

Although the type of job that environmental engineers have often determines whether they work outdoors, most work in offices the majority of the time.

Even though employment of environmental engineers should be less affected by economic conditions than that of most other types of engineers, a significant economic downturn could reduce the emphasis on environmental protection, reducing employment opportunities. Environmental engineers need to keep abreast of a range of environmental issues to ensure steady employment because their area of focus may change frequently—for example, from hazardous wastesite cleanup to the prevention of water pollution.

Earnings

Median annual earnings of environmental engineers were \$57,780 in 2000. The middle 50 percent earned between \$45,740 and \$71,280. The lowest 10 percent earned less than \$37,210, and the highest 10 percent earned more than \$87,290. Median annual earnings in the industries employing the largest numbers of environmental engineers in 2000 were:

Engineering and architectural services	\$53,580
State government	53,210
Management and public relations	52,110

According to a 2001 salary survey by the National Association of Colleges and Employers, bachelor's degree candidates in environmental engineering received starting offers averaging \$51,167 a year.

Sources of Additional Information

Further information about environmental engineers can be obtained from:

- ▶ American Academy of Environmental Engineers, 130 Holiday Court, Suite 100, Annapolis, MD 21401. Internet: <http://www.enviro-engrs.org>
(See the introduction to the section on engineers for information on working conditions, training requirements, and other sources of additional information.)

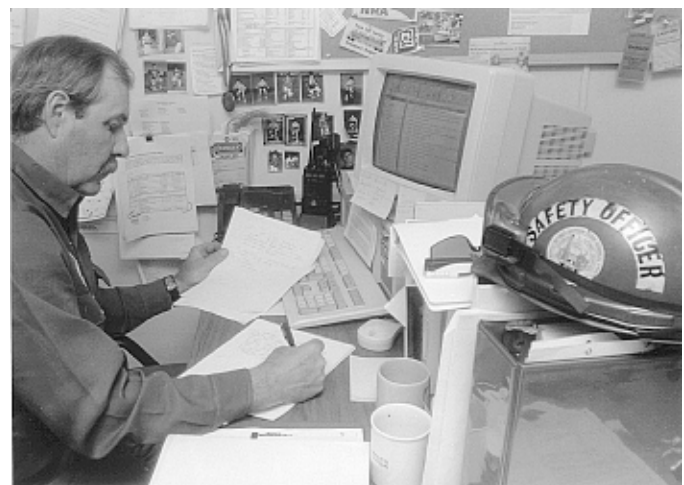
Industrial Engineers, Including Health and Safety

(O*NET 17-2111.01, 17-2111.02, 17-2111.03, 17-2112.00)

Nature of the Work

Industrial engineers determine the most effective ways for an organization to use the basic factors of production—people, machines, materials, information, and energy—to make a product or to provide a service. They are the bridge between management goals and operational performance. They are more concerned with increasing productivity through the management of people, methods of business organization, and technology than are engineers in other specialties, who generally work more with products or processes. Although most industrial engineers work in manufacturing industries, they also work in consulting services, healthcare, and communications.

To solve organizational, production, and related problems most efficiently, industrial engineers carefully study the product and its requirements, use mathematical methods such as operations research to meet those requirements, and design manufacturing and information systems. They develop management control systems to aid in financial planning and cost analysis, design production planning and control systems to coordinate activities and ensure product quality, and design or improve systems for the physical distribution of goods and services. Industrial engineers determine which plant location has the best combination of raw materials availability, transportation facilities, and costs. Industrial engineers use computers for simulations and to control various activities and devices, such as assembly lines and robots. They also develop wage and salary administration systems and job evaluation programs. Many industrial engineers move into management positions because the work is closely related.



Health and safety engineers anticipate and evaluate hazardous conditions and develop hazard control methods.

The work of health and safety engineers is similar to that of industrial engineers in that they are concerned with the entire production process. They promote worksite or product safety and health by applying knowledge of industrial processes, as well as mechanical, chemical, and psychological principles. They must be able to anticipate and evaluate hazardous conditions as well as develop hazard control methods. They also must be familiar with the application of health and safety regulations.

Employment

Industrial engineers, including health and safety, held about 198,000 jobs in 2000. More than 65 percent of these jobs were in manufacturing industries. Because their skills can be used in almost any type of organization, industrial engineers are more widely distributed among manufacturing industries than are other engineers.

