

## ELECTRICAL II

### COURSE DESCRIPTION

*Electrical II* is a course in which students will learn and practice intermediate skills related to electrical systems, with emphasis on commercial systems. Topics covered include overcurrent protection; sizing conductors; lighting systems; three-phase motors; motor control circuits; sizing raceways, boxes, and fittings; and connecting distribution transformers, including a laboratory experience conducted in a shop environment that supports electrical assembly projects by students. This course gives students a substantial skill and knowledge foundation typically required for apprentice electricians.

*It is strongly recommended that administration and guidance follow the scope and sequence and course recommendations as listed.*

<b>Recommended:</b>	Construction Core, Electrical I, Algebra I, Principles of Technology I or Physical Science, Geometry
<b>Recommended Credits:</b>	2
<b>Recommended Grade Level(s):</b>	12 <sup>th</sup>
<b>Number of Competencies in Course:</b>	107

## **ELECTRICAL II**

### **STANDARDS**

- 1.0** Students will demonstrate leadership, citizenship, and teamwork skills required for success in the school, community, and workplace.
- 2.0** Students will assume responsibility for the safety of themselves, their coworkers, and bystanders.
- 3.0** Students will demonstrate a working knowledge of alternating current.
- 4.0** Students will demonstrate a knowledge of the theory and application of motors.
- 5.0** Students will recognize types and uses of different lighting.
- 6.0** Students will practice and become proficient in bending conduit.
- 7.0** Students will be able to identify and properly use pull and junction boxes.
- 8.0** Students will be able to pull cable and describe the installation of conductors.
- 9.0** Students will describe and properly select cable trays.
- 10.0** Students will be able to perform proper conductor terminations and splices.
- 11.0** Students will explain the purpose of grounding and bonding.
- 12.0** Students will explain the purpose of circuit breakers and fuses.
- 13.0** Students will describe the operating principles of contactors and relays.

## **ELECTRICAL II**

### **STANDARD 1.0**

Students will demonstrate leadership, citizenship, and teamwork skills required for success in the school, community, and workplace.

### **LEARNING EXPECTATIONS**

The student will:

- 1.1** Demonstrate leadership skills.
- 1.2** Use problem-solving techniques to address and propose solutions to school, community, and workplace problems.
- 1.3** Demonstrate the ability to work professionally with others.
- 1.4** Participate in SkillsUSA as an integral part of instruction.
- 1.5** Exhibit integrity and pride in the practice and quality of work.

### **PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET**

The student:

- 1.1A** Uses critical-thinking and consensus building skills in group deliberations.
- 1.1B** Keeps group work focused on task.
- 1.2A** Determines the root causes of observed conflicts or problems.
- 1.2B** Mediates disputes between parties.
- 1.3A** Participates in a job shadowing experience.
- 1.3B** Assembles a student team to solve an assigned problem.
- 1.4** Attends and participates in periodic meetings of SkillsUSA or similar organization.
- 1.5** Exhibits integrity and pride in the practice and quality of work.

### **SAMPLE PERFORMANCE TASKS**

These are sample projects of the type and scale recommended to address one or more of the learning expectations for this standard. Other projects can be used at the instructor's discretion.

- Participate in various SkillsUSA or similar programs and/or competitive events.
- Attend a professional organization meeting, such as local Chamber of Commerce meeting.
- Participate in the American Spirit Award competition with SkillsUSA.
- Participate in job shadowing or internship program with local business or industry.
- Take an active role in a group project assigned by the instructor.
- Identify and detail a problem area in the school, community, or workplace, and propose solutions. If possible, and with appropriate approvals, implement or facilitate the solution.

## **INTEGRATION LINKAGES**

SkillsUSA *Professional Development Program* (PDP), SkillsUSA, Communications and Writing Skills, Teambuilding Skills, Research, Language Arts, Sociology, Psychology, Algebra, Geometry, English, Social Studies, Problem Solving, Interpersonal Skills, Employability Skills, Critical-Thinking Skills, MAVCC, SCANS (Secretary's Commission on Achieving Necessary Skills), Chamber of Commerce, Colleges, Universities, Technology Centers, and Employment Agencies

## **ELECTRICAL II**

### **STANDARD 2.0**

Students will assume responsibility for the safety of themselves, their coworkers, and bystanders.

