

Eugene J. Hall

English For Careers

The Language of Mechanical Engineering in English



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Regents Publishing Company, Inc.

Illustrations by Bernie Case

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of Roy Hughson.*

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FOREWORD

This book is one of a series of texts called *English for Careers*, intended to introduce students of English as a foreign language to a number of different professional and vocational fields. The career areas that are covered are those in which English is widely used throughout the world; these include air travel, computer programming, international commerce, or in the case of this book, engineering and specifically mechanical engineering.

Each book in the series serves a dual purpose: to give the student an English introduction to a particular vocational area in which he or she is involved and to improve the student's use of English as a foreign language. This book is not a detailed training manual. It is a broad introduction to the language and terminology of mechanical engineering.

From the point of view of learning English as a foreign language, *English for Careers* books are intended for a student at the high intermediate or advanced level—one who is acquainted with most of the structural patterns of English. The principal goals of the learner should be mastering vocabulary, using language patterns, and improving his or her ability to communicate naturally in English.

These books are helpful with all of these needs. Each lesson begins with a glossary of special terms in which words and expressions used in the specific vocation are discussed and defined. The special terms are followed by a vocabulary practice section in which questions and answers help the reader use these terms. Then these terms are used again within a contextual frame of reference. Each section is followed by questions for discussion which give the opportunity to use both special terms and structural patterns.

Each lesson ends with a review section in which some of the exercises pose problems which occur when actually working in the field.

In this book, the student is asked to identify different types of machine components and explain their characteristics or to describe key features of the engines that have acted as power sources since the Industrial Revolution. Doing such exercises is excellent practice in the specialized vocabulary, general vocabulary, and structural patterns of the English language.

Much successful language learning is not conscious. In offering these books, it is hoped that the student's interest in the career will enhance his or her ability to communicate fluently in English.

EUGENE J. HALL
Washington, D.C.

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UNIT ONE

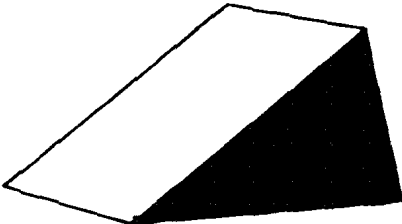
THE ENGINEERING PROFESSION

Special Terms

Engineering: The application of scientific principles to practical ends. An *engineer* is a member of the engineering profession, though the term also refers to people who operate or maintain certain kinds of equipment—a locomotive engineer on a railroad for example. In the latter use, the person referred to is a highly trained technician rather than a professional engineer.

Empirical Information: Information that is based on observation and experience rather than on theoretical knowledge.

Wedge: A triangular-shaped piece of material with one very acute angle. It is one of the simple basic machines used for tightening or levering.



A wedge.



An inclined plane.

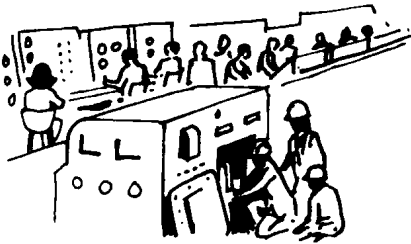
Inclined Plane: A surface at an angle less than 90° from the horizontal. It is another simple or basic machine used to raise or lower a load by rolling or sliding.

Quantification: Giving numerical values to information.

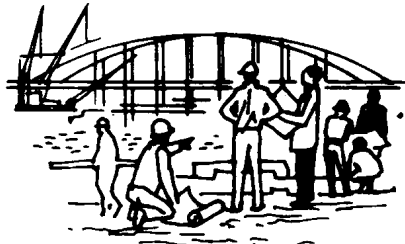
Horsepower: A measure used in the English-speaking countries for the work performed by a machine. It was devised in the eighteenth century by James Watt and equals 33,000 foot-pounds per minute.

Mechanical Advantage: The ratio of the output force of a machine to the input force necessary to work the machine.

Mechanical Engineering: The branch of engineering that deals with machines and their uses. *Industrial engineering* is a branch of this field that deals with the use of machines in industrial environments such as factories.



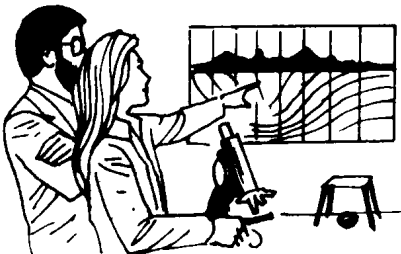
A mechanical engineer.



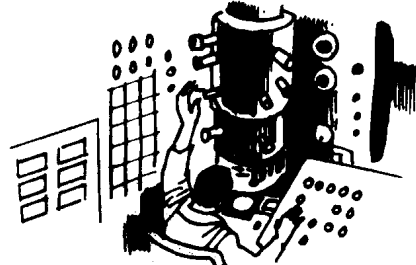
A civil engineer.

