AWS A3.0M/A3.0:2025
An American National Standard

Standard Welding Terms and Definitions

Including Terms for Additive Manufacturing, Adhesive Bonding, Brazing, Soldering, Thermal Cutting, Thermal Spraying, and Nondestructive Examination

American Welding Society®

Approved American National Standard
ANSI

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Approved by the
American National Standards Institute
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14th Edition

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Prepared by the
American Welding Society (AWS) A2 Committee on Definitions and Symbols

Under the Direction of the
AWS Technical Activities Committee

Approved by the
AWS Board of Directors

Abstract

This standard is a glossary of the technical terms used in the welding industry. Its purpose is to establish standard terms to aid in the communication of information related to welding and allied processes. Since it is intended to be a comprehensive compilation of welding terminology, nonstandard terms used in the welding industry are also included. All terms are designated as either standard or nonstandard and are arranged in word-by-word alphabetical sequence.

American Welding Society®

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This standard is subject to revision at any time by the AWS A2 Committee on Definitions and Symbols. It must be reviewed every five years, and if not revised, it must be either reaffirmed or withdrawn. Comments (recommendations, additions, or deletions) and any pertinent data that may be of use in improving this standard are requested and should be addressed to AWS Headquarters. Such comments will receive careful consideration by the AWS A2 Committee on Definitions and Symbols and the author of the comments will be informed of the Committee's response to the comments. Guests are invited to attend all meetings of the AWS A2 Committee on Definitions and Symbols to express their comments verbally. Procedures for appeal of an adverse decision concerning all such comments are provided in the Rules of Operation of the Technical Activities Committee. A copy of these Rules can be obtained from the American Welding Society, 8669 NW 36 St, # 130, Miami, FL 33166.

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Foreword

This foreword is not part of this standard but is included for informational purposes only.

The A2 Committee on Definitions and Symbols was formed by the American Welding Society to establish standard terms and definitions to aid in the communication of welding information. This publication is the major product of work done by the Subcommittee on Definitions in support of that purpose.

The evolution of AWS A3.0M/A3.0, *Standard Welding Terms and Definitions Including Terms for Additive Manufacturing, Adhesive Bonding, Brazing, Soldering, Thermal Cutting, Thermal Spraying, and Nondestructive Examination*, is shown below:

January 18, 1940	*Tentative Definitions of Welding Terms and Master Chart of Welding Processes*;
May 7, 1942	*Definitions of Welding Terms and Master Chart of Welding Processes*;
A3.0-49	*Standard Welding Terms and Their Definitions*;
A3.0-61	*AWS Definitions, Welding and Cutting*;
A3.0-69	*Terms and Definitions*;
A3.0-76	*Welding Terms and Definitions Including Terms for Brazing, Soldering, Thermal Spraying, and Thermal Cutting*;
A3.0-80	*Welding Terms and Definitions Including Terms for Brazing, Soldering, Thermal Spraying, and Thermal Cutting*;
ANSI/AWS A3.0-85	*Standard Welding Terms and Definitions Including Terms for Brazing, Soldering, Thermal Spraying, and Thermal Cutting*;
ANSI/AWS A3.0-89	*Standard Welding Terms and Definitions Including Terms for Brazing, Soldering, Thermal Spraying, and Thermal Cutting*;
ANSI/AWS A3.0-94	*Standard Welding Terms and Definitions Including Terms for Brazing, Soldering, Thermal Spraying, and Thermal Cutting*;
AWS A3.0:2001	*Standard Welding Terms and Definitions Including Terms for Adhesive Bonding, Brazing, Soldering, Thermal Spraying, and Thermal Cutting*;
AWS A3.0M/A3.0:2010	*Standard Welding Terms and Definitions Including Terms for Adhesive Bonding, Brazing, Soldering, Thermal Spraying, and Thermal Cutting*;
AWS A3.0M/A3.0:2020	*Standard Welding Terms and Definitions Including Terms for Adhesive Bonding, Brazing, Soldering, Thermal Spraying, and Thermal Cutting*; and
AWS A3.0M/A3.0:2025	*Standard Welding Terms and Definitions Including Terms for Additive Manufacturing, Adhesive Bonding, Brazing, Soldering, Thermal Cutting, Thermal Spraying, and Nondestructive Examination*

The present publication, AWS A3.0M/A3.0:2025, *Standard Welding Terms and Definitions Including Terms for Additive Manufacturing, Adhesive Bonding, Brazing, Soldering, Thermal Cutting, Thermal Spraying, and Nondestructive Examination*, defines over 1500 terms, with numerous illustrations to support and clarify the definitions, as well as classification charts and corollary information related to welding and allied processes. This latest revision includes significant enhancements to:

- Additive manufacturing
- GMAW process variations
- Hybrid welding
- Nondestructive examination
- Plastic welding
- Qualification – procedure and performance
- SAW process variations
- Temper bead welding
- Waveform-controlled welding
- Welding test positions

New terms and definitions have been introduced, and existing terms and definitions have been modified in these and other areas. Of significance are new/modified terms and definitions for surfacing weld test positions, procedure and performance qualification for brazing, soldering, and welding, gas metal arc welding transfer modes and process electrical variations, submerged arc welding process variations with multiple electrodes, nondestructive examination methods and their application, and measurement of arc energy for waveform-controlled welding. The term design effective throat has been added, as has the term contact tip-to-work distance. Table A1 has been modified to include ISO 4063 numeric process designations. Figure A7—Plastic Welding Classification Chart has been added. Users are encouraged to refer to summaries of the various changes in this edition found in Tables D1, D2, D3, D4, and D5.

Revisions to the 2025 edition are identified by underlines as well as vertical lines in the margin next to the text (see Clause 1, General Requirements).

Figures in this edition are identified in Annex B and are not intended to represent all possible conceptual variations; they are examples only and are not intended to illustrate acceptable or rejectable conditions.

As was the case for previous editions, numerous terms and definitions related to brazing are included in this edition. The intent is to include in AWS A3.0 those brazing terms and definitions corresponding with those for soldering and welding. It must be understood other important terms and definitions related to the description and application of brazing exist but are beyond the scope of AWS A3.0. For additional information and details, users are encouraged to refer to the AWS *Brazing Handbook*.

It must be understood that the Definitions Subcommittee cannot be the ultimate judge in terms of the preferability, acceptability, or correctness of any term for a specific situation. Such determinations are left to the discretion and opinion of the welding terminology user. There is one exception: when the use of a nonstandard term may endanger personal safety, that term is defined as both nonstandard and incorrect. The Definitions Subcommittee has neither the authority nor the desire to dictate welding terminology but considers it within its province to establish standard terms and nonstandard terms.

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Standard Welding Terms and Definitions

Including Terms for Additive Manufacturing, Adhesive Bonding, Brazing, Soldering, Thermal Cutting, Thermal Spraying, and Nondestructive Examination

1. General Requirements

1.1 Scope

The purpose of this document is to establish standard terms and definitions to aid in the communication of information related to welding, additive manufacturing, adhesive bonding, brazing, soldering, thermal cutting, thermal spraying, and nondestructive examination. The standard terms and definitions published in this document should be used in the oral and written language associated with these related processes.

Whenever AWS A3.0 is mentioned in this document, it refers to the latest edition, AWS A3.0M/A3.0:2025.

When terms from AWS A3.0 are used in other AWS standards, it is intended that the AWS A3.0 definitions apply, unless a more specific meaning is intended or necessary. AWS standards may provide alternative definitions where a process-specific definition improves understanding, or when specific limits of acceptance, applicability, or performance are incorporated.

It is one of the goals of the Definitions Subcommittee that AWS A3.0 encompass all terms, not adequately defined in the dictionary, directly related to welding or allied fields. Both standard and nonstandard jargon, as well as dialect and vernacular terms, are accepted for inclusion in AWS A3.0. Nonstandard terms are primarily included to direct the user to preferred standard terms.

As this document is a comprehensive compilation of terminology, nonstandard terms are included with cross-references to the corresponding standard terms. **Boldface** type indicates standard terms, lightface type indicates nonstandard terms. Terms for standard welding processes and for standard welding process variations are followed by their standard letter designations.

For the user's convenience, all new text is underlined. Additionally, a single vertical line in the margin next to a term denotes a minor change to an existing definition. A double line denotes a new term or a major change. Terms for standard processes and standard process variations are followed by their standard letter designation. All terms are arranged in word-by-word alphabetical sequence.

The principles applied by the Definitions Subcommittee for the creation of terms and definitions in AWS A3.0 are described in Annex C.

1.2 Units of Measurement

This standard makes use of both the International System of Units (SI) and U.S. Customary Units. The latter are shown within brackets ([ ]) or in appropriate columns in tables and figures. The measurements may not be exact equivalents; therefore, each system must be used independently.

1.3 Safety

Safety and health issues and concerns are beyond the scope of this standard, and therefore are not fully addressed herein.

Safety and health information is available from the following sources:

American Welding Society

(1) ANSI Z49.1, *Safety in Welding, Cutting, and Allied Processes*

(2) AWS Safety and Health Fact Sheets

(3) Other safety and health information on the AWS website

Material or Equipment Manufacturers:

(1) Safety Data Sheets supplied by materials manufacturers

(2) Operating Manuals supplied by equipment manufacturers

Applicable Regulatory Agencies

Work performed in accordance with this standard may involve the use of materials that have been deemed hazardous, and may involve operations or equipment that may cause injury or death. This standard does not purport to address all safety and health risks that may be encountered. The user of this standard should establish an appropriate safety program to address such risks as well as to meet applicable regulatory requirements. ANSI Z49.1 should be considered when developing the safety program.

2. Normative References

The documents listed below are referenced within this publication and are mandatory to the extent specified herein. For undated references, the latest edition of the referenced standard shall apply. For dated references, subsequent amendments or revisions of the publications may not apply since the relevant requirements may have changed.

American Welding Society (AWS) standard:

AWS A1.1, *Metric Practice Guide for the Welding Industry*

Other Document:

Webster's Third New International Dictionary of the English Language, Unabridged.

3. Terms and Definitions

For the purposes of this document, the following definitions apply:

definition. A statement of the meaning of a word or word group. The statement may also describe the interrelationship with other terms and association with other relevant information such as tables, figures, and commentary.

nonstandard term. A word or expression used colloquially that is provided as a link to the standard term in AWS A3.0. When used in AWS A3.0, nonstandard terms are shown in lightface type.

standard term. A word or expression recognized in AWS A3.0 as the preferred terminology for use in oral and written language. When used in AWS A3.0, standard terms are shown in **boldface** type.

term. A word or expression directly related to welding or allied areas that has a meaning more specialized or restricted than that given in the dictionary (see Clause 2).

4. Glossary

1F, *plate*. A welding test position designation for a linear fillet weld applied to a joint in which the weld is made in the flat welding position. See Figure B18(A).

1FR, *pipe*. A welding test position designation for a circumferential fillet weld applied to a rotated test coupon, with its axis approximately 45º from horizontal, where welding is applied in the flat welding position. Rotation may be continuous or incremental. See Figure B20(A).

1GR, *pipe*. A welding test position designation for a circumferential groove weld applied to a rotated horizontal test coupon, where welding is applied in the flat welding position. Rotation may be continuous or incremental. See Figure B19(A).

1G, *plate*. A welding test position designation for a linear groove weld applied to a joint in which the weld is made in the flat welding position. See Figure B17(A).

1S. A welding test position designation for a weld applied to a plate or stationary pipe surface in the flat welding position. This designation may be used for both stud and surfacing welds. Surfacing welds on pipe may be applied in either circumferential or axial direction. See Figures B17(A), B19(A), and (B19F).

1SR, *pipe*. A welding test position designation for a circumferential surfacing weld applied to a rotated horizontal test coupon, where welding is applied in the flat welding position. Rotation may be continuous or incremental. See Figure B19(A).

2F, *pipe*. A welding test position designation for a circumferential fillet weld applied to a joint in pipe with its axis approximately vertical and the weld made in the horizontal welding position. The pipe may be fixed or rotated about the pipe axis, either continuously or incrementally. See Figure B20(B).

2F, *plate*. A welding test position designation for a linear fillet weld applied to a joint in which the weld is made in the horizontal welding position. See Figure B18(B).

2FR, *pipe*. A welding test position designation for a circumferential fillet weld applied to a rotated horizontal test coupon, where welding is applied in the horizontal welding position. Rotation may be continuous or incremental. See Figure B20(C).

2G, *pipe*. A welding test position designation for a circumferential groove weld applied to a joint in a pipe, with its axis approximately vertical, in which the weld is made in the horizontal welding position. The test coupon may be fixed or rotated about the pipe axis, either continuously or incrementally. See Figure B19(B).

2G, *plate*. A welding test position designation for a linear groove weld applied to a joint in which the weld is made in the horizontal welding position. See Figure B17(B).

2G-RA, *pipe*. A welding test position designation for a circumferential groove weld applied to a joint in a pipe, with its axis approximately vertical, in which the weld is made in the horizontal position. The pipe may be fixed or rotated. This welding test position differs from the classic 2G welding test position in that the bottom member is beveled, and a restriction ring is positioned adjacent to the square edge shape to limit access to the joint to simulate a production joint between a horizontal ring above a beveled pipe. See Figure B17(E).

2G-RA, *plate*. A welding test position designation for a linear groove weld applied to a joint in which the weld is made in the horizontal welding position. This welding test position differs from the classic 2G welding test position in that the bottom member is beveled, and a restriction plate is positioned adjacent to the square edge shape to limit access to the joint to simulate a production joint between a horizontal plate above a beveled plate. See Figure B17(E).

2S. A welding test position designation for a weld applied to a plate or stationary pipe surface in the horizontal welding position. This designation may be used for both stud and surfacing welds. For stud welds on pipe, the stud shall be applied to a lateral surface quadrant of a stationary test coupon with its axis approximately horizontal. See Figures B17(B) and B19(F).

2S, *pipe*. A welding test position designation for a circumferential surfacing weld applied to a pipe with its axis approximately vertical, where welding is applied in the horizontal welding position. The test coupon may be fixed or rotated about its axis either continuously or incrementally. See Figure B19(B).

3F, *plate*. A welding test position designation for a linear fillet weld applied to a joint in which the weld is made in the vertical welding position. See Figure B18(C).

3FR, *pipe*. A welding test position designation for a circumferential fillet weld applied to a rotated horizontal test coupon, where welding is applied in the vertical welding position. Rotation may be continuous or incremental. See Figure B20(C).

3GR, *pipe*. A welding test position designation for a circumferential groove weld applied to a rotated horizontal test coupon, where welding is applied in the vertical welding position. Rotation may be continuous or incremental. See Figure B19(A).

3G, *plate*. A welding test position designation for a linear groove weld applied to a joint in which the weld is made in the vertical welding position. See Figure B17(C).

3S. A welding test position designation for a weld applied to a plate or stationary pipe surface in the vertical welding position. This designation may be used for both stud and surfacing welds. Surfacing welds on pipe may be applied in either circumferential or axial direction. See Figures B17(C) and B19(A).

3SR, *pipe*. A welding test position designation for a circumferential surfacing weld applied to a rotated horizontal test coupon, where welding is applied in the vertical welding position. Rotation may be continuous or incremental. See Figure B19(A).

4F, *pipe*. A welding test position designation for a circumferential fillet weld applied to a joint in pipe with its axis approximately vertical and the weld made in the overhead welding position. The pipe may be fixed or rotated about the pipe axis, either continuously or incrementally. See Figure B20(D).

4F, *plate*. A welding test position designation for a linear fillet weld applied to a joint in which the weld is made in the overhead welding position. See Figure B18(D).

4FR, *pipe*. A welding test position designation for a circumferential fillet weld applied to a rotated horizontal test coupon, where welding is applied in the overhead welding position. Rotation may be continuous or incremental. See Figure B20(C).

4GR, *pipe*. A welding test position designation for a circumferential groove weld applied to a rotated horizontal test coupon, where welding is applied in the overhead welding position. Rotation may be continuous or incremental. See Figure B19(A).

4G, *plate*. A welding test position designation for a linear groove weld applied to a joint in which the weld is made in the overhead welding position. See Figure B17(D).

4S. A welding test position designation for a weld applied to a plate or stationary pipe surface in the overhead welding position. This designation may be used for both stud and surfacing welds. Surfacing welds on pipe may be applied in either circumferential or axial direction. See Figures B17(D), B19(A), and B19(F).

4SR, *pipe*. A welding test position designation for a circumferential surfacing weld applied to a rotated horizontal test coupon, where welding is applied in the overhead welding position. Rotation may be continuous or incremental. See Figure B19(A).

5F, *pipe.* A multiple welding test position designation for a circumferential fillet weld applied to a joint in pipe with its axis approximately horizontal and the weld made in the horizontal, vertical, and overhead welding positions. The pipe remains fixed until the welding of the joint is complete. See Figure B20(E).

5G. A multiple welding test position designation for a circumferential groove weld applied to a joint in a pipe with its axis horizontal, in which the weld is made in the flat, vertical, and overhead welding positions. The pipe remains fixed until the welding of the joint is complete. See Figure B19(C).

5S. A multiple welding test position designation for a circumferential weld applied to a pipe surface in the flat, vertical, and overhead welding positions. See Figure B19(C).

6F. A multiple welding test position designation for a circumferential fillet weld applied to a joint in pipe, with its axis approximately 45º from horizontal, in which the weld is made in the flat, vertical, and overhead welding positions. The pipe remains fixed until welding is complete. See Figure B20(F).

6G. A multiple welding test position designation for a circumferential groove weld applied to a joint in pipe, with its axis approximately 45º from horizontal, in which the weld is made in the horizontal, vertical, and overhead welding positions. The pipe remains fixed until welding is complete. See Figure B19(D).

6GR. A multiple welding test position designation for a circumferential groove weld applied to a joint in pipe, with its axis approximately 45º from horizontal, in which the weld is made in the horizontal, vertical, and overhead welding positions. A restriction ring is added, adjacent to the joint, to restrict access to the weld. The pipe remains fixed until welding is complete. See Figure B19(E).

6S. A multiple welding test position designation for a circumferential weld applied to an inclined pipe surface in the horizontal, vertical, and overhead welding positions. See Figure B19(D).

A

A-Number. A designation for ferrous weld metal for procedure qualification based upon chemical composition.

abrasion soldering. A soldering process variation during which surface wetting is enhanced by abrading the faying surfaces.

abrasive blasting. A method of cleaning or surface roughening by a forcibly projected stream of abrasive particles.

absorptive lens. A filter lens designed to attenuate the effects of transmitted and reflected light. See also **filter plate**.

accelerating potential, *electron beam cutting* and *electron beam welding*. The potential imparting velocity to the electrons.

acceptable weld. A weld meeting the applicable requirements.

acceptance criteria. Limits placed on characteristics of an item as specified by the applicable standard.

acetylene feather, *oxyacetylene cutting* and *oxyacetylene welding*. The intense white, feathery-edged outer cone of a carburizing flame. See Figure B40(B).

acid core solder. See **acid cored soldering filler metal**.

acid cored soldering filler metal. A flux cored soldering filler metal containing an acid flux. See also **rosin cored soldering filler metal**.

acoustic emission testing (AET). A nondestructive examination method using applied stress to produce and detect transient stress waves emanating from discontinuities within the test object.

activated rosin flux. A rosin-based flux containing an additive to increase wetting of the soldering filler metal.

active brazing filler metal. A brazing filler metal containing additional activation elements to promote wetting and capillary action on metallic or nonmetallic surfaces that would otherwise be difficult to braze.

active flux, *submerged arc welding*. A flux formulated to provide shielding of the molten weld metal and affect the relative amounts of Mn and Si in the resulting weld metal, dependent on arc voltage. See also **alloy flux** and **neutral flux**.

active gas. A shielding gas composition affecting arc stability and influencing composition, penetration and wetting. See also **protective atmosphere**.

actual throat. The shortest distance between the weld root and the face of a fillet weld. See Figure B25(A)−(D). See also **effective throat** and **theoretical throat**.

adaptive control, *adj*. Pertaining to a method of application using a control system, which senses changes in conditions, to direct appropriate action. See Table A4. See also **automatic**, **manual**, **mechanized**, **robotic**, and **semiautomatic**.

adaptive control brazing (B-AD). See **adaptive control process**.

adaptive control process (XXXX-AD). An operation with a control system sensing changes in conditions and automatically directing the equipment to take appropriate action. See **adaptive control brazing**, **adaptive control soldering**, **adaptive control thermal cutting**, **adaptive control thermal spraying**, and **adaptive control welding**. See Table A4. See also **automatic process**, **manual process**, **mechanized process**, **robotic process**, and **semiautomatic process**.

adaptive control soldering (S-AD). See **adaptive control process**.

adaptive control thermal cutting (TC-AD). See **adaptive control process**.

adaptive control thermal spraying (TS-AD). See **adaptive control process**.

adaptive control welding (W-AD). See **adaptive control process**.

adaptively-controlled, *waveform-controlled welding*. A mode of operation in which the power source reacts to changes in the process and adjusts the output waveform.

additive manufacturing. Production of a functional engineered component using a welding or thermal spraying process to selectively apply volumes of material in an additive manner, i.e. point-by-point and layer-by-layer, using a path derived directly from a three-dimensional computer model. The functional component may require additional post-processing such as heat treatment, machining, or finishing.

additive manufacturing procedure specification (AMPS). A document detailing the required process variables for production of a component to ensure repeatability when executed by properly trained and qualified personnel.

adhesive. A polymeric material having chemical and physical properties differing from those of the base materials, placed at their faying surfaces, to join the materials together as a result of the attractive forces of this polymeric material.

adhesive bond. A surface attraction, generally physical in nature, between materials.

adhesive bonding (AB). A joining process in which an adhesive, placed between faying surfaces, solidifies to produce an adhesive bond.

advancing side, *friction stir welding*. The side of the weld in which the direction of tool rotation and travel are the same. See also **retreating side**. See Figure B46.

advancing side, *high energy beam welding*. The side in which the direction of beam pattern and travel are the same. See also **retreating side**.

agglomerated flux, *submerged arc welding*. A granular flux produced by baking a pelletized mixture of powdered ingredients and bonding agents at a temperature sufficient to remove moisture, followed by processing to produce the desired particle size. See also **bonded flux** and **fused flux**.

air acetylene welding (AAW). An oxyfuel gas welding process using an air acetylene flame. The process is used without the application of pressure. This is an obsolete or seldom used process. See Table A5.

air cap. A thermal spraying torch component for shaping the atomizing gas exiting the nozzle.

air carbon arc cutting (CAC-A). A carbon arc cutting process variation removing molten metal with a jet of air.

air carbon arc cutting torch. A device used to transfer electric current to a fixed cutting electrode, position the electrode, and direct the flow of air.

air feed. A thermal spraying process variation in which an air stream carries the powdered surfacing material through the torch and into the heat source.

aligned discontinuities. A localized grouping of discontinuities forming an approximately linear pattern.

aligned porosity. A localized grouping of porosity forming an approximately linear pattern.

alloy. A substance with metallic properties and composed of two or more chemical elements of which at least one is a metal.

alloy flux, *submerged arc welding*. A flux containing ingredients to provide shielding and react with the weld pool to achieve a weld metal composition significantly different from the welding electrode, or to compensate for elemental losses during transfer across the arc or in the weld pool. See also **active flux** and **neutral flux**.

alloy powder. Powder prepared from a homogeneous molten alloy or from the solidification product of such an alloy. See also **powder blend**.

angle of bevel. See **bevel angle**.

arc. See **welding arc**.

arc blow. The deflection of an arc from its normal path due to magnetic forces.

arc braze welding (ABW). A braze welding process variation using an electric arc as the heat source. See also **carbon arc braze welding**.

arc chamber. A nonstandard term for **plenum chamber**.

arc cutter. See **thermal cutter**. See also **oxygen cutting operator**.

arc cutting (AC). A group of thermal cutting processes severing or removing metal by melting with the heat of an arc between an electrode and the workpiece.

arc cutting gun. A device used to transfer electric current to a continuously fed cutting electrode, guide the electrode, and direct the shielding gas.

arc cutting operator. See **thermal cutting operator**. See also **oxygen cutter**.

arc cutting torch. See **air carbon arc cutting torch**, **gas tungsten arc cutting torch**, and **plasma arc cutting torch**.

arc energy. The product of welding amperage, voltage, and time interval. See Annex C, C1.5.9.

arc force. The axial force developed by arc plasma.

arc gap. A nonstandard term when used for **arc length**.

arc gas. A nonstandard term when used for **orifice gas**.

arc gouging (AG). Thermal gouging using an arc cutting process variation to form a bevel or groove.

arc length. The distance from the tip of the welding electrode to the adjacent surface of the weld pool.

arc oxygen cutting. A nonstandard term for **oxygen arc cutting**.

arc plasma. A gas heated by an arc to at least a partially ionized condition, enabling it to conduct an electric current.

arc seam weld. A seam weld made using an arc welding process. See Figures B14(A) and B14(B).

arc seam weld size. See **seam weld size**.

arc spot weld. A spot weld made using an arc welding process. See Figure B14(G).

arc spot weld size. See **spot weld size**.

arc sprayer. See **thermal sprayer**.

arc spraying (ASP). A thermal spraying process using an arc between two consumable electrodes of surfacing materials as a heat source and a compressed gas to atomize and propel the surfacing material to the substrate.

arc spraying operator. See **thermal spraying operator**.

arc strike. A discontinuity resulting from an arc, consisting of any localized remelted metal, heat-affected metal, or change in the surface profile of any metal object.

arc stud welding (SW). An arc welding process using an arc between a metal stud, or similar part, and the other workpiece. The process is used without filler metal, with or without shielding gas or flux, with or without partial shielding

from a ceramic or graphite ferrule surrounding the stud, and with the application of pressure after the faying surfaces are sufficiently heated.

arc time. The time during which an arc is maintained in making an arc weld.

arc voltage, *arc welding*. The electrical potential between the electrode and workpiece.

arc welding (AW). A group of welding processes producing coalescence of workpieces by melting them with an arc. The processes are used with or without the application of pressure and with or without filler metal.

arc welding deposition efficiency. The ratio of the weight of filler metal deposited in the weld metal to the weight of filler metal melted, expressed in percent.

arc welding electrode. The component of the welding circuit, terminating at the arc, through which welding current is conducted.

arc welding gun. A device used to transfer welding current to a continuously fed consumable electrode, guide the electrode, and direct the shielding gas.

arc welding torch. A device used to transfer welding current to a fixed welding electrode, position the electrode, and direct the shielding gas. See Figures B35 and B36.

arm. A beam extending from the frame of a resistance welding machine to transmit electrode force and sometimes conduct welding current.

as-brazed, *adj*. Pertaining to the condition of brazements prior to subsequent thermal, mechanical, or chemical treatments.

assembly. One or more components, members, or parts fit in preparation for joining.

assist gas. A gas used to blow molten metal away to form the kerf in laser beam inert gas cutting, or to blow vaporized metal away from the beam path in laser beam evaporative cutting.

as-soldered, *adj*. Pertaining to the condition of solderments prior to subsequent thermal, mechanical, or chemical treatments.

as-welded, *adj*. Pertaining to the condition of weldments prior to subsequent thermal, mechanical, or chemical treatments.

atomic hydrogen welding (AHW). An arc welding process using an arc between two metal electrodes in a shielding atmosphere of hydrogen and without the application of pressure. This is an obsolete or seldom used process. See Table A5.

atmospheric electron beam welding. See **nonvacuum electron beam welding**.

atmospheric plasma spraying (APSP). A plasma spraying process variation accomplished at atmospheric pressure.

autogenous weld. A fusion weld made without the addition of filler metal.

automatic, *adj*. Pertaining to a method of application using equipment requiring only occasional or no observation and no manual adjustments during its operation. See Table A4. See also **adaptive control**, **manual**, **mechanized**, **robotic**, and **semiautomatic**.

automatic arc welding weld time. See **weld time**, *automatic arc welding*.

automatic brazing (B-AU). See **automatic process**.

automatic gas cutting. A nonstandard term for **automatic oxygen cutting**.

automatic process (XXXX-AU). An operation performed with equipment requiring occasional or no observation and no manual adjustment during its operation. Variations of this term are **automatic brazing**, **automatic soldering**, **automatic thermal cutting**, **automatic thermal spraying**, and **automatic welding**. See Table A4. See also **adaptive control process**, **manual process**, **mechanized process**, **robotic process**, and **semiautomatic process**.

automatic soldering (S-AU). See **automatic process**.

automatic thermal cutting (TC-AU). See **automatic process**.

automatic thermal spraying (TS-AU). See **automatic process**.

automatic welding (W-AU). See **automatic process**.

auxiliary enlarger. A nonstandard term for **auxiliary magnifier**.

auxiliary magnifier. An additional lens used to magnify the field of vision.

average instantaneous power (AIP), *waveform-controlled welding.* The average of products of amperages and voltages determined at sampling frequencies sufficient to quantify waveform changes during a welding interval. See Annex C, C1.5.10.

AWS Certified Welder. An individual with credentials attesting to qualification in accordance with AWS QC7, *Standard for AWS Certified Welders*, based on testing performed at an AWS Accredited Testing Facility (ATF).

AWS Qualifier. A CWI or SCWI qualified as a WPQ1 in accordance with AWS QC47, *Specification for AWS Certification of Welders and Accreditation of Test Facilities*, to conduct and document welder qualification tests.

AWS Welder Performance Qualifier. An individual who, by experience and examination, is considered capable of conducting and documenting performance qualification of welding personnel. This individual shall successfully pass a *Welder Performance Qualifier Endorsement* (WPQ1) examination.

AWS Welding Procedure Qualifier. An individual who, by experience and examination, is considered capable of conducting and documenting the qualification of welding procedures. This individual shall successfully pass a *Welding Procedure Qualifier Endorsement* (WPQ2) examination.

axis of weld. See **weld axis**.

B

back bead. A weld bead resulting from a back weld pass.

back cap. A device used to exert pressure on the collet in a gas tungsten arc welding torch and create a seal to prevent air from entering the back of the torch. See Figure B36.

back weld. A weld made at the back of a single groove weld. See Figure B24(C).

back weld pass. A weld pass resulting in a back weld.

backfire. The momentary recession of the flame into the oxyfuel torch, potentially causing a flashback or sustained backfire. It is usually signaled by a popping sound, after which the flame may either extinguish or reignite at the end of the tip. See also **flashback** and **sustained backfire**.

backgouging. The removal of weld metal and base metal from the weld root side of a welded joint to facilitate complete fusion and complete joint penetration upon subsequent welding from that side.

background level, *pulsed welding*. The low pulse amplitude of power in the welding waveform of the power source output. This value may be preset, programmed, or adaptively-controlled. See Figure B53. See also **waveform-controlled welding**.

backhand welding. A welding technique in which the travel angle of a welding torch or gun is directed opposite to the progression of welding. See Figure B21. See also **drag angle**, **forehand welding**, **travel angle**, and **work angle**.

backing. A material or device placed adjacent to the joint root, or on both faces of a joint in electroslag and electrogas welding, to support and shield molten weld metal. The metal or nonmetal backing may be partially fused or remain unfused during welding. See Figures B8(D), B12(C), and B37.

backing bead. A weld bead resulting from a backing weld pass.

backing filler metal. A nonstandard term for **consumable insert**.

backing gas. See **root shielding gas**.

backing ring. Backing in the form of a ring, generally used in the welding of pipe.

backing shoe, *electroslag welding* and *electrogas welding*. A material or device placed against the open face(s) of a joint to contain molten weld metal. See Figure B37. See also **backing**, **moving shoe**, and **stationary shoe**.

backing weld. Backing in the form of a weld. See Figure B24(D).

backing weld pass. A weld pass resulting in a backing weld.

backstep sequence. A longitudinal sequence in which weld passes are made in the direction opposite the progression of welding. See Figure B23(A).

backup, *flash and upset welding*. A locating device used to transmit all or a portion of the upset force to the workpieces or to aid in preventing the workpieces from slipping during upsetting.

backup electrode. A resistance welding electrode having a large electrode face opposing the welding force.

bakeout. See **hydrogen bakeout**.

balling up, *brazing* and *soldering*. The formation of globules of molten filler metal or flux due to insufficient base metal wetting.

bare electrode. A filler metal electrode produced as a wire, strip, or bar with no coating or covering except one incidental to its manufacture or preservation.

bare metal arc welding (BMAW). An arc welding process using an arc between a bare or lightly coated electrode and the weld pool. The process is used without shielding, without the application of pressure, and filler metal is obtained from the electrode. This is an obsolete or seldom used process. See Table A5.

base material. The material being welded, brazed, soldered, cut, or coated. See also **base metal** and **substrate**.

base metal. The metal or alloy being welded, brazed, soldered, cut, or coated. See also **base material** and **substrate**.

base metal test specimen. A test specimen composed wholly of base metal.

base metal zone (BMZ). The portion of base metal adjacent to a weld, braze or solder joint or thermal cut and unaffected by welding, brazing, soldering, or thermal cutting. See Figure B24(G). See also **heat-affected zone** and **weld metal zone**.

base plate. A nonstandard term when used for **base metal**.

bead. See **weld bead**.

bead reentrant angle. The reentrant angle between adjacent weld beads. In a multipass weld, this angle can be present at the weld bead toe or at the end of a weld bead. See also **toe reentrant angle**. See Figure B32(J).

bead weld. A nonstandard term for **surfacing weld**.

beam divergence. The expansion of a beam's cross section as the beam emanates from its source.

bend test. See **face bend test**, **guided bend test**, **root bend test**, and **side bend test**.

berry formation. A nonstandard term for **nozzle accumulation**.

bevel. An angular edge shape. See Figures B6 and B7.

bevel angle. The angle between the bevel of a joint member and a plane perpendicular to the surface of the member. See Figures B6(A)—(D), and B6(I).

bevel depth. The perpendicular distance from the base metal surface to the bottom of the bevel face. See Figures B6(A)—(D), and B6(K).

bevel edge shape. A type of edge shape in which the prepared surface or surfaces lies at some angle other than perpendicular to the material surface. See Figures B7(B) and B7(C).

bevel face. The prepared surface of a bevel edge shape. See Figures B6(A), B6(C), and B6(D). See also **groove face** and **root face**.

bevel-groove weld. A groove weld applied to a joint with a bevel edge shape. See Figures B8(B) and B9(B).

bevel radius. The radius used to form a J-edge shape. See Figures B6(B) and B6(F).

bit. Part of the soldering iron, usually made of copper, provided to directly transfer heat, and sometimes soldering filler metal, to the joint.

blacksmith welding. A nonstandard term when used for **forge welding**.

blanket brazing. A brazing process variation employing a flexible, resistance-heated blanket(s) as the heat source.

blasting. See **abrasive blasting**.

blind joint. A joint, no portion of which is visible.

block brazing (BB). A brazing process employing heated blocks as the heat source. This is an obsolete or seldom used process. See Table A5.

block sequence. A distortion-control technique using a combined longitudinal and cross-sectional sequence for a continuous multiple-pass weld in which separated segments are completely or partially welded before intervening segments are welded. See Figure B23(B). See also **cascade sequence**, **cross-sectional sequence**, **progressive block sequence**, and **successive block sequence**.

blowhole. A nonstandard term when used for **porosity**.

blowpipe. See **brazing blowpipe**, **oxyfuel gas welding torch**, and **soldering blowpipe**.

bond. See **adhesive bond**, **mechanical bond**, and **metallic bond**.

bond bar. A nonstandard term for **bond specimen**.

bond cap. A nonstandard term for **bond specimen**.

bond coat, *thermal spraying*. A thermal spray deposit applied to improve adherence of a subsequent coating.

bond line, *thermal spraying*. The cross section of the interface between a thermal spray deposit and the substrate. See Figure B31(B).

bond specimen, *thermal spraying*. The test specimen on which a thermal spray deposit has been applied to determine bond strength and thermal spray deposit strength.

bond strength, *thermal spraying*. The unit force required to separate a thermal spray deposit from the substrate.

bonded flux, *submerged arc welding*. A granular flux produced by baking a pelletized mixture of powdered ingredients and bonding agents at a temperature below its melting point, but high enough to create a chemical bond, followed by processing to produce the desired particle size. See also **agglomerated flux** and **fused flux**.

bonding. A nonstandard term when used for **brazing**, **soldering**, and **welding**. See Annex C, C1.5.1.

bonding force. The attractive force holding atoms together.

bottle. A nonstandard term when used for **gas cylinder**.

boxing. The continuation of a fillet weld around a corner of a member as an extension of the principal weld. See Figure B23(F).

braided shunt. A flexible secondary circuit conductor constructed of one or more flat braided conductors. See also **laminated shunt**.

braze, *n*. A metallic bond produced as a result of heating an assembly to the brazing temperature, using a brazing filler metal distributed and retained between the closely fitted faying surfaces of the joint by capillary action. See Figure B31(A).

braze, *v.* The act of brazing.

braze interface. The boundary between braze metal and base material in a brazed joint. See Figure B31(A).

braze metal. The brazing filler metal melted during brazing. See Figure B31(A).

braze welding (BW). A joining process in which the brazing filler metal is distributed in the joint without capillary action. See also **arc braze welding**, **carbon arc braze welding**, **electron beam braze welding**, **exothermic braze welding**, **flow welding**, and **laser beam braze welding**.

brazeability. The capacity of a material to be brazed under the imposed fabrication conditions into a specific, suitably designed structure capable of performing satisfactorily in the intended service.

brazed test assembly. A brazement produced for the purpose of qualifying brazing procedures and personnel.

brazement. An assembly joined by brazing.

brazer. An individual performing manual or semiautomatic brazing.

brazer certification. Documentation attesting to the performance qualification of a brazer.

brazer performance qualification. See **performance qualification**.

brazer performance qualification test record (BPQTR). See **performance qualification test record**.

brazer performance qualification variable. See **performance qualification variable**.

brazing (B). A group of joining processes in which the workpiece(s) and brazing filler metal are heated to the brazing temperature to form a brazed joint. The brazing filler metal is distributed and retained between closely fitted faying surfaces by capillary action. See Figures A1, A3, and A6.

brazing alloy. A nonstandard term for **brazing filler metal**.

brazing blowpipe. A device used to obtain a small, accurately directed flame for fine work. A portion of any flame is blown to the desired location by the blowpipe, which is usually mouth operated.

brazing filler metal. A filler metal having a liquidus above 450 ºC [840 ºF] and below the solidus of the base material. See also **brazing foil**, **brazing filler metal paste**, **brazing powder**, **brazing rod**, **brazing rope**, **brazing sheet**, **brazing strip**, **brazing tape**, and **brazing wire**.

brazing filler metal paste. Brazing filler metal in the form of a paste consisting of finely divided brazing filler metal with a flux or neutral carrier.

brazing foil. Brazing filler metal in thin sheet form.

brazing flux. A flux used for brazing. See **noncorrosive flux**. See also **soldering flux** and **welding flux**.

brazing operator. An individual responsible for observing and controlling an automatic, mechanized, or robotic brazing process.

brazing operator certification. Documentation attesting to the performance qualification of a brazing operator.

brazing operator performance qualification. See **performance qualification**.

brazing operator performance qualification test record (BOPQTR). See **performance qualification test record**.

brazing operator performance qualification variable. See **performance qualification variable**.

brazing paste. A nonstandard term when used for **brazing filler metal paste**.

brazing powder. Brazing filler metal in the form of finely divided particles.

brazing procedure. A detailed description of the materials and methods used to braze materials, including activities before and after the application of the brazing process. A brazing procedure specification could be an element of this procedure.

brazing procedure qualification. Demonstration of the use of a process to braze materials using detailed techniques resulting in a test coupon meeting an applicable qualification standard.

brazing procedure qualification record (BPQR). See **procedure qualification record**.

brazing procedure qualification variable. See **procedure qualification variable**.

brazing procedure specification (BPS). See **procedure specification**.

brazing rod. A form of solid or flux cored brazing filler metal supplied in straight lengths that may include a flux coating.

brazing rope. Brazing powder held in an extruded form by a plastic binder.

brazing sheet. Brazing powder held in sheet form by a plastic binder.

brazing shim. A nonstandard term for **brazing foil**.

brazing strip. A long, narrow form of brazing foil or brazing sheet.

brazing symbol. A graphical representation of the specifications for producing a brazed joint. For examples and rules for their application, refer to AWS A2.4, *Standard Symbols for Welding, Brazing, and Nondestructive Examination*.

brazing tape. Brazing strip with an applied adhesive.

brazing technique. Details of the brazing operation controlled by the brazer or brazing operator.

brazing temperature. The temperature to which the base material is heated to enable the brazing filler metal to wet the base material and form a brazed joint. This temperature should be above the liquidus of the brazing filler metal and below the solidus of the base metal.

brazing test assembly. See **test coupon.**

brazing variable. See **procedure qualification variable**.

brazing wire. A solid or flux cored form of brazing filler metal supplied on coils or spools.

bronze welding. A nonstandard term when used for **braze welding**.

build model, *additive manufacturing*. The digital or mathematical model defining the programmed deposition profile and path for the entire build, including support structure, machining stock, and witness specimens.

buildup. A surfacing variation primarily used to achieve required dimensions. See also **buttering**, **cladding**, and **hardfacing**.

buildup sequence. A nonstandard term for **cross-sectional sequence**.

burn-through. A hole or depression in the root bead of a single-groove weld due to excess penetration. See Figure B32(O).

burn-through. A nonstandard term when used for **melt-through**.

burn-through weld. A nonstandard term for an **arc seam weld** or **arc spot weld**.

burnback time. A nonstandard term for **meltback time**.

burner. A nonstandard term when used for **oxyfuel gas cutter**.

burning. A nonstandard term when used for **oxyfuel gas cutting**.

burning in. A nonstandard term for **flow welding**.

burnoff rate. A nonstandard term when used for **melting rate**.

butt joint. A joint type formed by butting ends of one or more workpieces aligned in approximately the same plane. See Figures B1(A), B2(A), B3, B10(A), B10(B), B10(D), B52(A), and B52(B). See also **skewed joint**.

butt weld. A nonstandard term for a weld in a butt joint.

butt welding, *resistance welding*. A nonstandard term when used for **upset welding**.

buttering. A surfacing variation primarily used to provide metallurgically compatible weld metal for the subsequent completion of the weld. See also **buildup**, **cladding**, and **hardfacing**.

butting member. See **butting workpiece**.

butting workpiece. A joint member prevented, by the other member, from movement in one direction perpendicular to its thickness dimension. For example, both members of a butt joint, or one member of a T-joint or corner joint. See Figure B11. See also **nonbutting workpiece**.

button. Part of a weld torn out in the destructive testing of projection, seam, or spot welds. It may include all or part of the nugget, the heat-affected zone (HAZ), and the base metal.

C

cap. A nonstandard term for the final **layer** of a groove weld.

cap, *resistance welding*. A nonstandard term for **electrode cap**.

capacitor discharge welding. A stored energy welding variation using capacitors to accumulate and discharge energy for welding.

capillary action. The force by which liquid in contact with a solid is distributed between the closely fitted faying surfaces of the joint to be brazed or soldered.

carbon arc braze welding (CABW). A braze welding process variation using an arc between a carbon electrode and the base metal as the heat source. This is an obsolete or seldom used process. See Table A5.

carbon arc brazing (CAB). A brazing process using heat from a carbon arc. This is an obsolete or seldom used process. See Table A5.

carbon arc cutting (CAC). An arc cutting process employing a carbon electrode. See also **air carbon arc cutting**.

carbon arc gouging (CAG). A thermal gouging process using heat from a carbon arc and the force of compressed air or other nonflammable gas. See also **oxygen gouging** and **plasma arc gouging**.

carbon arc welding (CAW). An arc welding process using an arc between a carbon electrode and the weld pool. The process is used with or without shielding and without the application of pressure. See also **gas carbon arc welding**, **shielded carbon arc welding**, and **twin carbon arc welding**.

carbon electrode. An arc welding or cutting electrode consisting of a plain or coated carbon or graphite rod.

carbonizing flame. A nonstandard term for **carburizing flame**.

carburizing flame, *oxyfuel cutting* and *oxyfuel welding*. A reducing oxyfuel gas flame in which there is an excess of fuel gas, resulting in a carbon-rich zone extending around and beyond the cone. See Figure B40(B). See also **neutral flame**, **oxidizing flame**, and **reducing flame**.

carrier gas. The gas used to transport powdered material from the feeder or hopper to a thermal spraying torch or thermal cutting torch.

cascade sequence. A combined longitudinal and cross-sectional sequence in which weld beads are made in overlapping layers. See Figure B23(C). See also **block sequence**, **continuous sequence**, and **cross-sectional sequence**.

cascade soldering. A wave soldering process variation where waves are produced as a bath of soldering filler metal flows down inclined steps while the workpiece travels in the opposite direction.

caulk weld. A nonstandard term for **seal weld**.

caulking. Localized plastic deformation of weld and adjacent base metal surfaces by mechanical means to seal or obscure discontinuities.

ceramic rod flame spraying. A thermal spraying process variation in which the surfacing material is in rod form.

certification. A credential attesting to a type or level of qualification.

certification authority. An organization or company responsible for authorization of qualification records.

certified welder. A welder with credentials attesting to qualification in accordance with an applicable standard.

certified welding operator. A welding operator with credentials attesting to qualification in accordance with an applicable standard.

chain intermittent weld. An intermittent weld on both sides of a joint in which the weld segments on one side are approximately opposite those on the other side. See Figure B23(G).

chemical-bath dip brazing. A dip brazing process variation using a chemical compound also serving as a flux. See also **metal-bath dip brazing** and **salt-bath dip brazing**.

chemical flux cutting. A nonstandard term for **flux cutting**.

chill ring. A nonstandard term when used for **backing ring**.

chill time. A nonstandard term when used for **quench time**.

circular electrode. A rotatable electrode with the contacting surface at the periphery through which welding current and force are applied to the workpieces. See **resistance welding electrode**.

circulating current. Undesired flow of electric current between two different power sources.

circumferential seam welding machine, *resistance seam welding*. A machine configuration in which the rotational axis of the electrode(s) is parallel to the axis of the welding machine throat. See also **longitudinal seam welding machine** and **universal seam welding machine**.

clad brazing sheet. A metal sheet on which one or both sides are clad with brazing filler metal. See also **clad metal**.

clad metal. A laminar composite consisting of a metal or alloy, with a metal or alloy of different chemical composition applied to one or more sides by casting, drawing, rolling, surfacing, chemical deposition, or electroplating.

cladding. A surfacing variation primarily used to improve corrosion or heat resistance. See also **buildup**, **buttering**, and **hardfacing**.

cluster porosity. A localized array of porosity having a random geometric distribution.

CO_2 welding. A nonstandard term when used for **flux cored arc welding** or **gas metal arc welding** with carbon dioxide shielding gas.

coalescence. The growing together or growth into one body of the materials being joined.

coated electrode. A nonstandard term for **covered electrode** or **lightly coated electrode**.

coating. A nonstandard term when used for **thermal spray deposit**.

coating density. A nonstandard term when used for **spray deposit density ratio**.

coextrusion welding (CEW). A solid-state welding process producing a weld by heating to the welding temperature and forcing the workpieces through an extrusion die.

coil with support. A filler metal packaging configuration in which the wire or strip is wound around a cylinder without flanges. See Figure B42(B). See also **coil without support** and **spool**.

coil without support. A filler metal packaging configuration in which the wire is coiled without an internal support and appropriately bound to maintain its shape. See also **coil with support** and **spool**.

cold brazed joint. A brazed joint with incomplete metallic bonding due to insufficient heating of the base material during brazing.

cold crack. A crack occurring in a metal at or near ambient temperatures. Cold cracks can occur in base metal (BMZ), heat-affected (HAZ), and weld metal zones (WMZ). See also **hot crack**.

cold lap. A nonstandard term when used for **incomplete fusion** or **overlap**, *fusion welding*.

cold soldered joint. A soldered joint with incomplete metallic bonding due to improper soldering conditions or procedures.

cold welding (CW). A solid-state welding process in which pressure is used to produce a weld at room temperature with substantial deformation at the weld. See also **diffusion welding**, **forge welding**, and **hot pressure welding**.

cold wire welding. A fusion welding process variation in which an unheated filler metal wire is fed into the weld pool. See also **hot wire welding**.

collar. The reinforcing metal of a nonpressure thermite weld.

collaring, *thermal spraying*. Adding a shoulder to a shaft or similar component as a protective confining wall for the thermal spray deposit. See Figures B43(A) and B43(B).

collet, *gas tungsten arc welding*, *plasma arc cutting*, *plasma arc welding*, and *thermal spraying*. A mechanical clamping device used to hold the electrode in position within the welding, cutting, or spraying torch. See Figure B36.

commutator-controlled welding. A resistance spot or projection welding variation in which multiple welds are produced sequentially as controlled by a commutating device activated when the contactor is closed.

companion panel. A nonstandard term when used for **spray tab**.

complete fusion. Fusion over the entire fusion faces and between all adjoining weld beads. See Figure B28. See also **incomplete fusion**.

complete joint penetration (CJP). A groove weld condition in which weld metal extends through the joint thickness. See Figure B26. See also **complete joint penetration weld**, **incomplete joint penetration**, **joint penetration**, and **partial joint penetration weld**.

complete joint penetration weld. A groove weld in which weld metal extends through the joint thickness. See Figures B26(F) and B26(G). See also **complete joint penetration**, **incomplete joint penetration**, **joint penetration**, and **partial joint penetration weld**.

complete joint penetration groove weld. See **complete joint penetration weld**.

composite. A material consisting of two or more discrete materials with each material retaining its physical identity. See also **clad metal**, **composite electrode**, and **composite thermal spray deposit**.

composite electrode. A generic term for multicomponent filler metal electrodes in various physical forms such as stranded wires, tubes, and covered wire. See also **covered electrode**, **flux cored electrode**, **metal cored electrode**, and **stranded electrode**.

composite thermal spray deposit. A thermal spray deposit made with two or more dissimilar surfacing materials that may be formed in layers.

concave fillet weld. A fillet weld having a concave face. See Figure B25(B).

concave root surface. The configuration of a groove weld exhibiting underfill at the root surface. See Figure B27(F).

concavity. The maximum distance from the face of a concave fillet weld perpendicular to a line joining the weld toes. See Figure B25(B).

concurrent heating. The application of supplemental heat to a structure during welding or cutting.

cone. See **inner cone**.

connection. A nonstandard term when used for a welded, brazed, or soldered **joint**.

constant current power source. An arc welding power source with a volt-ampere relationship yielding a small welding current change from a large arc voltage change. See also **welding power source**.

constant voltage power source. An arc welding power source with a volt-ampere relationship yielding a large welding current change from a small arc voltage change. See also **welding power source**.

constant voltage short circuiting transfer, *gas metal arc welding*. Short circuiting transfer accomplished using a power source with constant voltage output. See Figures B39(B) and B39(D). See also **short circuiting transfer**.

constant voltage spray transfer, *gas metal arc welding*. Spray transfer accomplished using a power source with constant voltage output. See Figures B39(C) and B39(D). See also **spray transfer**.

constricted arc. A plasma arc column shaped by the constricting orifice in the nozzle of the plasma arc torch or plasma spraying torch.

constricting nozzle. A device at the exit end of a plasma arc torch or plasma spraying torch, containing the constricting orifice. See Figure B35.

constricting orifice. The hole in the constricting nozzle of the plasma arc torch or plasma spraying torch through which the arc plasma passes. See Figure B35.

constricting orifice diameter. See Figure B35.

constricting orifice length. See Figure B35.

consumable electrode. An electrode providing filler metal. See also **nonconsumable electrode**.

consumable guide, *electroslag welding*. A current-carrying member used to guide the electrode to the molten conductive slag. See Figure B37(B).

consumable guide electroslag welding (ESW-CG). An electroslag welding process variation incorporating a guiding member extending the full length of the joint to conduct electricity, direct the electrode, provide filler metal, and sometimes contribute flux to the molten slag bath. See Figure B37(B).

consumable insert. Filler metal placed at the joint root before welding, and intended to be completely fused into the joint root to become part of the weld. See Figure B13(E).

contact resistance, *resistance welding*. Resistance to the flow of electric current through faying surfaces of workpieces, an electrode and workpiece, or mating surfaces of components in the secondary circuit.

contact tip. A tubular component of an arc welding gun or arc spraying torch delivering welding current to, and guiding, a continuous electrode. See Figures B38, B39(A), and B39(C).

contact tip setback, *flux cored arc welding* and *gas metal arc welding*. The distance from the contact tip to the end of the gas nozzle. See Figure B38(A). See also **electrode setback**.

contact tip-to-work distance (CTWD). In continuously-fed electrode arc welding processes, the axial distance from the end of the contact tip to the workpiece. See also **arc length**. See Figure B38(A).

contact tube. A nonstandard term when used for **contact tip**.

contact tube setback. A nonstandard term when used for **contact tip setback**.

continuous feed. A nonstandard term when used for **melt-in feed**.

continuous sequence. A longitudinal sequence in which each weld bead is made continuously from one end of the joint to the other. See also **backstep sequence**, **block sequence**, and **cascade sequence**.

continuous wave laser. A laser having an uninterrupted output operating with a period exceeding 25 milliseconds. See also **pulsed laser**.

continuous weld. A weld extending completely from one end of a joint to the other. Where the joint is essentially circular, it extends completely around the joint. See also **intermittent weld**.

controlled atmosphere brazing (B-CA). Brazing performed in an oven or furnace where the composition of the atmosphere is controlled. This includes vacuum and partial-pressure vacuum with controlled inert gas content.

controlled deposition technique. A variation of a temper bead sequence in which the order, position, and size are controlled to obtain desired heat-affected zone properties.

controlled waveform welding. A nonstandard term when used for **waveform-controlled welding**.

convex fillet weld. A fillet weld having a convex weld face. See Figure B25(A).

convex root surface. The configuration of a groove weld exhibiting root reinforcement at the root surface. See Figure B27(E).

convexity. The maximum distance from the face of a convex fillet weld perpendicular to a line joining the weld toes. See Figure B25(A).

cool time, *resistance welding*. Any interval between squeeze time and hold time when no resistance welding current is being conducted. See Figure B49.

copper brazing. A nonstandard term when used for brazing with a copper-based **brazing filler metal**.

cord, *thermal spraying*. Surfacing material in the form of a plastic tube filled with powder extruded to a compact, flexible cord with characteristics similar to a wire.

cored solder. A nonstandard term for **flux cored soldering filler metal**.

corner-flange weld. A nonstandard term when used for an **edge weld** in a **flanged corner joint**.

corner joint. A joint type formed by butting or nonbutting ends of one or more workpieces converging approximately perpendicular to one another. See Figures B1(B), B2(B), B10(C), and B10(E). See also **skewed joint**.

corona, *resistance welding*. The region of a resistance weld where joining is the result of solid-state welding.

corrective lens. A lens ground to the wearer's individual corrective prescription.

corrosive flux*, brazing* and *soldering*. A flux with a residue chemically attacking the base metal. It may be composed of inorganic salts and acids, organic salts and acids, or activated rosin.

cosmetic bead. A weld bead used to enhance appearance. See also **cover bead**, **intermediate bead**, and **smoothing bead**.

cosmetic pass. A weld pass resulting in a cosmetic bead. See also **cover pass**, **intermediate pass**, and **smoothing pass**.

coupon. A prepared material or substrate used to produce a welding, brazing, soldering, or thermal spraying **test coupon**.

cover bead. A weld bead resulting from a cover pass. See also **cosmetic bead**, **intermediate bead**, and **smoothing bead**.

cover lens. A nonstandard term for a **cover plate**.

cover pass. A weld pass or passes resulting in the exposed layer of a multipass weld on the side from which welding was done. See also **cosmetic pass**, **intermediate pass**, and **smoothing pass**.

cover plate. A removable pane of colorless glass, plastic-coated glass, or plastic covering the filter plate and protecting it from weld spatter, pitting, or scratching.

covered electrode. A composite filler metal electrode consisting of a bare or metal cored electrode with a flux covering sufficient to provide a slag layer and/or alloying elements. See also **lightly coated electrode**.

crack. A fracture-type discontinuity characterized by a sharp tip and high ratio of length and width to opening displacement. See Figure B33.

crater. A depression in the weld face at the termination of a weld bead.

crater crack. A crack initiated and localized within a crater. See Figure B33.

crater fill current. The welding current value during crater fill time. See Figure B54.

crater fill time. The time interval following weld time but prior to meltback time during which arc voltage or current reach a preset value greater or less than welding values. Progression of welding may or may not stop at this point. See Figure B54.

crater fill voltage. The arc voltage value during crater fill time. See Figure B54.

cross-sectional sequence. The order in which the weld passes of a multiple-pass weld are made with respect to the cross section of the weld. See Figures B23(B)–(E). See also **block sequence**, **cascade sequence**, and **continuous sequence**.

cross wire welding. A projection welding joint design in which the localization of the welding current and force is achieved by the contact of intersecting wires.

crushed slag. A nonstandard term when used for **recycled slag**.

cup. A nonstandard term when used for **gas nozzle**.

cutter. See **thermal cutter**. See also **oxygen cutting operator**.

cutting. See **thermal cutting**.

cutting attachment. A device for converting an oxyfuel gas welding torch into an oxyfuel gas cutting torch.

cutting blowpipe. A nonstandard term for **oxyfuel gas cutting torch**.

cutting electrode. A nonfiller metal electrode used in arc cutting. See also **carbon electrode**, **metal electrode**, and **tungsten electrode**.

cutting head. The part of a cutting machine in which a cutting torch or tip is incorporated.

cutting nozzle. A nonstandard term for **cutting tip**.

cutting operator. See **thermal cutting operator**. See also **oxygen cutter**.

cutting tip. The part of an oxyfuel gas cutting torch from which the gases issue. See Figure B41.

cutting torch. See **air carbon arc cutting torch**, **gas tungsten arc cutting torch**, **oxyfuel gas cutting torch**, and **plasma arc cutting torch**.

cycle, *resistance welding*. The interval of one input power waveform period.

cylinder. See **gas cylinder**.

cylinder manifold. A header for interconnection of multiple gas sources with distribution points.

D

defect. A discontinuity or discontinuities which, by nature or accumulated effect, render(s) a part or product unable to meet applicable standards or specifications. See also **discontinuity** and **flaw**.

delamination. The separation of a lamination under stress.

delayed crack. A nonstandard term when used for **cold crack**, **hydrogen-induced crack**, or **underbead crack**.

deposit. A nonstandard term when used for **thermal spray deposit**. See Annex C, C1.5.8.

deposit sequence. A nonstandard term when used for **weld pass sequence**.

deposited metal, *brazing*, *soldering*, and *welding*. Filler metal added during brazing, soldering or welding.

deposited metal, *surfacing*. Surfacing metal added during surfacing.

deposition efficiency. See **arc welding deposition efficiency** and **thermal spraying deposition efficiency**.

deposition rate. The weight of material deposited in a unit of time.

deposition sequence. A nonstandard term when used for **weld pass sequence**.

depth of bevel. See **bevel depth**.

depth of fusion. See **fusion depth**.

depth of groove. See **groove depth**.

design effective throat, *structural welding*. The minimum calculated weld dimension necessary to withstand applied loads considering loading type, direction, and magnitude when using a filler metal of a specified minimum allowable strength. Based on this determination, the required size of fillet weld or partial joint penetration groove weld with reinforcing fillet weld can be specified. See also **effective throat**.

detonation flame spraying. A thermal spraying process variation in which the controlled explosion of a mixture of fuel gas, oxygen, and powdered surfacing material is utilized to melt and propel the surfacing material to the substrate.

die. A nonstandard term when used for **resistance welding die**.

die welding. A nonstandard term when used for **cold welding** and **forge welding**.

diffusion, *plastic welding*. The process of polymer chain migration across a melt interface.

diffusion aid. A solid filler metal applied to the faying surfaces to assist in diffusion welding.

diffusion bonding. A nonstandard term for **diffusion brazing** and **diffusion welding**.

diffusion brazing (DFB). A brazing process wherein a brazing filler metal or an in situ liquid phase diffuses with the base material(s) to produce joint properties approaching those of the base material(s). Pressure may or may not be applied. See Figures A1 and A6. See Tables A1, A2, and A3.

diffusion welding (DFW). A solid-state welding process producing a weld by the application of pressure at elevated temperature with no macroscopic deformation or relative motion of the workpieces. A diffusion aid may be inserted between the faying surfaces. See also **cold welding**, **forge welding**, and **hot pressure welding**. See Annex C, C1.5.2.

dilution. The change in chemical composition of a welding filler metal caused by the admixture of the base metal or previous weld metal in the weld bead. See also **percent dilution**.

dilution ratio. See **percent dilution**.

dip brazing (DB). A brazing process using heat from a molten bath. See also **chemical-bath dip brazing**, **metal-bath dip brazing**, and **salt-bath dip brazing**.

dip feed, *gas tungsten arc welding*, *oxyfuel gas welding*, and *plasma arc welding*. A process variation in which filler metal is intermittently fed into the leading edge of the weld pool.

dip soldering (DS). A soldering process using heat from a metal, oil, or salt bath in which it is immersed. See **metal-bath dip soldering**, **oil-bath dip soldering**, and **salt-bath dip soldering**. See also **wave soldering**.

dip transfer. A nonstandard term when used for **dip feed** or **short circuiting transfer**.

direct current electrode negative (DCEN). The arrangement of direct current arc welding leads in which the electrode is the negative pole and workpiece is the positive pole of the welding arc. See Figure B34(B).

direct current electrode positive (DCEP). The arrangement of direct current arc welding leads in which the electrode is the positive pole and the workpiece is the negative pole of the welding arc. See Figure B34(A).

direct current reverse polarity. A nonstandard term for **direct current electrode positive**.

direct current straight polarity. A nonstandard term for **direct current electrode negative**.

direct drive friction welding (FRW-DD). A variation of friction welding in which the energy required to make the weld is supplied to the welding machine through a direct motor connection for a preset period of the welding cycle. See Figure B45. See also **inertia friction welding**.

direct resistance welding. A secondary circuit configuration in which welding current and force are applied to workpieces by directly opposed electrodes. See Figures B48(A)–(C). See also **indirect resistance welding**.

discontinuity. An interruption of the typical structure of a material, such as a lack of homogeneity in its mechanical, metallurgical, or physical characteristics. A discontinuity is not necessarily a defect. See also **defect** and **flaw**.

dissolution, *brazing.* Dissolving of base material into filler metal or filler metal into base material.

double arcing. A condition in which the welding or cutting arc of a plasma arc torch does not pass through the constricting orifice but transfers to the inside surface of the nozzle. A secondary arc is simultaneously established between the outside surface of the nozzle and the workpiece.

double-bevel edge shape. A type of bevel edge shape having two prepared surfaces adjacent to opposite sides of the material. See Figure B7(C).

double-bevel groove. A double-sided weld groove formed by the combination of a butting workpiece having a double-bevel edge shape abutting a planar surface of a companion member. See Figure B9(B).

double-bevel-groove weld. A weld in a double-bevel-groove welded from both sides. See Figure B9(B).

double-flare-bevel groove. A double-sided weld groove formed by the combination of a butting workpiece having a round edge shape and a planar surface of a companion member. See Figure B9(F).

double-flare-bevel-groove weld. A weld in a double-flare-bevel groove welded from both sides. See Figure B9(F).

double-flare-V groove. A double-sided weld groove formed by the combination of butting workpieces having round edge shapes. See Figure B9(G).

double-flare-V-groove weld. A weld in a double-flare-V-groove welded from both sides. See Figure B9(G).

double-groove weld, *fusion welding*. A groove weld made from both sides. See Figures B9, B24(C), and B24(D).

double-J edge shape. A type of edge shape having two prepared surfaces adjacent to opposite sides of the material. See Figure B7(E).

double-J groove. A double-sided weld groove formed by the combination of a butting workpiece having a double-J edge shape abutting a planar surface of a companion member. See Figure B9(D).

double-J-groove weld. A weld in a double-J groove welded from both sides. See Figure B9(D).

double-spliced butt joint. See **spliced joint**. See Figure B3(B).

double-square-groove weld. A weld in a square groove welded from both sides. See Figure B9(A).

double-U groove. A double-sided weld groove formed by the combination of butting workpieces having double-J edge shapes. See Figure B9(E).

double-U-groove weld. A weld in a double-U groove welded from both sides. See Figure B9(E).

double-V groove. A double-sided weld groove formed by the combination of butting workpieces having double-bevel edge shapes. See Figure B9(C).

double-V-groove weld. A weld in a double-V groove welded from both sides. See Figure B9(C).

double-welded joint, *fusion welding*. A joint welded from both sides. See Figures B9, B24(C), and B24(D).

dovetailing, *thermal spraying*. A method of surface roughening involving angular undercutting to interlock the thermal spray deposit. See Figure B43(C).

downhand. A nonstandard term for **flat welding position**.

downhill, *adv*. Welding with a downward progression.

downslope time. The interval during which the welding current or power is continuously decreased. See Figures B49 and B53.

drag, *thermal cutting*. The offset distance between the actual and straight line exit points of the gas stream or cutting beam measured on the exit surface of the base metal. See Figure B41.

drag angle. The travel angle when the electrode is pointing in a direction opposite to the progression of welding. This angle can also be used to partially define the orientation of guns, torches, rods, and beams. See Figure B21. See also **backhand welding**, **push angle**, **travel angle**, and **work angle**.

drop-through, *brazing*. An undesirable sagging or surface irregularity, usually encountered near the solidus of the base metal.

drop-through, *welding*. A nonstandard term for **root reinforcement**.

dross, *thermal cutting*. The remaining solidified, oxidized metallic material adhering to the workpiece adjacent to the cut surface.

drum. A cylindrical package used to contain a continuous length of wound or coiled filler metal or surfacing material wire.

dry chamber welding. A variation of underwater welding performed in a hyperbaric chamber fitted over the joint. Water is displaced from the chamber by a gas, resulting in a dry environment for welding.

dry welding. A variation of underwater welding in which water is excluded from the immediate vicinity of the joint by physical means. See also **wet welding**.

duty cycle. During a specified test period, the percentage of time a power source or its accessories can be operated at rated output without experiencing thermal overload. Test periods for arc welding and resistance welding are commonly ten (10) minutes and one (1) minute, respectively.

dwell time, *thermal spraying*. The length of time the surfacing material is exposed to the heat zone of the thermal spraying torch.

dwell time, *welding*. The time during which the energy source pauses at any point in each oscillation.

dye penetrant testing. See **penetrant testing (PT)**.

dynamic electrode force, *resistance welding.* The actual force applied to the workpieces by the electrodes during welding. See also **electrode force**, **static electrode force**, and **theoretical electrode force**.

E

eddy current testing (ET), *nondestructive examination*. The use of induced electric currents and magnetic fields in a test object for determination of material properties or detection of discontinuities.

edge effect, *thermal spraying*. Loosening of the bond between the thermal spray deposit and the substrate at the edge of the thermal spray deposit.

edge-flange weld. A nonstandard term for an **edge weld** in a **flanged butt joint**.

edge joint. See **parallel joint**.

edge loss, *thermal spraying*. Thermal spray deposit lost as overspray beyond the edge of the workpiece.

edge preparation. The preparation of the edges of the joint members, by cutting, cleaning, plating, or other means.

edge preparation. A nonstandard term when used for **edge shape**.

edge shape. The shape of the edge of the joint member. See Figure B7.

edge weld. A weld in a flanged butt, flanged corner, or parallel joint in which the full thicknesses of the workpiece ends are fused. See Figures B10(A)—(C), B13(A), and B25(H).

edge weld size. The weld metal thickness measured from the weld root. See Figure B25(H).

effective fillet weld size. Reduced size due to the presence of a fitup irregularity such as a root opening. See Figure B25(D).

effective throat. The minimum distance from the fillet weld face, minus any convexity, to the weld root. In the case of a fillet weld combined with a partial joint penetration groove weld, the weld root of the groove weld is used. See Figures B25(A)–(D) and B25(I). See also **actual throat**, **design effective throat**, and **theoretical throat**.

electric arc spraying. A nonstandard term for **arc spraying**.

electric bonding. A nonstandard term when used for **surfacing** by thermal spraying.

electric brazing. A nonstandard term for **arc brazing** and **resistance brazing**.

electrode. A component of the welding circuit terminating at the arc, molten conductive slag, or base metal. See **consumable electrode**, **consumable guide**, **cutting electrode**, **nonconsumable electrode**, **resistance welding electrode**, **tungsten electrode**, and **welding electrode**.

electrode adapter, *resistance welding*. A device used to attach an electrode or electrode cap to an electrode holder.

electrode cap. A replaceable electrode adapter tip used for resistance spot welding.

electrode cap extractor. A tool used to facilitate removal of an electrode cap from an electrode adapter or electrode holder.

electrode extension, *carbon arc cutting* and *carbon arc gouging*. The length of electrode extending beyond the electrode holder or cutting torch.

electrode extension, *flux cored arc welding*, *electrogas welding*, *gas metal arc welding*, and *submerged arc welding*. The length of electrode extending beyond the end of the contact tip. See Figure B38. See also **stickout**.

electrode extension, *gas tungsten arc welding* and *plasma arc welding*. The length of tungsten electrode extending beyond the end of the collet. See Figure B36. See also **stickout**.

electrode face, *resistance welding*. The surface of a resistance welding electrode contacting the workpiece.

electrode force, *resistance welding*. The force applied by the electrodes to the workpieces in making spot, seam, or projection welds. See also **dynamic electrode force**, **static electrode force**, and **theoretical electrode force**.

electrode gap. A nonstandard term for **arc length**.

electrode holder. A device used for mechanically holding and conducting welding current to an electrode or electrode adapter.

electrode indentation, *resistance welding*. A depression in the surface of a weldment formed by an electrode during welding.

electrode lead. A secondary circuit conductor transmitting energy from the power source to the electrode holder, gun, or torch**.** See Figures B34, B36, and B37(B).

electrode life, *resistance welding*. The endurance of a welding electrode between initial use and required servicing or replacement.

electrode mushrooming, *resistance welding*. The enlargement of the electrode face due to the heat and pressure of welding.

electrode pickup, *resistance welding.* Contamination of the electrode by the base metal or its coating during welding.

electrode setback. The distance the electrode is recessed behind the constricting orifice of the plasma arc torch or thermal spraying torch, measured from the outer face of the constricting nozzle. See Figure B35. See also **contact tip setback**.

electrode skid. A surface discontinuity resulting from electrode skidding.

electrode skidding, *resistance welding*. The transverse movement of the electrode with respect to the workpiece resulting from the application of electrode force.

electrode tip. A nonstandard term when used for **electrode cap** or **electrode face**.

electrofusion welding (EFW), *thermoplastics*. A welding process using heat from an electrically energized resistive element embedded in the weld zone.

electrogas welding (EGW). An arc welding process using an arc between a continuous filler metal electrode and the weld pool, employing approximately vertical welding progression with backing to confine the molten weld metal. The process is used with or without an externally supplied shielding gas and without the application of pressure.

electromagnetic testing. See **eddy current testing**.

electron beam braze welding (EBBW). A braze welding process variation employing a defocused or oscillating electron beam as the heat source. See Figures A1 and A6. See Tables A1, A2, and A3.

electron beam brazing (EBB). A brazing process using heat from a slightly defocused or oscillating electron beam. See Figures A1 and A6. See Tables A1, A2, and A3.

electron beam cutting (EBC). A thermal cutting process severing metals by melting them with the heat from a concentrated beam, composed primarily of high-velocity electrons, impinging on the workpiece.

electron beam cutting operator. See **thermal cutting operator**.

electron beam gun. A device for producing and accelerating electrons. Typical components include the emitter (also called the *filament* or *cathode*) heated to produce electrons via thermionic emission, a cup (also called the grid or grid cup), and the anode.

electron beam gun column. The electron beam gun plus auxiliary mechanical and electrical components that may include beam alignment, focus, and deflection coils.

electron beam welding (EBW). A welding process producing coalescence with a concentrated beam, composed primarily of high-velocity electrons, impinging on the joint. The process is used without shielding gas and without the application of pressure. See also **high vacuum electron beam welding**, **medium vacuum electron beam welding**, and **nonvacuum electron beam welding**.

electroslag welding (ESW). A welding process producing coalescence of metals with a molten slag melting the continuous filler metal electrode and fusion faces while shielding the weld pool which progresses upward along the full cross section of the joint. The conductive slag is kept molten by its resistance to electric current passing between the electrode and the workpieces. See Figure B37. See also **consumable guide electroslag welding**.

elongated porosity. A form of porosity having a length greater than its width lying approximately parallel to the weld axis. See also **piping porosity**.

emissive electrode. A filler metal electrode consisting of a core of a bare electrode or a composite electrode to which a very light coating has been applied to produce a stable arc. See also **lightly covered electrode**.

end dam. See **weld dam**.

end return. A nonstandard term for **boxing**.

erosion, *brazing*. The condition in which the base metal thickness has been reduced by dissolution.

essential variable, *performance qualification*. A parameter deemed critical to the ability of an individual to use or operate a joining process to successfully produce an acceptable test coupon. Changes outside the acceptable range of the applicable qualification standard require requalification of the individual.

essential variable, *procedure qualification*. A joining process parameter deemed critical to production of a test coupon with acceptable properties. Changes outside the acceptable range of the applicable qualification standard require requalification of the procedure.

evaluation, *nondestructive examination*. The process by which a relevant indication is compared with an applicable standard to determine its acceptability.

examination, *nondestructive examination.* The process of direct or indirect assessment of an area of interest for evidence of a discontinuity.

examination method designation. A letter designation incorporated into a nondestructive examination symbol to specify the examination method. For examples and rules for their application, refer to AWS A2.4, *Standard Symbols for Welding, Brazing, and Nondestructive Examination*.

exhaust booth. A mechanically ventilated, semi-enclosed area in which an air flow across the work area is used to remove fumes, gases, and solid particles.

exothermic braze welding (EXBW). A braze welding process variation using an exothermic chemical reaction as heat source with the brazing filler metal provided as a reaction product. See Figures A1 and A6. See Tables A1, A2, and A3.

exothermic brazing (EXB). A brazing process using an exothermic chemical reaction as the heat source for the joint in which the brazing filler metal has been preplaced. See Figures A1 and A6. See Tables A1, A2, and A3.

explosion welding (EXW). A solid-state welding process producing a weld by high velocity impact of the workpieces as the result of a controlled detonation.

expulsion*, resistance welding.* The ejection of molten metal during welding, either at the faying surface or the contact point(s) of the electrode face. See also **surface expulsion**.

expulsion point, *resistance welding*. The threshold of welding current above which expulsion occurs for a given set of welding conditions.

extension, *resistance welding*. The distance the workpiece or electrode projects from a resistance welding die, clamp, chuck, or electrode holder.

extrusion welding (EW), *thermoplastics*. A welding process in which a molten filler material is extruded into a joint, which may or may not be preheated.