### **LEARNING EXPECTATIONS**

The student will:

- 2.1** Exhibit and encourage in others a positive attitude regarding safety practices and issues.
- 2.2** Habitually inspect and use appropriate personal protective equipment for assigned tasks.
- 2.3** Inspect, maintain, and employ safe operating procedures with tools and equipment, such as scaffolding, lifting equipment, and air-powered drivers.
- 2.4** Exhibit a well-developed awareness of potential hazards to self and others.
- 2.5** Carry out responsibilities under HazCom (Hazard Communication) regulations.
- 2.6** Take action to protect coworkers and bystanders from hazards as required by regulations and Occupational Safety and Health Administration (OSHA) policies.
- 2.7** Report accidents and observed hazards and execute emergency response procedures as required by regulations and Occupational Safety and Health Administration (OSHA) policies.
- 2.8** Demonstrate appropriate construction-related safety procedures.
- 2.9** Pass with 100 % accuracy a written examination relating specifically to electrical safety issues
- 2.10** Pass with 100% accuracy a performance examination relating to electrical tools and equipment.
- 2.11** Maintain a portfolio record of written safety examinations and equipment examinations for which the student has passed an operational checkout by the instructor.

### **PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET**

The student:

- 2.1A** Includes safety procedures in activity plans.
- 2.1B** Exhibits an awareness of proper safety procedures by coworkers.
- 2.1C** Responds positively to instruction, advice, and correction regarding safety issues.
- 2.1D** Reports to school or work physically ready to perform to professional standards, such as rested or not impaired by medications, drugs, alcohol.
- 2.2** Selects, inspects, and uses the correct personal protective equipment for the assigned task.
- 2.3A** Checks scaffolding for stability, bracing, walk boards, and guard rails prior to use.
- 2.3B** Inspects extension cords for the presence of a functional ground connection, prior to use.
- 2.4A** Is observant of personnel and activities in the vicinity of the work area.
- 2.4B** Warns nearby personnel, prior to starting potentially hazardous actions
- 2.5A** Applies information from material safety data sheet (MSDS) to protect self and others from the health hazards associated with assigned tasks.

- 2.5B** Reports hazards found on the job site to the supervisor and remedies the hazard as instructed.
- 2.6A** Warns and protects workers and bystanders of overhead loads in transit.
- 2.6B** Provides and activates adequate ventilation equipment as required by the task.
- 2.7A** Reports all injuries and observed unguarded hazards to the immediate supervisor.
- 2.7B** Executes assigned tasks as described in emergency response procedures.
- 2.8A** Is observant of safety issues and concerns relevant to the construction industry
- 2.8B** Complies with all safety guidelines and regulations set forth by industry and Occupational Safety and Health Administration (OSHA).
- 2.9** Passes with 100 % accuracy a written examination relating specifically to electrical safety issues.
- 2.10** Passes with 100% accuracy a performance examination relating specifically to electrical tools and equipment safety.
- 2.11** Maintains a portfolio record of written safety examinations and equipment examinations for which the student has passed an operational checkout by the instructor.

### **SAMPLE PERFORMANCE TASKS**

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- Prior to assigning a task using power tools, the instructor removes some required safety items and instructs students to perform an inspection of tools.
- Instruct a visitor to obviously approach the vicinity of a student conducting a hazardous activity and note the level of awareness demonstrated by the student.
- In a project requiring solvents or adhesives, introduce a new brand or type and require students to retrieve the MSDS and identify possible health hazards.

