



# Electrical

## Study Guide

### Assessments:

**3201 Commercial/Industrial  
Electrician's Assistant**

**3202 Residential Electrician's  
Assistant**

career tech ✓  
**Testing**  
*The Provider of Online Testing Solutions*

Aligned to Oklahoma  
Construction Industries  
Board Standards



**OKLAHOMA  
WORKS**

## Overview

This study guide is designed to help students prepare for the following Electrical Trades assessments: Commercial/Industrial Electrician's Assistant and Residential Electrician's Assistant. It not only includes information about the assessments, but also the skill standards upon which the assessments are based, resources that can be used to prepare for the assessments, and test taking strategies.

Each of the four sections in this guide provides useful information for students preparing for the Electrical Trades assessments and the Oklahoma Construction Industries Board (OCIB) equivalent written certification exams.

- CareerTech and Competency-Based Education: A Winning Combination
- Electrical Trades assessments
  - ▶ Assessment Information
  - ▶ Standards and Test Content
  - ▶ Sample Questions
  - ▶ Textbook/Curriculum Crosswalk
  - ▶ Abbreviations, Symbols, and Acronyms
- Strategies for Test Taking Success
- Notes

These assessments were developed and aligned with the OCIB certification exams. They have also been crosswalked to NCCER National Standards for Electrician Entry Level One and Industrial Electrician.

The Electrical Trades assessments measure a student's ability to apply knowledge and skills at a level greater than an electrical apprentice. These assessments are designed to prepare a student for the OCIB licensure assessments or NCCER certification exams. It is intended that those completing training for these occupations and passing these assessments will have expertise greater than an Electrical Apprentice, and approaching that of a Journeyman Electrician, as licensed by the State of Oklahoma. The main difference between these two occupations is the level of practical experience attained.

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## CareerTech and Competency-Based Education: A Winning Combination

Competency-based education uses learning outcomes that emphasize both the application and creation of knowledge and the mastery of skills critical for success. In a competency-based education system, students advance upon mastery of competencies, which are measurable, transferable outcomes that empower students.

Career and technology education uses industry professionals and certification standards to identify the knowledge and skills needed to master an occupation. This input provides the foundation for development of curriculum, assessments and other instructional materials needed to prepare students for wealth-generating occupations and produce comprehensively trained, highly skilled employees demanded by the work force.

### Tools for Success

CareerTech education relies on three basic instructional components to deliver competency-based instruction: skills standards, curriculum materials, and competency assessments.

**Skills standards** provide the foundation for competency-based instruction and outline the knowledge and skills that must be mastered in order to perform related jobs within an industry. Skills standards are aligned with national skills standards and/or industry certification requirements; therefore, a student trained to the skills standards is equally employable in local, state and national job markets.

**Curriculum materials and textbooks** contain information and activities that teach students the knowledge and skills outlined in the skills standards. In addition to complementing classroom instruction, curriculum resources include supplemental activities that enhance learning by providing opportunities to apply knowledge and demonstrate skills.

**Certification Assessments** test the student over material outlined in the skills standards and taught using the curriculum materials and textbooks. When used with classroom performance evaluations, certification assessments provide a means of measuring occupational readiness.

Each of these components satisfies a unique purpose in competency-based education and reinforces the knowledge and skills students need to gain employment and succeed on the job.

### Measuring Success

Evaluation is an important component of competency-based education. Pre-training assessments measure the student's existing knowledge prior to receiving instruction and ensure the student's training builds upon this knowledge base. Formative assessments administered throughout the training process provide a means of continuously monitoring the student's progress towards mastery.

Certification assessments provide a means of evaluating the student's mastery of knowledge and skills. Coaching reports communicate assessment scores to students and provide a breakdown of assessment results by standard area. The coaching report also shows how well the student has mastered skills needed to perform major job functions and identifies areas of job responsibility that may require additional instruction and/or training.

# Electrical Trades Assessment Information

## What are the Electrical Trades assessments?

The Electrical Trades assessments are end-of-program assessments for students in electrical trades programs. The assessments provide an indication of a student's mastery of the knowledge and skills necessary for success in electrical careers.

## How were the assessments developed?

The assessments were developed by the CareerTech Testing Center to align with the Oklahoma Construction Industries Board (OCIB) certification exams. A committee of industry representatives and educators validated the standards covered on each assessment. Each assessment's content was developed and reviewed by a committee of subject matter experts.

The committee assigned frequency and criticality ratings to each skill, which determines the significance of each task for test development:

**Frequency:** represents how often the task is performed on the job. Frequency rating scales vary for different occupations. The rating scale used in this publication is presented below:

1 = less than once a week      2 = at least once a week      3 = once or more a day

**Criticality:** denotes the level of consequence associated with performing a task incorrectly. The rating scale used in this publication is presented below:

1 = slight                                      2 = moderate                                      3 = extreme

## What do the assessments cover?

The assessments are aligned with the OCIB technical specifications for licensure. They have also been crosswalked to NCCER National Standards for Electrician Entry Level One and Industrial Electrician. The areas of emphasis are as follows for each assessment:

### Commercial/Industrial Electrician's Assistant (33201) – 70 questions

Plan and Organize Work	6%	Trim Out Electrical Devices & Appliances	8%
Perform Activities Related to Basic Circuits	3%	Maintain & Repair Existing Wiring Systems	6%
Perform Activities Related to AC Circuits	11%	Install & Maintain Special Systems	1%
Demonstrate Knowledge of NEC	4%	Install Transformers	6%
Perform Calculations	8%	Install AC & DC Rotating Equipment	7%
Install Services	3%	Construct, Install, Maintain Electrical Control Systems & Devices	6%
Install Switch & Outlet Boxes	3%	Install Low Voltage & Data Communication Systems	3%
Rough-in Circuits	13%	Demonstrate Safety Skills	7%
Install Electrical Field Wiring for Environmental Control Systems	4%		

## Residential Electrician's Assistant (33202) – 55 questions

Plan and Organize Work	5%	Install Electrical Field Wiring for Environmental Control Systems	9%
Perform Activities Related to Basic Circuits	2%	Rough-in Circuits	7%
Perform Activities Related to AC Circuits	5%	Trim Out Electrical Devices & Appliances	11%
Demonstrate Knowledge of NEC	5%	Maintain & Repair Existing Wiring Systems	2%
Perform Calculations	25%	Install & Maintain Special Systems	2%
Install Services	4%	Install Low Voltage & Data Communication Systems	2%
Install Switch & Outlet Boxes	5%	Demonstrate Safety Skills	16%

### What are the benefits of using these assessments?

Students receive a certificate for each assessment that he/she passes. This certificate may be included in his/her portfolio and used to communicate the student's mastery of the subject matter to potential employers.

### When should the assessments be taken?

The CareerTech Testing Center recommends that students take an assessment as soon as possible after receiving all standards-related instruction, rather than waiting until the end of the school year.

### Are the assessments timed?

No. Although students may take as long as they need, most finish an assessment within one hour.


### What resources can students use on these assessments?

Students are allowed to use calculators and scratch paper on CTTC assessments; however, these items must be provided by the testing proctor and returned to the proctor before the student's exam is submitted for scoring. Calculator apps on cell phones and other devices may not be used on these assessments.

Students taking the electrical trades tests may also use a publisher-bound National Electrical Code Reference, Ugly's Electrical References and CFR Title 29 Part 1926 OSHA Reference.

