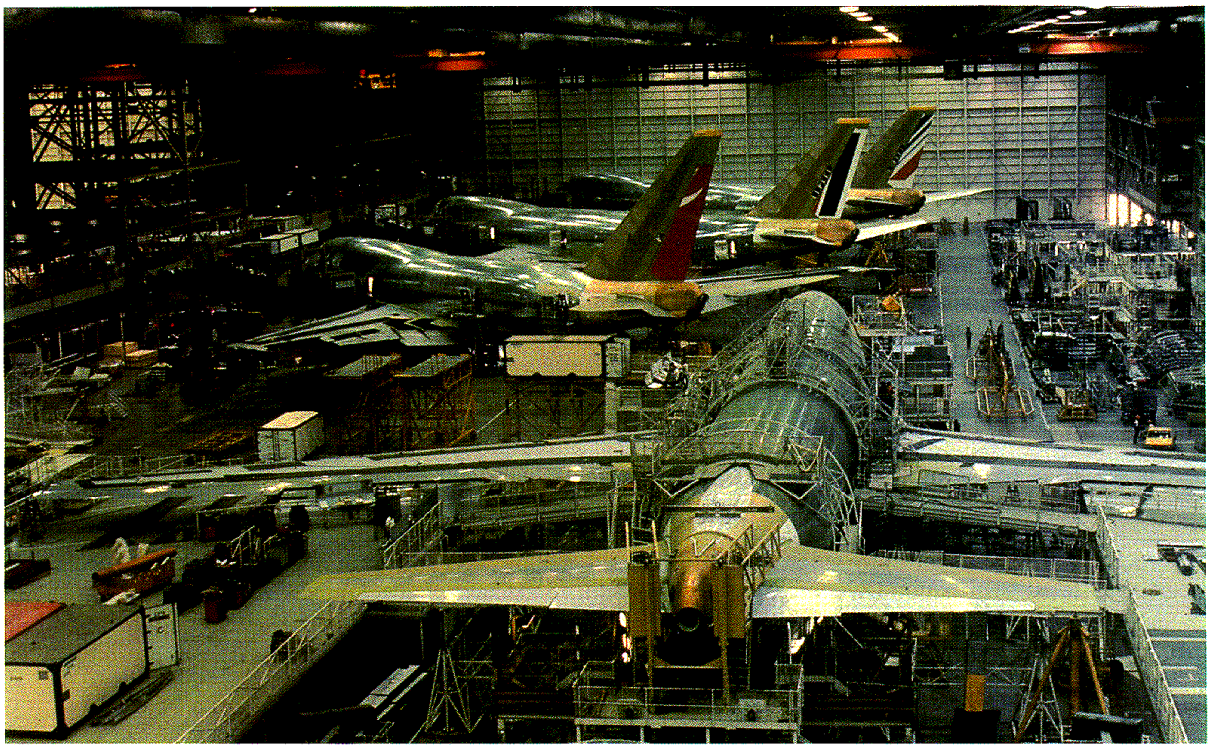
AVIATION CAREERS SERIES

AIRCRAFT MANUFACTURING



U S. Department of Transportation
Federal Aviation Administration

Office of Public Affairs
Aviation Education Program

PA 124-91

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INTRODUCTION

Aviation has progressed a long way since the 120-foot flight by Orville Wright on December 17, 1903, at Kitty Hawk, North Carolina, and since the first US airline began operating between Tampa and St. Petersburg, Florida, on January 1, 1914. Today supersonic aircraft fly routinely across the oceans, and more than two million people are employed in aviation, the aerospace and air transportation industries.

In response to its Congressional mandate, the Federal Aviation Administration, as part of its effort to plan for the future of air transportation, conducts an Aviation Education Program to inform students, teachers, and the public about the Nation's air transportation system.

Aviation offers many varied opportunities for exciting and rewarding careers. The purpose of this brochure, and others in the FAA Aviation Careers Series, is to provide information that will be useful in making career decisions. Publications in this series include:

1. Pilots & Flight Engineers
2. Flight Attendants
3. Airline Non-Flying Careers
4. Aircraft Manufacturing
5. Aviation Maintenance and Avionics
6. Airport Careers
7. Government Careers

There is also an overview brochure entitled "Your Career in Aviation: The Sky's the Limit," and a brochure entitled "Women in Aviation."

