SkillsUSA® CHAMPIONSHIPS

ADDITIVE MANUFACTURING

SkillsUSA Championships Technical Standards

Date of competition

Saturday April 18, 2026 @ 8am – 2pm (EST)

Due date of initial design submission

Wednesday April 15, 2026 @ 5pm (EST)

Due date of design adaptation

Thursday April 16, 2026 @ 5pm (EST)

Purpose

To evaluate each team's preparation for employment and to recognize outstanding students for excellence and professionalism in the field of Digital and Additive Manufacturing (AM).

First, visit and download the 2026 competition updates for Additive Manufacturing at the following link 53rd Skills USA Maryland Competition.

Eligibility

Open to a team of two (2) active SkillsUSA members from the same local chapter (school) enrolled in computer-aided design classes, design classes, manufacturing, etc. Team must be registered.

Clothing Requirements

Class E: Competition Specific — Business Casual

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

Note: Wearing socks or hose is not required. If worn, socks must be black dress socks and hose must be either black or skin-tone and seamless/non-pattern.

These regulations refer to SkillsUSA Championships Clothing Classifications that are pictured and described at skillsusastore.org. If you have questions about competition uniforms, call the SkillsUSA Store at 888-501-2183.

Note: Competitors must wear their official competition clothing to the competition orientation.

Equipment and Materials

1. Supplied by the technical committee:
    a. Graduated water container (minimum 500mL)
    b. Clean water supply
    c. Catch basin or collection container
    d. Timer or stopwatch
    e. Digital scale (for leak measurement)
    f. Measuring cylinder (for leaked volume)
    g. Drop test platform/pad
    h. Visual inspection light
2. Supplied by the competitor:
    a. 3D printers and post processing equipment (not required on competition day)
    b. Personal computer system with a CAD system capable of rendering files in STL format. (not required on competition day)
    c. CAD Design program or program(s) of choice these can include but are not limited to: SOLIDWORKS, Autodesk Fusion, Inventor, Onshape, TinkerCAD. Competency or familiarity in more than one program is not required but is highly encouraged to maximize success.
    d. Calipers
    e. Needle nose pliers
    f. Pencil or pen
    g. Sandpaper

h. Gloves for wash tank
i. Post processing tools
j. Blank engineering notebooks for teams to use during competition
k. Applications or program(s) of choice to be used during presentation. All competitors may bring their own computer (laptop preferred). SkillsUSA is not responsible for computers, or any property left in the competition space.
l. All competitors must create and submit a one-page single sided resume. See "Online Submission Requirements" below for guidelines.

Prohibited Devices

Cellphones, electronic watches and/or other electronic devices not approved by a competition's national technical committee are NOT allowed in the competition area. Please follow the guidelines in each technical standard for approved exceptions. Technical committee members may also approve exceptions onsite during the SkillsUSA Championships if deemed appropriate.

Penalties for Prohibited Devices

If a competitor's electronic device makes noise or if the competitor is seen using it at any time during the competition, an official report will be documented for review by the Director of the SkillsUSA Championships. If confirmed that the competitor used the device in a manner which compromised the integrity of the competition, the competitor's scores may be removed.

Online Submission Requirements

All SkillsUSA national competitors must submit their required documents to the competition chair using the following link 2026 Submissions.

Failure to submit any of the required document(s) listed below by the established deadline will result in a 50-point penalty.

Design 1 and Design Adaptation: PDF format Full Assembly Drawings, Exploded Assembly Drawing w/ parts list, Technical Drawings of each part, STL format part and/or assembly files, 3D print report file (time and usage).

Scope of the Competition

Knowledge Performance

All competitors are required to take the SkillsUSA Maryland Professional Development Test. The exam must be completed prior to the State Championship. PD test scores may be used as state contest tiebreakers so students are strongly encouraged to review this information:

2026 Study Guide

Sample Questions

Please see the State Conference website for more information.

