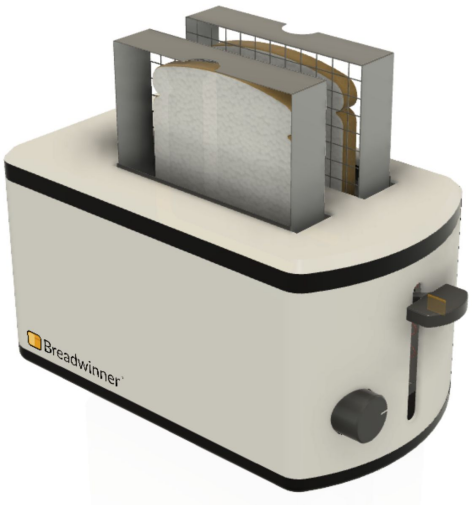


“The Breadwinner”

Toaster with Heat Trapping Technology

ME 170 Design Team

AB7-01

Team Members:

Keshav Sivaram

Matthew Zhang

Patrick Ding

Phoenix Bauer

Date: 12/11/2020

Project Description

The Breadwinner is a new toaster idea mainly designed with greater toasting efficiency in mind. When conducting interviews, our group found that many of the interviewees led busy lives. Oftentimes, they juggled multiple responsibilities such as work and family. In fact, all three of our interviewees were working parents in the age range of 30-50 years old. Therefore, we quickly realized one of the responsibilities that a busy family life can bring is the challenge of making food for family while still being able to continue with other responsibilities. As a result, we quickly turned our attention to kitchen products with the goal of allowing people like our interviewees to be able to quickly fulfill cooking tasks and focus on other responsibilities.

When one of our interviewees complained that his toaster oven lets heat escape through the top, which makes cooking times longer than they should be, we decided to address the unmet need of inefficient cooking times, focusing on the toaster as our product. Our central question became: How might we more easily produce, and utilize heat in a toaster to lower the amount of energy/time used? We set about creating concepts to address this question. The main point of escape we noticed for the classic 2-panel toaster design was the slots for where the bread went in. So, all of our initial ideas went toward addressing a way to cover these holes as the bread is cooking inside the toaster in order to conserve more heat within the toaster, which in theory would mean the bread would cook faster because there is more heat held within the toaster.

After considering a few rough ideas that will be further highlighted within the PUGH selection matrix, we decided to go with our Breadwinner. The main attraction with this product is that it utilizes sliding trays with raised lips. These trays were extensively designed to be able to fit any grain product available on the market. This includes items like bagels and even Texas Toast. The way the product works is that the bread slides into the tray, and the tray slides down into the toaster, with the raised lip of the tray covering almost all of the slot (there is a small hole that is mainly used as a thumb grip in order to help grip the trays). Along with combining a new approach to toasting, the Breadwinner stays intuitive at heart, as the basic motion of toasting remains the same. There is no learning curve to our toaster; it uses the same lever system that almost all other toasters on the market do. All the consumer has to do is put the bread in and push down on our front button. The core simplicity of the product with the added efficiency of the trays preserving heat means that this toaster is an improvement upon other models who simply let heat escape through the slots or other orifices.

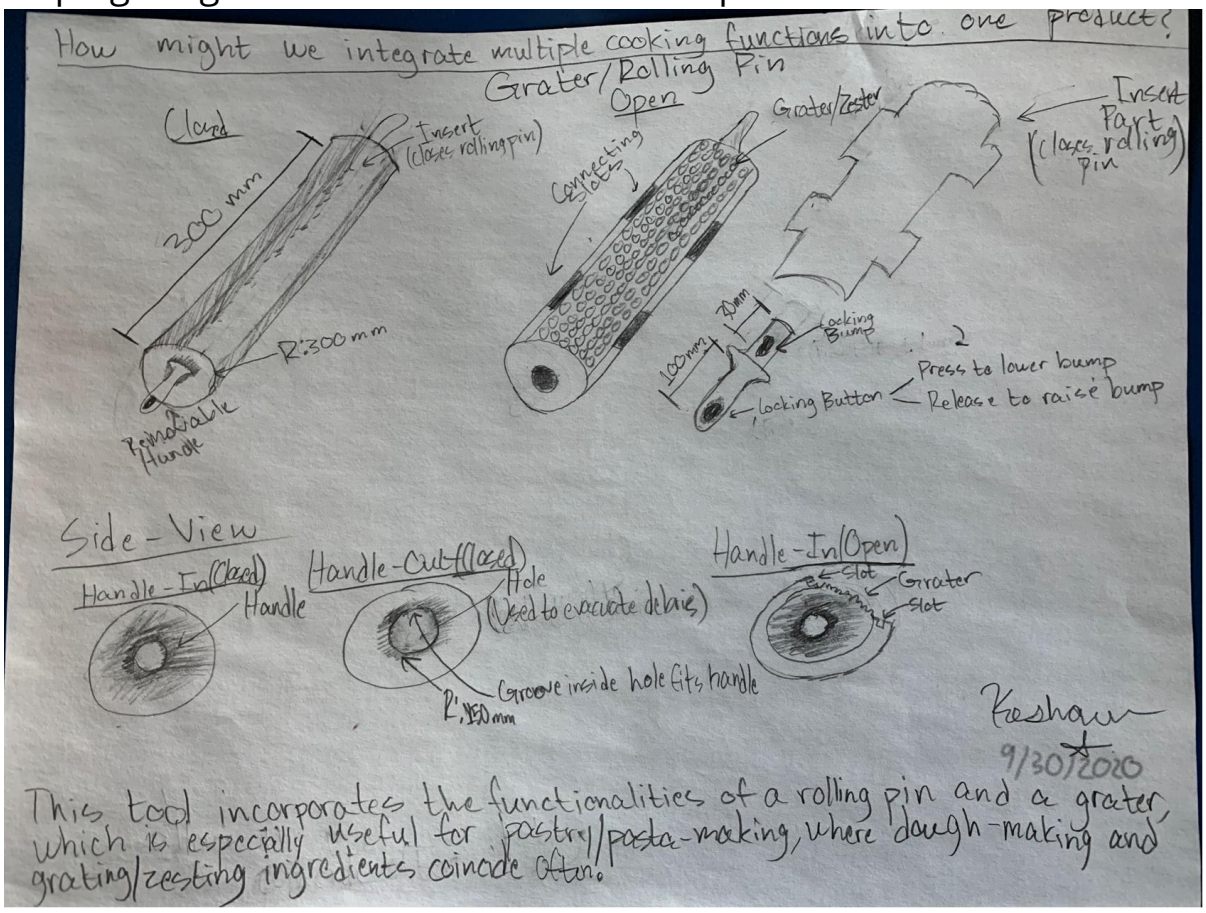
The Breadwinner is also easier to clean than other toasters because the trays help to store crumbs. Rather than having to clean out an expansive crumb tray, the Breadwinner keeps crumbs within the confines of its trays, which can simply be removed from their tray holders and dumped out when needed. From a manufacturing standpoint, this also makes the Breadwinner easier to produce as machinery and resources do not need to be spent on producing a crumb tray to fit into the body.

Aesthetically, we aimed for our product to have an understated and sleek approach, with a very subtle black and white plastic molded exterior and a modest frame so that the toaster does not become bothersome when not in use.

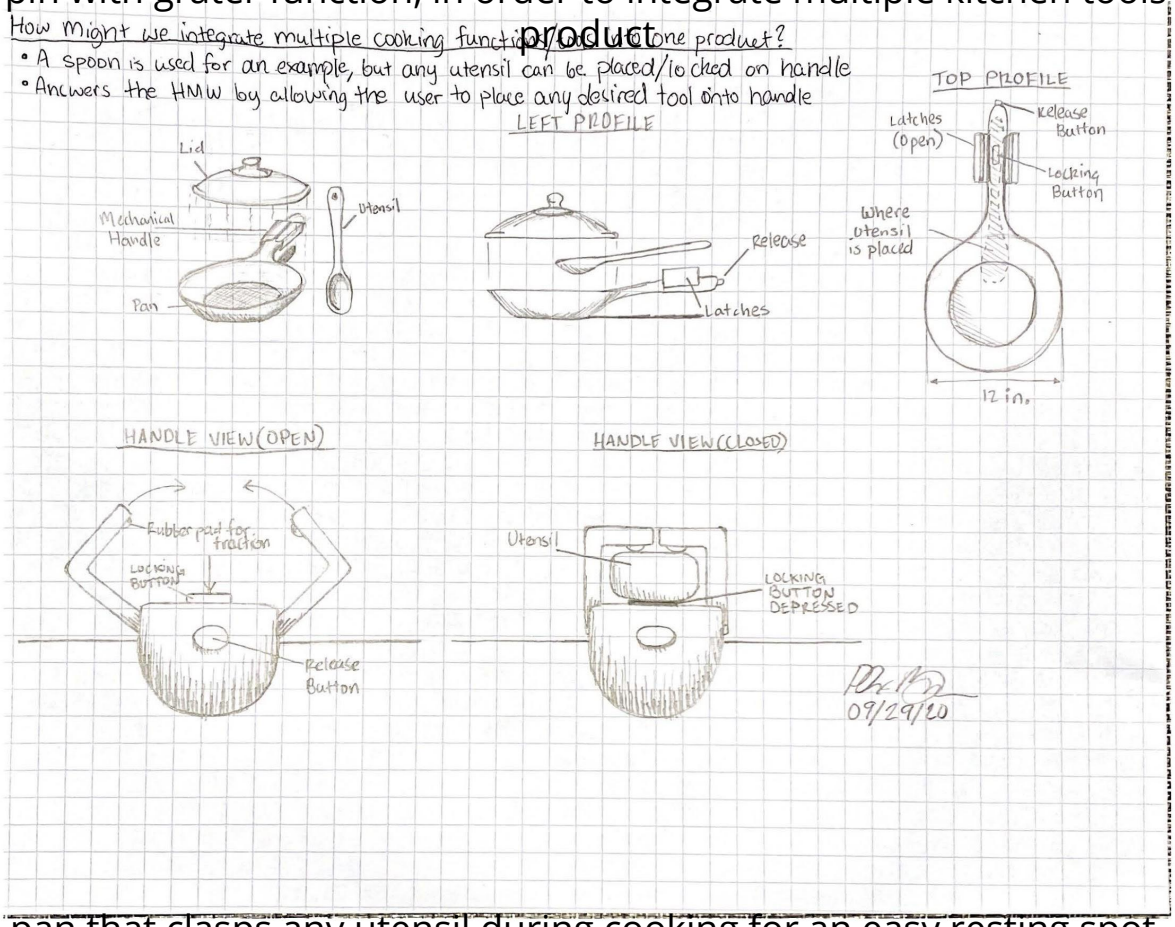
Overall, the Breadwinner aims to bring a pleasantly efficient toasting experience while retaining the rustic simplicity of the classic toaster concept with sliding trays to cover up the holes and deliver more efficiently cooked items on a consistent basis.

Concept Sketches

Initial concept sketches: These were our original ideation sketches after developing insights from the initial interview phase.

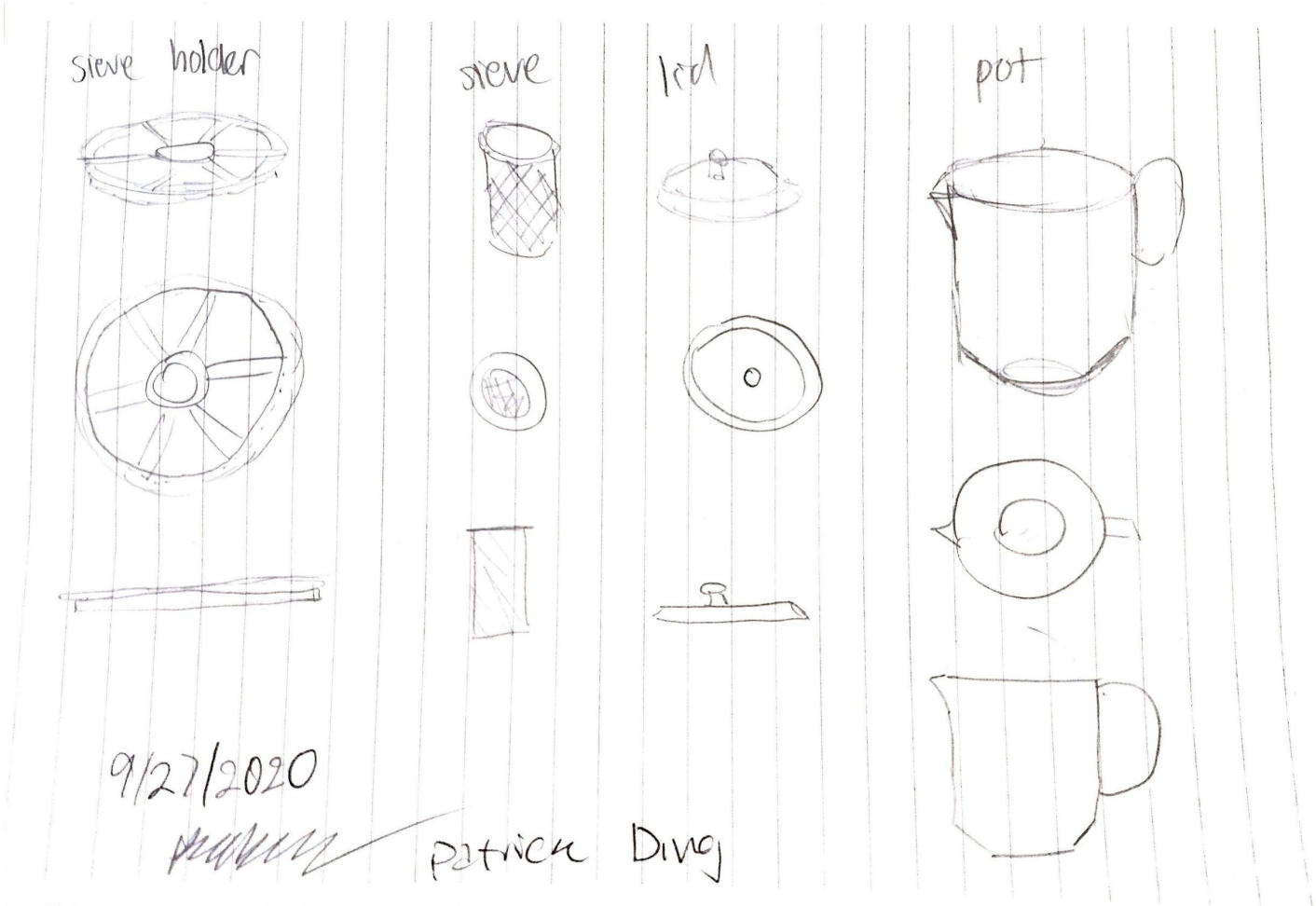


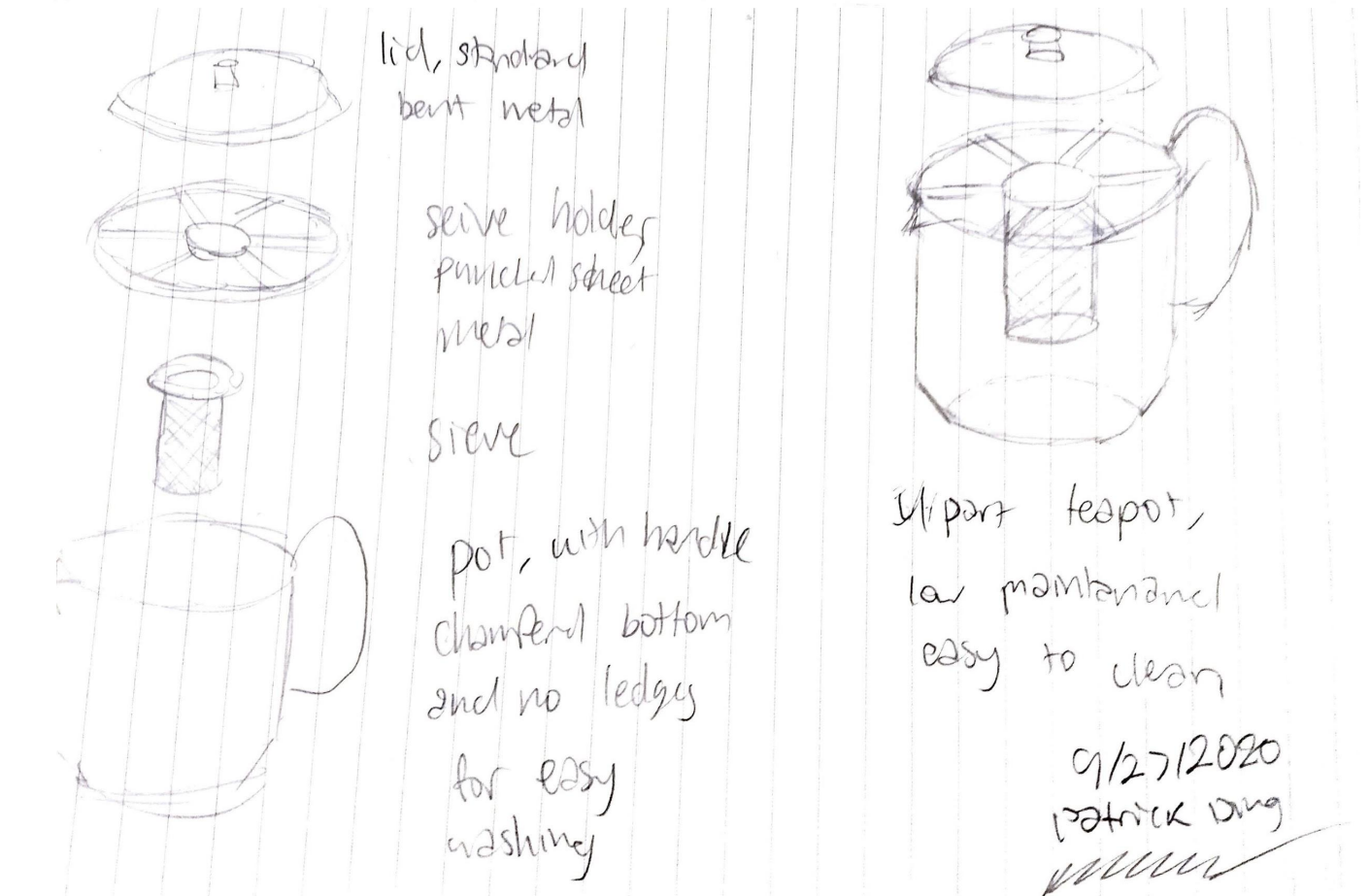
A rolling pin with grater function, in order to integrate multiple kitchen tools into one product



A pan that clasps any utensil during cooking for an easy resting spot

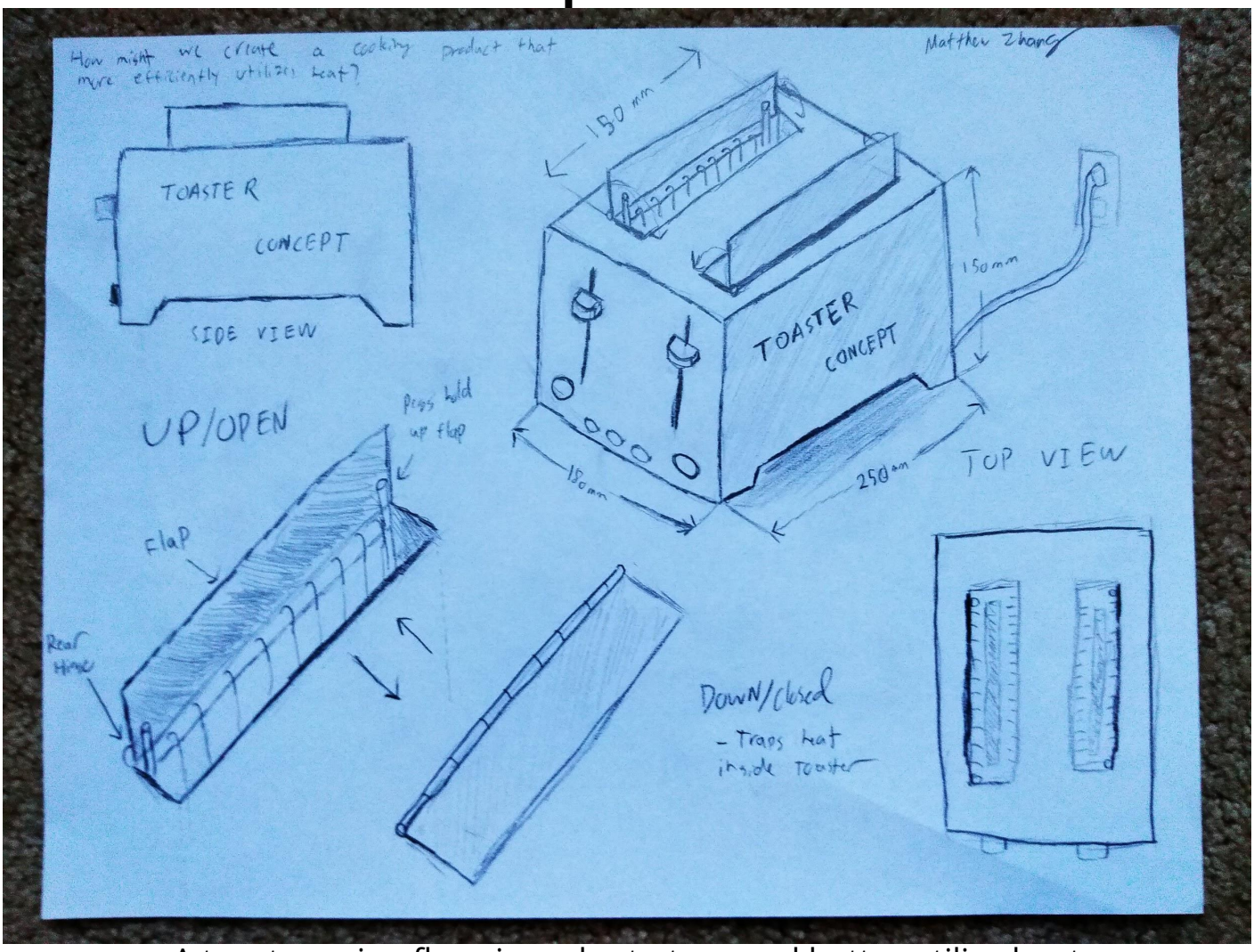
Concept Sketches





A teapot, designed for low maintenance with use, and easy cleaning.

