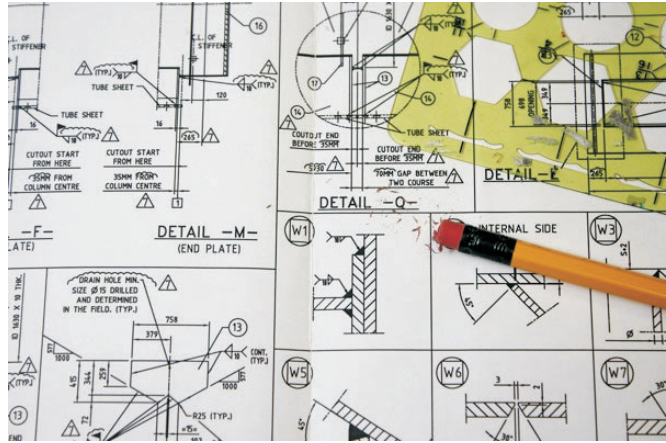


Print Reading: Welding Design

READING welding prints requires you to pay close attention to details. The welding symbol holds vital information for the engineer and fabricator. It is a graphic that shows where the weld is to be located and all of its specific features. The graphic holds coded numbers and smaller symbols. Their specific location on the graphic is important because the location gives detailed information about the weld. Once you learn the basics, you can begin to read welding prints.



Objectives:



1. Analyze welding prints.
2. Interpret welding print symbols, abbreviations, and terms.

Key Terms:



arc welding
brazing
contour welding
field weld

fillet weld
resistance welding
seam welding
spot welding

thermit welding
weld symbol
welding prints
welding symbol

Welding Prints

Welding prints are drawings that convey construction and fabrication information necessary to produce or assemble metalwork. The drawings have a series of standard information about the print plans, including date produced, who produced them, what they represent, reference information, and any change orders that may have been made.

ELEMENTS OF A WELDING PRINT

A welding print incorporates various pieces of essential information. It will typically include a title block, revision block, reference number, dash numbers, and a scale.

Title Block

A title block is an area that includes the name of the company or organization that produced the drawing, the final issue date, and information about an individual part or project. It contains a print name and reference number (and/or letter). All information necessary to identify who produced the drawing and the specific intent of the drawing is located in the title block.

Revision Block

A revision block is any drawing that has been revised from the original and is usually located in the upper right corner. Any changes are noted in this block; they are dated and identified by a number or letter.

Reference Number

A reference number is an item used to identify a drawing within a set of drawing sheets. There are usually multiple sheets (drawings) for a project or product. Drawings that convey similar information will be grouped by the same number or by the same letter. A cover sheet lists all drawings with their corresponding numbers and letters.

Dash Number

Some drawings contain multiple details or require additional drawings to describe a part; these drawings have additional reference numbers that generally appear in the title block followed by a dash and the extra digits identifying that particular set.

Scale

Drawings always contain a scale located in the title block. Scale indicates the drawing size compared to the actual size of the part or assembly it represents. This is a reference only. It does not ensure that the drawing is printed exactly to that scale. The drawing's dimensions are used for fabrication.

WELDING SYMBOL

The weld symbol and welding symbols were developed by the American Welding Society and are standard across the United States. Welding prints must contain clearly understood information that allows the engineer, designer, and fabricator to work together on a part and/or project. A **weld symbol** is a graphic that indicates the details of the specific type of weld. A **welding symbol** is assemblages of common weld symbols, abbreviations, and terms used to represent the full weld on a drawing. All the necessary information for each weld is contained

