

## ELECTRICAL I

### COURSE DESCRIPTION

*Electrical I* will provide basic skills and knowledge related to residential and commercial electrical systems. Course content includes leadership development, safe practices, Ohm's law, installing conduit, conductors, residential and commercial electrical systems, and services according to National Electrical code (NEC) and local codes. This course gives students an introduction to the skill and knowledge base 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, Algebra I (may be concurrent)
<b>Recommended Credits:</b>	1
<b>Recommended Grade Level(s):</b>	11 <sup>th</sup> 12 <sup>th</sup>
<b>Number of Competencies in Course:</b>	80

# ELECTRICAL I

## 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** Orientation to the Electrical Trade: Describe career, training, sectors, tasks of electricians, aptitudes of an electrician.
- 4.0** Electrical Safety: Demonstrate safe working practices, purpose of OSHA, electrical hazards, lockout/tag out, confined spaces, respiratory.
- 5.0** Introduction to Electrical Circuits: Define and identify voltage and the ways it can be produced, differentiate conductors and insulators, and demonstrate an understanding of units of measure, meters used to measure voltage, current, resistance, series and parallel circuits.
- 6.0** Electrical Theory: Describe characteristics of combination circuits, calculate using Kirchhoff's voltage and current law, Ohms Law series parallel and series-parallel circuits.
- 7.0** Introduction to National Electric Code (NEC): Explain the purpose of the NEC, the NEC layout and navigation, and the purpose of NEMA and NFFA and UL.
- 8.0** Device Boxes: Describe different types of boxes, fill requirements, identify box type and size, identify appropriate method mounting given box.
- 9.0** Hand Bending: Identify and determine methods for bending conduit.
- 10.0** Raceways and Fittings: Identify types and sizes for a given application, forming, uses of raceway systems. Demonstrate how to install and terminate raceway systems.
- 11.0** Conductors and cables: Describe the insulation, jacket materials, conductor size and type, number of conductors, temperature rating and permitted uses. Identify NEC requirements.
- 12.0** Basic Electrical Drawings: Identify layout, title block, lines used in electrical construction drawings. Interpret equipment schedules.
- 13.0** Residential Electrical Services: Describe the role of NEC, grounding, service entrance, proper working methods, current loads, ground fault circuit, interrupters, outlet size, wiring devices, lighting fixtures.
- 14.0** Operation of test equipment: Describe the operation of the Voltmeter, Ohmmeter, clamp-on ammeter, multimeter, megohmmeter.

## **ELECTRICAL I**

### **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** Exhibit positive leadership skills.
- 1.2** Participate in SkillsUSA as an integral part of classroom instruction.
- 1.3** Assess situations and apply problem-solving and decision-making skills to particular client relations in the community, and workplace.
- 1.4** Demonstrate the ability to work cooperatively with others in a professional setting.
- 1.5** Exhibit integrity and pride in workmanship.

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

The student:

- 1.1A** Demonstrates character, leadership, and integrity using creative and critical-thinking skills.
- 1.2A** Applies the points of the creed to personal and professional situations.
- 1.2B** Participates and conducts meetings and other business according to accepted rules of parliamentary procedure.
- 1.3** Analyzes situations in the workplace and uses problem-solving techniques to solve the problem.
- 1.4A** Participates in a community service project.
- 1.4B** Assists with an officer campaign with Tennessee SkillsUSA.
- 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.

- Create a leadership inventory and use it to conduct a personal assessment.
- Participate in various SkillsUSA programs and/or competitive events.
- Evaluate an activity within the school, community, and/or workplace and project effect of the project.
- Implement an annual program of work.
- Prepare a meeting agenda for a SkillsUSA monthly meeting.
- Attend a professional organization meeting.
- Participate in the American Spirit Award competition with SkillsUSA.

