

# MARINE SERVICE TECHNOLOGY BLUEPRINT

This Blueprint contains the subject matter content of this Skill Connect Assessment. This Blueprint does **NOT** contain the information one would need to fully prepare for a SkillsUSA Championships contest. Please refer to the *SkillsUSA Championships Technical Standards* CD-ROM for the current year or purchase and download the relevant "Contest Singles." Both are available through [www.skillsusa.org](http://www.skillsusa.org) > Shop > Educational Materials Catalog.

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## Standards and Competencies

### Demonstrate general shop practices

- Establish proper shop safety tool and equipment procedures
- Apply MSDS and procedures specific to the workplace environment
- Recognize and utilize proper personnel protection related to marine service and repair procedures
- Follow HAZMAT storage and disposal requirements

### Utilize marine engine components and theory of operation

- Apply knowledge of four-cycle gasoline-fueled engines:
  - Employ the principles of operation of a four-stroke gasoline-fueled engine
  - Identify internal components of a typical marinized four-cycle gasoline-fueled engine and describe how the components interact during the four cycles
- Demonstrate knowledge of four-stroke diesel engines.
  - Differentiate between the diesel and gasoline-fueled four-cycle
  - Differentiate between compression ignitions and spark ignitions
  - Perform valve adjustment procedures on overhead valve and pushrod engine
  - Perform valve adjustment on overhead cam engine
  - Utilize precision measuring instruments such as micrometers, dial indicators, vernier calipers and feeler gauges
- Understand two-cycle outboard engines.
  - Demonstrate principles of operation of a two-stroke outboard engine
  - Identify internal components of a typical two-stroke outboard engine and describe how the components interact with each other to achieve proper engine operation

### Display knowledge of industry standards related to engine installations

- Identify relevant American Boat and Yacht Council Standards as they apply to inboard engine installations. Specifically, these are engine control systems, belt guards and oil sump design, and fuel and exhaust system requirements recommended by the ABYC and the U.S. Code of Federal Regulations (CFRs)

### Exhibit knowledge of marine electrical systems

- Apply basic electrical theory, circuit design and application
- Use a digital multi-meter (DMM) to perform electrical troubleshooting procedures such as voltage and amperage measurements, as well as to test for electrical continuity and measure electrical resistance values
- Follow electrical system installation requirements as recommended by the ABYC and mandated by the U.S. Coast Guard's CFR specific to recreational boats, particularly in regard to battery installations, over-current protection requirements, ignition protection requirements and accepted wire sizing techniques for both AC and DC marine systems
- Terminate wire connections using the proper techniques
- Demonstrate knowledge of ABYC requirements for proper wire support and chafe protection
- Demonstrate circuit troubleshooting procedures

- Examine engine starting systems
- Assess battery condition
- Monitor engine ignition system
- Check battery charging systems
- Read and utilize wiring diagrams and follow troubleshooting flow charts to diagnose electrical system problems

#### **Utilize knowledge of marine fuel system services**

- Identify fuel system components and their functions in the system
  - Disassemble, clean and replace, and adjust standard carburetor internal components associated with an overhaul
  - Perform fuel system pressure tests on both carbureted and fuel injected fuel systems
  - Properly mix fuel stabilization additives and prepare fuel systems for extended lay-up

#### **Demonstrate knowledge of marine cooling systems**

- Identify raw water and closed cooling system component functions on a variety of marinized engines
- Access water pump assemblies on outboard and inboard/outboard engines
- Remove service and install water pumps on same
- Overhaul a conventional raw water pump on an inboard engine assembly
- Identify the need for sacrificial anodes in raw water cooling systems
- Identify correct procedures for cooling system anode selection and replacement
- Determine engine coolant condition and freeze level protection level
- Differentiate between ethylene glycol and propylene glycol anti-freeze and where each must be used
- Identify heat exchanger design and service procedures
- Replace and properly adjust engine drive belts, both v and serpentine types
- Determine proper thermostat operation and replacement if required
- Utilize an infrared heat sensing gun to track coolant flow through engine and heat exchangers and explain temperature readings as they relate to the cooling system's condition
- Pressure test cooling systems and coolant recovery container caps to locate potential leaks and proper pressure rating of container caps

#### **Apply knowledge of lubrication systems**

- Classify engine oil ratings as established by the American Petroleum Institute (API)
- Determine engine oil quantity and type recommended using engine workshop manuals
- Change engine oil and filter following manufacturer's recommendations for the engine
- Determine maintenance interval adjustments or excessive component wear by an analysis of a lubrication lab
  - Interpret an oil analysis report and describe potential internal component faults to both engines and gear units

