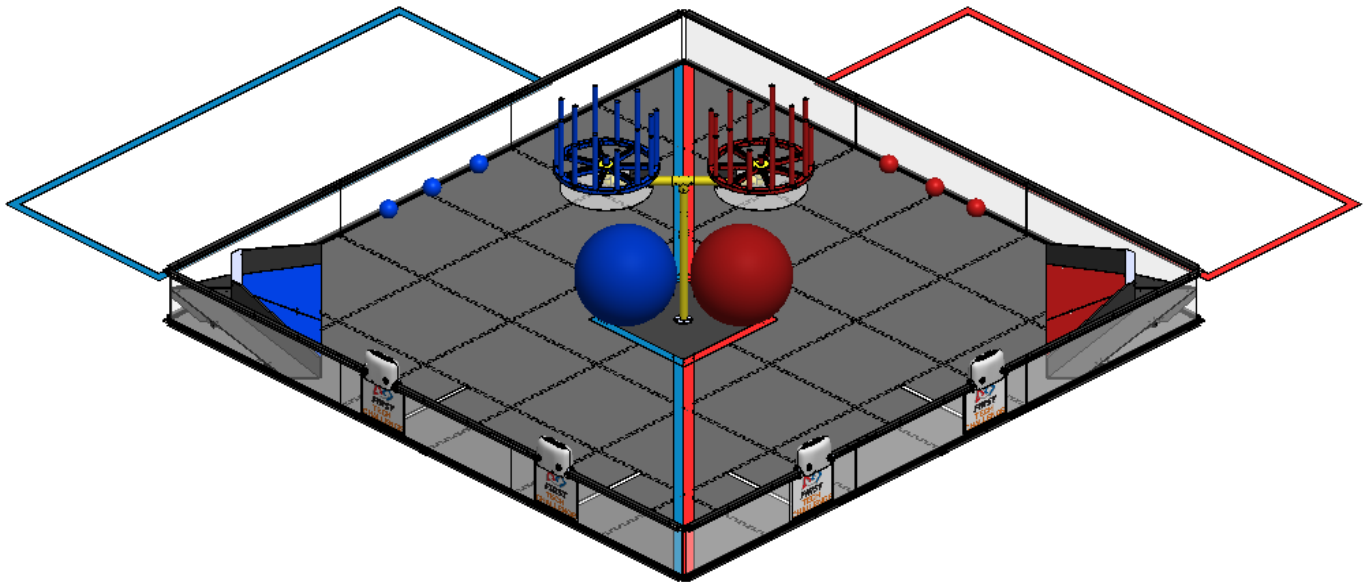


VELOCITY VORTEX<sup>SM</sup>  
2016-2017 *FIRST*<sup>®</sup> Tech Challenge  
Field Assembly Guide

Rev 1.3W



**AndyMark<sup>®</sup>** Field Components for 2016-2017 *FIRST*<sup>®</sup> Tech Challenge

*Read through all the instructions and take a parts inventory before you begin to assemble the game elements!*

This guide contains instructions for assembling the Field Elements for the 2016-2017 *FIRST*® Tech Challenge Game *VELOCITY VORTEX*™.

#### REVISION HISTORY

Rev.	Date	Description
1.0	7/8/16	Initial Printed Release
1.1	7/11/16	Added part numbers to steps, adjusted typos.
1.1W	8/10/16	Reformat for Web and <b>Printing 8.5x11"</b>
1.2W	8/17/16	Minor Changes
1.3W	9/8/16	Minor Changes

ASSEMBLY VIDEOS CAN BE FOUND ON OUR WEBSITE:  
[AndyMark.com/FTCVideo](http://AndyMark.com/FTCVideo)

Videos can also be found on the *How to/Pictures* tab on each AndyMark.com product page.



#### **CAUTION!**

**Edges of field parts may be sharp. File or deburr sharp corners or edges as needed.**














# TOOLS NEEDED

Component	QTY	Part Photo
Safety Equipment		
Rivet Gun	1	
3/8" Nut Driver or Socket	1	
7/16" Nut Driver or Socket	1	
9/16" or 14mm Wrench	1	
Drill	1	
7/32 Drill Bit	1	
Zip Tie Cutters	1	
5/32 Hex Key Driver	1	
#0 Small Phillips Screwdriver	1	
#2 Phillips Screwdriver	1	
File	1	
25' Tape Measure	1	
Hammer	1	
Rubber Mallet	1	
Black Paint & Paintbrush (Official Events Only) Behr "Mouse Ears" black, color code DC4B-10-5, semi gloss (base 3300)	1	
9V Battery	1	

Tools can be purchased as a tool set from AndyMark



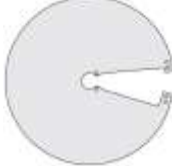


















# CORNER VORTEX (CV)

\*Quantities listed are for each vortex, one red and one blue vortex are needed per field.

Component	Part #	QTY*	Part Photo
<b>Ramp Box</b>			
CV Side Support	am-3383	2	
CV Surface Half (Red OR Blue)	am-3384R/B	2	
Ball Return Slope	am-3385	2	
Center Spine	am-3386	1	
Crossbar	am-3387	1	
<b>CV Hardware Pack</b>			
NOTE: TFS = Thread Forming Screw SHCS=Socket Head Cap Screw			
Peanut Standoff	am-3090_03	4	
90° Bolt Bracket	am-2846	10	
HD Zip Ties	am-1067	8	
1/4-20 x 1.00" TFS	am-1182	8	
10-32 x 1.00" SHCS	am-1056	2	
10-32 x 0.75" SHCS	am-1047	6	
#10 Washers	am-1026	6	
10-32 Nyloc Jam Nut	am-1063	8	
1/8" Short Rivet	am-1410	10	
NOTE: TFS = Thread Forming Screw SHCS=Socket Head Cap Screw			

# CENTER VORTEX ASSEMBLY

NOTE: One Center Vortex Assembly is needed per field.

Component	Part #	QTY	Part Photo
Vortex Spoke RED	am-3359R	7	
Vortex Spoke BLUE	am-3359B	7	
Sheet Plastic Cone	am-3365	2	
5.75" Pipe RED	am-3366R_057	1	
9.5" Pipe RED	am-3366R_095	7	
13" Pipe RED	am-3366R_130	7	
5.75" Pipe BLUE	am-3366B_057	1	
9.5" Pipe BLUE	am-3366B_095	7	
13" Pipe BLUE	am-3366B_130	7	
Center Vortex Circle	am-3373	4	
Anti-Rotation Device	am-3388	2	
HD Zip Ties	am-1067	12	
Base Plate	am-3379	1	
Steel Pipe	am-3380	1	
Steel Flange	am-3381	1	
PVC Tee Joint	am-3367	1	
PVC Elbow	am-3369	2	
PVC Vertical Pole	am-3368_vp	1	
PVC Crossbar	am-3368_cb	2	
1.25"-0.75" Reducer	am-3370	2	
Spacer Donut	am-3371	1	

## Center Vortex Hardware Pack






NOTE: FHS = Flat Head Screw SHCS=Socket Head Cap Screw

10-32 x 1.50" SHCS	am-1014	14	
10-32 Nyloc Jam Nut	am-1063	19	
#10 Washer	am-1026	28	
¼-20 x 1.00" FHS	am-1409	4	
¼-20 Spike Tee Nut	am-1079	4	
10-32 x 2.250" SHCS	am-1156	5	
Rubber Standoff	am-3382	5	

NOTE: FHS = Flat Head Screw SHCS=Socket Head Cap Screw







## Beacon Parts

NOTE: Four Beacons are needed per field.

