The following pages are a sample chapter and worksheet from the textbook:

Hands-On Print Reading for Welders
by Michael Mohn, CWI

For more information about the textbook or the complete welding symbols and print reading course, please go to:

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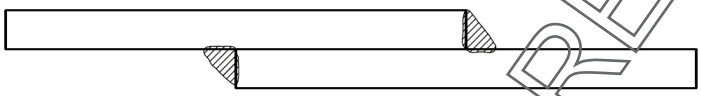
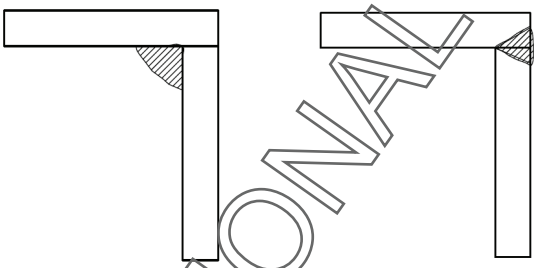
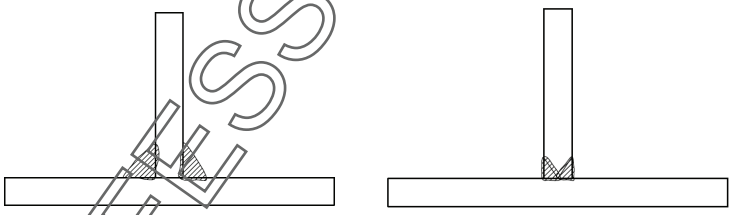
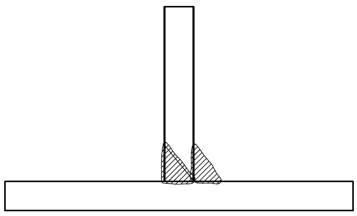
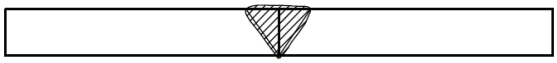
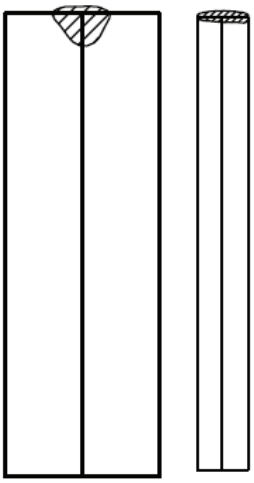
3. Joint Types and Square-Groove, V-Groove, and Bevel-Groove Welds

Joint Types

So far, with the study of fillet welding symbols, we have used only T-joints. There are, however, five different joint type designations for welded construction: lap joints, T-joints, corner joints, butt joints, and edge joints.

Lap joints are usually welded with fillet welds, T-joints and corner joints may be welded with either fillet or groove welds (or both), while butt joints require groove welds. Edge joints may be welded with a groove weld if the members are thick; however, they are usually welded with edge welds (formerly called "flange welds" in previous editions of the welding symbols standard).

WELD EXAMPLE	COMMENTS
	Lap joint with double-fillet welds.
	Corner joints welded with a fillet weld (left) and a groove weld (right).
	T-joints welded with fillet welds (left) and a groove weld (right).
	T-joint welded with both groove and fillet welds.

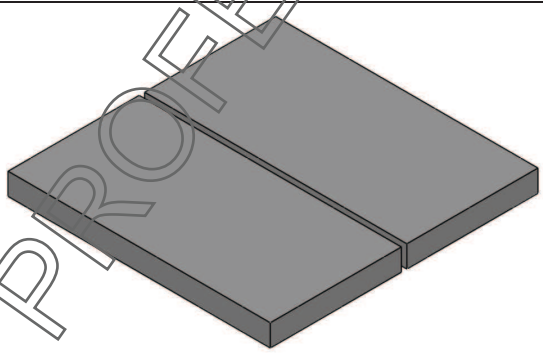
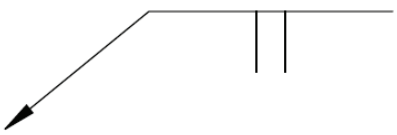
WELD EXAMPLE	COMMENTS
	Butt joint welded with a groove weld.
	Edge joint welded with a groove weld (left) and an edge weld (right). Note: the edge weld fuses the entire edge of the joint, while the groove weld does not.

Groove Welds

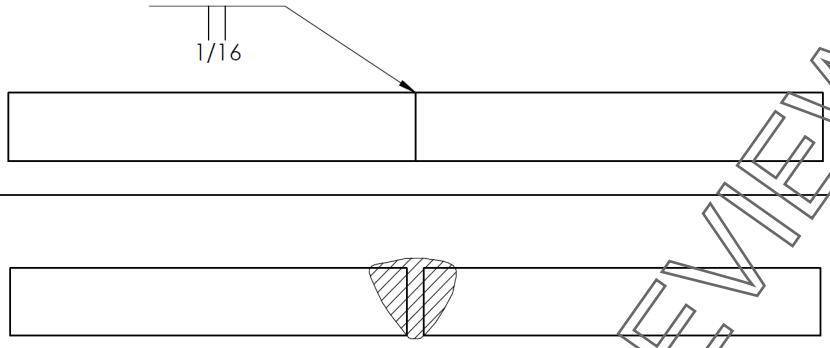
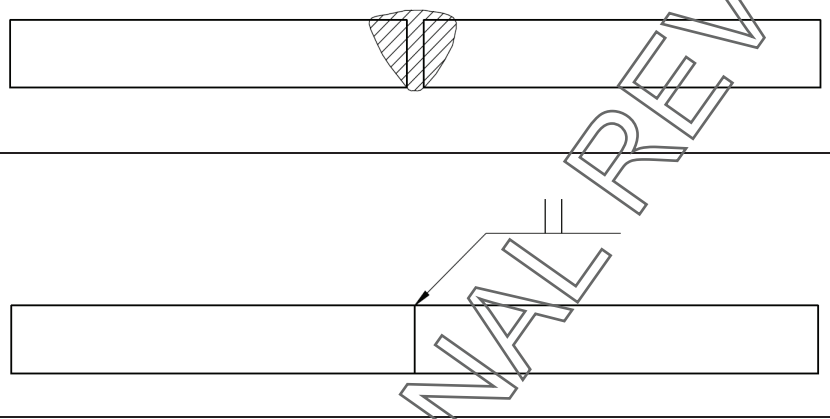
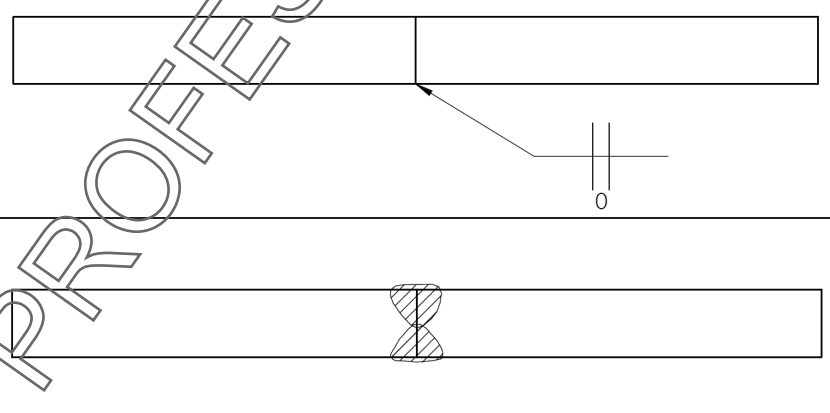
The welding symbols for the groove welds can be used to provide all the necessary details for joint geometry, including root opening, joint type, bevel angel, and groove depth. With this detail in the welding symbol, the drawing needs to show only the joint location–the specific details of the joint do not need to be drawn.

