Welding joints

ISO/TR 25901-1:2016(en)
AWS A3.0M/A3.0:2010

http://www.weldguru.com/

Welding is a materials joining process used in making welds.

WELD:

A localized fusion of metals produced by heating to suitable temperatures. Pressure and/or filler metal may or may not be used. The filler metal has a melting point approximately the same or below that of the base metals, but always above 800 ºF (427 ºC).

WELDMENT:

An assembly whose component parts are formed by welding.

To produce a usable structure or weldment, there must be weld joints between the various pieces that make the weldment.

ISO/TR 25901-1:2016(en)

2.1.1.1 welding

joining process in which two or more parts are united producing a continuity in the nature of the workpiece material(s) by means of heat or pressure or both, and with or without the use of **filler material** (2.1.10.4)

Note 1 to entry: Welding processes may be used also for **surfacing** (2.1.9.1) and remelting.

2.1.1.3 weld

result of **welding** (2.1.1.1)

Note 1 to entry: The weld includes the weld metal (2.1.2.1) and the heat-affected zone (2.1.2.2).

2.1.1.4 weldment

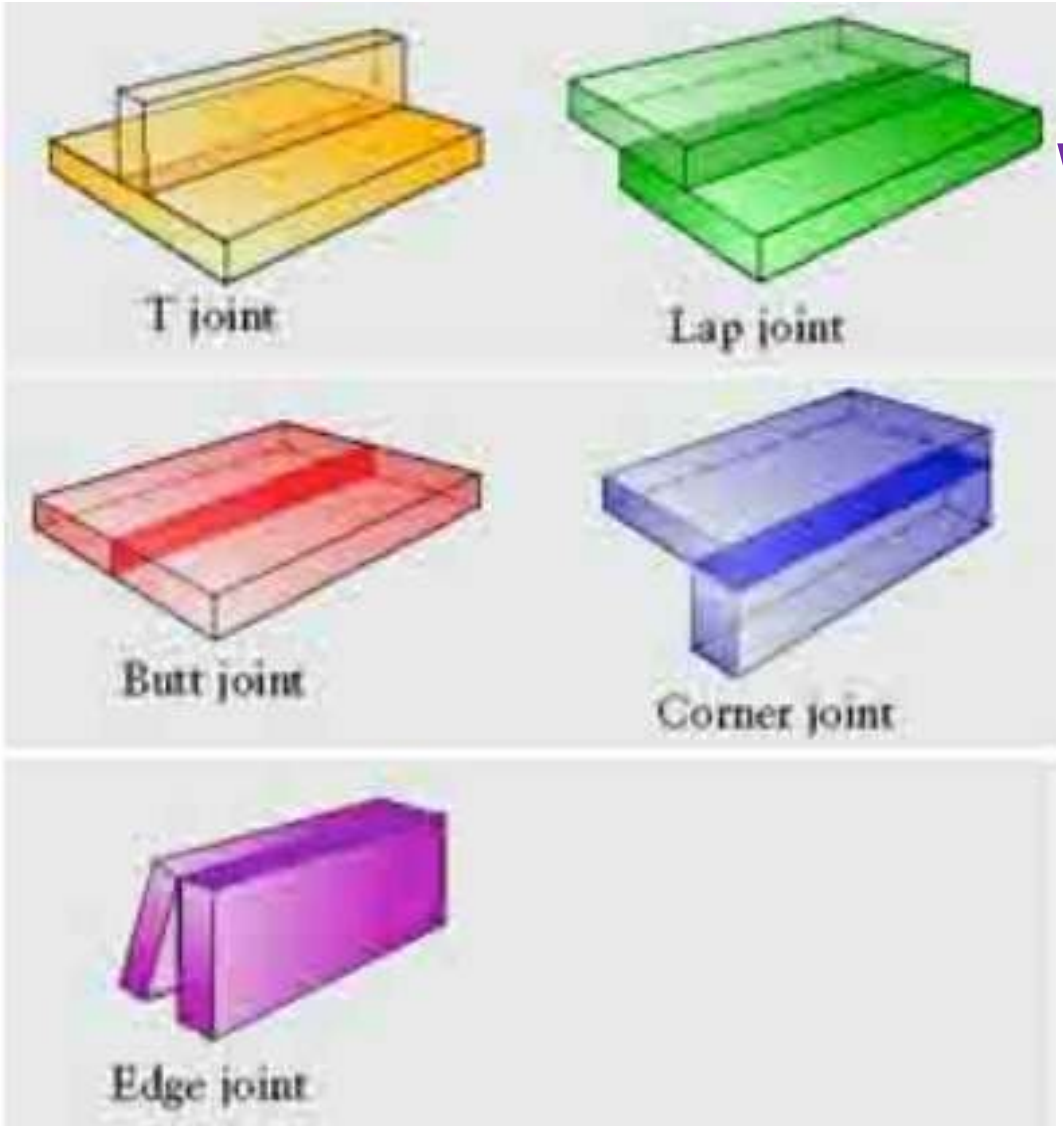
assembly incorporating one or more **welded joint(s)** (2.1.4.2)

2.1.4.2 welded joint

assembly that is produced by welding (2.1.1.1) together two or more parts

JOINT:

The portion of a structure in which separate base metal parts are joined.



Welding Joint Diagram

- T-joint
- Butt joint
- Edge joint
- Lap joint
- Corner joint

2.1.4 Type of joints

(**ISO/TR 25901-1:2016(en)**)

2.1.4.1 joint

junction of workpieces or the edges of workpieces that are to be joined or have been joined

2.1.4.2 welded joint

assembly that is produced by welding (2.1.1.1) together two or more parts

2.1.4.3 multiple joint

type of joint (2.1.4.1) where three or more parts meet at any required angles to each other

2.1.4.4 parallel joint

type of joint (2.1.4.1) where the parts lie parallel to each other

EXAMPLE:In explosive cladding.

2.1.4.5 butt joint

type of joint (2.1.4.1) where the parts lie in the same plane and against one another at an angle of 135° to 180°

2.1.4.6 T-joint

angle joint (2.1.4.8) where the parts meet each other forming a T-shape

2.1.4.7 lap joint

type of joint (2.1.4.1) where the parts lie parallel to each other (0° to 5°) and overlap each other

2.1.4.8 angle joint

type of joint (2.1.4.1) where one part meets the other at an acute angle greater than 5° but not more than 90°

Note 1 to entry: For a fillet weld (2.1.6.11), the angle is over 5° and less than 45°.
Note 2 to entry: For a butt weld (2.1.6.3), the angle is between 45° to 90° inclusive.

2.1.4.9 corner joint

type of joint (2.1.4.1) where two parts meet at their edges at an angle between 30° and 135° to each other

2.1.4.10 edge joint

type of joint (2.1.4.1) where two parts meet at their edges at an angle of 0° to 30°

2.1.4.11 cross joint

type of joint (2.1.4.1) where two parts lie crossing over each other

EXAMPLE:Wires that cross over each other.

2.1.4.12 cruciform joint

type of joint (2.1.4.1) where two parts lying in the same plane each meet, at right angles, a third part lying between them

2.1.4.13 homogeneous joint

welded joint (2.1.4.2) in which the weld metal (2.1.2.1) and parent material (2.1.1.5) have no significant differences in mechanical properties and/or chemical composition

Note 1 to entry: A welded joint (2.1.4.2) made of similar parent materials (2.1.1.5) without filler metal is considered homogeneous.

2.1.4.14 heterogeneous joint

welded joint (2.1.4.2) in which the weld metal (2.1.2.1) and parent material (2.1.1.5) have significant differences in mechanical properties and/or chemical composition

2.1.4.15 dissimilar material joint

welded joint (2.1.4.2) in which the parent materials (2.1.1.5) have significant differences in mechanical properties and/or chemical composition

5 Типы соединений

Тип соединения определяют количеством, размерами и относительной ориентацией соединяемых деталей. На рисунке 1 схематично показаны примеры с соответствующими терминами и пояснениями.

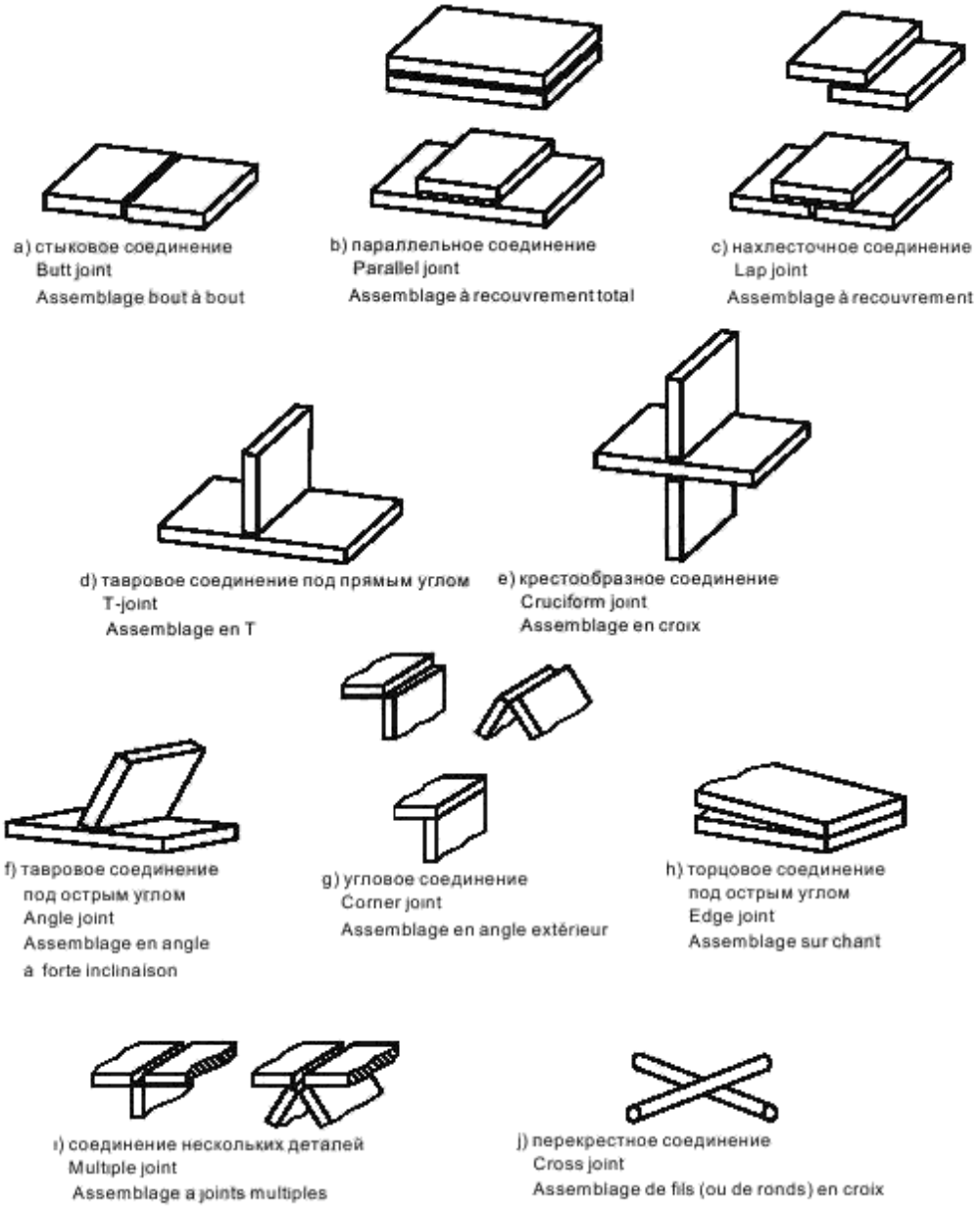
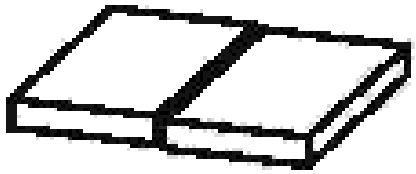


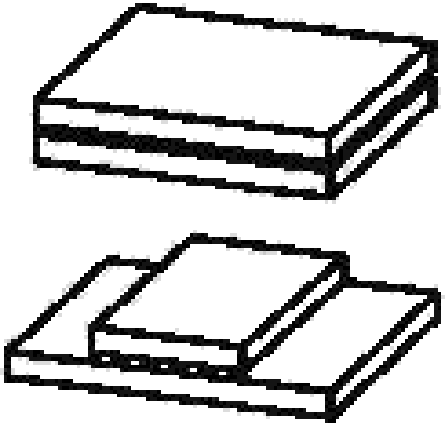
Рисунок 1 — Типы соединений
Figure 1 — Types of joints
Figure 1 — Types d'assemblages

5 Типы соединений

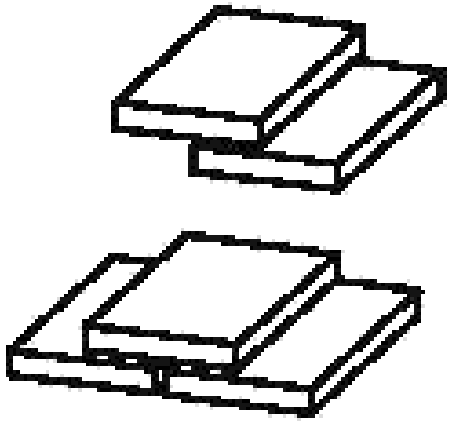
Тип соединения определяют количеством, размерами и относительной ориентацией соединяемых деталей. На рисунке 1 схематично показаны примеры с соответствующими терминами и пояснениями.



