Aerospace Engineer

Snapshot

Career Cluster: Science, Technology, Engineering & Mathematics
Interests: Engineering, mathematics, physical sciences, flight, jet propulsion
Earnings (Yearly Average): $107,700
Employment & Outlook: Slower Than Average Growth Expected

OVERVIEW

Sphere of Work

Aerospace engineers design, develop, test, maintain, and assist in the manufacture of different types of aircraft, missiles, spacecraft, and other technologically advanced modes of transport. Aerospace engineers in the field of aeronautical engineering work on civilian and military aircraft, which may include helicopters, airliners, fighter jets, missiles, and other airborne craft. Aerospace engineers in the field of astronautical engineering work with satellites, rockets, and similar space-bound technologies. Aerospace engineers focus

on aerodynamics, propulsion, hull composition, communications networks, and electrical systems.

Work Environment

Aerospace engineers typically work in government or business offices, where they manage administrative tasks, design models and schematics, and write reports. They also spend time working in laboratories, industrial plants, and manufacturing facilities, where they work with other technicians to assemble systems and aircraft. Those engineers who work in astronautical engineering also work at launch facilities, while aeronautical engineering typically requires spending time at noisy airfields. Aerospace engineers generally work in several complex and busy locations over the course of a project, with many separate activities taking place simultaneously. They work a regular forty-hour workweek, although longer hours may be required as deadlines draw near.

Profile

Working Conditions: Work Indoors
Physical Strength: Light Work
Education Needs: Bachelor's Degree, Master's Degree, Doctoral Degree
Licensure/Certification: Required
Opportunities For Experience: Internship, Apprenticeship, Military Service, Part-Time Work
Holland Interest Score*: IRE

* See Appendix A

Occupation Interest

Aerospace engineers are part of an exciting industry, one that helps develop high-speed trains, deep-sea vessels, missiles/rockets, commercial airliners, and many other large aircraft and spacecraft. They use the most advanced technology to design, build, test, and maintain these vehicles. Because they have expertise unique to their field and area of specialization, aerospace engineers receive highly competitive salaries. The job market for aerospace engineers is continuously growing, thanks to the sales of new aircraft and missiles, as well as growth in the commercial airline construction industry.

A Day in the Life—Duties and Responsibilities

There are two basic types of aerospace engineers: aeronautical engineers (who focus on aircraft, missiles, and other "earthbound" technologies) and astronautical engineers (who focus on spacecraft and space exploration technologies). Both aeronautical and

astronautical engineers further specialize in certain types of products or product features. Aerospace engineers create conceptual designs of aeronautical or astronautical vehicles, instrumentation, defense systems, guidance and navigation systems, and propulsion systems according to the specifications of the client. They also improve the structural design of existing aircraft and spacecraft. Some engineers specialize in innovating more sophisticated production methods. All of these design and development processes include practical steps such as analyzing production costs, developing quality control standards, and testing methodologies, as well as establishing timelines for project development and completion. During the course of construction and/or assembly, aerospace engineers travel to the production site and conduct inspections and tests on the systems to ensure that they are operating efficiently and according to the needs of the client. Many aerospace engineers assist in the production phase, integrating systems and examining components as they are being built.

When production is complete, the aerospace engineer creates performance and technical reports so that customers have a full knowledge of the vehicle's capabilities. He or she retains copies of such reports for future reference. In the event that the vehicle or a vehicular system malfunctions, aerospace engineers play an important role in the investigation, examining damaged parts and reviewing performance reports and other documentation to determine the cause of the malfunction.

Duties and Responsibilities

- **Designing and developing aircraft**
- **Overseeing the manufacture of prototypes (models)**
- **Testing prototypes to evaluate their operation**
- **Estimating the time and cost to complete projects**

OCCUPATION SPECIALTIES

Aeronautical Engineers

Aeronautical Engineers design, develop, and test aircraft that operate within the earth's atmosphere. They test models to study how they operate under a variety of conditions in order to make aircraft safe and effective.

Astronautical Engineers

Astronautical Engineers design, develop, and test spacecraft that operate outside the earth's atmosphere. They test models to study how they operate under a variety of conditions in order to make spacecraft safe and effective.

Aerospace Engineering Technicians

Aerospace Engineering Technicians, who usually work under an Aerospace Engineer or other senior staff person, operate and maintain equipment used in developing and testing new aircraft and spacecraft.

