



## POWER EQUIPMENT TECHNOLOGY



SkillsUSA Championships Technical Standards

### PURPOSE

To evaluate each competitor's preparation for employment and recognize outstanding students for excellence and professionalism in engine and equipment diagnostics, overhaul and repair of both liquid and air-cooled engines. It will also evaluate the ability to troubleshoot and overhaul the mechanical and hydraulic system components of a piece of powered equipment or machinery.

First, download and review the General Regulations at: <http://updates.skillsusa.org>.

### ELIGIBILITY

Open to active SkillsUSA members enrolled in programs with small, air-cooled engine repair, compact diesel engine repair or power equipment-related repair as an occupational objective.

### CLOTHING REQUIREMENTS

#### **Class D: Competition Specific — Blue Attire**

- Official SkillsUSA light blue work shirt
- Navy pants
- Black, brown or tan leather work safety shoes (with protective toe cap).

**Note:** Safety glasses must have side shields or goggles. (Prescription glasses may be used only if they are equipped with side shields. If not, they must be covered with goggles.)

These regulations refer to clothing items that are pictured and described at [www.skillsusastore.org](http://www.skillsusastore.org). If you have questions about clothing or other logo items, call 1-888-501-2183.

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

## EQUIPMENT AND MATERIALS

1. Supplied by the technical committee:
  - a. All necessary engines, engine parts, workstations, test stands, power equipment, fuel, oil and all basic hand tools as well as necessary specialty tools
  - b. Industry manuals, including service and repair instruction manuals
2. Supplied by the competitor:
  - a. All competitors must create a one-page resume to submit online. See “Resume Requirement” below for guidelines. Additionally, and as part of the competition, competitors will submit a hard copy of their resume at orientation.

### RESUME REQUIREMENT

Competitors must create a one-page resume to submit online. SkillsUSA national competitors should submit their resume by June 1. The link for resume submission will be published on <http://updates.skillsusa.org> on May 1. Failure to submit a resume will result in a 10-point penalty.

**Your resume must be saved as a PDF file type using file name format of “Last Name\_First Name.”** For example, “Amanda Smith” would save her resume as **Smith\_Amanda**. If you need assistance with saving your file as a PDF, visit [the Adobe website](#) for more information.

*Note:* Check the Competition Guidelines and/or the updates page on the SkillsUSA website at <http://updates.skillsusa.org>.

### PROHIBITED DEVICES

Cell phones 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 SkillsUSA Championships director. If confirmed that the competitor used the device in a manner which compromised the integrity of the competition, the competitor’s scores may be canceled.

## SCOPE OF COMPETITION

This competition assesses understanding of the following:

- Two-stroke and four-stroke engines of various design types, 2 through 42 horsepower, single and multi-cylinder designs, including compact diesel engines
- Mechanical and hydraulic systems, drivetrains, steering, braking, and PTO systems
- Electrical systems, including battery-powered equipment both handheld, and mobile

## **KNOWLEDGE PERFORMANCE**

The competition will include a written knowledge exam based on an industry standard test. Additionally, the test could cover manufacturer's engines, parts identification, ordering and/or related equipment. There will also be the possibility of additional written portions during the day of the skill event.

## **SKILL PERFORMANCE**

The competition will include a series of power equipment technology testing stations to assess skill performance.

## **COMPETITION GUIDELINES**

1. Competitors should understand both engine and electrical theory, engine and equipment operation, diagnostic, failure analysis and repair and testing of engines and related power equipment as identified in the Standards and Competencies section following.
2. The competition will include a series of workstations to assess skill performance. The number of stations will be determined by the technical committee. Topics include:
  - a. General Competencies
  - b. Electrical Systems
  - c. Fuel and Governor Systems
  - d. Cooling and Lubrication Systems
  - e. Valves, Exhaust, and Engine Block Systems
  - f. Diagnostic and Failure Analysis
  - g. Shop Procedures
  - h. Business Operations
  - i. Mechanical and Hydraulic Systems

## **STANDARDS AND COMPETENCIES**

### **PET 1.0 — General Competencies**

- 1.1. Basic reading and comprehension
- 1.2. Understand basic two/four-stroke and compact diesel engine theory/troubleshooting
- 1.3. Understand fuel injection, carburetion, and other related fuel system theory.
- 1.4. Understand basic hydraulic and electrical theory
- 1.5. Read and interpret schematics for hydraulics and electrical systems
- 1.6. Understand mechanical/hydraulic drivetrains, steering, and braking systems
- 1.7. Communicate effectively to others
- 1.8. Demonstrate basic computer skills

