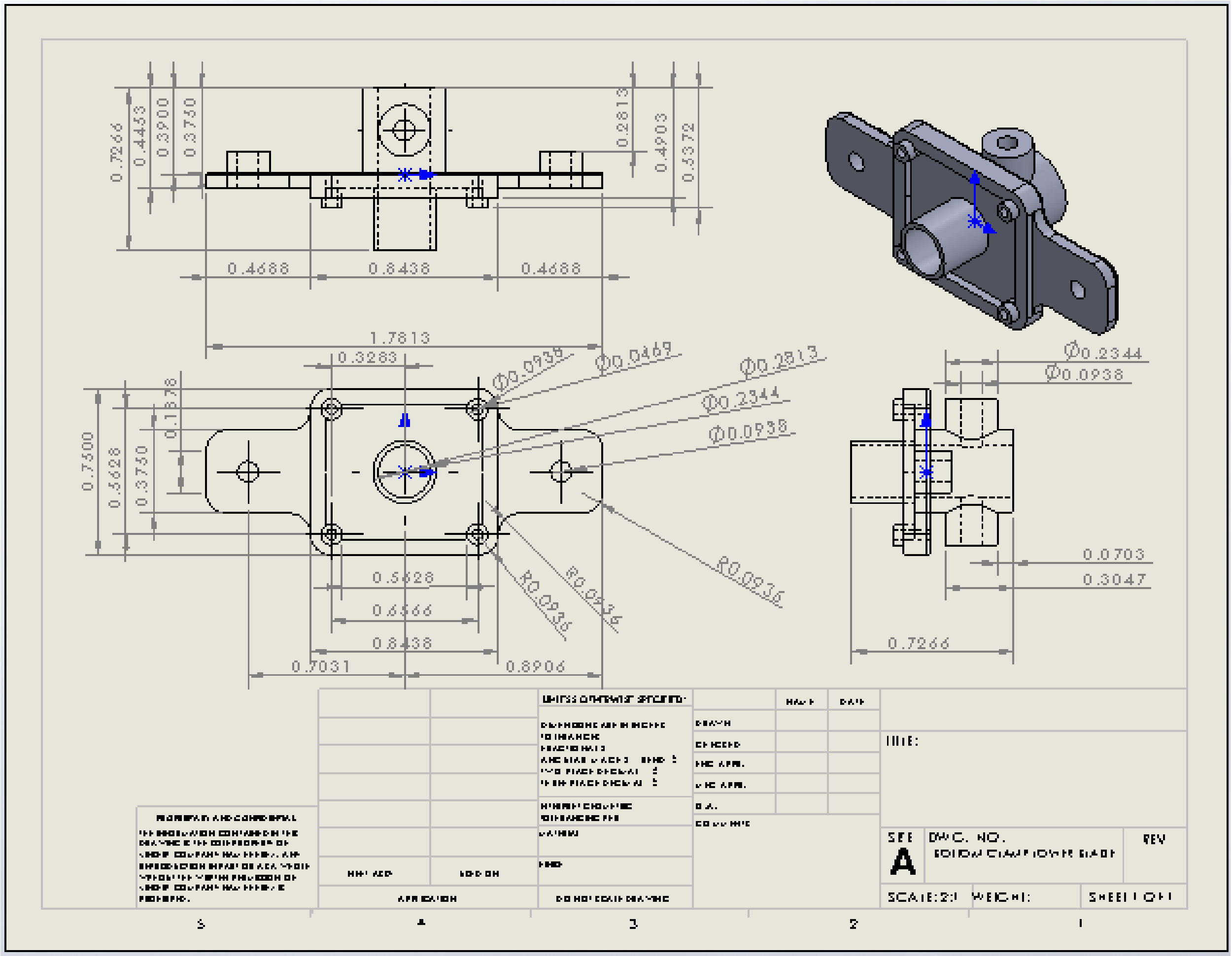
Drawing 15. Medium pin



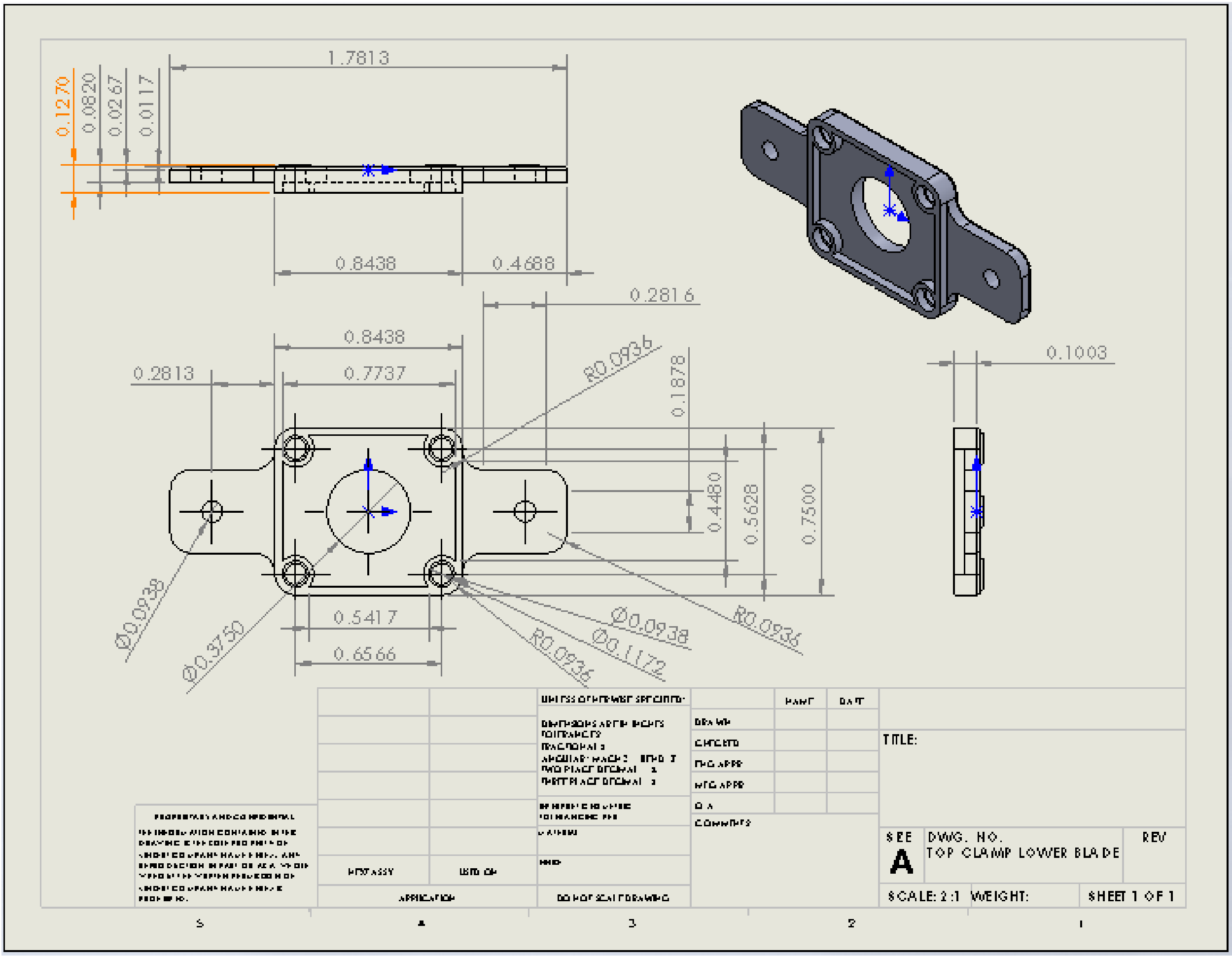
Drawing 16. Mid body



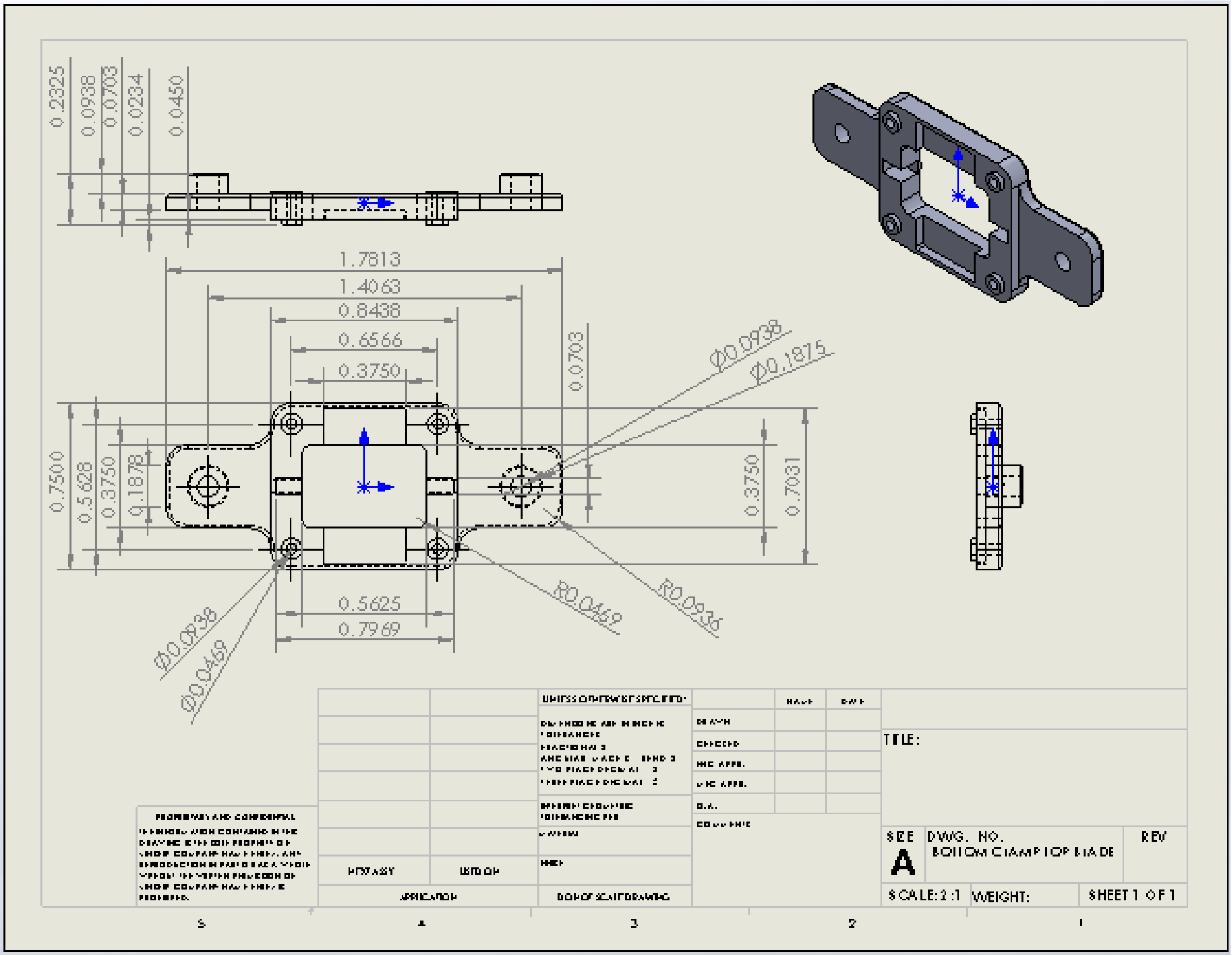
Drawing 17. Pinion



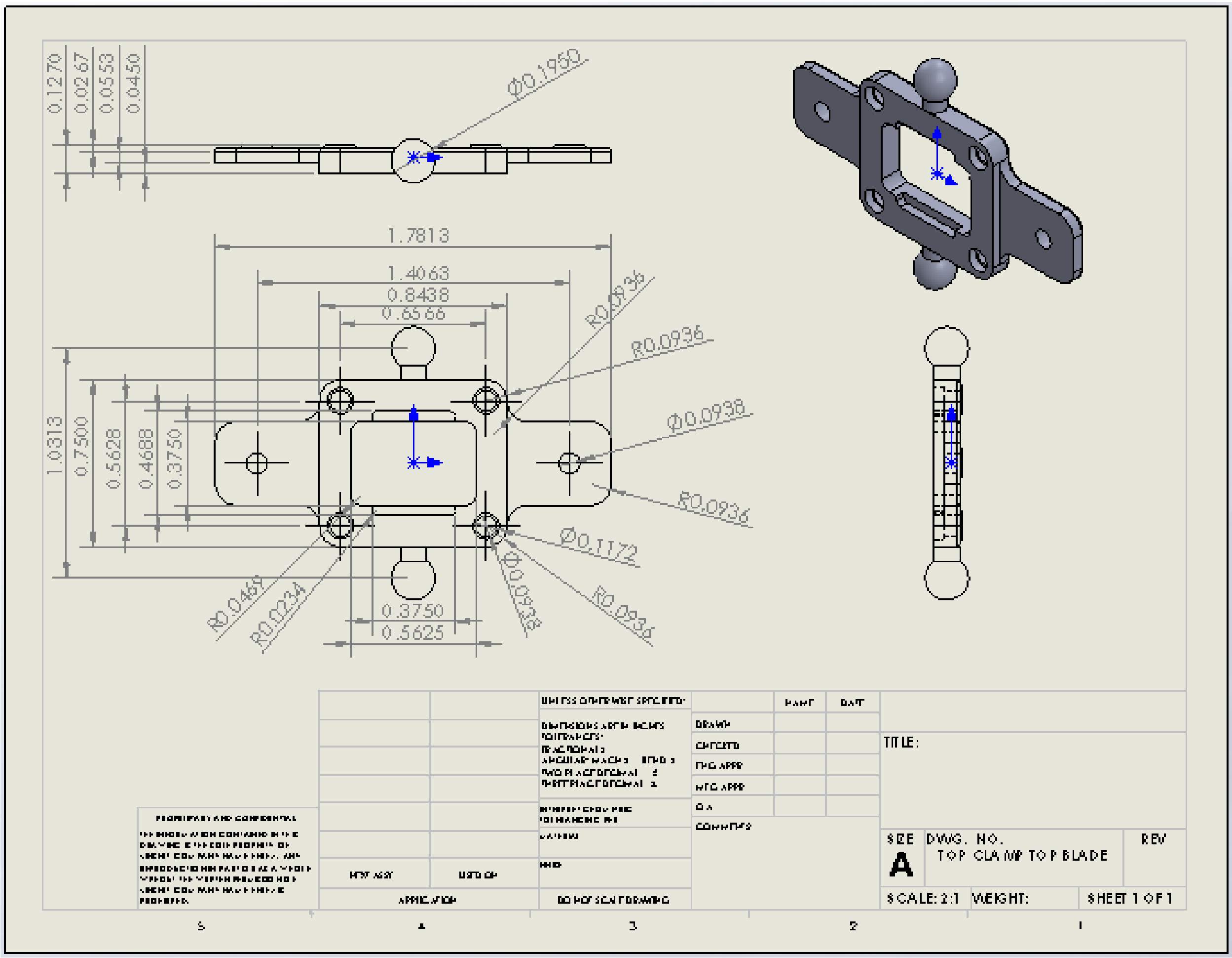
