



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

### **Rules and Guidelines 2024-2025**



## Important Dates

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- March 14<sup>th</sup> – Deadline for Design Summary
- March 28<sup>th</sup> – Deadline for STL Submission
- May 20<sup>th</sup> – Competition Day and Student Check-in

## Contestant Requirements

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1. 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 with SAMPE conference regulations. The following rules are to be considered as 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 not consistent with these rules' spirit will be disqualified. Students are encouraged to ask for clarification of these rules.

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 submitting student.

3. Each student must submit a **1-to-2-page** design summary in **PDF form** of their entry for approval by the Governing Committee (email address: [studentadditive@sampe.org](mailto:studentadditive@sampe.org)). Students must use the **AMC Design Summary template** linked on the competition page and **fill out all information completely** to be entered while also following the Name\_Summary\_Date.pdf naming convention for the file. Each design summary will be checked for compliance with contest rules and scored by the Governing Committee.

NOTE: Your registration number should be 11 characters and will contain a combination of letters and numbers. 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 location your number, please email Lauren McLean at [lauren@sampe.org](mailto:lauren@sampe.org)

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

The Governing Committee will approve or send instructions for required revisions to attain approval no later than 5 days after the Design Summary Deadline and STL Deadline.

NOTE: Students are encouraged to submit design summaries early to receive approval and helpful feedback. If there is enough time, the Governing Committee will recommend improvements if significant design issues are noticed during the review process.

## General Rules

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Students will design a structure tested to failure between the platens of a typical load frame. See this [link](#) for more information. The load will be limited to 10,000-lbs to protect the load frame. The design must be approved by the Governing Committee so as not to put the load frame in jeopardy. This limit is only intended as an upper bounding limit with the optimal design solution unlikely to approach this limit. All entries will be printed using ASA polymer. Entries may be assembled from multiple printed pieces. Only printed parts may be used in the assembly with no adhesives allowed. Support material may be used to create the part, but support-free designs are suggested since removal can damage delicate features. Any trapped support material will be considered part of the structure and thus included in the weight. Basic hand tools (hobby knives, files, sandpaper, etc.) will be available for finishing and fitting work at the conference if needed.

## Design Summary Evaluation

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Design summaries and entry models will be evaluated by the AMC Committee. The following Design Summary criteria will be evaluated from 1 to 10 points, for a maximum score of 40 points.

### Design Summary Evaluation Criteria:

- Depth of technical content (thoroughness of analysis)
- Readability (font, text formatting, conciseness)
- Presentation and layout (flow of information)
- How well the design summary and .STL file submission adhere to the rules

## Additive Categories

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### A. Compression Column

#### A.1 Compression Column Category

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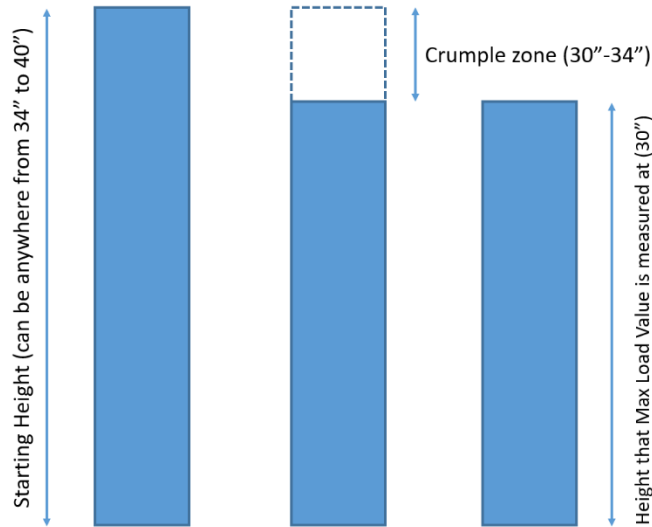
Students will design a rigid vertical support column that must meet minimum load requirements at two different heights, along with the space between those two heights. The column must fit on a 6-in diameter platen and must not be any taller than 40 inches when fully assembled prior to test. No part of the column may extend outside this circle (6-in diameter). The entry must support at least 20 pounds at a height of 34 +/- 0.1 inches and while column is being compressed by 4 inches, the column must also support at least 20 lbs at all heights within this “crumple zone”. Please note that there is NO advantage to exceeding this design load; it is a pass-fail requirement. The entry must then be compressed to 30 +/- 0.1 inches and must support at least 100 lbs. **The load carried by the column during this stage of testing is the primary scoring metric.** During the test, the top platen will move down and compress the column at a speed of 7.2 inches per minute.

All inputs will be normalized 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.

$$Weight/Load/Analysis_{Normalized} = \frac{Entry - Minimum}{Maximum - Minimum}$$

The Weight value is the weight in grams.