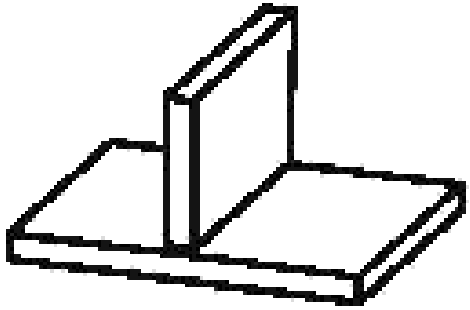
a) стыковое соединение
Butt joint
Assemblage bout à bout



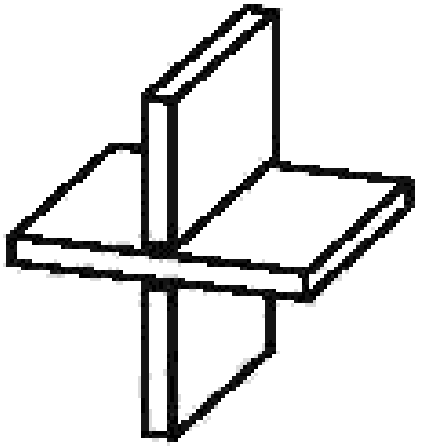
b) параллельное соединение
Parallel joint
Assemblage à recouvrement total



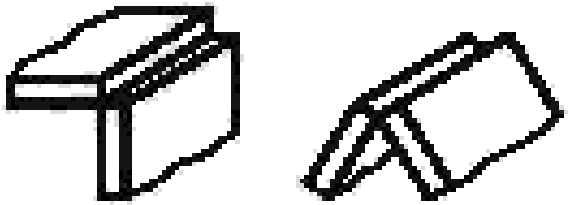
c) нахлесточное соединение
Lap joint
Assemblage à recouvrement

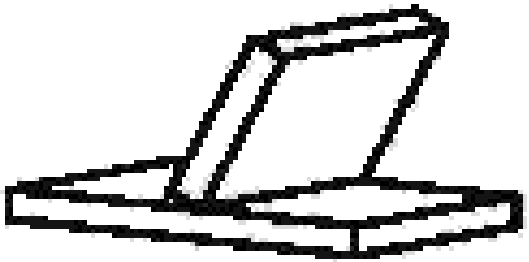


d) тавровое соединение под прямым углом
T-joint
Assemblage en T

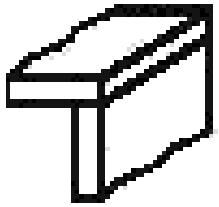


e) крестообразное соединение
Cruciform joint
Assemblage en croix

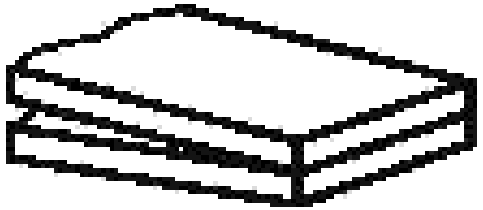




f) тавровое соединение
под острым углом
Angle joint
Assemblage en angle
a forte inclinaison

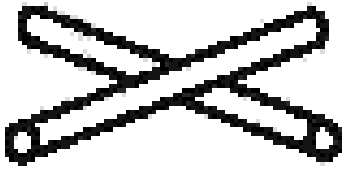


g) угловое соединение
Corner joint
Assemblage en angle extérieur



h) торцовое соединение
под острым углом
Edge joint
Assemblage sur chant

i) соединение нескольких деталей
Multiple joint
Assemblage a joints multiples



j) перекрестное соединение
Cross joint
Assemblage de fils (ou de ronds) en croix

Рисунок 1 — Типы соединений
Figure 1 — Types of joints
Figure 1 — Types d'assemblages

WELDABILITY:

The capacity of a material to form a strong bond of adherence under pressure or when solidifying from a liquid.

WELDING POSITIONS:

There are four welding positions including flat, horizontal, overhead and vertical.

WELDING PROCEDURE:

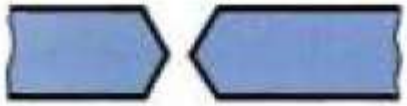
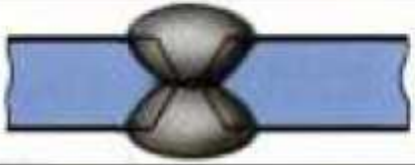
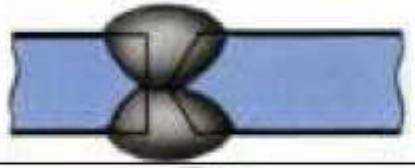
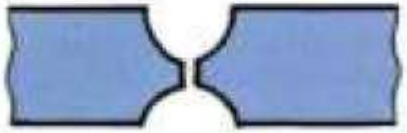
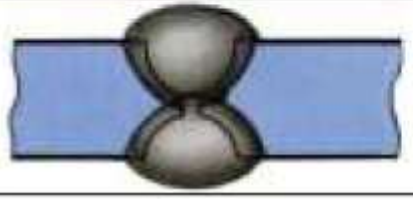
The detailed methods and practices including all joint welding procedures involved in the production of a weldment.

JOINT PENETRATION:

The maximum depth a groove weld extends from its face into a joint, exclusive of reinforcement.

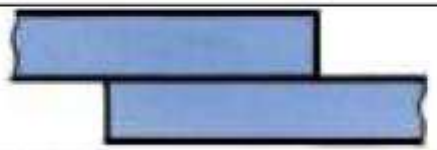
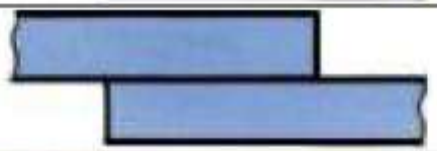
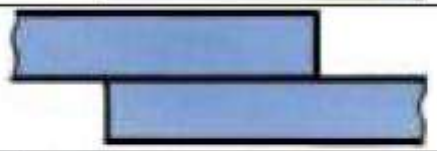
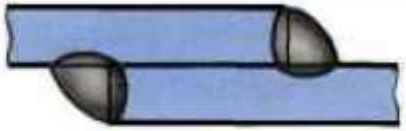
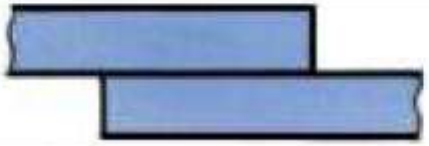
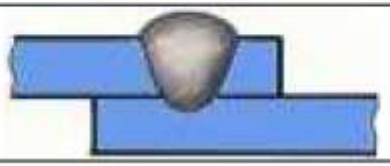
Butt joints

Table 5 – Butt joints

Edge preparation	Type of weld	Edge prepared cross-section	Weld cross-section	Sheet thickness
Flange butt joint	Single-side			1…4
Plain butt joint without preparation	Single-side			1…6
Plain butt joint without preparation	Double-side			3…8
Plain butt joint with V-grooving	Single-side			3…60
Plain butt joint with X-grooving	Double-side			8…120
Plain butt joint with K-grooving	Double-side			8…100
Plain butt joint with U-grooving	Double-side			15…100

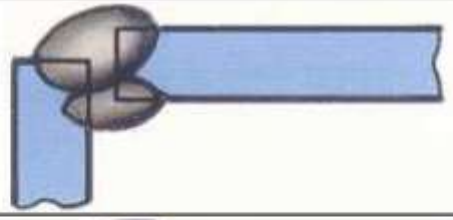
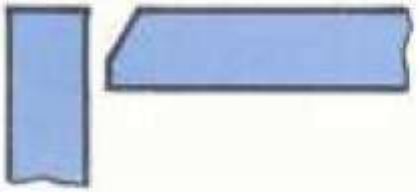
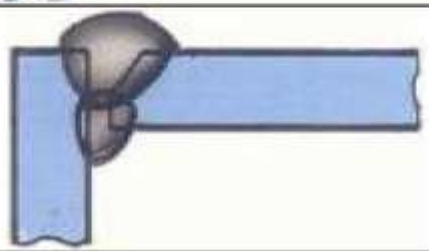
Lap joints

Table 6 – Lap joints

Type of welding	Type of weld	Edge prepared cross-section	Weld cross-section	Sheet thickness
Resistance welding				0,3…6
Arc or oxyfuel welding	Single-side			1…60
Arc or oxyfuel welding	Double-side			1…60
Arc welding	Plug weld			1…6

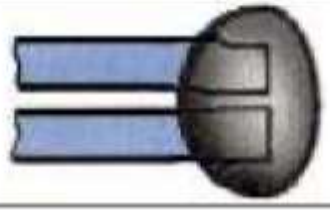
Corner joints

Table 7 – Corner joints

Edge preparation	Type of weld	Edge prepared cross-section	Weld cross-section	Sheet thickness
Square edges	Single-side			1…6
Square edges	Double-side			2…30
Beveled edges	Double-side			3…60

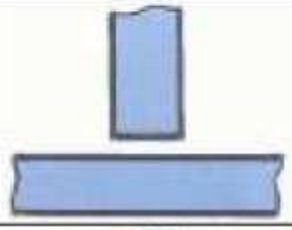
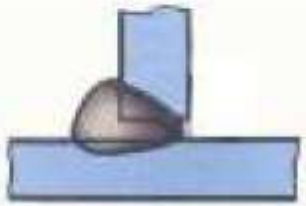
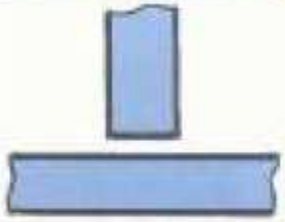
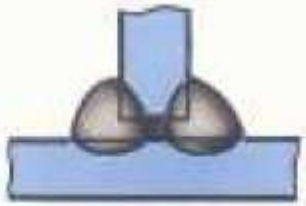
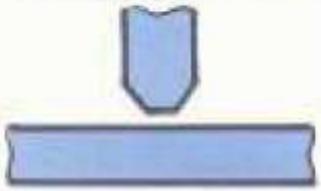
Edge joints

Table 8 – Edge joints

Edge preparation	Type of weld	Edge prepared cross-section	Weld cross-section	Sheet thickness
Square edges	Single-side			2…60

T-joints

Table 9 – Tee joints

Edge preparation	Type of weld	Edge prepared cross-section	Weld cross-section	Sheet thickness
Square edges	Single-side			1…6
Square edges	Double-side			2…40
Beveled edges	Double-side			8…100

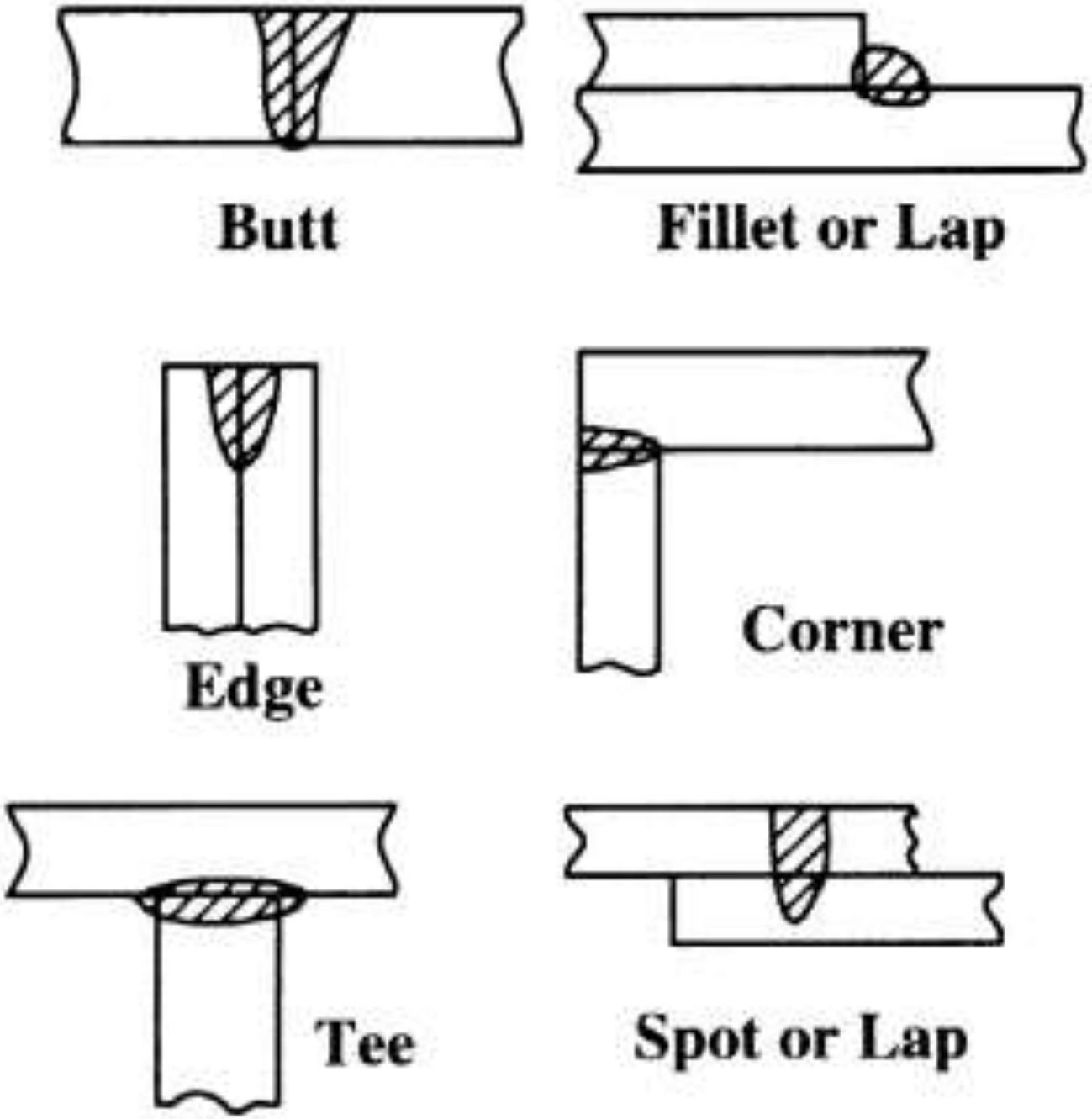
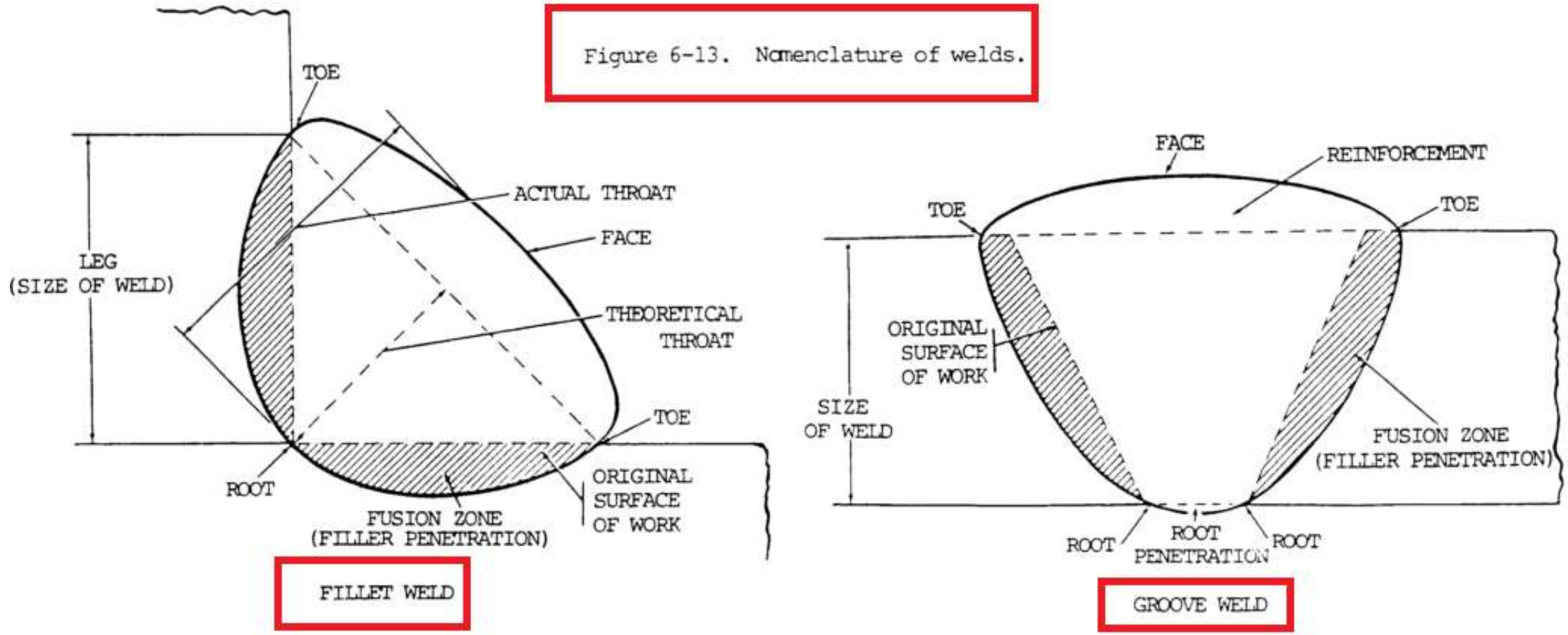


Fig. 10. Examples of Laser Weld Joint Designs.



