FIRST ROBOTICS COMPETITION

REEFSCAPE℠ PRESENTED BY HAAS Gene Haas Foundation

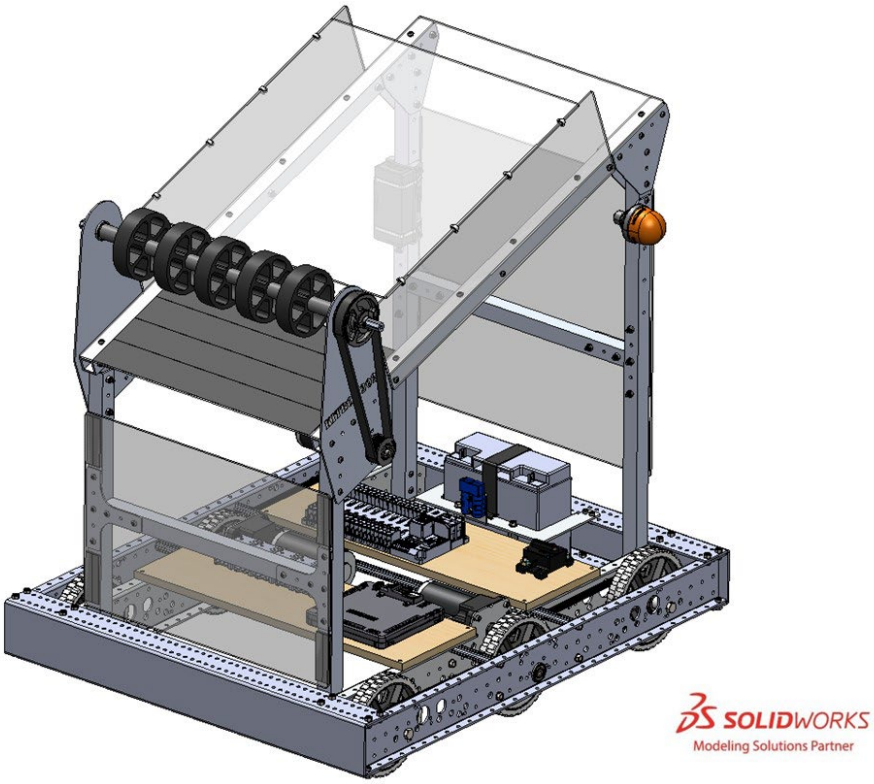
FIRST® DIVE℠
presented by Qualcomm

firstinspires.org/robotics/frc

2025 *FIRST*® Robotics Competition KitBot Instruction Guide

1 KitBot Overview

Figure 1: 2025 KitBot



The KitBot for REEFSCAPE℠ presented by Haas is capable of completing the following actions. Some actions will need the team to explicitly add code to make this possible (e.g. Auto code):

- Drive around the field using a differential drivetrain (also commonly referred to as “tank”) geared for a top achievable speed of ~15 feet per second (~4.5 m/s). The KitBot does not fit under Deep or Shallow Cages but can maneuver between the Cages or push them out of the way while driving through.
- Pre-load a Coral for use in Auto
- Score Leave points
- Score Coral into L1 of the Reef
- Collect Coral from the Coral Station
- Play defense

This is a fairly basic set of capabilities with respect to all of the possible tasks in the game. Additionally, the KitBot has been designed to keep things very simple, which means there may be opportunities to iterate and improve on the existing capabilities it has. With this in mind, teams may choose to add additional components to allow the robot to pick game pieces up off the ground, climb on the Barge, or more! Teams can reference the KitBot Enhancement/Iteration Guide for a process to explore these improvements.

Thanks to Team 118 and their Everybot project for providing inspiration and allowing us to utilize pieces of their previous documentation in these instructions. No details of the game, or this design, were shared with Team 118.

2 Before you get started

Note that the Drive Base (AM14U6 Integration), Bumper Assembly, and Electronics & Wiring may be completed in parallel before they are combined into a single assembly.

2.1 AM14U6 Integration

While the KitBot superstructure could feasibly be integrated with a variety of drivetrain shapes and types, it is designed to most easily integrate with the AM14U6 chassis constructed in the long orientation. If your team has sufficient resources, assembly of the AM14U6, electronics, and KitBot superstructure may all be done in parallel up to a certain point.

Older versions of the AM14U style chassis can also be used, but the length of the front and back rails will likely need to be modified, and there are some holes that will need to be drilled in the side rails as there are new holes in the AM14U6.

Follow the AM14U6 instructions for the Long Chassis. All of the work to assemble the KitBot superstructure can be done separately and completely before attaching it to the completed chassis.

2.2 Fasteners and Hole Sizes

There are a few locations on the KitBot superstructure where specific fasteners are required. See the Fasteners section for details on what is required.

All other fasteners are specified as #10-32 but may be modified based on team preference and fastener availability. The plates provided in the Black Tote have 0.201 in. holes suitable for 3/16 in. rivets or #10-32 bolts. These holes may also be a loose fit for a M4.5 bolt or a tight fit for M5 (may need to be opened with a slightly larger drill). For all through hole hardware, teams should drill the appropriate size based on the hardware they choose as noted in Table 1.

Table 1: Drill Bit Size for Common Fasteners

Hardware	Recommended	Tight Fit	Free Fit
#10-32 Bolts	#7 (.201 in.)	#9 (.196 in.)	#7 (.201 in.)
3/16 in. Rivets	#7 (.201 in.)	#11 (.191 in.)	#9 (.196 in.)
M5 Bolts	5.5 mm	5.3mm	5.5mm
5mm Rivet	5 mm	5mm	5.1mm
¼-20 Bolts	17/64 in.	F (.257 in.)	17/64 in.
M6 Bolts	6.6 mm	6.4mm	6.6mm

2.3 Precision Machining Tips

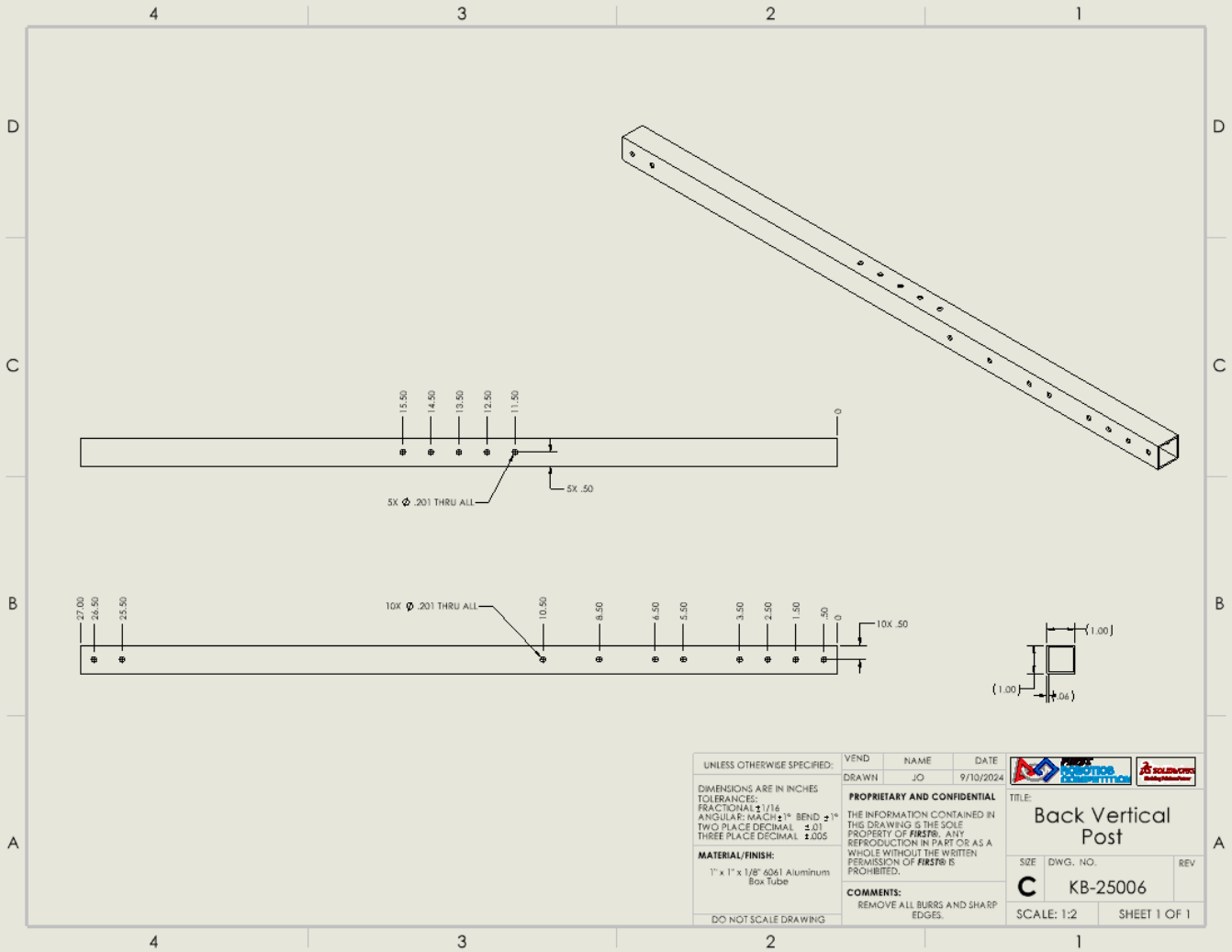
Here are some tools and tips to getting more accurate parts in a modest shop:

- **Squares**: A combination square can be used to easily mark lines to cut perpendicular to the edge of a piece of material. The metal "handle" slides along a ruler and can be tightened in place and provide a perpendicular edge to mark along. A "scribe" for scratching cut lines is also commonly screwed into the handle. A "speed" square or carpenter's square can help to make sure two components are at perfect 90-degree angles to one another.
- **Marking Tools:** When marking measurements, a number of tools can be used for marking:
    - **Scribe –** A scribe or scratch awl is used to make a thin scratch line in the surface being marked. This scratch is generally smaller than most drawn lines and therefore can be more accurate. This can be used in conjunction with a sharpie (make the sharpie mark first) for increased visibility (this mimics the professional technique of using layout fluid).
    - **Pen or Mechanical Pencil –** These tools can often make fairly narrow lines but may not have the best visibility when used on metal or plastic components.
    - **Sharpie –** Shows up very well on all surfaces, but generally draws thick lines. Make sure to align one edge of the wide line with the desired measurement, not the center.
- **Punch**: To make accurate holes, consider marking where you need to drill with a center punch, which will leave a small indentation that you can line a drill bit up with. Automatic punches are available which do not need to be struck to make an indentation. Always drill your holes as straight as possible. If available, teams can use a drill press to help ensure straight holes.
- **Calipers**: Calipers are sort of a very accurate ruler or tape measure – but only for shorter parts. They read the distance between the two "teeth" – if you are trying to mark a hole 4.25 in. inwards from the edge of a part, slowly slide the display section along the ruler until it reads 4.25. Then place one of the teeth against the edge of your part, and the other will measure to the point 4.25 in. from there. Use the teeth of the calipers to make a straight scratch in the metal, then change the distance to the 2nd dimension for the desired location and make a 2nd scratch. The center of the cross will be much more accurate than marking the location with a Sharpie, especially if you use a punch right where the marks cross before drilling.
- **Drill vs Drill Press**: Although the KitBot can be built with just a drill, many parts will appreciate a high degree of precision, and holes will turn out straighter and more accurately located if drilled out on a drill press. When using a drill press it is still important to use a punch as the drill bit can still wander when beginning a hole. Make sure your piece is clamped firmly and that the drill bit is lined up to come down directly at the mark from your punch.

2.4 Reading Part Drawings

This document uses engineering "drawings" like the one below to aid you in machining parts of the KitBot correctly.

Figure 2: Example Part Drawing



The name of the piece you are looking at is in the bottom right corner. For the purposes of this document, all dimensions directly provided will be shown in both imperial and metric units. All links to drawings within this document will be linked to the imperial version but there are also versions of the drawings using metric available.

Each drawing will generally show multiple views of the same part in order to show you all relevant dimensions and features. The overall 3D view (isometric view) can be used to help orient yourself when looking at the other (front, top, side) views.

The drawings use a few types of dimensioning.

- **Ordinate Dimensioning** – This is where dimensions are all indicated relative to a single origin. In a given view, the origin (generally on the left) will be marked with a dimension of "0". Subsequent features will be marked with leader lines pointing to them and a dimension measured from that origin point along a straight horizontal or vertical line.

- **Relative Dimensioning** - These dimensions are indicated by a pair of lines pointing to the features that define the dimension and a set of arrows, either inside or outside the line pair. The dimension indicated is the measurement between the two features marked by the line pair.
- **Diameter Dimensioning** - These dimensions are indicated by a ⌀ symbol and reflect the diameter of holes. Often only a single hole will be marked with a number followed by the letter 'X' indicating how many of that size hole are on that face (e.g., 6X .201).

Technical drawings can be complicated and hard to understand initially. We suggest trying to go through each drawing slowly and mark the parts you understand down onto your physical pieces as you go. **Don't forget to double check your work before you cut and drill!**

2.5 What if I have questions or need help?

The *FIRST*® Forums contain a specific section for posting questions or discussion about the KitBot. Staff will be monitoring this forum throughout the build and competition season and will attempt to provide timely answers to all questions.

3 Materials

This section covers all the materials needed for the KitBot Structure. Please note that the Radio noted in these instructions is provided in the Season Specific Box.

3.1 Raw Materials

Table 2: Raw Materials List

Material	Qty	Info
1 in. x 1 in. Aluminum Square Tube 1/16 in. wall thickness. 8 ft. long. (25 mm x 25 mm, 1.5mm wall thickness, ~244 cm long)	2	Okay to use other wall thickness if preferred. Okay to use other lengths down to 32 in., need quantity 5 for lengths from 44 in. to 58 in. (112 cm to 147 cm) Use the 5.1 Cut List below to figure out quantity for other lengths. All parts are designed so that Pre-Drilled Tubing such as WCP-0924, WCP-1023, am-5177, REV-21-2160 can be easily used if preferred.
4 ft. x 4 ft. Polycarbonate Sheet 0.118 in. thickness (~1200 mm x 1200 mm, 3 mm thickness)	1	It is okay to use 0.125 in. instead if preferred. Make sure to use polycarbonate and not acrylic. Acrylic of this thickness is likely to shatter either when machined or when subjected to the shock of robot operation. Other materials (0.125 in. aluminum, 0.25 in. plywood, etc.) may be used but have not been tested and bolt and spacer lengths may be affected if modifying material thickness. Also available from vendors in smaller sizes such as: WCP-0294 (3 sheets needed)
2 ft. x 2 ft. Sheet of ¾ in. Plywood (600 mm x 600 mm, 19mm thickness)	1	Used for electronics board. May also need additional plywood for Bumper Backing, see Table 6 for details. Other materials may be used but have not been tested and bolt lengths may be affected if modifying material thickness.
(Optional) – ¾ in. Schedule 40 PVC Pipe (20mm DIN PVC pipe)	2 ft. (~600mm)	This material is to make spacers which can also be purchased or can be 3D Printed. (see Team Sourced Parts)

3.2 Black Tote

These items come in the Black Tote which is provided to teams along with their Kickoff Kit as long as they did not opt out of this tote.

Table 3: Black Tote Parts List

Part	Qty	Provided part and Info	Alternative Parts
Roller Plate 1 (KB-25001)	1	Laser-Cut Aluminum Plate	Can be manufactured out of Aluminum Sheet 1/8 in. thick or teams can purchase on Kickoff from any supplier who chooses to produce them or use the SendCutSend Voucher to have these produced
Roller Plate 2 (KB-25002)	1	Laser-Cut Aluminum Plate	
Back Angle Plate (KB-25003)	4	Laser-Cut Aluminum Plate	
T-Bracket (KB-25004)	4	Laser-Cut Aluminum Plate	TTB-0083, am-4158, REV-21-2328, WCP-1069 Hole patterns differ from provided T-Bracket, center the bracket and use aligned holes
RSL Mount (KB-25005)	1	Laser-Cut Aluminum Plate	
Roller Shaft (KB-25013)	1	Cut to length Hex Shaft (made from REV-41-3205)	am-2291-3, WCP-0915, TTB-0069
Radio Mount (KB-25014)	1	3D Printed Part	Can be 3D Printed from provided files
24 Tooth Pulley (KB-25015)	1	3D Printed Part	Can be 3D Printed from provided files or TTB-0126, WCP-0992, am-4626
48 Tooth Pulley (KB-25016)	1	3D Printed Part	Can be 3D Printed from provided files
1/8 in. long ½ in. Hex Spacer (KB-25017)	2	TTB-0017-1/8	REV-21-2004-PK10, am-3948-125, WCP-0788
4 in. Compliant Wheels	5	TTB-0057	While other wheels may be used, this wheel was specifically chosen for the way it interacts with the Coral in this design.
130 Tooth 5mm HTD Belt	1	WCP-0652	am-5215_130T, TTB-0195
CIM (8mm Key) to 1/2 in. Hex Adapter	1	WCP-0794	am-0588_long, REV-21-1879, TTB-0044

3D Printed Part ½ in. Hex Adapters	4	WCP-1121	
8mm Shaft Push-on Retaining Ring	1	am-0033	TTB-0093
2 in. Premium Black Gaffer's Tape	10'	am-2944-18 (color does not matter for use case)	Any Premium 2 in. Gaffer's Tape (~48mm width x 3m length)
CIM Key Stock	1	am-1121	WCP-0793
1/2 in. Hex Bearings	2	REV-21-1915	TTB-0001, am-2986, WCP-0783
1/2 in. Hex Shaft Collars	2	REV-21-1911	WCP-0799, am-1526_black, TTB-0013
Reclosable Fastener	4'	3M SJ3540 / 7000051932	Any reclosable fasteners or hook and loop
CIM Motor	1	am-0255	See the game manual for a complete list of legal CIM part numbers.
Spark MAX motor controllers	1	REV-11-2158	am-4261
Robot Signal Light	1	855PB-B12ME522	am-3583

3.2.1 Fasteners

The are a few locations on the KitBot superstructure where specific fasteners are required. Everything listed in Table 4 is included in the Black Tote:

Table 4: Required Fasteners

Part	Qty	Provided Part and Info	Alternative Parts
#10-32 1.5 in. long Button Head Cap Screw	8	**Required** – Attachment to AM14U6. WCP-0257	M5 ~40mm
#10-32 Locknut	8	**Required** – Nuts for bolts above. WCP-0325	M5 Locknut
#10-32 1.75 in. long Socket Head Cap Screw	2	**Required** – 3D Printed Radio Mounts. WCP-1549	M5 ~40mm
#10-32 Locknut	2	**Required** – Nuts for bolts above. WCP-0325	M5 Locknut
#10-32 0.625 in. long Socket Head Cap Screw	2	**Required** – Attaching CIM motor to KB-25001. am-1120	
#10-32 1.5 in. long Button Head Cap Screw	58	WCP-0257	M5 ~40mm Other bolt head styles may be used or Aluminum or Steel 3/16 in. diameter, 0.126 in. -

			0.25 in. grip range pop rivets (5mm diameter, 4-6mm grip range).
#10-32 Locknut	58	WCP-0325	M5 Locknut if using M5 bolts. If rivets used, these are not needed.

3.3 Team Sourced Parts

These are the parts needed for the KitBot that must be sourced by the team. Some items can be 3D printed or created from raw material rather than sourced directly.

Table 5: Team Sourced Parts List

Part	Qty	Info
2 in. long ½ in. Hex Spacers (KB-25018)	4	Can be 3D Printed from provided files or made from PVC pipe as noted in KitBot Part Manufacturing. May be substituted with 5/8 in or ¾ in. round (~15mm-20mm diameter, 50mm length) spacers that are available at many hardware stores, McMaster, MSC, etc. or hex spacers that are available at many common *FIRST* Robotics Competition suppliers. May be built up from smaller lengths.
2-3/8 in. long ½ in. Hex Spacers (KB-25019)	2	
Cable Ties	10	50lb, 8 in. Cable Ties (~5mm width, 203mm or greater length) These cable ties are available in the Rookie Tote.
#10-32 1.5 in. long Button Head Cap Screw	8	Used to attach the electronics board. May use other bolt head styles or M5 ~40mm.
#10-32 Locknut	8	Used to attach the electronics board. M5 Locknut if using M5 bolts.

3.4 Bumpers

These materials are needed to create 2 sets of bumpers following our recommended steps as noted in the Bumper Assembly section.

Table 6: Bumper Materials

Material	Qty	Info
4 ft. x 8 ft. Sheet of ¾ in. Plywood (1.2 m x 2.4 m, 19mm thickness)	1	The size noted here is used for the electronics board and bumpers. May also use two 2 ft. x 4. Ft (~60 cm x 120 cm) sheets or a 5 ft. x 5 ft. (~150 cm x 150 cm) sheet. Other materials may be used but have not been tested.

