

attachment to the occupation, many workers with limited skills leave the occupation when they find they dislike the work or because they can't find steady employment.

Additional job openings will be created by the rising demand for drywall work. Employment is expected to grow more slowly than the average for all occupations, reflecting the slow growth of new construction and renovation. In addition to traditional interior work, the growing acceptance of insulated exterior wall systems will provide additional jobs for drywall workers.

Despite the growing use of exterior panels, most drywall installation and finishing is done indoors. Therefore, these workers lose less work time because of inclement weather than some other construction workers. Nevertheless, they may be unemployed between construction projects and during downturns in construction activity.

Earnings

In 1998, the median hourly earnings of drywall installers and finishers were \$14.38. The middle 50 percent earned between \$11.34 and \$19.22. The lowest 10 percent earned less than \$9.04 and the highest 10 percent earned more than \$24.47.

Trainees usually started at about half the rate paid to experienced workers and received wage increases as they became more highly skilled.

Some contractors pay these workers according to the number of panels they install or finish per day; others pay an hourly rate. A 40-hour week is standard, but sometimes the workweek may be longer. Those who are paid hourly rates receive premium pay for overtime.

Related Occupations

Drywall installers and finishers combine strength and dexterity with precision and accuracy to make materials fit according to a plan. Other occupations that require similar abilities include carpenters, floor covering installers, form builders, insulation workers, and plasterers and stucco masons.

Sources of Additional Information

For information about work opportunities in drywall application and finishing, contact local drywall installation contractors; a local of the unions previously mentioned; a local joint union-management apprenticeship committee; a State or local chapter of the Associated Builders and Contractors; or the nearest office of the State employment service or State apprenticeship agency.

For details about job qualifications and training programs in drywall application and finishing, write to:

- ☛ Associated Builders and Contractors, Inc., 1300 North 17th St., Rosslyn, VA 22209.
- ☛ Home Builders Institute, National Association of Home Builders, 1201 15th St. NW., Washington, DC 20005.
- ☛ International Brotherhood of Painters and Allied Trades, 1750 New York Ave. NW., Washington, DC 20006.
- ☛ United Brotherhood of Carpenters and Joiners of America, 101 Constitution Ave. NW., Washington, DC 20001.

Electricians

(O*NET 87202A and 87202C)

Significant Points

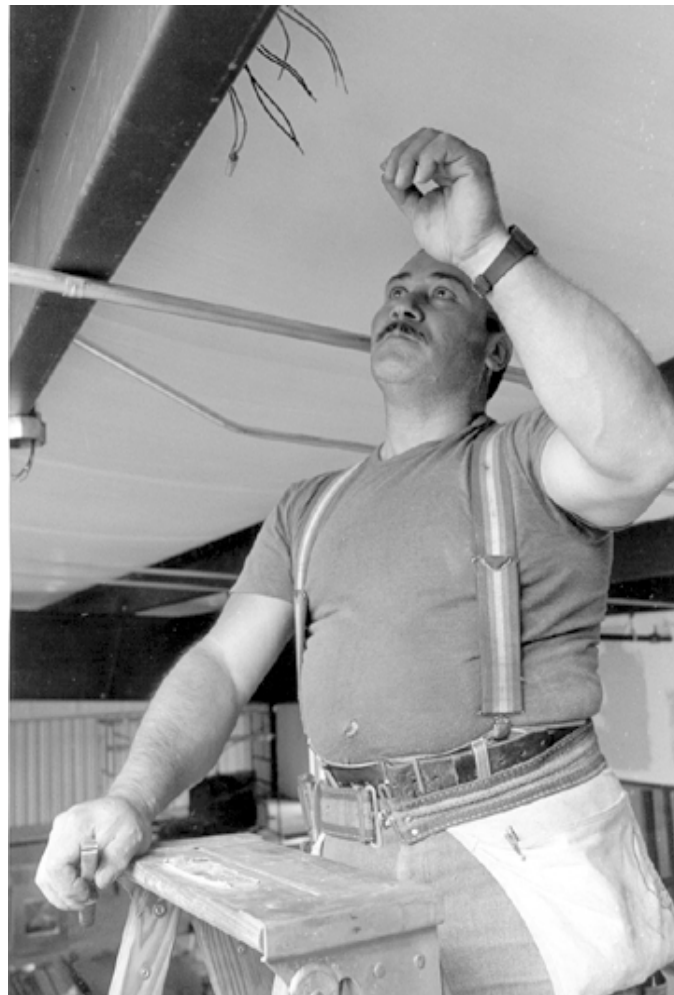
- Job opportunities are expected to be very good for qualified electricians.
- Most electricians acquire their skills by completing a formal 4-or 5-year apprenticeship program.
- In contrast to other construction trades, about one-third of all electricians work in industries other than construction.

