



Design/Build Challenge



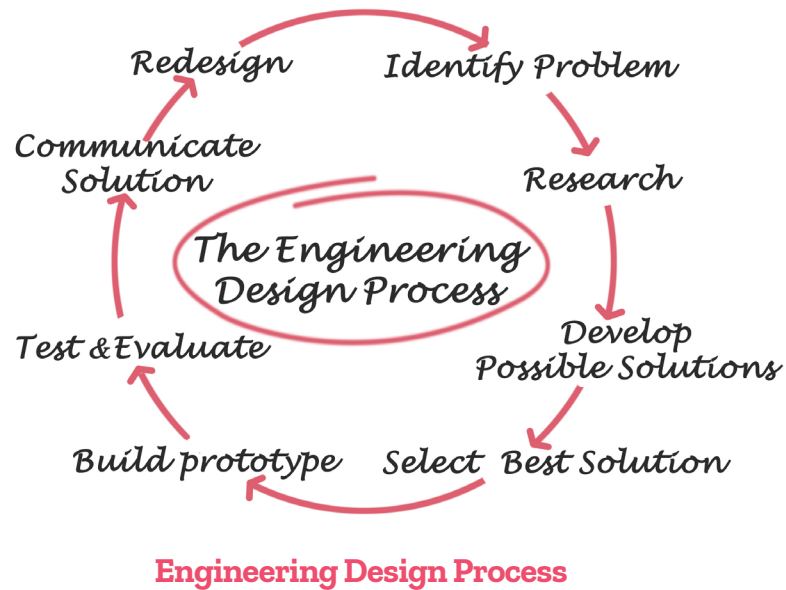
Technology Student Association

1904 Association Drive • Reston, VA 20191

TSAweb.org

The Challenge

Design and Build a Delivery Device





An engineer uses science, technology and math to solve problems. We can see engineering everywhere in the world around us, improving the ways we work, travel, communicate, stay healthy, and entertain. Engineers design machinery, build skyscrapers, and oversee public works, but they address society's needs and problems on many other levels as well.

Robotic engineering has become an increasingly important field with the intention of designing intelligent machines that can help and assist humans in their day-to-day lives. In the field of healthcare, robotics has enabled human beings to preserve their quality of life, however, in order to achieve this, engineers engage in the iteration process to develop safe prototypes.

A pandemic has forced people into quarantine and has caused the need to limit human contact. Our engineering firm has been awarded a contract to design a means to deliver materials to manufacturers to construct masks. Our task is to deliver the "textiles" (cut paper towel rectangles) using a remote delivery device (RDD). The device must lift the "textile" (paper towel rectangle) into the designated packaging (target box). You are part of the research and development team – today, you will brainstorm some solutions and build and test a prototype. Since our firm has many locations throughout the country, your team will submit a video clearly showing your prototype in action.

Materials List

Each team member must gather the following materials:

1. *Five (5) 6" x 4" rectangles cut from standard household paper towels
2. Two (2) measuring tapes or rulers
3. Scotch tape (only used to construct the receptacle and tape down items in place)
4. Five (5) Pieces of corrugated cardboard (no more than 2.75" wide, no more than 25" long, no more than ¼" thick)
5. Ten (10) Binder Clips (any size) 
6. Ten (10) Wooden (spring-type) Clothespins 
7. Twenty-five (25) 4.5" Craft Sticks
8. One-hundred (100) count box of Paper Clips (any size)
9. Ten (10) standard size wooden pencils
10. Twenty (20) Rubber Bands
11. Two (2) Wire Hangers
12. Twine: four (4) feet total
13. Scissors
14. String: four (4) feet total
15. One (1) table (minimum size 30" x 30")
16. Stopwatch, phone, or other means to record time
17. Printer
18. Video recording capabilities
19. Video conferencing capabilities
 - a. **Note:** several sessions of videoconferencing may be needed if conference capabilities are limited. For example, the free ZOOM account only permits forty (40) minutes of video conferencing.
 - b. Teams will need to establish and circulate the method/link(s) for videoconferencing to the team members and proctor prior to the start of the competition.