(optional) Brackets	4	Brackets are only needed if teams are making L Bumpers as described in Bumper Assembly. Teams can source any bracket similar to the Bumper Wood Corner Brackets (am-3233a) or can manufacture similar brackets out of aluminum angle.
Pool Noodles, 2 ½ nominal diameter (~63 mm), ~55 in. long (~140 cm)	~10	5 Pool Noodles are provided in the Rookie Tote. Rookie teams can either source 5 additional pool noodles or do swappable bumper covers. Teams may optionally choose to use other padding if preferred as noted in the Game Manual.
(optional) ½ in. Foam Tiles (~13 mm)	~5 sq ft. (~½ sq m)	Frequently sold as 2 ft. x 2 ft. tiles, 2 tiles will back one set of bumpers.
Red Fabric	1 ½ yards (~1.4 m)	18 in. x 160 in. of each color is included in the Rookie Tote and is sufficient for a set of Bumpers. If buying in a standard width (60 in.), 1 ½ yards are needed of each color.
Blue Fabric	1 ½ yards (~1.4 m)	
(Optional) White Paint	1	1 small paint container should be sufficient. Teams may use other materials to add numbers to Bumpers.

4 Tools

The following tools are needed to prepare & assemble the KitBot Structure:

- Safety Glasses
- Tape Measure
- Punch
- Marking tool
- Jigsaw or Bandsaw
- Drill + Drill Bits
  - #7 (or 5.5mm for metric hardware) Drill Bit
  - See Table 1: Drill Bit Size for Common Fasteners for alternate sizes
- Clamps
- Flush Cutters/Diagonal Cutters
- Fastener Tools
  - 5/32 in. (or 4mm for metric hardware) Allen key
  - 1/8 in. (or 3mm for metric hardware) Allen Key
  - 3/8 in. (or 8mm for metric hardware) Open Ended Wrench or Socket
  - Other tools may vary based on chosen hardware
- Staples
- Staple Gun

- (optional) Circular or Table Saw
- (optional) Deburring Tools
- (optional) Calipers
- (optional) Square
- (optional) Pop Rivet Tool

5 KitBot Part Manufacturing

The first step in building the KitBot superstructure is to gather all the Raw Materials needed and to prepare pieces for assembly. Teams can reference the Drawings for additional details.

> Cutting and drilling holes can leave sharp edges and burrs on both aluminum and polycarbonate. Teams should take care around machined holes and edges and may wish to use a file or deburring tool to remove this hazard.

Holes for specified fasteners will call out the drill size. Holes for team selected fasteners will not call out a specific size and teams should use the appropriate size for their fastener per Table 1.

5.1 Cut List

The following cut lists for 1 in. x 1in. x 1/16 in. square aluminum tubing (25 mm x 25 mm, 1.5mm wall thickness) are designed around 8 ft. long (~244 cm) pieces which are commonly available from local hardware stores. If using other lengths, you may need to re-do the cut list layout to optimize material usage.

Table 7: Cut List for Stick #1

Part	Length	Quantity
Diagonal Rail (KB-25008)	32 in. (813mm)	2
Back Vertical Post (KB-25006)	27 in. (686mm)	1

Table 8: Cut List for Stick #2

Part	Length	Quantity
Back Vertical Post (KB-25006)	27 in. (686mm)	1
Front Vertical Post (KB-25007)	17 in. (432mm)	2
Crossbeam (KB-25009)	16 in. (406mm)	2

5.2 Part Preparation:

Step 1: Cut 1 in. square tubing per the cut list in Table 7 and Table 8.

Step 2: Using the drawing for the Diagonal Rail (KB-25008, appended to this document), drill all 20 holes with a .201 in. (or 5.5mm for metric hardware) drill bit in each part.

Step 3: Using the drawing for the Front Vertical Post (KB-25007, appended to this document), drill all 10 holes with a .201 in. (or 5.5mm for metric hardware) drill bit in each part.

Step 4: Using the drawing for the Crossbeam (KB-25009, appended to this document), drill all 6 holes with a .201 in. (or 5.5mm for metric hardware) drill bit in each part.

Step 5: Using the drawing for the Back Vertical Post (KB-25006, appended to this document), drill all 15 holes with a .201 in. (or 5.5mm for metric hardware) drill bit in each part.

Step 6: Using the drawing for the Track Floor (KB-25010, appended to this document), cut the Track Floor out of a sheet of .118 in. (3mm) polycarbonate, and drill all 12 holes with a .201 in. (or 5.5mm for metric hardware) drill bit.

Step 7: Using the drawing for the Track Side Panel (KB-25011, appended to this document), cut the Track Side Panels out of a sheet of .118 in. (3mm) polycarbonate, and drill all 7 holes with a .201 in. (or 5.5mm for metric hardware) or 1/4 in. (or 6mm) drill bit.

Step 8: Using the drawing for the Track Roof (KB-25012, appended to this document), cut the Track Roof out of a sheet of .118 in. (3mm) polycarbonate, and drill all 8 holes with a 1/4 in. (or 6mm) drill bit.

Step 9: Using the drawing for the Front Guard Panel (KB-25020, appended to this document), cut the Front Guard Panel out of a sheet of .118 in. (3mm) polycarbonate.

Step 10: Using the drawing for the Back Guard Panel (KB-25021, appended to this document), cut the Back Guard Panel out of a sheet of .118 in. (3mm) polycarbonate.

Step 11: (Optional – this step is only needed if you do not have pre-purchased spacers).
Make the following spacers using a 3D Printer (provided files) or cut them from 3/4 in. (metric) PVC pipe. **Do not use a miter saw or other high-speed rotary saw to cut these small PVC parts as it is dangerous**. Instead use a PVC pipe cutter, hand saw (such as hacksaw) or oscillating/reciprocating saw (such as a jigsaw).

Part	Length	Quantity
KB-25018	2 in. (50mm)	4
KB-25019	2-3/8 in. (60mm)	2

The PVC pipe spacers may be replaced with:
- 3D printed spacers,
- exact length, hardware appropriate, spacers, or
- assembled from smaller common length spacers.

See Team Sourced Parts for more information.

6 KitBot Assembly

Before beginning assembly, be sure you have the parts from Table 3 & Table 5 and the materials that you manufactured as noted below in Table 9. Be sure to complete all items in the KitBot Part Manufacturing before attempting to assemble the KitBot.

Table 9: Fabricated Parts List

Part	Qty	Part Number	Info
Back Vertical Post	2	KB-25006	1 in. Square x 27 in. Aluminum Tube
Front Vertical Post	2	KB-25007	1 in. Square x 17 in. Aluminum Tube
Diagonal Rail	2	KB-25008	1 in. Square x 32 in. Aluminum Tube
Crossbeam	2	KB-25009	1 in. Square x 16 in. Aluminum Tube
Track Floor	1	KB-25010	32 in. x 18 in. x .118 in. Polycarbonate Plate
Track Side Panel	2	KB-25011	20-3/4 in. x 6 in. x .118 in. Polycarbonate Plate
Track Roof	1	KB-25012	18-1/4 in. x 18-1/4 in. x .118 in. Polycarbonate Plate
Front Guard Panel	1	KB-25020	18 in. x 12 in. x .118 in. Polycarbonate Plate
Back Guard Panel	1	KB-25021	18 in. x 18 in. x .118 in. Polycarbonate Plate
2 in. long ½ in. Hex Spacers	4	KB-25018	PVC or 3D printed or sourced as noted in the Team Sourced Parts section
2-3/8 in. long ½ in. Hex Spacers	2	KB-25019	PVC or 3D printed or sourced as noted in the Team Sourced Parts section

6.1 Assembly Notes

When tightening bolts which pass through box tubing, it is easy to overtighten the fastener and begin crushing the tube. Make sure to pay close attention when tightening bolts to avoid this.

The Top Frame (Section 6.2.1), Back Frame (Section 6.2.2), and Front Frame (Section 6.2.3) may be assembled in parallel before they are combined into a single assembly.

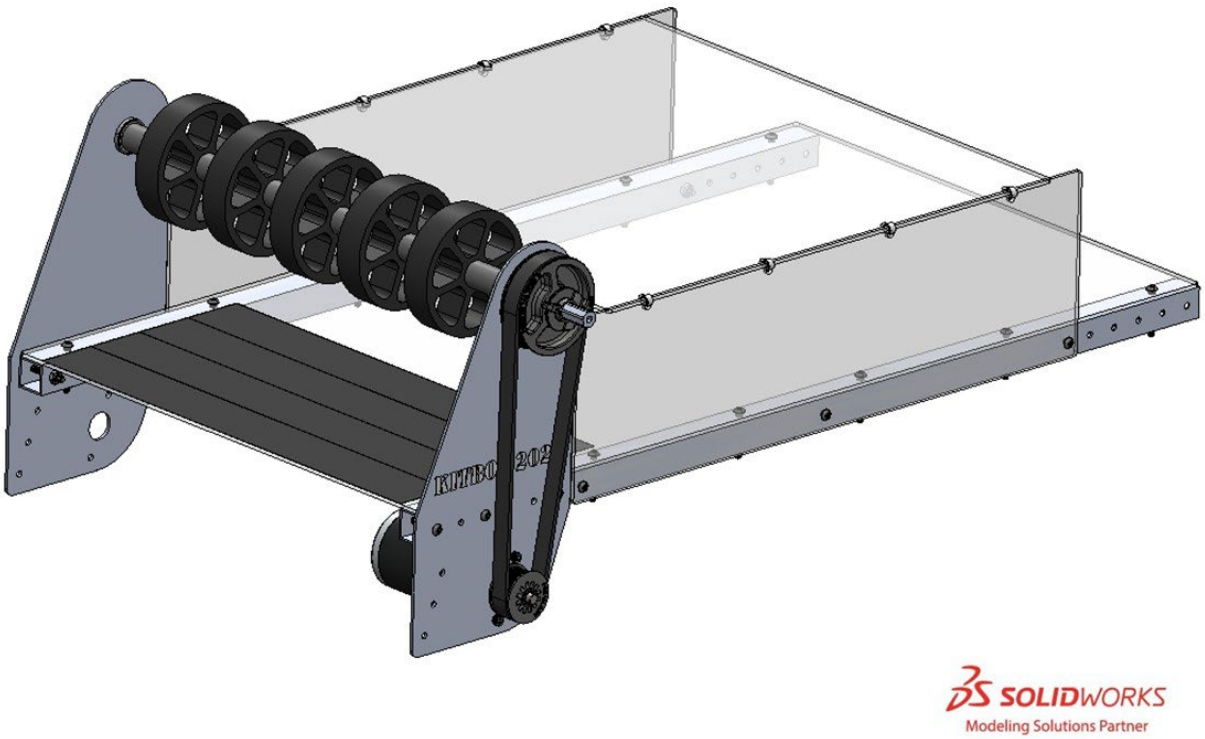
All assembly instructions are written assuming teams are using the provided items from the Black Tote and inch sized team sourced parts. If teams have sourced alternatives, substitute the alternate parts, referring back to the tables in Materials if needed to determine the equivalent. Some alternatives may also require teams to make minor adjustments such as drilling larger holes, leaving some holes unbolted, etc.

Need help? Watch the 2025 KitBot Build Video for a walkthrough of building the KitBot.

6.2 Assembly Instructions

6.2.1 Build the Top Frame

Figure 3: Top Frame



Parts needed:

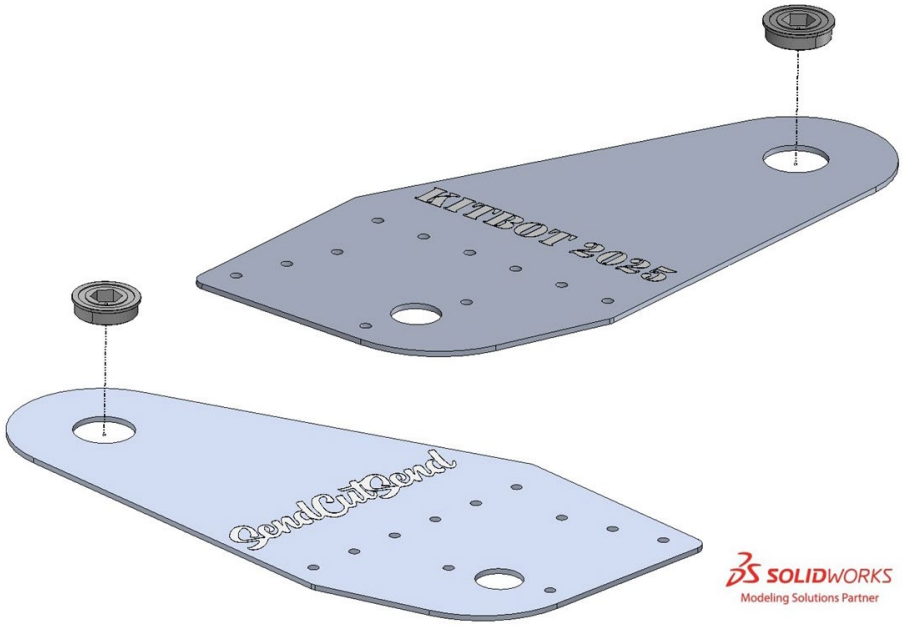
- Roller Plate 1 (KB-25001) - qty 1
- Roller Plate 2 (KB-25002) - qty 1
- Diagonal Rail (KB-25008) - qty 2
- Track Floor (KB-25010) - qty 1
- Track Sides (KB-25011) - qty 2
- Track Roof (KB-25012) - qty 1
- Roller Shaft (KB-25013) - qty 1
- 24 Tooth Pulley (KB-25015) - qty 1
- 48 Tooth Pulley (KB-25016) - qty 1
- CIM Motor - qty 1
- 2mm x 2mm x 10mm Machine Key (am-1121) - qty 1
- 8mm Push-on retaining ring (am-0033) - qty 1
- 3D Printed Part Hex Adapter (WCP-1121) - qty 4

- 1/2 in. Hex Bearings (REV-21-1915) - qty 2
- 4 in. Compliant Wheels (TTB-0057) - qty 5
- 1/2 in. Hex Shaft Collars (REV-21-1911) - qty 2
- 130 Tooth HTD Belt (WCP-0652) - qty 1
- 1/8 in. long 1/2 in. Hex Spacers (TTB-0017-1/8) - qty 2
- 2 in. long 1/2 in. Hex Spacers - qty 4
- 2-3/8 in. long 1/2 in. Hex Spacers - qty 2
- 1/2 in. long #10-32 Socket Head Cap Screw - qty 2
- 1-1/2 in. long #10-32 Button Head Cap Screw - qty 24
- #10-32 Locknut - qty 24
- 2 in. wide Black Gaffer's Tape
- 50lb, 8 in. Cable Ties – qty 8

Step 1: Using an arbor press, tabletop vice, or lightly tapping with a rubber mallet (or you may be able to do it by hand), insert the hex bearings into the two roller plates as shown in Figure 4, with the flange of the bearing ending up on the same side as the engraved text.

> Support the plates as close to the bearing hole as possible while pressing to avoid bending the plate.

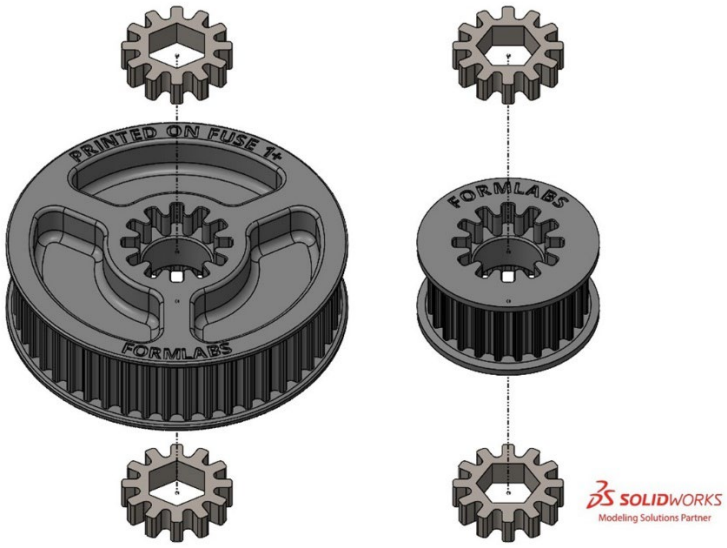
Figure 4: Inserting the hex bearings



Step 2: Using an arbor press, tabletop vice, or lightly tapping with a rubber mallet (or you may be able to do it by hand), insert the 3D Printed Part Hex Shaft Adapters (WCP-1121) into each end of each Pulley (KB-25015 and KB-25016) as shown in Figure 5.

It is very important to make sure the two hex adapters are aligned to each other in each pulley so that a hex shaft can slide through both of them.

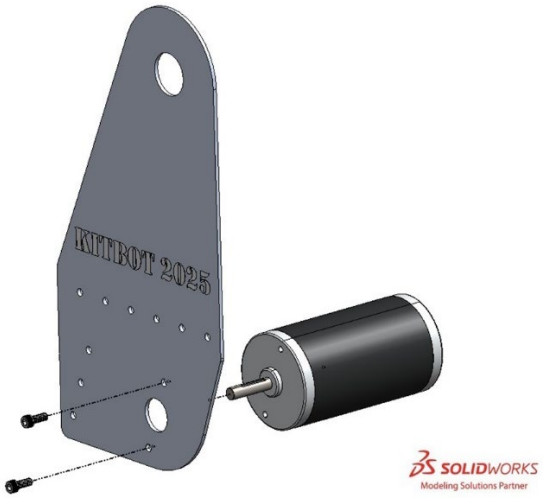
Figure 5: Inserting Hex Adapters into Pulleys



Step 3: Attach the CIM Motor to the Roller Plate with "KitBot 2025" engraved on the side of it (KB-25001), with the motor body on the opposite side of the engraved text, as shown in Figure 6. Attach with two 1/2 in. long #10-32 socket head cap screws.

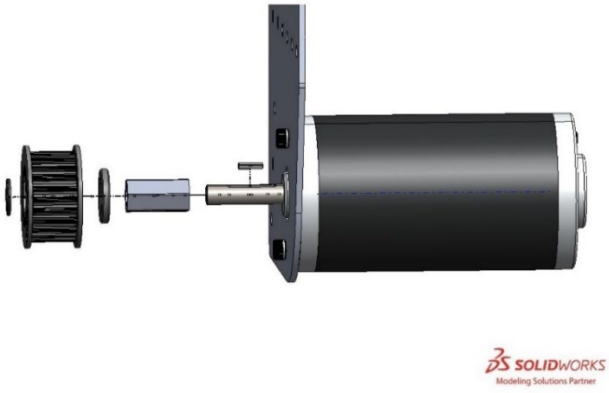
Threadlocker can be used to help ensure these bolts do not vibrate loose during operation.

Figure 6: Attaching the CIM Motor



Step 4: Insert the 2mm x 2mm x 10mm Machine Key (am-1121) into the keyway on the CIM Motor shaft (this may require pliers to press into the keyway). Then slide the 8mm Round to 1/2 in. Hex Adapter (WCP-0794) onto the shaft, noting to align the keyway over the recently installed Machine Key. Then, slide the 1/8 in. long Hex Spacer (KB-25017), 24 Tooth Pulley (KB-25015), and the Push-On Retaining Ring (am-0033) onto the shaft in that order, as shown in Figure 7.

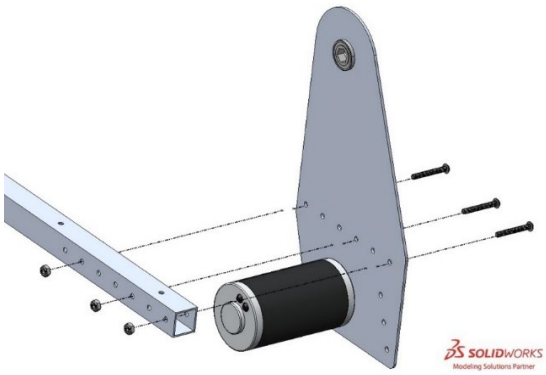
Figure 7: Assembling the Motor Shaft



Step 5: Take one of the Diagonal Rails (KB-25008) and identify the end that has seven holes drilled into it. Take the Roller Plate with the motor attached to it and bolt it to the Diagonal Rail, starting with the first of the seven holes, and putting 1-1/2 in. long #10-32 button head cap screws through the first, third and sixth holes, as shown in Figure 8. Once everything is lined up, put a #10-32 locknut onto each bolt, and tighten all of them. Be careful not to overtighten to the point of crushing the box tube.

