

Team 3176 White Paper

Title: Bumper Frame Manufacturing	Author(s): Mollie Dial
Sub-team: Fabrication	Subject: Bumper Frame Manufacturing
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Abstract: The purpose of this white paper is to explain how I have helped others fabricate the frame for the robot's bumper. I manufactured this part with Jillian, Darshan, and Shane.

Materials: The basic materials you will need to create the frame of the bumper include: a drill and drill bit, screws, and $\frac{3}{4}$ in. thick plywood. We also used other basic machines and materials such as the band saw, safety glasses, a tape measurer, 90 degree clamps, ect. To complete our project, we referenced section 10.5 of the FIRST rule handbook for Destination: Deep Space.

Basic Rules (a few examples in reference to section 10.5 of the FIRST rule handbook):

- Each set of bumpers must weigh no more than 15lbs
- Bumpers must be designed for quick and easy installation and removal to facilitate inspection and weighing
- Bumpers must not wrap around sharp corners (less than 160 degrees)

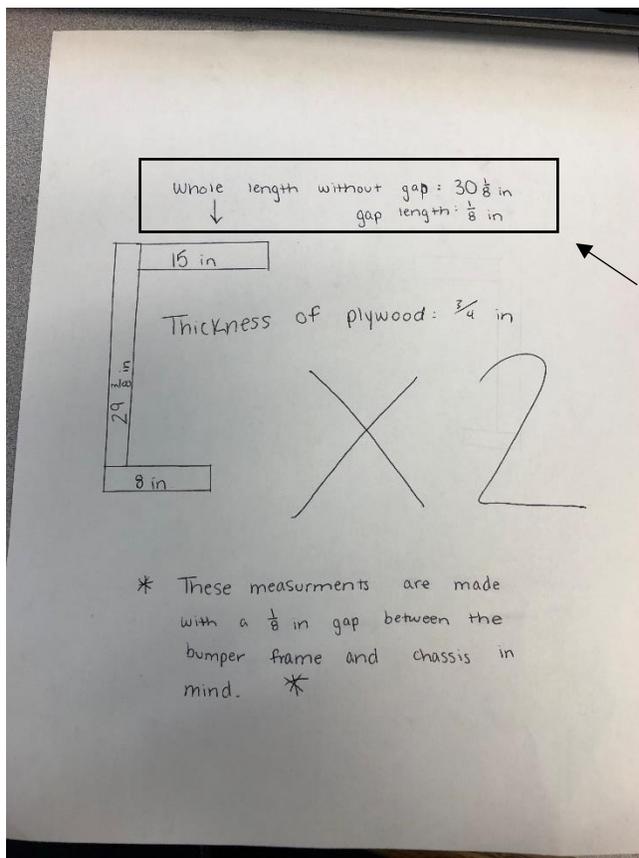
Things to Take into Consideration:

We designed our bumpers so that we can easily access them while on the robot. Some things we did to help make this happen include leaving a $\frac{1}{8}$ in. gap from the robot to the bumpers for an easy fit. We also split the bumpers into two different pieces. This made it easy for us to install and remove the bumpers. The section of the bumpers that was removed from the back side of the chassis was only $\frac{1}{8}$ of an inch in length, and we made the bumpers covering the front side cover the exact length of the front part of the chassis. Since there is no gap on the back side of the chassis, there was no need for a huge gap from where each set of bumpers would have been connected.

Tips for Manufacturing: At first, we made this simple task a lot more difficult than it needed to be. A tool that ended up helping us was the 90 degree clamp. We used two of these clamps, one on the top and one on the bottom of the two parts we were connecting together, for a

precise 90 degree angle. We had a total of two 90 degree angle edges for both pieces of the bumper. Another tip that helped us manufacture the bumpers included the use of the band saw. Because we cannot cut a whole plywood board on a chop saw, the band saw helped us to cut out the parts we needed. In total, we used three plywood parts per piece of the bumper (there are two pieces of the bumper). You can see the three parts in the sketch below.

Finding the Correct Measurements: What seemed to be the most difficult part of this project was finding the correct measurements for the parts that we were to assemble together. What we continually forgot to include while finding the measurements was the 1/8 in. gap between the bumpers and the robot. This made our measurements too small while manufacturing. We also needed to include the small gap that disconnects the bumper into two different pieces, which was also 1/8 of an inch in length.



Here is a picture of our final dimensions for the bumper frame. The "X2" represents the multiplication of all of the given dimensions by two for the two pieces of the bumper. As you can see, if we were to add the other bumper piece next to the first, there would be a 1/8 in. gap in between the two pieces in the back side of the bumper.

Pictured below: The final product of our two bumper pieces!

