



## **ELECTRICAL AND POWER TRANSMISSION INSTALLERS, OTHER**

**CIP Code 46.0399**

This document is a Program of Study for Electrical and Power Transmission Installers programs at the secondary level. This program of study is considered a framework, not a curriculum. From this framework educators may use this as a tool to provide structure for developing learning modules, unit plans, or daily lesson plans that meet the tasks or standards within the program of study. This program of study is based on research, experience, and many resources. The goal is to train a workforce that is skilled, knowledgeable, and able to meet the needs of the industry today and well into the future.

Electricians bring electricity into homes, businesses, and factories. They install and maintain the wiring, fuses, and other components through which electricity flows. Many electricians also install and maintain electrical machines in factories.

Electricians usually start their work by reading blueprints. Blueprints are technical diagrams that show the locations of circuits, outlets, load centers, panel boards, and other equipment. To ensure public safety, electricians follow the National Electrical Code, and State and local building codes.

Electricians connect all types of wires to circuit breakers, transformers, outlets, or other components. They join the wires in boxes with various specially designed connectors. When installing wiring, electricians use hand tools such as conduit benders, screwdrivers, pliers, knives, hacksaws, and wire strippers, as well as power tools such as drills and saws. Later, they use ammeters, ohmmeters, voltmeters, oscilloscopes, and other equipment to test connections and ensure the compatibility and safety of components.

Electricians generally focus on either construction or maintenance, although many do both. Electricians specializing in construction primarily install wiring systems into factories, businesses, and new homes. Electricians specializing in maintenance work fix and upgrade existing electrical systems and repair electrical equipment.

When electricians install wiring systems in factories and commercial settings, they first place conduit (pipe or tubing) inside partitions, walls, or other concealed areas as designated by the blueprints. They also fasten small metal or plastic boxes to the walls that will house electrical switches and outlets. They pull insulated wires or cables through the conduit to complete circuits between these boxes. The diameter and number of wires installed depends on how much power will need to run through it. The greater the diameter of the wire, the more electricity it can handle. In residential construction, electricians usually install insulated wire encased in plastic, which does not need to run through conduit.

Some electricians also install low-voltage wiring systems in addition to electrical systems, although line installers and repairers specialize in this work. Low-voltage wiring accommodates voice, data, and video equipment, such as telephones, computers, intercoms, and fire alarm and security systems. Electricians also may install coaxial or fiber optic cable for telecommunications equipment and electronic controls for industrial uses.

Maintenance electricians repair or replace electric and electronic equipment when it breaks. They make needed repairs as quickly as possible in order to minimize inconvenience. They may replace items such as circuit breakers, fuses, switches, electrical and electronic components, or wire. Electricians also periodically inspect all equipment to ensure it is operating properly and to correct problems before breakdowns occur.

Maintenance work varies greatly, depending on where an electrician works. Electricians who focus on residential work perform a wide variety of electrical work for homeowners. They may rewire a home and replace an old fuse box with a new circuit breaker box to accommodate additional appliances, or they may install new lighting and other electric household items, such as ceiling fans. These electricians might also do some construction and installation work. Electricians in large factories usually do maintenance work that is more complex. They may repair motors, transformers, generators, and electronic controllers on machine tools and industrial robots. Electricians also advise management whether continued operation of equipment could be hazardous.

Electricians work indoors and out, at construction sites, in homes, and in businesses or factories. Work may be strenuous at times and may include bending conduit, lifting heavy objects, and standing, stooping, and kneeling for long periods. Electricians risk injury from electrical shock, falls, and cuts. They must follow strict safety procedures to avoid injuries. When working outdoors, they may be subject to inclement weather conditions. Some electricians may have to travel long distances to jobsites.

Most electricians work a standard 40-hour week, although overtime may be required. Those who do maintenance work may work nights or weekends and be on call to go to the worksite when needed. Electricians in industrial settings may have periodic extended overtime during scheduled maintenance or retooling periods. Companies that operate 24 hours a day may employ three shifts of electricians.

