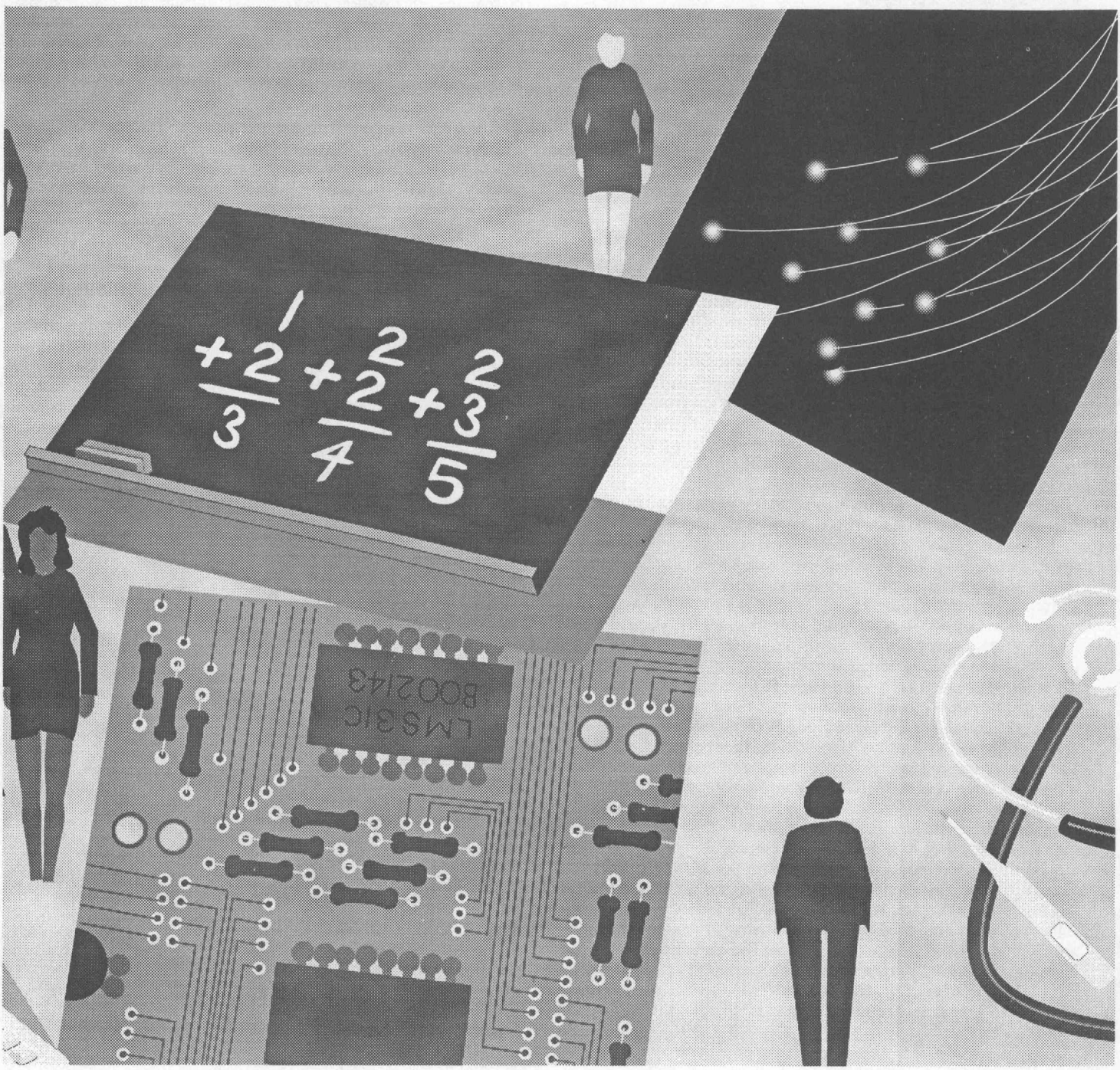
Technologists and Technicians, Except Health

ISBN 0-16-043058-5

Reprinted from the
Occupational Outlook Handbook, 1994-95 Edition

U.S. Department of Labor
Bureau of Labor Statistics

Bulletin 2450-11



Aircraft Pilots

(D.O.T. 196 except 163 and 621.261-018)

Nature of the Work

Pilots are highly trained professionals who fly airplanes and helicopters to carry out a wide variety of tasks. Although most pilots transport passengers and cargo, others are involved in more unusual tasks, such as dusting crops, spreading seed for reforestation, testing aircraft, directing firefighting efforts, tracking criminals, monitoring traffic, and rescuing and evacuating injured persons. The vast majority of pilots fly airplanes.

Except on small aircraft, two pilots usually make up the cockpit crew. Generally, the most experienced pilot (called captain) is in command and supervises all other crew members. The copilot assists in communicating with air traffic controllers, monitoring the instruments, and flying the aircraft. Some large aircraft still have a third pilot in the cockpit—the flight engineer—who assists the other pilots by monitoring and operating many of the instruments and systems, making minor inflight repairs, and watching for other aircraft. New technology can perform many flight tasks, however, and virtually all new aircraft now fly with only two pilots, who rely more heavily on computerized controls.

Before departure, pilots plan their flights carefully. They thoroughly check their aircraft to make sure that the engines, controls, instruments, and other systems are functioning properly. They also make sure that baggage or cargo has been loaded correctly. They confer with flight dispatchers and aviation weather forecasters to find out about weather conditions enroute and at their destination. Based on this information, they choose a route, altitude, and speed that should provide the fastest, safest, and smoothest flight. When flying under instrument flight rules (procedures governing the operation of the aircraft when there is poor visibilty), the pilot in command or their company dispatcher, normally files an instrument flight plan with air traffic control so that the flight can be coordinated with other air traffic.

Takeoff and landing are the most difficult parts of the flight and require close coordination between the pilot and copilot. For example, as the plane accelerates for takeoff, the pilot concentrates on the runway while the copilot scans the instrument panel. To calculate the speed they must attain to become airborne, pilots consider the altitude of the airport, outside temperature, weight of the plane, and the speed and direction of the wind. The moment the plane reaches takeoff speed, the copilot informs the pilot, who then pulls back on the controls to raise the nose of the plane.

Unless the weather is bad, the actual flight is relatively easy. Airplane pilots with the assistance of autopilot and the flight management computer, steer the plane along their planned route and are monitored by the air traffic control stations they pass along the way. They continuously scan the instrument panel to check their fuel supply, the condition of their engines, and the air- conditioning, hydraulic, and other systems. Pilots may request a change in altitude or route if circumstances dictate. For example, if the ride is rougher than expected, they may ask air traffic control if pilots flying at other altitudes have reported better conditions. If so, they may request a change. This procedure also may be used to find a stronger tailwind or a weaker headwind to save fuel and increase speed. Because helicopters are used for short trips at relatively low altitude, pilots must be constantly on the lookout for trees, bridges, power lines, transmission towers, and other dangerous obstacles. Regardless of the type of aircraft, all pilots must monitor warning devices designed to help detect sudden shifts in wind conditions that can cause crashes.

If visibility is poor, pilots must rely completely on their instruments. Using the altimeter readings, they know how high above ground they are and whether or not they can fly safely over mountains and other obstacles. Special navigation radios give pilots precise information which, with the help of special maps, tell them their exact position. Other very sophisticated equipment provides directions to a point just above the end of a runway and enables pilots to land completely "blind."

Once on the ground, pilots must complete records on their flight for their organization and the Federal Aviation Administration (FAA).

The number of nonflying duties that pilots have depends on the employment setting. Airline pilots have the services of large support staffs and consequently perform few nonflying duties. Pilots employed by other organizations such as charters or business operators have many other duties. They may load the aircraft, handle all passenger luggage to ensure a balanced load, and supervise refueling; other nonflying responsibilities include keeping records, scheduling flights, arranging for major maintenance, and performing minor maintenance and repair work on their aircraft.

Some pilots are instructors. They teach their students the principles of flight in ground-school classes and demonstrate how to operate aircraft in dual-controlled planes and helicopters. A few specially trained pilots are "examiners" or "check pilots." They periodically fly with other pilots or applicants to make sure that they are proficient.

Working Conditions

By law, airline pilots cannot fly more than 100 hours a month or more than 1,000 hours a year. Most airline pilots fly an average of 75 hours a month and work an additional 120 hours a month performing nonflying duties. The majority of flights involve layovers away from home. When pilots are away from home, the airlines provide hotel accommodations, transportation between the hotel and airport, and an allowance for expenses. Airlines operate flights at all hours of the day and night, so work schedules often are irregular. Based on seniority, pilots generally have a choice of flights.

Aircraft pilots check equipment and controls before takeoff.

For sale by the U.S. Government Printing Office
Superintendent of Documents, Mail Stop: SSOP, Washington, DC 20402-9328
ISBN 0-16-043058-5

Pilots employed outside the airlines often have irregular schedules as well; they may fly 30 hours one month and 90 hours the next. Because these pilots frequently have many nonflying responsibilities, they have much less free time than airline pilots. Except for business pilots, most pilots employed outside the airlines do not remain away from home overnight. They may work odd hours, because emergencies happen round the clock. In addition, pilots working as instructors often give lessons at night or on weekends.

Airline pilots, especially those on international routes, often suffer jet lag—fatigue caused by many hours of flying through different time zones. The work of test pilots, who check the flight performance of new and experimental planes, may be dangerous. Pilots who are crop dusters may be exposed to toxic chemicals and seldom have the benefit of a regular landing strip. Helicopter pilots involved in police work may be subject to personal injury.

Although flying does not involve much physical effort, the mental stress of being responsible for a safe flight, no matter what the weather, can be tiring. Particularly during takeoff and landing, pilots must be alert and quick to react if something goes wrong.

Employment

Civilian pilots held about 85,000 jobs in 1992. Three-fifths worked for the airlines. Many others worked as flight instructors at local airports or for large businesses that use their own airplanes or helicopters to fly company cargo and executives. Some pilots flew small planes for air taxi companies, usually to or from lightly traveled airports not served by the airlines. Others worked for a variety of businesses performing tasks such as crop dusting, inspecting pipelines, or conducting sightseeing trips. Federal, State, and local governments also employed pilots. Several thousand pilots were self-employed.

Training, Other Qualifications, and Advancement

All pilots who are paid to transport passengers or cargo must have a commercial pilot's license with an instrument rating issued by the FAA. Helicopter pilots must hold a commercial pilot's certificate with a helicopter rating. To qualify for these licenses, applicants must be at least 18 years old and have at least 250 hours of flight experience. The time can be reduced through participation in certain school curricula approved by the FAA. They also must pass a strict physical examination to make sure that they are in good health and have 20/20 vision with or without glasses, good hearing, and no physical handicaps that could impair their performance. Applicants must pass a written test that includes questions on the principles of safe flight, navigation techniques, and FAA regulations. They also must demonstrate their flying ability to FAA or designated examiners.

To fly in periods of low visibility pilots must be rated by the FAA to fly by instruments. Pilots may qualify for this rating by having a total of 105 hours of flight experience, including 40 hours of experience in flying by instruments; passing a written examination on procedures and FAA regulations covering instrument flying; and demonstrating their ability to fly by instruments.

Airline pilots must fulfill additional requirements. They must pass FAA written and flight examinations to earn a flight engineer's license. Captains must have an airline transport pilot's license. Applicants for this license must be at least 23 years old and have a minimum of 1,500 hours of flying experience, including night and instrument flying.

All licenses are valid as long as a pilot can pass the periodic physical examinations and tests of flying skills required by Government and company regulations.

The Armed Forces have always been an important source of trained pilots for civilian jobs. Military pilots gain valuable experience on jet aircraft and helicopters, and persons with this experience are generally preferred. This primarily reflects the extensive flying time military pilots receive. The FAA has certified about 600 civilian flying schools, including some colleges and universities that offer degree credit for pilot training. In recent years, the Armed Services have increased financial incentives in an effort to retain more pilots. This has shifted more of the burden for training pilots to FAA certified schools. Over the next several years, the number of available pilots who have been trained in the military should increase as reductions in military budgets result in more pilots leaving military service. Over the long haul, however, fewer pilots will be trained by the Armed Forces and this will mean that FAA certified schools will do more of the training.

Although some small airlines will hire high school graduates, most airlines require 2 years of college and prefer to hire college graduates. In fact, most entrants to this occupation have a college degree. If the number of college educated applicants increases, employers may raise their educational requirements. Because pilots must be able to make quick decisions and accurate judgments under pressure, airline companies reject applicants who do not pass required psychological and aptitude tests.

New airline pilots usually start as copilots. Although airlines favor applicants who already have a flight engineer's license, they may train those who have only the commercial license. All new pilots receive several weeks of intensive training in simulators and classrooms before being assigned to a flight.

Organizations other than airlines generally require less flying experience. However, a commercial pilot's license is a minimum requirement, and employers prefer applicants who have experience in the type of craft they will be flying. New employees usually start as copilots or flying less sophisticated equipment. Test pilots often are required to have an engineering degree.

Advancement for all pilots generally is limited to other flying jobs. Many pilots start as flight instructors, building up their flying hours while they earn money teaching. As they become more experienced, these pilots occasionally fly charter planes and perhaps get jobs with small air transportation firms, such as air taxi companies. Some advance to business flying jobs. A small number get flight engineer jobs with the airlines.

In the airlines, advancement usually depends on seniority provisions of union contracts. After 2 to 7 years, flight engineers advance according to seniority to copilot and, after 5 to 15 years, to captain. Seniority also determines which pilots get the more desirable routes. In a nonairline job, a copilot may advance to pilot and, in large companies, to chief pilot or director of aviation in charge of aircraft scheduling, maintenance, and flight procedures.

