Salt River Solar Air Heater
Operations and Assembly Manual

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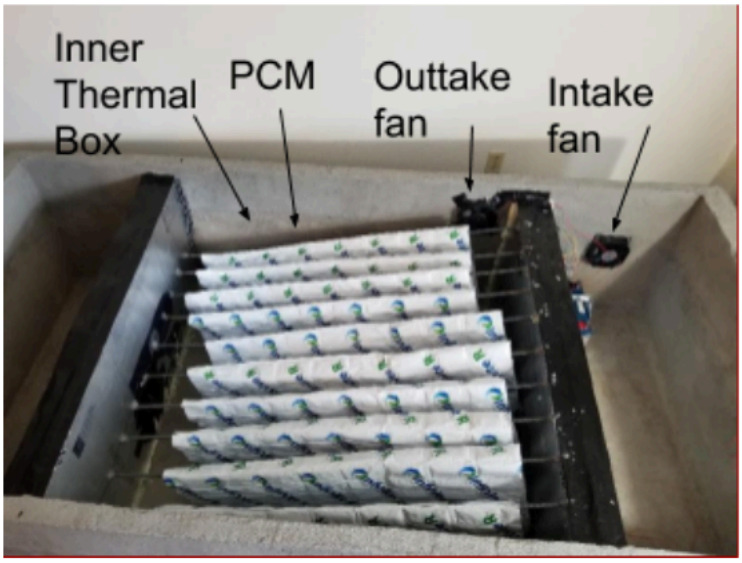
Table of Contents

1. Introduction

The Solar Air Heater is a heating unit that is built separate like an air conditioning unit that you can attach via installation duct tubing. This project was built by Team F2 at Northern Arizona University for our sponsor Salt River Project (SRP) to help improve heating systems for off grid homes on the Navajo Reservation in Northern Arizona. This manual will explain the overall circumference of our Solar Air Heater.

2. Manufacturing

This section covers the procedures for manufacturing of the Green Rhino box with a compartment inside called the thermal box made out of ThermaSheath and rebar. This compartment will contain the phase change material (PCM) which will heat up during the day and dissipate energy throughout the night keeping the home warm.



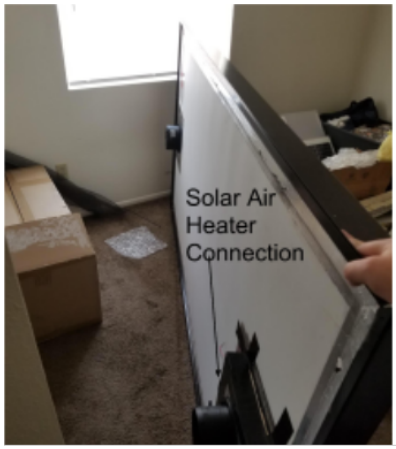
2.1 Box Specifications

Item	Details	Quantity
Battery	12 Volt 55 Amp hour Powersonic	1
Phase Change Material	InfiniteR 2'x4' sheet	10
Solar Thermal Air Heater	SolarThermix	1
Fan	6 inch diameter	3
Green Rhino Box	2 inch thick	1
Rebar	4 foot long steel	10
Foam Insulation	4 inch Rmax foam insulation	2
2 Foot Ducting	6 inch diameter fiberglass with foil covering	3
Micro Controller	Arduino Uno	1
Air Branch	WYE branch w/ control valve	1

2.2 Assembly Instructions

To begin the assembly, refer to the Appendix A for the Assembly and parts that are contained.

1. Cut two holes large enough for a fan to fit (about 6" diameter) in the Green Rhino Box on the longest side about a foot apart and two feet from the end of the box.
2. Cut the foam insulation so that walls can be made that fit within the interior of the box(about 4' x 2.25') with a roof cut from the insulation of the same dimensions.
3. Cut rebar so that they fit within the interior of the thermal box(about 4') and stick them into the thermal box walls so that they hang in midair between the walls.
4. Place fans in fan holes and screw them in place.
5. Create fixture from remaining foam for thermal air heater intake and outtake fans.
6. Cut ducting holes in thermal box insulation walls so that ducting can be run from the cold side of the box to the hot side with the pcm material. Both



insulation place from the inner side walls about 18 inches apart to create a space for the PCM storage.

7. Wire fans with microcontroller to control the fan system. In accordance with the schematic in the Appendix B.
8. Place PCM on racks created from rebar. As shown in Appendix A of Figure 5.
9. Measure the ducting sizes needed to connect the intake from the house to the Green Rhino box intake, from the GreenRhino box intake to the WYE branch, from the WYE branch to the warm section of the box, from the WYE branch to the solar air heater intake, from the solar air heater outtake to the thermal box and from the outtake of the box to the house. Connect ducting within system to respective areas; connecting intakes and outtakes using duct tape and fasteners.
10. Connect power supply. Caution: Be careful not to connect to the power source while connecting.
11. Connect the Solar Panel to the 12 V battery.
12. Run a test with the power supply configuration to make sure that the wires will not burn out.

2.3 Box Dimensions

Length	8 Foot
Width	4 Foot
Height	4 Foot
Thickness	2 Inches

3. Box Maintenance

This box is powered by electricity from a battery which is charged by a solar photovoltaic panel which require little maintenance. Below are guidelines that will need to be followed in order to ensure that the electricity is available overnight for the fans and Arduino to run properly.

3.1 Powersonic Battery

In order to ensure that the battery is charged, the user can check the battery level displayed on the side of the battery. The user should check the battery once every week in order to ensure that the level is not low. Since the solar panel is used in order to charge the battery, the battery could become low on multiple days in a row that are cloudy.

3.2 Check Connections

There are wire connections in the box that will be needed in order to run the fans from the Arduino, the user must check the wires from time to time. The attached wire schematic in Appendix B shows how the wires should be connected if there is a misconnection in the wires. The user will know if there is a problem in the wiring if there is no heat coming into their house. In the case of the wires being disconnected, the user will check the schematic that is attached. Each fan has a power and a ground wire. The fans that are attached to the box on the side are going to be connected directly to positive and negative terminals of the battery. If the side fans were to be disconnected, each terminal will just need to be connected to the right terminals. In the event of the fans on the solar air heater being disconnected the user will have to check the schematic more closely. These fans are connected to the battery by an NPN transistor. The transistor has 3 terminals: base, emitter, and collector. The base is connected to the positive terminal of the battery, the emitter will be connected to the positive of the fans and the collector terminal will be connected to the positive of the battery. Check these connections and make sure they are are right. If the fans are still not running, the transistor may have been damaged and may need to be replaced. In the event of the fans are not running, the negative terminal or positive terminal may not be fully connected to the system; check those connections to ensure success. If all the fans are still not running after the connections are corrected, then the battery may be damaged and may need to be replaced. The wiring of the the box is fairly simple and can be easily managed.

4. Operating the Box and Safety

Since the box is self-operating, there is little that the user needs to do. The only intervention that the user needs to do in order to ensure proper functioning of the box is to clear debris or snow that accumulates on top of the box and the aforementioned maintenance, if the the need arises.

Since the box is made of concrete, should there be a spark inside of the box from a bad wire, a potential fire will be contained. The phase change material is a salt hydrate, so it is fire resistant as well as the foam insulation. Because the box will be outside, there is little concern for the box to cause harm to the users.

