

CHAPTER 4:**WELD JOINT GEOMETRY AND
WELDING TERMINOLOGY****Introduction**

There was considerable discussion in Chapter 1 that one of the more important aspects of the welding inspector's job is communication with others involved in the fabrication of a weldment. The inspector needs to be capable of effectively stating inspection findings to others as well as understanding their responses or questions. This does not imply that all communication must be oral. It also applies to written or graphic explanations.

As pointed out in Chapter 2, another part of the welding inspector's job is the review and interpretation of various documents relating to the welded fabrication. All aspects of this communication require that the individual have a full understanding of the proper terms and definitions used.

The American Welding Society has long realized the need for standardized terms and definitions for use by those actively involved in the fabrication of welded products. In answer to this need, AWS has published the document AWS A3.0, *Welding Terms and Definitions*. It was developed by the Committee on Definitions and Symbols to aid in the communication of welding information. The standard terms and definitions published in AWS A3.0 are those that should be used in the oral and written language of welding. While these are the standard, or preferred terms, they are by no means the only terms used to describe various situations. Since the purpose here is to educate, it is felt to be important to mention some of these common terms, even though they are not preferred terminology.

When these terms are mentioned, they will appear in parentheses after the preferred words.

While most of the terms used apply to the actual welding operation, it is important for the welding inspector to understand other definitions which apply to other related operations. For example, the welding inspector should understand how to describe the various weld joint configurations and elements of the fitting process. After welding is completed, the welding inspector may need to describe the location of some welding discontinuity which has been discovered. If such a discontinuity requires further attention, it is important that the inspector accurately describe the location of the problem so that the welder will know where the repair is to be made.

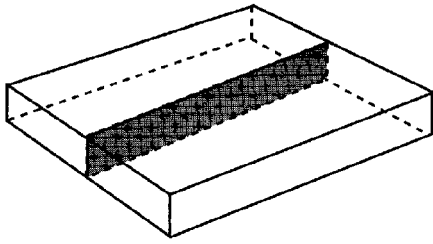
Types of Joints

Before welding begins, the welding inspector may be required to examine the weld joint configuration and fit. This is one of the most important aspects of welding inspection, because it is possible to detect potential problems. When discovered at this stage, these problems can be corrected more economically.

When a welding inspector is performing a joint inspection, it is necessary that he know the differences between the various types of weld joints. A *joint* is "the junction of members or edges of members which are to be joined or have been joined." There are five basic types of joints: butt, corner, T-, lap, and edge.

These five joint types get their names from their basic configurations. The butt joint describes the configuration when two members to be joined lie in the same plane and are connected at their edges.

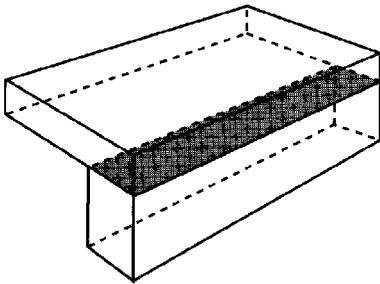
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(A) BUTT JOINT

APPLICABLE WELDS

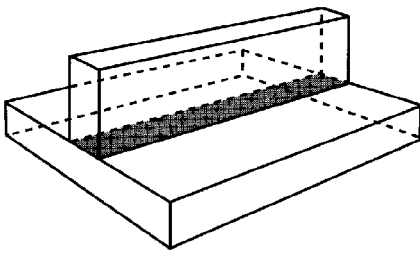
BEVEL GROOVE	U-GROOVE
FLARE BEVEL GROOVE	V-GROOVE
FLARE V-GROOVE	EDGE FLANGE
J-GROOVE	BRAZE
SQUARE GROOVE	



(B) CORNER JOINT

APPLICABLE WELDS

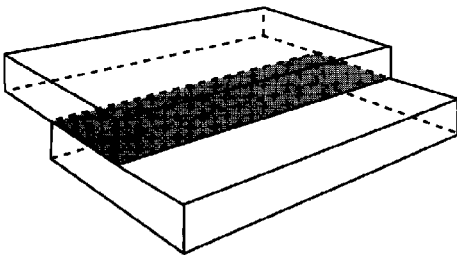
FILLET	CORNER FLANGE
BEVEL GROOVE	EDGE FLANGE
FLARE BEVEL GROOVE	PLUG
FLARE V-GROOVE	SLOT
J-GROOVE	SPOT
SQUARE GROOVE	SEAM
U-GROOVE	PROJECTION
V-GROOVE	BRAZE



(C) T-JOINT

APPLICABLE WELDS

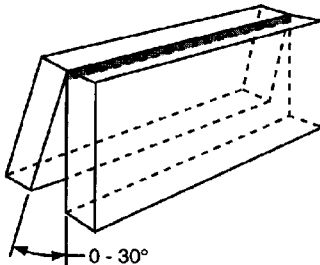
FILLET	SLOT
BEVEL GROOVE	SPOT
FLARE BEVEL GROOVE	SEAM
J-GROOVE	PROJECTION
SQUARE GROOVE	BRAZE
PLUG	



(D) LAP JOINT

APPLICABLE WELDS

FILLET	SLOT
BEVEL GROOVE	SPOT
FLARE BEVEL GROOVE	SEAM
FLARE V-GROOVE	PROJECTION
J-GROOVE	BRAZE
PLUG	



(E) EDGE JOINT

APPLICABLE WELDS

BEVEL GROOVE	V-GROOVE
FLARE BEVEL GROOVE	EDGE
FLARE V-GROOVE	CORNER FLANGE
J-GROOVE	EDGE FLANGE
SQUARE GROOVE	SEAM
U-GROOVE	

JOINT TYPES (Source: ANSI/AWS A3.0)

With a corner joint, the two members to be joined lie in perpendicular planes and their edges are connected. The T-joint is similar in that the two members lie in perpendicular planes, except the edge of one member is joined to the planar surface of the other. In a lap joint, the two members lie in parallel planes, but not the same plane. The joint occurs where the two members overlap each other to form a double thickness region. The final joint configuration, the edge, also has the two members lying in parallel planes, but the two members lie with their planar surfaces in contact so that the actual welding occurs around the perimeter, or outside, of the joint.

Parts of the Weld Joint

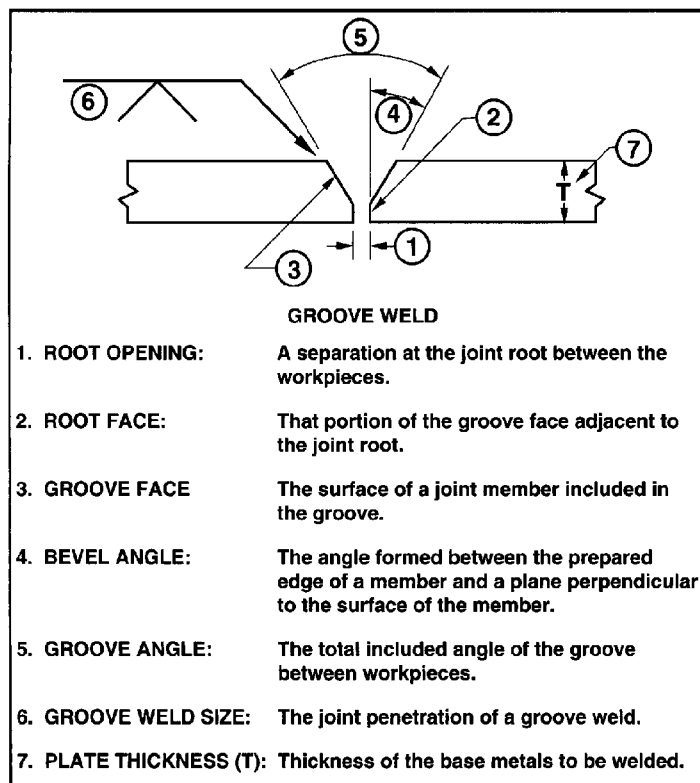
Once the type of joint has been identified, it may be necessary to further describe the exact configuration required. To do this, the welding inspector must be capable of naming the various features of that particular joint. Some of these ele-

ments include: joint root, groove face, root face, root edge, root opening, bevel, bevel angle, groove angle, and groove radius. Depending upon the particular type of joint configuration, these features may take on slightly different shapes.