Job Outlook

Pilots are expected to face considerable competition for jobs through the year 2005 because the number of applicants for new positions is expected to exceed the number of openings. Aircraft pilots understandably have an extremely strong attachment to their occupation because it requires a substantial investment in specialized training and can offers very high earnings. In addition, the glamour, prestige, and travel benefits make this a very desirable occupation and pilots rarely change occupations. However, because of the large number of pilots who will reach retirement age over the next decade or so, replacement needs will generate several thousand job openings each year.

Additional jobs will be created from rising demand for pilots. Employment is expected to increase faster than the average for all occupations through the year 2005. While computerized flight management systems will all but eliminate the demand for flight engineers, the expected growth in airline passenger and cargo traffic will create a need for more airliners, pilots, and flight instructors. Employment of business pilots is expected to grow more slowly than in the past as more businesses opt to fly with regional and smaller airlines serving their area rather than buy and operate their own aircraft. On the other hand, helicopter pilots are expected to grow more rapidly as the demand for the type of services they can offer expands.

Opportunities for aircraft pilots will be poor in the short run as an increasing number of pilots leave the Armed Forces and look for jobs in the civilian sector. This situation will be compounded by the large number of pilots who have lost their jobs during the restructuring of the airline industry. The mergers and bankruptcies of the

past few years have created a glut of trained pilots. As this glut is absorbed over the next few years, prospects should improve dramatically. Pilots who have logged the greatest number of flying hours in the more sophisticated equipment generally have the best prospects. This is the reason military pilots usually have an advantage over other applicants. Jobseekers with the most FAA licenses will also have a competitive advantage.

Employment of pilots is sensitive to cyclical swings in the economy. During recessions, when a decline in the demand for air travel forces airlines to curtail the number of flights, airlines may temporarily furlough some pilots. Commercial and corporate flying, flight instruction, and testing of new aircraft also decline during recessions, adversely affecting pilots employed in those areas.

Earnings

Earnings of airline pilots are among the highest in the Nation. According to the Future Aviation Professionals of America, the 1992 average salary for airline pilots was about $80,000 a year; for flight engineers, $42,000; for copilots, $65,000; and for captains, $107,000. Some senior captains on the largest aircraft earned as much as $165,000. Earnings depend on factors such as the type, size, and maximum speed of the plane, and the number of hours and miles flown. Extra pay may be given for night and international flights.

Generally, pilots working outside the airlines earn lower salaries. The median salary for chief pilots was $62,000 a year in 1992, according to a survey conducted by the National Business Aircraft Association; for captains/pilots, $57,900 and for copilots, $42,000. Usually, pilots who fly jet aircraft earn higher salaries than nonjet pilots.

Airline pilots generally are eligible for life and health insurance plans financed by the airlines. They also receive retirement benefits and if they fail the FAA physical examination at some point in thir careers, they get disability payments. Some airlines provide allowances to pilots for purchasing and cleaning their uniforms. As an additional benefit, pilots and their immediate families usually are entitled to free or reduced fare transportation on their own and other airlines.

Most airline pilots are members of the Airline Pilots Association, International. Those employed by one major airline are members of the Allied Pilots Association. Some flight engineers are members of the Flight Engineers' International Association.

Related Occupations

Although they are not in the cockpit, air traffic controllers and dispatchers also play an important role in making sure flights are safe and on schedule, and participate in many of the decisions pilots must make.

Sources of Additional Information

Information about job opportunities in a particular airline and the qualifications required may be obtained by writing to the personnel manager of the airline. For addresses of airline companies and information about job opportunities and salaries, contact:

☞ Future Aviation Professionals of America, 4291 J. Memorial Dr., Atlanta, GA 30032. (This organization may be called toll free at 1-800-JET-JOBS.)

For information on airline pilots, contact:

☞ Airline Pilots Association, 1625 Massachusetts Ave. NW., Washington, DC 20036.

☞ Air Transport Association of America, 1709 New York Ave. NW., Washington, DC 20006.

For information on helicopter pilots, contact:

☞ Helicopter Association International, 1619 Duke St., Alexandria, VA 22314.

For a copy of *List of Certificated Pilot Schools*, write to:

☞ Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

For information about job opportunities in companies other than airlines, consult the classified section of aviation trade magazines and apply to companies that operate aircraft at local airports.

Air Traffic Controllers

(D.O.T. 193.162 except -022 and .167-010)

Nature of the Work

The air traffic control system is a vast network of people and equipment that ensures the safe operation of commercial and private aircraft. Air traffic controllers coordinate the movement of air traffic to make certain that planes stay a safe distance apart. Their immediate concern is safety, but controllers also must direct planes efficiently to minimize delays. Some regulate airport traffic; others regulate flights between airports.

Although airport tower or terminal controllers watch over all planes traveling through the airport's airspace, their main responsibility is to organize the flow of aircraft in and out of the airport. Relying on radar and visual observation, they closely monitor each plane to ensure a safe distance between all aircraft and to guide pilots between the hangar or ramp and the end of the airport's airspace. In addition, controllers keep pilots informed about changes in weather conditions such as wind shear—a sudden change in the velocity or direction of the wind that can cause the pilot to lose control of the aircraft.

During arrival or departure, several controllers handle each plane. As a plane approaches an airport, the pilot radios ahead to inform the terminal of its presence. The controller in the radar room just beneath the control tower has a copy of the plane's flight plan and already has observed the plane on radar. If the way is clear, the controller directs the pilot to a runway; if the airport is busy, the plane is fitted into a traffic pattern with other aircraft waiting to land. As the plane nears the runway, the pilot is asked to contact the tower. There, another controller, who also is watching the plane on radar, monitors the aircraft the last mile or so to the runway, delaying any departures that would interfere with the plane's landing. Once the plane has landed, a ground controller in the tower directs it along the taxiways to its assigned gate. The ground controller usually works entirely by sight, but may use radar if visibility is very poor.

The procedure is reversed for departures. The ground controller directs the plane to the proper runway. The local controller then informs the pilot about conditions at the airport, such as the weather, speed and direction of wind, and visibility. The local controller also issues runway clearance for the pilot to take off. Once in the air, the plane is guided out of the airport's airspace by the departure controller.

After each plane departs, airport tower controllers notify enroute controllers who will next take charge. There are 22 enroute control centers located around the country, each employing 300 to 700 controllers, with more than 150 on duty during peak hours at the busier facilities. Airplanes generally fly along designated routes; each center is assigned a certain airspace containing many different routes. Enroute controllers work in teams of up to three members, depending on how heavy traffic is; each team is responsible for a section of the center's airspace. A team, for example, might be responsible for all planes that are between 30 to 100 miles north of an airport and flying at an altitude between 6,000 and 18,000 feet.

To prepare for planes about to enter the team's airspace, the radar associate controller organizes flight plans coming off a printer. If two planes are scheduled to enter the team's airspace at nearly the same time, location, and altitude, this controller may arrange with the preceding control unit for one plane to change its flight plans. The previous unit may have been another team at the same or an adjacent center, or a departure controller at a neighboring terminal. As a plane approaches a team's airspace, the radar controller accepts responsibility for the plane from the previous controlling unit. The controller also delegates responsibility for the plane to the next controlling unit when the plane leaves the team's airspace.

The radar controller, who is the senior team member, observes the planes in the team's airspace on radar and communicates with the pilots when necessary. Radar controllers warn pilots about nearby planes, bad weather conditions, and other potential hazards. Two planes on a collision course will be directed around each other.

If a pilot wants to change altitude in search of better flying conditions, the controller will check to determine that no other planes will be along the proposed path. As the flight progresses, the team responsible for the aircraft notifies the next team in charge. Through team coordination, the plane arrives safely at its destination.

Both airport tower and enroute controllers usually control several planes at a time and often have to make quick decisions about completely different activities. For example, a controller might direct a plane on its landing approach and at the same time provide pilots entering the airport's airspace with information about conditions at the airport. While instructing these pilots, the controller also would observe other planes in the vicinity, such as those in a holding pattern waiting for permission to land, to ensure that they remain well separated. More powerful computers are helping controllers deal with these demands. Traditional air traffic controller tasks like determining how far apart planes should be kept are now routinely done by computer. Improved communication between computers on airplanes and those on the ground also is making the controller's job a little easier.

In addition to airport towers and enroute centers, air traffic controller specialists also work in flight service stations operated at over 100 locations. These specialists provide pilots with information on the station's particular area, including terrain, preflight and inflight weather information, suggested routes, and other information important to the safety of a flight. Flight service station specialists help pilots in emergency situations and participate in searches for missing or overdue aircraft. However, they are not involved in actively managing air traffic.

Working Conditions

Controllers work a basic 40-hour week; however, they may work additional hours for which they receive overtime pay or equal time off. Because most control towers and centers operate 24 hours a day, 7 days a week, controllers rotate night and weekend shifts.

During busy times, controllers must work rapidly and efficiently. This requires total concentration to keep track of several planes at the same time and make certain all pilots receive correct instructions. The mental stress of being responsible for the safety of several aircraft and their passengers can be exhausting for some persons.

Employment

Air traffic controllers held about 23,000 Federal Government jobs in 1992, at airports—in towers and flight service stations—and in enroute traffic control centers. The overwhelming majority worked for the FAA. About 18,000 controllers were actively working controlling air traffic; 4,000 worked at flight service stations and another 800 worked in administative staff positions; a small number of civilian controllers worked for the Department of Defense. In addition to controllers employed by the Federal Government, some worked for private air traffic control companies providing service to non-FAA towers.

Controllers carefully monitor the progress of each plane.

Training, Other Qualifications, and Advancement

Air traffic controller trainees are selected through the competitive Federal Civil Service system. Applicants must pass a written test that measures their ability to learn the controller's duties. Applicants with experience as a pilot, navigator, or military controller can improve their rating by scoring well on the occupational knowledge portion of the examination. Abstract reasoning and three-dimensional spatial visualization are among the aptitudes the exam measures. In addition, applicants generally must have 3 years of general work experience or 4 years of college, or a combination of both. Applicants also must survive a 1 week screening at the FAA's Aeronautical Center Academy in Oklahoma City which includes aptitude tests using computer simultors, physical and psychological examinations. Successful applicants receive drug screening tests. For airport tower and enroute center positions, applicants must be less than 31 years old. Those 31 years old and over are eligible for positions at flight- service stations.

Controllers must be articulate, because directions to pilots must be given quickly and clearly. Intelligence and a good memory also are important because controllers constantly receive information that they must immediately grasp, interpret, and remember. Decisiveness is also required because controllers often have to make quick decisions. The ability to concentrate is crucial because controllers must make these decisions in the midst of noise and other distractions.

Trainees learn their craft through a combination of formal and on-the-job training. They receive 3-4 months of intensive training at the FAA academy, where they learn the fundamentals of the airway system, FAA regulations, controller equipment, aircraft performance characteristics, as well as more specialized tasks. Based on aptitude and test scores, trainees are selected to work at either an enroute center or a tower. Regardless of the type of training, students must demonstrate their ability to make quick, correct decisions in simulated air traffic situations. After graduation, it takes several years of progressively more responsible work experience, interspersed with considerable classroom instruction and independent study, to become a fully qualified controller. This training includes instruction in the operation of the new, more automated air traffic control system—including the automated Microwave Landing System that enables pilots to receive instructions over automated data links—that is being installed in control sites across the country.

At airports, new controllers begin by supplying pilots with basic flight data and airport information. They then advance to ground controller, then local controller, departure controller, and finally, arrival controller. At an enroute traffic control center, new controllers first deliver printed flight plans to teams, gradually advancing to radar associate controller and then radar controller.

Failure to become certified in any position at a facility within a specified time may result in dismissal. Controllers who fail to complete either the academy or the on-the-job portion of the training are usually dismissed. Controllers must pass a physical examination each year and a job performance examination twice each year. Controllers also are subject to drug screening as a condition of continuing employment.

Controllers can transfer to jobs at different locations or advance to supervisory positions, including management or staff jobs in air traffic control and top administrative jobs in the FAA. However, there are only limited opportunities for a controller to switch from a position in an enroute center to a tower.

Job Outlook

Employment of air traffic controllers is expected to grow more slowly than the average for all occupations through the year 2005.

Employment growth is not expected to keep pace with growth in the number of aircraft flying because of the introduction of laborsaving air traffic control equipment that should make controllers more productive.

Competition for air traffic controller jobs is expected to remain keen because the occupation attracts many more qualified applicants than the small number of job openings stemming from growth of the occupation and replacement needs. Turnover is very low; because of the relatively high pay and liberal retirement benefits, controllers have a very strong attachment to the occupation. Because most of the current work force was hired after the controller's strike during the 1980's, the average age of the current work force is fairly young. As a result, most controllers will not be eligible to retire until 2005 or later.

Air traffic controllers who continue to meet the proficiency and medical requirements enjoy more job security than most workers. The demand for air travel and the workloads of air traffic controllers decline during recessions, but controllers seldom are laid off.

Earnings

Air traffic controllers who started with the FAA in 1993 earned about $22,700 (grade 7) a year. Controllers at the grade 9 level and above earn 5 percent more than other Federal workers in an equivalent grade. A controller's pay is determined by both the worker's job responsibilities and the complexity of the particular facility. Earnings are higher at facilities where traffic patterns are more complex. In 1993, controllers averaged about $53,800 a year.