### What accommodations can be made for students with Individualized Education Plans (IEPs)?

Accommodations are allowed for students with an Individualized Education Plan. Examples of allowable accommodations include:

- Extended time — This assessment is not timed; therefore, students may take as much time as needed to finish. The assessment must be completed in one testing session.
- Readers — A reader may be used to read the assessment to a student who has been identified as needing this accommodation.
- Enlarged text — Students needing this accommodation can activate this feature by clicking the  icon in the upper right corner of the screen.

## What can students expect on Test Day?

All CTTC assessments are web-based and delivered exclusively by a proctor in the school's assessment center. The proctor **cannot** be an instructor or anyone who was involved with the student during instruction.

Assessments are delivered in a question-by-question format. When a question is presented, the student can select a response or leave the question unanswered and advance to the next question. Students may also flag questions to revisit before the test is scored. All questions must be answered before the test can be submitted for scoring.

After the assessment is scored, the student will receive a score report that not only shows the student's score on the assessment, but also how the student performed in each standard area.

## Can students retake the test?

Students may retake the test unless their school or state testing policies prohibit retesting. Students who can retest must wait at least three days between test attempts.



## Standards and Test Content

### Plan and Organize Work

1. Plan a sequence of work operations **(1/2)**
  - review plans and specifications
2. Inventory equipment and supplies **(1/2)**
3. Compile a list of motor nameplate data **(1/2)**
4. Update schematic print files for machinery **(1/2)**
5. Plan a shutdown procedure for a given area **(1/2)**
6. Set up a trouble log on maintenance or equipment **(1/2)**
7. Compile list of materials from wiring blueprints **(1/2)**
8. Coordinate work with public utilities **(1/2)**
9. Draw control panel diagrams **(1/2)**
10. Draw external power diagrams **(1/2)**
11. Draw schematic diagrams from pre-wired circuits **(1/2)**
12. Draw an as-built electrical plan **(1/2)**

### Perform Activities Related to Basic Circuits

1. Construct/analyze/install series circuits **(3/2)**
2. Troubleshoot series circuit **(3/2)**
3. Draw series circuit and calculate circuit values **(3/2)**
4. Construct/analyze/install parallel circuits **(3/2)**
5. Troubleshoot parallel circuits **(3/2)**
6. Draw parallel circuit and calculate circuit values **(3/2)**
7. Construct/analyze/install series-parallel circuits **(3/2)**
8. Troubleshoot series-parallel circuits **(3/2)**
9. Draw series-parallel circuits and calculate circuit values **(3/2)**
10. Set up and operate for basic circuits **(3/2)**
  - volt amp meter
  - ohmmeter
  - voltage tester



## Perform Activities Related to Alternating Current Circuits

1. Identify AC sources **(3/3)**
2. Analyze and apply principles of transformers to AC circuits **(3/3)**
  - buck and boost
  - low voltage
3. Install single-phase circuits **(3/3)**
4. Troubleshoot single-phase circuits **(3/3)**
5. Construct/analyze/install polyphase circuits **(3/3)**
6. Troubleshoot polyphase circuits **(3/3)**
7. Remove/replace capacitors in an AC circuit **(3/3)**
8. Test capacitors in an AC circuit **(3/3)**
9. Install power transformers **(3/3)**
10. Troubleshoot power transformers **(3/3)**
11. Install control transformers **(3/3)**
12. Troubleshoot control transformers **(3/3)**
13. Make proper connections on dual voltage motors **(3/3)**
14. Make proper connections on dual voltage generators **(3/3)**
15. Set up and operate for AC circuits **(3/3)**



## Demonstrate Knowledge of NEC Introduction, Definitions, and Requirements for Electrical Installations

1. Demonstrate knowledge of Article 90 (Introduction) **(3/3)**
2. Demonstrate knowledge of Article 100 (Definitions) **(3/3)**
3. Demonstrate knowledge of Article 110 (Requirements for Electrical Installations) **(3/3)**
4. Demonstrate knowledge of Article 210 (Branch Circuit Requirements) **(3/3)**
5. Demonstrate knowledge of Article 230 (Service Point Locations) **(3/3)**

## Perform Calculations

1. Calculate and balance the total load per phase **(2/3)**
2. Calculate the grounding electrode system and bonding requirements **(2/3)**
  - size
  - materials
3. Calculate individual circuits **(2/3)**
4. Calculate the load in volt-amperes and the load current in amperes **(2/3)**





5. Calculate service size **(2/3)**
  - branch circuit
  - feeder circuit
  - service circuit
6. Determine the number of convenience and appliance outlets per circuit **(2/3)**
7. Perform transformer and motor calculations **(2/3)**
8. Calculate voltage drop **(2/3)**
9. Calculate conductors **(2/3)**
  - de-rating
  - correction factors
10. Calculate size of raceways and enclosures **(2/3)**
11. Calculate overcurrent protection **(2/3)**
12. Perform calculations using Ohm's Law **(2/3)**

## Install Services

1. Ground service equipment **(1/3)**
  - grounding electrode systems
  - bonding
2. Size and install service conductors **(1/3)**
3. Install mast-type service **(1/3)**
4. Install main service disconnects (master switches) **(1/3)**
5. Install circuit breakers in panels **(1/3)**
6. Install and connect mobile home/office service **(1/3)**
7. Install service panels (distribution panel boards) **(1/3)**
8. Install temporary service **(1/3)**
9. Install underground service **(1/3)**
10. Install metering equipment **(1/3)**

## Install Switch and Outlet Boxes

1. Install and size boxes **(3/1)**
  - new construction
  - existing construction
  - hazardous locations
2. Install recessed fixture housings in ceilings **(3/1)**
3. Install bar-hanger mounted box **(3/1)**
4. Install flush mount junction box **(3/1)**



5. Install flush mount switch and outlet box in **(3/1)**
  - drywall
  - paneled wall
  - lathe and plaster wall
  - masonry wall
6. Install gangable boxes **(3/1)**
7. Install octagon outlet box **(3/1)**
8. Install surface mount junction box **(3/1)**
9. Install subsurface enclosures **(3/1)**
10. Install raceway supported enclosures **(3/1)**

## Rough-In Circuits

1. Lay out electrical systems **(2/3)**
  - use material and devices labeled and listed for the purpose
  - follow all grounding and bonding requirements
2. Rough-in feeders and circuits using a cable system **(2/3)**
  - new construction
  - existing construction
3. Rough-in and properly secure circuits in conduits and other raceways **(2/3)**
  - new construction
  - existing construction
4. Rough-in and properly secure cables or conduits for branch circuits **(2/3)**
5. Connect circuits to circuit breaker panels **(2/3)**
6. Rough-in circuits to outlet boxes **(2/3)**
7. Rough-in cables between existing boxes and newly installed boxes **(2/3)**
8. Rough-in a circuit for an outlet controlled with: **(2/3)**
  - three-way switches
  - three-way switches and four-way switches
  - feed to the device outlet box
  - feed to the device
  - feed to the three-way switch
9. Rough-in low-voltage circuits **(2/3)**
  - door chime system
  - intercom system
10. Rough-in cables for general purpose branch circuits **(2/3)**
  - single-pole switch
  - three-way switch
  - four-way switch
  - receptacle outlet
  - lighting outlet
11. Make splices using mechanical-type connectors **(2/3)**
  - split bolt connectors
  - wire nuts
12. Make joints using crimp type connectors (splices) **(2/3)**