FILLET WELD:

A weld of approximately triangular cross section, as used in a lap joint, joining two surfaces at approximately right angles to each other.

GROOVE WELD:

A weld made by depositing filler metal in a groove between two members to be joined.

http://www.weldguru.com/welding-terminology.html#d-f

http://www.weldguru.com/SMAWNomenclatureandJoints.html

Glossary of Names for Parts of the Groove Weld and Fillet Weld

- **Fusion Zone (Filler Penetration):**
  The fusion zone is the area of base metal melted as determined in the cross section of a weld.
- **Leg of a Fillet Weld:**
  The leg of a fillet weld is the distance from the root of the joint to the toe of the fillet weld. There are two legs in a fillet weld.
- **Root of the Weld:**
  This is the point at which the bottom of the weld intersects the base metal surface, as shown in the cross section of weld.
- **Size of the Weld**

  Equal leg-length fillet welds:

  The size of the weld is designated by leg-length of

the largest isosceles right triangle that can be scribed within the fillet weld cross section.

Unequal leg-length fillet welds:

The size of the weld is designated by the leg-length of the largest right triangle that can be inscribed within the fillet weld cross section.

Groove weld:

The size of the weld is the depth of chamfering plus the root penetration when specified.

- **Throat of a Fillet Weld**

Theoretical throat:

This is the perpendicular distance of the weld and the hypotenuse of the largest right triangle that can be inscribed within the fillet weld cross section.

Actual throat:

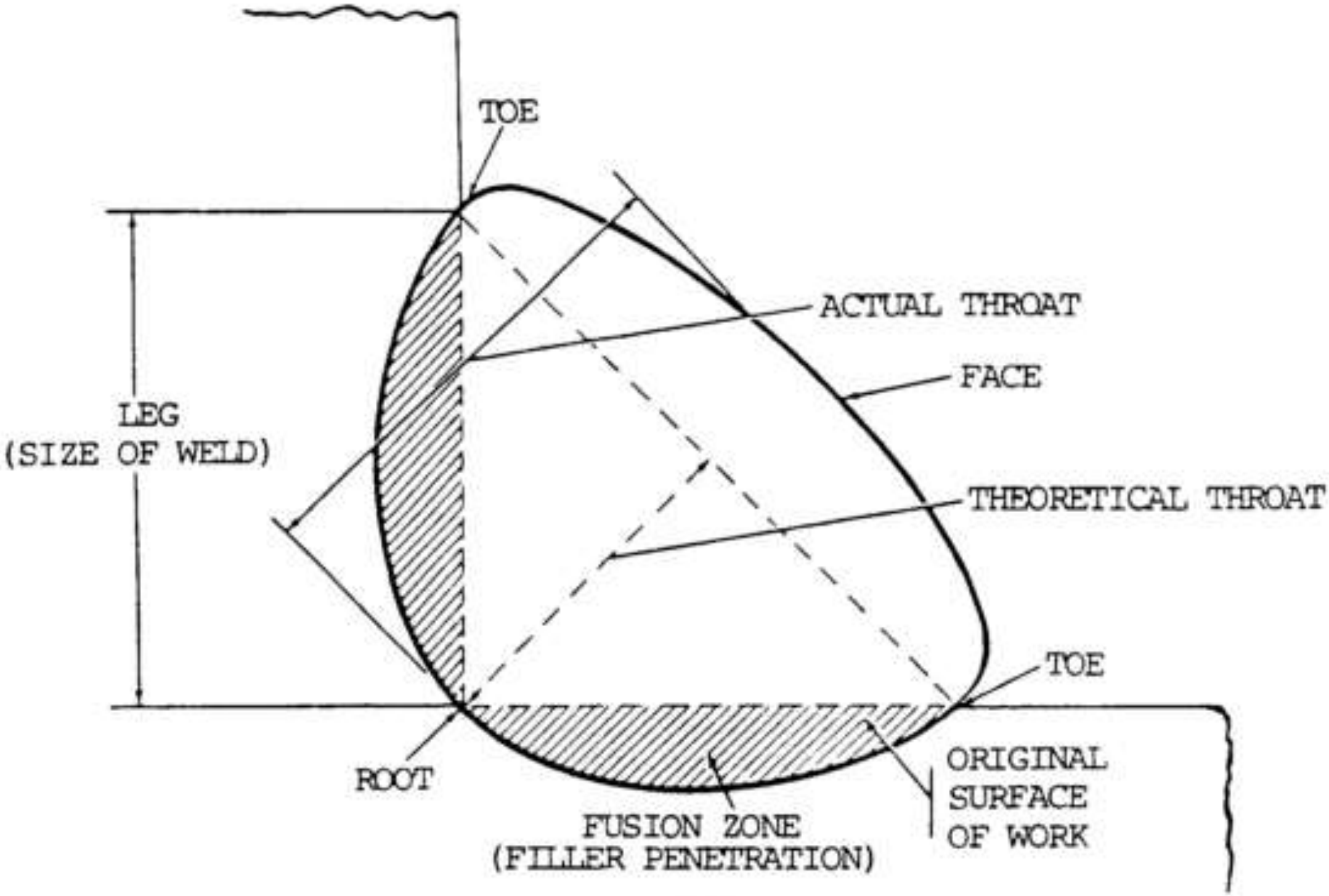
This is distance from the root of a fillet weld to the center of its face. f. Face of the Weld. This is exposed surface of the weld, made by an arc or gas welding process on the side from which the welding was done.

- **Toe of the Weld:**

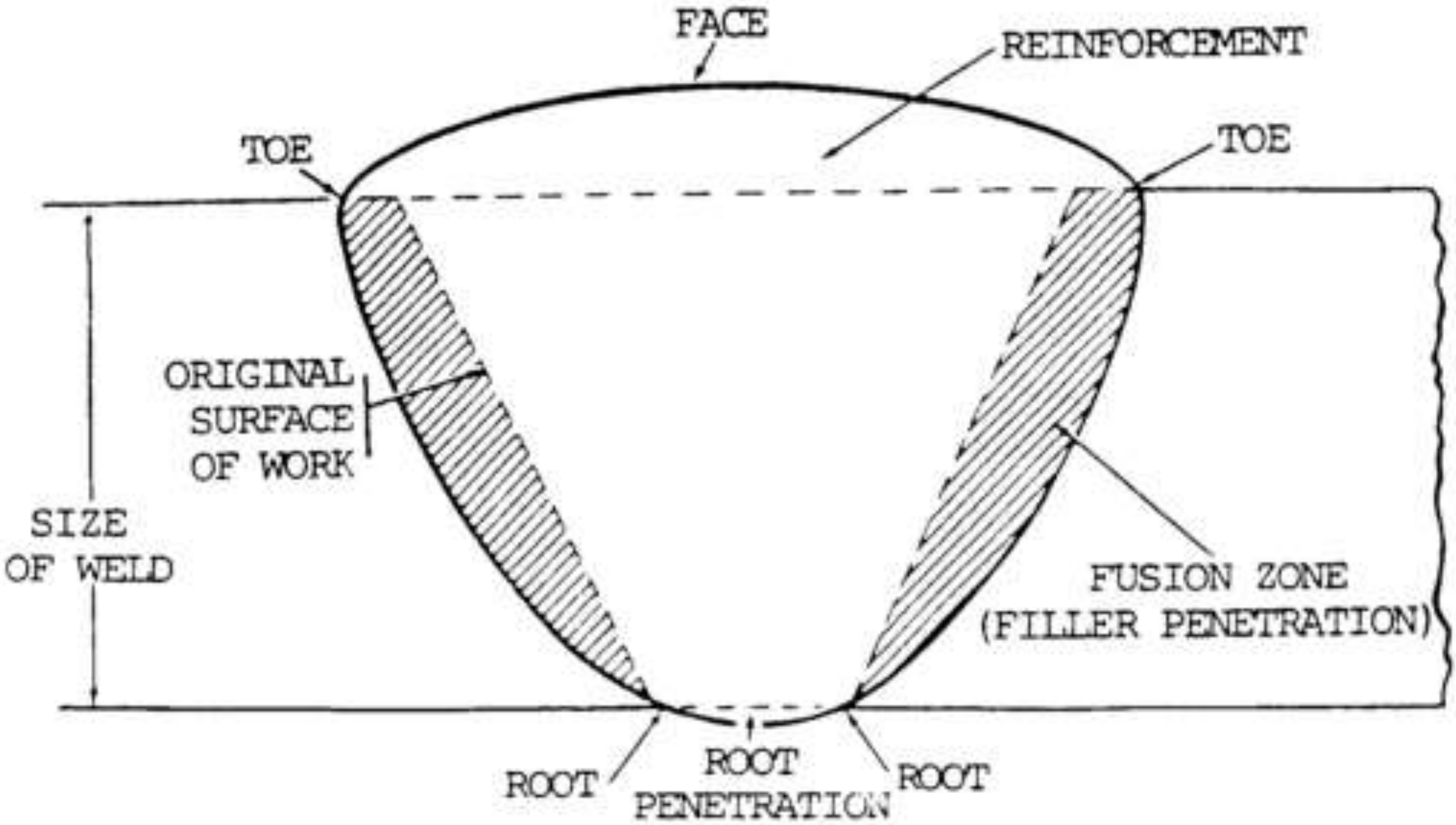
  This is the junction between the face of the weld and the base metal.

- **Reinforcement of the Weld:**

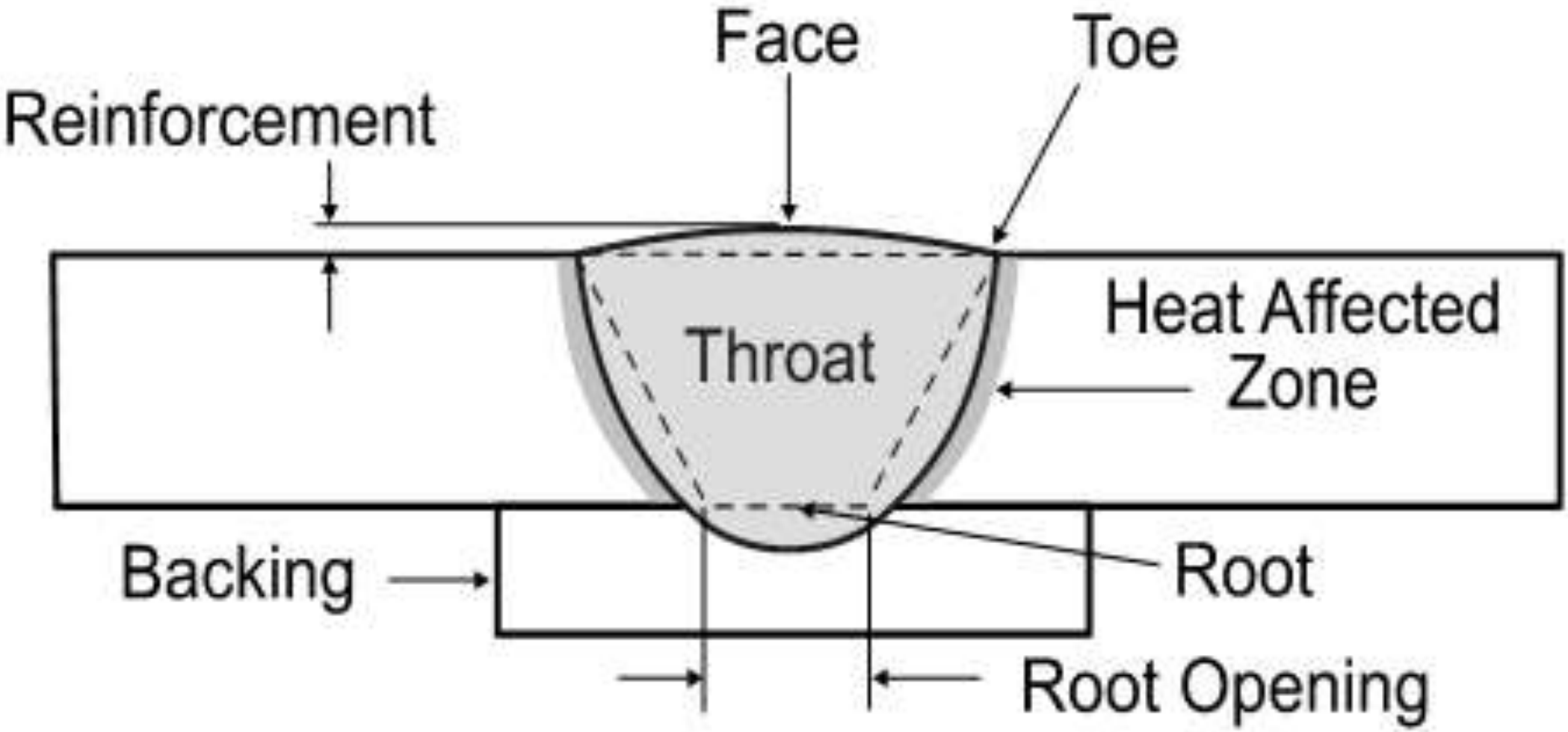
  This is the weld metal on the face of a groove weld in excess of the metal necessary for the specified weld size.