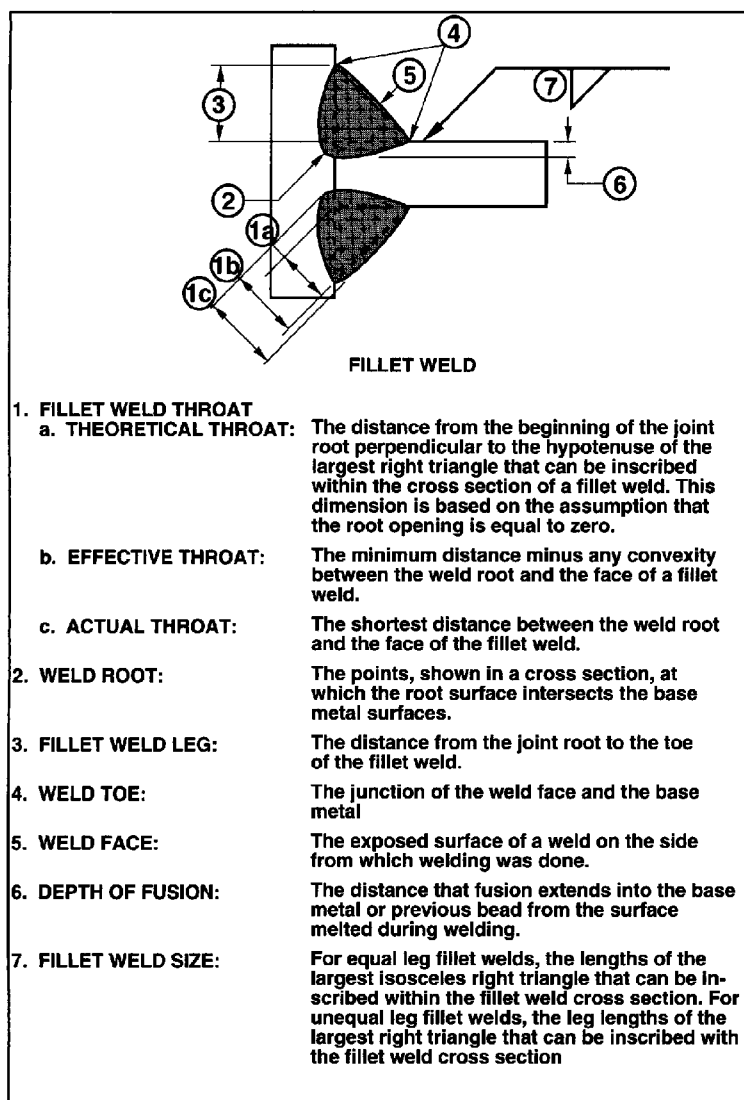
A perfect example of this is the *joint root*, or "that portion of a joint to be welded where the members approach closest to each other. In cross section, the joint root may be either a point, line, or an area."

Some other related terms are: groove face, root face and root edge. By definition, *groove face* is "that surface of a member included in the groove." The *root face* (also commonly called the land, nose or flat) is "that portion of the groove face adjacent to the joint root." The *root edge* is defined as "a root face of zero width."

Terms describing actual shapes and dimensions are some of the other features which may require description by the welding inspector. These elements are often essential variables for welding procedure specifications, so the welding inspector may be required to actually measure them to judge their compliance with applicable drawings or other documents. The *root opening* (gap) is described as "the separation between the workpieces at the joint root." The *bevel* (also referred to as chamfer) is "an angular edge preparation." The *bevel angle* is defined as "the angle formed between the prepared edge of a member and a plane perpendicular to the surface of the member." The *groove angle* is "the total included angle of the groove between workpieces." For a single-bevel-groove-weld, the bevel angle and the groove angle are equal. The final term, groove radius, applies only to J- and U-groove welds. It is described as "the radius used to form the shape of a J- or U-groove weld." Normally, a J- or U-groove weld configuration is specified by both a bevel (or groove) angle and a groove radius.



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The figure above illustrates the various parts of a fillet weld.

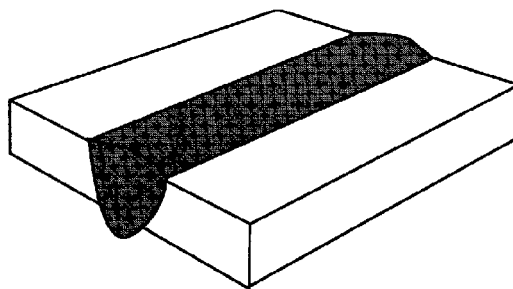
Types of Welds

There are numerous welds which can be applied to the various types of joints. According to AWS A3.0, there are 18 basic types of welds used in arc welding, including:

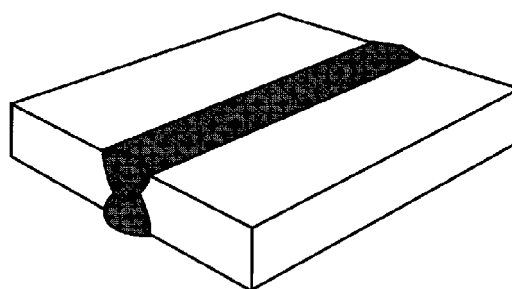
- 1) Square-groove weld
- 2) Bevel-groove weld
- 3) V-groove weld
- 4) J-groove weld
- 5) U-groove weld

- 6) Flare-bevel-groove weld
- 7) Flare-V-groove weld
- 8) Fillet weld
- 9) Edge weld
- 10) Edge-flange weld
- 11) Corner-flange weld
- 12) Spot weld
- 13) Seam weld
- 14) Plug weld
- 15) Slot weld
- 16) Surfacing weld
- 17) Back weld
- 18) Backing weld

With this variety of weld geometries available, the welding fabricator can choose the one which best suits his needs. This choice could be based on considerations such as: accessibility, type of welding process being used, method of joint preparation, and adaptation to particular designs of the structure being fabricated. The previous figure showing the various types of weld joints also



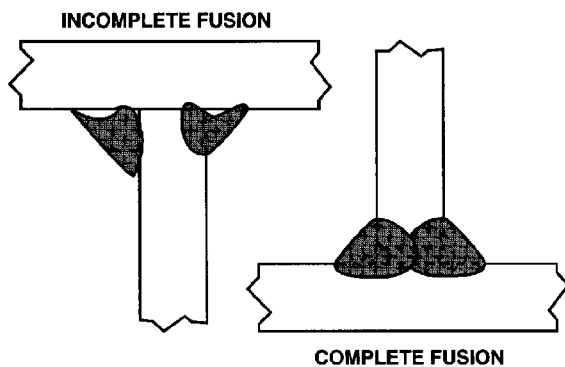
SINGLE V-GROOVE WELD



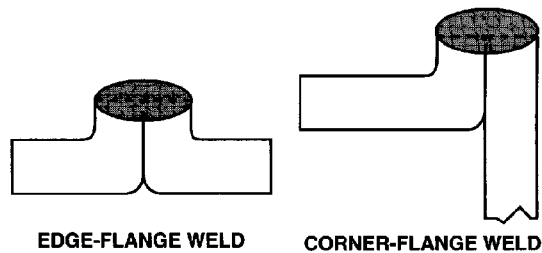
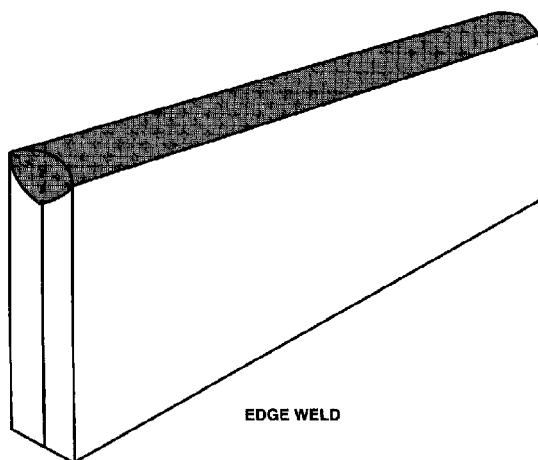
DOUBLE V-GROOVE WELD

indicates which of the above welds can be applied to each of the five types of weld joints.