Drawing 18. Propeller lower blade clamp bottom



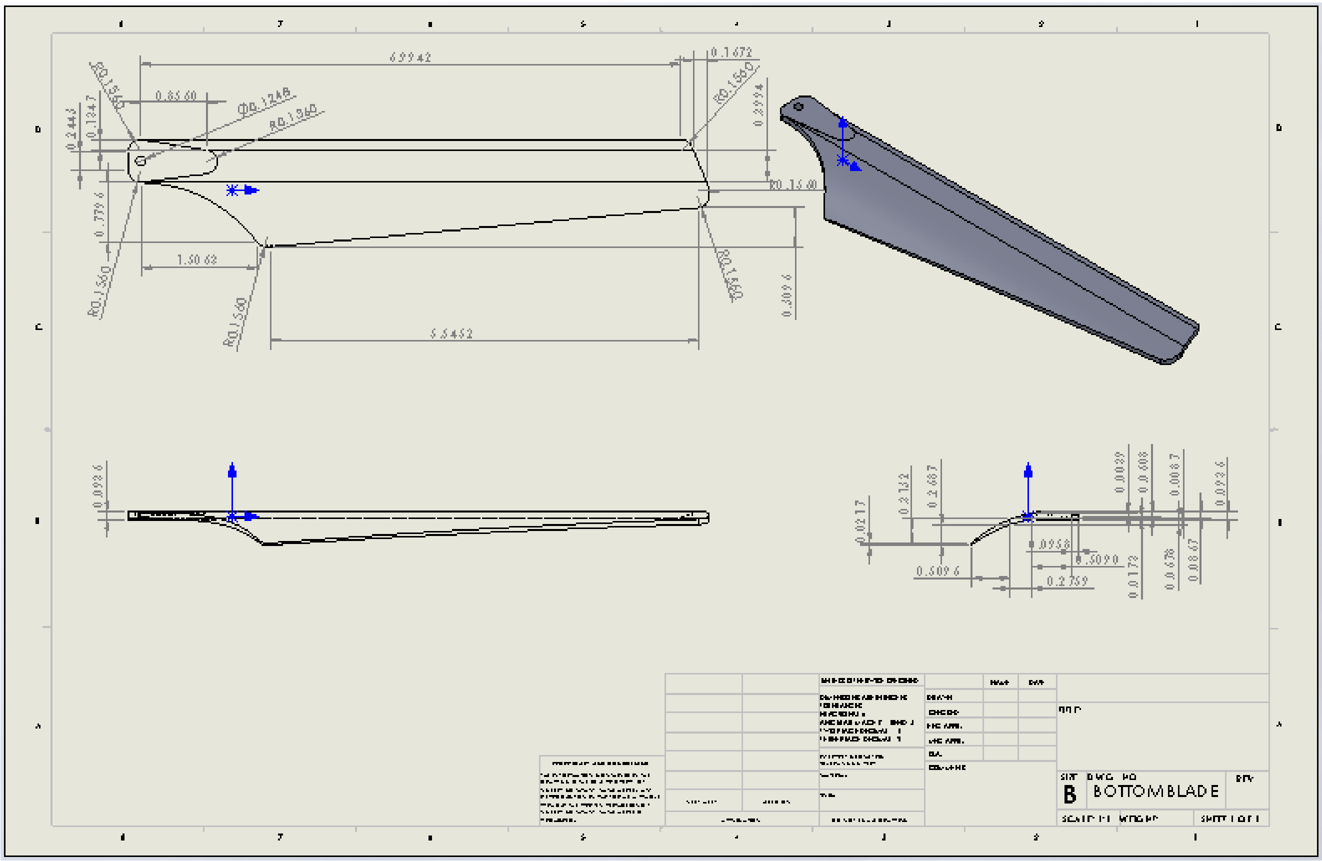
Drawing 19. Propeller lower blade clamp top



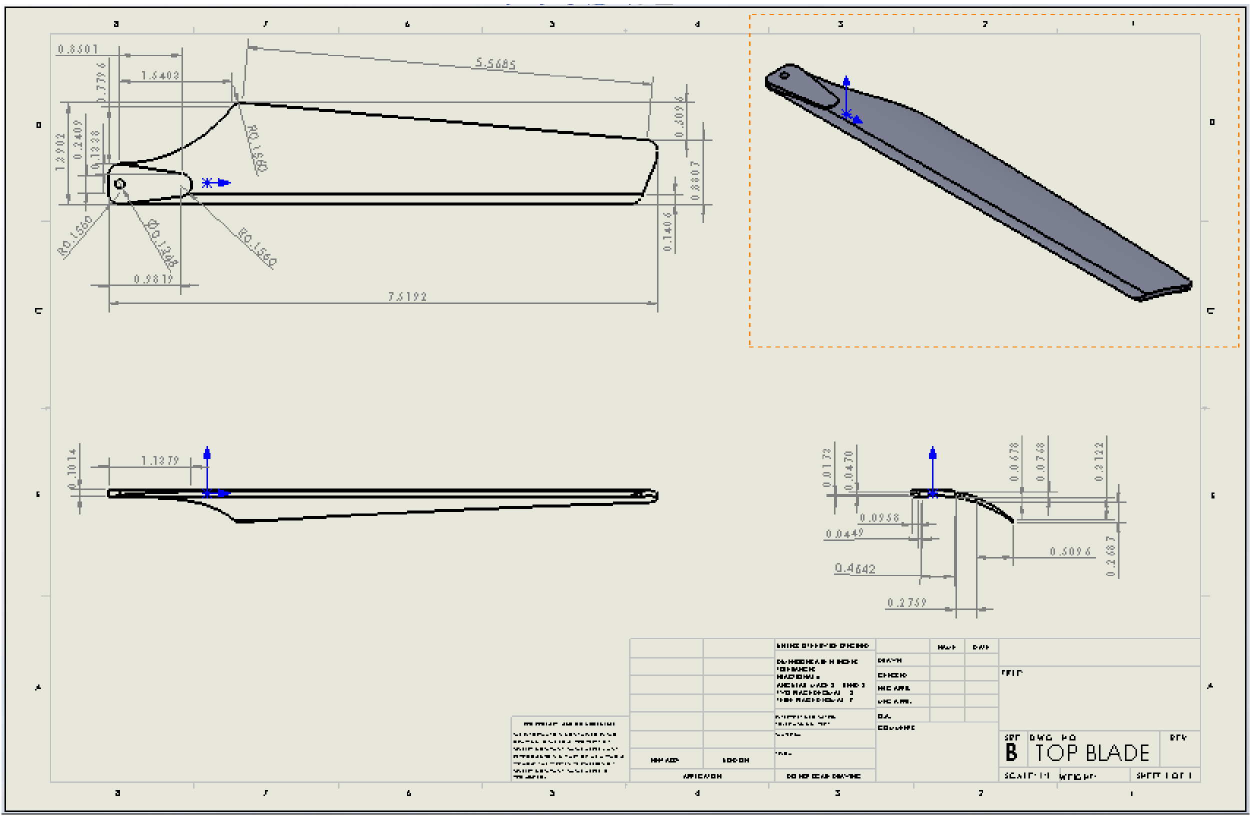
Drawing 20. Propeller upper blade clamp bottom