TOE
ACTUAL THROAT
FACE
LEG
(SIZE OF WELD)
THEORETICAL THROAT
TOE
ROOT
ORIGINAL
SURFACE
OF WORK
FUSION ZONE
(FILLER PENETRATION)

FILLET WELD


FACE
REINFORCEMENT
TOE
TOE
ORIGINAL
SURFACE
OF WORK
SIZE
OF WELD
FUSION ZONE
(FILLER PENETRATION)
ROOT
ROOT
PENETRATION
ROOT

GROOVE WELD



Groove Weld Terminology

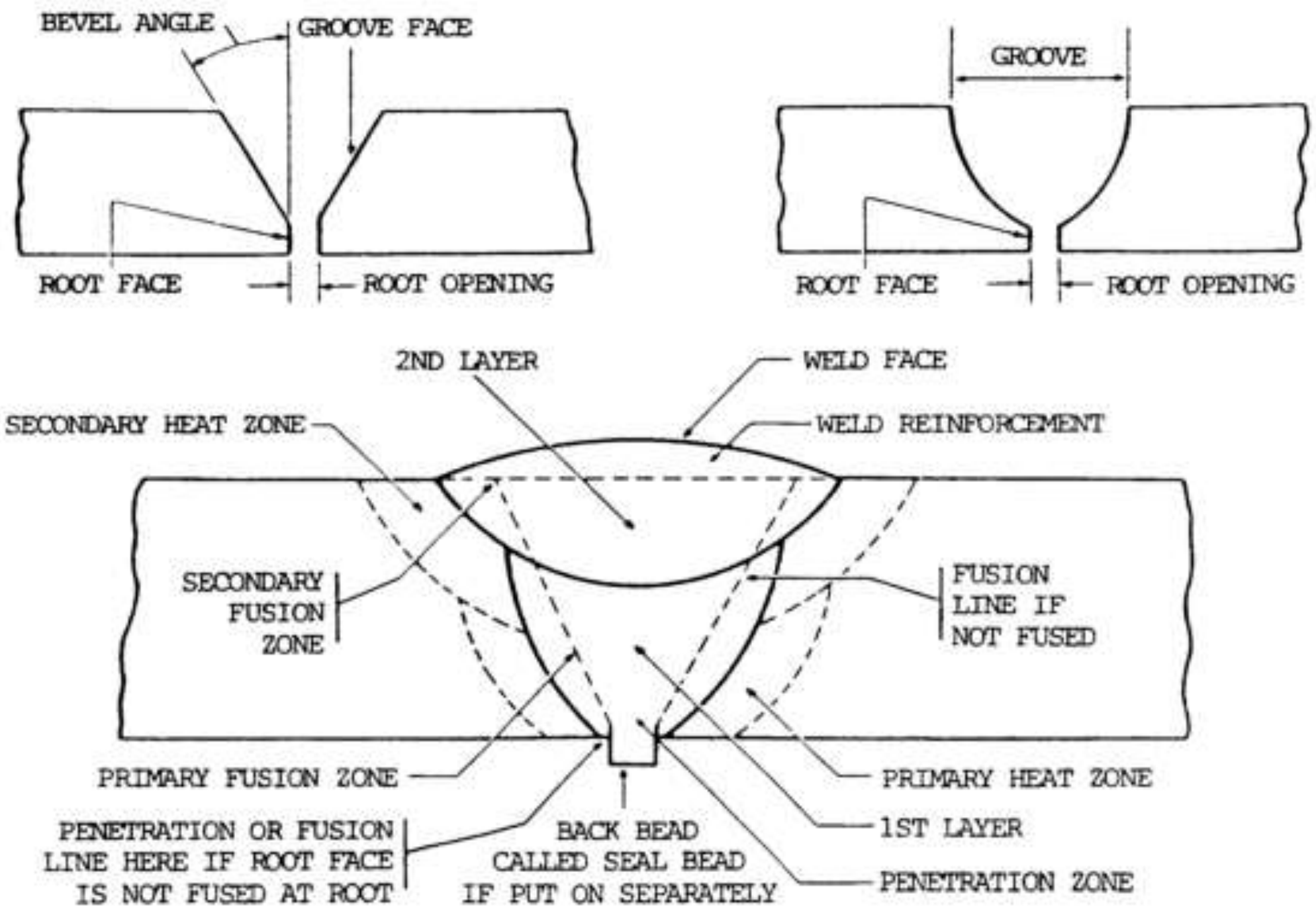


Figure 6-14. Heat affected zones in a multipass weld.

MULTIPASS WELDS

- The nomenclature of the weld, the **zones affected by the welding heat** when a butt weld is made by more than one pass or layer, and the nomenclature applying to the grooves used in butt welding are shown in figure 6-14.
- Figure 6-15 is based on weld type and position.
- The **primary heat zone** is the area fused or affected by heat in the first pass or application of weld metal.
- The **secondary heat zone** is the area affected in the second pass and overlaps the primary heat zone.
- The portion of base metal that hardens or changes its properties as a result of the welding heat in the

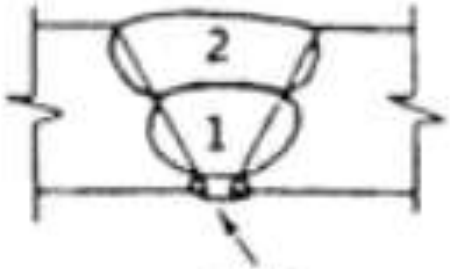
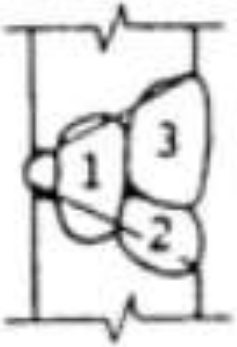
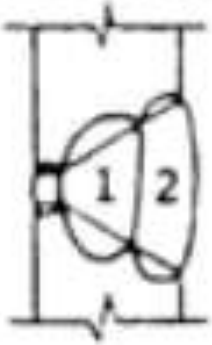
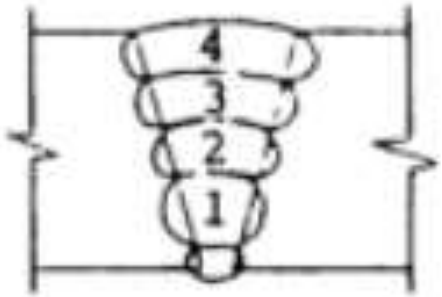
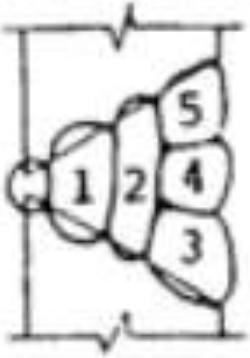
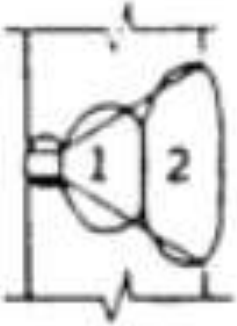
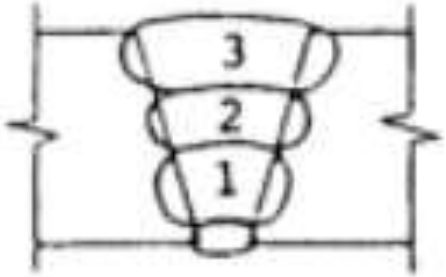
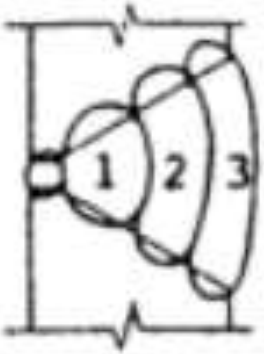
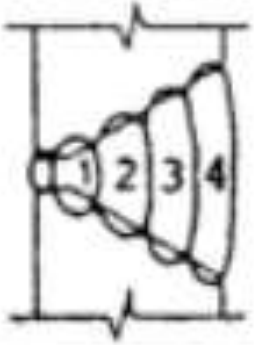
primary zone is partly annealed or softened by the welding heat in the secondary zone.

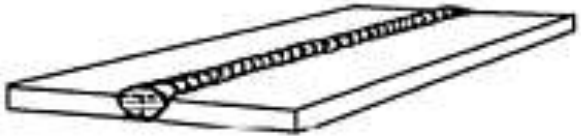
- The weld metal in the first layer is also refined in structure by the welding heat of the second layer.
- The two heating conditions are important in determining the order or sequence in depositing weld metal in a particular joint design.

Welding procedure schedule of various welds

The nomenclature of the weld, the zones affected by the welding heat when a butt weld is made by more than one pass or layer, and the nomenclature applying to the grooves used in butt welding are shown in figure 6-14. Figure 6-15 is based on weld type and position.

Flat, Horizontal and Flat Weld Position Chart

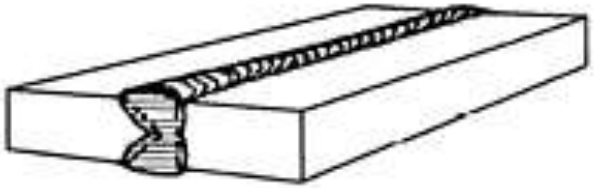
MATERIAL THICKNESS (INCH)	WELDING POSITION		
	FLAT 1G	HORIZONTAL 2G	VERTICAL UP 3G (U)
3/8			
1/2			
5/8			



