Chapter 1

Introduction to Contemporary Drafting

Objectives

The student will be able to:

- relate the historical development of drafting
- state the importance and need for drafting as a technical communication skill
- identify the roles and responsibilities of various drafting specialists
- state how drafting is used in different fields as the major source of communication
- recognize the levels of education, training, and experience required for the various drafting positions

History

Drawings have been used throughout history as an art form and a method of communication. Early humans drew crude pictures of animals on cave walls **(Fig. 1-1)**, and by 4000 B.C., stone tablet drawings **(Fig. 1-2)** were used to show the outline of structures. By 2000 B.C., drawings were prepared on parchment. Around 1000 to 500 B.C., detailed construction drawings were widely used. The Egyptian pyramids, the Greek Parthenon, and the Roman Coliseum are examples of structures designed and constructed with detailed drawings on parchment **(Fig. 1-3)**.

Figure 1-1
Early humans drew crude pictures on cave walls.

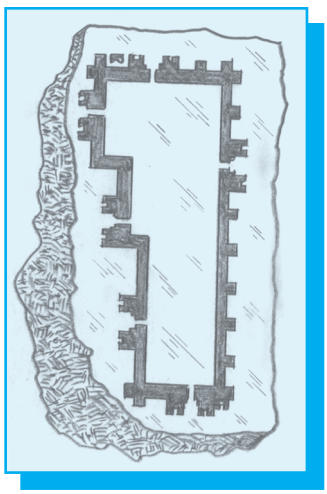

Figure 1-2
By 4000 B.C. stone tablets were being used to define the outline of fortifications.

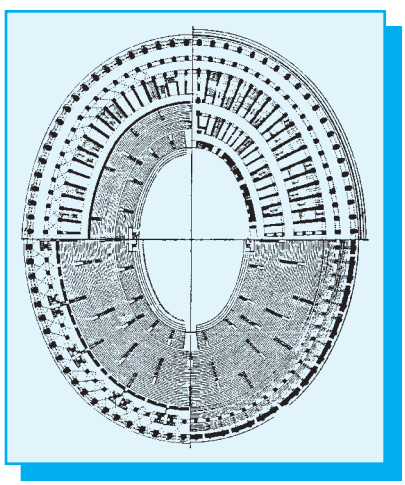

Figure 1-3
Detailed construction drawings were used to build the Egyptian pyramids, the Greek Parthenon, and the Roman Coliseum.

By the first century A.D., Romans were using detailed and dimensioned drawings as guides in building their structures, roadways, and aqueducts. It was not until the fifteenth century that two-dimensional working drawings were used for product drawings. An example is Leonardo da Vinci's sketch in **Figure 1-4**. Can you tell what his invention will do from his five hundred-year-old sketch?

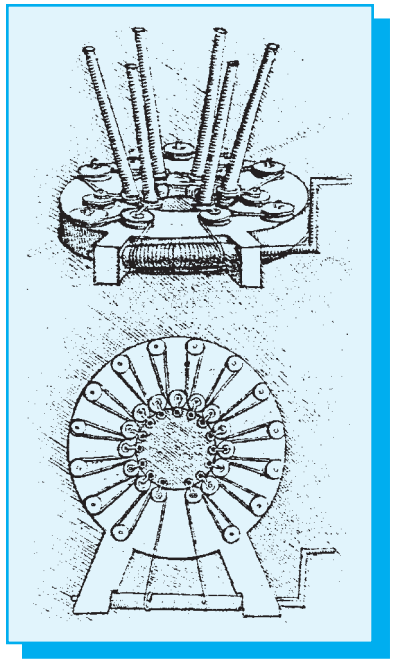

Figure 1-4
Leonardo da Vinci used pictorial and two-dimensional working drawings to develop his inventions. Can you figure out what this one will do?

Today's Drafters

Today's drafters must possess a broad understanding of the drafting knowledge and skills covered in this text. In addition, drafters must gain specific knowledge of the manufacturing methods and standards practiced in the industry in which they work. Regardless of the level of responsibility or the drafting specialization, all drafters must:

- understand the basics of drafting and design.
- communicate ideas with freehand sketches.
- use conventional drafting instruments quickly and clearly.
- use computer-aided drafting and design systems.

There are now nearly one million women and men working in drafting, design, and related positions. As more products are developed and manufactured, and more buildings are designed and constructed, the need for personnel with high levels of drafting skills and knowledge will continue to increase.