## **INTEGRATION LINKAGES**

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

## **ELECTRICAL 1**

### **STANDARD 2.0**

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

### **LEARNING EXPECTATIONS:**

The student will:

- 2.1 Implement safety procedures established by the Environmental Protection Agency (EPA) and Occupational Safety & Health Administration (OSHA).
- 2.2 Analyze and categorize safety and health hazards and their prevention and treatment in the electrical industry.
- 2.3 Determine safe and correct procedures for working with electricity.
- 2.4 Exhibit acceptable dress and personal grooming identified by the electrical industry.
- 2.5 Use protective clothing, eye protection, and safety equipment.
- 2.6 Demonstrate first aid practices.
- 2.7 Use fire protection equipment.
- 2.8 Comprehend the importance of a safe work environment.
- 2.9 Pass with 100% accuracy a written examination relating to safety issues.
- 2.10 Pass with 100% accuracy a performance examination relating to tools and equipment.
- 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.

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

The student:

- 2.1A Establishes and maintains a safe and healthy working environment.
- 2.1B Distinguishes and employs preventive measures of ecological, chemical, and physical contaminants.
- 2.1C Interprets information from a Material Safety Data Sheet (MSDS).
- 2.1D Comprehends their responsibilities, regulations, and Occupational Safety and Health Administration (OSHA) policies regarding reporting of accidents and observed hazards and regarding emergency response procedures.
- 2.1E Comprehends their responsibilities, regulations, and Occupational Health and Safety Administration (OSHA) policies to protect coworkers and bystanders from hazards.
- 2.2A Differentiates between hazardous materials, substances, and waste.
- 2.2B Retrieves MSDSs and identifies the health hazards associated with new materials.
- 2.2C Reports hazards found on the job site to their supervisor.
- 2.2D Maintains electrical equipment and laboratory in a safe and clean condition.
- 2.2E Identify and explain Confined Spaces as per the Occupational Safety & Health Administration (OSHA) guidelines.
- 2.2F Comprehends their responsibilities under HazCom regulations.
  
- 2.3A Selects, inspects, and uses the correct instruments for working with electrical equipment and systems.
- 2.3B Selects, inspects, and uses the correct personal protective equipment for working with electrical equipment and systems.
- 2.3C Understand and explain the effects of voltage on the human body.

- 2.3D** Erects shields, barriers, and signage to protect coworkers and bystanders prior to starting potentially hazardous electrical tasks.
- 2.4A** Compares and contrasts acceptable dress and personal grooming for specific jobs in the electrical industry.
- 2.4B** Understand the importance of personal hygiene and cleanliness in work and social environments.
- 2.5A** Selects, inspects, and uses the correct personal protective equipment for the assigned task.
- 2.5B** Inspects, maintains, and employs safe operating procedures with tools and equipment, such as hand and power tools, ladders, and lifting equipment.
- 2.6** Administers simulated basic first aid procedures including treating burns and cuts and electrical shock.
- 2.7A** Identify the components of fire.
- 2.7B** Identify the four types of fire extinguishers.
- 2.7C** Explain the proper use of each class of fire extinguisher.
- 2.7D** Explain the PASS method (**P**ull, **A**im, **S**queeze, and **S**weep).
- 2.8A** Continuously is aware of potential hazards to self and others.
- 2.8B** Provides and activates adequate ventilation equipment as required by the task.
- 2.8C** Researches the effects of substance abuse on performance.
- 2.8D** Operates and maintains tools in accordance with manufacturer’s instructions and as required by regulation or Occupational Safety and Health Administration (OSHA) policy.
- 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.
- 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**

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.

- Conduct a safety and health inspection and identify any potential hazards.
- List causes of most common accidents and outlines a safety prevention program.
- Participate in the Occupational Health and Safety competitions with SkillsUSA.
- Outline a safety management program.
- Develop emergency policies for the electrical laboratory or classroom.
- Role-play proper procedure for treating burns, cuts, electrical shock treatments according to standards set forth by the American Red Cross.
- Obtain an American Red Cross First Aid Certification and/or CPR Certification.
- Select fire extinguishers for the proper application.
- Demonstrate the *PASS* method of fire extinguisher use.
- Select, inspect, and use the correct personal protective equipment for the assigned task.
- Inspect power tools for intact guards, shields, insulation, and other protective devices.
- Inspect extension cords for the presence of a functional ground connection, prior to use.

