



## **Student Additive Manufacturing Competition (AMC)**

### **Rules and Guidelines 2022-23**



#### Important Dates

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- March 10<sup>th</sup> - Design Summary Deadline
- March 17<sup>th</sup> - STL Submission Deadline
- April 18<sup>th</sup> - Competition Day

## Contestant Requirements

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The contest is for enrolled students at an accredited university, college, community college or high school only. Students attending the contest must be 16 years of age or older in accordance to SAMPE conference regulations. The following rules are to be considered an outline of the requirements and are subject to interpretation by the Governing Committee. The contest is intended to provide an opportunity for students to learn and expand their abilities in additive manufacturing and engineering design. Any design or concept which is not consistent with the spirit of these rules will be disqualified. Students are encouraged to ask for clarification of these rules. The governing committee will publish the question(s) and the committee's answer on the SAMPE AM contest web site:

<http://www.nasampe.org/?page=additivecontest>

2. Contest entries will only be accepted on an individual basis with only one entry allowed per student. Students must be SAMPE members. Students are encouraged to solicit advice, instruction, and training from faculty, peers, and industry members during the design of their structure. However, the final design entry must be the original work of the individual.

3. Each student must submit a **1-page** design summary in **PDF form** of their entry for approval by the Governing Committee (email address: [studentadditive@sampe.org](mailto:studentadditive@sampe.org)). Please refer to the AMC Design Summary Example for formatting and clarification.

Each design summary will be checked for compliance with contest rules and scored by the Governing Committee. The design summaries will be scored on the metrics of: thoroughness, clarity, adherence to the guidelines, and style.

The Summaries must include the following elements or they will be returned without review or approval:

- Student's Name and Email Address. This email address will be used by the Governing Committee to provide feedback and/or approval for the design summary as well as confirming other contest details.
- Registration Number (e.g., 07-XXXX) Note: If you registered online, your Registration Number was generated and sent to you via email as part of the registration process. If you registered via mail or fax, your registration number will be emailed to the email address provided on your form once SAMPE has received it into the registration system. If you are unable to locate your number, please email Lauren Mclean at [lauren@sampe.org](mailto:lauren@sampe.org)
- Name of school
- Visual depiction of your design (sketch, screenshot of CAD model etc...)
- Written description of your design (Why did you choose it? What makes it unique?)

- Calculation of your design's structural capability. Must include failure mode prediction and show the relevant calculations performed. For example, a long column or support element should be analyzed for both compression strength and bulking strength.
- Predicted volume of entry from model and calculation for density based on printing parameters. For a design with thin walls or 100% infill: Volume X Density of polymer = Mass. A thicker design intended to be printed with an infill percentage below 100% may need a more complex calculation or program to assist with the calculation.

NOTE: Whether the participant will be printing their own entry and will be hand delivering it to the competition, will be shipping it to the SAMPE office 2 weeks or more before the competition, or will require assistance printing their entry.

The Governing Committee will approve or send instructions for required revisions to attain approval no later than 2 days after the Design Summary Deadline. Changes may be made to a design after the proposal has been approved; however, the design may be disqualified if the changes violate the spirit of the rules.

Registration is allowed through STL Submission Deadline. However, entries that have not submitted their design summary and STL file for approval by the week of the STL Submission Deadline may be subject to disqualification if they are not fully compliant with the competition rules.

\*\*Students are encouraged to submit design summaries early in order to receive approval and feedback on their design earlier. If there is enough time, the Governing Committee will recommend improvements if any significant design issues are noticed during the review process.

## General Rules

Students will design a structure that will be tested to failure between the platens of a typical load frame. See this [link](#) for more information. Load will be limited to 10,000-lbs to protect the load frame. The design must be approved by Governing Committee so as not to put the load frame in jeopardy. This limit is only intended as an upper bounding limit, the optimal design solution will not likely approach this limit. All entries must be printed using un-filled, un-reinforced, and un-blended ABS polymer. Filament with fillers, especially fiber additives will not be allowed. Entries may be assembled from multiple printed parts. Only printed parts may be used in the assembly and no adhesives will be allowed to assist assembly. Support material may be used to create the part but designs that print without support are suggested. Removal of support material can damage delicate features unless dissolvable supports can be used. Any trapped support material will be considered part of the structure and thus included in the weight. Basic hand tools (hobby knives, files and sand paper) will be available for finishing and fitting work at the conference if needed.

## Additive Categories

### A. Compression Column

## A.1 Compression Column Category

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Students will design a rigid vertical support (column or tower) that will be tested to failure. The column must have at *least* a 2:1 aspect ratio (its height must be at *least* twice its width). It must fit on a 6-in diameter platen and not be taller than 36-in. No part of the column may extend outside of this cylinder (6-in diameter by 36-in long). Columns may not deflect more than 20% of their original height. If they do, the peak load will be determined up to the 20% deflection point. Columns must be a minimum of 2-inches tall and hold a minimum of 100-lbs to be considered for awards.