Their skills can be readily applied outside manufacturing as well. Some work in engineering and management services, utilities, and business services; others work for government agencies or as independent consultants.

Job Outlook

Despite industrial growth and more complex business operations, overall employment of industrial engineers, including health and safety, is expected to grow more slowly than the average for all occupations through 2010, reflecting greater use of automation in factories and offices. Employment of industrial engineers is expected to grow more slowly than average while health and safety engineers are expected to grow about as fast as average.

Because the main function of industrial and health and safety engineers is to make a higher quality product as efficiently and as safely as possible, their services should be in demand in the manufacturing sector as firms seek to reduce costs and increase productivity. There also is an increased demand for industrial engineers within the financial services sector, as more emphasis is put on information technology. Also, the growing concern for health and safety within work environments should increase the need for health and safety engineers.

Earnings

Median annual earnings of industrial engineers were \$58,580 in 2000. The middle 50 percent earned between \$47,530 and \$71,050. The lowest 10 percent earned less than \$38,140, and the highest 10 percent earned more than \$86,370. Median annual earnings in the manufacturing industries employing the largest numbers of industrial engineers in 2000 were:

Motor vehicles and equipment	\$63,010
Electronic components and accessories	62,560
Computer and office equipment	62,260
Computer and data processing services	60,510
Aircraft and parts	58,290

Median annual earnings of health and safety engineers were \$54,630 in 2000. The middle 50 percent earned between \$44,230 and \$67,500. The lowest 10 percent earned less than \$34,710, and the highest 10 percent earned more than \$82,320. In 2000, the median annual earnings of health and safety engineers in railroads were \$56,970.

According to a 2001 salary survey by the National Association of Colleges and Employers, bachelor's degree candidates in industrial engineering received starting offers averaging about \$48,320 a year; master's degree candidates averaged \$56,265 a year; and Ph.D. candidates were initially offered \$59,800.

Sources of Additional Information

For further information about industrial engineers, contact:

► Institute of Industrial Engineers, Inc., 25 Technology Park/Atlanta, Norcross, GA 30092. Internet: <http://www.iienet.org>

General information about safety engineers is available from:

► American Society of Safety Engineers, 1800 E Oakton St., Des Plaines, IL 60018-21. Internet: <http://www.asse.org>

Information about certification of safety professionals, including safety engineers, is available from:

► Board of Certified Safety Professionals, 208 Burwash Ave., Savoy, Illinois 61874-957. Internet: <http://www.bccsp.org>

(See introduction to the section on engineers for information on working conditions, training requirements, and other sources of additional information.)

Materials Engineers

(O*NET 17-2131.00)

Nature of the Work

Materials engineers are involved in the extraction, development, processing, and testing of the materials used to create a diversity of products, from computer chips and television screens to golf clubs and snow skis. They work with metals, ceramics, plastics, semiconductors, and combinations of materials called composites to create new materials that meet certain mechanical, electrical, and chemical requirements. They also are involved in selecting materials for new applications.

There are numerous new developments within materials engineering that make it possible to manipulate and use materials in various ways. For example, materials engineers have developed the ability to create and then study materials at an atomic level using advanced processes, electrons, neutrons, or x-rays and to replicate the characteristics of materials and their components with computers.

Materials engineers specializing in metals can be considered *metallurgical engineers*, while those specializing in ceramics can be considered *ceramic engineers*. Most metallurgical engineers work in one of the three main branches of metallurgy—extractive or chemical, physical, and process. Extractive metallurgists are concerned with removing metals from ores and refining and alloying them to obtain useful metal. Physical metallurgists study the nature, structure, and physical properties of metals and their alloys, and relate them to the methods of processing them into final products. Process metallurgists develop and improve metalworking processes such as casting, forging, rolling, and drawing. Ceramic engineers develop ceramic materials and the processes for making ceramic materials into useful products. Ceramics include all non-metallic, inorganic materials that generally require high temperatures in their processing. Ceramic engineers work on products as diverse as glassware, automobile and aircraft engine components, fiber-optic communication lines, tile, and electric insulators.

Employment

Materials engineers held about 33,000 jobs in 2000. Because materials are building blocks for other goods, materials engineers are widely distributed among manufacturing industries. In fact, 84 percent of materials engineers worked in manufacturing industries, primarily metal production and processing, electronic and other electrical equipment, transportation equipment, and industrial machinery and equipment. They also worked in services industries such as engineering and management and research and testing services. Most remaining materials engineers worked for Federal and State governments.