Square-Groove Welds

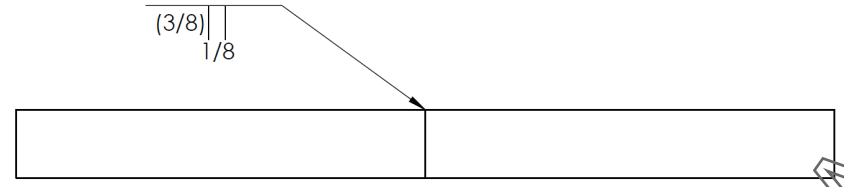
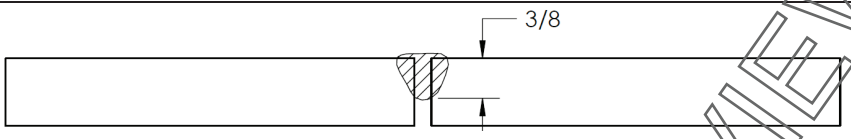
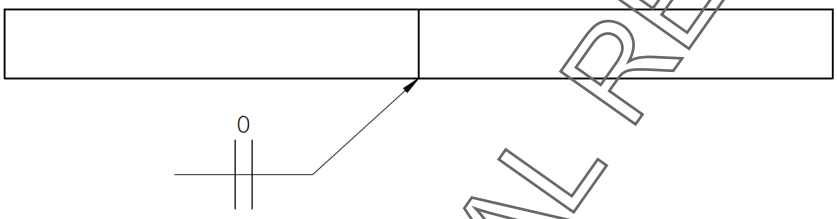
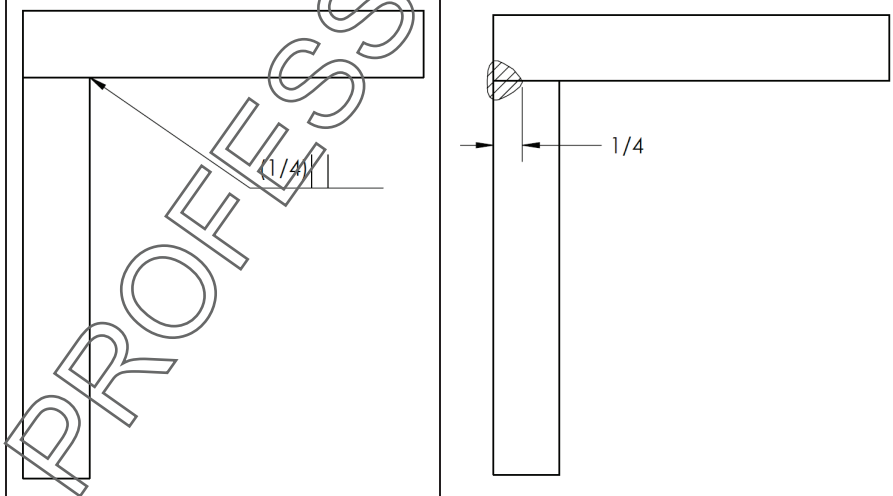
The simplest groove weld is the square-groove weld. The joint design is simple, just the squared edges of the members to be welded. Usually square-groove welds are specified on thinner materials, or on thicker plate where complete joint penetration is not essential. The weld symbol shows the joint design as just two squared plate ends:

The weld symbol indicates which side the weld is to be made from, the arrow side, the other side, or both sides. Sometimes a root opening may be specified to allow deeper penetration of the square-groove weld. When a root opening is specified, it is shown inside the weld symbol, on only one side of the reference line. If no root opening is specified, then the welder may use any root opening that will ensure a good joint. If no root opening is allowed, then the symbol will specify "0" for the root opening.

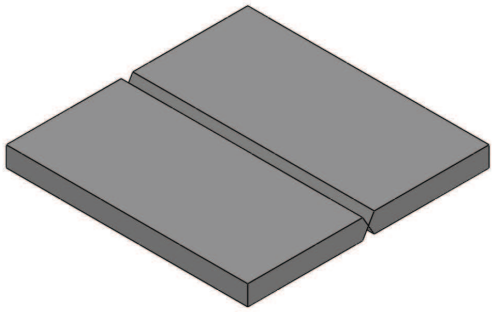
PRINT WELD EXAMPLE	COMMENTS
	Butt joint with single-square-groove weld on the arrow side. The root opening is 1/16-inch.
	Butt joint with single-square-groove weld on the other side. Note: because the root opening is unspecified, the welder may use whatever is appropriate to make a full penetration joint.
	Butt joint with double-square-groove weld. The root opening is 0.

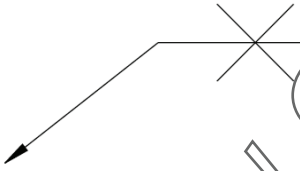
A weld size may be specified for groove welds, just as for fillet welds, to the left of the weld symbol. For groove welds, however, the weld size is enclosed in parenthesis. If no weld size is specified, then the joint is to have complete joint penetration.

PRINT WELD EXAMPLE	COMMENTS
 	Butt joint with single-square-groove weld on the arrow side. The root opening is ⅛-inch and the weld size is ⅜-inch.
 	Butt joint with double-square-groove welds. The root opening is 0. Note: because no weld size is given, full penetration is required.
	Corner joint with single-square-groove weld on the other side. The weld size is ¼-inch. Note: because the root opening is unspecified, the welder may use any appropriate root opening to achieve the specified weld size and maintain the weldment dimensions.