WORK ENVIRONMENT

Physical Environment

Aerospace engineers spend long hours working at drawing boards in offices but also spend significant amounts of time working in laboratories, manufacturing facilities, test facilities, and airfields. These locations are generally clean, very well organized, and well ventilated. There are physical risks when working with or in close proximity to machines, electricity, manufacturing chemicals, and engines, so safety protocols are strictly enforced.

Relevant Skills and Abilities

Communication Skills
- Speaking effectively
- Writing concisely

Interpersonal/Social Skills
- Working as a member of a team

Organization & Management Skills
- Paying attention to and handling details
- Performing duties which change frequently

Research & Planning Skills
- Using logical reasoning

Technical Skills
- Applying technology to a task
- Performing scientific, mathematical and technical work

Human Environment

Aerospace engineers work with many other professionals, including engineers with different specialties. They interact with electricians, technicians, construction personnel, forklift and other heavy machinery operators, physicists, chemists, and project managers.

Technological Environment

Aerospace engineers use a variety of analytical tools and sophisticated technology in their daily work. Computer-aided design (CAD) and computer-aided manufacturing (CAM) software, as well as a variety of computer modeling and design programs, are used for planning and design. Analytical and scientific software help aerospace engineers to examine thermal patterns, complex mathematical formulas, and other aspects of systems engineering. At test facilities, engineers use such tools as flow meters, lasers, and vibration testing equipment.

EDUCATION, TRAINING, AND ADVANCEMENT

High School/Secondary

High school students who intend to become aerospace engineers should study mathematics, including algebra, applied mathematics, trigonometry, calculus, and geometry. Physics, chemistry, and other laboratory sciences are equally important. Computer science courses expose high school students to design and analytical software, while industrial arts courses expose them to mechanical equipment, such as engines and electrical systems. High school students interested

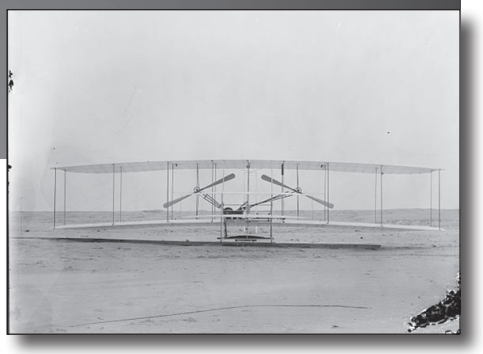
in the field of aerospace engineering must apply to related college or university programs.

Suggested High School Subjects

- Algebra
- Applied Communication
- Applied Math
- Applied Physics
- Blueprint Reading
- Calculus
- Chemistry
- College Preparatory
- Composition
- Computer Science
- Drafting
- Electricity & Electronics
- English
- Geometry
- Mathematics
- Physics
- Science
- Statistics
- Trigonometry

Famous First

Orville and Wilbur Wright flew the first airplane at Kitty Hawk, NC, in December, 1903. "The Flyer" was designed to reach 23 MPH.



College/Postsecondary

All aerospace engineers must have at least a bachelor's degree in engineering. Most obtain a master's degree or a doctorate in engineering, mathematics, or natural sciences. Some universities and colleges offer two- and four-year degrees in engineering technology. These programs give students direct exposure to applied engineering, which is useful for future design and production work.

Related College Majors

- Aerospace, Aeronautical & Astronautical Engineering
- Drafting, General
- Engineering Design
- Mechanical Drafting

Adult Job Seekers

Qualified aerospace engineers may apply directly to aerospace companies, such as aircraft manufacturers and commercial airlines, or on government agencies, such as NASA. In many cases, applicants to government positions must pass a civil service examination. Many other candidates apply to universities, consulting firms, and research and design companies. Professional associations, such as the Aerospace Industries Association and the American Institute of Aeronautics and Astronautics, provide networking opportunities.

Professional Certification and Licensure

All aerospace engineers are required to pass examinations and register as Professional Engineers (PE). The National Society of Professional Engineers (NSPE) works to establish consistent professional and ethical standards throughout the states. If an aerospace engineer is the lead engineer on a project, he or she must pass additional examinations in the state where the work is conducted.

Additional Requirements

Aerospace engineers must have strong analytical and research skills, with an exceptional ability to understand and solve complex problems. They should be experienced with computer systems and design software. Aerospace engineers must have an eye for detail and

scientific and mathematical approach to solving issues. Finally, they must have strong communications skills to coordinate with other professionals and customers.

