SkillsUSA 2023 Additive Manufacturing Nationals Challenge

Gripper Assembly Challenge

Additive manufacturing/3D printing is changing the way things are made from the rapid prototyping lab all the way to the manufacturing floor. Companies in the automotive, aerospace, and consumer goods industries are leaning into an era of Industry 4.0, a technological playing field where 3D printing or additive manufacturing augments other designs, prototyping, and manufacturing tools. Engineering teams are now able to shave weeks off product development cycles. How? 3D Printing. Additive manufacturing combined with traditional tools of the trade and off-the-shelf components is changing the way things are made, speeding time to market and leaving a budget for innovation.

Image 1: Design versatility allows 3D printing to be leveraged for making unique robot are end effectors.

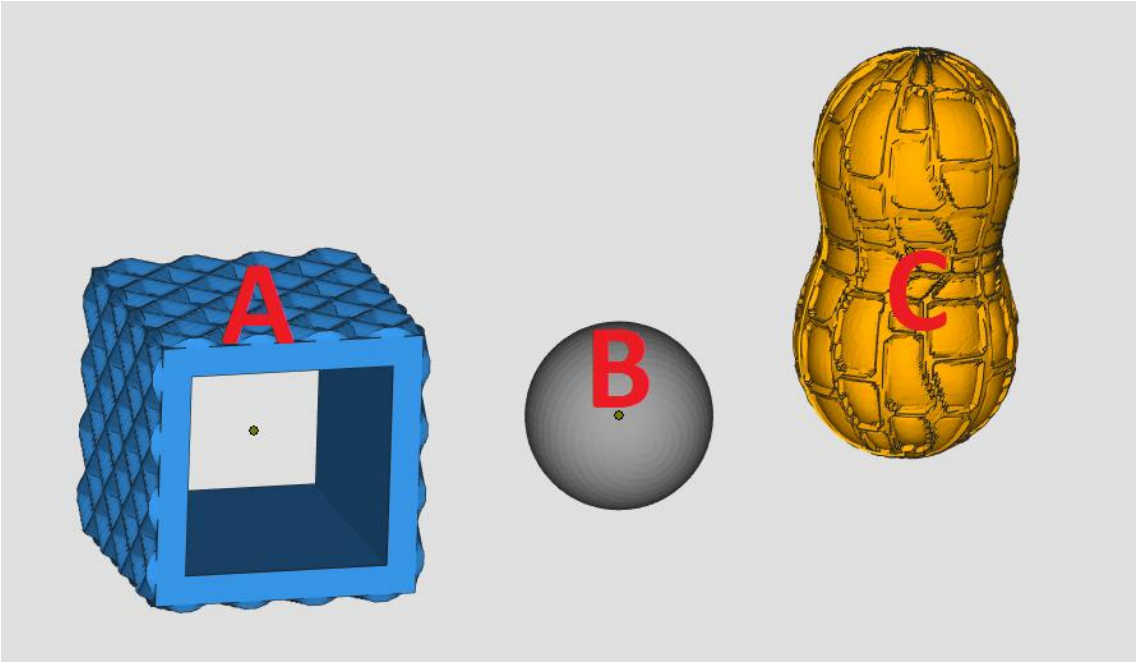
Traditional approaches to manufacturing are no longer the only way to develop a product. Additive manufacturing is being added daily to manufacturing companies' mix of technology. This addition allows for multiple design iterations in which designs can be tested, and improvements can be made immediately.

Challenge Overview

Contestants will be given a designated test fixture with a rotating mounting point on one side and an object held up on a stand (Stand A) approximately 4 inches away on the other end. A second object stand (Stand B) will remain empty 45 degrees away from Stand A. Contestants must design an assembly that is able to attach to the mounting point of the fixture and be operated to grab and hold the object on Stand A. Once the contestant's assembly has grasped the object on Stand A, the contestants must use the built in rotating mount drive to rotate the assembly 45 degrees to Stand B. The contestants then must operate their assembly to release and place the object on Stand B to complete the challenge.

There will be three progressively more difficult objects to attempt to grab and move for more points.