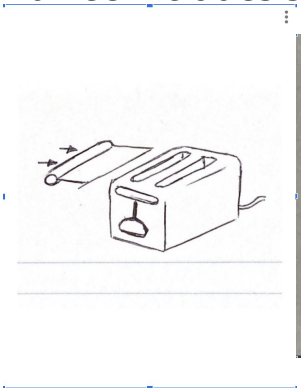
Concept Sketches

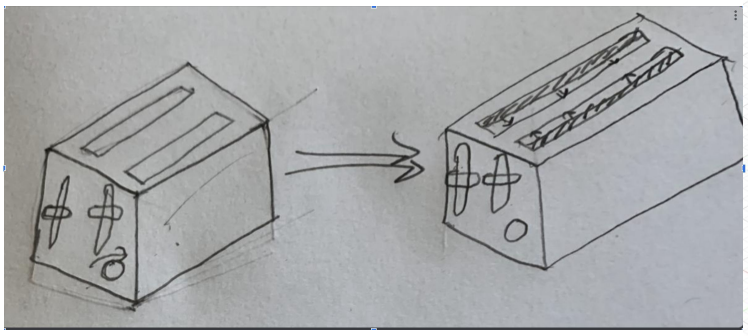


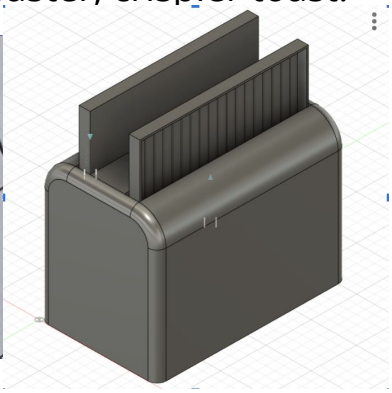
A toaster using flaps in order to trap and better utilize heat

We felt that trying to further innovate this toaster concept would allow us the most opportunity to address the unmet need of faster and more efficient kitchen appliances.

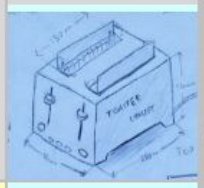
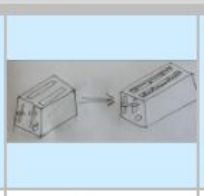
Pugh's Concept Selection Matrix sketches: These were the four sketches included in our decision matrix, and helped us ideate our final concept for, "The Breadwinner". The first of the four was Matthew's original design. The other 3 utilized different methods to entrap energy produced by the toaster. The left picture uses a slider in order to block the openings, the middle uses a rotating guide much like a car's AC to block the openings, and the last of the three includes sliding trays which enclose the bread for a faster, crispier toast.







Concept Selection Process

		1	2	3	4	
		Alternatives				
Criteria						Totals
Performance	0	0	0	0	0	0
Service Life	0	0	+	–	+	1
Maintenance	0	0	+	–	0	0
Target Costs	0	0	+	–	+	1
Competition	0	0	0	0	0	0
Size	0	0	0	+	0	1
Weight	0	0	–	0	–	-2
Ergonomics	0	0	–	+	–	-1
Quality/Reliability	0	0	–	0	0	-1
Aesthetics and Finish	0	0	–	+	+	1
	Totals	0	-1	0	1	
	Rank	2	4	3	1	

We decided to go with the 4th concept on our PUGH matrix. The reason we chose this one was because of its superior cost and service life, as well as aesthetics. In addition, we think that the downsides such as the increased weight aren't super important to consumers, and the ergonomics issue can be addressed in further stages of ideation. Besides these downsides, this concept is expected to maintain performance with the competition while also being cheaper to produce through sheet metal stamping for the trays and injection molding for the body.

PDS

1. Performance:
- < 4 minutes to toast 2 slices of bread
- 5 toasting cycles per hour used
- 900W power consumed
- Consistently toasts bread to same darkness
- Able to toast about any type of bread in 1 cycle
- 2 slice toaster

2. Environment:
- Wide temperature range
- Ambient 50-90 degrees fahrenheit
- Internally up to 500 degrees fahrenheit
- Could be in a dirty environment
- Should be food-safe
- Able to handle moderate physical abuse (Fall off of a counter and survive)
- Can handle some humidity from steam/other appliances

3. Service Life:
- Should last 6-9 years
- 3/hrs a day max, 7 days a week

4. Maintenance:
- Easy to clean (crumb tray)
- Parts are somewhat modular and easy to replace
- Tray should take less than 30 seconds to empty
- 3 year warranty

5. Target Costs:
- Retail Price: 30-50 dollars
- Manufacturing cost: 15-25 dollars

6. Competition:
- Solution aims to function similarly to competitor's with a small change to improve heating
- All PDS has been based off of competitors. There are no outliers

PDS

7. Shipping:
   - Most units shipped to retailers
   - Retailers may ship to consumers over standard mail
   - Would have to generate shipping quote for precise cost

8. Product Volume:
   - At least 1 million units/year
   - Injection molded plastic and stamped sheet metal
   - Dies needed for part molding (high tooling cost)

9. Packing:
   - Detailed images on box that show off product features
   - Standard foam packing on inside to prevent damage

10. Manufacturing Facility:
    - Fill an existing plant (overhead for storage)
    - Reuse existing machines, but invest in hard tooling

11. Size:
    - Max size: Around 8x9x13 inches maximum
    - Around 5.5x6x10 inches minimum
    - Optimum size would be around 7x8x12 inches

12. Weight:
    - Average/target weight is about 2.5 lbs
    - Max weight 3.5 lbs

13. Aesthetics and Finish:
    - Rounded edges
    - Stainless steel and Black/Colored plastic
    - Brushed metal finish, matte plastic
    - “Modern” look

14. Materials:
    - Nichrome
    - Stainless Steel
    - Polypropylene
    - Rubber (Nylon)

PDS

15. Product Life Span:
    - 10 year life span

16. Standards, Specifications, and Legal Aspects:
    - We are held liable by our 3 year warranty, if the product malfunctions or fails.

17. Ergonomics:
    - Needs to be easy/convenient to push buttons or turn knobs
    - Can deal with extra force people put on the product

18. Customer:
    - Someone who is busy who wants their toast toasted fast
    - Middle-class consumer

19. Quality and Reliability:
    - Aim for 100 defects / million produced

20. Shelf Life:
    - 10 years
    - Not many components that can degrade over non-operation

21. Processes:
    - Flow soldering for circuit boards

22. Timescales:
    - Creation of hard tooling could create lead times
    - Probably about 2-4 weeks lead times for the dies

23. Testing:
    - Thermal testing- Measuring heat retention
    - Bread-toasting test- Measuring cook time
    - Mechanical parts testing (stress testing springs/levers)

24. Safety:
    - Food-safe (ISO 22000)

25. Company Constraints:
    - Depends on previous products of company and/or manufacturer

PDS

26. Market Constraints:
    - Using specifically chinese labor could be problematic with current trade conditions

27. Patents, Literature, and Product Data:
    - US20200253411- Closing system that closes at least one toaster slot with a flap during the toasting/steaming process
    - WO2019207601- Multiple vertical slots are blocked by baffles in order to reduce heat during the bread-toasting process

28. Political and Social Implications:
    - Very unlikely to affect social climate

29. Disposal:
    - Standard garbage disposal, non biodegradable
    - Due to long product lifespan, disposal should not be a main issue

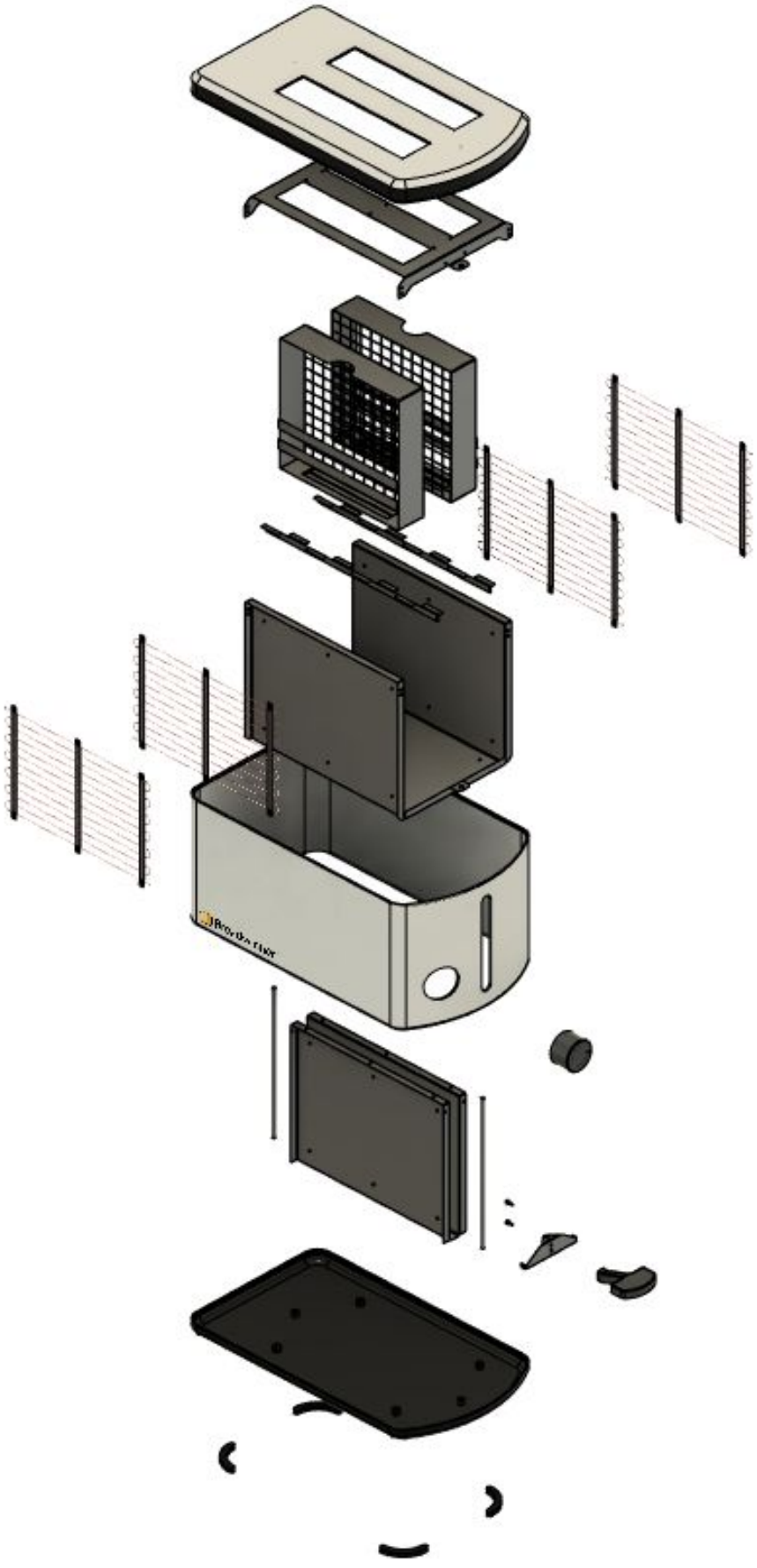
CAD Models

Assembly Front Corner View

Assembly Rear Corner View

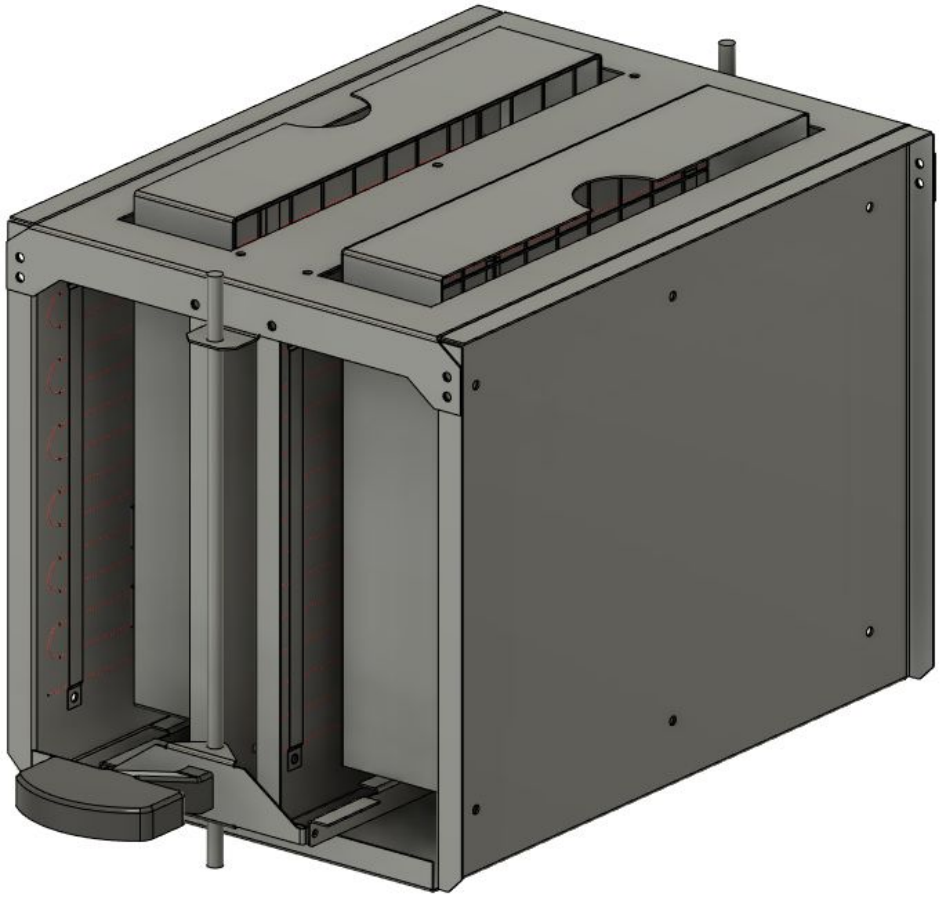
Assembly Underside View

CAD Models

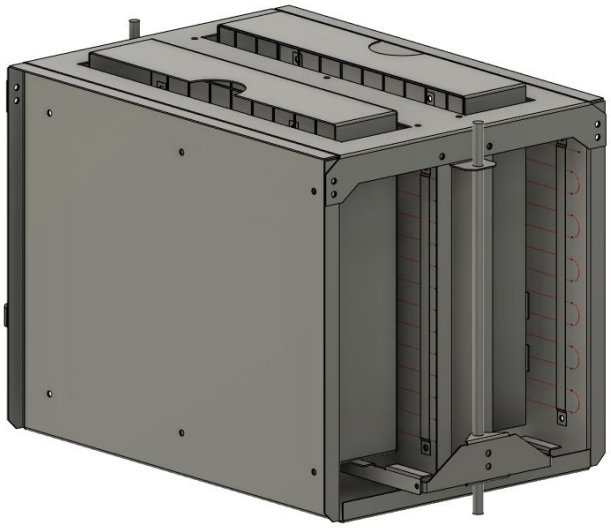


Assembly Exploded View

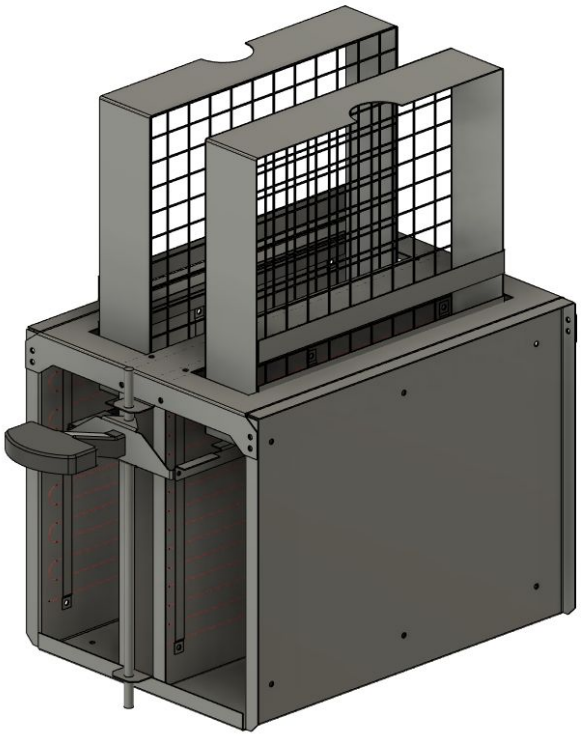
CAD Models



Internal Assembly Front Corner View

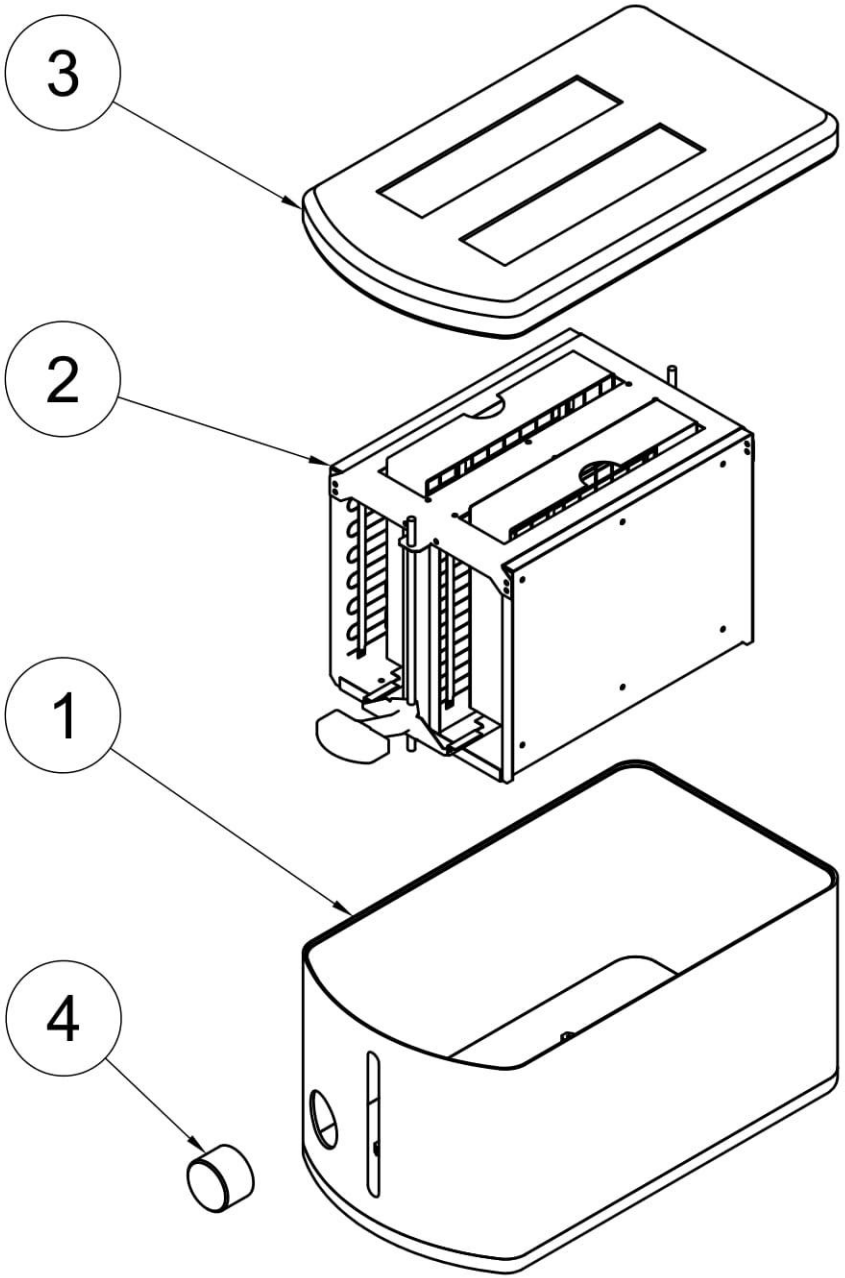


Internal Assembly Rear Corner View



Internal Assembly with trays raised

Exploded Assembly Views



PARTS LIST			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	ME170-TP004	OUTER SHELL
2	1	INTERNALASSEMBLY	INTERNAL ASSEMBLY
3	1	ME170-TP002	LID
4	1	ME170-TP005	KNOB