**Please note the disposable masks have been replaced with paper towels.*

Side 1

Side 2

Instructions for Constructing the Target Box:

1. To print this page click on **XXXX**.
2. This Target Box is set to print to a specific size of 6.5" x 4.5" when constructed. Any modifications to the size of the box will result in automatic disqualification of the team.
3. Cut out the box along the green lines.
4. Fold the box along the red lines.
5. Tape the sides together, matching the numbers (e.g. Side 2 should be taped to the corresponding Side 2).
6. Click here (<https://vimeo.com/497699832/be15ad3d0a>) for a quick video tutorial on constructing the target box.

Side 1

Side 2

Side 4

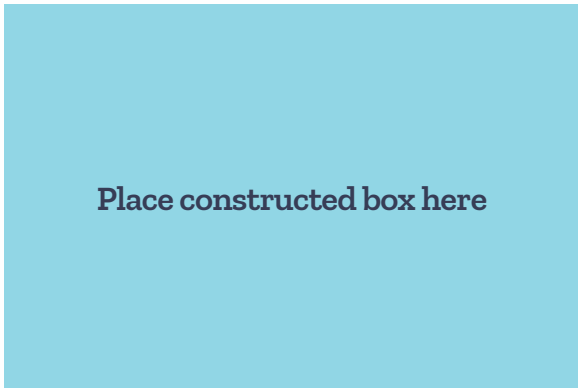
Side 3

Side 4

Side 3

Starting Point

End Point



Place constructed box here

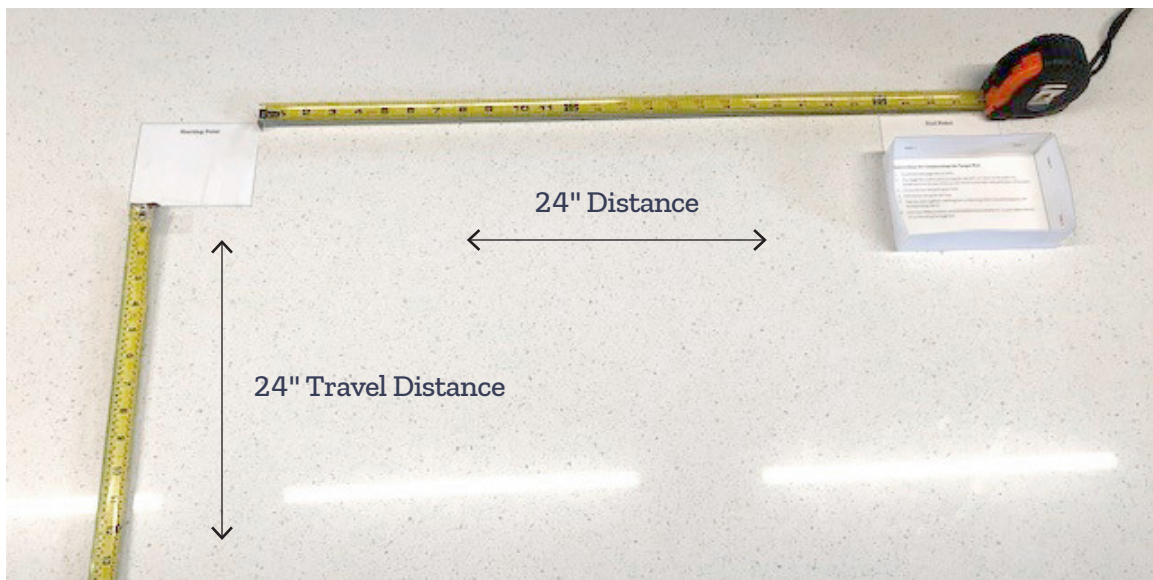
Regulations and Procedures

Challenge Release and Testing Station Set-Up

Total Time: twenty-five (25) minutes:

1. Each team member is permitted twenty-five (25) minutes to review the challenge and set up the testing station.
2. Each individual team member must set up a testing station in the event that their prototype is chosen as the solution.
3. Testing station set-up:
 - a. A rectangular table
 - b. Two (2) strips of measuring tape or rulers to mark the distance
 - i. Twenty-four (24) inches is measured from the right edge or the starting point to the left edge of the target box.
 - ii. The designated target box, which is also twenty-four (24) inches from the edge of a table to the edge of the target shall be clearly marked. The measurement from the start point to the end points is perpendicular to the measurement from the edge of the table as shown.
 - c. Five (5) 6" x 4" rectangles cut from standard household paper towels
 - d. Printed copies of the start and end markers to use as the official beginning and target points. These points may be taped to the table for stability.
 - e. One (1) printed and constructed target box for testing, and place the box at the ending point location as indicated on the print out.

