IS 812 (1957): Glossary of terms relating to welding and cutting of metals [MTD 11: Welding General]

BLANK PAGE

IS : 812 - 1957
(Reaffirmed 2003)
2008

Indian Standard

GLOSSARY OF TERMS RELATING TO WELDING AND CUTTING OF METALS

(Seventh Reprint MARCH 1998)

UDC 621·791 : 001·4

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Gr 14

October 1958

Indian Standard

GLOSSARY OF TERMS RELATING TO WELDING AND CUTTING OF METALS

Structural Steel Sectional Committee, BDC 7

Chairman	
SHRI J. J. GHANDY	Director-in-Charge, The Tata Iron & Steel Co. Ltd., Jamshedpur
SHRI P. H. KUTAR (*Alternate Chairman*)	Technical Director, The Tata Iron & Steel Co. Ltd., Jamshedpur
Members	
SHRI N. PADMANABHA AYYAR	Ministry of Iron & Steel
SHRI N. C. BAGCHI	Government Test House, Calcutta
SHRI S. L. BAZAZ	Roads Wing, Ministry of Transport
SHRI P. C. POONEN (*Alternate*)	
MR. H. M. CROWE	Durgapur Steel Mills, Durgapur
SHRI S. DAS GUPTA	The Tata Iron & Steel Co. Ltd., Jamshedpur
MR. H. HODGKINSON (*Alternate*)	
SHRI D. S. DESAI	(i) Braithwaite, Burn & Jessop Construction Co. Ltd., Calcutta; (ii) Institution of Engineers (India), Calcutta; and (iii) Indian Roads Congress, New Delhi
SHRI M. P. NAGARSHETH (*Alternate*)	Indian Roads Congress, New Delhi
DIRECTOR	Central Building Research Institute (CSIR), Roorkee
SHRI R. N. DUTT	Iron & Steel Controller, Calcutta
DR. B. D. KALELKAR	Development Wing, Ministry of Commerce & Industry
SHRI N. KRISHNASWAMI (*Alternate*)	
SHRI T. KRISHNAPPA	Mysore Iron & Steel Works, Bhadravati
SHRI A. S. VALLISHAYEE (*Alternate*)	
SHRI S. L. KUMAR	Structural Steel Research Subcommittee (BDC 7:4), Indian Standards Institution
DR. A. K. MALLIK	Indian Iron & Steel Co. Ltd., Burnpur
SHRI T. J. MANICKAM	Indian Institute of Architects, Bombay
MR. J. W. MILLER	Indian Engineering Association, Calcutta
MR. W. D. HOLTON (*Alternate*)	
SHRI S. K. MITRA	Engineering Association of India, Calcutta
SHRI S. SRINIVASAN (*Alternate*)	
SHRI K. K. NATHANI	Inspection Wing, Directorate General of Supplies & Disposals (Ministry of Works, Housing & Supply)
MR. E. P. NICOLAIDES	J. C. Gammon Ltd., Bombay

(*Continued on page 2*)

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

(*Contd from page* 1)

DR. O. G. F. PAULSSEN	Palm Court, Queens Road, Bombay
MR. J. W. RANKIN	Bridge & Roof Co. (India) Ltd., Calcutta
SHRI A. L. RAO	Central Public Works Department, New Delhi
REPRESENTATIVE	Bhilai Steel Mills, Bhilai
SHRI SUKU SEN	Hindustan Steel Private Ltd., Calcutta
SHRI L. N. MISRA (*Alternate*)	
COL G. S. SIHOTA	Engineer-in-Chief's Branch, Army Headquarters
SHRI R. S. MEHANDRU (*Alternate*)	
SHRI K. RAMA VARMAN	National Buildings Organization, New Delhi
SHRI L. G. TOYE (*Alternate*)	
SHRI V. VENKATARAMAYYA	Railway Board, New Delhi
SHRI K. VYASULU	Planning Commission, New Delhi
DR. LAL C. VERMAN (*Ex-officio*)	Director, Indian Standards Institution
Staff	
SHRI T. V. JOSEPH	Officer on Special Duty, Indian Standards Institution
MR. M. L. GOLDSMITH	Resident Engineer of Messrs Ramseyer & Miller Inc., Consultants to Iron & Steel Industry, New York
SHRI B. S. KRISHNAMACHAR	Assistant Director (Structural & Metals), Indian Standards Institution

Welding Subcommittee, BDC 7 : 3

Convener	
SHRI D. S. DESAI	Braithwaite, Burn & Jessop Construction Co. Ltd., Calcutta
Members	
SHRI B. M. AHUJA	Engineer-in-Chief's Branch, Army Headquarters
SHRI N. C. BAGCHI	Government Test House, Calcutta
SHRI P. K. BANERJEE	Central Public Works Department, New Delhi
SHRI R. G. BHATAWADEKAR	Railway Board, New Delhi
SHRI B. N. BOSE	Hind Constructions Ltd., Calcutta
SHRI P. K. CHAUDHURI (*Alternate*)	
DR. D. R. DHANBHOORA	The Tata Iron & Steel Co. Ltd., Jamshedpur
SHRI S. VISWANATHAN (*Alternate*)	
MR. MARTIN EICHLER	Tata Locomotive & Engineering Co. Ltd., Tatanagar
SHRI M. K. MOOKERJEE (*Alternate*)	
SHRI K. P. GANGWAL	Asiatic Oxygen & Acetylene Co. Ltd., Calcutta
SHRI P. K. V. CHALLAM (*Alternate*)	
SHRI H. N. GHOSAL	Philips India Ltd., Calcutta
SHRI A. M. KAPADIA	Structural Engineering Works Ltd., Bombay
SHRI S. B. KAPADIA	Hindustan Shipyard Private Ltd., Visakhapatnam
SHRI I. T. MIRCHANDANI	J. B. Advani-Oerlikon Electrodes Ltd., Bombay
SHRI S. V. NADKARNI (*Alternate*)	
SHRI K. K. NATHANI	Inspection Wing, Directorate General of Supplies & Disposals (Ministry of Works, Housing & Supply)
SHRI J. V. PATEL	New Standard Engineering Co. Private Ltd., Bombay
MR. T. R. SHIELDS	Indian Oxygen & Acetylene Co. Ltd., Calcutta
SHRI B. S. SINDHU	Institution of Engineers (India), Calcutta
SHRI K. RAMA VARMAN	National Buildings Organization, New Delhi
SHRI L. G. TOYE (*Alternate*)	

CONTENTS

	PAGE
0. FOREWORD	4
1. SCOPE	7
2. ARRANGEMENT	7
PART I WELDING IN GENERAL	8
3. COMMON TERMS	8
PART II WELDING WITH PRESSURE	14
4. GENERAL TERMS	14
5. TERMS RELATING TO EQUIPMENT	15
6. TERMS RELATING TO FORGE WELDING	17
7. TERMS RELATING TO PRESSURE-WELDING	19
8. TERMS RELATING TO RESISTANCE WELDING	20
9. TERMS RELATING TO STUD WELDING	30
10. TERMS RELATING TO THERMIT PRESSURE WELDING ...	30
PART III FUSION WELDING (WELDING WITHOUT PRESSURE)	31
11. GENERAL TERMS	31
12. TERMS RELATING TO ARC WELDING	46
13. TERMS RELATING TO EQUIPMENT	50
14. TERMS RELATING TO GAS WELDING	54
15. TERMS RELATING TO THERMIT FUSION WELDING ...	56
PART IV BRAZING AND BRONZE WELDING	57
16. GENERAL TERM	57
17. TERMS RELATING TO BRAZING	57
18. TERMS RELATING TO BRONZE WELDING	58
PART V TESTING	58
19. TERMS RELATING TO TESTING	58
PART VI WELD IMPERFECTIONS	62
20. TERMS RELATING TO WELD IMPERFECTIONS	62
21. TERMS RELATING TO WELD. IMPERFECTIONS APPROPRIATE FOR RADIOGRAPHIC EXAMINATION	64
PART VII CUTTING	78
22. GENERAL TERMS	78
23. TERMS RELATING TO ARC CUTTING	79
24. TERMS RELATING TO EQUIPMENT	79
25. TERMS RELATING TO GAS CUTTING	80
PART VIII ALPHABETICAL INDEX OF TERMS ...	81

Indian Standard

GLOSSARY OF TERMS RELATING TO WELDING AND CUTTING OF METALS

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 11 February 1957, on approval by the Building Division Council of the draft finalized on 15 June 1956, by the Structural Steel Sectional Committee.

0.2 In the course of recent years, considerable developments have been made in the application of welding technique. This has resulted in an increase in the number of terms used, necessitating standardization of terminology on more exact basis, so as to avoid ambiguity and confusion arising out of misinterpretation of terms. It is hoped that this standard glossary of terms will help in fixing a more precise meaning to words which, because of their convenience, have acquired too general a significance.

0.3 In a number of cases information is available where more than one term is being used for the same purpose. Such alternate terms have been grouped together. The terms given first are recommended for use and the use of terms given in brackets is deprecated.

0.4 Taking into consideration the views of the producers, consumers, technologists, etc, the Sectional Committee responsible for the preparation of this standard felt that it should be related to the trade practices followed in the country in this field. Furthermore, due weightage had to be given to the need for international co-ordination between standards prevailing in different countries of the world These considerations led the Sectional Committee to derive assistance from the following standards and publications:

IRS PRB. $\frac{100\ (N)}{500}$: 1945 CODE OF PRACTICE FOR ELECTRIC ARC WELDING OF MILD STEEL STRUCTURES. Ministry of Railways, Government of India.

B.S. 499: 1952 GLOSSARY OF TERMS (WITH SYMBOLS) RELATING TO THE WELDING AND CUTTING OF METALS. British Standards Institution.

WELDING HANDBOOK, 3RD ED. (1951) American Welding Society, New York.

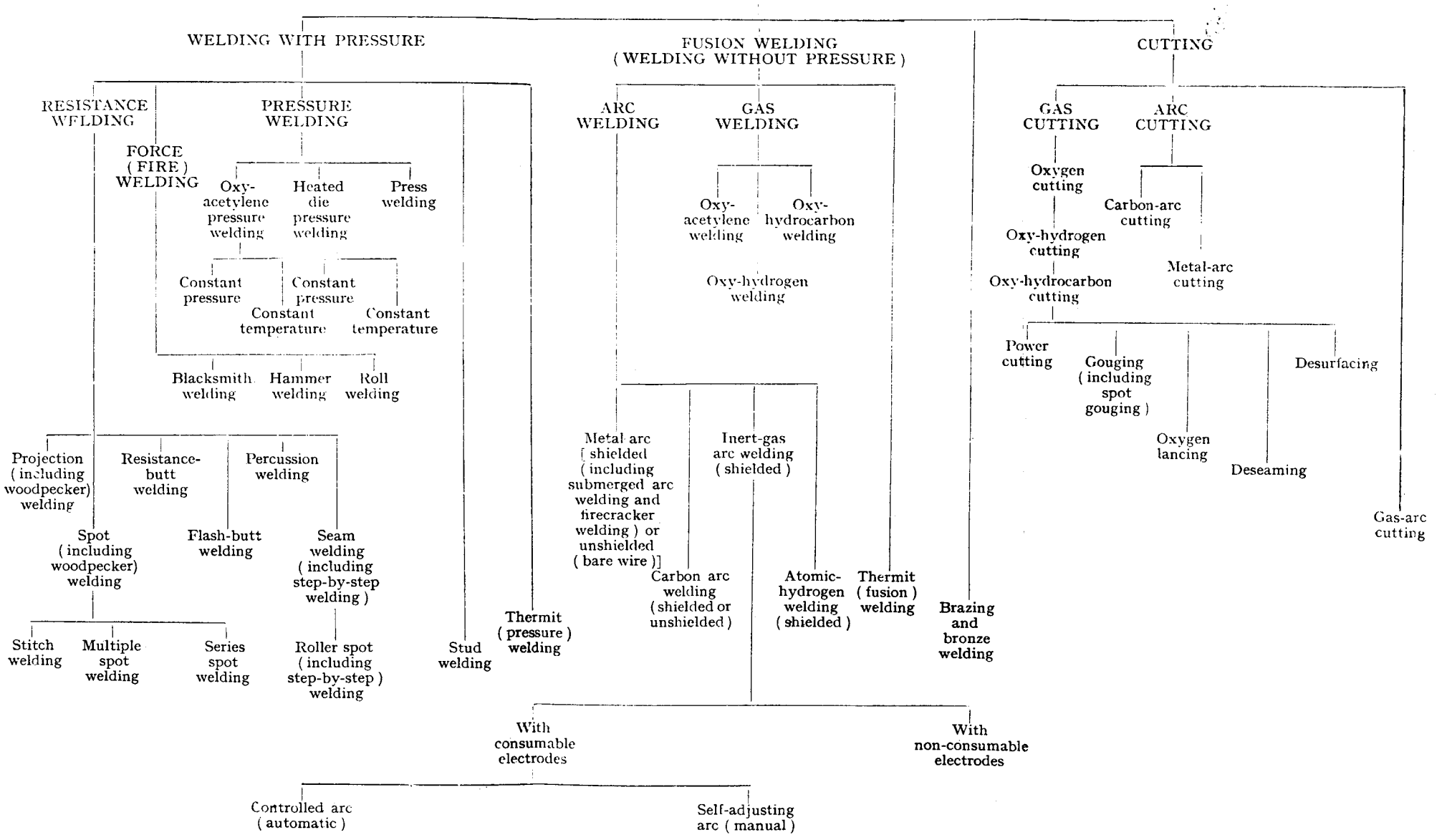


FIG 1 CHART SHOWING DERIVATION OF WELDING AND CUTTING PROCESSES

As in the Original Standard, this Page is Intentionally Left Blank

0.5 This standard defines the terms relating to welding and cutting of metals. Other Indian Standards being formulated in the field of welding comprise the following:

a) Scheme of symbols for welding
b) Specification for covered electrodes for metal arc welding of mild steel
c) Classification and coding of covered electrodes for metal arc welding of mild steel and of low alloy high-tensile steels
d) Code of practice for use of metal arc welding for general construction in mild steel
e) Code of practice for training and testing of metal arc welders
f) Code of practice for safety and health requirements in electric and gas welding and cutting operations
g) Code of practice for resistance spot welding for light assemblies in mild steel
h) Code of practice for use of welding in tubular construction
j) Code of practice for use of welding in pipelines
k) Code of practice for inspection of welds
m) Procedure code for manual metal arc welding of structural steel
n) Code of practice for use of welding in structures subject to dynamic loading-bridges

0.6 This standard is intended mainly to cover the technical definitions of terms, and it does not necessarily include all the legal meanings of the terms.

1. SCOPE

1.1 This standard defines the terms relating to welding and cutting of metals.

2. ARRANGEMENT

2.1 For convenience of reference and comparison of terms on related processes, this glossary has been divided into seven main classes and each has been dealt with under a separate part of the standard. Parts I to IV deal with terms relating to welding processes and parts V to VII are devoted to terms relating to testing, weld imperfections and cutting. The terms in each part have further been grouped together under suitable and convenient sub-classes, and under each part the terms have been listed in alphabetical order. The terms common to the whole class have been dealt with under the heading ' General Terms ' which precedes other sub-classes.

2.2 A chart showing derivation of welding and cutting processes is also given for reference (*see* Fig 1).

2.3 An index to all the terms defined under Parts I to VII is given in Part VIII, where all terms including the alternatives mentioned in parentheses have been listed in one alphabetical sequence according to IS : 382-1952 Practice for Alphabetical Arrangement.

PART I WELDING IN GENERAL

3. COMMON TERMS

3.1 As-Welded — The condition of weld metal, welded joints and weldments after welding prior to any subsequent thermal or mechanical treatment.

3.2 Butt Weld — A weld in which the weld metal lies substantially within the extension of the planes of the surfaces of the parts joined or within the extension of the planes of the smaller of the two parts of differing size (*see* Fig 2).

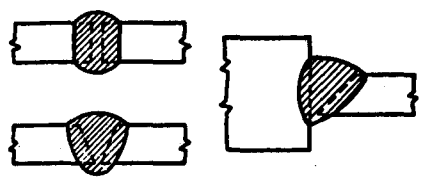


FIG 2 EXAMPLES OF BUTT WELDS

3.3 Chipping Goggles — A protective device enclosing a space in front of the eyes to shield them from injury during chipping or grinding. They are fitted with two plain glasses.

3.4 Deposited Metal (Added Metal)

a) *In Welding* — Filler metal after it becomes part of the weld

b) *In Bronze Welding or in Brazing* — Filler metal after it becomes part of the joint.

3.5 Deposition Efficiency — The ratio of the weight of deposited metal to the net weight of core wire of electrodes consumed, exclusive of stubs.

3.6 Electrode Holder — A device to hold an electrode and to convey current to it. It may be part of a welding machine, or a manual device held by an operator.

3.7 Face Mask — A protective device worn in front of the face to shield it from injury during welding. It is fitted with welding glass(es) and plain glass(es).

3.8 Face Shield (Hand Screen, Hand Shield) — A protective device held in the hand to shield the face and throat from injury during welding. It is fitted with a window consisting of welding glass and plain glass.

3.9 Faired (Tapered) Member — The thicker member of a joint tapered down to the thickness of the thinner member.

3.10 Filler Metal — Metal to be added in welding or brazing.

3.11 Fixed Shield — An independently mounted device to protect the whole of the face and throat from injury during welding. It is fitted with welding glass and plain glass.

3.12 Full Penetration — Welding, using a technique which ensures full penetration.

3.13 Flux — Fusible material used in welding or oxygen-cutting to dissolve and facilitate removal of oxides and other undesirable substances. Also commonly used to designate covering of covered electrodes.

3.14 Fusion Penetration

a) *In Fusion Welding* — The depth to which the parent metal has been fused.

b) *In Spot, Seam, or Projection Welding* — The distance from the interface to the edge of the weld nugget, measured in each case on a cross-section through the centre of the weld and normal to the surface (*see* Fig 3).

NOTE — ' Depth penetration ' is sometimes used as an alternative term in fusion welding, but ' fusion penetration ' is preferred.

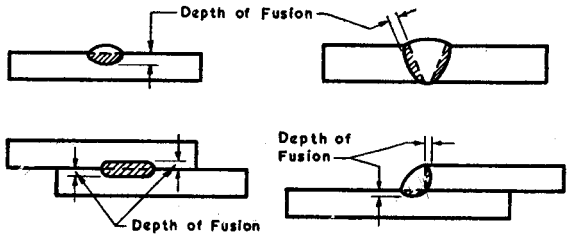


FIG 3 FUSION PENETRATION

3.15 Fusion Zone — The portion of a weld in which parent metal has been fused (*see* Fig 4).

3.16 Heat-Affected Zone — Parent metal metallurgically affected by the heat of welding (or cutting), but neither melted nor made plastic (*see* Fig 4).

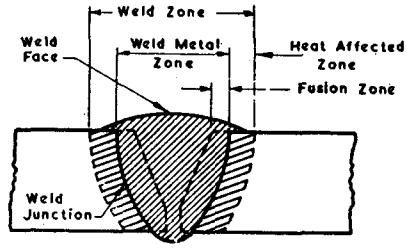


FIG 4 VARIOUS ZONES OF A TYPICAL WELD

3.17 Helmet (Head Screen) — A protective device supported on the head and arranged to shield the face and throat from injury during welding. It is fitted with a window consisting of welding glass and plain glass.

3.18 Ignition Powder — A readily ignitable mixture, usually of powdered aluminium and oxidizing material, used for initiating the reaction in thermit pressure welding and thermit fusion welding.

3.19 Longitudinal Axis of Weld — A line through the length of a weld, perpendicular to the cross-section at its centre of gravity (*see* Fig 5).

3.20 Melt Run — A line of parent metal which has been melted by passing a welding flame or arc along the surface of the plate.

3.21 Parent Metal (Base Metal) — The metal to be joined or cut.

3.22 Plain Glass (Cover Glass) — Clear glass or other transparent material used to protect the surface of welding glass.

3.23 Peening — The mechanical working of metals by means of hammer blows.

3.24 Penetration (Through) Pass — The first run of a multi-run butt weld, the penetration bead of which can be seen.

3.25 Residual Welding Stress — Stress remaining in a metal part or structure as a result of welding.

3.26 Strength Weld — A weld designed to be under stress.

3.27 Stress Relief Heat Treatment — Uniform heating of an assembly or portion thereof to a suitable temperature below the lower critical point for sufficient time to reduce the residual stresses followed by uniform cooling.

3.28 Stubs — Waste ends of electrodes and welding rods.

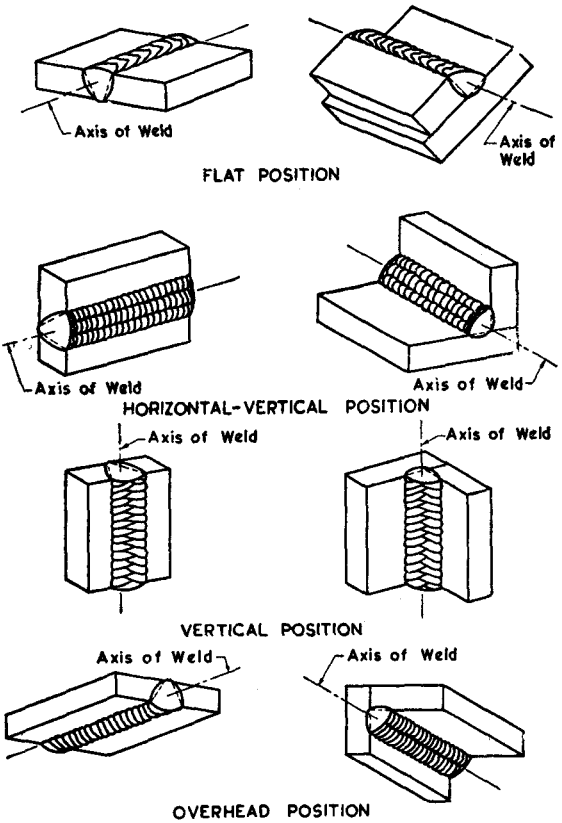


FIG 5 LONGITUDINAL AXIS OF WELDS

3.29 Surfacing — The deposition of filler metal by welding process on to a metal surface to obtain desired properties.

3.30 Weld — A union between two pieces of metal at faces rendered plastic or liquid by heat or by pressure, or both. Filler metal may be used to effect the union.

3.31 Weld Gauge — A device designed for checking the shape and size of welds (*see* Fig 6).

3.32 Weld Metal — All metal melted and/or made plastic in making a weld.

3.33 Weld-Metal Zone — The portion of a weld consisting of weld metal (*see* Fig 4).

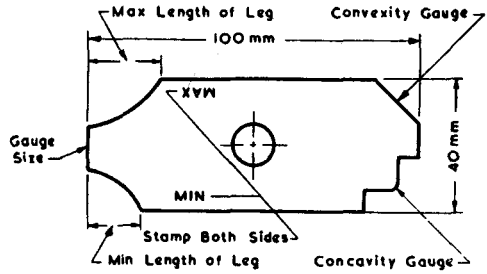


FIG 6 TYPE OF WELD GAUGE

3.34 Weld Width — Distance between the toes of the weld.

3.35 Weld Zone — The sum of the weld-metal zone and the heat-affected zone (*see* Fig 4).

3.36 Welded Joint — For the purposes of design calculations, a full strength butt joint is a joint produced by a fully penetrated weld or by fully penetrated welds between parts of equal section aligned and lying within the included angle of 135 to 180° in such a manner that the flow of normal stresses does not undergo any considerable deviation in the zone of the joint.

3.37 Welder — The operator who performs the welding operation.

NOTE — This term is often used in the United States of America to describe a welding machine.

3.38 Welder's Sleeve — Covering to protect the arm during welding.

3.39 Welder's Spats — Coverings to protect the upper part of the feet and ankles during welding.

3.40 Welding — The making of a weld.

3.41 Welding Apron — An apron, usually of leather or asbestos, used to protect the welder from harmful radiation and spatter.