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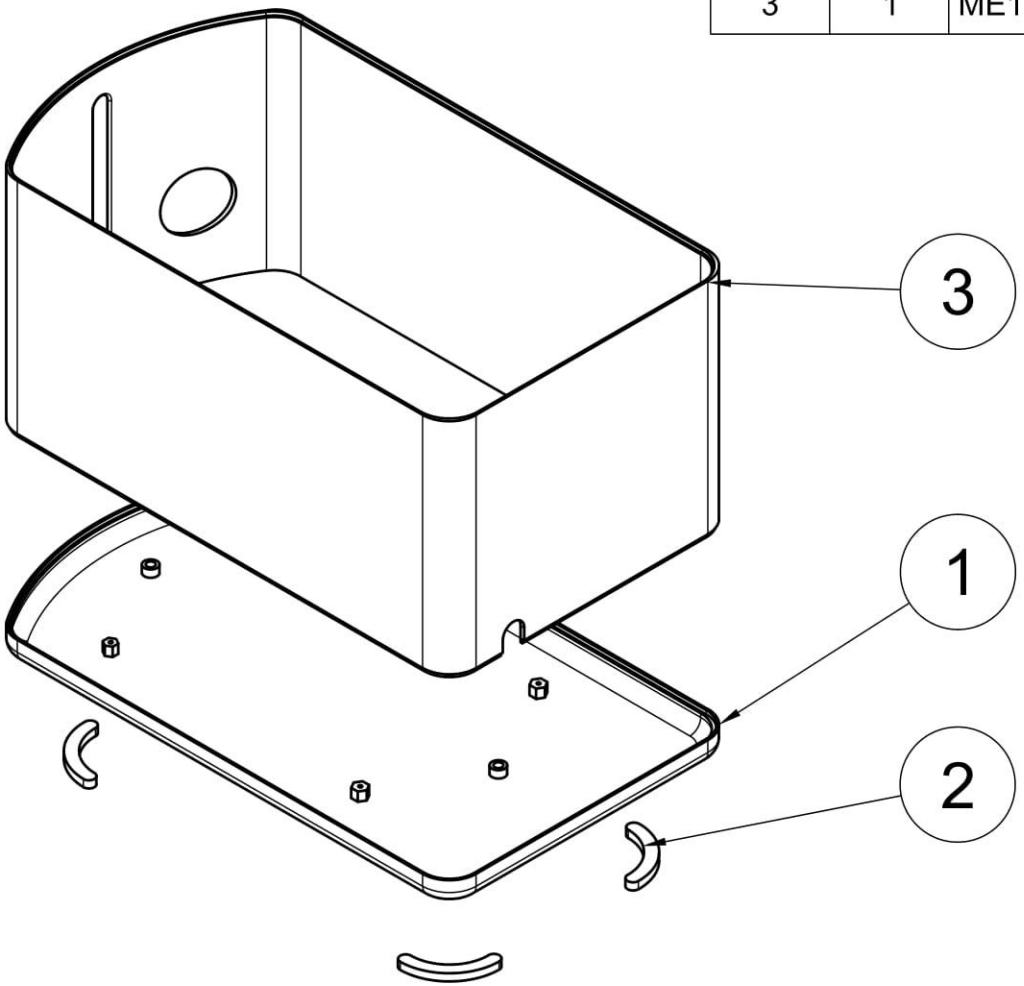
Title
Sub-Assembly Exploded Drawing

Size	Drawn By	DWG NO	Rev
A	Phoenix Bauer		
Scale 1:4	Date 11/25/20		Sheet No. 1/5

PARTS LIST			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	ME170-TP003	BOTTOM SHELL
2	1	ME170-TP001	FEET
3	1	ME170-TP004	OUTER SHELL



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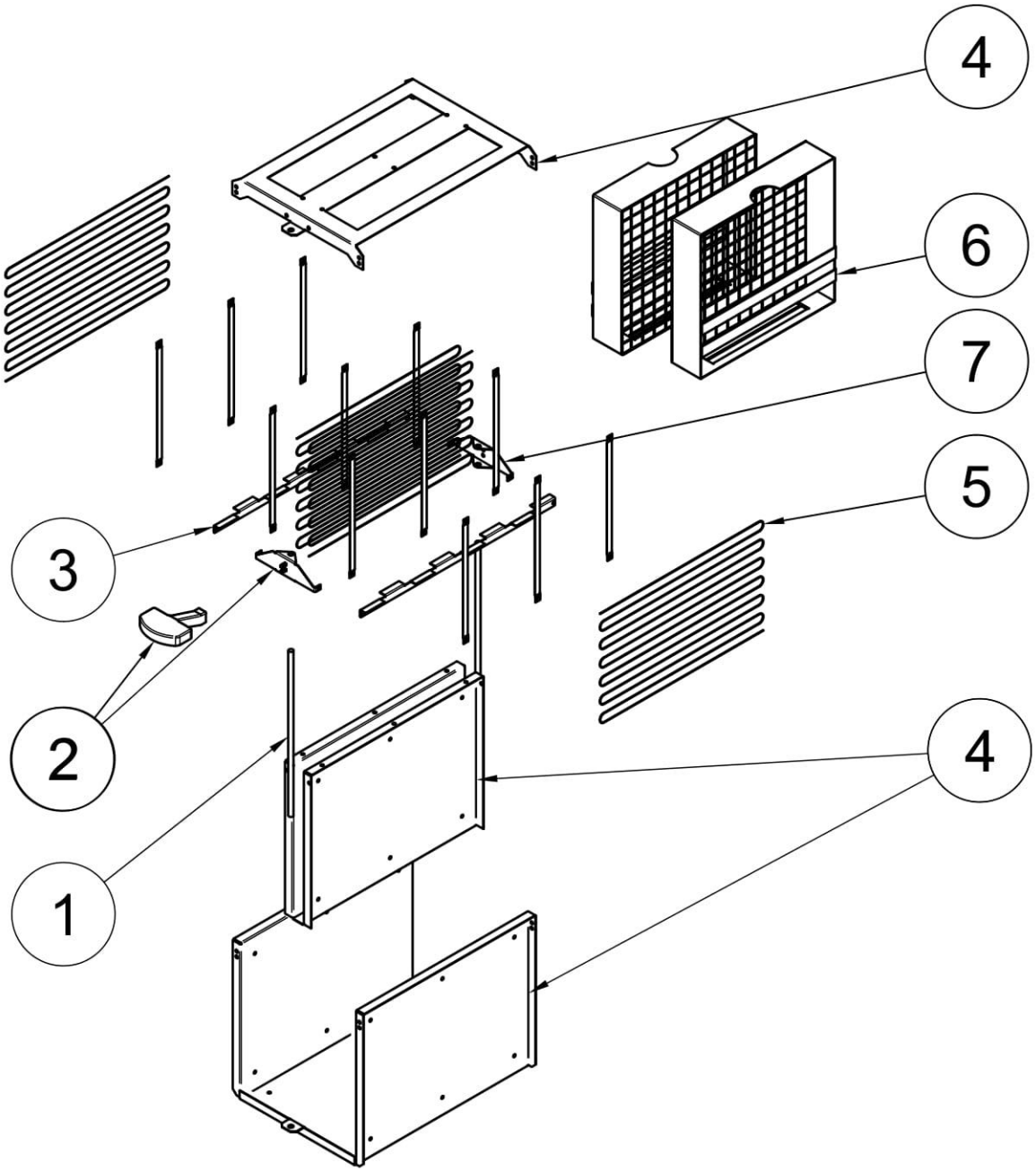
Title
Outer Sub-Assembly

Size	Drawn By	DWG NO	Rev
A	Keshav Sivaram		
Scale 1:4	Date 12/9/2020		Sheet No. 1/1



PARTS LIST

ITEM	QTY	PART NUMBER	DESCRIPTION
1	2	6112K34	SHAFT FOR TOASTER CARRIAGE
2	1	CARRIAGEFRONTASSEMBLY	ASSEMBLY OF CARRIAGE PANEL AND BUTTON
3	2	ME170-TP107	TRAY HOLDER
4	1	FRAMEASSEMBLY	INTERNAL FRAME
5	4	HEATER ASSEMBLY	ASSEMBLY OF HEATER AND MOUNTS
6	2	ME170-TP108	BREAD TRAY
7	1	ME170-TP104	CARRIAGE PANEL THAT RIDES ON SHAFT

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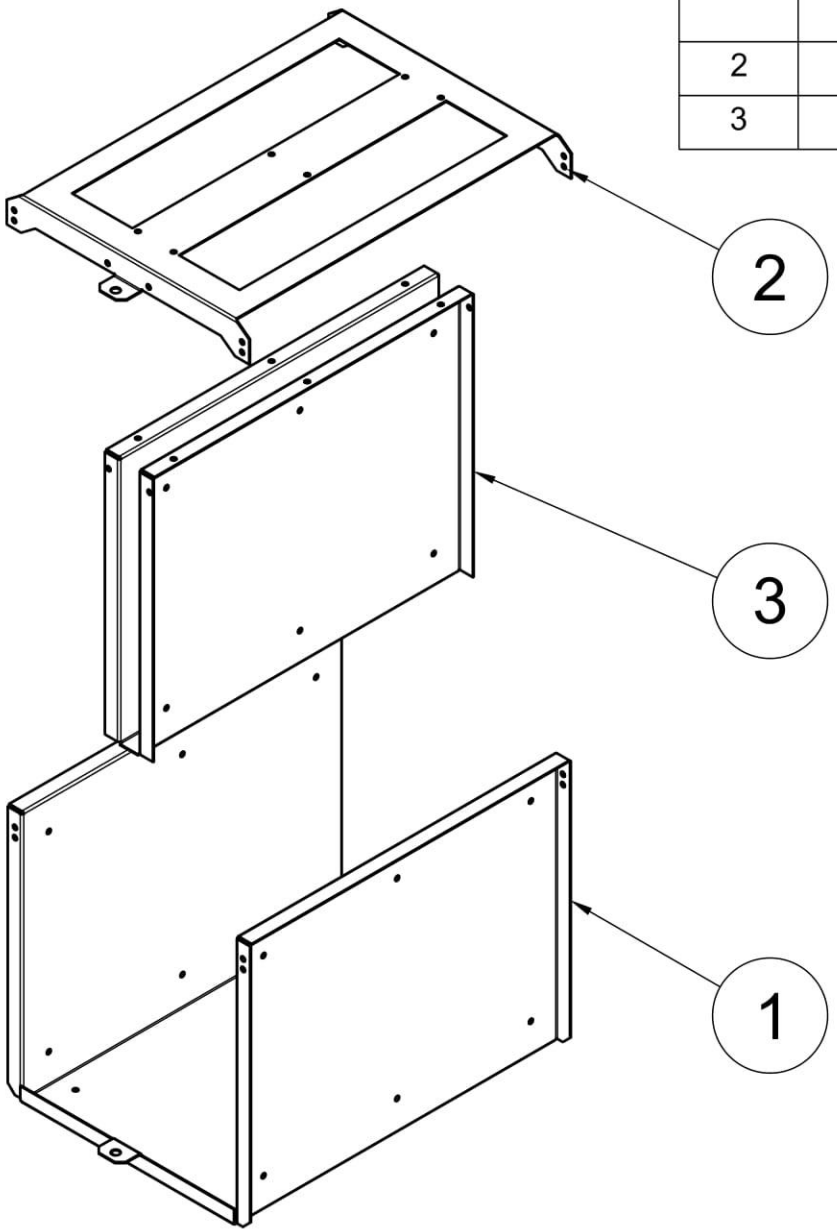
URBANA -CHAMPAIGN

Title
Internal Toaster Assembly

Size	Drawn By	DWG NO	Rev
A	Matthew Zhang		
Scale	Date		Sheet No.
1:5	11/16/2020		1/4

PARTS LIST			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	ME170-TP101	FRAME BOTTOM HALF
2	1	ME170-TP102	TOP PANEL
3	1	ME170-TP103	CENTER STRUCTURE OF FRAME



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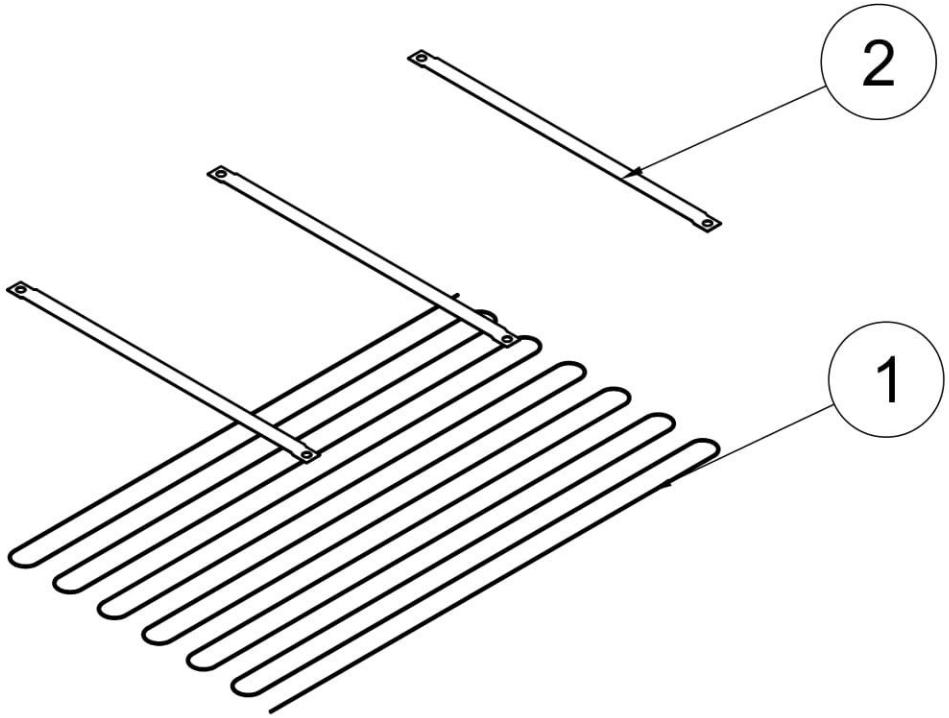
Title: Internal Frame

Size	Drawn By	DWG NO	Rev
A	Matthew Zhang		
Scale 1:3	Date 11/16/2020		Sheet No. 1/1

PARTS LIST			
ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	NICHROME WIRE HEATER	ELECTRIC HEATING ELEMENT
2	3	ME170-TP106	HEATING ELEMENT MOUNT



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Title
Heater Assembly

Size	Drawn By	DWG NO	Rev
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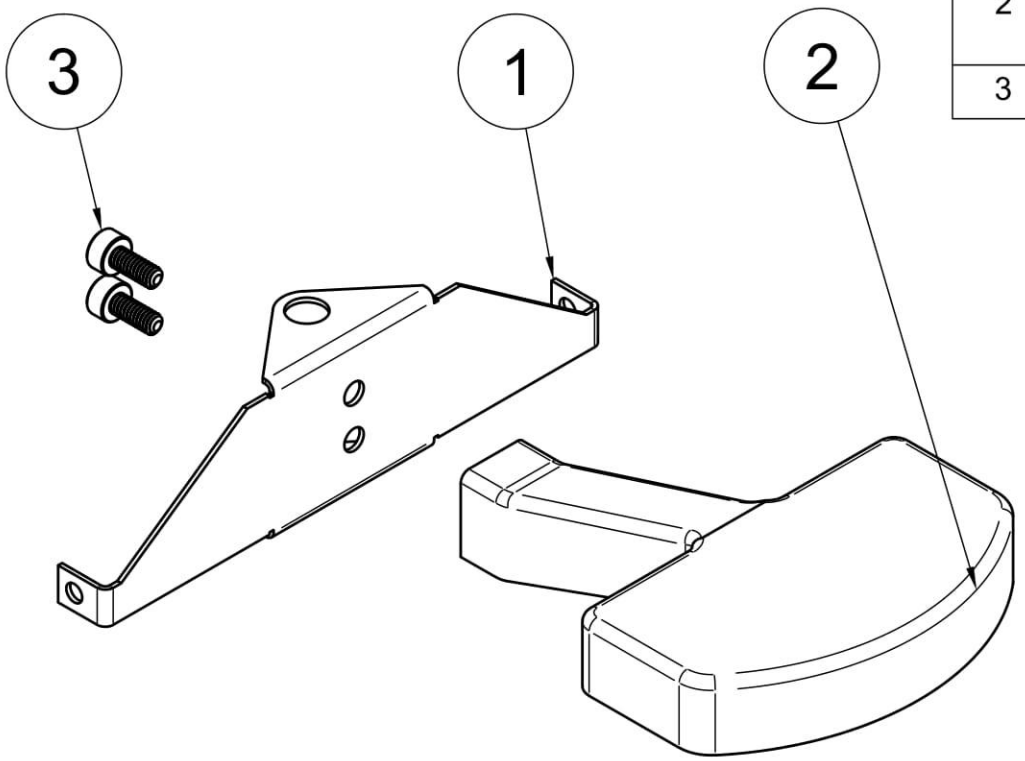
Scale 1:2	Date 12/10/2020		Sheet No. 1/1



PARTS LIST

ITEM	QTY	PART NUMBER	DESCRIPTION
1	1	ME170-TP104	CARRIAGE PANEL THAT RIDES ON SHAFT
2	1	ME170-TP105	BUTTON
3	2	91290A012	M2X0.4 6MM SCREW