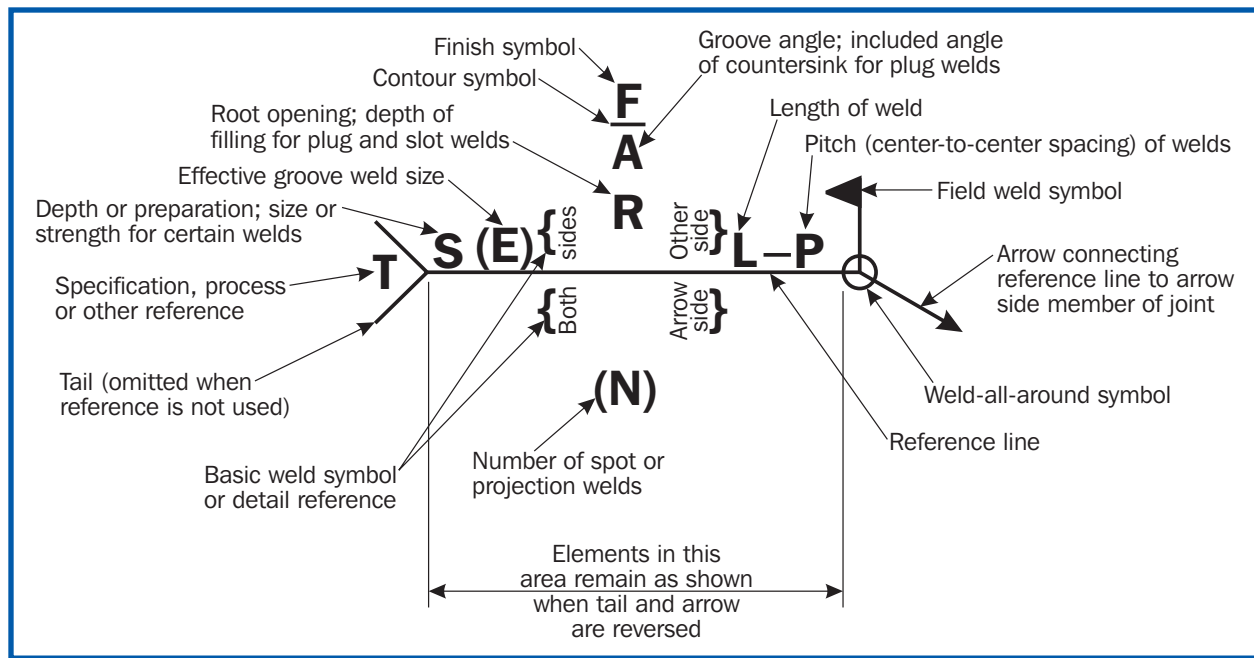


FIGURE 1. A welding symbol includes all the necessary information for the fabricator to create the exact weld required. (Adapted from Shanghai Jiao Tong University, Shanghai, China)

in a welding symbol. The three main parts to the welding symbol are the reference line, arrow, and tail.

- ◆ **Reference line**—The actual joint of the weld is the point of reference for the welding symbol. Information can be noted above or below the reference line; it is referred to as the “arrow side” and the “other side.” Symbols and abbreviations on the reference line provide information about the weld: contour, extent, dimensions, location, and any additional information that may be required.
- ◆ **Arrow**—The arrow is drawn to locate the welding symbol to the joint or area to be welded. The terms “arrow side,” “other side,” and “both sides” are used to locate the weld with respect to the joint.
- ◆ **Tail**—The welding and cutting processes are located on the tail of the symbol. The procedure, specifications, and any required additional information for making the weld are located on the tail.

Symbols, Abbreviations, and Terms

SYMBOLS

The location of the weld symbol on the reference line tells the welder where (on which side of the object) to make the weld. The weld symbol is located on the bottom of the reference

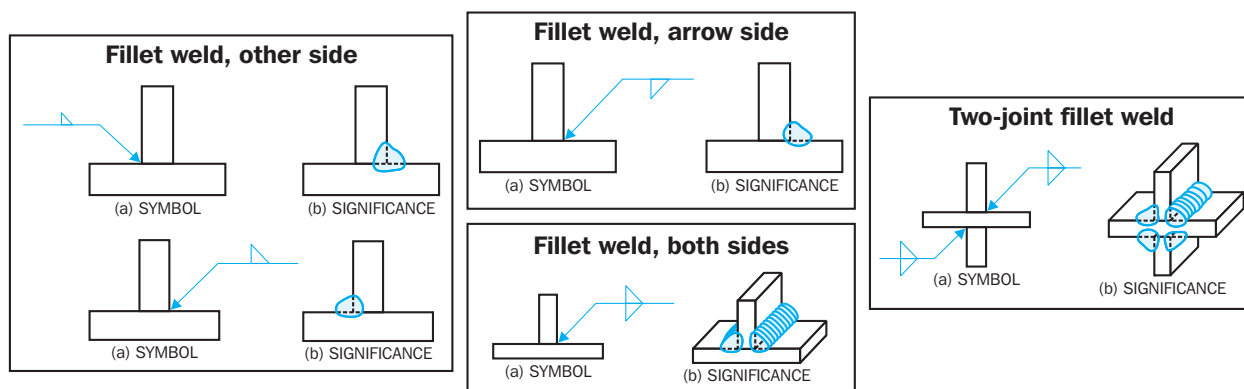


FIGURE 2. In these basic welding details, the reference line points to the location of the weld. The weld (type) symbol is properly located above or below the reference line to note on which side to place the weld. There are also examples of multiple welds on opposite sides. (Adapted from Shanghai Jiao Tong University, Shanghai, China)

line when the weld is to be made on the arrow side. When it is located on the top of the reference line, the weld is located on the opposite side of the arrow. If the symbol is on both sides of the line, the weld is on both sides.

