REVERSIBLE BUMPER INSTRUCTIONS

JUDY BRYANT & JOSHUA BRYANT

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ABSTRACT

This document will cover how to make straight and corner reversible bumpers according to the 2018 robot rules. By the end of this document, you should have one full set of reversible bumpers ready to mount to the robot. This document is intended for those with at least basic or better skills in sewing and pattern making. This document is not intended to serve as an introduction to sewing.

GENERAL ADVICE/INFORMATION

This document will cover how to make straight and corner reversible bumpers. When straight bumpers <cut off text>. The wood is not connected at the corners as you would have for continuous bumpers. Corner bumpers are one bumper for each corner of the robot. The wood is connected together and just over the corner and at least 6" out on each side of the bumper. This process does not lend itself well to continuous bumpers and some other process will need to be used if continuous bumpers are needed. In <cut off text>. If there are any conflicts between what you are told in this document in regards to the bumpers and what the rules say, the official rules take precedence.

Some general information for reading these instructions:

- $\frac{1}{2}$" seam allowance is used unless otherwise noted.
- **These instructions are based on the bumper rules from 2018. Before making your bumpers, please review the rules for 2019 and make appropriate adjustments for any changes.**
- You should work with the chassis build team to determine the type of bumpers needed, the length of each bumper, the mounting points, and mounting hardware placement. it is important to have all this information prior to making your pattern and sewing the bumpers.
- The bumpers will have to be removed for inspections. This should be a consideration when planning on the mounting of the bumpers to the chassis. You will not have to remove the bumpers between matches, just at inspection time.
- If making straight bumpers, the wood should be cut to the appropriate length, mounting hardware that will be attached to the wood should be attached, and pool noddles should be loosely attached to the wood with duct or masking tape.
- Verify —- bumpers at each step.
- Ease is built into the pattern measurements. The ease is important to allow the pool noddle to take the energy of any contact during the competition. If the fabric is attached too tightly, the fabric will take the energy and you will have a higher risk of fabric failure in high velocity impact games. (Save the tight fabric for show bumpers, eased fabric bumpers for competition).

SUPPLIES NEEDED

Supplies needed for making bumpers:

- Measuring Tool
- Scissors
- 4 yards bumper fabric (Duck Canvas is recommended due to it's strength, durability, and flexibility)

    2 yards red bumper fabric

2 yards blue bumper fabric

- Hook and Loop fastener (sew in version). Blue and Red is recommended but black is acceptable in 2018 robot rules
- Thread
- 8 sets Iron on Numbers (4 sets for blue bumpers, 4 sets for red bumpers)
- Iron
- Ironing pad or ironing board with heat resistant cover
- Sewing Machine
- Machine Needles (you will have better results if you change the needle before beginning the project, after sewing the bumpers and before applying the hook and loop fasteners, and again half way through applying the hook and loop).
- Large sheet of paper for making your pattern (bulletin board paper or rolled craft paper are good options)
- Pencil
- Straight Edge
- Pool Noodles
- $\frac{3}{4}$" wood cut to size (if making corner bumpers, wood should be fastened together with wood screws)
- Mounting Hardware
- Staple Gun and Staples

MAKING THE PATTERN

This section contains instructions for both corner bumpers and straight bumpers. The corner bumpers are identical to the straight bumpers with an additional notch cut in them to allow for the corner bend. For both types of bumpers, cut four of each color. If the robot is not square, adjust the measurements labeled A, C, and F to accommodate.

Straight Bumper Pattern

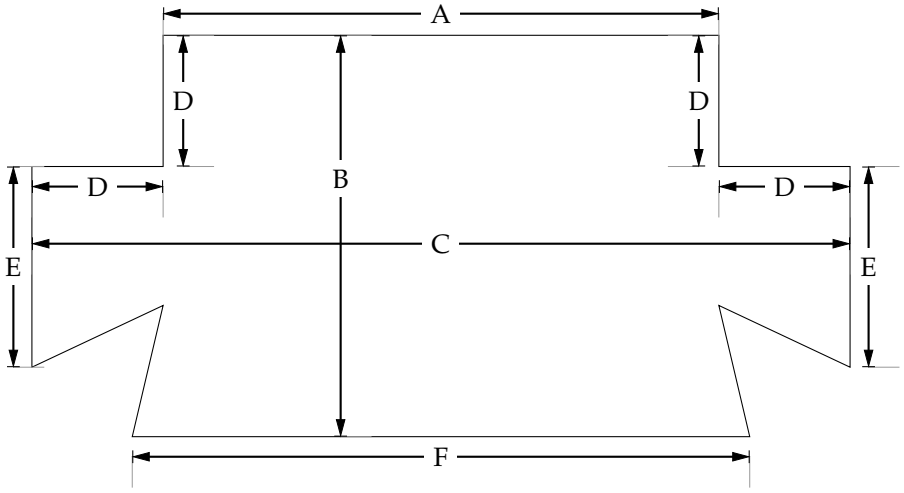

Figure 1: Pattern for straight bumpers with labeled lengths to mark.