Component	Part #	QTY	Part Photo
2017 Electronics Board	am-3011_board	1	
Wire	am-3011_twistedwire	3	
Button	am-3182	3	
9V Battery Terminal	am-3411	1	
2017 Beacon Housing	am-3011a_housing	2	

## Beacon Hardware Pack

BHCS=Button Head Cap Screw SHCS=Socket Head Cap Screw  
TFS = Thread Forming Screw

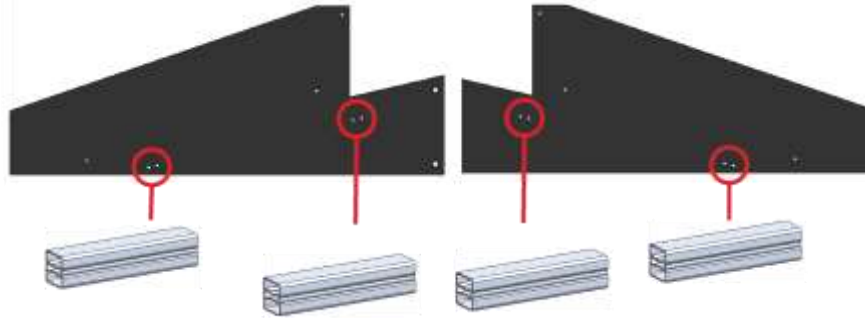
Beacon C-Clamp Left	am-3391L	1	
Beacon C-Clamp Right	am-3391R	1	
10-32 x 0.625" SHCS	am-1007	2	
10-32 X 0.375" BHCS Phillips	am-1028	2	
10-32 Nyloc Jam Nut	am-1063	2	
10-24 x 0.50" TFS	am-1355	4	

BHCS=Button Head Cap Screw SHCS=Socket Head Cap Screw  
TFS = Thread Forming Screw

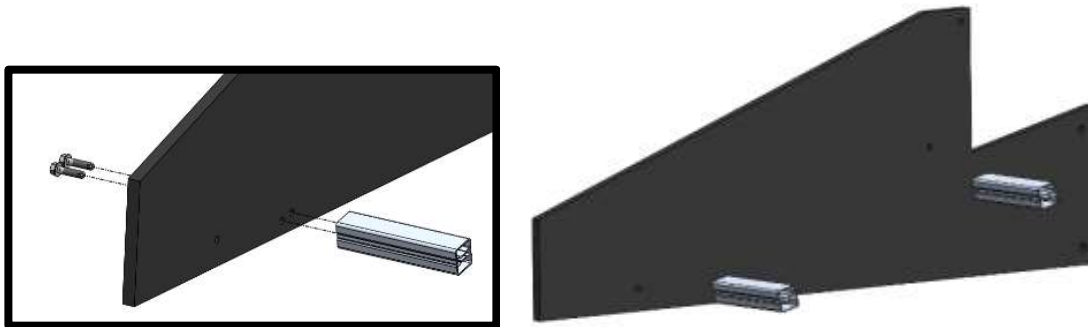
## Corner Vortex Assembly Instructions

VELOCITY VORTEX<sup>SM</sup> is played with one BLUE Corner Vortex and one RED Corner Vortex in opposing corners of the field. This assembly shows a BLUE Corner Vortex being built but can be used for both the RED and BLUE Vortices.

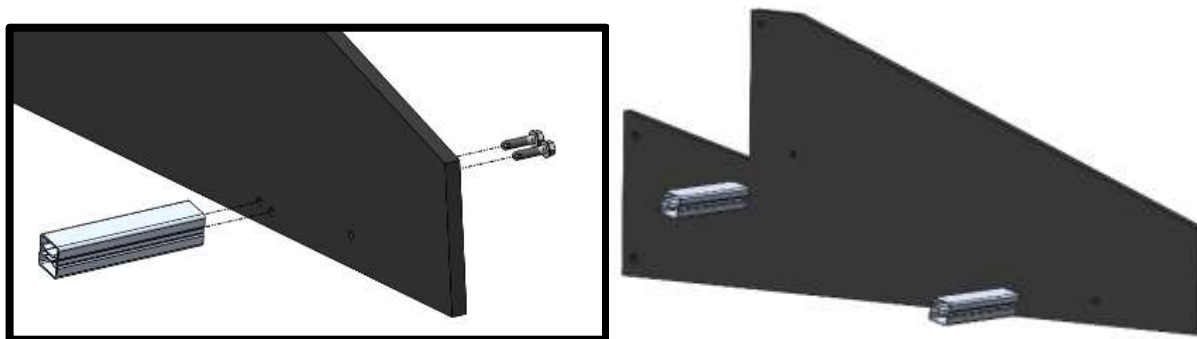
Step 1-1: Layout the two Corner Vortex (CV) Side Supports (am-3383) and identify the hole location for the Peanut Standoffs (am-3090\_03) as shown below. You will build two mirrored assemblies.



Step 1-2: Align the double holes in the CV Side Supports to the holes in the Peanut Standoff. Attach two Peanut Standoffs (am-3090\_03) to a CV Side Support (am-3383) using 2x 1/4-20 x 1.00" TFS (am-1182) per standoff.

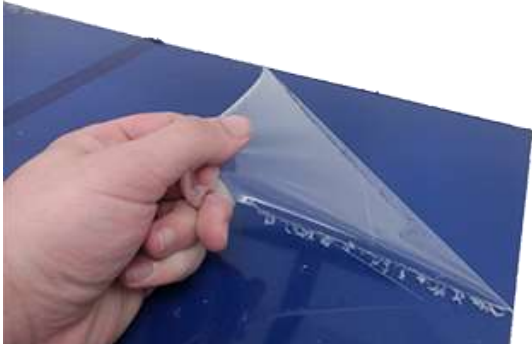


Step 1-3: Attach two more Peanut Standoffs (am-3090\_03) to the other CV Side Support (am-3383) using 2x 1/4-20 x 1.00" TFS (am-1182) per standoff. This assembly should be a mirror of the assembly built in step 1-2.

