

# Unit 14

# Welding Symbols

After completing Unit 14, you will be able to:

- List the basic elements of a welding symbol.
- Explain the meaning and use of each element of a welding symbol.
- Interpret which side of the weld joint the weld is placed.
- Identify and interpret nonpreferred weld symbols.
- Explain a welding symbol by developing a pattern to follow.
- Explain the difference between AWS and ISO welding symbols.

## Key Words

arrow	identification line	other side
arrow side	International	reference line
back weld	Organization for	supplementary symbols
backing weld symbol	Standardization	tail
bent leader	(ISO)	weld-all-around symbol
broken leader	joint penetration	welding symbol
contour symbol	melt-through symbol	weld length
field weld symbol	nonpreferred weld symbols	weld size
finish symbol	notation	weld symbol

## Introduction

To make welds indicated on a drawing, the welder must be able to interpret welding symbols. Symbols are used to condense a large quantity of information about the weld into a small amount of space. This is shown in Figure 14-1.

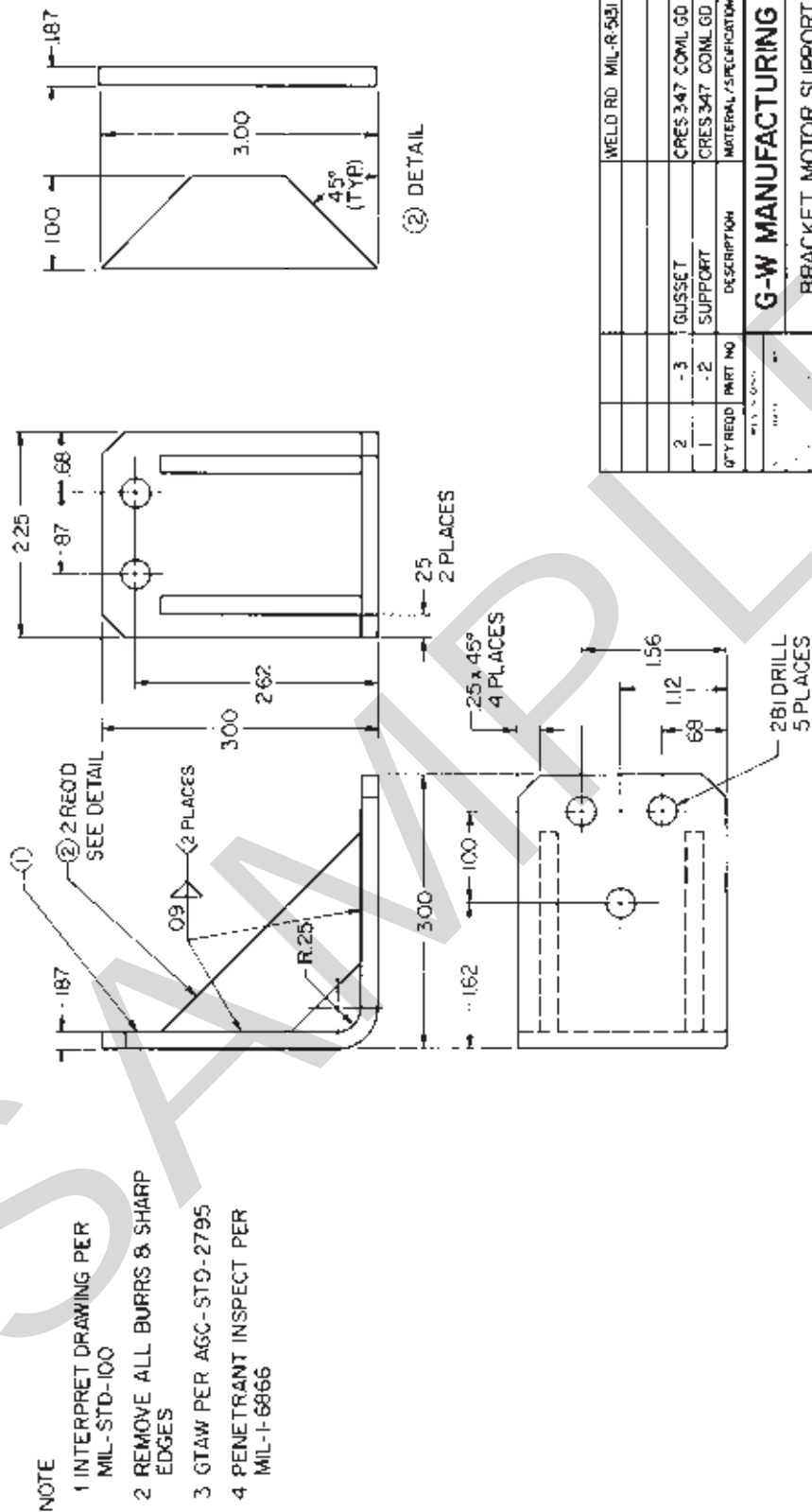
A **welding symbol** is a graphic assembly of the elements needed to fully specify weld requirements, Figure 14-2. Welding symbols simplify communications between engineers who design the product and shop personnel who must fabricate the product. Used on drawings, symbols contain the data needed to “tell” a welder the exact type of weld wanted by the designer or engineer.

## Elements of a Welding Symbol

Unless needed for clarity, all elements do *not* have to be used on every welding symbol. Only the reference line and arrow are required.

The eight possible elements of a welding symbol include:

- Reference line
- Weld symbol
- Arrow
- Tail
- Supplementary symbols
- Dimensions
- Finish symbols
- Notations pertaining to the process, filler metal, and any related standard

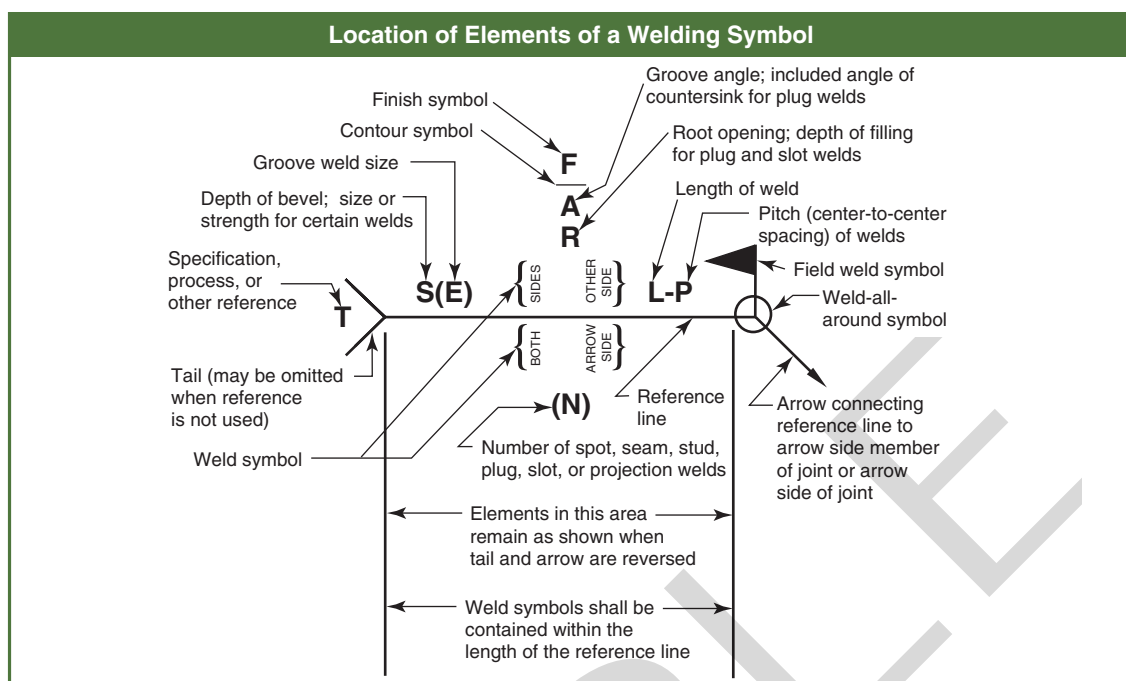


QTY REQD	PART NO	DESCRIPTION	MATERIAL / SPECIFICATION	NO
2	-3	GUSSET	CRES 347 CONL GD	2
1	-2	SUPPORT	CRES 347 CONL GD	1
G-W MANUFACTURING				
BRACKET MOTOR SUPPORT				
JAN 3-17 3-17 3-17 3-17 3-17				
LJ BS GF B 371-2123				
WELD RD. MIL-R-581 5				
4				
3				
2				
1				

WELDING 1001 1001 1001 1001 1001

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**Figure 14-1.** To make the welds indicated on this drawing, the welder must be able to "read" symbols that furnish weld specifications.



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**Figure 14-2.**

A welding symbol is a graphic explanation of the elements needed to fully specify weld requirements.

