

# Making a Laser Shoot Surface for Science Olympiad 2016-2017 Optics Events

Alan Chalker  
alan@chalker.org



**NOTE: COMPETITORS ARE NOT REQUIRED TO BUILD AN LSS.  
EVENT SUPERVISORS WILL PROVIDE ONE DURING THE COMPETITION.  
GET THE 'TIPS AND TRICKS' DOCUMENT FOR DETAILS ON MORE ADVANCED ADDITIONS TO  
THE LSS, INCLUDING THE REQUIRED MIRROR COVERINGS**

## Materials needed:

- Box of 2" deck screws (~\$2 @ Home Depot)
- Box of #4 x 1/2" wood screws (~\$2 @ Home Depot)
- 1 1" x 4" x 8' finished (not rough cut) board (~\$5 @ Home Depot)
- 1 1/4" thick 2' x 2' plywood (~\$5 @ Home Depot)
- 6 2" x 2" (or larger) square mirrors (~\$2.50 for 10 @ Hobby Lobby)
- 1 1' wooden rulers with metric markings (~\$0.50 @ Target)
- 1 Class 2 or 3A or IIIA laser pointer (~\$15 @ Walmart)
- Super glue
- Tape (Electrical or Masking work best)

## Tools needed:

- Tape measure
- Drill and 3/32" and 1/2" bits
- Compound miter saw or hand saw and miter box
- Circular saw
- Straight edge
- Pipe clamps
- Square
- Circular file

Construction consists of the following steps:

1. Mark off lines on the 1" x 4" at the following distances from one end (all in inches): 23.5, 47, 60.75, 74.5, 76.5, 78.5, 80.5, 82.5, 84.5, 86.5, 88.5, 90.5
  2. Use the straight edge to draw a line down the exact middle of one 4" side of the board.
  3. Use the compound miter saw to cut the 1" x 4" on each of the marked line, as square as possible (note some home improvement stores will do this for a small fee). You should end up with the following pieces (plus some extra leftover): 2 x 23.5", 2 x 13.75", 8 x 2"
  4. Use the straight edge to mark a line on the 2' x 2' plywood, 15.25" from one side, and cut it with a circular saw
- Your major pieces should somewhat look like this:



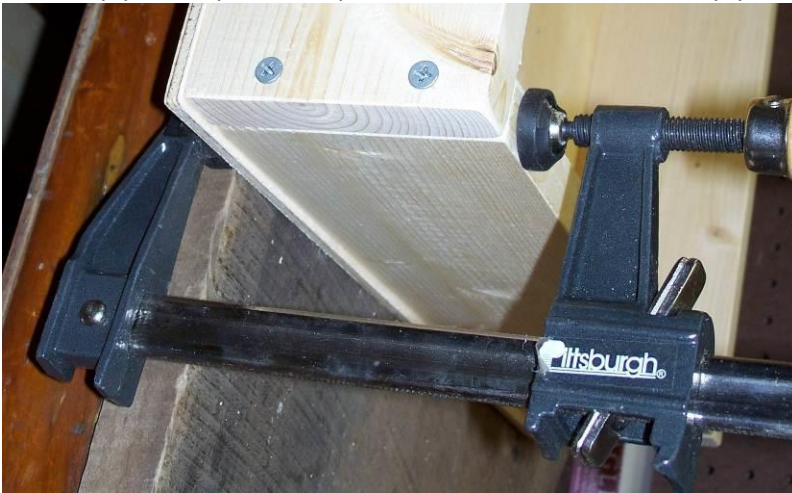
5. Stand the 1" x 4" pieces up on end around the edges of the plywood, in approximately the correct position they will end up in. Make sure the lines marking the middle all face inwards. Note that the longer pieces will overlap the edges of the side pieces (as seen in the picture on the first page).
6. Use a pipe clamp to hold the pieces together as shown below. Make sure the pieces are as square as possible and firmly seated against the plywood base. Note the pipe clamp should be positioned at the bottom of the boards to allow room to drill holes.



7. Drill holes in each end of the long pieces with the 3/32" bit as shown below left. Note the screws will end up in the orientation shown below right.



8. Screw in 4 of the 2" deck screws into the holes to hold the sides in place.
9. Move the pipe clamps up to the top edge of the boards (covering the screws) and repeat the drilling process with the bottom edges such that there are 2 screws in each corner.
10. Use the pipe clamps to clamp the side frame to the bottom plywood base, as shown below:



11. Flip the LSS over and drill 4 3/32" holes offset from each corner about an inch in a clockwise direction as shown in the picture below.



12. Screw the base to the side frame with 4 2" deck screws.

13. Unscrew the plywood base and set the side frame on edge. Align the metric edge of the wooden rulers with the middle lines of 1 short edge as shown below.



14. Use the  $\frac{3}{32}$ " drill to drill through the ruler and into the side boards.  
15. Use the #4 x  $\frac{1}{2}$ " wood screws to hold the ruler in place.  
16. Mark the exact middle point of the short edge that does not have a ruler attached to it and drill a  $\frac{1}{2}$ " hole through that point. A drill press is best used here to ensure the hole is perfectly square.  
17. The  $\frac{1}{2}$ " hole will be slightly too small for most laser pointers. Use the circular file to enlarge it as shown below. Go slowly and test fit the laser often in order to ensure a very tight fit.



18. Reassemble to side frame to the base and turn on the laser. Mark the point where it hits the far wall with a small pencil mark.  
19. Use the square to translate the mark from the target point and the center of the laser to the plywood base as shown below.



20. Remove the plywood base and use a straight edge to draw a straight line between the two marks made in the previous step, as shown below. This will be the middle line.



21. Use super glue to glue the mirrors to the middle of 6 of the 2" wide mounting blocks as shown below. You should also use wrap tape around the top and bottom of the mirror to ensure it doesn't fall off. Label the prefinished edges of the mounting blocks as top or bottom, and the edges that you cut as the sides, in order to ensure the mirrors stand at right angles to the base.



22. The extra blocks are used as the other 2 barriers in Division C. A setup with laser hitting the target point is shown below and on the first page.



**NOTE: GET THE 'TIPS AND TRICKS' DOCUMENT FOR DETAILS ON MORE ADVANCED ADDITIONS TO THE LSS, INCLUDING THE REQUIRED MIRROR COVERINGS**