3.42 Welding Glass (Filter Glass) — A light-filter to protect the eyes from harmful radiations emanating from an electric arc or a gas flame.

3.43 Welding Gloves — Gloves to protect the hands, or gauntlets to protect the hands and forearms, from heat and metal splashes due to welding.

3.44 Welding Goggles — Goggles with tinted lenses used during welding or oxygen cutting to shield eyes from injury during welding or cutting.

3.45 Welding Procedure — A specified course of action to be followed in welding, including a list of materials and tools to be used. Three typical examples of welding procedure are given under **3.45.1** to **3.45.3**

3.45.1 *Arc Welding*

a) Classification and size of electrodes,
b) Current and open-circuit voltage,
c) Length of run per electrode, or speed of travel,
d) Number and arrangement of runs in multi-run welds,
e) Position of welding,
f) Preparation and set-up of parts,
g) Welding sequence, and
h) Pre- or post-heating.

3.45.2 *Gas Welding*

a) Specification and diameter of filler rod and, if required, specification of the flux;
b) Gas pressures and nozzle size;
c) Manipulation and angles of rod and blowpipe and, if required, correct application of flux;
d) Technique of welding;
e) Edge preparation and, if required, tacking;
f) Position of welding and number of runs;
g) Welding sequence; and
h) Pre- or post-heating.

3.45.3 *Resistance Welding*

a) Electrodes sizes and permissible variations,
b) Particulars of machine settings,
c) Welding sequence, and
d) Particulars of tests required.

3.46 Welding Rod — Filler metal, in wire or rod form, used in gas welding and brazing processes, and those arc welding processes wherein the electrode does not furnish the filler metal.

3.47 Welding Sequence — The order and/or direction in which either welds or runs are made.

3.48 Welding Technique — The manner in which an operator manipulates an electrode, a blowpipe or the like.

3.49 Welding Thermit — A mixture of iron oxide, finely divided aluminium, steel and de-oxidizers. On ignition of the mixture, an exothermic reaction takes place, resulting in the production of molten metal which acts as a source of heat for the subsequent welding and also as added metal.

NOTE 1 — This is also known as ' standard welding thermit ' or (in the USA) as ' forging thermit ' to differentiate it from welding thermits containing other alloying metals or materials added for specific purposes.

NOTE 2 — ' Thermit ', as such, is a mixture of metallic oxides and finely divided aluminium, the heat from the chemical reaction between which produces molten metal. This material has no application in welding except as a source of heat.

PART II WELDING WITH PRESSURE

4. GENERAL TERMS

4.1 Faying Surface — That surface of a member which is in contact with another member to which it is to be joined.

4.2 Gather (Shortening) — The reduction in length accompanying the production of upset metal.

4.3 Initial Pressure — The first steady or peak pressure, normal to the surface contact area, applied during a welding cycle.

4.4 Interface — The contact area between faying surfaces.

4.5 Pressure Contact Area — The initial surface contact area of the components through which pressure is transmitted.

4.6 Sheet Separation — In spot, seam and projection welding, the gap surrounding the weld, between faying surfaces, after the joint has been welded.

4.7 Upset Metal — Parent metal proud of the normal surfaces of the work as a result of forging or pressing.

4.8 Upset Pressure — Pressure producing, or tending to produce, upset metal.

NOTE — Upset pressure may be expressed as force or as pressure per unit of pressure contact area.

4.9 Welding Pressure — The pressure, at the abutting surfaces of a workpiece, required to consolidate a weld.

NOTE — In the resistance welding, this is the electrode pressure less the pressure required to overcome rigidity of the workpiece when bringing the abutting surfaces into contact.

5. TERMS RELATING TO EQUIPMENT

5.1 Angle Electrode — An electrode in which the tip is not normal to the axis of the shank (*see* Fig 7).

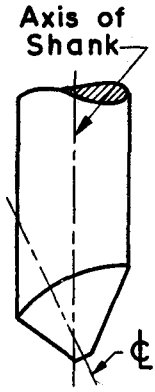


FIG 7 ANGLE ELECTRODE

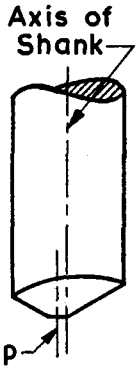


FIG 8 OFFSET ELECTRODE

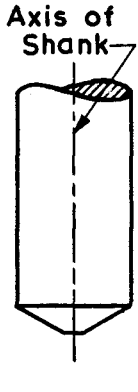


FIG 9 VERTICAL ELECTRODE

5.2 Arc Damper (Arc Blow Compensator) — A device for centralizing an arc in a stud welding tool.

5.3 Arm — A member of a welding machine which conducts current to an electrode holder, or supports a conductor conveying current to it; and which is required to withstand the welding pressure.

5.4 *Battery Spot-Welding Machine — A spot-welding machine in which a battery is used to provide the welding current.

5.5 Bolster – An electrode holder intended for mounting on the platen of a projection-welding machine.

5.6 Burner — A multi-jet blowpipe used to supply the heat for oxy-acetylene pressure welding.

NOTE — Burners are usually shaped to the section of the parts joined and may be split to facilitate removal. They are sometimes water-cooled. The term is sometimes erroneously applied to operatives.

5.7 *Condenser-Discharge Spot-Welding Machine (Capacitor Spot-Welding Machine) — A spot-welding machine in which a large momentary current is obtained in the secondary circuit by discharging a capacitor through the primary circuit.

*These machines are sometimes referred to as ' stored energy machines '.

5.8 Electrode Shank — The portion of an electrode intended to be held by, and to make electrical contact with, an electrode holder.

5.9 Electrode Tip — The portion of an electrode for spot or for stitch welding intended to make contact with the workpiece.

5.10 Electrode Wheel — A rotatable electrode of disk form.

5.11 Ferrule — A collar or ring of refractory material, surrounding the base of the stud during stud welding, to protect and contain the molten metal and, where required, to shape the weld fillet.

5.12 Foot-Operated Welding Machine (Pedal-Operated Welding Machine)— A welding machine in which mechanical pressure is applied by means of a pedal.

5.13 Gun Welding Machine — A portable spot-welding machine having a single electrode through which manual pressure is applied directly to one component of the workpiece; the electrical circuit is completed through a cable connection to the other component of the workpiece.

5.14 Hand-Operated Welding Machine — A welding machine (usually for flash welding) the operation of which is controlled by hand.

5.15 *Inductor Spot-Welding Machine — A spot-welding machine in which a large momentary current is obtained in the secondary circuit by interrupting a direct current in the primary circuit.

5.16 Insert — A small piece of metal, usually hard wearing and/or of comparatively high resistivity, used as an electrode tip or attached to a welding die and projecting sufficiently beyond it to make contact with the workpiece where welding is required.

5.17 Motor-Operated Welding Machine — A welding machine in which the travel of the electrodes is obtained, and the mechanical pressure is applied, by means of a motor-driven mechanism.

5.18 Offset Electrode — An electrode in which the centre of the electrode tip is offset from the axis of the electrode shank (*see* Fig 8).

5.19 Pad Electrode (Flat Electrode)— An electrode in which the electrode tip is larger than the weld required, the size of the weld being controlled by the diameter of the other electrode tip.

5.20 Platen — Part of a resistance-welding machine on which welding dies are mounted and which conveys pressure and welding current to them.

NOTE — Use of platens is generally confined to projection-welding, flash-welding and butt-welding machines.

*These machines are sometimes referred to as ' stored energy machines '.

5.21 Plier Spot-Welding Machine (Pincer Spot-Welding Machine) — A portable spot-welding machine in which pressure is applied to the electrodes by means of a lever system similar to that of pincers.

5.22 Portable-Spot Welding Machine — A spot-welding machine in which the electrodes, the moving arms and the pressure application device are connected flexibly to the transformer and control gear so as to provide a limited amount of portability.

5.23 Power-Operated Welding Machine — A welding machine in which mechanical pressure is applied pneumatically or hydraulically.

5.24 Resistance-Welding Electrode (Electrode) — A replaceable portion of a resistance-welding machine which transmits current, and usually applies pressure, to the workpiece.

5.25 Stud Welding Tool (Stud Welding Gun) — An appliance for holding and operating the stud during stud welding, and for conveying pressure and current to it during the weld cycle.

5.26 Vertical Electrode — An electrode in which the electrode tip is normal to the axis of the electrode shank (*see* Fig 9).

5.27 Welding Dies — A member usually shaped to the work contour to clamp the parts being welded and conduct the welding current.

6. TERMS RELATING TO FORGE WELDING

6.1 Blacksmith Welding — A group of welding processes wherein weld is produced by heating in a forge or other furnace and by applying pressure by manual hammering.

6.2 Double-Glut Butt Joint — A butt joint incorporating two wedge-shaped gluts (*see* Fig 10).

6.3 Forge Welding (Fire Welding) — Any welding process in which the weld is made by hammering or other impulsive pressure while the surfaces to be united are plastic.

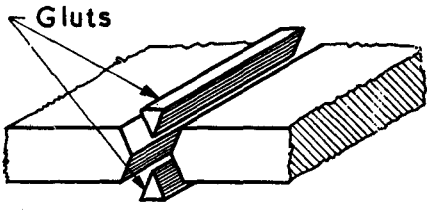


FIG 10 DOUBLE-GLUT BUTT JOINT (BEFORE FORGING)

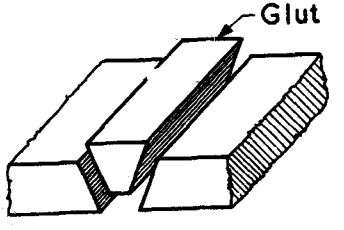


FIG 11 SINGLE-GLUT BUTT JOINT (BEFORE FORGING)

6.4 Glut — Metal, usually in the form of a bar, added during blacksmith welding to facilitate the making of a joint (*see* Fig 10, 11 *and* 12).

6.5 Hammer Welding — Forge welding in which weld is produced by heating in a forge or other furnace and by applying pressure mechanically.

6.6 Plain Butt Joint (Jumped Joint) — A butt joint in which the ends to be welded are usually upset before welding, i.e. their area is increased by hammering (*see* Fig 13).

6.7 Roll Welding — Forge welding in which weld is produced by heating in a forge or other furnace and by applying pressure progressively by mechanically operated rolls.

6.8 Scarf Joint — A joint in which the weld lies at an angle to the axis of the parts joined (*see* Fig 14).

6.9 Single-Glut Butt Joint — A butt joint incorporating a blunt-wedge-shaped glut (*see* Fig 11).

6.10 Split Joint — A double scarf joint in which the tapered end of each part to be joined is split longitudinally into two halves which are bent in opposite directions, so that the parts to be joined can be interlocked to prevent lateral motion during welding (*see* Fig 15).

6.11 Square Corner Joint — A corner joint incorporating a glut (*see* Fig 12).

6.12 Tee Butt Joint — A tee-joint in which the end of the stalk of the tee is upset before welding (*see* Fig 16).

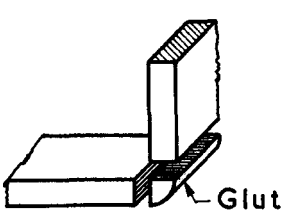


FIG 12 SQUARE CORNER JOINT
(BEFORE FORGING)

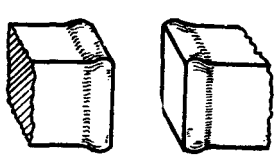


FIG 13 PLAIN BUTT JOINT
(BEFORE FORGING)

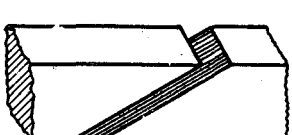


FIG 14 SCARF JOINT
(BEFORE FORGING)

FIG 15 SPLIT JOINT
(BEFORE FORGING)

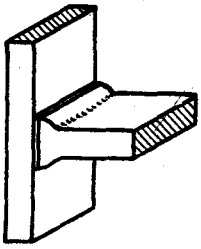


FIG 16 TEE BUTT JOINT
(BEFORE FORGING)

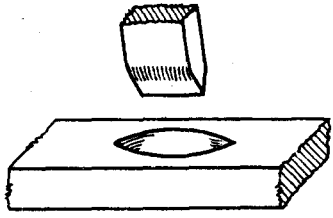


FIG 17 TEE SPLIT JOINT
(BEFORE FORGING)

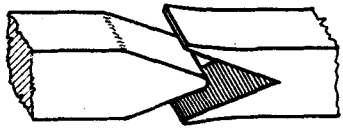


FIG 18 VEE JOINT (BEFORE FORGING)

6.13 Tee Split Joint — A tee-joint in which the end of the stalk of the tee is tapered and welded within a split formed in the table of the tee (*see* Fig 17).

6.14 Vee Joint — A double scarf joint formed between a wedge on the end of one part to be joined and a vee notch in the end of the other (*see* Fig 18).

7. TERMS RELATING TO PRESSURE-WELDING

7.1 Cold Welding (Press Welding)— Pressure-welding in which pressure alone is used.

7.2 Constant-Pressure Pressure-Welding — Pressure-welding in which gather occurs during the period of increasing temperature at a constant pressure.

7.3 Constant-Temperature Pressure-Welding — Pressure-welding in which gather occurs during the application of suddenly increased pressure at a substantially constant temperature.

7.4 Deformation — The local percentage reduction in the total thickness of sheets or plates at a pressure-welded lap joint.

7.5 Heated-Die Welding — Pressure-welding in which the surfaces to be united are made plastic by heat transferred from heated press tools of suitable shape. Such tools are known as ' dies '.

7.6 Heating Time — In pressure-welding, the time, if any, during which the parts to be joined are held together whilst being heated under reduced pressure until welding temperature is reached.

7.7 Oxy-Acetylene Pressure-Welding — Pressure-welding in which an oxy-acetylene flame is used to make plastic the surfaces to be united. No filler metal is used.

7.8 Pressure-Welding (Solid-Phase Welding) — Any welding process in which the weld is made by sustained pressure while the surfaces to be united are plastic.

7.9 Welding Time — In pressure-welding, the time during which the parts to be joined are maintained at welding temperature under full welding pressure.

8. TERMS RELATING TO RESISTANCE WELDING

8.1 Back Pressure — The pressure or the force (a) tending to separate the electrodes, or (b) in a dual-pressure cycle, reducing the electrode pressure by acting in opposition to the forward pressure.

NOTE — Back pressure may or may not be present under (a) during the making of a weld depending on the type of machine.

8.2 Butt-Seam Welding — A modification of seam welding, used for making butt welds, in which the electrode wheels rotate continuously but do not apply the welding pressure.

8.3 *Chill Time — The period of time between the end of welding current and the start of post-heat current.

8.4 *Cool Time (Off-Time) — In pulsation and seam welding, the period of time between two successive heat times in the same weld cycle.

8.5 Cross-Wire Weld — A resistance weld at the point of contact between crossed wires or rods with pressure applied continuously.

8.6 *Current-Off Time — The period of time between the cessation of current in one weld cycle and the beginning of current in the next.

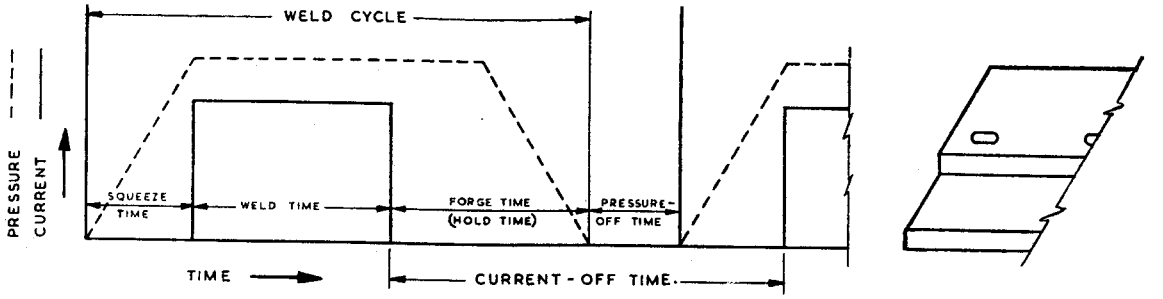
8.7 Cycle — An arbitrary unit of time, of duration equal to that of one cycle of the alternating current supply.

NOTE — The term as here defined is used in a sense different from that in the definitions under **8.8** and **8.9**.

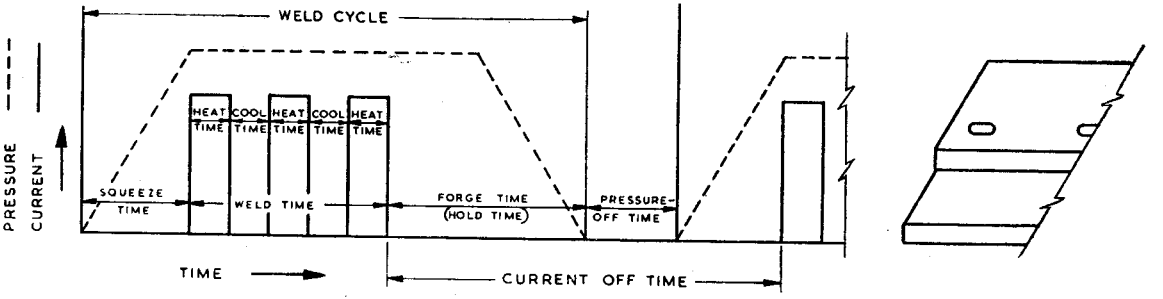
8.8 Dual-Pressure Cycle — A cyclic alternation, during a weld cycle, of two different predetermined electrode pressures.

---

*For diagrammatic representation, *see* Fig 19 to 23.

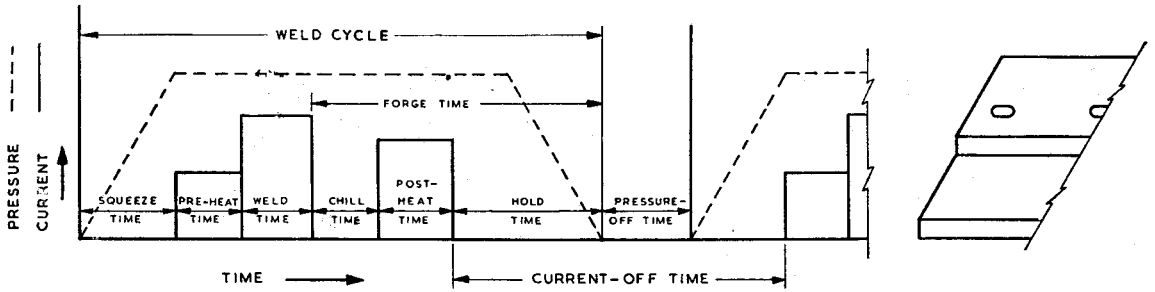


Simple Spot Stitch Or Projection Welding

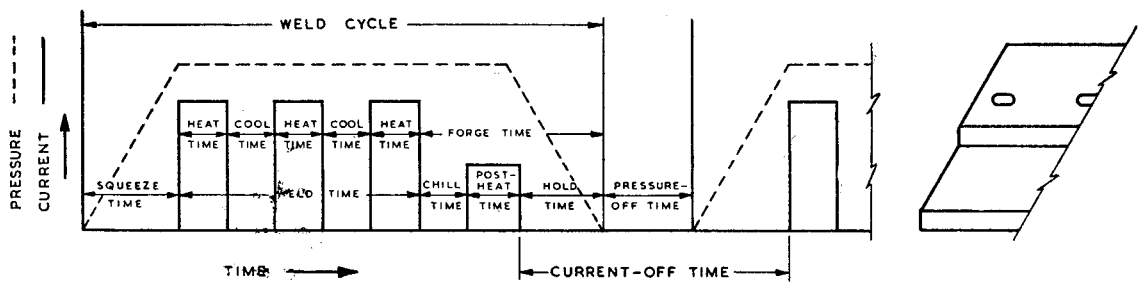


Pulsation Spot Or Projection Welding

FIG 19 TIME AND PRESSURE DIAGRAMS FOR SIMPLE FORMS OF RESISTANCE WELDING



Spot Or Projection Welding, Programme Control



Pulsation Spot Or Projection Welding, Programme Control

FIG 20 TIME AND PRESSURE DIAGRAMS FOR FORMS OF RESISTANCE WELDING WITH PROGRAMME CONTROL

8.9 Duty Cycle — The percentage ratio of duration of current flow during a period to the period.

8.10 Edge Distance — The distance between the toe of the weld and the nearest edge of the workpiece.

8.11 Electrode Contact Area (Clamp Contact Area)— The area through which current passes from an electrode or a clamp to the workpiece.

8.12 Electrode Pressure — The pressure transmitted by the electrodes to the workpiece.

NOTE — This is the forward pressure less any back pressure.

8.13 Fin (Flash)— An extrusion of metal extending outward beyond the upset in the form of a fin.

8.14 Flash Welding (Flash-Butt Welding)— A resistance-welding process wherein coalescence is produced, simultaneously over the entire area of abutting surfaces, by the heat obtained from resistance to the flow of electric current between the two surfaces, and by the application of pressure after heating is substantially completed. Flashing and upsetting are accompanied by expulsion of metal from the joint.

8.15 Flashing Allowance (Burn Off)— In making a flash weld, the length allowed for the total shortening of both components due to flashing.

8.16 Flashing Current — The current flowing during flashing time.

8.17 *Flashing Time — The period in flash welding from the start of continuous flashing to the time when upset pressure is applied.

8.18 *Forge Time — The period of time between the cessation of welding current and the end of the weld cycle.

8.19 Forward Pressure — The pressure or the force required to move the electrodes towards each other and to keep them in contact with the workpiece.

NOTE — Forward pressure is the sum of the pressures required (a) to overcome any back pressure, (b) to overcome friction and inertia, and (c) to provide electrode pressure.

8.20 *Heat Time (On-Time)— The duration of each successive welding current impulse during either pulsation or seam welding.

8.21 *Hold Time — In spot and projection welding, the time during which force is applied at the point of welding after the last impulse of current ceases to flow.

In seam, flash and upset welding, the time during which force is applied to the work after current ceases to flow.

*For diagrammatic representation, *see* Fig 19 to 23.

