Unit Contents

*Assignment Sheets are located in the Student Workbook.

Prerequisites:
None

Learning Activities Sheet

Student Name _____

Place a checkmark in the appropriate box as you complete each of the steps below.

❑	1. **Take**	Pretest provided by instructor. After test has been evaluated, follow instructor's recommendations.
❑	2. **Read**	Objective Sheet.
❑	3. **View**	Videotape entitled "Welding: Making It Happen."
❑	4. **Research**	Online resources regarding welding products and services. Visit www.aws.org (American Welding Society) as one of your resources.
❑	5. **Study**	Information Sheet, Objectives 1 and 2.
❑	6. **Do**	Assignment Sheet 1, "Identify Welding Processes."
❑	7. **Stop**	Have instructor evaluate the completed assignment sheet and if the evaluation is satisfactory, continue to step 8. If the evaluation is not satisfactory, repeat Steps 5 and 6.
❑	8. **Study**	Information Sheet, Objectives 3 through 9.
❑	9. **View**	Videotape entitled "Welding as a Career."
❑	10. **Research**	Online resources regarding general occupational information. Visit www.bls.gov (Occupation Outlook Handbook) as one of your resources.
❑	11. **Do**	Assignment Sheet 2, "Compare Employment Opportunities in Welding."
❑	12. **Stop**	Have instructor evaluate the completed assignment sheet and if the evaluation is satisfactory, continue to step 13. If the evaluation is not satisfactory, repeat Steps 8 through 11.
❑	13. **Study**	Information Sheet, Objectives 10 and 11.

Optional

Optional

❑ 14.	**Check**	With instructor for any additional assignments to be completed.
❑ 15.	**Take**	Posttest provided by instructor. After test has been evaluated, follow instructor's recommendations.
❑ 16.	**Stop**	Have instructor evaluate your unit performance. If the evaluation is satisfactory, proceed to next learning activities sheet. If evaluation is not satisfactory, ask instructor for further instructions.

Objective Sheet

Unit Objective

After completing this unit, the student should be able to discuss the importance of welding and cutting processes and identify common welding processes. The student should demonstrate these competencies by completing the assignment sheets and by scoring a minimum of 85 percent on the written test.

Specific Objectives

After completing this unit, the student should be able to:

1. Define terms related to welding orientation.
2. Complete statements about welding processes.
3. Select true statements about brazing and braze welding.
4. Complete statements about cutting processes.
5. Select true statements about where welders work.
6. Complete statements about what welders earn.
7. Select true statements about the job outlook for welders.
8. Complete statements about what it takes to become a good welder.
9. Select career opportunities for welders.
10. Match the terms standard, code, and specification to their definitions.
11. Complete statements about standards and their importance to the welding industry.

*12. Identify welding processes. (Assignment Sheet 1)

*13. Compare employment opportunities in welding. (Assignment Sheet 2)

*Assignment Sheets are located in the Student Workbook.

Information Sheet

Objective 1

Terms and definitions

a. **Base metal**—The metal or alloy that is welded, brazed, soldered, or cut

b. **Coalescence**—The growing together or growth into one body of the materials being welded

c. **Fusion welding**—The melting together of filler metal and base metal, or of base metal only, to produce a weld

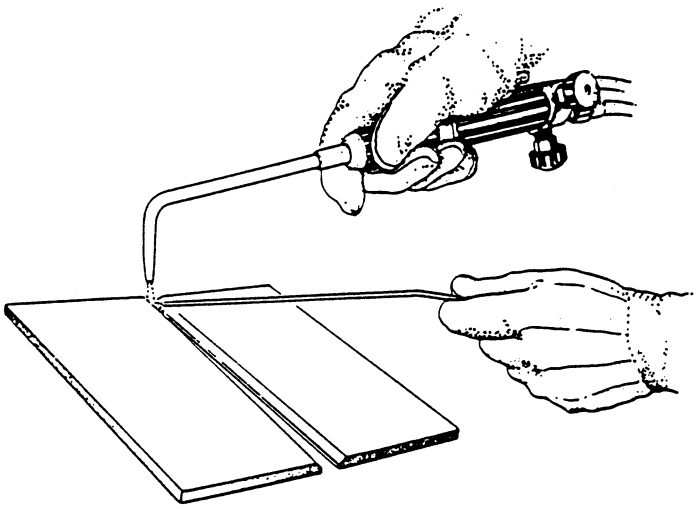
d. **Welding**—A joining process that produces coalescence of materials by heating to a melting point, with or without the application of pressure and with or without the use of filler metal

