



ENGINEERING 15.0000.00

TECHNICAL STANDARDS

An Industry Technical Standards Validation Committee developed and validated these standards on September 17, 2020. The Arizona Career and Technical Education Quality Commission, the validating authority for the Arizona Skills Standards Assessment System, endorsed these standards on January 27, 2021.

Note: Arizona's Professional Skills are taught as an integral part of the Engineering program.

The Technical Skills Assessment for Engineering is available SY2021-2022.

Note: In this document i.e. explains or clarifies the content and e.g. provides examples of the content that must be taught.

STANDARD 1.0 INVESTIGATE THE FIELD OF ENGINEERING TO ADDRESS THE NEEDS OF A GLOBAL SOCIETY

- 1.1 Define the disciplines of engineering (types of engineers) (i.e., chemical, civil, electrical, mechanical, agricultural, industrial, aeronautical, software, biomedical, etc.)
- 1.2 Recognize that engineers solve a wide range of problems involving innovation, cost reduction, and more efficient/effective processes
- 1.3 Describe the specialties/areas of training that may lead to jobs/careers (i.e., transportation, construction, research and development, analytical design, disaster management, waste management, environmental, automation and robotics, etc.)
- 1.4 Explore emerging fields in engineering and challenges to future work and future life [i.e., drones, electric cars, autonomous cars, AI, IoT, Virtual Reality (VR), Augmented Reality (AR), Mixed Reality (MR), Additive Manufacturing (AM), Smart City design, Automation, Machine Learning (ML), M2M (Machine-to-Machine), H2M (Human-to-Machines), etc.]
- 1.5 Analyze the societal, environmental, legal, and ethical responsibilities of engineers (e.g., Engineering Code of Ethics, economic, political, sustainability, and community health and safety)
- 1.6 Determine the skills and education required to enter engineering careers (i.e., aptitude for math and science; complex problem-solving, critical thinking and decision-making; interpreting plans, schematics, and blueprints; communication skills to influence and convey facts with specificity, etc.)

STANDARD 2.0 CREATE ENGINEERING SOLUTIONS BY APPLYING A STRUCTURED PROBLEM-SOLVING/DECISION-MAKING PROCESS

- 2.1 Identify the problem
- 2.2 Develop a problem statement based on facts, research, and experience
- 2.3 Explore possible issues or options to the problem
- 2.4 Select the best solution within the constraints and criteria
- 2.5 Develop a prototype or model to test the selected solution
- 2.6 Implement the solution
- 2.7 Evaluate the solution, and revise or repeat if necessary (i.e., Are there other solutions, better solutions, or cheaper solutions? etc.)
- 2.8 Document and report all results

STANDARD 3.0 APPLY MATHEMATICAL LAWS AND PRINCIPLES RELEVANT TO ENGINEERING TECHNOLOGY

- 3.1 Use basic mathematical functions and tools (i.e., Google Sheets, Excel, graphing calculator, etc.)
- 3.2 Use data collection and analysis to display data and verify its accuracy
- 3.3 Display data graphically using diagrams and working drawings
- 3.4 Use statistical measures of a central tendency (mean, median, and mode) as needed in the structured problem-solving process
- 3.5 Use mathematical models including algebraic, geometric, trigonometric, and calculus relationships to solve, analyze, and design solutions
- 3.6 Generate manually and electronically mathematical solutions and evaluate their validity

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3.7 Use English and Metric systems of measurement

STANDARD 4.0 APPLY SCIENTIFIC LAWS AND PRINCIPLES RELEVANT TO ENGINEERING TECHNOLOGY

- 4.1 Use the relationship among energy, work, and power to solve a variety of problems involving mechanical, fluid, electrical, and thermal systems
- 4.2 Use Newton's Laws of Motion to analyze static and dynamic systems with and without the presence of external forces
- 4.3 Use the laws of conservation of energy, charge, and momentum to solve a variety of problems involving mechanical, fluid, electrical, and thermal systems
- 4.4 Analyze relevant properties of materials used in engineering projects [i.e., chemical, environmental, mechanical (tension, compression, torque), electrical, physical, etc.]

STANDARD 5.0 APPLY TECHNOLOGY AND TOOLS TO ENGINEERING SOLUTIONS

- 5.1 Explain the concepts of precision, accuracy, and tolerance as they relate to measurement tools (i.e., micrometers, dial indicator, digital calipers, etc.)
- 5.2 Use measurement devices such as calipers, oscilloscopes, and digital multimeters to gather data for analysis
- 5.3 Verify the calibration status of measurement tools (i.e., quality control, test, and retest, etc.)
- 5.4 Use software tools to solve, model, analyze, and/or design solutions to engineering problems (i.e., SOLIDWORKS, AutoCAD, On-shape, Fusion360, Google Sheets, Excel, etc.)
- 5.5 Identify hazards, risks, and incidents related to tools and equipment
- 5.6 Practice safe use of tools, machines, equipment, and materials (i.e., OSHA, SDS sheets, PPE, etc.)
- 5.7 Review fabrication methods to create potential solutions to engineering problems (e.g., 3D printing, injection molding, woodworking, and welding)

STANDARD 6.0 APPLY COMMUNICATION SKILLS TO ENGINEERING PROJECTS

- 6.1 Apply technical writing skills and use visual aids to present critical information in reports (i.e., results/outcomes, conclusions, future work recommendations, etc.)
- 6.2 Utilize the three stages of oral presentation (e.g., planning, practicing, and presenting)
- 6.3 Apply communication skills, including listening skills, with project teams, project managers, clientele, and/or contractors
- 6.4 Explain the importance of multiculturalism in creative and professional decision-making (e.g., better decisions based on different views, perspectives, ideas, and proposals; fosters critical thinking, analysis, and collaboration)

STANDARD 7.0 APPLY PROJECT MANAGEMENT TOOLS AND TECHNIQUES TO ENGINEERING SOLUTIONS

- 7.1 Determine the tools, materials, manpower, and money allocation required to manage the project
- 7.2 Utilize time-management techniques (e.g., prioritizing and planning, creating goals, scheduling, advocating, and taking action)
- 7.3 Organize and maintain work using project management tools (e.g., Gantt Chart, AGILE, Kanban, Waterfall model, dashboards, task lists, project reports, and time sheets)
- 7.4 Schedule daily/weekly meetings to check status of the project and to deal with any constraints and obstacles to the project
- 7.5 Document and present project results/outcomes as appropriate
- 7.6 Analyze the project from various perspectives (i.e., sustainability, political, economic, health and safety perspectives, etc.)

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