### **INTEGRATION LINKAGES**

Science, Computer Skills, Research and Writing Skills, Language Arts, Communication Skills, Leadership Skills, Teamwork Skills, English, Algebra, Geometry, Secretary's Commission on Achieving Necessary Skills (SCANS), SkillsUSA, Associated Builders and Contractors (ABC), Associated General Contractors (AGC), National Center for Construction Education and Research (NCCER), Occupational Safety and Health Administration (OSHA), Environmental Protection Agency (EPA), United States Department of Labor, Tennessee Department of Labor and Workforce Development, International Brotherhood of Electrical Workers (IBEW)

## **ELECTRICAL II**

### **STANDARD 3.0**

Students will demonstrate a working knowledge of alternating current.

## **LEARNING EXPECTATIONS**

The student will:

- 3.1 Calculate the peak and effective voltage or current values for an AC waveform.
- 3.2 Calculate the phase relationship between two AC waveforms.
- 3.3 Describe the voltage and current phase relationship in a resistive AC circuit.
- 3.4 Describe the voltage and current transients that occur in an inductive circuit.
- 3.5 Define inductive reactance and state how it is affected by frequency.
- 3.6 Describe the voltage and current transients that occur in a capacitive circuit.
- 3.7 Define capacitive reactance and state how it is affected by frequency.
- 3.8 Explain the relationship between voltage and current in the following types of AC circuits:
  - RL circuit
  - RC circuits
  - LC circuits
  - RLC circuits
- 3.9 Explain the following terms as they relate to AC circuits:
  - True power
  - Apparent power
  - Reactive power
  - Power factor
- 3.10 Explain basic transformer action.

## **PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET**

The student:

- 3.1 Calculates the peak and effective voltage or current values for an AC waveform.
- 3.2 Calculates the phase relationship between two AC waveforms.
- 3.3 Describes the voltage and current phase relationship in a resistive AC circuit.
- 3.4 Describes the voltage and current transients that occur in an inductive circuit.
- 3.5 Defines inductive reactance and state how it is affected by frequency.
- 3.6 Describes the voltage and current transients that occur in a capacitive circuit.
- 3.7 Defines capacitive reactance and state how it is affected by frequency.

## **INTEGRATION LINKAGES**

Science, Computer Skills, Research and Writing Skills, Language Arts, Communication Skills, Leadership Skills, Teamwork Skills, English, Algebra, Geometry, Secretary's Commission on Achieving Necessary Skills (SCANS), SkillsUSA, Associated Builders and Contractors (ABC), Associated General Contractors (AGC), National Center for Construction Education and Research (NCCER), Occupational Safety and Health Administration (OSHA), Environmental Protection Agency, United States Department of Labor, Tennessee Department of Labor and Workforce Development, International Brotherhood of Electrical Workers

## **ELECTRICAL II**

### **STANDARD 4.0**

Students will demonstrate a knowledge of the theory and application of motors.

## **LEARNING EXPECTATIONS**

The student will:

- 4.1 Define the following terms:
  - Controller
  - Duty cycle
  - Full-load amps
  - Interrupting rating
  - Thermal protection
  - NEMA design
  - Over current
  - Overload
  - Power factor
  - Rated full-load speed
  - Rated horsepower
  - Service factor
- 4.2 Describe the various types of motor enclosures.
- 4.3 Explain the relationships among speed, frequency, and the number of poles in a three-phase induction motor.
- 4.4 Define percent slip and speed regulation.
- 4.5 Explain how the direction of a three-phase motor is changed.
- 4.6 Describe the component parts and operating characteristics of a three-phase wound-rotor induction motor.
- 4.7 Describe the component parts and operating characteristics of a three-phase synchronous motor.
- 4.8 Describe the design and operating characteristics of various DC motors.
- 4.9 Describe the methods for determining various motor connections.
- 4.10 Describe general motor protection requirements as delineated in the (NEC).
- 4.11 Define the braking requirements for AC and DC motors.
- 4.12 Explain how the direction of a DC motor is changed.
- 4.13 Describe the design and characteristics of a DC shunt, series, and compound motor.
- 4.14 Describe dual voltage motors and their applications.
- 4.15 Describe the methods for determining various motor connections.
- 4.16 Describe general motor protection requirements as delineated in the NEC.