### Reference Line

The **reference line** is the “backbone,” or required central element, of the welding symbol. It is always shown in a horizontal position. Other elements describing weld requirements are located on, above, below, and/or at either end of the reference line.

### Weld Symbol

The basic weld symbol should be differentiated from the welding symbol. The basic **weld symbol** depicts the cross-sectional shape of the weld or joint. It is one part of the welding symbol. Study the basic weld symbols shown in Figure 14-3.

Square-Groove	Scarf-Groove	V-Groove	Bevel-Groove	U-Groove	J-Groove	Flare-V-Groove	Flare-Bevel-Groove	
Fillet	Plug	Slot	Stud	Spot or Projection	Seam	Back or Backing	Surfacing	Edge

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**Figure 14-3.**

Memorize the names and shapes of the basic weld symbols. The reference line is shown as a dashed line.

Either a basic weld symbol or notations in the tail are required on a welding symbol. In some situations, however, both elements may be included on a welding symbol to furnish complete weld specifications.

### Arrow

An **arrow** (or leader) connects the reference line of a welding symbol to one side of the joint to be welded. The shape and location of the arrow are important. The use of the arrow is required.

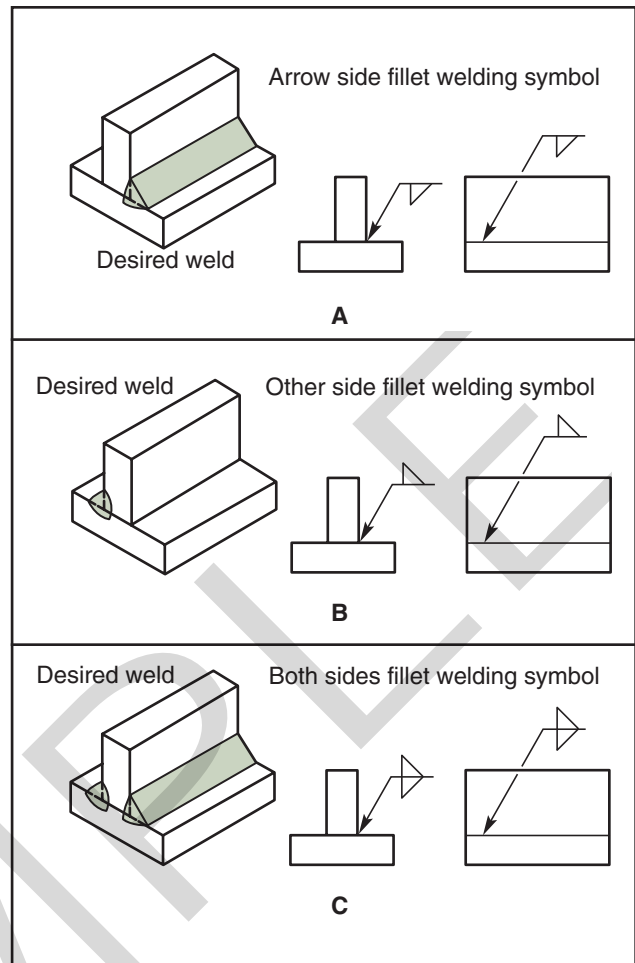
Running the arrow from the reference line to one side of the required weld indicates the placement of *fillet, groove, and edge welds*.

The lower side of the reference line is called the **arrow side**. It indicates the same side or near side of the joint, Figure 14-4. A weld symbol *below* the reference line signifies the weld should be on the arrow side (same side) of the joint.

The opposite side of the arrow side is considered the **other side**. It is located on the upper side of the reference line. The other side indicates the far side of the joint, Figure 14-4. When the weld symbol is *above* the reference line, a weld is only required on the other side (opposite side) of the joint.

Weld symbols on *both* sides of the reference line indicate welds are needed on both the arrow side and other side of the joint, Figure 14-5.

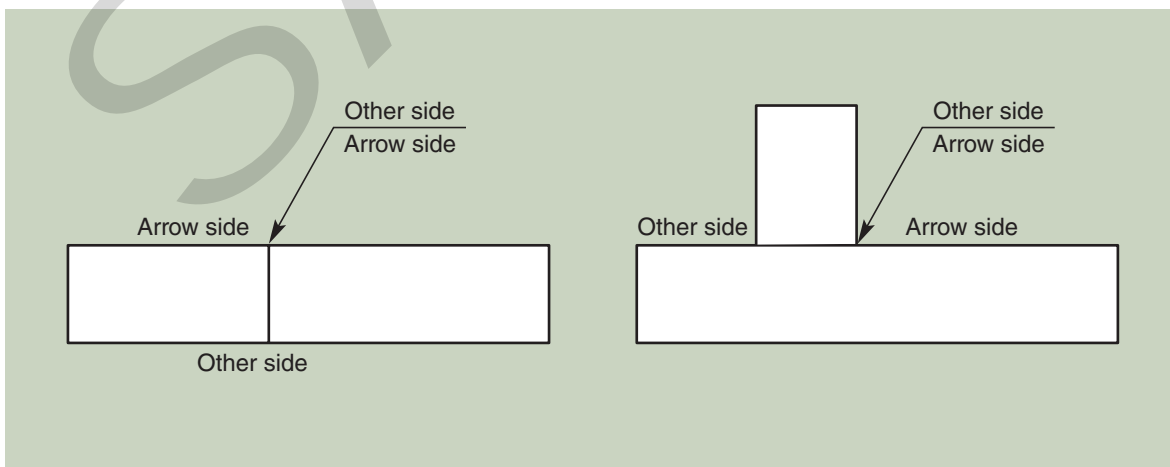
The arrow for *bevel and J-groove welds* uses a **bent leader** (or **broken leader**). The arrow head points to the particular section to be prepared, either by machining, flame cutting, air carbon arc gouging, or some other process, Figure 14-6.



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**Figure 14-5.**

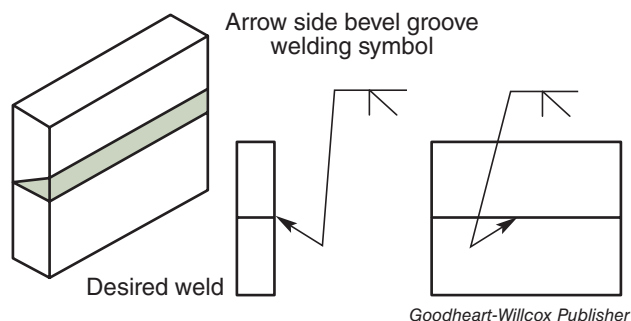
Each fillet weld symbol shown means something different. A—The arrow side fillet welding symbol means the weld is on the same side as the arrow. B—The other side fillet welding symbol means the weld is on the opposite side of the arrow. C—This welding symbol means weld on both sides.



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**Figure 14-4.**

The arrow side and the other side welds are specified in this manner.

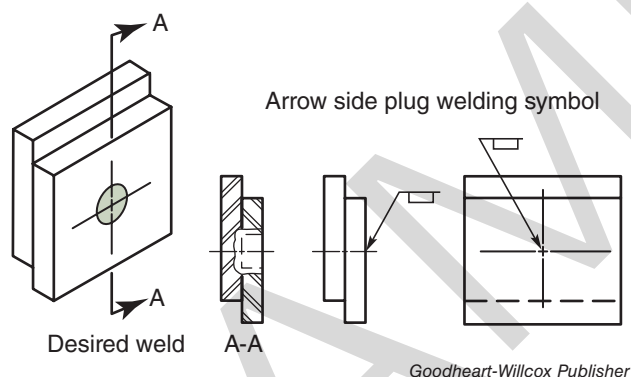


**Figure 14-6.**

The arrow for a bevel or J-groove weld uses a bent leader. The arrow head points to the particular section to be machined.

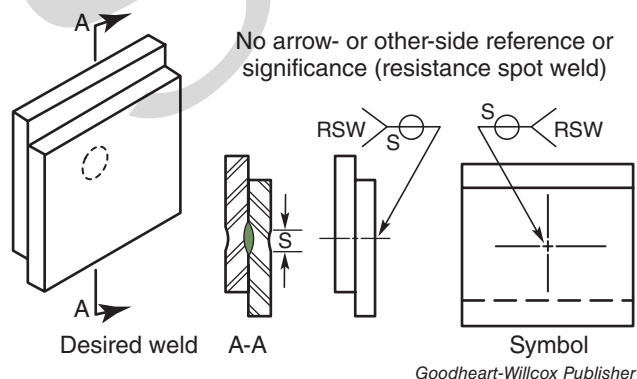
When *plug*, *slot*, *spot*, *seam*, and *projection* welds are required, the arrow points to the outer surface of one of the joint members at the center line of the desired weld. This member is considered the *arrow side member*. The other section of the joint is the *other side member*; Figure 14-7.