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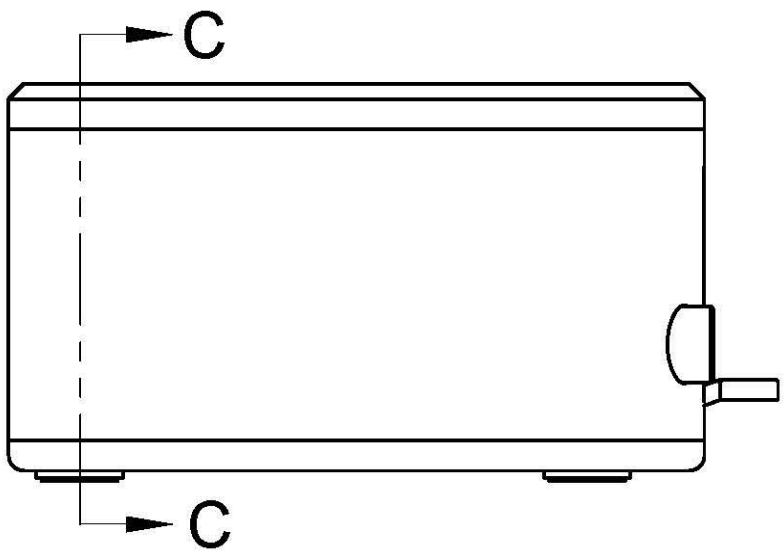
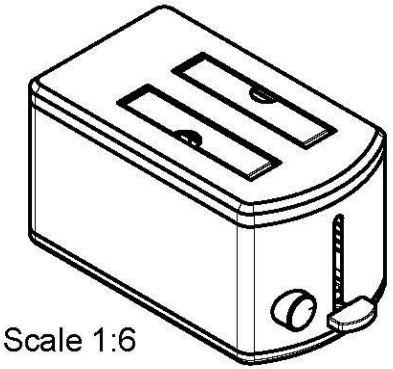
Title
CarriageFrontAssembly

Size	Drawn By	DWG NO	Rev
A	Matthew Zhang		
Scale 3:2	Date 11/16/2020		Sheet No. 1/1

Assembly Section Views





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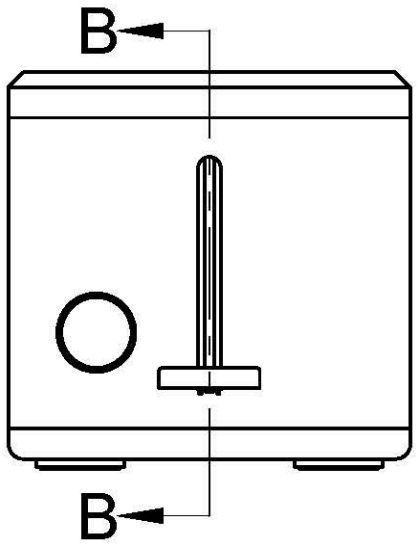
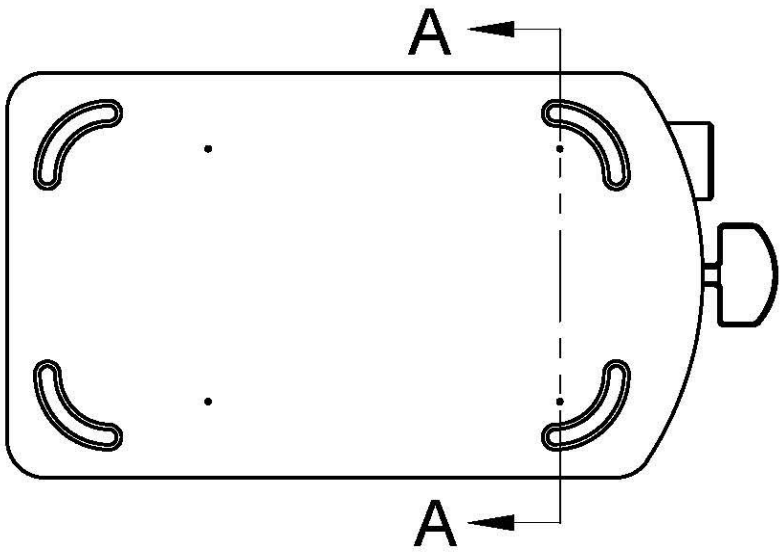
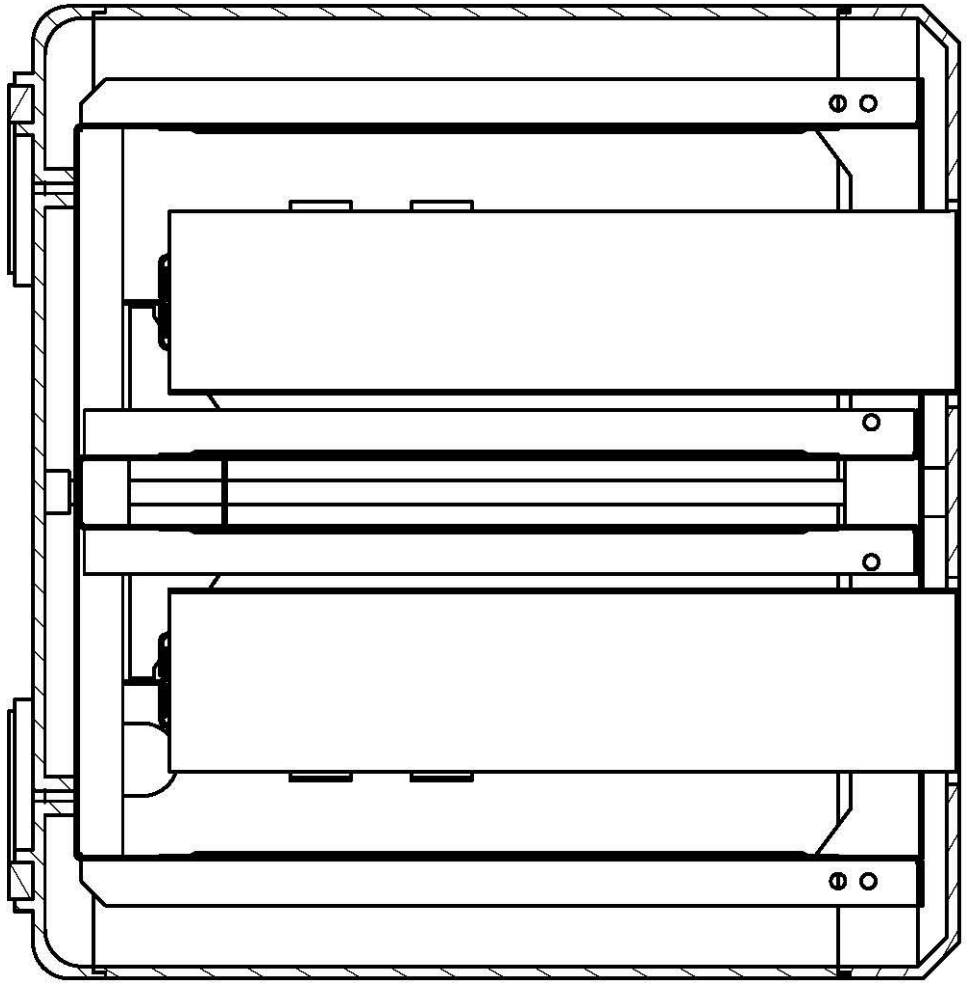




UNIVERSITY OF ILLINOIS
URBANA -CHAMPAIGN

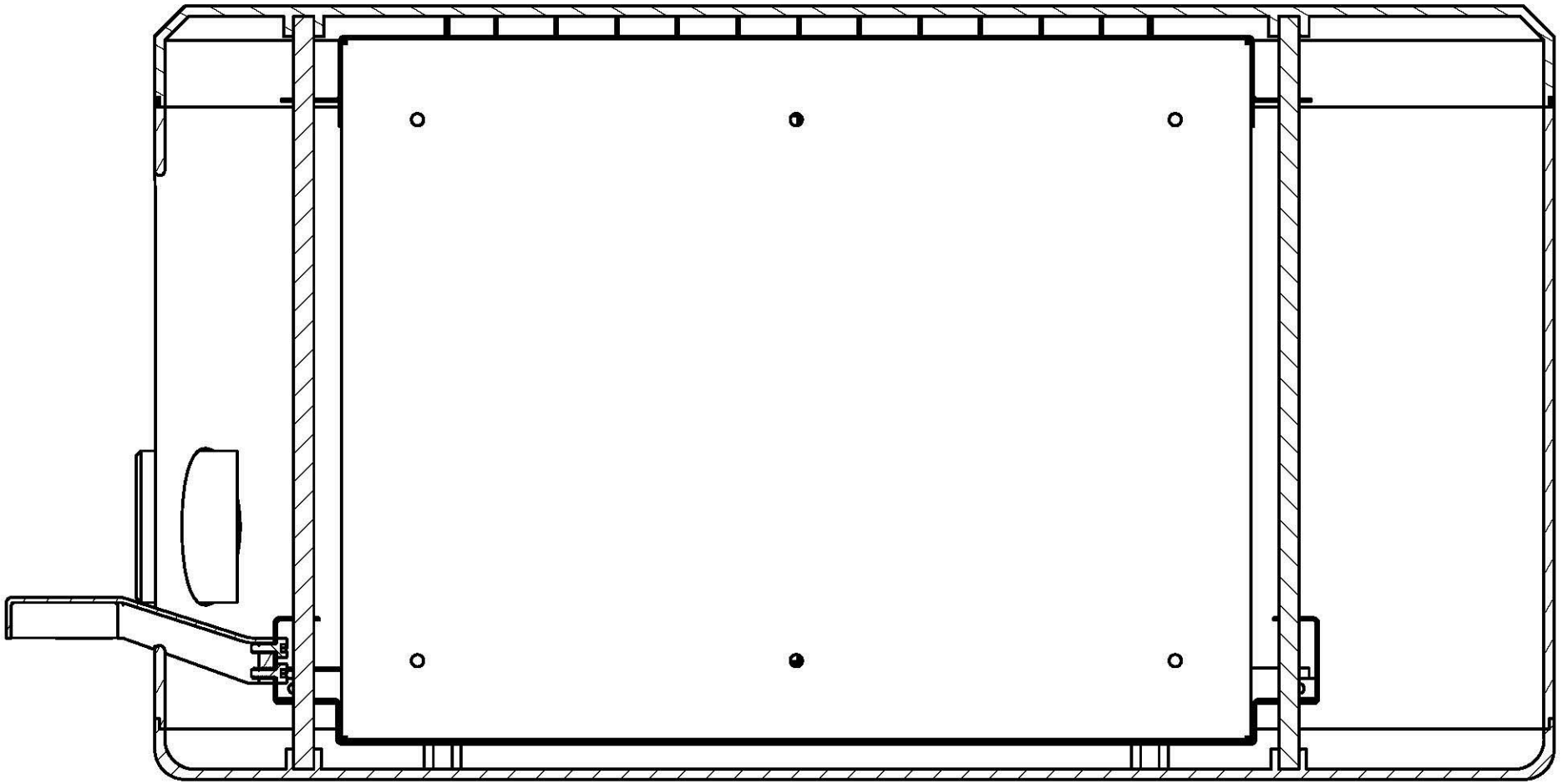
Title
Sub-Assembly Drawing

Size	Drawn By	DWG NO	Rev
A	Phoenix Bauer	ME170-TP	
Scale 1:3	Date 11/25/20		Sheet No. 2/5



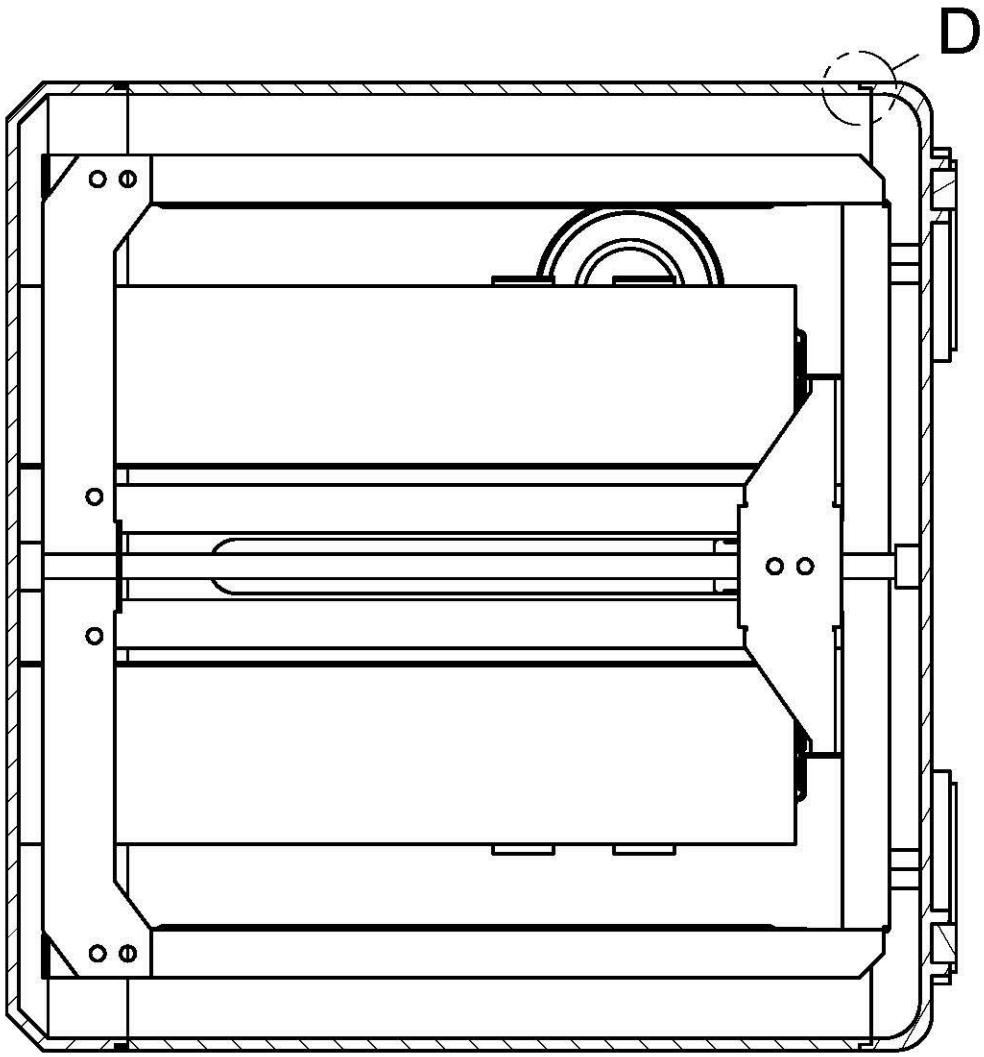
SECTION A-A
SCALE 1:1.25

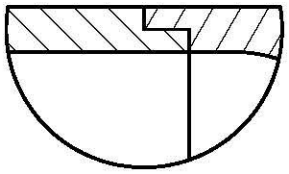
UNIVERSITY OF ILLINOIS URBANA -CHAMPAIGN			
Title Assembly Cross Section A-A Drawing			
Size A	Drawn By Phoenix Bauer	DWG NO ME170-TP	Rev
Scale 1:8	Date 11/25/20		Sheet No. 3/5



SECTION B-B
SCALE 1:1.25

UNIVERSITY OF ILLINOIS URBANA -CHAMPAIGN			
Title Assembly Cross Section B-B Drawing			
Size A	Drawn By Phoenix Bauer	DWG NO ME170-TP	Rev
Scale 1:8	Date 11/25/20		Sheet No. 4/5



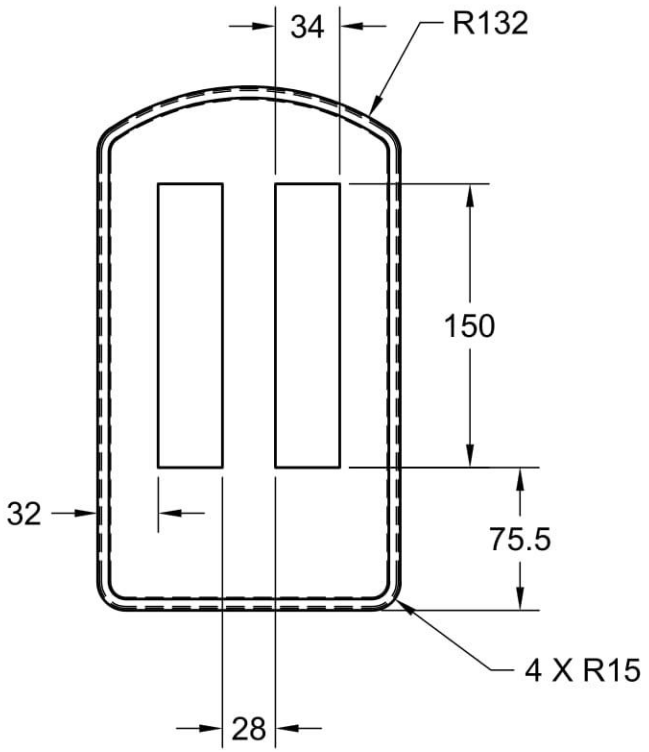


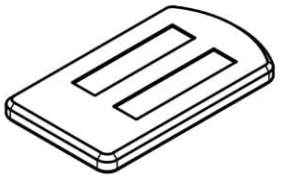
DETAIL D
SCALE 3:1

SECTION C-C
SCALE 1:1.25

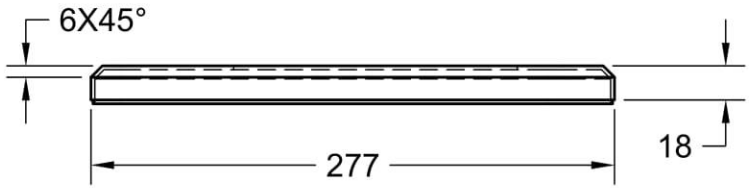
UNIVERSITY OF ILLINOIS URBANA -CHAMPAIGN			
Title Assembly Cross Section C-C Drawing			
Size A	Drawn By Phoenix Bauer	DWG NO ME170-TP	Rev
Scale 1:8	Date 11/25/20		Sheet No. 5/5

Part Drawings



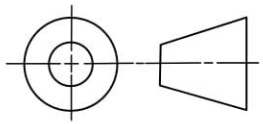


Scale 1:8



UNLESS OTHERWISE SPECIFIED
DIM ARE IN MILLIMETERS
TOL ON ANGLES ± 1°
0 PLACE ± 0.25 1 PLACE ± 0.125
INTERPRET DIM AND TOL PER
ASME Y14.5M- 2018

THIRD ANGLE PROJECTION

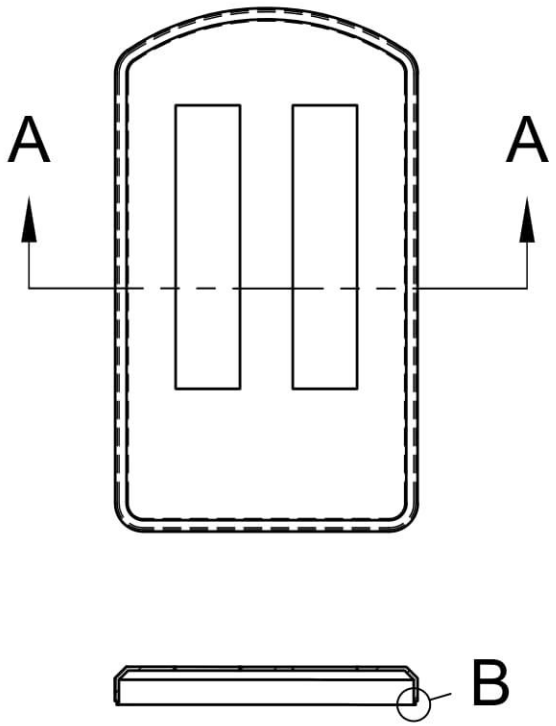


UNIVERSITY OF ILLINOIS
URBANA -CHAMPAIGN

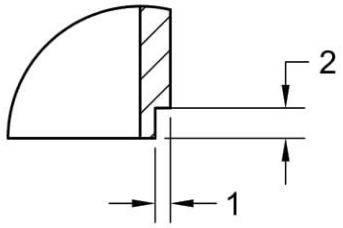
Title: Toaster Lid

Size	Material	DWG NO	Rev
A	Plastic	ME170-TP-002	

Scale	Drawn By	Date	Sheet No.
1:4	Keshav Sivaram	11/5/2020	1/2



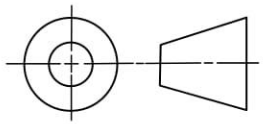
SECTION A-A
SCALE 1:4



DETAIL B
SCALE 2:1

UNLESS OTHERWISE SPECIFIED
DIM ARE IN MILLIMETERS
TOL ON ANGLES ± 1°
0 PLACE ± 0.25 1 PLACE ± 0.125
INTERPRET DIM AND TOL PER
ASME Y14.5M- 2018