Skill Performance

1. The competition will consist of the following:
    a. 3D design that demonstrates thoughtful design for additive manufacturing and solves a given problem under given constraints to be printed prior to the competition event.
    b. 3D printing "design adaptation update" designed to test the competitors' ability to adjust print designs to real-world changes and customer requests.
    c. Engineering notebook documenting design process for challenges during competition.
    d. Evaluation from judges.
2. The competition will focus on real-world challenges of an individual and team and build on each team's understanding of:
    a. Physical, functional, and performance characteristics or specifications that uniquely identify a component or device and determine its performance of set expectations.
    b. Material properties (material specifications will be provided)
3. Final designs will demonstrate an ability to:
    a. Design for performance of specified task expectations
    b. Adapt to customer requested changes after initial design creation and testing.

Competition Guidelines

Portable Gravity-Fed Water Filter Housing

Competition Core Story

Competitors are acting as members of a humanitarian engineering response team deployed to support communities affected by natural disasters, infrastructure failures, or remote living conditions. Due to limited access to centralized manufacturing and unpredictable supply chains, replacement components for essential equipment must be manufactured locally using additive manufacturing technologies. One such critical component is a portable, gravity-fed water filtration system housing, which must function reliably without electricity or complex tooling.

Problem Statement

Design, document, and manufacture a gravity-fed water filter housing using additive manufacturing. The final solution must securely contain a supplied filter cartridge, prevent leakage under gravity head pressure, allow controlled and repeatable water flow, withstand normal handling, and comply with all documented design constraints. Competitors must also comply with a State-Specific Competition Update to be released after submission of initial design.

Competition Phases

Design 1 – Initial Design Solution: The initial engineering solution based on the original problem statement and filter cartridge specification, emphasizing documentation, manufacturability, and DFAM principles.

Design Adaptation - State-Specific Competition Update: Competitors must incorporate a required design change in the final manufactured solution.

- Update will be provided after submission of initial design.

Design Requirements

Cartridge Interface Constraints

- Designs must securely accommodate the primary standard cartridge provided in the competition documentation.
- The final manufactured solution must physically incorporate the state-specific design adaptation
- Cartridge retention and sealing must be achieved without adhesives.

Size & Print Constraints

These requirements define the allowable size, materials, and print parameters for all submitted designs. Compliance is mandatory.

1. *Overall Size Constraints*

- Maximum build volume:
  The complete final assembly must fit within a single desktop FDM printer build volume: 200 mm × 200 mm × 200 mm (8 × 8 × 8 inches)
- The housing may consist of multiple printed parts, provided all parts fit within the build volume individually.
- Assemblies that require surfaces larger than the specified build envelope are not permitted.

2. *Cartridge Interface Constraints*

- Designs must securely accommodate the standard cartridge provided
  - Overall shape: circular cylinder
  - Outer diameter (OD): 40.0 mm +/- 0.3 mm
  - Length: 120.0 mm +/- 0.5 mm
- Functional Features
  - Cartridge outer surface is smooth
  - No threads
  - No flanges
  - No barbs
  - No keying features
- Cartridge design information (performance competition will use shared test fixtures supplied by technical competition)
  - Both ends are flat
  - One end is open internally (for water flow)
  - Internal geometry may be perforated or hollow
  - Internal Bore
    - 20-25 mm
  - Side Holes
    - (4) 5mm diameter holes
    - Spaced evenly along length
    - (12) per cartridge
  - Material
    - PETG or PLA
  - Print settings
    - Nozzle: 0.4 mm
    - Layer height: 0.20 mm
    - Walls: 4 perimeters

        - Infill: 20%
        - Print orientation: Vertical (axis aligned w/ Z)
    - See supplied part drawing CF-00005985

3. *Material Constraints*

- Approved materials:
- PLA (required baseline material)
- PETG (allowed if printers support it)
- Prohibited materials:
- ABS
- Nylon
- Carbon-fiber or glass-fiber reinforced filaments
- Flexible filaments (TPU, TPE)

4. *Nozzle & Layer Constraints*

- Nozzle diameter:
    - 0.4 mm only
- Layer height:
    - Minimum: 0.12 mm
    - Maximum: 0.28 mm
- Specialty nozzles or variable-diameter extrusion are not permitted.

5. *Wall Thickness & Infill Constraints*

- Wall/perimeter count:
    - Minimum: 2 perimeters
    - Maximum: equivalent of ~1.6 mm wall thickness
- Infill percentage:
    - Maximum: 25%
- Designs should rely on additive-appropriate geometry (ribs, shells, curvature) rather than solid mass for strength.