Fun Fact

The University of Michigan is home to the U.S.'s oldest collegiate aeronautics program, which started in 1914—11 years after the Wright Brothers' first flight at Kitty Hawk, NC.

Source: www.engin.umich.edu/aero/about/facts; www.wright-house.com/wright-brothers/wrights/1903.html

EARNINGS AND ADVANCEMENT

Earnings depend on the individual's education, experience, field of specialization and job duties. According to a salary survey by the National Association of Colleges and Employers, the average starting salary offer to college graduates with a bachelor's degree in aerospace engineering was $61,532 in 2012. Those with a master's degree were offered $70,299, and those with a Ph.D. were offered $83,078. Mean annual earnings of aerospace engineers were $107,700 in 2014. The lowest ten percent earned less than $66,110, and the highest ten percent earned more than $155,240.

Aerospace engineers may receive paid vacations, holidays, and sick days; life and health insurance; and retirement benefits. These are usually paid by the employer.

Metropolitan Areas with the Highest Employment Level in this Occupation

Metropolitan area	Employment [1]	Employment per thousand jobs	Annual mean wage
Seattle-Bellevue-Everett, WA	8,400	5.63	N/A
Los Angeles-Long Beach-Glendale, CA	4,440	1.09	$122,920
Huntsville, AL	3,040	14.57	$108,800
Washington-Arlington-Alexandria, DC-VA-MD-WV	2,850	1.20	$136,420
Wichita, KS	2,680	9.22	$98,150
Houston-Sugar Land-Baytown, TX	2,510	0.88	$114,850
Fort Worth-Arlington, TX	1,940	2.09	$113,850
Cincinnati-Middletown, OH-KY-IN	1,840	1.82	N/A
Santa Ana-Anaheim-Irvine, CA	1,560	1.05	$112,950
San Diego-Carlsbad-San Marcos, CA	1,550	1.17	$103,570

[1]Does not include self-employed. Source: Bureau of Labor Statistics

EMPLOYMENT AND OUTLOOK

There were approximately 89,000 aerospace engineers employed nationally in 2012. Employment of aerospace engineers is expected to grow slower than the average for all occupations through the year 2022, which means employment is projected to increase 3 percent to 9 percent. New designs and new technologies involved in the creation of commercial and military aircraft will encourage demand for aerospace engineers.

Employment Trend, Projected 2012–22

Total, All Occupations: 11%

Engineers (all): 9%

Aerospace engineers: 7%

Note: "All Occupations" includes all occupations in the U.S. Economy. Source: U.S. Bureau of Labor Statistics, Employment Projections Program

Related Occupations

- Electrical & Electronics Engineer
- Mechanical Engineer

Related Military Occupations

- Aerospace Engineer
- Space Operations Officer

Conversation With . . .
JOHN ROSE

Chief of Staff, Boeing Defense Space and Security
Huntington Beach, CA
Aerospace Engineer, 17 years

1. What was your individual career path in terms of education/training, entry-level job, or other significant opportunity?

I've always loved aviation and spaceflight, and originally wanted to be an astronaut. By high school, I knew I wanted to be an aerospace engineer and took AP courses in chemistry and physics. My physics class got to visit the Space Academy in Huntsville, Alabama, which was my second visit there.

I got my B.S. in aerospace from Cal Poly Pomona. In college, I worked part-time on the attractions in the Disneyland Resort and spent a summer interning with Disney's Ride & Show Engineering, Inc., where I later spent two years of my career. I also did two other internships.

As graduation approached, Rockwell International, the builder of the Space Shuttle, asked me to interview. I was thrilled, since working on the Space Shuttle was THE job I wanted. So, my first full-time job in the aerospace industry was in a group supporting the Space Shuttle and International Space Station.

A benefit of working for a large company like Rockwell (which became Boeing) is that they may pay for your advanced degrees. I got my M.S. in aerospace, also from Cal Poly Pomona, and my M.B.A. from the University of Southern California.

I've always leveraged the opportunities at Boeing. In my current role, in the Office of the Vice President of Engineering, Mission Assurance and Product Support, I'm working with top leadership to develop global strategy on our defense side.

