

Drafters and Engineering Technicians

Drafters

(O*NET 17-3011.01, 17-3011.02, 17-3012.01, 17-3012.02, 17-3013.00)

Significant Points

- The type and quality of postsecondary drafting programs vary considerably; prospective students should be careful in selecting a program.
- Opportunities should be best for individuals who have at least 2 years of postsecondary training in drafting and considerable skill and experience using computer-aided drafting (CAD) systems.
- Demand for particular drafting specializations varies geographically, depending on the needs of local industry.

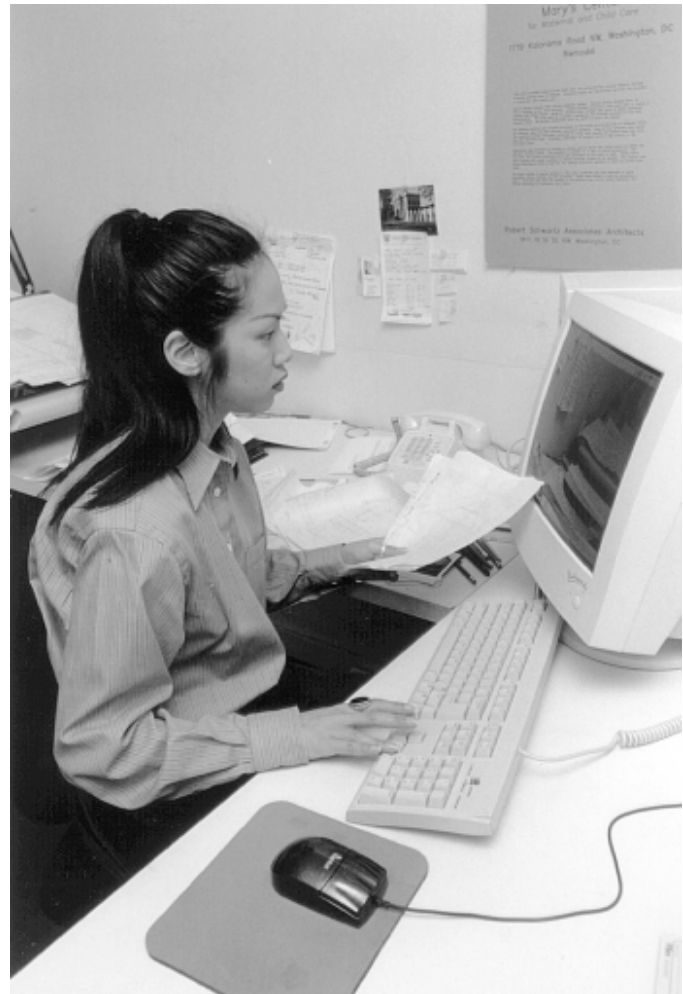
Nature of the Work

Drafters prepare technical drawings and plans used by production and construction workers to build everything from manufactured products, such as toys, toasters, industrial machinery, or spacecraft, to structures, such as houses, office buildings, or oil and gas pipelines. Their drawings provide visual guidelines, showing the technical details of the products and structures and specifying dimensions, materials to be used, and procedures and processes to be followed. Drafters fill in technical details, using drawings, rough sketches, specifications, codes, and calculations previously made by engineers, surveyors, architects, or scientists. For example, they use their knowledge of standardized building techniques to draw in the details of a structure. Some drafters use their knowledge of engineering and manufacturing theory and standards to draw the parts of a machine in order to determine design elements, such as the number and kind of fasteners needed to assemble it. They use technical handbooks, tables, calculators, and computers to do this.

Traditionally, drafters sat at drawing boards and used pencils, pens, compasses, protractors, triangles, and other drafting devices to prepare a drawing manually. Most drafters now use computer-aided drafting (CAD) systems to prepare drawings. Consequently, some drafters are referred to as CAD operators. CAD systems employ computer workstations to create a drawing on a video screen. The drawings are stored electronically so that revisions or duplications can be made easily. These systems also permit drafters to easily and quickly prepare variations of a design. Although drafters use CAD extensively, it is only a tool. Persons who produce technical drawings using CAD still function as drafters, and need the knowledge of traditional drafters—relating to drafting skills and standards—in addition to CAD skills. Despite the near-universal use of CAD systems, manual drafting still is used in certain applications.

