
SkillsUSA 2019 – Additive Manufacturing State Challenge – Heads to Tails

Overview

The goal of the 2019 SkillsUSA Additive Manufacturing State Competitions is to challenge competitors at that state level and send the best prepared students to compete at the National Competition in June. Each year's suggested state competition focuses on an additive manufacturing design with strict requirements on form, fit, and function of compact and intricate designs similar to nationals.

The below contests have been designed with the upcoming National Competition in mind and are designed to challenge students understanding of and skills in Additive Manufacturing.

This year's contest challenges students to design a 3D-printed device to flip an unmodified U.S. quarter) from heads to tails. They will need to design a device that fits into the testing rig and performs a specific task. They will also need to use their 3D printing knowledge to design a part that prints within the specified build volume, materials and times specified.

You will notice that there are two options for the contest on pages 4 and 5 - the difference lies in accuracy of the quarter flip and landing – specification #3. Please choose whichever one fits your competitor's skills the best.

The contest descriptions, page 4/5 and criteria page 6 - have been written so that you can distribute directly to competitors. If you'd like to make modifications to fit your state's needs, please do.

If you have questions about the contest, please email:
edu.curriculum@stratasys.com

Materials & Supplies Needed

Materials to be Provided by Student Competitor:

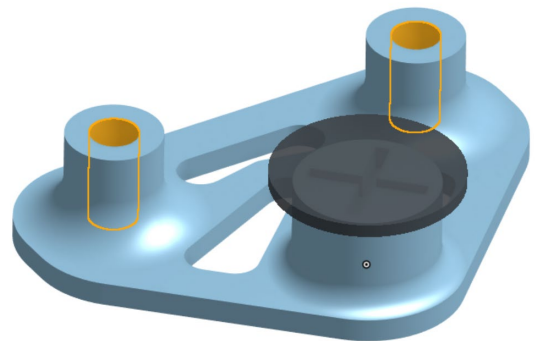
- 3D design submitted by **DATE: April 19th, 4:00 PM**
- Thumb drive loaded with 3D design
- Engineering notebook
- Presentation

Materials to be Provided by State Competition Host:

- 3D printed testing rig
- Lumber (least 12"x12" to secure rig to)
- US Quarters
- "Standard" 4 cm rubber bands for each competitor ([Amazon Link](#))
- *Student designs 3D printed
**At the national competition Stratasys prints on-site, at the state level you have the option to have students print their designs before and bring them, print them at a 3D printing partner before and bring them on competition day or print on-site if you have access to a printer and a multi-day competition.*

About the Testing Rig

- The Challenge Rig is a single 3D-printed bracket consisting of 2x ¼-inch "mounting holes" and a "coin stand".
- The overall dimensions of the rig are as follows: 2" (long) x 2.75" (wide) x 0.625" (tall).
- It is recommended that competition host have the rig printed and attached to a flat surface (a piece of lumber or plywood is sufficient). The Contest 2 rules will utilize the flat surface below the rig; so the surface should be at least 12"x12".
- The files to print these two parts can be found on GrabCAD here: <https://grabcad.com/library/2019-testing-rig-1>



Judging Suggestions:

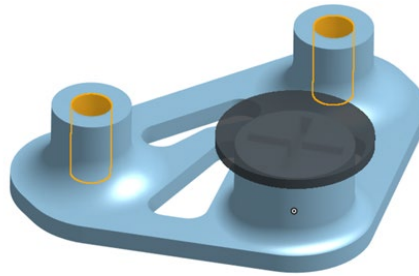
Students should be judged on:

- 1) Engineering notebooks
 - a) Did the students follow the guidelines provided? States are encouraged to provide their own Engineering Notebook Guidelines.
 - b) Did students show their design process?
 - c)
- 2) Following all requirements outlined in contest criteria
 - a) Build time
 - b) Build volume
 - c) Material usage
 - d) Support material usage
 - e) Did the students consider additive manufacturing when creating their design? Are they able to explain the role that additive manufacturing played in their design?
- 3) Presentation
 - a) Does the presentation include:
 - i) Explanation of the design process through examples in their engineering notebook
 - ii) Understanding of form, fit, and function
- 4) Quality of final 3D printed part
 - a) Does it perform the function in the manner it was designed to do?
 - b) Does it meet all requirements in contest guidelines?
 - c) Does the printed part include a moving assembly?
 - d) Did the students design the part with additive manufacturing in mind?