A

Item Description	Measurement
Length of Bumper	x″
Seam Allowance (x2, one on each end)	$\frac{1}{2}'' * 2 = 1''$
Total	$(x + 1)''$

B

Item Description	Measurement
Attachment to back of board	1″
Thickness of wood backing	$\frac{3}{4}''$
Height of pool noodle	$2\frac{1}{2}''$
Width of pool noodle x2 (height of bumper)	$2\frac{1}{2}'' * 2 = 5''$
Height of pool noodle	$2\frac{1}{2}''$
Thickness of wood backing	$\frac{3}{4}''$
Seam Allowance	$\frac{1}{2}''$
Total	13″

C

Item Description	Measurement
Attachment to wood backing	1″
Thickness of wood backing	$\frac{3}{4}''$
Width of pool noodle	$2\frac{1}{2}''$
Length of bumper	x″
Width of pool noodle	$2\frac{1}{2}''$
Thickness of wood backing	$\frac{3}{4}''$
Attachment to wood backing	1″
Total	$(x + 8\frac{1}{2})''$

D

Item Description	Measurement
Attachment to wood backing	1″
Thickness of wood backing	$\frac{3}{4}''$
Width of pool noodle	$2\frac{1}{2}''$
Total	$4\frac{1}{4}''$

	Item Description	Measurements
E	Seam Allowance	$\frac{1}{2}''$
	Height of pool noodle x2 (height of bumper)	$2\frac{1}{2}'' * 2 = 5''$
	Easement	$\frac{1}{2}''$
	Seam Allowance	$\frac{1}{2}''$
	Total	$6\frac{1}{2}''$

	Item Description	Measurements
	Seam Allowance	$\frac{1}{2}''$
	Easement	$\frac{1}{2}''$
F	Length of bumper	x''
	Easement	$\frac{1}{2}''$
	Seam Allowance	$\frac{1}{2}''$
	Total	$(x+2)''$

Corner Bumper Pattern

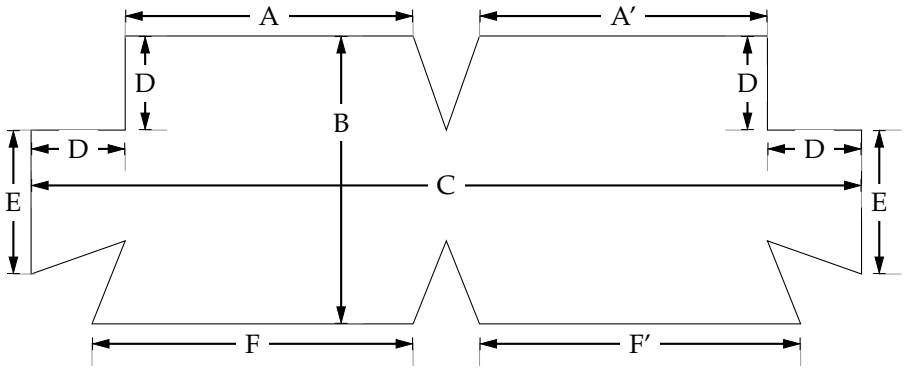

Figure 2: Pattern for the corner bumpers, including corner notch cutout, with labeled lengths to mark.

	Item Description	Measurement
	Length of Bumper	x''
A	Outside Seam Allowance	$\frac{1}{2}''$
	Corner Seam Allowance	$\frac{1}{2}''$
	Total	$(x+1)''$

	Item Description	Measurement
	Attachment to wood backing	$1''$
	Thickness of wood backing	$\frac{3}{4}''$
	Height of pool noodle	$2\frac{1}{2}''$
B	Height of bumper (2x width of pool noodle)	$2\frac{1}{2}'' * 2 = 5''$
	Height of pool noodle	$2\frac{1}{2}''$
	Thickness of wood backing	$\frac{3}{4}''$
	Seam Allowance	$\frac{1}{2}''$
	Total	$13''$

C

Item Description	Measurement
Attachment to wood backing	$1''$
Thickness of wood backing	$\frac{3}{4}''$
Width of pool noodle	$2\frac{1}{2}''$
Length of bumper	x''
Width of pool noodle (*2 for noodle overlap in corner)	$2\frac{1}{2}'' * 2 = 5''$
Length of bumper	x'''
Width of pool noodle	$2\frac{1}{2}''$
Thickness of wood backing	$\frac{3}{4}''$
Attachment to wood backing	$1''$
Total	$(x + x' + 13.5)''$

x and x' are only used to denote if one side of the bumpers is longer than the other. They correspond to the A, A', F, and F' marked on Figure 2. If both sides are the same, then this reduces to $(2 * x + 13.5)''$ for the total length.