Today's Industries

In today's advancing technologies we are continually improving existing industries and creating new ones. All industries will require some degree of graphic representation for manufacturing, assembly, maintenance, and sales. A few of the major industries are: aerospace **(Fig. 1-5)**, passenger airlines **(Fig. 1-6)**, architectural and structural

Figure 1-5
A flight with the space shuttle *(National Aeronautics and Space Adminstration)*

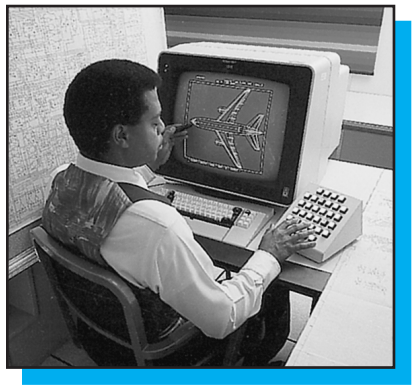

Figure 1-6
A well-designed passenger airliner *(Lockheed Martin)*

engineering **(Fig. 1-7)**, construction **(Fig. 1-8)**, defense **(Fig. 1-9)**, nuclear **(Fig. 1-10)**, petroleum **(Fig. 1-11)**, robotics **(Fig. 1-12)**, sporting goods **(Fig. 1-13)**, and transportation **(Fig. 1-14)**.

The Language of Drawing

Humans now routinely communicate with each other through the use of verbal sounds, written words, body movements, and many types of drawings. Written, verbal, or body language is very effective in communicating personal and social ideas or emotions. Only drawings are effective in describing the precise size and shape of objects. To illustrate this point, verbally describe the helicopter in **Figure 1-15** to a friend. Now show the picture to your friend. How good was your verbal description? This exercise should clearly illustrate the old Chinese proverb, "A picture is worth a thousand words."

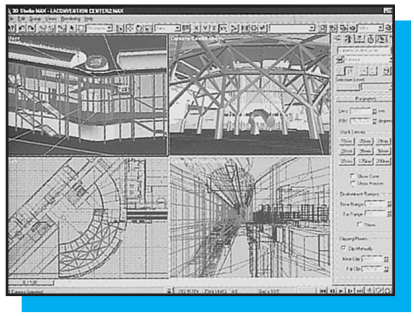

Figure 1-7
Computer-generated architectural drawings
(Courtesy and copyright of Autodesk, Inc.)

Figure 1-8
Construction industry

Figure 1-9
Product of the defense industry
(Courtesy of McDonnell Douglas Corp.)

Figure 1-10
Nuclear industry

Figure 1-11
Petroleum industry

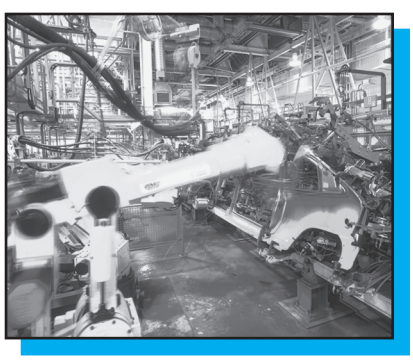

Figure 1-12
Robotics industry

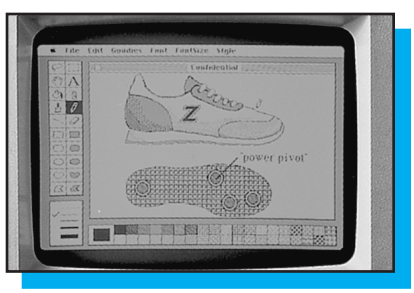

Figure 1-13
Sporting goods industry
(Courtesy of Apple Computer)

The Graphic Creators

Because each industry is highly specialized, the drafters in each industry must have the knowledge to correctly design and draw each part for manufacture. The personnel involved with designing and producing the working drawings may be placed into three general categories depending on their formal education, knowledge, creativity, experience, and work ethics. These categories are top-level professionals, mid-level drafters, and intern-level drafters.

Figure 1-14
Transportation industry

Figure 1-15
"A picture is worth a thousand words."

Top-Level Professional

This position requires a college degree (B.A., M.A., or Ph.D.) and often a state license in a specialty. These people have the responsibility for successful operations. That is why they draw the largest salaries. Following is a brief description of several professional positions:

The **aeronautical engineer** performs a variety of work with research, planning, designing, and testing of airplanes, satellites, and rockets.