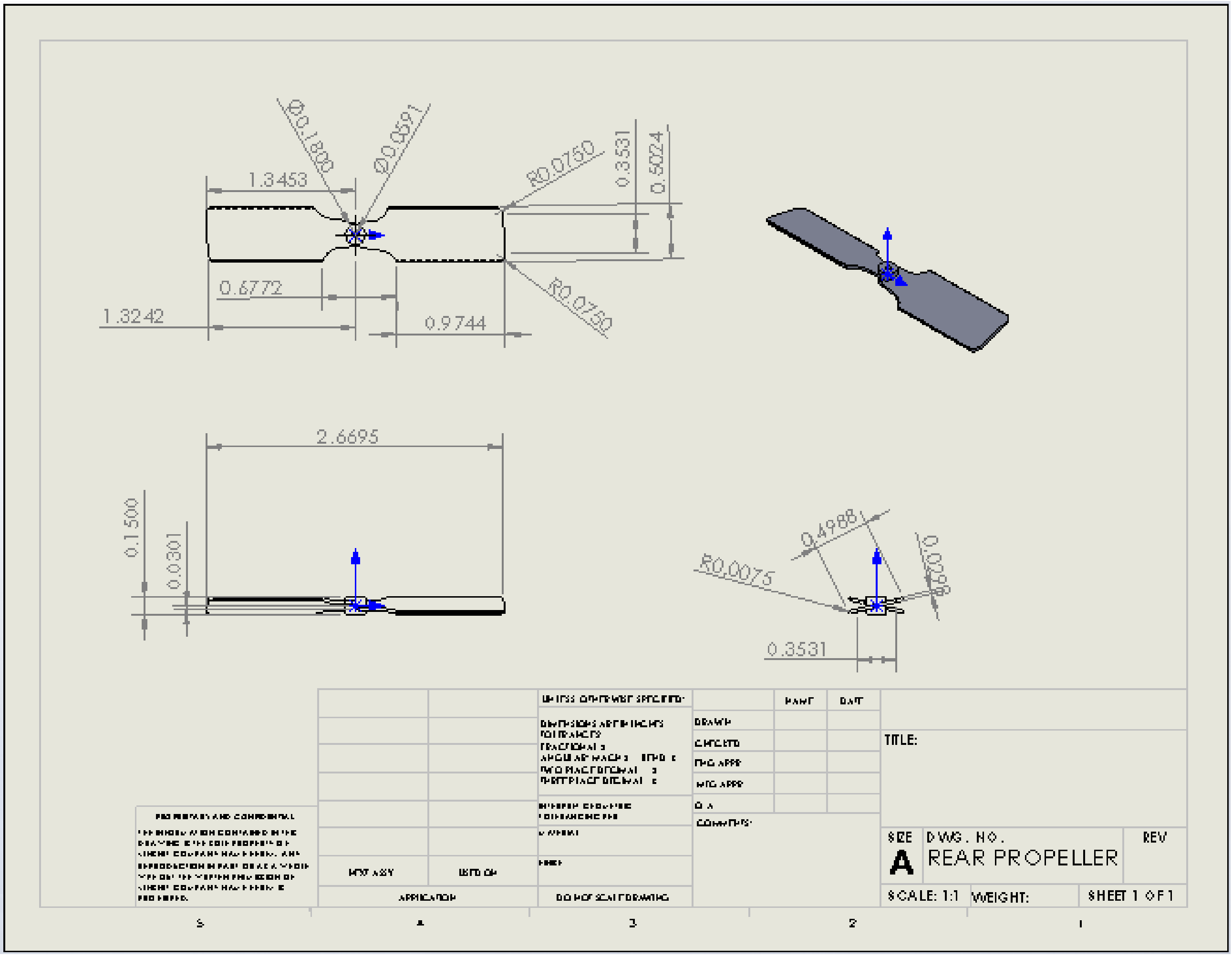
Drawing 21. Propeller upper blade clamp top



