

Installation, Maintenance, and Repair Occupations

Electrical and Electronic Equipment Mechanics, Installers, and Repairers

Computer, Automated Teller, and Office Machine Repairers

(O*NET 49-2011.01, 49-2011.02, 49-2011.03)

Significant Points

- Workers receive training in electronics from associate degree programs, the military, vocational schools, equipment manufacturers, or employers.
- Job growth reflects the increasing dependence of business and residential customers on computers and other sophisticated office machines.
- Job prospects will be best for applicants with knowledge of electronics, as well as repair experience; opportunities for computer repairers should be excellent, as employers report difficulty finding qualified applicants.

Nature of the Work

Computer repairers, also known as *data processing equipment repairers*, service mainframe, server, and personal computers; printers; and disc drives. These repairers primarily perform hands-on repair, maintenance, and installation of computers and related equipment. Workers who provide technical assistance, in person or by telephone, to computer system users are known as computer support specialists. (See the statement on computer support specialists and systems administrators elsewhere in the *Handbook*.)

Automated teller machines (ATMs) allow customers to carry out bank transactions without the assistance of a teller. ATMs now provide a growing variety of other services, including stamp, phone card, and ticket sales. *Automated teller machine servicers* repair and service these machines.

Office machine and cash register servicers work on photocopiers, cash registers, mail processing equipment, and fax machines. Newer models of office machinery increasingly include computerized components that allow them to function more effectively than earlier models.

To install large equipment, such as mainframe computers and ATMs, repairers connect the equipment to power sources and communication lines. These lines allow the transmission of information over computer networks. For example, when an ATM dispenses cash, it also transmits the withdrawal information to the customer's bank. Workers also may install operating software and peripheral equipment, checking that all components are configured to correctly function together. The installation of personal computers and other small office machines is less complex and may be handled by the purchaser.

When equipment breaks down, many repairers travel to customers' workplaces or other locations to make the necessary repairs.

These workers, known as *field technicians*, often have assigned areas in which they perform preventive maintenance on a regular basis. *Bench technicians* work in repair shops located in stores, factories, or service centers. In small companies, repairers may work in both repair shops and at customer locations.

Computer repairers usually replace defective components instead of repairing them. Replacement is common because components are inexpensive and businesses are reluctant to shut down their computers for time-consuming repairs. Components commonly replaced by computer repairers include video cards, which transmit signals from the computer to the monitor; hard drives, which store data; and network cards, which allow communication over the network. Defective components may be given to bench technicians, who use software programs to diagnose the problem and who may repair the components, if possible.



Office machine repairers maintain and fix photocopiers.

When ATMs malfunction, computer networks recognize the problem and alert repairers. Common problems include worn magnetic heads on card readers, which prevent the equipment from recognizing customer bankcards; and “pick failures,” which prevent the equipment from dispensing the correct amount of cash. Field technicians travel to the locations of ATMs and usually repair equipment by removing and replacing defective components. Broken components are brought to a repair shop where bench technicians perform the necessary repairs. Field technicians perform routine maintenance on a regular basis, replacing worn parts and running diagnostic tests to ensure that the equipment functions properly.

Office machine repairers usually work on machinery at the customer’s workplace; customers also may bring small equipment to a repair shop for maintenance. Common malfunctions include paper misfeeds due to worn or dirty parts, and poor copy quality due to problems with lamps, lenses, or mirrors. These malfunctions usually can be resolved simply by cleaning components. Breakdowns also may result from failure of commonly used parts. For example, heavy usage of a photocopier may wear down the printhead, which applies ink to the final copy. In such cases, the repairer usually replaces the part, instead of repairing it.

Workers use a variety of tools for diagnostic tests and repair. To diagnose malfunctions, they use multimeters to measure voltage, current, resistance, and other electrical properties; signal generators to provide test signals; and oscilloscopes to monitor equipment signals. When diagnosing computerized equipment, repairers also use software programs. To repair or adjust equipment, workers use handtools, such as pliers, screwdrivers, soldering irons, and wrenches.

Working Conditions

Repairers usually work in clean, well-lighted surroundings. Because computers and office machines are sensitive to extreme temperatures and to humidity, repair shops usually are air-conditioned and well-ventilated. Field repairers must travel frequently to various locations to install, maintain, or repair customer equipment. ATM repairers may have to perform their jobs in small, confined spaces that house the equipment.

Because computers and ATMs are critical for many organizations to function efficiently, data processing equipment repairers and ATM field technicians often work around the clock. Their schedules may include evening, weekend, and holiday shifts; shifts may be assigned on the basis of seniority. Office machine and cash register servicers usually work regular business hours because the equipment they repair is not as critical.

