

# Engineers

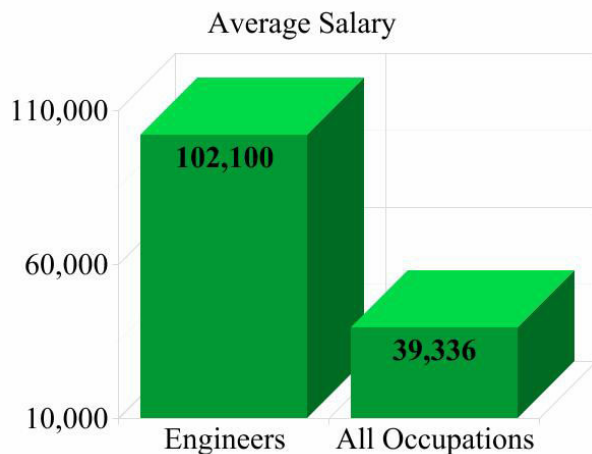
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## WHAT THEY DO

Engineers apply the principles of science and mathematics to develop economical solutions to technical problems. Their work is the link between scientific discoveries and the commercial applications that meet societal and consumer needs.

Many engineers develop new products. During the process, they consider several factors. For example, in developing an industrial robot, engineers specify the functional requirements precisely; design and test the robot's components; integrate the components to produce the final design; and evaluate the design's overall effectiveness, cost, reliability, and safety. This process applies to the development of many different products, such as chemicals, computers, powerplants, helicopters, and toys.

In addition to their involvement in design and development, many engineers work in testing, production, or maintenance. These engineers supervise production in factories, determine the causes of a component's failure, and test manufactured products to maintain quality. They also estimate the time and cost required to complete projects. Supervisory engineers are responsible for major components or entire projects.



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Most engineers specialize. Numerous other specialties are recognized by professional societies, and each of the major branches of engineering has numerous subdivisions. Civil engineering, for example, includes structural and transportation engineering, and materials engineering includes ceramic, metallurgical, and polymer engineering. Engineers also may specialize in one industry, such as motor vehicles, or in one type of technology, such as turbines or semiconductor materials.

## EDUCATION REQUIRED

A bachelor's degree in engineering is required for almost all entry-level engineering jobs. College graduates with a degree in a natural science or mathematics occasionally may qualify for some engineering jobs, especially in specialties that are in high demand. Most engineering degrees are granted in electrical and electronics engineering, mechanical engineering, and civil engineering. However, engineers trained in one branch may work in related branches. For example, many aerospace engineers have training in mechanical engineering. This flexibility allows employers to meet staffing needs in new technologies and specialties in which engineers may be in short supply. It also allows engineers to shift to fields with better employment prospects or to those which more closely match their interests.

Most engineering programs involve a concentration of study in an engineering specialty, along with courses in both mathematics and the physical and life sciences. Many programs also include courses in general engineering. A design course, sometimes accompanied by a computer or laboratory class or both, is part of the curriculum of most programs. Often, general courses not directly related to engineering, such as those in the social sciences or humanities, also are required.

In addition to the standard engineering degree, many colleges offer 2-year or 4-year degree programs in engineering technology. These programs, which usually include various hands-on laboratory classes that focus on current issues in the application of engineering principles, prepare students for practical design and production work, rather than for jobs that require more theoretical and scientific knowledge. Graduates of 4-year technology programs may get jobs similar to those obtained by graduates with a bachelor's degree in engineering. Engineering technology graduates, however, are not qualified to register as professional engineers under the same terms as graduates with degrees in engineering. Some employers regard technology program graduates as having skills between those of a technician and an engineer.

Graduate training is essential for engineering faculty positions and some research and development programs, but is not required for the majority of entry-level engineering jobs.

## Engineers - Continued

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### OTHER USEFUL SKILLS

Engineers should be creative, inquisitive, analytical, and detail oriented. They should be able to work as part of a team and to communicate well, both orally and in writing. Communication abilities are becoming increasingly important as engineers interact more frequently with specialists in a wide range of fields outside engineering.

Engineers who work for the Federal Government usually must be U.S. citizens. Some engineers, particularly nuclear engineers and aerospace and other engineers working for defense contractors, may need to hold a security clearance.

### HOW TO ADVANCE

Beginning engineering graduates usually work under the supervision of experienced engineers and, in large companies, also may receive formal classroom or seminar-type training. As new engineers gain knowledge and experience, they are assigned more difficult projects with greater independence to develop designs, solve problems, and make decisions. Engineers may advance to become technical specialists or to supervise a staff or team of engineers and technicians. Some eventually may become engineering managers or enter other managerial or sales jobs. In sales, an engineering background enables them to discuss a product's technical aspects and assist in product planning, installation, and use.

Numerous professional certifications for engineers exist and may be beneficial for advancement to senior technical or managerial positions. Many certification programs are offered by the professional societies listed as sources of additional information for engineering specialties at the end of this statement.

### WORK ENVIRONMENT

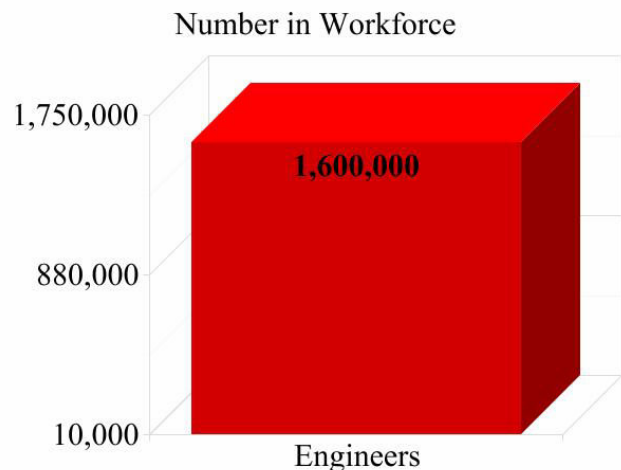
Most engineers work in office buildings, laboratories, or industrial plants. Others may spend time outdoors at construction sites and oil and gas exploration and production sites, where they monitor or direct operations or solve onsite problems. Some engineers travel extensively to plants or worksites here and abroad.

Many engineers work a standard 40-hour week. At times, deadlines or design standards may bring extra pressure to a job, requiring engineers to work longer hours.

### JOB GROWTH

Overall engineering employment is expected to grow by 11 percent over the 2008–18 decade, about as fast as the average for all occupations. Engineers traditionally have been concentrated in slower growing or declining manufacturing industries, in which they will continue to be needed to design, build, test, and improve manufactured products. However, increasing employment of engineers in engineering, research and development, and consulting services industries should generate most of the employment growth. The job outlook varies by engineering specialty, as discussed later.

Competitive pressures and advancing technology will force companies to improve and update product designs and to optimize their manufacturing processes. Employers will rely on engineers to increase productivity and expand output of goods and services. New technologies continue to improve the design process, enabling engineers to produce and analyze various product designs much more rapidly than in the past. Unlike the situation in some other occupations, however, technological advances are not expected to substantially limit employment opportunities in engineering, because engineers are needed to provide the ideas that lead to improved products and more productive processes.



The continued globalization of engineering work will likely dampen domestic employment growth to some degree. There are many well-trained, often English-speaking, engineers available around the world who are willing to work at much lower salaries than U.S. engineers. The rise of the Internet has made it relatively easy for part of the engineering work previously done by engineers in this country to be done by engineers in other countries, a factor that will tend to hold down employment growth. Even so, there will always be a need for onsite engineers to interact with other employees and clients.