

## Welding, Soldering, and Brazing Workers

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### Significant Points

- Job prospects should be excellent.
- Training ranges from a few weeks of school or on-the-job training for low-skilled positions to several years of combined school and on-the-job training for highly skilled jobs.

### Nature of the Work

Welding is the most common way of permanently joining metal parts. In this process, heat is applied to metal pieces, melting and fusing them to form a permanent bond. Because of its strength, welding is used in shipbuilding, automobile manufacturing and repair, aerospace applications, and thousands of other manufacturing activities. Welding also is used to join beams when constructing buildings, bridges, and other structures, and to join pipes in pipelines, power plants, and refineries.

Welders use many types of welding equipment set up in a variety of positions, such as flat, vertical, horizontal, and overhead. They may perform manual welding, in which the work is entirely controlled by the welder, or semiautomatic welding, in which the welder uses machinery, such as a wire feeder, to help in performing welding tasks.

Arc welding is the most common type of welding. Standard arc welding involves two large metal alligator clips that are carrying a strong electrical current. One clip is attached to any part of the workpiece being welded. The second clip is connected to a thin welding rod. When the rod touches the workpiece, a powerful electrical circuit is created. The massive heat created by the electrical current causes both the workpiece and the steel core of the rod to melt together, cooling quickly to form a solid bond. During welding, the flux that surrounds the rod's core vaporizes, forming an inert gas that serves to protect the weld from atmospheric elements that might weaken it. Two common advanced types of arc welding are Gas Tungsten Arc (TIG) and Gas Metal Arc (MIG) welding. Instead of welding rods, these welding systems use a spool of continuously fed wire, which allows the welder to weld longer stretches without stopping to replace the rod. Instead of using gas flux surrounding the rod, TIG and MIG protect the initial weld from the environment by blowing inert gas onto the weld.

Like arc welding, soldering and brazing use metal to join two pieces of metal. However, the metal added during the process has melting point lower than that of the workpiece, so only the added metal is melted, not the workpiece. Soldering uses metals with a melting point below 800 degrees Fahrenheit; brazing uses metals with a melting point above 800 degrees Fahrenheit. Because soldering and brazing do not melt the workpiece, these processes normally do not create distortions or weaknesses in the workpiece that can occur with welding. Soldering commonly is used to join electrical, electronic, and other small metal parts. Brazing produces a stronger joint than does soldering, and often is used to join metals other than steel, such as brass parts.

Skilled welding, soldering, and brazing workers generally plan work from drawings or specifications or use their knowledge of fluxes and base metals to analyze parts. These workers then select and set up welding equipment and examine welds, to ensure that they meet standards or specifications. Some welders have more limited duties, however. They perform routine jobs that already have been planned and laid out and do not require extensive knowledge of welding techniques.



*A relatively small proportion of welding, soldering, and brazing workers are in construction.*

Automated welding is used in an increasing number of production processes. In these instances, a machine or robot performs the welding tasks while monitored by a welding machine operator. Welding, soldering, and brazing machine setters, operators, and tenders follow specified layouts, work orders, or blueprints. Operators must load parts correctly and constantly monitor the machine to ensure that it produces the desired bond.

The work of arc, plasma, and oxy-gas cutters is closely related to that of welders. However, instead of joining metals, cutters use the heat from an electric arc, a stream of ionized gas, or burning gases to cut and trim metal objects to specific dimensions. Cutters also dismantle large objects, such as ships, railroad cars, automobiles, buildings, or aircraft. Some operate and monitor cutting machines similar to those used by welding machine operators. Plasma cutting has been increasing in popularity because, unlike other methods, it can cut a wide variety of metals, including stainless steel, aluminum, and titanium.

### Working Conditions

Welding, soldering, and brazing workers often are exposed to a number of potential hazards, including the intense light created by the arc, hazardous fumes, and burns. In the interests of safety, they wear safety shoes, goggles, hoods with protective lenses, and other devices designed to prevent burns and eye injuries and to protect them from falling objects. They normally work in well-ventilated areas to limit their exposure to fumes. Automated welding, soldering, and brazing machine operators are not exposed to as many dangers, however, and a face shield or goggles usually provide adequate protection for these workers.

Welders and cutters may work outdoors, often in inclement weather, or indoors, sometimes in a confining area designed to contain sparks and glare. When outdoors, they may work on a scaffold or platform high off the ground. In addition, they may be required to lift heavy objects and work in a variety of awkward positions, having to make welds while bending, stooping, or working overhead.

Although about half of welders, solderers, and brazers work a 40-hour week, overtime is common, and some welders work up to 70 hours per week. Welders also may work in shifts as long as 12 hours. Some welders, solderers, brazers, and machine operators work in factories that operate around-the-clock.

### Employment

Welding, soldering, and brazing workers held about 521,000 jobs in 2000. Of these jobs, 3 of every 4 were found in manufacturing and services. Most manufacturing jobs were in the transportation

equipment, industrial machinery and equipment, or fabricated metal products industries. Services industry jobs were mainly in repair shops and personnel supply agencies. Most jobs for welding, soldering, and brazing machine setters, operators, and tenders were found in manufacturing industries, primarily those producing fabricated metal products, motor vehicles, and construction and related machinery.