Depending on length of service, they receive 13 to 26 days of paid vacation and 13 days of paid sick leave each year, life insurance, and health benefits. In addition, controllers can retire at an earlier age and with fewer years of service than other Federal employees. Air traffic controllers are eligible to retire at age 50 with 20 years of service as an active air traffic controller or after 25 years of active service at any age. There is a mandatory retirement age of 56 for controllers who manage air traffic.

Related Occupations

Other occupations that involve the direction and control of traffic in air transportation are airline-radio operator and airplane dispatcher.

Sources of Additional Information

A pamphlet providing general information about controllers and instructions for submitting an application is available from any U.S. Office of Personnel Management Job Information Center. Look under U.S. Government, Office of Personnel Management, in your telephone book to obtain a local Job Information Center telephone number, and call for a copy of the Air Traffic Controller Announcement. If there is no listing in your telephone book, dial the toll-free number 1-800-555-1212 and request the number of the Office of Personnel Management Job Information Center for your location.

Broadcast Technicians

(D.O.T. 193.167-014, .262-018, and -038; 194.062, .122, .262-010, -018, -022, .282, .362, and .382-014 and -018)

Nature of the Work

Broadcast technicians install, test, repair, set up, and operate the electronic equipment used to record and transmit radio and television programs. They work with television cameras, microphones, tape recorders, light and sound effects, transmitters, antennas, and other equipment. Some broadcast technicians develop movie sound tracks in motion picture production studios.

In the control room of a radio or television broadcasting studio, these technicians operate equipment that regulates the signal strength, clarity, and range of sounds and colors of recording or broadcasts. They also operate control panels to select the source of the material. Technicians may switch from one camera or studio to another, from film to live programming, or from network to local programs. By means of hand signals and, in television, telephone headsets, they give technical directions to studio personnel.

Broadcast technicians in small stations perform a variety of duties. In large stations and at the networks, technicians are more specialized, although job assignments may change from day to day. The terms "operator," "engineer," and "technician" often are used interchangeably to describe these jobs. *Transmitter operators* monitor and log outgoing signals and operate transmitters. *Maintenance technicians* set up, adjust, service, and repair electronic broadcasting equipment. *Audio control engineers* regulate sound pickup, transmission, and switching, and *video control engineers* regulate the quality, brightness, and contrast of television pictures. *Recording engineers* operate and maintain video and sound recording equipment. Technicians operate equipment designed to produce special effects, such as the illusions of a bolt of lightning or a police siren. *Field technicians* set up and operate broadcasting portable field transmission equipment outside the studio.

Television news coverage requires so much electronic equipment, and the technology is changing so fast, that many stations assign technicians exclusively to news. *Chief engineers, transmission engineers,* and *broadcast field supervisors* supervise the technicians who operate and maintain broadcasting equipment.

Technicians in the motion picture industry are called *sound mixers* or *rerecording mixers.* Mixers produce the sound track of a movie by a process called dubbing. They sit at sound consoles facing the screen and fade in and fade out each sound and regulate its volume. Each technician is responsible for certain sounds. Technicians follow a script that tells at precisely what moment, as the film runs through the projector, each of the sounds must be faded in and out. All the sounds for each shot are thus blended on a master sound track.

Working Conditions

Broadcast technicians generally work indoors in pleasant surroundings. However, those who broadcast from disaster areas or crime scenes may work under less favorable conditions. Technicians doing maintenance may climb poles or antenna towers, while those setting up equipment do heavy lifting.

Technicians in large stations and the networks usually work a 40-hour week, but may occasionally work overtime under great pressure to meet broadcast deadlines. Technicians in small stations routinely work more than 40 hours a week. Evening, weekend, and holiday work is usual because most stations are on the air 18 to 24 hours a day, 7 days a week.

Those who work on motion pictures may be on a tight schedule to finish according to contract agreements.

Broadcast technicians in small stations perform a variety of duties.

Employment

Broadcast technicians held about 35,000 jobs in 1992. About 7 out of 10 broadcast technicians were in radio and television broadcasting. Almost 2 in 10 worked in the motion picture industry. About 8 percent worked for cable and other pay television services. Some were self employed, providing their services to motion picture production of other industries. Television stations employ, on the average, many more technicians than radio stations. Some are employed in other industries, producing employee communications, sales, and training programs. Technician jobs in television are located in virtually all cities, while jobs in radio are also found in most smaller towns. The highest paying and most specialized jobs are concentrated in New York City, Los Angeles, Chicago, and Washington, D.C.—the originating centers for most of the network programs. Motion picture production jobs are concentrated in Los Angeles and New York City.

Training, Other Qualifications, and Advancement

The best way to prepare for a broadcast technician job in radio and television—particularly for those who hope to advance to supervisory positions or to jobs in large stations and at the networks—is to obtain technical school, community college, or college training in broadcast technology or in engineering or electronics. On the other hand, there is no formal training for jobs in the motion picture industry. People are hired as apprentice editorial assistants and work their way up to more skilled jobs. Reputation, determination, and luck are important in getting jobs.

Federal law requires a restricted radiotelephone operator permit for persons who operate and maintain broadcast transmitters in radio and television stations. No examination is required to get one. The Federal Communications Commission no longer requires persons working with microwave to have a general radiotelephone operator license; however, some States may require a license.

Beginners learn skills on the job from experienced technicians and supervisors. They generally begin their careers in small stations and, if qualified, move on to larger ones. Large stations generally only hire technicians with experience. Many employers pay tuition and expenses for courses or seminars to help technicians keep abreast of developments in the field.

Certification by the Society of Broadcast Engineers is a mark of competence and experience. The certificate is issued to experienced technicians who pass an examination.

Prospective technicians should take high school courses in math, physics, and electronics. Building electronic equipment from hobby kits and operating a "ham" or amateur radio are good experience, as is work in college radio and television stations.

Broadcast technicians must have an aptitude for working with electrical and mechanical systems and equipment and manual dexterity—the ability to perform tasks requiring precise, coordinated hand movements.

Experienced technicians may become supervisory technicians or chief engineers. A college degree in engineering is generally needed to become chief engineer at a large TV station.

Job Outlook

Employment of broadcast technicians is expected to grow more slowly than the average for all occupations through the year 2005. Employment in radio and television broadcasting is expected to decline because of laborsaving technical advances such as computer-controlled programming and remote control of transmitters. This has shifted the emphasis from operations to maintenance work, which frequently is performed by commercial and industrial electronic equipment repairers employed by broadcasting equipment manufacturers. (See the statement on this occupation elsewhere in the *Handbook.*) People seeking beginning jobs as radio and television broadcast technicians are expected to face strong competition in major metropolitan areas, where the number of qualified jobseekers greatly exceeds the number of openings. There, stations seek highly experienced personnel. Prospects for entry level positions generally are better in small cities and towns for people with appropriate training.

Employment in the motion picture industry will grow faster than the average for all occupations, as more movies are made. Job prospects are expected to remain competitive, however, because of the large number of people attracted to this relatively small field.

Most job openings will result from the need to replace experienced technicians who leave the occupation. Turnover is relatively high for broadcast technicians. Many leave the occupation for electronic jobs in other areas such as computer technology or commercial and industrial repair because the number of jobs is limited in large cities where pay is high.

Earnings

Television stations usually pay higher salaries than radio stations; commercial broadcasting usually pays more than educational broadcasting; and stations in large markets pay more than those in small ones.

According to a survey conducted by the National Association of Broadcasters and the Broadcast Cable Financial Management Association, the median earnings for technicians at radio stations were $22,725 a year in 1992; salaries ranged from $13,250 in the smallest markets to $28,500 in the largest markets. For chief technicians, average earnings were $26,140 and the range was $12,000 to $52,110. In television, the median earnings for operator technician were $22,136 a year, and salaries ranged from $15,500 in the smallest markets to $37,282 in the largest markets; for technical director, the median earnings were $24,705 and the range was $16,800 to $47,059; for maintenance technician, the median was $28,280 and the range was $22,050 to $42,819; and for chief engineer, the median was $47,741 and the salaries ranged from $35,500 in the smallest markets to $69,465 in the largest markets.

Earnings in the motion picture industry depend on skill and reputation, and, based on limited information, range from $20,000 to $100,000 a year

Related Occupations

Broadcast technicians need the electronics training and hand coordination necessary to operate technical equipment, and they generally complete specialized postsecondary programs. Others with similar jobs and training include drafters, engineering and science technicians, surveyors, air traffic controllers, radiologic technologists, respiratory therapy workers, cardiovascular technologists and technicians, EEG technicians, and medical laboratory technicians.

Sources of Additional Information

For information about licensing, write to:

☞ Federal Communications Commission, 1919 M St. NW., Washington, DC 20554.

For information on careers for broadcast technicians, write to:

☞ National Association of Broadcasters Employment Clearinghouse, 1771 N St. NW., Washington, DC 20036.

For a list of schools that offer programs or courses in broadcasting, contact:

☞ Broadcast Education Association, National Association of Broadcasters, 1771 N St. NW., Washington, DC 20036.

For information on certification, contact:

☞ Society of Broadcast Engineers, 8445 Keystone Crossing, Suite 140, Indianapolis, IN 46240.

Computer Programmers

(D.O.T. 030.162-010, -018, -022, and .167-010)

Nature of the Work

Computers increasingly affect our daily lives. They control the temperature and air quality in office buildings, expand dramatically the capabilities of our telephones, control manufacturing and other business processes, and even control the scoreboards at major athletic events. Computer programmers write, update, and maintain the detailed instructions (called programs or software) that list in a logical

order the steps that computers must execute to perform these and other functions.

In many large organizations, programmers follow descriptions prepared by systems analysts who have carefully studied the task that the computer system is going to perform. These descriptions list the input required, the steps the computer must follow to process data, and the desired arrangement of the output. (A more detailed description of the work of systems analysts is presented in the statement on computer scientists and systems analysts elsewhere in the *Handbook*.) Some organizations, particularly smaller ones, do not employ systems analysts. Instead, workers called programmer-analysts are responsible for both systems analysis and programming. Programmers in software development companies often work without the contribution of systems analysts. Instead, they may work directly with experts from various fields to create software—either programs designed for specific clients or packaged software for general use ranging from games and education software to programs for desktop publishing, financial planning, and spreadsheets.

The transition from a mainframe environment to primarily a PC-based environment has brought about a blurring of the once rigid distinction between the programmer and the user. Increasingly adept users are taking over many of the programming tasks previously performed by programmers. For example, the growing use of packaged software, like spreadsheet and data base management software packages, allows users to write simple programs to calculate or access data.

Regardless of setting, programmers write specific programs by breaking down each step into a logical series of instructions the computer can follow. They then code these instructions in a conventional programming language, such as C and FORTRAN, or one of the more advanced artificial intelligence or object oriented languages, such as LISP, Prolog, C++, or Ada.

Much of the programming being done today is the preparation of packaged software, one of the most rapidly growing segments of the computer industry. Despite the prevalence of packaged software, many programmers are involved in updating, repairing, and modifying code for existing programs. When making changes to a section of code, called a routine, programmers need to make other users aware of the task that the routine is to perform. They do this by inserting comments in the coded instructions so others can understand the program. Programmers using computer-aided software engineering (CASE) can concentrate on writing the unique parts of the program because the computer automates some of the more basic processes. This also yields more reliable and consistent programs and increases programmers' productivity by eliminating some of the routine steps.

When a program is ready to be tested, programmers run the program to ensure that the instructions are correct and will produce the desired information. They prepare sample data that test every part of the program and, after trial runs, review the results to see if any errors were made. If errors do occur, the programmer must change and recheck the program until it produces the correct results. This is called "debugging" the program.

Finally, programmers working in a mainframe environment prepare instructions for the computer operator who will run the program. (The work of computer operators is described in the statement on computer and peripheral equipment operators elsewhere in the *Handbook*.) They may also contribute to a user's manual for the program.

Programs vary with the type of information to be accessed or generated. For example, the data involved in updating financial records are different from those required to simulate a flight on a pilot trainee's monitor. Although simple programs can be written in a few hours, programs that use complex mathematical formulas or many data files may require more than a year of work. In most cases, several programmers may work together as a team under a senior programmer's supervision.

Programmers often are grouped into two broad types: applications programmers and systems programmers. Applications programmers usually are oriented toward business, engineering, or science. They write software to handle specific jobs, such as a program used in an inventory control system or one to guide a missile after it has been fired. They also may work alone to revise existing packaged software. Systems programmers, on the other hand, maintain the software that controls the operation of an entire computer system. These workers make changes in the sets of instructions that determine how the central processing unit of the system handles the various jobs it has been given and communicates with peripheral equipment, such as terminals, printers, and disk drives. Because of their knowledge of the entire computer system, systems programmers often help applications programmers determine the source of problems that may occur with their programs.

Working Conditions

Programmers work in offices in comfortable surroundings. They usually work about 40 hours a week, but their hours are not always from 9 to 5. Programmers may report early or work late to use the computer when it is available; occasionally, they work longer hours in order to meet deadlines or fix critical problems that occur during off hours.

