
Welding, Soldering, and Brazing Workers

(O*NET 51-4121.00, 51-4121.06, 51-4121.07, 51-4122.00)

Significant Points

- About 2 out of 3 jobs are in manufacturing industries.
- Training ranges from a few weeks of school or on-the-job training to several years of combined school and on-the-job training.
- Employment is projected to grow more slowly than average.
- Job prospects should be excellent as employers report difficulty finding enough qualified people.

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.

There are over 80 different welding processes that a welder can employ. Some are performed manually, and the work is entirely controlled by the welder. Others are semiautomatic, and the welder uses machinery, such as a wire feeder, to perform welding tasks.

One of the most common types of welding is arc welding. Standard arc welding involves two large metal alligator clips that carry a strong electrical current. One clip is attached to any part of the piece being welded. The second clip is connected to a thin welding rod. When the rod touches the piece, a powerful electrical circuit is created. The massive heat created by the electrical current causes both the piece and the steel core of the rod to melt together, cooling quickly to form a solid bond. The speed with which the welder works can affect the strength of the weld.

Two common and advanced types of arc welding are Tungsten Inert Gas (TIG) and Metal Inert Gas (MIG) welding. TIG welding often is used with stainless steel or aluminum. The welder holds the welding rod in one hand and an electric torch in the other hand. The torch is used to simultaneously melt the rod and the piece. MIG uses a spool of continuously fed wire instead of a rod, which allows the welder to join longer stretches of metal without stopping to replace a rod. The welder holds the wire feeder, which functions like the alligator clip in arc welding.

Like arc welders, soldering and brazing workers use molten metal to join two pieces of metal. However, the metal added during the soldering and brazing process has a melting point lower than that of the piece, so only the added metal is melted, not the piece. Soldering uses metals with a melting point below 800 degrees Fahrenheit; brazing uses metals with a higher melting point. Because soldering and brazing do not melt the piece, these processes normally do not create the distortions or weaknesses in the piece 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. Brazing can also be used to apply coatings to parts to reduce wear and protect against corrosion.

Skilled welding, soldering, and brazing workers generally plan work from drawings or specifications and use their knowledge of welding processes and base metals to determine how best to join the parts. The difficulty of the weld is determined by its position—horizontal, vertical, overhead, or 6G (circular, such as in large pipes)—and by the type of metals to be fused. Highly skilled welders often are trained to work with a wide variety of materials, such as titanium, aluminum, or plastics, in addition to steel. Welders then select and set up welding equipment, execute the planned welds, and examine welds to ensure that they meet standards or specifications.

By observing problems during the welding process, welders can compensate by adjusting the speed, voltage, amperage, or feed of the rod. 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.

Automated welding is used in an increasing number of production processes. In these instances, a machine or robot performs the welding tasks while being monitored by a welding machine operator. Welding, soldering, and brazing machine setters, operators, and tenders follow specified layouts, work orders, or



Welders inspect their work to ensure a strong bond.

Projections data from the National Employment Matrix

Occupational Title	SOC Code	Employment, 2006	Projected employment, 2016	Change, 2006-16	
				Number	Percent
Welding, soldering, and brazing workers.....	51-4120	462,000	484,000	22,000	5
Welders, cutters, solderers, and brazers	51-4121	409,000	430,000	21,000	5
Welding, soldering, and brazing machine setters, operators, and tenders.....	51-4122	53,000	54,000	1,600	3

NOTE: Data in this table are rounded. See the discussion of the employment projections table in the *Handbook* introductory chapter on *Occupational Information Included in the Handbook*.

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 called plasma, 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.

Work environment. Welding, soldering, and brazing workers often are exposed to a number of hazards, including very hot materials and the intense light created by the arc. 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, 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 confined area designed to contain sparks and glare. 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, while bending, stooping, or standing to perform work overhead.

Although about 50 percent of welders, solderers, and brazers work a 40-hour week, overtime is common, and nearly 1 out of 5 welders work 50 hours per week or more. 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, necessitating shift work.

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.