2. What are the most important skills and/or qualities for someone in your profession?

Aerospace, particularly defense, can be cyclical, so you need to be adaptable. Contracts come and go, sometimes without much notice. Also, new graduates need to recognize that the way something is done in industry may not be how they learned it in class. Inquisitiveness and passion are also important. In addition, the aerospace

industry is typically risk averse, so experience is a highly valued commodity. This means younger engineers must be patient; there isn't always a lot of support for putting untested or inexperienced individuals in a critical role.

3. What do you wish you had known going into this profession?

Aerospace products are a prime target for cybersecurity threats and must be protected from being taken offline or taken control of. Had I known cybersecurity would develop into such an important area, I would have taken related coursework.

Also, I had to learn that it's easy to slip through the cracks at a large company and that it isn't a bad thing to ask about opportunities if they aren't presenting themselves.

4. Are there many job opportunities in your profession? In what specific areas?

Companies like Boeing or Lockheed Martin offer jobs in a wide variety of areas, including business development, finance, software development, manufacturing, structural design, systems engineering and computer science.

Unmanned Aerial Vehicles (UAVs) are fueling a major evolution. Pilotless vehicles can remove human physiological limitations on what a vehicle can do (for example, making sharper turns or diving deeper) as well as spare humans from some dangerous missions. UAVs are adding a new commercial aspect to the industry because they can be made by smaller companies.

5. How do you see your profession changing in the next five years, what role will technology play in those changes, and what skills will be required?

The fact that most products will be tied to the Internet will change how we design and build them, as well as how we approach vulnerabilities relative to such systems as flight controls. Air traffic management is becoming satellite-based, and that's a quickly evolving area of cybersecurity where we need to respond to threats.

Additive manufacturing, or 3D printing, is revolutionizing how things are built. Small, portable machines are building pieces used in rocket engines. The concept is also being used on the International Space Station where a 3D CADD model for a specific part or tool can be designed on earth, emailed up to the ISS, and 'printed' out.

Immersive development—which is kind of a virtual reality that allows us to try out a repair procedure or do a virtual walkaround of a product without the time and expense of travel—will be a bigger part of the design of and customer support for products.

Systems thinking—being able to conceptualize all of the moving pieces and influencers, versus focusing on one piece—will be valuable.

6. What do you enjoy most about your job? What do you enjoy least about your job?

I really love the amazing products that our industry produces. I love going to an airshow with my son and seeing them. I also love that many of our products support our armed forces. And I have amazing opportunities to work on projects in different parts of the United States and the world.

But I also have to deal with non-technical, administrative issues like coordinating meetings that are necessary but not exciting. Another downside is the cyclical nature of being tied to defense and space budgets.

7. Can you suggest a valuable "try this" for students considering a career in your profession?

Try to find an internship. Also, get to an airshow—seeing all the products and watching them fly is great exposure to the amazing things we build.

SELECTED SCHOOLS

Most colleges and universities offer programs in engineering; a variety of them also have concentrations in aeronautical engineering. Some of the more prominent schools in this field are listed below.

California Institute of Technology
1200 East California Boulevard
Pasadena CA, 91125
Phone: (626) 395-6811
http://www.caltech.edu

Georgia Institute of Technology
225 North Avenue NW
Atlanta, GA 30332
Phone: (404) 894-2000
www.gatech.edu

Massachusetts Institute of Technology
77 Massachusetts Avenue
Cambridge, MA 02139
Phone: (617) 253-1000
http://web.mit.edu

Purdue University, West Lafayette
Schleman Hall, 475 Stadium Mall Drive
West Lafayette, IN 47907-2050
Phone: (765) 494-4600
http://www.purdue.edu

Stanford University
450 Serra Mall
Stanford, CA 94305
Phone: (650) 723-2300
https://www.stanford.edu

Texas A&M University
Jack K. Williams Bldg.
College Station, TX 77843
Phone: (979) 845-7541
http://engineering.tamu/aerospace

University of Colorado
422 UCB
Boulder, CO 80309
Phone: (303) 735-4900
www.colorado.edu

University of Illinois, Urbana, Champaign
601 East John Street
Champaign, IL 61820
Phone: 217 333-1000
http://illinois.edu

University of Michigan, Ann Arbor
500 S. State St.
Ann Arbor, MI 48109
Phone: (734) 764-1817
https://www.umich.edu

University of Texas, Austin
Austin, Texas 78712-1111
Phone: (512) 471-3434
http://www.utexas.edu

MORE INFORMATION

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Arlington, VA 22209
703.358.1000
www.aia-aerospace.org

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National Aeronautics Space Agency (NASA)
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