Appendix A - CAD Model of Box

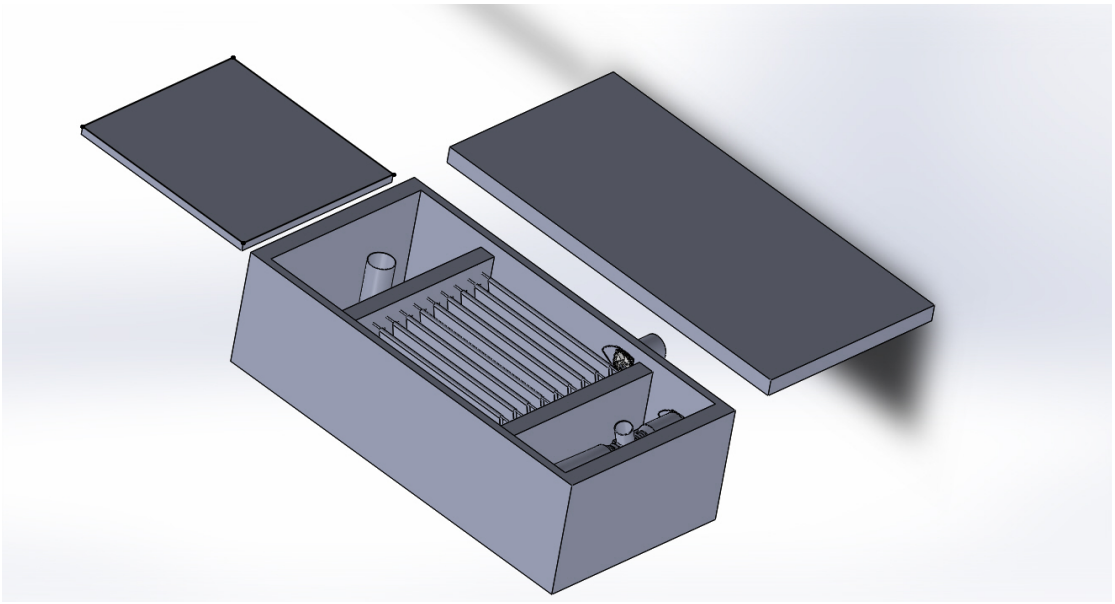
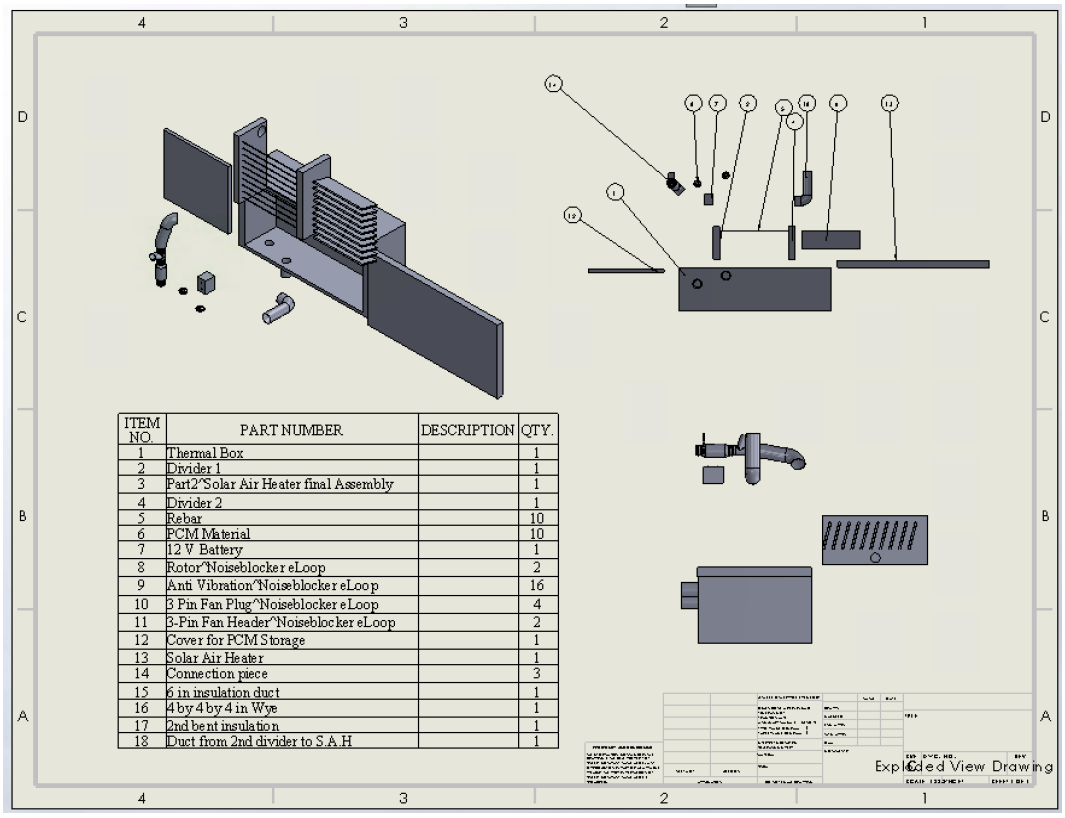


Figure 1: Isometric View of Box Assembly



ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	Thermal Box		1
2	Divider 1		1
3	Part2^Solar Air Heater final Assembly		1
4	Divider 2		1
5	Rebar		10
6	PCM Material		10
7	12 V Battery		1
8	Rotor^Noiseblocker eLoop		2
9	Anti Vibration^Noiseblocker eLoop		16
10	3 Pin Fan Plug^Noiseblocker eLoop		4
11	3-Pin Fan Header^Noiseblocker eLoop		2
12	Cover for PCM Storage		1
13	Solar Air Heater		1
14	Connection piece		3
15	6 in insulation duct		1
16	4 by 4 by 4 in Wye		1
17	2nd bent insulation		1
18	Duct from 2nd divider to S.A.H		1