Most electricians learn their trade through apprenticeship programs. These programs combine on-the-job training with related classroom instruction. Because of the comprehensive training received, those who complete apprenticeship programs qualify to do both maintenance and construction work. Apprenticeship programs usually last 4 years. Each year includes at least 144 hours of classroom instruction and 2,000 hours of on-the-job training. In the classroom, apprentices learn electrical theory, blueprint reading, mathematics, electrical code requirements, and safety and first aid practices. They also may receive specialized training in soldering, communications, fire alarm systems, and cranes and elevators.

On the job, apprentices work under the supervision of experienced electricians. At first, they drill holes, set anchors, and attach conduit. Later, they measure, fabricate, and install conduit and install, connect, and test wiring, outlets, and switches. They also learn to set up and draw diagrams for entire electrical systems. Eventually, they practice and master all of an electrician's main tasks.

Some people start their classroom training before seeking an apprenticeship. A number of public and private vocational-technical schools and training academies offer training to become an electrician. Employers often hire students who complete these programs and usually start them at a more advanced level than those without this training. A few people become electricians by first

working as helpers—assisting electricians by setting up job sites, gathering materials, and doing other nonelectrical work—before entering an apprenticeship program. Electricians may also need classes in mathematics because they solve mathematical problems on the job.

Education can continue throughout an electrician’s career. Electricians often complete regular safety programs, manufacturer-specific training, and management training courses. Classes on installing low-voltage voice, data, and video systems have recently become common as these systems become more prevalent. Other courses teach electricians how to become contractors.

Most States and localities require electricians to be licensed. Although licensing requirements vary from State to State, electricians usually must pass an examination that tests their knowledge of electrical theory, the National Electrical Code, and local electric and building codes. Experienced electricians periodically take courses offered by their employer or union to learn about changes in the National Electrical Code.

Other skills needed to become an electrician include manual dexterity, eye-hand coordination, physical fitness, and a good sense of balance. They also need good color vision because workers frequently must identify electrical wires by color. In addition, apprenticeship committees and employers view a good work history or military service favorably.

For those who seek to advance, it is increasingly important to be able to communicate in both English and Spanish in order to relay instructions and safety precautions to workers with limited understanding of English; Spanish-speaking workers make up a large part of the construction workforce in many areas. Spanish-speaking workers who want to advance in this occupation need very good English skills to understand electrician classes and installation instructions, which are usually written in English and are highly technical.

## **Assumptions of This Program of Study**

High-quality programs should meet the following standards:

- Promote **positive working relationships**
- Implement a **curriculum** that fosters all areas of skill development – cognitive, emotional, language, physical, and social
- Use developmentally, culturally, and linguistically appropriate and **effective teaching approaches**
- Provide **ongoing assessments** of student progress
- Employ and support qualified **teaching staff**
- Establish and maintain collaborative relationships **with families**
- Establish and maintain relationships and use resources of the **community**
- Provide a safe and healthy learning **environment**
- Implement strong program organization and supervision policies that result in **high-quality teaching and learning**
- Integrate academic skills and aptitudes necessary for gainful employment and promoting a foundation of **lifelong learning**

## Academic Rigor

Research shows that career success requires the same level of college-prep courses as postsecondary success requires. The Department of Education's focus is to ensure that every student graduates prepared for college and a career. In order to be successful in this program of study, students should follow the academic sequence as determined by Pennsylvania's high school reform efforts.

