

Major Assembly 1:

Team Element Hub – Complex Version

TE-22100 & TE-22100-AM

This document includes an overview of the Complex version of the Team Element Hub, a shopping list for needed materials, and cut sheets referenced by FIRST in the creation of the shopping list.

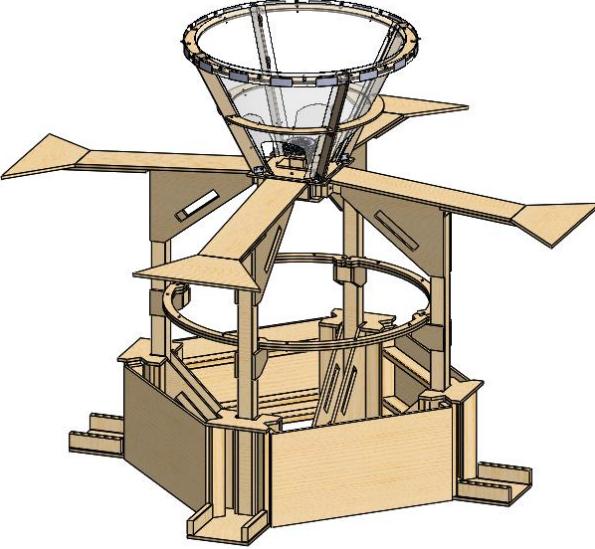
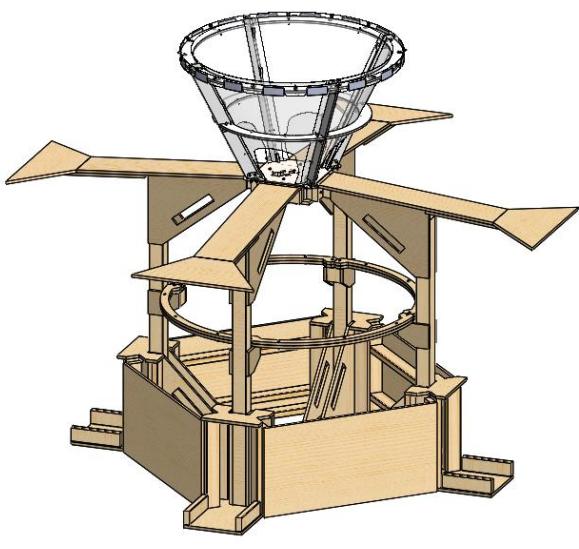
- The Team Element Hubs create key geometries that are found on the 2022 Rapid React Field
- There are 2 categories of Team Element Hubs for teams to choose from – Complex and Simple.
- AndyMark sells a few different field elements that can integrate into the Simple or Complex Hubs
 - AM-4671 – Upper Hub -> Complex Build
 - AM-4672 – Upper Hub Vision Ring -> Simple Build
 - AM-4673 – Passive Agitator -> Complex Build
 - AM-4674 – Active Agitator -> Complex Build

1 OVERVIEW OF TEAM ELEMENT HUB – COMPLEX

The Hub – Complex Build has 2 major assemblies, each with the option to add various types of Agitators.

Complex Build: TE-22100 – Wooden Upper Hub

Complex Build TE-22100-AM – AndyMark's Production Upper Hub

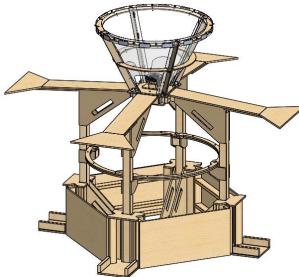
TE-22100 HUB - Complex Build - Full Hub Assembly		Represents all key features from the Field, including an entire Upper Hub, full Upper Hub Vision Ring, a passive Agitator, four Upper Exits, a full Lower Hub top ring, four Fenders, and four Lower Exits. AndyMark's AM-4673 (Active) or AM-4674 (Passive) Agitators can be installed into this Assembly.
TE-22100-AM HUB - Complex Build - Full Hub Assembly with AndyMark Upper Hub AM-4671 Note: Team will need to purchase AM-4671 from AndyMark for this assembly.		Represents all key features from the Field, including AndyMark's AM-4671 Upper Hub, four Upper Exits, a full Lower Hub top ring, four Fenders, and four Lower Exits. AndyMark's AM-4673 (Active) or AM-4674 (Passive) Agitators can be installed into this Assembly.

1.1 FILES INCLUDED IN TEAM ELEMENT HUB - COMPLEX

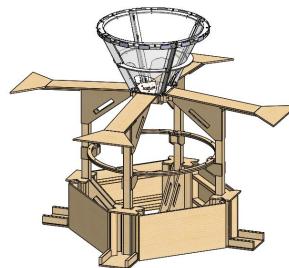
In this compressed folder, you will find all the PDF Drawings, SolidWorks CAD and Drawing Files, and STEP Files for these designs.

- PDF Drawings: For your convenience, all drawing files have been exported to PDF Format. There is one combined PDF File for TE-22100 and one combined PDF File for TE-22100-AM.
- SolidWorks CAD Files: All SolidWorks files required to build or modify the assembly.
- STEP Files: STEP files of the assembly are included for the convenience of non-SolidWorks users.

1.2 Shopping List for TE-22100 and TE-22100-AM



OR



1.2.1 MATERIAL NOTES

- Plywood and Hardboard Sheets – quality of plywood is up to the user. Plywood of lower qualities may contain voids and may warp more than high quality plywood. All dimensions listed are “nominal”. For example $\frac{1}{2}$ ” plywood is typically $15/32$ ”.
- Lumber - quality of lumber is up to the user. Please keep in mind that lumber of lower qualities may warp more than high quality lumber. All dimensions below are the “mill cut” dimensions. For example, 2” x 4” lumber is really $1\frac{1}{2}$ ” x $3\frac{1}{2}$ ”.
- Wood screw quantities are approximate and should account for having spares left over.
- A small number of spare cable ties, bolts, washers, and nuts are accounted for in total quantities.

1.2.2 MATERIALS NEEDED

General Material:

- 2” x 4” x 8’ Long Lumber – Qty 14
- 4” x 4” x 8’ Long Lumber – Qty 8
- 4’ x 8’ x $\frac{3}{4}$ ” Thick Plywood – Qty 6
- $\frac{1}{2}$ ” Plywood – Qty 1
 - This can be omitted if building TE-22100-AM and using AndyMark’s Upper Hub (AM-4671)
- 1/8” Polycarbonate – Qty 2
 - This can be omitted if building TE-22100-AM and using AndyMark’s Upper Hub (AM-4671)
- 1 $\frac{1}{2}$ ” x 1 $\frac{1}{2}$ ” x 1/16” thick x 8’ Long Aluminum Angle – Qty 1
 - This can be omitted if building TE-22100-AM and using AndyMark’s Upper Hub (AM-4671)
- $\frac{1}{2}$ ” Hex Shaft – ~8” Length Needed
 - This can be omitted if using AndyMark’s Active (AM-4674) or Passive (AM-4673) Agitator
- $\frac{1}{2}$ ” Schedule 40 PVC Pipe (or equivalent length of Hex Spacer) - ~2” Length Needed

- This can be omitted if using AndyMark's Active (AM-4674) or Passive (AM-4673) Agitator

