



## ***CUSTOMIZED TEACHER ASSESSMENT BLUEPRINT***

### **ENGINEERING TECHNOLOGIES/TECHNICIANS**

**Test Code: 5991**

**Version: 01**

#### ***Specific competencies and skills tested in this assessment:***

##### **Engineering Fundamentals and Safety**

- Implement a safety plan
- Operate lab equipment according to safety guidelines
- Use appropriate personal protective equipment
- Comply with OSHA and EPA regulations for a safe work site
- Identify emergency first aid procedures
- Maintain safe working practices around tools and equipment
- Participate in classroom and laboratory management and clean-up activities
- Investigate engineering careers, training, and associated opportunities
- Explain the purpose and functions of an engineering team
- Analyze current Professional Engineering codes of ethics
- Analyze ethical engineering issues
- Analyze and explain ethical and technical issues contributing to an engineering disaster

##### **Problem Solving, Design Process, and Teamwork**

- Identify the engineering problem
- Gather information about problems and solutions
- Apply steps in the problem-solving method
- Identify the way numbers are expressed in scientific notation, engineering notation, and System International (SI) notation
- Actively participate as a member of an engineering project team
- Apply constructive feedback
- Resolve conflict within the team
- Demonstrate active listening techniques
- Demonstrate formal and informal speaking skills
- Explain the importance of selling a project idea to team members
- Identify the steps of an iterative design process
- Determine whether design is safe for a given user
- Generate a design improvement to address specific flaws/failures
- Create a proposal for an engineering project
- Participate in a design review

## ***Engineering Technologies/Technicians (continued)***

### **Graphics and Modeling**

- Proper use of graphics equipment and tools
- Describe various types of drawings
- Perform metric-U.S. system conversions
- Use engineer's and architect's scales
- Prepare freehand sketches
- Apply line conventions
- Prepare additional views to clarify the design
- Apply principles of dimensioning and annotation
- Prepare drawings for product assembly, fabrication, or construction
- Create schematics
- Identify the three areas of modeling (i.e., physical, conceptual, and mathematical)
- Create a scale model or working prototype
- Identify methods and sources for obtaining materials and supplies
- Compile a materials list that includes vendors and costs for all required materials and equipment to build the prototype
- Write a step-by-step procedure for an assembly

### **Knowledge of Manufacturing and Manufacturing Systems**

- Research the history of manufacturing and its milestones
- Research a topic in manufacturing
- Describe procedures used in manufacturing
- Identify basic flowcharting and discuss their functions
- Create and apply a flowchart that portrays a manufacturing process
- Create a control system that replicates a factory cell
- Demonstrate how research is used in Engineering Economics
- Demonstrate the relationship of time and cost to manufacturing systems
- Explain the difference between primary and secondary manufacturing processes
- Evaluate and present a production line activity
- Outline the product-development process
- Plan steps of production for a manufactured product
- List tools needed for a manufactured product
- Make a list of the production processes in manufacturing
- Apply manufacturing systems to develop and produce a prototype for a product
- Evaluate a product prototype and the processes used in its manufacture
- Prepare a process, identify machines that will be used to carry out the process, then describe the work that each machine performs
- Research the history and industrial use of CAM

### **Power, Energy, and Green Technology**

- Define "What is Power"
- Discuss the forms of potential energy
- Discuss the forms of kinetic energy
- Research methods of energy conversion (e.g., electrical, fluid, mechanical)
- Define terms used in power systems
- Name the Laws of Thermodynamics
- Research renewable/non-renewable energy sources
- Study energy efficiency and conservation
- Calculate material properties relating to a stress strain curve
- Create a model that will utilize a renewable energy concept
- Create a written report of material test evaluations
- Prepare a concept of an alternative energy for transportation

## ***Engineering Technologies/Technicians (continued)***

### **Engineering Mechanics**

Locate and explain examples of the six simple machines, their attributes, and components  
Measure forces and distances related to mechanisms  
Calculate mechanical advantage and drive ratios of mechanisms  
Design, create, and test various drive systems  
Determine efficiency in a mechanical system  
Convert power between units  
Measure torque, and use it to calculate power  
Demonstrate principles of mechanical systems as they relate to power transmission  
Identify components of a fluid system  
Calculate values in a fluid power system, using Pascal's Law  
Calculate values in a pneumatic system, using the ideal gas laws  
Calculate flow rate, flow velocity, and mechanical advantage in a fluid power system  
Given a set of data, calculate distance, displacement, speed, velocity, and acceleration  
Calculate acceleration due to gravity, based on data from a free-fall device  
Design a vehicle that stores and releases potential energy for propulsion

### **Machine Controls and Automated Systems**

Choose appropriate machine control inputs and outputs, based on the need of a technological system  
Differentiate between the characteristics of digital and analog devices  
Select between open and closed loop systems to solve a technological problem  
Create system control programs that use flowchart logic  
Define and discuss open and closed loop systems  
Create and use flowcharts  
Identify components needed to integrate computer controls for an automated system  
Plan, design, and construct an automated system  
Program an automated system using computer hardware and software  
Interface output devices to a computer, microcontroller, or programmable logic controller