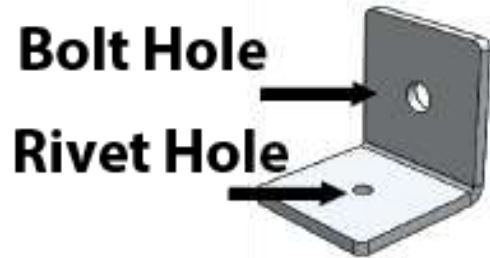


**NOTE:** The Thread Forming Screws are designed to cut into the aluminum of the Peanut Standoffs and make their own threads. The holes in the Peanut Standoffs do not need to be tapped.

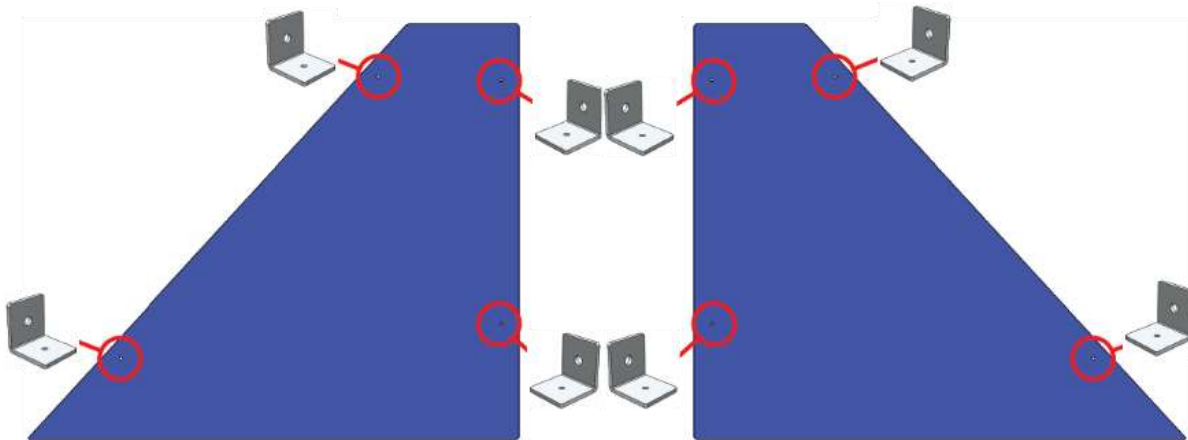
Step 1-4: Remove the white or clear protective film from both sides of both the RED or BLUE panels (am-3384R/B).



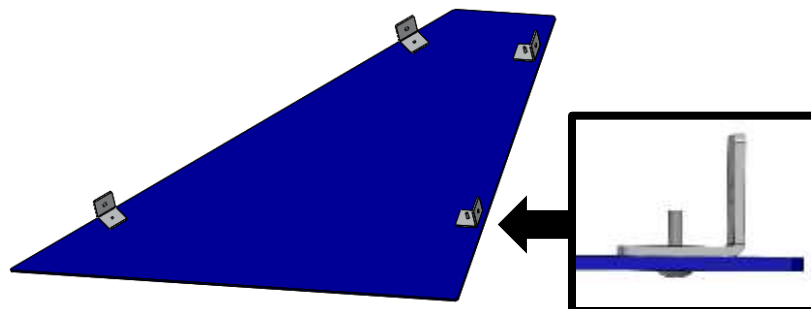
Step 1-5: The 90° Bolt Brackets (am-2846) have a large hole and a small hole. The small hole is sized for rivets. The large hole is sized for #10 screws. Place 8X 90° Bolt Brackets rivet hole down on the CV Surface Halves.



Step 1-6: Lay out the RED or BLUE CV Surface Halves in the following orientation and identify holes for the 90° Bolt Brackets. The panels have a shiny and a dull side. It does not matter which side is up or down. The panels will be mirror images of each other.

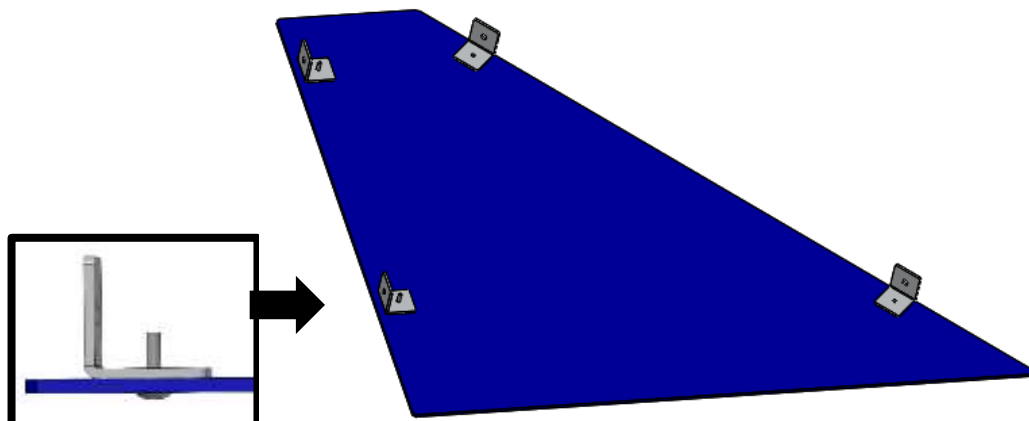


Step 1-7: Rivet the 4X 90° Bolt Brackets to the holes in the first panel as shown in the diagram below. Push the rivet (am-1410) up from the bottom so that the rivet head is up against the flat surface of the panel. The bolt hole faces of the brackets should be parallel with the edges of the CV Surface Halves.

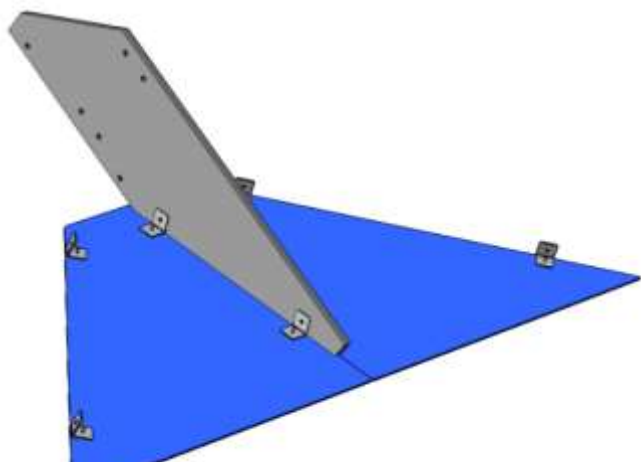




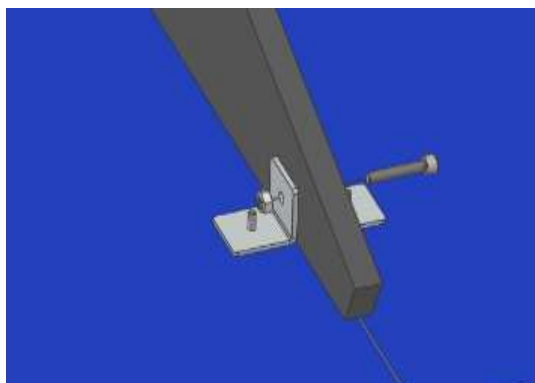
Step 1-8: Attach the 4X 90° Bolt Brackets (am-2846) to the holes in the second panel as shown in the diagram below. This panel should be a mirror image of the panel assembled in step 1-7. Push the rivet up from the bottom so that the rivet head is up against the flat surface of the panel. The bolt hole faces of the brackets should be parallel with the edges of the CV Surface Halves.