#### **Exhibit knowledge of gear drive systems, inboard and outboard**

- Demonstrate knowledge of power flow through a manual inboard engine reverse gear assembly in both forward and reverse operation
- Explain why gear ratios vary from one installation to another
- Distinguish between gear and bearing types and the advantages/ disadvantages of different types in torque and load handling capabilities
- Demonstrate knowledge of inboard engine propeller shaft alignment techniques and acceptable tolerances based on engine shaft sizes
- Relate knowledge of power flow through an outboard engine from power head to propeller
- Disassemble and reassemble an outboard engine lower unit/drive assembly using manufacturer-supplied special tools and manuals
- Take measurements using precision measurement tools such as dial indicators and micrometers according to manufacturer workshop manual instructions
- Contrast a power flow through a typical inboard/outboard upper and lower unit drive assembly

- Perform pressure and vacuum tests to an IO gear drive unit to determine seal integrity
- Disassemble and reassemble an IO drive assembly following correct manufacturer procedures and using manufacturer supplied special tools and manuals

#### **Service and repair boat and trailer rigging**

- Properly wire boat trailer and connect to various vehicle types
- Establish trailer tongue weight and match to vehicle capacity
- Service trailer wheel bearings and ensure proper lubrication
- Service trailer braking systems

#### **Service and repair marine sanitation systems**

- Identify marine sanitation system types and their application in accordance with EPA standards and regional laws
- Identify pump types used in marine sanitation systems and the advantages and disadvantages of each type for a specific application
- Disassemble and reassemble a typical marine head piston type pump system and replace key pump components as needed
- Demonstrate knowledge of typical type-3 marine sanitation system installation including all components such as through-hull valves, anti-siphon valves and holding tanks

#### **Demonstrate knowledge of marine materials, composites, woodworking and metalworking**

- Identify modern composite materials used in boat construction and repair
  - Identify composite cloth material types (fiberglass, Kevlar, carbon fiber) and the application of each in marine construction or repair procedures
  - Identify the characteristics of the various cloth materials used in laminate construction and repair
- Distinguish between three primary resin types (polyester, vinylester, epoxy) and the characteristics of each as they apply to specific applications
  - Practice safe storage and use of the various resin types
  - Recognize catalyzation procedures for the various resin types and the use of ratios and proportions for mixing of same to ensure proper curing and pot life while working
  - Identify core materials used in composite construction and the advantages/disadvantages of each type for a given application
- Recognize various marine woods used in marine construction and the characteristics of each type for a specific application
- Identify proper hand and power tools used to cut and shape marine woods, as well as safety practices specific to each of the tools commonly used such as table saws, band saws, jig saws and power sanding equipment
- Measure properly in order to build small wooden cabinets and shelving as is common to marine applications
- Identify safe and effective use of metal working equipment such as drill presses, band saws, hand drills and taps and die sets used for threading metal
- Demonstrate knowledge of marine metal applications and the susceptibility of common stainless steel, aluminum, mild steel and bronze metals to various types of corrosion such as crevice, poulitice, galvanic and stray current

#### **Model proper customer service/employability skills**

- Recognize proper boat care while conducting service procedures
- Demonstrate basic warranty procedures related to dealer installed equipment
- Complete a standard work order form and gather necessary service related information before work is performed
- Communicate effectively in written and verbal form with customers relative to service procedures either recommended or performed

- Demonstrate professionalism in appearance (proper attire) and work habits such as promptness and adhering to a schedule and deadlines

**Demonstrate professional development skills in a simulated customer-service or employment situation. Examples may include:**

- Job interview
- Customer service scenario
- Communications
- Decision making, problem solving and/or critical thinking

### **Committee Identified Academic Skills**

The SkillsUSA national technical committee has identified that the following academic skills are embedded in the marine service technology training program and assessment:

#### **Math Skills**

- Use fractions to solve practical problems
- Use proportions and ratios to solve practical problems
- Simplify numerical expressions
- Solve practical problems involving percents
- 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
- Solve problems using proportions, formulas and functions
- Find slope of a line

#### **Science Skills**

- Use knowledge of mechanical, chemical and electrical energy
- Use knowledge of temperature scales, heat and heat transfer
- 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 verbal communication skills: word choice, pitch, feeling, tone and voice
- Demonstrate use of nonverbal communication skills: eye contact, posture and gestures using interviewing techniques to gain information
- Demonstrate comprehension of a variety of informational texts
- Use text structures 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

## 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
- Communication
- Connections
- Representation

**Source:** NCTM Principles and Standards for School Mathematics. To view high school standards, visit: [standards.nctm.org/document/chapter7/index.htm](http://standards.nctm.org/document/chapter7/index.htm). Select “Standards” from menu.

### Science Standards

- Understands relationships among organisms and their physical environment
- 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: [www.mcrel.org/standards-benchmarks/](http://www.mcrel.org/standards-benchmarks/).

### Language Arts Standards

- Students read a wide range of print and nonprint texts to build an understanding of texts, of themselves and of the cultures of the United States and the world; to acquire new information; to respond to the needs and demands of society and the workplace; and for personal fulfillment. Among these texts are fiction and nonfiction, classic and contemporary works
- 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 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 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.readwritethink.org/standards/index.html](http://www.readwritethink.org/standards/index.html).