SQUARE GROOVE WELD

SQUARE GROOVE WELD

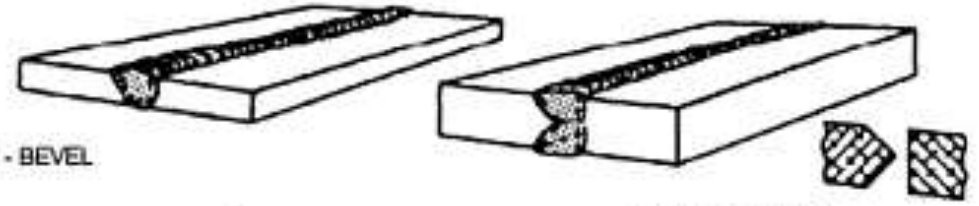
SINGLE - BEVEL GROOVE WELD



DOUBLE - BEVEL GROOVE WELD

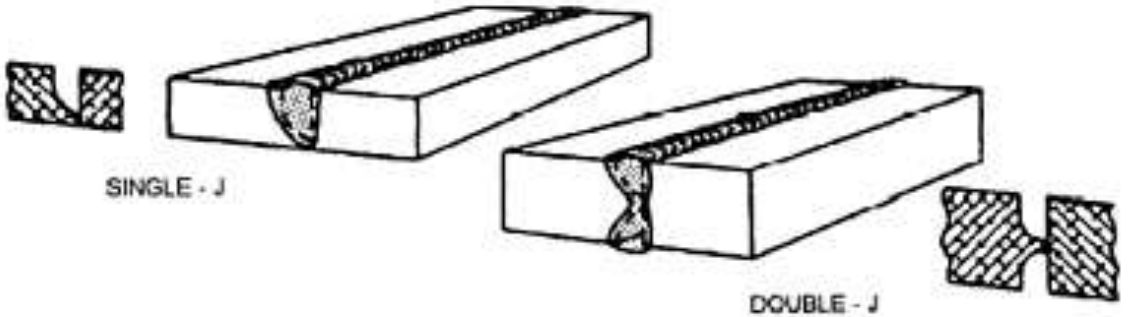
SINGLE - VEE GROOVE WELD

DOUBLE - GROOVE WE



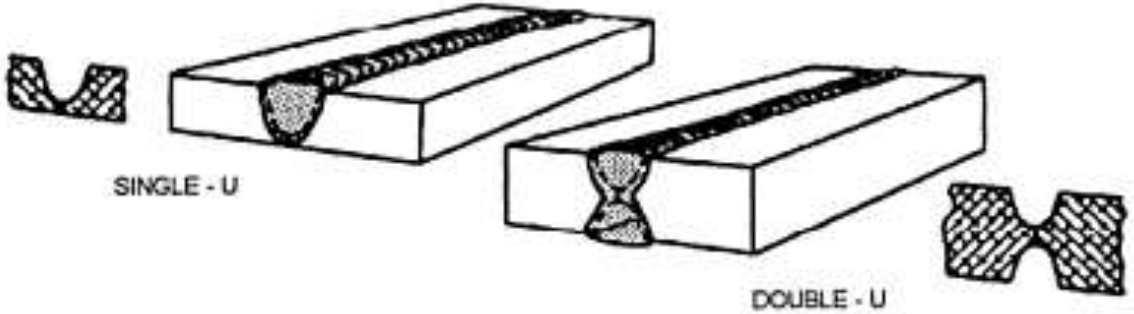
SINGLE - BEVEL

DOUBLE - BEVEL



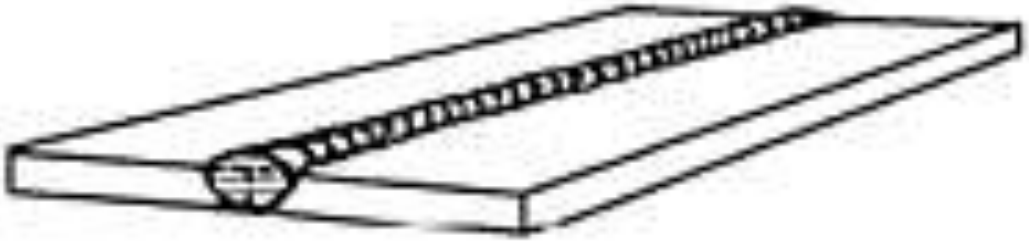
SINGLE - J

DOUBLE - J

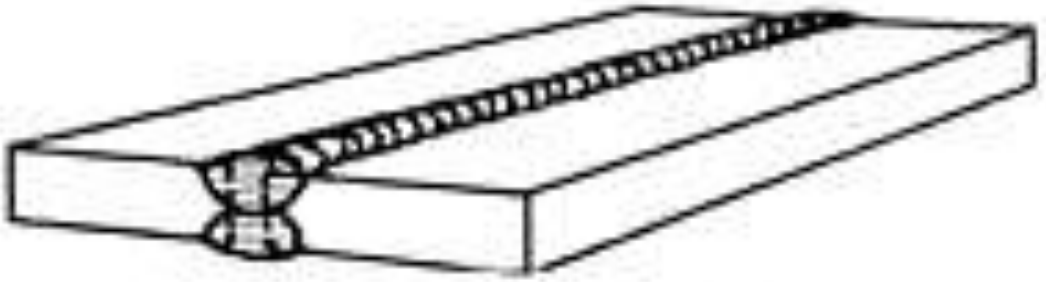


SINGLE - U

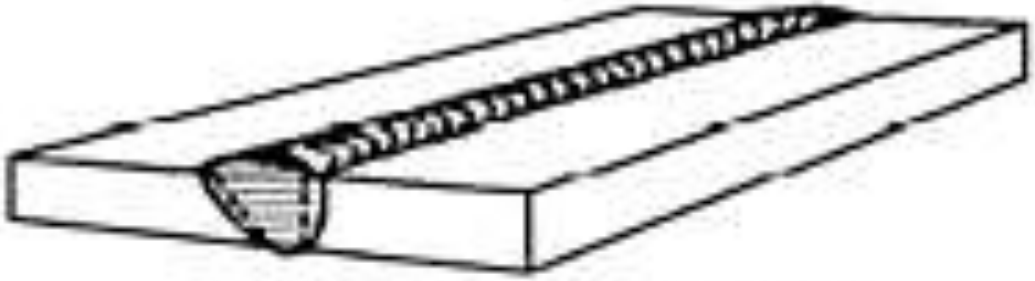
DOUBLE - U



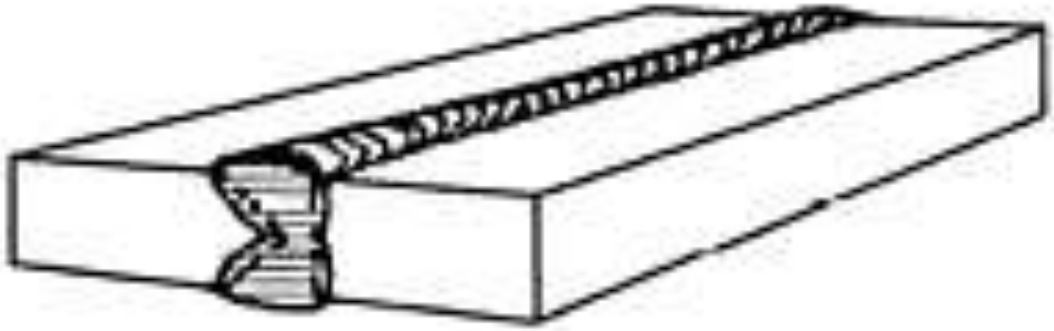
SQUARE GROOVE WELD



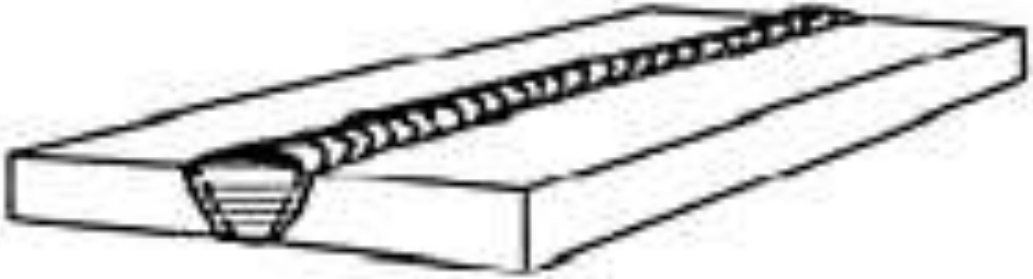
SQUARE GROOVE WELD



SINGLE - BEVEL GROOVE WELD

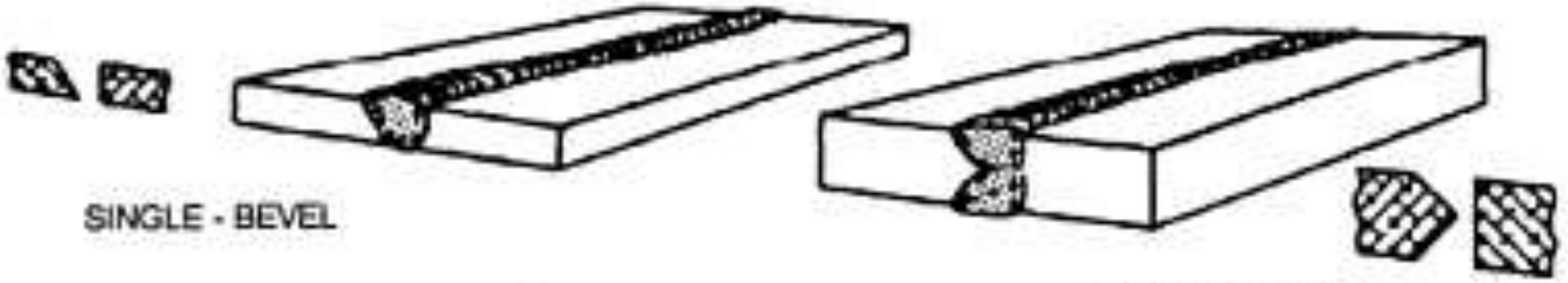


DOUBLE - BEVEL GROOVE WELD



