National Craft Assessment and Certification Program
S P E C I F I C A T I O N S

INDUSTRIAL ELECTRICIAN V4
ELEC26_O4
Released September 2013

Focus Statement
An Industrial Electrician must be able to interpret job specifications, interpret industrial drawings, install, connect, and troubleshoot power distribution and control equipment, install raceway and cable distribution systems, install and connect transformers, install and connect medium voltage splices and terminations, and recognize electrical hazards.

Overview
- Two-hour closed-book examination
- May use a basic function, non-printing calculator
- No extra papers, books, notes or study materials are allowed
- The minimum passing score is 75
- A Performance Verification is available

Study Materials
All NCCER written assessments are referenced to NCCER's curriculum listed in the content. You may order modules from Pearson (800.922.0579) or from NCCER's Online Catalog at www.nccer.org.

Assessment Development
All questions are developed and approved by subject matter experts under the direction of NCCER and Prov™, NCCER's testing partner.

Credentials
NCCER will send appropriate credentials to the assessment center for successful completions.

Training Prescription Reports
Each candidate will have access to individual results of the written assessment from Prov's website at www.provexam.com.

Registry
Assessment results will be maintained in NCCER's Registry and become a portable record of the candidate's training and assessment achievements.

Written Assessment Contents:

Content Domain	Number of Questions
Electrical Safety *[26102-14]*	8
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Total Number of Questions	**100**

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S P E C I F I C A T I O N S

Learning Objectives related to Assessment:

	Electrical Safety
Registry ID Number:	**Module Title and Objectives:**
26102-14	**Electrical Safety**
	1. Recognize safe working practices in the construction environment.
	2. Explain the purpose of OSHA and how it promotes safety on the job.
	3. Identify electrical hazards and how to avoid or minimize them in the workplace.
	4. Explain electrical safety issues concerning lockout/tagout procedures, confined space entry, respiratory protection, and fall protection systems.
	5. Develop a task plan and a hazard assessment for a given task and select the appropriate PPE and work
	Introduction to Electrical Circuits
Registry ID Number:	**Module Title and Objectives:**
26103-14	**Introduction to Electrical Circuits**
	1. Define voltage and identify the ways in which it can be produced.
	2. Explain the difference between conductors and insulators.
	3. Define the units of measurement that are used to measure the properties of electricity.
	4. Identify the meters used to measure voltage, current, and resistance.
	5. Explain the basic characteristics of series and parallel circuits.
	Electrical Theory
Registry ID Number:	**Module Title and Objectives:**
26104-14	**Electrical Theory**
	1. Explain the basic characteristics of combination circuits.
	2. Calculate, using Kirchhoff's voltage law, the voltage drop in series, parallel, and series-parallel circuits.
	3. Calculate, using Kirchhoff's current law, the total current in parallel and series-parallel circuits.
	4. Using Ohm's law, find the unknown parameters in series, parallel, and series-parallel circuits.
	Raceways and Fittings
Registry ID Number:	**Module Title and Objectives:**
26108-14	**Raceways and Fittings**
	1. Identify and select various types and sizes of raceways and fittings for a given application.
	2. Identify various methods used to fabricate (join) and install raceway systems.
	3. Identify uses permitted for selected raceways.

	4. Demonstrate how to install a flexible raceway system.
	5. Terminate a selected raceway system.
	6. Identify the appropriate conduit body for a given application.
	Conductors and Cables
Registry ID Number:	**Module Title and Objectives:**
26109-14	**Conductors and Cables**
	1. From the cable markings, describe the insulation and jacket material, conductor size and type, number of conductors, temperature rating, voltage rating, and permitted uses.
	2. Determine the allowable ampacity of a conductor for a given application.
	3. Identify the NEC® requirements for color coding of conductors.
	4. Install conductors in a raceway system.
	Basic Electrical Drawings
Registry ID Number:	**Module Title and Objectives:**
26110-14	**Basic Electrical Drawings**
	1. Explain the basic layout of a set of construction drawings.
	2. Describe the information included in the title block of a construction drawing.
	3. Identify the types of lines used on construction drawings.
	4. Using an architect's scale, state the actual dimensions of a given drawing component.
	5. Interpret electrical drawings, including site plans, floor plans, and detail drawings.
	6. Interpret equipment schedules found on electrical drawings.
	7. Describe the type of information included in electrical specifications.
	Electrical Test Equipment
Registry ID Number:	**Module Title and Objectives:**
26112-14	**Electrical Test Equipment**
	1. Explain the operations of and describe the following pieces of test equipment: • Voltmeter • Ohmmeter • Clamp-on ammeter • Multimeter • Megohmmeter • Motor and phase rotation testers
	2. Select the appropriate meter for a given work environment based on category ratings.
	3. Identify the safety hazards associated with the various types of test equipment.

