

## Instructional/Task Analysis

### Related Information: What the Student Should Know

### Application: What the Student Should Be Able to Do

#### Unit 1: Occupational Introduction

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| 1. Definitions of <i>NEC</i> and occupation              | 11. List careers associated with the electrical trade        |
| 2. Major purposes of the <i>NEC</i>                      | 12. Interview an electrical worker                           |
| 3. Areas the <i>NEC</i> is intended to cover             | 13. Compare employment opportunities in the electrical field |
| 4. Areas the <i>NEC</i> is not intended to cover         |  |
| 5. Job responsibilities of electrical workers            |  |
| 6. Desirable physical abilities of electrical workers    |  |
| 7. Employment opportunities in the electrical field      |  |
| 8. Occupation hazards related to electrical work         |  |
| 9. Electrical trade organizations and their descriptions |  |
| 10. Code compliance                                      |  |

#### Unit 2: General Safety and First Aid

1. Terms and definitions
2. Guidelines for dressing safely on the job
3. General job and shop safety rules
4. Shop conditions that should be reported
5. OSHA's role in workplace health and safety
6. Terms associated with fall protection systems
7. Fall protection systems
8. Terms associated with confined space entry
9. Responsibilities concerning confined space entry
10. Respirator requirements
11. Hazardous cleaners and lubricants
12. Storage of hazardous materials
13. Common hazardous materials found at the job site

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#### Unit 2: General Safety and First Aid (continued)

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|--|---|
| 14. Purposes of material safety data sheets (MSDS)                                   | 31. Locate material safety data sheets                                      |
| 15. Ways hazardous materials can enter the body                                      | 32. Interpret a material safety data sheet                                  |
| 16. Colors of the safety color code and their uses                                   | 33. Draw a layout of your school shop and apply the safety color code       |
| 17. Safety tags with their color coding  | 34. Interpret portable fire extinguisher symbols and operating instructions |
| 18. Components of the fire triangle  | 35. Identify and correct safety violations                                  |
| 19. Types of fires and their classifications   | 36. Operate a fire extinguisher   |
| 20. Types of fire extinguishers and their uses                                       | 37. Lift a heavy object properly  |
| 21. Fire extinguisher general operating instructions that follow the letters P-A-S-S | 38. Place and climb a ladder safely   |
| 22. Causes of back injuries and their contributing factors                           |   |
| 23. Guidelines for lifting and moving items safely                                   |   |
| 24. Guidelines for preventing slips, trips, and falls                                |   |
| 25. Rules of using ladders safely  |   |
| 26. Safety guidelines for using scaffolds  |   |
| 27. Safety guidelines for using power lifts  |   |
| 28. General steps for handling any emergency situation                               |   |
| 29. General guidelines for first-aid emergencies                                     |   |
| 30. Basic first aid procedures for various emergency situations                      |   |

#### Unit 3: Electrical Safety

1. Terms and definitions
2. Major causes of electrical accidents
3. Basic electrical safety practices
4. Electrical fire prevention practices
5. Safety practices around live circuits
6. Proper grounding
7. Importance of the third wire
8. Ground-fault circuit-interrupters
9. Instances when lockout devices should be used

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#### Unit 3: Electrical Safety (continued)

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|---|---|
| 10. Electrical shock  | 12. Read about controlling electrical hazards             |
| 11. Proper response for treating the victim of electrical shock | 13. Identify and describe safety violations               |
|   | 14. Solve problems concerning electrical safety practices |