Drafting work has many specialties, and titles may denote a particular discipline of design or drafting. *Aeronautical drafters* prepare engineering drawings detailing plans and specifications used for the manufacture of aircraft, missiles, and related parts.

Architectural drafters draw architectural and structural features of buildings and other structures. They may specialize by the type of structure, such as residential or commercial, or by the kind of material used, such as reinforced concrete, masonry, steel, or timber.



Drafters use computer-aided drafting systems to prepare drawings.

Civil drafters prepare drawings and topographical and relief maps used in major construction or civil engineering projects, such as highways, bridges, pipelines, flood control projects, and water and sewage systems.

Electrical drafters prepare wiring and layout diagrams used by workers who erect, install, and repair electrical equipment and wiring in communication centers, powerplants, electrical distribution systems, and buildings.

Electronic drafters draw wiring diagrams, circuitboard assembly diagrams, schematics, and layout drawings used in the manufacture, installation, and repair of electronic devices and components.

Mechanical drafters prepare detail and assembly drawings of a wide variety of machinery and mechanical devices, indicating dimensions, fastening methods, and other requirements.

Process piping or pipeline drafters prepare drawings used for layout, construction, and operation of oil and gas fields, refineries, chemical plants, and process piping systems.

Working Conditions

Drafters usually work in comfortable offices furnished to accommodate their tasks. They may sit at adjustable drawing boards or drafting tables when doing manual drawings, although most drafters work

at computer terminals much of the time. Because they spend long periods in front of computer terminals doing detailed work, drafters may be susceptible to eyestrain, back discomfort, and hand and wrist problems.

Employment

Drafters held about 213,000 jobs in 2000. More than 40 percent of drafters worked in engineering and architectural services firms that design construction projects or do other engineering work on a contract basis for organizations in other industries. Another 29 percent worked in durable goods manufacturing industries, such as machinery, electrical equipment, and fabricated metals. The remainder were mostly employed in the construction; government; transportation, communications, and utilities; and personnel-supply services industries. About 10,000 were self-employed in 2000.

Training, Other Qualifications, and Advancement

Employers prefer applicants who have completed postsecondary school training in drafting, which is offered by technical institutes, community colleges, and some 4-year colleges and universities. Employers are most interested in applicants who have well-developed drafting and mechanical drawing skills; a knowledge of drafting standards, mathematics, science, and engineering technology; and a solid background in computer-aided drafting and design techniques. In addition, communication and problem-solving skills are important.

Individuals planning careers in drafting should take courses in math, science, computer technology, design or computer graphics, and any high school drafting courses available. Mechanical ability and visual aptitude also are important. Prospective drafters should be able to draw three-dimensional objects as well as draw freehand. They also should do detailed work accurately and neatly. Artistic ability is helpful in some specialized fields, as is knowledge of manufacturing and construction methods. In addition, prospective drafters should have good interpersonal skills because they work closely with engineers, surveyors, architects, other professionals, and sometimes customers.

Training and coursework differ somewhat within the drafting specialties. The initial training for each specialty is similar. All incorporate math and communication skills, for example, but coursework relating to the specialty varies. In an electronics drafting program, for example, students learn the ways that electronic components and circuits are depicted in drawings.

Entry-level or junior drafters usually do routine work under close supervision. After gaining experience, intermediate-level drafters progress to more difficult work with less supervision. They may be required to exercise more judgment and perform calculations when preparing and modifying drawings. Drafters may eventually advance to senior drafter, designer, or supervisor. Many employers pay for continuing education and, with appropriate college degrees, drafters may go on to become engineering technicians, engineers, or architects.

Many types of publicly and privately operated schools provide some form of drafting training. The kind and quality of programs vary considerably. Therefore, prospective students should be careful in selecting a program. They should contact prospective employers regarding their preferences and ask schools to provide information about the kinds of jobs obtained by graduates, type and condition of instructional facilities and equipment, and faculty qualifications.