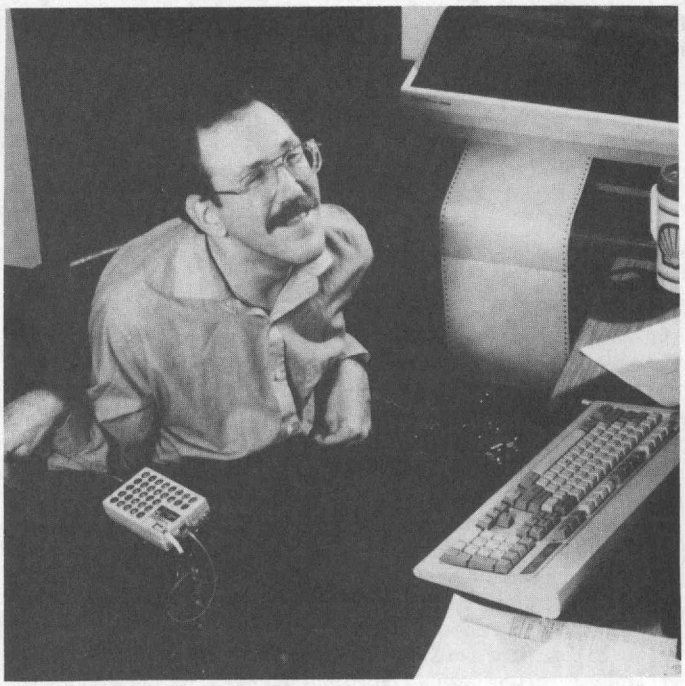
Because programmers spend long periods of time in front of a computer monitor typing at a keyboard, they are susceptible to eyestrain and back discomfort and hand and wrist problems.

Employment

Computer programmers held about 555,000 jobs in 1992. Programmers are employed in most industries, but the largest concentrations are in data processing service organizations, including firms that write and sell software; firms that provide engineering and management services; manufacturers of office, computing, and accounting machines; banks; educational institutions, and government agencies.

Applications programmers work for all types of firms that use computer systems. Systems programmers, on the other hand, usually work for organizations with large computer centers and for firms that manufacture computers or develop software.

A small but growing number of programmers are employed on a temporary basis. A marketing firm, for example, may need the services of several extra programmers to write and "debug" the software necessary to get a new data base management system running. Once the software is functioning, however, their services are no longer needed. Rather than hiring these programmers as permanent employees and then laying them off after the job is done, employers increasingly are contracting with temporary help agencies, consulting firms, or directly with programmers themselves. Such temporary jobs usually last several months but some last a year or longer.



Many programmers develop packaged software.

Training, Other Qualifications, and Advancement

There are no universal training requirements for programmers because employers' needs vary so much that computer applications have become so widespread and varied. Computer programming is taught at public and private vocational schools, community and junior colleges, and universities. High schools in many parts of the country also offer introductory courses in data processing. Many programmers obtain 2-year degrees or certificates. Two-year colleges are targeted toward producing graduates for entry level jobs and may have strong ties to the local job market.

The majority of programmers hold a 4-year degree. Of these, some hold a B.A. or B.S. in computer science or information systems while others have taken special courses in computer programming to supplement their study in fields such as accounting, inventory control, or other business areas. College graduates who are interested in changing careers or developing an area of expertise may return to a junior college for more training.

The level of education and quality of training that employers seek have been rising due to the growth in the number of qualified applicants and the increasing complexity of some programming tasks. Bachelor's degrees are now commonly required; in the absence of a degree, substantial specialized experience may be needed.

Employers using computers for scientific or engineering applications prefer college graduates who have degrees in computer or information science, mathematics, engineering, or the physical sciences. Graduate degrees are required for some jobs. Knowledge of C and FORTRAN programming languages is desirable since these are the most common languages used in this area.

Employers who use computers for business applications prefer to hire people who have had college courses in management information systems (MIS), programming, and business. Knowledge of Cobol, C, Fourth Generation Languages (4GL), CASE tools, C++ and other object oriented programming languages is highly desirable. General business skills and experience related to the operations of the firm generally are preferred by employers. In the future, it may be common for applications programmers to obtain a multidisciplinary degree to provide adequate knowledge of the application area along with programming skills. A relatively small number of employers promote workers such as computer operators who have taken courses in programming to programmer jobs because of their knowledge of and particular work experience with computer systems.

Most systems programmers hold a 4-year degree in computer science. Extensive knowledge of operating systems is essential. This includes being able to configure the operating system to work with different types of hardware and adapting the operating system to best meet the needs of the particular company.

The Institute for Certification of Computer Professionals offers the Certificate in Computer Programming (CCP) to those who pass a core examination plus exams in two specialty areas. College graduates with little or no experience may be tested for certification as an Associate Computer Professional (ACP). Certification is not mandatory but it may give a jobseeker a competitive advantage.

When hiring programmers, employers look for people who can think logically and who are capable of exacting analytical work. The job calls for patience, persistence, and the ability to work with extreme accuracy even under pressure. Ingenuity and imagination are also particularly important when programmers test their work for potential failures. Increasingly, interpersonal skills are valued because of the use of programmer teams and user support centers. The ability to work with abstract concepts and do technical analysis is especially important for systems programmers because they work with the software that controls the computer's operation.

Beginning programmers may spend their first weeks on the job attending training classes. After this initial instruction, they may work alone on simple assignments, or on a team with more experienced programmers. Either way, they generally must spend at least several months working under close supervision. Because of rapidly changing technology, programmers must continuously update their training by taking courses sponsored by their employer or software vendors.

For skilled workers, the prospects for advancement are good. In large organizations, they may be promoted to lead programmer and be given supervisory responsibilities. Some applications programmers become systems programmers after they gain experience and take courses in systems software. With general business experience, both applications programmers and systems programmers may become systems analysts or be promoted to a managerial position. Other programmers, with specialized knowledge and experience with a language or operating system, may work in research and development areas such as artificial intelligence or CASE.

Job Outlook

Employment of programmers is expected to grow faster than the average for all occupations through the year 2005 as computer usage expands. The demand for programmers will increase as organizations seek new applications for computers and improvements to the software already in use. The rising demand for information, further automation of offices and factories, advances in health and medicine, and continuing scientific research will stimulate the demand for skilled programmers.

One important area of progress will be data communications. Networking computers so they can communicate with each other is necessary to achieve the greater efficiency that organizations require to remain competitive. Expert systems and other artificial intelligence principles and languages will increasingly be used in the years ahead, becoming productivity-enhancing tools available to programmers. Programmers will be creating and maintaining expert systems and embedding these technologies in more and more products. As this trend continues, knowledge of C++ and other object-oriented languages will become increasingly important.

Employment, however, is not expected to grow as rapidly as in the past as improved software and programming techniques, including CASE and 4GL, simplify or eliminate some programming tasks. Someone who can apply CASE tool programming along with design and systems analysis is able to produce applications quickly and more cheaply. Employers are increasingly interested in workers who can combine both of these skills.

In addition, the introduction of data base management systems is allowing users to take over many of the tasks previously performed by the programmer. Greater use of packaged software such as word processing and spreadsheet packages also may moderate the growth in demand for applications programmers.

Although the proportion of programmers leaving the occupation each year is smaller than in most occupations, most of the job openings for programmers will result from replacement needs. Most of the programmers who leave the occupation transfer to other occupations, such as manager or systems analyst. Opportunities will exist throughout the economy, but jobs for both systems and applications programmers should be particularly plentiful in data processing service firms, software houses, and computer consulting businesses.

Because the number and quality of applicants have increased, employers have become more selective. Competition has increased for entry level positions, affecting even applicants with a bachelor's degree. Graduates of 2-year programs in data processing and people with less than a 2-year degree or its equivalent in work experience are facing especially strong competition for programming jobs. Many observers expect opportunities for people without college degrees to diminish in coming years as programming tasks become more complex. Prospects should be good for college graduates who are familiar with a variety of programming languages, particularly newer languages that apply to computer networking, data base management, and artificial intelligence.

Many employers prefer to hire applicants with previous experience in the field. Firms also desire programmers who develop a technical specialization in areas such as structured methodology programming, multimedia programming, graphic user interface, or 4th and 5th generation programming tools. Therefore, people who want to become programmers can enhance their chances by combining work experience with the appropriate formal training. Students have various options: Holding a summer or part-time job in a data processing department, participating in a college work-study program, or undertaking an internship. Students can greatly improve

their employment prospects by also taking courses such as accounting, management, engineering, or science—allied fields in which applications programmers are in demand.

Earnings

Median earnings of programmers who worked full time in 1992 were about $35,600 a year. The lowest 10 percent earned less than $19,700, and the highest 10 percent, more than $58,000. On average, systems programmers earn more than applications programmers.

In the Federal Government, the entrance salary for programmers with a college degree or qualifying experience was about $18,300 a year in 1993; for those with a superior academic record, $22,700.

Related Occupations

Programmers must pay great attention to detail as they write and "debug" programs. Other professional workers who must be detail-oriented include statisticians, engineers, financial analysts, accountants, auditors, actuaries, and operations research analysts.

Sources of Additional Information

State employment service offices can provide information about job openings for computer programmers. Also check with your city's chamber of commerce for information on the area's largest employers.

For information about certification as a computer professional, contact:

☞ Institute for the Certification of Computer Professionals, 2200 East Devon Ave., Suite 268, Des Plaines, IL 60018.

Further information about computer careers is available from:

☞ The Association for Computing Machinery, 1515 Broadway, New York, NY 10036.

Drafters

(D.O.T. 001.261-010, -014; 002.261; 003.131, .261 except -010, 281; 005.281; 007.161-010, -014, and -018, .261, and .281; 010.281 except -022; 014.281; 017 except .261-010 and .684; and 726.364-014)

Nature of the Work

Drafters prepare technical drawings used by production and construction workers to build spacecraft, automobiles, industrial machinery and other manufactured products, as well as structures such as office buildings, houses, bridges, and oil and gas pipelines. Their drawings show the technical details of the products and structures from all sides, with exact dimensions, the specific materials to be used, procedures to be followed, and other information needed to carry out the job. Drafters prepare and fill in technical details, using drawings, rough sketches, specifications, and calculations made by engineers, surveyors, architects, and scientists. For example, working from rough sketches, drafters use knowledge of standardized building techniques to draw the details of a structure, or employ knowledge of engineering and manufacturing theory to arrange the parts of a machine and determine the number and kind of fasteners needed. For this, they may use technical handbooks, tables, calculators, and computers.

There are two methods by which drawings are prepared. In the traditional method, drafters sit at drawing boards and use compasses, dividers, protractors, triangles, and other drafting devices to prepare the drawing manually. Drafters also use computer-aided drafting (CAD) systems. They use computer work stations to create the drawing on a video screen. They may print the drawing on paper but also store it electronically so that revisions and/or duplications can be made more easily. These systems also permit drafters to easily prepare many variations of a design.

When CAD systems were first introduced, some thought a new occupation—CAD operator—would result. It is now apparent that a person who produces a technical drawing using CAD is still a drafter, and needs all the knowledge of traditional drafters as well as CAD skills.

Because the cost of CAD systems is dropping rapidly, by the year 2005 it is likely that almost all drafters will use CAD systems regularly. However, manual drafting probably will still be used in certain applications, especially in low-volume firms that produce many one-of-a-kind drawings with little repetition.

Many drafters specialize. *Architectural drafters* draw architectural and structural features of buildings and other structures. They may specialize by the type of structure, such as schools or office buildings, or by material, such as reinforced concrete or stone.

Aeronautical drafters prepare engineering drawings used for the manufacture of aircraft and missiles.

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

Electronic drafters draw wiring diagrams, circuit board assembly diagrams, schematics, and layout drawings used in the manufacture, installation, and repair of electronic equipment.

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

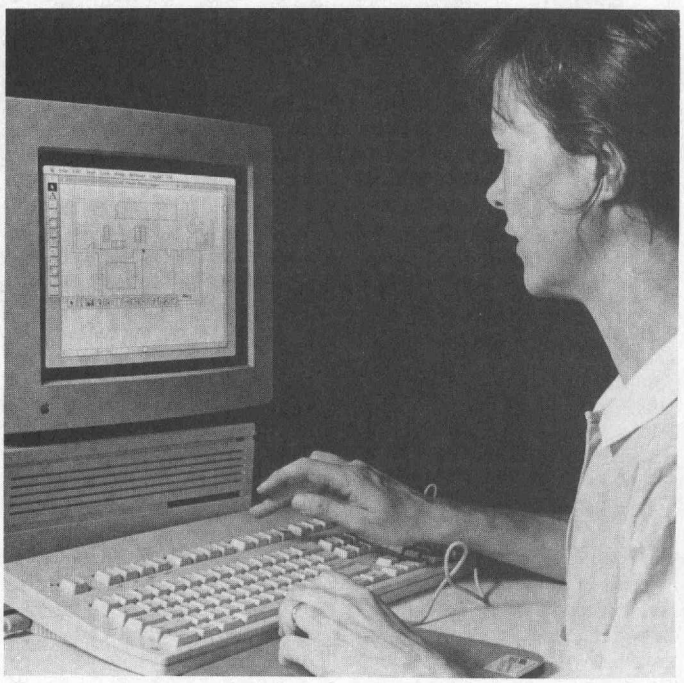
Mechanical drafters draw detailed working diagrams of machinery and mechanical devices, including dimensions, fastening methods, and other engineering information.

Working Conditions

Drafters usually work in offices or rooms with lighting appropriate to their tasks. They often sit at drawing boards or computer terminals for long periods of time doing detailed work, which may cause eyestrain and back discomfort. Drafters who spend the majority of their time using a computer keyboard for CAD work risk repetitive motion injuries, such as carpal tunnel syndrome.

Employment

Drafters held about 314,000 jobs in 1992. Over one-third of all 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 parts of the economy; about one-third worked in durable goods manufacturing industries, such as machinery, electrical equipment, and fabricated metals; and the



Computer-aided design systems enable drafters to make revisions to designs more easily.

remainder were mostly employed in the construction, communications, utilities, and personnel supply services industries.

About 11,000 drafters worked in government in 1992, primarily at the State and local level.