Education and training. Formal training is available in high schools and postsecondary institutions, such as vocational-technical institutes, community colleges, and private welding schools. The U.S. Armed Forces operate welding schools as well. Although some employers provide training, they prefer to hire workers who already have experience or formal training. Courses in blueprint reading, shop mathematics, mechan-

ical drawing, physics, chemistry, and metallurgy are helpful. An understanding of electricity also is very helpful, and knowledge of computers is gaining importance, especially for welding, soldering, and brazing machine operators, who are becoming more responsible for the programming of robots and other computer-controlled machines. Since understanding the welding process and inspecting welds is important for both welders and welding machine operators, companies hiring machine operators prefer workers with a background in welding.

Certification and other qualifications. Some welding positions require general certifications in welding or certifications in specific skills such as inspection or robotic welding. The American Welding Society certification courses are offered at many welding schools. Some employers have developed their own internal certification tests.

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 must be willing to receive training and perform tasks in other production jobs.

Advancement. 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. Other welders, especially those who obtain a bachelor's degree, become welding engineers.

Employment

Welding, soldering, and brazing workers held about 462,000 jobs in 2006. About 2 of every 3 welding jobs were found in manufacturing. Jobs were concentrated in fabricated metal product manufacturing, transportation equipment manufacturing, machinery manufacturing, architectural and structural metals manufacturing, and construction.

Job Outlook

Employment of welding, soldering, and brazing workers is expected to grow more slowly than average. They will have excellent job opportunities as some welding employers report difficulty finding trained welders.

Employment change. Employment of welding, soldering, and brazing workers is expected to grow about 5 percent over the 2006-16 decade, slower than the average for all occupations. Welding has grown significantly over the long term because of advances that have allowed it to replace other joining technologies in many applications. Thus, demand for welders is increasing in the construction, manufacturing, and utilities industries.

Despite overall employment declines in the manufacturing industry, the outlook for welders in manufacturing is far stronger than for other occupations. The basic skills of welding are the same across industries, so welders can easily shift from one industry to another depending on where they are needed most. For example, welders laid off in the auto industry have been able to find work in the booming oil and gas industry, although the shift may require relocating.

Automation is less of a threat to welders and welding machine operators than to other manufacturing occupations. Welding machines must still be operated by someone who is knowledgeable about welding and can inspect the weld and make adjustments. In custom applications, much of the work is difficult or impossible to automate. This includes manufacturing small batches of items, construction work, and making repairs in factories.

Job prospects. Retirements and job growth in the oil and gas and other industries are expected to create excellent opportunities for welders. Welding schools report that graduates have little difficulty finding work, and some welding employers report difficulty finding trained welders.

Earnings

Median wage-and-salary earnings of welders, cutters, solderers, and brazers were \$15.10 an hour in May 2006. The middle 50 percent earned between \$12.30 and \$18.47. The lowest 10 percent had earnings of less than \$10.08, and the top 10 percent earned over \$22.50. The range of earnings of welders reflects the wide range of skill levels. Median hourly wage-and-salary earnings of welders, cutters, solderers, and brazers in the industries employing the largest numbers of them were:

Other general purpose machinery manufacturing	\$15.43
Agriculture, construction, and mining machinery manufacturing	14.90
Commercial and industrial machinery and equipment (except automotive and electronic) repair and maintenance.....	14.59
Architectural and structural metals manufacturing.....	14.39
Motor vehicle body and trailer manufacturing	13.68

Median wage-and-salary earnings of welding, soldering, and brazing machine setters, operators, and tenders were \$14.90 an hour in May 2006. The middle 50 percent earned between \$12.02 and \$18.90. The lowest 10 percent had earnings of less than \$9.95, and the top 10 percent earned over \$25.44. Their median wage-and-salary earnings in motor vehicle parts manufacturing, the industry employing them in the largest numbers, were \$17.75 an hour in May 2006.

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, Pipefitting, Sprinkler 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 skilled 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. Assemblers and fabricators of electrical and electronic equipment often assemble parts using soldering. Pipelayers, plumbers, pipefitters, and steamfitters also need welding skills.

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, certifications, and educational opportunities in welding is available from:

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