Bumpers 2026

Ryan B. and Ansh K.

OUTLINE

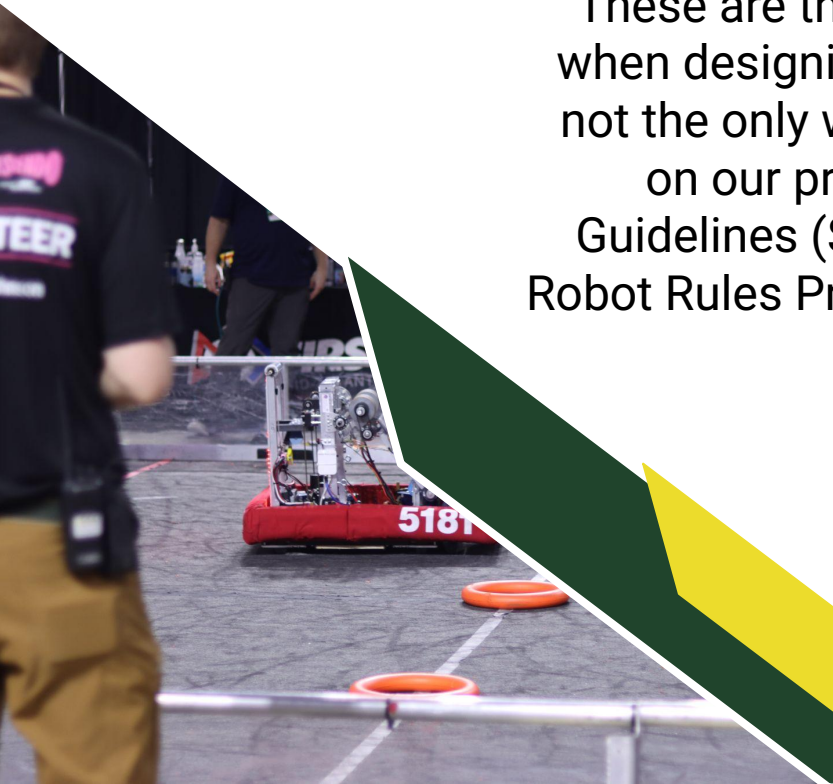
- Design
- Planning and Materials
- Fabrication
- Final Touches
- Resources

DISCLAIMER

These are the standards that FRC Team 1403 upholds when designing and fabricating bumpers; however, it is not the only way to build bumpers. This presentation is on our process. Ensure your bumpers follow FIRST Guidelines (Section 8.4 of the 2025 FRC Manual, 2026 Robot Rules Preview) and check the rules to ensure your bumpers follow guidelines.

Thank you to Christine Low for supplying your bumper presentation!

Disclaimer



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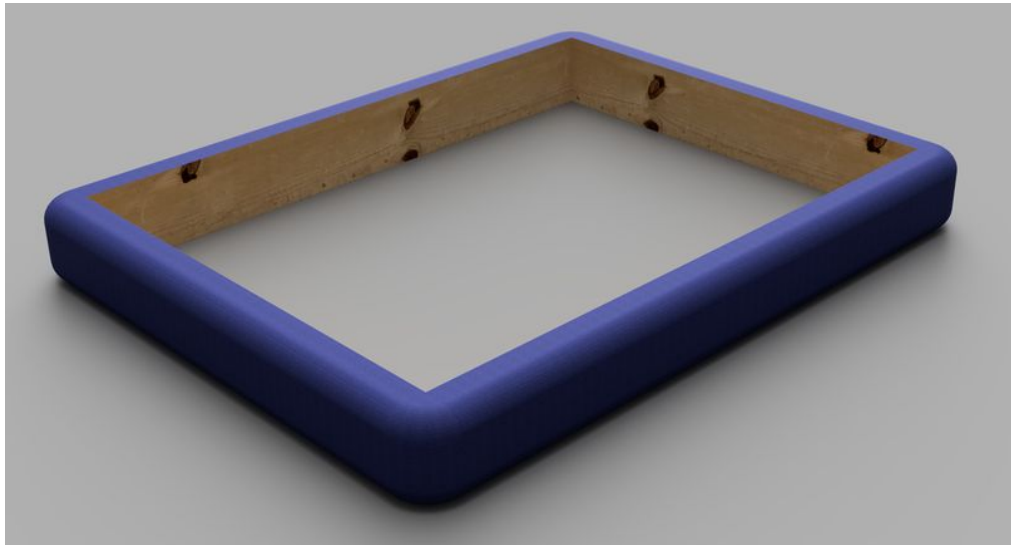
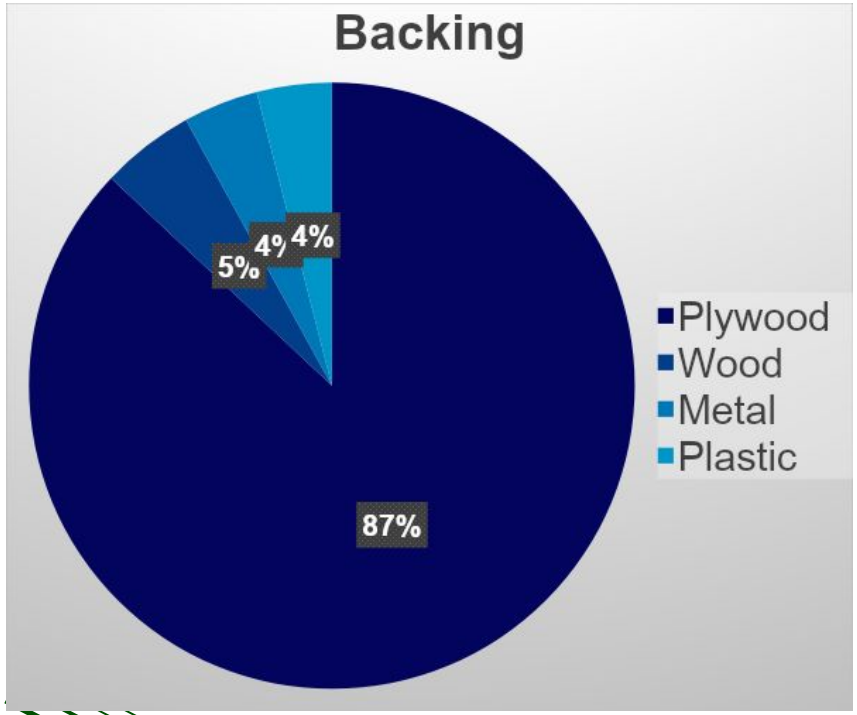
WHY MAKE BUMPERS?