### **INTEGRATION LINKAGES**

Science, Math, Computer Skills, Research and Writing Skills, Language Arts, 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 I**

### **STANDARD 3.0**

Orientation to the Electrical Trade: Describe career, training, sectors, tasks of electricians, aptitudes of an electrician.

### **LEARNING EXPECTATIONS**

The student will:

- 3.1 Describe the apprenticeship/training process for electricians.
- 3.2 Describe various career paths/opportunities one might follow in the electrical trade.
- 3.3 Describe the various sectors of the electrical industry.
- 3.4 State the tasks typically performed by an electrician.
- 3.5 Explain the responsibilities and aptitudes of an electrician.

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

The student:

- 3.1 Describes the apprenticeship/training process for electricians.
- 3.2 Describes various career paths/opportunities one might follow in the electrical trade.
- 3.3 Describes the various sectors of the electrical industry..
- 3.5 Explain the responsibilities and aptitudes of an electrician.

### **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.

- Students could shadow and Electrician and gain knowledge of the trade.
- A guest speaker (Electrician) could come in and explain to the class what he does on a daily basis.
- Students could do a research paper on the Electrical trade.

### **INTEGRATION LINKAGES**

Science, Math, Computer Skills, Research and Writing Skills, Language Arts, 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 I**

### **STANDARD 4.0**

Electrical Safety: Demonstrate safe working practices, purpose of OSHA, electrical hazards, lockout/tag out, confined spaces, respiratory.

### **LEARNING EXPECTATIONS**

The student will:

- 4.1 Recognize safe working practices in the construction environment.
- 4.2 Explain safety issues concerning lockout/tagout procedures, confined space entry, respiratory protection, and fall protection systems.
- 4.3 Identify electrical hazards and how to avoid or minimize them in the workplace.
- 4.4 Explain the purpose of OSHA and how it promotes safety on the job.
- 4.5 Develop a task plan and a hazard assessment for a given task and select the appropriate PPE and work methods to safely perform the task.

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

The student:

- 4.1 Performs a visual inspection on various types of ladders.
- 4.2A Sets up a ladder properly to perform a task.
- 4.2B Properly dons a harness.
- 4.3 Performs a hazardous assessment of a job such as replacing the lights in your classroom.

### **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.

- Discuss the work to be performed and the hazards involved.
- Locate the closest phone to the work site and ensure that the local emergency telephone numbers are either posted at the phone or known by you and your partner.
- Plan an escape route from the location in the event of an accident.

### **INTEGRATION LINKAGES**

Science, Math, Computer Skills, Research and Writing Skills, Language Arts, 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 I**

### **STANDARD 5.0**

Introduction to Electrical Circuits: Define and identify voltage and the ways it can be produced, differentiate conductors and insulators, and demonstrate an understanding of units of measure, meters used to measure voltage, current, resistance, series and parallel circuits.

### **LEARNING EXPECTATIONS**

The student will:

- 5.1** Define voltage and identify the ways in which it can be produced.
- 5.2** Explain the difference between conductors and insulators.
- 5.3** Define the units of measurement that are used to measure properties of electricity.
- 5.4** Identify the meters used to measure voltage, current and resistance.
- 5.5** Explain the basic characteristics of series and parallel circuits.

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

The student:

- 5.1** Defines voltage and identify the ways in which it can be produced.
- 5.2** Explains the difference between conductors and insulators.
- 5.3** Defines the units of measurement that are used to measure properties of electricity.
- 5.4** Identifies the meters used to measure voltage, current and resistance.
- 5.5** Explains the basic characteristics of series and parallel circuits.

### **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.

- Performance tasks for this module are at the instructor's discretion.