### **PET 2.0 — Electrical Systems**

- 2.1. Understand and be able to inspect, test, repair, or replace the ignition, starting, and charging system components
- 2.2. Demonstrate the correct use of a multimeter
- 2.3. Understand common power equipment electrical circuit logic, i.e., safety interlock circuit, ignition interrupt circuits
- 2.4. Demonstrate the ability to test a troubleshoot electrical system components

- 2.5. Demonstrate the ability to troubleshoot common electrical system issues utilizing a wiring schematic and a multimeter
- 2.6. Identify and properly repair signs of corrosion or damage in electrical systems, i.e., pinched or cut wire, corroded, loose or broken connections

### **PET 3.0 —Fuel and Governor Systems**

- 3.1. Fuel Systems
  - 3.1.1. Explain the theory of operation and be able to inspect, service, and repair both diaphragm-type and float-type carburetors
  - 3.1.2. Inspect, service, and or repair various fuel system components such as; fuel regulators, filters, pumps, tanks, fuel lines, sensors, and solenoids
  - 3.1.3. Demonstrate the ability to test and troubleshoot fuel system components for both carbureted (float & diaphragm) and electronic fuel injection systems
  - 3.1.4. Test equipment-related fuel tanks, lines, and related systems and understand the procedures for testing for compliance systems as they are related to emission requirements and standards
- 3.2. Governor Systems
  - 3.2.1. Understand and be able to explain the various governor systems
  - 3.2.2. Inspect, service, adjust, and reassemble various governor systems
  - 3.2.3. Understand and be able to explain which components cause engines to increase or decrease in the number of revolutions per minute

### **PET 4.0 — Cooling and Lubrication Systems**

- 4.1. Cooling Systems
  - 4.1.1. Recognize, test, and troubleshoot both liquid and air-cooled cooling systems of both engines and equipment
  - 4.1.2. Understand and recognize signs of heat-related failures or problems
- 4.2. Lubricating Systems
  - 4.2.1. Define and understand the various styles and types of lubrication systems
  - 4.2.2. Demonstrate the ability to check oil levels and fuel/oil mixtures
  - 4.2.3. Demonstrate the method of checking oil pressurized systems with the use of required tools
  - 4.2.4. Understand and explain the various grades of oils and uses in the proper engines/equipment

### **PET 5.0 — Valves, Exhaust, and Engine Block Systems**

- 5.1. Valves
  - 5.1.1. Identify and be able to service various types and styles of valve train components; explain why the sealing function of these components is important
- 5.2. Exhaust Systems
  - 5.2.1. Identify the various types of exhaust systems and explain how they relate to the engine and or equipment
  - 5.2.2. Inspect and service exhaust and understand the procedures for testing for compliance systems as they are related to emission requirements and standards
- 5.3. Engine Block Components
  - 5.3.1. Understand, identify and provide the necessary service/repair techniques to the various manufacturers within the industry; this could include disassembly,

inspection and measuring of crankshafts, connecting rod bearings, journals, cylinders, pistons and rings

- 5.3.2. Complete repairs to correct torque of critical fasteners and replace any gaskets and sealants

### **PET 6.0 — Diagnostic and Failure Analysis**

- 6.1. Demonstrate the proper use of the various specialized tools of the industry. i.e., pressure and vacuum gauges, compression gauges, air leak down testers, multimeter, tachometer, spark tester, OEM diagnostic tool and software, and any other required tools
- 6.2. Demonstrate the ability to test crankcase vacuum/pressure, cylinder compression, spark, voltage drop, high resistance, and amperage testing
- 6.3. Analyze failed engine/equipment components to determine the correct type of failure; select the best method to repair and estimate the cost of repair

### **PET 7.0 — Shop Procedures**

- 7.1. Demonstrate the proper techniques in the care and use of tools and equipment
- 7.2. Demonstrate the ability to work accurately with precision instruments
- 7.3. Read, understand, and follow proper safety procedures; demonstrate the ability to use service, parts, and operation manuals as well as service bulletins
- 7.4. Perform tasks within assigned time limits
- 7.5. Give a verbal response to a customer and answer customer-related problematic questions
- 7.6. Prepare equipment for delivery

### **PET 8.0 — Business Operation**

- 8.1. Demonstrate the ability to look up proper part numbers by using paper or electronic means
- 8.2. Prepare both shop work orders and warranty claims
- 8.3. Demonstrate the ability to calculate costs accurately
- 8.4. Understand and operate equipment within equipment manufacturer's guidelines
- 8.5. Understand effective customer interaction and professional customer communications and relations