#### Unit 4: Related Math and Measuring

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|---|---|
| 1. Terms and definitions                              | 27. Add whole numbers                   |
| 2. Symbols used in math problems                      | 28. Subtract whole numbers              |
| 3. Place values of a whole number                     | 29. Multiply whole numbers              |
| 4. Adding whole numbers                               | 30. Divide whole numbers                |
| 5. Subtracting whole numbers                          | 31. Reduce fractions to lowest terms    |
| 6. Multiplying whole numbers                          | 32. Convert fractions and mixed numbers |
| 7. Dividing whole numbers                             | 33. Add fractions                       |
| 8. Types of fractions                                 | 34. Subtract fractions                  |
| 9. Reducing fractions to lowest terms                 | 35. Multiply fractions                  |
| 10. Converting fractions and mixed numbers            | 36. Add decimal numbers                 |
| 11. Adding fractions                                  | 37. Subtract decimal numbers            |
| 12. Subtracting fractions                             | 38. Multiply decimal numbers            |
| 13. Multiplying fractions                             | 39. Divide decimal numbers              |
| 14. Placing values in a decimal number                | 40. Convert fractions and percentages   |
| 15. Adding decimal numbers                            | 41. Solve percentage problems           |
| 16. Subtracting decimal numbers                       | 42. Calculate area of geometric figures |
| 17. Multiplying decimal numbers                       |   |
| 18. Dividing decimal numbers                          |   |
| 19. Converting decimal fractions to common fractions  |   |
| 20. Solving percentage problems                       |   |
| 21. Terms used in geometry and their definitions      |   |
| 22. Types of geometric figures and their descriptions |   |
| 23. Units of measure and their equivalents            |   |
| 24. Calculating area of geometric figures             |   |
| 25. Metric prefixes and their values                  |   |
| 26. English-metric conversion                         |   |

## Instructional/Task Analysis

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### Related Information: What the Student Should Know

### Application: What the Student Should Be Able to Do

#### Unit 5: Hand Tools

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|---|---|
| 1. Terms and definitions  | 8. List and price electrician's tools           |
| 2. Common hand tools used in the electrical field               | 9. Measure objects using a tape measure         |
| 3. Electricity-specific hand tools used in the electrical field | 10. Clean and lubricate an adjustable hand tool |
| 4. Common hand tools and their uses                             | 11. Use a cutting/crimping tool                 |
| 5. Electricity-specific hand tools and their uses               | 12. Adjust wire strippers                       |
| 6. Factors to consider when purchasing hand tools               | 13. Set up and use a hacksaw to cut conduit     |
| 7. Rules for care of various hand tools                         | 14. Ream and thread rigid conduit               |
|   | 15. Bend EMT conduit                            |
|   | 16. Use a knockout punch                        |
|   | 17. Use a hole saw                              |

#### Unit 6: Powered/Specialty Tools and Equipment

1. Terms and definitions
2. Common powered tools
3. Common powered tools and their uses
4. Typical powered/specialty equipment
5. General safety rules for using powered/specialty equipment
6. Parts of a hydraulic knockout set
7. Specific safety rules for using hydraulic knockout sets
8. Parts of a hydraulic pipe bender
9. Specific safety rules for using hydraulic pipe benders
10. Parts of a polyvinylchloride (PVC) heater and blanket
11. Specific safety rules for using polyvinylchloride heaters and blankets
12. Parts of a power drill
13. Specific safety rules for using power drills
14. Parts of a power cable puller
15. Specific safety rules for using a power cable puller

## Instructional/Task Analysis

### Related Information: What the Student Should Know

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#### Unit 6: Powered/Specialty Tools and Equipment (continued)

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|---|---|
| 16. Parts of portable and table bandsaws                        | 28. Determine dimensions on a drawing using an architect's scale      |
| 17. Specific safety rules for using portable and table bandsaws | 29. Use a hydraulic knockout punch                                    |
| 18. Parts of a dieless hydraulic crimper                        | 30. Bend a 90-degree stub using a hydraulic pipe bender               |
| 19. Specific safety rules for using hydraulic crimpers          | 31. Make offset and 90-degree bends using an electrical PVC heater    |
| 20. Parts of a hammer drill                                     | 32. Cut, ream, and thread rigid conduit with a power threader         |
| 21. Specific safety rules for using hammer drills               | 33. Measure resistance using a VOM                                    |
| 22. Parts of a core drilling machine                            | 34. Measure DC voltages using a VOM                                   |
| 23. Specific safety rules for using a core drilling machine     | 35. Measure AC voltages using a VOM                                   |
| 24. Parts of a portable power threader                          | 36. Measure amperage using a clamp-on ammeter                         |
| 25. Specific safety rules for using a portable power threader   | 37. Determine the current of a multiple loop using a clamp-on ammeter |
| 26. Rules and uses for an architect's scale                     | 38. Check conductor insulation with a megger                          |
| 27. Typical electrical test equipment                           |   |