Some *resistance welds* have no arrow-side or other-side significance because the weld is made at the interface of the members, Figure 14-8.



**Figure 14-7.**

On plug, slot, spot, seam, and projection welds, the arrow points to the outer surface of one of the joint members at the center of the weld. This member is considered the arrow side member.

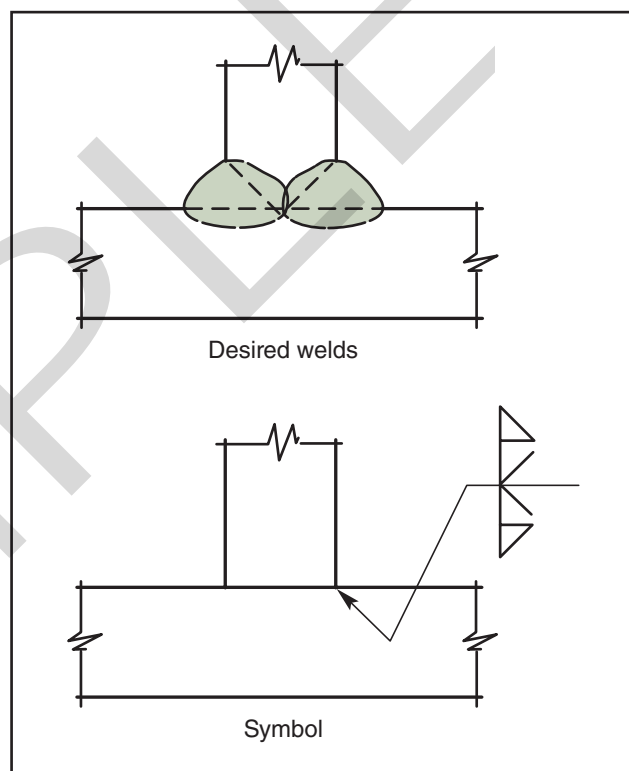


**Figure 14-8.**

A resistance weld is made at the interface of the members. It has no arrow-side or other-side significance.

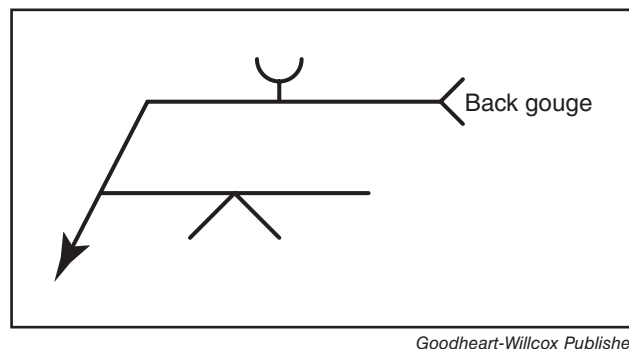
Joints having more than one type of weld have a weld symbol for each weld, Figure 14-9. Multiple reference lines may also be used to indicate the sequence of welding a joint. The reference line closest to the leader shows the weld that is made first. Figure 14-10 shows the sequence of a V-groove weld and U-groove back gouge.

A chart showing basic welding symbols and their location significance is given in Figure 14-11. Learn to name each weld symbol and explain its location on the joint.



**Figure 14-9.**

A joint with more than one type of weld will have a weld symbol for each weld. In this example, there is a bevel weld and a fillet weld on each side of the joint.



**Figure 14-10.**

Follow this sequence for welding a V-groove weld and U-groove back gouge.

Basic Welding Symbols and Their Location Significance

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	Square-Groove	V-Groove	Bevel-Groove	U-Groove	J-Groove	Flare-V-Groove	Flare-Bevel-Groove	Scarf for Brazed Joint
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

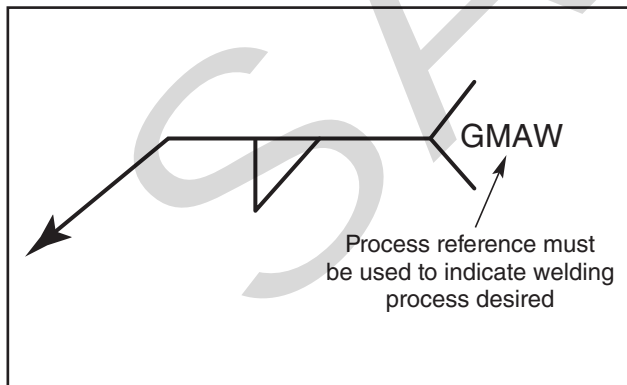
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Figure 14-11.

It is important to know the basic welding symbols and their location significance.

## Tail

The **tail** contains notes pertaining to the process, filler metal, and any related standards needed to establish specific weld requirements, Figure 14-12. If notations are not used, the tail element may be omitted.



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Figure 14-12.

The tail of a welding symbol may contain notes on a process, filler metal, and/or any related standards for weld requirements. This one shows gas metal arc welding.

## Supplementary Symbols

**Supplementary symbols** are often included with basic weld symbols to provide more specific weld data not provided by other elements in the welding symbol. Supplementary symbols are shown in Figure 14-13.

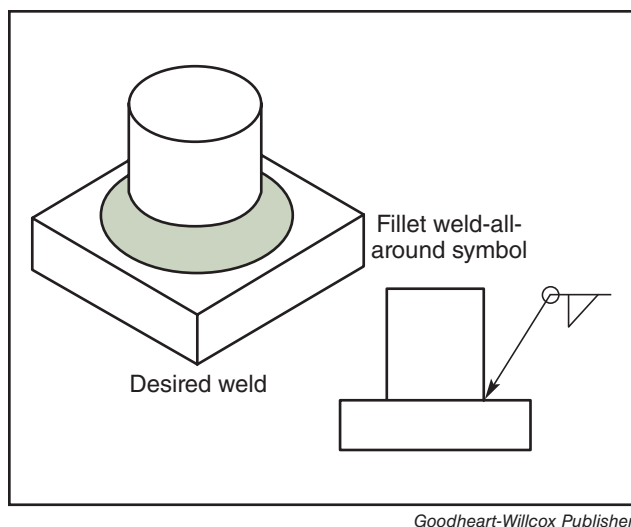
The **weld-all-around symbol** signifies the weld is to be made completely around the joint without interruption, Figure 14-14.

Supplementary Symbols			
Weld-All-Around	Field Weld	Melt-Through	Consumable Insert
Backing or Spacer (Rectangular)		Contour	
		Flush	Convex
			Concave

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Figure 14-13.

Study the supplementary symbols.



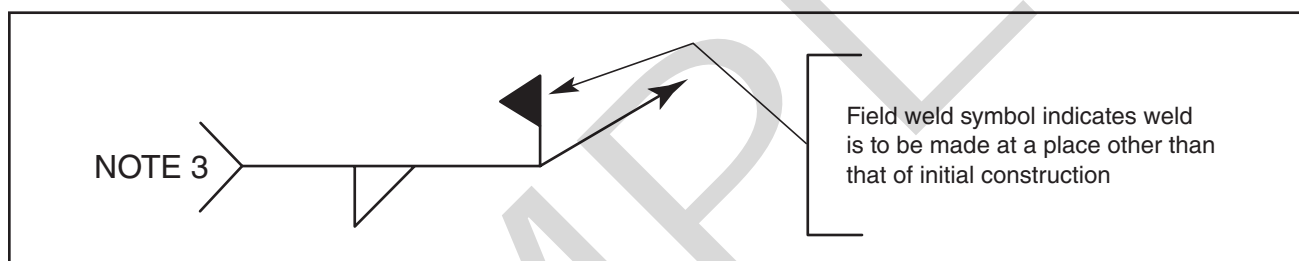
**Figure 14-14.**

Note the fillet weld-all-around symbol.

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A **field weld symbol** indicates the weld is not done where the unit is initially made, Figure 14-15. Instead, it is made in the field.