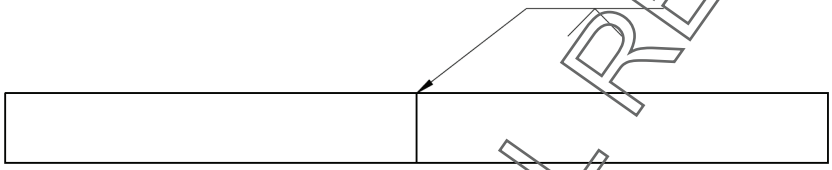
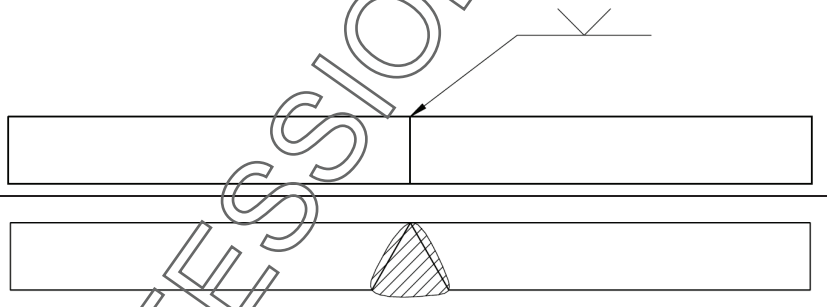
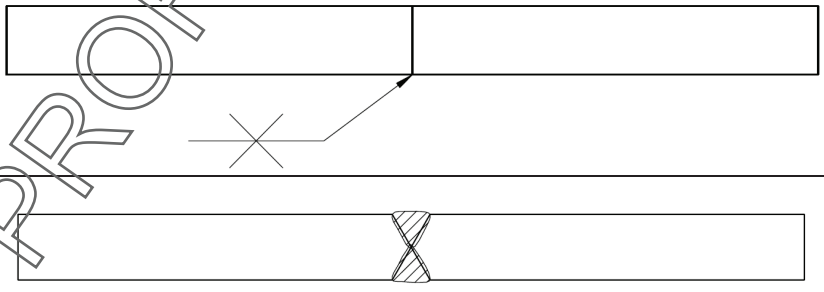
V-Groove Welds

If both members are to receive a bevel, the weld is a V-groove weld.

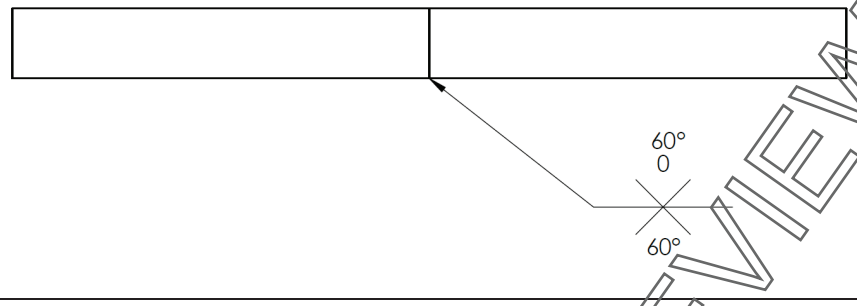
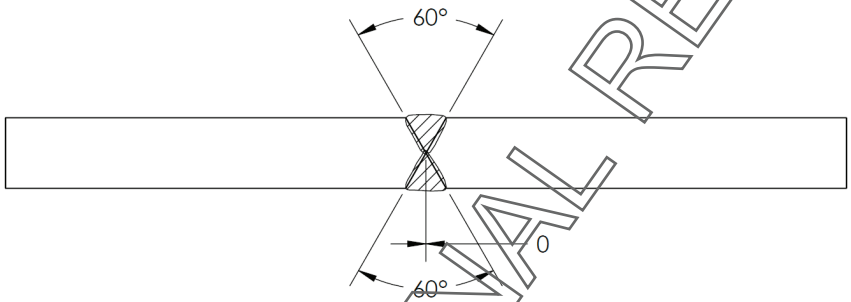
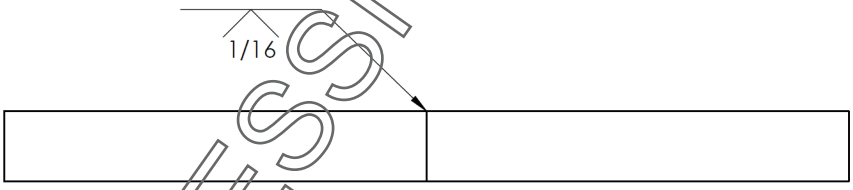
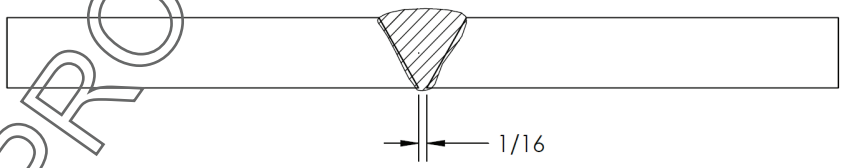




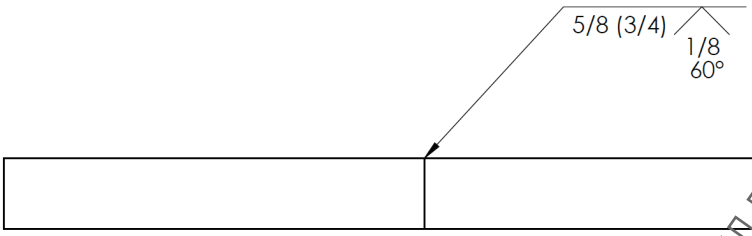
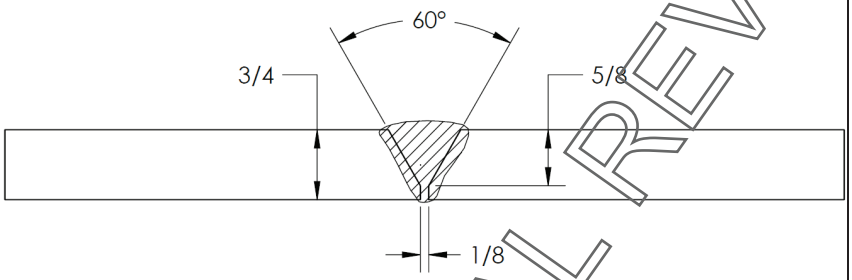
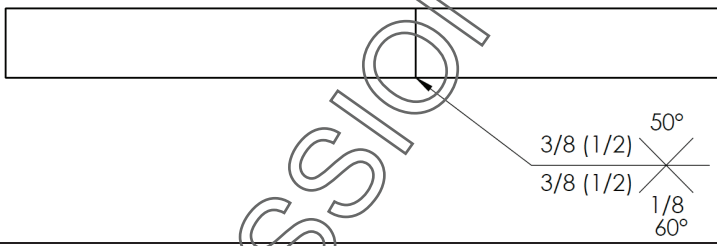
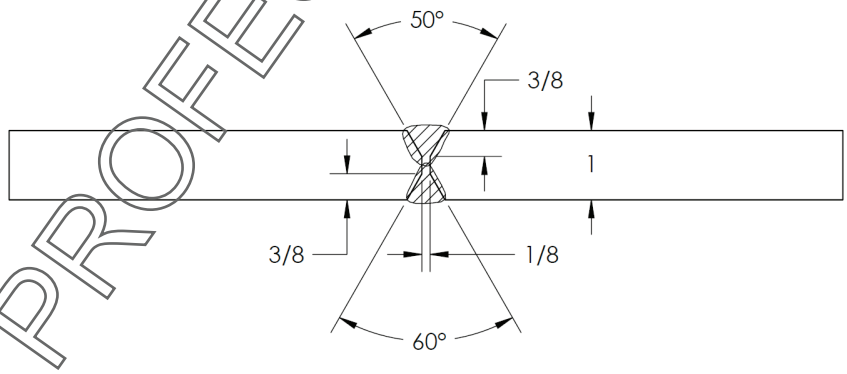
V-groove welds may be made from the arrow side, the other side, or both sides of the joint.