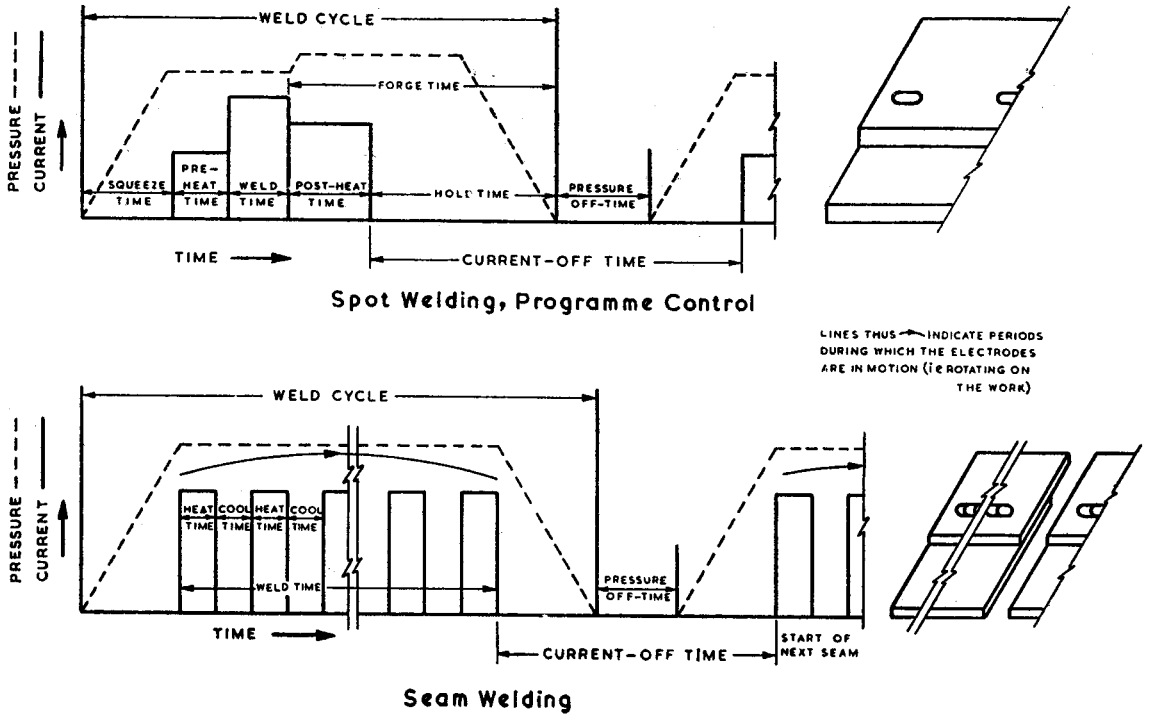


FIG 21 TIME AND PRESSURE DIAGRAMS FOR SPOT WELDING (PROGRAMME CONTROL) AND SEAM WELDING

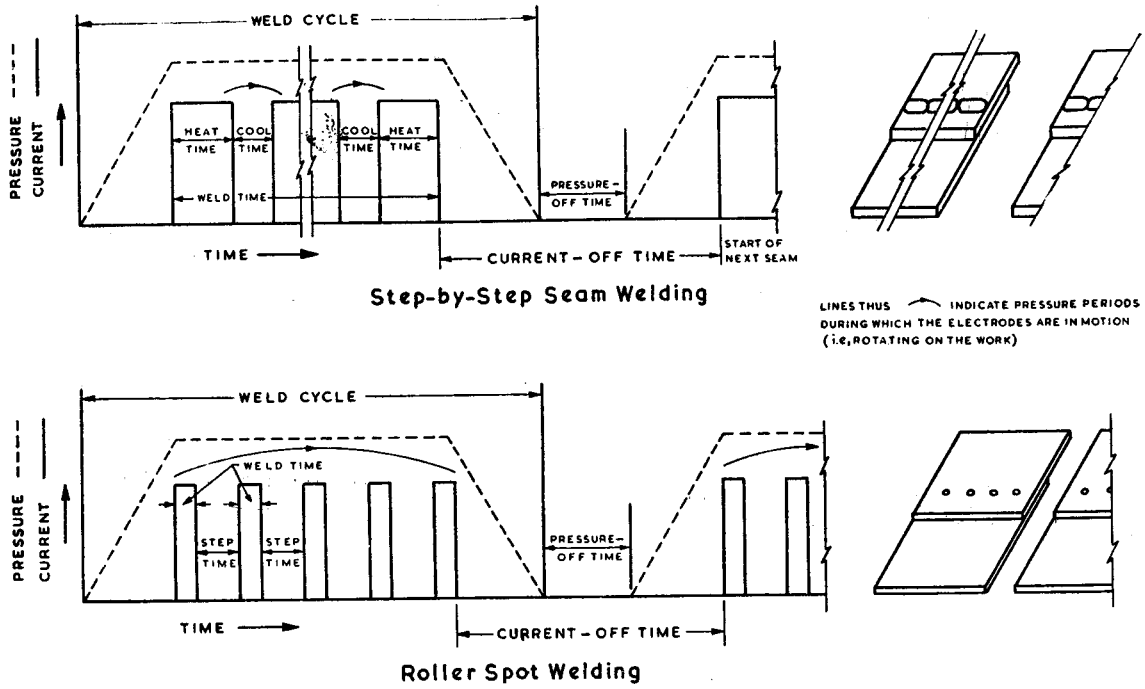


FIG 22 TIME AND PRESSURE DIAGRAMS FOR STEP-BY-STEP SEAM WELDING AND ROLLER SPOT WELDING

8.22 Machine Stroke — The maximum operational stroke obtainable.

8.23 Mash Weld — A seam or stitch weld, between two components of equal thickness with a small amount of overlap, so made that the ultimate thickness of the workpiece at the weld approximates to that of a component.

8.24 Multiple-Spot Welding — Spot welding in which, by the use of more than two electrodes, two or more welds are made simultaneously or in an automatically-controlled sequence.

8.25 Operational Stroke — The distance through which the electrode(s) may travel from rest to the final position during welding.

8.26 Percussion Welding — A resistance-welding process wherein weld is produced, simultaneously over the entire area of abutting surfaces, by the heat obtained from an arc produced by a rapid discharge of stored electrical energy, with impact pressure applied during or immediately following the electrical discharge.

8.27 Pick-Up — Particles of the surface of the workpiece which adhere to the surface of the electrodes, or *vice versa*. (For definition of the term applicable to gas welding, *see* **14.13**.)

8.28 *Post-Heat Time — The time during which a completed weld is heated by current for metallurgical reasons.

8.29 *Pre-Heat Time — The time during which pre-heating current flows. In flash welding, it is the time between the first passage of current and the start of continuous flashing.

8.30 Pre-Heating Current — Current used to raise gradually the temperature of a workpiece from ambient temperature to a pre-determined value below welding temperature just before the application of welding current.

8.31 *Pressure-Off Time — The period of time between two successive weld cycles.

8.32 Programme Control — A pre-determined automatic sequence of operations within a weld cycle.

8.33 Projection Welding — Resistance welding in which throughout the making of a weld the pressure is applied at a small projection or projections on one or more of the workpieces. The projections collapse during welding.

8.34 Pulsation Welding (Woodpecker Welding) — Spot or projection welding in which the welding current is interrupted one or more times without release of pressure or change of location of the electrodes.

*For diagrammatic representation, *see* Fig 19 to 23.

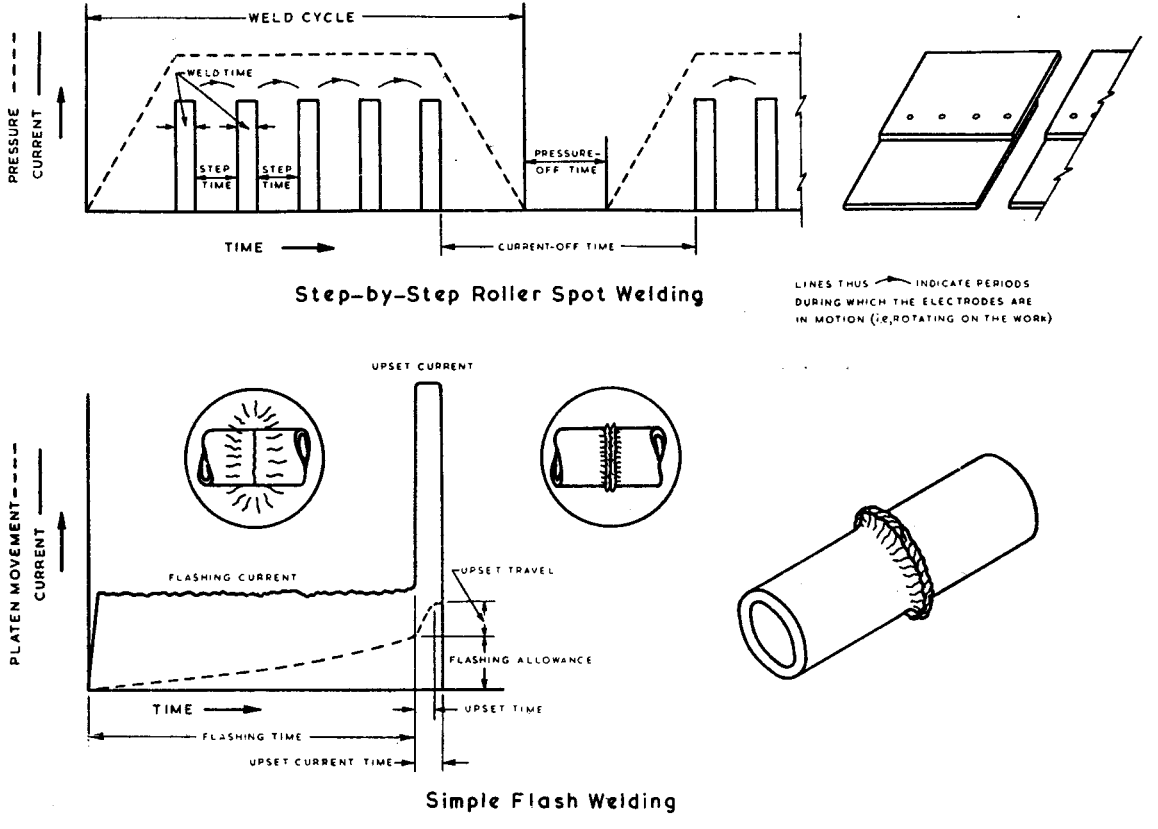


FIG 23 TIME AND PRESSURE DIAGRAMS FOR STEP-BY-STEP ROLLER SPOT WELDING AND SIMPLE FLASH WELDING

8.35 Resistance Welding (Upset Welding) — Welding in which pressure is applied between abutting surfaces at some stage in the process, and in which welding heat is produced by the electrical resistance at, and adjacent to, these surfaces during the passage of an electric current.

8.36 Resistance-Butt Welding — A resistance-welding process wherein weld is produced, simultaneously over the entire area of abutting surfaces or progressively along a joint, by the heat obtained from resistance to the flow of electric current through the area of contact of those surfaces. Pressure is applied before heating is started and is maintained throughout the heating period.

8.37 Roller-Spot Welding — Resistance welding in which pressure is applied continuously, and current impulsively, to produce a series of intermittent linear welds, the workpiece being between two electrode wheels or between an electrode wheel and an electrode bar. The electrode wheels apply the pressure, and may be rotated continuously or stopped during the passage of current.

8.38 Seam Welding — Resistance welding in which pressure is applied continuously, and current impulsively, to produce a linear weld, the workpiece being between two electrode wheels, or between an electrode wheel and an electrode bar. The electrode wheels apply the pressure, and may be rotated continuously or stopped during the passage of current.

8.39 Series-Spot Welding — Spot welding in which two or more welds are made simultaneously in electrical series (*see* Fig 24).

8.40 Spot Welding — A resistance-welding process wherein weld is produced by the heat obtained from resistance to the flow of electric current through the work parts held together under pressure by electrodes. The size and shape of the individually formed welds are limited primarily by the size and contour of the electrodes.

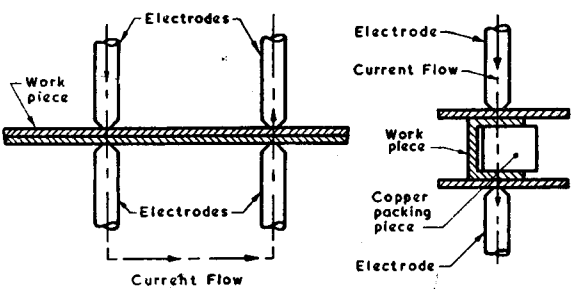


FIG 24 EXAMPLES OF SERIES-SPOT WELDING

8.41 *Squeeze Time — The period of time between the application of pressure by electrodes to the workpiece and the first passage of current.

8.42 *Step Time — The time between successive weld times in roller-spot welding and in step-by-step roller-spot welding.

8.43 Step-By-Step Welding — Seam or roller-spot welding in which the electrode wheel is stationary during the passage of current and rotates when no current is flowing.

8.44 Stitch Welding — Spot welding in which successive welds overlap.

8.45 Throat Depth (Throat) — In a resistance-welding machine, the distance from the centre-line of the electrodes or platens to the nearest point of interference for flatwork or sheets. In the case of a seam-welding machine with a universal head, the throat depth is measured with the machine arranged for transverse welding.

8.46 Throat Gap — The minimum unobstructed distance between the arms of a welding machine.

8.47 Total Allowance — In resistance-butt welding, the upset allowance. In flash welding, the sum of the flashing and upset allowances.

8.48 Tread — The peripheral surface of an electrode wheel.

8.49 Upset Allowance — The length allowed for the total shortening of both components due to upset.

8.50 Upset Current Time — The duration of current from the commencement of upset travel.

8.51 *Upset Time — The duration of upset travel.

8.52 Upset Travel — The distance travelled by the moving head of a resistance-butt or flash welding machine in forging a weld. In resistance-butt welding, it is the travel from the point where the components are first brought together to the position where the weld is completed. In flash welding, it is the travel from the point where the components have been brought together at the end of flashing to the position where the weld is completed.

8.53 Wearing Depth — The distance between the tip of an electrode, or the tread of an electrode wheel, and that part at which further use becomes impracticable.

8.54 Weld Contact Area — The area through which welding current passes from one component to another during resistance welding.

8.55 *Weld Cycle — The time required for one complete welding operation.

*For diagrammatic representation, *see* Fig 19 to 23.

8.56 Weld Nugget — The fusion zone of a spot, projection or seam weld (*see* Fig 25).

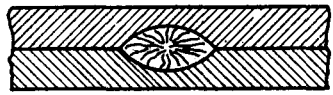


FIG 25 WELD NUGGET

8.57 Welding Current — The current flowing through the welding circuit during the making of a weld. In resistance welding, the current used during preweld or postweld intervals is excluded.

8.58 *Weld Time — The total time between the start of welding current and the end of the welding current during the making of one weld.

NOTE — A seam weld is considered to be one weld.

9. TERMS RELATING TO STUD WELDING

9.1 Lift — The distance, if any, by which the stud is retracted, where necessary, from the parent metal in order to initiate the arc in stud welding.

9.2 Stud Welding — Welding in which fusion is effected by the heat of an arc between one end of a stud and a parent metal surface, and consolidation by the application of pressure.

10. TERMS RELATING TO THERMIT PRESSURE WELDING

10.1 Thermit Combined Weld — A weld used for joining rails. The heads of the rails are joined by thermit pressure welding, with or without the interposition of a shim of suitable metal, and the feet and webs of the rails are joined simultaneously by thermit fusion welding.

10.2 Thermit Crucible — The vessel in which the thermit reaction takes place in thermit pressure welding and in thermit fusion welding. It has a hole in the bottom through which the molten metal passes (*see* Fig 26).

10.3 Thermit Pressure Welding — A welding process in which the parts to be joined, when in contact, are heated by means of ignited welding thermit and are then pressed together to form a weld.

---

*For diagrammatic representation, *see* Fig 19 to 23.

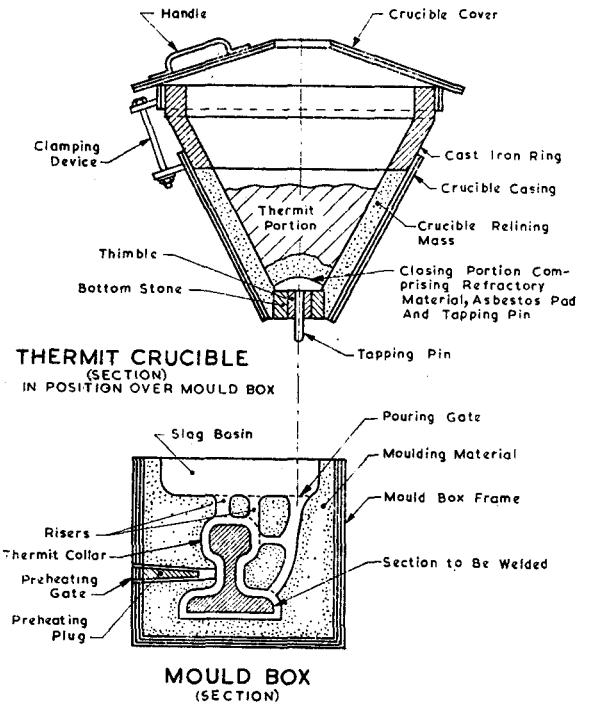


FIG 26 SET UP OF APPARATUS FOR A THERMIT FORM OF WELD

PART III FUSION WELDING (WELDING WITHOUT PRESSURE)

11. GENERAL TERMS

11.1 Angle of Bevel — The angle at which the edge of a component is bevelled in preparation for making a butt weld. The angle should be measured as shown in Fig 27 and 28.

11.2 Automatic Welding — Fusion welding in which control of the welding operation is predominantly automatic

11.3 Back-Step Sequence — A longitudinal sequence wherein the weld bead increments are deposited in the direction opposite to the progress of welding the joint (*see* Fig 29). (*See* also block sequence.)

11.4 Back Weld — A weld deposited at the back of a single-butt weld after the main weld (*see* Fig 30).

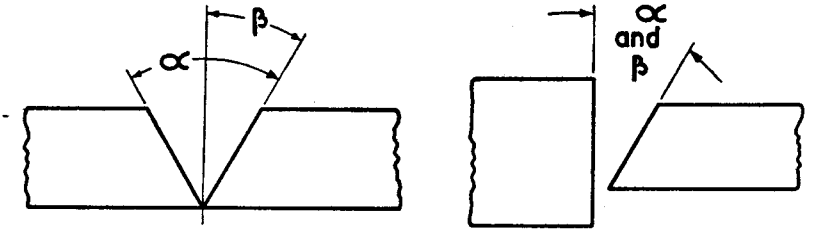


FIG 27 EXAMPLES OF INCLUDED ANGLE AND ANGLE OF BEVEL

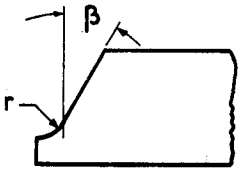


FIG 28 ROOT RADIUS (r) AND ANGLE OF BEVEL (β)

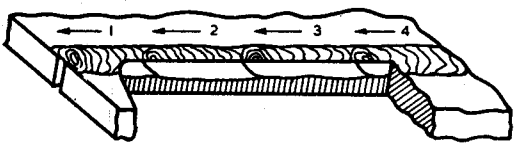


FIG 29 BACK-STEP SEQUENCE

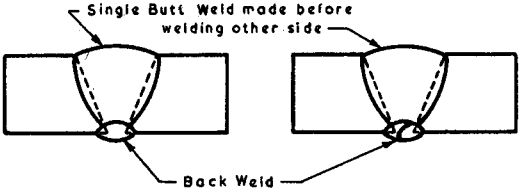


FIG 30 BACK WELDS

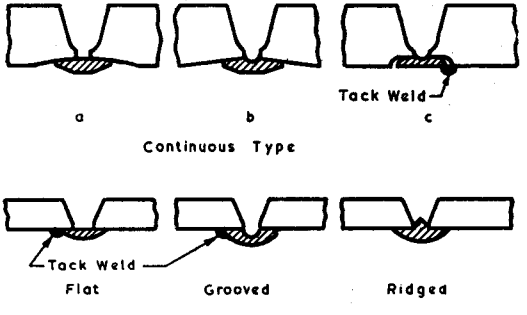


FIG 31 TYPICAL BACKING RINGS

11.5 Backing Ring — Backing in the form of a ring generally used in the welding of piping (*see* Fig 31).

11.6 Backing Strip — A piece of metal placed at a root and penetrated by weld metal. It may remain as part of the joint or may be removed by machining or other means (*see* **13.6** *and* Fig 32).

11.7 Balanced Welding — A welding procedure such that deformation due to shrinkage on cooling is controlled by proper disposal and sequence of welds.

11.8 Block Sequence — A combined longitudinal and build-up sequence for a continuous multiple-pass weld wherein separated lengths are completely or partially built up in cross-section before intervening lengths are deposited. (*See* back-step sequence *and see* Fig 33.)

11.9 Bead — A single run of weld metal deposited on a surface (*see* Fig 34).

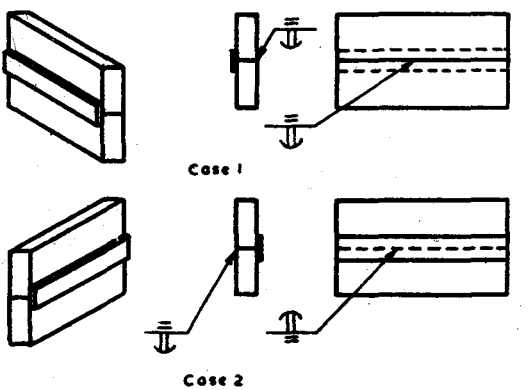


FIG 32 BACKING STRIP

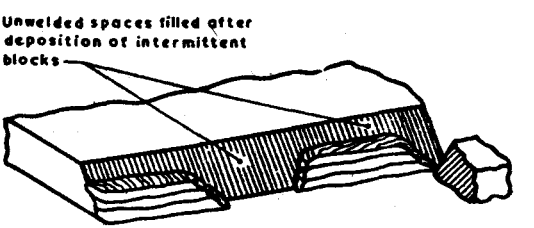


FIG 33 BLOCK SEQUENCE

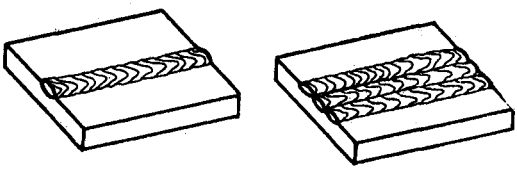


FIG 34 BEAD WELDS

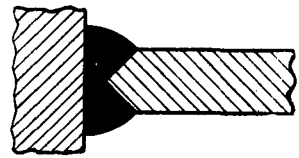


FIG 35 DOUBLE-BEVEL BUTT WELD

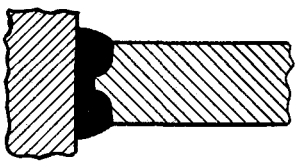


FIG 36 DOUBLE-J BUTT WELD

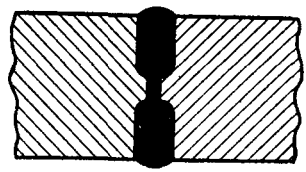


FIG 37 DOUBLE-U BUTT WELD

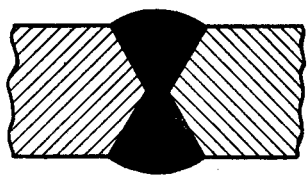


FIG 38 DOUBLE-V BUTT WELD

11.10 Close Joint — A preparation in which the components to be joined are substantially in contact before welding.

11.11 Composite Joint — A joint wherein welding is used in conjunction with a mechanical joining process.

11.12 Concave Fillet Weld — A fillet weld in which the weld face is concave.

11.13 Continuous Weld — Welding where the continuity is not broken by recurring unwelded spaces.

11.14 Convex Fillet Weld — A fillet weld in which the weld face is convex.

11.15 Convexity — The maximum distance from the face of a convex fillet weld perpendicular to a line joining the toes.

11.16 Double-Bevel Butt Weld — A butt weld in the preparation of which the edge of one component is double bevelled and the fusion face of the other component is at right angles to the surfaces of the first component (*see* Fig 35).

11.17 Double-J Butt Weld — A butt weld in the preparation of which the edge of one component is prepared so that in cross-section the fusion face is in the form of two opposing J's and the fusion face of the other component is at right angles to the surfaces of the first component (*see* Fig 36).

NOTE — All preparations covered by terms defined under **11.16**, **11.19**, **11.55** and **11.58** may or may not have root faces. Those covered by definitions under **11.17**, **11.18**, **11.56** and **11.57** always have root faces.

11.18 Double-U Butt Weld — A butt weld in the preparation of which the edges of both components are prepared so that in cross-section the fusion faces form two opposing U's having a common base (*see* Fig 37).

11.19 Double-V Butt Weld — A butt weld in the preparation of which the edges of both components are double bevelled so that in cross-section the fusion faces form two opposing V's (*see* Fig 38).

11.20 Downhand Position (Flat Position) — A position in which the weld slope does not exceed 10° and the weld rotation does not exceed 10° (*see* Fig 39).

11.21 Edge Preparation — Squaring, grooving or bevelling an edge in preparation for fusion welding (*see* Fig 40).

11.22 Edge Weld — A weld used for joining two or more components in which the edges joined are substantially in the same plane and in which the weld metal covers a part or all of the edges joined and lies substantially outside their plane (*see* Fig 41).