F

F-Number. A designation used to group welding filler metals for procedure and performance qualifications based primarily on usability.

face bend test. A mechanical test creating tension in the weld face side by bending the specimen around a tool of a given radius.

face crack. A crack occurring in the weld face. See Figure B33.

face feed, *brazing* and *soldering*. The application of filler metal after the joint has been heated to the brazing temperature.

face of weld. See **weld face**.

face reinforcement. Weld reinforcement on the side of the joint from which welding was done. See Figures B24(A) and B24(C). See also **root reinforcement**.

face shield. A device positioned in front of the eyes and over all or a portion of the face to protect the eyes and face. See also **hand shield** and **welding helmet**.

false indication, *nondestructive examination*. An indication resulting from a condition other than a discontinuity. See also **nonrelevant indication**.

faying surface. The mating surface of a workpiece in contact with or in close proximity to another workpiece to which it is to be joined. See Figure B30(D).

feather. See **acetylene feather**.

feed rate, *thermal spraying*. A nonstandard term for **spraying rate**.

Ferrite Number (FN). A value designating the ferrite content of an austenitic or duplex stainless steel weld metal based on its magnetic properties. Ferrite Number and percent ferrite are not necessarily equivalent.

ferrule, *arc stud welding*. A ceramic device surrounding the stud base to contain the molten metal and shield the arc.

field weld. A weld made at a location other than a shop or the place of initial fabrication.

fill bead. A nonstandard term when used for **intermediate weld bead**.

fill pass. A nonstandard term when used for **intermediate weld pass**.

filler. A metal plate inserted between the splice member and thinner joint member to accommodate joint members of dissimilar thickness in a spliced butt joint. See Figure B3(B).

filler bead. A nonstandard term when used for **intermediate weld bead**.

filler material. The material to be added in making a brazed, soldered, or welded joint. See also **consumable insert**, **filler metal**, **welding rod**, and **welding wire**.

filler metal. The metal or alloy to be added in making a brazed, soldered, or welded joint. See also **brazing filler metal**, **consumable insert**, **diffusion aid**, **filler material**, **filler metal powder**, **soldering filler metal**, **welding electrode**, **welding filler metal**, **welding rod**, and **welding wire**.

filler metal powder. Filler metal in particle form.

filler metal start delay time. The time interval from arc initiation to the start of filler metal feeding. See Figure B54.

filler metal stop delay time. The time delay interval from beginning of downslope time to the stop of filler metal feeding. See Figure B53.

filler pass. A nonstandard term when used for **intermediate weld pass**.

filler wire. A nonstandard term for **welding wire**.

fillet, *brazing* and *soldering*. The radiussed portion of the braze metal or solder metal adjacent to the joint.

fillet weld. A weld of approximately triangular cross section joining two edges in a corner joint, one surface and one edge in a lap joint, or two surfaces in a T-joint.

fillet weld break test. A test in which the specimen is loaded so that the weld root is in tension.

fillet weld leg. The distance from the joint root to the toe of the fillet weld. See Figures B24(E), B25(A), B25(B), and B25(E).

fillet weld size, *equal leg*. The leg length of the largest isosceles right triangle inscribed within the fillet weld cross section. See Figures B25(A) and (B).

fillet weld size, *unequal leg*. The leg lengths of the largest right triangle inscribed within the fillet weld cross section. See Figure B25(E).

fillet weld throat. See **actual throat**, **design effective throat**, **effective throat**, and **theoretical throat**.

filter glass. A nonstandard term for **filter plate**.

filter lens. A nonstandard term for a round **filter plate**.

filter material. An optically transmissive material limiting ultraviolet, infrared, and visible radiation.

filter plate. A rigid **filter material**.

final current. The welding current after downslope but prior to its termination. See Figure B53.

final taper current. The welding current at the end of the taper interval prior to downslope. See Figure B53.

fines. Particles of flux or filler metal having a size smaller than a particular mesh size.

firecracker welding. A shielded metal arc welding process variation employing a length of covered electrode placed along the joint in contact with the workpieces during welding. The stationary electrode is consumed as the arc travels the length of the electrode. This is an obsolete or seldom used process variation. See Table A5.

fisheye. A discontinuity, attributed to the presence of hydrogen in the weld, observed on the fracture surface of a weld in steel consisting of a small pore or inclusion surrounded by an approximately round, bright area.

fit, *v*. The act of bringing together the workpiece(s) in preparation for joining.

fitter. One who fits the workpiece(s) in preparation for joining.

fitup. The as-fit joint geometry.

fixture. A device designed to maintain the fit workpiece(s) in the proper relationship.

flame cutting. A nonstandard term for **oxygen cutting**.

flame propagation rate. The speed at which flame travels through a mixture of gases.

flame sprayer. See **thermal sprayer**. See also **thermal spraying operator**.

flame spraying (FLSP). A thermal spraying process in which an oxyfuel gas flame is the source of heat for melting the surfacing material. Compressed gas may or may not be used for atomizing and propelling the surfacing material to the substrate.

flame spraying operator. See **thermal spraying operator**. See also **thermal sprayer**.

flame. See **carburizing flame**, **neutral flame**, **oxidizing flame**, and **reducing flame**.

flange weld. A nonstandard term for a **weld** in a flanged joint.

flanged butt joint. A form of a butt joint in which at least one of the members has a flanged edge shape at the joint. See Figures B2(A), B10(A), B10(B), B10(D), and B27(D).

flanged corner joint. A form of a corner joint in which the butting workpiece has a flanged edge shape at the joint, and an edge weld is applicable. See Figures B2(B), B10(C), B10(E), and B27(B).

flanged edge joint. See flanged parallel joint.

flanged edge shape. A type of edge shape produced by forming the member. See Figure B7(F).

flanged joint. A form of one of the five basic joint types in which at least one of the joint members has a flanged edge shape at the joint. See Figures B2, B10, B27(B), and B27(D).

flanged lap joint. A form of a lap joint in which at least one of the members has a flanged edge shape at the joint, and an edge weld is not applicable. See Figure B2(D).

flanged parallel joint. A form of a parallel joint in which at least one of the members has a flanged edge shape at the joint. See Figure B2(E).

flanged T-joint. A form of a T-joint in which the butting workpiece has a flanged edge shape at the joint, and an edge weld is not applicable. See Figures B2(C) and B10(F).

flare-bevel-groove weld. A weld in the groove formed between a joint member with a curved surface and another with a planar surface. See Figures B8(H), B9(F), B10(F), and B26(H).

flare-groove weld. A weld in the groove formed between a joint member with a curved surface and another with a planar surface, or between two joint members with curved surfaces. See Figures B8(H), B8(I), B9(F), B9(G), B10(D), and B10(F). See also **flare-bevel-groove weld** and **flare-V-groove weld**.

flare-V-groove weld. A weld in a groove formed by two members with curved surfaces. See Figures B8(I), B9(G), and B10(D).

flash, *arc stud welding*. Metal displaced from the joint beyond the original stud base diameter.

flash, *flash welding*. Molten metal displaced from the joint by expulsion or extrusion.

flash butt welding. A nonstandard term for **flash welding**.

flash coat, *brazing* and *soldering*. A thin metallic coating, usually less than 0.005 mm [0.0002 in] thick, applied to the workpiece(s) to promote joining.

flash time. Period of the flash welding cycle during which flashing action occurs. See Figure B51.

flash welding (FW). A resistance welding process producing a weld at the faying surfaces of butting workpieces by the rapid upsetting of the workpieces after a controlled period of flashing action.

flashback. The recession of the flame through the oxyfuel torch and into the hose, regulator, or gas cylinder, potentially causing an explosion. See also **backfire** and **sustained backfire**.

flashback arrester. A device to limit damage from a flashback by preventing propagation of the flame front beyond the location of the arrester.

flashing action. The phenomenon in flash welding wherein points on the faying surfaces are melted and explosively ejected.

flashover, *electron beam welding*. Undesirable arcing occurring within the electron beam gun.

flat position. See **flat welding position**.

flat position, *brazing*. The position used to braze from the upper side of the joint resulting in the face of the braze being oriented approximately horizontal.

flat welding position. The welding position in which welding is performed from the upper side of a joint or surface in which the weld axis, at the point of welding, is approximately horizontal, and the weld face lies in an approximately horizontal plane. See Figures B16A–B16C, B17(A), B18(A), B19(A), and B20(A).

flaw. An undesirable discontinuity. See also **defect**.

flood cooling, *resistance seam welding*. The application of liquid coolant directly on the workpieces and electrodes.

flood welding. A special application of a high deposition arc welding process using large diameter electrodes, typically used to fill large cavities in dies and castings. Each layer extends over the entire area of the cavity.

flow brazing (FLB). A brazing process using heat from the brazing filler metal poured over the joint. This is an obsolete or seldom used process. See Table A5. See also **flow welding** and **wave soldering**.

flow brightening, *soldering*. Bonding of a soldering filler metal coating on a base metal to improve its finish. See also **precoating**.

flow fusion welding (FFW), *thermoplastics*. A welding process for joining workpieces using a band(s) placed across the joint to resistively heat the constrained weld zone.

flow welding (FLOW). A braze welding process variation using molten filler metal poured over the fusion faces as the heat source. This is an obsolete or seldom used process. See Table A5. See also **flow brazing**.

flowability, *brazing* and *soldering*. The ability of molten filler metal to be drawn into the joint or spread over the surface of the base material.

flux. A material applied to the workpiece(s) before or during joining or surfacing to promote interactions for oxide and other contaminant removal, improve wetting, and affect the final surface profile. Welding flux may also affect the weld metal chemical composition. See also **brazing flux**, **soldering flux**, **and welding flux**.

flux coated rod, *brazing.* Brazing filler metal rod coated with flux.

flux cored arc welding (FCAW). An arc welding process using an arc between a continuous filler metal electrode and the weld pool. The process is used with shielding gas from a flux contained within the tubular electrode, with or without additional shielding from an externally supplied gas, and without the application of pressure. See also **flux cored electrode**, **gas-shielded flux cored arc welding**, and **self-shielded flux cored arc welding**.

flux cored electrode. A composite tubular filler metal electrode consisting of a metal sheath and a core of various powdered materials, producing an extensive slag cover on the face of a weld bead.

flux cored soldering filler metal. A form of filler metal containing a flux. See also **acid cored soldering filler metal** and **rosin cored soldering filler metal**.

flux cover, *metal-bath dip brazing* and *dip soldering*. A layer of molten flux over the molten filler metal bath.

flux cutting (OC-F). An oxygen cutting process using heat from an oxyfuel gas flame, with a flux in the flame to aid cutting.

flux oxygen cutting. A nonstandard term for **flux cutting**.

focal point. A nonstandard term for **focal spot**.

focal spot. In a high energy beam, the location having the smallest cross-sectional area, and consequently, the highest energy density.

follow-up, *resistance welding*. The ability of the moveable electrode to maintain specified electrode force and contact with the workpiece as metal movement occurs.

forehand welding. A welding technique in which the travel angle of a welding torch or gun is directed toward the progression of welding. See Figure B21. See also **backhand welding**, **push angle**, **travel angle**, and **work angle**.

forge-delay time, *resistance welding*. The duration between a preselected point in the welding cycle and the initiation of the forging force. See Figure B49.

forge force. A compressive force applied to the weld, causing plastic deformation.

forge welding (FOW). A solid-state welding process producing a weld by heating the workpieces to the welding temperature and applying sufficient blows to cause permanent deformation at the faying surfaces. See also **cold welding**, **diffusion welding**, and **hot pressure welding**.

forging speed, *friction welding*. The relative velocity of the workpieces at the instant the forge force is applied.

freezing point. A nonstandard term when used for **liquidus** and **solidus**.

friction soldering. A nonstandard term for **abrasion soldering**.

friction speed, *friction welding*. The relative velocity of the workpieces at the time of initial contact. See Figures B44 and B45.

friction stir welding (FSW). A variation of friction welding producing a weld by the friction heating and plastic material displacement caused by a rapidly rotating tool traversing the joint. See Figure B46.

friction upset distance. The decrease in length of workpieces during the time of friction welding force application. See Figures B44 and B45.

friction welding (FRW). A solid-state welding process producing a weld under the compressive force contact of workpieces rotating or moving relative to one another to produce heat and plastically displace material from the faying surfaces. See Figures B31(D), B44, and B45. See also **direct drive friction welding**, **friction stir welding**, and **inertia friction welding**.

friction welding force. The compressive force applied to the faying surfaces during the time there is relative movement between the workpieces from the start of welding until the application of the forge force. See Figures B44 and B45.

fuel gas. A gas, when mixed with air or oxygen and ignited, producing heat for cutting, joining, or thermal spraying.

full penetration. A nonstandard term for **complete joint penetration**.

furnace brazing (FB). A brazing process in which assemblies are heated to the brazing temperature in a furnace.

furnace soldering (FS). A soldering process using heat from a furnace or oven.

fused flux, *submerged arc welding.* A granular flux produced by mixing the ingredients followed by melting, cooling to the solid state and processing to produce the desired particle size. See also **agglomerated flux** and **bonded flux**.

fused thermal spray deposit. A self-fluxing thermal spray deposit subsequently heated to coalescence within itself and with the substrate using the spray-fuse thermal spraying technique.

fused zone. A nonstandard term for **fusion zone**.

fusing. A nonstandard term for **fusion**.

fusion, *fusion welding*. The melting together of filler metal and base metal, or of base metal only, to produce a weld. See also **fusion depth**.

fusion face. A surface of the base metal melted during welding. See Figure B30(A)−(D).

fusion depth. The distance fusion extends into the base metal or previous bead from the surface melted during welding. See Figure B30(A)−(D). See also **joint penetration**.

fusion line. A nonstandard term for **weld interface**.

fusion welding. Any welding process using fusion of the base metal to make the weld. See Figures A1, A3, A4, and A7.

fusion zone. The area of base metal melted as determined on the cross section of a weld. See Figure B30.

G

gap. A nonstandard term when used for **arc length**, **joint clearance**, or **root opening**.

gas brazing. A nonstandard term for **torch brazing**.

gas carbon arc welding (CAW-G). A carbon arc welding process variation employing a shielding gas. This is an obsolete or seldom used process. See Table A5.

gas cup. A nonstandard term for **gas nozzle**.

gas cutter. A nonstandard term for **oxygen cutter**.

gas cutting. A nonstandard term for **oxygen cutting**.

gas cylinder. A portable container used for transportation and storage of compressed gas.

gas generator. Equipment producing a gas for joining or cutting.

gas gouging. A nonstandard term for **oxygen gouging**.

gas laser. A laser in which the lasing medium is a gas.

gas lens. One or more fine mesh screens located in the gas nozzle to produce a stable stream of shielding gas. This device is primarily used for gas tungsten arc welding.

gas metal arc cutting (GMAC). An arc cutting process employing a continuous consumable electrode and a shielding gas.

gas metal arc welding (GMAW). An arc welding process using an arc between a continuously fed consumable electrode and the weld pool. The process is used with shielding from an externally supplied gas and without the application of pressure. See Figures B38(A) and B39. See also **pulsed gas metal arc welding** and **short circuiting gas metal arc welding**. See Annex C, C1.5.3.

gas nozzle. A device at the exit end of the torch or gun for directing shielding gas. See Figures B35, B36, B38(A), B39(A), and B39(C).

gas pocket. A nonstandard term for **porosity**.

gas regulator. A device for controlling the delivery of gas at some substantially constant pressure.

gas-shielded arc welding. A group of processes including **electrogas welding**, **flux cored arc welding**, **gas metal arc welding**, **gas tungsten arc welding**, and **plasma arc welding**.

gas-shielded flux cored arc welding (FCAW-G). A flux cored arc welding process variation in which shielding gas is supplied through the gas nozzle in addition to that obtained from the flux within the electrode.

gas torch. A nonstandard term when used for **blowpipe**, **cutting torch**, and **welding torch**.

gas tungsten arc cutting (GTAC). An arc cutting process employing a single tungsten electrode with gas shielding.

gas tungsten arc cutting torch. A device used to transfer electric current to a fixed cutting electrode, position the electrode, and direct the flow of shielding gas.

gas tungsten arc welding (GTAW). An arc welding process using an arc between a tungsten electrode (nonconsumable) and the weld pool. The process is used with shielding gas and without the application of pressure. See also **hot wire welding** and **pulsed gas tungsten arc welding**. See Figure B36. See Annex C, C1.5.3.

gas tungsten arc welding torch. A device used to transfer welding current to a fixed welding electrode, position the electrode, and direct the flow of shielding gas. See Figure B36.

gas welding. A nonstandard term for **oxyfuel gas welding**.

getter. A material, such as hot titanium or zirconium, used to purify vacuum or inert gas atmospheres by absorbing or reacting with impurities.

globular arc. A nonstandard term for **globular transfer**.

globular transfer, *gas metal arc welding*. The metal transfer mode in which large drops of molten metal move from the consumable electrode across the arc to the weld pool. See Figure B39(A) and Figure B39(D). See also **short circuiting transfer** and **spray transfer**.

goggles. Protective glasses equipped with filter plates set in a frame fitting snugly against the face and used primarily with oxyfuel gas processes.

gouging. See **thermal gouging**.

governing metal thickness, *resistance welding*. The workpiece thickness on which the required weld nugget size and depth of fusion are based.

gradated thermal spray deposit. A composite thermal spray deposit composed of mixed materials in successive layers progressively changing in composition from the substrate to the surface of the thermal spray deposit.

groove and rotary roughening, *thermal spraying.* A method of surface preparation in which grooves are made and the original surface is roughened and spread. See Figure B43(D). See also **knurling**, **rotary roughening**, and **threading and knurling**.

groove angle. The included angle between the groove faces of a weld groove. See Figures B6(E)—(I), and B6(K). See also **bevel angle**.

groove depth. The perpendicular distance from the base metal surface to the joint root or bottom of the prepared groove. See Figures B6(E)—(H), and B6(J)—(L).

groove face. Any surface in a weld groove prior to welding**.** See Figure B5. See also **bevel face** and **root face**.

groove radius. A nonstandard term when used for **bevel radius**.

groove weld. A weld in a weld groove on a workpiece surface, between workpiece edges, between workpiece surfaces, or between workpiece edges and surfaces. See Figures B8, B9, B17, B19, and B21(A).

groove weld size. The joint penetration of a groove weld. See Figure B26.

ground clamp. A nonstandard and incorrect term for **workpiece connection**.

ground connection. An electrical connection of the welding machine frame to the earth for safety. See Figure B34. See also **workpiece connection** and **workpiece lead**.

ground lead. A nonstandard and incorrect term for **workpiece lead**.

grounding reactor. An electrical component used in an alternating current system to provide a low impedance path for electric current to ground in the event of a short circuit.

guided bend test. A bend test in which a specimen is formed to a given radius. See also **face bend test**, **root bend test**, and **side bend test**.

gun. See **arc cutting gun**, **arc welding gun**, **electron beam gun**, **resistance welding gun**, and **soldering gun**.

H

habitat welding. A variation of **dry chamber welding** in which the joint and welder are fully contained in the same environment so diving dress is not typically required during welding.

half-bead technique. A variation of a temper bead sequence in which the thickness of prior weld bead, or beads, is reduced prior to application of a temper pass.

hammer welding. A nonstandard term for **cold welding** and **forge welding**.

hammering, *resistance spot welding*. Excessive electrode impact on the surface of the workpiece during the welding cycle.

hand shield. A protective device used in arc cutting, arc welding, and thermal spraying, for shielding the eyes, face, and neck. It is equipped with a filter plate and is designed to be held by hand.

hand soldering. A nonstandard term when used for **manual soldering**.

hard solder. A nonstandard term for silver-based **brazing filler metal**.

hard surfacing. A nonstandard term for **hardfacing**.

hardfacing. A surfacing variation used to improve wear resistance. See also **buildup**, **buttering**, and **cladding**.

head. See **cutting head** and **welding head**.

heat-affected zone (HAZ). The portion of base metal whose mechanical properties or microstructure have been altered by the heat of welding, brazing, soldering, or thermal cutting. See Figure B24(G). See also **base metal zone** and **weld metal zone**.

heat-affected zone crack. A crack occurring in the heat-affected zone. See Figure B33.

heat balance. The various material, joint, and welding conditions determining the welding heat pattern in the joint.

heat input (HI). The energy applied to the workpiece during welding. See also **heat input rate**. See Annex C, C1.5.9.

heat input rate (HIR). The heat input per unit length of weld. See also **heat input**. See Annex C, C1.5.9.

heat pattern. The shape of the heat distribution in a material resulting from the application of heat.

heat time, *resistance welding*. See **weld time**.

heat tint. Discoloration of the surface of metal by formation of an oxide film when metal is exposed to an oxygen-containing atmosphere at elevated temperature.

heated tool welding (HTW), *thermoplastics*. A process using a device to heat the faying surfaces to the welding temperature, before the device is withdrawn and the members are forced together.

heating gate. The opening in a thermite mold through which the workpieces are preheated.

heating pattern. A description of the manner in which some heat source is applied for joining, cutting, thermal spraying, preheating, postheating, or thermal forming to produce a heat pattern.

heating torch. A device for directing the heating flame produced by the controlled combustion of fuel gases.

helmet. See **welding helmet**.

hermetically sealed container. A container closed in a manner to provide a nonpermeable barrier to the passage of air or gas in either direction.

high energy beam cutting (HEBC). A group of thermal cutting processes severing or removing material by localized melting, burning, or vaporizing of the workpieces using beams having high energy densities.

high energy beam seam weld. A seam weld made using a high energy beam welding process. See Figure B14(C).

high energy beam spot weld. A spot weld made using a high energy beam welding process. See Figure B14(H).

high energy beam welding (HEBW). A group of welding processes using beams of energy with sufficient density to produce the coalescence of workpieces. The processes are applied with and without the application of pressure and with or without the application of filler metal. See Figure A1.

high-frequency resistance welding. A group of resistance welding process variations using welding current of at least 10 kHz to concentrate the welding heat at the desired location. See Figure B52. See also **high-frequency seam welding**, **high-frequency upset welding**, and **induction welding**.

high-frequency seam welding (RSEW-HF). A resistance seam welding process variation in which welding current of at least 10 kHz is supplied through electrodes into the workpieces. See Figure B52(C). See also **high-frequency resistance welding** and **induction seam welding**.

high-frequency upset welding (UW-HF). An upset welding process variation in which welding current of at least 10 kHz is supplied through electrodes into the workpieces. See Figures B52(A), B52(B), and B52(D). See also **high-frequency resistance welding** and **induction upset welding**.

high-low. A nonstandard term for **joint mismatch**.

high pulse current, *pulsed welding*. The welding current during the high pulse time producing the high heat level. See Figure B53. See also **peak level**.

high pulse time, *pulsed welding*. The duration of the high pulse current. See Figure B53.

high vacuum electron beam welding (EBW-HV). An electron beam welding process variation in which welding is accomplished at a pressure of 10^{-4} to 10^{-1} pascals [approximately 10^{-6} to 10^{-3} torr].

high velocity oxyfuel spraying (HVOF). A thermal spraying process using a high pressure oxyfuel mixture to heat and propel a powdered surfacing material to a substrate.

hold time, *resistance welding*. The interval between the end of the last heat function and the termination of the weld force application signal. See Figures B49 and B50.

hollow bead. A nonstandard term when used for **elongated porosity** occurring in a root bead.

hood. A nonstandard term when used for **welding helmet**.

horizontal fixed position, *pipe*. A nonstandard term when used for **multiple welding position** designated as **5G**.

horizontal position. See **horizontal welding position**.

horizontal rolled position, *pipe*. A nonstandard term when used for the **flat welding position** designated as **1GR**.

horizontal welding position, *fillet weld*. The welding position in which the weld is on the upper side of an approximately horizontal surface and against an approximately vertical surface. See Figures B16B, B18(B), B20(B), and B20(C).

horizontal welding position, *groove weld* and *surfacing weld*. The welding position in which the weld axis, at the point of welding, is approximately horizontal and the weld face lies in an approximately vertical plane. See Figures B16A, B16C, B17(B), and B19(B).

horn, *resistance welding*. An extension of the resistance welding machine arm transmitting electrode force, and which may conduct welding current or support the workpiece.

horn, *ultrasonic welding*. A device used to amplify ultrasonic motion and direct energy into the **workpiece**.

horn spacing. A nonstandard term for **throat height**.

hot crack. A crack occurring in a metal during solidification or at elevated temperatures. Hot cracks can occur in both heat-affected (HAZ) and weld metal zones (WMZ). See also **cold crack**.

hot gas welding (HGW), *thermoplastics*. A welding process using hot gas to heat the workpieces and filler material.

hot isostatic pressure welding (HIPW). A diffusion welding process variation producing coalescence of metals by heating and applying hot inert gas under pressure.

hot pass, *pipe*. A nonstandard term when used for the **weld pass** subsequent to the root pass.

hot pressure welding (HPW). A solid-state welding process producing a weld with heat and application of pressure sufficient to produce macro deformation of the workpieces. See also **cold welding**, **diffusion welding**, and **forge welding**.

hot start current. A brief interval of welding current at arc initiation to stabilize the arc. See Figure B53.

hot wire welding. A fusion welding process variation in which a resistively preheated filler metal is fed into the weld pool. See **cold wire welding**.

hybrid welding. The combination of two or more welding processes applied concurrently to produce a weld.

hydrogen bakeout. Heating a base metal or weldment at elevated temperature to release residual hydrogen.

hydrogen brazing. A nonstandard term when used for **brazing** in a hydrogen atmosphere.

hydrogen-induced crack (HIC). A cold crack caused, in part, by the presence of hydrogen.

hydromatic welding. A nonstandard term for **pressure-controlled resistance welding**.

hyperbaric welding. Welding at pressures in excess of atmospheric pressure. See also **hypobaric welding**, **one-atmosphere welding**, and **underwater welding**.

hypobaric welding. Welding at pressures below atmospheric pressure. See also **hyperbaric welding** and **one-atmosphere welding**.

I

impulse, *resistance welding*. A period of conduction in a frequency converter welding machine consisting of half-cycles of welding current in one polarity.

inclined position. A nonstandard term when used for the **multiple welding position** designated as **6G**.

inclined position with restriction ring. A nonstandard term when used for the **multiple welding position** designated as **6GR**.

included angle. A nonstandard term when used for **groove angle**.

inclusion. Entrapped foreign solid material, such as slag, flux, tungsten, or oxide.

incomplete bond, *adhesive bonding*. A discontinuity in which joining did not occur between the adhesive and a portion of the faying surface.

incomplete bond, *brazing* and *soldering*. A discontinuity in which joining did not occur between the filler metal and a portion of the faying surface.

incomplete coalescence, *solid-state welding*. A weld discontinuity in which complete joining of joint faying surfaces has not been achieved.

incomplete fusion (IF). A weld discontinuity in which fusion did not occur between the weld metal and the fusion faces or the adjoining weld beads. See Figure B29. See also **complete fusion**.

incomplete joint penetration (IJP). A joint root condition in a groove weld in which weld metal does not extend through the joint thickness. See Figure B26. See also **complete joint penetration**, **complete joint penetration weld**, **joint penetration**, and **partial joint penetration weld**.

indentation, *resistance welding.* A nonstandard term for **electrode indentation**.

indication, *nondestructive examination*. A response from a characteristic of a material or a discontinuity in a component being examined. See also **false indication**, **nonrelevant indication**, and **relevant indication**.

indirect resistance welding. A secondary circuit configuration in which the welding current is directed to the weld zone through the workpieces from application points away from the weld zone. See Figures B48(D)–(G). See also **direct resistance welding**.

induction brazing (IB). A brazing process using heat from the resistance of the assembly to the induced electric current.

induction coil. Electrical conductor transmitting high-frequency energy from an induction power source to a metallic workpiece to create localized heating. See Figure B52(E).

induction power source. An electrical device used to convert line frequency into high frequency for induction heating.

induction seam welding (RSEW-I). A resistance seam welding process variation in which high-frequency welding current is induced in the workpieces. See also **high-frequency resistance welding** and **high-frequency seam welding**.

induction soldering (IS). A soldering process in which the heat required is obtained from the resistance of the workpieces to induced electric current.

induction upset welding (UW-I). An upset welding process variation in which high-frequency welding current is induced in the workpieces. See Figure B52(E). See also **high-frequency resistance welding** and **high-frequency upset welding**.

induction welding (IW), *resistance welding*. A welding process using heat from the resistance of the workpieces to the flow of induced high-frequency welding current, with or without the application of pressure. See Figure B52(E).

induction plastic welding (IW-P), *thermoplastics.* A welding process using heat from the inductive heating of a susceptor inserted in the joint and the application of pressure.

induction work coil. The inductor used when welding, brazing, or soldering with induction heating equipment. See Figure B52(E).

industrial robot. An automatically controlled, reprogrammable multipurpose manipulator programmable in three or more axes used in manufacturing applications.

inert gas. A gas providing shielding without significant chemical reaction with base and filler metals. See also **protective atmosphere**.

inert gas metal arc welding. A nonstandard term for **gas metal arc welding**.

inert gas tungsten arc welding. A nonstandard term for **gas tungsten arc welding**.

inertia friction welding (FRW-I). A variation of friction welding in which the energy required to make the weld is supplied primarily by the stored rotational kinetic energy of the welding machine. See Figure B44. See also **direct drive friction welding**.

infrared brazing (IRB). A brazing process using heat from infrared radiation.

infrared radiation. Electromagnetic energy with wavelengths from 770 nanometers to 12,000 nanometers [7,700 Å to 120,000 Å].

infrared soldering (IRS). A soldering process using heat from infrared radiation.

infrared welding (IRW), *thermoplastics*. A welding process using heat from infrared radiation and the application of pressure.

initial current. The electric current after starting, but before establishment of welding current. See Figure B53.

inner cone, *oxyfuel cutting* and *oxyfuel welding*. The conical part of an oxyfuel gas flame adjacent to the cutting or welding tip orifice. See Figure B40.

inspection, *nondestructive examination*. Activities comprising the overall quality control process.

insulating nozzle, s*elf-shielded flux cored arc welding*. A device at the exit end of the welding gun protecting the contact tip from spatter, and possibly increasing the electrode extension with a shorter stickout. See Figure B38(B).

interface. See **braze interface**, **solder interface**, **thermal spray deposit interface**, and **weld interface**.

intergranular penetration. The penetration of liquid metal along the grain boundaries of a base metal.

intermediate flux. A soldering flux with a residue that generally does not attack the base metal. The original composition may be corrosive.

intermediate bead. A weld bead resulting from an intermediate pass. See also **cosmetic bead**, **cover bead**, and **smoothing bead**.

intermediate pass. A single progression of welding along a joint subsequent to the root pass(es) and prior to the cover pass(es). See also **cosmetic pass**, **cover pass**, and **smoothing pass**.

intermittent weld. A weld in which continuity is interrupted by recurring unwelded spaces. See Figures B23(G)–(I). See also **continuous weld**.

interpass temperature, *thermal spraying*. In multipass thermal spraying, the temperature of the thermal spray area between thermal spray passes. See also **preheat temperature**.

interpass temperature, *welding*. In a multipass weld, the temperature of the weld area immediately prior to applying subsequent passes. See also **preheat temperature**.

interpretation, *nondestructive examination*. The process by which an indication is classified as false, nonrelevant, or relevant.

interpulse time, *resistance welding*. The time between successive impulses of welding current within a heat time.

interrupted spot welding. A nonstandard term when used for **multiple-impulse welding**.

iron soldering (INS). A soldering process in which the heat required is obtained from a soldering iron.

J

J-edge shape. An edge shape formed by the combination of a bevel with a bevel radius. See Figures B7(D) and B7(E).

J-groove weld. A groove weld applied to a joint with a J-edge shape. See Figures B8(F) and B9(D).

joining. Any process used for connecting materials. See Figures A1 though A7.

joint. The junction of workpiece(s) before and after joining. See Figures B1 and B2.

joint brazing procedure. A nonstandard term when used for **brazing procedure specification**.

joint buildup sequence. A nonstandard term for **cross-sectional sequence**.

joint clearance, *brazing* and *soldering*. The distance between the faying surfaces prior to joining. See Figure B31(A).

joint design. The specified shape, dimensions, and configuration of the joint. See also **joint geometry**.

joint efficiency. The ratio of the strength of a joint to the strength of the base metal.

joint filler. See **filler**.

joint geometry. The shape, dimensions, and configuration of a joint prior to joining. See also **joint design**.

joint misalignment. See **joint mismatch**.

joint mismatch. Misalignment of members in a butt joint prior to welding. See Figure B13(C). See also **offset**.

joint opening. A nonstandard term for **joint clearance** or **root opening**.

joint penetration. In a groove weld, the distance weld metal extends from the weld face to the weld root, exclusive of weld reinforcement. See Figure B26. See **groove weld size**.

joint recognition. A function of an adaptive control determining changes in joint geometry during welding and directing the welding equipment to take appropriate action. See also **joint tracking** and **weld recognition**.

joint remelt temperature, *brazing* and *soldering*. The temperature to which a brazed or soldered joint must be raised in order to remelt the braze metal or solder metal. The joint remelt temperature may be higher than the original process temperature.

joint root. The 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, a line, or an area. See Figure B4.

joint spacer. A metal part, such as a strip, bar, or ring, inserted in the joint root to serve as a backing and to maintain the root opening during welding. See Figure B24(F).

joint tracking. A function of an adaptive control determining changes in joint location during welding and directing the welding machine to take appropriate action. See also **joint recognition** and **weld recognition**.

joint type. Classification of a joint based upon the relative orientation of the workpieces being joined. See Figures B1 and B2. See **butt joint**, **corner joint**, **parallel joint**, **flanged butt joint**, **flanged corner joint**, **flanged parallel joint**, **flanged lap joint**, **flanged T-joint**, **lap joint**, and **T-joint**. See Annex C, C1.5.7.

joint welding sequence. See **welding sequence**.

K

kerf. The gap produced by a cutting process. See Figure B41.

keyhole welding. A technique in which a concentrated heat source penetrates partially or completely through a workpiece, forming a hole (keyhole) at the leading edge of the weld pool. As the heat source progresses, the molten metal fills in behind the hole to form the weld bead.

keying. A nonstandard term for **mechanical bond**.

kickless welding cable. A flexible water-cooled current carrying element consisting of two sets of parallel, opposing polarity conductors, interleaved to minimize the magnetic field intensity and resulting cable movement.

knee. The supporting structure of the lower arm or platen of a resistance welding machine.

knurling, *thermal spraying*. A method of surface roughening in which the surface is upset with a knurling tool. See also **groove and rotary roughening**, **rotary roughening**, and **threading and knurling**. See Figure B43(E).

L

lack of bond. A nonstandard term for **incomplete bond**.

lack of fusion. A nonstandard term for **incomplete fusion**.

lack of penetration. A nonstandard term for **incomplete joint penetration**.

lamellar tear. A subsurface terrace- or step-like crack in a wrought base metal parallel to the surface caused by tensile stresses in the through-thickness direction. See Figure B33(B).

laminated shunt. A flexible secondary circuit conductor constructed of thin laminations of conductive foil. See also **braided shunt**.

lamination. A type of base metal discontinuity generally aligned parallel to the rolled surface of a metal.

lance. See **oxygen lance** and **oxygen lance cutting**.

land. A nonstandard term for **root face**.

lap joint. A joint type formed by nonbutting ends of one or more workpieces overlapping parallel to one another. See Figures B1(D), B2(D), and B52(C). See also **skewed joint**.

laser beam air cutting (LBC-A). A laser beam cutting process variation melting the workpiece and using an air jet to remove molten and vaporized material.

laser beam braze welding (LBBW). A braze welding process variation using a laser beam as the heat source.

laser beam brazing (LBB). A brazing process using a laser beam as the heat source.

laser beam cutting (LBC). A thermal cutting process severing metal by locally melting or vaporizing it with the heat from a laser beam. The process is used with or without assist gas to aid the removal of molten and vaporized material. See also **laser beam air cutting**, **laser beam evaporative cutting**, **laser beam inert gas cutting**, and **laser beam oxygen cutting**.

laser beam cutting operator. See **thermal cutting operator**.

laser beam diameter. The diameter of a laser beam circular cross section at a specified location along the laser beam axis.

laser beam evaporative cutting (LBC-EV). A laser beam cutting process variation vaporizing the workpiece, with or without an assist gas, typically inert gas, to aid the removal of vaporized material.

laser beam expander. A device employing optical elements to modify the size or shape of the beam.

laser beam inert gas cutting (LBC-IG). A laser beam cutting process variation melting the workpiece and using an inert assist gas to remove molten and vaporized material.

laser beam oxygen cutting (LBC-O). A laser beam cutting process variation using heat from the chemical reaction between oxygen and the base metal at elevated temperatures. The necessary temperature is maintained with a laser beam.

laser beam splitter. An optical device using controlled reflection to produce two beams from a single incident beam.

laser beam welding (LBW). A welding process producing coalescence with the heat from a laser beam impinging on the joint.

lasing gas. A gaseous lasing medium.

lasing medium. A material emitting coherent radiation by virtue of stimulated electronic or molecular transitions to lower energy.

layer. A stratum of weld metal consisting of one or more weld beads. See Figures B23(D) and B23(E).

layer level wound. A nonstandard term for **level wound**.

layer wound. A nonstandard term for **level wound**.

lead angle. A nonstandard term for **travel angle**.

lead burning. A nonstandard term when used for the **welding** of lead.

leaf shunt. A nonstandard term when used for **laminated shunt**.

leak testing (LT). A family of nondestructive examination methods using pressure of a gas or liquid for detection, location, or measurement of leaks.

leg of a fillet weld. See **fillet weld leg**.

level wound. Spooled or coiled filler metal wound in distinct layers with adjacent turns touching. See also **random wound**.

lightly coated electrode, *shielded metal arc welding*. A filler metal electrode consisting of a metal wire with a light coating applied subsequent to the drawing operation, primarily for stabilizing the arc. This is an obsolete or seldom used term. See also **covered electrode**.

linear indication, *nondestructive examination*. An observed indication having a length-to-width ratio of at least 3:1. See also **rounded indication**.

linear porosity. A nonstandard term when used for **aligned porosity**.

liquation. The partial melting of compositional heterogeneities such as banding or inclusion stringers in heated base metal or heat-affected zones.

liquation, *brazing*. The separation of a low-melting constituent of a brazing filler metal from the remaining constituents, usually apparent in brazing filler metals having a wide melting range.

liquid penetrant testing. See **penetrant testing** (PT).

liquidus. The lowest temperature at which a metal is completely liquid.

localized preheating. Preheating a specific portion of a workpiece.

localized stress relief heat treatment. Stress relief heat treatment of a specific portion of a workpiece.

locked-up stress. A nonstandard term for **residual stress**.

long electrode extension, *electrogas welding*, *flux cored arc welding*, *gas metal arc welding*, and *submerged arc welding.* An increased length of electrode extension for the purpose of increasing electrical resistance for enhanced flux activation to provide adequate shielding (FCAW-S) or increased weld deposition rate. See Figure B38(B).

longitudinal bend specimen. See **longitudinal weld test specimen**.

longitudinal crack. A crack approximately parallel to the joint axis or the weld axis. See Figure B33.

longitudinal seam welding machine, *resistance seam welding*. A machine configuration in which the rotational axis of the electrode(s) is perpendicular to the welding machine throat. See also **circumferential seam welding machine** and **universal seam welding machine**.

longitudinal sequence. The order in which the weld passes of a continuous weld are made with respect to its length. See also **backstep sequence**, **block sequence**, **cascade sequence**, **continuous sequence**, and **random sequence**. See Figures B23(A)–(C).

longitudinal tension specimen. See **longitudinal weld test specimen**.

longitudinal weld test specimen. A weld test specimen with its major axis parallel to the weld axis. See also **transverse weld test specimen**.

low pulse current, *pulsed welding*. The welding current during the low pulse time producing the low heat level. See Figure B53. See also **background level**.

low pulse time, *pulsed welding*. The duration of the low pulse current. See Figure B53.

M

M-Number. A designation used to group base metals for procedure and performance qualifications. See AWS B2.1/B2.1M, *Specification for Welding Procedure and Performance Qualification*.

machine, *adj*. A nonstandard term when used for **mechanized**.

machine qualification record (MQR), *additive manufacturing*. A record of the variables used to produce an acceptable standard qualification build and results of tests conducted to verify qualification of an additive manufacturing machine.

machine welding. See **mechanized welding**.

macroetch test. A test in which a specimen is prepared with a fine finish, etched, and examined using no magnification or low magnification.

macroexamination. A metallographic examination in which a surface is examined using no magnification or low magnification.

magnetic particle testing (MT). A nondestructive examination method using applied or residual magnetic fields to detect surface and near-surface discontinuities.

magnetic particle inspection. See **magnetic particle testing**.

magnetically impelled arc welding (MIAW). An arc welding process in which an arc is created between the butted ends of tubes and propelled around the joint by a magnetic field, followed by an upsetting operation.

manifold. See **cylinder manifold**.

manual, *adj*. Pertaining to the method of application where the electrode holder, gun, or torch is held and manipulated by hand. Accessory equipment, such as part motion devices and handheld material feeders may be used. See Table A4. See also **adaptive control**, **automatic**, **mechanized**, **robotic**, and **semiautomatic**.

manual brazing (B-MA). See **manual process**.

manual gun, *resistance welding*. A resistance welding gun configured for manipulation by hand. See also **manual transgun**.

manual process (XXXX-MA). An operation with the torch, gun, or electrode holder held and manipulated by hand. Accessory equipment, such as part motion devices and handheld filler material feeders may be used. Variations of this term are **manual brazing**, **manual soldering**, **manual thermal cutting**, **manual thermal spraying**, and **manual welding**. See Table A4. See also **adaptive control process**, **automatic process**, **mechanized process**, **robotic**, and **semiautomatic process**.

manual soldering (S-MA). See **manual process**.

manual thermal cutting (TC-MA). See **manual process**.

manual thermal spraying (TS-MA). See **manual process**.

manual transgun, *resistance welding*. A transgun configured for manipulation by hand. See also **manual gun**.

manual welding (W-MA). See **manual process**.

mash resistance seam welding. A nonstandard term for **mash seam welding**.

mash seam welding (RSEW-MS). A resistance seam welding process variation producing a solid-state weld using electrodes extending beyond the joint overlap. The resulting joint thickness is less than the original assembled thickness. See Figure B30(G).

mask, *thermal spraying*. A device for protecting a substrate surface from the effects of blasting or adherence of a thermal spray deposit.

mechanical bond, *thermal spraying*. The adherence of a thermal spray deposit to a roughened surface by the mechanism of particle interlocking.

mechanically mixed flux, *submerged arc welding*. A flux produced by intentionally mixing two or more types of fluxes.

mechanized, *adj*. Pertaining to the method of application where the gun or torch is mechanically held and movement of the gun, torch, or workpiece is along a preset path with manual adjustments made by an operator in response to observation of the process. See Table A4. See also **adaptive control**, **automatic**, **manual**, **robotic**, and **semiautomatic**.

mechanized brazing (B-ME). See **mechanized process**.

mechanized process (XXXX-ME). An operation with equipment requiring manual adjustment by an operator in response to visual observation, with the torch, gun, wire guide assembly, or electrode holder held by a mechanical device. See **mechanized brazing**, **mechanized soldering**, **mechanized thermal cutting**, **mechanized thermal spraying**, and **mechanized welding**. See Table A4. See also **adaptive control process**, **automatic process**, **manual process**, **robotic process**, and **semiautomatic process**.

mechanized soldering (S-ME). See **mechanized process**.

mechanized thermal cutting (TC-ME). See **mechanized process**.

mechanized thermal spraying (TS-ME). See **mechanized process**.

mechanized welding (W-ME). See **mechanized process**.

medium-frequency resistance welding. A group of resistance welding process variations using welding current at frequencies above 60 Hz and below 10 kHz to concentrate the welding heat at the desired location. See also **medium-frequency seam welding** and **medium-frequency upset welding**.

medium-frequency seam welding (RSEW-MF). A resistance seam welding process variation in which welding current at frequencies above 60 Hz and below 10 kHz is supplied through electrodes into the workpieces. See also **medium-frequency resistance welding**.

medium-frequency upset welding (UW-MF). An upset welding process variation in which welding current at frequencies above 60 Hz and below 10 kHz is supplied through electrodes into the workpieces. See also **medium-frequency resistance welding**.

medium vacuum electron beam welding (EBW-MV). An electron beam welding process variation in which welding is accomplished at a pressure of 10^{-1} pascal to 3×10^{3} pascal [approximately 10^{-3} torr to 25 torr].

melt-in feed, *gas tungsten arc welding*, *oxyfuel gas welding*, and *plasma arc welding*. A process variation in which filler metal is preplaced or continuously fed into the leading edge of the weld pool.

melt-through. Visible root reinforcement in a joint welded from one side. See also **root reinforcement** and **root surface**. See Figures B27(A)—(D).

meltback. A condition when welding a lap joint in sheet material where the edge of the sheet melts but does not become part of the weld, resulting in a void. See Figure B32(P).

meltback time. The time interval at the end of crater fill time to arc outage during which electrode feed is stopped. See Figure B54.

melting range. The temperature range between solidus and liquidus.

melting rate. The weight or length of electrode, wire, rod, or powder melted in a unit of time.

member. See **workpiece**. See also **butting workpiece** and **nonbutting workpiece**.

metal active gas (MAG) welding. A nonstandard term for **flux cored arc welding** or **gas metal arc welding** with an active gas.

metal-bath dip brazing. A dip brazing process variation in which the components to be joined are placed in a bath of molten brazing filler metal. See also **chemical-bath dip brazing** and **salt-bath dip brazing**.

metal-bath dip soldering. A dip soldering variation using heat from a bath of molten soldering filler metal. See also **oil-bath dip soldering** and **salt-bath dip soldering**. See also **wave soldering**.

metal cored electrode. A composite tubular filler metal electrode consisting of a metal sheath and a core of various powdered materials, producing no more than slag islands on the face of a weld bead.

metal electrode. A filler or nonfiller metal electrode used in arc welding and cutting consisting of a metal wire or rod manufactured by any method and either bare or covered.

metal inert gas (MIG) welding. A nonstandard term for **gas metal arc welding**.

metal powder cutting (OC-P). An oxygen cutting process using heat from an oxyfuel gas flame, with iron or other metal powder to aid cutting.

metal transfer mode, *gas metal arc welding.* The manner in which molten metal travels from the end of a consumable electrode across the welding arc to the workpiece. See Figure B39D. See also **globular transfer**, **pulsed spray transfer**, **rotational spray transfer**, **short circuiting transfer**, and **spray transfer**.

metallic bond. The primary force holding metals together arising from the close proximity of metal atoms. See also **adhesive bond** and **mechanical bond**.

metallizing. A nonstandard term when used for **thermal spraying** or the application of a metal coating.

metallurgical bond. A nonstandard term when used for **metallic bond**.

microetch test. A test in which the specimen is prepared with a polished finish, etched, and examined under high magnification.

microexamination. A metallographic examination in which a prepared surface is examined at high magnification.

mid-frequency resistance welding. See **medium-frequency resistance welding**.

MIG welding. A nonstandard term for **gas metal arc welding**. See Annex C, C1.5.3.

mismatch. See **joint mismatch**.

mixed zone. The portion of the weld metal consisting of a mixture of base metal and filler metal. See also **unmixed zone**.

mixing chamber. The part of a welding or cutting torch in which a fuel gas and oxygen are mixed.

molding shoe. A nonstandard term for **backing shoe**.

molten weld pool. A nonstandard term for **weld pool**.

moving shoe. A backing shoe sliding along the joint during welding. See also **stationary shoe**.

multipass weld. A fusion weld produced by more than one progression of the arc, flame, or energy source along the joint.

multiple electrode submerged arc welding (SAW-M). See **multiple electrode welding.** See also **parallel electrode submerged arc welding** and **series electrode submerged arc welding**.

multiple electrode welding. An arc welding process variation with two or more consumable electrodes feeding a single weld pool. Each electrode is controlled, fed, and powered separately. See also **parallel electrode welding** and **series electrode welding**.

multiple-impulse welding. A nonstandard term when used for **pulsation welding**.

multiple welding test position. An orientation for a nonrotated circumferential joint requiring welding in more than one welding position. See Figures B19(C)-(E) and Figures B20(E) and B20(F). See **5F**, **5G**, **5S**, **6F**, **6G**, **6GR**, and **6S**.

multiport nozzle. A constricting nozzle of the plasma arc torch containing two or more orifices located in a configuration to achieve some control over the arc shape.

multispot welding machine. A resistance welding machine configuration incorporating two or more resistance welding guns to perform an automatically controlled welding sequence.

N

narrow gap welding. A nonstandard term for **narrow groove welding**.

narrow groove electroslag welding (ESW-NG). A variation of consumable guide electroslag welding employing a reduced root opening and custom consumable guide to minimize heat input and increase heat-affected zone toughness.

narrow groove welding. A variation of a welding process using multiple-pass welding with filler metal. The use of a small root opening, with either a square groove or a V-groove and a small groove angle, yields a weld with a high ratio of depth to width.

neutral flame. An oxyfuel gas flame that is neither oxidizing nor reducing. See Figure B40(C). See also **carburizing flame**, **oxidizing flame**, and **reducing flame**.

neutral flux, *submerged arc welding*. A flux formulated to provide shielding of the molten weld metal with minimal effect on the relative amounts of manganese and silicon in the resulting weld metal, independent of arc voltage. See also **active flux** and **alloy flux**.

nonbutting member. See **nonbutting workpiece**.

nonbutting workpiece. A joint member free to move in any direction perpendicular to its thickness dimension. For example, both members of a lap or parallel joint, or one member of a T-joint or corner joint. See Figure B11. See also **butting workpiece**.

nonconsumable electrode. An electrode not providing filler metal. See Figures B35 and B36.

noncorrosive flux, *brazing* and *soldering*. A flux in either its original or residual form that does not chemically attack the base metal.

nondestructive evaluation. See **nondestructive examination**. See Annex C, C1.5.6.

nondestructive examination (NDE). The process of determining acceptability of a material or a component in accordance with established criteria without impairing its future usefulness.

nondestructive inspection (NDI). See **nondestructive examination**.

nondestructive testing (NDT). See **nondestructive examination**.

nonrelevant indication, *nondestructive examination*. An indication whose size, shape, or origin is deemed to be irrelevant in terms of acceptability assessment, and requires no further evaluation. See also **false indication** and **relevant indication**.

nonsynchronous initiation. Closing of a resistance welding contactor without regard to input voltage waveform.

nonsynchronous timing. A nonstandard term for **nonsynchronous initiation**.

nontransferred arc. An arc established between the electrode and constricting nozzle of the plasma arc torch or thermal spraying torch. The workpiece is not in the electrical circuit. See also **transferred arc**.

nonvacuum electron beam welding (EBW-NV). An electron beam welding process variation in which welding is accomplished at atmospheric pressure.

notching. Burn-through at the end of a lap joint in sheet materials. See Figure B32(Q).

nozzle. See **constricting nozzle**, **gas nozzle**, and **insulating nozzle**.

nozzle, *arc spraying*. A device at the exit end of the torch directing the atomizing air or other gas. See also **air cap**.

nozzle, *flame spraying*. A device at the exit end of the torch directing and forming the flow shape of atomized spray particles and the accompanying air or other gases.

nozzle accumulation. Undesirable metallic particles adhering to the inner surface or exit end of a nozzle.

nugget. The weld metal zone in a spot, seam, or projection weld.

nugget size. A nonstandard term when used for **projection weld size**, **resistance weld size**, or **seam weld size**.

O

off time. The interval between welding cycles when operating in a repeat mode. See Figure B50.

offset. A condition in a welded butt joint in which the members are misaligned. See Figure B13(C). See also **joint mismatch**.

oil-bath dip soldering. A dip soldering variation using heat from a bath of heated oil. See also **metal-bath dip soldering** and **salt-bath dip soldering**.

one-atmosphere welding. Welding in an enclosure maintained at approximately one atmosphere of pressure. See also **hyperbaric welding** and **hypobaric welding**.

open butt joint. A nonstandard term for **open root joint**.

open circuit voltage. The voltage between the output terminals of the power source when the rated primary voltage is applied and no electric current is flowing in the secondary circuit.

open groove. A nonstandard term for **open root joint**.

open joint. A nonstandard term for **open root joint**.

open root joint. An unwelded joint without backing or consumable insert.

orbital welding. Automatic or mechanized welding of pipe or tube in which the welding arc traverses a stationary joint.

orifice. See **constricting orifice**.

orifice gas. The gas directed into the plasma arc torch or thermal spraying torch to surround the electrode. It becomes ionized in the arc to form the arc plasma and issues from the constricting orifice of the nozzle as a plasma jet. See Figure B35.

orifice throat length. The length of the constricting orifice in the plasma arc torch or thermal spraying torch.

oscillation. An alternating pattern of motion relative to the direction of travel in a welding, brazing, soldering, thermal cutting, or thermal spraying process device. See also **weaving** and **whipping**.

out-of-position welding. Welding in any position other than the horizontal fillet or flat welding positions.

outer cone, *oxyfuel cutting* and *oxyfuel welding*. The conical part of a reducing gas flame extending beyond the inner cone. See Figure B40(B).

outer envelope of flame, *oxyfuel welding*. The region of the flame beyond the inner cone where a reducing atmosphere causes hydrogen and carbon monoxide to combine with air and burn. See Figures 40(B)−(D).

output circuit. A component of the electrical circuit supplying effective energy.

oven soldering. A nonstandard term for **furnace soldering**.

overhang. A nonstandard term when used for **extension**.

overhead position. See **overhead welding position**.

overhead welding position. The welding position in which welding is performed from the underside of a joint or surface in which the weld axis, at the point of welding, is approximately horizontal, and the weld face lies in an approximately horizontal plane. See Figures B16(A)–(C), B17(D), B18(D), and B20(D).

overlap, *fusion welding*. A weld profile discontinuity in which the reentrant angle at the weld toe, weld root, or weld bead toe is acute (less than 90º). See Figures B32(C), B32(D), and B32(M).

overlap, *resistance seam welding*. The portion of the preceding weld nugget remelted by the succeeding weld. See Figure B30(E).

overlap. A nonstandard term when used for **incomplete fusion**.

overlay, *corrosion resistant*. See **cladding**.

overlay, *hardfacing*. See **hardfacing**.

overlaying. A nonstandard term when used for **surfacing**.

overspray, *thermal spraying*. The portion of the thermal spray deposit not deposited on the workpiece.

oxidizing flame. An oxyfuel gas flame in which there is an excess of oxygen, resulting in an oxygen-rich zone extending around and beyond the inner cone. See Figure B40(D). See also **carburizing flame**, **neutral flame**, and **reducing flame**.

oxyacetylene cutting (OFC-A). An oxyfuel gas cutting process variation employing acetylene as the fuel gas.

oxyacetylene welding (OAW). An oxyfuel gas welding process employing acetylene as the fuel gas. The process is used without the application of pressure. See Figure B40.

oxyfuel gas cutter. One who performs oxyfuel gas cutting.

oxyfuel gas cutting (OFC). A group of oxygen cutting processes using heat from an oxyfuel gas flame. See also **oxyacetylene cutting**, **oxyhydrogen cutting**, **oxynatural gas cutting**, and **oxypropane cutting**.

oxyfuel gas cutting torch. A device used for directing the preheating flame produced by the controlled combustion of fuel gases and to direct and control the cutting oxygen.

oxyfuel gas spraying. A nonstandard term for **flame spraying**.

oxyfuel gas welding (OFW). A group of welding processes producing coalescence of workpieces by heating them with an oxyfuel gas flame. The processes are used with or without the application of pressure and with or without filler metal.

oxyfuel gas welding torch. A device used in oxyfuel gas welding, torch brazing, and torch soldering for directing the heating flame produced by the controlled combustion of fuel gases.

oxygas cutting. A nonstandard term for **oxyfuel gas cutting**.

oxygen arc cutting (OAC). An oxygen cutting process using an arc between the workpiece and a consumable tubular electrode through which oxygen is directed to the workpiece.

oxygen cutter. See **thermal cutter**. See also **thermal cutting operator**.

oxygen cutting (OC). A group of thermal cutting processes severing or removing metal by means of the chemical reaction between oxygen and the base metal at elevated temperature. The necessary temperature is maintained by the heat from an arc, an oxyfuel gas flame, or another source.

oxygen cutting jet. The forceful stream of oxygen issuing from the cutting tip to induce an exothermic reaction and assist in molten metal removal.

oxygen cutting operator. See **thermal cutting operator**. See also **thermal cutter**.

oxygen gouging (OG). Thermal gouging using an oxygen cutting process variation to form a bevel or groove.

oxygen grooving. A nonstandard term for **oxygen gouging**.

oxygen lance. A length of pipe used to convey oxygen to the point of cutting in oxygen lance cutting.

oxygen lance cutting (OLC). A thermal cutting process employing oxygen supplied through a consumable lance. Preheat to start the cutting is obtained by other means.

oxygen lancing. A nonstandard term for **oxygen lance cutting**.

oxyhydrogen cutting (OFC-H). An oxyfuel gas cutting process variation employing hydrogen as the fuel gas.

oxyhydrogen welding (OHW). An oxyfuel gas welding process employing hydrogen as the fuel gas. The process is used without the application of pressure.

oxynatural gas cutting (OFC-N). An oxyfuel gas cutting process variation employing natural gas as the fuel gas.

oxypropane cutting (OFC-P). An oxyfuel gas cutting process variation employing propane as the fuel gas.

P

parallel electrode submerged arc welding (SAW-P). See **parallel electrode welding**. See also **multiple electrode submerged arc welding** and **series electrode submerged arc welding**.

parallel electrode welding. An arc welding process variation with two consumable electrodes, electrically connected in parallel, powered by a single power source to form an arc between the electrodes and the work. See also **multiple electrode welding** and **series electrode welding**.

parallel gap welding. A nonstandard term when used for **series welding** with closely spaced electrodes.

parallel joint. A joint type formed by butting, parallel surfaces of one or more workpieces with flush ends. See Figures B1(E) and B2(E). See also **skewed joint**.

parallel resistance welding. A secondary circuit configuration in which the welding current is conducted through electrodes and workpieces in parallel electrical paths to form multiple resistance spot, seam, or projection welds simultaneously. See Figures B47(A) and B47(B). See also **push-pull resistance welding** and **series resistance welding**.

parent metal. A nonstandard term for **base metal** or **substrate**.

partial joint penetration groove weld. See **partial joint penetration weld**.

partial joint penetration weld. A groove weld in which incomplete joint penetration exists. See Figures B26(A)—(E) and B26(H)—(J). See also **complete joint penetration**, **complete joint penetration weld**, **incomplete joint penetration**, and **joint penetration**.

pass. See **thermal spraying pass** and **weld pass**.

pass sequence. See **weld pass sequence**.

paste braze. A nonstandard term when used for **brazing filler metal paste**.

paste brazing filler metal. A nonstandard term when used for **brazing filler metal paste**.

paste solder. A nonstandard term when used for **soldering filler metal paste**.

paste soldering filler metal. A nonstandard term when used for **soldering filler metal paste**.

peak level, *pulsed welding*. The high pulse amplitude of power in the welding waveform of the power source output. This value may be preset, programmed, or adaptively-controlled. See Figure B53. See also **waveform-controlled welding**.

peel test. A destructive testing method mechanically separating a lap joint by peeling.

peening. The mechanical working of metals using impact blows.

penetrant testing (PT). A nondestructive examination method using a penetrating medium to enhance visual detection of discontinuities open to the test surface.

penetration. A nonstandard term when used for **fusion depth**, **joint penetration**, or **root penetration**.

penetration-enhancing compound, *gas tungsten arc welding*. A material applied to the joint to increase joint penetration.

penetration-enhancing flux. A nonstandard term when used for **penetration-enhancing compound**.

percent dilution. The amount of base metal or previously deposited weld melted and incorporated into the weld bead. See Figure B24(L).

percent ferrite. A nonstandard term when used for **Ferrite Number**.

percussion welding (PEW). A welding process producing coalescence with an arc resulting from a rapid discharge of electrical energy. Pressure is applied percussively during or immediately following the electrical discharge.

performance qualification. Demonstration of an individual's ability to produce an acceptable test coupon in accordance with an applicable qualification standard. Variations of this term are **brazer performance qualification**, **brazing operator performance qualification**, **solderer performance qualification**, **soldering operator performance qualification**, **welder performance qualification**, and **welding operator performance qualification**.

performance qualification test record (PQTR). Documentation of performance qualification variables, test results, and ranges qualified.

performance qualification variable. One of a set of parameters defining personnel qualification limits for joining and surfacing processes. Variations of this term are **brazer performance qualification variable**, **brazing operator performance qualification variable**, **solderer performance qualification variable**, **soldering operator performance qualification variable**, **welder performance qualification variable**, and **welding operator performance qualification variable**. See also **essential variable**, *performance qualification*.

phased array ultrasonic testing (PAUT). A variation of ultrasonic testing using a transducer comprised of multiple piezoelectric elements individually connected to transmit or receive signals either separately or in combination, allowing for both steering and shaping of the ultrasonic wave in the item being examined.

pilot arc. A low current arc between the electrode and the constricting nozzle of the plasma arc torch to ionize the gas and facilitate the start of the welding arc.

piping porosity. A form of porosity having a length greater than its width extending through the weld approximately perpendicular to the weld face. See also **elongated porosity**.

plasma. See **arc plasma**.

plasma arc cutting (PAC). An arc cutting process employing a constricted arc and removing molten metal with a high-velocity jet of ionized gas issuing from the constricting orifice.

plasma arc cutting torch. A device used to transfer electric current to a fixed cutting electrode, position the electrode, and direct the flow of shielding gas and orifice gas. See Figure B35.

plasma arc gouging (PAG). A thermal gouging process using heat from a constricted arc and the force of an orifice gas. See also **carbon arc gouging** and **oxygen gouging**. See Figure A2.

plasma arc welding (PAW). An arc welding process employing a constricted arc between a nonconsumable electrode and the weld pool (transferred arc) or between the electrode and the constricting nozzle (nontransferred arc). Shielding is obtained from the ionized gas issuing from the torch, which may be supplemented by an auxiliary source of shielding gas. The process is used without the application of pressure. See also **hot wire welding**.

plasma arc welding torch. A device used to transfer welding current to a fixed welding electrode, position the electrode, and direct the flow of shielding gas and orifice gas. See Figure B35.

plasma sprayer. See **thermal sprayer**. See also **thermal spraying operator**.

plasma spraying (PSP). A thermal spraying process using a nontransferred arc to create a plasma for melting and propelling the surfacing material to the substrate. See also **atmospheric plasma spraying** and **vacuum plasma spraying**.

plasma spraying operator. See **thermal spraying operator**. See also **thermal sprayer**.

platen, *resistance welding*. A component of the secondary circuit with a flat mounting surface to which electrodes, fixtures, or electrode holders are attached, and which transmits the electrode or upset force.

platen spacing. The distance between opposing platen surfaces in a resistance welding machine.

plenum. See **plenum chamber**.

plenum chamber. The space between the electrode and the inside wall of the constricting nozzle of the plasma arc torch or thermal spraying torch. See Figure B35.

plug weld. A weld made in a circular hole in one member of a joint fusing it to a backing member in which the weld extends over the entire area of the hole. See Figure B15(E).

plug weld size. The diameter of the weld metal in the plane of the faying surfaces.

plume, *laser beam welding*. The vapor cloud above the weld pool consisting of material vaporized by the laser beam.

poke welding. A nonstandard term for **push welding**.

polarity. See **direct current electrode negative** and **direct current electrode positive**.

pore. See **porosity.**

porosity. Cavity-type discontinuities formed by gas entrapment during solidification or in a thermal spray deposit.

portable gun, *resistance welding*. A nonstandard term when used for a **manual gun**.

portable transgun, *resistance welding*. A nonstandard term when used for a **manual transgun**.

position. See **welding position**.

position of welding. See **welding position**.

positional usability. Classification of a welding filler metal based on its ability to be applied in a given welding position and progression.

postflow time. The time interval from welding current shut-off to either the shielding gas or the cooling water shut-off. See Figures B53 and B54.

postheating. The application of heat, in the range of preheat temperature, to an assembly after brazing, soldering, thermal spraying, thermal cutting, or welding.

postweld heat treatment (PWHT). Any heat treatment applied to a weldment subsequent to welding. See also **hydrogen bakeout** and **stress relief heat treatment**.

postweld interval, *resistance welding*. The duration from the end of the weld interval through the hold time. See Figure B49.

powder alloy. A nonstandard term for **alloy powder**.

powder blend. A mixture of two or more alloy, metal, or nonmetal powders. See also **alloy powder**.

powder composite. Two or more different materials combined to form a single particle, formed by either chemical coating or mechanical agglomeration.

powder cutting. A nonstandard term for **flux cutting** and **metal powder cutting**.

powder feed gas. A nonstandard term for **carrier gas**.

powder feed rate. The quantity of powder fed to a thermal spraying gun or a cutting torch per unit of time.

powder feeder. A device for supplying powdered material for thermal cutting, thermal spraying, or welding.

powder flame spraying (FLSP-P). A flame spraying process variation in which the surfacing material is in powder form.

power density. The power per unit area.

power ratio, *temper bead welding*. For mechanized or automatic welding with a nonconsumable electrode process and mechanized filler metal feed, a measure of heat input as a function of deposited weld metal volume.

power source. An apparatus for supplying electric current and voltage suitable for welding, thermal cutting, or thermal spraying.

power supply. A nonstandard term when used for **power source**.

precoating, *brazing* and *soldering*. The application of a filler metal to components prior to assembly and joining. See also **flow brightening**.

preflow time. The time interval between start of shielding gas flow and arc starting. See Figures B53 and B54.

preform, *brazing* and *soldering*. Filler metal in a shape suitable for preplacement within or adjacent to the joint prior to application of heat.

preheat, *n*. Heat applied to the workpiece(s) to attain and maintain the preheat temperature prior to joining, thermal cutting, or thermal spraying.

preheat, *v*. The act of applying heat to the workpiece(s) prior to joining, thermal cutting, or thermal spraying.

preheat current, *resistance welding*. One or more current pulses applied to cause heating of the workpieces prior to the application of welding current. See Figure B49.

preheat temperature, *brazing* and *soldering*. The temperature of the base material in the volume surrounding the joint immediately before brazing or soldering is started.

preheat temperature, *thermal cutting*. The temperature of the base material in the volume surrounding the point of thermal cutting immediately before thermal cutting is started.

preheat temperature, *thermal spraying*. The temperature of the substrate in the volume surrounding the point of thermal spraying immediately before thermal spraying is started. See also **interpass temperature**.

preheat temperature, *welding*. The temperature of the base material in the volume surrounding the point of welding immediately before welding is started. See also **interpass temperature**.

preheat time, *resistance welding*. The duration of preheat current flow. See Figure B49.

prequalified welding procedure specification (PWPS). A welding procedure specification in compliance with the stipulated conditions of a particular welding standard deemed acceptable for use without the need for procedure qualification testing.

press-type welding machine. A resistance welding machine configuration incorporating a ram-mounted moveable platen or electrode holder and a lower platen for mounting tooling.

pressure gas welding (PGW). An oxyfuel gas welding process producing a weld simultaneously over the entire faying surfaces. The process is used with the application of pressure and without filler metal.

pressure welding. A nonstandard term when used for **cold welding**, **diffusion welding**, **forge welding**, **hot pressure welding**, **pressure gas welding**, and **solid-state welding**.

pressure-controlled resistance welding (RW-PC). A resistance welding process variation in which a number of spot or projection welds are made with several electrodes functioning progressively under the control of a pressure-sequencing device.

pretinning. A nonstandard term for **precoating**.

preweld interval, *resistance welding*. The elapsed time between the initiation of the squeeze time and the beginning of the weld time or weld interval time. See Figure B50.

procedure. The detailed elements of a process or method used to produce a specific result.

procedure qualification. Demonstration of a process for joining or surfacing using specified materials and techniques resulting in a test coupon meeting applicable requirements.

procedure qualification record (PQR). A record of qualification variables observed while preparing a test coupon, along with test results verifying properties and characteristics, supporting a qualified procedure specification. Variations of this term are **brazing procedure qualification record**, **soldering procedure qualification record**, and **welding procedure qualification record**.

procedure qualification record (PQR), *additive manufacturing*. A record of qualification variables observed while preparing a test build, along with test results verifying properties and characteristics, supporting a qualified additive manufacturing procedure specification.

procedure qualification test build, *additive manufacturing*. A test build produced using qualification variables, providing the basis for an additive manufacturing procedure specification.

procedure qualification variable. One of a set of parameters defining qualification limits of a procedure specification. Variations of this term are **brazing procedure qualification variable**, **soldering procedure qualification variable**, and **welding procedure qualification variable**.

procedure specification (PS). A document detailing the required process variables for a specific application to ensure repeatability when executed by properly trained and qualified personnel. Variations of this term are **additive manufacturing procedure specification**, **brazing procedure specification**, **soldering procedure specification**, and **welding procedure specification**.

process. A grouping of basic operational elements used in brazing, soldering, thermal cutting, thermal spraying, or welding. See Figures A1 and A2.

process orientation, *hybrid welding*. The order of welding process application in the direction of progression along the joint.

process separation, *hybrid welding*. The distance between the projected centerlines of the welding processes at the workpiece surface.

production welding. Welding performed as part of a fabrication or manufacturing operation leading to the creation of finished or semifinished components or assemblies.

progressive block sequence. A block sequence in which subsequent blocks are completed progressively along the weld, either from one end to the other or from an intermediate location of the weld toward either end. See also **successive block sequence**.

projection weld size. The nugget dimension(s) in the plane of the faying surfaces. See Figure B25(F).

projection welding (PW). A resistance welding process in which the weld size, shape, and placement are determined by the presence of a projection, embossment, or intersection in one overlapping member which serves to localize the applied heat and force. See Figure B30(F). See **cross wire welding**.

protective atmosphere. A gas or vacuum envelope present during joining, thermal cutting, or thermal spraying used to prevent or reduce the formation of oxides and other detrimental surface substances and facilitate their removal. See also **active gas**, **backing gas**, **inert gas**, **reducing atmosphere**, and **shielding gas**.

pry test. A test method employing mechanical means to deform the workpiece sufficiently to confirm the presence of a weld.

puddle. A nonstandard term when used for **weld pool**.

puddle weld. A nonstandard term for an **arc spot weld** or **plug weld**.

pull angle. See **drag angle**.

pull gun technique. A nonstandard term for **backhand welding**.

pulsation welding, *resistance welding*. A process variation incorporating multiple pulses, each separated by a cool time. See Figure B49.

pulse, *AC resistance welding*. A period of electric current conduction consisting of a quantity of uniform amplitude positive and negative half cycles.

pulse, *DC resistance welding*. A period of single-polarity electric current conduction.

pulse start delay time. The time interval from electric current initiation to the beginning of current pulsation. See Figure B53.

pulse time, *resistance welding*. The duration of a pulse. See Figure B49 and B50.

pulsed gas metal arc welding (GMAW-P). See **pulsed welding**. See also **waveform-controlled welding**.

pulsed laser. A laser whose output is controlled to produce a pulse whose duration is 25 milliseconds or less. See also **continuous wave laser**.

pulsed power welding. See **pulsed welding**.

pulsed short circuiting transfer, *gas metal arc welding*. A short circuiting transfer variation using pulsed power. See Figure B39(D). See also **globular transfer**, **spray transfer**, and **waveform-controlled welding**. See Annex C, C1.5.10.

pulsed spray transfer, *gas metal arc welding*. A spray transfer variation using pulsed power. See Figure B39(D). See also **constant voltage spray transfer** and **rotational spray transfer**. See Annex C, C1.5.10.

pulsed welding, *arc welding*. A process variation in which the welding power source output cycles between high and low power levels, resulting in a lower average power.

pulsed welding, *gas metal arc welding*. Waveform-controlled welding in which the power source output cycles between high and low power levels resulting in spray transfer or short circuiting transfer of metal using a lower average power.

purge. The introduction of a gas to remove contaminants from a system or provide root shielding during welding.

purge gas. See **root shielding gas**.

push angle. The travel angle when the electrode is pointing in the direction of weld progression. This angle can also be used to partially define the orientation of guns, torches, rods, and beams. See Figure B21. See also **drag angle**, **forehand welding**, **travel angle**, and **work angle**.

push-pull resistance welding. A secondary circuit configuration in which two transformers are configured in an opposed polarity arrangement to minimize the effective throat area. See also **parallel resistance welding** and **series resistance welding**.

push welding. A resistance welding process variation in which spot or projection welds are produced by manually applying force to one electrode.