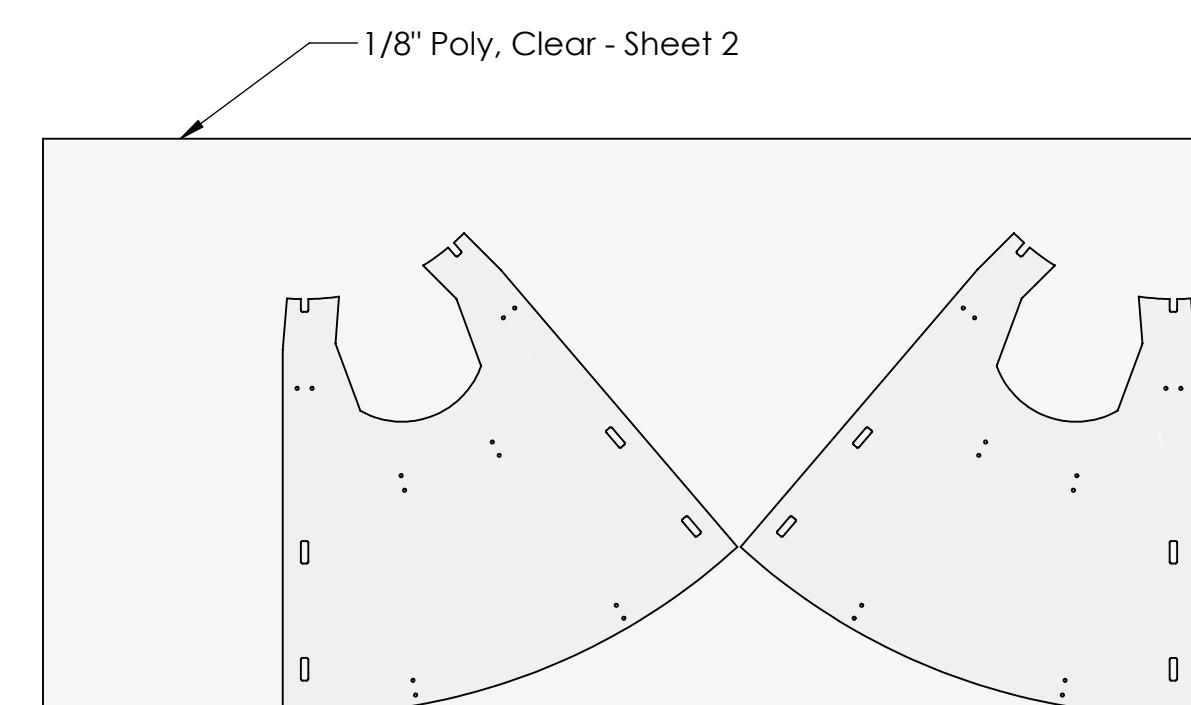
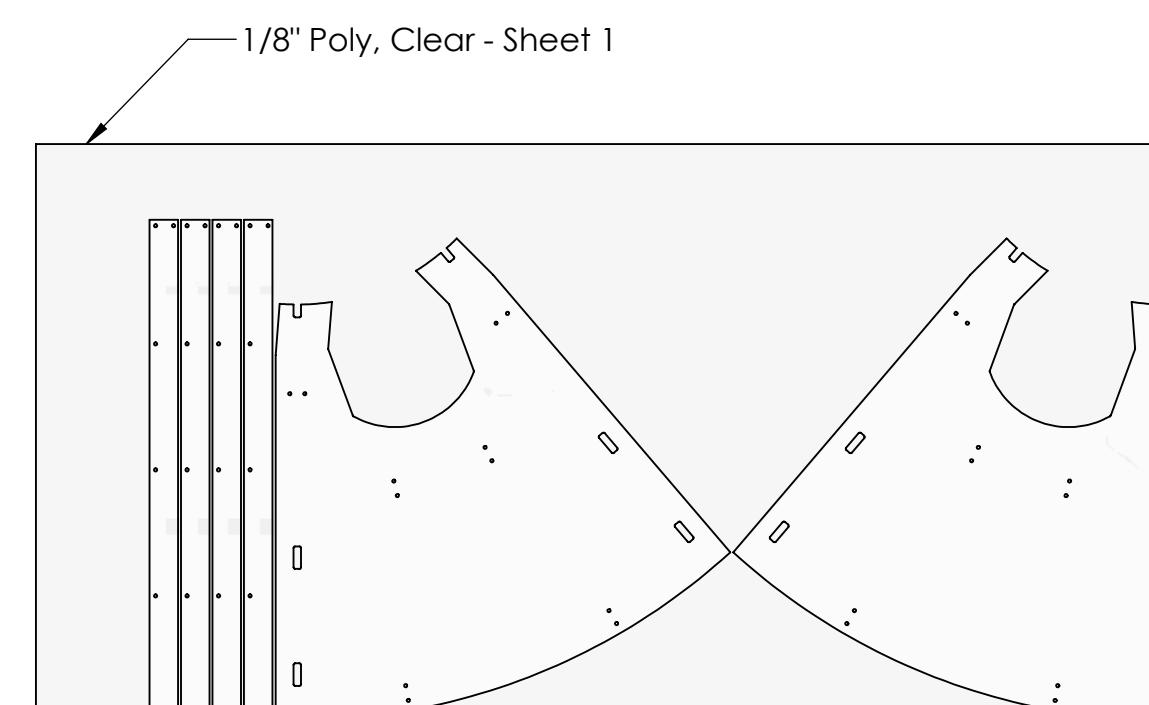
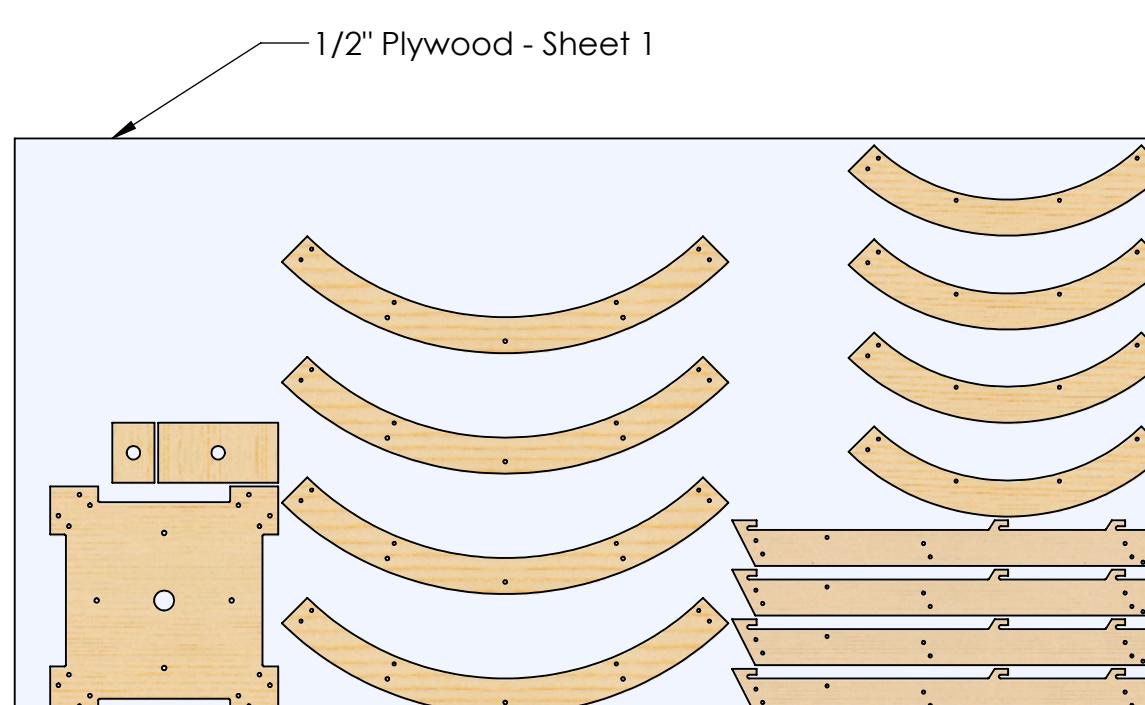
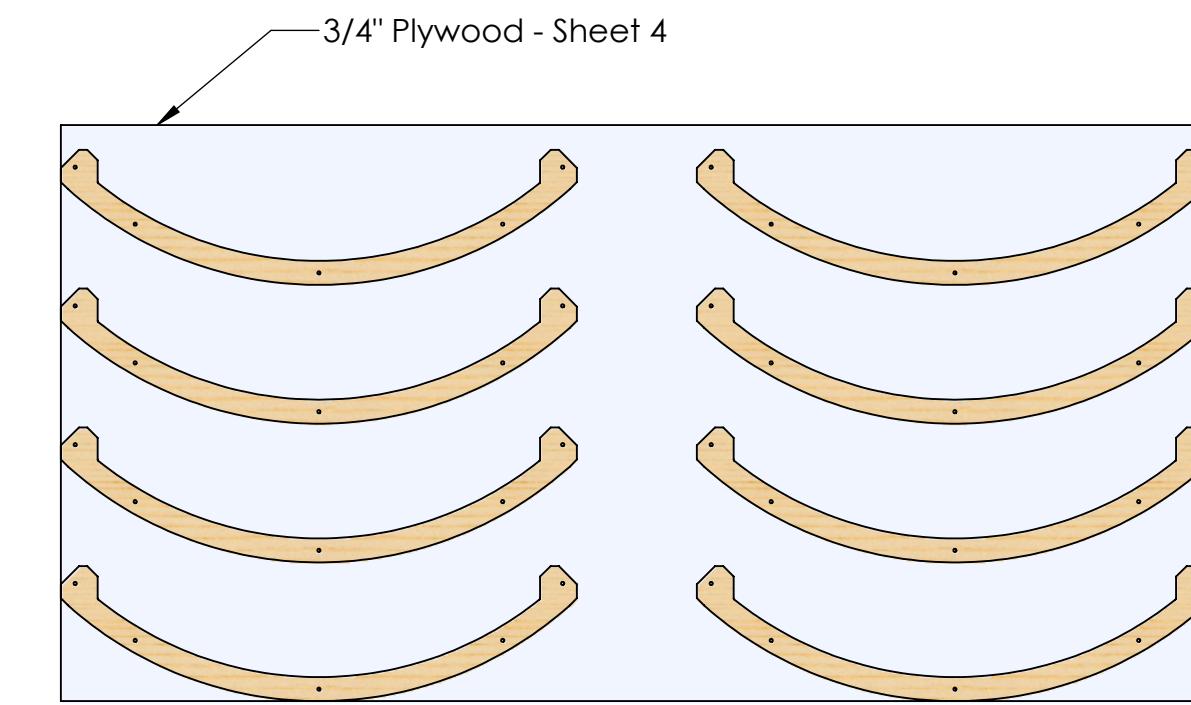
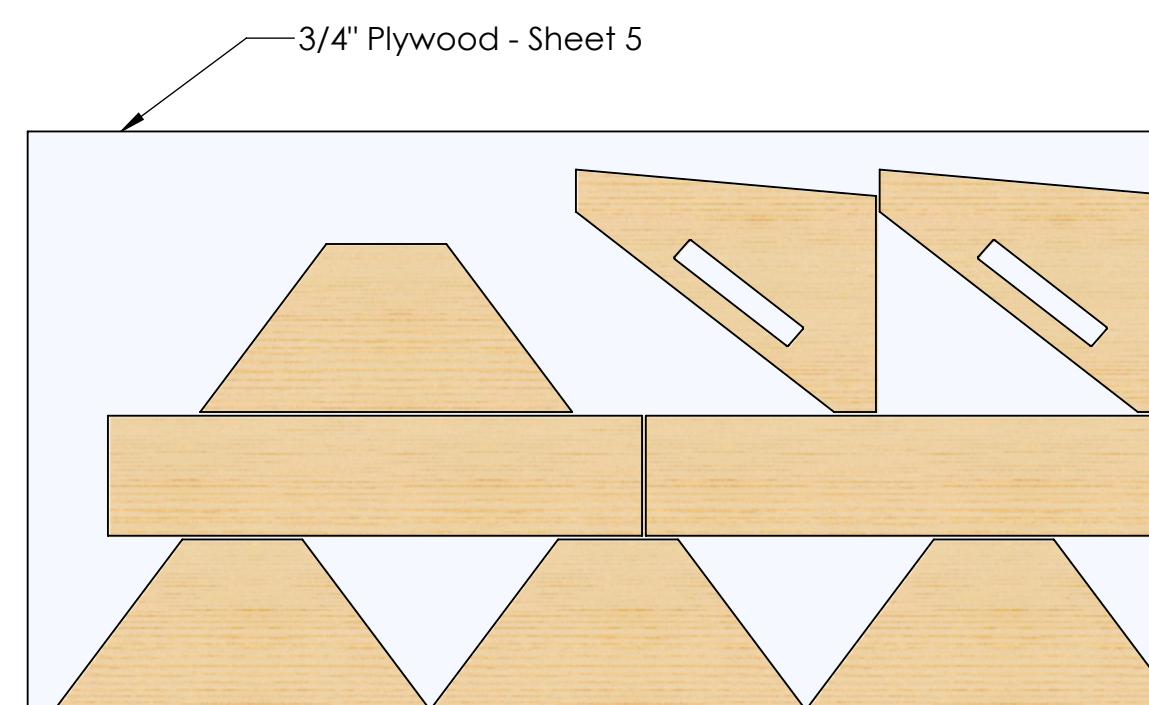
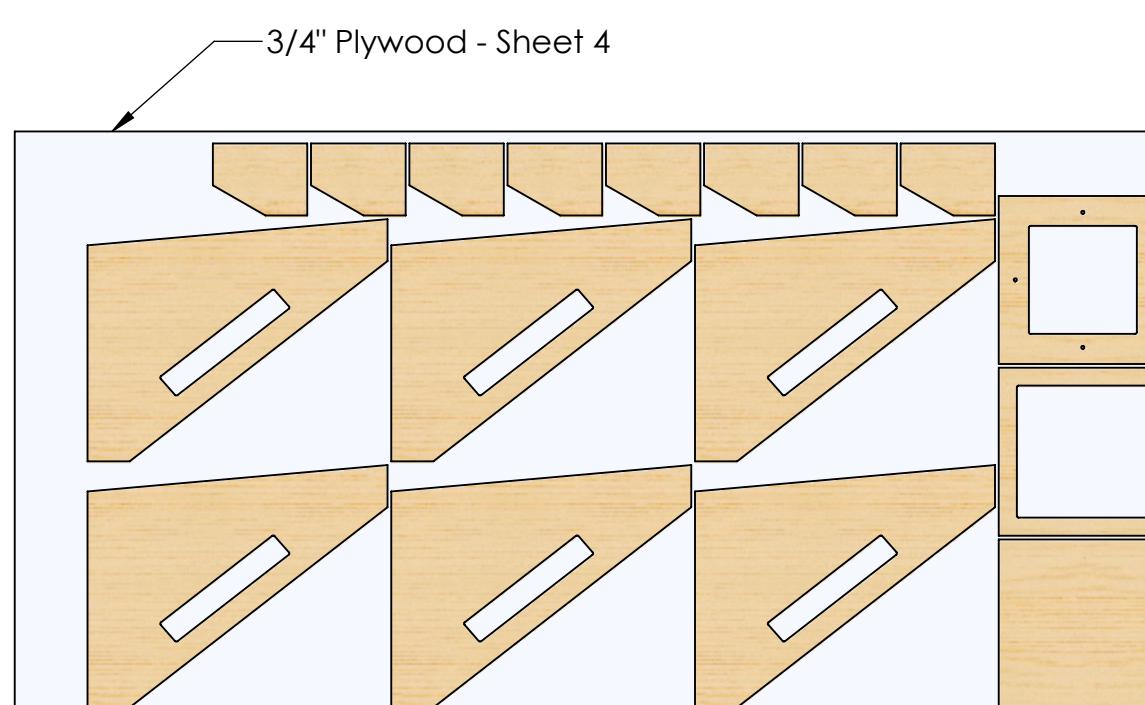
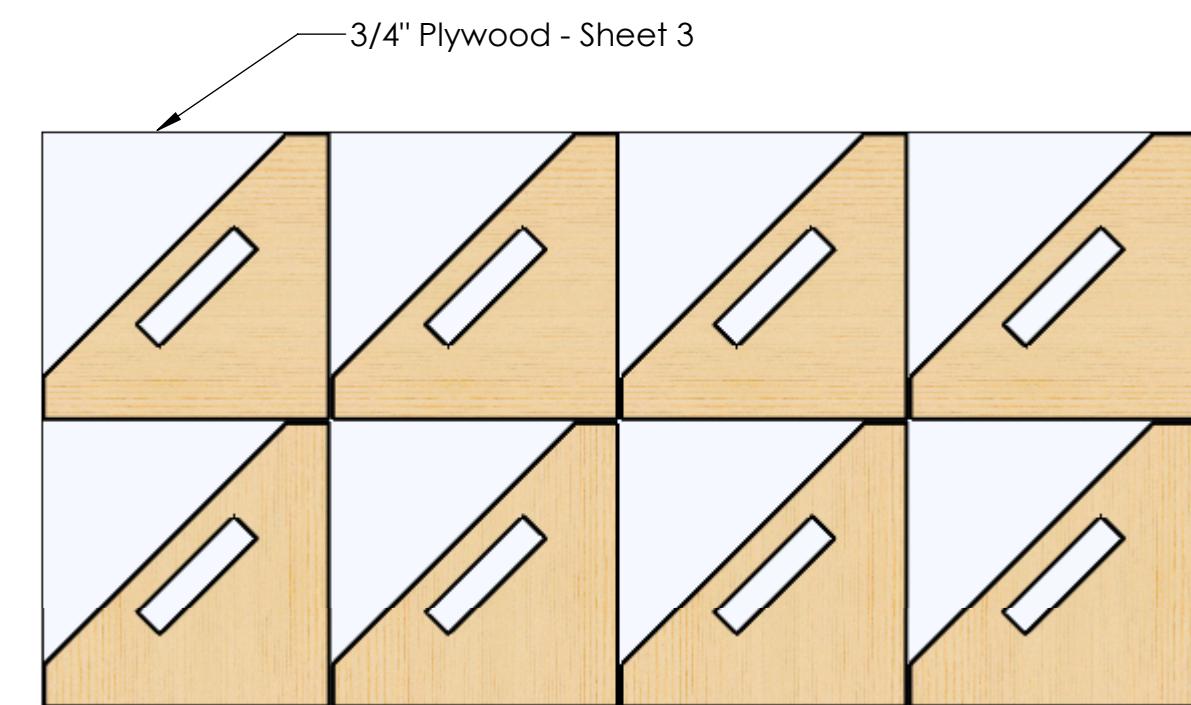
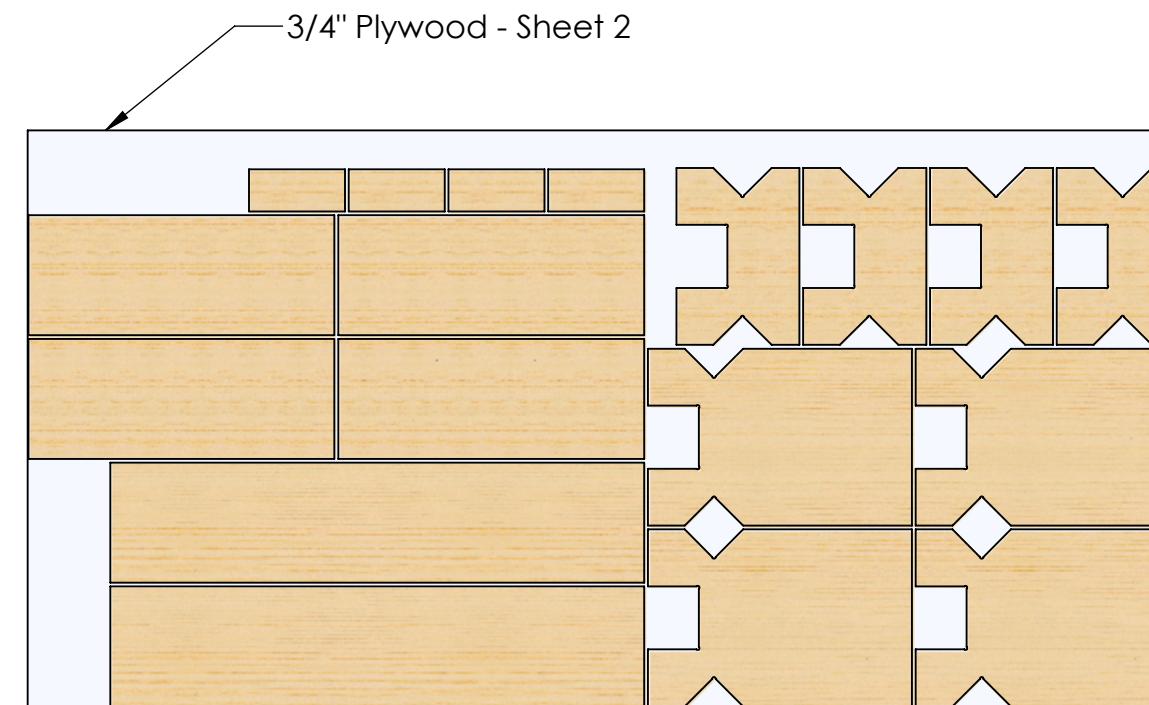
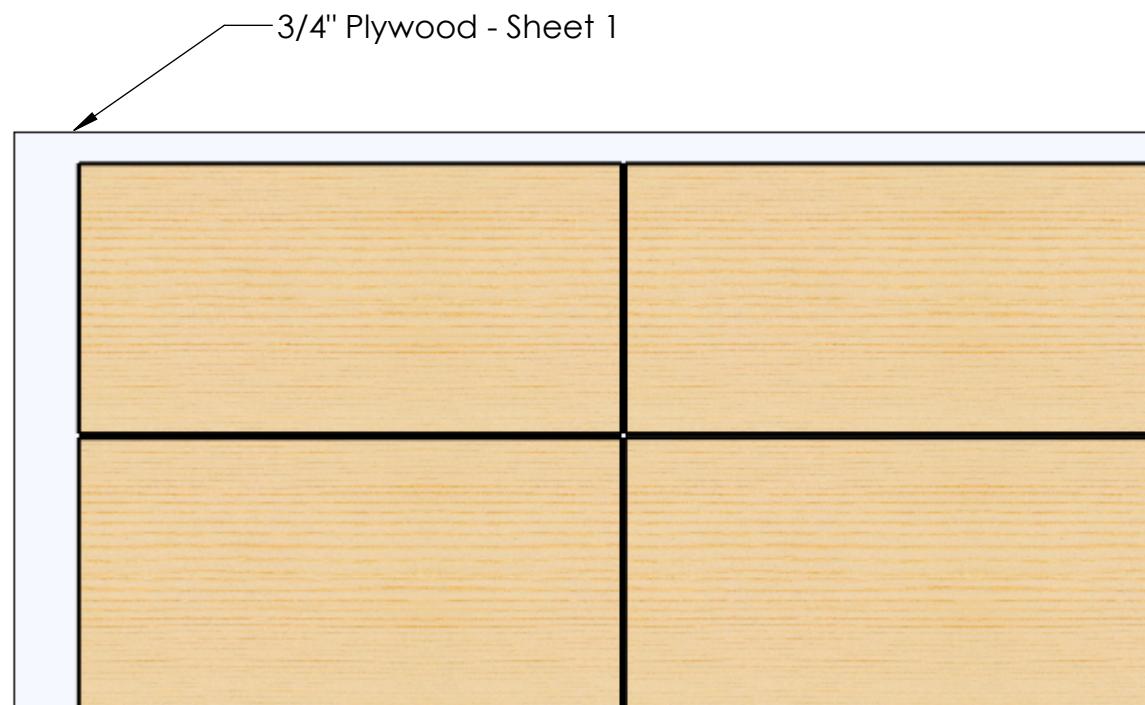
Hardware:

- 10-32 Nylock – Qty 6
 - This can be omitted if using AndyMark's Active (AM-4674) or Passive (AM-4673) Agitator
- 10-32 x 2" Socket Head Screw – Qty 6
 - This can be omitted if using AndyMark's Active (AM-4674) or Passive (AM-4673) Agitator
- ¼"-20 x ¾" Bolt, Fully Threaded – Qty 15
 - This can be omitted if building TE-22100-AM and using AndyMark's Upper Hub (AM-4671)
- ¼"-20 x 1" Bolt, Fully Threaded – Qty 90
 - This can be omitted if building TE-22100-AM and using AndyMark's Upper Hub (AM-4671)
- ¼"-20 x 2" Bolt, Fully or Partially Threaded - Qty 20
- ¼"-20 x 3.5" Bolt, Fully or Partially Threaded – Qty 10
- ¼-20 x 5.5" Bolt, Fully or Partially Threaded – Qty 8
- ¼" Washer – Qty 130
 - Note: Some number of washers can be omitted if using AndyMark's Upper Hub (AM4671)
- ¼" Nylock – Qty 130
 - Note: Some number of Nylock can be omitted if using AndyMark's Upper Hub (AM4671)
- #8 Wood Screw x 1" Long – Qty 4
- #8 Wood Screw x 1.25" Long – Approximately ½ lb.
- #8 Wood Screw x 2" Long – Approximately 3 lbs.
- #8 Wood Screw x 2.5" Long – Approximately 1 ½ lbs.