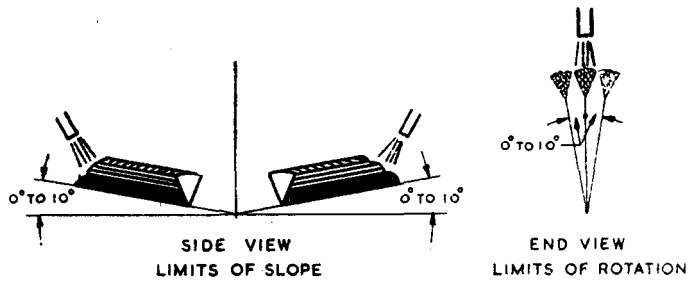


FIG 39 DOWNHAND (FLAT) POSITION

FIG 40 EXAMPLES OF EDGE PREPARATION

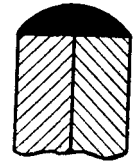


FIG 41 EDGE WELD

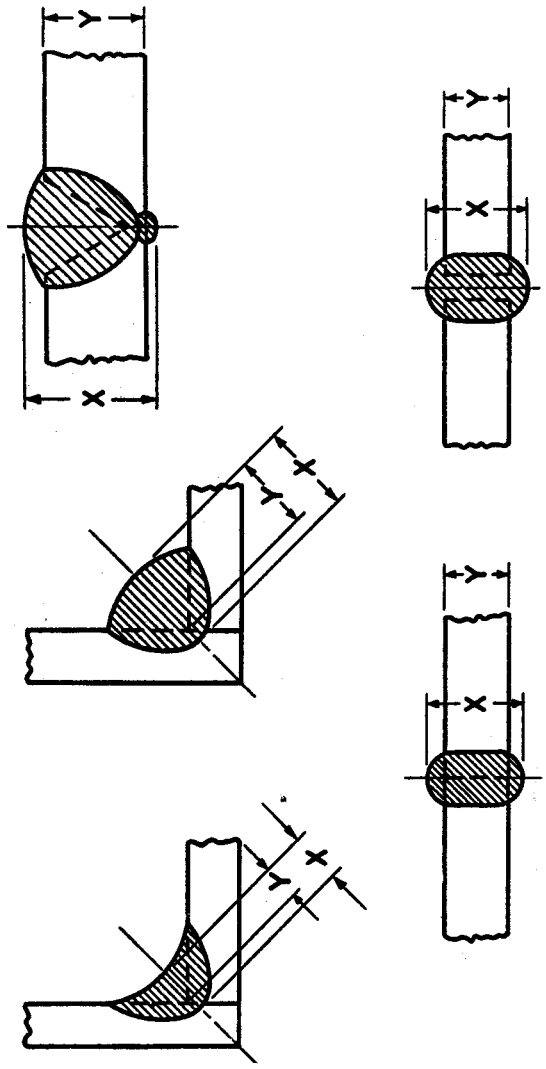


FIG 42 EXAMPLES OF THROAT THICKNESS

11.23 Effective Length of Weld — The length of weld throughout which the correctly proportioned cross-section exists.

11.24 Effective Throat Thickness — A dimension arbitrarily adopted as throat thickness for purposes of design (*see* Fig 42).

11.25 Full Fillet Weld — A fillet weld whose size is equal to the thickness of the thinner member joined.

11.26 Fillet Weld — A weld of approximately triangular cross-section joining two surfaces approximately at right angles to each other in a lap joint, tee joint or corner joint (*see* Fig 43 *and* 44).

11.27 Fusion Face — The portion of a surface, or of an edge, which is to be fused in making a fusion weld (*see* Fig 45).

11.28 Fusion Welding — Any welding process in which the weld is made between metals in a state of fusion without hammering or pressure.

11.29 Gap — The minimum distance, intentional or otherwise, at any cross-section between edges, ends or surfaces to be joined (*see* Fig 46).

11.30 Gas Envelope

a) *In Atomic Hydrogen Welding* — An envelope of gas surrounding an arc fan.

b) *In Gas Welding* — An envelope of gas surrounding an inner cone.

c) *In Inert Gas or Other Types of Arc Welding* — An envelope of gas surrounding an arc.

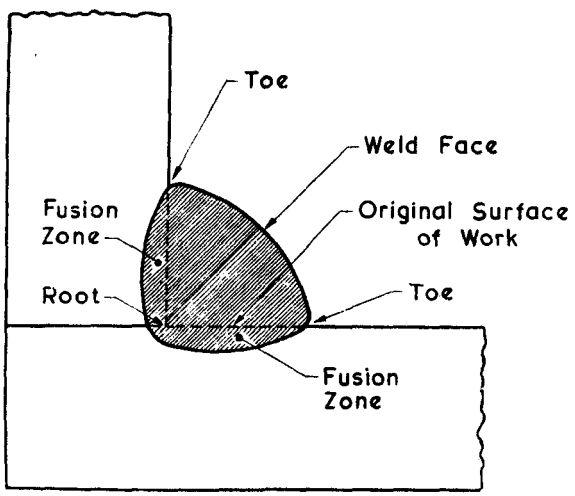


FIG 43 FILLET WELD

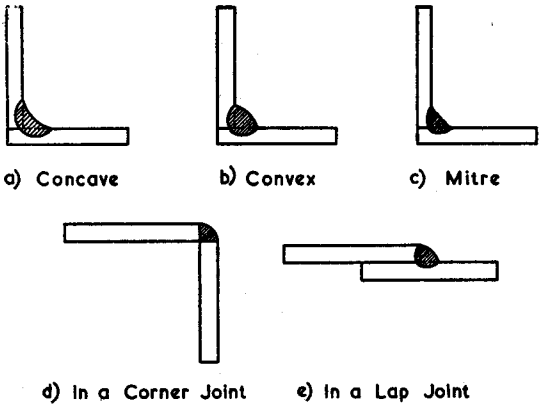


FIG 44 EXAMPLES OF FILLET WELDS

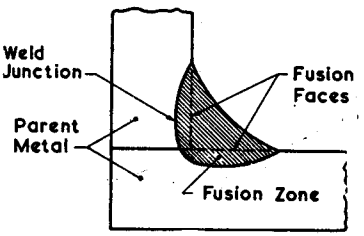


FIG 45 FUSION FACE

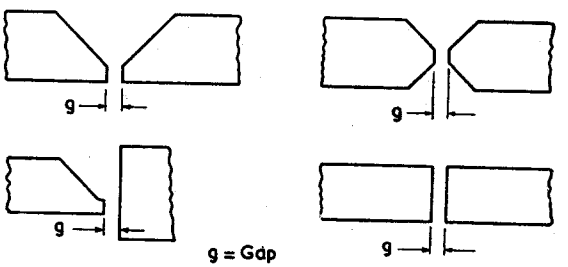


FIG 46 EXAMPLES OF GAP

11.31 Horizontal-Vertical Position — A position in which the weld slope does not exceed 10° and the weld rotation is greater than 10°, but does not exceed 90° (*see* Fig 47).

NOTE — The terms 'horizontal-vertical overhand weld' and 'horizontal-vertical underhand weld' are sometimes erroneously used to describe the welds shown respectively in Fig 47A and 47B. In the United States, the horizontal-vertical position is designated as the horizontal position.

11.32 Inclined Position — A position in which the weld slope exceeds 10° but not 45° and in which the weld rotation does not exceed 90° (*see* Fig 48).

11.33 Included Angle — The angle between the planes of the fusion faces of parts to be welded (*see* Fig 27).

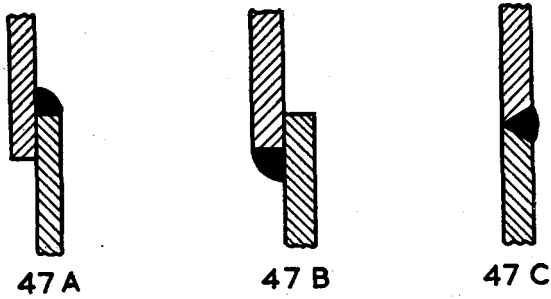


FIG 47 HORIZONTAL-VERTICAL POSITION

NOTE — The correct terms to be used for Fig 47A and Fig 47B are respectively 'horizontal-vertical fillet weld' and 'overhead fillet weld'. Figure 47C shows a 'horizontal-vertical butt weld'.

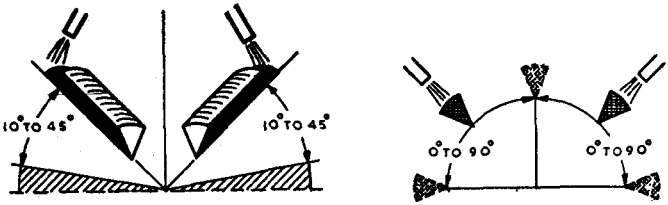


FIG 48 INCLINED POSITION

11.34 Intermittent Weld — Welding with a series of welds at specified intervals along a joint (*see* Fig 49).

11.35 Leg — A fusion face in a fillet weld (*see* Fig 50).

11.36 Leg Length — The distance from the root to the toe of a fillet weld, measured along the fusion face (*see* Fig 50).

11.37 Manual Welding — Fusion welding in which the welding device is held and manipulated by hand.

11.38 Mitre Fillet Weld (Flat Face Fillet Weld) — A fillet weld in which the weld face is approximately flat.

11.39 Molten Pool — The pool of liquid metal caused by the arc or flame.

11.40 Open Joint — A preparation in which the components to be joined are separated by a specified gap before welding.

11.41 Overhead Position — A position in which the weld slope does not exceed 45° and the weld rotation is greater than 90° (*see* Fig 51).

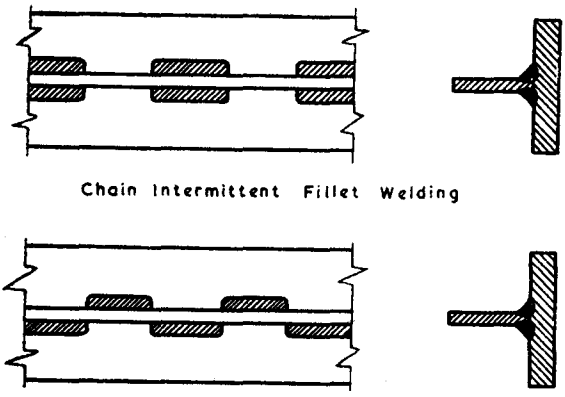


FIG 49 INTERMITTENT WELD

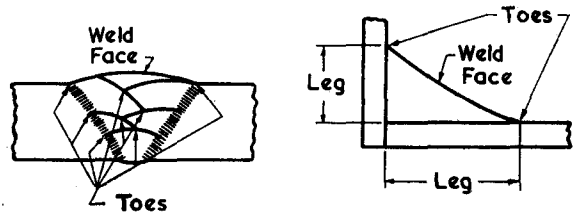


FIG 50 EXAMPLES OF WELD FACES, TOES AND LEGS

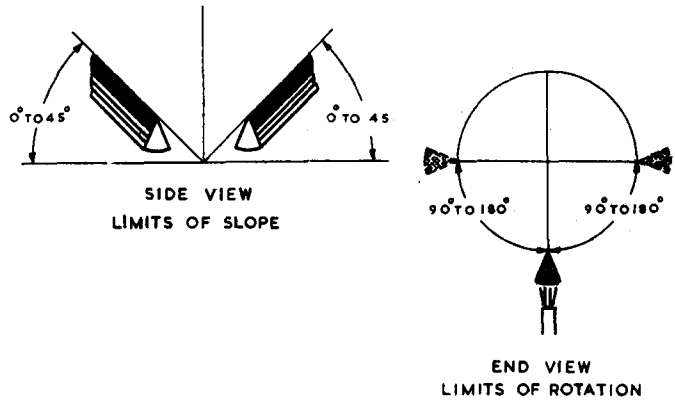


FIG 51 OVERHEAD POSITION

11.42 Penetration Bead — Metal protruding through the root of a fusion butt weld (*see* Fig 52).

11.43 Plug Weld — A weld made by filling a hole in one component of a workpiece with filler metal so as to join it to the surface of a contiguous component exposed through the hole (*see* Fig 53).

11.44 Reinforcement — Weld metal lying outside the plane joining the toes (*see* Fig 54).

11.45 Root of Preparation

a) *In the Preparation of V-, U-, J- and Bevel-Butt Welds* — The zone in the neighbourhood of, and including, the gap.

b) *In an Open Square Butt Weld* — The zone between the prepared edges adjacent to a backing strip.

c) *In Parts Assembled for Fillet Welding* — The zone in the neighbourhood of the actual or projected intersection of the fusion faces (*see* Fig 55).

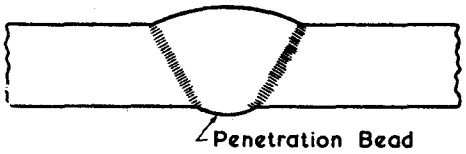


FIG 52 PENETRATION BEAD

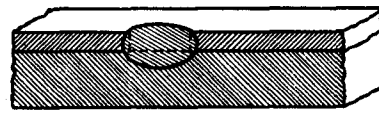


FIG 53 PLUG WELD

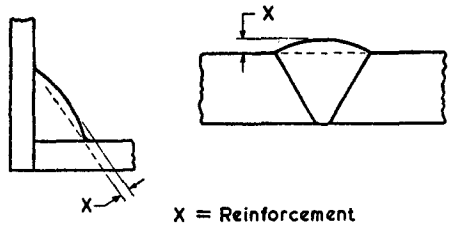


FIG 54 EXAMPLES OF REINFORCEMENT

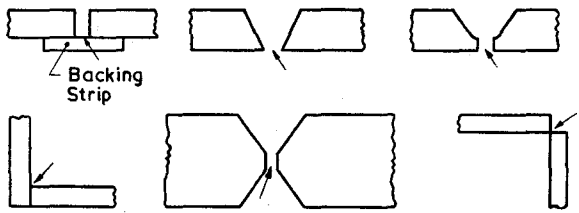


FIG 55 ROOTS OF TYPICAL WELD PREPARATIONS
(Arrow-head indicates the root of preparation)

11.46 Root of Weld — The points, as shown in cross-section, at which the bottom of the weld intersects the base metal surfaces (*see* Fig 56).

11.47 Root Face (Nose) — The unbevelled or ungrooved portion of a fusion face at the root (*see* Fig 57).

11.48 Root Radius — The radius of the curved portion of the fusion face in a component prepared for a single-J, single-U, double-J or double-U weld (*see* Fig 28).

11.49 Run (Pass) — The metal deposited during one passage of the electrode or blowpipe in the making of a joint.

11.50 Run-Off Plate(s) — A piece, or pieces, of metal so placed as to enable the full section of weld metal to be maintained up to the end of a joint.

11.51 Run-On Plate(s) — A piece, or pieces, of metal so placed as to enable the full section of weld metal to be obtained at the beginning of a joint.

11.52 Seal Weld (Sealing Weld) — A weld used to assist in obtaining a liquid-tight or gas-tight joint (*see* **11.53** *and* Fig 58).

11.53 Sealing Run (Backing Run) — The final run deposited on the root side of a fusion weld (*see* **11.52**).

11.54 Semi-Automatic Welding — Arc welding with equipment which controls only the filler metal feed. The advance of the welding is usually manually controlled.

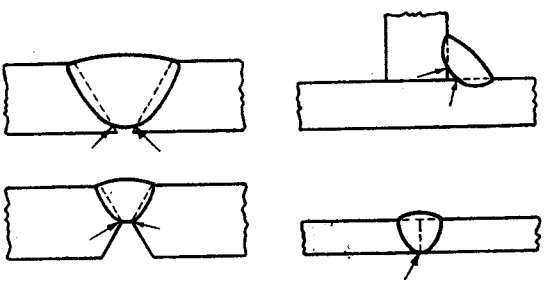


FIG 56 ROOTS OF WELD
(Arrow-head indicates the root of weld)

FIG 57 ROOT FACES
(Arrow-head indicates the root face)

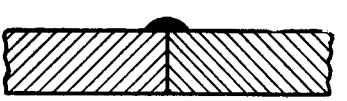


FIG 58 SEAL WELD

11.55 Single-Bevel Butt Weld — A butt weld in the preparation of which the edge of one component is bevelled and the fusion face of the other component is at right angles to the surfaces of the first component (*see* Fig 59).

11.56 Single-J Butt Weld — A butt weld in the preparation of which the edge of one component is prepared so that in cross-section the fusion face is in the form of a 'J' and the fusion face of the other component is at right angles to the surfaces of the first component (*see* Fig 60).

11.57 Single-U Butt Weld — A butt weld in the preparation of which the edges of both components are prepared so that in cross-section the fusion faces form a 'U' (*see* Fig 61).

11.58 Single-V Butt Weld — A butt weld in the preparation of which the edges of both parts are bevelled so that in cross-section the fusion faces form a 'V' (*see* Fig 62).

11.59 Size of a Butt Weld — The effective throat thickness of a butt weld (*see* Fig 63).

11.60 Size of a Fillet Weld — The minimum leg length of a convex or mitre fillet weld or 1·414 times the effective throat thickness of a concave fillet weld (*see* Fig 64).

11.61 Skip Sequence (Wandering Sequence) — A longitudinal sequence where continuous weld is obtained by depositing weld increments at planned intervals.

11.62 Slot Weld — A method of joining two contiguous components by depositing a fillet weld round the periphery of a hole in one component so as to join it to the surface of the other component exposed through the hole (*see* Fig 65).

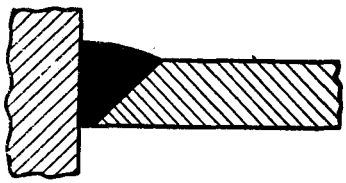


FIG 59 SINGLE-BEVEL BUTT WELD

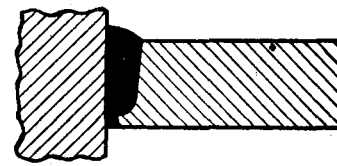


FIG 60 SINGLE-J BUTT WELD

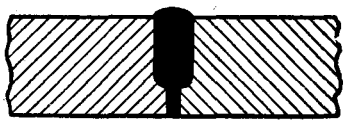


FIG 61 SINGLE-U BUTT WELD

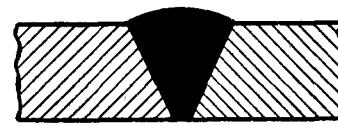


FIG 62 SINGLE-V BUTT WELD

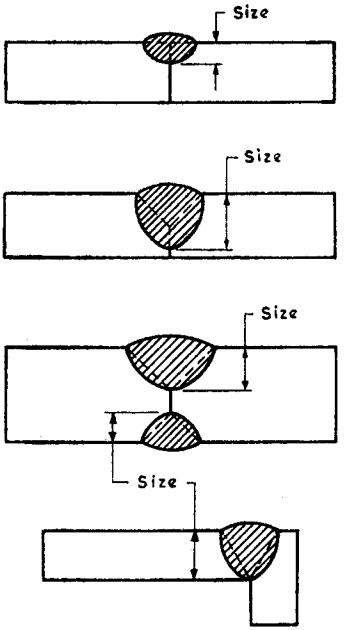


FIG 63 SIZE of BUTT WELD

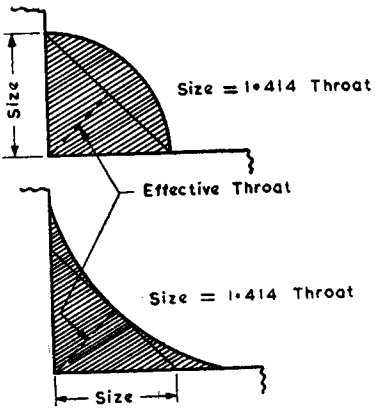


FIG 64 SIZE OF FILLET WELD

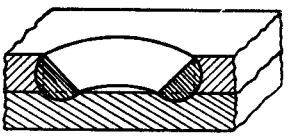


FIG 65 SLOT WELD

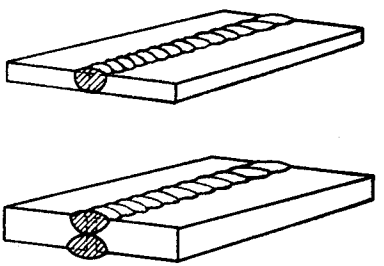


FIG 66 SQUARE BUTT WELD

11.63 Square Butt Weld — A butt weld in the preparation of which the fusion faces lie approximately at right angles to the surfaces of the components to be joined and are substantially parallel to one another (*see* Fig 66)

11.64 Tack Weld — A relatively small weld made to hold parts together to assist assembly or to maintain alignment of edges during welding.

11.65 Throat Thickness — The minimum thickness of weld metal in a fusion weld measured as under (*see* Fig 42):

a) *For a Fillet Weld or a V-, U-, J- or a Bevel-Butt Weld* — Along a line passing through the root.

b) *For a Close Square-Butt Weld* — In the plane of the abutting faces.

c) *For an Open Square-Butt Weld* — At the centre of the original gap in a plane parallel to the fusion faces.

11.66 Toe of Weld (Weld Edge) — The junction between the face of a weld and the parent metal.

11.67 Vertical Position — Any position in which the weld slope exceeds 45° and the weld rotation is greater than 90° (*see* Fig 67).

11.68 Weaving — Transverse oscillation of the arc end of an electrode or of a blowpipe nozzle during the deposition of weld metal (*see* Fig 68).

11.69 Weld Face — A surface of a fusion weld exposed on the side from which the weld has been made (*see* Fig 50).

11.70 Weld Junction — The boundary between the fusion zone and the heat-affected zone (*see* Fig 4).

11.71 Weld Rotation — The angle between the upper portion of the vertical reference plane passing through the line of a weld root, and a line drawn through the same root intersecting the weld surface at a point equidistant from either toe of the weld (*see* Fig 69-71).