SkillsUSA 2019 Additive Manufacturing State Challenge

Quarter Query - Heads to Tails

Welcome to the “Quarter Query” challenge! The task at hand is to design and use a device made of only 3D printed parts to flip an un-modified U.S. quarter (provided at the competition location) from heads to tails.



“What’s the catch?” you say. Well, there are four, and here they are:

1. The device may only be operated by a single, unbent finger. Note: the device may not attach to the finger in any way.
2. The device must remain in contact with at least one Connection Point (orange in the diagram) at all times.
3. The quarter will begin heads-up on the Coin Pedestal (X mark) and must finish tails-up back on the pedestal.
4. The device must follow these 3D printing specs measured in GrabCAD Print:
 - Prints in less than 2 hours
 - Has a build volume of no greater than 2x2x2 in
 - Uses no more than 5 in³ of model material
 - Uses no more than 2 in³ of support material

Sound impossible?

Here’s some help: you may use one rubber band in your design. The rubber band that you must use in testing will be provided to you at the competition, but if you want to practice ahead of time, this is the model that will be provided.

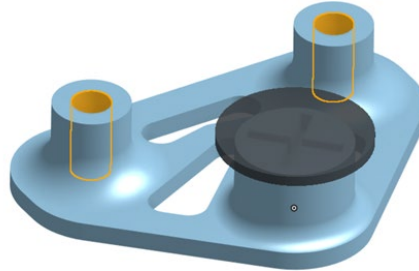
The competition rig will be fixed to a large flat surface, and its file can be found here <https://grabcad.com/library/2019-testing-rig-1>

(Advanced)

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Quarter Query - Heads to Tails

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“What’s the catch?” you say. Well, there are four, and here they are:

1. The device may only be operated by a single, unbent finger. Note: the device may not attach to the finger in any way.
2. The device must remain in contact with at least one Connection Point (orange in the diagram) at all times.
3. The quarter will begin heads-up on the Coin Pedestal (X mark) and must finish tails-up anywhere on the flat surface provided.
4. The device must follow these 3D printing specs. Measured in GrabCAD Print:
 - Prints in less than 2 hours
 - Has a build volume of no greater than 2x2x2 in
 - Uses no more than 5 in³ of model material
 - Uses no more than 2 in³ of support material

Sound impossible?

Here’s some help: you may use one rubber band in your design. The rubber band that you must use in testing will be provided to you at the competition, but if you want to practice ahead of time, this is the model that will be provided.

The competition rig will be fixed to a large flat surface, and its file can be found here <https://grabcad.com/library/2019-testing-rig-1>

(Moderate)

5

Contest Criteria

Prior to contest day:

Students should submit designs by **DATE: April 19th, 4:00PM** to:

Todd Woolston: **todd@mw3ds.com**

On contest day, students must submit:

1. Engineering Notebook (Engineering notebook guidelines below)
2. 3D printed design files
3. Printed part (Provided by contest chair day of contest)
4. Presentation of design

1. Engineering Notebook should:

- Be clearly labeled with contestant name(s), date and page # on each page
- Begin with a problem statement
- Include discovery and documentation of approach to solve problem
- Include sketched design concepts with critical features labeled
- Critical dimensions clearly labeled in design sketch
- Considerations for designing for FDM distinctly addressed (i.e. part strength, part orientation) especially including any expected risks during printing
- Design decisions and alternatives are documented and evaluated thoughtfully

2. 3D Printed Design - Students must create a design that:

- Prints in less than *2 hours*
- With a build volume of no greater than *2X2X2in*.
- Using no more than 5 in³ of build material
- Using no more than 2 in³ amount* of support material

*Students must submit CMB files to be printed via GrabCAD Workbench no later than 11:59 *CST* on *date*. Final prints will be delivered day of contest so that students can test, assemble/modify and be evaluated.*

3. Presentation Criteria

- The team clearly describes their understanding of the problem to be solved.
- Design Process: good design logic is used for key design choices was intentional and well-communicated
- The presentation is professional and well-rehearsed
- Practical evaluation: Part functions way team intended in 3 out of 3 tests.