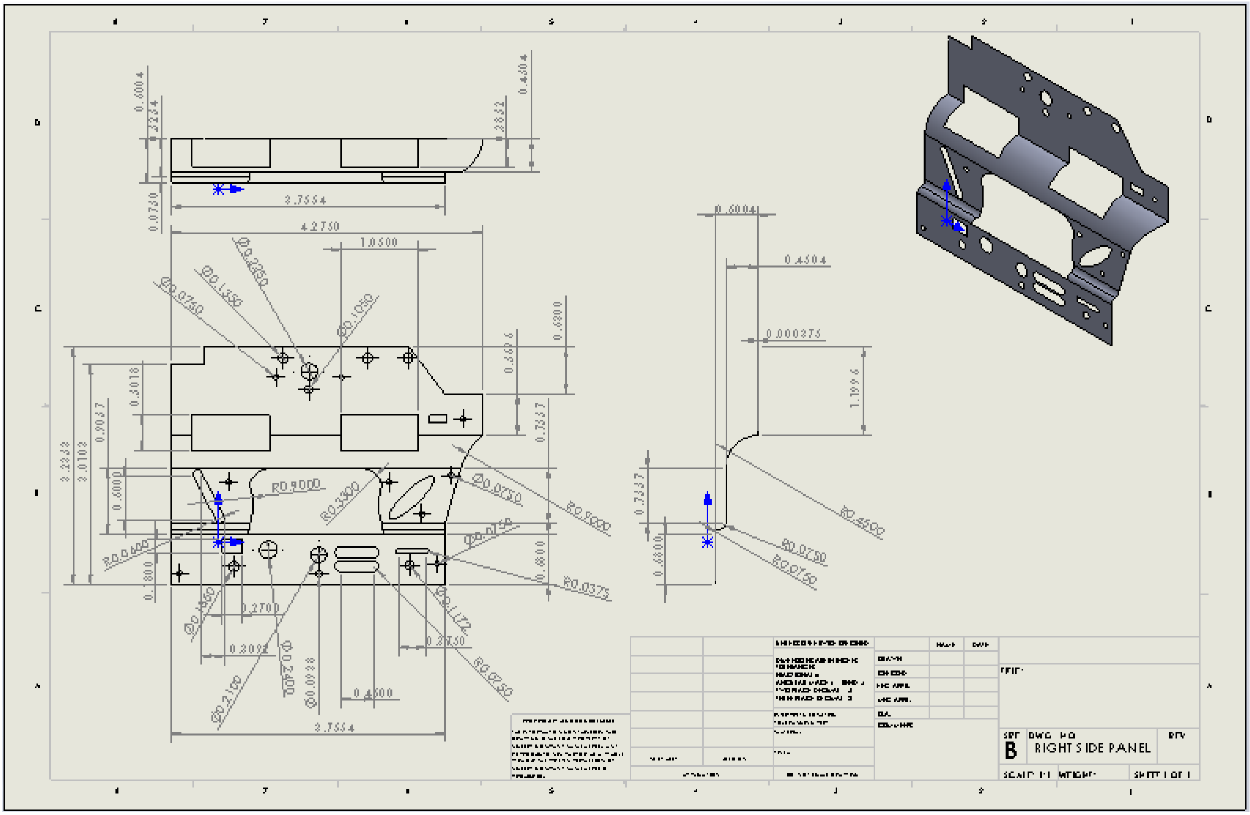
Drawing 22. Propeller bottom blade



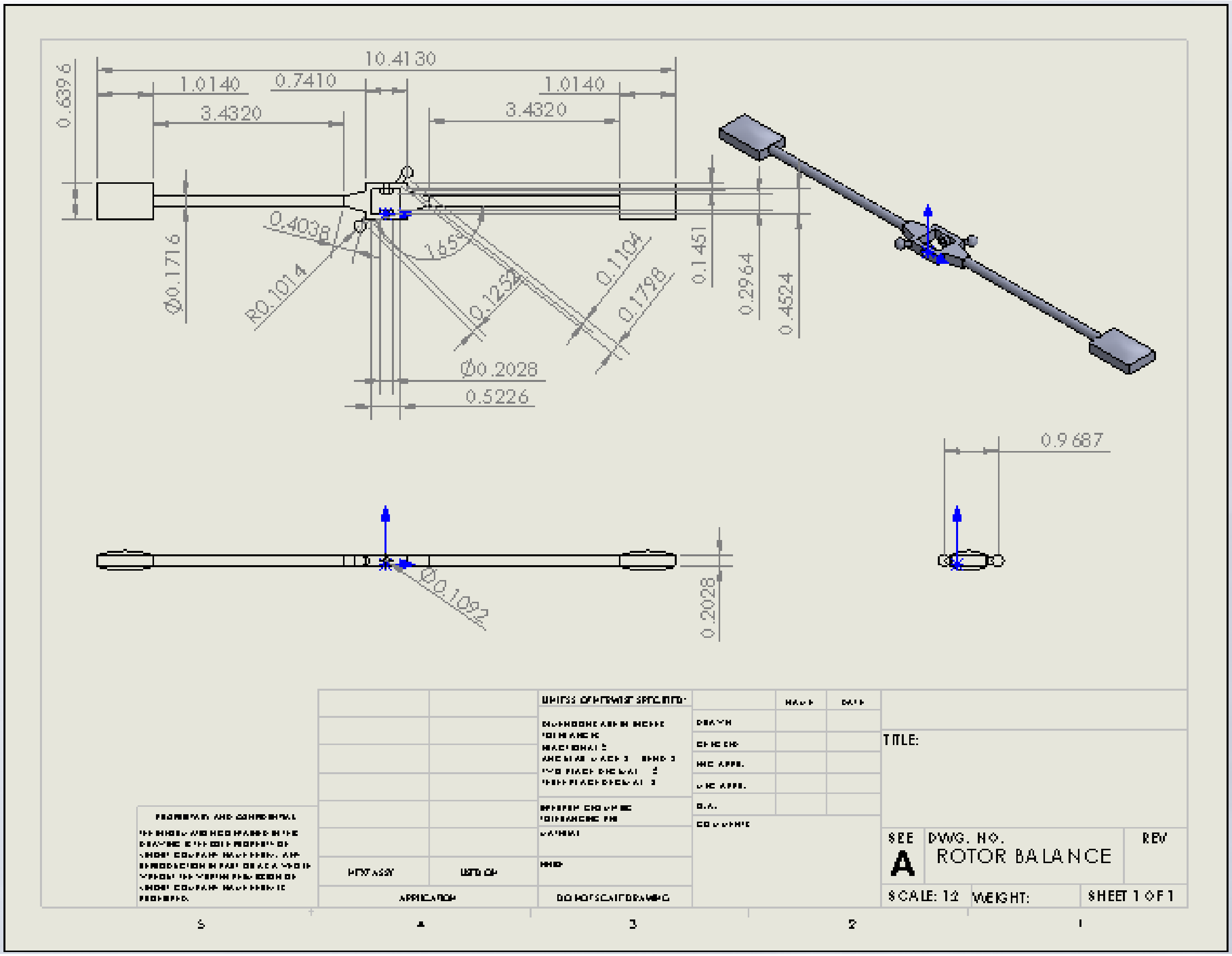
Drawing 23. Propeller top blade



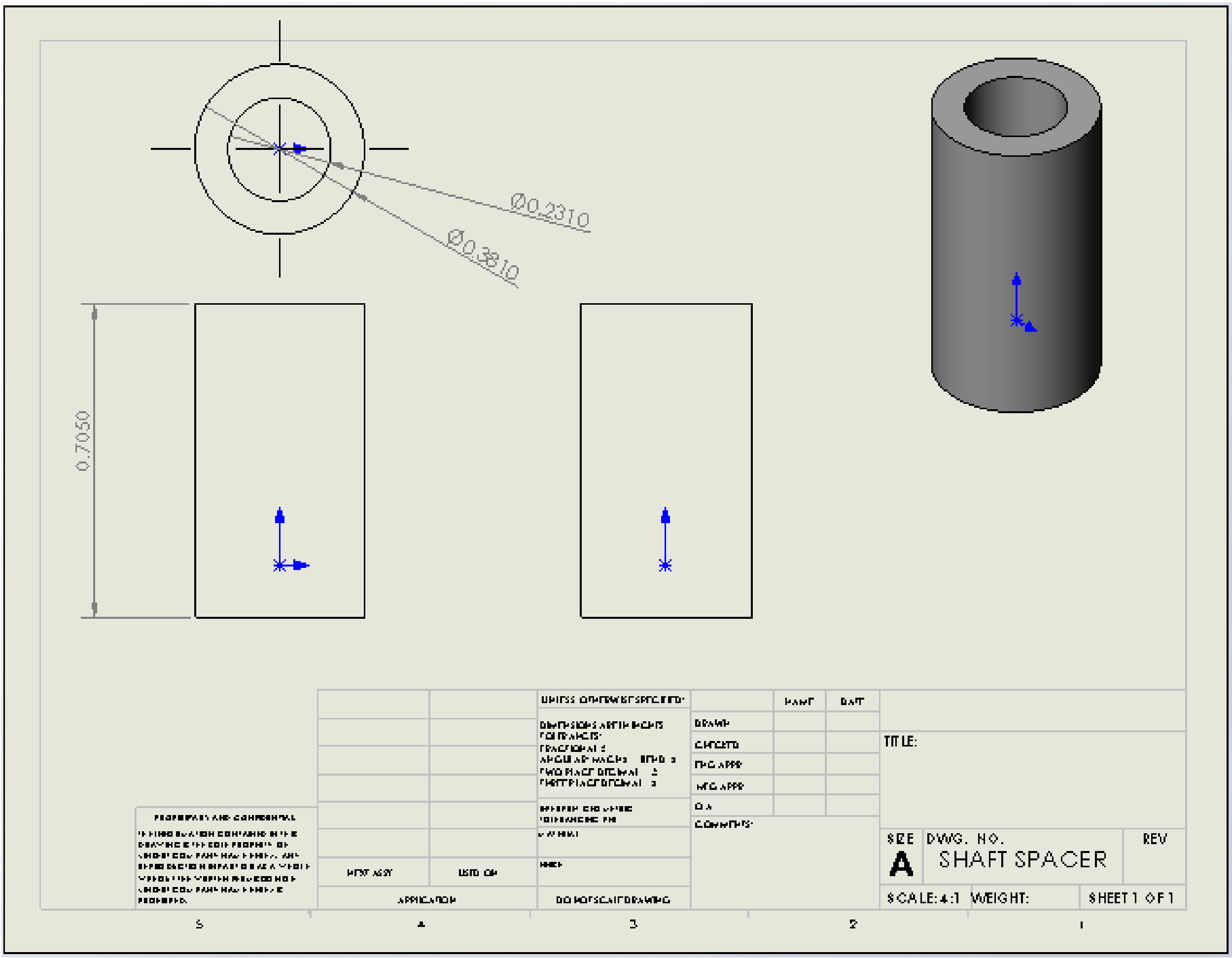
Drawing 24. Rear propeller



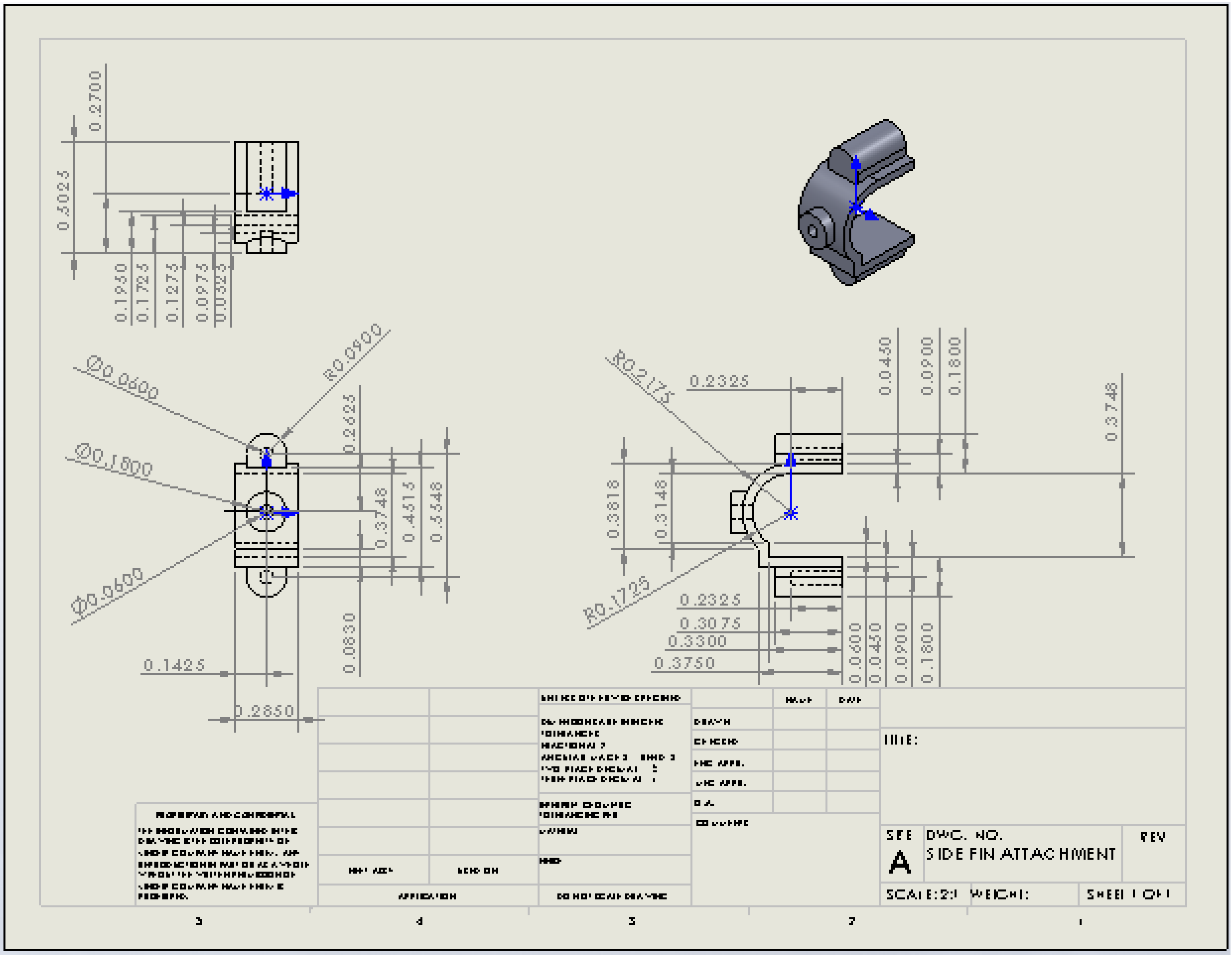
Drawing 25. Right side panel



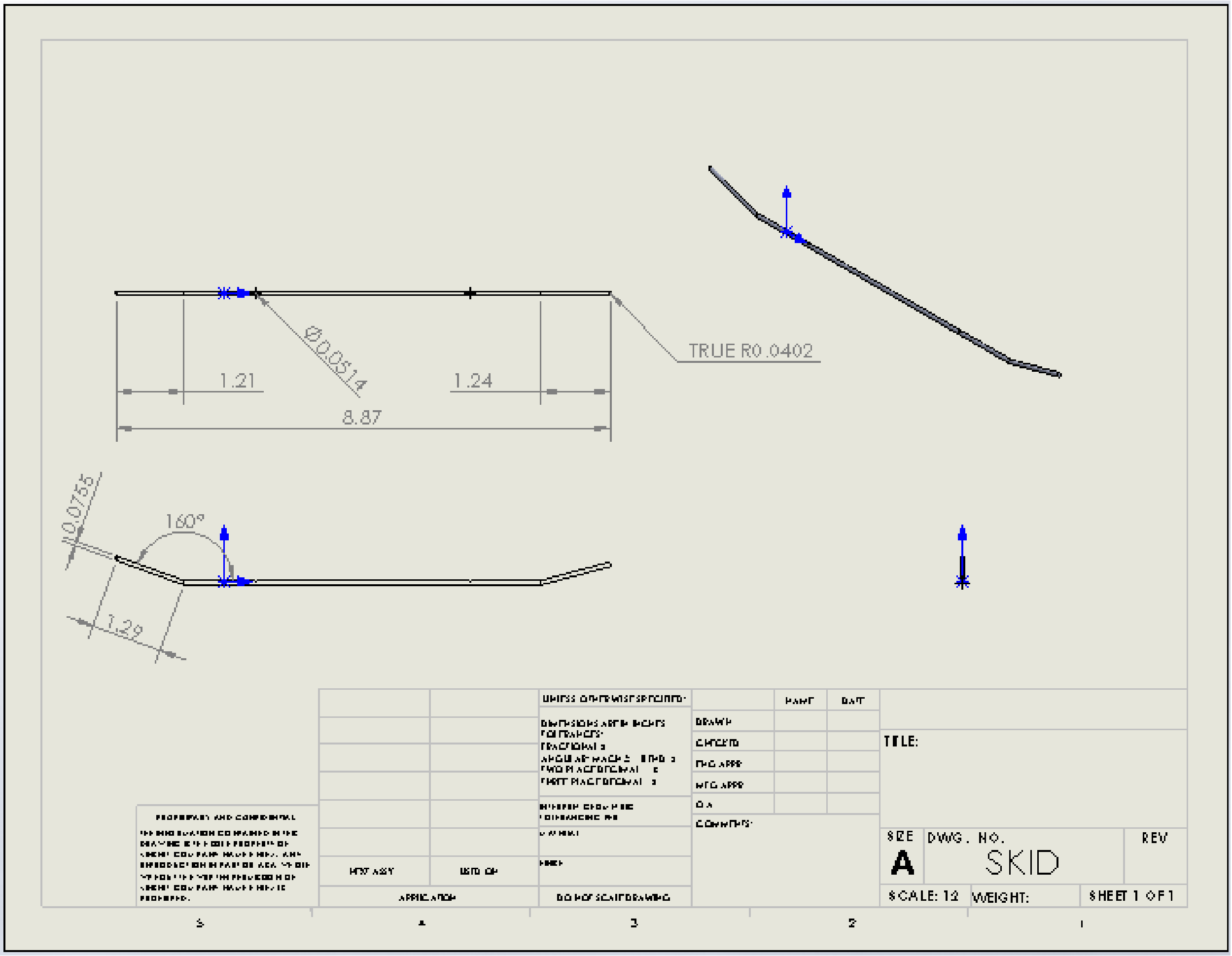