Figure 2: Drawing of Exploded View of Assembly

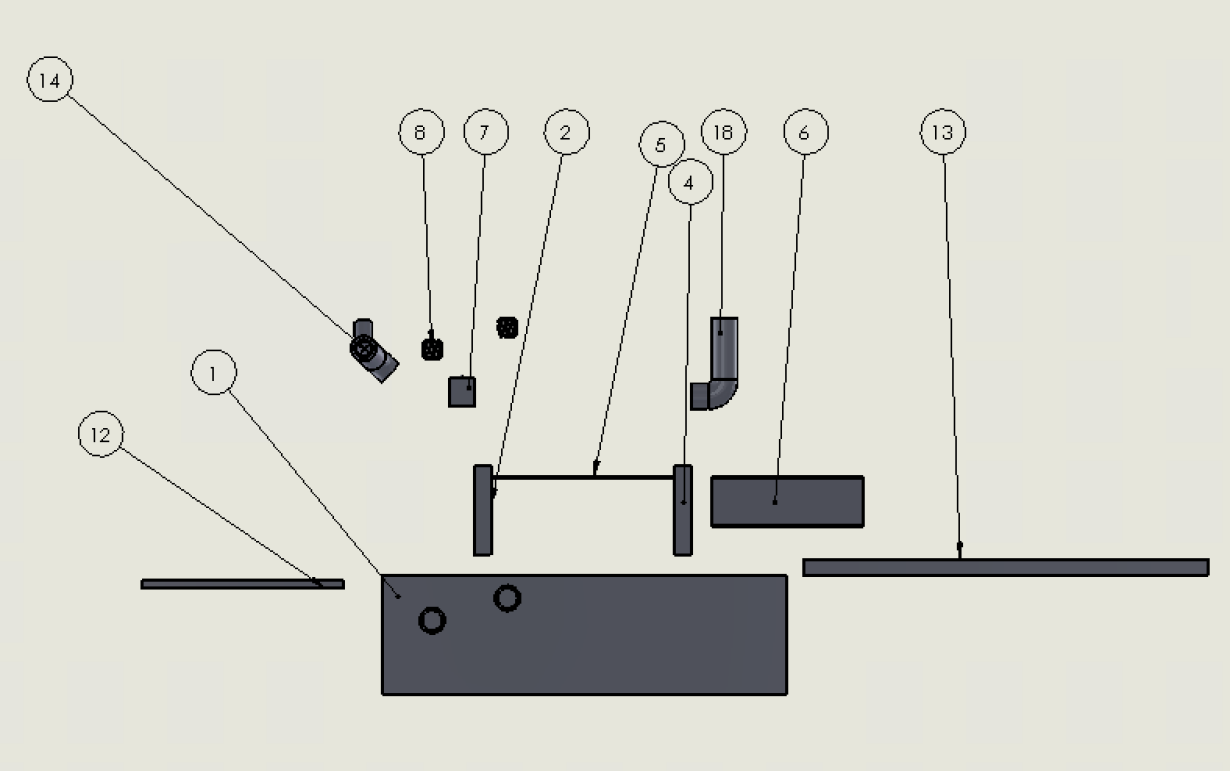


Figure 3: Detailed View of Exploded Assembly

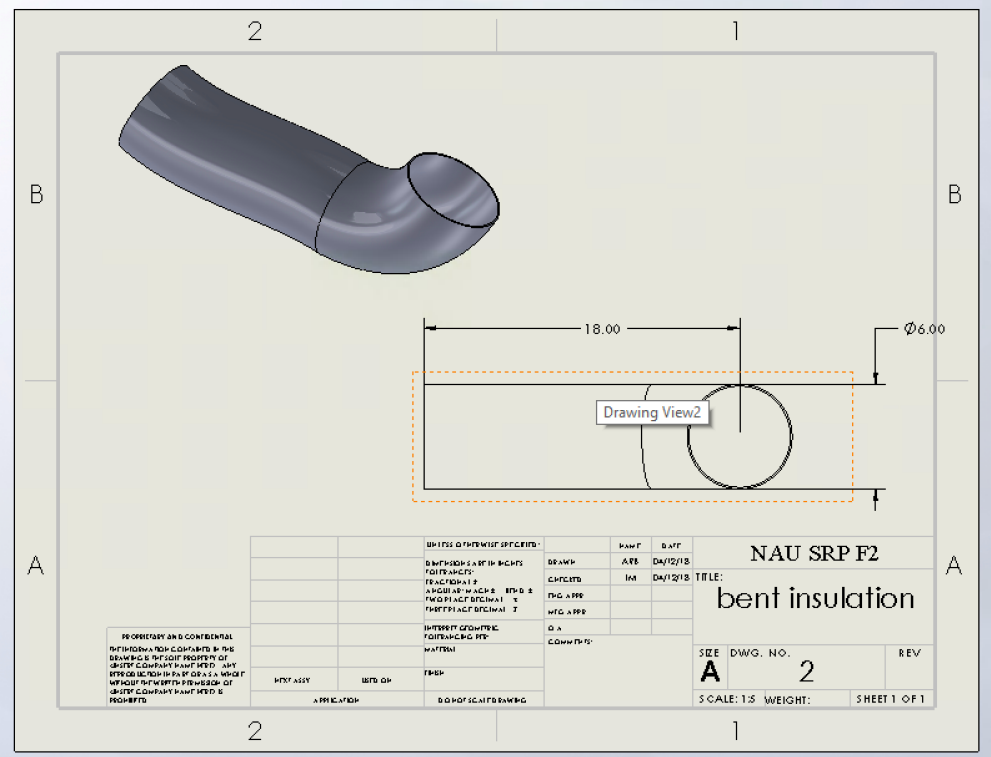


Figure 4: Bent Insulation Drawing

