



APPENDIX A

PLANT MAINTENANCE – ELECTRICIAN

D.O.T. CODE 829.261-018

O*NET CODE 47-2111.00

This training outline is the current standard for Work Processes and Related Instruction. Changes in technology, regulations, and safety/health issues may result in the need for additional on-the-job or classroom learning.

WORK PROCESSES

	<u>Approximate Hours</u>
A. <u>Tools, Equipment, Materials and Supply Room</u>	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 highlifts	
6. Identifying names of materials, basic kinds of wire and conduit	
7. Lock-out/Tag-out (under proper supervision; not to be undertaken until apprentice has received all appropriate and required training)	
8. Proper use and care of industrial trucks (if applicable)	
B. <u>Lighting</u>	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
 8. 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, 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.	<u>Three-Phase Motor Repair</u>	200
	<ol style="list-style-type: none"> 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.	<u>Special A.C. Circuits</u>	950
	<ol style="list-style-type: none"> 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.	<u>D.C. Machinery</u>	800
	<ol style="list-style-type: none"> 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.	<u>General and Specialized Wiring</u>	1,100
	<ol style="list-style-type: none"> 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 	

	<ul style="list-style-type: none"> 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 circuit television, nurse call systems. Maintaining and troubleshooting these systems 	
J.	<u>Testing Equipment</u>	200
	<p>Proper use and care of electrical and electronic testing equipment; use of testing equipment in troubleshooting process:</p> <ul style="list-style-type: none"> 1. volt meter 2. ammeter 3. watt meter 4. ohmmeter 5. power factor meter 6. recording meter 7. test lamp 8. oscilloscope 9. meggers 10. all other instruments utilized 	
K.	<u>Power Factor Correction (optional*)</u>	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 system capacity and power rates 	
L.	<u>Industrial Electronics</u>	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.	<u>Computerized Controls</u>	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.	<u>Introduction to High Voltage/Power Distribution</u>	150
1.	Following all safety procedures and policies	
2.	Proper use of associated equipment	
3.	Switch gear maintenance	
O.	<u>Photovoltaic Systems (optional*)</u>	400
1.	Installing	
2.	Maintaining	
3.	Repairing/troubleshooting	
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	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 <http://www.labor.state.ny.us/workerprotection/publicwork/PDFs/Article8FAQS.pdf>

APPENDIX B

PLANT MAINTENANCE – ELECTRICIAN

RELATED INSTRUCTION

Safety and Health

Basic Industrial Safety *or* OSHA 10-hour General Industry Safety Course

Trade Safety, including the following:

Personal Protective Equipment (PPE)

Lock-Out/Tag-Out

National Fire Protection Association Arc Flash Training

Fall Prevention

Proper Lifting Techniques

Confined Space Safety

Right-to-Know/Material Safety Data Sheets (MSDS)

Asbestos Awareness – minimum 4 hours (see attachment)

First Aid – minimum 6.5 hours every 3 years

Blueprint Reading and Sketching

Elementary Blueprint Reading and Sketching

Blueprint Reading and Sketching for Electricians

Electrical Circuit Diagrams

Reading Specifications, Technical Manuals

Mathematics

Fundamentals of Mathematics

Mathematics for Electricians

Estimating for Electricians (costs, prices, time, materials)

Trade Theory and Science

Fundamentals of Building Construction

A.C. Fundamentals

D.C. Fundamentals

Circuit Theory

Electrical Grounding

Trade Terminology

Tools and Equipment of the Trade

Materials of the Trade

Conduit Fabrication

Stock Room

Electrical Measurement
Resistance
Magnetism
Inductive Reactance
Capacitive Reactance
Soldering
National Electric Code (NEC) and All Updates
Federal, State and Local Building and Electrical Codes
Motor Fundamentals
Generator Fundamentals
Transformer Fundamentals
Radio Fundamentals
Motor Control
Fundamentals of Pneumatic, Hydraulic and Mechanical Systems
Lighting Installation
High Voltage Power Distribution
Power Wiring
Signal Wiring
Instrumentation
Process Control Systems
Appliance Repair
Industrial Electronics (including analog and digital electronics)
Specialized Systems (voice, video, data, etc.)
Programmable Controllers
Fire Alarms
Security Systems
Distributed Control
Welding and Brazing
Photovoltaic Systems (if Work Process "O" is selected)
Predictive Maintenance
Service and Troubleshooting
Rigging

Other Workplace Skills

Computer Literacy
Use of Trade-Related Software (if applicable)
Communication Skills (written and oral)
Sexual Harassment Prevention Training – minimum 3 hours

Other Related Courses as Necessary

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

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:
 - Asbestos-related diseases
 - Risks to families
 - Cigarette smoking
 - 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.