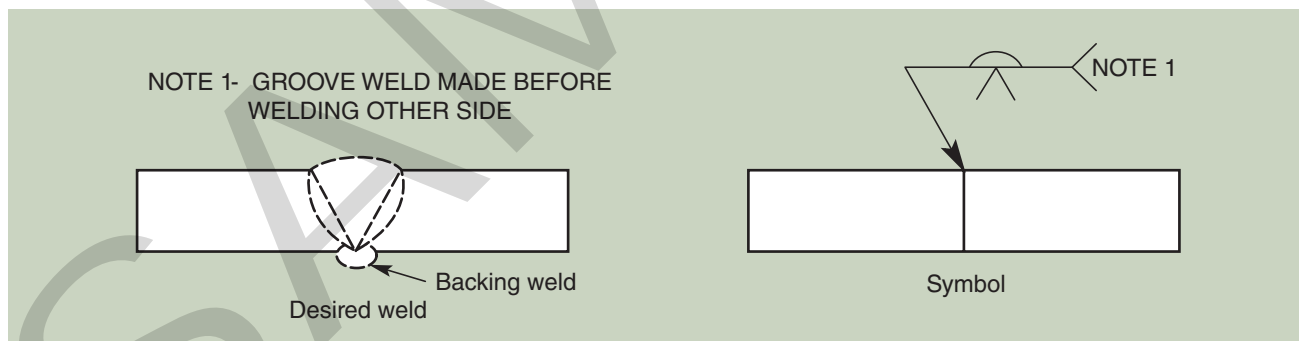
The **backing weld symbol** indicates a bead-type backing weld on the opposite side of the regular weld. This is pictured in Figure 14-16. A **back weld** is made after the required weld indicated by the symbol is complete. The back weld assures full weld material through the joint (sometimes called complete joint penetration or CJP). **Joint penetration** refers to the distance the weld metal extends from the weld face into a joint, not including weld reinforcement. Figure 14-17 shows a back weld. Notice the groove weld is made first and the back weld is used to provide full penetration and full strength. Figure 14-18 shows the back weld symbol. Back weld is listed in the tail.



**Figure 14-15.**

This welding symbol indicates the weld must be made in the field.

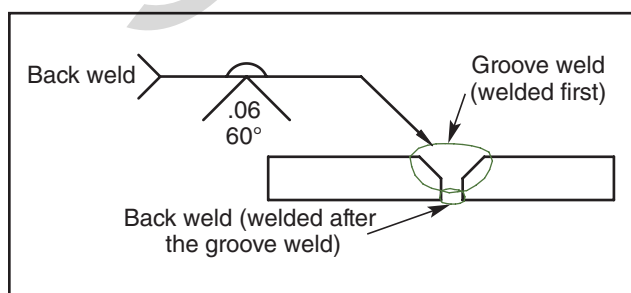
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**Figure 14-16.**

The backing weld symbol means a bead-type backing weld is to be made on the opposite side of the regular weld.

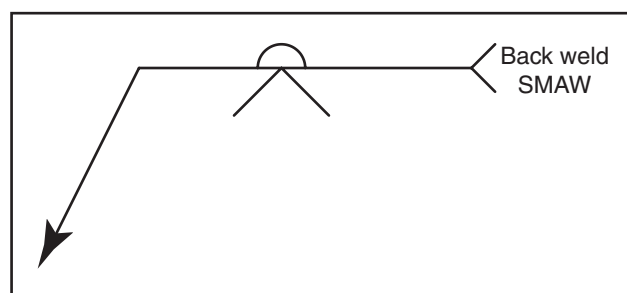
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**Figure 14-17.**

A back weld ensures complete joint penetration.

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**Figure 14-18.**

The back weld symbol contains the weld process in the tail.

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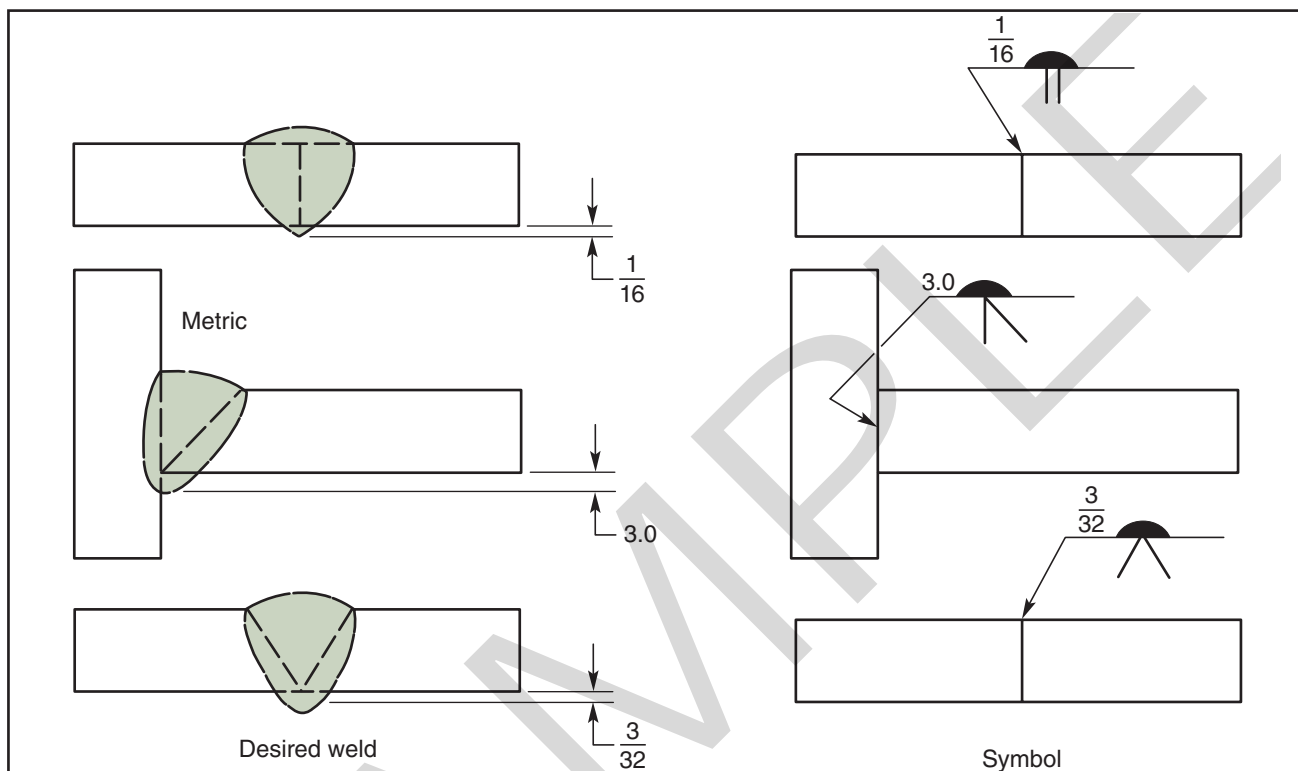
The **melt-through symbol** is used when complete joint penetration is required in a weld made from only one side, Figure 14-19. It also ensures 100% weld penetration.

### Dimensions

Weld dimensions may be indicated in inches/fractions of an inch, or in millimeters (mm). Angles are specified in degrees.

The **weld size** dimension is placed on the left side of the weld symbol. **Weld length** is shown on the right side of the weld symbol. See Figure 14-20. No length dimension is given when the weld is to be made the full length of the joint.

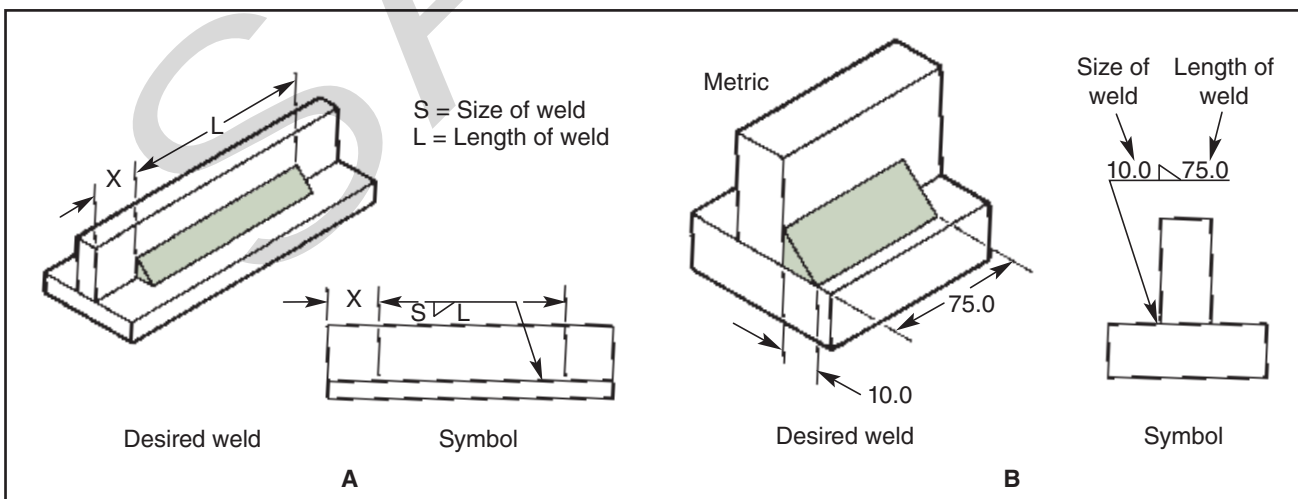
Information on weld dimensions, as it refers to specific types of welds, is included in subsequent units.



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**Figure 14-19.**

A melt-through symbol requires full joint penetration in a weld made from only one side. The number indicates the amount of penetration.



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**Figure 14-20.**

Size and length dimensions of welds are indicated on the drawing. Weld size is placed on the left side of the weld symbol. Weld length is shown on the right side of the weld symbol.