Testing Station Set-up



Regulations and Procedures

Independent Design Build

Total Time: forty (40) minutes:

1. Each team member has forty (40) minutes to build a prototype during the independent design build and to test their solutions.
2. All team members must be online, designing under the supervision of the proctor.
3. Using only the materials on the TEAMS Design/Build Materials List team members must build a “delivery device” to pick up the pre-cut paper towel rectangles from the starting point, **one at a time, with the goal of placing all five (5) into the target box** (from p.5).
4. **Each prototype must incorporate at least four (4) different materials into the design. Failure to do so will result in a 20% penalty.**
5. Each team member will be required to take a photo of their individual prototype to submit with the video of the final solution.
6. **Testing the solution:**
 - a. The team member will place the first cut paper towel on the starting point.
 - b. The delivery device must pick up the paper towel at the starting point and transport it twenty-four (24) inches to ending point, placing the paper towel rectangle entirely inside the target box.
 - c. The delivery device must completely disengage from the cut paper towel.
 - d. All parts of the paper towel are placed inside the target box (see image). No parts of the cut paper towel may be visible across the top edge of the box. The team member may use the delivery device to make adjustments as needed until all parts are seated in the target box.
 - e. **Only after one (1) paper towel rectangle is successfully placed into the target box can the team member place the next cut paper towel rectangle on the starting point.**
 - f. The team member must repeat this procedure until all five (5) paper towels are properly seated in the target box.
 - g. **During the demonstration, no part of the operator may touch the plane of the table’s edge** (see figure on p.12).

Allowable building materials include only:

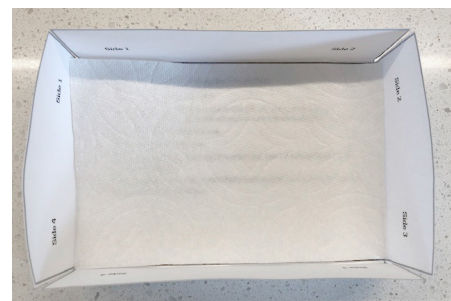
- Cardboard
- Binder clips
- Clothespins
- Craft sticks
- Paper clips
- Wooden pencils
- Rubber bands
- Wire hangers
- Twine
- String

