

However, during economic slowdowns some repair shops may lay off repairers.

Earnings

Median annual earnings, including commission, of home appliance repairers were \$28,860 in 2000. The middle 50 percent earned between \$21,840 and \$38,040 a year. The lowest 10 percent earned less than \$17,300, and the highest 10 percent earned more than \$45,750 a year. Median annual earnings in the two industries employing the largest numbers of home appliance repairers in 2000 were \$27,560 in electrical repair shops and \$24,860 in household appliance stores.

Earnings of home appliance repairers vary according to the skill level required to fix equipment, geographic location, and the type of equipment repaired. Because many repairers receive commission along with their salary, earnings increase along with the number of jobs a repairer can complete in a day.

Many larger dealers, manufacturers and service stores offer benefits such as health insurance coverage, sick leave, and retirement and pension programs. Some home appliance repairers belong to the International Brotherhood of Electrical Workers.

Related Occupations

Other workers who repair electrical and electronic equipment include heating, air-conditioning, and refrigeration mechanics and installers; small-engine mechanics; office machine and cash register servicers; electronic home entertainment equipment installers and repairers; and coin, vending, and amusement machine servicers and repairers.

Sources of Additional Information

For information about jobs in the home appliance repair field, contact local appliance repair shops, manufacturers, vocational trade schools, appliance dealers, and utility companies, or the local office of the State employment service.

For general information about the work of home appliance repairers, contact:

- ▶ Appliance Service News, P.O. Box 809, St. Charles, IL 60174.
- ▶ North American Retail Dealers Association, 10 E. 22nd St., Suite 310, Lombard, IL 60148-4915. Internet: <http://www.narda.com>
- ▶ National Appliance Service Association, 9247 N. Meridian, Suite 105, Indianapolis, IN 46260.

For information on technician certification, as well as general information about the work of home appliance repairers, contact:

- ▶ National Appliance Service Technician Certification Program (NASTeC), 10 E. 22nd St., Suite 310, Lombard, IL 60148. Internet: <http://www.nastecnet.org>
- ▶ Professional Service Association, 71 Columbia St., Cohoes, NY 12047.

Industrial Machinery Installation, Repair, and Maintenance Workers

(O*NET 49-9041.00, 49-9042.00, 49-9043.00, 49-9044.00)

Significant Points

- Workers learn their trade through a 4-year apprenticeship program, or through informal on-the-job training supplemented by classroom instruction.
- Despite slower-than-average employment growth resulting from technological advancements in machinery, applicants with broad skills in machine repair should have favorable job prospects.

Nature of the Work

When production workers encounter problems with the machines they operate, they call industrial machinery installation, repair, and maintenance workers. These workers include industrial machinery mechanics, millwrights, and general maintenance and repair and machinery maintenance workers. Their work is important not only because an idle machine will delay production, but also because a machine that is not properly repaired and maintained may damage the final product or injure the operator.

Industrial machinery mechanics repair, install, adjust, or maintain industrial production and processing machinery or refinery and pipeline distribution systems. *Millwrights* install, dismantle, or move machinery and heavy equipment according to layout plans, blueprints, or other drawings. *General maintenance and repair workers* perform work involving the skills of two or more maintenance or craft occupations to keep machines, mechanical equipment, or the structure of an establishment in repair. *Machinery maintenance workers* lubricate machinery, change parts, or perform other routine machinery maintenance.

Much of the work begins when machinery arrives at the job site. New equipment must be unloaded, inspected, and moved into position. To lift and move light machinery, industrial machinery installation, repair, and maintenance workers use rigging and hoisting devices, such as pulleys and cables. In other cases, they require the assistance of hydraulic lift-truck or crane operators to position the machinery. Because industrial machinery installation, repair, and maintenance workers often decide which device to use for moving machinery, they must know the load-bearing properties of ropes, cables, hoists, and cranes.

Industrial machinery installation, repair, and maintenance workers consult with production managers and others to determine the optimal placement of machines in a plant. In some instances, this placement requires building a new foundation. Industrial machinery installation, repair, and maintenance workers either prepare the foundation themselves or supervise its construction, so they must know how to read blueprints and work with building materials, such as concrete, wood, and steel.

When assembling machinery, industrial machinery installation, repair, and maintenance workers fit bearings, align gears and wheels, attach motors, and connect belts, according to the manufacturer's blueprints and drawings. Precision leveling and alignment are important in the assembly process; industrial machinery installation, repair, and maintenance workers must have good mathematical skills, so that they can measure angles, material thickness, and small distances with tools such as squares, calipers, and micrometers. When a high level of precision is required, devices such as lasers and ultrasonic measuring tools may be used. Industrial machinery installation, repair, and maintenance workers also work with hand and power tools, such as cutting torches, welding machines, and soldering guns. Some of these workers use metalworking equipment, such as lathes or grinders, to modify parts to specifications.