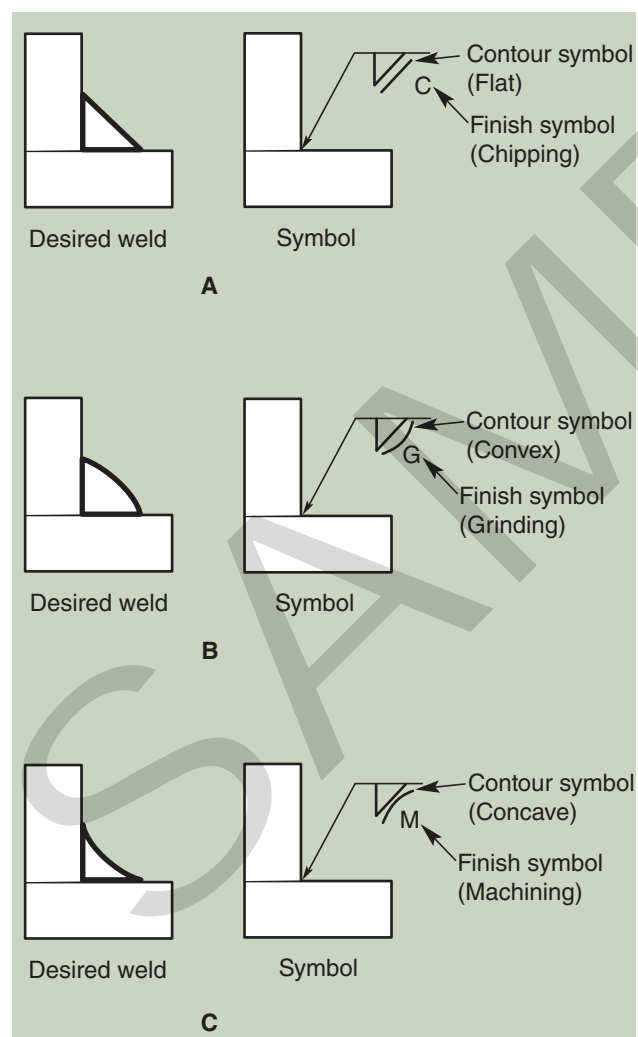


## Contour and Finish Symbols

A **contour symbol** is used with the weld symbol when the finished shape of the weld is important. If a weld is to be contoured or finished (other than being cleaned), a **finish symbol** is included with the contour symbol, Figure 14-21.

The finish symbol indicates the method, not the degree, of finish. Standard finishing methods are designated by symbols and include the following:

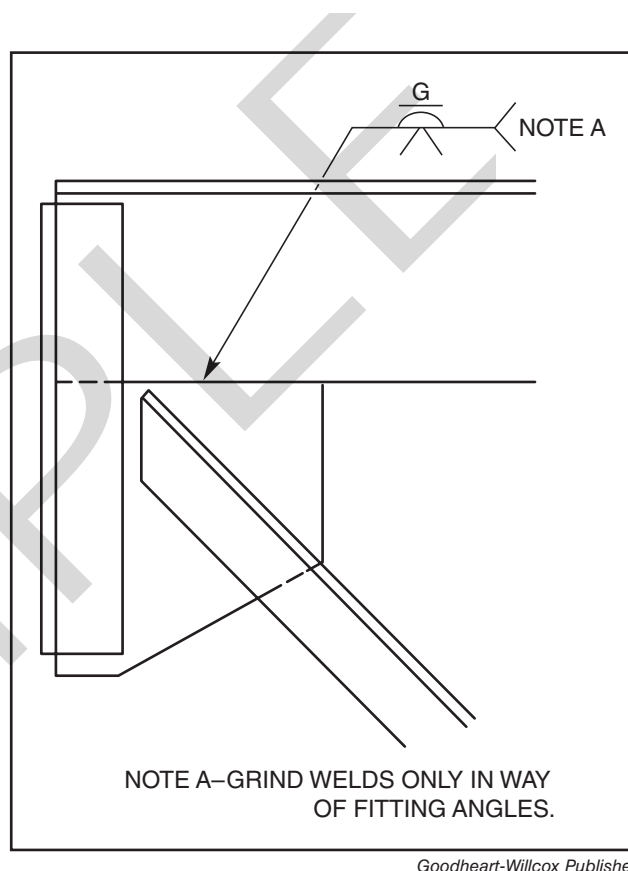
- C—Chipping
- G—Grinding
- H—Hammering
- M—Machining
- R—Rolling



**Figure 14-21.** Know symbols for contour and surface finish. Shown are symbols designating finishing methods for fillet welds.

## Notations

A **notation** is information called out in the tail of a welding symbol. It is often in the form of abbreviations or notes. Sometimes there is insufficient room in the tail for all of the notation. In that case, a reference given in the tail states where more information on the notation can be found elsewhere on the print, Figure 14-22.



**Figure 14-22.** Sometimes a note accompanies a welding symbol.

A notation may indicate a welding process by using a standard abbreviated form. Refer to Figure 14-23 for the letter designations of welding and related processes. Study this table carefully!

## Nonpreferred Weld Symbols

The **nonpreferred weld symbols** have been replaced by newer symbols. They are not used on newer prints. However, nonpreferred weld symbols may still be found on older prints and are included in Figure 14-24 for reference purposes.

### Suffixes for Optional Use in Applying Welding and Allied Processes

Suffix	Process
AD	adaptive control
AU	automatic
MA	manual
ME	mechanized
AU	robotic
SA	semiautomatic

### Letter Designations of Welding and Allied Processes

Letter Designation	Processes and Variations
AAW	air acetylene welding
ABW	arc braze welding
AC	arc cutting
AHW	atomic hydrogen welding
AOC	oxygen arc cutting
ASP	arc spraying
AW	arc welding
B	brazing
BB	block brazing
BMAW	bare metal arc welding
BW	braze welding
CABW	carbon arc braze welding
CAC	carbon arc cutting
CAC-A	air carbon arc cutting
CAW	carbon arc welding
CAW-G	gas carbon arc welding
CAW-S	shielded carbon arc welding
CAW-T	twin carbon arc welding
CEW	coextrusion welding
CW	cold welding
DB	dip brazing
DFB	diffusion brazing
DFW	diffusion welding
DS	dip soldering
EBC	electron beam cutting
EBW	electron beam welding
EBW-HV	high vacuum electron beam welding
EBW-MV	medium vacuum electron beam welding
EBW-NV	nonvacuum electron beam welding
EGW	electrodeless welding
ESW	electroslag welding
EXB	exothermic brazing
EXBW	exothermic braze welding
EXW	explosion welding
FB	furnace brazing
FCAW	flux cored arc welding
FCAW-G	gas shielded flux cored arc welding
FCAW-S	self-shielded flux cored arc welding
FLB	flow brazing
FLOW	flow welding
FLSP	flame spraying
FOC	flux cutting
FOW	forge welding
FRW	friction welding
FS	furnace soldering
FW	flash welding
GMAC	gas metal arc cutting
GMAW	gas metal arc welding
GMAW-P	pulsed gas metal arc welding

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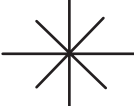



**Figure 14-23.**

Welding and allied processes are known by standard abbreviations used on prints.

Letter Designation	Processes and Variations
GMAW-S	short circuit gas metal arc welding
GTAC	gas tungsten arc cutting
GTAW	gas tungsten arc welding
GTAW-P	pulsed gas tungsten arc welding
HPW	hot pressure welding
IB	induction brazing
INS	iron soldering
IRB	infrared brazing
IRS	infrared soldering
IS	induction soldering
IW	induction welding
LBC	laser beam cutting
LBC-A	laser beam air cutting
LBC-EV	laser beam evaporative cutting
LBC-IG	laser beam inert gas cutting
LBC-O	laser beam oxygen cutting
LBW	laser beam welding
LOC	oxygen lance cutting
OAW	oxyacetylene welding
OC	oxygen cutting
OFC	oxyfuel gas cutting
OFC-A	oxyacetylene cutting
OFC-H	oxyhydrogen cutting
OFC-N	oxynatural gas cutting
OFC-P	oxypropane cutting
OFW	oxyfuel gas welding
OHW	oxyhydrogen welding
PAC	plasma arc cutting
PAW	plasma arc welding
PEW	percussion welding
PGW	pressure gas welding
POC	metal powder cutting
PSP	plasma spraying
PW	projection welding
RB	resistance brazing
ROW	roll welding
RS	resistance soldering
RSEW	resistance seam welding
RSEW-HF	high-frequency seam welding
RSEW-I	induction seam welding
RSW	resistance spot welding
RW	resistance welding
S	soldering
SAW	submerged arc welding
SAW-S	series submerged arc welding
SMAC	shielded metal arc cutting
SMAW	shielded metal arc welding
SSW	solid-state welding
SW	arc stud welding
TB	torch brazing
TC	thermal cutting
TCAB	twin carbon arc brazing
THSP	thermal spraying
TS	torch soldering
TW	thermite welding
USS	ultrasonic soldering
USW	ultrasonic welding
UW	upset welding
UW-HF	high-frequency upset welding
UW-I	induction upset welding
WS	wave soldering

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Figure 14-23. (continued)

Plug or Slot	Arc Seam or Arc Spot	Projection	Resistance Spot	Resistance Seam	Flash or Upset	Field Weld
						

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**Figure 14-24.**

Nonpreferred weld symbols are no longer standard but may still be present on older prints.