Drawing 26. Rotor balance



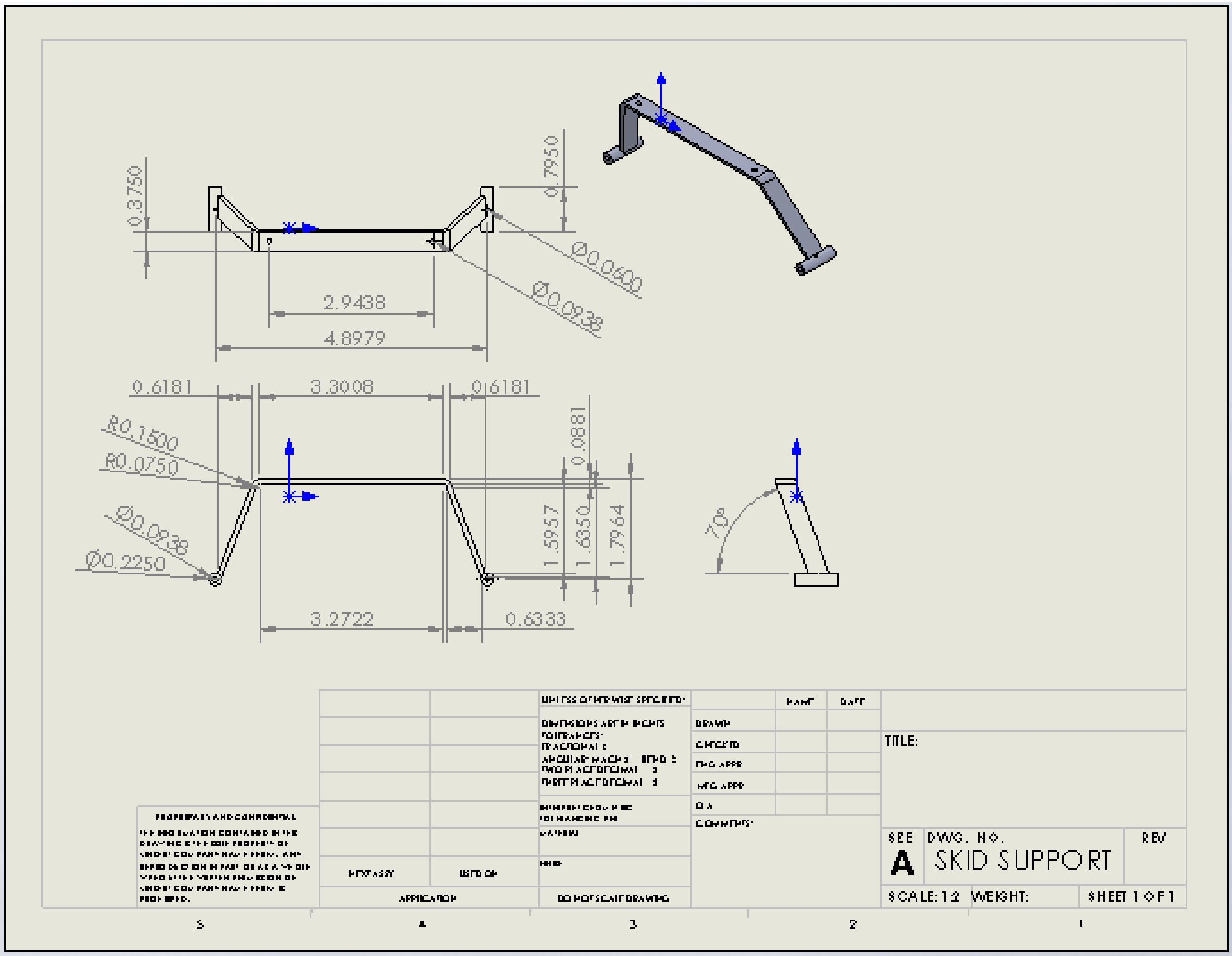
Drawing 27. Shaft spacer



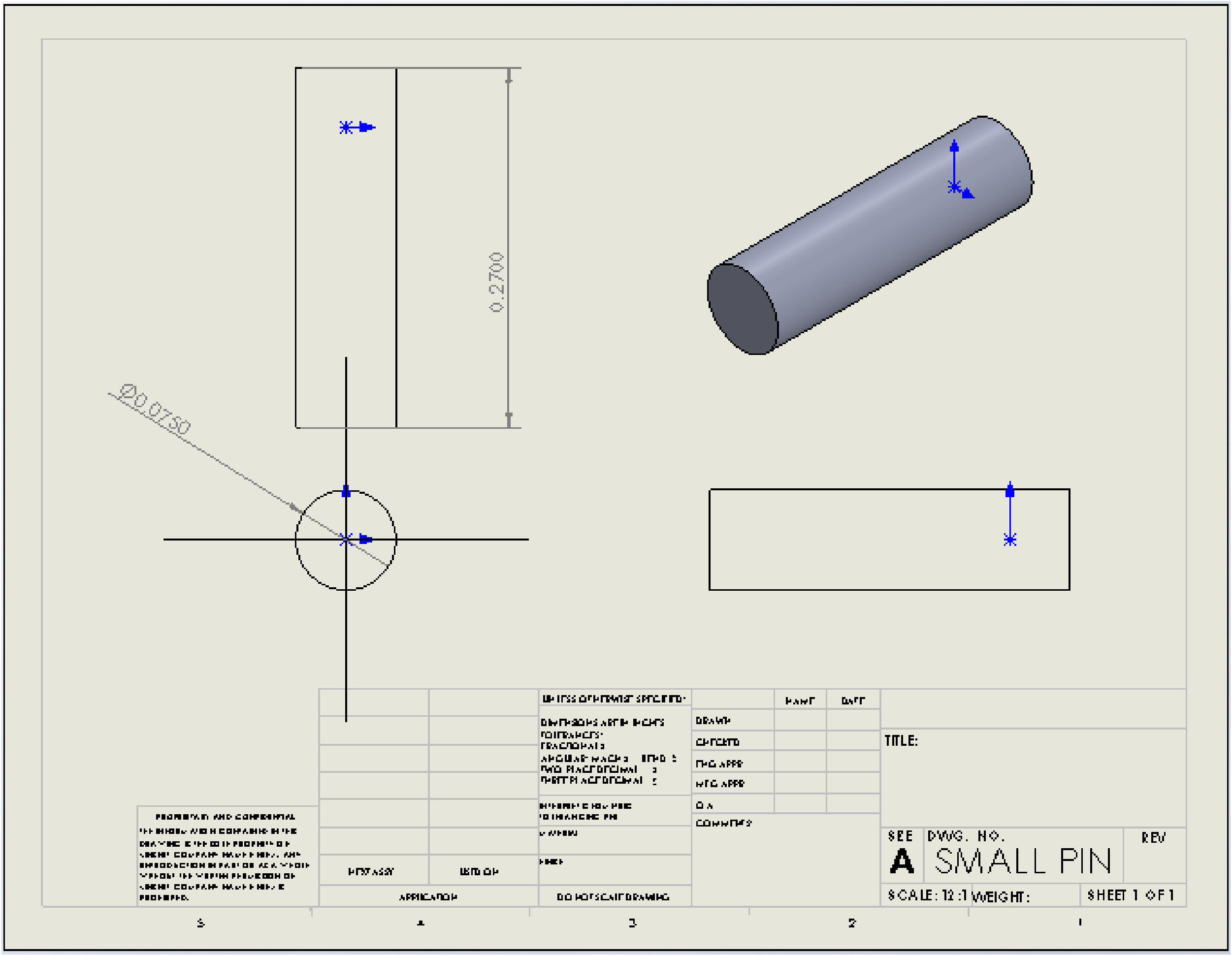
Drawing 28. Side fin attachment



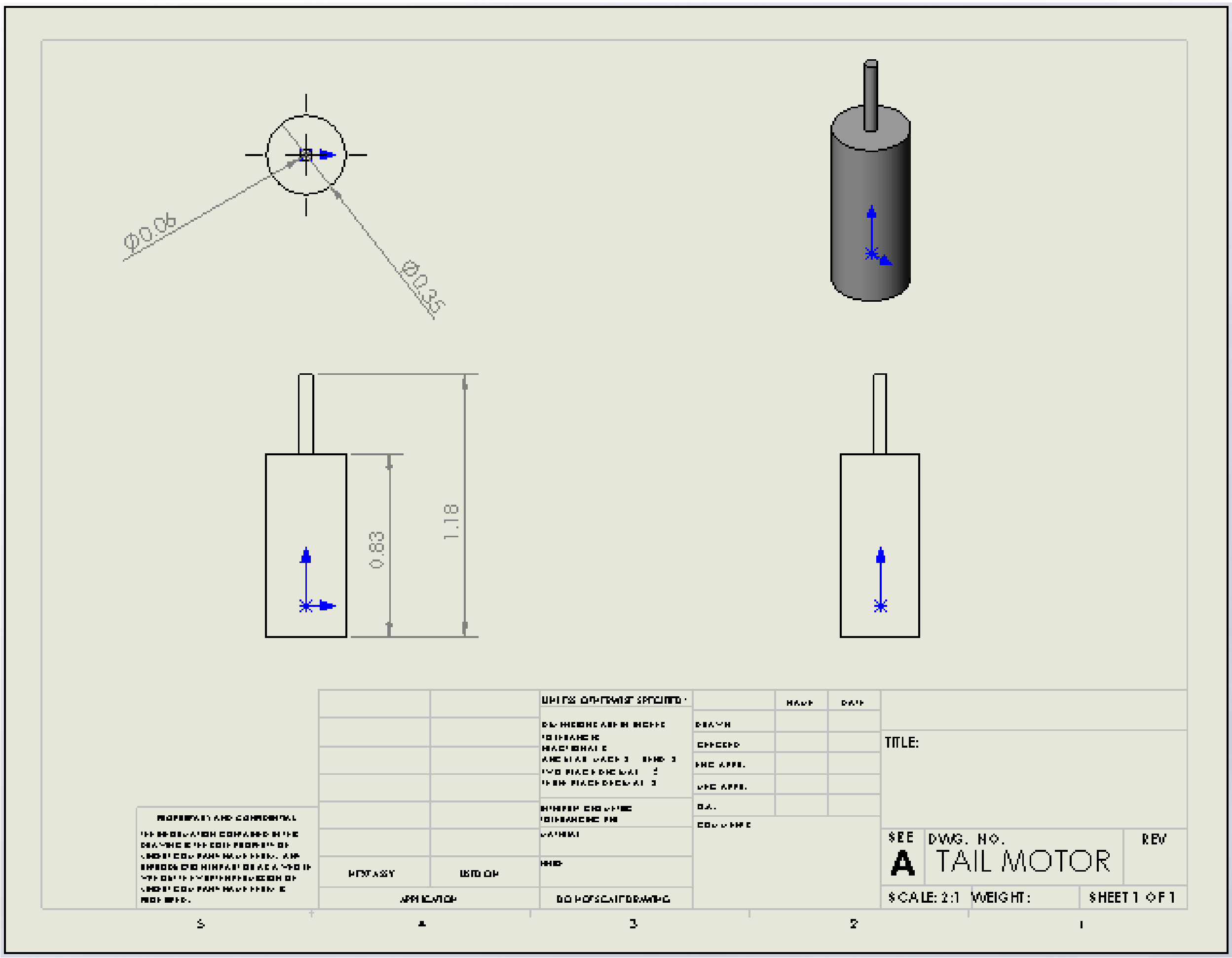
Drawing 29. Skid



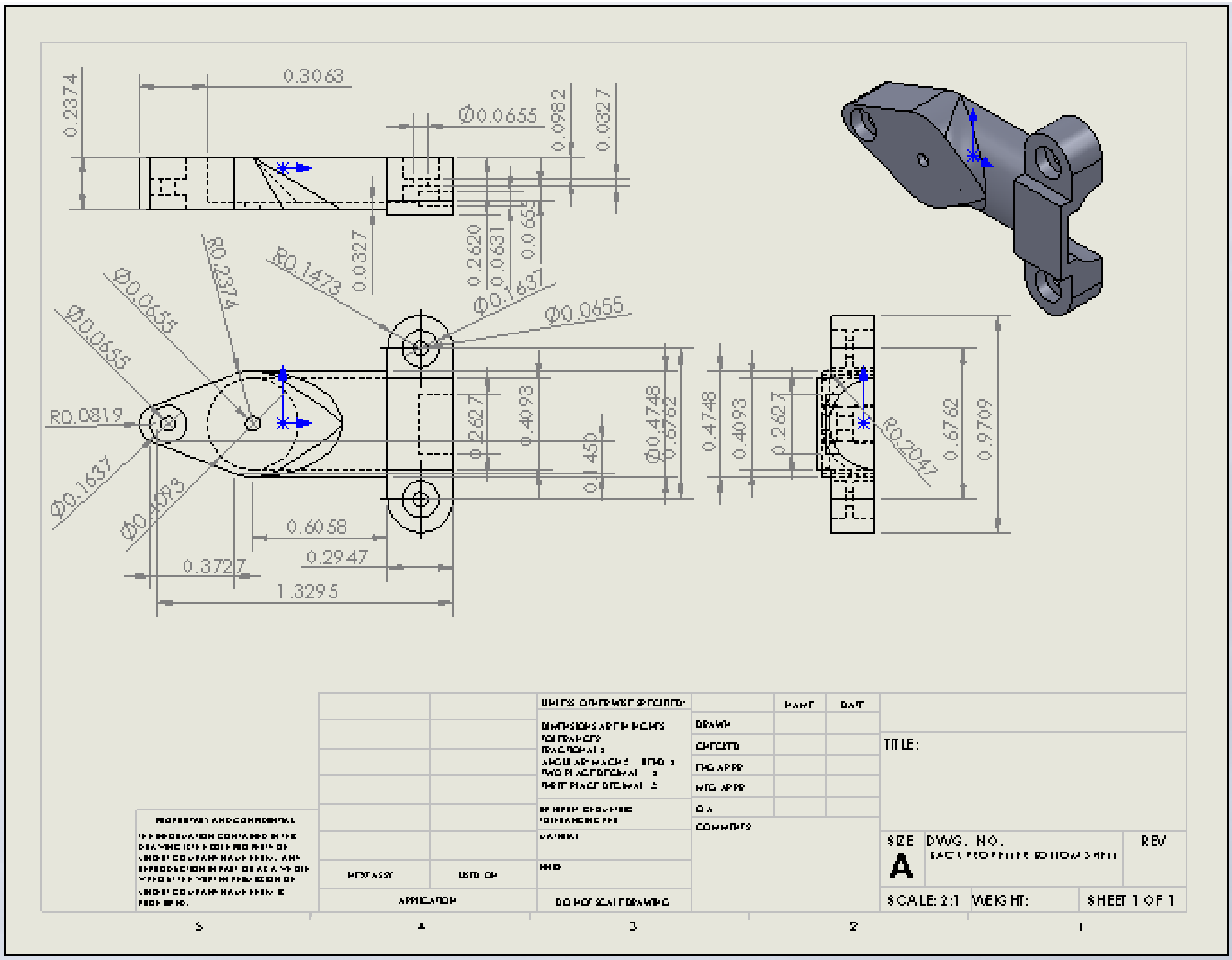
Drawing 30. Skid support