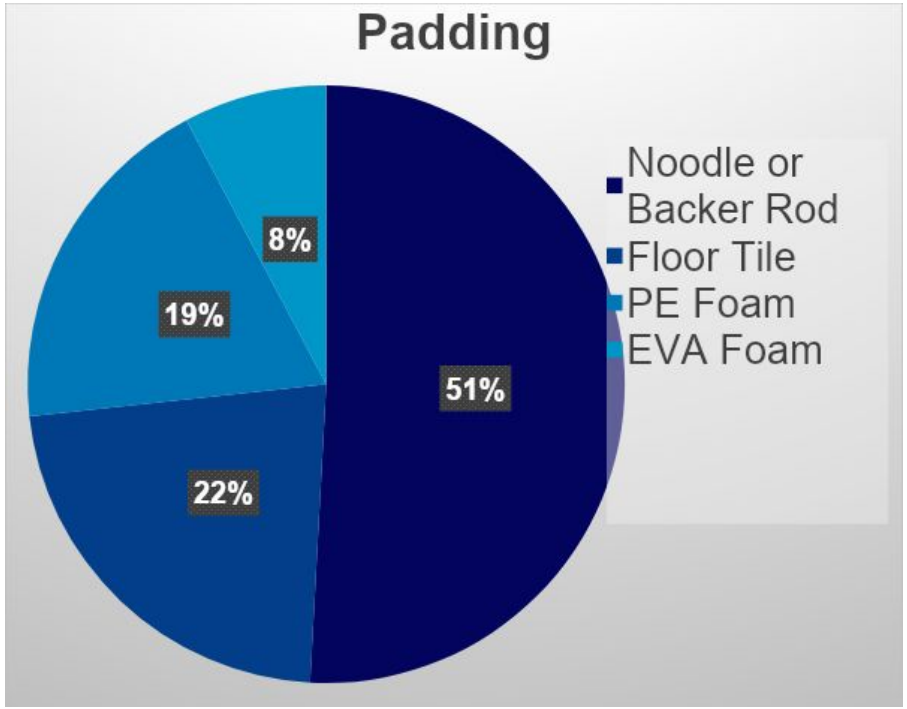
- FIRST requires that all outside corners of the frame perimeter be protected by bumpers.
- Bumpers protect your robot from being damaged when running into game elements or other robots on the field.
- Bumpers must pass inspection before each competition.

- Bumpers should matter as much as your drivetrain in today's FRC



BUMPER STATISTICS (2025)





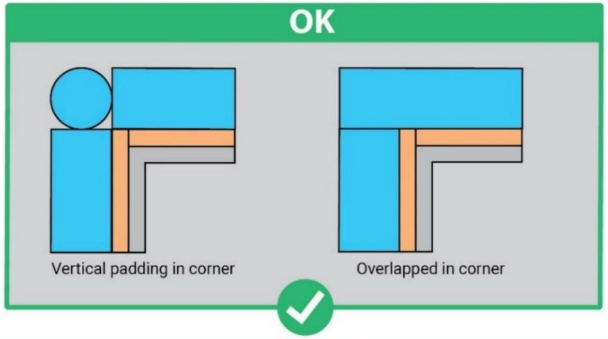
* Thanks to Gus Michel II “GeeToo” for creating the poll for these statistics

BUMPER BASICS – MATERIALS

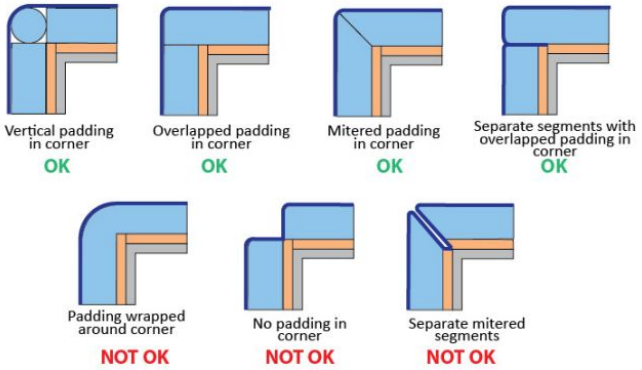
What this section will cover:

- Padding/foam
- Backer Materials
- Fabric or “cloth”
- Bumper Numbers
- Bumper Mounting

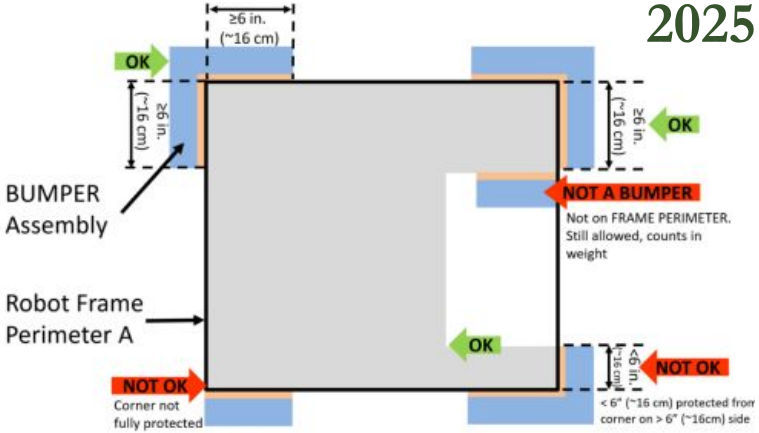
BUMPER RULES THROUGHOUT THE YEARS

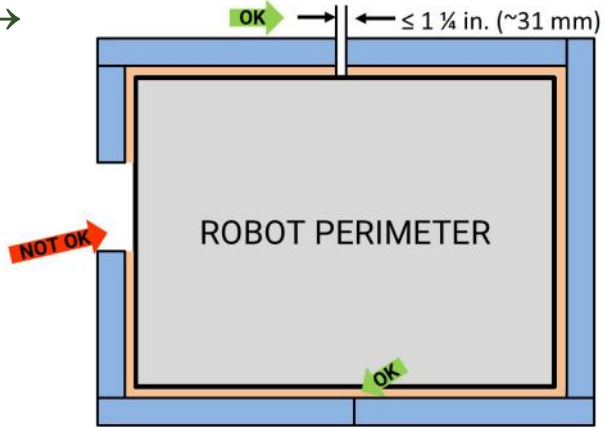


← 2024



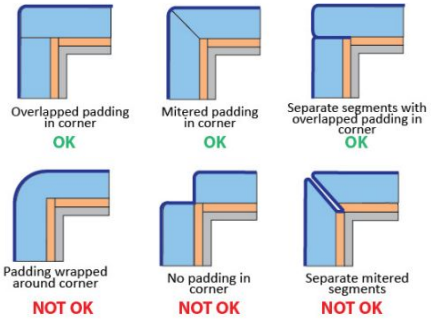
2025 →





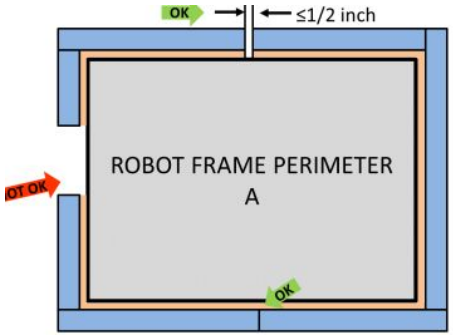
BUMPER RULES

FRAME PERIMETER RULES



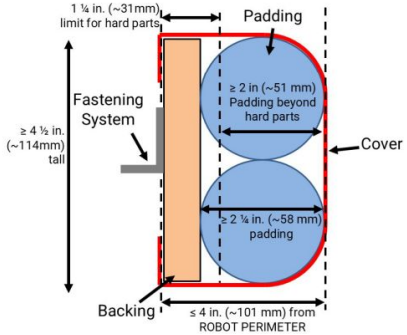
Frame Perimeter Rules (R406 of 2025 FRC Manual)