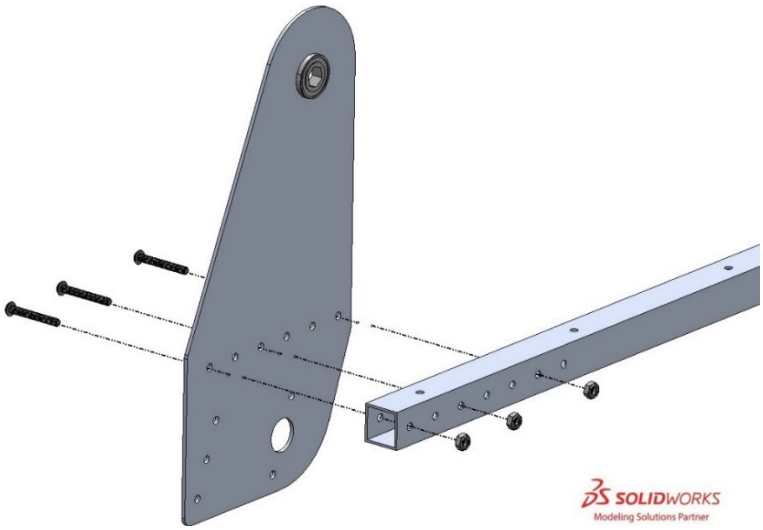
> Ensure that the motor and the Diagonal Rail are on the same side of the plate and that the bolt heads are on the engraved side of the plate where the pulley is.
>
> Sometimes, due to minor fabrication errors, your holes may not quite line up. In this case, try to get at least one bolt in and tightened to act as a clamp (you may want to supplement with an actual clamp as well), then use a drill to drill out the other holes, one at a time, opening them up to allow the fasteners to fit through.

Figure 8: Attaching a Diagonal Rail



Step 6: Similar to the last step, take the other Diagonal Rail and find the end with seven holes, and line it up to the other Roller Plate (KB-25002), so that the engraved text is on the opposite side of the Diagonal Rail. Using the first, third and sixth holes, attach the plate and tube together using 1-½ in. long #10-32 button head cap screws and #10-32 locknuts.

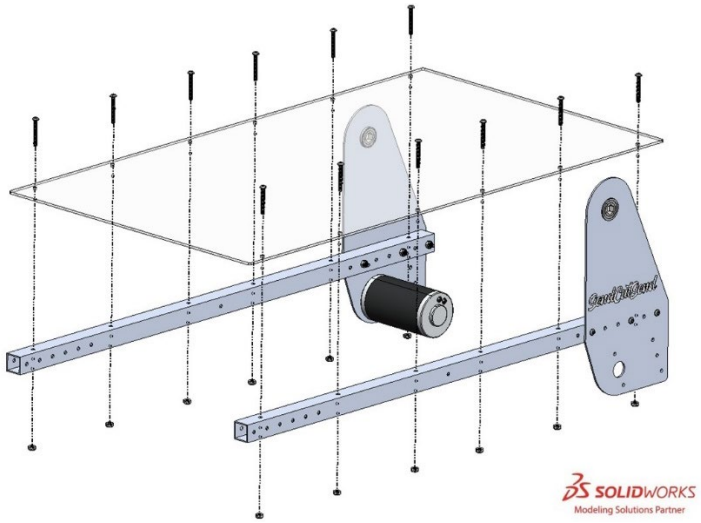
Figure 9: Attaching the Opposite Diagonal Rail



Step 7: Take the two assemblies that have been built in the previous two steps and the Track Floor (KB-25010) and line them up so that the Track Floor is on top of the tubes (on the same side of the tubes as the bearings in the plates), as shown in Figure 10. There are 12 holes that should line up between the Track Floor and the two Diagonal Rails. Attach these three items together using 12 1-1/2 in. long #10-32 button head cap screws inserted through the plastic, then the rails, and secured with #10-32 locknuts.

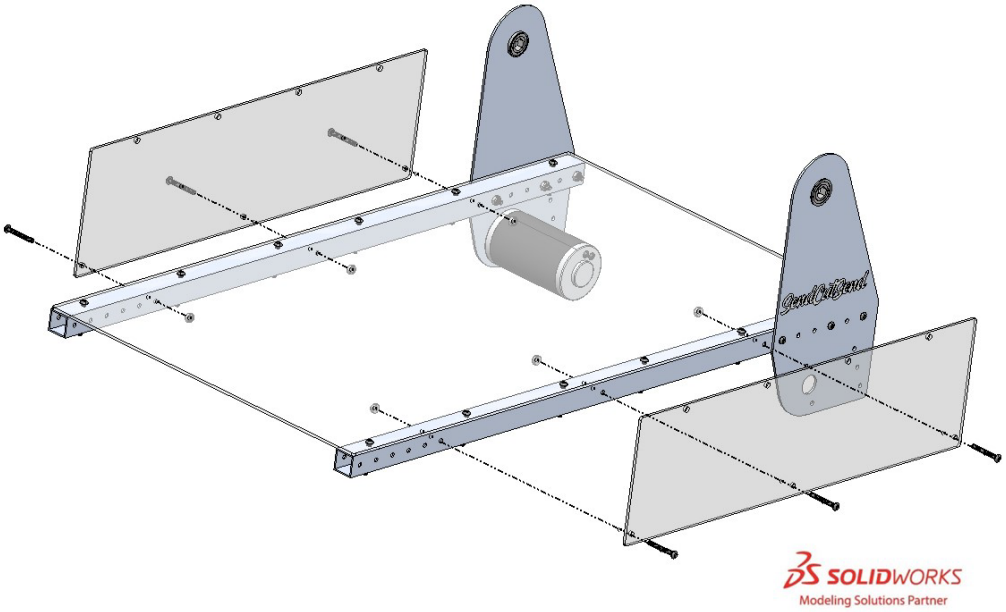
Ensure that the bolt heads are on the plastic side.

Figure 10: Attaching the Track Floor



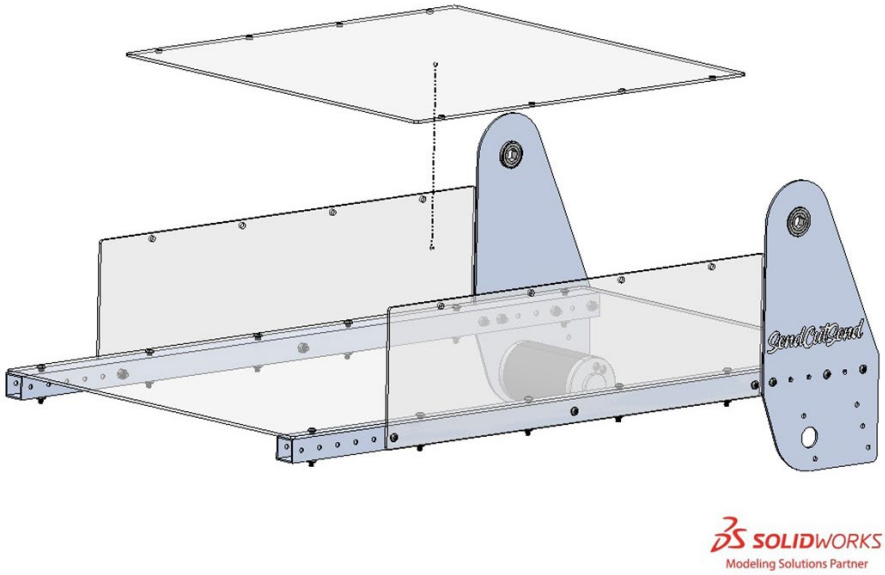
Step 8: Attach one of the Track Sides (KB-25011) to each side of the assembly, as shown in Figure 11, using the edge of the panel that has three holes along it. Attach with six 1-1/2 in. long #10-32 button head cap screws and #10-32 locknuts.

Figure 11: Attaching the Track Sides



Step 9: Attach the Track Roof (KB-25012) to the Track Sides (KB-25011) by lining its holes up with the holes on the Track Sides and connecting with 50lb cable ties. Keep the heads of the cable ties on the outside of the structure, then use flush cutters to trim the excess cable tie once they are all tight.

Figure 12: Attaching the Track Roof

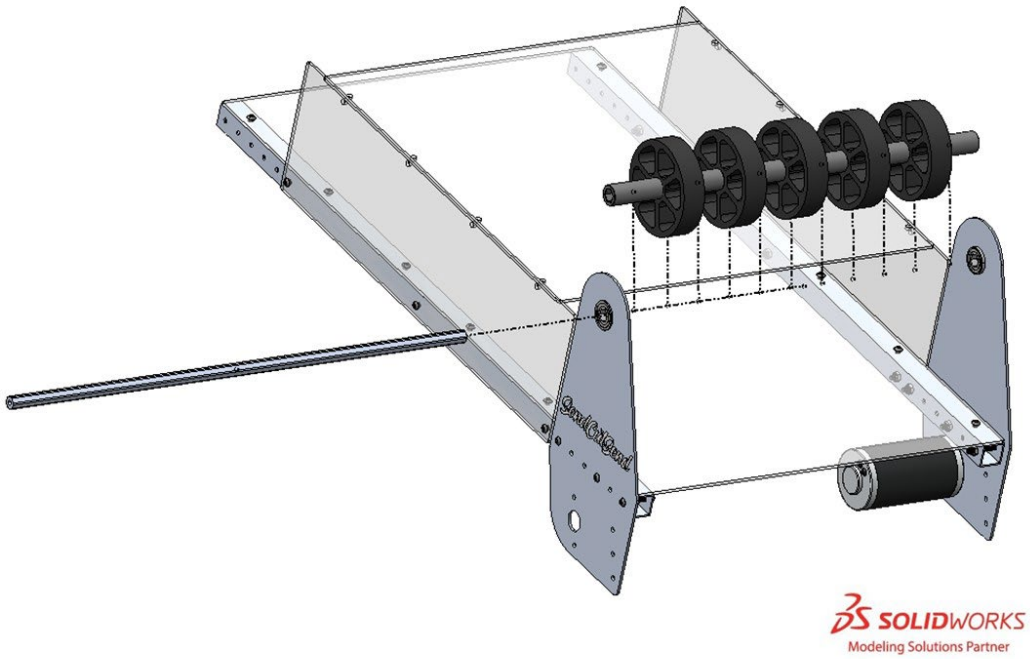


Step 10: Take the Roller Shaft (KB-25013) and slide it through one of the hex bearings in the assembly as shown in Figure 13. As it slides through, add the following items in order:

- 2-3/8 in. long hex spacer
- 4 in. compliant wheel
- 2 in. long hex spacer
- 4 in. compliant wheel
- 2 in. long hex spacer
- 4 in. compliant wheel
- 2 in. long hex spacer
- 4 in. compliant wheel
- 2 in. long hex spacer
- 4 in. compliant wheel
- 2-3/8 in. long hex spacer

At the end of these parts, there should be minimal space left before the bearing in the opposite plate. Push the shaft through the second bearing so that it sticks out on both sides of the assembly. If it is challenging to push the shaft through the second bearing, loosen up the bolts holding the rest of the assembly together and re-tighten once it is in a position where the shaft can move freely.

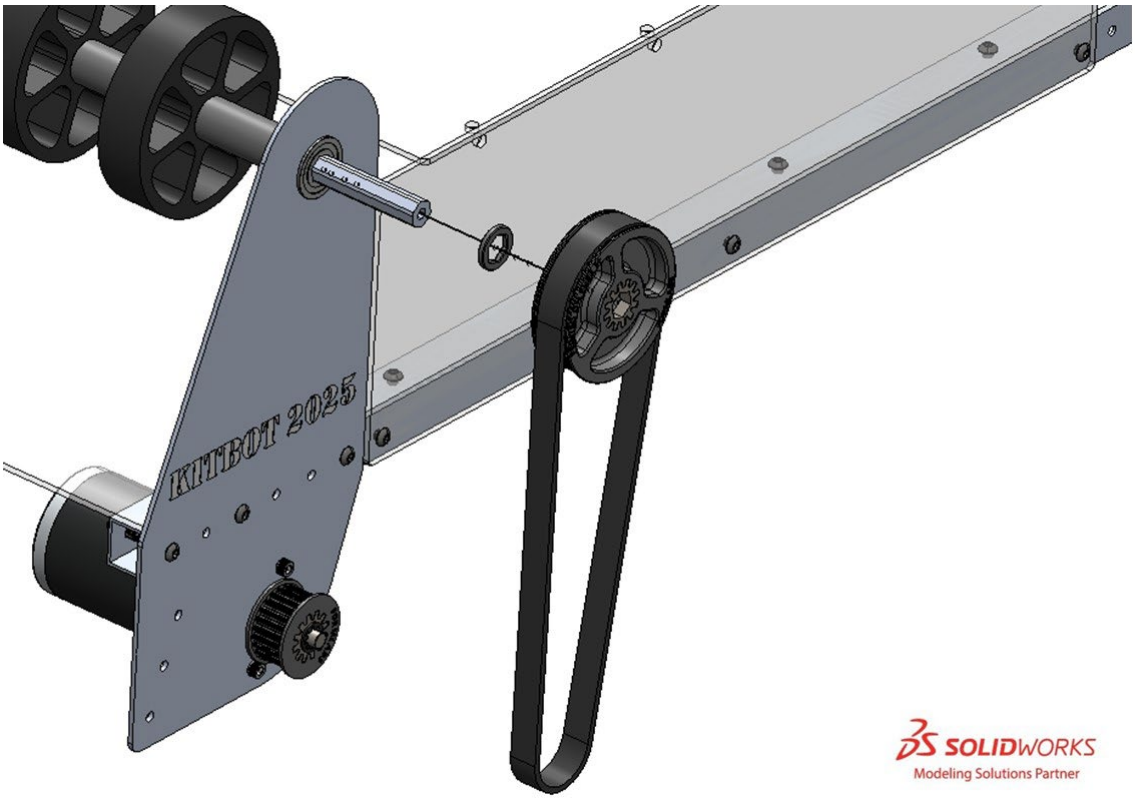
Figure 13: Assembling the Roller Shaft



Step 11: On the same side of the assembly as the small pulley (near the KitBot 2025 engraving), slide an 1/8 in. long hex spacer on to the Roller Shaft, and then slide the large pulley on with the 130 tooth HTD belt and wrap the belt around both pulleys so they are connected as shown in Figure 14.

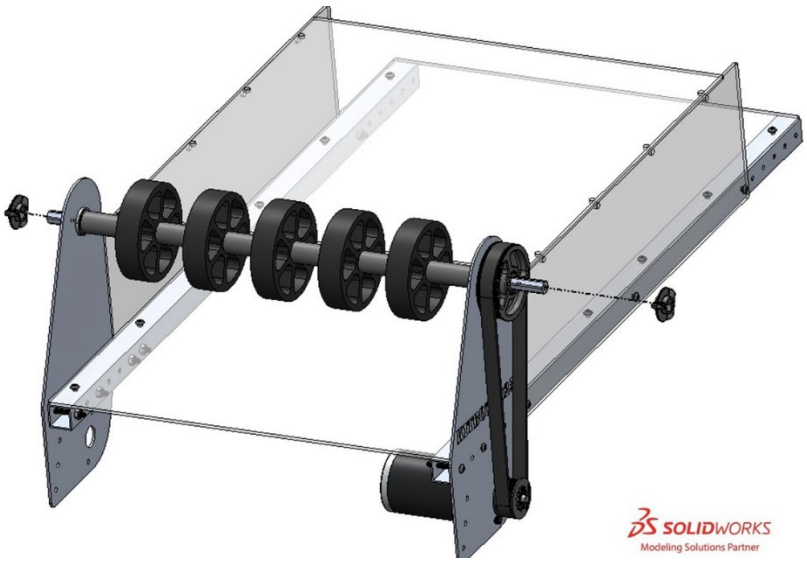
> This may be challenging, and another method of adding the belt can be to "walk" the belt on to a pulley by rotating it slowly and pushing the belt sideways on to it. Another method is to put the belt around both pulleys and push the shaft through the pulley after.

Figure 14: Assembling the Belt System



Step 12: Push the Roller Shaft so that the remaining extra shaft is approximately even on both sides, slide the Hex Shaft Collars (REV-21-1915) onto each end of the shaft, push them against the bearing and pulley on each end, then tighten the screws to lock them in place. These should keep the shaft from being able to slide sideways.

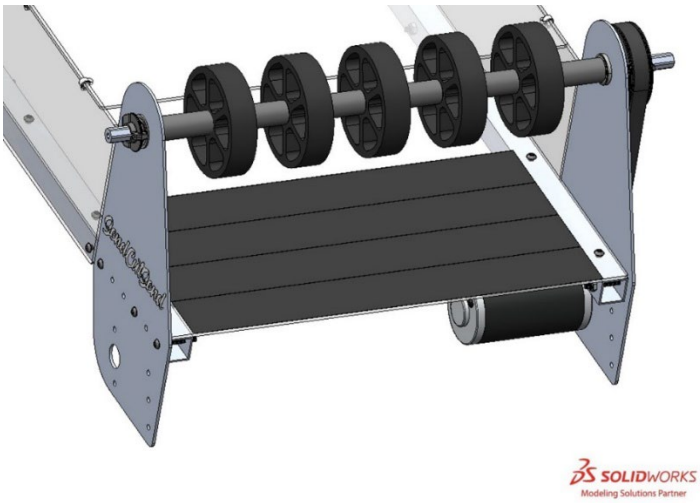
Figure 15: Adding on Shaft Collars



Step 13: Cut four 16 in. strips of 2 in. wide black Gaffer's tape and stick them in a row at the end of the Track Floor, leaving no gaps.

> These pieces of tape are meant to add friction between the game piece and the Track Floor, and therefore this tape may need to be replaced throughout the season to ensure an ample amount of friction.
>
> Additional tape may be added if desired.

Figure 16: Adding Friction Tape



6.2.2 Build the Back Frame

Figure 17: Back Frame

SOLIDWORKS Modeling Solutions Partner

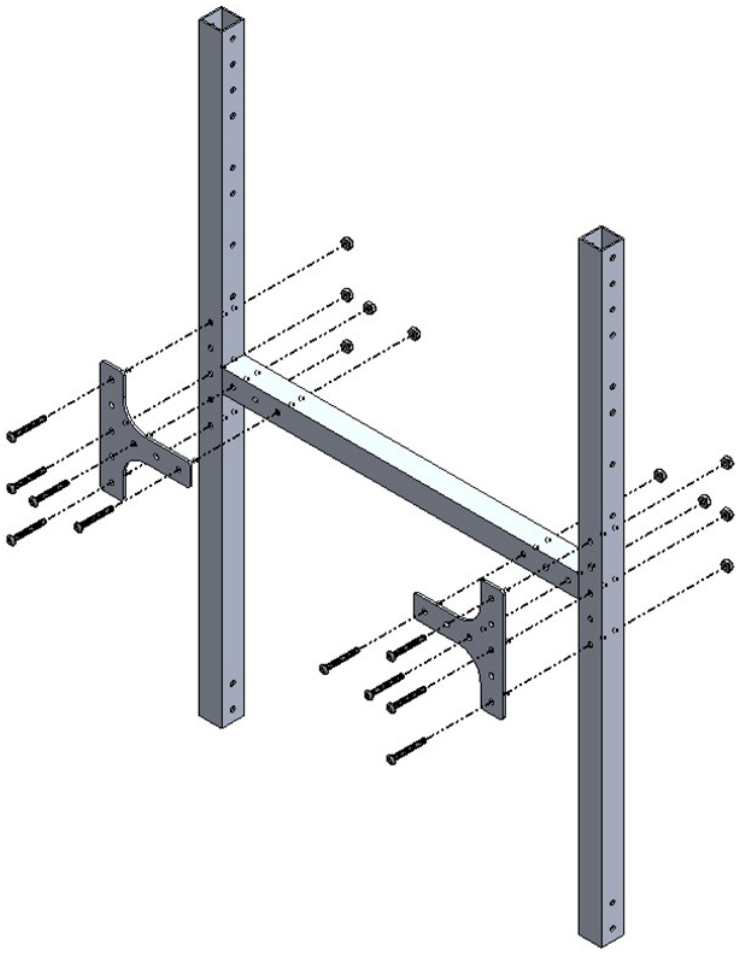
Parts needed:

- T-Bracket (KB-25004) - qty 2
- RSL Mount (KB-25005) - qty 1
- Back Vertical Post (KB-25006) - qty 2
- Crossbeam (KB-25009) - qty 1
- Radio Mount (KB-25014) - qty 2
- 1-3/4 in. long #10-32 Socket Head Cap Screw – qty 2
- 1-1/2 in long #10-32 Button Head Cap Screw – qty 12
- #10-32 Locknut – qty 14

Step 1: Find the row of five consecutive holes in approximately the middle of the Back Vertical Posts (KB-25006) and line up a T-Bracket so that all five holes line up. Do the same for the second Back Vertical Post, ensuring the Posts match direction (matching holes on top/bottom) and the T-brackets face in towards each other, as shown in Figure 18. Next, align a Crossbeam between the Back Vertical Posts, aligning the holes in the Crossbeam with the holes in the T-Brackets. Assemble these parts in this orientation with 1-1/2 in. long #10-32 button head cap screws and #10-32 locknuts, as shown below.

> Do not fully tighten these bolts until after putting bolts in all the holes so that it is easier to line up other bolt holes.
>
> If the holes are not quite lining up, start with one side, ensuring the T bracket stays square with the post and drill out holes as needed to secure.