Technical institutes offer intensive technical training but less general education than junior and community colleges. Certificates or diplomas based on completion of a certain number of course hours may be rewarded. Many technical institutes offer 2-year associate

degree programs, which are similar to, or part of, the programs offered by community colleges or State university systems. Other technical institutes are run by private, often for-profit, organizations, sometimes called proprietary schools. Their programs vary considerably in both length and type of courses offered.

Community colleges offer curriculums similar to those in technical institutes but include more courses on theory and liberal arts. Often, there is little or no difference between technical institute and community college programs. However, courses taken at community colleges are more likely to be accepted for credit at 4-year colleges than are those at technical institutes. After completing a 2-year associate degree program, graduates may obtain jobs as drafters or continue their education in a related field at 4-year colleges. Four-year colleges usually do not offer drafting training, but college courses in engineering, architecture, and mathematics are useful for obtaining a job as a drafter.

Area vocational-technical schools are postsecondary public institutions that serve local students and emphasize training needed by local employers. Many offer introductory drafting instruction. Most require a high school diploma, or its equivalent, for admission.

Technical training obtained in the Armed Forces also can be applied in civilian drafting jobs. Some additional training may be necessary, depending on the technical area or military specialty.

The American Design Drafting Association (ADDA) has established a certification program for drafters. Although drafters usually are not required to be certified by employers, certification demonstrates that the understanding of nationally recognized practices and knowledge standards have been met. Individuals who wish to become certified must pass the Drafter Certification Test, which is administered periodically at ADDA-authorized testsites. Applicants are tested on their knowledge and understanding of basic drafting concepts such as geometric construction, working drawings, and architectural terms and standards.

Job Outlook

Employment of drafters is expected to grow about as fast as the average for all occupations through 2010. Industrial growth and increasingly complex design problems associated with new products and manufacturing processes will increase the demand for drafting services. Further, drafters are beginning to break out of the traditional drafting role and increasingly do work traditionally performed by engineers and architects, thus increasing the need for drafters. However, the greater use of CAD equipment by drafters, as well as by architects and engineers, should limit demand for lesser-skilled drafters. In addition to those created by employment growth, many job openings are expected to arise as drafters move to other occupations or leave the labor force.

Opportunities should be best for individuals who have at least 2 years of postsecondary training in a drafting program that provides strong technical skills, and who have considerable skill and experience using CAD systems. CAD has increased the complexity of drafting applications while enhancing the productivity of drafters. It also has enhanced the nature of drafting by creating more possibilities for design and drafting. As technology continues to advance, employers will look for drafters with a strong background in fundamental drafting principles, a higher level of technical sophistication, and an ability to apply this knowledge to a broader range of responsibilities.

Demand for particular drafting specialties varies throughout the country because employment usually is contingent upon the needs of local industry. Employment of drafters remains highly concentrated in industries that are sensitive to cyclical changes in the economy, such as engineering and architectural services and durable-goods manufacturing. During recessions, drafters may be

laid off. However, a growing number of drafters should continue to be employed on a temporary or contract basis, as more companies turn to the personnel-supply services industry to meet their changing needs.

Earnings

Earnings for drafters vary by specialty and level of responsibility. Median hourly earnings of architectural and civil drafters were \$16.93 in 2000. The middle 50 percent earned between \$13.79 and \$20.86. The lowest 10 percent earned less than \$11.18, and the highest 10 percent earned more than \$26.13. Median hourly earnings of architectural and civil drafters in engineering and architectural services in 2000 were \$16.75.

Median hourly earnings of electrical and electronics drafters were \$18.37 in 2000. The middle 50 percent earned between \$14.19 and \$23.76. The lowest 10 percent earned less than \$11.30, and the highest 10 percent earned more than \$29.46. In engineering and architectural services, the average hourly earnings for electrical and electronics drafters were \$17.30.

Median hourly earnings of mechanical drafters were \$18.19 in 2000. The middle 50 percent earned between \$14.43 and \$23.20. The lowest 10 percent earned less than \$11.70, and the highest 10 percent earned more than \$28.69. The average hourly earnings for mechanical drafters in engineering and architectural services were \$16.98.