Although their job is not strenuous, repairers must lift equipment and work in a variety of postures. Repairers of computer monitors need to discharge voltage from the equipment to avoid electrocution. Workers may have to wear protective goggles.

Employment

Computer, automated teller, and office machine repairers held about 172,000 jobs in 2000. Wholesale trade establishments employed slightly less than one-half of the workers in this occupation; most of these establishments were wholesalers of professional and commercial equipment. Many workers were employed in computer and data processing services, as well as in appliance, radio, TV, and music stores. More than 1 in 7 computer, automated teller, and office machine repairers was self-employed.

Training, Other Qualifications, and Advancement

Knowledge of electronics is necessary for employment as a computer, automated teller, or office machine repairer. Employers prefer workers who are certified as repairers or who have training in

electronics from associate degree programs, the military, vocational schools, or equipment manufacturers. Employers generally provide some training to new repairers on specific equipment; however, workers are expected to arrive on the job with a basic understanding of equipment repair. Employers may send experienced workers to training sessions to keep up with changes in technology and service procedures.

Most office machine and ATM repairer positions require an associate degree in electronics. A basic understanding of mechanical equipment also is important, as many of the parts that fail in office machines and ATMs are mechanical, such as paper loaders. Entry-level employees at large companies normally receive on-the-job training lasting several months. This may include a week of classroom instruction followed by a period of 2 weeks to several months assisting an experienced repairer.

Field technicians work closely with customers and must have good communications skills and a neat appearance. Employers normally require that field technicians have a driver’s license.

Several organizations administer certification programs for electronic or computer equipment repairers. Numerous certifications, including A+, Net+, and Server+, are available through the Computing Technology Industry Association (CompTIA). To receive the certifications, candidates must pass several tests that assess computer repair skills. The International Society of Certified Electronics Technicians (ISCET) and the Electronics Technicians Association (ETA) also administer certification programs. Repairers may specialize in computer repair or a variety of other skills. To receive certification, repairers must pass qualifying exams corresponding to their level of training and experience. Both programs offer associate certifications to entry-level repairers.

Newly hired computer repairers may work on personal computers or peripheral equipment. With experience, they can advance to positions maintaining more sophisticated systems, such as networking equipment and servers. Field repairers of ATMs may advance to bench-technician positions responsible for more complex repairs. Experienced workers may become specialists who help other repairers diagnose difficult problems or work with engineers in designing equipment and developing maintenance procedures. Experienced workers also may move into management positions responsible for supervising other repairers.

Because of their familiarity with equipment, experienced repairers also may move into customer service or sales positions. Some experienced workers open their own repair shops or become wholesalers or retailers of electronic equipment.

Job Outlook

Employment of computer, automated teller, and office machine repairers is expected to grow about as fast as the average for all occupations through 2010. Job growth will be driven by the increasing dependence of business and residential customers on computers and other sophisticated office machines. The need to maintain this equipment in working order will create new jobs for repairers. In addition, openings will result from the need to replace repairers who retire or move into new occupations.

Job prospects will be best for applicants with knowledge of electronics as well as repair experience; opportunities for computer repairers should be excellent, as employers report difficulty finding qualified applicants and as reliance on computers continues to increase. Although computer equipment continues to become less expensive and more reliable, malfunctions still occur and can cause severe problems for users, most of whom lack the knowledge to make repairs. Computers are critical to most businesses today and will become even more so to companies that do business on the Internet and to households that make purchases online.

People also are becoming increasingly reliant on ATMs. Besides bank and retail transactions, ATMs provide an increasing number of other services, such as employee information processing and distribution of government payments. ATM design improvements have increased reliability and simplified repair tasks, reducing the number and extent of repairs. Opportunities for ATM repairers should be available, primarily arising from the need to replace workers who leave the specialty, rather than from employment growth.

Conventional office machines, such as calculators, are inexpensive, and often are replaced instead of repaired. However, digital copiers and other newer office machines are more costly and complex. This equipment often is computerized, designed to work on a network, and able to perform multiple functions. The growing need for repairers to service such sophisticated equipment should result in job opportunities for office machine repairers.

Earnings

Median hourly earnings of computer, automated teller, and office machine repairers were \$15.08 in 2000. The middle 50 percent earned between \$11.80 and \$19.20. The lowest 10 percent earned less than \$9.50, and the highest 10 percent earned more than \$23.42. Median hourly earnings in the industries employing the largest numbers of computer, automated teller, and office machine repairers in 2000 are shown below.