Figure 18: Assembling the Back Frame



Step 2: With the T-Brackets facing away from you and the Back Vertical Posts oriented with the single pair of holes at the bottom, locate the fourth and fifth hole down on the outside of the right post, as shown in Figure 19. Use two 1-1/2 in. long #10-32 button head cap screws and #10-32 locknuts to attach the RSL Mount (KB-25005) so that the large hole in the RSL mount is toward you, on the opposite side of the tube compared to the T-Brackets, as shown in Figure 19.

Figure 19: Attaching the RSL Mount

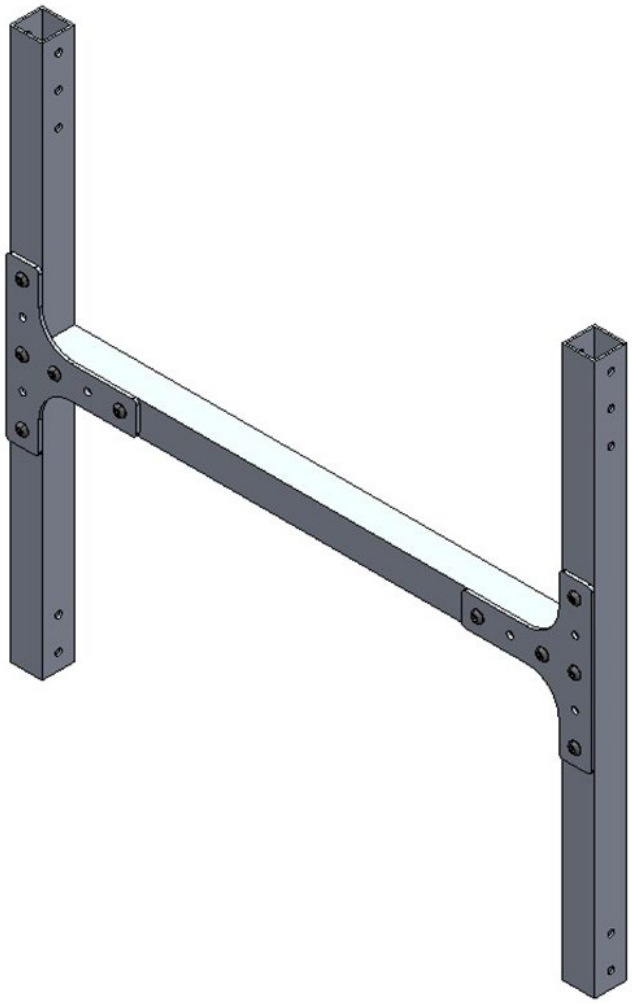
Step 3: On the top of the other Back Vertical Post, attach the 3d printed Radio Mount (KB-25014) to the sixth and eighth holes down, sandwiching the aluminum tube as shown in Figure 20. The large flat side of the Radio mounts should both face away from the T-Brackets. Attach these using two 1-3/4 in. long #10-32 socket head cap screws and #10-32 locknuts.

> The 3D printed parts have a hex shaped counterbore in them so that you don't need a wrench to hold the nut in place while tightening.

Figure 20: Attaching the Radio Mounts

6.2.3 Build the Front Frame

Figure 21: Front Frame



SOLIDWORKS Modeling Solutions Partner

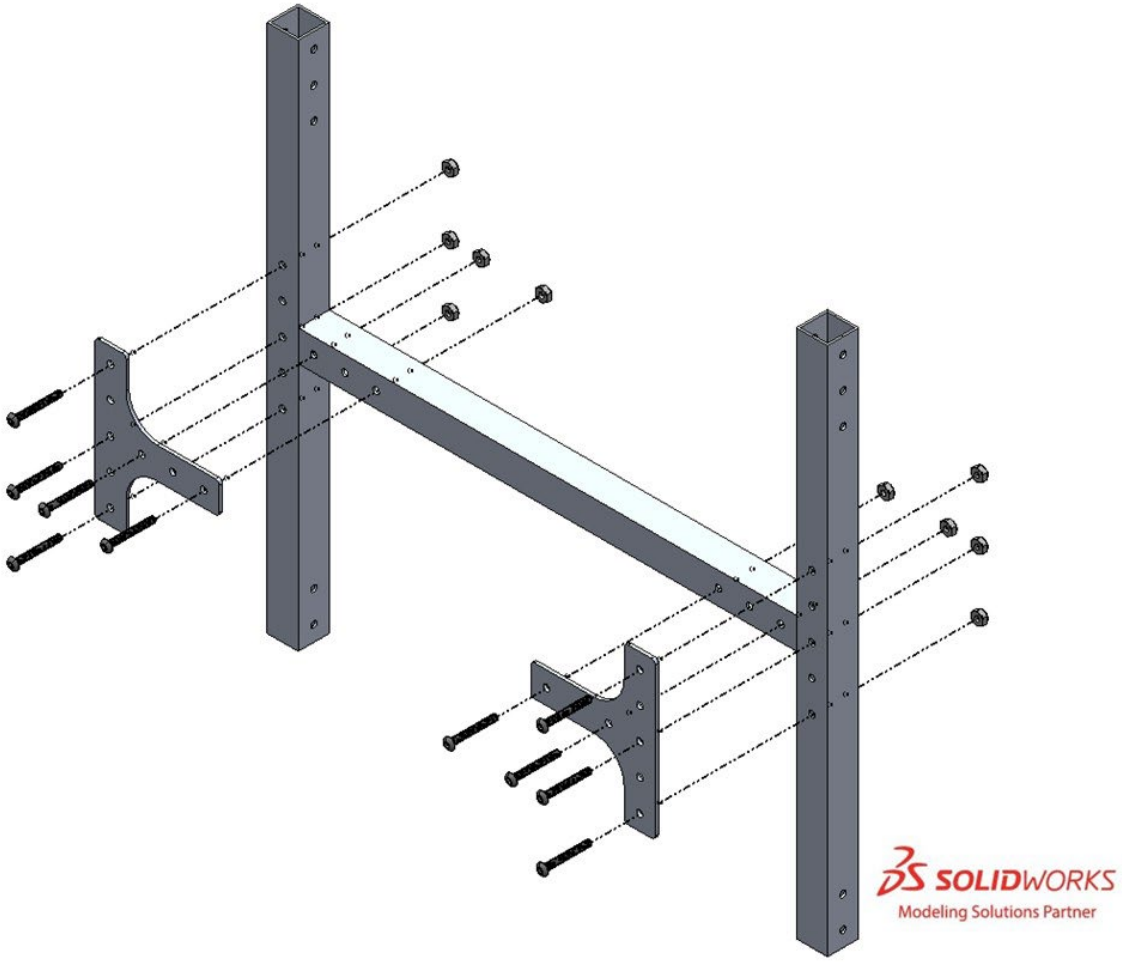
Parts needed:

- T-Bracket (KB-25004) - qty 2
- Front Vertical Post (KB-25007) - qty 2
- Crossbeam (KB-25009) - qty 1
- 1-1/2 in. long #10-32 Button Head Cap Screw – qty 10
- #10-32 Locknut – qty 10

Step 1: Find the row of five consecutive holes near the center of a Front Vertical Post (KB-25007) and line up a T-Bracket so that all five holes line up. Do the same for the second Front Vertical Post, ensuring the Posts match direction (matching holes on top/bottom) and the T-brackets face in towards each other, as shown in Figure 22. Next, align a Crossbeam between the Front Vertical Posts, aligning the holes in the Crossbeam with the holes in the T-Brackets. Assemble these parts in this orientation with 1-1/2 in. long #10-32 button head cap screws and #10-32 locknuts, as shown below.

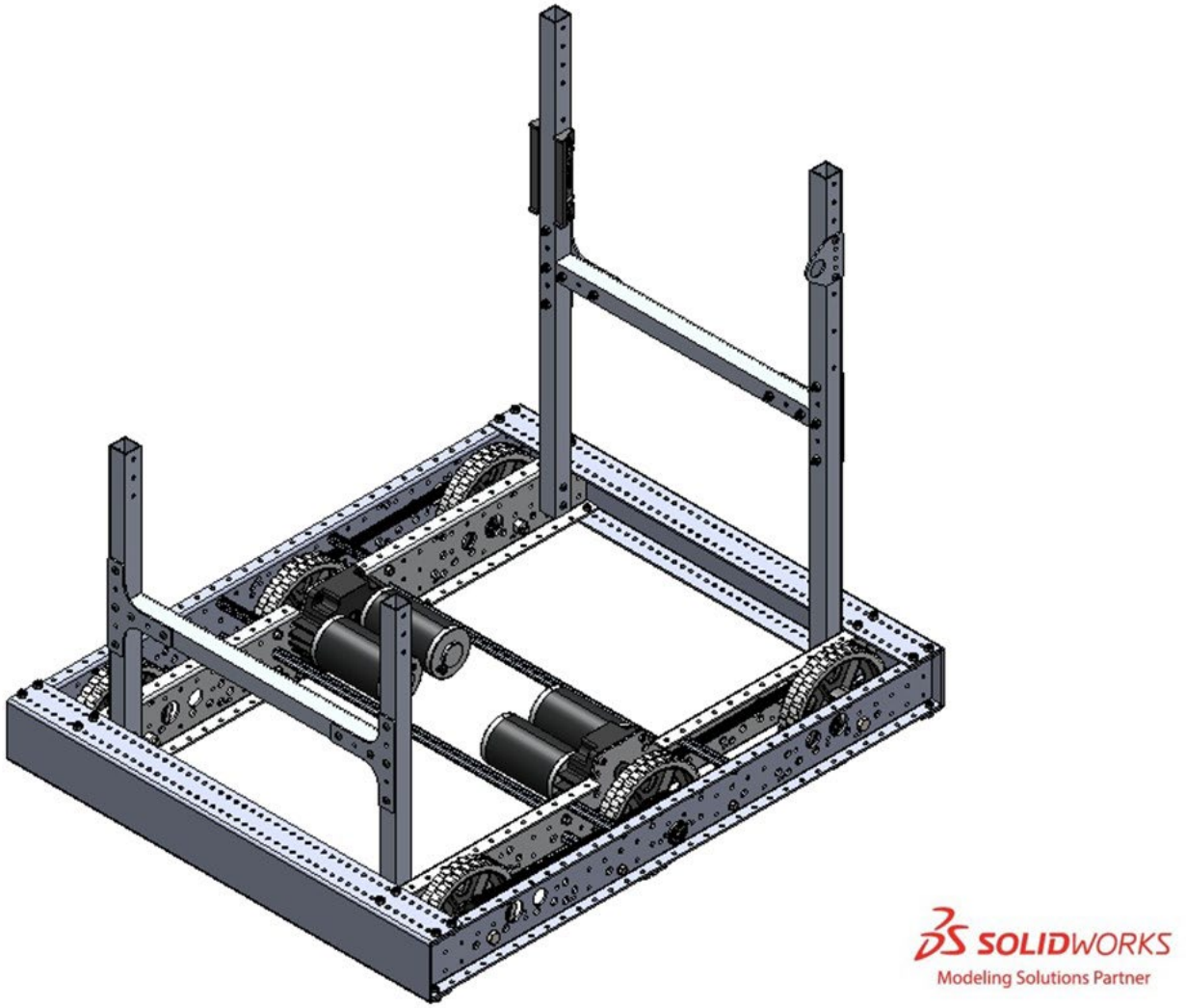
> Do not fully tighten these bolts until after putting bolts in all the holes so that it is easier to line up other bolt holes.

Figure 22: Assembling the Front Frame



6.2.4 Attach Front and Back Frames to the Drive Base

Figure 23: Front and Back Frames on the Robot



Parts needed:

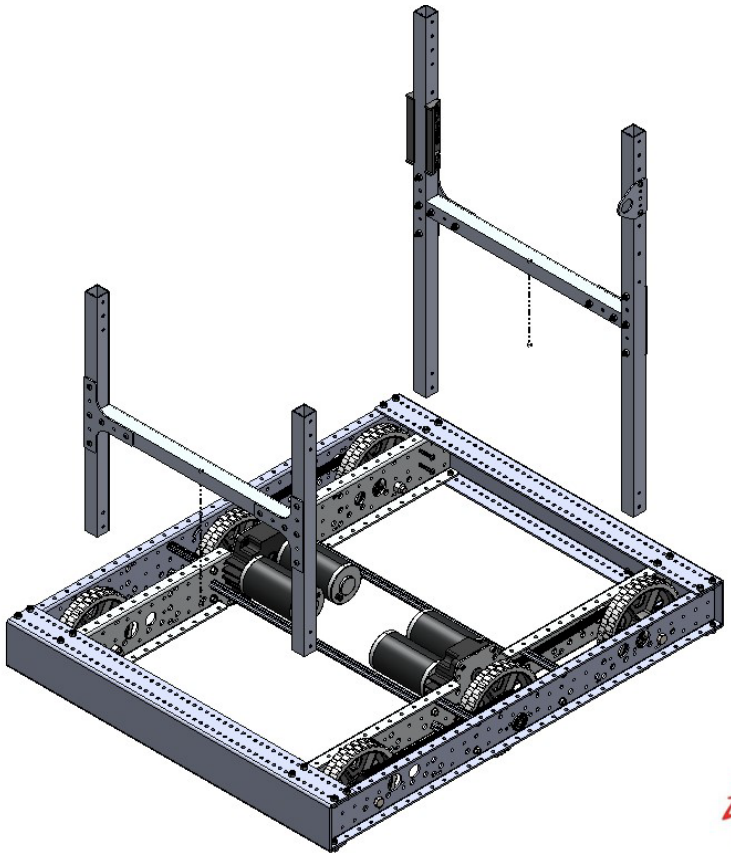
- Front Frame (from 6.2.3)
- Back Frame (from 6.2.2)
- AM14U6 Drive Base
- 1-1/2 in. long #10-32 Button Head Cap Screw – qty 8
- #10-32 Locknut – qty 8

Step 1: With the T-Brackets facing the outside of the robot, drop the Front Frame and Back Frame into the completed AM14U6 Drive Base so that the bottom of the tubes (the sides that have two holes) are below the top of the rails. Attach these frames to the Drive Base with 1-1/2 in. long #10-32 button head cap screws and #10-32 locknuts, with the bolt head facing the inside of the robot.

Pay special attention to Figure 24, Figure 25, and Figure 26 below to make sure you are attaching these frames into the correct locations.

> If you are struggling to fit a wrench in or to get the locknut into place while tightening, you can either:
>
> A. remove the outer plate and front and back wheels of the drivetrain to increase access.
> B. Use a small piece of tape and place it on the back side of the wrench (works especially well on the closed side if the wrench has one) and then place the nut into the pocket formed by the tape. This allows you to use the wrench to carry the nut into the correct spot to get started.

Figure 24: Attaching the Front and Back Frames



SOLIDWORKS Modeling Solutions Partner

Figure 25: Bolt Hole Locations for Front and Back Frames

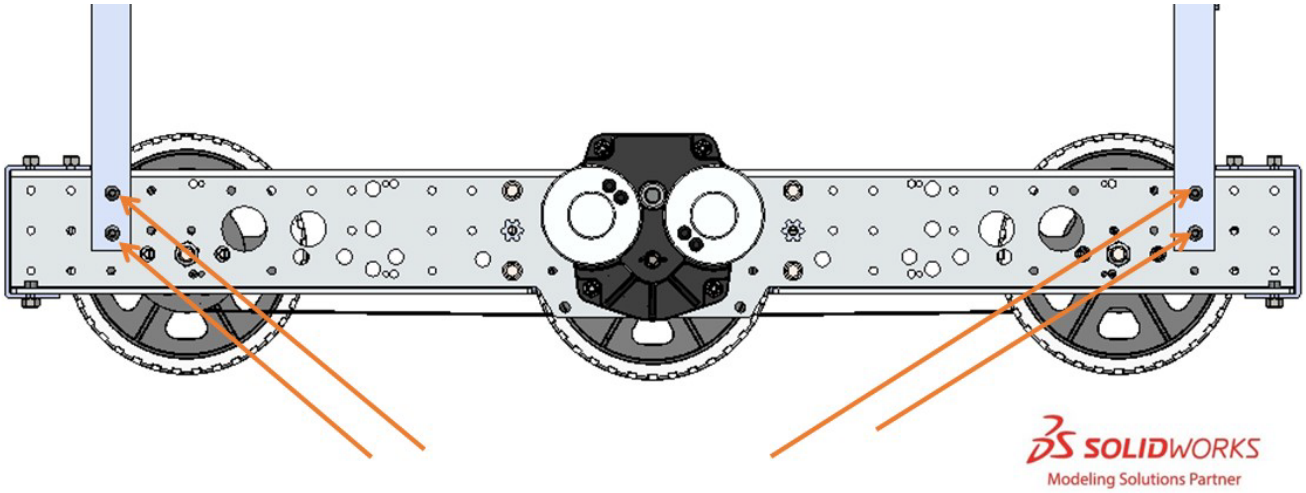
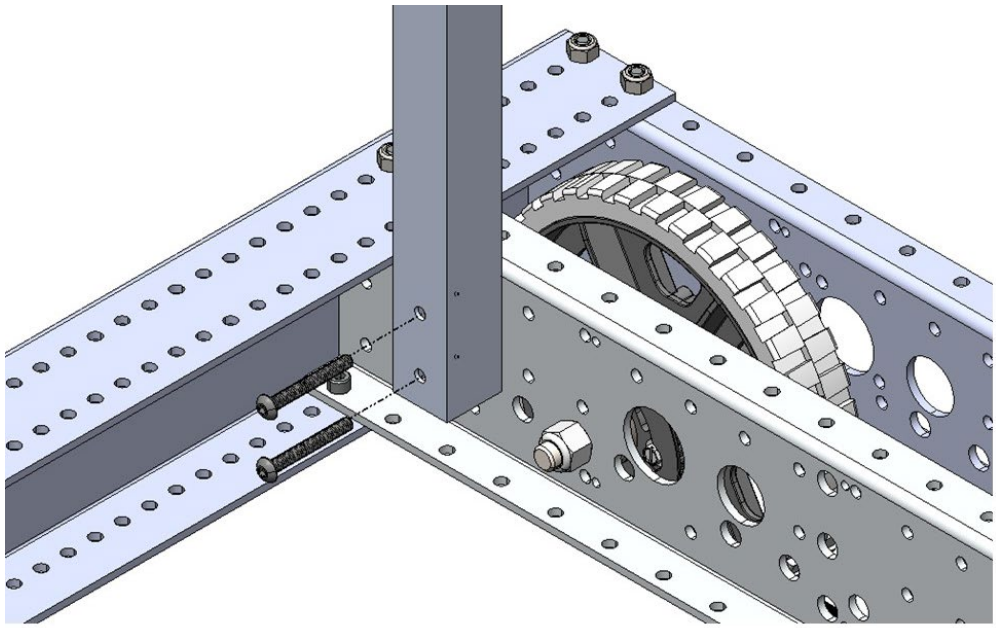
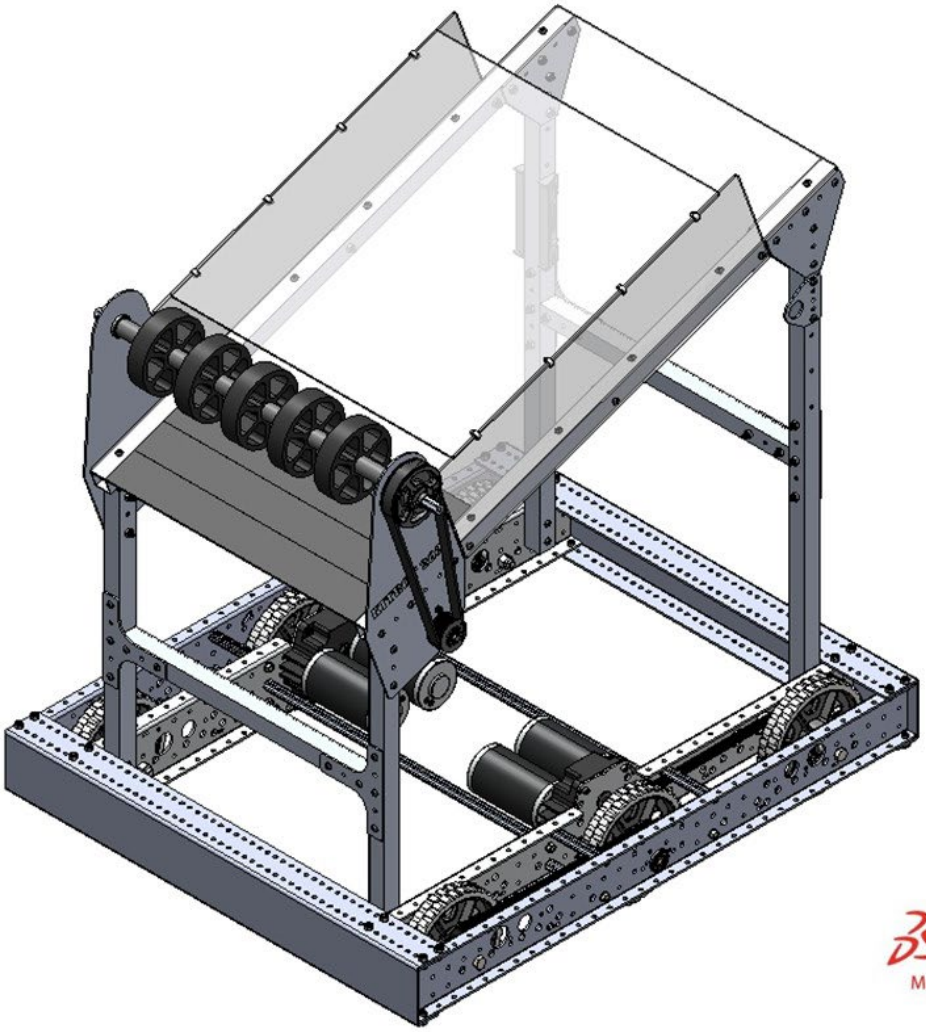