Q

qualification. See **performance qualification** and **procedure qualification**.

qualification authority. An organization, company, or individual responsible for the qualification of procedures and personnel.

qualified brazer. An individual who has successfully demonstrated the ability to perform manual or semiautomatic brazing per the applicable standard.

qualified brazing operator. An individual who has successfully demonstrated the ability to set up and operate automatic, mechanized, or robotic brazing per the applicable standard.

qualified brazing procedure. A brazing procedure specification meeting the qualification requirements of a recognized qualification standard.

qualified solderer. An individual who has successfully demonstrated the ability to perform manual or semiautomatic soldering per the applicable standard.

qualified soldering operator. An individual who has successfully demonstrated the ability to set up and operate automatic, mechanized, or robotic soldering per the applicable standard.

qualified soldering procedure. A soldering procedure specification meeting the qualification requirements of a recognized qualification standard.

qualified welder. An individual who has successfully demonstrated the ability to perform manual or semiautomatic welding per the applicable standard.

qualified welding operator. An individual who has successfully demonstrated the ability to set up and operate automatic, mechanized, or robotic welding per the applicable standard.

qualified welding procedure. A welding procedure specification meeting the qualification requirements of a recognized qualification standard.

qualifier. An employer, organization, or individual(s) responsible for conducting, supervising, and documenting qualification testing in accordance with an applicable standard. See also **AWS Qualifier**, **AWS Welder Performance Qualifier**, and **AWS Welding Procedure Qualifier**.

quench time, *resistance welding*. The duration from the end of the weld interval or downslope time to the beginning of the temper time, during which no welding current flows through the workpieces and the weld is rapidly cooled by the electrodes. See Figure B49.

R

radio frequency welding (RFW), *thermoplastics*. A welding process using heat induced by radio frequency emission.

radiographic testing (RT). A nondestructive examination method using penetrating radiation to produce images for detection of discontinuities in a test object.

random sequence. A longitudinal sequence in which the weld bead segments are made at random.

random wound. Spooled or coiled filler metal not wound in distinct layers. See also **level wound**.

rate of deposition. See **deposition rate**.

rate of flame propagation. See **flame propagation rate**.

reaction soldering. A soldering process variation in which a reactive flux is used.

reactive flux, *soldering*. Flux containing constituents reacting with the workpiece(s) during heating to contribute filler metal.

reactive gas. See **active gas**.

reactor. A device used in arc welding circuits to minimize irregularities in the flow of the welding current.

reconditioned flux, *submerged arc welding*. Unfused flux processed for use or reuse. The processing may include screening for particle sizing, removal of magnetic particles, and baking to remove moisture.

recrushed slag. A nonstandard term when used for **recycled slag**.

recycled flux, *submerged arc welding*. Reusable unfused granular flux recovered after welding and reconditioned for use. See also **virgin flux**.

recycled slag, *submerged arc welding*. Fused slag recovered after welding and processed for use as flux.

reduced section tension test. A test in which a transverse section of the weld is located in the center of the reduced section of the specimen.

reducing atmosphere. A type of protective atmosphere that dissociates metal oxides at elevated temperatures.

reducing flame. An oxyfuel gas flame with an excess of fuel gas. See Figure B40(B). See also **carburizing flame**, **neutral flame**, **oxidizing flame**, and **reducing atmosphere**.

reentrant angle. The angle between lines tangent to weld profile surfaces at the junction of those surfaces. See also **bead reentrant angle** and **toe reentrant angle**. See Figures B32(I)—(M).

reflow soldering. A soldering process in which the filler metal, normally in the form of a paste or preform, is applied to the joint prior to the application of heat.

reflowing. A nonstandard term when used for **flow brightening**.

relevant indication, *nondestructive examination*. An indication requiring evaluation.

remelt temperature, *brazing* and *soldering*. The temperature necessary to melt braze metal or solder metal in a completed joint. See also **joint remelt temperature**.

remote laser welding. A laser beam welding process variation employing a dynamic mirror arrangement to direct a focused laser beam to the weld locations or paths.

residual stress. Stress present in a joint member or material that is free of external forces or thermal gradients.

resistance brazing (RB). A brazing process using heat from the resistance to the electric current flow in a circuit that includes the assembly.

resistance butt welding. A nonstandard term for **flash welding** and **upset welding**.

resistance seam weld. A seam weld made using a resistance seam welding process. See Figures B14(D), B30(D), and B30(E).

resistance seam weld size. See **seam weld size**.

resistance seam welding (RSEW). A resistance welding process producing a weld at the faying surfaces of overlapped parts progressively along a length of a joint. The weld may be made with overlapping weld nuggets, a continuous weld nugget, or by forging the joint as it is heated to the welding temperature by resistance to the flow of the welding current. See Figures B14(D), B23(I), B30(D), B30(E), and B52. See also **high-frequency seam welding** and **induction seam welding**.

resistance plastic welding (RW-P), *thermoplastics*. A welding process producing coalescence of a polymer interface using heat obtained from the resistive heating of an insert in the joint and with the application of pressure.

resistance soldering (RS). A soldering process using heat from the resistance to the flow of electric current in a circuit containing the workpiece(s).

resistance spot weld. A spot weld made using a resistance spot or projection welding process. See Figures B10(E), B14(E), B14(F), and B30(D).

resistance spot weld size. See **spot weld size**.

resistance spot welding (RSW). A resistance welding process producing a spot weld. See Figures B14(E), B14(F), B30(D), and B47—B50.

resistance weld size. See **spot weld size** and **seam weld size**.

resistance welding (RW). A group of welding processes producing coalescence of the faying surfaces with the heat obtained from the resistance of the workpieces to the flow of the welding current in a circuit of which the workpieces form part and by the application of pressure. See Figure A1.

resistance welding control. A controller having ratings, operating characteristics, and construction optimized for adjustment and maintenance of resistance welding process parameters.

resistance welding die. A resistance welding electrode matching the contour of the workpiece to clamp or shape the workpieces and conduct welding current.

resistance welding electrode. The part of a secondary circuit responsible for the transmission of welding current and force to the workpieces. The electrode may be in the form of a rotating wheel, rotating roll, bar, cylinder, plate, clamp, or modification thereof.

resistance welding gun. A device used to apply electrode force and transfer welding current to the workpieces. It may be manipulatable or an element of a welding machine. See also **manual gun**, **manual transgun**, **robot gun, servogun**, and **transgun**.

resistance welding voltage. The voltage between the resistance welding electrodes, measured across the workpieces.

resistance welding weld time. See **weld time**, *resistance welding*.

resolution, *nondestructive examination*. The ability of a method to detect and discriminate between two or more closely-spaced discontinuities.

retaining shoe. A nonstandard term for **backing shoe**.

retreating side, *friction stir welding*. The side of the weld in which the directions of tool rotation and travel are opposite. See Figure B46. See also **advancing side**.

retreating side, *high energy beam welding*. The side in which the direction of beam pattern and travel are opposite. See also **advancing side**.

reverse polarity. A nonstandard term for **direct current electrode positive**.

riser, *electrogas welding* and *electroslag welding*. Weld tabs sufficient to allow the process to continue beyond the top of the joint to assure complete fusion of the weld metal to the groove faces of the joint. See Figure B12(D).

robot gun. A resistance welding gun adapted for manipulation by a robot.

robotic, *adj*. Pertaining to a method of application where equipment moves along a controlled path using programmed parameters with no manual intervention once a cycle is initiated. See Table A4. See also **adaptive control**, **automatic**, **manual**, **mechanized**, and **semiautomatic**.

robotic brazing (B-RO). See **robotic process**.

robotic process (XXXX-RO). An operation with equipment moving along a controlled path using controlled parameters with no manual intervention once a cycle is initiated. See Table A4. See **robotic brazing**, **robotic soldering**, **robotic thermal cutting**, **robotic thermal spraying**, and **robotic welding**. See also **adaptive control process**, **automatic process**, **manual process**, **mechanized process**, and **semiautomatic process**.

robotic soldering (S-RO). See **robotic process**.

robotic thermal cutting (TC-RO). See **robotic process**.

robotic thermal spraying (TS-RO). See **robotic process**.

robotic welding (W-RO). See **robotic process**.

rocker welding machine. A resistance welding machine configuration incorporating a fulcrum mounted arm, driving a moveable electrode against one supported by a protruding stationary arm.

roll spot welding. A resistance seam welding process variation producing spot welds at intervals using one or more circular electrodes rotating continuously or intermittently.

roll welding (ROW). A solid-state welding process producing a weld by the application of heat and sufficient pressure with rolls to cause deformation at the faying surfaces. See also **forge welding**.

rollover. A nonstandard term when used for **overlap**, *fusion welding*.

root. A nonstandard term when used for **joint root** or **weld root**.

root bead. A weld bead extending into or including part or all of the joint root.

root bend test. A mechanical test creating tension in the root surface by bending the specimen around a tool of a given radius.

root crack. See Figure B33.

root edge. A root face of zero width. See Figure B5.

root face. The portion of the groove face within the joint root. See Figure B5.

root face extension. An extension of the base metal adjacent to the root face in a bevel or J-edge shape beyond the bevel or bevel radius, respectively, to provide for improved weld penetration control or joint root access. See Figure B13(D).

root gap. A nonstandard term for **root opening**.

root of joint. See **joint root**.

root of weld. See **weld root**.

root opening. The separation between workpieces at the joint root. See Figures B6(E) and B25(D).

root pass. A weld pass made to produce a root bead.

root penetration. The distance the weld metal extends into the joint root. See Figure B26.

root radius. A nonstandard term for **bevel radius**.

root reinforcement. Weld reinforcement opposite the side from which welding was done. See Figure B24(A). See also **face reinforcement**.

root shielding gas. A shielding gas used to provide a protective atmosphere for the root surface and adjacent base metal. See also **purge gas**.

root surface. The exposed surface of a weld opposite the side from which welding was done. See Figures B24(B), B27(E), and B27(F).

root surface crack. A crack occurring at the weld root surface. See Figure B33.

root surface underfill. See **underfill**. See Figure B32(E).

rosin cored soldering filler metal. A flux cored soldering filler metal containing a rosin flux. See also **acid cored soldering filler metal**.

rotary roughening, *thermal spraying*. A method of surface roughening in which a revolving tool is pressed against the surface being prepared, while either the work or the tool, or both, move. See Figure B43(D). See also **groove and rotary roughening**, **knurling**, and **threading and knurling**.

rotated horizontal test coupon, *pipe fillet*. A welding test coupon for a pipe-to-pipe lap joint or a pipe-to-plate T-joint configured for rotation around a horizontal pipe axis. See Figure B20(C).

rotated horizontal test coupon, *pipe groove*. A welding test coupon for a butt joint configured for rotation around a horizontal pipe axis. See Figure B19(A).

rotated horizontal test coupon, *pipe surfacing*. A welding test coupon configured for the application of surfacing when rotated around a horizontal pipe axis. See Figure B19(A).

rotational spray transfer, *gas metal arc welding*. A spray transfer variation in which a longer electrode extension and specialized gas mixtures are used to produce a helical pattern of very fine droplets. See Figure B39(D). See also **constant voltage spray transfer** and **pulsed spray transfer**. See Annex C, C1.5.10.

rough threading, *thermal spraying*. A method of surface roughening consisting of cutting threads with the sides and tops of the threads jagged and torn. See Figure B43(E).

round edge shape. A type of edge shape in which the surface is curved. See Figure B7(G).

rounded indication, *nondestructive examination*. An observed indication having a length-to-width ratio less than 3:1. See also **linear indication**.

rub soldering. A nonstandard term when used for **abrasion soldering**.

run-off weld tab. A weld tab at the end of the joint where welding is terminated. See Figure B12(E). See also **run-on weld tab**, **starting weld tab**, and **weld tab**.

run-on weld tab. A weld tab at the end of the joint where welding is initiated. See Figure B12(E). See also **run-off weld tab**.

S

salt-bath dip brazing. A variation of chemical-bath dip brazing using heat from a molten salt bath. See also **metal-bath dip brazing**.

salt-bath dip soldering. A dip soldering variation using heat from a molten salt bath. See **metal-bath dip soldering** and **oil-bath dip soldering**.

sandwich brazement. A brazed assembly consisting of layers of dissimilar materials joined using preplaced brazing filler metal.

scarf. A nonstandard term for **bevel**.

scarf groove. A groove formed by the assembly of butting workpieces having single-bevel edge shapes with parallel groove faces. See Figure B13(B).

scarf joint. A nonstandard term for **scarf groove**.

seal-bonding material, *thermal spraying*. A material partially forming a metallic bond with the substrate in the as-sprayed condition.

seal coat, *thermal spraying*. Material applied to infiltrate and close the pores of a thermal spray deposit.

seal weld. Any weld intended primarily to provide a specific degree of tightness against leakage.

seam. A nonstandard term when used for **joint**.

seam weld. A continuous weld produced between overlapping members with coalescence initiating and occurring at faying surfaces or proceeding from the outer surface of one member. The weld can consist of either a weld bead, multiple overlapping nuggets, or a single nugget formed by the simultaneous application of resistance heating and forging force along the joint. See Figures B14(A)–(D), B30(E), and B52(C). See also **arc seam weld**, **high-energy beam seam weld**, and **resistance seam weld**.

seam weld size. The nugget width in the plane of the faying surfaces. See Figures B25(F) and B25(G).

seam welding wheel. See **circular electrode**.

secondary circuit. See **welding circuit**.

secondary current path, *resistance welding*. The electrical path through which the welding current passes.

self-fluxing alloy, *thermal spraying*. A surfacing material wetting the substrate and coalescing when heated to its melting point, with no flux other than the boron and silicon contained in the alloy.

self-shielded flux cored arc welding (FCAW-S). A flux cored arc welding process variation in which the internal flux provides necessary shielding and arc stabilization, without the need of an auxiliary shielding gas.

semiautomatic, *adj*. Pertaining to the method of application where the gun or torch is held and manipulated by hand with equipment controlling one or more of the process variables. See Table A4. See also **adaptive control**, **automatic**, **manual**, **mechanized**, and **robotic**.

semiautomatic brazing (B-SA). See **semiautomatic process**.

semiautomatic process (XXXX-SA). An operation performed manually with equipment controlling one or more of the process conditions. See **semiautomatic brazing**, **semiautomatic soldering**, **semiautomatic thermal cutting**, **semiautomatic thermal spraying**, and **semiautomatic welding**. See Table A4. See also **adaptive control process**, **automatic process**, **manual process**, **mechanized process**, and **robotic process**.

semiautomatic soldering (S-SA). See **semiautomatic process**.

semiautomatic thermal cutting (TC-SA). See **semiautomatic process**.

semiautomatic thermal spraying (TS-SA). See **semiautomatic process**.

semiautomatic welding (W-SA). See **semiautomatic process**.

semiblind joint. A joint in which a portion of the joint is not visible.

sensitivity, *nondestructive examination*. The ability of an NDE method to detect discontinuities of a specified size.

sequence time. A nonstandard term when used for **welding cycle**.

series electrode submerged arc welding (SAW-S). See **series electrode welding**. See also **multiple electrode submerged arc welding** and **parallel electrode submerged arc welding**.

series electrode submerged arc welding, *surfacing*. A variation of series electrode submerged arc welding in which the electrodes may be skewed significantly from normal and spaced sufficiently to assure the weld pool completes the electrical path between electrodes. Travel direction is oriented perpendicular to the electrical path.

series electrode welding. An arc welding process variation with two consumable electrodes, powered by a single power source. The weld pool forms the electrical path between the two electrodes without the need for a work connection. See also **multiple electrode welding** and **parallel electrode welding**.

series resistance welding. A secondary circuit configuration in which the welding current is conducted through electrodes and workpieces in a series electrical path to form multiple resistance spot, seam, or projection welds simultaneously. See Figures B47(C) and B47(D). See also **parallel resistance welding** and **push-pull resistance welding**.

series submerged arc welding (SAW-S). See **series electrode submerged arc welding**.

servogun. A resistance welding gun incorporating an electric, hydraulic, or pneumatic servoactuator to generate electrode force.

set down. A nonstandard term when used for **upset distance**.

setback. See **contact tip setback** and **electrode setback**.

shadow mask, *thermal spraying*. A device partially shielding an area of the workpiece, producing a feathered edge of the thermal spray deposit.

sheet separation, *resistance welding*. The distance between faying surfaces adjacent to the weld once a spot, seam, or projection weld has been produced.

shelf bar. A member placed below a horizontal groove to support weld metal and facilitate complete cross-sectional filling of the weld groove. See Figure B12(B).

shielded carbon arc welding (CAW-S). A carbon arc welding process variation using shielding from the combustion of solid material fed into the arc, or from a blanket of flux on the workpieces, or both. This is an obsolete or seldom used process. See Table A5.

shielded metal arc cutting (SMAC). An arc cutting process employing a covered electrode.

shielded metal arc welding (SMAW). An arc welding process with an arc between a covered electrode and the weld pool. The process is used with shielding from the decomposition of the electrode covering, without the application of pressure, and with filler metal from the electrode. See also **firecracker welding**.

shielding gas. A gas used to produce a protective atmosphere. See also **backing gas**, **inert gas**, **purge gas**, and **root shielding gas**.

short arc. A nonstandard term when used for **short circuiting transfer**.

short circuiting gas metal arc welding (GMAW-S). See **short circuiting gas metal arc welding (GMAW-SC)**.

short circuiting gas metal arc welding (GMAW-SC). A process variation in which the consumable electrode is deposited during repeated short circuits.

short circuiting arc welding. A nonstandard term for **short circuiting gas metal arc welding**.

short circuiting transfer, *gas metal arc welding*. The metal transfer mode in which molten metal from a consumable electrode is deposited during repeated short circuits. See also **constant voltage short circuiting transfer**, **globular transfer**, and **spray transfer**. See Figure B39(D).

shoulder. A nonstandard term when used for **root face**.

shrinkage stress. Residual stress resulting from resistance to contraction of materials upon cooling from joining, thermal cutting, or thermal spraying.

shrinkage void. A cavity-type discontinuity formed as a metal contracts during solidification.

shunt weld. A weld providing an intentional path for welding current flow between two workpieces separated by a nonconductive material.

shunting current. Undesired flow of electric current resulting from alternative conduction paths.

side bend test. A mechanical test creating tension in the side of a transverse section of the weld by bending the specimen around a tool of a given radius.

sidewall. A nonstandard term when used for **bevel face** or **groove face**.

sieve analysis. A method of determining particle size distribution, usually expressed as the weight percentage retained by each of a series of standard screens having progressively smaller openings.

silver alloy brazing. A nonstandard term when used for **brazing** with a silver-based brazing filler metal.

silver soldering. An incorrect term for **brazing** with a silver-containing brazing filler metal.

single welded joint, *fusion welding*. A joint welded from one side only. See Figure B8.

single-bevel edge shape. A type of bevel edge shape having one prepared surface. See Figure B7(B).

single-bevel groove. A weld groove formed by the combination of a butting workpiece having a bevel edge shape with a planar surface of a butting workpiece, a butting workpiece having a bevel or square edge shape with a skewed surface of a nonbutting workpiece. See Figures B6(I), B6(K), and B8(B).

single-bevel-groove weld. A weld in a single-bevel groove welded from one side. See Figure B8(B).

single-flare-bevel groove. A weld groove formed by the combination of a butting workpiece having a round edge shape and a planar surface of a companion member. See Figure B8(H).

single-flare-bevel-groove weld. A weld in a single-flare-bevel groove welded from one side. See Figure B8(H).

single-flare-V groove. A weld groove formed by the combination of butting workpieces having round edge shapes. See Figure B8(I).

single-flare-V-groove weld. A weld in a single-flare-V groove welded from one side. See Figure B8(I).

single-groove weld, *fusion welding*. A groove weld made from one side only. See Figure B8.

single-impulse welding. A resistance welding process variation in which spot, projection, or upset welds are produced with a single impulse of welding current. See Figure B50.

single-J edge shape. A type of J-edge shape having one prepared surface. See Figure B7(D).

single-J groove. A weld groove formed by the combination of a butting workpiece having a single-J edge shape abutting a planar surface of a companion member. See Figure B8(F).

single-J-groove weld. A weld in a single-J groove welded from one side. See Figure B8(F).

single-port nozzle. A constricting nozzle of the plasma arc torch containing one orifice, located below and concentric with the electrode.

single-spliced butt joint. See **spliced joint**. See Figure B3(A).

single-spliced joint. See **spliced joint**. See Figure B3(A).

single-square-groove weld. A weld in a square groove welded from one side. See Figure B8(A).

single-U groove. A weld groove formed by the combination of two butting workpieces having single-J edge shapes. See Figure B8(G).

single-U-groove weld. A weld in a single-U groove welded from one side. See Figure B8(G).

single-V groove. A V-shaped weld groove formed by the combination of butting workpieces having single-bevel edge shapes, butting and nonbutting workpieces having planar surfaces arranged to form a groove, or a V-shaped groove in the surface of a member. See Figures B8(C)–(E).

single-V-groove weld. A weld in a single-V groove welded from one side. See Figures B8(C)–(E).

size of weld. See **weld size**.

skewed joint. A variation of any one of the five basic joint types in which the members are oriented at angles different than the typical orthogonal angles.

skip weld. A nonstandard term for **intermittent weld**.

skull, *brazing* and *soldering*. The unmelted residue from a filler metal resulting from either incomplete melting or an inadequate protective atmosphere.

slag. A nonmetallic byproduct of the mutual dissolution of flux with nonmetallic impurities in welding and brazing processes.

slag inclusion. A discontinuity consisting of slag entrapped in weld metal or at the weld interface.

slot weld. A weld made in an elongated hole in one member of a joint fusing it to a backing member in which the weld extends over the entire area of the hole. The hole may be open at one end. See Figure B15(D).

slot weld size. The width and length of the slot at the faying surfaces.

slugging. The unauthorized addition of metal, such as a length of rod, to a joint before welding or between passes, often resulting in a weld with incomplete fusion.

smoothing bead. A weld bead made to correct an undesirable weld surface contour. See also **cosmetic bead**, **cover bead**, and **intermediate bead**.

smoothing pass. A weld pass resulting in a smoothing bead. See also **cosmetic pass**, **cover pass**, and **intermediate pass**.

socket fusion welding (SFW). A variation of heated tool welding using a tool configured to heat the outside surface of one workpiece and the inside surface of the mating workpiece.

soft solder. A nonstandard term for **soldering filler metal**.

solder, *n*. A bond produced as a result of heating an assembly to the soldering temperature using a soldering filler metal distributed and retained between the closely fitted faying surfaces of the joint by capillary action. See Figure B31(A).

solder, *v.* The act of soldering.

solder. A nonstandard term when used for **soldering filler metal**.

solder interface. The boundary between solder metal and base material in a soldered joint. See Figure B31(A).

solder metal. The soldering filler metal melted during soldering.

solder paste. A nonstandard term when used for **soldering filler metal paste**.

solderability. The capacity of a material to be soldered under the imposed fabrication conditions into a specific, suitably designed structure and to perform satisfactorily in the intended service.

soldered test assembly. A solderment produced for the purpose of qualifying soldering procedures and personnel.

solderer. An individual performing manual or semiautomatic soldering.

solderer certification. Documentation attesting to the performance qualification of a solderer.

solderer performance qualification. See **performance qualification**.

solderer performance qualification variable. See **performance qualification variable**.

soldering (S). A group of joining processes in which the workpiece(s) and soldering filler metal are heated to the soldering temperature to form a soldered joint. The soldering filler metal is distributed and retained between the closely fitted faying surfaces of the joint by capillary action. See Figures A1, A3, and A6.

soldering blowpipe. A device used to divert a portion of a flame for fine work, such as jewelry. Using this device, the flame is blown to the desired location, usually by mouth.

soldering filler metal. A filler metal having a liquidus at or below 450 ºC [840 ºF] and below the solidus of the base material. See also **soldering filler metal paste**.

soldering filler metal paste. Paste consisting of a filler metal powder, a flux, and a neutral carrier.

soldering flux. A flux used for soldering. See **acid core solder**, **activated rosin flux**, **intermediate flux**, **noncorrosive flux**, and **reactive flux**. See also **brazing flux** and **welding flux**.

soldering gun. An electrically heated soldering iron with a pistol grip.

soldering iron. A tool for manual soldering used to heat the workpiece(s) by thermal conduction from the tip, which is heated by internal electrical resistance or external flame.

soldering operator. An individual responsible for observing and controlling an automatic, mechanized, or robotic soldering process.

soldering operator certification. Documentation attesting to the performance qualification of a soldering operator.

soldering operator performance qualification. See **performance qualification**.

soldering operator performance qualification variable. See **performance qualification variable**.

soldering procedure. A detailed description of the materials and methods used to solder materials, including activities before and after the application of the soldering process. A soldering process specification could be an element of this procedure.

soldering procedure qualification. Demonstration of the use of a process to solder materials using detailed techniques resulting in a test coupon meeting an applicable qualification standard.

soldering procedure qualification record (SPQR). See **procedure qualification record**.

soldering procedure qualification variable. See **procedure qualification variable**.

soldering procedure specification (SPS). See **procedure specification**.

soldering temperature. The temperature to which the faying surfaces are heated to enable the soldering filler metal to wet the base material and form a soldered joint.

soldering test assembly. See **test coupon**.

soldering variable. See **procedure qualification variable**.

solderment. An assembly joined by soldering.

solid-state welding (SSW). A group of welding processes producing coalescence by the application of pressure without melting any of the joint components. See Figures A1, A3, and A5.

solidus. The highest temperature at which a metal is completely solid.

sound metal. Metal free of rejectable discontinuities.

soundness test. A means of determining a material's freedom from imperfections. Such tests are classified as either destructive or nondestructive and used primarily to evaluate procedure and performance qualification testpieces.

spacer. See **joint spacer**.

spacer strip. A nonstandard term for **joint spacer**.

spatter. Metal particles expelled during fusion welding. Those particles adhering to the weld and adjacent base metal may require removal if they interfere with subsequent operations.

spatter loss. Metal lost due to spatter.

specimen. See **test specimen**.

specimen blank. That portion of a test coupon removed, finished, or otherwise prepared to form a test specimen.

spiking, *electron beam welding* and *laser beam welding*. A condition where the joint penetration is nonuniform and changes abruptly over the length of the weld.

spin welding (SPW), *thermoplastics*. A fusion welding process producing a weld by rotating one of the workpieces, around its central axis, against a stationary workpiece under pressure.

spit. A nonstandard term when used for **expulsion** and **flash**.

splice. A nonstandard term when used for a brazed, soldered, or welded **joint**.

splice member. The workpiece spanning the joint in a spliced joint. See Figures B3(A) and B3(B).

spliced butt joint. See **spliced joint**. See Figures B3(A) and B3(B).

spliced joint. A joint in which an additional workpiece spans the joint and is welded to each joint member. See Figures B3(A) and B3(B). See also **splice member**.

split layer technique. A welding technique resulting in layers having more than one weld bead. See Figure B23(D).

split pipe backing. A pipe segment used as a backing for welding butt joints in round bars. See Figure B12(C).

spool. A filler metal packaging configuration in which the wire is wound around a cylinder (called a barrel), which is flanged at both ends. The flanges contain a spindle hole centered inside the barrel. See Figure B42(A). See also **coil without support** and **coil with support**.

spot weld. A weld produced between or upon overlapping members with coalescence initiating and occurring at faying surfaces or proceeding from the outer surface of one member. The weld typically has a round cross section in the plane of the faying surfaces. See Figures B14(E)–(H). See also **arc spot weld**, **high-energy beam spot weld**, and **resistance spot weld**.

spot weld size. The diameter of the nugget in the plane of the faying surfaces. See Figures B25(F), B25(G), and B30(D).

spray arc. A nonstandard term for **spray transfer**.

spray deposit. See **thermal spray deposit**.

spray deposit density ratio. See **thermal spray deposit density ratio**.

spray-fuse. A thermal spraying technique in which the deposit is reheated to fuse the particles and form a metallurgical bond with the substrate.

spray tab, *thermal spraying*. A small piece of additional material thermally sprayed concurrently with the workpiece and used to evaluate the quality of the thermal spray deposit.

spray transfer, *gas metal arc welding*. The metal transfer mode in which small droplets of molten metal from a consumable electrode are propelled axially across the arc. See Figures B39(C) and B39(D). See also **globular transfer**, and **short circuiting transfer**. See Annex C, C1.5.10.

sprayer. See **thermal sprayer**. See also **thermal spraying operator**.

spraying booth. An exhaust booth where thermal spraying is performed.

spraying operator. See **thermal spraying operator**. See also **thermal sprayer**.

spraying rate, *thermal spraying*. The rate at which surfacing material passes through the torch.

spraying sequence, *thermal spraying*. The order in which layers of materials are applied, such as overlapped, superimposed, or at various angles.

square edge shape. A type of edge shape in which the prepared surface lies perpendicular to the material surface. See Figure B7(A).

square groove. A weld groove formed by the combination of a butting workpiece having a square edge shape and a planar surface of a companion member. See Figures B8(A) and B9(A).

square-groove weld. A weld in a square groove. See Figures B8(A) and B9(A).

squeeze time, *resistance welding*. The interval between initiation of the welding cycle and first application of welding current. See Figures B49 and B50.

stack cutting. Thermal cutting of stacked metal plates arranged so that all the plates are severed by a single cut.

staggered intermittent weld. An intermittent weld on both sides of a joint in which the weld segments on one side are alternated with respect to those on the other side. See Figure B23(H).

stake weld. See **high energy beam spot weld** or **high energy beam seam weld**.

standard qualification build, *additive manufacturing*. A qualification build from which standard test specimens are removed, tested, and evaluated. This build supports qualification of a machine.

standard welding procedure specification (SWPS). A welding procedure specification qualified according to the requirements of AWS B2.1/B2.1M, compiled and approved by AWS, and made available for production welding, without qualification, by companies or individuals other than those who performed the original qualification.

standoff distance. The distance between a nozzle and the workpiece. See Figures B35, B36, and B38.

standoff distance, *explosion welding*. The distance between two plates fit to be joined.

start current. The welding current value during the start time interval. See Figure B54.

start time. The time interval prior to the weld time during which arc voltage and welding current reach a preset value greater or less than welding values. See Figure B54.

starting weld tab. See **run-on weld tab**. See Figure B12(E).

static electrode force, *resistance welding*. The force exerted by electrodes on the workpieces under welding conditions, but without welding current flowing or movement between the welding electrodes. See also **dynamic electrode force** and **theoretical electrode force**.

stationary shoe. A backing shoe remaining in a fixed position during welding. See also **moving shoe**.

step brazing. A brazing process variation in which successive joints of an assembly are produced without melting previously brazed joints.

step soldering. A soldering process variation in which successive joints of an assembly are soldered without melting previously soldered joints.

stepback sequence. A nonstandard term for **backstep sequence**.

stick electrode. A nonstandard term for **covered electrode**.

stick electrode welding. A nonstandard term for **shielded metal arc welding**.

stickout, *gas metal arc welding* and *gas-shielded flux cored arc welding*. The length of unmelted electrode extending beyond the end of the gas nozzle. See Figure B38. See also **electrode extension**.

stickout, *gas tungsten arc welding*. The length of tungsten electrode extending beyond the end of the gas nozzle. See Figure B36. See also **electrode extension**.

stinger. A nonstandard term for **electrode holder**.

stitch weld. A nonstandard term for **intermittent weld**.

stopoff, *brazing* and *soldering*. A material applied to surfaces adjacent to a joint to limit the spread of filler metal or flux.

stored energy welding. A welding process variation in which welding current is produced from electrical energy accumulated electrostatically, electromagnetically, or electrochemically at a low rate and released at a relatively high rate.

straight polarity. A nonstandard term for **direct current electrode negative**.

stranded electrode. A composite filler metal electrode consisting of stranded wires that may mechanically enclose materials to improve properties, stabilize the arc, or provide shielding.

stress corrosion crack. Failure of metals as a result of the combined actions of corrosion and stress, residual or applied. In brazing, the term applies to the cracking of stressed base metal due to the presence of a liquid filler metal.

stress relief crack. Intergranular cracking in the heat-affected zone or weld metal as a result of the combined action of residual stresses and postweld exposure to an elevated temperature.

stress relief heat treatment. A type of postweld heat treatment used primarily for the reduction of residual stresses.

strike. See **arc strike**.

stringer bead. A weld bead formed without appreciable weaving. See Figure B22(A). See also **weave bead**.

strongback. A device attached to the members of a joint to maintain their alignment during welding.

stub. The short length of filler metal electrode, welding rod, or brazing rod remaining after its use for welding or brazing.

stud arc welding. A nonstandard term for **arc stud welding**.

stud welding. A general term for joining a metal stud or similar part to a workpiece. Welding may be accomplished by arc, resistance, friction, or other process with or without external gas shielding. See also **arc stud welding**.

submerged arc welding (SAW). An arc welding process using an arc or arcs between a continuous filler metal electrode or electrodes and the weld pool. The arc and molten metal are shielded by a blanket of granular flux on the workpieces. The process is used without pressure and with filler metal from the electrode and sometimes from a supplemental source (welding rod, flux, or metal granules). See also **hot wire welding** and **series submerged arc welding**.

substrate. A workpiece onto which a coating is applied.

successive block sequence. A block sequence in which subsequent blocks are completed in an order selected to control residual stresses and distortion. See also **progressive block sequence**.

suck-back. A nonstandard term when used for **underfill** at the root surface.

sump, *electrogas welding* and *electroslag welding*. Starting weld tabs sufficient to allow the process to reach stable operation for complete fusion of the weld metal to the groove faces of the joint. See Figure B12(D).

support structure, *additive manufacturing*. Material deposited during the build cycle used to support the integrity of the build but not considered part of the final part geometry. Support structures may include mechanical supports, thermal supports, or protective features.

surface expulsion, *resistance welding*. Expulsion occurring between the electrode and the workpiece.

surface preparation. The operations necessary to produce a desired or specified surface condition.

surface roughening, *thermal spraying*. A group of methods for producing irregularities on a surface. See also **abrasive blasting**, **dovetailing**, **groove and rotary roughening**, **rotary roughening**, **rough threading**, and **threading and knurling**. See Figure B43.

surface temper bead. A weld bead resulting from a surface temper pass. A surface temper bead or layer may or may not be mechanically removed. See Figure B23(J). See also **toe temper bead**.

surface temper pass. A weld pass deposited on the cover layer in a manner to affect the mechanical and metallurgical properties of the previously deposited weld metal and heat-affected zone. See also **toe temper pass**.

surfacing. The application by welding, brazing, or thermal spraying of a layer, or layers, of material to a surface to obtain specified properties or dimensions, as opposed to joining. See also **buildup**, **buttering**, **cladding**, and **hardfacing**.

surfacing material. The material applied to a base metal or substrate during surfacing.

surfacing metal. The metal or alloy applied to a base metal or substrate during surfacing.

surfacing weld. A weld applied to a surface, as opposed to making a joint, to obtain desired properties or dimensions. See Figures B15(C) and B30(C).

susceptor. An inductively heated component positioned near a joint to aid in heating.

sustained backfire. The recession of the flame into the oxyfuel torch body with continued burning characterized by an initial popping sound followed by a squealing or hissing sound, potentially burning through the torch body. See also **backfire** and **flashback**.

sweat soldering. A nonstandard term for **soldering**.

sweating. A nonstandard term for **soldering**.

synchronous timing, *resistance welding*. Coordination of AC output and welding transformer primary current with input voltage waveform.

synergic control. A change of multiple welding parameters in response to a single adjustment.

T

T-joint. A joint type formed by a butting workpiece aligned approximately perpendicular to the surface of a nonbutting workpiece. See Figures B1(C), B2(C), and B10(F). See also **skewed joint**.

tab. See **runoff weld tab**, **starting weld tab**, and **weld tab**.

tack weld. A weld made to hold the parts of a weldment in proper alignment until the final welds are made.

tack welder. One who performs manual or semiautomatic welding to produce tack welds.

tacker. A nonstandard term for **tack welder**.

tandem submerged arc welding. A nonstandard term when used for **multiple electrode submerged arc welding**.

tap. A nonstandard term when used for **transformer tap**.

tap switch. A mechanical device used to select a **transformer tap**.

taper delay time. The time interval after upslope during which the maximum welding current or high pulse current is constant. See Figure B53.

taper time. The time interval when current increases or decreases continuously from the welding current to final taper current. See Figure B53.

temper bead. See **surface temper bead** and **toe temper bead**.

temper bead sequence. A cross-sectional sequence in a multiple-pass weld in which the order and position of weld passes result in the creation of temper beads. See Figure B23(J).

temper bead welding, (TBW). Use of a weld bead sequence to reheat previously deposited weld metal in a controlled manner to affect mechanical and metallurgical properties of the previously deposited weld metal or heat-affected zone. The technique may be used as a single weld pass or multiple coordinated passes to achieve the desired result. See Figure B23.

temper pass. See **surface temper pass and toe temper pass**.

temper time, *resistance welding*. The time following quench time during which a current is passed through the weld for heat treating. See Figure B49.

temporary weld. A weld made to attach a piece or pieces to a weldment for temporary use in handling, shipping, or working on the weldment.

tension test. A test in which a specimen is loaded in tension until failure occurs. See also **reduced section test specimen**.

test coupon. A weldment, brazement, solderment, or coated substrate, consisting of one or more coupons, used for qualification or process control testing.

test specimen. A portion of a test coupon or a specimen blank prepared for testing.

test weldment. See **test coupon**.

testpiece. An assembly or component used for qualification or process control testing.

theoretical electrode force, *resistance welding*. The calculated force, neglecting friction and inertia, developed by the mechanical system of a resistance welding device. See also **dynamic electrode force** and **static electrode force**.

theoretical throat. The distance from the beginning of the joint root perpendicular to the hypotenuse of the largest right triangle inscribed within the cross section of a fillet weld. See Figures B25(A)–(D). See also **actual throat** and **effective throat**.

thermal cutter. One who performs manual or semiautomatic thermal cutting. Variations of this term are **arc cutter** and **oxygen cutter**. See also **thermal cutting operator**.

thermal cutting (TC). A group of cutting processes severing or removing metal by localized melting, burning, or vaporizing of the workpieces. See also **arc cutting**, **high energy beam cutting**, and **oxygen cutting**.

thermal cutting operator. One who operates automatic, mechanized, or robotic thermal cutting equipment. Variations of this term are **arc cutting operator**, **electron beam cutting operator**, **laser beam cutting operator**, and **oxygen cutting operator**. See also **thermal cutter**.

thermal gouging (TG). A thermal cutting process variation removing metal by melting or burning the entire removed portion to form a bevel or groove. See also **arc gouging**, **backgouging**, and **oxygen gouging**.

thermal spray deposit. The coating or layer of surfacing material applied by a thermal spraying process. See Figure B31(B).

thermal spray deposit density ratio. The ratio of the density of the thermal spray deposit to the theoretical density of the surfacing material, usually expressed as percent of theoretical density.

thermal spray deposit interface. The boundary between the thermal spray deposit and the substrate.

thermal spray deposit strength. The tensile strength of a thermal spray deposit.

thermal spray deposit stress. The residual stress in a thermal spray deposit resulting from rapid cooling of molten or semimolten particles as they impinge on the substrate.

thermal spray pass. A single progression of the thermal spraying torch across the substrate surface.

thermal sprayer. One who performs manual or semiautomatic thermal spraying. Variations of this term are **arc sprayer**, **flame sprayer**, and **plasma sprayer**.

thermal spraying (THSP). A group of processes in which finely divided metallic or nonmetallic surfacing materials are deposited in a molten or semimolten condition on a substrate to form a thermal spray deposit. The surfacing material feedstock may be in the form of powder, rod, cord, or wire. See also **arc spraying**, **flame spraying**, **high velocity oxyfuel spraying**, and **plasma spraying**.

thermal spraying deposition efficiency. The ratio of the weight of thermal spray deposit to the weight of surfacing material sprayed, expressed as a percentage.

thermal spraying torch. A device for heating, feeding, and directing the flow of surfacing material.

thermal spraying operator. One who operates automatic, mechanized, or robotic thermal spraying equipment. Variations of this term are **arc spraying operator**, **flame spraying operator**, and **plasma spraying operator**.

thermal stress. Stress in a material or assembly resulting from nonuniform temperature distribution or differential thermal expansion.

thermite crucible. The vessel in which the thermite reaction takes place.

thermite mixture. A mixture of metal oxide and finely divided aluminum with the addition of alloying metals as required.

thermite mold. A mold formed around the workpieces to receive molten metal.

thermite reaction. The chemical reaction between metal oxide and aluminum producing superheated molten metal and a slag containing aluminum oxide.

thermite welding (TW). A welding process producing coalescence of metals by heating them with superheated liquid metal from a chemical reaction between a metal oxide and aluminum, with or without the application of pressure. Filler metal is obtained from the liquid metal.

thermocompression bonding. A nonstandard term for **hot pressure welding**.

threading and knurling, *thermal spraying*. A method of surface roughening in which spiral threads are prepared, followed by upsetting with a knurling tool. See Figure B43(E). See also **groove and rotary roughening**, **knurling**, and **rotary roughening**.

throat area, *resistance welding*. The region bounded by the physical components of the secondary circuit of a welding machine.

throat crack. A crack in the throat of a fillet weld. See Figure B33.

throat depth, *resistance welding*. The distance from the centerline of the electrodes or platens to the nearest point of interference for flat sheets.

throat height, *resistance welding*. The minimum distance between the arms of the welding machine throughout the throat area.

throat length. A nonstandard term when used for **constricting orifice length**.

throat of a groove weld. A nonstandard term for **groove weld size**.

throat opening. A nonstandard term for **throat height**.

tie-in, *n., fusion welding*. The junction of weld metal and base metal or prior weld metal where fusion is intended.

tie-in, *v., fusion welding*. To manipulate the welding process at the junction of the weld metal and base metal or weld metal to facilitate fusion.

TIG welding. A nonstandard term for **gas tungsten arc welding**. See Annex C, C1.5.3.

tinning. A nonstandard term when used for **precoating** for soldering.

tip. See **cutting tip** and **welding tip**.

tip dresser. A tool for restoring a resistance welding electrode face profile.

tip skid. A nonstandard term for **electrode skidding**.

toe crack. A crack observed at the weld toe. See Figures B32(A) and B33(A).

toe of weld. See **weld toe**.

toe reentrant angle. The angle between lines tangent to the adjacent base metal surface and weld face at the weld toe or root surface at the weld root. See also **bead reentrant angle**. See Figures B32(I), B32(K)—(M).

toe temper bead. A weld bead resulting from a toe temper pass. See Figure B23(J). See also **surface temper bead**.

toe temper pass. A weld pass deposited on the cover bead adjacent to the weld toe in a manner to affect the mechanical and metallurgical properties of the cover bead heat-affected zone. The result of a toe temper pass is a toe temper bead. See Figure B23(J).

torch. See **air carbon arc cutting torch**, **arc cutting torch**, **arc welding torch**, **cutting torch**, **gas tungsten arc cutting torch**, **gas tungsten arc welding torch**, **heating torch**, **oxyfuel gas cutting torch**, **oxyfuel gas welding torch**, **plasma arc cutting torch**, **plasma arc welding torch**, **thermal spraying torch**, and **welding torch**.

torch brazing (TB). A brazing process using heat from a fuel gas flame.

torch extension. A device attached to a thermal spraying torch to permit spraying within confined areas or deep recesses.

torch soldering (TS). A soldering process using heat from a fuel gas flame.

torch tip. See **cutting tip** and **welding tip**.

total instantaneous energy (TIE), *waveform-controlled welding.* The sum of products of amperages, voltages, and time intervals determined at sampling frequencies sufficient to quantify waveform changes during a welding interval. See Annex C, C1.5.10.

transfer mode. See **metal transfer mode**.

transfer tape. A nonstandard term when used for **brazing tape**.

transferred arc. An arc established between the electrode of the plasma arc torch and the workpiece. See also **nontransferred arc**.

transformer tap. One of multiple connections to a transformer winding used to establish the transformer turns ratio, thereby controlling welding voltage and welding current.

transgun. A resistance welding gun with an integral, closely coupled resistance welding transformer.

transverse bend specimen. See **transverse weld test specimen**.

transverse crack. A crack with its major axis oriented approximately perpendicular to the weld axis. See Figure B33(A).

transverse tension specimen. See **transverse weld test specimen**.

transverse weld test specimen. A weld test specimen with its major axis perpendicular to the weld axis. See also **longitudinal weld test specimen**.

travel angle. The angle less than 90º between the electrode axis and a line perpendicular to the weld axis, in a plane determined by the electrode axis and the weld axis. This angle can also be used to partially define the position of guns, torches, rods, and beams. See Figure B21. See also **drag angle**, **push angle**, and **work angle**.

travel angle, *pipe*. The angle less than 90º between the electrode axis and a line perpendicular to the weld axis at its point of intersection with the extension of the electrode axis, in a plane determined by the electrode axis and a line tangent to the pipe surface at the same point. This angle can also be used to partially define the position of guns, torches, rods, and beams. See Figure B21. See also **drag angle**, **push angle**, and **work angle**.

travel speed, *welding*. The rate of progression with respect to the weld axis.

travel start delay time. The time interval from arc initiation to the start of the torch, gun, or workpiece travel. See Figure B53.

travel stop delay time. The time interval from beginning of downslope time or crater fill time to shut-off of torch, gun, or workpiece travel. See Figure B53.

tubular joint. A joint between two or more members, at least one of which is tubular.

tungsten active gas (TAG) welding. A nonstandard term for **gas tungsten arc welding** with an active gas.

tungsten electrode. A nonfiller metal electrode used in arc welding, arc cutting, and plasma spraying, made principally of tungsten.

tungsten inclusion. A discontinuity consisting of tungsten entrapped in weld metal.

tungsten inert gas (TIG) welding. A nonstandard term for **gas tungsten arc welding** with an inert gas.

twin carbon arc brazing (TCAB). A brazing process using heat from an arc between two carbon electrodes. This is an obsolete or seldom used process. See Table A5.

twin carbon arc welding (CAW-T). A carbon arc welding process variation using an arc between two carbon electrodes and no shielding. This is an obsolete or seldom used process. See Table A5.

type of joint. See **joint type**.

U

U-groove weld. A groove weld applied to a joint with mating J-edge shapes. See Figures B8(G) and B9(E).

ultrasonic coupler, *ultrasonic soldering* and *ultrasonic welding*. Elements through which ultrasonic vibration is transmitted from the transducer to the tip.

ultrasonic soldering (USS). A soldering process variation in which high-frequency vibratory energy is transmitted through molten solder to remove undesirable surface films and thereby promote wetting of the base metal. This operation is usually accomplished without flux.

ultrasonic testing (UT). A nondestructive examination method using high-frequency sound waves for the detection of volumetric discontinuities in a test object.

ultrasonic welding (USW). A solid-state welding process producing a weld by the local application of high-frequency vibratory energy as the workpieces are held together under pressure.

ultrasonic plastic welding (USW-P), *thermoplastics*. A fusion welding process using high-frequency, low amplitude, vibratory energy, applied perpendicular to the joint, as the workpieces are held together under pressure.

ultra-speed welding. A nonstandard term for **commutator-controlled welding**.

underbead crack. A heat-affected zone crack in steel weldments arising from the occurrence of a crack-susceptible microstructure, residual or applied stress, and the presence of hydrogen. See Figures B32(B) and B33(A).

undercut. A groove melted into the base metal adjacent to the weld toe or weld root and left unfilled by weld metal. See Figures B32(C) and B32(D).

underfill. A groove weld condition in which the weld face or root surface is below the adjacent surface of the base metal at the joint. See Figures B32(E)—(H).

underwater welding. Welding performed within the confines of a body of water. See **dry chamber welding**, **dry welding**, **habitat welding**, and **wet welding**. See also **one-atmosphere welding**.

unfused flux, *submerged arc welding*. Flux not melted during welding.

universal seam welding machine, *resistance seam welding*. A machine configuration which may be configured as either a circumferential or longitudinal seam welder. See also **circumferential seam welding machine** and **longitudinal seam welding machine**.

unmixed zone. A thin layer of fused base metal, adjacent to the weld interface, solidified without mixing with the weld metal. See also **mixed zone**.

uphill, *adv.* Welding with an upward progression.

upset. Bulk deformation of a workpiece(s) resulting from the application of pressure, with or without added heat, expressed in terms of increase in transverse section area, reduction in length, reduction in thickness, or reduction of the cross wire weld stack height.

upset butt welding. A nonstandard term for **upset welding**.

upset distance. The total reduction in the axial length of the workpieces from the initial contact to the completion of the weld. In flash welding, the upset distance is equal to the platen movement from the end of flash time to the end of upset. See Figures B44 and B45.

upset force. The force exerted at the faying surfaces during upsetting.

upset time. The portion of a welding cycle during which upset occurs.

upset welding (UW). A resistance welding process producing a weld over the entire area of faying surfaces or progressively along a butt joint. See Figures B15(A), B31(C), B52(A), B52(B), B52(D), and B52(E). See also **high-frequency upset welding** and **induction upset welding**.

upslope time. The interval during which the welding current or power is continuously increased. See Figures B49 and B53.

usability. A measure of the relative ease of application of a filler metal to result in a sound weld or braze joint. Qualification standards assign F-numbers to groups of filler metal classifications exhibiting similar usability.

V

V-groove weld. A groove weld applied to a joint with mating bevel edge shapes. See Figures B8(C), B8(D), and B9(C).

vacuum brazing. A nonstandard term for various **brazing** processes taking place in a chamber or retort below atmospheric pressure.

vacuum laser beam welding (LBW-V). A laser beam welding process variation in which welding is accomplished in a vacuum without gas shielding.

vacuum plasma spraying (VPSP). A plasma spraying process variation accomplished below atmospheric pressure.

variable polarity. A type of alternating current output from an arc welding power source in which the positive and negative periods can be separately adjusted in terms of duration, amplitude, or both.

vertical-down. A nonstandard term for **downhill**.

vertical-up. A nonstandard term for **uphill**.

vertical position. See **vertical welding position**.

vertical position, *pipe welding*. A nonstandard term when used for the pipe **welding test position** designated as **2G**.

vertical welding position. The welding position in which the weld axis, at the point of welding, is approximately vertical, and the weld face lies in an approximately vertical plane. See Figures B16(A)—(C), B17(C), and B18(C).

vibration welding (VW), *thermoplastics*. A fusion welding process using low-frequency high-amplitude vibratory energy, applied parallel to the joint, as the workpieces are held together under pressure.

virgin flux, *submerged arc welding*. Unused flux produced using new raw materials. See also **recycled flux**.

visual examination. See **visual testing**.

visual inspection. See **visual testing**.

visual testing (VT). A nondestructive examination method using vision to directly or indirectly examine a test object for detection and evaluation of surface discontinuities and conditions.

void. A nonstandard term when used for **incomplete bond**.

voltage regulator. An automatic electrical control device for maintaining a constant voltage supply to the primary of a welding transformer.

W

Wall neutrality number, *submerged arc welding*. An index assigned to a flux to allow its classification as either an active or neutral flux based on a given electrode classification. Means of determining this index are described in AWS A5.17/A5.17M, *Specification for Carbon Steel Electrodes and Fluxes for Submerged Arc Welding*, and AWS A5.23/A5.23M, *Specification for Low-Alloy and High Manganese Steel Electrodes and Fluxes for Submerged Arc Welding*.

wash pass. A nonstandard term when used for a **cosmetic pass**, **cover pass**, or **smoothing pass**.

waster plate, *oxyfuel gas cutting*. A carbon steel plate placed on an alloy workpiece at the torch side to provide the necessary iron to facilitate cutting of the alloy workpiece.

water wash. The forcing of exhaust air and fumes from a spray booth through water so the vented air is free of thermal sprayed particles or fumes.

waveform-controlled welding, *arc welding*. A process modification using software to purposely manipulate the output welding waveform. See Annex C, C1.5.10.

wave soldering (WS). A soldering process using heat from a bath of soldering filler metal flowing against the joint by an induced wave action. See also **dip soldering**.

wax pattern, *thermite welding*. Wax molded around the workpieces to the form desired for the completed weld.

weave bead. A weld bead formed using weaving. See Figure B22(B). See also **stringer bead**.

weaving. A welding technique in which the thermal source is oscillated transversely as it progresses along the weld path. See also **oscillation** and **whipping**.

weld, *n*. A localized coalescence of metals or nonmetals produced either by heating the materials to the welding temperature, with or without the application of pressure, or by the application of pressure alone and with or without the use of filler material.

weld, *v.* The act of welding.

weld access hole. An opening that permits access for welding, backgouging, or for insertion of backing.

weld axis. A line through the length of the weld, perpendicular to and at the geometric center of its cross section. See Figures B16A, B16B, and B21.

weld bead. A weld resulting from a weld pass. See Figures B22, B23(D), and B23(E). See also **stringer bead** and **weave bead**.

weld bead toe. The junction between adjacent weld bead surfaces on the face of a multipass weld. See Figures B24(Q) and B24(R).

weld bonding. A welding process variation in which the weld strength is augmented by adhesive at the faying surfaces.

weld brazing. Brazing using heat from a welding process wherein the preplaced brazing filler metal is melted to form a braze augmenting the weld by increasing joint strength or creating a seal between spot or intermittent welds.

weld brazing. A nonstandard term when used for **resistance brazing**.

weld crack. A crack located in the weld metal zone or heat-affected zone. See Figure B33.

weld dam. A metallic or nonmetallic object placed at the end of a weld groove to contain the molten metal and facilitate complete cross-sectional filling of the weld groove. See also **weld tab**.

weld dam. A nonstandard term when used for **backing shoe**.

weld face. The exposed surface of a weld on the side from which welding was done. See Figures B24(A) and B24(E).

weld face underfill. See **underfill**. See Figures B32(E) and B32(F).

weld gage. See **weld gauge**.

weld gauge. A device designed for measuring the shape and size of welds.

weld groove, *fusion welding*. A channel in the surface of a workpiece or an opening between two joint members providing space to contain weld metal.

weld interface. The boundary between weld metal and base metal in a fusion weld, between base metals in a solid-state weld without filler metal, or between filler metal and base metal in a solid-state weld with filler metal. See Figures B30(A)–(D), B31(C), and B31(D).

weld interface crack. A crack occurring at the weld interface. See Figure B33.

weld interval, *resistance welding*. The sum of heat and cool times to produce a pulsation weld. See Figure B49. See also **weld time**.

weld joint mismatch. See **joint mismatch**.

weld line. A nonstandard term for **weld interface**.

weld lobe. See **weldability lobe**.

weld metal. The metal in a fusion weld composed of that portion of the base metal and filler metal (if used) melted during welding. See also **dilution**, **mixed zone**, **unmixed zone**, and **weld metal zone**.

weld metal crack. A crack occurring in the weld metal zone. See Figure B33.

weld metal zone (WMZ). The portion of the weld area consisting of weld metal. See Figure B24(G). See also **base metal zone** and **heat-affected zone**.

weld pass. A single progression of welding along a joint. The result of a weld pass is a weld bead or layer.

weld pass sequence. The order in which the weld passes are made. See **cross-sectional sequence** and **longitudinal sequence**.

weld penetration. A nonstandard term for **joint penetration** or **root penetration**.

weld pool. The localized volume of molten metal in a weld prior to its solidification as weld metal.

weld puddle. A nonstandard term for **weld pool**.

weld recognition. A function of an adaptive control determining changes in the shape of the weld pool or the weld metal during welding, and directing the welding machine to take appropriate action. See also **joint recognition** and **joint tracking**.

weld reinforcement. Weld metal in excess of the quantity required to fill a weld groove. See Figures B24(A) and (C). See also **convexity**, **face reinforcement**, and **root reinforcement**.

weld root. The points, shown in cross section, at which the weld metal intersects the base metal and extends furthest into the joint. See Figures B24(B)—(E), B24(H)—(K), and B24(M)—(P).

weld seam. A nonstandard term for **joint**, **seam weld**, or **weld**.

weld shoe. A nonstandard term when used for **backing shoe**.

weld size. See **edge weld size**, **fillet weld size**, **groove weld size**, **plug weld size**, **projection weld size**, **seam weld size**, **slot weld size**, and **spot weld size**.

weld symbol. A graphic character connected to the reference line of a brazing or welding symbol specifying the joint geometry or weld type. For examples and rules for their application, refer to AWS A2.4, *Standard Symbols for Welding, Brazing, and Nondestructive Examination*.

weld tab. Material added to either end of a weld joint to provide support for weld metal at the start or termination of weld passes. Weld tabs should be configured to match the joint geometry. See Figure B12(E). See **run-off weld tab** and **run-on weld tab**.

weld throat. See **actual throat**, **effective throat**, and **theoretical throat**.

weld time, *automatic arc welding*. The time interval from the end of start time or end of upslope to beginning of crater fill time or beginning of downslope. See Figures B53 and B54.

weld time, *resistance welding*. The duration of time when welding current passes through workpieces in a single pulse. See Figures B49 and B50. See also **weld interval**.

weld toe. The junction of the weld face and the base metal. See Figures B24(A) and B24(E).

weld type. A weld classification based on its basic shape and joint design. See Figures B1, B7, B8, B9, B10, B13(A), B14, and B15.

weld voltage. See **arc voltage**.

weldability. The relative ease with which a material may be welded to meet an applicable standard.

weldability lobe, *resistance welding*. Ranges of welding current, time, and force, in combination, resulting in acceptable welds.

weldability test. A test used to determine weldability of a material using mechanical or metallurgical means.

welded test assembly. See **test coupon**.

welder. An individual performing manual or semiautomatic welding. This individual may be qualified separately to use welding for joining or surfacing. See Annex C, C1.5.4.

welder certification. Documentation attesting to the performance qualification of a welder.

welder performance qualification. See **performance qualification**.

welder performance qualification variable. See **performance qualification variable**.

welding. A joining process producing coalescence of materials by heating them to the welding temperature, with or without the application of pressure or by the application of pressure alone, and with or without the use of filler metal. See Figures A1, A3—A5, and Figure A7.

welding arc. A controlled electrical discharge between the electrode and the workpiece formed and sustained by the establishment of a gaseous conductive medium, called an arc plasma.

welding blowpipe. A nonstandard term for **oxyfuel gas welding torch**.

welding circuit. Conductive material through which the welding current is intended to flow.

welding current. The electric current in the secondary circuit during the weld interval or weld time. See Figures B49, B50, B51, B53, and B54.

welding cycle. The complete series of events involved in the making of a weld. See Figures B49, B50, B53, and B54.

welding electrode. A component of the welding circuit through which current is conducted and that terminates at the arc, molten conductive slag, or base metal. See also **arc welding electrode**, **bare electrode**, **carbon electrode**, **composite electrode**, **consumable guide**, **covered electrode**, **emissive electrode**, **flux cored electrode**, **lightly coated electrode**, **metal cored electrode**, **metal electrode**, **resistance welding electrode**, **stranded electrode**, and **tungsten electrode**.

welding filler metal. The filler metal to be added in making a fusion weld.

welding flux. A flux used for welding. See also **brazing flux** and **soldering flux**.

welding flux, *submerged arc welding.* A granular material comprised of metallic and nonmetallic constituents applied during welding to provide atmospheric shielding and cleaning of the molten weld metal and influence the profile of the solidified weld metal. This material may also provide filler metal and affect the weld metal composition. See **active flux**, **agglomerated flux**, **alloy flux**, **bonded flux**, **fused flux**, **mechanically mixed flux**, **neutral flux**, **reconditioned flux**, **recycled flux**, and **virgin flux**.

welding force. See **dynamic electrode force**, **electrode force**, **forge force**, **friction welding force**, **static electrode force**, **theoretical electrode force**, and **upset force**.

welding generator. An electric generator used to produce welding current.

welding ground. A nonstandard and incorrect term for **workpiece connection**.

welding head. The part of a welding machine in which a welding gun or torch is incorporated.

welding helmet. A device equipped with a filter plate designed to be worn on the head to protect eyes, face, and neck from arc radiation, radiated heat, spatter, or other harmful matter expelled during some welding and cutting processes.

welding hood. A nonstandard term for **welding helmet**.

welding inspection. The process of verifying the attainment of acceptable weld quality using observations before, during, and after the application of welding.

welding leads. The workpiece lead and the electrode lead of an arc welding circuit. See Figure B34.

welding machine. Equipment used to perform the welding operation. For example, spot welding machine, arc welding machine, and seam welding machine.

welding operator. An individual who observes and controls an automatic, mechanized, or robotic welding process.

welding operator certification. Documentation attesting to the performance qualification of a welding operator.

welding operator performance qualification. See **performance qualification**.

welding operator performance qualification variable. See **performance qualification variable**.

welding position. The relationship between the weld pool, joint, joint members, and welding heat source during welding. See Figures B16–B20. See also **flat welding position**, **horizontal welding position**, **overhead welding position**, **vertical welding position**, and **welding test position**.

welding power source. An apparatus for supplying electric current and voltage suitable for welding. See also **constant current power source**, **constant voltage power source**, **welding generator**, **welding rectifier**, and **welding transformer**.

welding procedure. A detailed description of the materials and methods used to weld materials, including activities before and after the application of the welding process.

welding procedure qualification. Demonstration of the use of a process to weld materials using detailed techniques resulting in a test coupon meeting an applicable qualification standard.

welding procedure qualification record (WPQR). See **procedure qualification record**.

welding procedure qualification variable. See **procedure qualification variable**.

welding procedure specification (WPS). See **procedure specification**.

welding progression, *vertical welding*. The direction of motion along the joint with respect to gravity. See also **downhill** and **uphill**.

welding rectifier. A device in a welding power source for converting alternating current to direct current.

welding rod. A form of welding filler material, normally supplied in straight lengths, not intended to conduct welding current. See Figure B36.

welding schedule. A written description, usually in tabular form, of welding procedure variables and sequence for performing a welding operation for a specific application. See also **welding procedure specification**.

welding sequence. The order of making welds in a weldment.

welding symbol. A graphical representation of the specifications for producing a welded joint. See also **weld symbol**. For examples and rules for their application, refer to AWS A2.4, *Standard Symbols for Welding, Brazing, and Nondestructive Examination*.

welding technique. Details of the welding operation controlled by the welder or welding operator.

welding test position. The orientation of a joint for welding procedure or welder qualification testing. See also **welding position** and **welding test position designation**.

welding test position designation. A symbol representation for weld type and joint orientation. See **1F**, **1FR**, **2F**, **2FR**, **3F**, **3FR**, **4F**, **4FR**, **5F**, **6F**, **1G**, **1GR**, **2G**, **2GR**, **2G-RA**, **3G**, **3GR**, **4G**, **4GR**, **5G**, **6G**, **6GR**, **1S**, **1SR**, **2S**, **3S**, **3SR**, **4S**, **4SR**, **5S**, and **6S**.

welding tip. A nonstandard term when used for **resistance welding electrode** for resistance spot welding.

welding tip, *oxyfuel gas welding*. The part of an oxyfuel gas welding torch from which gases issue.

welding torch. See **arc welding torch**, **gas tungsten arc welding torch**, **oxyfuel gas welding torch**, and **plasma arc welding torch**.

welding transformer. A transformer converting input power into useable levels of voltage and electric current for welding at a rated duty cycle.

welding variable. See **procedure qualification variable.**

welding voltage. See **arc voltage**, **open circuit voltage**, and **resistance welding voltage**.

welding waveform. A graphic representation of a welding power source output affecting specific characteristics, including penetration, fusion depth, wetting, bead size and shape, and metal transfer mode. See Figures B53 and B54. See Annex C, C1.5.10.

welding wheel. A nonstandard term for **circular electrode**.

welding wire. A form of welding filler material, normally packaged as coils or spools, that may or may not conduct electric current depending upon the welding process with which it is used. See Figure B36. See also **welding electrode** and **welding rod**.

weldment. An assembly joined by welding.

wet welding. A variation of underwater welding performed at ambient pressure with no physical barrier around the joint. See also **dry welding**.

wetting, *brazing* and *soldering*. The phenomenon whereby a liquid filler metal or flux spreads and adheres in a thin continuous layer on a solid surface.

whipping. A welding technique in which the thermal source is oscillated longitudinally as it advances along the progression of welding. See also **oscillation** and **weaving**.

wiped joint. A joint made with soldering filler metal having a wide melting range and with the heat supplied by the molten solder poured onto the joint. The solder is manipulated with a handheld cloth or paddle so as to obtain the required size and contour.

wire feed speed. The rate at which wire is consumed in arc cutting, thermal spraying, or welding.

wire flame spraying (FLSP-W). A flame spraying process variation in which the surfacing material is in wire form.

wire straightener. A device used for controlling the cast and helix of coiled wire to enable it to be easily fed through the wire feed system.

witness specimen, *additive manufacturing*. Material deposited along with a preproduction or production build for reference or testing purposes.

work angle. The angle less than 90º between a line perpendicular to the major workpiece surface and a plane determined by the electrode axis and the weld axis. In a T-joint or a corner joint, the line is perpendicular to the nonbutting workpiece. This angle can also be used to partially define the position of guns, torches, rods, and beams. See Figure B21. See also **drag angle**, **push angle**, and **travel angle**.

work angle, *pipe*. The angle less than 90º between a line perpendicular to the cylindrical pipe surface at the point of intersection of the weld axis and the extension of the electrode axis, and a plane determined by the electrode axis and a line tangent to the pipe at the same point. In a T-joint, the line is perpendicular to the nonbutting workpiece. This angle can also be used to partially define the position of guns, torches, rods, and beams. See Figure B21(C). See also **drag angle**, **push angle**, and **travel angle**.

work coil. See **induction work coil**.

work connection. A nonstandard term for **workpiece connection**.

work lead. A nonstandard term for **workpiece lead**.

workpiece. An assembly, component, member, or part in the process of being manufactured. See Annex C, C1.5.5.

workpiece connection. A nonstandard term when used for **workpiece connector**.

workpiece connector. A device used to provide an electrical connection between the workpiece and the workpiece lead. See Figure B34.

workpiece lead. A secondary circuit conductor transmitting energy from the power source to the workpiece connector. See Figure B34.

wormhole porosity. A nonstandard term when used for **piping porosity**.

Annex A (Normative)
Processes, Classifications, and Designations

This annex is part of this standard and includes mandatory elements for use with this standard.