13. Make terminations **(2/3)**
14. Rough-in branch circuit wires to panels **(2/3)**
15. Install panels and subpanels **(2/3)**
16. Run feeder cables from main service panels to subpanels **(2/3)**
17. Rough-in weatherproof outlet boxes and covers **(2/3)**
18. Rough-in electrical environmental control components **(2/3)**
19. Install conduits, cables, raceways, and equipment **(2/3)**
  - indoor
  - outdoor
  - underground
  - non-liquid tight flexible metal
  - liquid-tight flexible metal
  - rigid
  - plastic
  - compensate for expansion
  - thin wall (EMT)
  - direct burial
  - multi-conductor
  - wet locations
  - dry locations
  - submerged locations
  - multi-conduit layout
20. Install receptacle circuits **(2/3)**
  - single-phase
  - three-phase
21. Rough-in thermostat wiring **(2/3)**
  - low voltage
  - temperature control

## Install Electrical Field Wiring for Environmental Control Systems

1. Install/connect baseboard heating systems **(1/2)**
2. Install/connect wall heaters **(1/2)**
3. Install/connect ceiling heat cables **(1/2)**
4. Connect central electric heat **(1/2)**
5. Install individual space heaters **(1/2)**
6. Connect thermostats **(1/2)**
  - line voltage
  - low voltage
7. Connect furnace motors **(1/2)**
8. Connect gas/oil fired heating units **(1/2)**
9. Connect wiring for boiler control systems **(1/2)**
10. Install/connect for ventilation systems **(1/2)**
11. Install/connect for air conditioning systems **(1/2)**
12. Install/connect all associated field wiring for environmental controls **(1/2)**

## Trim Out (Finish) Electrical Devices and Appliances

1. Install/connect all lighting fixtures and circuits **(3/2)**
2. Install/connect paddle fans **(3/2)**
3. Install/connect a photoelectric control on a light **(3/2)**
4. Install/connect heat-a-vent lights **(3/2)**
5. Install/connect post lights **(3/2)**
6. Determine the proper location for and install/connect emergency lighting systems **(3/2)**
7. Install/connect receptacles **(3/2)**
8. Install/connect switches **(3/2)**
9. Install/connect time switches **(3/2)**
  - delayed action
10. Install/connect appliances **(3/2)**
11. Connect sump and well pump motors **(3/2)**
12. Install/connect panels **(3/2)**
13. Install/connect de-icing equipment **(3/2)**
14. Install/connect low voltage systems **(3/2)**
15. Install/connect ground fault interrupting devices **(3/2)**
16. Connect water heaters **(3/2)**
17. Connect humidity control devices **(3/2)**
18. Install/connect circuits for hydromassage tubs **(3/2)**
19. Install/connect pilot indicating lights **(3/2)**
20. Determine the proper location for and install smoke and CO<sub>2</sub> detectors **(3/2)**
21. Install/connect lighting dimmer systems **(3/2)**



## Maintain and Repair Existing Wiring Systems

1. Troubleshoot/repair/replace HVAC system controls **(1/2)**
2. Troubleshoot/repair/replace relays and timers **(1/2)**
3. Troubleshoot/repair/replace lighting fixtures **(1/2)**
  - electric discharge lighting
  - incandescent
4. Troubleshoot/replace electrical components of water heaters **(1/2)**
5. Troubleshoot/repair/replace overcurrent protective devices **(1/2)**
6. Troubleshoot/repair/replace service entrance equipment **(1/2)**
7. Replace receptacles or switches **(1/2)**
8. Troubleshoot/repair/replace automatic control devices **(1/2)**

9. Troubleshoot/replace transformers (1/2)
10. Troubleshoot/repair/replace electric motors (1/2)

## Install and Maintain Special Systems

1. Install ducts (1/3)
  - busways
  - feeder
  - plug-in
2. Install wireway (1/3)
  - lay-in
  - underfloor
  - surface mount
3. Install wiring in mounted wireways and cable trays (1/3)
4. Install circuit breakers, fuses, and disconnecting means (1/3)
5. Install circuits using nonmetallic sheathed cables (1/3)
6. Install and connect system grounds (1/3)
7. Install raceway systems and conductors (1/3)
8. Install systems in hazardous locations (1/3)
9. Install battery charging systems (1/3)
10. Install lighting dimmer systems (1/3)
11. Install/splice/terminate high voltage cables and equipment (1/3)
12. Troubleshoot high voltage cables and equipment (1/3)
13. Test the insulation of cables and equipment (1/3)
14. Troubleshoot/install/replace surge and lightning protector systems (1/3)
15. Troubleshoot/install/replace grounding, bonding, and circuits (1/3)
16. Troubleshoot/install/replace pool grounding, bonding, and circuits (1/3)



## Install Transformers

1. Install and connect transformers (1/3)
  - step-up
  - step-down
  - single-phase
  - polyphase
  - current
  - potential
  - boost
  - buck
2. Test transformer for output and performance under load (1/3)
3. Clean power transformer (1/3)
4. Connect a dual-voltage transformer for (1/3)
  - highest input/output
  - low input/output

5. Connect auto transformer to give a variety of voltages **(1/3)**
6. Connect power-supply distribution transformer to supply **(1/3)**
  - three-phase, four-wire connections
  - three-phase, delta configuration
  - three-phase, wye configuration
7. Connect three single-phase transformers to form a **(1/3)**
  - delta-delta configuration (3-wire or 4-wire)
  - delta-wye configuration
  - wye-delta configuration
  - wye-wye configuration
  - corner grounded delta configuration
8. Connect two single-phase transformers in **(1/3)**
  - an open delta configuration (3-wire or 4-wire)
  - parallel
9. Connect a voltmeter to a power line through the use of a potential transformer **(1/3)**
10. Connect an amp meter to high voltage line using current transformer **(1/3)**

## Install AC & DC Rotating Equipment

1. Install/connect/replace DC circuits **(1/2)**
  - shunt
  - series
  - compound
2. Install/connect/replace DC generators **(1/2)**
  - separately-excited shunt
  - self-excited
  - compound
  - series
3. Change the output of DC generator **(1/2)**
4. Change the direction of rotation of electrical motors **(1/2)**
5. Install/connect AC motors **(1/2)**
6. Install/connect/replace AC alternator **(1/2)**
7. Install/connect phase converters **(1/2)**
8. Connect single-phase AC motor to run from different voltages **(1/2)**
9. Connect three-phase AC motor to run from different voltages **(1/2)**
10. Connect three-phase motor stator for **(1/2)**
  - delta operation
  - wye operation
11. Connect/replace motors **(1/2)**
  - capacitor-run
  - capacitor-start
  - repulsion-start, induction-run
  - split-phase induction
  - universal
  - three-phase wound-rotor induction
  - three-phase synchronous
  - shaded-pole
  - three-phase squirrel-cage induction
12. Connect a three-phase alternator **(1/2)**