## **PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET**

The student:

- 4.1 Collect data from a motor nameplate.
- 4.2 Identify various types of motors and their applications.
- 4.3 Connect the terminals for a dual-voltage motor.

## **SAMPLE PERFORMANCE TASKS**

These are sample projects of the type and scale recommended to address one or more of the learning expectations for this standard. Other projects can be used at the instructor's discretion.

## **INTEGRATION LINKAGES**

Science, Computer Skills, Research and Writing Skills, Language Arts, Communication Skills, Leadership Skills, Teamwork Skills, English, Algebra, Geometry, Secretary's Commission on Achieving Necessary Skills (SCANS), SkillsUSA, Associated Builders and Contractors (ABC), Associated General Contractors (AGC), National Center for Construction Education and Research (NCCER), Occupational Safety and Health Administration (OSHA), Environmental Protection Agency, United States Department of Labor, Tennessee Department of Labor and Workforce Development, International Brotherhood of Electrical Workers

## **ELECTRICAL II**

### **STANDARD 5.0**

Students will recognize types and uses of different lighting.

### **LEARNING EXPECTATIONS**

The student will:

**5.1** Describe the characteristics of light.

- 5.2 Recognize the different kinds of lamps and explain the advantages and disadvantages of each type:
  - Incandescent
  - Halogen
  - Fluorescent
  - High intensity discharge (HID)
- 5.3 Properly select and install various lamps in lighting fixtures.
- 5.4 Recognize and describe the installation requirements for various types of lighting fixtures.
- 5.5 Recognize ballasts and describe their use in fluorescent and HID lighting fixtures.
- 5.6 Explain the relationship of Kelvin temperature to the color of light produced by a lamp.
- 5.7 Recognize basic occupancy sensors, photoelectric sensors, and timers used to control lighting circuits and describe how each device operates.

### **PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET**

The student:

- 5.1 Read and interpret information given in lamp manufacturers' catalogs for one or more selected lamps.
- 5.2 Properly select and install lamps into lighting fixtures.
- 5.3 Install one or more of the following lighting fixtures:
  - Surfaced-mounted
  - Recessed
  - Suspended
  - Track-mounted

### **SAMPLE PERFORMANCE TASKS**

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### **INTEGRATION LINKAGES**

Science, Computer Skills, Research and Writing Skills, Language Arts, Communication Skills, Leadership Skills, Teamwork Skills, English, Algebra, Geometry, Secretary's Commission on Achieving Necessary Skills (SCANS), SkillsUSA, Associated Builders and Contractors (ABC), Associated General Contractors (AGC), National Center for Construction Education and Research (NCCER), Occupational Safety and Health Administration (OSHA), Environmental Protection Agency, United States Department of Labor, Tennessee Department of Labor and Workforce Development, International Brotherhood of Electrical Workers



## **ELECTRICAL II**

### **STANDARD 6.0**

Students will practice and become proficient in bending conduit.

### **LEARNING EXPECTATIONS**

The student will:

- 6.1** Bend offsets, kicks, saddles, segmented, and parallel bends.
- 6.2** Explain the requirements of the NEC for bending conduit.
- 6.3** Compute the radius, degrees in bend, developed length, and gain for a conduit up to six inches.

### **PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET**

The student:

- 6.1** Make an offset in a length of conduit to miss a 10" high obstruction with a clearance between the obstruction and the conduit of not less than 1" nor more than 1 1/2".
- 6.2** Make a saddle in a length of conduit to cross an 8" pipe with 1" clearance between the pipe and the conduit.

### **SAMPLE PERFORMANCE TASKS**

These are sample projects of the type and scale recommended to address one or more of the learning expectations for this standard. Other projects can be used at the instructor's discretion.