Objective 2

Welding processes and their applications

a. Oxyfuel Gas Welding (OFW)—A group of welding processes that produces coalescence by heating materials with an oxyfuel gas flame or flames, with or without pressure, and with or without the use of filler material

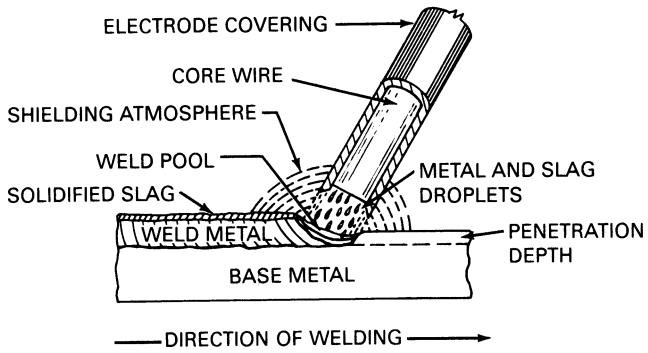
Figure 1



Courtesy Union Carbide Corporation, Linde Division

b. Shielded Metal Arc Welding (SMAW)—An arc welding process that produces coalescence of materials by heating them with an arc between a covered electrode and a workpiece; shielding is obtained from decomposition of the electrode cover, pressure is not used, and filler metal is obtained from the electrode

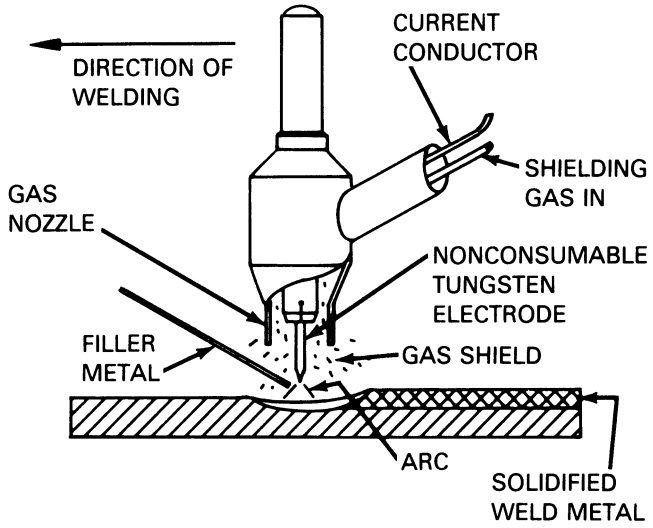
Figure 2



Courtesy American Welding Society

c. Gas Tungsten Arc Welding (GTAW)—An arc welding process that produces coalescence of materials by heating them with an arc between a nonconsumable tungsten electrode and a workpiece; shielding is obtained from a gas, and filler metal may or may not be used

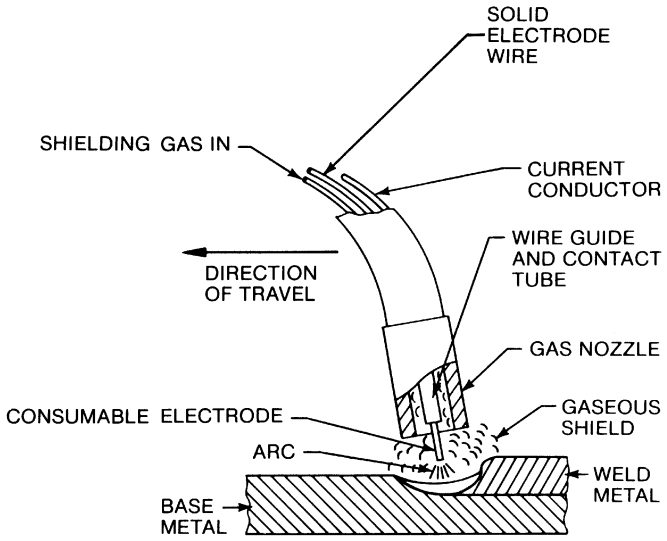
Figure 3



Courtesy American Welding Society

d. Gas Metal Arc Welding (GMAW)—An arc welding process that produces coalescence of metals by heating them with an arc between a continuous filler metal electrode and a workpiece; shielding is obtained entirely from an externally supplied gas