## Resources Used for This Program of Study

- MAVCC (Multistate Academic Vocational Curriculum Consortium)  
<http://www.mavcc.org/>
- NOCTI (National Occupational Competency Testing Institute <http://www.nocti.org/>)
- O\*NET <http://online.onetcenter.org/>
- Pennsylvania Approved Certifications for Industry-Recognized Certifications for Career and Technical Education Programs  
[http://www.portal.state.pa.us/portal/server.pt/community/instructional\\_resources/7392/industry-recognized\\_certifications\\_for\\_career\\_and\\_technical\\_education\\_programs/507887](http://www.portal.state.pa.us/portal/server.pt/community/instructional_resources/7392/industry-recognized_certifications_for_career_and_technical_education_programs/507887)
- Pennsylvania Department of Labor & Industry High Priority Occupations  
[http://www.portal.state.pa.us/portal/server.pt/community/high\\_priority\\_occupations/12910](http://www.portal.state.pa.us/portal/server.pt/community/high_priority_occupations/12910)
- VTECS (A Consortium of Innovative Career and Workforce Development Resources)  
<http://www.vtecs.org/>

## CIP Code

### **46.0399 ELECTRICAL AND POWER TRANSMISSION INSTALLERS, OTHER**

#### **Pennsylvania CIP**

An instructional program that prepares individuals to apply technical knowledge and skills necessary to install, operate, maintain and repair electrically-energized residential, commercial and industrial systems, and DC and AC motors, controls and electrical distribution panels. Instruction emphasizes practical application of mathematics, science, circuit diagrams and use of electrical codes and includes blueprint reading, sketching and other subjects essential for employment in the electrical occupations. Reading and interpretation of commercial and residential construction wiring codes and specifications, installation and maintenance of wiring, service and distribution networks within large construction complexes are also critical components of the program.

## **Integrate Academic Career Education and Work Standards for Student Success**

As students participate in career exploration activities and rigorous studies from elementary grades through graduation, they learn to appreciate the relationship between their classroom learning and the skills needed within the workplace. The academic and workplace skills within the Academic Standards for Career Education and Work are expected to be addressed within

classrooms and achieved by all students throughout Pennsylvania. No student should leave secondary education without a solid foundation in these Standards.

[http://www.portal.state.pa.us/portal/server.pt/community/state\\_board\\_of\\_education/8830/state\\_academic\\_standards/529102](http://www.portal.state.pa.us/portal/server.pt/community/state_board_of_education/8830/state_academic_standards/529102)

CEW Standards Tool Kit for teachers to implement CEW Standards

[www.pacareerstandards.com](http://www.pacareerstandards.com)

## **Pennsylvania Approved Certifications**

[http://www.portal.state.pa.us/portal/server.pt/community/instructional\\_resources/7392/industry-recognized\\_certifications\\_for\\_career\\_and\\_technical\\_education\\_programs/507887](http://www.portal.state.pa.us/portal/server.pt/community/instructional_resources/7392/industry-recognized_certifications_for_career_and_technical_education_programs/507887)

## **The Programs of Study Documents**

- Crosswalk Template for Task Alignment (excel) – Electrical and Power Transmission Installers, Other – Instructions: Indicate the number code(s) of your school’s program competency or competencies aligned to each program of study competency.
- Crosswalk Template for Task Alignment (pdf) – Electrical and Power Transmission Installers, Other – Instructions: Indicate the number code(s) of your school’s program competency or competencies aligned to each program of study competency.
- Scope and Sequence Template (word) – Enter secondary technical Program of Study courses. Postsecondary courses will be determined when the Statewide Articulation Agreement for this Program of Study is complete.
- Scope and Sequence Template (pdf) – Enter secondary technical Program of Study courses. Postsecondary courses will be determined when the Statewide Articulation Agreement for this Program of Study is complete.
- PA Academic Standards/Eligible Content Alignment to Electrical and Power Transmission Installers, Other Task List (excel) – Crosswalk of PA Academic Standards/Eligible Content for Reading, Writing, Speaking and Listening (RWSL), Math, and Science aligned to Program of Study Secondary Competency List.
- PA Academic Standards/Eligible Content Alignment to Electrical and Power Transmission Installers, Other Task List (pdf) – Crosswalk of PA Academic Standards/Eligible Content for Reading, Writing, Speaking and Listening (RWSL), Math, and Science aligned to Program of Study Secondary Competency List.

### **For more information, contact:**

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