### **INTEGRATION LINKAGES**

Science, Math, Computer Skills, Research and Writing Skills, Language Arts, Communication Skills, Leadership Skills, Teamwork Skills, Secretary's Commission on Achieving Necessary Skills (SCANS), Skills/USA, 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 I**

## **STANDARD 6.0**

Electrical Theory: Describe characteristics of combination circuits, calculate using Kirchhoff's voltage and current law, Ohms Law series parallel and series parallel circuits.

### **LEARNING EXPECTATIONS**

The student will:

- 6.1** Explain the basic characteristics of combination circuits.
- 6.2** Calculate, using Kirchhoff's voltage law, the voltage drop in series, parallel, and series-parallel circuits.
- 6.3** Calculate, using Kirchhoff's current law, the total current in parallel and series-parallel circuits.
- 6.4** Using Ohm's law, find the unknown parameters in series, parallel, and series-parallel circuits.

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

The student:

- 6.2** Calculate a series of problems using Kirchhoff's law.
- 6.3** Calculate a series of problems using Ohms law, find the unknown parameters in parallel and series parallel circuits.

### **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.

- Give students a work sheet with examples of Kirchhoff's and Ohms law.

### **INTEGRATION LINKAGES**

Science, Math, Computer Skills, Research and Writing Skills, Language Arts, Communication Skills, Leadership Skills, Teamwork Skills, Secretary's Commission on Achieving Necessary Skills (SCANS), Skills/USA, 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 I**

### **STANDARD 7.0**

Introduction to National Electric Code (NEC): Explain the purpose of the NEC, the NEC layout and navigation, and the purpose of NEMA and NFFA and UL.

### **LEARNING EXPECTATIONS**

The student will:

- 7.1** Explain the purpose and history of the NEC.
- 7.2** Describe the layout of the NEC.
- 7.3** Demonstrate how to navigate the NEC.
- 7.4** Describe the purpose of the National Electrical Manufacturers Association and the NFPA.
- 7.5** Explain the role of nationally recognized testing laboratories.

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

The student:

- 7.1** Uses NEC Article 90 to determine the scope of the NEC. State what is covered by the NEC and what is not.
- 7.2** Finds the definition of the term *feeder* in the NEC.
- 7.3A** Looks up the NEC specifications that you would need to follow if you were installing an outlet near a swimming pool.
- 7.3B** Finds the minimum wire bending space for two 1/0 AWG conductors installed in a junction box or cabinet and entering opposite the terminal.

### **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.

- Determine required ground wire for residential service or mockup.
- Identify and choose from allowable ground connections for a residential or commercial service.

### **INTEGRATION LINKAGES**

Science, Math, Computer Skills, Research and Writing Skills, Language Arts, 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 I**

### **STANDARD 8.0**

Device Boxes: Describe different types of boxes, fill requirements, identify box type and size, identify appropriate method mounting given box.

### **LEARNING EXPECTATIONS**

The student will:

- 8.1** Identify the appropriate box type and size for a given application.
- 8.2** Calculate the NEC fill requirements for boxes under 100 cubic inches.
- 8.3** Describe the different types of nonmetallic and metallic boxes.
- 8.4** Select and demonstrate the appropriate method for mounting a given box.

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

The student:

- 8.1A** Identifies the appropriate box type and size for a given application.
- 8.2A** Selects the minimum size pull junction box for the following applications:
  - Conduit entering and exiting for a straight pull
  - Conduit entering and exiting at an angle

### **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.

- Show different types of boxes
- Have students select and hang the proper box for the given application.

### **INTEGRATION LINKAGES**

Science, Math, Computer Skills, Research and Writing Skills, Language Arts, 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 I**

### **STANDARD 9.0**

Hand Bending: Identify and determine methods for bending conduit.

### **LEARNING EXPECTATIONS**

The student will:

- 9.1** Make 90-degree, back-to-back bends, offsets, kicks, and saddle bends using a hand bender.
- 9.2** Cut, ream, and thread conduit.
- 9.3** Identify the methods for hand bending and installing conduit.
- 9.4** Determine conduit bends.