Misc. Items:

- 8in. Pneumatic Wheel (AM-0970) – Qty 1
 - This can be omitted if using AndyMark's Active (AM-4674) or Passive (AM-4673) Agitator
- ½" Hex Shaft Collar (AM-1526) – Qty 2
 - This can be omitted if using AndyMark's Active (AM-4674) or Passive (AM-4673) Agitator
- ½" Hex Hub (for Pneumatic Wheel) (AM-4124) – Qty 1
 - This can be omitted if using AndyMark's Active (AM-4674) or Passive (AM-4673) Agitator
- ½" Flanged Hex Bearing – Qty 2
 - This can be omitted if using AndyMark's Active (AM-4674) or Passive (AM-4673) Agitator
- 50-lb Cable Tie – Qty 25
 - This can be omitted if building TE-22100-AM and using AndyMark's Upper Hub (AM-4671)
- 2" wide 3M 8830 Scotchlite Reflective Material – 80"
- 0.266" Diameter (Drill size H or #71) Drill Bit
- 5/16" Diameter x 4" (minimum) Depth Drill Bit (for drill through 4" x 4" lumber)
- 3/8" Diameter Drill Bit
- 1 1/8" Spade Bit, Forstner Bit, or Hole Saw (for drilling a hole for a ½" Hex bearing)
- Optional: Safety Edging such as Pool Noodles or Baby Proofing Material

Optional: Wood Staples



Notes:

- Provided layouts show boxed-out cuts, meaning a rectangle can be drawn around a part without intersecting with another part's rectangle. More efficient layouts may exist at the cost of complexity.
- Parts are spaced 5/16" apart to ensure gap for blade thickness or other cutting tool.
- These cuts reflect how we specified material usage on the shopping list.
- Plywood grain has been considered in layouts.
- Dimensions provided are for reference. See the drawing for each part for most accurate dimensions.
- Parts that can be omitted if building TE-22100-AM are noted on following sheets.

UNLESS OTHERWISE SPECIFIED:	TEAM	NAME	DATE
	DRAWN	KAMC	12/15/2021
PROPRIETARY AND CONFIDENTIAL			
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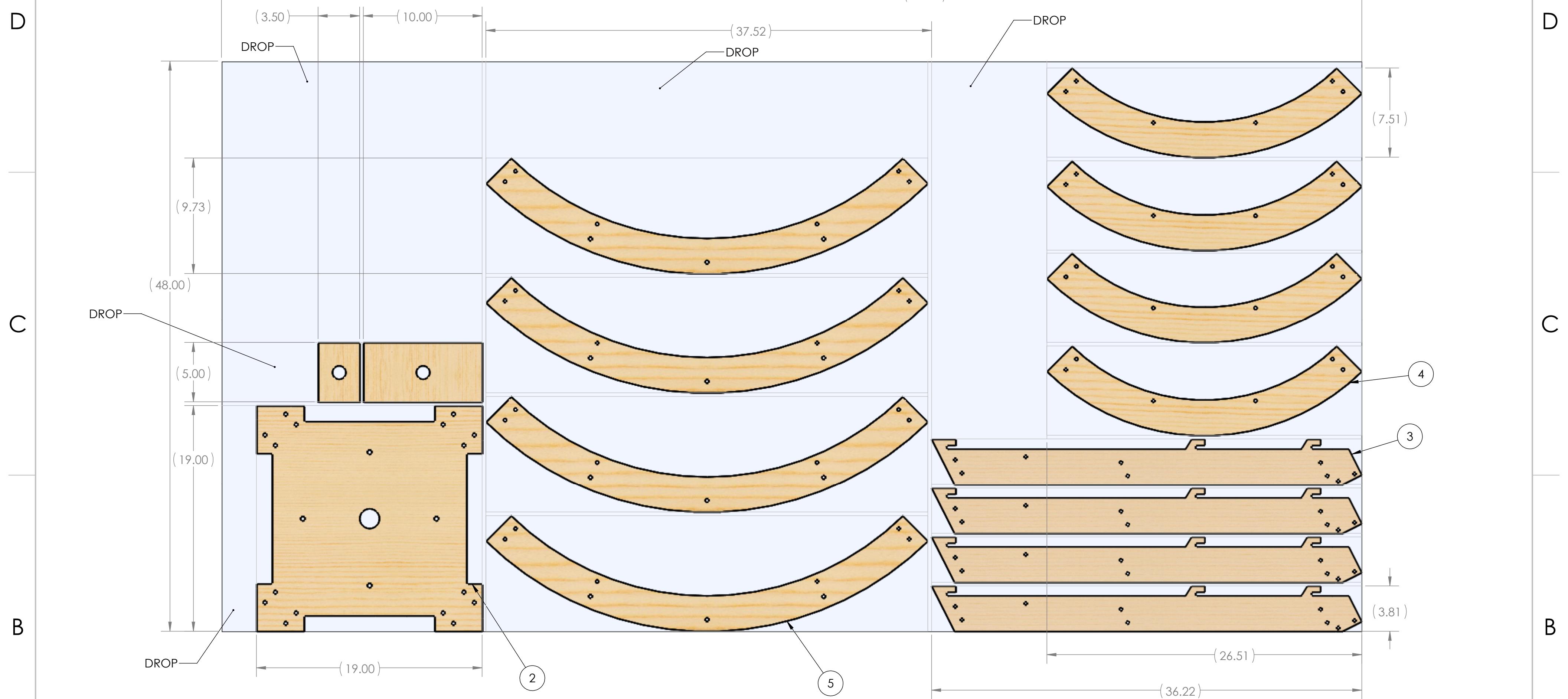
FIRST ROBOTICS COMPETITION SOLIDWORKS Modeling Solutions Partner

Complex Sheet Cut

C Sheet Cuts

SIZE DWG. NO. REV

SCALE: 1:16 SHEET 1 OF 10



Note: This sheet is not needed if build TE-22100-AM.