Nature of the Work

Electricity is essential for light, power, air-conditioning, and refrigeration. Electricians install, connect, test, and maintain electrical systems for a variety of purposes, including climate control, security, and communications. They also may install and maintain the electronic controls for machines in business and industry. Although most electricians specialize in either construction or maintenance, a growing number do both.

Electricians work with blueprints when they install electrical systems in factories, office buildings, homes, and other structures. Blueprints indicate the location of circuits, outlets, load centers, panel boards, and other equipment. Electricians must follow the National Electric Code and comply with State and local building codes when they install these systems. In factories and offices, they first place conduit (pipe or tubing) inside designated partitions, walls, or other concealed areas. They also fasten to the wall small metal or plastic boxes that will house electrical switches and outlets. They then pull insulated wires or cables through the conduit to complete circuits between these boxes. In lighter construction, such as residential, plastic-covered wire usually is used rather than conduit.

Regardless of the type of wire used, electricians connect it to circuit breakers, transformers, or other components. They join the wires by twisting ends together with pliers, and covering the ends with special plastic connectors. When stronger connections are required, electricians may use an electric "soldering gun" to melt metal onto the twisted wires, which they then cover with durable electrical tape. After they finish the wiring, they use testing equipment, such as ohmmeters, voltmeters, and oscilloscopes, to check the circuits



Electricians need color vision because wires are usually identified by color.

for proper connections, ensuring electrical compatibility and safety of components.

In addition to wiring a building's electrical system, electricians may install coaxial or fiber optic cable for computers and other telecommunications equipment. A growing number of electricians installs telephone, computer wiring and equipment, and fire alarm and security systems. They also may connect motors to electrical power and install electronic controls for industrial equipment.

Maintenance work varies greatly, depending on where the electrician is employed. Electricians who specialize in residential work may rewire a home and replace an old fuse box with a new circuit breaker to accommodate additional appliances. Those who work in large factories may repair motors, transformers, generators, and electronic controllers on machine tools and industrial robots. Those in office buildings and small plants may repair all types of electrical equipment.

Maintenance electricians spend much of their time in preventive maintenance. They periodically inspect equipment, and locate and correct problems before breakdowns occur. Electricians may also advise management on whether continued operation of equipment could be hazardous or not. When needed, they install new electrical equipment. When breakdowns occur, they must make the necessary repairs as quickly as possible in order to minimize inconvenience. Electricians may replace items such as circuit breakers, fuses, switches, electrical and electronic components, or wire. When working with complex electronic devices, they may work with engineers, engineering technicians, or industrial machinery repairers. (For information about each of these occupations, see the statements located elsewhere in the *Handbook*.)

Electricians use handtools such as screwdrivers, pliers, knives, and hacksaws. They also use power tools and testing equipment such as oscilloscopes, ammeters, and test lamps.

Working Conditions

Electricians' work is sometimes strenuous. They may stand for long periods of time and frequently work on ladders and scaffolds. Their working environment varies, depending on the type of job. Some may work in dusty, dirty, hot, or wet conditions, or in confined areas, ditches or other uncomfortable places. Electricians risk injury from electrical shock, falls, and cuts; to avoid injuries, they must follow strict safety procedures. Some electricians may have to travel to job sites, which may be up to 100 miles away.

Most electricians work a standard 40-hour week, although overtime may be required. Those in maintenance work may have to work nights, on weekends, and be on call. Companies that operate 24 hours a day may employ three shifts of electricians. Generally, the first shift is primarily responsible for routine maintenance, while the other shifts perform preventive maintenance.