Figure 26: Bolt Direction for Front and Back Frames



6.2.5 Attach the Top Frame

Figure 27: Top Frame on the Robot



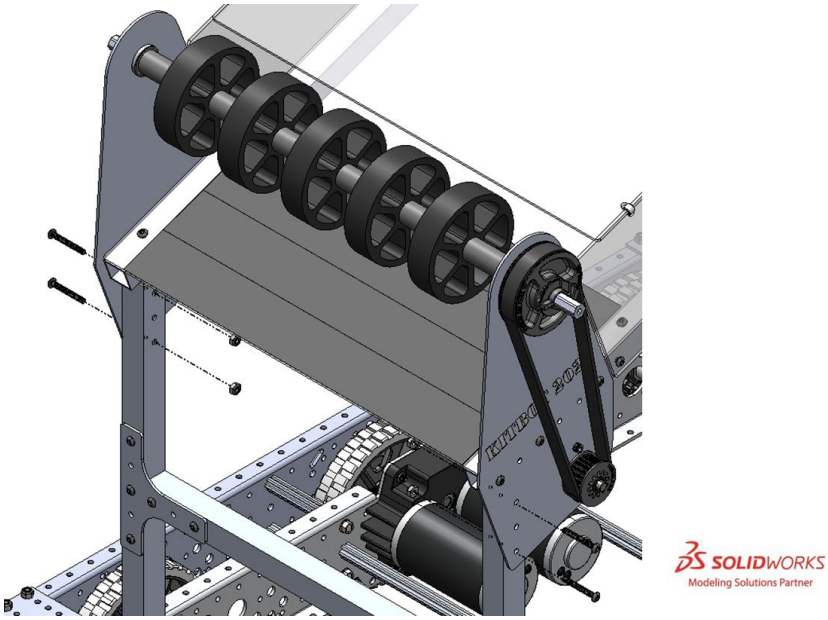
Parts needed:

- Robot through 6.2.4
- Top Frame (from 6.2.1)
- Back Angle Plate (KB-25003) - qty 4
- 1-1/2 in. long #10-32 Button Head Cap Screw – qty 14
- #10-32 Locknut – qty 14

Step 1: Take the top frame and line up the remaining holes on the Roller Plates to the Front Frame and attach with two 1-1/2 in. long #10-32 button head cap screws and #10-32 locknuts on each side.

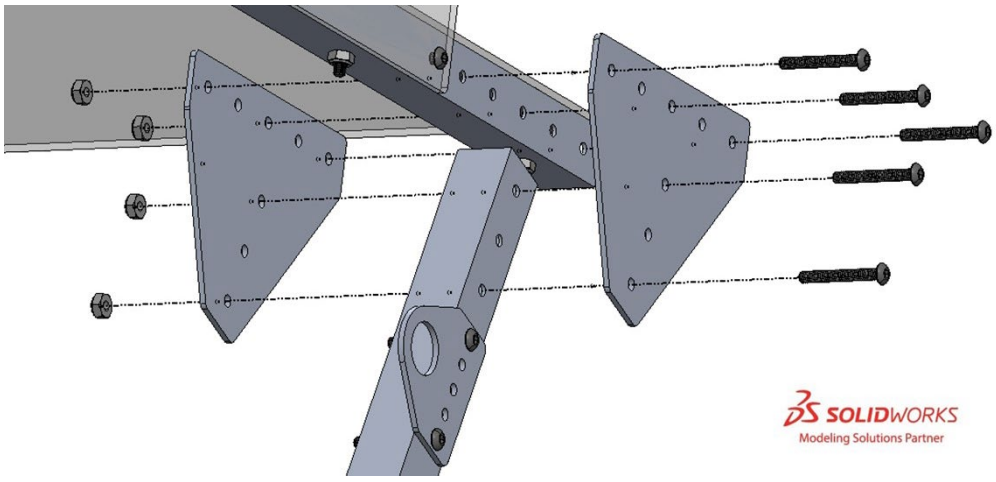
> Do not fully tighten these bolts until after completing Step 2: so that it is easier to line up other bolt holes.

Figure 28: Attaching the Top Frame to the Front Frame



Step 2: Use the Back Angle Plates (KB-25003) and sandwich them around the Top Frame and the Back Frame, as shown in Figure 29, then attach with 1-1/2 in. long #10-32 button head cap screws and #10-32 locknuts.

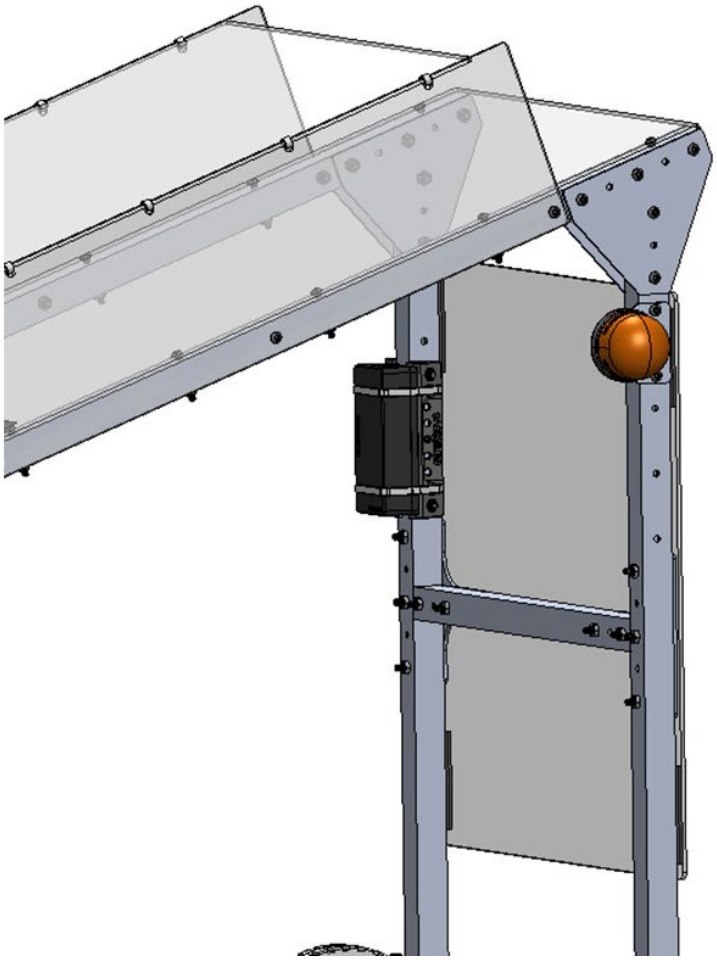
Figure 29: Attaching the Top Frame to the Back Frame



Step 3: Once all bolts have been attached, go back and tighten bolts from the previous steps.

6.2.6 Radio, RSL and Protective Panels

Figure 30: Electronics and Panels

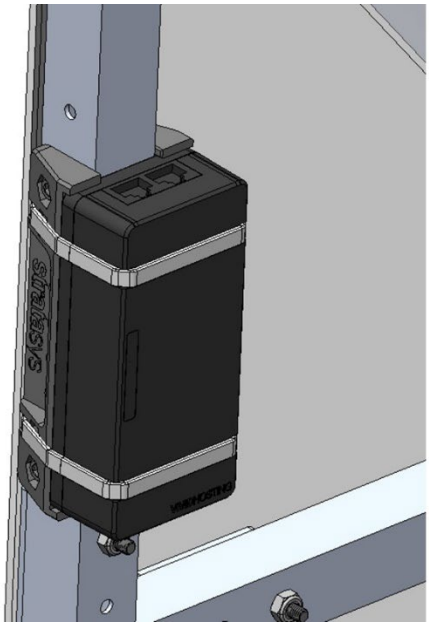


Parts needed:

- Robot through 6.2.5
- Front Guard Panel (KB-25020) - qty 1
- Back Guard Panel (KB-25021) - qty 1
- Reclosable Fastener
- VH-109 Radio – qty 1 (available from the Season Specific Box)
- RSL Light – qty 1
- 50lb Cable Ties – qty 2

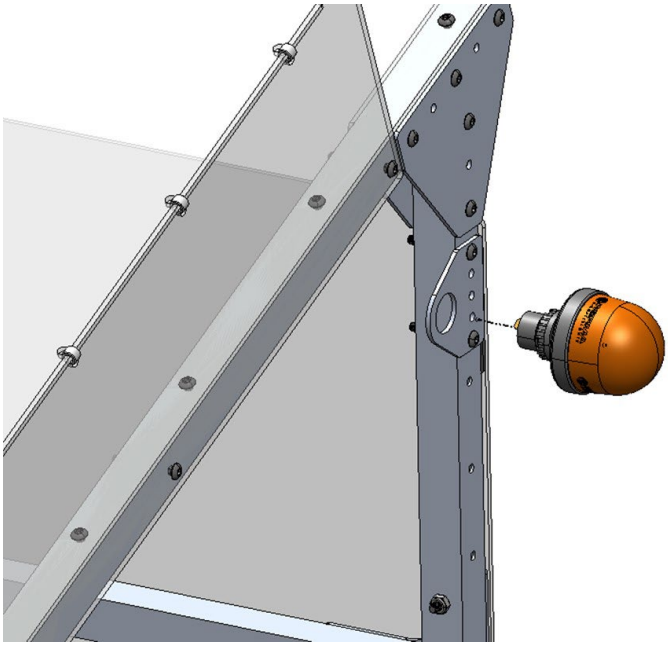
Step 1: Take the VH-109 Radio and attach it to the 3D Printed Radio Mounts with two 50lb cable ties wrapping around the vertical box tube, ensuring the power connection is facing down. Cut off the excess cable tie with flush cutters after tightening.

Figure 31: Attaching the Radio



Step 2: Remove the plastic nut from the RSL. Insert the RSL (Radio Signal Light) into the RSL Mount Plate (KB-25005) on the Back Frame so that the light is on the outside of the robot, then use the plastic nut to attach the RSL to the plate.

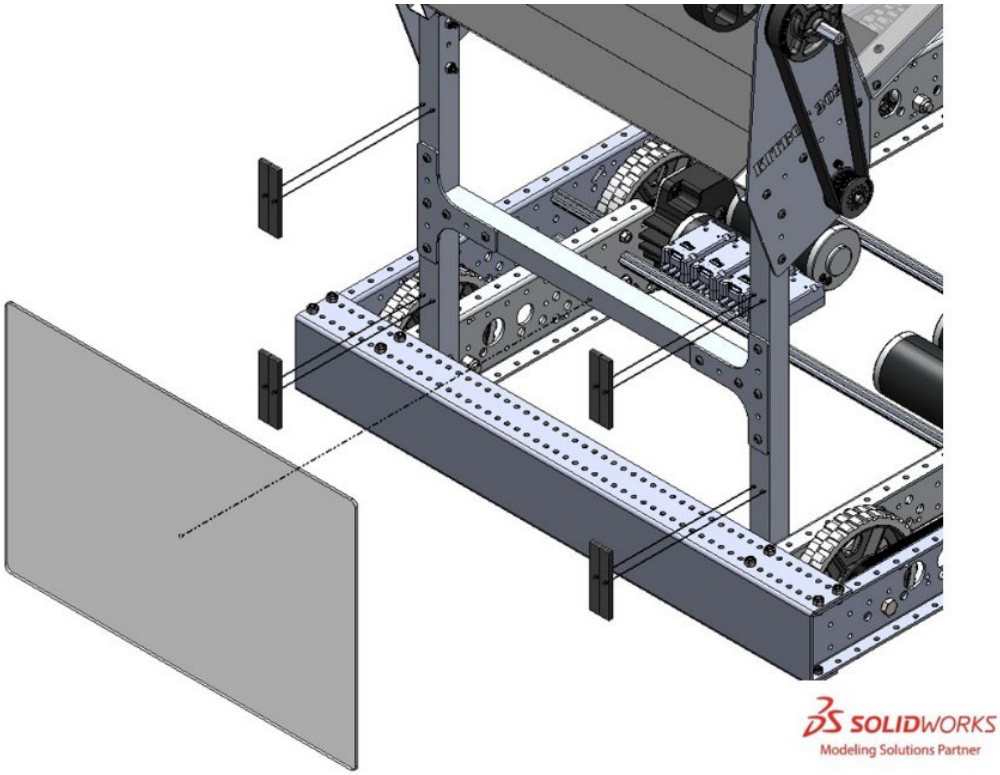
Figure 32: Attaching the RSL



Step 3: Stick multiple pieces of Reclosable Fastener (approximately 2 in. long) on the Front Frame aluminum tubes and the Front Guard Panel (KB-25020) so that the panel can be added and removed from the robot repeatedly and easily.

> One technique to attach the panels is to secure matching pieces of the reclosable fastener. Next, peel the backing from one side of the matching pieces exposing the adhesive and stick the reclosable fastener onto the panel in each spot. Then remove the backing from the other side of the Reclosable Fasteners and carefully position the guard panel onto the aluminum tubes and press it into place (make sure to press firmly and give the adhesive some time to adhere before removing the panel).

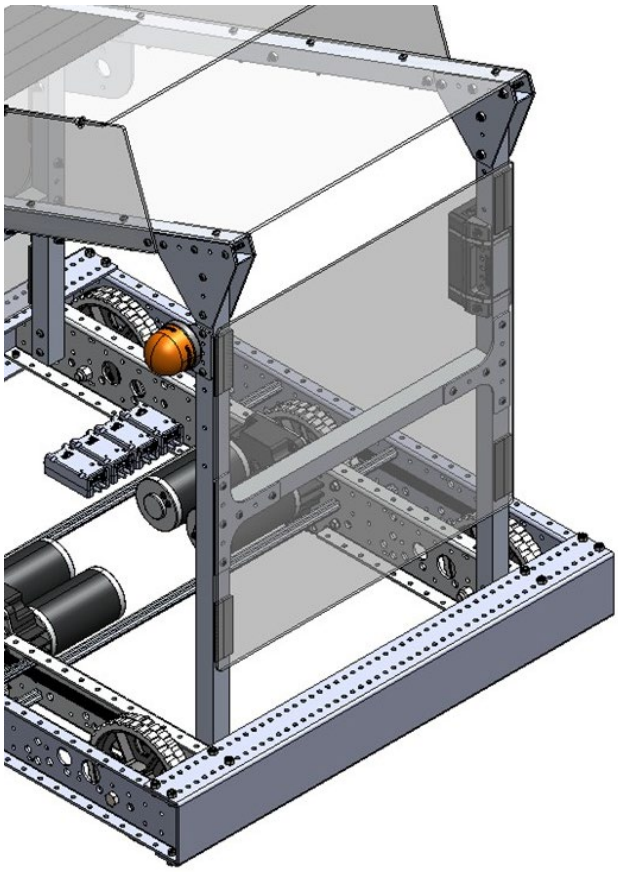
Figure 33: Attaching the Front Guard Panel



Step 4: Similar to the last step, stick multiple pieces (approximately 2 in. long) of Reclosable Fastener on the Back Frame aluminum tubes and the Back Guard Panel (KB-25021) so that the panel can be added and removed from the robot repeatedly and easily.

> These two panels are a great place to add stickers of your team sponsors and logos.

Figure 34: Attaching the Back Guard Panel



7 Bumper Assembly

The following section suggests two different ways on how to build 2 sets of bumpers (red and blue), but teams may choose to use other materials and processes if desired. Be sure to reference the 2025 Game Manual for specifics on what is and is not allowed.

Teams sourcing materials themselves may choose Option 1 or 2 or do a different process if preferred and can reference the Bumper Guide for an overview of other materials and methods for making bumpers.

7.1 Option 1 – L Bumpers

For teams using the materials provided in the Rookie Tote, L Bumpers are recommended as they better utilize the materials in the Rookie Tote. Rookie teams will still need to source additional pool noodles to make 2 sets or figure out how to do swappable bumper covers (some recommendations are in the Bumper Guide). These directions assume that teams have sourced additional pool noodles.

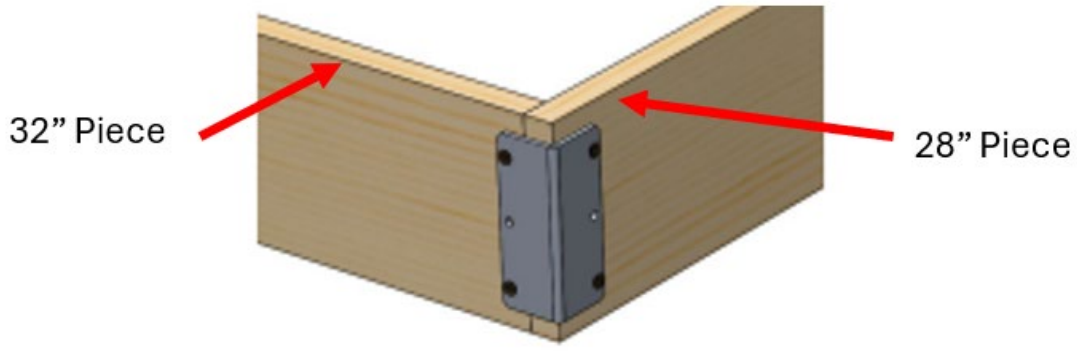
Step 1: Cut ¾ in. Plywood according to the following dimensions:

Table 10: Bumper Backing Dimensions

Dimensions	Quantity
32 in. x 5 in. (813 x 127 mm)	4
28 in. x 5 in. (711 x 127 mm)	4

Step 2: Attach one of the 32 in. long pieces to the 28 in. long pieces with a corner bracket. Ensure that the end of the 32 in. should meet the face of the 28 in. piece

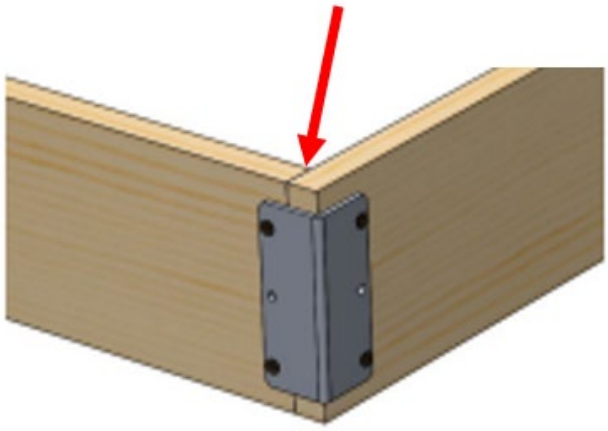
Figure 35: Correct Alignment of wood



Step 3: Repeat Step 2 with all pieces of wood.

Step 4: Measure and mark 2 in. and 20 in. from the inside edge of the corner (as shown in Figure 36) on the smaller length of wood (28 in.).

Figure 36: Correct spot to measure from



Step 5: Measure and mark 7 in. & 27 in. (178 mm & 686 mm) from the inside edge of the corner (as shown in Figure 36) on the longer length of wood (32 in.)

Step 6: Align the brackets and attach as described in the bumper mounting instructions.

Step 7: Cut pool noodles to the following dimensions:

Table 11: Pool Noodle Lengths

Length	Quantity
33.5 in. (851 mm)	8
34.5 in. ***** (876 mm)	8

***** For an easy performance increase, we recommend that teams purchase ½ in. (13 mm) foam tiles and cut the sheets to be 5 in. (127 mm) by the above lengths and place behind pool noodles. If teams do this, add 1 in. (26 mm) to the longer dimension noodle (34.5 in.) to end up at 35.5 in. (902 mm) in length

It's easiest to cut pool noodles with a serrated knife. Smaller pieces of pool noodle may be combined to meet the total length needed but additional tape may be needed to secure in place.

Step 8: Attach pool noodles to wood with a piece of tape taking care to not compress the pool noodles.

The pool noodles on the shorter piece of wood will overhang on both sides so pieces should be placed approximately center.

Step 9: Cut Fabric to the following dimensions:

Dimensions	Quantity
77 in. x 15 in. ***** (196 cm x 38 cm)	4 red, 4 blue

> ***** For teams using the fabric provided in the Rookie Kit, it's easiest to cut the material in half and use half the material for each bumper segment and trim excess after attaching

Step 10: Wrap the fabric around the pool noodles and attach fabric to the back of the wood with staples.