Training, Other Qualifications, and Advancement

Employers prefer applicants for drafting positions who have post-high school training in technical institutes, junior and community colleges, or extension divisions of universities. Employers are most interested in applicants who have well-developed drafting and mechanical drawing skills, a solid background in computer-aided design techniques, and courses in mathematics, science, and engineering technology.

Many types of publicly and privately operated schools provide drafting training. The kind and quality of programs can 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, instructional facilities and equipment, and faculty qualifications.

Technical institutes offer intensive technical training but less theory and general education than junior and community colleges. Many 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 length and types of courses offered. Some are 2-year associate degree programs.

Junior and community colleges offer curriculums similar to those in technical institutes but may include more theory and liberal arts. Often there may be little or no difference between technical institute and community college programs. However, courses taken at junior or community colleges are more likely to be accepted for credit at 4-year colleges than those at technical institutes. After completing the 2-year program, some graduates qualify for jobs as drafters while others 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. Most require a high school diploma or its equivalent for admission.

Other training may be obtained in the Armed Forces in technical areas which can be applied in civilian drafting jobs. Some additional training may be needed, depending on the military skills acquired and the kind of job, but often this is gained on the job.

Those planning careers in drafting should be able to draw freehand three-dimensional objects and 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 communication skills because they work closely with engineers, surveyors, architects, and other workers.

In 1992, the American Design Drafting Association (ADDA) established a certification program for drafters. Although drafters are not required to be certified, certification demonstrates to employers that nationally recognized standards have been met. Individuals who wish to become certified must pass the Drafter Certification Test, which is administered periodically at ADDA-authorized test sites. Applicants are tested on their knowledge and understanding of basic drafting concepts such as geometric construction, working drawings, and architectural terms and standards.

Entry level drafters usually do routine work under close supervision. After gaining experience, they do more difficult work with less supervision and may advance to senior drafter, designer, or supervisor. With appropriate college courses, they may become engineers or architects.

Job Outlook

Employment of drafters is expected to grow more slowly than the average for all occupations through the year 2005. Industrial growth and the increasingly complex design problems associated with new products and processes will increase the demand for drafting services. However, greater use of CAD equipment by architects and engineers, as well as drafters, is expected to offset some of this growth in demand. Although productivity gains from CAD have been relatively modest since CAD use became widespread, CAD technology continues to advance. CAD is expected to become an increasingly powerful tool, simplifying many traditional drafting tasks. Nevertheless, as in other areas, the ease of obtaining computer-generated information stimulates a demand for more information, so there will continue to be growth in the occupation. Individuals who have at least 2 years of training in a technically strong drafting program and who have experience with CAD systems will have the best opportunities. Although growth in employment will create many job openings, most job openings are expected to arise as drafters retire or leave the labor force for other reasons.

Drafters are highly concentrated in industries that are sensitive to cyclical swings in the economy, such as engineering and architectural services and durable goods manufacturing. During recessions, when fewer buildings are designed, drafters may be laid off.

Earnings

Median annual earnings of drafters who worked year round, full time were about $27,400 in 1992; the middle 50 percent earned between $20,600 and $35,100 annually; 10 percent earned more than $43,500; 10 percent earned less than $15,900.

According to a survey of workplaces in 160 metropolitan areas, experienced drafters had median earnings of about $30,200 a year in 1992, with the middle half earning between about $27,100 and $34,000 a year.

Related Occupations

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

Sources of Additional Information

State employment service offices can provide information about job openings for drafters.

Engineering Technicians

(D.O.T. 002.261-014, .262-010; 003.161, .261-010, .362; 005.261; 006.261; 007.161-026 and -030, .167-010, .181 and .267-014; 008.261; 010.261-010 and -026; 011.261-010, -014, -018, and -022, .281, .361; 012.261-014, .267; 013.161; 017.261-010; 019.161-014, .261-018, -022, -026, -030, and -034, .267, .281; 194.381, .382-010; 199.261-014; 726.261-010 and -014; 761.281-014; 828.261-018; and 869.261-026)

Nature of the Work

Engineering technicians use the principles and theories of science, engineering, and mathematics to solve problems in research and development, manufacturing, sales, construction, and customer service. Their jobs are more limited in scope and more practically oriented than those of scientists and engineers. Many engineering technicians assist engineers and scientists, especially in research and development. Others work in production or inspection jobs.

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

Engineering technicians who work in manufacturing follow the general directions of engineers. They may prepare specifications for materials, devise and run tests to ensure product quality, or study ways to improve manufacturing efficiency. They may also supervise production workers to make sure they follow prescribed procedures.

Civil engineering technicians help civil engineers plan and build highways, buildings, bridges, dams, wastewater treatment systems, and other structures and do related surveys and studies. Some inspect water and wastewater treatment systems to ensure that pollution control requirements are met. Others estimate construction costs and specify materials to be used. (See statement on cost estimators elsewhere in the *Handbook*.)

Electronics engineering technicians help develop, manufacture, and service electronic equipment such as radios, radar, sonar, television, industrial and medical measuring or control devices, navigational equipment, and computers, often using measuring and diagnostic devices to test, adjust, and repair equipment. Workers who only repair electrical and electronic equipment are discussed in several other statements elsewhere in the *Handbook*. Many of these repairers are often called electronics technicians.

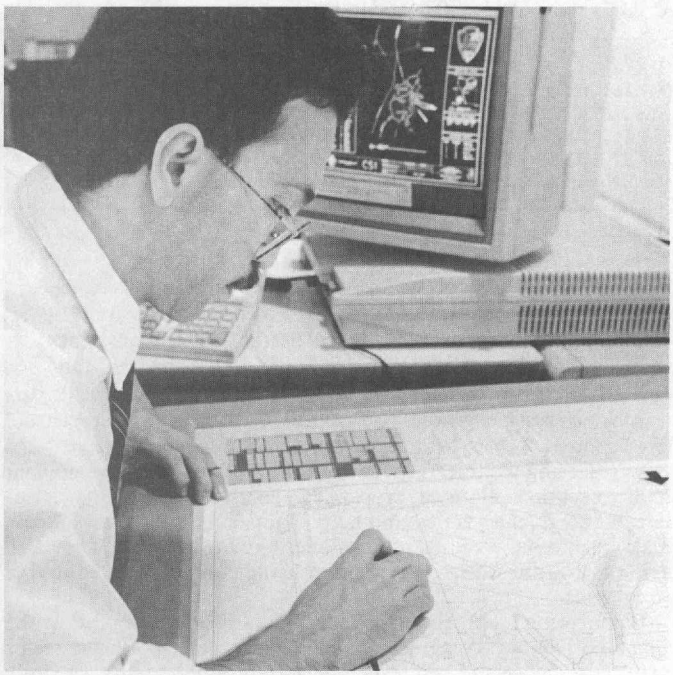
Industrial engineering technicians study the efficient use of personnel, materials, and machines in factories, stores, repair shops, and offices. They prepare layouts of machinery and equipment, plan the flow of work, make statistical studies, and analyze production costs.

Mechanical engineering technicians help engineers design and develop machinery, robotics, and other equipment by making sketches and rough layouts. They also record data, make computations, analyze results, and write reports. When planning production, mechanical engineering technicians prepare layouts and drawings of the assembly process and of parts to be manufactured. They estimate labor costs, equipment life, and plant space. Some test and inspect machines and equipment in manufacturing departments or work with engineers to eliminate production problems.

Chemical engineering technicians are usually employed in industries producing pharmaceuticals, chemicals, and petroleum products, among others. They help design, install, and test or maintain process equipment or computer control instrumentation, monitor quality control in processing plants, and make needed adjustments.

Working Conditions

Most engineering technicians work regular hours in laboratories, offices, electronics and industrial plants, or construction sites. Some may be exposed to hazards from equipment, chemicals, or toxic materials.



Like engineers, engineering technicians specialize in a specific area, such as mechanics, electronics, or chemicals.

Employment

Engineering technicians held about 695,000 jobs in 1992. About two-fifths worked in manufacturing, mainly in the electrical and electronic machinery and equipment, transportation equipment, industrial machinery equipment, and computer and office equipment industries. Over one-fourth worked in service industries, mostly in engineering or business services companies who do engineering work on contract for government, manufacturing, or other organizations.

In 1992, the Federal Government employed about 59,000 engineering technicians. Major employers were the Departments of Defense, Transportation, Agriculture, and the Interior, the Tennessee Valley Authority, and the National Aeronautics and Space Administration. State governments employed about 30,000 and local governments about 28,000.

Training, Other Qualifications, and Advancement

Although it is possible to qualify for some engineering technician jobs with no formal training, most employers prefer to hire someone who will require less on-the-job training and supervision. Training is available at technical institutes, junior and community colleges, extension divisions of colleges and universities, public and private vocational-technical schools, and through some technical training programs in the Armed Forces. Persons with college courses in science, engineering, and mathematics may also qualify for some positions but may need additional specialized training and experience.

Many types of publicly and privately operated schools provide technical 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, instructional facilities and equipment, and faculty qualifications. Graduates of programs accredited by the Accreditation Board of Engineering and Technology (ABET) are generally recognized to have achieved a minimum level of competence in the mathematics, science, and technical courses required for this occupation.

Technical institutes offer intensive technical training but less theory and general education than junior and community colleges. Many offer 2-year associate degree programs, and are similar to or are part of a community college or are part of State university systems. Other technical institutes are run by private, often for-profit, organizations, sometimes called proprietary schools; their programs vary considerably in length and types of courses offered. Some are 2-year associate degree programs.

Junior and community colleges offer curriculums similar to those in technical institutes but may include more theory and liberal arts. Often there may be little or no difference between technical institute and community college programs, as both offer associate degrees. After completing the 2-year program, some graduates get jobs as engineering technicians, while others continue their education at 4-year colleges. However, there is a difference between an associate degree in pre-engineering and one in engineering technology. Students who enroll in a 2-year pre-engineering program may find it very difficult to find work as an engineering technician should they decide not to enter a 4-year engineering program because pre-engineering programs usually focus less on hands-on applications and more on academic preparatory work. Conversely, graduates of 2-year engineering technology programs may not receive credit for many of the courses they have taken if they choose to transfer to a 4-year engineering program.

Four-year colleges usually do not offer engineering technician training, but college courses in science, engineering, and mathematics are useful for obtaining a job as an engineering technician. Many 4-year colleges offer bachelor's degrees in engineering technology, but graduates of these programs are often hired to work as applied engineers, not technicians.

Area vocational-technical schools include postsecondary public institutions that serve local students and emphasize training needed by local employers. Most require a high school diploma or its equivalent for admission.

Other training in technical areas may be obtained in the Armed Forces. Many military technical training programs are highly regarded by employers. Some additional training may be needed, depending on the military skills acquired and the kind of job, but often this is gained on the job. Some correspondence schools also offer training for engineering technicians.

Prospective engineering technicians should take as many high school science and math courses as possible. Engineering technicians need an aptitude for mathematics and science. For design work, creativity also is desirable. They should be able to work well with others since they are often part of a team of engineers and other technicians. Those in sales and service should be able to work independently and deal effectively with customers.

Engineering technicians usually begin by doing routine work under the close supervision of an experienced technician, engineer, or scientist. As they gain experience, they are given more difficult assignments with only general supervision. Some engineering technicians eventually become supervisors.

Job Outlook

Well-qualified engineering technicians should experience good employment opportunities through the year 2005. Employment is expected to increase as fast as the average for all occupations due to expected continued growth in the output of technical products. Competitive pressures and advancing technology will force companies to improve and update manufacturing facilities and product designs more rapidly than in the past. However, like engineers, employment of engineering technicians is influenced by local and national economic conditions. The employment outlook also varies with the area of specialization and industry. Some types of engineering technicians, such as civil engineering and aeronautical engineering technicians, experience greater cyclical fluctuations than others. Technicians whose jobs are defense related may experience fewer opportunities because of defense cutbacks.

In addition to growth, nearly as many job openings will be to replace technicians who retire or leave the labor force for other reasons.

Earnings

According to a survey of workplaces in 160 metropolitan areas, engineering technicians at the most junior level had median earnings of about $20,900 in 1992, with the middle half earning between about $18,900 and $22,600 a year. Engineering technicians with more experience and the ability to work with little supervision had median earnings of about $28,800, and those in supervisory or senior level positions earned about $41,400.

In the Federal Government, engineering technicians could start at about $14,600, $16,400, or $18,300 in 1993, depending on their education and experience. In 1993, the average annual salary for engineering technicians in supervisory, nonsupervisory, and management positions in the Federal Government was $37,337; for electronics technicians, $42,436; and for industrial engineering technicians, $38,006.

Related Occupations

Engineering technicians apply scientific and engineering principles usually acquired in postsecondary programs below the baccalaureate level. Similar occupations include science technicians, drafters, surveyors, broadcast technicians, and health technologists and technicians.

Sources of Additional Information

A number of engineering technology-related organizations provide information on engineering technician and technology careers. JETS-Guidance, at 1420 King St., Suite 405, Alexandria, VA 22314, serves as a central distribution point for information from most of these organizations. Enclose a self-addressed, business-size envelope with four first class stamps to obtain a sampling of materials available.

For information on chemical engineering technicians, contact:
☞ American Institute of Chemical Engineers, Attention: Mr. Chung Lam, 345 East 47th St., New York, NY 10017.

Library Technicians

(D.O.T. 100.367-018)

Nature of the Work

Library technicians help librarians acquire, prepare, and organize material, and assist users in finding materials and information. Technicians in small libraries handle a wide range of duties; those in large libraries usually specialize.

