

# SkillsUSA 2024 Nationals

## Additive Manufacturing Challenge

### CMF (Color, Material, Finish)

From hairbrushes, to headphones, Consumer Goods manufacturers compete every day to produce new merchandise that draws attention, changes perception, and looks fresh. Fast changing customer demands, shifting regulations, and tricky supply chains require constant rethinking of consumer products. The strategic selection of color, material, and finish (CMF) are critical for new products. Every new design goes through multiple drafting iterations, often tested by control groups, and must be signed off by management. This frequently results in a variety of challenges: a slow and costly design phase, losing IP from outsourcing prototyping, and/or losing the opportunity to be first to market. With full-color, multi-material 3D printing the companies can gain a competitive advantage with faster time-to-market and lower design costs and risks.



Image 1: Full color printing capabilities allow for rapid prototyping of designs that accurately represent the color, material, and finish of the final product.

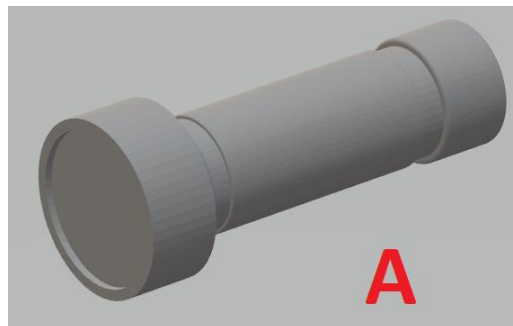
Traditional approaches to manufacturing are no longer the only way or even preferred way to develop a product. Additive manufacturing is being added daily to manufacturing companies' mix of technology. This addition allows for multiple design iterations in which designs can be tested, and improvements can be made immediately.

## Challenge Overview

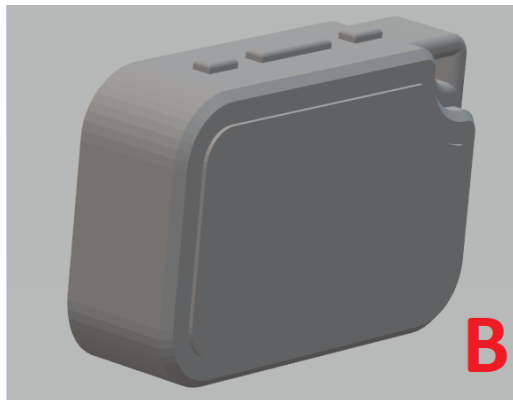
You have been selected to design a new product that your company will soon be releasing. Before the new product is sent into production, management wants to review a prototype that will replicate the color, material, and finish of your new eye catching design that promises to capture interest and attention of the target audience.

Contestants must start by choosing one of the two basic product forms. Contestants will then be required to take that basic model and make a presentable consumer product prototype by altering the physical design, adding colors, applying textures, and/or splitting or adding parts to make multi body/material assemblies (lenses, grips, covers, buttons, etc..) in an effort to showcase a CMF prototype to the judges on Thursday.

**Object A:** Flashlight



**Object B:** Portable Speaker



## Competitive Requirements

1. The design **must** contain team numbers in specific RGB color (0,161, 221).
2. The design **must** contain more than three colors.
3. The design and concept **must** be original – no copying an existing product or utilizing AI.
4. The design **can** contain added geometry.
5. The design **can** have applied texture (not displacement).
6. The design **can** contain physical displacements.
7. The design **can** be split and printed in multiple pieces and assembled.
8. The new design **must not** exceed 1 hour past the base (original) design-build time estimate in GrabCAD Print.
9. The base design **can** be recreated in any CAD software used by the contestant.
10. Contestants **can** change base designs for the second design submission BUT will do so at the cost of points.

## Other things to consider:

### CMF Design

- Color, material, and finish (CMF) of the design is the most important element of this challenge. However, more complex geometries and material finishes will aid in a higher design score.
- Different colors/material blends can be applied to different CAD bodies of a design in GrabCAD Print's "Model Settings."
- Using Textures such as wood, stone, or fabric require parts to be exported from CAD as a .3MF or .VMRL

### Function

- Although valued lower than CMF Design, added Function will also boost part performance scores.
- Function includes movement/assemblies.
- Examples include, but are not limited to, attachable lens cap, button, switch, snap fits, covers, etc...
- Movement in parts requires designed clearances. These can be different values depending on if the assembly is printed in place or printed disassembled then later put together.