Follow the performance tasks in the test booklet

### **INTEGRATION LINKAGES**

Science, Computer Skills, Research and Writing Skills, Language Arts, Communication Skills, Leadership Skills, Teamwork Skills, English, Algebra, Geometry, Secretary's Commission on Achieving Necessary Skills (SCANS), SkillsUSA, Associated Builders and Contractors (ABC), Associated General Contractors (AGC), MAVCC, National Center for Construction Education and Research (NCCER), Occupational Safety and Health Administration (OSHA), Environmental Protection Agency, United States Department of Labor, Tennessee Department of Labor and Workforce Development, International Brotherhood of Electrical Workers

## **ELECTRICAL II**

### **STANDARD 7.0**

Students will be able to identify and properly use pull and junction boxes.

### **LEARNING EXPECTATIONS**

The student will:

- 7.1** Describe the different types of nonmetallic and metallic pull and junction boxes.
- 7.2** Properly select, install, and support pull and junction boxes and their associated fittings.
- 7.3** Describe the NEC regulations governing pull and junction boxes.
- 7.4** Size pull and junction boxes for various applications.
- 7.5** Understand the NEMA and IP classifications for pull and junction boxes.
- 7.6** Describe the purpose of conduit bodies and Type FS boxes.

### **PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET**

The student:

- 7.1** Identify various NEMA Boxes.
- 7.2** Properly select, install, support pull and junction boxes over 100 cubic inches in size.
- 7.3** Identify various conduit bodies and fittings.

### **SAMPLE PERFORMANCE TASKS**

These are sample projects of the type and scale recommended to address one or more of the learning expectations for this standard. Other projects can be used at the instructor's discretion.

### **INTEGRATION LINKAGES**

Science, Math, Computer Skills, Research and Writing Skills, Language Arts, Communication Skills, Leadership Skills, Teamwork Skills, English, Secretary's Commission on Achieving Necessary Skills (SCANS), SkillsUSA, Associated Builders and Contractors (ABC), Associated General Contractors (AGC), MAVCC, National Center for Construction Education and Research (NCCER), International Brotherhood of Electrical Workers, Occupational Safety and Health Administration (OSHA), Environmental Protection Agency, United States Department of Labor, Tennessee Department of Labor and Workforce Development

## **ELECTRICAL II**

### **STANDARD 8.0**

Students will be able to pull cable and describe the installation of conductors.

### **LEARNING EXPECTATIONS**

The student will:

- 8.1** Explain the importance of communication during a cable pulling operation.
- 8.2** Plan and set up for a cable pull.
- 8.3** Set up reel stands and spindles for a wire-pulling installation.
- 8.4** Explain how mandrels, swabs, and brushes are used to prepare conduit for conductors.
- 8.5** Properly install a pull line for a cable pulling operation.
- 8.6** Explain how and when to support conductors in vertical conduit runs.
- 8.7** Describe the installation of cables in cable trays.
- 8.8** Calculate the probable stress or tension in cable pulls.

### **PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET**

The student:

- 8.1** Prepare multiple conductors for pulling in a raceway.
- 8.2** Prepare multiple conductors for pulling using a wire-pulling basket.

### **SAMPLE PERFORMANCE TASKS**

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### **INTEGRATION LINKAGES**

Science, Math, Computer Skills, Research and Writing Skills, Language Arts, English, Communication Skills, Leadership Skills, Teamwork Skills, Secretary's Commission on Achieving Necessary Skills (SCANS), SkillsUSA, Associated Builders and Contractors (ABC), Associated General Contractors (AGC), MAVCC, National Center for Construction Education and Research (NCCER), International Brotherhood of Electrical Workers, Occupational Safety and Health Administration (OSHA), Environmental Protection Agency, United States Department of Labor, Tennessee Department of Labor and Workforce Development

## **ELECTRICAL II**

### **STANDARD 9.0**

Students will describe and properly select cable trays.