The **architect** does the planning, designing, structural engineering, and supervising of construction for all types of structures.

The **cartographer** designs and produces all types of maps.

The **civil engineer** does the planning, designing, and supervising for roads, airports, harbors, dams, tunnels, and most construction systems that are not inhabited buildings.

The **chemical engineer** plans the research to develop new and improved chemical manufacturing processes and production procedures.

The **developmental engineer** does the data research for the development of new ideas and new products.

The **electrical engineer** does the planning, designing, and supervising of the manufacturing of electrical and electronics components, equipment, and systems.

The **industrial designer** is a creative person who will use new ideas and materials to design a functional and attractive external package for all industrial items.

The **industrial engineer** or **mechanical engineer** works in all areas of industry, applying math and physics to a design so it will function properly and safely.

The **instructor of drafting** is a rewarding job for people who enjoy working with and helping others. Positions in secondary schools, technical schools, colleges, and universities are open to people with degrees, teaching credentials, and industrial drafting experience.

The **project coordinator** is a very talented person who is versed in most of the engineering, designing, and manufacturing processes. This person will coordinate all the engineers, designers,

drafters, manufacturing, and assembly for a smooth process and troubleshoot any problems that may arise.

The **drafting/engineering supervisor** coordinates all the workers involved with the production of all the working drawings for specific projects. It is his or her responsibility to get well-designed and error-free working drawings finished on schedule.

The **tool designer** plans and designs the tools used to produce the manufacturing systems, machinery, and tools for all areas of industrial production.

Mid-Level Drafters

These are the technicians. They have a very broad and diversified job classification depending on their education, knowledge, creativity, drafting skills, and attitudes. They are classified as semi-professionals. Most will be supervised by the top-level professionals. Some technicians, even though they do not have a college degree, are highly capable and may perform the top-level job requirements, but they will not reach the top salary levels. It is recommended that they have an A.A.S. degree from a two-year college.

The **checker** is an experienced drafter whose responsibility is to see that all the drafter's working drawings are properly drawn and are error-free. This is critical, because correcting an error during production is very expensive.

The **chief drafter/senior drafter** will supervise the drafting personnel and set the parameters for the standards, practices, schedules, and drawing procedures for the project's set of working drawings.

The **commercial artist** prepares attractive illustrations for magazines, books, posters, and so on, to help promote recognition and sales of the manufactured item.

The **design technician** combines design skills and drafting ability, usually working from the top-level designer's sketches.

The **senior detailer** is skilled in understanding the engineer's concepts and can produce the complex working drawings needed for manufacture.

The **technical illustrator** creates three-dimensional drawings from the working drawings. The drawings are used to view a complicated part for better understanding **(Fig. 1-16)** or to show an exploded drawing of a part to simplify its assembly.

Intern-Level Drafters

This position usually does not have a formal education requirement but receives on-the-job training. Interns may advance to technician levels depending on their abilities. Many engineers and technicians will have interns working with them.

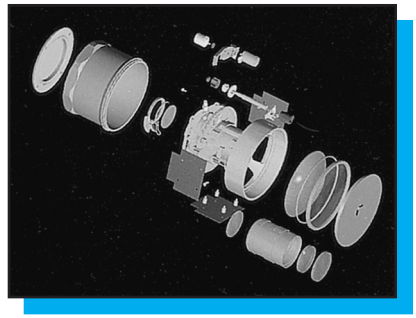

Figure 1-16
Example of technical illustration of a turbofan engine
(Courtesy and copyright of Autodesk, Inc.)

The **computer-aided drafting operator** has a skill that is important for all designers and drafters. It is an asset in gaining employment and advancement in the workplace.

The **junior detailer** prepares working drawings from the sketches of the senior detailer and corrects drawing errors marked by the checker.

The **junior drafter** must have good manual drafting and lettering skills and be trainable on a computer-aided drafting (CAD) system. He or she starts with simple working drawings and is closely supervised.

The **printing operator** makes reproductions of working drawings on various equipment such as copy machines, cameras, diazo printers, and printing presses. Copies are then stored, filed, and/or distributed to assigned places.

The **tracer** is the starting entry level. This job requires good drafting and lettering skills because it involves copying or recopying sketches or quick drawings from engineers and designers who did not take the time to do a neat drawing.

