



## INDUSTRIAL MOTOR CONTROL



SkillsUSA Championships Technical Standards

### PURPOSE

To evaluate each competitor's preparation for employment and to recognize outstanding students for excellence and professionalism in the field of industrial motor controls.

### ELIGIBILITY

Open to active SkillsUSA members enrolled in programs with industrial motor control as an occupational objective.

### CLOTHING REQUIREMENT

#### **Class C: Competition Specific — Manufacturing/Construction Khaki Attire**

- Official SkillsUSA khaki short-sleeve work shirt
- Khaki pants
- Black, brown, or tan work shoes

*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.

### EQUIPMENT AND MATERIALS

1. Supplied by the technical committee:
  - a. All tools for the competition, including hand tools, power tools, and meters, will be provided. Competitors do not need to bring their own tools.
  - b. All wiring panels, electrical supplies and materials as required by the problem assigned.

2. Supplied by the competitor:
  - a. Safety glasses
  - b. Latest edition of the National Electrical Code® (NEC®). Ugly’s, the NEC® Handbook, and keyword indexes are not permitted.
  - c. All competitors must create a one-page resume. See “Resume Requirement” below for guidelines.

**Note:** Hardhats are not required. 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.)

## **RESUME REQUIREMENT**

Competitors must create a one-page resume to submit online. SkillsUSA South Carolina competitors should submit their resume by the deadline published on the competition updates page of our website. 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 state website.

## **PROHIBITED DEVICES**

Cellphones, electronic watches and/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 Director of the SkillsUSA Championships. If confirmed that the competitor used the device in a manner which compromised the integrity of the competition, the competitor’s scores may be removed.

## SCOPE OF THE COMPETITION

The competition is defined by manufacturer and customer specifications, industry practice, federal regulations, and industry standards such as the National Electrical Code. The competition is divided into three parts: a written portion; an oral interview; and a series of testing stations designed to demonstrate knowledge of manufacturer and customer specifications, industry practice, federal regulations, and industry standards. Students are also judged on the ability to apply both that knowledge and manual proficiency in applying and installing electrical wiring methods and equipment.

### KNOWLEDGE PERFORMANCE

The competition will include a written knowledge exam that will be administered during the competitors' orientation meeting. Competitors are required to take the SkillsUSA Professional Development Test.

The competition will also include written descriptions of required electrical installations and/or job sheets with schematic diagrams and accompanying requirements for wiring an industrial motor control installation. The purpose will be to select and install the wiring methods, devices, and equipment to complete the specified installation. All work must conform to the specifications of the latest edition of the National Electrical Code as of the January prior to the SkillsUSA Championships.

### SKILL PERFORMANCE

The competition will include a series of testing stations designed to test the ability to perform jobs or skills selected from the following list of competencies as determined by the SkillsUSA Championships technical committee.

### STANDARDS AND COMPETENCIES

#### **MOTR 1.0 — Demonstrate knowledge/application of basic academic, physical and employability skills**

- 1.1. Demonstrate ability to read and comprehend
  - 1.1.1. Explain the meaning of safety rules and signs
  - 1.1.2. Summarize instruction sheets for tools and equipment
  - 1.1.3. Explain technical documents, codes and standards, customer and manufacturer instructions and specifications
  - 1.1.4. Use graphs, charts and diagrams
- 1.2. Demonstrate ability to perform basic mathematical operations necessary to the occupation
  - 1.2.1. Perform addition, subtraction, multiplication and division of whole numbers, fractions, decimals, mixed numbers, ratios and percentages
  - 1.2.2. Convert square units and English and metric units
  - 1.2.3. Perform direct measurements of objects and distances
  - 1.2.4. Use basic algebra, calculate degrees and angles, and compute area and volume
  - 1.2.5. Read, interpret and perform math operations based on word problems

- 1.3. Use verbal, written and nonverbal communication skills
  - 1.3.1. Explain and use verbal instructions and warnings
  - 1.3.2. Communicate orally with others
  - 1.3.3. Communicate in writing with others
- 1.4. Demonstrate physical ability through the installation and operation of equipment
  - 1.4.1. Ensure ability to hear warning signals
  - 1.4.2. Verify ability to distinguish colors
  - 1.4.3. Maintain, balance and perform construction activities while on a ladder
  - 1.4.4. Use both hands to manipulate small objects and wires
  - 1.4.5. Operate two-handed power equipment
  - 1.4.6. Lift and carry objects up to 50 pounds
  - 1.4.7. Reach and stretch to position equipment while maintaining balance
- 1.5. Implement employability skills and workplace attributes to work independently and with a team
  - 1.5.1. Apply ability to be self-motivated, responsible and dependable without close supervision
  - 1.5.2. Demonstrate the ability to work smoothly with others as a team
  - 1.5.3. Demonstrate ability to remain calm in emergency situations
  - 1.5.4. Maintain good working relationships with others in a work setting
  - 1.5.5. Develop alternate solutions and choose the best alternative
  - 1.5.6. Plan and organize tasks to meet deadlines
  - 1.5.7. Implement the ability to supervise and monitor others