- ◆ The basic weld symbol is the primary symbol shown within on the welding symbol. It notes the specific type of weld required. In addition to the weld type, the groove type is required. It is noted with a groove weld symbol.

GROOVE WELD SYMBOLS							
Square	Scarf	V	Bevel	U	J	Flare-V	Flare Bevel
Fillet	Plug or Slot	Stud	Slot or Projection	Seam	Back or Backing	Surfacing	Edge

NOTE: ---- (dashed line) represents reference line

FIGURE 3. These are the basic weld types and groove symbols. They are shown in various possible positions to allow you to see on which side the weld and groove are placed. (Courtesy, Shanghai Jiao Tong University, Shanghai, China)

Location Significance	Fillet	Plug or Slot	Spot or Projection	Stud	Seam	Back or Backing**	Surfacing	Edge
Arrow Side								
Other Side				NOT USED			NOT USED	
Both Sides		NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	
No Arrow Side or Other Side Significance	NOT USED	NOT USED		NOT USED		NOT USED	NOT USED	NOT USED

Location Significance	Groove							
	Square	V	Bevel	U	J	Flare-V	Flare-Bevel	Scarf
Arrow Side								
Other Side								
Both Sides								
No Arrow Side or Other Side Significance		NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED	NOT USED

*Used for ESW and EGW

**Back or backing is specified in tail of welding of symbol having a single reference line.

FIGURE 4. Understanding how to use the reference line is critical to communicating and reading welding instructions. Be certain which type of weld you are using and on which side of the part it is to be located. (Courtesy, Shanghai Jiao Tong University, Shanghai, China)

- ◆ A standard set of supplementary weld symbols can be added to basic weld symbols. Supplements may include the weld contour and if the work is to be done on- or off-site.
- ◆ The exact location of the weld symbol on the reference line is important. The symbol can be on the arrow side, the other side, or both sides.
- ◆ The specifications on how to finish a weld and its contour are designated in the weld symbol. They can be used to produce refined welds with smooth finishes.
- ◆ Specific applications may require more than one weld. In some cases, multiple operators may produce the welds. In addition, each operator may be required to perform a different type of weld. This is noted with multiple reference lines or multiple symbols.
- ◆ The dimensions on welding symbols are used to designate the size, strength, length, pitch, and the number of welds (e.g., for a spot weld). This data has a very specific location on the welding symbol based on the reference line. Size dimensions applied to weld (type) symbols are located adjacent to the symbol.
- ◆ Special information is occasionally required for a weld. The additional information is often noted in the tail of the welding symbol. The required information may be in a separate drawing or alternate location; if so, a reference is given in the form of a letter, number, or another print (drawing) number.