#### Unit 7: Using Trade Information

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|---|---|
| 1. Terms and definitions  | 8. Using the <i>National Electrical Code</i>  |
| 2. Purposes of the <i>National Electrical Code</i>                                      | 9. Use the <i>National Electrical Code</i> index to answer questions about Code sections                        |
| 3. Factors that are not covered by the <i>National Electrical Code</i>                  | 10. Use the <i>National Electrical Code</i> title page, table of contents, and introduction to answer questions |
| 4. Intent of the <i>National Electrical Code</i> regarding mandatory enforcement        | 11. Use the <i>National Electrical Code</i> first chapter to define terms                                       |
| 5. <i>National Electrical Code</i> chapter numbers and their areas of application       | 12. Use the <i>National Electrical Code</i> to answer general questions related to residential wiring practices |
| 6. Sequence of organizational components of <i>National Electrical Code</i> information | 13. Use the <i>National Electrical Code</i> to locate allowable ampacities for various conductors               |
| 7. Steps for finding information in the <i>National Electrical Code</i>                 | 14. Use the <i>National Electrical Code</i> to interpret conduit fill tables                                    |
|   | 15. Find information in the <i>National Electrical Code</i>   |

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### Related Information: What the Student Should Know

### Application: What the Student Should Be Able to Do

#### Unit 8: Basic Equipment

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|---|--|
| 1. Terms and definitions                                      | 11. Determine the correct number of conductors for boxfill                         |
| 2. Classes of outlet boxes used in electrical wiring          | 12. Install outlet boxes on wood studs on a framed wall                            |
| 3. Information needed to calculate boxfill                    | 13. Install outlet boxes on steel structures and rods using caddy clips            |
| 4. Types of enclosures and their conditions for use           | 14. Install outlet boxes on steel studs using caddy metal clips for switch boxes   |
| 5. Purposes of controller enclosures                          | 15. Install masonry boxes in a block wall using caddy metal clips for switch boxes |
| 6. Types of devices commonly used in electrical wiring        |  |
| 7. Types of covers and plates used in electrical wiring       |  |
| 8. Supports and anchors commonly used in electrical wiring    |  |
| 9. Screws, bolts, and nuts commonly used in electrical wiring |  |
| 10. Classes of box mounting devices for steel structures      |  |

#### Unit 9: Basic Theory

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|--|---|
| 1. Terms and definitions                               | 16. Draw a diagram of the power distribution supplying your school shop or home |
| 2. Principles of electron flow                         | 17. Solve problems for unknown voltages   |
| 3. Basic sources of electrical generation              | 18. Solve problems for unknown amperage   |
| 4. Distribution of electricity                         | 19. Solve problems for unknown resistances and wattages                         |
| 5. Electrical schematic symbols                        | 20. Solve problems for an unknown quantity                                      |
| 6. Diagrams and schematics                             |   |
| 7. Electrical abbreviations and their units of measure |   |
| 8. Ohm's law   |   |
| 9. Ohm's law in wheel expression                       |   |
| 10. Uses of Ohm's law                                  |   |
| 11. Unit of measure formulas for Ohm's law             |   |
| 12. Ohm's law for power                                |   |
| 13. Ohm's law for power in wheel expression            |   |
| 14. Uses of Ohm's law for power                        |   |
| 15. Unit of measure formulas from Ohm's law for power  |   |