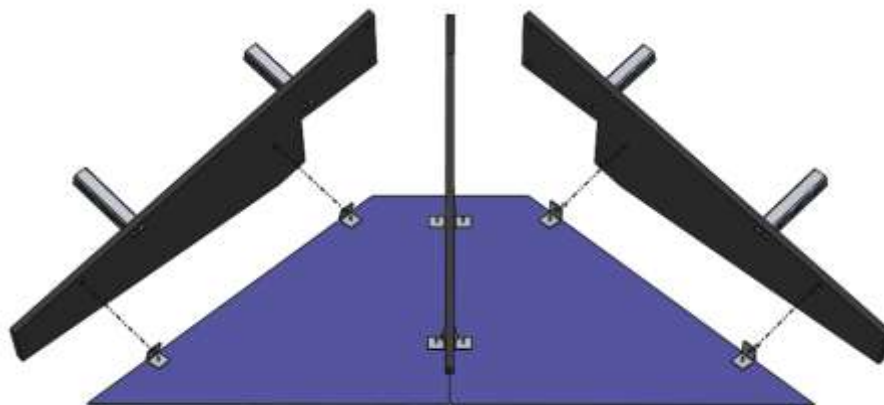
Step 1-9: Place the CV Center Spine (am-3386) between the CV Surface Half Assemblies in the following orientation with the longest edge facing up.



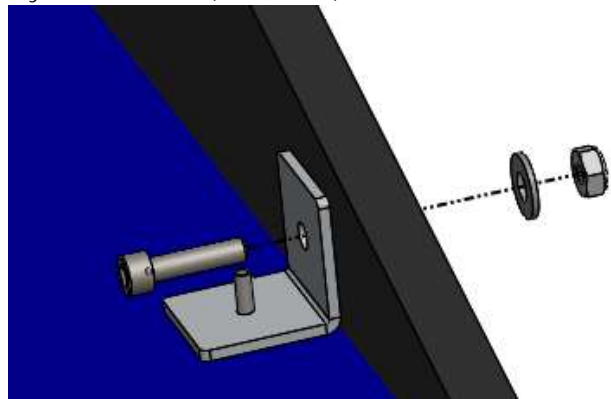
Step 1-10: Secure the CV Center Spine to the 90° bolt brackets on both sides using 2X 10-32 x 1.00" SHCS (am-1056) and 10-32 Nyloc Jam Nut (am-1063). No washers are needed for these screws.



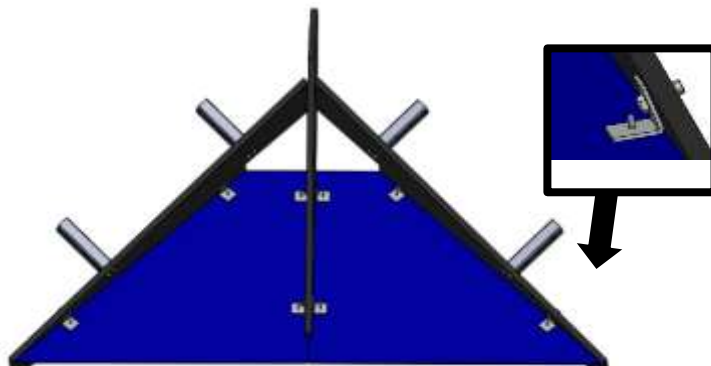
Step 1-11: Place the CV Side Support Assemblies along the side of the Ramp Halves in the following orientations with the Peanut Standoffs facing away from the CV Surface Halves.



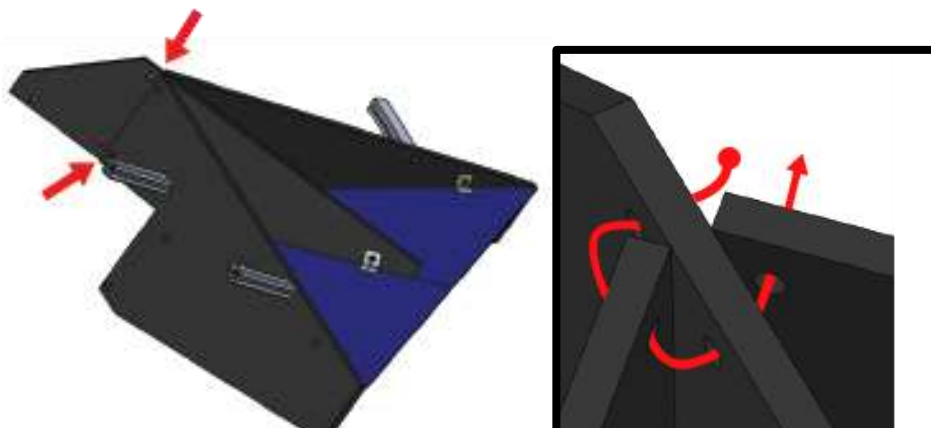
Step 1-12: Secure each 90° Degree Bolt Bracket (two per side) to a CV Side Support using a 10-32 x 0.75" SHCS (am-1047), #10 Washer (am-1026) and Nyloc Jam Nut (am-1063).



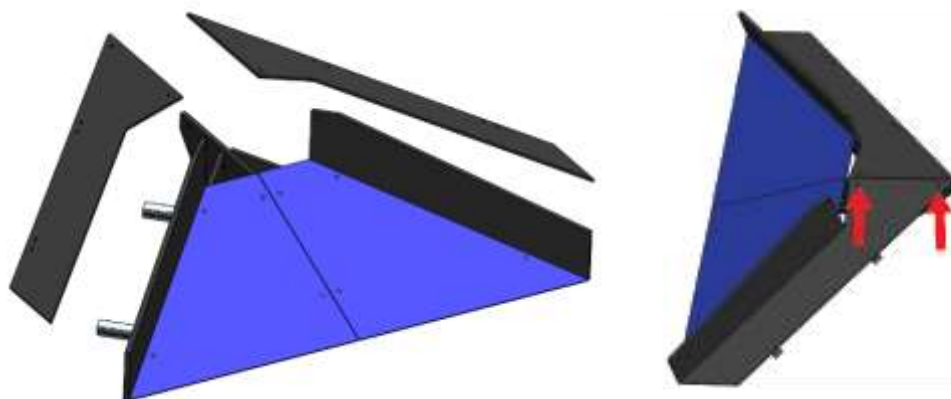
Step 1-13: The brackets holding the CV Side Supports will need to be bent. Take each CV Side Support and bend until the end of each support lines up with the CV Center Spine.