Depending on the employer, library technicians may have other titles, such as library technical assistants. Technicians assist in the use of public catalogs, direct library users to standard references, organize and maintain periodicals, handle interlibrary loan requests, perform routine cataloging and coding of library materials, verify information on order requests, retrieve information from computer data bases, and supervise other support staff, such as circulation desk workers. The widespread use of computerized information storage and retrieval systems has resulted in technicians handling more technical and user services, such as entering catalog information into the library's computer, that were once performed by librarians. Technicians also may assist with customizing data bases. (See the statement on librarians elsewhere in the *Handbook*.)

Some library technicians operate and maintain audiovisual equipment, such as projectors, tape recorders, and videocassette recorders, and assist library users with microfilm or microfiche readers. Technicians may also design posters, bulletin boards, or displays.

Those in school libraries teach students to use the school library/media center and encourage them to do so. They also help teachers get instructional materials and help students with special assignments. Some work in special libraries maintained by government agencies, corporations, law firms, advertising agencies, museums, professional societies, medical centers, and research laboratories, where they conduct literature searches, compile bibliographies, and prepare abstracts, usually on subjects of particular interest to the organization.

Working Conditions

Technicians who work with users answer questions and provide assistance. Technicians who prepare library materials sit at desks or computer terminals for long periods and may develop headaches or eyestrain from working with video display terminals. Some duties like calculating circulation statistics can be repetitive and boring. Others, such as computer searches using local and regional library networks and cooperatives, can be interesting and challenging.

Library technicians in school libraries work regular school hours. Those in public libraries and college and university (academic) libraries may work weekends and evenings. Library technicians in

Library technicians may retrieve information from computer data bases.

special libraries usually work normal business hours, although they are often called upon to work overtime.

Employment

Library technicians held about 71,000 jobs in 1992. Most worked in school, academic, or public libraries. Some worked in hospitals and religious organizations. The Federal Government, primarily the Department of Defense and the Library of Congress, and State and local governments also employed library technicians.

Training, Other Qualifications, and Advancement

Training requirements for library technicians vary widely, ranging from a high school diploma to postsecondary training as a library technician. Some libraries may require that tecnicians have a bachelor's degree. Employers may hire individuals with work experience or other training, or may train inexperienced workers on the job. Given the widespread use of automation in libraries, computer skills are needed for many jobs.

Some 2-year colleges offer an associate of arts degree in library technology. Programs include both liberal arts and library-related study. Students learn about library and media organization and operation and how to order, process, catalog, locate, and circulate library materials, and work with library automation.

Library technicians usually advance by assuming added responsibilities. For example, technicians may start at the circulation desk, checking books in and out. After gaining experience, they may be responsible for storing and verifying information. As they advance, they may become involved in budget and personnel matters in their department. Some library technicians advance to supervisory positions and are in charge of overseeing the day-to-day operation of their department.

Job Outlook

Employment of library technicians is expected to grow about as fast as the average for all occupations through the year 2005. The increasing use of library automation may spur job growth among library technicians. Computerized information systems have simplified certain tasks, such as descriptive cataloging, which can now be handled by technicians instead of librarians. For instance, the technician can now easily retrieve information from a central data base and store it in the library's own computer. However, budgetary constraints may dampen employment growth of library technicians in school, public, and college and university libraries. Additional job openings will result from the need to replace library technicians who transfer to other fields or leave the labor force.

Growth in the number of professional and other workers who use special libraries should result in relatively fast employment growth among library technicians in special libraries. Willingness to relocate enhances an aspiring library technician's job prospects.

Earnings

Salaries for library technicians vary widely, depending on the type of library and geographic location. Salaries of library technicians in the Federal Government averaged $23,900 in 1993.

Related Occupations

Library technicians perform organizational and administrative duties. Workers in other occupations with similar duties include library clerks, information clerks, record clerks, medical record technicians, and title searchers. Library technicians also assist librarians. Other workers who assist professional workers include museum technicians, teacher aides, legal assistants, and engineering and science technicians.

Sources of Additional Information

Information about a career as a library technician and a directory of schools offering training programs in this field can be obtained from:

☞ Council on Library/Media Technicians, P.O. Box 951, Oxon Hill, MD 20750.

For information on training programs for library/media technical assistants, write to:

☞ American Library Association, Office for Library Personnel Resources, 50 East Huron St., Chicago, IL 60611.

Information on schools receiving Federal financial assistance for library training is available from:

☞ Office of Educational Research and Improvement, Library Programs, Library Development Staff, U.S. Department of Education, 555 New Jersey Ave. NW., Washington, DC 20208-5571.

Those interested in a position as a library technician in the Federal service should write to:

☞ Office of Personnel Management, 1900 E St. NW., Washington, DC 20415.

Information concerning requirements and application procedures for positions in the Library of Congress may be obtained directly from:

☞ Personnel Office, Library of Congress, Washington, DC 20540.

State library agencies can furnish information on requirements for technicians, and general information about career prospects in the State. Several of these agencies maintain job "hotlines" which report openings for library technicians.

State departments of education can furnish information on requirements and job opportunities for school library technicians.

Machinists and Tool Programmers

(D.O.T. 007.167-018; 600.260, -022, .280-022, -026, -030, -034, -042, .281-010, .380-010; 609.262-010; and 714.281-018)

Nature of the Work

Machinists produce precision metal parts, usually using machine tools such as lathes, drill presses, and milling machines. Although machinists can and sometimes do produce large quantities of one part, machinists often produce small batches or one-of-a-kind items. They set up and operate a wide variety of machine tools and know the working properties of metals such as steel, cast iron, aluminum, and brass. Using their skill with machine tools and their knowledge of metals, machinists plan and carry out the operations needed to make machined products that meet precise specifications.

Increasingly, the machine tools used to produce metal parts are numerically controlled (NC)—that is, they contain an electronic controller that directs the machine's operations. Most NC machines today are computer numerically controlled (CNC), which means that the controllers are computers. The controller "reads" a program—a coded list of the steps necessary to perform a specific machining job—and runs the machine tool's mechanisms through the steps. The quality of the products these machines produce depends largely on the programs, which may be produced by machinists or by workers who specialize in programming machine tools known as tool programmers. Although tool programmers and machinists are often considered separate occupations, because many of their duties are very similar or identical, both are covered in this statement.

Machinists first review blueprints or written specifications for a job. Next, they calculate where to cut or bore into the workpiece, how fast to feed the metal into the machine, and how much metal to remove. They then select tools and materials for the job, plan the sequence of cutting and finishing operations, and mark the metal stock to show where these cuts should be made.

After this layout work is completed, they perform the necessary machining operations. Machinists position the metal stock on the machine tool—drill presses, lathes, milling machines, or others—set the controls, and make the cuts. Today, new machinery allows various functions to be performed with one setup, which reduces the need for additional, labor-intensive setups, saving time and money. During the machining process, they must constantly monitor the feed and speed of the machine. Machinists must also ensure that the workpiece is being properly lubricated and cooled because the machining of metal products generates a significant amount of heat.

Traditionally, machinists have had direct control of their machines. However, the introduction of numerically controlled machines, and in particular, computer numerically controlled machines, has greatly changed the nature of the work for machinists. NC machines not only are more productive, they enable parts to be produced with a level of precision beyond that possible with traditional machining techniques. Furthermore, because precise movements are recorded in the program, they allow this high level of precision to be consistently repeated. This uniformity is key to fulfilling customers' needs for quality products.

Tool programmers begin as machinists do—by analyzing blueprints, computing the size and position of the cuts, determining the sequence of machine operations, selecting tools, and calculating the machine speed and feed rates. They then write the program in the language of the machine's controller and store it. Skilled machinists also do programming. As computer software becomes more user friendly, machinists are expected to perform this function increasingly.

Machinists may work alone or with tool programmers to check new programs to ensure that machinery will function properly and the output will meet specifications. Because a problem with the program could damage the costly machinery and cutting tools, computer simulations may be used instead of a trial run to check the program. If errors are found, the program must be changed and retested until the problem is resolved. Programs can then be used for other jobs with similar specifications by making small adjustments to the existing program. This reduces the time and effort needed to start production of a part.

A growing number of firms have computer-aided design (CAD) systems that are used to write programs. When a part is designed using a CAD system, data about its dimensions are calculated; the CAD system can then use these data to develop the controller's program.

As machinery has become more complex, close tolerances or high precision of machined parts has also increased in importance. In some cases, for example, a part may have to meet specifications equal to one-twentieth of a strand of hair. As a result measuring devices have also increased in sophistication. Optical, acoustical, and laser measuring devices commonly ensure that work meets specifications.

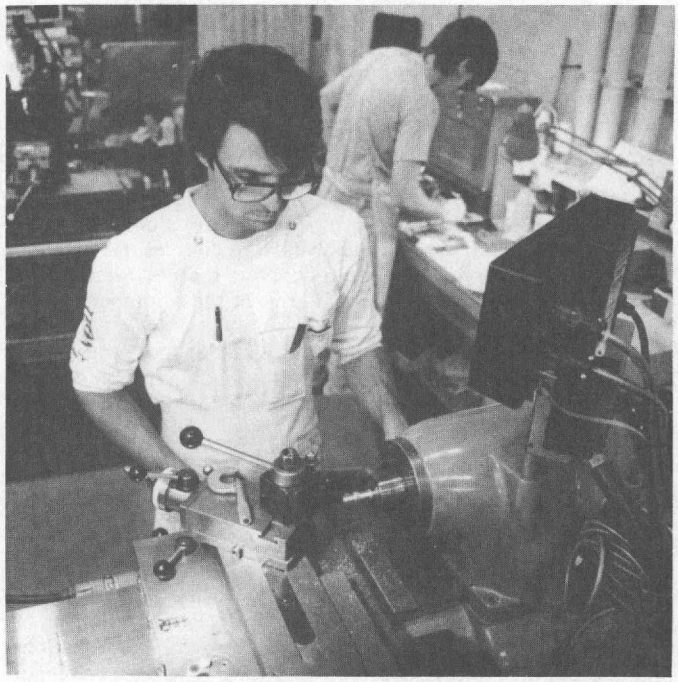
Although machinists and tool programmers perform many similar duties, jobs can vary greatly. Some machinists, often called production machinists, may produce large quantities of one part, especially parts needing unusually complex operations, great precision, or when unusually sophisticated, expensive machinery is used. Usually, however, large numbers of parts requiring more routine operations are produced by metalworking machine operators (see the statement on metalworking and plastics-working machine operators elsewhere in the *Handbook*). Other machinists do maintenance work—repairing or making new parts for existing machinery. For example, to repair a broken part, maintenance machinists may refer to blueprints and perform the same machining operations that were needed to create the original part.

Working Conditions

Most machine shops are well lighted and ventilated. Nevertheless, working around high-speed machine tools presents certain dangers, and workers must follow safety precautions. Machinists must wear protective equipment such as safety glasses to shield against bits of flying metal and earplugs to protect against machinery noise. They must also exercise caution when cleaning and disposing of coolants and lubricants because many of these materials can be hazardous. The job requires stamina because machinists stand most of the day and may lift moderately heavy workpieces.

Some tool programmers work in offices that are near, but separate from, the shop floor. These work areas are usually clean, well lighted, and free of machine noise.

Most machinists and tool programmers work a 40-hour week. Evening and weekend shifts are becoming more common as companies invest in more expensive machinery. Overtime is common during peak production periods.



Machinists frequently use lathes to make round or circular parts.

Employment

Machinists and tool programmers held about 359,000 jobs in 1992. Most machinists worked in small machining shops or in manufacturing firms that produce durable goods such as metalworking and industrial machinery, aircraft, or motor vehicles. Maintenance machinists work in most industries that use production machinery. Although machinists and tool programmers work in all parts of the country, jobs are most plentiful in areas where manufacturing is concentrated.

Training, Other Qualifications, and Advancement

A high school or vocational school education, including mathematics, blueprint reading, metalworking, and drafting, is desirable for becoming a machinist or tool programmer. A basic knowledge of computers and electronics is helpful because of the increased use of computer-controlled machine tools. Experience with machine tools also is helpful. In fact, many of the people who enter the occupation have previously worked as machine tool operators or setters.

Machinist training varies from formal apprenticeship programs to informal on-the-job training. However, most employers consider a formal apprenticeship program the best way to learn the machinist trade. Apprentice programs consist of shop training and related classroom instruction. In shop training, apprentices learn filing, handtapping, and dowel fitting, as well as the operation of various machine tools. Classroom instruction includes math, physics, blueprint reading, mechanical drawing, and shop practices. In addition, as machine shops have increased their use of computer-controlled equipment, training in the operation and programming of numerically controlled machine tools has become essential. Community colleges and technical institutes increasingly offer classroom training in connection with company or association training programs.

Qualifications for tool programmers vary widely depending upon the complexity of the job. Basic requirements parallel those of machinists. Employers often prefer skilled machinists, tool and die makers, or those with technical school training. For some specialized types of programming, such as with complex parts for the aerospace or shipbuilding industries, employers may prefer individuals with a degree in engineering.

For those entering tool programming directly, a basic knowledge of computers and electronics is helpful because of the increased use of computer-controlled machine tools. Experience with machine tools also is helpful. Classroom training includes an introduction to

numerical control and the basics of programming and then advances to more complex topics such as computer-aided design. Then, trainees start writing simple programs under the direction of an experienced programmer. Although machinery manufacturers are trying to standardize programming languages, currently there are numerous languages in use. Because of this, tool programmers must be able to learn and adapt to new programming languages.

Established workers may also take courses to update their skills and to learn the latest technology and equipment. Some employers offer tuition reimbursement for job-related courses. In addition, when new machinery is introduced, workers receive training in its operation—usually from a representative of the equipment manufacturer.