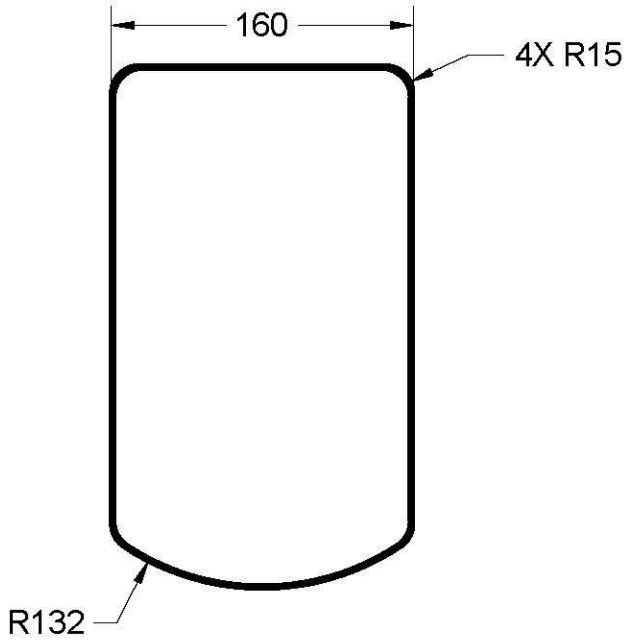
THIRD ANGLE PROJECTION

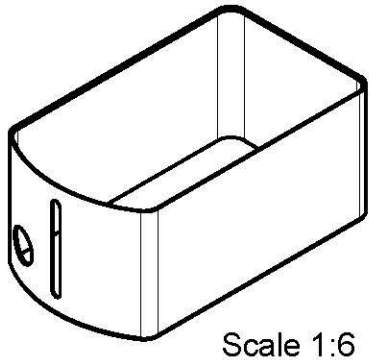


UNIVERSITY OF ILLINOIS
URBANA -CHAMPAIGN

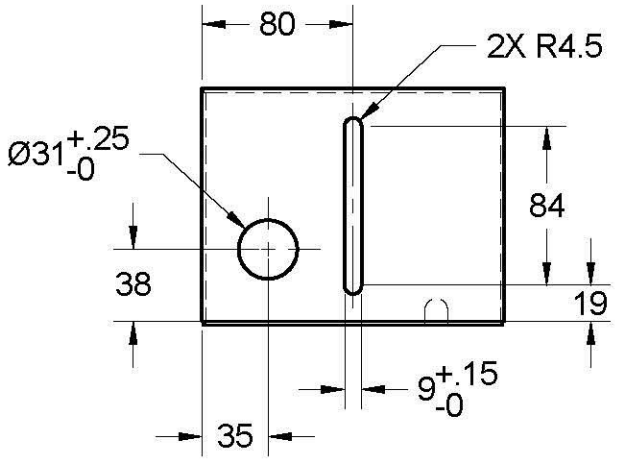
Title: Toaster Lid

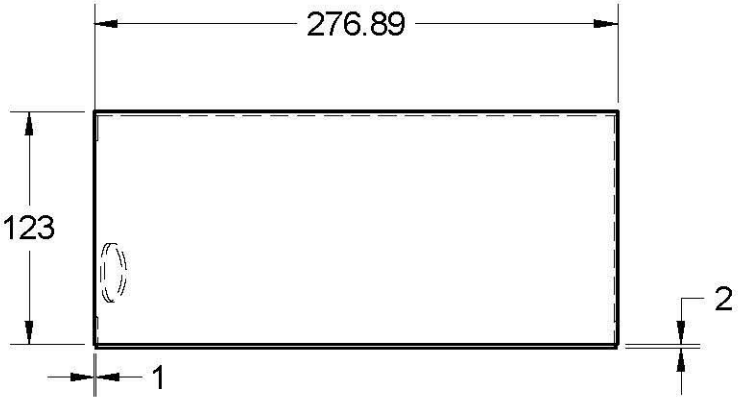
Size	Material	DWG NO	Rev
A	Plastic	ME170-TP-002	
Scale	Drawn By	Date	Sheet No.
1:4	Keshav Sivaram	11/5/2020	2/2





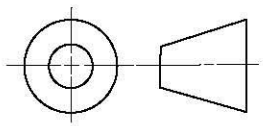
Scale 1:6





UNLESS OTHERWISE SPECIFIED
DIM ARE IN MILLIMETERS
TOL ON ANGLES ± 1°
0 PLACE ± 0.25 1 PLACE ± 0.125
INTERPRET DIM AND TOL PER
ASME Y14.5M- 2018

THIRD ANGLE PROJECTION



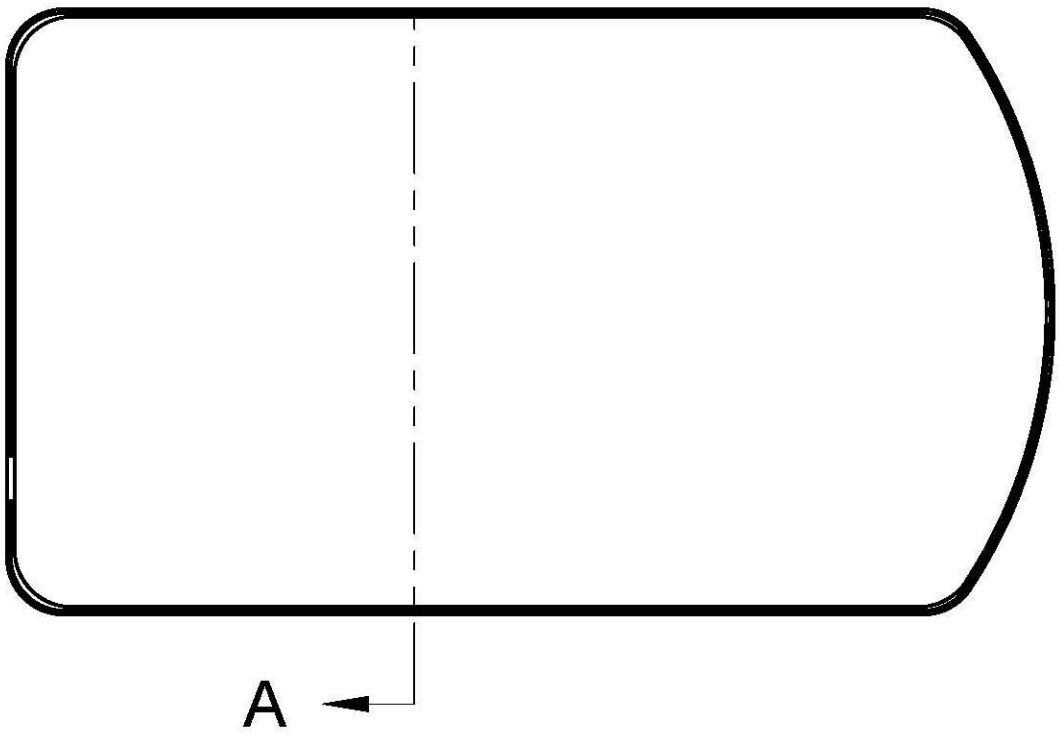
UNIVERSITY OF ILLINOIS

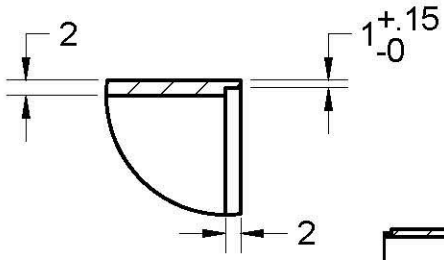
URBANA -CHAMPAIGN

Title

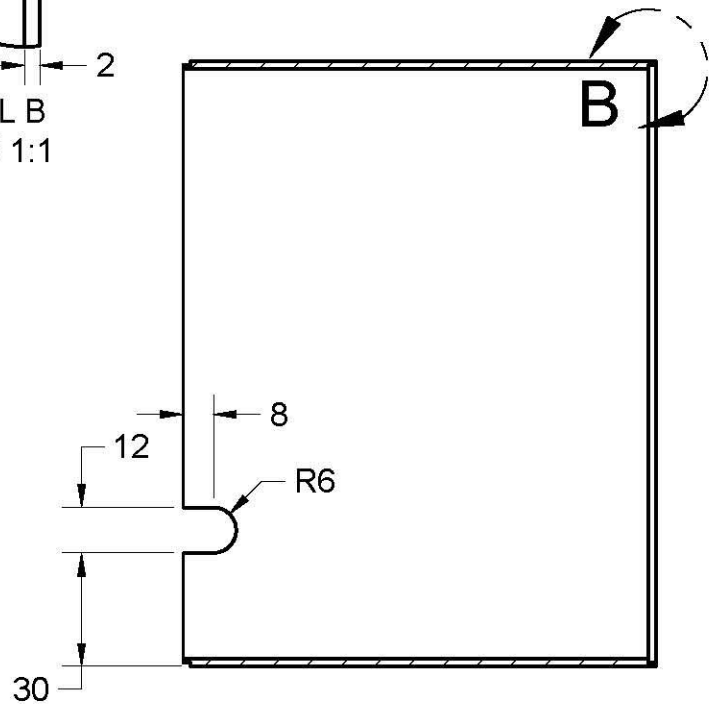
Outer Shell Drawing

Size	Material	DWG NO	Rev
A	ABS White	ME170-TP004	
Scale	Drawn By	Date	Sheet No.
1:4	Phoenix Bauer	11/8/20	1/2





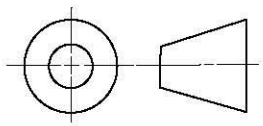
DETAIL B
SCALE 1:1



SECTION A-A
SCALE 1:2

UNLESS OTHERWISE SPECIFIED
DIM ARE IN MILLIMETERS
TOL ON ANGLES ± 1°
0 PLACE ± 0.25 1 PLACE ± 0.125
INTERPRET DIM AND TOL PER
ASME Y14.5M- 2018

THIRD ANGLE PROJECTION

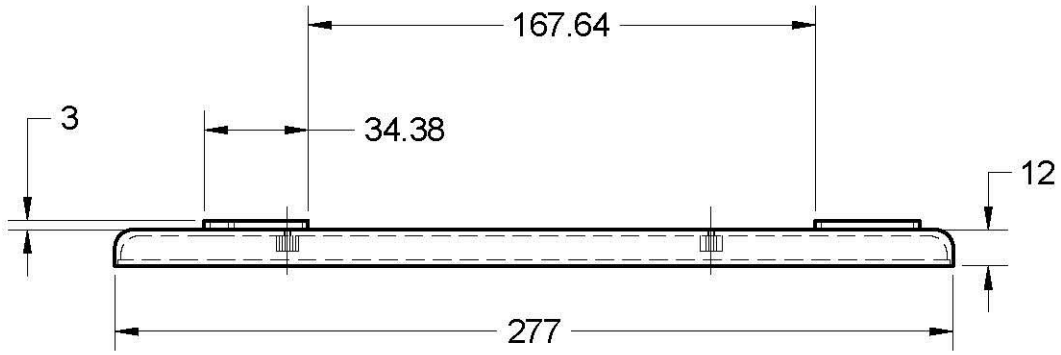


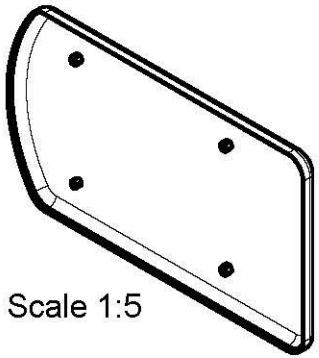
UNIVERSITY OF ILLINOIS
URBANA -CHAMPAIGN

Title: Outer Shell Drawing

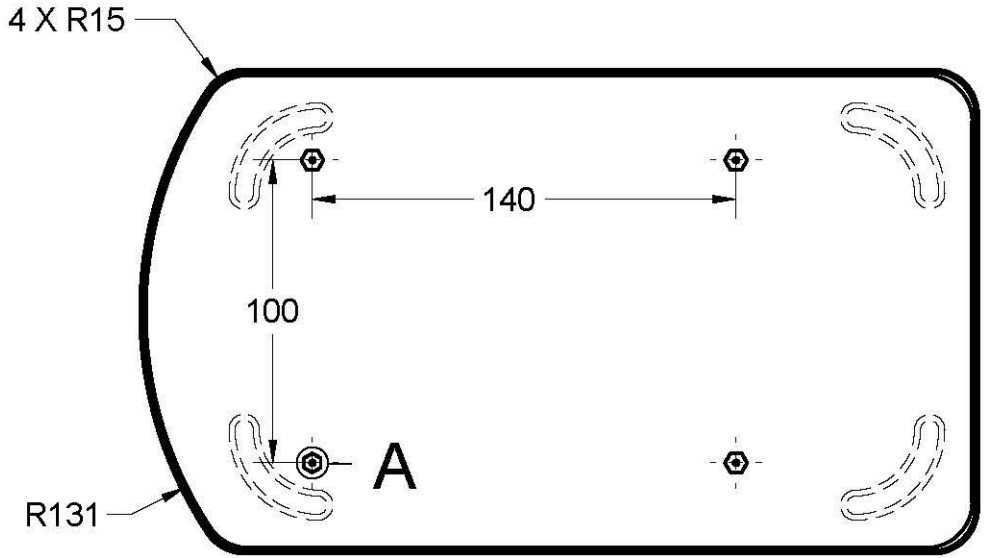
Size	Material	DWG NO	Rev
A	ABS White	ME170-TP004	

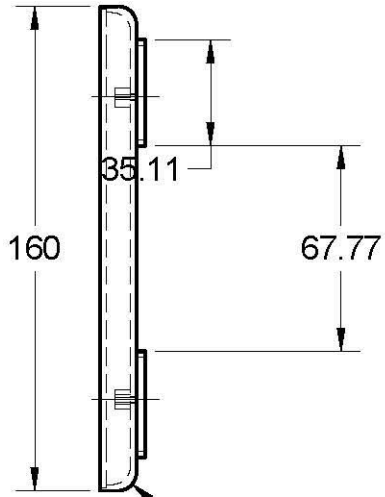
Scale	Drawn By	Date	Sheet No.
1:3	Phoenix Bauer	11/8/20	2/2

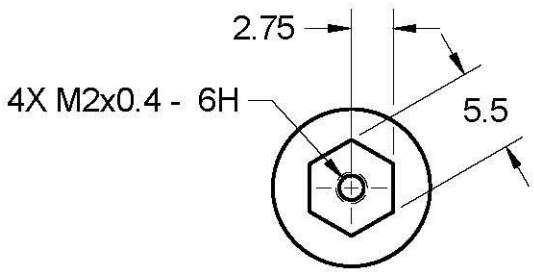




Scale 1:5



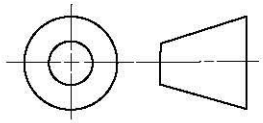




DETAIL A
SCALE 2:1

UNLESS OTHERWISE SPECIFIED
DIM ARE IN MILLIMETERS
TOL ON ANGLES ± 1°
0 PLACE ± 0.25 1 PLACE ± 0.125
INTERPRET DIM AND TOL PER
ASME Y14.5M- 2018

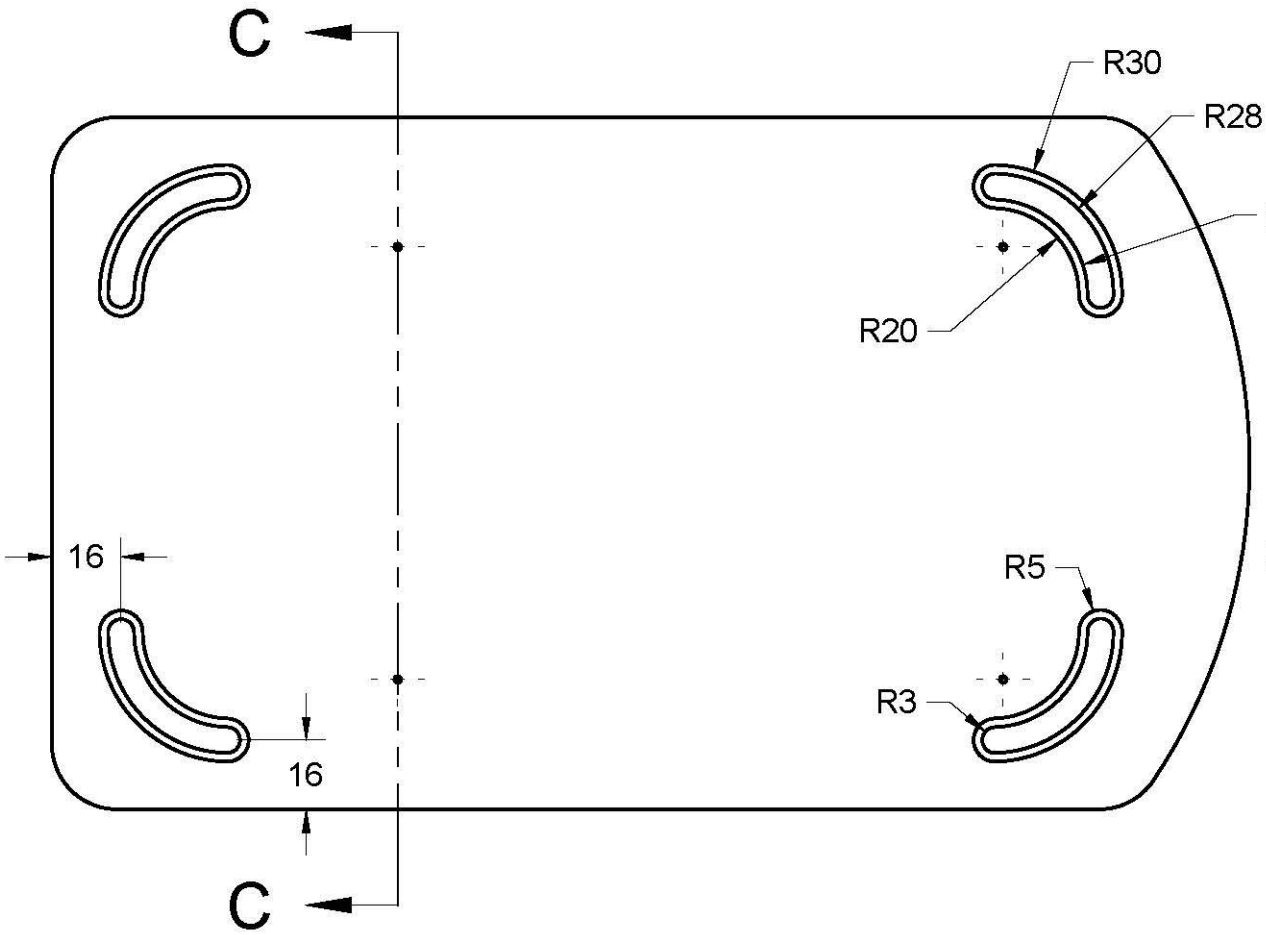
THIRD ANGLE PROJECTION

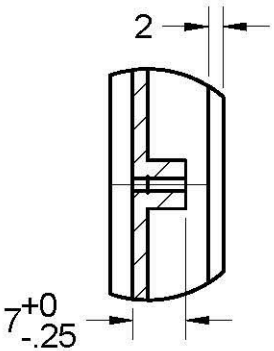


UNIVERSITY OF ILLINOIS
URBANA -CHAMPAIGN

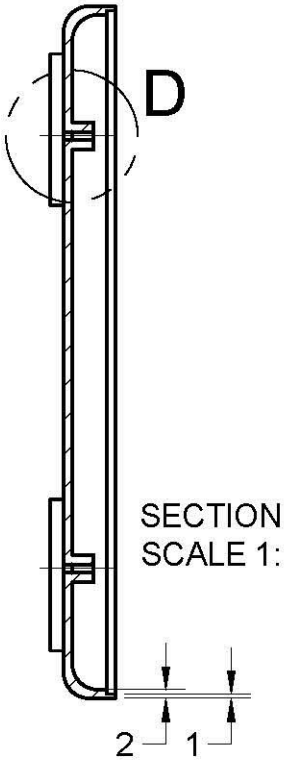
Title
Bottom Shell Drawing

Size	Material	DWG NO	Rev
A	ABS - Black	ME170-TP003	
Scale	Drawn By	Date	Sheet No.
1:4	Phoenix Bauer	11/5/2020	1/2