1/2" Plywood - Sheet 1

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	4ft x 8ft Sheet		1
2	TE-22191	Hub - Complex Build - Upper Hub Base	1
3	TE-22192	Hub - Complex Build - Upper Hub Vertical Support	4
4	TE-22193	Hub - Complex Build - Upper Hub Lower Ring	4
5	TE-22194	Hub - Complex Build - Upper Hub Upper Ring	4
6	TE-22212	Hub - Complex Build - Passive Agitator Top	1
7	TE-22215	Hub - Complex Build - Passive Agitator Bottom	1

Note:

TE-22191 is shown here as item (2). You may wish to use TE-22191-AMActive or TE-22191-AMPassive, based on the type of agitator you are using.

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DIMENSIONS ARE IN INCHES	DRAWN	KAMC	12/15/2021
TOLERANCES: FRACTIONAL $\pm 1/16$	PROPRIETARY AND CONFIDENTIAL		
ANGULAR: MACH $\pm 1^\circ$ BEND $\pm 1^\circ$	THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF FIRST. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF FIRST IS PROHIBITED.		
TWO PLACE DECIMAL $\pm .13$	SIZE DWG. NO. REV		
THREE PLACE DECIMAL $\pm .125$	C Sheet Cuts		
MATERIAL/FINISH: 1/2" Plywood (nominally 15/32" thick)	COMMENTS: REMOVE ALL BURRS AND SHARP EDGES.		
DO NOT SCALE DRAWING			

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Complex Sheet Cut

C Sheet Cuts

SCALE: 1:6 SHEET 2 OF 10

4

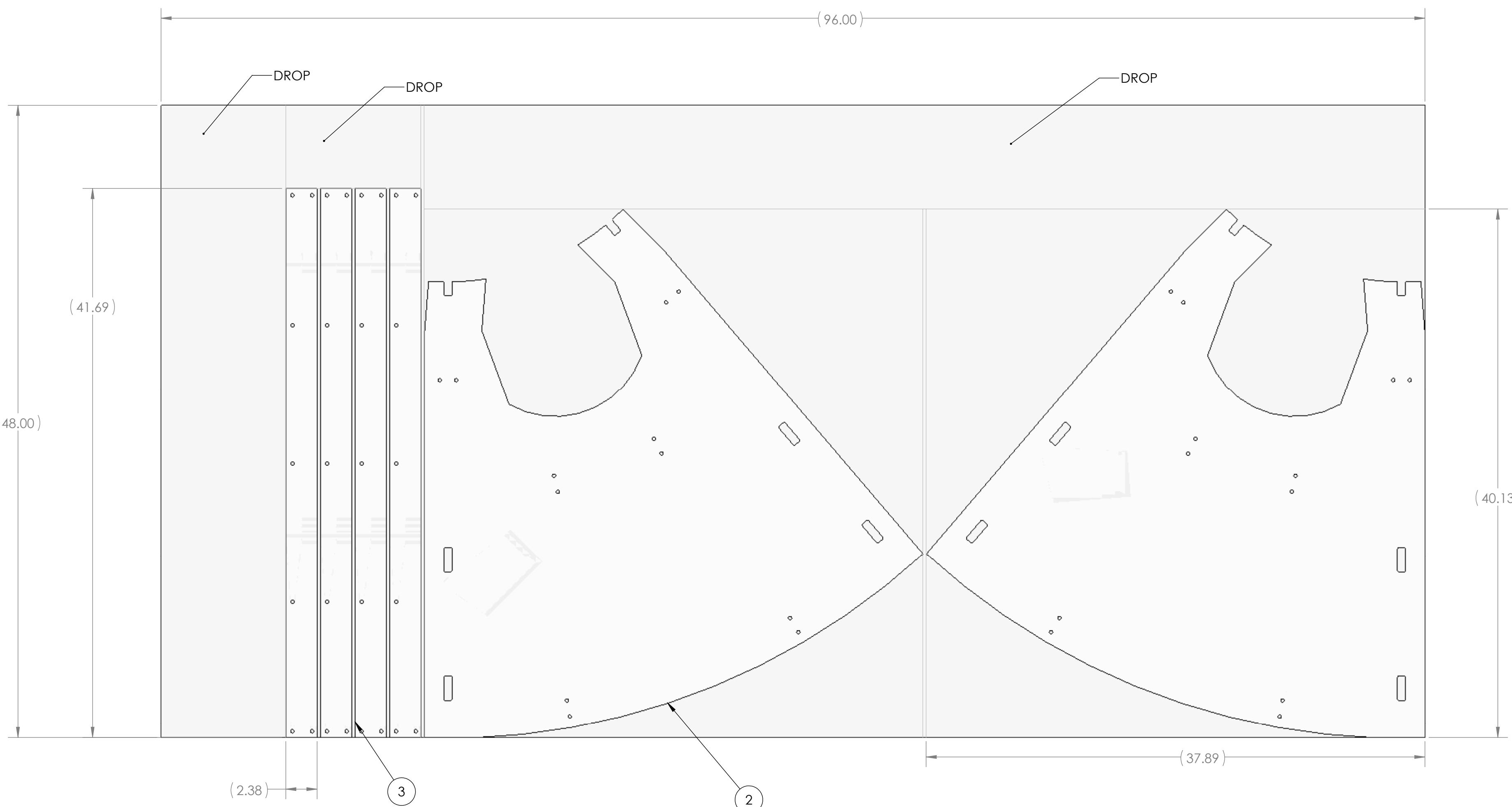
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1/8" Poly, Clear - Sheet 1

Note: This sheet is not needed if build TE-22100-AM.

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	4ft x 8ft Sheet		1
2	TE-22197	Hub - Complex Build - Upper Hub Plastic	2
3	TE-22201	Hub - Complex Build - Upper Hub Vision Ring Plastic	4

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MATERIAL/FINISH: 1/8" Polycarbonate, Clear			
COMMENTS: REMOVE ALL BURRS AND SHARP EDGES.			
DO NOT SCALE DRAWING			
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SIZE DWG. NO. REV			
C Sheet Cuts			
SCALE: 1:6 SHEET 3 OF 10			

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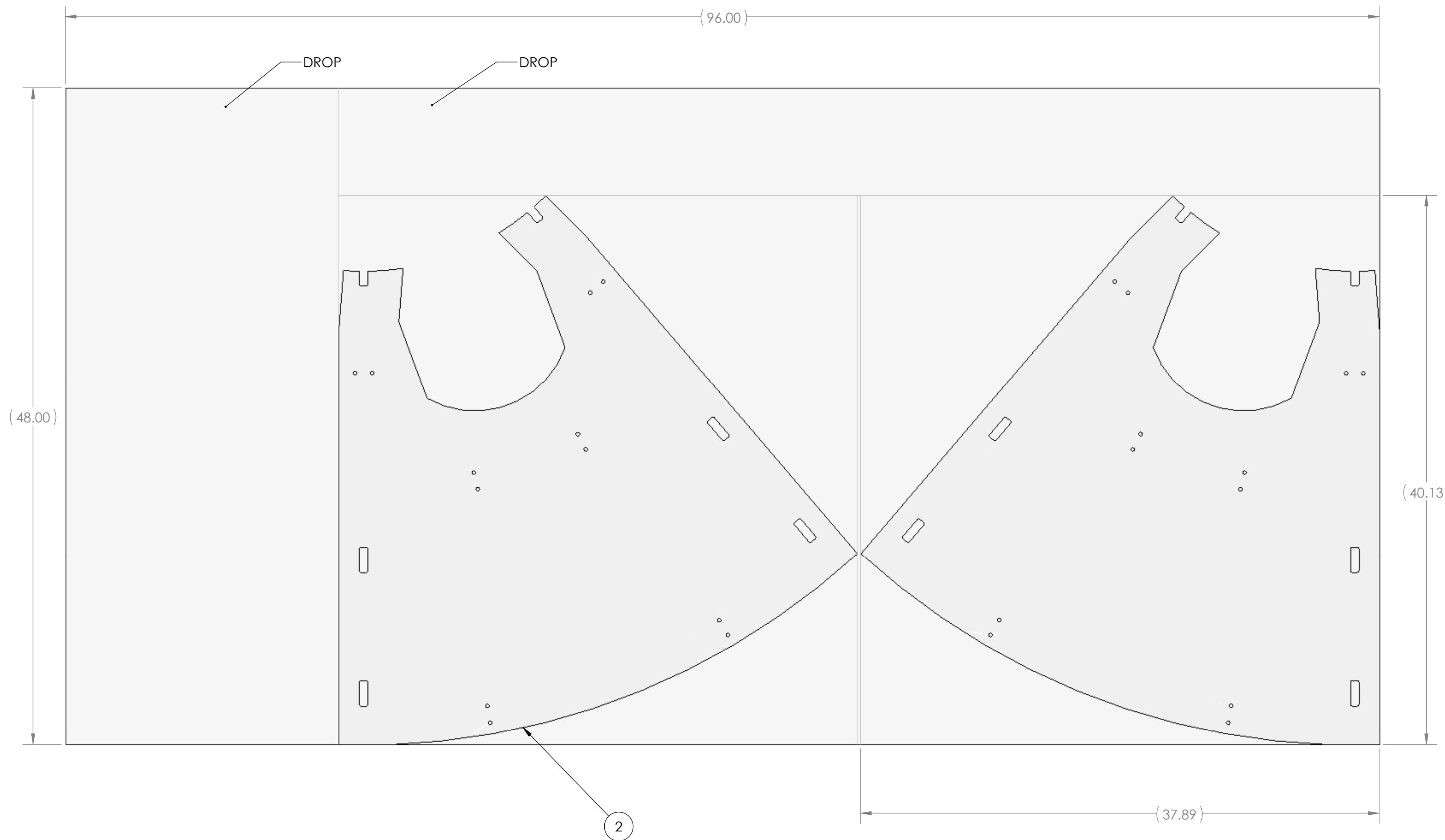
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1/8" Poly, Clear - Sheet 2

Note: This sheet is not needed if build TE-22100-AM.