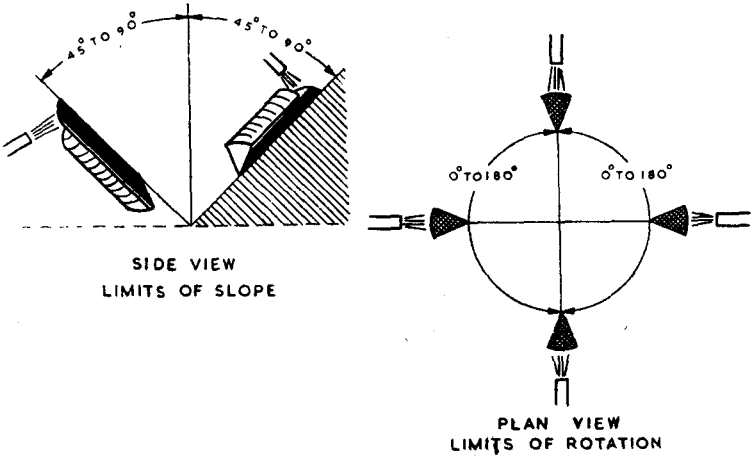


FIG 67 VERTICAL POSITION

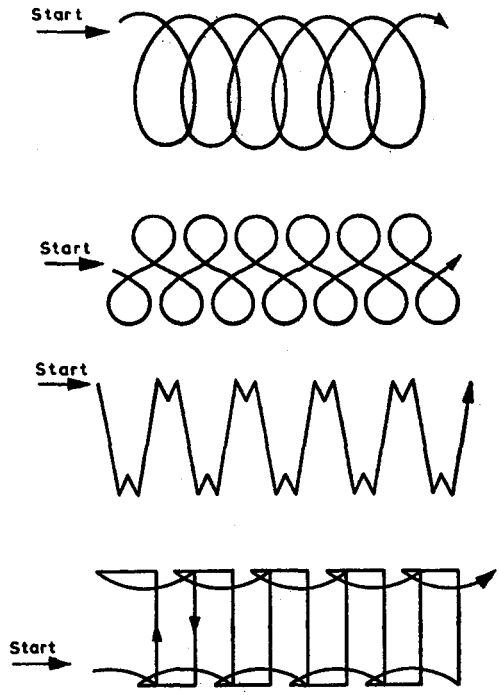


FIG 68 WEAVE MOTIONS

11.72 Weld Slope — The angle between the line of the root of a weld and the horizontal (*see* Fig 69-71).

12. TERMS RELATING TO ARC WELDING

12.1 Arc Fan — The characteristic fan-shaped flame produced in the neighbourhood of the atomic hydrogen arc.

12.2 Arc Voltage — The voltage across the welding arc.

12.3 Arc Welding — Fusion welding in which heat for welding is obtained from an electric arc or arcs.

12.4 Arcing Time Factor — The ratio of arcing time to the total time the supply is available for the arc.

12.5 Atomic-Hydrogen Welding — Arc welding in which hydrogen, passing through an arc between two non-consumable electrodes, is

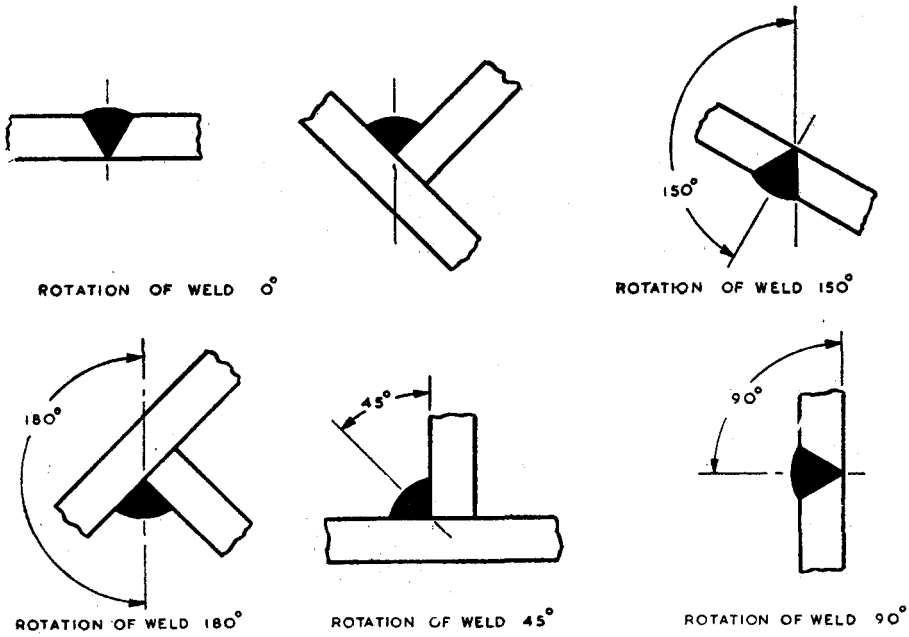


FIG 69 DIAGRAMS TO ILLUSTRATE WELD ROTATION

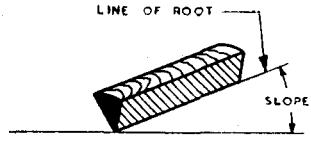


FIG 70 DIAGRAM TO ILLUSTRATE WELD SLOPE

atomized and then recombined thereby to supply the heat for welding. Shielding is obtained from hydrogen. Pressure may or may not be applied and filler metal may or may not be used.

12.6 Bare Metal-Arc Welding — An arc welding process wherein weld is produced with an electric arc between a bare or lightly-coated metal electrode and the work and no shielding is used. Pressure is not used and filler metal is obtained from the electrode.

12.7 Burden — The layer of melt and fused metal above the welding zone in submerged-arc welding.

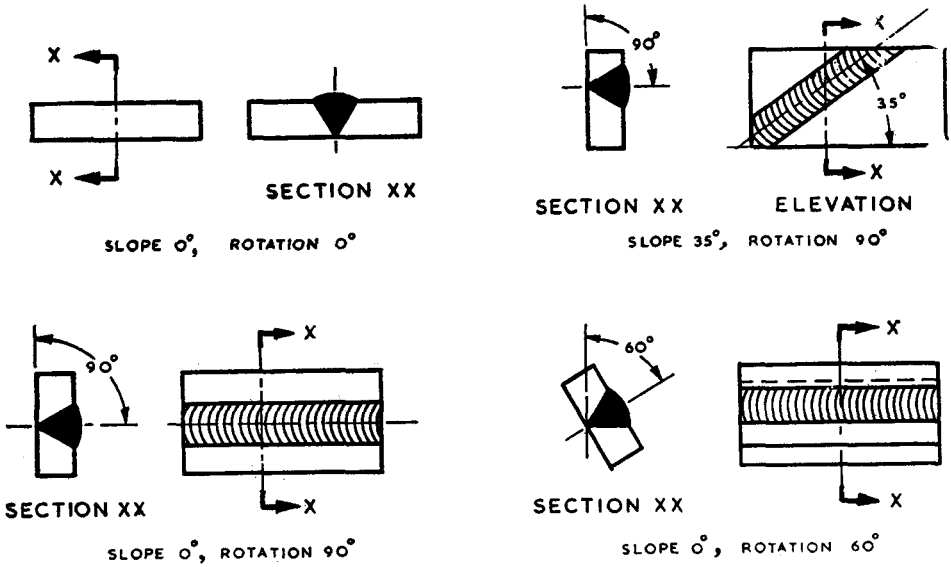


FIG 71 EXAMPLES OF ' SLOPE ' AND ' ROTATION '

12.8 Carbon-Arc Welding — Arc welding with a carbon electrode or electrodes. Filler metal may be used.

12.9 Continuous Test Current — The maximum current that an arc-welding set can supply continuously at the rated welding load voltage without exceeding a specified temperature-rise.

12.10 Controlled-Arc Welding — Metal-arc welding in which the rate of feed of the electrode is controlled by the arc voltage.

12.11 Controlled Tungsten-Arc Welding — Inert-gas tungsten-arc welding in which the arc length is controlled by the arc voltage.

12.12 Electrode Negative — Direct-current arc welding in which the electrode is connected to the negative pole of the supply (*see* Fig 72).

NOTE — This has sometimes been known in British practice as ' reversed polarity ' and in American practice as ' straight polarity ' Both these terms are deprecated.

12.13 Electrode Positive — Direct-current arc welding in which the electrode is connected to the positive pole of the supply (*see* Fig 73).

NOTE — This has sometimes been known in British practice as ' straight polarity ' and in American practice as ' reversed polarity '. Both these terms are deprecated.

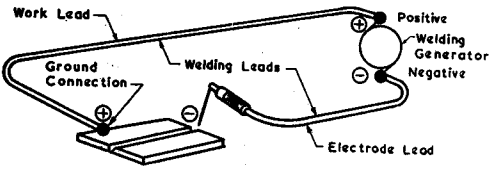


FIG 72 ELECTRODE NEGATIVE

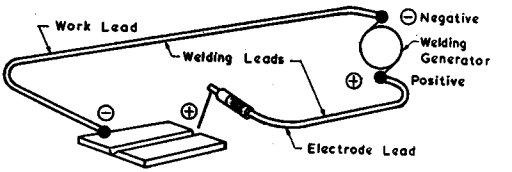


FIG 73 ELECTRODE POSITIVE

12.14 Firecracker Welding — Shielded-arc welding in which an electrode is laid on the parent metal. An arc is started between one end of the electrode and the work and travels along the work as the electrode melts. The electrode is shielded or is enveloped in a suitable flux.

12.15 Fused Melt — Glass-like material formed from melt during submerged-arc welding.

12.16 Inert-Gas Arc Welding — Shielded-arc welding in which the shielding medium is an inert gas, as in argon-arc welding and helium-arc welding.

12.17 Inert-Gas Metal-Arc Welding — Inert-gas arc welding using a consumable electrode.

12.18 Inert-Gas Tungsten-Arc Welding — Inert-gas arc welding with a non-consumable electrode of tungsten.

12.19 Maximum Welding Current — The maximum current permitted by the current regulator to be drawn from a single welding point at a specified welding load voltage.

12.20 Metal-Arc Welding — Arc welding with a metal electrode or electrodes the melting of which provides the filler metal.

12.21 Metal-Run-Out — Molten metal inadvertently lost from a weld by gravitational flow through a joint.

NOTE — The term is used mainly in submerged-arc welding, where the effect arises from incorrect edge preparation.

12.22 Nominal Hand-Welding Current — The maximum permissible current to be drawn from a single welding point when working continuously with an arcing time factor of 0·75.

12.23 Open-Circuit Voltage — The voltage between the output terminals of a welding set ready to weld, but carrying no current.

12.24 Self-Adjusting Arc Welding — Metal-arc welding in which an electrode is fed at a constant speed while the arc length is maintained substantially constant by the inherent electrical characteristics of the welding current circuit.

12.25 Shielded-Arc Welding — Arc welding in which the arc and the weld metal are protected from the atmosphere by a shielding medium.

12.26 Striking Voltage — The minimum voltage at which an arc may be struck.

12.27 Submerged-Arc Welding — Arc welding in which a bare wire electrode is used; the arc is enveloped in a powdered flux, some of which fuses to form a removable covering of slag on the weld.

12.28 Test Load Factor — A function of the arcing time factor used to obtain the continuous test current.

12.29 Time of Recovery — The time required, after a disturbance has taken place in a circuit, for either the current or the voltage, or both, to recover to a specified percentage of their values before the disturbance.

12.30 Welding Load Voltage — The voltage between the output terminals of an arc-welding set (i.e. those to which the electrode and return leads are connected) when a specified current is flowing.

13. TERMS RELATING TO EQUIPMENT

13.1 Air-Acetylene Blowpipe (Bunsen Type) — A blowpipe incorporating an injector to produce a flame suitable for lead-burning or soldering.

13.2 Air-Acetylene Blowpipe (High Temperature Type) — A blowpipe incorporating an injector with a hooded head to produce a flame suitable for brazing.

13.3 Arc-Welding Electrode (Electrode) — A rod of metal (which may be used as filler metal), or a rod of carbon, between one end of which and either the work or another electrode, the arc is formed.

13.4 Arc-Welding Set (Arc-Welding Plant) — Apparatus for providing and controlling electrical energy for a single welding arc (single-operator welding set) or for two or more welding arcs (multi-operator welding set).

13.5 Atomic-Hydrogen Torch — An electrode holder carrying the electrodes and incorporating a means of supplying hydrogen to the arc in atomic-hydrogen welding.

13.6 Backing Bar — Backing piece of metal or other material used to assist in making a weld but not intended to become part of the weld (*see also* **11.6**).

13.7 Bare Electrode — A filler-metal electrode, used in arc welding, consisting of a metal wire with no coating other than that incidental to the drawing of the wire.

13.8 Cast-Iron Thermit — Welding thermit with the addition of ferro-silicon for the thermit fusion welding of cast-iron.

13.9 Constant-Voltage Welding Generator — A direct-current welding generator forming part of an arc-welding set and having a terminal voltage which remains substantially constant from full load to no load.

13.10 Consumable Electrode — An arc-welding electrode which provides filler metal.

13.11 Cored Electrode — A metal electrode with a core of flux and/or other materials to modify the properties of the weld metal and to facilitate welding.

NOTE — The term 'flux' in this context is used in its ordinary engineering sense. The core is sometimes loosely described as flux, whether or not other materials are present.

13.12 Covered Electrode — A filler-metal electrode, used in arc welding, consisting of a metal core wire with a relatively thick covering to modify the properties of the weld metal and to facilitate welding.

13.13 Covered Filler Rod (Coated Filler Rod) — A filler rod with a covering of flux and/or other material to modify the properties of the filler metal.

NOTE — The term 'flux' in this context is used in its ordinary engineering sense. The covering is sometimes loosely described as flux, whether or not other materials are present.

13.14 Drooping-Characteristic Welding Generator — A direct-current welding generator forming part of an arc-welding set and having a terminal voltage which drops automatically from the open-circuit voltage to the arc voltage when an arc is struck.

13.15 Dual-Gas Economizer — An auxiliary device for temporarily cutting off the supply of gas and oxygen, except for that to a pilot jet.

NOTE — It is actuated by depressing a lever, which generally takes the form of a hook upon which the blowpipe is hung; it obviates resetting the flame after interruptions of welding.

13.16 Fillet Weld Extension — A device for attachment to the welding head of a submerged-arc welding machine to enable fillet welds to be made.

13.17 Fillet Weld Guide — A fillet weld extension fitted with a guide wheel.

13.18 Fitted Hose — A length of hose each end of which is fitted with a hose coupling nipple and a hose coupling nut.

13.19 HF Unit (HF Ionizer) — A high frequency electrical oscillator used to enable an arc to be struck without contact between the electrode and the workpiece.

13.20 Hooded Head — A tubular device with an injector fitted into one end and series of apertures in the base of the tube wall through which a stream of air is induced.

13.21 Hose Coupler — A metal component, consisting of a hexagonal centre portion with threaded ends, for connecting two lengths of fitted hose.

13.22 Hose Coupling Nipple — A metal component, one end of which is secured in the tail piece by the hose coupling nut and the other end inserted into the hose.

13.23 Hose Coupling Nut — A nut, provided with a shoulder on one face, used for securing the hose coupling nipple in position in the threaded hose connection.

13.24 Hydrogen Valve — An electrically operated on-off valve used in atomic-hydrogen welding to allow hydrogen to flow only when an arc is struck.

13.25 Inert-Gas Shield — A tube, usually of refractory material, which forms the nozzle of an inert-gas shielded-arc torch and confines the gas to the immediate neighbourhood of the arc.

13.26 Inert-Gas Shielded-Arc Torch — A combined electrode holder and gas tube so arranged as to enable an electric arc to be formed in an inert-gas envelope.

13.27 Lightly Coated Electrode — A filler-metal electrode, used in arc welding, consisting of a metal wire with a light coating applied subsequent to the drawing operation, primarily for stabilizing the arc.

13.28 Melt — The powdered flux used in submerged-arc welding.

13.29 Melt Distributing Assembly — A system of channels and guides, attached to the welding head of a submerged-arc welding machine, for conveying the melt and securing an even and sufficient burden.

13.30 Melt Hopper — A hopper, attached to a submerged-arc welding machine, for storing the melt and feeding it to the melt distributing assembly.

13.31 Non-Consumable Electrode — An arc welding electrode which does not provide filler metal.

13.32 Pre-Heating Gate — An opening in a mould to facilitate pre-heating of parts to be joined by thermit fusion welding (*see* Fig 26).

13.33 Plugging Material — Refractory material placed on top of the tapping pin to prevent its melting.

13.34 Sheathed Electrode — A covered electrode with an external sheath, usually of metal.

13.35 Spacer Strip — A metal strip or bar inserted in the root of a joint prepared for a groove weld to serve as a backing and to maintain root opening during welding (*see* Fig 74).

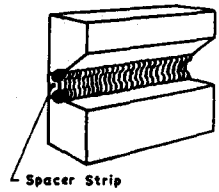


FIG 74 SPACER STRIP

13.36 Stone — A ring of refractory material, usually pressed magnesite, built into the bottom of a thermit crucible for the reception of a thimble.

13.37 Tapping Pin — A metal plug closing the hole in a thimble (*see* Fig 26).

13.38 Thimble — A renewable ring of refractory material (usually magnesite) inserted in a stone, through the centre of which the molten metal passes (*see* Fig 26).

13.39 Threaded Hose Connection — The threaded component (inlet or outlet) on a welding or cutting appliance into which the bull-nose end of the hose coupling nipple is inserted.

13.40 Wax Pattern — Wax introduced between parts to be joined by means of thermit fusion welding. It forms the foundation for the mould and is removed by the pre-heating operation.

13.41 Welding Blowpipe — A device used in gas welding for controlling the admixture of gases so as to produce a flame suitable for welding.

13.42 Welding Head — A device used for automatic arc welding and comprising an electrode feed mechanism and means for conveying current to the electrode(s). It may include electrode straightening gear and the head may be stationary and the work in motion or *vice versa*.

13.43 Welding Regulator — A valve, for attachment to a gas cylinder or pipeline, to reduce the pressure to the working-pressure of the blowpipe.

NOTE — After adjustment by the operator, the valve maintains the working-pressure automatically.

14. TERMS RELATING TO GAS WELDING

14.1 All-Position Rightward Welding — A variation of rightward welding in which the flame is approximately normal to the molten pool (*see* Fig 75).

FIG 75 ALL-POSITION RIGHTWARD WELDING

14.2 Backfire — The momentary recession of the flame into the blowpipe followed by immediate re-appearance or complete extinguishment of the flame, usually accompanied by an explosive sound.

14.3 Carburizing Flame — A reducing flame in which gas or gases burnt are carbonaceous.

NOTE — In an oxy-acetylene carburizing flame the inner cone is not sharply defined and is surrounded by a quantity of unburned gas known as a 'feather'.

14.4 Flame Snap-Out — Harmless unintentional extinction of a gas welding flame, sometimes accompanied by a minor explosion.

14.5 Flashback — Dangerous retrogression of a gas welding flame beyond the blowpipe body into the hose, with subsequent explosion.

NOTE — The violence of the explosion depends upon where it occurs.

14.6 Full-Fusion Welding — A name given to gas (fusion) welding to distinguish it from surface-fusion (semi-fusion) welding and non-fusion welding.

14.7 Gas Welding — A group of welding processes wherein weld is produced by heating with a gas flame or flames, with or without the application of pressure and with or without the use of filler metal.

14.8 Inner Cone — The inner part of a gas welding flame adjacent to the blowpipe nozzle (*see* Fig 76).

14.9 Leftward Welding (Forward Welding) — Welding in which the flame is directed towards the unwelded part of the joint (*see* Fig 77).

14.10 Neutral Flame — A gas flame wherein the portion used is neither oxidizing nor reducing (*see* Fig 78).

NOTE — In an oxy-acetylene neutral flame the quantities of gas and admixed oxygen are generally approximately equal and the inner cone is sharply defined, except for a haze or mistiness at its extremity.

14.11 Non-Fusion Welding — A term applied to the deposition, by the oxy-acetylene process, of filler metal on parent metal without fusion of the latter.

14.12 Oxidizing Flame — A gas flame wherein the portion used has an oxidizing effect due to the existence of excess of oxygen over fuel gas (*see* Fig 79).

14.13 Pick-Up — That property of a flux which causes some of it to adhere to the heated end of a filler rod, i.e. the property which gives rise

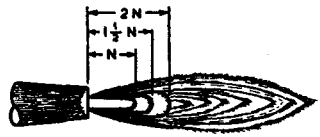


FIG 76 COMPOSITION DIAGRAM SHOWING INNER CONES OF VARIOUS FLAMES

NOTE — N = Neutral Flame, 1½ N and 2 N are reducing flames for non-fusion welding and for the welding of some non-ferrous metals (*see* **14.11**).

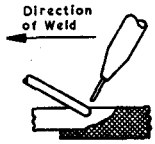


FIG 77 LEFTWARD WELDING

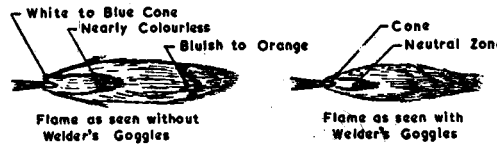


FIG 78 NEUTRAL FLAME

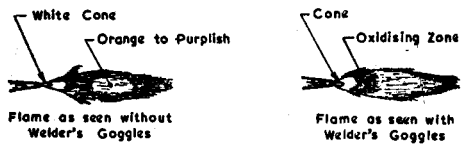


FIG 79 OXIDIZING FLAME

to the ' tuft ' which is applied to the molten pool. (For definition of the term applicable to resistance welding, *see* **8.27.**)

14.14 Reducing Flame — A gas flame wherein the portion used has reducing effect due to the existence of excess of fuel gas over oxygen (*see* Fig 80).

14.15 Rightward Welding (Backward Welding)— Welding in which the flame is directed towards the welded part of the joint (*see* Fig 81).

NOTE — The use of the term ' backhand welding ' in this connection is deprecated.

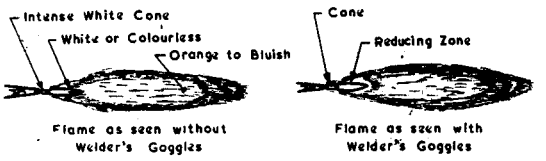


FIG 80 REDUCING FLAME

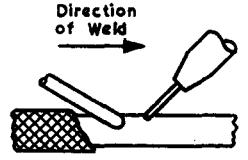


FIG 81 RIGHTWARD WELDING

14.16 Surface-Fusion Welding (Semi-Fusion Welding) — Gas welding in which a carburizing flame is used to melt the surface of the parent metal, which then unites with molten metal from a suitable filler rod.

NOTE — This application is used for Linde welding, hard surfacing, building-up and the like.

14.17 Sustained Backfire — Possibly harmful retrogression of a gas welding flame into the blowpipe neck or body, the flame remaining alight.

NOTE — It is usually accompanied by popping or squealing and sometimes there is a small pointed flame at the nozzle.

15. TERMS RELATING TO THERMIT FUSION WELDING

15.1 Collar — Weld metal projecting around the periphery of weld made by thermit fusion welding (*see* Fig 26).

NOTE — It has the effect of supplying sufficient metal for feeding the main section on cooling and also of ensuring fusion at the extreme edges of the parts being joined.

15.2 Thermit Fusion Welding — A fusion welding process in which welding heat is obtained from welding thermit and the molten metal acts as added metal. The parent metal is pre-heated.

PART IV BRAZING AND BRONZE WELDING

16. GENERAL TERM

16.1 Stopping-Off Agent — Lamp-black, graphite, or similar material placed on a workpiece around the joint to prevent molten filler metal from adhering to adjacent surfaces.

17. TERMS RELATING TO BRAZING

17.1 Brazing — A process of joining metals in which molten filler metal is drawn by capillary attraction into the space between closely adjacent surfaces of the parts to be joined. In general, the melting point of the filler metal is above 500°C.

17.2 Brazing Alloy — Filler metal used in brazing.

17.3 Dip Brazing — A process in which a workpiece is partially or totally immersed in a bath of molten filler metal which is covered by a layer of molten flux.

17.4 Flame Brazing (Torch Brazing)— A process in which heat for brazing is obtained from a gas flame from a manually operated blowpipe or torch.

17.5 Furnace Brazing — A process in which brazing heat is obtained by putting a complete workpiece into a furnace which may contain a protective atmosphere.

17.6 Induction Brazing — A process in which brazing heat is obtained by inducing high-frequency electric current within the material in the neighbourhood of the joint. A protective atmosphere may be used.

17.7 Resistance Brazing — A process in which brazing heat is obtained by

a) the passage of an electric current between the parts to be joined, as in resistance welding, or

b) the passage of an electric current through two carbon electrodes and the parts to be joined. The greater part of the brazing heat is generated in the electrodes and conducted to the joint.

17.8 Salt Bath Brazing — A process in which brazing heat is obtained by immersing a complete workpiece in a bath of molten salt of suitable melting point. The salt used should act as a flux.

17.9 Spelter — A brazing alloy consisting nominally of 50 percent copper and 50 percent zinc.

NOTE — The term ' spelter ' is not used here in the ordinary metallurgical sense.

18. TERMS RELATING TO BRONZE WELDING

18.1 Bell Butt Joint — A joint between two pipes of the same diameter, in which one pipe end is swaged out to receive the end of the other pipe (*see* Fig 82).

18.2 Branch Tee Saddle Joint — A joint between a branch pipe set at 90° to a main pipe, the end of the branch pipe being shaped to fit snugly against the main pipe (*see* Fig 83).

18.3 Bronze Filler Metal — A filler metal used for bronze welding, consisting basically of copper and zinc. It may also contain nickel, manganese, and/or other metals.

NOTE — The term 'bronze' is not used here in the ordinary metallurgical sense.

18.4 Bronze Welding — A method of joining metals by means of the deposition of molten copper-rich filler metal on the parts to be joined, without necessarily fusing them. In general, the melting point of the filler metal is above 850°C.

NOTE — The meaning now attached to the term is quite arbitrary, since bronze is not used and the process is not necessarily welding. Bronze welding, unlike brazing (qv), does not depend upon capillary attraction.

18.5 Diminishing Bell Butt Joint — A joint between two pipes of different diameters, in which the end of the smaller pipe is swaged out to fit the bore of the larger pipe (*see* Fig 84).