Persons interested in becoming a machinist or tool programmer should be mechanically inclined. They also should be able to work independently and do highly accurate work that requires concentration as well as physical effort.

Job Outlook

Employment of machinists and tool programmers is expected to decline slightly through the year 2005. Nevertheless, many job openings will arise each year from the need to replace experienced machinists and programmers who transfer to other occupations or retire. In recent years, employers have reported difficulties in attracting workers to machining and tool programming occupations. Therefore, good employment opportunities should exist for candidates with the necessary mechanical and mathematical aptitudes.

The number of openings for machinists is expected to be far greater than the number of openings for tool programmers because there are many more machinists than tool programmers. In addition, machinists are increasingly taking on the functions of tool programming as the programming of machine tools becomes easier due to simplified programming languages and procedures.

As the economy expands, so will the demand for goods that use machined metal parts. But, demand for these workers will be constrained by improvements in metalworking technology. For example, the use of computer-controlled machine tools reduces the time required for machining operations and increases productivity. Furthermore, when demand for machined goods falls, machinists and tool programmers involved in production may be laid off or be forced to work fewer hours. Apprenticeship opportunities may also decline.

Employment of machinists involved in plant maintenance is often more stable because proper maintenance and repair of costly equipment remain vital concerns even when production levels fall.

Earnings

Earnings of machinists compare favorably with those of other skilled workers. In 1992, median weekly earnings for machinists were about $492. Most earned between $376 and $623. Ten percent of all machinists had median weekly earnings of less than $275; the 10 percent with the highest earnings made more than $750 a week. In addition to their hourly wage, most workers receive health and life insurance, a pension plan, paid vacations, and sick leave.

Related Occupations

Occupations most closely related to that of machinist and tool programmer are, of course, the other machining occupations. These include tool and die maker, tool and die designer, tool planner, and instrument maker. Workers in other occupations that require precision and skill in working with metal include blacksmiths, gunsmiths, locksmiths, metal patternmakers, and welders.

Tool programmers apply their knowledge of machining operations, metals, blueprints, and machine programming to write programs that run machine tools. Computer programmers also write detailed instructions for a machine—in this case a computer.

Sources of Additional Information

For general information about this occupation, contact:

☞ The Association for Manufacturing Technology, 7901 Westpark Dr., McLean, VA 22102.

☞ The National Tooling and Machining Association, 9300 Livingston Rd., Fort Washington, MD 20744.

☞ The Tooling and Manufacturing Association, 1177 South Dee Rd., Park Ridge, IL 60068.

☞ Precision Metalforming Association, 27027 Chardon Rd., Richmond Heights, OH 44143.

Paralegals

(D.O.T. 119.267-022 and -026)

Nature of the Work

Not all legal work requires a law degree. Lawyers are often assisted in their work by paralegals—also called "legal assistants"—who perform many of the same tasks as lawyers, except for those tasks considered to be the practice of law.

Paralegals work directly under the supervision of lawyers. Although the lawyers assume responsibility for the legal work, they often delegate to paralegals many of the tasks they perform as lawyers. Paralegals are prohibited from setting legal fees, giving legal advice, or presenting a case in court.

Paralegals generally do background work for lawyers. To help prepare cases for trial, paralegals investigate the facts of cases to make sure that all relevant information is uncovered. Paralegals may conduct legal research to identify the appropriate laws, judicial decisions, legal articles, and other materials that may be relevant to clients' cases. After organizing and analyzing all the information, paralegals may prepare written reports that attorneys use to decide how cases should be handled. Should attorneys decide to file lawsuits on behalf of clients, paralegals may help prepare the legal arguments, draft pleadings to be filed with the court, obtain affidavits, and assist the attorneys during trials. Paralegals also keep files of all documents and correspondence important to cases.

Besides litigation, paralegals may also work in areas such as bankruptcy, corporate law, criminal law, employee benefits, patent and copyright law, and real estate. They help draft documents such as contracts, mortgages, separation agreements, and trust instruments. They may help prepare tax returns and plan estates. Some paralegals coordinate the activities of the other law office employees and keep the financial records for the office.

Paralegals who work for corporations help attorneys with such matters as employee contracts, shareholder agreements, stock option plans, and employee benefit plans. They may help prepare and file annual financial reports, maintain corporate minute books and resolutions, and help secure loans for the corporation. Paralegals may also review government regulations to make sure that the corporation operates within the law.

The duties of paralegals who work in government vary depending on the type of agency that employs them. Generally, paralegals in government analyze legal material for internal use, maintain reference files, conduct research for attorneys, collect and analyze evidence for agency hearings, and prepare informative or explanatory material on the law, agency regulations, and agency policy for general use by the agency and the public.

Paralegals employed in community legal service projects help the poor, the aged, and other persons in need of legal aid. They file forms, conduct research, and prepare documents. When authorized by law, they may represent clients at administrative hearings.

Some paralegals, usually those in small and medium-sized law firms, have varied duties. One day the paralegal may do research on judicial decisions on improper police arrests and the next day may help prepare a mortgage contract. This requires a general knowledge of many areas of the law.

Some paralegals who work for large law firms, government agencies, and corporations, specialize in one area of the law. Some specialties are real estate, estate planning, family law, labor law, litigation, and corporate law. Even within specialties, functions often are broken down further so that paralegals may deal with one narrow area of the specialty. For example, paralegals who specialize in labor law may deal exclusively with employee benefits.

A growing number of paralegals are using computers in their work. Computer software packages are increasingly used to search

legal literature stored in the computer and identify legal texts relevant to a specific subject. In litigation that involves many supporting documents, paralegals may use computers to organize and index the material. Paralegals may also use computer software packages to perform tax computations and explore the consequences of possible tax strategies for clients.

Working Conditions

Paralegals do most of their work at desks in offices and law libraries. Occasionally, they travel to gather information and perform other duties.

Paralegals employed by corporations and government work a standard 40-hour week. Although most paralegals work year round, some are temporarily employed during busy times of the year then released when work diminishes. Paralegals who work for law firms sometimes work very long hours when they are under pressure to meet deadlines. Some law firms reward such loyalty with bonuses and additional time off.

Paralegals handle many routine assignments, particularly when they are inexperienced. Some find that these assignments offer little challenge and become frustrated with their duties. However, paralegals usually assume more responsible and varied tasks as they gain experience. Furthermore, as new laws and judicial interpretations emerge, paralegals are exposed to many new legal problems that make their work more interesting and challenging.

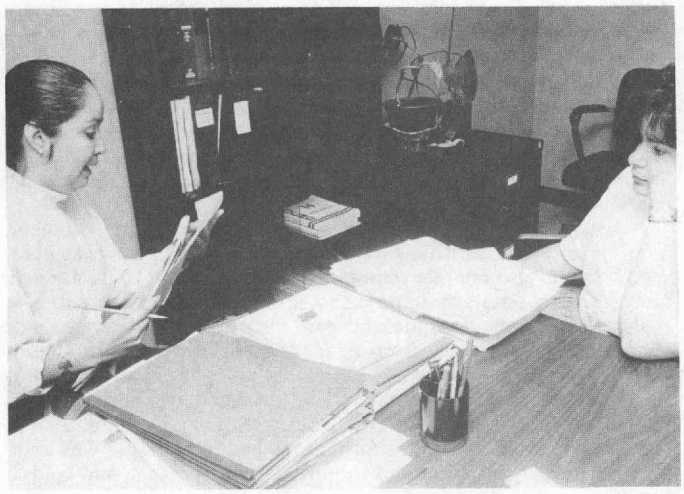
Employment

Paralegals held about 95,000 jobs in 1992. Private law firms employed the vast majority; most of the remainder worked for various levels of government. Paralegals are found in nearly every Federal Government agency; the Departments of Justice, Treasury, Interior, and Health and Human Services, and the General Services Administration are the largest employers. State and local governments and publicly funded legal service projects employ paralegals as well. Banks, real estate development companies, and insurance companies also employ small numbers of paralegals.

Training, Other Qualifications, and Advancement

There are several ways to enter the paralegal profession. Employers generally require formal paralegal training; several types of training programs are acceptable. However, some employers prefer to train their paralegals on the job, promoting experienced legal secretaries or hiring persons with college education but no legal experience. Other entrants have experience in a technical field that is useful to law firms, such as a background in tax preparation for tax and estate practice or nursing or health administration for personal injury practice.

Over 600 formal paralegal training programs are offered by 4-year colleges and universities, law schools, community and junior colleges, business schools, and proprietary schools. In 1993, 177 programs had been approved by the American Bar Association (ABA). Although this approval is neither required nor sought by many programs, graduation from an ABA-approved program can enhance one's employment opportunities. The requirements for admission to formal training programs vary widely. Some require some college courses or a bachelor's degree. Others accept high school graduates or persons with legal experience. A few schools require standardized tests and personal interviews.



Paralegals may have to consult with clients to gather relevant information for court cases.

Most paralegal programs are completed in 2 years, although some take as long as 4 years and award a bachelor's degree upon completion. Other programs take only a few months to complete, but require a bachelor's degree for admission. Programs typically include a combination of general courses on subjects such as the law and legal research techniques, and courses that cover specialized areas of the law, such as real estate, estate planning and probate, litigation, family law, contracts, and criminal law. Many employers prefer applicants with training in a specialized area of the law. Programs also increasingly include courses that introduce students to the legal applications of computers. Many paralegal training programs include an internship in which students gain practical experience by working for several months in a law office, corporate legal department, or government agency. Experience gained in internships is an asset when seeking a job after graduation. Depending on the program, graduates may receive a certificate, an associate degree, or, in some cases, a bachelor's degree.

The quality of paralegal training programs varies; the better programs generally emphasize job placement. Prospective students should examine the experiences of recent graduates of programs in which they are considering enrolling.

Paralegals need not be certified, but the National Association of Legal Assistants has established standards for voluntary certification which require various combinations of education and experience. Paralegals who meet these standards are eligible to take a 2-day examination given each year at several regional testing centers by the Certifying Board of Legal Assistants of the National Association of Legal Assistants. Persons who pass this examination may use the designation Certified Legal Assistant (CLA). This designation is a sign of competence in the field and may enhance employment and advancement opportunities.

Paralegals must be able to handle legal problems logically and effectively communicate, both orally and in writing, their findings and opinions to their supervising attorney. They must understand legal terminology and have good research and investigative skills. Familiarity with the operation and applications of computers in legal research and litigation support is increasingly important. Paralegals must always stay abreast of new developments in the law that affect their area of practice.

Because paralegals often deal with the public, they must be courteous and uphold the high ethical standards of the legal profession. A few States have established ethical guidelines that paralegals in the State must follow.

Experienced paralegals usually are given progressively more responsible duties and less supervision. In large law firms, corporate legal departments, and government agencies, experienced paralegals may supervise other paralegals and clerical staff and delegate work assigned by the attorneys. Advancement opportunities include promotion to managerial and other law-related positions within the firm or corporate legal department. However, some paralegals find it easier to move to another law firm when seeking increased responsibility or advancement.

Job Outlook

Employment of paralegals is expected to grow much faster than the average for all occupations through the year 2005. Job opportunities are expected to expand as more employers become aware that paralegals are able to do many legal tasks for lower salaries than lawyers. Both law firms and other employers with legal staffs should continue to emphasize hiring paralegals so that the cost, availability, and efficiency of legal services can be improved.

New jobs created by rapid employment growth will create most of the job openings for paralegals in the future. Other job openings will arise as people leave the occupation. Although the number of job

openings for paralegals is expected to increase significantly through the year 2005, so will the number of persons pursuing this career. Thus, keen competition for jobs should continue as the growing number of graduates from paralegal training programs keeps pace with employment growth. Still, job prospects are expected to be favorable for graduates of highly regarded formal programs.

Private law firms will continue to be the largest employers of paralegals as a growing population needs more legal services. The growth of prepaid legal plans also should contribute to the demand for the services of law firms. A growing array of other organizations, such as corporate legal departments, insurance companies, real estate and title insurance firms, and banks will also hire paralegals.

Job opportunities for paralegals will expand even in the public sector. Community legal service programs—which provide assistance to the poor, the aged, minorities, and middle-income families—operate on limited budgets and will employ more paralegals to keep expenses down and serve the most people. Federal, State, and local government agencies, consumer organizations, and the courts also should continue to hire paralegals in increasing numbers.

To a limited extent, paralegal jobs are affected by the business cycle. During recessions, demand declines for some discretionary legal services, such as planning estates, drafting wills, and handling real estate transactions. Corporations are less inclined to initiate litigation when falling sales and profits lead to fiscal belt tightening. As a result, full-time paralegals employed in offices adversely affected by a recession may be laid off or have their work hours reduced. On the other hand, during recessions, corporations and individuals are more likely to face other legal problems, such as bankruptcies, foreclosures, and divorces, that require legal assistance. Furthermore, the continuous emergence of new laws and judicial interpretations of existing laws creates new business for lawyers and paralegals without regard to the business cycle.

Earnings

Earnings of paralegals vary greatly. Salaries depend on the education, training, and experience the paralegal brings to the job, the type and size of employer, and the geographic location of the job. Generally, paralegals who work for large law firms or in large metropolitan areas earn more than those who work for smaller firms or in less populated regions.

Paralegals had an average annual salary of about $28,300 in 1993, according to a utilization and compensation survey by the National Association of Legal Assistants. Starting salaries of paralegals averaged $23,400, while paralegals with from 6 to 10 years of experience averaged $28,200 a year. Salaries of paralegals with from 11 to 15 years of experience averaged $29,800 annually, according to the same survey. In addition to a salary, many paralegals received an annual bonus, which averaged $1,700 in 1993. Employers of the majority of paralegals provided life and health insurance benefits and contributed to a retirement plan on their behalf.