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	4ft x 8ft Sheet		1
2	TE-22197	Hub - Complex Build - Upper Hub Plastic	2

UNLESS OTHERWISE SPECIFIED:	TEAM	NAME	DATE
DIMENSIONS ARE IN INCHES	DRAWN	KAMC	12/15/2021
TOLERANCES: FRACTIONAL $\pm 1/16$ ANGULAR: MACH $\pm 1^\circ$ BEND $\pm 1^\circ$	PROPRIETARY AND CONFIDENTIAL		
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MATERIAL/FINISH:	1/8" Polycarbonate, Clear		
COMMENTS: REMOVE ALL BURRS AND SHARP EDGES.			
DO NOT SCALE DRAWING			

FIRST ROBOTICS COMPETITION Modeling Solutions Partner

Complex Sheet Cut

C Sheet Cuts

SCALE: 1:6 SHEET 4 OF 10

D



3/4" Plywood - Sheet 1

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	4ft x 8ft Sheet		1
2	TE-22131	HUB - Complex Build - Fender Front Face	4

UNLESS OTHERWISE SPECIFIED:	TEAM	NAME	DATE
DIMENSIONS ARE IN INCHES	DRAWN	KAMC	12/15/2021
TOLERANCES: FRACTIONAL $\pm 1/16$ ANGULAR: MACH $\pm 1^\circ$ BEND $\pm 1^\circ$	PROPRIETARY AND CONFIDENTIAL		
TWO PLACE DECIMAL $\pm .13$ THREE PLACE DECIMAL $\pm .125$	THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF FIRST. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF FIRST IS PROHIBITED.		
MATERIAL/FINISH: 3/4" Plywood (nominally 23/32" thick)	COMMENTS: REMOVE ALL BURRS AND SHARP EDGES.		
DO NOT SCALE DRAWING			
TITLE:		SIZE DWG. NO. REV	
C Complex Sheet Cut		Sheet Cuts	
SCALE: 1:6		SHEET 5 OF 10	

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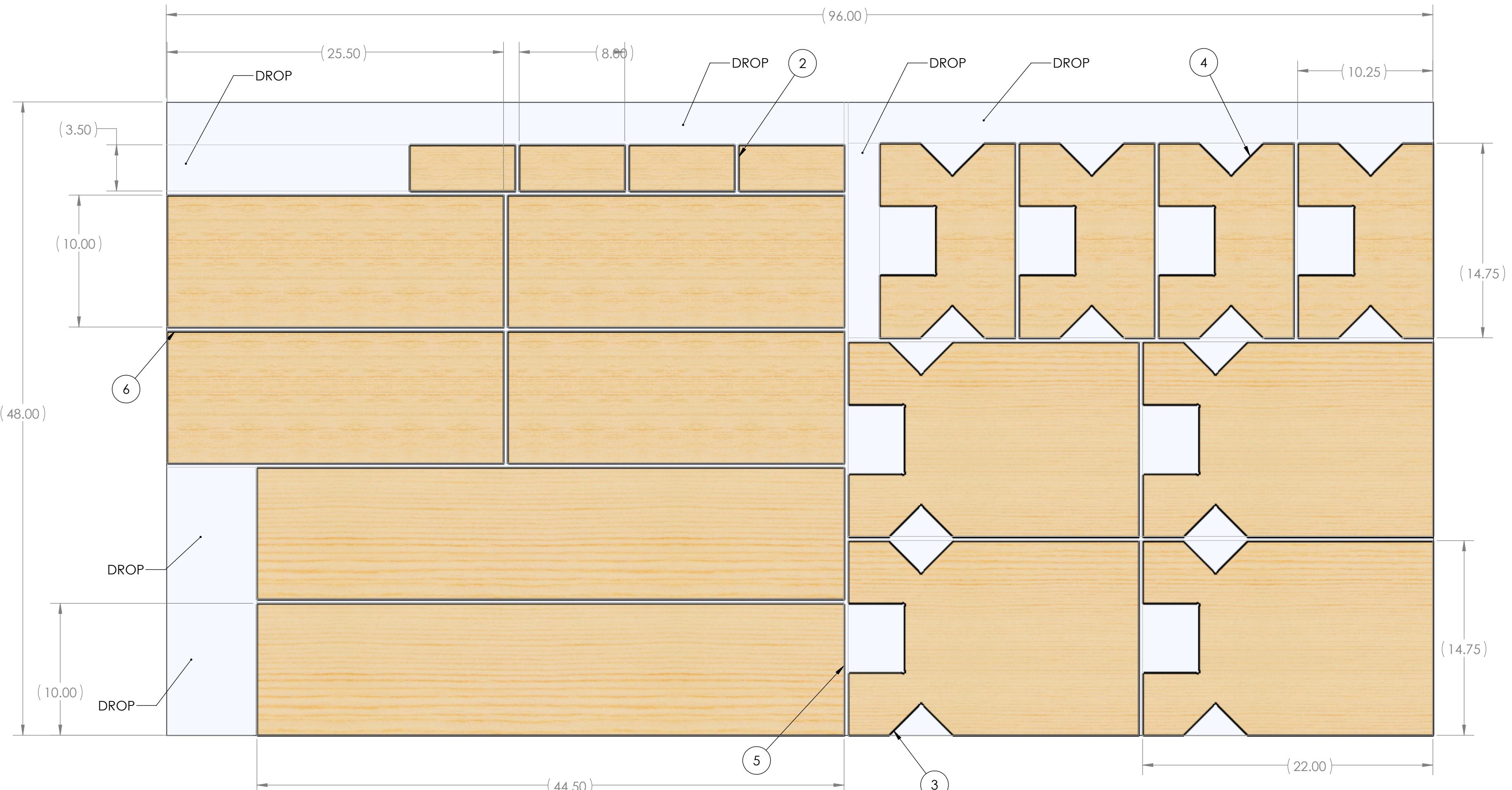
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3/4" Plywood - Sheet 2

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	4ft x 8ft Sheet		1
2	TE-22114	HUB - Complex Build - Base to Leg Connection Plate	4
3	TE-22121	HUB - Complex Build - Lower Exit Bottom	4
4	TE-22125	HUB - Complex Build - Lower Exit Top	4
5	TE-22162	HUB - Complex Build - Upper Exit Base	2
6	TE-22163	HUB - Complex Build - Upper Exit Connection Plate	4

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COMMENTS: REMOVE ALL BURRS AND SHARP EDGES.				
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SOLIDWORKS Modeling Solutions Partner				
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SIZE	DWG. NO.	REV		
C	Sheet Cuts			
SCALE: 1:6		SHEET 6 OF 10		

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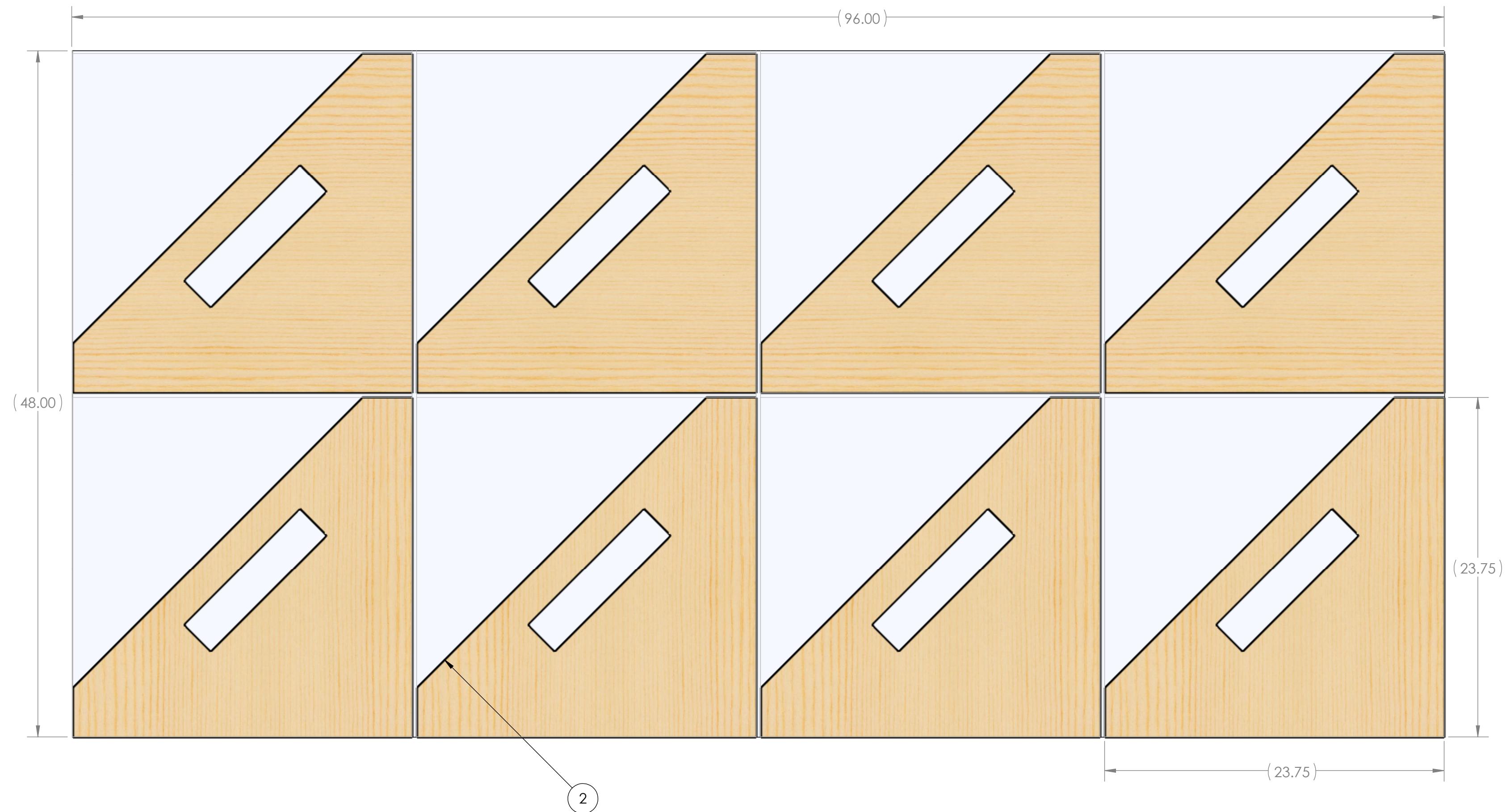
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3/4" Plywood - Sheet 3

