SkillsUSA ILLINOIS

Additive Manufacturing

Career Competition

Career Cluster: Manufacturing/STEM

State Qualifying Exam: No **National Contest:** Yes **Participation:** Team of 2

Competition Description

Evaluate the competitors understanding and ability to design a functional/movable assembly using additive manufacturing (DFAM).

Tasks To Be Evaluated

1. Engineering Notebook content.
2. CAD designs.
3. Quality of final assembly.
4. Design for additive manufacturing (DFAM).
5. Presentation.

Clothing Requirement

National Requirement:

Class E: Competition Specific: Business Casual Attire

- Official SkillsUSA white polo shirt
- Black dress slacks or black dress skirt (knee-length minimum)
- Black, closed- toe dress shoes.

State Requirement:

National Requirement OR

- White polo shirt or button-down dress shirt (other colored polo/dress shirt will be subject to deductions)
- Black dress slacks or black dress skirt (knee-length minimum)
- Black, closed-toe dress shoes.
- Any embroidered names or school patches must be covered, if applicable.

Provided by Competitor

- All competitors must create a one-page resume and submit a hard copy to the technical committee chair at orientation.
- Paints (optionals)

Provided by Technical Committee

- Scratch paper and pencils.
- Printed models.
- Caliper.

Additional Information

No reference materials may be used other those provided by the technical committee.
Presentation time: 8 minutes per team.

SkillsUSA 2024 Additive Manufacturing State Challenge

Make It Run

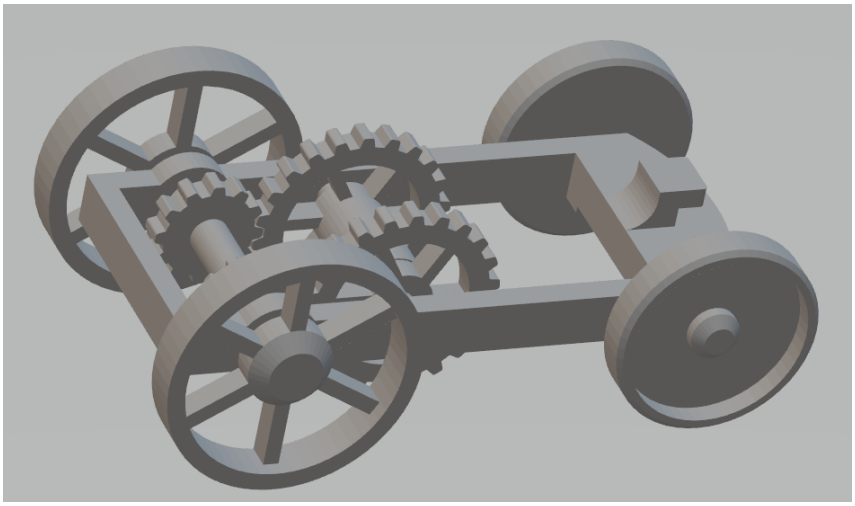
Welcome to the “Make It Run” challenge!

The task at hand is to design and fully print a 4 wheeled vehicle powered only by a single rubber band. The vehicles will then be tested on a “track” for functionality, and additional scoring.

Design Considerations:

- Interlocking parts
- Printed Assemblies
- Snap fits
- Printable Tolerances
- Motion
- Kinetic to Potential Energy

Example of Basic Design



Competition Requirements

1. The design **must** be completely 3D printed.
2. The design **must not** contain any outside hardware (axles, screws, washers
3. The design **can** be 3d printed using any technology.
4. The design **must** contain a legibly printed team number/name
5. The design **can** contain 3D printed bodies that are assembled after printing for the final part.
6. The final design **can** use super glue for assembly, for a loss of points (see grading rubric)
7. Parts **must** have printed wheels
8. The design **must** contain at least 3 moving parts
9. Wheels **can not** be larger than 3 inches in diameter
10. The design **must** be powered only by a single rubber band
11. The printed design **must** have moving bodies.
12. The design **must not** exceed 6” x 4” x 4”
13. 3D Printed Design - Students **must** create a design that:
    - Is original and designed by contestant
    - Print all parts in less than **12** hours total
    - Uses less than **5** cubic inches of model and/or support combined for all parts.