Paralegal Specialists hired by the Federal Government in 1993 started at about $18,000 or $23,000 a year, depending on their training and experience. The average annual salary of paralegals who worked for the Federal Government in 1993 was about $37,600.

Related Occupations

Several other occupations also call for a specialized understanding of the law and the legal system but do not require the extensive training of a lawyer. Some of these are abstractors, claim examiners, compliance and enforcement inspectors, occupational safety and health workers, patent agents, police officers, and title examiners.

Sources of Additional Information

General information on a career as a paralegal and a list of paralegal training programs approved by the American Bar Association may be purchased for $5 from:

☞ Standing Committee on Legal Assistants, American Bar Association, 750 North Lake Shore Dr., Chicago, IL 60611.

For information on certification of paralegals, schools that offer training programs in a specific State, and standards and guidelines for paralegals, contact:

☞ National Association of Legal Assistants, Inc., 1601 South Main St., Suite 300, Tulsa, OK 74119.

Information on a career as a paralegal, schools that offer training programs, and local paralegal associations can be obtained from:

☞ National Federation of Paralegal Associations, P.O. Box 33108, Kansas City, MO 64114.

Information on paralegal training programs may be obtained from:

☞ American Association for Paralegal Education, P.O. Box 40244, Overland Park, KS 66204.

Science Technicians

(List of D.O.T. codes available on request from the Chief, Division of Occupational Outlook, Bureau of Labor Statistics, Washington, DC 20212.)

Nature of the Work

Science technicians use the principles and theories of science and mathematics to solve problems in research and development and to investigate, invent, and help improve products. Their jobs are more practically oriented than those of scientists.

In recent years, laboratory instrumentation and procedures have become more complex, changing the work of science technicians in research and development. The increasing use of robotics to perform many routine tasks formerly done by technicians has freed technicians to operate other, more sophisticated laboratory equipment. Science technicians make extensive use of computers, computer-interfaced equipment, robotics, and high-technology industrial applications such as biological engineering.

Technicians set up, operate, and maintain laboratory instruments, monitor experiments, calculate and record results, and often develop conclusions. Those who work in production test products for proper proportions of ingredients or for strength and durability.

Agricultural technicians work with agricultural scientists in food and fiber research, production, and processing. Some conduct tests and experiments to improve the yield and quality of crops or to increase the resistance of plants and animals to disease, insects, or other hazards. Other agricultural technicians do animal breeding and nutrition work.

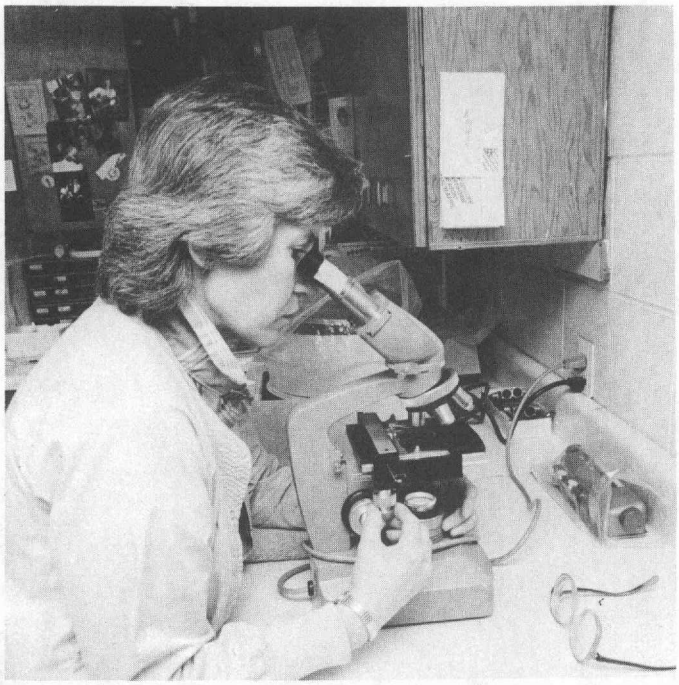
Biological technicians work with biologists, studying living organisms. They may assist scientists who conduct medical research, helping to find a cure for cancer or AIDS, for example, or they may help conduct pharmaceutical research. Biological technicians also analyze organic substances such as blood, food, and drugs; some examine evidence in criminal investigations. Biological technicians working in biotechnology labs use the knowledge and techniques gained from basic research by scientists, including gene splicing and recombinant DNA, and apply these techniques in product development.

Chemical technicians work with chemists and chemical engineers, developing and using chemicals and related products and equipment. Most do research and development, testing, or other laboratory work. For example, they might test packaging for design, materials, and environmental acceptability; assemble and operate new equipment to develop new products; monitor product quality; or develop new production techniques. Some chemical technicians collect and analyze samples of air and water to monitor pollution levels. Those who focus on basic research might produce compounds through complex organic synthesis.

Nuclear technicians operate nuclear test and research equipment, monitor radiation, and assist nuclear engineers and physicists in research. Some also operate remote control equipment to manipulate radioactive materials or materials to be exposed to radioactivity.

Petroleum technicians measure and record physical and geologic conditions in oil or gas wells using instruments lowered into wells or by analysis of the mud from wells. In oil and gas exploration, they collect and examine geological data or test geological samples to determine petroleum and mineral content. Some petroleum technicians, called scouts, collect information about oil and gas well drilling operations, geological and geophysical prospecting, and land or lease contracts.

Other science technicians collect weather information or assist oceanographers.



Employers seek well trained individuals with good laboratory skills for science technician positions.

Working Conditions

Science technicians work under a wide variety of conditions. Many work indoors, usually in laboratories, and have regular hours. Some occasionally work irregular hours to monitor experiments that can't be completed during regular working hours. Others, such as agricultural and petroleum technicians, perform much of their work outdoors, sometimes in remote locations, and some may be exposed to hazardous conditions. Chemical technicians sometimes work with toxic chemicals; nuclear technicians may be exposed to radiation; and biological technicians sometimes work with disease-causing organisms or radioactive agents. However, there is little risk if proper safety procedures are followed.

Employment

Science technicians held about 244,000 jobs in 1992. Nearly 40 percent worked in manufacturing, mostly in the chemical industry, but also in the petroleum refining and food processing industries. Almost 20 percent worked in colleges and universities and another 12 percent worked in research and testing services.

In 1992, the Federal Government employed about 19,000 science technicians, mostly in the Departments of Defense, Agriculture, Interior, and Commerce.

Training, Other Qualifications, and Advancement

There are several ways to qualify for a job as a science technician. Most employers prefer applicants who have at least 2 years of specialized training. Many junior and community colleges offer associate degrees in a specific technology or a more general education in science and mathematics. A number of 2-year associate degree programs are designed to provide easy transfer to a 4-year college or university if desired. Technical institutes generally offer technician training but provide less theory and general education than junior or community colleges. The length of programs at technical institutes varies, although 2-year associate degree programs are common. Some of these schools offer cooperative-education programs, allowing students the opportunity to work at a local company while attending classes in alternate terms. Many science technicians have a bachelor's degree in science or mathematics, or have had science and math courses in 4-year colleges. Some people with bachelor's degrees in a physical or life science become science technicians because they can't find or don't want a job as a scientist or because employers couldn't find properly trained technicians with less education. In some cases, they may be able to move into jobs as scientists, managers, or technical sales workers.

Some companies offer formal or on-the-job training for science technicians. Technicians also may qualify for their jobs with some types of Armed Forces training.

Persons interested in careers as science technicians should take as many high school science and math courses as possible. Science courses taken beyond high school, in an associate's or bachelor's program, should be laboratory oriented, with an emphasis on "bench" skills. Because computers and computer-interfaced equipment are often used in research and development laboratories, technicians should have strong computer skills. Communication skills are important, and technicians should be able to work well with others since technicians often are part of a team.

Technicians usually begin work as trainees in routine positions under the direct supervision of a scientist or experienced technician. Job candidates whose training or educational background encompasses extensive hands-on experience with a variety of laboratory equipment, including computers and related equipment, usually require a much shorter period of on-the-job training. As they gain experience, they take on more responsibility and carry out assignments under only general supervision. Some eventually become supervisors.

Job Outlook

Employment of science technicians is expected to increase about as fast as the average for all occupations through the year 2005. Continued growth of scientific research and development and the production of technical products should spur demand for all science technicians. Advances in biotechnology will increase the need for biological technicians in particular. However, growth of job openings will be moderated somewhat by an expected slowdown in overall employment growth in the chemical industry, where many chemical technicians are employed.

Nevertheless, job opportunities are expected to be very good for graduates of science technician training programs who are well-trained on the equipment currently in use in industrial and government laboratories. As the instrumentation and techniques used in industrial research and development laboratories becomes more complex, employers are seeking well trained individuals with highly developed technical and communication skills.

Despite the projected growth, most job openings will arise from the need to replace technicians who retire or leave the labor force for other reasons.

Earnings

Median annual earnings of science technicians were about $25,300 in 1992; the middle 50 percent earned between $18,700 and $33,400. Ten percent earned less than $14,400, and 10 percent earned over $42,400. At all income levels, chemical technicians earned significantly more than biological technicians.

In the Federal Government in 1993, science technicians could start at $14,600, $16,390, or $18,340, depending on their education and experience. The average annual salary for biological science technicians in nonsupervisory, supervisory, and managerial positions employed by the Federal Government in 1993 was $24,828; for mathematical technicians, $29,239; for physical science technicians, $31,484; for geodetic technicians, $37,282; for hydrologic technicians, $28,635; and for meteorologic technicians, $36,408.

Related Occupations

Other technicians who apply scientific principles at a level usually taught in 2-year associate degree programs include engineering technicians, broadcast technicians, drafters, and health technologists and technicians. Some of the work of agricultural and biological technicians is related to that in agriculture and forestry occupations.

Sources of Additional Information

For information about a career as a chemical technician, contact:

☞ American Chemical Society, Education Division, Career Publications, 1155 16th St. NW., Washington, DC 20036.

☆ U.S. GOVERNMENT PRINTING OFFICE: 1994 363-539 2450-11

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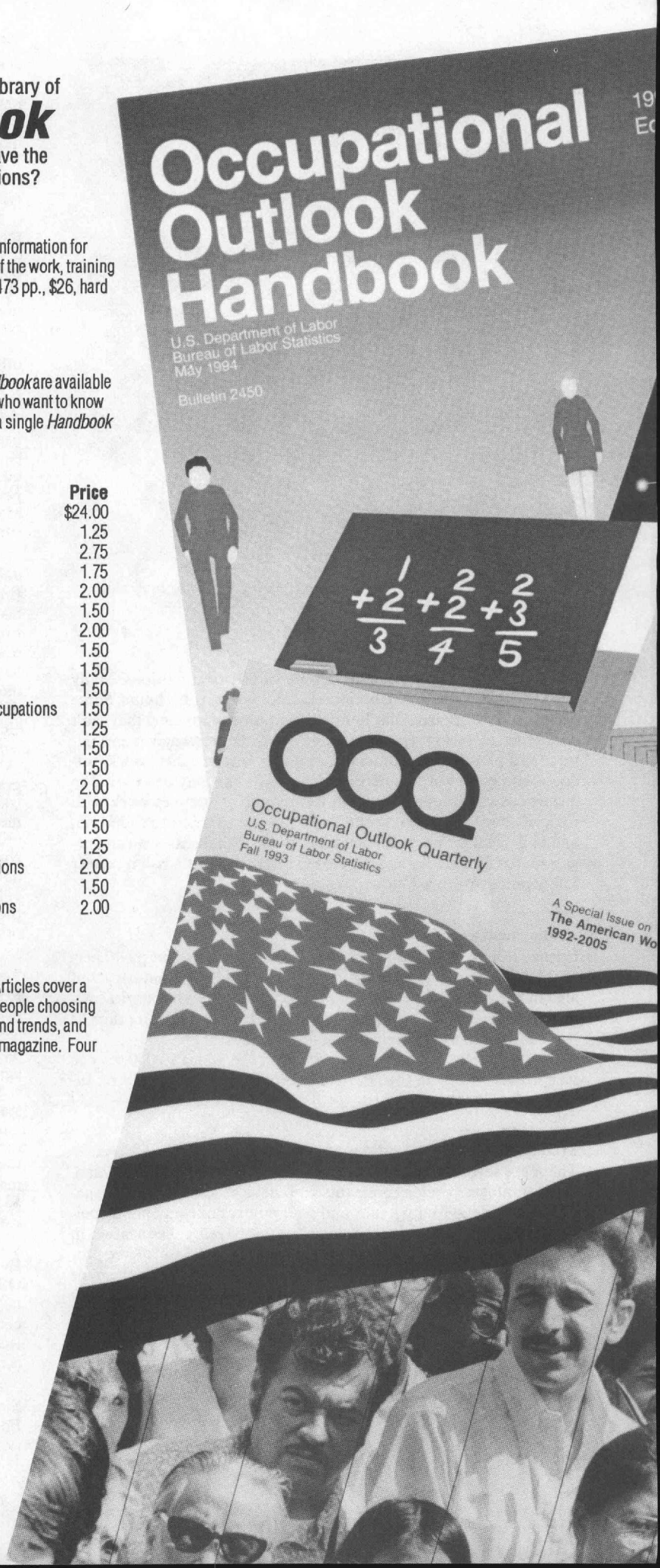

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