## Construct, Install, and Maintain Electrical Control Systems and Devices

1. Install, troubleshoot, and repair motor control systems **(1/2)**
  - single-phase system
  - three-phase system
  - magnetic motor starters
  - hand off, automatic systems
  - interlocking, reversing systems
  - multiple station systems
    - 3-wire motor control systems
    - 5-wire motor control systems
  - overload relays
  - timed sequence systems
  - automatic sequence systems
  - jogging systems
  - plugging systems
  - hand sequence systems
  - reversing motor control systems
    - using drum switches
    - using reversing starters
2. Install, troubleshoot, and repair solid state motor control systems **(1/2)**
  - silicon controlled rectifier (SCR) and Triac systems
  - transistor speed control systems
  - closed-loop speed control systems
  - pulse width speed control systems
  - pulse-triggered speed control systems
3. Install, troubleshoot, and repair special purpose motor control systems **(1/2)**
  - AC reduced voltage starters (resistance)
  - part winding starters
  - three-phase multi-speed controllers
  - DC motor controllers
  - pilot-motor-driven timing controls
4. Install, troubleshoot, and repair motor driven systems **(1/2)**
  - electric braking devices and systems
    - dynamic braking circuit for DC motor
    - braking circuit for AC motor
    - direct drive stations
    - gear motor stations
5. Install, troubleshoot and repair sensors, controls and relay control systems **(1/2)**
  - control relay systems
  - photoelectric cells
  - photoelectric relay circuits
  - rheostats/potentiometers
  - time delay relays
    - on-delay
    - off-delay
  - control switches
  - flow switches
  - pressure switches
  - thermostats
  - potential-type motor starting relay
6. Troubleshoot and repair solid state devices in control systems **(1/2)**
  - solid state rectifiers
    - single-phase
    - three-phase
    - half-wave
    - full-wave
  - silicone controlled rectifiers
  - triacs
  - voltage regulators
    - linear
    - switching

7. Install, troubleshoot and repair power distribution systems for computers **(1/2)**
8. Install, troubleshoot and repair control wiring for a programmable controller system **(1/2)**
9. Install control systems using Class 1, Class 2, and Class 3 wiring materials and methods **(1/2)**

## Install Low-voltage and Data Communications Systems

1. Troubleshoot/install/connect/replace power and control transformers **(1/1)**
2. Troubleshoot/install/connect/replace door chime systems **(1/1)**
3. Troubleshoot/install/connect/replace intercom systems **(1/1)**
4. Troubleshoot/install/connect/replace telephone systems **(1/1)**
5. Troubleshoot/install/connect/repair/replace emergency warning systems **(1/1)**
  - fire
  - burglar
6. Troubleshoot/install/connect/replace digital communications cabling **(1/1)**
7. Troubleshoot/install/connect/replace fiber optic communications cabling **(1/1)**
8. Troubleshoot/install/connect/replace public address systems **(1/1)**
9. Troubleshoot/install/connect/replace under carpet cabling system **(1/1)**
10. Install/connect cable television systems **(1/1)**
11. Install/connect cables and terminations **(1/1)**
  - telephone
  - computer
12. Install/connect automatic garage door operator **(1/1)**



## Demonstrate Safety Skills — General Construction Industry Health and Safety

1. Identify common jobsite hazards and discuss the purpose of safety policies **(3/3)**
2. Describe the role and discuss the importance of the Occupational Safety and Health Administration (OSHA) **(3/3)**
3. Identify and describe OSHA requirements **(3/3)**
  - lock out/tag out procedures
  - HAZCOM
  - MSDS
  - exposure to blood borne pathogens
  - personal protective equipment
  - working in confined spaces
  - ladders, scaffolding, and fall arrest systems
  - proper lifting procedures
  - reporting work site hazards
4. Identify and describe first aid and emergency response procedures **(3/3)**
5. Identify fire hazards, and describe fire protection and response procedures **(3/3)**
6. Identify and describe safety precautions and procedures for using hand tools, portable power tools, and stationary power equipment **(3/3)**
7. Discuss how the use of alcohol, prescription drugs, nonprescription drugs, and controlled substances affect jobsite safety **(3/3)**
8. Complete accident/incident report **(3/3)**



## Demonstrate Safety Skills — Electrical Safety and Health

9. Identify safety precautions and procedures for working with and around electricity and high voltage transmission equipment **(3/3)**
10. Identify precautions for avoiding electrical shock and the procedures to follow when treating victims of electrical shock **(3/3)**
11. Identify safety precautions and procedures for working with “live” circuits **(3/3)**
12. Identify safety precautions and procedures for using test equipment **(3/3)**
13. Identify safety precautions and procedures for installing temporary wiring, power systems, and service installations **(3/3)**
14. Identify safety precautions and procedures for installing circuit and feeder disconnects **(3/3)**
15. Identify and clearly mark safe working clearances around electrical equipment **(3/3)**
16. Describe the safe use of flexible cords and cables **(3/3)**
17. Demonstrate knowledge of device and conductor polarity identification **(3/3)**
18. Demonstrate knowledge of GFCI applications **(3/3)**

## Sample Questions

- \_\_\_\_\_ 1. What measurement tool is used to measure distance on prints?
- architect's square
  - fish tape
  - speed square
  - try scale
- \_\_\_\_\_ 2. When should accidents be reported?
- at the earliest convenience
  - before the end of the shift
  - immediately
  - the next day
- \_\_\_\_\_ 3. On a 480V three-phase system, how many kVA are generated from 120A?
- 50kVA
  - 100kVA
  - 200kVA
  - 500kVA
- \_\_\_\_\_ 4. How many feet from overhead power lines should mechanical equipment be positioned?
- 2
  - 5
  - 10
  - 15
- \_\_\_\_\_ 5. Which of the following motor parts rotates during operation?
- armature
  - commutator
  - capacitor
  - stator
- \_\_\_\_\_ 6. What do the letters FLA on a motor nameplate stand for?
- full load amps
  - full load armature
  - fused lower arm
  - fused lever arm

- \_\_\_\_\_ 7. Residential systems are usually grounded at the \_\_\_\_\_.
- a. outdoor meter
  - b. service drop
  - c. pole-mounted transformer
  - d. main panelboard neutral bus
- \_\_\_\_\_ 8. What is the maximum number of 90° bends allowed between pull points in a conduit system?
- a. 1
  - b. 2
  - c. 3
  - d. 4
- \_\_\_\_\_ 9. What is the outer finish for a conductor having a higher voltage than the ground on a delta-connected, three-phase system?
- a. black
  - b. green
  - c. orange
  - d. white
- \_\_\_\_\_ 10. The minimum number of current-carrying conductors that can be bundled before de-rating factors apply is \_\_\_\_\_.
- a. 3
  - b. 6
  - c. 9
  - d. 12



## Sample Questions — Key

1. What measurement tool is used to measure distance on prints?
  - a. architect's square **Correct**
  - b. fish tape **Incorrect by definition**
  - c. speed square **Incorrect by definition**
  - d. try scale **Incorrect by definition**
  
2. When should accidents be reported?
  - a. at the earliest convenience **Wrong, but plausible**
  - b. before the end of the shift **Wrong, but plausible**
  - c. immediately **Correct**
  - d. the next day **Wrong, but plausible**
  
3. On a 480V three-phase system, how many kVA are generated from 120A?
  - a. 50kVA **Wrong, but plausible**
  - b. 100kVA **Correct**
  - c. 200kVA **Wrong, but plausible**
  - d. 500kVA **Wrong, but plausible**
  
4. How many feet from overhead power lines should mechanical equipment be positioned?
  - a. 2 **Wrong, but plausible**
  - b. 5 **Wrong, but plausible**
  - c. 10 **Correct**
  - d. 15 **Wrong, but plausible**
  
5. Which of the following motor parts rotates during operation?
  - a. armature **Correct**
  - b. commutator **Wrong, but plausible**
  - c. capacitor **Wrong, but plausible**
  - d. stator **Wrong, but plausible**
  
6. What do the letters FLA on a motor nameplate stand for?
  - a. full load amps **Correct**
  - b. full load armature **Wrong, but plausible**
  - c. fused lower arm **Wrong, but plausible**
  - d. fused lever arm **Wrong, but plausible**

7. Residential systems are usually grounded at the \_\_\_\_\_.

- a. outdoor meter                      Wrong, but plausible
- b. service drop                        Wrong, but plausible
- c. pole-mounted transformer        Wrong, but plausible
- d. main panelboard neutral bus      Correct

8. What is the maximum number of 90° bends allowed between pull points in a conduit system?

- a. 1                                        Wrong, but plausible
- b. 2                                        Wrong, but plausible
- c. 3                                        Wrong, but plausible
- d. 4                                        Correct

9. What is the outer finish for a conductor having a higher voltage than the ground on a delta-connected, three-phase system?