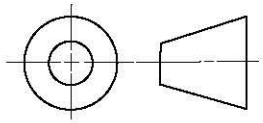
DETAIL D
SCALE 1:1



SECTION C-C
SCALE 1:1.75

UNLESS OTHERWISE SPECIFIED
DIM ARE IN MILLIMETERS
TOL ON ANGLES ± 1°
0 PLACE ± 0.25 1 PLACE ± 0.125
INTERPRET DIM AND TOL PER
ASME Y14.5M- 2018

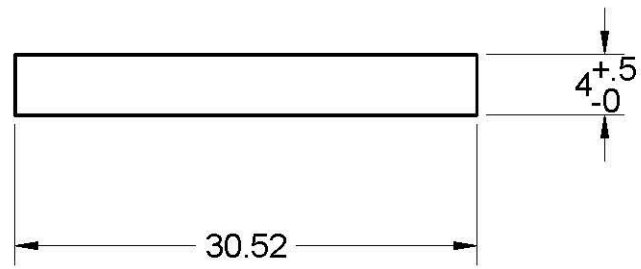
THIRD ANGLE PROJECTION

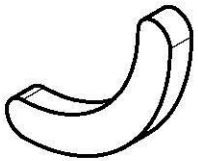


UNIVERSITY OF ILLINOIS
URBANA -CHAMPAIGN

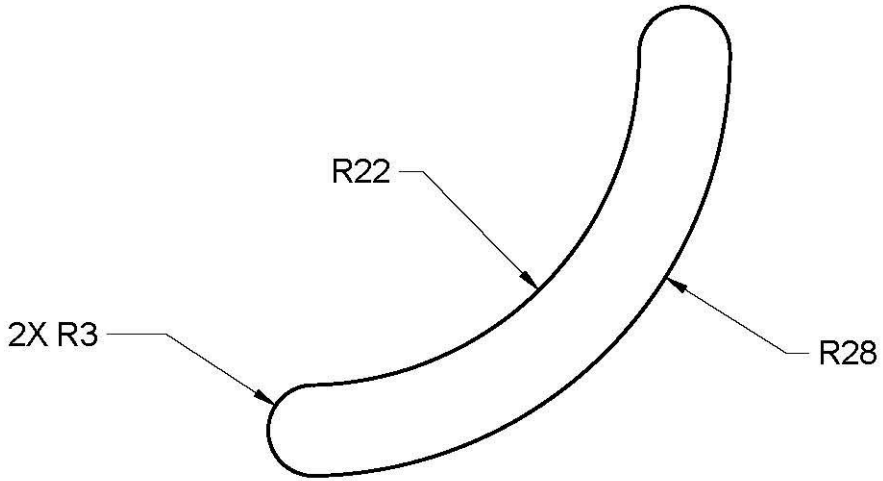
Title: Bottom Shell Drawing

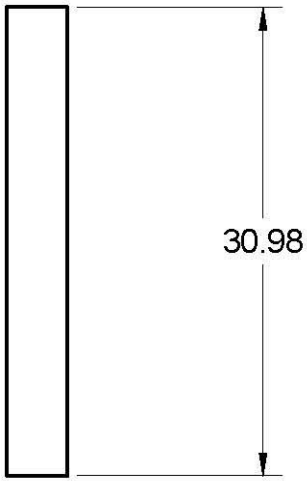
Size	Material	DWG NO	Rev
A	ABS - Black	ME170-TP003	
Scale	Drawn By	Date	Sheet No.
1:4	Phoenix Bauer	11/5/2020	2/2





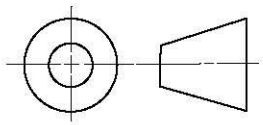
Scale 1:1





UNLESS OTHERWISE SPECIFIED
DIM ARE IN MILLIMETERS
TOL ON ANGLES ± 1°
0 PLACE ± 0.25 1 PLACE ± 0.125
INTERPRET DIM AND TOL PER
ASME Y14.5M- 2018

THIRD ANGLE PROJECTION

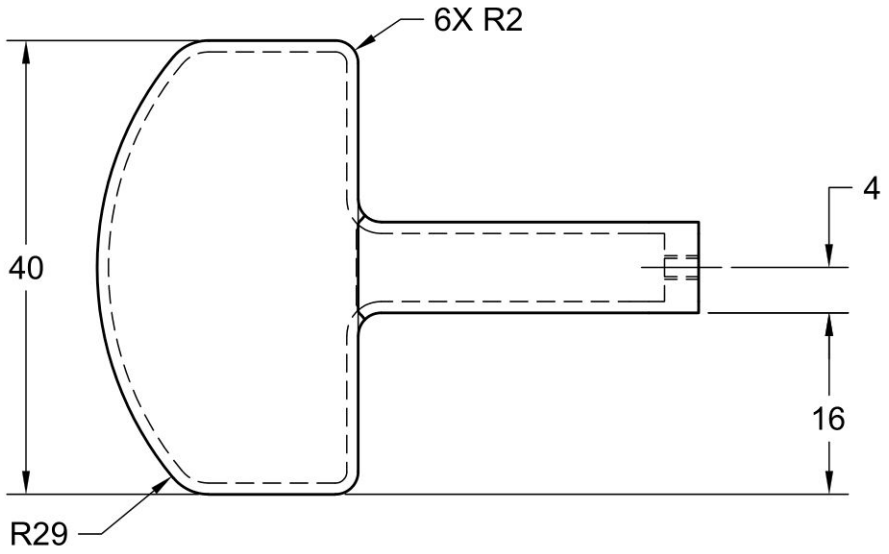


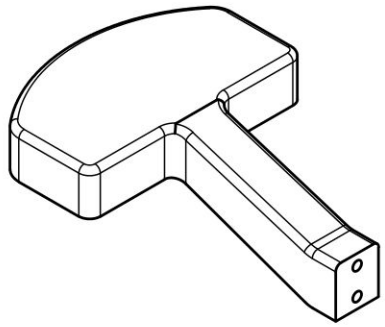
UNIVERSITY OF ILLINOIS
URBANA -CHAMPAIGN

Title: Foot Drawing

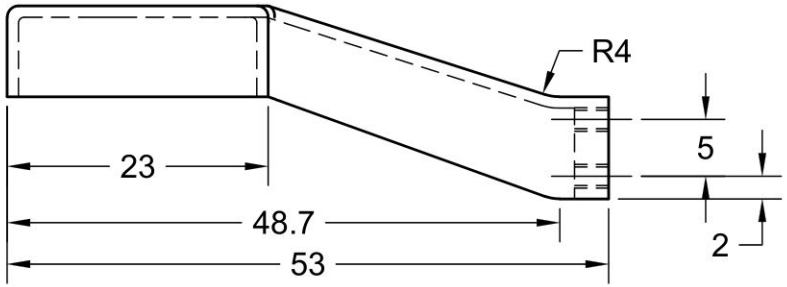
Size	Material	DWG NO	Rev
A	Nylon Type 6 - Black	ME170-TP001	

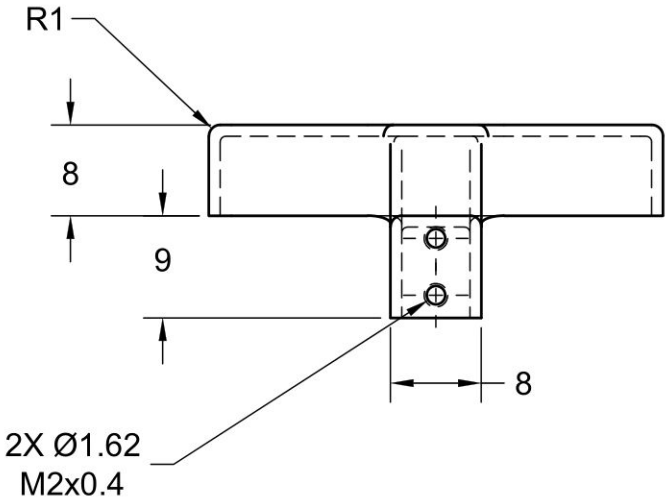
Scale	Drawn By	Date	Sheet No.
2:1	Phoenix Bauer	11/5/2020	1/1

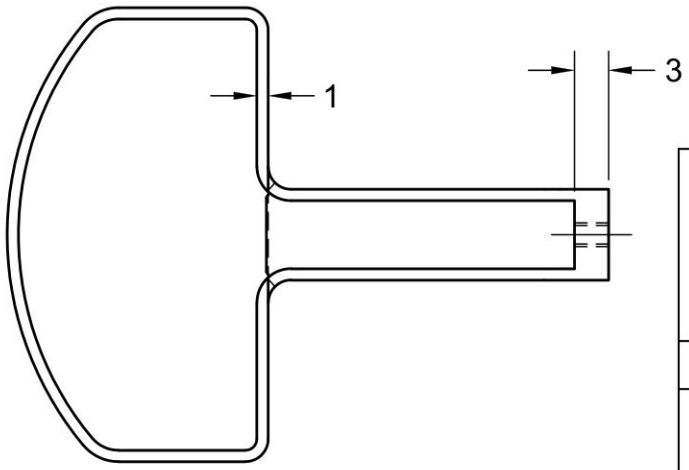




SCALE: 1:1

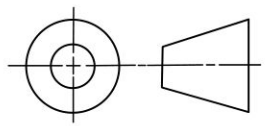






UNLESS OTHERWISE SPECIFIED
DIM ARE IN MILLIMETERS
TOL ON ANGLES ± 1°
0 PLACE ± 0.25 1 PLACE ± 0.125
INTERPRET DIM AND TOL PER
ASME Y14.5M- 2018

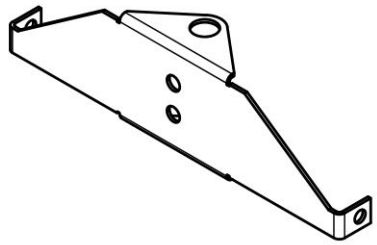
THIRD ANGLE PROJECTION

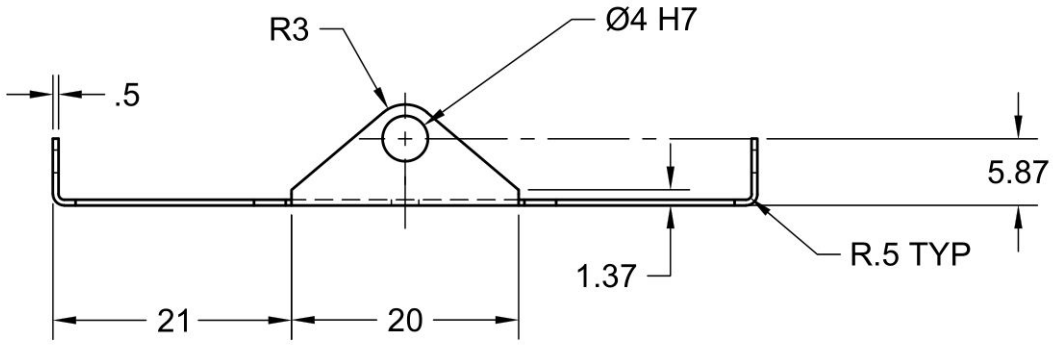


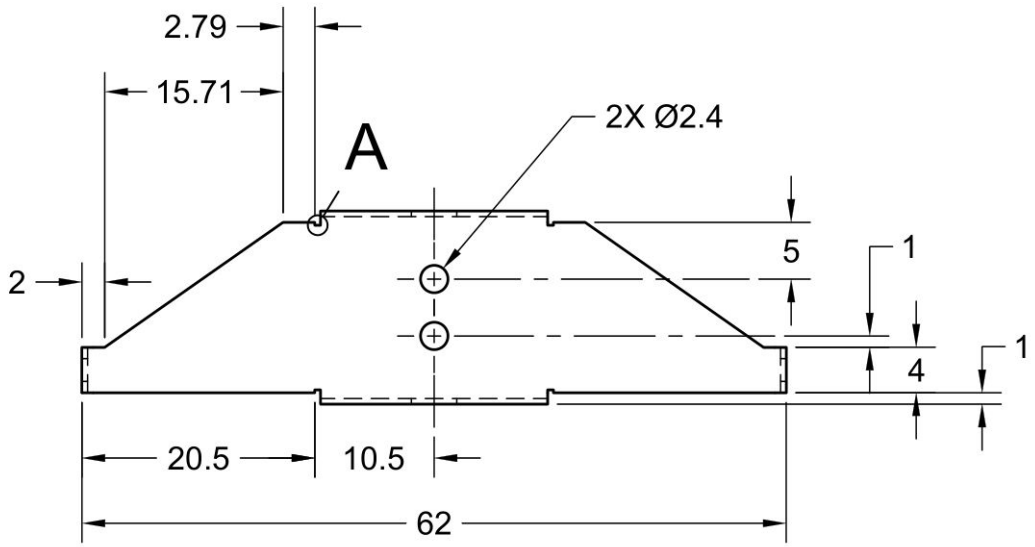
UNIVERSITY OF ILLINOIS
URBANA -CHAMPAIGN

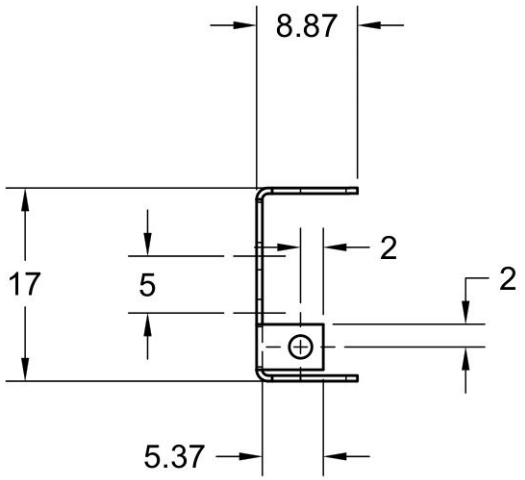
Title
BUTTON

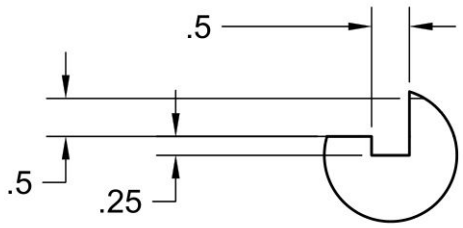
Size	Material	DWG NO	Rev
A	ABS PLASTIC	ME170-TP105	1
Scale	Drawn By	Date	Sheet No.
3:2	Matthew Zhang	11/6/2020	1/1







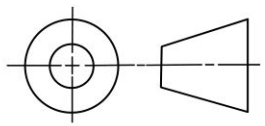




DETAIL A
SCALE 10:1

UNLESS OTHERWISE SPECIFIED
DIM ARE IN MILLIMETERS
TOL ON ANGLES ± 1°
0 PLACE ± 0.25 1 PLACE ± 0.125
INTERPRET DIM AND TOL PER
ASME Y14.5M- 2018

THIRD ANGLE PROJECTION

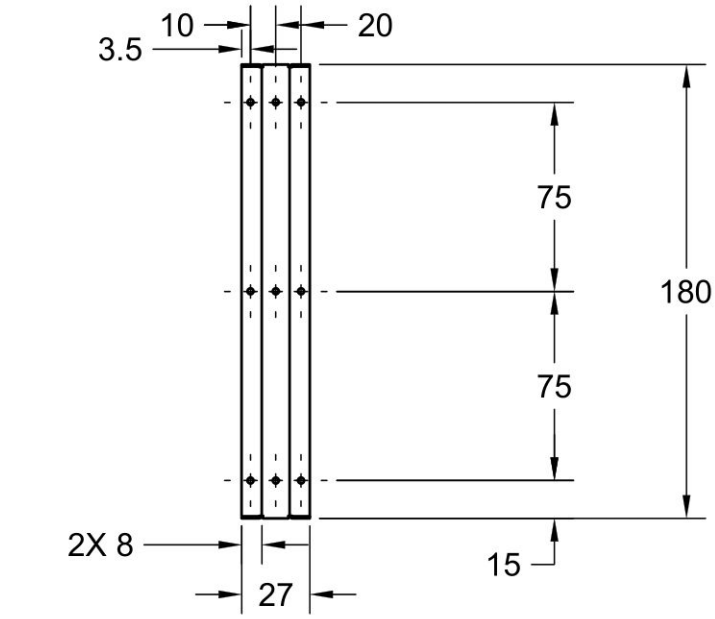


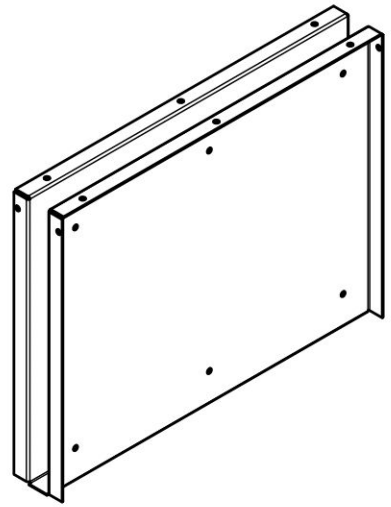
UNIVERSITY OF ILLINOIS
URBANA -CHAMPAIGN

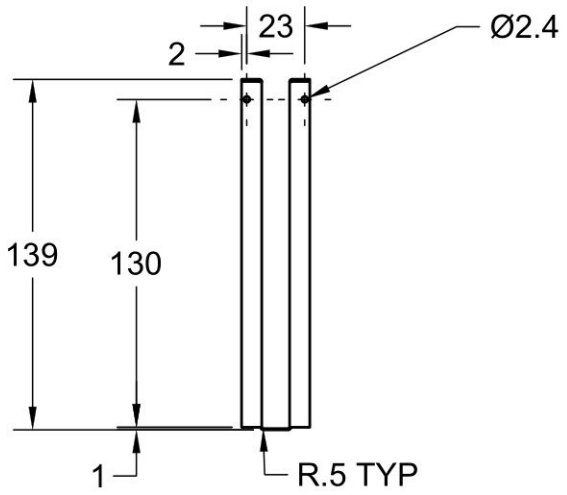
Title: Carriage Front Panel

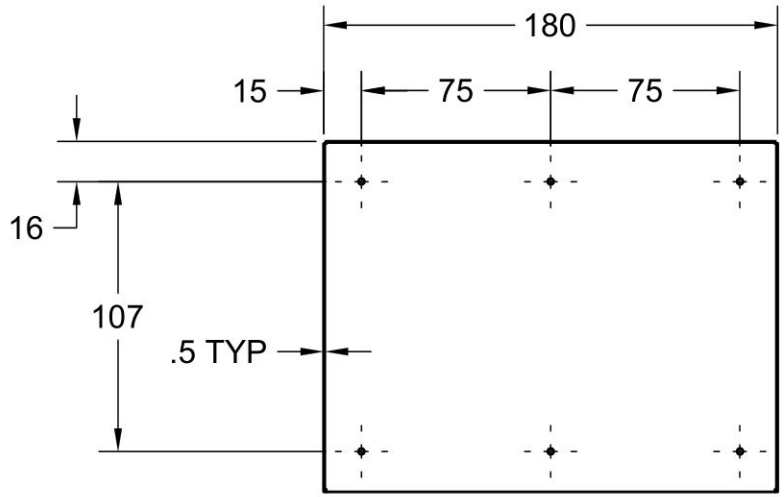
Size	Material	DWG NO	Rev
A			

Scale	Drawn By	Date	Sheet No.
1:1	Matthew Zhang	11/10/2020	1/1



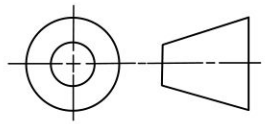






UNLESS OTHERWISE SPECIFIED
DIM ARE IN MILLIMETERS
TOL ON ANGLES ± 1°
0 PLACE ± 0.25 1 PLACE ± 0.125
INTERPRET DIM AND TOL PER
ASME Y14.5M- 2018