Table A1
Letter Designations of Welding, Joining, and Allied Processes

Process	Letter Designation	ISO 4063 Designation[a,b]
adhesive bonding	AB	2000
arc gouging	AG	87
arc welding	AW	1
arc stud welding	SW	78
carbon arc welding	CAW	181
electrogas welding	EGW	73
flux cored arc welding	FCAW	(114, 136)
gas shielded flux cored arc welding	FCAW-G	(136)
self-shielded flux cored arc welding	FCAW-S	(114)
gas metal arc welding	GMAW	13
pulsed gas metal arc welding	GMAW-P	13-P
short circuiting gas metal arc welding	GMAW-SC	13-D
gas tungsten arc welding	GTAW	14
pulsed gas tungsten arc welding	GTAW-P	14-P
magnetically impelled arc welding	MIAW	185
plasma arc welding	PAW	15
shielded metal arc welding	SMAW	111
submerged arc welding	SAW	12
multiple electrode submerged arc welding	SAW-M	(12)
parallel electrode submerged arc welding	SAW-P	(12)
series submerged arc welding	SAW-S	(12)
brazing	B	9
controlled-atmosphere brazing	B-CA	(921)
diffusion brazing	DFB	919
dip brazing	DB	923
electron beam brazing	EBB	914
exothermic brazing	EXB	(93)
furnace brazing	FB	921
induction brazing	IB	916

Table A1 (Continued)
Letter Designations of Welding, Joining, and Allied Processes

Process	Letter Designation	ISO 4063 Designation[a,b]
infrared brazing	IRB	911
laser beam brazing	LBB	913
resistance brazing	RB	918
torch brazing	TB	912
braze welding	BW	97
arc braze welding	ABW	972
electron beam braze welding	EBBW	977
exothermic braze welding	EXBW	(97)
laser beam braze welding	LBBW	976
electroslag welding	ESW	72
consumable guide electroslag welding	ESW-CG	(72)
narrow groove electroslag welding	ESW-NG	(72)
high energy beam welding	HEBW	5
electron beam welding	EBW	51
high vacuum electron beam welding	EBW-HV	(511)
medium vacuum electron beam welding	EBW-MV	(511)
nonvacuum electron beam welding	EBW-NV	(511)
laser beam welding	LBW	52
vacuum laser beam welding	LBW-V	(52)
induction welding	IW	74
oxyfuel gas welding	OFW	31
oxyacetylene welding	OAW	311
oxyhydrogen welding	OHW	313
pressure gas welding	PGW	47
percussion welding	PEW	(44)
plastic welding	PLW	6
electrofusion welding	EFW	611
extrusion welding	EW	647
flow fusion welding	FFW	671
hot gas welding	HGW	64
heated tool welding	HTW	66
induction plastic welding	IW-P	69
infrared welding	IRW	753
radio frequency welding	RFW	62
resistance plastic welding	RW-P	61
socket fusion welding	SFW	663
spin welding	SPW	(42)
ultrasonic plastic welding	USW-P	41
vibration welding	VW	(4)

Table A1 (Continued)
Letter Designations of Welding, Joining, and Allied Processes

Process	Letter Designation	ISO 4063 Designation[a,b]
resistance welding	RW	2
flash welding	FW	24
pressure-controlled resistance welding	RW-PC	(2)
projection welding	PW	23
resistance seam welding	RSEW	22
high-frequency seam welding	RSEW-HF	(22)
induction seam welding	RSEW-I	742
mash seam welding	RSEW-MS	222
resistance spot welding	RSW	21
upset welding	UW	25
high-frequency upset welding	UW-HF	27
induction upset welding	UW-I	741
soldering	S	94
dip soldering	DS	955
furnace soldering	FS	953
induction soldering	IS	946
infrared soldering	IRS	941
iron soldering	INS	943
resistance soldering	RS	948
torch soldering	TS	942
ultrasonic soldering	USS	947
wave soldering	WS	951
solid-state welding	SSW	(4)
coextrusion welding	CEW	493
cold welding	CW	48
diffusion welding	DFW	45
hot isostatic pressure welding	HIPW	451
explosion welding	EXW	441
forge welding	FOW	(44)
friction welding	FRW	42
direct drive friction welding	FRW-DD	421
friction stir welding	FSW	43
inertia friction welding	FRW-I	422
hot pressure welding	HPW	49
roll welding	ROW	(4)
ultrasonic welding	USW	41
thermal cutting	TC	(8)
arc cutting	AC	82
carbon arc cutting	CAC	(82)
air carbon arc cutting	CAC-A	821
gas metal arc cutting	GMAC	(82)
gas tungsten arc cutting	GTAC	(82)
plasma arc cutting	PAC	83
shielded metal arc cutting	SMAC	82
high energy beam cutting	HEBC	(84)
electron beam cutting	EBC	—

Table A1
Letter Designations of Welding, Joining, and Allied Processes

Process	Letter Designation	ISO 4063 Designation[a,b]
laser beam cutting	LBC	84
laser beam air cutting	LBC-A	(84)
laser beam evaporative cutting	LBC-EV	(84)
laser beam inert gas cutting	LBC-IG	(84)
laser beam oxygen cutting	LBC-O	(84)
oxygen cutting	OC	81
flux cutting	OC-F	(81)
metal powder cutting	OC-P	(81)
oxyfuel gas cutting	OFC	(81)
oxyacetylene cutting	OFC-A	(81)
oxyhydrogen gas cutting	OFC-H	(81)
oxynatural gas cutting	OFC-N	(81)
oxypropane cutting	OFC-P	(81)
oxygen arc cutting	OAC	822
oxygen lance cutting	OLC	822
thermal gouging	TG	(8)
carbon arc gouging	CAG	(87)
oxygen gouging	OG	872
plasma arc gouging	PAG	88
thermal spraying	THSP	—
arc spraying	ASP	—
flame spraying	FLSP	—
powder flame spraying	FLSP-P	—
wire flame spraying	FLSP-W	—
high velocity oxyfuel spraying	HVOF	—
plasma spraying	PSP	—
vacuum plasma spraying	VPSP	—
thermite welding	TW	71

[a] ISO 4063, *Welding and allied processes —Nomenclature of processes and reference numbers*. For informational purposes only.
[b] Process designations in parenthesis are not exact equivalents to the AWS process acronym.

Table A2
Alphabetical Cross-Reference to Table A1 by Process

Process	Letter Designation
adhesive bonding	AB
air carbon arc cutting	CAC-A
arc braze welding	ABW
arc cutting	AC
arc gouging	AW
arc spraying	ASP
arc stud welding	SW
arc welding	AW
braze welding	BW
brazing	B
controlled-atmosphere brazing	B-CA
carbon arc cutting	CAC
carbon arc gouging	CAG
carbon arc welding	CAW
coextrusion welding	CEW
cold welding	CW
consumable guide electroslag welding	ESW-CG
diffusion brazing	DFB
diffusion welding	DFW
dip brazing	DB
dip soldering	DS
direct drive friction welding	FRW-DD
electrofusion welding	EFW
electrogas welding	EGW
electron beam braze welding	EBBW
electron beam brazing	EBB
electron beam cutting	EBC
electron beam welding	EBW
electroslag welding	ESW
exothermic braze welding	EXBW
exothermic brazing	EXB
explosion welding	EXW
extrusion welding	EW
flame spraying	FLSP
flash welding	FW
flow fusion welding	FFW
flux cored arc welding	FCAW
flux cutting	OC-F
forge welding	FOW
friction stir welding	FSW
friction welding	FRW
furnace brazing	FB
furnace soldering	FS
gas metal arc cutting	GMAC
gas metal arc welding	GMAW
gas shielded flux cored arc welding	FCAW-G
gas tungsten arc cutting	GTAC
gas tungsten arc welding	GTAW
heated tool welding	HTW
high energy beam cutting	HEBC
high energy beam welding	HEBW
high vacuum electron beam welding	EBW-HV
high velocity oxyfuel spraying	HVOF
high-frequency seam welding	RSEW-HF
high-frequency upset welding	UW-HF
hot gas welding	HGW
hot isostatic pressure welding	HIPW
hot pressure welding	HPW
induction brazing	IB
induction plastic welding	IW-P
induction seam welding	RSEW-I
induction soldering	IS
induction upset welding	UW-I
induction welding	IW
inertia friction welding	FRW-I
infrared brazing	IRB
infrared soldering	IRS
infrared welding	IRW
iron soldering	INS
laser beam air cutting	LBC-A
laser beam braze welding	LBBW
laser beam brazing	LBB
laser beam cutting	LBC
laser beam evaporative cutting	LBC-EV
laser beam inert gas cutting	LBC-IG
laser beam oxygen cutting	LBC-O
laser beam welding	LBW
magnetically impelled arc welding	MIAW
mash seam welding	RSEW-MS
medium vacuum electron beam welding	EBW-MV
metal power cutting	OC-P
narrow groove electroslag welding	ESW-NG
nonvacuum electron beam welding	EBW-NV
oxyacetylene cutting	OFC-A
oxyacetylene welding	OAW
oxyfuel gas cutting	OFC
oxyfuel gas welding	OFW
oxygen arc cutting	OAC

Table A2 (Continued)
Alphabetical Cross-Reference to Table A1 by Process

Process	Letter Designation	Process	Letter Designation
oxygen cutting	OC	self-shielded flux cored arc welding	FCAW-S
oxygen gouging	OG	series submerged arc welding	SAW-S
oxygen lance cutting	OLC	shielded metal arc cutting	SMAC
oxyhydrogen gas cutting	OFC-H	shielded metal arc welding	SMAW
oxyhydrogen welding	OHW	short circuiting gas metal arc welding	GMAW-SC
oxynatural gas cutting	OFC-N	socket fusion welding	SFW
oxypropane cutting	OFC-P	soldering	S
percussion welding	PEW	solid-state welding	SSW
plasma arc cutting	PAC	spin welding	SPW
plasma arc gouging	PAG	submerged arc welding	SAW
plasma arc welding	PAW	thermal cutting	TC
plasma spraying	PSP	thermal gouging	TG
powder flame spraying	FLSP-P	thermal spraying	THSP
pressure gas welding	PGW	thermite welding	TW
pressure-controlled resistance welding	EW-PC	torch brazing	TB
projection welding	PW	torch soldering	TS
pulsed gas metal arc welding	GMAW-P	ultrasonic soldering	USS
pulsed gas tungsten arc welding	GTAW-P	ultrasonic welding	USW
radio frequency welding	RFW	ultrasonic plastic welding	USW-P
resistance brazing	RB	upset welding	UW
resistance seam welding	RSEW	vacuum laser beam welding	LBW-V
resistance soldering	RS	vacuum plasma spraying	VPSP
resistance spot welding	RSW	vibration welding	VW
resistance welding	RW	wave soldering	WS
resistance plastic welding	RW-P	wire flame spraying	FLSP-W
roll welding	ROW		

Table A3
Alphabetical Cross-Reference to Table A1 by Letter Designation

Letter Designation	Process	Letter Designation	Process
AB	adhesive bonding	FRW-I	inertia friction welding
ABW	arc braze welding	FS	furnace soldering
AC	arc cutting	FSW	friction stir welding
AG	arc gouging	FW	flash welding
AHW	atomic hydrogen welding	GMAC	gas metal arc cutting
ASP	arc spraying	GMAW	gas metal arc welding
AW	arc welding	GMAW-P	pulsed gas metal arc welding
B	brazing	GMAW-S	see GMAW-SC
B-CA	controlled-atmosphere brazing	GMAW-SC	short circuiting gas metal arc welding
BW	braze welding	GTAC	gas tungsten arc cutting
CAC	carbon arc cutting	GTAW	gas tungsten arc welding
CAC-A	air carbon arc cutting	GTAW-P	pulsed gas tungsten arc welding
CAG	carbon arc gouging	HEBC	high energy beam cutting
CAW	carbon arc welding	HEBW	high energy beam welding
CEW	coextrusion welding	HGW	hot gas welding
CW	cold welding	HIPW	hot isostatic pressure welding
DB	dip brazing	HPW	hot pressure welding
DFB	diffusion brazing	HTW	heated tool welding
DFW	diffusion welding	HVOF	high velocity oxyfuel spraying
DS	dip soldering	IB	induction brazing
EBB	electron beam brazing	INS	iron soldering
EBBW	electron beam braze welding	IRB	infrared brazing
EBC	electron beam cutting	IRS	infrared soldering
EBW	electron beam welding	IRW	infrared welding
EBW-HV	high vacuum electron beam welding	IS	induction soldering
EBW-MV	medium vacuum electron beam welding	IW	induction welding
EBW-NV	nonvacuum electron beam welding	IW-P	induction plastic welding
EFW	electrofusion welding	LBB	laser beam brazing
EGW	electrogas welding	LBBW	laser beam braze welding
ESW	electroslag welding	LBC	laser beam cutting
ESW-CG	consumable guide electroslag welding	LBC-A	laser beam air cutting
ESW-NG	narrow gap electroslag welding	LBC-EV	laser beam evaporative cutting
EW	extrusion welding	LBC-IG	laser beam inert gas cutting
EXB	exothermic brazing	LBC-O	laser beam oxygen cutting
EXBW	exothermic braze welding	LBW	laser beam welding
EXW	explosion welding	LBW-V	vacuum laser beam welding
FB	furnace brazing	MIAW	magnetically impelled arc welding
FCAW	flux cored arc welding	OAC	oxygen arc cutting
FCAW-G	gas shielded flux cored arc welding	OAW	oxyacetylene welding
FCAW-S	self-shielded flux cored arc welding	OC	oxygen cutting
FFW	flow fusion welding	OC-F	flux cutting
FLSP	flame spraying	OC-P	metal powder cutting
FLSP-P	powder flame spraying	OFC	oxyfuel gas cutting
FLSP-W	wire flame spraying	OFC-A	oxyacetylene cutting
FOW	forge welding	OFC-H	oxyhydrogen gas cutting
FRW	friction welding	OFC-N	oxynatural gas cutting
FRW-DD	direct drive friction welding	OFC-P	oxypropane cutting

Table A3 (Continued)
Alphabetical Cross-Reference to Table A1 by Letter Designation

Letter Designation	Process	Letter Designation	Process
OFW	oxyfuel gas welding	S	soldering
OG	oxygen gouging	SAW	submerged arc welding
OHW	oxyhydrogen welding	SAW-S	series submerged arc welding
OLC	oxygen lance cutting	SFW	socket fusion welding
PAC	plasma arc cutting	SMAC	shielded metal arc cutting
PAG	plasma arc gouging	SMAW	shielded metal arc welding
PAW	plasma arc welding	SPW	spin welding
PEW	percussion welding	SSW	solid-state welding
PGW	pressure gas welding	SW	arc stud welding
PSP	plasma spraying	TB	torch brazing
PW	projection welding	TC	thermal cutting
RB	resistance brazing	TG	thermal gouging
RFW	radio frequency welding	THSP	thermal spraying
ROW	roll welding	TS	torch soldering
RS	resistance soldering	TW	thermite welding
RSEW-MS	mash seam welding	USS	ultrasonic soldering
RSEW	resistance seam welding	USW	ultrasonic welding
RSEW-HF	high-frequency seam welding	USW-P	ultrasonic plastic welding
RSEW-I	induction seam welding	UW	upset welding
RSW	resistance spot welding	UW-HF	high-frequency upset welding
RW	resistance welding	UW-I	induction upset welding
RW-P	resistance plastic welding	VPSP	vacuum plasma spraying
RW-PC	pressure-controlled resistance welding	WS	wave soldering

Table A4
Suffixes for Application Modes of Welding, Joining, and Allied Processes

Application Mode	Letter Designation
Adaptive control	-AD
Automatic	-AU
Manual	-MA
Mechanized	-ME
Robotic	-RO
Semiautomatic	-SA

Note: Application mode designator is added to a process designator in the following format: XXXX-YY, where XXXX is the process designator and YY is the application mode designator. For example, manual gas tungsten arc welding is designated as GTAW-MA.

Table A5
Obsolete or Seldom Used Processes

Welding Process or Variation	Letter Designation
air acetylene welding	AAW
atomic hydrogen welding	AHW
bare metal arc welding	BMAW
block brazing	BB
carbon arc brazing	CAB
carbon arc braze welding	CABW
firecracker welding	
flow brazing	FLB
flow welding	FLOW
gas carbon arc welding	CAW-G
shielded carbon arc welding	CAW-S
twin carbon arc brazing	TCAB
twin carbon arc welding	CAW-T

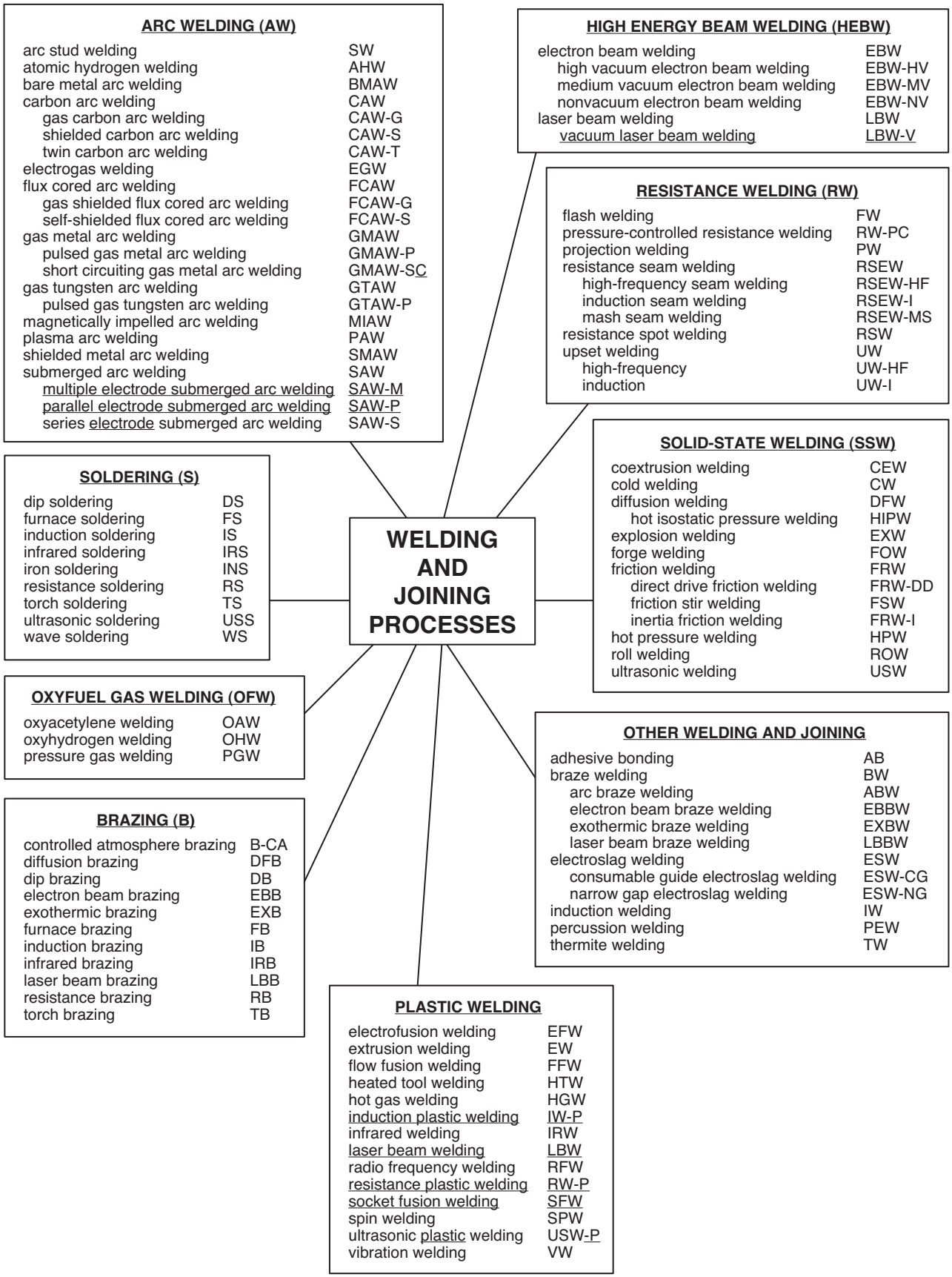


Figure A1—Master Chart of Welding and Joining Processes

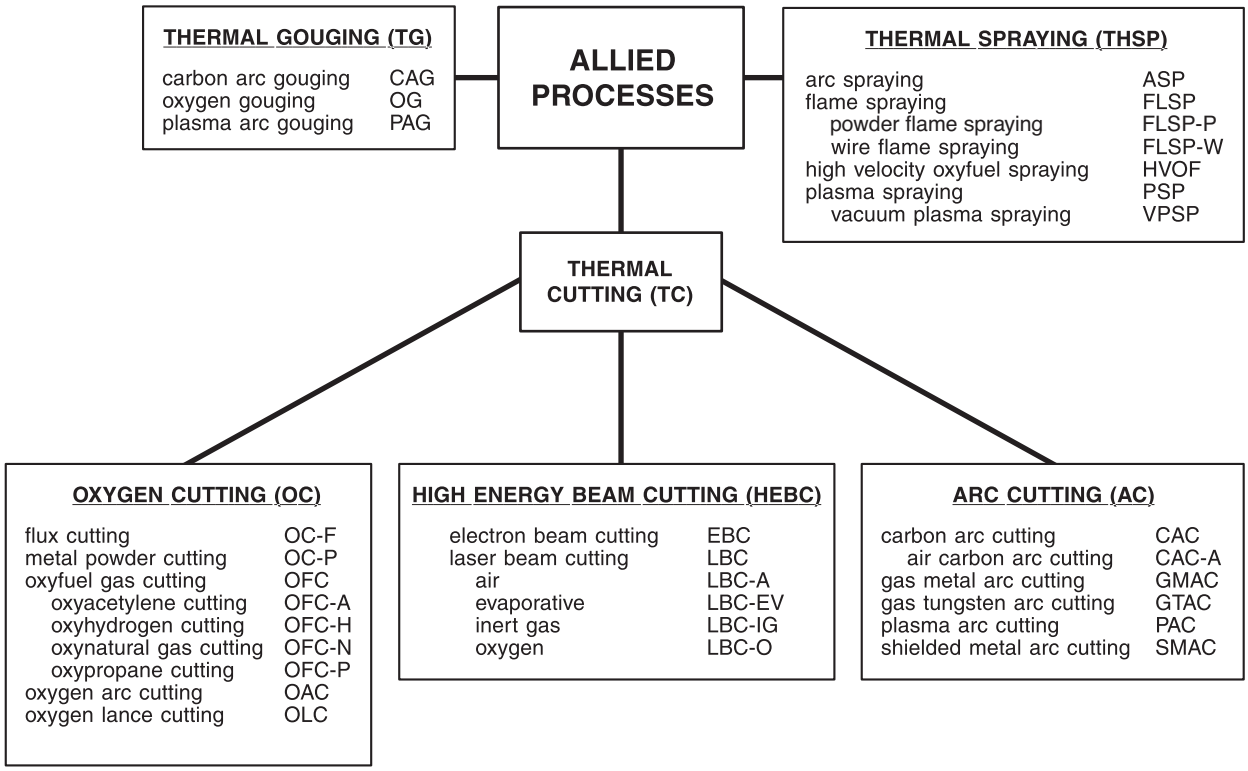
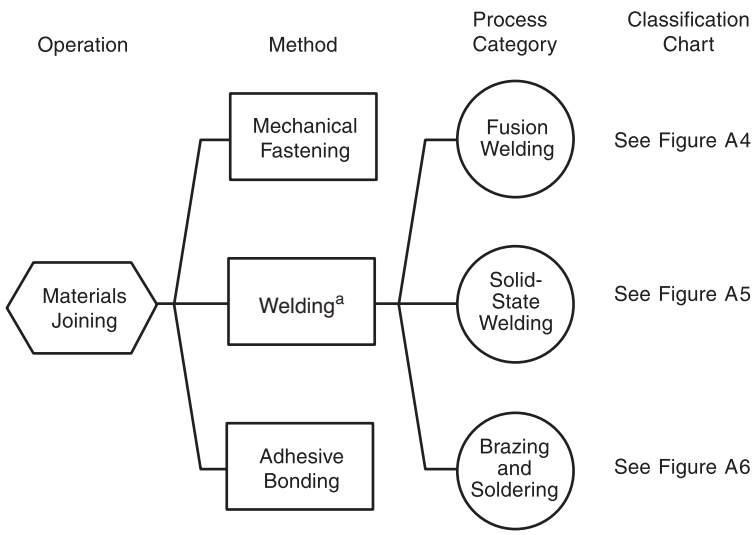
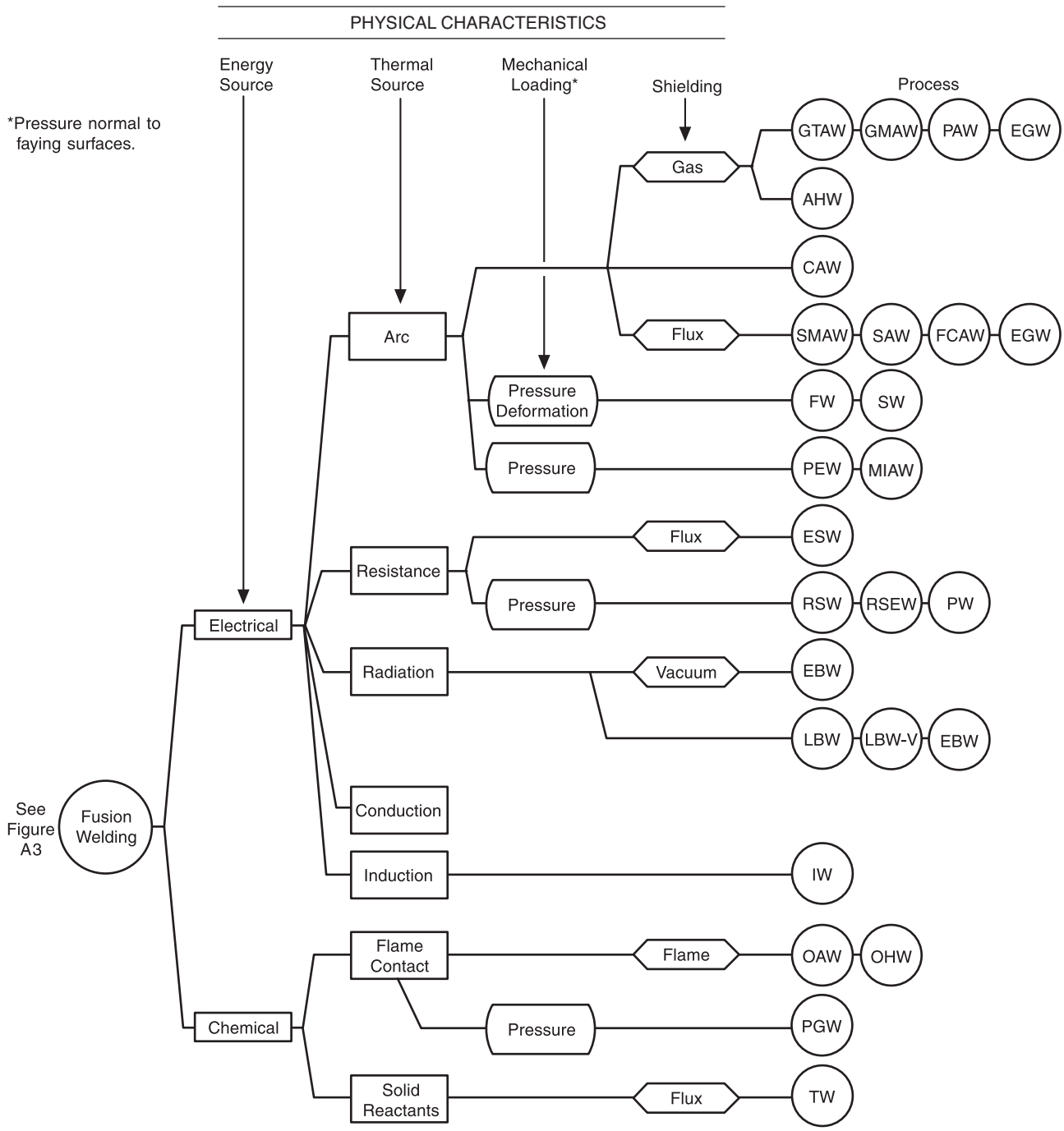


Figure A2—Master Chart of Allied Processes



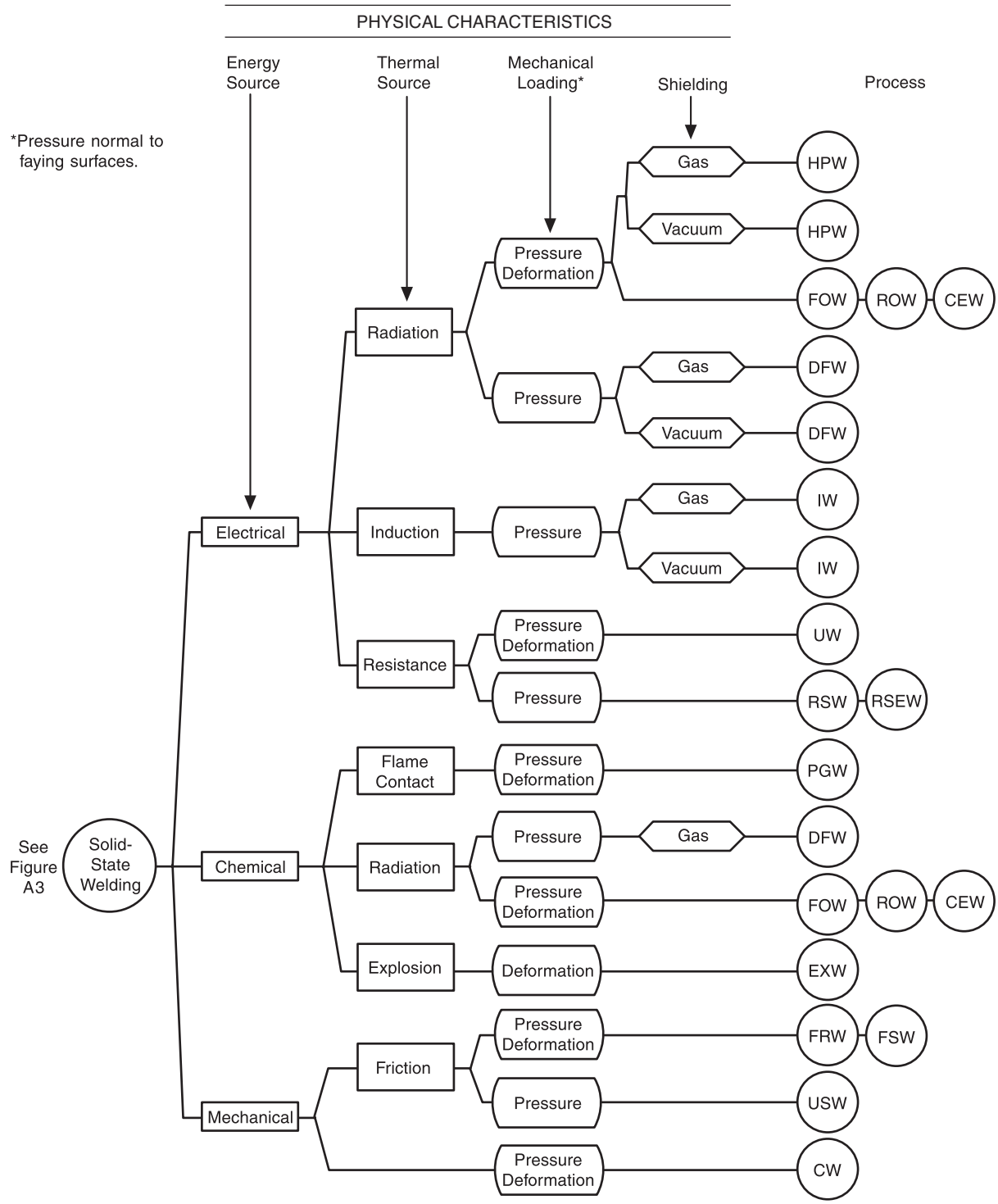
[a] Welding refers to the group of process categories.

Figure A3—Joining Method Chart



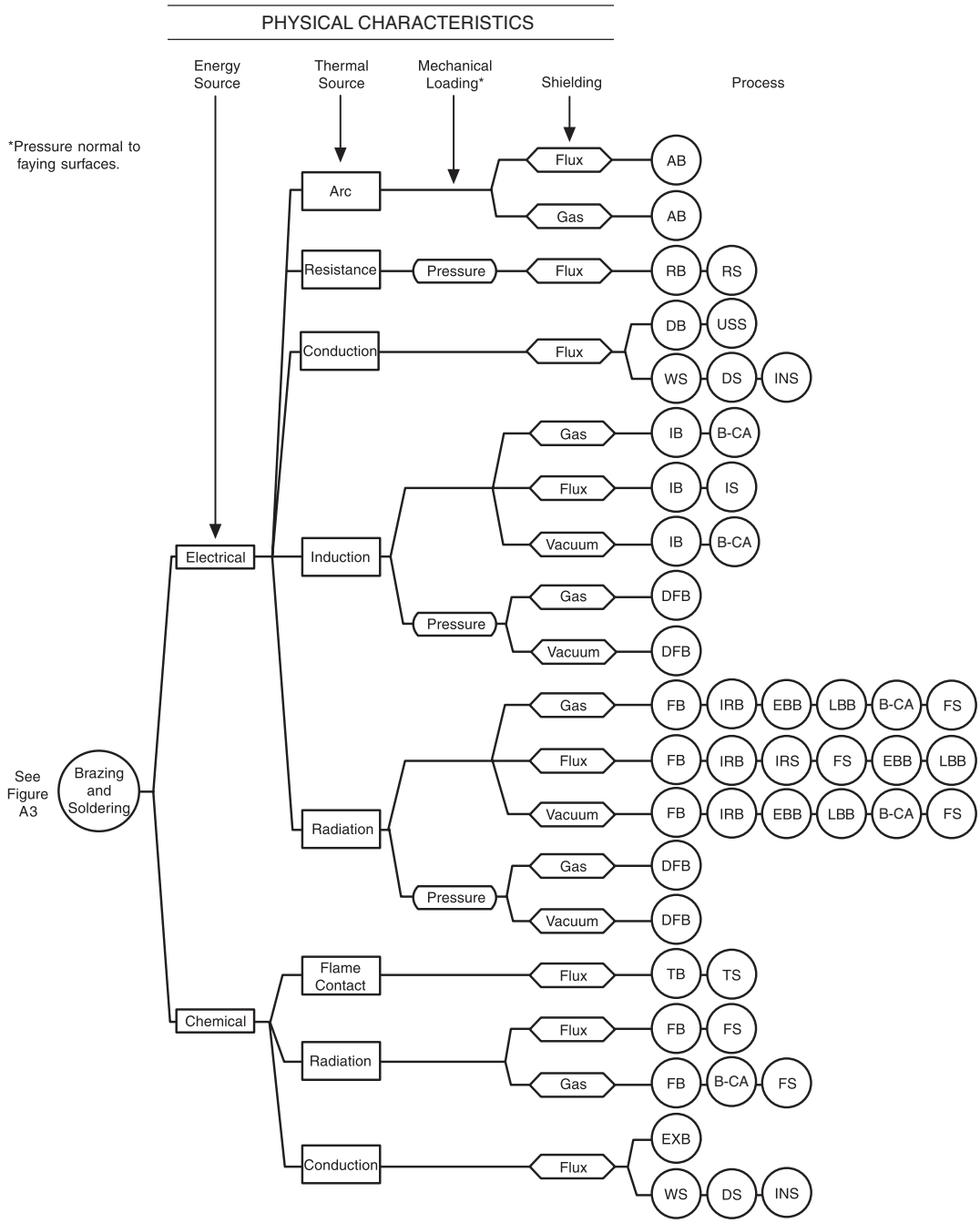
Designation	Welding Process	Designation	Welding Process	Designation	Welding Process
CAW	carbon arc welding	IW	induction welding	PGW	pressure gas welding
EBW	electron beam welding	LBW	laser beam welding	PW	projection welding
EGW	electrogas welding	LBW-V	vacuum laser beam welding	RSEW	resistance seam welding
ESW	electroslag welding	MIAW	magnetically impelled arc welding	RSW	resistance spot welding
FCAW	flux cored arc welding	OAW	oxyacetylene welding	SAW	submerged arc welding
FW	flash welding	OHW	oxyhydrogen welding	SMAW	shielded metal arc welding
GMAW	gas metal arc welding	PAW	plasma arc welding	SW	arc stud welding
GTAW	gas tungsten arc welding	PEW	percussion welding	TW	thermite welding

Figure A4—Fusion Welding Classification Chart



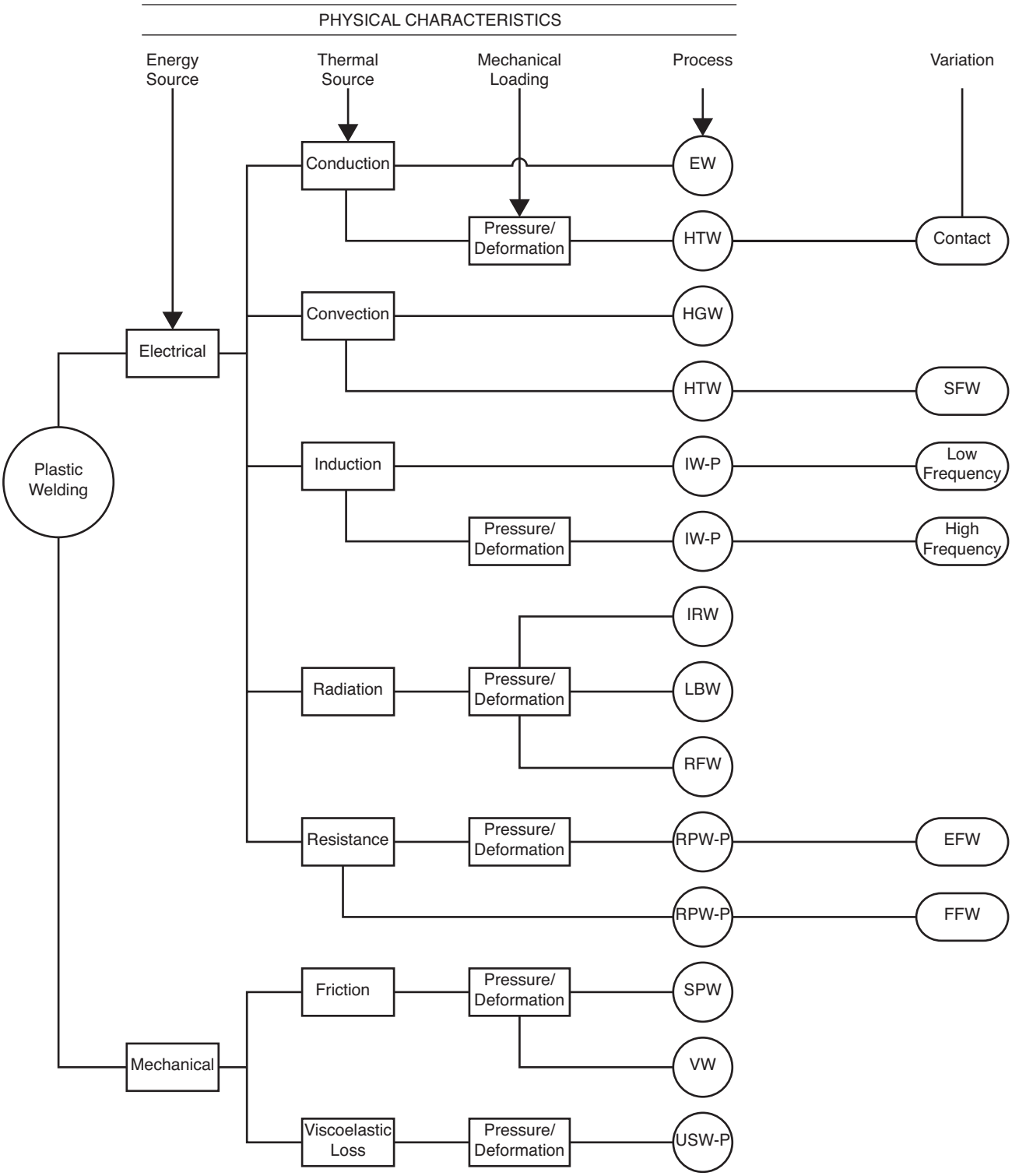
Designation	Welding Process	Designation	Welding Process	Designation	Welding Process
CEW	coextrusion welding	FRW	friction welding	RSEW	resistance seam welding
CW	cold welding	FSW	friction stir welding	RSW	resistance spot welding
DFW	diffusion welding	HPW	hot pressure welding	ROW	roll welding
EXW	explosion welding	IW	induction welding	USW	ultrasonic welding
FOW	forge welding	PGW	pressure gas welding	UW	upset welding

Figure A5—Solid-State Welding Classification Chart



Designation	Welding Process	Designation	Welding Process	Designation	Welding Process
B-CA	controlled-atmosphere brazing	FS	furnace soldering	RB	resistance brazing
DB	dip brazing	IB	induction brazing	RS	resistance soldering
DS	dip soldering	IS	induction soldering	TB	torch brazing
DFB	diffusion brazing	IRB	infrared brazing	TS	torch soldering
EBB	electron beam brazing	IRS	infrared soldering	USS	ultrasonic soldering
EXB	exothermic brazing	INS	iron soldering	WS	wave soldering
FB	furnace brazing	LBB	laser beam brazing		

Figure A6—Brazing and Soldering Classification Chart



Designation	Welding Process	Designation	Welding Process	Designation	Welding Process
EFW	electrofusion welding	IW-P	induction plastic welding	SFW	socket fusion welding
EW	extrusion welding	IRW	infrared welding	SPW	spin welding
FFW	flow fusion welding	LBW	laser beam welding	USW-P	ultrasonic plastic welding
HTW	heated tool welding	RFW	radio frequency welding	VW	vibration welding
HGW	hot gas welding	RW-P	resistance plastic welding		

Figure A7—Plastic Welding Classification Chart

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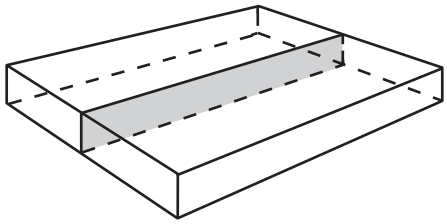
Annex B (Normative)
Figures

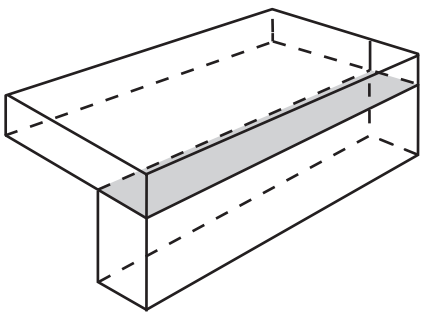
This annex is part of this standard and includes mandatory elements for use with this standard.



(A) BUTT JOINT

APPLICABLE WELD TYPES

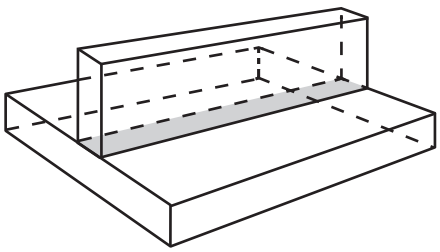
BEVEL-GROOVE	SQUARE GROOVE
FLARE-BEVEL-GROOVE	U-GROOVE
FLARE-V-GROOVE	V-GROOVE
J-GROOVE	BRAZE



(B) CORNER JOINT

APPLICABLE WELD TYPES

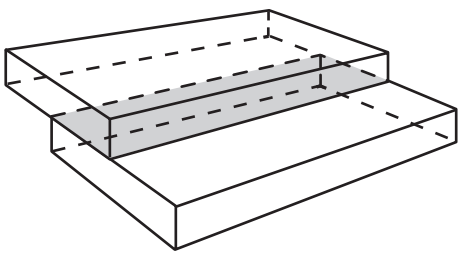
FILLET	V-GROOVE
BEVEL-GROOVE	PLUG
FLARE-BEVEL-GROOVE	SLOT
FLARE-V-GROOVE	SPOT
J-GROOVE	SEAM
SQUARE-GROOVE	PROJECTION
U-GROOVE	BRAZE



(C) T-JOINT

APPLICABLE WELD TYPES

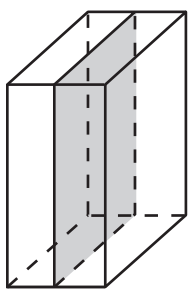
FILLET	SLOT
BEVEL-GROOVE	SPOT
FLARE-BEVEL-GROOVE	SEAM
J-GROOVE	PROJECTION
SQUARE-GROOVE	BRAZE
PLUG	



(D) LAP JOINT

APPLICABLE WELD TYPES

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



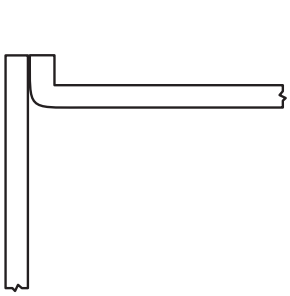
(E) PARALLEL JOINT

APPLICABLE WELD TYPES

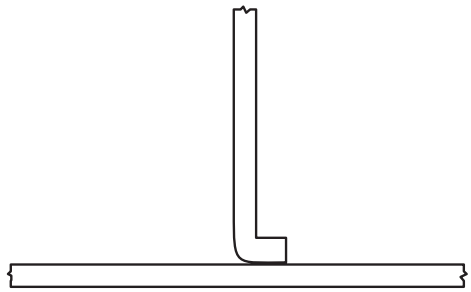
BEVEL-GROOVE	V-GROOVE
FLARE-BEVEL-GROOVE	EDGE
FLARE-V-GROOVE	SEAM
J-GROOVE	SPOT
SQUARE-GROOVE	PROJECTION
U-GROOVE	BRAZE

Figure B1—Joint Types

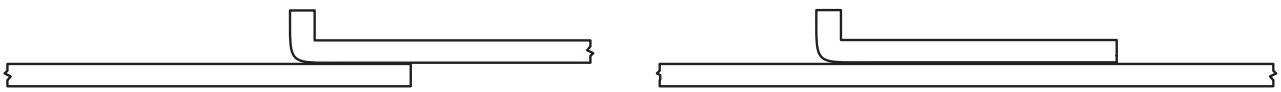
(A) FLANGED BUTT JOINTS



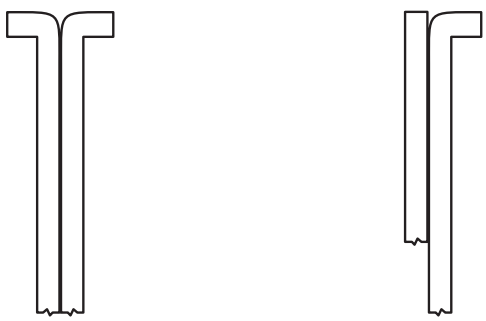
(B) FLANGED CORNER JOINT



(C) FLANGED T-JOINT

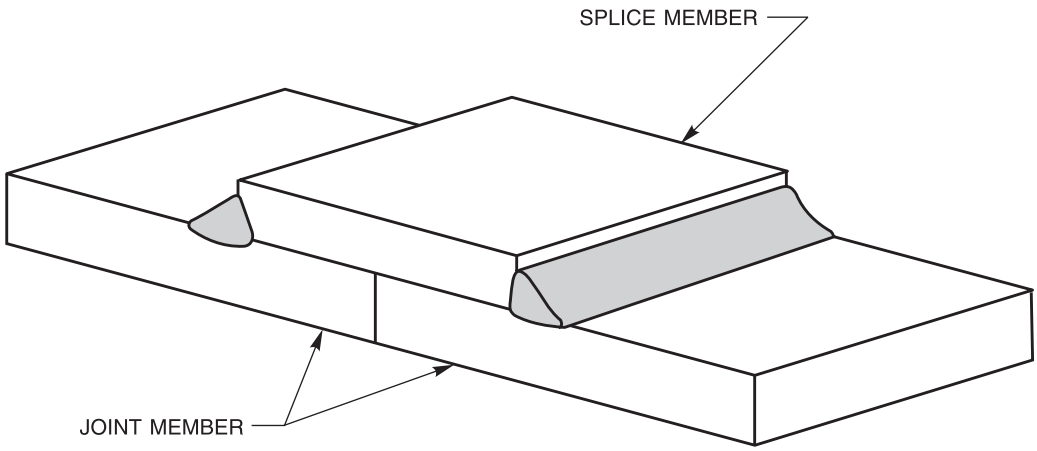


(D) FLANGED LAP JOINTS

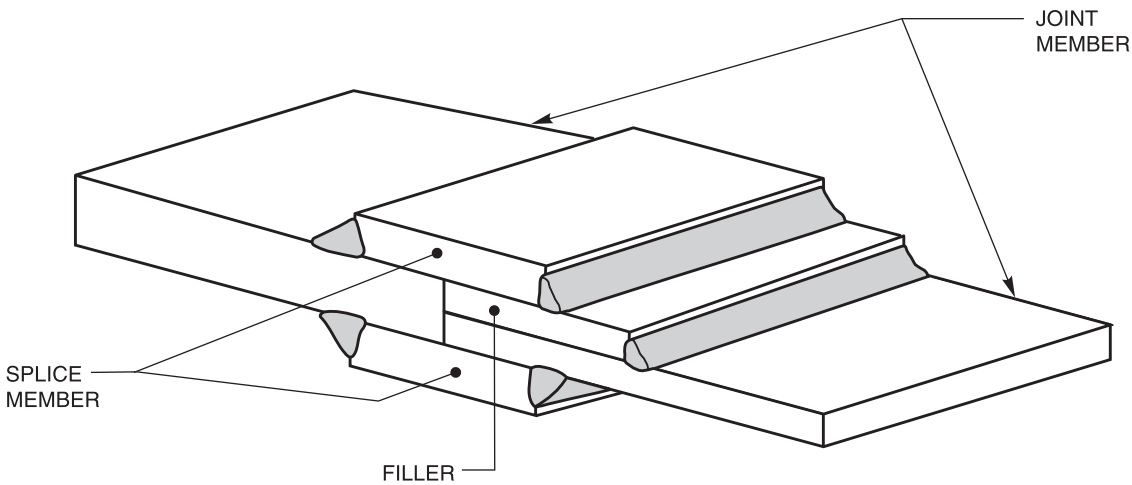


(E) FLANGED PARALLEL JOINTS

Figure B2—Flanged Joints

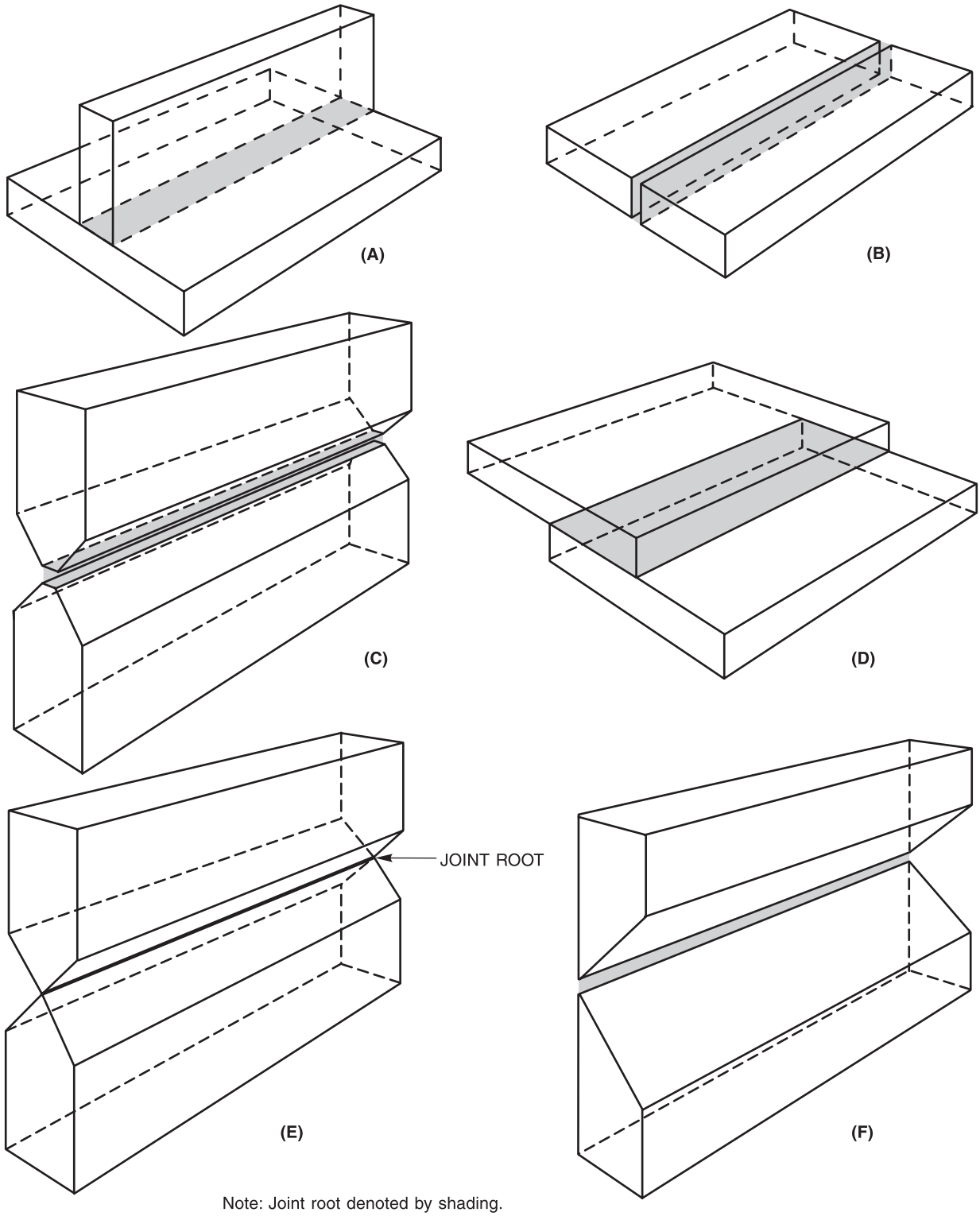


(A) SINGLE-SPLICED BUTT JOINT



(B) DOUBLE-SPLICED BUTT JOINT WITH FILLER

Figure B3—Spliced Butt Joints



Note: Joint root denoted by shading.

Figure B4—Joint Root

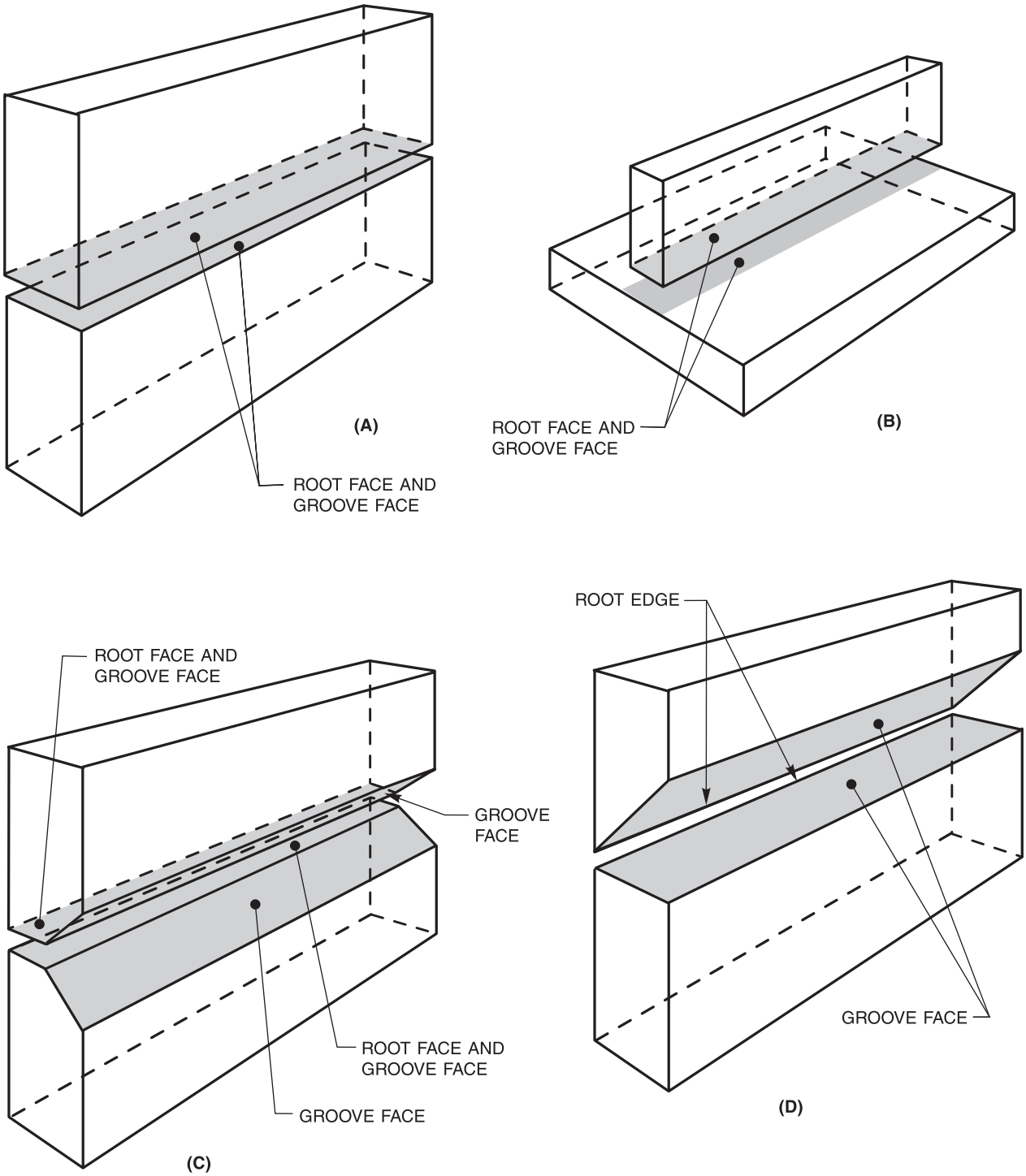


Figure B5—Groove Face, Root Edge, and Root Face

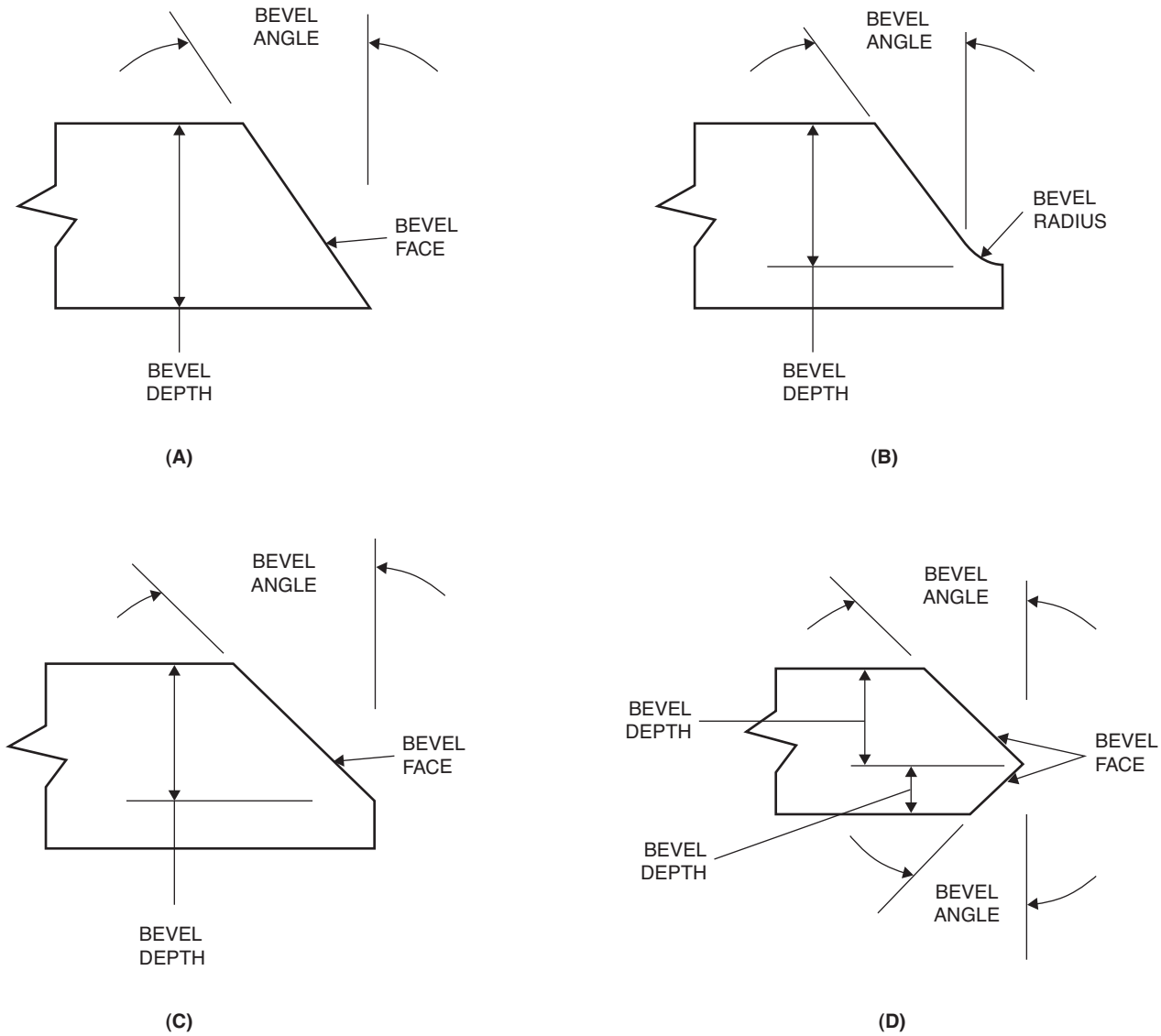


Figure B6—Bevel Angle, Bevel Face, Bevel Depth, Groove Angle, Groove Depth, Bevel Radius, and Root Opening

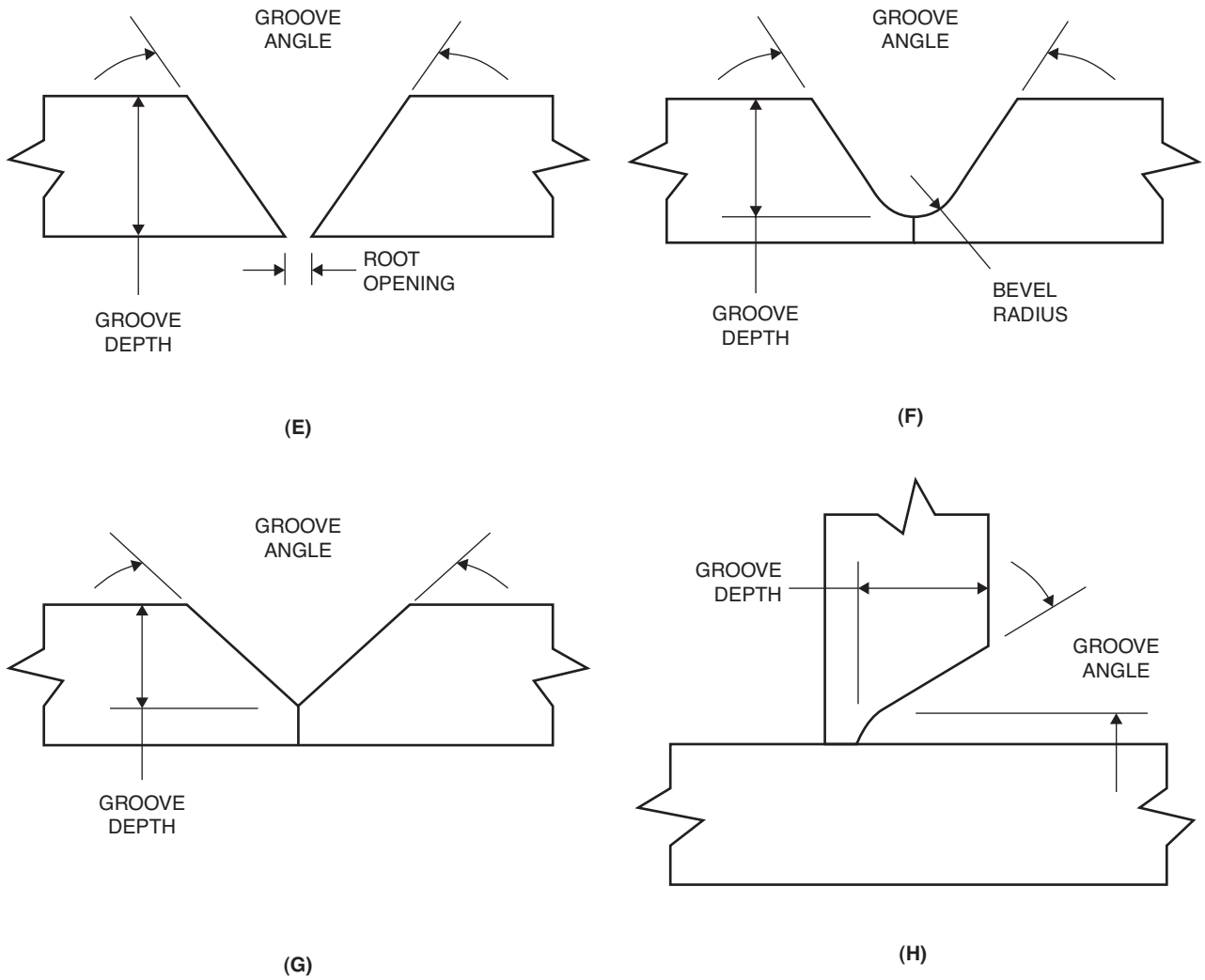


Figure B6 (Continued)—Bevel Angle, Bevel Face, Bevel Depth, Groove Angle, Groove Depth, Bevel Radius, and Root Opening

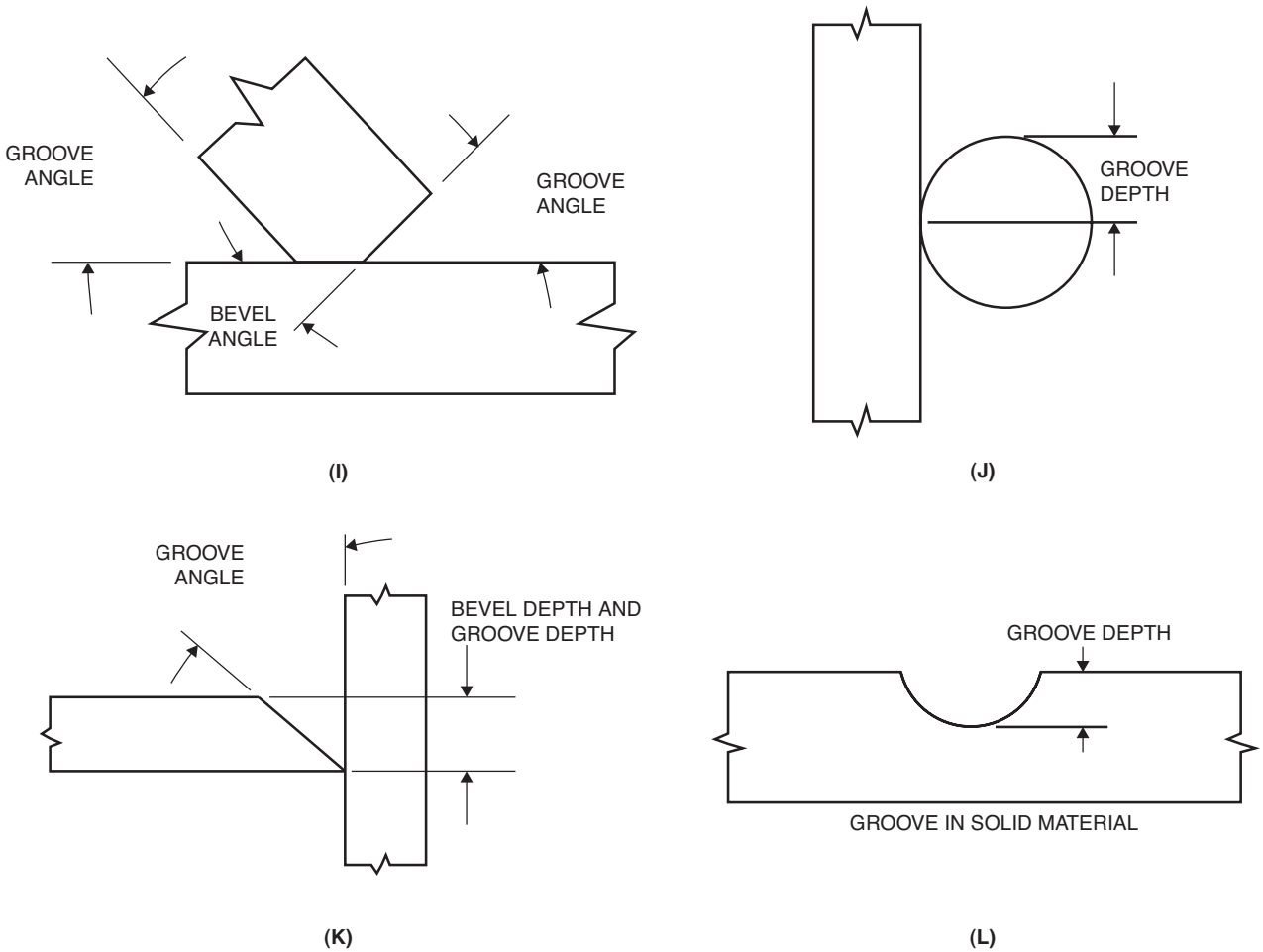
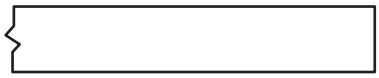


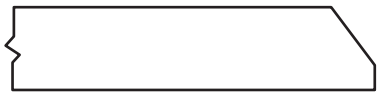
Figure B6 (Continued)—Bevel Angle, Bevel Face, Bevel Depth, Groove Angle, Groove Depth, Bevel Radius, and Root Opening



(A) SQUARE EDGE SHAPE

APPLICABLE WELD TYPES

DOUBLE-BEVEL-GROOVE	SINGLE-J- GROOVE
DOUBLE-BEVEL-FLARE-GROOVE	SQUARE-GROOVE
DOUBLE-J-GROOVE	EDGE
SINGLE-BEVEL-GROOVE	FILLET
SINGLE-FLARE-BEVEL-GROOVE	BRAZE