Free brochures may be obtained by sending a self-addressed mailing label with your request to: Superintendent of Documents, Retail Distribution Division, Consigned Branch, 8610 Cherry Lane, Laurel, MD 20707.

ACKNOWLEDGMENTS

The FAA wishes to thank Keith Connes, Barbara de Boinville, the Aerospace Industries Association, and Ed Leng of Hughes Aircraft for their contributions to this publication.

TABLE OF CONTENTS

Aviation Careers Series—Aircraft Manufacturing

GENERAL INFORMATION

The world would be vastly different without the airplane. We depend on it to transport people and goods, to explore, to search and rescue, to fight fires, and, of course, to defend our Nation and our allies.

Would you like to become involved in manufacturing aircraft —perhaps even designing the planes of the future? Aircraft manufacturing is a vital part of America's vast aerospace industry that also includes missiles, satellites, spacecraft, and navigation and guidance systems. There are four major aircraft manufacturing divisions: airframe, components, accessory and equipment, and engine.

The industry requires skilled scientists, engineers, technicians, production workers, and administrative and support activities personnel. Each of these five job categories will be discussed in this brochure.

Scientists and Engineers. Scientists and engineers must have knowledge or training that is equivalent to a four-year college education with a major in these areas. Scientific fields include aerodynamics, physics, mathematics, chemistry, physiology, metallurgy, cryogenics, meteorology, and avionics. An exciting new field of study concerns the uses of composites and ceramics in aircraft manufacturing.

Engineering fields include design, aerodynamics, avionics, instrumentation, manufacturing materials, weights and balance, field service, and flight test. College degrees are offered in aeronautical, aerospace, ceramic, chemical, civil, electronic, electrical, industrial, mechanical, metallurgical and nuclear engineering, engineering mechanics, and engineering physics. One out of five of the engineers in the aerospace industry has an aeronautical or aerospace engineering degree; the others received degrees in other disciplines.

The aerospace industry is one of the nation's primary employers of scientists and engineers for research and development. More than half of the industry's scientists and engineers are in research and development. The remainder are in production planning, quality control, tool designing, technical purchasing, technical sales and service, technical writing and illustrating, and related fields.

Technical areas of endeavor include aircraft and flight equipment, chemistry, communications, detection, electrical equipment, electronics and electronic equipment, fluid mechanics, fuels and combustion, ground transportation, equipment, installations and construction, materials (non-metallic), mathematics, metallurgy, military sciences and operations, navigation, nuclear propulsion, ordnance, personnel and training, physics, propulsion systems, and research and research equipment.

Technicians. This job category includes all persons engaged in work requiring knowledge of physical or life sciences, engineering, and mathematics. This knowledge can be acquired at technical institutes or junior colleges, or through other formal post-high-school training. Equivalent on-the-job training or experience may be acceptable. (Craft workers, such as machinists and electricians, are not included in the technicians job category.)

The fields of study for science technicians and engineering technicians are the same as those already mentioned above for scientists and engineers. Technicians also can be drafters or technical writers and illustrators. Examples of technicians titles are as follows: senior documentation analyst, software programmer, contracts administrator, technical illustrator, technical writer, supervisor of blueprint and microfilm files, tool designer, training equipment designer, drafter, research mechanic, research electrician, laboratory technician, electronics technician, and production planner.

Aircraft Manufacturing Employees. This job category includes working supervisors and all non-supervised workers engaged in fabricating, processing, assembling, inspecting, receiving, storing, handling, packing, warehousing, shipping, maintaining, and repairing aircraft. It also includes janitorial and guard services, product development, auxiliary production for a plant's own use, record keeping, and other services closely associated with the aforementioned operations.

Aircraft manufacturing employees can have a variety of occupations: sheet metal and other metal-processing work, composite fabrication, machinery and tool fabrication, assembly and installation, inspecting and testing (quality control), flight check-out, materials handling, and maintenance. Administrative and support activities personnel include executives responsible for direction and supervision of research and production; officials in departments such as sales, purchasing, personnel, accounting, public relations, advertising, and industrial relations; and secretaries, stenographers, typists, clerks, and tabulating machine operators.