FRAME PERIMETER RULES



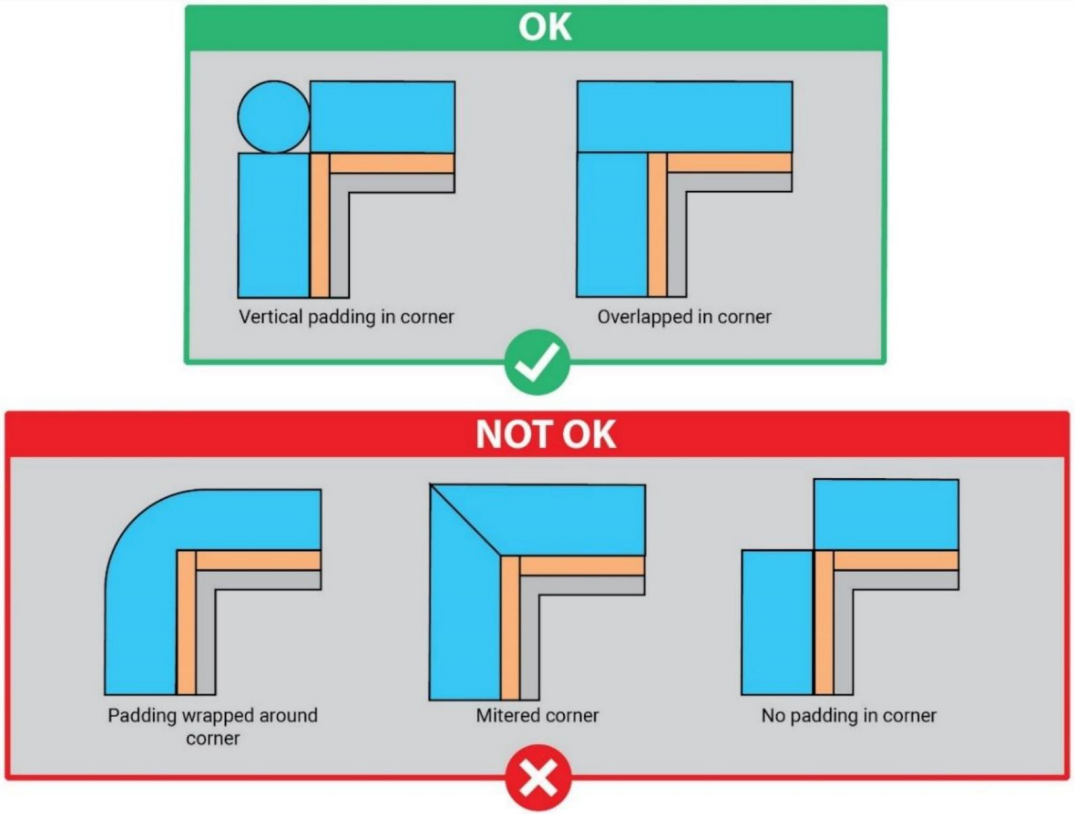
Corner Frame (R401 of 2025 FRC Manual)

BUMPER RULES



- Must be plywood
- 11/16 inch is also acceptable, or even 23/32 inch (actual size)
- Padding must be a minimum of 2 ¼ in thick (New from 2025)

NEW BUMPER RULES - 2026



Allow thicker padding extending up to 4.25 in. from the frame perimeter

Allow taller bumpers

Increase bumper to bumper overlap between robots by requiring the bumpers to fill the portion of the BUMPER ZONE between 2.5 in. and 5.5 in.

Cannot use hollow pool noodles

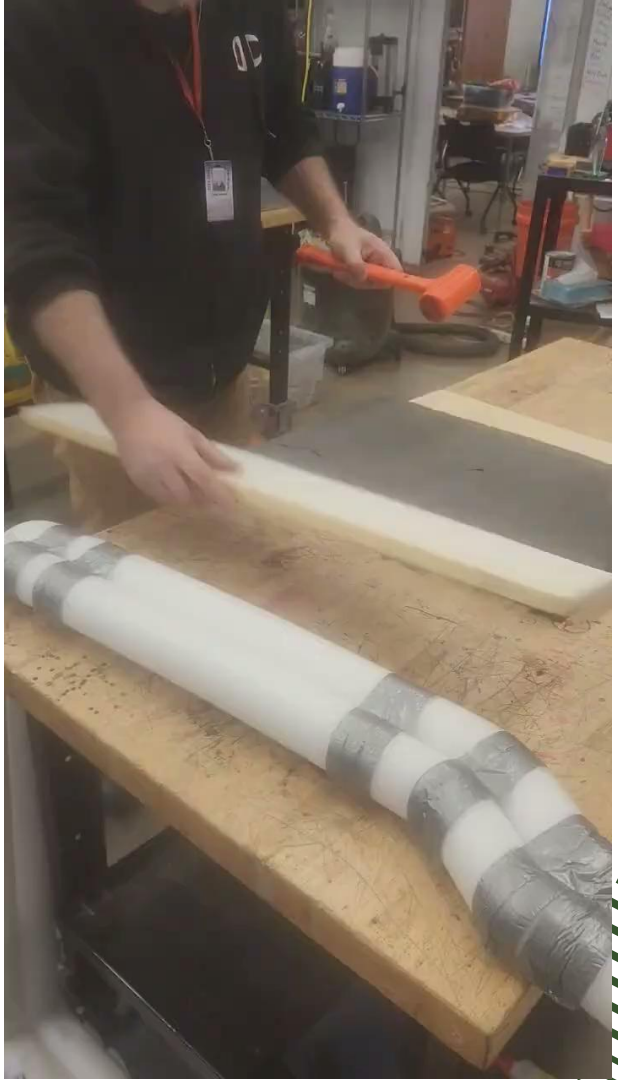
BUMPER BASICS - FOAM/PADDING

Legal foam 2025

- Pool noodles or backer rod
- Solid PE closed cell foam, 1.5 - 3 #
- Solid EVA closed cell foam, 2 - 6 #
- Foam floor tiles

Recommended

Video: Thanks to Joel Noble, (retired from FRC)
Formerly with FRC 1339 “Angelbotics”
Filmed before kickoff 2025



BUMPER BASICS – FOAM COST

Product	Price
Cross Linked Polyethylene - 2LB Thickness: **1"** Sheet Size: **48" x 24"**	$27.99
Cross Linked Polyethylene - 3LB Charcoal Thickness: **1/2"**	$19.99

For 1 bumper of size 5” x 35”

- with 2” of 2# and ½” of 3#…

Need 1.3 sheets 2#, and 1/5 sheet 3#

For 2 bumpers, cost is:

3 sheets 2#	$55.98
1 sheet 3#	$19.99

“New Good Foam” Total **$75.97**

Purchase pool noodles from AndyMark:

- “about 6-8 pool noodles are used for 1 set of bumpers depending”

1 Pool noodle is $2.70 (23 Aug 2025)

15 pool noodles = **$40.50**

(not including tax & shipping)