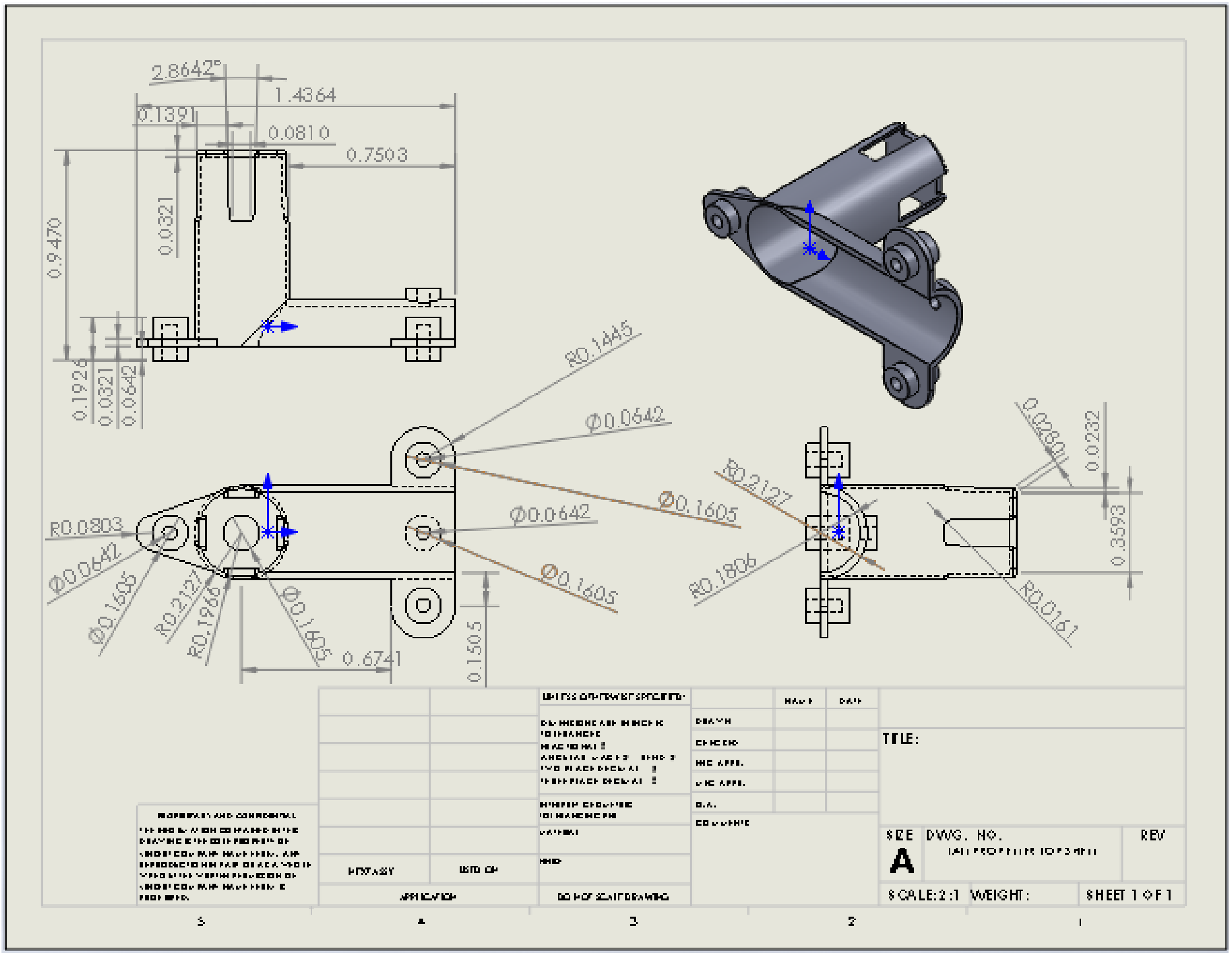
Drawing 31. Small pin



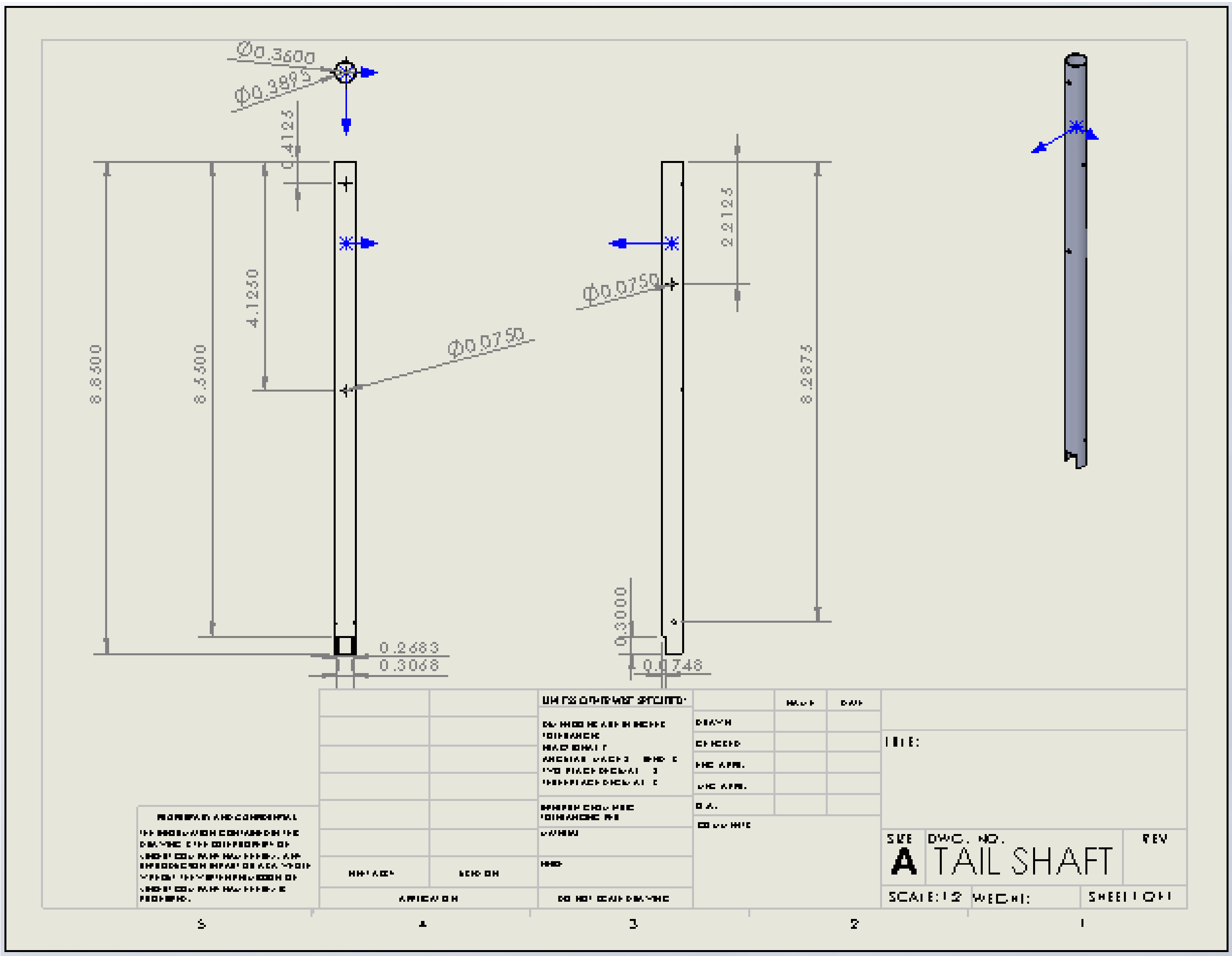
Drawing 32. Tail motor



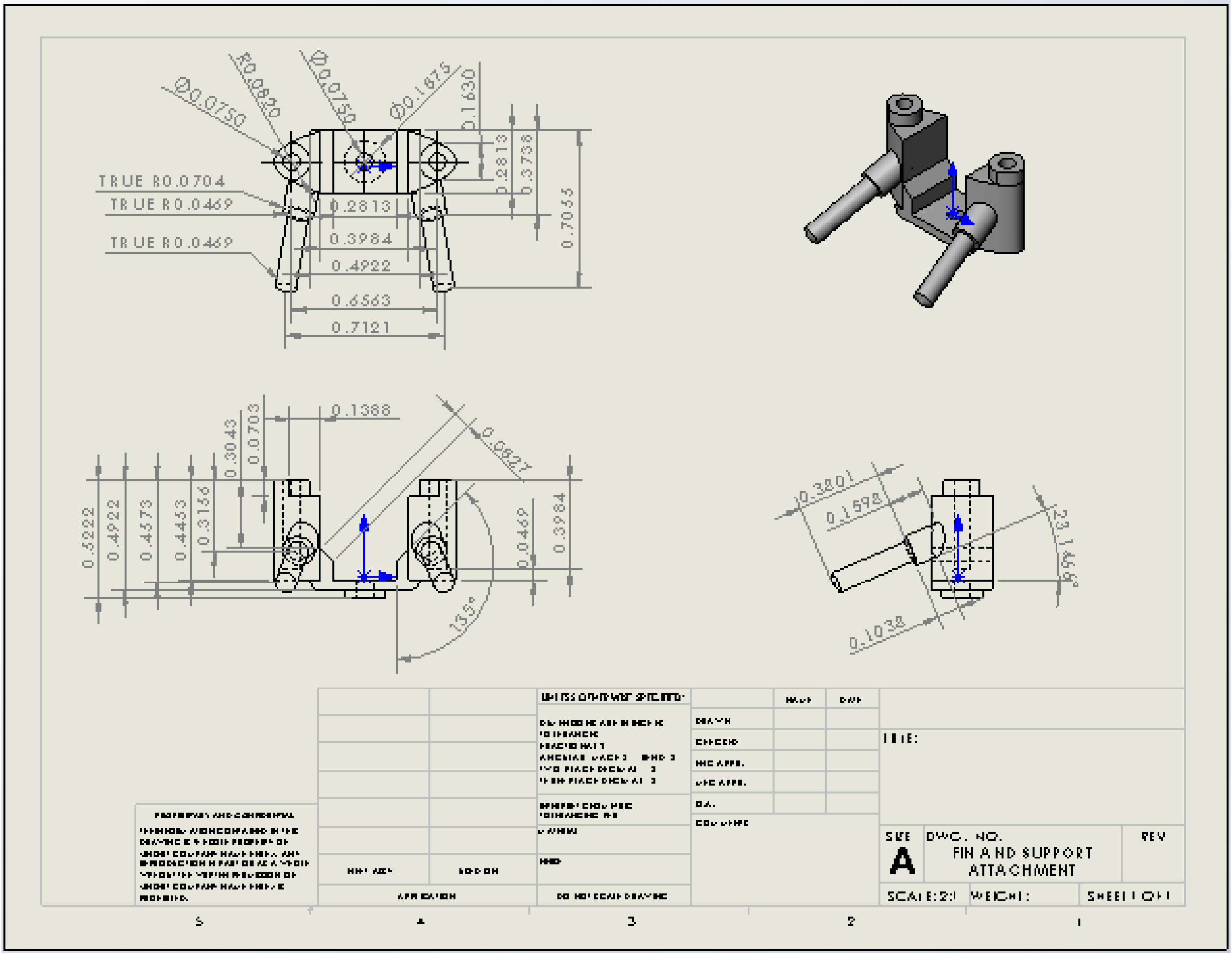
Drawing 33. Tail propeller bottom shell



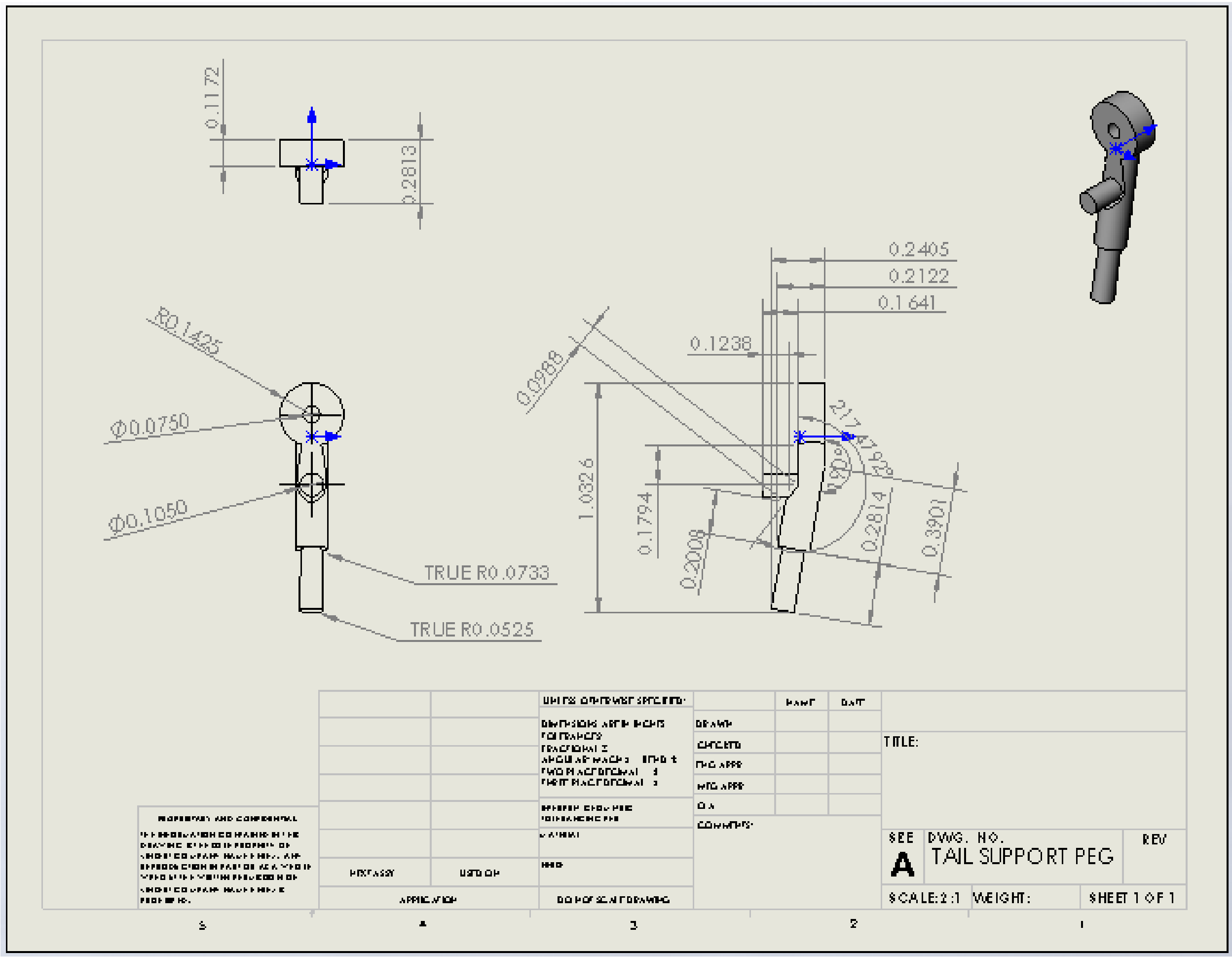
Drawing 34. Tail propeller top shell



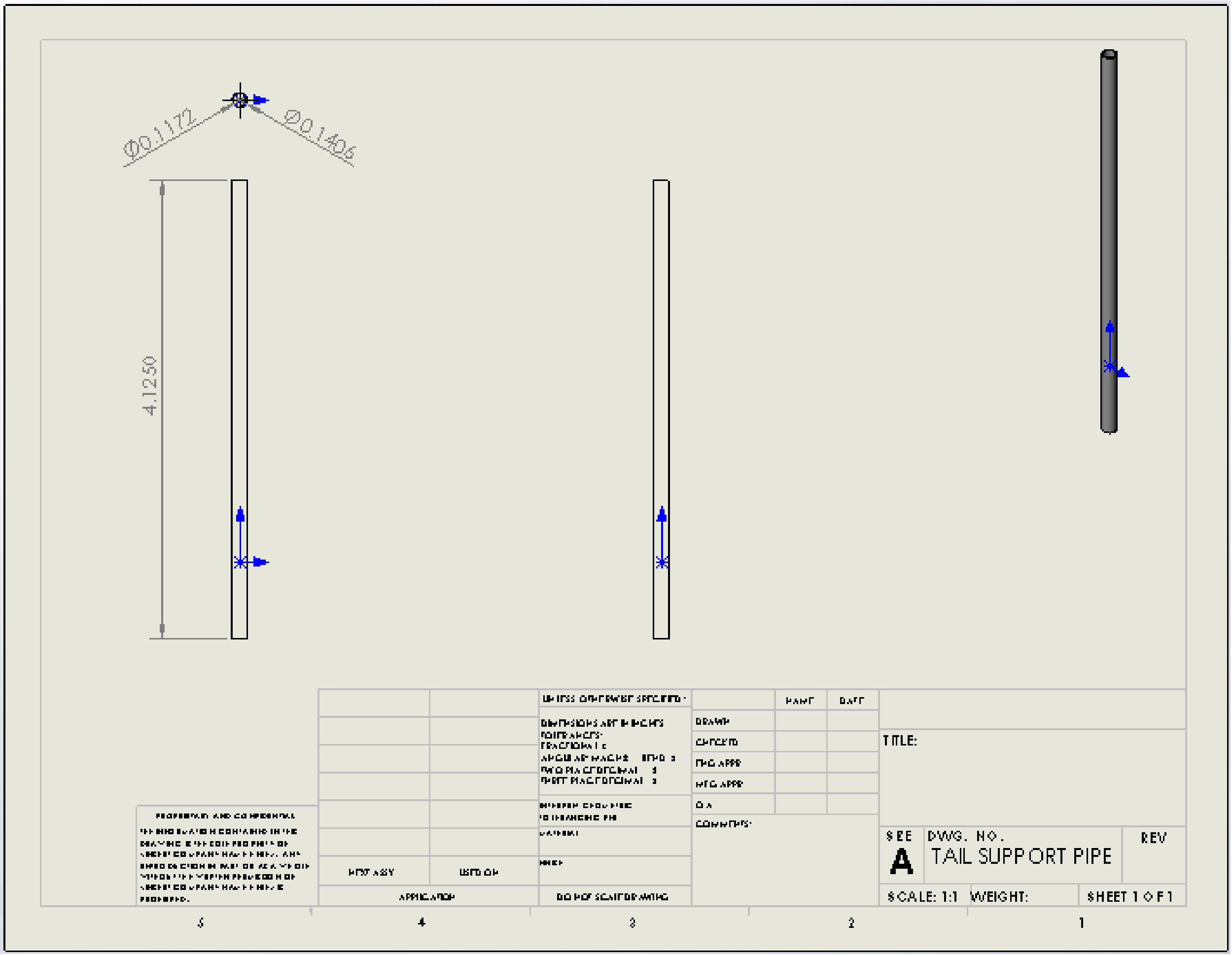