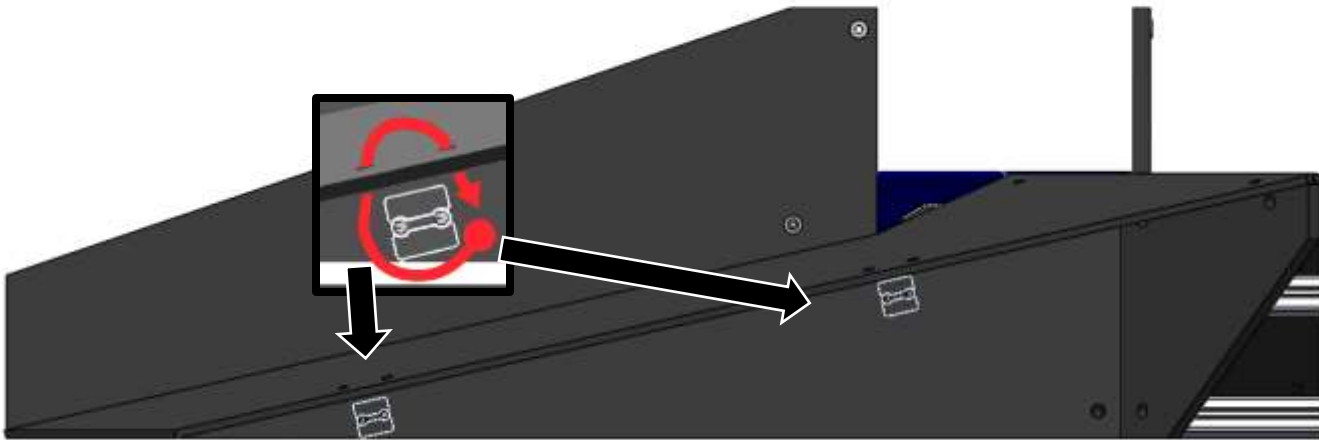
Step 1-14: Use 2 Zip Ties to secure the CV Center Spine to the CV Side Supports. The Zip Tie should pass through all four holes and be secured so that the Spine and Side Supports don't move. Cut the excess tail of each Zip Tie.



Step 1-15: Flip the Corner Vortex Assembly over and place one Ball Return Slope on each side on top of the Peanut Standoffs. Secure both Slopes to the CV Center Spine using Two Zip Ties. The Zip Tie should pass through both slopes and the CV Center Spine. Cut the excess tail of each Zip Tie.



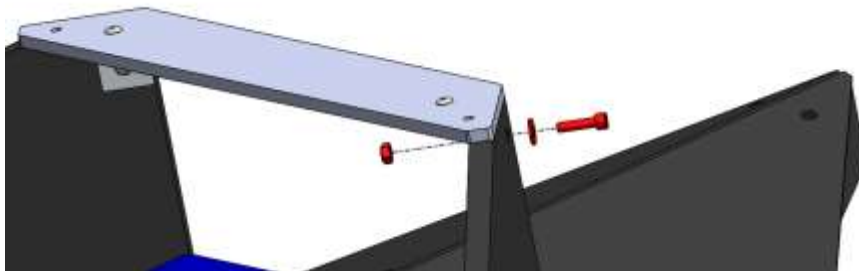
Step 1-16: Use 4X Zip Ties to secure the Ball Return Slopes to the Peanut Standoffs. The Slopes should rest on top of the lower screws on the CV Side Supports. Cut the excess tail of each Zip Tie.



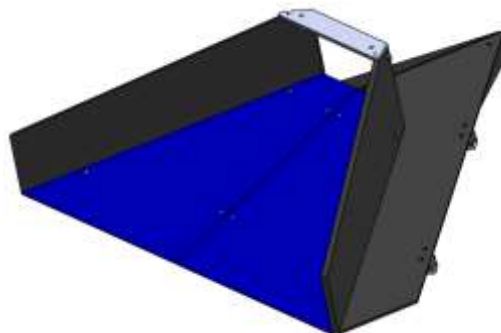
Step 1-17: Rivet the 2X remaining 90° bolt Brackets to the small holes on the Crossbar (am-3387). Push the rivet up from the bottom so that the rivet head is up against the flat surface of the Crossbar.



Step 1-18: Using 2X 10-32 x 0.75" SHCS (am-1047), #10 Washers, and 10-32 Nyloc Jam Nut secure the Crossbar to the Corner Vortex Assembly. The Crossbar will span across the top of the CV Side Supports with the edges aligned.



Step 1-19: The BLUE Corner Vortex is complete. Repeat the assembly for the RED Corner Vortex.



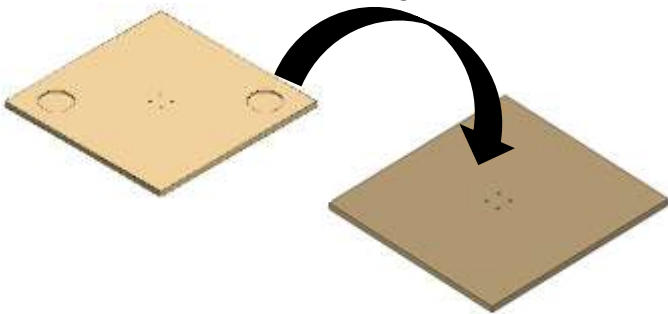
# Center Vortex Assembly

## Base Plate Assembly Instructions

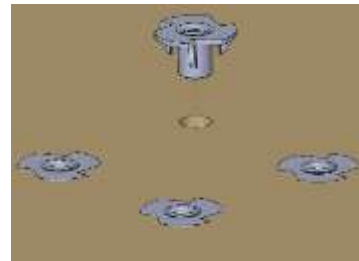


Note: For Official Events, the base plate must be painted black using Behr **"Mouse Ears"** black, color code DC4B-10-5, semi gloss (base 3300) .

Step 2-1: Locate the Base Plate and flip upside down with the recessed circles facing downward.



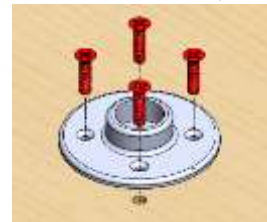
Step 2-2: Take 4X 1/4-20 Spike Tee Nuts (am-1079) and hammer one per hole into the bottom of the base plate. The spikes will dig into the plywood and the nut should be flush with the bottom surface.



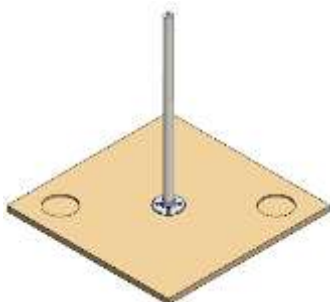
Step 2-3 Place 5X Rubber Standoffs (am-3382) in the following locations on the bottom of the Base Plate on the same side as the Spike Tee Nuts.