> If you plan to use another method besides paint to attach team numbers, attach numbers before attaching the fabric
>
> For recommended fabric attachment processes, please refer to the Bumper Guide for options.

Step 11: Trim excess fabric to make attaching bumpers to the robot easier.

> Be careful not to trim too close to the staples.

Step 12: Paint your team numbers on each side of the bumpers, as described in the Game Manual. (assuming you have not already attached numbers using another method)

7.2 Option 2 – Straight Segments

If not using the material from the Rookie Kit, some teams may prefer to fabricate bumpers as individual segments. These individual segments are easier to transport and may be easier to get the brackets installed such that they all line up with the robot correctly.

Step 1: Cut ¾ in. Plywood according to the following dimensions:

Table 12: Bumper Backing Dimensions

Dimensions	Quantity
32 in. x 5 in. (813 x 127 mm)	4
28 in. x 5 in. (711 x 127 mm)	4

Step 2: Measure and mark 2.75 in. & 20.75 in. (70 mm & 527 mm) from one edge on the smaller length of wood (28 in.).

Step 3: Measure and mark 7 in. & 27 in. (178 mm & 686 mm) from one edge on the longer length of wood (32 in.)

Step 4: Align the brackets and attach as described in the bumper mounting instructions.

Step 5: Cut pool noodles to the following dimensions:

Table 13: Pool Noodle Lengths

Length	Quantity
33.5 in. (851 mm)	8
34.5 in. ***** (876 mm)	8

***** For an easy performance increase, we recommend that teams purchase ½ in. (13 mm) foam tiles and cut the sheets to be 5 in. (127 mm) by the above lengths and place behind pool noodles. If teams do this, add 1 in. (26 mm) to the longer dimension noodle (34.5 in.) to end up at 35.5 in. (902 mm) in length

It's easiest to cut pool noodles with a serrated knife. Smaller pieces of pool noodle may be combined to meet the total length needed but additional tape may be needed to secure in place.

Step 6: Attach pool noodles to wood with a piece of tape taking care to not compress the pool noodles.

Step 7: Cut Fabric to the following dimensions:

Dimensions	Quantity
44 in. x 15 in. ***** (112 cm x 38 cm)	4 red, 4 blue

***** For teams using the fabric provided in the Rookie Kit, only 160 in. of fabric is provided, if attempting single segments, you will have to optimize use of the fabric beyond what is suggested in the table (you may need to secure the fabric to the side of the plywood instead of the back).

The lengths of the bumpers are close enough, so we recommend cutting all fabric the same and trimming excess after the fabric has been attached.

Step 8: Wrap the fabric around the pool numbers and attach fabric to the back of the wood with staples.

If you plan to use another method besides paint to attach team numbers, attach numbers before attaching the fabric

For recommended fabric attachment processes, please refer to the Bumper Guide for options.

Step 9: Trim excess fabric to make attaching bumpers to the robot easier.

Be careful not to trim too close to the staples.

Step 10: Paint your team numbers on each side of the bumpers, as described in the Game Manual. (assuming you have not already attached numbers using another method)

8 Electronics & Wiring

The electronics panel for the KitBot is also designed to enable parallel work. Components can be attached to the panels, and some of the wiring can be done before installing the panels on the robot. You can attach these panels before or after the KitBot superstructure.

The KitBot electronics panels are rectangular panels 19.75 in. x 6.5 in. (500mm x 165 mm) made from ¾ in. (19 mm) plywood. This material is probably a bit overkill but allows for the same material as used for bumper backing and provides stiffness across the center of the drive base. The panels are positioned across the chassis on either side of the center gearboxes/motors. To make the holes for mounting the panels to the chassis, you can use a chassis rail (if your chassis is not assembled) or flip the chassis (if already opened) over to mark the hole locations from the bottom up. It is recommended to secure the panel with at least 4 bolts, 1 near each corner.

The wiring document indicates where you should pause if you have not yet installed the panels on the KitBot.

You'll also need to install the battery tray, this can be done either before or after the rest of the electronics.

9 Next Steps

Congratulations, you have successfully completed the KitBot. After your robot is constructed, check out the code and software guides to get it up and running. The KitBot Enhancement/Iteration Guide has some tips on how to purposefully test your robot and decide on improvements.

The Guide to Selecting Drivers can provide some ideas about how to narrow down who will drive/operate your robot in competition and the Improving Driver Performance document can help provide ideas for how they can practice effectively.

It is highly recommended to do a self-inspection prior to attending an event to help identify any issues before attending the event. Teams can do this by utilizing the Inspection Checklist (keep an eye out for this to be released in a Team Update) and verifying their robot complies with each item on the list.

Teams are also encouraged to start the inspection process as soon as possible. First, go to the inspection station to figure out how the inspection process works at your event. Even if you are not 100% ready, partial inspections, such as height and weight compliance, can be started early to minimize surprises and ensure you get inspected before qualification matches begin.

10 Troubleshooting

The KitBot performs best when using fully charged batteries. With this, we highly recommend teams check the batteries they are using and have multiple batteries to ensure time to recharge between matches.

10.1 Problem: Pipe Not Ejecting (Roller Stalling)

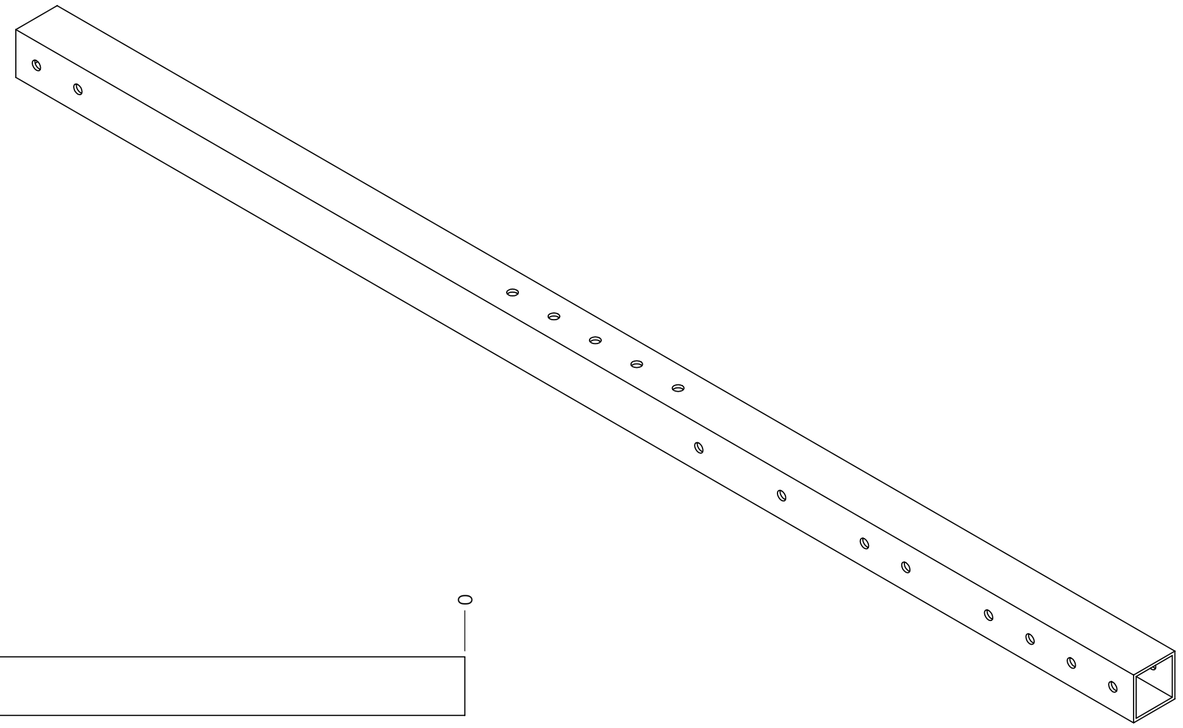
Potential Solutions:

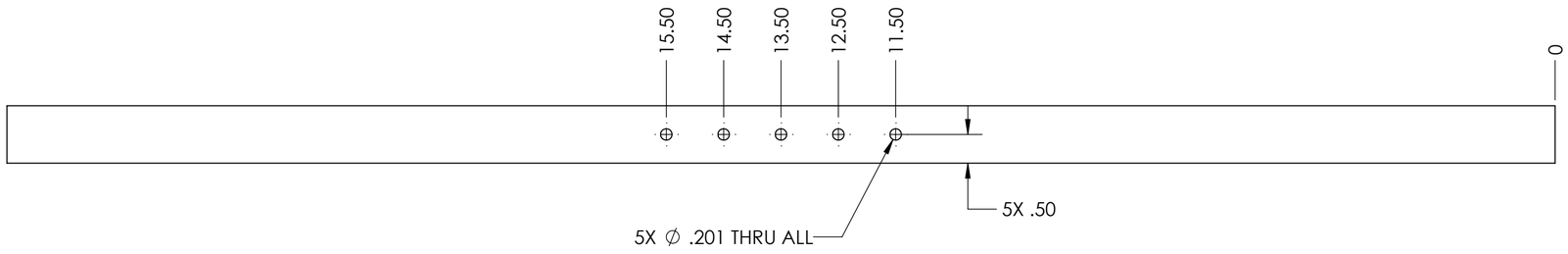
- Ensure the robot has a charged battery
- Verify that all electrical connections to the roller motor are secure
- Increase the roller motor power in the robot code (you may wish to create multiple buttons with different power settings)
- Verify that Gaffer's Tape has been attached to increase friction and is not worn out

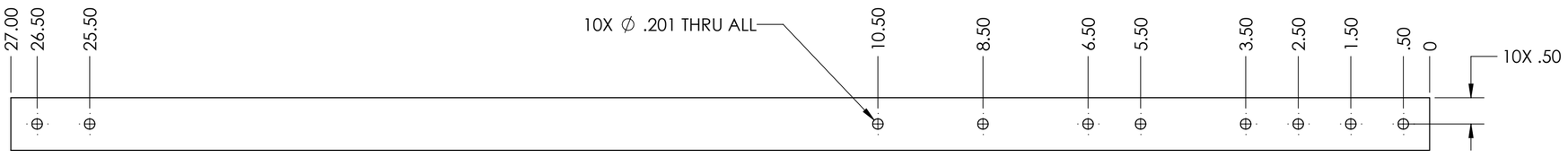
10.2 Problem: Pipe Ejected too Forcefully

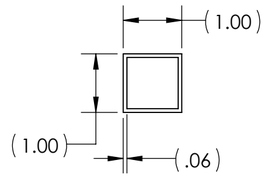
Potential Solutions:

- Decrease roller motor power in robot code (you may wish to create multiple buttons with different power settings)









UNLESS OTHERWISE SPECIFIED:

DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ±1/16
ANGULAR: MACH ±1° BEND ±1°
TWO PLACE DECIMAL ±.01
THREE PLACE DECIMAL ±.005

MATERIAL/FINISH:

1" x 1" x 1/16" 6061
Aluminum Box Tube

DO NOT SCALE DRAWING

	VEND	NAME	DATE
DRAWN		JO	9/10/2024

PROPRIETARY AND CONFIDENTIAL

COMMENTS:

REMOVE ALL BURRS AND SHARP EDGES.

FIRST ROBOTICS COMPETITION

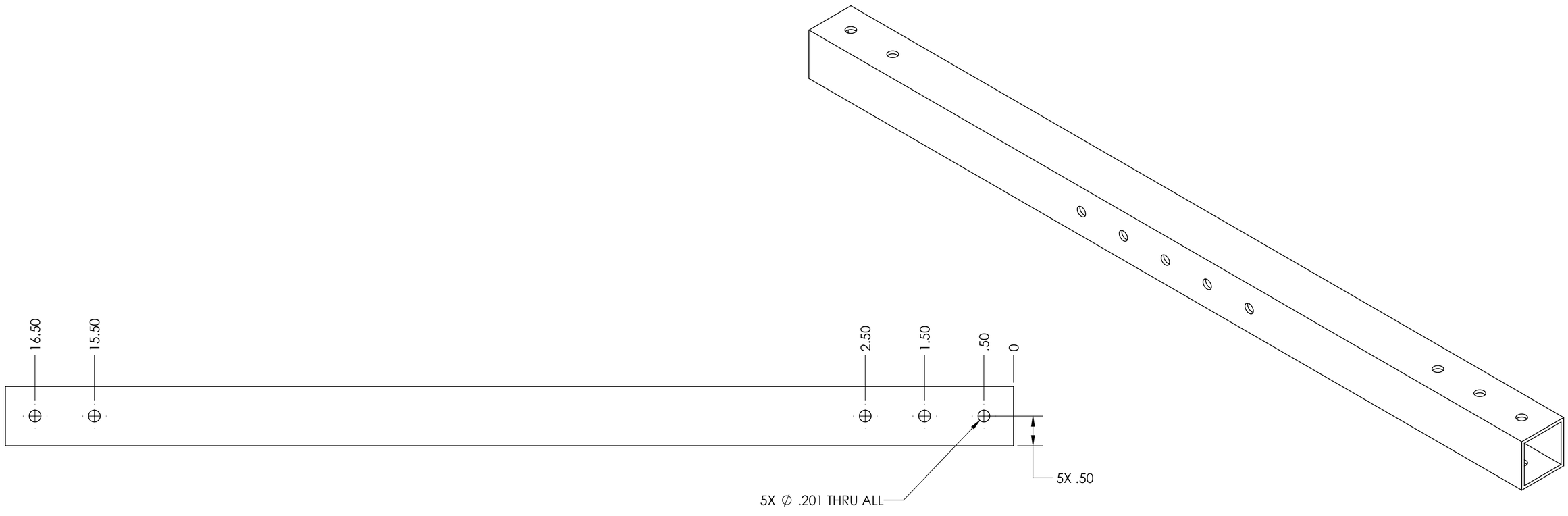
SOLIDWORKS Modeling Solutions Partner

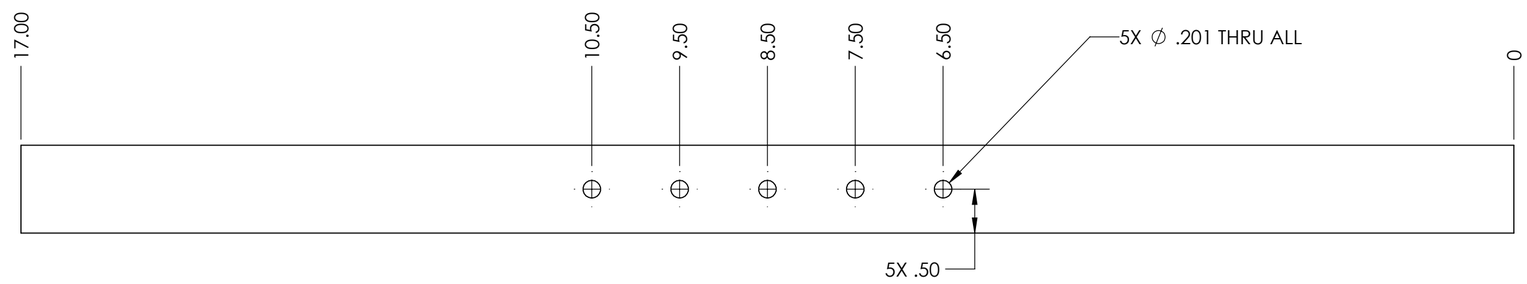
TITLE:

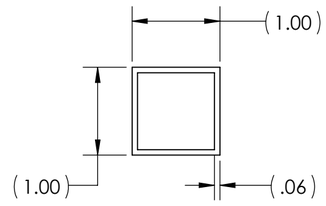
Back Vertical Post

SIZE	DWG. NO.	REV
C	KB-25006	

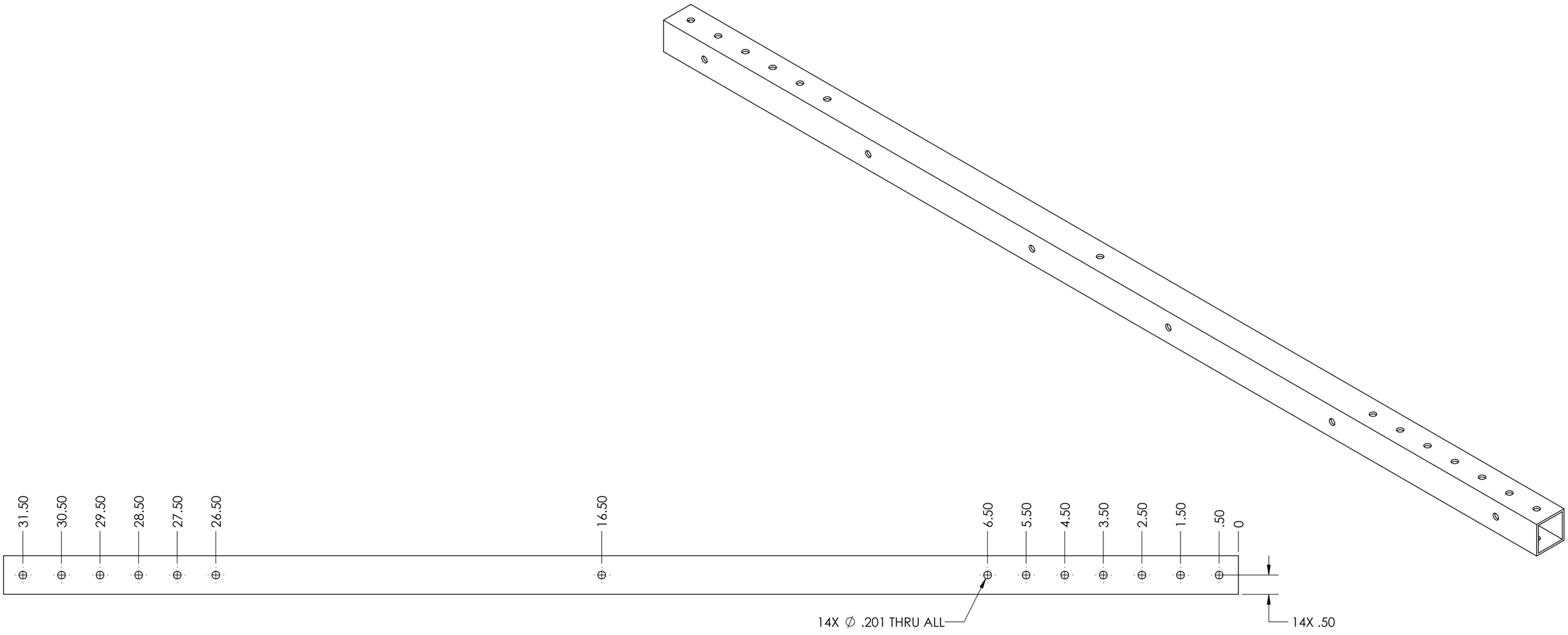
SCALE: 1:2 SHEET 1 OF 1

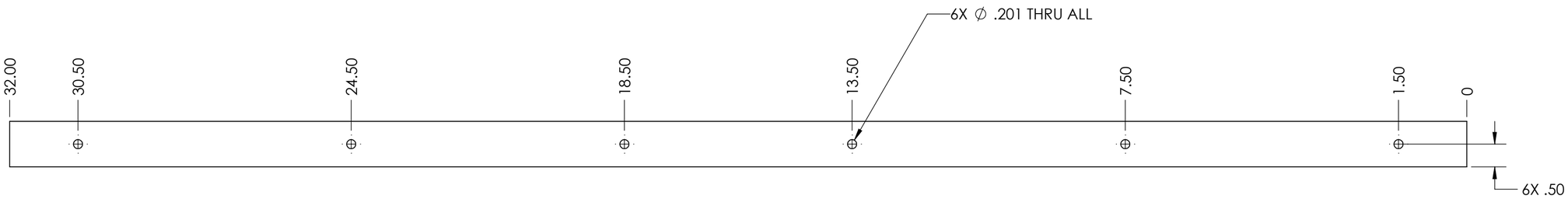


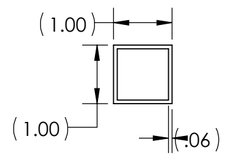




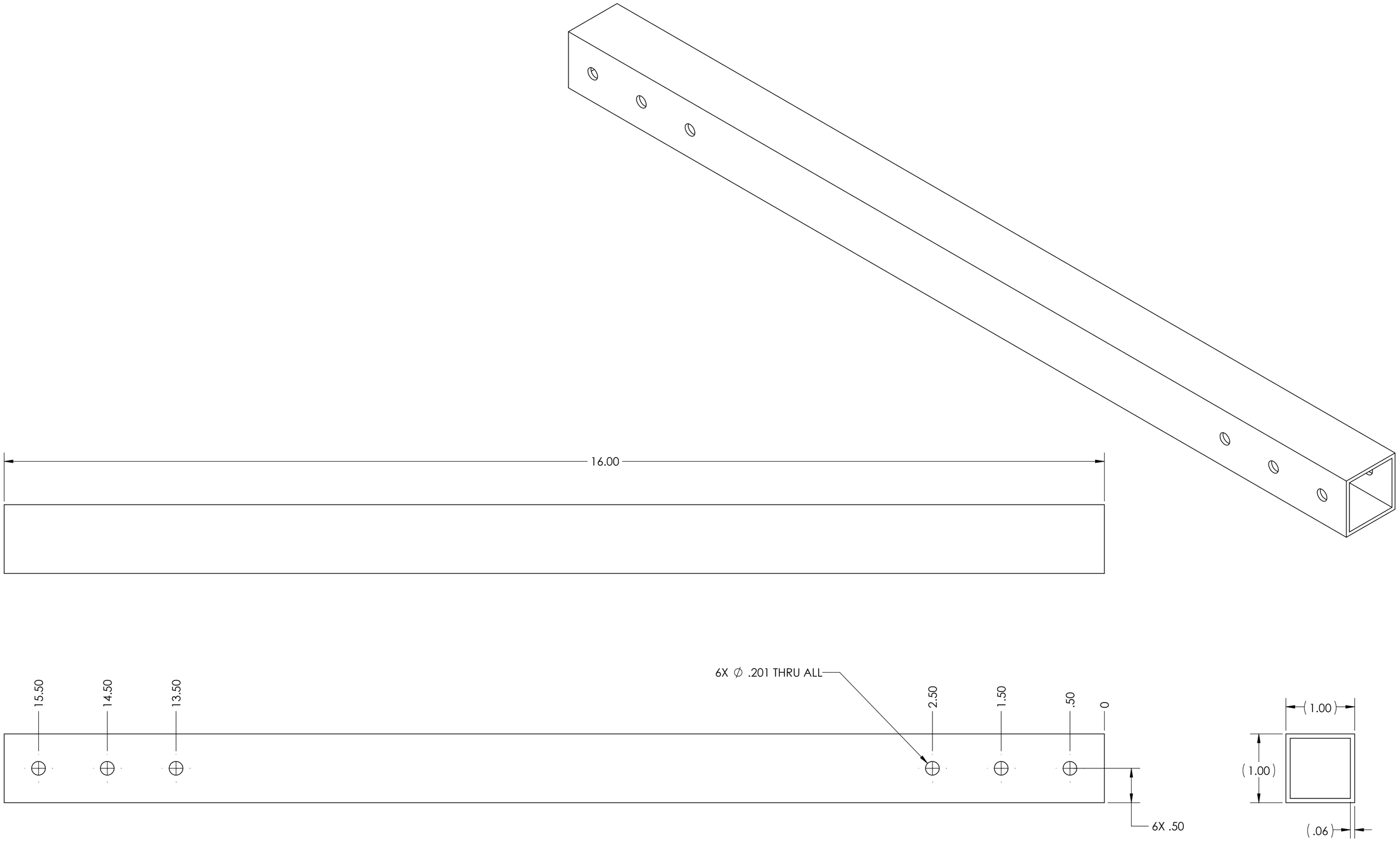
UNLESS OTHERWISE SPECIFIED:	VEND	NAME / DATE
DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ±1/16 ANGULAR: MACH ±1° BEND ±1° TWO PLACE DECIMAL ±.01 THREE PLACE DECIMAL ±.005	DRAWN	JO / 9/10/2024
MATERIAL/FINISH: 1" x 1" x 1/16" 6061 Aluminum Box Tube	**PROPRIETARY AND CONFIDENTIAL** THE INFORMATION 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.	TITLE: Front Vertical Post
DO NOT SCALE DRAWING	**COMMENTS:** REMOVE ALL BURRS AND SHARP EDGES.	SIZE: C / DWG. NO.: KB-25007 / REV: / SCALE: 3:4 / SHEET 1 OF 1





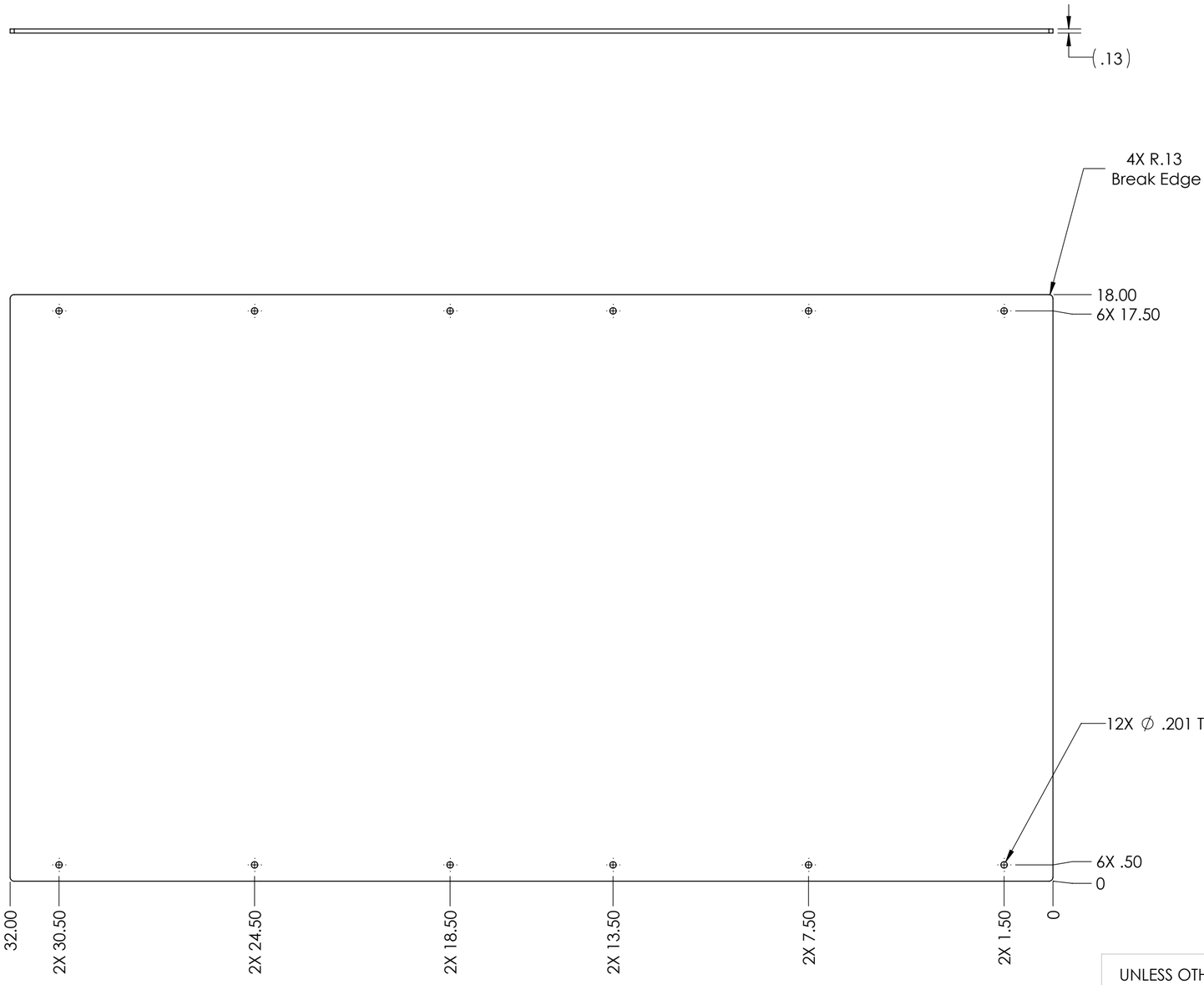


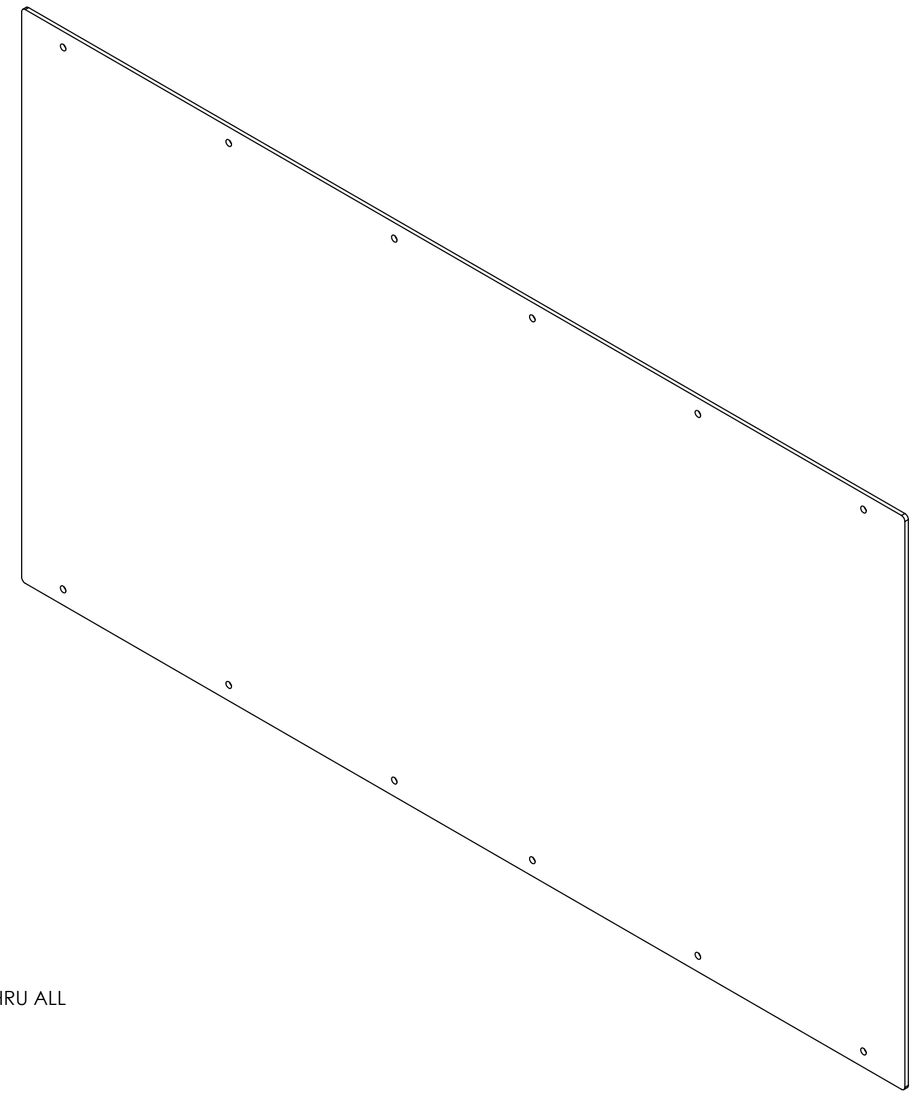
UNLESS OTHERWISE SPECIFIED:	VEND	NAME / DATE
DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ±1/16 ANGULAR: MACH ±1° BEND ±1° TWO PLACE DECIMAL ±.01 THREE PLACE DECIMAL ±.005	DRAWN	JO / 9/10/2024
MATERIAL/FINISH: 1" x 1" x 1/16" 6061 Aluminum Box Tube	**PROPRIETARY AND CONFIDENTIAL** THE INFORMATION 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.	TITLE: Diagonal Rail
DO NOT SCALE DRAWING	**COMMENTS:** REMOVE ALL BURRS AND SHARP EDGES.	SIZE: C / DWG. NO.: KB-25008 / REV: / SCALE: 1:2 / SHEET 1 OF 1



UNLESS OTHERWISE SPECIFIED:	VEND	NAME / DATE
DIMENSIONS ARE IN INCHES TOLERANCES: FRACTIONAL ±1/16 ANGULAR: MACH ±1° BEND ±1° TWO PLACE DECIMAL ±.01 THREE PLACE DECIMAL ±.005	DRAWN	JO / 9/10/2024
MATERIAL/FINISH: 1" x 1" x 1/16" 6061 Aluminum Box Tube	**PROPRIETARY AND CONFIDENTIAL** 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.	TITLE: Crossbeam
DO NOT SCALE DRAWING	**COMMENTS:** REMOVE ALL BURRS AND SHARP EDGES.	SIZE: C / DWG. NO.: KB-25009 / REV:
		SCALE: 1:1 / SHEET 1 OF 1

FIRST ROBOTICS COMPETITION — SOLIDWORKS Modeling Solutions Partner





UNLESS OTHERWISE SPECIFIED:

DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ±1/16
ANGULAR: MACH ±1° BEND ±1°
TWO PLACE DECIMAL ±.01
THREE PLACE DECIMAL ±.005

MATERIAL/FINISH:

1/8" Polycarbonate Sheet

DO NOT SCALE DRAWING

	NAME	DATE
VEND		
DRAWN	JO	9/10/2024

COMMENTS:

REMOVE ALL BURRS AND SHARP EDGES.

FIRST ROBOTICS COMPETITION

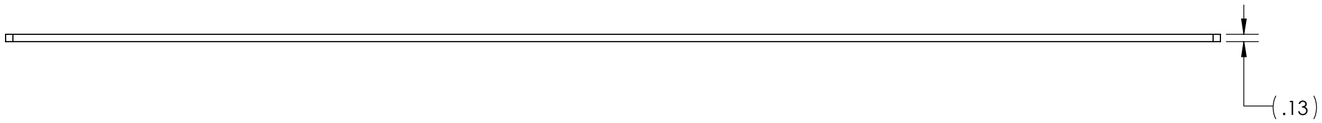
SOLIDWORKS Modeling Solutions Partner

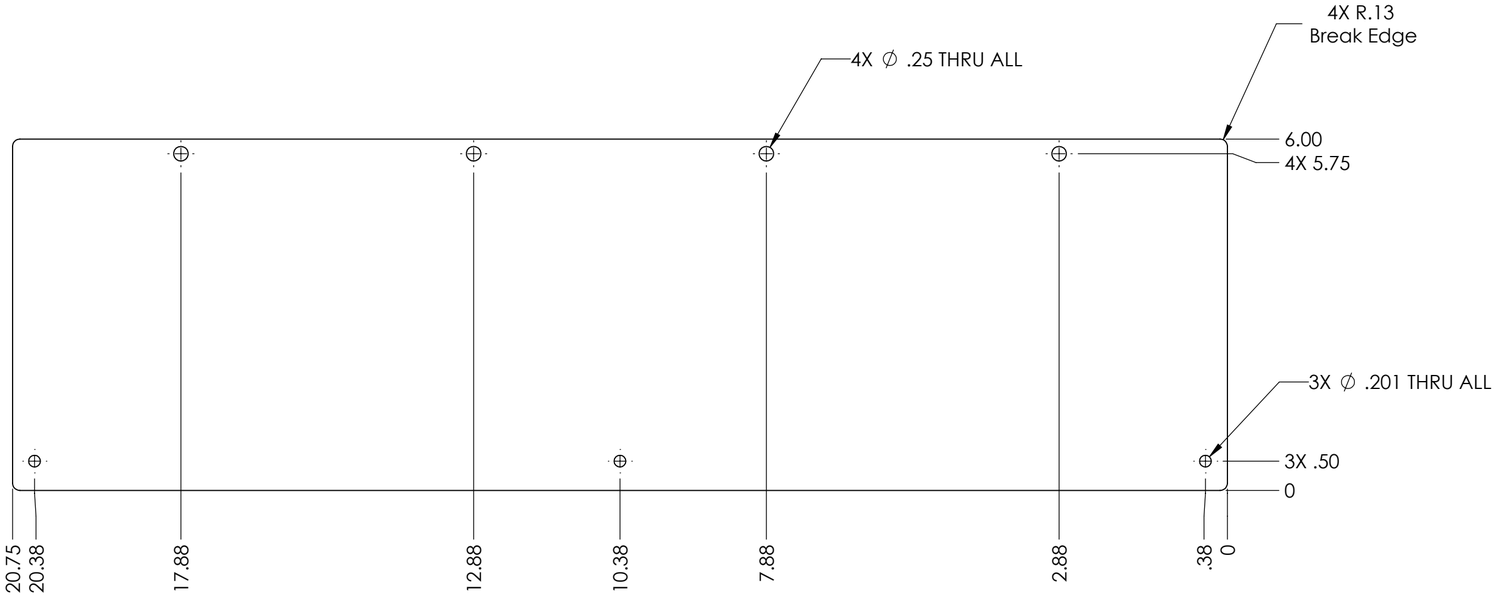
TITLE:

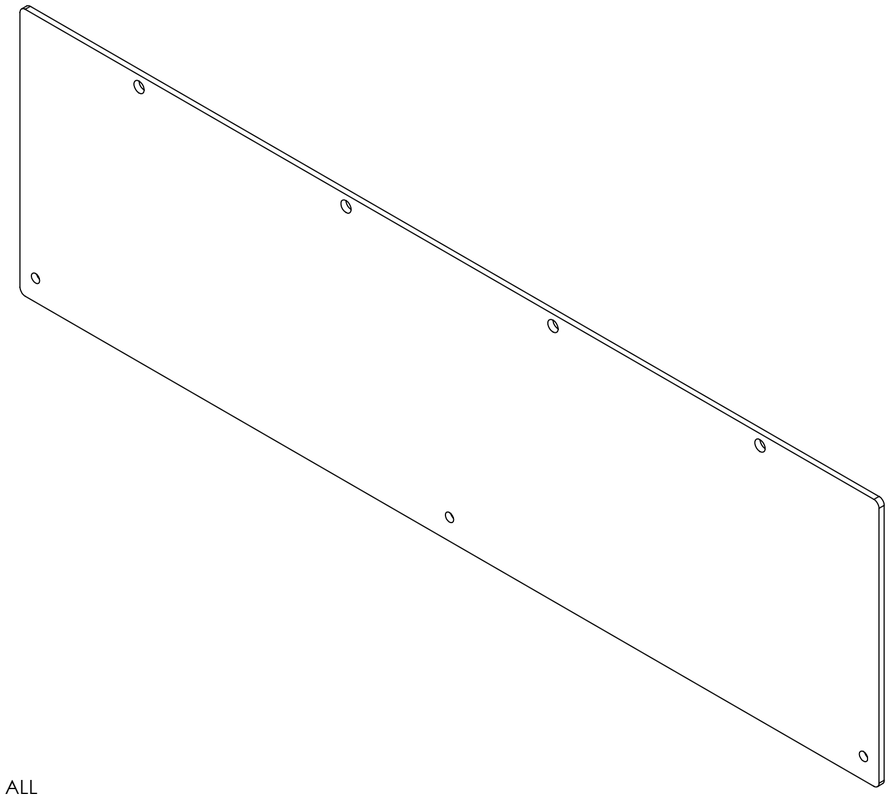
Track Floor

SIZE	DWG. NO.	REV
C	KB-25010	

SCALE: 1:3 | SHEET 1 OF 1







UNLESS OTHERWISE SPECIFIED:	VEND	NAME	DATE
	DRAWN	JO	9/10/2024

DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ±1/16
ANGULAR: MACH ±1° BEND ±1°
TWO PLACE DECIMAL ±.01
THREE PLACE DECIMAL ±.005

MATERIAL/FINISH:

1/8" Polycarbonate Sheet

DO NOT SCALE DRAWING

COMMENTS:

REMOVE ALL BURRS AND SHARP EDGES.