Object A: Cored Textured Cube (FDM)
Object B: Metal Ball Bearing
Object C: Weighted Peanut (Polyjet)

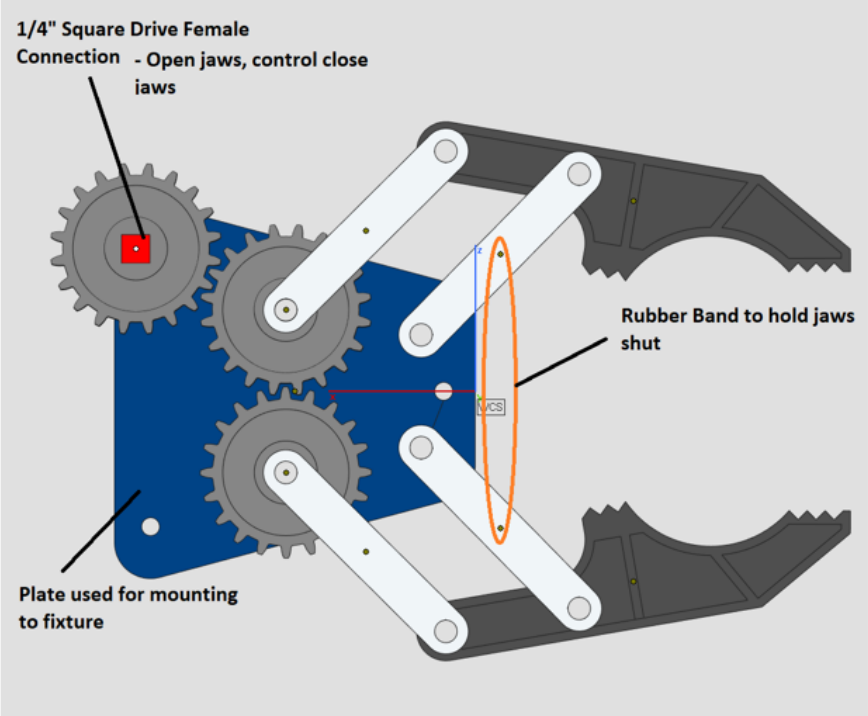


Competitive Requirements

1. The design **must** attach to the fixture mounting point with no other additional supplies other than what is provided.
2. The design **must** consist of an assembly of at least 4 printed bodies, with at least 3 bodies that move in the function of the design.
3. The designed assembly **must** only be manually operated by the supplied ¼" male square driver.
4. The design **must** grab and hold the Objects without dropping from Stand A to Stand B.
   (3 tries will be given total to restart if any of the 3 objects are dropped)
5. The mount will be rotated manually by the contestants at their own pace.
6. The design **must hold** the object **unassisted** while moving the object from Stand A to Stand B.
7. The design **must** then be manually driven by the 1/4th drive to release and place the object on stand B
8. The design, once mounted, **must** start **no closer than 1 inch** to the object before being operated to grab it (Figure X)
9. The design **must** be original and not something downloaded from the internet.
10. The competitors will have 60 seconds to mount their design, grab the object from stand A, rotate, and place the object on Stand B.
11. A supplied #2 rubber band and 2 paper clips **can** be used to aid in the design.
12. The design **can** be printed disassembled individually or printed together as one part. (Points will be lost for printing disassembled)
13. Competitors **can** attempt to grab and/or relocate the progressively more difficult objects for additional points.
14. Contestants **can** make modifications to their design between objects but will only have 60 seconds to do so.
15. The printed design on the final day may use parts from day one's build.
16. Print takes **no longer than** 3.5 Hours and consumes **no more than** 3.5in^3 of Model material and no more than 2.5in^3 of Support Material
17. Competitors can attempt to gain points by only holding objects unassisted for 8 seconds. If attempting to only hold the object, before moving to the next Object, this will count as one of

the restarts. If attempting to hold vs moving an Object competitors must be verbally declared to the judges before each attempt.

Basic example of what a build might look like



Provided Supplies:

- One #2 Rubber Band
- Two paperclips
- ¼" Square Driver
- Mounting Pin
- Calipers and other measuring tools
- Competition part mount and test rig

Competition Materials required for Contestants:

- CAD Modeling Software
- GrabCAD Print Software

The function of this part, as well as the form, is important to the design. The competing teams will need to understand the core criteria to maximize points in this competition.

A. Design (20%) – Design quality, aesthetics, and overall adherence to guidelines.

B. Part Performance (30%) - Size, Printability, Form, Fit & Function - design compatible with FDM 3d printing capabilities and limitations. Does the design serve a purpose in the greater product design? Does the part fit together, and functions as expected? Can it be reassembled multiple times, or printed in one assembled piece? The design must also have the team # designed onto it for identification.

C. / D. Presentation & Engineering "PPT/Notebook" (27.5%) - see score sheet for required elements.

F. Other: Exam & Skills Test (12.5%) & Mini Challenge (10%)

Note, Design Consultation

At the start of the main challenge each team will be given a golden ticket – allowing them a 10-minute block of design consultation with our AEs. This can be used anytime during Design 1 or 2 by raising the ticket in the air.