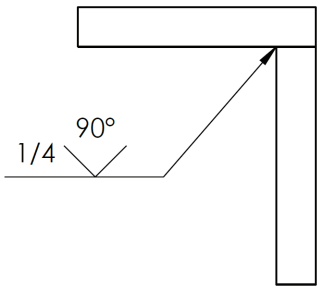
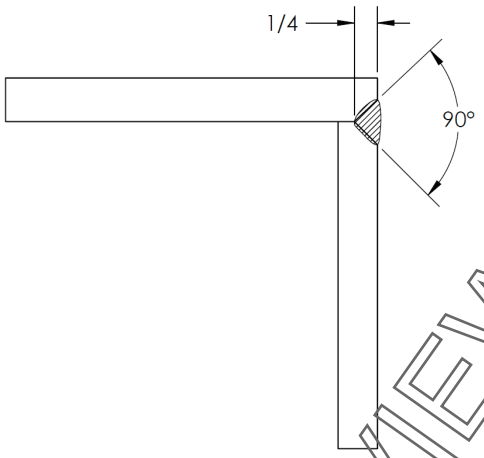
PRINT WELD EXAMPLE	COMMENTS
	Butt joint with single-V-groove weld on the arrow side.
	Butt joint with single-V-groove weld on the other side.
	Butt joint with double-V-groove weld.

A root opening may be specified; if no root opening is given then the welder may use any root opening that will make a sound weld and maintain required dimensions. The included angle of the V-groove may also be specified in the weld symbol. On a double-V-groove weld, the angle must be specified on both sides of the symbol, even if they are the same. The root opening is only specified on one side of the symbol. If no angle is given, then the welder may use any appropriate angle to make a sound weld.

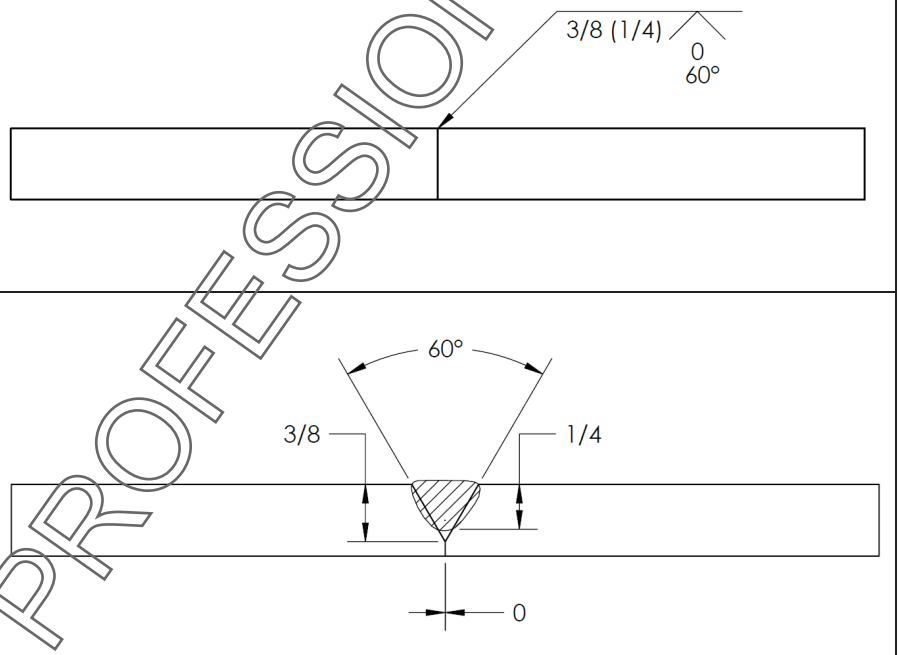
PRINT WELD EXAMPLE	COMMENTS
 	Butt joint with double-V-groove weld. The groove angle is 60° on each side, and the root opening is 0.
 	Butt joint with single-V-groove weld on the arrow side. The root opening is 1/16-inch. Note: because no groove angle is given, the welder may use whatever is appropriate to make a sound weld.

The depth of bevel and the weld size are specified to the left of the weld symbol. The weld size is always in parenthesis for a groove weld. If the depth of bevel is not given, then the entire edge is beveled (for a double-bevel joint, the bevels are equal and cut to the center of the member) and there is no root face. If the weld size is not given and not specified anywhere else, then the weld is to be at least equal to the depth of bevel.

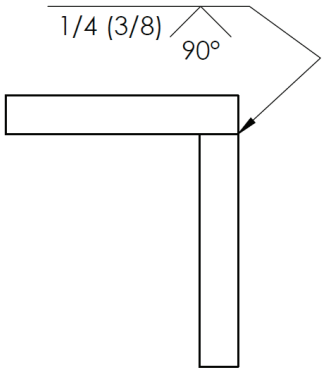
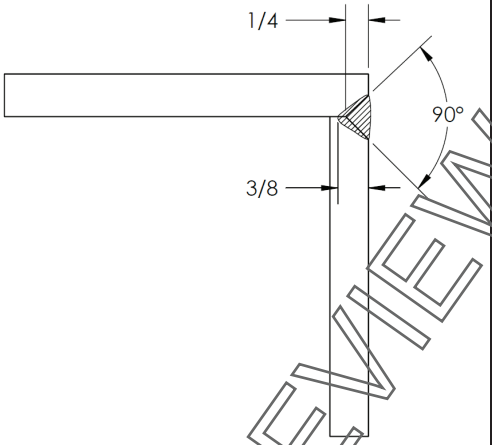
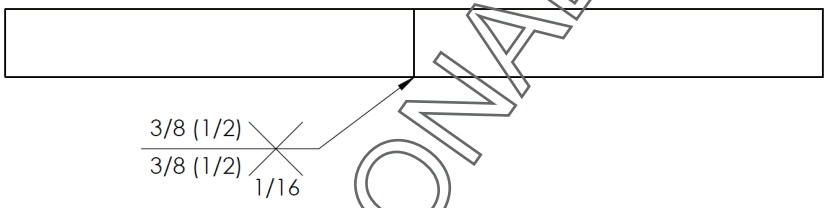
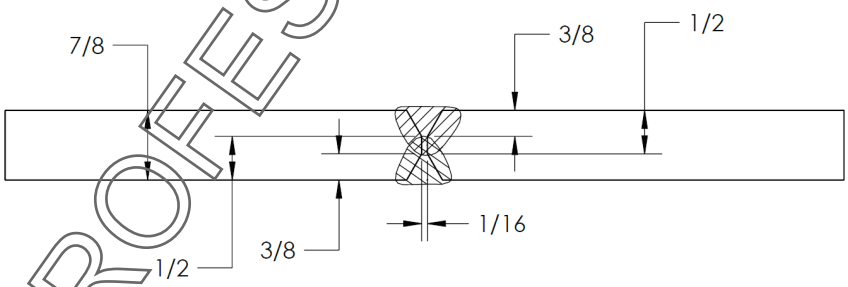
PRINT WELD EXAMPLE	COMMENTS
	Butt joint with single-V-groove weld. The groove angle is 60° and the root opening is ⅛-inch. The depth of bevel is ⅝-inch (leaving a ⅛-inch root face), and the ¾-inch weld size indicates a full penetration weld of the ¾-inch thick plate.
	