The Design Process

The design process and the personnel involved in each industry will vary considerably, but the goal of an efficient product remains the same. A typical process may be:

1. Recognition of Needs
2. Scientific Investigation
3. Proposal of Concept
4. Layout and Development Drawings
5. Conceptual Design Reviews and Analysis
6. Component Testing of Prototype
7. Final Design Review
8. Detail Design
9. Quality Assurance
10. Manufacturing
11. Assembly
12. Installation
13. Final Testing
14. Operation
15. Planning for the Second-Generation Upgrade

An example of the design process for an automobile is shown in **Figures 1-17a** through **1-17d**.

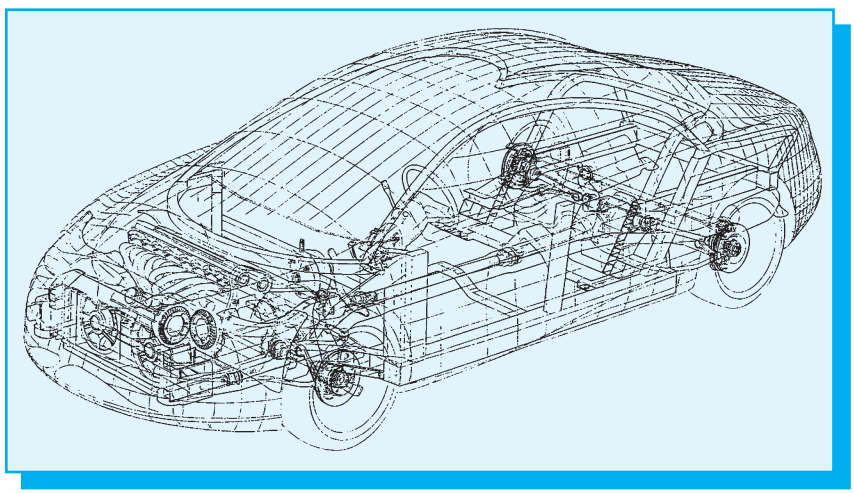

Figure 1-17a
CAD-generated design

Drafting Today

Drafting is the universal language of industry and construction. Through the use of standardized symbols and engineering drawing conventions, the drawings help overcome international language barriers by describing manufactured products, buildings, and processes without verbal communication. Drawings are now the primary method of communication between designers and manufacturers, architects and builders, engineers and production personnel, and advertisers and their customers.

When used to show the material, size, and shape of a product, a drawing is known as a *technical working drawing*. All manufactured products of structures, regardless of size, must start with a working drawing. The design and manufacture of any product, no matter how simple or small, still requires a working drawing **(Fig. 1-18)**. Larger and more complex products may require hundreds or thousands of working drawings if they are to be properly manufactured. Each step of the manufacturing process must be specified. There must be no guesswork or redesigning during the manufacturing process.

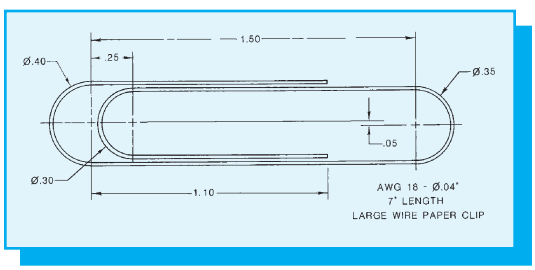

Figure 1-18
The design and manufacture of a simple paper clip requires technical working drawings.

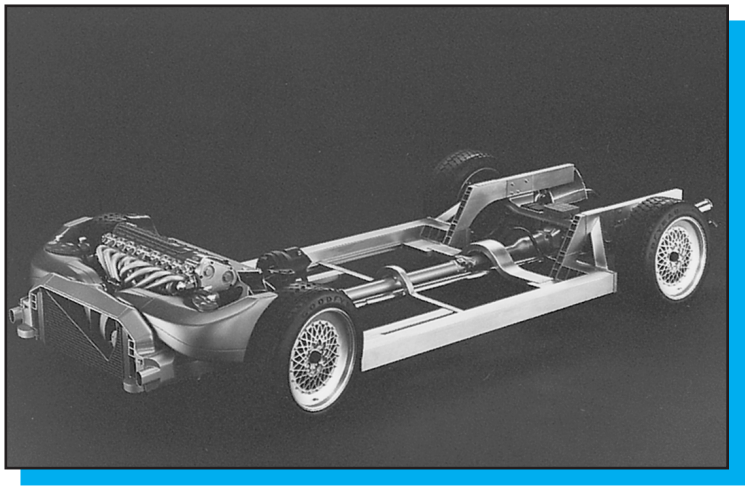

Figure 1-17b Mechanical design phase
(Courtesy of Ford Motor Co.)