6. *Support Material Constraints*

- Supports are permitted but should be minimized.
- Support usage must be:
    - Reported in documentation
    - Required only where functionally necessary
- Designs that rely excessively on support for sealing surfaces or critical geometry may be penalized under Design Feasibility / DFAM scoring.

7. *Print Time Constraints*

- Maximum print time per individual part:
    - 8 hours
- Teams must report:

    - Estimated print time
    - Material usage (model + supports)
- Designs exceeding time limits are non-compliant, regardless of functionality.

8. *Assembly & Fastener Constraints*

- Adhesives are not permitted
- Snap-fits, threads, captured components, and press fits are encouraged
- Metal fasteners are discouraged and may be restricted by event officials
- Assembly must rely primarily on printed features consistent with DFAM principles.

9. *Final Submission Requirement*

- Competitors must submit a final manufactured solution that:
    - Meets all size and print constraints
    - Physically incorporates the required design adaptation
    - Is fully assembled and ready for skill performance testing
- Documentation-only or hypothetical compliance is not acceptable.

10. *Design Intent Reminder (SkillsUSA Alignment)*

These constraints are intended to:

- Simulate real-world manufacturing limitations
- Promote Design for Additive Manufacturing (DFAM)
- Ensure equitable competition across equipment platforms
- Emphasize engineering judgment over brute-force printing

Skill Performance (Live Testing)

Skill Performance testing validates the functional quality and reliability of the final manufactured solution. All printing and manufacturing must be completed prior to the competition event. No redesign, modification, or printing occurs onsite. All testing is conducted by judges using standardized SkillsUSA-aligned procedures.

- Leak Resistance Test (best of three trials)
- Flow Performance Test (best of three trials)
- Structural / Handling Test (scoring after three trials)
- Fit and Finish Evaluation

Submission Guidelines

Competitors must submit a final manufactured solution that physically incorporates the state-specific competition update.

The final submitted part must demonstrate the required design adaptation as specified.

Documentation-only or hypothetical design adaptations do not receive full credit.

Competitors may not touch, adjust, or repair their part during Skill Performance testing.

Judges will not provide coaching or assistance at any stage of testing.

SkillsUSA Alignment

This challenge is aligned with SkillsUSA Championships Technical Standards and reflects industry-recognized engineering and manufacturing practices. The competition emphasizes engineering documentation, Design for Additive Manufacturing (DFAM), iterative problem-solving, manufacturing feasibility, and functional validation under defined constraints, consistent with SkillsUSA's mission of preparing workplace-ready technical skill professionals.

Scoring Rubric – Water Filter Housing Challenge

Total Possible Points: 1000

See scoring point breakdown below.