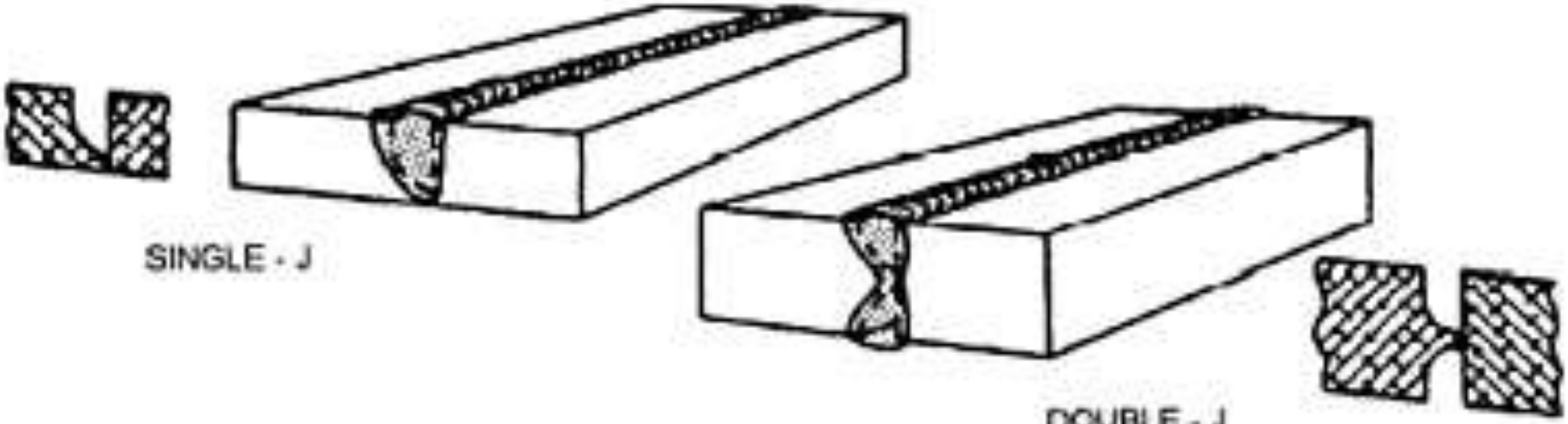
SINGLE - VEE GROOVE WELD

DOUBLE - GROOVE WELD



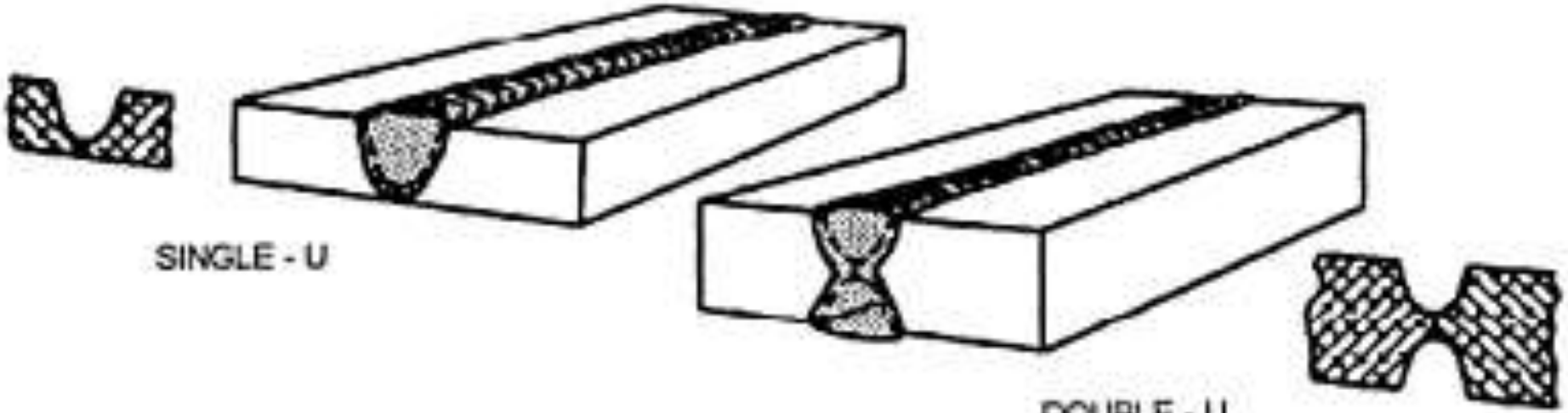
SINGLE - BEVEL

DOUBLE - BEVEL



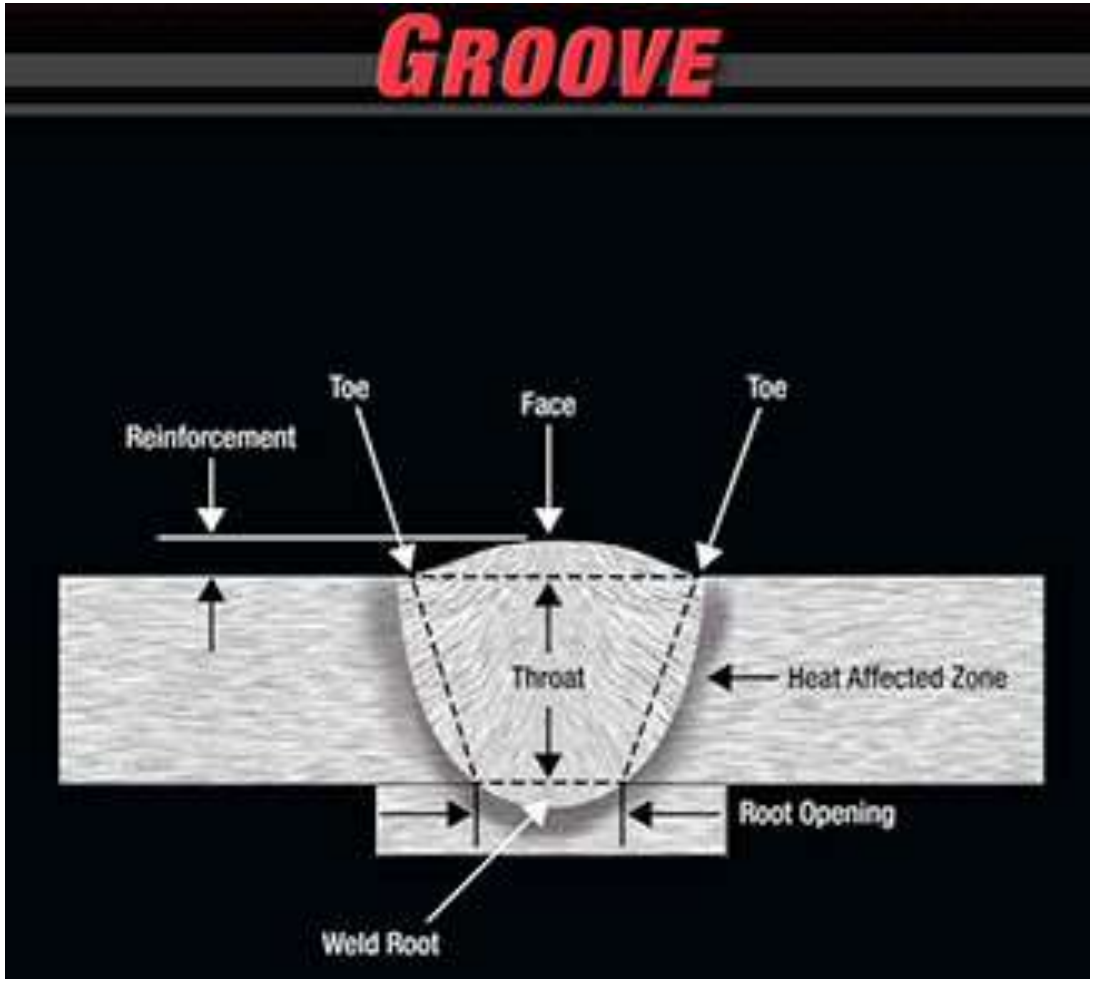
SINGLE - J

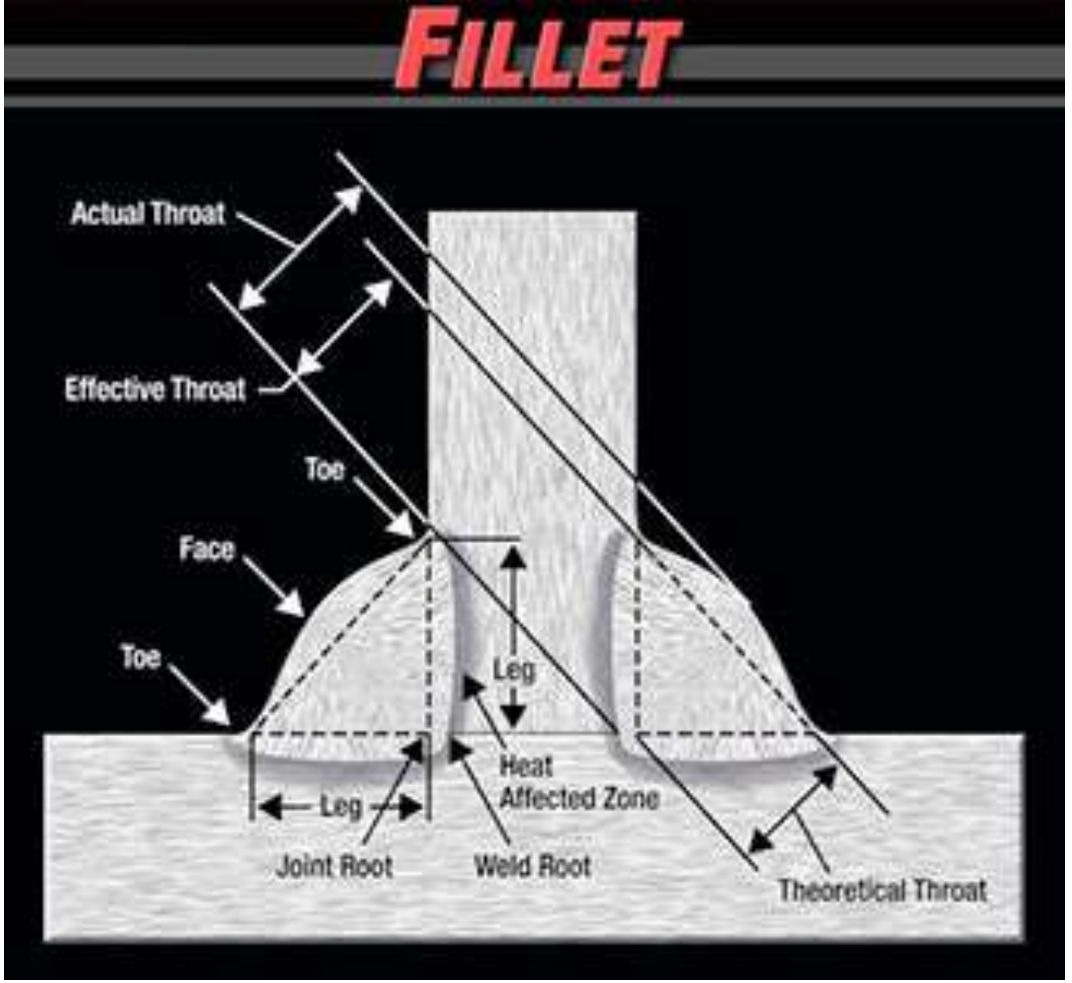
DOUBLE - J



SINGLE - U

DOUBLE - U


GROOVE
Reinforcement
Toe
Face
Toe
Throat
Heat Affected Zone
Root Opening
Weld Root


FILLET
Actual Throat
Effective Throat
Toe
Face
Toe
Leg
Heat
Affected Zone
Leg
Joint Root
Weld Root
Theoretical Throat

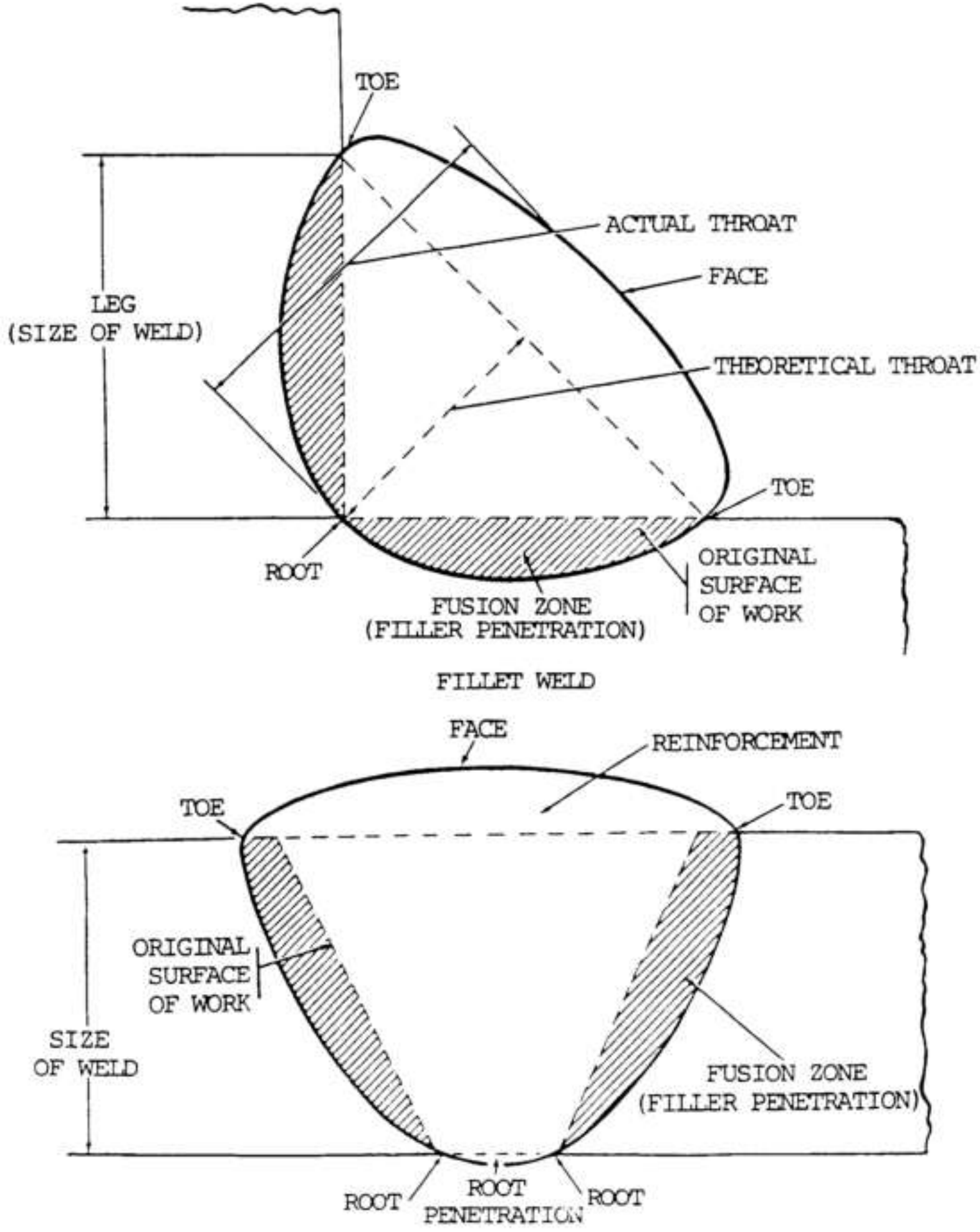


Figure 6-13. Nomenclature of welds.

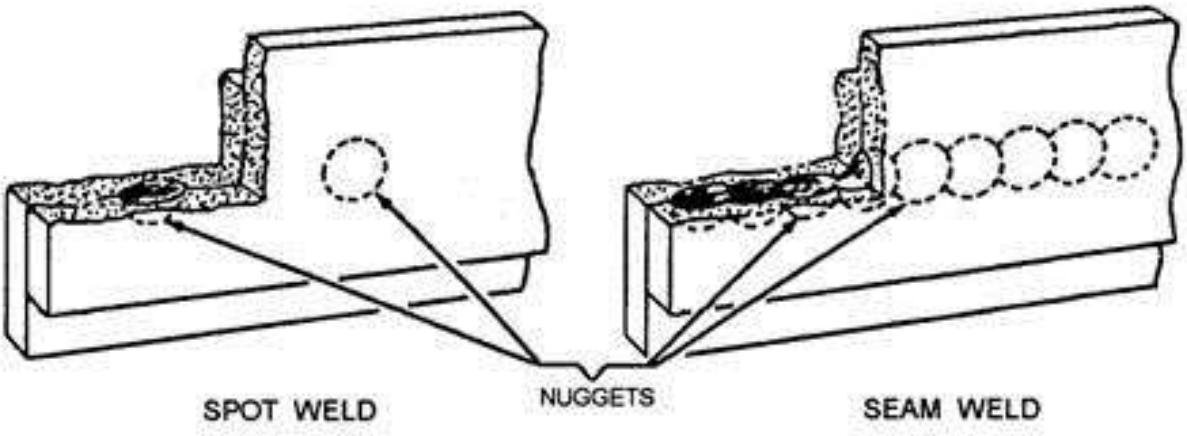
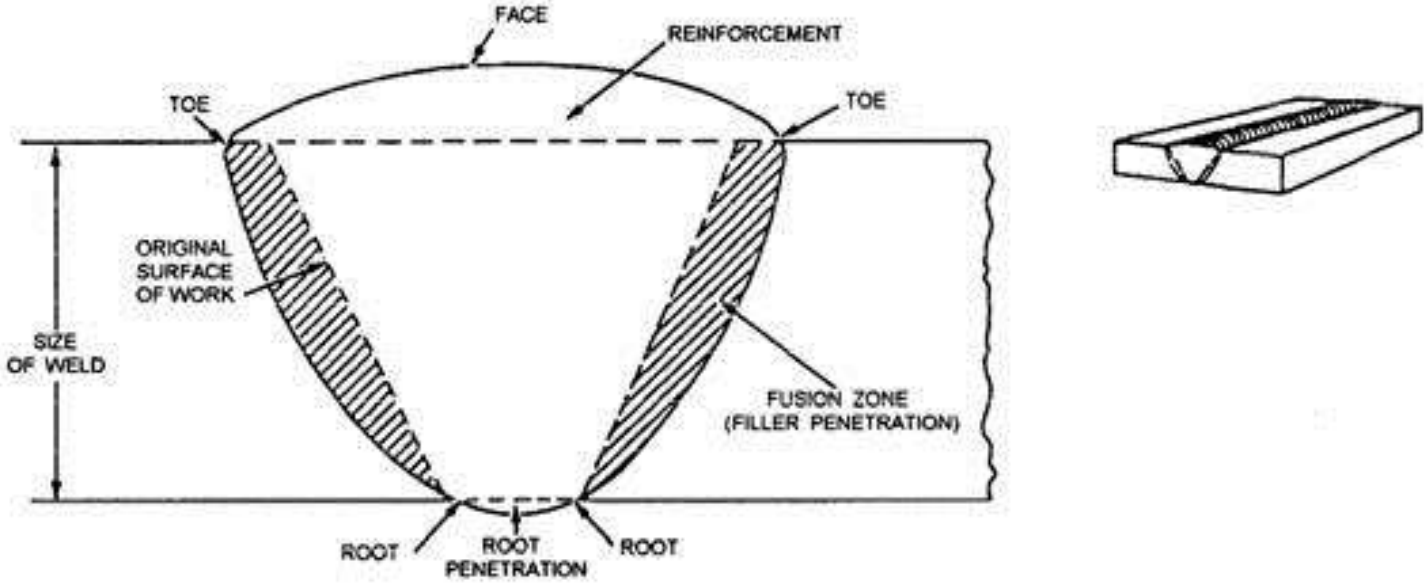
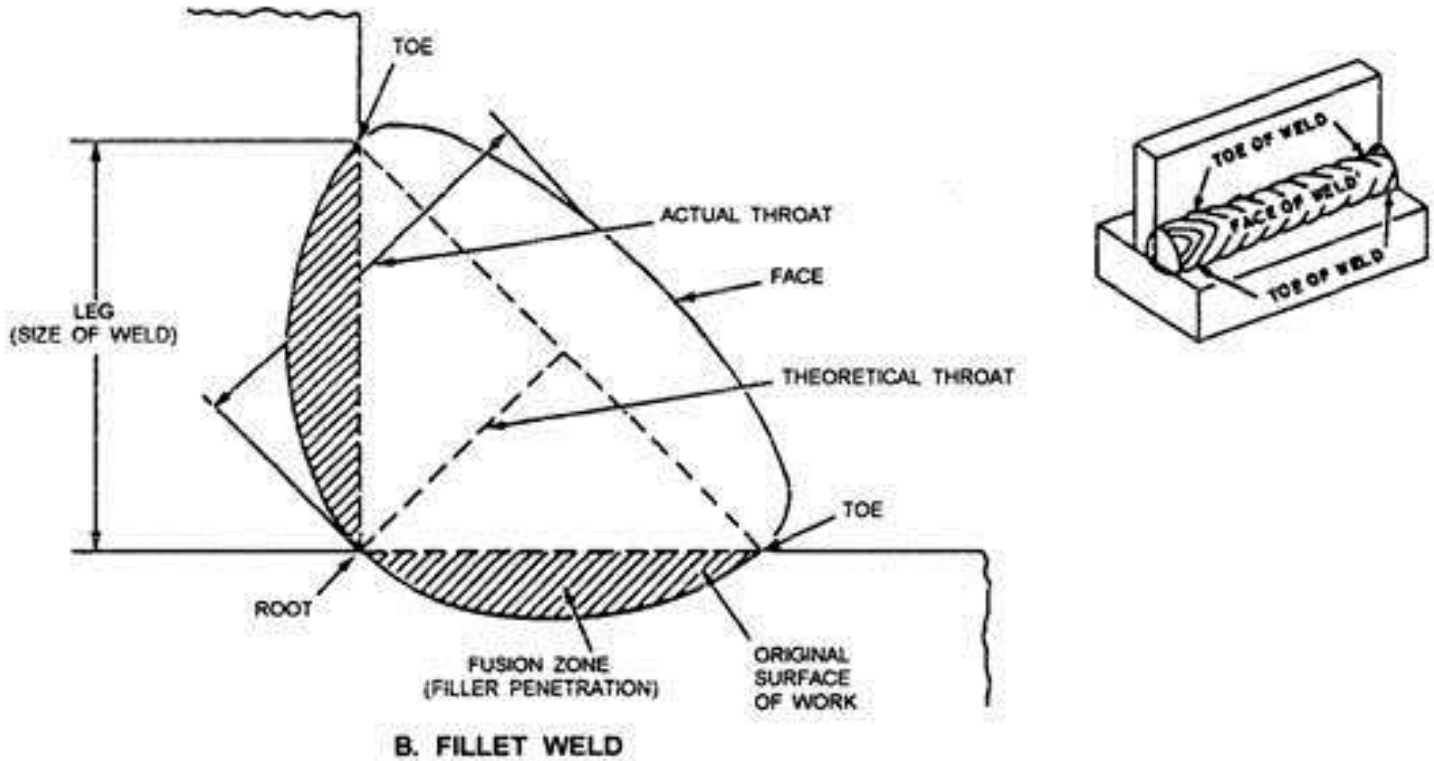


Figure 3-19.—Spot and seam welds.