The first seven types of welds refer to different groove configurations. Their names imply what the actual configurations look like when viewed in cross section. All of these groove weld types can be applied to joints which are welded from a single side or both sides. As would be expected, a *single-welded joint* is "a fusion welded joint that is welded from one side only," while a *double-welded joint* is "a fusion welded joint that is welded from both sides."



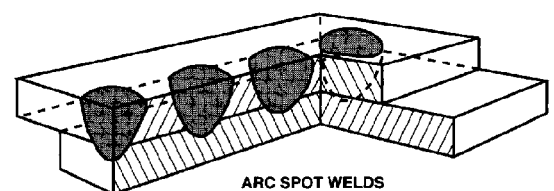
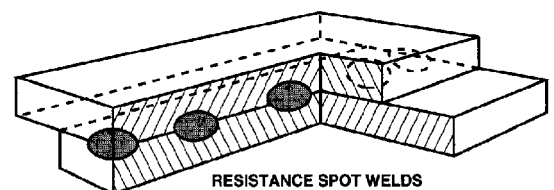
The next category of weld is the fillet weld. This weld type is possibly the most commonly used. An important thing to remember is that a fillet weld is not a type of joint. It is a particular type of weld which can be applied to a lap, T- or corner joint. AWS A3.0 defines a *fillet weld* as "a weld of approximately triangular cross section



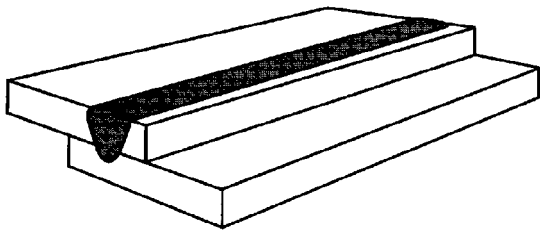
joining two surfaces approximately at right angles to each other in a lap joint, T-joint, or corner joint."

An *edge weld* is described as "a weld in an edge joint." Two modifications of the edge weld are used for flange welds. A flange weld is "a weld made on the edges of two or more members to be joined, at least one of which is flanged." The two common types are the edge-flange weld and the corner-flange weld. The edge-flange weld has both of the members flanged, while the corner-flange weld is used to join two members where only one of the members is flanged.

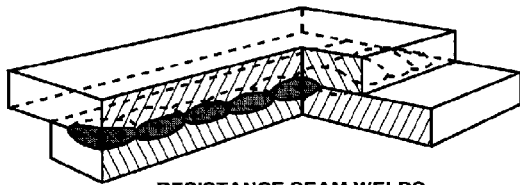
The next type of weld to be discussed is the spot weld. We most commonly associate spot welds with resistance welding, which is used extensively in the automotive and aerospace industries. However, a very effective way to join a lap joint configuration is through the use of an arc spot weld. In general, a *spot weld* is "a weld made between or upon overlapping members in which coalescence (the act of combining or uniting) may start and occur on the faying surfaces or may proceed from the outer surface of one member." A *faying surface* is "the mating surface of a member



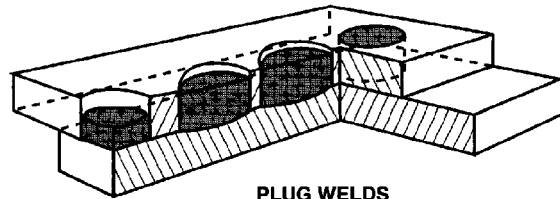
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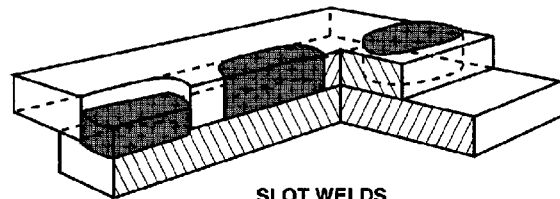
ARC SEAM WELD



RESISTANCE SEAM WELDS



PLUG WELDS



SLOT WELDS

that is in contact with or in close proximity to another member to which it is joined." In the case of arc spot welding, the weld is accomplished by melting through the top member using one of the arc welding processes such that fusion occurs between it and the member which it overlaps.

A seam weld is a similar type of weld except that instead of the weld being applied in a single spot, it forms a continuous weld having some length. As was the case for spot welds, seam welds can be accomplished using resistance or arc welding methods. In either case, the *seam weld* is defined as "a continuous weld made between or upon overlapping members, in which coalescence may start and occur on the faying surfaces, or may have proceeded from the outer surface of one member." Like the arc spot weld, the arc seam weld extends through one member to provide fusion to the member which is overlapped.

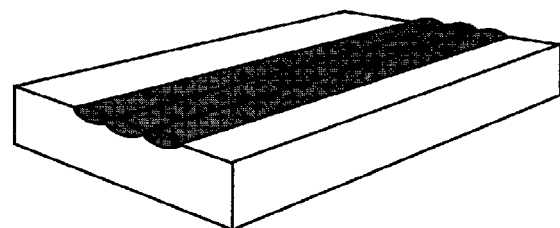
Two other types of welds which are used for the joining of overlapping members are plug and slot welds. They are different than spot and seam welds in that the near side member has a hole or slot cut to provide access to the member which it overlaps. The *plug weld* is defined as "a weld made in a circular hole in one member of a joint fusing that member to another member.

Similarly, a *slot weld* is "a weld made in an elongated hole in one member of a joint fusing

that member to another member. The hole may be open at one end." In either case, the hole or slot is normally filled completely flush with the top surface. A fillet weld applied in a circular hole or slot is not considered to be either a plug or slot weld.

The next weld type of interest is the surfacing weld. As one might expect, the particular type of weld is applied to the surface of a metal. Normally, the primary reason for this application is to provide some barrier against abrasion or corrosion. Often, this approach is more economical than the use of a full thickness of some more expensive material. AWS A3.0 defines a *surfacing weld* as "a weld applied to a surface, as opposed to making a joint, to obtain desired properties or dimensions."

The final weld types to be discussed are called back and backing welds. From the names, it is apparent that these welds are meant to be applied to the back side of a weld joint. Although



SURFACING WELD

they are applied to the same location, they differ depending upon when they are deposited. AWS A3.0 describes a *back weld* as “a weld made at the back of a single groove weld,” and a *backing weld* as “backing in the form of a weld.” Therefore, a back weld is applied after the front side has already been welded, while the backing weld is deposited prior to the welding of the front side.