THIRD ANGLE PROJECTION

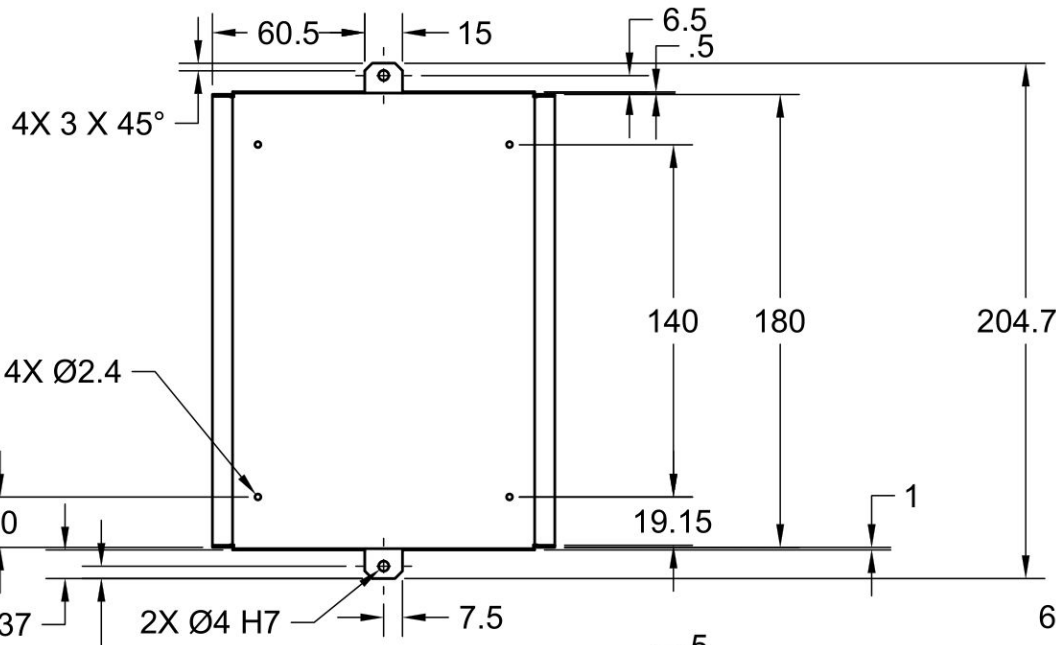


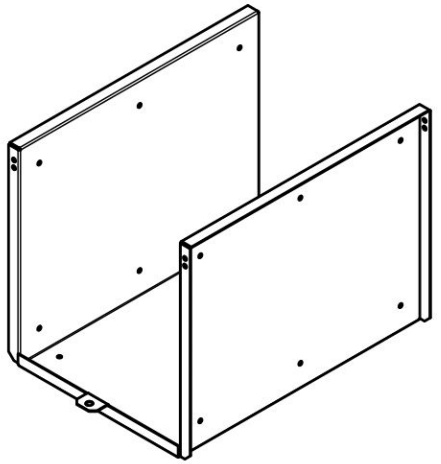
UNIVERSITY OF ILLINOIS
URBANA -CHAMPAIGN

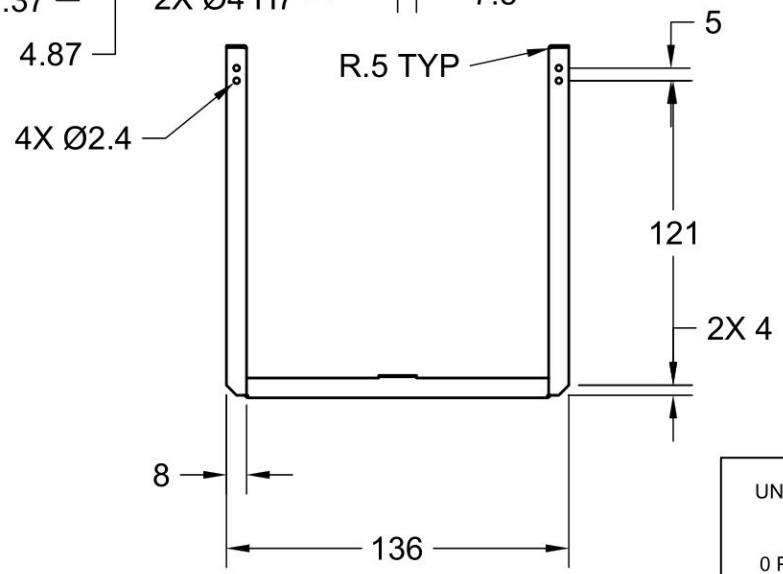
Title
Center Panel

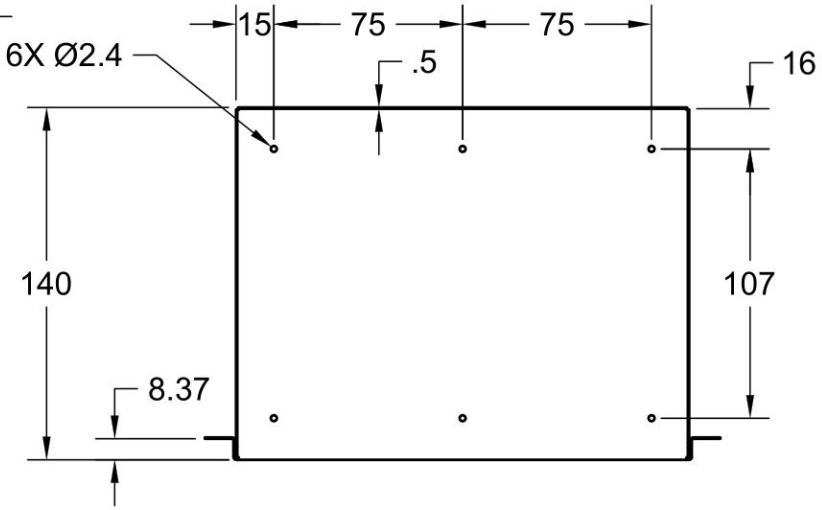
Size	Material	DWG NO	Rev
A			

Scale	Drawn By	Date	Sheet No.
1:4	Matthew Zhang	11/7/2020	1/1



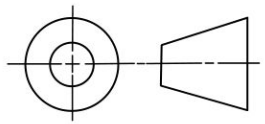






UNLESS OTHERWISE SPECIFIED
DIM ARE IN MILLIMETERS
TOL ON ANGLES ± 1°
0 PLACE ± 0.25 1 PLACE ± 0.125
INTERPRET DIM AND TOL PER
ASME Y14.5M- 2018

THIRD ANGLE PROJECTION



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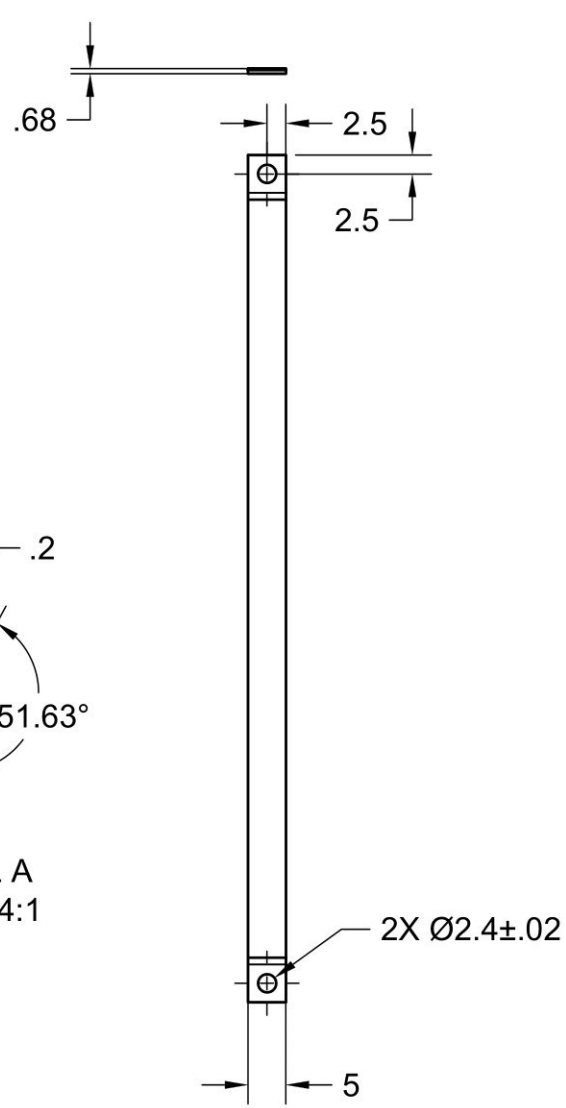
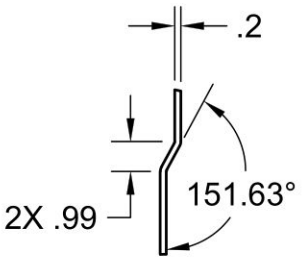
Title
Frame Bottom Half

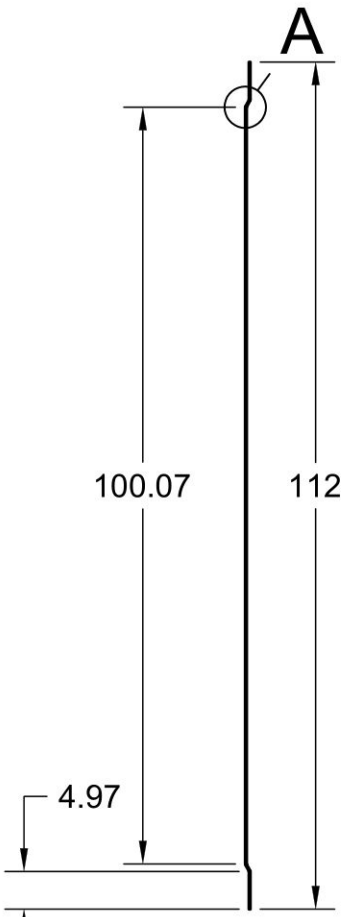
Size	Material	DWG NO	Rev
A			

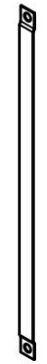
Scale	Drawn By	Date	Sheet No.
1:3	Matthew Zhang	11/7/2020	1/1





DETAIL A
SCALE 4:1

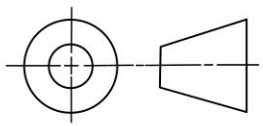




Scale 1:2

UNLESS OTHERWISE SPECIFIED
DIM ARE IN MILLIMETERS
TOL ON ANGLES ± 1°
0 PLACE ± 0.25 1 PLACE ± 0.125
INTERPRET DIM AND TOL PER
ASME Y14.5M- 2018

THIRD ANGLE PROJECTION



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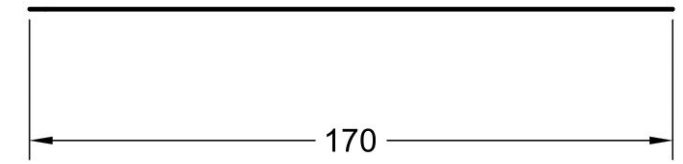
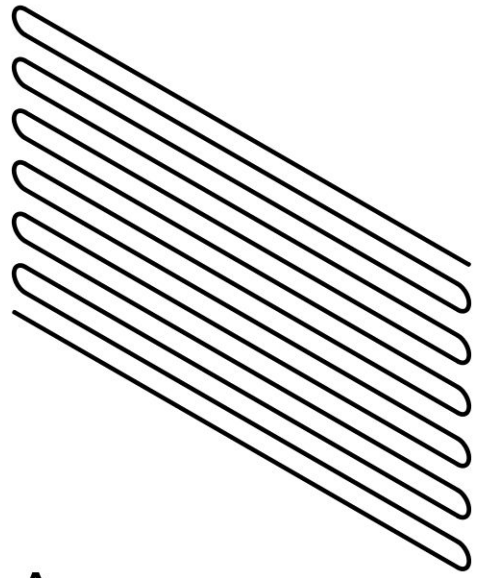
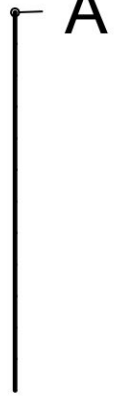
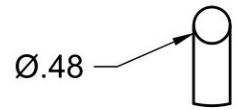
Title
Heating Element Mount

Size	Material	DWG NO	Rev
A	Aluminum Alloy	ME170-TP010	
Scale	Drawn By	Date	Sheet No.
1:1	Phoenix Bauer	11/8/20	1/1





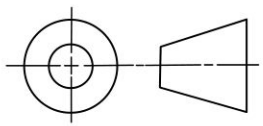




DETAIL A
SCALE 10:1

UNLESS OTHERWISE SPECIFIED
DIM ARE IN MILLIMETERS
TOL ON ANGLES ± 1°
0 PLACE ± 0.25 1 PLACE ± 0.125
INTERPRET DIM AND TOL PER
ASME Y14.5M- 2018

THIRD ANGLE PROJECTION



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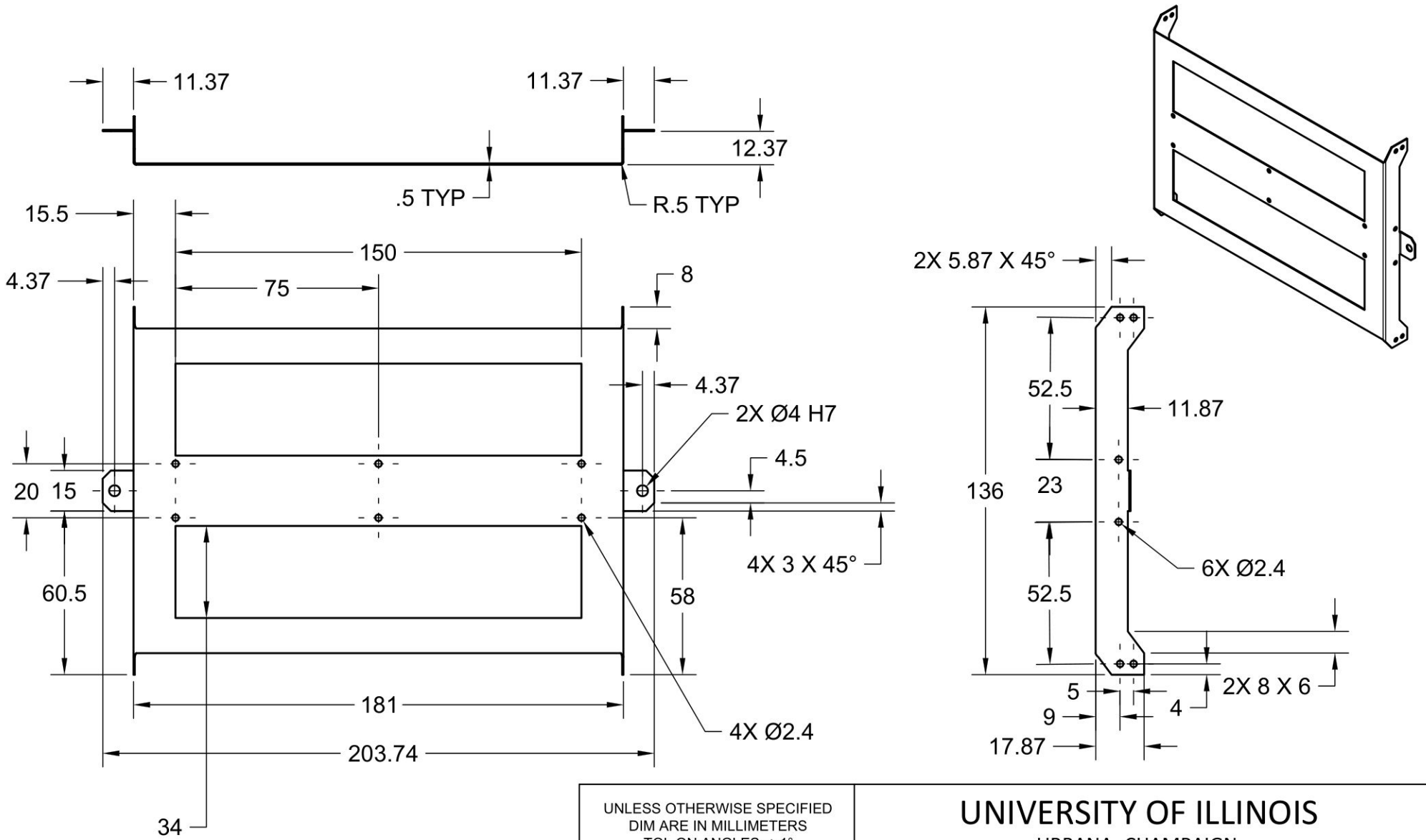
Title: Nichrome Wire Heater

Size	Material	DWG NO	Rev
A			

Scale	Drawn By	Date	Sheet No.
1:2	Matthew Zhang	11/10/2020	1/1



UNLESS OTHERWISE SPECIFIED
DIM ARE IN MILLIMETERS
TOL ON ANGLES ± 1°
0 PLACE ± 0.25 1 PLACE ± 0.125
INTERPRET DIM AND TOL PER
ASME Y14.5M- 2018