Nature of the Work

Scientists, Engineers, and Technicians. Almost every branch of science and engineering is involved in the design and production of faster and more efficient aircraft and in the inflight operation and ground servicing of planes, their passengers and cargo. The mechanical and electrical equipment needed by the airlines is increasingly complex.

The challenge facing aircraft manufacturers today is to build planes that are more cost-effective. Jumbo jets are being replaced by somewhat smaller aircraft that are more fuel efficient and offer lower passenger seat/mile costs. Also needed are specialized aircraft for business and recreation purposes. All designs must provide improved safety factors and must address environmental considerations—especially noise reduction.

Professional scientists and engineers and semiprofessional technicians work in one of three major areas: (1) research, design, or development; (2) production, operation, or control; and (3) installation, maintenance, or sales engineering. The emphasis is on thinking and on team work--a coordinated effort by scientists, engineers and technicians.

Scientists are chiefly concerned with basic and applied research—-the search for scientific knowledge, new concepts, the extension of theory, and the practical applications of this knowledge and theory. Engineers normally have a definite goal in mind: namely, designing a specific piece of equipment so it will perform a specific task. Working closely with scientists and engineers, technicians concentrate on the practical aspects of using and testing equipment, not on the theory involved in building it. Technicians usually begin as trainees or in the routine positions under the direct supervision of an experienced technician, scientist, or engineer. As technicians gain experience, they receive more responsible assignments. The team of scientists, engineers, and technicians is concerned with all phases of the development of aircraft--from the initial planning and design to the final manufacturing and testing.

A little more than half of all aircraft manufacturing employees are production workers or “blue collar” workers. They fabricate, assemble, install, and test the many parts of a modem airplane. Other plant workers handle materials and provide maintenance and custodial services. These occupations range from highly skilled to semiskilled jobs.

Working Conditions

Scientists, engineers, and technicians work primarily indoors at a desk or in a laboratory. Some outdoor work may be necessary. Research and engineering departments are usually in modern, clean, and temperature controlled factory buildings. These departments are normally equipped with the latest electronic and mechanical instruments, drafting instruments, and laboratory apparatus.

Most administrative and support activities personnel also work in modern, clean, temperature-controlled of offices.

Aircraft Manufacturing employees work in departments such as riveting, metal-processing and welding. These areas are filled with the noise of metal cutting, riveting guns, and power tools. Employees engaged in composite fabrication have a quieter job since the substances they mold essentially begin as fabric. Resins are molded rather than stamped, shaped, and riveted. The loudest noise is often the whir of a hair dryer as it heats the fabric..

Some jobs generate fumes and odors. Assemblers often, work in hard-to-reach cramped spaces; they must stoop, kneel, crouch, and crawl to perform their tasks. Assembly, welding, and molding operations and mechanic and machine shop jobs require frequent lifting or carrying of heavy loads (up to 50 pounds) and medium loads (up to 25 pounds). Although there are some hazards, aviation plants are relatively safe working places: their injury frequency rate averages less than that for the manufacturing industry as a whole.

Where the Jobs Are

Almost every state has some aircraft manufacturing jobs. The largest concentration is in California. States with many jobs include New York, Washington, Connecticut, Texas, Florida, Ohio, Missouri, Pennsylvania, Massachusetts, Kansas, Alabama, Maryland, New Jersey, and Georgia.

Wages and Benefits

Scientists and Engineers. The median entry-level salary of a scientist or engineer is about $40,000 a year, with top pay escalating to about $93,000. Earnings are generally highest in the West, lowest in the South; the larger the city is, the better the pay Scientists and engineers generally begin their weekday between 6 and 9 a.m. and work an eight-hour day, or overtime as projects necessitate. Employers often pay scientists and engineers to attend seminars and meetings of professional societies. Some also pay the membership dues of these societies, as well as the tuition for classes and continued education in the employee’s field of expertise.