(B) SINGLE-BEVEL EDGE SHAPE

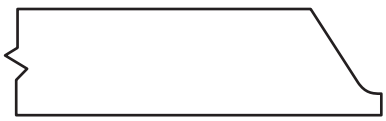
APPLICABLE WELD TYPES

SINGLE-BEVEL-GROOVE
SINGLE-V-GROOVE
BRAZE

(C) DOUBLE-BEVEL EDGE SHAPE

APPLICABLE WELD TYPES

DOUBLE-BEVEL-GROOVE
DOUBLE-V-GROOVE



(D) SINGLE-J EDGE SHAPE

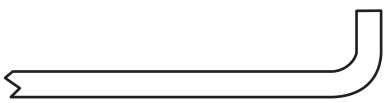
APPLICABLE WELD TYPES

SINGLE-J-GROOVE
SINGLE-U-GROOVE

(E) DOUBLE-J EDGE SHAPE

APPLICABLE WELD TYPES

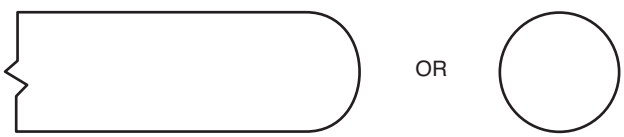
DOUBLE-J-GROOVE
DOUBLE-U-GROOVE



(F) FLANGED EDGE SHAPE

APPLICABLE WELD TYPES

SINGLE-FLARE-BEVEL-GROOVE	PROJECTION
SINGLE-FLARE-V-GROOVE	SEAM
EDGE	SPOT
FILLET	BRAZE

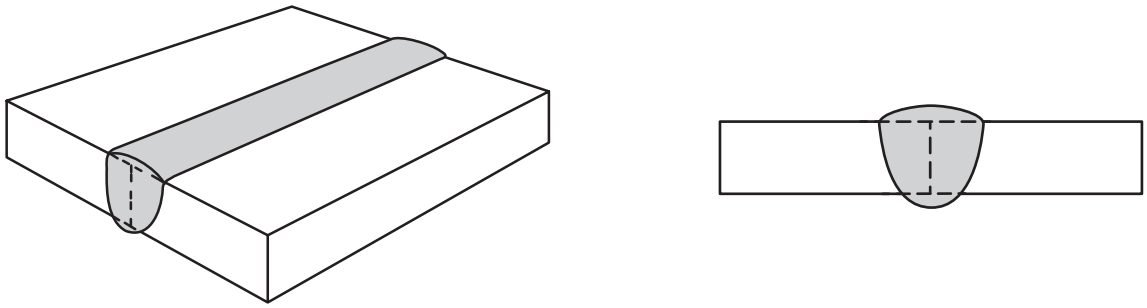


(G) ROUND EDGE SHAPE

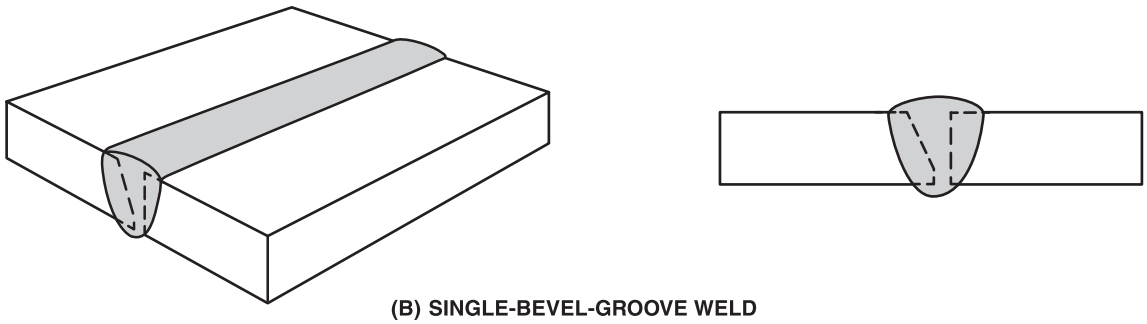
APPLICABLE WELD TYPES

DOUBLE-FLARE-BEVEL GROOVE
DOUBLE-FLARE-V-GROOVE
BRAZE

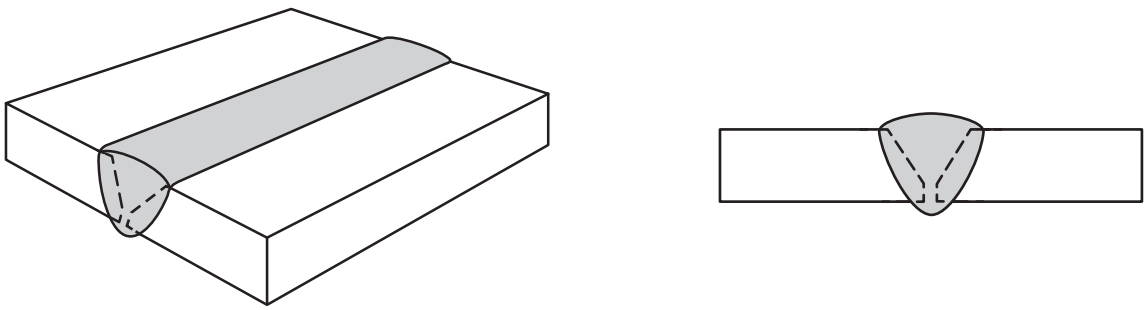
Figure B7—Edge Shapes



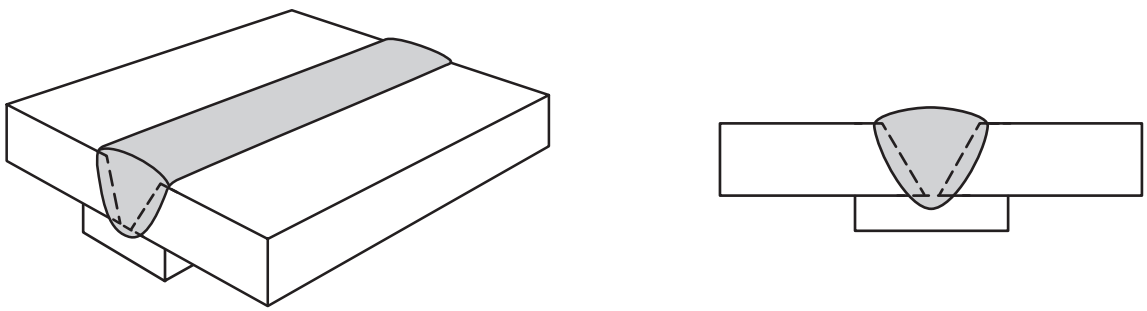
(A) SINGLE-SQUARE-GROOVE WELD



(B) SINGLE-BEVEL-GROOVE WELD

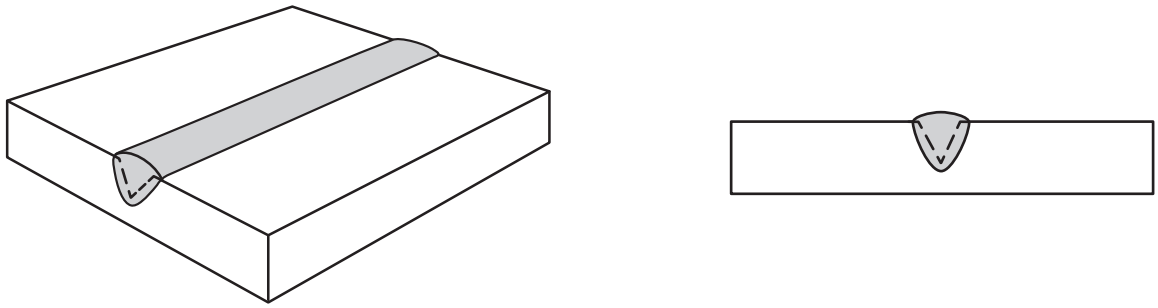


(C) SINGLE-V-GROOVE WELD

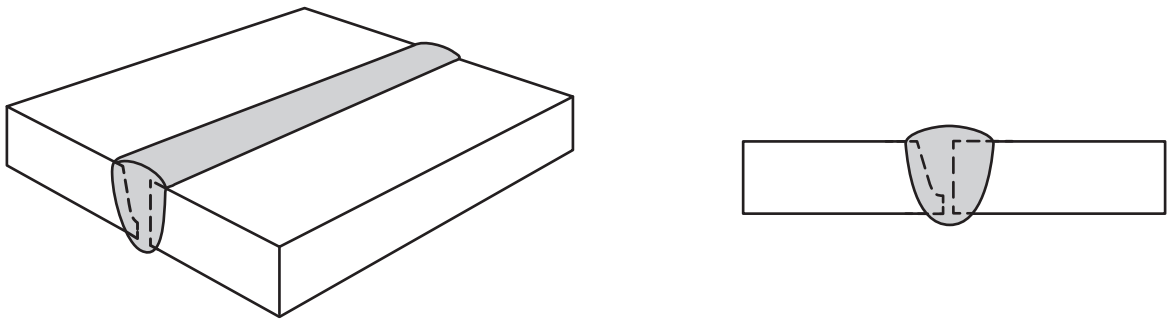


(D) SINGLE-V-GROOVE WELD WITH BACKING

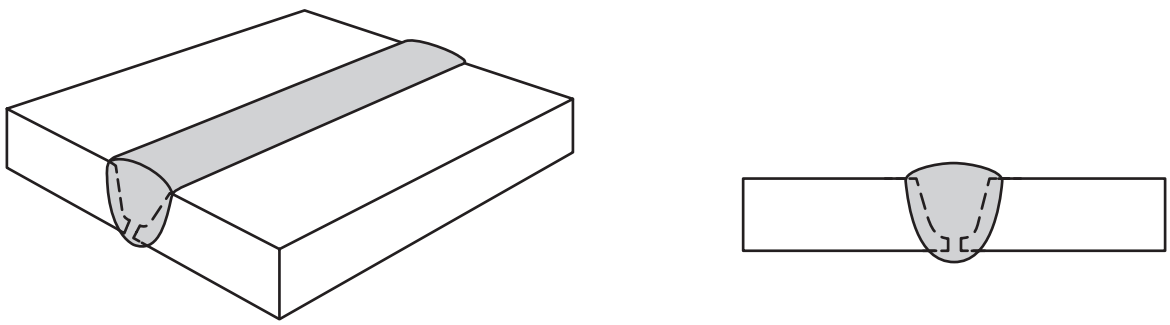
Figure B8—Single-Groove Weld Types



(E) SINGLE-V-GROOVE WELD ON A SURFACE

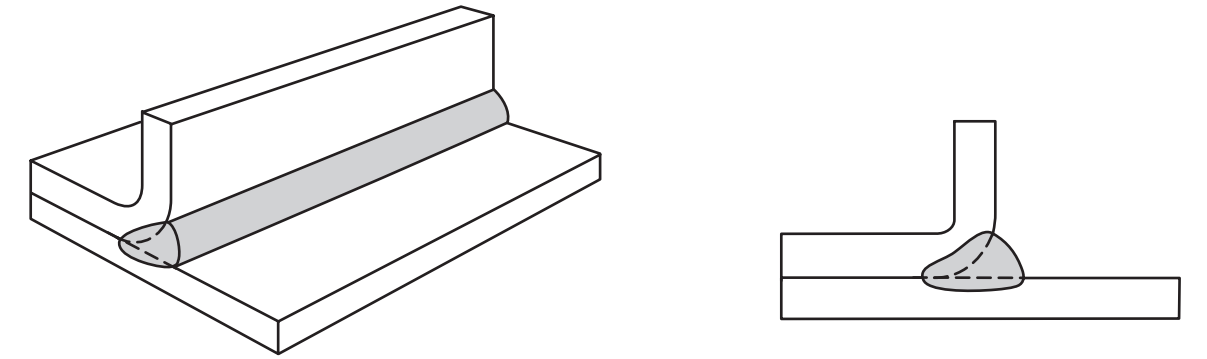


(F) SINGLE-J-GROOVE WELD

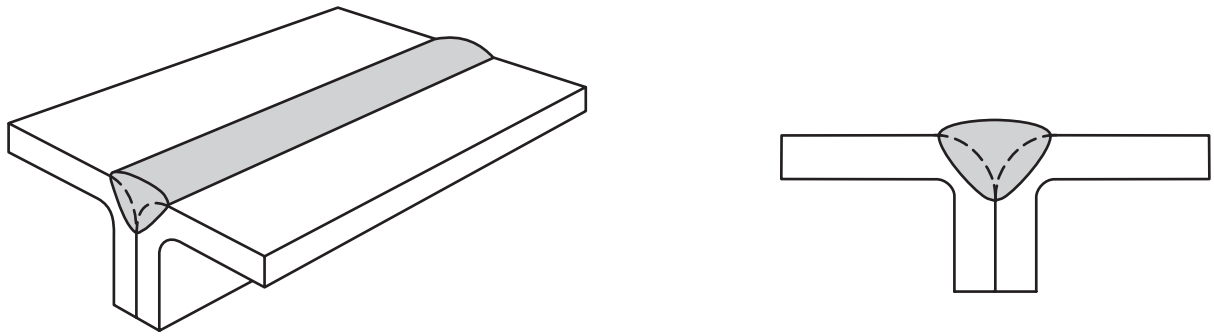


(G) SINGLE-U-GROOVE WELD

Figure B8 (Continued)—Single-Groove Weld Types

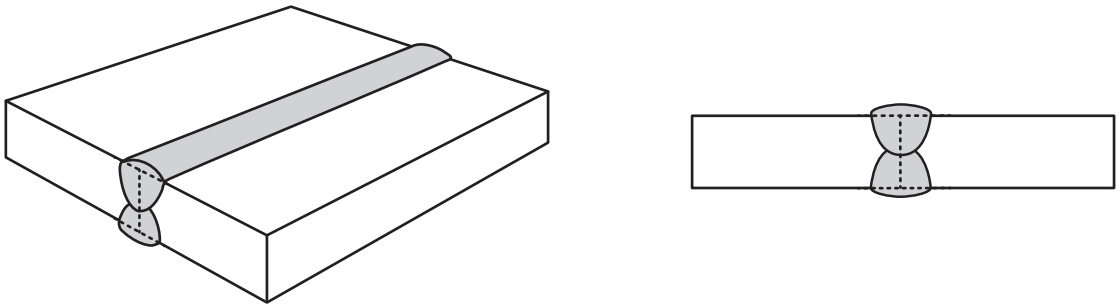


(H) SINGLE-FLARE-BEVEL-GROOVE WELD

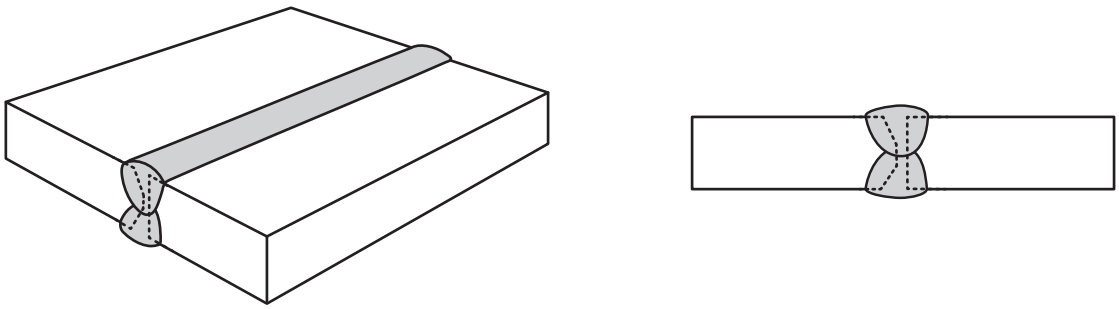


(I) SINGLE-FLARE-V-GROOVE WELD

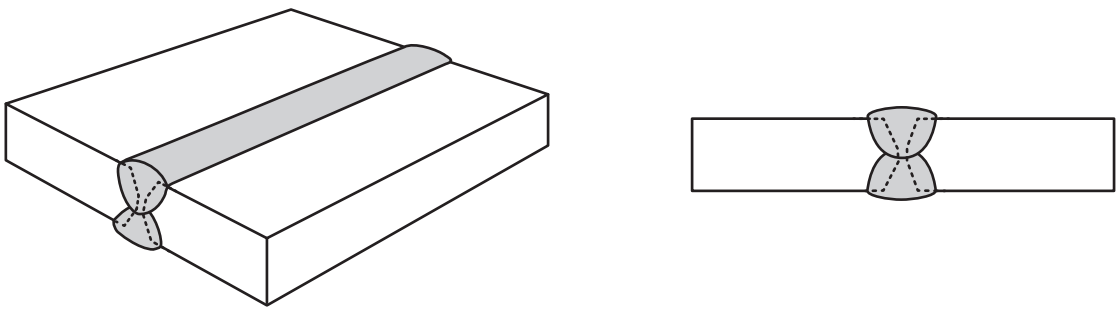
Figure B8 (Continued)—Single-Groove Weld Types



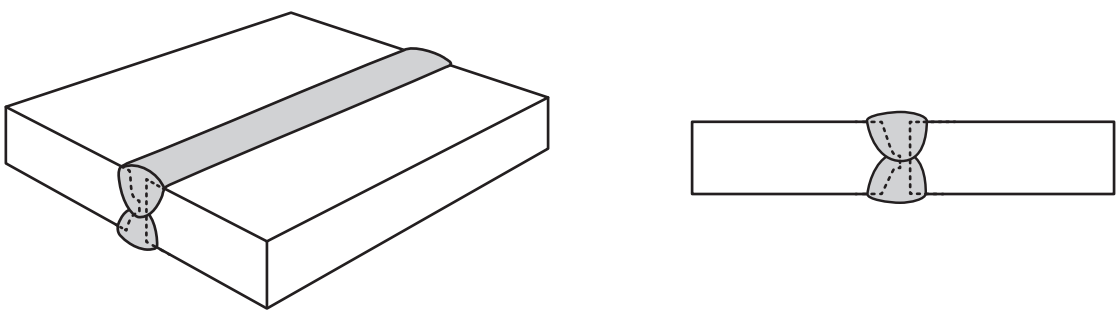
(A) DOUBLE-SQUARE-GROOVE WELD



(B) DOUBLE-BEVEL-GROOVE WELD

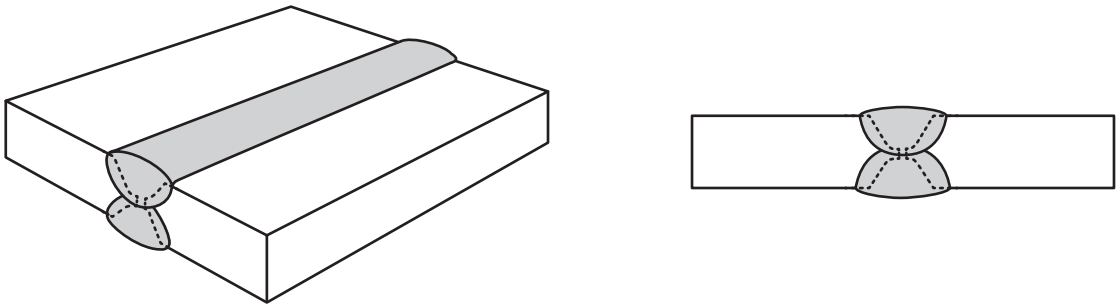


(C) DOUBLE-V-GROOVE WELD

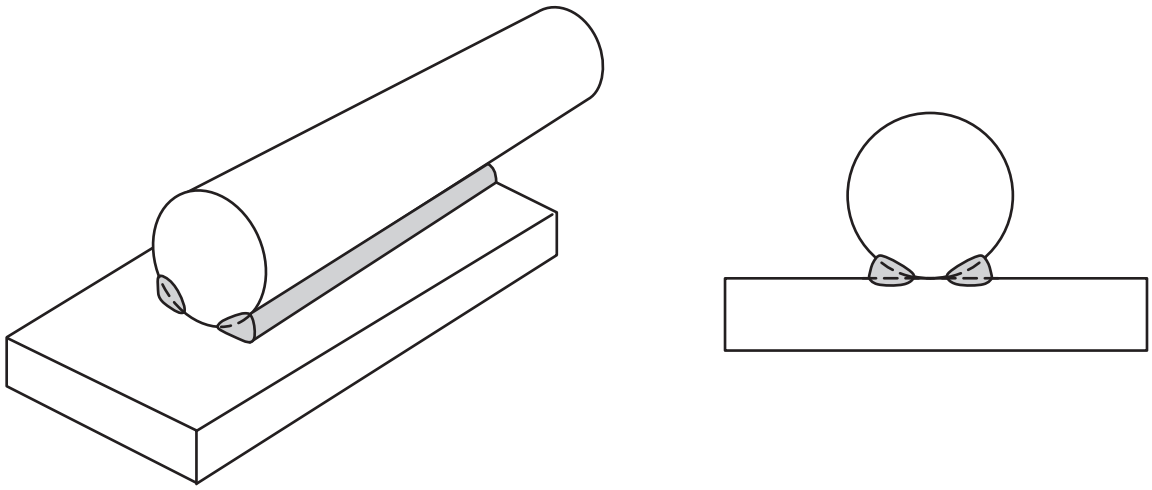


(D) DOUBLE-J-GROOVE WELD

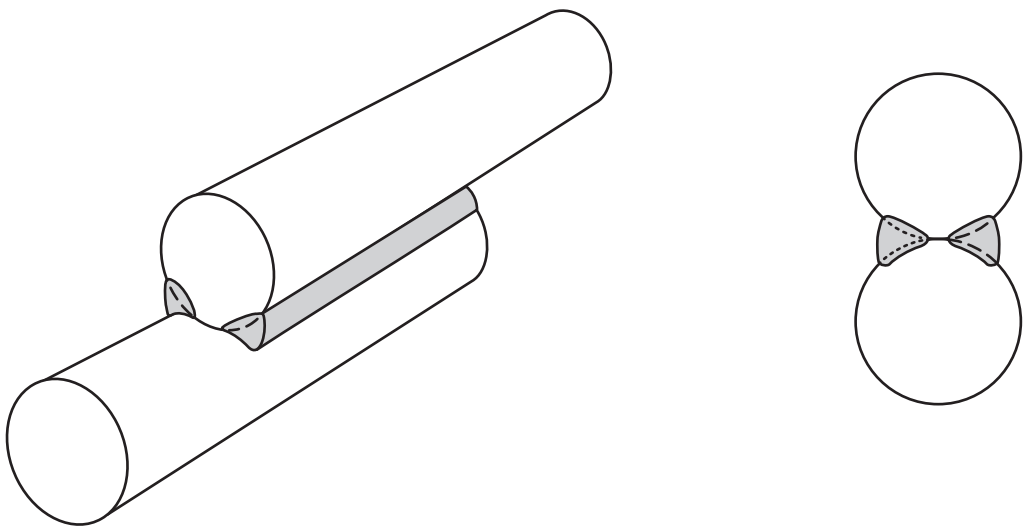
Figure B9—Double-Groove Weld Types



(E) DOUBLE-U-GROOVE WELD

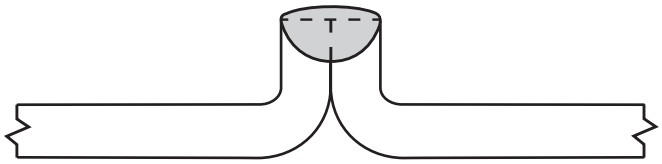


(F) DOUBLE-FLARE-BEVEL-GROOVE WELD

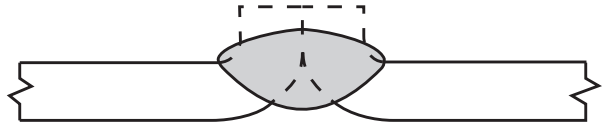


(G) DOUBLE-FLARE-V-GROOVE WELD

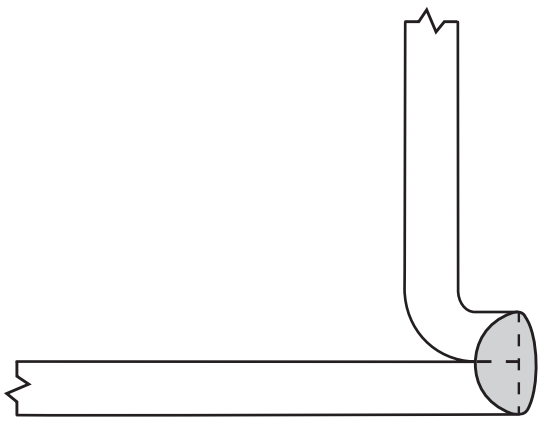
Figure B9 (Continued)—Double-Groove Weld Types



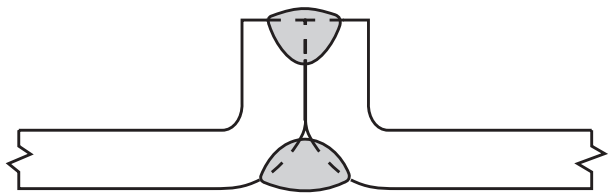
(A) EDGE WELD IN A FLANGED BUTT JOINT



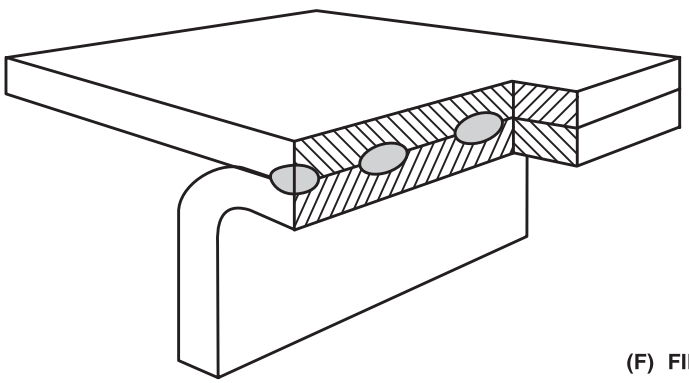
(B) EDGE WELD WITH MELT-THROUGH
IN A FLANGED BUTT JOINT



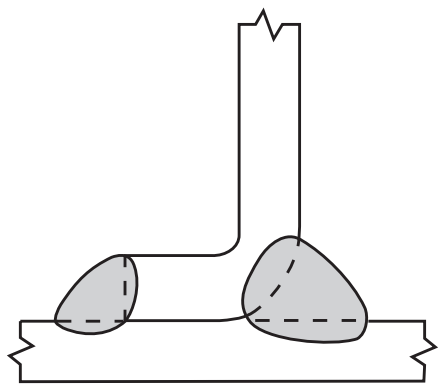
(C) EDGE WELD IN A FLANGED CORNER JOINT



(D) SQUARE-GROOVE WELD AND FLARE-V-GROOVE WELD
IN A FLANGED BUTT JOINT



(E) RESISTANCE SPOT WELDS
IN A FLANGED CORNER JOINT



(F) FILLET WELD AND FLARE-BEVEL-GROOVE WELD
IN A FLANGED T-JOINT

Figure B10—Welds in Flanged Joints

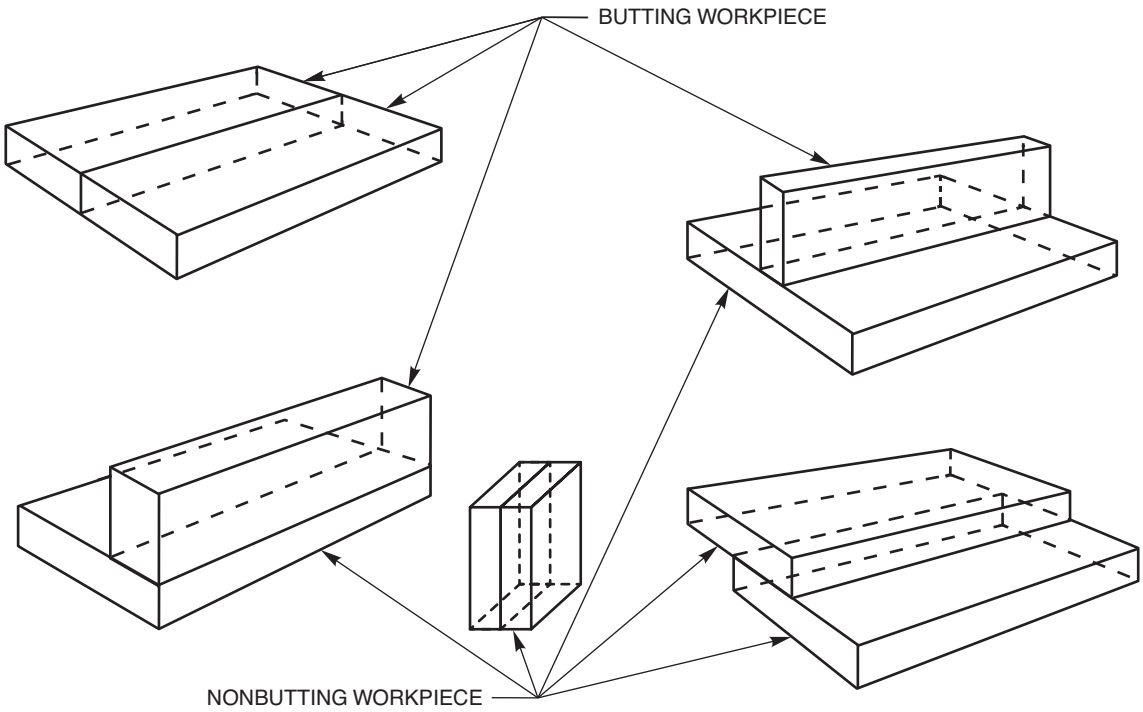
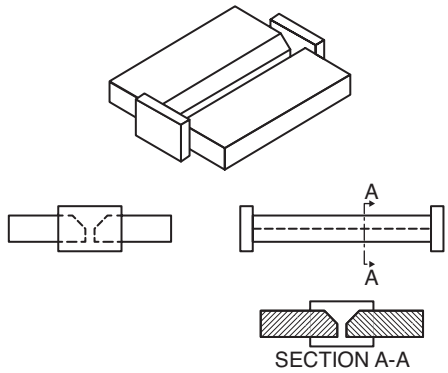
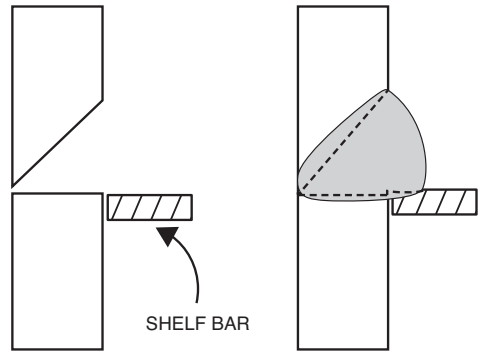


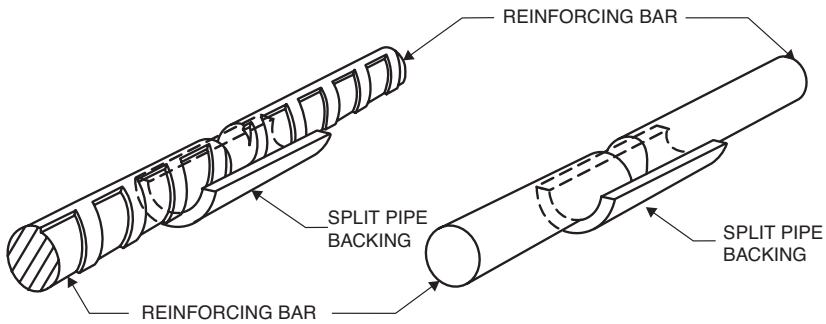
Figure B11—Butting and Nonbutting Workpiece or Workpieces



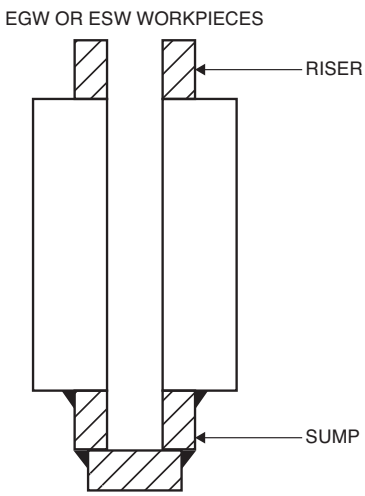
(A) END DAM



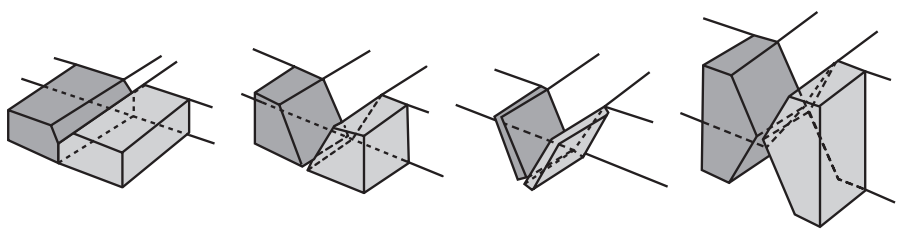
(B) SHELF BAR



(C) SPLIT PIPE BACKING



(D) RISER AND SUMP



(E) RUNOFF WELD TAB, STARTING WELD TAB

Figure B12—End Dam, Shelf, Split Pipe Backing, Riser, Sump, Starting Weld Tab, and Runoff Tab

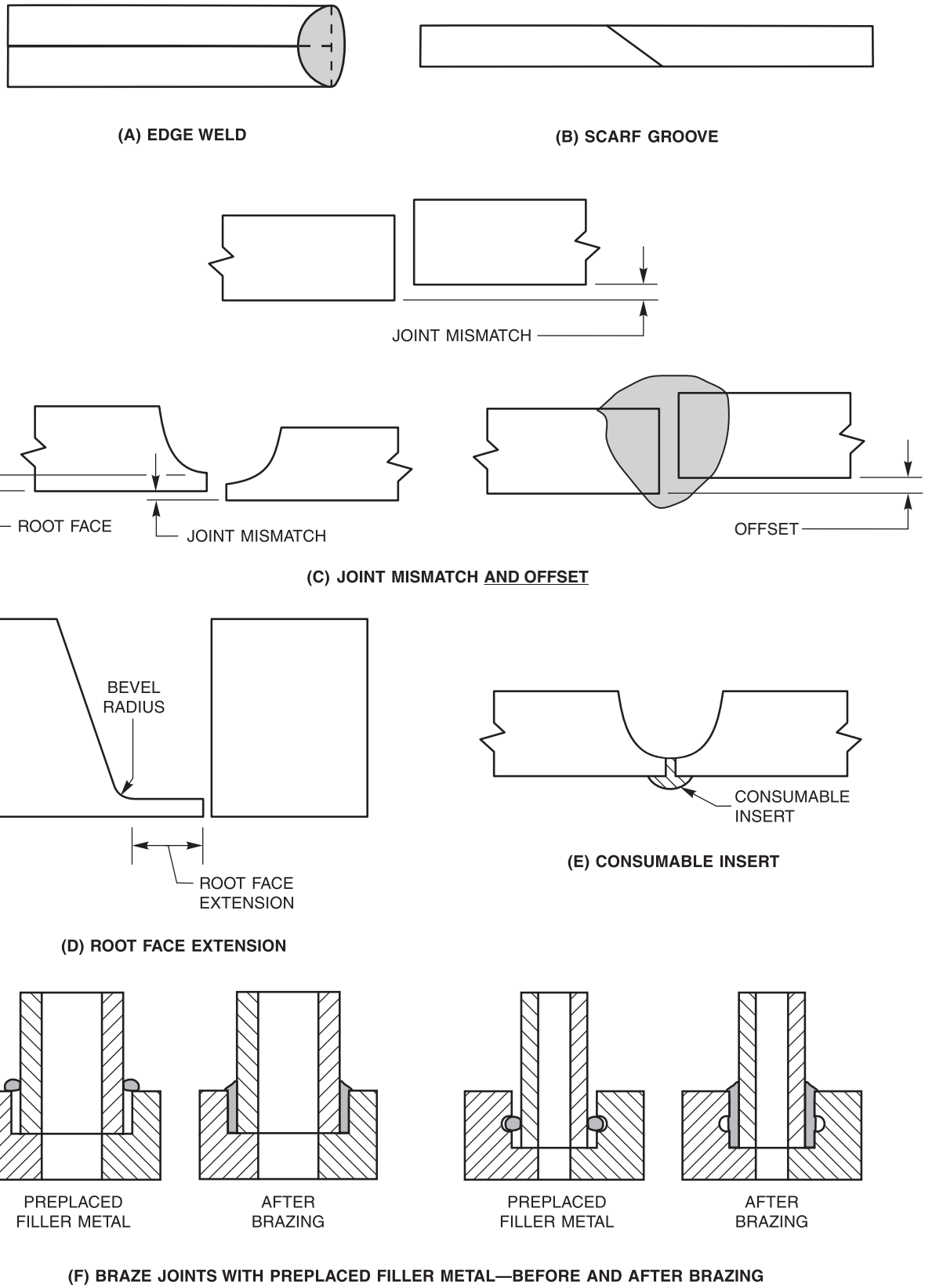


Figure B13—Edge Weld, Scarf Groove, Joint Mismatch, Root Face Extension, Consumable Insert, and Preplaced Filler Metal in a Brazed Joint

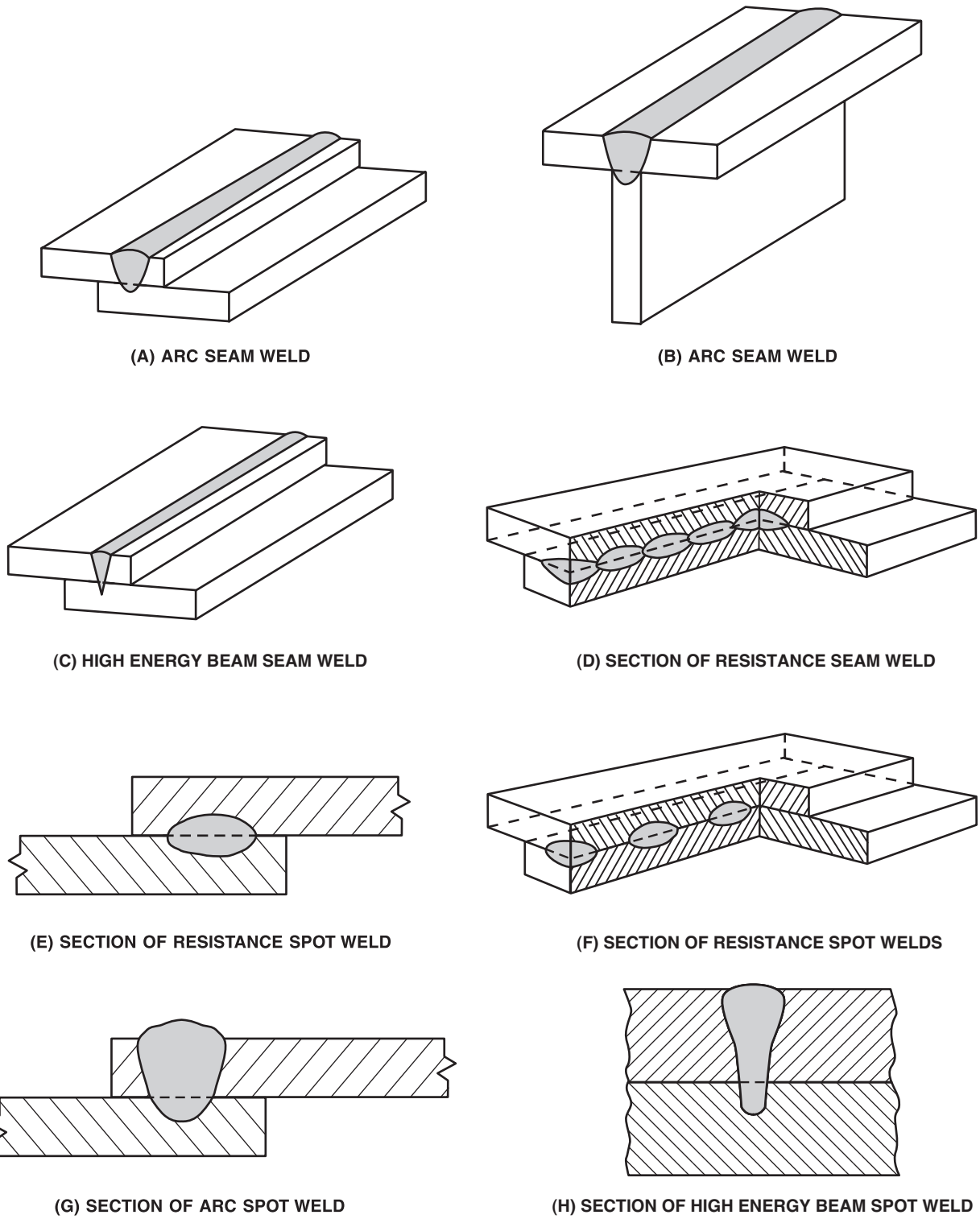


Figure B14—Seam and Spot Weld Types

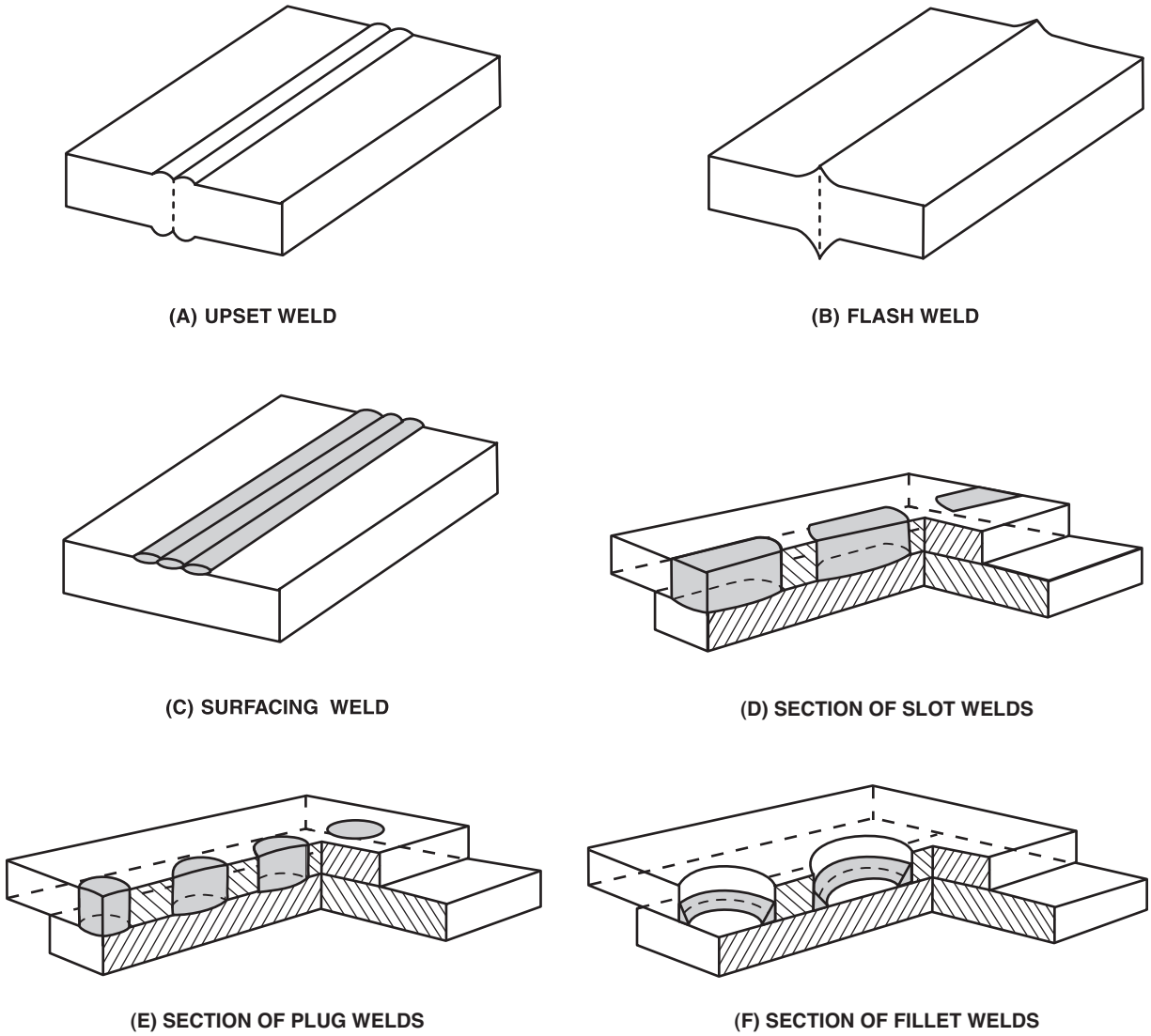
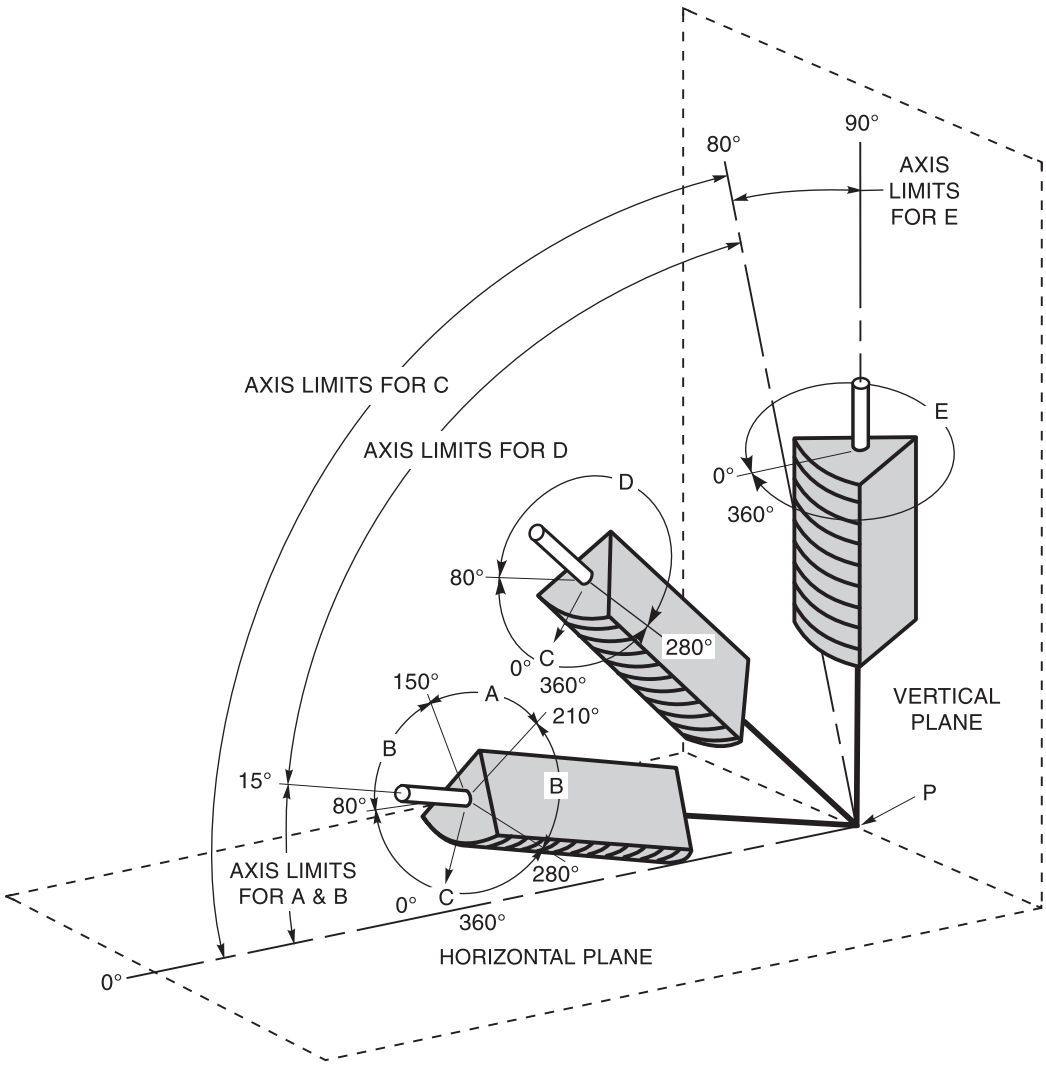


Figure B15—Various Weld Types

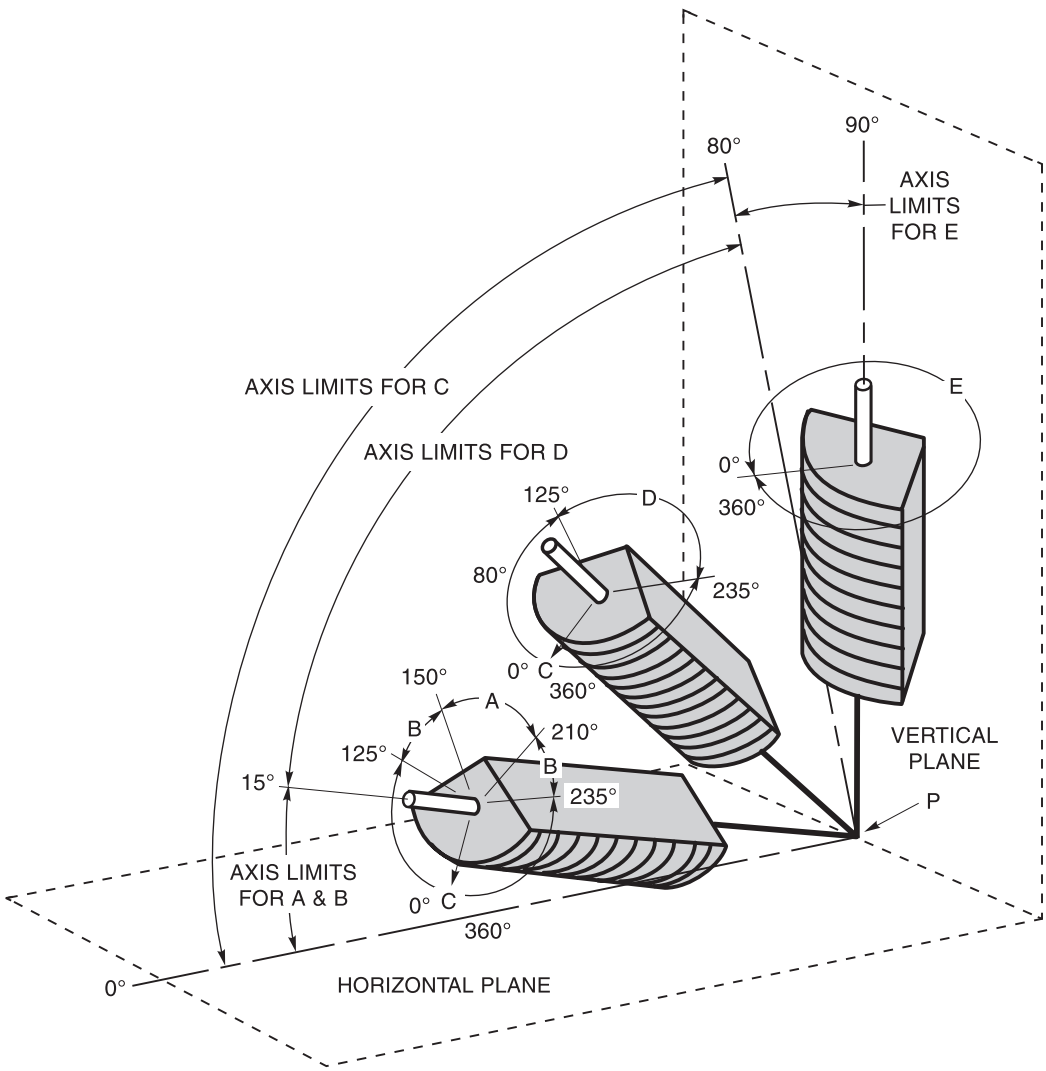
Tabulation of Positions of Groove Welds and Surfacing Welds			
Position	**Diagram Reference**	**Inclination of Axis**	**Rotation of Face**
Flat	A	0° to 15°	150° to 210°
Horizontal	B	0° to 15°	80° to 150°
			210° to 280°
Overhead	C	0° to 80°	0° to 80°
			280° to 360°
Vertical	D	15° to 80°	80° to 280°
	E	80° to 90°	0° to 360°



Notes:
1. The horizontal reference plane is always taken to lie below the weld under consideration.
2. The inclination of the weld axis is measured from the horizontal reference plane toward the vertical reference plane.
3. The angle of rotation of the weld face is determined by a line perpendicular to the weld face passing through the weld axis. The reference position (0°) of rotation of the weld face invariably points in the direction opposite to that in which the axis angle increases. When looking at point P, the angle of rotation of the weld face is measured in a clockwise direction from the reference position (0°).
4. Groove welds are shown for illustrative purposes.

Figure B16A—Welding Position Diagram for Groove Welds and Surfacing Welds in Plate

Tabulation of Positions of Fillet Welds			
Position	**Diagram Reference**	**Inclination of Axis**	**Rotation of Face**
Flat	A	0° to 15°	150° to 210°
Horizontal	B	0° to 15°	125° to 150°
			210° to 235°
Overhead	C	0° to 80°	0° to 125°
			235° to 360°
Vertical	D	15° to 80°	125° to 235°
	E	80° to 90°	0° to 360°



Notes:
1. The horizontal reference plane is always taken to lie below the weld under consideration.
2. The inclination of the weld axis is measured from the horizontal reference plane toward the vertical reference plane.
3. The angle of rotation of the weld face is determined by a line perpendicular to the weld face passing through the weld axis. The reference position (0°) of rotation of the weld face invariably points in the direction opposite to that in which the axis angle increases. When looking at point P, the angle of rotation of the weld face is measured in a clockwise direction from the reference position (0°).

Figure B16B—Welding Position Diagram for Fillet Welds in Plate

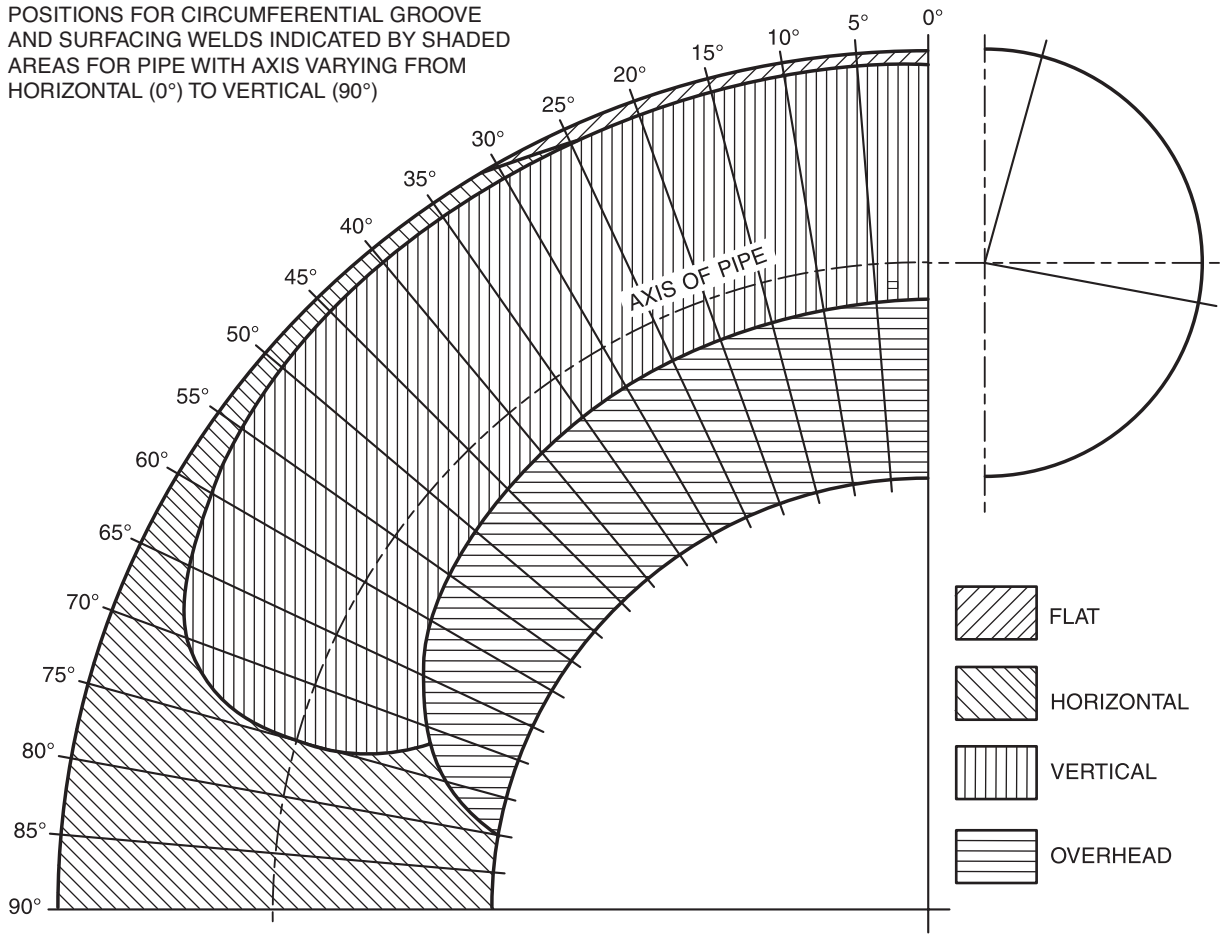
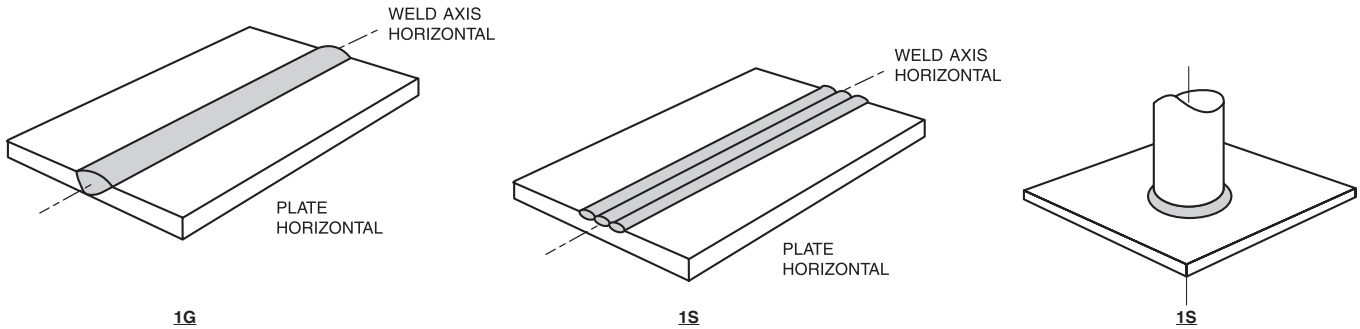
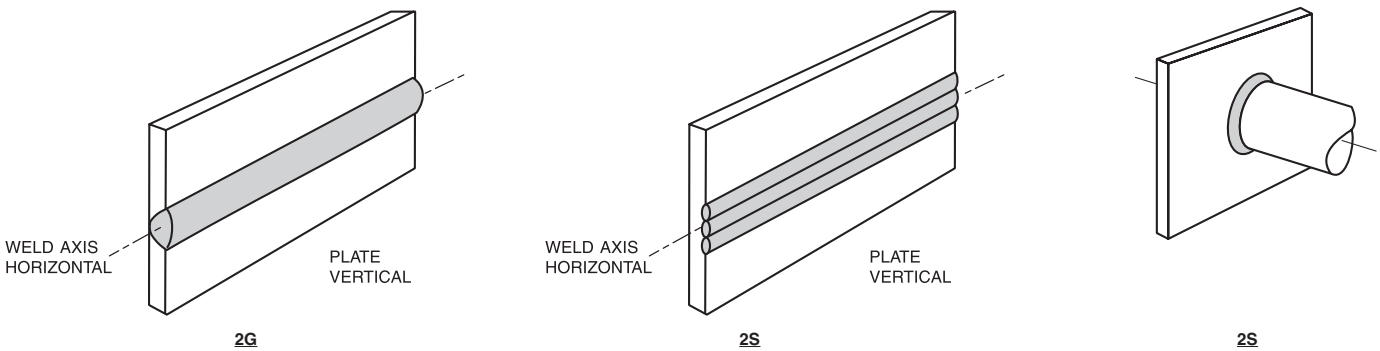


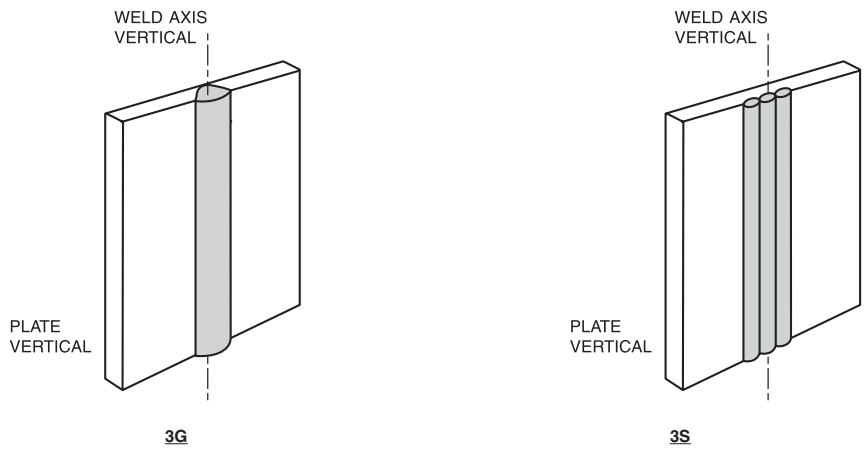
Figure B16C—Welding Position Diagram for Groove Welds and Surfacing Welds in Pipe



(A) FLAT WELDING TEST POSITIONS—1G AND 1S

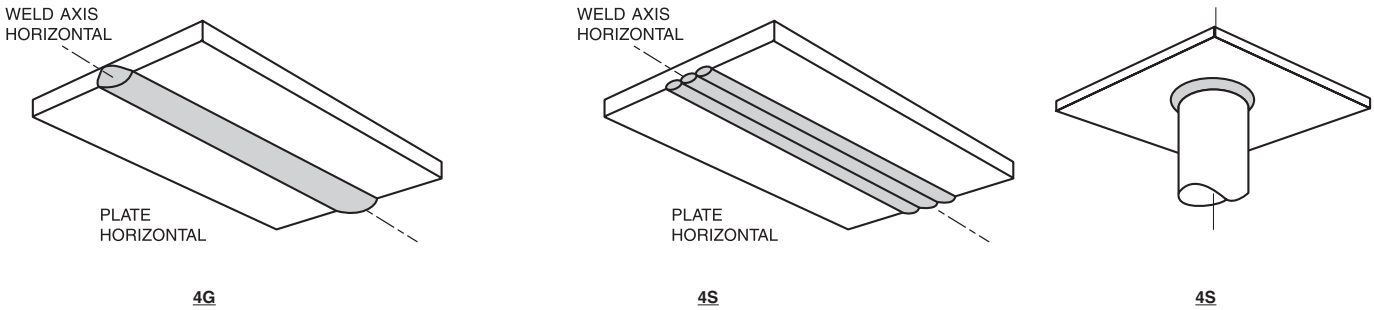


(B) HORIZONTAL WELDING TEST POSITIONS—2G AND 2S



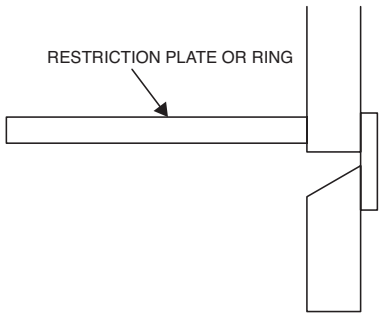
(C) VERTICAL WELDING TEST POSITION—3G AND 3S

Figure B17—Welding Test Positions and Their Designations for Groove Welds, Stud Welds, and Surfacing Welds in Plate



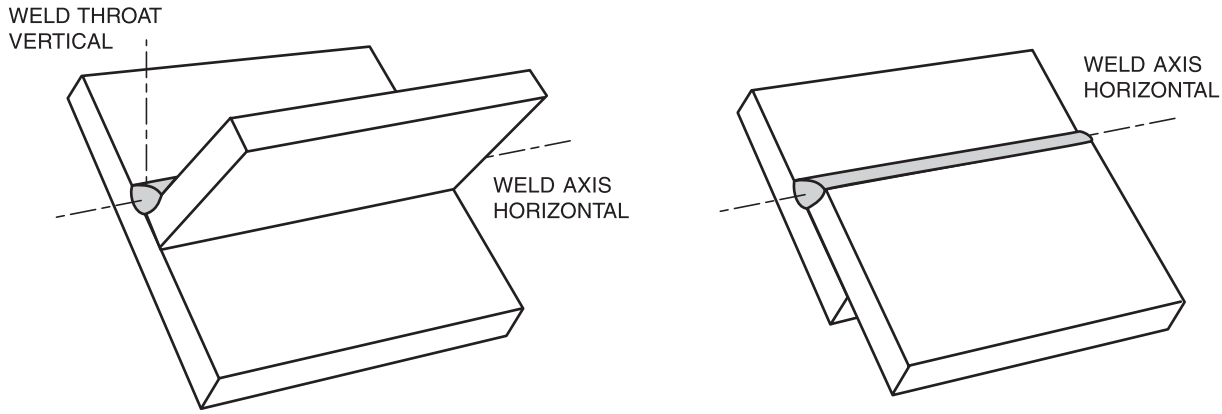
4G 4S 4S

(D) OVERHEAD WELDING TEST POSITION—4G AND 4S

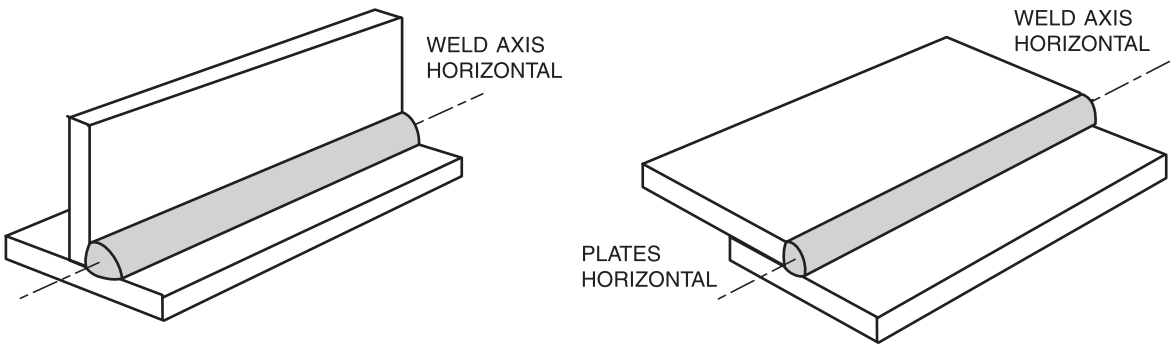


(E) RESTRICTED ACCESS HORIZONTAL GROOVE WELD—2G-RA

Figure B17 (Continued)—Welding Test Positions and Their Designations for Groove Welds, Stud Welds, and Surfacing Welds in Plate



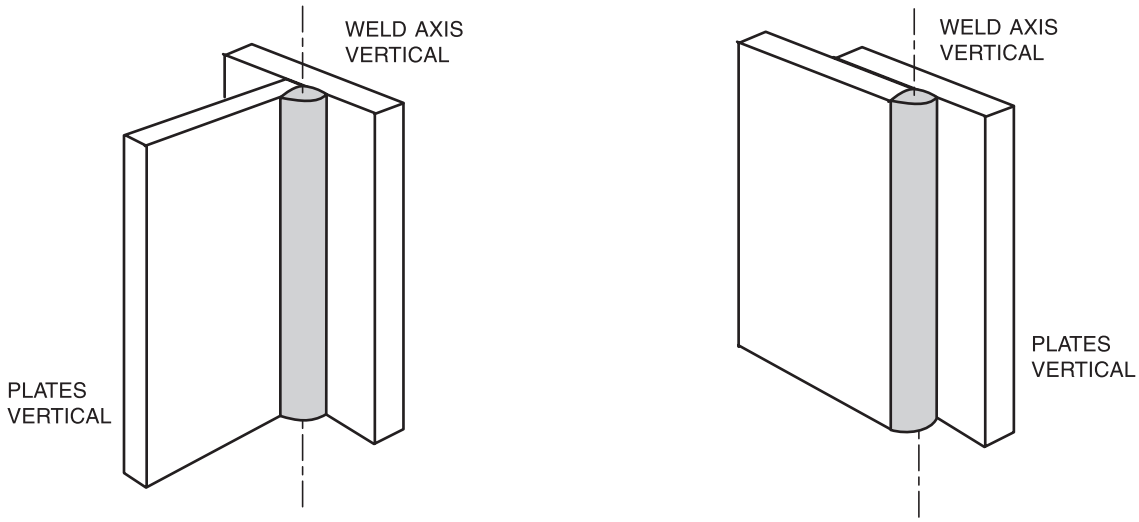
(A) FLAT WELDING TEST POSITION—1F



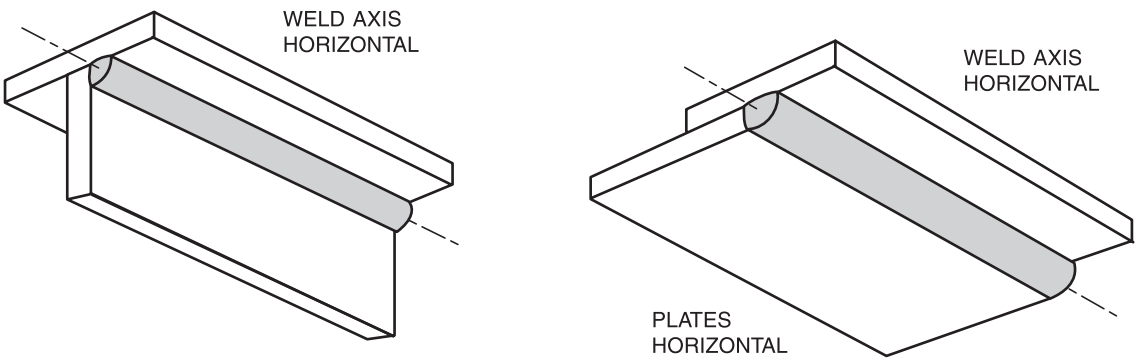
Note: One plate must be horizontal.

(B) HORIZONTAL WELDING TEST POSITION—2F

Figure B18—Welding Test Positions and Their Designations for Fillet Welds in Plate



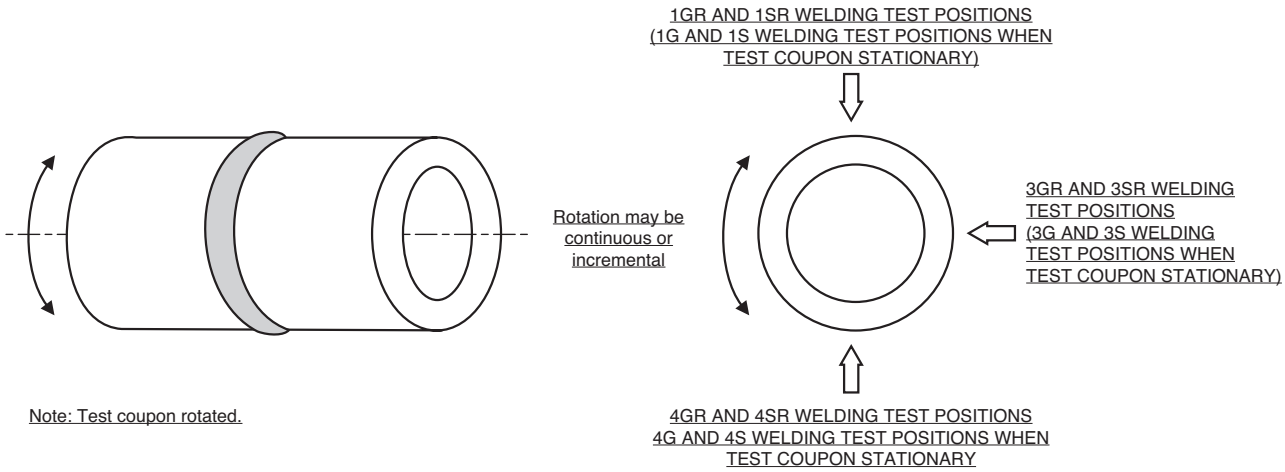
(C) VERTICAL WELDING TEST POSITION—3F



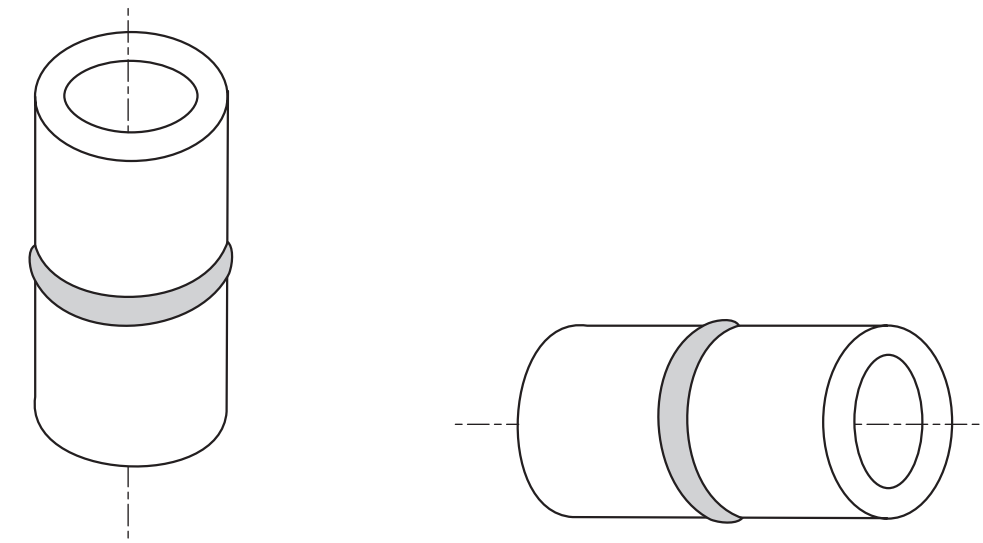
Note: One plate must be horizontal.

(D) OVERHEAD WELDING TEST POSITION—4F

Figure B18 (Continued)—Welding Test Positions and Their Designations for Fillet Welds in Plate



**(A) ROTATED HORIZONTAL GROOVE OR SURFACING WELD TEST COUPON –
FOR QUALIFICATION IN THE 1G, 1GR, 1S, 1SR, 3G, 3GR, 3S, 3SR, 4G, 4GR, 4S, AND 4SR TEST POSITIONS**

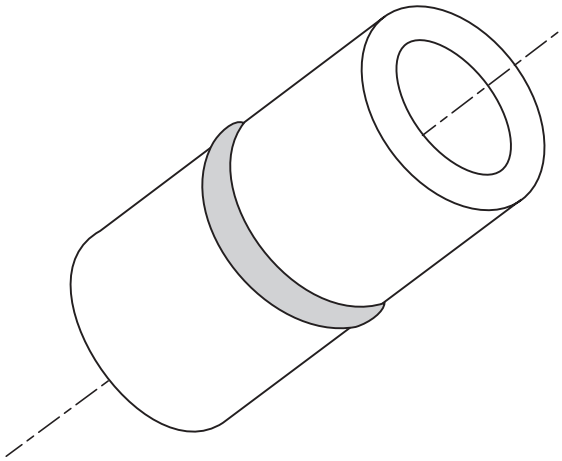


Note: Test coupon stationary.