D

Item Description	Measurement
Attachment to wood backing	$1''$
Thickness of wood backing	$\frac{3}{4}''$
Width of pool noodle	$2\frac{1}{2}''$
Total	$4\frac{1}{4}''$

E

Item Description	Measurement
Seam Allowance	$\frac{1}{2}''$
Height of Bumper (*2 height of pool noodle)	$2\frac{1}{2}'' * 2 = 5''$
Easement	$\frac{1}{2}''$
Seam Allowance	$\frac{1}{2}''$
Total	$6\frac{1}{2}''$

F

Item Description	Measurement
Seam Allowance	$\frac{1}{2}''$
Easement	$\frac{1}{2}''$
Length of bumper	x''
Easement	$\frac{1}{2}''$
Seam Allowance	$\frac{1}{2}''$
Total	$(x + 2)''$

CUTTING THE FABRIC

Once you have a pattern, you are ready to begin work with fabric. for straight bumpers, you will cut 4 of each color. For corner bumpers that are the minimum 6" on each side of the corner, you will cut 4 of each color. If one side of the bumpers will be longer than the other, you will cut 2 of each color with the pattern face up and 2 of each folor with the pattern face down (for experienced sewers, cut 2 of each color with right side of fabric together).

Now take a moment to decide which color will be attached to the top of the bumper and which color will be attached at the bottom. It might help to mark the fabric within the 1" attachment allowance with a top or bottom designation. This will help when you are applying the team numbers and securing the fabric.

At this point, I like to do a simple zig zag finish around each piece of fabric. It is not necessary, but I like the neatness that this step brings to the finished product.

TEAM NUMBERS

The team numbers are required to be displayed on all four sides of the bumpers. The numbers must be at least 4" tall with at least 1/2" stroke. Most teams use one of the 3 following methods for team numbers:

- Iron on numbers
- Make a template and paint on the fabric
- Make appliques and sew the numbers on.

If you are making corner bumpers and have a 4-digit team number, you will probably need to split the numbers and place 2 digits on one side and the other 2 digits on the other side. Plan this placement carefully in order to have the numbers correctly placed on the bumpers. For example with team number 1234:

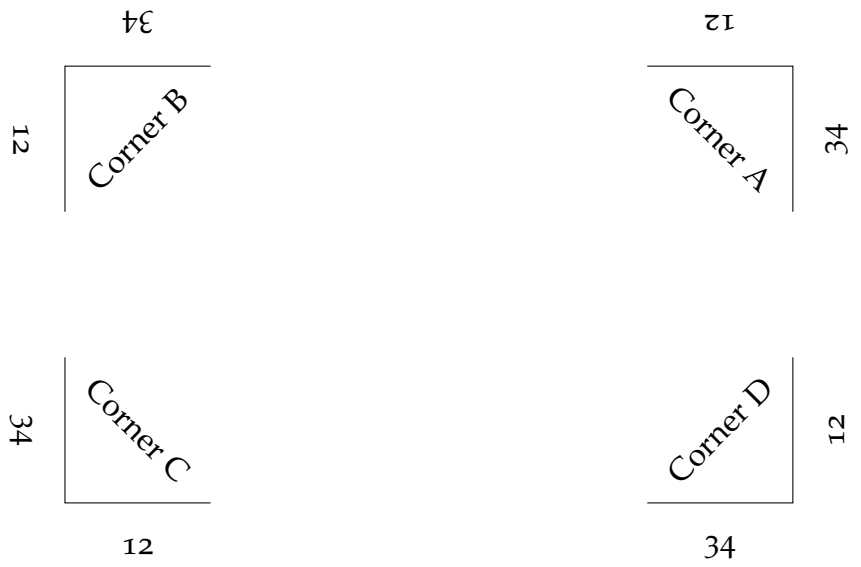

Figure 3: Allignment of team numbers on bumpers so that each side of the bumpers display the full team number across the gap between bumpers.