### **LEARNING EXPECTATIONS**

The student will:

- 9.1** Describe the components that make up a cable tray assembly.
- 9.2** Explain the methods used to hang and secure cable tray.
- 9.3** Describe how cable enters and exits cable tray.
- 9.4** Select the proper cable tray fitting for the situation.
- 9.5** Explain the *National Electric Code (NEC)* requirements for cable tray installations.
- 9.6** Select the required fittings to ensure equipment grounding continuity in cable tray systems.
- 9.7** Interpret electrical working drawings showing cable tray fittings.
- 9.8** Size cable tray for the number and type of conductors contained in the system.

### **PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET**

The student:

- 9.1** Prepare a list of materials for a cable tray layout. List all the components required, including the fasteners required to complete the system.
- 9.2** Join two straight, ladder-type cable tray sections together.

### **SAMPLE PERFORMANCE TASKS**

These are sample projects of the type and scale recommended to address one or more of the learning expectations for this standard. Other projects can be used at the instructor's discretion

Follow performance tasks in your test booklet.

### **INTEGRATION LINKAGES**

Science, Math, Computer Skills, Research and Writing Skills, Language Arts, Communication Skills, English, Leadership Skills, Teamwork Skills, Secretary's Commission on Achieving Necessary Skills (SCANS), SkillsUSA, Associated Builders and Contractors (ABC), Associated General Contractors (AGC), MAVCC, National Center for Construction Education and Research (NCCER), International Brotherhood of Electrical Workers, Occupational Safety and Health Administration (OSHA), Environmental Protection Agency, United States Department of Labor, Tennessee Department of Labor and Workforce Development

## **ELECTRICAL II**

### **STANDARD 10.0**

Students will be able to perform proper conductor terminations and splices.

### **LEARNING EXPECTATIONS**

The student will:

- 10.1** Describe how to make a good conductor termination.
- 10.2** Prepare cable ends for terminations and splices and connect using lugs and connectors.
- 10.3** Train cable at termination points.
- 10.4** Understand the *NEC* requirements for making cable terminations and splices.
- 10.5** Demonstrate crimping techniques.
- 10.6** Select the proper lug or connector for the job.

### **PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET**

The student:

- 10.1** Terminates conductors using selected crimp-type and mechanical-type terminals and connectors.
- 10.2** Terminate conductors on a terminal strip.
- 10.3** Insulate selected types of wire splices and/or install a motor connection kit.

### **SAMPLE PERFORMANCE TASKS**

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### **INTEGRATION LINKAGES**

Science, Computer Skills, Research and Writing Skills, Language Arts, Communication Skills, Leadership Skills, Teamwork Skills, English, Algebra, Geometry, Secretary's Commission on Achieving Necessary Skills (SCANS), SkillsUSA, Associated Builders and Contractors (ABC), Associated General Contractors (AGC), MAVCC, National Center for Construction Education and Research (NCCER), Occupational Safety and Health Administration (OSHA), Environmental Protection Agency, United States Department of Labor, Tennessee Department of Labor and Workforce Development, International Brotherhood of Electrical Workers

## **ELECTRICAL II**

### **STANDARD 11.0**

Students will explain the purpose of grounding and bonding.

## **LEARNING EXPECTATIONS**

The student will:

- 11.1 Explain the purpose of grounding and bonding and the scope of *NEC Article 250*.
- 11.2 Distinguish between a short circuit and a ground fault.
- 11.3 Define the NEC requirements related to bonding and grounding.
- 11.4 Distinguish between grounded systems and equipment grounding.
- 11.5 Use the NEC Table 250.66 to size the grounding electrode conductor for various AC systems.
- 11.6 Explain the function of the grounding electrode system and determine the grounding electrodes to be used.
- 11.7 Define electrodes and explain the resistance requirements for electrodes using NEC Section 250.56.
- 11.8 Use NEC Table 250.112 to size the equipment grounding conductor for raceways and equipment.
- 11.9 Explain the function of the main and system bonding jumpers in the grounding system and size the main and systems bonding jumpers for various applications.
- 11.10 Size the main bonding jumper for a service utilizing service disconnecting means.
- 11.11 Explain the importance of bonding equipment in clearing ground faults in a system.
- 11.12 Explain the purpose of the grounded conductor (neutral) in the operation of overcurrent devices.