Maintenance mechanics must be able to detect and diagnose minor problems and correct them before they become major ones. For example, after hearing a vibration from a machine, the mechanic must decide whether it is due to worn belts, weak motor bearings, or some other problem. Computerized maintenance, vibration analysis techniques, and self-diagnostic systems are making this task easier. Self-diagnostic features on new industrial machinery can determine the cause of a malfunction and, in some cases, alert the mechanic to potential trouble spots before symptoms develop.

After diagnosing the problem, the mechanic disassembles the equipment and repairs or replaces the necessary parts. Once the



Industrial machinery mechanics repair, install, adjust, or maintain machinery.

machine is reassembled, the final step is to test it to ensure that it is running smoothly. When repairing electronically controlled machinery, maintenance mechanics may work closely with electronic repairers or electricians who maintain the machine's electronic parts. However, industrial machinery installation, repair, and maintenance workers increasingly need electronic and computer skills to repair sophisticated equipment on their own. (Statements on electrical and electronics installers and repairers as well as electricians appear elsewhere in the *Handbook*.)

Although repairing machines is the most important job of industrial machinery installation, repair, and maintenance workers, they also perform preventive maintenance. This includes keeping machines and their parts well oiled, greased, and cleaned. Repairers regularly inspect machinery and check performance. For example, they adjust and calibrate automated manufacturing equipment such as industrial robots, and rebuild components of other industrial machinery. By keeping complete and up-to-date records, mechanics try to anticipate trouble and service equipment before factory production is interrupted.

A wide range of tools may be used when performing repairs or preventive maintenance. Repairers may use a screwdriver and wrench to adjust a motor, or a hoist to lift a printing press off the ground. When replacements for broken or defective parts are not readily available, or when a machine must be quickly returned to production, repairers may sketch a part that can be fabricated by the plant's machine shop. Repairers use catalogs to order replacement parts and often follow blueprints and engineering specifications to maintain and fix equipment.

Installation of new machinery is another responsibility of industrial machinery installation, repair, and maintenance workers. As plants retool and invest in new equipment, they increasingly rely on these workers to properly situate and install the machinery. As employers increasingly seek workers who have a variety of skills, industrial machinery installation, repair, and maintenance workers are taking on new responsibilities.

Working Conditions

Working conditions for repairers who work in manufacturing are similar to those of production workers. These workers are subject to common shop injuries such as cuts and bruises, and use protective equipment such as hardhats, protective glasses, and safety belts. Industrial machinery installation, repair, and maintenance workers also may face additional hazards because they often work on top of a ladder or underneath or above large machinery in cramped

conditions. Industrial machinery installation, repair, and maintenance workers may work independently or as part of a team. They must work quickly and precisely, because disabled machinery costs a company time and money.

Because factories and other facilities cannot afford breakdowns of industrial machinery, repairers may be called to the plant at night or on weekends for emergency repairs. Overtime is common among industrial machinery installation, repair, and maintenance workers—more than a third work over 40 hours a week. During power outages, industrial machinery installation, repair, and maintenance workers may be assigned overtime and be required to work in shifts to deal with the emergency.

Employment

Industrial machinery installation, repair, and maintenance workers held about 1.6 million jobs in 2000. Employment was distributed among the following occupations:

Maintenance and repair workers, general	1,251,000
Industrial machinery mechanics	198,000
Maintenance workers, machinery	114,000
Millwrights	72,000

About 1 of every 3 worked in manufacturing industries, primarily food processing, textile mill products, chemicals, fabricated metal products, and primary metals. Others worked for government agencies, public utilities, mining companies, and other establishments in which industrial machinery is used.

Industrial machinery installation, repair, and maintenance workers are found in a wide variety of plants and in every part of the country. However, employment is concentrated in heavily industrialized areas.

Training, Other Qualifications, and Advancement

Most industrial machinery installation, repair, and maintenance workers, including millwrights, learn their trade through a 4-year apprenticeship program combining classroom instruction with on-the-job-training. These programs usually are sponsored by a local trade union. Other machinery maintenance workers start as helpers and pick up the skills of the trade informally and by taking courses offered by machinery manufacturers and community colleges.

Trainee repairers learn from experienced repairers how to operate, disassemble, repair, and assemble machinery. Trainees also may work with concrete and receive instruction in related skills, such as carpentry, welding, and sheet metal work. Classroom instruction focuses on subjects such as shop mathematics, blueprint reading, welding, electronics, and computer training.

Most employers prefer to hire those who have completed high school or its equivalency, and who have some vocational training or experience. High school courses in mechanical drawing, mathematics, blueprint reading, physics, computers, and electronics are especially useful.

Mechanical aptitude and manual dexterity are important characteristics for workers in this trade. Good physical conditioning and agility also are necessary because repairers sometimes have to lift heavy objects or climb to reach equipment located high above the floor.

Opportunities for advancement are limited. Industrial machinery installation, repair, and maintenance workers advance either by working with more complicated equipment or by becoming supervisors. The most highly skilled repairers can be promoted to master mechanic or can become machinists or tool and die makers.

