Welders

Welders (ˈweld-ərs) join and fuse two or more ferrous or nonferrous metals or other material by applying heat, pressure, or a related process.

Welding is a broad field of work. Welders work in every industry that works with metal, uses metal, or manufactures metal products. Jobs are open in almost any field of endeavor. There are more than 100 different kinds of welding. Three of the most common are arc welding, gas welding, and resistance welding.

Arc welding uses heat from an electric current to melt two pieces of metal and make them flow together. Gas welding uses a flame from combustible gases to heat and melt the metal so that the two pieces fuse. In resistance welding, a strong electric current is forced to pass through a restricted metal path. The resistance of the metal generates heat. The heat, along with pressure, fuses the metals.

Because welded joints and seams are strong, they are used to construct and repair products such as ships, automobiles, and spacecraft, and structures such as bridges, buildings, and nuclear power plants.

Work Performed

When starting a welding job, welders plan their work from drawings or specifications. They select and set up their welding equipment. Welders use their chosen equipment to apply heat to the joint being welded. A welding positioner holds the metal pieces in place for welding. Welders wear goggles or a face shield, protective gloves, and safety shoes.

Before joining metal pieces, welders clean oil, rust, or dirt from the parts. When they finish the weld, they may scrape, file, chip, and grind off rough spots or burrs to make the weld surface smooth.

Some welders are skilled in one type of welding. Others are experts in several kinds of welding. Arc welders weld together metal components of products, such as pipelines, aircraft, and manufactured homes, using electric arc-welding equipment. In shielded metal arc welding (SMAW), welders place an electrode, which looks like a metal pencil, in a holder connected to the power

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along the weld line. The beam pierces the metal as it advances.

The intense heat thus produced vaporizes parts. The item being welded may be placed in a vacuum chamber. The intense heat from the arc melts the metal, which flows together. Welders control the amount of metal they deposit by the length of time they hold the electrode in place, and by the current setting on the machine.

In gas metal arc welding (GMAW), the electrode is a continuous wire with properties compatible with those of the metals to be welded. The welders control a welding torch through which the wire passes to the weld point. The wire serves as filler for the weld. This process may also be fully automated.

In gas tungsten arc welding (GTAW), welders use a tungsten electrode (which does not melt) to hold the arc. Inert gas such as argon or helium from a cylinder shields the weld to keep it from being contaminated by gases in the atmosphere. These welders may or may not add filler metal to the joint from a rod they hold in their other hand. Welders use gas tungsten arc welding to weld aluminum, stainless steel, carbon steel, and other alloys.

**Gas welders** use a torch (rather than electric current) to heat the metal edges they want to weld. The torch burns a fuel gas (usually acetylene) and pure oxygen from cylinders of compressed gas. Equipment includes a steel cylinder that contains a compressed gas such as oxygen or acetylene. A cylinder valve releases or restricts the flow of gas from the cylinder. An igniter creates sparks to ignite the gas.

Welders set the pressure controls on the gas cylinders. They set the valves on the torch for the right amount of flame. They direct the flame against the metal edges until the metal begins to melt. At the same time they heat the welding rod to supply the filler metal that will fill the weld.

**Resistance welders** run machines that melt and fuse metal parts. Operators set the controls. A strong charge of electric current, along with heat and pressure, fuses the parts. The operators feed metal parts into the machine and take out the welded pieces.

Among other welding processes are laser beam welding, electron beam welding, and ultrasonic welding. In laser beam welding, a complex piece of equipment produces a controlled beam of light that can melt metals. This technique is very precise. The spot heated can be very small. Laser beam technology has a strong potential for use in scientific and technical applications.

In electron beam welding, a stream of electrons (produced by heating a filament) are focused on a welding point. The item being welded may be placed in a vacuum chamber. The intense heat thus produced vaporizes parts of the metal. The beam pierces the metal as it advances along the weld line.

Welding conditions depend on the kind of welding workers do. Welders who work on buildings, pipelines, ships, and bridges may work in all kinds of weather. Some building codes require that the weld area be protected from the weather.

The extent of their physical activity depends on the job. On some jobs they stand, walk, and climb on beams or scaffolds. They may have to work in awkward positions to weld work that is flat, vertical, horizontal, or overhead.

Welders often work high off the ground. At times they sit or stand on a scaffold or on a platform fixed to the boom of a crane while they work. Some welders are divers who work underwater. Other welders work in garages, repair shops, and similar places. Some welders in factories may operate robots or other automatic welding equipment.

Welders avoid hazards by following strict rules on safety. Gloves, face shields, safety glasses, aprons, fire-resistant clothing, respirators, and safety shoes protect the workers from burns and other injuries. Welders in construction or pipeline work may have to travel daily to a distant work site or be away from home for days at a time.

**Hours and Earnings**

Welders usually work five days a week, eight hours a day. Welders who do maintenance or heavy shop fabrication work have year-round employment. In normal times production line welders average from seven to eleven months of work a year. Maintenance welders in large plants may work any shift including weekends.

According to the Bureau of Labor Statistics, welders earned an average of $32,880 a year in 2006. Wages ranged from a high of more than $46,800 a year to a low of less than $20,970 a year. Earnings depend on the skills of the welders and the industries in which they work. Those who work in motor vehicles and equipment and construction and related machinery earn more than those working in personnel supply services and miscellaneous repair shops. Earnings of skilled hand welders match those of other skilled metalworkers. Resistance welding machine operators, who need less training and fewer skills, earn less than skilled manual welders.

Welders employed full-time usually receive benefits including health and life insurance, paid vacation, holiday, and sick days, and retirement plans.

**Education and Training**

Training for welders may range from a few weeks of school or on-the-job training for low-skilled jobs to several years of school and on-the-job training for skilled work. Formal training is available in high schools, vocational
schools, community colleges, and private welding schools. Some employers offer training to help welders update their skills.

Apprenticeships run by trade unions are sometimes available. The International Association of Machinists and Aerospace Workers (IAMAW), for instance, offers welding instruction and training as a part of its basic apprenticeship program.

High school students should take courses in mathematics, mechanical drawing, physics, and chemistry. Mathematics will teach them to work with numbers, shapes, and angles. They should take mechanical drawing to learn drafting and blueprint reading. In the study of physics they will learn the laws of electricity, heat, pressure, and radiation. In chemistry they learn about metals, alloys (mixtures of metals), and the gases welders use. Students who take metal shop will learn to work with metals and tools.

**Licensing, Certification, Unions and Professional Societies**

Welders must pass tests to work on jobs that have strict standards. Testing procedures are usually based on the standards and codes set by any one of several industry associations such as the American Welding Society (AWS), the American Society of Mechanical Engineers (ASME), and the American Petroleum Institute (API), which the employer may be affiliated with. Reliability standards in nuclear power plants and in the aerospace field are very high. Insurance firms, employers, and inspection agencies often set criteria for welders on certain jobs. Tests for welders may comprise a written part and performance on a welding task.

Many welders belong to unions. These unions include the International Association of Machinists and Aerospace Workers (IAMAW); the International Brotherhood of Boilermakers; the International Union, United Automobile, Aerospace and Agricultural Implement Workers of America (UAW); United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the United States and Canada (UA); and the United Electrical, Radio and Machine Workers of America (UE).

**Personal Qualifications**

Most welding is hard work. Welders must be accurate, careful, and patient. They should be able to concentrate on detailed work for long periods of time. These workers should be able to work well both alone and with others. Welders should like doing hands-on work.

Occupations can be adapted for workers with disabilities. Persons should contact their school or employment counselors, their state office of vocational rehabilitation, or their state department of labor to explore fully their individual needs and requirements as well as the requirements of the occupation.

**Where Employed**

In the year 2006, there were about 376,630 welders at work. Three out of five welders work in industries that make autos, locomotives, planes, ships, tools and dies, and boilers. They also work on highway construction and building construction. They weld steel framework for buildings and bridges. Laying pipelines requires many welders. Welders also work for metalworking repair shops. Government agencies such as arsenals, road commissions, and departments of public works employ welders.

Arc and gas welders do upkeep and repair work. They work in railroad shops, power plants, foundries, and factories. Resistance welding operators do production work in factories that make sheet-metal products.

Welders work in every state, but most work in manufacturing centers in the Midwest and the Northeast. About one third work in Pennsylvania, Ohio, Michigan, Indiana, and Illinois. Many work in New York, Texas, and California.

**Employment Outlook**

The long-range outlook for welders is good. In certain industries such as construction and repair services, where the work is not adaptable to automation, the employment of welders will grow rapidly. Welders will find jobs in shipbuilding, oil refineries, pipeline construction, and power plants. They will find work building aircraft, spacecraft, railroad equipment, and heavy construction equipment.

Manual welders with a wide range of skills will be in demand for maintenance and repair work. Workers knowledgeable in new welding processes such as laser beam welding and in techniques for welding plastics will also find employment. Welders who are also divers may find underwater construction and salvage work.

In manufacturing, where automated welding is taking over, jobs will be less plentiful. Robots are replacing some welders on assembly lines in auto plants and other industries. Welders are also subject to seasonal layoffs during factory retooling and during economic slumps.

**Entry Methods**

The local state employment office has both local and national information. Local union offices that have welders among their members keep track of welding jobs and of apprenticeships. Many companies hire welders. These firms may be repair shops, factories, pipeline companies, or construction companies.

Professional associations, such as the American Welding Society, offer online career centers where job seekers can post their resumes and view job openings. Membership with an associations also provides networking opportunities which often leads to career opportunities.
**Advancement**

Advancement prospects for welders are good. Depending upon education and experience, welders can start out by serving as apprentices or helpers and advance their careers by learning additional welding processes. Professional certifications can be earned which establish the welder’s proficiency in various welding processes. Exciting opportunities and high pay are available in specialized fields of welding such as underwater welding, aerospace and defense welding, and welding for the oil and gas industry. With additional experience and specialized training, welders often will advance to performing welding supervision or welding inspection duties. These jobs have increased pay, benefits, and better working conditions. For those welders who wish to pursue additional schooling, advance degrees can be obtained at the college or postgraduate level that allow the welding professional to perform welding engineering and even applied research into the science of joining metals.

Many welders enjoy a long career in the welding industry in a myriad of opportunities. Welding education, sales and distribution of welding equipment and supplies, and operating their own welding shops can serve as the basis of a successful career in the welding industry.

Persons interested in working with metal might consider the jobs of construction ironworkers, automotive body repairers, sheet-metal workers, pipe fitters and steam fitters, or boilermakers. They might look into the work of machinists, tool and die makers, blacksmiths, and forge shop workers.

**For Further Research**

American Petroleum Institute, 1220 L Street, NW, Washington, DC 20005-4070. Web site: www.api.org

American Society of Mechanical Engineers, 3 Park Avenue, New York, NY 10016-5990. Web site: www.asme.org

American Welding Society, 550 NW LeJeune Road, Miami, FL 33126. Web site: www.aws.org

International Association of Machinists and Aerospace Workers, 9000 Machinists Place, Upper Marlboro, MD 20772-2687. Web site: www.goiam.org

International Brotherhood of Boilermakers, 753 State Avenue, Kansas City, KS 66101. Web site: www.boilermakers.org

International Union, United Automobile, Aerospace and Agricultural Implement Workers of America, Solidarity House, 8000 East Jefferson Avenue, Detroit, MI 48214. Web site: www.uaw.org

United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry of the United States and Canada, United Association Building, 901 Massachusetts Avenue, NW, Washington, DC 20001-4397. Web site: www.ua.org

United Electrical, Radio and Machine Workers of America, One Gateway Center, Suite 1400, Pittsburgh, PA 15222-1416. Web site: www.ueinternational.org

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