Civil Engineering: The branch of engineering that deals with the design and building of structures intended to be stationary—buildings, dams, and bridges, for example.

Mining and Metallurgy: The branch of engineering that deals with extracting materials from the earth and refining them.

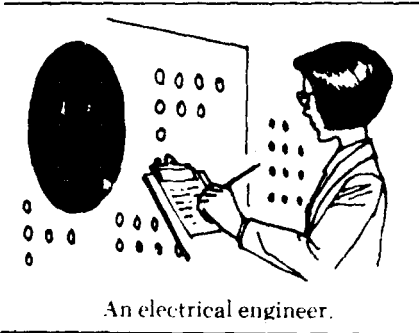


A mining engineer.

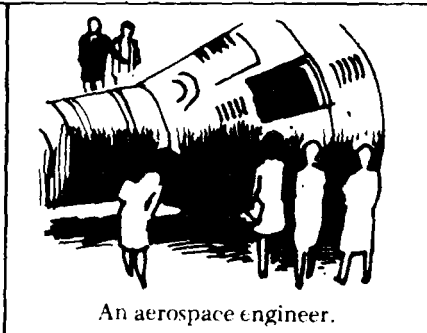


A chemical engineer.

Chemical Engineering: The branch of engineering that deals with processes involving reactions among the elements, the basic natural substances. *Petroleum engineering* deals specifically with processes involving petroleum.



An electrical engineer.



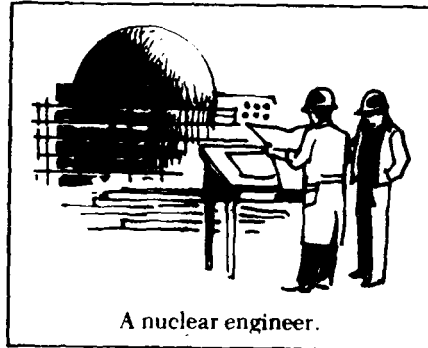
An aerospace engineer.

Electrical and Electronic Engineering: The branch of engineering that deals with the effects and processes resulting from the behavior of tiny particles of matter called electrons.

Aerospace Engineering: A branch of engineering that deals with flight in the earth's atmosphere or in space.

Nuclear Engineering: A modern branch of engineering that deals with the processes resulting from the break-up of some particles of matter.

Systems Engineer: An engineer who coordinates the work of other engineers from different disciplines who are involved in one project.



A nuclear engineer.

Profession: An occupation such as law, medicine or engineering which requires specialized education at the university level.