Employment

Electricians held about 656,000 jobs in 1998. About two-thirds were employed in the construction industry. Others worked as maintenance electricians and were employed in virtually every industry. In addition, about 1 out of 10 electricians was self-employed.

Because of the widespread need for electrical services, jobs for electricians are found in all parts of the country.

Training, Other Qualifications, and Advancement

Most people learn the electrical trade by completing a 4- or 5-year apprenticeship program. Apprenticeship gives trainees a thorough knowledge of all aspects of the trade and generally improves their ability to find a job. Although more electricians are trained through apprenticeship than workers in other construction trades, some still learn their skills informally, on the job.

Large apprenticeship programs are usually sponsored by joint training committees made up of local unions of the International Brotherhood of Electrical Workers, and local chapters of the National Electrical Contractors Association. Training may also be

provided by company management committees of individual electrical contracting companies and by local chapters of the Associated Builders and Contractors and the Independent Electrical Contractors. Because of the comprehensive training received, those who complete apprenticeship programs qualify to do both maintenance and construction work.

The typical large apprenticeship program provides at least 144 hours of classroom instruction each year, and 8,000 hours of on-the-job training over the course of the apprenticeship. In the classroom, apprentices learn blueprint reading, electrical theory, electronics, mathematics, electrical code requirements, and safety and first aid practices. They also receive specialized training in welding, communications, fire alarm systems, and cranes and elevators. On the job, under the supervision of experienced electricians, apprentices must demonstrate mastery of the electrician's work. At first, they drill holes, set anchors, and set up conduit. Later, they measure, fabricate, and install conduit, as well as install, connect, and test wiring, outlets, and switches. They also learn to set up and draw diagrams for entire electrical systems.

Those who do not enter a formal apprenticeship program can begin to learn the trade informally by working as helpers for experienced electricians. While learning to install conduit, connect wires, and test circuits, helpers also learn safety practices. Many helpers supplement this training with trade school or correspondence courses.

Regardless of how one learns the trade, previous training is very helpful. High school courses in mathematics, electricity, electronics, mechanical drawing, science, and shop provide a good background. Special training offered in the Armed Forces and by postsecondary technical schools also is beneficial. All applicants should be in good health and have at least average physical strength. Agility and dexterity also are important. Good color vision is needed because workers must frequently identify electrical wires by color.

Most apprenticeship sponsors require applicants for apprentice positions to be at least 18 years old and have a high school diploma or its equivalent. For those interested in becoming maintenance electricians, a background in electronics is increasingly important because of the growing use of complex electronic controls on manufacturing equipment.

Most localities require electricians to be licensed. Although licensing requirements vary from area to area, electricians usually must pass an examination that tests their knowledge of electrical theory, the National Electrical Code, and local electric and building codes.

Electricians periodically take courses offered by their employer or union to keep abreast of changes in the National Electrical Code, materials, or methods of installation.

Experienced electricians can become supervisors and then superintendents. Those with sufficient capital and management skills may start their own contracting business, although this may require an electrical contractor's license.

Job Outlook

Job opportunities for skilled electricians are expected to be very good as the growth in demand outpaces the supply of workers trained in this craft. There is expected to be a shortage of skilled workers during the next decade because of the anticipated smaller pool of young workers entering training programs.

Employment of electricians is expected to increase about as fast as the average for all occupations through the year 2008. Nearly two-thirds of wage and salaried electricians are concentrated in the construction industry, which is expected to grow more slowly than the average for all industries. Nevertheless, 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. New technologies also are expected to continue to stimulate the demand for these workers. Increasingly, buildings will be prewired during construction to accommodate use of computers and telecommunications equipment. More and more factories will be using robots and automated manufacturing systems. Installation of this equipment, which is expected to increase, should also stimulate demand for electricians. Additional jobs will be created by rehabilitation and retrofitting of existing structures.

In addition to jobs created by increased demand for electrical work, many openings will occur each year as electricians transfer to other occupations, retire, or leave the labor force for other reasons. Because of their lengthy training and relatively high earnings, a smaller proportion of electricians than other craft workers leave their occupation each year. The number of retirements is expected to rise, however, as more electricians reach retirement age.