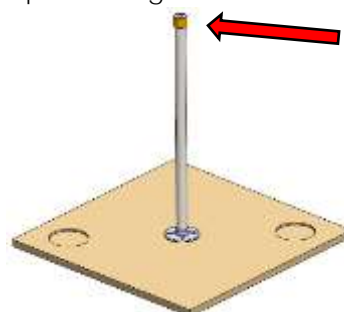
Step 2-4: Flip the Base Plate over and attach the Steel Flange (am-3381) by screwing 4X 1/4-20 x 1.00" FHS (am-1409) into the Spike Tee Nuts.



Step 2-5: Screw the Steel Pipe (am-3380) into the Steel Flange on the Base Plate.

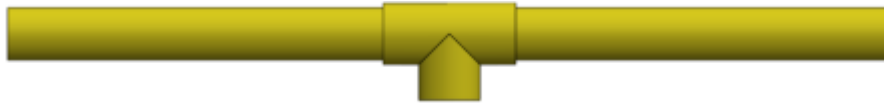


Step 2-6: Screw the Spacer Donut (am-3371) onto the threads of Steel Pipe. The donut should be pushed onto the pipe as far as it can until it stops moving.

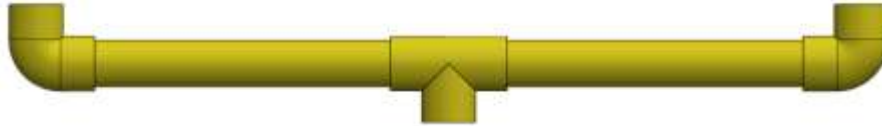


## Crossbar Assembly Instructions

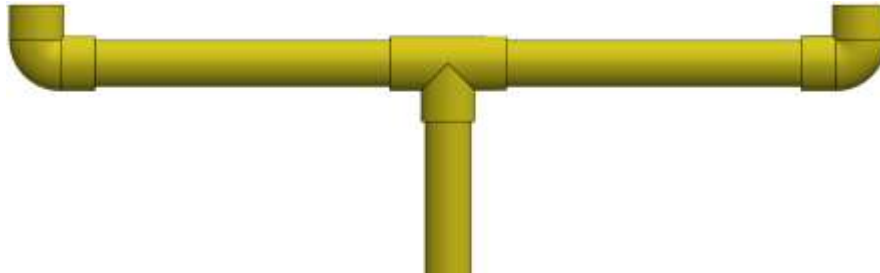
Step 2-7: Locate PVC Tee Joint (am-3367) and insert 2X PVC Crossbars (am-3368\_cb) across the T portion so they form a horizontal bar. A mallet may be needed to fully insert the pieces.



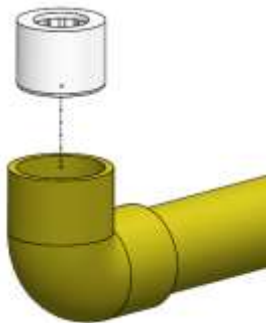
Step 2-8: Attach a PVC Elbow (am-3369) to each PVC Crossbar end. The elbow should point in the opposite direction as the end of the PVC Tee Joint.



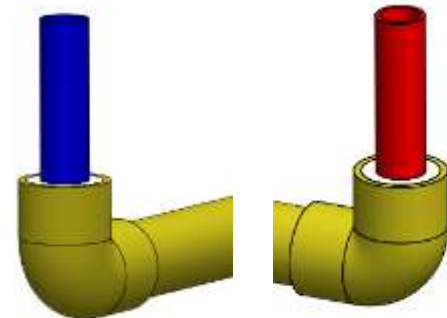
Step 2-9: Insert the PVC Vertical Pole (am-3368\_vp) into the bottom of the Tee Joint.



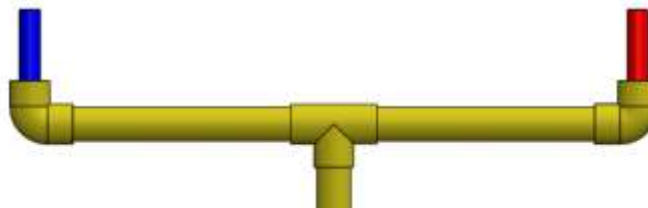
Step 2-10: Insert a Reducer (am-3370) into the other ends of the PVC Elbows.



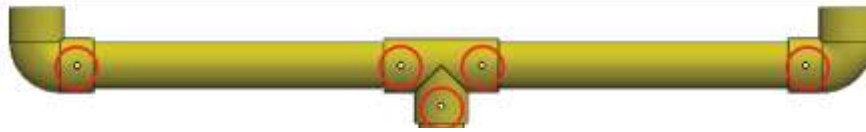
Step 2-11: Add a short pipe (am-3366R/B\_057) to the Reducer on both ends of the PVC Crossbar.



Step 2-12: Ensure that the crossbar assembly is in the correct orientation and that all the fittings are aligned. The assembly should measure 32" from the top of the Tee to the bottom of the pipe.

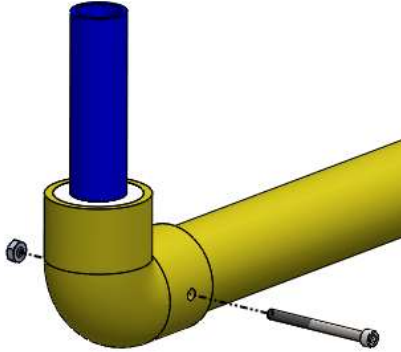


Step 2-13: Using a 7/32 drill bit, drill a hole through the connectors and pipes in the following locations.



Step 2-14: Secure all 5 locations with 10-32 x 2.25" SHCS (am-1156) and 10-32 Nyloc Jam Nuts (am-1063).

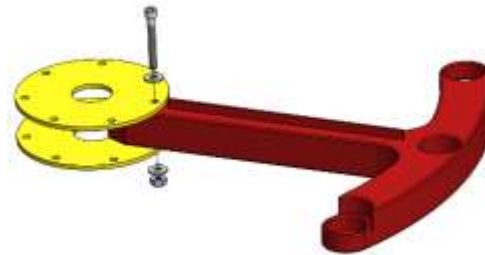
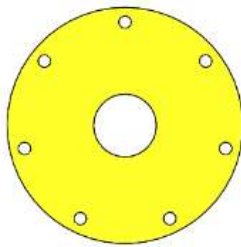
Step 2-15: Place Crossbar Assembly onto base plate assembly.



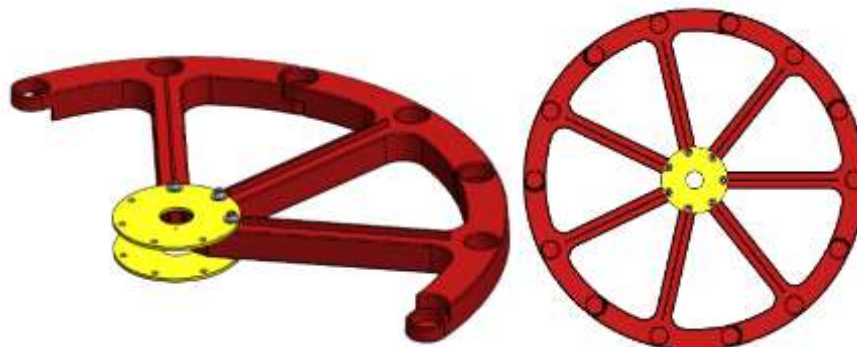
### *Vortex Basket Assembly Instructions*

Step 2-16: Locate 7X RED Vortex Spokes (am-3359R) and 2 Center Vortex Circles (am-3373).