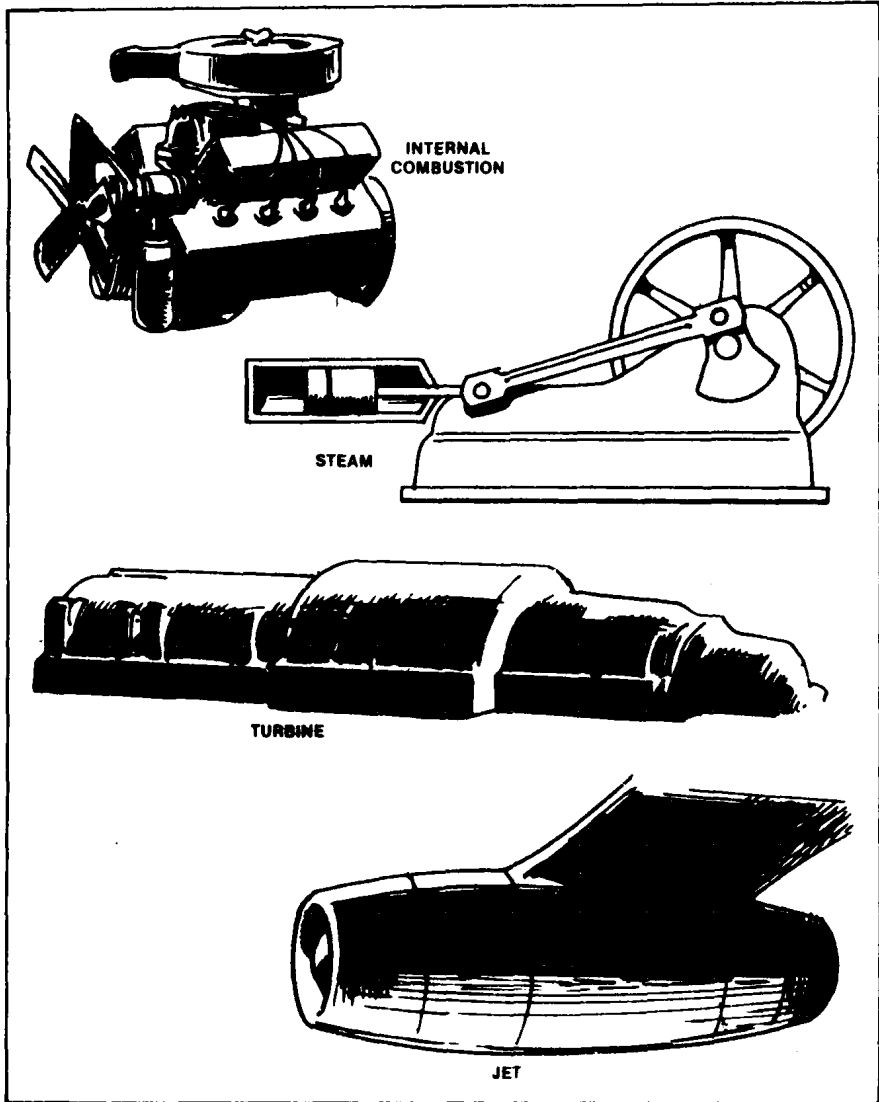
Vocabulary Practice

1. What does *engineering* mean?
2. What is *empirical information*?
3. What is a *wedge*? What is it used for?

4. What is an *inclined plane*? What can it do?
5. What does *quantification* mean?
6. What is *horsepower*? When and by whom was the term devised? What does it equal?
7. What is *mechanical advantage*?
8. What does a *mechanical engineer* deal with?
9. What is a branch of *mechanical engineering*? What is it concerned with?
10. What does a *civil engineer* deal with?
11. What does a *mining and metallurgical engineer* deal with?
12. What does a *chemical engineer* deal with? Name a branch of chemical engineering.
13. What does an *electrical and electronic engineer* deal with?
14. What does an *aerospace engineer* deal with?
15. What does a *nuclear engineer* deal with?
16. What does a *systems engineer* do?
17. What is a *profession*? Give some examples.
18. How does a *locomotive engineer* differ from a *professional engineer*?

The Engineering Profession

Engineering is one of the oldest occupations in history. Without the skills included in the broad field of engineering, our present-day civilization never could have evolved. The first



Some common machines.

toolmakers who chipped arrows and spears from rock were the forerunners of modern mechanical engineers. The craftsmen who discovered metals in the earth and found ways to refine and use them were the ancestors of mining and metallurgical engineers. And the skilled technicians who devised irrigation systems and erected the marvelous buildings of the ancient world were the civil engineers of their time. One of the earliest great names in history is

that of Imhotep, designer of the stepped pyramid at Saqqarah in Egypt, built in the twenty-seventh century B.C.

Engineering is often defined as making practical application of theoretical sciences such as physics and mathematics. Many of the early branches of engineering were based not on science but on *empirical information* that depended on observation and experience rather than on theoretical knowledge. Those who devised methods for splitting the massive blocks that were needed to build Stonehenge in England or the unique pyramids of Egypt discovered the principle of the *wedge* by trial and error rather than by mathematical calculations. The huge blocks of stone for the pyramids were probably raised into place by means of ramps of earth that surrounded the structures as they rose; it was a practical application of the *inclined plane*, even though the concept was not understood in terms that could be quantified or expressed mathematically.

Quantification has been one of the principal reasons for the explosion of scientific knowledge since the beginning of the modern age in the sixteenth and seventeenth centuries. Another important factor has been the development of the experimental method to verify theories. Quantification involves putting the data or pieces of information resulting from experimentation into exact mathematical terms. It cannot be stressed too strongly that mathematics is the language of modern engineering.

The great engineering works of ancient times were constructed and operated largely by means of slave labor. After the fall of the Roman Empire there were fewer slaves available in Europe. During the Middle Ages people began to seek devices and methods of work that were more efficient and humane. Wind, water, and animals were used to provide energy for some of these new devices. This kind of experimentation eventually led to what is known as the Industrial Revolution which began in the eighteenth century. First steam engines and then other kinds of machines took over more and more of the work that had previously been done by human beings or by animals. James Watt, one of the key figures in the early development of steam engines, devised the concept of *horsepower* to make it easier for his customers to understand the amount of work his machines could perform.

Since the nineteenth century both scientific research and practical application of its results have escalated. The mechanical

engineer now has the mathematical ability to calculate the *mechanical advantage* that results from the complex interaction of many different mechanisms. He or she also has new and stronger materials to work with and enormous new sources of power. The Industrial Revolution began by putting water and steam to work; since then machines using electricity, gasoline, and other energy sources have become so widespread that they now do a very large proportion of the work of the world.