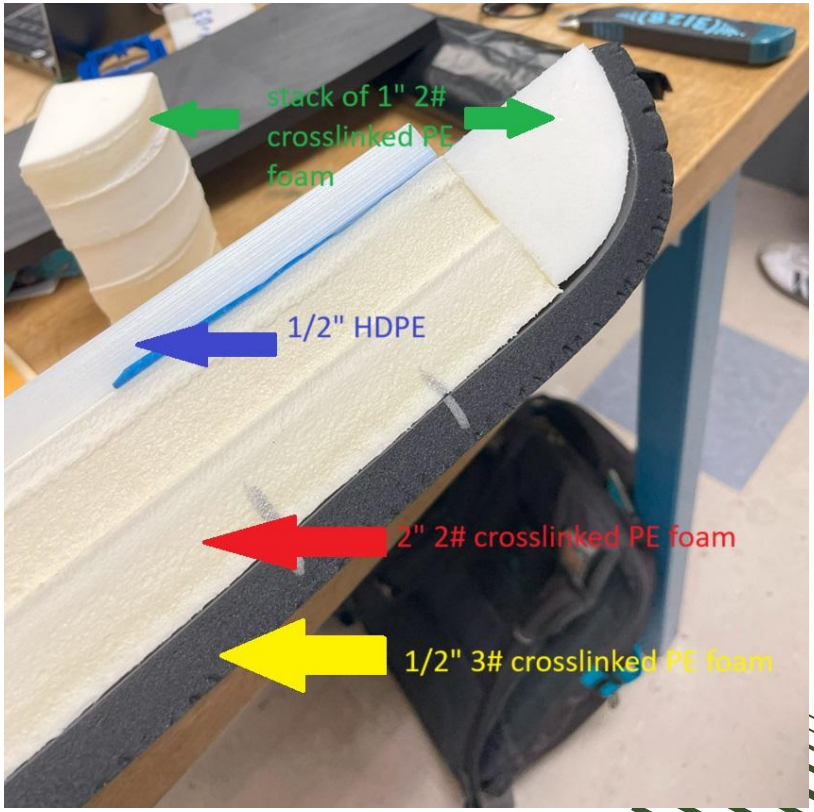
vs $40.50 for pool noodles

BUMPER BASICS – FOAM ATTACHMENT

Attaching foam:

- Double-sided carpet tape
  - Layers can be separated if needed
  - Works with all foam (so far)
  - Holds foam to foam
  - Holds foam to backer (well enough)
- Rubber cement
  - Takes time to dry
  - Can’t always separate (foam rips)

Recommended

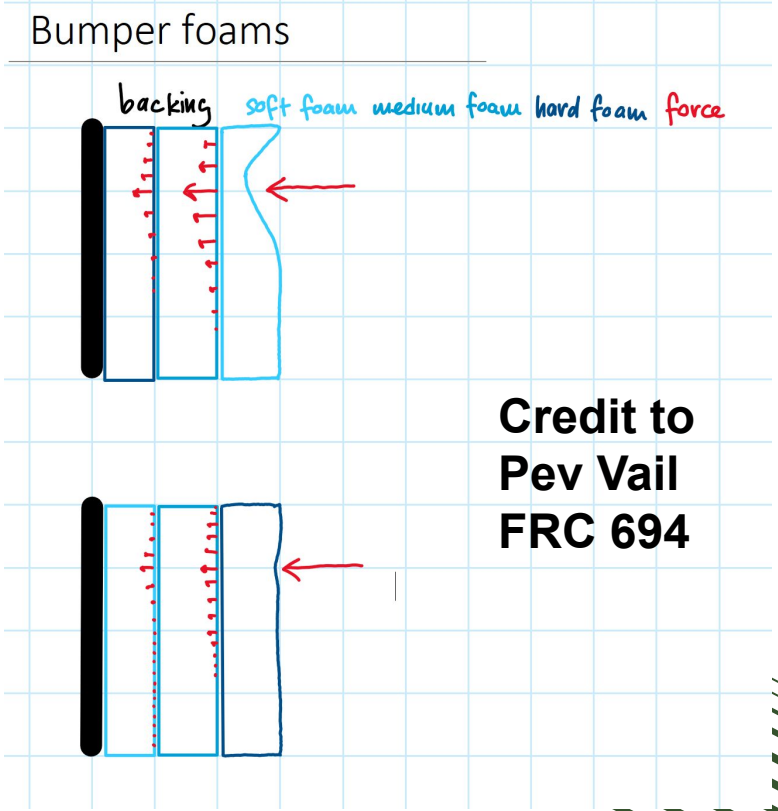


BUMPER BASICS – FOAM LAYERING

Layering Choices:

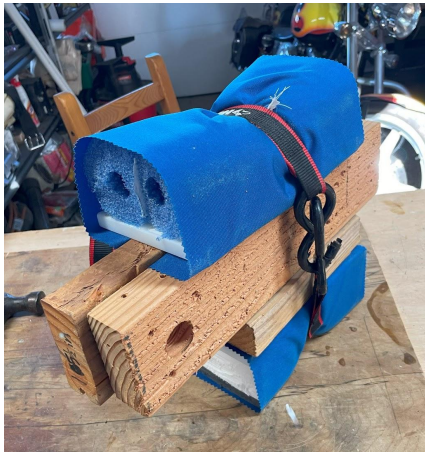
- Denser foam OUTSIDE
  - Spreads the impact forces
  - “Hard candy shell” over soft squishier inside
- Can use different foams in the same bumper

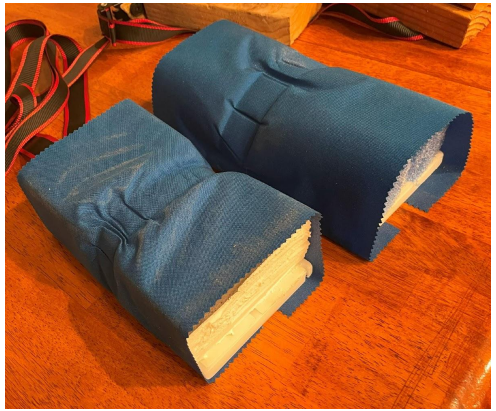
Recommended



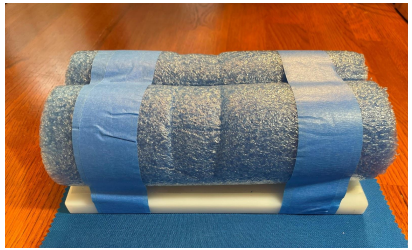
BUMPER BASICS – FOAM

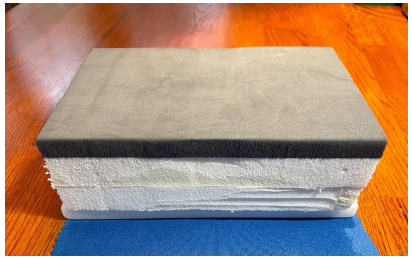
“Squish test” – which foam recovers from 48 hour compression with a ratchet strap?