- a. black                                  Wrong, but plausible
- b. green                                 Wrong, but plausible
- c. orange                                Correct
- d. white                                 Wrong, but plausible

10. The minimum number of current-carrying conductors that can be bundled before de-rating factors apply is \_\_\_\_\_.

- a. 3                                        Correct
- b. 6                                        Wrong, but plausible
- c. 9                                        Wrong, but plausible
- d. 12                                      Wrong, but plausible

## Curricula Crosswalk

### Crosswalk to NCCER Modules and Multistate Academic and Vocational Curriculum Consortium (MAVCC) Electrical Series

The following crosswalk is intended for guidance purposes only. It does not represent all curricula or resource materials that may be used for electrical programs. It is intended as a reference for curriculum planning and mapping standards to available curricula.

#### Curriculum/Resource Titles:

- (1) MAVCC - Basic Wiring
- (2) MAVCC - Residential Wiring
- (3) MAVCC - Commercial and Industrial Wiring
- (4) NCCER - Electrical Level One
- (5) NCCER - Electrical Level Two
- (6) NCCER - Electrical Level Three

For more information about MAVCC curricula, please go to [www.okcimc.com](http://www.okcimc.com).

Module Name — Objective	Unit/Module
<b>Plan and Organize Work</b>	(1) Units 2, 5, 6, 8-17 (2) Units 1-5 (3) Unit 4, 7, 8, 9, 10, 12, 14 (4) Module 26110 (5) Module 26202
1. Plan a sequence of work operations	(3) Projects (4) Module 26110 (5) Module 26202
2. Inventory equipment and supplies	(1) Units 2, 5, 6, 8-17 (2) Units 1-5 (4) Module 26110
3. Compile a list of motor nameplate data	(3) Unit 7 (5) Module 26202
7. Compile list of materials from wiring blueprint	(3) Projects (4) Module 26110 (5) Module 26202
9. Draw control panel diagrams	(4) Module 26110 (5) Module 26202
10. Draw external power diagrams	(3) Unit 8 (4) Module 26110 (5) Module 26202
11. Draw schematic diagrams from pre-wired circuits	(3) Units 4, 9, 10, 12, 14 (4) Module 26110 (5) Module 26202

Module Name — Objective	Unit/Module
12. Draw an as-built electrical plan	(2) 1 & 4 (3) Projects (4) Module 26110 (5) Module 26202
<b>Perform Activities Related to Basic Circuits</b>	(1) Units 6, 10 (4) Module 26103, 26104, 26112 (5) Module 26202
1. Construct/analyze/install series circuits	(1) Unit 10 (4) Module 26103, 26104, 26112 (5) Module 26202
3. Draw series circuit and calculate circuit values	(1) Unit 10 (4) Module 26103, 26104, 26112 (5) Module 26202
4. Construct/analyze/install parallel circuits	(1) Unit 10 (4) Module 26103, 26104, 26112 (5) Module 26202
6. Draw parallel circuit and calculate circuit values	(1) Unit 10 (4) Module 26103, 26104, 26112 (5) Module 26202
7. Construct/analyze/install series-parallel circuits	(1) Unit 10 (4) Module 26103, 26104, 26112 (5) Module 26202
9. Draw series-parallel circuits and calculate circuit values	(1) Unit 10 (4) Module 26103, 26104, 26112 (5) Module 26202
10. Set up and operate for basic circuits	(1) Unit 6 (4) Module 26103, 26104, 26112 (5) Module 26202
<b>Perform Activities Related to Alternating Current Circuits</b>	(1) Module Unit 6, 11 (2) Unit 5 (3) Unit 4, 7 (5) Module 26201
1. Identify AC sources	(1) Module Unit 11 (5) Module 26201
2. Analyze and apply principles of transformers to AC circuits	(1) Module Unit 11 (2) Unit 5 (5) Module 26201
3. Install single-phase circuits	(5) Module 26201
4. Troubleshoot single-phase circuits	(5) Module 26201
5. Construct/analyze/install polyphase circuits	(1) Module Unit 11 (5) Module 26201

<b>Module Name — Objective</b>	<b>Unit/Module</b>
6. Troubleshoot polyphase circuits	(1) Module Unit 6 (5) Module 26201
7. Remove/replace capacitors in an AC circuit	(5) Module 26201
8. Test capacitors in an AC circuit	(1) Module Unit 11 (3) Unit 4 (5) Module 26201
9. Install power transformers	(5) Module 26201
11. Install control transformers	(5) Module 26201
13. Make proper connections on dual voltage motors	(5) Module 26201
14. Make proper connections on dual voltage generators	(5) Module 26201
15. Set up and operate for AC circuits	(1) Module Unit 6, 11 (3) Unit 4, 7 (5) Module 26201
<b>Demonstrate Knowledge of NEC — Introduction, Definitions, &amp; Requirements for Electrical Installations</b>	(1) Unit 7 (4) Module 26105
1. Demonstrate knowledge of Article 90 (Introduction)	(1) Unit 7 (4) Module 26105
2. Demonstrate knowledge of Article 100 (Definitions)	(1) Unit 7 (4) Module 26105
3. Demonstrate knowledge of Article 110 (Requirements for Electrical Installations)	(1) Unit 7 (4) Module 26105
4. Demonstrate knowledge of Article 210 (Branch Circuit Requirements)	(1) Unit 7 (4) Module 26105
5. Demonstrate knowledge of Article 230 (Service Point Locations)	(1) Unit 7 (4) Module 26105
<b>Perform Calculations</b>	(1) Unit 7, 9, 10, 11, 13, 15, 17 (2) Unit 1, 2 (3) Unit 1, 4, 5, 9, 10, 12, 13 (4) Module 26108, 26111 (5) Module 26206, 26209, 26210 (6) Module 26301, 26302, 26307 26308
1. Calculate and balance the total load per phase	(1) Unit 11 (4) Module 26111 (6) Module 26308
2. Calculate the grounding electrode system and bonding requirements	1) Unit 7 (2) Unit 2 (4) Module 26111 (5) Module 26209 (6) Module 26308
3. Calculate individual circuits	(1) Unit 13 (3) Unit 1 (4) Module 26111 (5) Module 26210 (6) Module 26301