Descriptions given in the materials list

Not Acceptable



Acceptable



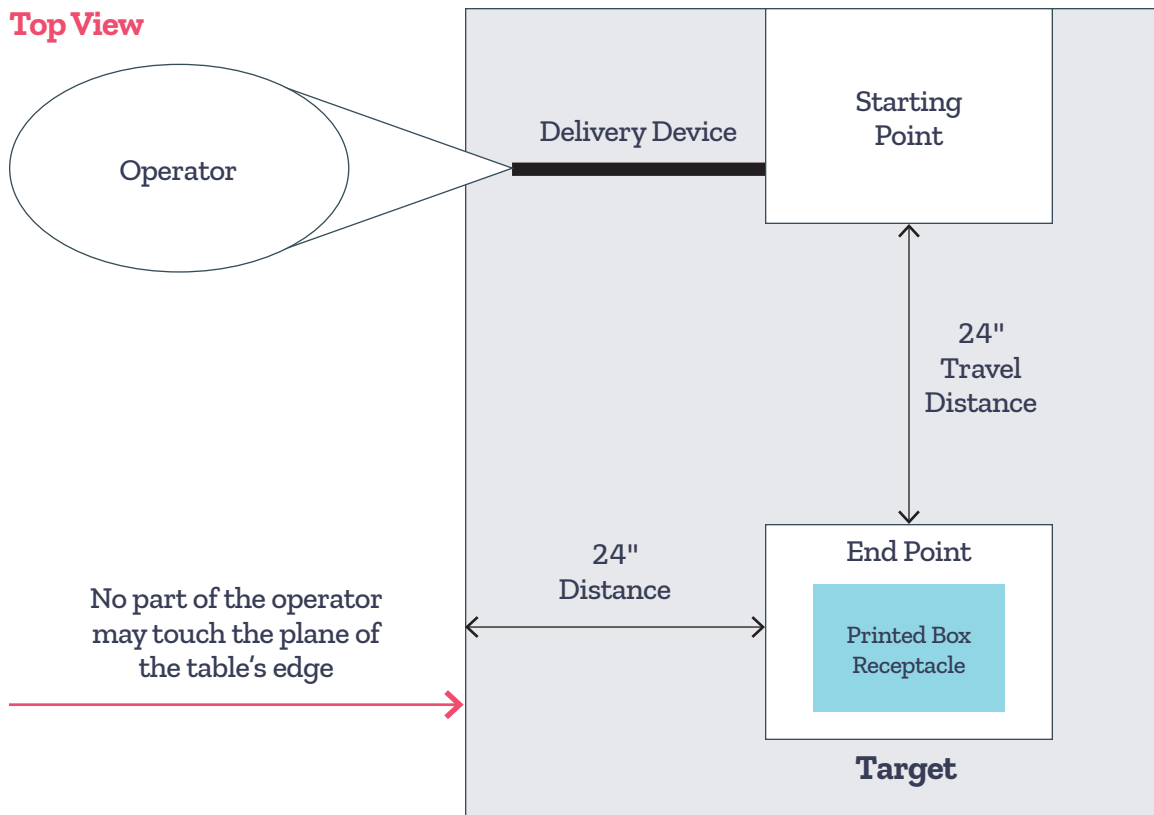
Regulations and Procedures

Iteration Process

Total Time: forty (40) minutes:

1. At the conclusion of the forty (40) minute independent build segment, team members share their designs and analyze each prototype to determine aspects that work well.
2. Team members will determine the best prototype. **That team member will become the designated representative to create and submit a video of the final demonstration.**
3. Team members may propose to adopt aspects of other designs to integrate into the chosen prototype. Team members will communicate the process of achieving this result to the designated member, who will modify the final prototype.
4. All team members should contribute to the process of designing and building the solution.
5. Teams designate one (1) team member to complete one (1) check-out sheet (see p.14).
6. Teams designate one (1) team member to create a multi-page PDF of the photographic evidence that each team member created a prototype, as well as an image of the final design (five [5] photographs in total).

Top View



Evaluation Criteria

You will need to fill out the check-out form, including the itemized materials list, to submit to your proctor who will enter your scores in the [online submission form](#) on your team's behalf. The data collected that will be used to judge the delivery device includes the following:

Cost: Lower cost is better: 40% of your final score.

The cost of production is always a factor when designing a product. Keeping your material cost low helps reduce production costs, therefore using only the materials needed to produce the most efficient design is best, however, at least four (4) different materials must be used in the construction of the final solution.

Fastest transfer of all five (5) textiles: Faster is better: 40% of your final score.

Each delivery device will be timed per the regulations. A faster time yields a better score.

Team Participation: 20% of the final score.

Each team member creates a prototype, submits a photograph, and contributes to the overall iteration design process of the final solution.

1. Best in State is determined by the combination of the three component scores – the essay (submitted prior to competition day), the multiple-choice exam, and the design-build challenge.
2. The top three (3) teams in each state with the best overall score are announced via the TSA TEAMS website.

Calculating Cost:

You are constrained to use only the allowable materials in your final delivery device.

Each item has a specific cost, as shown in the check-out form.

When your device is complete, your team is to list the number of each item used on the check-out sheet (e.g. if you use 5 binder clips, enter “5” in column B and calculate the total cost in Column D):

Materials Used Column A	Amount Used Column B	Cost of Item Column C	Calculated Total Cost Column D
Pieces of corrugated cardboard	1	20 each	20
Binder clips	5	5 each	25

For the cost breakdown per item used, see the check-out sheet.