Immediately after strap removal

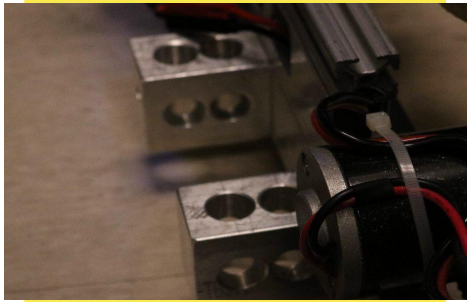




48 hours after strap removal

MOUNTING

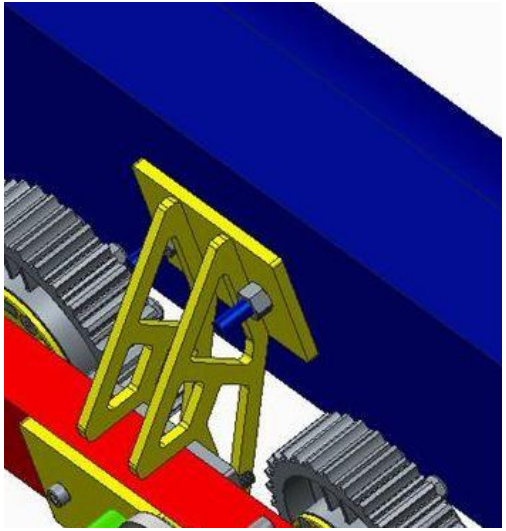
- Decide how to mount bumpers before making
- Mounts decide
  - How bumpers are made
  - Do they require hinges?
  - Further assembly beyond the main bumper frame
- Check rules for dimensions!

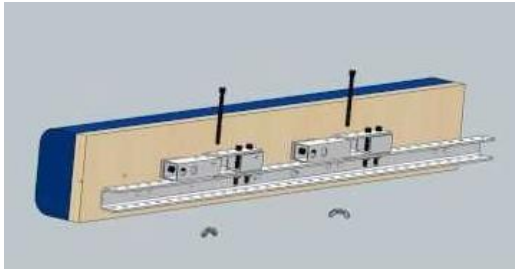


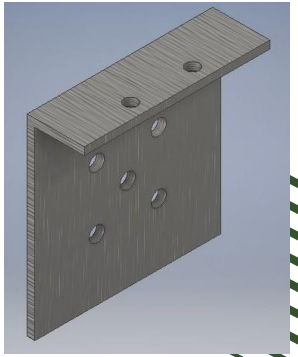
MOUNTING METHODS

Some viable methods for mounting include:

- Bolting down onto a static frame
- Wing-nuts
- Slide-on and self-latching
- L-Bracket mounts
- Securing Pins and Pegs







STYLES OF BUMPERS

- Focus on the design and functionality of the bumpers
- Suggest a single bumper for each color, with hinges on the back corners
- Lets us have one long bumper instead of multiple shorter bumpers
- Other options are one bumper for each side

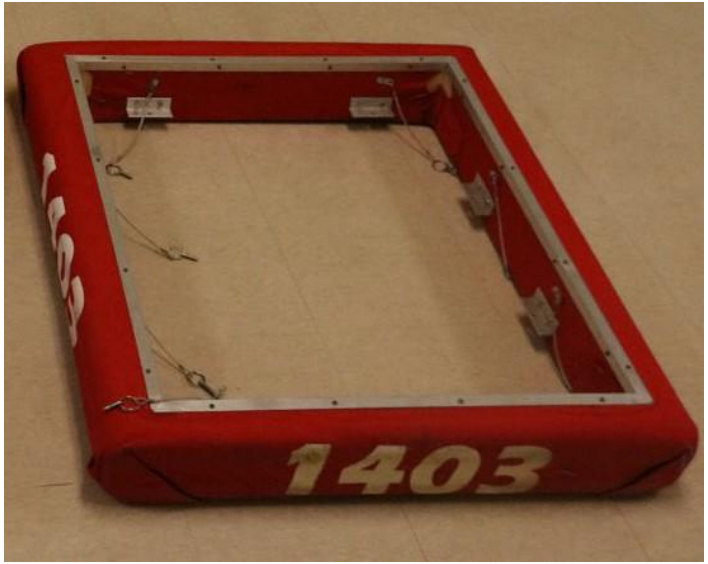
STYLES CONT.

- Another popular style is a single bumper with reversible fabric for both colors
  - Heavier and needs sewing
  - Makes changing bumper colors faster
  - Difficult to fabricate
- Before choosing a style, **check the game manual** for that year and make sure that the design of the bumper is valid and meets the requirements

BUMPER TYPE 1: COMPLETE COVERAGE

This bumper goes all the way around the robot, so it cannot be slid on. Instead, brackets and cables can be used to secure it to the robot.

Remember that this type does not allow for a break in the bumper, which may influence robot design.