Drawing 35. Tail shaft



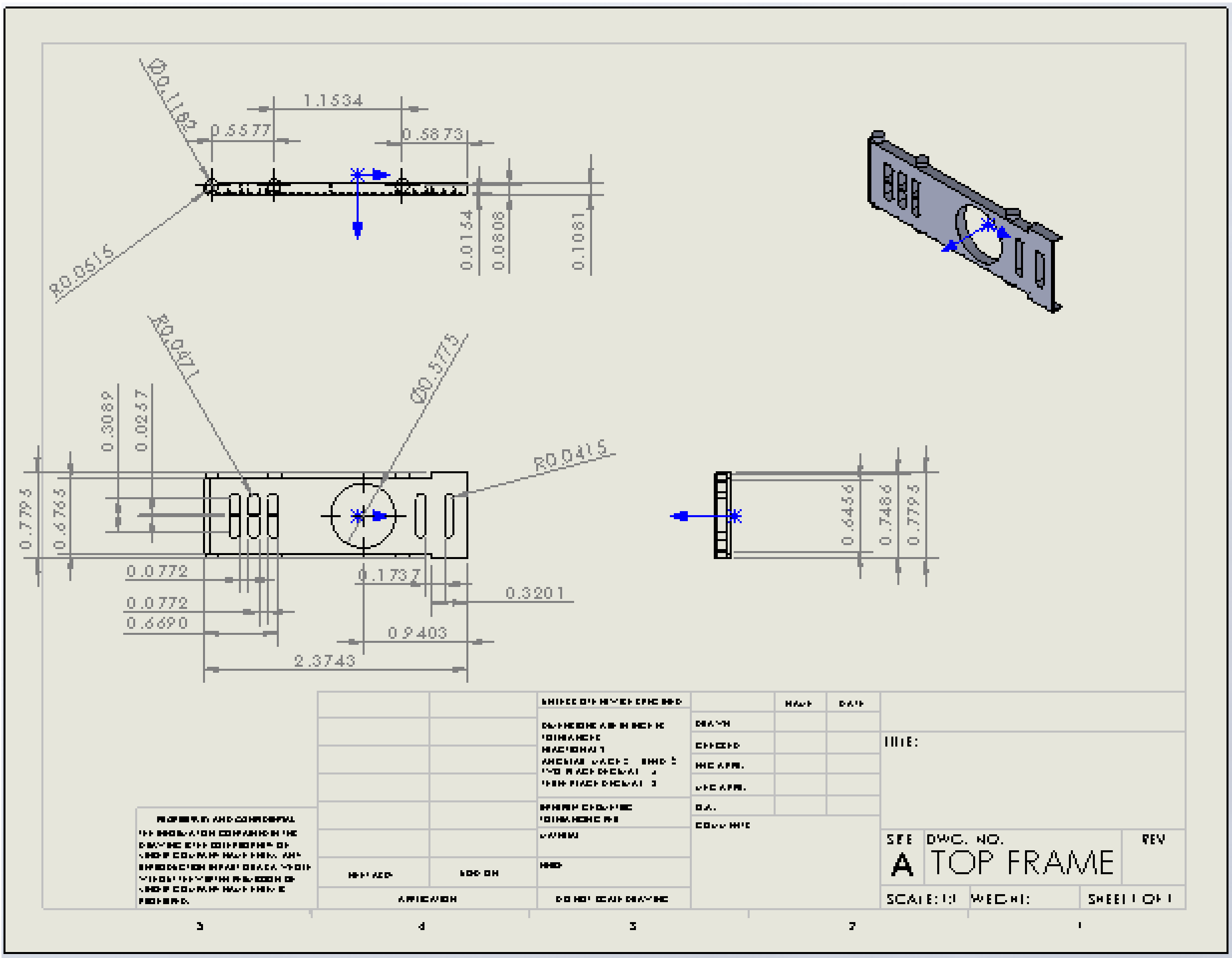
Drawing 36. Tail support and fin attachment



Drawing 37. Tail support peg

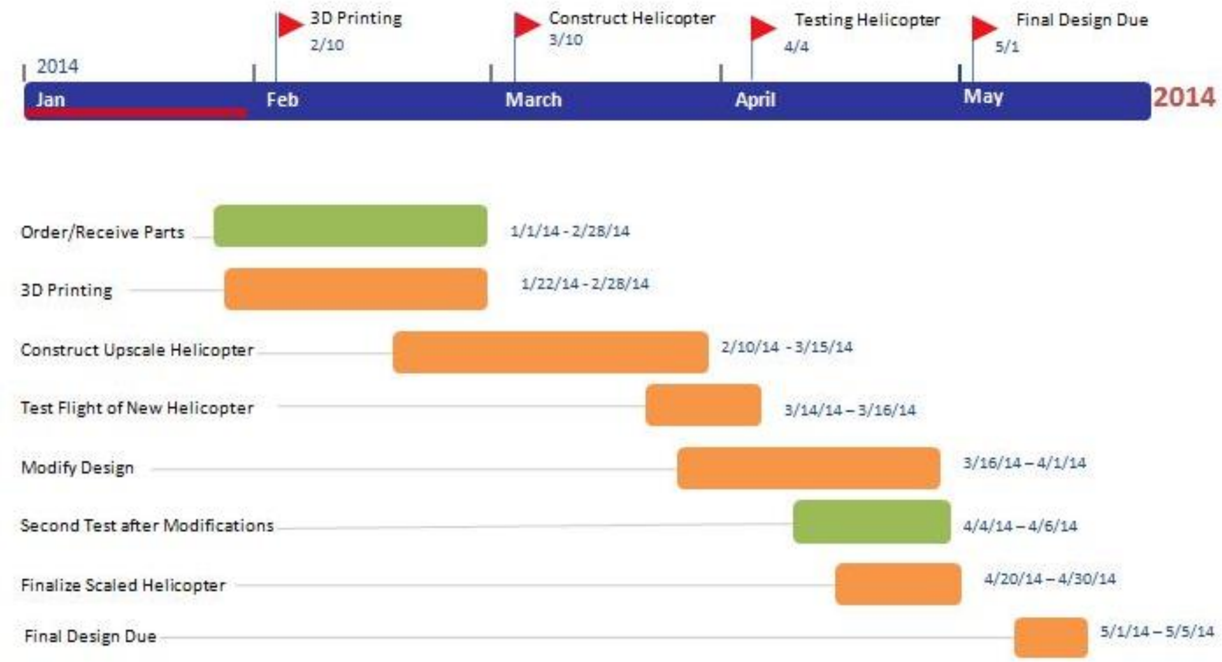


Drawing 38. Tail support pipe



Drawing 39. Top of frame

Appendix B



The project plan, in the Gantt chart above is on track based on our predicted dates. We have ordered our parts and are waiting to receive our purchases, and we have discussed and began the process to make sure that 3D printing parts will happen in a timely manner. The main goal of this semester is to construct test and modify the up scaled version of the U13A helicopter.