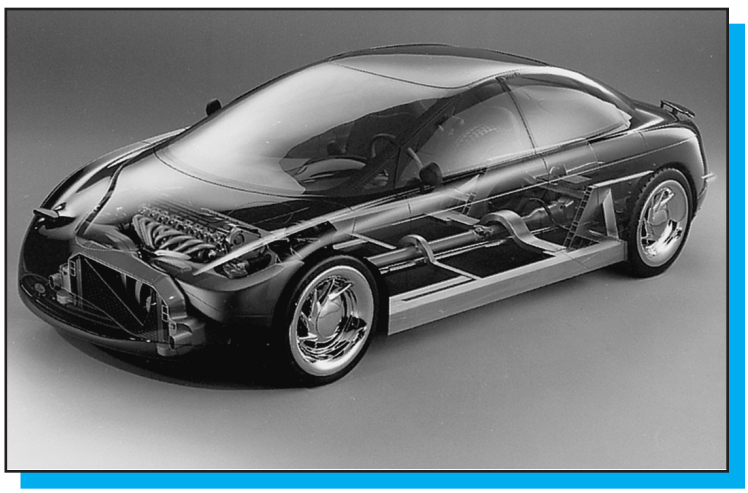

Figure 1-17c
Body design around the power drive
(Courtesy of Ford Motor Co.)

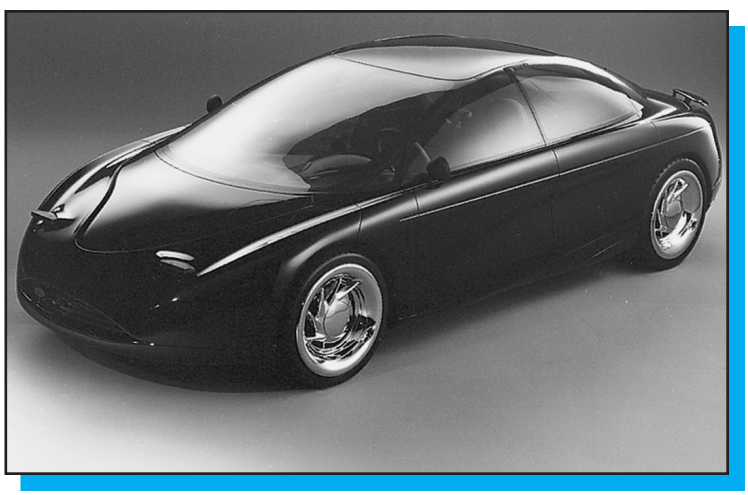

Figure 1-17d Design process completed
(Courtesy of Ford Motor Co.)

Types of Basic Engineering Graphics

Most of the aspects of engineering graphics (drawings) are common to all the industrial areas of drafting. The following types of drawings are used:

1. *Multiview drawings* are several views of the object drawn using orthographic projection. The complete shape of the item with all its details and dimensions must be shown in the drawing **(Fig. 1-19)**.

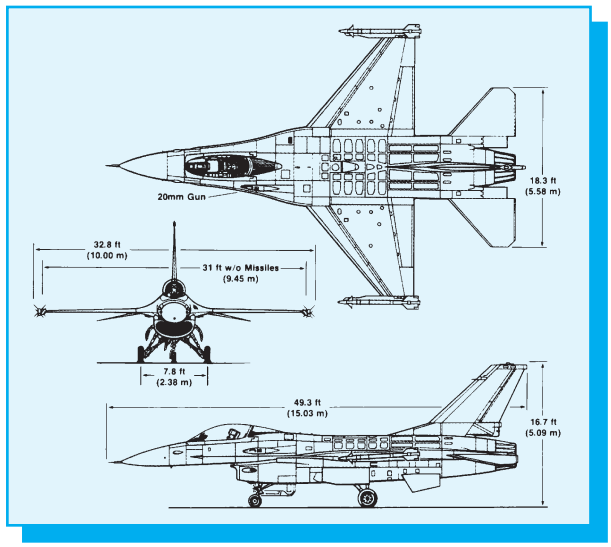

Figure 1-19
Multiview drawing for the F-16A aircraft
(Courtesy of General Dynamics)