## **PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET**

The student:

- 11.1 Using the proper fittings, connect one end of a No. 4 AWG bare copper grounding wire to a length of three-quarter inches galvanized water pipe and the other end to the correct terminal in a main panelboard.
- 11.2 Install two lengths of Type NM cable in a switch box using NM cable clamps:
  - Strip the ends of the cable to conform with NEC requirements.
  - Secure the cable in the switch box and tighten the cable clamps.
  - Connect and secure the equipment grounding conductors according to NEC requirements, and secure the switch box with either a ground clip or a grounding screw.
- 11.3 Size the minimum required grounding electrode conductor for a 200A service fed by 3/0 copper.
- 11.4 Size the minimum required equipment grounding conductor in each conduit for a 400A feeder gap using two parallel runs of 3/0 copper.
- 11.5 Size the minimum required bonding jumper for a copper water pipe near a separately derived system (transformer) where the secondary conductors are 500 kcmil copper.

## **SAMPLE PERFORMANCE TASKS**

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Follow performance tasks in your test booklet.

## **INTEGRATION LINKAGES**

Science, Computer Skills, Research and Writing Skills, Language Arts, Communication Skills, Leadership Skills, Teamwork Skills, English, Algebra, Geometry, Secretary's Commission on Achieving Necessary Skills (SCANS), SkillsUSA, Associated Builders and Contractors (ABC), Associated General Contractors (AGC), MAVCC, National Center for Construction Education and Research (NCCER), Occupational Safety and Health Administration (OSHA), Environmental Protection Agency, United States Department of Labor, Tennessee Department of Labor and Workforce Development, International Brotherhood of Electrical Workers

## **ELECTRICAL II**

### **STANDARD 12.0**

Students will explain the purpose of circuit breakers and fuses.

### **LEARNING EXPECTATIONS**

The student will:

- 12.1 Explain the necessity of overcurrent protection devices in electrical circuits.
- 12.2 Define the terms associated with fuses and circuit breakers.
- 12.3 Describe the operation of a circuit breaker.
- 12.4 Apply the NEC requirements for overcurrent devices.
- 12.5 Describe the operation of single-element and time-delay fuses.

### **PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET**

The student:

- 12.1 Identifies the flowing on one or more circuit breaker(s) and fuse(s): number of poles, load rating, voltage rating, amperage interrupting rating.

### **SAMPLE PERFORMANCE TASKS**

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### **INTEGRATION LINKAGES**

Science, Computer Skills, Research and Writing Skills, Language Arts, Communication Skills, Leadership Skills, Teamwork Skills, English, Algebra, Geometry, Secretary's Commission on Achieving Necessary Skills (SCANS), SkillsUSA, Associated Builders and Contractors (ABC), Associated General Contractors (AGC), MAVCC, National Center for Construction Education and Research (NCCER), Occupational Safety and Health Administration (OSHA), Environmental Protection Agency, United States Department of Labor, Tennessee Department of Labor and Workforce Development, International Brotherhood of Electrical Workers

## **ELECTRICAL II**

### **STANDARD 13.0**

Students will describe the operating principles of contactors and relays.

### **LEARNING EXPECTATIONS**

The student will:

- 13.1 Describe the operating principles of contactors and relays.
- 13.2 Select contactors and relays for use in specific electrical systems.
- 13.3 Explain how mechanical contactors operate.

- 13.4 Explain how solid-state contactors operate.
- 13.5 Install contactors and relays according to the NEC requirements.
- 13.6 Select and install contactors and relays for lighting control.
- 13.7 Read wiring diagrams involving contactors and relays.
- 13.8 Describe how overload relays operate.
- 13.9 Connect a simple control circuit.
- 13.10 Test control circuits.