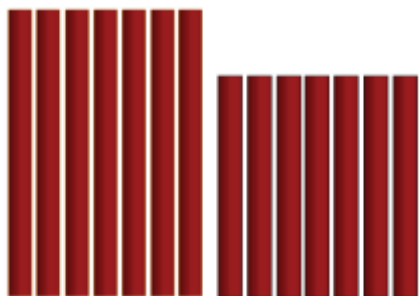
Step 2-17: Attach a Center Vortex Circle to the top and bottom of a Vortex Spoke using a 10-32 x 1.50" SHCS (am-1014), #10 Washer on each side, and 10-32 Nyloc Jam Nut. Be careful not to over tighten screws as to not crush the circles.



Step 2-18: Continue adding 6X Vortex Spokes to the assembly overlapping the ends to form a ring.



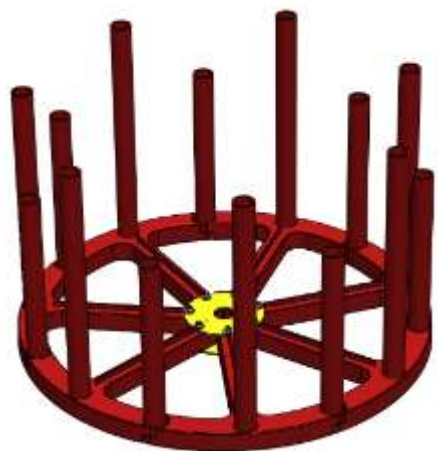
Step 2-19: There are 3 lengths of pipe for each Vortex. The 7 long and 7 medium pipes shown below will be placed around the ring.



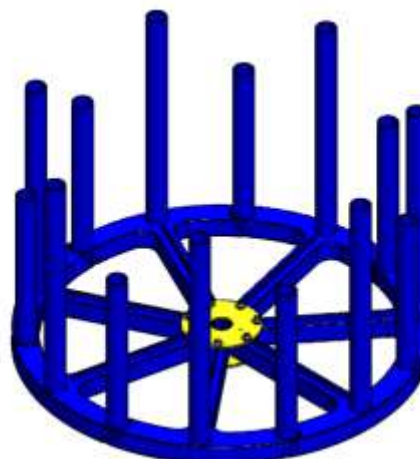
Step 2-20: Using a pushing and twisting motion, insert the 7 medium length pipes (am-3366R\_095) measuring 9.5" in length into the overlapping sockets around the ring. These pipes will hold the ring together.



Step 2-21: Using a pushing and twisting motion, add the long pipes (am-3366R\_130) to the middle sockets.



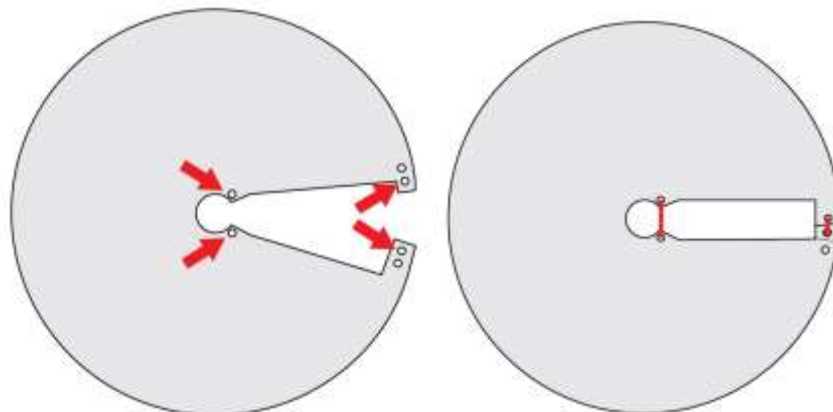
Step 2-22: Repeat steps 2-16 to 2-21 for the BLUE Vortex.



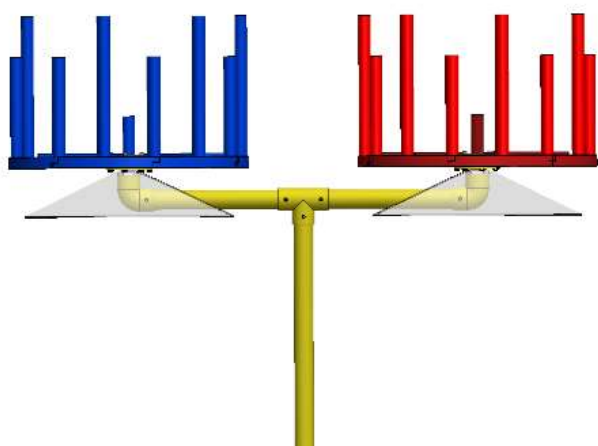
Step 2-23: Wrap a plastic sheet cone (am-3365) around each short pipe and crossbar.



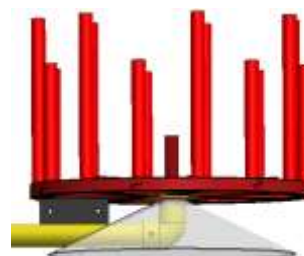
Step 2-24: Secure each cone at the inner and outer edge with 2 Zip Ties and tighten so the cone is secure. On the outer edge of the cone, the holes nearest to the edge will overlap. On the inner edge the holes will not overlap. The Zip Tie heads should sit on the underside of the cone. Cut the excess tail of each Zip Tie.



Step 2-25: Slide each Vortex onto the short pipe of matching color on the PVC Crossbar.



Step 2-26: Locate Anti-Rotation Device (am-3388) and place it in the following location between the Crossbar and the basket.



Step 2-27: Secure the Anti-Rotation (am-3388) Device to the Vortex Spoke using two Zip Ties. Next, attach the Anti-Rotation device to the Crossbar using two Zip Ties.



Step 2-28: The Center Vortex Assembly is now complete!





# Beacon Assembly Instructions

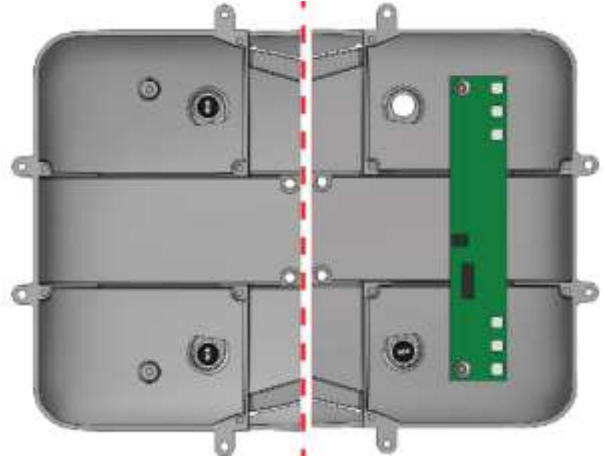
Step 3-1: Remove the nut off the 3 Buttons using a 9/16" wrench (or 14mm wrench) and use it to securely attach three Buttons (am-3182) to the Housing halves (am-3011a-housing). Be sure to securely tighten the nut on the inside of the Housing.



