



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

**POWER GENERATION MAINTENANCE ELECTRICIAN  
PGME50**

January 2013

**Focus Statement**

A Power Generation Maintenance Electrician must be able to safely use hand, power, and electrical tools, as well as electrical test equipment and PPE, according to regulatory and industry standards; interpret job specifications and industrial drawings; install, connect, troubleshoot and maintain power generation, distribution and utilization systems and components; install raceway and cable distribution systems; and install and connect transformers and troubleshoot PLCs.

**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 (1.800.922.0579) or from NCCER's Online Catalog at [www.nccer.org](http://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](http://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
<b>Conductors</b> [40212-08, 40213-08, 40307-09]	8
<b>Electrical Theory</b> [40106-07, 40203-08, 40204-08, 40205-08]	12
<b>Personnel Safety</b> [26501-09, 40201-08, 40308-09]	10
<b>System Maintenance</b> [26410-08, 32401-09, 40113-07, 50401-11]	10
<b>System Safety</b> [26209-08, 26210-08, 26305-08, 40301-09]	9
<b>Controls</b> [26211-08, 40311-09, 40312-09, 40409-09]	9
<b>Power Plant Systems</b> [40401-09, 50301-11]	6
<b>Power Plant Equipment</b> [40305-09, 50402-11, 26406-08, 40306-09]	12
<b>Wiring Methods and Materials</b> [26207-08, 26409-08, 26411-08, 40103-07]	10
<b>Motor Maintenance</b> [26202-08, 26407-08, 40304-09, 40313-09]	11
<b>Troubleshooting</b> [40105-07, 40303-09, 26203-08, 26303-08]	5
<b>Total Number of Questions</b>	<b>102</b>



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**Learning Objectives related to Assessment:**

<b>Conductors</b>	
<b>Registry ID Number:</b>	<b>Module Title and Objectives:</b>
<b>40212-08</b>	<b>Conductors &amp; Cables</b>
	From the cable markings, describe the insulation and jacket material, conductor size and type, number of conductors, temperature rating, voltage rating, and permitted uses.
	Determine the allowable ampacity of a conductor for a given application.
	Identify the NEC® requirements for color coding of conductors.
	Install conductors in a raceway system.
<b>40213-08</b>	<b>Conductor Terminations &amp; Splices</b>
	Describe how to make a sound conductor termination.
	Prepare cable ends for terminations and splices and connect the ends using lugs or connectors.
	Describe the National Electrical Code® (NEC®) requirements for making cable terminations and splices.
	Demonstrate crimping techniques.
	Select the proper lug or connector for the job.
<b>40307-09</b>	<b>Conductor Selection &amp; Calculations</b>
	Select electrical conductors for specific applications.
	Calculate and apply NEC® tap rules to a specific application.
	Size conductors for the load.
<b>Electrical Theory</b>	
<b>Registry ID Number:</b>	<b>Module Title and Objectives:</b>
<b>40106-07</b>	<b>Craft Related Mathematics</b>
	Use formulas to solve basic problems.
	Solve area problems.
	Solve volume problems.
	Solve circumference problems.
	Solve right triangles using the Pythagorean Theorem.
<b>40203-08</b>	<b>Electric Theory</b>
	Define voltage and identify the ways in which it can be produced.
	Explain the difference between conductors and insulators.
	Define the units of measurements that are used to measure the properties of electricity.
	Identify the meters used to measure voltage, current, and resistance.
	Explain the basic characteristics of series and parallel circuits.
	Use the formula for Ohm's law to calculate voltage, current, and resistance.
<b>40204-08</b>	<b>Alternating Current</b>
	Calculate the peak and effective voltage or current values for an AC waveform.
	Describe the voltage and current phase relationship in a resistive AC circuit.

	Define inductive reactance and state how it is affected by frequency.
	Define capacitive reactance and state how it is affected by frequency.
	Explain the following terms as they relate to AC circuits: <ul style="list-style-type: none"> <li>• True power</li> <li>• Apparent power</li> <li>• Reactive power</li> <li>• Power factor</li> </ul>
	Explain basic transformer action.
<b>40205-08</b>	<b>E &amp; I Test Equipment</b>
	Identify and explain the purposes of test instruments commonly used to test and troubleshoot E & I equipment.
	Explain how to read and convert from one scale to another using the above test equipment.
	Explain the importance of proper meter polarity.
	Define frequency and explain the use of a frequency meter.
	Explain the difference between digital and analog meters.
	<b>Personnel Safety</b>
<b>Registry ID Number:</b>	<b>Module Title and Objectives:</b>
<b>26501-09</b>	<b>Managing Electrical Hazards</b>
	Identify types of electrical hazards and locations, and explain related safety guidelines and terms.
	Recognize and explain hazard boundaries.
	Explain employer and employee responsibilities in recognizing and managing electrical hazards.
	List common factors that lead to electrical incidents and explain the importance of using appropriate procedures and safe work practices.
	Analyze the electrical hazards of a given task, plan the job, and complete an electrical work permit request.
	Select, inspect, and maintain personal protective equipment (PPE) and test equipment used for electrical work.
	Explain how to create an electrically safe work condition.
<b>40201-08</b>	<b>Industrial Safety for E &amp; I</b>
	Demonstrate safe working procedures in an industrial environment.
	Recognize electrical/energy hazards and describe how to avoid or minimize them in the workplace.
	Explain safety issues concerning lockout/tagout procedures, personal protection using assured grounding and isolation programs, confined space entry, respiratory protection, and fall protection systems.
	Recognize and apply safe working practices.
<b>40308-09</b>	<b>Temporary Grounding</b>
	Explain the purpose of temporary grounding.
	Explain requirements associated with temporary grounding devices.
	Identify and explain temporary grounding equipment.
	Explain how to install and remove temporary grounding devices.
	<b>System Maintenance</b>
<b>Registry ID Number:</b>	<b>Module Title and Objectives:</b>
<b>26410-08</b>	<b>Motor Operation &amp; Maintenance</b>
	Identify motors needing replacement.

<b>32401-09</b>	<b>Preventive &amp; Predictive Maintenance</b>
	Explain preventive and predictive maintenance.
<b>40113-07</b>	<b>Lubrication</b>
	Read and interpret a material safety data sheet (MSDS).
	Explain the EPA-hazardous waste control program.
	Explain lubricant classification.
	Explain how to select lubricants.
<b>50401-11</b>	<b>Generator Maintenance</b>
	Identify the components of AC and DC generators.
	Describe how a generator produces single-phase and three-phase AC voltage.
	Explain how AC voltage is changed to DC voltage.
	Describe the different types of connections, including: <ul style="list-style-type: none"> <li>• Delta and wye connections</li> <li>• Protective instrumentation (potential and current transformers)</li> </ul>
	Identify the factors that determine output voltage.
	Describe how a voltage regulator/control system operates.
	Describe the purposes and identify the major components of auxiliary systems for AC generators.
	Using prescribed safety precautions perform an inspection of a brush assembly and remove and replace a brush.
	Using prescribed safety precautions inspect a filter assembly and remove and replace a filter.
	<b>System Safety</b>
<b>Registry ID Number:</b>	<b>Module Title and Objectives:</b>
<b>26209-08</b>	<b>Grounding &amp; Bonding</b>
	Distinguish between a short circuit and a ground fault.
	Define the National Electrical Code® (NEC®) requirements relating to bonding and grounding.
	Distinguish between grounded systems and equipment grounding.
	Use NEC Table 250.66 to size the grounding electrode conductor for various AC systems.
	Explain the importance of bonding equipment in clearing ground faults in a system.
<b>26210-08</b>	<b>Circuit Breakers &amp; Fuses</b>
	Explain the necessity of overcurrent protection devices in electrical circuits.
	Define the terms associated with fuses and circuit breakers.
	Describe the operation of a circuit breaker.
	Apply the National Electrical Code® (NEC®) requirements for overcurrent devices.
	Describe the operation of single-element and time-delay fuses.
<b>26305-08</b>	<b>Overcurrent Protection</b>
	Select and size overcurrent protection for specific applications.
<b>40301-09</b>	<b>Hazardous Locations</b>
	Define the various classifications of hazardous locations.
	Describe the wiring methods permitted for branch circuits and feeders in specific hazardous locations.
	Select seals and drains for specific hazardous locations.
	Select wiring methods for Class I, Class II, and Class III hazardous locations.
	Follow the National Electrical Code® (NEC®) requirements for installing explosion-

	proof fittings in specific hazardous locations.
	<b>Controls</b>
<b>Registry ID Number:</b>	<b>Module Title and Objectives:</b>
<b>26211-08</b>	<b>Control Systems and Fundamental Concepts</b>
	Describe the operating principles of contactors and relays.
	Select contactors and relays for use in specific electrical systems.
	Explain how mechanical contactors operate.
	Explain how solid-state contactors operate.
	Read wiring diagrams involving contactors and relays.
	Describe how overload relays operate.
<b>40311-09</b>	<b>Hydraulic Controls</b>
	Explain hydraulic system safety.
	Explain a hydraulic system in a process application.
<b>40312-09</b>	<b>Pneumatic Controls</b>
	Explain pneumatic system safety.
	Identify and explain pneumatic system components and symbols.
<b>40409-09</b>	<b>Programmable Logic Controllers</b>
	Describe the function and purpose of a programmable logic controller (PLC).
	Explain the general function of an input/output (I/O) module, including the following types: <ul style="list-style-type: none"> <li>• Discrete</li> <li>• Numerical and analog data</li> <li>• Special</li> <li>• Remote</li> </ul>
	Explain the power supply and ground connections to I/O modules.
	Describe the features of relay ladder logic instruction categories.
	<b>Power Plant Systems</b>
<b>Registry ID Number:</b>	<b>Module Title and Objectives:</b>
<b>40401-09</b>	<b>Standby &amp; Emergency Systems</b>
	Describe the operating principles of an engine-driven standby AC generator.
	Recognize and describe the operating principles of both automatic and manual transfer switches.
	Recognize the different types of storage batteries used in emergency and standby systems and explain how batteries charge and discharge.
	For selected types of batteries, describe their characteristics, applications, maintenance, and testing.
	Explain normal vs. emergency sources for various applications.
<b>50301-11</b>	<b>Power Plant Electrical Systems</b>
	Explain electrical power distribution associated with a power-generating facility: <ul style="list-style-type: none"> <li>• Identify how the power distribution system within a plant is configured and how it ties into the grid</li> <li>• Identify and describe alternate supply paths</li> <li>• Interpret plant drawings</li> </ul>
	Explain the functions of mediums-voltage and low-voltage motor control centers

	(MCCs).
	Locate and identify the feeds for a power station.
	<b>Power Plant Equipment</b>
<b>Registry ID Number:</b>	<b>Module Title and Objectives:</b>
<b>40305-09</b>	<b>Distribution Equipment</b>
	Explain the necessity of overcurrent protection devices in electrical circuits.
	Describe the purpose of switchgear.
	Describe switchgear construction, metering layouts, wiring requirements, and maintenance.
	Describe the visual and mechanical inspections and electrical tests associated with low-voltage and medium-voltage cables, metal-enclosed busways, and metering and instrumentation.
	Describe a ground fault relay system and explain how to test it.
<b>50402-11</b>	<b>Switchgear &amp; Breaker Maintenance</b>
	Describe the safety practices that must be followed when installing and maintaining medium-and low-voltage equipment.
	Describe and demonstrate how to safely rack out, remove, inspect, and replace low-voltage and medium-voltage breakers.
	Describe and demonstrate procedures for testing and maintenance of circuit breakers, switchgear, MCCs, and associated components.
<b>26406-08</b>	<b>Specialty Transformers</b>
	Identify three-phase transformer connections.
	Identify specialty transformer applications.
	Calculate and install overcurrent protection for specialty transformers.
	Ground specialty transformers in accordance with National Electrical Code® (NEC®) requirements.
<b>40306-09</b>	<b>Transformer Application</b>
	Identify three-phase transformer connections.
	Identify specialty transformer applications.
	Ground specialty transformers in accordance with National Electrical Code® (NEC®) requirements.
	<b>Wiring Methods and Materials</b>
<b>Registry ID Number:</b>	<b>Module Title and Objectives:</b>
<b>26207-08</b>	<b>Cable Tray</b>
	Select the required fittings to ensure equipment grounding continuity in cable tray systems.
<b>26409-08</b>	<b>Heat Tracing &amp; Freeze Protection</b>
	Identify and describe the purpose of electric heat tracing equipment used with pipelines and vessels.
<b>26411-08</b>	<b>Medium Voltage Terminations &amp; Splices</b>
	Select the proper materials and tools for medium-voltage terminations and splices.
	Prepare medium-voltage cable for terminations and splices.
	Complete cable assemblies using terminations and splices.
	Inspect and test medium-voltage terminations and splices.
<b>40103-07</b>	<b>Fasteners &amp; Anchors</b>

	Select the correct fasteners and anchors for given applications.
	<b>Motor Maintenance</b>
<b>Registry ID Number:</b>	<b>Module Title and Objectives:</b>
<b>26202-08</b>	<b>Motors: Theory &amp; Application</b>
	<p>Define the following terms:</p> <ul style="list-style-type: none"> <li>• Duty cycle</li> <li>• Full-load amps</li> <li>• Interrupting rating</li> <li>• Thermal protection</li> <li>• NEMA-design letter</li> <li>• Overcurrent</li> <li>• Overload</li> <li>• Power Factor</li> <li>• Rated full-load speed</li> <li>• Rated horsepower</li> <li>• Service factor</li> </ul>
	Explain the relationships among speed, frequency, and the number of poles in a three-phase induction motor.
	Explain how the direction of the three-phase motor is changed.
	Describe the methods for determining various motor connections.
<b>26407-08</b>	<b>Advanced Motor Controls</b>
	Select and install solid-state relays for specific applications in motor control circuits.
	Recognize the different types of reduced-voltage starting motor controllers and describe their operating principles.
	Demonstrate and/or describe the special precautions used when handling and working with solid-state motor controls.
	Perform preventive maintenance and troubleshooting tasks in motor control circuit.
<b>40304-09</b>	<b>Motor Controls</b>
	Identify contactors and relays both physically and schematically and describe their operating principles.
	Identify pilot devices both physically and schematically and describe their operating principles.
	Interpret motor control wiring, connection, and ladder diagrams.
	Select and size contactors and relays for use in specific electrical motor control systems.
	Select and size pilot devices for use in specific electrical motor control systems.
<b>40313-09</b>	<b>Motor-Operated Valves</b>
	State safety regulations associated with motor-operated valves (MOVs).
	Explain the operating principles of various types of MOVs.
	Remove, replace, and torque a limit switch.
	<b>Troubleshooting</b>
<b>Registry ID Number:</b>	<b>Module Title and Objectives:</b>
<b>40105-07</b>	<b>Gaskets &amp; Packing</b>

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	Describe the use of O-rings.
<b>40303-09</b>	<b>E &amp; I Drawings</b>
	Identify common types of electrical and instrumentation diagrams and drawings.
	Read and interpret electrical diagrams used in instrumentation work: <ul style="list-style-type: none"> <li>• Wiring diagrams</li> <li>• Ladder diagrams</li> <li>• One-line diagrams</li> <li>• Motor controller diagrams</li> </ul>
	Read and interpret instrumentation diagrams: <ul style="list-style-type: none"> <li>• P&amp;ID diagrams</li> <li>• Loop diagrams</li> <li>• Raceway diagrams</li> </ul>
<b>26203-08</b>	<b>Electric Lighting</b>
	Recognize ballasts and describe their use in fluorescent and HID lighting fixtures.
	Recognize basic occupancy sensors, photoelectric sensors, and timers used to control lighting circuits and describe how each device operates.
<b>26303-08</b>	<b>Practical Applications of Lighting</b>
	Identify the lighting requirements associated with lighting systems used in selected applications such as office buildings, schools, theaters, hazardous areas, etc.