### Training, Other Qualifications, and Advancement

Training for welding, soldering, and brazing workers can range from a few weeks of school or on-the-job training for low-skilled positions to several years of combined school and on-the-job training for highly skilled jobs. Formal training is available in high schools, vocational schools, and postsecondary institutions, such as vocational-technical institutes, community colleges, and private welding schools. The Armed Forces operate welding schools as well. Some employers provide training. Courses in blueprint reading, shop mathematics, mechanical drawing, physics, chemistry, and metallurgy are helpful. Knowledge of computers is gaining in importance, especially for welding, soldering, and brazing machine operators, who are becoming responsible for the programming of computer-controlled machines, including robots.

Some welders become certified, a process whereby the employer sends a worker to an institution, such as an independent testing lab or technical school, to weld a test specimen to specific codes and standards required by the employer. Testing procedures are based on the standards and codes set by one of several industry associations with which the employer may be affiliated. If the welding inspector at the examining institution determines that the worker has performed according to the employer's guidelines, the inspector will then certify the welder being tested as able to work with a particular welding procedure.

Welding, soldering, and brazing workers need good eyesight, hand-eye coordination, and manual dexterity. They should be able to concentrate on detailed work for long periods and be able to bend, stoop, and work in awkward positions. In addition, welders increasingly need to be willing to receive training and perform tasks in other production jobs.

Welders can advance to more skilled welding jobs with additional training and experience. For example, they may become welding technicians, supervisors, inspectors, or instructors. Some experienced welders open their own repair shops.

### Job Outlook

Job prospects should be excellent for skilled candidates, as many potential entrants who have the educational and personal qualifications to acquire the necessary skills may prefer to attend college or may prefer work that has more comfortable working conditions. Employment of welding, soldering, and brazing workers is expected to grow about as fast as the average for all occupations over the 2000-10 period. In addition, many openings will arise as workers retire or leave the occupation for other reasons.

The major factor affecting employment of welders is the health of the industries in which they work. Because almost every manufacturing industry uses welding at some stage of manufacturing or in the repair and maintenance of equipment, a strong economy will keep demand for welders high. A downturn affecting industries such as auto manufacturing, construction, or petroleum, however, would have a negative impact on the employment of welders in those areas, and could cause some layoffs. Levels of government funding for infrastructure repairs and improvements also are expected to be an important determinant of the future number of welding jobs.

Regardless of the state of the economy, the pressures to improve productivity and hold down labor costs are leading many companies to invest more in automation, especially computer-controlled and robotically-controlled welding machinery. This may affect the demand for low-skilled manual welding, soldering, and brazing

workers because the jobs that are currently being automated are the simple, repetitive ones. The growing use of automation, however, should increase demand for highly skilled welding, soldering, and brazing machine setters, operators, and tenders. Welders working on construction projects or in equipment repair will not be affected by technology change to the same extent that other welders are, because their jobs are not as easily automated.

Technology is helping to improve welding, creating more uses for welding in the workplace and expanding employment opportunities. For example, new ways are being developed to bond dissimilar materials and nonmetallic materials, such as plastics, composites, and new alloys. Also, laser beam and electron beam welding, new fluxes, and other new technologies and techniques are improving the results of welding, making it applicable to a wider assortment of jobs. Improvements in technology also have boosted welding productivity, making it more competitive with other methods of joining metals.

### Earnings

Median hourly earnings of welders, cutters, solderers, and brazers were \$13.13 in 2000. The middle 50 percent earned between \$10.74 and \$16.37. The lowest 10 percent had earnings of less than \$8.86, while the top 10 percent earned over \$20.74. Median hourly earnings in the industries employing the largest numbers of welders, cutters, solderers, and brazers in 2000 were:

Construction and related machinery .....	\$13.51
Motor vehicles and equipment .....	13.43
Fabricated structural metal products .....	12.91
Miscellaneous repair shops .....	12.33
Personnel supply services .....	10.55

Median hourly earnings of welding, soldering, and brazing machine setters, operators, and tenders were \$13.09 in 2000. The middle 50 percent earned between \$10.41 and \$16.83. The lowest 10 percent had earnings of less than \$8.64, while the top 10 percent earned over \$23.32. Median hourly earnings in the industries employing the largest numbers of welding machine operators in 2000 were:

Motor vehicles and equipment .....	\$16.16
Construction and related machinery .....	13.72
Fabricated structural metal products .....	12.77

Many welders belong to unions. Among these are the International Association of Machinists and Aerospace Workers; the International Brotherhood of Boilermakers, Iron Ship Builders, Blacksmiths, Forgers and Helpers; the International Union, United Automobile, Aerospace and Agricultural Implement Workers of America; the United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the United States and Canada; and the United Electrical, Radio, and Machine Workers of America.

### Related Occupations

Welding, soldering, and brazing workers are skilled metal workers. Other metal workers include machinists; machine setters, operators, and tenders—metal and plastic; computer-control programmers and operators; tool and die makers; sheet metal workers; and boilermakers.

### Sources of Additional Information

For information on training opportunities and jobs for welding, soldering, and brazing workers, contact local employers, the local office of the State employment service, or schools providing welding, soldering, or brazing training.

Information on careers in welding is available from:

► American Welding Society, 550 N.W. Lejeune Rd., Miami, FL 33126-5699. Internet: <http://www.aws.org>