

PLANT MAINTENANCE – ELECTRICIAN

APPENDIX A

O*NET CODE 47-2111.00

This training outline is a minimum standard for Work Processes and Related Instruction. Changes in technology and regulations may result in the need for additional on-the-job or classroom training.

WORK PROCESSES

	Approximate Hours
A. Tools, Equipment, Materials and Supply Room	300
1. Safety	
2. Proper use and care of ladders and scaffolds	
3. Use and care of hand tools	
4. Use and care of power tools	
5. Use and operation of high lifts	
6. Identifying names of materials, basic kinds of wire and conduit	
a. Lock-out/Tag-out (under proper supervision; not to be undertaken until apprentice has received all appropriate and required training)	
b. Proper use and care of industrial trucks (if applicable)	
B. Lighting	400
1. Repair and installation of wiring, fuses, circuit breakers, switches, outlets, incandescent lamps, fluorescent fixtures (including starters, ballast, and sockets)	
2. Lighting under control equipment	
3. Demonstrating an understanding of energy conservation and power consumption, including retrofitting evaluation	
4. Estimating number of fixtures and types of lighting (calculating foot-candles delivered per square foot) (if applicable)	
C. Installation of A.C. Wiring	800
1. Reading and understanding blueprints, codes, specifications	
2. Planning layout and installation of wiring	

3. Measuring, bending, cutting, threading, assembling, and installing conduit
4. Selecting and using proper fittings for rigid, thin wall and flexible condulets
5. Performing installation wiring of machines, wiring contactors, push buttons
6. Demonstrating a knowledge of the principles of overload devices, and proper selection
7. Accurately estimating amounts of conduit, condulets, wiring
 - a. Ensuring that wiring is in compliance with OSHA and NEC requirements

D. Troubleshooting A.C. Wiring 500

1. Repairing contactor troubles; replacing contacts and contactor coils; locating and replacing blown fuses, limit switches, push buttons, etc.
2. Inspection, preventive maintenance, and troubleshooting

E. Minor A.C. Motor, Small Motor and Appliance Repair 200

1. Assembling and disassembling motors
2. Replacing parts including: bearings, controls, and switches
3. Inspection, cleaning, and maintenance of windings
4. Repair and maintenance of small motors in drills, portable tools, fans, appliances
5. Testing and troubleshooting

F. Three-Phase Motor Repair 200

1. Repair and replacement of grounds and coils
2. Tapping and reconnecting of windings for voltage changes
3. Vibration analysis (if applicable)
4. Motor alignment (optional*)

G. Special A.C. Circuits 950

1. Demonstrating an understanding of relay logic
2. Correctly interpreting wiring diagrams/ladder diagrams
3. Testing continuity of circuit
4. Circuit breakers
5. Switches

6. Time delays
7. Electronic control circuits

H. D.C. Machinery

800

1. Predictive maintenance
2. Testing and discussing malfunctions with operator and/or other appropriate employees
3. Troubleshooting D.C. motor and generator troubles in fields, armatures, bearings, brush holders and commutators
4. Demonstrating knowledge of variable speed D.C. drives, reliance motor generators
5. Repair and maintenance of D.C. contactors and field control
6. Repair and maintenance of trucks, batteries, battery chargers, rectifiers, and motor generator types (if applicable)

I. General and Specialized Wiring

1,100

1. Accurately estimating load requirements; laying out conduit runs
2. Installation and maintenance of general wiring, fuse panels, power feeding, breakers, etc.
3. Wiring methods
4. Connecting transformers: three-phase, star (WYE) and delta connections; transformer polarity; demonstrating a knowledge of generally used wiring systems and current relationship
5. Three-phase and two-phase
6. Single-phase two and three wire
7. Three-phase four wire
8. Signaling, power and control wiring
9. Wiring of specialized systems, such as: sound, data transmission, telephone, fire alarm**, fiber optics, security systems**, energy management, closed
10. circuit television, nurse call systems.
11. Maintaining and troubleshooting these systems

J. Testing Equipment	200
<ul style="list-style-type: none"> 1. Proper use and care of electrical and electronic testing equipment; use of testing equipment in troubleshooting process: <ul style="list-style-type: none"> a. volt meter b. ammeter c. watt meter d. ohmmeter e. power factor meter f. recording meter g. test lamp h. oscilloscope i. meggers j. all other instruments utilized 	
K. Power Factor Correction (optional*)	100
<ul style="list-style-type: none"> 1. Learning use of condensers 2. Learning use of synchronous motors 3. Estimating amount of K.V.A.R. required for proper correction, and its effect on power 4. system capacity and power rates 	
L. Industrial Electronics	1,300
<ul style="list-style-type: none"> 1. Installation of power supply wiring for newly installed machines and equipment 2. Predictive maintenance 3. Testing malfunctioning equipment and systems; conferring with users and/or other appropriate employees 4. Installation, operation, and repair of electronic devices 5. Installation, operation, and repair of AC frequency speed control units 6. Installation, operation, and repair of public address systems 7. Installation, operation, testing and repair of electronic controls for machines and equipment 8. Installation, maintenance, and repair of distributive control systems 9. Installation, maintenance, and repair of induction heating 	

10. Installation, maintenance, and repair of position sensing devices (if available)
11. Diagnosing, repairing, replacing electronic components, such as printed circuit boards
12. Demonstrating an understanding of related systems, including: diagnosing and replacing faulty mechanical, hydraulic, and pneumatic components of machines and equipment (if applicable)