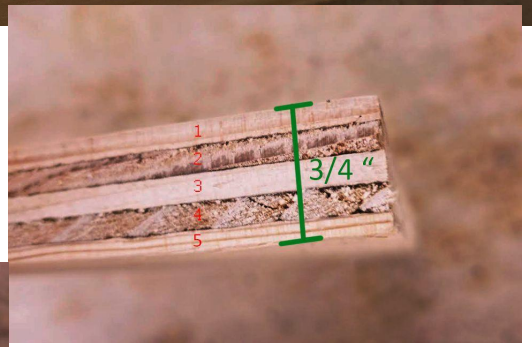


BUMPER TYPE 2: 4 PC. SINGLE-SIDE BUMPERS

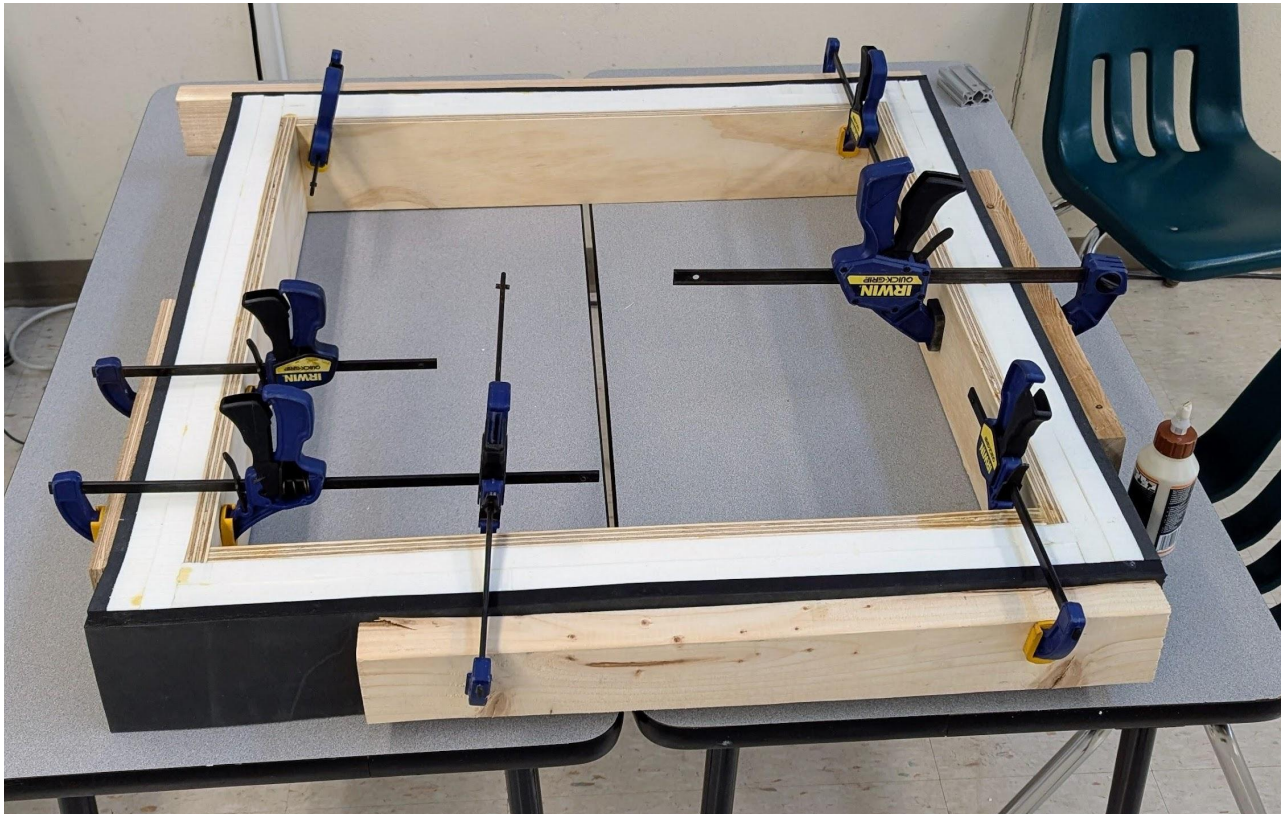
These bumpers are smaller and made for each side, making assembly simpler. Make sure 6” on each corner are still covered. Remember that this type **does not absorb impacts as well**, and are weaker at the junctions between bumpers

PLYWOOD

The first step of building a bumper is cutting down wood for the backplate. Use ¾-inch or 11/16 inch plywood cut to a legal width. The greater the number of ply, the stronger the plywood. 7 and 5 ply of Baltic Birch are ideal.



BUILDING YOUR BUMPERS



PREPARING TO ATTACH WOOD (1 PC. BUMPER)

The next step is to join your pieces of wood. We recommend using #8 or larger wood screws and wood glue to attach them. Be sure to drill pilot holes for screws.

Mark 3 holes equally spaced apart

Drill through holes at the marks with counterbores

Drill through for pilot holes

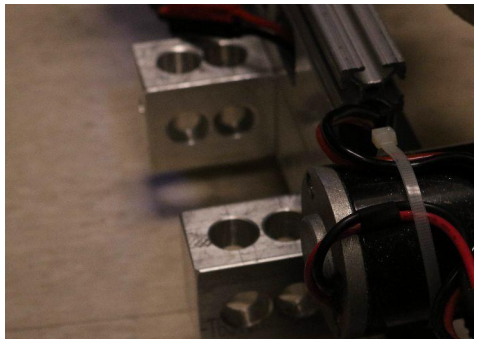
Finished pilot holes

ATTACHING THE WOOD TOGETHER

Use glue to attach the boards before driving in screws. Be sure to wipe away any excess glue before it dries. Let the glue dry for 24 hours before moving on to the next step.

ATTACHMENT MECHANISM

Now we insert pegs through the wooden frame. It is easier to do this now than it is later, as the padding can get in the way of you working. Make sure the pegs line up with their receiving ends (blocks or holes in the drivetrain). Make sure now that your bumpers are within regulations for that year.



FITTING FOAM

When cutting foam, hacksaw blades are especially effective.

Use gaffer tape when initially holding the foam to the board before wrapping.

REMEMBER: Attaching bumpers with tape is only legal if the the foam retains their shape. (R406 2025) Do not tape the padding tight enough for deformation.

Avoid “foam welding”: can damage the structure of your bumpers

no hollow pool noodles!

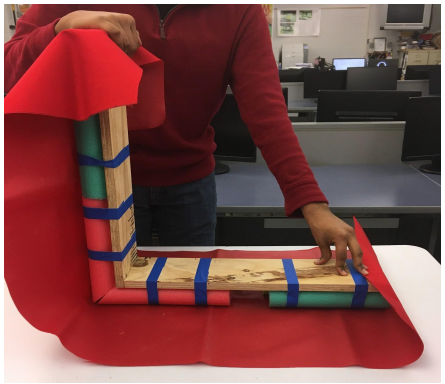
DETERMINING YOUR FABRIC

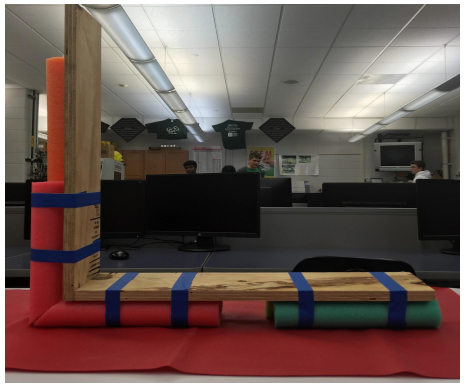
- There are a few different places you can get your bumper fabric from.
  - seattlefabrics.com → 1000 Denier Nylon Fabric (Red & Blue)
    - https://www.seattlefabrics.com/60-1000-D-Cordura-Nylon-1350-linear-yard_p_53.html
  - andymark.com:
    - Slick Bumper Material (am-2955 & am-2956)
      - Helpful for when you want objects to slide rather than grip
      - Less durable and more likely to tear
    - Regular Bumper Material (am-2675 & am-2676)
      - Heavy duty nylon cloth, slightly more expensive

There are other options as well, don’t forget to explore!

LAYING OUT FABRIC

- Lay out all the parts of your bumper on the fabric, making sure you have as little slack as possible between the parts of the bumper
  - Good craftsmanship
- Mark out where your numbers will go
  - Easier to put on #’s before attaching fabric (and good planning!)





ATTACHING NUMBERS

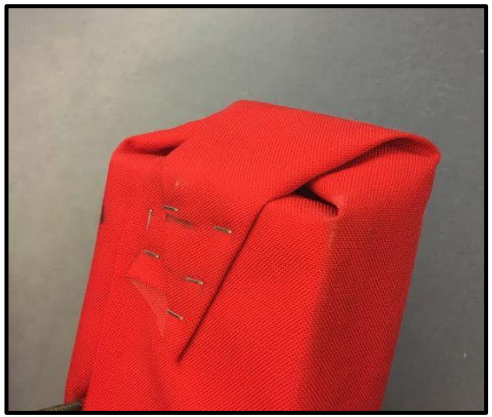
Mark out where your numbers will go before mounting them. We use pre-cut numbers for our bumpers and a **heat press** to attach the numbers to the fabric. It is also possible to **paint the numbers** onto the fabric. It is important to mount numbers on your fabric before attaching your fabric to the bumpers. They must be **white** or have a **1/16 inch white outline.** Make sure the numbers used are in accordance with the manual. We used the AndyMark Vinyl Adhesive Numbers, but painted them on last year. (https://www.andymark.com/products/vinyl-adhesive-numbers-white-4-in-tall-qty-4-options).