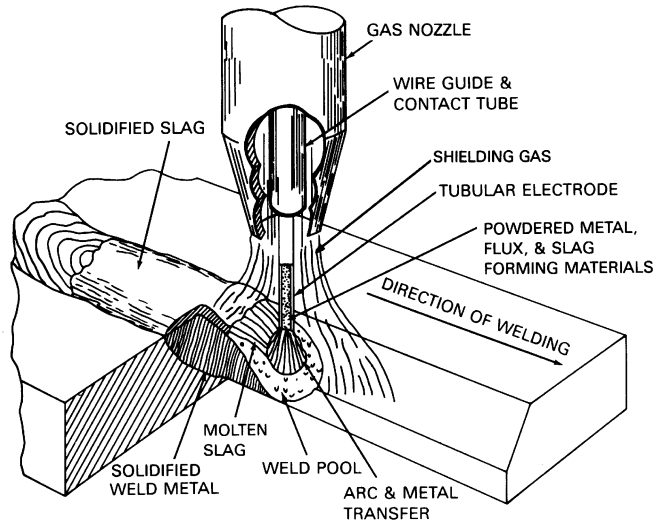
Figure 4



Courtesy American Welding Society

e. Flux-Cored Arc Welding (FCAW)—An arc welding process that produces coalescence of metals by heating them with an arc between a continuous filler metal electrode and a workpiece; shielding is provided by a flux contained within the tubular electrode, and additional shielding may or may not be obtained from an externally supplied gas or gas mixture

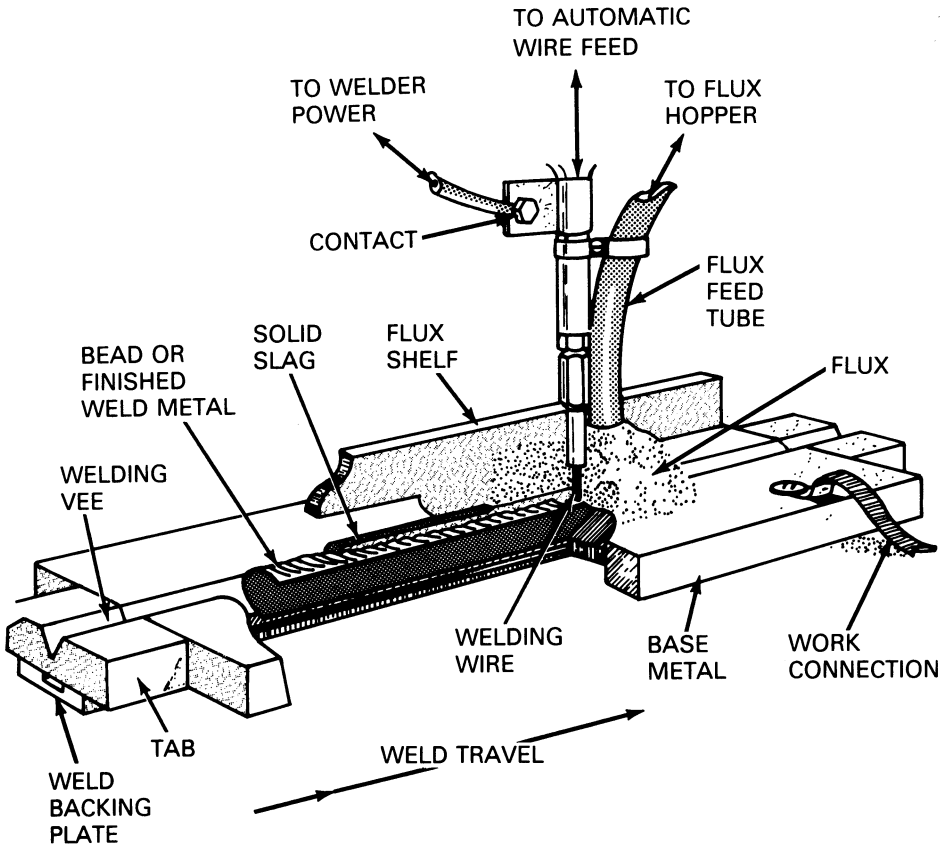
Figure 5



Courtesy American Welding Society

f. Submerged Arc Welding (SAW)—An arc welding process that produces coalescence of metals by heating them with an arc or arcs between a bare metal electrode or electrodes and a workpiece; the arc and molten metal are shielded by a blanket of granular, fusible material on the workpiece; pressure is not used, and filler metal is obtained from the electrode or sometimes from a supplemental source