	Alternating Current
Registry ID Number:	**Module Title and Objectives:**
26201-14	**Alternating Current**
	1. Calculate the peak and effective voltage or current values for an AC waveform.
	2. Calculate the phase relationship between two AC waveforms.
	3. Describe the voltage and current phase relationship in a resistive AC circuit.
	4. Describe the voltage and current transients that occur in an inductive circuit.
	5. Define inductive reactance and state how it is affected by frequency.
	6. Describe the voltage and current transients that occur in a capacitive circuit.
	7. Define capacitive reactance and state how it is affected by frequency.
	8. Explain the relationship between voltage and current in the following types of AC circuits: • RL circuit • RC circuit • LC circuit • RLC circuit
	9. Explain the following terms as they relate to AC circuits: • True power • Apparent power • Reactive power • Power factor
	10. Explain basic transformer action.
	Motors: Theory and Application
Registry ID Number:	**Module Title and Objectives:**
26202-14	**Motors: Theory and Application**
	1. Define the following terms: • Controller • Duty cycle • Full-load amps • Interrupting rating • Thermal protection • NEMA design letter • Overcurrent • Overload • Power factor • Rated full-load speed • Rated horsepower • Service factor
	2. Describe the various types of motor enclosures.
	3. Explain the relationships among speed, frequency, and the number of poles in a three-phase induction motor.
	4. Define percent slip and speed regulation.
	5. Explain how the direction of a three-phase motor is changed.

	6. Describe the component parts and operating characteristics of a three-phase wound-rotor induction motor.
	7. Describe the component parts and operating characteristics of a three-phase synchronous motor.
	8. Describe the design and operating characteristics of various DC motors.
	9. Describe the methods for determining various motor connections.
	10. Describe general motor protection requirements as delineated in the *National Electrical Code*® (*NEC*®).
	11. Define the braking requirements for AC and DC motors.
	Conduit Bending
Registry ID Number:	**Module Title and Objectives:**
26204-14	**Conduit Bending**
	1. Describe the process of conduit bending using power tools.
	2. Identify all parts of electric and hydraulic benders.
	3. Bend offsets, kicks, saddles, segmented, and parallel bends.
	4. Explain the requirements of the *National Electrical Code*® for bending conduit.
	5. Compute the radius, degrees in bend, developed length, and gain for conduit up to six inches.
	Pull and Junction Boxes
Registry ID Number:	**Module Title and Objectives:**
26205-14	**Pull and Junction Boxes**
	1. Describe the different types of nonmetallic and metallic pull and junction boxes.
	2. Properly select, install, and support pull and junction boxes and their associated fittings.
	3. Describe the *National Electrical Code*® (*NEC*®) regulations governing pull and junction boxes.
	4. Size pull and junction boxes for various applications.
	5. Understand the NEMA and IP classifications for pull and junction boxes.
	6. Describe the purpose of conduit bodies and Type FS boxes.
	Conductor Installations
Registry ID Number:	**Module Title and Objectives:**
26206-14	**Conductor Installations**
	1. Explain the importance of communication during a cable-pulling operation.
	2. Plan and set up for a cable pull.
	3. Set up reel stands and spindles for a wire-pulling installation.
	4. Explain how mandrels, swabs, and brushes are used to prepare conduit for conductors.
	5. Properly install a pull line for a cable-pulling operation.
	6. Explain how and when to support conductors in vertical conduit runs.
	7. Describe the installation of cables in cable trays.
	8. Calculate the probable stress or tension in cable pulls.

	Cable Tray
Registry ID Number:	**Module Title and Objectives:**
26207-14	**Cable Tray**
	1. Describe the components that make up a cable tray assembly.
	2. Explain the methods used to hang and secure cable tray.
	3. Describe how cable enters and exits cable tray.
	4. Select the proper cable tray fitting for the situation.
	5. Explain the *National Electrical Code*® (*NEC*®) requirements for cable tray installations.
	6. Select the required fittings to ensure equipment grounding continuity in cable tray systems.
	7. Interpret electrical working drawings showing cable tray fittings.
	8. Size cable tray for the number and type of conductors contained in the system.
	Conductor Terminations
Registry ID Number:	**Module Title and Objectives:**
26208-14	**Conductor Terminations**
	1. Describe how to make a good conductor termination.
	2. Prepare cable ends for terminations and splices and connect using lugs or connectors.
	3. Train cable at termination points.
	4. Understand the *National Electrical Code*® (*NEC*®) requirements for making cable terminations and splices.
	5. Demonstrate crimping techniques.
	6. Select the proper lug or connector for the job.
	Grounding and Bonding
Registry ID Number:	**Module Title and Objectives:**
26209-14	**Grounding and Bonding**
	1. Explain the purpose of grounding and bonding and the scope of NEC Article 250.
	2. Distinguish between a short circuit and a ground fault.
	3. Define the *National Electrical Code*® requirements related to bonding and grounding.
	4. Distinguish between grounded systems and equipment grounding.
	5. Use NEC Table 250.66 to size the grounding electrode conductor for various AC systems.
	6. Explain the function of the grounding electrode system and determine the grounding electrodes to be used.
	7. Define electrodes and explain the resistance requirements for electrodes using NEC Section 250.56.
	8. Use NEC Table 250.122 to size the equipment grounding conductor for raceways and equipment.
	9. Explain the function of the main and system bonding jumpers in the grounding system and size the main and system bonding jumpers for various applications.
	10. Size the main bonding jumper for a service utilizing multiple service disconnecting means.
	11. Explain the importance of bonding equipment in clearing ground faults in a system.