The columns will be ranked according to the score below, larger values being better. Please note that this means there is NO advantage to exceeding the ultimate design load. Also, taller and lighter structures will score better.

$$Score = -Weight_{normalized} + Height_{normalized} + Load_{normalized}$$

All normalized values will be done so using the following formula. This means the highest scoring entry for each category will receive a score of 1 and the lowest scoring a 0. This will then be multiplied by the weighting factors shown above.

$$Weight_{normalized} = \frac{(Your\ column\ weight - Min\ of\ Competitors)}{(Max\ of\ competitors - Min\ of\ Competitors)}$$
$$Height_{normalized} = \frac{(Your\ column\ height - Min\ of\ Competitors)}{(Max\ of\ Competitors - Min\ of\ Competitors)}$$
$$Load_{normalized} = \frac{(Your\ columns\ peak\ load - Min\ of\ Competitors)}{(Max\ of\ Competitors - Min\ of\ Competitors)}$$

First place, second place and third place will be awarded to the highest three scores. In the event of a tie, the entry with the shorter print time will be awarded the higher place.

## A.2 Column Printing Details

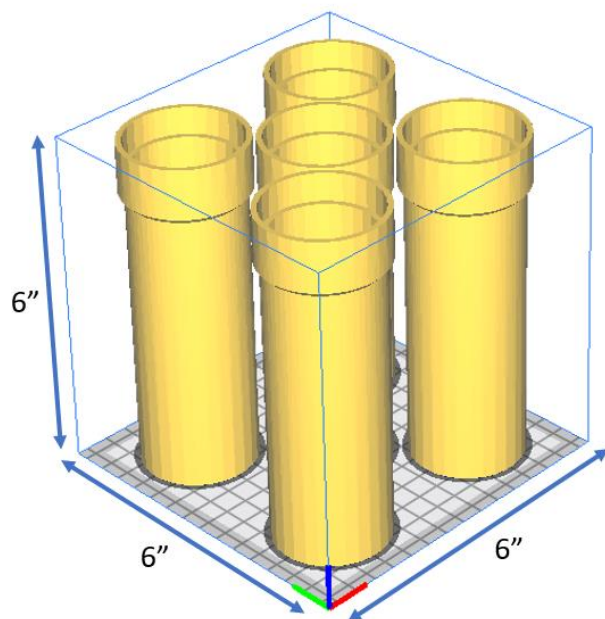
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For this category of the competition, students are encouraged to print their own designs and either bring them to the competition or ship them to the SAMPE office at least 2 weeks prior to the conference. All entries must be printed from un-filled, un-reinforced, and un-blended ABS polymer. The choice of assisted printing or self-printing with either hand delivery or shipping to the SAMPE office must be communicated on the design summary form. Any entrants needing assistance with finding printing resources will be supported by the committee. Students must submit an STL file of their design regardless of printing source, via email to the Competition Committee. If an entry consists of multiple pieces, **all pieces must be arranged in a single .STL file** for review and printing. If students submit entries for assisted printing, they may view their entries beginning at 9am on Tuesday, April 17<sup>th</sup> Post-

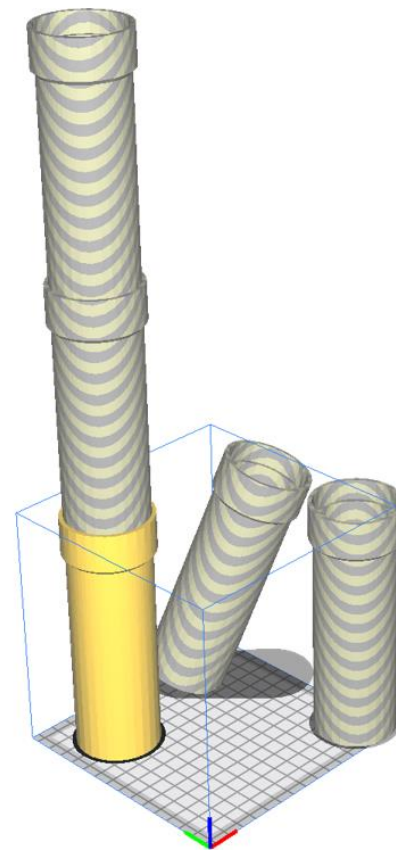
processing and assembly may be done until test time. However, entries may not leave the test area once delivered. Students need not attend the event to enter the contest. If necessary, they may submit assembly instructions via email. However, the committee cannot guarantee that the assembly will meet the student's design intent. STL files will be checked for quality by the committee. Printing parameters may vary depending on design intent and optimal printer setting for a specific design. Design for printing without support is suggested.

A typical entry may be printed with 4 shells and 30% infill. A minimum wall thickness of at least 0.040" should be used to accommodate 2 beads of material. Ideally, a larger minimum wall thickness will increase the odds of a successful print.

Note, there is no maximum print time requirement. Each entry must be printed in one single print envelope. That is, each entry (including all pieces) must be able to fit within a **6"x6"x6" box** for printing. See Below for example.



**Properly fits in build envelope requirement**



**Violates build envelope requirement**

## Awards

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Each category will have First place winner who will be awarded \$500. Second place will be awarded \$300 (USD). Third place will be awarded \$200 (USD). Awards will be given in the form of a check issued to the contestant and mailed to the address identified on the Registration Form.

The contestant who receives the highest point total from design summaries and category score will receive a SAMPE AMC trophy.

## Questions

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When submitting a question, please reference the relevant paragraph(s) in the rules, and include any supporting pictures/images in a Microsoft Word document if needed. All questions and responses may be posted to SAMPE website:

<https://www.nasampe.org/page/additivecontest>

Submit question(s) for review by the Governing Committee at [studentadditive@sampe.org](mailto:studentadditive@sampe.org)

## The Governing Committee

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- Joseph Vanherweg, Northrup Grumman
- Cory Cunningham, The Boeing Co.
- Yash Parikh, Carnegie Mellon University
- Adam Brown, The Boeing Co.