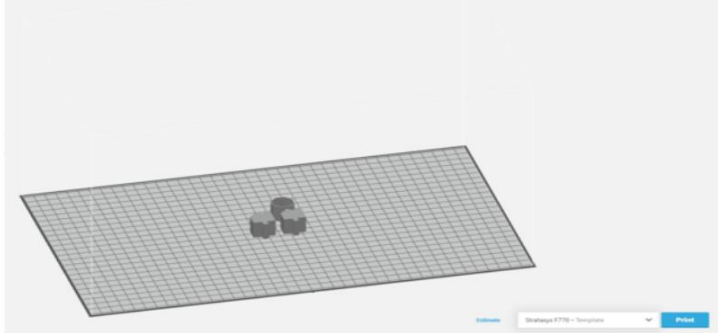
## Print Deliverable Specifications

At the end of each design time (twice during the competition), students will submit their files on thumb drive labeled with their team’s number in their team basket to have parts 3D printed. Late and/or unlabeled thumb drives will lose points and be deprioritized in the printing queue.

## File Folder Specifications

File folder specifications are also critical to scoring. Each thumb drive should have:

- A file folder titled “Team [#] - Submission” (fill in “[#]” with team number)
  1. Example” Team 634 – Submission 1
- Within the above folder, include the following files (all files must be formatted in this way: “Team [#] -] - [File Description]”):
  1. GrabCAD Print Project File (.print) file saved at these settings:
    - Machine: J55 Prime
    - Material: VeroCyan-V, VeroMagenta-V, VeroYello-V, VeroUltraWhite, and UltraClearS or ElasticoClear
  2. All STL (.stl) files of design (If an Assembly), **OR** .3MF, **OR** .VRML
  3. The team’s Native CAD files of re-design
  4. Screenshot of GrabCAD Print screen that shows print time and material used.
  5. Manufacturing traveler sheet. Digitally fill in your team number, material estimates, and screenshot of the parts in GrabCAD Print with your desired printing orientation. If you rotate the part in GrabCAD Print, include the rotation values in the traveler document. (Example: 30 degrees in X, 45 degrees in Y, 0 degrees in Z) The more information specifically and clearly provided on this sheet the better chance teams will get back the part they expected to get.

<b>Manufacturing Products Traveler</b>			
Machine Number:	D002367	Date and Time:	6/15/2022 11:29
Requester:	TEAM NAME		
Job Name:			
Pre-Build			
Model Material:	ABS	Model Tip:	T14
Support Material:	SR30	Support Tip:	T14
Model Material Estimate:	15.3ci	Can Pack be Relocated?:	<input type="radio"/> Yes <input type="radio"/> No
Support Material Estimate:	1.5ci	Initiate Auto Cool Down?:	<input type="radio"/> Yes <input type="radio"/> No
Special Instructions:			
			
Post-Build			
Remove Parts from Machine?:	<input type="radio"/> Yes <input type="radio"/> No		
Remove Parts from Sheet?:	<input type="radio"/> Yes <input type="radio"/> No		
Remove Supports?:	<input type="radio"/> Manually <input type="radio"/> Tank <input type="radio"/> Either <input type="radio"/> No		
Special Instructions:			
Finishing?:	<input type="radio"/> Yes <input type="radio"/> No		
Finishing Instructions:			
Ship? (Include Shipping Form)	<input type="radio"/> Yes <input type="radio"/> No		Needed By:

## **Provided Supplies:**

- Thumb drive with files: traveler, .SLDPRT of Parts, .STEP of Parts, and .STL of parts
- Calipers
- Printed material samples

## **Competition Materials required for Contestants:**

- Computer Workstation(s)
- CAD Modeling Software
- GrabCAD Print Software

## **Scoring Details:**

Form / CMF Design is the most important part of the design, but function can be added in for more points. See rubric for exact scoring details.

## **Presentation Day**

The final part of the challenge is the presentation & judging on Thursday. Students are welcome to update their design engineering notes documentation and spend as much time as they want on their presentation outside of the competition space.

Students are allowed to show up 15 minutes before their judging time. Upon arrival, students will check in and see/handle their printed part.

When the judges are ready (no sooner than the “judging time”), the team will be called to share their presentation and, given 10 minutes to present their process, engineering design notebook, and printed designs. Students are welcome to use PowerPoint or Google Slides to do this. Judges will ask necessary questions to fully score student design based on criteria. View the Judging Procedure below for details on the requirements of the presentation and judging. Students should fully review the Judging Rubric below to assist in crafting their final presentation.