## Reading and Explaining a Welding Symbol

Often you may have to explain or discuss a welding symbol with a coworker or supervisor. It is good practice to follow a consistent pattern when explaining the symbol. The symbol used in Figure 14-25 shows a fillet weld on the arrow side.

Use this pattern when explaining the symbol:

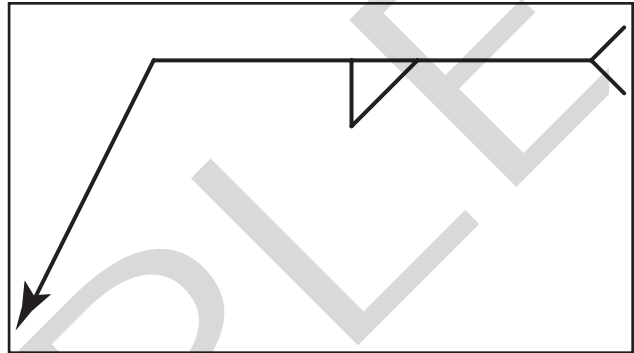
- State the weld to be made first.
- Then state the side on which the weld is to be made.
- State the size of the weld or the amount of joint preparation.
- State the angle of preparation, depth of penetration, and finish requirements.
- State other supplemental information, such as weld-around or field weld.

Refer to Figure 14-26. Using the pattern just given, it may be explained as follows: “This symbol is a V-groove weld on the arrow side, with .25 depth of penetration at an included angle of 60°, made flush after welding.”

## International Welding Symbols

Although the American Welding Society has developed a standard for welding, brazing, and non-destructive examination symbols for use in the United States, other countries may use a different standard for symbols. The *International Organization for Standardization (ISO)* developed a standard for welding symbols that is often used in Europe or for products sold to the European community. This standard, ISO 2553, uses a somewhat different method to represent welding symbols.

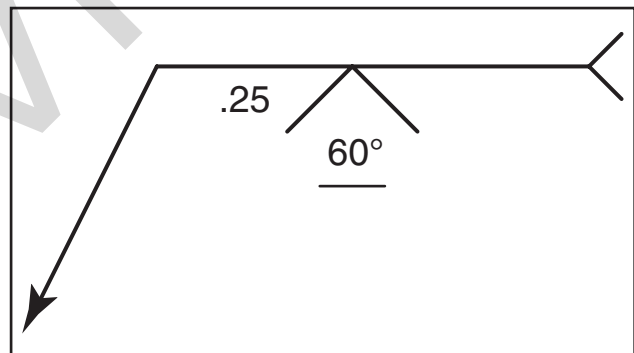
The main difference between the AWS system and the ISO system is that the ISO system uses an additional horizontal reference line called an *identification line*.



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**Figure 14-25.**

Follow a pattern when explaining symbols such as this fillet weld on the arrow side.



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**Figure 14-26.**

Explain this V-groove weld.

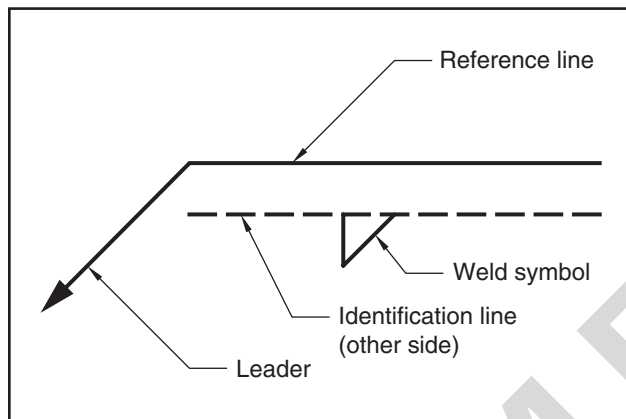
One horizontal reference line is solid, like those used in the AWS system, but the second horizontal reference line is dashed, as shown in Figure 14-27. This dashed line is always used to show the other side of the joint. The dashed line may be placed above or below the solid line, so you must remember that the dashed line indicates the other side of the joint. Figure 14-28 shows the application of the dashed line.

ISO 2553 weld symbols are similar to AWS symbols, but there are some slight shape differences. Additionally, ISO 2553 includes a few symbols not found in the AWS standard, and the ISO 2553 edge weld symbol is different from the AWS edge weld symbol. See Figure 14-29.

Another major difference between the AWS and ISO standards is the dimensioning of fillet welds. For AWS fillet weld dimensioning, the leg dimension is given in the symbol. Figure 14-30 shows a fillet weld

on the arrow side of the joint with a .25 equal leg (additional information is provided in Unit 15).

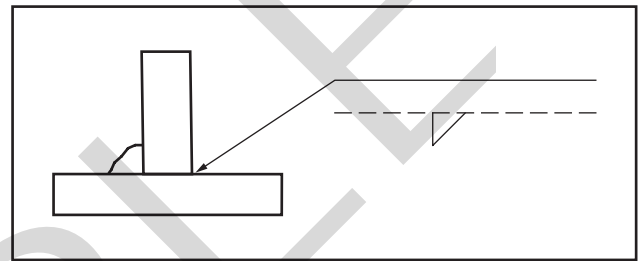
ISO 2553 requires that either the letter *a* or the letter *z* be placed in front of the fillet weld symbol. The letter *a* indicates that the fillet dimension given in the symbol is the throat dimension of the weld. The letter *z* indicates that the fillet dimension given in the symbol is the leg dimension of the weld. Figure 14-31 shows an example of the dimensioning method.



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**Figure 14-27.**

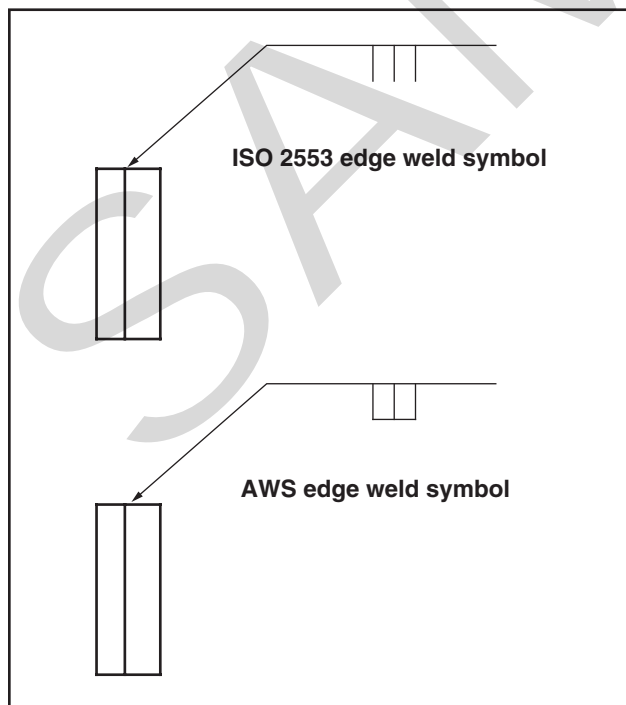
ISO welding symbol. Note the location of the identification line.



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**Figure 14-28.**

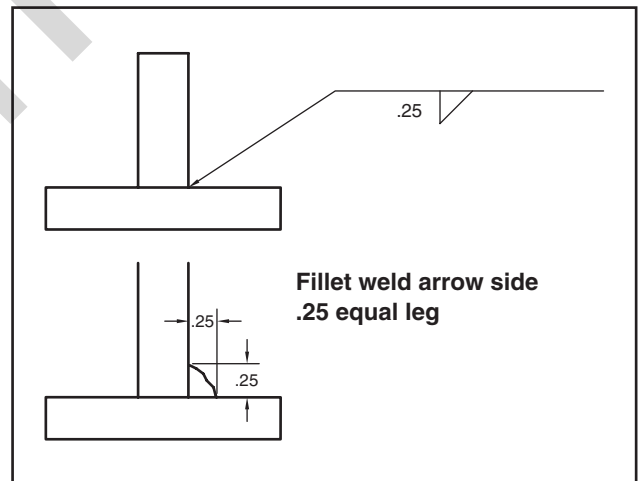
The dashed line in this figure indicates that a fillet weld should be made on the other side of the joint.