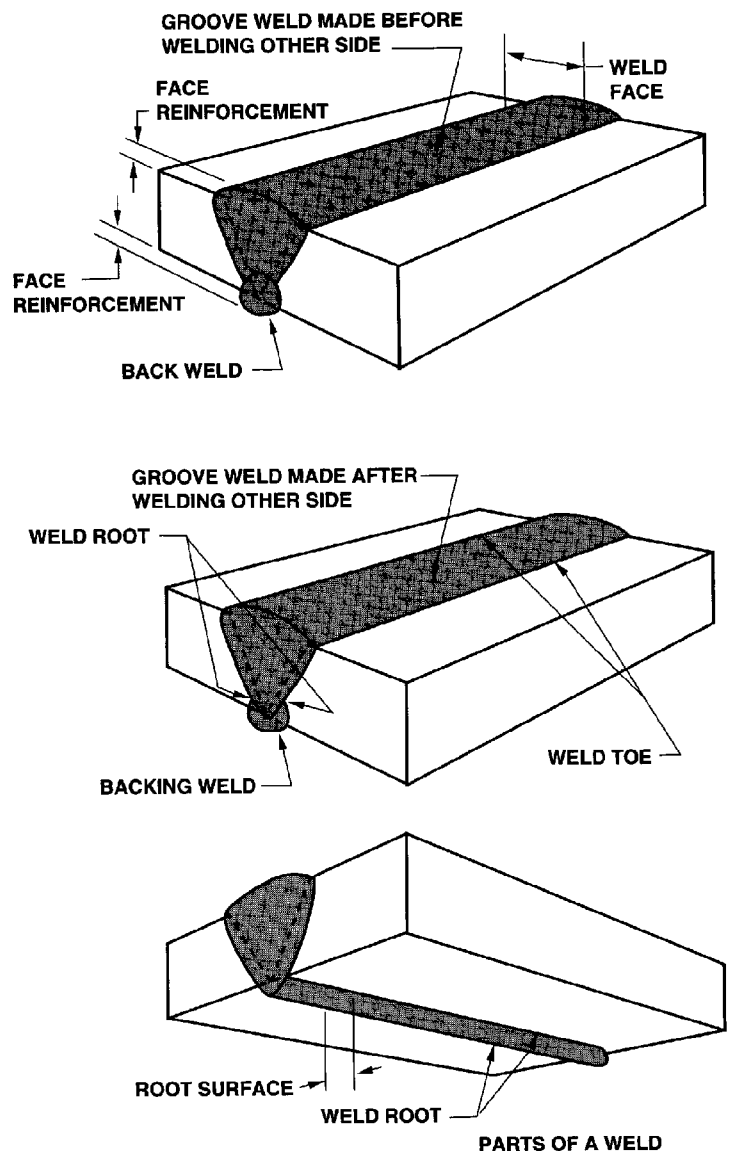
Parts of Completed Welds

So far, the discussion has been limited to the description of weld joints and types of weld configurations. However, the welding inspector must also be aware of terms used to describe conditions or features of completed welds. When a completed weld is being inspected, the inspector should describe the conditions which exist when reporting inspection findings. Groove welds have several primary components. The first part, the *weld face*, is “the exposed surface of a weld on the side from which welding was done.” “The junction of the weld face and the base metal” is referred to as the *weld toe*. Opposite the weld face is the weld root. The *weld root* is defined as “the points, as shown in cross section, at which the root surface intersects the base metal surfaces. The root surface is “the exposed surface of the weld opposite the side from which welding was done.” Therefore, the root surface is bounded by the weld root on either side.

Other terms relate to *weld reinforcement*, which is “weld metal in excess of the quantity required to fill a joint.” The *face reinforcement* (also commonly called weld crown) is “the weld reinforcement at the side of the joint from which welding was done.” Conversely, the root reinforcement is “the weld reinforcement opposite the side from which welding was done.” In both cases, this represents that portion of the weld metal which extends beyond the surface of the base metal.

The previous explanations assume a single-welded joint, or all welding was performed from one side. In the case of a double-welded joint, both sides of the joint will have a weld face, and the amount of reinforcement present on each side will be referred to as the face reinforcement. This is illustrated in the figure below showing the use of a back weld.

Just as groove welds have names for various parts, standard terminology exists for parts of fillet welds. As with the groove weld, the surface of the weld which the inspector will evaluate is



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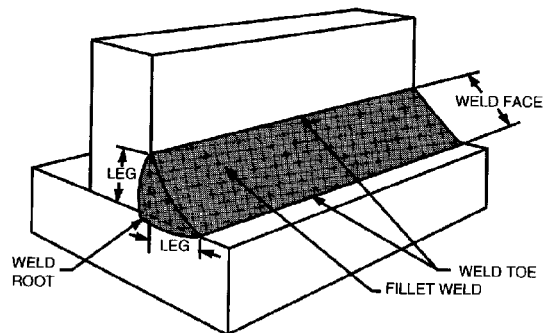
referred to as the weld face. The junctions of the weld face with the base metal are the weld toes. The furthest penetration of the weld metal into the joint is the weld root.

The distance from the weld toe to the joint root is called the *fillet weld leg*. One other feature of a fillet weld is the weld throat. In general, this is the shortest distance through the cross section of the weld. Various types of fillet weld throats will be discussed in more detail under the topic of sizing convex and concave fillet welds.

Fusion and Penetration Terminology

There are also terms relating to the fusion and penetration of the weld metal into the base metal. Although these are features which are difficult for the visual inspector to check without further destructive or nondestructive examination, it is still important to understand what the various terms mean.

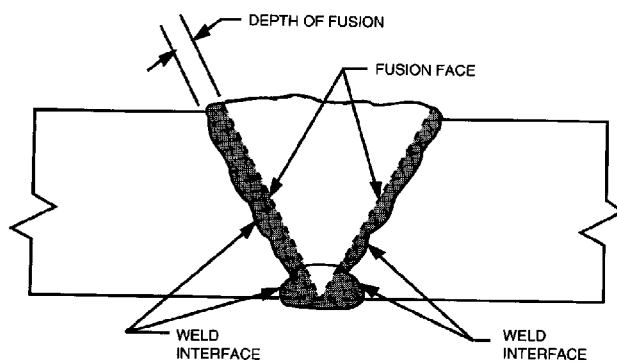
In general, fusion refers to the actual melting together of the filler metal and base metal, or of



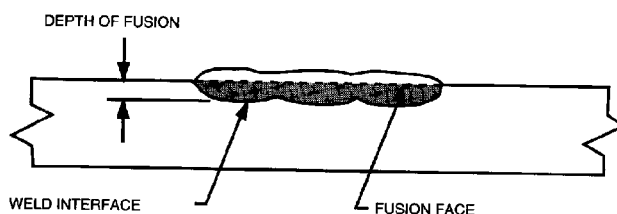
PARTS OF A WELD

the base metal only. Penetration is a term which relates to the distance that the weld metal has progressed into the joint. The degree of penetration achieved has a direct effect on the strength of the joint and is therefore related to the weld size.

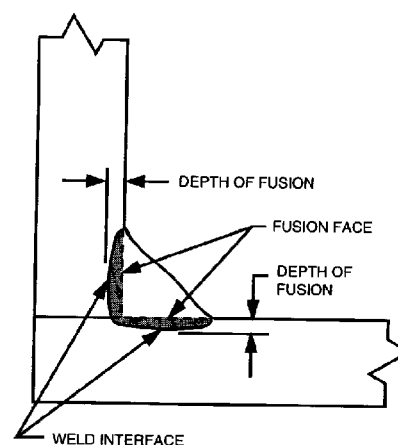
Numerous terms exist which describe the degree or location of either fusion or penetration. During the welding operation, the original groove face is melted such that the final boundary of the weld metal is deeper than the original surface. The groove face is referred to as the fusion face since it will be melted during welding. The



(A) GROOVE WELD



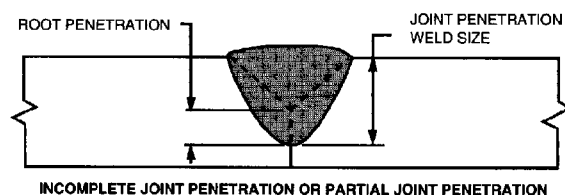
(C) SURFACING WELD



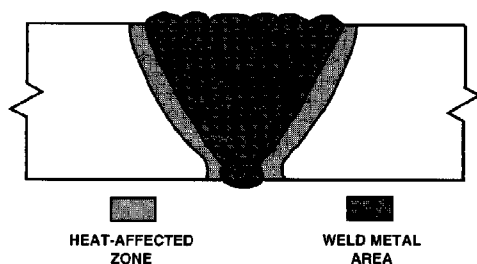
(B) FILLET WELD

FUSION WELDS

boundary between the weld metal and base metal is referred to as the weld interface. The depth of fusion is the distance from the fusion face to the weld interface. The depth of fusion is always measured perpendicular to the fusion face. These terms are applied similarly for other types of welds such as fillet and surfacing welds.



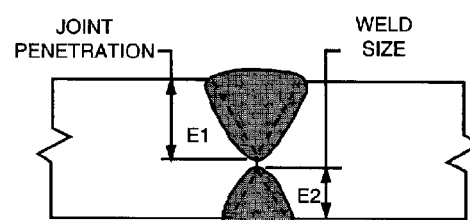
There are also several terms which refer to penetration of the weld. *Root penetration* is the distance that the weld metal has melted into the joint beyond the joint root. The *joint penetration* is the distance from the furthest extension of the weld into the joint to the weld face, excluding any weld reinforcement which may be present. For groove welds, this same length is also referred to as the weld size (sometimes improperly referred to as effective throat).