**(B) HORIZONTAL WELDING
TEST POSITION—2G AND 2S**

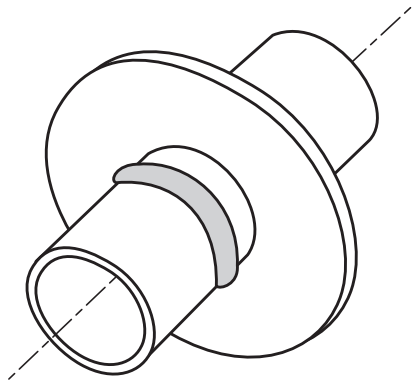
**(C) MULTIPLE WELDING
TEST POSITION—5G AND 5S**

Figure B19—Welding Test Positions and Their Designations for Groove Welds and Surfacing Welds in Pipe



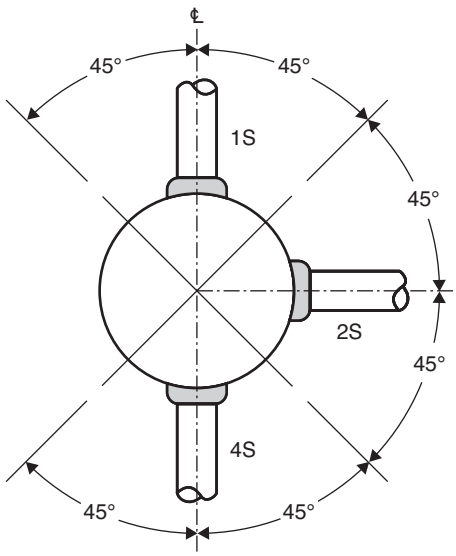
Note: Test coupon stationary.

(D) MULTIPLE WELDING TEST POSITION—6G AND 6S



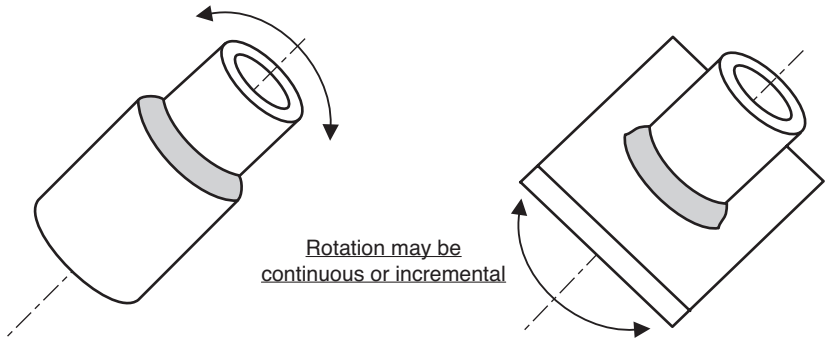
Note: Test coupon stationary.

(E) MULTIPLE WELDING TEST POSITION WITH RESTRICTION RING—6GR

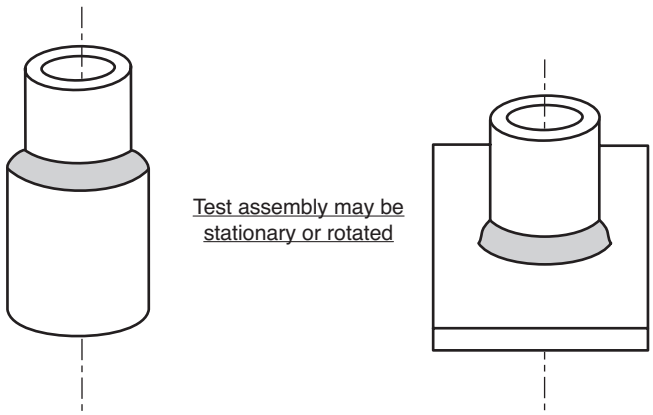


(F) STUD WELDING POSITIONS

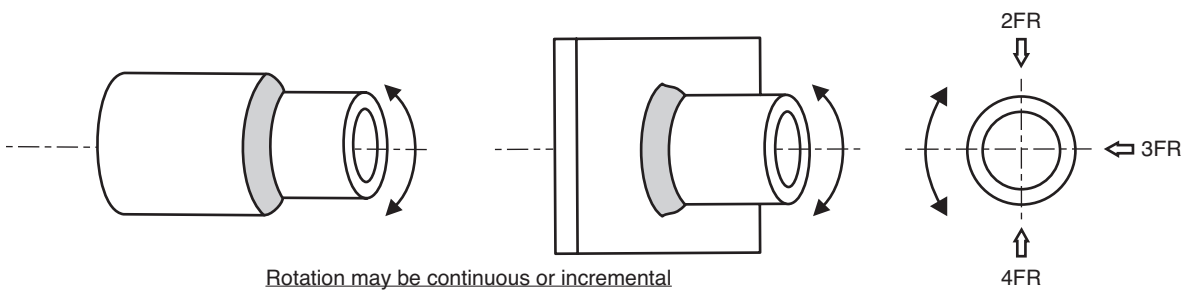
Figure B19 (Continued)—Welding Test Positions and Their Designations for Groove Welds and Surfacing Welds in Pipe



(A) FLAT WELDING TEST POSITION—1FR

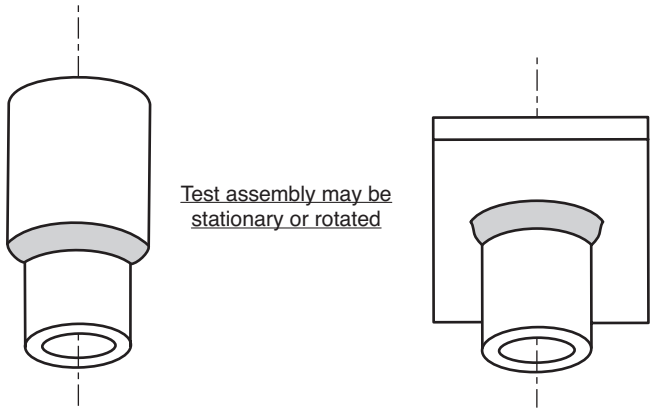


(B) HORIZONTAL WELDING TEST POSITION—2F



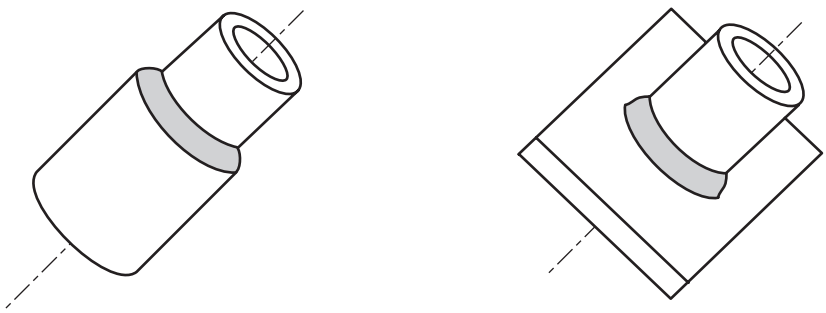
(C) ROTATED HORIZONTAL FILLET WELD TEST COUPON—FOR QUALIFICATION IN THE 2FR, 3FR, OR 4FR WELDING TEST POSITION

Figure B20—Welding Test Positions and Their Designations for Fillet Welds in Pipe



(D) OVERHEAD WELDING TEST POSITION—4F

(E) MULTIPLE WELDING TEST POSITION—5F



(F) MULTIPLE WELDING TEST POSITION—6F

Figure B20 (Continued)—Welding Test Positions and Their Designations for Fillet Welds in Pipe

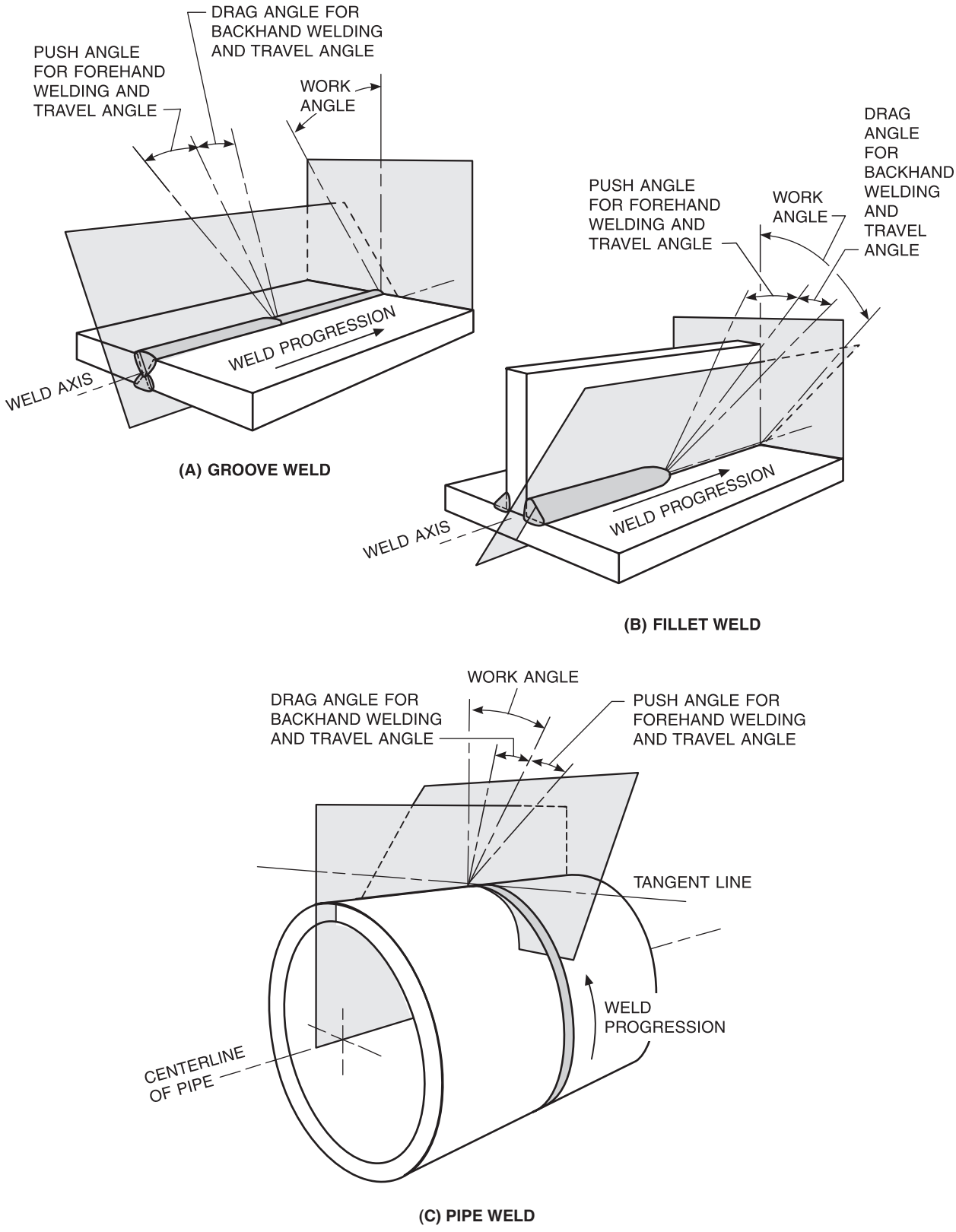
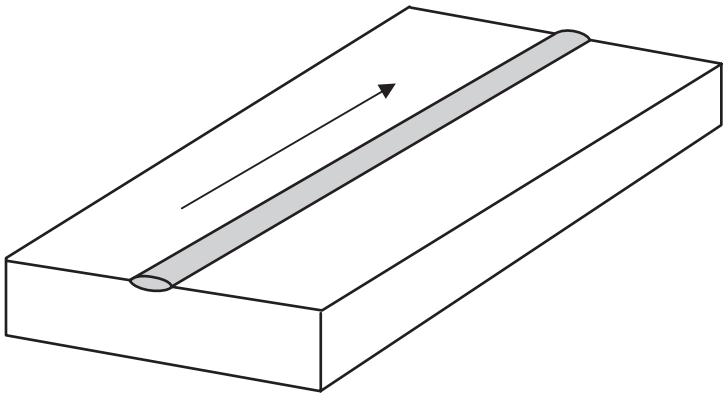
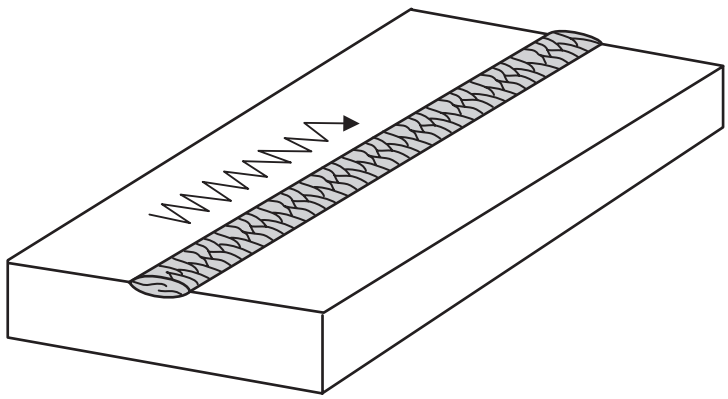


Figure B21—Position of Beam, Filler Material, Gun, or Torch



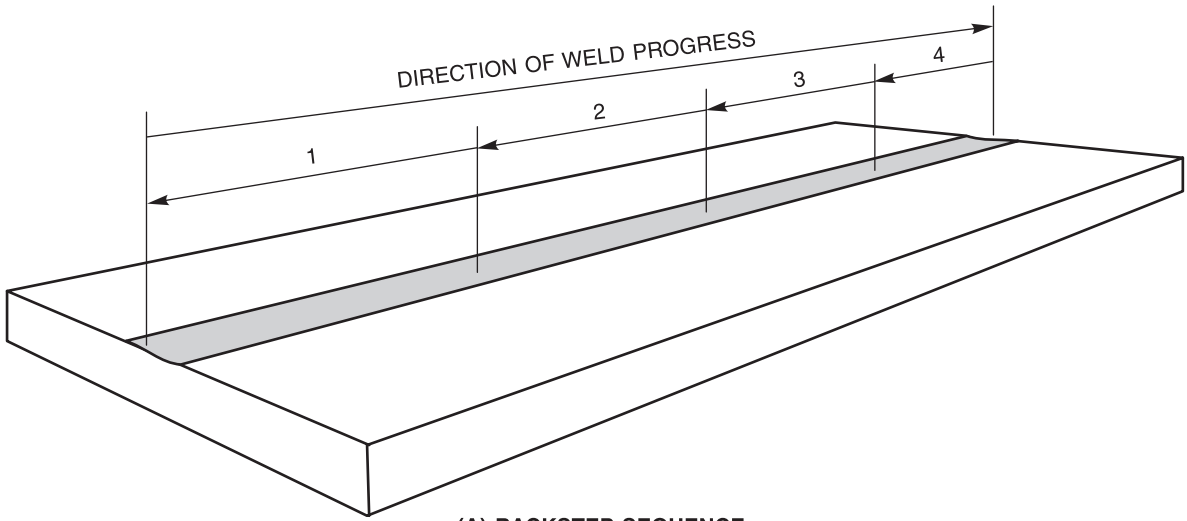
(A) STRINGER BEAD



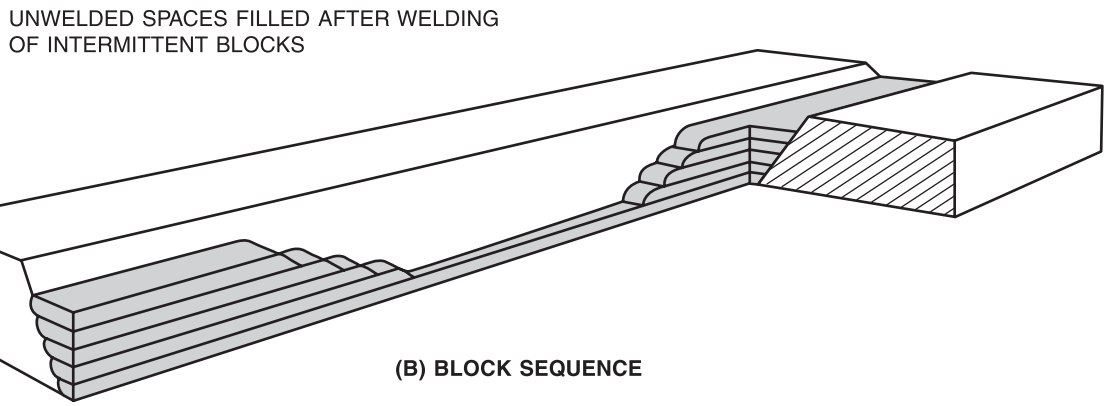
(B) WEAVE BEAD

Note: The arrows adjacent to the weld beads indicate the approximate motion of the electrode, flame, or other energy source relative to the workpiece.

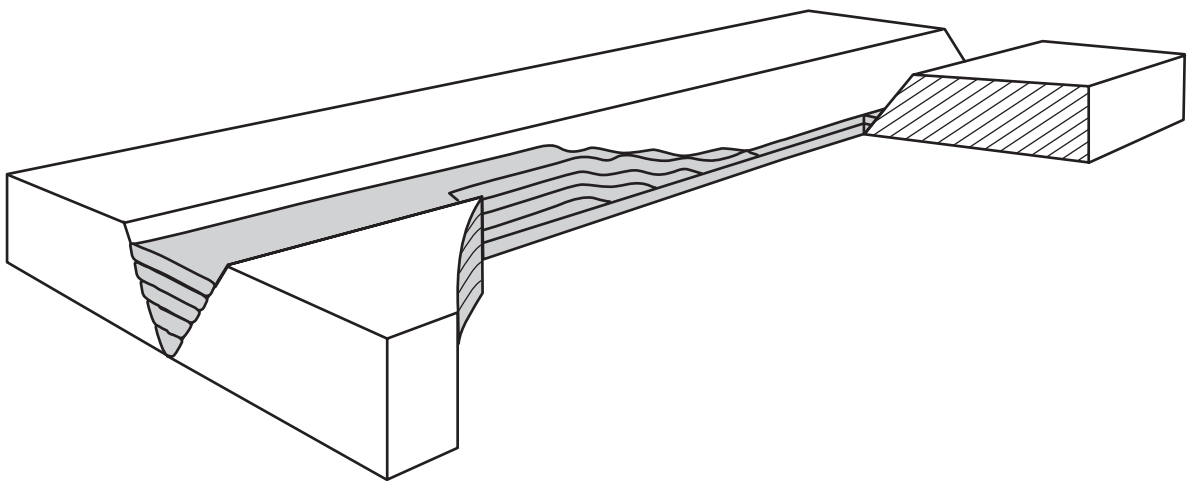
Figure B22—Weld Bead Types



(A) BACKSTEP SEQUENCE

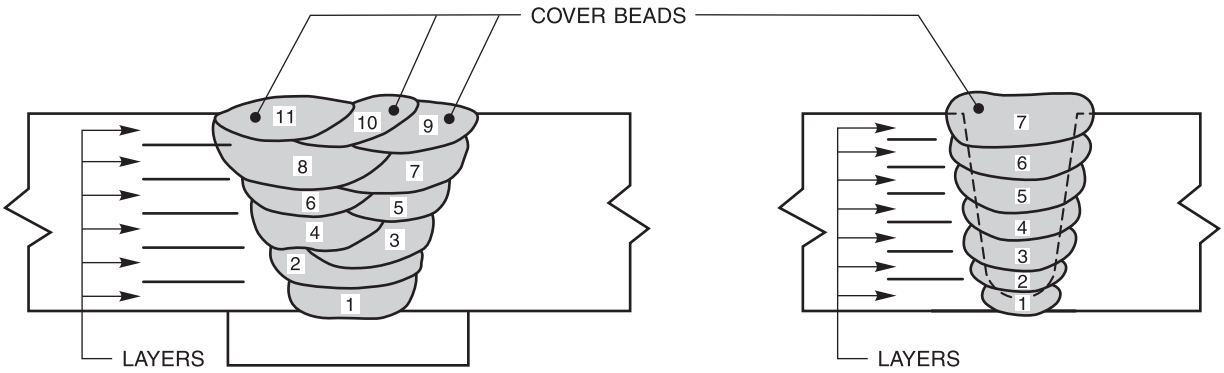


(B) BLOCK SEQUENCE



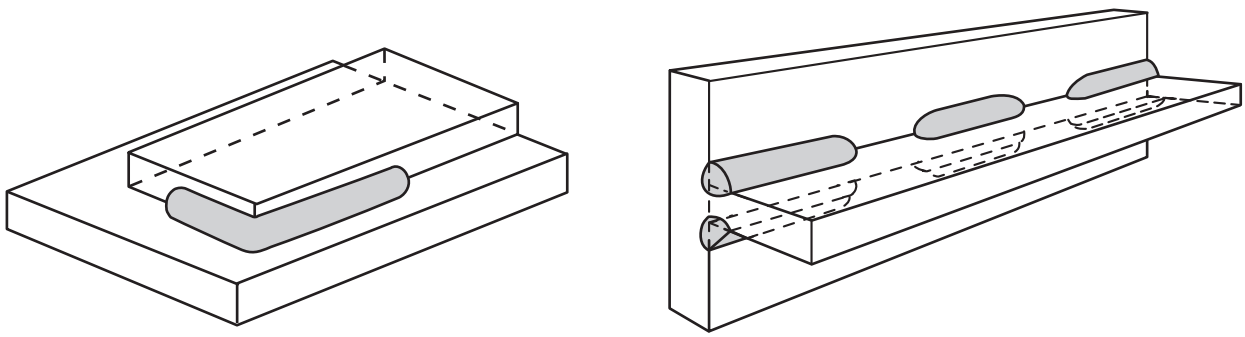
(C) CASCADE SEQUENCE

Figure B23—Welding Application Nomenclature

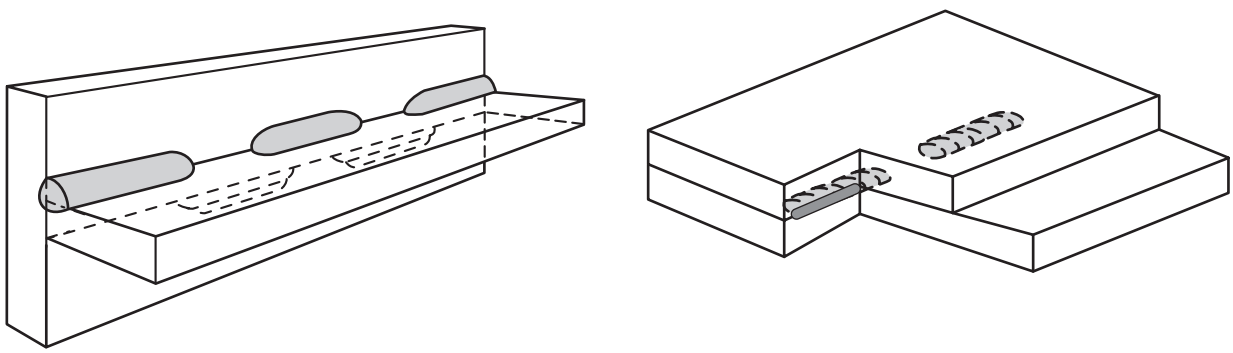


(D) CROSS-SECTIONAL SEQUENCE* (E) CROSS-SECTIONAL SEQUENCE*

*Each weld bead is numbered sequentially.

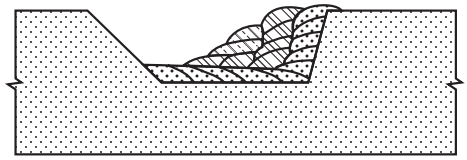


(F) BOXING (G) CHAIN INTERMITTENT FILLET WELD

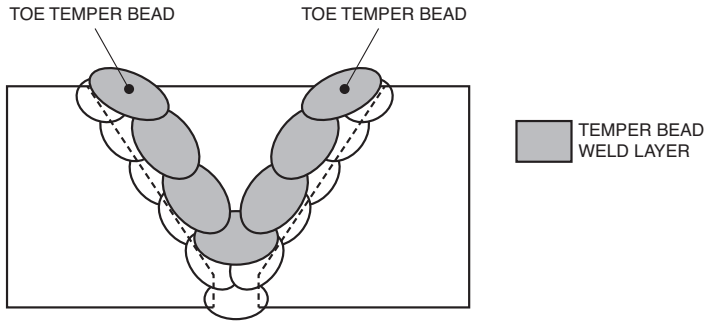


(H) STAGGERED INTERMITTENT FILLET WELD (I) INTERMITTENT SEAM WELD

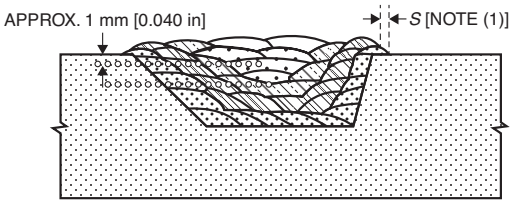
Figure B23 (Continued)—Welding Application Nomenclature



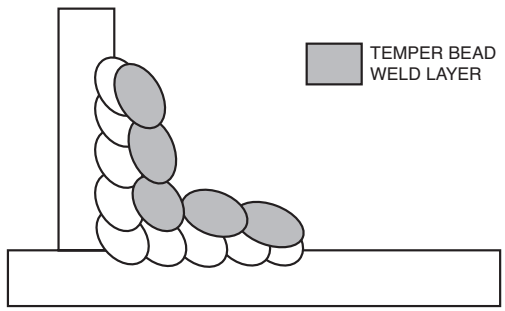
PARTIALLY COMPLETED GROOVE WELD



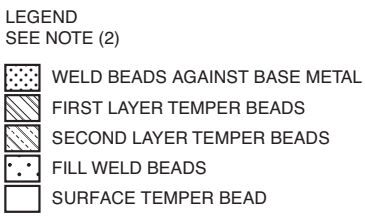
PARTIALLY COMPLETED GROOVE WELD WITH TEMPER BEAD WELD LAYER

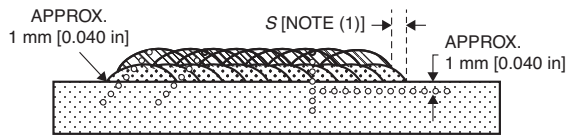


COMPLETED GROOVE WELD



PARTIALLY COMPLETED FILLET WELD WITH TEMPER BEAD WELD LAYER





OVERLAY WELD

General Notes:
(a) Weld beads shown above may be deposited in any sequence that will result in placement of the beads as shown.
(b) Surface temper bead may cover the entire weld surface or may only be placed at the toe of the weld; they may or may not be mechanically removed.

Notes:
(1) The distance, S, is measured from the toe of the weld to the edge of the temper beads. Measurements shall be made parallel to the base metal surface.
(2) Beads near the finished surface may be both tempering beads and surface temper beads.

Source: Adapted from ASME 2013 *BPVC, Section IX*, by permission of The American Society of Mechanical Engineers, Figure QW-462.12.

(J) TEMPER BEADS

Figure B23 (Continued)—Welding Application Nomenclature

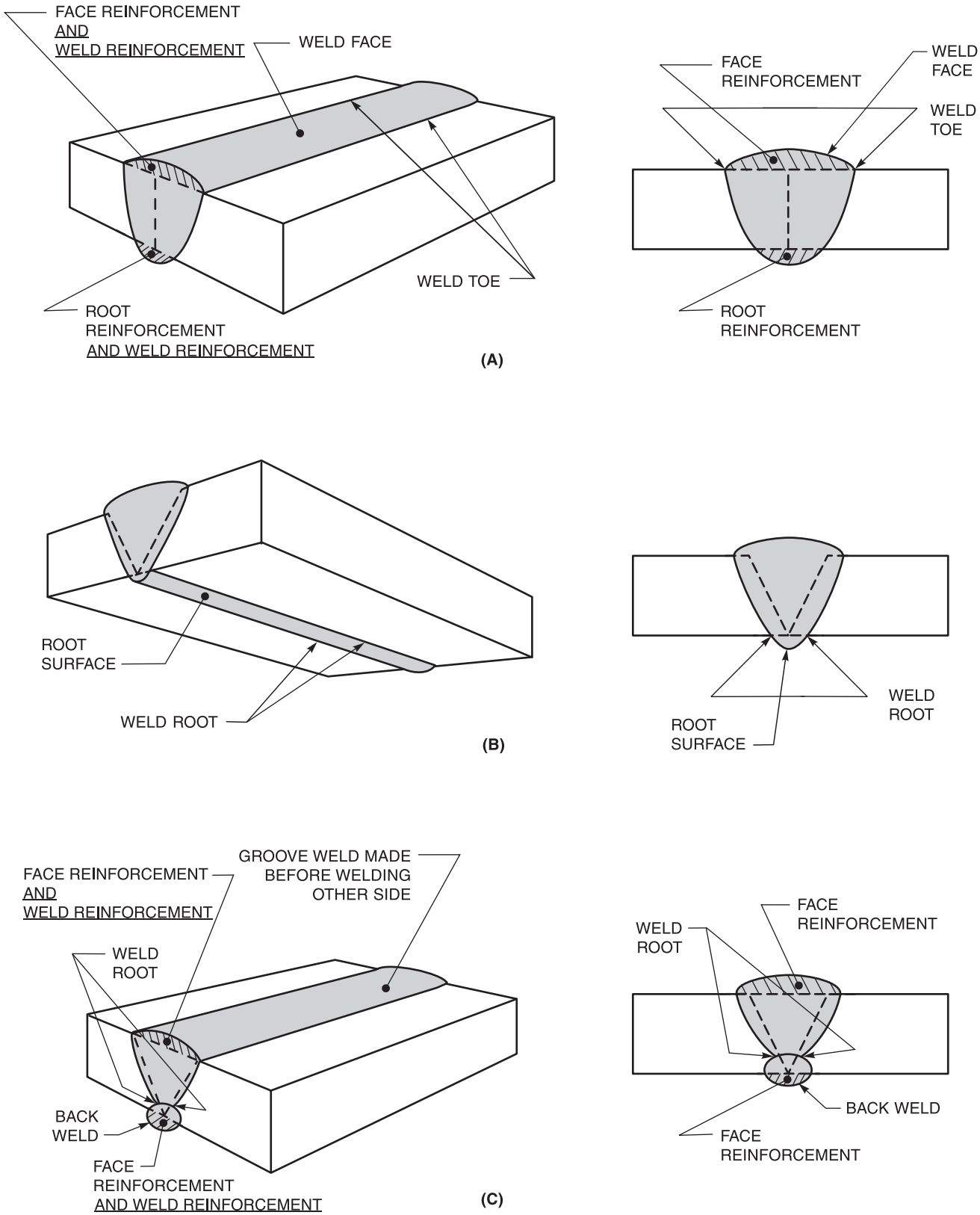


Figure B24—Parts of a Weld

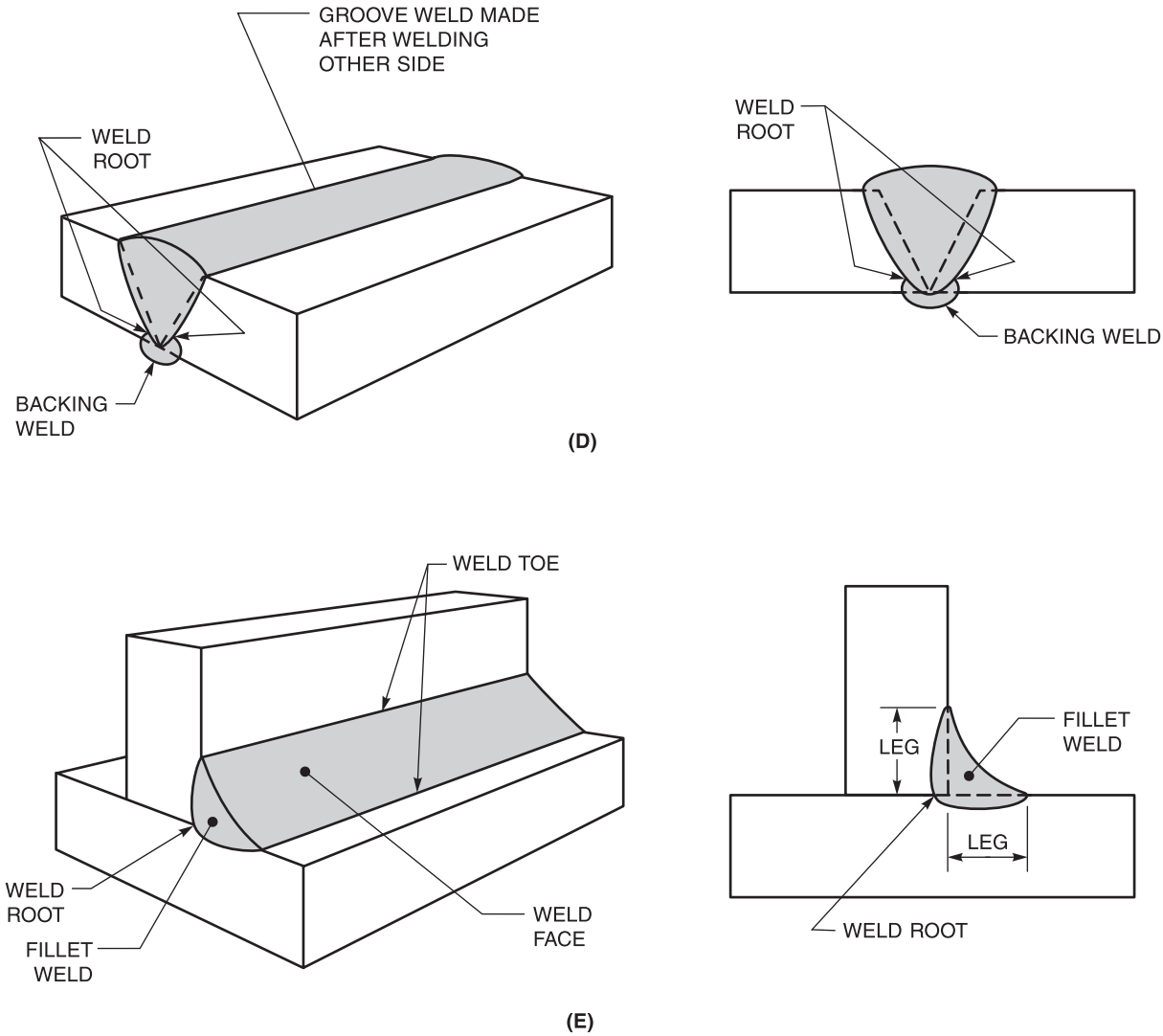
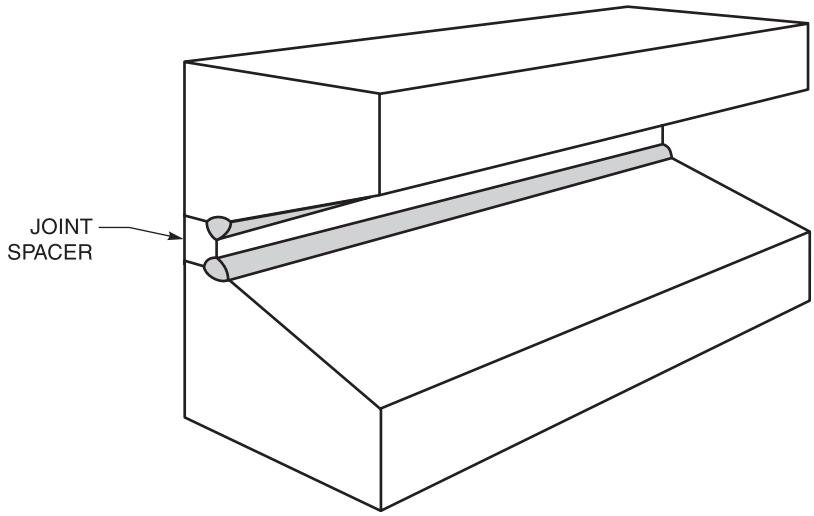
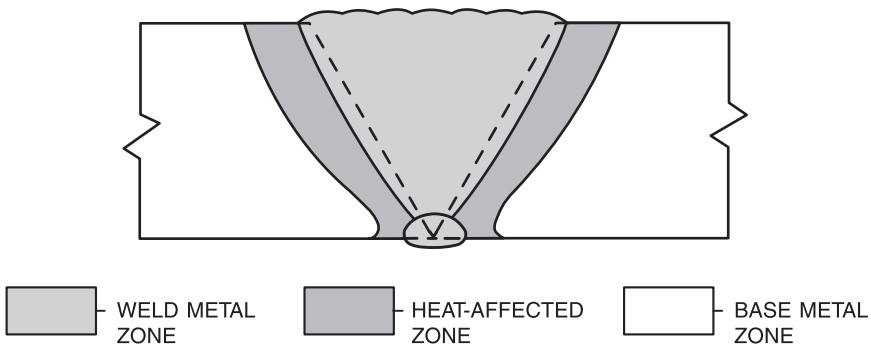


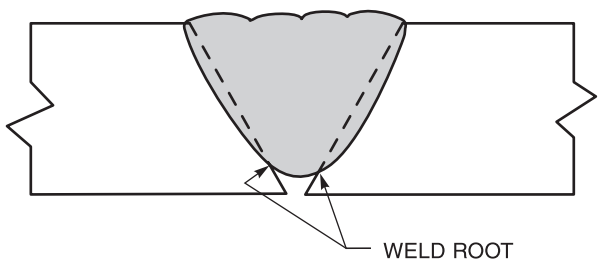
Figure B24 (Continued)—Parts of a Weld



(F)



(G)



(H)

Figure B24 (Continued)—Parts of a Weld

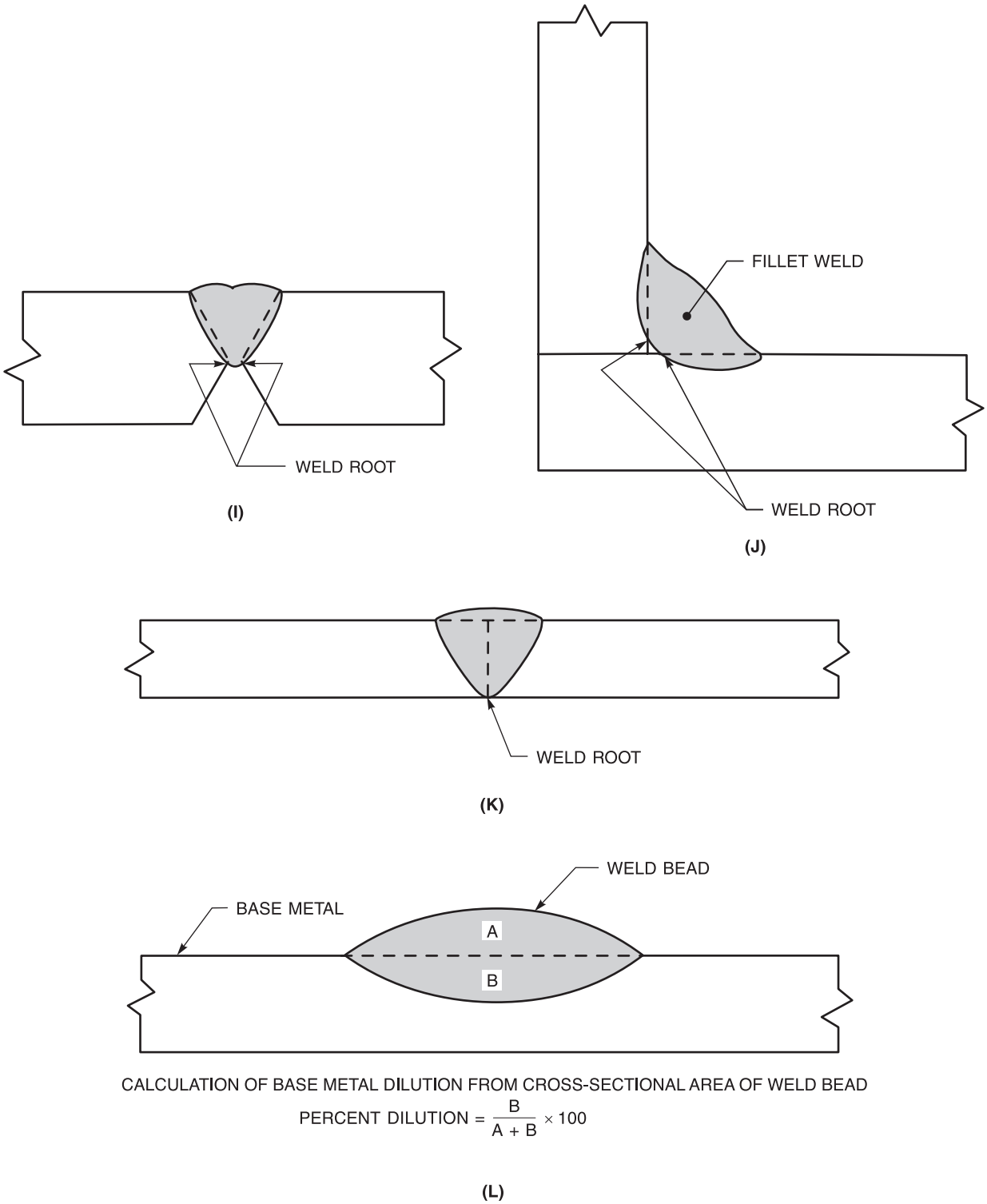
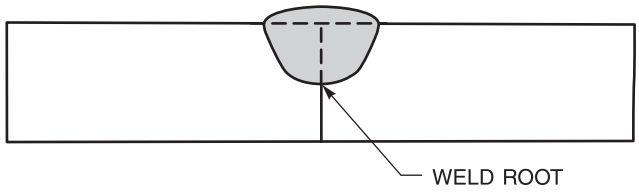
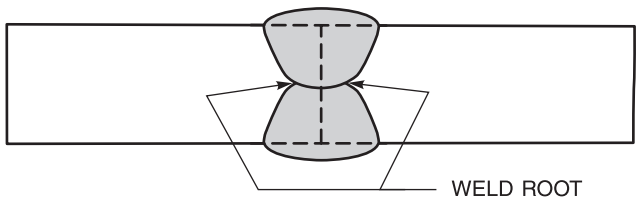


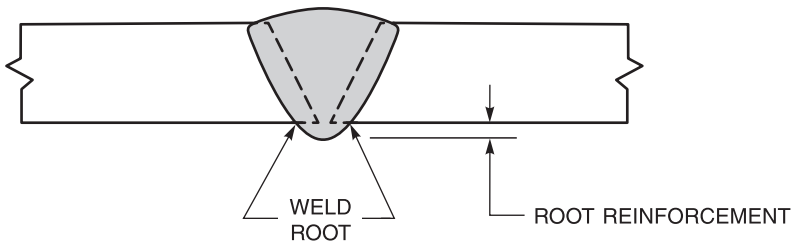
Figure B24 (Continued)—Parts of a Weld



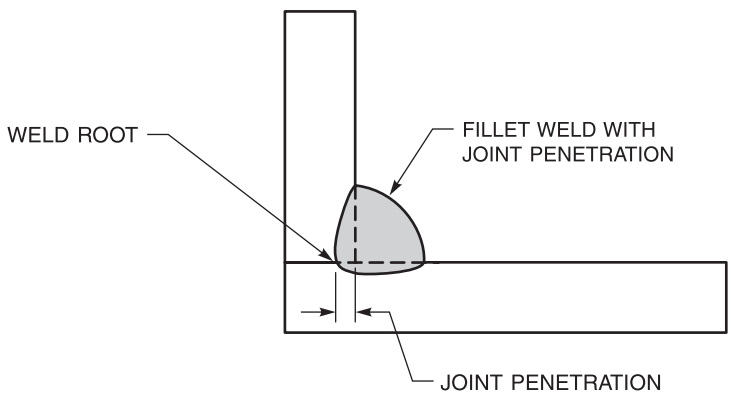
(M) SINGLE-SQUARE-GROOVE WELD



(N) DOUBLE-SQUARE-GROOVE WELD

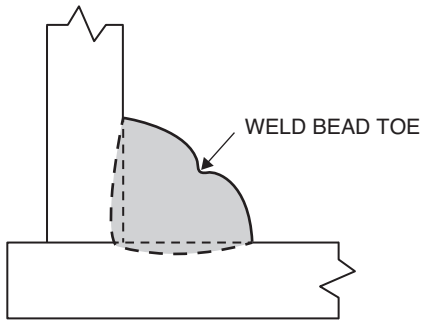


(O) SINGLE-GROOVE WELD WITH ROOT REINFORCEMENT

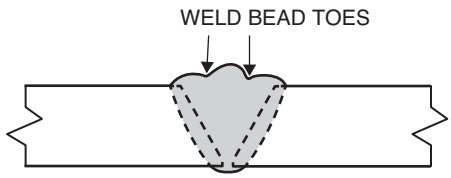


(P) FILLET WELD WITH JOINT PENETRATION

Figure B24 (Continued)—Parts of a Weld

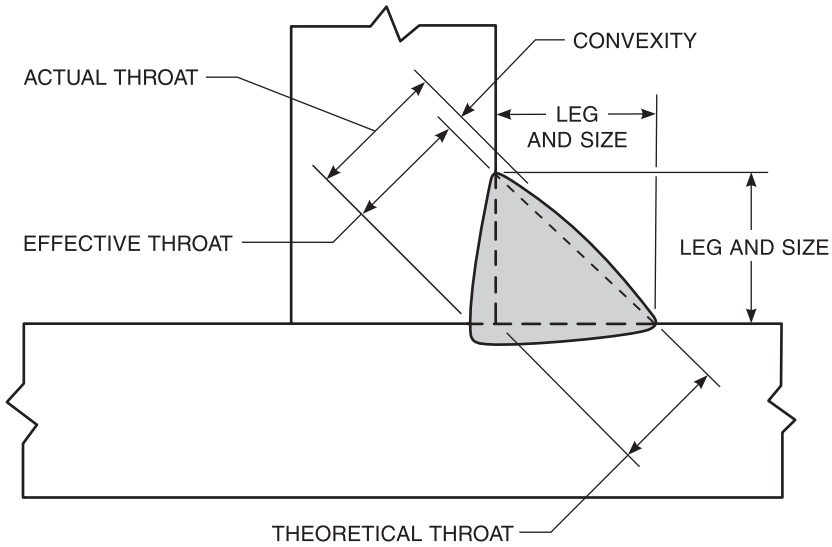


(Q) WELD BEAD TOE AT FILLET WELD FACE

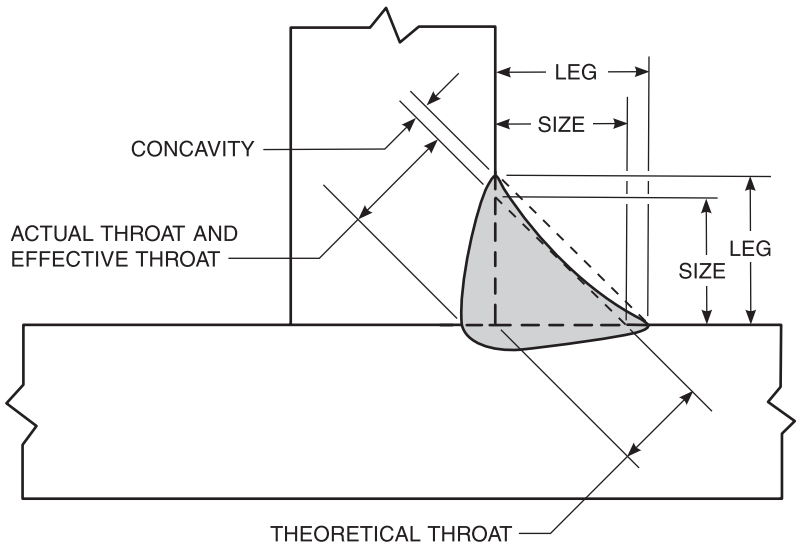


(R) WELD BEAD TOES AT GROOVE WELD FACE

Figure B24 (Continued)—Parts of a Weld

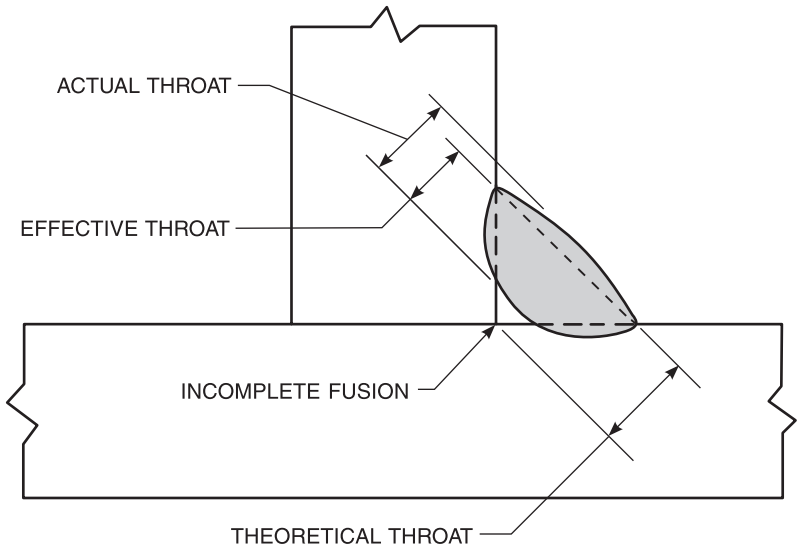


(A) CONVEX FILLET WELD

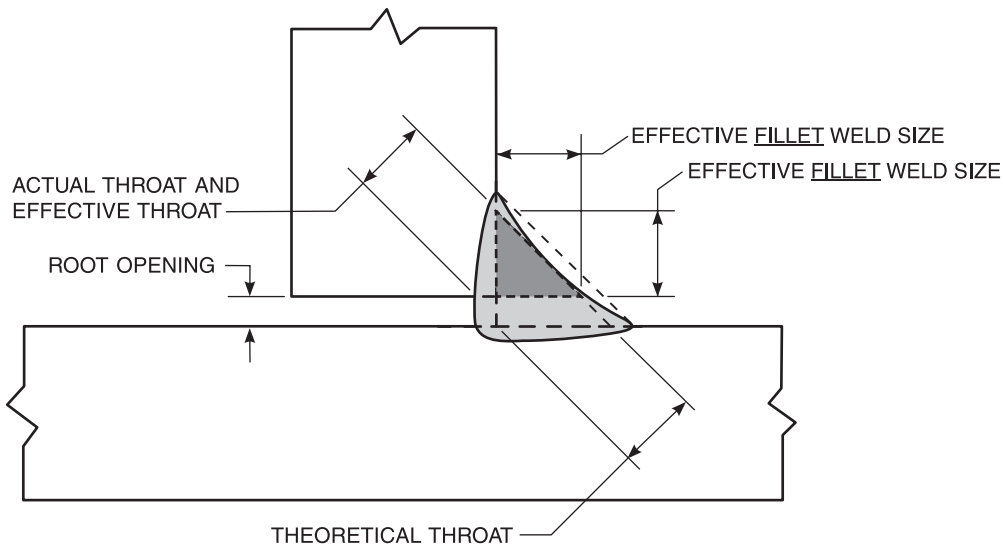


(B) CONCAVE FILLET WELD

Figure B25—Weld Sizes

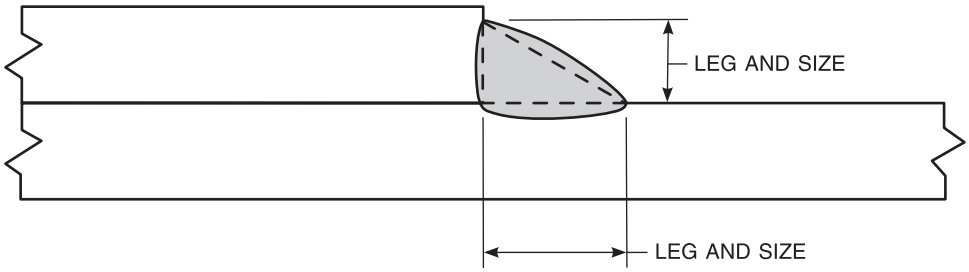


(C) FILLET WELD WITH INCOMPLETE FUSION

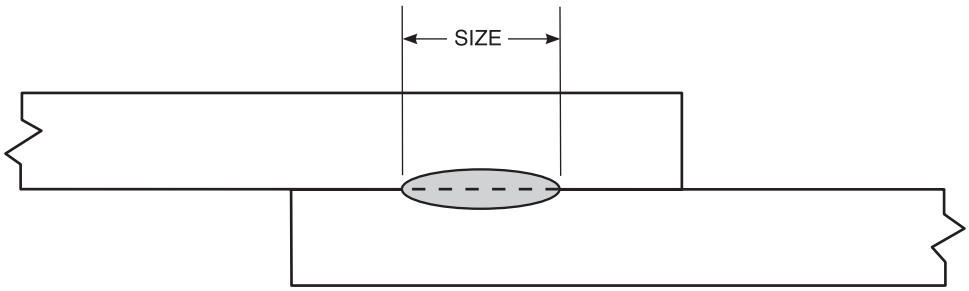


(D) T-JOINT WITH ROOT OPENING

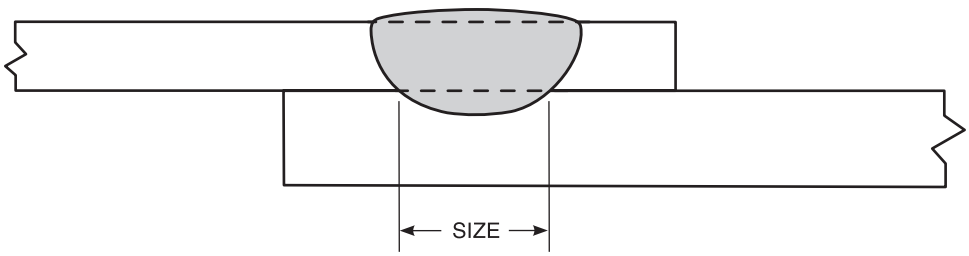
Figure B25 (Continued)—Weld Sizes



(E) UNEQUAL LEG FILLET WELD

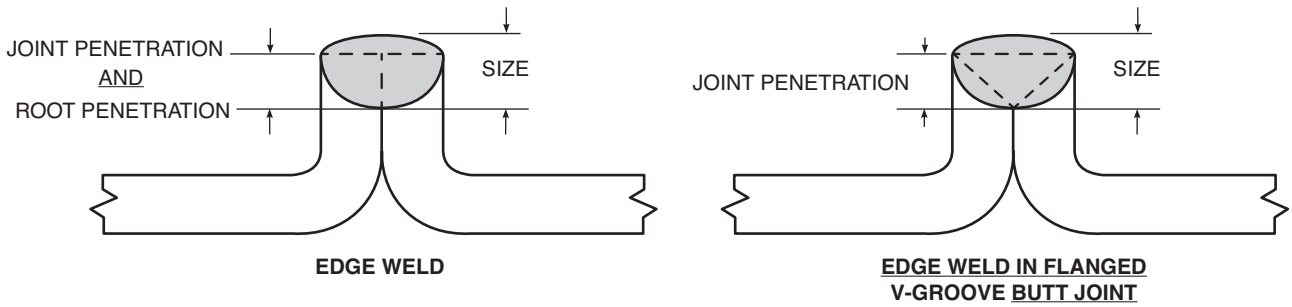


(F) SIZE OF SEAM OR SPOT WELD



(G) ARC SEAM OR ARC SPOT WELD SIZE

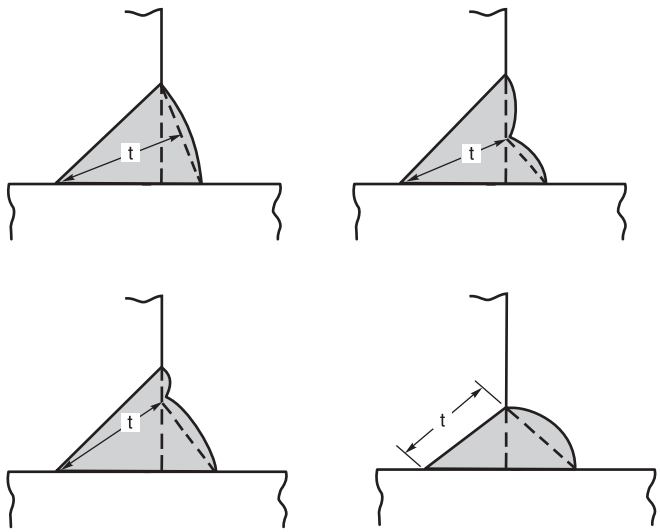
Figure B25 (Continued)—Weld Sizes



EDGE WELD

EDGE WELD IN FLANGED V-GROOVE BUTT JOINT

(H) WELD SIZES FOR FLANGED BUTT JOINTS



(I) EFFECTIVE THROATS FOR PARTIAL JOINT PENETRATION GROOVE WELDS WITH REINFORCING FILLET WELDS

Figure B25 (Continued)—Weld Sizes

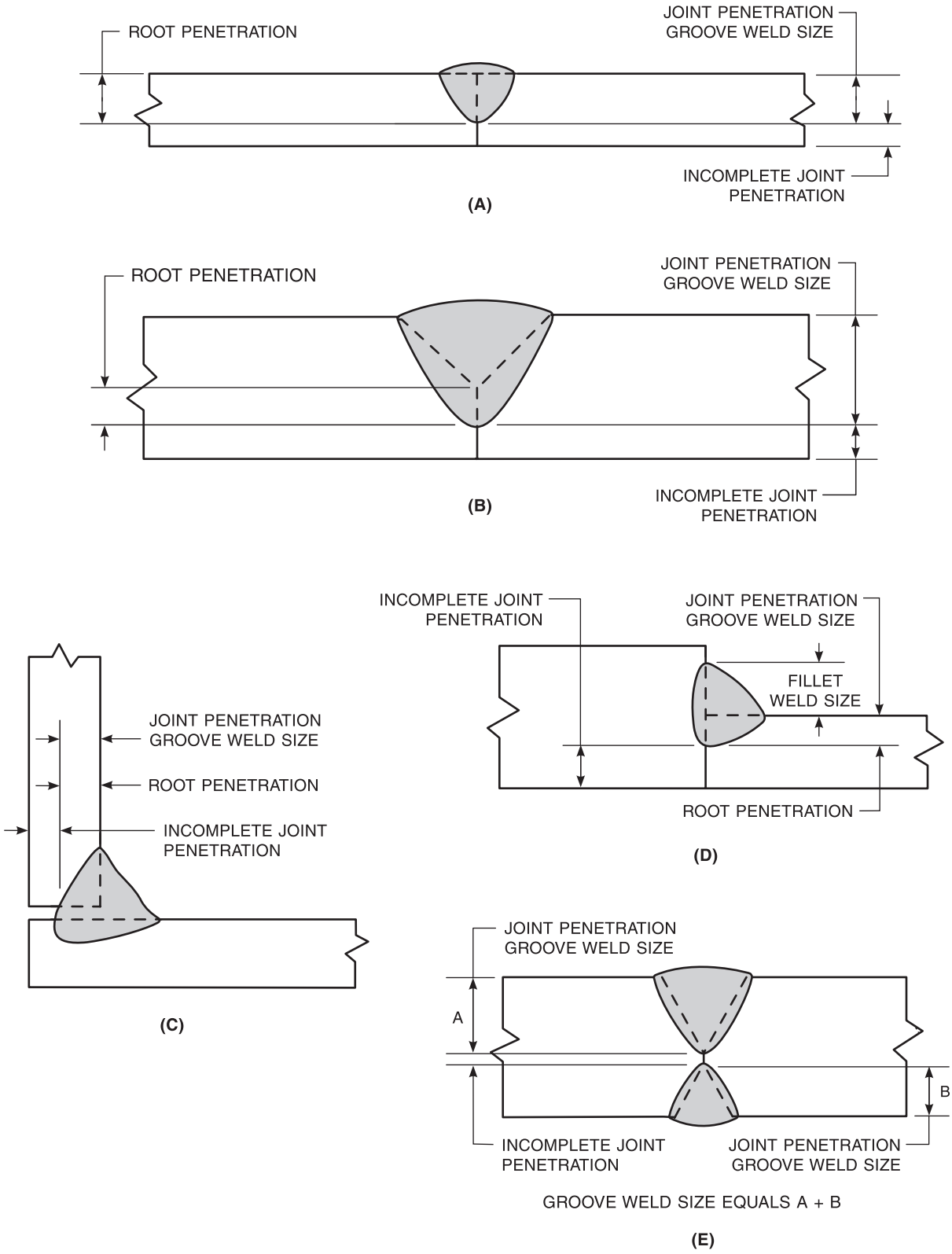


Figure B26—Groove Weld Size and Joint Penetration

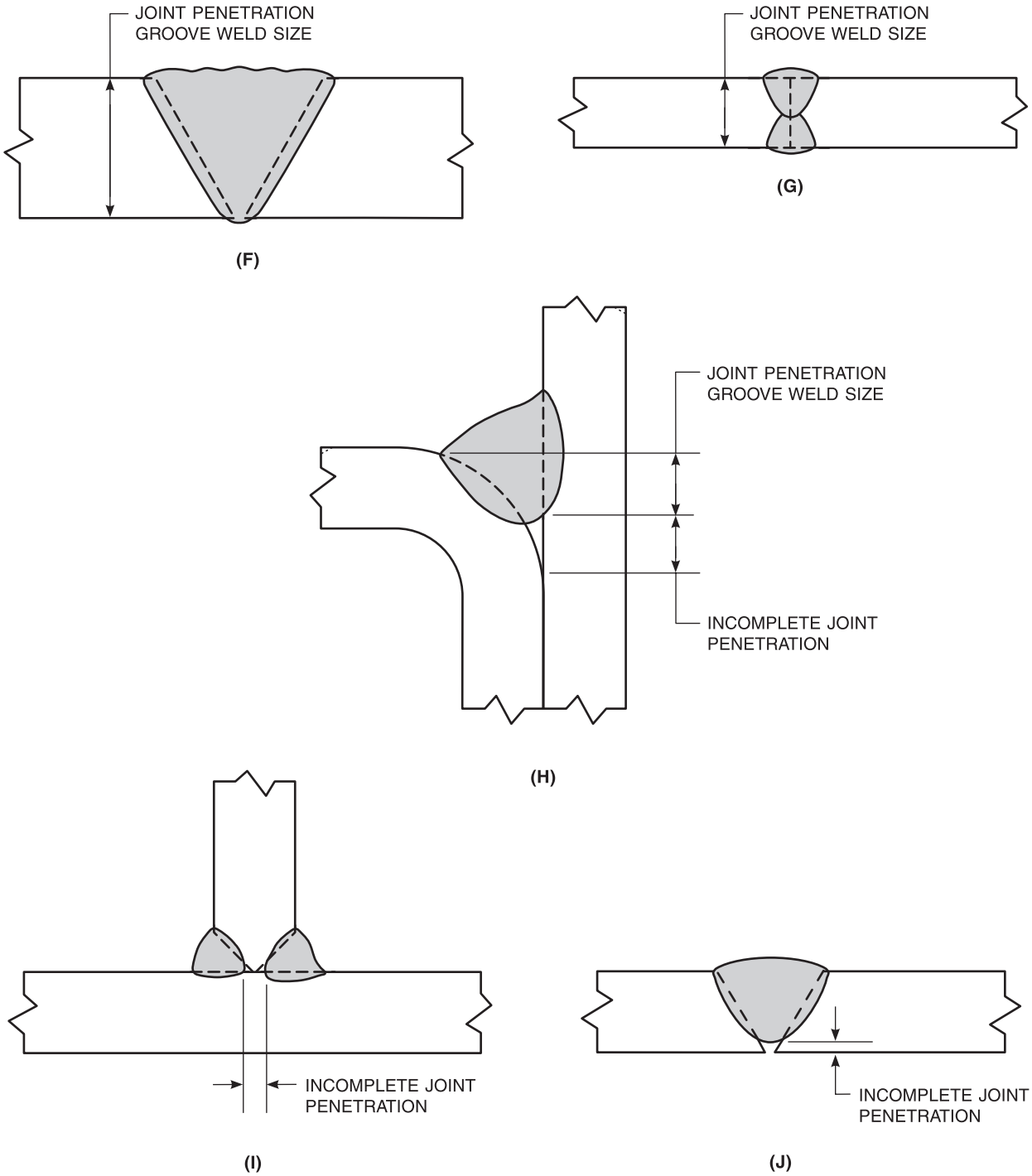
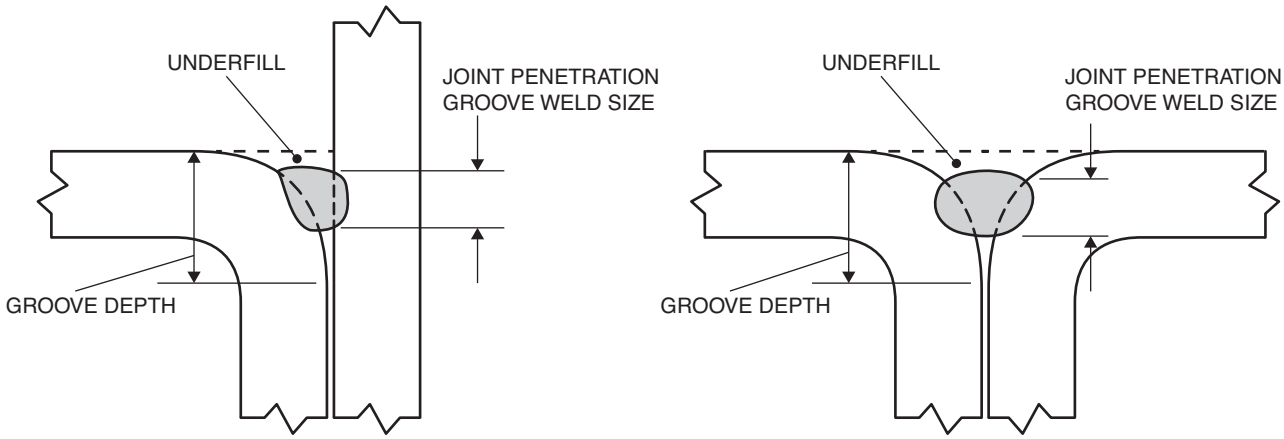