18.6 Short Bell Branch Joint — A branch joint in which the metal round a hole in a main pipe is swaged out to receive the end of a branch pipe (*see* Fig 85).

18.7 Weldable Fitting — A specially shaped component of suitable copper alloy, fitted to copper or copper-alloy pipe to facilitate joining them by bronze welding.

PART V TESTING

19. TERMS RELATING TO TESTING

19.1 All-Weld Test Piece — A block of metal consisting of one bead or of a number of beads fused together. It may, or may not, include portions of parent metal.

19.2 All-Weld Test Specimen — An all-weld test piece after preparation for testing.

NOTE — Some test specimens may have portions of parent metal at their ends to facilitate gripping during testing, but all parent metal is removed from the portion under test.

19.3 Cruciform Test Piece — A flat plate to which two other flat plates or bars are welded at right angles. It may be of Type A or Type B as shown in Fig 86.

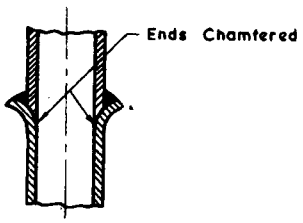


FIG 82 BELL BUTT JOINT

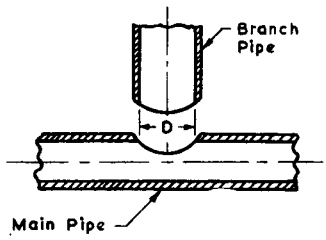


FIG 83 BRANCH TEE SADDLE JOINT

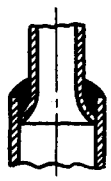


FIG 84 DIMINISHING BELL BUTT JOINT

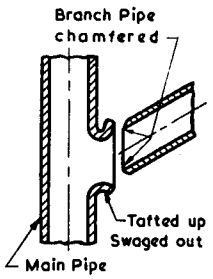
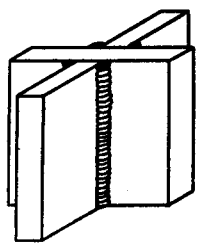
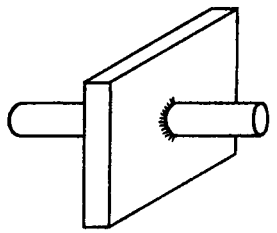


FIG 85 SHORT BELL BRANCH JOINT



86 (A) Test Piece-Type A



86 (B) Test Piece-Type B

FIG 86 CRUCIFORM TEST PIECES

19.4 Cruciform Test Specimen — A portion cut from a cruciform test piece of Type A (*see* Fig 86) and prepared for testing as shown in Fig 87 or the whole of a test piece of Type B (*see* Fig 86).

19.5 Flattening Test (In Bronze Welding) — A test in which a bronze welded pipe joint (*see* **18.1**, **18.2**, **18.5** *and* **18.6**) is flattened until the internal walls are substantially in contact.

19.6 Free Bend Test — A bend test made by pre-setting the ends of a specimen to promote bending, and by concluding the test without using a former.

19.7 Guided Bend Test — A bend test made by bending the specimen round a former.

19.8 Hot Cracking Test — A test designed to indicate the cracking propensities of metal while it is solidifying after it has been deposited from an electrode.

19.9 Normal Bend Test (Face Bend Test) — A bend test in which a specified side of the weld specimen is adjacent to the bending former, namely:

a) the side containing the root or to which the root is nearer, or

b) the side other than that containing the last-made run when the root is central, or

c) the inner side of a pipe or tube in welds made with pressure.

19.10 Notch-Break Specimen (Nick-Break Specimen) — A test specimen in which small notches are cut to promote fracture in a predetermined position for inspection of the interior of the weld.

19.11 Reverse Bend Test — A bend test in which the side other than that specified for a normal bend test is adjacent to the bending former.

19.12 Shear-Test Piece — A test piece incorporating an agreed number (usually not more than three) of spot or projection welds (*see* Fig 88).

19.13 Shear-Test Specimen — A shear-test piece prepared for testing in a tensile testing machine by drilling out or otherwise rendering ineffective those welds not to be tested.

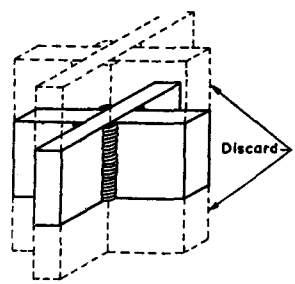


FIG 87 METHOD OF OBTAINING CRUCIFORM TEST SPECIMEN

NOTE — The test is a tensile test of the fillet welds in which the free ends of the parts welded on are gripped in tensile testing machine.

19.14 Slug Test — A test of a spot weld or of a projection weld in which the plates containing the weld are forced apart by bending one plate until the two separate.

NOTE — In a good weld, the weld metal adheres to one of the plates and is called a slug.

19.15 Test Piece — Components welded together in accordance with a specified welding procedure, or a portion detached from a welded structure, for test.

19.16 Test Specimen — A portion detached from a test piece and prepared as required for testing.

19.17 Tongue-Bend Test Specimen — A portion so cut in two straight lengths of pipe butt-welded together as to produce a tongue containing a portion of the weld. The cuts are made so that the tongue is parallel to the axis of the pipes and the weld is tested by bending the tongue round a former (*see* Fig 89).

19.18 Transverse Bend Specimen — A test specimen for a bend test, which is transversely bisected by the portion of the weld included in it.

19.19 Transverse Tensile Specimen — A test specimen for a tensile test, which is transversely bisected by the portion of the weld included in it.

19.20 U-Tensile Test — A method of tensile testing spot or projection welds. After welding the test plates are bent as shown in Fig 90 and the specimen is then pulled apart.

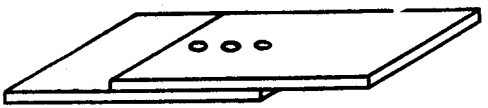


FIG 88 SHEAR-TEST PIECE

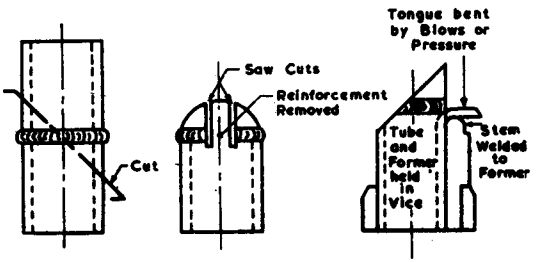


FIG 89 TONGUE-BEND TEST SPECIMEN

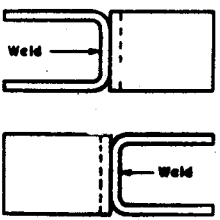


FIG 90 U-TENSILE TEST SPECIMEN

PART VI WELD IMPERFECTIONS

20. TERMS RELATING TO WELD IMPERFECTIONS

20.1 Blowhole — A large cavity due to entrapped gas.

NOTE — This term is conveniently applied to cavities exceeding 1·6 mm (or $\frac{1}{16}$ in.) in diameter.

20.2 Capillary Pipe — A fine pipe extending along the junction of weld and parent metal.

NOTE — The defect is caused by faults in the parent metal (e.g. laminations or layers of segregation) mostly occurring along the whole length of the metal concerned.

20.3 Crack — A discontinuity produced either by tearing of the metal while in a plastic condition (hot crack or hot tear) or by fracture when cold (cold crack or cold tear).

20.4 Crater — A depression left in weld metal where the arc was broken or the flame was removed.

20.5 Edge of Plate Melted Off — An imperfection in a fillet weld due to a free edge of a plate being melted off and insufficiently built up (*see* **21.1.3**).

20.6 End Crater — A crater at the end of a weld or at the end of a joint (*see* **21.1.2.1**).

20.7 Exposed Inclusion — An inclusion near the surface, exposed, but not completely removed, by dressing.

20.8 Exposed Porosity — Porosity near the surface, exposed, but not completely removed, by dressing.

20.9 Gas Pore — A small cavity due to entrapped gas.

NOTE — This term is conveniently applied to cavities not exceeding 1·6 mm (or $\frac{1}{16}$ in.) in diameter.

20.10 Inclusion — Slag or other foreign matter entrapped during welding.

20.11 Incomplete Inter-Run Penetration — A gap occurring in a multi-run weld where the weld metal fails to fill a crevice formed by a previous run or runs. The crevice is usually at the toes of the underlying run or runs (*see* **21.2.6**).

20.12 Incomplete Root Penetration — A gap left by failure of weld metal to fill the root (*see* **21.2.7**).

20.13 Incorrect Profile (Incorrect Contour) — A departure of the shape and/or size of an otherwise correctly formed weld from that specified.

20.14 Lack of Fusion — Lack of union in a weld.

NOTE — Lack of union in a weld may be

a) between deposited metal and parent metal, or

b) between parent metal and parent metal, or

c) between deposited metal and deposited metal (*see* **21.2.8** *and* Fig 91)

20.15 Lack of Inter-Run Fusion — Lack of union between adjacent runs of weld metal in a multi-run weld (*see* **21.2.8**).

20.16 Lack of Root Fusion — Lack of union between weld metal and parent metal, or between the adjacent faces of the parent metal at the root (*see* **21.2.8**).

20.17 Lack of Side Fusion — Lack of union between weld metal and parent metal at a side of a weld outside the root (*see* **21.2.8**).

20.18 Overlap — An imperfection at a toe or root of a weld caused by metal flowing on to the surface of the parent metal without fusing to the latter (*see* **21.1.10**).

20.19 Pipe — An elongated or tubular cavity in weld metal due to entrapped gas (*see* **21.2.9**).

20.20 Porosity — A group of gas pores (*see* **21.2.10**).

NOTE — Porosity may be conveniently differentiated according to size as fine, medium, or coarse, and may occur as clusters or chains, or may be scattered.

20.21 Root Concavity — An intermittent broad groove, or series of cavities, occurring in submerged-arc welding in the penetration bead, or in the root, of a weld.

NOTE — The imperfection occurs when a copper backing-bar is used, and is caused by fused flux powder trickling through the irregular abutting faces of the parent metal and the copper backing-bar.

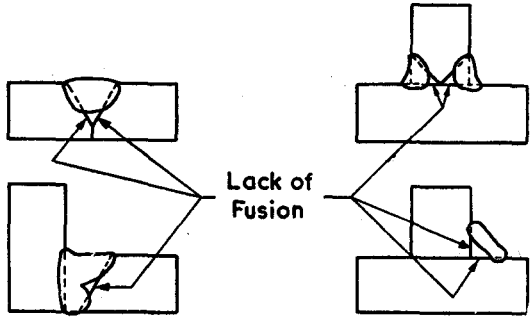


FIG 91 LACK OF FUSION

20.22 Root Groove — A shallow groove occurring fortuitously in the root of a butt weld during welding (*see* **21.1.13**).

20.23 Shrinkage Groove — A shallow groove in the parent metal along each side of a penetration bead.

20.24 Undercut — A groove cut into the base metal along the toe of a weld and left unfilled by the weld metal (*see* **21.1.18**).

20.25 Underflushing — A reduction in metal thickness due to excessive dressing (*see* **21.1.19**).

21. TERMS RELATING TO WELD IMPERFECTIONS APPROPRIATE FOR RADIOGRAPHIC EXAMINATION

21.0 Introduction

21.0.1 The terms given under **21.1** and **21.2** are intended to be comprehensive, with the exception of those relating to characteristic defects confined to specialized methods, such as flash butt welding or spot welding, in which radiographic inspection is not yet in general use.

21.0.2 Since the terms primarily concern radiographic inspection of welds, the definitions have been amplified by means of diagrams and illustrative radiographs. The radiographs have been selected with the one object of illustrating the salient features of the defects, and the examples have been chosen to facilitate their reproduction in half-tone blocks. Consequently, the faults are rather more marked than is usual, in order to compensate for losses in the printing process. The radiographer will appreciate that the image of a given defect on a photographic film becomes more ill-defined and more indistinct as the thickness of metal increases, or if salt intensifying screens are used instead of metal screens, etc. Moreover, the sharply defined contours of a blowhole, or a pipe viewed end-on, may be blurred and diffused by halation, so that interpretation may be more difficult than these illustrations would suggest.

21.0.3 Not only is interpretation more difficult when these conditions are present, but it is also complicated by the fact that defects of more than one kind often occur together: porosity is often mixed with fine inclusions; incomplete penetration or lack of fusion may be accompanied by inclusions, or may be partially obscured by overlying defects in other runs of the weld; cavities may be partially filled with foreign matter, while inclusions sometimes have cracks radiating from sharp edges and corners.

21.0.4 In some of the terms, the radiographic shadows are characteristic of a particular defect (e.g. crack, blowhole); in others, the first interpretation is not free from ambiguity (e.g. lack of side fusion may be indistinguishable from capillary piping; undercut from a line inclusion). Tube-shift or stereo-radiographic exposures as also the position of the image relative to the centre-line of the weld may assist in resolving the ambiguity. For the sake of completeness a few imperfections, such as overlap, which cannot in general be detected radiographically, have also been included. Other surface imperfections in the weld or adjacent metal, which are readily seen by visual surface inspection, have also been included since they may be revealed in the radiograph. They would be removed in the final surface dressing where this is required by specification, but if their elimination is incomplete they are liable, in the first examination of the radiographs, to be interpreted erroneously, as internal defects, and are therefore of significance in radiographic inspection.

21.0.5 The terms are defined under the following two headings:

a) Surface imperfections in the weld or adjacent metal, and

b) Internal defects in the weld or adjacent metal.

21.0.6 This distinction between surface imperfections and internal defects has been drawn because of the different standards of acceptance which would normally be applied in the two cases.

21.0.7 Surface imperfections are generally removed in the final dressing of the surface of the weld where this is required by specification, but, if their elimination is incomplete, they are liable to be interpreted erroneously as internal defects in the first examination of the radiographs. Where visual inspection of the surface is impracticable, surface imperfections may be distinguished from internal defects by stereo-radiography or tube-shift methods.

21.1 Surface Imperfections in the Weld or Adjacent Metal

21.1.1 *Chipping Mark* — An indentation resulting from chipping in preparation or dressing. It gives rise to a dark shadow of corresponding shape in the radiograph.

21.1.2 *Crater* — A depression left in a weld where the arc was broken or the flame was removed. It appears in the radiograph as a dark shadow varying in density and shape with the dimensions of the imperfection.

21.1.2.1 *End crater* — A crater at the end of a weld or joint. It gives a radiographic image similar to that of a crater.

21.1.3 *Edge of Plate Melted Off* — An imperfection in a fillet weld due to a free edge of a plate being melted off and insufficiently built up.

It appears in the radiograph as a dark ribbon with diffuse edges corresponding in position to the toe of the weld (*see* Fig 92).

21.1.4 *Excessive Penetration Bead* (*Excessive Under-Bead*) — Excess of metal protruding through the root in a fusion butt weld. It appears in the radiograph as a continuous or intermittent light irregular band within the image of the weld (*see* Fig 93).

21.1.5 *Exposed Inclusion* — An inclusion near the surface, exposed, but not completely removed, by dressing. The radiographic image is similar to that given by an inclusion situated wholly within the metal (*see also* **21.2.5**).

21.1.6 *Exposed Porosity* — Porosity near the surface, exposed, but not completely removed, by dressing. The radiographic image is similar to that given by porosity situated wholly within the metal (*see also* **21.2.10**).

21.1.7 *Grinding Scratch* — A groove in the surface of parent metal or of a weld made by a grinding wheel or surfacing tool. A grinding scratch, if of sufficient depth, may give a radiographic appearance similar to that of a welding defect.

21.1.8 *Incompletely Filled Groove* — A continuous or intermittent channel in a butt-weld face where the thickness of the throat is less than that of the parent metal. It appears in the radiograph as a dark area corresponding to the size and shape of the defect. When present at a fusion face, the radiographic appearance is similar to that of undercut, except that the edge of the image corresponding to the edge of the fusion face preparation is straight (*see* Fig 94).

21.1.9 *Incorrect Profile* (*Incorrect Contour*) — A departure of the shape and/or size of an otherwise correctly formed weld from that specified. The presence of this defect may sometimes be inferred from the variation in density of the radiograph in the region of the weld.

21.1.10 *Overlap* — An imperfection at a toe or root of a weld caused by an overflow of weld metal on to the surface of the parent metal without fusing to the latter. Visual and radiographic examination may give an exaggerated impression of the width of the reinforcement fused to the parent plates. It is not possible to detect overlap

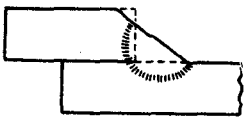


FIG 92 EDGE OF PLATE MELTED OFF

FIG 93 EXCESSIVE PENETRATION BEAD

FIG 94 INCOMPLETELY FILLED GROOVE

radiographically, but it may usually be revealed in steel welds by magnetic crack detectors (*see* Fig 95).

21.1.11 *Peening Mark* — An indentation, due to a peening blow, in the weld or parent metal. It gives rise to a dark shadow of corresponding shape in the radiograph.

21.1.12 *Root Concavity* — An intermittent broad groove or series of concavities in an under-bead, or in the root of a weld. It appears in the radiograph as a series of dark areas along the centre of the weld seam varying in density according to the depth of the imperfection. It is usually intermittent (*see* Fig 96).

NOTE — The imperfection occurs in submerged-arc welds when a copper-backing plate is used and is caused by fused flux powder trickling through the irregular abutting faces of the parent metal and becoming entrapped between the weld metal and the copper-backing plate.

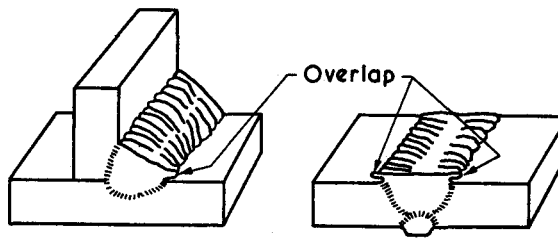


FIG 95 OVERLAP

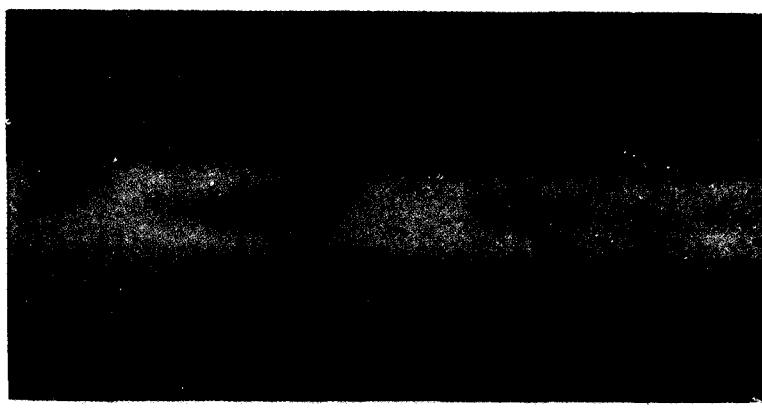


FIG 96 ROOT CONCAVITY

21.1.13 *Root Groove* — A shallow groove in the root of a butt weld formed during welding. The edges of the groove are smoothly continuous with the metal surface on both sides. It may be present even though full fusion has occurred. It appears in the radiograph as a dark band varying in density according to the depth of the groove (*see* Fig 97).

21.1.14 *Shrinkage Groove* — A shallow groove in the parent metal along each side of an under-bead in a butt weld. The radiograph shows each groove as a dark band varying in density according to its depth (*see* Fig 98 *and* 99).

NOTE — The imperfection occurs in gas welding and is caused by plastic deformation and/or oxidation of the parent metal adjacent to the roots of the weld.

21.1.15 *Spatter* (*Splatter, Splash, Spitting*) — Globules of metal expelled during arc welding on to the surface of parent metal or of a weld. Spatter appears in the radiograph as small light rounded area (*see* Fig 100).

21.1.16 *Surface Pitting* — An imperfection in the surface of the parent metal usually in the form of small depressions which may be so

FIG 97 ROOT GROOVE

FIG 98 MACROGRAPH OF SHRINKAGE GROOVES

FIG 99 RADIOGRAPH OF SHRINKAGE GROOVES

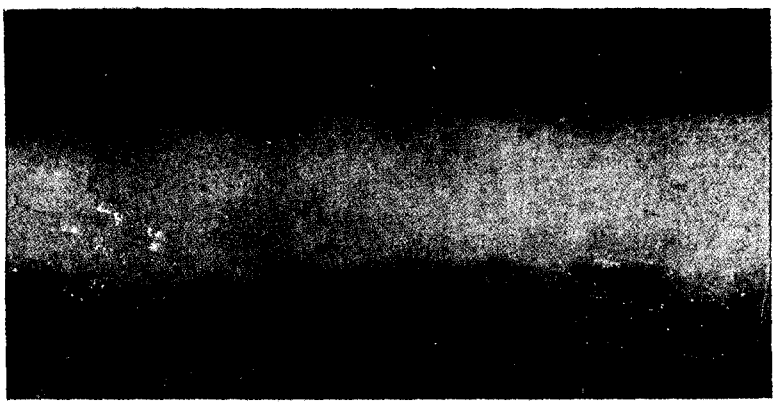


FIG 100 SPATTER

close to a weld as to be mistaken for a welding defect. The imperfection appears in the radiograph as small dark images (*see* Fig 101).

21.1.17 *Torn Surface* — A surface irregularity due to the removal of tack-welded jigs and the like. The radiographic appearance corresponds in outline to that of the affected area and may be either light or dark, depending on whether the tack or the parent metal has been torn.

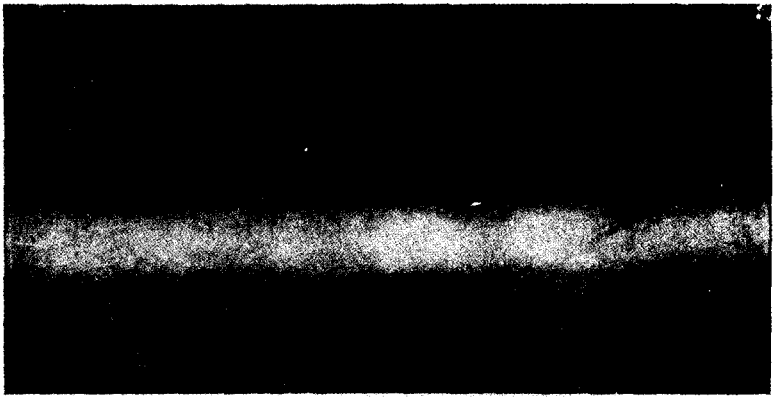


FIG 101 SURFACE PITTING

FIG 102 UNDERCUT

21.1.18 *Undercut* — A groove or channel along a toe of a weld caused by wastage of the parent metal. It appears in the radiograph as a dark line, sometimes broad and diffuse, in a position corresponding to the toe of the weld (*see* Fig 102 *and* 103).

21.1.19 *Underflushing* (*Excessive Dressing, Excessive Grinding*) — A reduction in metal thickness due to excessive dressing. The imperfection

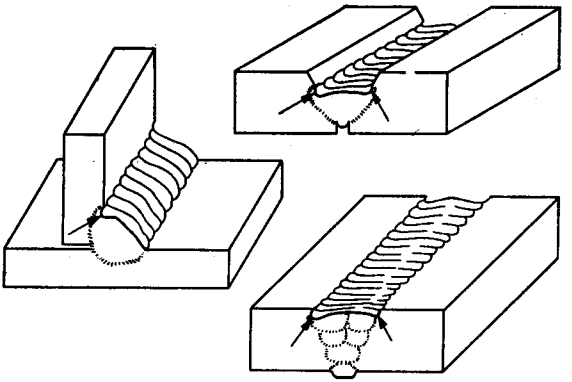


FIG 103 EXAMPLES OF UNDERCUT
(Arrow-head indicates the undercut)

FIG 104 UNDERFLUSHING

produces a characteristic appearance of extended dark areas with diffuse edges (*see* Fig 104).

21.2 Internal Defects in the Weld or Adjacent Metal

21.2.1 *Blowhole* (*Void, Gas Pocket*)— A large cavity due to entrapped gas. It appears in the radiograph as a dark shadow of rounded contour (*see* Fig 105).