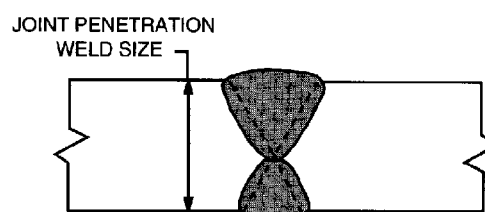
Another related term is *heat-affected zone*. This region is defined as "that portion of the base metal that has not been melted, but whose mechanical properties or microstructure have been altered by the heat of welding, brazing, soldering, or cutting."

Weld Size Terminology

The previous discussion describes joint penetration, and therefore the weld size, for single-groove weld configurations.



**INCOMPLETE JOINT PENETRATION
OR PARTIAL JOINT PENETRATION**



COMPLETE JOINT PENETRATION

For the case of a double-groove weld configuration where the joint penetration is less than complete, the weld size is equal to the sum of the joint penetrations from both sides.

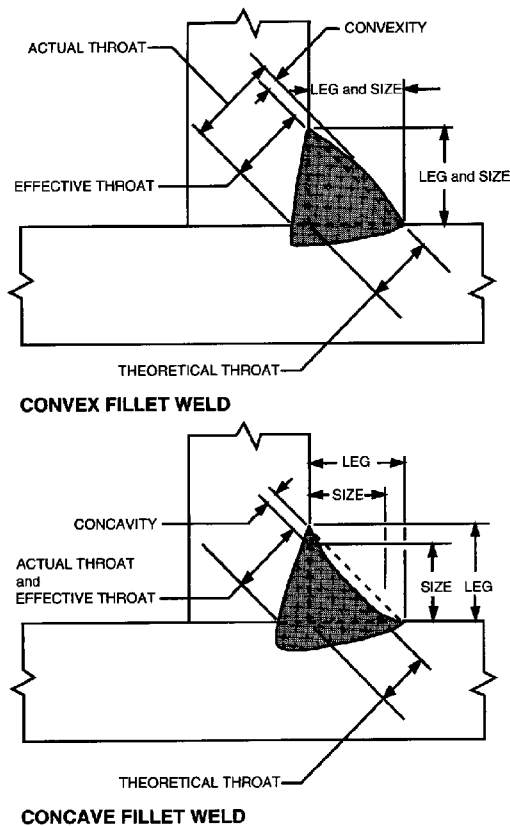
For a complete penetration groove weld, the weld size will be equal to the thickness of the thinner of the two members joined, since there is no credit given for any weld reinforcement present.

To determine the size of a fillet weld, we must first know whether the final weld configuration is convex or concave. By convex, we mean that the weld face exhibits some buildup causing it to appear slightly curved outwardly. This is referred to as the amount of convexity. Convexity in a fillet weld is analogous with weld reinforcement in a groove weld. If a weld has a concave profile, we mean that its face is "dished in."

For either configuration, the fillet weld size for equal leg fillet welds is described as the leg lengths of the largest isosceles (two legs of equal length) right triangle which can be inscribed within the fillet weld cross section."

These inscribed isosceles right triangles are shown with dotted lines in the two illustrations

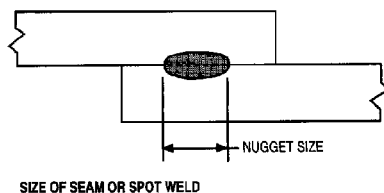
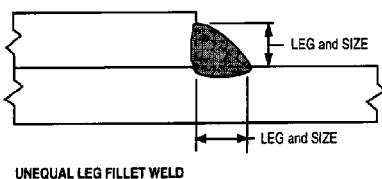
4-10



above. So, for the convex fillet weld, the leg and size are equal. However, the size of a concave fillet weld is slightly less than its leg length.

For unequal leg fillet welds, the fillet weld size is defined as "the leg lengths of the largest right triangle that can be inscribed within the fillet weld cross section.

It can be noted that there are additional notations on these illustrations which refer to fillet weld throats. There are really three different types of weld throats with which we may be concerned. The first is the theoretical throat. This is the minimum amount of weld which the designer counts on when he originally specifies a weld size.



The *theoretical throat* is described as "the distance from the beginning of the joint root perpendicular to the hypotenuse (side of the triangle opposite the right angle) of the largest right triangle that can be inscribed within the cross section of a fillet weld. This dimension is based on the assumption that the root opening is equal to zero."

The *effective throat* takes into account any additional joint penetration which may be present. So, the effective throat can be defined as "the minimum distance minus any convexity between the weld root and the face of a fillet weld." The final throat dimension, the actual throat, takes into account both the joint penetration as well as any additional convexity present at the weld face.

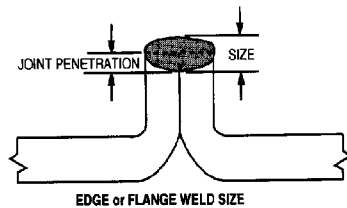
Technically, the *actual throat* is "the shortest distance between the weld root and the face of a fillet weld." For a concave fillet weld, the effective throat and actual throat are equal, since there is no convexity present.

The welding inspector may also be asked to somehow determine the sizes of other types of welds. One example might be a spot or seam weld, where the weld size is equal to the actual nugget size or diameter.

For an edge or flange weld, the weld size is equal to the total thickness of the weld from the weld root to the weld face.

Weld Application Terminology

To complete this discussion of welding terms and definitions, it seems appropriate to mention some of the terminology associated with the actual application of welds. Some welding procedures will refer to these details, so the welding inspector should be familiar with their meanings. The first aspect is the difference

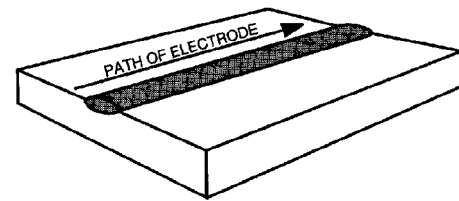


among the terms weld pass, weld bead and weld layer. A *weld pass* is a single progression of welding along a joint. The *weld bead* is that weld which results from a weld pass. A *weld layer* is a single level of weld within a multiple-pass weld. A weld layer may consist of a single bead or multiple beads.

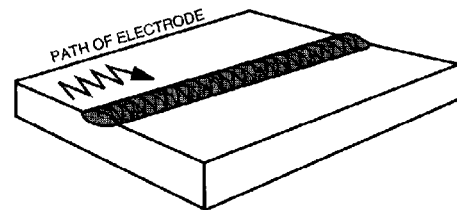
When a weld bead is deposited, it could have a different name, depending upon the technique which the welder uses. If the welder progresses along the joint with little or no side-to-side motion, the resulting weld bead is referred to as a *stringer bead*. A *weave bead* results when the welder manipulates the electrode laterally, or side to side, as the weld is deposited along the joint.

The weave bead is typically wider than the stringer bead. Due to the amount of lateral motion used, the travel speed, as measured along the longitudinal axis of the weld, is less than would be the case for a stringer bead.

There are several terms which describe the actual sequence in which the welding is to be done. This is commonly done to reduce the



STRINGER BEAD



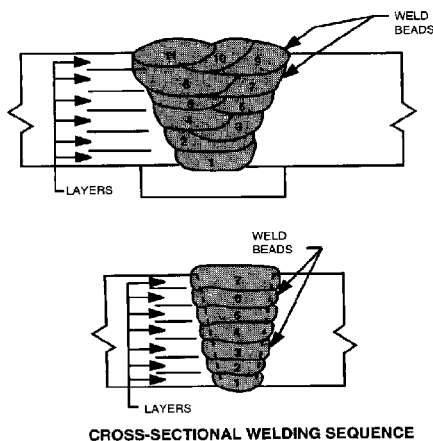
WEAVE BEAD

amount of distortion caused by welding. Three common techniques are: *backstep sequence*, *block sequence* and *cascade sequence*. The backstep sequence is a technique where each individual weld pass is deposited in the direction opposite that of the overall progression of welding.

A *block sequence* is defined as "a combined longitudinal and cross sectional sequence for a continuous multiple pass weld in which separated increments are completely or partially welded before intervening increments are welded." With the block sequence, it is important that each subsequent layer is slightly shorter than the previous one so that the end of the block has a gentle slope. This will provide the best chance of obtaining adequate fusion when the adjacent block is filled in later.