**MOTR 2.0 — Follow OSHA rules and safety regulations to ensure job site and equipment safety**

- 2.1. Apply job site and shop rules and regulations (OSHA)
- 2.2. Select and use electrical and hand tools correctly
- 2.3. Perform proper techniques and practices for working on and around live equipment
- 2.4. Apply knowledge of proper grounding methods

**MOTR 3.0 — Apply knowledge of the National Electric Code**

- 3.1. Read and interpret the National Electrical Code
- 3.2. Demonstrate ability to apply National Electrical Code requirements

**MOTR 4.0 — Interpret and draw wiring and ladder diagrams**

- 4.1. Draw wiring diagrams and ladder diagrams
- 4.2. Interpret wiring diagrams and ladder diagrams
- 4.3. Read and understand customer job specifications

**MOTR 5.0 — Read and interpret written and oral customer and manufacturer specifications/instructions**

**MOTR 6.0 — Perform electrical calculations including sizing of circuits and conductors, and calculate conduit fill**

- 6.1. Size branch circuit conductors
- 6.2. Size feeder conductors
- 6.3. Size control conductors
- 6.4. Size overcurrent protection for branch circuit

- 6.5. Size overcurrent protection for feeder circuit
- 6.6. Size overloads protection
- 6.7. Calculate conduit fill

**MOTR 7.0 — Select materials and equipment to meet customer needs**

- 7.1. Select materials and equipment based on manufacturer and customer specifications/instructions, wiring and ladder diagrams, calculations, and applicable codes and standards

**MOTR 8.0 — Select and use hand, electrical and cutting tools properly**

- 8.1. Demonstrate dexterity and proper use of hand tools
- 8.2. Demonstrate the ability to properly select and use electrical ohmmeters and volt-ohmmeters
- 8.3. Select and properly use special equipment (conduit benders, KO punches, etc.)
- 8.4. Properly select and operate electrical power tools
- 8.5. Properly select and use conduit cutting and reaming equipment

**MOTR 9.0 — Lay out components on mounting boards based upon customer specifications**

**MOTR 10.0 — Select and install proper wiring methods, boxes and enclosures**

- 10.1. Select the proper wiring methods, boxes and enclosures based on manufacturer and customer specifications, wiring/ladder diagrams and applicable codes and standards
- 10.2. Install the selected wiring methods
- 10.3. Mount boxes and enclosures according to manufacturer and customer specifications and instructions, federal regulations, and applicable codes and standards
- 10.4. Bend and install raceways using the proper tools and supplies

**MOTR 11.0 — Demonstrate the ability to properly install and connect devices and equipment**

- 11.1. Install and connect disconnect switches
- 11.2. Install and connect push buttons
- 11.3. Install and connect selector switches
- 11.4. Install and connect indicator lights
- 11.5. Install and connect limit switches
- 11.6. Install and connect control transformers
- 11.7. Install and connect control relays
- 11.8. Install and connect timing relays (all types)
- 11.9. Install and connect contractors
- 11.10. Install and connect motor starters
- 11.11. Install and connect photoelectric switches
- 11.12. Install and connect temperature control
- 11.13. Install and connect counters
- 11.14. Install and connect overload relays
- 11.15. Install and connect solid-state motor starters
- 11.16. Install, connect, and properly wire a dual-voltage motor
- 11.17. Install and connect reversing motor starters
- 11.18. Install and connect press-to-test pilot lights

## **MOTR 12.0 — Troubleshoot and repair power and control circuits**

- 12.1. Use a wiring diagram or ladder diagram, and an electrical multimeter
- 12.2. Demonstrate the ability to troubleshoot a fault in either a power or control circuit

## **MOTR 13.0 — Complete necessary job tickets, reports and as-built drawings**

- 13.1. Demonstrate the ability to prepare necessary job tickets, reports and as-built drawings as directed by your supervisor

## **MOTR 14.0 — 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, as you may be scored on specific elements applied to your project. For more, visit: [www.skillsusa.org/who-we-are/skillsusa-framework/](http://www.skillsusa.org/who-we-are/skillsusa-framework/).



## **COMMITTEE IDENTIFIED ACADEMIC SKILLS**

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

### **Math Skills**

- Use fractions to solve practical problems
- Use proportions and ratios to solve practical problems
- Simplify numerical expressions
- Use scientific notation
- Solve practical problems involving percentages
- Solve single variable algebraic expressions
- Measure angles
- Find surface area and perimeter of two-dimensional objects
- Find volume and surface area of three-dimensional objects
- Construct three-dimensional models
- Apply Pythagorean Theorem
- Solve problems using proportions, formulas and functions
- Use laws of exponents to perform operations

### **Science Skills**

- 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
- 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
- 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
- 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. 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/](http://www2.mcrel.org/compendium/).*

### **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 employ a wide range of strategies as they write and use different writing process elements appropriately to communicate with different audiences for a variety of purposes.
- Students apply knowledge of language structure, language conventions (e.g., spelling and punctuation), media techniques, figurative language and genre to create, critique and discuss print and nonprint texts.
- Students conduct research on issues and interests by generating ideas and questions, and by posing problems. They gather, evaluate and synthesize data from a variety of sources (e.g., print and nonprint texts, artifacts, people) to communicate their discoveries in ways that suit their purpose and audience.
- 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.ncte.org/standards](http://www.ncte.org/standards).*