### **PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET**

The student:

- 13.1 Mounts and connects a 120V lighting contactor with a three-wire pushbutton control.

### **SAMPLE PERFORMANCE TASKS**

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### **INTEGRATION LINKAGES**

SkillsUSA *Professional Development Program* (PDP), Science, Computer Skills, Research and Writing Skills, Language Arts, Communication Skills, Leadership Skills, Teamwork Skills, English, Algebra, Geometry, Secretary's Commission on Achieving Necessary Skills (SCANS), SkillsUSA, Associated Builders and Contractors (ABC), Associated General Contractors (AGC), MAVCC, National Center for Construction Education and Research (NCCER), Occupational Safety and Health Administration (OSHA), Environmental Protection Agency, United States Department of Labor, Tennessee Department of Labor and Workforce Development, International Brotherhood of Electrical Workers

## **ELECTRICAL II**

### **SAMPLING OF AVAILABLE RESOURCES**

- *Core Curriculum*, National Center for Construction Education and Research (NCCER), Prentice Hall, Upper Saddle River, NJ. Also known as the Contren Learning Series materials.
- *Electrical Level One*, National Center for Construction Education and Research (NCCER), Prentice Hall, Upper Saddle River, NJ. Also known as the Contren Learning Series materials.

- *Electrical Level Two*, National Center for Construction Education and Research (NCCER), Prentice Hall, Upper Saddle River, NJ. Also known as the Contren Learning Series materials.
  - *Electrical Level Three*, National Center for Construction Education and Research (NCCER), Prentice Hall, Upper Saddle River, NJ. Also known as the Contren Learning Series materials.
  - *Electrical Level Four*, National Center for Construction Education and Research (NCCER), Prentice Hall, Upper Saddle River, NJ. Also known as the Contren Learning Series materials.
  - *Residential Electrical I*, National Center for Construction Education and Research (NCCER), Prentice Hall, Upper Saddle River, NJ. Also known as the Contren Learning Series materials.
  - *Residential Electrical II*, National Center for Construction Education and Research (NCCER), Prentice Hall, Upper Saddle River, NJ. Also known as the Contren Learning Series materials.
  - MAVCC, Oklahoma Department of Vocational and Technical Education
  - *Total Quality Curriculum*, National SkillsUSA
  - Professional Development Program, National SkillsUSA—[www.skillsusa.org](http://www.skillsusa.org)
  - Power Tool Institute, [www.powertoolinstitute.com](http://www.powertoolinstitute.com)
  - Fluke Educators Portal, <http://support.fluke.com/educators>
  - National Association of Home Builders, [www.nahb.org](http://www.nahb.org)
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- International Brotherhood of Electrical Workers, [www.ibew.org](http://www.ibew.org)
  - National Association of Women in Construction, [www.nawiceducation.org](http://www.nawiceducation.org)
  - Homebuilders Institute, [www.hbi.org](http://www.hbi.org)
  - United States Department of Labor, [www.dol.gov](http://www.dol.gov)
  - United States Department of Labor, Occupational Outlook Handbook, [www.dol.gov](http://www.dol.gov) (link)

- Secretary's Commission on Achieving Necessary Skills, [www.dol.gov](http://www.dol.gov) (link)
- Occupational Safety and Health Administration (OSHA), [www.osha.gov](http://www.osha.gov)
- Environmental Protection Agency (EPA), [www.epa.gov](http://www.epa.gov)
- National Safety Council, [www.nsc.org](http://www.nsc.org)
- National Skills Standards Board Institute, [www.nssb.org](http://www.nssb.org)
- Vocational Information Center, [www.khake.com](http://www.khake.com)
- Power Tool Institute (PTI), [www.powertoolinstitute.com](http://www.powertoolinstitute.com)
- Associated Builders and Contractors, [www.abc.org](http://www.abc.org)
- Associated General Contractors of America, [www.agcofamerica.org](http://www.agcofamerica.org)
- Building Officials and Code Administration International, [www.bocai.org](http://www.bocai.org)