<b>Module Name — Objective</b>	<b>Unit/Module</b>
4. Calculate the load in volt-amperes and the load current in amperes	(1) Unit 11 (3) Unit 1 (4) Module 26111 (5) Module 26210 (6) Module 26301
5. Calculate service size	(2) Unit 2 (3) Projects (4) Module 26111 (5) Module 26210 (6) Module 26308
6. Determine the number of convenience and appliance outlets per circuit	(2) Unit 1 (4) Module 26111 (5) Module 26210 (6) Module 26307
7. Perform transformer and motor calculations	(1) Unit 13 (2) Unit 1, 4 (6) Module 26307
8. Calculate voltage drop	(1) Unit 11 (3) Projects (6) Module 26302
9. Calculate conductors	(1) Units 13, 15, 17 (2) Unit 2 (3) Units 1, 5, 9, 10, 12, 13 (4) Module 26111 (5) Module 26206 (6) Module 26301, 26302
10. Calculate size of raceways and enclosures	(4) Module 26108
11. Calculate overcurrent protection	(1) Unit 15 (2) Unit 2 (3) Units 1, 9, 10, 12 (4) Module 26111 (5) Module 26210 (6) Module 26302
12. Perform calculations using Ohm's Law	(1) Unit 9, 10 (4) Module 26111 (6) Module 26308

Module Name — Objective	Unit/Module
<b>Install Services</b>	(1) Unit 16 (2) Unit 2 (3) Unit 3 (4) Module 26109, 26111 (5) Module 26202, 26206, 26209 (6) Module 26302, 26306, 26308
1. Ground service equipment	(2) Unit 2 (3) Unit 3 (4) Module 26111 (5) Module 26209 (6) Module 26308
2. Size and install service conductors	(1) Unit 16 (2) Unit 2 (3) Unit 3 (4) Module 26109, 26111 (5) Module 26206 (6) Module 26302, 26308
3. Install mast-type service	(6) Module 26308
4. Install main service disconnects (master switches)	(1) Unit 16 (4) Module 26111 (6) Module 26308
5. Install circuit breakers in panels	(1) Unit 16 (4) Module 26111 (6) Module 26308
7. Install service panels (distribution panel boards)	(6) Module 26306
8. Install temporary service	(3) Unit 3
9. Install underground service	(2) Unit 2 (4) Module 26111
10. Install metering equipment	(2) Unit 2 (3) Unit 3 (4) Module 26111 (6) Module 26306, 26308
<b>Install Switch and Outlet Boxes</b>	(1) Unit 11, 17 (2) Unit 4 (3) Unit 5 (4) Module 26106, 26108, 26111 (5) Module 26205 (6) Module 26304, 26308
1. Install and size boxes	(4) Module 26106, 26111 (5) Module 26205 (6) Module 26304, 26308
2. Install recessed fixture housings in ceilings	(1) Unit 17 (2) Unit 4 (4) Module 26106, 26111 (6) Module 26308

Module Name — Objective	Unit/Module
3. Install bar-hanger mounted box	(1) Unit 11, 17 (2) Unit 4 (3) Unit 5 (4) Module 26106, 26111 (6) Module 26308
4. Install flush mount junction box	(2) Unit 4 (4) Module 26106, 26111 (6) Module 26308
5. Install flush mount switch and outlet box in different locations	(1) Unit 17 (2) Unit 4 (3) Unit 5 (4) Module 26106, 26111 (6) Module 26308
6. Install gangable boxes	(2) Unit 4 (3) Unit 5 (4) Module 26106, 26111 (6) Module 26308
7. Install octagon outlet box	(1) Unit 11, 17 (2) Unit 4 (3) Unit 5 (4) Module 26106, 26111 (6) Module 26308
8. Install surface mount junction box	(2) Unit 4 (3) Unit 5 (4) Module 26106, 26111 (5) Module 26205 (6) Module 26308
10. Install raceway supported enclosures	(4) Module 26108
<b>Rough-In Circuits</b>	(1) Unit 11, 12, 13, 14, 16, 17 (2) Unit 2, 4, 5, (3) Unit 5, 16 (4) Module 26107, 26108, 26109 26111 (5) Module 26204, 26205, 26206 26208, 26210 (6) Module 26304, 26308
1. Lay out electrical systems	(2) Unit 4 (3) Unit 5, Projects (4) Module 26111 (5) Module 26205, 26206 26208, 26210 (6) Module 26304, 26308

Module Name — Objective	Unit/Module
2. Rough-in feeders and circuits using a cable system	(2) Unit 2 (3) Unit 5 (4) Module 26109, 26111 (5) Module 26206 (6) Module 26308
3. Rough-in and properly secure circuits in conduits and other raceways	(1) Unit 17 (2) Unit 2 (4) Module 26109, 26111 (6) Module 26308
4. Rough-in and properly secure cables or conduits for branch circuits	(2) Unit 4 (3) Unit 5 (4) Module 26109, 26111 (6) Module 26308
5. Connect circuits to circuit breaker panels	(1) Unit 16 (2) Unit 2, 4 (3) Unit 5 (4) Module 26111 (5) Module 26210 (6) Module 26308
6. Rough-in circuits to outlet boxes	(1) Unit 16 (2) Unit 4 (3) Unit 5 (4) Module 26111 (5) Module 26210 (6) Module 26308
7. Rough-in cables between existing boxes and newly installed boxes	(1) Unit 17 (4) Module 26111 (5) Module 26206 (6) Module 26308
8. Rough-in a circuit for an outlet controlled with switches & to devices	(1) Unit 11 (2) Unit 4 (3) Unit 5 (4) Module 26111 (5) Module 26210 (6) Module 26308
9. Rough-in low-voltage circuits	(1) Unit 14 (2) Unit 5 (4) Module 26111 (5) Module 26210
10. Rough-in cables for general purpose branch circuits	(1) Unit 16 (2) Unit 4 (3) Unit 5 (4) Module 26111 (6) Module 26308

<b>Module Name — Objective</b>	<b>Unit/Module</b>
11. Make splices using mechanical-type connectors	(1) Unit 12, 13 (2) Unit 4 (4) Module 26111 (6) Module 26308
12. Make joints using crimp type connectors (splices)	(5) Module 26208
13. Make terminations	(1) Unit 13 (2) Unit 4 (4) Module 26111 (5) Module 26208 (6) Module 26308
14. Rough-in branch circuit wires to panels	(2) Unit 4 (3) Unit 5 (4) Module 26111 (6) Module 26308
15. Install panels and subpanels	(1) Unit 16 (2) Unit 2 (3) Projects (4) Module 26111 (6) Module 26308
16. Run feeder cables from main service panels to subpanels	(4) Module 26111 (6) Module 26308
17. Rough-in weatherproof outlet boxes and covers	(3) Projects (5) Module 26205
18. Rough-in electrical environmental control components	(4) Module 26111 (6) Module 26308
19. Install conduits, cables, raceways, and equipment	(1) Unit 13 (2) Unit 2, 4 (3) Unit 5, 16 (4) Module 26107, 26108, 26109 26111 (5) Module 26204, 26205, 26206 (6) Module 26304, 26308
20. Install receptacle circuits	(2) Unit 4 (3) Unit 5 (4) Module 26111 (5) Module 26210 (6) Module 26308
21. Rough-in thermostat wiring	(1) Unit 13 (4) Module 26111 (6) Module 26308