Average hourly pay for aircraft production workers ranges from about $17 to $19, depending on the type of work being performed.

Opportunities for Advancement

Scientists and Engineers. Promotion to senior scientist or senior engineer brings a pay increase. The chief advancement possibilities involve supervision and management positions and executive positions. The “team” or “project” approach to fulfilling objectives has increased the need for talented managers.

Technicians. A technician can advance to a professional position by getting more education or by performing well tasks normally assigned to professionals. Technicians also can be promoted to supervisory positions. Technicians who have a good working knowledge of the equipment produced by the company and who have the right personality for the job may become company sales persons, technical representatives, or troubleshooters.

Traditionally, skilled workers can advance to positions requiring higher skills and experience, such as foremen, inspectors, and supervisors. Educational opportunities are available to advance to semiprofessional positions. A possible advancement progression in engineering might be from assembler to quality control inspectors, to engineering technician to junior engineer, and finally to engineer. Union contracts normally require advancement of semiskilled workers to be based upon seniority of qualified individuals. By taking courses offered by the company or by vocational or technical schools in the community, semiskilled workers may prepare themselves for a skilled job, such as blueprint reading, welding or mechanic.

Administrative and Support Activities Personnel. Advancement in these areas is normally to similar positions with greater responsibilities and higher salaries.

Requirements to Enter the Job

The aircraft manufacturing industry seeks individuals with self-discipline, a willingness to accept responsibility, a sound foundation in technology, and team spirit. More and more women are pursuing careers in the industry. For example, at Beech Aircraft Corporation—a manufacturer primarily of corporate and military airplanes—women make up about 50 percent of the work force in the composites production area. About 30 percent of its metal-manufacturing, assembly-line jobs are held by women. And according to a Stanford University report, the University has seen an increase in the number of freshman women enrolling in engineering because of the excellent job prospects. More and more universities across the nation report similar increases.

Scientists and Engineers. A college degree in one of the sciences or in engineering is the minimum requirement for scientific or engineering jobs. Applicants frequently have advanced degrees. (Infrequently, someone with years of semiprofessional experience and some college or college-equivalent training is hired as a scientific or engineer.) An interdisciplinary approach to aircraft manufacturing is taken today, and this requires better training in, for example, the interrelated functions of mathematics, physics, and chemistry. A solid foundation in the fundamental concepts and basic general areas of science and engineering is recommended. There is a need for constant study to keep up with the rapidly changing technology.

Technicians. Much of what has been mentioned concerning scientists and engineers applies to science technicians and engineering technicians. An Associate in Science degree or Associate in Engineering degree is normally required or a diploma from a college or university, junior or community college, technical institute, or technical or vocational school. Technical institutes offer courses designed to qualify the graduate for a specific job or cluster of jobs immediately upon graduation and with a minimum of on-the job training. One may qualify for some technician jobs by completing an on-the-job training program or taking part-time, post-secondary school-level courses. Experience obtained while on active duty with the military services or other work experience is taken into account by employers.

Aircraft Manufacturing Employees. The training required for plant jobs varies from a few days of on-the- job instruction (for semiskilled workers such as material handlers and guards) to several years of formal apprenticeship (for craft workers such as machinists, tool and die makers, aircraft mechanics, sheet metal workers, pattern-makers, and electricians). Workers with little or no previous training or experience may be hired for assembly jobs requiring the least skill. Skilled assemblers, however, may need two to four years of plant experience, plus a high school education or vocational or technical school education, or the equivalent. Workers with little experience begin as helpers or assistants and develop their skills on the job and by taking training courses offered at the plant. An individual may increase his or her chances of being hired by acquiring a skill at a vocational or technical school.

Administrative and Support Activities Personnel. The requirements for these jobs are generally the same as the requirements for similar jobs in other industries. A person's chances for employment can be improved by acquiring a knowledge of engineering, technology, and the aviation industry.

Opportunities for Training

Because workers who are highly trained and knowledgeable about new developments are needed in the industry, most aircraft plants conduct training classes or pay tuition and related costs for employees to take courses at schools in the community. Some plants do both. Some classes are held during working hours; the trainee is paid for class time. Other classes are held after working hours. Courses are available for practically every occupational group and cover many skills and areas of knowledge.