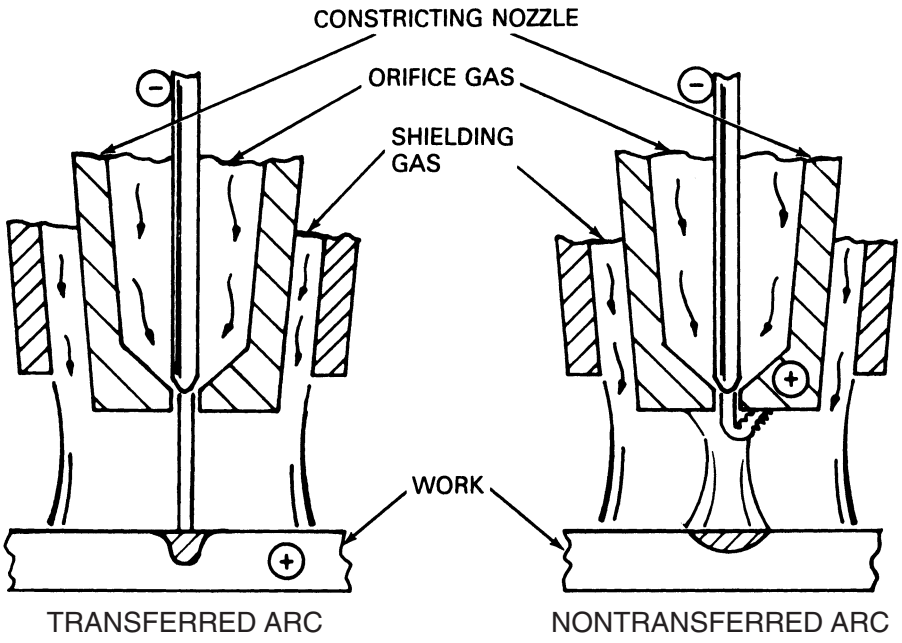
Figure 6



Courtesy American Welding Society

g. Plasma Arc Welding (PAW)—An arc welding process that produces coalescence of metals by heating them with a constricted arc between a nonconsumable electrode and a workpiece (transferred arc), or the electrode and a constricting nozzle (nontransferred arc)

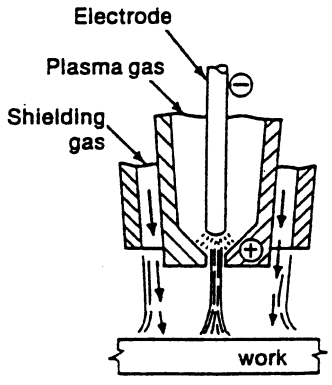
Figure 7



Courtesy American Welding Society

h. In PAW, shielding is obtained from the hot, ionized gas issuing from the torch, and this may be supplemented with an auxiliary source of shielding gas; shielding gas may be an inert gas or a mixture of gases, and filler metal may or may not be used

Figure 8



Courtesy Lincoln Electric Company

Information Sheet

Objective 3

Brazing and braze welding

a. Brazing is a group of welding processes that produces coalescence of materials by heating them to the brazing temperature in the presence of a filler metal having a melting point above 840°F and below the melting point of the base metal.

b. In brazing processes, the filler metal is distributed between the closely fitted surfaces of the joint by capillary action.

c. Braze welding is a welding process variation that uses a filler metal with a melting point above 840°F and below the melting point of the base metal.

d. Unlike brazing, in braze welding, the filler metal is not distributed in the joint by capillary action.

Objective 4

Cutting processes

a. Oxyfuel Gas Cutting (OFC)—A group of cutting processes used to sever metals by means of the chemical reaction of oxygen with a base metal at elevated temperatures; the necessary temperature is maintained by means of gas flames obtained from the combustion of a specified fuel gas and oxygen

Note: The oxyfuel cutting processes include oxyacetylene, OFC-A; oxyhydrogen, OFC-H; oxynatural, OFC-N; oxypropane, OFC-P; and others.

b. Carbon Arc Cutting (CAC)—A group of cutting processes that sever or remove metal by melting with the heat of the arc between an electrode and the workpiece

Note: Some popular arc cutting processes are carbon arc cutting-air (CAC-A) and plasma arc cutting (PAC). These processes are discussed in other texts of the MAVCC welding series.

Objective 5

Where welders work

a. Welders, cutters, and welding machine operators held about 453,000 jobs in 1996.

b. About 9 out of 10 welders and cutters were employed in manufacturing, services, construction, or wholesale trade.

c. The majority of those in manufacturing were employed in transportation equipment, industrial machinery and equipment, or fabricated metal products.

d. All welding machine operators were employed in manufacturing industries, primarily fabricated metal products, machinery, and motor vehicles.