Job Outlook

Overall employment of industrial machinery installation, repair, and maintenance workers is projected to grow more slowly than the average for all occupations through 2010. Nevertheless, applicants with broad skills in machine repair should have favorable job prospects. As more firms introduce automated production equipment, industrial machinery installation, repair, and maintenance workers will be needed to ensure that these machines are properly maintained and consistently in operation. However, many new machines are capable of self-diagnosis, increasing their reliability and, thus, reducing the need for repairers. As a result, the majority of job openings will stem from the need to replace repairers who transfer to other occupations or leave the labor force.

As automation of machinery becomes more widespread, there is a greater need for repair work than for the installation of new machinery. Industrial machinery installation, repair, and maintenance workers are becoming more productive through the use of technologies such as hydraulic torque wrenches, ultrasonic measuring tools, and laser shaft alignment, as these technologies allow fewer workers to perform more work. In addition, the demand for industrial machinery installation, repair, and maintenance workers will be adversely affected as lower-paid workers, such as electronics technicians, increasingly assume some installation and maintenance duties.

Unlike many other occupations concentrated in manufacturing industries, industrial machinery installation, repair, and maintenance workers usually are not affected by seasonal changes in production. During slack periods, when some plant workers are laid off, repairers often are retained to do major overhaul jobs. Although these workers may face layoff or a reduced workweek when economic conditions are particularly severe, they usually are less affected than are other workers because machines have to be maintained regardless of production level.

Earnings

Earnings of industrial machinery installation, repair, and maintenance workers vary by industry and geographic region. Median hourly earnings of industrial machinery mechanics were \$17.30 in 2000. The middle 50 percent earned between \$13.73 and \$21.93. The lowest 10 percent earned less than \$11.31, and the highest 10 percent earned more than \$26.26. Median hourly earnings in the industries employing the largest numbers of industrial machinery mechanics in 2000 are shown below:

Motor vehicles and equipment	\$24.28
Electric services	24.12
Plastics materials and synthetics	20.14
Machinery, equipment, and supplies	15.01
Meat products	13.06

Median hourly earnings of general maintenance and repair workers were \$13.39 in 2000. The middle 50 percent earned between \$10.05 and \$17.47. The lowest 10 percent earned less than \$7.84, and the highest 10 percent earned more than \$21.43. Median hourly earnings in the industries employing the largest numbers of general maintenance and repair workers in 2000 are shown below:

Local government	\$13.99
Elementary and secondary schools	13.17
Real estate agents and managers	10.85
Real estate operators and lessors	10.71
Hotels and motels	10.07

Median hourly earnings of millwrights were \$19.33 in 2000. The middle 50 percent earned between \$15.19 and \$23.98. The

lowest 10 percent earned less than \$12.02, and the highest 10 percent earned more than \$27.07. Median hourly earnings in the industries employing the largest numbers of millwrights in 2000 are shown below:

Motor vehicles and equipment	\$25.73
Miscellaneous special trade contractors	19.64
Blast furnace and basic steel products	18.85

Median hourly earnings of machinery maintenance workers were \$14.89 in 2000. The middle 50 percent earned between \$11.54 and \$18.79. The lowest 10 percent earned less than \$9.20, and the highest 10 percent earned more than \$22.74. Median hourly earnings in miscellaneous plastics products, the industry employing the largest numbers of machinery maintenance workers, were \$15.28 in 2000.

More than 25 percent of industrial machinery mechanics are union members. More than 67 percent of millwrights belong to labor unions, one of the highest rates of unionization in the economy. Labor unions that represent industrial machinery installation, repair, and maintenance workers include the United Steelworkers of America; the United Automobile, Aerospace and Agricultural Implement Workers of America; the International Association of Machinists and Aerospace Workers; and the International Union of Electronic, Electrical, Salaried, Machine, and Furniture Workers.

Related Occupations

Other occupations that involve repairing machinery include aircraft and avionics equipment mechanics and service technicians; electrical and electronics installers and repairers; coin, vending, and amusement machine servicers and repairers; automotive body and related repairers; automotive service technicians and mechanics; electronic home entertainment equipment installers and repairers; heating, air-conditioning, and refrigeration mechanics and installers; and radio and telecommunications equipment installers and repairers.

Sources of Additional Information

Information about employment and apprenticeship opportunities for industrial machinery installation, repair, and maintenance workers may be obtained from local offices of the State employment service or from:

- ▶ United Brotherhood of Carpenters and Joiners of America, 101 Constitution Ave. NW., Washington, DC 20001.
- ▶ The National Tooling and Machining Association, 9300 Livingston Rd., Fort Washington, MD 20744. Internet: <http://www.ntma.org>
- ▶ Precision Machined Products Association, 6700 West Snowville Rd., Brecksville, OH 44141. Internet: <http://www.pmpa.org>
- ▶ Associated General Contractors of America, 1957 E St. NW., Washington, DC 20006. Internet: <http://www.agc.org>

Line Installers and Repairers

(O*NET 49-9051.00, 49-9052.00)

Significant Points

- Projected employment growth reflects the expansion of telecommunications and cable networks.
- Line installers and repairers work outdoors; the work can be hazardous.
- Earnings are relatively high.