2024 PRE-ENGINEERING

Program Standards

CONTENT STANDARD 1.0: PROFESSIONAL ORGANIZATIONS AND LEADERSHIP

Performance Standard 1.1: Student Leadership in Career Technical Student Organizations (CTSO) and Professional Associations

1.1.1 Explore the role of professional organizations and/or associations in the Engineering Industry.
1.1.2 Define the value, role, and opportunities provided through career technical student organizations.
1.1.3 Engage in career exploration and leadership development.

CONTENT STANDARD 2.0: LAB/WORKPLACE SAFETY AND TOOL USE

Performance Standard 2.1: Safety

2.1.1. Describe the role of the Occupational Safety and Health Administration (OSHA).
2.1.2 Comply with requirements for personal protection equipment (PPE).
2.1.3 Describe material handling, storage, use, and disposal requirements.
2.1.4 Interpret safety data sheets (SDS) before using materials (i.e., handling, storage use, disposal requirements).
2.1.5 Interpret safety signage for hazards, evacuation routes, and safety areas.
2.1.6 Identify the location and the types of fire extinguishers and other fire equipment.
2.1.7 Describe procedures for using fire extinguishers and other fire safety equipment.
2.1.8 Describe the requirements for using eye-wash stations.
2.1.9 Describe electrical hazards and the effects of electrical shock on the human body.

Performance Standard 2.2: Tool Identification and Safe Use

2.2.1 Identify hand tools and power tools, including precision measuring tools.
2.2.2 Maintain tools.
2.2.3 Match tools to their intended use and purpose.
2.2.4 Perform a safety check before using tools.

CONTENT STANDARD 3.0: IMPACT OF ENGINEERING

Performance Standard 3.1: Engineering Careers

3.1.1 Define engineering.
3.1.2 Research career opportunities and the educational requirements for a given engineering field.
3.1.3 Create an education and career plan for a career in engineering.
3.1.4 Describe the importance of collaboration in the engineering industry.

Performance Standard 3.2: Ethics in Engineering

3.2.1 Identify current engineering codes of ethics and their purpose.
3.2.2 Describe ethical engineering issues.
3.2.3 Analyze the ethical issues involved in an engineering failure.

CONTENT STANDARD 4.0: ENGINEERING DESIGN PROCESS

Performance Standard 4.1: Design Process Concepts

4.1.1 Apply the steps of the design process to solve a design problem (i.e., define the problem, generate concepts, develop a solution, develop a design proposal, construct and test a prototype, refine the design, evaluate a solution, and communicate the processes and results).
4.1.2 Describe how social, environmental, regulatory, and financial constraints influence the design process.

4.1.3 Describe the evolution and lifecycle of a product (i.e., introduction, growth, maturity, decline).

Performance Standard 4.2: Measuring and Scaling

4.2.1 Identify imperial/standard and metric/SI units of measure and level of accuracy requirements for an engineering problem/design.
4.2.2 Convert between imperial/standard and metric/SI units of measure in an engineering problem/design.
4.2.3 Determine scale on a blueprint.
4.2.4 Apply algebraic and geometric calculations to determine size, mass, volume, and surface area in an engineering problem/design.
4.2.5 Convert between fractions and decimals in an engineering problem/design.
4.2.6 Report measurements by using and reading precision measuring tools.

Performance Standard 4.3: Technical Sketching and Drawing

4.3.1 Communicate ideas, using freehand sketching (e.g., pictorial, multi-view) and annotations.
4.3.2 Produce drawings from sketches.
4.3.3 Identify the six primary orthographic views.
4.3.4 Identify the alphabet of lines (i.e., styles, weights) and line conventions.
4.3.5 Apply basic elements (e.g., title block information, dimensions, and line types) in a technical drawing.
4.3.6 Identify basic industry standard symbols on sketches, drawings, and blueprints.
4.3.7 Produce various types of drawings (e.g., part, assembly, pictorial, orthographic, isometric, and schematic), given an engineering design.
4.3.8 Arrange dimensions and annotations, using ANSI and ISO standards for an engineering problem/design.
4.3.9 Create a bill of materials or schedule from blueprints and specifications.

Performance Standard 4.4: Engineering Documentation

4.4.1 Describe documentation and communication methods used in engineering.
4.4.2 Maintain documentation during the engineering design process.
4.4.3 Describe the importance of proprietary documentation (e.g., copyright, patent) in engineering.
4.4.4 Create project-management timelines for an engineering design.
4.4.5 Write a technical report for an engineering design.

Performance Standard 4.5: Modeling

4.5.1 Identify the areas of modeling (e.g., physical, conceptual, mathematical).
4.5.2 Create a scale model or a working prototype.
4.5.3 Evaluate the accuracy of a scale model or a working prototype.