Module Name — Objective	Unit/Module
<b>Install Electrical Field Wiring for Environmental Control Systems</b>	(2) Unit 4 (3) Projects (4) Module 26111
1. Install/connect baseboard heating systems	(4) Module 26111
2. Install/connect wall heaters	(4) Module 26111
3. Install/connect ceiling heat cables	(4) Module 26111
4. Connect central electric heat	(4) Module 26111
5. Install individual space heaters	(4) Module 26111
6. Connect thermostats	(4) Module 26111
10. Install/connect for ventilation systems	(3) Projects (4) Module 26111
11. Install/connect for air conditioning systems	(2) Unit 4 (4) Module 26111
12. Install/connect all associated field wiring for environmental controls	(4) Module 26111
<b>Trim Out (Finish) Electrical Devices and Appliances</b>	(1) Unit 14 (2) Unit 4, 5 (3) Unit 5, 10, Projects (4) Module 26111 (5) Module 26203, 26210 (6) Module 26301, 26303, 26308
1. Install/connect all lighting fixtures and circuits	(2) Unit 4 (4) Module 26111 (5) Module 26203 (6) Module 26303, 26308
2. Install/connect paddle fans	(2) Unit 4 (4) Module 26111 (6) Module 26308
3. Install/connect a photoelectric control on a light	(4) Module 26111 (5) Module 26203 (6) Module 26308
6. Determine the proper location for and install/connect emergency lighting systems	(4) Module 26111 (5) Module 26203 (6) Module 26308
7. Install/connect receptacles	(2) Unit 4 (4) Module 26111 (6) Module 26308
8. Install/connect switches	(2) Unit 4 (4) Module 26111 (6) Module 26308
9. Install/connect time switches	(4) Module 26111 (6) Module 26308

Module Name — Objective	Unit/Module
10. Install/connect appliances	(2) Unit 4 (4) Module 26111 (6) Module 26308
11. Connect sump and well pump motors	(3) Projects (4) Module 26111 (6) Module 26308
12. Install/connect panels	(3) Projects (4) Module 26111 (6) Module 26308
14. Install/connect low voltage systems	(2) Unit 5 (3) Unit 10 (4) Module 26111 (6) Module 26308
15. Install/connect ground fault interrupting devices	(5) Module 26210
16. Connect water heaters	(6) Module 26301
18. Install/connect circuits for hydromassage tubs	(4) Module 26111
20. Determine the proper location for and install smoke and CO <sub>2</sub> detectors	(1) Unit 14 (2) Unit 5 (3) Unit 5 (4) Module 26111 (6) Module 26308
21. Install/connect lighting dimmer systems	(6) Module 26308
<b>Maintain and Repair Existing Wiring Systems</b>	(2) Unit 4 (3) Unit 7, Projects (4) Module 26111 (5) Module 26202, 26210 (6) Module 26301, 26303, 26305 26306, 26307, 26308, 26311
1. Troubleshoot/repair/replace HVAC system controls	(4) Module 26111 (6) Module 26308
2. Troubleshoot/repair/replace relays and timers	(3) Projects (6) Module 26306
3. Troubleshoot/repair/replace lighting fixtures	(2) Unit 4 (4) Module 26111 (6) Module 26303, 26308
4. Troubleshoot/replace electrical components of water heaters	(4) Module 26111 (6) Module 26301
5. Troubleshoot/repair/replace overcurrent protective devices	(5) Module 26210 (6) Module 26305, 26308
6. Troubleshoot/repair/replace service entrance equipment	(2) Unit 4 (4) Module 26111
7. Replace receptacles or switches	(4) Module 26111 (6) Module 26308

<b>Module Name — Objective</b>	<b>Unit/Module</b>
9. Troubleshoot/replace transformers	(6) Module 26307
10. Troubleshoot/repair/replace electric motors	(3) Unit 7 (5) Module 26202 (6) Module 26311
<b>Install and Maintain Special Systems</b>	(1) Unit 17 (2) Unit 2, 4 (3) Unit 4, Projects (4) Module 26108, 26111 (5) Module 26206, 26207, 26209 26210 (6) Module 26303, 26304, 26308
1. Install ducts	(4) Module 26108
2. Install wireway	(1) Unit 17 (4) Module 26108 (6) Module 26308
3. Install wiring in mounted wireways and cable trays	(4) Module 26108 (5) Module 26206, 26207
4. Install circuit breakers, fuses, and disconnecting means	(4) Module 26111 (5) Module 26210 (6) Module 26308
5. Install circuits using nonmetallic sheathed cable	(5) Module 26210
6. Install and connect system grounds	(5) Module 26210
7. Install raceway systems and conductors	(2) Unit 4 (4) Module 26108
8. Install systems in hazardous locations	(3) Projects (6) Module 26304
10. Install lighting dimmer systems	(6) Module 26303
13. Test the insulation of cables and equipment	(3) Unit 4 (4) Module 26111 (6) Module 26308
15. Troubleshoot/install/replace grounding, bonding, and circuits	(4) Module 26111 (5) Module 26209 (6) Module 26308
16. Troubleshoot/install/replace pool grounding, bonding, and circuits	(4) Module 26111 (5) Module 26209 (6) Module 26308
<b>Install Transformers</b>	(3) Unit 4 (6) Module 26307
1. Install and connect transformers	(3) Unit 4 (6) Module 26307
2. Test transformer for output and performance under load	(3) Unit 4 (6) Module 26307
3. Clean power transformer	(6) Module 26307
4. Connect a dual-voltage transformer for different outputs	(6) Module 26307



<b>Module Name — Objective</b>	<b>Unit/Module</b>
5. Connect auto transformer to give a variety of voltages	(6) Module 26307
6. Connect power-supply distribution transformer to supply	(6) Module 26307
7. Connect three single-phase transformers to form different configurations	(3) Unit 4 (6) Module 26307
8. Connect two single-phase transformers to form different configurations	(6) Module 26307
9. Connect a voltmeter to a power line through the use of a potential transformer	(6) Module 26307
10. Connect an amp meter to high voltage line using current transformer	(6) Module 26307
<b>Install AC &amp; DC Rotating Equipment</b>	(3) Unit 7, 13 (5) Module 26202 (6) Module 26309, 26311
1. Install/connect/replace DC circuits	(5) Module 26202 (6) Module 26309, 26311
2. Install/connect/replace DC generators	(5) Module 26202 (6) Module 26309, 26311
3. Change the output of DC generator	(5) Module 26202 (6) Module 26309, 26311
4. Change the direction of rotation of electrical motors	(3) Unit 13 (5) Module 26202 (6) Module 26309, 26311
5. Install/connect AC motors	(5) Module 26202 (6) Module 26309, 26311
6. Install/connect/replace AC alternator	(5) Module 26202 (6) Module 26309, 26311
7. Install/connect phase converters	(5) Module 26202 (6) Module 26309, 26311
8. Connect single-phase AC motor to run from different voltages	(5) Module 26202 (6) Module 26309, 26311
9. Connect three-phase AC motor to run from different voltages	(3) Unit 7 (5) Module 26202 (6) Module 26309, 26311
10. Connect three-phase motor stator for different operations	(5) Module 26202 (6) Module 26309, 26311
11. Connect/replace motors	(5) Module 26202 (6) Module 26309, 26311
12. Connect a three-phase alternator	(5) Module 26202 (6) Module 26309, 26311