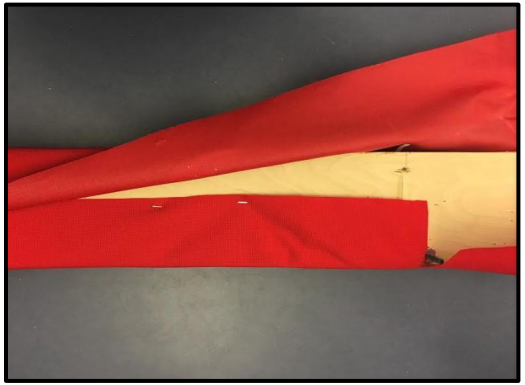
Example of painted numbers

Example of Heat-pressed numbers

ATTACH THE FABRIC

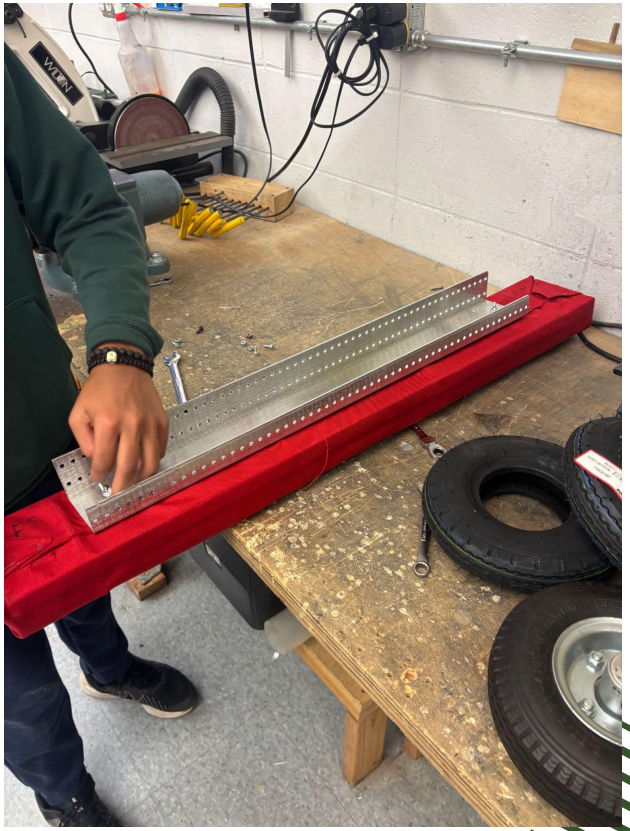
Attaching the fabric is quite straightforward. Our fabric curves around the top and bottom edges of the bumper and meets in the middle, where we staple it into the wood. Remember, less fabric means a better fit and a more stable bumper.



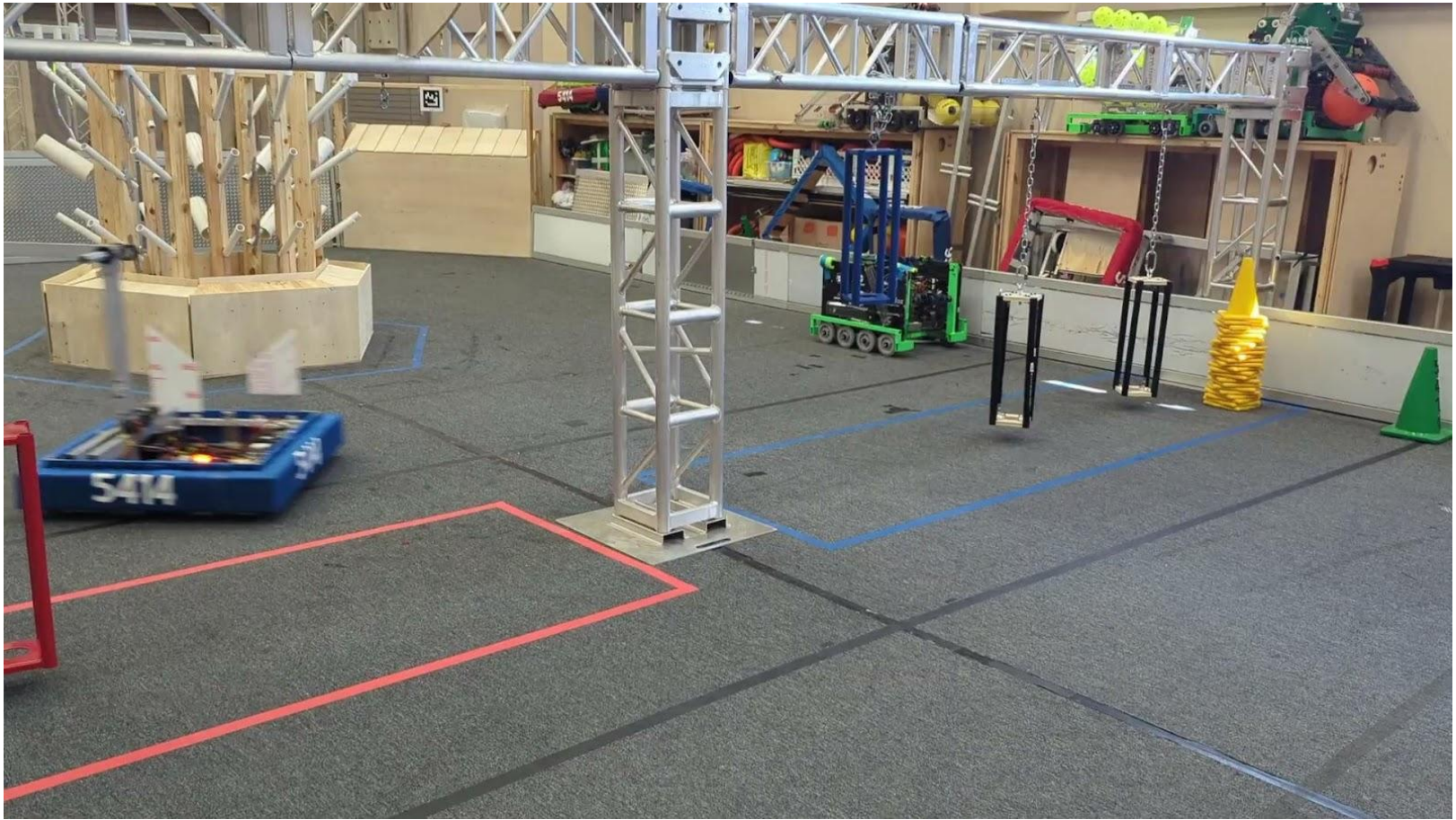


PUTTING THE MOUNTS ON YOUR BUMPERS

- Make sure your mount attaches firmly to the backing of your bumper
- There are many different styles of mounts that you can utilize, make sure are able to integrate them with your robot
- More is always better: If it takes more than you need to secure the bumper, no problem
- Make sure you can minimize the time it takes to change bumpers in the pits during competition



BUMPER TESTING VIDEO - 5414 PEARADOX



BUMPER BASICS – SCRAPPY VERSION

Materials:

- **Plywood, ¾" thick** for Bumper Backing
  - Baltic Birch/marine grade plywood
  - "sheathing" plywood at Big-Box
- **Cordura** or **heavy nylon fabric** (red & blue)
  - Andymark - best bang for the buck
- **Paint-on Bumper Numbers***
- **VERY SIMPLE mounting system**
- **The best foam you can get your hands on $$**
  - 2-3# XLPE or EVA foam, or foam floor tiles

** You choose the paint*

Design & Build

- **Design 4-piece bumpers very early**
  - 2 sets – red & blue
  - Avoid "reversible bumper" temptation
- Back bumps firmly to a ROBUST Robot frame
- **Build test bumpers very early**
- TEST the robot with Bumpers on
  - A LOT
- Be Mean to test bumpers – if they break, re-assess

BUMPER BASICS – "PUSH THE BLEEDING EDGE"

Materials:

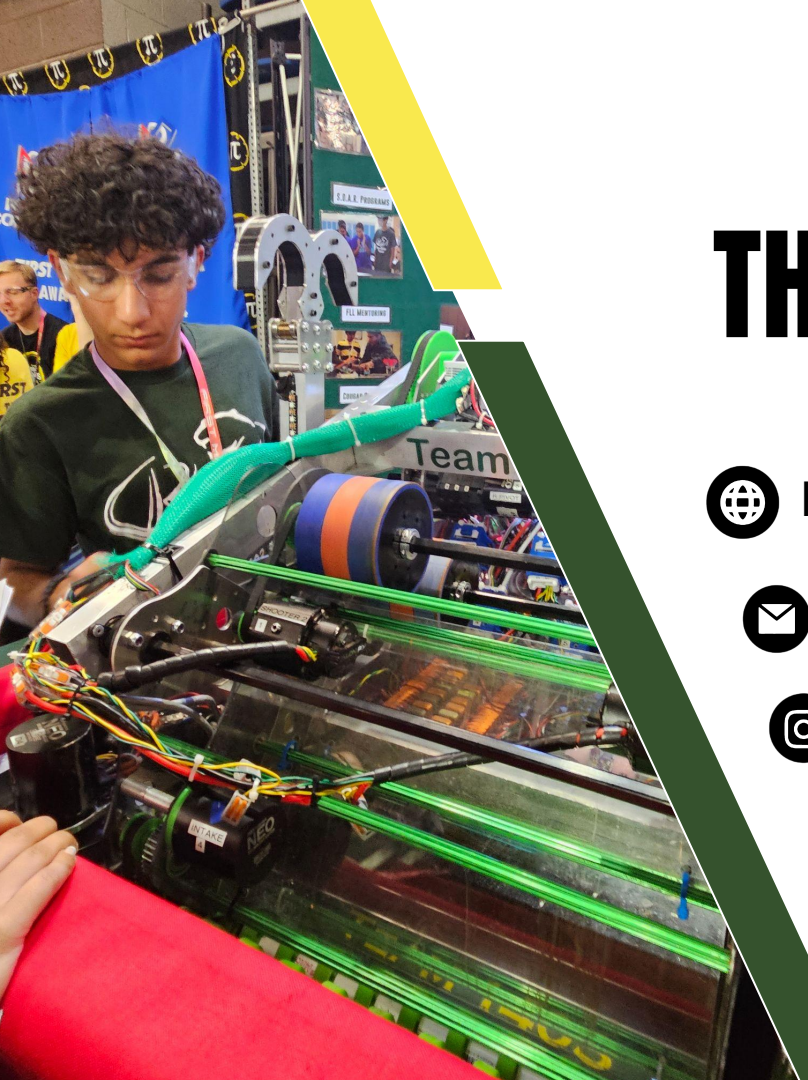
- Bumper Backing (your choice)
  - choose and test in off-season
- Cordura or heavy nylon fabric (red & blue)
- HTV or Paint-on Bumper Numbers
- Well understood, within-your-capabilities mounting system
- **The best foam you can get your hands on*** **$$**
  - 2-3# XLPE or EVA foam, or foam floor tiles

Design & Build

- Design & build bumpers in off-season with new materials
- Back bumps firmly to a ROBUST Robot frame
- TEST the robot with Bumpers on
  - A LOT. Be Mean.
- Assess results
- If you have the capability – try reversible or "fancy" bumpers
- Choose what worked best for 2026
  - Post on Chief Delphi!

RESOURCES

- FRC 2024 Rule Manual: https://firstfrc.blob.core.windows.net/frc2024/Manual/2024GameManual.pdf
- FRC 2025 Rule Manual: https://firstfrc.blob.core.windows.net/frc2025/Manual/2025GameManual.pdf
- 2026 Robot Rules Preview https://community.firstinspires.org/2025-robot-rules-preview-for-2026
- How to Build Your Own Bumpers (without losing your mind) v5 https://docs.google.com/presentation/d/1XtGaLiOz1X9Xr3XBmaJe6xdF7ybtdiYF6-gFDlIPozI/edit?slide=id.g38550a58f60_2_76#slide=id.g38550a58f60_2_76
- AndyMark Vinyl Adhesive Numbers: https://www.andymark.com/products/vinyl-adhesive-numbers-white-4-in-tall-qty-4-options
- ID Trail Fabric 1000 Denier Nylon Fabric (Red & Blue):
  - http://www.oldtrailfabric.com/1000-denier-red-cordura-nylon-fabric-robotics.html
  - http://www.oldtrailfabric.com/1000-denier-royal-blue-cordura-nylon-fabric-robotics.html



THANK YOU

https://cougarrobotics.com/

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@team1403

QUIZ!

1. What is the primary purpose of bumpers in the FIRST Robotics Competition?

A) To protect the robot from falling over

B) To make the robot look stylish

C) To protect the robot from damage during collisions

D) To increase the robot’s speed

QUIZ!

2. Which of the following materials is NOT allowed for robot bumpers in FRC?

A) Foam

B) Wood

C) Fabric

D) Aluminum

QUIZ!

3. What color must bumpers be in the FIRST Robotics Competition?

A) Red and blue

B) Any color as long as it is visible

C) Solid black only

D) A single solid color with a contrasting team number visible

QUIZ!

4. How many inches of bumper coverage must a robot have around its perimeter in FRC?

A) 100% of the perimeter

B) 75% of the perimeter

C) 50% of the perimeter

D) 90% of the perimeter

QUIZ!

5. What is the maximum thickness of the bumper foam that is allowed in FRC?

a. 1 inch
b. 2.5 inch
c. 5.5 inch
d. 4.25 inch

QUIZ!

6. How should the bumpers be attached to the robot?

A) Using tape

B) Using Velcro only

C) With bolts or fasteners

D) Using magnets

QUIZ!

7. When designing bumpers, teams must ensure that the bumper fabric covers at least how much of the bumper's length?

A) 100%

B) 90%

C) 75%

D) 50%

QUIZ!

8. If a robot's bumpers are not properly secured or have other issues, what can happen?

A) The team will be disqualified for the entire event

B) The robot will be sent home early

C) The robot may not be allowed to compete until the issue is fixed

D) The robot automatically gains 10 points