Related Occupations

Other workers who prepare or analyze detailed drawings and make precise calculations and measurements include architects, except landscape and naval; landscape architects; designers; engineers; engineering technicians; science technicians; and surveyors, cartographers, photogrammetrists, and surveying technicians.

Sources of Additional Information

Information on schools offering programs in drafting and related fields is available from:

► Accrediting Commission of Career Schools and Colleges of Technology, 2101 Wilson Blvd., Suite 302, Arlington, VA 22201.

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

Information about certification is available from:

► American Design Drafting Association, P.O. Box 11937, Columbia, SC 29211. Internet: <http://www.adda.org>

Engineering Technicians

(O*NET 17-3021.00, 17-3022.00, 17-3023.01, 17-3023.02, 17-3023.03, 17-3024.00, 17-3025.00, 17-3026.00, 17-3027.00)

Significant Points

- Electrical and electronic engineering technicians make up about 45 percent of all engineering technicians.
- Because the type and quality of training programs vary considerably, prospective students should carefully investigate training programs before enrolling.
- Opportunities will be best for individuals with an associate degree or extensive job training in engineering technology.

Nature of the Work

Engineering technicians use the principles and theories of science, engineering, and mathematics to solve technical problems in research

and development, manufacturing, sales, construction, inspection, and maintenance. Their work is more limited in scope and more practically oriented than that of scientists and engineers. Many engineering technicians assist engineers and scientists, especially in research and development. Others work in quality control—inspecting products and processes, conducting tests, or collecting data. In manufacturing, they may assist in product design, development, or production. Although many workers who repair or maintain various types of electrical, electronic, or mechanical equipment often are called technicians, these workers are covered in the *Handbook* section on installation, maintenance, and repair occupations.

Engineering technicians who work in research and development build or set up equipment, prepare and conduct experiments, collect data, calculate or record the results, and help engineers or scientists in other ways, such as making prototype versions of newly designed equipment. They also assist in design work, often using computer-aided design equipment.

Most engineering technicians specialize in certain areas, learning skills and working in the same disciplines as engineers. Occupational titles, therefore, tend to follow the same structure as those of engineers.

Aerospace engineering and operations technicians install, construct, maintain, and test systems used to test, launch, or track aircraft and space vehicles. They may calibrate test equipment and determine the cause of equipment malfunctions. Using computer and communications systems, aerospace engineering and operations technicians often record and interpret test data.

Chemical engineering technicians usually are employed in industries producing pharmaceuticals, chemicals, and petroleum products, among others. They work in laboratories as well as processing plants. They help develop new chemical products and processes, test processing equipment and instrumentation, gather data, and monitor quality.

Civil engineering technicians help civil engineers plan and build highways, buildings, bridges, dams, wastewater treatment systems, and other structures, and perform related surveys and studies. Some estimate construction costs and specify materials to be used, and some may even prepare drawings or perform land-surveying duties. Others may set up and monitor instruments used to study traffic conditions. (Separate statements on cost estimators; drafters; and surveyors, cartographers, photogrammetrists, and surveying technicians can be found elsewhere in the *Handbook*.)

Electrical and electronics engineering technicians help design, develop, test, and manufacture electrical and electronic equipment such as communication equipment, radar, industrial and medical measuring or control devices, navigational equipment, and computers. They may work in product evaluation and testing, using measuring and diagnostic devices to adjust, test, and repair equipment. (Workers who only repair electrical and electronic equipment are discussed in the statement on electrical and electronics installers and repairers found elsewhere in the *Handbook*. Many of these repairers often are referred to as electronics technicians.)

Electrical and electronic engineering technology is also applied to a wide variety of systems such as communications and process controls. *Electromechanical engineering technicians* combine fundamental principles of mechanical engineering technology with knowledge of electrical and electronic circuits to design, develop, test, and manufacture electrical and computer-controlled mechanical systems.

Environmental engineering technicians work closely with environmental engineers and scientists in developing methods and devices used in the prevention, control, or correction of environmental hazards. They inspect and maintain equipment affecting air pollution and recycling. Some inspect water and wastewater