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**Figure 14-29.**

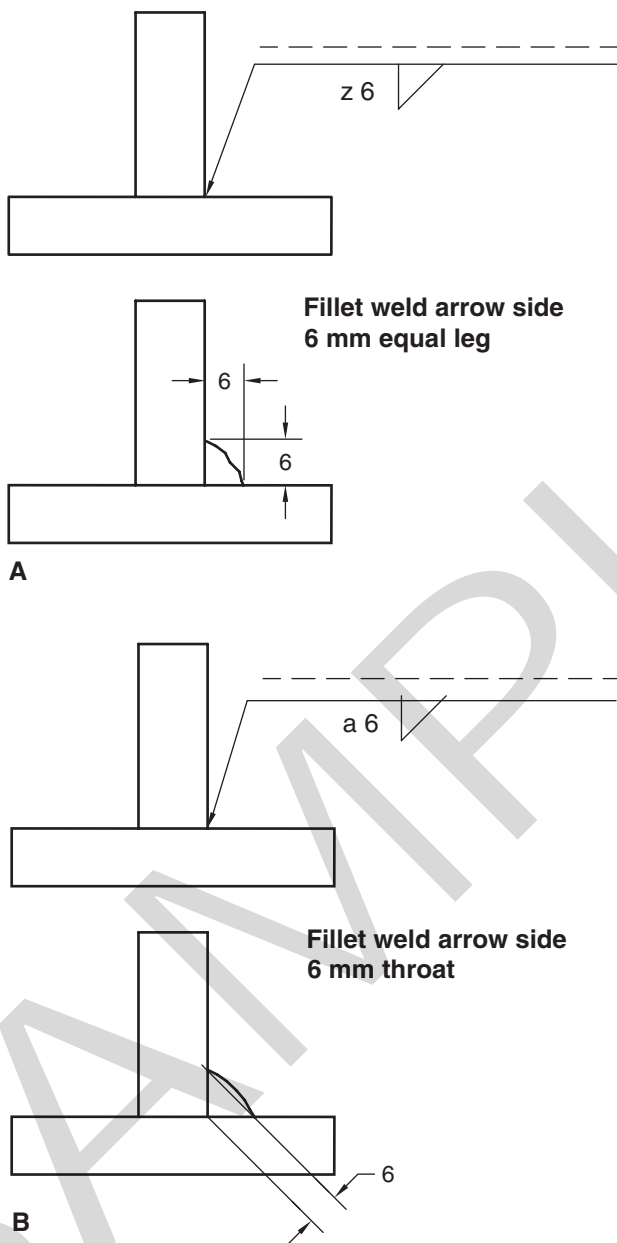
The ISO edge weld symbol differs from the AWS symbol.



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**Figure 14-30.**

This AWS fillet weld symbol has a leg size designator.



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**Figure 14-31.**

A—This ISO fillet weld symbol has a leg size designator. B—This ISO fillet weld symbol has a throat size designator.

Name \_\_\_\_\_ Date \_\_\_\_\_ Class \_\_\_\_\_

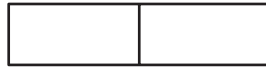
## Print Reading Activities

### Part I

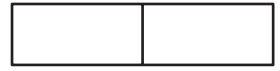
Draw the correct AWS symbols for the following welds.



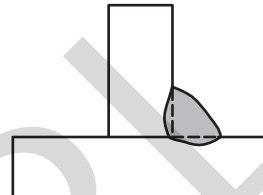
A



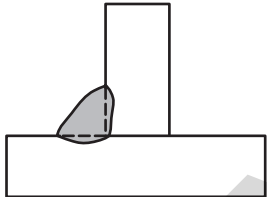
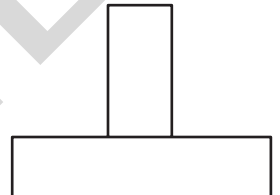
B



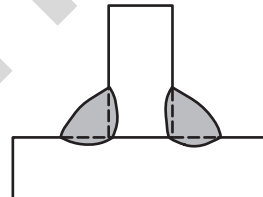
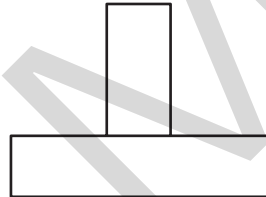
C



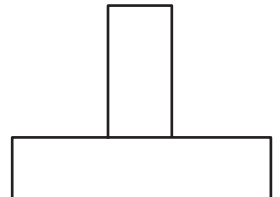
D



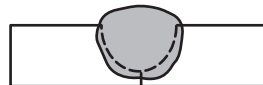
E



F



G



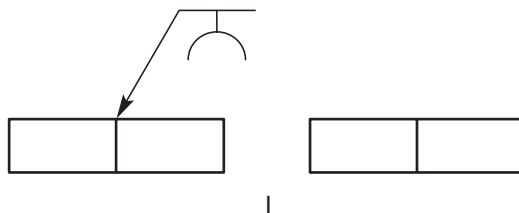
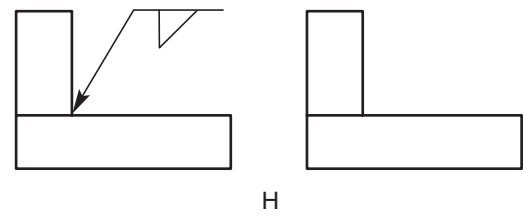
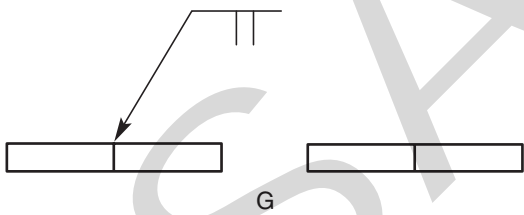
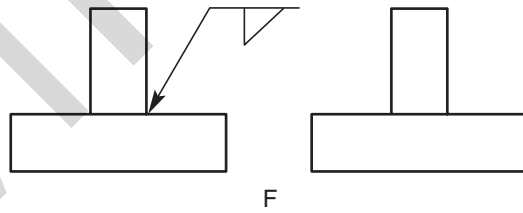
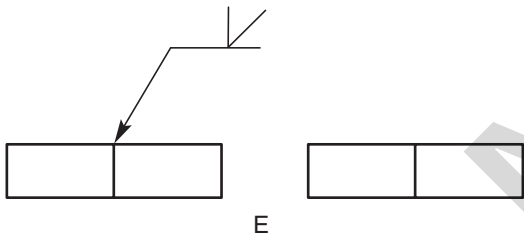
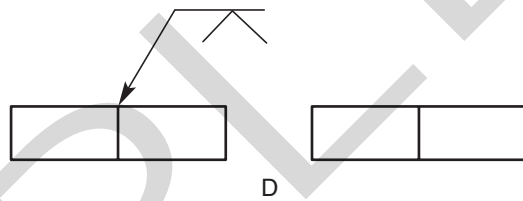
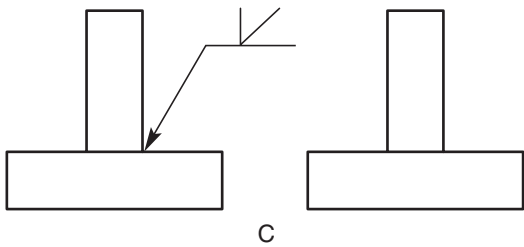
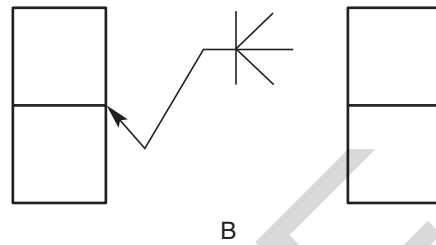
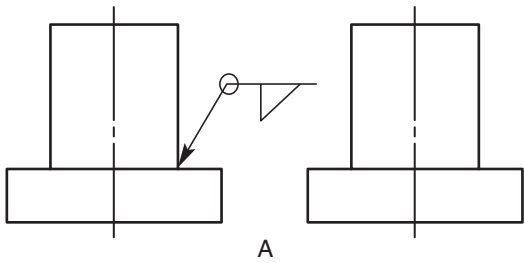
H