Module Name — Objective	Unit/Module
<b>Construct, Install, and Maintain Electrical Control Systems and Devices</b>	(3) Unit 7, 9, 10, 11, 12, 13, 14, 15, Projects (5) Module 26211 (6) Module 26309, 26311
1. Install, troubleshoot, and repair motor control systems	(3) Unit 7, 9, 11, 12, 13, 14, Projects (5) Module 26211 (6) Module 26309, 26311
2. Install, troubleshoot, and repair solid state motor control systems	(5) Module 26211 (6) Module 26309, 26311
3. Install, troubleshoot, and repair special purpose motor control systems	(3) Unit 9, 10, Projects (5) Module 26211 (6) Module 26309, 26311
4. Install, troubleshoot, and repair motor driven systems	(5) Module 26211 (6) Module 26309, 26311
5. Install, troubleshoot and repair sensors, controls and relay control systems	(3) Unit 9, 10, 12, 14, Projects (5) Module 26211 (6) Module 26309, 26311
6. Troubleshoot and repair solid state devices in control systems	(3) Unit 10 (5) Module 26211 (6) Module 26309, 26311
7. Install, troubleshoot and repair power distribution systems for computers	(5) Module 26211 (6) Module 26309, 26311
8. Install, troubleshoot and repair control wiring for a programmable controller system	(3) Unit 10, 15 (5) Module 26211 (6) Module 26309, 26311
9. Install control systems using Class 1, Class 2, and Class 3 wiring materials and methods	(3) Unit 14 (5) Module 26211 (6) Module 26309, 26311
<b>Install Low-voltage &amp; Data Communications Systems</b>	(1) Unit 14 (2) Unit 5 (6) Module 26310
1. Troubleshoot/install/connect/replace power and control transformers	(2) Unit 5 (6) Module 26310
2. Troubleshoot/install/connect/replace door chime systems	(1) Unit 14 (2) Unit 5 (6) Module 26310
3. Troubleshoot/install/connect/replace intercom systems	(6) Module 26310
4. Troubleshoot/install/connect/replace telephone systems	(2) Unit 5 (6) Module 26310
5. Troubleshoot/install/connect/repair/replace emergency warning systems	(1) Unit 14 (2) Unit 5 (6) Module 26310

<b>Module Name — Objective</b>	<b>Unit/Module</b>
6. Troubleshoot/install/connect/replace digital communications cabling	(6) Module 26310
7. Troubleshoot/install/connect/replace fiber optic communications cabling	(6) Module 26310
8. Troubleshoot/install/connect/replace public address systems	(6) Module 26310
9. Troubleshoot/install/connect/replace under carpet cabling system	(6) Module 26310
10. Install/connect cable television systems	(6) Module 26310
11. Install/connect cables and terminations	(6) Module 26310
12. Install/connect automatic garage door operator	(6) Module 26310
<b>Demonstrate Safety Skills</b>	(1) All Units (2) All Units (3) All Units (4) Module 26102
<i>General Construction Industry Health and Safety</i>	
1. Identify common jobsite hazards and discuss the purpose of safety policies	(1) All Units (2) All Units (3) All Units (4) Module 26102
2. Describe the role and discuss the importance of the Occupational Safety and Health Administration (OSHA)	(1) All Units (2) All Units (3) All Units (4) Module 26102
3. Identify and describe OSHA requirements	(1) All Units (2) All Units (3) All Units (4) Module 26102
4. Identify and describe first aid and emergency response procedures	(1) All Units (2) All Units (3) All Units (4) Module 26102
5. Identify fire hazards, and describe fire protection and response procedures	(1) All Units (2) All Units (3) All Units (4) Module 26102
6. Identify and describe safety precautions and procedures for using hand tools, portable power tools, and stationary power equipment	(1) All Units (2) All Units (3) All Units (4) Module 26102
7. Discuss how the use of alcohol, prescription drugs, nonprescription drugs, and controlled substances affects jobsite safety	(1) All Units (2) All Units (3) All Units (4) Module 26102

<b>Module Name — Objective</b>	<b>Unit/Module</b>
8. Complete accident/incident report	(1) All Units (2) All Units (3) All Units (4) Module 26102
<i>Electrical Safety and Health</i>	
9. Identify safety precautions and procedures for working with and around electricity and high voltage transmission equipment	(1) All Units (2) All Units (3) All Units (4) Module 26102
10. Identify precautions for avoiding electrical shock and the procedures to follow when treating victims of electrical shock	(1) All Units (2) All Units (3) All Units (4) Module 26102
11. Identify safety precautions and procedures for working with “live” circuits	(1) All Units (2) All Units (3) All Units (4) Module 26102
12. Identify safety precautions and procedures for using test equipment	(1) All Units (2) All Units (3) All Units (4) Module 26102
13. Identify safety precautions and procedures for installing temporary wiring, power systems, and service installation	(1) All Units (2) All Units (3) All Units (4) Module 26102
14. Identify safety precautions and procedures for installing circuit and feeder disconnects	(1) All Units (2) All Units (3) All Units (4) Module 26102
15. Identify and clearly mark safe working clearances around electrical equipment	(1) All Units (2) All Units (3) All Units (4) Module 26102
16. Describe the safe use of flexible cords and cable	(1) All Units (2) All Units (3) All Units (4) Module 26102
17. Demonstrate knowledge of device and conductor polarity identification	(1) All Units (2) All Units (3) All Units (4) Module 26102
18. Demonstrate knowledge of GFCI applications	(1) All Units (2) All Units (3) All Units (4) Module 26102

## Abbreviations, Symbols and Acronyms

The following is a list of abbreviations, symbols, and acronyms used in the Electrical study guide and on the Electrical assessments.

°	Degree
°F	Degree Fahrenheit
\$	Dollars
'	Foot/feet
"	Inch/inches
Ω	Ohms
%	Percent
A	Amps
AC	Alternating Current
AWG	American Wire Gauge
CATV	Community Antenna Television
CATVP	Community Antenna Television Plenum
CATVR	Community Antenna Television Riser
CATVX	Community Antenna Television Limited-use
CM	Communication cable
CMP	Communication Plenum cable
CMR	Communications Riser cable
CMX	Communications cable limited use
DC	Direct Current
EMT	Electrical Metallic Tubing
FLA	Full Load Amperes/Amps
FLC	Full Load Current
ft <sup>2</sup>	Feet Squared
GFCI	Ground-fault Circuit Interrupter
HAZCOM	Hazard Communication
HP	Horse Power
HVAC	Heating Ventilation and Air Conditioning
kV	Kilovolts
kW	Kilowatt
MC	Metal clad
MSDS	Material Safety Data Sheet
NEC	National Electric Code
NM	Nonmetallic
OSHA	Occupation Safety and Health Act
PLC	Programmable Logic Controller
RMC	Rigid Metal Conduit
THHN	Thermoplastic High Heat-resistant Nylon
THW	Thermoplastic Heat-resistant Vinyl Wire
UF	Underground feeder
XHHW	Cross-linked High Heat Water-resistant Insulated Wire
V	Volts
VA	Volt-Ampere

## Test Taking Strategies

This section of the study guide contains valuable information for testing success and provides a common-sense approach for preparing for and performing well on any test.

### General Testing Advice

1. Get a good night's rest the night before the test — eight hours of sleep is recommended.
2. Avoid junk food and “eat right” several days before the test.
3. Do not drink a lot or eat a large meal prior to testing.
4. Be confident in your knowledge and skills!
5. Relax and try to ignore distractions during the test.
6. Focus on the task at hand — taking the test and doing your best!
7. Listen carefully to the instructions provided by the exam proctor. If the instructions are not clear, ask for clarification.

### Testing Tips

1. Read the entire question before attempting to answer it.
2. Try to answer the question before reading the choices. Then, read the choices to determine if one matches, or is similar, to your answer.
3. Do not change your answer unless you misread the question or are certain that your first answer is incorrect.
4. Answer questions you know first, so you can spend additional time on the more difficult questions.
5. Check to make sure you have answered every question before you submit the assessment for scoring — unanswered questions are marked incorrect.