THIRD ANGLE PROJECTION

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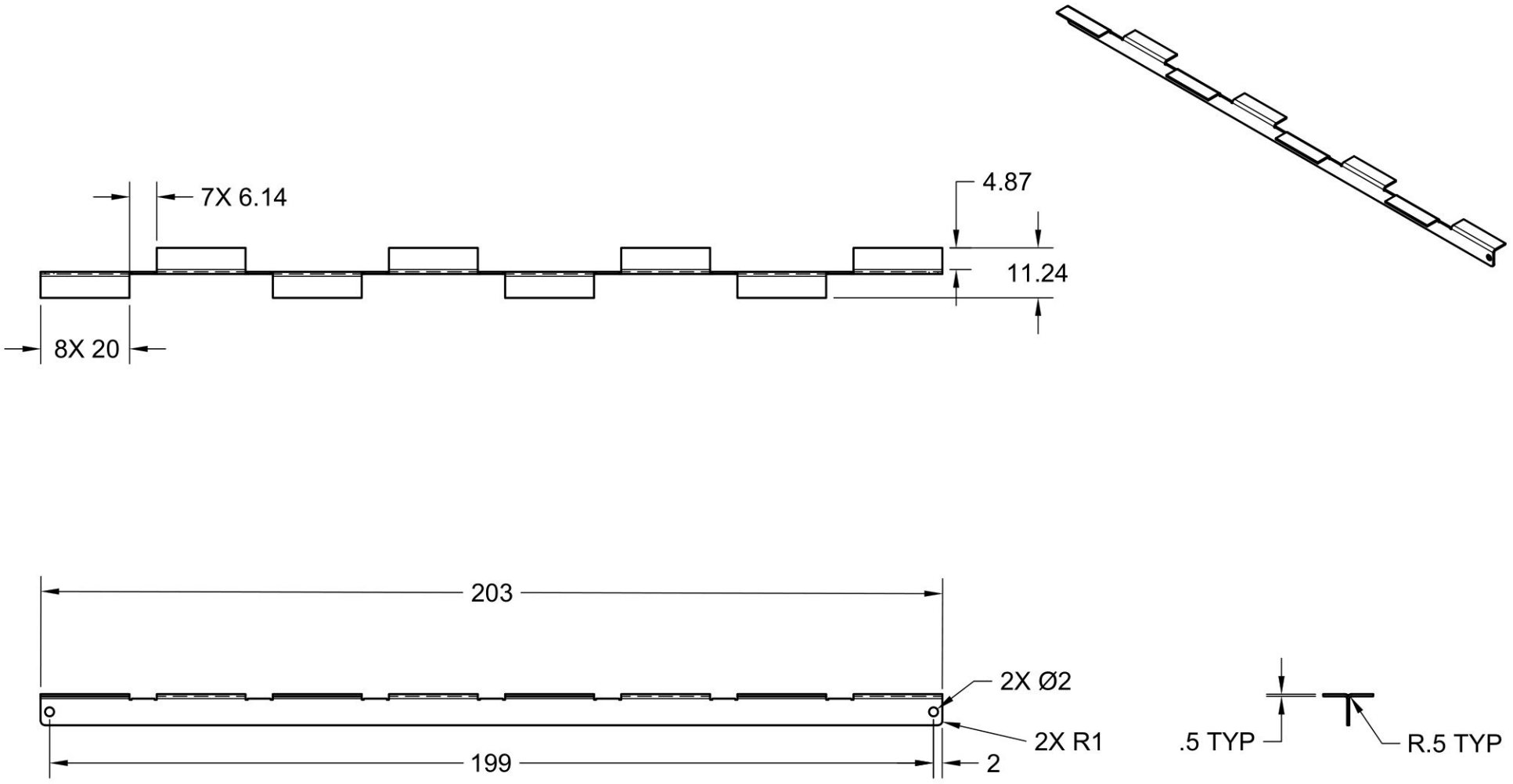
Title: Top Panel

Size	Material	DWG NO	Rev
A			

Scale	Drawn By	Date	Sheet No.
1:3	Matthew Zhang	11/7/2020	1/1



UNLESS OTHERWISE SPECIFIED
DIM ARE IN MILLIMETERS
TOL ON ANGLES ± 1°
0 PLACE ± 0.25 1 PLACE ± 0.125
INTERPRET DIM AND TOL PER
ASME Y14.5M- 2018

THIRD ANGLE PROJECTION

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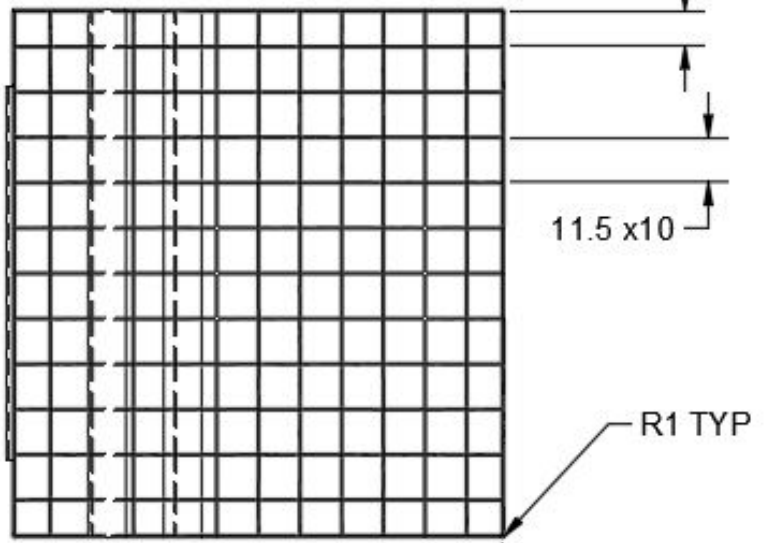
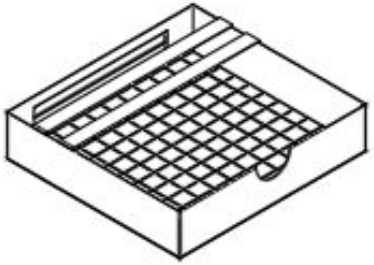
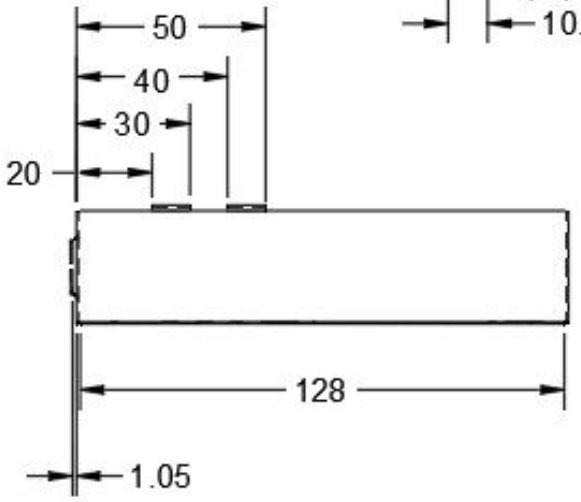
Title: TrayHolder

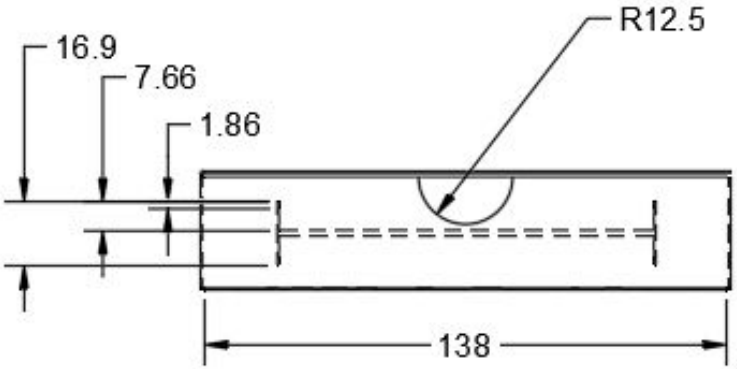
Size	Material	DWG NO	Rev
A			

Scale	Drawn By	Date	Sheet No.
1:2	Keshav Sivaram	11/8/2020	1/1



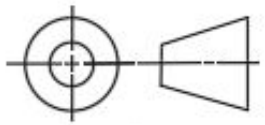






UNLESS OTHERWISE SPECIFIED
DIM ARE IN MILLIMETERS
TOL ON ANGLES ± 1°
0 PLACE ± 0.25 1 PLACE ± 0.125
INTERPRET DIM AND TOL PER
ASME Y14.5M- 2018

THIRD ANGLE PROJECTION



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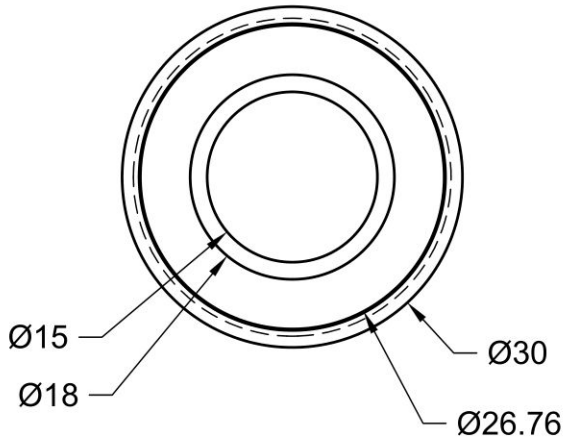
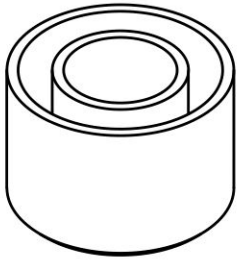
URBANA -CHAMPAIGN

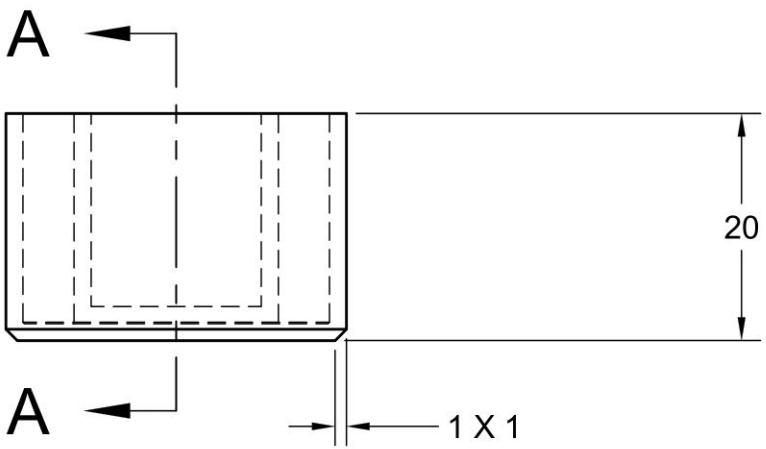
Title
Bread Tray

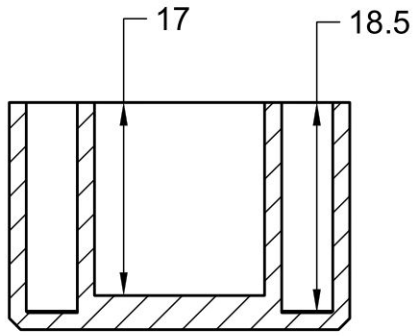
Size	Material	DWG NO	Rev
A			

Scale	Drawn By	Date	Sheet No.
1:4	Patrick Ding	11/11/2020	1/1





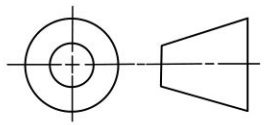




SECTION A-A
SCALE 3:2

UNLESS OTHERWISE SPECIFIED
DIM ARE IN MILLIMETERS
TOL ON ANGLES ± 1°
0 PLACE ± 0.25 1 PLACE ± 0.125
INTERPRET DIM AND TOL PER
ASME Y14.5M- 2018

THIRD ANGLE PROJECTION



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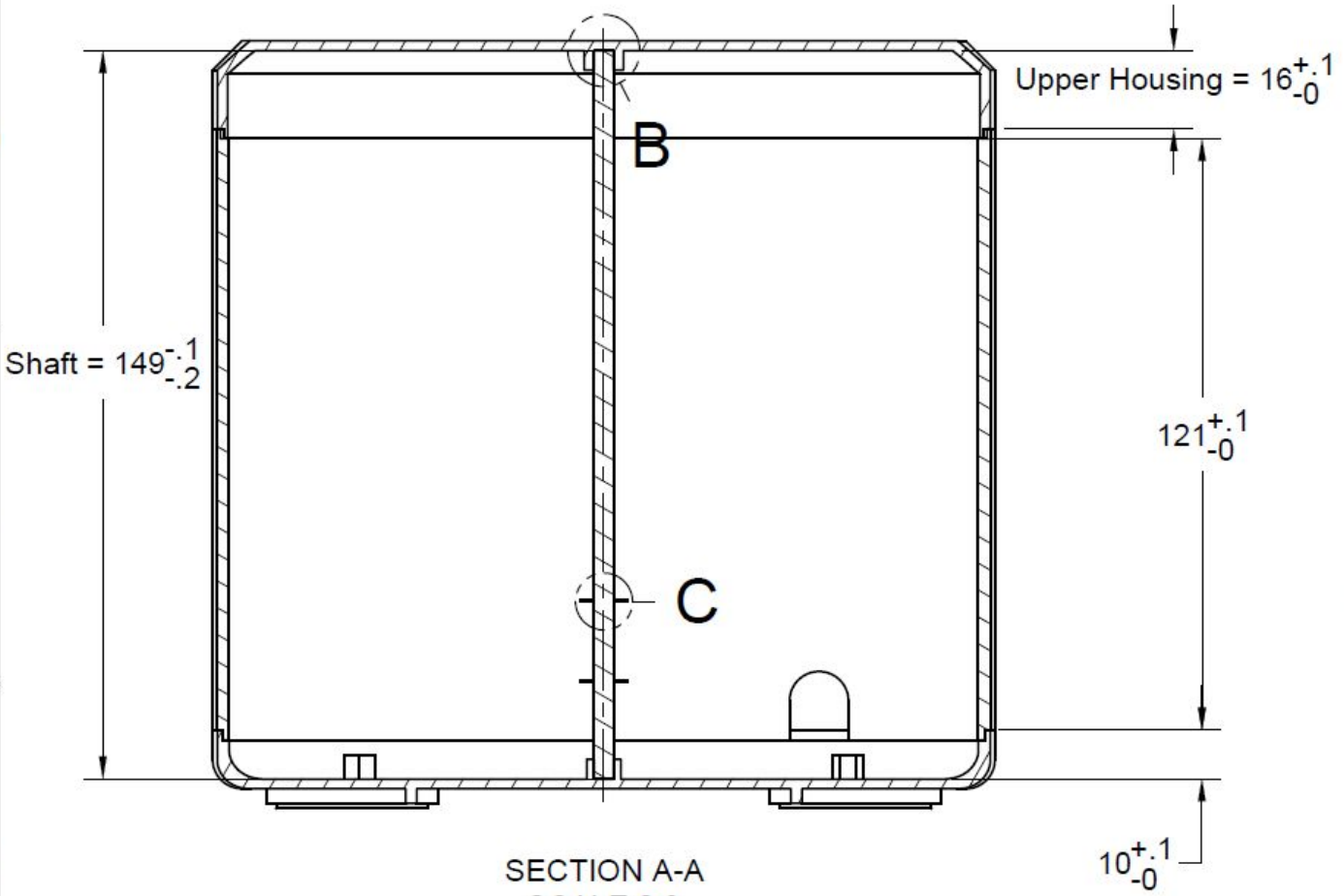
URBANA -CHAMPAIGN

Title: Knob

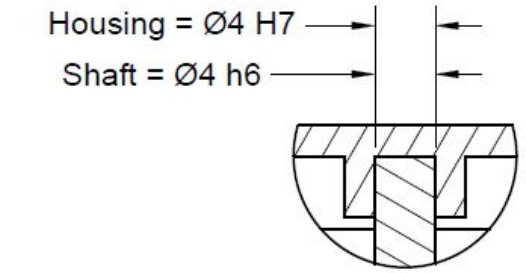
Size	Material	DWG NO	Rev
A			

Scale	Drawn By	Date	Sheet No.
1:1	Matthew Zhang	12/10/2020	1/1

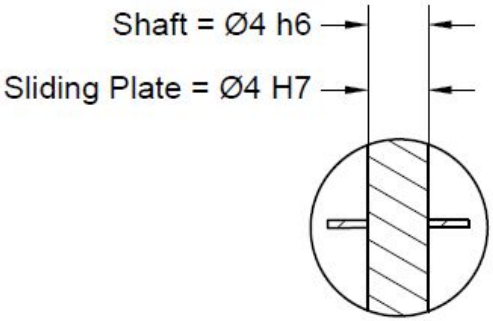
Tolerance Analysis



SECTION A-A
SCALE 2:3



DETAIL B
SCALE 2:1



DETAIL C
SCALE 2:1

Radial Fits

Shaft and Housing

Allowance: 4.012 - 3.992 = .02
Clearance: 4 - 4 = 0

Shaft and Sliding Plate

Allowance: 4.012 - 3.992 = .02
Clearance: 4 - 4 = 0

Axial Fits

Shaft and Housing

Allowance:10.1 + 121.1 + 16.1 - 148.8 = .5
Clearance: 10 + 121 + 16 -148.9 = .1

Narrative:

The parts being put together are a shaft, the housing of the toaster, and a sliding plate that goes up and down with the trays.

The sliding plate and shaft use a H7/h6 clearance fit for a snug but slideable fit.

The shaft and housing axial fit is designed with a much looser clearance fit due to the tolerance build up of the 3 parts of the housing, and for easy assembly.

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Title			
Tolerance Analysis			
Size: A	Drawn By: Matthew Zhang	DWG NO:	Rev:
Scale: 2:3	Date: 12/8/2020		Sheet No.: 1/1

Cost Analysis

Bill of Materials:

Part #	Description	Material and Manufacturing Method (or order details if an off-the-shelf item)	Part Cost (fully burdened and catalog)	Quantity	Total Part Costs	Investment Costs (tooling, fixtures etc)
ME170-TP105	Button	Molded Plastic - ABS : Injection molding - 8 cavity mold	$0.04	1	$0.04	$34,628
ME170-TP102	Top Panel	Sheet Metal - 1020CR steel: Progressive Die stamping	$0.64	1	$0.64	$48,598
ME170-TP101	Frame Bottom Half	Sheet Metal - 1020CR steel: Progressive Die stamping	$1.64	1	$1.64	$70,860
ME170-TP103	Center Panel	Sheet Metal - 1020CR steel: Progressive Die stamping	$1.13	1	$1.13	$62,562
ME170-TP104	Carriage Front Panel	Sheet Metal - 1020CR steel: Progressive Die stamping	$0.10	2	$0.20	$28,039
ME170-TP004	Outer Shell	Molded Plastic - ABS: Injection Molding - 8 cavity mold	$1.04	1	$1.04	$117,172
ME170-TP003	Bottom Shell	Molded Plastic - ABS: Injection Molding - 8 cavity mold	$0.70	1	$0.70	$88,049
ME170-TP001	Feet	Molded Plastic - Nylon: Injection Molding 16 cavity mold	$0.04	4	$0.16	$13,174
ME170-TP106	Heating Element Mount	Sheet Metal - 1020CR steel: Progressive Die stamping	$0.06	12	$0.72	$26,135
ME170-TP107	Tray Holder	Sheet Metal - 1020CR steel: Progressive Die stamping	$0.11	2	$0.22	$26,894
ME170-TP002	Toaster Lid	Molded Plastic- ABS: Injection Molding- 4 cavity mold	$0.47	1	$0.47	$37,124
ME170-TP005	Knob	Molded Plastic - ABS: Injection Molding - 8 cavity mold	$0.05	1	$0.05	$18,841
ME170-TP108	Bread Tray	Sheet Metal - 1020CR steel: Progressive Die stamping	$0.43	2	$0.86	$36,472
8880K82	Nichrome Wire Heating Element	Nichrome Wire (https://www.mcmaster.com/8880K82/)	$0.10	4	$0.39	N/A
6112K34	Linear Motion Shaft	4mm Steel Shaft (https://www.mcmaster.com/6112K34/)	$2.71	2	$5.41	N/A
91290A012	6mm M2 Screws	https://www.mcmaster.com/91290A012/	$0.05	49	$2.27	N/A
				TOTALS	**$15.95**	**$608,548.34**

Narrative:
None of the parts in this product are particularly difficult to manufacture, as the internals are made of sheet metal, and the outer casing, which is made from ABS plastic has no overhangs which would be hard to injection mold. This bill of materials also does not include electronics or cost of assembly.

Note: The bill of materials does not cover the cost of electronics and springs, so the actual cost of materials will be greater than the value given here.

Conclusion

Overall, the Breadwinner is an innovation on the already well known toaster. In regards to its market viability, its ability to return a profit would completely rely on how effective the heat retention of the trays is, which would only come from real world testing and analysis. Taking into account the heat retention that would make the Breadwinner special, and its aesthetics and construction, as long as the cooking times could be cut by 10-20%, the Breadwinner could be put onto the market. With the estimated costs of materials of about $16, even doubling this to account for assembly and electronics, the toaster could be sold at around $40-$50 due to its selling points as a mid to high end toaster. The risk of investing into the tooling needed to manufacture the Breadwinner is a sizable $608,548.34, due to the number of custom molds we would need.

The final verdict is that the Breadwinner is a medium risk product in terms of investment, but has the potential to do well on the market.

Breadwinner®