## Instructional/Task Analysis

### Related Information: What the Student Should Know

### Application: What the Student Should Be Able to Do

#### Unit 10: DC Circuits

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|--|---|
| 1. Terms and definitions                       | 10. Solve problems for unknown current                                |
| 2. Applications of DC circuits                 | 11. Solve problems for unknown resistance                             |
| 3. Application of Ohm's law to direct current  | 12. Solve problems for unknown voltage                                |
| 4. Characteristics of series circuits          | 13. Determine total resistance in series circuits                     |
| 5. Three basic formulas for Watt's law         | 14. Determine unknown resistance values in series circuits            |
| 6. Kirchoff's voltage law                      | 15. Solve problems for unknown current in series circuits             |
| 7. Characteristics of parallel circuits        | 16. Solve problems for unknown resistance in series circuits          |
| 8. Kirchoff's current law                      | 17. Solve problems for unknown voltage in series circuits             |
| 9. Characteristics of series-parallel circuits | 18. Apply Kirchoff's voltage law to series circuits                   |
|  | 19. Solve problems for unknown resistance in parallel circuits        |
|  | 20. Solve problems for unknown current in parallel circuits           |
|  | 21. Apply Kirchoff's current law to parallel circuits                 |
|  | 22. Solve problems for unknown resistance in series-parallel circuits |
|  | 23. Solve problems for unknown voltage in series-parallel circuits    |
|  | 24. Solve problems for unknown current in series-parallel circuits    |
|  | 25. Determine power using Ohm's law                                   |

#### Unit 11: AC Circuits

1. Terms and definitions
2. Principles of AC theory
3. Principles of induction
4. Inductance characteristics
5. Factors affecting inductors
6. Power characteristics in inductive circuits

## Instructional/Task Analysis

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### Related Information: What the Student Should Know

### Application: What the Student Should Be Able to Do

#### Unit 11: AC Circuits (continued)

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|--|--|
| 7. Transformer characteristics                               | 19. Research processes used for producing AC electricity   |
| 8. Classes of transformers                                   | 20. Solve RC and RL circuit problems   |
| 9. Single-phase transformer connections                      | 21. Solve power factor problems  |
| 10. Other transformer connections found in electrical trades | 22. Draw a diagram of a single-pole switch on a light  |
| 11. Power in three-phase circuits                            | 23. Draw a diagram of two three-way switches on a light  |
| 12. Testing for polarity                                     | 24. Draw a diagram of two three-way switches and a four-way switch on a light  |
| 13. Capacitance characteristics                              | 25. Wire a single-pole switch controlling a single lighting outlet with the supply line entering the switch box          |
| 14. Types, ratings, and common defects of capacitors         | 26. Wire a single-pole switch controlling a single lighting outlet with the supply line entering the lighting outlet box |
| 15. Capacitive AC circuits                                   | 27. Wire a three-way switching situation with the supply line entering a single lighting outlet                          |
| 16. Inductive AC circuits                                    | 28. Wire a four-way switching situation with the supply line entering the lighting outlet box                            |
| 17. Power characteristics in AC circuits                     |  |
| 18. Basic switching circuits used in electricity             |  |

#### Unit 12: Wiring Methods

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|---|---|
| 1. Terms and definitions                        | 4. Identify environments and structures requiring electrical wiring installations   |
| 2. Wiring methods found in electrical trades    | 5. Reference the <i>National Electrical Code</i> to identify uses of wiring methods |
| 3. Wiring methods and their common applications | 6. Install a set-screw conduit fitting  |
|   | 7. Install a compression-type conduit fitting                                       |
|   | 8. Prepare MC cable for termination   |
|   | 9. Install a connector onto liquidtight flexible metallic conduit (Seal-Tite®)      |
|   | 10. Install a connector onto rigid nonmetallic conduit                              |

### Related Information: What the Student Should Know

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#### Unit 13: Conductors

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|--|---|
| 1. Terms and definitions   | 12. Report on an electrical fire  |
| 2. Factors that determine conductor type and size                                  | 13. List conductors in order, by size                                       |
| 3. Characteristics of good connections   | 14. Calculate ampacity of conductors, given insulation and conductor type   |
| 4. Types of connectors, terminals, and lugs  | 15. Calculate corrected ampacity of conductors                              |
| 5. Wire insulation and its characteristics   | 16. Select conductors for various ampacities and temperatures               |
| 6. Types of wire insulation, their characteristics, applications, and code letters | 17. Calculate ampacity of conductors, given number of conductors in raceway |
| 7. Conductors commonly found in electrical wiring                                  | 18. Calculate ampacity and conductor sizes for specific types of loads      |
| 8. Color codes for conductors  | 19. Select cords for various applications                                   |
| 9. Means of identifying “grounded” and equipment “grounding” conductors            | 20. Select proper types of insulation                                       |
| 10. Types of cable and their uses  | 21. Install cord on utilization equipment                                   |
| 11. Cords and their conductors   | 22. Use a fish tape to install wire in conduit                              |
|  | 23. Prepare an aluminum conductor for termination                           |
|  | 24. Splice solid conductors using a wire nut                                |