	Butt joint with double-V-groove weld. The bevel angle is 60° on the arrow side, 50° on the other side, and the root opening is ⅛-inch. The depth of bevel is ⅜-inch on each side (leaving a ¼-inch root face), and the ½-inch weld sides indicate a full penetration weld of the 1-inch thick plate.
	

PRINT	WELD EXAMPLE	COMMENTS
		Corner joint with single-V-groove weld. The bevel angle is 90° and the depth of bevel is ¼-inch. Note: because no weld size is given, the minimum weld side is the same as the depth of bevel. Because no root opening is given, the welder may use whatever root opening is appropriate for the joint, in this case 0.

Weld sizes may be given which are not as large as the depth of bevel, to produce partial penetration welds.

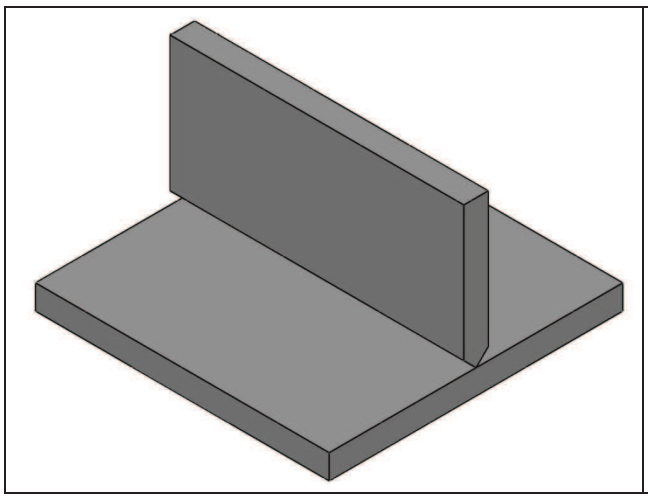
PRINT WELD EXAMPLE	COMMENTS
	Butt joint with single-V-groove weld. The groove angle is 60° and the root opening is 0. The depth of bevel is ⅜-inch, and the ¼-inch weld size indicates a partial penetration weld.

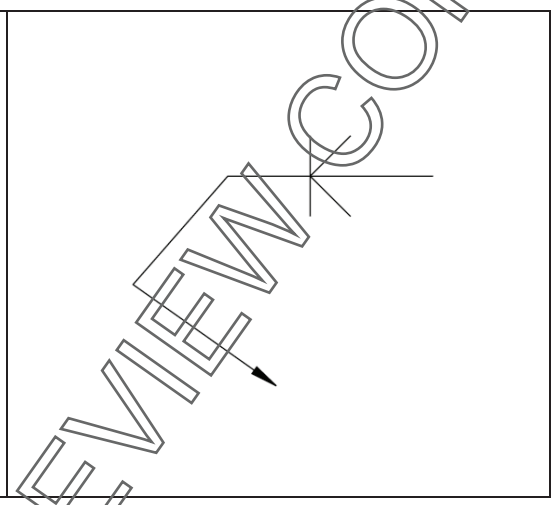
Weld sizes may also be given which are greater than the depth of bevel, even to the point of creating overlapping beads in the weld cross section.

PRINT	WELD EXAMPLE	COMMENTS
		Corner joint with single-V-groove weld. The bevel angle is 90° and the depth of bevel is ¼-inch. The weld size is ⅜-inch. Note: because no root opening is given, the welder may use whatever root opening is appropriate for the joint, in this case 0.
		Butt joint with double-V-groove weld. The root opening is 1⁄16-inch, the depth of bevel is ⅜-inch, and the ½-inch weld size indicates a full penetration weld. The total weld size is ⅞-inch—the same as the plate thickness. Note: because no bevel angles are given, the welder may use any angle that is appropriate to produce a sound weld.
		

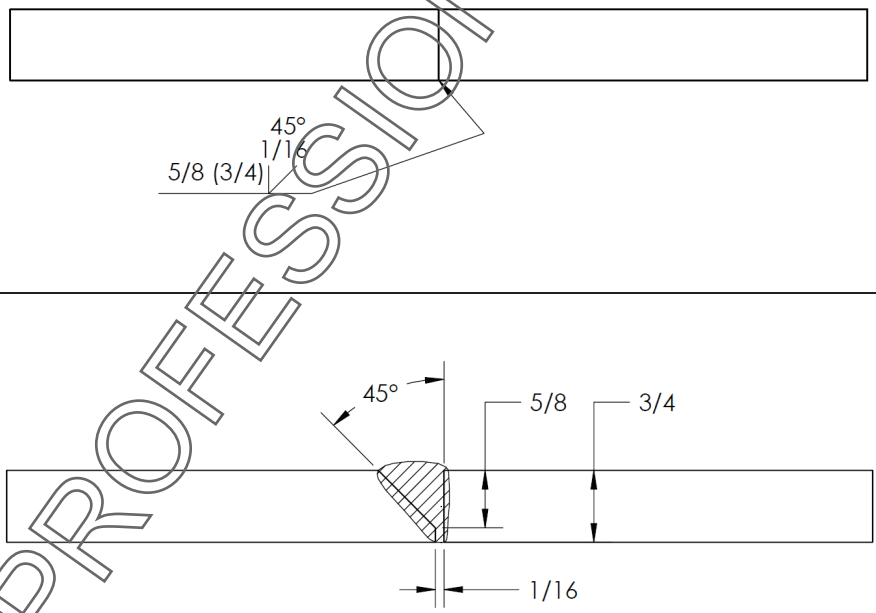
Bevel-Groove Welds

If only one member has a bevel and the other member remains square, then the joint is a bevel-groove joint. Like V-groove joints, bevel-groove joints may also be single or double.