	12. Explain the purposes of the grounded conductor (neutral) in the operation of overcurrent devices.
	Conductor Selection and Calculations
Registry ID Number:	**Module Title and Objectives:**
26302-14	**Conductor Selection and Calculations**
	1. Select electrical conductors for specific applications.
	2. Calculate voltage drop in both single-phase and three-phase applications.
	3. Apply *National Electrical Code*® (*NEC*®) regulations governing conductors to a specific application.
	4. Calculate and apply *NEC*® tap rules to a specific application.
	5. Size conductors for the load.
	6. Derate conductors for fill, temperature, and voltage drop.
	7. Select conductors for various temperature ranges and atmospheres.
	Hazardous Locations
Registry ID Number:	**Module Title and Objectives:**
26304-14	**Hazardous Locations**
	1. Define the various classifications of hazardous locations.
	2. Describe the wiring methods permitted for branch circuits and feeders in specific hazardous locations.
	3. Select seals and drains for specific hazardous locations.
	4. Select wiring methods for Class I, Class II, and Class III hazardous locations.
	5. Follow *National Electrical Code*® (*NEC*®) requirements for installing explosionproof fittings in specific hazardous locations.
	Overcurrent Protection
Registry ID Number:	**Module Title and Objectives:**
26305-14	**Overcurrent Protection**
	1. Apply the key *National Electrical Code*® (*NEC*®) requirements regarding overcurrent protection.
	2. Check specific applications for conformance to *NEC*® sections that cover short circuit current, fault currents, interrupting ratings, and other sections relating to overcurrent protection.
	3. Determine let-through current values (peak and rms) when current-limiting overcurrent devices are used.
	4. Select and size overcurrent protection for specific applications.

	Distribution Equipment
Registry ID Number:	**Module Title and Objectives:**
26306-14	**Distribution Equipment**
	1. Describe the purpose of switchgear.
	2. Describe the four general classifications of circuit breakers and list the major circuit breaker ratings.
	3. Describe switchgear construction, metering layouts, wiring requirements, and maintenance.
	4. List *National Electrical Code*® (*NEC*®) requirements pertaining to switchgear.
	5. Describe the visual and mechanical inspections and electrical tests associated with low-voltage and medium-voltage cables, metal-enclosed busways, and metering and instrumentation.
	6. Describe a ground fault relay system and explain how to test it.
	Transformers
Registry ID Number:	**Module Title and Objectives:**
26307-14	**Transformers**
	1. Describe transformer operation.
	2. Explain the principle of mutual induction.
	3. Describe the operating characteristics of various types of transformers.
	4. Connect a multi-tap transformer for the required secondary voltage.
	5. Explain *National Electrical Code*® (*NEC*®) requirements governing the installation of transformers.
	6. Compute transformer sizes for various applications.
	7. Connect a control transformer for a given application.
	8. Describe how current transformers are used in conjunction with watt-hour meters.
	Motor Controls
Registry ID Number:	**Module Title and Objectives:**
26311-14	**Motor Controls**
	1. Identify contactors and relays both physically and schematically and describe their operating principles.
	2. Identify pilot devices both physically and schematically and describe their operating principles.
	3. Interpret motor control wiring, connection, and ladder diagrams.
	4. Select and size contactors and relays for use in specific electrical motor control systems.
	5. Select and size pilot devices for use in specific electrical motor control systems.
	6. Connect motor controllers for specific applications according to National Electrical Code®(NEC®) requirements.

	Heat Tracing and Freeze Protection
Registry ID Number:	**Module Title and Objectives:**
26409-14	**Heat Tracing and Freeze Protection**
	1. Identify and describe the purpose of electric heat tracing equipment used with pipelines and vessels.
	2. Select, size, and install electric heat tracing equipment on selected pipelines and vessels in accordance with the manufacturer's instructions and *National Electrical Code*® (*NEC*®) requirements.
	3. Identify and describe the purpose of electric heating equipment used with roof, gutter, and down-spout de-icing systems.
	4. Select, size, and install selected roof, gutter, and downspout de-icing systems in accordance with the manufacturer's instructions and *NEC*® requirements.
	5. Identify and describe the purpose of electric heating equipment used with snow-melting and anti-icing systems.
	6. Select, size, and install selected snow-melting and anti-icing systems in accordance with the manufacturer's instructions and *NEC*® requirements.
	7. Identify and describe the purpose of electric heat tracing equipment used with domestic hot-water temperature maintenance systems.
	8. Select, size, and install selected electric heat traced domestic hot-water systems in accordance with the manufacturer's instructions and *NEC*® requirements.
	9. Identify and describe the purpose of electric floor heating/warming systems.
	10. Select, size, and install selected electric floor heating/warming systems in accordance with the manufacturer's instructions and *NEC*® requirements.