A. GROOVE WELD



B. FILLET WELD

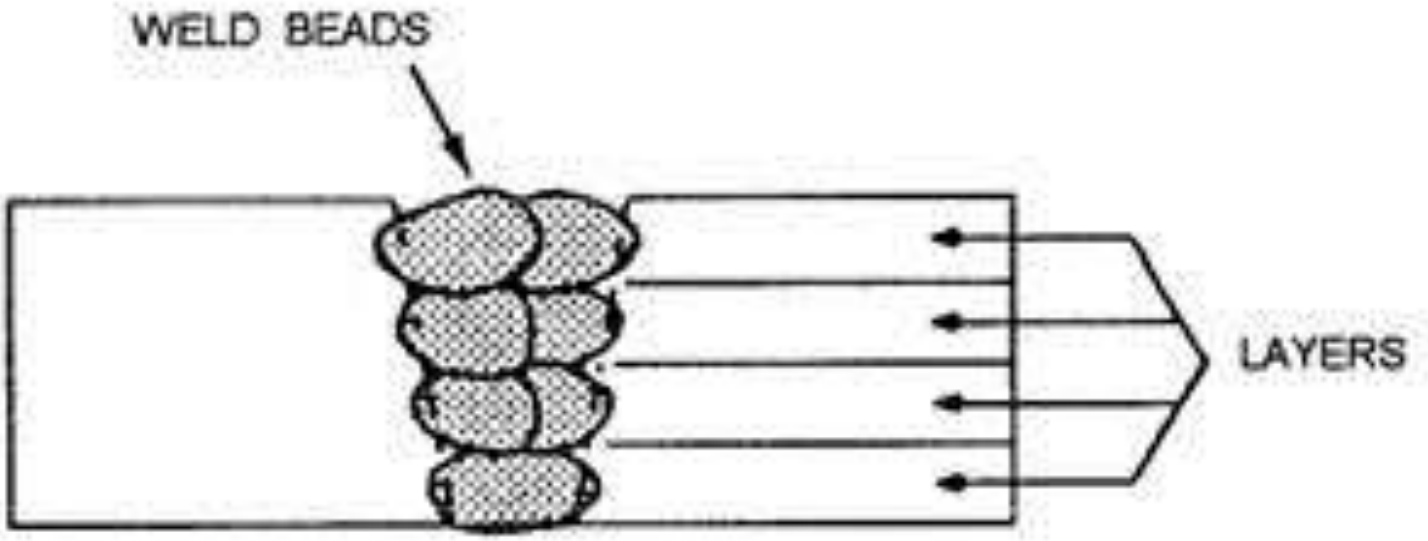


Figure 3-14.-Multiple-pass layers.

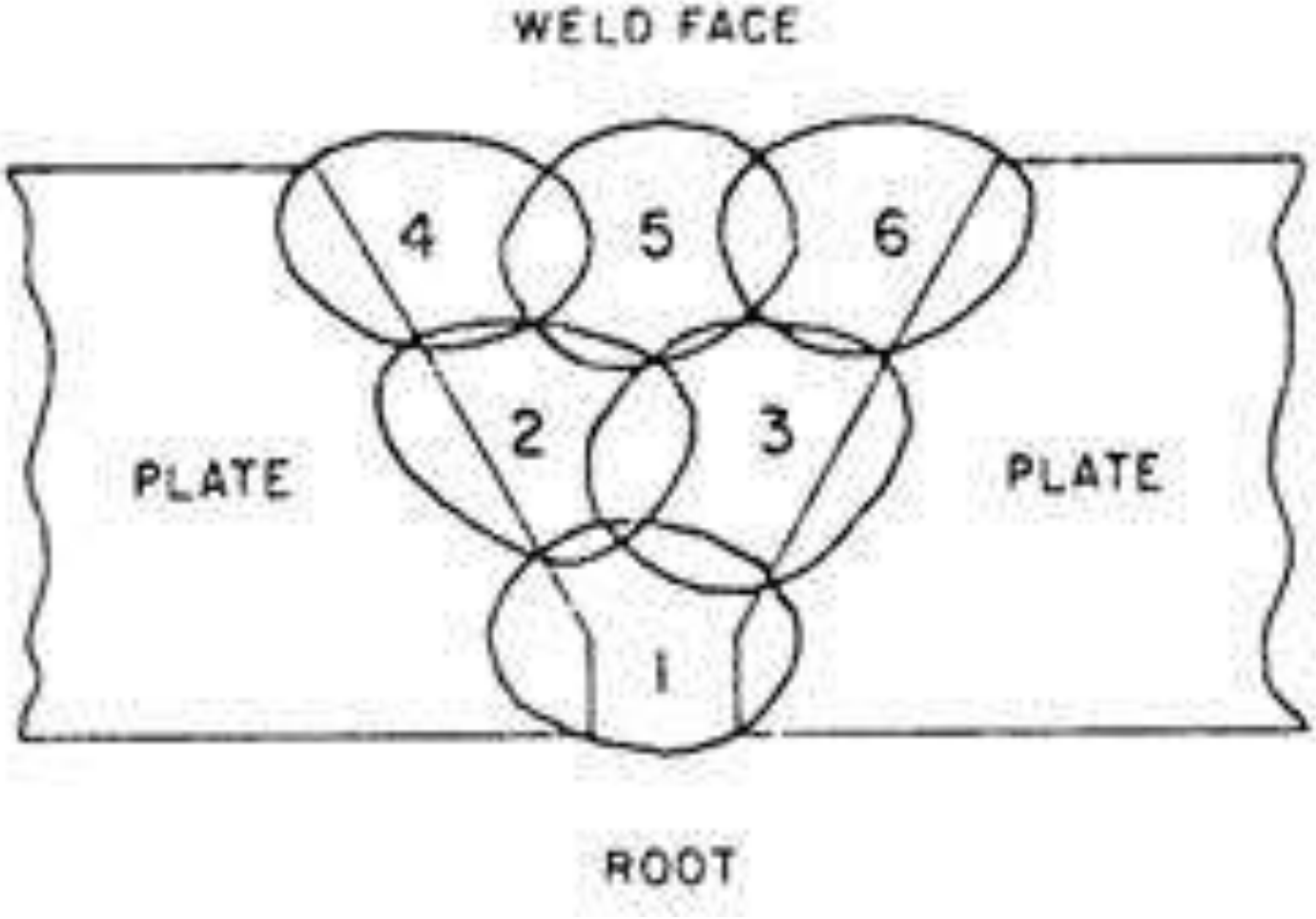


Figure 3-15.-Weld layer sequence.

Slag - - окалина

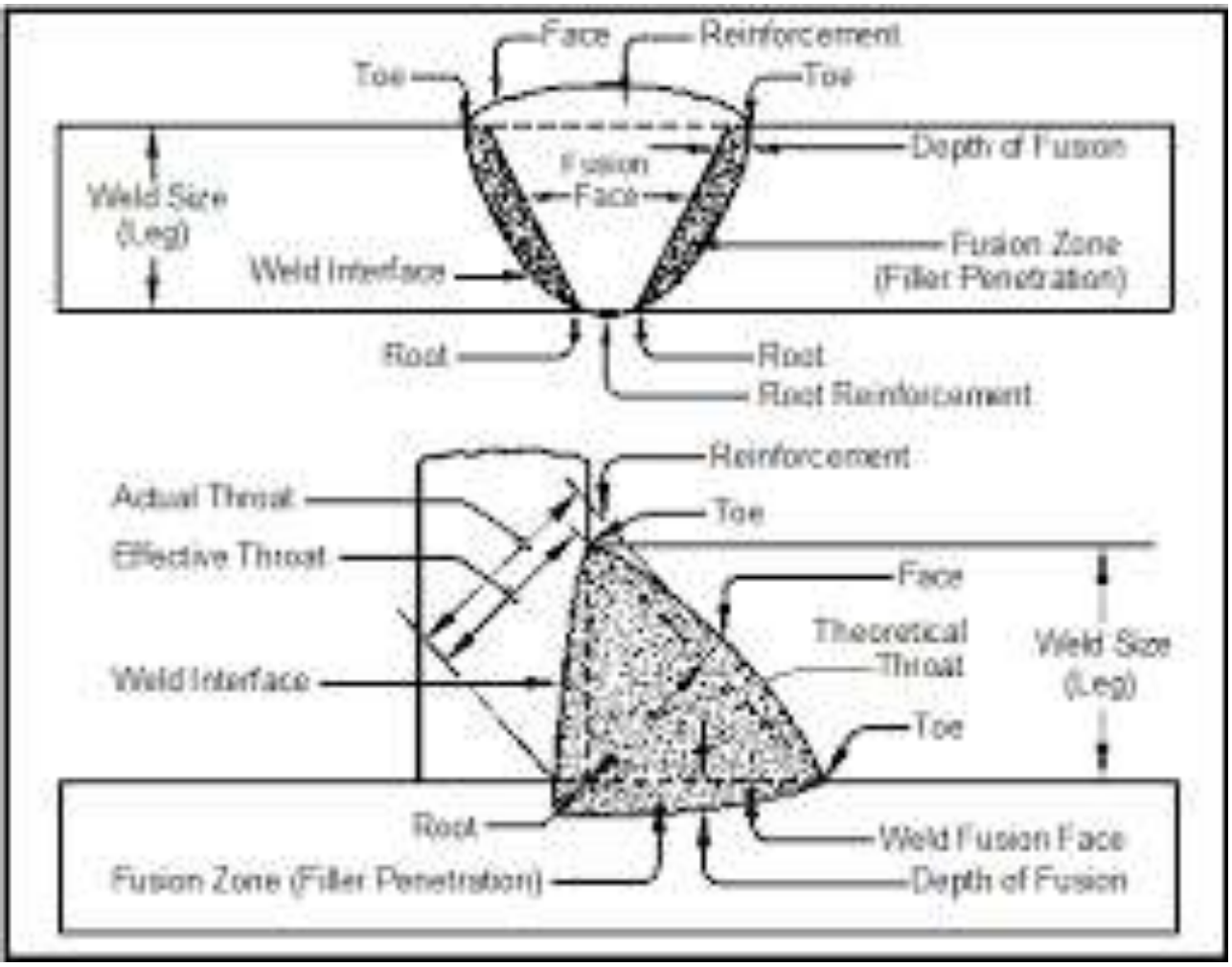
GROOVE:
The opening provided between two members to be joined by a groove weld.

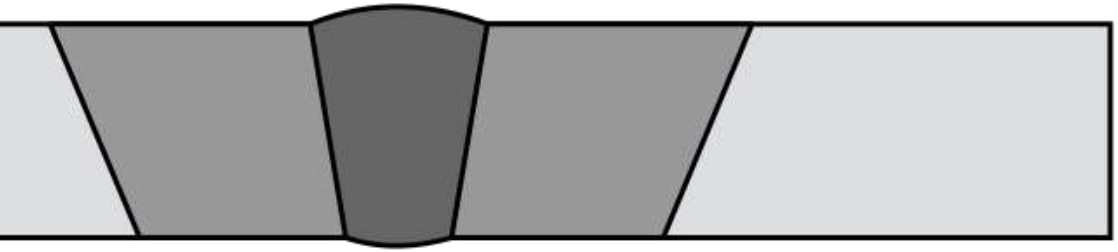
GROOVE ANGLE:
The total included angle of the groove between parts to be joined by a groove weld.

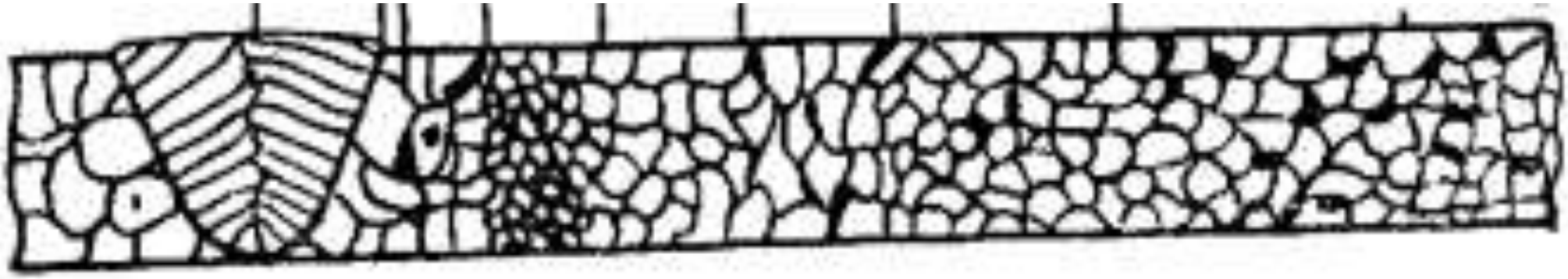
GROOVE FACE:
That surface of a member included in the groove.

GROOVE RADIUS:
The radius of a J or U groove.

GROOVE WELD:
A weld made by depositing filler metal in a groove between two members to be joined.







