
Electricians

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Significant Points

- Job opportunities should be very good, especially for those with the broadest range of skills.
- Most electricians acquire their skills by completing an apprenticeship program lasting 4 to 5 years.
- About 4 out of 5 electricians work in the construction industry or are self-employed, but there also will be opportunities for electricians in other industries.

Nature of the Work

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. When working with complex electronic devices, they may consult with engineers, engineering technicians, line installers and repairers, or industrial machinery mechanics and maintenance workers. (Statements on these occupations appear elsewhere in the *Handbook*.)

Work environment. 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 work-site 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.



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Training, Other Qualifications, and Advancement

Most electricians learn their trade through apprenticeship programs. These programs combine on-the-job training with related classroom instruction.

Education and training. Most electricians learn their trade through apprenticeship programs. These programs combine paid on-the-job training with related classroom instruction. Joint training committees made up of local unions of the International Brotherhood of Electrical Workers and local chapters of the National Electrical Contractors Association; individual electrical contracting companies; or local chapters of the Associated Builders and Contractors and the Independent Electrical Contractors Association usually sponsor apprenticeship programs.

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. All apprentices need a high school diploma or a General Equivalency Diploma (G.E.D.). 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.

Licensure. 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.

Electrical contractors who do electrical work for the public, as opposed to electricians who work for electrical contractors, often need a special license. In some States, electrical contractors need certification as master electricians. Most States require master electricians to have at least 7 years of experience as an electrician. Some States require a bachelor's degree in electrical engineering or a related field.

Other qualifications. Applicants for apprenticeships usually must be at least 18 years old and have a high school diploma or a G.E.D. They also may have to pass a test and meet other requirements.

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.

Advancement. Experienced electricians can advance to jobs as supervisors. In construction, they also may become project managers or construction superintendents. Those with sufficient capital and management skills can start their own contracting business, although this often requires a special electrical contractor's license. Supervisors and contractors should be able to identify and estimate costs and prices and the time and materials needed to complete a job. Many electricians also become electrical inspectors.

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.

Employment

Electricians held about 705,000 jobs in 2006. About 68 percent of wage-and-salary workers were employed in the construction industry and the remainder worked as maintenance electricians in other industries. In addition, about 11 percent of electricians were self-employed.

Projections data from the National Employment Matrix

Occupational Title	SOC Code	Employment, 2006	Projected employment, 2016		Change, 2006-16	
			Number	Percent	Number	Percent
Electricians.....	47-2111	705,000	757,000	52,000	7	

NOTE: Data in this table are rounded. See the discussion of the employment projections table in the *Handbook* introductory chapter on *Occupational Information Included in the Handbook*.

Job Outlook

Average employment growth is expected. Job prospects should be very good, particularly for workers with the widest range of skills, including voice, data, and video wiring.

Employment change. Employment of electricians should increase 7 percent between 2006 and 2016, about as fast as the average for all occupations. As the population and economy grow, more electricians will be needed to install and maintain electrical devices and wiring in homes, factories, offices, and other structures. An increase in power plant construction over the next ten years will require many additional electricians. New technologies also are expected to continue to spur demand for these workers. For example, buildings increasingly need wiring to accommodate computers and telecommunications equipment. Robots and other automated manufacturing systems in factories also will require the installation and maintenance of more complex wiring systems. As the economy rehabilitates and retrofits older structures, which usually require electrical improvements to meet modern codes, it will create additional jobs.

Job prospects. In addition to jobs created by the increased demand for electrical work, many openings are expected over the next decade as a large number of electricians retire. This will create very good job opportunities, especially for those with the widest range of skills, including voice, data, and video wiring. Job openings for electricians will vary by location and specialty, however, and will be best in the fastest growing regions of the country, especially those areas where power plants are being constructed.

Employment of electricians, like that of many other construction workers, is sensitive to the fluctuations of the economy. Workers in these trades may experience periods of unemployment when the overall level of construction falls. On the other hand, shortages of these workers may occur in some areas during peak periods of building activity.