#### Unit 14: Low Voltage Wiring

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|--|---|
| 1. Terms and definitions   | 12. List licensing requirements for low voltage wiring systems  |
| 2. Parts of a low voltage wiring system  | 13. Draw a wiring diagram indicating the proper connection for bell circuit equipment                                       |
| 3. Process that takes place during a low voltage lighting circuit off/on cycle | 14. Draw a wiring diagram indicating the proper connections for a single smoke detector and interconnecting smoke detectors |
| 4. Process that takes place during the energizing of a chime circuit           | 15. Wire a two-button chime circuit   |
| 5. Manual fan switching circuit  | 16. Wire two interconnecting smoke detectors  |
| 6. Thermostat system switch in the cool position and the fan switch on auto    |   |
| 7. Thermostat system switch in the heat position and the fan switch on auto    |   |
| 8. Anticipator circuits on low voltage thermostats                             |   |
| 9. Communication circuits and their characteristics                            |   |
| 10. Smoke and fire alarm systems   |   |
| 11. Operation of a garage door opener  |   |

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#### Unit 15: Overcurrent Protection

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|---|---|
| 1. Terms and definitions                                    | 10. Identify overcurrent protective devices |
| 2. Types of overcurrent protective devices                  | 11. Calculate conductor and fuse sizes      |
| 3. Operation of a single-element fuse                       | 12. Test cartridge fuses                    |
| 4. Operation of a dual-element, time-delay fuse             |   |
| 5. Types of circuit breakers and their operation            |   |
| 6. Requirements for fuses of less than 600 volts            |   |
| 7. Requirements for circuit breakers of less than 600 volts |   |
| 8. Installations that require GFCI protection               |   |
| 9. Installations that require AFCI protection               |   |

#### Unit 16: Load Centers and Safety Switches

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|--|---|
| 1. Terms and definitions   | 10. Determine cost of load center construction                      |
| 2. Types of safety switch enclosures                             | 11. Using the <i>NEC</i> , answer questions related to load centers |
| 3. Safety switch system configurations                           | 12. Install a safety switch   |
| 4. Types of load centers and enclosures                          | 13. Wire a load center or breaker panel                             |
| 5. Common load center accessories and their uses                 | 14. Wire a receptacle to a load center                              |
| 6. Parts of a fusible, single-phase load center                  |   |
| 7. Parts of a breaker load center                                |   |
| 8. Common panel bus configurations                               |   |
| 9. Safety rules for wiring near load centers and safety switches |   |

### Related Information: What the Student Should Know

### Application: What the Student Should Be Able to Do

#### Unit 17: Existing Structures

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|--|--|
| 1. Terms and definitions   | 11. Determine the number of conductors allowed to be added to an existing conduit  |
| 2. Construction members common in existing structures  | 12. Install a metallic box with dry-wall grips in a plasterboard wall  |
| 3. Common routes for new cable installations   | 13. Secure a box with dry-wall supports (box tins)   |
| 4. Possible methods for getting cable through or around construction members   | 14. Install a plastic box with dry-wall grips in a plasterboard wall   |
| 5. Wall or ceiling compositions that may be found in an existing structure   | 15. Install a box in a paneled wall  |
| 6. Conditions for using optional calculations for additional loads to existing installations                                   | 16. Install a box in a concrete block wall   |
| 7. Exceptions to the <i>NEC</i> requirements for support of flexible metal conduit   | 17. Install a box in a brick wall  |
| 7. Steps for determining the number of conductors allowed in a conduit, based on conductors of the same size and type          | 18. Install a box in a ceiling with an accessible attic  |
| 8. Steps for determining the number of conductors allowed in a conduit, based on using conductors of different sizes and types | 19. Install cable between an existing box and a newly installed box horizontally along a wall in a channel behind base board |
| 9. Replacement of receptacles in existing structures   | 20. Install cable between an existing box and a newly installed box, using an underfloor crawl space                         |
| 10. Equipment grounding connections in existing structures   | 21. Install cable between an existing box and a newly installed box, using attic space                                       |