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	4ft x 8ft Sheet		1
2	TE-22173	HUB - Complex Build - Lower Leg Base Side	8

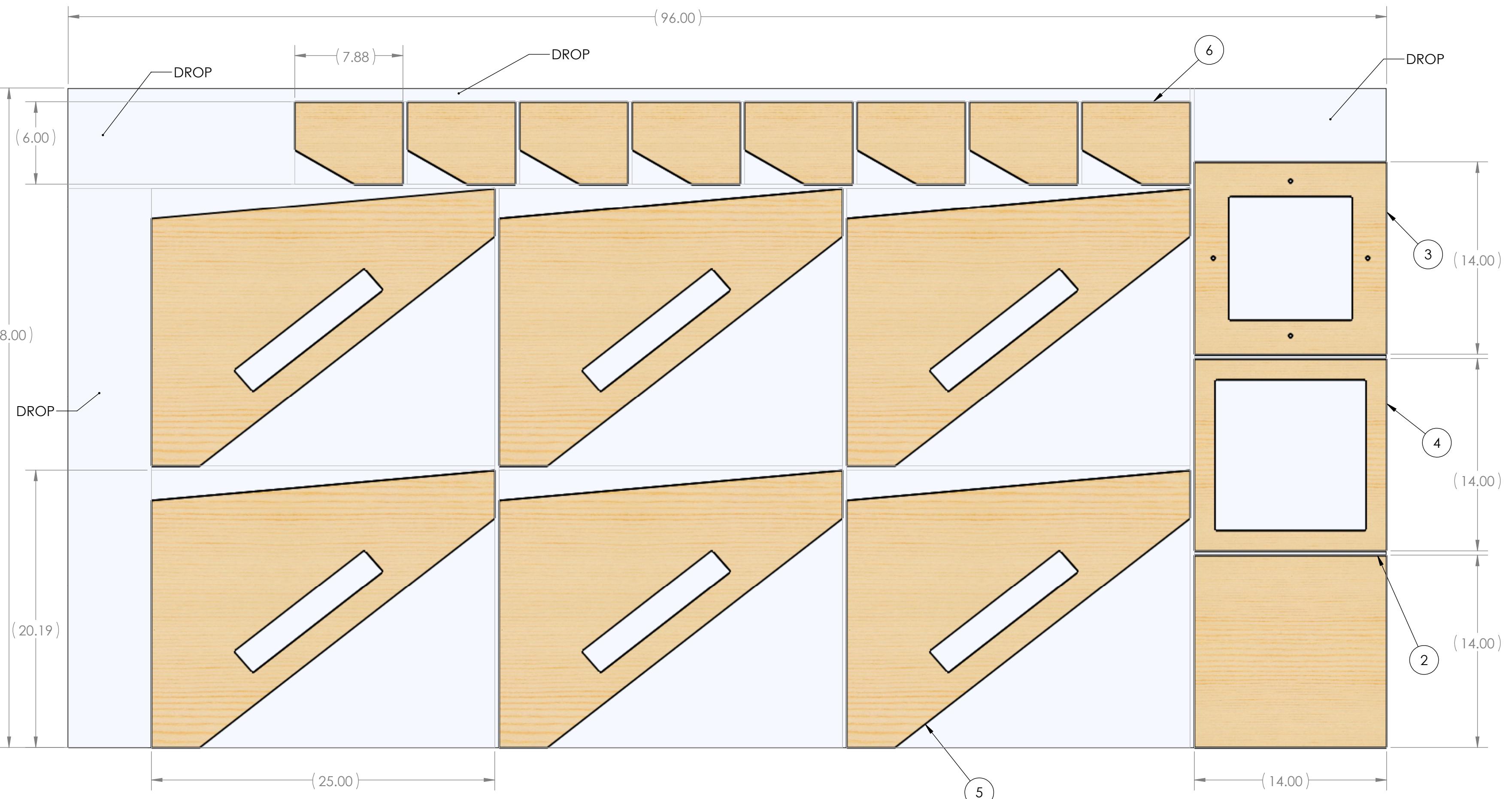
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DIMENSIONS ARE IN INCHES	DRAWN	KAMC	12/15/2021
TOLERANCES: FRACTIONAL $\pm 1/16$ ANGULAR: MACH $\pm 1^\circ$ BEND $\pm 1^\circ$	PROPRIETARY AND CONFIDENTIAL		
TWO PLACE DECIMAL $\pm .13$ THREE PLACE DECIMAL $\pm .125$	THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF FIRST®. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF FIRST® IS PROHIBITED.		
MATERIAL/FINISH: 3/4" Plywood (nominally 23/32" thick)	COMMENTS: REMOVE ALL BURRS AND SHARP EDGES.		
DO NOT SCALE DRAWING			

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Complex Sheet Cut

C Sheet Cuts

SCALE: 1:6 SHEET 7 OF 10



3/4" Plywood - Sheet 4

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	4ft x 8ft Sheet		1
2	TE-22111	Hub - Complex Build - Center Base Plate	1
3	TE-22142	HUB - Complex Build - Connection Box Top	1
4	TE-22143	HUB - Complex Build - Connection Box Bottom	1
5	TE-22175	HUB - Complex Build - Upper Leg Side	6
6	TE-22182	HUB - Complex Build - Lower Hub Ring to Leg Side	8

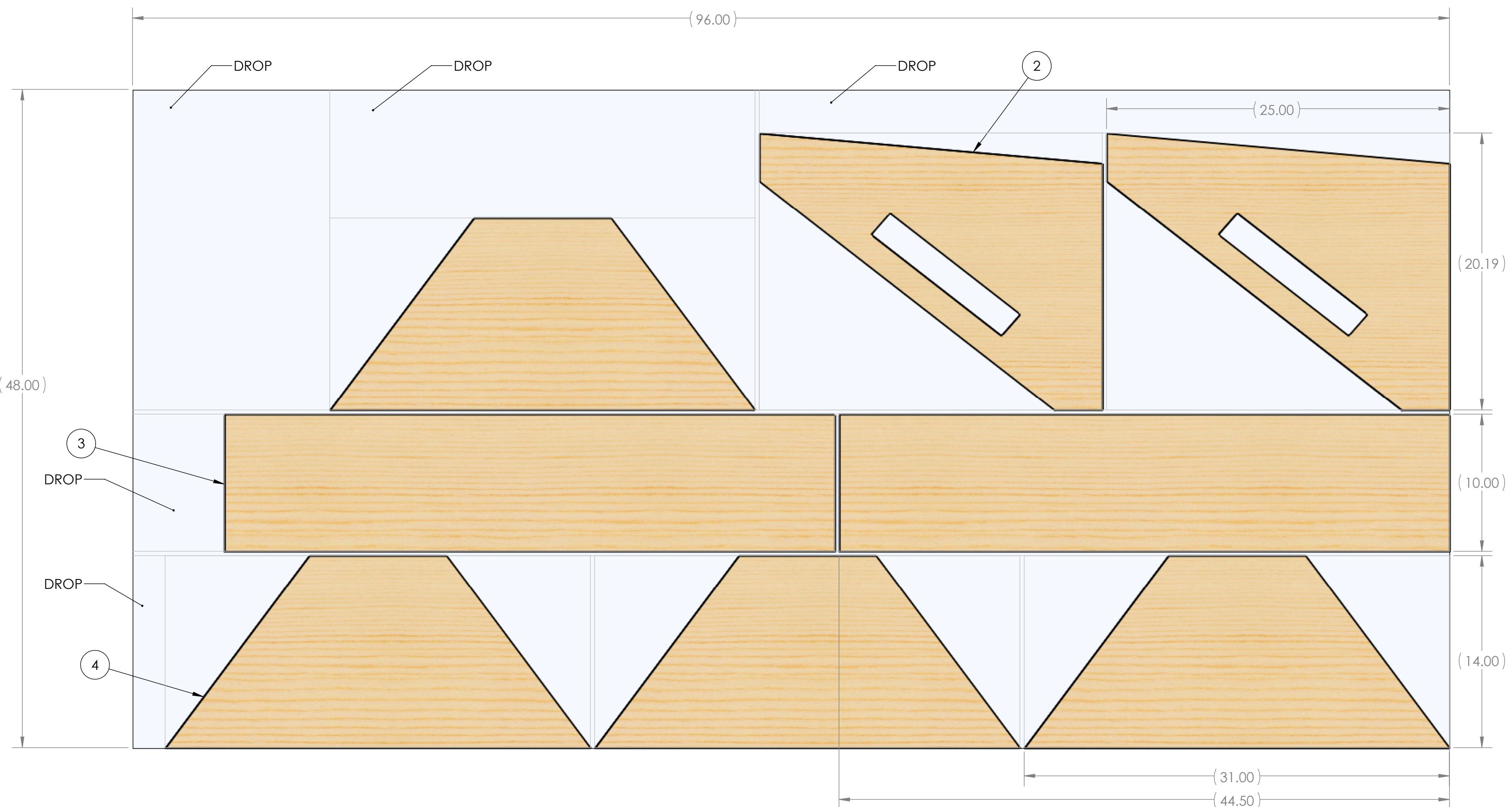
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COMMENTS: REMOVE ALL BURRS AND SHARP EDGES.				
DO NOT SCALE DRAWING				
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TITLE: Complex Sheet Cut				
SIZE	DWG. NO.	REV		
C	Sheet Cuts			
SCALE: 1:6		SHEET 8 OF 10		