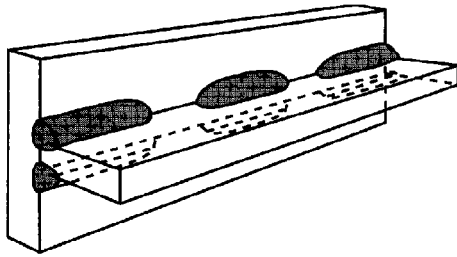
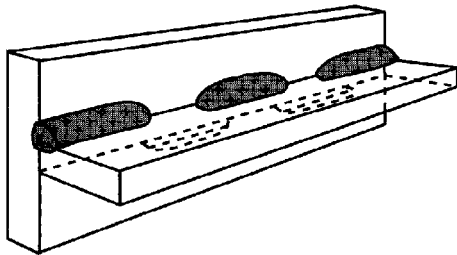
A *cascade sequence* is described as "a combined longitudinal and cross sectional sequence in which weld passes are made in overlapping layers." This method differs from the block sequence in that each subsequent pass is longer than the previous one.

When fillet welds are required, there will be some cases where the design does not warrant the use of continuous welds. The designer may therefore specify intermittent fillet welds. If there are intermittent fillet welds specified on both sides



CROSS-SECTIONAL WELDING SEQUENCE

4-12

**CHAIN INTERMITTENT FILLET WELD****STAGGERED INTERMITTENT FILLET WELD**

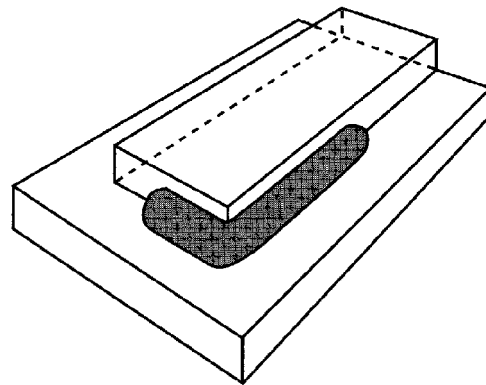
of a particular joint, they can be detailed as either chain intermittent or staggered intermittent fillet welds. The *chain intermittent fillet weld* has the increments on either side of the joint directly opposite each other.

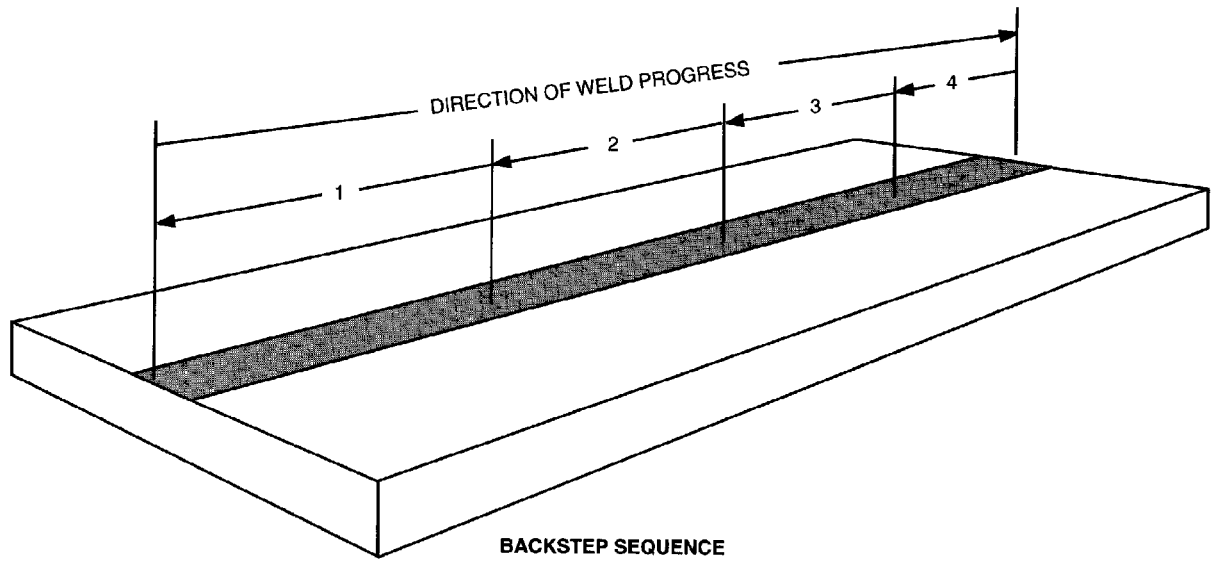
Similarly, a *staggered intermittent fillet weld* is an intermittent fillet weld on both sides of a joint in which the weld increments on one side are alternated with respect to those on the other side.

One final term related to the actual welding operation is boxing (commonly referred to as end returning). *Boxing* is defined as "the continuation of a fillet weld around a corner of a member as an extension of the principal weld."

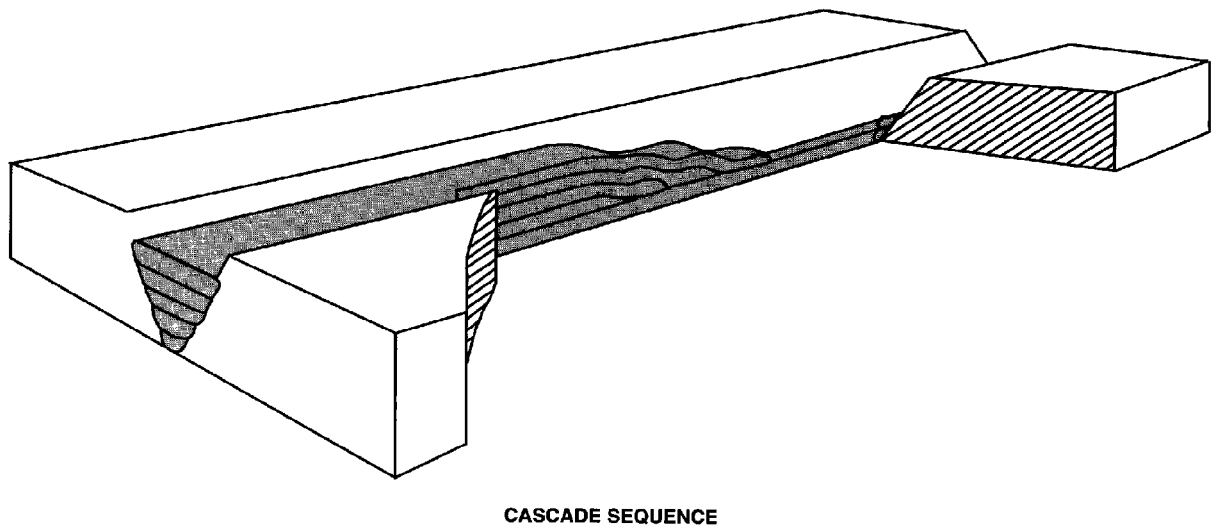
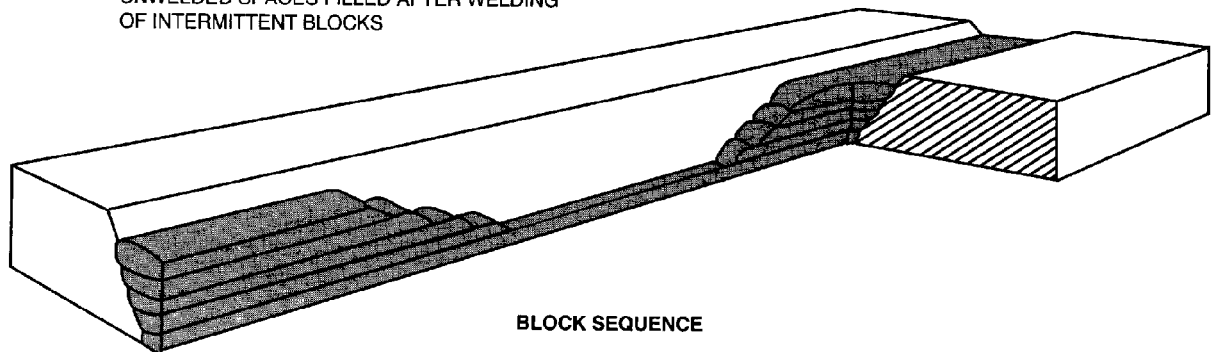
Summary

While numerous terms have been discussed here, that does not imply that these are the only ones which are applied to welding. This does provide some basis upon which the inspector can begin to understand how to describe a weld or some feature of that weld. These written explanations and illustrations are simply a beginning. As you gain experience, you will learn to correlate these "textbook" terms with actual physical characteristics. It is only after working with and using these terms that you will gain full understanding of how to describe various welding attributes.