NOTE — This term is conveniently applied to cavities exceeding 1·6 mm (or $\frac{1}{16}$ in.) in diameter.

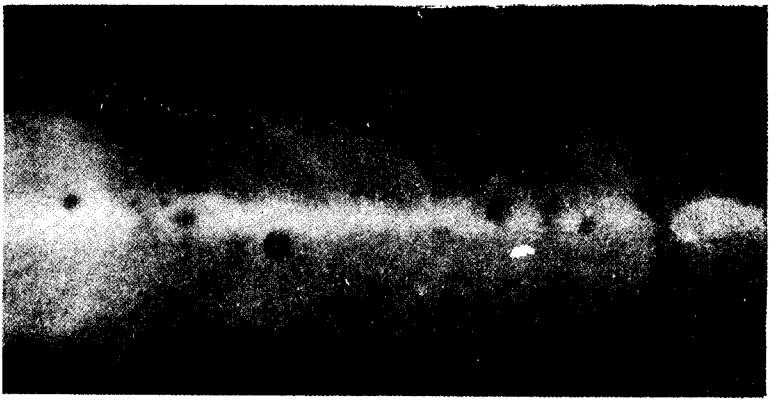


FIG 105 BLOWHOLES

FIG 106 MACROGRAPH OF CAPILLARY PIPES

21.2.2 *Capillary Pipe* — A fine pipe extending along the junction of a weld and parent metal. It appears in the radiograph as a straight, dark, rather diffuse line which may be either continuous or intermittent (*see* Fig 106 *and* 107).

NOTE — The defect is caused by faults in the parent metal (e.g. lamination or layers of segregation), mostly occurring along the whole length of the metal concerned.

FIG 107 RADIOGRAPH OF CAPILLARY PIPES

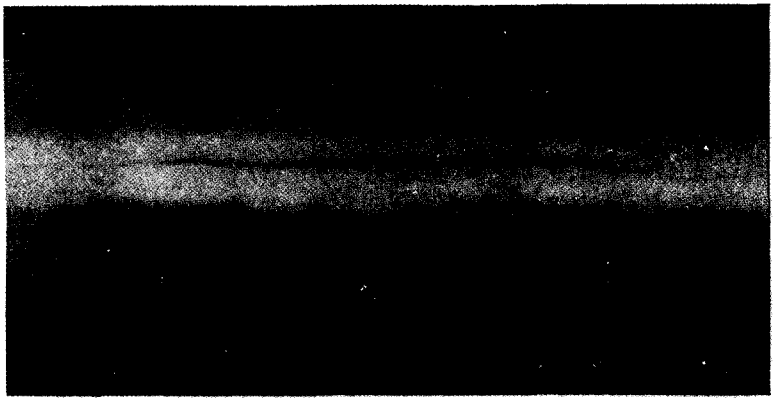


FIG 108 CRACK

21.2.3 *Crack* (*Hot Tear, Springing*)— A discontinuity produced either by tearing of the metal while in a plastic condition (hot crack), or by fracture when cold (cold crack). Radiographically, the former is revealed as a fine dark line wandering in direction and tapered at the ends; often discontinuous, when the segments are roughly parallel but slightly displaced and possibly overlapping. A cold fracture gives, in general, a shadow which is finer, straighter, continuous and free from bifurcations (*see* Fig 108).

NOTE 1 — The detection of a crack, or part of it, is dependent on its orientation relative to the X-ray beam and accordingly it may not be equally well

revealed along its entire length. As the orientation diverges from the optimum direction for detection, the radiographic shadow becomes broadened and increasingly difficult to recognize.

NOTE 2 — Cracks may be further differentiated as longitudinal, transverse, crater, centre line, fusion zone, under-bead, weld metal, or parent metal cracks, and it is helpful to include such descriptions in radiographic reports.

21.2.4 *Gas Pore* — A small cavity due to entrapped gas. The radiographic appearance is a sharply defined dark shadow of circular contour (*see also* **21.2.10**).

NOTE — This term is conveniently applied to cavities not exceeding 1·6 mm (or $\frac{1}{16}$ in.) in diameter.

21.2.5 *Inclusion* (*Slag, Slag Trap*) — Slag or other foreign matter entrapped during welding. The defect is usually more irregular in shape than a gas cavity. The radiographic image is, in general, of lower contrast than that of a gas cavity of the same dimensions. The inclusions are more generally encountered in the following forms (*see* Fig 109):

a) *Large isolated inclusion* — This appears in the radiograph as a dark shadow of irregular contour.

b) *Cluster of small inclusions* — This appears in the radiograph as a group of dark ill-defined spots.

c) *Line inclusion* — This appears in the radiograph as a dark shadow with wavy edges along the weld, often occurring in a long, continuous run. It is sometimes found along both edges of a run of welding in roughly parallel lines, rather like tram lines or wagon

FIG 109 INCLUSIONS

tracks. It may also appear as a series of dashes somewhat similar to characters in the Morse alphabet (*see* Fig 110).

NOTE — The defect may be accompanied by fine cracks, although these are not always revealed in the radiograph.

21.2.6 *Incomplete Inter-Run Penetration* (*Lack of Inter-Penetration*)— A gap occurring in a multi-run weld where the weld metal fails to fill a crevice formed by a previous run or runs (usually at the toes of the underlying run or runs). It appears in the radiograph as a dark, intermittent or continuous line which may have both edges wavy or one edge straight and the other wavy (*see* Fig 111).

21.2.7 *Incomplete Root Penetration* (*Lack of Root Penetration, Non-Penetration*)— A gap left by failure of the weld metal to fill the root. It appears in the radiograph as a dark continuous or intermittent line which may have both edges straight or one edge straight and the other wavy (*see* Fig 112).

21.2.8 *Lack of Fusion* (*Lack of Adhesion, Non-Adhesion, Adhesion*)— Lack of union in a weld between weld metal and parent metal, or between

FIG 110 LINE INCLUSIONS

FIG 111 INCOMPLETE INTER-RUN PENETRATION

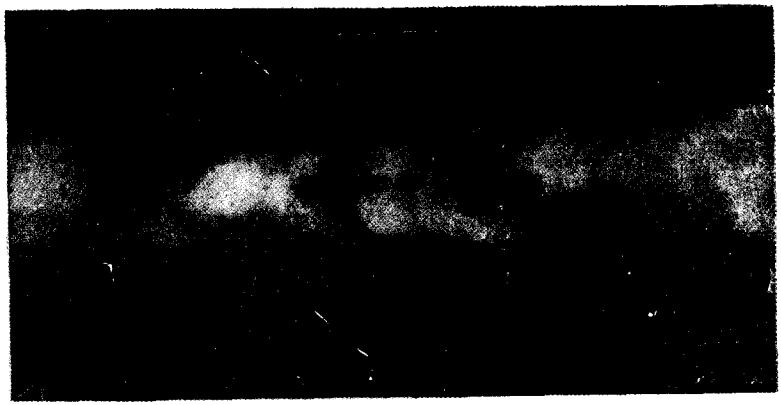


FIG 112 INCOMPLETE ROOT PENETRATION

FIG 113 LACK OF SIDE FUSION

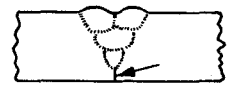


FIG 114 LACK OF ROOT FUSION

parent metal and parent metal, or between weld metal and weld metal. Its radiographic detection depends on its orientation with respect to the X-ray beam. It occurs in the following forms:

a) *Lack of side fusion* — Lack of union between weld metal and parent metal at a side of a weld outside the root. When revealed in the radiograph, it appears as a dark, straight line, of low intensity, with sharply defined edges (*see* Fig 113).

b) *Lack of root fusion* — Lack of union between weld metal and parent metal, or between the adjacent faces of the parent metal at the root. When revealed in the radiograph, it has a similar appearance to that of lack of side fusion (*see* Fig 114 *and* 115).

c) *Lack of inter-run fusion* — Lack of union between adjacent runs of weld metal in a multi-run weld. When revealed in the radiograph, it appears as a faint line with sharply defined edges (*see* Fig 116).

21.2.9 *Pipe* (*Worm Hole*)— An elongated or tubular cavity due to entrapped gas. It appears in the radiograph as a dark shadow of which the shape depends on the orientation of the defect. If the pipe is end-on

to the X-rays, a very dark rounded shadow is produced, often showing halation at the edges; if it is at an angle to the X-rays, an elongated shadow is produced (*see* Fig 117).

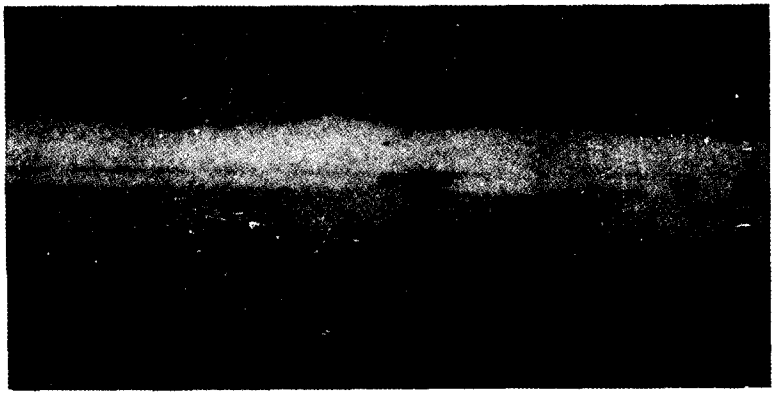


FIG 115 LACK OF ROOT FUSION

FIG 116 LACK OF INTER-RUN FUSION

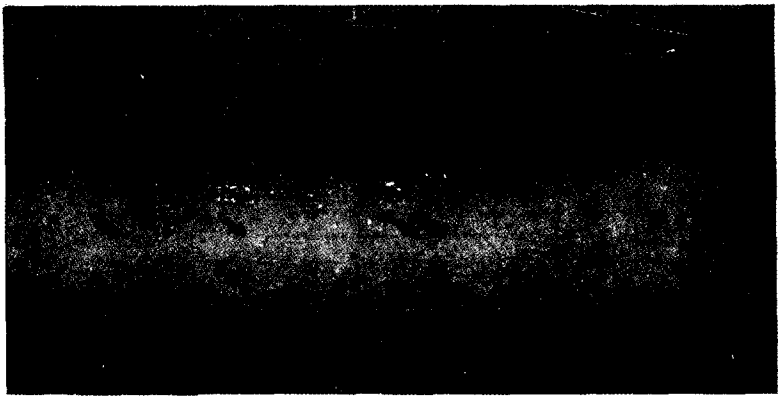


FIG 117 PIPES

21.2.10 *Porosity* — A group of gas pores. Porosity has a radiographic appearance of dark shadows of circular contour (*see* **21.2.4** *and* Fig 118).

NOTE — Porosity may conveniently be differentiated according to size as fine, medium or coarse. It may occur as clusters or chains or may be scattered.

PART VII CUTTING

22. GENERAL TERMS

22.1 Cutting Oxygen — Oxygen used at a relatively high pressure for gas cutting.

22.2 Drag — A component of the distance between the two ends of a drag line, measured as shown in Fig 119.

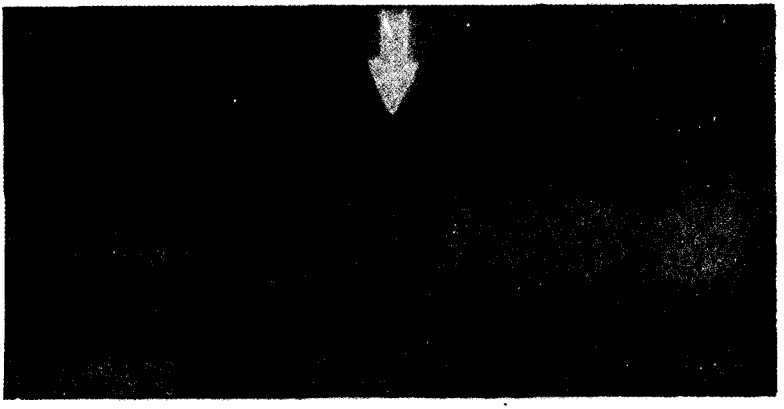


FIG 118 POROSITY

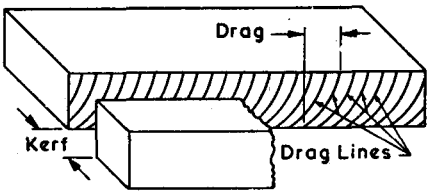


FIG 119 DRAG AND KERF

22.3 Drag Lines — The serrations left on the face of the cut by the gas cutting or arc cutting.

22.4 Gas Cutting — The cutting of metal by the chemical action of oxygen with or without other materials.

NOTE — The metal is raised to ignition temperature progressively and then cut by a jet of oxygen which also removes molten material from the cut.

22.5 Kerf — Gap left after cutting (*see* Fig 119).

22.6 Stack Cutting — The gas cutting of a stack of plates usually clamped together.

23. TERMS RELATING TO ARC CUTTING

23.1 Carbon-Arc Cutting — The cutting of metal by melting a narrow strip with the heat of an arc between a carbon electrode and the metal to be cut.

23.2 Metal-Arc Cutting — The cutting of metal by melting a narrow strip with the heat of an arc between a metal electrode and the metal to be cut.

24. TERMS RELATING TO EQUIPMENT

24.1 Cutting Blowpipe — A device used in gas cutting for controlling the gases used to produce ignition temperature and for controlling and directing the stream of cutting oxygen.

NOTE — A cutting blowpipe is sometimes erroneously called a cutter or burner.

24.2 Cutter Guide — A device, attached to a manual cutting blowpipe, for maintaining the nozzle at a constant distance from the surface of the metal to be cut and assisting the operator in cutting to a required shape.

24.3 Floating Head — A holder for the blowpipe in a gas-cutting machine; it permits vertical movement of the blowpipe.

NOTE — In conjunction with a device riding on the surface of the work, it enables a constant distance to be maintained between the blowpipe nozzle and the work.

24.4 Gouging Blowpipe — A cutting blowpipe designed for gouging.

NOTE — It is sometimes erroneously called a gouging cutter.

24.5 Oxygen Lance — A steel tube used for oxygen lancing. It may be packed with steel wires which, with the tube, are consumed in the process.

24.6 Oxygen-Lance Holder — A device for holding an oxygen lance and for controlling the flow of oxygen through it.

25. TERMS RELATING TO GAS CUTTING

25.1 Deseaming (Scarfing)— The removal of surface defects from cold ingots, blooms, billets and slabs by means of manual gas cutting.

25.2 Desurfacing — The removal of surface layers from hot blooms, billets and slabs by means of a gas-cutting machine.

25.3 Gouging — The forming of a groove by means of gas cutting, using a special blowpipe.

25.4 Oxygen-Arc Cutting — Cutting in which ignition temperature is produced by an electric arc, and oxygen is conveyed through the centre of a covered electrode, the latter being consumed in the process.

25.5 Oxygen Lancing — Cutting or boring holes in metals or other materials by means of an oxygen lance.

NOTE — The end of the oxygen lance is first brought to ignition temperature and oxygen is then passed through it whilst the lance is pressed against the metal or other material.

25.6 Pre-Heating Oxygen — Oxygen used at a relatively low pressure in conjunction with fuel gas for raising to ignition temperature the metal to be cut by gas cutting.

25.7 Powder Cutting — Gas cutting in which powder is used in addition to the cutting oxygen.

25.8 Spot Gouging — Gouging in which the groove is short.

PART VIII ALPHABETICAL INDEX OF TERMS

	Clause No.
A	
Added Metal	3.4
Adhesion, Lack of	21.2.8
Agent, Stopping-Off	16.1
Air-Acetylene Blowpipe:	
Bunsen Type	13.1
High Temperature Type	13.2
Allowance, Flashing	8.15
Total	8.47
Upset	8.49
Alloy, Brazing	17.2
All-Position Rightward Welding	14.1
All-Weld Test Piece	19.1
All-Weld Test Specimen	19.2
Angle Electrode	5.1
Angle, Included	11.33
Angle of Bevel	11.1
Apron, Welding	3.41
Arc Blow Compensator	5.2
Arc Cutting, Carbon-	23.1
Metal-	23.2
Oxygen-	25.4
Arc Damper	5.2
Fan	12.1
Arcing Time Factor	12.4
Arc Voltage	12.2
Welding	12.3
-Welding Electrode	13.3
-Welding Plant	13.4
-Welding Set	13.4
Arc Welding, Carbon-	12.8
Controlled-	12.10
Controlled Tungsten-	12.11
Inert-Gas	12.16
Metal-	12.20
Self-Adjusting	12.24
Shielded-	12.25
Submerged-	12.27
Area, Clamp Contact	8.11
Electrode Contact	8.11
Pressure Contact	4.5
Weld Contact	8.54
Arm	5.3
As-Welded	3.1
Assembly, Melt Distributing	13.29
Atomic-Hydrogen Torch	13.5
Welding	12.5
Automatic Welding	11.2

	Clause No.
B	
Backfire	14.2
Backfire, Sustained	14.17
Backing Bar	13.6
Ring	11.5
Run	11.53
Strip	11.6
Back Pressure	8.1
Back-Step Sequence	11.3
Backward (Backhand) Welding	14.15
Back Weld	11.4
Balanced Welding	11.7
Bar, Backing	13.6
Bare Electrode	13.7
Bare Metal-Arc Welding	12.6
Base Metal	3.21
Battery Spot-Welding Machine	5.4
Bead	11.9
Bead, Excessive Penetration	21.1.4
Penetration	11.42
Bell Branch Joint, Short	18.6
Bell Butt Joint	18.1
Bend Specimen, Transverse	19.18
Bend Test, Face	19.9
Free	19.6
Guided	19.7
Normal	19.9
Reverse	19.11
Bend Test Specimen, Tongue	19.17
Bevel, Angle of	11.1
Blacksmith Welding	6.1
Block Sequence	11.8
Blowhole	20.1, 21.2.1
Blowpipe, Air Acetylene:	
Bunsen Type	13.1
High Temperature Type	13.2
Blowpipe, Cutting	24.1
Gouging	24.4
Welding	13.41
Bolster	5.5
Branch Joint, Short Bell	18.6
Branch Tee Saddle Joint	18.2
Brazing	17.1
Brazing Alloy	17.2
Brazing, Dip	17.3
Flame	17.4
Furnace	17.5
Induction	17.6

	Clause No.
Brazing, Dip (*Contd*):	
Resistance	17.7
Salt Bath	17.8
Torch	17.4
Bronze Filler Metal	18.3
Bronze Welding	18.4
Burden	12.7
Burner	5.6
Burn-Off	8.15
Butt Joint, Bell	18.1
Diminishing Bell	18.5
Double-Glut	6.2
Plain	6.6
Single-Glut	6.9
Tee	6.12
Butt Seam Welding	8.2
Butt Weld	3.2
Butt Weld, Double-Bevel	11.16
Double-J	11.17
Double-U	11.18
Double-V	11.19
Single-Bevel	11.55
Single-J	11.56
Single-U	11.57
Single-V	11.58
Size of	11.59
Square	11.63

C

Capacitor Spot-Welding Machine	5.7
Capillary Pipe	20.2
Carbon-Arc Cutting	23.1
Welding	12.8
Carburizing Flame	14.3
Cast-Iron Thermit	13.8
Chill Time	8.3
Chipping Goggles, Mark	3.3, 21.1.1
Clamp Contact Area	8.11
Close Joint	11.10
Coated Filler Rod	13.13
Cold Welding	7.1
Collar	15.1
Combined Weld, Thermit	10.1
Compensator, Arc Blow	5.2
Composite Joint	11.11
Concave Fillet Weld	11.12
Concavity, Root	20.21, 21.1.12
Condenser-Discharge Spot-Welding Machine	5.7
Cone, Inner	14.8
Connection, Threaded Hose	13.39
Constant-Pressure Pressure-Welding	7.2
Constant-Temperature Pressure-Welding	7.3
Constant-Voltage Welding Generator	13.9
Consumable Electrode	13.10
Contact Area, Clamp	8.11
Electrode	8.11
Pressure	4.5
Weld	8.54
Continuous Test Current	12.9
Continuous Weld	11.13
Contour, Incorrect	20.13, 21.1.9
Control, Programme	8.32
Convex Fillet Weld	11.14
Convexity	11.15
Cool Time	8.4
Cored Electrode	13.11
Corner Joint, Square	6.11
Coupler, Hose	13.21
Coupling Nipple, Hose	13.22
Coupling Nut, Hose	13.23
Cover Glass	3.22
Covered Electrode	13.12
Filler Rod	13.13
Crack	20.3, 21.2.3
Cracking Test, Hot	19.8
Crater	20.4, 21.1.2
Crater, End	20.6, 21.1.2.1
Cross-Wire Weld	8.5
Crucible, Thermit	10.2
Cruciform Test Piece	19.3
Test Specimen	19.4
Current, Continuous Test	12.9
Flashing	8.16
Maximum Welding	12.19
Nominal Hand-Welding	12.22
Current-Off Time	8.6
Current, Pre-Heating	8.30
Current Time, Upset	8.50
Current, Welding	8.57
Cutter, Gouging	24.4
Cutter Guide	24.2
Cutting Blowpipe	24.1
Cutting, Carbon-Arc	23.1
Gas	22.4
Metal-Arc	23.2
Cutting Oxygen	22.1
Cutting, Oxygen-Arc	25.4
Powder	25.7
Stack	22.6
Cycle	8.7
Cycle, Dual-Pressure	8.8
Duty	8.9
Weld	8.55

	Clause No.
D	
Damper, Arc	5.2
Deformation	7.4
Deposited Metal	3.4
Deposition Efficiency	3.5
Depth Penetration	3.14
Depth, Throat	8.45
Wearing	8.53
Deseaming	25.1
Desurfacing	25.2
Die Welding, Heated-	7.5
Dies, Welding	5.27
Diminishing Bell Butt Joint	18.5
Dip Brazing	17.3
Distance, Edge	8.10
Distributing Assembly, Melt	13.29
Double-Bevel Butt Weld	11.16
Double-Glut Butt Joint	6.2
Double-J Butt Weld	11.17
Double-U Butt Weld	11.18
Double-V Butt Weld	11.19
Downhand Position	11.20
Drag	22.2
Drag Lines	22.3
Dressing, Excessive	21.1.19
Drooping-Characteristic Welding Generator	13.14
Dual-Gas Economizer	13.15
Dual-Pressure Cycle	8.8
Duty Cycle	8.9
E	
Economizer, Dual-Gas	13.15
Edge:	
Distance	8.10
Of Plate Melted Off	20.5, 21.1.3
Preparation	11.21
Weld	11.22
Edge, Weld	11.66
Effective Length of Weld	11.23
Throat Thickness	11.24
Electrode	5.24, 13.3
Electrode, Angle	5.1
Arc Welding	13.3
Bare	13.7
Consumable	13.10
Electrode Contact Area	8.11
Electrode, Cored	13.11
Covered	13.12
Flat	5.19
Electrode Holder	3.6
Electrode, Lightly Coated	13.27
Electrode Negative	12.12
Electrode, Non-Consumable	13.31
Offset	5.18
Pad	5.19
Electrode Positive	12.13
Pressure	8.12
Electrode, Resistance Welding	5.24
Electrode Shank	5.8
Electrode, Sheathed	13.34
Electrode Tip	5.9
Electrode, Vertical	5.26
Electrode Wheel	5.10
End Crater	20.6, 21.1.2.1
Envelope, Gas	11.30
Excessive Dressing	21.1.19
Grinding	21.1.19
Penetration Bead	21.1.4
Under-Bead	21.1.4
Exposed Inclusion	20.7, 21.1.5
Porosity	20.8, 21.1.6
Extension, Fillet Weld	13.16
F	
Face Bend Test	19.9
Face, Fusion	11.27
Face Mask	3.7
Face, Root	11.47
Face Shield	3.8
Face, Weld	11.69
Factor, Arcing Time	12.4
Test Load	12.28
Faired (Tapered) Member	3.9
Fan, Arc	12.1
Faying Surface	4.1
Ferrule	5.11
Filler Metal	3.10
Filler Metal, Bronze	18.3
Filler Rod, Covered (Coated)	13.13
Fillet Weld	11.26
Fillet Weld, Concave	11.12
Convex	11.14
Fillet Weld Extension	13.16
Fillet Weld, Flat Face	11.38
Full	11.25
Fillet Weld Guide	13.17
Fillet Weld, Mitre	11.38
Size of	11.60
Filter Glass (Welding Glass)	3.42
Fin	8.13
Fire Welding	6.3
Firecracker Welding	12.14
Fitted Hose	13.18
Fittings, Weldable	18.7
Fixed Shield	3.11