Many aircraft plants provide their employees with financial aid for college enrollment. This aid is furnished either as direct grants or in the form of scholarships, and it is possible for an employee to work and to continue his or her education at the same time. These opportunities help workers advance more rapidly to higher skills and to better paid jobs.

The best jobs go to those with the most education. A high school education, at the minimum, is practically mandatory for any worker in the aircraft industry. Post-secondary-school training is vitally important, and such training may be obtained from area vocational-technical schools, technical institutes, junior or community colleges, or four-year colleges or universities.

Outlook for the Future

The aviation industry has had its ups and downs over recent years. Airline deregulation in the 1970s opened the airways to more regional carriers, but a number of major airlines have either merged or ceased operation. On the other hand, the surviving airlines have placed substantial orders for the newer, more efficient aircraft.

The demand for general aviation aircraft has been flat for some time, but recent changes in aviation product liability laws—which are favorable to the manufacturers of small planes—may give some new life to this segment of the industry. The manufacture of military aircraft has been affected by defense cutbacks resulting from the end of the cold war and the need to reduce government spending.

Employment in the manufacture of commercial transport aircraft peaked in 1991 at 124,200 workers, then declined to 91,500 in 1993, with a further reduction to 86,400 estimated for 1994. Future growth will be greatly dependent on economic conditions in the US and abroad. Job opportunities should be most favorable for highly trained workers, such as scientists, engineers, and technicians, but less skilled workers also will be needed to fill entry-level production positions.

AEROSPACE INDUSTRY EMPLOYMENT DECEMBER 1980-DECEMBER 1991

TYPE OF EMPLOYMENT	1980	1981	1982
Aircraft Manufacturing Employees	414,000	399,000	367,000
Scientists & Engineers	158,000	156,000	151,000
Technicians	62,000	69,000	59,000
All Others	268,000	276,000	254,000
Total	**902,000**	**900,000**	**831,000**

TOTAL OF EMPLOYMENT	1985	1986	1989
Aircraft Manufacturing Employees	392,000	446,000	439,000
Scientists & Engineers	175,000	178,000	204,000
Technicians	67,000	66,000	65,000
All others	305,000	277,000	286,000
Total	**939,000**	**967,000**	**994,000**

TYPE OF EMPLOYMENT	1990	1991
Aircraft Manufacturing Employees	420,000	406,000
Scientists & Engineers	196,000	196,000
Technicians	62,000	61,000
All others	266,000	260,000
Total	**9 44,000**	**923,000**

Source: Aerospace Industries Assn.

An Engineer Talks About His Job

Ed Leng is an engineer with Hughes Aircraft in the Los Angeles area.

During the years I've been with Hughes, I've learned that the most important skills I use each day are thoroughness and the ability to analyze, which enables me to approach a problem from a logical point of view.

You should also have an open mind, and be able to take suggestions from supervisors and co-workers. It's important to be a team player. While creativity is a plus, a solid foundation in math and the sciences is vital.

Basic training should be in math and physics. A solid background in these areas is far more important than being creative.

I design infrared systems for military helicopters. The end product is almost like a TV image for helicopter pilots. I use CAD-CAM, which required some training, and that is available through internal company seminars. These training courses last three to five days. However, because I was familiar with an IBM PC, I relied upon computer manuals. But I'll soon enroll in the sessions in order to familiarize myself with more technical systems. Clearly, some computer experience is a plus.

I graduated from the University of Southern California engineering school with a BS degree; a Masters degree is important if a graduate wants to advance and eventually wind up in a management position. But an advanced degree isn't really necessary in order to work in the aerospace industry. However, where you go to school will determine your salary, to some extent. A grad of MIT, CalTech, or Stanford will get the big money up front. Someone out of a small institution won't receive the same sort of salary.

I think that a prospective employer looks at schooling and grade point average, but personal chemistry during an interview is important. Don't count yourself out if you are articulate and can converse with an interviewer. That helps a lot. So, in addition to a degree and the standard credentials, having good interviewing skills is an important part of any education.