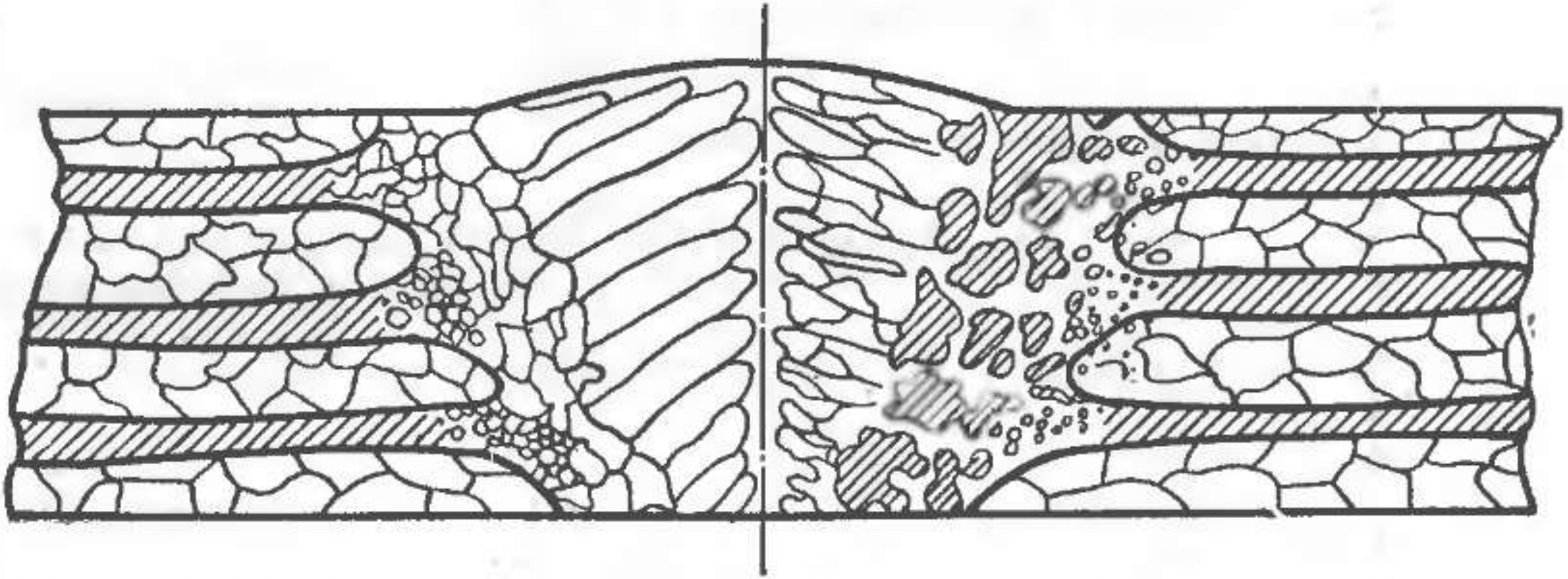


Рис. 157. Схема структуры металла сварного соединения.

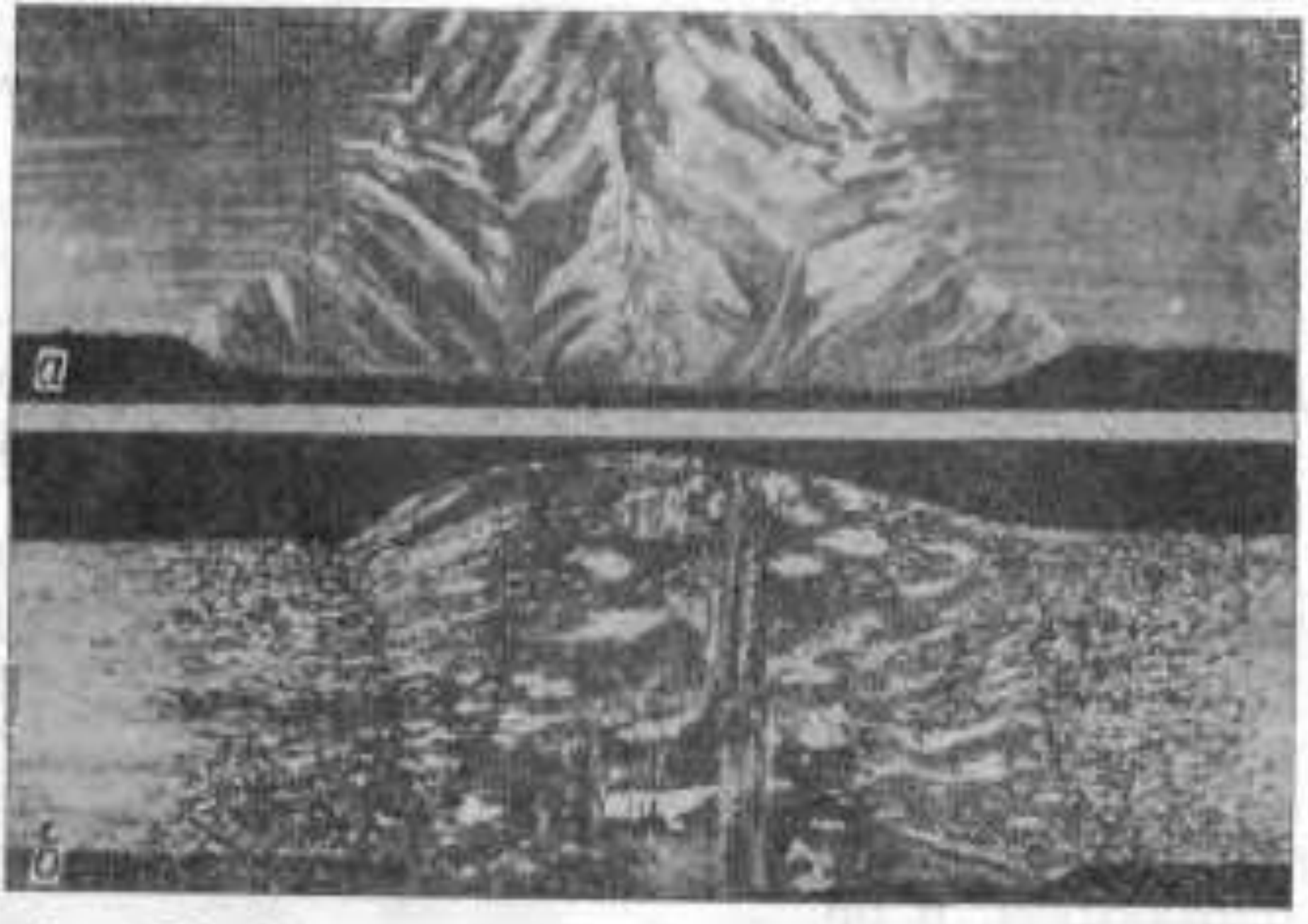
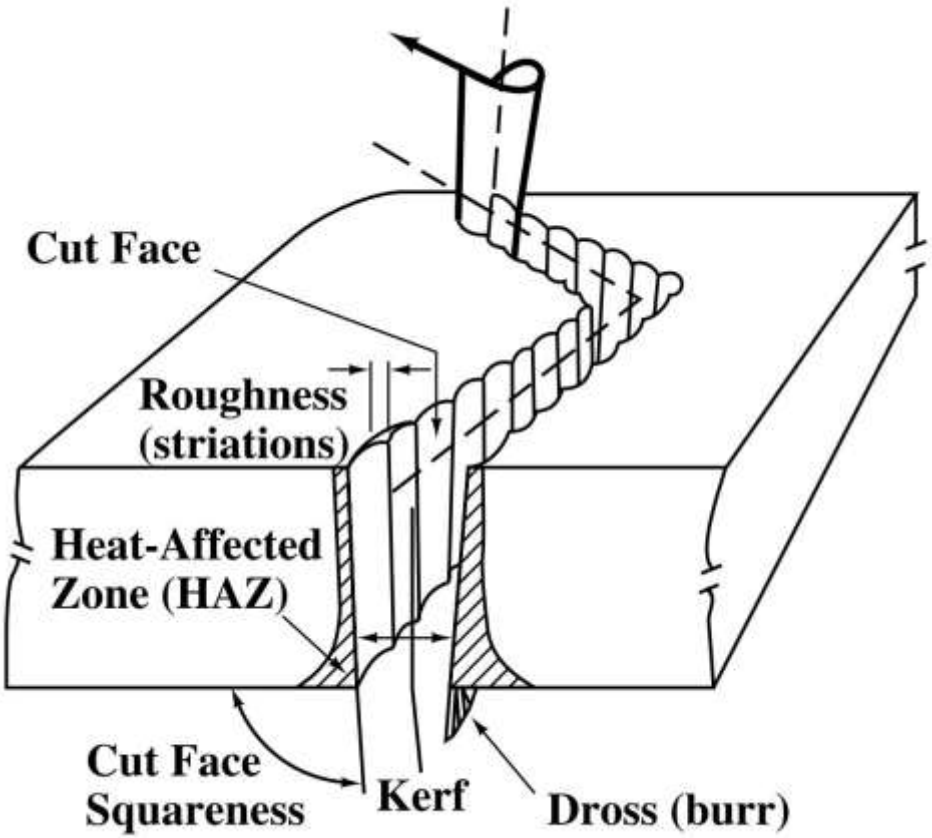
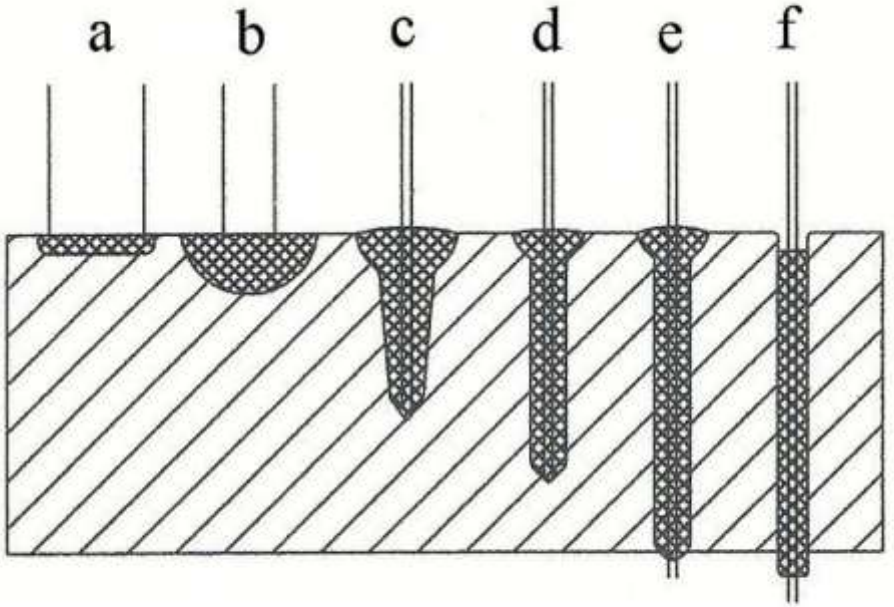


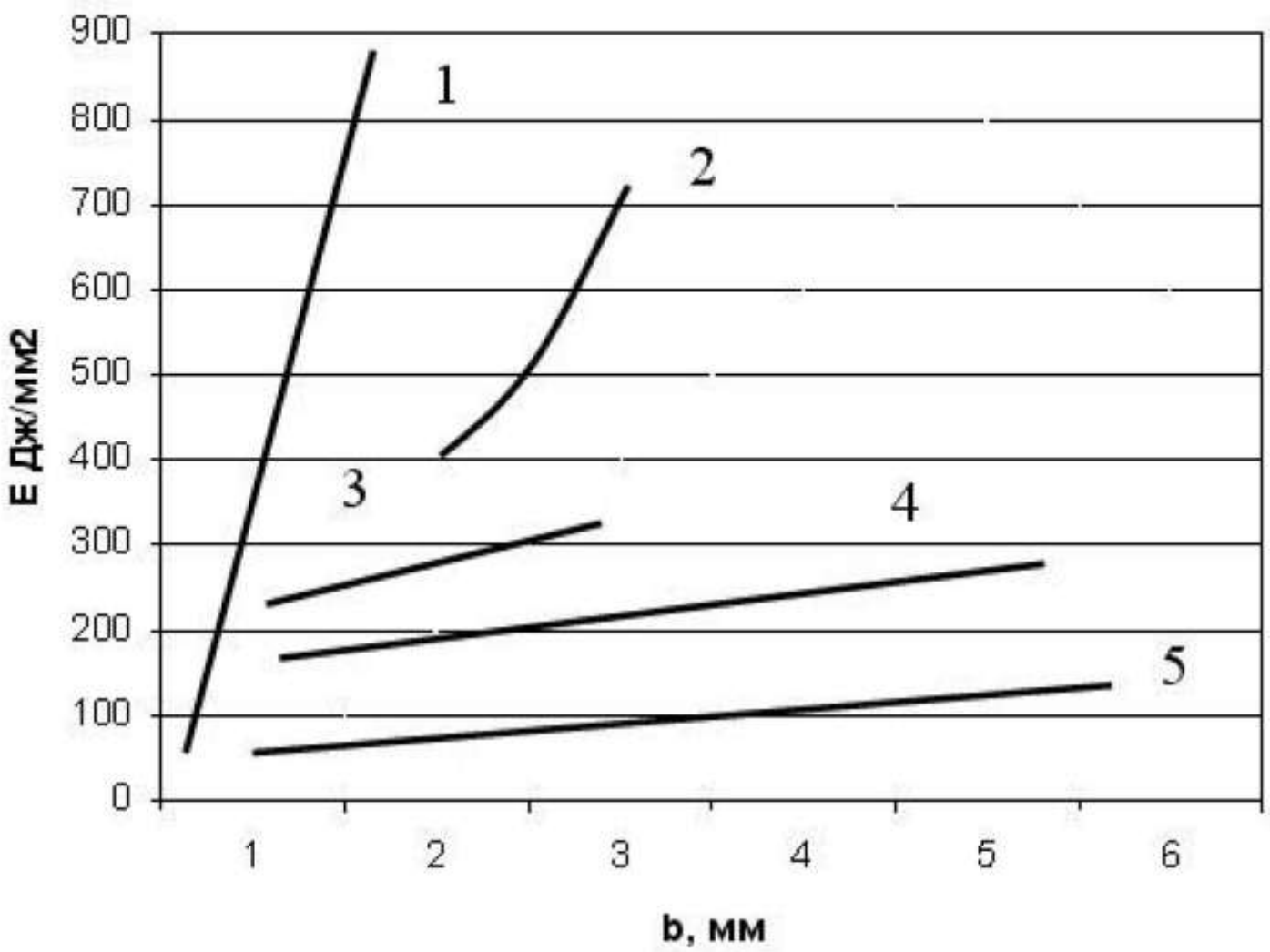
Рис. 226. Макроструктура сварного шва.

2.3 Results of the electron beam application





Various forms of melted zone



Средние значения удельной энергии E, необходимой для свар ки стали в зависимости от её толщины[4]: 1 — свар ка аргоно-дуговая W-электродом, 2 — сварка дуговая по флюсом, 3 — сварка плазменно-дуговая, 4 — сварка дуго вая в вакууме, 5 — сварка электронно-лучевая.