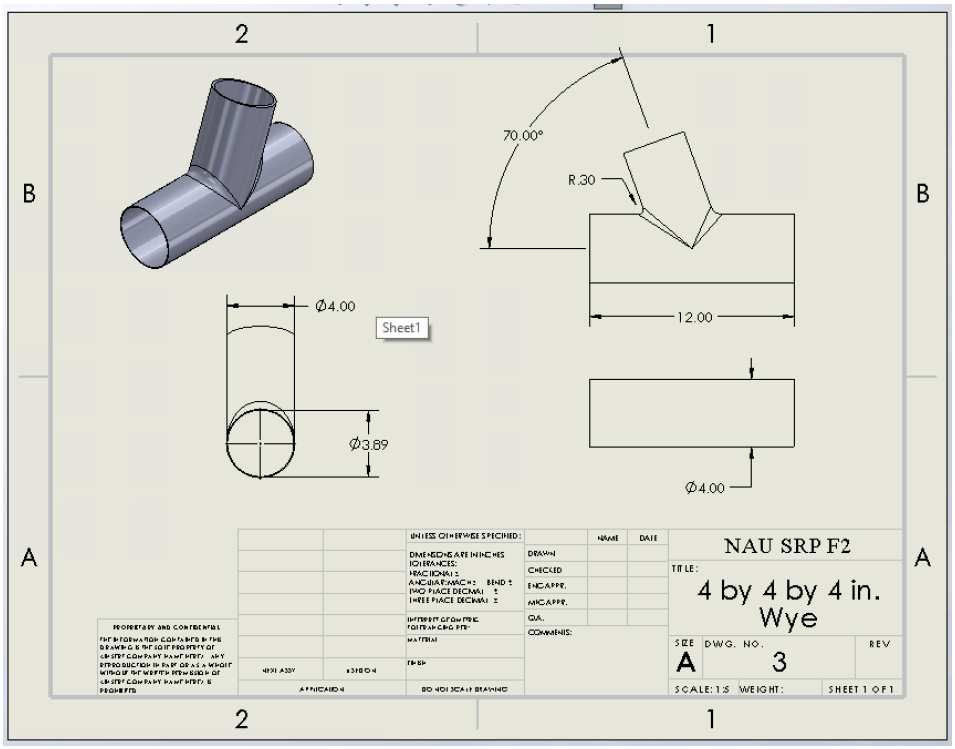


Figure 5: 4 by 4 Inch Wye Drawing

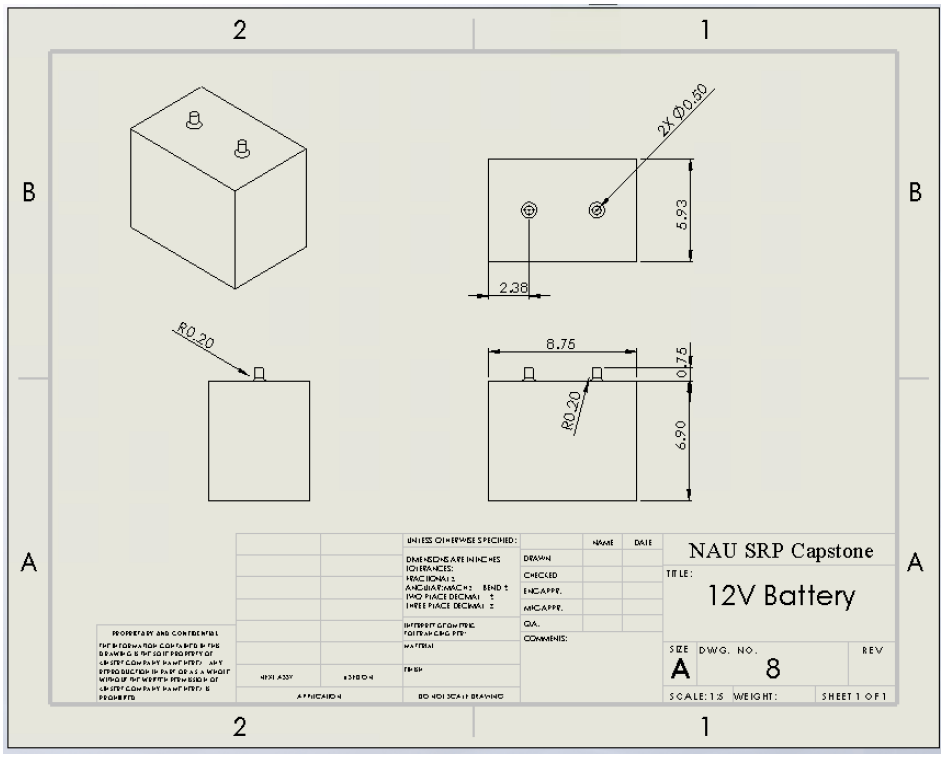


Figure 6: 12 Volt Drawing

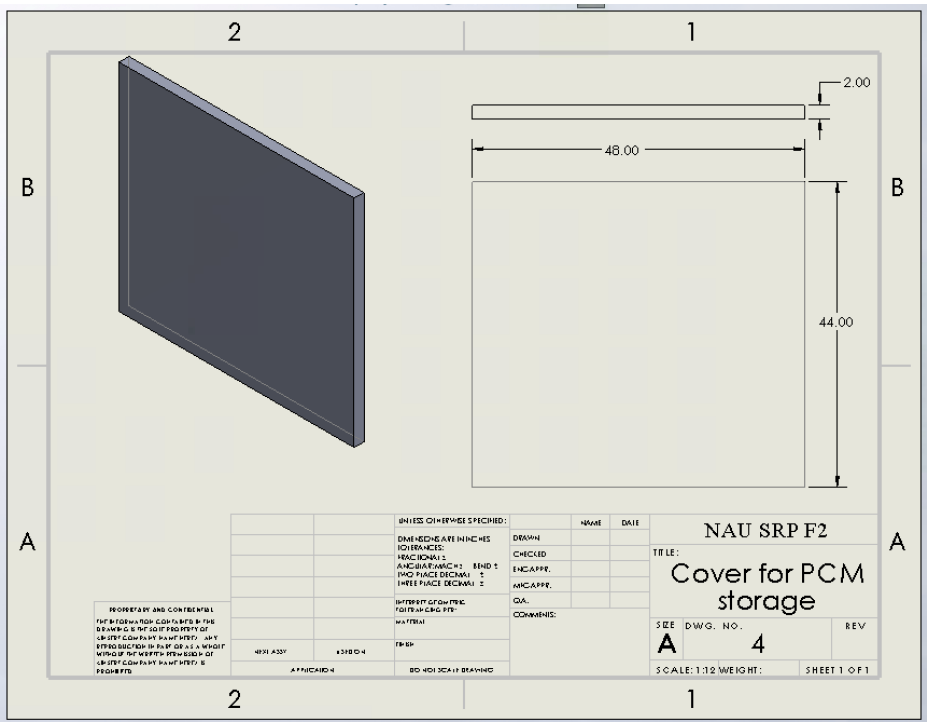