Objective 6

What welders earn

a. The median earning for welders and welding machine operators was about $478 a week in 1996.

Note: Figures are from the Bureau of Labor Statistics for the late 1990s.

b. Beginners and lesser paid welders averaged $278 a week, but welders in the top 10 percent income bracket earned over $807 a week.

c. Many welders work in situations where company benefits make the job more attractive, and over one-fourth of all welders belong to a union.

Note: Some of the unions that welders find attractive are the International Association of Machinists and Aerospace Workers; the International Brotherhood of Boilermakers, Iron Ship Builders, Blacksmiths, Forgers and Helpers; United Automobile Workers, Aerospace and Agricultural Implement Workers of America; 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.

Objective 7

Job outlook for welders

a. Employment of welders and cutters is expected to increase by 8.3% from 1998 through the year 2008.

b. In some areas, the need for welders will decline through the year 2008 but many job openings will arise because of the need to replace experienced workers who transfer or retire.

c. The areas that look best for good welding jobs are in construction and business services (repair) because these are areas that are difficult to automate.

d. Many jobs will be open in manufacturing, but they will be jobs in maintenance, repair, and other areas where the work cannot be automated.

Objective 8

What it takes to become a good welder

a. Training for welding should start early in high school and include courses in shop math, mechanical drawing, print reading, physics, chemistry, and metallurgy. If available, take applied courses in the preceding courses; take applied physics instead of traditional physics.

b. Some welding machine operators can learn their jobs in a few days or weeks, but employers prefer applicants who have high school, vocational and/or postsecondary training in welding.

c. Welders and cutters need manual dexterity, good eyesight, and good eye-hand coordination.

d. Good welders should also be able to concentrate on detailed work for long periods, and be able to bend, stoop, and work in awkward positions.

Information Sheet

Objective 9

Career opportunities for welders

a. The welding machine operator or robotic cell operator will probably take a specialized course to learn the equipment and work in a manufacturing facility that uses automated equipment.

b. The combination welder will normally be found in plant maintenance or a repair shop, and because combination welders can do it all, they are often in demand.

c. The welder-fitter is something of a specialist and works in manufacturing jobs that require a knowledge of metallurgy and joint design in addition to welding skills.

d. The specialist welder will become highly skilled in one or two welding processes and work on special products or projects.

Example: The gas tungsten arc process on stainless steel is a popular process for making bright, shiny salad bars and other restaurant equipment, and is also used frequently with stainless steel applications in medical installations.

e. Welders who demonstrate leadership ability often advance to a supervisory position and may run a welding crew or supervise welders in a facility.

f. Other advanced jobs open to skilled welders include:

(1) Certified welding inspector (CWI);
(2) Welding tester;
(3) Equipment salesperson;
(4) Sales troubleshooter;
(5) Certified welding educator (CWE)

g. Welders who continue their education can advance to the level of welding engineer, metallurgist, or several other jobs where associate or advanced college degrees are required.

Objective 10

Standards, codes, and specifications

a. Standard—A document that governs and guides welding activities

- Describes the technical requirements for a material, process, product, system, or service

- Indicates the procedures, methods, equipment, or tests used to determine that requirements have been met

Note: Standards keep the welder safe and hold them accountable for the work they accomplish.

b. Code—A type of standard that uses the words *shall* and *will* to indicate the mandatory use of certain materials or actions, or both

- Generally associated with a process

c. Specification—A type of standard that uses the words *shall* and *will* to indicate the mandatory use of certain materials or actions, or both

- Generally associated with a product

Objective 11

Standards and their importance to the welding industry

a. In 1936, the Committee on Standard Qualification Procedures issued its first report to the American Welding Society; the report called for general qualification standards for procedures and performances of welders.

b. Today, standards guide many industrial producers, and standards affecting welding are produced by other groups who have welding minimums that must be met and procedures that must be followed.

Note: Standards include codes, specifications, recommended practices, classifications, methods, and guides.

Examples: The American Petroleum Institute sets standards for pipeline welding, the American Society of Mechanical Engineers, among others, sets standards for high pressure boilers, and the Aluminum Association sets standards for welding aluminum.

c. The American Welding Society has various committees who meet to update and change standards as needs require, and among these standards, three are important to all welders, including beginners:

(1) Standard for Welding Procedure and Performance Qualification
(2) Standards Symbols for Welding, Brazing, and Nondestructive Examination
(3) Standard Welding Terms and Definitions

Note: The standards for symbols and terms are not only AWS standards, they are also American National Standards adapted by the American National Standards Institute, ANSI.