CONTENT STANDARD 5.0: MATERIALS

Performance Standards 5.1: Material Properties

5.1.1 Identify the major categories of materials (e.g., ceramics, composites, polymers, metals) and their applications.
5.1.2 Describe the characteristics of materials by their applications in engineering.
5.1.3 Describe the cost and environmental factors that affect choosing specific materials for a design process.
5.1.4 Differentiate among raw material, standard stock, and finished products.

Performance Standards 5.2: Materials Strength

5.2.1 Describe the various forms of stress (e.g., compression, tension, torque, and shear) and how they affect materials selection for an engineering design.
5.2.2 Describe the fundamental principles of a stress-strain curve.
5.2.3 Create free-body diagrams of objects, identifying all forces acting on the object.
5.2.4 Differentiate between scalar and vector quantities.
5.2.5 Define magnitude, direction, and sense of a vector.

5.2.6 Measure the magnitude, direction, and sense of a vector.
5.2.7 Define moment and torque forces.
5.2.8 Calculate moment and torque forces in an engineering design.

CONTENT STANDARD 6.0: FUNDAMENTAL POWER SYSTEMS AND ENERGY PRINCIPLES

Performance Standard 6.1: Basic Mechanical Systems

6.1.1 Distinguish among the characteristics and components of the six simple machines.
6.1.2 Measure forces and distances related to mechanisms in an engineering design.
6.1.3 Determine efficiency in a mechanical system.
6.1.4 Calculate mechanical advantage and drive ratios of mechanisms.
6.1.5 Calculate work, power, and torque/moment.
6.1.6 Design a basic mechanical system.
6.1.7 Assemble a basic mechanical system.
6.1.8 Test a basic mechanical system.

Performance Standard 6.2: Power Systems and Energy Forms

6.2.1 Identify the types of basic power systems, components, and related terminology (e.g., energy, potential energy, kinetic energy, power, work, horsepower, watts).
6.2.2 Describe the factors that affect the choice of power system in an engineering design.
6.2.3 Calculate the efficiency of power systems and conversion devices.
6.2.4 Categorize major forms of energy (e.g., thermal, radiant, nuclear, chemical, electrical, mechanical, fluid).
6.2.5 Define units used to measure energy.
6.2.6 Calculate conversions between common energy measurements in an engineering design.
6.2.7 Describe the purpose and function of an energy conversion device (e.g., solar panel, windmill, battery, turbine).

Performance Standard 6.3: Energy Sources and Applications

6.3.1 Categorize various energy sources as nonrenewable, renewable, or inexhaustible.
6.3.2 Measure circuit values, using a multimeter.
6.3.3 Calculate power in a system that converts energy from electrical to mechanical.
6.3.4 Determine the efficiency of a system that converts an electrical input to a mechanical output.
6.3.5 Describe the relationship of voltage, current, and resistance.
6.3.6 Calculate values of current, resistance, and voltage in a circuit, using Ohm's law.
6.3.7 Create series and parallel circuits, using the basic laws of electricity and Kirchhoff's law.

Performance Standard 6.4: Automation Systems

6.4.1 Create detailed operational flowcharts and logic in a system-control program.
6.4.2 Select appropriate input and output devices, based on system specifications and constraints.
6.4.3 Differentiate between the attributes of digital and analog devices.
6.4.4 Compare open and closed loop systems.
6.4.5 Design a control system, based on specifications and constraints.

Performance Standard 6.5: Basic Fluid Systems

6.5.1 Define fluid systems (e.g., hydraulic, pneumatic, vacuum).
6.5.2 Identify the components of fluid systems and their functions.
6.5.3 Compare hydraulic and pneumatic systems.
6.5.4 Identify the advantages and disadvantages of using fluid power systems.
6.5.5 Describe the difference between gauge pressure and absolute pressure.
6.5.6 Describe the safety concerns of working with liquids and gases under pressure.
6.5.7 Calculate mechanical advantage, using Pascal's law.
6.5.8 Calculate values in a pneumatic system, using the ideal gas law (i.e., general gas equation).

CONTENT STANDARD 7.0: ANALYSIS OF DESIGNS AND PROTOTYPES

Performance Standard 7.1: Statistics

7.1.1 Define statistical terminology (e.g., mean, mode, median, range, standard deviation).
7.1.2 Illustrate frequency distribution.
7.1.3 Calculate the central tendency of a data array to include mean, median, and mode.
7.1.4 Calculate data variation to include range, standard deviation, and variance.

IDCTE Document Control Information

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Date	Standard #	Original	Summary of Change	Revised By	Approved By