Type	Skill Description	MAX Score
Standard	Design 1: Clearly and correctly formatted technical drawings are submitted in PDF format	5
Standard	Design 1: Clearly and correctly formatted part files in STL format	5
Standard	Design 1: Clearly and correctly formatted Full Assembly drawings	20
Standard	Design 1: Clearly and correctly formatted Exploded Assembly Drawing w/ parts list	20
Standard	Design 1: Clearly and correctly formatted Technical Drawing sheet for each part	20
Standard	Design 1: Clearly and correctly formatted 3D print report files (time and usage)	5
Standard	Design 1: Print time is within or under parameters	15
Standard	Design 1: Model material amount is within or under parameters	15
Standard	Design 1: Support material is within or under parameters	15
Standard	Design 2: Clearly and correctly formatted technical drawing file in PDF format	5
Standard	Design 2: Clearly and correctly formatted part files in STL format	5
Standard	Design 2: Clearly and correctly formatted Full Assembly drawings	20
Standard	Design 2: Clearly and correctly formatted exploded Assembly Drawing w/ parts list	20
Standard	Design 2: Clearly and correctly formatted Technical Drawing sheet for each part	20
Standard	Design 2: Clearly and correctly formatted 3D print report files (time and usage)	5
Standard	Design 2: Print time is within or under parameters	10
Standard	Design 2: Model material amount is within or under parameters	10
Standard	Design 2: Support material is within or under parameters	10
Standard	Presentation: Team introduces themselves to judges	20
Standard	Presentation: Team clearly describes their understanding of the problem to be solved (real-world context)	40
Standard	Presentation: Team clearly describes their execution plan and constraints	40
Standard	Presentation: The presentation is professional and well-rehearsed	40
Standard	Presentation: Limitations and Lessons learned from Design 1 to Design 2 are presented	20
Standard	Presentation: Visual aides are used to accompany oral presentation	20
Standard	Presentation: Team Functionality is apparent both team members are present and participate	20
Standard	Presentation: Clearly explains design logic	20
Standard	Notebook: Book is labeled with team number	20
Standard	Notebook: Pages are #'d, dated and signed	20
Standard	Notebook: Problem stated	20
Standard	Notebook: Design decisions and alternatives are documented & evaluated for design 1 and 2	30
Standard	Notebook: Concepts are sketched by hand or digitally and critical features labeled	30
Standard	Notebook: Considerations for designing for Fused Deposition Modeling are addressed	15
Standard	Notebook: Plans and Results of Design 1 are compared and intelligently analyzed with Design 2	20
Standard	Notebook: Next steps, conclusion included and lessons learned included	15
Standard	Part Performance: Design part(s) are printable and in hand	20
Standard	Part Performance: Printed as a sealed mechanical assembly	25
Standard	Part Performance: Fit & Finish	40
Standard	Part Performance: Leak Test (best of 3)	100
Standard	Part Performance: Flow Test (best of 3)	100
Standard	Part Performance: Structural Test (3 completed drops)	100
Penalty	File Deadline Penalty	-50
Penalty	Resume Penalty	-10
Tie Breaker	Engineering Notebook	1
Tie Breaker	PD Test Score	1
		1000

1. Design & Documentation — 225 points

You must submit complete and correctly formatted **assembly drawings**, **exploded views**, and **part-level technical drawings**, along with **STL** and **native CAD files**. **Print time** and **material usage** must be reported. Designs must be printable, realistic, and aligned with Design for Additive Manufacturing (DFAM) principles.

2. Oral Presentation — 220 points

You will present your design, explaining the real-world problem, your design solution, manufacturing approach, and lessons learned. Both team members should participate.

3. Engineering Notebook — 170 points

Your engineering notebook should be labeled, have numbered and dated pages, clearly document problem definition, multiple design concepts, design decisions, iteration from Design 1 to the final solution, DFAM considerations, and lessons learned. The engineering notebook is also used as the primary tie-breaker.

4. Part Performance (Skill Performance) — 385 points

Your final printed part will be evaluated through standardized skill performance testing, including leak resistance, flow performance, and structural durability. Each test will be performed three times; the best result is scored.

State-Specific Competition Update – Required Design Adaptation

You are required to submit a final manufactured solution that physically incorporates the design adaptation introduced by the state-specific competition update. The final submitted part must demonstrate accommodation for this update. All printing and manufacturing must be completed prior to the event; no onsite redesign or printing occurs. Designs that address the update only through documentation or explanation will not receive full credit.

Penalties

Clothing violation: –10 points
Missing resume: –10 points
Late file submission: –50 points
Poor preparation or missing materials: –50 points

Standards and Competencies

AMF 1.0 — Design sketch and plan machine work to U.S. National CAD Standards

1. Create CAD file for manufacturing using standard CAD terminology and standard practice
2. Initiate manufacturing documentation process
3. Export a CAD file to .stl format
4. Process engineering change orders

AMF 2.0 — Preform and inspect part(s) using a Total Quality Management process

1. Verify part(s) to provided standards
2. Verify part(s) to ECO standards
3. Document process of verification and inspection

AMF 3.0 — Demonstrate safety practices in a working situation to the related duty tasks of the National Institute for Metalworking Skills (NIMS) Duties and Standards

1. Carry out assigned responsibilities while adhering to safe practices in accordance with OSHA requirements and guidelines
2. Document safety activities as required

AMF 4.0 — Provide an accurate quotation given an automated manufacturing technology simulated scenario

1. Solve various solutions to the process that is involved in quoting a job in a rapid prototyping environment

AMF 5.0 — SkillsUSA Framework

The SkillsUSA Framework is used to pinpoint the Essential Elements found in Personal Skills, Workplace Skills and Technical Skills Grounded in Academics. Students will be expected to display or explain how they used some of these Essential Elements. For more, visit:

www.skillsusa.org/who-we-are/skillsusa-framework/.