4

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3/4" Plywood - Sheet 5

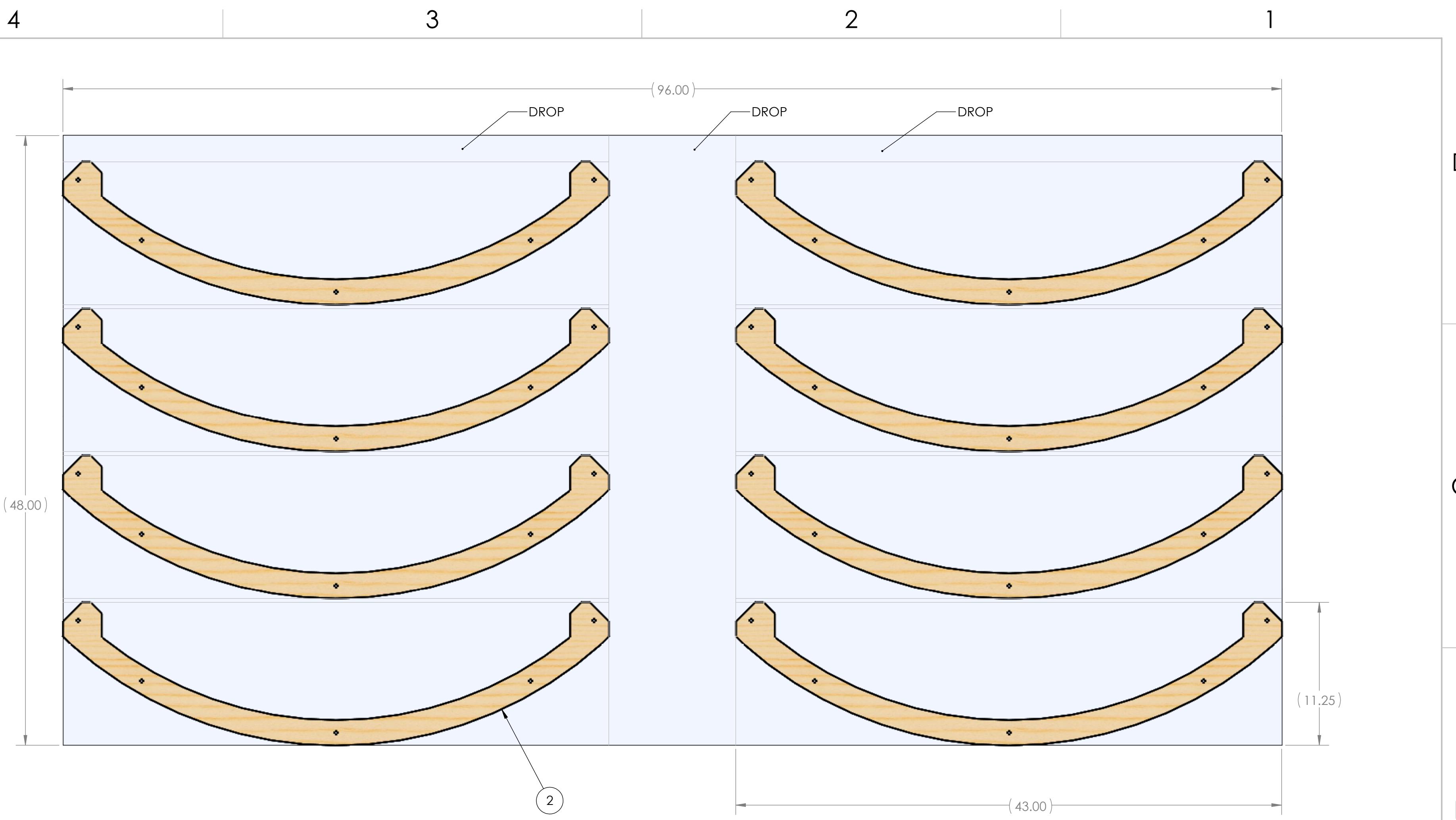
ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	4ft x 8ft Sheet		1
2	TE-22175	HUB - Complex Build - Upper Leg Side	2
3	TE-22162	HUB - Complex Build - Upper Exit Base	2
4	TE-22161	HUB - Complex Build - Upper Exit End	4

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MATERIAL/FINISH:	SIZE	DWG. NO.	REV
3/4" Plywood (nominally 23/32" thick)	C	Sheet Cuts	
DO NOT SCALE DRAWING	SCALE: 1:6	SHEET 9 OF 10	



TITLE:
Complex Sheet Cut

SIZE DWG. NO. REV
C Sheet Cuts



3/4" Plywood - Sheet 6

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	4ft x 8ft Sheet		1
2	TE-22151	HUB - Complex Build - Lower Hub Ring	8

UNLESS OTHERWISE SPECIFIED:	TEAM	NAME	DATE
DIMENSIONS ARE IN INCHES	DRAWN	KAMC	12/15/2021
TOLERANCES: FRACTIONAL $\pm 1/16$ ANGULAR: MACH $\pm 1^\circ$ BEND $\pm 1^\circ$	PROPRIETARY AND CONFIDENTIAL		
TWO PLACE DECIMAL $\pm .13$ THREE PLACE DECIMAL $\pm .125$	THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF FIRST. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF FIRST IS PROHIBITED.		
MATERIAL/FINISH:	COMMENTS:		
3/4" Plywood (nominally 23/32" thick)	REMOVE ALL BURRS AND SHARP EDGES.		
DO NOT SCALE DRAWING			

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Modeling Solutions Partner

TITLE: Complex Sheet Cut

SIZE DWG. NO. REV

C Sheet Cuts

SCALE: 1:6 SHEET 10 OF 10

Hub Complex Build Lumber Cuts

Hub Complex Build Lumber Cuts

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Hub Complex Build Lumber Cuts

Number	Cut Identifier	Material Size	Length	Trim Off	Drop	Cut 1			Cut 2																				
1	A - 1/4	4x4	Length	Trim Off	Drop	HUB - Complex Build - Lower Leg Vertical 4x4*			HUB - Complex Build - Lower Leg Base 4x4																				
						Leg A - 1/1			Leg A - 1/1																				
						Cut	Part	Blade	Cut	Part	Blade	Cut	Part	Blade	Cut	Part	Blade	Cut	Part	Blade	Cut	Part	Blade	Cut	Part	Blade			
96	6	3.0625				66.1875	TE-22171	0.25	20.25	TE-22172	0.25																		
2	A - 2/4	4x4	Length	Trim Off	Drop	Cut 1			Cut 2																				
						HUB - Complex Build - Lower Leg Vertical 4x4*			HUB - Complex Build - Lower Leg Base 4x4																				
						Leg B - 1/1			Leg B - 1/1																				
96	6	3.0625				66.1875	TE-22171	0.25	20.25	TE-22172	0.25																		
3	A - 3/4	4x4	Length	Trim Off	Drop	Cut 1			Cut 2																				
						HUB - Complex Build - Lower Leg Vertical 4x4*			HUB - Complex Build - Lower Leg Base 4x4																				
						Leg C - 1/1			Leg C - 1/1																				
96	6	3.0625				66.1875	TE-22171	0.25	20.25	TE-22172	0.25																		
4	A - 4/4	4x4	Length	Trim Off	Drop	Cut 1			Cut 2																				
						HUB - Complex Build - Lower Leg Vertical 4x4*			HUB - Complex Build - Lower Leg Base 4x4																				
						Leg D - 1/1			Leg D - 1/1																				
96	6	3.0625				66.1875	TE-22171	0.25	20.25	TE-22172	0.25																		
5	B	4x4	Length	Trim Off	Drop	Cut 1			Cut 2			Cut 3			Cut 4			Cut 5			Cut 6			Cut 7					
						HUB - Complex Build - Base Long 4x4			HUB - Complex Build - Base Short 4x4			HUB - Complex Build - Base Short 4x4			HUB - Complex Build - Upper Leg 4x4*			HUB - Complex Build - Lower Hub Ring to Leg 4x4			HUB - Complex Build - Lower Hub Ring to Leg 4x4			HUB - Complex Build - Lower Hub Ring to Leg 4x4					
						Base - 1/1			Base - 1/2			Base - 2/2			Leg A - 1/1			Leg A - 1/1			Leg B - 1/1			Leg C - 1/1					
96	6	3.5				23.75	TE-22112	0.25	10.125	TE-22113	0.25	10.125	TE-22113	0.25	27.625	TE-22174	0.25	4.375	TE-22181	0.25	4.375	TE-22181	0.25	4.375	TE-22181	0.25	4.375	TE-22181	0.25
6	C	4x4	Length	Trim Off	Drop	Cut 1			Cut 2			Cut 3			Cut 4														
						HUB - Complex Build - Upper Leg 4x4*			HUB - Complex Build - Upper Leg 4x4*			HUB - Complex Build - Upper Leg 4x4*			HUB - Complex Build - Lower Hub Ring to Leg 4x4														
						Leg B - 1/1			Leg C - 1/1			Leg D - 1/1			Leg D - 1/1			Leg A - 1/1											
96	6	1.75				27.625	TE-22174	0.25	27.625	TE-22174	0.25	27.625	TE-22174	0.25	4.375	TE-22181	0.25												