### **PET 9.0 — Mechanical and Hydraulic Systems**

- 9.1. Understand the theory of operation of transmissions, transaxles, steering, braking, and power take-off (PTO) components.
- 9.2. Disassemble and reassemble transmission, transaxle, steering, braking, and (PTO) power take-off components
- 9.3. Diagnose and repair potential problems with various transmission, transaxle, steering, braking, and Power take off (PTO)
- 9.4. Understand the different types of transmissions, transaxles, and hydraulic systems

## **PET 9.0 — 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. Please reference the graphic above, as you may be scored on specific elements applied to your project. For more, visit: [www.skillsusa.org/about/skillsusa-framework/](http://www.skillsusa.org/about/skillsusa-framework/).



## **ADDITIONAL RESOURCES AND NOTES**

Additional source material can be found on the manufacturers' websites or through the local central distributors, dealers, or associations. Those manufacturers and associations are:

- Briggs & Stratton Corp. — [www.briggsandstratton.com](http://www.briggsandstratton.com)
- Kohler Engines — [www.kohlerengines.com](http://www.kohlerengines.com)
- Equipment and Training Council — [www.etc.org](http://www.etc.org)
- ECHO — [www.echo-usa.com](http://www.echo-usa.com)
- Yamaha Golf-Car Company — [www.yamahagolfcar.com](http://www.yamahagolfcar.com)
- Miller Welders — [www.millerwelds.com](http://www.millerwelds.com)
- Oregon Products — [www.oregonproducts.com](http://www.oregonproducts.com)
- Tuff Torq — [www.tufftorq.com](http://www.tufftorq.com)
- Polaris — [Become a Technician | Polaris](http://www.polaris.com)

## **COMMITTEE IDENTIFIED ACADEMIC SKILLS**

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

### **Math Skills**

- Use proportions and ratios to solve practical problems.
- Use scientific notation.
- Solve practical problems involving percentages.
- Measure angles.
- Find surface area and perimeter of two-dimensional objects.
- Find volume and surface area of three-dimensional objects.
- Make predictions using knowledge of probability.
- Make comparisons, predictions and inferences using graphs and charts.
- Organize and describe data using matrices.
- Find slope of a line.

### **Science Skills**

- Plan and conduct a scientific investigation.
- Use knowledge of patterns of cellular organization (cells, tissues, organs, systems).
- Describe basic needs of organisms.

- Describe and recognize elements, compounds, mixtures, acids, bases and salts.
- Describe and recognize solids, liquids and gases.
- Describe characteristics of types of matter based on physical and chemical properties.
- Use knowledge of classification of elements as metals, metalloids and nonmetals.
- Describe and demonstrate simple compounds (formulas and the nature of bonding).
- Understand Law of Conservation of Matter and Energy.
- Predict chemical changes to matter (types of reactions, reactants and products; and balanced equations).
- Use knowledge of potential and kinetic energy.
- Use knowledge of mechanical, chemical and electrical energy.
- Use knowledge of heat, light and sound energy.
- Use knowledge of temperature scales, heat and heat transfer.
- Use knowledge of sound and technological applications of sound waves.
- Use knowledge of the nature and technological applications of light.
- Use knowledge of speed, velocity and acceleration.
- 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.
- Use knowledge of principles of electricity and magnetism.
- Use knowledge of static electricity, current electricity and circuits.
- Use knowledge of magnetic fields and electromagnets.
- Use knowledge of motors and generators.

### **Language Arts Skills**

- Provide information in conversations and in group discussions.
- Provide information in oral presentations.
- 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.
- Analyze mass media messages.
- Demonstrate comprehension of a variety of informational texts.
- Use text structures to aid comprehension.
- Identify words and phrases that signal an author's organizational pattern to aid comprehension.
- Understand source, viewpoint and purpose of texts.
- Organize and synthesize information for use in written and oral presentations.
- Demonstrate knowledge of appropriate reference materials.
- Use print, electronic databases and online resources to access information in books and articles.
- Demonstrate narrative writing.
- Demonstrate persuasive writing.
- 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
- Measurement
- Problem Solving
- Reasoning and Proof
- Communication
- Connections
- Representation

*Source: NCTM Principles and Standards for School Mathematics. For more information, visit: [www.nctm.org](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.

*Source: McREL compendium of national science standards. To view and search the compendium, visit: [www2.mcrel.org/compendium/browse.asp](http://www2.mcrel.org/compendium/browse.asp).*