Step 3-2: Mount the Electronics Board (am-3011\_board) to the Beacon Housing with one button attached using 2x 10-32 x 0.375" BHCS (am-1028).



Step 3-3: Layout the Beacon Housings so that the bottoms are touching.



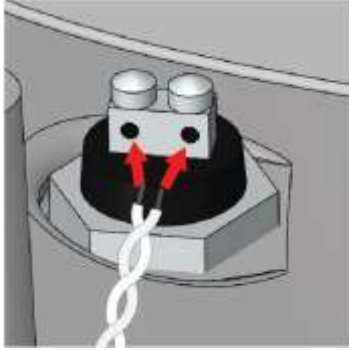
Step 3-4: The wires (am-3011\_twistedwire) should already have the ends scored. Ensure that the metal is fully exposed by pulling off any insulation left on the wire ends.



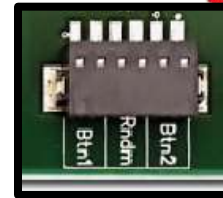
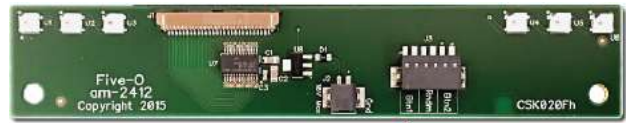
Step 3-5: Using a small Phillips screwdriver loosen the two screws on the button until one wire can be pushed into the hole.



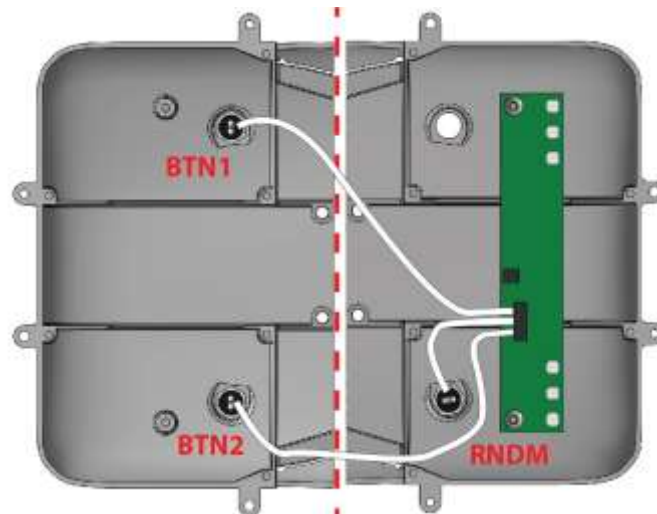
Step 3-6: Take a twisted wire pair and insert one metal lead into each hole on the button. Tighten down the screws to secure the wires. Repeat for the remaining two buttons.



Step 3-7: Locate the beacon button connector on the circuit board. Each wire will plug into the lower row of holes on the connector in each labeled spot.



Step 3-8: Each button plugs into the section of the connector matching the name in the diagram below. It does not matter which end of each twisted pair goes to each hole.



Step 3-9: To insert a wire into the connector insert a small screwdriver into the hole directly above the hole for the wire. This will open the connector and the wire can be pushed by hand into the connector.



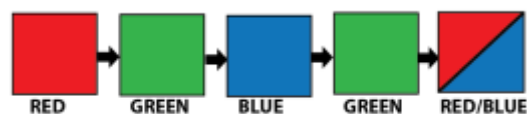
Step 3-10: Once all three buttons are wired, gently tug each wire to verify they are all securely fastened. The wires should remain in the connector when gently pulled.

Step 3-11: Attach the 9V pigtail (am-3411) to the power connector on the circuit board.

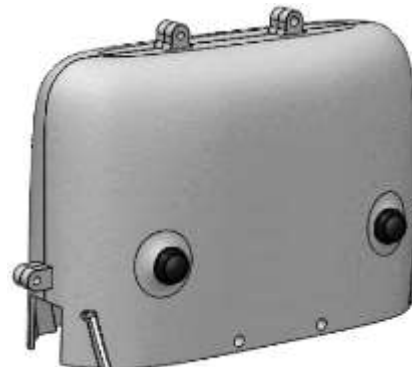


Step 3-13: If the lights do not illuminate when a charged battery is connected, check to ensure the wires are secure and connected to the correct places. If the light pattern does not match and show green lights, the beacon board may need to be reprogrammed for the 2016-2017 game.

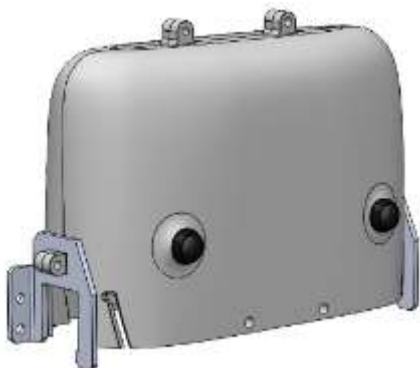
Step 3-12: Verify that the beacon is wired correctly by attaching a 9V battery. If setup correctly, a startup light sequence will run. If the correct 2016-2017 program is running on the beacon board the lights will show the following sequence during startup.



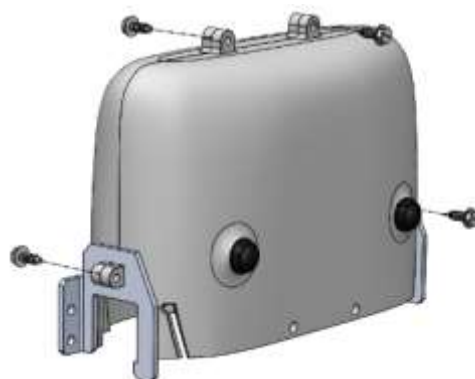
Step 3-14: Carefully close the beacon halves. Be careful not to pinch the *Wires*.



Step 3-15: Add the Beacon Brackets (am-3391R/L) to the side of the beacon. The flange of the bracket should face away from the side with two buttons.



Step 3-16: Secure the beacon halves by adding a 10-24 x 0.50" TFS (am-1355) screw to the top and side holes.



Additional hardware will be left over and used for attaching components to the field. Extra hardware should be kept and not discarded.

Additional instructions on the following can be found in the Field Setup and Configuration Guide Available on [AndyMark.com/FTC](http://AndyMark.com/FTC)

- Setting up the Floor and Field Perimeter
- Instructions for Field Layout and Orientation
- Tournament Setup

More resources on this year's challenge can be found on <http://www.firstinspires.org/roboticsprograms/ftc>