The Load value is the load carried by the column **at the 30-inch height**. If the column fails to hold at least 20 pounds at the initial 34-inch (+/-0.1 inch) height, the whole column is considered “failed” regardless of the load carried at the 30-inch height. The figure below shows a visual representation of the different stages of the test:



The design summaries and analysis therein will receive an analysis score according to the formula below:

$$Score_{Analysis} = 1 - \left| \frac{Load_{Tested} - Load_{Predicted}}{Load_{Tested}} \right| + Design\ Summary_{Normalized}$$

The final score for the competition (and thus placing/prizes) is determined by the following formula:

$$Final\ Score = 0.70 * (Load_{Normalized} - Weight_{Normalized}) + 0.30 * Analysis_{Normalized}$$

First place, second place and third place will be awarded to the highest three scores.

## A.2 Column Printing Details

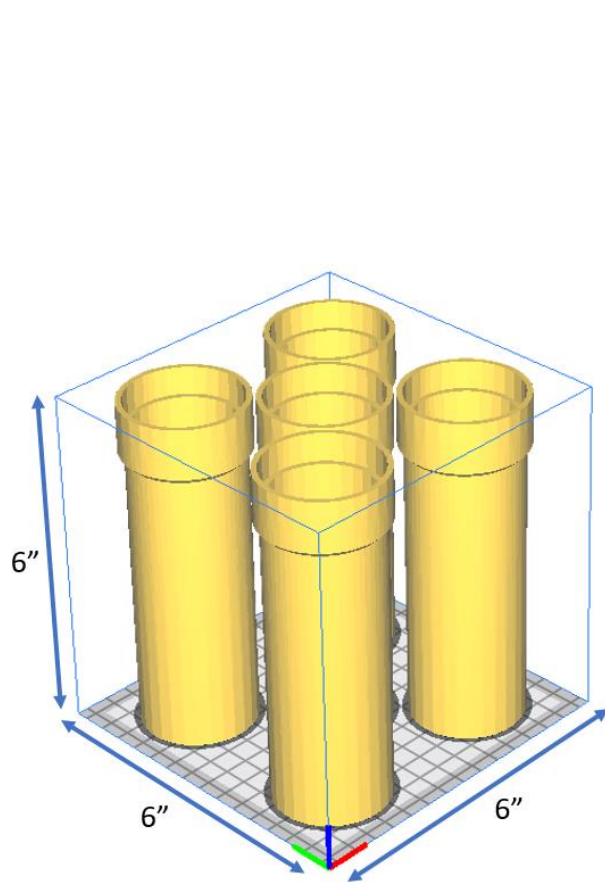
For this category of the competition, all entries will be printed by SAMPE on a Stratasys® F370 FDM printer from ASA polymer. The entry will be multiple pieces, so **all pieces must be arranged in a single .STL file** for review and printing. Students may view their entries beginning at 9am on Tuesday, May 20<sup>th</sup>. All non-entrapped support structures will be removed prior to delivery. Post-processing and assembly may be required for mating features and can be done prior to test time using the basic hand tools (hobby knives, files, and sandpaper) available at the competition check-in desk for finishing and fitting

work. Entries may not leave the test area once formally submitted for cataloging. Students **MUST PHYSICALLY ATTEND** the event to have their entry tested and be considered for awards. STL files will be checked for quality by the committee.

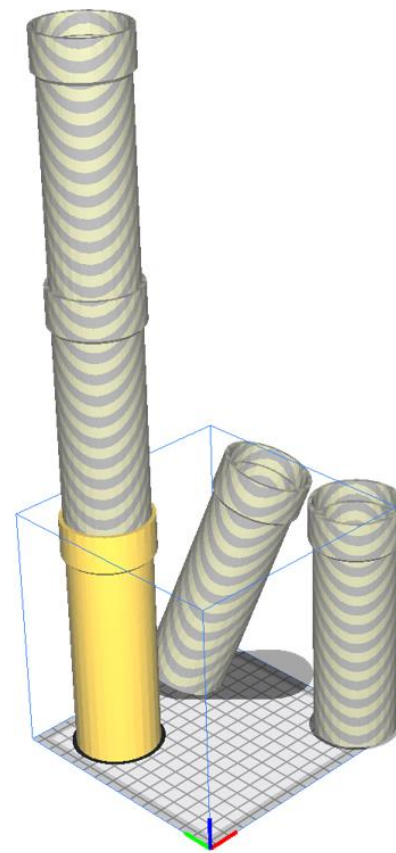
Design notes: Design for printing without support material is suggested. Features below 0.050" tend to not print well. A minimum of a 0.010" gap between mating features is recommended.

Entries will be printed with 2 contour wall thickness (0.040") and 30% sparse double dense infill. The default orientation of the print will be the longest dimension aligned in the z-direction. If students would like the fabricator to deviate from default wall thickness or build direction, they must specify it on their design summary; however 30% sparse double dense infill will be a locked parameter and no deviations from this parameter will be accepted. Submitting a .cmb OR a .print slice file are preferred options for specifying desired parameter settings and build direction.

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. Due to the height requirements, this will require the entry to be built using multiple pieces that connect/stack together, all of which will need to fit together inside a 6"x6"x6" box. 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 an STL of the 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, Lockheed Martin
- Cory Cunningham, The Boeing Company
- Adam Brown, The Boeing Company