14. Students **must** submit files to be printed via State designated file share site no later than **8 p.m.** on **Sunday, April 20, 2025**. Final prints will be delivered on the day of the contest so that students can test, assemble/modify and be evaluated.

Tips for Competitors

Here are some tips to maximize the points awarded to you:

- Build debossed text on a horizontal surface for best results. This may require building the part on its edge or standing up.
- Utilize soluble support structures for print in place assemblies
- Understand the achievable design tolerance of your printer for print in place, or hand assembled designs to allow motion between parts.
- Leverage post-processing techniques to smooth printed bodies.
- Additional moving parts may add to your score but can produce more points of failure on the final assembly.

- Use online resources (YouTube, GrabCAD Tutorials)
- Whenever intellectual property (IP) deters you from a project, try using approximate geometries to communicate the design intent.
- Optional design for additive manufacturing learning resources:
    - Stratasys Think Additively™ Masterclass:
        - https://youtube.com/playlist?list=PLUYaY5EIPtNBdU-s-7l9rl05lBHHlTarl

State Competition Procedure

Before or on contest day:

1. Students submit Engineering Notebook (Engineering notebook guidelines below)
2. Students submit print files in both CAD (.step, .iges, .sldprt, etc.) and mesh (STL, 3MF, OBJ, etc) format within a .zip file to https://airtable.com/appWk1iQWzvWm5ZSQ/shroK04lQ0r5STm62
3. Students submit physical parts
4. Students submit final assembly if applicable
5. Students submit their Presentation

State Competition Judging Criteria

1. The Engineering Notebook should contain robust content, including at a minimum the following:
    - 1.1. Be clearly labeled with contestant name(s), date and page # on each page
    - 1.2. Begin with a problem statement
    - 1.3. Include discovery and documentation of approach to solve problem
    - 1.4. Include sketched design concepts with critical features labeled
    - 1.5. Critical dimensions clearly labeled in design sketch
    - 1.6. Considerations for designing for additive manufacturing distinctly addressed (i.e. part strength, part orientation) especially including any expected risks during printing
    - 1.7. Screenshots of the print time and material usage for all printed parts
    - 1.8. Design decisions and alternatives are documented and evaluated thoughtfully

2. The design must adhere to the Competition Requirements stated in the prior page.

3. Quality of final assembly

3.1. Does it perform the function in the manner it was designed to do?
3.2. Does it meet all requirements in contest guidelines?
3.3. Do inserted components or multiple printed parts mate together properly?
3.4. Did the students design the part with additive manufacturing in mind?
3.5. Is there sufficient tolerance between parts for movement?

4. The design must illustrate best practices for "design for additive manufacturing (DFAM)". Below are some *potential* DFAM metrics to optimize for.
   4.1. Build Time
   4.2. Post-Processing/Support Removal Time
   4.3. Functionality Optimization (gear ratio, pliability, strength, etc.)
   4.4. Monetary Savings
   4.5. Material Consumption
   4.6. Energy Usage
   4.7. Component Consolidation (lack of store-bought hardware)
   4.8. Lightweighting for Ergonomics

5. Presentation Criteria
   5.1. The team clearly describes their understanding of the problem to be solved.
   5.2. Design Process: good design logic is used for key design choices. Intentional and well-communicated
   5.3. The presentation is professional and well-rehearsed
   5.4. The presentation emphasizes quantitative improvements (measured and estimated) of the time, quality, or cost of the improvement as well as any DFAM tactics employed.
   5.5. Practical evaluation: team demonstrates visually (videos, photos, drawings, animation, etc) the task they improved, both before and after.

6. Racetrack Setup
   6.1. Track will have a stating line and distance markers at 1", 6",12", and with marks every foot after up to 6 feet. Ruler or measuring tape will be used for final measurement above 12".
   6.2. Front tire/tires must begin behind the starting line.
   6.3. A **small** nudge can be used to help get the car moving (see grading rubric)
   6.4. Each design will have 2 chances to run on the track. The better of the two scores will be used for final judging.

6.5. **Final distance of vehicle is measured where the front wheels touch the ground**