FIRST ROBOTICS COMPETITION

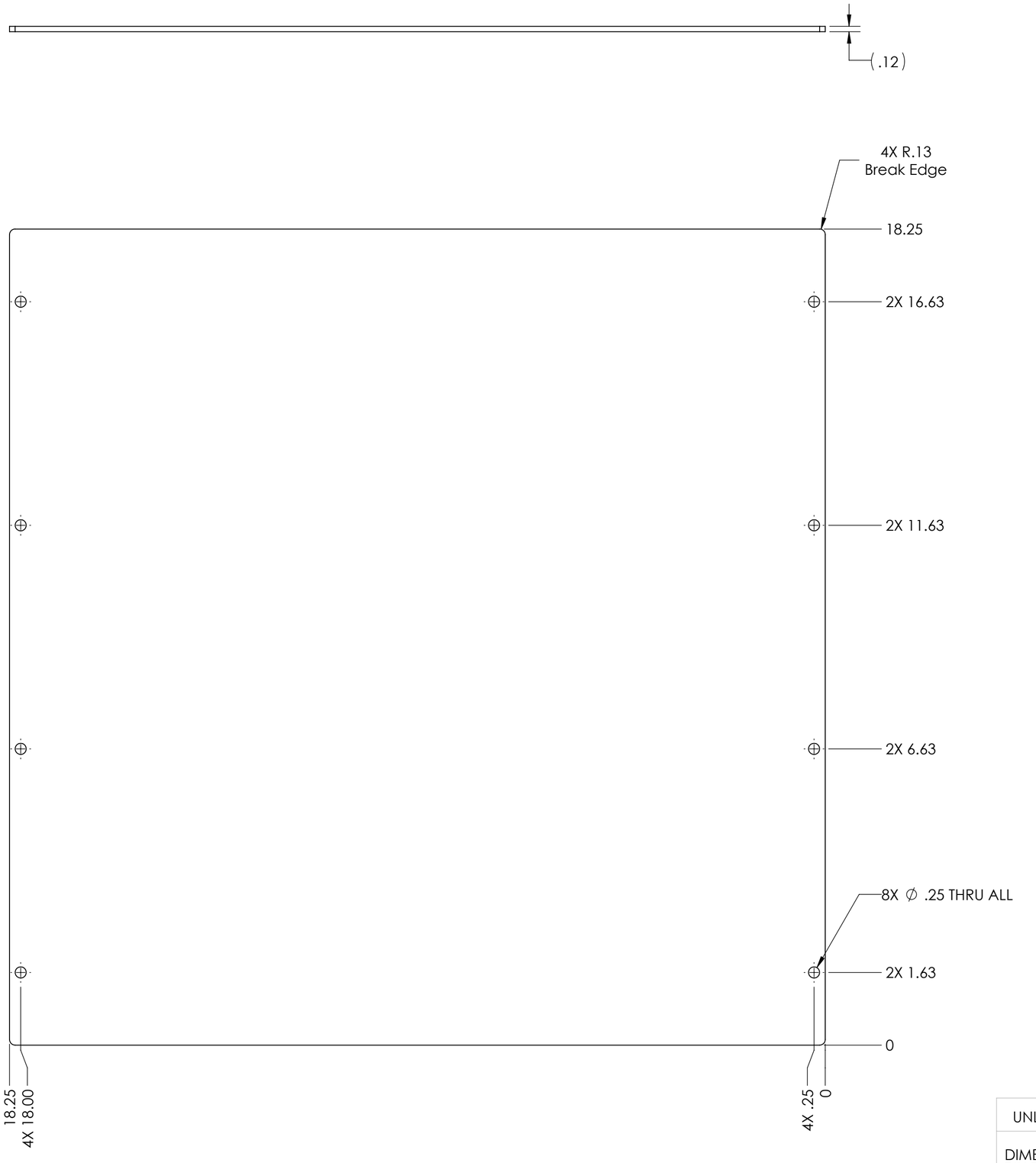
SOLIDWORKS Modeling Solutions Partner

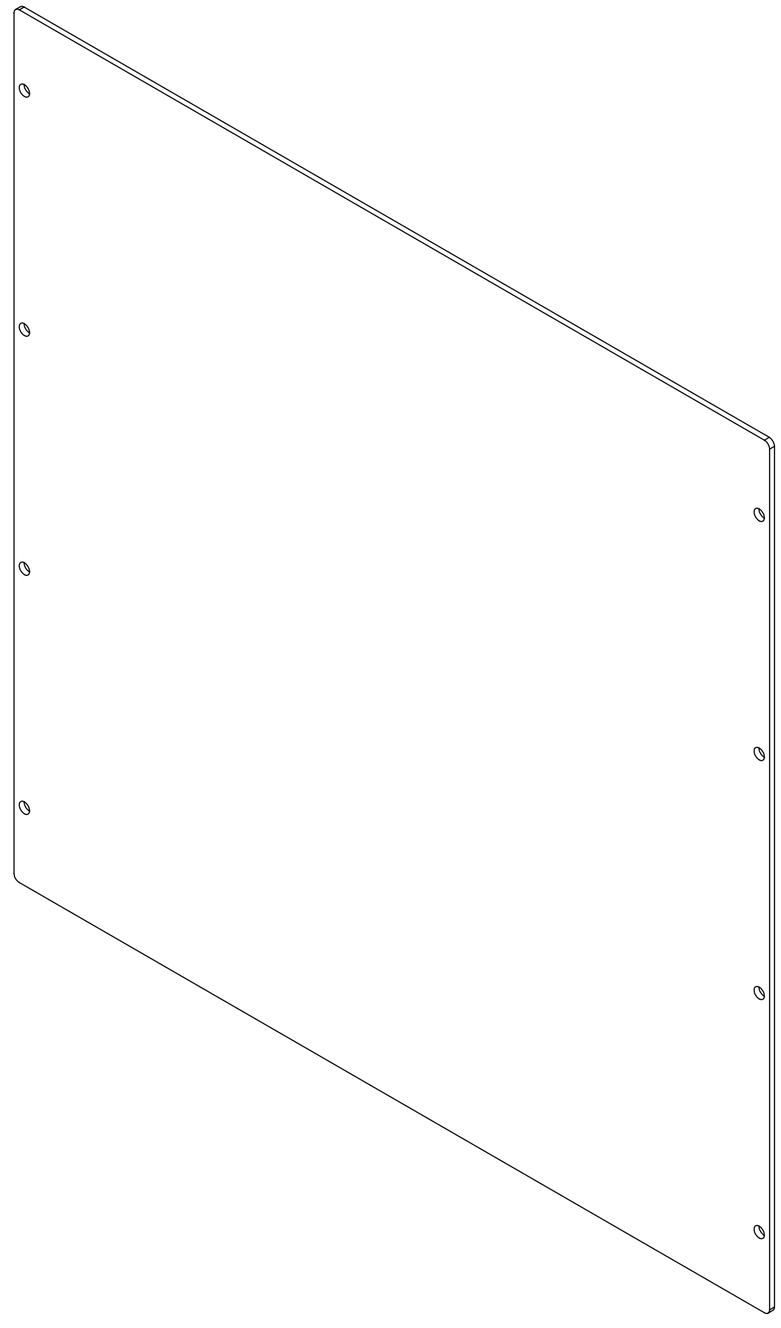
TITLE:

Track Side Panel

SIZE	DWG. NO.	REV
C	KB-25011	

SCALE: 1:2 SHEET 1 OF 1





UNLESS OTHERWISE SPECIFIED:	VEND	NAME	DATE
	DRAWN	JO	9/10/2024

DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ±1/16
ANGULAR: MACH ±1° BEND ±1°
TWO PLACE DECIMAL ±.01
THREE PLACE DECIMAL ±.005

MATERIAL/FINISH:

1/8" Polycarbonate Sheet

DO NOT SCALE DRAWING

COMMENTS:

REMOVE ALL BURRS AND SHARP EDGES.

FIRST ROBOTICS COMPETITION

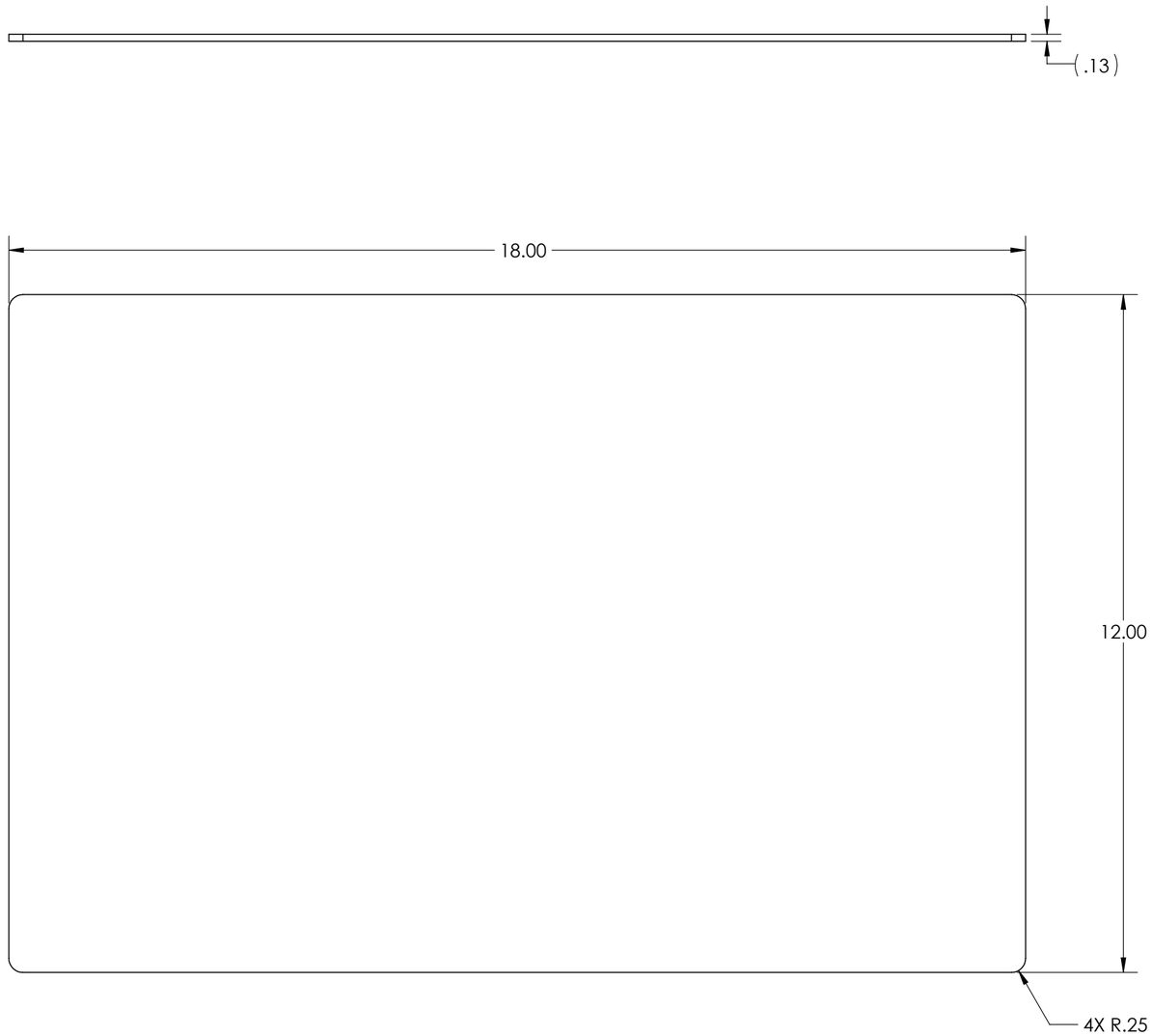
SOLIDWORKS Modeling Solutions Partner

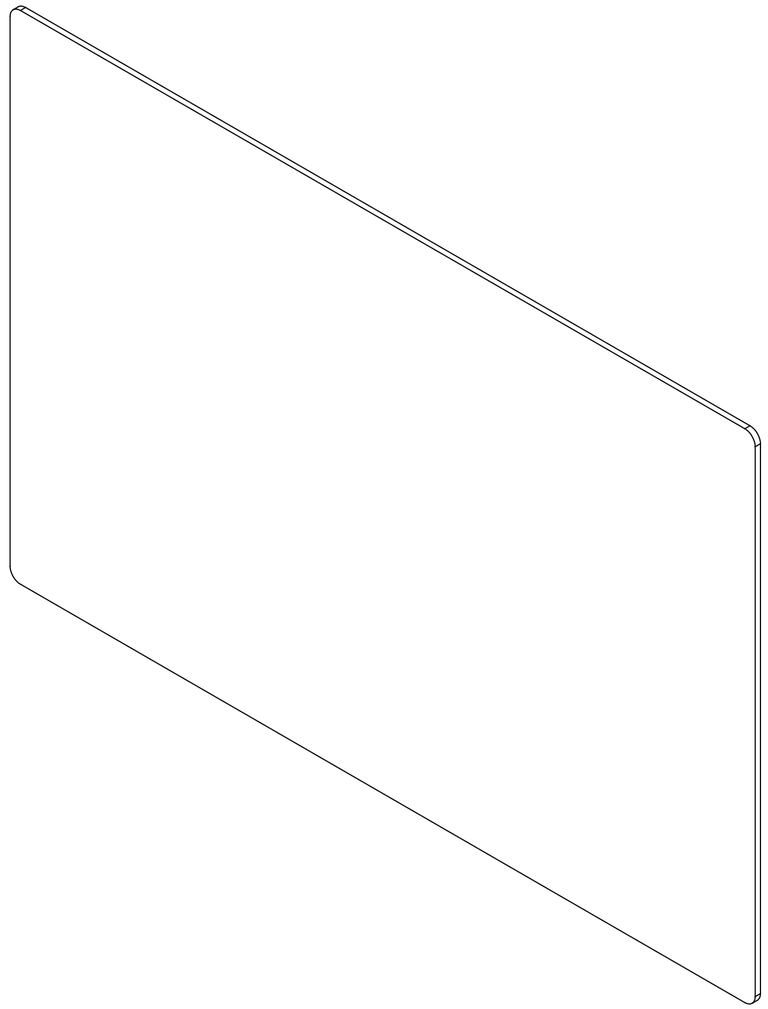
TITLE:

Track Roof

SIZE	DWG. NO.	REV
C	KB-25012	

SCALE: 1:2 | SHEET 1 OF 1





UNLESS OTHERWISE SPECIFIED:

DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ±1/16
ANGULAR: MACH ±1° BEND ±1°
TWO PLACE DECIMAL ±.01
THREE PLACE DECIMAL ±.005

MATERIAL/FINISH:

1/8" Polycarbonate

DO NOT SCALE DRAWING

	NAME	DATE
VEND		
DRAWN	JO	10/7/2024

COMMENTS:

REMOVE ALL BURRS AND SHARP EDGES.

FIRST ROBOTICS COMPETITION

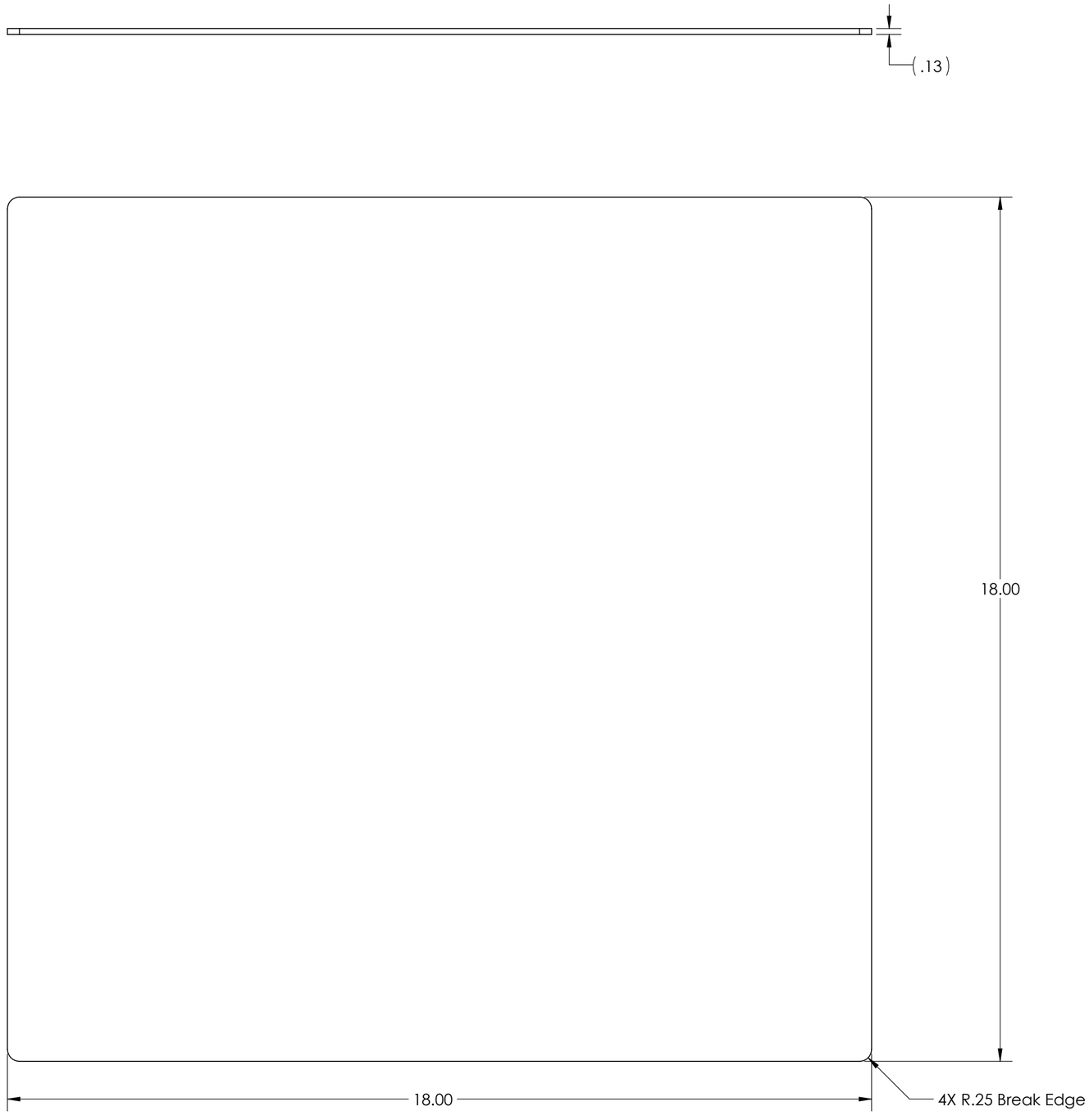
SOLIDWORKS Modeling Solutions Partner

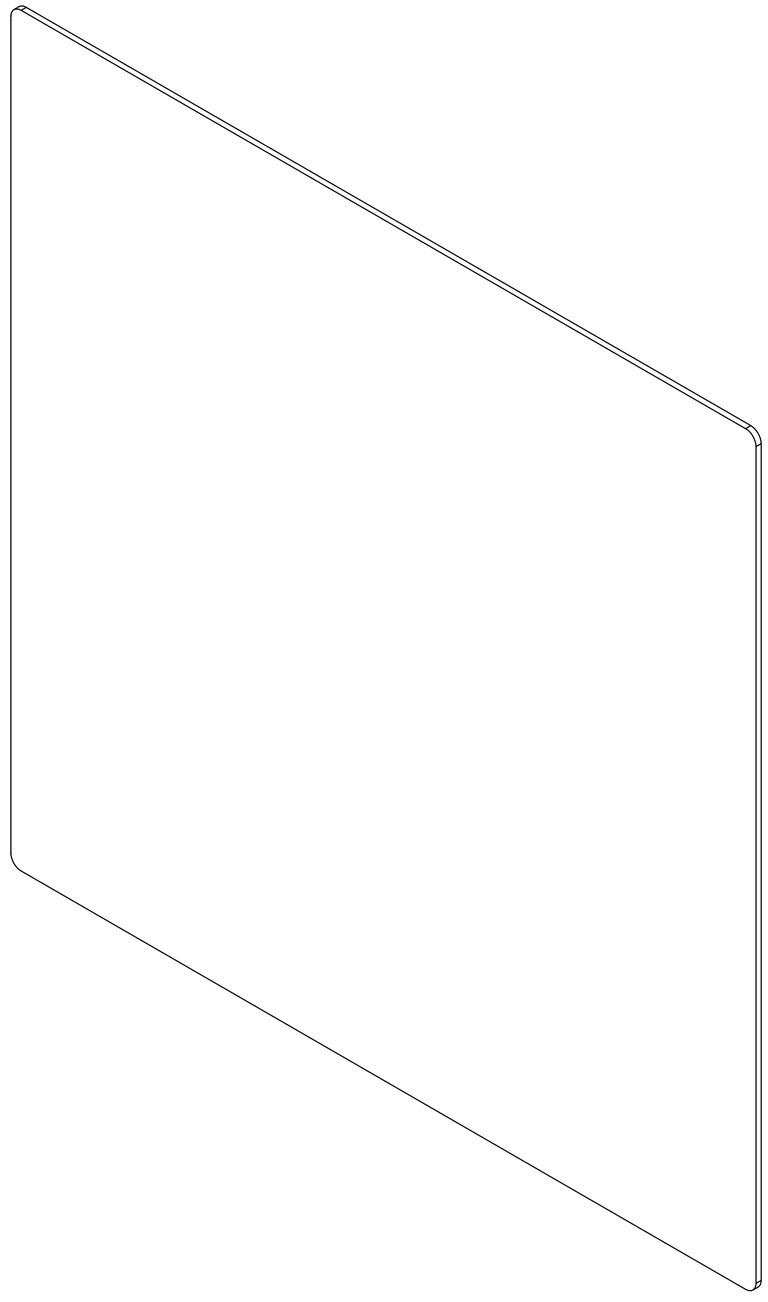
TITLE:

Front Guard Panel

SIZE	DWG. NO.	REV
C	KB-25020	

SCALE: 1:2 SHEET 1 OF 1





UNLESS OTHERWISE SPECIFIED:	VEND	NAME	DATE
	DRAWN	JO	10/7/2024

DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONAL ±1/16
ANGULAR: MACH ±1° BEND ±1°
TWO PLACE DECIMAL ±.01
THREE PLACE DECIMAL ±.005

MATERIAL/FINISH:

1/8" Polycarbonate

DO NOT SCALE DRAWING

COMMENTS:

REMOVE ALL BURRS AND SHARP EDGES.

FIRST ROBOTICS COMPETITION

SOLIDWORKS Modeling Solutions Partner

TITLE:

Back Guard Panel

SIZE	DWG. NO.	REV
C	KB-25021	
SCALE: 1:2	SHEET 1 OF 1	