## Part II

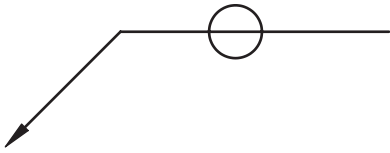
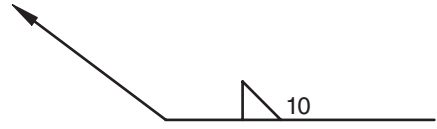
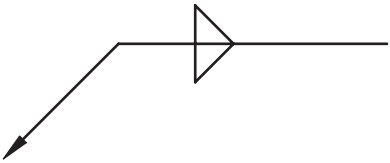
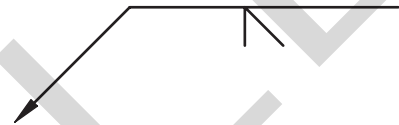
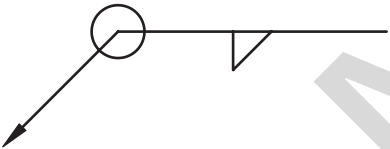
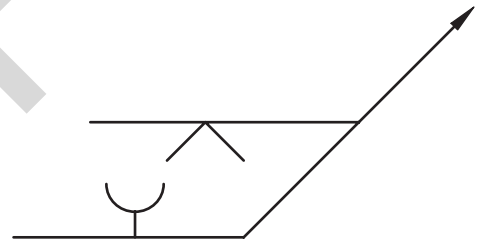
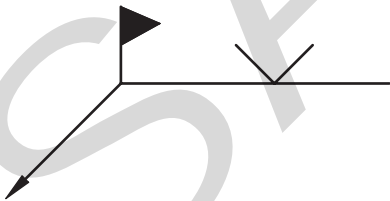
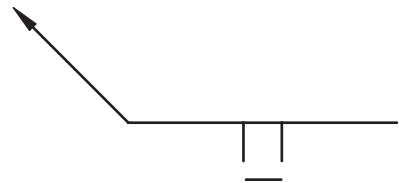
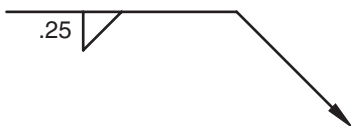
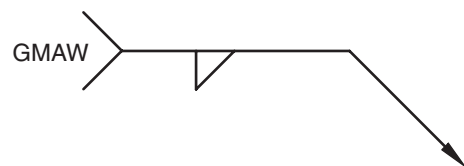
Draw the correct weld as indicated by the AWS symbol.



Name \_\_\_\_\_

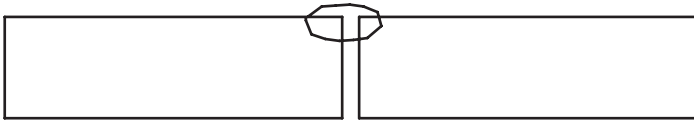
**Part III**

Explain the following AWS welding symbols, using the examples in this unit as a guide.

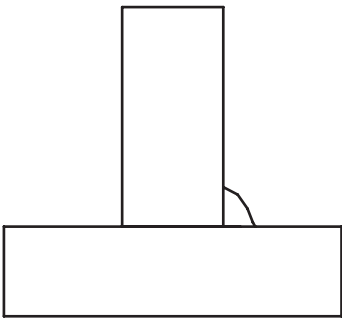
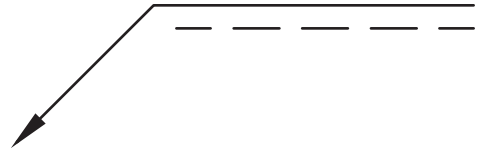
A. \_\_\_\_\_  
\_\_\_\_\_B. \_\_\_\_\_  
\_\_\_\_\_C. \_\_\_\_\_  
\_\_\_\_\_D. \_\_\_\_\_  
\_\_\_\_\_E. \_\_\_\_\_  
\_\_\_\_\_F. \_\_\_\_\_  
\_\_\_\_\_G. \_\_\_\_\_  
\_\_\_\_\_H. \_\_\_\_\_  
\_\_\_\_\_I. \_\_\_\_\_  
\_\_\_\_\_J. \_\_\_\_\_  
\_\_\_\_\_

**Part IV**

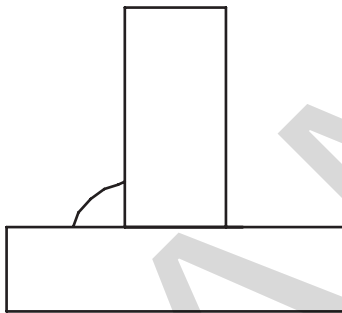
Draw the correct ISO symbol for the following welds.



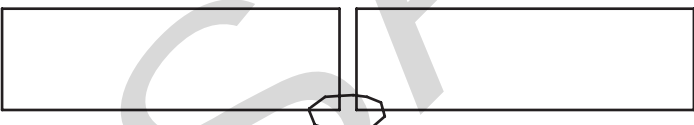
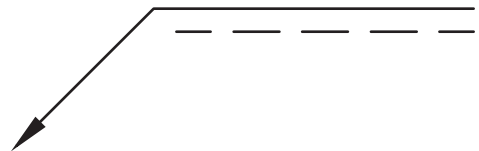
A.



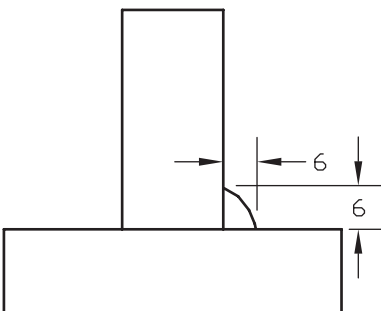
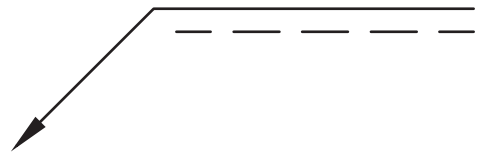
B.



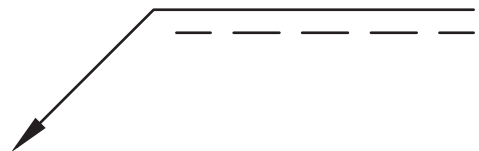
C.



D.



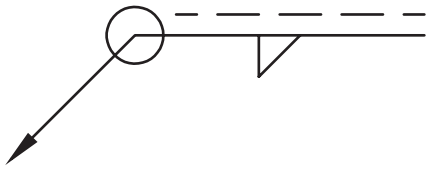
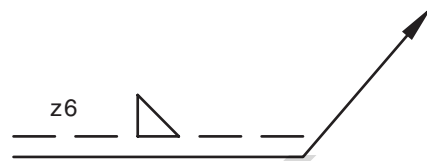
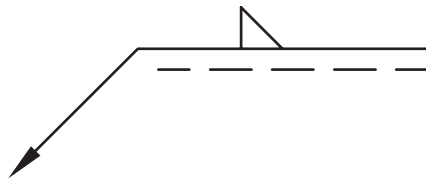
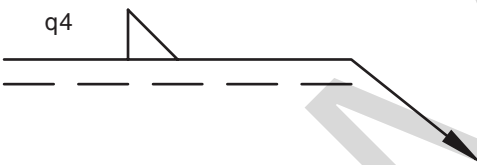
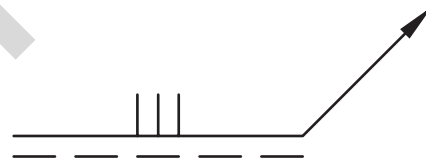
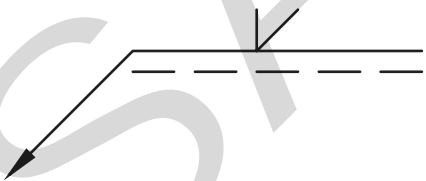
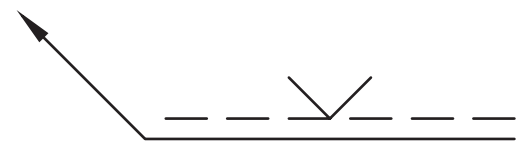
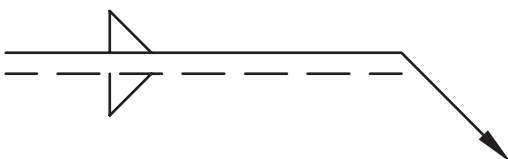
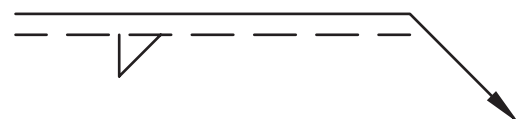
E.



Name \_\_\_\_\_

**Part V**

Explain the following ISO welding symbols, using the examples in this unit as a guide.

A. \_\_\_\_\_  
\_\_\_\_\_B. \_\_\_\_\_  
\_\_\_\_\_C. \_\_\_\_\_  
\_\_\_\_\_D. \_\_\_\_\_  
\_\_\_\_\_E. \_\_\_\_\_  
\_\_\_\_\_F. \_\_\_\_\_  
\_\_\_\_\_G. \_\_\_\_\_  
\_\_\_\_\_H. \_\_\_\_\_  
\_\_\_\_\_I. \_\_\_\_\_  
\_\_\_\_\_J. \_\_\_\_\_  
\_\_\_\_\_

## Notes

SAMPLE