Figure B26 (Continued)—Groove Weld Size and Joint Penetration



(K) FLARE-BEVEL-GROOVE WELD WITH UNDERFILL (L) FLARE-V-GROOVE WELD WITH UNDERFILL

Figure B26 (Continued)—Groove Weld Size and Joint Penetration

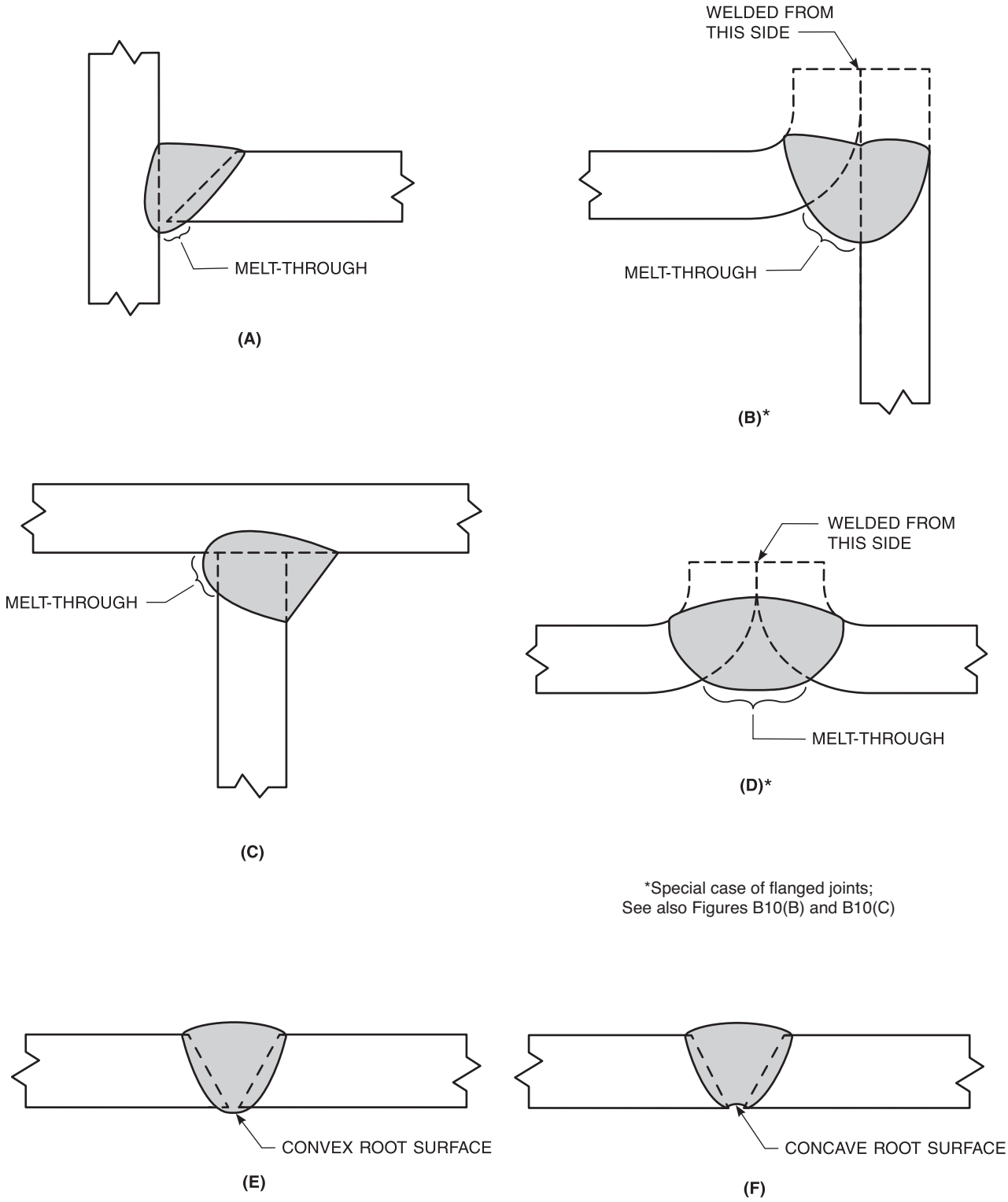


Figure B27—Melt-Through and Root Surface Profile

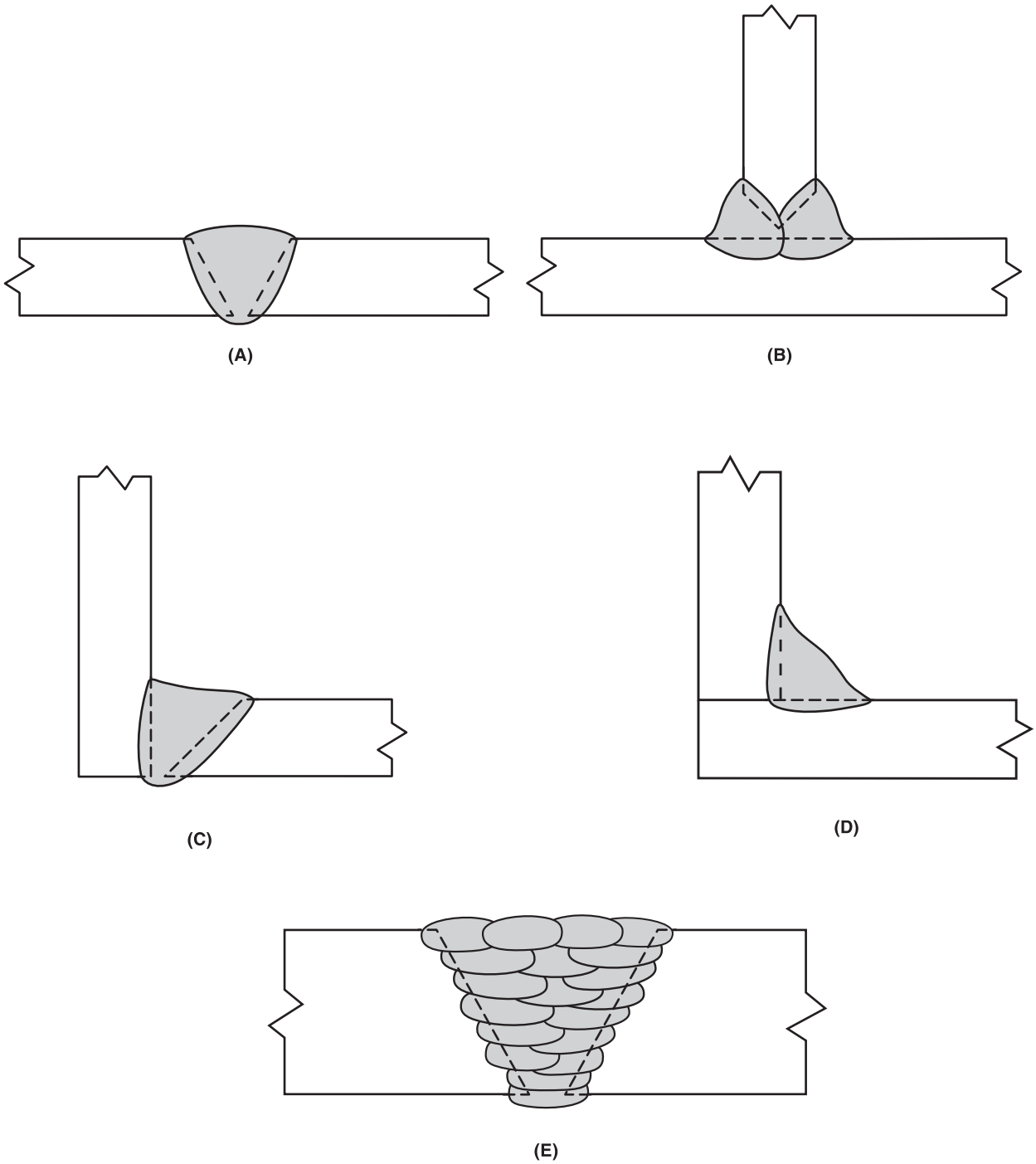


Figure B28—Complete Fusion

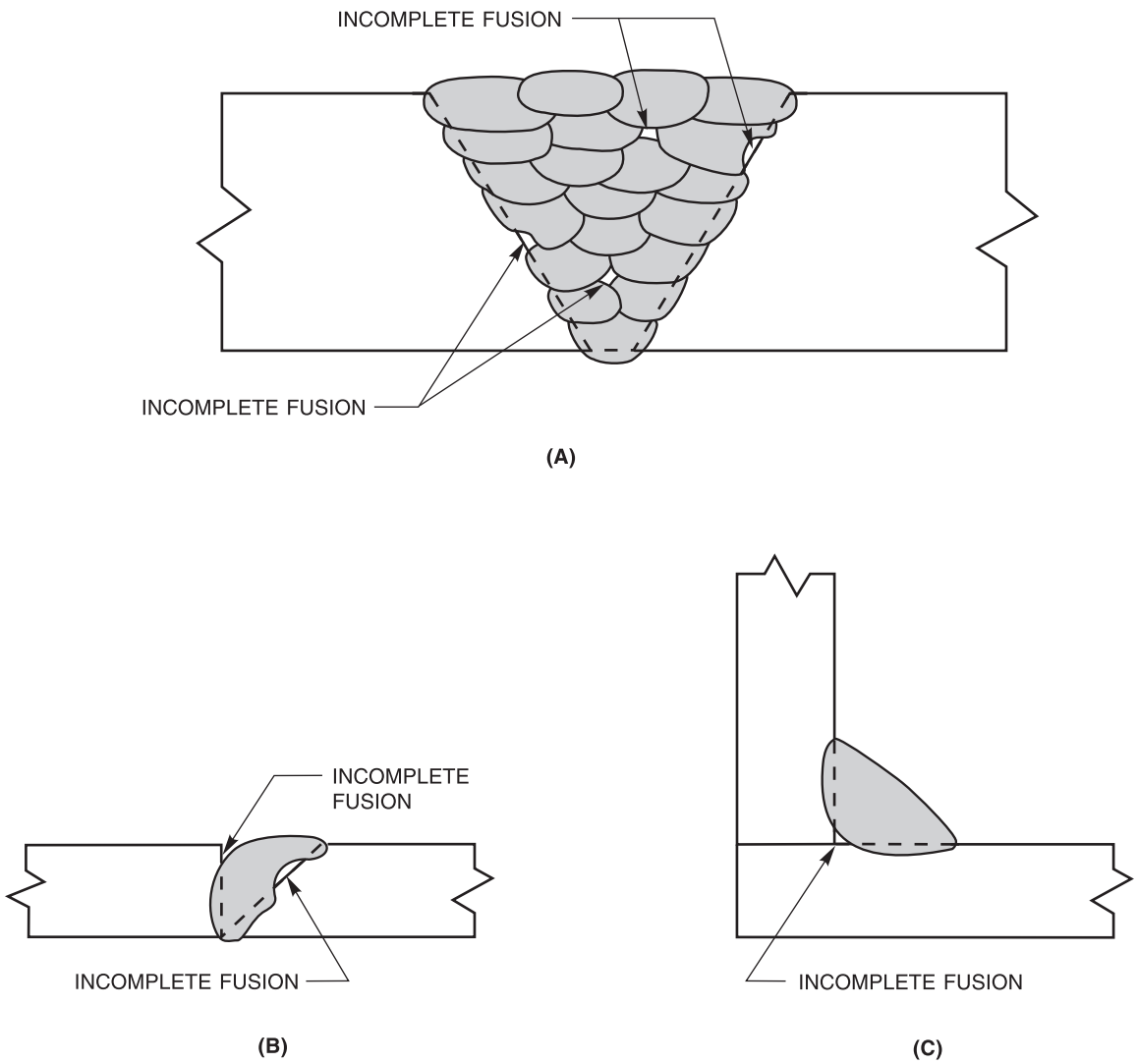
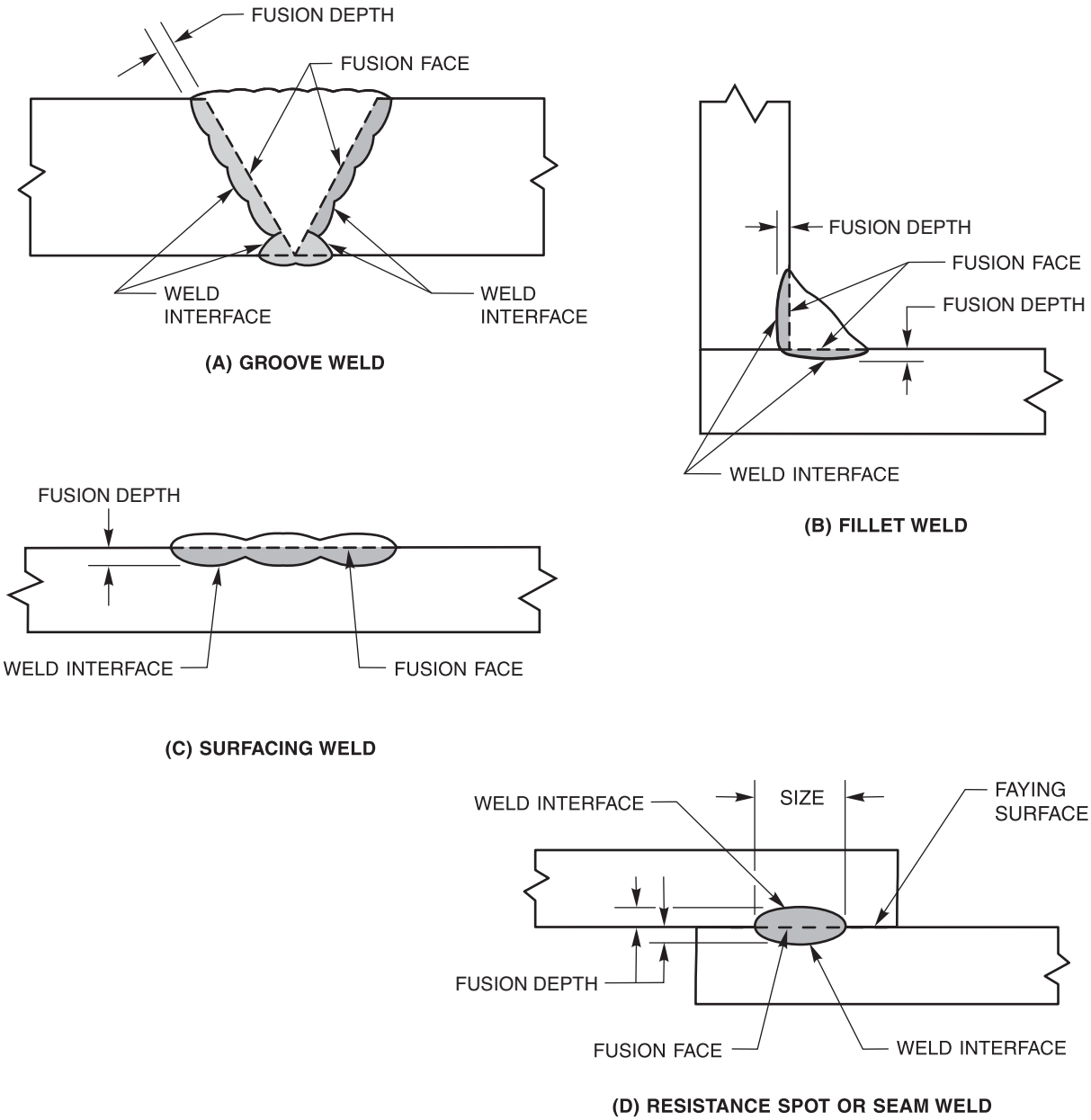
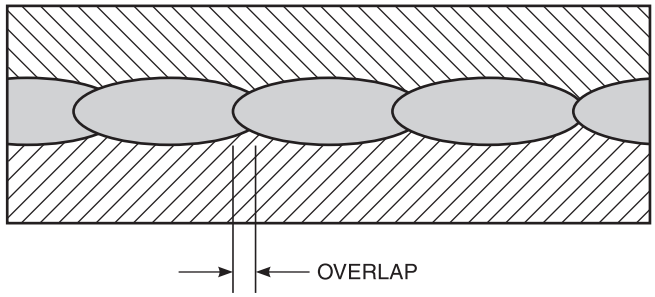


Figure B29—Incomplete Fusion

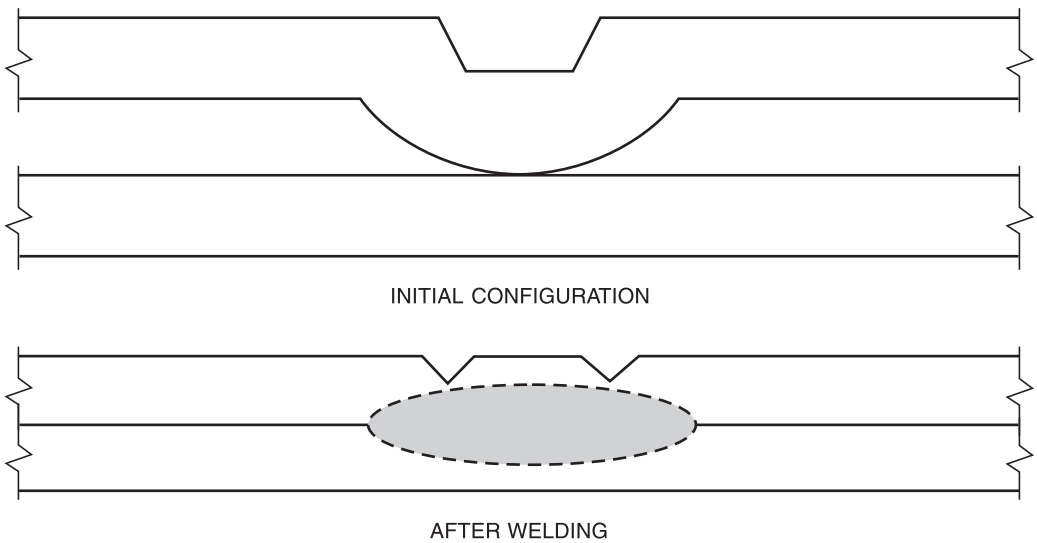


Note: Fusion zones indicated by shading.

Figure B30—Fusion Welds

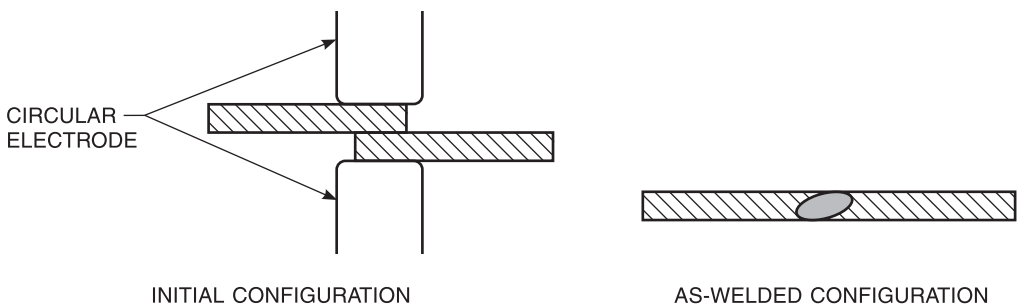


(E) RESISTANCE SEAM WELD (LONGITUDINAL SECTION)



Source: Detail F reproduced from AWS C1.1M/C1.1:2019-AMD1, *Recommended Practices for Resistance Welding*, Figure 26, Miami: American Welding Society.

(F) EXAMPLE OF A PROJECTION WELD



(G) EXAMPLE OF A MASH SEAM WELD

Figure B30 (Continued)—Fusion Welds

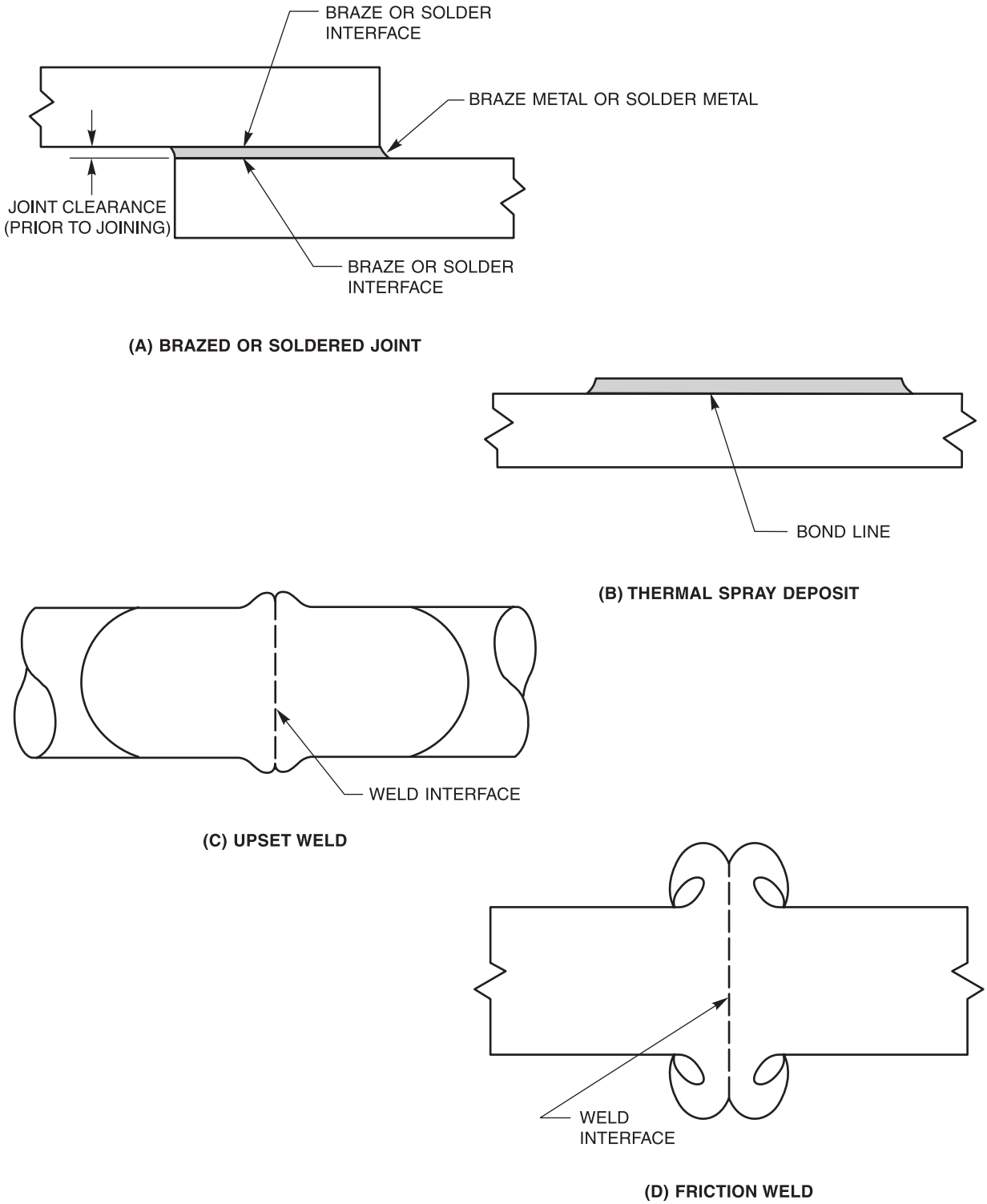


Figure B31—Joining Without Fusion

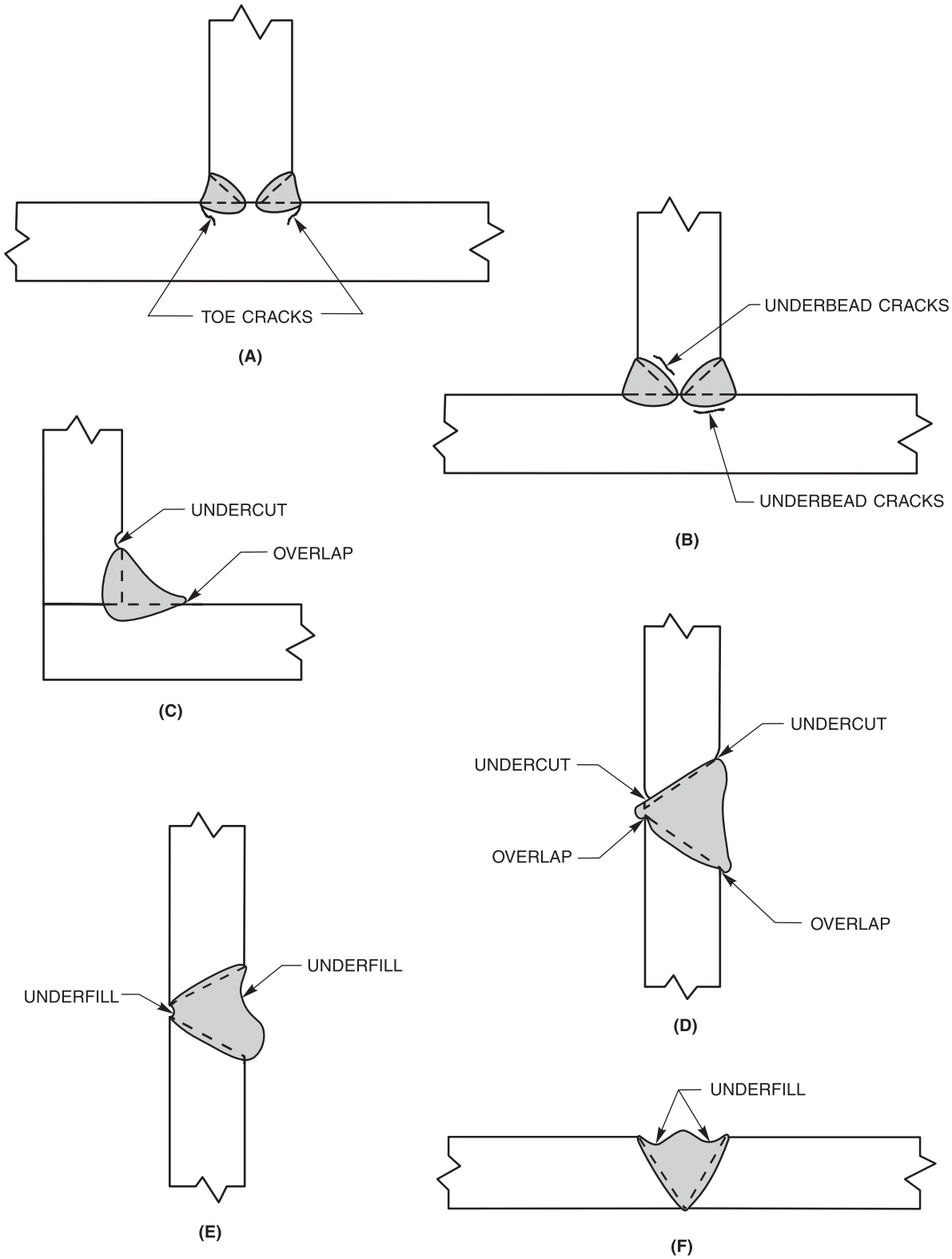
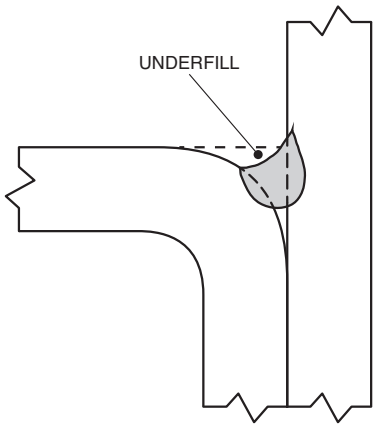
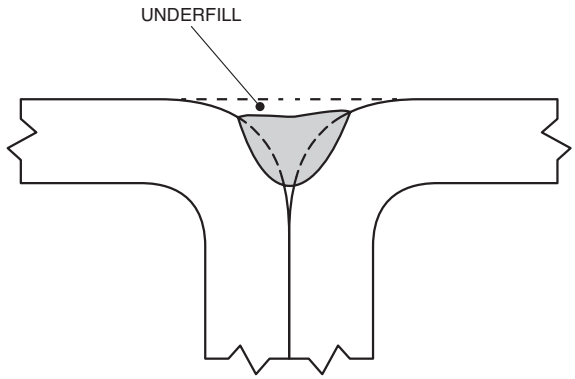


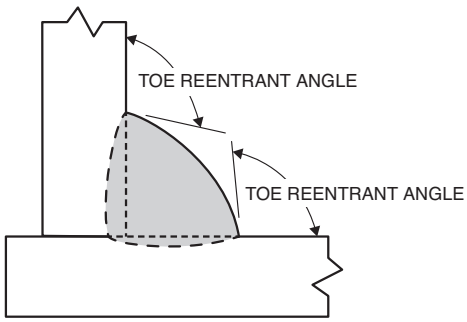
Figure B32—Weld Discontinuities



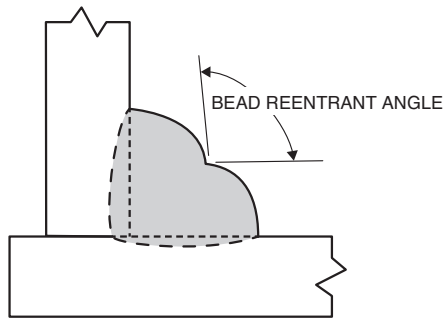
(G)



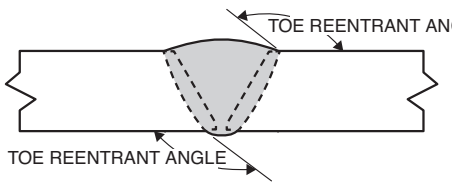
(H)



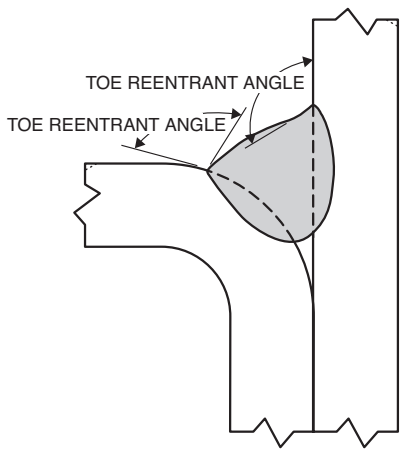
(I) REENTRANT ANGLES AT FILLET WELD TOES



(J) REENTRANT ANGLE AT WELD BEAD TOE



(K) REENTRANT ANGLES AT GROOVE WELD FACE AND ROOT SURFACE



(L) REENTRANT ANGLES AT GROOVE WELD FACE

Figure B32(Continued)—Weld Discontinuities

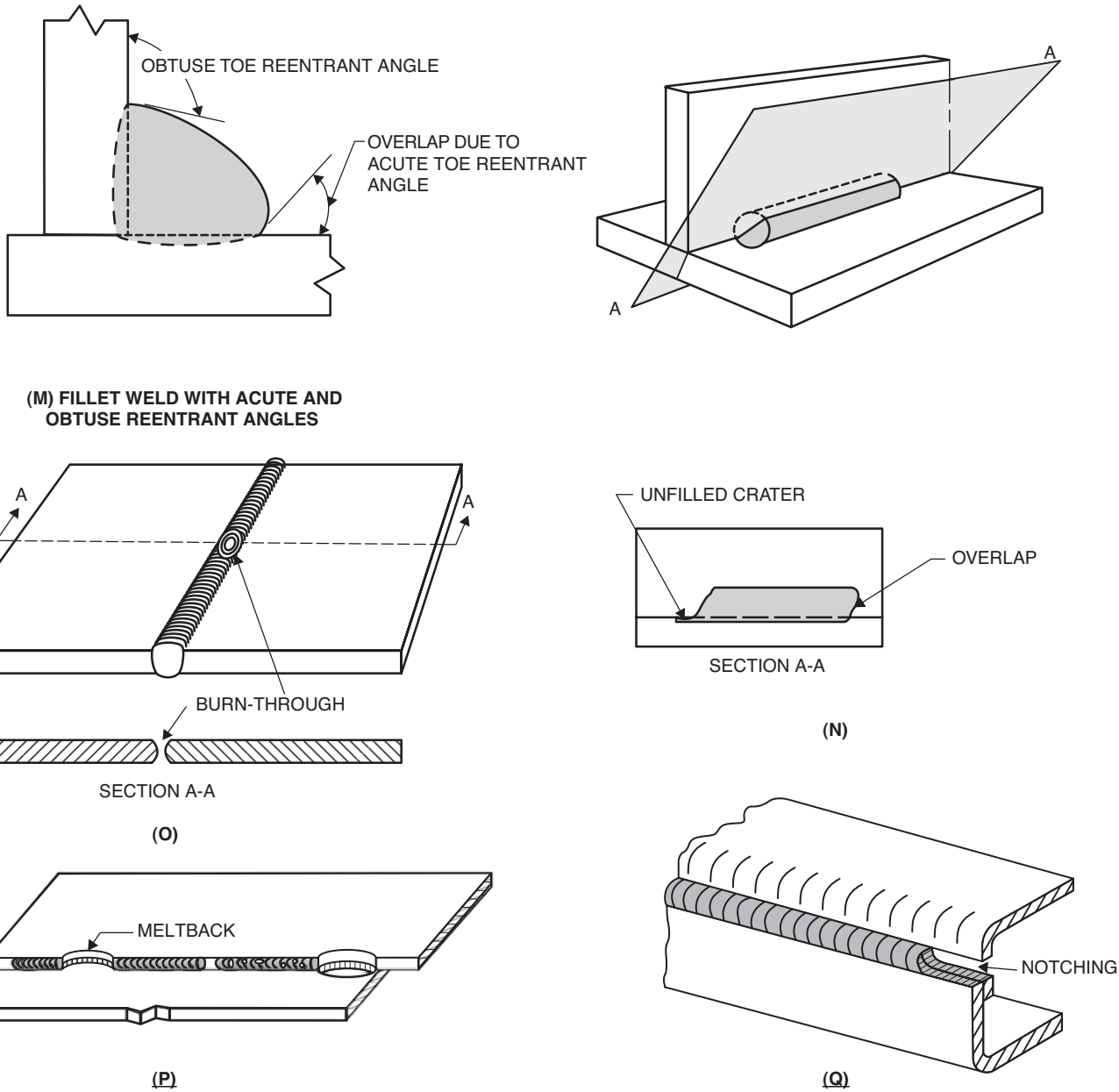
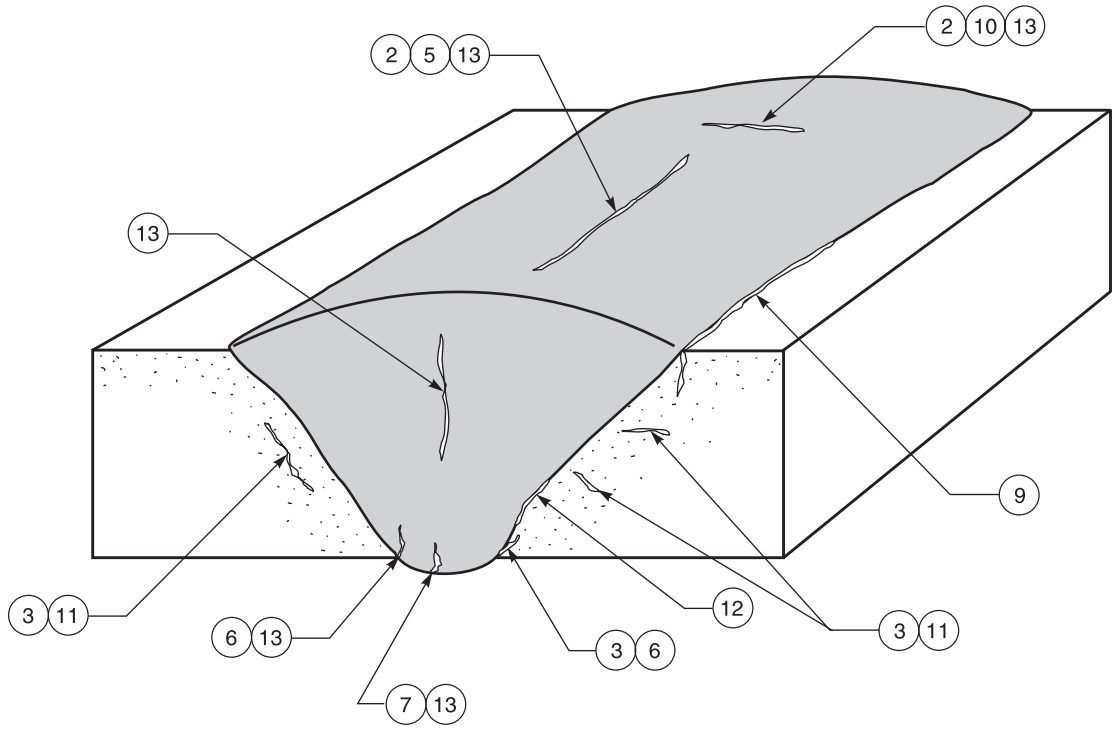
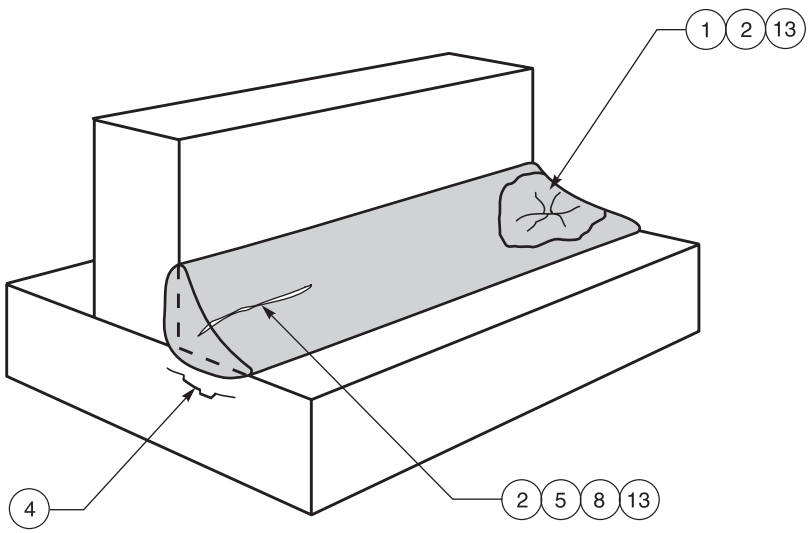


Figure B32(Continued)—Weld Discontinuities



(A)

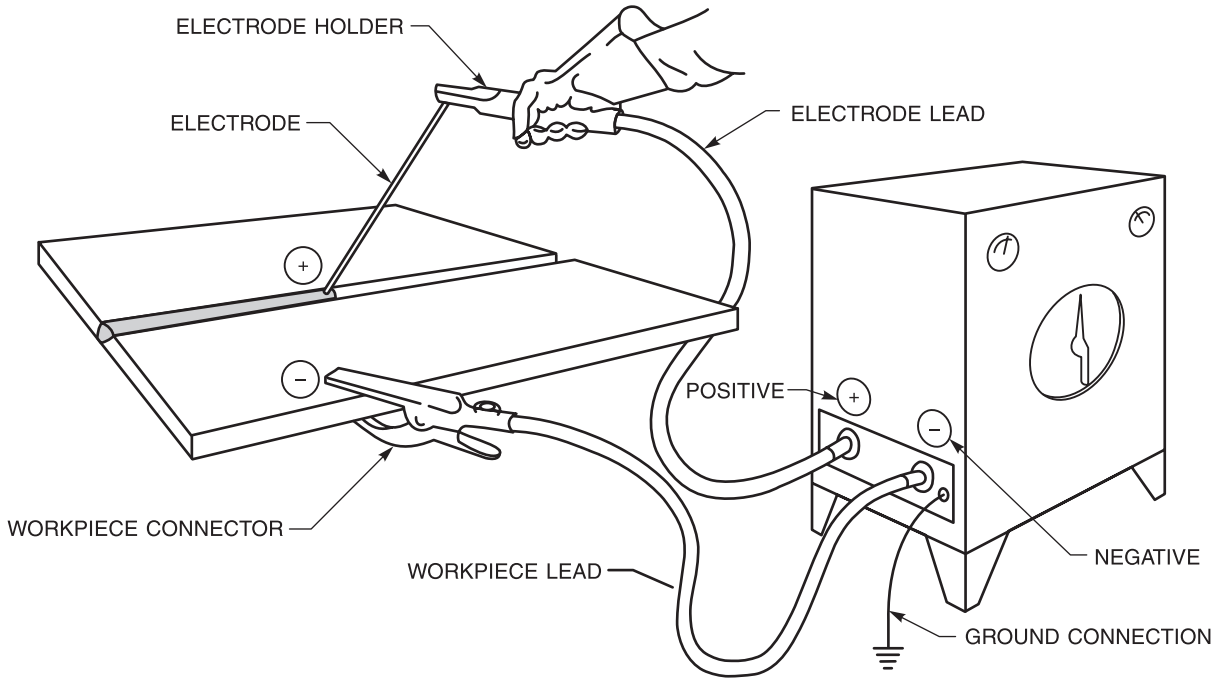


LEGEND:

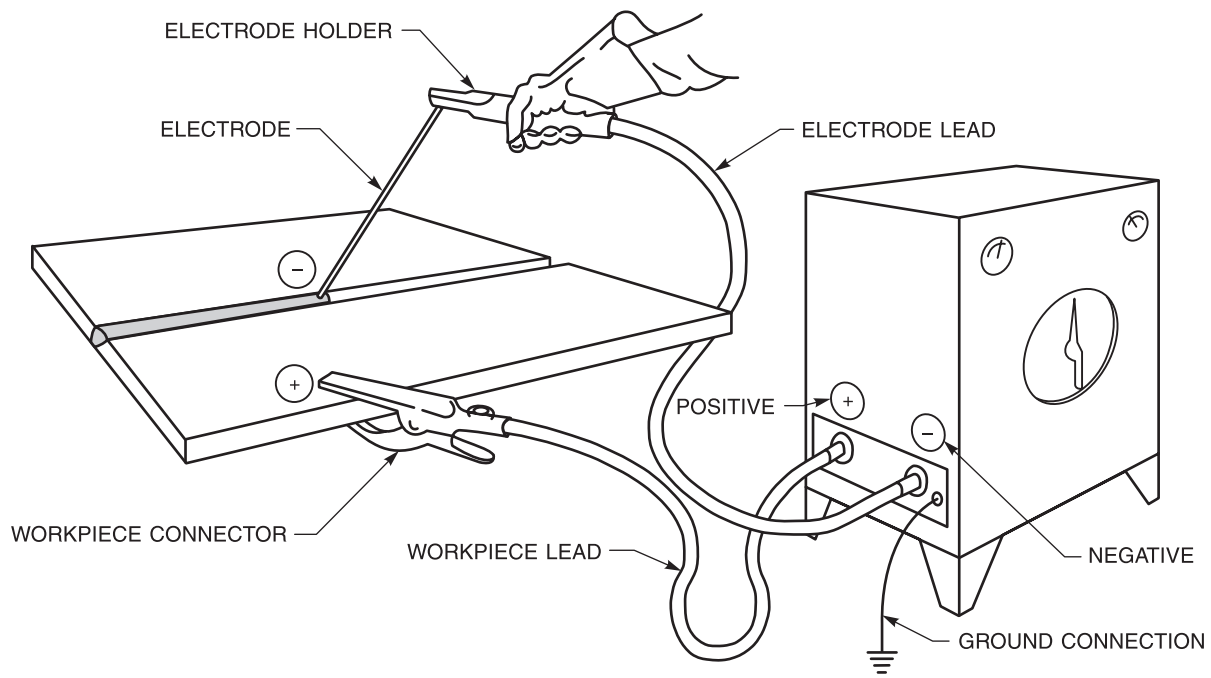
1	CRATER CRACK
2	FACE CRACK
3	HEAT-AFFECTED ZONE CRACK
4	LAMELLAR TEAR
5	LONGITUDINAL CRACK
6	ROOT CRACK
7	ROOT SURFACE CRACK
8	THROAT CRACK
9	TOE CRACK
10	TRANSVERSE CRACK
11	UNDERBEAD CRACK
12	WELD INTERFACE CRACK
13	WELD METAL CRACK

(B)

Figure B33—Crack Types



(A) DIRECT CURRENT ELECTRODE POSITIVE



(B) DIRECT CURRENT ELECTRODE NEGATIVE

Figure B34—Welding Current Polarity

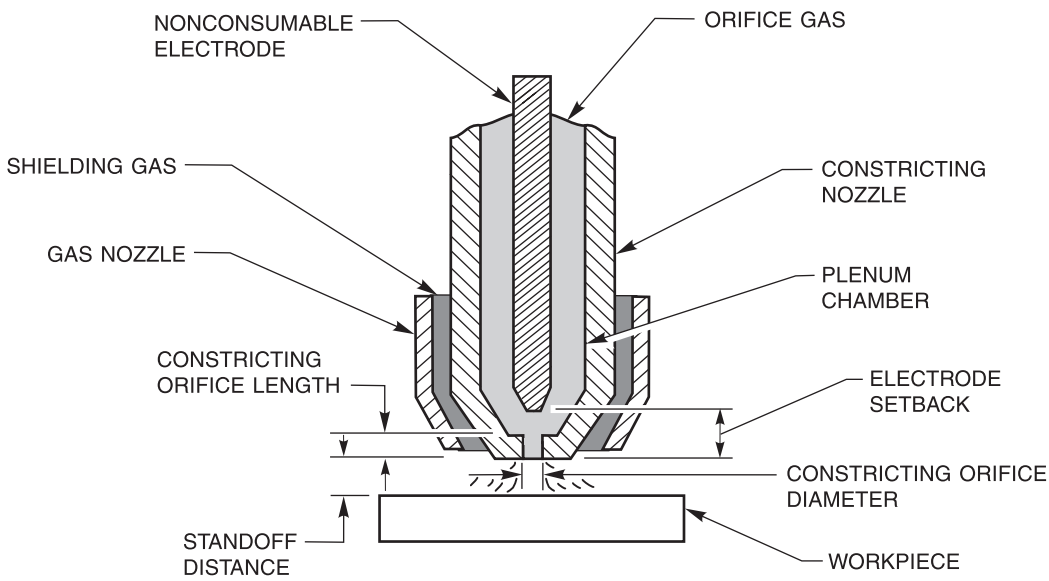


Figure B35—Plasma Arc Torch Nomenclature

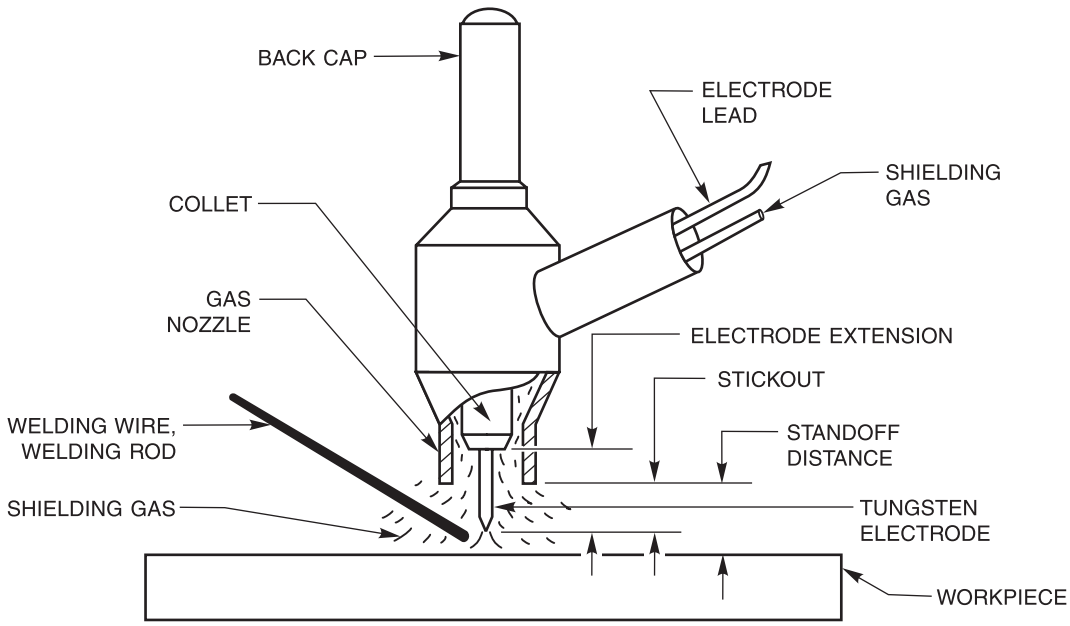
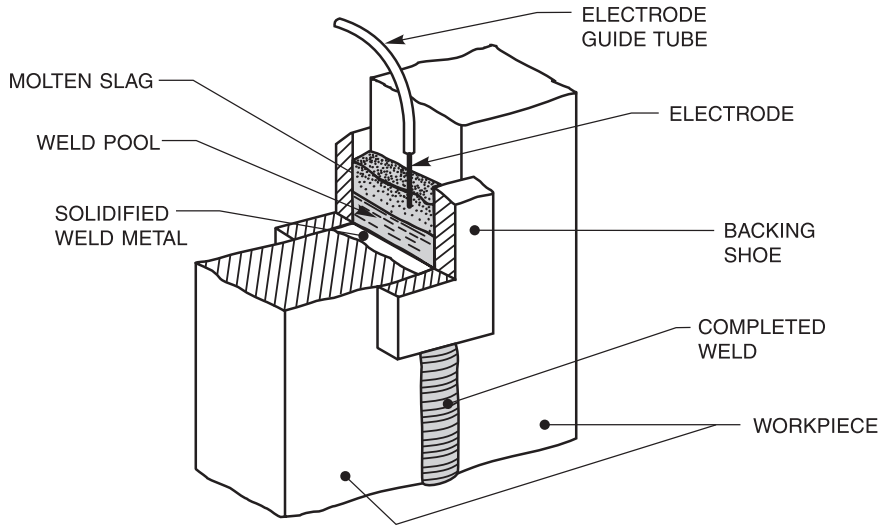
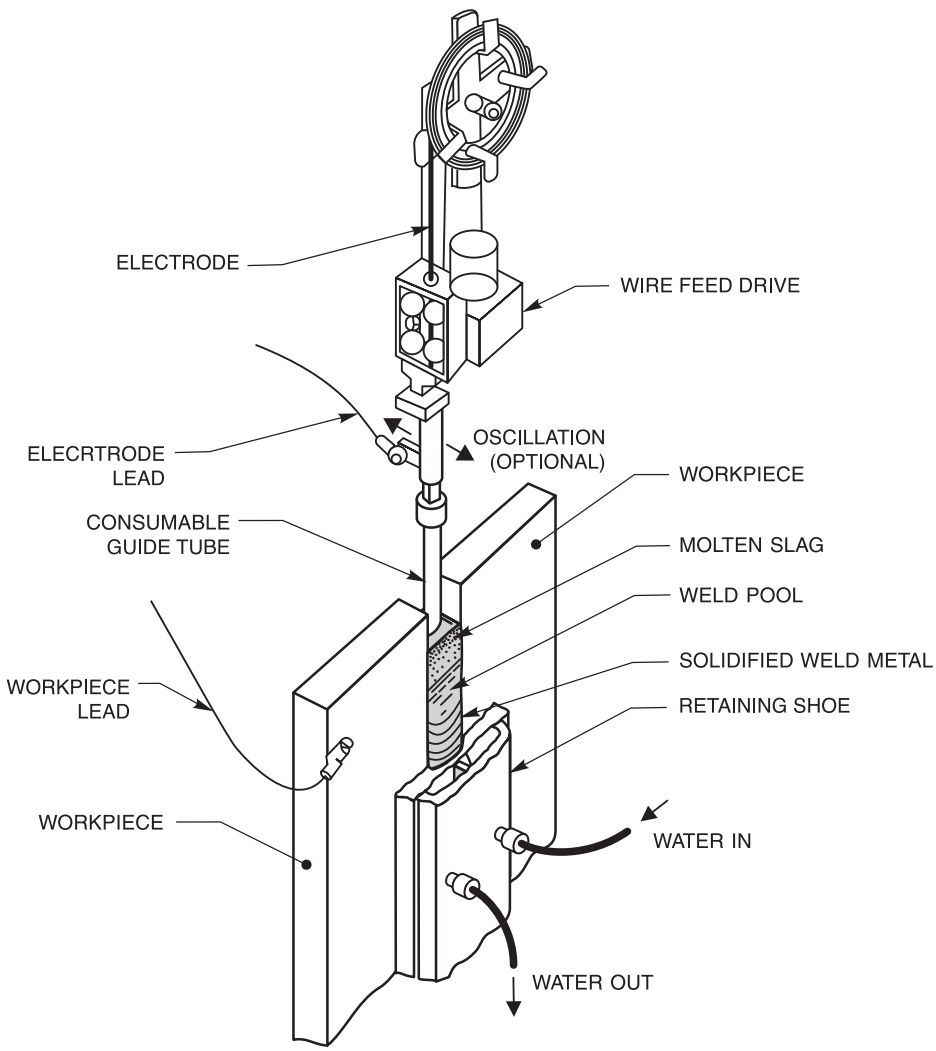


Figure B36—Gas Tungsten Arc Welding Torch Nomenclature



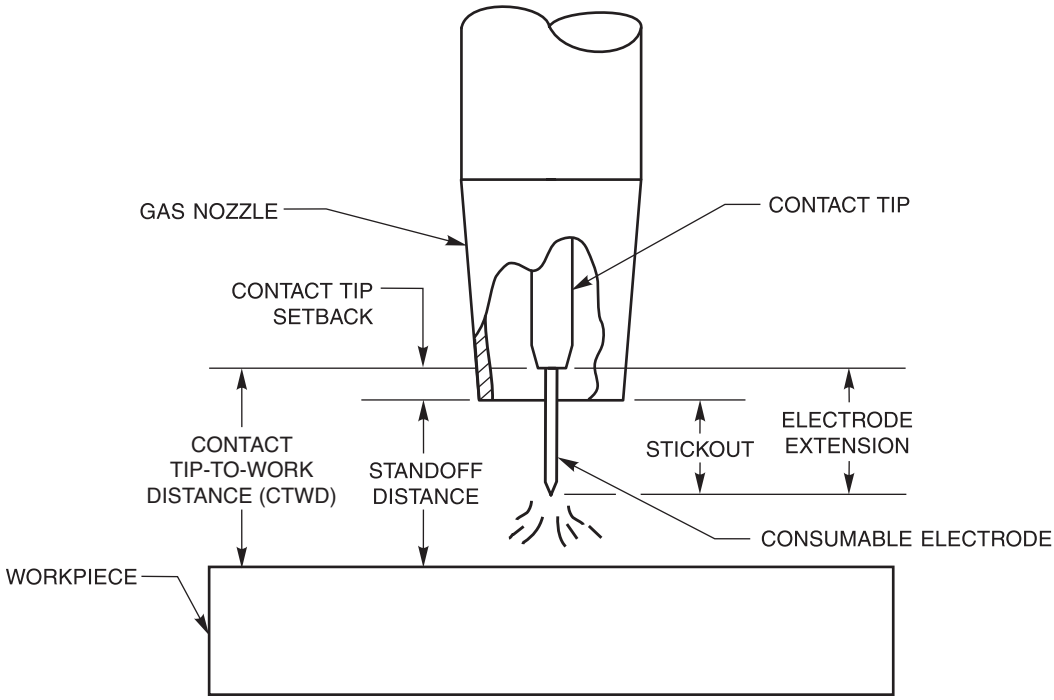
(A) ELECTROSLAG WELDING NOMENCLATURE



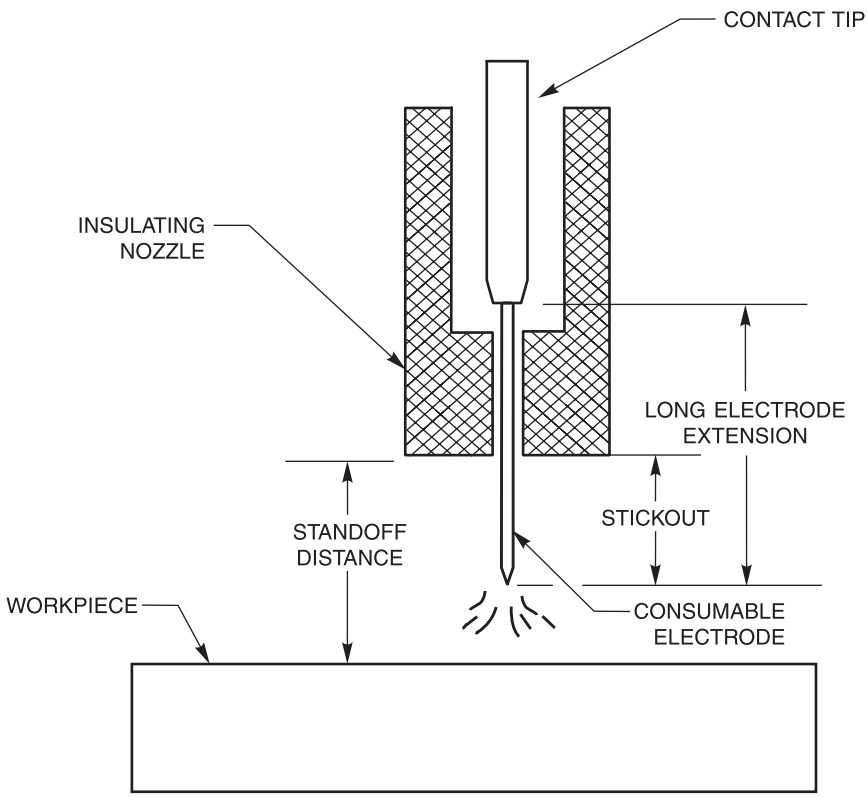
(B) CONSUMABLE GUIDE ELECTROSLAG WELDING NOMENCLATURE

Source: Adapted from AWS C5.7:2000 (R2006), *Recommended Practices for Electrogas Welding*, Figure 5, American Welding Society.

Figure B37—Electroslag Welding Process Nomenclature

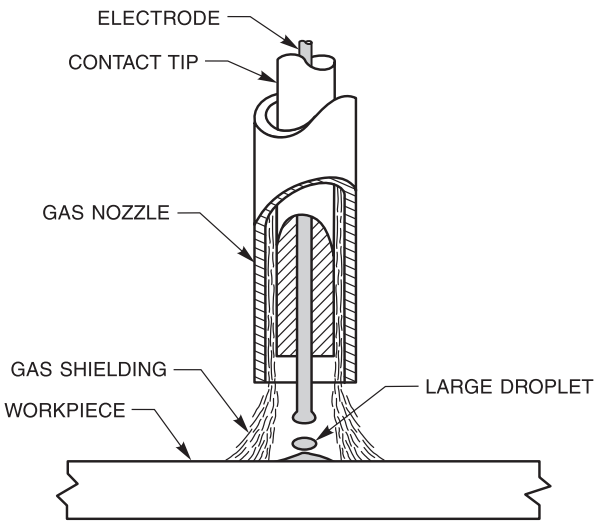


(A) CONTACT TIP-TO-WORK DISTANCE WITH A GAS NOZZLE

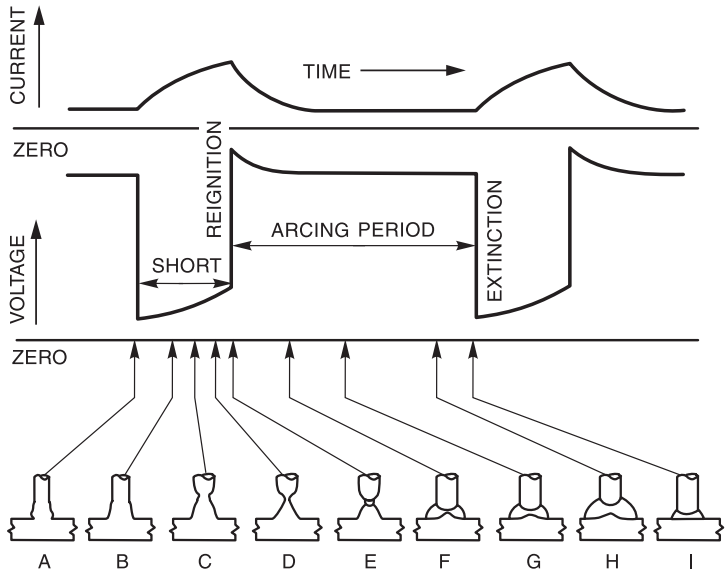


(B) LONG ELECTRODE EXTENSION WITH AN INSULATING NOZZLE

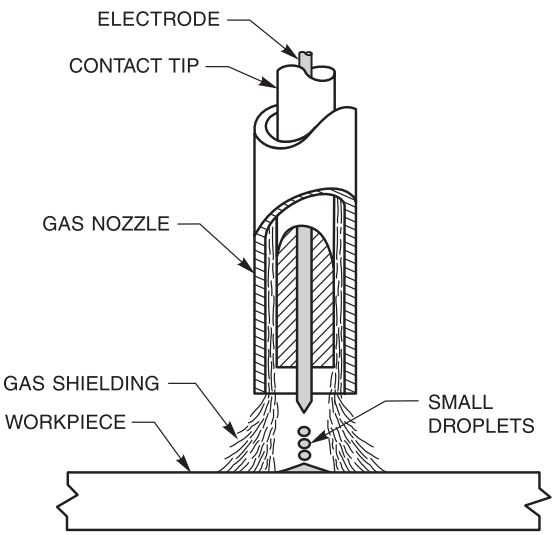
Figure B38—Gas Metal Arc Welding Gun and Flux Cored Arc Welding Gun Nomenclature



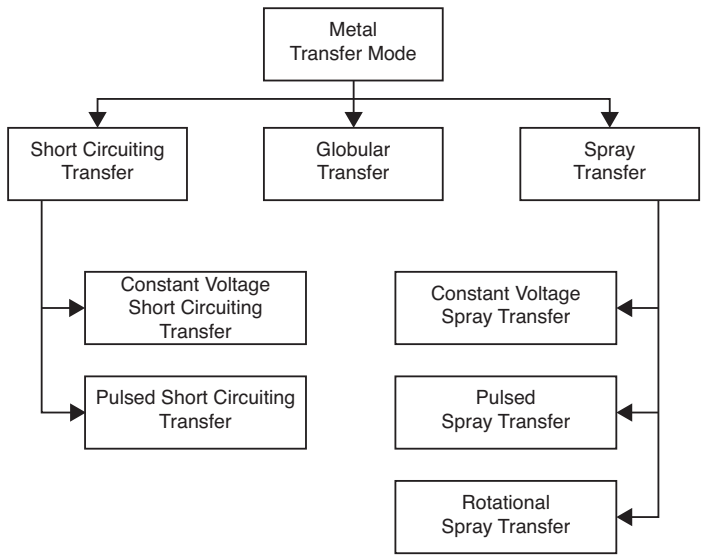
(A) GLOBULAR TRANSFER



(B) SCHEMATIC REPRESENTATION OF SHORT CIRCUITING METAL TRANSFER



(C) SPRAY TRANSFER

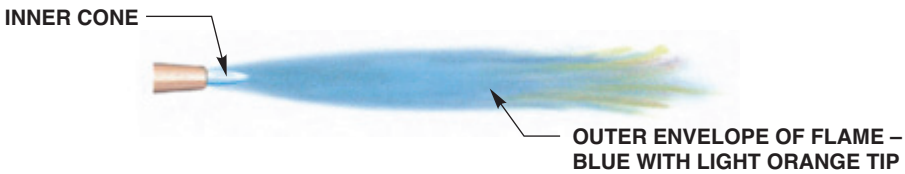


(D) GMAW METAL TRANSFER MODES

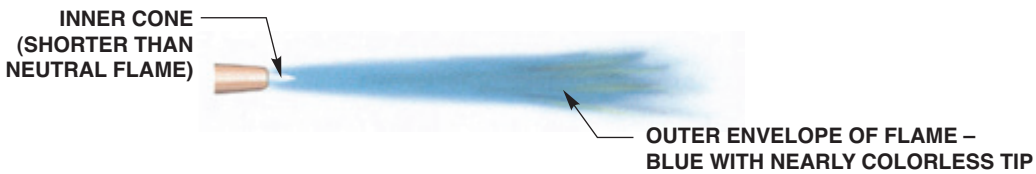
Figure B39—Metal Transfer in Gas Metal Arc Welding

(A) ACETYLENE FLAME IN AIR

(B) CARBURISING (REDUCING) FLAME



(C) NEUTRAL FLAME



(D) OXIDIZING FLAME

Source: Adapted from AWS C4.7/C4.7M:2020, *Recommended Practices for Oxyacetylene Welding of Steel*, Figure 90, American Welding Society.

Figure B40—Oxyacetylene Flame Types

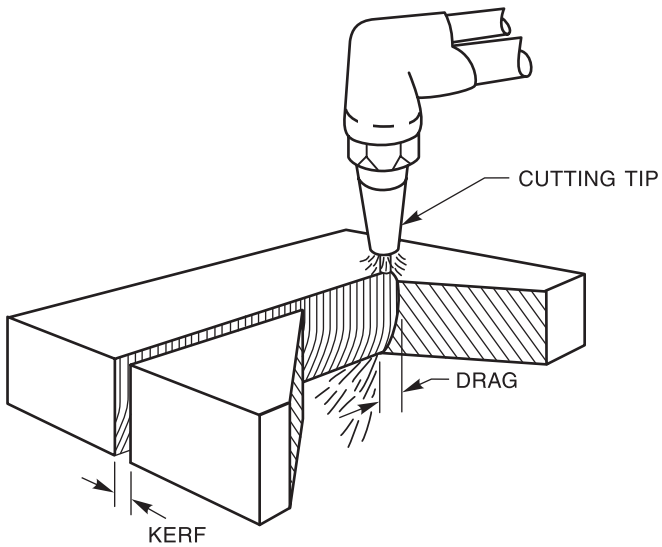


Figure B41—Oxygen Cutting

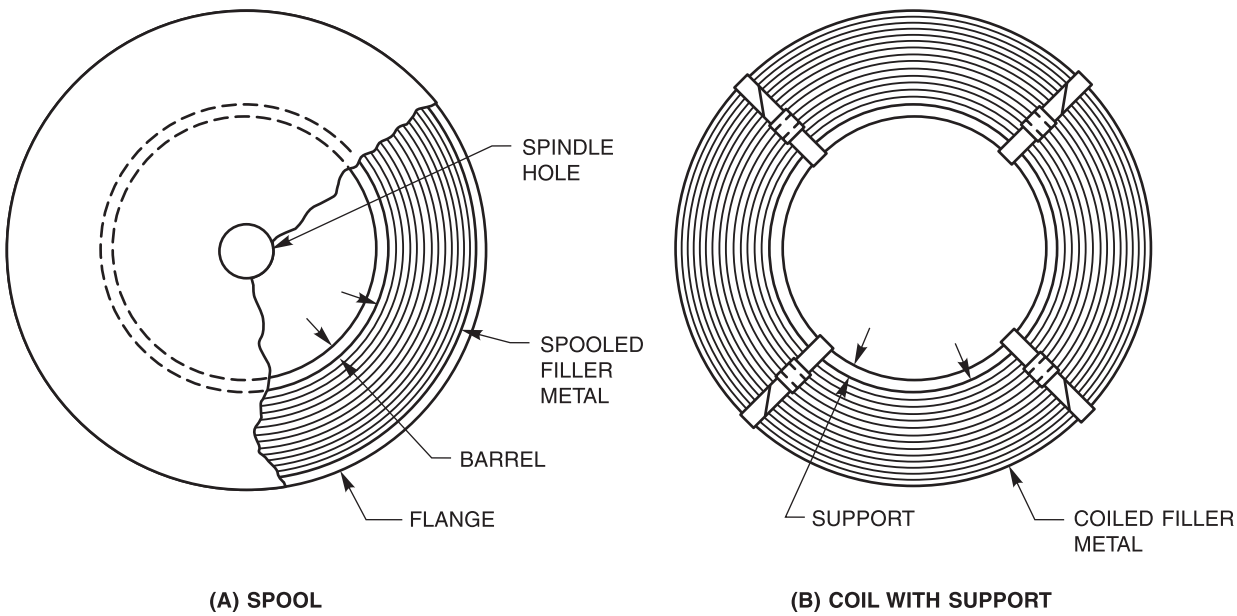


Figure B42—Filler Metal Packaging

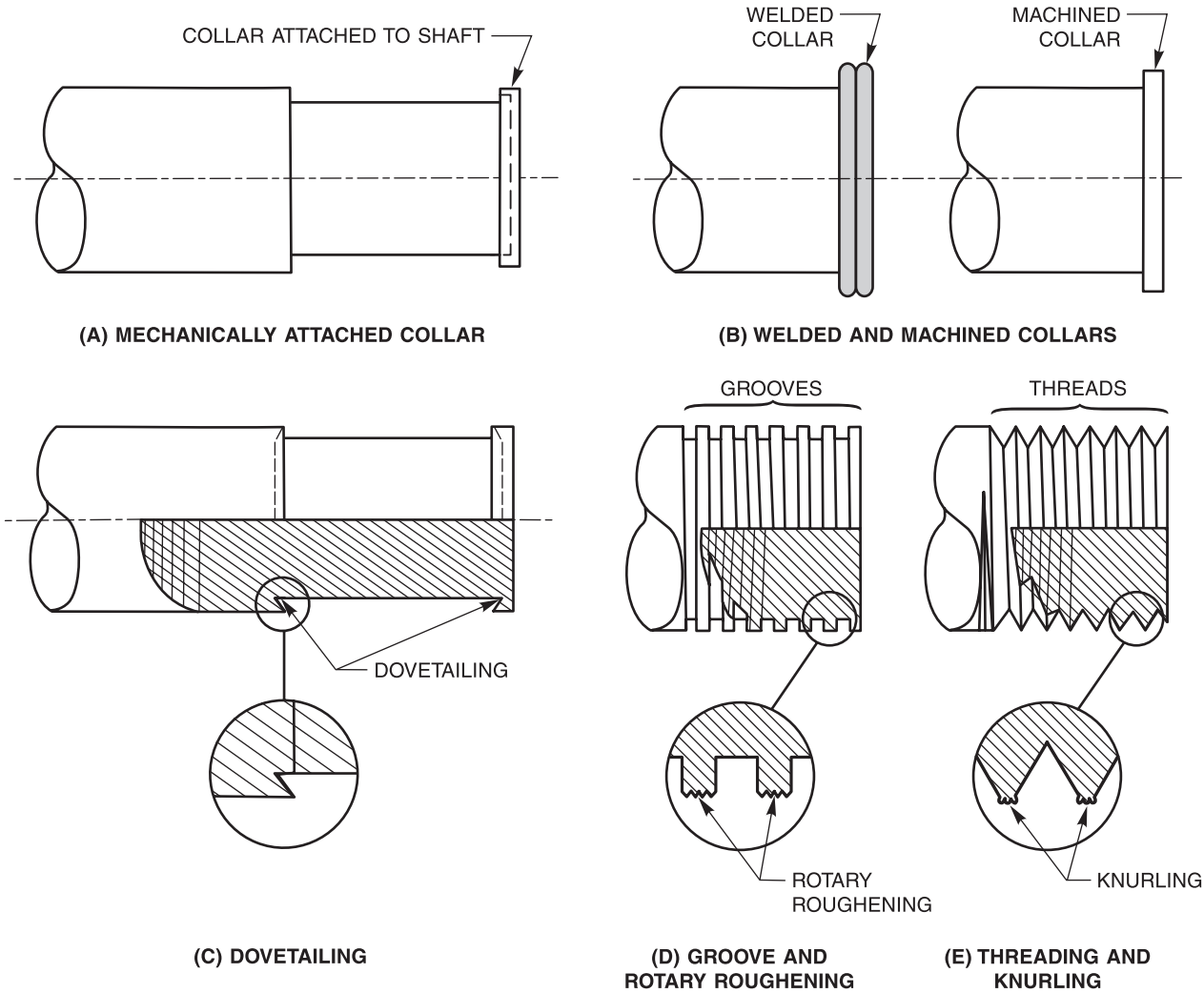
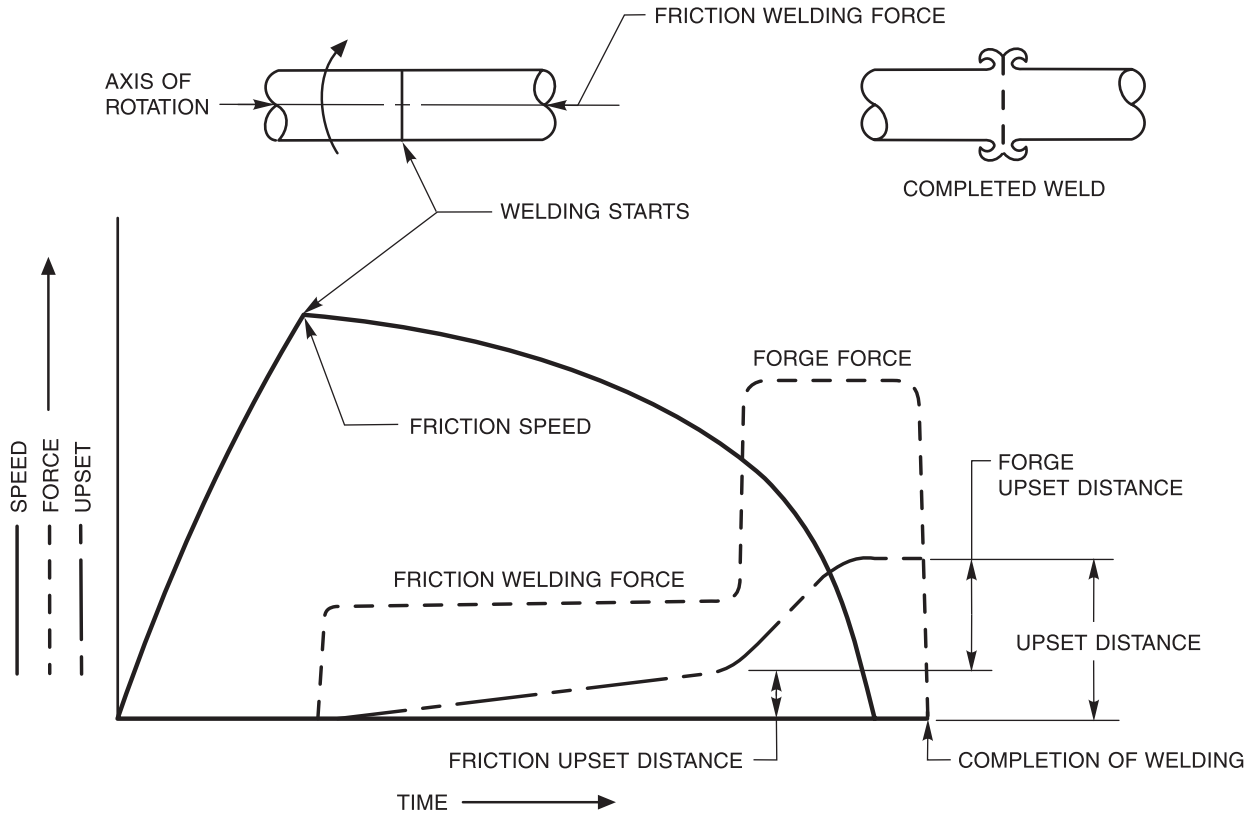


Figure B43—Thermal Spraying Surface Preparation



B44—Generalized Diagram of Inertia Friction Welding

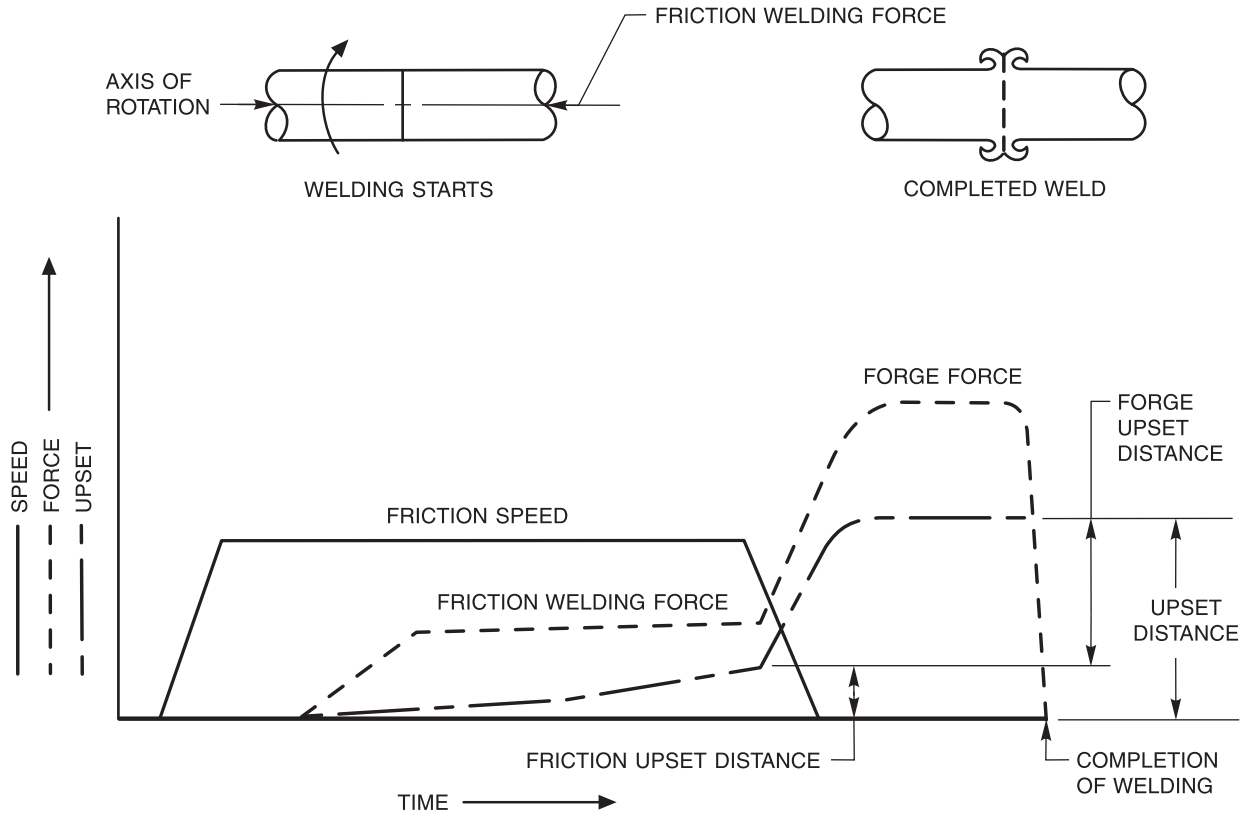
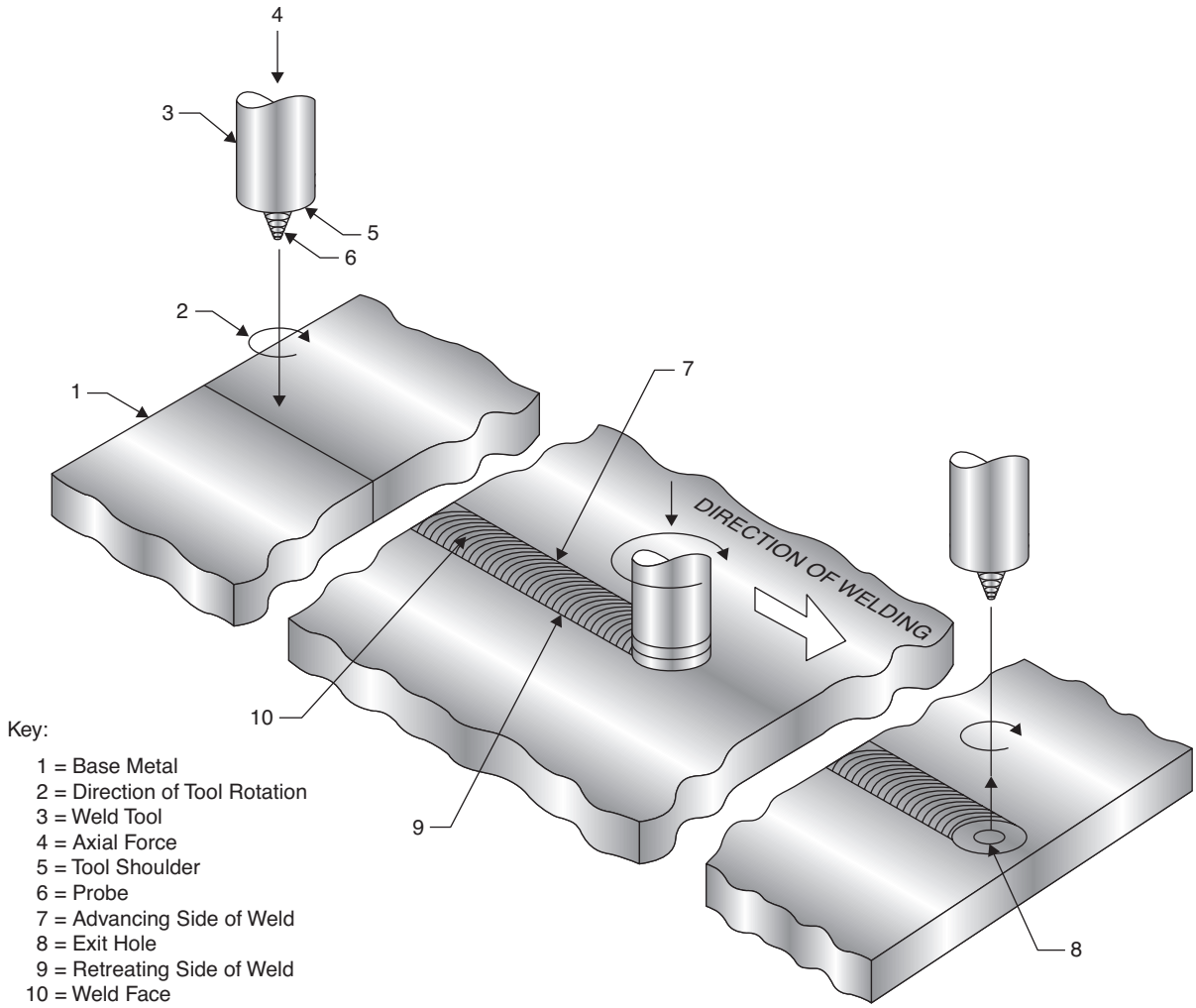


Figure B45—Generalized Diagram of Direct Drive Friction Welding



Source: Reproduced from the AWS Welding Handbook, 2007, 9th Edition, Volume 3, Figure 7.1, Miami: American Welding Society. *Original Source:* Adapted from Thomas, W. T., Tool Drawing No. WMT104/04Lrt, Cambridge: TWI.