Committee Identified Academic Skills

The technical committee has identified that the following academic skills are embedded in this competition.

Math Skills

- Numbers and operations
- Algebra
- Geometry
- Measurement
- Problem Solving
- Reasoning and proof
- Communication
- Connections
- Representation
- Use fractions to solve practical problems.
- Use proportions and ratios to solve practical problems.
- Simplify numerical expressions.
- Solve single variable algebraic expressions.
- Solve multiple variable algebraic expressions.
- Measure angles.
- Use scientific notation.
- Find surface area and perimeter of two-dimensional objects.
- Construct three-dimensional models.
- Apply Pythagorean Theorem.
- Make predictions using knowledge of probability.
- Solve problems using proportions, formulas and functions.
- Find slope of a line.
- Solve practical problems involving complementary, supplementary and congruent angles.
- Solve problems involving symmetry and transformation.

Science Skills

- Use knowledge of the particle theory of matter.
- Describe characteristics of types of matter based on physical and chemical properties.
- Use knowledge of physical properties (shape, density, solubility, odor, melting point, boiling point, color).

- Use knowledge of classification of elements as metals, metalloids and nonmetals.
- Describe and identify physical changes to matter.
- Predict changes to matter (types of reactions, reactants, and products; and balanced equations).
- Use knowledge of potential and kinetic energy.
- Use knowledge of Newton's laws of motion.
- Use knowledge of work, force, mechanical advantage, efficiency and power.
- Use knowledge of simple machines, compound machines, powered vehicles, rockets and restraining devices.

Language Arts Skills

- Provide information in conversations and in group discussions.
- Demonstrate comprehension of a variety of informational texts.
- Use text structures to aid comprehension.
- Organize and synthesize information for use in written and oral presentations.
- Demonstrate knowledge of appropriate reference materials.
- Demonstrate use of such verbal communication skills as word choice, pitch, feeling, tone and voice.
- Demonstrate use of such nonverbal communication skills as eye contact, posture and gestures using interviewing techniques to gain information.
- Demonstrate informational writing.
- Edit writing for correct grammar, capitalization, punctuation, spelling, sentence structure and paragraphing.

CONNECTIONS TO NATIONAL STANDARDS

State-level academic curriculum specialists identified the following connections to national academic standards.

Math Standards

- Numbers and operations
- Algebra
- Geometry
- Measurement
- Data analysis and probability
- Problem solving
- Reasoning and proof
- Communication

- Connections
- Representation

Source: NCTM Principles and Standards for School Mathematics. NCTM Principles and Standards for School Mathematics. For more information, visit: http://www.nctm.org.

Science Standards

- Understands the structure and properties of matter
- Understands the sources and properties of energy
- Understands forces and motion
- Understands the nature of scientific inquiry

Language Arts Standards

- Students apply a wide range of strategies to comprehend, interpret, evaluate and appreciate texts. They draw on their prior experience, their interactions with other readers and writers,
- their knowledge of word meaning and of other texts, their word identification strategies, and their understanding of textual features (e.g., sound-letter correspondence, sentence structure, context, graphics).
- Students adjust their use of spoken, written and visual language (e.g., conventions, style, vocabulary) to communicate effectively with a variety of audiences and for different purposes.
- Students apply knowledge of language structure, language conventions (e.g., spelling and punctuation), media techniques, figurative language and genre to create, critique and discuss print and nonprint texts.
- Students use a variety of technological and information resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and to create and
- communicate knowledge.
- Students participate as knowledgeable, reflective, creative and critical members of a variety of literacy communities.
- Students use spoken, written and visual language to accomplish their own purposes (e.g., for learning, enjoyment, persuasion, and the exchange of information).

Source: IRA/NCTE Standards for the English Language Arts. To view the standards, visit: www.ncte.org/standards.