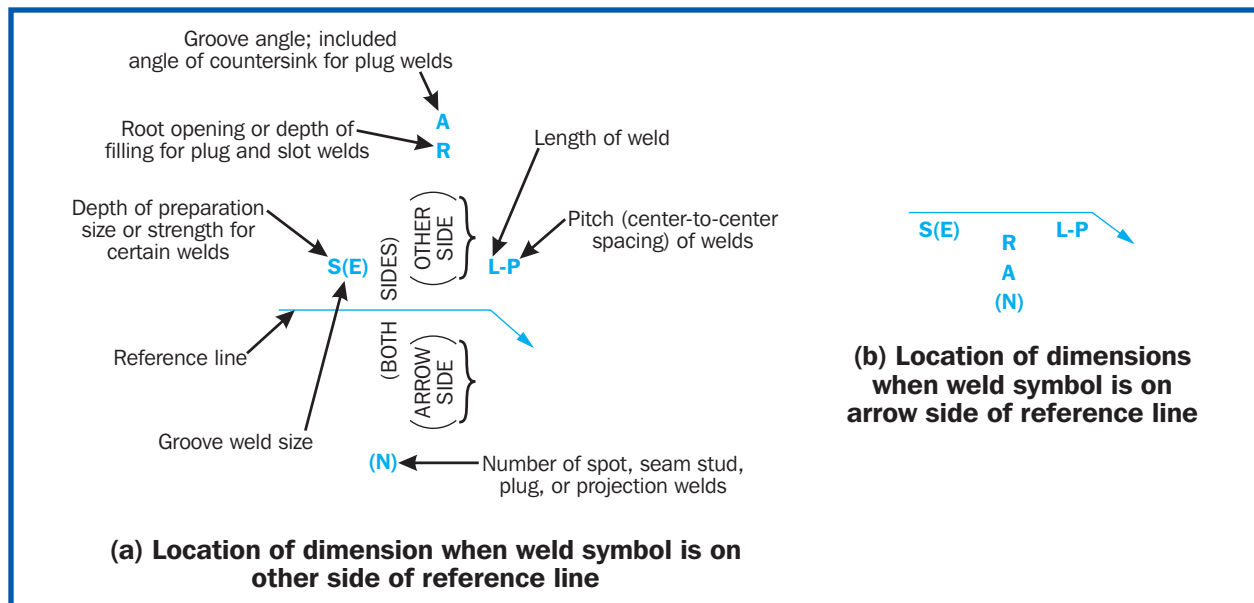


FIGURE 5. There are several locations for dimensions on the welding symbol. Once you are more familiar with the location of supplemental information, you will see that the dimension location aligns with the symbols or abbreviations it references. (Courtesy, Shanghai Jiao Tong University, Shanghai, China)

ABBREVIATIONS

Abbreviations are common on welding prints and in welding symbols. They typically designate the welding process or the cutting process. The abbreviations are usually the first letter of each word used. If a redundancy exists, the first and second letters are used in one of the words. For example, the abbreviation TB designates the welding process of torch brazing.

TABLE 1. Common Welding Process Abbreviations

Welding Process	Abbreviation (Letter Designation)
Brazing	
Torch brazing	TB
Twin carbon-arc brazing	TCAB
Furnace brazing	FB
Induction brazing	IB
Resistance brazing	RB
Dip brazing	DB
Block brazing	BB
Flow brazing	FLB
Flow welding	FLOW

(Continued)

Welding Process	Abbreviation (Letter Designation)
Resistance welding	
Flash welding	FW
Upset welding	UW
Percussion welding	PEW
Induction welding	IW
Arc welding	
Bare metal-arc welding	BMAW
Stud welding	SW
Gas shielded stud welding	GSSW
Submerged arc welding	SAW
Gas tungsten-arc welding	GTAW
Gas metal-arc welding	GMAW
Atomic hydrogen welding	AHW
Shielded metal-arc welding	SMAW
Twin carbon-arc welding	TCAW
Carbon-arc welding	CAW
Gas carbon-arc welding	GCAW
Shielded carbon-arc welding	SCAW
Flux cored-arc welding	FCAW
Thermit welding	
Nonpressure thermit welding	NTW
Pressure thermit welding	PTW
Gas welding	
Pressure gas welding	PGW
Oxyhydrogen welding	OHW
Oxyacetylene welding	OAW
Air-acetylene welding	AAW
Forge welding	
Roll welding	RW
Die welding	DW
Hammer welding	HW

TABLE 2. Common Welding Application Method Abbreviations

Welding Application Method	Abbreviation (Letter Designation)
Automatic welding	AU
Machine welding	ME
Manual welding	MA
Semi-automatic welding	SA

TABLE 3. Common Cutting Process Abbreviations

Cutting Process	Abbreviation (Letter Designation)
Arc cutting	AC
Air-carbon-arc cutting	AAC
Carbon-arc cutting	CAC
Metal-arc cutting	MAC
Oxygen cutting	OC
Chemical flux cutting	FOC
Metal powder cutting	POC
Arc-oxygen cutting	AOC

TABLE 4. Common Cutting Method Abbreviations

Cutting Method	Abbreviation (Letter Designation)
Automatic cutting	AU
Machine cutting	ME
Manual cutting	MA
Semi-automatic cutting	SA

TERMINOLOGY

- ◆ **Arc welding** (shielded metal) is the process of joining two metal pieces using a flux-covered electrode. The electrode is melted in an electric arc and becomes part of the pieces being welded.
- ◆ **Brazing** is the process of joining two pieces of metal with a metallic filler (the braze material). The filler is melted across the joint and then cools to form a solid bond.



FURTHER EXPLORATION...