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

The student:

- 9.1** Makes 90-degree, back-to-back bends, offsets, kicks, and saddle bends using a hand bender.
- 9.2** Cuts, reams, and threads conduit.

### **SAMPLE PERFORMANCE TASKS**

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

- Students should bend as many angles as possible.
- Have an electrician come to class and demonstrate how to bend conduit.
- If available, take students to a job site to view conduit properly bent and installed.

### **INTEGRATION LINKAGES**

Science, Math, Computer Skills, Research and Writing Skills, Language Arts, 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 I**

### **STANDARD 10.0**

Raceways and fittings: Identify types and sizes for a given application, forming, uses of raceway systems. Demonstrate how to install and terminate raceway systems.

### **LEARNING EXPECTATIONS**

The student will:

- 10.1** Identify and select various types and sizes of raceways and fittings for a given application.
- 10.2** Demonstrate how to install a flexible raceway system.
- 10.3** Terminate a selected raceway system.
- 10.4** Identify various methods used to fabricate (join) and install raceway systems.
- 10.5** Identify the appropriate conduit body for a given application.
- 10.6** Identify uses permitted for selected raceways.

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

The student:

- 10.1** Identifies and selects various types and sizes of raceways and fittings for a given application.
- 10.2** Demonstrates how to install a flexible raceway system.
- 10.3** Terminates a selected raceway system.
- 10.4** Identifies the appropriate conduit body for a given application.

### **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.

- Build a mock wall and have students install flexible raceway.
- Using a mock wall set-up have students select and install various types and sizes of raceways and fittings.

### **INTEGRATION LINKAGES**

Science, Math, Computer Skills, Research and Writing Skills, Language Arts, Communication Skills, Leadership Skills, Teamwork Skills, Secretary's Commission on Achieving Necessary Skills (SCANS), Skills/USA, 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 I**

## **STANDARD 11.0**

Conductors and Cables: Describe the insulation, jacket materials, conductor size and type, number of conductors, temperature rating and permitted uses. Identify NEC requirements.

### **LEARNING EXPECTATIONS**

The student will:

- 11.1** Install conductors in a raceway system.
- 11.2** Determine the allowable ampacity of a conductor for a given application.
- 11.3** Identify the NEC requirements for color coding of conductors.
- 11.4** From the cable markings, describe the insulation and jacket material, conductor size and type, number for conductors, temperature rating, voltage rating, and permitted uses.

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

The student:

- 11.1** Installs conductors in a raceway system.

### **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.

- Have various sizes of conductors and have students identify each and their uses.
- Using the NEC have students find the articles which explains conductors their sizes and application.

### **INTEGRATION LINKAGES**

Science, Math, Computer Skills, Research and Writing Skills, Language Arts, Communication Skills, Leadership Skills, Teamwork Skills, Secretary's Commission on Achieving Necessary Skills (SCANS), Skills/USA, 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 I**

### **STANDARD 12.0**

Basic Electrical Drawings: Identify layout, title block, lines used in electrical construction drawings. Interpret equipment schedules.

## **LEARNING EXPECTATIONS**

The student will:

- 12.1 Using an architect's scale, state the actual dimensions of a given drawing component..
- 12.2 Interpret electrical drawings, including site plans, floor plans, and detail drawings.
- 12.3 Identify the types of lines used on construction drawings.
- 12.4 Explain the basic layout of a set of construction drawings
- 12.5 Describe the information included in the title block of a construction drawing.
- 12.6 Interpret equipment schedules found on electrical drawings.
- 12.7 Describe the type of information included in electrical specifications.

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

The student:

- 12.1 Using an architect's scale, states the actual dimensions of a given drawing component.
- 12.2 Makes a material takeoff of the lighting fixtures specified in Performance Profile Sheet 2 using the drawing provided on Performance Profile Sheet 3. The takeoff requires that all lighting fixtures be counted, and where applicable, the total number of lamps for each fixture must be calculated.