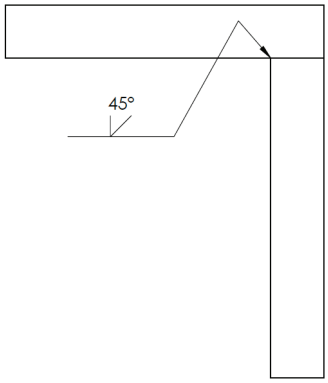
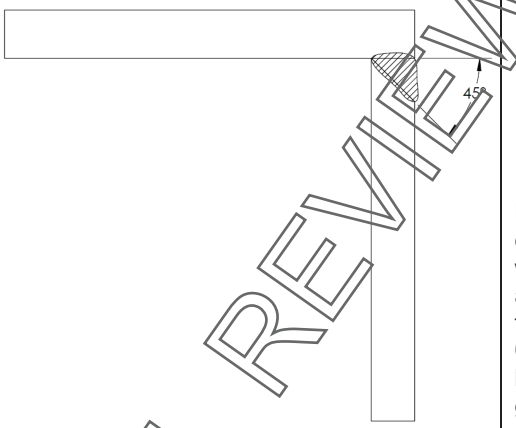
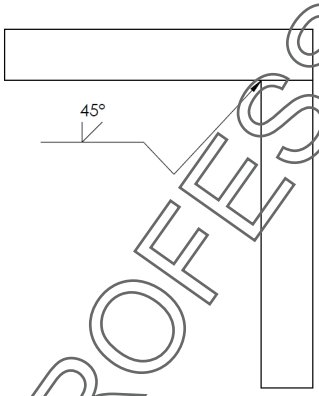
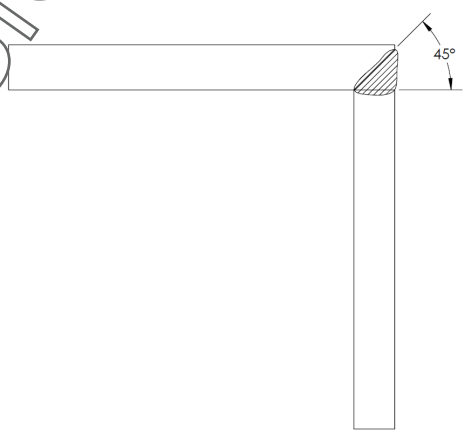




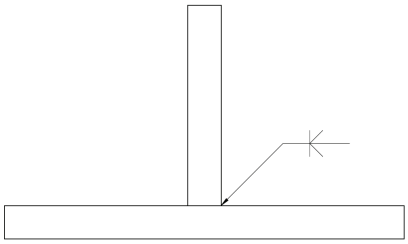
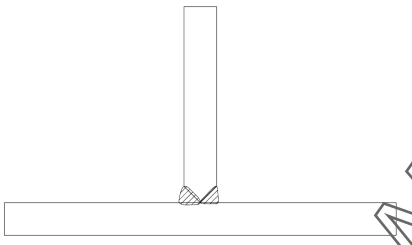
Also like V-groove joints, root opening, bevel angle, groove depth, and weld size may all be specified in the bevel-groove welding symbol.

PRINT WELD EXAMPLE	COMMENTS
	Butt joint with single-bevel-groove weld. The groove angle is 45° and the root opening is 1/16-inch. The depth of bevel is 5/8-inch, and the 3/4-inch weld size indicates a full penetration weld in the 3/4-inch thick plate.

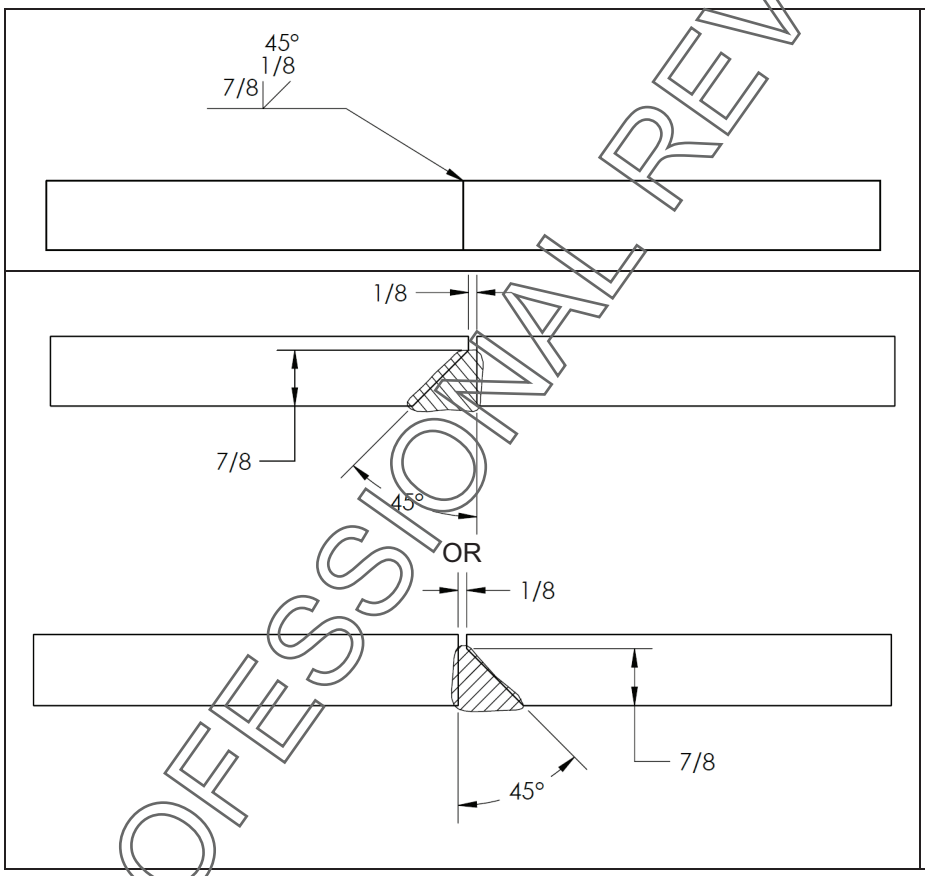
Since a bevel-groove weld is prepared on only one member, the welding symbol for a bevel-groove weld can specify which member is to receive the bevel. This is done by adding a joint in the arrow, called a broken arrow, to allow the arrow to point specifically towards the member to receive the bevel. The arrows of other types of welding symbols may be broken too, but in this case there is special meaning to the jog in the arrow.

PRINT	WELD EXAMPLE	COMMENTS
		Corner joint with single-bevel-groove weld. The bevel angle is 45° and the vertical member receives the bevel. Note: because no root opening is given, the welder may use any appropriate root opening for the joint, in this case 0. Because no depth of bevel or weld size is given, the full plate thickness is beveled.
		Corner joint with single-bevel-groove weld. The bevel angle is 45° and the horizontal member receives the bevel. Note: because no root opening is given, the welder may use any appropriate root opening for the joint, in this case 0. Because no depth of bevel or weld size is given, the full plate thickness is beveled.