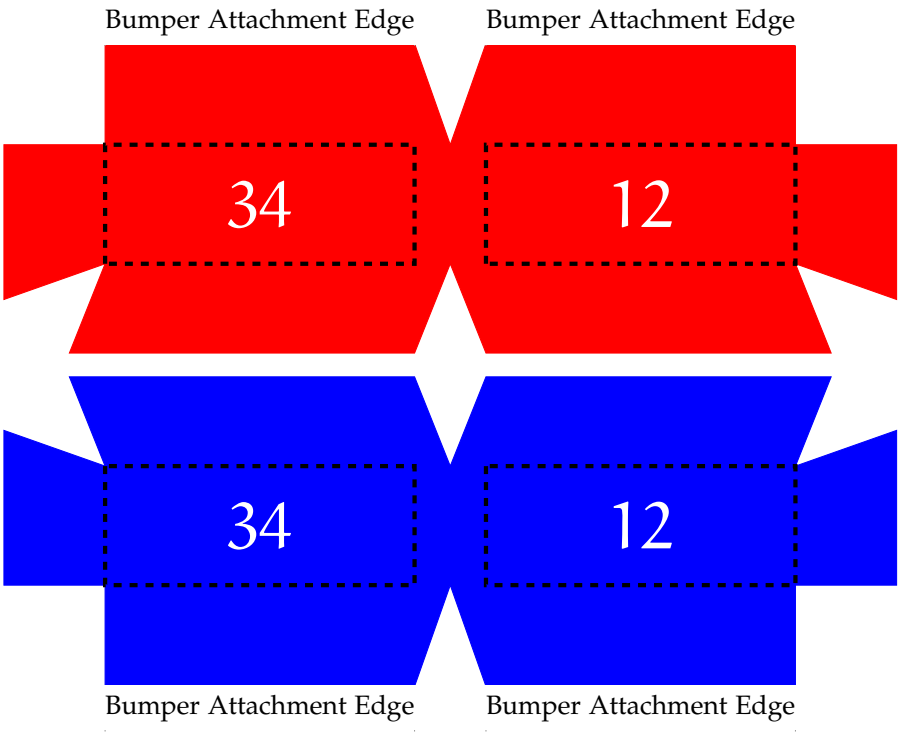

Figure 4: Allignment of Team Numbers on bumpers with red bumper fabric attached to bumper backing on top and blue bumper fabric mounted at bottom of bumper backing. The dashed outlines show the region team numbers should appear in.

For straight bumpers, measure to the center and place the numbers in order (1234). You do have to make sure that you know which color will be attached at the top and which color attached at the bottom.

SEWING THE BUMPERS

Note: Right side of fabric refers to the side of the fabric with the team numbers. All seams are made with right sides together unless noted otherwise.

For straight and corner bumpers, start with the red bumper fabric for a bumper:

1. On each end of the fabric, sew D and D together. For corner bumpers between the 2 A's also sew the "V" together (forms the corner).
2. On the flap side, sew the end notches together. For the corner bumpers, leave the center notch unsewn for now.
3. Repeat steps 1 and 2 for blue fabric for the same bumper.
4. Mark the center of the E section at the end of each bumper.
5. Place right sides together for the red and blue fabric of the same bumper matching center marking and end notch seams on flap side of the bumper.
6. Sew flap side of bumper from center marking to center marking using a 1" seam allowance from center marking to notch seam, 1/2"

allowance from notch seam to notch seam, and 1" from notch seam to center marking. For corner bumpers, sew the notch in the center (corner) coming to a point near the point of the notch. Reinforce the point y sewing over the seam. Trim the fabric at the point to reduce the bulk when turning. This creates a flap that will overlap at the corner and allowing enough to give to quickly turn the flap reversing the color showing on the robot.

7. Clip the fabric at center mark and make a reinforcing stitch.
8. Turn the bumpers resulting in the right side of the fabric facing out.
9. Test fit of bumpers on attachment sides to the wood over the noodles.
10. Make sure team number will display roperly on both colors and flap will turn properly.
11. Top stitch close to folded flap edges from center mark to center mark.
12. Mark center line from side E to side E on both colors of the bumper.
13. Pin both colors together matching center line.
14. Sew along center line. This forms the flap that will be turned from top to bottom or bottom to top changing the color of the bumper on the robot.
15. Perform another test fit on your bumper. Make sure the flap will turn properly.
16. Verify that you have 1" of fabric that will fold under the wood for attaching the fabric to the wood. This fabric will end up between the wood and the chassis frame of the robot.
17. Mark the edge of the wood on the fabric. This is important because the hook and loop fastener has to be supported by the wood per the robot rules.
18. Sew the hook portion of the hook and loop to the attachment side of the fabric (on the right side of fabric).

    If using blue and red hook and loop, sew the blue on the blue fabric and the red on the red fabric.
19. Sew the loop portion of the hook and loop to the flap of the fabric (F).
20. Repeat steps 18 and 19 for the other color fabric. On the second color for the flap, you will be sewing through 2 layers of Loop.

    I recommend changing your needle between each bumper. Otherwise, you will probably have thread fraying issues.
21. Verify proper fit to bumpers and verify flaps will turn properly.
22. For corner bumpers, trim excess fabric from corner.
23. Trim fabric around mounting hardware.
24. Making sure that hook and loop is supported by the 3/4" edge of the wood. Staple fabric to the back of the bumper wood (side of the wood that will be facing the chassis).
25. Repeat process for remaining bumper sections.