Although employment of maintenance electricians is steadier than that of construction electricians, those working in the automotive and other manufacturing industries that are sensitive to cyclical swings in the economy may experience lay offs during recessions. In addition, opportunities for maintenance electricians may be limited in many industries by the increased contracting out for electrical services in an effort to reduce operating costs. However, increased job opportunities for electricians in electrical contracting firms should partially offset job losses in other industries.

Earnings

In May 2006, median hourly earnings of wage and salary electricians were \$20.97. The middle 50 percent earned between \$16.07 and \$27.71. The lowest 10 percent earned less than \$12.76, and the highest 10 percent earned more than \$34.95. Median hourly earnings in the industries employing the largest numbers of electricians were:

Motor vehicle parts manufacturing	\$31.90
Electric power generation, transmission, and distribution	26.32
Local government	23.80
Nonresidential building construction	20.58

Electrical contractors	20.47
Plumbing, heating, and air-conditioning contractors	19.56
Employment services	17.15

Apprentices usually start at between 40 and 50 percent of the rate paid to fully trained electricians, depending on experience. As apprentices become more skilled, they receive periodic pay increases throughout their training.

Some electricians are members of the International Brotherhood of Electrical Workers. Among unions representing maintenance electricians are the International Brotherhood of Electrical Workers; the International Union of Electronic, Electrical, Salaried, Machine, and Furniture Workers; the International Association of Machinists and Aerospace Workers; the International Union, United Automobile, Aircraft and Agricultural Implement Workers of America; and the United Steelworkers of America.

Related Occupations

To install and maintain electrical systems, electricians combine manual skill and knowledge of electrical materials and concepts. Workers in other occupations involving similar skills include heating, air-conditioning, and refrigeration mechanics and installers; line installers and repairers; electrical and electronics installers and repairers; electronic home entertainment equipment installers and repairers; and elevator installers and repairers.

Sources of Additional Information

For details about apprenticeships or other work opportunities in this trade, contact the offices of the State employment service, the State apprenticeship agency, local electrical contractors or firms that employ maintenance electricians, or local union-management electrician apprenticeship committees. Apprenticeship information is also available from the U.S. Department of Labor's toll free helpline: (877) 872-5627.

Information also may be available from local chapters of the Independent Electrical Contractors, Inc.; the National Electrical Contractors Association; the Home Builders Institute; the Associated Builders and Contractors; and the International Brotherhood of Electrical Workers.

For information about union apprenticeship and training programs, contact:

► National Joint Apprenticeship Training Committee, 301 Prince George's Blvd., Upper Marlboro, MD 20774.

Internet: <http://www.njatc.org>

► National Electrical Contractors Association, 3 Metro Center, Suite 1100, Bethesda, MD 20814.

Internet: <http://www.necanet.org>

► International Brotherhood of Electrical Workers, 1125 15th St.NW., Washington, DC 20005.

Internet: <http://www.ibew.org>

For information about independent apprenticeship programs, contact:

► Associated Builders and Contractors, Workforce Development Department, 4250 North Fairfax Dr., 9th Floor, Arlington, VA 22203. Internet: <http://www.trytools.org>

► Independent Electrical Contractors, Inc., 4401 Ford Ave., Suite 1100, Alexandria, VA 22302.

Internet: <http://www.ieci.org>

➤ National Association of Home Builders, Home Builders Institute, 1201 15th St.NW., Washington, DC 20005.

Internet: <http://www.hbi.org>

➤ National Center for Construction Education and Research, 3600 NW 43rd St., Bldg. G, Gainesville, FL 32606.

Internet: <http://www.nccer.org>

For general information on apprenticeships and how to get them, see the *Occupational Outlook Quarterly* article “Apprenticeships: Career training, credentials—and a paycheck in your pocket,” in print at many libraries and career centers and online at: <http://www.bls.gov/opub/ooq/2002/summer/art01.pdf>