	Clause No.
Flame Brazing	17.4
Flame, Carburizing	14.3
Neutral	14.10
Oxidizing	14.12
Reducing	14.14
Flame Snap Cut	14.4
Flash	8.13
Flashback	14.5
Flash-Butt Welding	8.14
Flashing Allowance	8.15
Current	8.16
Time	8.17
Flash Welding	8.14
Flat Electrode	5.19
Flat Face Fillet Weld	11.38
Flat Position	11.20
Flattening Test	19.5
Floating Head	24.3
Flux	3.13
Foot-Operated Welding Machine	5.12
Forge Time	8.18
Welding	6.3
Forward Pressure	8.19
Welding	14.9
Free Bend Test	19.6
Full Fillet Weld	11.25
Full-Fusion Welding	14.6
Full Penetration	3.12
Furnace Brazing	17.5
Fused Melt	12.15
Fusion Face	11.27
Fusion, Lack of	20.14, 21.2.8
Fusion Penetration	3.14
Fusion Welding	11.28
Fusion Welding, Full-	14.6
Non-	14.11
Semi-	14.16
Surface-	14.16
Thermit	15.2
Fusion Zone	3.15

G

Gap	11.29
Gap, Throat	8.46
Gas Cutting	22.4
Gas Economizer, Dual-	13.15
Gas Envelope	11.30
Pocket	21.2.1
Pore	20.9, 21.2.4
Welding	14.7
Gate, Pre-Heating	13.32
Gather	4.2
Gauge, Weld	3.31
Generator:	
Constant-Voltage Welding	13.9
Drooping-Characteristic Welding	13.14
Glass, Cover	3.22
Filter	3.42
Plain	3.22
Welding	3.42
Gloves, Welding	3.43
Glut	6.4
Goggles, Chipping	3.3
Welding	3.44
Gouging	25.3
Gouging Blowpipe (Cutter)	24.4
Gouging, Spot	25.8
Grinding, Excessive	21.1.19
Grinding Scratch	21.1.7
Groove, Incompletely Filled	21.1.8
Root	20.22, 21.1.13
Shrinkage	20.23, 21.1.14
Guide, Cutter	24.2
Fillet Weld	13.17
Guided Bend Test	19.7
Gun, Stud Welding	5.25
Gun Welding Machine	5.13

H

Hammer Welding	6.5
Hand-Operated Welding Machine	5.14
Hand Screen (Shield)	3.8
Hand-Welding Current, Nominal	12.22
Head, Floating	24.3
Hooded	13.20
Head Screen	3.17
Head, Welding	13.42
Heat-Affected Zone	3.16
Heat Time	8.20
Heat Treatment, Stress Relief	3.27
Heated-Die Welding	7.5
Heating Time	7.6
Helmet	3.17
HF Unit (HF Ionizer)	13.19
Hold Time	8.21
Holder, Electrode	3.6
Oxygen-Lance	24.6
Hole, Worm	21.2.9
Hooded Head	13.20
Hopper, Melt	13.30
Horizontal-Vertical Position	11.31
Hose Connection, Threaded	13.39
Hose Coupler	13.21
Hose Coupling:	
Nipple	13.22
Nut	13.23

	Clause No.
Hose, Fitted	13.18
Hot Cracking Test	19.8
Tear	21.2.3
Hydrogen Torch, Atomic	13.5
Hydrogen Valve	13.24
Hydrogen Welding, Atomic-	12.5

I

Ignition Powder	3.18
Inclined Position	11.32
Included Angle	11.33
Inclusion	20.10, 21.2.5
Inclusion, Exposed	20.7, 21.1.5
Incomplete Inter-Run Penetration	20.11, 21.2.6
Incomplete Root Penetration	20.12, 21.2.7
Incompletely Filled Groove	21.1.8
Incorrect Contour	20.13, 21.1.9
Profile	20.13, 21.1.9
Induction Brazing	17.6
Inductor Spot-Welding Machine	5.15
Inert-Gas Arc Welding	12.16
Metal-Arc Welding	12.17
Shield	13.25
Shielded-Arc Torch	13.26
Tungsten-Arc Welding	12.18
Initial Pressure	4.3
Inner Cone	14.8
Insert	5.16
Interface	4.4
Intermittent Weld	11.34
Inter-Run Fusion, Lack of	20.15, 21.2.8
Inter-Run Penetration, Incomplete	20.11, 21.2.6
Ionizer (HF)	13.19

J

Joint, Bell Butt	18.1
Branch Tee Saddle	18.2
Close	11.10
Composite	11.11
Diminishing Bell Butt	18.5
Double-Glut Butt	6.2
Jumped	6.6
Open	11.40
Plain Butt	6.6
Scarf	6.8
Short Bell Branch	18.6
Single-Glut Butt	6.9
Split	6.10
Square Corner	6.11
Joint, Bell Butt (*Contd*):	
Tee Butt	6.12
Tee Split	6.13
Vee	6.14
Welded	3.36
Jumped Joint	6.6
Junction, Weld	11.70

K

Kerf	22.5

L

Lack of Adhesion	21.2.8
Lack of Fusion	20.14, 21.2.8
Inter-Penetration	21.2.6
Inter-Run Fusion	20.15, 21.2.8
Root Fusion	20.16, 21.2.8
Root Penetration	21.2.7
Side Fusion	20.17, 21.2.8
Lance, Oxygen	24.5
Lance Holder, Oxygen-	24.6
Lancing, Oxygen	25.5
Leftward Welding	14.9
Leg	11.35
Leg Length	11.36
Length, Effective	11.23
Leg	11.36
Lift	9.1
Lightly Coated Electrode	13.27
Lines, Drag	22.3
Load Factor, Test	12.28
Load Voltage, Welding	12.30
Longitudinal Axis of Weld	3.19

M

Machine, Battery Spot-Welding	5.4
Capacitor Spot-Welding	5.7
Condenser-Discharge Spot-Welding	5.7
Foot-Operated Welding	5.12
Gun Welding	5.13
Hand-Operated Welding	5.14
Inductor Spot-Welding	5.15
Motor-Operated Welding	5.17
Pedal-Operated Welding	5.12
Plier (Pincer) Spot-Welding	5.21
Portable Spot-Welding	5.22
Power-Operated Welding	5.23
Stored Energy	5.4
Machine Stroke	8.22
Manual Welding	11.37
Mark, Chipping	21.1.1

	Clause No.
Mark, Peening	21.1.11
Mash Weld	8.23
Mask, Face	3.7
Material, Plugging	13.33
Maximum Welding Current	12.19
Melt	13.28
Melt Distributing Assembly	13.29
Melt, Fused	12.15
Melt Hopper	13.30
Run	3.20
Metal, Added	3.4
Metal-Arc Cutting	23.2
Welding	12.20
Metal-Arc Welding, Inert-Gas	12.17
Metal, Base	3.21
Bronze Filler	18.3
Deposited	3.4
Filler	3.10
Parent	3.21
Metal-Run-Out	12.21
Metal, Upset	4.7
Weld	3.32
Mitre Fillet Weld	11.38
Molten Pool	11.39
Motor-Operated Welding Machine	5.17
Multiple-Spot Welding	8.24

N

Negative, Electrode	12.12
Neutral Flame	14.10
Nick-Break Specimen	19.10
Nipple, Hose Coupling	13.22
Nominal Hand-Welding Current	12.22
Non-Consumable Electrode	13.31
Non-Fusion Welding	14.11
Normal Bend Test	19.9
Nose	11.47
Notch-Break Specimen	19.10
Nugget Weld	8.56
Nut, Hose Coupling	13.23

O

Offset Electrode	5.18
Off-Time	8.4
On-Time	8.20
Open-Circuit Voltage	12.23
Open Joint	11.40
Operational Stroke	8.25
Overhead Position	11.41
Overlap	20.18, 21.1.10
Oxidizing Flame	14.12
Oxy-Acetylene Pressure Welding	7.7
Oxygen-Arc Cutting	25.4
Oxygen, Cutting	22.1
Oxygen Lance	24.5
Oxygen-Lance Holder	24.6
Oxygen Lancing	25.5
Oxygen, Pre-Heating	25.6

P

Pad Electrode	5.19
Parent Metal	3.21
Pass	11.49
Pattern, Wax	13.40
Pedal-Operated Welding Machine	5.12
Peening	3.23
Peening Mark	21.1.11
Penetration Bead	11.42
Penetration Bead, Excessive	21.1.4
Penetration, Depth	3.14
Penetration, Full	3.12
Fusion	3.14
Incomplete Inter-Run	20.11, 21.2.6
Incomplete Root	20.12, 21.2.7
Penetration (Through) Pass	3.24
Percussion Welding	8.26
Pick-Up	8.27, 14.13
Piece, All-Weld Test	19.1
Cruciform Test	19.3
Shear-Test	19.12
Test	19.15
Pin, Tapping	13.37
Pincer Spot-Welding Machine	5.21
Pipe	20.19, 21.2.9
Pipe, Capillary	20.2, 21.2.2
Pitting, Surface	21.1.16
Plain Butt Joint	6.6
Plain Glass	3.22
Plant, Arc-Welding	13.4
Plate Melted Off, Edge Of	20.5, 21.1.3
Platen	5.20
Plates, Run-Off	11.50
Run-On	11.51
Plier Spot-Welding Machine	5.21
Plug Weld	11.43
Plugging Material	13.33
Pocket, Gas	21.2.1
Polarity, Reversed	12.12, 12.13
Straight	12.12, 12.13
Pool, Molten	11.39
Pore, Gas	20.9, 21.2.4
Porosity	20.20, 21.2.10
Porosity, Exposed	20.8, 21.1.6
Portable Spot-Welding Machine	5.22

	Clause No.
Position, Downhand (Flat)	11.20
Horizontal-Vertical	11.31
Inclined	11.32
Overhead	11.41
Vertical	11.67
Positive, Electrode	12.13
Post-Heat Time	8.28
Powder Cutting	25.7
Powder, Ignition	3.18
Power-Operated Welding Machine	5.23
Pre-Heat Time	8.29
Pre-Heating Current	8.30
Gate	13.32
Oxygen	25.6
Preparation, Edge	11.21
Pressure, Back	8.1
Pressure Contact Area	4.5
Cycle, Dual-	8.8
Pressure, Electrode	8.12
Forward	8.19
Initial	4.3
Pressure-Off Time	8.31
Pressure, Upset	4.8
Welding	4.9
Pressure-Welding	7.8
Pressure-Welding, Constant-Pressure	7.2
Constant-Temperature	7.3
Oxy-Acetylene	7.7
Thermit	10.3
Press Welding	7.1
Procedure, Welding	3.45
Profile, Incorrect	20.13, 21.1.9
Programme Control	8.32
Projection Welding	8.33
Pulsation Welding	8.34

R

Radius, Root	11.48
Recovery, Time of	12.29
Reducing Flame	14.14
Regulator, Welding	13.43
Reinforcement	11.44
Residual Welding-Stress	3.25
Resistance Brazing	17.7
Resistance-Butt Welding	8.36
Resistance Welding	8.35
Resistance Welding Electrode	5.24
Reverse Bend Test	19.11
Reversed Polarity	12.12, 12.13
Rightward Welding	14.15
Rightward Welding, All-Position	14.1
Ring, Backing	11.5
Rod, Coated (Covered) Filler	13.13
Rod, Welding	3.46
Roller-Spot Welding	8.37
Roll Welding	6.7
Root Concavity	20.21, 20.1.12
Face	11.47
Fusion, Lack of	20.16, 21.2.8
Groove	20.22, 21.1.13
Of Preparation	11.45
Of Weld	11.46
Penetration, Incomplete	20.12, 21.2.7
Radius	11.48
Rotation, Weld	11.71
Run	11.49
Run, Backing	11.53
Melt	3.20
Sealing	11.53
Run-Off Plates	11.50
Run-On Plates	11.51
Run-Out, Metal	12.21

S

Saddle Joint, Branch Tee	18.2
Salt Bath Brazing	17.8
Scarfing	25.1
Scarf Joint	6.8
Scratch, Grinding	21.1.7
Screen, Hand	3.8
Head	3.17
Sealing Run	11.53
Weld	11.52
Seal Weld	11.52
Seam Welding	8.38
Self-Adjusting Arc Welding	12.24
Semi-Automatic Welding	11.54
Semi-Fusion Welding	14.16
Sequence, Back-Step	11.3
Block	11.8
Sequence, Welding	3.47
Series-Spot Welding	8.39
Set, Arc-Welding	13.4
Shank, Electrode	5.8
Shear-Test Piece	19.12
Test Specimen	19.13
Sheathed Electrode	13.34
Sheet Separation	4.6
Shield, Face	3.8
Fixed	3.11
Hand	3.8
Inert-Gas	13.25
Shielded-Arc Torch, Inert-Gas	13.26
Shielded-Arc Welding	12.25
Short Bell Branch Joint	18.6

	Clause No.
Shortening	4.2
Shrinkage Groove	20.23, 21.1.14
Side Fusion, Lack of	20.17, 21.2.8
Single-Bevel Butt Weld	11.55
Single-Glut Butt Joint	6.9
Single-J Butt Weld	11.56
Single-U Butt Weld	11.57
Single-V Butt Weld	11.58
Size of Butt Weld	11.59
Of Fillet Weld	11.60
Skip Sequence (Wandering Sequence)	11.61
Slag	21.2.5
Slag Trap	21.2.5
Sleeve, Welder's	3.38
Slope, Weld	11.72
Slot Weld	11.62
Slug Test	19.14
Snap-Out, Flame	14.4
Solid-Phase Welding	7.8
Spacer Strip	13.35
Spats, Welder's	3.39
Spatter	21.1.15
Specimen, All-Weld Test	19.2
Cruciform Test	19.4
Notch-Break (Nick-Break)	19.10
Shear-Test	19.13
Test	19.16
Tongue-Bend Test	19.17
Transverse Bend	19.18
Transverse Tensile	19.19
Spelter	17.9
Spitting	21.1.15
Splash	21.1.15
Splatter	21.1.15
Split Joint	6.10
Split Joint, Tee	6.13
Spot Gouging	25.8
Spot Welding	8.40
Spot-Welding Machine:	
Battery	5.4
Capacitor	5.7
Condenser-Discharge	5.7
Inductor	5.15
Pincer (Plier)	5.21
Portable	5.22
Springing	21.2.3
Square Butt Weld	11.63
Corner Joint	6.11
Squeeze Time	8.41
Stack Cutting	22.6
Step-by-Step Welding	8.43
Step Time	8.42
Stitch Welding	8.44
Stone	13.36
Stopping-Off Agent	16.1
Stored Energy Machines	5.4
Straight Polarity	12.12, 12.13
Strength Weld	3.26
Stress Relief Heat Treatment	3.27
Stress Residual-Welding	3.25
Striking Voltage	12.26
Strip, Backing	11.6
Strip, Spacer	13.35
Stroke, Machine	8.22
Operational	8.25
Stubs	3.28
Stud Welding	9.2
Stud Welding Gun (Tool)	5.25
Submerged-Arc Welding	12.27
Surface, Faying	4.1
Surface-Fusion Welding	14.16
Surface Pitting	21.1.16
Surfacing	3.29
Surface, Torn	21.1.17
Sustained Backfire	14.17

T

Tack Weld	11.64
Tapered (Faired) Member	3.9
Tapping Pin	13.37
Tear, Hot	21.2.3
Technique, Welding	3.48
Tee Butt Joint	6.12
Tee Saddle Joint, Branch	18.2
Tee Split Joint	6.13
Tensile Specimen, Transverse	19.19
Test Current, Continuous	12.9
Test, Face Bend	19.9
Flattening	19.5
Free Bend	19·6
Guided Bend	19.7
Hot Cracking	19.8
Test Load Factor	12.28
Test, Normal Bend	19.9
Test Piece	19.15
Test Piece, All-Weld	19.1
Cruciform	19.3
Shear	19.12
Test, Reverse Bend	19.11
Test Specimen	19.16
Test Specimen, All-Weld	19.2
Cruciform	19.3
Shear	19.13
Tongue-Bend	19.17
Test, Slug	19.14
Test, U-Tensile	19.20

	Clause No.
Thermit, Cast-Iron	13.8
Thermit Combined Weld	10.1
Crucible	10.2
Fusion Welding	15.2
Pressure Welding	10.3
Thermit, Welding	3.49
Thickness, Effective Throat	11.42
Throat	11.65
Thimble	13.38
Threaded Hose Connection	13.39
Throat (Throat Depth)	8.45
Throat Gap	8.46
Throat Thickness	11.65
Throat Thickness, Effective	11.24
Time, Chill	8.3
Cool	8.4
Current-Off	8.6
Time Factor, Arcing	12.4
Time, Flashing	8.17
Forge	8.18
Heat	8.20
Heating	7.6
Hold	8.21
Off-	8.4
Time of Recovery	12.29
Time, On-	8.20
Post-Heat	8.28
Pre-Heat	8.29
Pressure-Off	8.31
Squeeze	8.41
Step	8.42
Upset	8.51
Upset-Current	8.50
Weld	8.58
Welding	7.9
Tip, Electrode	5.9
Toe of Weld	11.66
Tongue-Bend Test Specimen	19.17
Tool, Stud-Welding	5.25
Torch, Atomic-Hydrogen	13.5
Torch Brazing	17.4
Torch, Inert-Gas Shielded-Arc	13.26
Torn Surface	21.1.17
Total Allowance	8.47
Transverse Bend Specimen	19.18
Tensile Specimen	19.19
Travel, Upset	8.52
Tread	8.48
Tungsten-Arc Welding, Inert-Gas	12.18

U

Under-Bead, Excessive	21.1.4
Undercut	20.24, 21.1.18
Underflushing	20.25, 21.1.19
Unit, HF	13.19
Upset Allowance	8.49
Current Time	8.50
Metal	4.7
Pressure	4.8
Time	8.51
Travel	8.52
Welding	8.35
U-Tensile Test	19.20

V

Valve, Hydrogen	13.24
V Butt Weld, Double-	11.19
Single-	11.58
Vee Joint	6.14
Vertical Electrode	5.26
Position	11.67
Void	21.2.1
Voltage, Arc	12.2
Open-Circuit	12.23
Striking	12.26
Welding Load	12.30

W

Wandering Sequence	11.61
Wax Pattern	13.40
Wearing Depth	8.53
Weaving	11.68
Weld	3.30
Weld, Back	11.4
Butt	3.2
Concave Fillet	11.12
Weld Contact Area	8.54
Weld, Continuous	11.13
Convex Fillet	11.14
Cross-Wire	8.5
Weld Cycle	8.55
Weld, Double-Bevel Butt	11.16
Double-J Butt	11.17
Double-U Butt	11.18
Double-V Butt	11.19
Weld Edge	11.66
Weld, Edge	11.22
Effective Length of	11.23
Weld Extension, Fillet	13.16
Weld Face	11.69
Weld, Fillet	11.26
Flat Face Fillet	11.38
Full Fillet	11.25
Weld Gauge	3.31
Guide, Fillet	13.17

	Clause No.
Weld, Intermittent	11.34
Weld Junction	11.70
Weld, Longitudinal Axis of	3.19
Mash	8.23
Weld Metal	3.32
Metal Zone	3.33
Weld, Mitre Fillet	11.38
Weld Nugget	8.56
Weld, Plug	11.43
Root of	11.45
Weld Rotation	11.71
Weld, Seal (Sealing)	11.52
Single-Bevel Butt	11.55
Single-J Butt	11.56
Single-U Butt	11.57
Single-V Butt	11.58
Weld, Size of Butt	11.59
Size of Fillet	11.60
Weld Slope	11.72
Weld, Slot	11.62
Square Butt	11.63
Strength	3.26
Tack	11.64
Weld, Thermit Combined	10.1
Weld Time	8.58
Weld, Toe of	11.66
Weld Width	3.34
Zone	3.35
Weldable Fittings	18.7
Welded Joint	3.36
Welder	3.37
Welder's Sleeve	3.38
Welder's Spats	3.39
Welding	3.40
Welding, All-Position Rightward	14.1
Welding Apron	3.41
Welding, Arc	12.3
Atomic-Hydrogen	12.5
Automatic	11.2
Backward (Backhand)	14.5
Balanced	11.7
Bare Metal-Arc	12.6
Blacksmith	6.1
Welding Blowpipe	13.41
Welding, Bronze	18.4
Butt-Seam	8.2
Carbon-Arc	12.8
Cold	7.1
Constant-Pressure Pressure-	7.2
Constant-Temperature Pressure-	7.3
Controlled-Arc	12.10
Controlled Tungsten-Arc	12.11
Welding Current	8.57
Current, Maximum	12.19
Current, Nominal Hand	12.22
Welding Dies	5.27
Electrode, Arc	13.3
Electrode, Resistance	5.24
Welding, Fire	6.3
Firecracker	12.14
Flash (Flash Butt)	8.14
Forge	6.3
Forward	14.9
Full-Fusion	14.6
Fusion	11.28
Gas	14.7
Welding Generator, Constant-Voltage	13.9
Drooping Characteristic	13.14
Welding Glass	3.42
Gloves	3.43
Goggles	3.44
Gun, Stud	5.25
Welding, Hammer	6.5
Welding Head	13.42
Welding, Heated-Die	7.5
Inert-Gas Arc	12.16
Inert-Gas Metal-Arc	12.17
Inert-Gas Tungsten-Arc	12.18
Leftward	14.9
Welding Load Voltage	12.30
Welding Machine, Foot-Operated	5.12
Gun	5.13
Hand-Operated	5.14
Motor-Operated	5.17
Pedal-Operated	5.12
Power-Operated	5.23
(*See also* Spot-Welding Machine)	
Welding, Manual	11.37
Metal-Arc	12.20
Multiple-Spot	8.24
Non-Fusion	14.11
Oxy-Acetylene Pressure	7.7
Percussion	8.26
Welding Plant, Arc	13.4
Welding, Press	7.1
Welding Pressure	4.9
Welding, Pressure	7.8
Welding Procedure	3.45
Welding, Projection	8.33
Pulsation	8.34
Welding Regulator	13.43
Welding, Resistance	8.35
Resistance-Butt	8.36
Rightward	14.15
Welded Rod	3.46

	Clause No.		*Clause No.*
Welding, Roll	6.7	Welding, Stud	9.2
Roller-Spot	8.37	Welding, Submerged-Arc ...	12.27
Seam	8.36	Surface-Fusion	14.16
Self-Adjusting Arc ...	12.24	Welding Technique	3.48
Semi-Automatic	11.54	Thermit	3.49
Semi-Fusion	14.16	Welding, Thermit Fusion ...	15.2
Welding Sequence	3.47	Thermit Pressure	10.3
Welding, Series-Spot ...	8.39	Welding Time	7.9
Welding Set, Arc	13.4	Tool, Stud	5.25
Welding, Shielded-Arc ...	12.25	Welding, Upset	8.35
Solid Phase	7.8	Woodpecker	8.34
Spot	8.40	Wheel, Electrode	5.10
Step-by-Step	8.43	Width, Weld	3.34
Stitch	8.44	Woodpecker Welding ...	8.34
Welding Stress, Residual ...	3.25	Worm Hole	21.2.9

PRINTED AT SIMCO PRINTING PRESS, DELHI, INDIA