Employment of construction electricians, like that of many other construction workers, is sensitive to changes in the economy. This results from the limited duration of construction projects and the cyclical nature of the construction industry. During economic downturns, job openings for electricians are reduced as the level of construction declines. Apprenticeship opportunities also are less plentiful during these periods.

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 be laid off during recessions. Also, efforts to reduce operating costs and increase productivity through the increased use of contracting out for electrical services may limit opportunities for maintenance electricians in many industries. However, this should be partially offset by increased demand by electrical contracting firms.

Job opportunities for electricians also vary by area. Employment opportunities follow the movement of people and businesses among States and local areas, and reflect differences in local economic conditions. The number of job opportunities in a given year may fluctuate widely from area to area. Some parts of the country may experience an oversupply of electricians, for example, while others may have a shortage.

Earnings

In 1998, median hourly earnings of electricians were \$16.98. The middle 50 percent earned between \$12.69 and \$22.34. The lowest 10 percent earned less than \$10.07 and the highest 10 percent earned more than \$30.99. Median hourly earnings in the industries employing the largest number of electricians in 1997 are shown below:

Motor vehicles and equipment	\$21.50
Local government, except education and hospitals	18.30
Electrical work	16.20
Personnel supply services	12.60

Depending on experience, apprentices usually start at between 30 and 50 percent of the rate paid to experienced electricians. As they become more skilled, they receive periodic increases throughout the course of the apprenticeship program. Many employers also provide training opportunities for experienced electricians to improve their skills.

Many construction electricians are members of the International Brotherhood of Electrical Workers. Among unions organizing 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, Aerospace 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 air-conditioning mechanics, cable installers and repairers, electronics mechanics, 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. This information may also 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.

Additional information on apprenticeships is available from:

✦ The National Joint Apprenticeship and Training Committee for the Electric Industry, 301 Prince Georges Blvd., Suite D, Upper Marlboro, MD 20744.

For general information about the work of electricians, contact:

✦ Independent Electrical Contractors, Inc., 2010-A Eisenhower Avenue Alexandria, VA 22314.

✦ National Electrical Contractors Association (NECA), 3 Metro Center, Suite 1100, Bethesda, MD 20814. Internet: <http://www.recant.org>

✦ International Brotherhood of Electrical Workers (IBEW), 1125 15th St. NW., Washington, DC 20005. Internet: <http://www.IBEW.org>

✦ Associated Builders and Contractors, 1300 North 17th St., Rosslyn, VA 22209.

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

Elevator Installers and Repairers

(O*NET 85932)

Significant Points

- Elevator installers and repairers learn the trade through years of on-the-job training, usually through a program run by their union.
- Almost 75 percent of elevator installers and repairers are union members—a greater proportion than nearly any other occupation.
- The combination of slow employment growth and the high pay these workers earn should continue to result in low job turnover and relatively few job openings.

Nature of the Work

Elevator installers and repairers—also called *elevator constructors* or *elevator mechanics*—assemble, install, and replace elevators, escalators, dumbwaiters, moving walkways, and similar equipment in new and old buildings. Once the equipment is in service, they maintain and repair it, as well. They are also responsible for modernizing older equipment.

To install, repair, and maintain modern elevators, which are almost all electronically controlled, elevator installers and repairers must have a thorough knowledge of electronics, electricity, and hydraulics. Many elevators today are installed with microprocessors, which are programmed to constantly analyze traffic conditions to dispatch elevators in the most efficient manner. With these computer controls, it is now possible to get the greatest amount of service with the least number of cars.

When installing a new elevator, installers and repairers begin by studying blueprints to determine the equipment needed to install rails, machines, car enclosures, motors, pumps, cylinders, and plunger foundations. Once this has been determined, they begin equipment installation. Working on scaffolding or platforms, installers bolt or weld steel rails to the walls of the shaft to guide the elevator.

Elevator installers put in electrical wires and controls by running tubing, called conduit, along a shaft's walls from floor to floor. Once in place, mechanics pull plastic-covered electrical wires through the conduit. They then install electrical components and related devices required at each floor and at the main control panel in the machine room.

Installers bolt or weld together the steel frame of an elevator car at the bottom of the shaft, install the car's platform, walls, and doors, and