**BOXING**



UNWELDED SPACES FILLED AFTER WELDING
OF INTERMITTENT BLOCKS



REVIEW - CHAPTER 4 WELD JOINT GEOMETRY AND WELDING TERMINOLOGY

- Q4-1** Which of the following is not considered a type of joint?
- a. butt
 - b. T
 - c. fillet
 - d. corner
 - e. edge
- Q4-2** The type of joint formed when the two pieces to be joined lie in parallel planes and their edges overlap is called:
- a. corner
 - b. T
 - c. edge
 - d. lap
 - e. butt
- Q4-3** That portion of the joint where the two pieces to be joined come closest together is referred to as the:
- a. bevel
 - b. joint root
 - c. groove angle
 - d. root face
 - e. both b & d
- Q4-4** In a single-V-groove weld, the sloped surfaces against which the weld metal is applied are called:
- a. root face
 - b. joint root
 - c. groove face
 - d. groove angle
 - e. bevel angle

- Q4-5** The type of weld produced by filling an elongated hole in an overlapping member attaching it to the member beneath is called a:
- a. plug weld
 - b. spot weld
 - c. seam weld
 - d. slot weld
 - e. none of the above
- Q4-6** The type of weld having a generally triangular cross section and which is applied to either a T-, corner or lap joint is called a:
- a. flange weld
 - b. flare weld
 - c. fillet weld
 - d. slot weld
 - e. spot weld
- Q4-7** The type of weld used to build up thinned surfaces, provide a layer of corrosion protection, provide a layer of abrasion-resistant material, etc. is referred to as a:
- a. edge weld
 - b. flare weld
 - c. flange weld
 - d. slot weld
 - e. surfacing weld
- Q4-8** The type of weld applied to the opposite side of a joint before a single-V-groove weld is completed on the near side of a joint is called a:
- a. melt-through weld
 - b. backing weld
 - c. back weld
 - d. root weld
 - e. none of the above
- Q4-9** In a completed groove weld, the surface of the weld on the side from which the welding was done is called the:
- a. crown
 - b. weld reinforcement
 - c. weld face
 - d. root
 - e. none of the above

4-16

- Q4-10** In a completed weld, the junction between the weld face and the base metal is called the:
- a. root
 - b. weld edge
 - c. weld reinforcement
 - d. leg
 - e. weld toe
- Q4-11** The height of the weld above the base metal in a groove weld is called the:
- a. crown
 - b. buildup
 - c. face
 - d. weld reinforcement
 - e. none of the above
- Q4-12** In a fillet weld, the leg and size are the same for what type of configuration?
- a. equal leg
 - b. concave
 - c. convex
 - d. unequal leg
 - e. oversize
- Q4-13** When looking at the cross section of a completed groove weld, the difference between the fusion face and the weld interface is called the:
- a. depth of fusion
 - b. depth of penetration
 - c. root penetration
 - d. joint penetration
 - e. effective throat
- Q4-14** For a concave fillet weld, which throat dimensions are the same?
- a. theoretical and effective
 - b. actual and effective
 - c. theoretical and actual
 - d. all of the above
 - e. none of the above

- Q4-15** In a partial penetration single-V-groove weld, the dimension measured from the joint root to the weld root is called the:
- joint penetration
 - effective throat
 - root penetration
 - depth of fusion
 - weld interface
- Q4-16** The size of a spot weld is determined by its:
- depth of fusion
 - spot diameter
 - depth of penetration
 - thickness
 - none of the above
- Q4-17** In the performance of a vertical position weld, the type of weld progression having a side-to-side motion is called:
- stringer bead technique
 - stagger bead technique
 - weave bead technique
 - unacceptable
 - none of the above
- Q4-18** Which of the following is only found in a single-welded groove?
- weld face
 - weld root
 - weld toe
 - root reinforcement
 - face reinforcement
- Q4-19** The technique used to control distortion of a long joint where individual passes are applied in a direction opposite the general progression of welding in the joint is called:
- backstepping
 - boxing
 - staggering
 - cascading
 - blocking

4-18

Q4-20 A technique used in a multiple layer weld deposit where each successive layer is longer than the previous one is called:

- a. block sequence
- b. box sequence
- c. cascade sequence
- d. backstep sequence
- e. stagger sequence

Questions **Q4-21** through **Q4-28** refer to Figure 1 below:

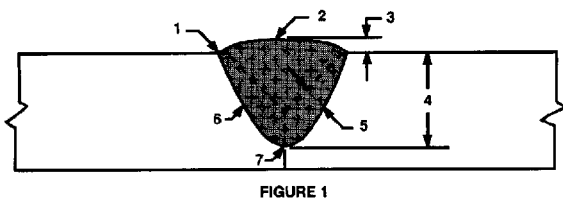


FIGURE 1

Q4-21 The weld face shown in Figure 1 is labeled:

- a. 1
- b. 2
- c. 3
- d. 6
- e. 7

Q4-22 The weld root shown in Figure 1 is labeled:

- a. 1
- b. 2
- c. 3
- d. 6
- e. 7

Q4-23 The type of weld shown in Figure 1 is a:

- a. double-bevel-groove
- b. single-bevel-groove
- c. double-V-groove
- d. single-V-groove
- e. none of the above

Q4-24 The weld reinforcement height shown in Figure 1 is labeled:

- a. 1
- b. 2
- c. 3
- d. 6
- e. 7

Q4-25 The weld toe shown in Figure 1 is labeled:

- a. 1
- b. 2
- c. 3
- d. 6
- e. 7

Q4-26 Number 6 shown in Figure 1 is the:

- a. weld root
- b. fusion face
- c. groove face
- d. weld interface
- e. depth of fusion

Q4-27 Number 5 (between arrows) shown in Figure 1 is the:

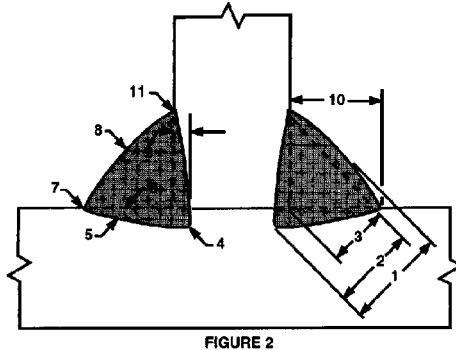
- a. weld root
- b. fusion face
- c. groove face
- d. weld interface
- e. depth of fusion

Q4-28 Number 4 shown in Figure 1 is the:

- a. weld size
- b. joint penetration
- c. actual throat
- d. theoretical throat
- e. a and b above

4-20

Questions **Q4-29** through **Q4-40** refer to Figure 2 below:



Q4-29 The weld face shown in Figure 2 is labeled:

- a. 7
- b. 8
- c. 6
- d. 11
- e. 10

Q4-30 The weld root shown in Figure 2 is labeled:

- a. 6
- b. 4
- c. 5
- d. 9
- e. 3

Q4-31 The welds shown in Figure 2 are:

- a. concave fillets
- b. conical fillets
- c. convex fillets
- d. T-fillets
- e. fillet of fish

Q4-32 The actual throat shown in Figure 2 is labeled:

- a. 1
- b. 2
- c. 3
- d. 10
- e. 9

Q4-33 The weld toe shown in Figure 2 is labeled:

- a. 11
- b. 8
- c. 10
- d. 7
- e. both a and d

Q4-34 Number 6 shown in Figure 2 is the:

- a. weld root
- b. fusion face
- c. groove face
- d. weld interface
- e. depth of fusion

Q4-35 Number 9 shown in Figure 2 is the:

- a. weld root
- b. fusion face
- c. groove face
- d. weld interface
- e. depth of fusion