ONLINE CONNECTION: The Brazing Process

There are several ways to weld; each one is used for a specific purpose. Each process allows for a different type of connection. Welders are typically required to learn how to perform each type of weld. To learn more about the brazing process for welding, watch the following video:

<http://www.youtube.com/watch?v=ZojlpKCo4TQ>

- ◆ **Contour welding** is a welding process in which a laser is guided along a predetermined pattern. The material only melts on the path on which the laser is directed.
- ◆ A **field weld** is a weld that is an operation performed at the construction site.
- ◆ A **fillet weld** is the most common type of weld. It is used to join two pieces of flat stock (steel) at a 90-degree angle. It is produced by running a weld bead at a 45-degree angle to a 90-degree corner. It looks like a triangle when viewed from the side.
- ◆ **Resistance welding** is a process that joins two pieces of metal by passing current between electrodes positioned on opposite sides of the pieces.
- ◆ **Seam welding** is a type of resistance welding that creates a lengthwise seam in sheet metal by a butt joint or an overlap joint. It is usually an automated process.

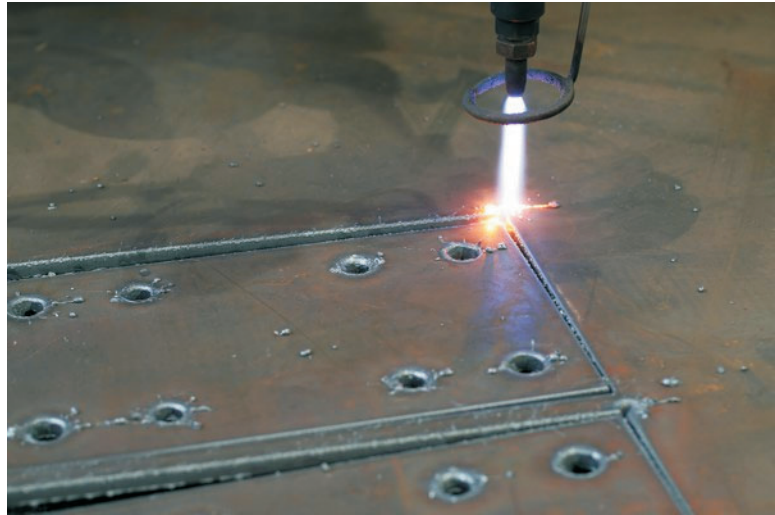


FIGURE 6. Contour welding is useful in precision applications.



FIGURE 7. Field welding is a common practice. It is often necessary to complete repairs and intricate welds on site.



FURTHER EXPLORATION...

ONLINE CONNECTION: How Spot Welding Works

Spot welding is a unique type of resistance welding. It is common in the automobile industry and is often automated. To learn more about how spot welding works, watch the video:

<http://www.youtube.com/watch?v=AwL1CAg43PU>

- ◆ **Spot welding** is a type of resistance welding in which materials are fused together by the heat from a flow of electric current through the pieces held together under pressure by the electrodes.
- ◆ **Thermit welding** is a group of welding processes in which fusion is produced by super-heating copper alloy to permanently join the conductors.

Summary:



Welding prints are used to convey construction and fabrication information necessary to produce or assemble metalwork. The drawings have a series of standard information necessary to identify when and who produced the plans and the project as well as reference information and any change orders.

All the necessary information for the weld is contained in a welding symbol. The actual weld joint is the point of reference for the welding symbol. Symbols and abbreviations on the reference line give you information about the weld, its contour, extent, dimensions, location, and any additional information that may be required to produce a perfect weld.

The welding and cutting processes are located on the tail of the symbol. The arrow is drawn to locate the welding symbol to the joint or area to be welded. The weld symbol location on the reference line tells you on which side of the object to make the weld.

Checking Your Knowledge:



1. Name the welding process in which a laser is guided along a predetermined pattern.
2. Name the primary symbol on the welding symbol.
3. What is a field weld?
4. What is a fillet weld?
5. Name the welding process that joins two pieces of metal by passing current between electrodes positioned on opposite sides of the pieces.

Expanding Your Knowledge:



Many books exist about how to read welding prints. If you are interested in learning more, check out one of these books from your local or school library. As you read through the books, create your own set of welding symbols, abbreviations, and terms. Keep your new journal for reference.

Web Links:



Welding Procedures and Techniques

<http://www.weldingengineer.com/>

Weld and Welding Symbols

<http://www.arcraftplasma.com/weldingsymbols.htm>

Welding Blueprint: Problem 3

<http://www.youtube.com/watch?v=d8iXJZZLIaA>

Welding Blueprint: Problem 8

<http://www.youtube.com/watch?v=Q3DJxmRV1-c&feature=related>