Professional and commercial equipment	\$15.28
Computer and data processing services	15.05
Radio, television, and computer stores	13.16

Related Occupations

Workers in other occupations who repair and maintain electronic equipment include broadcast and sound engineering technicians and radio operators; electronic home entertainment equipment installers and repairers; electrical and electronics installers and repairers; industrial machinery installation, repair, and maintenance workers; and radio and telecommunications equipment installers and repairers.

Sources of Additional Information

For information on certification programs, contact:

- ▶ Computing Technology Industry Association, 450 East 22nd St., Suite 230, Lombard, IL 60148-6158. Internet: <http://www.comptia.org>
- ▶ International Society of Certified Electronics Technicians, 3608 Pershing Ave., Fort Worth, TX 76107. Internet: <http://www.iscet.org>
- ▶ Electronics Technicians Association, 502 North Jackson, Greencastle, IN 46135. Internet: <http://www.eta-sda.com>

Electrical and Electronics Installers and Repairers

(O*NET 49-2092.01, 49-2092.02, 49-2092.03, 49-2092.04, 49-2092.05, 49-2092.06, 49-2093.00, 49-2094.00, 49-2095.00, 49-2096.00)

Significant Points

- Knowledge of electrical equipment and electronics is necessary for employment; many applicants complete 1 to 2 years at vocational schools and community colleges, although some less skilled repairers may have only a high school diploma.
- Projected employment growth will be slower than average, but varies by occupational specialty.
- Job opportunities will be best for applicants with a thorough knowledge of electrical and electronic equipment, as well as repair experience.

Nature of the Work

Businesses and other organizations depend on complex electronic equipment for a variety of functions. Industrial controls automatically monitor and direct production processes on the factory floor. Transmitters and antennae provide communications links for many organizations. Electric power companies use electronic equipment to operate and control generating plants, substations, and monitoring equipment. The Federal Government uses radar and missile control systems to provide for the national defense and to direct commercial air traffic. These complex pieces of electronic equipment are installed, maintained, and repaired by electrical and electronics installers and repairers.

Electrical equipment and electronics equipment are two distinct types of industrial equipment, although much equipment contains both electrical and electronic components. In general, electrical portions of equipment provide the power for the equipment while electronic components control the device, although many types of equipment still are controlled with electrical devices. Electronic sensors monitor the equipment and the manufacturing process, providing feedback to the programmable logic control (PLC) that controls the equipment. The PLC processes the information provided by the sensors and makes adjustments to optimize output. To adjust the output the PLC sends signals to the electrical, hydraulic, and pneumatic devices that power the machine—changing feed rates, pressures, and other variables in the manufacturing process. Many installers and repairers, known as *field technicians*, travel to factories or other locations to repair equipment. These workers often have assigned areas where they perform preventive maintenance on a regular basis. When equipment breaks down, field technicians go to a customer's site to repair the equipment. *Bench technicians* work in repair shops located in factories and service centers. They work on components that cannot be repaired on the factory floor.

Some industrial electronic equipment is self-monitoring and alerts repairers to malfunctions. When equipment breaks down, repairers first check for common causes of trouble, such as loose connections or obviously defective components. If routine checks do not locate the trouble, repairers may refer to schematics and manufacturers' specifications that show connections and provide instructions on how to locate problems. Automated electronic control systems are increasing in complexity, making diagnosing problems more challenging. Repairers use software programs and testing equipment to diagnose malfunctions. They use multimeters, which measure voltage, current, and resistance; advanced multimeters also measure capacitance, inductance, and current gain of transistors. They also use signal generators that provide test signals, and oscilloscopes that graphically display signals. Repairers use handtools such as pliers, screwdrivers, soldering irons, and wrenches to replace faulty parts and to adjust equipment.

Because component repair is complex and factories cannot allow production equipment to stand idle, repairers on the factory floor usually remove and replace defective units, such as circuit boards, instead of fixing them. Defective units are discarded or returned to the manufacturer or to a specialized shop for repair. Bench technicians at these locations have the training, tools, and parts to thoroughly diagnose and repair circuit boards or other complex components. These workers also locate and repair circuit defects, such as poorly soldered joints, blown fuses, or malfunctioning transistors.

Electrical and electronics installers often fit older manufacturing equipment with new automated control devices. Older manufacturing machines are frequently in good working order, but are limited by inefficient control systems that lack replacement parts. Installers replace old electronic control units with new PLCs. Setting up and installing a new PLC involves connecting it to different