Figure B46—Schematic of the Friction Stir Welding Process

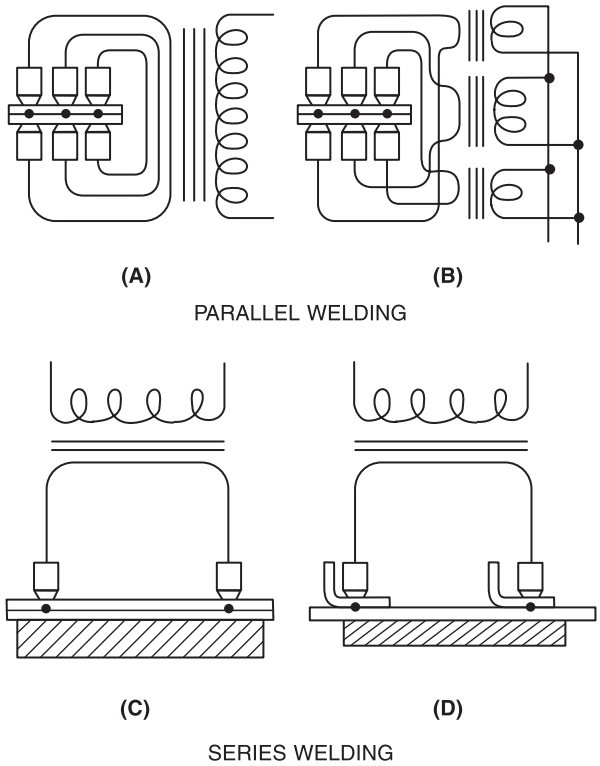


Figure B47—Typical Arrangements for Multiple Spot Welding

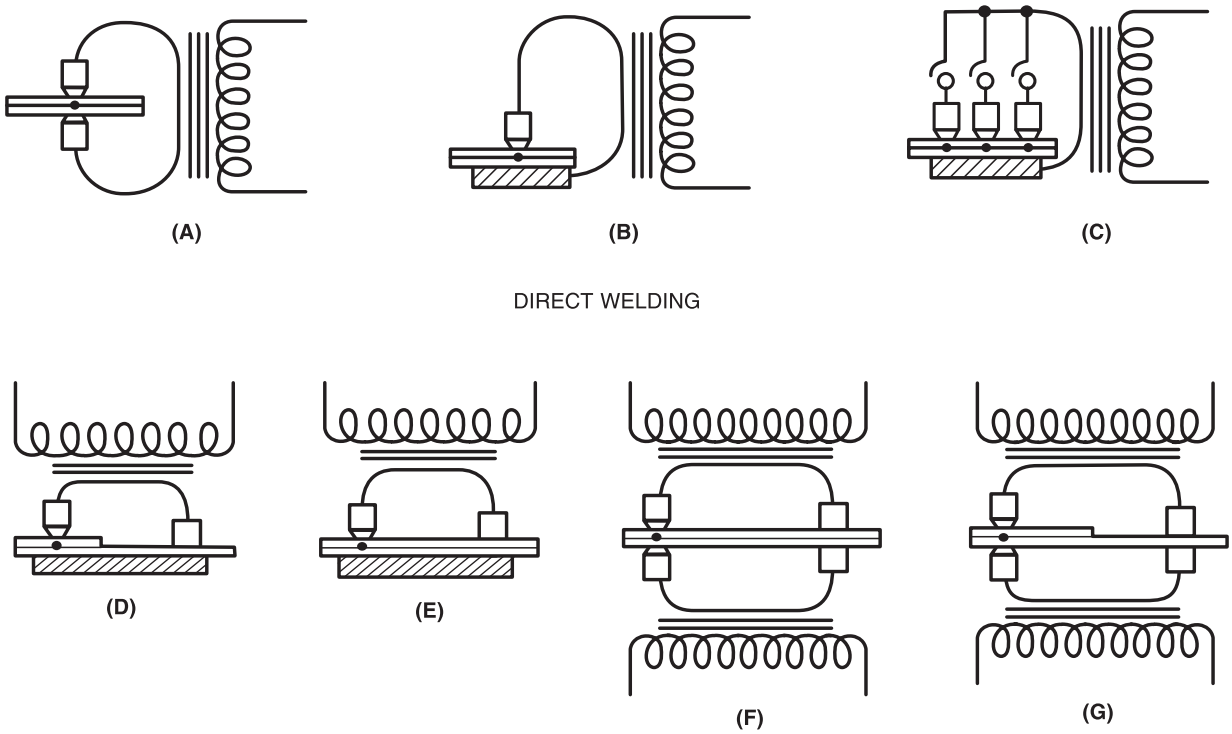
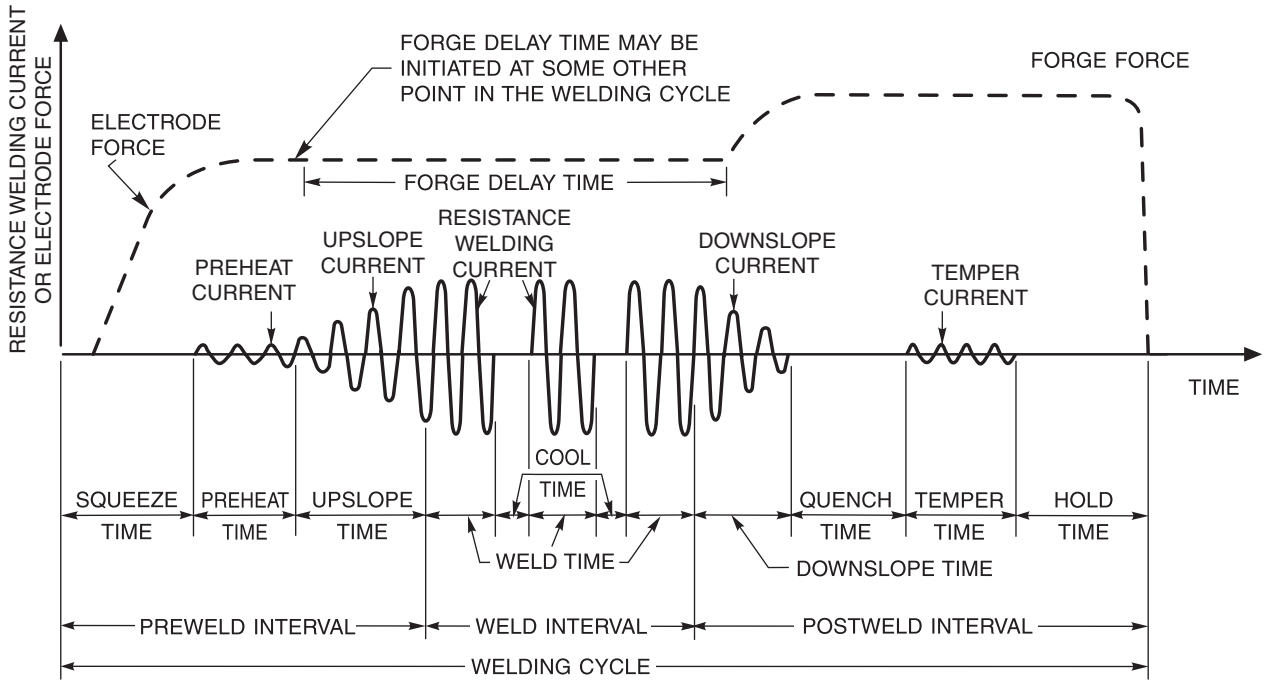


Figure B48—Typical Arrangements for Single Spot Welds



Source: Reproduced from AWS J1.1M/J1.1:2013, *Specification for Resistance Welding Controls*, Figure A.3, Miami: American Welding Society.

Figure B49—Example of a Pulsation Welding Waveform for Resistance Spot Welding

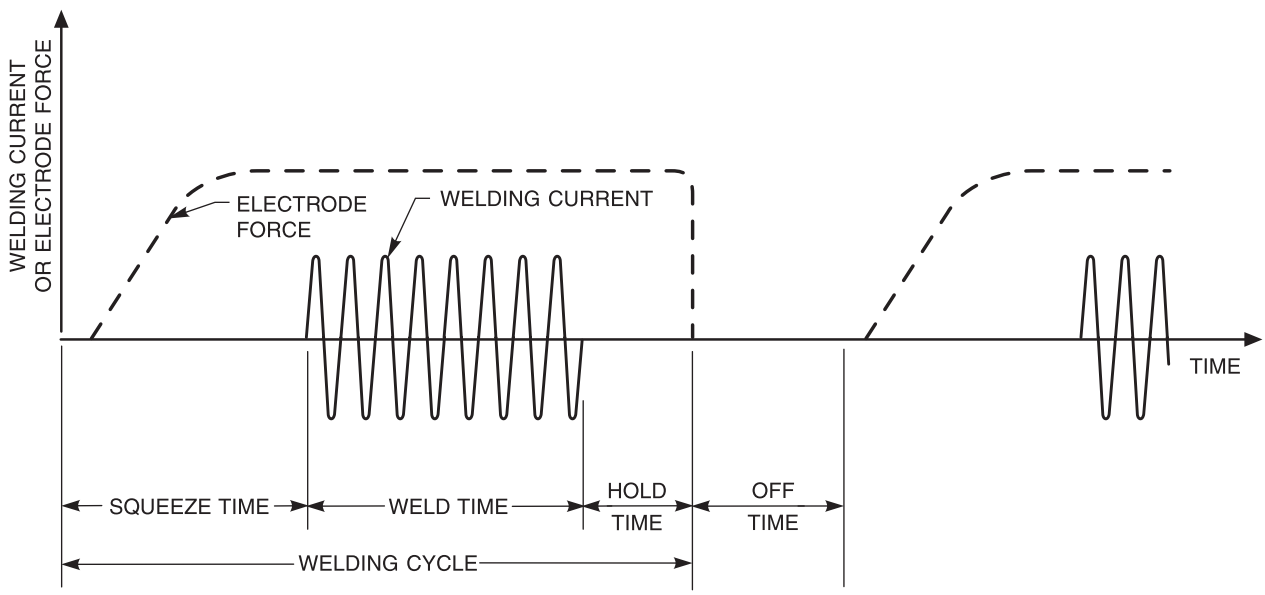
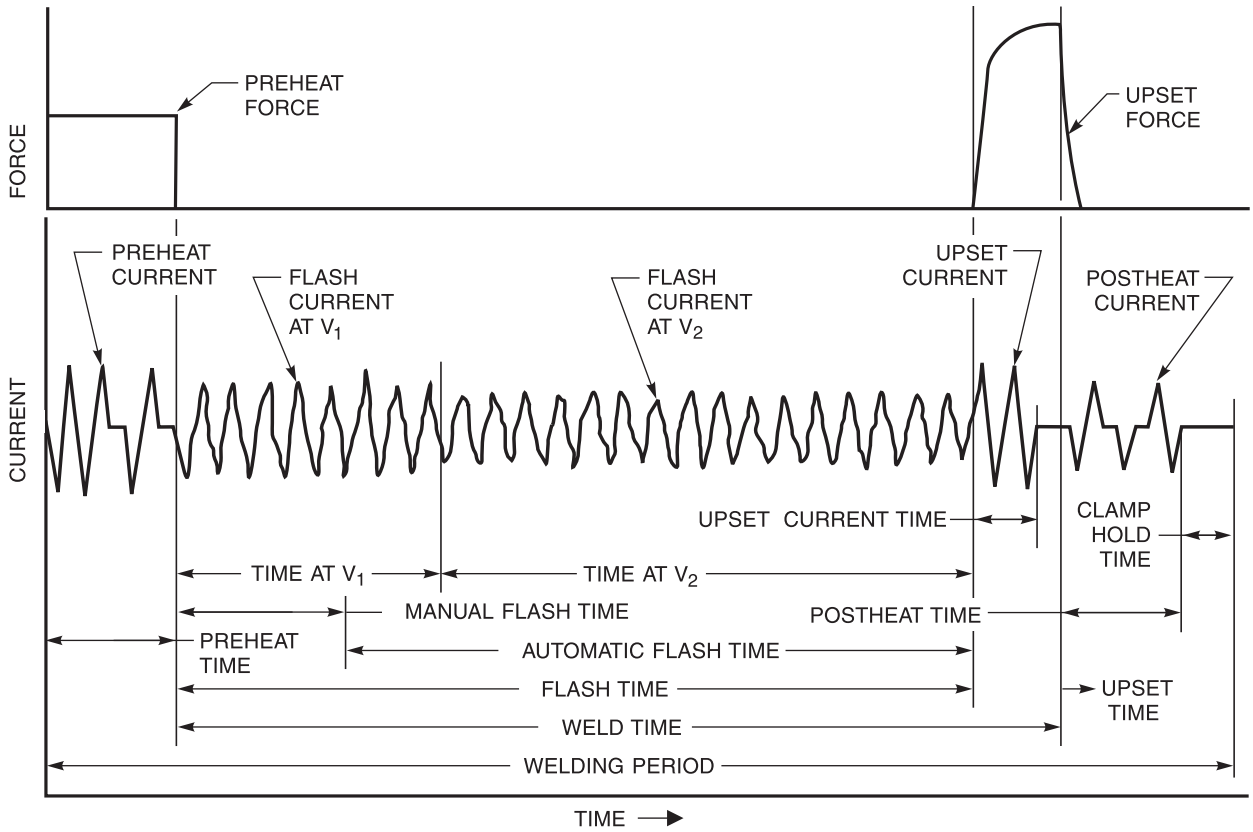
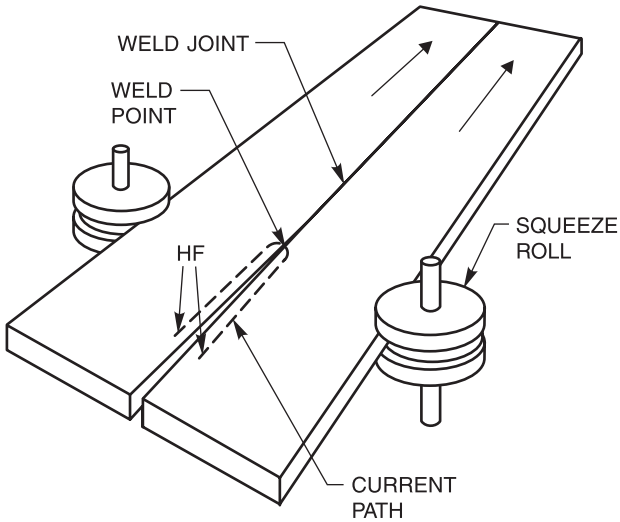


Figure B50—Example of a Single-Pulse Resistance Spot Welding Waveform

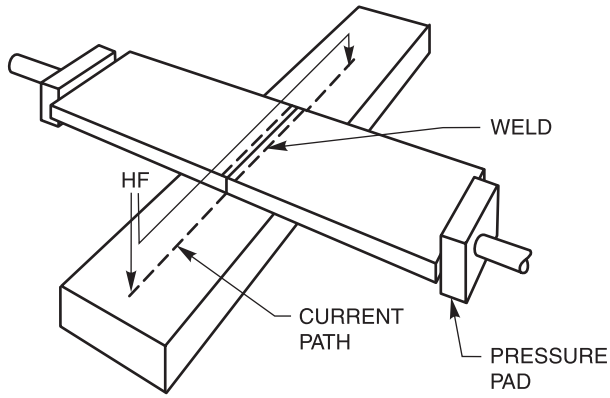


Source: Reproduced from AWS C1.1M/C1.1:2019-AMD1, *Recommended Practices for Resistance Welding*, Figure 31, Miami: American Welding Society.

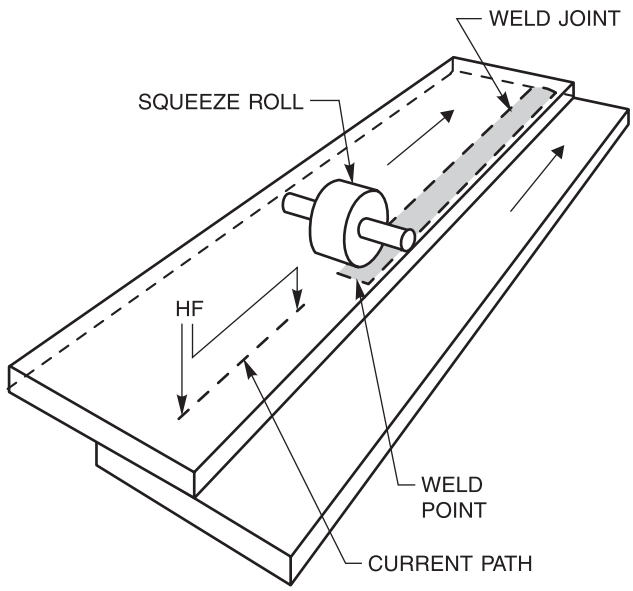
Figure B51—Electro-Mechanical Synchronization in a Typical Flash Welding Cycle



(A) RESISTANCE SEAM WELD IN BUTT JOINT USING HIGH-FREQUENCY UPSET WELDING

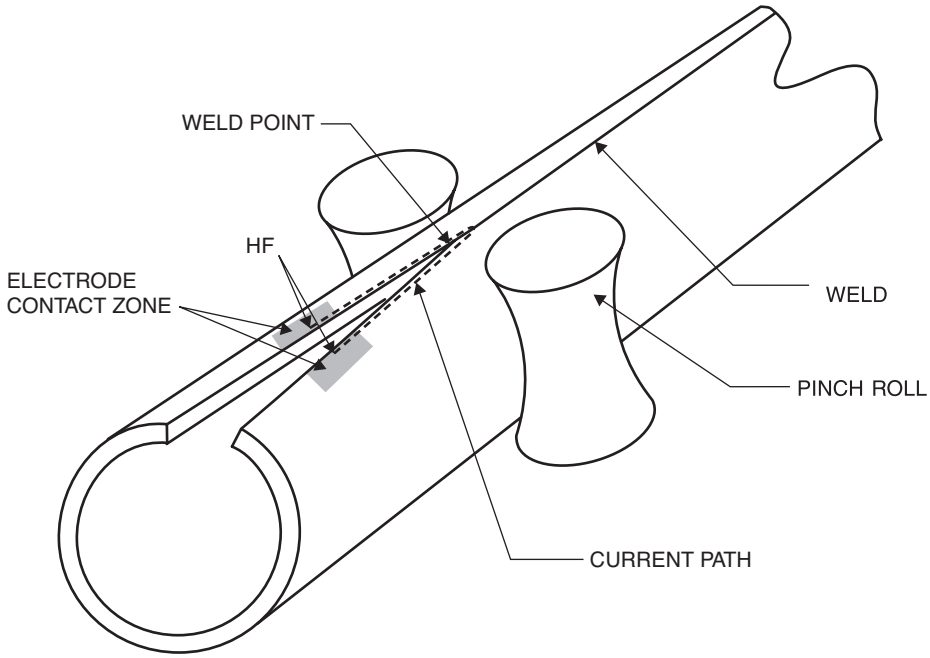


(B) RESISTANCE SEAM WELD IN BUTT JOINT USING HIGH-FREQUENCY UPSET WELDING



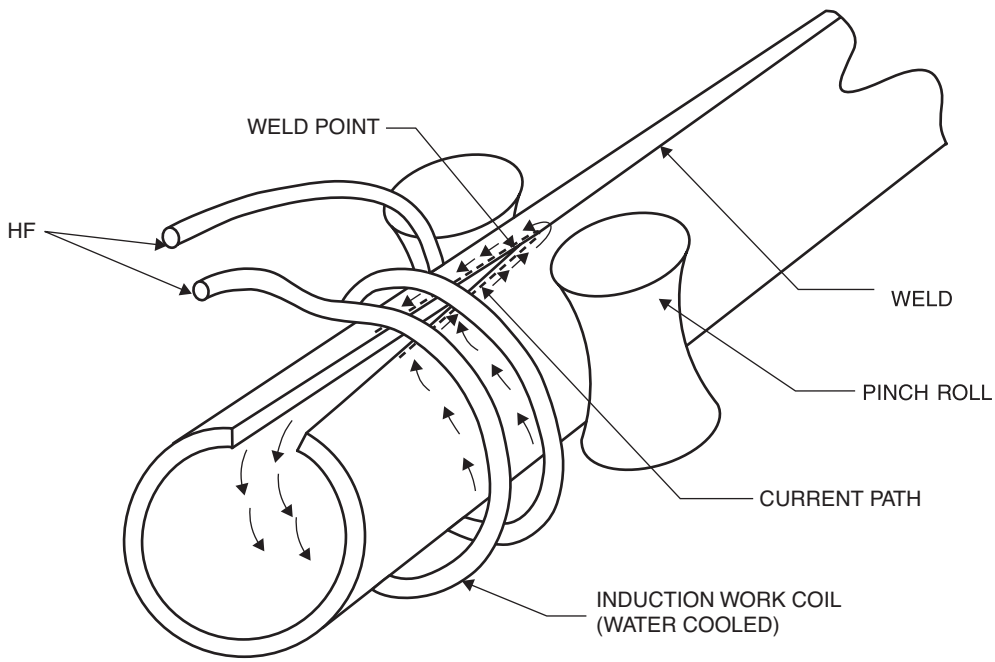
(C) RESISTANCE SEAM WELD IN BUTT JOINT USING HIGH-FREQUENCY SEAM WELDING

Figure B52—High-Frequency Resistance Welding



Note: Either sliding or rolling electrodes may be used.

(D) HIGH FREQUENCY UPSET WELDING OF TUBE



(E) INDUCTION UPSET WELDING OF TUBE

Figure B52 (Continued)—High-Frequency Resistance Welding

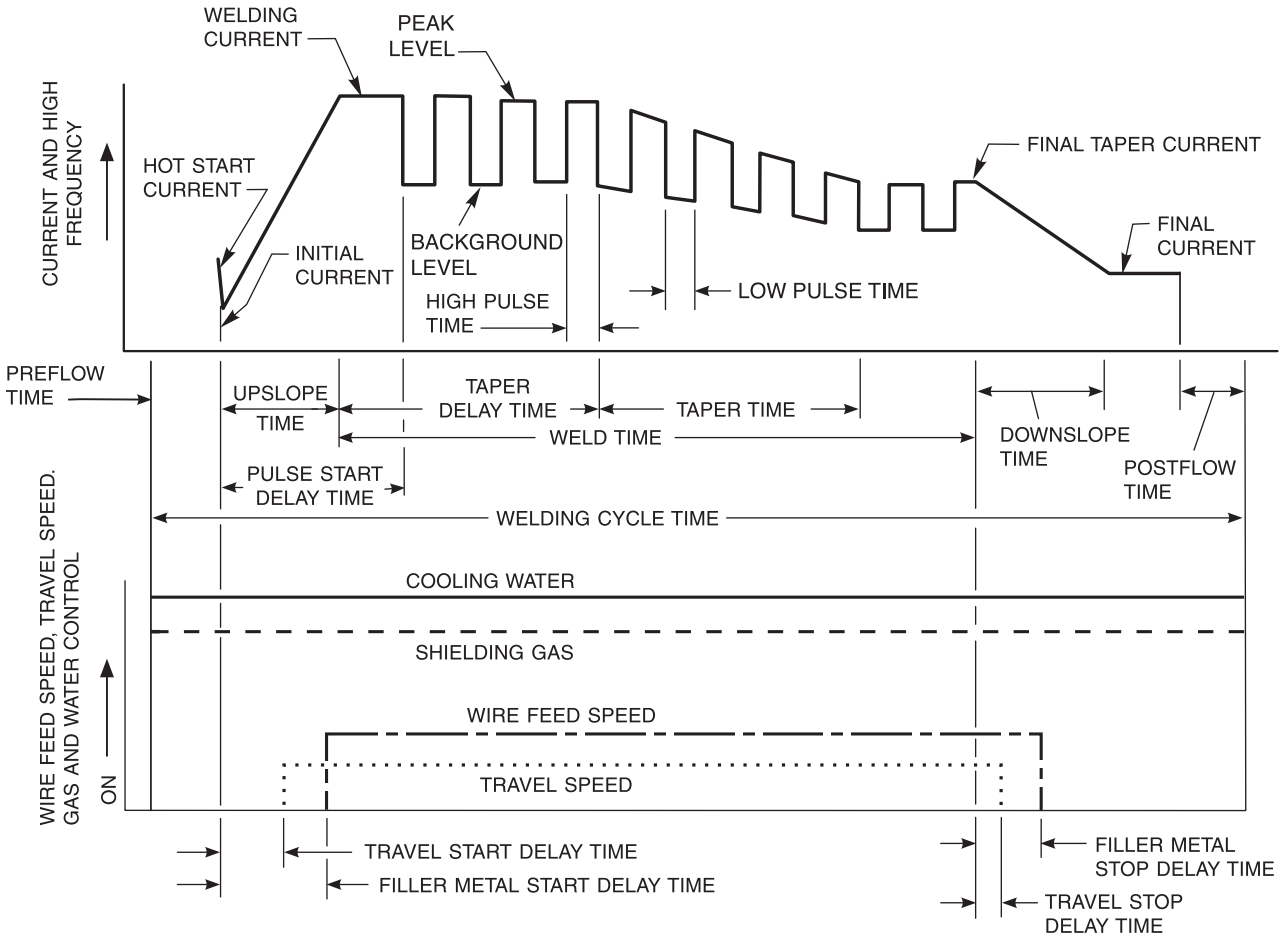


Figure B53—An Example of a Welding Cycle for Pulsed Welding

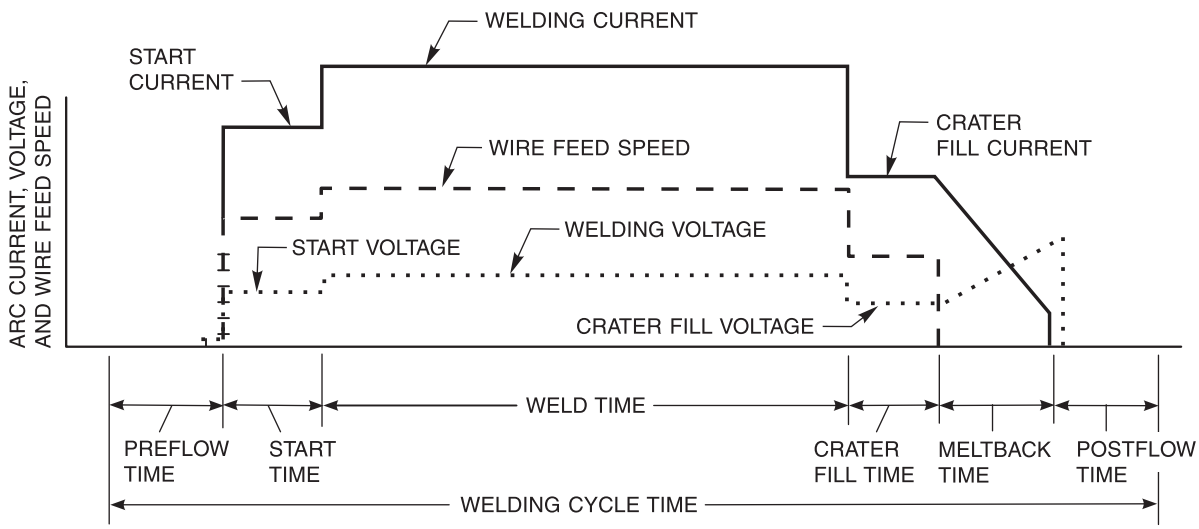


Figure B54—Typical GMAW, FCAW, and SAW Welding Cycle

Annex C (Informative)
Principles of AWS A3.0M/A3.0 Style

This annex is not of this standard but is included for informational purposes only.

C1. Selection and Construction of Terminology

AWS A3.0 encompasses terms, not adequately defined in the dictionary, directly related to welding or allied fields. Both standard and nonstandard jargon, as well as dialect and vernacular terms, are considered for inclusion in AWS A3.0. This clause presents the Subcommittee policy governing this consideration.

C1.1 Incorporated Terms. Any term that conforms to the definition given in Clause 3, and

(1) That does not conflict with other established AWS A3.0 terminology;

(2) Whose meaning as related to welding or allied processes is not clear from a combination of dictionary and/or AWS A3.0 definitions (i.e. multiple-word terms). Examples are: **automatic welding**, **contact tip**, **root surface**, **shielding gas**, and **workpiece connector**.

(3) Process delimited terms have been incorporated where consistent industry usage makes their continued use preferable.

C1.2 Terms Not Normally Incorporated

(1) Terms that violate fundamental dictates of logic or grammar;

(2) Are adequately defined in the English dictionary;

(3) Terms consisting of word combinations, where the definitions of their elements (found in either the dictionary or in AWS A3.0) make the meaning of the combination clear;

(4) In the case of synonyms, the Subcommittee selects one of those synonyms as the standard term, while the remainder become nonstandard terms;

(5) Iteration of standard terms. Example: The term *joint* is defined; other forms such as joints, joining, joined, and join are not. The term *weldability* is defined; other forms such as weldable and unweldable are not.

C1.3 Format of Terms. The format of the presented terms is such that:

(1) Only one term is defined in a single location;

(2) Standard terms are printed in **boldface** type. The use of **boldface** type is restricted to standard terms when they are:

(a) The term being defined,

(b) Given in a definition cross-reference,

(c) The standard term given in the definition of a nonstandard term. Examples: **weld reinforcement**, narrow gap welding, **furnace brazing**.

(3) Standard terms are shown in lightface type when used within a definition, except when included as a cross-reference.

(4) Multiple word terms are hyphenated at the discretion of the Subcommittee based on common application and historical precedence.

(5) Letter designations for standard welding and allied processes shall be included after the standard term and shall be printed in boldface and enclosed in parentheses, e.g., **electroslag welding (ESW)**. Letter designations for other standard terminology shall be included after the standard term and will be enclosed in parentheses but not printed in boldface, e.g., **heat-affected zone** (HAZ).

When the application mode is incorporated in the process term the application mode suffixes listed in Table A4 will be appended to the process or process variation designation. Examples, **automatic brazing (B-AU)**, **robotic short circuiting gas metal arc welding (GMAW-SC-RO)**.

(6) Where a verb is commonly used and treated as a noun, the term is stated in the form of a gerund (ending in "ing"). Example: **boxing**.

(7) A verb is stated in the infinitive form and identified as such by placing a comma and the letter *v* in italic type after the term. Example: **braze**, *v*.

(8) A term that is an adjective is identified as such by placing a comma and *adj*. in italic type after the term. Example: **as-welded**, *adj*.

(9) Where identification of a noun is deemed beneficial to highlight the distinction from the verb or adjective form, a noun may be identified as such by placing a comma and the letter *n* in italic type after the term. A term that is a noun is stated in the singular form. Example: **braze**, *n*.

C1.4 Arrangement of Terms

(1) Terms are arranged alphabetically, word-by-word, with a hyphen considered equivalent to a space.

(2) Terms should not be included as groups; however, if an exception is made, each term within the group is also listed in alphabetical order.

(3) The process delimiter is not considered when arranging the terms.

C1.5 Subcommittee Decisions Pertaining to Terms. For various factors, such as entrenched use, disagreement among our own members, pressure from those with parochial interests, or human fallibility, the Definitions Subcommittee must compromise between the sometimes incompatible characteristics of good welding or allied process terminology. Where there is no clear superiority between competing versions of a given term or its definition, the Definitions Subcommittee has no choice but to make a somewhat arbitrary decision. The significant Definitions Subcommittee decisions are recorded here to inform the reader as to the logic applied in arriving at the approved AWS A3.0 terms.

C1.5.1 *bonding*. The Definitions Subcommittee discourages the use of the term "bonding" for "welding." We reserve the term *bonding* for the joining and allied processes, where either an adhesive bond or a mechanical bond is predominant at the interface created by the process actions, i.e., adhesive bonding, brazing, soldering, and thermal spraying. When an atomic bond between the atoms at that interface is predominant, the resulting joint is called a *weld*, and the process that produced that joint is called *welding*, without regard to whether the weld interface is created as a result of fusion or in the solid state. The interatomic bond existing between metal atoms at the weld interface of a fusion weld is no different than that at the weld interface of a solid-state weld.

C1.5.2 *diffusion welding*. Diffusion welding is consistent with international custom. The translation of that joining process from any language of the industrial nations into English has for many years been diffusion welding—not diffusion bonding. The replacement by the British Standards Institution (*Welding Terms and Symbols*, BS499, Part 1. Glossary for welding, brazing, and thermal cutting, 1983) of diffusion bonding by diffusion welding means that *diffusion welding*, rather than "diffusion bonding," is now universally accepted as a part of standard welding terminology.

The origin of the term *diffusion bonding* is unknown, but its widest proliferation may be found in the aircraft and associated industries. It was thought by some that if diffusion welding were given a different name, the aversion to welding would be overcome. It was not, but welding terminology remains plagued by the term *diffusion bonding* and a multitude of corollary terms spawned by the bonding fad.

C1.5.3 *gas tungsten arc welding* (or *gas metal arc welding*) versus TIG (or MIG). The Definitions Subcommittee prefers the terms *gas metal arc welding* and *gas tungsten arc welding*, with modifiers to denote the variations of the processes. In this case, we have made an exception and chosen not to join the reputed majority, in the hope that logic will ultimately prevail. The gas tungsten arc welding process was originally used with an inert gas as the arc shielding

atmosphere. The term *tungsten inert gas (TIG)* became popular. The later application of non-inert, i.e., active, gases for arc shielding rendered the term *TIG* inaccurate. To remove that discrepancy, the term *tungsten active gas (TAG)* has been proposed by some. With that terminology, the welding of stainless steel with argon is referred to as a "TIG welding process," and if hydrogen is added to the argon shielding gas, the welding process becomes "TAG." If the latter gas mixture is used for welding a noble metal, the welding process would then revert to "TIG." Thus the name of the welding process depends not only on the composition of the shielding gas but also on the base metal composition. Such terminology is no more logical than making the name of the shielded metal arc welding process dependent upon the type of electrode covering and the composition of the base metal. The proponents of TIG cite its simplicity, brevity, and ease of pronunciation. Tungsten inert gas, by itself, is rather meaningless. Only when the word "welding" is added is the term complete and may be legitimately compared with gas tungsten arc welding. The term *TIGW* then loses some of its cited advantages.

Arguments similar to those made in support of GTAW also apply to gas metal arc welding (GMAW) versus metal inert gas welding (MIGW or simply MIG), or in the case where reactive gases are used, metal active gas welding (MAGW or simply MAG). Both GTAW and GMAW are part of a coherent letter designation system that has been developed by the Definitions Subcommittee for all of the welding and allied processes. Haphazard changes cannot be made without damage to the letter designation system as a whole. That fact is seldom considered by those of the TIG-MIG school.

C1.5.4 ***welder.*** The use of the term *welder* to indicate the person who does the welding originated in the early days of welding and has been reaffirmed by the American Welding Society since the 1969 edition. To distinguish the welder from the machine used to perform the welding, the term *welding machine* was introduced for the latter.

C1.5.5 ***workpiece.*** The use of the term *workpiece* to indicate the part to be welded, brazed, soldered, thermal cut, or thermal sprayed, has not always been popularly received. Webster's Third New International Dictionary offers a single meaning for the term "workpiece" – that being a piece of work in process of manufacture. Other terms that could be considered synonymous such as component, member, and part, include numerous meanings and usages, most of which do not specify particular meanings that reference manufacturing.

C1.5.6 ***nondestructive examination.*** The standard term **nondestructive examination** (NDE) was first introduced in the 2001 edition of AWS A3.0. With several recognized choices, the subcommittee spent several meetings discussing which term would be selected as the standard term. This even included solicitation of input from other organizations, including American Society of Mechanical Engineers (ASME), American Society for Nondestructive Testing (ASNT), and American Society for Testing and Materials (ASTM). Also part of this selection process was the review of dictionary definitions for examination, evaluation, inspection, and testing. This exercise also fell short of revealing the best choice, as each was considered a synonym of the others.

The attention then turned to a look at the general usage of these terms as applied in the welding and welding quality control community. Below are definitions for these activities in terms of their general application:

(1) examination. The act of observing an object in terms of its appearance, size, shape, or other physical characteristic.

(2) evaluation. The act of comparing attributes with some standard.

(3) inspection. A general term describing the activities associated with the overall quality assurance function, including activities occurring before, during, and after the welding activity.

(4) testing. The act of determining the suitability of a material or object for its intended purpose by directly subjecting it to service conditions.

Based on the above, and after significant discussion, the choice for the standard term became **nondestructive examination** (NDE) and it was defined as "The process of determining acceptability of a material or a component in accordance with established criteria without impairing its future usefulness." At that time, the other choices were each listed as "A nonstandard term when used for **nondestructive examination**."

During preparation of the 2020 edition of AWS A3.0, the subcommittee revisited these definitions, from the standpoint of whether listing the alternate terms as being nonstandard was technically correct in terms of their common usage. Since all of the forms are used by various standards and reference documents as well as usage by various industry segments, it was decided that rather than being nonstandard terms, they are really alternatives to the standard term, with all having the same general meaning. It was agreed that nondestructive examination (NDE) should remain as the standard term, but the definitions for the others were listed as "See **nondestructive examination**." While this may appear to be a minor change,

in actuality, it is really quite significant. It means that any of these variations of the term may be used and that they all have the same meaning.

At this same time, the existing definition also came into scrutiny. What was questioned was the portion of the definition stating ". . . determining the suitability of some material or component for its intended purpose . . ." It was realized that the act of performing nondestructive examination could not, in and of itself, guarantee that a component was suitable for its intended purpose. As a result, the new definition was changed to "The process of determining acceptability of a material or a component in accordance with established criteria without impairing its future usefulness."

C1.5.7 Joint is defined as "The junction of workpiece(s) before and after joining." **Joint type** is defined as "A weld joint classification based on the relative orientation of the members being joined." Historically, five basic joint types have been recognized, namely: butt, corner, edge, lap, and T-joint. Of these five, the names of all but one are descriptive of the relative orientation of the members. The exception, **edge joint**, could identify the location of a weld applied to this type of joint; however, it does not describe the orientation of the members. Adding to this dilemma is the fact there also exists an **edge weld**.

In an effort to correct this irregularity, the term **parallel joint** was introduced as a replacement for **edge joint** and is defined as "A joint type formed by butting, parallel surfaces of one or more workpieces with flush ends." Instead of relegating **edge joint** to the status of a nonstandard term, it is defined as "See **parallel joint**."

With this change, the definition for **joint type** is now "A weld joint classification based on the relative orientation of the members being joined. The five basic joint types are the butt, corner, lap, parallel, and T-joints."

C1.5.8 deposit. The term deposit or any of its derivatives, is used only in connection with the terms **filler metal** or **surfacing material**. Use with such terms as **weld metal**, **weld bead**, **weld**, etc., is nonstandard.

C1.5.9 arc energy, heat input, and heat input rate. For fusion welding processes, the amount of heat generated to produce melting of base and filler metals is a critical factor. For arc welding processes, this heat is generated by the arc itself. Consequently, operation and control of these processes is dependent on the amount of heat the arc produces, which is quantified as *arc energy*, and defined as "The product of arc amperage, voltage, and time interval." Since this value is critical to the achievement of sound welds, this is considered an important and controlled variable for a welding procedure, where the value is generally referred to as *heat input*.

Standards for qualification of welding procedure specifications (WPSs) and subsequent control of production welding may limit the amount of energy being applied by the welding process. For welding processes requiring motion along the weld joint, this value is more accurately referred to as *heat input rate*, which is calculated as the amount of energy applied per unit length of weld bead. For simplicity, welding standards use the term *heat input* to describe this quantity.

Theoretically, heat input is considered to be the amount of heat generated in the workpiece as a result of the amount of arc energy. When comparing heat input among different welding processes, it is necessary to include factors such as thermal efficiency of the process, joint design, or welding direction. The relationship between heat input and arc energy is mainly affected by the welding process, so for a given welding process it is common to use arc energy as a substitute for heat input. So, for our common welding qualification standards, arc energy is the calculated value, but it is referred to as heat input.

C1.5.10 waveform-controlled welding, *arc welding*. This is defined as "A process modification using software to purposely manipulate the output welding waveform." As would be expected, this process variation requires a power source capable of operating in this mode. Those processes most commonly applied in this manner are gas metal arc welding (GMAW) and gas tungsten arc welding (GTAW), with GMAW being the more dominant. Arc characteristics are often varied based on feedback from the arc and may involve changes to the wire feed rate. Because of this, reference is made to a welding system rather than a welding power source.

When using either constant current (CC) or constant voltage (CV) arc welding power sources with either alternating current (AC) or direct current (DC) output, conventional voltmeters and ammeters are commonly used, and the readings obtained are adequate provided the welding arc is relatively stable. With the advent of power sources with pulsing power outputs, conventional meters are no longer considered capable of accurately measuring output amperages and voltages.

With the increased use of waveform-controlled welding processes such as pulsed gas metal arc welding (GMAW-P) or short-circuiting gas metal arc welding (GMAW-SC), it was recognized that resulting weld metal and HAZ properties often did not correspond with the conventionally calculated heat input using the basic equation where the product of

amperage and voltage is divided by travel speed. This disconnect was due to errors in the method of measuring the average amperage and voltage and calculating heat input using those values. The measurement errors were due not only to the rapidly changing output from the welding system, but also because there was a significant difference in the amperage and voltage wave shapes and phases in these systems. Re-establishing this relationship requires that not only are amperage and voltage measured at a very rapid rate, it is equally important that the product of these measurements is also determined at the same rate.

To accurately measure waveform-controlled outputs, amperage and voltage are required to be sensed and multiplied together with incremental time at sampling frequencies many times the pulsing frequency; typically these are greater than 5 kHz to be accurate. These may be reported as total instantaneous energy (TIE) or average instantaneous power (AIP). Due to rapidly changing outputs, phase shifts or synergic changes, TIE or AIP measurements must be used to correctly calculate heat input. For a more detailed description of the manner in which these measurements are made, the reader is directed to AWS B2.5/B2.5M, *Specification for Measurement of Welding Power Source Output for Calculation of Welding Procedure Heat Input*.

Any welding process employing rapid pulsing is considered waveform-controlled welding. While GMAW-P is most often considered to be waveform-controlled welding, pulsed gas tungsten arc welding (GTAW-P) and GMAW-SC would also be considered forms of waveform-controlled welding. Power sources and systems marketed as synergic, programmable or microprocessor-controlled are generally capable of operating in waveform-controlled welding mode. Should any doubt exist as to whether waveform-controlled welding is being performed, the welding equipment manufacturer should be consulted. Waveform control may be active for some, but not all of the welding process or equipment settings for a particular power source.

C1.6 Obsolete or Seldom Used Terms. When it is known or suspected that a process term or designation has been superseded, or has limited usage, the reader is alerted to this by incorporating "This is an obsolete or seldom used process." in the definition. The terms identified as such are summarized in Table A5.

C2. Definition Style and Format

C2.1 Purpose. Definitions should:

(1) Include as many uses as possible, while still retaining clarity and accuracy, but should not be extended to every nuance of meaning.

(2) Eliminate unnecessary words.

(3) Have only one clearly applicable definition that accurately reflects the term's use in the welding world.

(4) Not be intended to replace portions of textbooks or specifications, but rather, are intended to ensure the meaning of each term used in those documents is clear and is the same for all readers.

C2.2 Essential Elements of Definitions. The definition shall consist of:

(1) At least one succinct and technically correct sentence to convey the fact or concept represented by the term. The basic definition is complete in one sentence when a simple verb such as "is" or "means" is substituted for the period separating the term and definition. The definition does not repeat the complete term.

(2) Supplementary information, in the form of complete sentences, may be included after the basic definition. However, developing this into an encyclopedic discussion is avoided. Unless required for clarity, handbook information and requirements of standards are not included.

(3) References to a sequential listing of relevant figures and tables then follow, with the list introduced using the word "See."

(4) References to similar and related terms then follow in alphabetical order after introducing with the words, "See also," except as explained in C2.3.

(5) Informative reference information may be associated with the glossary entry, including:

(a) Notes providing statements, instructions, recommendations, requirements, or reference to commentary in Annex C that impart clarity to the application or use of the glossary entry. Multiple notes should be provided when more

than one point is being presented. Such notes are introduced with "NOTE x TO ENTRY – "where "x" is a sequential number starting with "1."

(b) The source of a definition reproduced from a document external to AWS shall be identified by "[*Source:* Document Designation, *Title*, Clause]" and, if the source definition has been modified – "[*Source:* Document Designation, *Title*, Clause, modified – description of modification] following the glossary entry.

C2.3 Format of Definitions.

C2.3.1 Use of Terminology Within Definitions. Definitions include only defined terms (in either AWS A3.0 or the dictionary), multiple-word partial terms, primary terms, and complete terms; not secondary or single-word partial terms.

C2.3.2 Definitions by Cross-reference. All standard terms are completely defined and the definition does not consist of only a cross-reference to another term, except as follows:

(1) Where context makes the meaning of a partial term clear, the partial term is defined by cross referencing the complete term. Example of a single-word partial term: **cylinder**. See **gas cylinder**. Example of a multiple-word partial term: **welding torch**.

(2) Where two forms of the same term are in common use and both are acceptable, the secondary form is defined by a cross-reference to the primary form, which has a complete definition. Example: **weld face**.

(3) When the meaning of a term is self evident, but a figure is useful, the term is defined by a cross reference to a figure. Example: **weld metal crack**.

(4) A multiple-word term is stated as it is normally written, accompanied by a definition of the basic term as a cross-reference to the multiple-word term. Examples: **arc welding deposition efficiency**, **deposition efficiency**.

C2.3.3 Abbreviations within Definitions. Abbreviations are not used in definitions. This includes letter designations of the welding and allied processes.

C2.3.4 Units of Measure in Definitions. Units of measurement are not included in definitions.

C2.3.5 Definitions of Nonstandard Terms. The definition of a nonstandard term:

(1) Starts with the phrase, "A nonstandard term for," when the term has no use as a standard term. Examples: diffusion bonding, globular arc, and hydrogen brazing.

(2) Starts with the phrase, "A nonstandard term when used for," when the term is nonstandard for the stated purpose, but may be a standard term when used for other purposes. Examples: bottle, lead burning, and metallizing.

(3) Includes a description of the term use after the introductory phrase of (1) or (2).

(4) Does not use or cross-reference a nonstandard term.

(5) Does not categorize the term as either standard or nonstandard or use another designation, such as preferred or nonpreferred, acceptable or nonacceptable, correct or incorrect, except when the misuse of a term may endanger personal safety. Where the potential for such misuse is identified, the term is identified as both nonstandard and incorrect. Example: ground lead.

C2.3.6 Formatting Definitions of Terms Having Specific Usage. No term has more than one definition, except for those terms delimited to indicate more than one application or use.

(1) Delimitations are indicated by the addition of a comma after the term or its letter designation, followed by the delimiter shown in *italicized*, lightface type. These delimiters are typically terms, however grammatic usage of terms can also be shown as an abbreviated delimiter as permitted by C1.3(7) for a verb, C1.3(8) for an adjective, and C1.3(9) for the noun form.

(2) A term with limited and clearly definable applicability includes the area of applicability in lightface italic type, preceded by a comma, immediately following the term. When multiple areas of applicability are cited, the terms are separated in typical sentence format with commas and the unitalicized word "and." Examples: **horizontal welding position**, *fillet weld* and **horizontal welding position**, *groove weld* and *surfacing weld.* The italicized expression (delimiter) is not required if either the term or definition reveals the application area. Example: **arc plasma**.

(3) Definitions of verbs begin with the word "To" or "the act of" and are expressed accordingly. Examples: **tie-in**, *v.* and **braze**, *v.*

C2.4 Committee Decisions Pertaining to Definitions. The significant Definitions Subcommittee decisions are recorded here to inform the reader as to the logic applied in arriving at the definition format.

C2.4.1 Application Mode. Where the process term variation includes a reference to application mode, e.g., **automatic brazing**, it has been decided to reduce redundancy in the definitions by making reference to a common application mode definition. The definition in this case will have the format "See xxxx process," where xxxx is one of the application modes listed in Table A4.

C2.4.2 Multi-Process Application. To promote consistent usage and standardization of terminology across a range of processes, definitions may refer back to a base term and definition. The base term definition provides a process-agnostic definition followed by a list of process specific terms introduced with the phrase "Variations of this term are." The definition of the associated process-specific terms will consist of the word "See" followed by the base term. Example: **performance qualification variable** and **welder performance qualification variable**.

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Annex D (Informative)
Modifications to AWS A3.0M/A3.0:2025 from AWS A3.0M/A3.0:2020

This annex is not part of this standard but is included for informational purposes only.

Table D1
New Terms and Definitions

1FR, *pipe*	**brazing test assembly**
1GR, *pipe*	**build model**, *additive manufacturing*
1S	**cascade soldering**
1SR, *pipe*	**certification**
2FR, *pipe*	**certification authority**
2G, *pipe*	**certified welder**
2G-RA, *pipe*	**certified welding operator**
2G-RA, *plate*	**cold wire welding**
2S	**constant voltage short circuiting transfer**, *gas metal arc welding*
2S, *pipe*	**constant voltage spray transfer**, *gas metal arc welding*
3FR, *pipe*	**consumable guide,** *electroslag welding*
3GR, *pipe*	**contact tip-to-work distance** (CTWD)
3S	**coupon**
3SR, *pipe*	**delamination**
4FR, *pipe*	**design effective throat**
4GR, *pipe*	**diffusion**, *plastic welding*
4S	**dilution ratio**
4SR, *pipe*	**dye penetrant testing**
5S	**eddy current testing** (ET), *nondestructive examination*
6S	**effective fillet weld size**
acoustic emission testing (AET), *nondestructive examination*	**electromagnetic testing**
active brazing filler metal	**evaluation**, *nondestructive examination*
active gas	**examination,** *nondestructive examination*
adaptively-controlled	**examination method designation**
additive manufacturing procedure specification (AMPS)	**false indication**, *nondestructive examination*
atmospheric plasma spraying (APSP)	**flanged parallel joint**
AWS Certified Welder	**flood welding**
AWS Qualifier	**guided bend test**
AWS welder performance qualifier	**heat tint**
AWS welding procedure qualifier	**hydrogen bakeout**
background level, *pulsed welding*	**hydrogen-induced cracking** (HIC)
bakeout	**indication**, *nondestructive examination*
brazer certification	**induction plastic welding (IW-P)**, *thermoplastics*
brazing operator certification	**industrial robot**
brazing operator performance qualification	**inspection**, *nondestructive examination*
brazing operator performance qualification test record (BOPQTR)	**interpretation**, *nondestructive examination*
brazing operator performance qualification variable	**leak testing** (LT)
brazer performance qualification	**liquid penetrant testing**
brazer performance qualification test record (BPQTR)	**machine qualification record** (MQR), *additive manufacturing*
brazing procedure qualification	**magnetic particle testing** (MT), *nondestructive examination*

Table D1 (Continued)
New Terms and Definitions

magnetic particle inspection	**series electrode submerged arc welding (SAW-S)**
meltback	**series electrode welding**
multiple electrode submerged arc welding (SAW-M)	**shielding gas**
multiple electrode welding	**short circuiting gas metal arc welding (GMAW-S)**
nonrelevant indication, *nondestructive examination*	**socket fusion welding (SFW)**
notching	**solderer**
offset	**solderer certification**
outer cone, *oxyfuel cutting* and *oxyfuel welding*	**solderer performance qualification**
outer envelope of flame, *oxyfuel cutting* and *welding*	**soldering operator**
outer envelope of flame, *oxyfuel welding*	**soldering operator certification**
percent dilution	**soldering operator performance qualification**
postweld heat treatment (PWHT)	**soldering operator performance qualification variable**
process orientation, *hybrid welding*	**soldering procedure**
procedure qualification test build, *additive manufacturing*	**soldering procedure qualification**
procedure specification (PS)	**soldering test assembly**
process separation, *hybrid welding*	**soundness test**
production welding	**specimen blank**
pry test	**standard qualification build**, *additive manufacturing*
pulsed short circuiting transfer, *gas metal arc welding*	**support structure**, *additive manufacturing*
pulsed welding, *gas metal arc welding*	**surface temper bead**
parallel electrode submerged arc welding (SAW-P)	**surface temper pass**
parallel electrode welding	**synergic control**
peak amperage, *pulsed welding*	tandem submerged arc welding
peak level, *pulsed welding*	**temper bead welding**, (TBW)
penetrant testing (PT), *nondestructive examination*	**test weldment**
phased array ultrasonic testing (PAUT), *nondestructive examination*	**testpiece**
plume, *laser beam welding*	**torch extension**
pore	**transfer mode**
power ratio, *temper bead welding*	**travel speed**, *welding*
procedure qualification record (PQR), *additive manufacturing*	**ultrasonic testing** (UT)
purge gas	**vacuum laser beam welding (LBW-V)**
qualified brazing procedure	**visual examination**
qualified soldering procedure	**visual inspection**
qualified welding procedure	**visual testing** (VT)
qualifier	**weld access hole**
radiographic testing (RT)	**weld interface crack**
reactive gas	**weld lobe**
relevant indication, *nondestructive examination*	**weldability lobe**, *resistance welding*
resistance weld size	**weldability test**
resistance plastic welding (RW-P), *thermoplastics*	**welder performance qualification**
resolution, *nondestructive examination*	**welding operator performance qualification**
riser, *electrogas welding* and *electroslag welding*	**welding operator performance qualification variable**
root spacing	**welding inspection**
rotated horizontal test coupon, *pipe fillet*	**welding procedure qualification**
rotated horizontal test coupon, *pipe groove*	**welding progression**, *vertical welding*
rotated horizontal test coupon, *pipe surfacing*	**witness specimen**, *additive manufacturing*
sensitivity, *nondestructive examination*	

Table D2
Modified Terms and Definitions

1FR, *pipe*
2F-H, *pipe*
2F-V, *pipe*
4F, *pipe*
acetylene feather
active brazing filler metal
adaptive control, *adj*
adhesive bond
air cap
air carbon arc cutting torch
air feed
alloy flux, *submerged arc welding*
arc cutting gun
arc energy
arc welding electrode
arc welding gun
arc welding torch
automatic, *adj*
backing
backing gas
backing shoe
base material
base metal
bend test
bond coat
braze metal
brazer
brazer performance qualification variable
brazing (B)
brazing filler metal
brazing operator
brazing procedure
brazing procedure qualification record (BPQR)
brazing procedure qualification variable
brazing procedure specification (BPS)
brazing temperature
brazing variable
button
carburizing flame
cone
consumable guide electroslag welding (ESW-CG)
crater fill current
crater fill time
definition

dilution
effective throat
electrode holder
electrode setback
electrode indentation, *resistance welding*
electroslag welding (ESW)
essential variable, *performance qualification*
essential variable, *procedure qualification*
expulsion point, *resistance welding*
extrusion welding (EW), *thermoplastics*
F-Number
face crack
Ferrite Number (FN)
field weld
fillet weld size, *equal leg*
fillet weld size, *unequal leg*
final current
final taper current
flanged edge joint
flash, *arc stud welding*
flow fusion welding (FFW), *thermoplastics*
gas tungsten arc cutting torch
gas tungsten arc welding torch
grounding reactor
heated tool welding (HTW), *thermoplastics*
high pulse current, *pulsed welding*
hold time, *resistance welding*
horizontal rolled position, *pipe*
horn, *resistance welding*
hot start current
hot wire welding
horn, *resistance welding*
hybrid welding
impulse, *resistance welding*
induction welding (IW), *resistance welding*
inert gas
initial current
inner cone
interpulse time, *resistance welding*
joint clearance
joint design
joint mismatch
lamellar tear
lamination

Table D2 (Continued)
Modified Terms and Definitions

laser beam expander
linear discontinuity
low pulse current, *pulsed welding*
manual, *adj*
mechanized, *adj*
narrow groove electroslag welding (ESW-NG)
nontransferred arc
nozzle, *arc spraying*
nozzle, *flame spraying*
nozzle accumulation
open circuit voltage
orifice gas
orifice throat length
oxidizing flame
performance qualification
performance qualification test record (PQTR)
performance qualification variable
piping porosity
plasma arc cutting torch
plasma arc welding torch
plasma spraying (PSP)
plenum chamber
postflow time
postheating
power source
preheat current, *resistance welding*
procedure qualification
procedure qualification record (PQR)
procedure qualification variable
pulse, *AC resistance welding*
pulse, *DC resistance welding*
pulse start delay time
pulsed gas metal arc welding (GMAW-P)
pulsed spray transfer, *gas metal arc welding*
pulsed welding, *arc welding*
purge
qualification authority
qualified brazer
qualified solderer
qualified welder
quench time, *resistance welding*
robotic, *adj*
root shielding gas
root surface crack
rotational spray transfer, *gas metal arc welding*

series submerged arc welding (SAW-S)
semiautomatic, *adj*
short circuiting gas metal arc welding (GMAW-SC)
shunt weld
slot weld size
solder metal
solderer performance qualification variable
soldering
soldering filler metal
soldering procedure qualification record (SPQR)
soldering procedure qualification variable
soldering procedure specification (SPS)
soldering temperature
soldering variable
spatter
spin welding (SPW), *thermoplastics*
squeeze time, *resistance welding*
start current
start time
stress corrosion crack
stress relief crack
stress relief heat treatment
submerged arc welding (SAW)
standard welding procedure specification (SWPS)
temper bead
test coupon
temper pass
toe reentrant angle
test specimen
thermal sprayer
thermal spraying torch
toe temper pass
transferred arc
transformer tap
usability
ultrasonic plastic welding (USW-P), *thermoplastics*
vacuum plasma spraying (VPSP)
vertical orientation, *pipe fillet*
vibration welding (VW), *thermoplastics*
weld metal
welded test assembly
welder
welder certification
welder performance qualification variable
welding current

Table D2 (Continued)
Modified Terms and Definitions

welding generator	**welding procedure specification** (WPS)
welding operator	**welding schedule**
welding operator certification	**welding test position designation**
welding power source	**welding transformer**
welding procedure	**welding variable**
welding procedure qualification record (WPQR)	**whipping**
welding procedure qualification variable	

Table D3
Terms with Editorially Revised Definitions

5F	**high pulse current**, *pulsed welding*
5G	**hot wire welding**
6F	**infrared radiation**
6G	**infrared welding (IRW)**, *thermoplastics*
6GR	**inner cone**, *oxyfuel cutting* and *oxyfuel welding*
accelerating potential, *electron beam cutting* and *electron beam welding*	**insulating nozzle**, s*elf-shielded flux cored arc welding*
acetylene feather, *oxyacetylene cutting* and *oxyacetylene welding*	**intermediate bead**
actual throat	**intermediate pass**
arc welding gun	**joint geometry**
average instantaneous power (AIP), *waveform-controlled welding*	joint opening
backstep sequence	**joint type**
bonding	**linear indication**, *NDE*
carburizing flame, *oxyfuel cutting* and *oxyfuel welding*	**long electrode extension**, *electrogas welding*, *flux cored arc welding*, *gas metal arc welding*, *and submerged arc welding*
carrier gas	**longitudinal crack**
circumferential seam welding machine, *resistance seam welding*	**longitudinal seam welding machine**, *resistance seam welding*
constricted arc	**low pulse time**, *pulsed welding*
constricting nozzle	machine
constricting orifice	**meltback**
contact tip	**metal transfer mode**, *gas metal arc welding*
copper brazing	**MIG welding**
cosmetic bead	**multiple welding test position**
cosmetic pass	**neutral flame**
cover bead	**nondestructive evaluation**
cover pass	penetration-enhancing flux
defect	**preheat**, *n.*
delayed crack	**protective atmosphere**
deposit	**push-pull-resistance welding**
diffusion welding (DFW)	**qualification**
dissolution, *brazing*	**root opening**
dwell time, *thermal spraying*	**rough threading**, *thermal spraying*
electrode	**seam weld**
F-Number	**short circuiting transfer**, *gas metal arc welding*
fillet weld throat	silver soldering
friction stir welding (FRW)	**single-V groove**
fusion welding	**smoothing bead**
gap	**smoothing pass**
gas metal arc welding (GMAW)	**spray transfer**, *gas metal arc welding*
gas tungsten arc welding (GTAW)	**spraying rate**, *thermal spraying*
globular transfer, *gas metal arc welding*	**sump**
gun	**surface roughening**
heat input (HI)	**test specimen**
heat input rate (HIR)	**thermal spray pass**
heated tool welding (HTW), *thermoplastics*	TIG welding

Table D3 (Continued)
Terms with Editorially Revised Definitions

toe temper bead	**welding**
torch	**welding torch**
total instantaneous energy (TIE), *waveform-controlled welding*	**welding waveform**
universal seam welding machine, *resistance seam welding*	**welding wire**
waveform-controlled welding, *arc welding*	**workpiece**
weld reinforcement	

Table D4
Term Revised from Nonstandard to Standard

root shielding gas

Table D5
Deleted Terms (Also see New Terms for revisions in delimiters)

1F, *pipe*	**laser**
1G, *pipe*	**lens**
3F, *pipe*	**linear discontinuity**
3G, *pipe*	**linear indication**
4G, *pipe*	**pulsed spray welding**, *pulsed gas metal arc welding*
gun extension	**weldor**

Annex E (Informative)
Terminology from Other Sources

This annex is not part of this standard but is included for informational purposes only.

International Organization for Standardization (ISO) documents:

ISO 857-2, *Welding and allied processes — Vocabulary — Part 2: Soldering and brazing processes and related terms*

ISO 15296, *Gas welding equipment — Vocabulary*

ISO 17659, *Welding – Multilingual terms for welded joints with illustrations*

ISO 17677-1, *Resistance welding — Vocabulary — Part 1: Spot, projection and seam welding*

ISO 25239-1, *Friction stir welding — Aluminium — Part 1: Vocabulary*

ISO/TR 25901, *Welding and related processes — Vocabulary*

International Institute of Welding (IIW) documents:

MCT Part 1, *Multilingual collection of terms for welding and allied processes – Part 1 – General terms*

MCT Part 2, *Multilingual collection of terms for welding and allied processes – Part 2 – Gas welding*

MCT Part 5, *Multilingual collection of terms for welding and allied processes (MCT) – Part 5 – Thermal cutting*

MCT Part 6, *Multilingual collection of terms for welding and allied processes – Part 6 – Hot spraying*

MCT Part 7, *Multilingual collection of terms for welding and allied processes – Part 7 – Brazing, soldering and braze welding*

MCT Part 9, *Multilingual collection of terms for welding and allied processes – Part 9 – Special welding processes*

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Annex F (Informative)
Requesting an Official Interpretation on an AWS Standard

This annex is not part of this standard but is included for informational purposes only.

F1. Introduction

The following procedures are here to assist standard users in submitting successful requests for official interpretations to AWS standards. Requests from the general public submitted to AWS staff or committee members that do not follow these rules may be returned to the sender unanswered. AWS reserves the right to decline answering specific requests; if AWS declines a request, AWS will provide the reason to the individual why the request was declined.

F2. Limitations

The activities of AWS technical committees regarding interpretations are limited strictly to the interpretation of provisions of standards prepared by the committees. Neither AWS staff nor the committees are in a position to offer interpretive or consulting services on (1) specific engineering problems, (2) requirements of standards applied to fabrications outside the scope of the document, or (3) points not specifically covered by the standard. In such cases, the inquirer should seek assistance from a competent engineer experienced in the particular field of interest.

F3. General Procedure for all Requests

F3.1 Submission. All requests shall be sent to the Managing Director, AWS Standards Development. For efficient handling, it is preferred that all requests should be submitted electronically through standards@aws.org. Alternatively, requests may be mailed to:

Managing Director
Standards Development
American Welding Society
8669 NW 36 St, # 130
Miami, FL 33166

F3.2 Contact Information. All inquiries shall contain the name, address, email, phone number, and employer of the inquirer.

F3.3 Scope. Each inquiry shall address one single provision of the standard unless the issue in question involves two or more interrelated provisions. The provision(s) shall be identified in the scope of the request along with the edition of the standard (e.g., D1.1:2006) that contains the provision(s) the inquirer is addressing.

F3.4 Question(s). All requests shall be stated in the form of a question that can be answered ‘yes’ or ‘no’. The request shall be concise, yet complete enough to enable the committee to understand the point of the issue in question. When the point is not clearly defined, the request will be returned for clarification. Sketches should be used whenever appropriate, and all paragraphs, figures, and tables (or annexes) that bear on the issue in question shall be cited.

F3.5 Proposed Answer(s). The inquirer shall provide proposed answer(s) to their own question(s).

F3.6 Background. Additional information on the topic may be provided but is not necessary. The question(s) and proposed answer(s) above shall stand on their own without the need for additional background information.

F4. AWS Policy on Interpretations

The American Welding Society (AWS) Board of Directors has adopted a policy whereby all official interpretations of AWS standards are handled in a formal manner. Under this policy, all official interpretations are approved by the technical committee that is responsible for the standard. Communication concerning an official interpretation is directed through the AWS staff member who works with that technical committee. The policy requires that all requests for an official interpretation be submitted in writing. Such requests will be handled as expeditiously as possible, but due to the procedures that must be followed, some requests for an official interpretation may take considerable time to complete.

F5. AWS Response to Requests

Upon approval by the committee, the interpretation is an official interpretation of the Society, and AWS shall transmit the response to the inquirer, publish it in the *Welding Journal*, and post it on the AWS website.

F6. Telephone Inquiries

Telephone inquiries to AWS Headquarters concerning AWS standards should be limited to questions of a general nature or to matters directly related to the use of the standard. The *AWS Board Policy Manual* requires that all AWS staff members respond to a telephone request for an official interpretation of any AWS standard with the information that such an interpretation can be obtained only through a written request. Headquarters staff cannot provide consulting services. However, the staff can refer a caller to any of those consultants whose names are on file at AWS Headquarters.

List of AWS Documents on Definitions and Symbols

Designation	Title
A2.1-WC[a]	*Welding Symbol Chart Wall Size*
A2.1-DC[a]	*Welding Symbol Chart — Desk Size*
A2.1-WC XL[a]	*Welding Symbol Chart — X-Large Wall Size*
A2.4	*Standard Symbols for Welding, Brazing, and Nondestructive Examination*
A3.0M/A3.0	*Standard Welding Terms and Definitions Including Terms for Additive Manufacturing, Adhesive Bonding, Brazing, Soldering, Thermal Cutting, Thermal Spraying, and Nondestructive Examination*
A3.1	*Master Chart of Welding and Joining Processes*

[a] A reproduction of the charts is shown in AWS A2.4. It should be understood that these charts are intended only as shop aids. The only complete and official presentation of the Standard Welding Symbols is in AWS A2.4.

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