## **SAMPLE PERFORMANCE TASKS**

These are sample performance tasks 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.

- Given a set of actual blueprints have students in groups do an electrical take-off.
- If possible take actual blue prints of an electrical job have students do a take-off and visit the job site to see the finished job.

## **INTEGRATION LINKAGES**

Science, Math, Computer Skills, Research and Writing Skills, Language Arts, Communication Skills, Leadership Skills, Teamwork Skills, Secretary's Commission on Achieving Necessary Skills (SCANS), Skills/USA, 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 I**

### **STANDARD 13.0**

Residential Electrical Services: Describe the role of NEC, grounding, service entrance, proper working methods, current loads, ground fault circuit, interrupters, outlet size, wiring devices, lighting fixtures.

### **LEARNING EXPECTATIONS**

The student will:

- 13.1** Calculate and select service-entrance equipment.
- 13.2** Compute branch circuit loads and explain their installation requirements.
- 13.3** Select the proper wiring methods for various types of residences.
- 13.4** Explain the role of the NEC in residential wiring and describe how to determine electric service requirements for dwellings.
- 13.5** Explain the grounding requirements of a residential electric service.
- 13.6** Explain the types and purposes of equipment grounding conductors.
- 13.7** Explain the purpose of ground fault circuit interrupters and tell where they must be located.
- 13.8** Size outlet boxes and select the proper type for different wiring methods.
- 13.9** Describe rules for installing electric space heating and HVAC equipment.
- 13.10** Describe the installation rules for electrical systems around swimming pools, spas, and hot tubs.
- 13.11** Explain how wiring devices are selected and installed.
- 13.12** Describe the installation and control of lighting fixtures.

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

The student:

- 13.1** For a residential dwelling of a given size, and equipped with a given list of major appliances, demonstrates or explains how to:
  - Compute the lighting, small appliance, and laundry loads
  - Compute the loads for large appliances
  - Size and select the service-entrance equipment (conductors, panelboard, and protective devices).
- 13.2** Using an unlabeled diagram of a panelboard (Performance Profile Sheet 3), labels the lettered components.
- 13.3** Selects the proper type and size outlet box needed for a given set of wiring conditions.

### **SAMPLE PERFORMANCE TASKS**

These are sample performance tasks 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.

- Students will visit a job site and examine a finished panel and critique the finished job.
- Create a mock panel box and have students install all necessary wiring.

## **INTEGRATION LINKAGES**

Science, Math, Computer Skills, Research and Writing Skills, Language Arts, Communication Skills, Leadership Skills, Teamwork Skills, Secretary's Commission on Achieving Necessary Skills (SCANS), Skills/USA, 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

## **STANDARD 14.0**

Operation of test equipment: Describe the operation of the Voltmeter, Ohmmeter, clamp-on ammeter, multimeter, megohmmeter.

### **LEARNING EXPECTATIONS**

The student will:

- 14.1** Explain the operation of and describe the following pieces of test equipment:
- Voltmeter
  - Ohmmeter
  - Clamp-on ammeter
  - Multimeter
  - Megohmmeter
  - Motor and phase rotation testers
- 14.2** Select the appropriate meter for a given work environment based on category ratings.
- 14.3** Identify the safety hazards associated with various types of test equipment.

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

The student:

- 14.1A** Under instructor supervision, measures the voltage in your classroom from line to neutral and neutral to ground.
- 14.1B** Under instructor supervision, uses an ohmmeter to measure the value of various resistors.

### **SAMPLE PERFORMANCE TASKS**

These are sample performance tasks 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.

- Given the expense of owning each meter, call in a local supplier to demonstrate the use of each meter.
- Have an electrician come to class to demonstrate each meter that might be used.

### **INTEGRATION LINKAGES**

Science, Math, Computer Skills, Research and Writing Skills, Language Arts, Communication Skills, Leadership Skills, Teamwork Skills, Secretary's Commission on Achieving Necessary Skills (SCANS), Skills/USA, 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 I**

### **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)
  
- 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)