Q4-36 Number 5 shown in Figure 2 is the:

- a. weld root
- b. fusion face
- c. groove face
- d. weld interface
- e. depth of fusion

Q4-37 Number 4 shown in Figure 2 is the:

- a. weld root
- b. fusion face
- c. groove face
- d. weld interface
- e. depth of fusion

4-22

Q4-38 Number 2 shown in Figure 2 is the:

- a. weld size
- b. effective throat
- c. actual throat
- d. theoretical throat
- e. a and b above

Q4-39 Number 3 shown in Figure 2 is the:

- a. weld size
- b. effective throat
- c. actual throat
- d. theoretical throat
- e. a and b above

Q4-40 Number 10 shown in Figure 2 is the:

- a. weld size and leg size
- b. weld size
- c. leg
- d. theoretical throat
- e. actual throat

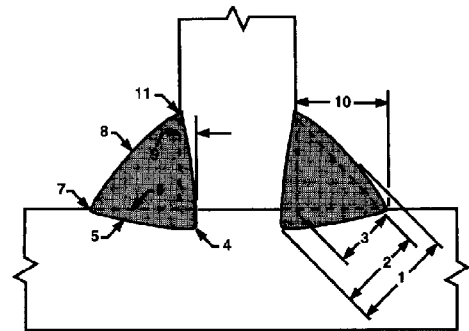


FIGURE 2

Questions **Q4-41** through **Q4-45** refer to Figure 3 below:

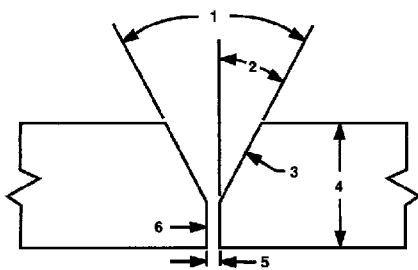


FIGURE 3

Q4-41 The groove angle shown in Figure 3 is labeled:

- a. 1
- b. 2
- c. 3
- d. 4
- e. 5

Q4-42 The bevel angle shown in Figure 3 is labeled:

- a. 1
- b. 2
- c. 3
- d. 4
- e. 5

Q4-43 Number 3 shown in Figure 3 is the:

- a. groove angle
- b. bevel angle
- c. groove face
- d. fusion face
- e. c and d above

Q4-44 Number 6 shown in Figure 3 is the:

- a. groove face
- b. fusion face
- c. bevel face
- d. root face
- e. bevel

Q4-45 Number 5 shown in Figure 3 is the:

- a. fusion face
- b. groove face
- c. root opening
- d. root face
- e. weld root

4-24

Questions Q4-46 through Q4-54 refer to Figure 4 below:

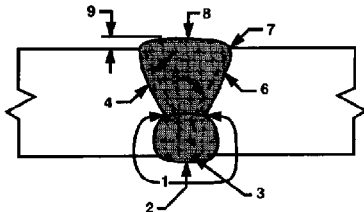


FIGURE 4

Q4-46 The weld faces shown in Figure 4 are labeled:

- a. 8 & 2
- b. 9 & 7
- c. 7 & 4
- d. 1 & 6
- e. 3 & 9

Q4-47 The weld roots shown in Figure 4 are labeled:

- a. 1
- b. 2
- c. 3
- d. 7
- e. a and c above

Q4-48 The weld shown in Figure 4 includes a:

- a. backing weld
- b. back weld
- c. double-V-groove
- d. double-bevel-groove
- e. none of the above

Q4-49 The weld size shown in Figure 4 is labeled:

- a. 9
- b. 8
- c. 7
- d. 2
- e. none of the above

Q4-50 The weld toe shown in Figure 4 is labeled:

- a. 1
- b. 2
- c. 3
- d. 6
- e. 7

Q4-51 Number 6 shown in Figure 4 is the:

- a. weld root
- b. fusion face
- c. groove face
- d. weld interface
- e. depth of fusion

Q4-52 Number 5 shown in Figure 4 is the:

- a. weld root
- b. fusion face
- c. groove face
- d. weld interface
- e. depth of fusion

Q4-53 Number 4 (between arrows) shown in Figure 4 is the:

- a. weld root
- b. fusion face
- c. groove face
- d. weld interface
- e. depth of fusion

Q4-54 Number 2 shown in Figure 4 is the:

- a. root surface
- b. fusion face
- c. weld face
- d. weld interface
- e. depth of fusion

4-26

Questions **Q4-55** through **Q4-58** refer to Figure 5 below:

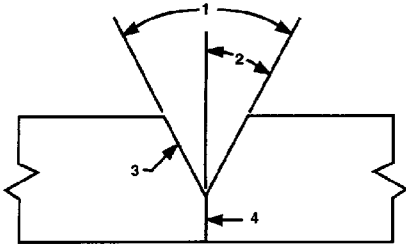


FIGURE 5

Q4-55 The bevel angle shown in Figure 5 is labeled:

- a. 1
- b. 2
- c. 3
- d. 4
- e. c and d above

Q4-56 The joint root shown in Figure 5 is labeled:

- a. 1
- b. 2
- c. 3
- d. 4
- e. none of the above

Q4-57 The groove face shown in Figure 5 is labeled:

- a. 1
- b. 2
- c. 3
- d. 4
- e. c and d above

Q4-58 The root face shown in Figure 5 is labeled:

- a. 1
- b. 2
- c. 3
- d. 4
- e. none of the above

Questions **Q4-59** through **Q4-69** refer to Figure 6 below:

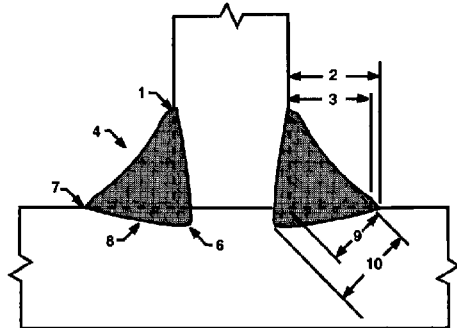


FIGURE 6

Q4-59 The weld face shown in Figure 6 is labeled:

- a. 1
- b. 4
- c. 7
- d. 3
- e. 2

Q4-60 The weld root shown in Figure 6 is labeled:

- a. 6
- b. 4
- c. 5
- d. 9
- e. 10

Q4-61 The welds shown in Figure 6 are:

- a. concave fillets
- b. conical fillets
- c. convex fillets
- d. T-fillets
- e. fillets of fish

Q4-62 The actual throat shown in Figure 6 is labeled:

- a. 9
- b. 10
- c. 3
- d. 2
- e. 5

4-28

Q4-63 The weld toe shown in Figure 6 is labeled:

- a. 1
- b. 8
- c. 10
- d. 7
- e. both a and d above

Q4-64 Number 6 shown in Figure 6 is the:

- a. weld root
- b. fusion face
- c. groove face
- d. weld interface
- e. depth of fusion

Q4-65 Number 8 shown in Figure 6 is the:

- a. weld root
- b. fusion face
- c. groove face
- d. weld interface
- e. depth of fusion

Q4-66 Number 5 shown in Figure 6 is the:

- a. weld root
- b. fusion face
- c. toe
- d. weld interface
- e. depth of fusion

Q4-67 Number 2 shown in Figure 6 is the:

- a. weld size
- b. leg size
- c. leg and weld size
- d. theoretical throat
- e. actual throat

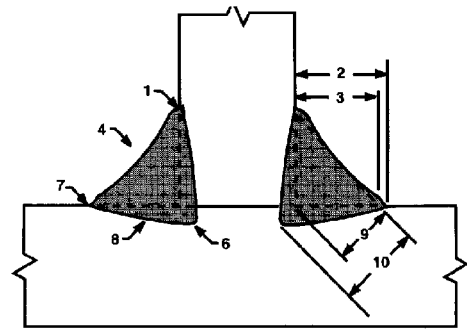


FIGURE 6

Q4-68 Number 3 shown in Figure 6 is the:

- a. weld size
- b. leg
- c. leg and weld size
- d. theoretical throat
- e. actual throat

Q4-69 Number 9 shown in Figure 6 is the:

- a. effective throat
- b. weld size
- c. leg
- d. theoretical throat
- e. actual throat