Figure 7: Cover for PCM Storage Drawing

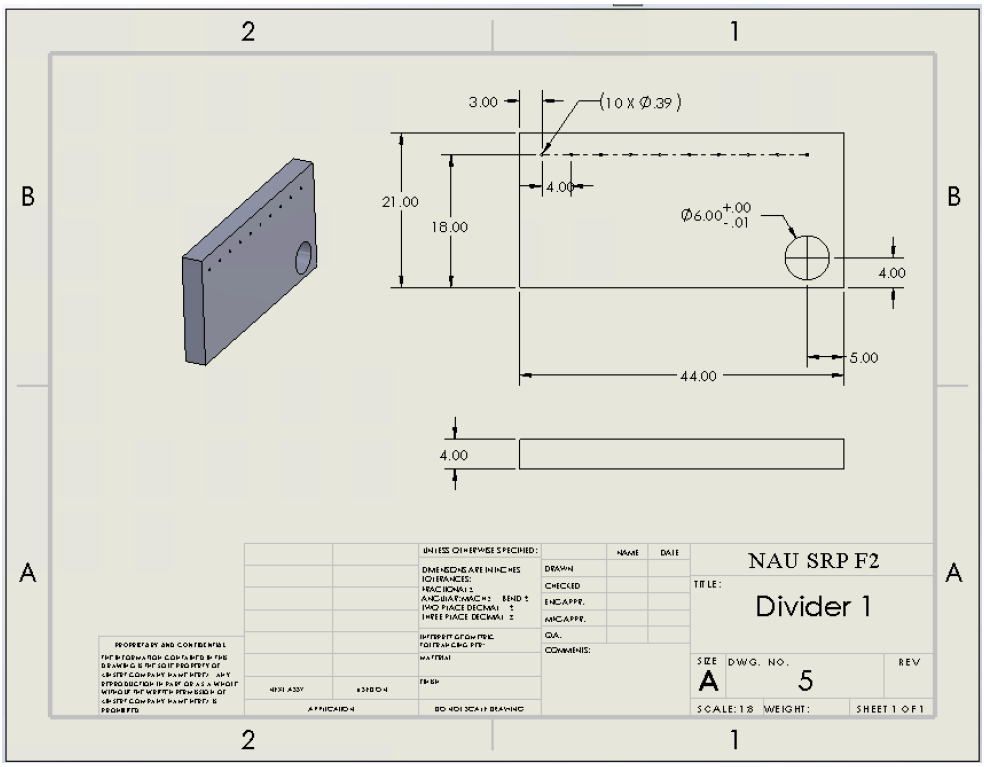


Figure 8: Divider 1 Drawing

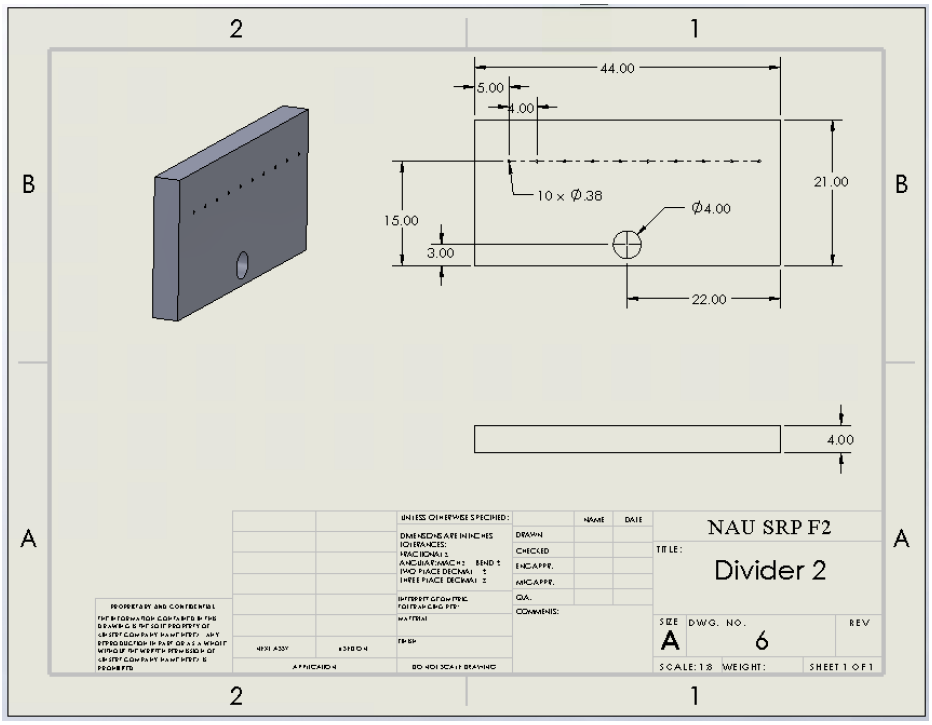


Figure 9: Divider 2 Drawing

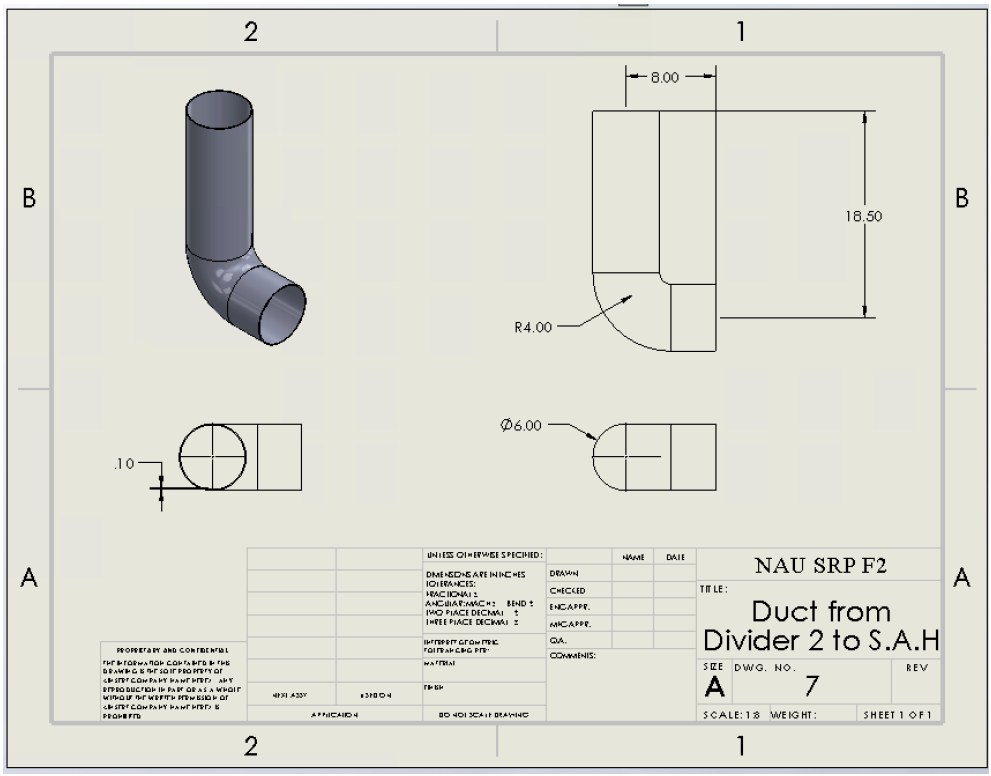


Figure 10: Duct from Divider 2 Drawing

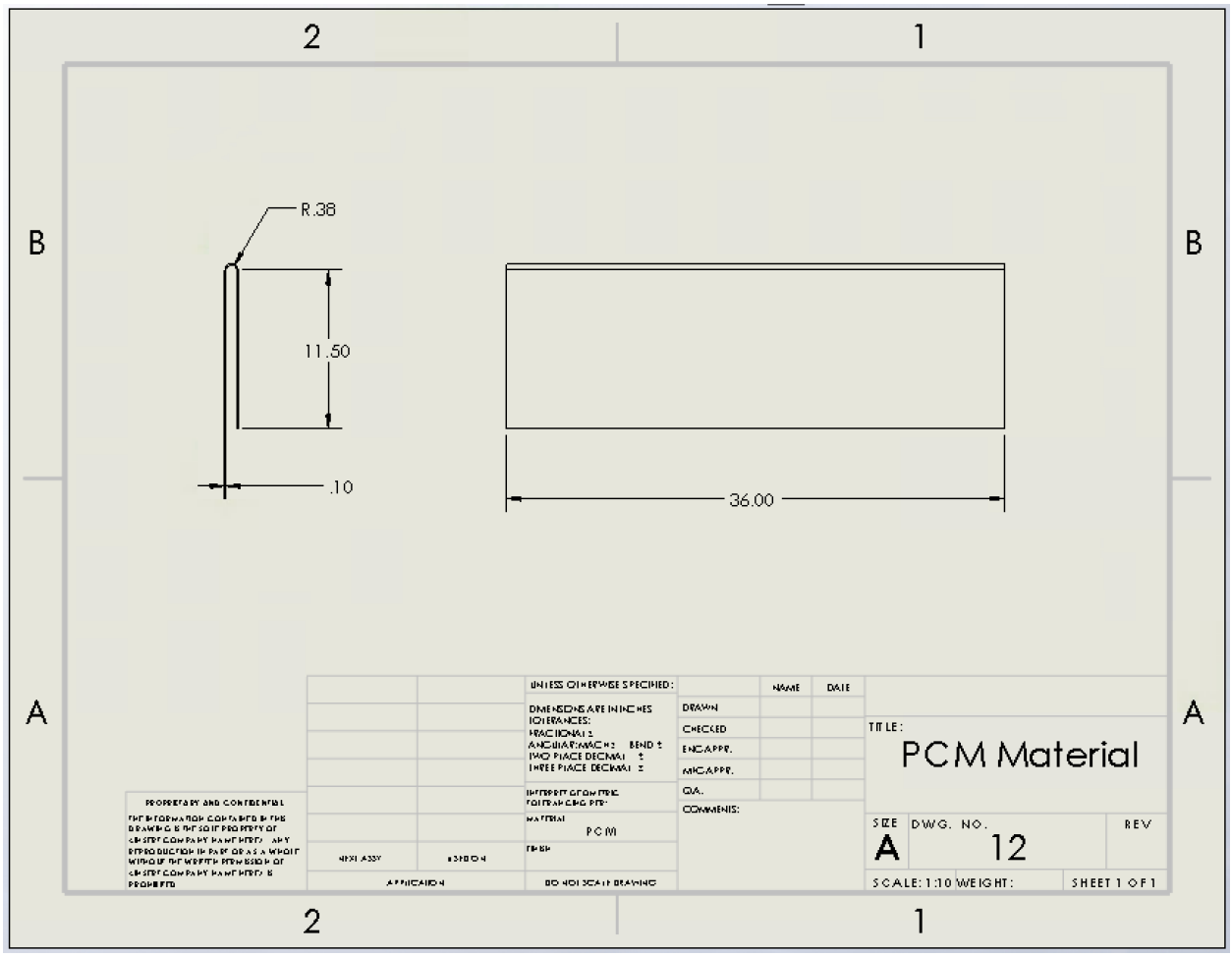


Figure 11: PCM Material

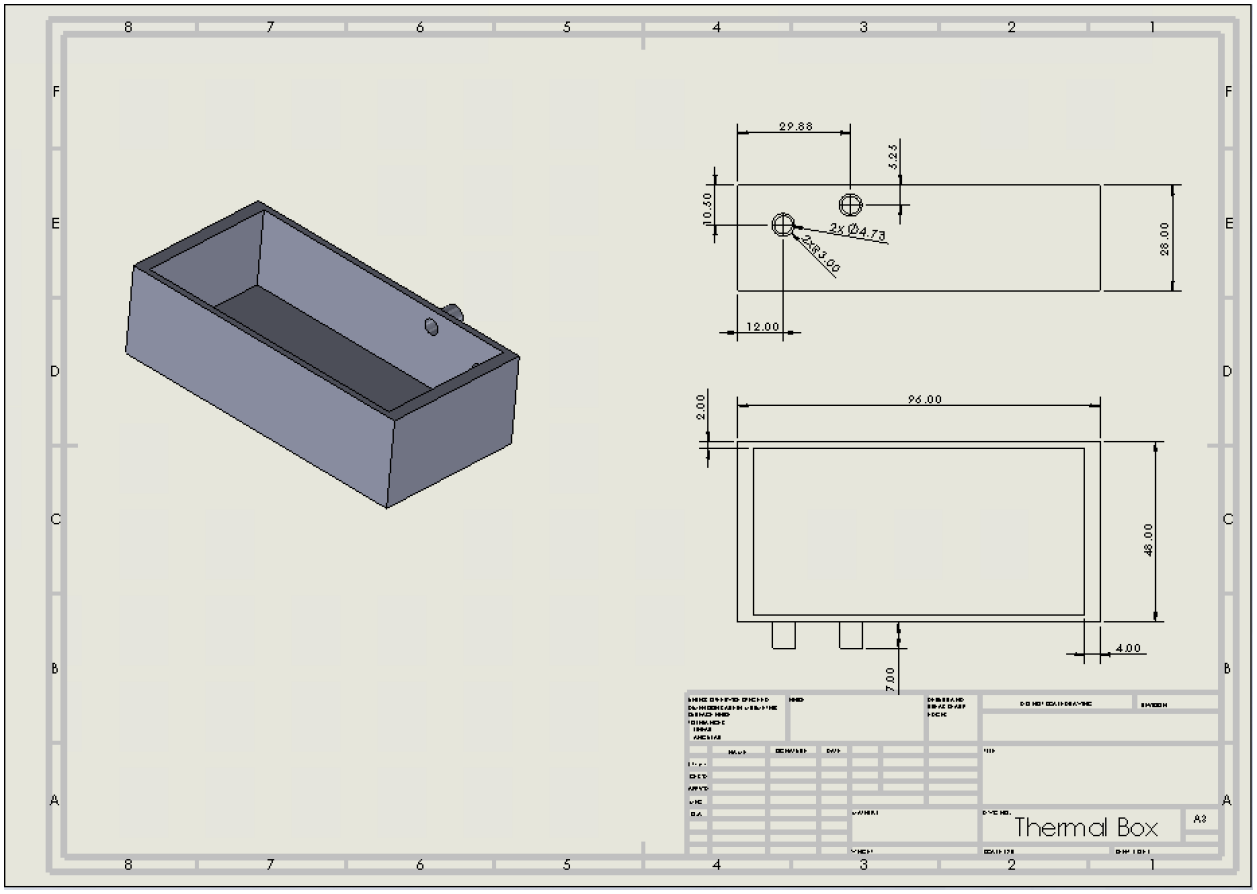


Figure 12: Thermal Box

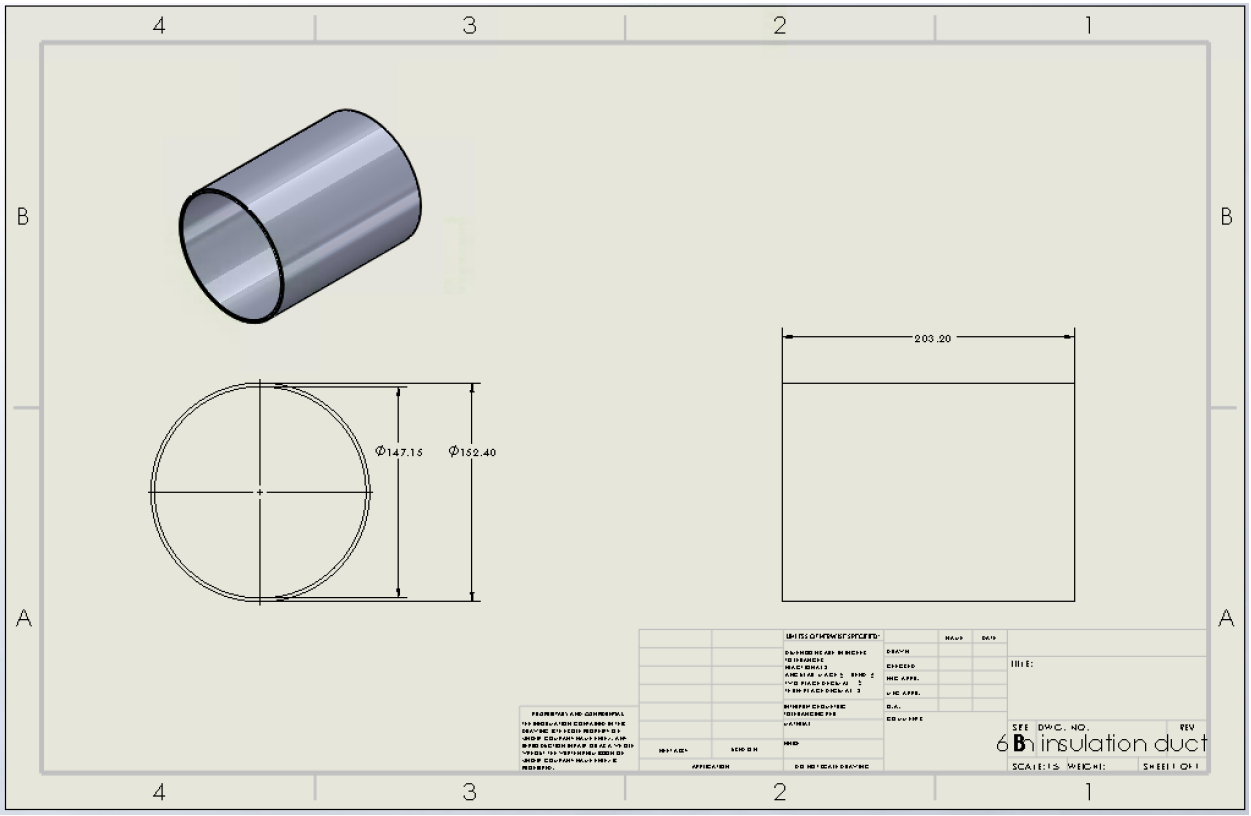


Figure 13: 6 ft insulation duct

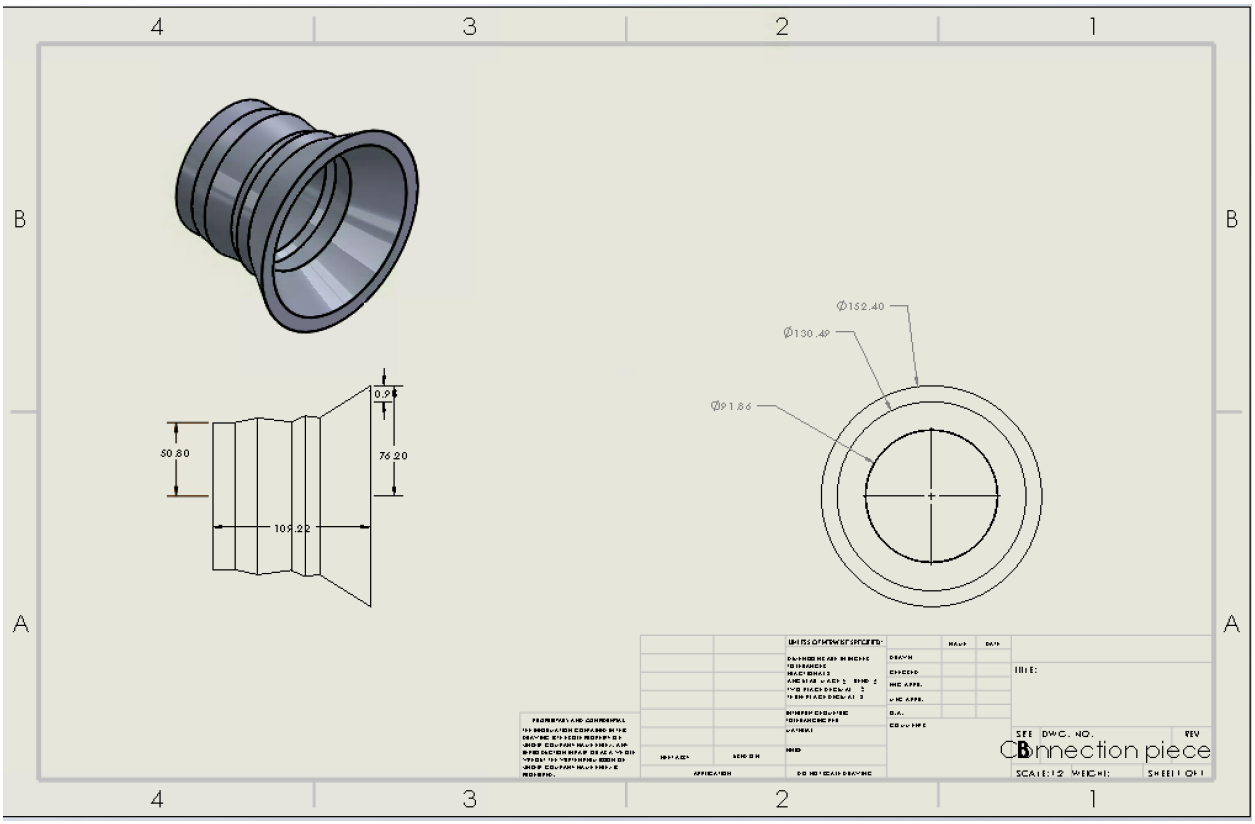


Figure 14: Connection Please: In general a depiction of manipulating the connection of the insulation ducts.

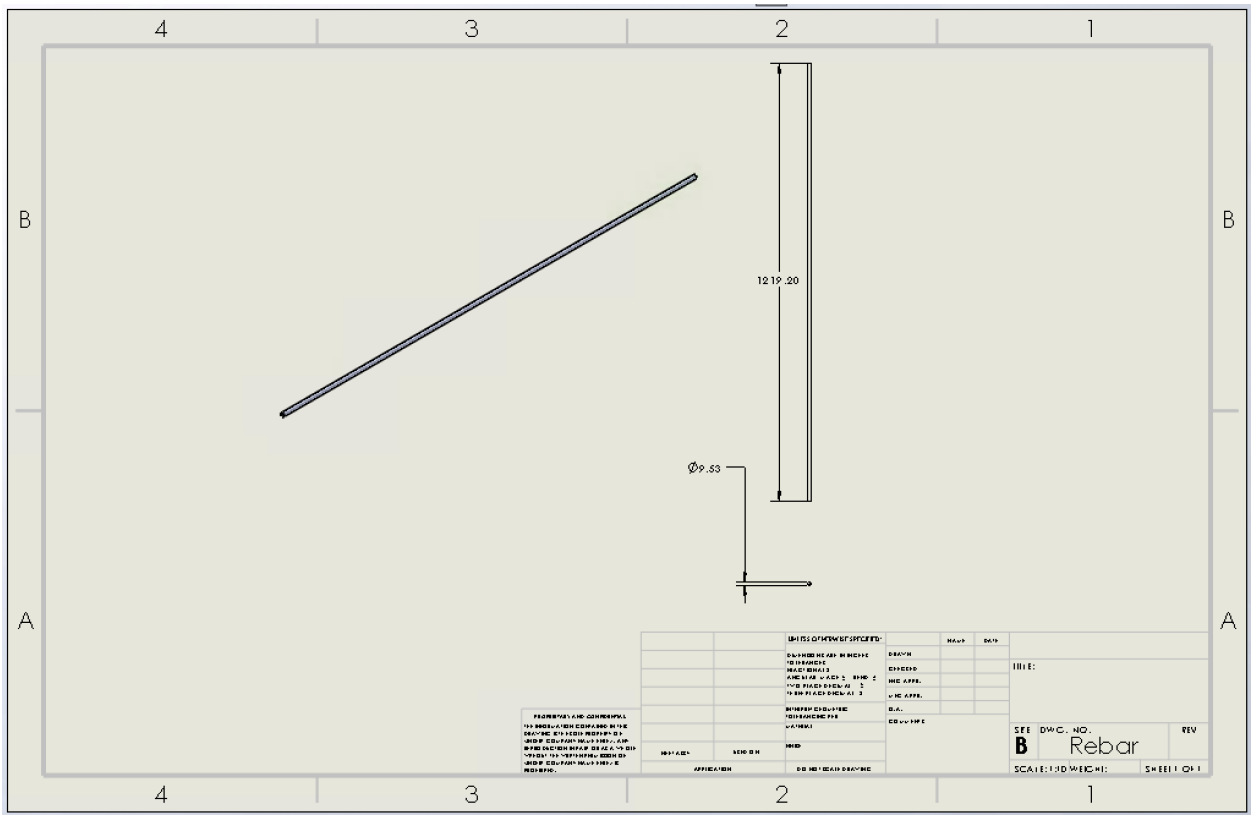


Figure 15: Rebar

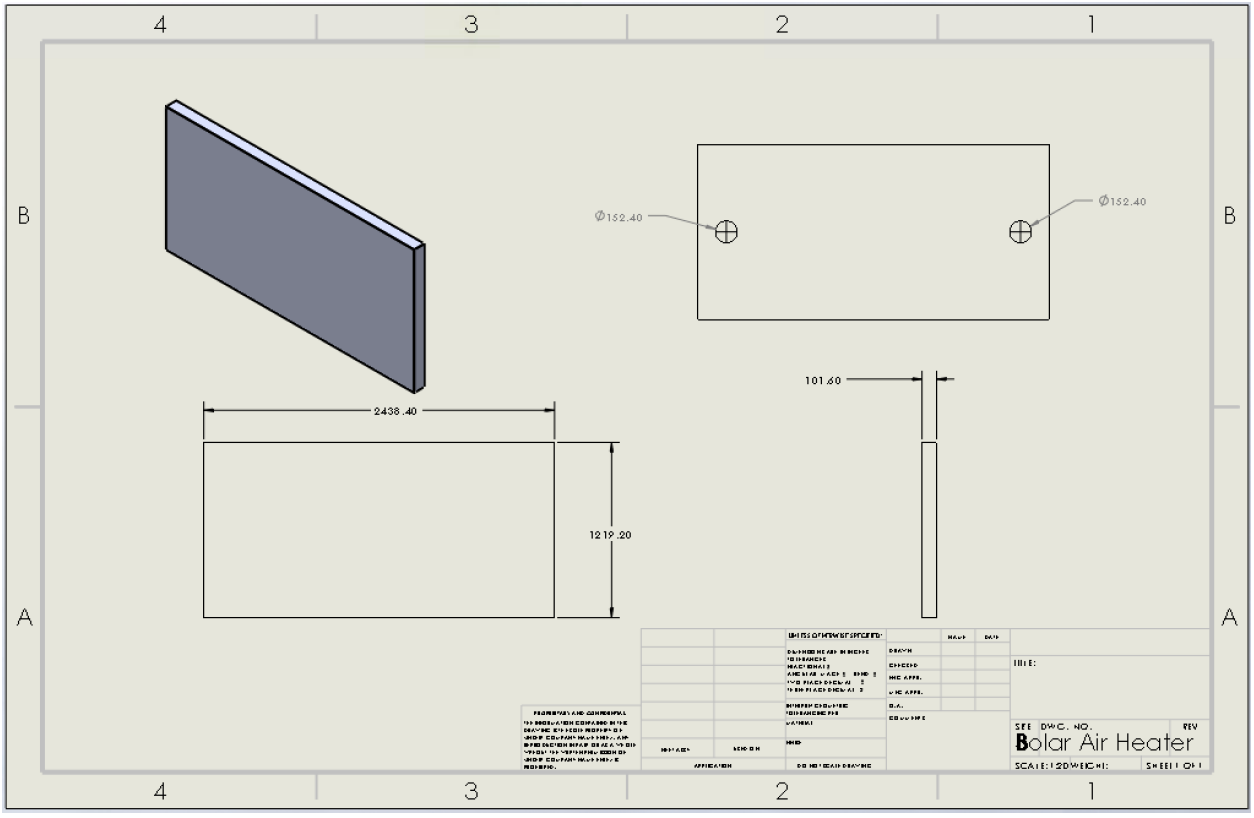


Figure 16: Solar Air Heater

Figure 17: PCM Storage

Figure 18: Top of Box without Solar Air Heater

Appendix B - Wiring Schematic

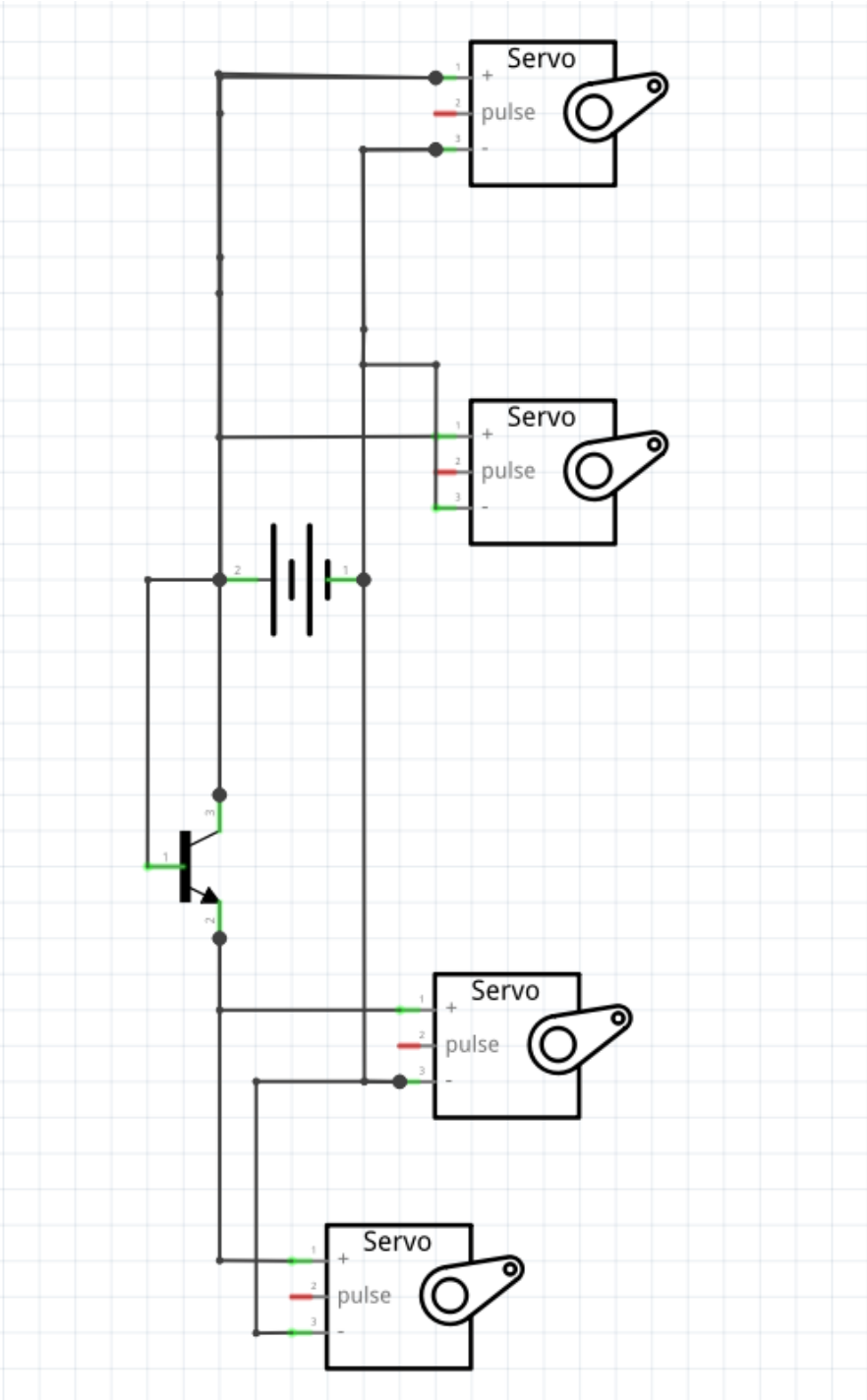


Figure 19 - Wiring Schematic