One result of the rapid expansion of scientific knowledge was an increase in the number of engineering specialties. By the end of the nineteenth century not only were *mechanical*, *civil*, and *mining and metallurgical engineering* established but the newer specialties of *chemical* and *electrical engineering* emerged. This growth in the number of specialties is continuing with the establishment of such disciplines as *aerospace*, *nuclear*, *petroleum*, and *electronic engineering*. Many of these are subdivisions of earlier specialties—for example, electronic from electrical engineering or petroleum from chemical. Within the field of mechanical engineering the major subdivision is *industrial engineering* which is concerned with complete mechanical systems for industry rather than individual machines.

Because of the large number of engineering fields today there are often many different kinds of engineers working on large projects such as the development of nuclear power or new aircraft. In the design of a new aircraft mechanical engineers work not only on the plane's engines but on other mechanical aspects such as the braking system. When the aircraft goes into production mechanical and industrial engineers are involved in designing the *machines* necessary to fabricate the different parts as well as the *entire system* for assembling them. In both phases of such a project mechanical engineers work with specialists in fields such as aerospace and electronic engineering. Each engineer is a member of a team often headed by a *systems engineer* able to combine the contributions made by all the different disciplines.

Another result of the increase of scientific knowledge is that engineering has become a *profession*. A profession is an occupation like law or medicine that requires specialized advanced education; such occupations are often called the "learned professions." Until the nineteenth century engineers were for the most part craftsmen or project organizers who learned their skills through appren-

ticeship, on the job training, or simply by trial and error. Today it requires at least four or five years of university study leading to a Bachelor of Science degree. More and more often engineers, especially those engaged in research, get an advanced master's or doctor's degree. Even those engineers who do not study for advanced degrees must keep up with changes in their profession and those related to it. A mechanical engineer who does not know about new materials cannot successfully compete with one who does. All of this means that an engineer's education is never really finished so he or she must be willing to continue the learning process.

The word engineer is used in two senses in English. One, as just indicated, refers to the professional engineer who has a university degree and an education in mathematics, science, and one of the engineering specialties. Engineer, however, is also used to describe a person who operates or maintains an engine or machine. An excellent example of this is the locomotive engineer who operates a train on a railroad. Engineers in this sense are essentially highly-trained technicians rather than professional engineers as the term is used in this book.

The systems that engineers produce must be workable not only from a technical but also from an economic point of view. This means that engineers work with management and government officials who are cost-conscious so the engineer must accommodate his or her ideas to the financial realities of the particular project.

The public has become much more aware, especially in the last decade, of the social and environmental consequences of engineering projects. For much of the nineteenth and twentieth centuries, the public attitude could be summed up in the phrase "Science is good," and the part of science that was most visible was the engineering work that made scientific knowledge useful. Countless cars and other mechanical devices are part of our engineered environment.

Today, however, people are more conscious of the hidden or delayed hazards in products and processes. The automobile is a typical example. No one disputes its convenience but many are also aware of the air pollution it causes and the amount of energy it consumes. Engineers are working to solve these problems by designing devices that reduce pollution and improve fuel efficiency.

The engineer, then, does not work in a scientific vacuum but must take into account the social consequences of his or her

work. Engineering is described as a profession that finds practical application of theoretical science. A successful engineer must enlarge the definition of *practical* to include the idea that the work is safe and desirable for society.

Discussion

1. Who were the forerunners of modern mechanical, mining and metallurgical, and civil engineers?
2. What is one of the earliest names we know in relation to building?
3. How is engineering often defined?
4. What kind of information were many of the early branches of engineering based on? Give some examples.
5. Name two important factors in the explosion of scientific knowledge in modern times.
6. What made people in the Middle Ages in Europe begin to experiment with new devices and methods of work?
7. What was the historical result of experimentation with different kinds of energy?
8. Who was James Watt? Why did he devise the concept of horsepower?
9. What advantages have scientific research and its applications given to the mechanical engineer?
10. What energy sources have come into common use since steam engines were developed at the beginning of the Industrial Revolution?

11. By the end of the nineteenth century, what engineering specialties were developed?
12. What are some other engineering specialties that have become established since then?
13. What is the major subdivision within the field of mechanical engineering?
14. Why do many different kinds of engineers often work on a single project? Give an example.
15. Who is often the head of a project where different kinds of engineers are working together?
16. What has made engineering one of the learned professions?
17. How has the education of an engineer changed since the nineteenth century?
18. Why does an engineer need constant new learning?
19. How do the two meanings of the word *engineer* differ from each other? How will the word *engineer* be used in this book?
20. Discuss two ways in which the systems that engineers produce must be workable.
21. How has the attitude of the general public recently changed toward engineering projects?
22. The automobile is a typical example of the public's divided attitude toward engineering projects. Discuss this.
23. What are engineers working on in connection with this problem?
24. What concept must an engineer include in his or her definition of *practical*?