### **Materials**

Describe the properties of materials  
Investigate methods used to alter materials  
Illustrate causes of failure in materials  
Investigate various types of metals and application  
Investigate various types of natural and manufactured wood and applications  
Investigate various types of ceramics and applications  
Investigate various composite and synthetic materials  
Demonstrate knowledge of the principles of statics and dynamics to calculate the strength of various engineering materials used to build a structure  
Create free body diagrams of objects, identifying all forces acting on the object  
Differentiate between scalar and vector quantities  
Identify magnitude, direction, and sense of a vector  
Calculate the X and Y components, given a vector  
Calculate moment forces, given a specified axis

### **Quality Control and Measurement**

Apply Total Quality Management techniques (TQM)  
Demonstrate knowledge of ISO-quality standards  
Make linear measurements accurately to 1/16-inch  
Use a micrometer to measure accurately to .001-inch  
Use a dial caliper to measure accurately to .001-inch  
Use combination squares and protractors for angular measurement

*Engineering Technologies/Technicians (continued)*

**Basic Electricity and Electronics**

Identify and demonstrate safety rules and use of electricity lab machines and equipment

Define and describe basic electrical terms

Determine the direction of current flow in DC circuits

Determine the direction of current flow in AC circuits

Identify and draw electronic symbols and circuit diagrams

Identify resistors by type and value

Describe types of sensing and control devices

Determine current, voltage, and resistance in series-parallel circuits

Measure circuit values with a multi-meter

Compute values of current, resistance, and voltage using Ohm's Law

Compute the values of electrical power

Calculate voltage, amperage, and resistance in series circuits

Calculate voltage, amperage, and resistance in parallel circuits

Use a variety of meters to take readings

Demonstrate lockout/tagout procedures

Identify purpose and location of over-current devices

Select over-current devices

Explain transformer operation

*Engineering Technologies/Technicians (continued)*

**Written Assessment:**

Administration Time: 3 hours

Number of Questions: 195

***Areas covered:***

8%	Engineering Fundamentals and Safety
11%	Problem Solving, Design Process, and Teamwork
14%	Graphics and Modeling
10%	Knowledge of Manufacturing and Manufacturing Systems
9%	Power, Energy, and Green Technology
11%	Engineering Mechanics
7%	Machine Controls and Automated Systems
10%	Materials
5%	Quality Control and Measurement
15%	Basic Electricity and Electronics

**Sample Questions:**

It is important to conduct research and gather information

- A. only when the problem requires it
- B. after a solution has been tested
- C. instead of identifying the problem
- D. when using the problem solving process

A/An \_\_\_\_\_ model requires a destructive prototype test.

- A. physical
- B. conceptual
- C. mathematical
- D. manufacturing

What is the primary function of insulation?

- A. to maintain temperature
- B. to keep the pipe or vessel from rusting
- C. to prevent infestation
- D. to maintain sanitary conditions

The main factor in selecting a closed loop system over an open loop system is

- A. cost saving to the engineer for design work
- B. the need to change variables depending on feedback
- C. materials needed for manufacture of the part
- D. increased safety and speed of outcomes

A \_\_\_\_\_ measures length to an accuracy of 0.001 inch.

- A. ruler
- B. scale
- C. micrometer
- D. millimeter

***Engineering Technologies/Technicians (continued)***

Wear approved safety glasses whenever working with machinery because

- A. they improve vision
- B. they are tested and rated for protection
- C. the manager said so
- D. they reduce glare

The event that started the Industrial Revolution was

- A. the organization of the U.S. Postal Service
- B. the distribution of government funding
- C. the invention of the steam engine
- D. the development of the microprocessor

The screw is an example of the application of which other simple machine?

- A. lever
- B. inclined plane
- C. wheel and axle
- D. pulley

Nonferrous metals have an absence of

- A. copper
- B. aluminum
- C. brass
- D. iron

When dealing with electricity, one should avoid

- A. wet or damp surfaces
- B. an electrostatic discharge bracelet
- C. using an oscilloscope
- D. using high wattage resistors

*Engineering Technologies/Technicians (continued)*

**Performance Assessment:**

Administration Time: 3 hours  
Number of Jobs: 2

***Areas Covered:***

- 54%      **Part Creation and Modification**  
*Participant will create a 3-D solid model using the diagram provided, print the drawing including necessary dimensions and save the completed job.*
- 46%      **Paper Tower**  
*Participant will use engineering design process to design and build the tallest tower possible using only the supplied tape and colored paper.*

***Sample Job:***                      Paper Tower

***Maximum Job Time:***              1 hour and 15 minutes

***Participant Activity:***              The participant will use engineering design process to design and build the tallest tower possible using only the supplied tape and colored paper.