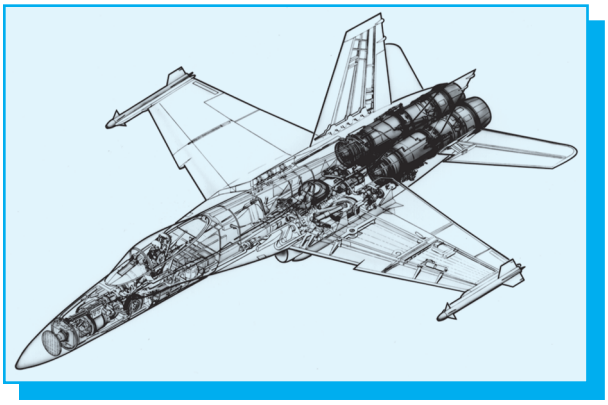

Figure 1-20
Pictorial cutaway of the F-16B aircraft
(Courtesy of General Dynamics)

2. *Pictorial drawings* show an object as in a photograph. Usually three adjacent surfaces are shown in one drawing **(Fig. 1-20)**.
3. *Schematic drawings and block diagrams* are used to show the flow of energy or work such as electricity or fluids **(Fig. 1-21)**.

Nearly every design process from the development of the ideas through the working drawings will use some degree of freehand sketching, manual drafting, and a CAD system for the creation of the multiview drawings, pictorial drawings, and schematics.

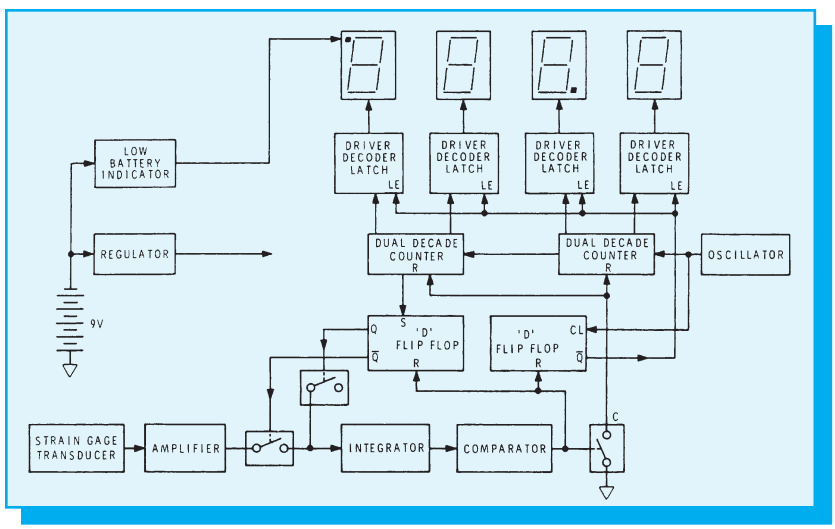

Figure 1-21
A block diagram schematic showing the electrical flow for a digital scale

Drafting Exercises

1. Pick one of the professional positions that you find the most interesting and write a short paper on the education, training, and type of work it involves.
2. Select one of the mid-level drafting positions that you find the most interesting and write a short paper on the education, training, and type of work it involves.
3. If you had to go to work directly from high school, what type of intern position would you prefer? Write a short paper on how you would apply for the internship.
4. Take a field trip to an industry with a CAD system. Watch a demonstration and interview the CAD operator. Take notes and write a short report on her or his background, education, training, and work performed on the CAD system.
5. Take a good look at the picture of the space shuttle **(Fig. 1-5)**. Try to list the personnel involved at each step of the design process described in this chapter.
6. Interview a college counselor and list the high school prerequisites needed for acceptance into an engineering school.
7. Interview a vocational or community college counselor and list the prerequisites needed for acceptance into a vocational training program.
8. Talk to your high school counselor about applying for a scholarship or an educational grant.
9. Practice writing a resumé to use to apply for an internship drafting position.

Key Terms

Aeronautical engineer
Architect
Computer-aided drafting operator
Cartographer
Checker
Civil engineer
Commercial artist
Design technician
Developmental engineer
Electrical engineer
Engineering supervisor
Industrial designer
Industrial engineer
Instructor of drafting
Junior detailer
Junior drafter
Mechanical engineer
Multiview drawings
Pictorial drawings
Printing operator
Project engineer
Schematic drawings
Senior detailer
Senior drafter
Technical illustrator
Technical working drawings
Tool designer
Tracer