M. Computerized Controls 600

1. Predictive maintenance
2. Using robot controller, teach pendant, and programmable controller to program, operate, test, and verify repairs on automated machinery such as robots (if such machinery is available)
3. Programmable logic controllers: reading diagrams and schematics; maintaining and troubleshooting
4. Troubleshooting process control loops (if applicable)
5. Computerized systems, such as: building control systems

N. Introduction to High Voltage/Power Distribution 150

1. Following all safety procedures and policies
2. Proper use of associated equipment
3. Switch gear maintenance

O. Photovoltaic Systems (optional*) 400

1. Installing
2. Maintaining
3. Repairing/troubleshooting

Approximate Total Hours 8,000

*If optional work processes are not selected, the hours should be devoted to further mastery of the required work processes.

**A security/fire alarm installer license is required for those who install “hard-wired” security /fire alarms and detectors. Please consult the New York State Department of State for licensing requirements. (Local municipalities may also have licensing requirements.)

Apprenticeship work processes are applicable only to training curricula for apprentices in approved programs. Apprenticeship work processes have no impact on classification determinations under Article 8 or 9 of the Labor Law. For guidance regarding classification for purposes of Article 8 or 9 of the Labor Law, please refer to <https://dol.ny.gov/public-work-and-prevailing-wage>.

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APPENDIX B

RELATED INSTRUCTION

Safety and Health

1. Basic Industrial Safety or OSHA 10-hour General Industry Safety Course
2. Trade Safety, including the following:
 - a. Personal Protective Equipment (PPE)
 - b. Lock-Out/Tag-Out
 - c. National Fire Protection Association Arc Flash Training
 - d. Fall Prevention
 - e. Proper Lifting Techniques
 - f. Confined Space Safety
 - g. Right-to-Know/Material Safety Data Sheets (MSDS)
 - h. Asbestos Awareness – minimum 4 hours (see attachment)
3. First Aid – minimum 6.5 hours every 3 years
4. Sexual Harassment Prevention – must comply with Section 201-g of the Labor Law

Blueprint Reading and Sketching

1. Elementary Blueprint Reading and Sketching
2. Blueprint Reading and Sketching for Electricians
3. Electrical Circuit Diagrams
4. Reading Specifications, Technical Manuals

Mathematics

1. Fundamentals of Mathematics
2. Mathematics for Electricians
3. Estimating for Electricians (costs, prices, time, materials)

Trade Theory and Science

1. Fundamentals of Building Construction
2. A.C. Fundamentals
3. D.C. Fundamentals
4. Circuit Theory

5. Electrical Grounding
6. Trade Terminology
7. Tools and Equipment of the Trade
8. Materials of the Trade
9. Conduit Fabrication
10. Stock Room
11. Electrical Measurement
12. Resistance
13. Magnetism
14. Inductive Reactance
15. Capacitive Reactance
16. Soldering
17. National Electric Code (NEC) and All Updates
18. Federal, State and Local Building and Electrical Codes
19. Motor Fundamentals
20. Generator Fundamentals
21. Transformer Fundamentals
22. Radio Fundamentals
23. Motor Control
24. Fundamentals of Pneumatic, Hydraulic and Mechanical Systems
25. Lighting Installation
26. High Voltage Power Distribution
27. Power Wiring
28. Signal Wiring
29. Instrumentation
30. Process Control Systems
31. Appliance Repair
32. Industrial Electronics (including analog and digital electronics)
33. Specialized Systems (voice, video, data, etc.)
34. Programmable Controllers
35. Fire Alarms
36. Security Systems

- 37. Distributed Control
- 38. Welding and Brazing
- 39. Photovoltaic Systems (if Work Process "O" is selected)
- 40. Predictive Maintenance
- 41. Service and Troubleshooting
- 42. Rigging

Other Workplace Skills

- 1. Computer Literacy
- 2. Use of Trade-Related Software (if applicable)
- 3. Communication Skills (written and oral)

Other Related Courses as Necessary

A minimum of 180 hours of Related Instruction is required for each apprentice for each of four years.

Appendix B topics are approved by New York State Education Department.

ATTACHMENT TO APPENDIX B

Asbestos Awareness

This course must be delivered by one of the following:

1. A provider currently approved by the New York State Department of Health to deliver asbestos safety training.
2. A person holding a current Asbestos Handler certificate from the New York State Department of Labor in the title of: Inspector, Supervisor, Project Monitor, Management Planner, or Project Designer.
3. Anyone otherwise approved by the New York State Education Department.

Minimum course contents must include the following:

1. Definition of asbestos
2. Types and physical characteristics
3. Uses and applications
4. Health effects:
 - a. Asbestos-related diseases
 - b. Risks to families
 - c. Cigarette smoking
 - d. Lack of safe exposure level
5. Employer-specific procedures to follow in case of potential exposure, including making a supervisor or building owner immediately aware of any suspected incidental asbestos disturbance so that proper containment and abatement procedures can be initiated promptly.

Notwithstanding the above course requirement, employers are advised that they must also be in compliance with New York State Department of Labor Industrial Code Rule 56 at all times.

Employers are further advised, and must advise all apprentices, that completion of the above course requirement does not authorize any person to remove, encapsulate, enclose, repair, disturb, or abate in any manner, any friable or non-friable asbestos, asbestos containing material, presumed asbestos containing material, or suspect miscellaneous asbestos containing material.