The arrow does not need to be broken if it is obvious which member is to be prepared, such as in a T-joint.

PRINT	WELD EXAMPLE	COMMENTS
		T-joint with double-bevel-groove weld. A broken arrow is not required because it is obvious that only the vertical member can receive the bevel.

If it does not matter which member receives the bevel, then the arrow is not broken, and the welder may choose which member to bevel.



Butt joint with single-bevel-groove weld. The groove angle is 45° and the root opening is ⅛-inch. The depth of bevel is ⅞-inch.

Note: because there is no break in the arrow, either member may receive the bevel. Because the weld size is not given, the weld must be at least the depth of bevel.

Welding Symbols Activities:

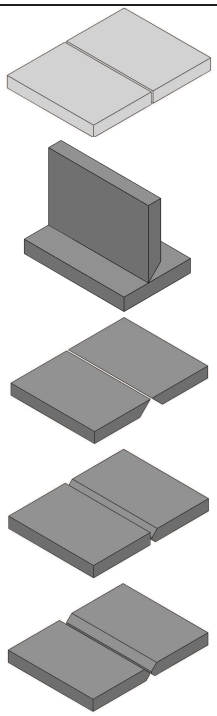
- Chapter 3 Worksheet (page 103).

Print reading lab work:

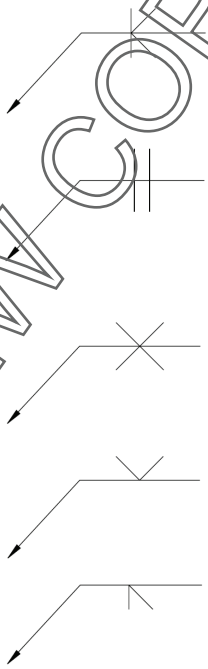
- Project 2: Step Fixture Block (page 171).

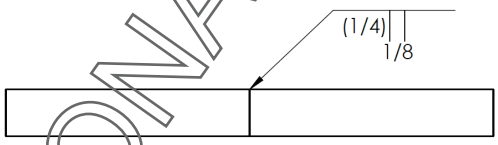
CHAPTER 3–JOINT TYPES AND SQUARE-GROOVE, V-GROOVE, AND BEVEL-GROOVE WELDS

Matching: Connect the groove weld type listed in the center column with the proper figures in the right and left columns.

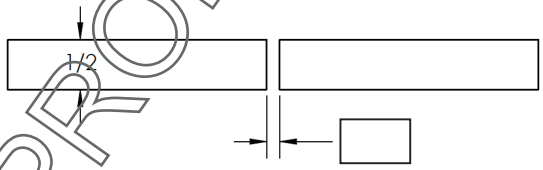


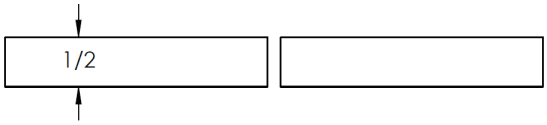
1. Single-V-Groove Weld
2. Single-Bevel-Groove Weld
3. Double-Square-Groove Weld
4. Double-V-Groove Weld
5. Double-Bevel-Groove Weld

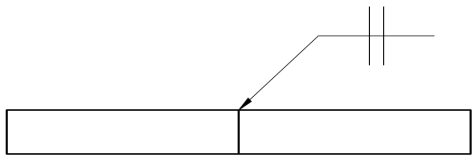




6. What type of weld is required? _____
7. Where is the weld located? _____
8. What is the weld size? _____
9. What is the root opening? _____
10. Dimension the joint sketch below left, and sketch the weld into the drawing below right.







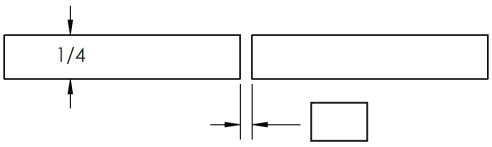
11. What type of weld is required? _____

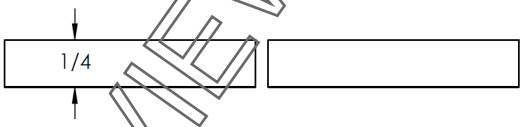
12. Where is the weld located? _____

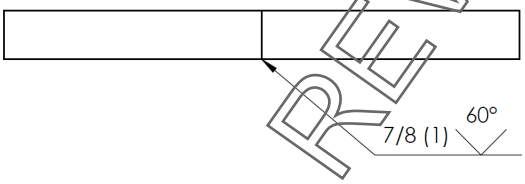
13. What is the total weld size? _____

14. What is the root opening? _____

15. Dimension the joint sketch below left, and sketch the weld into the drawing below right.







16. What type of weld is required? _____

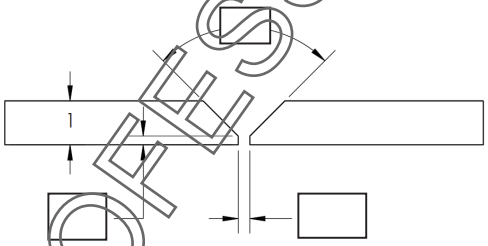
17. What is the root opening? _____

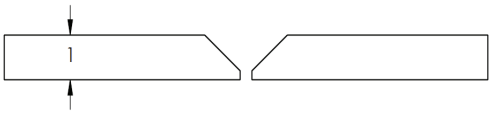
18. What is groove angle? _____

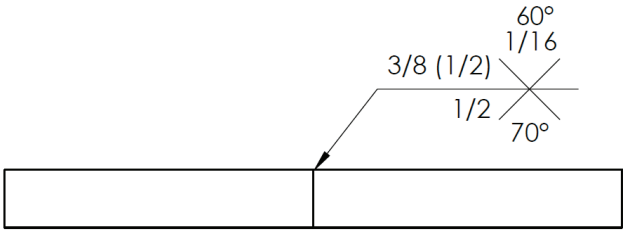
19. What is the depth of preparation? _____

20. What is the weld size? _____

21. Dimension the joint sketch below left, and sketch the weld into the drawing below right.







22. What type of weld is required?

23. What is the root opening?

24. What is the bevel angle on the arrow side?

25. What is the depth of bevel on the arrow side?

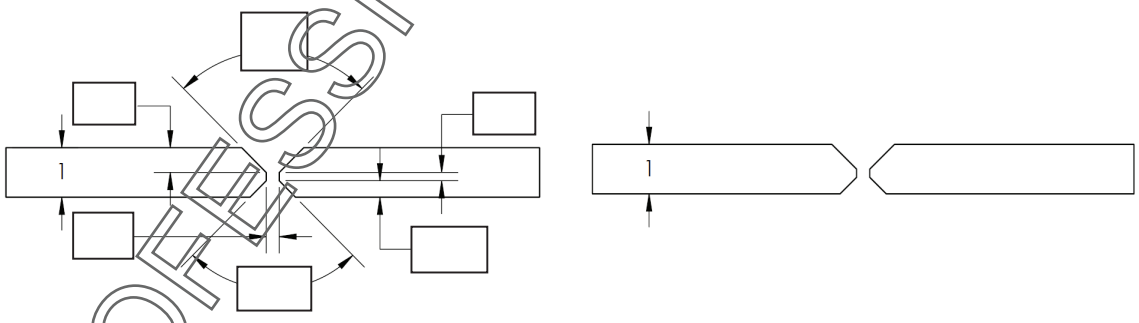
26. What is the weld size on the arrow side?