Print Deliverable Specifications

Twice during the competition students will submit their files to have parts 3D printed.

File Folder Specifications

- A file folder titled "Team [#] - Submission" (fill in "[#]" with team number)
- Within the above folder, include the following files (all files must be formatted in this way: "Team [#] -] - [File Description]"):
- GrabCAD Print Project (.print) file saved at these settings:
- Machine: Stratasys F370 Template Printer
- Material: ABS
- Slice Height: 0.010" or 0.013" slice
- All STL (.stl) files of design (ensure correct mm/in scaling)
- native CAD files of design
- Screenshot of GrabCAD Print
- Manufacturing traveler filled in with 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)

Presentation Day

The final part of the challenge is 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 competition space.

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

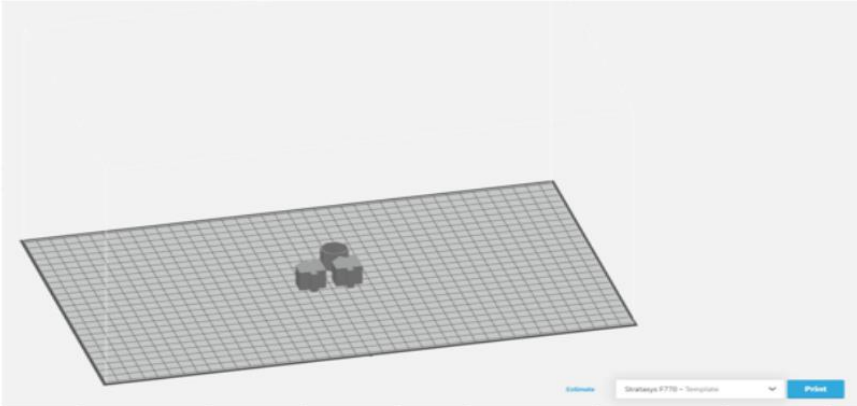
When the judges are ready (no sooner than the "judging time"), the team will be called to share their presentation and, given 10 minutes to present their process, engineering design notebook and printed designs. Students are welcome to use PowerPoint or Google Slides to do this. Judges will ask necessary 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 crafting their final presentation.

AGENDA

Tuesday, June 20, 2023	**Contest Day 1: Orientation, 1st day design**
9:00am	Students Arrive
10:00am – 11:00am	Contest Orientation
11:00am – 11:30am	Break: Use restroom, prepare.
11:30am – 12:30pm	**Mini Challenge**
12:30pm – 1:00pm	Lunch/Restroom
1:00pm – 1:30pm	Orientation, Q & A before design clock starts.
1:30pm - 4:30pm	Design Time
4:30pm	Students Dismissed
Wednesday, June 21, 2023	**Contest Day 2:**
8:00am	Students Arrive
8:00 am - 8:30am	Keynote speaker
8:30 am - 9:00am	*Questions from Day 1 & Debrief on the Mini Challenge*
9:00am – 12:00pm	Design Time
12:00pm – 12:45pm	Lunch Break: Use restroom
12:45pm	Students arrive in room C107-Keynote Bob Willig, SME CEO
1:30pm – 4:30pm	**Additive Manufacturing Certification Exam – Classroom C 107**
4:30pm	Students Dismissed
Thursday, June 22, 2023	**Judging Day 3:**
8:00am	Judges Arrive
8:00am - 8:30am	Judges Briefing
Students Arrive at their assigned time beginning at 8:30am Students are dismissed after they are judged.	
2:45pm – 3:30pm	All Students gather for a debrief.
3:30pm	Students Dismissed

Manufacturing Products Traveler

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?:**	(•) Yes ( ) No
Support Material Estimate:	1.5ci		**Initiate Auto Cool Down?:**	( ) Yes (•) No
Special Instructions:				



Post-Build				
Remove Parts from Machine?:	(•) Yes ( ) No			
Remove Parts from Sheet?:	(•) Yes ( ) No			
Remove Supports?:	( ) Manually ( ) Tank (•) Either ( ) No			
Special Instructions:				
Finishing?:	( ) Yes (•) No			
Finishing Instructions:				
Ship? (Include Shipping Form)	( ) Yes (•) No		**Needed By:**	

Design Specifications

● Final housing Design should be less than 3 total cubic inches of model material and no more than 2 cubic inches of support.

● The design should consider the text location for the team number.

● Materials Available: ABS

● Files should be 3d printable – watertight 3d volumes, no open surfaces.

● Geometry with negative angles will be contacted with support material. Please consider the support removal process while designing.

● If there is a need for post-processing please define what kind and where in the traveler