



8 Hour 2023 NEC Code Theory Renewal Online

Course Outline and Objectives

Course Structure: Six Sections, 1 Hour and 20 Minutes Each

Section 1: Electrical Theory and Fundamental Code Principles (1 Hour 20 Minutes)

- **Subsection 1:** Basic Electrical Theory and the Role of the NEC – Understanding voltage, current, resistance, and power as applied in electrical work.
 - **Subsection 2:** Series and Parallel Circuits – Reviewing circuit behavior, load distribution, and voltage drop considerations.
 - **Subsection 3:** Ohm's Law and Power Calculations – Applying formulas to determine electrical system efficiency and safety.
 - **Subsection 4:** Understanding Alternating Current (AC) and Direct Current (DC) Systems – Exploring differences in applications and code requirements.
 - **Subsection 5:** Conductor Resistance and Voltage Drop Calculations – Importance of proper conductor sizing to maintain efficiency and compliance.
 - **Subsection 6:** Electrical System Grounding and Bonding Principles – A deeper look at NEC requirements for safe electrical grounding practices.
 - **Subsection 7:** Overcurrent Protection and Coordination – Understanding circuit breakers, fuses, and short-circuit current ratings.
 - **Subsection 8:** Arc Flash Hazards and Code-Mandated Safety Practices – Importance of personal protective equipment (PPE) and safe work distances.
 - **Subsection 9:** Electrical Load Calculations for Residential and Commercial Applications – Applying NEC tables for service sizing and circuit design.
 - **Subsection 10:** Oregon-Specific Electrical Code Amendments and Regulations – Examining state-specific deviations from the NEC.
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Section 2: Electrical Installations in Residential and Commercial Buildings (1 Hour 20 Minutes)

- **Subsection 1:** Service Entrance Equipment and Metering Requirements – Installation standards for safe and code-compliant service entrances.
 - **Subsection 2:** Panelboard and Load Center Installations – Proper placement, working space, and circuit breaker arrangements.
 - **Subsection 3:** Branch Circuit and Feeder Sizing – Understanding NEC requirements for conductor ampacity and protection.
 - **Subsection 4:** Wiring Methods and Materials – Reviewing different conduit types, cable selections, and NEC-approved wiring techniques.
 - **Subsection 5:** Outlet and Receptacle Placement in Residential and Commercial Buildings – Understanding minimum requirements and special location considerations.
 - **Subsection 6:** Switching and Lighting Control Requirements – Ensuring proper controls, occupancy sensors, and energy efficiency compliance.
 - **Subsection 7:** GFCI and AFCI Protection Requirements Beyond the NEC Updates – Understanding where these protective devices are required.
 - **Subsection 8:** Emergency Systems and Standby Power Requirements – Reviewing NEC mandates for emergency power generation and backup systems.
 - **Subsection 9:** Special Occupancies and Uses in Residential and Commercial Settings – Applying NEC articles related to healthcare facilities, hotels, and retail spaces.
 - **Subsection 10:** Common Code Violations in Residential and Commercial Installations – Avoiding mistakes that lead to failed inspections and safety risks.
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Section 3: Electrical Equipment, Motors, and Transformers (1 Hour 20 Minutes)

- **Subsection 1:** General Installation Requirements for Electrical Equipment – NEC guidelines for safe placement and operation.
- **Subsection 2:** Electrical Motor Installation and Protection – Overcurrent protection, grounding, and thermal overload considerations.
- **Subsection 3:** Motor Control Circuits and NEC Compliance – Wiring diagrams, starter types, and troubleshooting best practices.
- **Subsection 4:** Industrial Control Panels and Enclosures – Understanding UL 508A requirements and NEC applications.
- **Subsection 5:** Transformer Sizing, Placement, and Protection – Key considerations for safely integrating transformers into electrical systems.
- **Subsection 6:** Energy Efficiency Standards for Motors and Transformers – Code-driven requirements for high-efficiency electrical equipment.

- **Subsection 7:** Hazardous Location Considerations for Motors and Equipment – Understanding Class I, II, and III locations and safe installations.
 - **Subsection 8:** Short-Circuit and Ground-Fault Protection for Motors and Transformers – NEC requirements for fault mitigation.
 - **Subsection 9:** Power Factor Correction and Demand Load Considerations – Optimizing electrical systems for efficiency and cost savings.
 - **Subsection 10:** Harmonics, Interference, and Power Quality Issues – NEC standards for mitigating electrical noise and power disturbances.
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Section 4: Specialized Electrical Installations and Code Compliance (1 Hour 20 Minutes)

- **Subsection 1:** Industrial and Commercial Kitchen Electrical Systems – NEC requirements for food service electrical installations.
 - **Subsection 2:** Agricultural and Farm Installations – Unique challenges and NEC requirements for barns, irrigation, and outdoor structures.
 - **Subsection 3:** Marinas and Boatyard Electrical Systems – NEC guidelines for safe electrical installations in marine environments.
 - **Subsection 4:** Swimming Pools, Hot Tubs, and Fountains – Electrical safety and compliance for water-related installations.
 - **Subsection 5:** Wiring for Theaters, Stages, and Entertainment Venues – Special considerations for temporary and permanent installations.
 - **Subsection 6:** Temporary Electrical Installations for Construction Sites – NEC rules for job site power distribution and safety.
 - **Subsection 7:** Signage, Billboards, and Outdoor Advertising Electrical Work – Understanding NEC Article 600 for illuminated signs.
 - **Subsection 8:** Wiring for Medical and Healthcare Facilities – NEC rules for patient care areas, operating rooms, and life-support systems.
 - **Subsection 9:** Electrical Installations for Elevators, Escalators, and Lifts – Understanding NEC Article 620 for vertical transportation.
 - **Subsection 10:** Common Errors and Best Practices for Specialized Electrical Work – Ensuring compliance in unique electrical applications.
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Section 5: Electrical Safety, Testing, and Troubleshooting (1 Hour 20 Minutes)

- **Subsection 1:** Lockout/Tagout (LOTO) and Electrical Work Safety Practices – NEC and OSHA regulations for de-energizing systems.

- **Subsection 2:** Testing and Verification of Electrical Systems – Best practices for using meters, megohm testers, and diagnostic tools.
- **Subsection 3:** Grounding System Testing and Performance Verification – Ensuring compliance through proper testing techniques.
- **Subsection 4:** Power Quality Analysis and Voltage Drop Testing – Diagnosing common power issues and ensuring system efficiency.
- **Subsection 5:** Identifying and Resolving Neutral and Grounding Issues – NEC requirements for properly installed grounding conductors.
- **Subsection 6:** Troubleshooting Circuit Breakers and Overcurrent Protection Devices – Diagnosing tripping issues and coordination failures.
- **Subsection 7:** Inspection and Compliance Checklists for Electrical Contractors – Ensuring jobs meet NEC and local code requirements.
- **Subsection 8:** Safety Considerations for High-Voltage Installations – Understanding special precautions for working with high-voltage systems.
- **Subsection 9:** Electrical Code Requirements for Fire Alarm Systems – NEC guidelines for fire alarm wiring and integration.
- **Subsection 10:** Arc Flash Risk Assessments and Mitigation Strategies – Understanding NFPA 70E and NEC requirements for electrical hazard reduction.

Section 6: Emerging Technologies and Future Code Considerations (1 Hour 20 Minutes)

- **Subsection 1:** Advancements in Smart Electrical Panels and Load Management – How modern electrical panels integrate with automation.
- **Subsection 2:** Energy Storage Systems (ESS) and Battery Technology – NEC rules for lithium-ion and alternative energy storage.
- **Subsection 3:** Electric Vehicle (EV) Charging Infrastructure – NEC requirements for residential and commercial EV charging stations.
- **Subsection 4:** Microgrid and Distributed Energy Resource (DER) Integration – How NEC provisions are evolving to accommodate these technologies.
- **Subsection 5:** Renewable Energy Electrical Code Considerations – Compliance for wind, solar, and hydroelectric energy installations.
- **Subsection 6:** Lighting Control and Energy Efficiency Regulations – The role of the NEC in LED technology and advanced control systems.
- **Subsection 7:** Home Automation and Smart Home Wiring Methods – NEC requirements for interconnected devices and IoT applications.

- **Subsection 8:** Alternative Wiring Systems and Flexible Conduit Applications – Emerging NEC trends in modular and prefabricated wiring.
- **Subsection 9:** Cybersecurity Considerations for Electrical Systems – Protecting electrical infrastructure from digital threats.
- **Subsection 10:** Future NEC Revisions and Expected Code Changes – Preparing for updates in upcoming NEC cycles.

Course Objectives

Upon successful completion of this course, the licensee will be able to:

1. **Demonstrate an applied understanding of foundational electrical theory**, including voltage, current, resistance, and power, and describe how these concepts inform safe and code-compliant electrical installations in both residential and commercial settings.
2. **Interpret and apply 2023 NEC code requirements** related to conductor sizing, grounding and bonding, overcurrent protection, circuit design, and equipment installation, with a particular emphasis on Articles 100, 200, 210, 250, 300, 310, and 400.
3. **Perform load calculations and voltage drop assessments** for various applications, using NEC-prescribed formulas and tables to ensure compliance and system efficiency.
4. **Identify code-compliant methods and materials** for wiring installations across a variety of building types and occupational settings, including panelboards, motor control centers, transformers, and temporary power systems.
5. **Evaluate NEC requirements for special occupancies and conditions**, including marinas, swimming pools, medical facilities, agricultural structures, and construction sites, and apply the appropriate standards for safety and functionality.
6. **Analyze common code violations and enforcement issues**, developing strategies to avoid costly mistakes and inspection failures in real-world job scenarios.
7. **Apply NEC standards to emerging technologies**, including energy storage systems (ESS), microgrids, EV charging infrastructure, and smart panels, and anticipate how future code revisions may influence installation practices.
8. **Integrate electrical safety practices and testing protocols** into day-to-day work, including lockout/tagout procedures, arc flash hazard awareness, fire alarm system compliance, and the safe use of testing equipment.