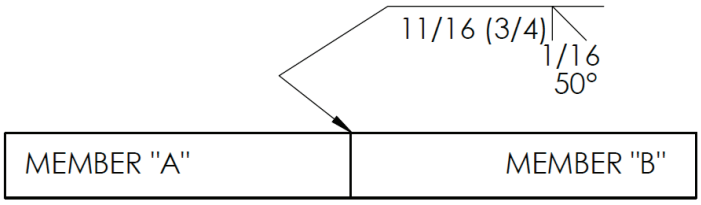
27. What is the bevel angle on the other side?

28. What is the depth of bevel on the other side?

29. What is the weld size on the other side?

30. Dimension the joint sketch below left, and sketch the weld into the drawing below right.





31. What type of weld is required?

32. Which member receives the bevel?

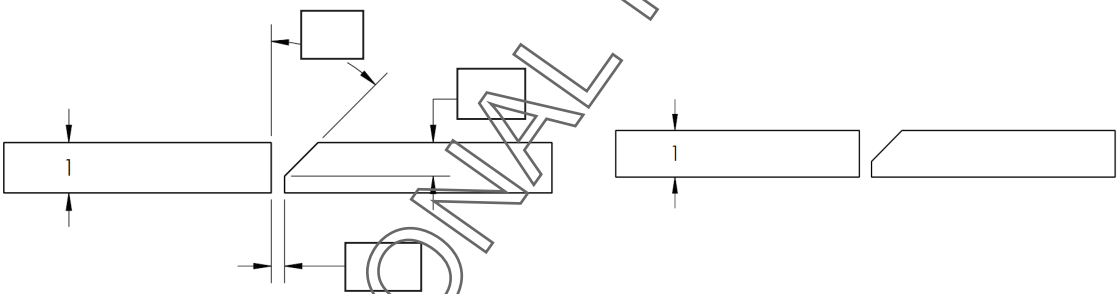
33. What is the root opening?

34. What is the bevel angle?

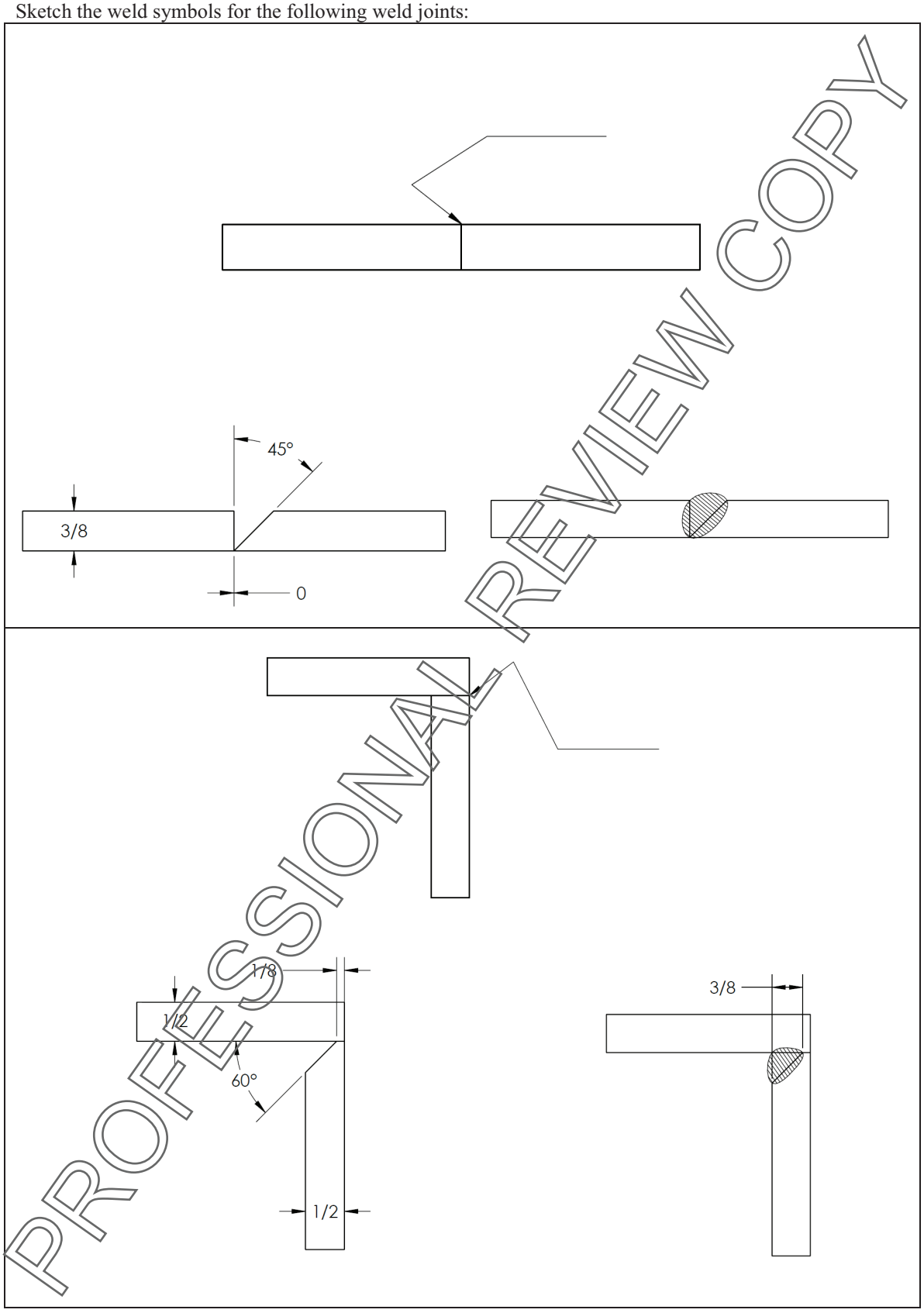
35. What is the depth of bevel?

36. What is the weld size?

37. Dimension the joint sketch below left, and sketch the weld into the drawing below right.



Sketch the weld symbols for the following weld joints:



Sketch the weld symbols for the following weld joints: